Bentley®
Advancing Infrastructure

Using 3D Models after the Design Process

Alexander Mabrich, PE, MSc / Xin Luo, PE PhD

Agenda

- Clearance Verification
- Geometry and Quantity Reports
- Scheduling and Construction Planning
- Intelligent Models
- Construction and Inspection

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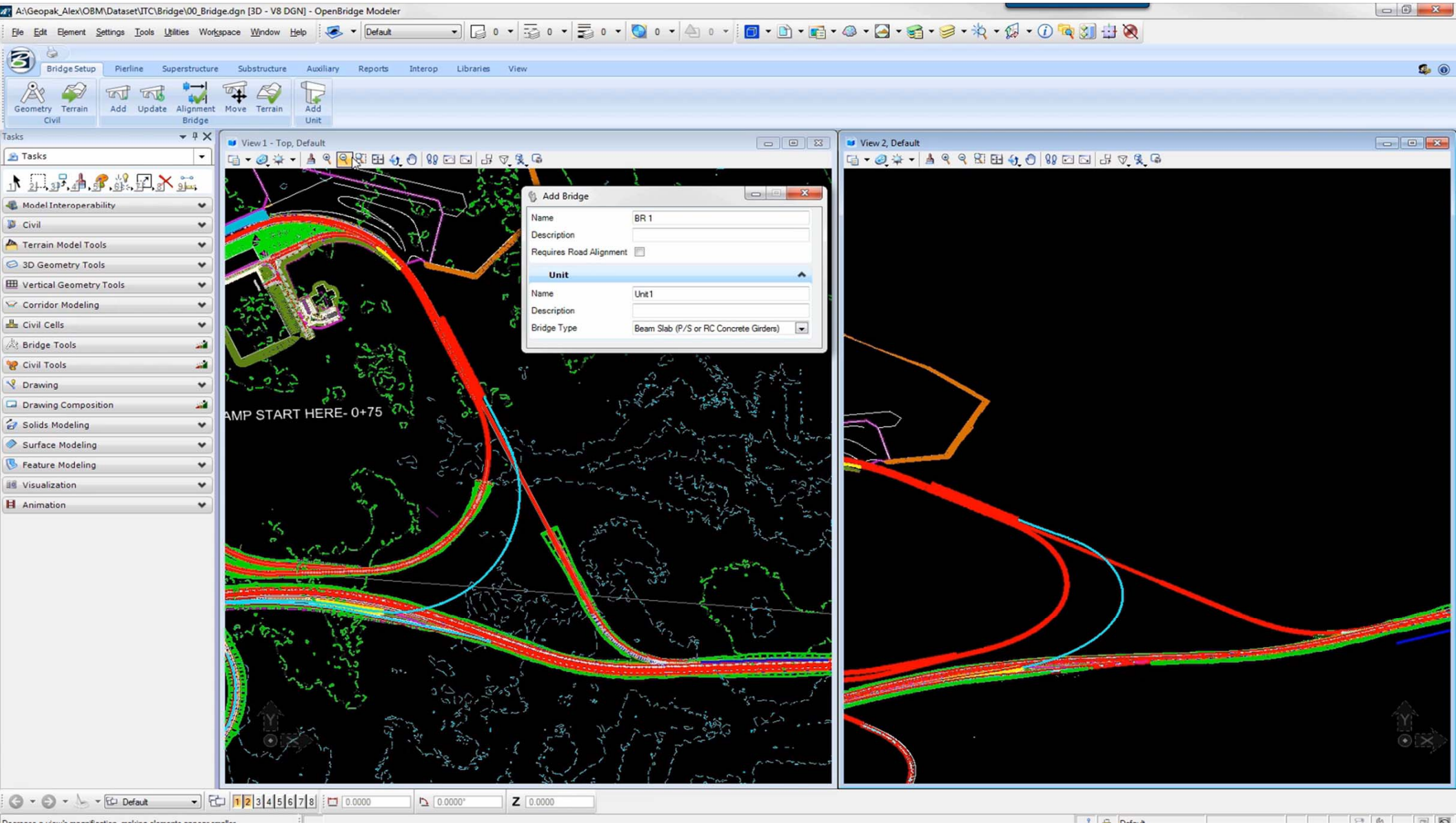
A:\Geopak_Alex\OBM\Dataset\ITC\Bridge\00_Bridge.dgn [3D - V8 DGN] - OpenBridge Modeler
File Edit Element Settings Tools Utilities Workspace Window Help
Bridge Setup Pierline Superstructure Substructure Auxiliary Reports Interop Libraries View
Geometry Terrain Civil
Add Update Alignment Move Terrain Bridge
Add Unit
Tasks
Model Interoperability
Civil
Terrain Model Tools
3D Geometry Tools
Vertical Geometry Tools
Corridor Modeling
Civil Cells
Bridge Tools
Civil Tools
Drawing
Drawing Composition
Solids Modeling
Surface Modeling
Feature Modeling
Visualization
Animation
View 1 - Top, Default
Add Bridge
Name BR 1
Description
Requires Road Alignment
Unit
Name Unit1
Description
Bridge Type Beam Slab (P/S or RC Concrete Girders)
AMP START HERE- 0+75
View 2, Default

OpenBridge Modeler

Clearance Verification

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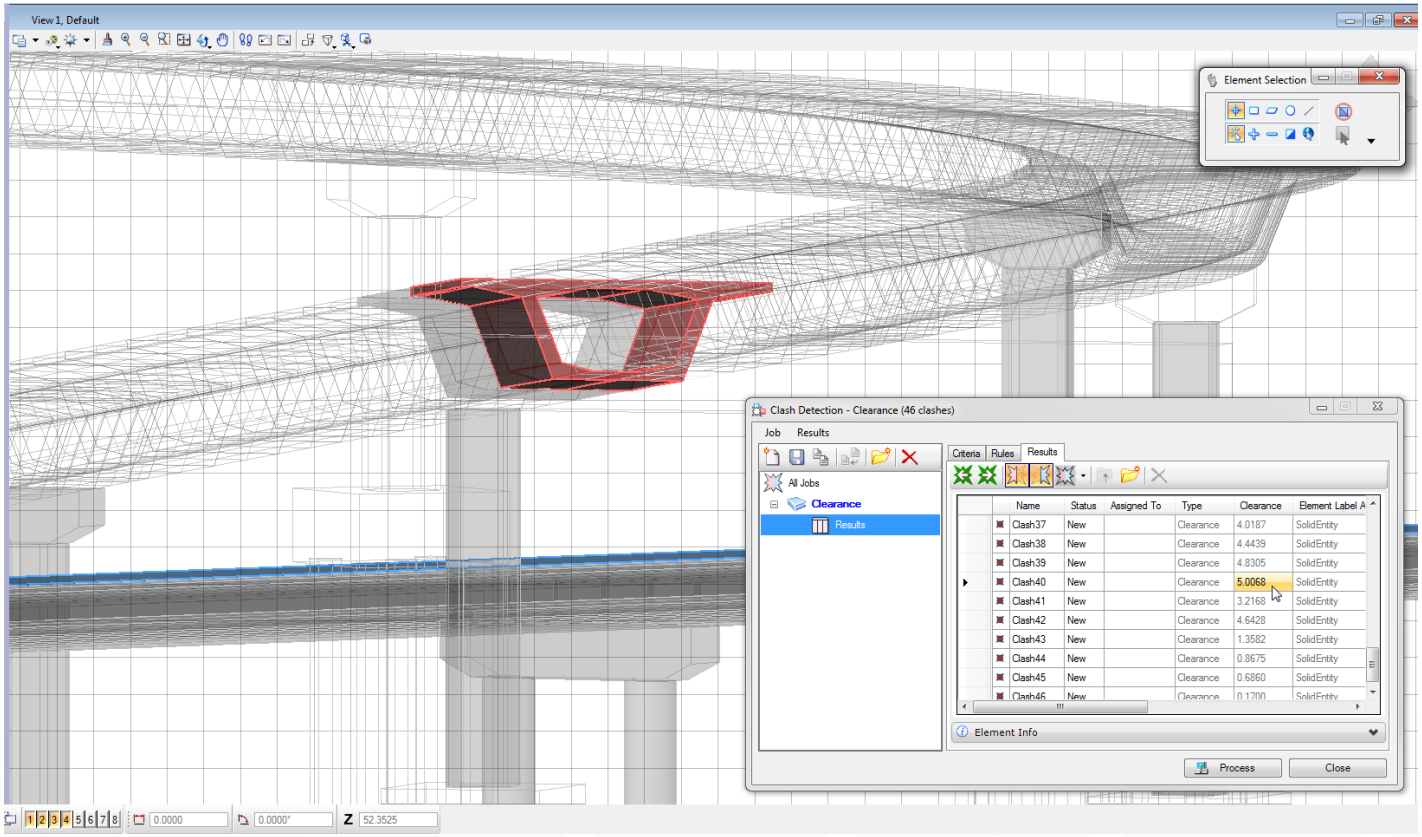
Clearance Verification

- Use Clash Detection tool
  - Tools > Clash Detection
  - Setup by level symbology or…
- Check all kind of clearances: horizontal / vertical
- Works with reference files
- Checks among any 3D elements



