

# Bentleyuser.dk Årsmøde 2012 Nordic Civil 2012

## **Bentley Civil Workshop**

**X09 Power Railtrack** 

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## Preface

The bulk of this workshop will be on turnouts and turnout advanced topics. You will learn how to create new turnouts in the turnout library. In addition, you will learn the differences between the *Swiss* and *German* rules for turnout bending. What are standard sleeper sets and how are they used. You will learn how to create a vertical alignment though a crossover. Also, we will investigate several obscure project options related to turnouts and how to use them. In addition, since regression analysis is such an important topic, we will learn how to use single element regression to create multiple alignments simultaneously.

In this workshop, we will use Power Rail Track V8i 08.11.07.594 or later.

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.

The workshop guide is yours to take with you. If you don't finish all the exercises, or just want to work with the dataset upon return to your office, the datasets (both initial and completed files) are provided on the Conference DVD. Many workshops will also have videos of all exercises on the DVD.

*Note* Prerequisite Knowledge Level: Participant should have a basic understanding of rail design and has used Bentley Rail Track or Bentley Power Rail Track.

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## **OVERVIEW**

Together

THE BENTLEY USER CONFERENCE

All users of *Power Rail Track* should be well versed in the functionality for the creation of horizontal alignments from regression points. A typical workflow is as followings:

- Use File > Text Import Wizard and import regression points as cogo points
- Use Horizontal Regression > Add Horizontal Regression Point and create a horizontal regression buffer from the cogo points by applying selection and sorting criteria
- Use Horizontal Regression > Curvature Diagram and review the regression points and remove questionable data
- Use Horizontal Regression > Edit / Review Horizontal Regression Points and the Select & Regress option to single element regress the obvious lines and circular arcs
- Use Horizontal Elements > Define Spiral and fill in the gaps with spirals
- Finally, use Horizontal Regression > Multiple Element Regression Analysis and fine tune the geometry

The result is a horizontal alignment, but sometimes the user has more than one track and wishes to create parallel tracks. In this lesson, we will use regression data from two tracks and create both tracks simultaneously. We will have the following results:

- Tangents will be parallel
- Circular arcs will be parallel
- Transition spirals will be in filled
- The offset will not be constant from one element to another

#### **PROJECT DESCRIPTION**

In this workshop, we will simultaneously construct two parallel horizontal alignments using single element regression.

### **GETTING STARTED**

In this lesson, we load the data, view the regression points and then create the two tracks using single element regression. But first, create a **Project Default** and load the .xin and the turnout.txt that is included in the workshop's data/ folder.



#### Exercise: Using Horizontal Regression Analysis

Exercise Objective: Simultaneously create multiple horizontal alignments from regression points

- 1. Open the file *Chapter 1.dgn*.
- 2. Open the file *Regression.alg.*
- 3. Use Horizontal Regression > View Horizontal Regression Points and display each track's regression points

Wiew Horizontal R	egression	Points			
Data:					Apply
Object	Prefix	Suffix	Precision	Name	
Fixed Symbol					Close
Fixed Text					Preferences
Normal Symbol					
Normal Text					<u>H</u> elp
Ignored Symbol					
Ignored Text					
Other Symbol					
Other Text					
Unacceptable Sym	ibol				
Unacceptable Text	t i				
Sorted Line					
Name					
Horizontal Slew	h=	mm	0		
Vertical Slew	v=	mm	0		
Slew Indicator					
Acceptable Slew:	0.1000		Annotate a	as: 🔘 Single I	Line
Scale:	1.0000000	0		Multiple	Lines
Mirror Right to Left			Annotate in	n: Millimeters	•
Symbology from Poi	nt Style				

4. Use **Horizontal Regression > Curvature Diagram** and display a curvature diagram for the active alignment *Track 1* 

Regression Po	pints:					Close
Name	Northing	Easting	Include in An	Status	-	Select Only
T1-1743	118494.3840	265973.4170	No	Normal		<u>Select Only</u>
T1-1742	118505.2170	265987.9850	No	Normal		Select & Regres
T1-1741	118517.2220	266004.1400	No	Normal		
T1-1740	118528.6940	266019.5840	No	Normal		Quick
T1-1739	118540.1320	266034.9790	No	Normal		Report
T1-1738	118551.0070	266049.6070	No	Normal		
T1-1737	118562.3430	266064.8660	No	Normal		<u>H</u> elp
T1-1736	118568.1980	266072.7490	No	Normal		
T1-1735	118577.0420	266084.6430	No	Normal		
T1-1734	118588.3010	266099.7930	No	Normal		
T1-1733	118599.9410	266115.4700	No	Normal	Ŧ	

5. Invoke the Horizontal Regression > Edit / Review Horizontal Regression Points.

In the Regression Points list view, do a right click and you will see the typical popup menu with *Insert, Edit* and *Delete*. Dismiss the pop-up. Now, hold down <Ctrl> and again do a right click. The menu is now different! You now have the following:

- Select All
- Select None
- Delete Last Element(s)
- Add Transition Spirals
- A list of all horizontal alignments that have horizontal regression points

*Note* The software will use the active horizontal alignment and any other related alignments that you select from the pop-up. Remember we will only use two in this exercise, but the software will use as many as you wish.

- 6. From the pop-up, right click *Track 2*
- 7. We will now use *Select & Regress* and select the tangents and circular arcs from the curvature diagram. As always, follow the prompts
  - i. Identify first point
  - ii. Identify second point
  - iii. Accept / Reject
- 8. Before exiting the command, let's again do a <Ctrl> right click and select the *Add Transition Spirals*. Now we have two alignments that have regressed tangents / circular arcs and we have filled in the gaps with spirals.

*Note* The software will use the default spiral type as defined in **File > Project Options**.

- 9. To review the results, go to **Horizontal Regression > Slew Diagram** and display a slew diagram for the active alignment
- 10. Let's use a tool that you may not be familiar with and review the track centers. Go to **Drafting > ProRail Extensions > View Track Centers** command. From the dialog
  - Set Track 1 as the Primary Alignment
  - Set Track 2 as the Secondary Alignment
  - Define an interval of 25 meters

Primary Alignment:	Track	c1	•	÷	Apply
Stationing					Interactive
Start:	0+00	0.0000		-	
Cham				+	Close
Stop:	0+00	0+000.0000			Preferences
Interval:	25.00	25.0000			Fielelences
Secondary Alignment:	Track	: 2	•	+	Help
Data:				_	
Object	Prefix	Suffix	Precision	Nam	ne
Track Spacing					
Track Distance		m	0.123		

*Note* If the **Drafting > ProRail Extensions** commands do not show up then go to **Rail Track Tools > Application Addins** and select it.

11. Click Apply and review the results.

*Note* The tracks are parallel, but the element's offset vary from element to element.

