Roadway Designer and Machine Control – What You Need to Know

Joe Waxmonsky, PE

Bentley
Sustaining Infrastructure

What Is Machine Control

- Grade control automation via earth moving equipment outfitted with GPS\Total Station\ Laser Augmentation or a combination of the three.
- Can be accurate from .1 to .01 feet depending on sensors.
- Makes use of high quality design data to control the earth moving equipment.
- Eliminates the need for tedious layout.

Bentley

Bentley's Role In Machine Control

- Create and export the intelligent data to the contractor

- Types of data to export:
  - Surfaces
  - Geometry
  - Reports

Bentley

Template Creation

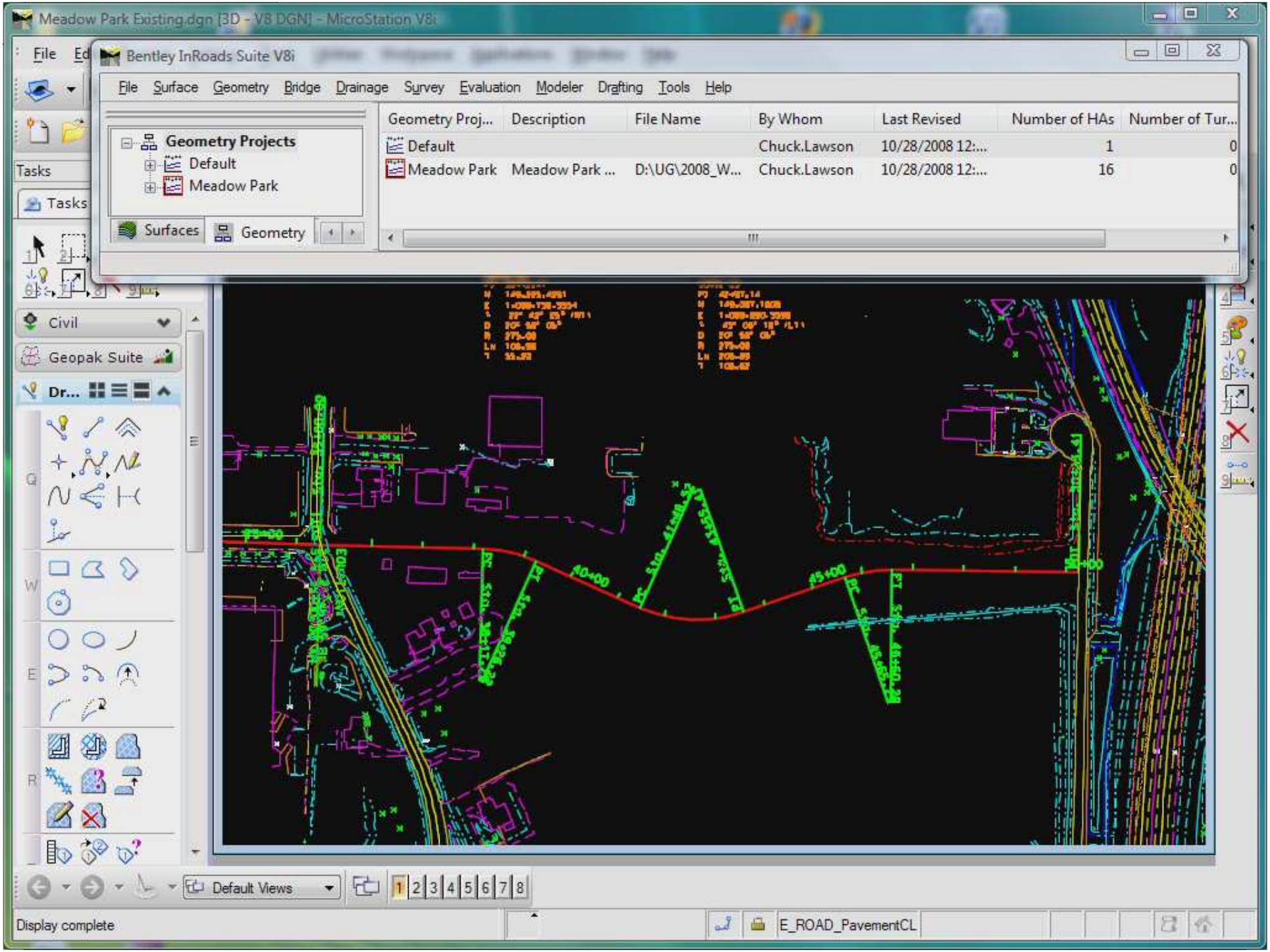
- Continue the use of classic Template creation techniques
- Supplement with Alternate Surfaces
- Project to Design Constraints

