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## ***Nordic Civil 2011***

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### **X03 - Using the New Geometry Tools in Production**

**Presenter:** Jay Vose, Senior Manager, Software Development - Road & Site Design

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# Preface

In this workshop, you will construct a roadway interchange horizontal layout utilizing the V8i SELECTseries 2 Horizontal Civil Geometry tools. We have structured the contents of the exercises herein to allow your interaction with a broad range of available tools, however, we will not use every tool. Also, it is impossible to engineer a complete interchange in the time frame of this workshop, but we will use the tools in their real-life context, so you can see how to utilize them in your own engineering projects.

This workshop is equally applicable for MX, InRoads or GEOPAK families of products. Each product contains the identical toolset and identical workflow. The only differences between the three products for the tools are slight differences in the use of feature definitions and some differences in the back end interaction with other native toolsets such as drainage. In this workshop, we will use Power InRoads V8i 08.11.07.536.

There are more exercises in this manual than we will have time to cover today. We will all complete the basic set of exercises, and for those veteran users in the group who complete them and still have time left in the exercise session, you are welcome to work on the optional.

In order for all participants to design the same layout and to stay on course and on time, we request that all participants utilize the files as listed in the workshop materials. At the beginning of each chapter, we will start with a fresh set of data. This ensures that everyone is using the same data, plus we have added data to avoid redundant work. For example, we draw some of the edges of pavement in the lab so you can understand the workflow, but have drawn the remainder in for expediency of time.

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**Note:** Prerequisite Knowledge Level: Participant should have a basic understanding of road design principles and be fluent in use of MicroStation and the native application (MX, InRoads or GEOPAK).

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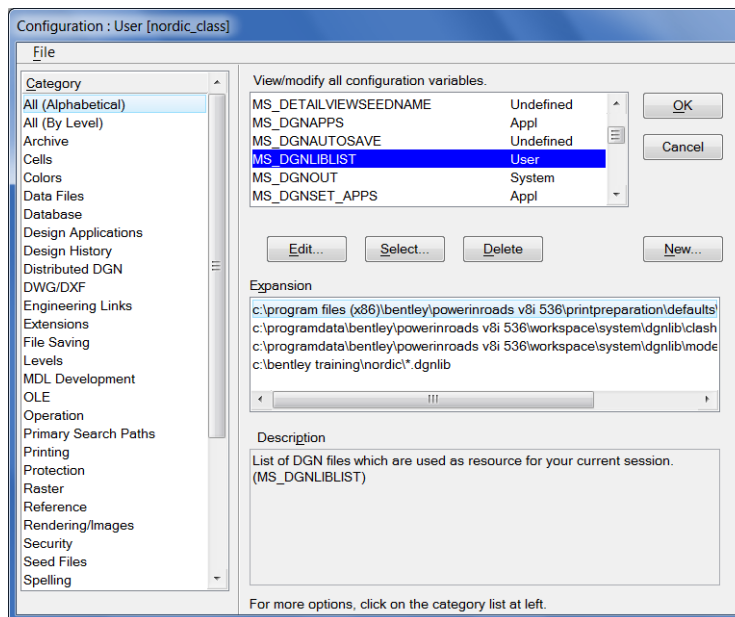
# Before the Workshop Begins...

While we are waiting to begin today's workshop, let's do some quick checks to be sure your workstation / laptop is ready to go. We have preloaded the workshop files and settings in order to save set-up time.



## *Exercise: Check Workstation / Laptop Settings*

1. Use the provided login and password to access your laptop.
2. Your instructor will provide the path to the workshop dataset. Using the Power InRoads icon on your desktop, open *checkworkshop.dgn*. The Power InRoads projects dialog opens. Do NOT close the dialog, just minimize it.
3. Select **Workspace > Configuration** from the Power InRoads main menu bar.
4. Scroll down and click on the variable MS\_DGNLibList.



5. Check to ensure the workshop path is included as one of the listings. If it is not listed, please advise the instructor and complete the following steps to add the files. Do NOT complete these steps if your configuration is already correct.
6. Click **Select**.
7. Chose the design standards and the XIN features file from our project directory. (Both can be done at the same time and have dgnlib extensions).
8. Click **Add**.
9. Click **Close** to exit the dialog.
10. Click **OK** to close the Configuration dialog. When prompted to save the configuration, click **Yes**.



- 
11. Next we'll check our cell library is attached. Select Element > Cells from the Power InRoads main menu bar. Stds2.cel (containing one cell) should be attached. If not, select **File > Select File** from the Cell Library dialog. Select stds2.cel from your project directory. Close the Cell Library dialog.
  12. Close the MicroStation file.

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# Chapter 1: Introduction to Horizontal Geometry Tools

## OVERVIEW

Civil Geometry is a dynamic, interactive, rules based approach to geometry that provides an unprecedented level of associativity by preserving design intent, snaps and Civil Accudraw input. The results of the tools are intelligent graphic elements which can be dynamically edited and associations between elements are automatically updated.

The results of the tools are graphical geometry elements stored as MicroStation elements. There is no external geometry file. The geometry elements are MicroStation elements with additional intelligence applied to store the rules and associations.

The Civil Geometry tools are installed as a part of GEOPAK, InRoads and MXROAD products. In order to be consumed by processes within GEOPAK, InRoads and MXROAD, the civil geometry must be written to the native application coordinate geometry file (alg, gpk or fil). This is handled automatically. Elements are written to and updated in native application based on properties of feature definitions.

## PROJECT DESCRIPTION

In this workshop we will construct a mainline alignment, a cross-road alignment and interchange including ramps, loops and access roads. Note the view is rotated so the mainline is displayed in a west-east orientation.



*Alignments created with horizontal geometry tools*

The table below is the dimensions we'll use throughout the project.

DESCRIPTION	VALUE
Lane Width	3.6m
Ramp Width	5.0m
Median Width	3.5m centerline, 3.0 loop/ramp
Entrance Taper	1:50
Exit Taper	1:15
Stationing Format	1+234

## GETTING STARTED

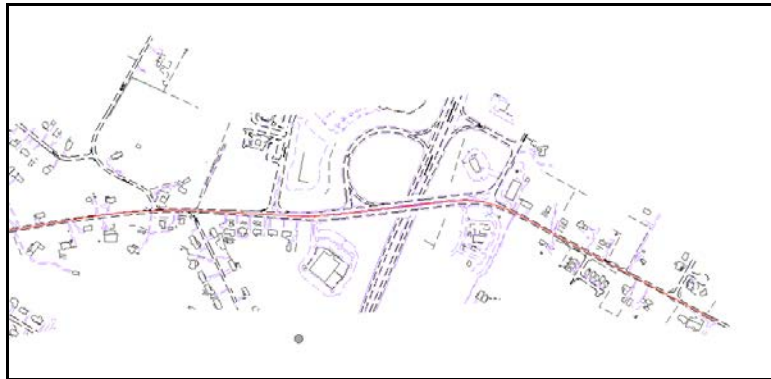
In this first section, we will review some of the tools and settings we'll be using throughout the workshop. For easy accessibility, we will dock the tools within the MicroStation view.



### *Exercise: Open Design File and Tools*

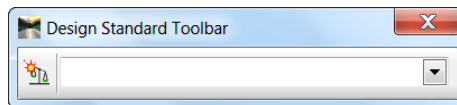
#### **Lesson Objective:**

1. Open file *Start\_ch1.dgn*.

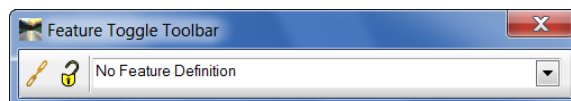


*The data is in a reference file (ExistingMap2.dgn) and is the background for our new geometric layout.*

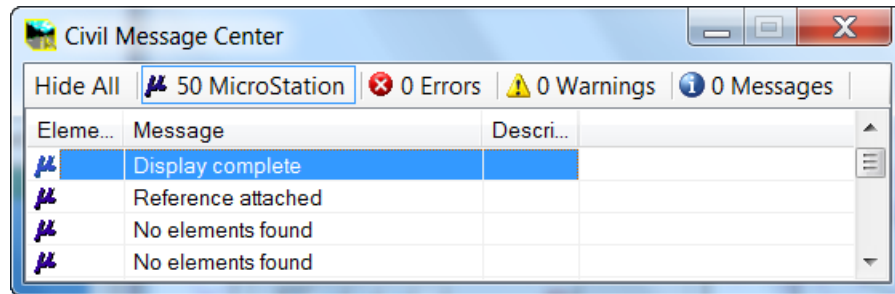
2. From the Power InRoads main menu bar, select **Tools > Civil Geometry > Design Standards** to open the design standards toggle bar.



3. From the Power InRoads main menu bar, select **Tools > Civil Geometry > Features Toggle Bar** to open the Feature Toggle ToolBar. Don't select any feature for now.

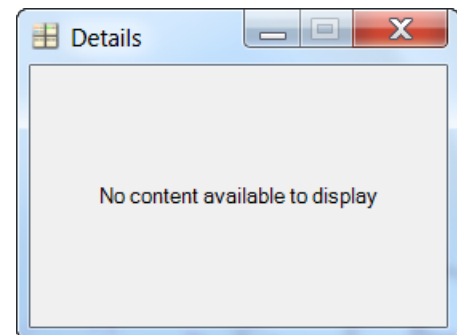
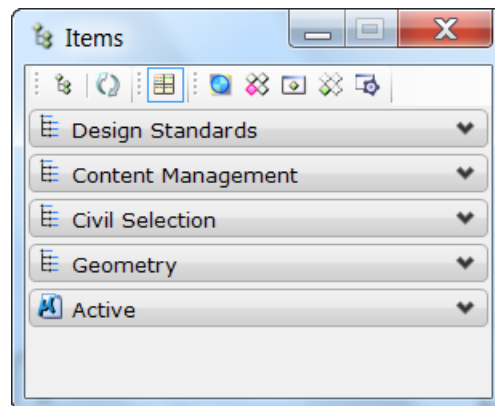


- From the Power InRoads main menu bar, select **Tools > Civil Geometry > Civil Message Center**. This is for feedback on our Design Standards and geometry tools.



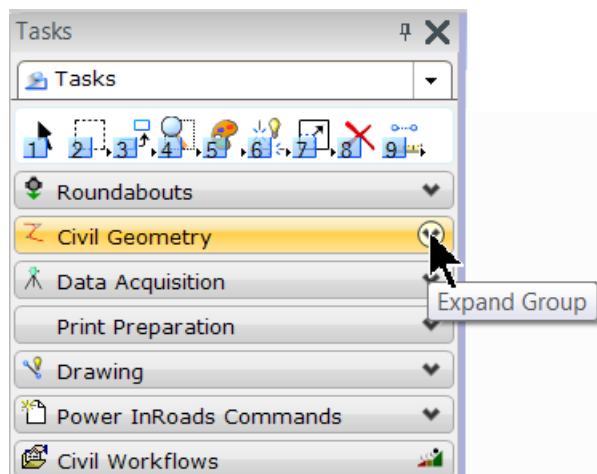
- Dock and pin the message center, design standards and feature definitions bars at the bottom.
- From the Power InRoads main menu bar, select **File > Item Browser**, which opens two dialogs, Items and Details. These are for reviewing Design Standards and Feature Definitions. Dock and pin the Items dialog on the right side and the Details on the bottom.

**Hint:** The Items Browser can also be found on the Primary toolbar but is hidden by default. Right click on the toolbar and select Items to enable access from the toolbar.

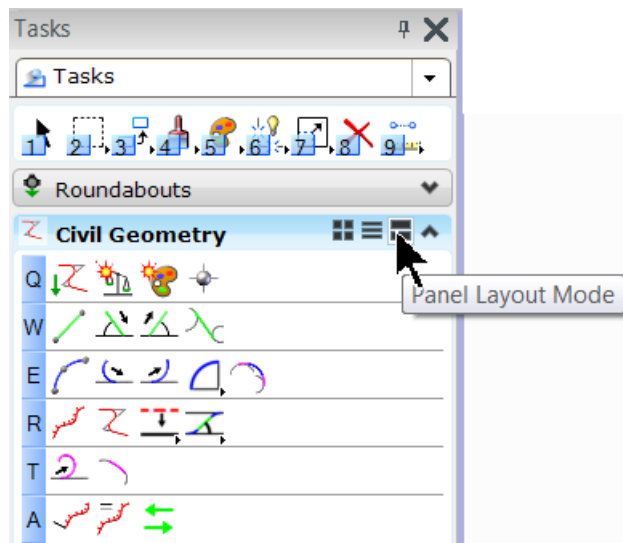


## NAVIGATING THE TASK BARS

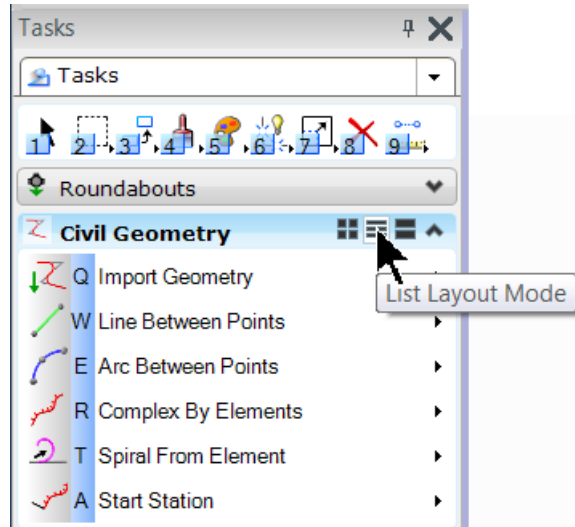
The Civil Geometry tools are located on the task navigation in group named “Civil Geometry”. To open the toolset, click Expand Group. Click the same icon to Collapse the group.



There are several ways the navigation group can be displayed. For this workshop, we'll use the Panel Layout Mode, which is the default.

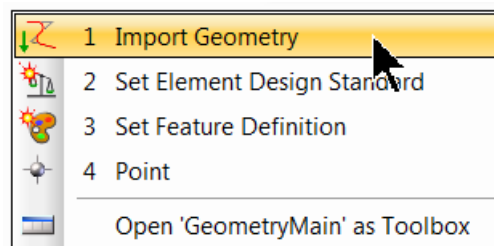


If you prefer listings rather than icons, you may prefer the List Layout Mode.

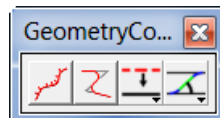


Your preference may be to not use the navigation task bar. Other options include:

- Select any tool from Tools > Civil Geometry > Tools or Horizontal Geometry from the Power InRoads main menu bar.
- Select <F2> from your keyboard which opens the main navigation menu. Select Civil Geometry. After selecting Civil Geometry, you can use Q, W, E, R, T, or A (corresponding to the letters to the left of the group). For example, selection of Q opens the Main Geometry pop-up menu.



To use the classic toolbox for any sub-group, right click on the line and select Select "Toolset" as Toolbox.



You can also customize which tools are displayed. Other customizing options can be found by right-clicking on the navigation groups. Customization of task navigation is outside the scope of this workshop, but you may want to experiment in your spare time or after the workshop is concluded.

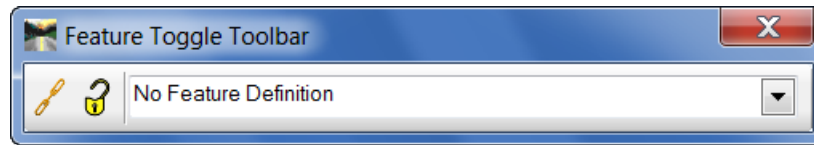
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**Hint:** If the Task panel disappears or you accidentally close it, select Tools > Tasks from the Power InRoads main menu bar to bring it back!

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## FEATURES AND FEATURE DEFINITIONS

In our initial set-up, we opened the Features Toggle ToolBar. There is no icon in task navigation, it must be opened from the Power InRoads main menu bar (**Tools > Civil Geometry > Features Toggle Bar** ).