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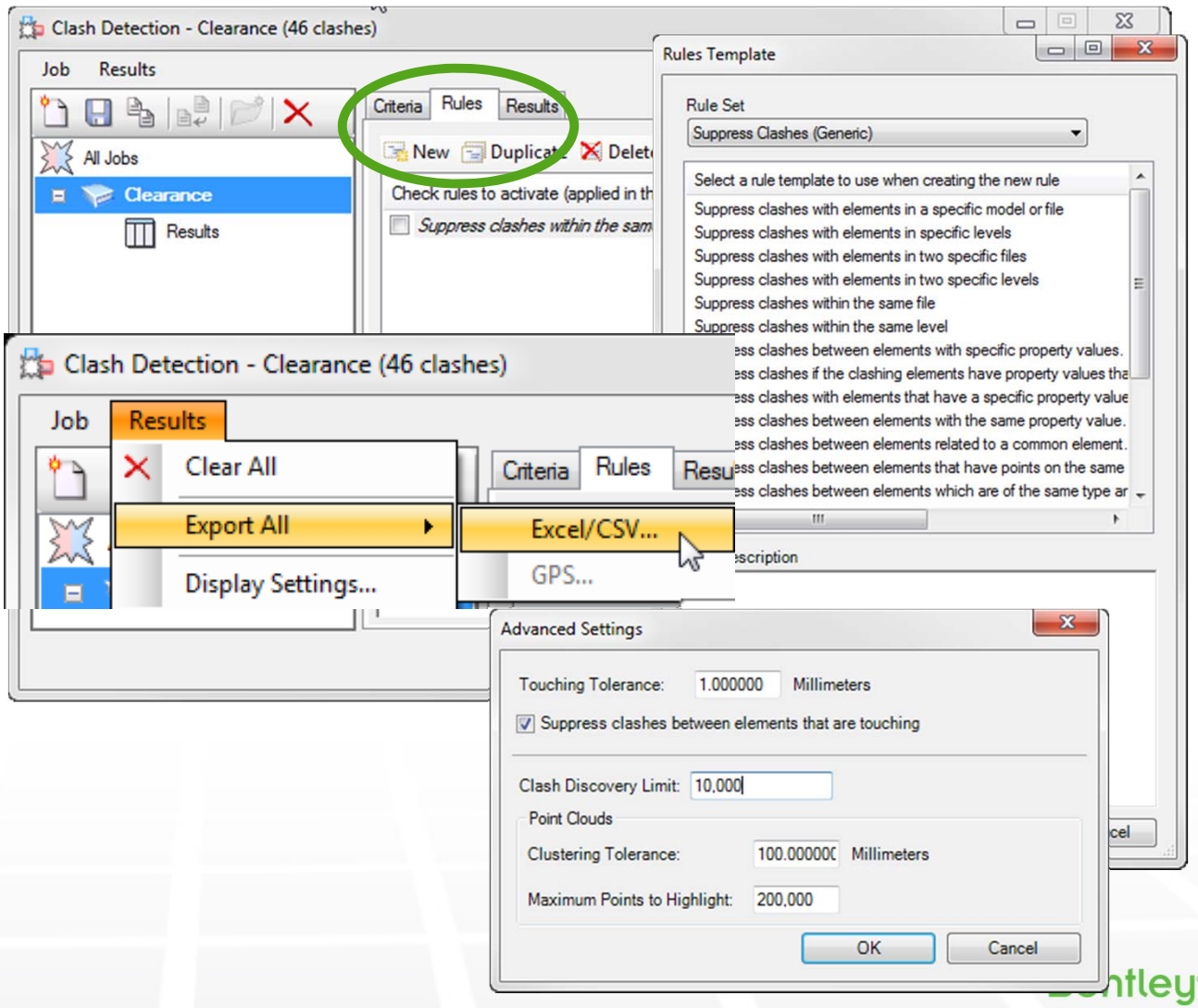
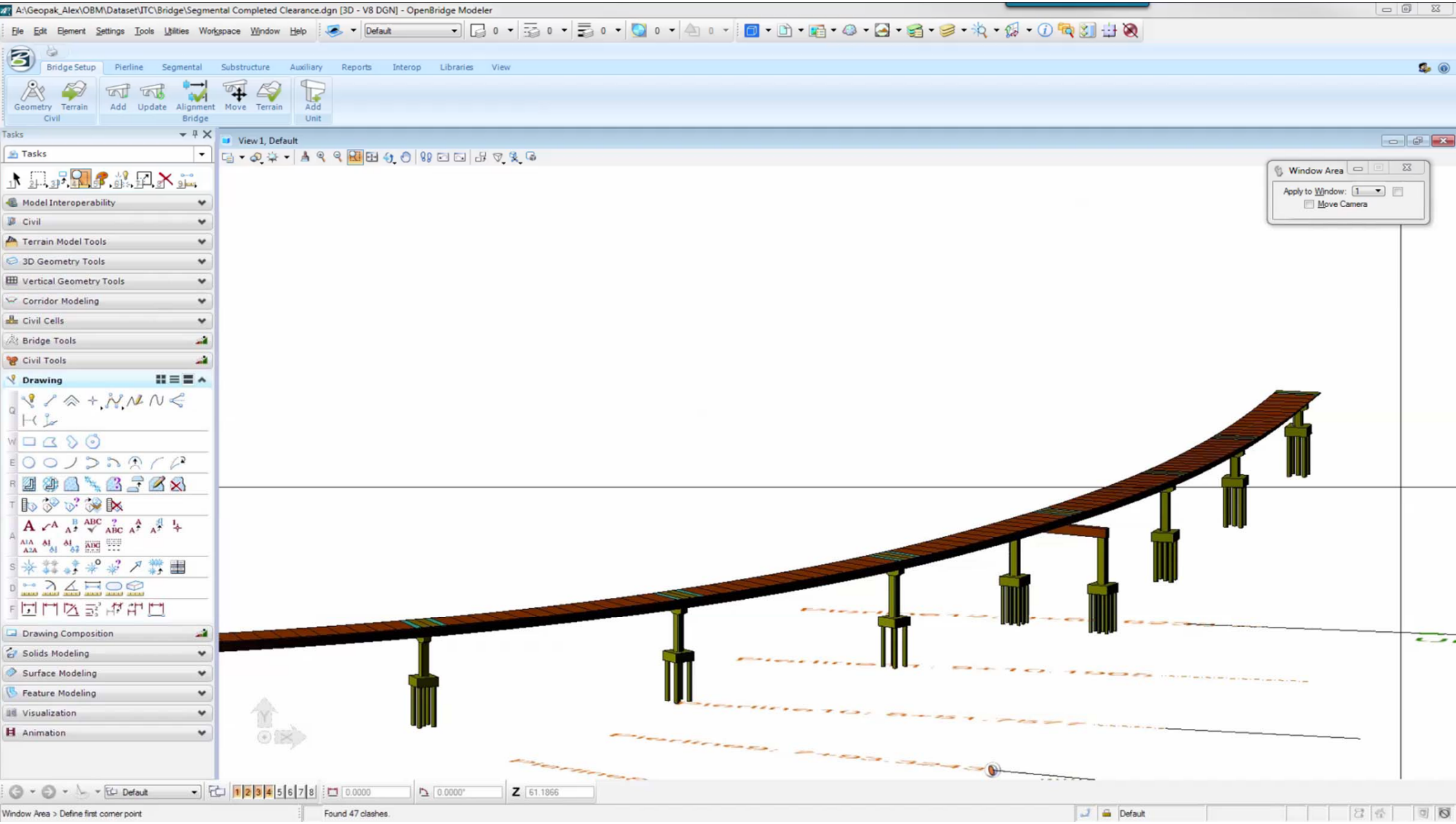
Clearance Verification

- Use Rules to refine the conflict detection.
- Export results to Excel
- Works also with Point Clouds

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File Edit Element Settings Tools Utilities Workspace Window Help
Bridge Setup Pierline Segmental Substructure Auxiliary Reports Interop Libraries View
Geometry Terrain Civil
Add Update Alignment Move Terrain Bridge
Add Unit
Tasks
Model Interoperability
Civil
Terrain Model Tools
3D Geometry Tools
Vertical Geometry Tools
Corridor Modeling
Civil Cells
Bridge Tools
Civil Tools
Drawing
Drawing Composition
Solids Modeling
Surface Modeling
Feature Modeling
Visualization
Animation
View 1, Default
Window Area
Apply to Window:
Move Camera
Found 47 clashes.
Window Area > Define first corner point

Quantity and Geometry Reports

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Quantity Reports

- Quantities
  - Concrete in v1.0
  - Rebar in future versions
  - Cost Estimates included
  - Unit price in Library

Bridge Name: BR 1

Bridge Unit: Unit1 :: Segmental Bridge

Materials Quantity Report

Superstructure Quantities

Component Name	Segment Type	Material Name	Material Type	Pay Unit	Unit Price	Quantity	Cost
1	Expansion EndBent	Precast Segmental Box Girders B	Concrete	Cubic Meter	1200.00	11.54	13842.58
2	Closure	Deck Concrete	Concrete	Cubic Meter	850.00	8.28	7041.80
3	3	Precast Segmental Box Girders A	Concrete	Cubic Meter	1230.00	25.95	31924.40
4	4	Precast Segmental Box Girders A	Concrete	Cubic Meter	1230.00	25.95	31924.40
5	5	Precast Segmental Box Girders A	Concrete	Cubic Meter	1230.00	25.95	31924.40

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Geometry Reports

- Echo input report
  - Review your data entry.
- Deck Elevations
  - Flexible reporting point options
- Beam/Seat Elevations
- Support Elevations

Bridge Name: BR 1

Bridge Unit: Unit1 :: Segmental Bridge

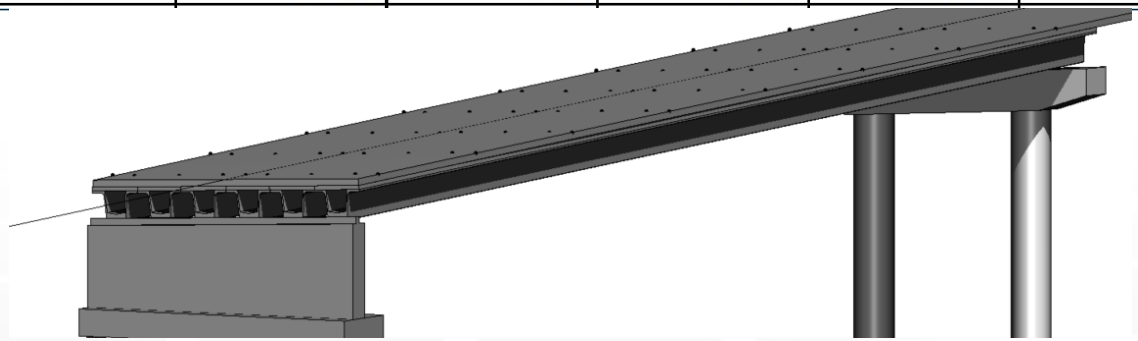
Deck Elevation Report

Normal to alignment

Alignment TE01a with offset = -2.0000,0.0000,2.0000

Span 4

Name	Station - Bridge Alg(m)	Offset - Bridge Alg(m)	Elevation(m)	X(m)	Y(m)
::2::Closure	5+00.7119	-2.0000	54.4114	239901.5708	3969219.7443
::2::Closure	5+00.7119	0.0000	54.4114	239902.7337	3969218.1171
::2::Closure	5+00.7119	2.0000	54.4114	239903.8966	3969216.4900
::3	5+01.1731	-2.0000	54.4183	239901.9429	3969220.0107
::3	5+01.1731	-0.0000	54.4183	239903.1087	3969218.3857
::3	5+01.1731	2.0000	54.4183	239904.2746	3969216.7606
::4	5+05.6731	-2.0000	54.4858	239905.5474	3969222.6452
::4	5+05.6731	0.0000	54.4858	239906.7417	3969221.0410



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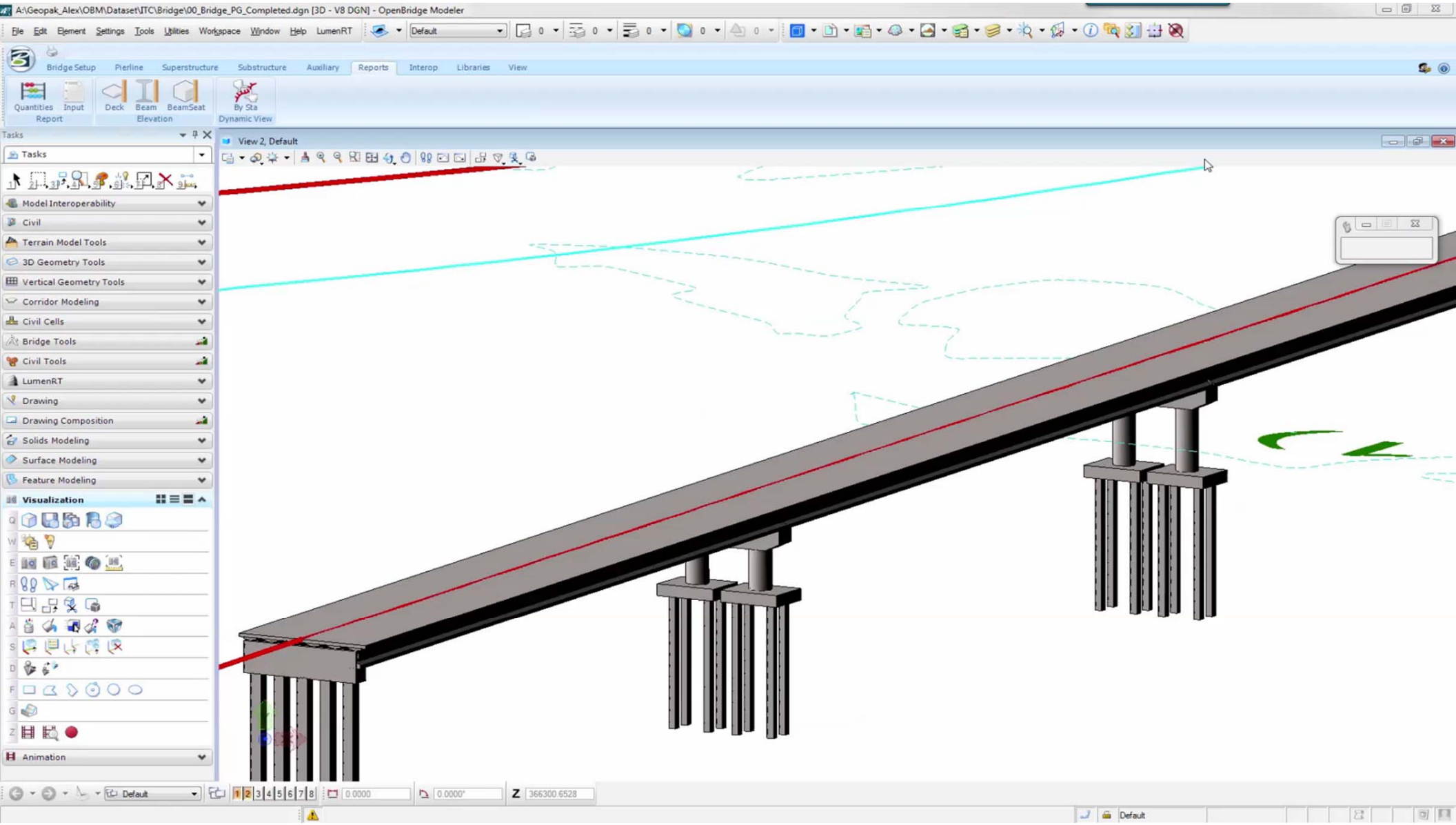
A:\Geopak_Alex\OBM\Dataset\ITC\Bridge\00_Bridge_PG_Completed.dgn [3D - V8 DGN] - OpenBridge Modeler
File Edit Element Settings Tools Utilities Workspace Window Help LumenRT
Default
Bridge Setup Pierline Superstructure Substructure Auxiliary Reports Interop Libraries View
Quantities Input Report
Deck Beam BeamSeat Elevation
By Sta Dynamic View
Tasks
Model Interoperability
Civil
Terrain Model Tools
3D Geometry Tools
Vertical Geometry Tools
Corridor Modeling
Civil Cells
Bridge Tools
Civil Tools
LumenRT
Drawing
Drawing Composition
Solids Modeling
Surface Modeling
Feature Modeling
Visualization
Animation
View 2, Default
Default
Z 366300.6528

