

# SCC Training: Point Cloud Module

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# 1 Rail Moudule

1

The following outlines the main tools and functionality within the SCC Rails Modules.

### 1.1 Rail Traverse

The following outlines the steps to process a Rail traverse. Error checking, the application of Centre Error Correction and the introduction of Known Stations are examined.

### Creating A Project Directory

From the Main Screen, select 'DATA tab > New''

Enter in a Project/Job name 'Rail\_Traverse'

Select a Project Template from the list 'Default v11 Complex.Project'

#### Select 'OK'

New Project	? ×
Project name Project template	Rail_Traversel       Default (v11-0-Complex).Project       Vick >>
Project folder Use default  Select an a	SCC project folder Iternative folder
	OK Cancel

#### Download Raw Data

From the Main Screen, select 'DATA tab > Download'

Set up the following:



#### Press 'Ok'

Select raw file '\RailData\Traverse\Rail-day.GSI'

Within the Leica data input (1100/1200/Wildsoft/LisCADD) dialog, pick 'Rail-day. GSIConfig' file and Press 'Ok'

Note: this file is within the SCC folder, as a result, available on the drop down menu

	ta input (1100/1200/Wildsoft/L	isCADD)			?	×
rmat file	e Rail-day.GSIConfig		Save	Oł	K Ca	ncel
nput da	ata fields					
	41 (Record Type)	Obs Type	42	43	44	
1	*	Detail	Not Used	Not Used	Not Used	Not
2	Dimensions	Detail	Not Used	Not Used	Not Used	Not
3	Line of Sight	Detail	Not Used	Not Used	Not Used	Par
4	Parallel	Copy Parallel	Not Used	Not Used	Feature	Par
5	Remark	Detail	Remark	Not Used	Not Used	Not
6	Tape	Tape	Not Used	Not Used	Not Used	Par
	Add Delete	Use any other	41 block as feat	ure names		
	Add Delete	Use any other	41 block as feat	ure names		
Point du	Add Delete	Use any other	41 block as feat ✓ Store s	ure names tation co-ordinates		
°oint du ● Disa	Add Delete uplication able duplicate points	Use any other	41 block as feat ✓ Store s	ure names tation co-ordinates all topo X,Y X data	(81,82,83)	
Point du ● Disa ● Ena	Add Delete uplication able duplicate points able for multiple code lines with "Do	Use any other uplicate' tag code	41 block as feat	ure names tation co-ordinates all topo X,YX data	(81,82,83)	
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Point du Disa Ena Ena	Add Delete uplication able duplicate points able for multiple code lines with 'Du able for all multiple code lines	Use any other	41 block as feat ✓ Store s ☐ Ignore ☐ Use top ✓ Use ins —	ure names tation co-ordinates all topo X,Y X data po X,Y Z in preferer trument height field	(81,82,83) nce of Ha,Va,Sd I (88) to indicate n	ew setup
Point du ● Disa ● Ena ● Ena ■ Cod	Add Delete uplication able duplicate points uble for multiple code lines with Du uble for all multiple code lines	Use any other	41 block as feat	ure names tation co-ordinates all topo X,Y X data po X,Y Z in preferer trument height field int number field (11	(81,82,83) nce of Ha,Va,Sd I (88) to indicate n ) for sighted station	ew setup
Point du Disa Ena Cod Offs	Add Delete uplication able duplicate points able for multiple code lines with Du uble for all multiple code lines eles precede observation sets follow observation	Use any other	41 block as feat Store s Ignore Use top Use ins Use po Use en	ure names tation co-ordinates all topo X,YX data soo X,YZ in preferer trument height field int number field (11 hanced coding ext	(81,82,83) nce of Ha,Va,Sd I (88) to indicate n ) for sighted station ensions E	ew setup n dit >>
Point du ● Disa ● Ena ● Ena ■ Offs ● Incl	Add Delete uplication able duplicate points able for multiple code lines with Du uble for all multiple code lines des precede observation ets follow observation ude all observations in traverse sh	Use any other	41 block as feat Store s Ignore Use top Use ins Use en Use en Use en	ure names tation co-ordinates all topo X,YX data oo X,YZ in preferer trument height field int number field (11 hanced coding ext es dimensions as en	(81,82,83) nce of Ha,Va,Sd ((88) to indicate n ) for sighted station ensions <u>E</u> ihanced codes	ew setup n dit >>
Point du ● Disa ○ Ena ○ Ena □ Cod □ Offs ● Only	Add Delete uplication able duplicate points able for multiple code lines with 'Du uble for all multiple code lines des precede observation uses follow observation ude all observations in traverse st y include observations with this fe	Use any other uplicate' tag code	41 block as feat Store s Ignore Use top Use po Use en Use en Store s Use po Use en Use en U	ure names tation co-ordinates all topo X,YX data oo X,YZ in preferer trument height field int number field (11 hanced coding ext s dimensions as en t units are millimeter	(81,82,83) nce of Ha,Va,Sd (88) to indicate ni ) for sighted station ensions <u>E</u> hanced codes	ew setup n dit >>
Point du Disa Ena Cod Offs Offs Only Only	Add Delete uplication able duplicate points able for multiple code lines with 'Du able for all multiple code lines des precede observation ude all observations in traverse sh p include observations with this fe ude all observations with alpha-nu	Use any other uplicate' tag code neet ature code STN	41 block as feat Store s Ignore Use top Use ins Use on Use en Proces Allow s	ure names tation co-ordinates all topo X,YX data no X,YZ in preferer trument height field int number field (11 hanced coding ext s dimensions as en t units are millimeter space seperated GS	(81,82,83) nce of Ha,Va,Sd I (88) to indicate n ) for sighted station ensions <u>E</u> hanced codes SI fields	ew setup n dit >>
Point du Disa Ena Cod Offs Only Only Only	Add Delete uplication able duplicate points able for multiple code lines with 'Du able for all multiple code lines des precede observation ude all observations in traverse sh y include observations with this fe ude all observations with this Phane ude all observations with apha-nu y include CHK FLY BS FS SS FS	Use any other uplicate' tag code neet ature code STN meric point number TN observations in traverse	41 block as feat Store s Ignore Use top Use ins Use on Proces Allow s Treat 1	ure names tation co-ordinates all topo X,YX data po X,YZ in preferer trument height field int number field (11 hanced coding ext is dimensions as en t units are millimeter pace seperated GS Im slope distances	(81,82,83) nce of Ha,Va,Sd (88) to indicate n (88) to indicate n (88) to indicate n ensions E shanced codes is Sl fields as zero distance	ew setup n dit >>
Point du	Add Delete uplication able duplicate points able for multiple code lines with 'Du able for all multiple code lines des precede observation sets follow observation ude all observations with this fe ude all observations with alphanu y include CHK,FLY,BS,FS,SS,FS ude observations to any previous	Use any other uplicate' tag code ature code STN americ point number TN observations in traverse v occupied or sighted static	41 block as feat Store s Ignore Use top Use top Use po Proces Allow s Treat 1 ns Hidden pc	ure names tation co-ordinates all topo X,YX data boo X,YZ in preferer trument height field int number field (11 hanced coding ext is dimensions as en t units are millimeter pace seperated GS im slope distances int feature code	(81,82,83) nce of Ha,Va,Sd I (88) to indicate n I (88) to indicate n I (88) to indicate n ensions E hanced codes is SI fields as zero distance	ew setup n dit >>
Point du © Disz © Ena © Ena © Cod © Only © Only © Only © Only © Incle © Only © Incle © Incle © Incle © Incle © Trav	Add Delete uplication able duplicate points able for multiple code lines with 'Du ble for all multiple code lines ests follow observation ude all observations in traverse sh uide all observations with his fe uide all observations to any previous ude observations to any previous	Use any other uplicate' tag code ature code STN immeric point number TN observations in traverse y occupied or sighted static	41 block as feat Store s Ignore Use top Use top Use po Use po Proces Proces Defaul Allow s Treat 1 ns Hidden po	ure names tation co-ordinates all topo X,YX data boo X,YZ in preferer trument height field int number field (11 hanced coding ext is dimensions as en t units are millimeter pace seperated GS im slope distances int feature code	(81,82,83) nce of Ha,Va,Sd (88) to indicate n (88) to indicate n (88) to indicate n ensione indicate n is SI fields as zero distance tadditional	ew setup n dit >>

### Error Checking

### Go to the 'TRAVERSE tab > Adjust > Reduce'

### Set up the following:

Traverse reduction options		×
Reduce face left / face right	Output results to	o Crystal reports
Reduce multiple rounds	Highlighting tolera	nces
Search for reversed rounds	dHoriz.Angle	000 00 05
Report only, do not store results	dVert.Angle	000 00 10
Store differences as obs residuals	dSlope.Dist	0.010
□ Store reduction standard deviations as standard errors	Use LU reduction	n method and output
☑ Turn off out of tolerance obs	OK	Cancel

### Press 'Ok'

### **Reduction Report**

From the Pick A Report dialog, select 'SCC Traverse reduction (All).rpt' and Press 'Ok'

Pick a report		×		
SCC traverse reduction (All).rpt		Pick>>		
Rail guage cant and ref.rpt Rail filt and slue.rpt Reduction averages.rpt Reduction face means.rpt Reference chainage, offsets and heights (Selected).rpt Reference chainage, offsets and heights.rpt SCC Feature Spec.rpt SCC Flater fit.rpt	^	OK Cancel		
SICE settings.rpt SICE Station locations.rpt SICE traverse blunder (Computed Coords).rpt SICE traverse blunder (Coords).rpt SICE traverse blunder (Known Coords).rpt SICE traverse blunder (Disp.lpt SICE traverse blunder (Disp.lpt SICE traverse blunder analysis.rpt SICE traverse reduction / All .rpt	v			

### **Examine Report:**

Line :L00016 110017	To Stn CST 04	<u>RodHt</u> 1.6480	<u>ha</u> 275 14 00	<u>va</u> 269 56 15	<u>sd</u> 122.2010	face 2
:L00015 110016	CST04	1.6480	095 13 54	090 03 48	122.2010	1
		Mean	095 13 57	090 03 47	122.2010	
		Spread	-000 00 06	000 00 03	0.0000	

