



# Rail Design from Geometry to Modeling

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Bentley Civil - Development

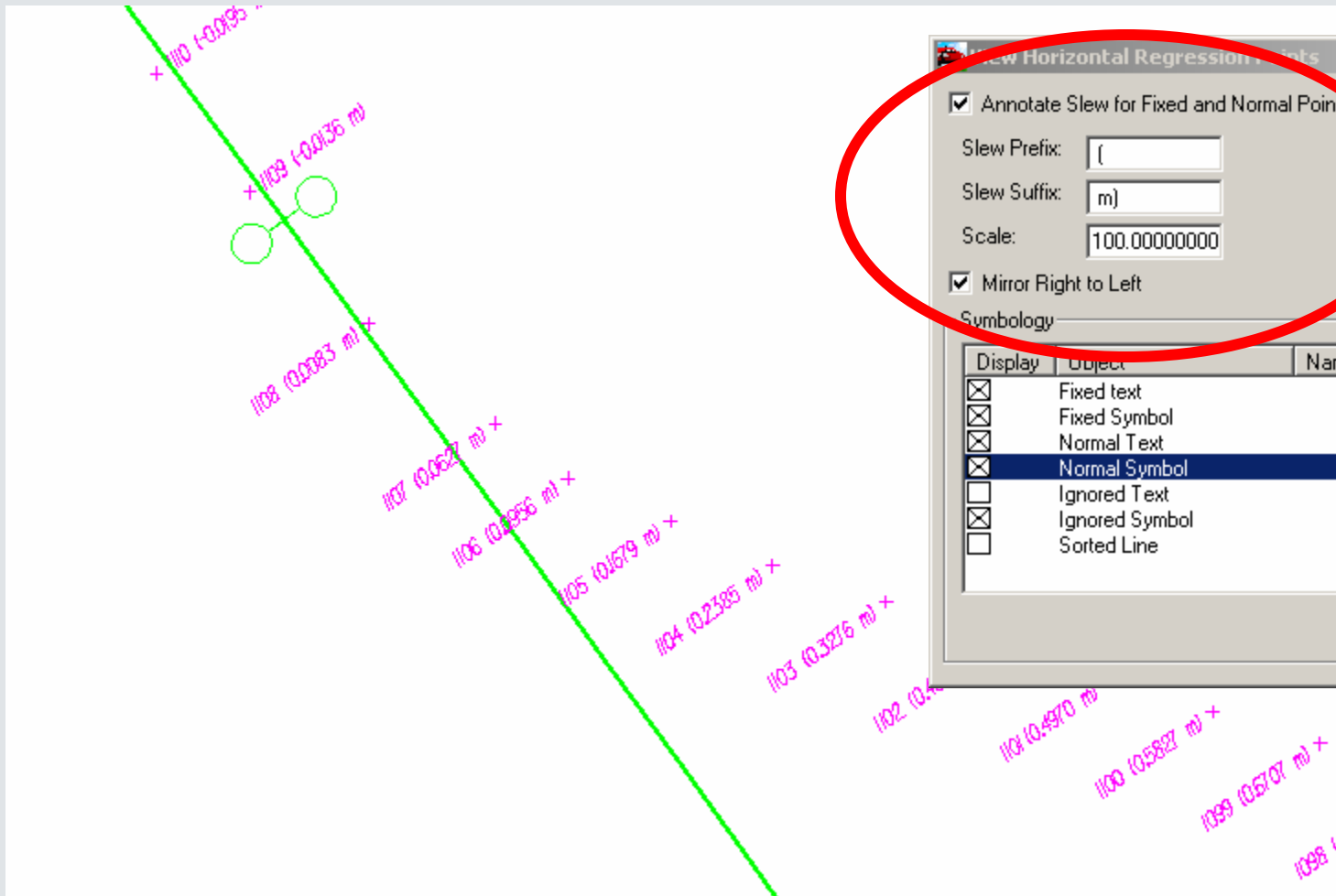


# Various Enhancements

- Production Enhancements
  - *Display Regression Points*
  - *Display Turnouts*
  - *Display Turnouts in Profile*
  - *Profile Annotation*
- Design Enhancements
  - Regression
  - Turnouts
  - Cant



# Display Regression Points

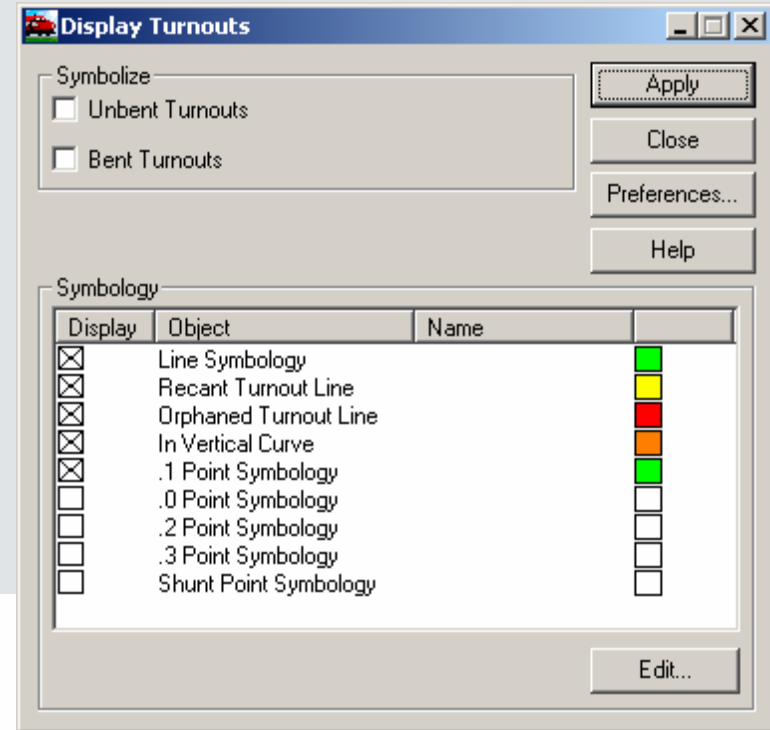
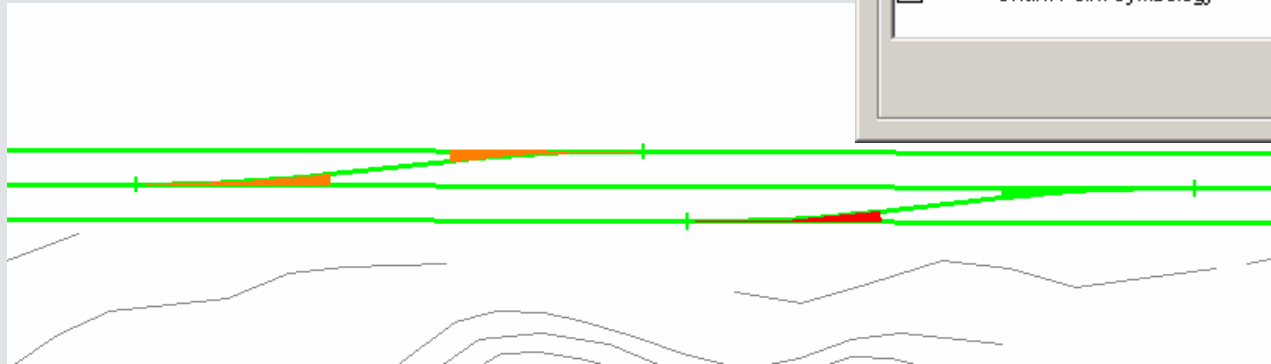