Scheduling and Construction Planning

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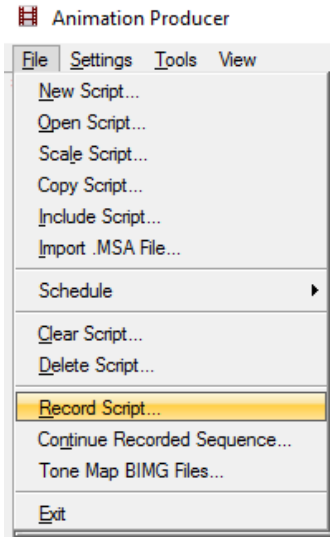
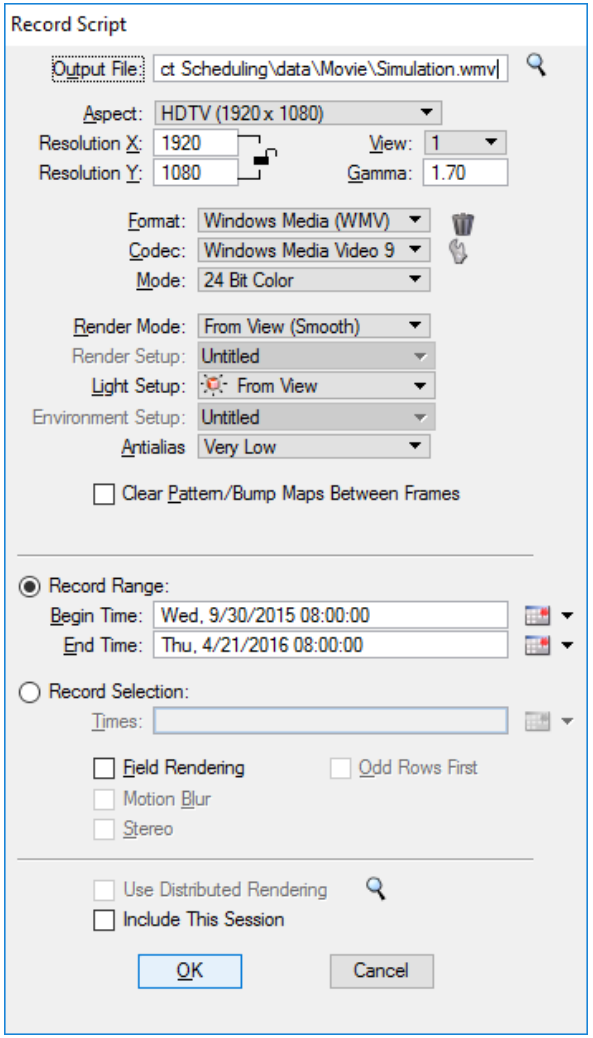
Scheduling

1. Connect the model with Project Scheduling software.
2. Add extra field matching the task with the MicroStation Level Name that will be constructed in that task.
3. Save the schedule in XML format.
4. Open the Animation Producer, and switch to the Scheduling View
5. Import the Schedule in the Animator.
6. Link the level name with the task.
7. Select Tools > Preview to start the simulation.
8. Record the simulation





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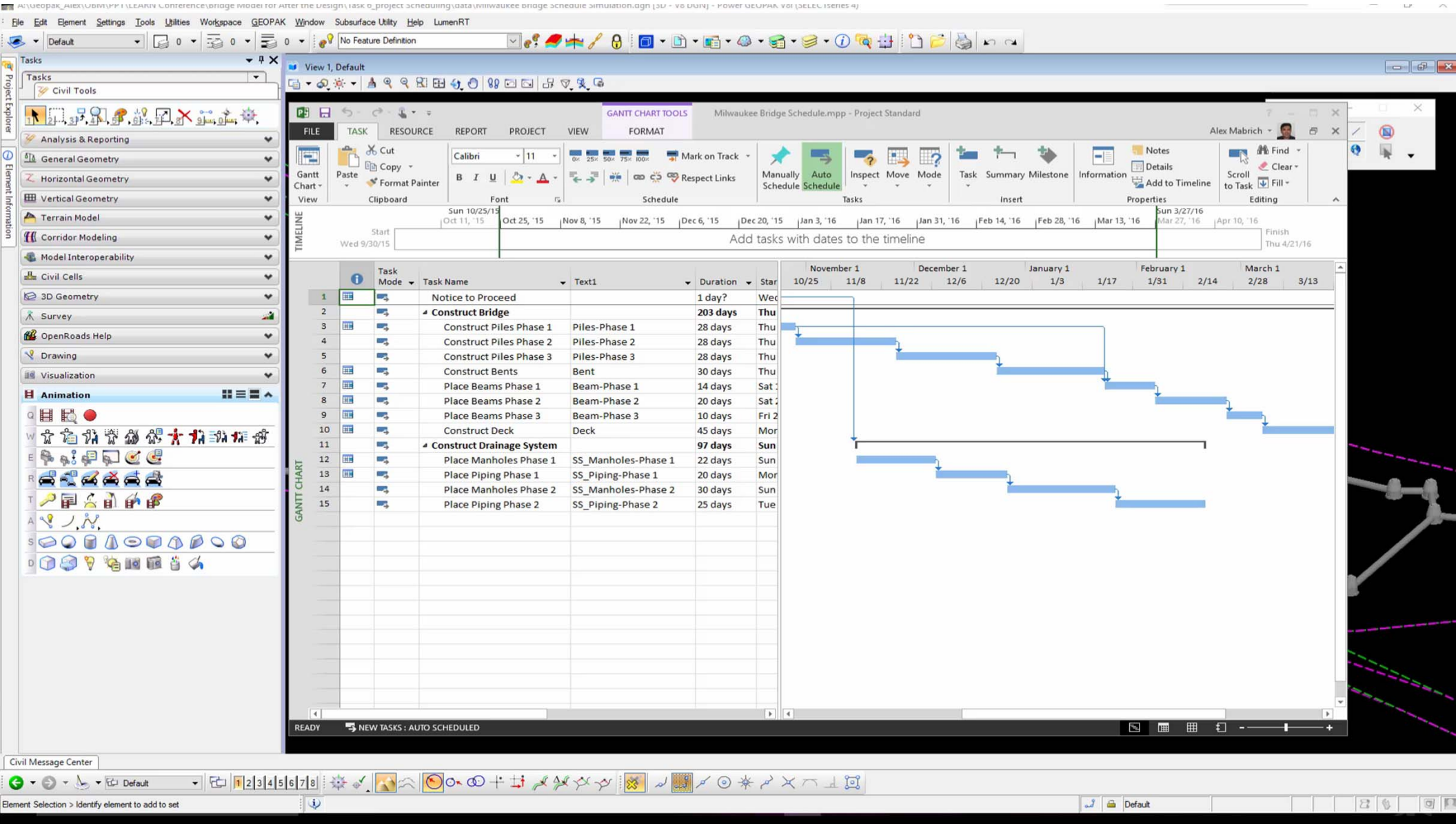
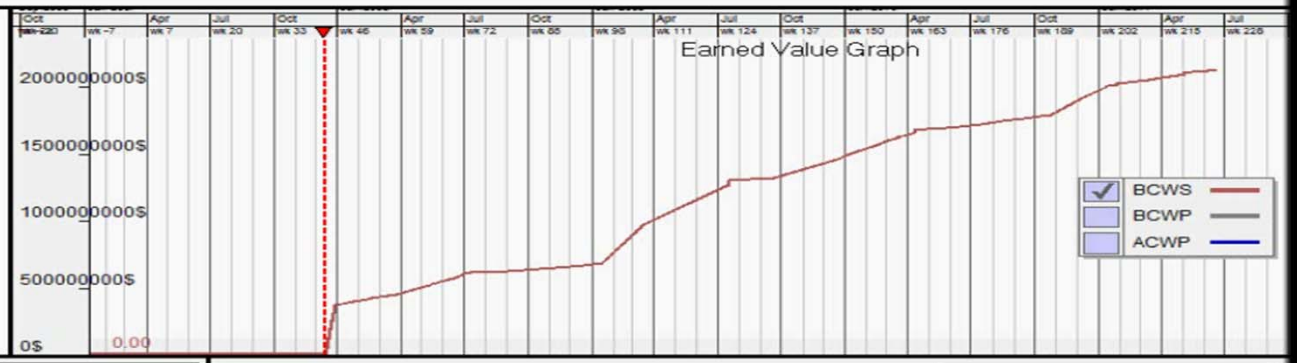

File Edit Element Settings Tools Utilities Workspace GEOPAK Window Subsurface Utility Help LumenRT
Tasks
Civil Tools
Analysis & Reporting
General Geometry
Horizontal Geometry
Vertical Geometry
Terrain Model
Corridor Modeling
Model Interoperability
Civil Cells
3D Geometry
Survey
OpenRoads Help
Drawing
Visualization
Animation
View 1, Default
GANTT CHART TOOLS
Milwaukee Bridge Schedule.mpp - Project Standard
FILE TASK RESOURCE REPORT PROJECT VIEW FORMAT
Alex Mabrich
Gantt Chart
Paste
Cut
Copy
Format Painter
Calibri
11
Mark on Track
Respect Links
Manually Schedule
Auto Schedule
Inspect
Move
Mode
Task
Summary
Milestone
Information
Notes
Details
Add to Timeline
Find
Clear
Fill
Scroll to Task
TIMELINE
Start Wed 9/30/15
Add tasks with dates to the timeline
Finish Thu 4/21/16
GANTT CHART
Task Mode
Task Name
Text1
Duration
1 Notice to Proceed 1 day?
2 Construct Bridge 203 days
3 Construct Piles Phase 1 Piles-Phase 1 28 days
4 Construct Piles Phase 2 Piles-Phase 2 28 days
5 Construct Piles Phase 3 Piles-Phase 3 28 days
6 Construct Bents Bent 30 days
7 Place Beams Phase 1 Beam-Phase 1 14 days
8 Place Beams Phase 2 Beam-Phase 2 20 days
9 Place Beams Phase 3 Beam-Phase 3 10 days
10 Construct Deck Deck 45 days
11 Construct Drainage System 97 days
12 Place Manholes Phase 1 SS_Manholes-Phase 1 22 days
13 Place Piping Phase 1 SS_Piping-Phase 1 20 days
14 Place Manholes Phase 2 SS_Manholes-Phase 2 30 days
15 Place Piping Phase 2 SS_Piping-Phase 2 25 days
November 1
December 1
January 1
February 1
March 1
READY
NEW TASKS : AUTO SCHEDULED
Civil Message Center
Element Selection > Identify element to add to set