# Reduction means and differences

Setup	At Stn	Inst. Ht					
1	CST02	1.5510					
At Stn CST02	To Stn CST01	<u>Mean Ha</u> 000 00 00.0	Mean Va 090 31 25.5	Mean Sd 101.2770			
Line :L00003 11	00 1.5550	Ha 000 00 00.0	<u>Va</u> 090 31 24.5	101.2770	<u>dHa</u> +000 00 00.0	<u>dVa</u> -000 00 01.0	0.0000
L00025 1	1.5550	000 00 00.0	090 31 27.0	101.2770	+000 00 00.0	+000 00 01.5	0.0000
:L00019 11	1.5550	000 00 00.0	090 31 26.5	101.2770	+000 00 00.0	+000 00 01.0	0.0000
L00013 1	1.5550	000 00 00.0	090 31 25.5	101.2770	+000 00 00.0	+000 00 00.0	0.0000
L00002 1	1.5550	000 00 00.0	090 31 24.0	101.2770	+000 00 00.0	-000 00 01.5	0.0000
At Stn CST02	To Stn CST03	Mean H a 195 13 41.8	Mean Va 090 06 17.4	Mean Sd 52.0012			
Line :L0003011	1.6480	Ha 195 13 27.0	Va 090 05 41.0	51.6010	dHa -000 00 14.8	dVa -000 00 36.4	dSD -0.4000
L00023 1	1.6480	195 13 24.0	090 05 41.5	51.6010	-000 00 17.8	-000 00 35.9	-0.4000
L00020 1	1.6480	195 14 51.5	090 08 42.0	53.6010	+000 01 09.7	+000 02 24.6	1.6000
L00014 1	1.6480	195 13 22.5	090 05 41.5	51.6020	-000 00 19.3	-000 00 35.9	-0.4000
:L00005 11	1.6480	195 13 24.0	090 05 41.0	51.6020	-000 00 17.8	-000 00 36.4	-0.4000
At Stn CST02	<u>ToStn</u> CST04	<u>Mean Ha</u> 185 13 59.6	Mean Va 090 03 46.0	Mean Sd			
Line L00028 11	RodHt	Ha 185 14 01.5	<u>Va</u> 090 03 46.0	122.2010	<u>dHa</u> +000 00 01.8	<u>dVa</u> -000 00 00.0	0.0000
L00015 1	1.6360	185 13 59.0	090 03 46.5	122.2010	-000 00 00.6	+000 00 00.5	0.0000
:L00021 1	1.6360	185 13 59.0	090 03 45.0	122.2010	-000 00 00.6	-000 00 01.0	0.0000
L00008 1	1.6360	185 13 59.0	090 03 46.5	122.2010	-000 00 00.6	+000 00 00.5	0.0000

There is a notable Slope Distance Error:

CÒ	ם 🖻 🗋	۵	) =												- 0	>
Y	Data	Traverse													St	iyle 🔻
Q								2 11 °		() Obout						
search .	Next	ed	it Records Records	Undo Kedo Cat	copy Paste	* *	is setup Au	r mouer	* Theip	*						
	Sear	ch and re	place	Undo CI	pboard	View		Compute	H	elp						
Rail	Traverse.Pr	oject:Stati	on Co-ordinates R	ailtrav.Traverse:Sheet ×												
	Setup	Round	At Stn.	To Stn.	Code	Use Obs	-Inst Ht-	-Rod Ht-	-HA-	-zVA-	-SI Dist-	Prism	A	Apply	Remark	
	1	3	CST02	CST01	ORO	Yes	1.5510	1.5550	090 00 00	269 28 36	101.277	0.0000	No	No	L00012 110013	
	1	4	CST02	CST01	ORO	Yes	1.5510	1.5550	269 59 56	090 31 27	101.277	0.0000	No	No	L00013 110014	
	1	4	CST02	CST03	SS	Yes	1.5510	1.6480	105 13 17	090 05 42	51.602	0.0000	No	No	L00014 110015	
	1	4	CST02	CST04	SS	Yes	1.5510	1.6480	095 13 54	090 03 48	122.201	0.0000	No	No	L00015 110016	
	1.	5	CST02	CST04	SS	Yes	1.5510	1.6360	275 14 00	269 56 15	122 201	0.0000	No	No	L00016 110017	
	1	5	CST02	CST03	SS	Yes	1.5510	1.6480	285 13 24	269 54 19	51.601	0.0000	No	No	L00017 110018	
	1	5	CST02	CST01	ORO	Yes	1.5510	1.5550	090 00 00	269 28 36	101.277	0.0000	No	No	L00018 110019	
	1	6	CST02	CST01	ORO	Yes	1.5510	1.5550	269 59 55	090 31 28	101.277	0.0000	No	No	L00019 110020	
	1	6	CST02	CST03	SS	Yes	1.5510	1.6480	105 14 49	090 08 42	53.601	0.0000	No	No	L00020 110021	
	1	6	CST02	CST04	SS	Yes	1.5510	1.6360	095 13 54	090 03 47	122.201	0.0000	No	No	L00021 110022	
·	1	7	CST02	CST04	SS	Yes	1.5510	1.6360	275 13 59	269 56 17	122.201	0.0000	No	No	L00022 110023	
3	1	7	CST02	CST03	SS	Yes	1.5510	1.6480	285 13 24	269 54 19	51.601	0.0000	No	No	L00023 110024	
	1	7	CST02	CST01	ORO	Yes	1.5510	1.5550	090 00 00	269 28 36	101.277	0.0000	No	No	L00024 110025	
	1	8	CST02	CST01	ORO	Yes	1.5510	1.5550	269 59 55	090 31 27	101.277	0.0000	No	No	L00025 110026	
)										-						

### Removing Error from Traverse:

Select 'No' within 'Use Obs' column for record 15 At Stn CST02 To Stn CST03

60	) 💣 🖬	i 🛱	•												_	٥	×
Y	Data 📄	Traverse														Styl	e • 🧭
Search	Search Rep Next Sear	lace Glol ed	bal Insert Delete It Records Records place	Undo Cli	Copy Paste	Obs Coorr	ds Setup Ad	just Model	Tools Help	About elp							
Rail	Traverse.Pr	oject:Stati	ion Co-ordinates	Railtrav.Traverse:Sheet ×	1				1	1		1			-		_
	Setup	Round	At Stn.	To Stn.	Code	Use Obs	-Inst Ht-	-Rod Ht-	-HA-	-zVA-	-SI Dist-	Prism	A	Apply	Rem	ark	^
7	1	3	CST02	CST01	ORO	Yes	1.5510	1.5550	090 00 00	269 28 36	101.277	0.0000	No	No	L00012 110013		
8	1	4	CST02	CST01	ORO	Yes	1.5510	1.5550	269 59 56	090 31 27	101.277	0.0000	No	No	L00013 110014		
9	1	4	CST02	CST03	SS	Yes	1.5510	1.6480	105 13 17	090 05 42	51.602	0.0000	No	No	L00014 110015		
10	1	4	CST02	CST04	SS	Yes	1.5510	1.6480	095 13 54	090 03 48	122.201	0.0000	No	No	L00015 110016		_
11	1	5	CST02	CST04	SS	Yes	1.5510	1.6360	275 14 00	269 56 15	122.201	0.0000	No	No	L00016 110017		_
12	1	5	CST02	CST03	SS	Yes	1.5510	1.6480	285 13 24	269 54 19	51.601	0.0000	No	No	L00017 110018		_
13	1	5	CST02	CST01	ORO	Yes	1.5510	1.5550	090 00 00	269 28 36	101.277	0.0000	No	No	L00018 110019		
14	1	6	CST02	CST01	ORO	Yes	1.5510	1.5550	269 59 55	090 31 28	101.277	0.0000	No	No	L00019 110020		_
15	1	6	CST02	CST03	SS (	No	1.5510	1.6480	105 14 49	090 08 42	53.601	0.0000	No	No	L00020 110021		
16	1	6	CST02	CST04	SS	400	1.5510	1.6360	095 13 54	090 03 47	122.201	0.0000	No	No	L00021 110022		_
17	1	7	CST02	CST04	SS	Yes	1.5510	1.6360	275 13 59	269 56 17	122.201	0.0000	No	No	L00022 110023		_
18	1	7	CST02	CST03	SS	Yes	1.5510	1.6480	285 13 24	269 54 19	51.601	0.0000	No	No	L00023 110024		_
19	1	7	CST02	CST01	ORO	Yes	1.5510	1.5550	090 00 00	269 28 36	101.277	0.0000	No	No	L00024 110025		_
	+ · -	-	L.	2. · · ·	1.00	v	1 5540		+			0.0000	No	No	11100 44000C		_
													No				

### **Re-run Reduction:**

Go to the 'TRAVERSE tab > Adjust > Reduce'

### Set up the following:

Traverse reduction options			×
Reduce face left / face right	Output results to	Crystal reports	
Reduce multiple rounds	Highlighting tolera	nces	
Search for reversed rounds	dHoriz.Angle	000 00 05	]
Report only, do not store results	dVert.Angle	000 00 10	]
Store differences as obs residuals	dSlope.Dist	0.010	]
Store reduction standard deviations as standard errors	Use LU reduction	method and outp	out
☑ Turn off out of tolerance obs	OK	Cancel	

Press 'Ok'

### **Reduction Report**

From the Pick A Report dialog, select 'SCC Traverse reduction (All).rpt' and Press 'Ok'

Review Results. Note how the Stand Deviation for Slope Distance is now 0.00

#### **Remove Stations From the Project**

Go to Project View, remove stations that have been downloaded from raw file

Select ''EDIT tab > Delete Records' set up the following:

4



### Adjust Traverse Based on Fixed Base Line

Go to 'TRAVERSE tab', Select 'Setup'

Set opening set up as shown below, allowing SCC to generate a RO values:

Opening Station         Reference Object Station           Name         CST02         Image: CST01         Image: CST01	ening Setup	Closing Setup			
Name         CST02         ✓           E/X         10000.000         E/X         10000.000           N/Y         10000.000         N/Y         10101.273           Level/Z         100.000         N/Y         10101.273           Station type         Orientation method         99.072           Y         Fixed         Orientation method         XY           Fixed         © Entered as a Bearing         Z         Fixed           Opening Orientation         000 00 00         000 00         00	Opening S	itation	Reference	Object Station	
E/X         10000.000           N/Y         10000.000           Level/Z         100.000           Level/Z         100.000           Station type         Orientation method           Y         Fixed           © Entered as a Bearing         XY           Fixed         © Calculated from Coordinates           Z         Fixed           Opening Orientation         000 00 00	Name	CST02 V	✓ Name		$\sim$
N/Y         10000.000           Level/Z         100.000           Station type         99.072           Y         Evel/Z           Station type         Orientation method           Y         Exted           Oxer         Entered as a Bearing           Fixed         Image: Calculated from Coordinates           Opening Orientation         000 00 00	E/X	10000.000	E/X	10000.000	
Level/Z 100.000 Level/Z 99.072 Station type	N/Y	10000.000	N/Y	10101.273	
Station type Orientation method Fixed Fixed Opening Orientation Opening Orientation Other Coordinates Opening Orientation Other Coordinates Other Coordinates Opening Orientation Other Coordinates Opening Orientation	Level/Z	100.000	Level/Z	99.072	

Press 'OK'

Select 'Adjust', set up the following and Press 'Ok'

6

Traverse Adjustment		?	×					
Adjustment method								
O Bowditch / Compass Ru	ile							
Least Squares / Variation	n of Coordinates							
Exclude fixed bearing observations for opening and closing set-ups								
Force station constraints								
<ul> <li>Compute provisional val</li> <li>No plan adjustment</li> </ul>	ues only							
<ul> <li>Least squares height adjust</li> </ul>	ment							
O No height adjustment								
Default/manual weighting	ng							
Height accuracy (mm)	3							
Thoight accuracy (min)	1.442	_						
Distance weighting (mm p	er KM)							
Output report filename	TRAVERSE.RI	EP						
o apactoport nonane	3							
Horizontal accuracy (secs)								
Distance accuracy (mm)	5							
Scale accuracy (ppm)	2		/					
Convergence tolerence	0.001							
Maximum iterations	10	Can	cel					

Review Results and select 'Yes, to use provisional coordinates'

### Applying Corrections: Centring Error

Go to 'TRAVERSE tab', Select 'Adjust drop down > Corrections'

Set up Centring Errors as shown below and Press 'Ok':