Display	Object	Name
<input checked="" type="checkbox"/>	Fixed text	
<input checked="" type="checkbox"/>	Fixed Symbol	
<input checked="" type="checkbox"/>	Normal Text	
<input checked="" type="checkbox"/>	Normal Symbol	
<input type="checkbox"/>	Ignored Text	
<input checked="" type="checkbox"/>	Ignored Symbol	
<input type="checkbox"/>	Sorted Line	

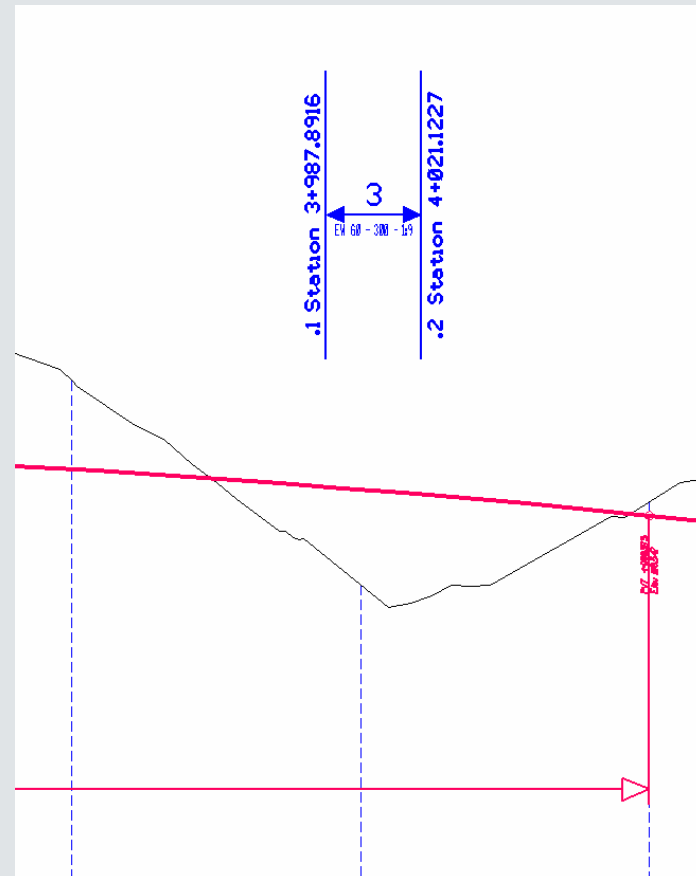
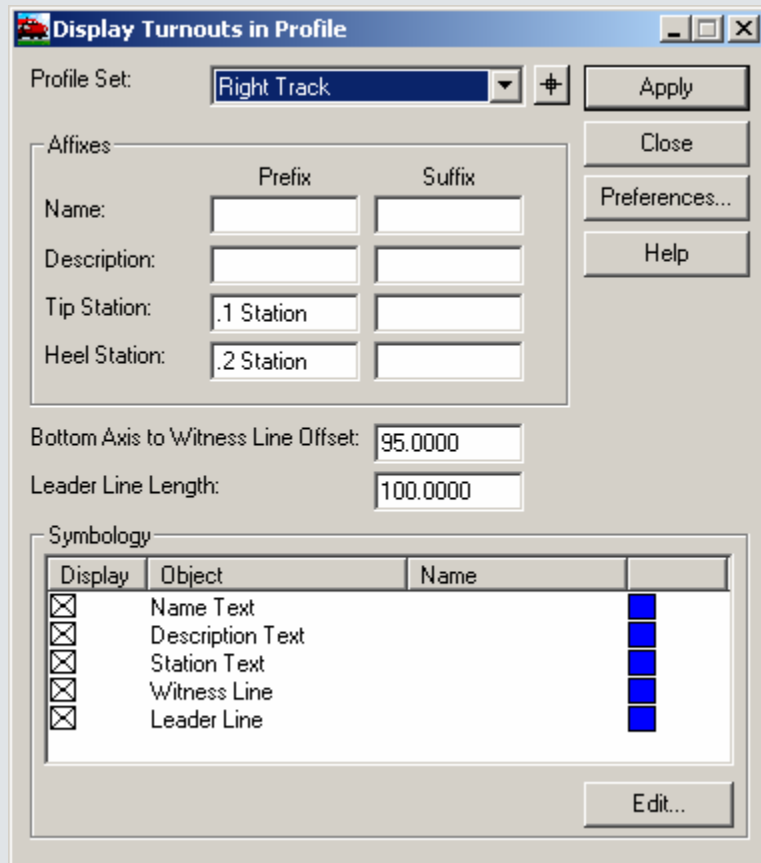


# Display Turnouts

- Viewing
- Integrity Checking
  - Recant?
  - Orphaned
  - In Vertical?

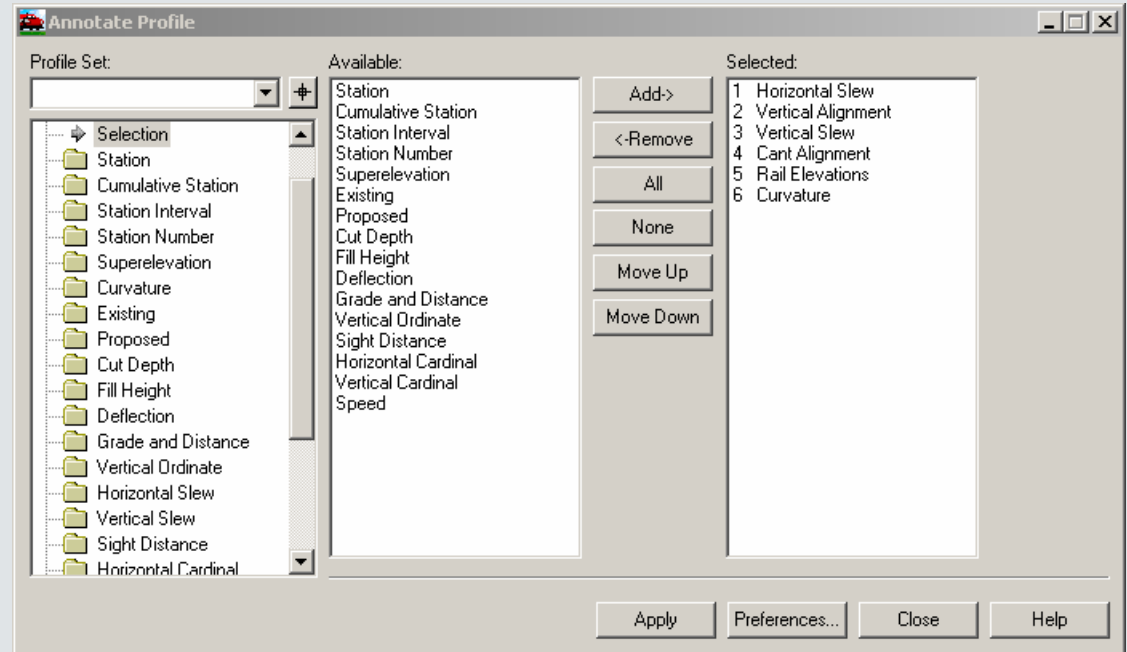


# Display Turnouts in Profiles



# Annotate Profile

- Includes slews
  - Horizontal & vertical
- Includes rail elevations
  - Utilizing vertical alignment and cant



# Regression Enhancements

- ***Add Point*** includes *near* points
  - Minor changed to the workflow
    - » Select first and second points from the dialog
- ***Review / Edit***
  - **Select and Regress**
    - » By pass ***Single Element Regression*** dialog (but it is still available!)
    - » Auto determines the element type
    - » Includes a heads-up mode
      - <Ctrl> <Spacebar> *Select*
      - A faster way to create the geometry!