Bentley

Design Project Introductions

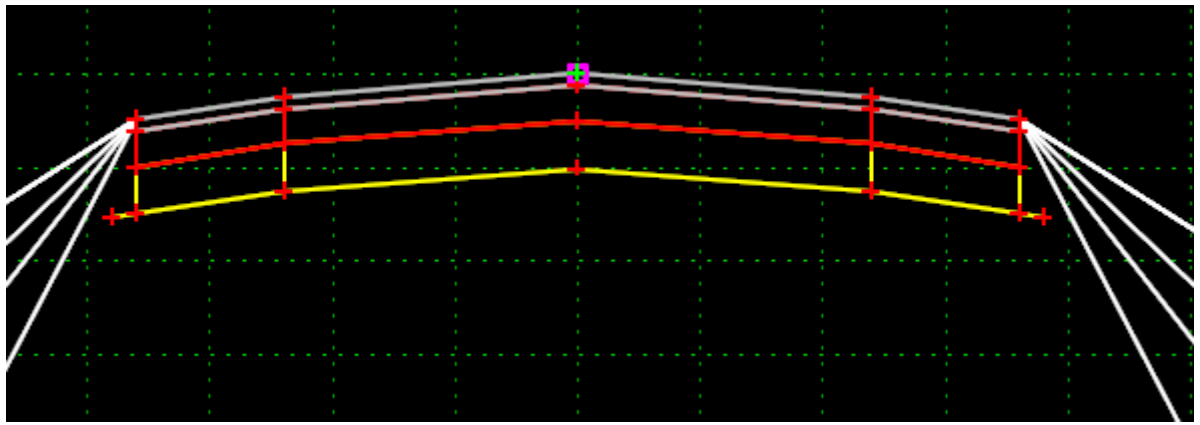
- Meadow Park Alignment
- Rural 2-Lane Roadway
- New Construction

