

Roundabouts

Bentley Civil Enhancement Tool & Generating
an InRoads 3D Model

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Overview

- The Bentley Civil Enhancement Roundabout Tool generates 2D InRoads horizontal geometry
- This tool can be customized for specific designs and symbology
- The tool uses design data as the basis for the Roundabout

Choices

- Roundabout design can be done with basic MicroStation element tools

~ or ~

- The Bentley Civil Enhancement Roundabout tool can be used

MicroStation Graphics

- Basic MicroStation element tools
- Freehand design
- Need to import graphics into InRoads geometry or surface
- Does not enforce design standards

Bentley Civil Tool

- Can use design features and symbology
- Roundabout geometry is generated when the roundabout is committed

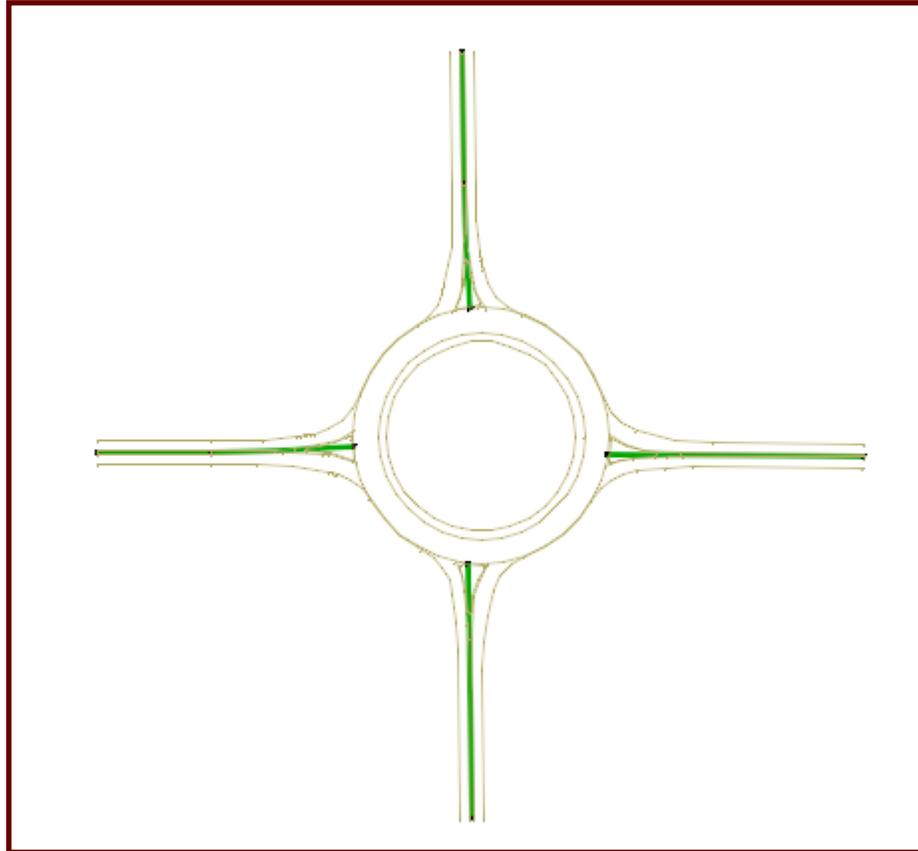
Accessing the Tool

- In V8i, access the Roundabout tool as a task
- This can also be launched from a toolbox

Library Browser

- The library contains several example roundabouts
- The DGN examples can be customized
- Add custom DGN libraries to the browser

Custom WSDOT Geometrics



Custom design with 10' offset per WSDOT Design Manual

Edit the DGN Library File

- Use the MicroStation Element Info command
- Update symbology, dimensions, names, parameters

Design Geometry

- The template DGN libraries can be set up in advance
- Edit feature names, design parameters, etc.

The screenshot shows the 'Element Info' dialog box with a tree view on the left and several property tables on the right. The tree view shows a hierarchy: RA_1 (parent), IC (child), EastApp (child of IC), NorthApp (child of IC), WestApp (child of IC), and SouthApp (child of IC). The 'SouthApp' element is selected and highlighted in purple. Below the tree view is a 'Freeze/Hide' dropdown menu.

The 'Approach' table contains the following data:

Approach	
Name	SouthApp
Description	South approach
Type	Parallel Side Triangle
Create Island	Yes
Roadway Type	Dual
Approach Length Type	Length
Approach Length	300.0000'
Offset	No

The 'Entry' table contains the following data:

Entry	
Central Reserve Width	2.0000'

The 'Exit' table contains the following data:

Exit	
Central Reserve Width	2.0000'

The 'Feature Name' table contains the following data:

Feature Name	
Center Line	AL_HW_CLinePSENew
Entry Central Reserve	RD_ED_RoadwayETWPa
Exit Central Reserve	Prop. EOP