Feature definitions are used to define options when creating features. These are the items which are created in advance, usually used across multiple projects and define symbology, annotation and quantities. The feature definition is assigned (usually) in the plan model and profile/3D feature definitions follow from there.

A Feature is anything that can be seen or located and is a physical part of your design, representing a real world thing. A feature's definition is one of its properties. At any given time in the design process, the feature will have a Horizontal Geometry, a Vertical Geometry, a 3D Geometry or a combination to define its location.

Most commands have entry fields for feature on their dialog.

- If Use Feature is not checked, then active MicroStation symbology is used and no feature is defined. No naming is used.
- If Use Feature is checked, but no feature is selected, then active MicroStation symbology is used and no feature is defined, but you can define a name prefix.
- If Use Feature is checked, then a feature is assigned, a naming prefix is applied and the symbology, attributes, and annotation defined in the feature definition are applied to the element.

---

**Note:** It is often useful to set the command to "Active Feature" and then control the active feature to be used in the Features Toggle Bar. Alternatively you can choose a specific feature directly in the command dialog and ignore the toggle bar.

---

## IMPORTING DATA

To begin any project, you will need some type of existing data. It may be CAD files from prior projects, survey information, or even historical paper plans. You can mix and match the type of data you have for your project. If you have no data, you can even start with a blank file!

In our project, we will use some historical data to create one of our crossing road centerline. For another alignment, we will import our mainline alignment from another project. We will then modify the alignment to adhere to our Design Standards.





### Exercise: Import the Existing Centerline

**Objective:** Import the mainline alignment and display in our file.

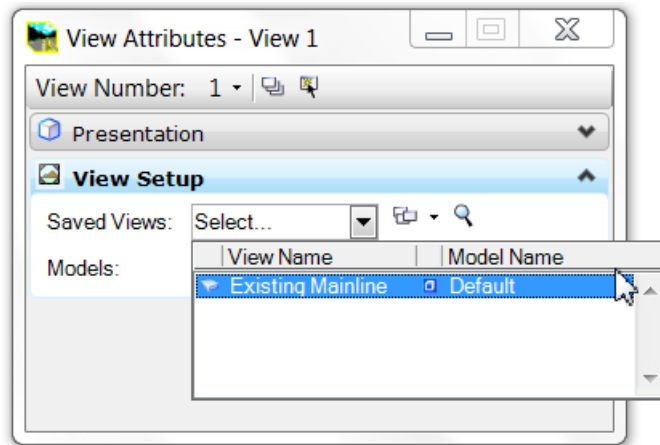
**Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
		Import Geometry

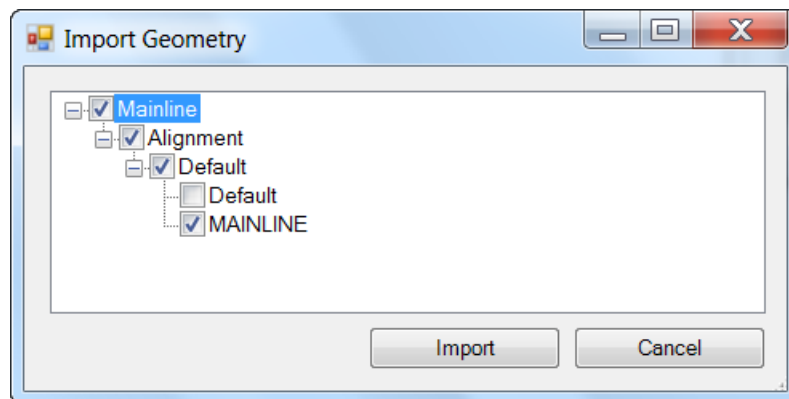
### Procedure:

1. Open file *Start\_ch1.dgn*.
2. Select the Saved View "Existing Mainline." In order to see the alignment we are importing, the saved view has turned off the display of the reference file.

**Hint:** The Saved Views can be accessed in the View Setup section at the bottom of the View Attributes dialog.



3. Select the Import Geometry command (top row, left icon).
4. Select *mainline.alg* (in your project folder) and click **Open**.



5. Navigate the tree and toggle on MAINLINE. Note the upper part of the hierarchy is toggled on also. Do NOT toggle on Default.
6. Click **Import**.

- 

## USING HISTORICAL DATA

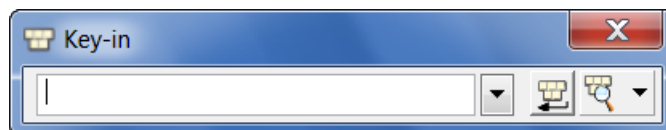


### Objective:

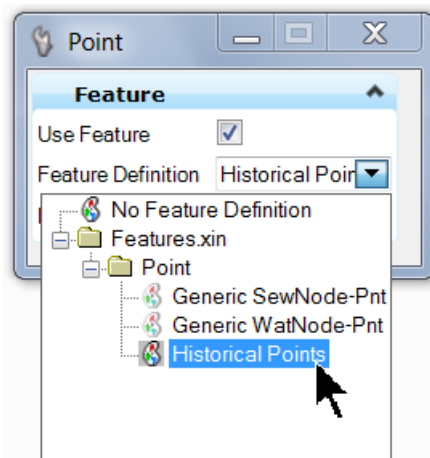
### Geometry Tools Used:

CIVIL GEOMETRY PANEL	ICON	TOOL
		Point
		Line Between Points

1. Continue in the file *Start\_ch1.dgn*.
2. Select the Saved View “Cross Highway.”
3. Select **Utilities > Keyin** from the Power InRoads main menu bar. We’ll use this for the coordinate data input.



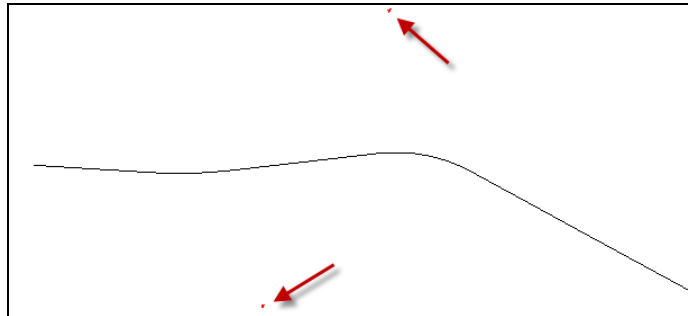
- 11/28/2011



6. Now we'll follow the heads-up prompt attached to the cursor to draw our points:

HEADS-UP PROMPT	USER ACTION
Enter Data Point	In the Key-in dialog opened in step 3, carefully type in: (do not space before or after the equal sign and include the comma) xy=767641.50,179118.90 <enter>
Enter Data Point	In the Key-in dialog opened in step 3, carefully type in: (do not space before or after the equal sign and include the comma) xy=767283.123,179478.032<enter>

7. Two red cells are drawn into the file. They are actually our triangle cell.



8. Close the Key-in dialog.  
 9. Select the Line Between Points command.  
 10. In the dialog, toggle on **Use Feature** and select the Feature Definition HA Roadway from the pick list. Notice the list is different than when we defined the Historical Points. The pick list differentiates between linear and point feature definitions.

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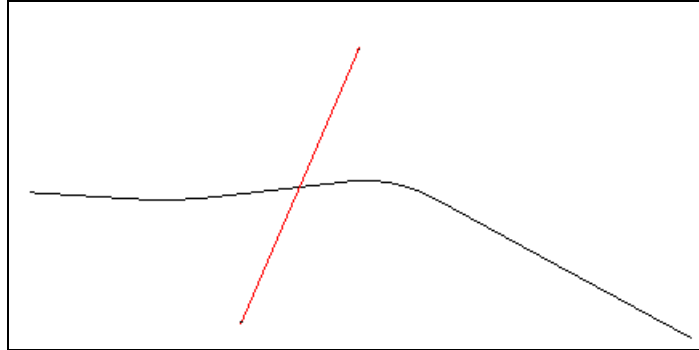
**Note:** When no feature is used, the elements are drawn with the active MicroStation symbology.

---

11. Now we'll follow the heads-up prompt attached to the cursor to draw our alignment.

HEADS-UP PROMPT	USER ACTION
Enter Start Point	Select the southern point you just placed. You can zoom in and out to reach the point.
Enter End Point	Select the northern point you just placed.

12. We now have the existing cross road alignment drawn in red. If yours is black, you didn't set the Feature Definition correctly. Simply undo the element and place again.



*Two existing alignments are now displayed*

## STATIONING AND STATION EQUATIONS

When creating an alignment, the stationing is set to zero, by default. However, you may want to station your alignments or add station equations. In order to add stationing, we need to specify the station value and define the point where the station should be applied. For this workshop, we will station our crossing alignment. Note station equations are outside the scope of the workshop.



### *Optional Exercise: Adding Stationing to Cross Road Alignment*

#### **Objective:**

Add initial stationing of 10+000 to our cross road alignment.

#### **Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
A		Start Station

#### **Procedure:**

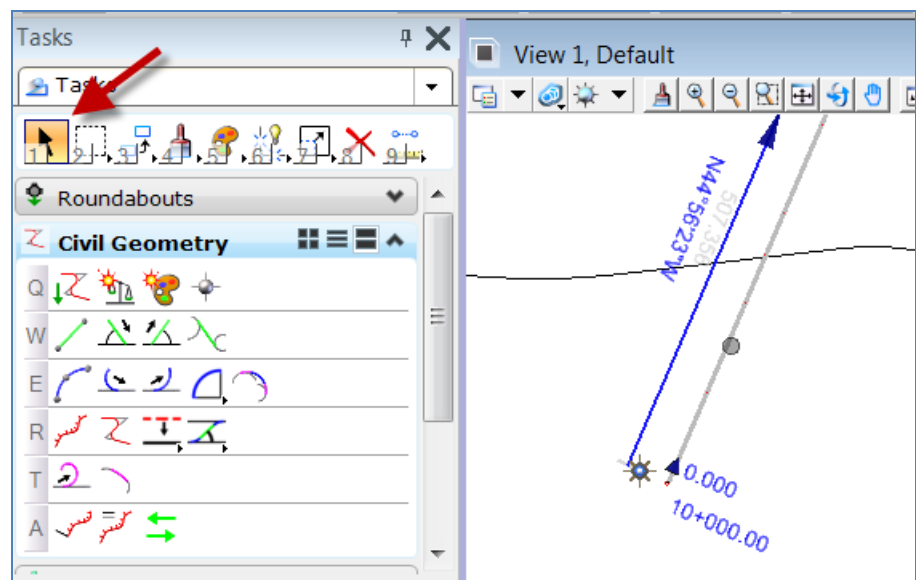
1. Continue in the file *Start\_ch1.dgn*.
2. Select the Start Station command. As we are not drawing any elements, this dialog does not have a feature definition.

3. Now we'll follow the heads-up prompt attached to the cursor to draw our alignment.

HEADS-UP PROMPT	USER ACTION
Locate Element	Select the cross road alignment near the southern end.
Start Station Position / Start Distance	Type 0 <enter>. Then data point on screen to move to the next prompt.
Enter Starting Station / Start Station	Type 10+000 <enter>. Then data point on the screen to complete the command.

4. Just above the Civil Geometry group task, click on Element Selection. Then select the alignment. The edit manipulators and station are now displayed.

**Hint:** The size and colours of the manipulators can be user defined in the Workspace > Preferences > View Options – Civil.



*The Element Selection icon is used to select civil geometry elements and display edit manipulators*

## CHAPTER SUMMARY

In this chapter, we have learned how to import horizontal geometry from an existing ALG file (created in Power InRoads), and also how to manually enter points from historical data. We created a single line alignment and added stationing.

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# Chapter 2: Alignments and Standards

## USING DESIGN STANDARDS

Design standards can be used to maintain required curvature and other alignment checks when performing geometric layouts. They work at two levels:

- Provide values for the element creation tools (for example, minimum radius and transition lengths)
- Check the suitability of complex elements (for example, check for kinks in the alignment)

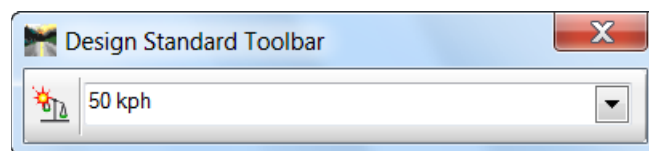
## DESIGN STANDARDS FEEDBACK

When a design standard is violated feedback is provided in two ways:

- An icon in the graphics, on the element that has the problem. Hover over the icon to reveal a tool tip report of the error.
- In the Civil .Message Center.

## DESIGN STANDARD TOOLBAR

On the menu select Tools > Civil Geometry > Design Standards to open the design standards toggle bar.



This toolbar allows you to set an active design standard used by all commands.

### Procedure:

1. Select the desired standard.
2. Click the button on the left to toggle the standard on or off. When on, all commands will make use of the values contained in the standard. When off, the selected standard is ignored.



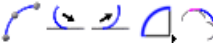

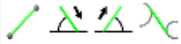





### *Exercise: Create the New Centerline Based on Standards*

**Objective:** We will utilize the design standards and feature definitions to modify the centerline for our mainline roadway. We'll use the eastern and western tangents, then rebuild the center section with arcs and tangents. The goal is to shift the roadway to lessen the skew between mainline and the

intersecting highway. This will help in the design of a full cloverleaf interchange.

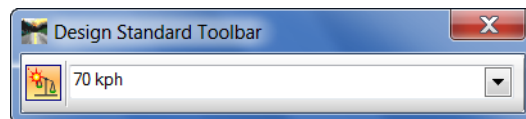
#### Geometry Tools Used:

CIVIL GEOMETRY PANEL	ICON	TOOL
W 		Line Between Points
E 		Arc From Element
W 		Line Between Arcs
R 		Complex By Elements

#### Procedure:

**Hint:** Remember if you don't like what is drawn, use the "Undo" command <ctrl> - Z on your keyboard or Edit > Undo on the Power InRoads main menu bar!

1. Open *Start\_ch2.dgn*.
2. Select the **70 KPH** standard from the Design Standard Toolbar. (This was docked at the bottom of your view in an earlier exercise.)



3. Toggle on Active Design Standard toggle to the left of the Toolbar, so it appears orange. Any subsequently created geometry elements will use the selected standard.
4. Double check the active symbology is set to Level - Working Elements, Weight 2, and color other than red. (Green is used for illustrations.)
5. Select the Line Between Points command.
6. In the dialog, toggle off **Use Feature**. We'll build all our working elements, then we'll select a Feature Definition when we connect them together.

**Note:** When no feature is used, the elements are drawn with the active MicroStation symbology.

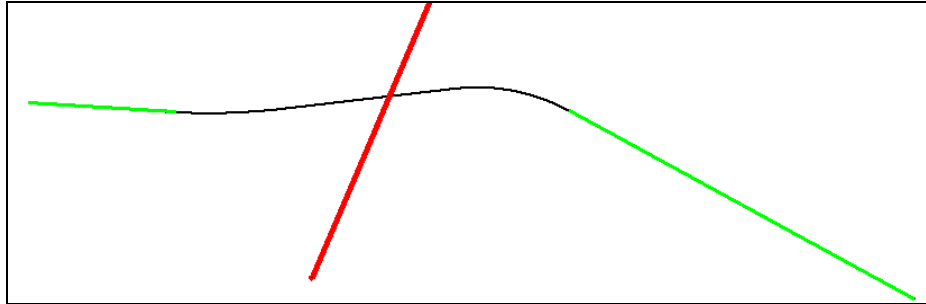
7. Now we'll follow the heads-up prompt attached to the cursor to draw our western tangent.

HEADS-UP PROMPT	USER ACTION
Enter Start Point	Select the western point of the mainline alignment.
Enter End Point	Snap to the other end of the same tangent section.

8. We now have the western tangent drawn in green.




9. Repeat the same process for a tangent at the eastern end.



10. Turn off the Default Level, as we no longer need to see the existing (black) alignment. This is the section we are going to redesign.
11. Now we'll draw a curve to 70KPH standards on the west end going northward, and another on the east end going southward.
12. Starting with the west end, select the Arc from Element command.