Bentley

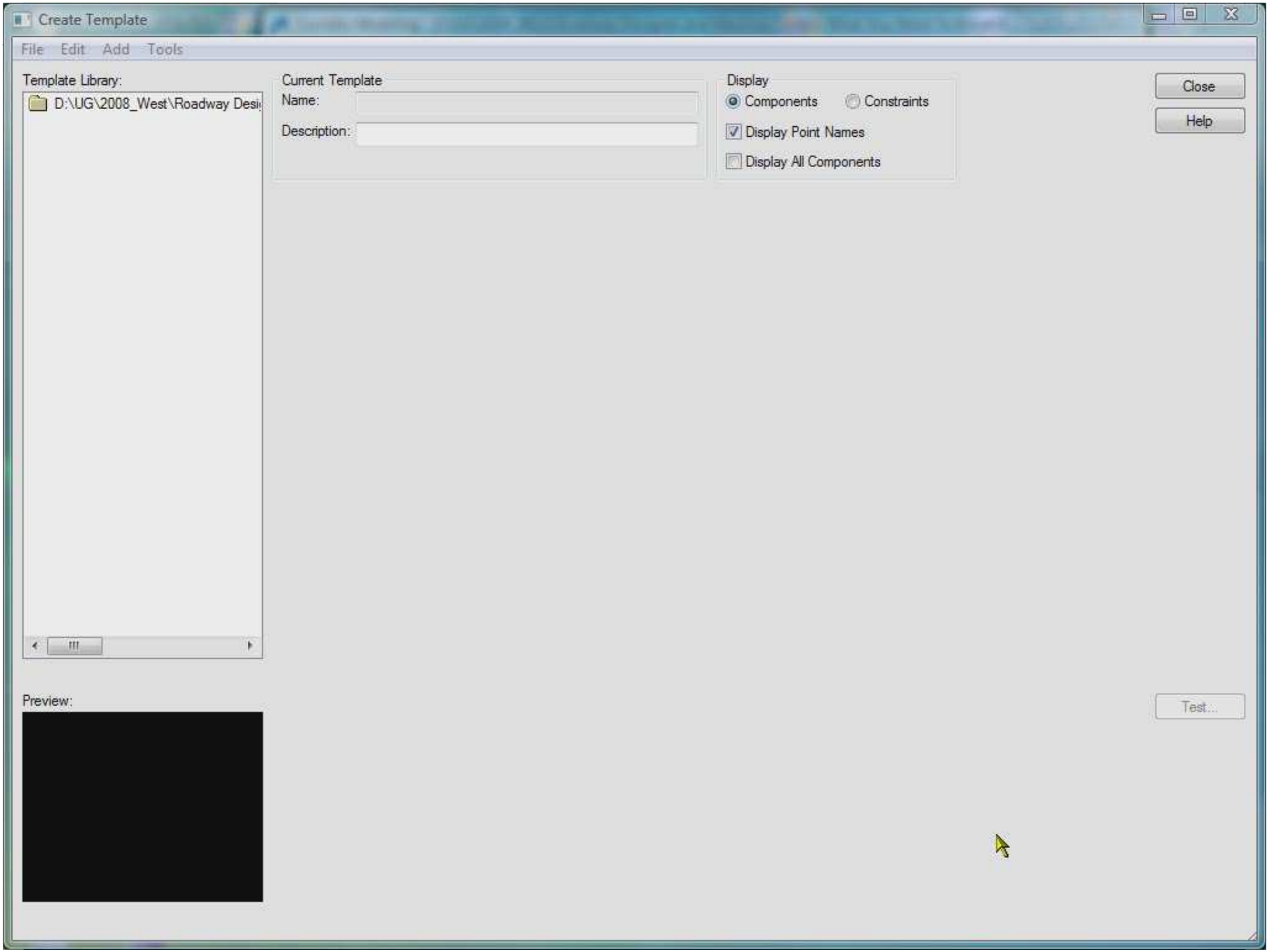

Meadow Park Existing.dgn [3D - V8 DGN] - MicroStation V8i
Bentley InRoads Suite V8i
File Surface Geometry Bridge Drainage Survey Evaluation Modeler Drafting Tools Help
Geometry Projects
Default
Meadow Park
Surfaces
Geometry
Geometry Proj... Description File Name By Whom Last Revised Number of HAs Number of Tur...
Default Chuck.Lawson 10/28/2008 12:... 1 0
Meadow Park Meadow Park ... D:\UG\2008_W... Chuck.Lawson 10/28/2008 12:... 16 0
Tasks
Civil
Geopak Suite
Default Views
Display complete
E_ROAD_PavementCL

Creating the Template

- 12’ Travel Lane
- 6’ Shoulder
- Variable Slope End Conditions



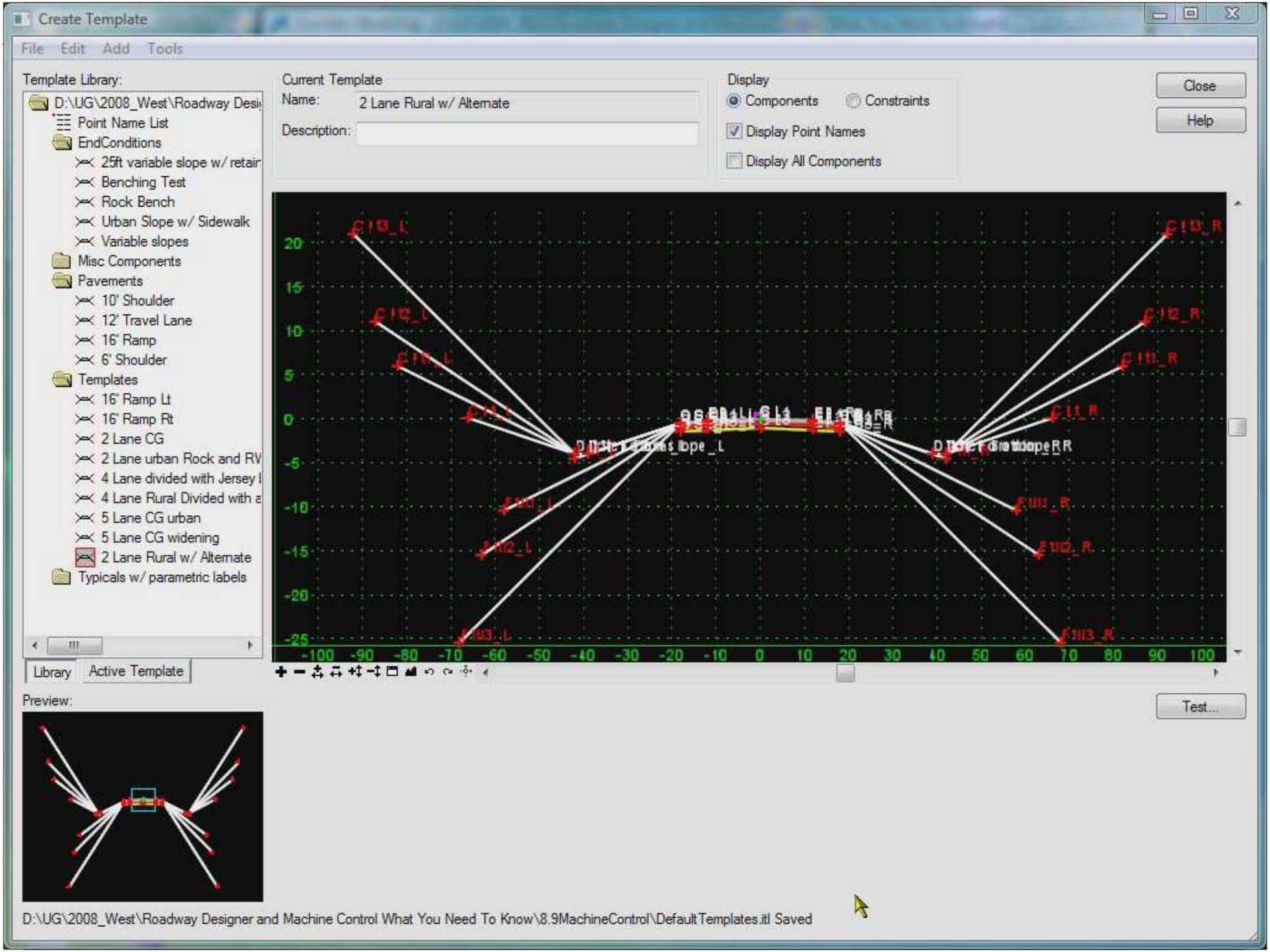
Bentley


Create Template
File Edit Add Tools
Template Library:
D:\UG\2008_West\Roadway Desi
Current Template
Name:
Description:
Display
Components
Constraints
Display Point Names
Display All Components
Close
Help
Preview:
Test...