	ID	Name	Duration	Start	Finish
1	ST00060	Telegraph Road	1189d	27/11/06	16/06/11

Side by Side Management Report

Baseline Scenario 1
v
Best Scenario 2
Including Best EVA



Intelligent Models

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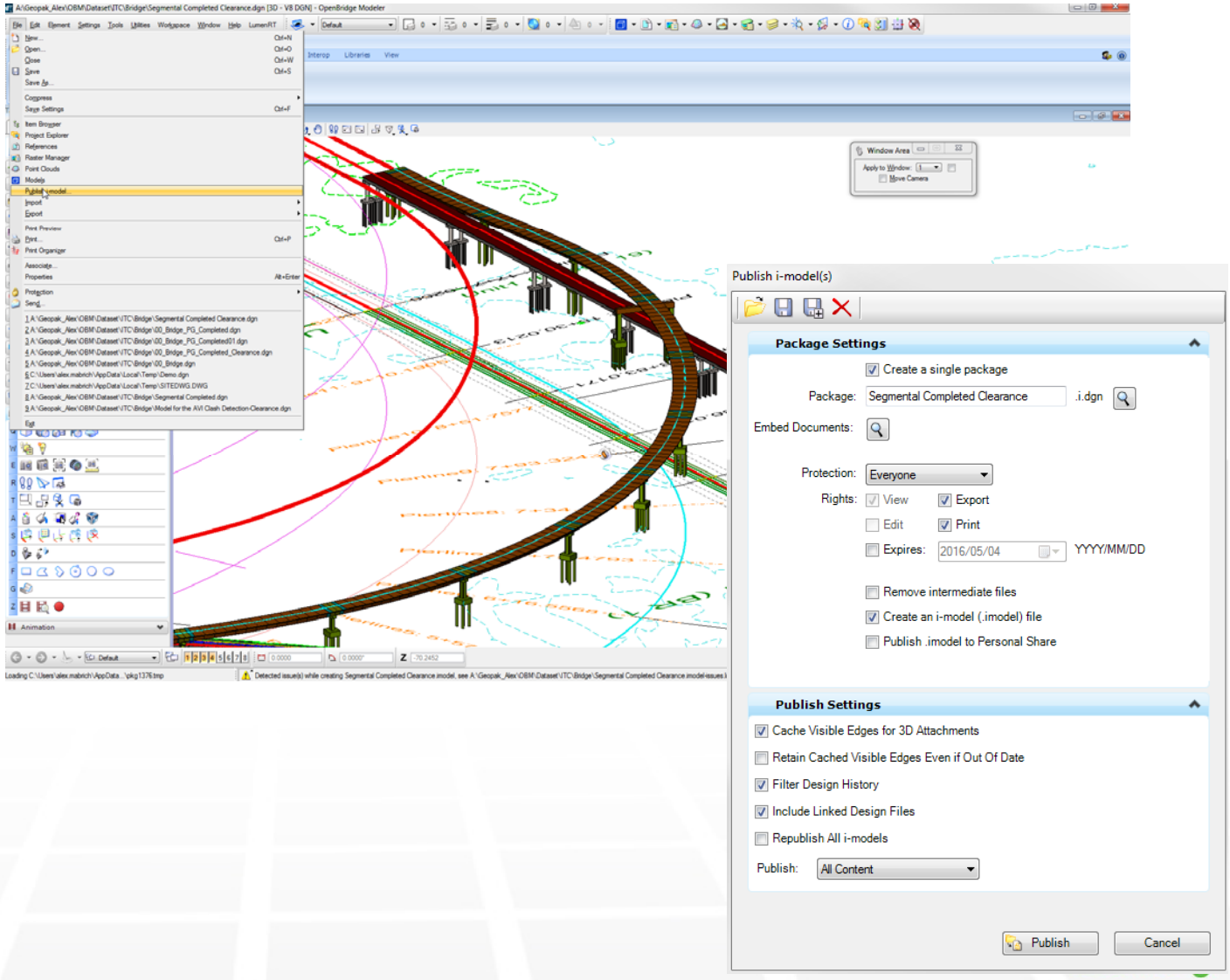
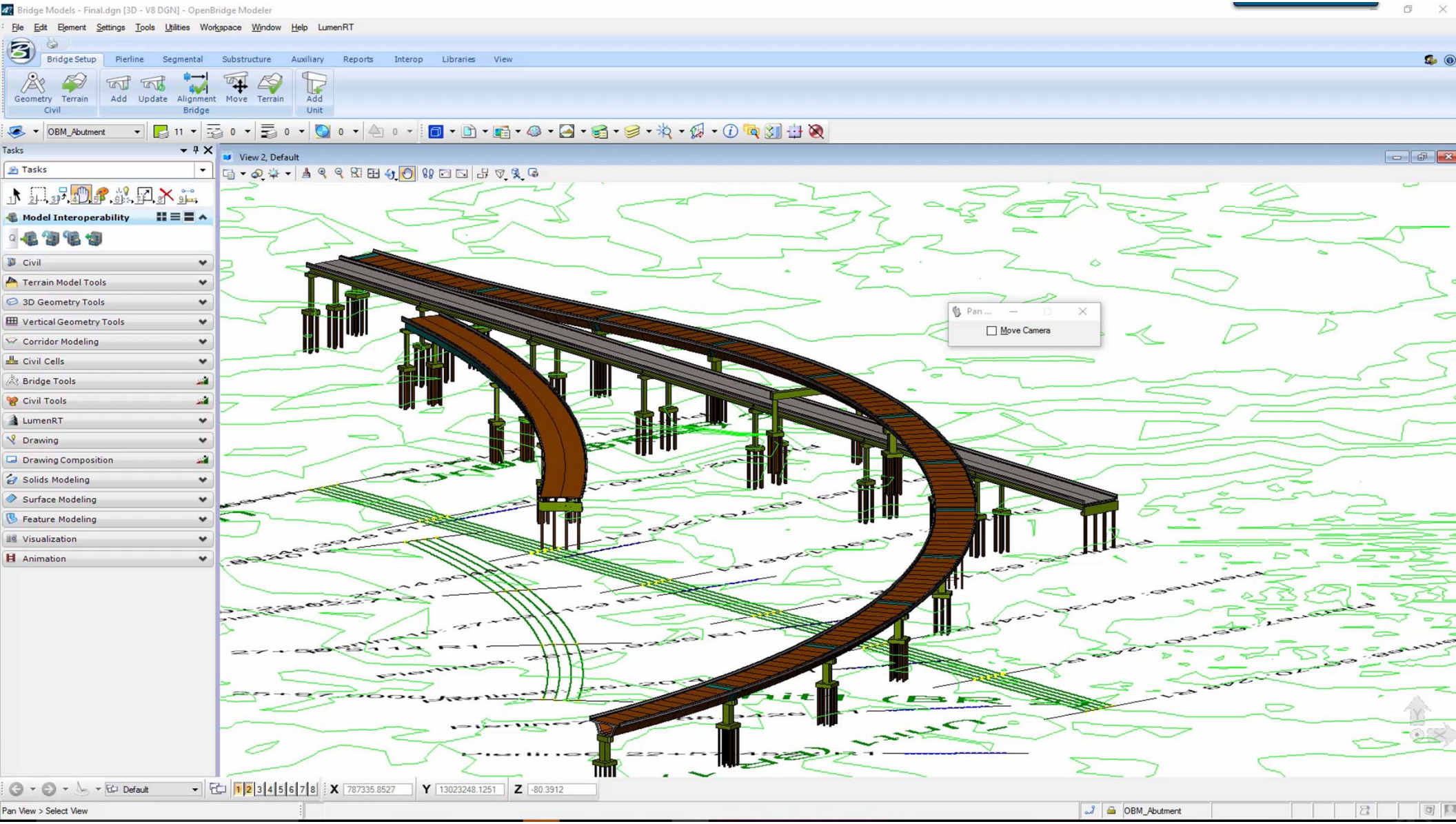
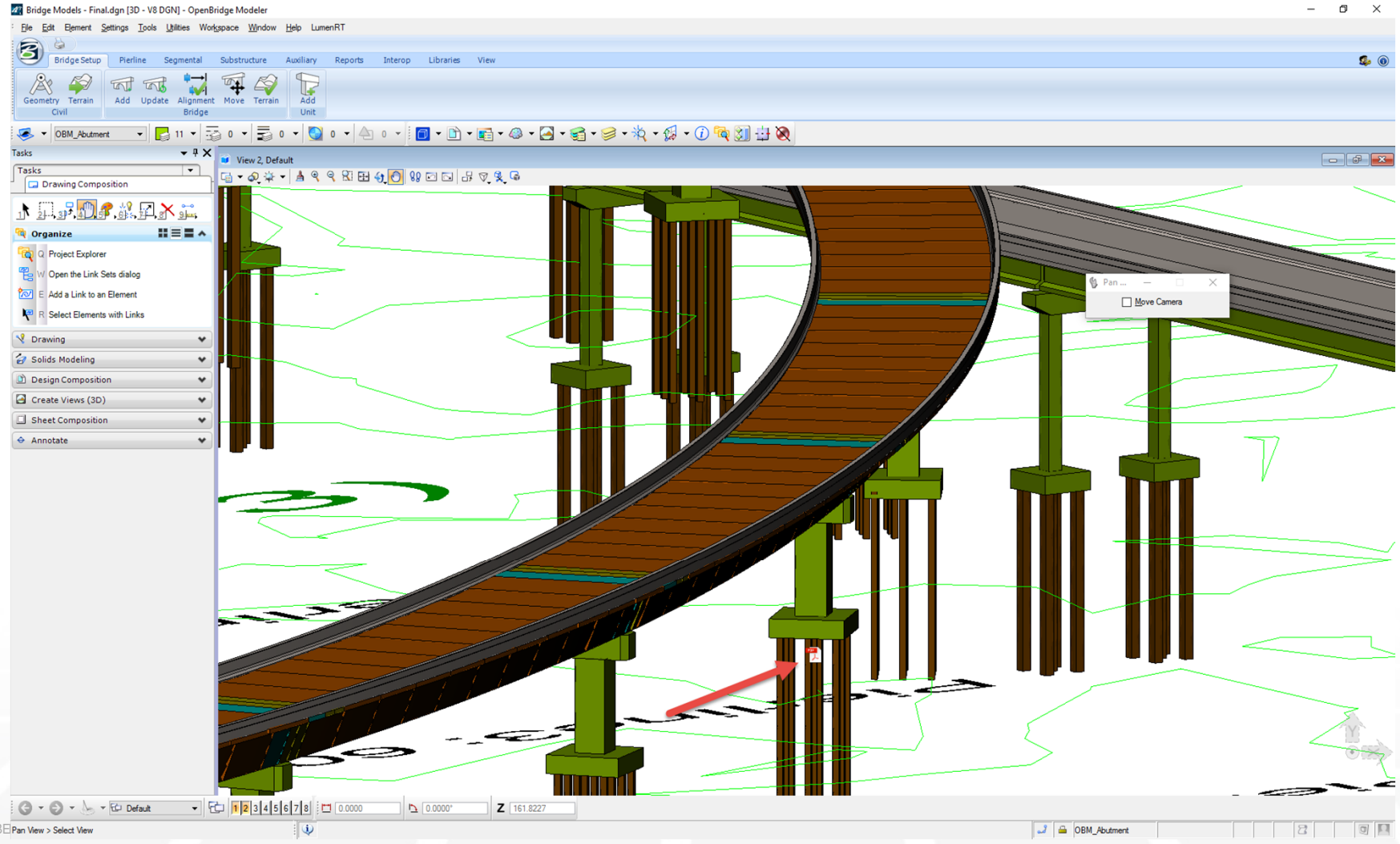
Publishing i-models

- File > Publish i-model
- Read only file for information exchange
- No need of additional applications.
- All reference files are included. Complete package including mobile.
- Open with Bentley Navigator.
- Could be open in other CADD software.




