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Workshop - X15 Introduction to Roundabouts

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Introduction to Roundabouts

Overview

This workshop gives the users the ability to use the new Roundabouts application in a hands-on environment.

The Roundabout tool is a rules-based approach that allows intelligence to be preserved in the design, standards to be applied to the roundabout design, and dynamic adjustment to the design.

Prerequisites

- Fluent in MicroStation and a basic understanding of roundabouts is recommended.

Objectives

After completing this course, you will be able to:

- Have a basic understanding of the rules based approach as it pertains to design
- Understand the concepts to manipulate your design and save your alternatives
- Understand how to setup a roundabout template for your agencies standards
- Manipulate the template to fit your needs

Project Overview

Designers will realize that every “at grade” intersection has its own specific design issues.

What may look the same from plan view may be a totally different design vertically due to the existing vertical conditions or specific requirements.

The amount of reconstruction of existing roadway can completely change the designers approach to two seemingly similar geometrical layouts.

Horizontally, the vehicle types and volumes can drastically alter the layout of the roundabout and its approaches.

We shall investigate one set of design constraints based on certain assumptions for this particular project and formulate a design strategy. We will overview the supplied data and constraints for this specific situation and investigate the effects of altering some of the data.

Note This is NOT a course to teach the principles and theories of roundabout design. It is a course to introduce the user the roundabout layout tool. It is the express desire that this course will enable the expert user to make use of the tools and apply the lessons to performing truly expert roundabout layout and design.

This training session evolved from an actual project which has been designed and built. The original project had a large traditional intersection where this workshop will explore a roundabout.

Note Since we are inserting a roundabout into a situation where it was not originally intended there might be some areas in the approaches to the roundabout which could have been better designed. For example, the eastern approach is a two lane approach which feeds into a one lane roundabout. This is certainly not a good idea and was not a part of the actual project design and construction.

➔ Exercise: Overview the supplied data and design constraints.

1. Open the File
.....\Roundabout\Chapter1\RoundaboutAtSchool.dgn
2. We shall discuss in the class the job requirements and design parameters.

Note This shows all of the plan view graphical elements required to begin this project. In this lesson we will fill in the intersection with a 4 way roundabout.



Constraints

Minimize cut/fill in the area of the traffic circle.

Minimum approaches to the roundabout. The remainder of the roads will be designed using other tools.

Keep in mind that sidewalks will be a part of the ultimate design which comes later. In particular we need to avoid the sidewalks drawn northeast and southeast of the roundabout.

We will use the Roundabout layout tool to do the horizontal design of the traffic circle and the minimum approaches.

Use the Roundabouts tools to analyze traffic flow through the traffic circle.

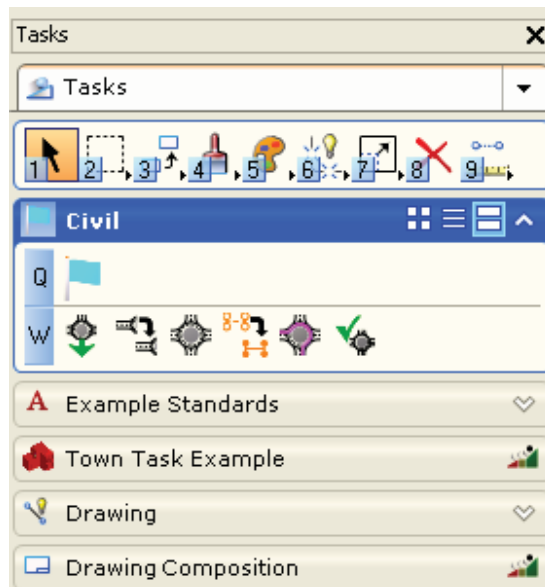
Make edits to the roundabout parameters to tweak the horizontal design

Horizontal Layout

- Place the roundabout using the roundabout tool, utilizing a preconfigured roundabout design library.
- Adjust the roundabout parameters to match our design needs and to match the approaches.
- Investigate the various edits available in the roundabouts design.

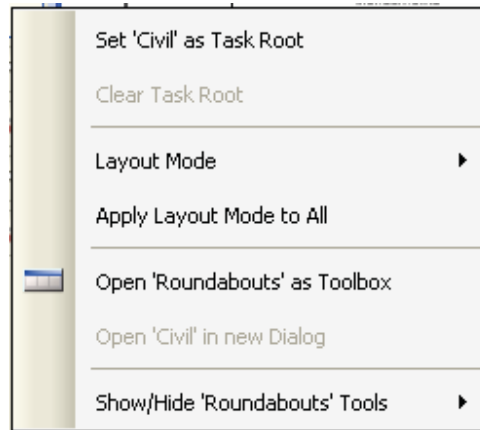
➔ **Exercise: Place Typical Roundabout from Library and edit approaches.**

1. Open the file ...\\RoundaboutSchool\\Chapter1\\RoundaboutLayout.dgn.
2. In V8i you will see a Civil group of tools in the task navigation area as shown below.




Note In the image above I have configured my installation of MicroStation to use the "Dialog" form of task navigation for easier identification. You can set this at *Workspace > Preferences > Task navigation*.


3. Right Click the Civil Toolbar and choose Open 'Roundabouts' as toolbox.





4. This opens the toolbox for those who prefer to work this way.




 The first icon is to open the library browser, which we will explore in a few minutes.

 The second icon is to replace an approach. We will explore this when we review the library items. Basically what it does is allow you to set up parameters once on a single approach and copy these settings to a second approach.

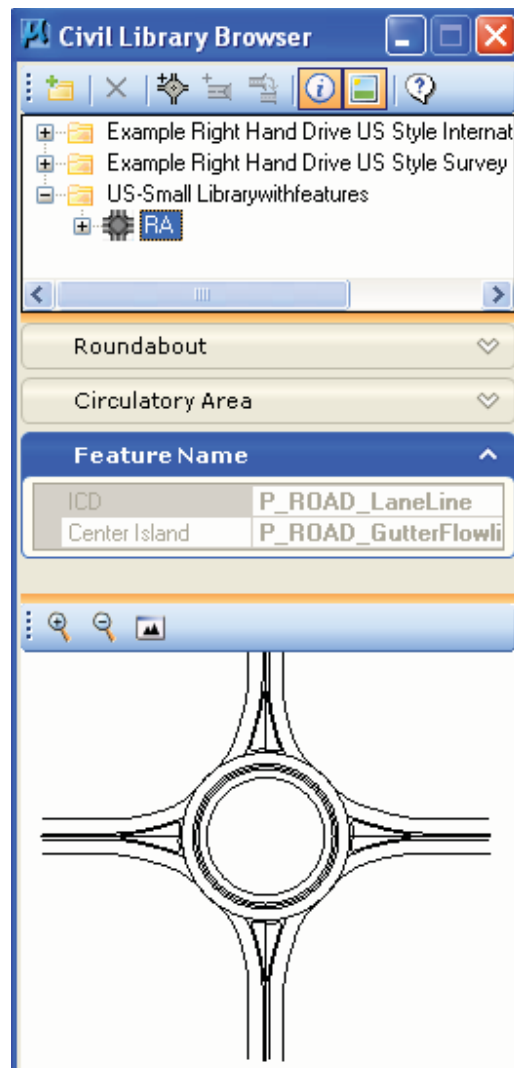
 The third icon is to update alignments. We will lay out our roundabout based upon a graphical alignment. If something happens to change these alignments then we can use this tool to redesign the roundabout to match.

 The fourth icon is the entry curve path analysis tool. We will use this tool later in this workshop.

 The fifth icon is to bring up the civil preferences. These preferences are mainly colors for manipulators and design speed factors.


Note The roundabouts tool uses a library for computing the design. A library is in essence a prototype. It defines the parameters for the various calculations required for the roundabout. In actuality this library is simply a DGN file which contains a simple roundabout already designed using this very same roundabouts tool. You can create your own libraries which contain the parameters you use most.