Template - Subgrade Extension

- Use “Vector – Offset” Constraint
- Use “Project To Design” Constraint
- Testing your changes

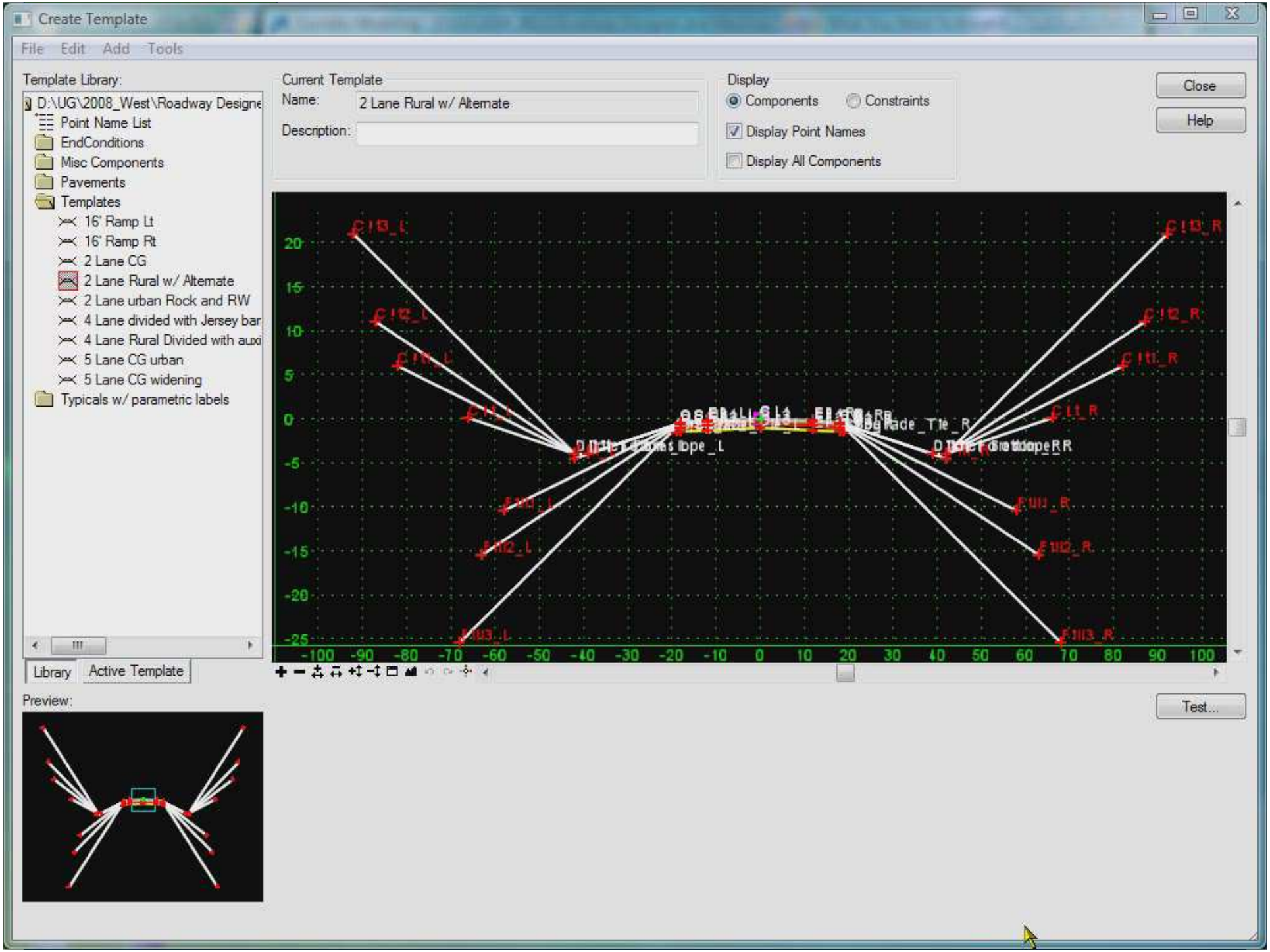
Bentley


Create Template
File Edit Add Tools
Template Library:
D:\UG\2008_West\Roadway Desi
Point Name List
EndConditions
25ft variable slope w/ retair
Benching Test
Rock Bench
Urban Slope w/ Sidewalk
Variable slopes
Misc Components
Pavements
10' Shoulder
12' Travel Lane
16' Ramp
6' Shoulder
Templates
16' Ramp Lt
16' Ramp Rt
2 Lane CG
2 Lane urban Rock and RV
4 Lane divided with Jersey I
4 Lane Rural Divided with a
5 Lane CG urban
5 Lane CG widening
2 Lane Rural w/ Alternate
Typicals w/ parametric labels
Library
Active Template
Preview:
Current Template
Name:
2 Lane Rural w/ Alternate
Description:
Display
Components
Constraints
Display Point Names
Display All Components
Close
Help
Test...
D:\UG\2008_West\Roadway Designer and Machine Control What You Need To Know\8.9MachineControl\DefaultTemplates.itl Saved

Template – Adding an Alternate Surface

- Each point property along the desired machine control sub-surface path needs to activate the the Alternate Surface option by assigning an alternate surface name.
- Alternate surface name must be consistent.
- No vertical lines allowed in the alternate surface path.
- Alternate surface will not show in testing, but only in surface creation.