Bridge Models - Final.dgn [3D - V8 DGN] - OpenBridge Modeler
File Edit Element Settings Tools Utilities Workspace Window Help LumenRT
Bridge Setup Pierline Segmental Substructure Auxiliary Reports Interop Libraries View
Geometry Terrain Civil
Add Update Alignment Move Terrain Bridge
Add Unit
OBM_Abutment
Tasks
Model Interoperability
Civil
Terrain Model Tools
3D Geometry Tools
Vertical Geometry Tools
Corridor Modeling
Civil Cells
Bridge Tools
Civil Tools
LumenRT
Drawing
Drawing Composition
Solids Modeling
Surface Modeling
Feature Modeling
Visualization
Animation
View 2, Default
Pan ...
Move Camera
Default
X 787335.8527
Y 13023248.1251
Z -80.3912
Pan View > Select View
OBM_Abutment

Augmented Model



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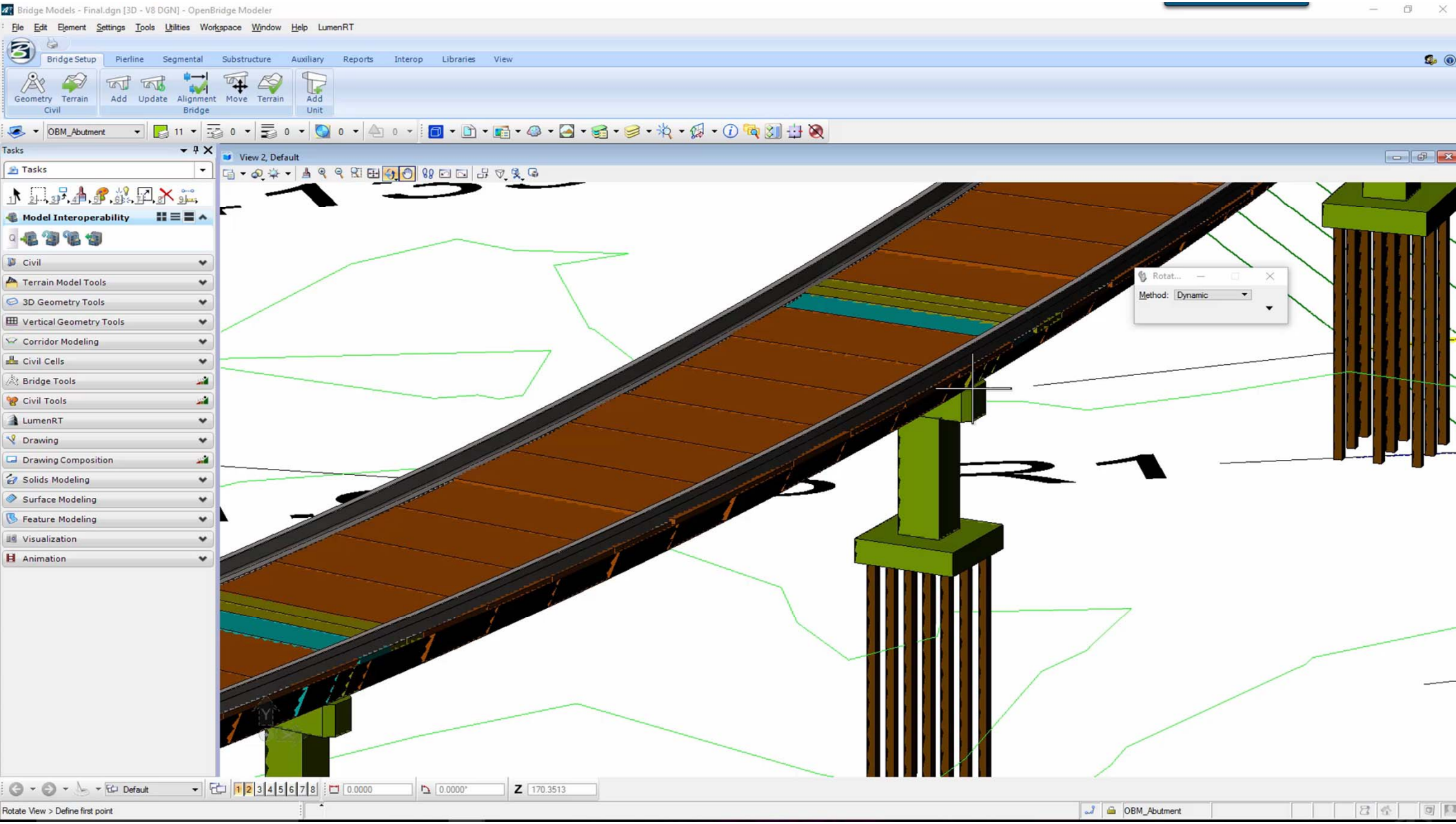
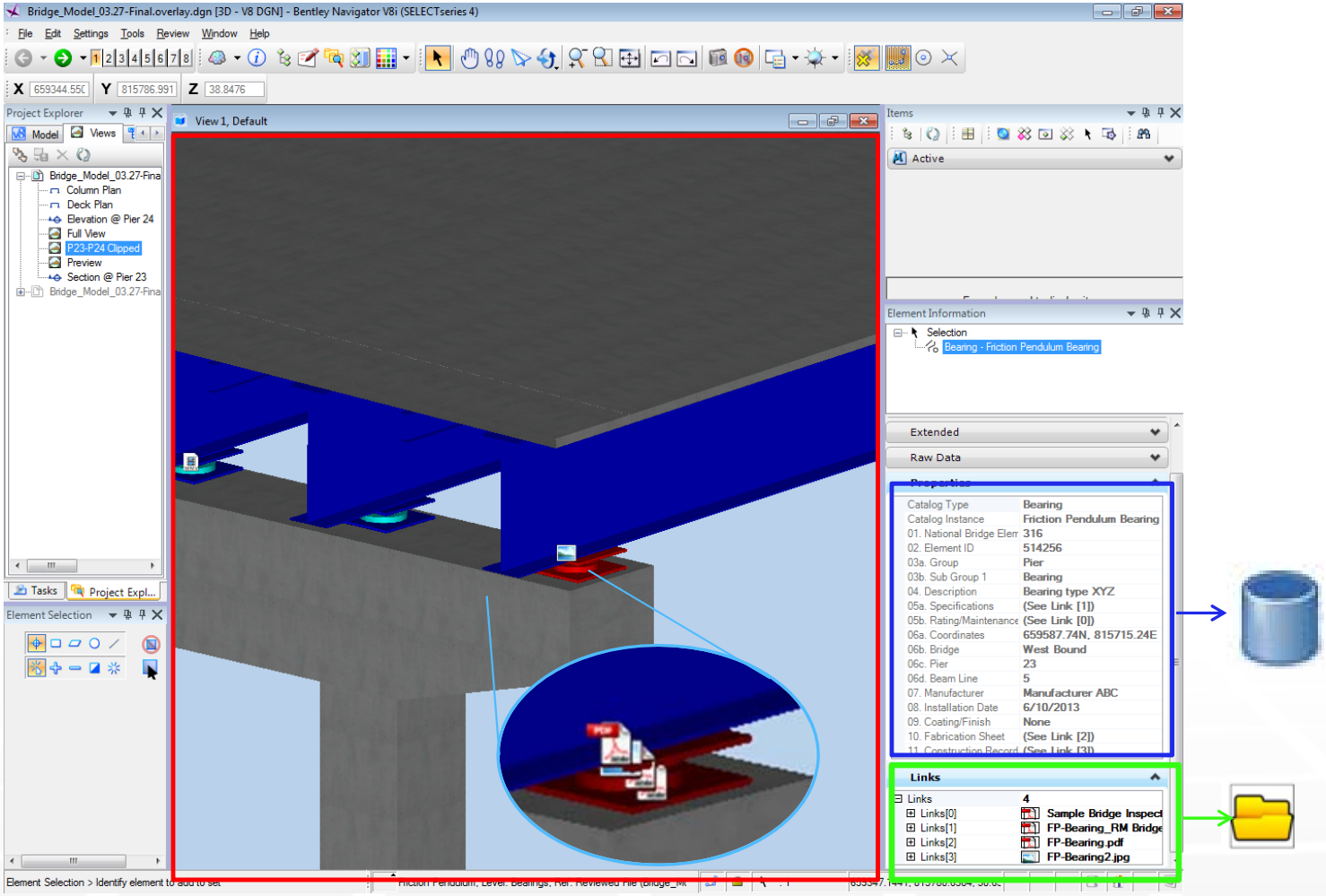

Bridge Models - Final.dgn [3D - V8 DGN] - OpenBridge Modeler
File Edit Element Settings Tools Utilities Workspace Window Help LumenRT
Bridge Setup Pierline Segmental Substructure Auxiliary Reports Interop Libraries View
Geometry Terrain Civil
Add Update Alignment Move Terrain Bridge
Add Unit
OBM_Abutment
Tasks
Model Interoperability
Civil
Terrain Model Tools
3D Geometry Tools
Vertical Geometry Tools
Corridor Modeling
Civil Cells
Bridge Tools
Civil Tools
LumenRT
Drawing
Drawing Composition
Solids Modeling
Surface Modeling
Feature Modeling
Visualization
Animation
View 2, Default
Rotat...
Method: Dynamic
Default
0.0000
0.0000°
Z 170.3513
Rotate View > Define first point
OBM_Abutment

Link Construction Documents



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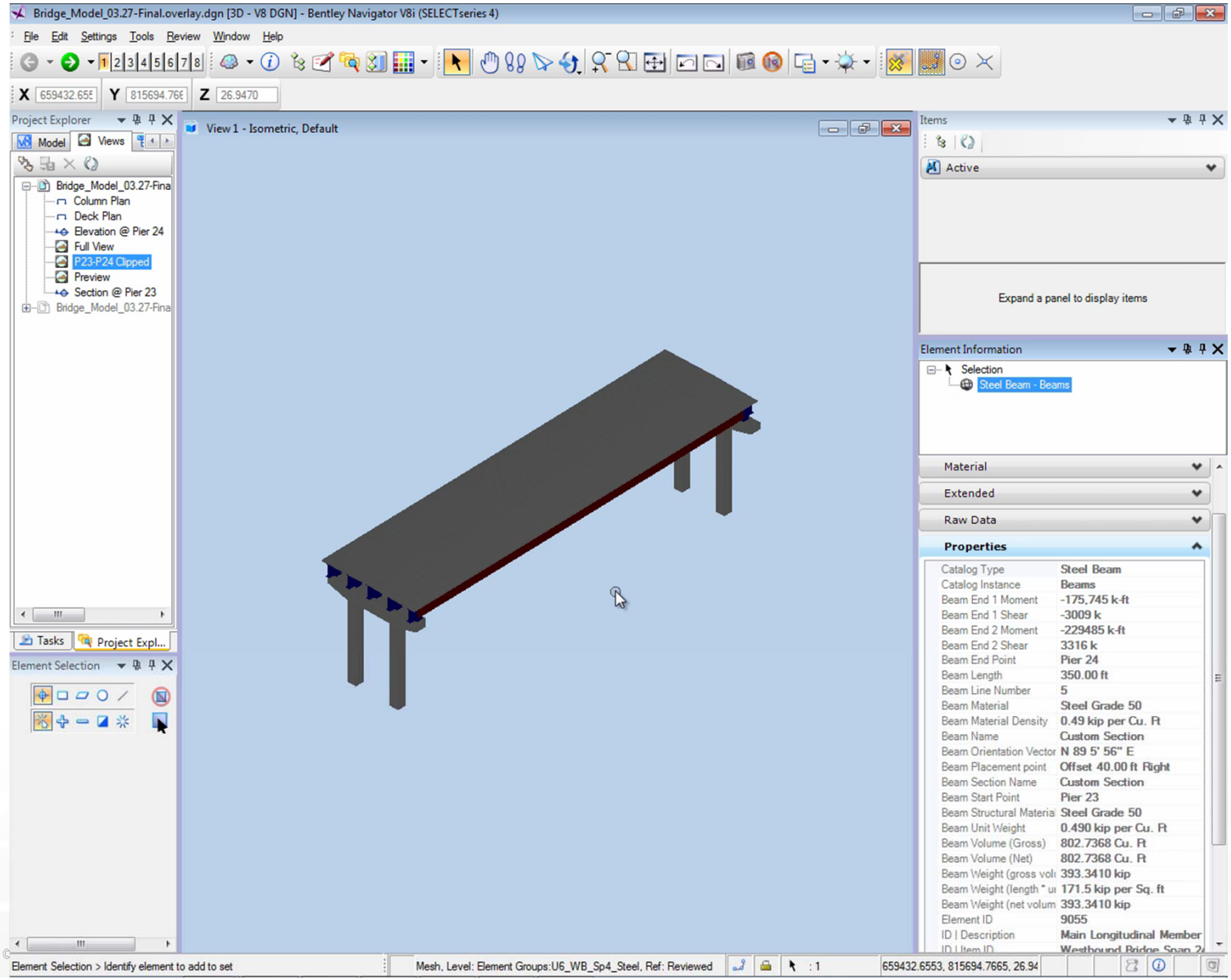
Bridge_Model_03.27-Final.overlay.dgn [3D - V8 DGN] - Bentley Navigator V8i (SELECTseries 4)
File Edit Settings Tools Review Window Help
X 659432.655 Y 815694.766 Z 26.9470
Project Explorer
Model Views
Bridge_Model_03.27-Fina
Column Plan
Deck Plan
Elevation @ Pier 24
Full View
P23-P24 Clipped
Preview
Section @ Pier 23
Bridge_Model_03.27-Fina
Tasks Project Expl...
Element Selection
View 1 - Isometric, Default
Items
Active
Expand a panel to display items
Element Information
Selection
Steel Beam - Beams
Material
Extended
Raw Data
Properties
Catalog Type Steel Beam
Catalog Instance Beams
Beam End 1 Moment -175.745 k-ft
Beam End 1 Shear -3009 k
Beam End 2 Moment -229485 k-ft
Beam End 2 Shear 3316 k
Beam End Point Pier 24
Beam Length 350.00 ft
Beam Line Number 5
Beam Material Steel Grade 50
Beam Material Density 0.49 kip per Cu. Ft
Beam Name Custom Section
Beam Orientation Vector N 89 5' 56" E
Beam Placement point Offset 40.00 ft Right
Beam Section Name Custom Section
Beam Start Point Pier 23
Beam Structural Materia Steel Grade 50
Beam Unit Weight 0.490 kip per Cu. Ft
Beam Volume (Gross) 802.7368 Cu. Ft
Beam Volume (Net) 802.7368 Cu. Ft
Beam Weight (gross vol 393.3410 kip
Beam Weight (length * u 171.5 kip per Sq. ft
Beam Weight (net volum 393.3410 kip
Element ID 9055
ID | Description Main Longitudinal Member
Element Selection > Identify element to add to set
Mesh, Level: Element Groups:U6_WB_Sp4_Steel, Ref: Reviewed
659432.6553, 815694.7665, 26.94

