

Bentleyuser.dk Årsmøde 2011 Nordic Civil 2011

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

X11

New Tools: Creating Roundabout Libraries

Presenter: Ian Rosam – Product Manager

Bentley Systems, Incorporated 685 Stockton Drive Exton, PA 19341 www.bentley.com Workshop: New Tools: Creating Roundabout Libraries

TOPICS COVERED IN THIS WORKSHOP

Some Common Roundabout Terms Creating and Editing a Roundabout library DGN Placing a Roundabout on Layout Geometry Editing the roundabout Design Analyzing the Roundabout Design

Lesson-1: Common Roundabout Terms

LESSON OBJECTIVE:

In this lesson, the user will be introduced to some common roundabout terms. Please note that any discussions about dimensions in this workshop are based on the U.S. Department of Transportation's, Federal Highway Administration publication number FHWA-RD-00-067," Roundabouts: An Informational Guide".

The following are some common terms used when designing a roundabout.

Splitter Island: A traffic island that is used to separate traffic entering and leaving the roundabout

Approach Width: The width of the approaching roadway travel lanes

Departure Width: The width of the departing roadway travel lanes

Inscribed Circle Diameter: The diameter of the roundabout as measured from the extreme outside edge of the circular travel way excluding any truck aprons

Entry Width: Width of the lanes entering the roundabout at the intersection point of the inside edge of the approaching travel lanes and the Inscribed Circle Diameter. This measurement is perpendicular to the travel lane.

Exit Width: Width of the lanes exiting the roundabout at the intersection point of the inside edge of the Departure travel lanes and the Inscribed Circle Diameter. This measurement is perpendicular to the travel lane.

Entry radius: Is the outside radius that used to make a smooth connection from the approach lane to the inscribed circle diameter. The end of this radius is also the start of the Exit Radius.

Exit radius: Is the outside radius that used to make a smooth connection from the departure lane to the inscribed circle diameter. The end of this radius is also the end of the Entry Radius.

Central Island: The circular island in the middle of the roundabout



Apron: Area set off from the roundabout design so large trucks can roll over the area but this area is not used in normal traffic flow.

The final dimensions of the roundabout are based on the approach speeds, the desirable speed of traffic in the roundabout and the type of traffic project to use the roundabout. Vehicle path studies are an important part of the process of the design and all the approaches and departures should be check.



It is not the intent of this workshop to teach design and analysis but to show you how the tools are used.

Lesson-2: Creating Roundabout Library DGN

LESSON OBJECTIVE:

In this lesson, the user will create a new DGN file. Place a default EU Roundabout in the DGN and then edit various values within the Library DGN.

Exercise: CREATING A New DGN LIBRARY FILE

This exercise will guide you through the steps to get started

1. Start InRoads: Start > All Programs > Bentley > InRoads Group V8i (SELECTseries 2) > InRoads

-Or-

Start MX: Start > All Programs > Bentley > Bentley MXRoad Suite V8i (SELECTseries 2) > Bentley Bentley MXRoad Suite

-Or-

Start GEOPAC: Start > All Programs > Bentley > Bentley GEOPAC Suite V8i (SELECTseries 2) > Bentley GEOPAC Civil Engineering Suite

2. Navigate to the workshop data folder.

...\X03-New Tools-Creating Roundabout Libraries\DATA

- 3. Select the *New* icon from the MicroStation Manager.
- 4. Select Browse and locate the Seed file for the Roundabout Library DGN.
 - "...\X03-New Tools-Creating Roundabout Libraries\DATA\Metric.dgn"

New - C:\2011 Nordic & Swedish\X11 - New Tools-Creating Roundabout Libraries\Data						
Save in:	🗼 Data	•	G 🤌 🛤	•		3 🗈
Pa	Name	~		Date modified	Туре	Size
and the second second	👢 Finished			28/10/2011 10:25	File folder	
Recent Places	👢 Lesson 3			28/10/2011 10:25	File folder	
	👢 Lesson 4			28/10/2011 10:25	File folder	
·	👢 Lesson 5			28/10/2011 10:25	File folder	
Desktop	👢 Lesson 6			28/10/2011 10:25	File folder	
	赵 Design.dgn			20/10/2011 17:45	Bentley MicroStation De	169 KB
	📕 Metric Seed.d	lgn		28/10/2011 10:30	Bentley MicroStation De	152 KB
Libraries						
Computer						
Network						
	File name:	Metric Roundabout.dgn			•	Save
	Save as type:	MicroStation DGN Files (*.dgn)			•	Cancel
	Seed: C:\2011 Nordic & Swedish\X11 - New Tools-Creating Roundabout Libraries\Data\Metric dgn Browse					

