

#### Bentley Rail Design Update

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#### **Regional Trends**

#### **Regional trends**

Western Europe: the high relevance of rail transport and continuing deregulation are the most important market drivers. In addition, there are important new projects in high-speed and urban rail transport.

Eastern Europe: this region has become much more important, due mainly to the rising importance of deregulation and improved financial conditions thanks to many countries' accession to the European Union. In addition, there are large installed bases of old vehicles and infrastructure which will have to be renewed. North America: this market is shaped by freight transport, which has benefited substantially from economic growth in recent years. In the future, the focus will be more on urban transport. Extensive infrastructure and procurement projects are planned here. South America: this market has also benefited in the past few years from the rising demand for raw materials. However, it must be assumed that current growth rates will not continue. A change of thinking is taking place in the market for urban rail transport, Urgently-needed infrastructure upgrades and the associated vehicle procurements are expected in the coming years. Asia: the massive expansion and upgrading projects in

China are shaping the market. India has very high growth potential and political announcements have been made to this effect. The high population in many cities and the lack of suitable commuter transport systems make billion-euro investments inevitable. Further investments are also being made in freight transport. Africa/Middle East: investments are currently being made in urban rail transport. The somewhat ambitious new projects in high-speed rail and urban transport are predominantly limited to northern Africa, the Gulf States and South Africa. Continuing urbanisation in this region will lead to further

growth in the long term. CIS: the signs are pointing towards growth. The high importance of the railways, large stocks of old vehicles and infrastructure and a reinvigorated railway industry are resulting in high rates of growth. In Russia the leading market - plans look fairly secure. The current focus is on the procurement of efficient rolling stock and renovation of the existing network. Australia/Pacific: momentum

is expected from the freight and urban transport sectors. Alongside Australia, New Zealand is also seeing a rise in investments following the recent renationalisation of the railway.

Source: http://www.railjournal.com/



### **Bentley's Rail Design Solution Offers...**

- Horizontal alignment design
- Vertical alignment design
  - Single and multi-element regression analysis for maintence
  - New line design
- Cant / superelevation design
- Turnouts
- Also includes *specialized* toolsets for
  - Design checking
  - Design to field
  - Light rail manufacturing
  - Magnetic levitation



### **Adapts to Any Project or Workflow**

- 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
  - Available in German, Spanish, Chinese plus other languages
- Bentley Rail Track is localizable
  - Deliver standard turnouts
  - Build in railway specific design checking



### Major Differences Between Road & Rail

- Horizontal alignment design based upon cant (i.e. superelevation)
  - Arc or chord definition alignments
  - Horizontal spiral transition types
    - Clothoids + cubic parabola, AREMA, bi-quadratic parabola, Bloss, sinusoid, cosine and Viennese
    - 1 to 1 relationship between the horizontal transition and the cant transition
- Vertical alignment design
  - Parabolic vertical curves
  - Circular vertical curves + clothoids
- *Turnouts* are a type of geometry
  - Multiple types (single, double and slips)
  - Multiple bending methodology



# **Horizontal & vertical geometry**

Includes new design as well as maintenance workflows.



### **Alignment Design**

- Multiple methods to define horizontal and vertical geometry
  - Curve sets
  - Fix / Float / Free Elements
  - Single / multi-element regression analysis
    - The *process* of *best fitting* true geometry to raw survey points
    - Quick regression (New in V8i)
  - A *horizontal* set of commands and a corresponding *vertical* set of commands
    - Reduces training issues
  - Tools are interchangeable
    - Use curve sets, elements or regression in combination



### **Regression Workflow...**

- Pre-regression data validation
- Point selection and sorting
  - Survey data ordering is not required
- Curvature diagrams



- Indicates questionable data
- Inclusion of cant, if surveyed, enhances the field data!
- Edit / review
  - Select / Regress, which is *heads-up selection / auto element* type determination!
    - Reduces potential user errors & time
  - Quick Regression (New in V8i)
- Slew diagrams and reporting



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### **Vertical Alignment Healing**

- An attempt to synchronize / update the vertical alignment when the horizontal alignment has changed.
  - The coordinate position of vertical PI's will be held!
    - Stationing up-station of the edit will change, but the coordinate position remains!
    - Add a station equation to account for the gap or overlap (and stationing will return to "even" values!)
    - (New in V8i)



### **Additional Transition Spirals**

#### • Cubic parabola

- Length along axis (Australia)
- Length along tangent (Czech & NSW (New in V8i)
- AREMA (New in V8i)
  - Chord definition
  - Length along axis
  - Simple & compound