HEADS-UP PROMPT	USER ACTION
Locate Element	Select the western tangent.
Enter Offset	Type 0 <enter>. Data point on the screen to move to the next prompt.
Enter Start Point	Select the right end of our tangent.
Thru Point or Radius	The radius is set to 510, from our standards. We'll use this value. Note the <=> at the right of the Radius value. This indicates additional options. Select the right arrow on your keyboard.
Back Transition Length	This is also from our standards. If you select the right arrow on your keyboard again, you'll see the Radius of 510. Data point to confirm the entries. Move the cursor towards the top of the screen to see the arc dynamically displayed. As you move the cursor, the Arc Length is changing. Data point when the length is approximately 300m.
Trim / Extend	Select Back (using the down arrow on your keyboard to toggle through the options) and data point to complete the command.

13. On the east end, we want to start the arc at a different location than the end of the tangent. Select the Saved View "East Tangent" so we the existing roadway edges are displayed.
14. Select the Arc from Element command and follow the Heads-up prompts.

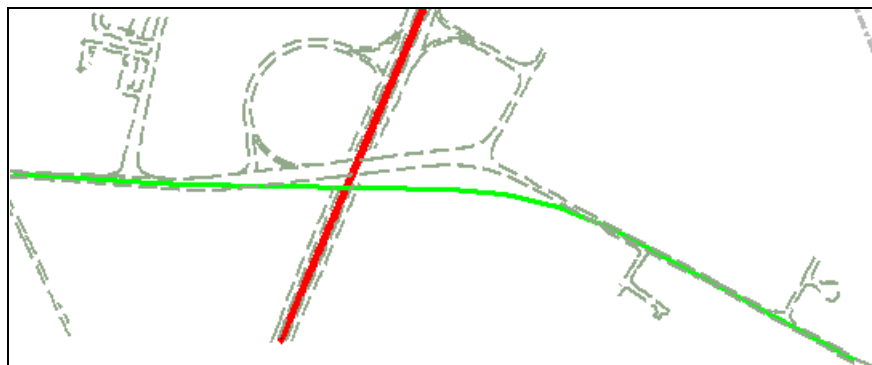
HEADS-UP PROMPT	USER ACTION
Locate Element	Select the eastern tangent.
Enter Offset	Type 0 <enter>. Data point on the screen to move to the next prompt.
Enter Start Point	Now we want to data point at the curb return as shown. 
Thru Point or Radius	The radius is set to 510, from our standards. We'll use this value. Note the <=> at the right of the Radius value. This indicates additional options. Select the right

	arrow on your keyboard.
Back Transition Length	This is also from our standards. If you select the right arrow on your keyboard again, you'll see the Radius of 510. Data point to confirm the entries. Move the cursor towards the bottom of the screen to see the arc dynamically displayed. As you move the cursor, the Arc Length is changing. Data point when the length is approximately 250m.
Trim / Extend	Select Back (using the down arrow on your keyboard to toggle through the options) and data point to complete the command.



15. Now we need to draw the tangent to connect the curves. Select the Line Between Arcs command (W row, fourth icon).
16. Follow the heads-up prompts to draw the line. Note we will be creating our alignment from west to east, so draw the line in that direction.

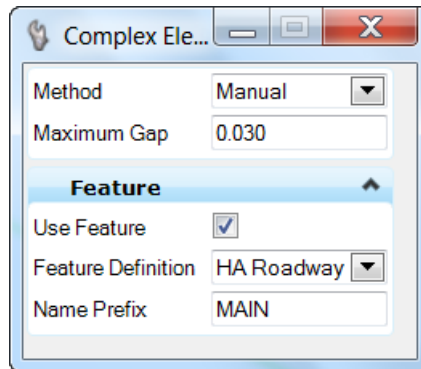
HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the western arc.
Start Offset	Set to 0 and data point to accept.
Locate Second Element	Select the eastern arc.
Second Offset	Set to 0 and data point to accept.
Solution	Actually, there are four solutions. Click <Alt> on your keyboard to see each solution. When the desired solution is displayed, data point to accept.
Trim / Extend	Use the down arrow on the keyboard for the Both option, then data point to complete the command.



*Tangent is drawn between two arcs, completing our last working element.*

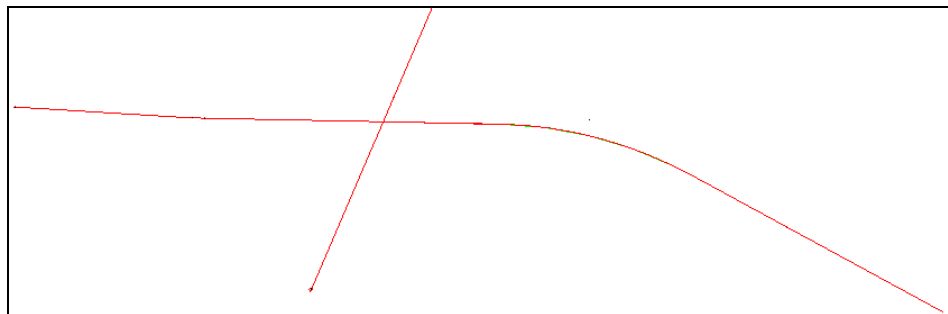
Now we are going to connect all the working elements together in one alignment. At the same time, we'll use a feature definition, so we get the correct symbology, correct naming, and persist back to the ALG file.

17. Select the Saved View "Complex Elements."
18. Select the Complex By Elements command to create the alignment (from left to right on the screen).
19. In the dialog, set the **Method** to Manual, as we have quite a few trimmed elements. Set the **Maximum Gap** to 0.03. We also want to toggle on **Use Feature** and set our **Feature Definition** to HA Roadway.



**Note:** The name prefix functions like an auto numbering process. In this example, the first element would be named CL, the next would be CL1, CL2, and so on. But it can also be used for absolute naming which is especially useful for alignments. So, for example, I could have entered a name prefix here of "BOB RD" and since there is no other element with that name, the alignment would be named "BOB RD". In other words, no suffix. The alignment will be annotated based on the settings of the native feature table (XIN). The active drawing scale must match a scale stored in the native feature table. (Settings > Drawing Scale) i.e., Metric plan scale = 500.



20. When prompted to Locate the First Element, select the western tangent on the western end, being mindful of the arrows. If the arrow is going the wrong direction, move the cursor until you get the correct direction. Continue selecting the elements in order, ignoring the Max Gap warnings. This is because we are using trimmed elements.
21. When all elements have been selected, data point a final time to accept the alignment. The alignment is chained together and the symbology is changed to match the feature definition.



## SETTING FEATURES AFTER - THE - FACT

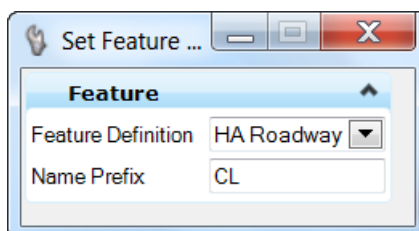
Did your alignment not change to red after creating complex from elements? Perhaps you forget to set (or incorrect set) the Feature Definition?

No problem, there's a tool to set a Feature Definition after elements are drawn.

CIVIL GEOMETRY PANEL	ICON	TOOL
		Set Feature Definition

### Procedure:

1. Select the Set Feature Definition command.





2. Select the Feature Definition from the pick list (linear options only).
3. Select the elements to apply the Feature Definition. Multiple elements may be selected without reselecting the command.

## SETTING DESIGN STANDARDS FEATURES AFTER - THE - FACT

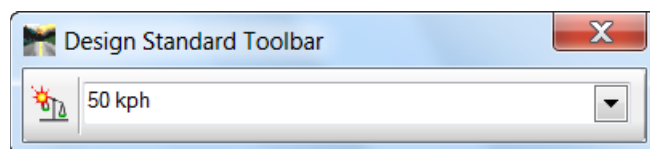
Did you forget to set (or incorrectly set) the Design Standard? Or would you like to check an existing alignment?

No problem, there's a tool to set a Design Standard after elements are drawn.

CIVIL GEOMETRY PANEL	ICON	TOOL
		Set Element Design Standard

### Procedure:

1. In the Design Standard Toolbar, select the desired Design Standard from the pick list.



2. Select the Set Element Design Standard command.
3. Select the elements to apply the Design Standard. Multiple elements may be selected without reselecting the command.

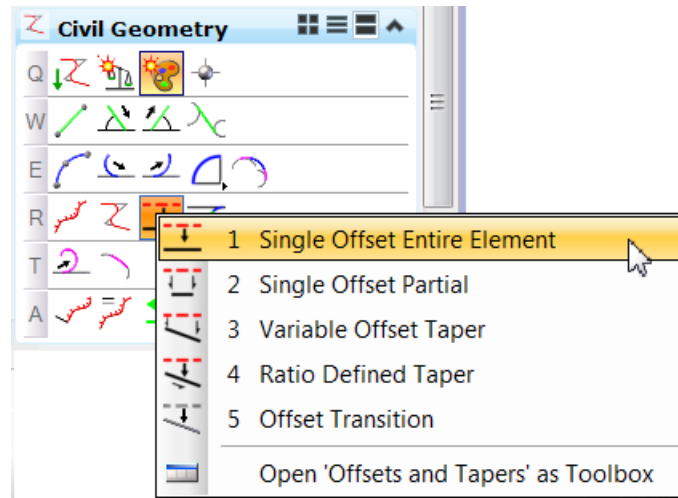
## CREATING NON-ALIGNMENT ELEMENTS

The horizontal geometry tools are used for more than just centerline alignments. In this session, we will utilize more of the horizontal tools in conjunction with feature definitions to construct the edges of pavement and shoulders for the mainline roadway. We need these in place before we develop the loop and ramp alignments.

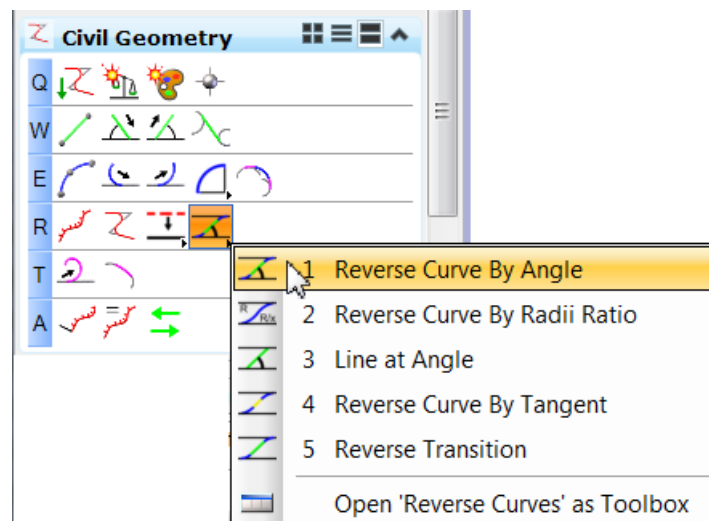
In addition, we'll see a new look to the one of our icons. Look closely at the Single Offset Entire Element and see the small black triangle in the lower right corner.



This indicates that there are multiple commands in this grouping.



The Reverse Curves (icon directly to the right of Offsets and Tapers) also has multiple commands.





### *Exercise: Construct the Edges of Pavement and Shoulders*

**Objective:** Construct edges of pavement and shoulders for both sides of the mainline alignment. We'll also use the Feature Toggle Toolbar to set the feature definition.

#### **Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
		Single Offset Entire Element

#### **Procedure:**

1. Continue in *start\_ch2.dgn*.
2. Set the Feature Toggle Toolbar to **Features.xin > Linear > SHLD Prop**.

**Hint:** The Features Toolbar should be docked on the bottom of the screen from an earlier exercise. If it's not docked, select **Tools > Civil Geometry > Features Tool Bar** from the Power InRoads main menu bar and dock at this time.

3. Select the Single Offset Entire Element command.
4. On the command dialog, toggle on **Use Feature**. Set the **Feature Definition** to Use Active Feature.
5. Now we'll follow the heads-up prompt attached to the cursor to draw our elements:

HEADS-UP PROMPT	USER ACTION
Locate Element	Select the mainline centerline.
Offset	Key in 3.3 <enter>. Note the lock symbol to the right of the offset value. Move cursor to the right side of the centerline and data point to accept the construction and create the offset element.
Offset	Key in 3.3 <enter>. Note the lock symbol to the right of the offset value. Move cursor to the right side of the centerline and data point to accept the construction and create the offset element. You do not have to reselect the mainline centerline.

Now we'll repeat the steps to draw the edges of pavement.

6. Set the Feature Toggle Toolbar to **Features.xin > Linear > EP Prop**.
7. Select the Single Offset Entire Element command.
8. On the command dialog, set the feature to active feature. (It should be set from the previous command.)
9. Now we'll follow the heads-up prompt attached to the cursor to draw our elements:

HEADS-UP PROMPT	USER ACTION
Locate Element	Select the mainline centerline.
Offset	Key in 17.4 <enter>. Note the lock symbol to the right of the offset value. Move cursor to the north side of the centerline and data point to accept the construction and create the offset element.
Offset	Key in 17.4 <enter>. Note the lock symbol to the right of the offset value.



	Move cursor to the south side of the centerline and data point to accept the construction and create the offset element. You do not have to reselect the mainline centerline.
--	---



*Optional Exercise: Drawing Partial Element for Southern Loops*

**Objective:** Now we'll draw another parallel element to use for our southern loops, this time just in the area of the interchange.

**Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
		Single Offset Partial Element (Note you need to select the small black triangle to get the command from the pulldown menu.)

**Procedure:**

1. Continue in *Start\_ch2.dgn*.
2. Set the Feature Toggle Toolbar to **Features.xin > Linear > HA Ramp**.
3. Select the Single Offset Partial Element command.
4. On the command dialog, set the feature to active feature. (It should be set from the previous command.)
5. Now we'll follow the heads-up prompt attached to the cursor to draw our elements:

HEADS-UP PROMPT	USER ACTION
Locate Element	Select the mainline centerline.
Offset	Key in 22.3 <enter>. Note the lock symbol to the right of the offset value. Note the <> to the right of the edit field. This indicates additional prompts. Press the <right arrow> on your keyboard.
Start Distance	This is measured from the beginning of the alignment. Key in 200 <enter>. Move the cursor to the south side of centerline and data point.
End Distance	This is also measured from the beginning of the alignment. Key in 650 <enter>. Move the cursor to the south side of centerline and data point to complete the construction.



*Non-alignment elements drawn with offset commands*

## EDITS AND MANIPULATION OF ELEMENTS

One advantage of placing civil elements is the ability to dynamically edit them. By selecting the element, edit manipulators are displayed. Edit fields are supported for many properties, along with graphic handlers for dynamic movement. The edit fields and handlers are based on the type of element selected and the command used to place them.





### ***Exercise: Edit the Pavement Edges***

**Objective:** In this lesson we will correct an error in the pavement edge calculations. Our section is 3 lanes in each direction (3.6m per lane) plus a (3.5m) median each side of centerline. So the outside edge should have been set at 14.3m not 17.4m.

### **Geometry Tools Used:**

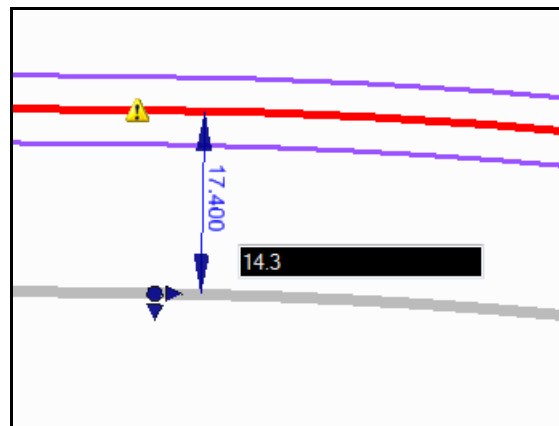
None.

### **Procedure:**

1. Continue in *Start\_ch2.dgn*.
2. Select one of the outside edges of pavement. Note the width drag handle at the midpoint.