- 5. Key-in the name of the Roundabout Library DGN file. "Metric Roundabout.dgn"
- 6. Select Save from the "New" dialog

File Open - C:\2	011 Nordic & Swee	dish\X11 - New Tools-Creating Rou	indabout Lib	raries\Data\				×
Look in:	👢 Data	-	G 👂 🖡	▼	"L 🔄	۲		
e.	Name	*		Date modified				
~>>	🐌 Finished			28/10/2011 10:2	5	E.		
Recent Places	👢 Lesson 3			28/10/2011 10:2	5	E.		
	👢 Lesson 4			28/10/2011 10:2	5	-F		
	📙 Lesson 5			28/10/2011 10:2	5	-F		
Desktop	👢 Lesson 6			28/10/2011 10:2	5	-F		
	📕 Design.dgn			20/10/2011 17:4	5	E.		
	📕 Metric.dgn			28/10/2011 10:3	0	I.		
Libraries								
							,	
Computer								
Network	•	111				4		
	File name:	Metric roundabout.dgn		-	Open		User:	untitled •
	Files of type:	CAD Files (*.dgn;*.dwg;*.dxf)		•	Cancel		Project	untitled -
		Open as read-only			Options		Interface:	default 🔻

- 7. Select the newly created file and Open.
- 8. On the MicroStation menu select Tools > Roundabouts > Default Roundabouts > European Union

🗮 Metric Roundabout.dgn [3D - V8 DGN] - Po	*									
File Edit Element Settings Tools	Attributes	val	uation ¹	Design	Drainage	Draft	ting I	Power InRoad	s Tools	Uti
	Primary				- 🖻 -	-		🖂 🗸 🥪 🤻	- 🤗 🗸	-5
	Standard			P 🗳			~~~		- <u>-</u>	M
No Feature Definition	Main									_
*n	 Tasks									
	Activate Map	\vdash								
View 1 - Top, Default	Animation •									
l 😤 🔄 ▼ 🥥 🌩 ▼ 📕 🍕 🍳 🕄 🎛 🚓 👌 👂	Base Geometry									
	Cells •									
	Civil Accudraw									
and the state of the second of the second	Christiansking	-	and a	×	a series of	~	h	مىسىنى 4	-	11. A
	and the second second second	1					χ			
	Clash Detection									
	Coordinate Systems									
	Curves •									
	Custom Linestyles									
	Multi-lines									
	Parametrics									
	Patterning									
	Point Cloud									
	Project Navigation									
	Properties •	¢	Open Lit	brary Bro	wser					
	Raster •	۳ 3	Replace	Approad	:h					
	Redline	٥	Entry Pat	th Curvat	ure Analysis	-	Aust	ralian		
	Reference	•	Civil Me	ssage Ce	nter		Euro	pean Union		
	Roundabouts		Default	Roundab	outs	→ *	e Unit	ed Kingdom		
	Madi 🗸 🔰									

9. Select **Right Hand Side** for Driving Side in the Place Default EU Roundabout toolbox.

V Place Def
Place Default EU 🔺
Driving Side Right Hand Side

10. When prompted to Select Center Point location, place the library roundabout at 0,0,0 via AccuDraw or Key-in.

X 0.0000	Y 0.0000	Z 0.0000	xy=0,0,0	~	표 🗸 🗸
and the second se					

11. Fit the View.

Note: This Roundabout Library DGN is being generated from the EU rule based model. All roundabouts placed using this command are metric and initially contain no feature styles.

12. Select Settings > View Attributes and toggle off the ACS Triad.



13. Dismiss the View Attributes tool

EXERCISE: EDITING THE ROUNDABOUT LIBRARY DGN FILE

This exercise will guide you through process of standardizing a roundabout library DGN. It will show you how to change the design settings of an approach. Then duplicate the edited approach to each side of the Roundabout.