Process

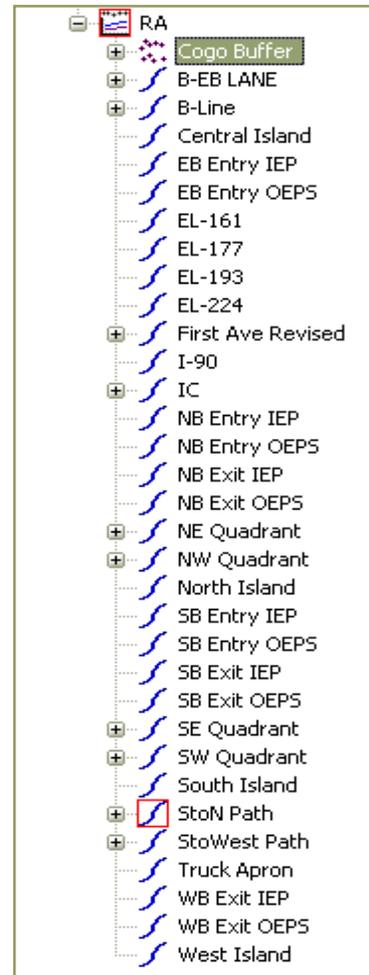
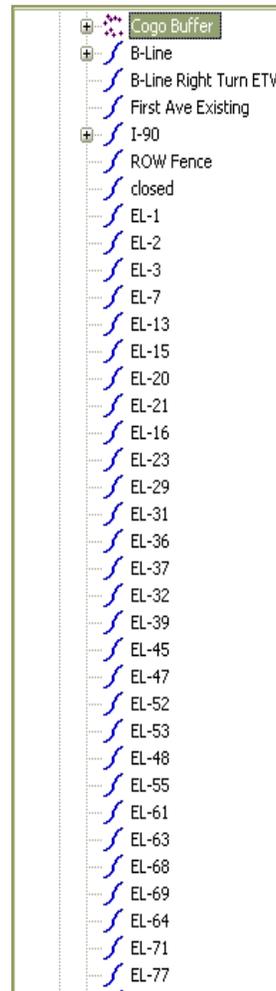
- The tool places a multi-leg roundabout on horizontal alignments
- The circulatory area and approaches can be modified to suit design standards and geometry constraints
- The roundabout is then committed to the active geometry file

Design Geometry

- There will be a lot of new alignments
- The alignment names can be cryptic
- Rename the alignment names or add specific descriptions in InRoads

Design Geometry

Before....



After....

Generated Alignments

- Traffic islands
- Edges of pavement
- Left and right inside edges of pavements
- Main circulatory area
- Inscribed roundabout geometry
- Quadrants

Roundabout Tool Specifics

- Robust geometric design functionality
- Multiple parameters for specific dimensions, radii, offsets, lengths, etc.
- Direct & complete import into InRoads geometry file

Help File

The tool includes useful help documentation



More Options

- ❑ Modify roundabout
- ❑ Update roundabout alignments
- ❑ Add approach
- ❑ Add approach from existing approaches
- ❑ Replace, copy or delete approaches
- ❑ Entry path curvature

InRoads Design Options

There are several options for generating InRoads 3D geometry and surfaces

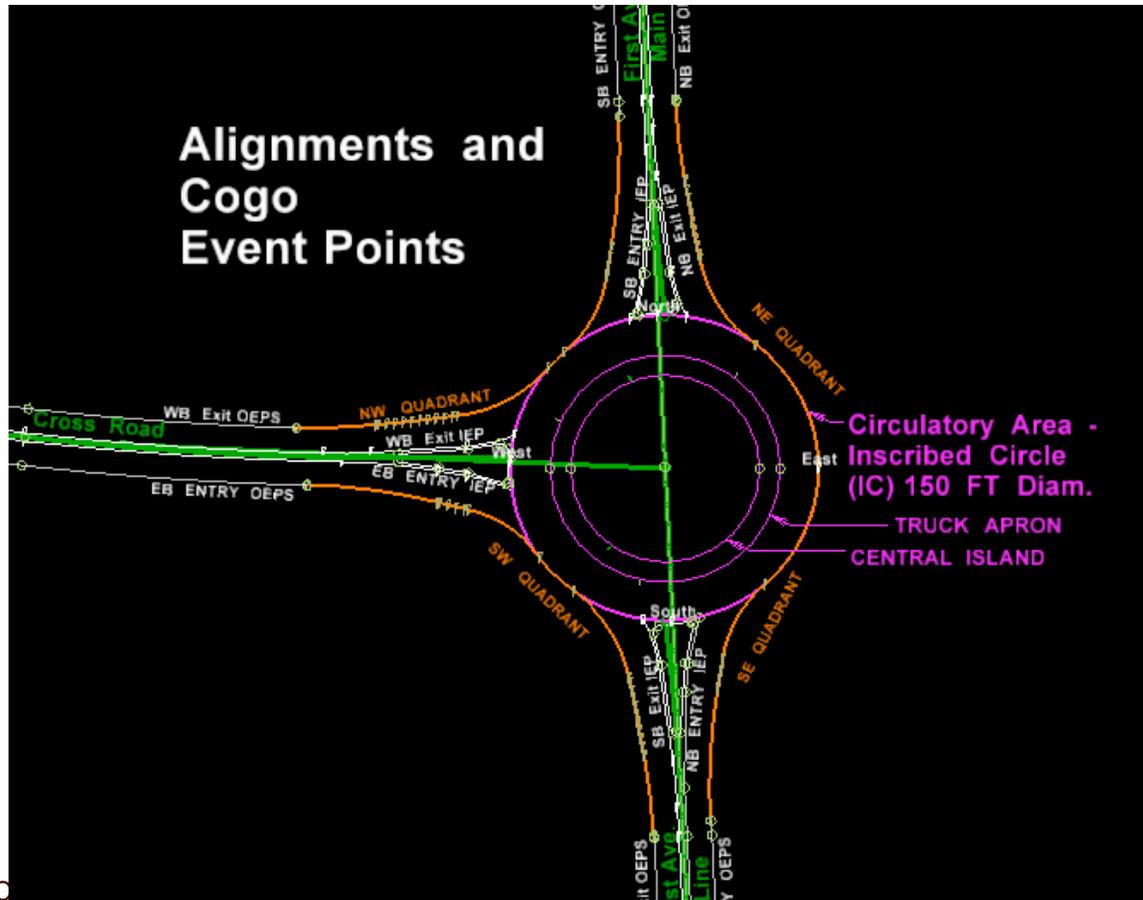
InRoads Design Options

- One option is using Cogo commands to develop vertical alignments for the IC and the quadrants
- Another option is to develop a surface that is larger than the circulatory area and then drape the IC onto this surface

Cogo Method

- Generate the 2D geometry with the Roundabout tool
- Label & categorize the InRoads horizontal geometry
- Tie the IC to the intersecting approach geometry

Horizontal Alignments



Vertical Alignments

- Quadrants are used for horizontal & vertical point controls
- These require vertical alignments
- Create a vertical alignment for the Inscribed Circle
- The start and stop elevations must match!