## **CHAPTER SUMMARY**

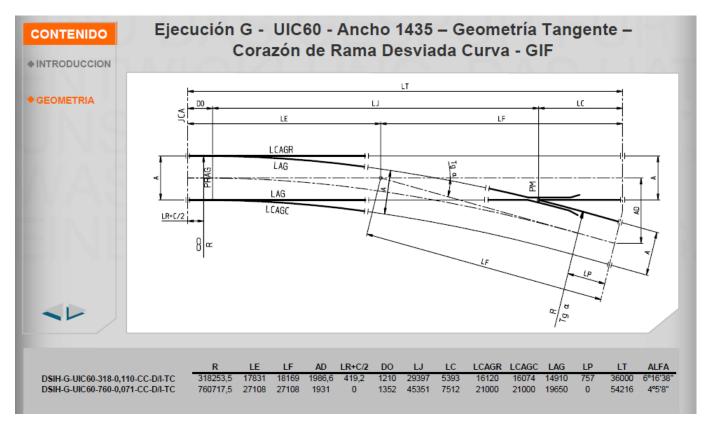
In this chapter, we have learned how to use single element regression analysis to simultaneously create multiple horizontal alignments with lines, circular arcs and transition spirals.



## **Chapter 2: Creating the Turnout Library**

## **OVERVIEW**

All users of *Power Rail Track* should be well versed in the functionality for the creation of horizontal alignments with turnouts. You may have used a turnout library that was provided by a client or another organization. But what if you need to add a new turnout? How do you go about defining a new turnout? Where do you start? Well the first place to start is from a set of drawings. Most of the time, you will find a schematic that provides the required information.



An example from a Spanish vendor

The standards are generally used by fabricators and constructors. As such they are sufficient, but the standards are not in a form that is easily digested by **Power Rail Track**. In this lesson, we will learn how to transform various unrelated standards and to create a turnout library within **Power Rail Track**.

### **PROJECT DESCRIPTION**

In this lesson, we will create a simple single branch turnout.

## **GETTING STARTED**

In this lesson, we will create a new single branch turnout in the current turnout library.



#### Exercise: Creating a new single branch turnout in the turnout library

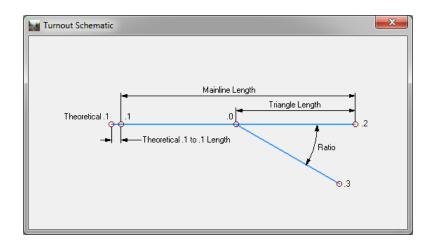
Exercise Objective: Understand how to create a new single branch turnout in the turnout library

#### Procedure:

- 1. Open the file *Chapter 2.dgn*.
- 2. Go to Turnouts > Turnout Library

<u>N</u> ame:	e5412001	85		<ul> <li>Apply</li> </ul>	
Description:	EW 54 - 1	EW 54 - 1200 - 1:18,5 Clos			
Туре:	Single			▼ Ne <u>w</u>	
Theoretical .1 to .1 Length:	0.000000		0.000000		
Length Along Mainline:	64.817600	)	0.000000	<u><u>C</u>opy</u>	
Tria <u>ng</u> le Length:	32.408800	)	0.000000	Delete	
Define By:	Ratio		O Angle	Rena <u>m</u> e	
Ratio at .0:	18.50000	)	0.000000	Verify	
Angle at .0:	03^05'38.	.6"	00^00'00.0	" Schematic	
Ratio at .1:	0.000000		0.000000	Help	
Angle at .1:	00^00'00	.0"	00^00'00.0	"	
Linear Slee <u>p</u> er Set:	0.000000		0.000000		
Circ <u>u</u> lar Sleeper Set:	9.900000		0.000000		
Distance to Last Long Sleeper:	9.900000		0.000000		
Minimum <u>B</u> ending Radius:	440.00000	00			
Bending Method:	Oefault		© <u>G</u> erman		
Maintain Length Along Inne	r Rail (from .	1 to IP)			
Maintain Length Along Oute	er Rail	Last B	ranch Elemen	t Always Unbent	
Branch Geometry Show: (a) <u>1</u> st Branch (C)	2nd Branch	h			
Element Type Length		Starting F	Radius	Stopping Radius	
		1200.000		1200.000000	

3. Click the *Schematic* button



Let's understand what is displayed and what it all means.

Obviously the *Name* and *Description* allows the user to provide textual information about a turnout. The name will ultimately be assigned to a turnout's style when an instance of the turnout is created in a **Power Rail Track** geometry project. The description will be assigned as the turnout's description.

*Note* Once a turnout name has been defined and used within a geometry project, you should not rename or delete that turnout.

The type of turnout is whether the turnout is a *single* branch, a *double* branch, a *single* or *double slip* or a *diamond crossing*. The most common type is single.

Note that we start to see various numeric data, such as *Length Along Mainline*, *Triangle Length* and *Ratio*. Refer to the Schematic for how these numeric values relate to .1, .0, .2 and .3

Let's skip down to the Branch Geometry group box. We see a list-view with element type, length and starting and ending radii. This allows the user to define each branch element as a linear, a circular arc or a spiral.

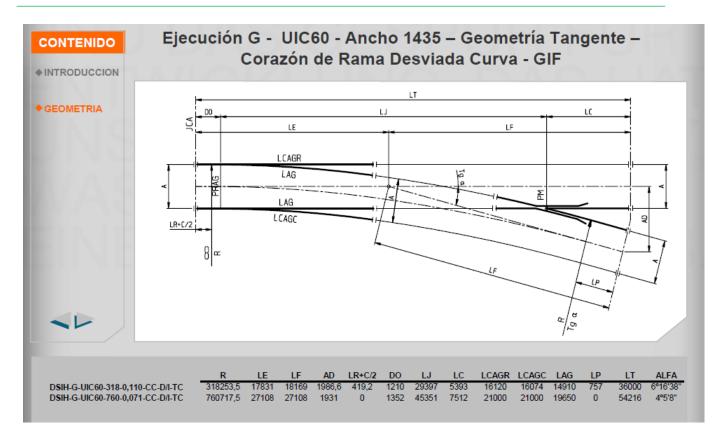
*Note* **Power Rail Track** supports various types of spirals. However, in the creation of turnouts the software will place with either clothoids or cubic parabolas. Cubic parabolas will be used only if the default spiral type is such in **Project Options**.

So when you start to collect the data for a new turnout, you need to look for the numeric data that is required on the dialog.

Let's look at various turnout standards. Open the Windows Explorer and navigate to the various .pdf's that are in the Chapter 2 folder.

It should be clear that various vendors / organizations provide the required numeric data in various forms. So let's try to use it and create a new turnout.

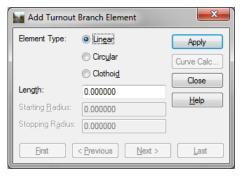
Using the following let's create a new turnout:



4. Click the New button and define the following in the dialog and then click OK

New Tur	nout		×
Туре:	Single	•	ОК
<u>N</u> ame:	UIC60-760-0,071	Cancel	
Description:			Preferences
Default Bend	ling Method: ) Default	🔘 Geman	<u>H</u> elp

- 5. On the **Turnout Library** dialog select the turnout that we just created and enter the following information
  - a. Theoretical .1 Length is 0.0
  - b. Mainline Length as 54.216
  - c. Triangle Length as 27.108
  - d. Ratio is 4 05 08 (switch from ratio to angle)
- 6. Now the branch elements. Right click in the branch geometry list-view and select *Add* to invoke the **Add Turnout Branch Elements** dialog.



7. We know we have a circular arc and we know the radius, but we don't know the circular arc length. But we do know the delta. So click the **Curve Calc** and define the radius as *760.0* and the delta as *4 05 08* and *Compute* and click *OK*.