3. We could drag this to set the width dynamically, but a more precise entry is needed.
4. Zoom in to the roadway (at mid-point or either end) until you also see a text manipulator for the width. Click on the text to allow changing of the value. Change the offset to 14.3m.



4. Repeat on left side with a value of 14.3m.

---

**Hint:** If you get it wrong just undo with <CTRL> Z.

---

## **CHAPTER SUMMARY**

In this chapter, we have utilized Design Standards to develop new alignments and learned how Feature Definitions affect the horizontal geometry elements. We have used the tools to develop non-alignment elements, and then manipulated them.

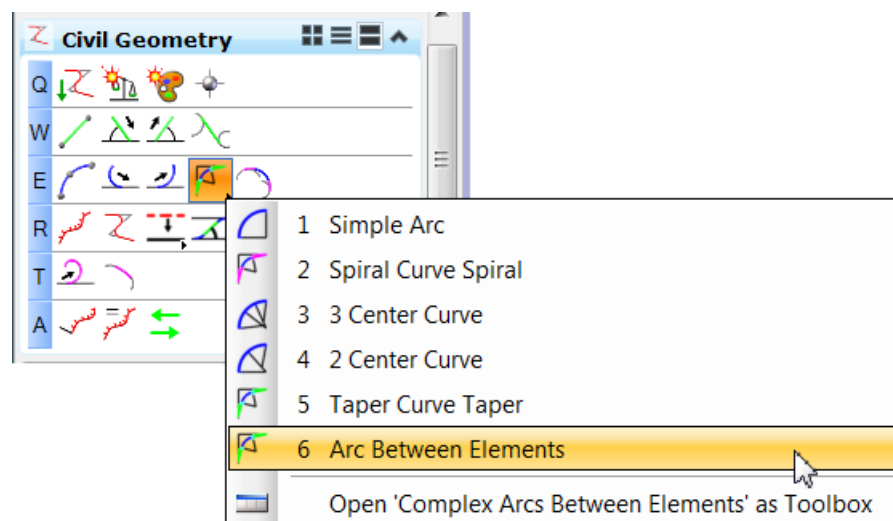
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# Chapter 3: Developing Loops

## OVERVIEW

In this chapter, we will construct the inside loops. We can use the Arc Between Elements command to construct the entire loop or ramp in one operation. In addition to spiral transitions, the tool can create arc transitions as well, which allows you to create 2-center and 3-center curves. By using the Design Standards tool, we can draw the elements to the desired design speed. We'll use our mainline and cross road alignments, and use offsets to define the starting and ending points. In that way, if we adjust the alignments, we can also update the loops or ramps.

The Complex Arcs icon has the small black triangle in the lower right corner. It's the fourth icon in the "E" row of tools. This indicates that there are multiple commands in this grouping.



## ELEMENT SELECTION FOR COMPLEX TOOLS

Now that we are starting to build more complex elements, we need to understand the relationship between the various input fields. In this chapter, we need two alignments to fit the loop or ramp. While we can select the elements in any order, each selection has associated transition and taper options. For example, if we select our mainline alignment as our first element, the Back Taper and Transition are based on that alignment. The second selected element relates to the Ahead Transition and Taper options.

The loops have some severe constraints that will reduce the design speed of the ramps. We will develop the inside edge as the alignment, then offset for the outside edge of the loop.



### *Exercise: Construct The Northeast Loop Alignment*

**Objective:** Construct the inside ramp centerline.

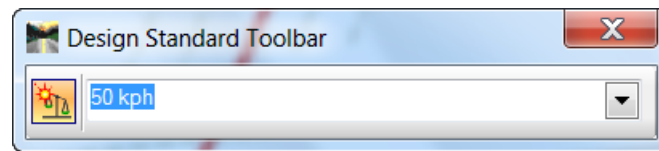
**Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
		Arc Between Elements


### **Procedure:**

**Hint:** Remember if you don't like what is drawn, use the "Undo" command <ctrl> - Z on your keyboard or Edit > Undo on the Power InRoads main menu bar!

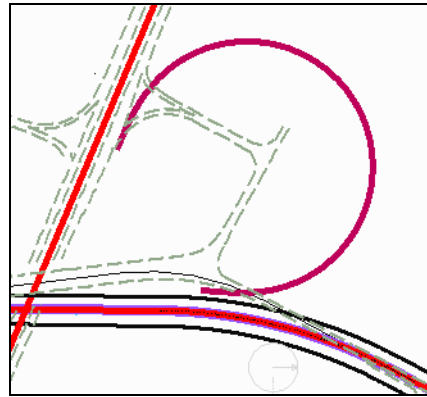
1. Open *Start\_ch3.dgn*.
2. Select the **50 KPH** standard from the Design Standard Toolbar. (This was docked at the bottom of your view in an earlier exercise.) Ensure the icon to the left of 50 KPH is toggled on (indicated by the orange color).



3. Set the Feature Toggle Toolbar to **Features.xin > Linear > HA Ramp**. This will draw on the same level as our other alignments, but in a deeper red color.
4. Select the Arc Between Elements command. (You may have to select the small black triangle to expand the command selection list to see it.)
5. At the bottom of the command dialog, toggle on **Use Feature** and set the **Feature Definition** to Active Feature. (It should be set from the previous command.)
6. Now we'll carefully follow the heads-up prompts attached to the cursor to draw our loop:

HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the cross road centerline.
Enter Start Offset	<p>We can graphically select the existing edge of pavement.</p>  <p>Move cursor to the right side of the centerline and data point to accept the element.</p>
Locate Second Element	Select the mainline centerline.
Second Offset	In this case, we have 14.3m to the shoulder, then we'll need 3m for the ramp median / gore plus 5m for the actual ramp for a total offset of 22.3m. Use the key-in prompt

	and data point to accept.
Select Construction Sector / Radius	Return to the dialog for a moment. Notice our offsets are populated with our selections. The Radius is populated from the Design Standards, along with Transition data. Toggle on Loop and return to the screen. Do NOT data point yet! If the arc is the wrong hand, use the <ALT> key to change to the alternate hand. If you are zoomed out quite a distance, you'll see a huge red loop, based on our standards. Since we cannot consume that big of a footprint, change the Design Standard to One Step Below Desired Minimum at 50 KPH. (Click the + to the left of 50 KPH to display this option. Note the red loop is substantially smaller and the radius value in the dialog is now set to 127. Data point to complete the construction.



Completed Northeast Loop

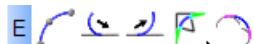



### Exercise: Construct The Northwest Loop Alignment

This loop has a smaller footprint than the northeast loop we just completed. Therefore, we will need to drop our standard one more step. Another option would be to lower the design speed. We will develop the inside edge as the alignment, then later we can offset for the outside edge of the loop.

**Objective:** Construct the inside ramp centerline.

#### Geometry Tools Used:

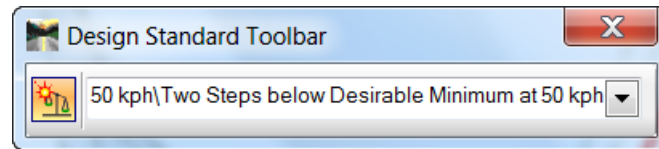
CIVIL GEOMETRY PANEL	ICON	TOOL
		Arc Between Elements

#### Procedure:

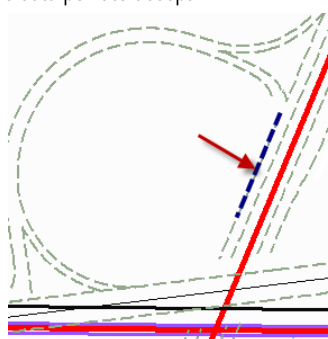
**Hint:** Remember if you don't like what is drawn, use the "Undo" command <ctrl> Z on your keyboard or Edit > Undo on the Power InRoads main menu bar!

1. Continue in start\_ch3.dgn.

2. Select the **50 KPH\Two Steps below Desirable Minimum at 50 KPH** standard from the Design Standard Toolbar. (This was docked at the bottom of your view in an earlier exercise.) Ensure the icon to the left of 50 KPH is toggled on (indicated by the orange color).



3. Verify the Feature Toggle Toolbar is still set to **Features.xin > Linear > HA Ramp**.
4. Select the Arc Between Elements command.
5. At the bottom of the command dialog, toggle on **Use Feature** and set the **Feature Definition** to Active Feature. (It should be set from the previous command.)
6. In the dialog, change the **Start Offset** to 15m. Note the radius value have also changed since we changed our Design Standard.
7. Now we'll carefully follow the heads-up prompts attached to the cursor to draw our loop:

HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the cross road centerline.
Enter Start Offset	<p>Since we changed the value to 15m in the dialog, we can just move the cursor to the left side of the centerline data point to accept.</p>  <p>However, we could have selected it graphically also.</p>
Locate Second Element	Select the mainline centerline.
Second Offset	In this case, it's the same as the previous loop, 22.3m.
Select Construction Sector / Radius	Move the cursor to see the northwest loop. It should be a smaller footprint than our northwest loop. Data point to accept.



Completed Northeast and Northwest Loops

## EDITS AND MANIPULATION OF ELEMENTS

As we saw in the last session, an advantage of placing civil elements is the ability to dynamically edit them. This is also true of complex elements, such as the loops we just developed.



### *Exercise: Edit the Northeast Loop*

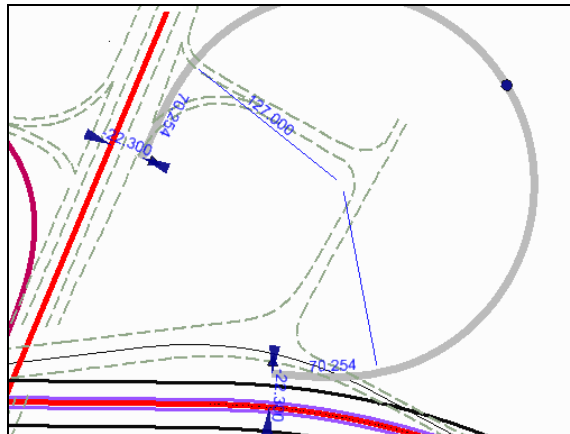
**Objective:** We will review the edit manipulators and handlers for the loop.

**Geometry Tools Used:**

None.

**Procedure:**

1. Zoom into the northeast loop so it fills the screen.
2. Select the loop (using the element selector).



3. We can edit the offsets, radii, or transition lengths. Experiment by changing the values and see the dynamic updating.

## DEVELOPING THE SOUTHWEST LOOP

For this alignment, we will once again use the Design Standards. However, we will combine it with the Spiral Curve Spiral command. In this case, the command does not have the option for offsets, so we need to select the actual elements.



### *Optional Exercise: Develop the Southwest Loop*

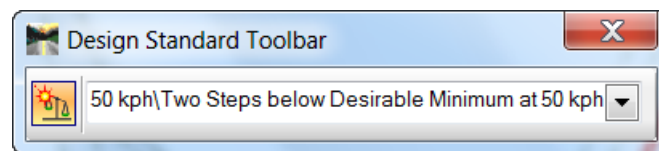
**Objective:** Construct the inside ramp centerline.

#### **Geometry Tools Used:**

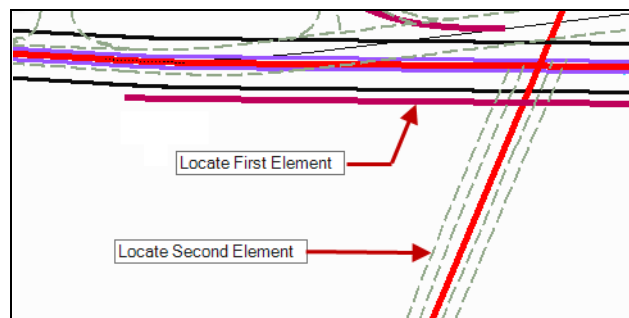
CIVIL GEOMETRY PANEL	ICON	TOOL
		Spiral Curve Spiral

#### **Procedure:**

1. Continue using the **50 KPH\Two Steps below Desirable Minimum at 50 KPH** standard from the Design Standard Toolbar. Ensure the icon to the left of 50 KPH is toggled on (indicated by the orange color).



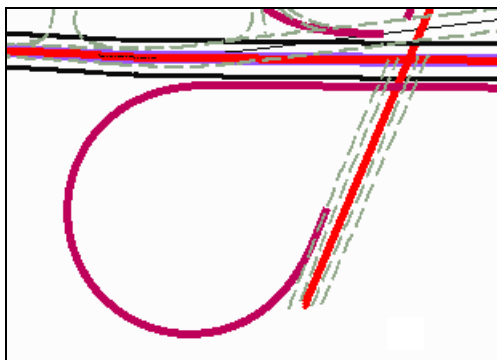
2. Verify the Feature Toggle Toolbar is still set to **Features.xin > Linear > HA Ramp**.
3. Select the Spiral Curve Spiral command.
4. At the top of the dialog, toggle on **Loop**. Note the Radius and Transition fields are populated with our Design Standard.
5. At the bottom of the command dialog, toggle on **Use Feature** and set the **Feature Definition** to Active Feature. (It should be set from the previous command.)
6. Now we'll carefully follow the heads-up prompts attached to the cursor to draw our loop using the illustration as a selection guide:



HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the east-west element.
Locate Second Element	Select the edge of the cross road.
Select Construction Sector / Radius	Move the cursor to see the southwest loop. The Radius is displayed. However, we don't have to use Radius as our input. In the heads-up prompt, type d55 <enter>.



	The Radius field in the dialog changes to the degree input and the loop changes dynamically. Data point to accept.
Trim / Extend Option	Set to Back and data point to accept the construction.



Completed Southwest Loop

## DEVELOPING THE SOUTHEAST LOOP



For this alignment, we will once again use the Design Standards. However, we will combine it with the 3 Center Curve command. In this case, the command does not have the option for offsets, so we need to select the actual elements.



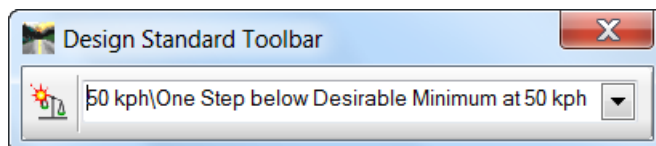
### Optional Exercise: Develop the Southeast Loop

**Objective:** Construct the inside ramp centerline.

#### Geometry Tools Used:

CIVIL GEOMETRY PANEL	ICON	TOOL
		3 Center Curve

1. Use the **50 KPH\One Step below Desirable Minimum at 50 KPH** standard from the Design Standard Toolbar. Ensure the icon to the left of 50 KPH is toggled on (indicated by the orange color).

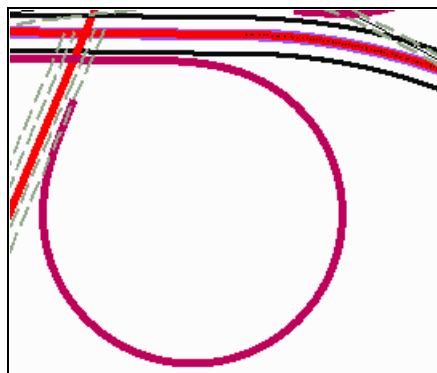


2. Verify the Feature Toggle Toolbar is still set to **Features.xin > Linear > HA Ramp**.
3. Select the 3 Center Curve command.
4. At the top of the dialog, toggle on **Loop**. Note the Radius and Transition fields are populated with our Design Standard.
5. At the bottom of the command dialog, toggle on **Use Feature** and set the **Feature Definition** to Active Feature.