Vertical Alignments

- Create event points at the key intersections
- View the event points in the profile window
- Best fit & refine the vertical geometry

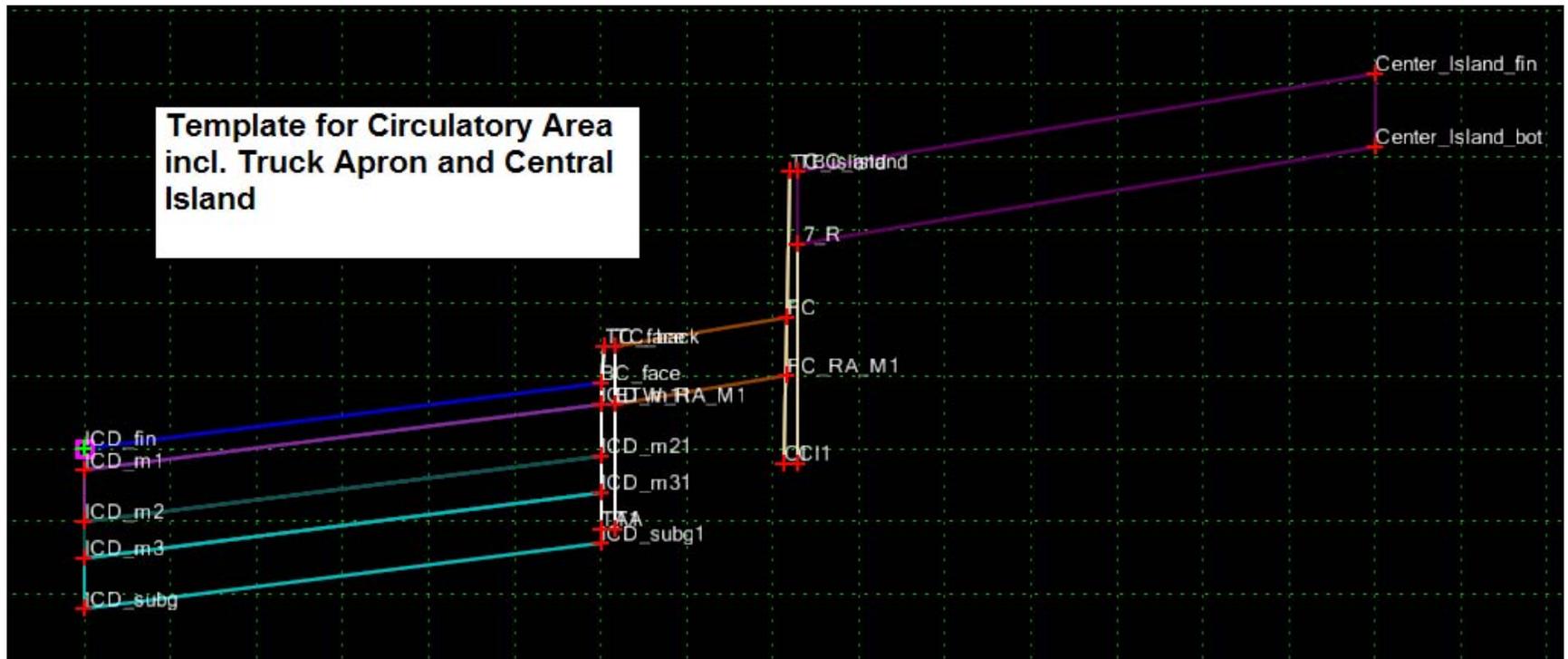
Useful InRoads Commands

- Geometry => Horizontal Curve Set
=> Events
- Evaluation => Profile => Points to Profile
- Geometry => Vertical Element => Edit Element