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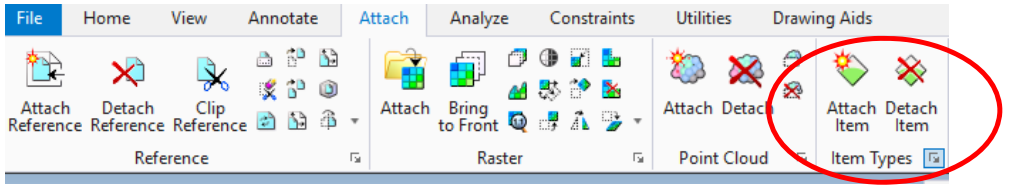
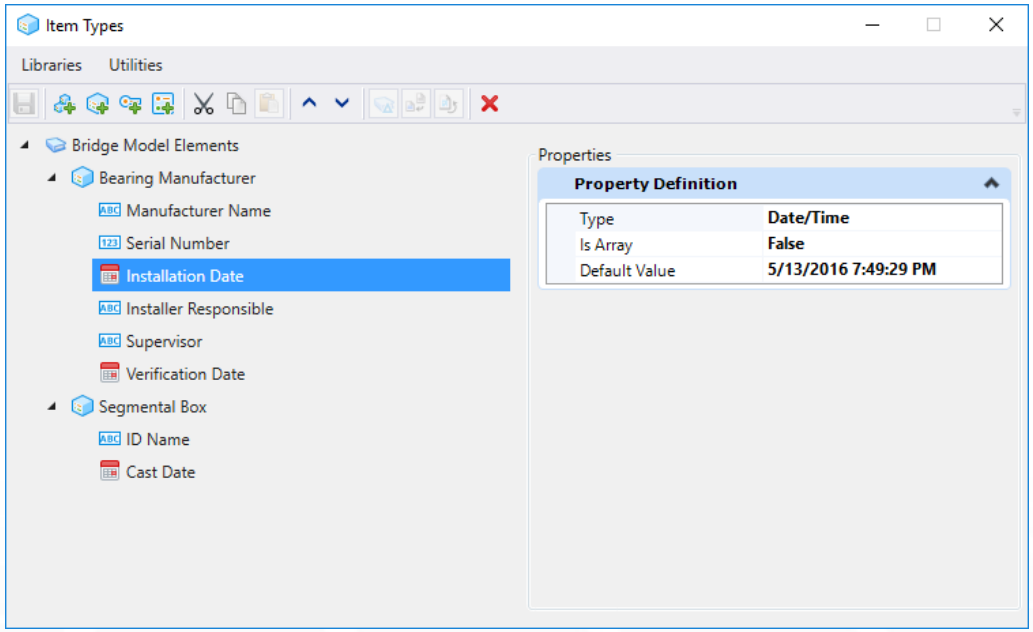
Adding Extra Intelligence to the Model

- Custom data not generated by Bentley design or modeling software.
- Adding extra information to the elements in the model.
- Custom library of property items.
- Import from DGN or DGNLIB
- Available as a standard tool in MicroStation CONNECT edition.
- Attach > Attach Item in the Items Types group.





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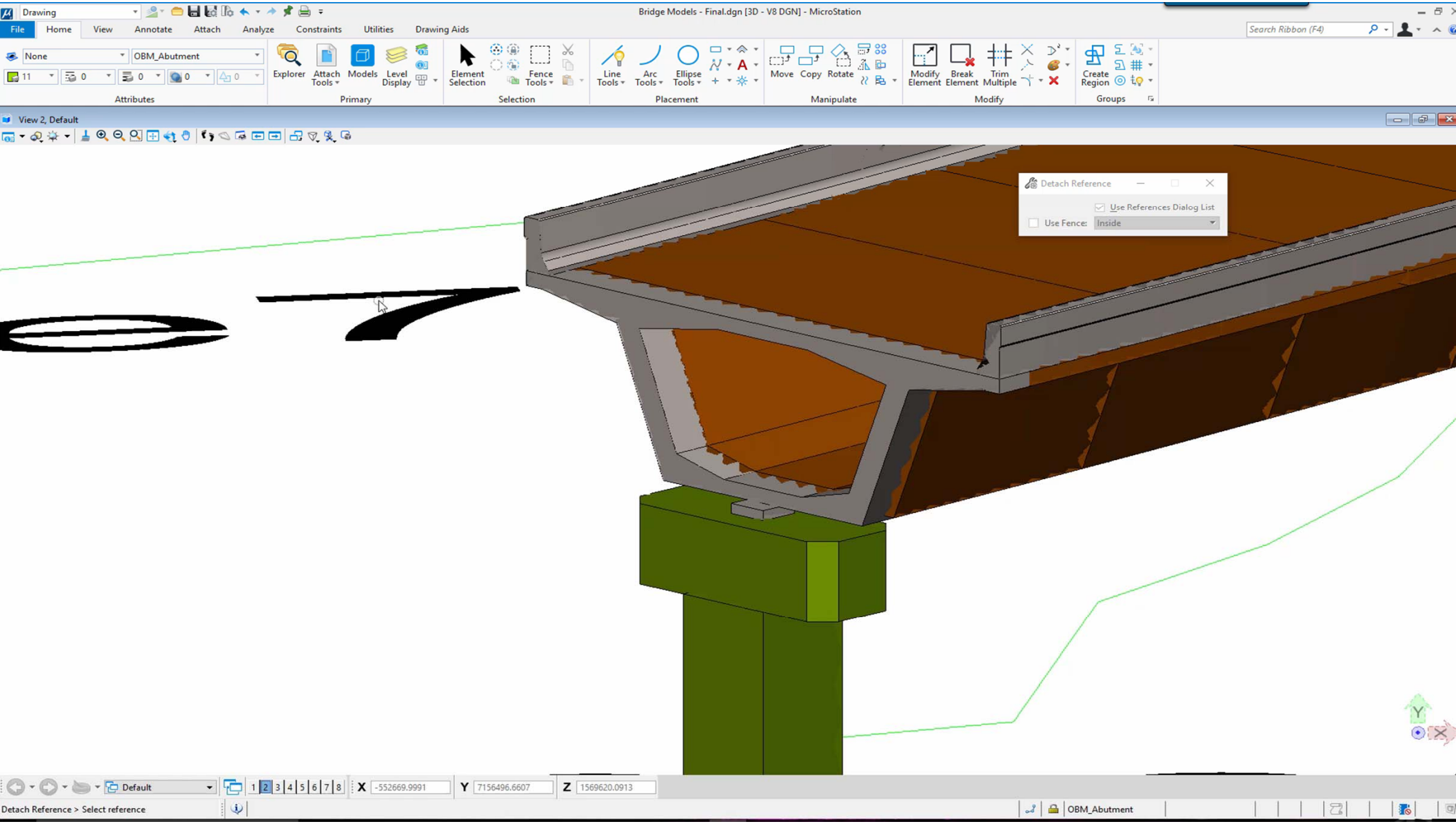
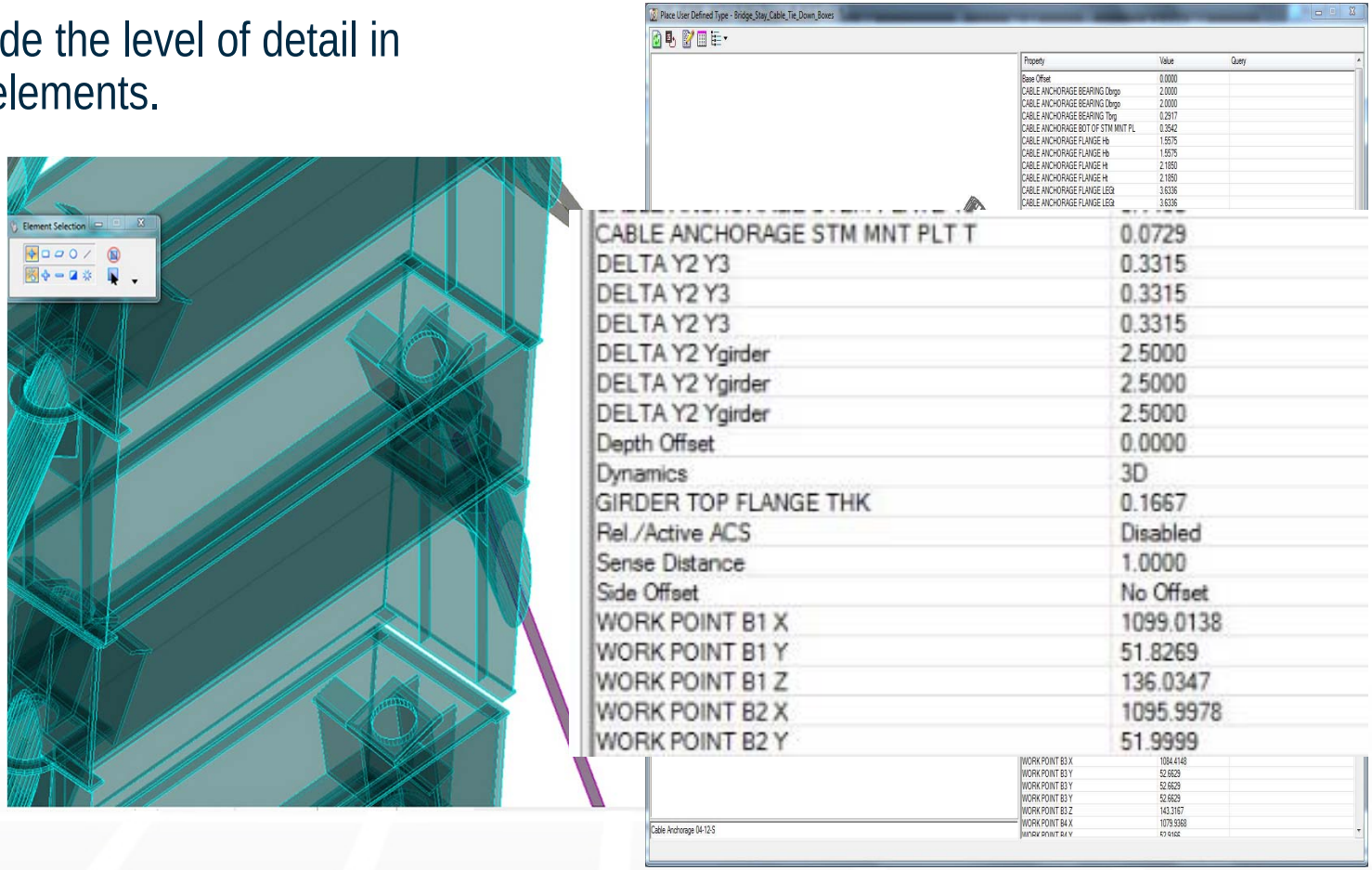

Drawing
Bridge Models - Final.dgn [3D - V8 DGN] - MicroStation
File
Home
View
Annotate
Attach
Analyze
Constraints
Utilities
Drawing Aids
Search Ribbon (F4)
None
OBM_Abutment
Explorer
Attach Tools
Models
Level Display
Element Selection
Fence Tools
Line Tools
Arc Tools
Ellipse Tools
Move
Copy
Rotate
Modify Element
Break Element
Trim Multiple
Create Region
Attributes
Primary
Selection
Placement
Manipulate
Modify
Groups
View 2, Default
Detach Reference
Use References Dialog List
Use Fence:
Inside
Default
X -552669.9991
Y 7156496.6607
Z 1569620.0913
Detach Reference > Select reference
OBM_Abutment

Adding Extra Intelligence to the Model

- Decide the level of detail in the elements.