Corrections		? ×
Refraction, 'k', and curvature		
O No corrections	Standard value for 'k'	0.14
<ul> <li>Earth curvature only</li> </ul>		
<ul> <li>Earth curvature, standard 'k'</li> </ul>	Radius of the Earth	6380000.000
<ul> <li>Earth curvature, calculated 'k'</li> </ul>		
Local Scale Factor		
None applied	Local map scale factor	1
O User defined scale factor	Scale factor along C.M.	1
◯ Transverse Mercator, User defined	Easting of central meridian	0.000
O TM, Ireland (Airy modified)	Minimum survey easting	9968.883
O TM, England (Airy)	Maximum survey easting	10000.000
O ITM, Ireland (GRS80)		
Centring errors		
O Do not compute centring errors	Compute but do not apply	) Compute and apply
Horizontal 0.001 Horizonta (Instrument) (Target)	I 0.001 Veri (Ins	ical 0.001
Horizontal Angle correction	) Vertical Angle corre	ction 000 00 00
Apply temperature and pressure	Apply mean sea level correcti	on
Load defaults Save defaults Rese	t defaults	IK Cancel

**Re-adjust and review report** 

### Level Data

**Open 'Levels.Traverse'** 

600	D 💕 🖬 🖨 🖬 🕫												-	٥	×
Y	Data Traverse													Styl	le 🕶 🕜
New	Stations Features Wizard	Download Upjoad Imp	ort Export Model Sections	Reports Tools	Settings	Printer Page Print Preview	Window	vs Hel	p About						
	Project	Transfer	Create	More		Print	Windo	"	Help						
Rai	Traverse.Project:Station Co	-ordinates Railtrav.Tr	averse:Sheet Levels.Traver:	e:Sheet 🗙											-
	At Stn.	To Stn.	Obs. Type	-Ht Diff-	-Err-	-Hor Dist-	-Err-	-PPM-		Remark	-rHt-	-rD-			~
1	CST01	CST02	Fixed Ht.diiff only	0.9291	0.0000	0.000	0.0000	0.0000			0.0000	0.0000	1		
2	CST02	CST03	Fixed Ht.diiff only	-0.1819	0.0000	0.000	0.0000	0.0000			0.0000	0.0000			
3	CST03	CST04	Fixed Ht.diiff only	-0.0340	0.0000	0.000	0.0000	0.0000			0.0000	0.0000			
4	CST04	CST05	Fixed Ht.diiff only	-1.2575	0.0000	0.000	0.0000	0.0000			0.0000	0.0000			

#### Go to 'TRAVERSE tab', Select 'Adjust'

#### Set up the following:

Traverse Adjustment		?	×					
Adjustment method								
O Bowditch / Compass Ru	le							
O Least Squares / Variatio	n of Coordinates							
Exclude fixed bearing observations for opening and closing set-ups								
Force station constraints								
Compute provisional values only								
No plan adjustment								
Least squares height adjust	ment							
O No height adjustment								
Default/manual weighting	Ig							
Height accuracy (mm)	3							
Distance weighting (mm p	er KM) 1.442							
Output conort filonomo	TRAVERSE.RI	EP						
Output report niename								
Horizontal accuracy (secs)	<u> </u>							
Distance accuracy (mm)	5							
Scale accuracy (ppm)	2		_					
Convergence tolerence	0.001							
Maximum iterations	10	Can	cel					

#### Select 'OK' and Review report

Select 'Yes, to use Adjusted Coordinates'

### Known Station Values

Close existing project and open 'GPSCoords.Project'

603	• 🖆 🖬 🖨 🖬 •											- 0	×
Y	Data Edit											2	tyle 🔻 🝘
New 1	tations Features Wizard	Download Upload Imp	ort Export Moo	Jel Sections	Reports Tools	Settings Print	Printer Page Preview	Help About					
	Project	Transfer		Create	More	Pr	int Window	Help					
Railf	rav.Traverse:Sheet Lev	els.Traverse:Sheet G	PS Coords.Project:	station Co-ordi	nates 🗙								-
	Name	Feature	X,Y Type	Z Type	Source	-E/X-	-N/Y-	-Ht/Z-	-rE/X-	-rN/Y-	-rHt/Z-	Lat	
1	CST01	CONTROL	Fixed	Constrain	Manual	516619.711	257842.745	18.8059	0.010	0.010	0.0050	000 0.00000N	00
2	CST02	CONTROL	Fixed	Constrain	Manual	516720.982	257842.743	19.7350	0.010	0.010	0.0050	000 0.00000N	00
3	CST03	CONTROL	Constrained	Constrain	Manual	516770.773	257829.199	19.5551	0.010	0.010	0.0050	000 0.00000N	00
4	CST04	CONTROL	Constrained	Constrain	Manual	516842.671	257831.599	19.5191	0.010	0.010	0.0050	000 0.00000N	00
5	CST05	CONTROL	Constrained	Constrain	Manual	516929.693	257811.629	18.2616	0.010	0.010	0.0050	000 0.00000N	00

Note: Coordinates are constrained based on information from the GPS report (rE/X, rN.Y, rHt/Z)  $\,$ 

### Run Adjustment

Go to 'TRAVERSE tab', Select 'Adjust'

8

Traverse Adjustment		?	×					
Adjustment method								
O Bowditch / Compass Ru	ıle							
Least Squares / Variation	in of Coordinates							
Exclude fixed bear and closing set-up	ring observations fo s	r openin	g					
Force station constraints								
<ul> <li>Compute provisional val</li> <li>No plan adjustment</li> </ul>	ues only							
Least squares height adjust	ment							
O No height adjustment								
Default/manual weighting	ng							
Height accuracy (mm)	3							
Theight decordey (min)	1 442	7						
Distance weighting (mm p	er KM)							
<b>.</b>	Railtrav.REP							
Uutput report riiename								
Horizontal accuracy (secs)	3							
Distance accuracy (mm)	5							
Scale accuracy (ppm)	2							
Convergence tolerence	0.001	0)	<					
	10	Can	cel					

### Press 'Ok' and Review Report

Select 'Yes, Use Adjustment Values'



## 1.2 Rail Analysis

SCC can be used for analysis and reporting of Rail data.

### 1.2.1 Rail Overlap

String comparison and overlap processing option are available within the model view under 'DESIGN tab > Rail button > Compare strings and remove overlaps'. This requires a model with one or more overlapping strings, and an alignment for reference purposes. The following is an example of the usage of this function based around the sample data provided;

### Creating A Project Directory

From the Main Screen, select 'DATA tab > New'' Enter in a Project/Job name 'Overlap' Select a Project Template from the list 'Default v11 Complex.Project' Select 'OK'

Project name	Overlap
Project template	Default (v11-0-Complex).Project V Pick >>
Project folder	
Use defaul	t SCC project folder
◯ Select an a	alternative folder

#### Create Model

Go to 'DATA tab > Model drop down > SCC Dataset'

Go to \RailData\Model\Biggin.Survey'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'

Model creation	×					
Create the mode	l and triangulation					
View model parameters >>						
Do not triange	ulate the model					
Inital Plot Scale	250.000000 ~					

Select 'Ok' to model attribute dialog

### Select RR String Information

Right click the mouse to bring up the Data Selection Dialog

Select 'All points on selected string' and 'Ok'

Data selection dialog		? ×
Interactive selection method Individual points All points in a window	Mark or clear points Mark selected points Clear selected points	Ok Cancel
All string segments intersecting line     All points on selected string     All similar strings (Same feature)     All points in a polygon	Polygon Selection	Advanced >>
O All points in selected polygon string	Create Polygon	
Mark or clear all points in model	Edit Polygon coordinates	

Left click mouse on RR line strings

### String Overlap

Go to 'DESIGN tab > Overlaps' button

Set up the following:

Process overlapping str	ings	
Feature for joined string	RR	]
Horizontal tolerance	0.005	]
Vertical tolerance	0.005	]
Maximum distance between survey points	20.000	]
Report only, do no ch	ange model	
Interpolate all points o           Use active alignment I	n all strings for reference	
Keep generated alignr	ment	Alignment>>
Do not compare point:	Ok	
<ul> <li>Report string to string</li> <li>Report string to mean</li> </ul>	Cancel	
11		

Press 'Alignment>>', set up the following and Press 'OK':

Create interface alignment			×				
Alignment name Interface0004							
O Create alignment from straights and	d fillet arcs	Add side slopes	to polygon edge				
Fillet radius 0.100	Cut gradient	+1:2.0					
Create alignment from straights and	d arc fits	Fill gradient	+1:2.0				
Minimum chord to arc distance	0.002	Compress geome	etry				
Maximum chord to arc distance	10.000	Horizontal tolerand	.e 0.000				
Minimum horizontal arc radius	1.000	Vertical tolerance	0.000				
Maximum horizontal arc radius	5000.000	Starting chainage	0.000				
Minimum vertical arc radius	0.000						
Maximum vertical arc radius	0.000	OK	Cancel				

Pick 'String Overlap (Diff).rpt' and Press 'OK'

Pick a report	>	K
String Overlaps (Diffs).rpt	Pick>>	1
SCC traverse blunder (Dbs).rpt SCC traverse blunder analysis.rpt SCC traverse reduction (All.rpt SCC traverse reduction (All.rpt SCC traverse reduction (Faces only).rpt SCC traverse reduction.rpt SCC traverse reduction.rpt SCC traverse reduction.rpt Scction heights (all.rpt Section heights (all.rpt Section radial comparisons (with X,Y).rpt Section radial comparisons.rpt Section radial comparisons.rpt	Cancel	]
Setup Misclosures and Checks.rpt Setup Misclosures.rpt String Overlaps (all rpt String Overlaps (Difs) rpt	~	

**Review Report** 

	Tel: Fax: email: web:		St	ring c ([	overla Differen	p col ces of	mpa nly)	risc	on
<u>Point</u> 9122	Feature RR	<u>Chainage</u> 110.670	Offset 0.000	<u>-E/X-</u> 7.767.785	<u>-N/Y-</u> 8.016.056	<u>-Ht/Z-</u> 21.577	<u>dDist</u> 0.001	<u>dZ</u> -0.004	<u>dOfs</u> 0.001
6131	RR	120.677	0.000	7,777.590	8,014.056	21.512	0.002	0.002	-0.002
9123	RR	120.712	-0.002	7,777.624	8,014.051	21.514	0.002	-0.002	0.002
6132	RR	130.774	-0.012	7,787.443	8,011.849	21.443	0.001	0.003	0.001
9141	RR	301.890	0.005	7,945.216	7,947.420	20.812	0.004	-0.003	-0.004
9142	RR	312.114	0.005	7,953.915	7,942.049	20.799	0.004	-0.002	-0.004
1037	RR	784.188	0.000	8,237.370	7,572.316	19.813	0.003	-0.004	0.003
2102	RR	784.192	0.002	8,237.370	7,572.311	19.810	0.005	0.004	-0.002
1036	RR	784.188	0.000	8,237.370	7,572.316	19.814	0.005	-0.004	0.002
2103	RR	794.331	0.000	8,242.384	7,563.499	19.785	0.001	0.005	0.001
1038	RR	794.352	0.001	8,242.393	7,563.481	19.790	0.001	-0.005	-0.001
1039	RR	804.406	0.001	8,247.364	7,554.741	19.766	0.001	0.000	0.000

### Repeat String Overlap

Go to 'DESIGN tab > Overlaps' button

Set up the following and Press 'Ok':

This time ensure that 'Report only, do not change model' is not selected and 'Use active alignment for reference' is selected

Process overlapping strings								
Feature for joined string	RR							
Horizontal tolerance	0.005							
Vertical tolerance	0.005							
Maximum distance between survey points	20.000							
Report only, do no cha	nge model							
Interpolate all points on	i all strings or reference							
Keep generated alignment in	ient	Alignment>>						
Do not compare points	on same string	Ok						
<ul> <li>Report string to string d</li> <li>Report string to mean of</li> </ul>	lifferences lifferences	Cancel						

On completion note the RR string is one complete string



### 1.2.2 Cant & Gauge Reporting

Using the opened data a Cant & Gauge report can be generated.