5. Click the Library Browser icon.

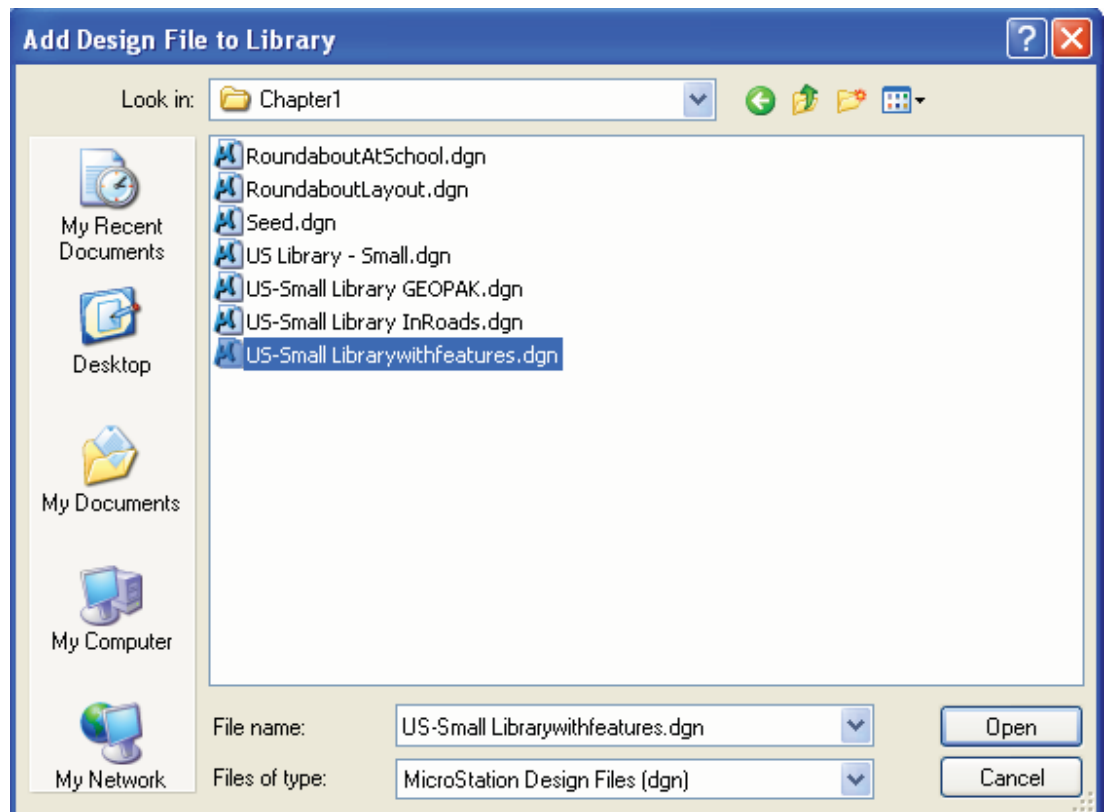


6. You will likely see several very curious libraries in the list which are installed with the roundabouts tool. We want to use a library which has been somewhat customized

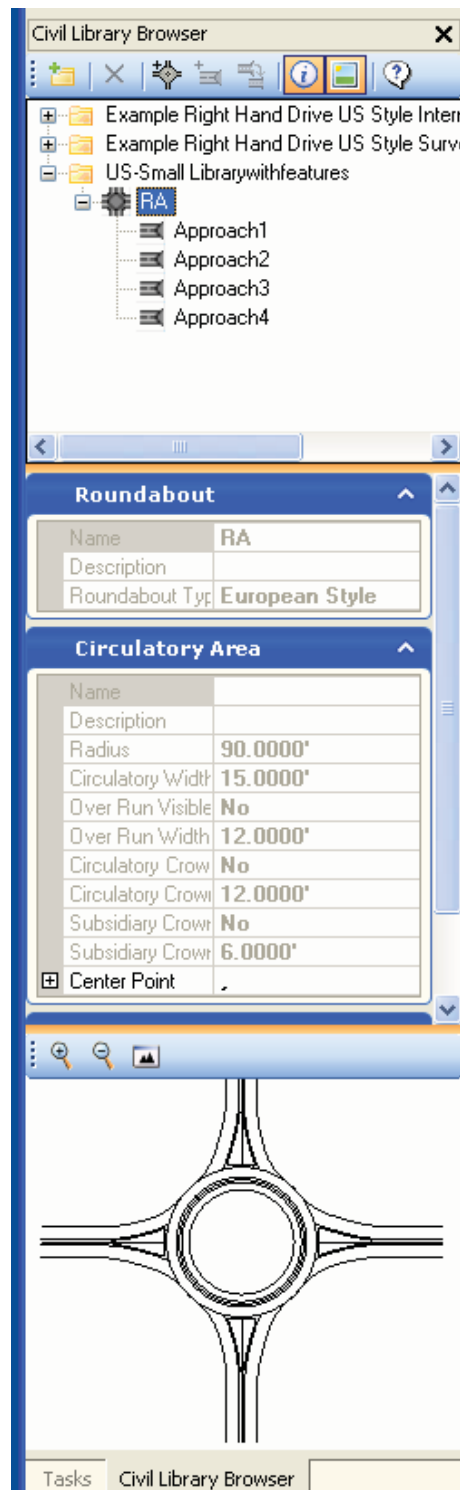
for this project. So select each of the libraries and click the delete button  at top of browser.

7. Now click the ADD button  and select the following library.


...\RoundaboutSchool\Chapter1\US-Small Librarywithfeatures.dgn.



8. Select the RA line in the browser and expand the items in the properties pane below. This allows inspection of, but not editing of, the parameters defined in the library. To edit the library we actually open the DGN file containing the library and edit the roundabout itself.

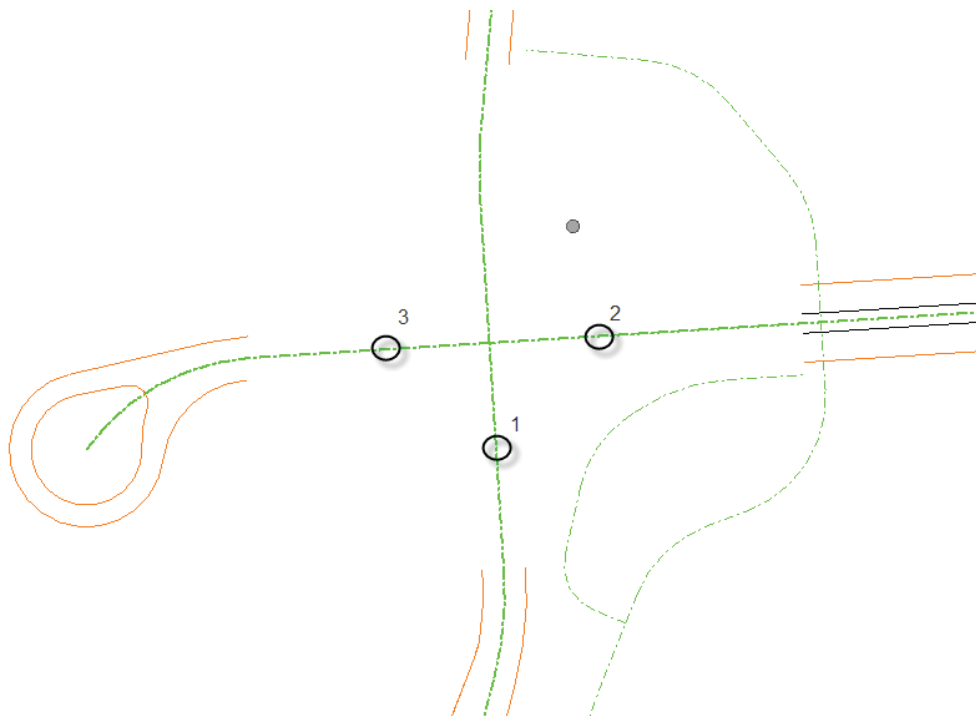


Note Similar properties can be reviewed for each of the approaches.

9. Now, let's create the actual roundabout. With the RA line in browser selected the Place Roundabout button becomes active.  Click the button.
10. One of the new concepts in the Civil Platform products of which the Roundabouts tool is a part is the use of heads up interface feedback. You will see prompts at the cursor to direct you to what is being asked for input. In this case you are prompted to select the reference element.

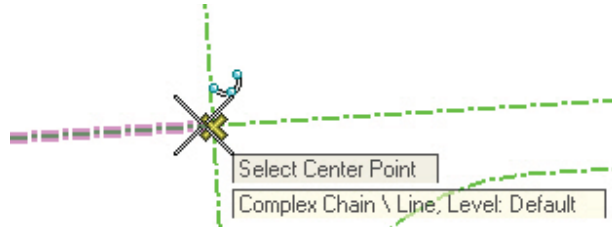


11. The reference element is the alignment for one of the approaches. Pick the approaches as shown below.



12. Once all three alignments are picked (the north-south line goes straight thru), then click the rest button to stop picking.