*Note* The radius on the drawings is 760.7175 meters, which is measured to the outside rail. We want the centerline, so we need to adjust for half gauge.

8. On the Add Turnout Branch Element dialog we should have

Add Turnout I	Branch Element	×
Element Type:	<ul> <li>Lingar</li> <li>Circular</li> <li>Clothoid</li> </ul>	Apply Curve Calc
Len <u>gt</u> h: Starting <u>R</u> adius:	54.192861 760.000000	Llose Help
Stopping R <u>a</u> dius:	760.000000	]
<u>F</u> irst	< <u>P</u> revious <u>N</u> ext >	Last

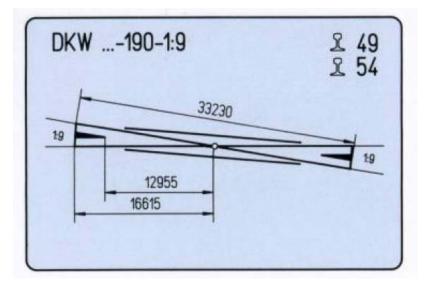
- 12. Click Apply to add the element
- 13. Click Close on the Add Turnout Branch Element dialog
- 14. On the **Turnout Library** dialog, you should see the following:

Turnout Library					×
<u>N</u> ame:	UIC60-760	0-0,071		-	Apply
Description:				Close	
Туре:	Single			-	New
Theoretical .1 to .1 Length:	1.352000		0.000000		
Length Along Mainline:	52.864000	)	0.000000		<u>C</u> opy
Tria <u>ng</u> le Length:	27.108000	)	0.000000		<u>D</u> elete
Define By:	Ratio		Angle		Rena <u>m</u> e
Ratio at .0:	14.000211	1	0.000000		<u>V</u> erify
Angle at .0:	04^05'08	.00"	00^00'00.0	)0''	Schematic
Ratio at .1:	0.000000		0.000000		Help
Angle at .1:	00^00'00	.00''	00^00'00.0	)0''	<u> </u>
Linear Slee <u>p</u> er Set:	0.000000		0.000000		
Circ <u>u</u> lar Sleeper Set:	0.000000		0.000000		
Distance to Last Long <u>S</u> leeper:	0.000000		0.000000		
Minimum <u>B</u> ending Radius:	0.000000				
Bending Method:	Oefault		© <u>G</u> erman		
🔲 Maintain Length Along Inner	Rail (from .	1 to IP)			
🔲 Maintain Length Along Oute	r Rail	Last B	ranch Elemen	t Always	Unbent
Branch Geometry Show: (a) <u>1</u> st Branch (C)	2nd Branch	h			
Element Type Length		Starting F	Radius	Stoppin	g Radius
Circular 54.192861		760.0000	00	760.000	000

- 15. Click *Apply* to accept this turnout and to add it to the turnout library.
- 16. Click *Close* to exit the command.
  - *Hint* Sometimes, when you click *Apply*, you will get a warning *"Turnout definition is inaccurate!"* You will need to adjust the data to resolve the inaccurate warning. This is where you will need to make an engineering decision. What data is the most important and what data can be changed?

## **GETTING STARTED**

In this lesson, we will create a new double slip turnout in the current turnout library. We will use the DKW54 -190-1:9 defined in *Chapter 2/ db\_weichen\_100dpi.pdf* 



As you can see we have the length along mainline, triangle length, ratio and we know radius from the turnout's name.



#### Exercise: Create a new double slip turnout in the turnout library

Exercise Objective: Understand how to create a new double slip turnout in the turnout library

- 1. We will remain in the same .dgn and .alg for this lesson
- 2. Go to Turnouts > Turnout Library
- 3. Click the New button to invoke the New Turnout dialog

New Turr	nout		×
Туре:	Double Slip	•	ОК
<u>N</u> ame:	DS54-190 1:9		Cancel
Description:			Preferences
Default Bend	ling Method: 💿 Default	🔘 German	Help

- 4. Change the type to Double Slip, enter a name and click OK
- 5. On the **Turnout Library** dialog select the double slip that you just created. Enter the length along mainline, triangle length and ratio for each side of the slip and click *Apply*. You should see the following on the dialog:

<u>N</u> ame:	DS54-190 1:9 👻			Apply	
Descripti <u>o</u> n:				Close	
Туре:	Double Slip		-	New	
Theoretical .1 to .1 Length:	0.000000	0.0000	00		
Length Along Mainline:	33.230000	33.230	000	<u>C</u> opy	
Tria <u>ng</u> le Length:	16.615000	16.615	000	<u>D</u> elete	
Define By:	Ratio	Angle	в	Rename	
Ratio at .0:	9.000000	9.0000	00	<u>V</u> erify	
Angle at .0:	06^20'24.69	" 06^20"	24.69"	Schematic	
Ratio at .1:	0.000000	0.0000	00	Help	
Angle at .1:	00^00'00.00	" 00^00"	00.00"		
Linear Slee <u>p</u> er Set:	0.000000	0.0000	00		
Circ <u>u</u> lar Sleeper Set:	0.000000	0.0000	00		
Distance to Last Long <u>S</u> leeper:	0.000000	0.0000	00		
Minimum <u>B</u> ending Radius:	0.000000				
Bending Method:					
Maintain Length Along Inner	Rail (from .1 t	o IP)			
Maintain Length Along Outer	r Rail	Last Branch Ele	ment Always	Unbent	
Branch Geometry Show: () <u>1</u> st Branch ()	2nd Branch				
	St	arting Radius	Stoppin	g Radius	

- 6. Okay, now we need to define the branch elements for each branch. Make sure that the *1st Branch* is selected and in the list-view click *Add* to invoke the **Add Turnout Branch Element.**
- Again, we need to define element type, length and radii, but in this case we don't really know the element lengths. So let's use the curve calculator and compute what is needed. So click on *Circular* and then click the *Curve Calc*. to invoke the **Curve Calculator dialog**. The following:
- 8. Enter a radius of 190
- 9. Enter a delta of *6 20 24.69*, now you see why I clicked *Apply* in step 5 above. We know the ratio, but the curve calculator does not understand ratio. The curve calculator wants delta as an angle!
- 10. Click Compute

Curve Calculator	
Curve Lock	
Radius:	190.0000
DOC:	30^09'20.42"
Length:	21.0249
Angle:	06^20'24.69"
Chord:	21.0141
Tangent:	10.5232
External:	0.2912
Ordinate:	0.2907
Comp <u>u</u> te: Sim	ple Curve 🔻
Curve Definition	1: Arc
OK Compute	Results Help Cancel

- 11. We want the tangent length 10.5232 meters and we want the circular arc's length of 21.0249 meters click *Cancel*
- On the Add Turnout Branch Element dialog, click the *Linear* radio button and enter a length of *6.09180* meters, which is the triangle length minus the circular arc's tangent (i.e. 16.615 – 10.5232)

Add Turnout	Branch Element	×
Element Type:	Linear	Apply
	Circ <u>u</u> lar	Curve Calc
	Clothoi <u>d</u>	Close
Length:	6.091800	Help
Starting <u>R</u> adius:	190.000000	
Stopping R <u>a</u> dius:	190.000000	]
<u>F</u> irst	< <u>P</u> revious <u>N</u> ext >	<u>L</u> ast

- 13. Click Apply to add the linear
- 14. Now click the *Circular* radio button and enter a length of *21.0249* meters (i.e. computed by the **Curve Calculator**) and a radius of *190* meters.