### **Reporting Cant & Gauge**

Go to 'DESIGN tab > Rail drop down menu > Report cant and gauge'

Note there must be an active alignment present

Set up the following and Press 'OK'

Report Rail cant and gauge	$\times$
Left Rail String RL (30) V N Right Rail String RR (34) V	
Ref. Rail String RR (40)	
Chainages	
From 0.000 To 894.076 Interval 10.000	
Out sections for analysis Use survey points	
Gauge 1.43 Tolerance 0.003 OK Cance	(



Pick a report	×
Rail guage and cant.rpt	Pick>>
DCC_StationDescriptionSheet_Detail.tpt       ,         Detail Dbservations.tpt       ,         distance residuals sit.rpt       ,         File CRCs.tpt       ,         File statis.tpt       ,         Formation adjustment.tpt       ,         Horizontal entity differences.tpt       ,         Log File (Actions, onles, warnings, and errors).tpt       ,         Log File (Actions, vors only).tpt       ,         Log File (Attions, vors, notes, warnings, and errors).tpt       ,         Log File (Attions angle Survey) (Coords).tpt       ,         Platorm Gauge Survey (Log state, pt)       ,	OK Cancel
Rail guage and cant (4 dp).rpt Rail guage and cant.rpt	

**Review Report** 

### 1.2.3 Lift & Slue Reporting

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Using the opened data a Lift & Slue report can be generated.

#### Remove Existing Alignment

Go to 'DESIGN tab > Attach'

Highlight attached alignment, select 'Detach All' and 'Ok'



#### Attach Design Alignment

Go to 'DESIGN tab > Attach drop down menu > Alignment'

Select ' \rail-day\Lift & Slue\MC02.Alignment'

#### **Reporting Lift & Slue**

Go to 'DESIGN tab > Rail drop down menu > Report Lift and Slue

Pick a report		×
Rail lift and slue.rpt		Pick>>
distance residuals str.rpt File CRCs.rpt File stats.rpt Formation adjustment.rpt	^	OK
Horizontal entity differences.rpt Log File (Actions only).rpt Log File (Actions, notes, warnings, and errors).rpt Log File (Actions, vars only).rpt		Cancel
Log File (All) rpt Log File, current document (Actions, notes, warnings, and errors) rpt Log File, last option (Actions, notes, warnings, and errors).rpt		
Flation Cauge Survey (Loods), pr Plation Cauge Survey, pt Rail guage and cant, [4 dp], pt Rail guage and cant, pt		
Rail guage cant and ref.rpt Rail lift and slue.rpt	v	



### 1.3 2nd Rail

Using Parallel offset options within SCC, a 2nd rail string can be generated.

Go to 'DATA tab > Model drop down > SCC Dataset'

Go to '\rail-day\2nd Rail\Rail2.Survey'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'

Model creation	×
Create the mode	el and triangulation
View model	parameters >>
Do not triang	ulate the model
Inital Plot Scale	250.000000 🗸

Select 'Ok' to model attribute dialog

### Additional String

Go to 'ADD tab > Parallel'

Set up the following Copy Parallel Options

Pick RD string on screen and then 'CheckCantAndGauge.rpt' from dialog. Press 'Ok'

• (= = = = 1		- 0 X
Data View Model	Add Annotate Design Analysis Tools Cloud	Style 👻 🧭
Ftr. 0 Tag Straight Select Snaps DTM DTM Elevation	Image: Provide state state     Provide state	
Copy parallel 4 ×	Overlap.Project:Station Co-ordinates BIGGIN (AutoSave).Model RAIL2 X RAIL2.Survey:Co-ordinates	÷.
Vertical offset     Prevent seture name     PR     Preve feature name     PR     Prevent seture name     Prevent nam     Prevent name     Prevent name     Prevent nam     Prevent	Pick a report Pick a report Pick Agment heigh differences pt Deck Agment heigh differences pt Hours odsubment pt Hours odsubment pt Hours odsubment pt	H
Apply Close		
X:1008.279 Y:1996.281 Z:0.000 RD Ro	d (STRING) Point 10	Copy parallel:Select string Snap Off

#### **Review Report**

Select Yes to 'Create rail string' and click on screen to position string

SCCW64r		×
() Cr	ate rail string?	
Ye	s	<u>4</u> o

### 1.4 Import Amberg Data

An input routine to support the Amberg Trolley data provided. This creates two points per line, one for left rail, one for right rail, using the station for string number and ident for point number. D1,D2, and D3 are used to store odometer, gauge, and super-elevation in the input file, such that they can be annotated as required. The rail features are named LRAIL and RRAIL.

Close all dataset and models. Leave existing Project file open

#### Importing Amberg Trolley Data

Go to 'DATA tab > Import drop down menu > Amberg GRPWin'

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oject oject:Station Co-ordinates × Name Fee CONTROL CONTROL CONTROL	Transf Comma Separated Fixed format ASCII ture DWG, DXF or DGN LandXML file	l File I file I file <b>ype</b>	More Source	Prir -E/X-	it Window	Help H	
Name Fez CONTROL CONTROL CONTROL	ture DWG, DXF or DGN LandXML file	file ype	Source	-E/X-	N/Y		
CONTROL CONTROL CONTROL	LandXML file		Manual			-Ht/Z-	
2 CONTROL 3 CONTROL	V V 7 ASCII file		Ividriudi	8289,403	7466.442	18,7812	_
CONTROL			Manual	8205.713	7633.935	19.2152	
	A, I, Z ASCITTIC		Manual	8100.104	7794.534	19.7742	
CONTROL	MX GENIO file		Manual	8026.191	7891.846	19.7262	ι
CONTROL	User defined ASCI	ll File	Manual	7873.212	7986.903	20.4252	L
6 CONTROL	ESRI shape file		Manual	7677.737	8026.572	22.5392	
CONTROL	Import SCC Text Fil	le	Manual	8220.311	7587.830	19.2725	
CONTROL	Ambara AD2		Manual	1000.000	2000.000	30.0000	
CONTROL	Amberg AR2		Manual	7844.535	7997.060	22.1815	
CONTROL	Amberg GRPWin		Manual	8134.924	7756.470	21.4679	8 19 - 69
	ASCII Wriggle surv	vey					
	Move3 stations						
	STAR*NET stations						
	CONTROL CONTROL CONTROL	CONTROL CONTROL CONTROL CONTROL Abberg GRPWin ASCII Wriggle sur Move3 stations STAR*NET stations	CONTROL CONTROL CONTROL Amberg GRPWin ASCII Wriggle survey Move3 stations STAR*NET stations	CONTROL     Amberg AR2     Manual       CONTROL     Amberg GRPWin     Manual       CONTROL     AsCII Wriggle survey     Manual       ASCII Wriggle survey     Move3 stations       STAR*NET stations	CONTROL     Amberg AR2     Manual     1000.000       CONTROL     Amberg GRPWin     Manual     7844.535       CONTROL     Ascil Wriggle survey     Manual     8134.924       ASCII Wriggle survey     Move3 stations     STAR*NET stations	CONTROL     Amberg AR2     Manual     1000.000     2000.000       CONTROL     Amberg GRPWin     Manual     7844.535     7997.060       CONTROL     Ascri Wriggle survey     Manual     8134.924     7756.470       Move3 stations     STAR*NET stations     STAR*NET stations     1000.000     2000.000	CONTROL         Amberg AR2         Manual         1000.000         2000.000         30.0000           CONTROL         Amberg GRPWin         Manual         7844.535         7997.060         22.1815           CONTROL         Amberg GRPWin         Manual         8134.924         7756.470         21.4679           Move3 stations         STAR*NET stations         STAR*NET stations         STAR*NET stations         STAR*NET stations

Pick 'DN Branch.asc', set up the following and then Press 'OK'

ile	C: pcc yairuay (okr u		anunasu				~ >>	
ield ma	appings Left rail			Track			Right rail	
01	Radius [m]	~	D1	Radius [m]	~	D1	Radius [m]	~
02	Super elev. meas.	$\sim$	D2	Super elev. meas.	~	D2	Super elev. meas.	~
3	Twist	~	D3	Twist	$\sim$	D3	Twist	~
Offset	Gauge	~	Offset	Gauge	~	Offset	Gauge	~

The dataset is present whereby the D1 is Dist, D2 is Gauge and D3 is Cant

	D 💕 🖬 🏟 😭 🔻														-	٥	×
Y	Data Survey															Sty	yle 🔹 🕜
New	Stations Features Wizard	Downlo	ad Upload	I Import Export	Model Sections	Reports	X C Tools Settin	ngs Print Print Print Previo	er Di Windows	Help About							
	Project	_	Trans	fer	Create		More	Print	Window	Help							
Ove	erlap.Project:Station Co-ordin	nates	DN Bran	ch:Co-ordinates	<mark>د</mark>						Dist.	Gauge	Cant				
	No.	Str	Pos	Feature	Туре	Tag	DTM	-E/X-	-N/Y-	-Ht/Z-	D(1)	D(2)	D(3)	Chainage	Offset	Obs#	Grc
1	1	1	0	LRAIL	Man	S	D	1900.265	3136.262	99.1428	0.0000	-0.0017	0.2208	-200.000	1.438	1	C
2	2	1	1	LRAIL	Man	S	D	1899.329	3146.172	99.1945	0.0000	0.0005	0.2208	-190.046	1.437	2	C
3	3	1	2	LRAIL	Man	S	D	1898.380	3156.135	99.2514	0.0000	-0.0028	0.3385	-180.038	1.438	3	C
4	4	1	3	LRAIL	Man	S	D	1897.449	3166.056	99.2979	0.0000	-0.0000	0.2821	-170.072	1.440	4	C
5	5	1	4	LRAIL	Man	S	D	1896.523	3175.996	99.3414	0.0000	-0.0001	0.0095	-160.088	1.443	5	C
6	6	1	5	LRAIL	Man	S	D	1895.593	3185.928	99.3790	0.0000	-0.0075	0.7370	-150.114	1.441	6	C
7	7	1	6	LRAIL	Man	S	D	1894.644	3195.880	99.4434	0.0000	-0.0002	0.7310	-140.118	1.438	7	C
8	8	1	7	LRAIL	Man	S	D	1893.713	3205.786	99.4864	0.0000	-0.0030	0.2798	-130.167	1.438	8	C
9	9	1	8	LRAIL	Man	S	D	1892.773	3215.750	99.5446	0.0000	-0.0013	0.1696	-120.160	1.440	9	C
10	10	1	9	[ RAIL	Man	S	D	1891.850	3225 667		2 0202	-0.0067	0.5468	-110.198	1.439	10	0

### Create Model

Go to 'DATA tab > Model drop down > SCC Dataset'

Pick 'DN Branch.Survey'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'

Model creation	×
Create the mode	el and triangulation
View model	parameters >>
Do not triang	ulate the model
Inital Plot Scale	250.000000 ~

Note the Chainage/Offset system present is been read from the dataset not an active Alignment

### 1.5 Design From XML

The following describes how to create different surfaces in SCC from a given design and export to XML for Machine Guidance.