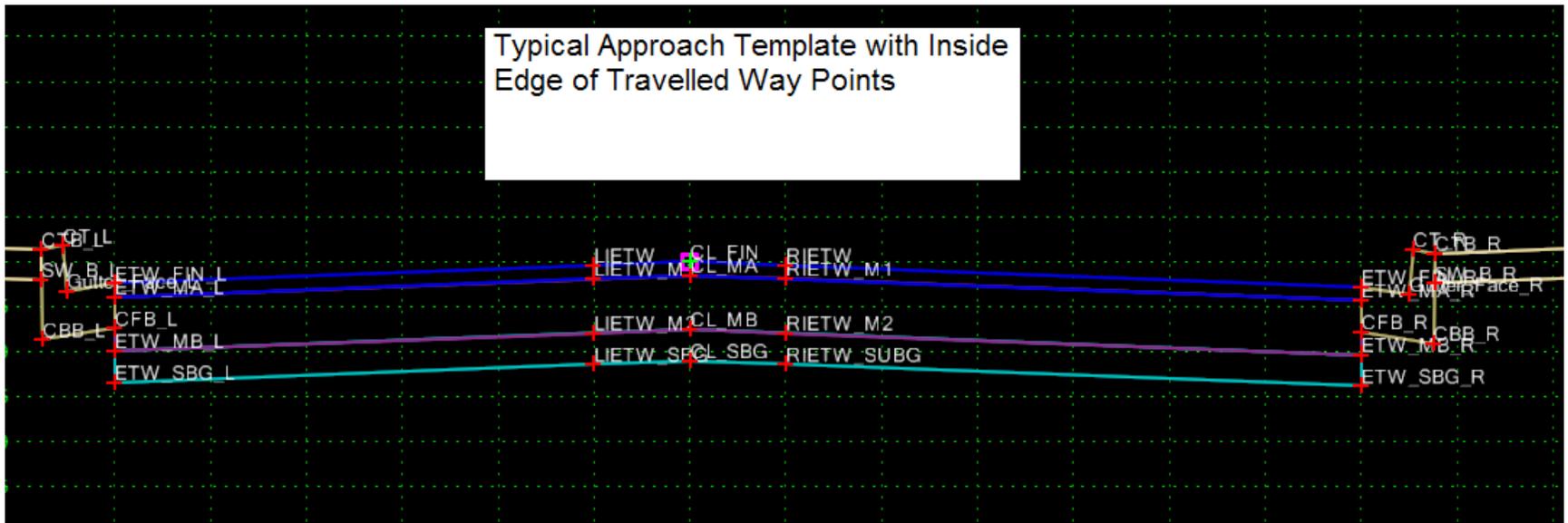
Template Design

- Create templates for the circulatory area, approaches, mainline, side roads, truck apron and traffic islands
- Constrain the template points!
- Add left & right inside edge of traveled way points
- These will be controlled horizontally