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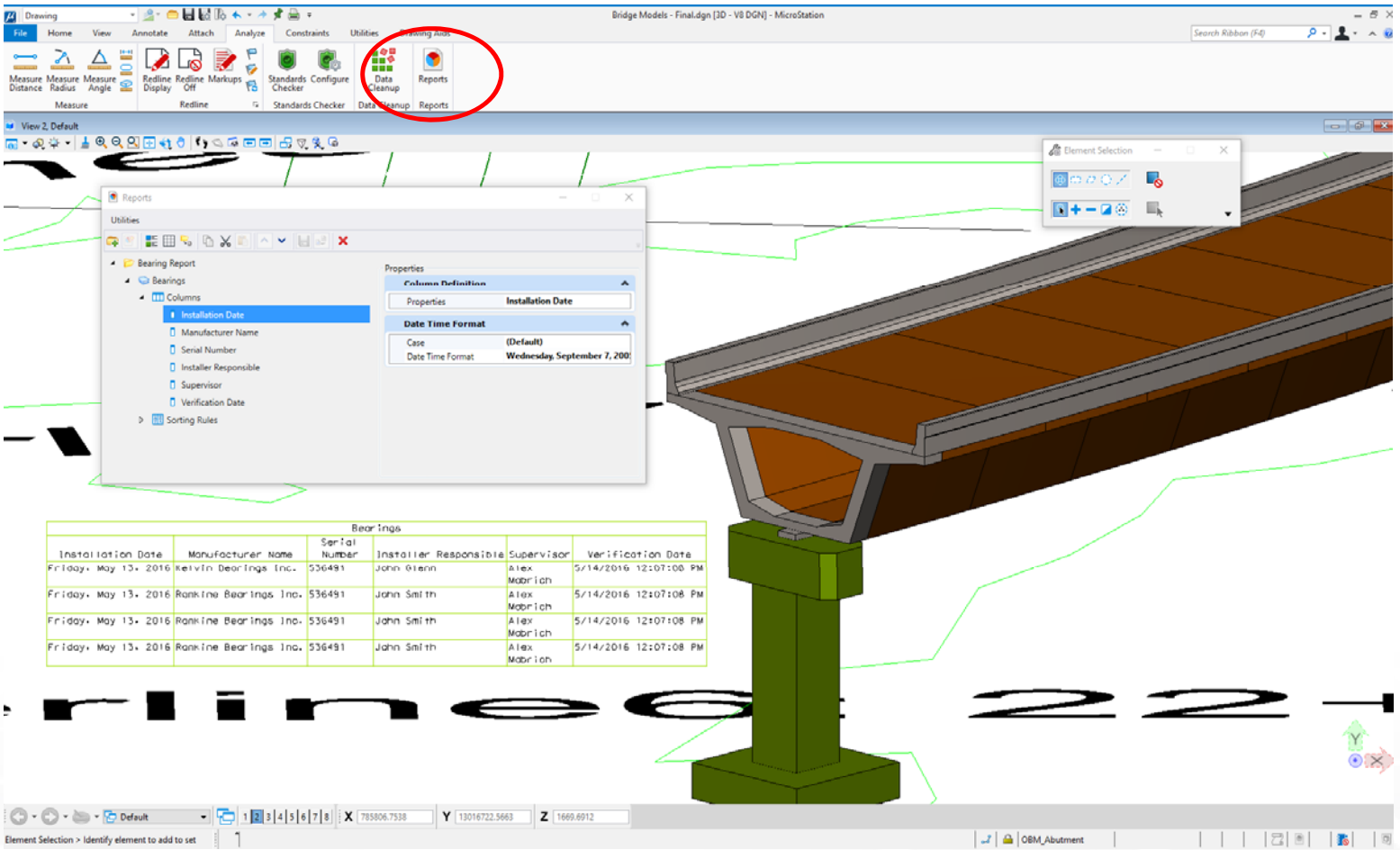
Generate Reports on the Model

- Custom reports in MicroStation CONNECT.
- Sorting options
- Tables as graphics in DGN, or spreadsheets
- Display formatting options.



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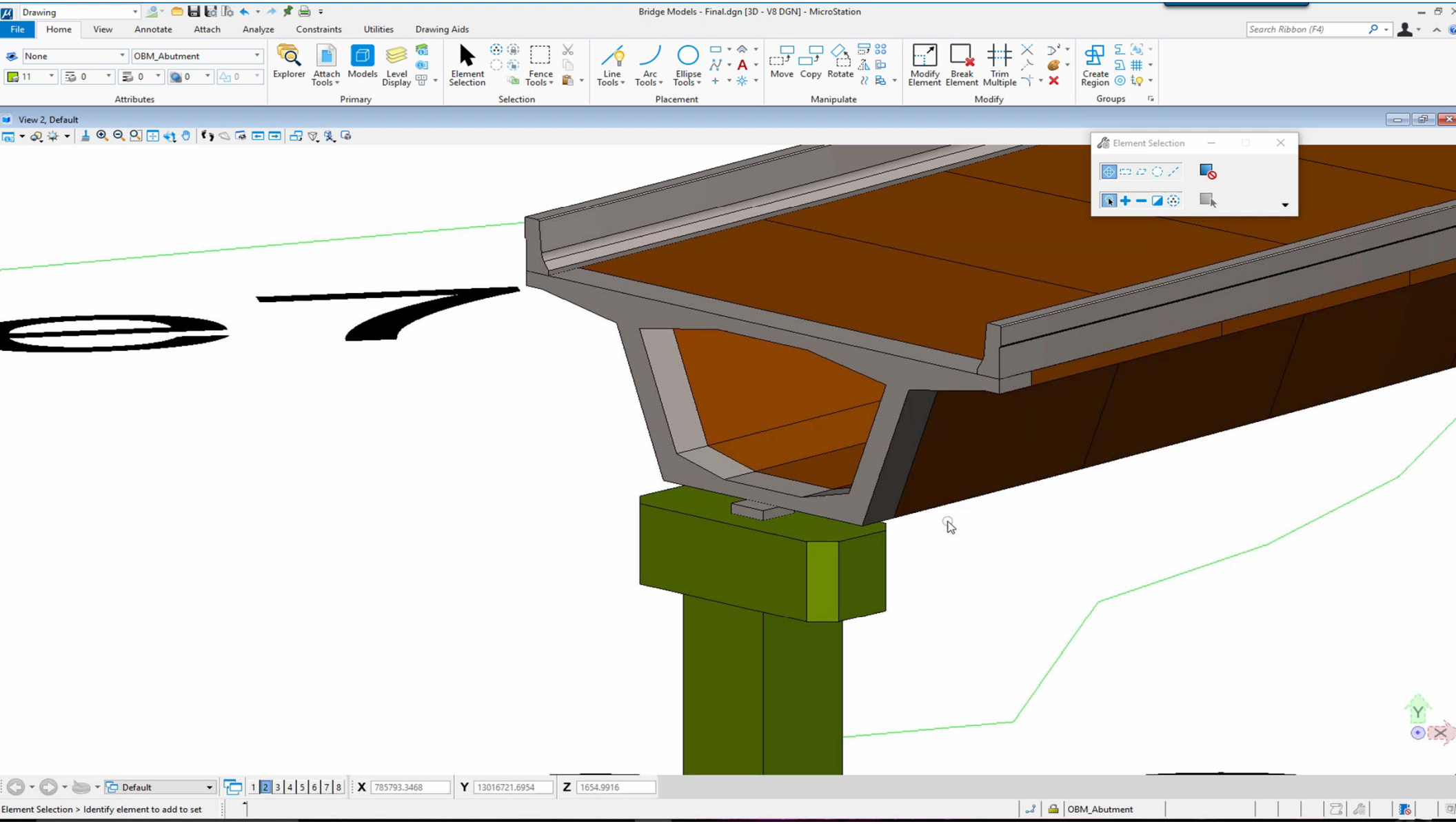
Drawing
Bridge Models - Final.dgn [3D - V8 DGN] - MicroStation
File
Home
View
Annotate
Attach
Analyze
Constraints
Utilities
Drawing Aids
Search Ribbon (F4)
None
OBM_Abutment
Explorer
Attach Tools
Models
Level Display
Element Selection
Fence Tools
Line Tools
Arc Tools
Ellipse Tools
Move
Copy
Rotate
Modify Element
Break Element
Trim Multiple
Create Region
Attributes
Primary
Selection
Placement
Manipulate
Modify
Groups
View 2, Default
Element Selection
Default
X 785793.3468
Y 13016721.6954
Z 1654.9916
Element Selection > Identify element to add to set
OBM_Abutment