- Design data will be provided as an XML file with a given centreline string including cant and gauge

- Three design surfaces are generated: Rails (including gauge and cant), Ballast and Formation
- The Ballast layer will ramp down at chainage 380m and ramp up at chainage 480m
- A 0.300m gap will be maintained from the lowest sleeper end to formation

### 1.5.1 Create A Project Directory

From the Main Screen, select 'DATA tab > New'

Enter in a Project/Job name 'Design from XML

#### Select a Project Template from the list 'Default v11 Complex.Project'

### Select 'OK'

New Project		?	$\times$
Project name Project template	DesignFronXML Default (v11-0-Complex).Project  V	Pick 3	>>
Project folder Use default Select an al	SCC project folder ternative folder		
	ОК	Cancel	

### 1.5.2 Modelling LandXML file

#### Within the 'DATA tab > Model drop down > LandXML file'

Data Edit	Download Upload Im	port Export	Mode	Sections	Reports	X Tools	Settings	Print F	Printer Page Preview	Windows	(?) Heip	<b>C</b>
Project	Transfer			SCC Dataset		e.,		Prir	nt	Window	۲	
DesignFromXML.Project:Static	n Co-ordinates 🗙			Point cloud	and LIDA	R 🕨						
Name	Feature	X,Y Typ		SCC Text file		,	-	E/X-	-	N/Y-	-Ht/	
				LandXML file X,Y,Z ASCII fi User defined MX GENIO fi ESRI shape fi ADB tree file Legacy form Feature libra	e le d ASCII Fil- ile ile ats ats	e ,						

Go to '\rail-day\Design XML\Biggins v1.1.xml' and Press 'Open'

Select Initial Plot Scale of 250 and 'Create the model and triangulation'

Model creation	×						
Create the mode	el and triangulation						
View model parameters >>							
Do not triangulate the model							
Inital Plot Scale	250.000000 ~						

Select 'Ok' to model attribute dialog

#### Set up the following and press 'Ok'

LandXML input options	×					
Input surface points						
Input surface triangles (slow on big models)						
Input alignment information as SCC alignments						
Input alignment information as strings						
OK Cancel						

Select 'Home' within Model to Zoom Extent

### 1.5.3 Attach Design Alignment

Within Model, go to 'DESIGN tab > Attach drop down menu > Alignment' Select 'Prop CL copy.Alignment

### 1.5.4 View Design Information

			v
	-	U	~
Data View Model Add Annotate Design Analysis Tools Cloud		Style	• 🕲
$\mathbb{R}$ $\wedge$ $\sim$ $\approx$ $\approx$ $\sim$ $\approx$ $\sim$ $\approx$ $\mathbb{R}$ $\approx$ $\approx$ $\approx$ $\approx$ $\approx$ $\approx$ $\approx$ $\sim$			
Horizontal Vertical Template String Move Rail Overlaps Model Dataset Attach View Tools Options			
Alignment Rail Export Horizontal Intersection Points Measure			
DesignFromXMLProjectStation Co-ordinates SCC Model15 x Prop CL copy:Horizontal Geometry Entitle Vertical Intersection Points			•
Horizontal Entities			
Vertical Entities			
Super-tereation Bail Cant			
Section template points			
Error at point 1, SPOT, Steps, Illegal first link at vertex 23	Select points Sr	hap Off	

Within the 'DESIGN tab > View > Vertical Entities'

600	🗋 💕 🖬	🖶 📬 🗧							
Y	Data	Design							
New	Stations Fe	Ftr Ftr atures Wizard t	nload Upload Impor	t Export Mode	Sections Reports	Tools Setting More	s Print Print Preview Print	Windows Window	Help About
De	signFromXM	IL.Project:Station Co-or	dinates SCC Mo	del16 Prop CL	. copy:Horizontal Geon	netry Entities	Prop CL copy.Alig	gnment:Vertica	l Geometry Entit
	No.	Туре	Chainage(1)	Length	Base Level	Gradient	Grade Diff.		
1	1	Straight	80.033	180.108	19.7761	+1:451.5	0.0		
2	2	V.Curve	260.140	0.000	20.1750	+1:451.5	+1:1069.7		
3	3	Straight	260.140	190.130	20.1750	+1:781.3	0.0		
4	4	V.Curve	450.271	0.000	20.4184	+1:781.3	+1:1453.8		
5	5	Straight	450.271	139.729	20.4184	+1:1689.0	0.0		
6	6	V.Curve	590.000	20.000	20.5011	+1:1689.0	-1:356.2		
7	7	Straight	610.000	110.306	20.5410	+1:294.1	0.0		
8	8	V.Curve	720.306	0.000	20.9160	+1:294.1	-1:500.7		
9	9	Straight	720.306	99.694	20.9160	+1:185.3	0.0		
10	10	V.Curve	820.000	20.000	21.4540	+1:185.3	-1:171.5		
11	11	Straight	840.000	39.879	21.6203	+1:89.1	0.0		

Within the 'DESIGN tab > View > Rail Cant'

New S	tations Features W	itr Do	wnload Up	oad Import Export	Model Sections Create	Reports Tools Settings More	Printer Page Print Preview Print	Winde Winde
Desig	gnFromXML.Project:	Station Co-	ordinates	SCC Model16	Prop CL copy:Horizo	ontal Geometry Entities	Prop CL copy.Align	mentrive
	Chainage	Cant	Rot					
	10.000	0.000	CW					
	289.715	0.000	CCW					
	343.156	60.000	CCW					
	761.113	60.000	CCW					
	773.313	60.000	CCW					
	879.856	60.000	CCW					

NOTE: If no Cant values where present in the XML file, values can be entered manually by viewing Rail Cant and then selecting 'DESIGN tab > Insert Records'. Cant is entered in mm. CW is Clockwise / CCW is Counter Clockwise.

Save Alignment

### 1.5.5 Creating Design Gauge & Cant

Go to 'DESIGN tab > Template button'

Then 'DESIGN tab > Tools > Enter gauge and compute cant'

<b>60</b> • • • • • • • • • • • • • • • • • • •		- 8 ×
Data Design		Style 👻 🥑
Open Search Search Alignment Delete Net         Open Search S	Artical Template Options Design Select reference alignment	
Section 1 Chainage 0.000 V.E 1 V.H.Grid 1.0 V.Grid 1.0 Cut Fill	Create an offset string	
Template design P X DesignFromXMLProject(Station Co-ordinates SCC Model1	Prop CL conv Alignment	
Templete Design Action	Set gradient of selected points	
⊖Add ⊖ Move ⊖ Delete ● Edit	Set Chainage/Offset for selected p	oints
	Plane fit selected points	
	Undo design option	
Apply to	Compute Horizontal Entities	
Approx	Compute Vertical Entities	
	Compute Super-Elevation	
Surface 000 Top-Surface V	Enter gauge and compute cant	
Feature SL	Check and report design geometry	
Horizontal component	Remove duplicate section template	3 20 000
Select with cursor	2.0 Compress Geometry	20.000
O Horizontal Offset 0.000	Average radii for entity range	1
O Width 0.000	Export to model	
O Slope Length 0.000		
Visited Community Soft by		0.0
Venical Component     String     Interview of the string     Interview of the string     Interview of the string		
Vertical Offset 0.000		
New section	-πR	
O C C C D D New Surface		1220
	-2.0	-4.0
Interface side slopes Undo		20
Left slope	-3.0	-3.0
Error at point 1, PROPCLCOPY, Pier (2PT + W), Illegal first link at vertex 23		Select points Snap Off

Set up the following:

Compute rail grade and run-off	×						
Default values O Use last entered values							
Gauge 1.507 Apply cant	Report cant by chainage  Right rail Feature 0/ffset 0.718						
Add sleepers to template Apply can Left sleeper Feature SLPL Offset 1.2	t from edge of sleeper Right sleeper Feature SLPR ~ Offset 1.2						
Create Template	OK Cancel						

### NOTE:

The dialog uses values from the input XML file

**Enter the Cant Base** 

Apply cant will apply cant form Cant Station (Cant entered is mm)

Report Cant by Chainage will give a report file showing cant, gauge and rail levels before continuing

Add Sleepers to template will include sleepers on the rail surface

Apply cant from edge of sleeper will apply cant from edge of sleeper

Select 'Create Template' which will use setting to create a section template

#### Press 'OK' to create a report

Prop CL copy.	Alignment-Cant.r	ep - WordPad								$\sim$		$\times$
File Edit View	Insert Format	Help										
			<b>B</b>									
Rail cant o Date: Mon F Alignment: Gauge: 1.50	check report Feb 20 08:56: Prop CL copy 07 Left Rail	:40 2017 Y.Alignmer L:RL Offse	nt et -0.718	Right Rail:	RR Offset 0.	.718						^
Cant applie Chainage	d from low s CL Height	Rail L.Cant	Rail R.Cant	per:SLPL Off Rail L.Height	Rail R.Height	Sleeper L.Cant	Sleeper R.Cant	Sleeper L.Height	Sleeper R.Height	Direct	tion	
10.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Pight	(CW)	
20.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right	(CW)	
30,000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right	(CW)	
40.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right	(CW)	
50.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right	(CW)	
60.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right	(CW)	
70.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right	(CW)	
80.000	0.000	+0.000	+0.000	0.000	0.000	+0.000	+0.000	0.000	0.000	Right	(CW)	
90.000	19.798	+0.000	+0.000	19.798	19.798	+0.000	+0.000	19.798	19.798	Right	(CW)	
100.000	19.820	+0.000	+0.000	19.820	19.820	+0.000	+0.000	19.820	19.820	Right	(CW)	
110.000	19.842	+0.000	+0.000	19.842	19.842	+0.000	+0.000	19.842	19.842	Right	(CW)	
120.000	19.865	+0.000	+0.000	19.865	19.865	+0.000	+0.000	19.865	19.865	Right	(CW)	
130.000	19.887	+0.000	+0.000	19.887	19.887	+0.000	+0.000	19.887	19.887	Right	(CW)	
140.000	19.909	+0.000	+0.000	19.909	19.909	+0.000	+0.000	19.909	19.909	Right	(CW)	
150.000	19.931	+0.000	+0.000	19.931	19.931	+0.000	+0.000	19.931	19.931	Right	(CW)	
160.000	19.953	+0.000	+0.000	19.953	19.953	+0.000	+0.000	19.953	19.953	Right	(CW)	
170 000	10 075	10 000		10 075	10 075			10 075	10 075	Di -ba		
r Heip, press Fl												

A Section Template is created.