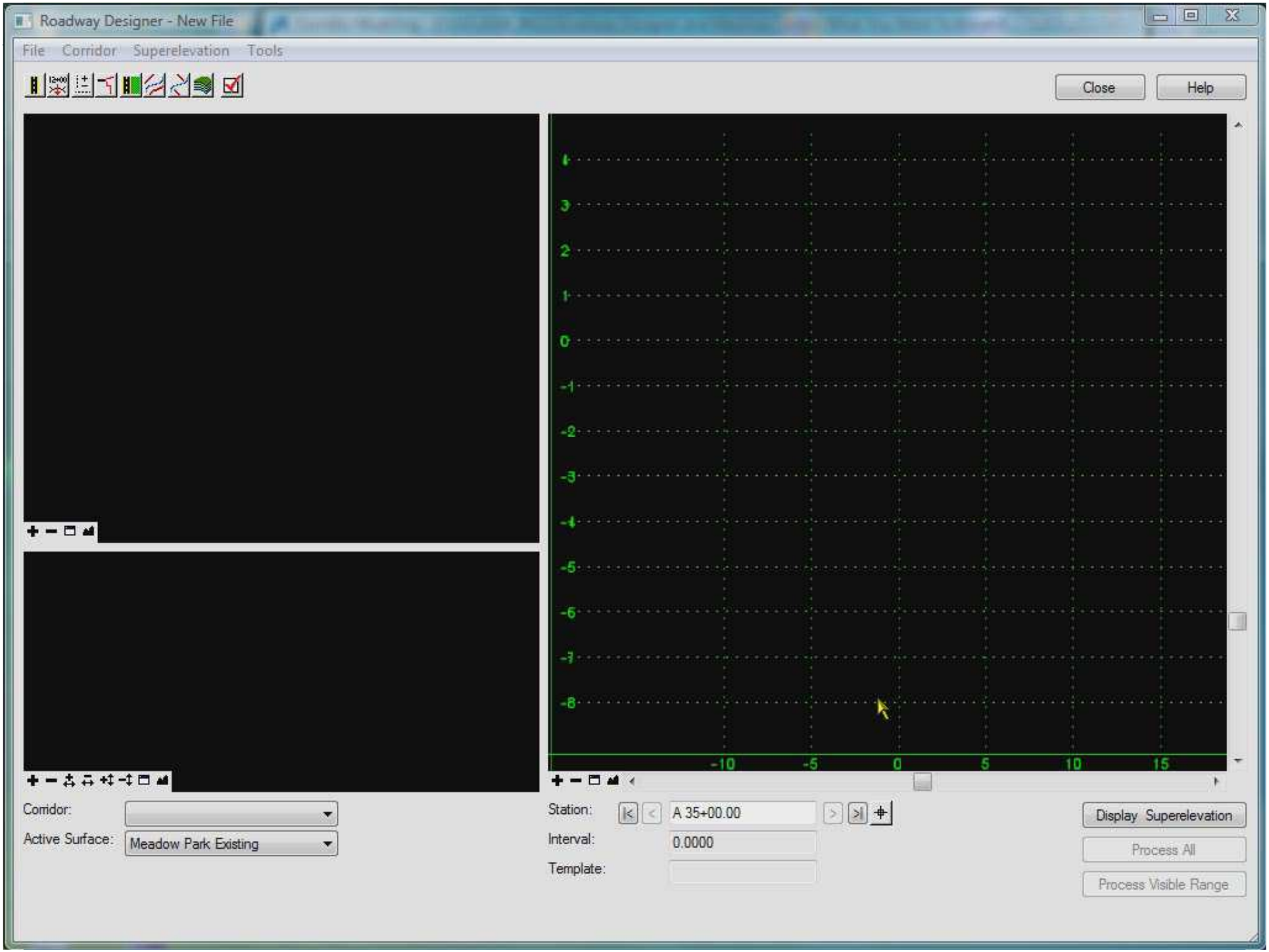
Bentley


Create Template
File Edit Add Tools
Template Library:
D:\UG\2008_West\Roadway Designe
Point Name List
EndConditions
Misc Components
Pavements
Templates
16' Ramp Lt
16' Ramp Rt
2 Lane CG
2 Lane Rural w/ Alternate
2 Lane urban Rock and RW
4 Lane divided with Jersey bar
4 Lane Rural Divided with auxi
5 Lane CG urban
5 Lane CG widening
Typicals w/ parametric labels
Library
Active Template
Preview:
Current Template
Name:
2 Lane Rural w/ Alternate
Description:
Display
Components
Constraints
Display Point Names
Display All Components
Close
Help
Test...

