



# Bentley Rail Track Update

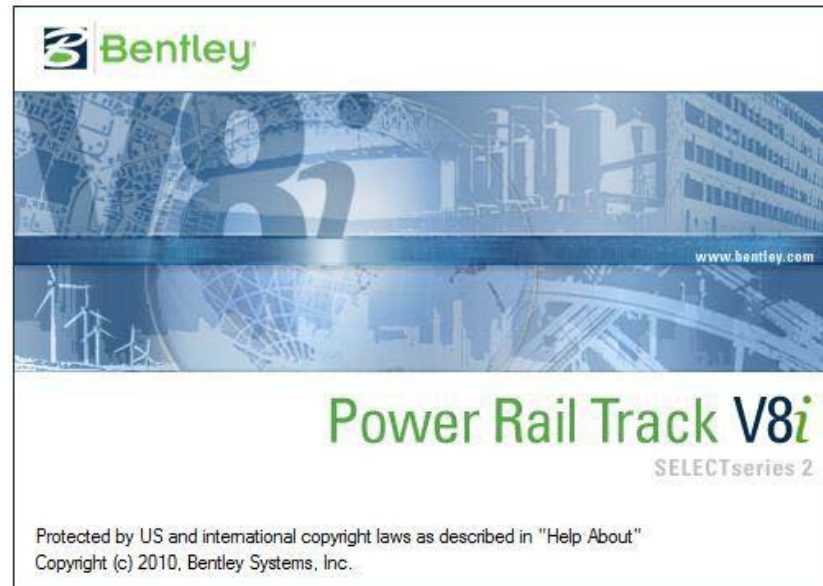
Robert Nice – Bentley Systems UK

## Recent Past and Near Future

- Today, I will discuss recent enhancements to **Bentley Rail Track**. Some of these enhancements you may be very familiar with and others you may not be aware of.
- Also, I will discuss the development of **Power Rail Overhead Line** that will be available later this year. You may be unaware of this product, but hopefully when it is released later this year, it will become another product that you will use on your projects!

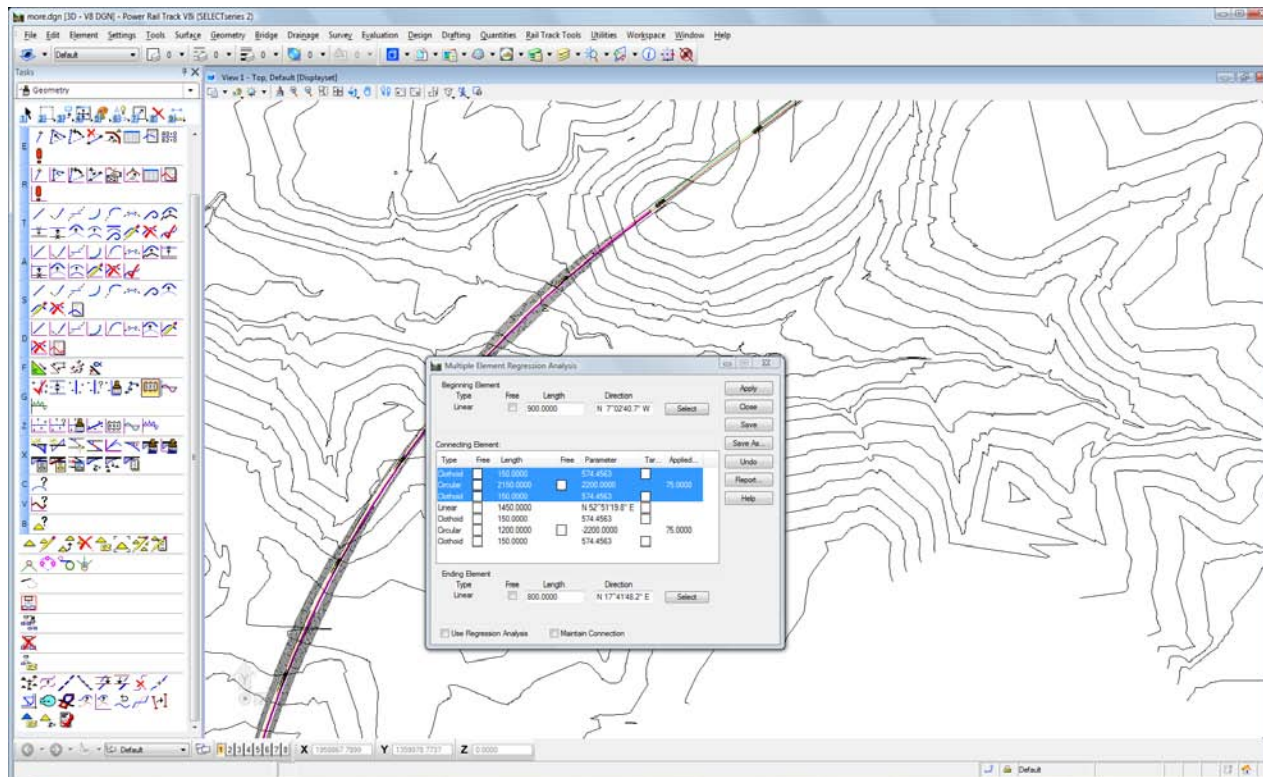
# New Product *Power Rail Track V8i*

- Similar to **Power InRoads & Power GEOPAK**
- **Power Rail Track** includes
  - **Bentley Rail Track Suite** functionality (everything!)
  - Data Acquisition
  - Map
  - Available in *SELECTseries 2* (i.e. now!)



# Power Rail Track V8i

- Interface is customizable with *common* tools
- Single menu & task bars



# Background

Just a bit of background on **Bentley Rail Track**

# Bentley Rail Track is a Global Solution!

- **Bentley Rail Track** is suitable for designing
  - Light rail
  - Heavy rail
  - High-speed rail
    - Steel on steel or magnetic levitation systems
- **Bentley Rail Track** has been internationalized & localized
  - Available in English, German, Spanish, Chinese, Russia, Italian plus other languages
  - Deliver standard turnouts
  - Build in railway specific design checking

# Bentley Rail Track offers...

- Horizontal & vertical alignment design
  - New design
  - Single and multi-element regression analysis for maintenance / renewals
- Cant / superelevation design
- Turnouts
  - Specialized geometry
- Also includes *specialized* toolsets for
  - Design checking
  - Field to design / Design to field
    - *Machine to design to machine*
  - Light rail manufacturing
  - Magnetic levitation

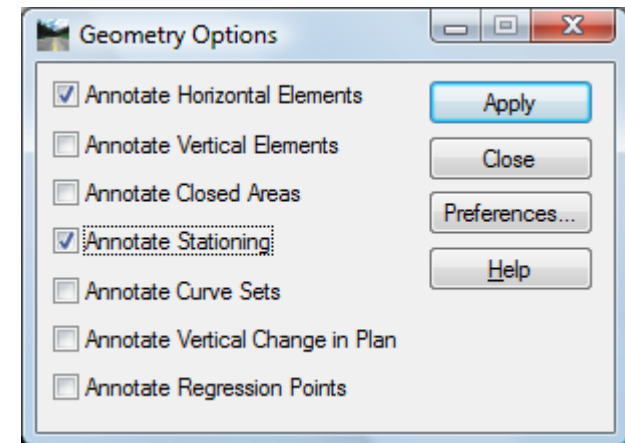
# Alignment Enhancements

Horizontal and vertical alignment enhancements for rail design



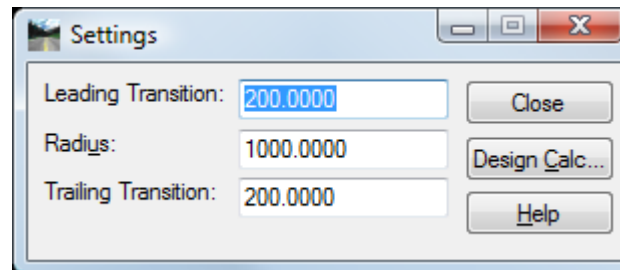
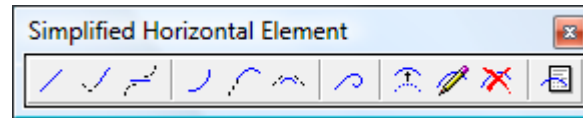
# View Options

- Update annotation as the geometry is created / edited
  - Based upon
    - Alignment's style
    - Persisted command's preferences
  - Allows different "type of alignments" to display differently
    - A road baseline would have:
      - Horizontal annotation
      - Stationing
      - Curve set annotation
    - A right of way take would have:
      - Horizontal annotation
    - A track would have:
      - Regression Points
      - Horizontal annotation
      - Stationing



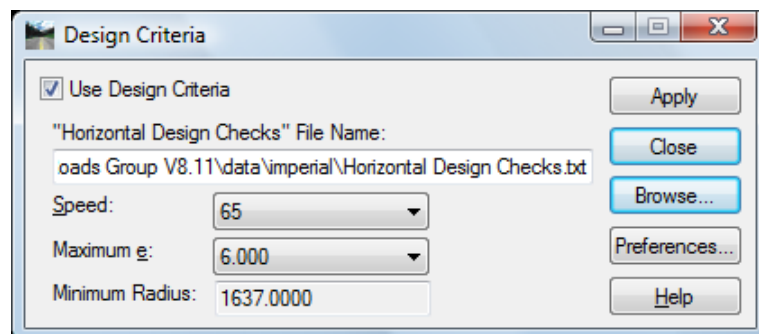
# Simplified Horizontal Elements

- *Horizontal Elements* without dialogs
  - Well, there is a *Settings* dialog, which defines the radius and optional spiral lengths!
    - This dialog is active even during graphics input
  - *Add Fixed, Float and Free* elements
  - *Move*
  - *Edit*
  - *Delete*
  - MicroStation only functionality!



# Horizontal Design Criteria

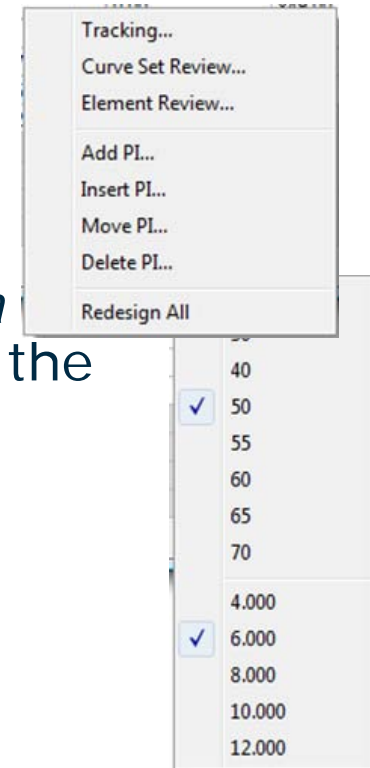
- Curve Set Based
  - Add PI & Insert PI
- Looks up radius based upon speed / maximum superelevation
  - ..\data\metric\Horizontal Design Checks.txt
  - *Primarily road oriented but this could be enhanced for rail*



* DESIGN SPEED	MAXIMUM E	MAXIMUM F	MINIMUM RADIUS
20.	.04	.17	127.
30.	.04	.16	302.
40.	.04	.15	573.
50.	.04	.14	955.
55.	.04	.13	1186.
60.	.04	.12	1528.
20.	.06	.17	116.
30.	.06	.16	273.
40.	.06	.15	509.
50.	.06	.14	849.
55.	.06	.13	1061.
60.	.06	.12	1348.
65.	.06	.11	1637.
70.	.06	.10	2083.

# Horizontal Table Editor

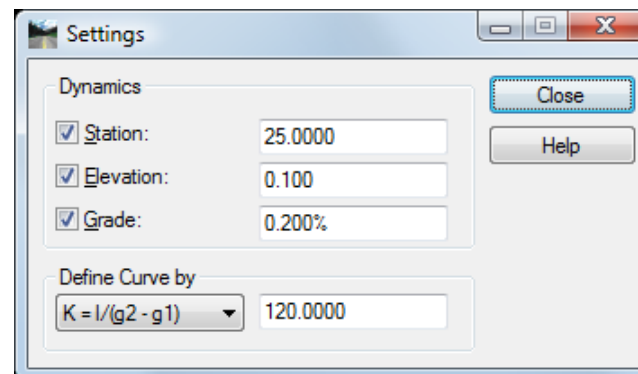
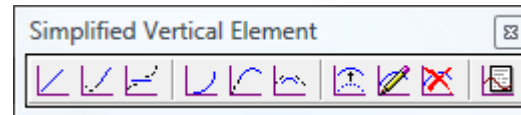
- Invokes *Add*, *Insert*, *Move* and *Delete PI* commands
- *Redesign All*
  - Based up *Horizontal Design Criteria*
  - Either invoke the *Horizontal Design Criteria* command or <Ctrl> right click and change the speed and / or maximum superelevation



Curve Sets:				
Northing	Easting	Leading Transition	Radius	Trailing Transition
1360809.925	1956506.741			
1361269.563	1958508.700	0.0000	1145.9156	0.0000
1360942.522	1959267.451	0.0000	402.0756	0.0000
1360996.754	1959484.216	0.0000	292.6403	0.0000
1361063.027	1959555.156			

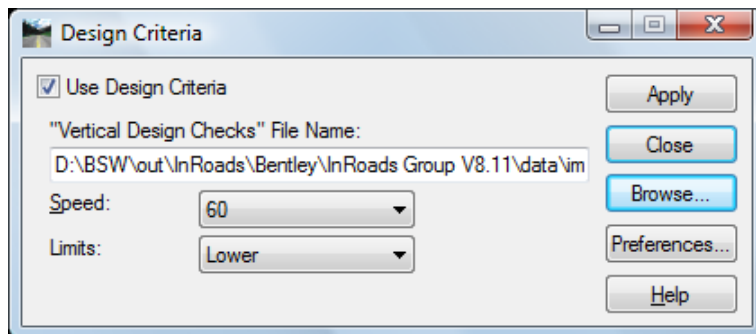
# Simplified Vertical Elements

- *Vertical Elements* without dialogs
  - Well, there is a *Settings* dialog, which defines the K or length of curve!
    - This dialog is active even during graphics input
  - *Add Fixed, Float and Free* elements
  - *Move*
  - *Edit*
  - *Delete*
  - MicroStation only functionality!