20



### 1.5.6 Applying Sleeper Vertical & Horizontal Offset

Within Template Design, select 'EDIT'

Left click mouse on 'SLPL' on screen

Set up SLPL: Horz. Offset -1.20 / Vert. Offset -0.3 (300mm lower than rails) as shown Press 'Apply'



Left click mouse on 'SLPL' on screen

Set up SLPR: Horz. Offset 1.20 / Vert. Offset -0.3 (300mm lower than rails) as shown Press 'Apply'



### 1.5.7 Add Ballast Layer

Select 'New Surface'

Set up the following and Press 'OK'

Create new design surface								
New Surface Name	BALLAST							
Copy from Surface	RAILS							
🗹 Do not copy Cut/	Do not copy Cut/Fill specific elements							
Add new surface for all sections     Only add new surface at current section								
From Left Offset	-1.200							
To Right Offset	1.200	OK						
Vertical Shift	0.300	Cancel						



### 1.5.8 Removing Sleepers From Ballast Surface

#### Select 'Delete'

Left click mouse on 'SLPL' and then select 'Delete Point'

Left click mouse on 'SLPR' and then select 'Delete Point'



SLPL RL

RE SLPR

0.0

-1.0

004

### 1.5.9 Editing Ballast Surface

Select 'Edit' Left click mouse on 'BL' point Enter Horz, Offset -0.2 and Vert. Offset -0.3 Press 'Edit Point'

0.0

-1.0

23

CO Deta Deta	-	O X
Search Search and replace Unde	Redo     Cys     Copy     Paste     Horizontal Vertical Template     Vertical Template     Options     Topio       to     Cipboard     Vere Shet     Delign     Hetip	Julie D
Section 1 Chainage 0.000 V.E 1 🗘 🗸	H.Grid 1.0 V.Grid 1.0 Cut Fill	
Template design # ×	DesignFromXMLProject:Station Co-ordinates SCC Model1 Prop CL copyAlignmentSection Template Design x	-
Template Design Action O Add O Move O Delete Press left button to update point		
	Section 1 Chainage 0.000 to 879.85	6
Apply to	2.0 2.0	
Cut and Fill     Cut Univ     Fill Univ		
Surface BALLAST ~		
Sclost with surger		
Horizontal Difset -2.000		
Owidth -2.718	BL SLPL . RR . SLPR	
O Slope Length -2.718		
Vertical Component Sort by Select with cursor number	-1.0 -1.0	
Vertical Offset     0.000     Height     0.0     New section     New section		
Usradent         Interface side slopes           Interface side slopes         Undo           Left slope         Right slope           0.0         0.0		
Horizontal Offset -6.743 , Vertical Offset 0.592	Press left button to update point	

Left click mouse on 'BR' point

Enter Horz, Offset 0.2 and Vert. Offset -0.3

Press 'Edit Point'



### 1.5.10 Add Formation Layer

Select 'New Surface'

Set up the following and Press 'OK'

24





### 1.5.11 Removing Sleepers From Formation Surface

### Select 'Delete'

Left click mouse on 'SLPL' and then select 'Delete Point'

Left click mouse on 'SLPR' and then select 'Delete Point'

	- a :	<
Data Design	Style *	0
Search Sector Ald replace	Korcontal Vetrical Template Options Tools View Sheet Design Help	
Section 1 Chainage 0.000 V.E 1 V.Grid 1.0 V.Grid 1.0	]Cu []Fil	
Template design # × DesignFromXML.Project:Station Co-or	ordinates SCC Model1 Prop CL copy.Alignment:Section Template Design ×	-
Template Design Action Add Move Delete Edt Use left mouse button to select point to delete	Section 1 Chainage 0 000 to 879 856	
Apply to		
Cut and Hill Obuilding Orinit Unity     Surface BALLAST      RL		
Hotizontal component     Select with cursor     Hotizontal fifthe     2000	0.0 RL	
O width         -4.000           O Slope Length         -4.000	-1.0 -1.0	
Vertical Component Sott by string string Select with cursor rumber  Vertical Offset 0.030	- FL - BB	
O Height 0.000 O Gradient 0.0 New Surface		
Interface side slopes Undo Lett slope  0.0 Delete Point Delete Point	-3.0	
Horizontal Offset 1.270 , Vertical Offset -2.055	Use left mouse button to select po	

### 1.5.12 Editing Formation Surface

Need to change Feature Codes on Formation surface and apply offset and grade change Select 'Edit'

-----

Left click on 'RL' on Formation Surface

Enter New feature code 'FL'

Horz, Offset -2 and Gradient +1:30

Press 'Edit Point'

Left click on 'RR' on Formation Surface

Enter New feature code 'FR'

Horz, Offset 2 and Gradient -1:30

**Press 'Edit Point'** 

<b>60 1 2 3 4 3 1</b>		- 8 ×
Data Design		Style 👻 🛞
Search Search Replace Global Inset Delete Next Control of the search and replace	Image: Constraint of	
Section 1 Chainage 0.000 V.E 1 🜩	□ H.Grid 1.0 □ V. Grid 1.0 □ Cut □ Fil	
Template design # ×	DesignFromXMLProject:Station Co-ordinates SCC Model1 Prop CL copy.Alignment:Section Template Design x	
Template Design Action ○Add ○ Move ○ Delete ● Edit		
Press left button to select point	Section 1 Chainage 0.000 to 8	379.856
Apply to Cut and Fill O Cut Only O Fill Only	-03 -03 -03 -03 -03 -03 -03 -03 -03 -03	
Surface FORMATION	1.0 1.0	
Horizontal component		
Horizontal Offset     2.000	0.0 RL RR 0.0	
Slope Length 4.002	-1.0 FL -1.0	
Vertical Component Sort by Select with cursor number	TR	
O Vertical Offset -0.976 O Height 0.133	-2.0 -2.0	
Gradient +1:30.0 New Surface	-04 -03 -03 -03 -01 -03 -03 -03 -03	
Interface side slopes         Undo           Left slope         Right slope           0.0         0.0   Edit Point		
Horizontal Offset 3.493 , Vertical Offset -1.769	Press left button to s	select point

### 1.5.13 Adding Ramp at Chainage 380 to 480

Ramp down at Chainage 380 and ramp up at Chainage 480

#### Select 'New Section'

Enter Starting chainage for new template of 380 and press 'OK'

Create a new section template	×
Starting chainage for new template	, 380
OK	Cancel



### Select 'New Section'

Enter Starting chainage for new template of 400 and press 'OK'

Create a new section template	×
Starting chainage for new template	400
ОК	Cancel

### 1.5.14 Inputting Ramp Design on Ballast layer

Section 3 Chainage 400

Select 'Edit'

Left click on 'BL' on Ballast Surface

Horz, Offset -2 and Vert. Offset -0.9

Press 'Edit Point'



Left click on 'BR' on Ballast Surface Horz, Offset 2 and Vert. Offset -0.9

### Press 'Edit Point'

		- 11 X
Data Design		Style * 🖗
Search Replace Global Insert Delete edit Records Search Replace Slobal Insert Delete	of Redo Copy Pate Informatial Vertical Template Options Tops Undo Clapbard Vertical Template Options Tops Help About Help About Help About	
Section 3 Chainage 400.000 V.E 1		
Template design 🗛 🗙	DesignFromXMLProject:Station Co-ordinates SCC Model1/ Prop CL copy.Alignment:Section Template Design x	•
Template Design Action Add Move Delete   Edit		
Press kett button to update point Apple to Cut Only Field Out Only	Section 3 Chainage 400.000 t	0 879.856
Horizontal Offset -6.507 , Vertical Offset -1.269	I Press left button t	o update point

### Select 'New Section'

Enter Starting chainage for new template of 480 and press 'OK'

Create a new section template	×
Starting chainage for new template	480
ОК	Cancel



#### Select 'New Section'

Enter Starting chainage for new template of 500 and press 'OK'

Create a new s	ection templa	te	Х
Starting chainage	ate 500		
	OK	Cano	el

Section 5 Chainage 500

#### Select 'Edit'

Left click on 'BL' on Ballast Surface

### Horz, Offset -2 and Vert. Offset -0.3

#### Press 'Edit Point'



Left click on 'BL' on Ballast Surface

Horz, Offset 2 and Vert. Offset -0.3

Press 'Edit Point'



#### Save Alignment

Template is visible on the model displaying the alignment



### 1.5.15 Export Rail Design

Go to 'DESIGN tab > Model' Export

Set up the following and press 'Ok':

Export alignment	?	×	
Chainage Interval		OK	
Generate interface strings	(	Cancel	
Create boundary from interface string			
Create slope signature strings (tadpoles)			
Design Surface to export RAILS	~	All	
Existing ground surface		Pick >>	
Design strings surface		Pick >>	
Chainage range			
◯ Entire alignment			
Limited chainage range			
From 300 To 550			
O Limit to section template bounds			
Apply Super-Elevation / Cant			

Press 'Ok' to model attribute dialog

### 1.5.16 Triangulate Rail Model

Within 'MODEL tab > Edit'

Using 'All triangles intersecting line' as the Selection Method and 'Remove triangle' as the 'Action', edit the TIN



### Select 'Apply'

Select 'Yes' to 'Store model boundary as a string'

SCCW64r		×
0	Store model boundary as a string ?	
	Yes <u>N</u> o	

Save Model as 'RAIL.Model'

### 1.5.17 Long Section With Cursor

Go to 'ANALYSIS tab > L. Sect button'

Left click mouse to pick first point of section and then again to pick second

Right click mouse to finish

A profile of the Rail surface is created

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### 1.5.18 Export Ballast Design

Go to 'DESIGN tab > Model' Export

Set up the following and press 'Ok':

Export alignment ?	×		
Chainage Interval 10.000	ОК		
Generate interface strings	Cancel		
Create boundary from interface string			
Create slope signature strings (tadpoles)			
Design Surface to export BALLAST			
Existing ground surface	Pick >>		
Design strings surface	Pick >>		
Chainage range			
◯ Entire alignment			
<ul> <li>Limited chainage range</li> </ul>			
From 300.000 To 550.000			
O Limit to section template bounds			
Apply Super-Elevation / Cant			

Press 'Ok' to model attribute dialog

### 1.5.19 Triangulate Ballast Model

Within 'MODEL tab > Edit'

Using 'All triangles intersecting line' as the Selection Method and 'Remove triangle' as the 'Action', edit the TIN



#### Select 'Apply'

Select 'Yes' to 'Store model boundary as a string'



Save Model as 'BALLAST.Model'

### 1.5.20 Export Formation Design

Go to 'DESIGN tab > Model' Export

Set up the following and press 'Ok':

Export alignment	?	×		
Chainage Interval 10.000		OK		
Generate interface strings	1	Cancel		
Create boundary from interface string				
Create slope signature strings (tadpoles	s]			
Besign Surface to export FORMATION	×	All 🗌		
Existing ground surface		Pick >>		
Design strings surface		Pick >>		
Chainage range				
O Entire alignment				
Limited chainage range				
From 300.000 To 550.000				
O Limit to section template bounds				
Apply Super-Elevation / Cant				

Note: Cant is not applied on Formation Level. Untick 'Apply Super-Elevation /Cant'

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### 1.5.21 Triangulate Formation Model

Within 'MODEL tab > Edit'

Using 'All triangles intersecting line' as the Selection Method and 'Remove triangle' as the 'Action', edit the TIN

Select 'Apply'

Select 'Yes' to 'Store model boundary as a string'

Save Model as 'FORMATION.Model'

Three Triangulated Model have been created.

