



Putting the Pieces Together – Creating Composite Models in OpenRoads

Presented by: Ian Rosam

Why do we need composite models ?

Once the design/engineering modeling is complete, there is still much more to be done.

This presentation covers the fundamental controls behind the creation of the model and how to share the downstream to for export machine-control or machine-guidance and create other engineering and construction deliverables such as i-Models.



Agenda

- Controlling the Model
 - Design Stages
- Creating and Exporting Surfaces for Machine Control
 - Using Design Stages
 - Using Alternate Surfaces
 - Manually
- Volumes
- i-Models



Design Stages

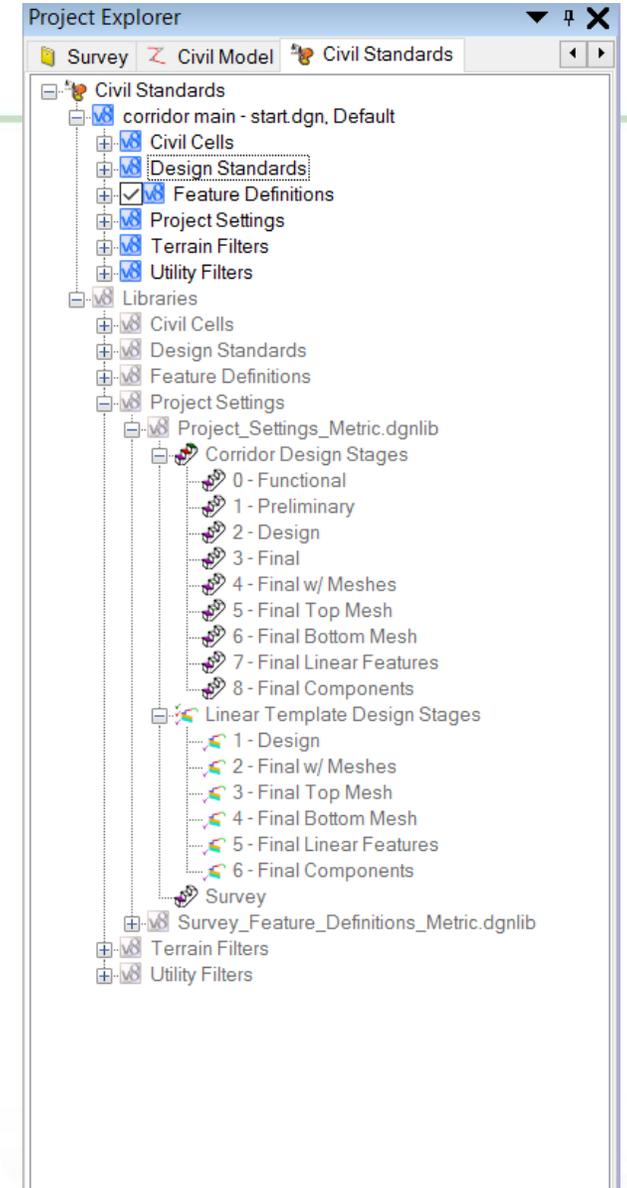
When you create a model, the properties of that model are controlled through the use of **Design Stages**. These **Design Stages** control such things as the following:

- Template Drop Interval
- Inclusion/Exclusion of Critical Sections
- Densification of Horizontal/Vertical Curves
- Look and Feel of the Corridor Element Handlers
- Mesh and Linear Feature Creation

Design Stages

Because these **Design Stages** are so important to creating the deliverable model, it is of course equally important that we understand these settings.

In this presentation, we'll look at the **Design Stages** that are delivered with the *Bentley-Civil* workspaces.



Project Settings

Standard *Design Stages* are stored in DGN Libraries in the workspace and the location is controlled by

CIVIL_PROJECTSETTINGSDGNLIBLIST

Design Stages are located as follows:

Project Explorer

> ***Civil Standards***

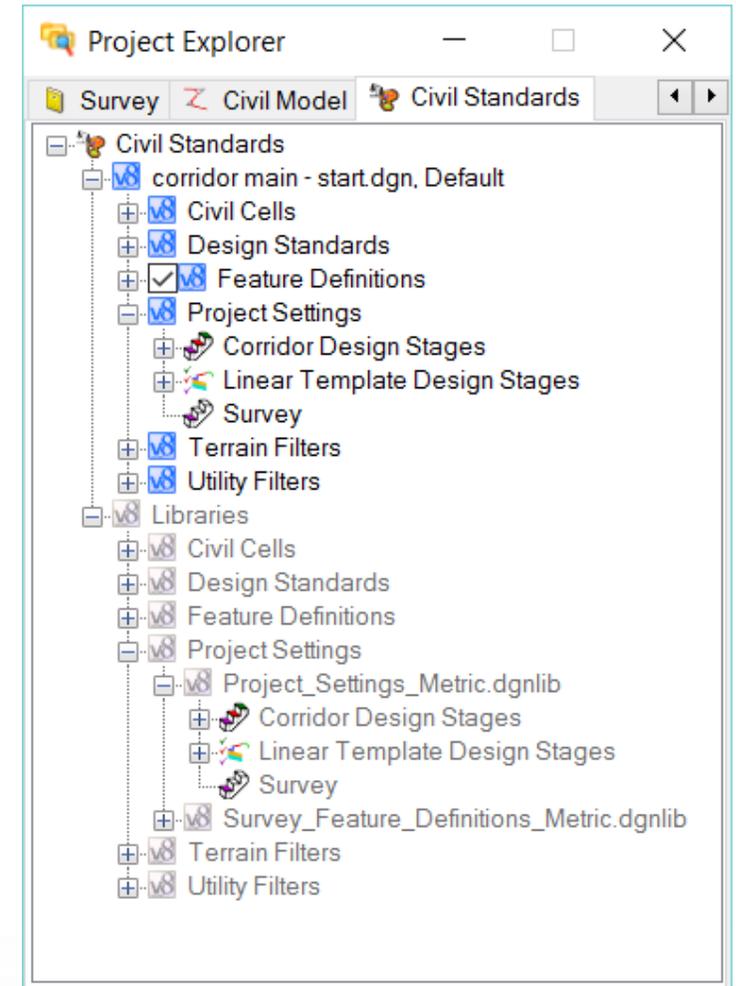
> ***Project Settings***

There are three categories:

Corridor

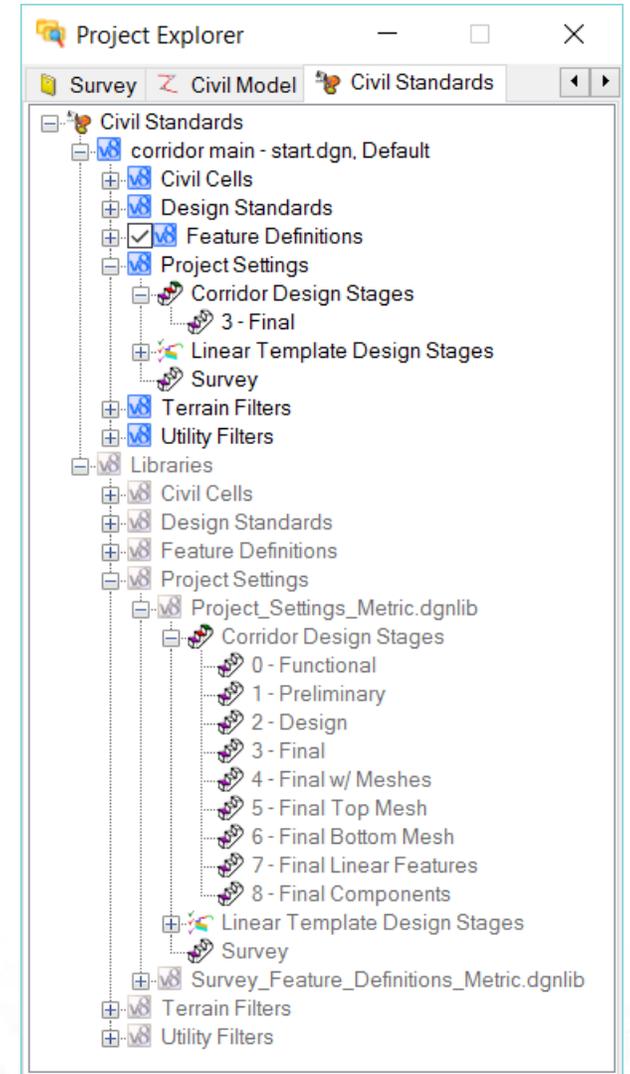
Linear Template

Survey



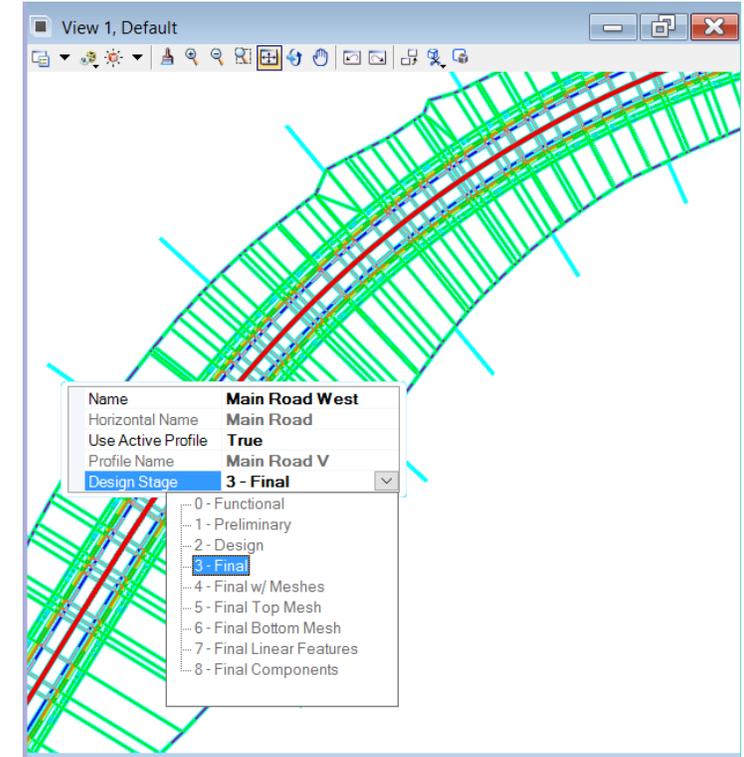
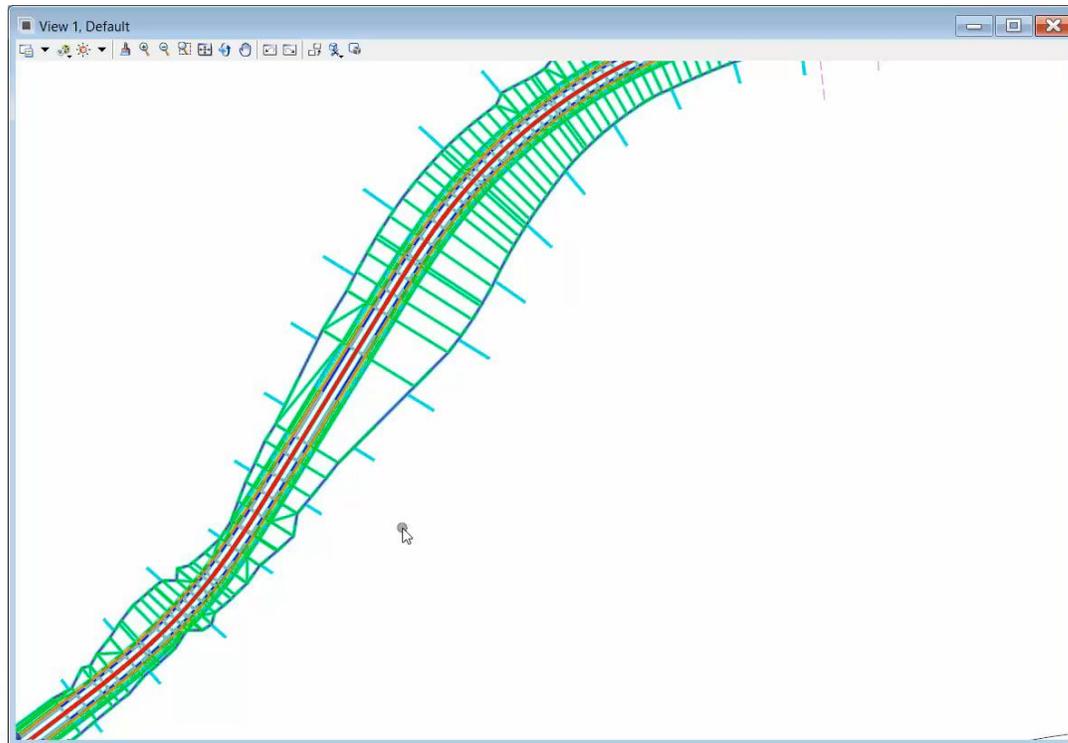
Design Stages

As **Design Stages** are used they are copied from the workspace library they are delivered in locally so they can be created, copied, modified or deleted from the 'right-click' menu.



Design Stages

Design Stages can be changed 'live' from the 'right-click' menu to change the state of the model and control the model output.



Corridor Design Stages - Properties

Corridor Design Stage.