1. Toggle off the Graphic Group Lock is it is on.



2. Put MicroStation in Element Selection mode.



3. Zoom into the Circulatory Area and select the Inscribed Circle Diameter of the roundabout to inspect it.

4. Change the Radius value to 35m. Simply select the manipulator value and an in-place editor will appear where a new value can be supplied.



Note: You can modify the value and if you don't like it use 'CTRL Z' to undo

- 5. Click in a clear area to release the Inscribed Circle Diameter graphic.
- 6. Click on the inner circle of the Central Island.

7. Select Element Information icon



- 8. Click Roundabout RA and rename to 'Basic Metric'
- 9. Click on the + sign next to Roundabout Basic Metric
- 10. Select Circulatory Area
- 11. Expand Transition Offset Rule
- 12. Confirm the following within this dialog (they are contained with the rules):

Circulatory Crown Offset = 4

Subsiduary Crown Offset = 4

Circulatory Width =8

Over Run Width =1



- 13. Select the Approach on the right side of the roundabout then right click.
- 14. Edit the Median Width to 0.5m either side.
- 15. Set the Approach to Length and limit the geometric construction length to 100m.



Note. The Element Selection tree view aids us in navigation by allowing single or multiple selection of components

16. Expand the branch for the approach by selecting the [+] sign. Navigate to and expand the entry and exit lanes, setting a lane width to 3.5.

Element Information
Selection> Approach Selection> Hedian Entry Lanes Selection Selection Entry Lanes Selection Exit Lanes Selection Anality Selection Approach Selection Selection
Transition Offset Rule
Width 3.5000

Element Information							
Selection>							
📄 🛒 Approach							
E Complex Elemen 🗄	nt: Road Centerline1						
🕀 💳 Median							
Entry Lanes							
Exit Lanes							
E S Complex Eler	nont Poodwoy (Edgo)8						
	nent Roadway (Euge)0						
	nent Roadway (Channel)3						
	nene riodaway (onannei)o						
Exit	~						
Offset	4.5000						
Back Radius	100.0000						
Front Radius	25.0000						
Entry	~						
Offset	4.5000						
Back Radius	100.0000						
Erent Dediue	25.0000						
Front Radius							
Construction	^						
Construction	26.0000						
Construction Length Offset	26.0000 0.5000						
Construction Length Offset Entrance Side Base Width	26.0000 0.5000 5.0000						
Construction Length Offset Entrance Side Base Width Exit Side Base Width	26.0000 0.5000 5.0000 1.5000						

17. Select the Deflection Area and set values as shown below.

Note. All the values can be modified to suit regional design requirements.

Image: Selection> Image: Selection> <							
Exit	*						
Type Corner Radius Front Offset Back Offset	Type Offset Corner Radius 0.5000 Front Offset 0.5000 Back Offset 0.5000						
Entry	^						
Type Corner Radius Front Offset Back Offset	Offset 0.5000 0.5000 0.5000 0.5000						
Front	*						
Type Entry Offset Exit Offset	Offset 1.0000 1.0000						
Back	^						

18. Select the "child" Island contained in the deflection area and confirm the construction values:

- 19. Select the Flare (radius return). Set the following:
 - ① Element Information Selection> Serectain
 A Serecain
 A Serecain
 A Serecain
 A Serectain
 A Serectain
 Deflection Area ± ⊆ Complex Element Roadway (Channel)16 Flare * Approach Radius 75.0000 Entrance Radius 15.0000 Linear variation 15.0000 Offset method Exit Radius Departure Radius 75.0000 Theoretical Entrance Wit 4.5000 Theoretical Exit Width 5.0000 Achieved Entrance Widt 4.0174 Achieved Exit Width 3.9489 Effective Entry Flare Ler 19.3274
 Entry Angle
 16*16*46

 Sharpness of Entry Flare
 -0.0214

 Maximum Entry Angle
 60*0'0"

 Minimum Entry Angle
 10*0'0"
 16°16'46"
- 20. Dismiss the Element Information tool.