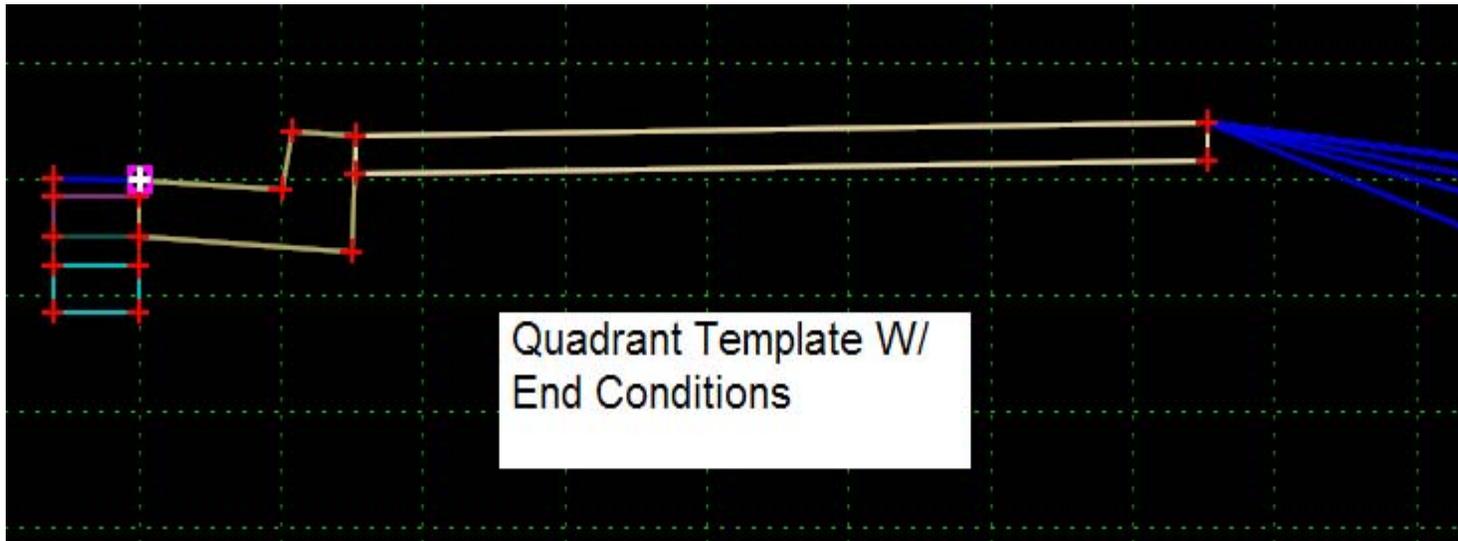
Templates



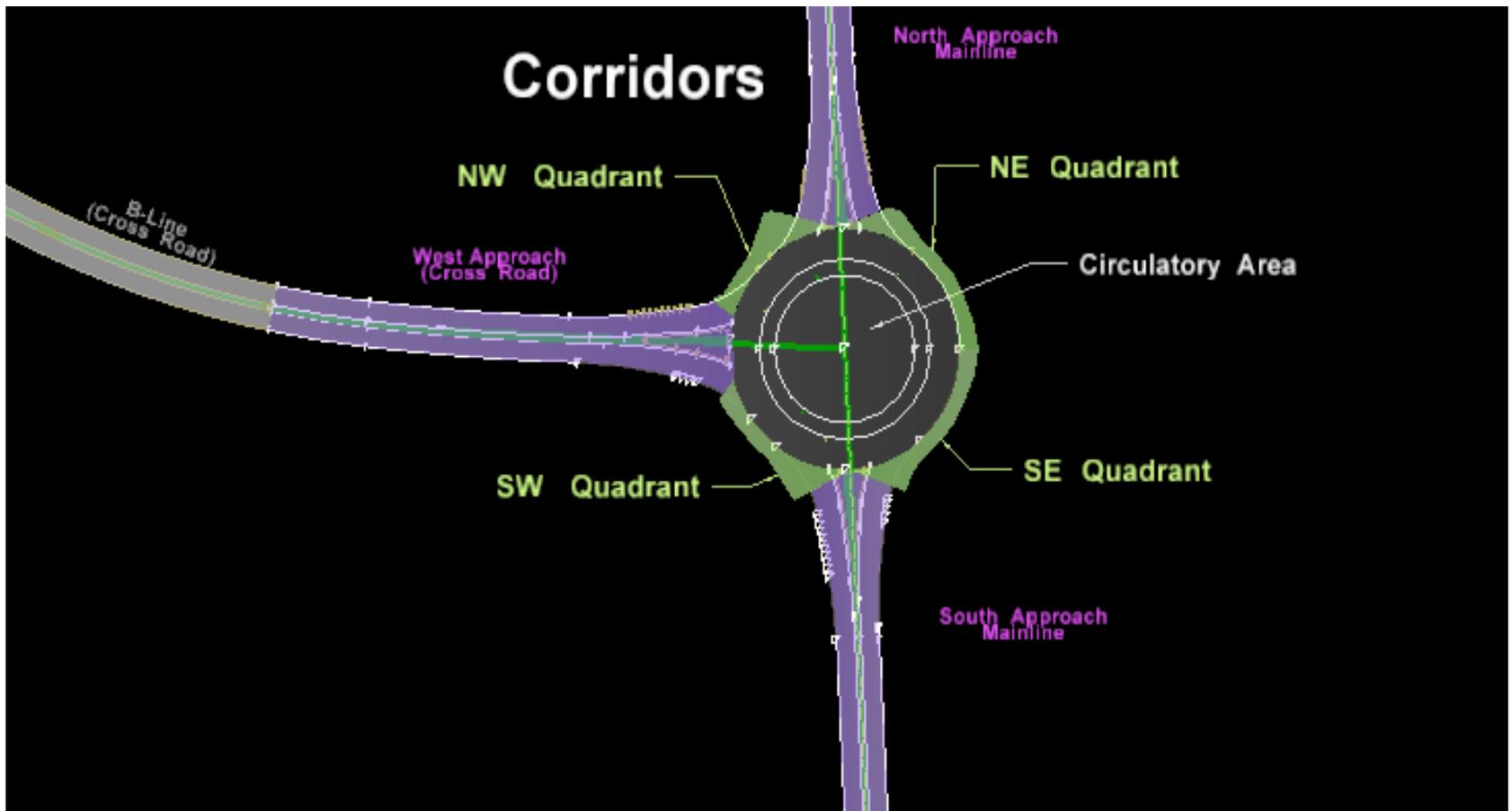
Templates



Templates



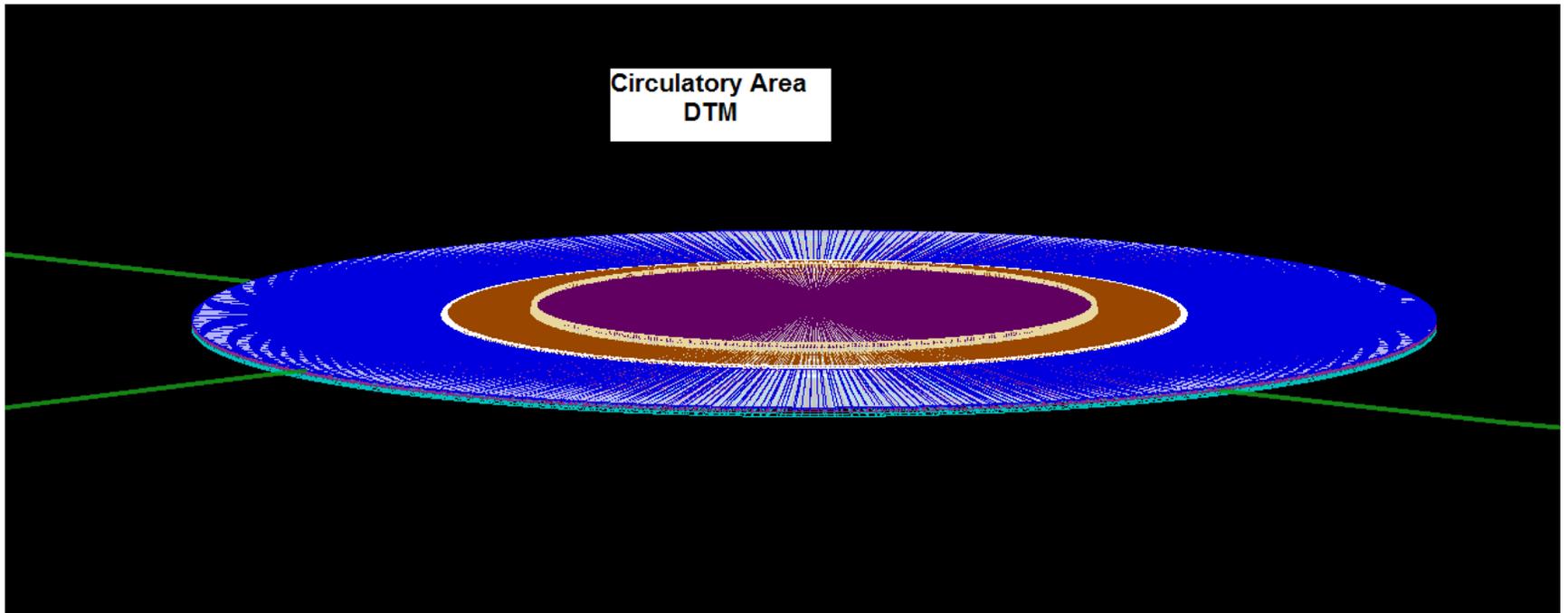
Corridors



Roadway Designer

- Create a model of the circulatory area without end conditions
- Use a one foot interval
- Model the approaches at one or two foot intervals