# Turnouts Enhancements

- ***Turnout Library***
  - Schematic view
  - Curve calculator build into edit element dialog
- ***Create Turnouts***
  - Offset from
    - » Define a minimum distance between a turnout
- ***Connection Editor***
  - Turnout to fixed element
    - » Allows the user to slide a turnout in an existing connection (a complex turnout to turnout case)





# Cant

- Cant is now an attribute of horizontal curves
  - Using the ***Cant Calculator*** will assign the cant and speed to the horizontal circular arc
  - Used by the ***Cant Alignment Editor***
- Cant Calculator
  - Additional methods to compute horizontal data
- Cant Alignment Editor
  - Indicates *dirty* stations
  - Uses results from ***Cant Calculator***



# Adding Cant to Horizontal Elements

The screenshot displays the 'Edit Horizontal Element' dialog box with the following settings:

- Define From:  Start  Stop
- Type: Circular Arc
- Transition: Clothoid
- Start Station: 4+941.2495
- Point Name: [Empty]
- Northing: 1361078.8848
- Easting: 1959906.1656
- Direction: 56.448229
- Radius: -2200.0000
- Stop Station: 6+131.5573
- Point Name: [Empty]
- Northing: 1362038.4925
- Easting: 1960585.6936
- Direction: 22.003982
- Radius: -2200.0000
- Length: 1190.3077
- Maintain Connected and Colinear

The 'Design Calculators' dialog box is open, showing the 'Cant Calculator' tab with the following settings:

- Compute: Cant
- Define By: Applied Constant
- Design Speed (kmph): 150.0000
- Equilibrium Constant: 11.8000
- Applied Constant: 7.1000
- Radius: -2200.0000
- Length: 1190.3077
- Transition: Clothoid
- Compound Transition Rate From:  Start  Stop
- Equilibrium Cant (mm): 120.6818
- Applied Cant (mm): 75.0000
- Cant Deficiency (mm): 45.6818
- Applied Rate of Change (mm/s): 0.0000
- Deficiency Rate of Change (mm/s): 0.0000
- Applied Cant Gradient: 0.0000

The 'Cant Alignment Editor' dialog box shows the following settings:

- Horizontal Alignment: Right Track
- Cant Alignment: Cant

The 'Define Cant Alignment' dialog box is open, showing the following settings:

- Cant Method:  Use Equilibrium Equations
- Lookup Cant from Table
- Station, Speed and Cant Table
- Design Speed (kph): 160.0000
- Equilibrium Constant: 11.8000
- Applied Constant: 7.1000
- Use Cant from Horizontal Alignment
- Apply Minimum Cant through Turnouts

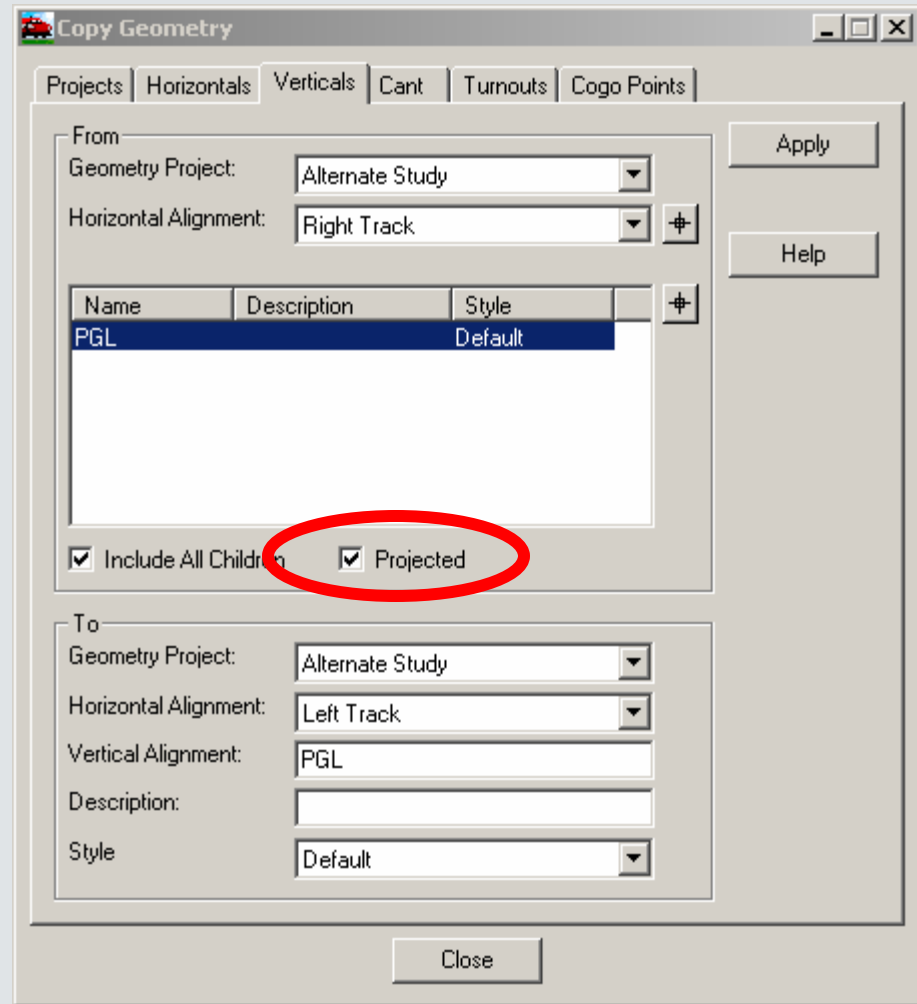
The 'Cant Alignment Editor' contains a table with the following data:

Type	Station	Speed (...)	Radius	Length	Transition	Eq. Can...	App. Ca...	Cant De...	App. Ra...	Def. Ra...	App. Gr...
POB	0+000.000...	150	0.0000	920.3776	Linear	0.0	0.0	0.0	0.0	0.0	0
TS	0+920.377...	150	0.0000	150.0000	Clothoid	0.0	0.0	0.0	20.8	12.7	2000
SC	1+070.377...	150	2200.0000	2146.2055	Circular	120.7	75.0	45.7	0.0	0.0	0
	00.0000	150.0000	0.0000	150.0000	Clothoid	120.7	75.0	45.7	20.8	12.7	2000
	00.0000	1424.6664	0.0000	150.0000	Linear	0.0	0.0	0.0	0.0	0.0	0
	00.0000	150.0000	0.0000	150.0000	Clothoid	0.0	0.0	0.0	20.8	12.7	2000
	00.0000...	1190.3077	0.0000	150.0000	Circular	120.7	75.0	45.7	0.0	0.0	0
	00.0000...	150.0000	0.0000	150.0000	Clothoid	120.7	75.0	45.7	20.8	12.7	2000
	00.0000	761.8932	0.0000	150.0000	Linear	0.0	0.0	0.0	0.0	0.0	0
	00.0000	0.0000	0.0000	150.0000	Linear	0.0	0.0	0.0	0.0	0.0	0

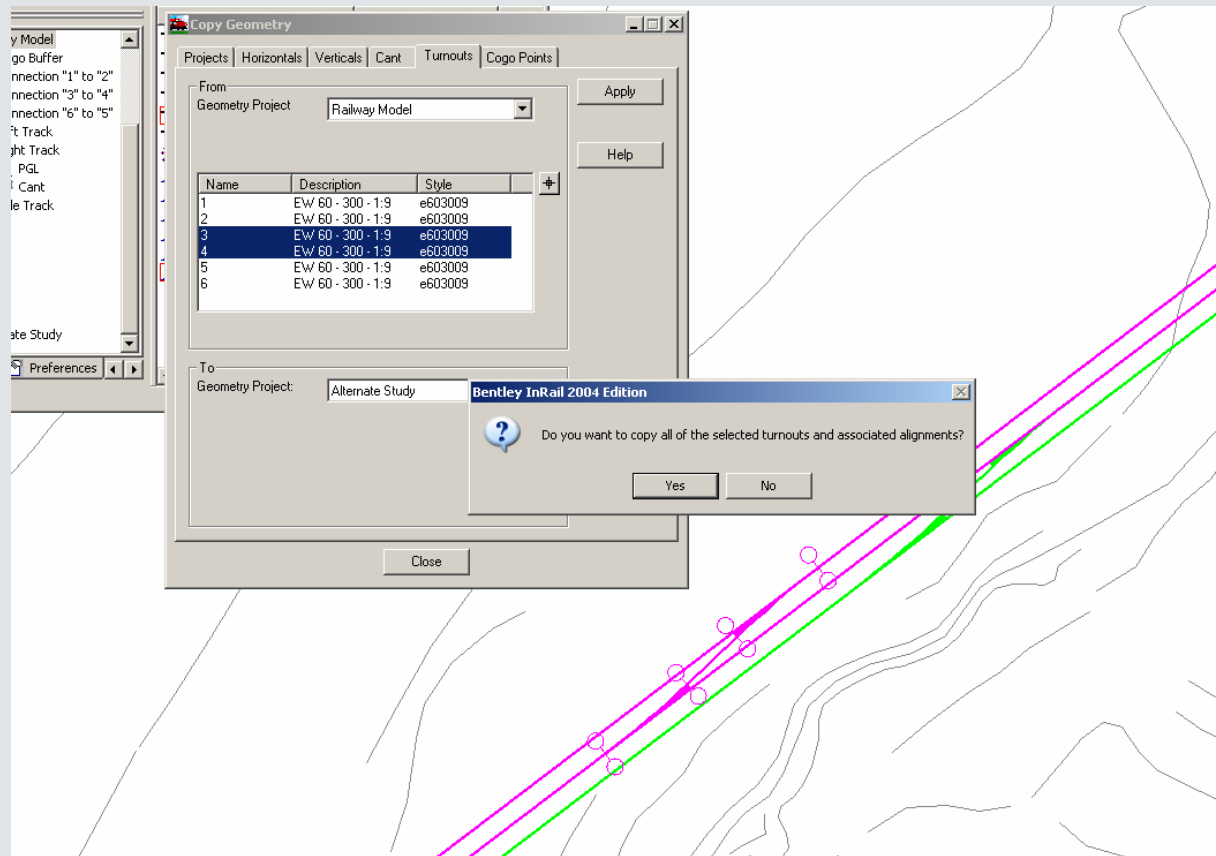


# Utilities

- Copy Geometry
  - Copy Vertical
    - » Includes a projected option
  - Copy Turnouts



# Copy Turnouts for an Alternate Design



# LRM

- Reporting of rail positions with ***LRM Reporting***
  - Station
  - offset
  - X, y, z
  - cant

**Bentley InRoads Report Browser - D:\Presentations\Models\Railway Model\lrm rail elevations.xml**

File Tools Help

d:\Program Files\bentley\inroads\gro

**Rail Elevations Report**

Report Created: 10/24/2005  
Time: 11:38am

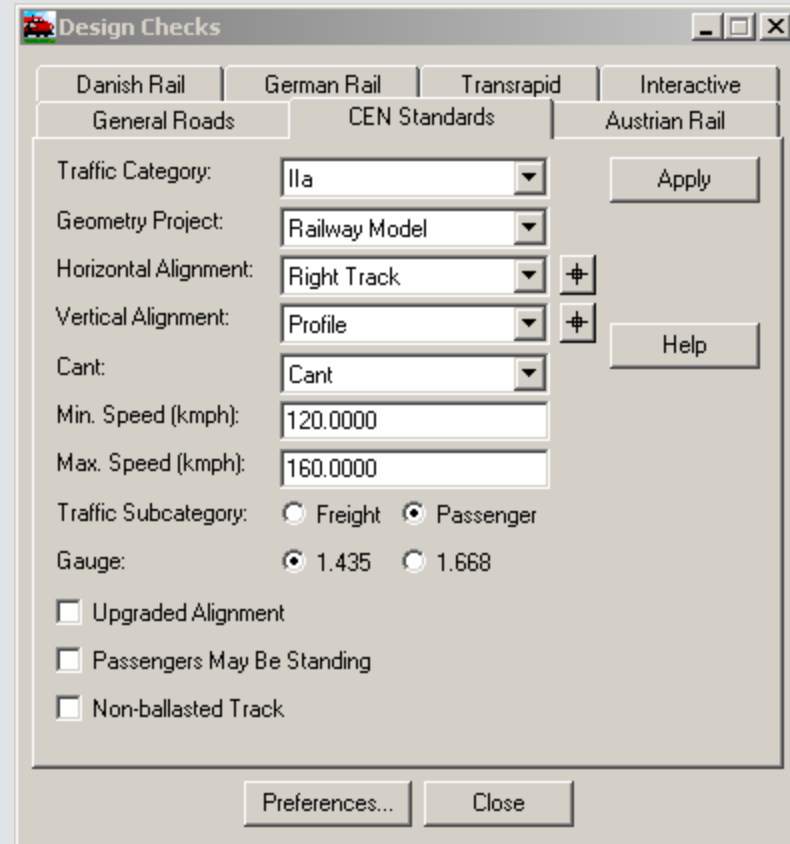
**Project:** Alternate Study  
**Description:**  
**File Name:**  
**Last Revised:** Richard Bradshaw 10/24/2005 11:36:28 AM  
**Input Grid Factor:** 1.00000000 **Note:** All units in this report are in meters unless specified otherwise.