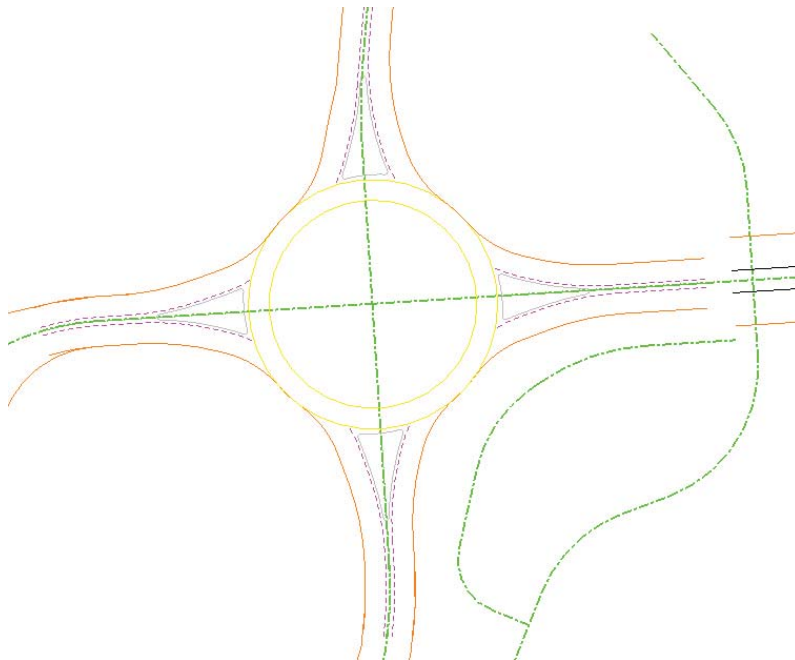
13. Now you are prompted to set the center of the roundabout.



14. Snap to the intersection of the alignments as shown above.

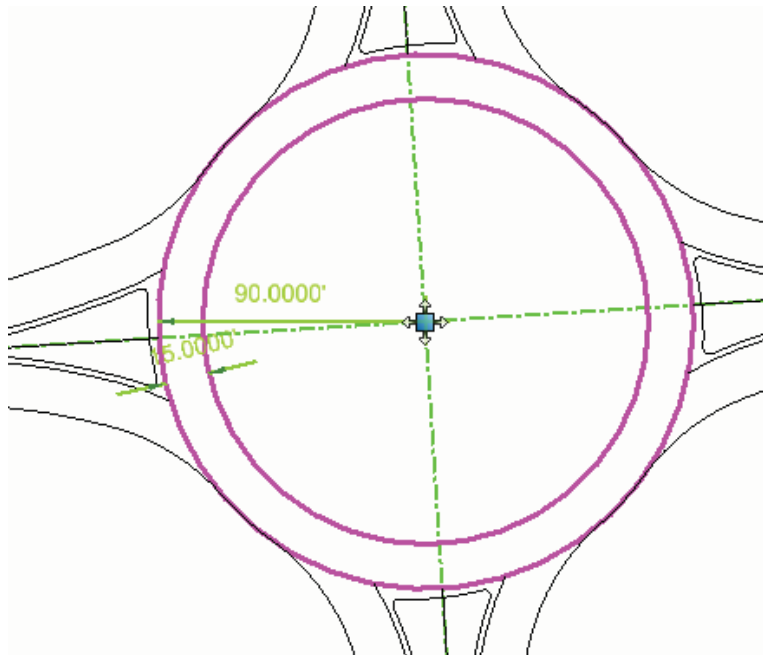
Note You do not have to snap to the intersection. Wherever you click (or snap) will be the center of the roundabout. Of course, there are certain advantages to using the intersection to make the roundabout symmetrical. Also, there is no requirement that the alignments must intersect. The only requirement is that each approach alignment must intersect the circulatory area of the traffic circle.


15. The roundabout is placed as shown below. Note the gaps and overlaps on the approaches. And the eastern approach is too narrow. Don't worry about these. We'll address them shortly.

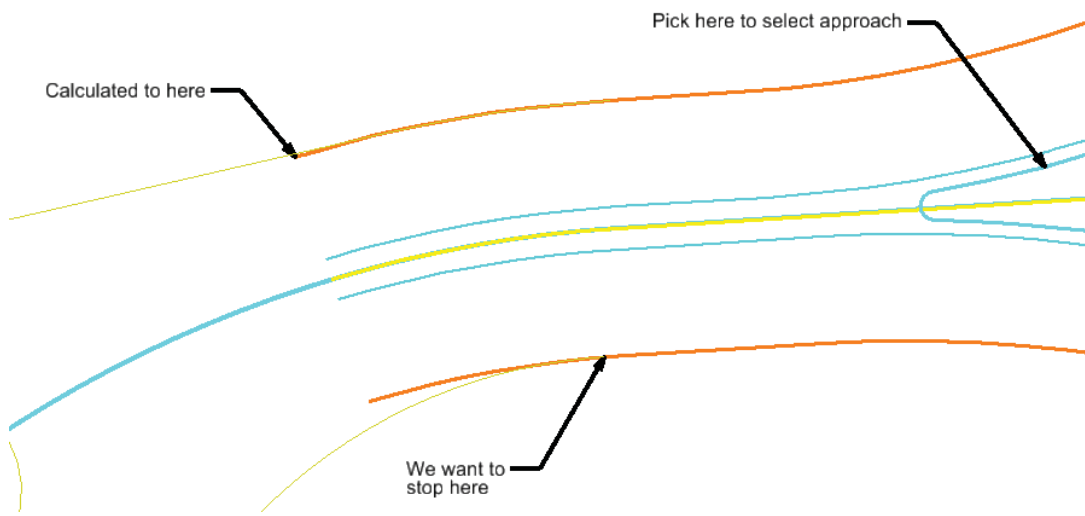


Note As noted above, the default design from the library does not exactly fit our needs. That's OK since it is only intended as a start point. We can now adjust the design to match our needs

16. First of all, the traffic circle can perhaps be made larger to improve traffic flow. Click on the outer circle and note that the radius is presented to us as 90.0 feet.
17. Hover over the 90.0 and it will change colors. Once it changes color, we can click and edit the value. Change the value to 100, and the entire roundabout will recalculate.



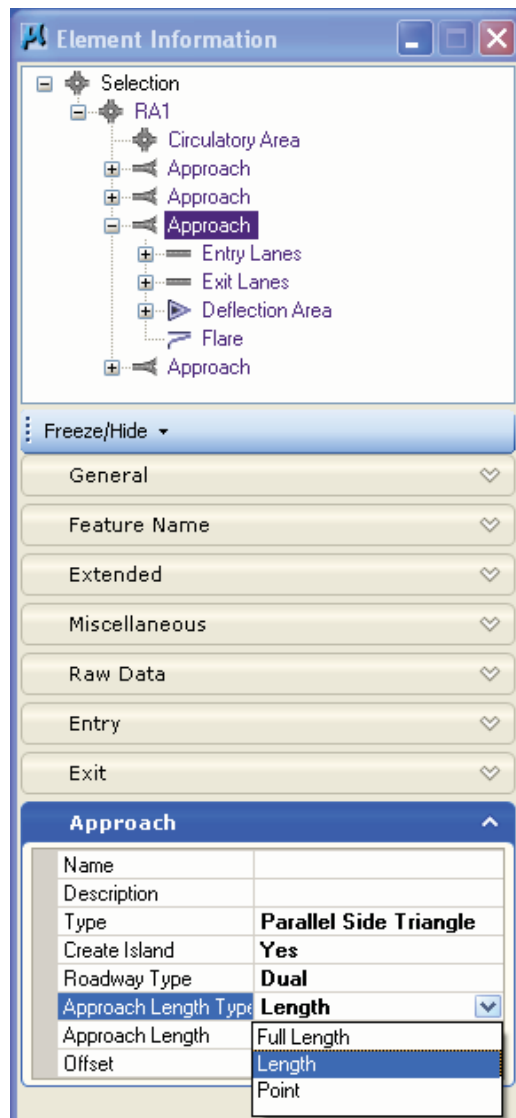
18. Note also the center point manipulator. We could (but will not) click and drag this  manipulator to reposition the circle and the roundabout will recalculate.
19. Now, let's turn our attention to the west approach. We can see that the approach is designed past the point where we want to stop. Let's adjust this length.



20. Open MicroStation's Element Information tool.
21. Use the Power Selector and select the roundabout, picking it where shown above.

Note You can pick anywhere there is a roundabout element. It is sometimes a little picky and you may have to try a few times until you get accustomed to the process.