Creating the Corridor

- Rural undivided pavement w/ shoulders
- 10’ interval drop for template
- Superelevation
- Shoulder roll-over at 4% max

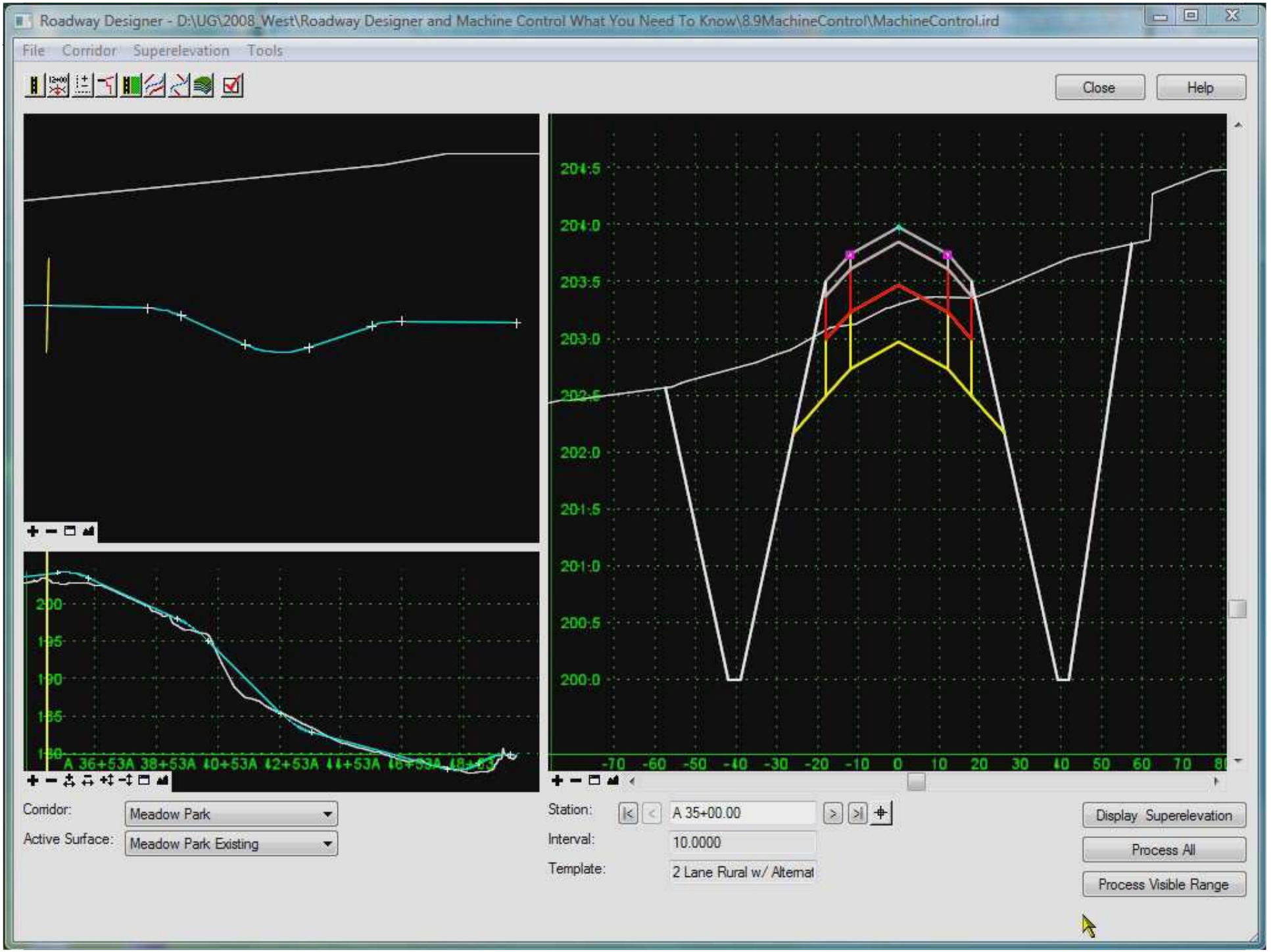
Bentley


Roadway Designer - New File
File
Corridor
Superelevation
Tools
Close
Help
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-10
-5
0
5
10
15
Corridor:
Active Surface:
Meadow Park Existing
Station:
A 35+00.00
Interval:
0.0000
Template:
Display Superelevation
Process All
Process Visible Range

Proposed / Alternate Surface Creation

- Turn on the Cardinal and Control Points
- Turn on option for Alternate Surface
- Creates proposed surface and alternate at the same time
- Generates LandXML files of surfaces