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3 10527 2682
8 10921.3357
7 12028.8778 5 11371.7164



## **Turnouts**

Specialized geometric objects



#### **Turnouts**

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









### **Advantages of utilizing turnouts**

- Manage the underlying horizontal alignments
  - Once created the software will re-establish the associated turnouts
  - After editing the software updates the associated turnouts and horizontal alignments
  - Maintain the rules for bending turnout geometry





#### **Creating Turnouts**

- Consolidate and minimized functionality (New in V8i)
  - Interface changes based upon library
  - Create from the interface or interactively

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### **Create Turnout Connections**

- Start with a single turnout and create a connection to a new turnout (New in V8i)
  - A simplification to minimize using the *Turnout Connection Editor* for simple crossovers
  - Ending turnout will match the beginning turnout.
  - Connection is linear or circular

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#### **Turnout Connection Editor**

- Used for more advanced geometric constructions
  - Crossovers
  - Sidings
- Editing an existing construction
- Maintains *rules* and *relationships*!

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#### **Resulting in models like these yards!**





### **Detailed Design Checking**

- Includes
  - CEN Standards
  - Austrian Rail
  - Danish Rail
  - Dutch Rail
  - German Rail
  - Transrapid
- Execute as you design
  - Interactive + passive
- Execute as a post-design process
  - Ideal for checking a consultant's design
- Written to match the railway's requirements



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#### **Display and also design check**





### **Working with Leading Suppliers**

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- Reading data from Plasser & Theurer's EM-SAT geometry measurement system
  - Advanced long chord measuring resolved to real world coordinates!



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Apply Close

Help

### Usability

- Configurable list views
  - Right click in list view title and check on / off columns
- Resizing dialogs
  - Cant Alignment Editor
  - Check Integrity
  - Review / Edit Regression Poir
  - Others...

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#### **Updated GUI Presentation**

- Implement *tree view* and *grids* for various geometry view commands
  - View Stationing
  - View Station & Offset
  - View Curve Set
  - View Vertical in Plan
  - View Switch Height Plan
  - Others...
- Consistency



### New in V8i (General)



- Roundabouts was added to the InRoads Group install. Activate the roundabout functionality by clicking a command such as the Civil Library Browser under MicroStation > Tasks > Civil > Roundabouts.
- Civil AccuDraw is new functionality similar to MicroStation AccuDraw with added civil engineering functionality. Access Civil AccuDraw through the MicroStation Tools menu.
- Civil Global Positioning System adds civil engineering functionality to the MicroStation > Tools > Geographic > Global Positioning System (GPS) command.



### New in V8i (General)



- Horizontal Element > Edit Horizontal Element. The Maintain Element Connectivity with Minimum Movement allows the user to change the geometry a line or a circular arc and have the adjacent elements also update. The option utilizes the component technique of fix, float and free to re-compute the geometry.
- Regression > Edit/Review Regression Points. The Select button is now called Select Only. This button will only select points for regression. The user can still do <Ctrl> + Select to include points in the analysis. The user can still <Shift> + Select to include points in a fence in the analysis. Also, the Regress button is now called Select & Regress. This button will allow the user to select the regression points and automatically perform the regression. The software will stay in this heads-up mode to select and regress multiple elements, until the user rejects. These changes apply to both the Edit / Review Horizontal Regression and Edit / Review Vertical Regression commands.



### New in V8i (General)



- Regression > Edit/Review Regression
   Points. The columns are now
   configurable.
- Regression > View Regression Points and Evaluation > Profile > Annotate Profile > Horizontal and Vertical Slew leafs. The ability to display the slew values in millimeters was added.
- Regression points are now removed from the buffer when the corresponding cogo point is deleted.





- Translators > Import EM-SAT was added to import data from a Plasser & Theurer survey machine.
- View Geometry > Stationing. The ability to display cant annotation at a user defined interval was added.
- Superelevation > Cant Editor. The columns are now configurable.





- Geometric element freedoms are now maintained with the data for the life of the data. The following commands are affected:
- Geometry > Horizontal Regression > Multiple Horizontal Element Regression Analysis
- Geometry > Vertical Regression > Multiple Vertical Element Regression Analysis
- Geometry > Turnouts > Turnout Connection Editor
- Geometry > Turnouts > Create Connection





- Horizontal Regression > Multiple Horizontal Element Regression Analysis. Editable Applied Cant fields were added for the Beginning and Ending Elements and an Applied Cant column was added in the Connecting Element list.
- Horizontal Regression > Multiple Horizontal Element Regression Analysis. If the Beginning Element is the first element in an alignment then the user will be able to edit a linears tangential direction or a circular arcs radius. In a similar manner, if the Ending Element is the last element in an alignment then the user will be able to edit a linears tangential direction or a circular arcs radius.
- Horizontal Regression > Edit/Review Horizontal Regression Points. Quick Regression was added.