----- Left Rail -----					----- Right Rail -----						
Station	Point Type	Offset	Northing	Easting	Elevation	Cant (mm)	Offset	Northing	Easting	Elevation	Cant (mm)
<b>Horizontal Alignment: Left Track</b>											
0+050.0000	POT	-0.7175	1357118.5336	1957851.1216	1088.0460	0	0.7175	1357118.7095	1957852.5458	1088.0460	0
0+100.0000	POT	-0.7175	1357168.1561	1957844.9895	1088.5452	0	0.7175	1357168.3321	1957846.4136	1088.5452	0
0+150.0000	POT	-0.7175	1357217.7786	1957838.8573	1089.0443	0	0.7175	1357217.9546	1957840.2815	1089.0443	0
0+200.0000	POT	-0.7175	1357267.4012	1957832.7252	1089.5434	0	0.7175	1357267.5772	1957834.1494	1089.5434	0
0+250.0000	POT	-0.7175	1357317.0237	1957826.5931	1090.0426	0	0.7175	1357317.1997	1957828.0172	1090.0426	0
0+300.0000	POT	-0.7175	1357366.6463	1957820.4609	1090.5417	0	0.7175	1357366.8223	1957821.8851	1090.5417	0
0+350.0000	POT	-0.7175	1357416.2688	1957814.3288	1091.0408	0	0.7175	1357416.4448	1957815.7530	1091.0408	0
0+400.0000	POT	-0.7175	1357465.8914	1957808.1967	1091.5400	0	0.7175	1357466.0674	1957809.6209	1091.5400	0
0+450.0000	POT	-0.7175	1357515.5139	1957802.0646	1092.0391	0	0.7175	1357515.6899	1957803.4887	1092.0391	0
0+500.0000	POT	-0.7175	1357565.1365	1957795.9324	1092.5382	0	0.7175	1357565.3125	1957797.3566	1092.5382	0
0+550.0000	POT	-0.7175	1357614.7590	1957789.8003	1093.0373	0	0.7175	1357614.9350	1957791.2245	1093.0373	0
0+600.0000	POT	-0.7175	1357664.3816	1957783.6682	1093.5365	0	0.7175	1357664.5575	1957785.0923	1093.5365	0
0+650.0000	POT	-0.7175	1357714.0041	1957777.5360	1094.0356	0	0.7175	1357714.1801	1957778.9602	1094.0356	0



# Design Checking

- Includes
  - Roadways
  - German
  - Danish
  - Austrian
  - Transrapid
  - CEN, new with InRail 8.7



# Modeling

- We will look at several different cases
  - Single track – ballasted
    - » Template creation with **Create Template**
    - » Modeling with **Roadway Designer**
  - Double track - ballasted
    - » Template creation
    - » Modeling with **Roadway Designer**
    - » Cross sections and volumes



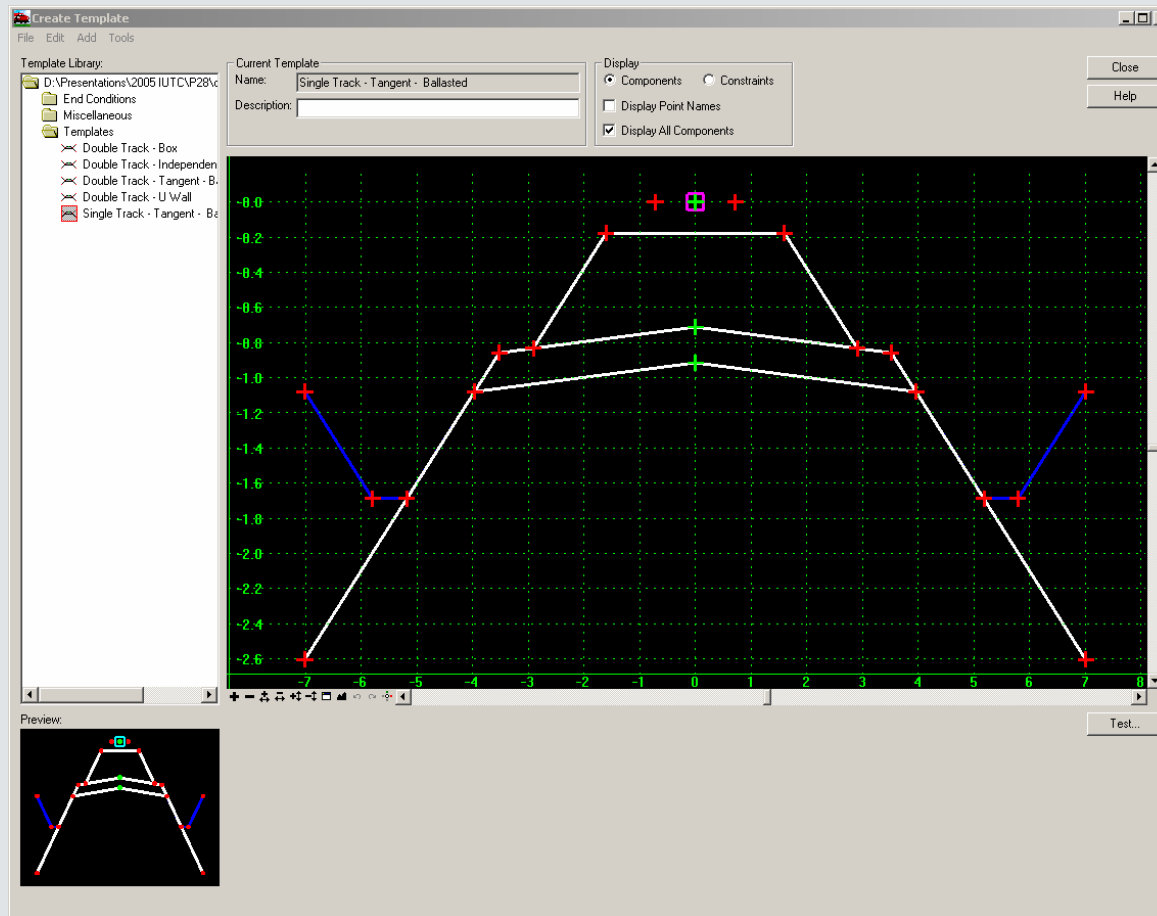
# Modeling Requirements

- Single template
  - Utilizing cant / rail superelevation
  - Utilizing cant rotation point (i.e. inside low rail)
  - Enabling subgrade widening (i.e. high side ballast)
  - Separate quantities for subballast and ballast as well as the typical excavation / embankment