# Vertical Design Criteria

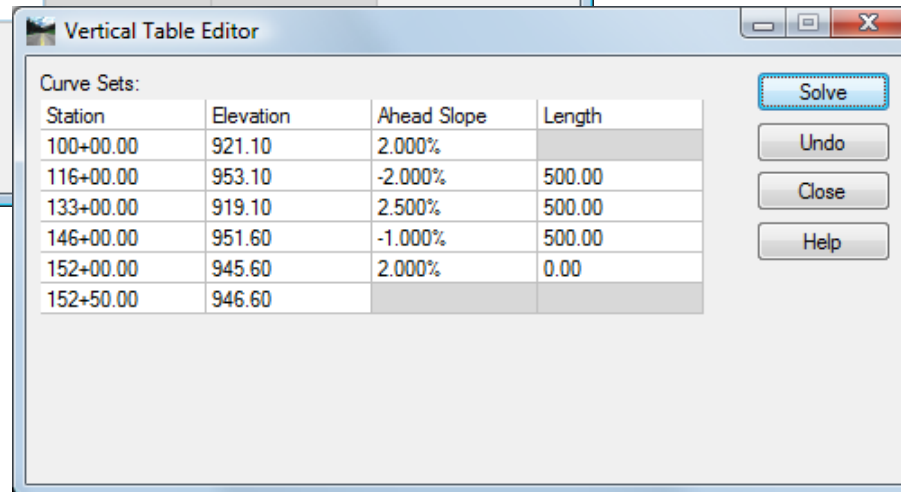
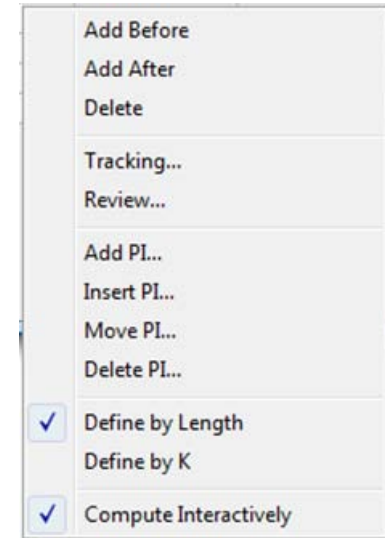
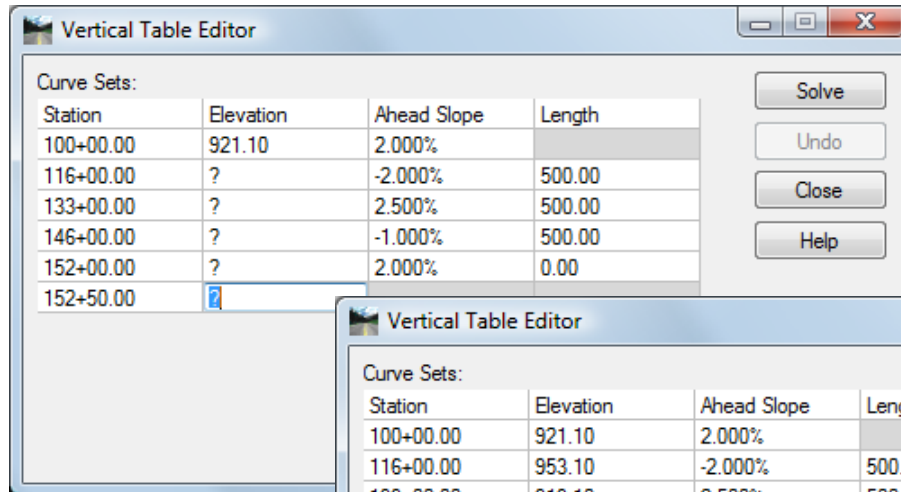
- Curve Set Based
  - Add PI & Insert PI
- Looks up K based upon speed / lower or upper limits
  - ..\data\imperial\Vertical Design Checks.txt
  - Primarily road oriented but this could be enhanced for rail



GEN D f	Crest Stop Dist	Upper K Value	Crest Stop Dist	Lower K Value	Sag Stop Dist	Upper K Value	Sag Stop Dist	Lower K Value	Passing Minimum Dist	Sight Dist. K Value
.40	125.	10.	125.	10.	125.	20.	125.	20.	800.	210.
.38	150.	20.	150.	20.	150.	30.	150.	30.	950.	300.
.35	200.	30.	200.	30.	200.	40.	200.	40.	1100.	400.
.34	250.	50.	225.	40.	250.	50.	250.	50.	1300.	550.
.32	325.	80.	275.	60.	325.	70.	275.	60.	1500.	730.
.31	400.	120.	325.	80.	400.	90.	325.	70.	1650.	890.
.30	475.	160.	400.	110.	475.	110.	400.	90.	1800.	1050.
.30	550.	220.	450.	150.	550.	130.	450.	100.	1950.	1230.
.29	650.	310.	525.	190.	650.	160.	525.	120.	2100.	1430.
.29	725.	400.	550.	230.	725.	180.	550.	130.	2300.	1720.
.28	850.	540.	625.	290.	850.	220.	625.	150.	2500.	2030.

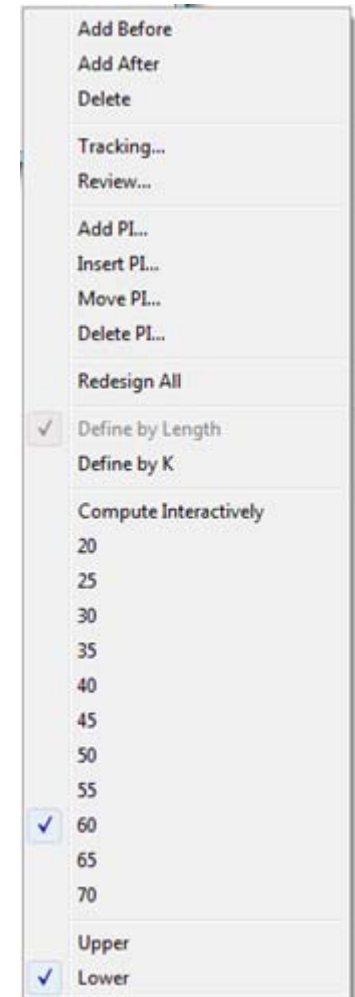
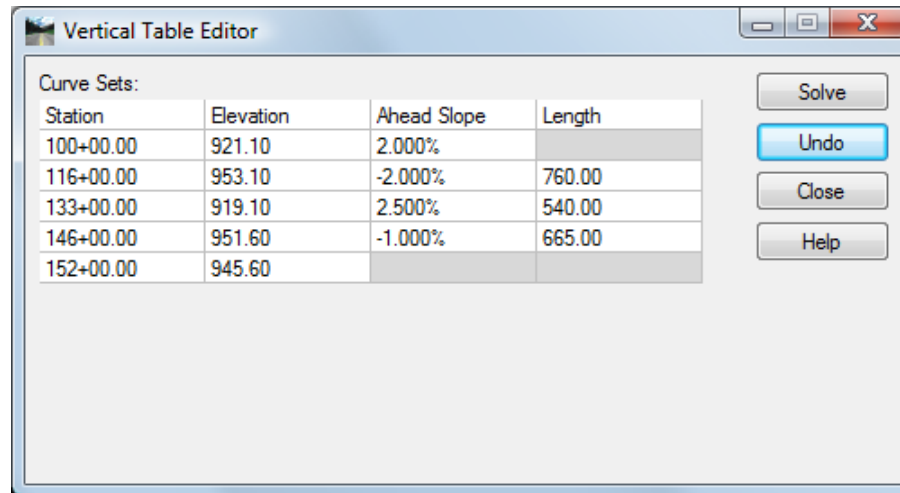
# Vertical Table Editor

- Two modes
  - *Compute Interactively*
  - Or wait and *Solve* for unknown values



# Vertical Table Editor

- Invokes *Add*, *Insert*, *Move* and *Delete PI* commands
- *Redesign All*
  - Based upon *Vertical Design Criteria*
  - Either invoke the *Vertical Design Criteria* command or <Ctrl> right click and change the speed and limits



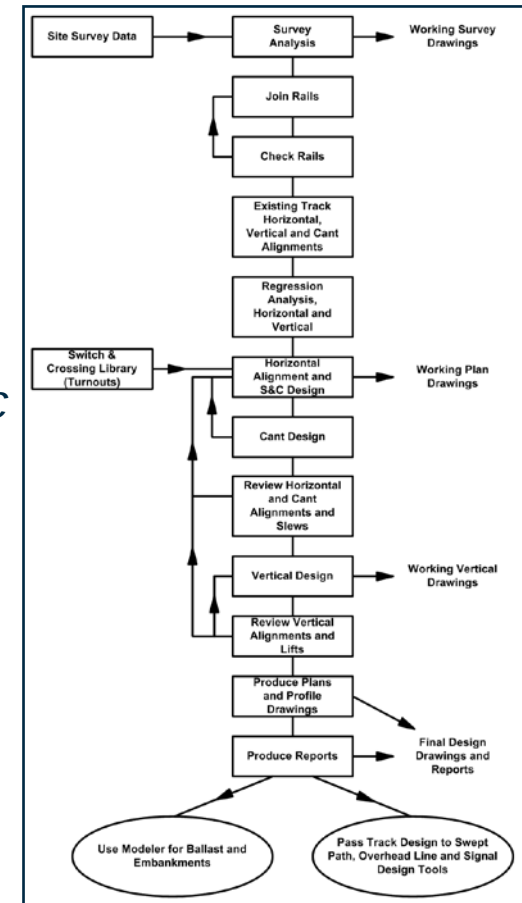


# Vertical Healing

- Synchronize / update the vertical alignment when the horizontal alignment has changed
  - The coordinate position of vertical PI's will be held!
    - The user is responsible for potential overlaps
    - The user is responsible for resolving verticals that are beyond the limits of the horizontal
    - Set in *File > Project Options > Geometry*, but it is one of those settings that you should set and remain set!
  - *This is one implementation, others would have been possible!*

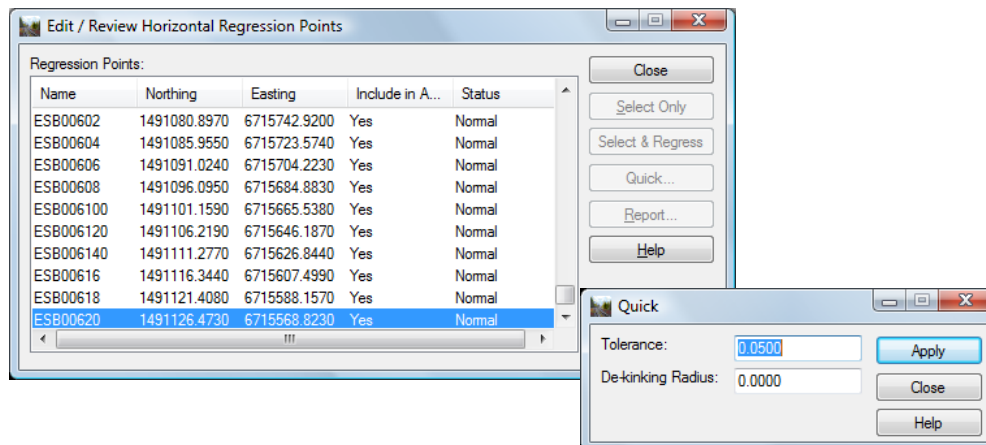
# Regression Workflow...

- Pre-regression data validation
- Point selection and sorting
  - Survey data ordering is not required
- Curvature diagrams
  - Indicates approximate locations of *specific elements* and their *types*
  - Indicates *questionable* data
  - Inclusion of cant enhances the field data!
- Edit / review
  - Select / Regress, which is *heads-up selection / auto element type determination!*
    - Reduces potential user errors & time
  - *Quick Regression*
- Slew diagrams and reporting



# Quick Regression

- *Quick* horizontal regression
  - A first pass – automatic regression
    - Includes lines, circular arcs and spirals
    - Resolves long straights into multiple straights
- *Quick* vertical regression
  - Similar to horizontal
  - Includes a standard lift & a lines only option



# Single Element Regression Enhancement

- Single element regression with multiple alignments
  - Single element regress 2 or more alignments at once
  - Regressed elements will be parallel / concentric to each other
  - Different offsets for each set of elements
- Enabled by right-clicking in *Edit / Review Regression Points* list-view
- Automatically occurs with *Select & Regress* option

# Cant / Superelevation Design

Specialized geometry for track cant / superelevation

# Cant / Superelevation

- Standard *international* railway terminology
  - Equilibrium cant, applied cant, cant deficiency, etc.
    - Imperial or metric units
- Calculations
  - Standard equilibrium equations that can be found in well known literature

The screenshot shows the 'Design Calculators' window with the 'Cant Calculator' tab active. The 'Table Lookups' sub-tab is also visible. The 'Compute' dropdown is set to 'Cant' and 'Define By' is set to 'Applied Constant'. The 'Design Speed (kmph)' is 160.0000, 'Equilibrium Constant' is 11.8000, 'Applied Constant' is 7.1000, 'Radius' is 0.0000 (with a secondary field of 1750.0000), and 'Length' is 140.0000. The 'Transition' is set to 'Cosine'. The 'Compound Transition Rate From' has 'Start' selected. The 'Always Round Applied Cant' checkbox is checked.

The 'Results' section shows the following values:

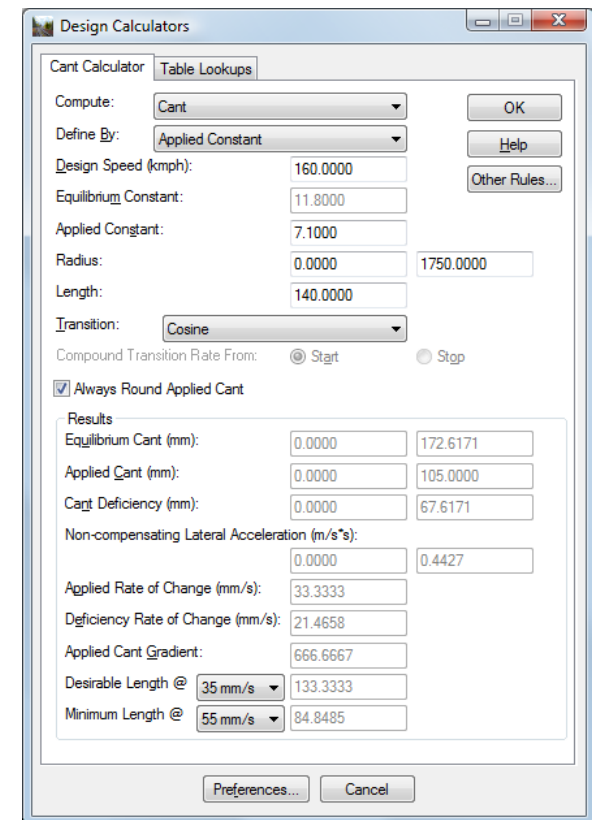
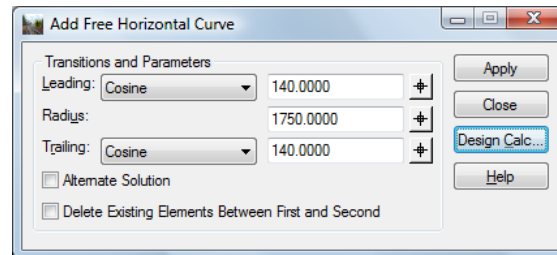
Parameter	Value	Value
Equilibrium Cant (mm):	0.0000	172.6171
Applied Cant (mm):	0.0000	105.0000
Cant Deficiency (mm):	0.0000	67.6171
Non-compensating Lateral Acceleration (m/s*s):	0.0000	0.4427
Applied Rate of Change (mm/s):	33.3333	
Deficiency Rate of Change (mm/s):	21.4658	
Applied Cant Gradient:	666.6667	
Desirable Length @ 35 mm/s	133.3333	
Minimum Length @ 55 mm/s	84.8485	

The bottom portion of the dialog shows the same results in imperial units:

Parameter	Value	Value
Cant Deficiency (in):	0.0000	0.6708
Non-compensating Lateral Acceleration (ft/s*s):	0.0000	0.1624
Applied Rate of Change (in/s):	1.6539	
Deficiency Rate of Change (in/s):	0.1887	
Applied Cant Gradient:	744.8980	
Ls = 1.63 * Eu * V	76.5394	
Ls = 62 * Ea	364.5600	

# Integrated into Horizontal Design

- Radius & spiral lengths based upon cant
  - Cant & Speed are persisted with the horizontal elements
  - Suggests spiral lengths
    - Imperial & metric are slightly different
  - Enables design optimization
  - Mix transitions types



# Cant Alignment Editor

- Creation based upon
  - Equilibrium equations
  - Alternate speed
  - User defined tables

Cant Alignment Editor

Horizontal Alignment: Variante 10 - EP

Cant Alignment: Variante 10 - EP

T...	Station	Spe...	Radius	Length	Transition	Eq. Cant...	App. Ca...	Cant Def...	App. Rate (...)
T...	123+066.207	160	0.0000	95.5101	Cosine	0.0	0.0	0.0	16.3
S...	123+161.718	160	5000.0000	600.2887	Circular	60.4	35.0	25.4	0.0
C...	123+762.006	160	5000.0000	233.5793	Cosine	60.4	35.0	25.4	16.2
S...	123+995.586	160	-3500.0000	2052.6546	Circular	86.3	50.0		
C...	126+048.240	160	-3500.0000	137.9591	Cosine	86.3	50.0		
S...	126+186.199	160	0.0000	564.0611	Linear	0.0	0.0		
T...	126+750.260	160	0.0000	137.9591	Cosine	0.0	0.0		
S...	126+888.220	160	3500.0000	738.1605	Circular	86.3	50.0		
C...	127+626.380	160	3500.0000	275.9176	Cosine	86.3	50.0		
S...	127+902.298	160	-3500.0000	1534.9369	Circular	86.3	50.0		
C...	129+437.235	160	-3500.0000	137.9591	Cosine	86.3	50.0		
S...	129+575.194	160	0.0000	3138.9481	Linear	0.0	0.0		
T...	132+714.142	160	0.0000	95.5101	Cosine	0.0	0.0		

Buttons: Define All..., Add..., Edit..., Delete

Define Cant Alignment

Cant Method:

Use Equilibrium Equations

Use Alternate Design Speed

Lookup Cant from Table

Station, Speed and Cant Table

Design Speed (kmph): 160.0000

Equilibrium Constant: 11.8000

Applied Constant: 7.1000

Use Cant from Horizontal Alignment

Apply Mainline Cant through Turnouts

Compute Stepped Linear Cant

Interpolate Cant

Buttons: OK, Cancel, Help

Edit Cant

Cant Design

Station: 126+750.260

Design Speed (kmph): 160.0000

Equilibrium Constant: 11.8000

Define By: Start Stop

Applied Cant: 0.0000 50.0000

Compound Transition Rate From:  Start  Stop

Applied Cant (mm): 0.0000 0.0000

Cant Deficiency (mm): 0.0000 0.0000

Radius: 0.0000 3500.0000

Length: 137.9591

Buttons: Apply, Close, Help, Select, First, < Previous, Next >, Last

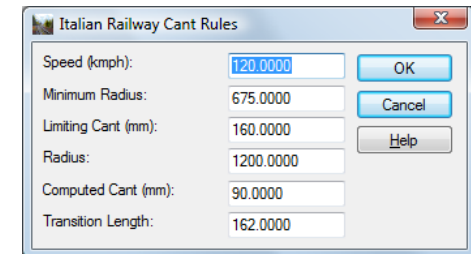
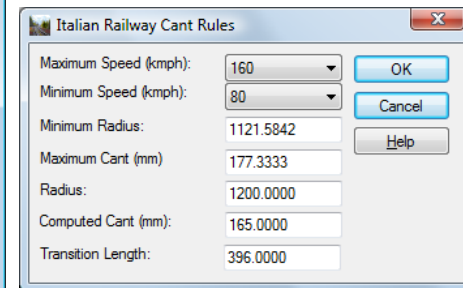
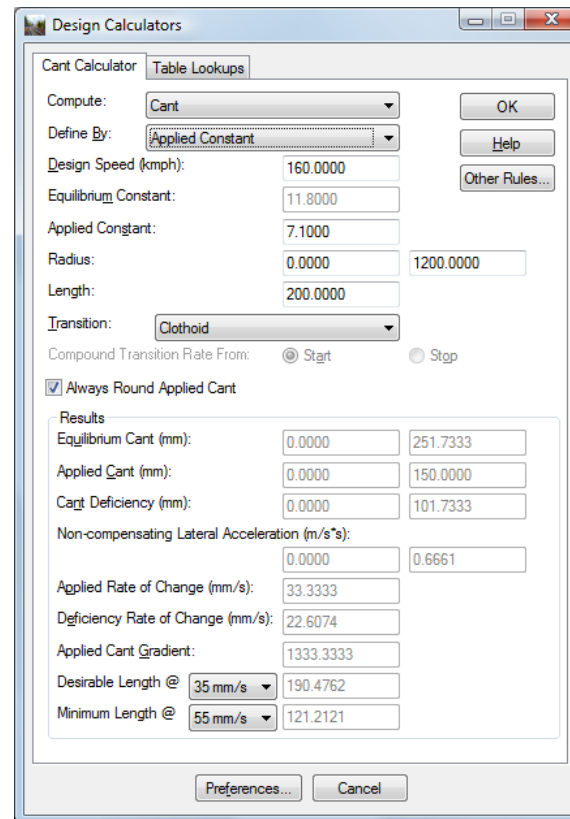
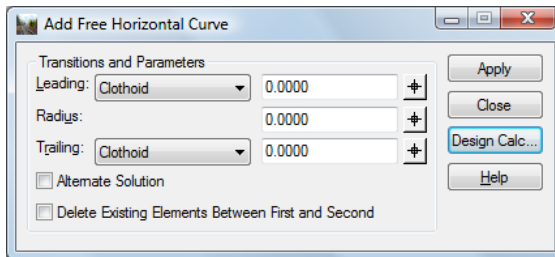
Cant Calculation Results

Equilibrium Cant (mm):	0.0000	86.3086
Applied Cant (mm):	0.0000	50.0000
Cant Deficiency (mm):	0.0000	36.3086
Non-compensated Lateral Acceleration (m/s <sup>2</sup> ):	0.0000	0.2377
Applied Rate Change (mm/s):	16.1078	
Deficiency Rate Change (mm/s):	11.6970	
Applied Cant Gradient:	1379.5914	



# Other Cant Rules

- Integrating *other* rules into the system

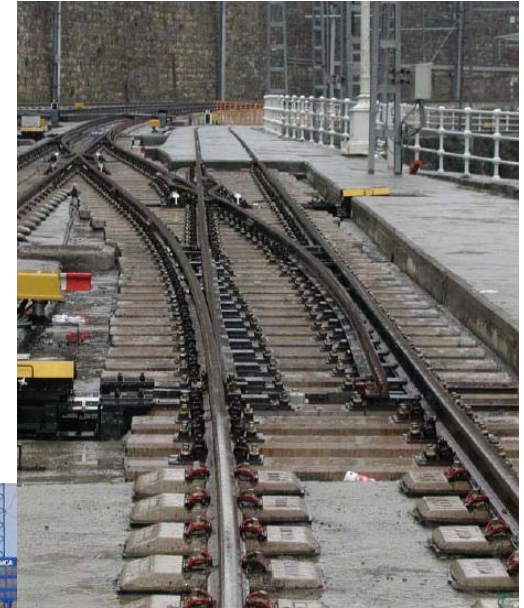


# Turnouts

Specialized geometry that conforms to well defined bending rules

# Turnouts

- Single, double and slips
  - Tangential and non-tangential turnouts
- Multiple bending / flexing methods to satisfy various industry standards!
  - Germany / Austrian
  - Swiss
  - UK

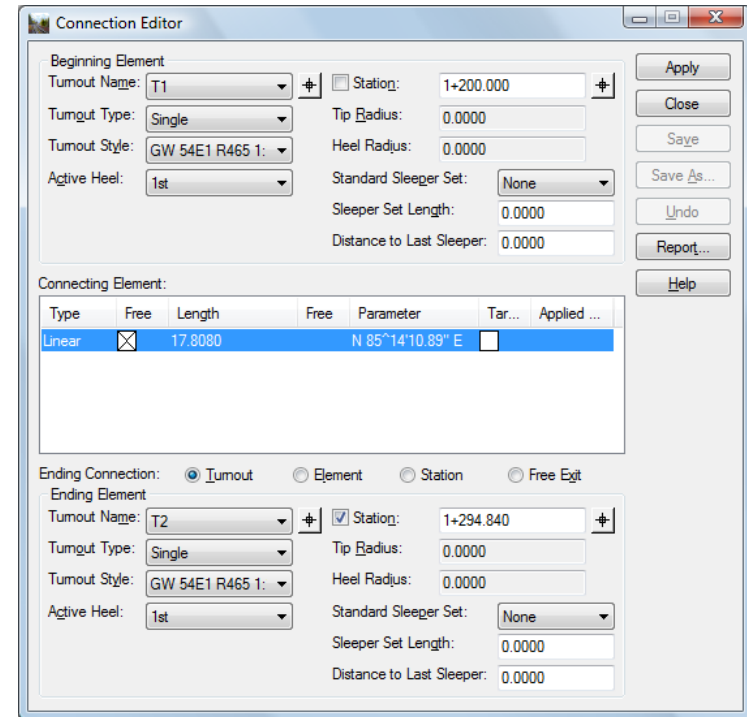


# Turnout Library

- Typical Turnout Library Editor
  - Creation of typical turnouts (standards)
    - The software delivers various country standards
      - Danish Railways
      - Dutch Railways / ProRail
      - German (heavy & light rail)
      - Indian Railways
      - Russian Railways
      - Spanish (heavy & light rail)
      - Swiss Railways
      - UK (113A's & NR60's)
      - AREMA
      - Or we will help you to create them

# Turnout Connection Editor

- Used for more advanced geometric constructions
  - Crossovers
  - Sidings
- Editing an existing construction
  - Change type
  - Dynamically move
- Maintains *rules* and *relationships*!
- Do you see the GUI changes?

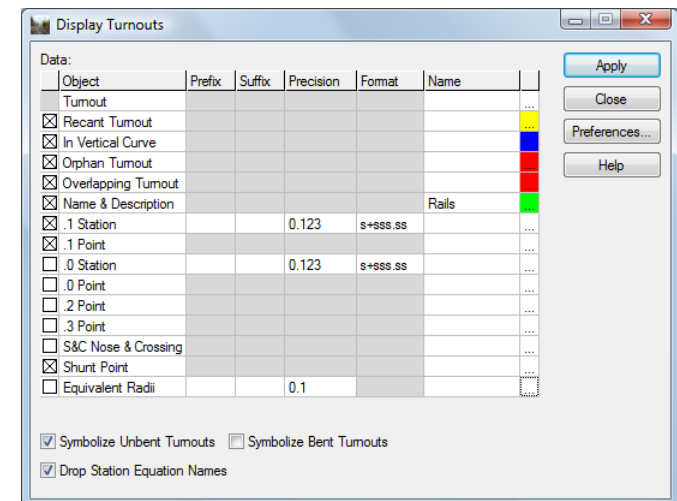
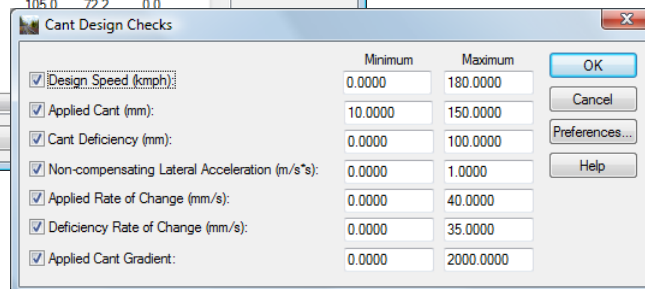
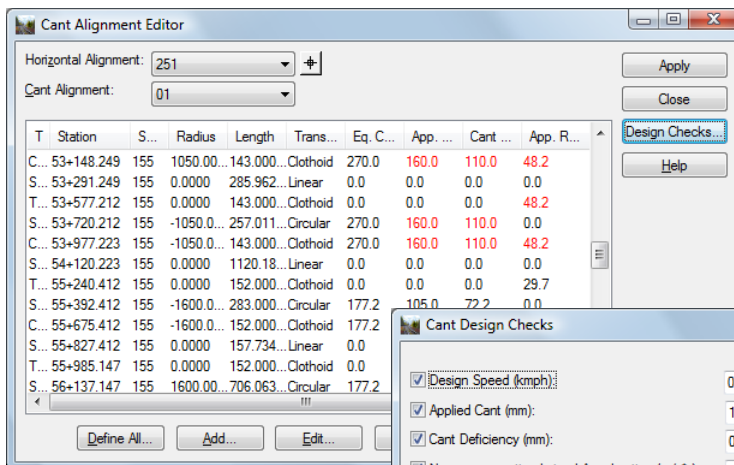


# Design Checking

Detailed design checking based upon simple built-in rules to specific / comprehensive railway rules.