Roadway Designer



Point Controls

- Secondary alignment point controls tie key template points horizontally
- Vertical alignment controls tie quadrant alignments

Point Controls

Point Controls

Corridor: South Approach

Point: L_SH_ESP_FIN

Mode: Horizontal Vertical Both

Control Type: Alignment

Horizontal Alignment: SB Exit OEPS

Use as Secondary Alignment

Priority: 1

Station Limits: Start: 12+84.255, Stop: 14+79.179

Horizontal Offsets: Start: 0.000, Stop: 0.000

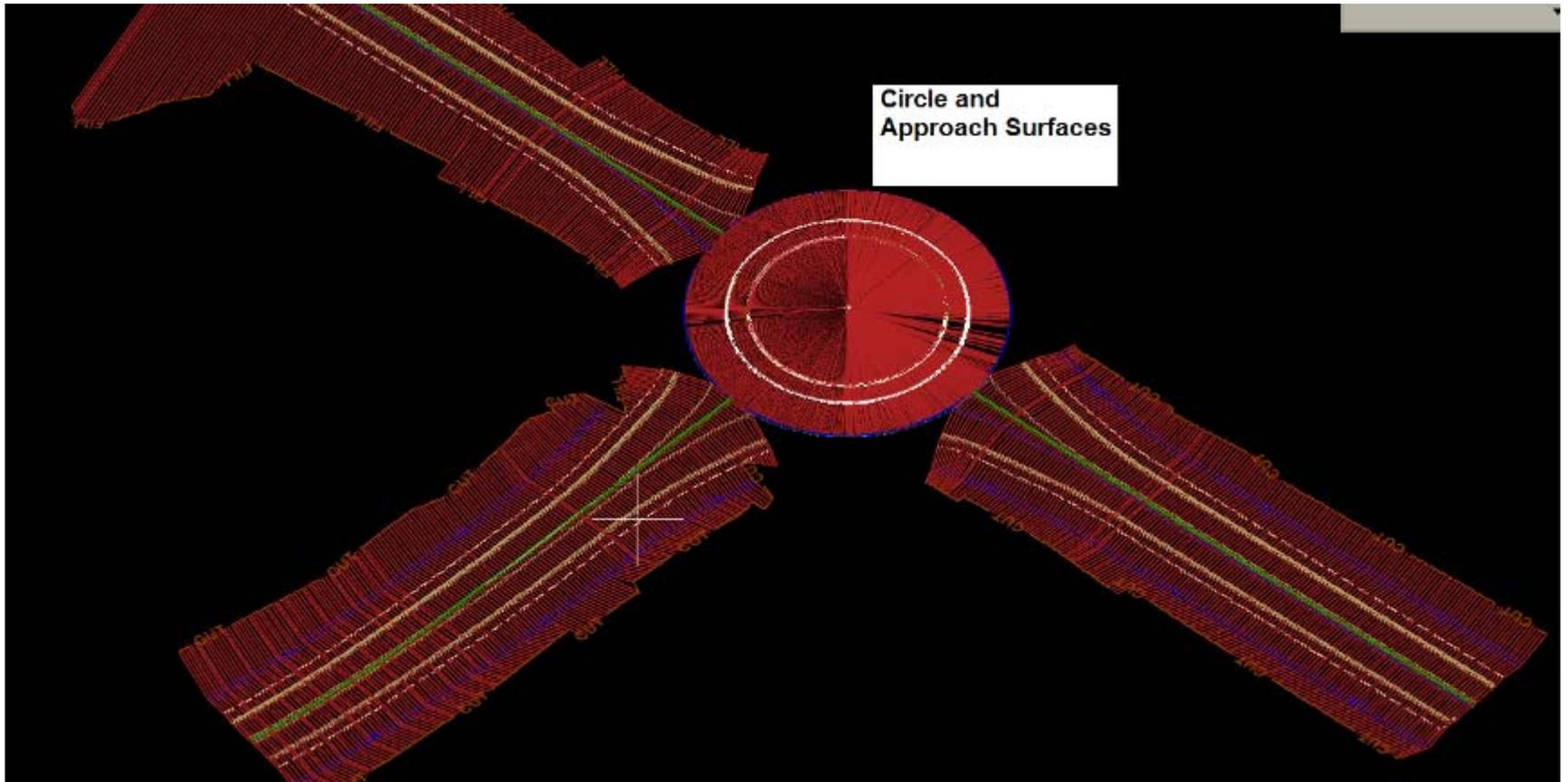
Vertical Offsets: Start: 0.000, Stop: 0.000

Buttons: Add, Close, Change, Help

South Approach Point Controls

Ena...	Priority	Name	Start Station	Stop Station	Mode	Type	Control
X	1	RIETW	12+84.255	15+84.103	Horizontal	Alignment	NB Entry IEP
X	1	R_SH_ESP_FIN	12+84.255	14+85.293	Horizontal	Alignment	NB Entry OEPS
X	1	LIETW	12+84.255	15+84.103	Horizontal	Alignment	SB Exit IEP
X	1	L_SH_ESP_FIN	12+84.255	14+79.179	Horizontal	Alignment	SB Exit OEPS
X	1	R_SH_ESP_FIN	14+85.293	15+84.103	Both	Alignment	SE Quadrant:SE Q...
X	1	L_SH_ESP_FIN	14+79.179	15+84.103	Both	Alignment	SW Quadrant:SW ...