- *Template Management*
- *Include Critical Sections*
- *Display Settings*
- *Output Settings*

Element Information

Selection
3 - Final

General

Extended

Template Management

Template Drop Interval Multiplier	1
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Include Critical Sections

Horizontal Cardinal Points	True
Vertical Cardinal Points	True
External Control Points	True
Densify Horizontal Curves	True
Densify Vertical Curves	True

Display Settings

Corridor - Element Template	Corridor Graphics\3 - Final\Corridor C
Corridor Handle Length Factor	0.3
Corridor Handle Spacing	35
Template Drop - Element Template	Corridor Graphics\3 - Final\Template
Template Drop Handle Length Factor	0.9
Single Station Drop - Element Template	Corridor Graphics\3 - Final\Template
Single Station Handle Length Factor	0.9
Transition - Element Template	Corridor Graphics\3 - Final\Template
Transition Handle Length Factor	0.9

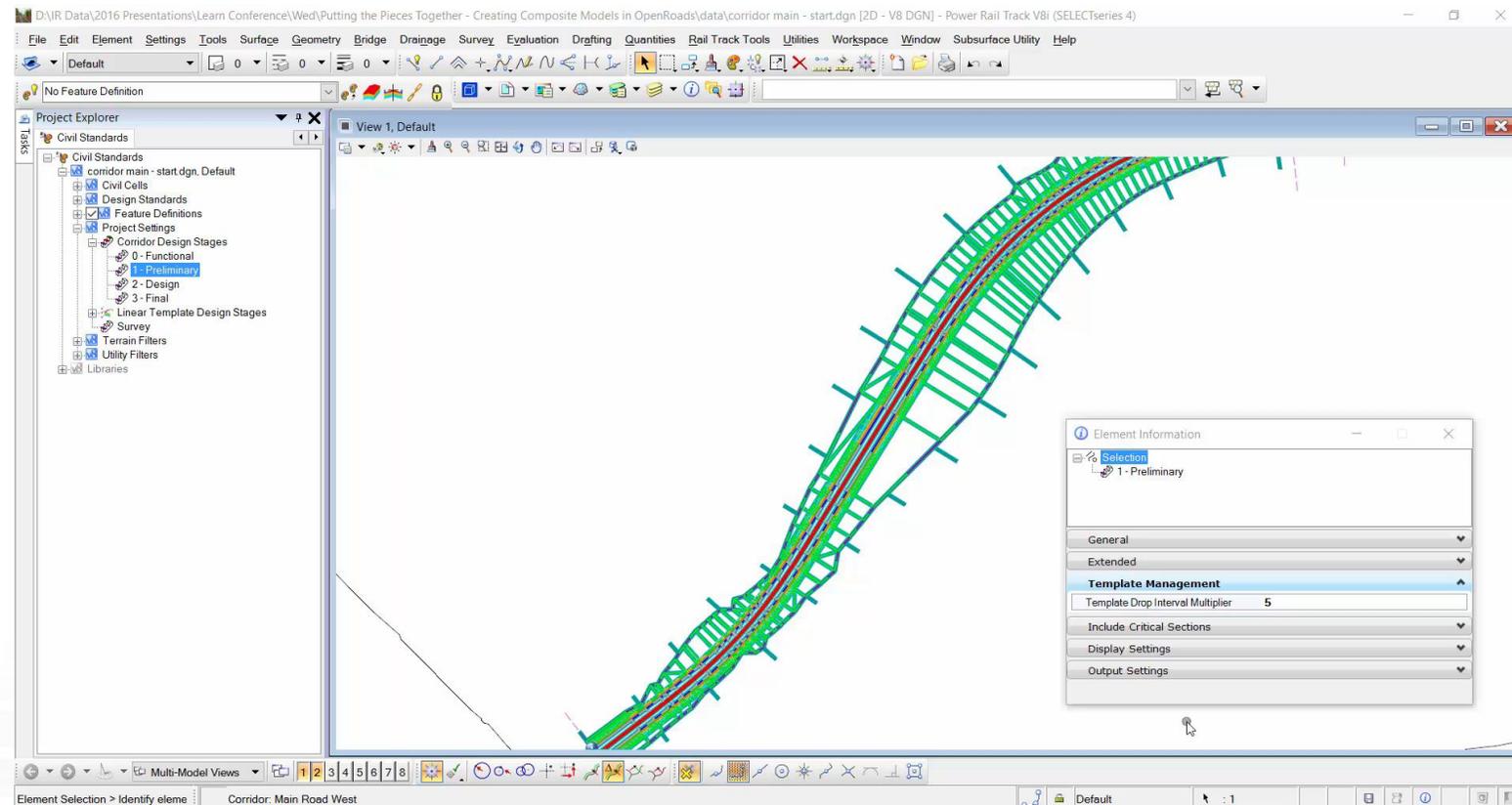
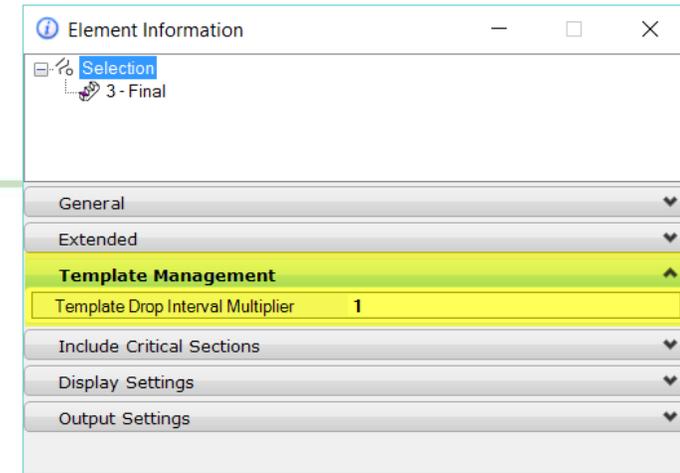
Output Settings

Create Top Mesh	False
Top Mesh Feature Definition	No Feature Definition
Create Bottom Mesh	False
Bottom Mesh Feature Definition	No Feature Definition
Create Linear Features	True
Create Component Meshes	True
Include Null Point Linear Features	False

Template Management

The *Template Drop Interval Multiplier* is used in conjunction with the interval specified when the template drop was created.

Its purpose is to enable designers to use larger intervals for preliminary work where quick processing is required and reduced accuracy is acceptable. As the design progresses alternative design stages can be applied down to a 1:1