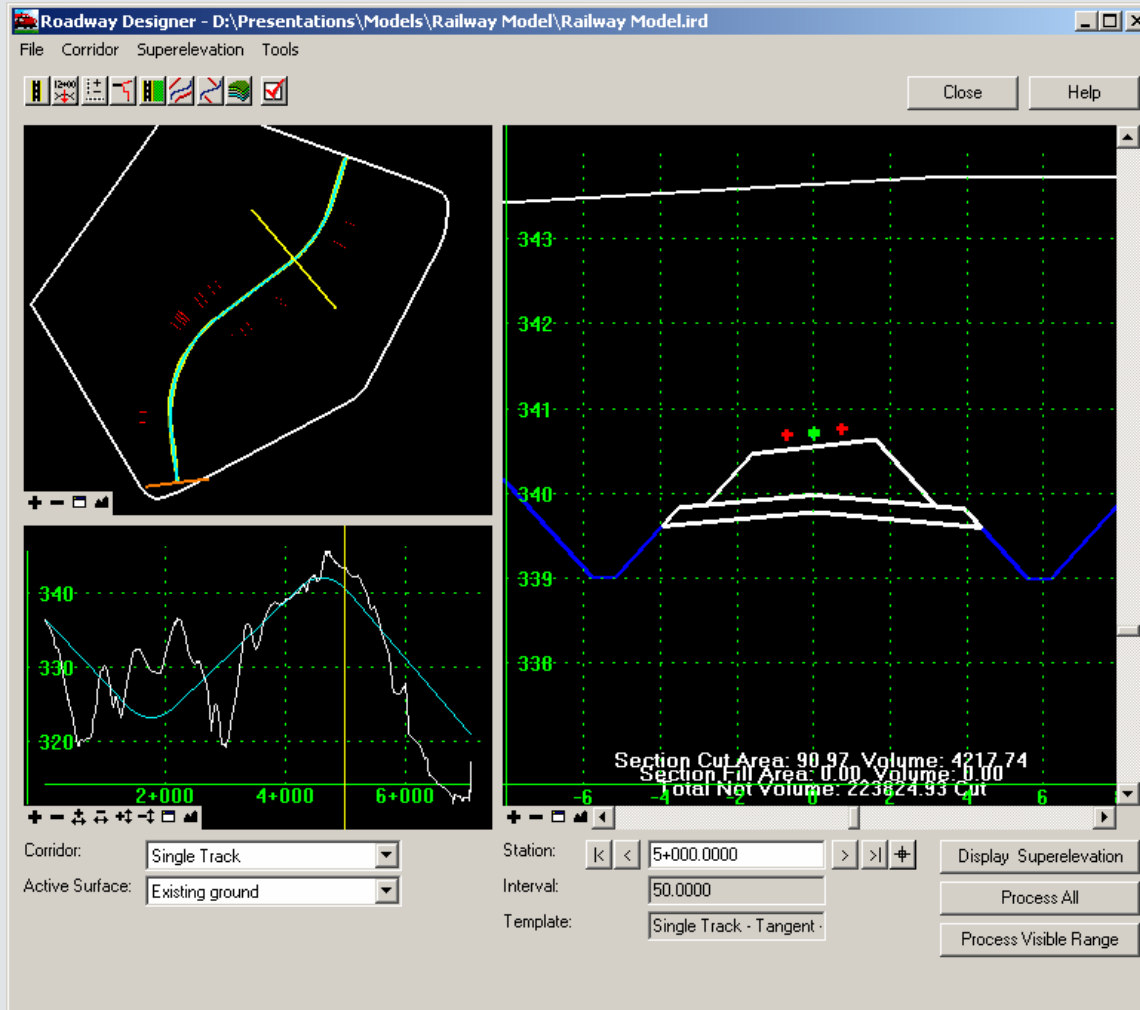




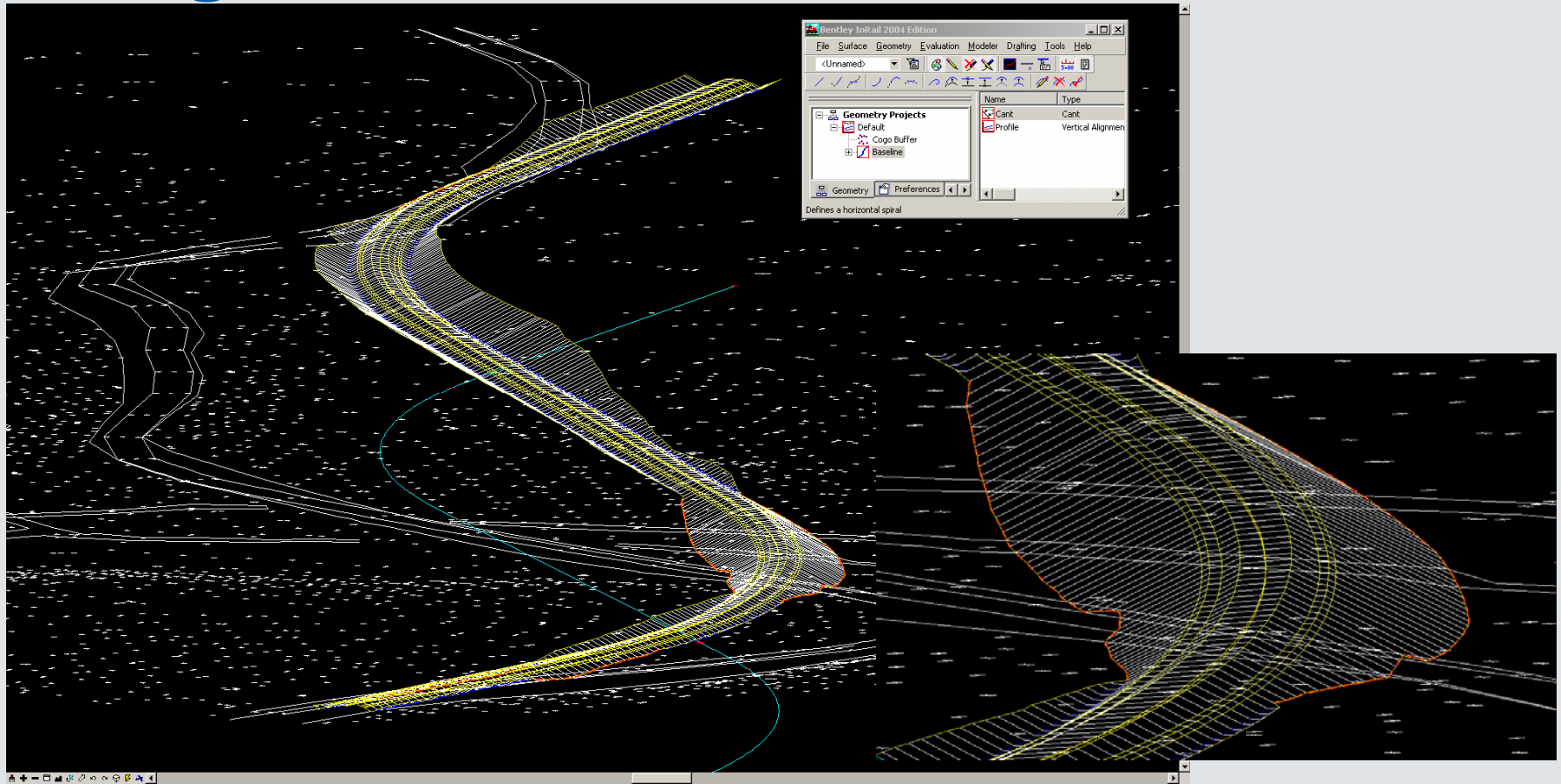
# Create Template & Single Track