EXERCISE: DEFINING FEATURES

This exercise will guide you through process of adding features to the library DGN.

1. From the Task Menu, select Civil Geometry > Set Feature Definition.

Tasks		
💁 Tasks 🔹		
1 2.3.4.5.2.1 1 1		
🗣 Roundabouts 🔹 🖌		
∠ Civil Geometry		
Q I Z I Z 🖗 🧐 ↔		
W/XXX	🖇 Set Feature	X
ECL2D3	Feature	*
R	Feature Definition EOP	•
Tarran	Name Prefix EOP	

2. Select EOP as the active feature definition.

You are now in a prompt to pick the elements, so we now need to work on just one approach as we can then copy that approach to others

3. Select the indicated features that fit the EOP description to define their features.





4. Select the indicated features that fit the ESHO description to define their features.

5. Finally for this short exercise select the approach centerline and roundabout crown line as the feature Proposed Horizontal Alignment.

Exercise: DUPLICATING THE EDITS - COPY APPROACH

This exercise will guide you through process of standardizing the library DGN from approach modifications we have already made by duplicating to each side of the Roundabout.

1. From the Task Menu, select Roundabouts > Replace Approach.

🔎 Ta	sks	
🔁 Ta	asks	
1	, , , _, , _, , _, _, , _, , _, ,	
∲ R	oundabouts	
Q 🗳	¢ =13 🗇	
ζc	ivil Geometry	*
M.	atar quisition	A Contraction of the local data

- 2. Select the Approach we edited in the previous steps and then select the approach at the top of the roundabout as the approach to replace.
- 3. Continue this task and replace the remaining two approaches.



Lesson-3: Placing a Roundabout

LESSON OBJECTIVE:

In this lesson, the user will add the new Roundabout Library DGN file to the Civil Library Browser. Place the attached Roundabout in the design DGN.

Exercise: Adding a Library DGN to the Browser

This exercise will guide you through process of adding the library DGN. You will invoke the Civil Library Browser and then add the DGN file to the list of available roundabout(s).

- 1. Open "Design.dgn" File > Open...
- 2. Open the Library Browser by selecting the icon from the Roundabouts Task Menu.



3. Within the Library Browser select Add Library.



4. Browse to the location of the roundabout Library DGN created in the previous lesson. Attach the file: *"Metric Roundabout.dgn"*



It should now be displayed in the browser folder leaf view.

🐂 Roundabout Library Browser	
i 🔤 × 🏘 🔄 🖆 🕡 🔳 🔇	٦
Example Right Hand Drive US Style Survey Foot Roundabout dgn Example Right Hand Drive US Style International Foot Roundabout dgn Example Right Hand Drive Italian Style Roundabouts Library dgn Example Right Hand Drive French Style Roundabouts Library dgn Example Right Hand Drive English Style Roundabouts Library dgn Example Left Hand Drive Australian Style Roundabouts Library dgn Example Left Hand Drive Australian Style Roundabouts Library dgn Metric Roundabout dgn Approach1 Approach2 Approach4	
Roundabout	
Circulatory Area	
Transition Offset Rule	-
Arc Rule	•

EXERCISE: PLACING A ROUNDABOUT ON REFERENCE GEOMETRY

This exercise will guide you through process of placing the library roundabout DGN in your design.

- 1. Select the Roundabout model from the library file just opened. The Place Roundabout will be activated.
- 2. Select the Place Roundabout command:



3. Follow the prompts; select the approaches by selecting the two reference features.



- 4. After both reference features 'alignments' have been selected, use the Right mouse button, and then identify the Center Point of the Roundabout as the intersection of the two reference elements.
- Note the centre point can be any XY location and does not need to be located on the reference elements.



5. Left Mouse button accepts the location.



Lesson-4: Editing a Roundabout

LESSON OBJECTIVE:

In this lesson, the user will review and edit the roundabout to correct an approach error. Then make some edits to the approaches.

EXERCISE: CORRECTING ERRORS AND PERFORMING EDITS.

1. Open Design.dgn in Lesson 4

Note the roundabout that has been placed in this drawing has an error where geometry can't be constructed. We need to review the error and adjust the roundabouts geometry.