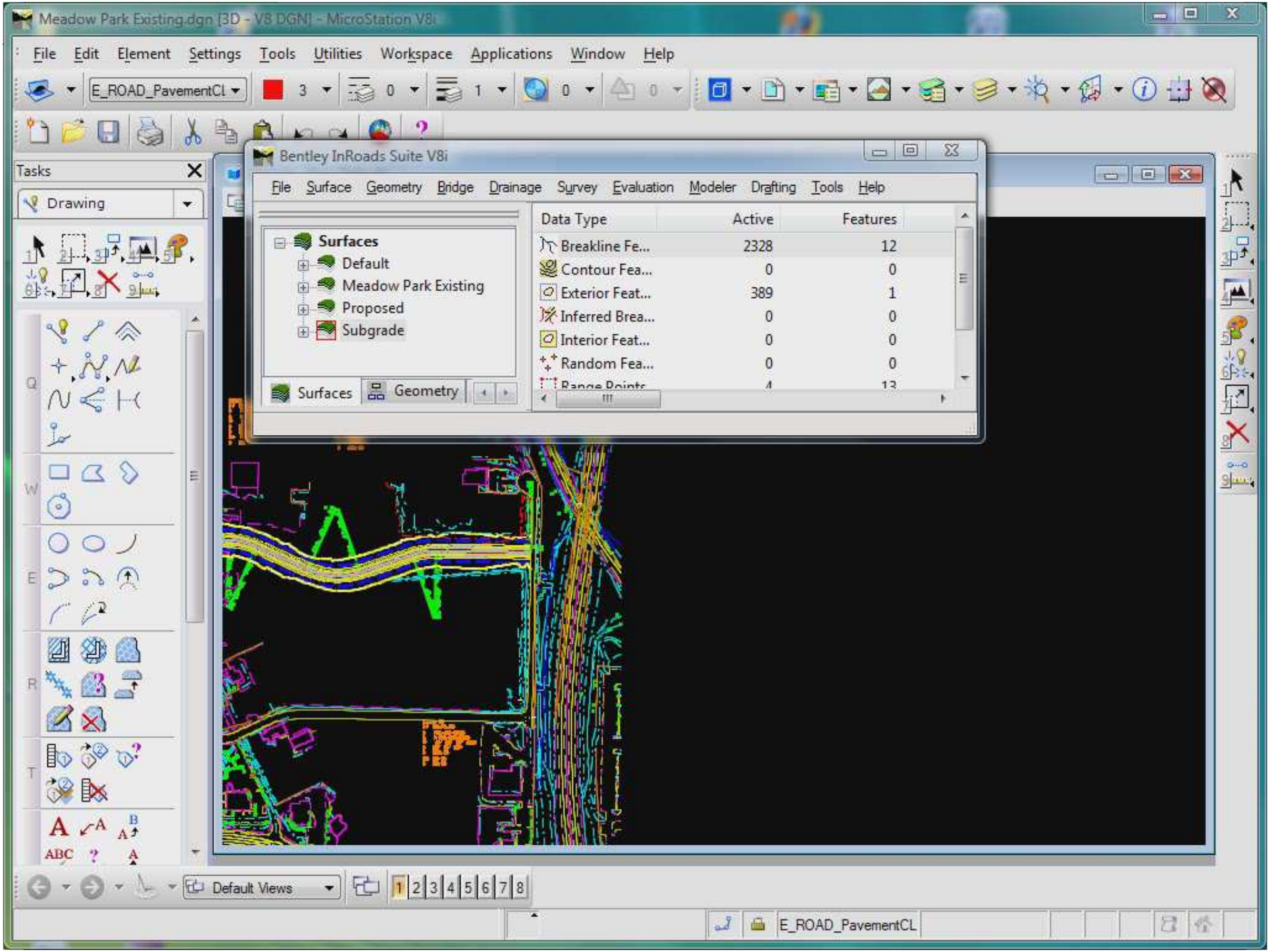
Bentley


Roadway Designer - D:\UG\2008_West\Roadway Designer and Machine Control What You Need To Know\8.9MachineControl\MachineControl.ird
File
Corridor
Superelevation
Tools
Close
Help
204:5
204:0
203:5
203:0
202:5
202:0
201:5
201:0
200:5
200:0
-70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70
200
195
190
185
180
A 36+53A 38+53A 40+53A 42+53A 44+53A
Corridor:
Meadow Park
Active Surface:
Meadow Park Existing
Station:
A 35+00.00
Interval:
10.0000
Template:
2 Lane Rural w/ Alternat
Display Superelevation
Process All
Process Visible Range

Reviewing the Cross Sections

- Two new surfaces now available → Proposed and the alternate Subgrade surface
- Set different styles for the two surfaces to easily distinguish the differences
- Leave components turned off initially to only compare the surfaces