#### 1.5.22 Check & Adjust Formation Levels

In order to maintain fixed depth levels between low rail and Formation, the 'Check and adjust formation levels' tool can be utilised.

#### Go to 'DESIGN tab > Rail > Check and adjust formation levels'

#### Set up the following including required vertical seperation and press 'Ok'

Adjust formation I	evels		×
Alignment	Prop CL copy.Alignment	~	>>
Rails model	RAILS.Model	~	>>
Formation model	FORMATION.Model	~	>>
Vertical seperation	0.4	OK Can	cel

#### Select 'Ok' to model attribute dialog

Pick 'Formation adjustment.rpt' file and press 'Ok'

Pick a report		×
Formation adjustment.rpt		Pick>>
Alignment height differences.rpt angle residuals srt.rpt Dheck Alignment.rpt	^	OK
Check as-built.pt Check shots (Leica HexML).pt Check shots.pt		Cancel
Check survey.pt CheckCantAndGuage.pt Checks shots.pt		
CoordDups.rpt DCC_StationDescriptionSheet_Detail.rpt Detail Observations.rpt		
distance residuals str.rpt File CRCs.rpt File stats.rpt		
Formation adjustment.rpt Horizontal entity differences.rpt	~	

The report details the Level adjustment, the exact difference in height between formation and low rail, and the chainage is note

SCC Report viewer					– a ×
🗿 🚝 📉 < → H 🔢 /5	💌 🌮 🌮 🛍 🕅 100% 🔍				Business Objects
Preview					
300.00				web:	^
310.00					
- 330.00					
340.00		For	matio	n adjustment	
350.00		101	mano	in adjustinent	
360.00					
370.00	Alignment model:	Prop	CL copy.Alignm	ent	
- 380.00	Original formation m	nodel: FOR	ATION, Model		
400.00	Minimum formation	depth: 0.40	0		
410.00					
- 420.00	Chainage: 300.000	Leve	adjustment:	0.432	
430.00	Feature	Offeet	Level/7	Depth to formation	
440.00	SLPL	-1.200	19.922	0.400	
450.00	RL	-0.718	20.226	0.720	
470.00	SLPR	1.200	19.941	0.498	
480.00					
490.00	Chainage: 310.000	Leve	adjustment:	0.429	
500.00	Feature	Offeet	Level/7	Depth to formation	
510.00	SLPL	-1.200	19.932	0.400	
520.00	RL	-0.718	20.239	0.723	
540.00	SIPR	1 200	20.201	0.793	
- 550.00					
	Chainage: 320.000	Leve	l adjustment:	0.425	
	<u>Feature</u>	Offset	Level/Z	Depth to formation	
	SLPL	-1.200	19.941	0.400	
	RR	0.718	20.284	0.807	
	SLPR	1.200	19.995	0.534	
	Chainage: 330.000	Leve	l adjustment:	0.422	
	<u>Feature</u>	Offset	Level/Z	Depth to formation	
	SLPL	-1.200	19.950	0.400	
	RL	-0./18	20.264	0.731	· · · · · · · · · · · · · · · · · · ·

The report can be exported to various formats

Format:		OK
		Grand
Destination:		Cancel
) 🗇 Disk file	•	

A new Adjusted Formation Model has been created.

Edit the TIN as above.

Save as 'AdjustedFormation.Model'

### 1.5.23 Combining Models & Alignment for QA puposes

As a QA check, models can be combined and section generated.

Within 'RAILS.Model', go to 'DESIGN tab > Attach drop down > Model' Select 'BALLAST.Model' and then repeat, to select 'AdjustedFormation.Model' Go to 'DESIGN tab > Attach drop down > Alignment' and select Alignment file



Go to 'ANALYSIS tab > L.Sect drop down > Live Section'

Set 'Cross section along alignment' and offset left/right 5.

Move cursor along along alignment, left click to generate live section in sub divided screen



Close without saving

Go to 'DESIGN tab > Attach drop down > Edit/Detach'

Highlight Ballast and Formation Model, select 'Detach' and 'Ok'

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Image: String Move       Annotate       Design       Analysis       Tools       Cloud         Image: String Move       Image: String Move       Image: String Move       Image: String Move       Image: String Move	– ♂ × Style * @
Alignment Rail Cront Gold Measure	
Designmrom.xml_Project:Station_Lo-oral Attach reference files to model	×
E SEDD engriftmer/ALVerage Loop (Advanced Amount of Anto Severy Mudel 1 C SECC Overage From VALVerage LC cosey Algement 0	
Traverse and network error ellipses           Display absolute (point) ellipses         Oant) display relative (line) ellipses         Select         Detach	Detach All
Elipse scaing factor 1000 Obiplay relative (line) elipses for measured lines only OK	Cancel
Alt	
X:8032.186 Y:7904.204 Z:20.200 SLPR Point 114 Ch+496.565, Of s+20.686	Select points Snap Off

### 1.5.24 Exporting XML For Machine Control

Within the 'Rails.Model' which has the Alignment file attached, go to 'DATA tab > Export drop down > LandXML'

Set up the following and press 'Ok'

Export LandXML		×
Schema version	● Land XML 1.1	O Land XML 1.2
Export triangulati Export bread Export bour Export Plan Feat Export String Export Alignment	on klines udaries ures Is as alignments ts	DK Cancel

Select 'Ok' to model export dialog



 $Close \ 'Rails.Model' \ and \ open \ 'BALLAST.Model', \ attach \ alignment \ file \ and \ repeat \ export \ steps$ 

Similarly, repeat for 'AdjustedFormation.Model'

### 1.6 Computing Platform Edge Using Bance Gauge

The following outlines the steps to compute platform edge using Bance Gauge.

### **Open Existing Project & Dataset**

From the Main Screen, SCC button 'Open'

Go to 'C:\SCC\rail-day\Bance Gauge'

Open 'Platform.Project' and 'Bance Gauge test1.Survey'

### **Compute Platform Position from Bance Gauge**

Go to 'SURVEY tab > Tools > Compute Platform Position From Bance Gauge'

#### Set up the following and press 'Ok'

Compute platform positions from gauge $\qquad \qquad \times$
Bance gauge (No coordinates)     OK     Coordinates and corrected gauge data     Coordinates and uncorrected gauge data     Cancel
Reference line / Left Rail
<ul> <li>Platform is on the left</li> <li>Platform is on the right</li> <li>Reverse cant (ClearRoute)</li> </ul>
Export result to SCP files
Coordinate platform results using alignment
Alignment >>
Horizontal Offset 0.000 Vertical Offset 0.000
Report results

### Select 'OK' to 'Extra Title Fields' dialog

	Name	Value	^
1	VER	3.00	
2	REL		
3	SYD	20 / 02 / 2017	
4	CUS		
5	SYS		
6	FLN	C:\SCC\rail-day\Bance Gauge\\SCP	
7	NTK	1	
8	DATE	20 / 02 / 2017	
9	ELR	LTN1	
10	NAME	Platform Platform	
11	INPT	(Unknown)	
12	MODE	Platform Gauge	
13	DIST	0	
14	INT	1	
15	ID1	G	
16	TD1	1	
17	LSP1	112.6541	
18	RAD1	0	
19	VRA1	0	~

#### Select 'PlatformGaugeSurvey.rpt' from Pick a Report dialog and press 'Ok'

Pick a report		×
Platform Gauge Survey.rpt		Pick>>
Checks shots.rpt CoordDups.rpt DCC_StationDescriptionSheet_Detail.rpt	^	OK
Detail Observations.rpt distance residuals srt.rpt File CRCs.rpt		Cancel
File stats.rpt Formation adjustment.rpt Horizontal entity differences.rpt		
Log File (Actions, notes, warnings, and errors).rpt Log File (Actions, vars only).rpt Log File (Actions, vars only).rpt		
Log File (All) rpt Log File, current document (Actions, notes, warnings, and errors).rpt Log File, last option (Actions, notes, warnings, and errors).rpt		
Platform Gauge Survey (Coords) rpt Platform Gauge Survey rpt	~	

**Review report** 

### Platform gauge survey

		Tel: Fax: email: web:					
Chainage	X (Gauge)	Y (Gauge)	Cant	Gauge	X (Corr)	Y (Corr)	
2,098,334	806.0000	162.0000	0.0110	1.4340	2,241.1770	144.8130	
2,098,334	806.0000	162.0000	0.0000	0.0000	806.0000	162.0000	
2,098,335	800.0000	180.0000	0.0110	1.4330	2,234.3160	162.8540	
2,098,343	807.0000	1,026.0000	0.0000	0.0000	807.0000	1,026.0000	
2,098,345	808.0000	1,024.0000	0.0090	1.4350	2,249.3780	1,009.9130	
2,098,350	808.0000	1,024.0000	0.0050	1.4340	2,245.5570	1,016.1770	
2,098,355	810.0000	1,024.0000	0.0050	1.4320	2,245.5620	1,016.1660	
2,098,360	814.0000	1,020.0000	0.0030	1.4320	2,248.1320	1,015.2920	
2,098,365	794.0000	1,026.0000	0.0010	1.4340	2,228.7150	1,024,4460	
2,098,370	793.0000	1,026.0000	0.0000	1.4340	2,227.0000	1,026.0000	
2,098,375	783.0000	1,032.0000	0.0000	1.4360	2,219.0000	1,032.0000	
2.098.380	782,0000	1,030,0000	0.0000	1,4300	2,212,0000	1,030,0000	
2 198 385	792.0000	1,017.0000	0.0010	4.	2,227.7080 219.0000 717(	1.015.4480	
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	Project		Trans	fer	Create	-	More	Print	Window	Help							
Platf	orm.Project:Station Co-ord	linates	Bance Ga	auge test1.Survey:Co-	ordinates Ba	ince Gaug	e test1 (Corr	ected output):Co-	ordinates ×								-
	No.	Str	Pos	Feature	Туре	Tag	DTM	-E/X-	-N/Y-	-Ht/Z-	D(1)	D(2)	D(3)	Chainage	Offset	Obs#	Gr
1	2098334	0	0	S	Man	S	D	806.000	162.000	0.0000	0.0000	0.0000	0.0000	2098334.000	0.000	0	C
2	2098335	0	0	S	Man	S	D	2234.316	162.854	0.0000	0.0110	1.4330	0.0000	2098335.000	0.000	0	C
3	2098340	0	0	S	Man	S	D	2241.177	144.813	0.0000	0.0110	1.4340	7424.287	2098334.000	0.000	0	C
4	2098343	0	0	S	Man	S	D	807.000	1026.000	0.0000	0.0000	0.0000	8520.580	2098343.000	0.000	0	C
5	2098345	0	0	S	Man	S	D	2249.378	1009.913	0.0000	0.0090	1.4350	0.0000	2098345.000	0.000	0	C
6	2098350	0	0	S	Man	S	D	2245.557	1016.177	0.0000	0.0050	1.4340	5748.071	2098350.000	0.000	0	C
7	2098355	0	0	S	Man	S	D	2245.562	1016.166	0.0000	0.0050	1.4320	3127.052	2098355.000	0.000	0	C
8	2098360	0	0	S	Man	S	D	2248.132	1015.292	0.0000	0.0030	1.4320	2953.537	2098360.000	0.000	0	C
9	2098365	0	0	S	Man	S	D	2228.715	1024.446	0.0000	0.0010	1.4340	2782.787	2098365.000	0.000	0	C
10	2098370	0	0	S	Man	S	D	2227.000	1026.000	0.0000	0.0000	1.4340	2268.221	2098370.000	0.000	0	C
11	2098375	0	0	S	Man	S	D	2219.000	1032.000	0.0000	0.0000	1.4360	2052.258	2098375.000	0.000	0	C
100	107 - 180	r	n	e	Man	S	n	2212 000	1020 00-			1 1300	2028.714	2098380 000	0.000	0	-
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### 1.7 Wriggle Survey Processing

Wriggle survey functionality which can be accessed as follows;

'DATA tab > Import > ASCII Wriggle Survey' from a project

'SURVEY tab > Tools > Compute Wriggle Survey' from the survey coordinates view'

''SURVEY tab > Tools > String using Chainage > Offset from the survey coordinates view'

This is used in conjunction with an alignment to group point data into rings.