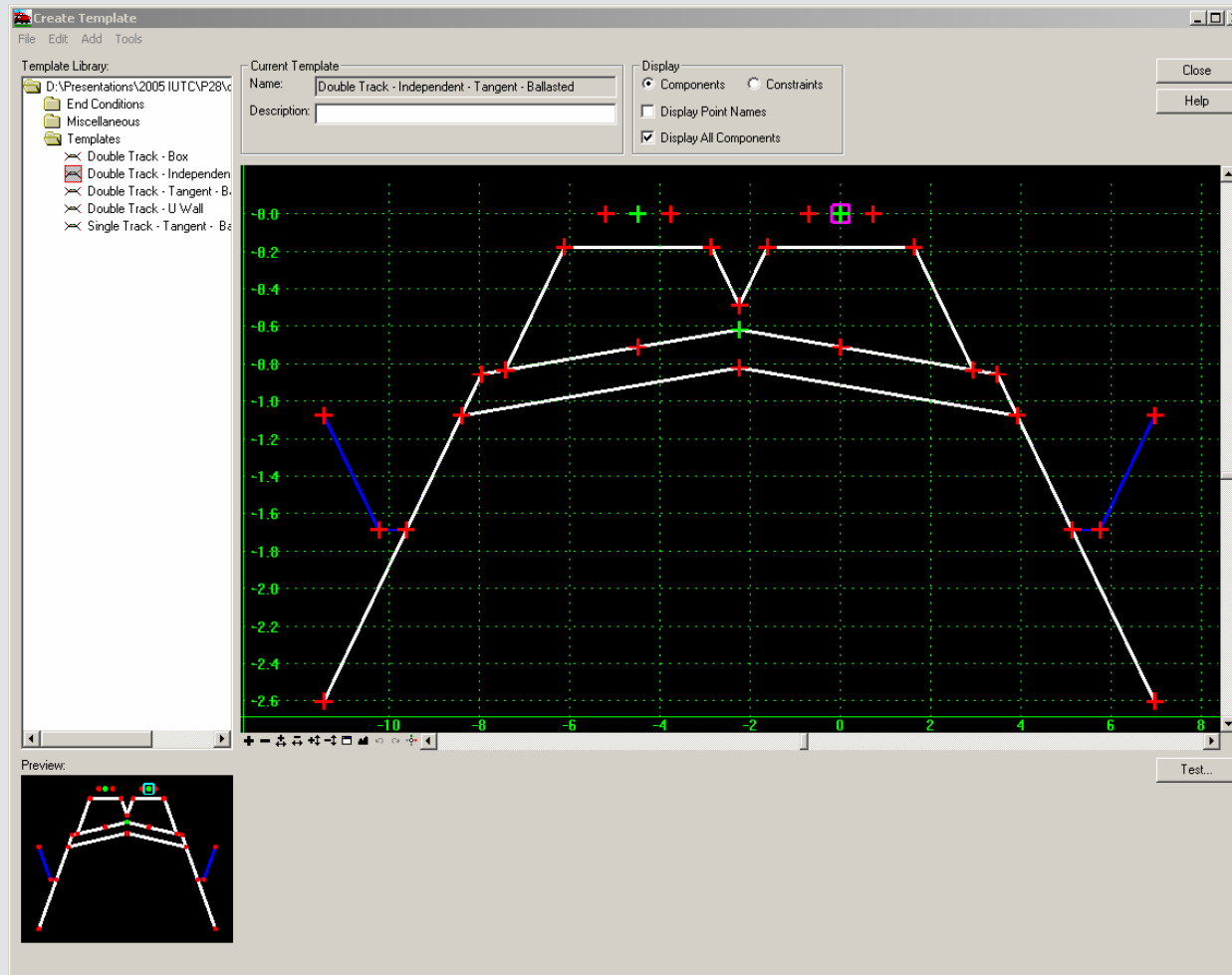
# Roadway Designer & Single Track



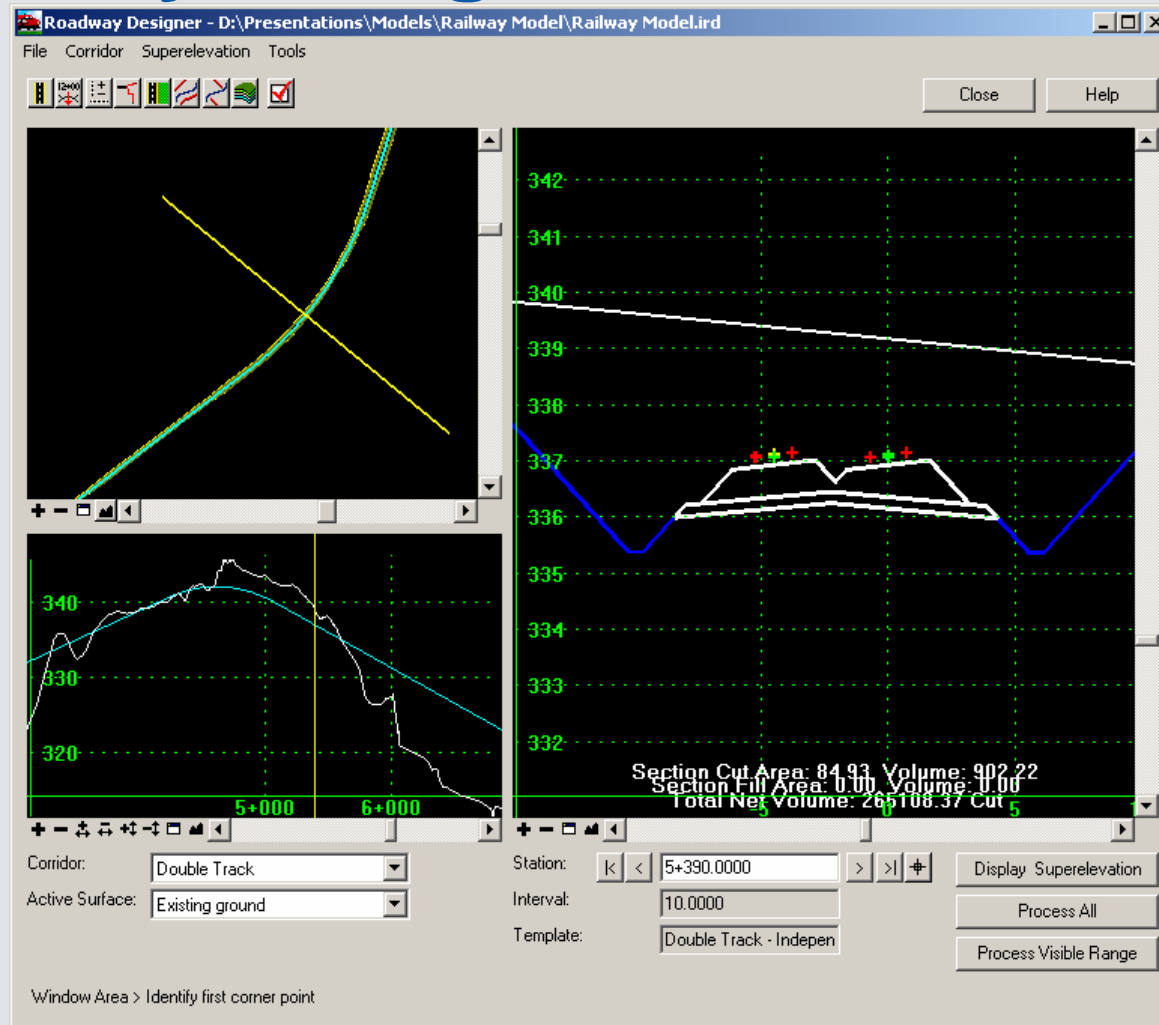
# Single track demo...