Edit Turnout E	Branch Element	×
Element Type:	⊚ Lin <u>e</u> ar	Apply
	Oircular	Curve Calc
	Clothoid	Close
Length:	21.024900	Help
Starting <u>R</u> adius:	190.000000	
Stopping R <u>a</u> dius:	0.000000	]
<u>F</u> irst	(Previous) Next >	Last

- 15. Click Apply to add the circular arc
- 16. And finally add the last linear by clicking *Linear* and defining the length as *6.0918* meters

Add Turnout	Branch Element	×
Element Type:	Uinear	Apply
	© Circ <u>u</u> lar	Curve Calc
	Clothoid	Close
Length:	6.091800	Help
Starting <u>R</u> adius:	190.000000	
Stopping Radius:	190.000000	]
<u>F</u> irst	< Previous Next >	Last

- 17. Click Apply and Close to exit the dialog
- 18. Click the *2nd branch* and defined the exact same data for the second branch. When you have finished, the **Turnout Library** dialog should look like the following:

Turnout Library				×
<u>N</u> ame:	DS54-190 1:9		•	Apply
Descripti <u>o</u> n:				Close
Туре:	Double Slip		•	New
Theoretical .1 to .1 Length:	0.000000	0.000000		
Length Along Mainline:	33.230000	33.230000		<u>C</u> opy
Triangle Length:	16.615000	16.615000		<u>D</u> elete
Define By:	Ratio	O Angle		Rena <u>m</u> e
Ratio at .0:	9.000000	9.000000		Verify
Angle at .0:	06^20'24.69"	06^20'24.	69''	Schematic
Ratio at .1:	0.000000	0.000000		Help
Angle at .1:	00^00'00.00''	00^00'00.	00"	
Linear Slee <u>p</u> er Set:	0.000000	0.000000		
Circ <u>u</u> lar Sleeper Set:	0.000000	0.000000		
Distance to Last Long <u>S</u> leeper	0.000000	0.000000		
Minimum <u>B</u> ending Radius:	0.000000	]		
Bending Method:	Default	© <u>G</u> erman		
Maintain Length Along Inne	er Rail (from .1 to IP)			
Maintain Length Along Out	er Rail 📃 Last B	Branch Elemer	nt Always l	Inbent
Branch Geometry Show: () <u>1</u> st Branch ()	) <u>2</u> nd Branch			
Element Type Length	Starting	Radius	Stopping	Radius
Linear 6.091800	0.00000		0.000000	
Circular 21.024900 Linear 6.091800	190.0000 0.000000		190.0000 0.000000	

- 19. Click Apply to save the double slip turnout into the turnout library
- 20. Click *Close* to exit the dialog.

## **CHAPTER SUMMARY**

In this chapter, we have learned how to create single and double slip turnouts in the turnout library.



## **Chapter 3: Turnout Bending Methods**

## **OVERVIEW**

In the previous lesson, we created a single branch turnout from standard drawings. That turnout can now be used and the resultant geometry will be a circular arc with a length of 54.193 meters and a radius of 760 meters, provided it is placed onto a linear element. What happens if that turnout is placed onto a circular arc? The resultant geometry will be bent or flexed based upon rules. The software uses two different sets of rules for bending. They are the *Swiss* and *German* rules.

The Swiss rule (i.e. it is called Default on the user interface) is simply:

 $R_{f} = (R_{m} \times R_{b}) / (R_{m} + / - R_{b})$ 

Where;

R<sub>f</sub> is the resultant flexed radius

R<sub>m</sub> is the mainline radius

 $R_{\rm b}$  is the branch radius as defined in the turnout library

The *Swiss* rule also states that the length along mainline is measured along the mainline alignment's centerline. Also the rule allows the user to set that the mainline length is applied to the *centerline*, the *outside rail* or the *inside rail*. The default is centerline, but some organizations clearly state that the length is along one of the rails.

The Swiss rule results in the following:

- Length along mainline held
  - Can be applied to inner or outer rail
- Coordinate Positions
  - o .1, .2, .0 and .3 held
- Tangential Directions
  - o .1 tangential <u>compromised</u>
  - o .2 tangential held
  - o .3 tangential held
  - o Multi-element branch geometry is not always collinear

The German rule is simply:

 $R_{f} = (R_{m} \times R_{b} - T^{2}) / (R_{m} + / - R_{b})$ 

Where

R<sub>f</sub> is the resultant flexed radius

R<sub>m</sub> is the mainline radius

 $R_b$  is the branch radius as defined in the turnout library

T is the sub-tangent length, which is the triangle length in a simple one element turnout, placed wholly within a circular element.

The *German* rule also states that the length along the mainline is measured along the mainline alignment's <u>sub-tangents</u>. Yes, that means that the length along the centerline will be shortened!

Maintains

- Length along mainline held, but it is interpreted as the *sub-tangent* length not the centerline length!
- Coordinate Positions
  - o .1, .2, .0 and .3 held
- Tangential Directions
  - o .1 tangential held
  - o .2 tangential held
  - o .3 tangential held
  - o Multi-element branch geometry is usually collinear

#### **PROJECT DESCRIPTION**

In this lesson, we will investigate the Swiss and German rules for turnout bending.

### **GETTING STARTED**

In this lesson, we will investigate the Swiss and German rules for turnout bending.



#### Exercise: Investigating the Swiss and German rules for turnout bending.

**Exercise Objective:** Understand the differences between the *Swiss* and *German* turnout bending rules.

- 1. Open the file *Chapter 3.dgn*
- 2. Open the file Turnout Bending.alg
- 3. Go to **Turnouts > Turnout Library** and select the turnout that was previously created.
- 4. Click the *Copy* option and copy this turnout and give it a name of *UIC60-760-0,071 German* and then *Close*.

From	r	Apply
Туре:	Single	Close
<u>N</u> ame:	UIC60-760-0,071	▼
Description:		<u>H</u> elp
То		
Na <u>m</u> e:	UIC60-760-0,071 German	
Description:		

5. Now select the UIC60-760-0,071 German turnout and change it from Default to German

*Note* The bending method is on each turnout, which means that you can mix *Swiss* and *German* bending into the same turnout library

- 6. Click Apply and click Close to exit the dialog
- 7. Let's used the defined turnouts to create several crossovers and then review the results.
- 8. Go to **Turnouts > Create Turnout**

Create Turnout				
Primary Control Method:	In Alignme	ent 🔹		Apply
Alignment:	Track 1	•	+	Close
Station:	0+600.00	0	+	Interactive
Offset from Placer	nent Point:	0.0000		Undo
Extend Mainline b	y Length:	0.0000		Help
Tumout Name: Description: Type: Style: Placement Point: Hand:	Tumout 1   Single UIC60-76	0-0,071		
	Right		-	
Orientation:	Leading		•	

- 9. We will create a *UIC60-760-0,071* on *Track 1* at station *0+600*. Set all values as shown and click *Apply* to create the new turnout.
- 10. Click Close to exit the dialog
- 11. Go to Turnouts > Create Connection to create the crossover