Point Controls



Point Controls

- Set point controls for the quadrants
- These controls are relative to the circle as well as the quadrant alignments

Targeting the quadrants

Corridor: SE Quadrant

Point: AC_curb_FIN

Mode: Horizontal Vertical Both

Control Type: Alignment

Horizontal Alignment: SE Quadrant

Vertical Alignment: SE Quad Vert

Use as Secondary Alignment

Priority: 1

Station Limits: Start: 1+13.500, Stop: 1+50.000

Horizontal Offsets: Start: 0.000, Stop: 0.000

Vertical Offsets: Start: 0.000, Stop: 0.000

E...	P...	Name	Start Stat...	Stop Stat...	Mode	Type	Control
X	1	CR_FIN	1+50.000	3+00.000	Both	Corridor Point	Circle:Center_...
X	1	AC_curb_FIN	1+13.500	1+50.000	Both	Alignment	SE Quadrant:...

Targeting the Circle

Point Controls

Corridor: SE Quadrant

Point: CR_FIN

Mode: Horizontal Vertical Both

Control Type: Corridor Point

Corridor: Circle

Reference Point: Center_FIN

Station Limits: Start: 1+50.000 Stop: 3+00.000

Horizontal Offsets: Start: 0.000 Stop: 0.000

Vertical Offsets: Start: 0.000 Stop: 0.000

Priority: 1

Horizontal and Vertical Controls:

E...	P...	Name	Start Stat...	Stop Stat...	Mode	Type	Control
X	1	CR_FIN	1+50.000	3+00.000	Both	Corridor Point	Circle:Center_...
X	1	AC_curb_FIN	1+13.500	1+50.000	Both	Alignment	SE Quadrant:...

Refine the Design

- Model all of the corridors
- Model the circulatory area
- Create a single surface using all of the corridors

Refining the Design

- Set clipping options to “Clip End Conditions Only” for quadrants in relation to the circle
- View the components in plan view
- Rotate the view and evaluate design
- Refine quadrant start & stop stations

Traffic Island & Truck Apron

- View the traffic island and truck apron horizontal alignments
- Import the geometry into the roundabout surface
- Verify that the new curb features have elevations

Traffic Island & Truck Apron

- Use the **Surface** => **Design Surface**
=> **Apply Template** command to generate curbs
- Import curb features into a dedicated surface for quality control
- Copy the curbing into the main roundabout surface

Final Surface



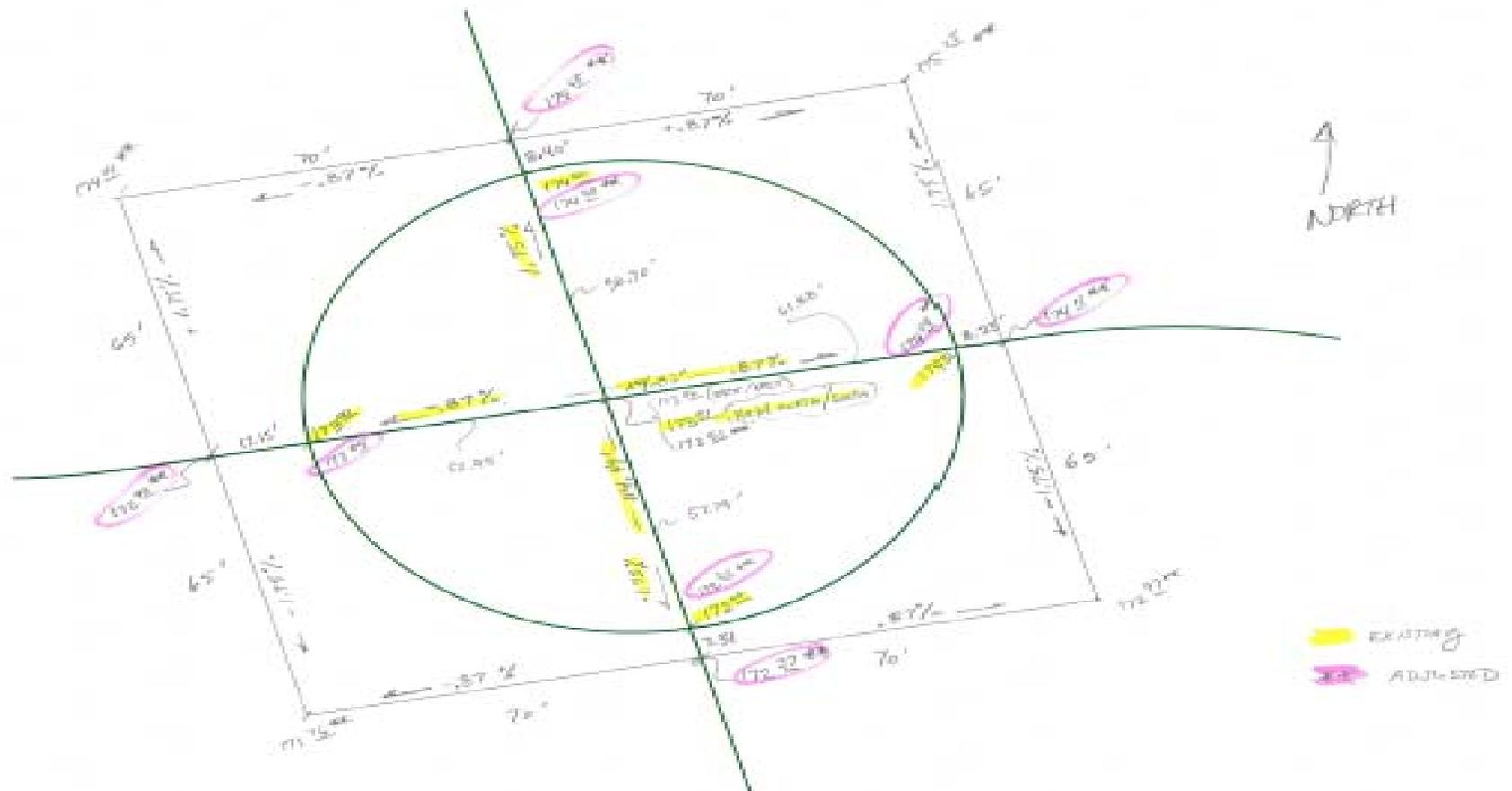
Alternate Surface Method

- This method uses a surface plane with calculations based on the intersection of the north-south, east-west and inscribed circle.
- This is useful for fitting a roundabout to the existing conditions.