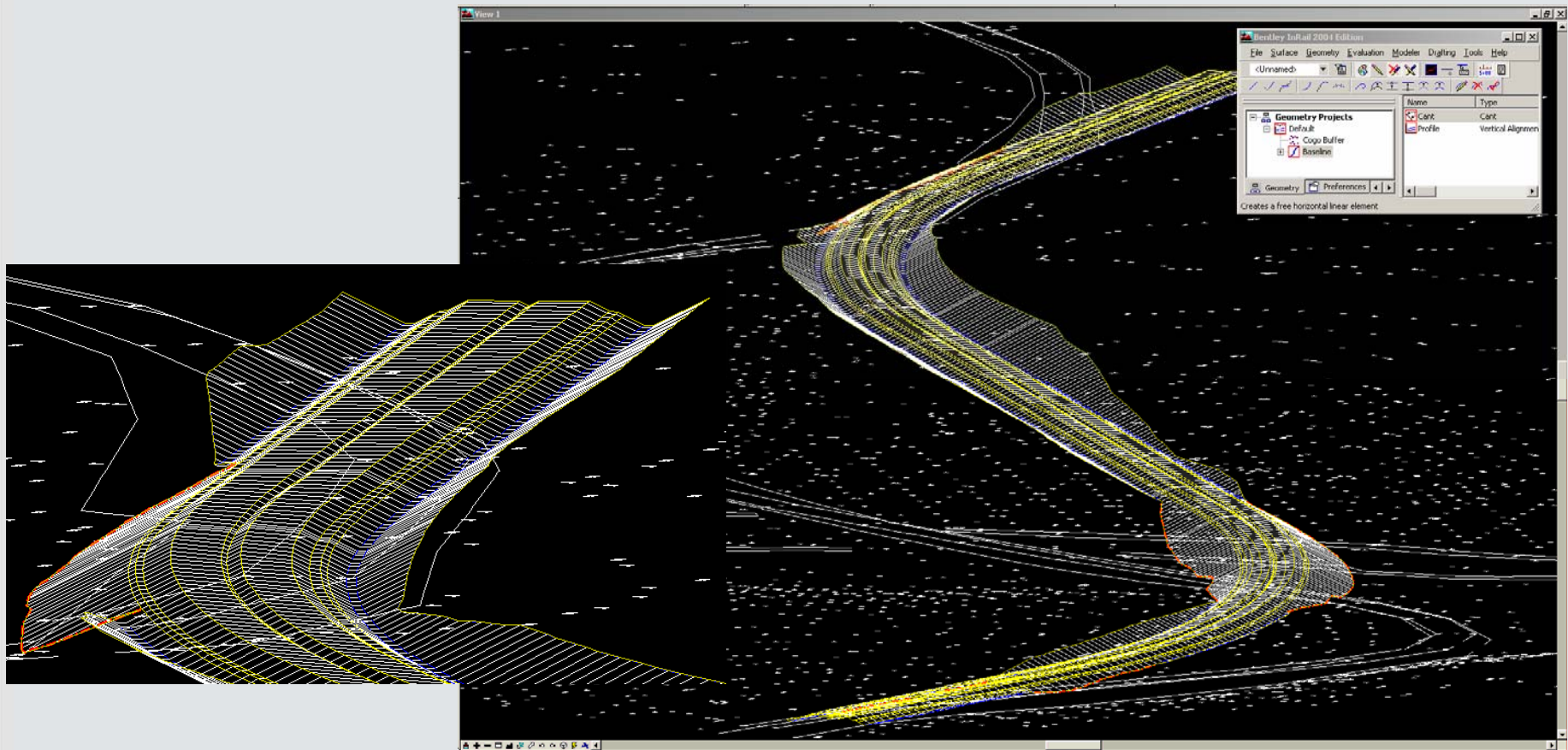
# Create Template & Double Track



# Roadway Designer & Double Track



# Double track demo...



# Reporting

- Typical reporting
  - XML / XSL
  - Geometry
  - Surfaces
  - Cross sections
  - Volumes
- Additional reporting
  - Turnouts
  - Cant

Shunt Limits Report Page 1 of 1

Shunt Limits Report

Report Created: 9/22/2005  
Time: 8:52pm

Project: Default  
Description:  
Input Grid Factor: 1.00000000 Note: All units in this report are in feet unless specified otherwise.

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Turnout: 9 AREA #20 Curved Split Switch (AREA #20 Curved)

Element Type	Length	Start Radius	End Radius	Start Northing	Start Easting
Linear	37.5201	0.0000	0.0000	9817.0799	5838.2033
Circular	109.7944	3329.9100	3329.9100	9815.7834	5875.8011
Linear	28.4246	0.0000	0.0000	9810.1913	5985.4480

Point Name	Mainline Alignment	Style	Station	Offset	Northing	Easting
.1	left1		14+00.0000	0.0000	9817.0799	5838.2033
.0	left1		14+61.0408	0.0000	9816.0146	5899.2349
.2	left1		15+75.8750	0.0000	9814.0104	6014.0516
.3	left1		15+75.7316	5.7381	9808.2757	6013.8080

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Turnout: 10 AREA #20 Curved Split Switch (AREA #20 Curved)

Element Type	Length	Start Radius	End Radius	Start Northing	Start Easting
Linear	37.5201	0.0000	0.0000	9795.0562	6254.7823
Circular	109.7944	3329.9100	3329.9100	9796.3527	6217.1846
Linear	28.4246	0.0000	0.0000	9801.9448	6107.5377

Point Name	Mainline Alignment	Style	Station	Offset	Northing	Easting
.1	Baseline		118+26.9398	0.0000	9795.0562	6254.7823
.0	Baseline		117+65.8990	0.0000	9796.1215	6193.7508
.2	Baseline		116+51.0648	0.0000	9798.1257	6078.9341
.3	Baseline		116+51.2083	-5.7381	9803.8603	6079.1777

file://C:\Documents and Settings\Richard.Bradshaw\Local Settings\Temp\InRoadsReport.htm 9/22/2005



## Data Exchange with the Field

- Added ***Export to Matisa*** tamper to complement ***Export to Plasser & Theurer***
  - Horizontal, vertical and cant
- LandXML and cant
  - Version 1.0 supports a Bentley extension for cant (InRail 8.5 Sp1)
  - Version 1.1 supports the LandXML standard for cant (new with InRail 8.7)





# Summary

Built on top of InRoads

Geometric layout of horizontal, vertical and cant alignments for many types of railways

Surface Modeling

Design Checking

Data exchange from / to field