Create Connectio	n		
Beginning Tumout Name: Style: Active Heel:	Tumout 1 UIC60-760-0,071 1st	▼ <b>+</b>	Apply Interactive Close Undo
Connection Length: Radius:	0.0000	+ +	Help
Ending Tumout Name: Description:	Tumout 2		
Type: Style: Alignment:	Single UIC60-760-0,071 Track 2	▼ ▼ ▼ +	
	indoit 2		

- *Note* We are going to create a simple crossover from *Track 1* to *Track 2* from the previously created turnout *UIC60-760-0,071*
- 12. Click *Interactive*, we could create the crossovers from the dialog, but this method is quicker. At the prompts:
  - 1. Identify turnout and select Turnout 1
  - 2. Identify mainline alignment and select Track 2
  - 3. Accept / Reject and accept the solution
- 13. We will repeat the steps 9 through 13 and create crossover using the *UIC60-760-0,071 German* turnout.
- 14. Go to **Turnouts > Create Turnout** and define the following:

Create Turnout				X
Primary Control Method: Alignment: Station:	In Alignment Track 1 0+750.000	• • • • • • • • • • • • • • • • • • •	<del>+</del>	Apply Close Interactive
Offset from Place	ment Point: 0	0000.		Undo
Extend Mainline t	y Length: ()	0000		Help
Turnout Name: Description:	Tumout 3			
Туре:	Single		•	
Style:	UIC60-760-0	),071 German	•	
Placement Point:	.1		•	
Hand:	Right		•	
Orientation:	Leading		•	

- 15. Click Apply and Close to exit the dialog
- 16. Go to Turnouts > Create Connection and define the following:

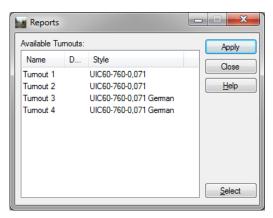
Create Connectio	n		- C X
Beginning Tumout Name: Style: Active Heel:	Tumout 3  UIC60-760-0,071 German Ist	) <del>+</del> )	Apply Interactive Close Undo
Connection Length: Radius:	0.0000	+ +	Help
Ending Tumout Name: Description: Type: Style: Alignment:	Tumout 4 Single UIC60-760-0,071 Gema Track 1	] ]	

17. Click Interactive and select Turnout 3 and Track 2 to create the new crossover

Swiss ruled turnouts on the left and German ruled turnouts on the right

**Chapter Summary** 

18. Now let's review the results. Go to **Turnouts > Reports** 



- 19. Select all of the turnouts by right clicking in the list-view and selecting Select All
- 20. Click Apply
- 21. In the **Civil Report Browser** select the *turnouts.xsl* and let's review the results.

Method	Turnout	Length along Mainline	Mainline Radius (R <sub>m</sub> )	Т	Branch Length	Bend Radius (R <sub>f</sub> )	Equation
Swiss	1	54.216	1000.000	n/a	54.158	431.818	$R_{f} = (R_{m} \times R_{b}) / (R_{m} + R_{b})$
Swiss	2	54.216	995	n/a	54.228	3217.872	$R_{f} = (R_{m} \times R_{b}) / (R_{m} - R_{b})$
German	3	54.203	1000.000	27.108	54.114	431.401	$R_{f} = (R_{m} \times R_{b} - T^{2}) / (R_{m} + R_{b})$
German	4	54.203	995	27.108	54.215	3220.999	$R_{f} = (R_{m} \times R_{b} - T^{2}) / (R_{m} - R_{b})$

Gathered from several reports

## **CHAPTER SUMMARY**

In this chapter, we have learned the differences between the Swiss and German bending rules.



## **Chapter 4: Standard Sleeper Sets**

## **OVERVIEW**

Now that we have defined the Swiss and German bending methods, we can now look at sleeper sets. A sleeper set is a standard set of sleepers that will be placed at the end of the turnout geometry (i.e. at .2 and .3). All that we know about a standard sleeper set is a length and whether the sleeper set is linear or circular.

So what is the difference between a linear and circular sleeper set? Primarily it has to do how the geometry is constructed.

A linear sleeper set will match the mainline geometry. So if we place a 10 meter linear sleeper set onto a mainline radius of 1000 meter then the sleeper set will have a 1000 meter radius.

A circular sleeper set will bent the geometry using the *Swiss* or *German* rules. So the resultant radius will be less than or greater than 1000 meters, depending upon whether it is bent to the *inside* or *outside*.

## **PROJECT DESCRIPTION**

In this lesson, we will learn about standard sleeper sets

## **GETTING STARTED**

In this lesson, we will modify the *UIC60-760-0,071 in the* turnout library and define a circular sleeper set. We will then place that turnout and let the software create the standard sleeper set geometry.



Exercise: Modifying a turnout to include a circular sleeper set.

**Exercise Objective:** Modifying a turnout to include a circular sleeper set.

#### Procedure:

- 1. Open the file Chapter 4.dgn
- 2. Open the file Standard Sleeper Set.alg
- 3. Go to Turnouts > Turnout Library
- 4. Select the UIC60-760-0,071 turnout
- 5. Set Circular Sleeper Set as 5 meters
- 6. Set Distance to Last Long Sleeper to 5 meters

*Note* A standard sleeper set and distance to last long sleeper are both optional. You can have neither, one without the other, or both.

Turnout Library					×
Name:	UIC60-76	0-0,071		•	Apply
Descripti <u>o</u> n:					Close
Туре:	Single			-	New
Theoretical .1 to .1 Length:	0.000000		0.000000		
Length Along Mainline:	54.216000	D	0.000000		<u>C</u> opy
Tria <u>n</u> gle Length:	27.10800	D	0.000000		<u>D</u> elete
Define By:	Ratio		Angle		Rena <u>m</u> e
Ratio at .0:	14.00021	1	0.000000		<u>V</u> erify
Angle at .0:	04^05'08	.00''	00^00'00.0	0''	Schematic
Ratio at .1:	0.000000		0.000000		Help
Angle at .1:	00^00'00	.00"	00^00'00.0	0''	
Linear Slee <u>p</u> er Set:	0.000000		0.000000		
Circ <u>u</u> lar Sleeper Set:	5.000000		0.000000		
Distance to Last Long Sleeper:	5.000000		0.000000		
Minimum <u>B</u> ending Radius:	0.000000				
Bending Method:	Oefault		) <u>G</u> erman		
Maintain Length Along Inner	Rail (from	.1 to IP)			
Maintain Length Along Oute	r Rail	Last B	anch Elemen	t Always U	Inbent
Branch Geometry Show:  (a) <u>1</u> st Branch	<u>2</u> nd Branc	h			
Element Type Length		Starting F	Radius	Stopping	Radius
Circular 54.192861		760.0000	)0	760.0000	00

- 7. Click *Apply* and then *Close* to exit the dialog.
- 8. Create two new turnouts using the *UIC60-760-0,071* turnout. You can refer back to the **Chapter 3** for how to create a simple crossover. Once you have created the crossover invoke the **Turnouts > Connection Editor** command.