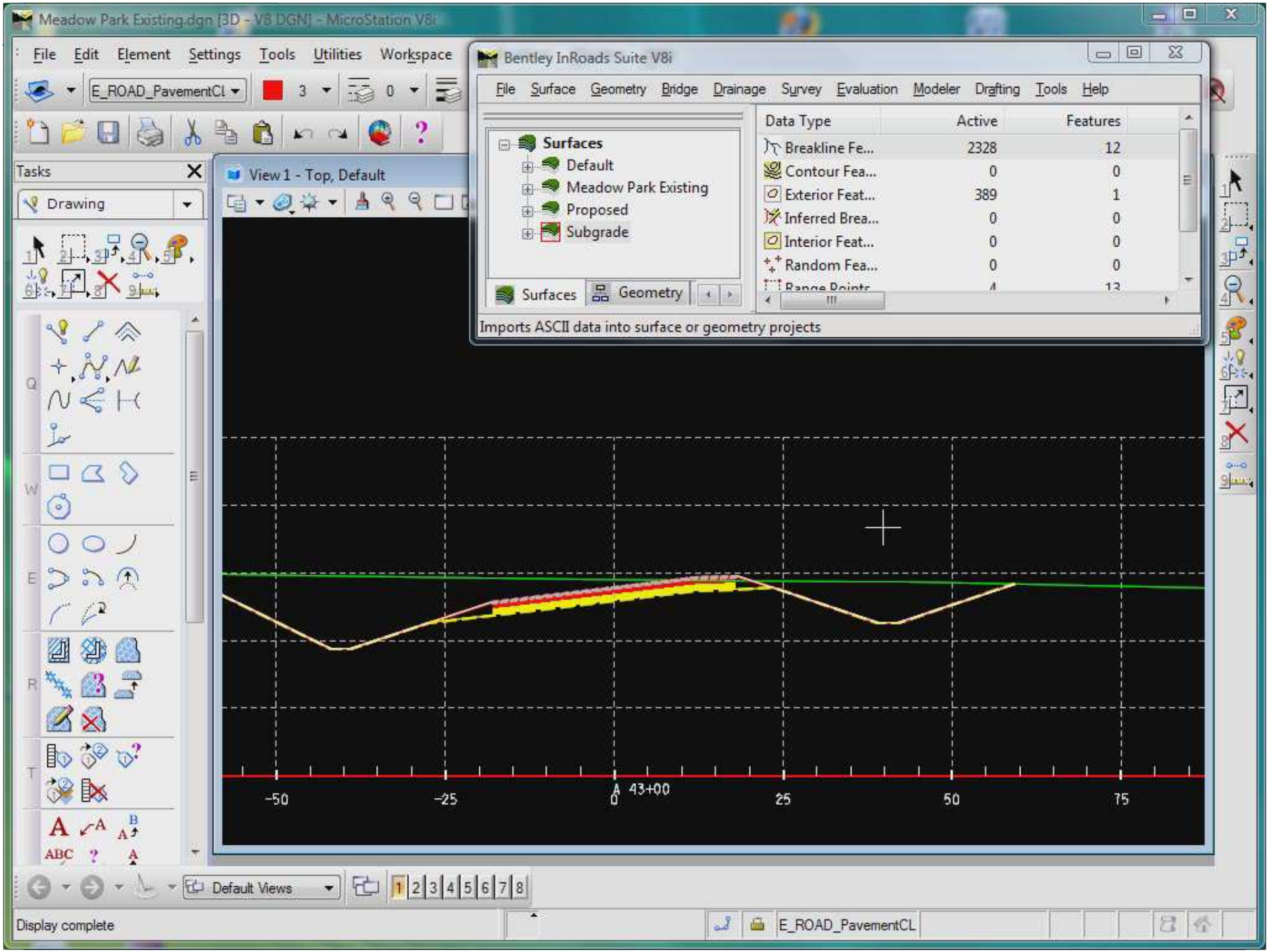
Bentley


Meadow Park Existing.dgn [3D - V8 DGN] - MicroStation V8i
File Edit Element Settings Tools Utilities Workspace Applications Window Help
Bentley InRoads Suite V8i
File Surface Geometry Bridge Drainage Survey Evaluation Modeler Drafting Tools Help
Surfaces
Default
Meadow Park Existing
Proposed
Subgrade
Data Type Active Features
Breakline Fe... 2328 12
Contour Fea... 0 0
Exterior Feat... 389 1
Inferred Brea... 0 0
Interior Feat... 0 0
Random Fea... 0 0
Surfaces Geometry
Tasks
Drawing
Default Views
E_ROAD_PavementCL

Exporting Data

- Need to activate the Translators in InRoads
- Trimble, Leica, LandXML formats…
- Don’t forget to toggle on the “Surface” option

Bentley


Meadow Park Existing.dgn [3D - V8 DGN] - MicroStation V8i
File Edit Element Settings Tools Utilities Workspace
E_ROAD_PavementCl
Tasks
Drawing
Bentley InRoads Suite V8i
File Surface Geometry Bridge Drainage Survey Evaluation Modeler Drafting Tools Help
Surfaces
Default
Meadow Park Existing
Proposed
Subgrade
Surfaces Geometry
Data Type Active Features
Breakline Fe... 2328 12
Contour Fea... 0 0
Exterior Feat... 389 1
Inferred Brea... 0 0
Interior Feat... 0 0
Random Fea... 0 0
Imports ASCII data into surface or geometry projects
View 1 - Top, Default
-50
-25
0
43+00
25
50
75
Default Views
1 2 3 4 5 6 7 8
Display complete
E_ROAD_PavementCL

Questions?

Bentley