6. Now we'll carefully follow the heads-up prompts attached to the cursor to draw our loop using the illustration as a selection guide:



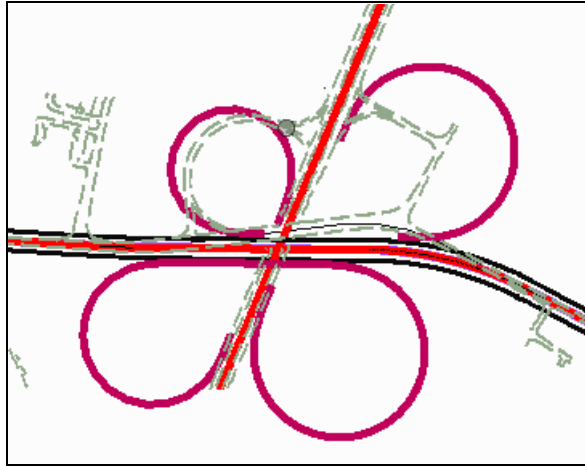
HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the east-west element.
Locate Second Element	Select the edge of the cross road.
Select Construction Sector / Radius	Move the cursor to see the southeast loop. Use the Radius and <>.
Select Construction Sector / Back and Ahead Transition Lengths	Set the Back and Ahead Transition Lengths to 100.
Trim / Extend Option	Set to Back and data point to accept the construction.



*Completed Southeast Loop*

## CHAPTER SUMMARY

In this chapter, we have utilized the Complex Arcs tool in conjunction with Design Standards to develop new loop alignments. We used a new Feature Definitions to distinguish the loop alignments from the mainline. We also reviewed the element manipulator and edit fields.



*Four completed loops*

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# Chapter 4: Developing Ramps

## OVERVIEW

Now that we have completed the loops, we can begin work on the ramps. There are a variety of ways to develop the ramps, and numerous different ways (and tools) to accomplish it. Keep in mind that we are demonstrating the tool usage, as we can't design the entire interchange in one short workshop.

## CONSTRUCT THE NORTHEAST RAMP



### *Construct the Northeast Ramp*

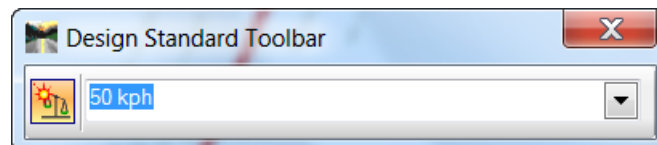
**Objective:** Construct the inside ramp centerline.

**Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
		Arc Between Elements
		Complex By Elements
		Single Offset Partial Element

### **Procedure:**

1. Continue in *Start\_ch4.dgn*.
2. Use the **50 KPH** standard from the Design Standard Toolbar. Ensure the icon to the left of 50 KPH is toggled on (indicated by the orange color).



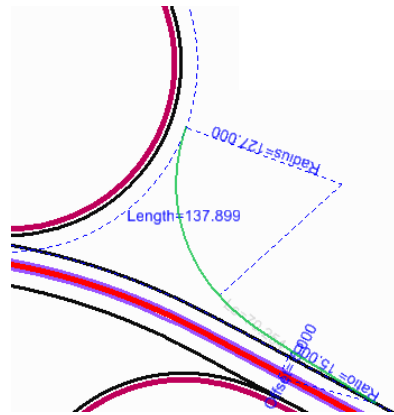
3. Set the Feature Toggle Toolbar to No Feature. We'll build the elements and when we connect them, we'll assign a feature definition at that time.
4. Select the Arc Between Elements command.
5. At the top of the dialog, toggle off **Loop**. Note the Radius and Transition fields are populated with our Design Standard.

6. Now let's enter some of our taper information into the dialog.

FIELD	VALUE
Back Taper section	
Method	Ratio-Offset
Offset	5
Ratio	1:15
Back Transition section	
Geometry	Spiral
Method	Length
Length	70.254 (set by standard)
Ahead Taper section	
Method	None
Ahead Transition section	
Geometry	None

7. Now we'll carefully follow the heads-up prompts attached to the cursor.

HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the mainline element.
Enter Start Offset	17.9m. Data point to accept.
Locate Second Element	Select the loop alignment.
Offset	17.6m (existing edge of exit lane, appears outside the loop). Data point to accept.
Select Construction Sector / Radius	Move the cursor to see the ramp. The Radius is displayed from our standard. Data point to accept.



Now we'll repeat the process to get the section of the alignment between the cross highway and the ramp.

8. Select the Arc Between Elements command again.  
9. We need to change a few entries in the dialog.

FIELD	VALUE
Back Taper section	
Method	Ratio-Offset
Offset	5
Ratio	1:50

10. Now we'll carefully follow the heads-up prompts attached to the cursor.

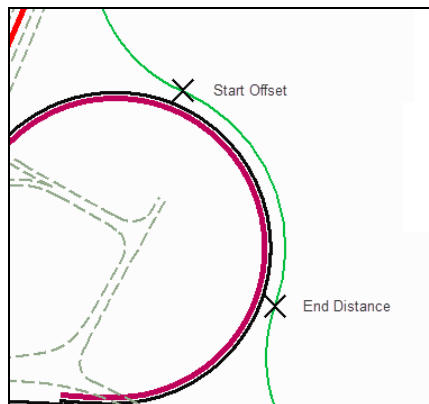
HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the cross highway element.
Enter Start Offset	17.6m. Data point to accept.
Locate Second Element	Select the loop alignment.
Offset	Also 17.6m. Data point to accept.
Select Construction Sector / Radius	Move the cursor to see the ramp. The Radius is displayed from our standard. Data point to accept.



*Two segments of the northeast ramp*

11. Select the Single Offset Partial Element command.

12. Now we'll carefully follow the heads-up prompts attached to the cursor, based on the illustration below.



HEADS-UP PROMPT	USER ACTION
Locate Element	Select the northeast loop centerline.
Start Parameters Offset	Snap to the end of the working element we just drew that is connected to the cross highway.
End Distance	Snap to the end of the working element we created connecting to the mainline alignment.

13. Select the Complex By Elements command to create the alignment (from the cross highway end to the mainline alignment).
14. In the dialog, set the **Method** to Automatic. Set the **Maximum Gap** to 0.03. We also want to toggle on **Use Feature** and set our **Feature Definition** to HA Ramp and use the default **Name Prefix**.
15. Follow the heads-up prompts, using the green working elements we just created.

HEADS-UP PROMPT	USER ACTION
Locate Element	Select the northeast ramp beginning near the cross highway. Watch that the arrow is pointing in the correct direction. Data point to accept. <div data-bbox="922 516 1198 810" data-label="Image"> </div>
Accept Complex	Of the entire ramp has changed color, data point to accept.



Completed Northeast quadrant – loop and ramp

## CREATE THE NORTHWEST RAMP

In order to fit the ramp in between the loop and a nearby frontage road, we are going to develop the alignment using the curve points of intersection (P.I.) along with our Design Standards. Then we can dynamically modify to fit our design.



### *Create the Northwest Ramp*

In this exercise, we'll use 5 points to create our alignment. Since we are using Design Standards, the curve and transition data will be populated by default.

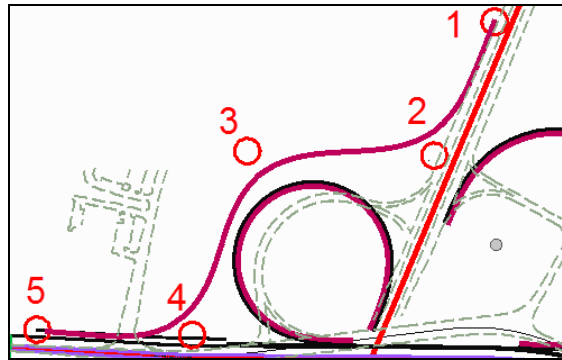


**Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
		Complex by PI

**Procedure:**

1. Continue in *start\_ch4.dgn*.
2. Set the Feature Toggle ToolBar to HA Ramp.
3. Set the Design Standard to 50 kph\Two Steps below Desirable Minimum at 50 kph.
4. Select the Complex by PI command.
5. Follow the heads-up prompts, using the illustration as guidance:



*Five points used as P.I. for northwest ramp.*

HEADS-UP PROMPT	USER ACTION
Enter First P.I.	Place the point on the edge of the existing cross highway. Note we could also have built a taper first and used that as our starting point, as the P.I. tool does not have offset options.
Enter Next P.I. / Radius	Place the point, still on the edge of the existing cross highway. The Radius should be set to 90m, based on our Design Standard.
Enter Next P.I. / Radius	Place the third data point.
Enter Next P.I. / Radius	Place the fourth and fifth points on the edge of the mainline pavement (or taper if you to placed one). Replace when all five points have been placed (to complete the command.)

6. If you don't like the placement, select the element, and dynamically adjust or change the edit fields.

## CREATE THE SOUTHWEST RAMP

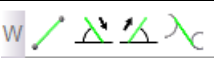

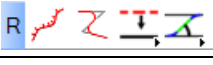

We are going to use a variety of tools for this area. First, we need to realign the southern access so it is perpendicular to the mainline. Then we'll modify the roadway from 2 way to one way to provide an entrance to the cross highway. This will set us up to realign the access road on the north side of mainline.



### Optional Exercise: Create the Southwest Ramp

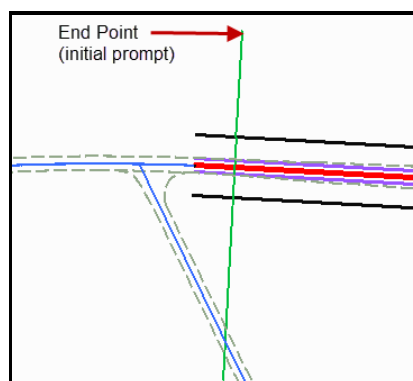
**Objective:** First, we're going to realign the road to the west of the southwest loop. We'll use this for both the southwest loop, and as a new intersection for the access road to the north. We want to be sure it's perpendicular to the mainline alignment. We'll use the Line to Element tool, but we could also use the Line by Points in conjunction with a Perpendicular snap.

#### Geometry Tools Used:

CIVIL GEOMETRY PANEL	ICON	TOOL
		Line To Element
		Reverse Curve by Angle

#### Procedure:

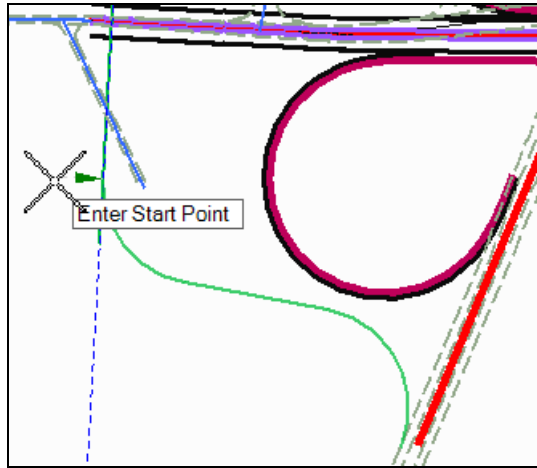
1. Continue in the file *start\_ch4.dgn*.
2. We won't use any feature definitions for the first steps, so set the Feature ToolBar to No Feature. Use the MicroStation Working Elements level.
3. Select the Line To Element command.
4. Follow the heads-up prompts, using the illustration as guidance:



HEADS-UP PROMPT	USER ACTION
End Point	We'll place a point on the north side of mainline, as we will use the alignment for both the southwest ramp and the north frontage road. When dropping a perpendicular line, we want to be inside the project limits, as indicated by the mainline alignment.
Locate Element	Select the mainline alignment.
Offset	Use 175m so it intersects the existing alignment and we have some line length to work with later. Data point to accept.
Skew	Use 90. (No need to type the minutes and seconds.) Data point to accept.
Start Distance	0
Trim	None.

5. Select the Reverse Curve by Angle command.
6. Set the Feature Definition to HA Ramp.

7. Set the Design Standard to 50 kph/Two Steps below Desirable Minimum and toggle on the standard.
8. Follow the heads-up prompts, using the illustration as guidance:



HEADS-UP PROMPT	USER ACTION
Locate Element	Select the working line we just created
Enter Start Point	Snap to the bottom of the working line.
Locate Second Element	Select the outside edge of pavement on the cross highway.
Define Radius	Both the Back and Ahead Radius should be set to 90, based on our Design Standard. If not set them, then data point to accept.
Start Point	Move the cursor near the original start point until the reverse curves fit, without overlapping the southwest loop. Moving the cursor to the right – left changes the shape of the curves. Data point when you're satisfied with the layout.
Trim / Extend	Back

9. We could use the Complex By Elements tool to connect the working element with the reverse curves. However, we want to use that same element on the north side, so we'll wait to finish up connecting the loop alignment at that time.

## CREATE THE SOUTHEAST RAMP

We are going to use the Taper Curve Taper command for this ramp. However, the command does not support offsets, so we have offset the southeast loop for the minimum distance between the two roadways and the mainline to account for the exit ramp. The Offset Partial Element tool was used to create these working elements.

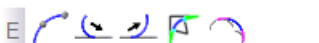



### *Optional Exercise: Create the Southeast Ramp*

#### **Objective:**

Create the two segments of the southeast ramp that will be combined with an offset loop segment to create the entire ramp alignment.

### Geometry Tools Used:

CIVIL GEOMETRY PANEL	ICON	TOOL
		Taper Curve Taper

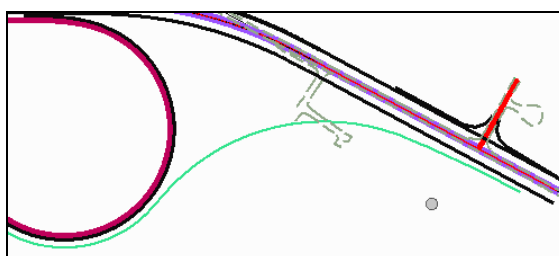
### Procedure:

1. Continue in the file *start\_ch4.dgn*.
2. We won't use any feature definitions, so set the Feature ToolBar to No Feature. Use the MicroStation Working Elements level.
3. Set the Design Speed to 50 kph.
4. Select the Taper Curve Taper command.
5. In the dialog, set the following:

FIELD	VALUE
Ahead Taper Method	Ratio-offset
Offset	5 (width of the ramp)
Ratio	1:15 (to fit within our project limits)

6. Follow the heads-up prompts.

HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the working element offset from the loop.
Locate Second Element	Select the working element offset from the mainline alignment.
Select Construction Sector / Radius	The Radius should be set to 255 kph from our Design Standard. Do NOT data point yet! View the curve and ensure the taper is within project limits, then data point to accept.
Trim / Extend	Both.



*Completed Segment of Southeast ramp.*

Now we'll use the same command and process to add the segment from the cross highway to the loop.

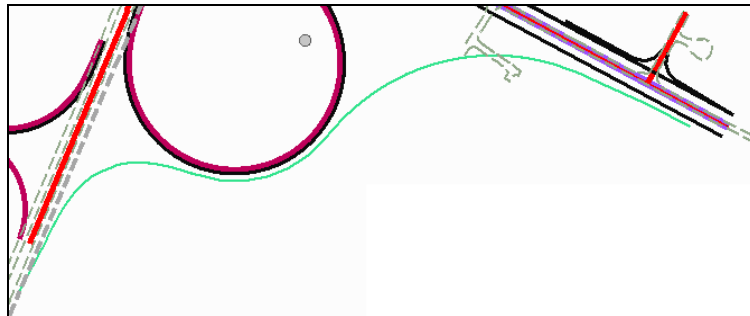
7. As we have limited project limits on cross highway, set the Design Speed to 50 kph\ Two Steps below Desirable Minimum at 50 kph.
8. Select the Taper Curve Taper command.

9. In the dialog, set the following:

FIELD	VALUE
Back Taper Method	Ratio-offset
Offset	5 (width of the ramp)
Ratio	1:15

10. Follow the heads-up prompts.

HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the working element offset from cross highway
Locate Second Element	Select the working element offset from the loop.
Select Construction Sector / Radius	The Radius should be set to 90m from our Design Standard. Do NOT data point yet! View the curve and ensure the taper is within project limits, then data point to accept.
Trim / Extend	Both.



*Completed Segments of Southeast ramp.*

11. We could use the Complex By Elements command to connect the working elements with the taper curve taper elements.

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# Chapter 5: Final Clean-up

## OVERVIEW

Now that we have to mainline, loops, and ramp alignments complete, there's still lots of work to be done. We can add more edges of pavement and shoulders with the Offset commands. We can add tapers and gore areas to complete the plan drawings. Many of these are done using the same tools we have already been working with in previous chapters.