2. Select the Civil Message Center to expose the errors in the rule based geometric construction.

🗮 Design.dgn [3D - V8 DGN] - Power InRoa	id:	A		
File Edit Element Settings Tools	s 🗸	Attributes		valuation Design Drainage 👔
🥪 🕶 Default 🔹 🚺 0	/	Primary Standard		
<u>*</u>		 Main		Definition
Tasks 7 🛪 🗙	1	Tasks)
🔊 Tasks 🔹	c 😡	Activate Map		9 99 E E E V & G 🔰
		Animation	►	
		Base Geometry	►	
▼ Roundabouts		Cells	►	
Q ♀] ₹ ♥		Civil Accudraw	►	\ 🔪 🐳
∠ Civil Geometry 🔹		Change Tracking	►	
🕅 Data Acquisition 👻		Civil Geometry	•	🗈 Design Standards Bar 🛛
Print Preparation		Clash Detection	►	Z Features Toggle Bar
💙 Drawing 😽		Coordinate Systems	►	Civil Message Center
Power InRoads Commands		Curves	►	Tools 🕨 🔰
🖉 Civil Workflows 🗳		Custom Linestyles	►	Horizontal Geometry 🕨 🖌
Solids Modeling		<u>D</u> atabase	•	
Surface Modeling	Ж	Data Acquisition		
Surface Mobelling	,	principant of	1	and a start of the

3. Click on MicroStation, Warnings and Messages in the Civil Message Center to turn them off, this will leave on just the Errors.



4. These errors are caused by the inability of approach deflection area to be constructed based on the baseline geometry. These errors can be corrected by reviewing the approach flare on the right side of the roundabout. Use the Element Information dialog and adjust the departure radius to 75m.



Note : Remember changes made to an approach can be easily replicated onto other approaches using the Replace Approach command.

Try editing the base alignments to see what happens - you can always undo

Lesson -5: Adding lanes to an Approach

LESSON OBJECTIVE:

In this lesson, the user will edit the roundabout approach to add auxiliary lanes along with a taper.

Exercise: Adding an Auxiliary Lane

This exercise will guide you through process of adding lanes to an approach. You are instructed to add the lane, then set the lane property as a widening lane and finally set the taper type and edit the appropriate values.

- 1. Select the approach at the top of the Roundabout.
- 2. Bring up the Element Information dialog if you have dismissed it. Expand the Approach tree to expose the Entry Lanes. This is where we will add a dedicated right turn lane.
- 3. Select the Entry Lanes and set the Number Of Lanes to 2.
- 4. Set the Widening property to Yes.



Note the information icon at the approach entry indicating something needs to be looked at;

- Civil Message Center Hide All # 50 MicroStation © 0 Errors © 0 Warnings © 1 Message Element Message Description © Create Flare Geometry Information Entrance width needs to be greater than or equal to the total lane width.
- 5. In the Civil Message Center, toggle on Message

6. Check the Civil Message Center for this informational message. An edit will need to be performed to correct this issue.

7. Now the auxiliary lane values need to be 'hardened'. Select the lane, then and expand the Widening Rule.

U Element Information		
	ment Prop_Horiz Alignment3 ex Element EOP11 ea	
Transition Offset Rule		
Width	3.5000	
Widening	^	
Start From	Previous Lane	
Distance from Yield Line	50.0000	
Spiral Method	Linear by Length	
Length	25.0000	

- 8. Correct the issues with the Information dialog.
- 9. Select the approach Flare and correct the values to

② Element Information		٢
Selection> → Approach → E. Complex Elen → Median → Entry Lanes → Exit Lanes → Deflection Are → Flare	nent Prop_Horiz Alignmen	t3
Flare		*
Approach Radius Entrance Radius Offset method Exit Radius Departure Radius Theoretical Entrance Wir Achieved Entrance Wirt Achieved Entrance Wirt Achieved Exit Wirth Effective Entry Flare Ler Entry Angle Sharpness of Entry Flare Maximum Entry Angle Minimum Entry Angle	100.0000 25.0000 Linear variation 15.0000 75.0000 3.5000 6.4068 6.0776 19.6018 32°19'37" -0.0199 60'0'0" 10'0'0"	

10. Edit the Theoretical Entrance Width to 7m.

Note the computed entrance width value relative to the theoretical value. This requires correction.