Include Critical Sections

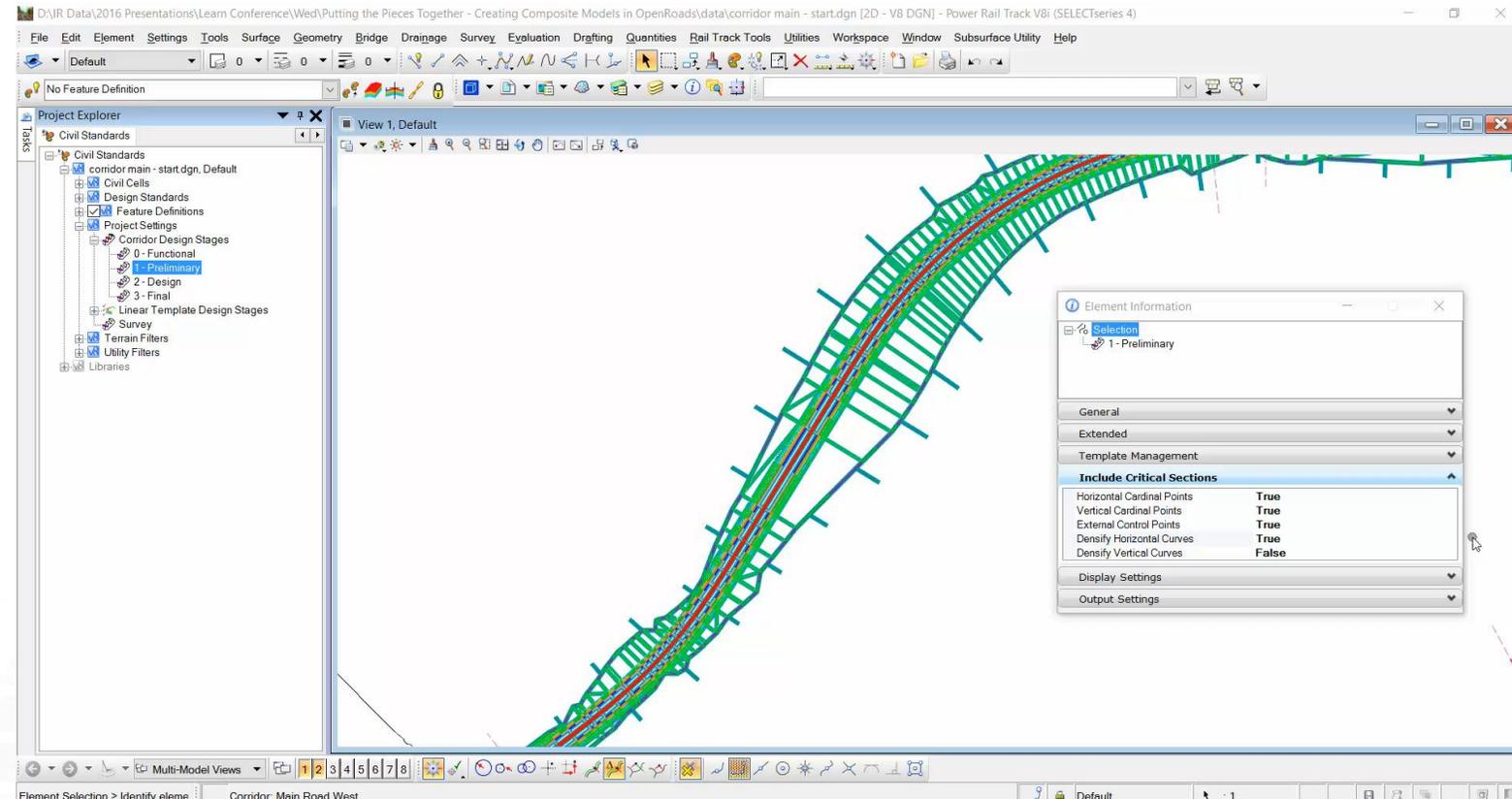
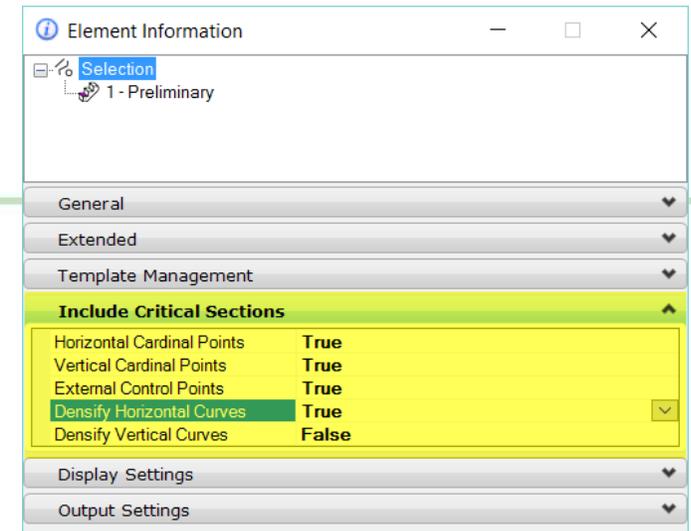
This essentially controls accuracy of the model by allowing the inclusion/exclusion of critical points from the design stage, as well as the densification of horizontal and vertical curves.

When working in a preliminary mode, densification may not be required

Note: chording values are controlled by the following configuration variables

Civil_Default_Curve_Stroking (default = .01)

Civil_Default_Profile_Stroking (default = .1)



Display Settings

The **Display Settings** options allow for the control of the grip handlers that are created with the corridor.

Setting	Value
Corridor - Element Template	Corridor Graphics\1 - Preliminary\Cor
Corridor Handle Length Factor	0.3
Corridor Handle Spacing	35
Template Drop - Element Template	Corridor Graphics\1 - Preliminary\Ten
Template Drop Handle Length Factor	0.9
Single Station Drop - Element Template	Corridor Graphics\1 - Preliminary\Ten
Single Station Handle Length Factor	0.9
Transition - Element Template	Corridor Graphics\1 - Preliminary\Ten
Transition Handle Length Factor	0.9

Note. Element Templates utilize construction class to hide these design aids

Element Selection > Identify eleme | Corridor: Main Road West

Output Settings

These properties are a simple True/False, which determines whether they are drawn or not.

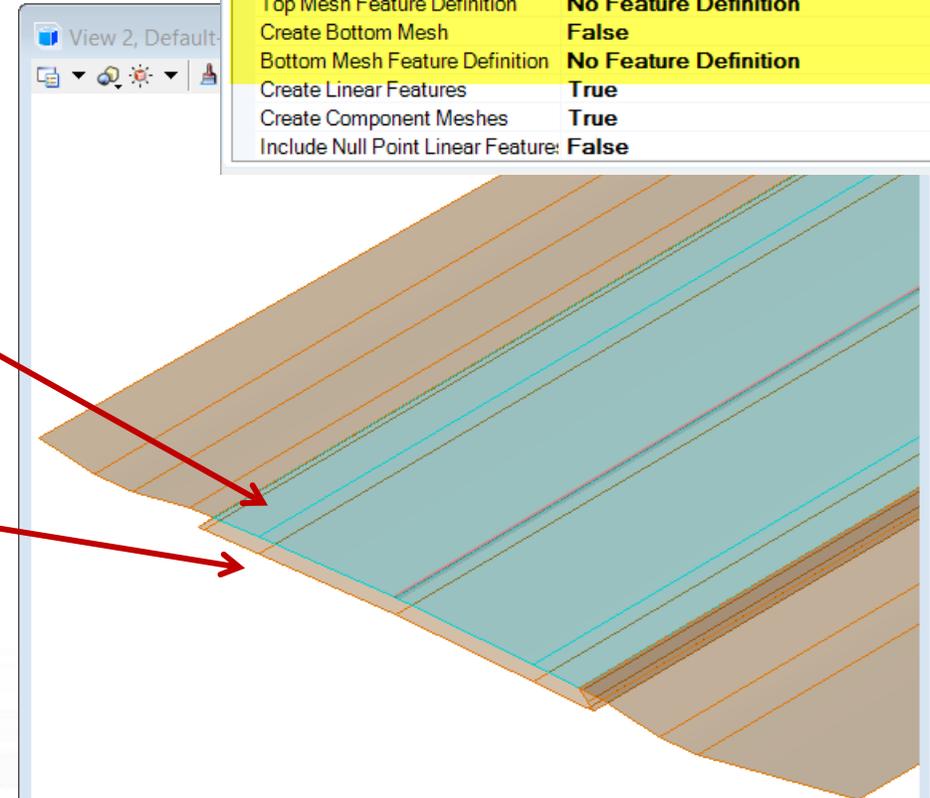
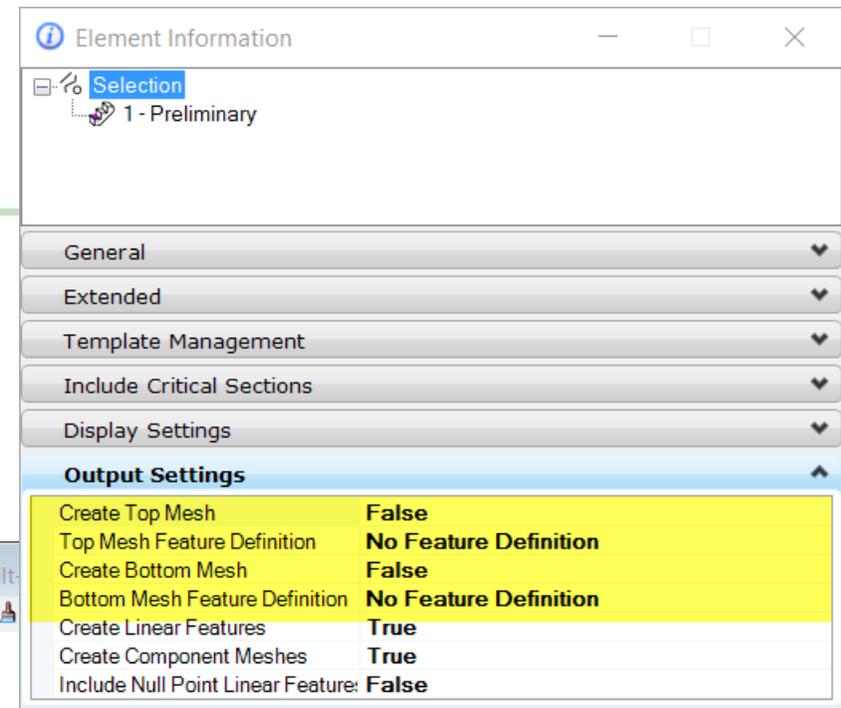
- **Create Top Mesh**