Before we tackle those tasks, we have a few access roads to redesign, and a few more tools to try using!



### *Exercise: Readjust Northeastern Side Road*

#### **Objective:**

We'll start by using a separate turnout lane (3.6m). This has already been drawn using the Single Offset Partial command. Next we'll establish the centerline for the existing roadway. Then we'll add the fillets and tapers.

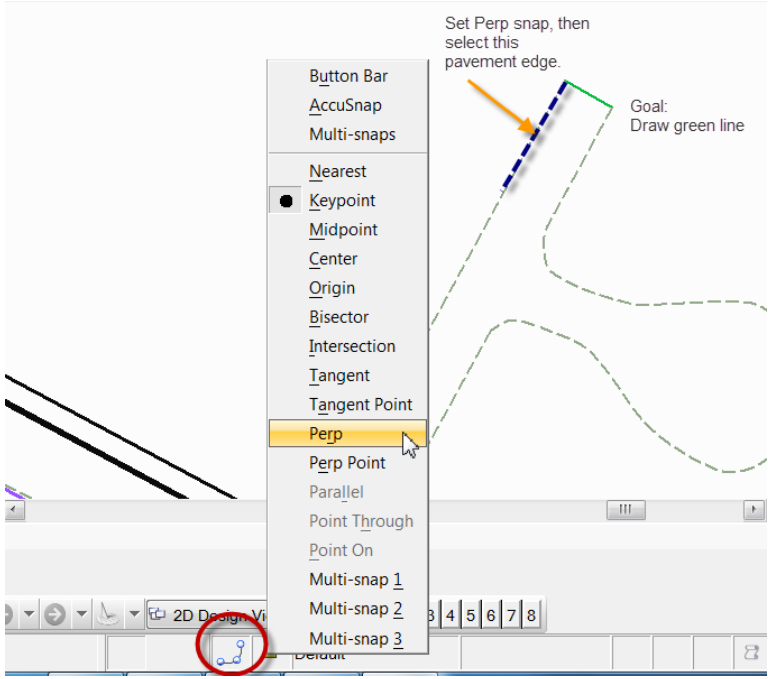
#### **Geometry Tools Used:**

CIVIL GEOMETRY PANEL	ICON	TOOL
		Single Offset Partial Element
		Line Between Points
		Line To Element
		Simple Arc
		Variable Offset Taper

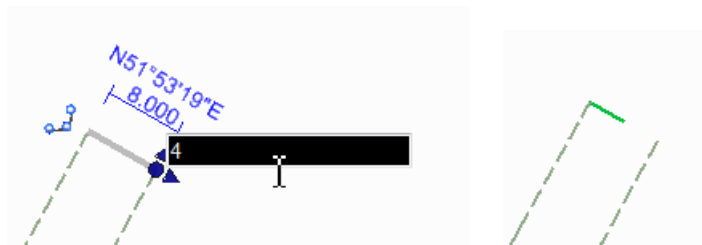
#### **Procedure:**

1. Open the file *start\_ch5.dgn*.
2. We won't use any feature definitions for these first few steps, so set the Feature ToolBar to No Feature.

3. Select the Line Between Points command. We're going to use it twice to establish two points on the existing centerline.

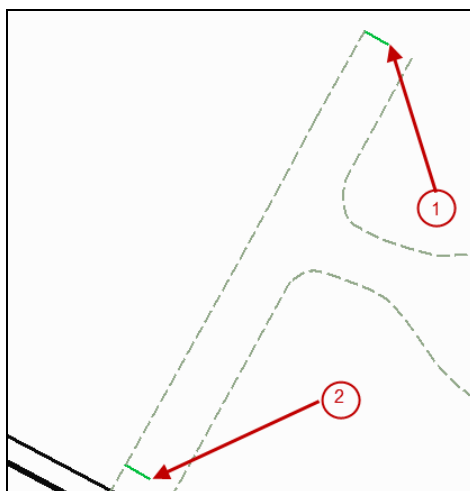
HEADS-UP PROMPT	USER ACTION
Select Start Point	<p>Set the MicroStation Snap to Perpendicular. Select the left edge of existing roadway. Since we selected perpendicular moving the cursor dynamically displays the perpendicular element.</p> 
Start Parameters Offset	Snap to the end of the working element we just drew that is connected to the cross highway.
End Distance	Snap to the end of the working element we created connecting to the mainline alignment.

4. Select the element you just drew, which displays the edit manipulators. One edit field is the length of the line (which is also the width of the roadway since we used the perpendicular snap during placement). Change the edit field so it is half the value (be sure to enter on the keyboard). The line is now half as long so its endpoint is the center of the existing roadway.





5. Repeat the process again so we have two centerline points of reference.



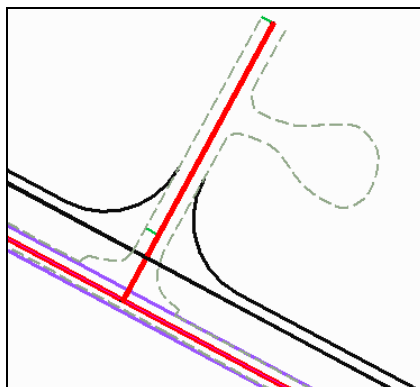
6. Select the Line To Element command.
7. Set the Feature Definition for HA Roadway.
8. Follow the heads-up prompts.

HEADS-UP PROMPT	USER ACTION
Enter End Point	Snap to the green working element (labeled point 1) at the north end of the roadway .
Locate Element	Select the mainline alignment.
Offset	0
Skew	Snap to the other working element (labeled point 2) we created.
Start Distance	0, then data point to accept.
Trim	None.

9. Select the Simple Arc command.
10. Set the Feature Definition for EP Prop.
11. Follow the heads-up prompts.

HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the existing edge of pavement.
Locate Second Element	Select the mainline edge of pavement.
Enter Through Point / Radius	25
Trim	Set to Both, as it will not trim the existing pavement (as it's in a reference file).

12. Repeat for other radius.

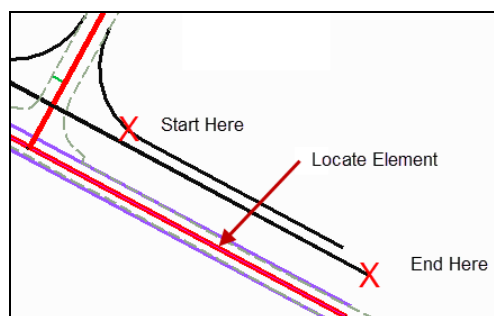


*Completed side road.*

13. To add the tape to the turnout, select the Variable Offset Taper command.

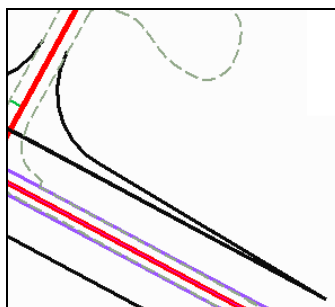
14. Set the Feature Definition for EP Prop.

15. Follow the heads-up prompts.



HEADS-UP PROMPT	USER ACTION
Locate Element	Select the mainline alignment.
Start Offset	Snap to the end of the side road radius.
End Offset	Snap to the edge of the mainline at the end of the project.

16. Final clean-up, striping, etc. can be done at the user's discretion.



## REROUTE THE NORTHWEST ACCESS / FRONTAGE ROAD



The expanded interchange, and in particular the northwest ramp, have cut off access from the northwest community. A safety issue is the number of accesses onto the main highway, so it is desirable to minimize the number, and make them normal to the mainline highway. Therefore, the original northwest access will be closed, and the road re-routed to the new intersection slightly to the west of the old location. Finally, it's combined into an intersection with the southwest ramp.



### *Exercise: Rework the Northwest Access / Frontage Road*

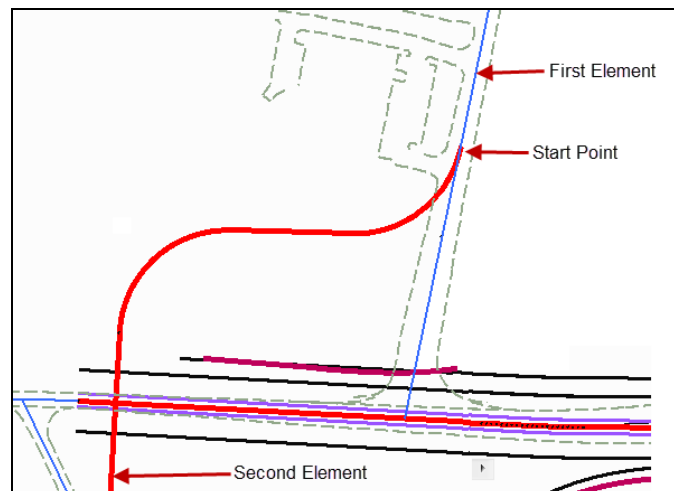
**Objective:** Create the two segments of the southeast ramp that will be combined with an offset loop segment to create the entire ramp alignment.

### Geometry Tools Used:

CIVIL GEOMETRY PANEL	ICON	TOOL
		Reverse Transition

### Procedure:

1. Continue in the file *start\_ch5.dgn*.
2. Set the Feature Toolbar to **HA Roadway**.
3. Toggle off the Design Speed Standard.
4. Select the Reverse Transition command.
5. In the dialog, set the **Ahead Offset** and **Back Offset** to 0. Set the **Ahead Radius** and **Back Radius** to 50. Lock all four values, by toggling on the box to the left of each field.
6. Follow the heads-up prompts, using the illustration below for guidance.



HEADS-UP PROMPT	USER ACTION
Locate First Element	Select the existing inplace frontage road.
Offset	0
Locate Second Element	Select the mainline edge of pavement.
Offset	0; then move the cursor until you have a reasonable set of reverse curves and do not encroach upon the mainline pavement. Note you will have the opportunity in the next step to slide it upwards on the inplace frontage road alignment.
Define Length	Dynamically set, but it try around 90m.
Enter Start Point	This slides the curves along the inplace frontage road. Data point as shown.
Trim / Extend	Both

# Appendix A: Feature Definitions

## OVERVIEW OF FEATURE DEFINITIONS

In this manual we used a prepared DGNLIB file which contained our feature definitions. This lesson shows how to create the DGNLIB using your preexisting DDB, XIN or PSS file. This example uses a GEOPAK D&C Manager (ddb) file for feature definitions but user can alternatively utilize an InRoads (XIN) file or an MXROAD (PSS) file.



### *Exercise: Create a DGNLIB that contains our feature definitions*

So that we can easily control symbology, annotation and quantities, we will create a feature definition table. The Civil Geometry tools make use of your existing DDB, XIN or PSS feature definition table so that you do not have to recreate everything from scratch.

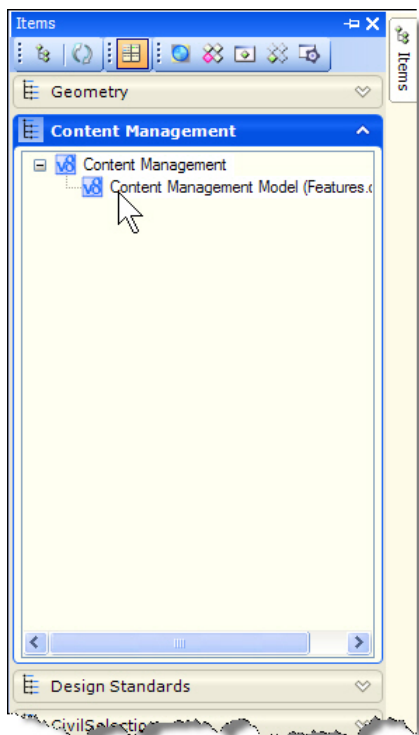
1. Open XINfeatures.DGNLIB file.
2. Use the Design Explorer and load the desired XIN file.

---

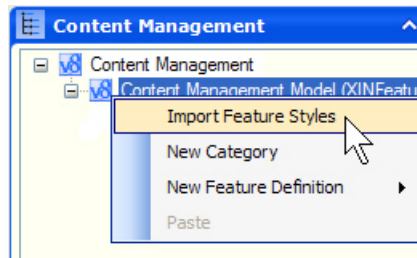
**Note:** This is the only time we will use any GEOPAK or InRoads commands in this exercise.

---

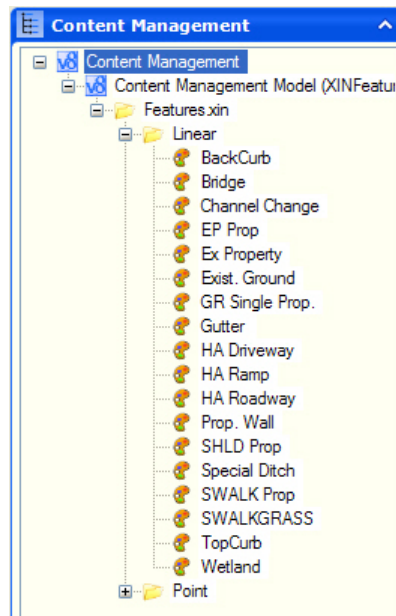
3. Now, open the Items browser > Content Management panel and note that no feature definitions exist in this file.



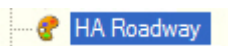
4. Right click on the Content Management Model line and choose Import Feature Style



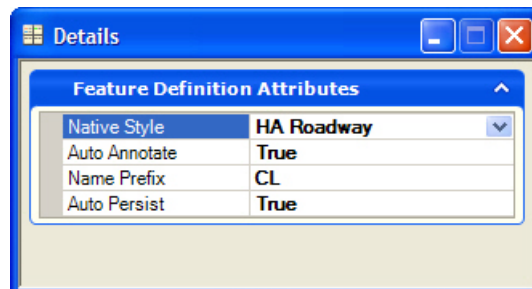
The features are now populated in the file.



5. Close Microstation and copy this file (Features.dgnlib) to a location defined by the configuration variable MS\_DGNLIBLIST.
6. The Content Management tools now provide some added functionality which is not necessarily available when using the features in their native applications. These are the ability to automatically persist the elements back into the external coordinate geometry database and to auto annotate the elements as they are created.
7. Open any dgn file and select the feature named HA Roadway.



8. Now look in the Details panel of the Items Browser.



9. For each feature definition you will have these settings:

- Native Style – This is the name of the style in the PSS, XIN, DDB file which is represented by this Content Management Feature definition.
- Auto Annotate – True or False. If true then as soon as an element is created with this feature then it will be annotated.

---

**Note:** Users must verify that the DGN model scale matches a scale defined in the XIN file.

---

- Name Prefix – As elements are created they are given a name. This is the default prefix presented to user.

---

**Note:** Users must be careful to observe any naming restrictions in MX, InRoads or GEOPAK.

---

- Auto persist – True or False. If true, then the elements are immediately created in the MX, InRoads or GEOPAK coordinate geometry database as soon as the civil elements are created in graphics. This eases the workflow when you need to continue the vertical design in one of these applications.