Construction and Inspection

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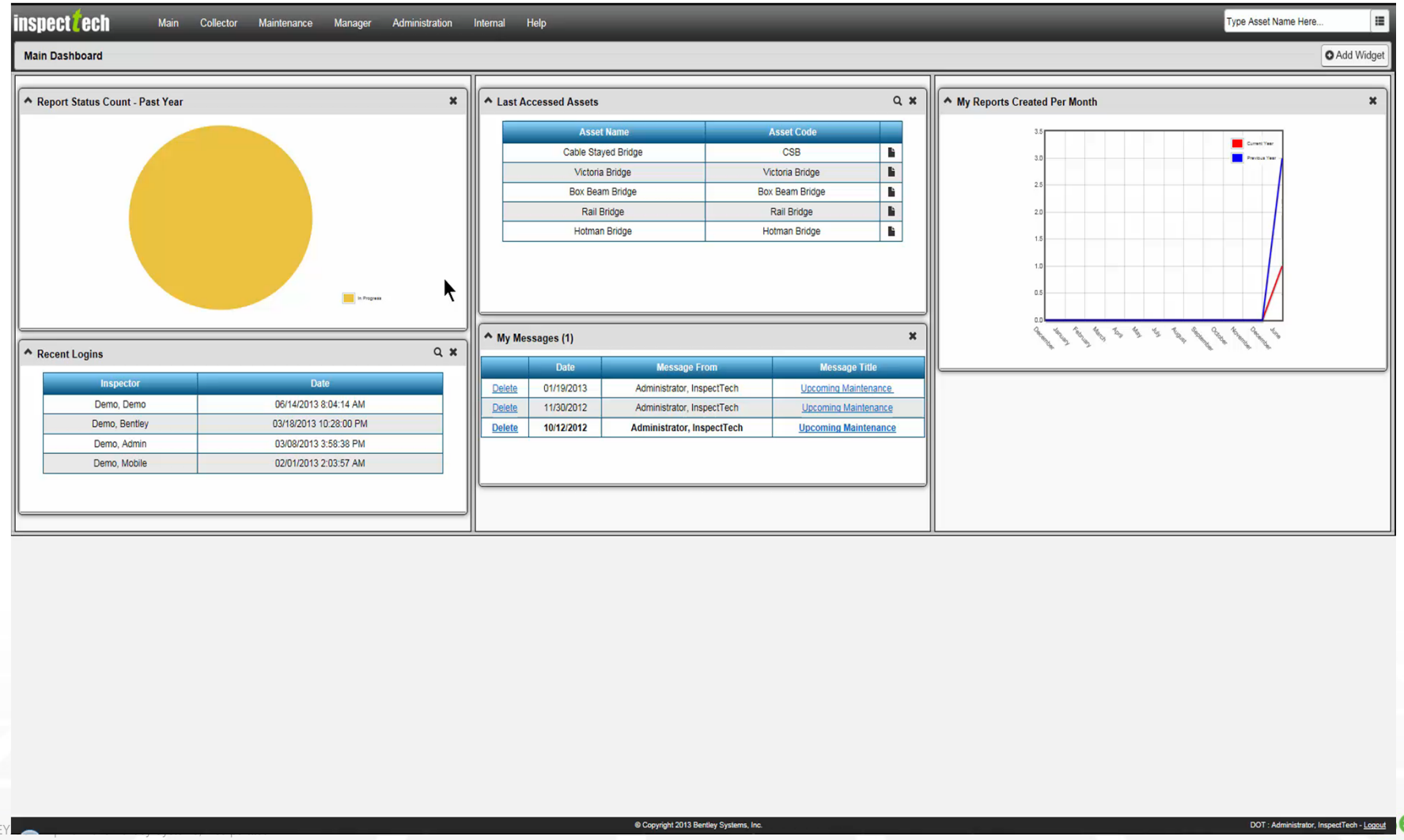
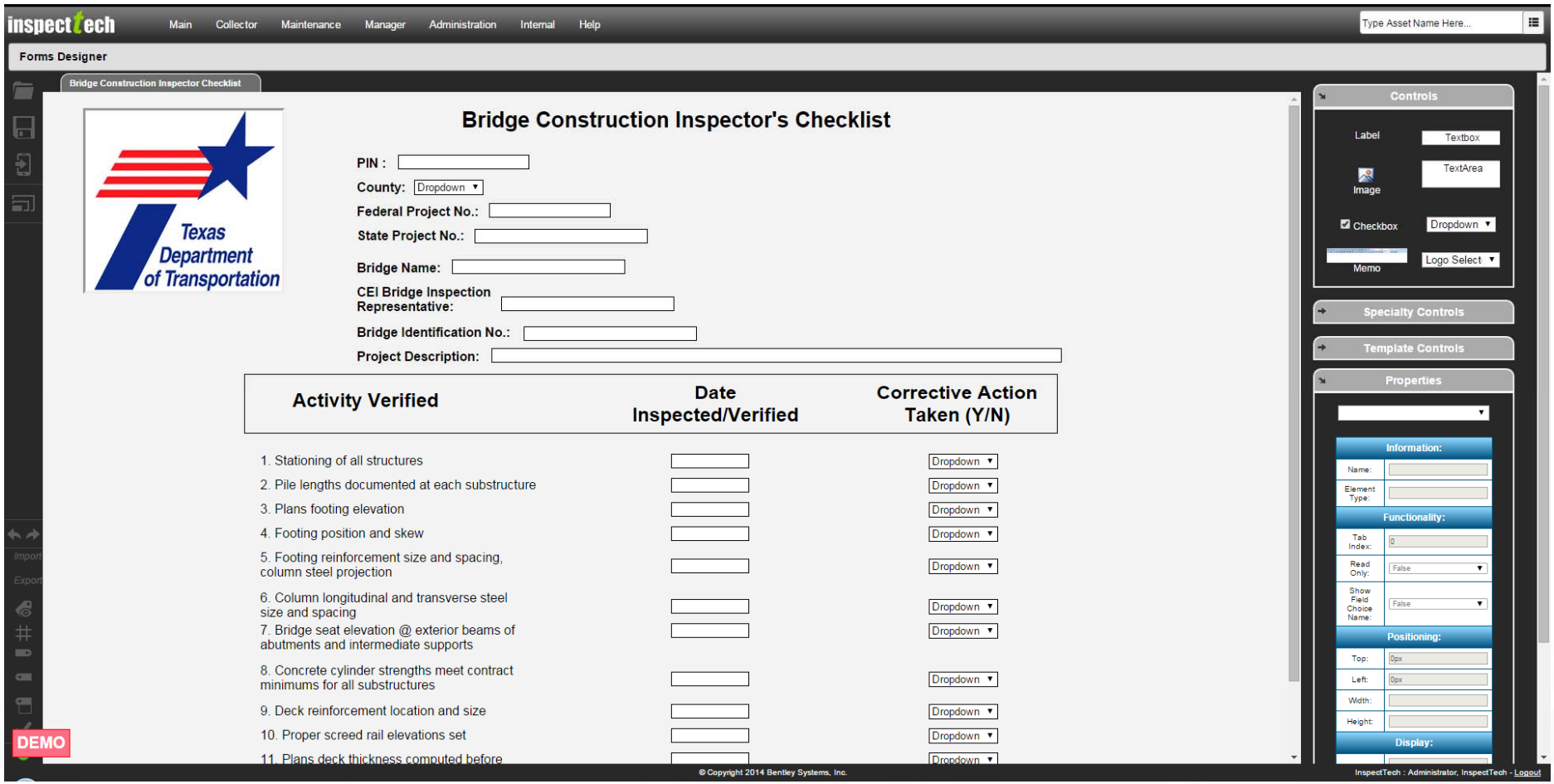
Design 3D Models To Asset Inspection



Bridge Construction Inspection



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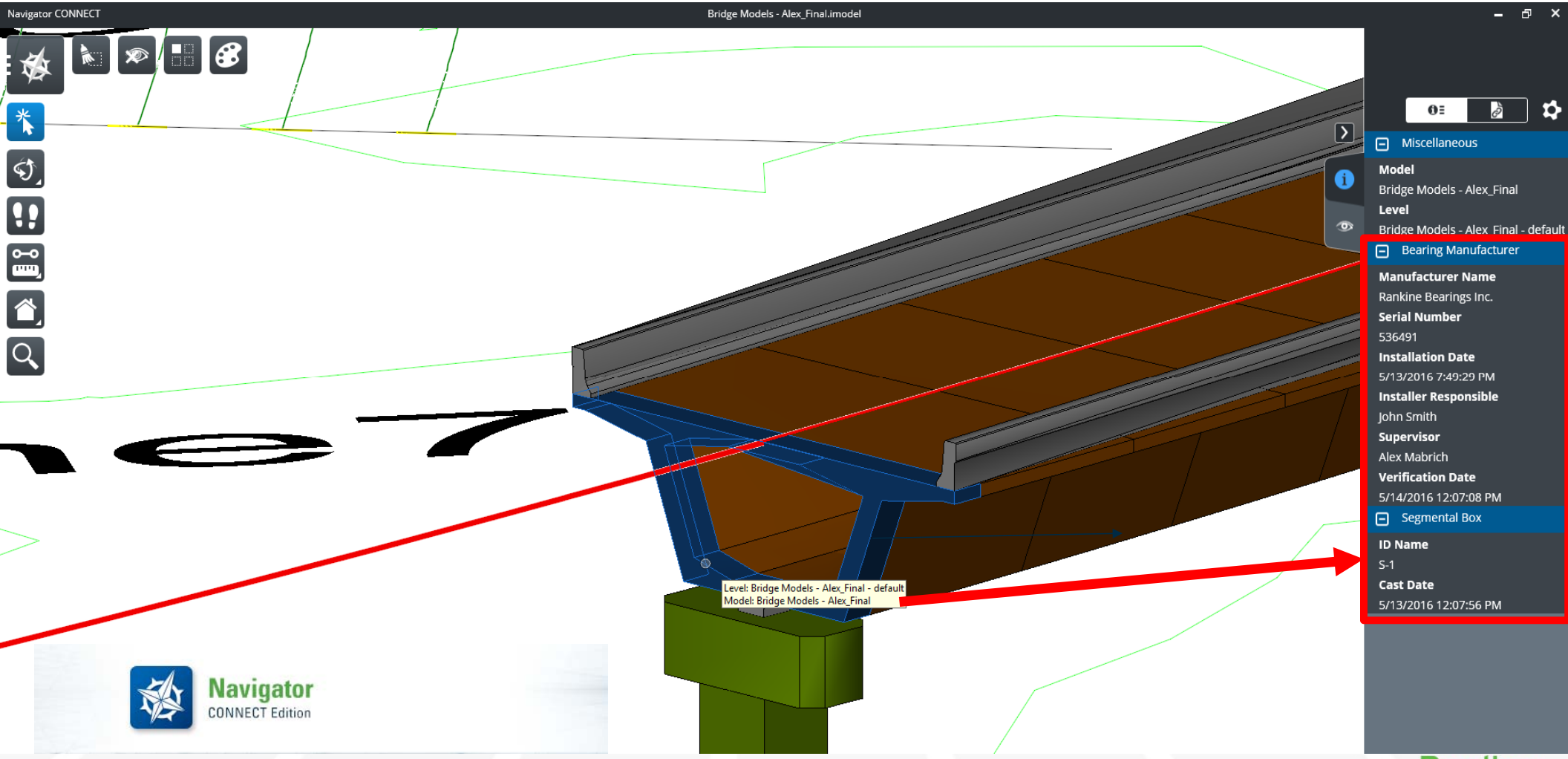
Intelligent Model in Construction



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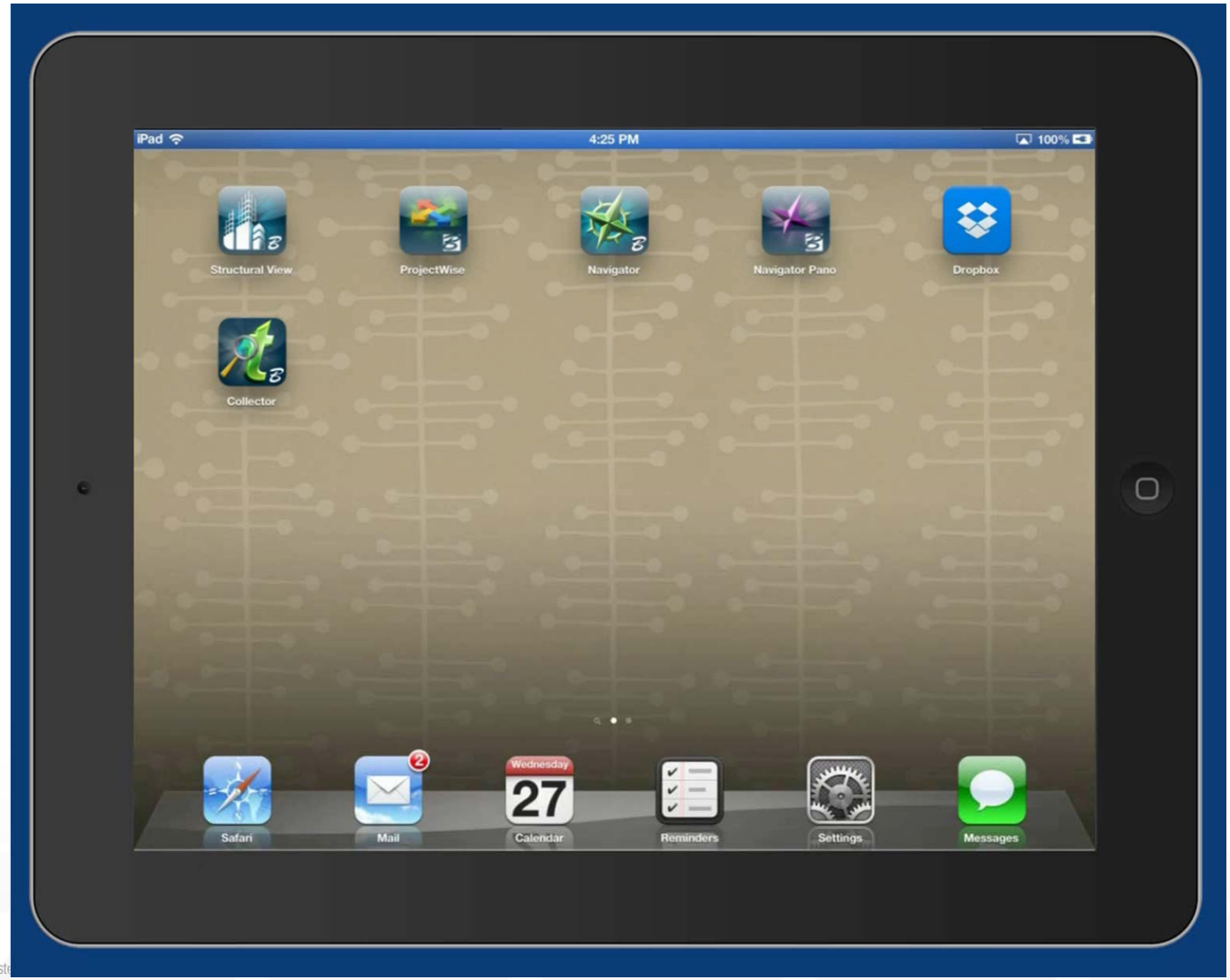
Mobile Inspection



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Summary

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Summary

1. The model is not just a 3D model…it is an intelligent 3D model.

2. Use in all phases of the project, from design to construction to asset management.

3. Accurate modeling allows:
   a. Clearance Verification
   b. Geometry and quantity reports
   c. Schedule and construction planning
   d. Add extra intelligence to elements
   e. Reports on the model

4. Ecosystem of Bentley solutions…which we already know and use every day.

Thank You !

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