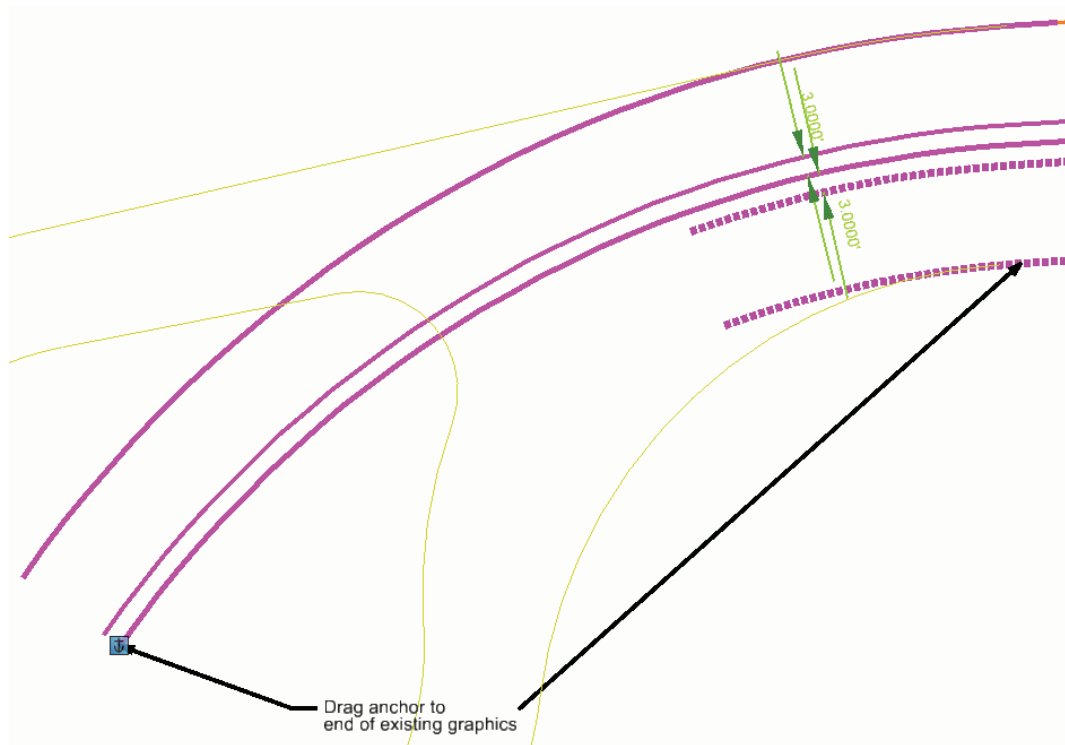
22. Keep in mind that there is an embedded intelligent roundabout object as well as visible graphics. We are after the roundabout object. When you select the right thing you will see the roundabout properties in the element information dialog.
23. Once selected and the roundabout properties are available in element info click on the western approach. The graphic will highlight when you select the correct one in element info.



24. One of the approach properties is the approach length as shown above. Change the property for “Approach Length Type” from “Length” to “Point”

Note The approach calculations will change to cover the entire alignment. The look will be undesirable, but we will fix this.

25. There will also appear an anchor symbol at the end of the alignment. Click and drag this manipulator and snap to the end of our existing approach graphics.

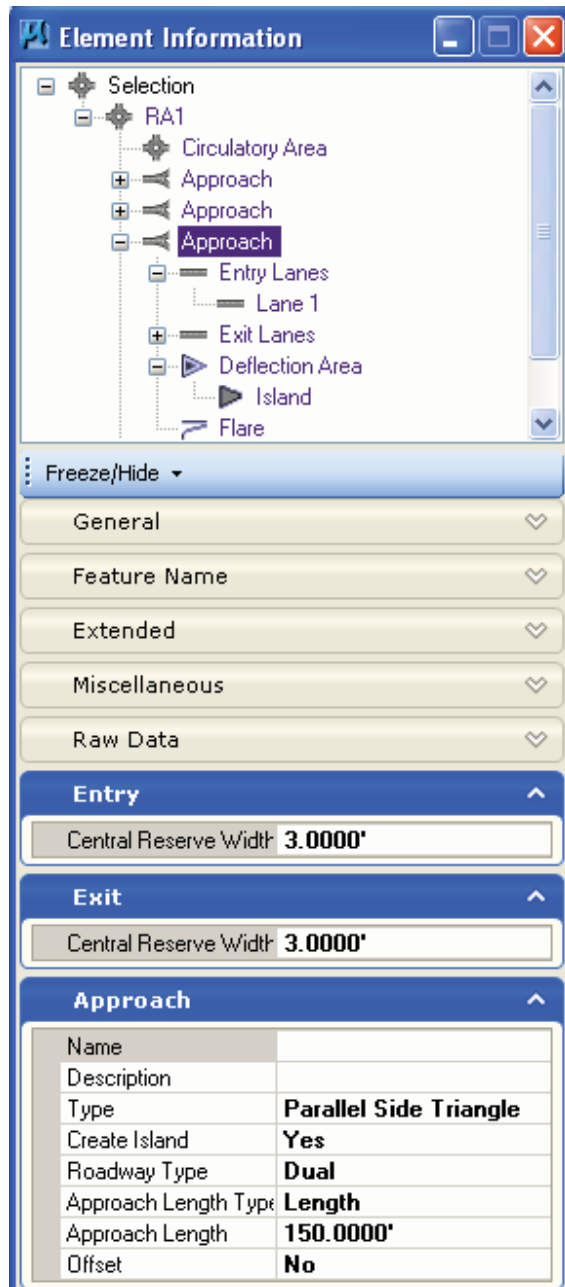


26. Once you drag the end point then the approach will heal itself
27. See, told you not to worry.
28. Now, repeat this exercise with the north and south approaches.

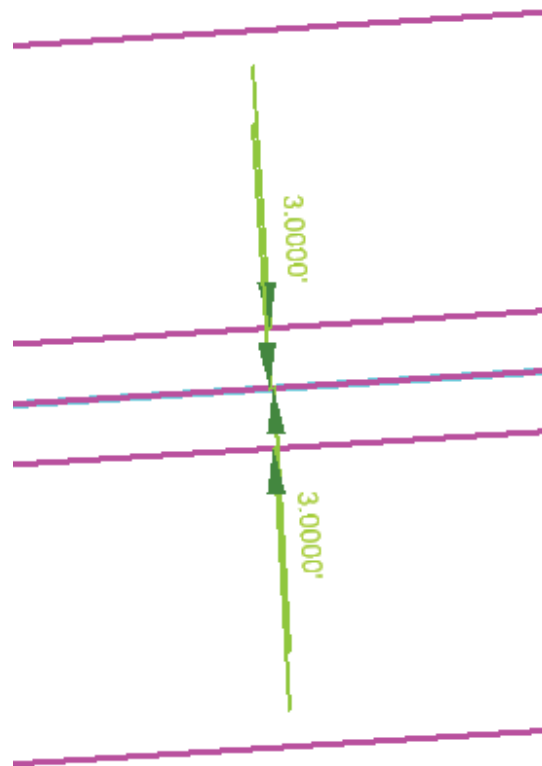
Note These will be a little difficult because the alignments are so long. You may need to zoom out and drag the anchor point multiple times.

➔ Modify the East Approach

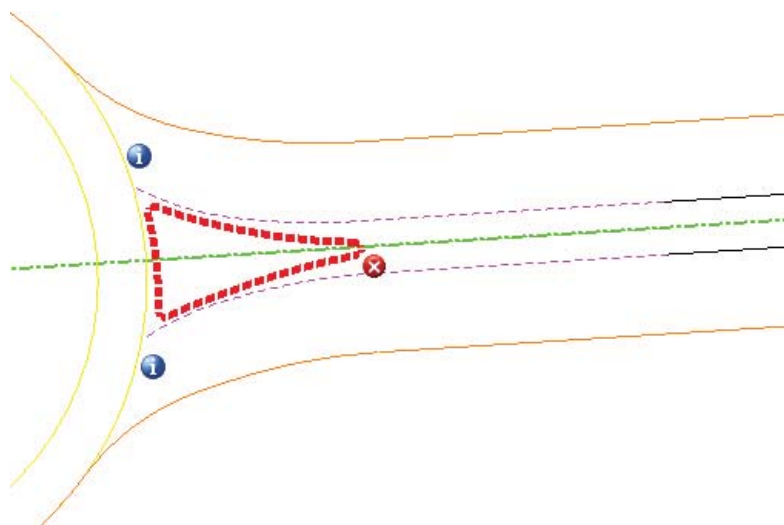
29. The east approach will need a little more modification. The length needs adjustment as we did on the other approaches and the width parameters need adjustment.
30. Adjust the length by point using the same procedure you used above for other approaches.
31. Now we need to adjust the width of the “central reserve”. In this case the central reserve serves us as the central median to match the rest of the approach. We can change this in the element information



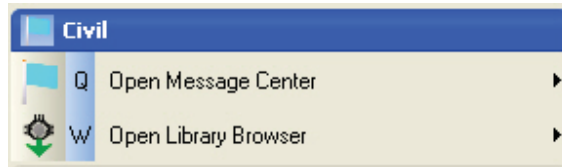
32. Or, by selecting the approach and zoom in until you can see the manipulator text.