---

**Note:** By default, auto persist is set to True for Power InRoads users.

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# Appendix B: Design Standards

## OVERVIEW OF DESIGN STANDARDS

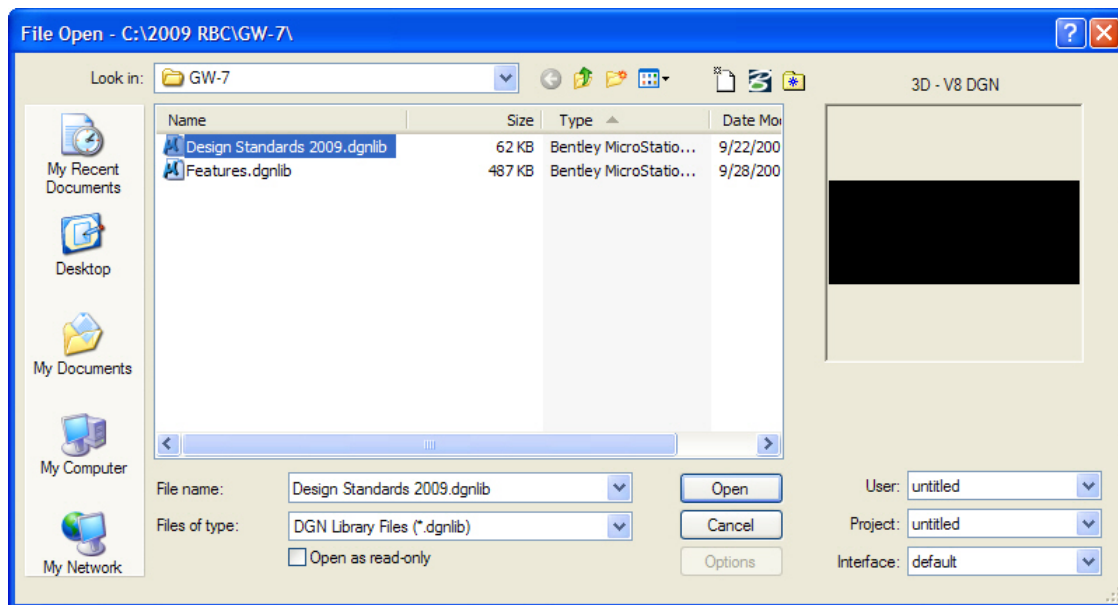
In this appendix, we will review the design standards appropriate to this project and will go through the process of creating a new design standard.



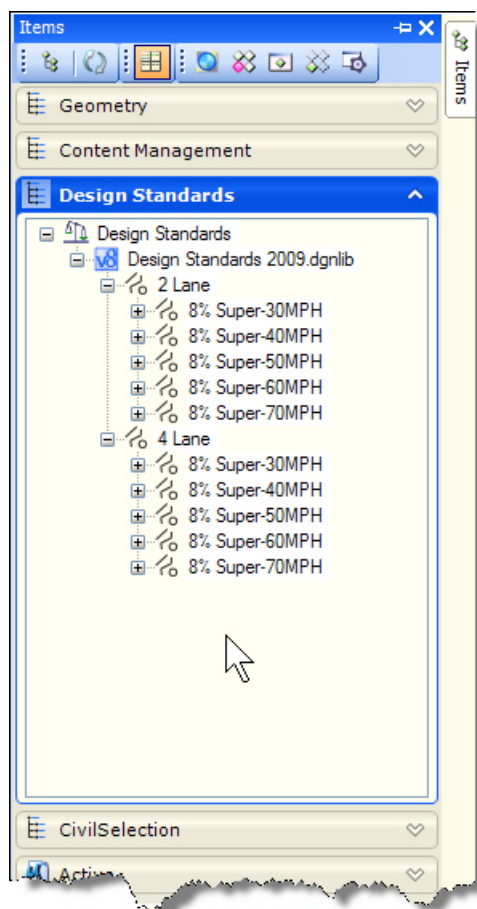
### *Exercise: Investigate the DGNLIB that contains our design standards*

Design Standards allow you to set up your organization's desired standards to control alignment configurations based on design speed and other considerations. For this release the standards are very much oriented towards alignments and control maximum/minimum radius and tangent lengths and also define required transition lengths.

1. Open a blank DGNLIB (or one which contains other standards that you use)



1. Now, open the Items browser > Design Standards panel and note that the design standards which already exist.



2. Select the standard in 4 Lane group labeled 8% Super-70MPH

- Open the details panel to review the settings.

The screenshot shows a 'Details' panel with three sections: 'Arc Values', 'Complex Checks - Arcs', and 'Complex Checks - Tangents'. Each section contains a table of settings.

Arc Values	
Speed	70
Default Radius	2864.795
Minimum Radius	1909.859
Transition Type	Table
Table	

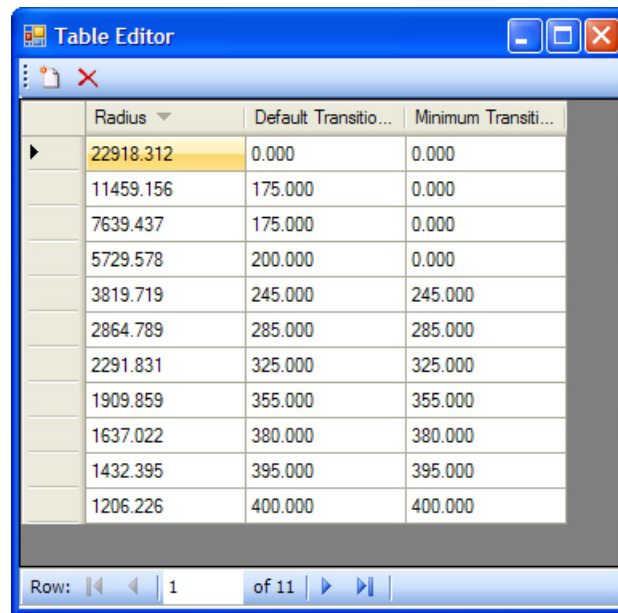
Complex Checks - Arcs	
Insure Tangency Arc	True
Include Transitions To Arcs	True
Include Transitions To Tangents	True
Maximum Arc Length	100000.000
Minimum Arc Length	500.000

Complex Checks - Tangents	
Insure Tangency Tangent	True
Include Transitions	False
Maximum Tangent Length	100000.000
Minimum Tangent Length	100.000
Maximum Deflection	1

- The properties for each standard are:
  - Speed – this is the design speed for the standard. This is for user information and also used in equations.
  - Default Radius – this is the radius used to populate commands when they start. (Note: Degree of curve input to the design standards settings are not supported at this time)
  - Minimum Radius – this is the minimum radius for the corresponding design speed. Utilizing values lower than this radius will cause a warning to be displayed.
  - Transition Type – can be by Table or Equation (Note: For this release, the transition length equation is a hard coded equation as found in the AASHTO Manual 2004. This is the same formula used in the United Kingdom (perhaps elsewhere)
  - Table – If transition type is table then this is used to populate the table. (See below)
  - Insure Tangency Arc – if True then the standard checks all arcs to insure against kinks.
  - Include Transitions to Arcs – If true then transitions are applied to arc commands.
  - Maximum Arc Length
  - Minimum Arc Length
  - Insure Tangency Tangent – If true then tangents are checked for kinks.
  - Include transitions – If true then line commands will have transitions added.
  - Maximum Tangent Length
  - Minimum Tangent Length
  - Maximum Deflection – Where two tangents join without a curve, what is the maximum angle between the lines.
- Transition Tables – This is a radius table which lists default and minimum transition lengths corresponding to each radius. If the actual used radius is not specifically

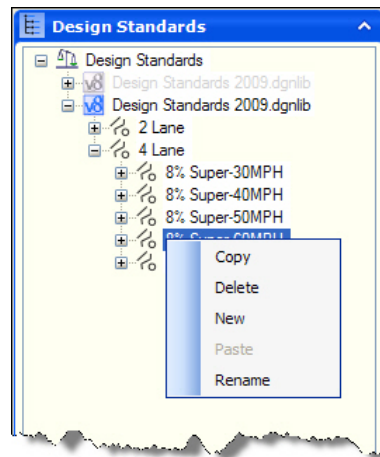
found in the list then the transition length for the radius which is closest to but not longer than the specific radius is used.



	Radius	Default Transiti...	Minimum Transiti...
▶	22918.312	0.000	0.000
	11459.156	175.000	0.000
	7639.437	175.000	0.000
	5729.578	200.000	0.000
	3819.719	245.000	245.000
	2864.789	285.000	285.000
	2291.831	325.000	325.000
	1909.859	355.000	355.000
	1637.022	380.000	380.000
	1432.395	395.000	395.000
	1206.226	400.000	400.000

Row: 1 of 11

- You can create a new standard by right click > New. Or by copy/paste of an existing standard



- Once your standards file is complete, copy it to a location defined in MS\_DGNLIBLIST and it will be available in all projects.

# Appendix C: Civil Geometry Settings

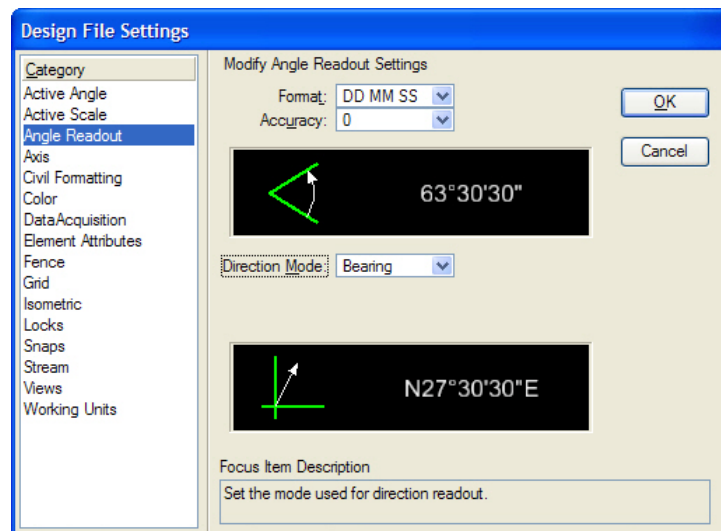
## OVERVIEW OF CIVIL GEOMETRY SETTINGS:

In this appendix, we will review the settings which control the Civil Geometry operation. Civil Geometry utilizes settings from 2 different places; DGN settings and WorkSpace Preferences.



### *Exercise: Investigate the DGN Settings*

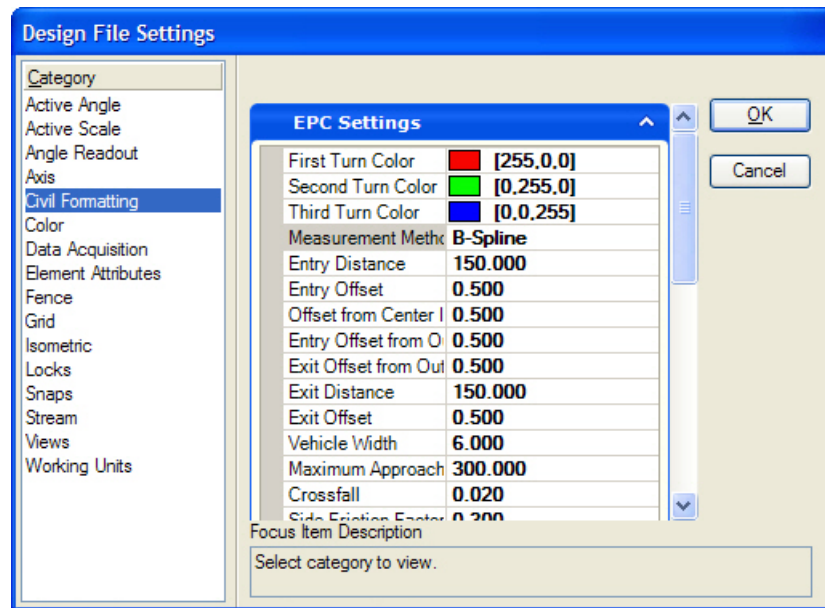
1. Angle formats used by Civil tools follow Angle Format Settings. These are same settings used by the rest of MicroStation.



2. Format: DD MM SS, DD.DDDD, DD MM, Gradians, Radians are all supported.
3. Direction Mode: Bearing and all formats of Azimuth are supported.

## CIVIL FORMATTING

When Civil Geometry is loaded then there is a new Civil Formatting panel of settings.



1. All the settings at top are related to settings required by the Roundabouts Entry Path Curvature Analysis tool.
  - First Turn Color, Second Turn Color, Third Turn Color – These are colors used when drawing the vehicle paths.
  - Measurement Method – Either Spline or Arc. Type of element to create when using the Entry Path Curvature tool.
  - Entry and Exit Distance – Distance measured along the entry or exit approaches to begin/end the vehicle path.
  - Entry and Exit offset – horizontal offset held off the entry and exit flares for the vehicle path.
  - Offset from center island – horizontal offset held off the central island in the traffic circle.
  - Vehicle Width – width of vehicle path.
  - Max Approach Radius -
  - Side Friction Factor – used to compute actual speed thru the roundabout.
  - Design Speed Units – MPH or KPH.

2. Scroll the settings down to see the remainder of settings.

Coordinate Settings	
Format	X, Y
Precision	0.1234

Ratio Settings (Distance:Offset)	
Format	1:D
Precision	0.1

Station Settings	
Format	ss+ss
Format Delimiter	+
Precision	0.12
Equation	By Index

Radius Settings	
Degree Of Curve Method	Arc
Degree Of Curve Length	100.000
Radius Toggle Character	d

- Coordinate Format: X,Y or N,E
- Coordinate Precision: Number of decimal places shown on coordinates.
- Ratio Settings Format: 1:D form or D:1 form.
- Ratio Precision: Number of decimal places used on ratios.
- Station Settings Format: No delimiter, 2 digits after delimiter, 3 digits after delimiter
- Station Format Delimiter: Usually a plus sign
- Station precision: number of decimal places on delimiter
- Station Equation Type: By Name (InRoads compatible) or By Region (GEOPAK compatible)
- Radius Settings Degree of Curve: By Chord or By Arc
- Degree of Curve Length: Length of chord or arc used to define a 1° curve.
- Radius Toggle: the keystroke used to define degree of curve instead of radius in commands.

## WORKING UNITS

Working Units are used by Civil Geometry to determine units and the precision is used for distances.

The image shows the 'Design File Settings' dialog box with the 'Working Units' category selected. The 'Modify Working Unit Settings' section contains the following options:

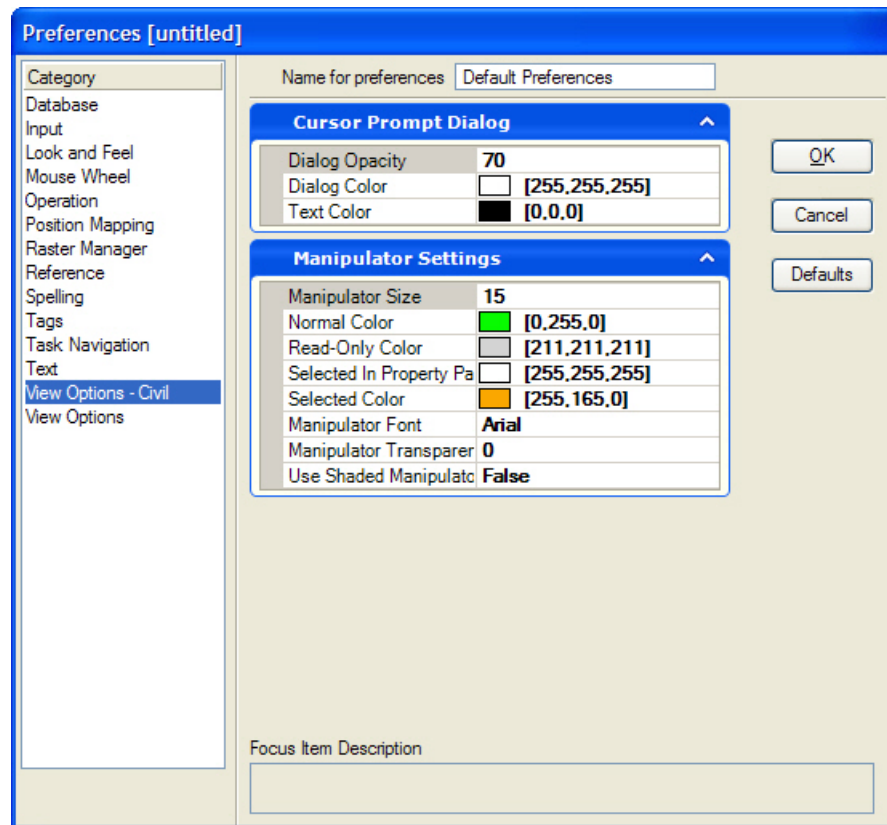
- Linear Units:**
  - Format: MU (dropdown)
  - Master Unit: Feet (dropdown)
  - Sub Unit: Custom (dropdown)
  - Accuracy: 0.123 (dropdown)
- Advanced Settings:**
  - Resolution: 10000 per Distance Foot
  - Working Area: 1.70591E+008 Miles
  - Solids Area: 81.3441 Miles
  - Solids Accuracy: 4.29497E-006 Feet

Buttons for 'OK', 'Cancel', 'Custom', and 'Edit' are present. The 'Focus Item Description' field at the bottom contains the text 'Select category to view.'