Connection	Editor						
Beginning Elen	nent					_	Apply
Turnout Name:	1	+	Station:	0+600.0	00	+	
Tumout Type:	Single	-	Tip <u>R</u> adius:	1000.00	00		Close
Turnout Style:	UIC60-760-0,071	•	Heel Radius:	1000.00	00		Sa <u>v</u> e
Active Heel:	1st	-	Standard Sleeper	Set:	None	•	Save <u>A</u> s
			Sleeper Set Leng	th:	0.0000	_	Undo
			Distance to Last	Sleeper:	5 0000	-1	Report
l							
Connecting Elem	ent:						<u>H</u> elp
Type Free	E Length	Free Pa	arameter	Tar M	Na Applie		
	on: () Turnout						
Ending Connecti Ending Elemen			ement 🔘 Sta	ation	⊚ Free E <u>x</u> it		
-	t	<u>+</u>	ement 💿 Statio <u>n</u> :	ation 0+723.4		+	
Ending Elemen	t				06	+	
Ending Elemen Turnout Na <u>m</u> e:	t		Station:	0+723.4	06	+	
Ending Elemen Turnout Na <u>m</u> e: Turn <u>o</u> ut Type:	t 2 Single		✓ Station: Tip <u>R</u> adius:	0+723.4 995.000 995.000	06	+	
Ending Elemen Turnout Name: Turnout Type: Turnout Style:	t 2 Single UIC60-760-0,071		✓ Station: Tip <u>R</u> adius: Heel Radjus:	0+723.4 995.000 995.000 Set:	0	+	

Let's take a look at what appears on the dialog and specific the standard sleeper set and last long sleeper. The *Standard Sleeper Set* is set to *None* and the *Sleeper Set Length* is *0.0* meters. Let's proceed to create the standard sleeper set elements.

- 9. Set the Standard Sleeper Set for each turnout to Circular and the software will set the Sleeper Set Length to 5.0 meters (remember that is what we added in the turnout library). You will notice as we added the standard sleeper set elements that the connection has lengthened!
- 10. Click *Apply* to recompute the connection. You will notice that the original connection element had a length of *15.963* meters and a radius of *1008.800* meters has been recomputed.
- 11. Click Report... and let's look at the results

The first element after the first turnout is defined as a circular arc with a length of 5.0 meters and a radius of 431.818 meters. The length of 5.0 meters is the standard sleeper length and since we defined it as a circular sleeper set then we would expect the radius to match the .3 radius. And it does!

The next element is also a circular arc of length 5.040 meters and a radius of 1034.641 meters.

The third element is the trailing turnout's sleeper set. Again it is 5.0 meters in length and the radius is 3217.872 meters

## **CHAPTER SUMMARY**

In this chapter, we have learned about standard sleeper sets.



## Chapter 5: Project Options and Turnouts

## **OVERVIEW**

In this lesson we will look at several ways to override and affect the crossover geometry. In Chapter 3, we read that the turnout geometry may not always be collinear. But, we can attempt to force the geometry to be collinear.

It should be noted that when we are talking about a turnout's colinearity, we are talking about the branch elements. The software will always force the first element outside the branch (i.e. the element after .3) to be collinear. How? The software will use the direction from .0 to .3 as the first element's entrance tangential direction.

Another issue is related to what happens when the mainline is canted. The turnout will be canted based upon the mainline. But the crossing is generally a fixed angle, so should the crossing angle be adjusted to account for cant?

The software provides options for accomplishing both of these. Whether you need to do is up to you!

### **PROJECT DESCRIPTION**

In this workshop, we will learn about options that affect the turnout's geometry.

## **GETTING STARTED**

In this lesson, we will learn how to attempt to force a turnout to be collinear.



Exercise: Forcing turnout colinearity.

Exercise Objective: How to attempt to force a turnout to be collinear.

- 1. Open the file Chapter 5.dgn
- 2. Open the file Forced Collinearity.alg
- 3. Go to File > Project Options and the Rail tab

Precision	General	Units and	Format Geometry		
Tolerances	Factors A	bbreviations	Rail Sight Distance		
			<u>H</u> elp		
Design Speed	d (kmph):		160.0000		
<u>E</u> quilibrium Co	onstant:		11.8000		
Applied Const	tant:		7.1000		
Cant Roundin	ng <u>C</u> onstant (r	nm):	5.0000		
Centerline <u>R</u> a	il to Centerlin	e Rail Distance	1.5000		
Inside <u>R</u> ail to	Inside Rail D	stance:	1.4350		
Center of Gra	vity:		1.8000		
<u>V</u> irtual Transit	tion Length:		0.0000		
Percent on Li	near:		50.0000		
Rotate Cant /	About:		Inside Rail 🔹		
Interpolate	e Speed				
Add Cant	at <u>S</u> piral to Sp	piral Station			
Compute	Turnouts <u>B</u> as	ed on Mainline	Cant		
🔽 Maintain 1	Furnout Brand	h Element Colli	nearity		
Compute	ndependent	Non-linear Rev	erse Transitions		
🔲 Horizontal	Slew Signag	e is Relative to	Point not Alignment		
A					

- 4. Check on Maintain Turnout Branch Element Colinearity
- 5. Click Apply and then click Close to exit the dialog
- 6. Go to Turnouts > Connection Editor
- 7. Select the crossover for alignment 1-2, by selecting turnout 1
- Keep the dialog up and go to Geometry > Review Horizontal and select the same crossover. You will see between the first and second elements, we have a non-collinear warning.

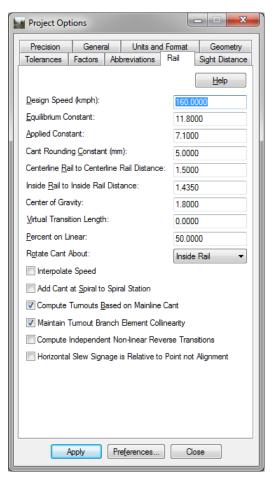
*Note* We have a 15 second difference in the directions, which equates to an offset of 2 millimeters over the length of the tangent of the turnout!

- 9. On the *Connection Editor* don't change anything, just click *Apply*. Since we have checked on *Maintain Turnout Branch Element Colinearity*, the software will re-compute the geometry.
- 10. Click Save to save the recomputed geometry
- 11. Now look at the *Review Horizontal* alignment dialog.
- 12. The first element's radius has changed from 431.818 meters to 431.401 meters and the non-collinear warning has gone away. The software will adjust the branch radius to force colinearity at .3.
- If we take a look at a second example, select the crossover 3-4 by selecting turnout 3.
   Essentially repeat steps 8 through 12. In this case, the first element's radius has changed from 3217.872 meters to 3221.042 meters and the non-collinear warning has gone away.