- *Creates a single mesh element by tracing the 'top' of the model.*

- **Create Bottom Mesh**

- *Creates a single mesh element by tracing the 'bottom' of the model.*

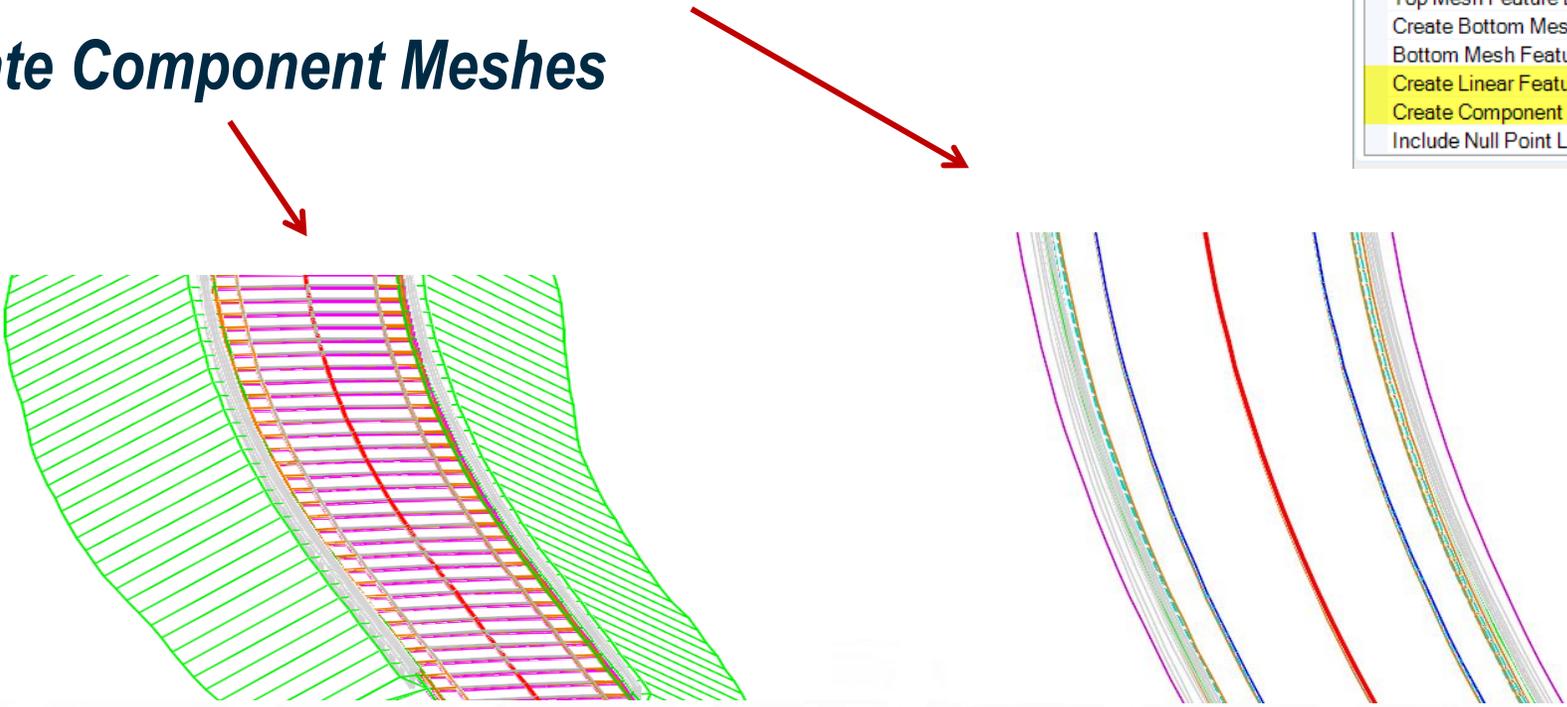
Note. From SELECTseries4 MR1 the top / bottom mesh are always created and retained with the model and the True/False is for display management



Output Settings

These properties are a simple True/False, which determines whether they are drawn or not.

- **Create Linear Features**
- **Create Component Meshes**



Element Information

Selection
1 - Preliminary

General

Extended

Template Management

Include Critical Sections

Display Settings

Output Settings

Create Top Mesh	False
Top Mesh Feature Definition	No Feature Definition
Create Bottom Mesh	False
Bottom Mesh Feature Definition	No Feature Definition
Create Linear Features	True
Create Component Meshes	True
Include Null Point Linear Feature:	False

Output Settings

The screenshot displays the Bentley OpenRoads software interface. The title bar shows the file path: D:\IR Data\2016 Presentations\Learn Conference\Wed\Putting the Pieces Together - Creating Composite Models in OpenRoads\data\corridor main - start.dgn [3D - V8 DGN] - Power Rail Track V8i (SELECTseries 4). The menu bar includes File, Edit, Element, Settings, Tools, Surface, Geometry, Bridge, Drainage, Survey, Evaluation, Drafting, Quantities, Rail Track Tools, Utilities, Workspace, Window, Subsurface Utility, and Help. The toolbar contains various icons for navigation and editing.