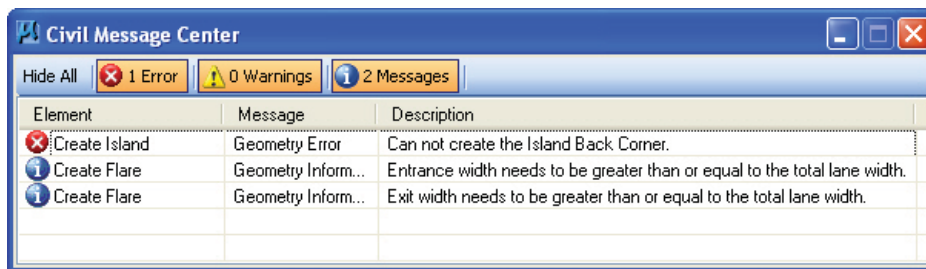
33. Whichever way you choose, change the width to 8.0 to match the rest of the approach roadway.
34. You will get an error on the island when you make this change. We'll explore this error later.
35. Similarly change the lane widths from 15.0 to 24.0 feet. Once this is done then our approaches are mostly complete.



36. Note that 3 little icons appeared on the median island. One is a red error message and 2 are informational messages. To see what these are open the message center by clicking on the message center tool in the task navigation.



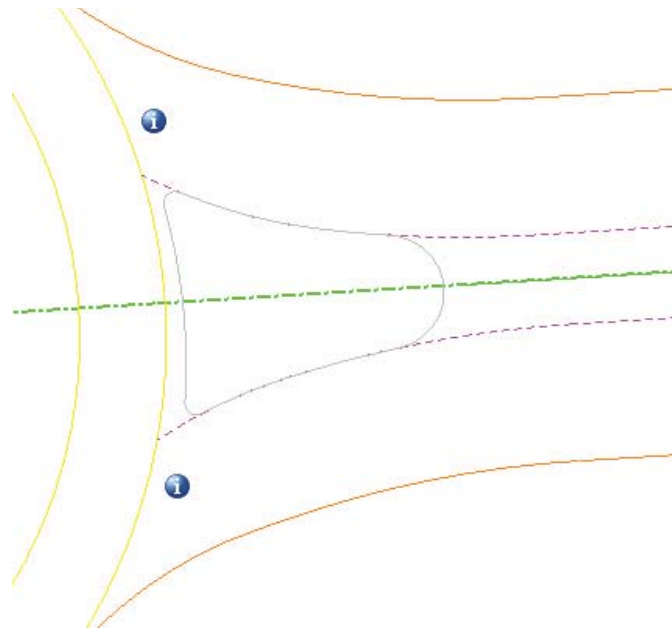
37. The message center will open, probably docked at the bottom of your MicroStation window.



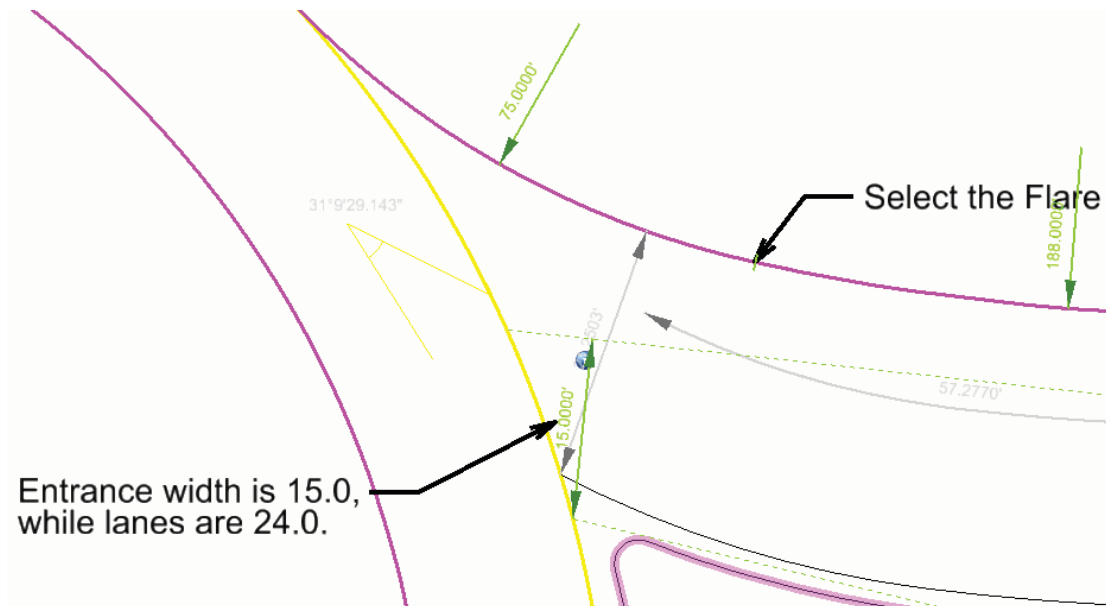
38. Here we see descriptions of the messages.

Note *In this case it is simple to determine where the problems are located. Sometimes though you can have a long list and it is not easy to determine where the problem is that corresponds to the message. You can right click any message in the message center and zoom to the location of the problem.*

39. The first is that we have developed a problem with the radius on the back of our island. It may not be immediately apparent what the problem is. A clue is that the problem surfaced when we increased the width of the central reserve. What has happened is that we have created an impossible set of parameters. Changing the back radius to 8.0 feet should solve the problem and make the error go away.
40. We also want to change the side offset of the islands from 2.0 to 0.0 so our island will match up to the median divider on the rest of the approach. This may necessitate changing the back radius again.



41. Now we have cleared the error. The remaining informational messages are telling us that the entrance and exit widths are narrower than the lanes, which of course, is contrary to desired standards.



42. Change the parameter for "theoretical entrance width" to 24.0 to clear the informational messages.

Entry Path Curvature Analysis

Designing a roundabout is an iterative procedure, where you may need to compromise one design objective to achieve another. The roundabout tasks and accompanying 'analysis' tasks combine to make the design and assessment of a layout easier and more efficient.

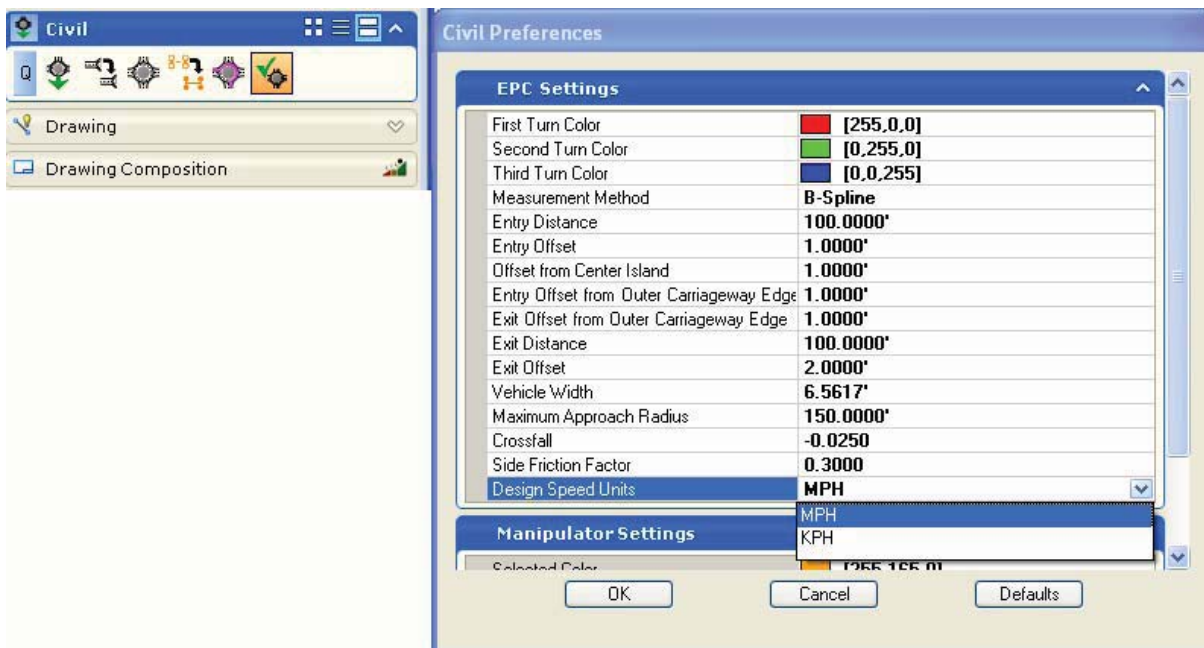
Entry path radius is one of the most important determinants of safety at roundabouts. This is a measure of the amount of entry deflection imposed on vehicles at the entry to a roundabout.