11. The computed value is controlled by a number of factors including the "theoretical value" edited in the previous step. Select the Deflection Area and edit the offset value and front radius at the entrance as shown below: On completion check the deflection area to see the resulting achieved width compared to theoretical.



12. Now duplicate the top approach to the bottom of the roundabout.



Lesson -6: Design Analysis and Layout Evaluation

LESSON OBJECTIVE:

In this lesson, the user will edit perform design analysis using the Entry Path Curvature command.

EXERCISE: ADDING AN ENTRY PATH CURVATURE

This exercise will guide you through process of adding Entry Path Curvature to an approach and analyze the results.

1. In MicroStation, select Settings > Design File > Civil Formatting

Design File Settings	124	
Category Active Angle Active Scale Angle Readout Axis Civil Formatting Color Data Acquisition Element Attributes Fence Grid Isometric Locks Snaps Stream Views Working Units	EPC Settings First Turn Color [255,0,0] Second Turn Color [0,255,0] Third Turn Color [0,0,255] Measurement M B-Spline Entry Distance 50,0000 Entry Offset 0.5000 Offset from 0.2500 Exit Offset from 0.2500 Exit Offset from 0.2500 Exit Offset Exit Offset 0.0000 Vehicle Width 2.0000 Maximum Appro 100.0000 Crossfall Design Speed UF KPH Focus Item Description Select category to view. Select category to view.	Cancel

- 2. Set and review the default preferences as shown above and click OK
- 3. In the Roundabouts task bar, select the Entry Path Curvature Analysis command or using the MicroStation menu Tools > Roundabouts > Entry Path Curvature Analysis



- 4. Set the Entry Path Curvature Analysis tool Measure Method to B-Spline
- 5. When prompted to identify the approach, select the left side approach and then select the top approach.

The analysis will complete but you should notice some warning's in the display that need to be reviewed. Open the Civil Message Center to review the resulting warnings.



6. To correct the warnings, select the flare at the top approach by selecting it then right clicking and edit the radii to 40m to modify the design. (alternatively this could be carried out in Element Information)



7. Select The error: "Entry Radius is too large" in the Message Centr. This indicates a fundamental flaw in our design. We have made the entrances to the roundabout so flat that the entry speed is too high and thus dangerous because it encourages motorist to not stop. This issue is probably exacerbated by the skewed approach alignment. Resolving these warnings requires adjustment of multiple values to attain optimum entry path and could be achieved by adjusting the entry lane as follows.

② Element Information		X
Selection>		*
Approach		
⊞ ≥ Complex Eleme	nt: Prop_Horiz Alignment4	
Entry Longo		
Entry Lanes		=
Deflection Area		
Island		
Arc: ESH015	5	
🛓 도 Complex Ele	ment: ESHO16	
🛓 🗉 Complex Ele	ment ESH017	-
<u> </u>		
Exit		^
Offset	4.5000	
Back Radius	60.0000	
Front Radius	25.0000	
Entry		*
Offset	4.5000	
Back Radius	60.0000	
Front Radius	25.0000	
Construction		*
Length	26.0000	
Offset	0.5000	
Entrance Side Base Width	4.0000	
Exit Side Base Width	1.5000	
Listely/Deep	4 7070	

8. Select the deflection area of the left approach and change to the following:

- 9. These changes resolve the "Entry Radius is too large error". They do not completely resolve all the errors but gets the entrance radius and exit radius to within a tolerance which may be acceptable.
- 10. Select the Entry Path Analysis to review the results of the geometric changes.



Additional Analysis can be carried out on the other approaches / exits to review speeds and geometry

Workshop: New Tools: Creating Roundabout Libraries

Conclusion

This workshop has taken you through a preliminary introduction to the following concepts in utilizing the Bentley Civil Roundabouts toolset:

Creating and Editing a New roundabout library DGN file Attaching this roundabout "template" to the Civil Library Brower Placing the Library roundabout in the design Performing edits to the roundabout to correct errors in the "Rule Based" construction Added auxiliary lanes for right turn only movement Performed a general analysis of the layout and performed some minor modifications in an attempt to improve the design.