To process the sample files  $\,9961065.ASC,\,200\_UPLINE-.CAN,\,200\_UPLINE-.HOR$  and ,  $\,200\_UPLINE-.VER$  do the following;

### **Creating A Project Directory**

From the Main Screen, select 'DATA tab > New'

Enter in a Project/Job name 'Wriggle'

Select a Project Template from the list 'Default v11 Complex.Project'

Select 'OK'

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Project name	Wriggle	
Project template	Default (v11-0-Complex).Project	Pick >
Design folder		
Use detaul	t SUU project folder	
<ul> <li>Select an a</li> </ul>	Iternative folder	

### Create an alignment from the 200\_UPLINE files

'DATA tab > New drop down > New document > SCC Alignment'

Stations Features Wizard	Download Upload Im	port Export Mo	odel Section
Name	Feature	Х,Ү Туре	Z Тур
SCC Model SCC Section SCC Transformation		ancel <u>H</u> elp	

'DATA tab > Import drop down > ACT horizontal entity file, picking '200\_UPLINE-.HOR'

'DATA tab > Import drop down > ACT vertical entity file, picking '200\_UPLINE-.VER'

'DATA tab > Import drop down > ACT cant file, picking '200\_UPLINE-.CAN'

From the Main Screen, SCC button 'Save As' 200\_UPLINE.Alignment'

'SCC button > Close'

### Import the ASCII survey file

'DATA tab > Import drop down > ASCII Wriggle Survey, picking '9961065.ASC'

SCC button 'Save'

#### Compute the wriggle survey

'SURVEY tab > Tools > Compute Wriggle Survey', using parameters shown and pick 'WriggleSurvey.RPT' as the report file

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	C:\SCC\rail-dau\u	riggle\Wriggle\Upline Alignm	nent ss	Export options	
Alignment	e. to be wall day to	niggie (minggie (opinię).Angrin	IOTIC 37	Export to survey data set	D1 Ht.Diff to Alignment
Use bearing computed from ring data				Export to model	D2 Ht.Diff to Centre
⊖ Use inst	tantaneous bearing from	n alignment		✓ Output design circles	D3 Diff.Radius from design
Gradient con	nputation			Output best fit circles	String surveyed rings
🖲 Use gra	dient computed from rin	g data		Uutput surveyed points	1000
⊖ Use inst	tantaneous gradient fro	m alignment		Keep generated alignment	Text thinning (m)
O Force h	orizontal gradient			Add rail data from model to a	output
	2,100		0.500		>>
Design radius	3.100	Outlier distance	0.000		
Radial offset	0.000	Deformation tolerance	0.010		OK Cancel

This will compute the wriggle survey and show the following report.

Note:

- that with bearing and gradient computed from ring data, the alignment is not used in the computations. It is still used in the report to show the difference between bearing and gradient values computed via linear regression and those computed for the alignment.
- Bearing and gradient computation determine whether the tunnel bearing and gradient is based on the alignment or the connected ring circles generated in processing
- Export options control whether in addition to the report you get a section file, model and/or survey data set on output, and whether they include the surveyed points, design circle radius and/or best fit circle radius.
- The design radius is the nominal radius of the tunnel
- The outlier distance is the distance from the design radius at which points are rejected as noise / not on the tunnel surface. The wriggle process is actually computed twice, first to remove outliers, second to get a clean result.
- The radial offset is a prism constant from observed point to tunnel face
- The deformation tolerance is the distance above which points in the survey are flagged as out of range / build tolerance / potential obstructions
- · Adding an extra rail model to the output shows the rail position with respect to the tunnel



• the contact details in the report are taken from 'General Options > Module Licenses >

Edit user details'. The layout and content of the report can be modified to suit individual client needs independently of SCC using Crystal reports XI or later. Results from the SCC viewer can be saved into Microsoft Excel for further analysis by pressing the export button on the top left of the viewer. This also supports a wide range of other formats included Word, PDF and ODBC database tables.

When comparing the results with the output file provided, 9961065.out, SCC is producing identical radii, and horizontal and vertical offsets that agree to within 1mm. The easting and northing of the centres deviate by ~10mm to 30mm but looking at the radial residuals, e.g. the difference between the final computed radius and distance from computed centre to each point, which would imply that the SCC result is more accurate because the sum of the residuals in the SCC report is smaller than those in the output report provided, indicating a slightly better circle fit. For example on ring 1, both routines agree a radius of 3.574, and the residuals are as follows;

9961065.out			SCC	
Point	Radius	Residual	Radius	Residual
1099601	3.578	0.004	3.579	0.005
1099602	3.584	0.010	3.584	0.010
1099603	3.567	-0.007	3.567	-0.007
1099604	3.565	-0.009	3.566	-0.008
1099605	3.579	0.005	3.579	0.005
1099606	3.579	0.005	3.579	0.005
1099607	3.577	0.003	3.577	0.003
1099608	3.561	-0.013	3.571	-0.003
Sum of square	e of resid	uals		
		0.056		0.046

We can see from this that the SCC centre is a slightly better fit for the data provided.

### **Case Study Data**

To process ascii compiler-1.csv, 300DOWNLINE-.HOR, 300DOWNLINE-.VER, and 300DOWNLINE-.CAN do the following

#### Downloading & Importing Data

Create a new project as described previously

Import the ACT alignment files into SCC as described previously

'DATA tab > Download' picking 'ascii compiler-1.csv' using the parameters shown below

Download survey data		?	×
Survey data logger GPS X	Advan	ced >>	
Data type Detail Topography Traverse As Set Out Levelling	Datalogger input Device Disk RS232 port (cable) Atlas communications controller Leica DBX database Trimble Link Engine	0	IK
Create model from input	data	Car	ncel

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Inpu	t GPS X,Y,Z					>	<										
	toint No, X, Y, Z, Fr toint No, X, Y, Z, Fr toint No, Y, Z, Fr toint No, X, Y, Z, Fr toint No, X, Y, Z, Fr toint No, X, Y, Z, G toint No, X, Y, Z, C toint No, X, Y, Z, C	eature, R eature, I eature, 1 , Y, Z, R eature, S ode list iver attri ode (MB e coding	emark D1, D2, Fag, D1 emark Str No, F butes S rivers	Remark , D2, Remark Tag, DTM, D1, D ) Options	Ca 2, D3, Re	DK ncel emark	]										
	lse enhanced codi	ng exter	nsions	View >>													
<b>69</b>	Data Survey					<b>•</b>	xyz	XYZ XYZ	<b>11</b>						-	- 🗇 Stj	X rle • @
Search	Search Replace Global Next edit F Search and replace	Insert De lecords Rec	elete Ui cords	ndo Redo Cut Undo Cli	Copy Paste	Obs.	Coords	Rebuild Options	Tools Help A	bout							
Wri	ggle.Project:Station Co-ore	dinates	ascii com	piler-1.Survey:Co-ordinal	tes x	Tee	DTM	E IV	NOV	1167	D(4)	D(2)	D(2)	Chainson	0#	01-#	×
1	17	3u 1	1	809	Detl	S	D	38292 174	-10/1-	-9.3860	0,0000	0.0000	0.0000	32357 894	3 263	3330	
2	3	1	2	809	Detl	S	D	38295.834	56760 231	-9.2790	0.0000	0.0000	0.0000	32357,883	-3.740	3274	č
3	4	1	3	809	Detl	S	D	38295.840	56760.203	-8.3590	0.0000	0.0000	0.0000	32357.903	-3.719	3296	č
4	5	1	4	809	Detl	S	D	38295.764	56759.939	-7.4660	0.0000	0.0000	0.0000	32357.976	-3.455	3318	- i
5	6	1	5	809	Detl	S	D	38295 577	56759 617	-6 8190	0.0000	0.0000	0.0000	32357 986	-3.082	3319	-
6	7	1	6	809	Detl	S	D	38295 341	56759 213	-6 2930	0.0000	0.0000	0.0000	32357 996	-2 615	3320	
7	8	1	7	809	Detl	S	D	38294 927	56758 486	-5 7200	0.0000	0.0000	0.0000	32358 025	-1 778	3321	
8	9	1	8	809	Detl	S	D	38294 407	56757 692	-5.4150	0.0000	0.0000	0.0000	32357 998	-0.830	3322	
9	10	1	9	809	Detl	S	D	38293 961	56756 989	-5 3690	0.0000	0.0000	0.0000	32357 986	0.003	3323	
10	11	1	10	809	Det	9	D	38293.638	56756 438	-5.3050	0.0000	0.0000	0.0000	32358 000	0.641	3324	
11	12	1	11	809	Det	9	D	38293 205	56755 827	-0.4000	0.0000	0.0000	0.0000	32357.951	1 389	3324	
	112	A 11	1.11	003	11 YEL	13	· .		00100 021		and the	10.0000	0.0000	32331.951	1.309		
														+			

### Computing Chainage Offset from X,Y

To group the data into rings, select 'SURVEY tab > Tools > Compute Chainage,Offset from X,Y'

X,Y <-> C	hainage, Offset 🛛 ? 🛛 🗙
Alignment	Downline.Alignment V Pick >>
Record ra	ange
From 1	то 3336
	OK Cancel

### String using Chainage Offset

Select 'SURVEY tab > Tools >String using Chainage & Offset'

String by Chainage/Offset							
O String by Chainage then Offset (Cross section)	OK						
O String by Offset then Chainage (Long section) Cancel							
String by Chainage then radially (Tunnel section)							
Distance tolerance							

'SCC button > Save'

### Compute the wriggle survey

'SURVEY tab > Tools > Compute Wriggle Survey', using parameters shown and pick 'WriggleSurvey.RPT' as the report file

Compute the wriggle survey as described previously, picking the 300 downline alignment file to get the following report



Notes from the results;

The computed bearing and gradient shown by SCC are ~180 degrees off the alignment value for the same section. This could be corrected using the alignment if required. Without an alignment the orientation of the section is arbitrary and can flip by 180 degrees, which also reverses the gradient.

It doesn't affect the centre, radius or offset values.

Comparing the results to those supplied in 320 wriggle analysis.xls all the radii in SCC are exactly 50mm smaller which appears to correspond to the BFC from DTA radial value and Lining radial value in the xls file. Horizontal and vertical offsets appear to agree to with about 2mm but centres are differ by ~50-60mm. This could possibly be related to radial offsets. Re-computing using alignment bearing and gradients does not appear to make a significant difference to this, though further investigation is probably required.

The xls provided appears to have a limit of size points per ring, though this could just be a reporting anomaly.