Project Explorer: Shows a tree view of project elements. Under "Corridor Design Stages", "1 - Preliminary" is selected.

Element Information: Shows the "Output Settings" for the selected element:

- Create Top Mesh: **False**
- Top Mesh Feature Definiti: **No Feature Definition**
- Create Bottom Mesh: **False**
- Bottom Mesh Feature Def: **No Feature Definition**
- Create Linear Features: **True**
- Create Component Mesh: **True**
- Include Null Point Linear F: **False**

View 1, Default: A 2D wireframe view of the corridor design, showing multiple parallel lines in green, red, and blue.

View 2, Default-3D: A 3D perspective view of the corridor design, showing the terrain surface in green and the corridor structure in grey and red.

Linear Template Design Stages

Linear Templates are a subset of a full corridor. They are intended for detailing not bulk modeling and draw directly on the element stroking.

The Design Stage properties for a Linear Template **do not include template drop multipliers or Include Critical Sections options** and only provide controls for:

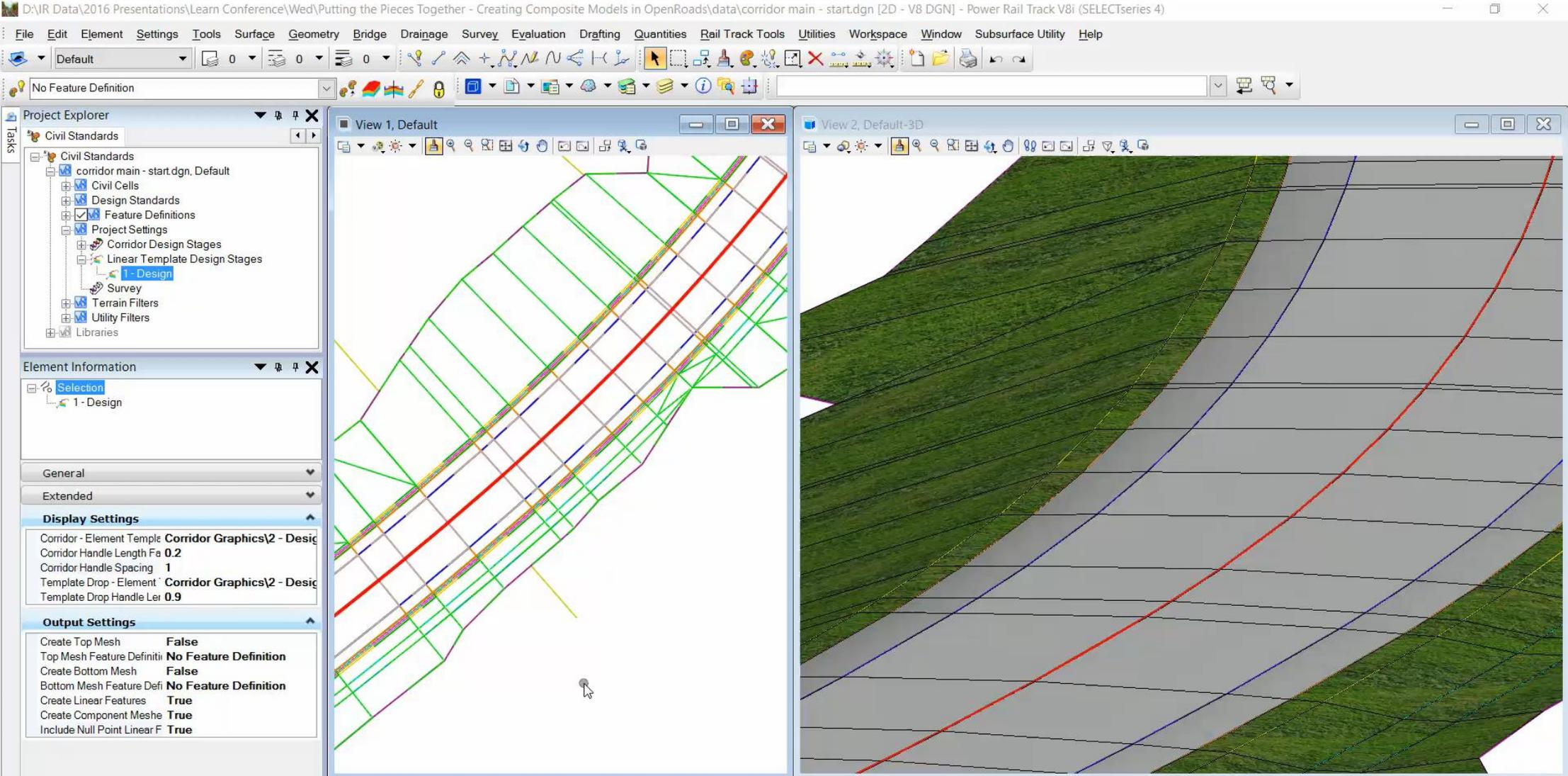
- *Display Settings*
- *Output Settings*

The screenshot displays the 'Civil Standards' software interface. The top panel shows a tree view of design standards, with '1 - Design' selected under 'Linear Template Design Stages'. The bottom panel, titled 'Element Information', shows the 'Selection' of '1 - Design' and provides configuration options for 'Display Settings' and 'Output Settings'.

Display Settings	
Corridor - Element Temple	Corridor Graphics\2 - Design
Corridor Handle Length Fa	0.2
Corridor Handle Spacing	1
Template Drop - Element	Corridor Graphics\2 - Design
Template Drop Handle Ler	0.9

Output Settings	
Create Top Mesh	False
Top Mesh Feature Definition	No Feature Definition
Create Bottom Mesh	False
Bottom Mesh Feature Definition	No Feature Definition
Create Linear Features	True
Create Component Meshes	True
Include Null Point Linear F	True