We have created a starting point for more analysis, as every roundabout will have its own characteristics and challenges.

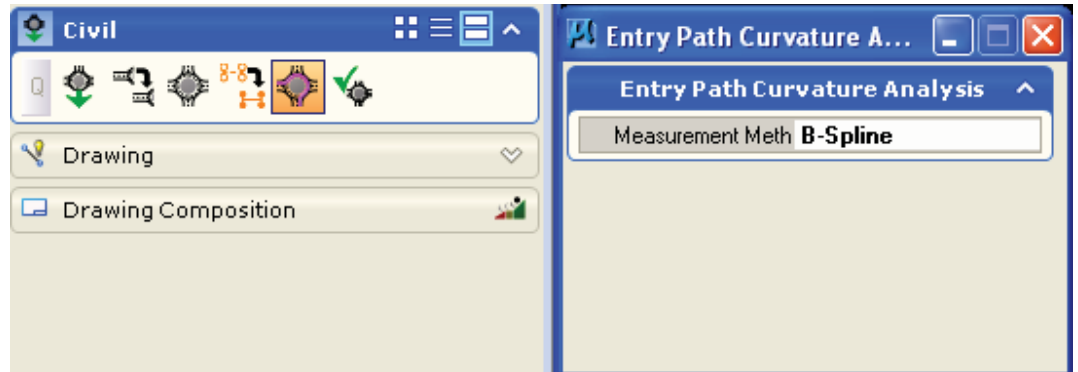
Note This class is intended to show you how to use the tools to create a good design. It is not intended to teach you the principals and theories of roundabout design.

→ Exercise: Analysis of Design Speed through Roundabout

1. Open the file
...\\RoundaboutSchool\\Chapter2\\RoundaboutLayout.dgn.
2. Click Civil Preferences and set the following settings to match the dialog below.



- Click on Entry Path Curvature Analysis and select measurement method to B-Spline

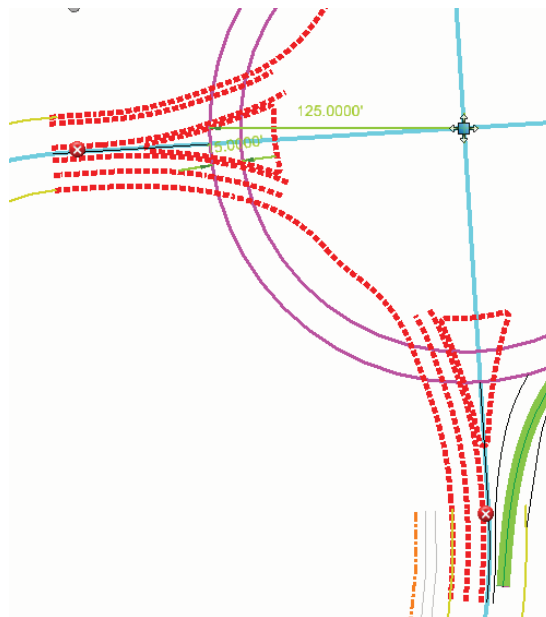


Hint: You other options are Arc. Make the adjustments using B-Spline and then switch the settings to Arc and notice the differences.

- Now Select the East approach first, and then select the West approach. Follow the prompts.
- Review your selections and see if there is any Alerts or Errors. Check your Message Center and make the necessary adjustments to correct the errors.
- Repeat the previous 2 steps for all approaches.


Hint: Place one Entry Path at a time and resolve any issues you may have before moving to next approach to minimize the number of Alerts you need to adjust.

Warning: If you get a design that looks like this, you need to make adjustments to the Error Messages first, and then handle the Alerts.



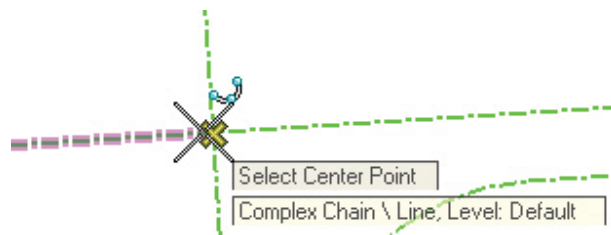
- Review your information on the Calculated Design Speeds for each approach.

8. You may remove all of the Alerts by changing the individual offsets and radii, but there may be times you will need to adjust your location of the roundabout.
9. With your Power Selector, select the outer circular element. Grab the center

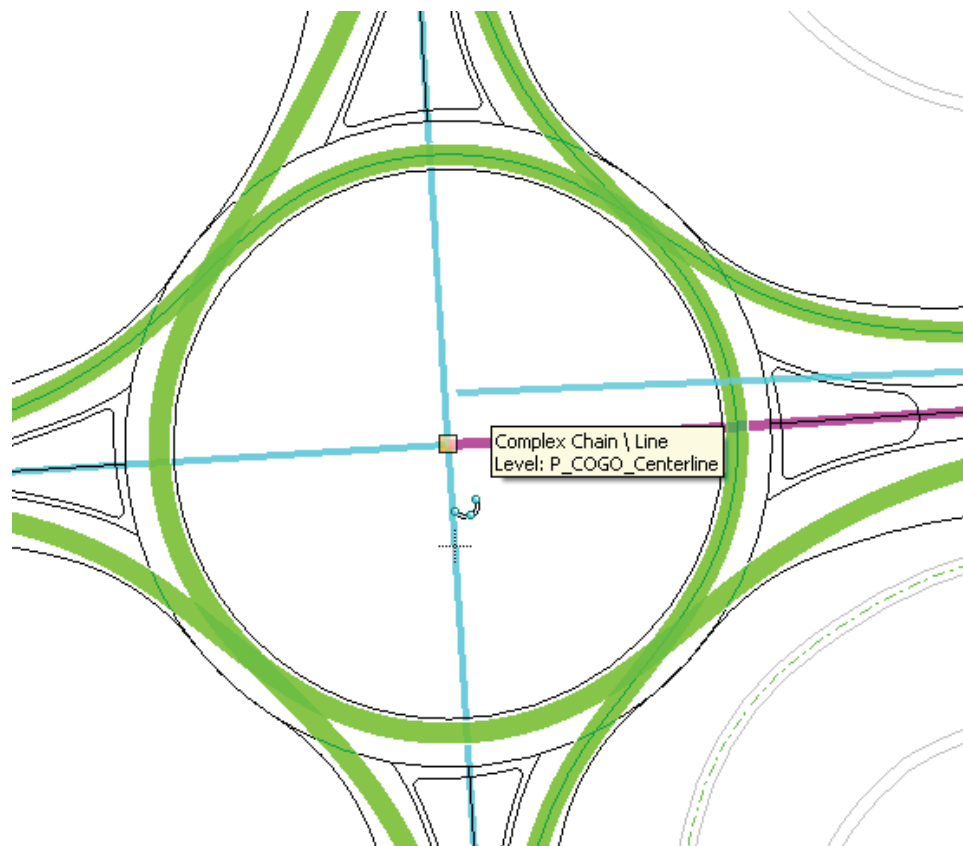
manipulator  and move it manually away from the intersection and watch it heal itself.

Warning: Do not move it too far or you will get many error messages in the Message Center.

10. Move the manipulator back to the intersection of the alignments.



11. Now Select the East alignment with the Power Selector and grab the handle and move the alignment away from the intersection and click.

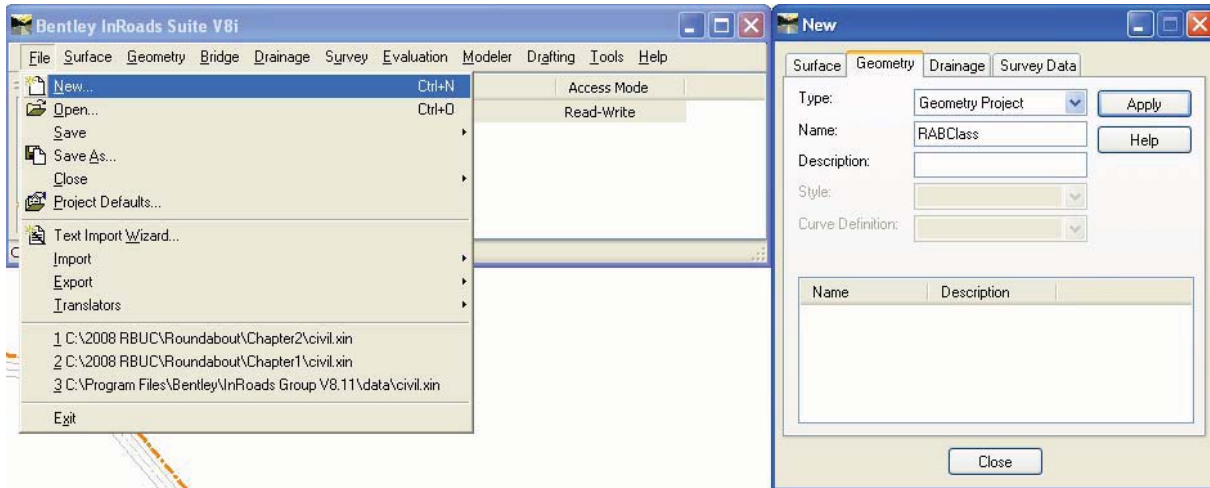


12. The approach will heal itself, if the rules will allow it. Now hit the MicroStation Undo button to move the alignment back.