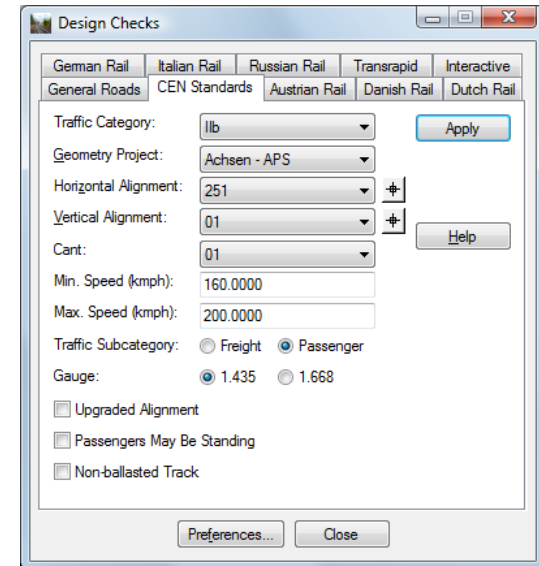
# Built in Design Checking

- *Cant Alignment Editor* includes basic parameters for design checking
- Visual checking with *Display Turnouts*



# More Comprehensive Design Checks

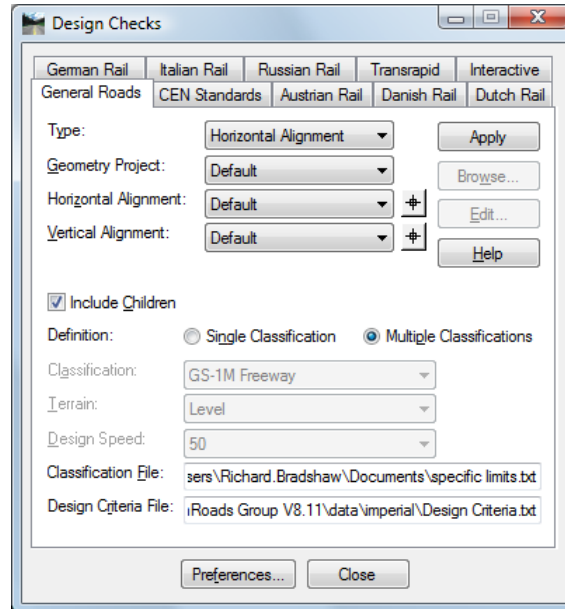
- Includes
  - CEN Standards
  - Austrian Rail
  - Danish Rail
    - will be updated in *SELECTseries 3*
  - German Rail
  - Italian Rail
  - ProRail / Dutch Rail
  - Russian
  - Transrapid (maglev)
- Execute as you design or as a post-design process
  - *Interactive + passive*
  - *Ideal for checking a consultant's design*
- Written to match a railway's requirements





# Design Checking

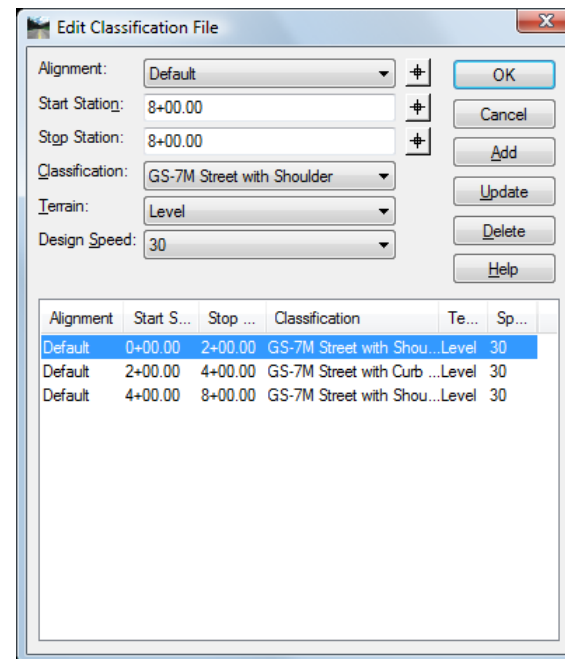
- Not just warnings!
  - Now it also indicates if the geometry is *acceptable!*
  - Good for QC



Checking stopping sight distances for alignment 'default'

10+550.0000  
 Classification: GS-1M Freeway Terrain: Rolling Speed: 60  
 Warning: Desirable minimum stopping sight distance exceeded!  
 Desirable minimum stopping sight distance: 205.0000  
 Desirable minimum length should be: 499.1020  
 Actual length: 300.0000

11+050.0000  
 Classification: GS-1M Freeway Terrain: Rolling Speed: 60  
 Acceptable: Actual length is greater than desirable minimum stopping sight distance.  
 Desirable minimum stopping sight distance: 205.0000  
 Actual length: 300.0000

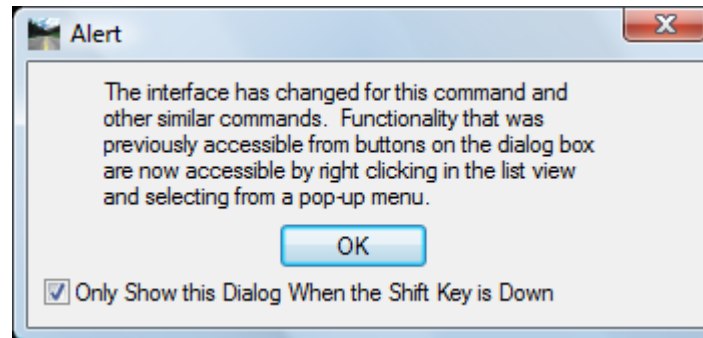


# User Interface

User interface enhancements.

# User Interface Enhancements

- Smaller dialogs
- Moved buttons to right-click popup menus
- *And to avoid user panic, an Alert has been added!*
  - After getting this Alert for awhile, check the button in the lower left!



# Configurable List View & Dialog Resizing

- Right click in title and select data of interest
  - *Check Integrity*
  - *Review / Edit Regression Points*
  - *Cant Alignment Editor*

The screenshot displays three overlapping dialog boxes from the Bentley software interface. The largest dialog, 'Cant Alignment Editor', is positioned in the upper right. It features a table with columns for 'T...', 'Station', 'Sp...', 'Radius', 'Transi...', 'Eq. C...', 'App. ...', and 'Cant ...'. The table contains data for various alignment types including POB, TS, SC, CS, ST, and POE. Below the table are buttons for 'Define All...', 'Add...', 'Edit...', 'Delete', and 'Report...'. To the left, two 'Check Horizontal Integrity' dialog boxes are visible. The one in the foreground shows a table with columns for 'Type', 'Station ...', 'Northing ...', 'Easting ...', 'Direction @...', 'Nor...', 'Easti...', 'Direction ...', 'Len...', 'Rad...', 'Constant', 'Inte...', 'Inte...', and 'Ele...'. It lists various alignment segments with their respective coordinates and integrity status (e.g., 'OK', 'Non-c...').

# Less Clutter

- Moved buttons to *right click* context sensitive pop-up menus
- Eliminated tabbed dialogs
  - Everything is together in one dialog but still without excess clutter!

Multiple Element Regression Analysis

Beginning Element

Type	Free	Length	Direction
Linear	<input checked="" type="checkbox"/>	1678.9730	N 77°04'09.61" E

Select

Connecting Element:

Type	Free	Length	Free	Parameter	Tar...
Circular	<input checked="" type="checkbox"/>	724.9587	<input type="checkbox"/>	1145.9156	
Linear	<input type="checkbox"/>	314.1614	<input type="checkbox"/>	S 66°40'57.83" E	<input type="checkbox"/>
Circular	<input checked="" type="checkbox"/>	264.0728	<input type="checkbox"/>	-402.0756	
Linear	<input type="checkbox"/>	9.3740	<input type="checkbox"/>	N 75°41'12.80" E	<input type="checkbox"/>

Ending Element

Type	Free	Length	Direction
Linear	<input type="checkbox"/>	20.0000	N 46°56'52.40" E

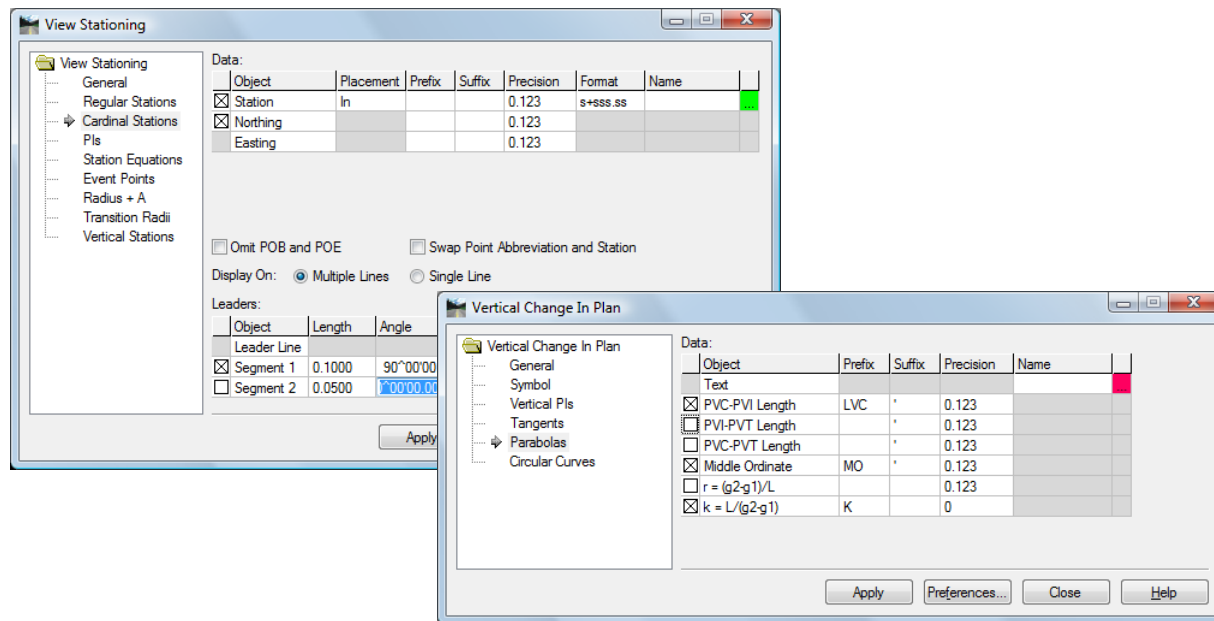
Select

Use Regression Analysis     Maintain Connection

Gauss Jordan  
 Singular Value Decomposition

# Tree / Leaf User Interface

- Converted most commands to tree / leaf
  - Allows greater consistency
  - Allows for potential enhancements
  - Allows for display / annotation during edits!
- You may / will need to look at preferences!



# Just more examples...

- *View Horizontal & Vertical Regression Points*
  - Additional content
    - Other points of interest
    - Combined horizontal & vertical slews

**View Horizontal Regression Points**

Data:	Object	Prefix	Suffix	Precision	Name	
<input checked="" type="checkbox"/>	Fixed Symbol					Yellow
<input checked="" type="checkbox"/>	Fixed Text					Yellow
<input checked="" type="checkbox"/>	Normal Symbol					Green
<input checked="" type="checkbox"/>	Normal Text					Green
<input checked="" type="checkbox"/>	Ignored Symbol					Blue
<input checked="" type="checkbox"/>	Ignored Text					Blue
<input checked="" type="checkbox"/>	Other Symbol					Red
<input checked="" type="checkbox"/>	Other Text					Red
<input checked="" type="checkbox"/>	Unacceptable Symbol					Red
<input checked="" type="checkbox"/>	Unacceptable Text					Red
<input type="checkbox"/>	Sorted Line					Green
<input checked="" type="checkbox"/>	Name					Green
<input checked="" type="checkbox"/>	Horizontal Slew	h=	mm	0		Green
<input type="checkbox"/>	Vertical Slew	v=	mm	0		Green
<input checked="" type="checkbox"/>	Slew Indicator					Green

Buttons: Apply, Close, Preferences..., Help

Acceptable Slew:  Annotate as:  Single Line  
 Scale:   Multiple Lines  
 Mirror Right to Left Annotate in:   
 Symbology from Point Style

**View Vertical Regression Points**

Data:	Object	Prefix	Suffix	Precision	Name	
<input checked="" type="checkbox"/>	Fixed Symbol					Yellow
<input checked="" type="checkbox"/>	Fixed Text					Yellow
<input checked="" type="checkbox"/>	Normal Symbol					Green
<input checked="" type="checkbox"/>	Normal Text					Green
<input checked="" type="checkbox"/>	Ignored Symbol					Blue
<input checked="" type="checkbox"/>	Ignored Text					Blue
<input checked="" type="checkbox"/>	Other Symbol					Red
<input checked="" type="checkbox"/>	Other Text					Red
<input checked="" type="checkbox"/>	Unacceptable Symbol					Red
<input checked="" type="checkbox"/>	Unacceptable Text					Red
<input type="checkbox"/>	Sorted Line					Green
<input checked="" type="checkbox"/>	Name					Green
<input type="checkbox"/>	Horizontal Slew	h=	mm	0		Green
<input checked="" type="checkbox"/>	Vertical Slew	v=	mm	0		Green
<input checked="" type="checkbox"/>	Slew Indicator					Green

Buttons: Apply, Close, Preferences..., Help

Acceptable Slew:  Annotate as:  Single Line  
 Scale:   Multiple Lines  
 Mirror Right to Left Annotate in:   
 Symbology from Point Style

# Just more examples...

**Curve Set Annotation**

Data:

Object	Column	Row	Prefix	Suffix	Precision	Format	Name
<input checked="" type="checkbox"/> Line							Prop Horizontal
<input checked="" type="checkbox"/> Point							Prop Horizontal
<input checked="" type="checkbox"/> Text							Prop Horizontal
<input checked="" type="checkbox"/> Curve Number	1	1	C#				
<input checked="" type="checkbox"/> Station	1	2	Sta=		0.123	s+sss.ss	
<input checked="" type="checkbox"/> Northing	1	5	N=		0.123		
<input checked="" type="checkbox"/> Easting	1	6	E=		0.123		
<input checked="" type="checkbox"/> Radius	1	9	R=	m	0		
<input checked="" type="checkbox"/> Degree of Curve	1	4	Dc=			ddd"mm'ss.ss"	
<input checked="" type="checkbox"/> Delta Left	1	3	Delta=		0.1	ddd"mm'ss.ss"	
<input checked="" type="checkbox"/> Delta Right							
<input checked="" type="checkbox"/> Arc Length	1	8		m	0.123		
<input checked="" type="checkbox"/> Spiral Length							
<input checked="" type="checkbox"/> Constant							
<input checked="" type="checkbox"/> Superelevation							
<input checked="" type="checkbox"/> Speed							
<input checked="" type="checkbox"/> Tangent Length							
<input checked="" type="checkbox"/> External Distance							

**Station Offset Annotation**

Data:

Object	Column	Row	Prefix	Suffix	Precision	Format	Name
<input type="checkbox"/> Name	1	4					
<input type="checkbox"/> Description	1	5					
<input type="checkbox"/> Style	1	6					
<input checked="" type="checkbox"/> Station	1	1			0.123	s+sss.ss	
<input checked="" type="checkbox"/> Offset Left	1	2	Off	L	0.123		
<input type="checkbox"/> Offset Right			Off	R			
<input checked="" type="checkbox"/> Northing	1	6	N		0.123		
<input checked="" type="checkbox"/> Easting	1	7	E		0.123		
<input checked="" type="checkbox"/> Elevation	1	3	EI		0.123		

Leaders:

Object	Length	Annotation
Leader Line		
<input checked="" type="checkbox"/> Segment 1	1.0000	
<input type="checkbox"/> Segment 2	1.0000	

**View Closed Areas**

Data:

Object	Prefix	Suffix	Precision	Name
<input type="checkbox"/> Text				Annotation-Plan
<input checked="" type="checkbox"/> Name				
<input checked="" type="checkbox"/> Description				
<input checked="" type="checkbox"/> Area in Square Meters	m2		0	
<input checked="" type="checkbox"/> Area in Hectares	ha		0.123	
<input checked="" type="checkbox"/> Perimeter in Meters	m		0.123	
<input type="checkbox"/> Area in Square Feet	ft2		0.12	
<input type="checkbox"/> Area in Acres	ac		0.12	
<input type="checkbox"/> Perimeter in Feet	ft		0.12	

Buttons: Apply, Preferences..., Close, Help



# Just more examples...

Switch Height Plan

Mode:  Plan  Plan and Diagrams  Chord Offset Diagram

Alignments  
Reference: Bestandsstrecke

Horizontal Alignment: v\*

Selected:

Name	Description	Style
Variante 10 - E...	Achse Gleis ...	
Variante 11 - E...	Default	

Switch Height Plan

Horizontal Elements

Horizontal Annotation

Annotate Inside of Curve Only  Annotate with Stationing

Annotate Partial Lengths

Include Spiral Subscript as Prefix  Include Spiral Subscript as Suffix

Override All Horizontal Abbreviations

Mirror Symbol for Counterclockwise Curvature

Switch Height Plan

Data:

Object	Prefix	Suffix	Precision	Format	Name
Linear Elements					
Circular Elements					
Spiral Elements					
Element Text					
<input checked="" type="checkbox"/> Linear Length	L	m	0.123		
<input checked="" type="checkbox"/> Radius	R c	m	0.123		
<input checked="" type="checkbox"/> Circular Length	Lc	m	0.123		
<input checked="" type="checkbox"/> Applied Cant	D	mm	0		
<input checked="" type="checkbox"/> Spiral Length	Ls	m	0.123		
<input checked="" type="checkbox"/> Cant Gradient	1:		0.123		
<input type="checkbox"/> Gap Equation			0.123	s+sss.ss	
<input type="checkbox"/> Overlap Equation					

Display Turnouts

Data:

Object	Prefix	Suffix	Precision	Format	Name
Turnout					
<input checked="" type="checkbox"/> Recant Turnout					
<input type="checkbox"/> In Vertical Curve					
<input checked="" type="checkbox"/> Orphan Turnout					
<input checked="" type="checkbox"/> Overlapping Turnout					
<input type="checkbox"/> Name & Description					Rails
<input type="checkbox"/> .1 Station			0.123	s+sss.ss	
<input checked="" type="checkbox"/> .1 Point					
<input type="checkbox"/> .0 Station			0.123	s+sss.ss	
<input type="checkbox"/> .0 Point					
<input type="checkbox"/> .2 Point					
<input type="checkbox"/> .3 Point					
<input type="checkbox"/> S&C Nose & Crossing					
<input checked="" type="checkbox"/> Shunt Point					
<input type="checkbox"/> Equivalent Radii			0.1		Rails

Display Turnouts in Profile

Profile Set:

Bottom Axis to Witness Line Offset: 10.0000

Leader Line Length: 10.0000

Drop Station Equation Names

Data:

Object	Prefix	Suffix	Precision	Format	Name
<input checked="" type="checkbox"/> Witness Line					
<input checked="" type="checkbox"/> Leader Line					
<input checked="" type="checkbox"/> Name					
<input checked="" type="checkbox"/> Description					
<input checked="" type="checkbox"/> .1 Station			0.123	s+sss.ss	
<input checked="" type="checkbox"/> .2 Station			0.123	s+sss.ss	
<input checked="" type="checkbox"/> LLS Point					
<input checked="" type="checkbox"/> LLS Station			0.123	s+sss.ss	

# Completing in SELECTseries 3

The image displays three overlapping screenshots of the 'View Vertical Annotation' dialog box, illustrating different configuration options for vertical annotations in SELECTseries 3.

**Top Screenshot (Tangents):** The 'Tangents' folder is selected in the tree view. The 'Data' table shows the following configuration:

Object	Row	Prefix	Suffix	Precision	Format	Name
<input checked="" type="checkbox"/> Tangents						Prop Vertical
<input checked="" type="checkbox"/> Tangent Annotation						Prop Vertical
<input checked="" type="checkbox"/> Short Tangent						Prop Vertical
<input checked="" type="checkbox"/> Offset Tangent						Prop Vertical
<input checked="" type="checkbox"/> Grade	3	G=		0.123	50%	
<input checked="" type="checkbox"/> Horizontal Length	2			0.123		
<input checked="" type="checkbox"/> Slope Length						
<input checked="" type="checkbox"/> PVI-PVI Length						

**Middle Screenshot (Points):** The 'Points' folder is selected. The 'Data' table shows the following configuration:

Object	Row	Prefix	Suffix	Precision	Format	Name
<input checked="" type="checkbox"/> Type	1					
<input checked="" type="checkbox"/> Station	1	PVC		0.123	s+sss.ss	Prop Vertical
<input checked="" type="checkbox"/> Elevation	-1	Elev		0.123		

**Bottom Screenshot (Curves):** The 'Curves' folder is selected. The 'Data' table shows the following configuration:

Object	Row	Prefix	Suffix	Precision	Format	Name
<input checked="" type="checkbox"/> Curve						Prop Vertical
<input checked="" type="checkbox"/> Curve Annotation						
<input checked="" type="checkbox"/> Witness						Prop Vertical
<input checked="" type="checkbox"/> Leader						Prop Vertical
<input checked="" type="checkbox"/> Terminator						
<input checked="" type="checkbox"/> Type	17	Type				
<input checked="" type="checkbox"/> Direction	16	Dir				
<input checked="" type="checkbox"/> Length	15	LVC	m	0.123		
<input checked="" type="checkbox"/> PVI Station	14	PVI		0.123	s+sss.ss	
<input checked="" type="checkbox"/> PVI Elevation	13	Elev		0.123		
<input checked="" type="checkbox"/> PVC-PVI Length	12	L1	m	0.123		
<input checked="" type="checkbox"/> PVI-PVT Length	11	L2	m	0.123		
<input checked="" type="checkbox"/> Entrance Grade	10	G1		0.123	50%	
<input checked="" type="checkbox"/> Exit Grade	9	G2		0.123	50%	
<input checked="" type="checkbox"/> Rate	7	R		0.123		
<input checked="" type="checkbox"/> K	6	K		0.123		
<input checked="" type="checkbox"/> Middle Ordinate	5	e	m	0.123		
<input type="checkbox"/> Sight (sag)	4	SD	m	0.123		
<input type="checkbox"/> Sight (crest)	3	SD	m	0.123		
<input checked="" type="checkbox"/> Radius	2	R =	m	0.123		

Additional options in the bottom screenshot include:

- Curve Annotation Location:  Annotate at Top of Grid  Append Index
- Witness Line Minimum Length: 400.0000  Qmt Line Terminators  Multiply K by 100

# Swept Envelope Analysis

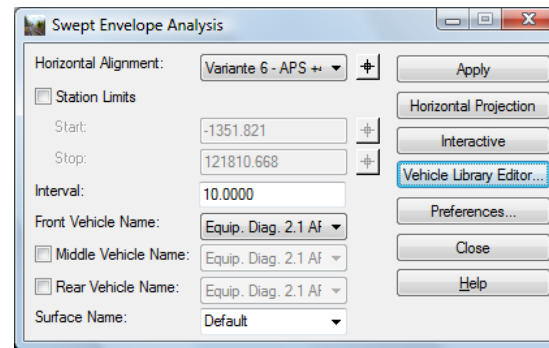
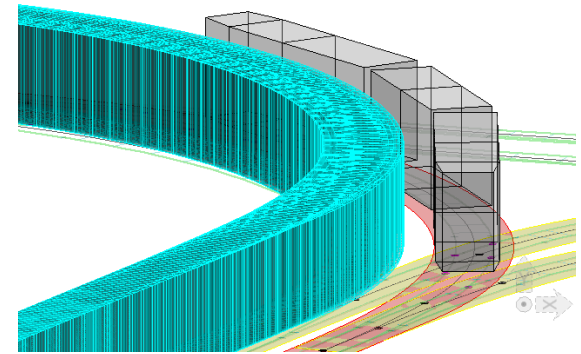
New functionality for the creation of vehicle swept envelopes

# Before Going Any Further, A Definition

- From the British Railways Track, Volume 9, Track Terminology book:
  - Swept Path – The plan area occupied by a rail vehicle as it moves along a track. The width of the swept path at any point is the same as the width of the swept envelope at that point.
  - **Swept Envelope – The kinematic envelope enlarged to allow for the effects of vertical and horizontal curvature, including end throw and centre throw of vehicles and cant applied to the track.**
  - Kinematic Envelope – The cross-sectional profile if a rail vehicle enlarged to include the effects of dynamic sway and vertical movement caused by speed, track curvature and cant, track position tolerances, rail wear, rail head/wheel flange clearances, tilt, vehicle wear and suspension performance at the particular location under consideration. Abbreviated to KE.

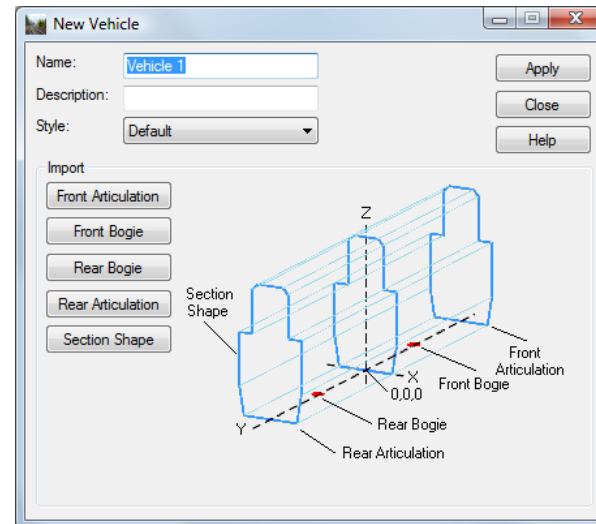
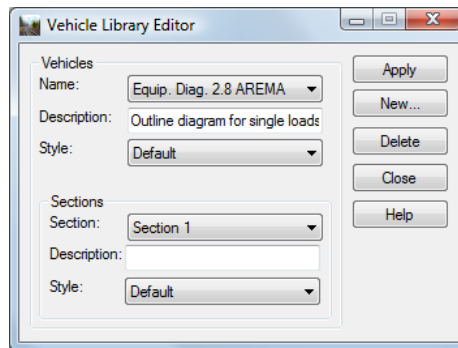
# Swept Envelope Analysis

- New functionality for the creation of swept path / vehicle envelopes
  - Results can be
    - Horizontal projection only
    - Interactive or
    - 3D mesh
  - Up to 3 vehicles in tandem
  - Uses horizontal, vertical and cant geometries

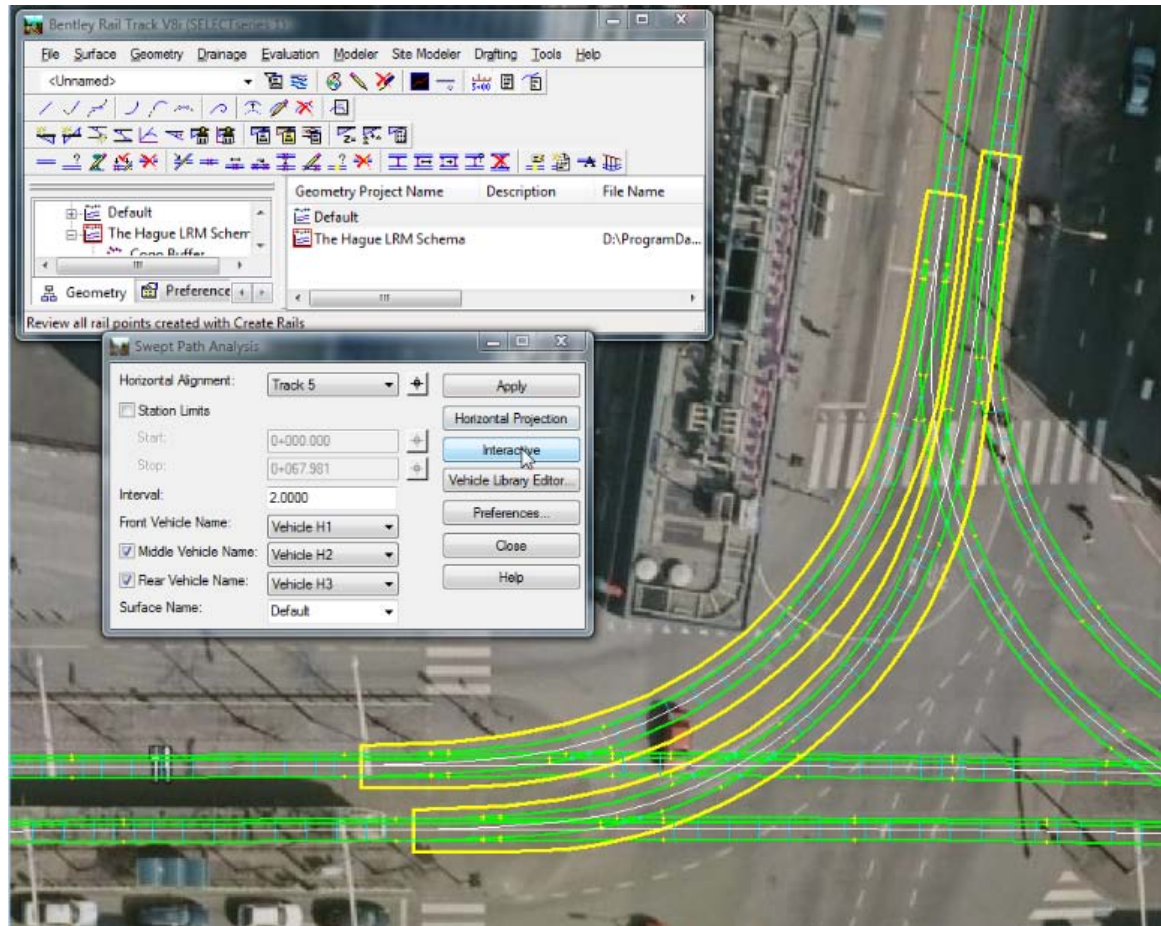


# Vehicle Library

- Manages an XML based file of vehicles
  - ..\Bentley Rail Track V8.11\data\metric\swept envelope vehicles.xml
- A selective / interactive import from .dgn
  - Bogie points
  - Optional articulation points
  - Front, middle & rear sections



# Short AVI



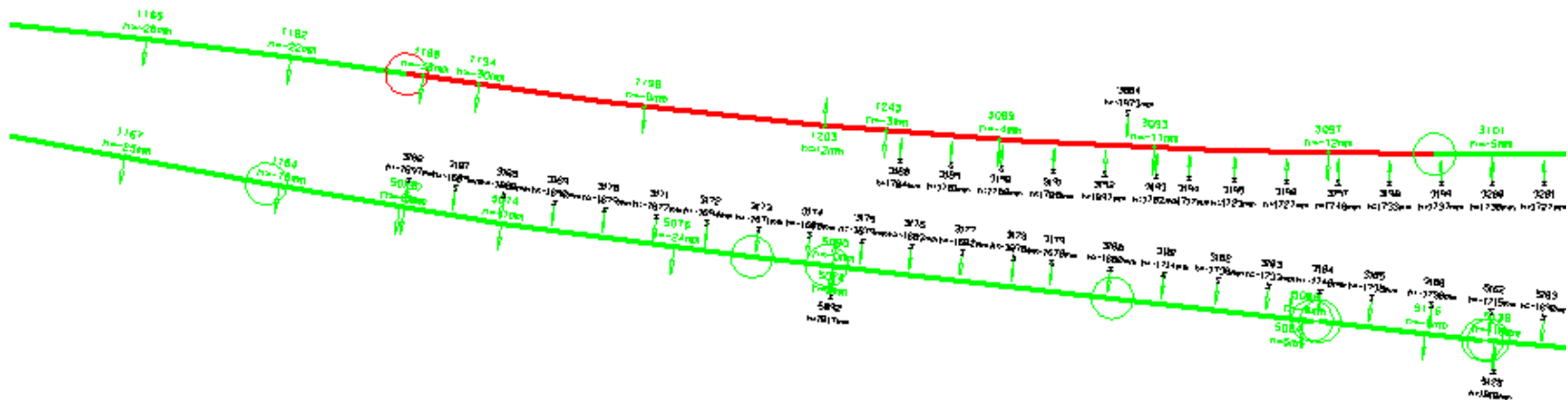
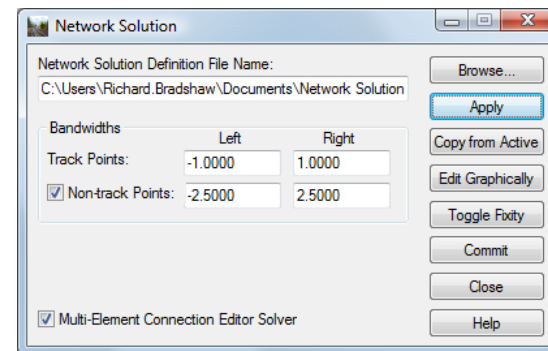
# Network Solution

New functionality that allows the user to create alignments including turnouts that have simple relationships.