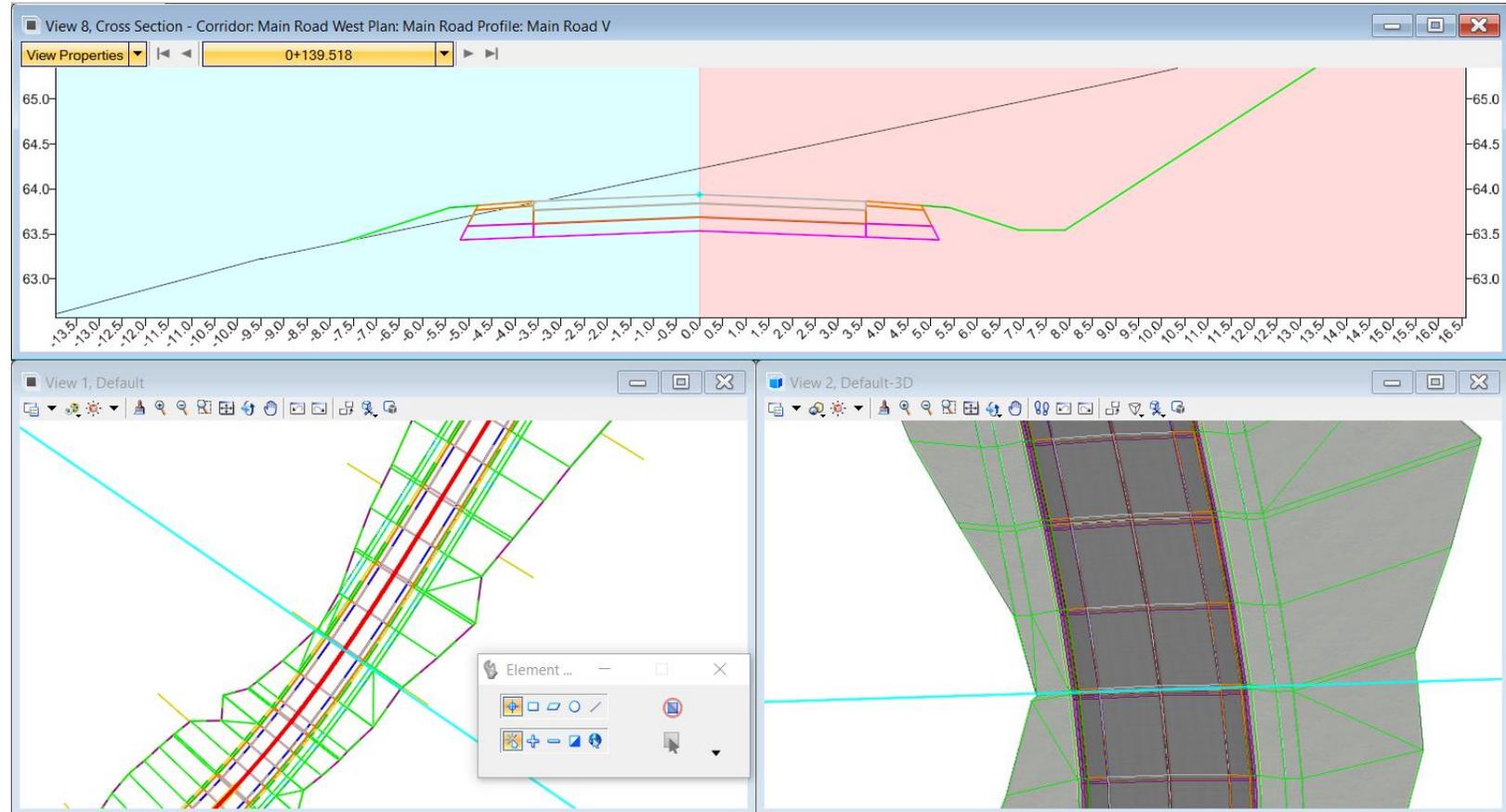
Linear Template



Pavement Layer Surfaces

We've seen how top and bottom meshes can be created as a resultant of Design Stages for the corridor model and how terrains can be subsequently created.

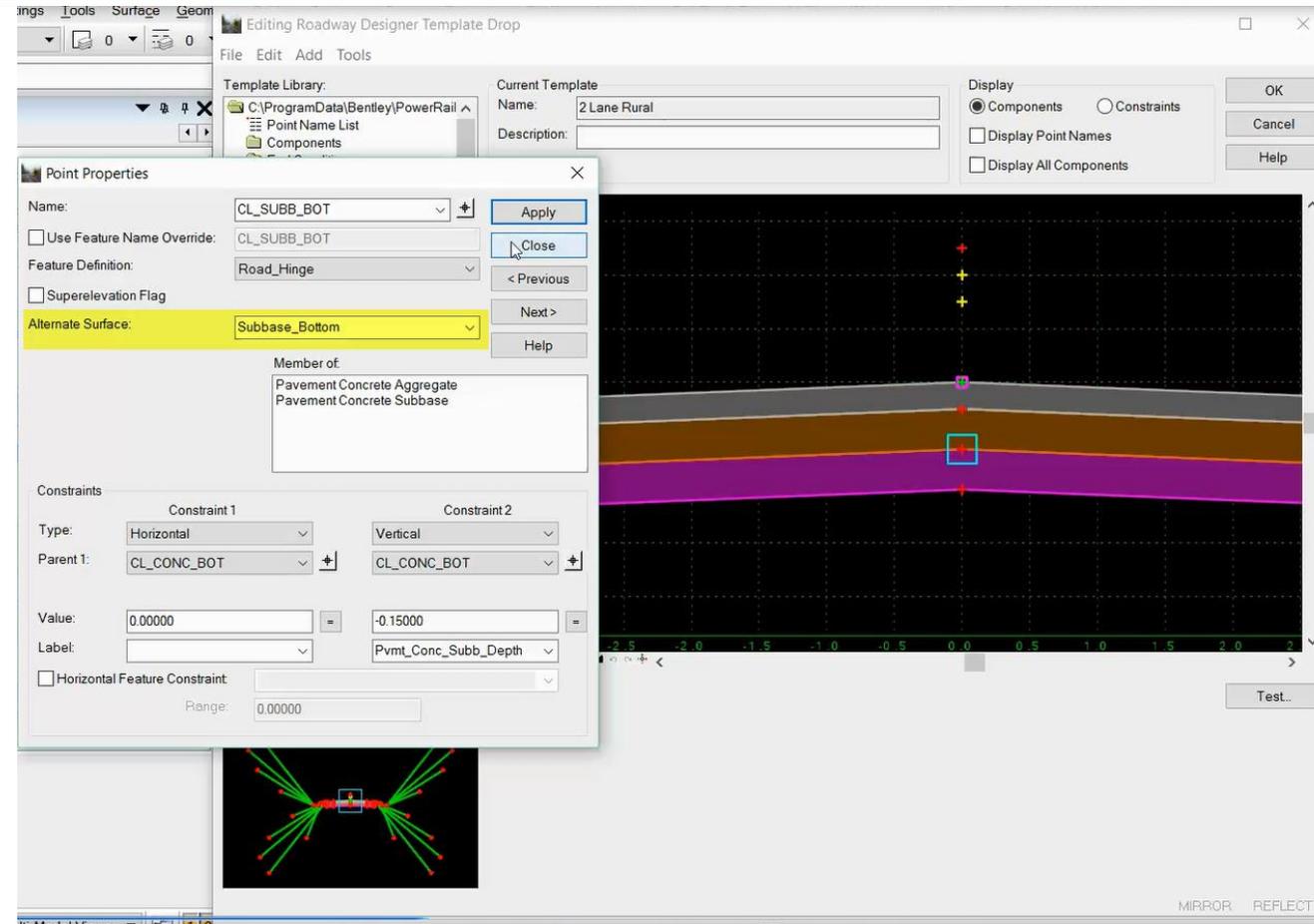
But how can other pavement layers be created as surfaces for export ?