## Exercise: Should I consider cant when computing turnouts?

Exercise Objective: Investigate the affects of computing a turnout based upon the mainline's cant

- 14. We will remain in the same .dgn and .alg for this lesson
- 15. Go to File > Project Options and the Rail tab



- 16. Check on Compute Turnouts Based on Mainline Cant
- 17. Click Apply and then click Close to exit the dialog.
- 18. Go to the Turnout > Connection Editor
- 19. Select the crossover for alignment 1-2, by selecting turnout 1

Connection E	ditor						- 🗆 🗙
Beginning Elem							Apply
Tumout Name:	1 •	+	Station:	0+600.0	000	<del>+</del>	
Tumout Type:	Single 👻		Tip <u>R</u> adius:	1000.00	00		Close
Turnout Style:	UIC60-760-0,071 -		Heel Radjus:	1000.00	00		Save
Active Heel:	1st ▼		Standard Sleepe	r Set:	None	-	Save <u>A</u> s
			Sleeper Set Leng	th:	0.0000	=	Undo
			Distance to Last	Sleeper:	5.0000		Report
Connecting Elem	ent:						Help
Type Free	Length Free	P	arameter	Tar M	Ma Applie		
Circular 🗙	15.9631	10	08.7699		0.0000		
Ending Connection		) E	ement 🔘 Sta	ation	⊚ Free E <u>x</u> it		
Turnout Name:		+	Station:	0+723.4	061	+	
Turnout Type:			Tip <u>R</u> adius:	995 000		_	
Turnout Style:	Single 👻		Heel Radius:		-		
-	UIC60-760-0,071 -		-	995.000	0		
Active Heel:	1st 🔻		Standard Slee <u>p</u> e		None	•	
			Sleeper Set Leng	ith:	0.0000		
			Distance to Last	Sleeper:	5.0000		

- 20. Note that the existing connecting element, which was computed without adjusting for cant, has a length of 15.963 meters and a radius of 1008.770 meters.
- 21. Click *Apply*, so that the crossover is recomputed and adjusts for cant. The software has recomputed the connecting element with a length of 16.039 meters and a radius of 1008.734 meters. More importantly, the software has maintained the turnout's cross angle along the track plane, thus flattening the angle on the horizontal plane.
  - *Note* It should be clear that in the case of enforce colinearity; the software did not change the .1, .0, .2 or .3. The software held those critical points. However, when the software adjusted for cant the coordinates and tangential direction at .3 changed.

## **CHAPTER SUMMARY**

In this chapter, we have learned how to force a turnout's to have collinear branch geometry. As well as, how to take into consideration the mainline alignment's cant in computing turnout horizontal position.



## **Chapter 6: Connection Editor**

## **OVERVIEW**

In a previous lesson, we created a crossover by using the **Create Connection** command. While this command is quick and easy, sometimes that is not enough. Or sometimes the design needs to be changed and you need a more robust tool. The **Connection Editor** is that tool.

The **Connection Editor** will allow the user to edit an existing connection. The following:

Selecting a turnout will invoke an existing crossover. So making a simple edit like moving a turnout up station by 10 meters is simply changing the starting station and clicking *Apply* to re-compute.

Selecting a turnout and changing it from one turnout style to another turnout style. Again just selecting the turnout invokes the previous connection and you simply change the turnout's style and re-compute.

## **PROJECT DESCRIPTION**

In this workshop, we will learn about the **Turnout Connection Editor**.

## **GETTING STARTED**

In this lesson, we will learn how to edit a previously computed crossover.



#### Exercise: Editing a previously computed crossover

Exercise Objective: Edit a previously computed crossover's starting station

- 1. Open the file *Chapter 6.dgn*
- 2. Open the file Connection Editor.alg
- 3. Go to the Turnout > Connection Editor

	ditor						
-Beginning Elem							Apply
Turnout Na <u>m</u> e:	1	•	Station:	0+600.0	0000	+	Close
Tumout Type:	Single	•	Tip <u>R</u> adius:	1000.00	000		
Turnout Style:	UIC60-760-0,071	•	Heel Radius:	1000.00	000		Sa <u>v</u> e
Active Heel:	1st	•	Standard Sleepe	r Set:	None	•	Save <u>A</u> s
			Sleeper Set Leng	th:	0.0000	=	Undo
			Distance to Last	Sleeper:	0.0000		Report
Connecting Eleme	ent:						Help
Type Free	Length	Free Pa	arameter	Tar M	Ma Applie		
Circular 🗙	10.0001	X 10	08.7699		0.0000		
Circular 🗙	15.9631		06.7655		0.0000		
Ending Connectio Ending Element Turnout Name:	n: <u>© T</u> umout		ement 🔘 Sta V Station:	0+720.7	○ Free Exit 7088	+	
Ending Connectio Ending Element Tumout Na <u>m</u> e: Tum <u>o</u> ut Type:	n: <u>© T</u> urnout 9 Single	© 8. • +	ement 💿 Sta V Statio <u>n</u> : Tip <u>R</u> adius:	0+720.7 995.000	© Free Exit 7088 00	<u>+</u>	
Ending Connectio Ending Element Turmout Name: Turmout Type: Turmout Style:	n: © <u>T</u> umout 9 Single UIC60-760-0,071	0 B	ement	0+720.7 995.000 995.000	© Free Egit 7088 00	<u>+</u>	
Ending Connectio Ending Element Tumout Na <u>m</u> e: Tum <u>o</u> ut Type:	n: <u>© T</u> urnout 9 Single	© 8. • +	ement O Sta Station: Tip <u>R</u> adius: Heel Radjus: Standard Sleege	0+720.7 995.000 995.000 r Set:	© Free Egit 7088 00 00 None	+	
Ending Connectio Ending Element Turmout Name: Turnout Type: Turnout Style:	n: © <u>T</u> umout 9 Single UIC60-760-0,071	© 8. • +	ement	0+720.7 995.000 995.000 r Set: gth:	Free Egt     7088     70     0     None     0.0000	+	

- 4. In this case we have selected turnout 1 and the software recalls the previous connection (as well as recalling the previous fixities).
- 5. Change the start station from 0+600 to 0+575, you will see that turnout 1 plus the connecting elements have moved.
- 6. Now click *Apply* and the software recomputes the entire crossover.
- 7. Now let's see everything move in a more dynamic fashion. Again, we will be changing the first turnout's start station. But this time we will use the data point button, but when we select the data point click <Ctrl> at the same time. Now the entire crossover is placed in dynamics and everything is recomputed.

- 8. Accept or reject the dynamics.
- 9. Click *Save* to save the results and click *Close* to exit the dialog.

```
Hint If a turnout is defined with a theoretical .1 the station on the user interface is the .1 station. The geometry will start at the theoretical .1 and when it is created as a horizontal alignment it will start at the theoretical .1
```



Exercise: Editing a previous computed crossover

Exercise Objective: Edit a previously computed crossover's by changing the turnout's style

#### Procedure:

- 10. Continuing with the same data, go to the Turnout > Connection Editor
- 11. Change the beginning turnout's style to e6050014
- 12. Change the ending turnout's style to e6076014
- 13. Click Apply to re-compute the solution