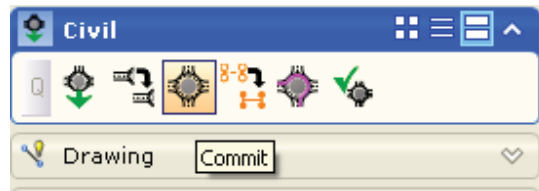
➔ **Exercise: Committing Design to InRoads**

To write the MicroStation graphics to InRoads, you will need to setup

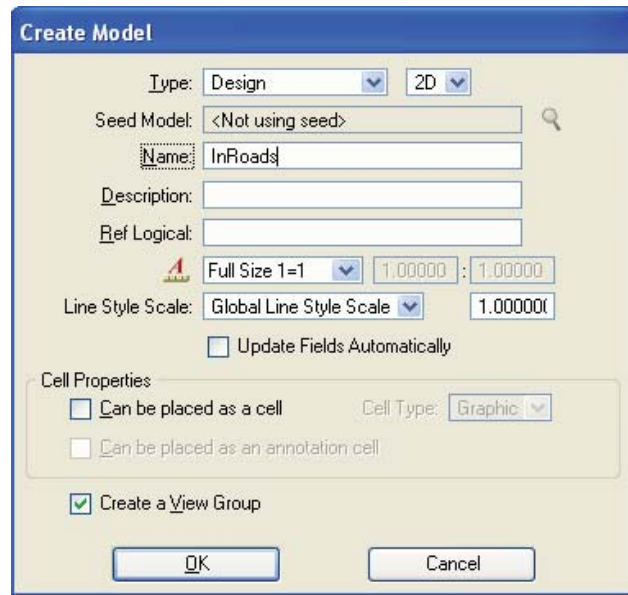
13. In InRoads, click File > New > Geometry > Geometry Project



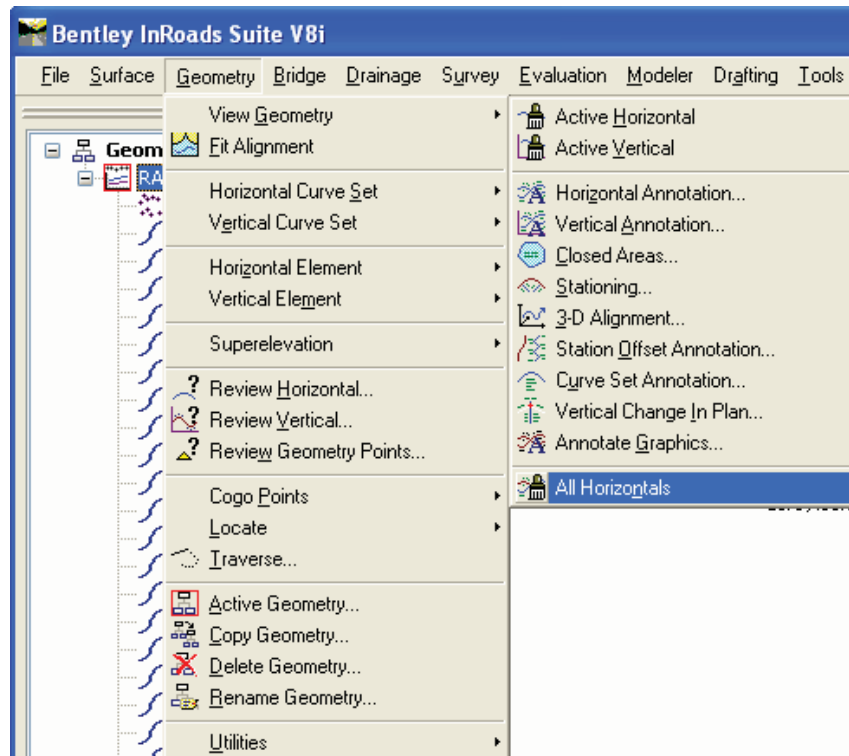
14. Type in RABClass and hit Apply.
15. Now, with the Geometry Project RABClass as the active project, hit the Commit icon in the Civil Menu.



16. Follow the prompts and select the roundabout to commit to InRoads.
17. Open up the Geometry Project and see all of the alignments that were created.
18. Create a new Design Model in RoundaboutLayout.dgn and call it InRoads. Use Design, 2D and click OK.



19. Open the Style File for InRoads
 ...\\RoundaboutSchool\\Chapter2\\civil.xin
20. In InRoads, click Geometry > View Geometry > All Horizontals

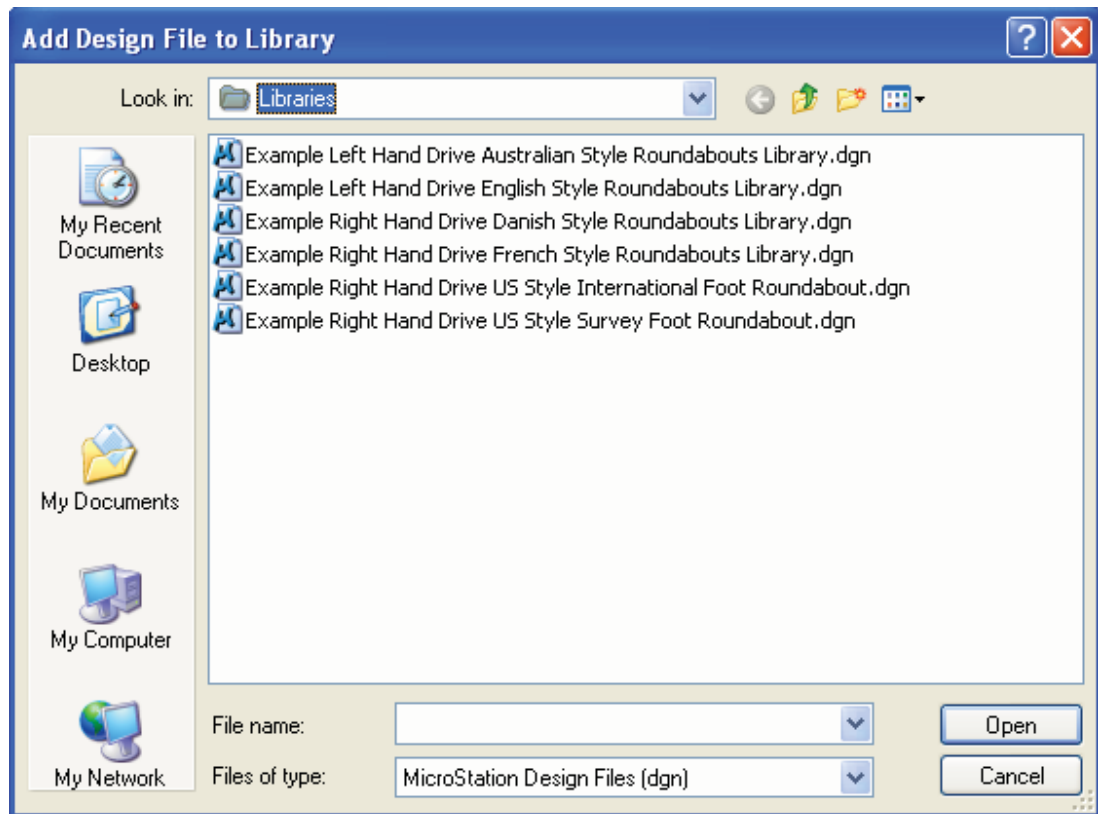


21. Fit view and see your completed Roundabout.

Creating a Library

To create a library item, it is relatively easy. We will use the same steps we have already covered in modifying an existing roundabout to create a new one to our standards and specifications.

There are 6 defaults that are available to pick from within MicroStation V8i. We will create our own in the following exercise.



These are located

...C:\Program Files\Common Files\Bentley Shared\Civil Platform\Libraries\

Note You can modify these or create your own set to use as default.

➔ **Exercise: We will create a custom Roundabout using predefined styles from InRoads.**

1. Open the file
... \RoundaboutSchool\Chapter3\Seed.dgn.
2. Copy it and rename it to **Roundabout Template.dgn**
3. Open Civil.xin within InRoads to load the Styles that will be used.