# Network Solution

- Primarily written for customers in The Netherlands, but it can adapt to others!
- Utilizes existing solvers
  - Multi-Element Connection
  - Turnout Connection
  - Or
  - Components



# Network Solution & Turnouts

- Relating one cross-over to another cross-over

```

Settings /XY /Degrees /Metric /Arc

Begin Points
E1 1000.0000 1000.0000
E2 2000.0000 1500.0000
E3 2500.0000 1500.0000
End Points

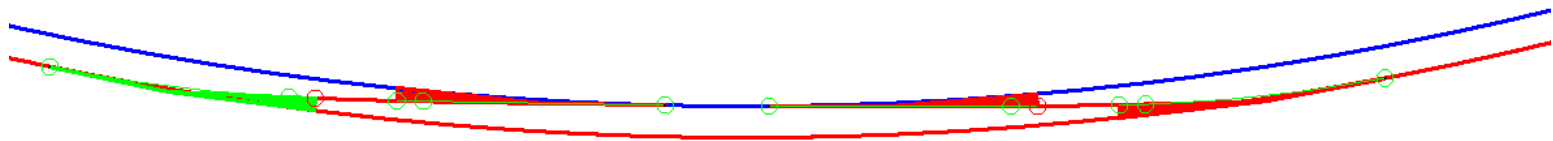
begin alignment /name= Track 1 /Station= 1+000.
line /length= 250. /start= E1 /direction= 90.
spiral /length= 100.
arc /length= ~500. /radius= -500.
spiral /length= 100.
line /length= 250.
spiral /length= 100.
arc /length= ~500. /radius= 500.
spiral /length= 100.
line /length= ~500. /end= E3 /direction= 100.
end alignment

begin alignment /name= Track 2 /Station= 1+000.
parallelTo /OffsetFrom= Track 1 /Offset= -4.5
end alignment
|
#
# create back to back cross-overs
#

begin alignment /name= T3-T4
turnout /name= T3 /Style= Gw 54E1 R465 1:12 /Mainline= Track 1 /Station= 1+400. /Leading /Left /Fixed
arc /length= ~15. /radius= ~-550.
turnout /name= T4 /Style= Gw 54E1 R465 1:12 /Mainline= Track 2 /Station= 1+500. /Trailing /Left /Free
end alignment

begin alignment /name= T5-T6
turnout /name= T5 /Style= Gw 54E1 R465 1:12 /Mainline= Track 1 /LengthFrom= T4 /FromToe= 15. /Leading /Right /Fixed
arc /length= ~15. /radius= ~-500.
turnout /name= T6 /Style= Gw 54E1 R465 1:12 /Mainline= Track 1 /LengthFrom= T5 /FromToe= 60. /Trailing /Right /Free
end alignment

```



## Demo

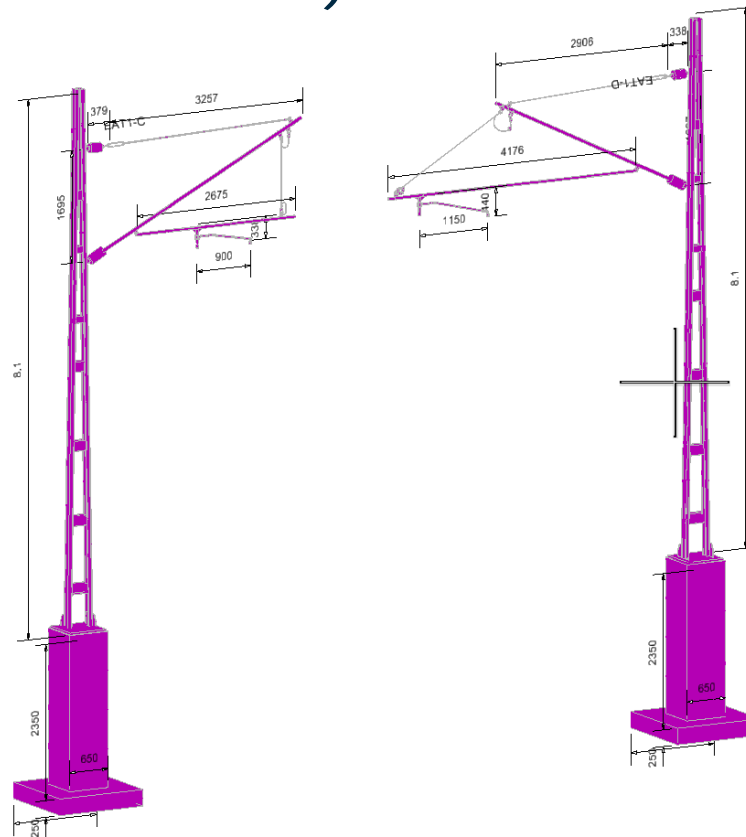
- ..\Documents\Copenhagen\Network Solution\Test case 7.txt
- ..\Documents\Copenhagen\Network Solution\Test case 10 (Arcadis example w turnouts).txt

# Power Rail Overhead Line

This will be a *new* product for the creation of overhead line equipment for electrified railways.

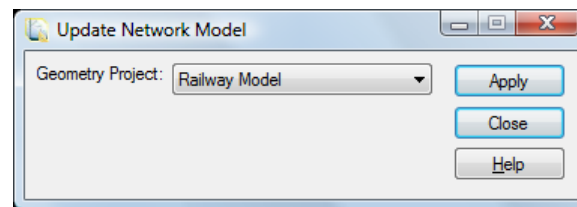
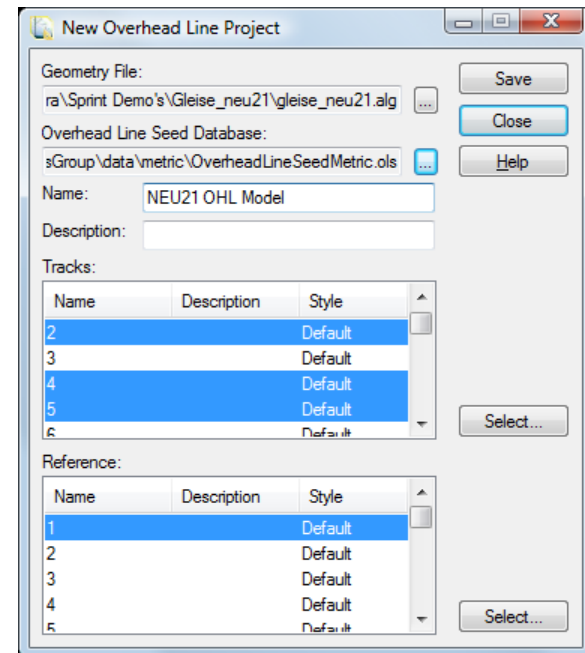
# Equipment

- Components (i.e. nuts and bolts)
- Assemblies (i.e. cantilevers)
  - 3D Cells
- Hierarchies
- Templates



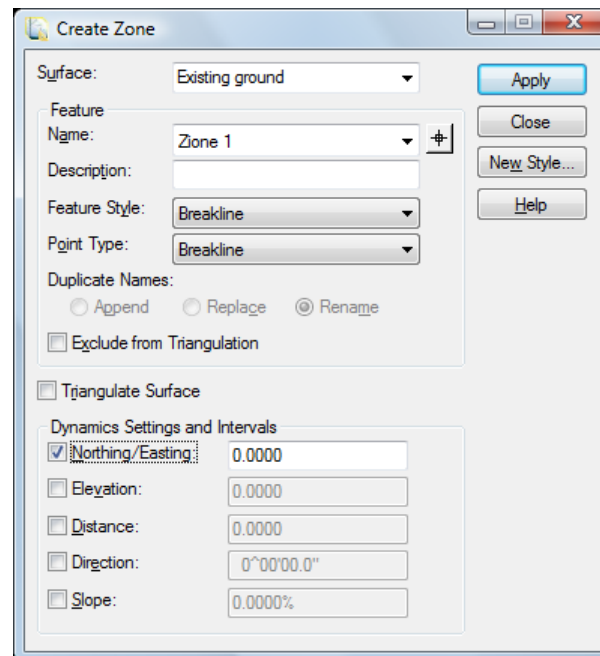
# Network Model

- A network model is created from **Bentley Rail Track** geometry
  - Horizontal
  - Vertical
  - Cant
  - Turnouts
- Update vertical & cant
  - And update the model!



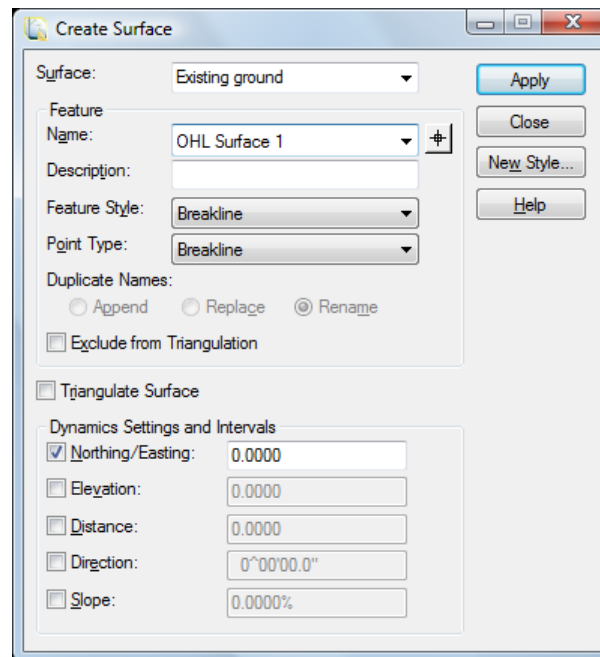
# Zones

- A *zone* is an area where you can not place overhead line structures
  - A road crossing
  - A utility crossing
  - Other objects that you need to avoid



# Surfaces

- A *surface* is an obstruction, like a bridge above the track, where a wire run may need to be lowered to provide clearance between the wire and the structure.

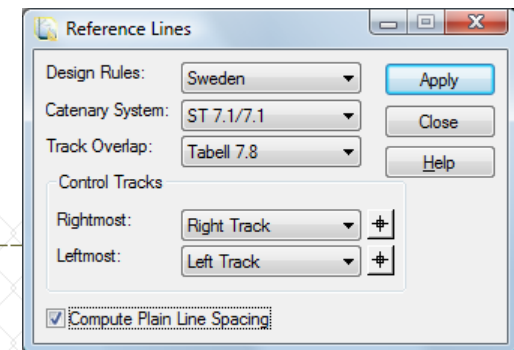




# Overlaps & Reference Lines

- Overlaps are where wire runs go in and out of service, one wire ends and a new wire starts
- Reference lines are working lines upon which structures will be placed
  - Placement is based upon design rules for a specific catenary system
    - Look up tables
    - User defined algorithms
  - Placement may need to be adjusted to avoid obstructions
  - Placement is interactive

Table	Radius	B1	B2	b1	b3	b4	b5
Tabell 7.7	INF	-0.3	0.3	-0.3	-0.1	0.1	0.3
Tabell 7.7	20000	-0.3	0.3	-0.3	-0.1	0.1	0.3
Tabell 7.7	10000	-0.3	0.3	-0.3	-0.2	0.1	0.2
Tabell 7.7	9000	-0.3	0.3	-0.3	-0.2	0.1	0.2
Tabell 7.7	8000	-0.3	0.3	-0.3	-0.2	0.1	0.2



# Turnout Reference Lines

- Place reference lines relative to a turnout
  - Uses look tables related to the turnout's style
  - User define lengths

TurnOut	Name	Position	OffsetToPosition
	UIC 60 - 760 1:15	800	34.87
TurnOut	Name	Position	OffsetToPosition
	UIC 60 - 760 1:15	900	36.98
TurnOut	Name	Position	OffsetToPosition
	UIC 60 - 760 1:15	1000	
TurnOut	Name	Position	OffsetToPosition
	UIC 60 - 760 1:15	1100	

Turnout Reference Lines

Design Rules: Sweden

Catenary System: ST 7.1/7.1

Control Tracks

Rightmost: Right Track

Leftmost: Left Track

Position 1: -6.0000

Position 2

Lookup: 1000

Distance: 30.0000

Apply

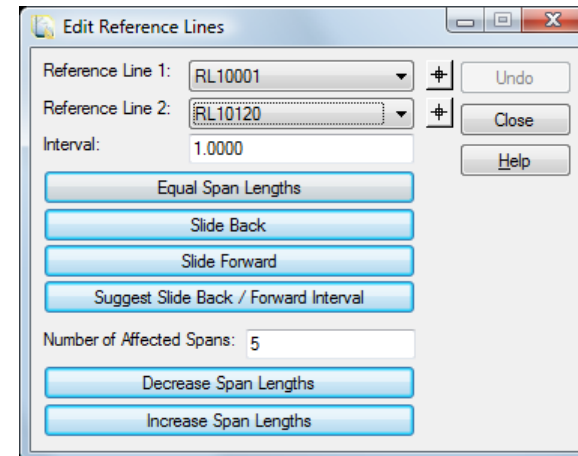
Close

Preferences...