Surface Method

- Create a plane surface using MicroStation commands
- These will accommodate all 4 legs

Calculate Intersections



Calculations

- Calculate slopes between the N-S and the E-W points on the IC
- Adjust to create a plane
- Fit to field conditions

Engineering Decisions

- Raise or lower the plane surface
- Rotate the axis
- Adjust the slope
- Keep in mind **constructability!**

Create Block Surface

- Parallel E-W alignment to outside the limits of the IC (65-75' or so)
- Parallel N-S alignment to outside the limits of the IC (60-70' or so)
- This shape is the outer limits of the plane surface

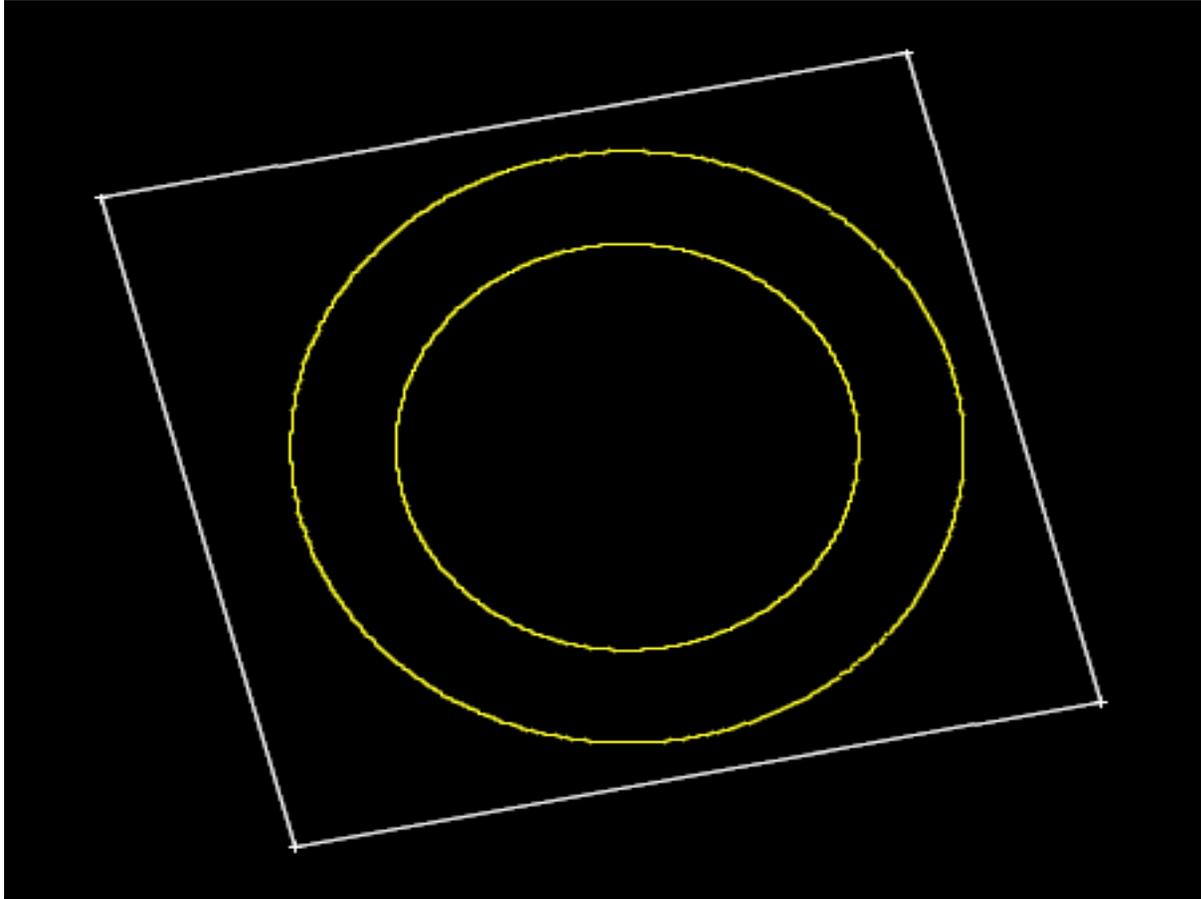
Surface

- Project adjusted elevations at the IC
- Calculate out to the intersection of alignment and outer box
- Store corner points to geometry file
- Use **File => Import Surface => From Geometry** command
- Verify slopes

Surface

- Project IC vertical alignment to the plane surface
- This vertical alignment should be true sine wave

Plane Surface



Useful Surface Commands

- Design Surface => Place Feature
- View Surface => Two Point Slope
- Edit Surface => Intersect Features
- View Surface => Single Point => Slope Vector
- View Surface => Single Point => Two Point Slope

Summary

- The Bentley Civil Enhancement Roundabout tool is a great way to generate MicroStation elements and InRoads horizontal geometry
- The 2D geometry can be used to generate a 3D model using a variety of work flows, including Cogo tools or creating a plane surface

Questions?