4. From the MicroStation pull downs go to Tools > Toolboxes > Roundabout Libraries

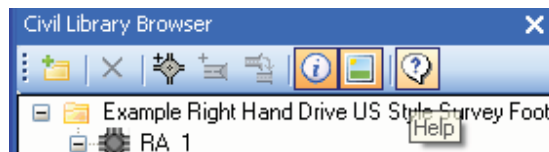


5. Click on the Place Default UK Roundabout
6. Now select the Right Hand Side option for placing the Roundabout.



7. Follow the prompts and click anywhere on your screen. Fit view.

Note The center location coordinates are not important; the center is located when we place it in our design. The design is rules-driven from the center out. If you would like more information on the different types of defaults you can use and how the design calculated. Open the Civil Library Browser and click on the Help icon. Navigate down to Roundabouts > Reference and review the different design calculations.



Roundabouts

Entry and Exit based on a triangle - parallel sided triangle

The entry and exit deflection area is based on a triangle with straight or curved sides, the same as the approach center line. This is constructed using a length and width.

This method is only available in European roundabout styles.

Geometric principles

A - Outer edge of the circulatory area

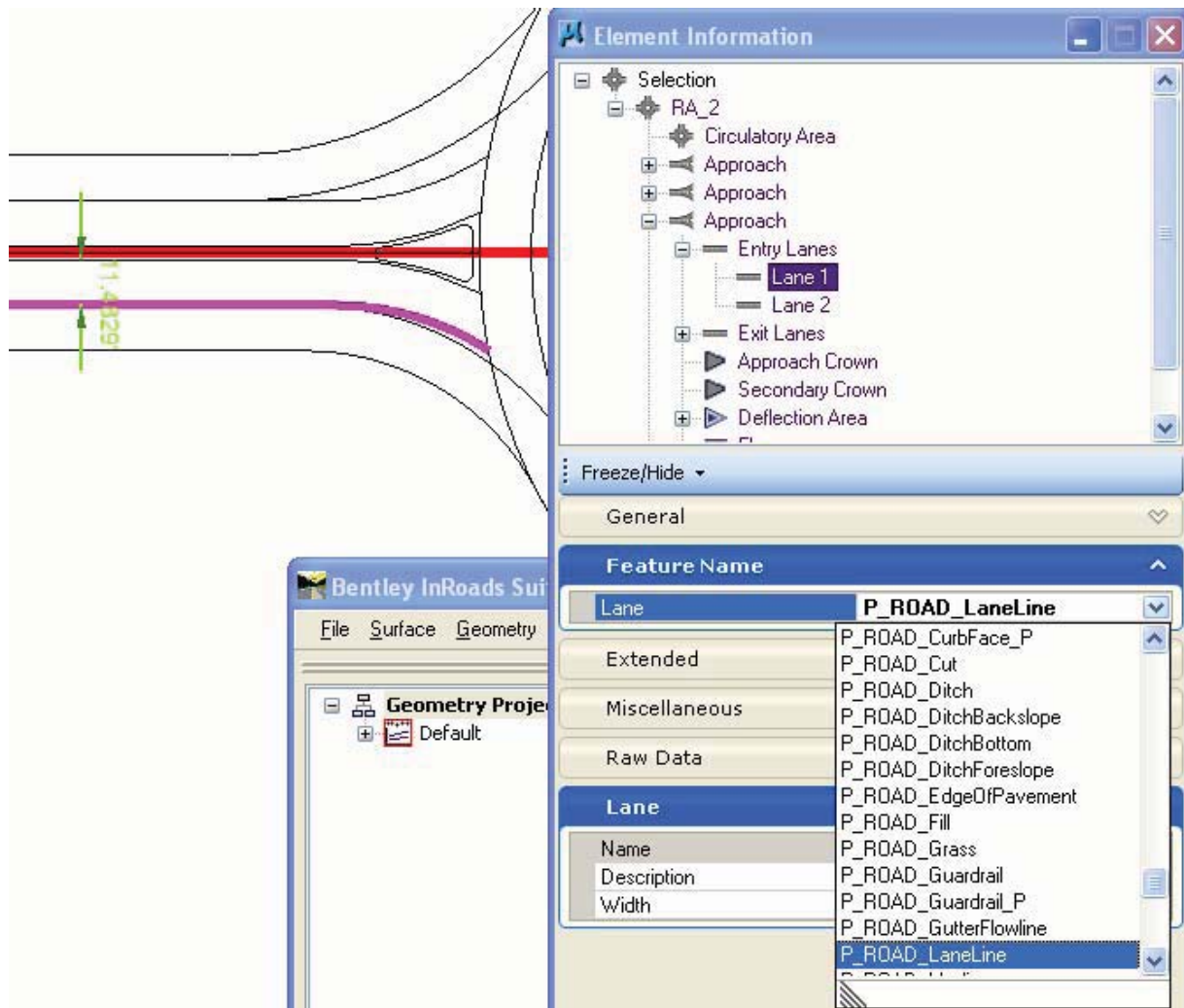
Roundabouts: Reference: Entry and Exit based on a triangle or rectangle - Variation 1

8. Now we have our basic design to modify.
9. Starting with the West approach, modify the approach dimensions using the on-screen manipulators or Information dialog. Use the skills you previously learned.

Note Now we will assign the drafting display standards

10. With the Power Selector, select the West approach. Navigate down to Entry Lanes > Lane 1.
11. Expand the Feature Name dialog and assign P_Road_LaneLine style to Lane 1.
12. Follow the same steps to assign a style to all the Feature Name Dialogs for the West Approach.

Warning: You should see the colors/levels change as you assign the styles. If not, make sure you have the Civil.xin file attached in InRoads.

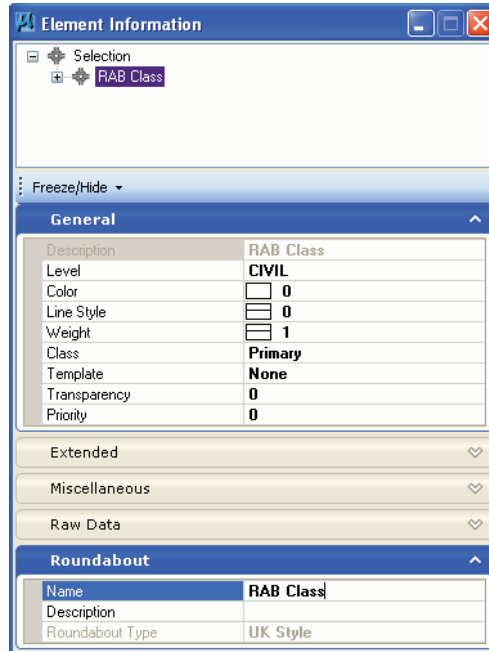


13. When you have completed the West approach, we will copy that design around to the remaining approaches using the Replace Approach tool in the Civil Toolbar.



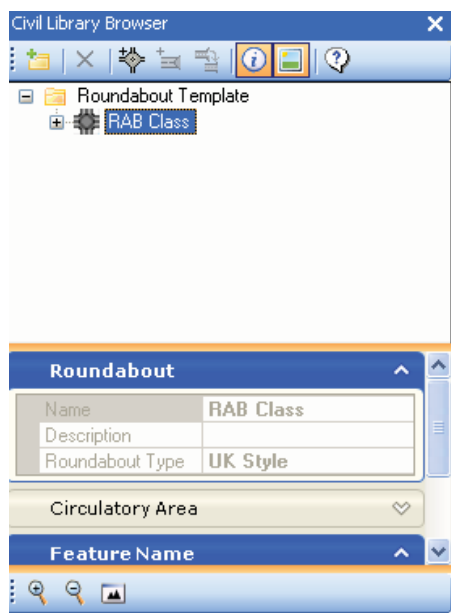
14. Follow the on screen prompts and select the West Approach, then select the South Approach.
15. Repeat for the remaining approaches.
16. Remember to Select the Circulatory area with the Power Selector and change the Feature Name properties to a style from InRoads.

- To give this a unique name, in the Information Dialog select the roundabout name at the top. Expand the Roundabout dialog and rename to RAB Class.



Note We now have a default that matches our design and drafting standards. If we want to make other variations of this, just copy the file and rename the DGN file. Adjust your settings and you will have another alternative.

- We now have a file we can add to our Civil Library Browser.



Roundabout Summary and Review

Summary

You are now able to:

- Have a basic understanding of the rules based approach as it pertains to design
- Understand the concepts to manipulate your design and save your alternatives
- Understand how to setup a roundabout template for your agencies standards
- Manipulate the template to improve the design with Entry Path Curvature Analysis