Help

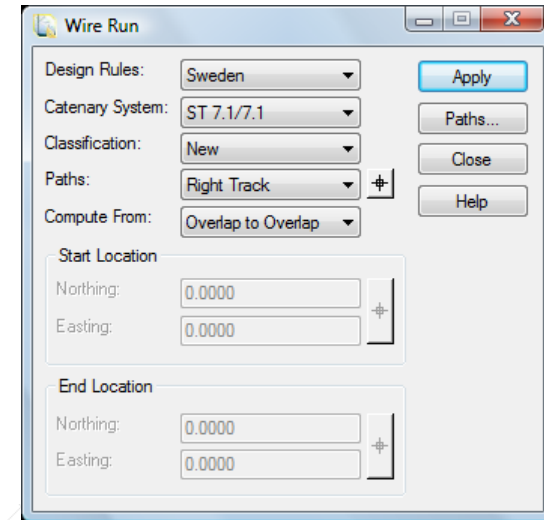
# Reference Line Editing

- Adjustment of reference lines
  - Normally by small amounts
  - Adjusting span lengths
  - Updates entire model
    - Reference lines
    - Overlaps
    - Wire Runs
    - Span Bonding
    - Structures
    - Other wires
      - And all annotation



# Wire Runs

- Wire runs consist of
  - Contact wire
  - Carrier wire
  - Droppers
- Utilizes design rules



Design Rule Set: Sweden  
Version: 1.1

Name	Maximum Span Length	Maximum Wire Run Length	Maximum Span Difference	Nominal Encumbrance	Minimum Span Encumbrance	Mid Span Encumbrance	Minimum Wire Height	Maximum Speed	Nominal Wire Height	Maximum Wire Height	Minimum Span Length	Mid Span Contact Wire Sag	Maximum Dropper Spacing	Distance To First Dropper	Number Of Droppers	Catenary Wire Sag Start Position
S 4.9/5.9	60	1300	10	1.3	0.6	5.2	120	5.5	5.65	0	0.080	8	8	Odd/Even	At Cantilever	
ST 7.1/7.1	60	1300	10	1.3	0.6	5.2	140	5.5	5.65	0	0.040	10		Odd/Even	At first dropper except in curves	
ST 9.8/9.8	60	1300	10	1.3	0.6	5.2	180	5.5	5.65	0	0.030	10		Odd/Even	At first dropper except in curves	
ST 9.8/11.8	60	1300	10	1.3	0.6	5.2	200	5.5	5.65	0	0.030	10		Odd/Even	At first dropper except in curves	
ST 15.0/15.0	65	1600	10	1.55	0.6	5.2	250	5.5	5.65	0	0.030	7	6	Odd	At first dropper	
SYT 15.0/15.0	65	1200	10	1.8	0.6	5.2	250	5.5	5.65	0	0	10	5	Odd	At first dropper	

# Height & Stagger

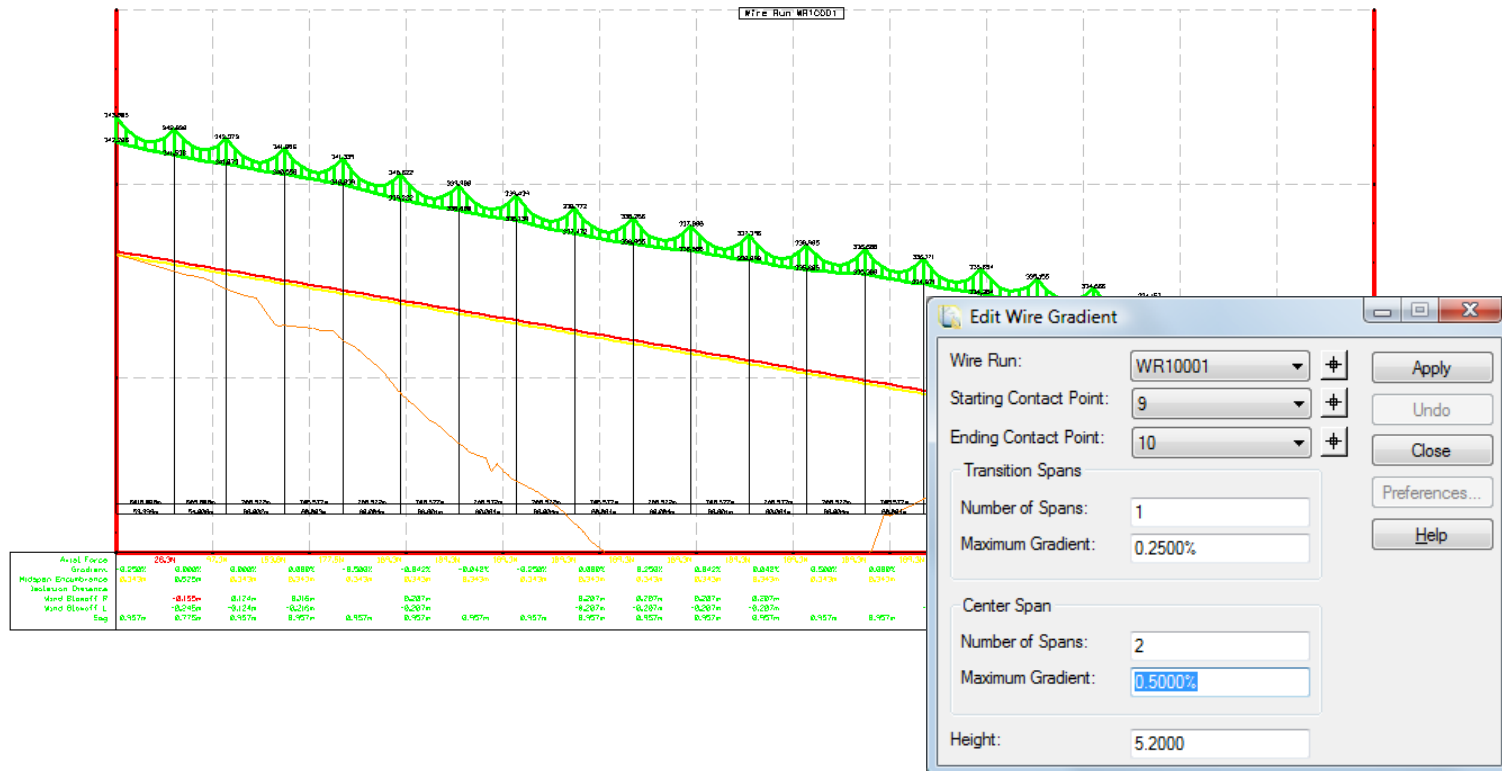
- *Height* will adjust the vertical position of the wires
- *Stagger* will adjust the horizontal position of wires
  - Wires going in and out of service
  - Design checking

The screenshot shows the 'Height & Stagger' dialog box with the 'Height' tab selected. The 'Wire Run' is set to 'WR10001'. The 'Starting Contact Point' and 'Ending Contact Point' are both set to '1'. The 'Starting Height' is '5.6500'. The 'Starting Encumbrance' is '1.3000'. The 'Ending Height' checkbox is checked, with a value of '5.6500'. The 'Ending Encumbrance' checkbox is unchecked, with a value of '1.3000'. Buttons for 'Apply', 'Get Defaults', and 'Help' are visible on the right. 'Undo' and 'Close' buttons are at the bottom.

The screenshot shows the 'Height & Stagger' dialog box with the 'Stagger' tab selected. The 'Wire Run' is set to 'WR10001'. The 'Starting Contact Point' is set to '2' and the 'Ending Contact Point' is set to '22'. The 'Stagger' value is '0.3000'. Buttons for 'All to Left', 'All to Right', 'Left than Right', and 'Right than Left' are visible on the right. A 'Help' button is at the bottom right. 'Undo' and 'Close' buttons are at the bottom.

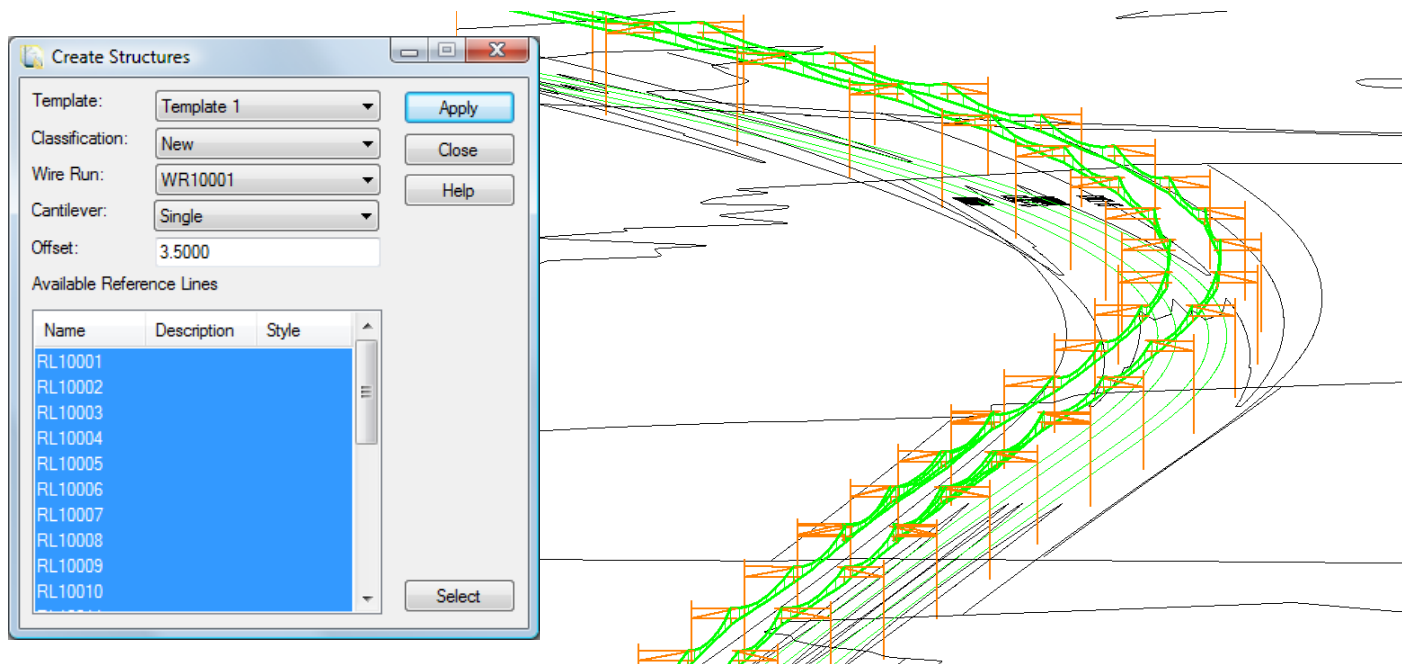
# Wire Gradient

- Used to transition the wire height from the normal height to a height exception, say transitioning under a bridge



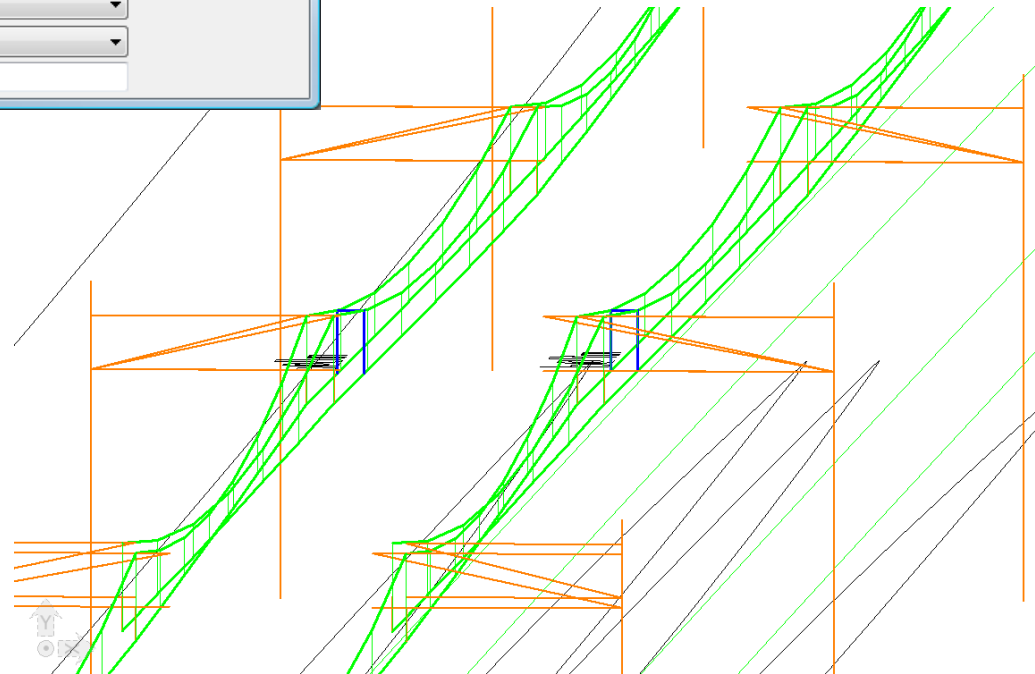
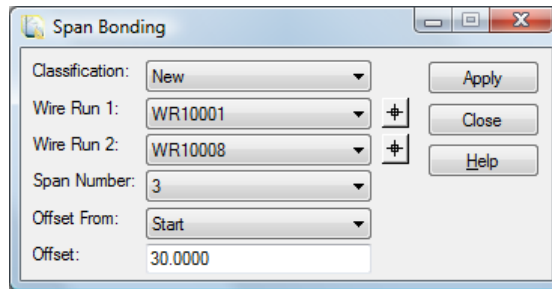
# Structures

- Utilizes equipment defined in a data base
  - Components (i.e. Nuts, bolts, brackets...)
  - Assemblies (i.e. 3d cells of poles, cantilevers, etc.)
  - Templates
    - Combination of components and assemblies



# Span Bonding

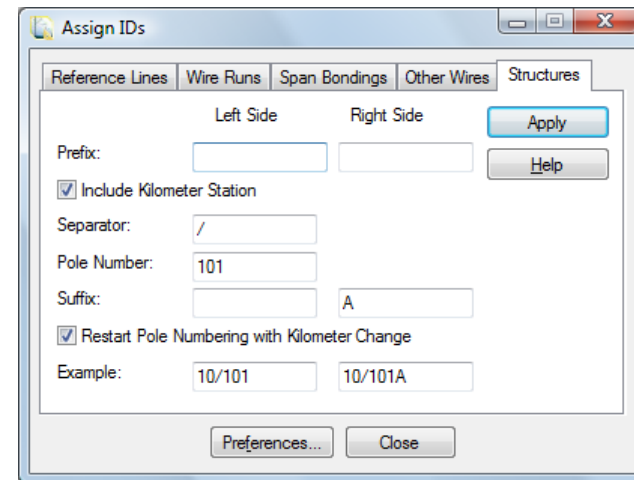
- Creates span bonding between adjacent wires





# Naming Utility

- Naming of
  - Reference Lines
  - Wire Runs
  - Span Bondings
  - Other Wires
  - Structures
    - Lots of customer variation



# Plan Viewing

The image displays three overlapping 'View Plan' dialog boxes, each showing a different configuration of objects to be displayed in a plan view. Each dialog has a tree view on the left and a 'Data' table on the right.

**Top Dialog (Reference Lines selected):**

- Tree View: Reference Lines is selected.
- Data Table:
 

Object	Prefix	Suffix	Precision	Format	Name
<input type="checkbox"/> Cell					
<input checked="" type="checkbox"/> Reference Lines					
<input type="checkbox"/> In Zone					
<input checked="" type="checkbox"/> Control Point					
<input checked="" type="checkbox"/> Margins					
<input type="checkbox"/> Name					
<input type="checkbox"/> De					
<input checked="" type="checkbox"/> St					
<input type="checkbox"/> No					
<input type="checkbox"/> E					
<input type="checkbox"/> El					
<input checked="" type="checkbox"/> Sp					

**Middle Dialog (Wire Runs selected):**

- Tree View: Wire Runs is selected.
- Data Table:
 

Object	Prefix	Suffix	Precision	Name
<input type="checkbox"/> Cell				
<input checked="" type="checkbox"/> Catenary Wires				
<input checked="" type="checkbox"/> Contact Wires				
<input checked="" type="checkbox"/> Dropper Wires				
<input checked="" type="checkbox"/> Name				

**Bottom Dialog (Structures selected):**

- Tree View: Structures is selected.
- Data Table:
 

Object	Prefix	Suffix	Precision	Format	Name
<input type="checkbox"/> Cell					
<input checked="" type="checkbox"/> Structure					
<input checked="" type="checkbox"/> Name					
<input type="checkbox"/> Description					
<input checked="" type="checkbox"/> Style					
<input checked="" type="checkbox"/> Station	Sta		0.123	s+sss.ss	
<input checked="" type="checkbox"/> Offset		m	0.123		
<input checked="" type="checkbox"/> Northing	N=		0.123		
<input checked="" type="checkbox"/> Easting	E=		0.123		
<input checked="" type="checkbox"/> Elevation	Pgl=		0.123		
<input checked="" type="checkbox"/> Height	H=	m	0.123		
<input checked="" type="checkbox"/> Stagger	S=	m	0.123		
<input checked="" type="checkbox"/> Encumbrance	E=	m	0.123		
<input checked="" type="checkbox"/> Cant	D=	mm	0		
- Offset: 0.4000

# Profile Viewing

The image displays three overlapping 'View Profile' dialog boxes, each showing a different view of the profile data.