Connecti	Un Lui	tor						
Beginning E		t						Apply
Turnout Naj	<u>m</u> e: 1		• +	Station:	0+600.0	000	+	Close
Tum <u>o</u> ut Typ	Imout Type: Single  Imout Style: e6050014		Tip <u>R</u> adius:	1000.0000		]		
Turnout Sty			•	Heel Radius:	1000.0000			Sa <u>v</u> e
A <u>c</u> tive Heel	l: 1:	st	•	Standard Sleepe	r Set:	None	•	Save <u>A</u> s
				Sleeper Set Leng	<u>i</u> th:	0.0000		Undo
				Distance to Last	Sleeper:	5.1000		Report.
onnecting E	Element							<u>H</u> elp
Type F	Free	Length	Free P	arameter	Tar N	Ma Applie		
Type F Circular 🔀		-		arameter 08.7699	lar N	Ma Applie 0.0000		
inding Conni Ending Eler Tumout Naj	ection: ment me: 2	15.9631 ⊚ <u>T</u> urnout	10	08.7699 ement ⓒ Statio <u>n</u> :	ation 0+723.4	© Free E <u>x</u> it		
inding Conne Ending Eler Tumout Naj	ection: ment me: 2 be: Si	( <u>0</u> <u>T</u> umout	∑ 10	08.7699 lement ⊙ Sta I Statio <u>n</u> : Tip <u>R</u> adius:	ation 0+723.4 995.000	0.0000		
inding Conne Ending Eler Turnout Nay Turnout Typ Turnout Sty	ection: ment me: 2 pe: Si le: ef	15.9631 ⊚ <u>T</u> urnout	∑ 10	lement ⓒ Station: Tip Radius: Heel Radius:	ation 0+723.4 995.000 995.000	0.0000		
inding Conne Ending Eler Tumout Naj	ection: ment me: 2 pe: Si le: ef	© <u>T</u> umout ingle 6076015	∑ 10	08.7699 lement ⊙ Sta I Statio <u>n</u> : Tip <u>R</u> adius:	ation 0+723.4 995.000 995.000	0.0000		
inding Conne Ending Eler Turnout Nay Turnout Typ Turnout Sty	ection: ment me: 2 pe: Si de: el	© <u>T</u> umout ingle 6076015	∑ 10	lement ⓒ Station: Tip Radius: Heel Radius:	ation 0+723.4 995.000 995.000 r Set:	© Free Exit		

- 14. Click *Save* to save the solution
- 15. Based upon previous lessons, what other edits could we make in the **Turnout > Connection Editor**?

*Hint* If we refer back to **Chapter 4**, we discussed standard sleeper sets and last long sleepers. While we originally defined these within the

turnout library, you could define a non-standard length sleeper set within the **Turnout > Connection Editor**. Just change the Standard Sleeper Set to *Linear* or *Circular* and define the Sleeper Set Length.

## **CHAPTER SUMMARY**

In this chapter, we have learned how to modify a previous defined crossover.



## Chapter 7: Creating Verticals through Turnouts

## **OVERVIEW**

In this lesson, we will learn how to create a vertical alignment through a crossover. The software will use the turnout's mainline alignment's vertical alignment and cant alignments plus the offset from the mainline to the branch geometry (at an interval) to compute the turnout's vertical. The intent is to project the mainline's plane through to the plane of the turnout. We are also trying to ensure that there is a smooth transition from one turnout to the next.

## **PROJECT DESCRIPTION**

In this lesson, we will learn how to create a vertical alignment through a crossover.

## **GETTING STARTED**

In this lesson, we will learn how to create a vertical alignment through a crossover.



#### Exercise: Creating a vertical alignment through a crossover

Exercise Objective: Creating a vertical alignment through a crossover.

- 1. Open the file Chapter 7.dgn
- 2. Open the file *Create Verticals.alg*
- 3. Go to Turnouts > Create Verticals
- 4. Set the vertical name, description and style as shown. Set the number of segments to 16. Also, toggle on compute from *Second Mainline* and check on *Use Alternate Solver (Partially with Cant Transition)*
- 5. Click Apply

Create Verticals				
	Connecting Alig 1-2 5-6	2nd Tum 2 6	out Mainline @ 2nd Track NS (top) Track NS (top)	Apply Close Help
Compute From: O First <u>M</u> ainline O <u>S</u> econd Mainline O <u>B</u> oth	St <u>y</u> le: <u>N</u> umber of Segn	D nents: 16	g I efault •	Select
Use Alternate Solver (Partially wit	hin Cant Transitions	;)		

- *Note* Track NS (top) has a defined vertical alignment and a cant alignment. Track SN (bottom) has a cant alignment. Its vertical will be created from Track NS (top) and the crossover 1-2. Also, note that crossover 1-2 is wholly within a horizontal circular arc and crossover 5-6 is partially within a spiral / cant transition!
- 6. Click on the crossover 5-6 and create the vertical and cant alignment by clicking Apply
- 7. Click Close to exit the dialog
- 8. To review the results go to **Evaluation > Create Profile**. Create a profile for crossover *1-2* and *5-6* using an elevation range with a maximum elevation of *255* and a minimum elevation of *250*. Also set the vertical exaggeration to *40*

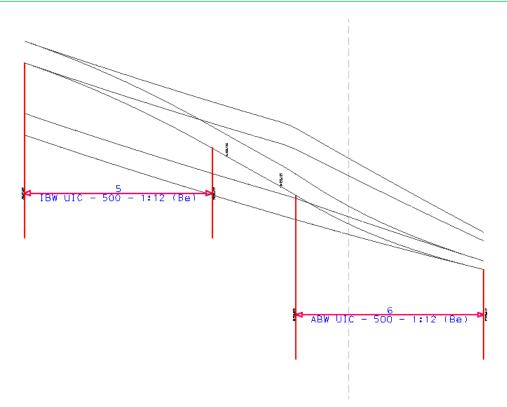
Create Profile			
Create Profile General	Set Name: 1-2 Direction	Exaggeration Vertical: 40.0000000 Horizontal: 1.0000000	
Axes Grid Details ASCII		Name	]
		Properties	
	A	pply Pre <u>f</u> erences Close	<u>H</u> elp

9. Go to **Geometry > View Rails** and select *Project to Profile* and select profile 1-2. Set the settings as shown below.

View Rails		_
Horizontal Alignment: Vertical Alignment: Cant: Apply Style:	I-2         ▼         Apply           p g I         ▼         Preferences           p g I         ▼         Close           Help         Default         ▼	
Mode Display as 2-D Display as 3-D Project to Profile: Append to Surface:	1-2 • + Default •	
Limits Station Start: 1+768.8947 Stop: 1+870.8079	Include Cardinal Points     Display As Complex Linestring     Interval:     Rail to Rail Distance:     1.4350	

- 10. Click Apply
- 11. Select horizontal alignment *Track NS (top)* and click *Apply* to project it onto the same profile.
- 12. Likewise select horizontal alignment Track SN (bottom) and project it onto the same profile.
- 13. Since that crossover was placed wholly within a circular arc and cant was constant, you will see that all rails are at a constant height above each other.
- 14. Now select the profile for 5-6 and project alignments 5-6, Track NS (top) and Track SN (bottom) into the profile window.
- 15. Before reviewing the results, go to **Turnouts > Display Turnouts in Profile**. Select the profile window for crossover *5-6*, set the settings as shown below and click *Apply*

		Profile				٢
Profile Set:	5-6			• +	Apply	
Placement:	Offset	Below T	umout	•	Close	5
Offset Above Witn	e:	10.0000		Preferences.	5	
Offset Below Witn	e	10.0000			-	
Drop Station E	quation	Names			Help	
Data:						
Object	Prefix	Suffix	Precision	Format	Name	
Witness Line						
Leader Line						
Name						
Description						
I Station		S+SSS.SS				
.1 Elevation			0.12			
2 Station			0.123	S+SSS.SS		
.2 Elevation			0.12			
LLS Point						
LLS Station			0.123	S+SSS.SS		



You can clearly see that turnout *6* is within a horizontal spiral and a corresponding cant transition. We have used **Geometry > View Rails** to project the rails onto a profile window. We could also have displayed the rails in plan (either as 2d or 3d) or appended them into a terrain model. In the case of the later, these could then be used as features within **Roadway Designer**.

## **CHAPTER SUMMARY**

In this chapter, we have learned how to create a vertical alignment through a crossover.