## WORKSPACE PREFERENCES

When Civil Geometry is loaded there is also an additional panel added to Workspace > Preferences.



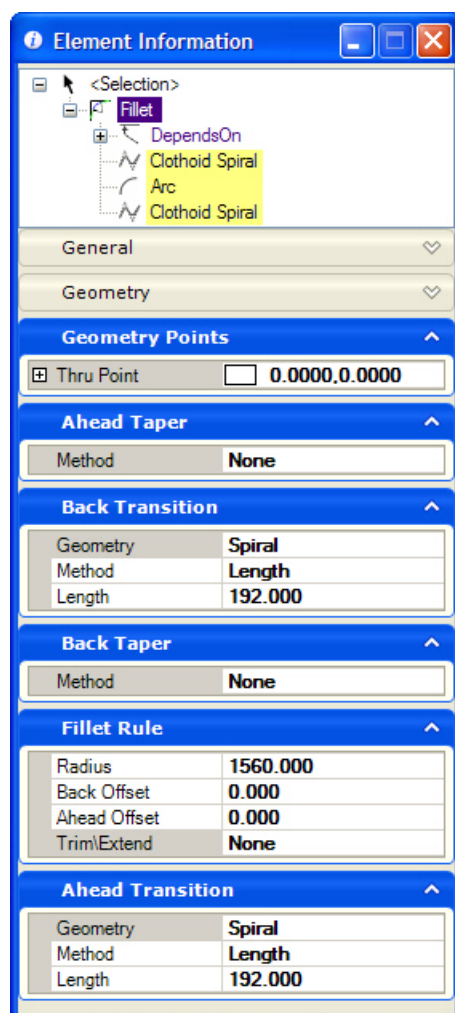
1. **Cursor Prompt Dialog** – Settings to control the heads up prompt. These are used for commands and Civil Accudraw.
  - Dialog Opacity – Set the opacity/transparency of the heads up prompt
  - Dialog Color – The color of the heads up prompt window.
  - Text Color – The text color used in the heads up prompt.
2. **Manipulator Settings**
  - Manipulator size – the size of manipulators. 10 is default. Smaller numbers translate to smaller manipulator size.
  - Normal Color – The default color of manipulators.
  - Selected in Property Pane – If use element information of a selected element then the manipulator corresponding to the property with focus is temporarily shown in this color.
  - Selected color – When you hover over or click on a manipulator it temporarily changes to this color.
  - Manipulator Font – The font used for text manipulators.
  - Transparency – The transparency applied to manipulators.
  - Use Shading – True uses a shaded pattern on the manipulators.



# Appendix D: Use of the Property Pane (Element Information)

## OVERVIEW OF ELEMENT INFORMATION

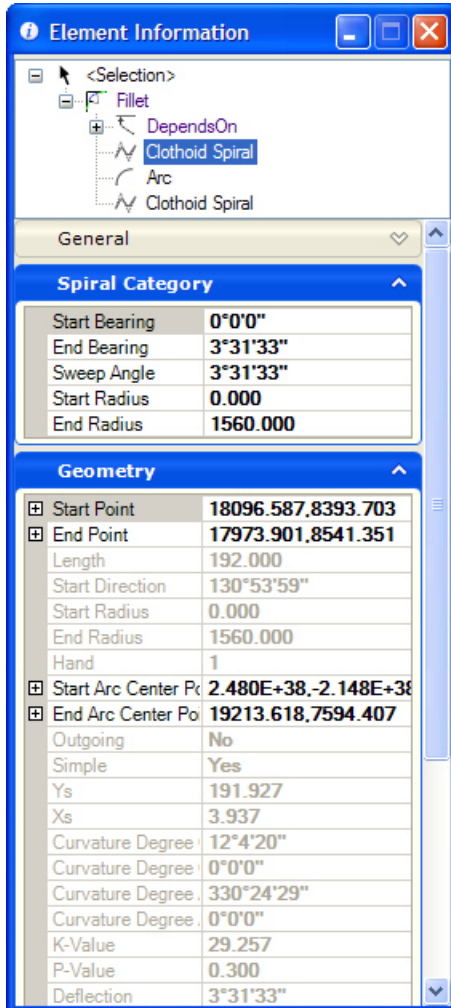
1. In this manual we have used the on screen prompts and on screen manipulators almost exclusively. The user may also find Element Information Property pane to be a useful tools for making edits.
2. Indeed for some of the more complex constructions the property panel contains some entries which are not available for editing anywhere else.
3. Let's use a Spiral-Curve-Spiral created with the Arc Between Elements command as an example of the sort of edits that are available in the Property Pane.
4. Select a SCS curve and open Element Information. Now we can see some familiar and some new things. The General and Geometry Tabs are the same information as would be expected for any selected element.



5. For civil elements the Raw Data and Extended tabs are hidden to limit confusion.
6. At the top, in the tree, we see that this is a Fillet. It is indeed a Microstation complex but instead of the generic "complex", the label is replaced with "Fillet"
7. Underneath, in the highlighted portion of the tree then we see that the fillet consists of two spiral and an arc. Selecting either of these branches of the tree (see below) would allow direct editing and additional information about these pieces of the construction.
8. The branch of tree titles "depends on" can be expanded to show the two lines which were used as the tangents for this fillet. (see below) In so doing these lines can be edited in the property pane without going back out and selecting them.
9. Geometry Points will list any points that are part of the civil construction. In this case there is only a thru point and it exists of a simple DP. But if this point had been constructed with a snap or Civil Accudraw input then the relevant information for the input from these sources would be reflected here.

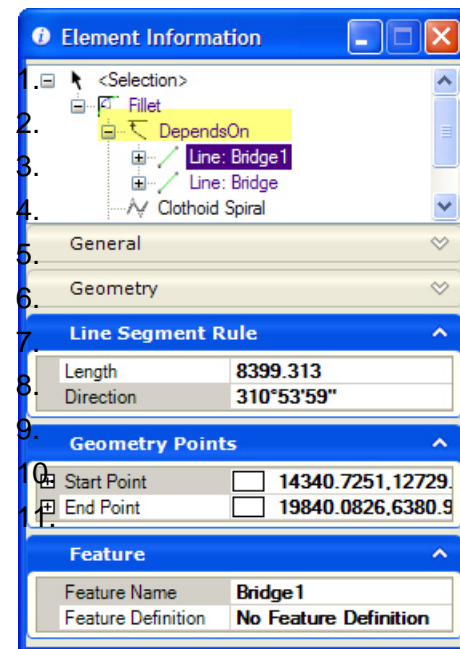
10. Back Transition and Ahead Transition Tabs – allows editing of the spirals. OR, you could change the spirals to arc transitions.
11. Ahead taper and Back Taper tabs – allows editing of the tapers which are part of the construction. There are none in this case but they could be added.
12. Fillet rule – Allows editing of the main rule which for fillet includes the central radius, offset from the tangent elements and the trim options, all of which can be edited here.

1. By selecting one of the components of the construction in the tree then you can isolate the parameters for that particular piece of the construction.



In this case, selecting the spiral shows some additional editable parameters and also notice that the Geometry Tab lists all the information you could ever wish to know about a spiral.

1. Note that this spiral data is read-only and not exposed for plans production purposes at this time, except for copy/paste into forms and etc.
2. And finally, in the image below, notice that by expanding the "depends on" branch of the tree then I can edit the lines which were used to construct the fillet in context with the rest of the construction.



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# Appendix E: Customizing Commands

## OVERVIEW OF CUSTOMIZING COMMANDS

All the civil commands can be customized to allow you to define workflows which make your users more productive.

Naturally, you can use the tools as delivered in the installation which is what we have done in this class. But if you are so inclined then you can customize workflows into DGN Libraries for use by all your users across a range of projects.

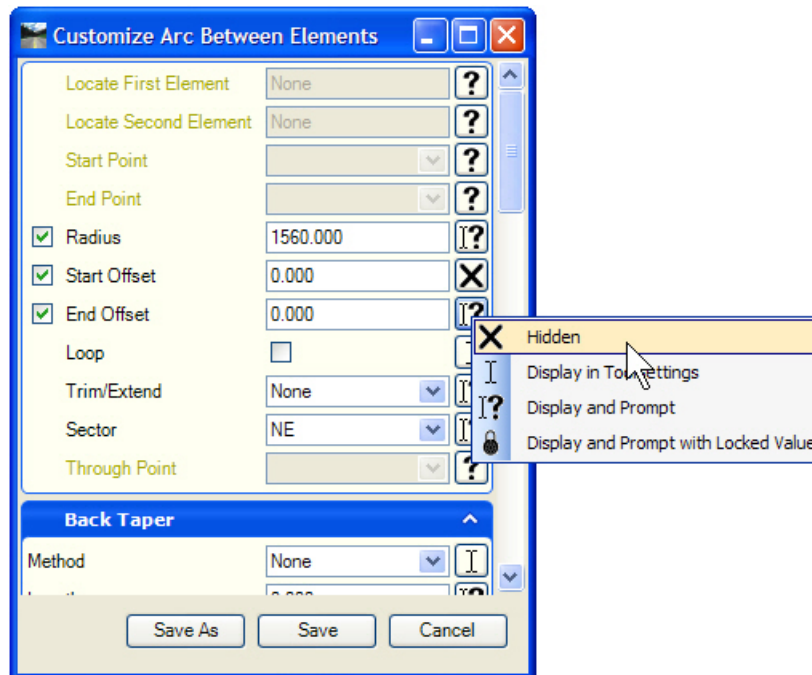


### *Customizing the Arc Between Elements Command*

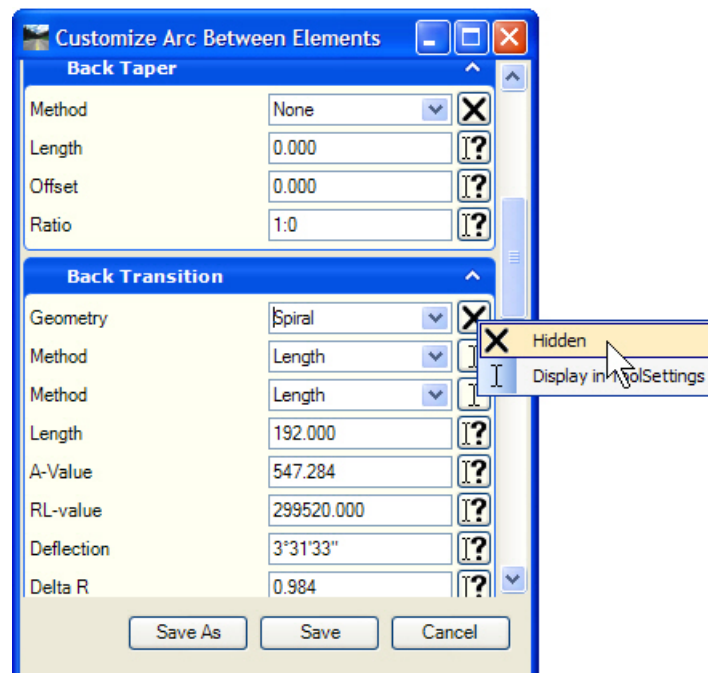
1. Select the Arc Between Elements command.

2. This is probably the largest of all the Civil dialogs because it has so many options.
3. For this exercise, let's assume you never need spirals and you always use zero for the offsets.

4. Right click on the dialog and then click **Customize**.
5. Enter zero for the offset values.
6. On the far right, click the button and set the offset prompts as **Hidden**.



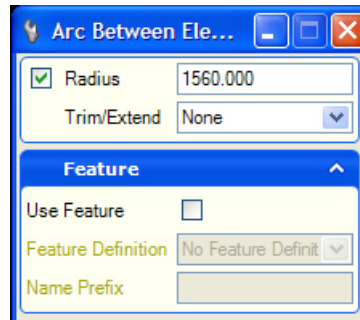
7. Scroll down to the Taper settings, set them to none and also make them hidden.



8. Once you have made the edits, then you can click SAVE to change how the tool is displayed by default or SAVE AS and you will be prompted for a DGNLIB file into which you can save the customization.



9. Now you have a much simpler dialog showing only the fields which are relevant to your needs.



---

**Note:** When using the Save As option, you need to have a DGNLIB file prepared in advance.

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You can then save multiple variations of multiple tools to create true workflows. For example, you could create a task navigation group titled “Cul-De-Sac” and contained two customized tools:

- Arc By Points locked at a 50 ft radius to build the bulb of the cul-de-sac.
- The other might be a Fillet customized similar to above with a locked radius of 75 to build the shoulder radii.

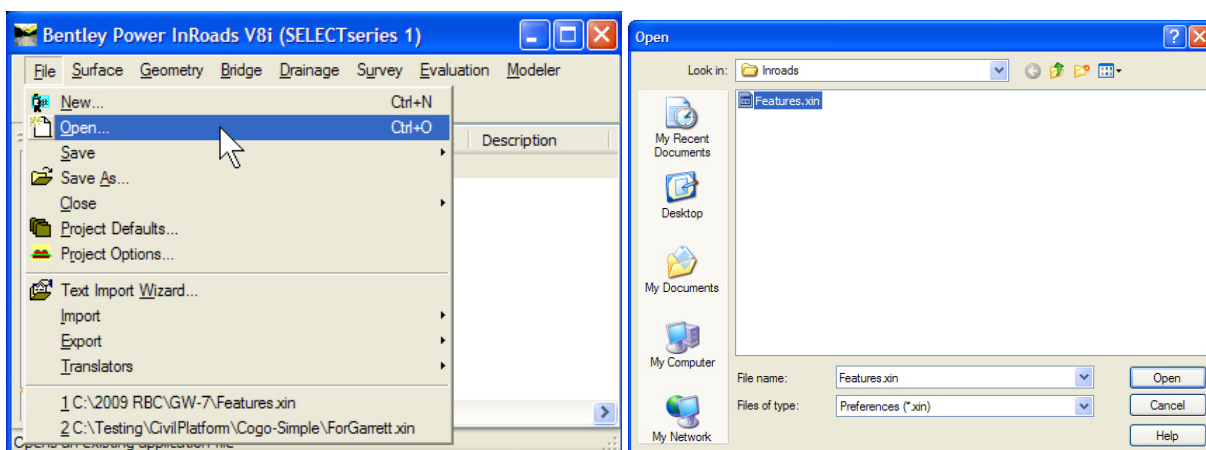
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# Appendix F: Features

## OVERVIEW OF FEATURES

The new civil tools utilize the feature tables from the native products to control symbology and annotation. The tools were developed with the express intent to allow users to continue to use their current feature tables with minimal modification so as to preserve your investment in these tables. But, since the three product's feature tables are quite different this leads to some small differences in the user experience depending on which type feature table is used.

1. the feature table must be imported into the active DGN or into a configured DGNLIB as described in Appendix A.
2. The InRoads feature table is an XIN file. In order to use the XIN features properly, the user needs to have the same XIN loaded in InRoads as is defined in the Items Browser.
3. In the InRoads explorer go to File > Open and choose the proper XIN file.



## APPEARANCE OF FEATURES IN THE ITEMS BROWSER

The InRoads XIN file is a flat database with no folders or directories. Therefore it will appear the same in the Items Browser. However, there will be a linear category and a point category when viewed in Items Browser. This is because an XIN feature can define all sorts of settings in a single feature. But, in the Civil tools, a feature can be either linear in nature or point in nature but not both. So if a feature is found which defines both linear and point settings, the linear settings are linked to the Content Management linear category and a feature named xxx-PNT is created to hold the link to point settings.