**Top Dialog (General View):** Shows 'Wire Runs' with 'Single' selected and 'WR10001' in the dropdown. An 'Example' section shows a profile diagram with a red arrow pointing to a specific point.

**Middle Dialog (Profile View):** Shows a 'Data' table with columns: Object, Prefix, Suffix, Precision, Name. The table contains the following rows:

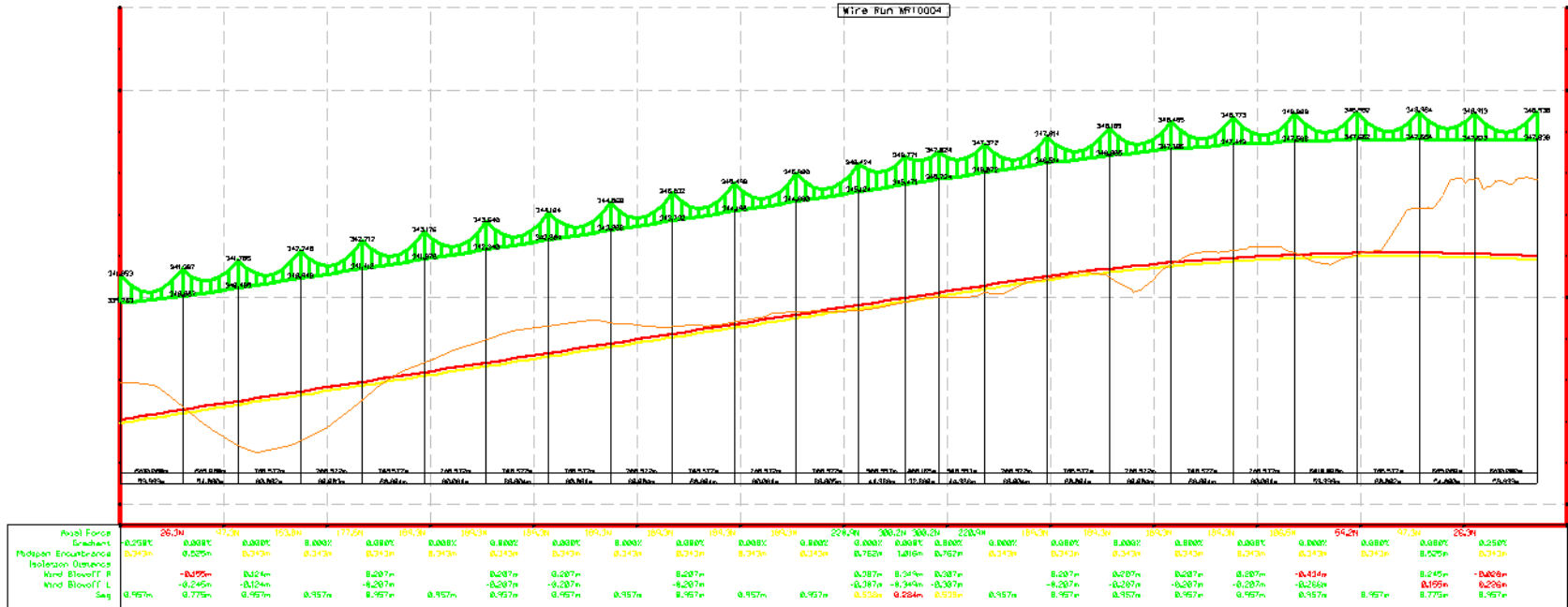
Object	Prefix	Suffix	Precision	Name	
<input checked="" type="checkbox"/> Wires					Green
<input checked="" type="checkbox"/> Profile Grade Line					Red
<input checked="" type="checkbox"/> Catenary Point					Green
<input checked="" type="checkbox"/> Cat					
<input checked="" type="checkbox"/> Cor					
<input checked="" type="checkbox"/> Fir					
<input checked="" type="checkbox"/> Las					
<input checked="" type="checkbox"/> Dro					
<input checked="" type="checkbox"/> Spa					
Lea					
Dim					

**Bottom Dialog (Design Checks View):** Shows a 'Data' table with columns: Object, Precision, Name. The table contains the following rows:

Object	Precision	Name	
Rule Name			Green
Text			...
Desired			Yellow
Relaxed			Yellow
Out of Range			Red
<input checked="" type="checkbox"/> Frame Lines			...
<input checked="" type="checkbox"/> Axial Force	0.1		
<input checked="" type="checkbox"/> Gradient	0.123		
<input checked="" type="checkbox"/> Midspan Encumbrance	0.123		
<input checked="" type="checkbox"/> Isolation Distance	0.12		
<input checked="" type="checkbox"/> Wind Blowoff R	0.123		
<input checked="" type="checkbox"/> Wind Blowoff L	0.123		
<input checked="" type="checkbox"/> Sag	0.123		

At the bottom of the Design Checks dialog, there are input fields for 'Starting Offset: 0.1000' and 'Spacing: 0.1000', along with 'Apply', 'Preferences...', 'Close', and 'Help' buttons.

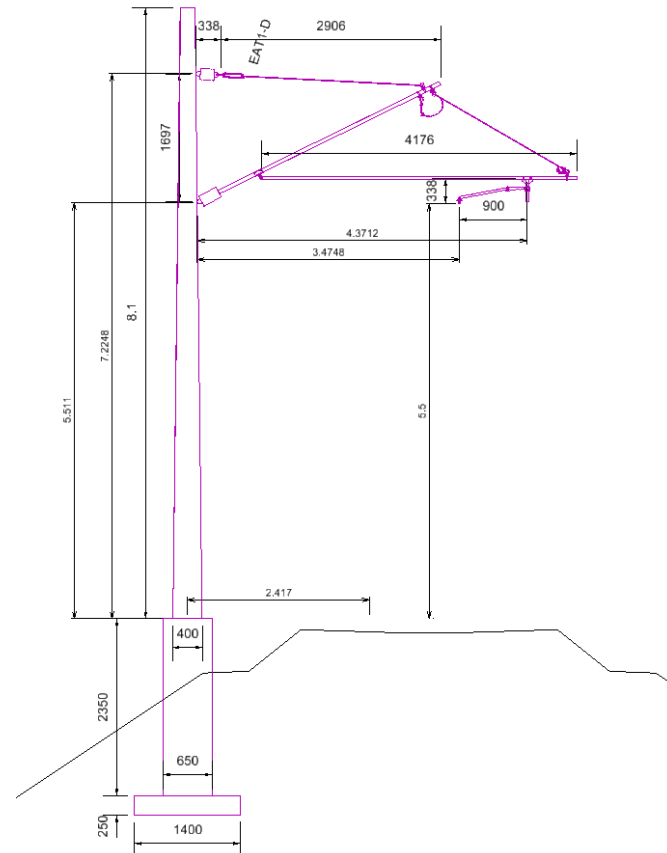
# Example of View Profile Annotation



	26.3N	97.3N	153.8N	177.5N	226.3N
<b>Axial Force</b>	26.3N	97.3N	153.8N	177.5N	226.3N
<b>Gradient</b>	-0.250%	0.000%	0.000%	0.000%	0.000%
<b>Midspan Encumbrance</b>	0.343m	0.525m	0.343m	0.343m	0.343m
<b>Isolation Distance</b>	0.207m	0.124m	0.207m	0.207m	0.207m
<b>Wind Blowoff R</b>	-0.155m	0.124m	0.207m	0.207m	0.207m
<b>Wind Blowoff L</b>	-0.245m	-0.124m	-0.207m	-0.207m	-0.207m
<b>Sag</b>	0.957m	0.775m	0.957m	0.957m	0.957m

# Cross Sections

- Graphical data and
- Non-graphic data



Assembly	Description	Count	Structure	Single Track Post 5	Component	Description	Count
EAT1-D		1	Chainage	7+026.571	1600-104	EAT1-D cantilever assembly	1
steady arm 0.9m - push		1	Orientation	N 17°33'27.78" E	1501-003	concrete footing, pole	1
foundation - pole		1					
Pole 8m		1	Wire	NW			
			Height	5.50			
			Stagger	0.40			
			Encumbrance	1.30			

# Reporting

- As always XML / XSL based

The image displays two windows from the Bentley Civil Report Browser. The top window shows a 'Dropper Spacing Report' for a project named 'Variable'. The report was created on 7/26/2010 at 10:26am. It details a design rule for Sweden with a catenary system of S 4.9/5.9. The report includes a table of wire runs with their span numbers, lengths, and spacing.

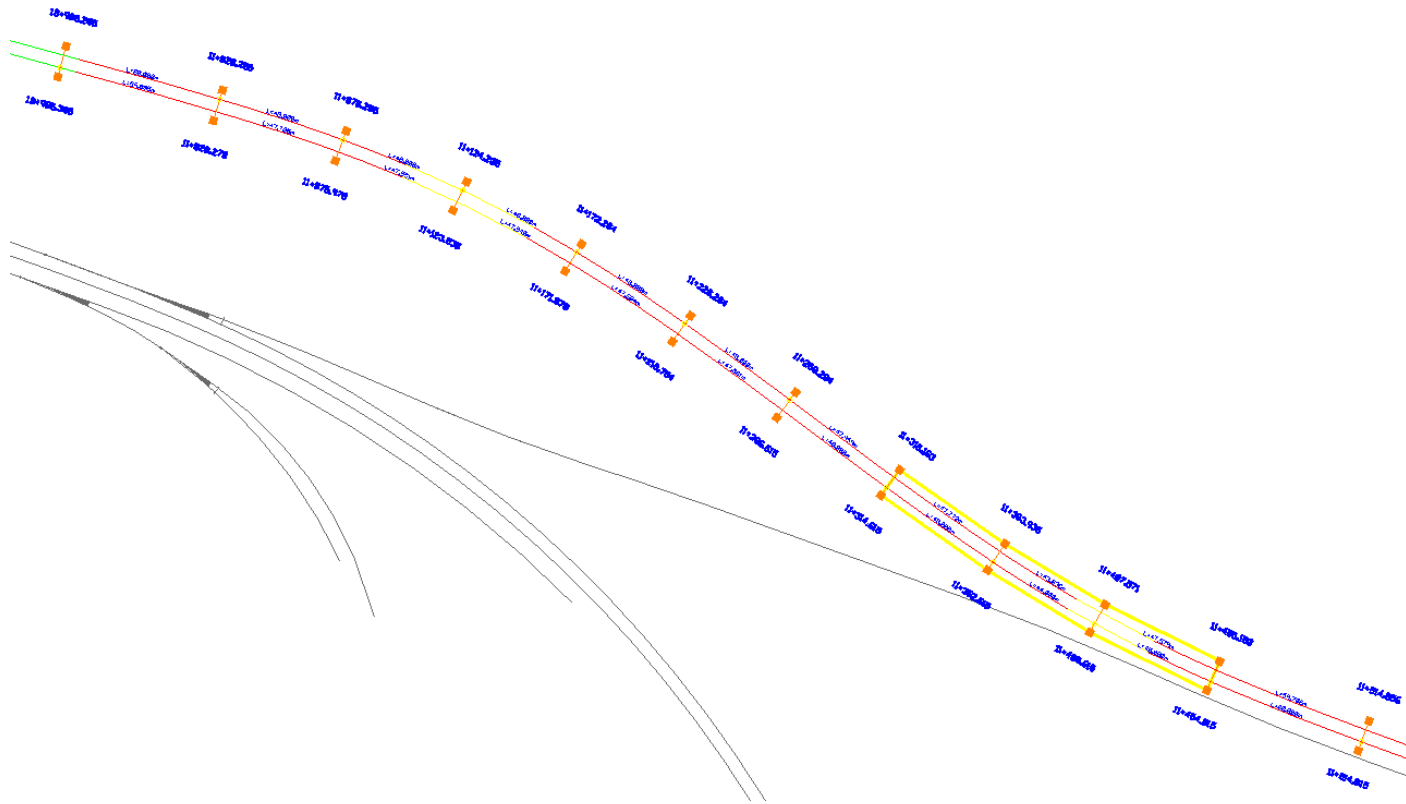
Wire Run	Span Number	Length To First	Number @ Spacing	Length To Last
WR1001	1	8.000	6 @ 7.333	8.000
WR1001	2	8.000	5 @ 7.400	8.000
WR1001	3	8.000	6 @ 7.334	8.000
WR1001	4	8.000	6 @ 7.334	8.000
WR1001	5	8.000	6 @ 7.334	8.000
WR1001	6	8.000	6 @ 7.319	8.000
WR1001	7	8.000	5 @ 7.714	8.000

The bottom window provides a detailed view for 'Wire Run: WR1001'. It lists various parameters for each span, including axial force, gradient, midspan encumbrance, isolation distance, wind blowoff, and sag.

Span Number	Axial Force	Gradient	Midspan Encumbrance	Isolation Distance	Wind Blowoff R	Wind Blowoff L	Sag
1		-0.250%	0.253m		-0.243m	0.043m	1.047m
2	22.264N	0.000%	0.483m			-0.254m	0.817m
3	81.261N	0.000%	0.253m				1.047m
4	127.826N	0.000%	0.253m				1.047m
5	147.488N	0.000%	0.253m				1.047m
6	149.905N	0.000%	0.256m		0.617m	-0.438m	1.044m
7	35.024N	0.000%	0.434m		0.751m	-0.367m	0.866m
8	415.385N	0.000%	0.440m		0.447m	-0.388m	0.860m
9	400.804N	0.000%	0.440m		0.447m	-0.388m	0.860m
10	401.041N	0.000%	0.439m		0.448m	-0.388m	0.861m
11	401.252N	0.000%	0.438m		0.449m	-0.388m	0.862m
12	401.482N	0.000%	0.437m		0.450m	-0.388m	0.863m
13	394.425N	0.000%	0.497m		0.391m	-0.393m	0.803m
14	318.516N	0.000%	0.720m		0.026m	-0.674m	0.580m
15	390.671N	0.296%	0.554m		0.034m	-0.698m	0.746m

# Demo...

- ..\Documents\Vectura\Sprint Demo's\7.1k



# Continuing to *Enhance and Create* Global Rail Solutions!

## Questions?