- Transition spirals. The cubic parabola spiral implementation has been enhanced for Czech Railways. The primary difference is the Czech cubic parabola is defined by the length along the spirals tangent rather than the length along the centerline.
- Transition spirals. The cubic parabola spiral implementation has been enhanced for New South Wales, Australia.
- Transition spirals. The software has been enhanced to also include the America Railway Engineering and Maintenance Associations cubic spiral. The AREMA transition is based upon degree of curvature defined as chord definition.
- Turnouts. Combined turnouts and the Switch & Crossing (S&C) style of turnouts into a single set of functionality. Within the Create Turnouts and Create Connection commands, the classical style of turnouts now has all of the applicable options that S&C has.





- Turnouts. The software now attempts to re-establish orphaned turnouts.
- Turnouts > Display Turnouts. The ability to display the station at the beginning of a turnout was added.
- Turnouts > Display Turnouts and Display Turnouts in Profile have been converted to grid views.
- Turnouts > Create Connection was added.
- Create Vertical through Turnouts. The computations were simplified to always copy & transform elements to the noncontrolling vertical.
- Drafting > Network Rail Extensions was added to display turnouts using Network Rail methodology.
- Light Rail Manufacturing > Annotate Rail Offsets has been enhanced.
- Utilities > Design Checks > Dutch Rail tab was added.



# **Bentley Rail Overhead Line**

A *new* product for the creation of overhead line equipment for electrified railways





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Name:	\$ 4 9/5 9	~	New
	3 4.3/3.3		New
	Attribute	Value	Delete
•	Max. Span Length (m)	60	Crew
	Max. Wire Run Length (m)	1300	Lopy
	Min. Curve Radius (m)	0	Rename
	Max. Span Difference (m)	10	
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	Min. Wire Height (m)	5.2	Stanger Badius
	Max. Wind Blow-off (m)	0.5	Conaggorithaanoon
	Max Speed (km/h)	120	Apply
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	Max. Wire Height (m)	5.65	Close
	Nominal Stagger (m)	0.4	
	Min. Span Length (m)	0	



#### Wire Runs

#### • Wire runs associated with network track paths



### **Height & Stagger**

- Modify & edit wire staggers
- Automatically calculates
  - Wind blow off
  - Axial forces
  - Etc.
    - Display design violations!
- Customizable to specific railway standards!





#### **Structures**

- Structures types include:
  - Mast single
  - Portal
  - Assembly
- Create individually or in multiples
- Utilize templates







#### **Templates**

- Used for
  - Structures
  - In-span equipment
  - Wire tension equipment
- User defined Templates
  - Made of assemblies
    - Made of components
    - Graphic & non-graphic data
- Create once, use over and over!





### **Wire Run End Conditions**

- Mid-Wire Tension
- End Wire Fixity/ Tension

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#### **Other Equipment**

- Transformers
- Post restraints
- In span equipment
- Span bonding







### Reporting

- Reports
   XML / XSL
- Checking
- Bills of materials
- Equipment pick lists

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	lang 3fastopp linjestp	Item Name	Item Name Item Description		Quantit	v
		0413127	Toppkonsol, lång trefas för linjestolpe		1	
		0421224	Stödisolator 140/55kV pinntyp av porslin		3	
		0424064	Najningsspiral toppnajn för 99mm2, 85mm nacke		6	
		5271951	Skruv M6S 8.8 FZV M 20x220		2	
		5323865	Mutter M6M ISO 4032-8 FZV	Mutter M6M ISO 4032-8 FZV M 20		
		5376388	Bricka BRB FZV 21x36x3		4	
	Тур5	Item Name	me Item Description			Quantity
		0411220	Fundament med fot för brygg och viktavspÃ $\!$			1
	Connection Point	Item Name	Item Description Quantity			
	Track Centreline	Item Name	Item Description Quantity			
	Right Rail	Item Name	Item Description Quantity			
	Left Rail	Item Name	Item Description Quantity			
	Ground	Item Name	Item Description Quantity			
	Component Name	Component	Items			
	SH1300 B 252	Item Name Item Description Quantity				
		0410100	Stand datum an at at 63 En 42 and	ñe 2		



#### **Overhead Line Modeling...**