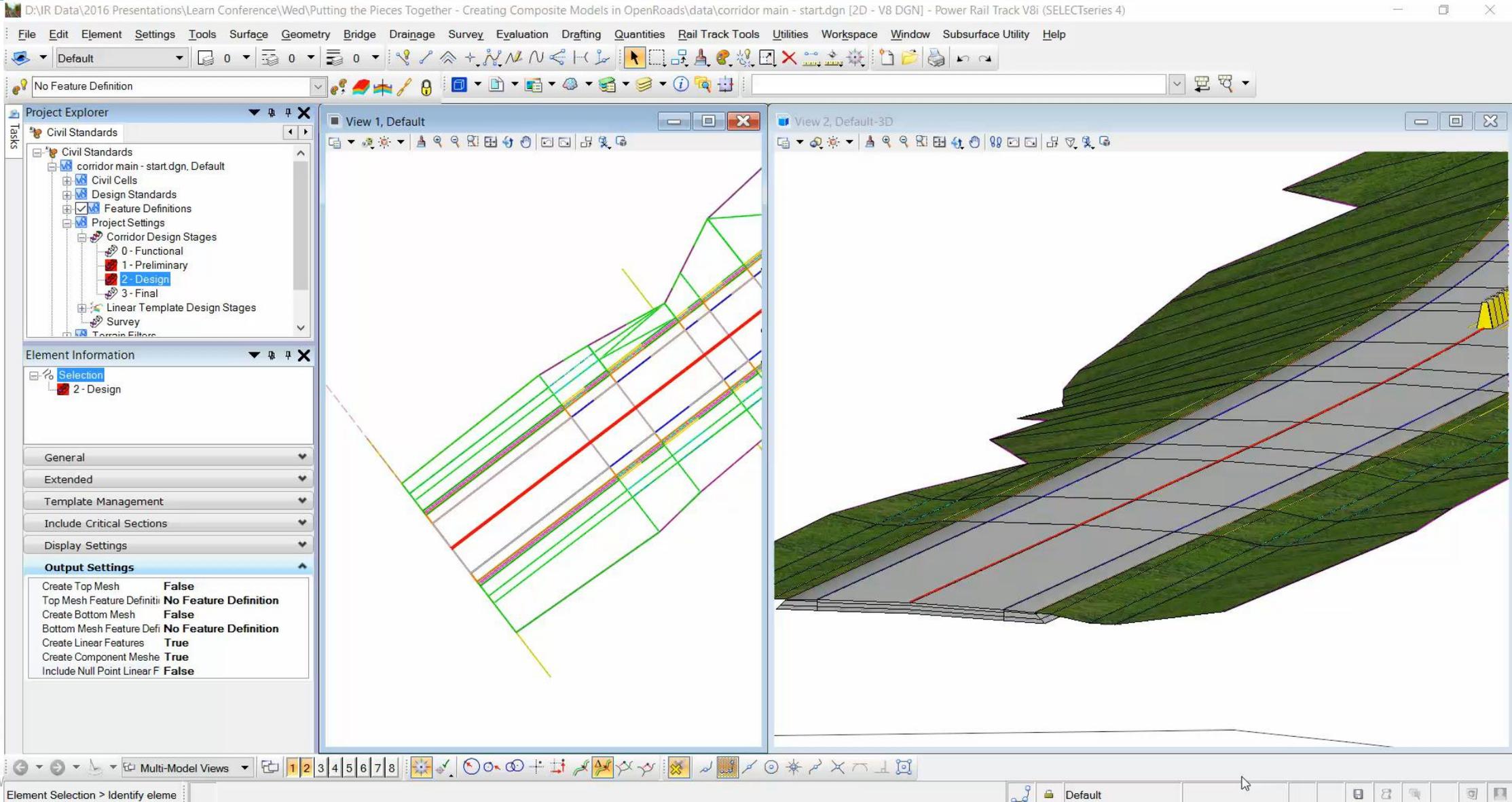
Using Alternate Surfaces

If the entire top or bottom corridor meshes are not required or only in part, then another method for creating terrain for the desired layer is **Alternate Surfaces**.

Alternate Surfaces are defined by the template, then created from the model through the use of the **Create Corridor Alternate Surfaces** application.



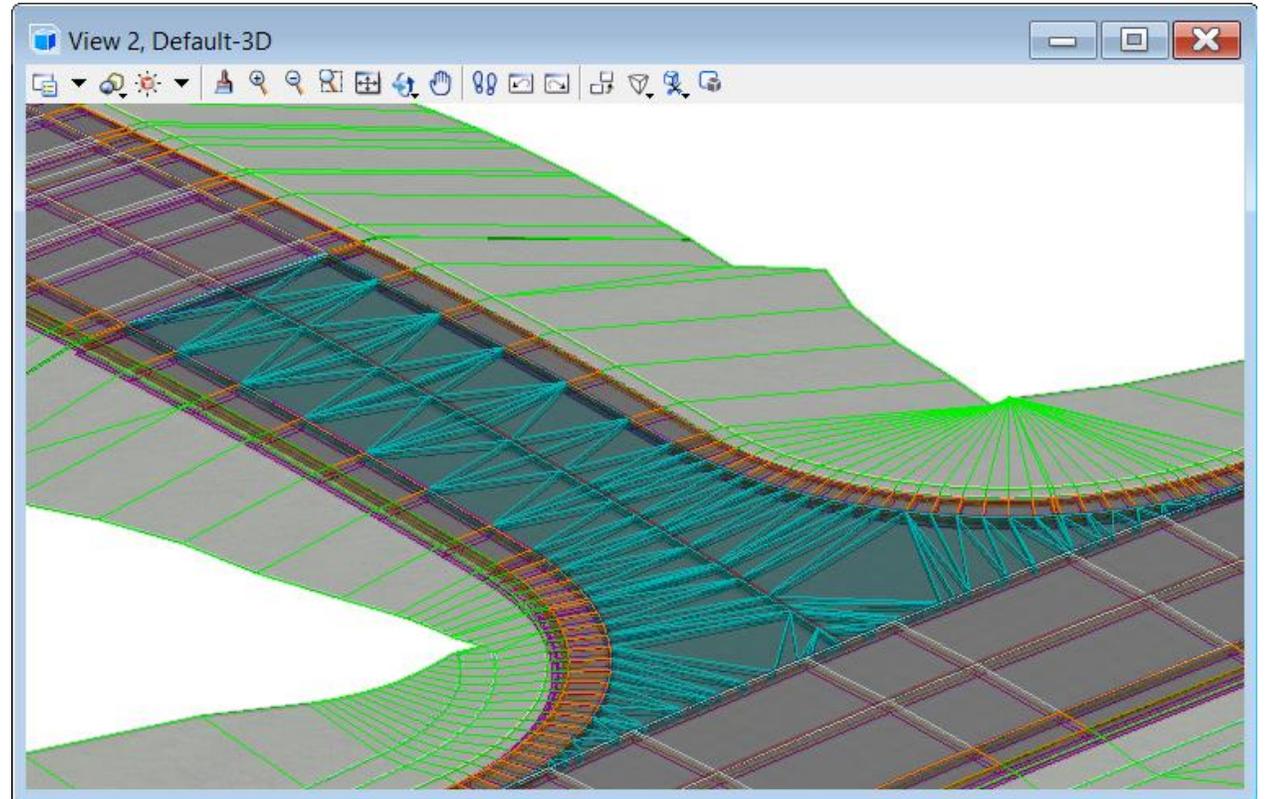
Alternate Surfaces



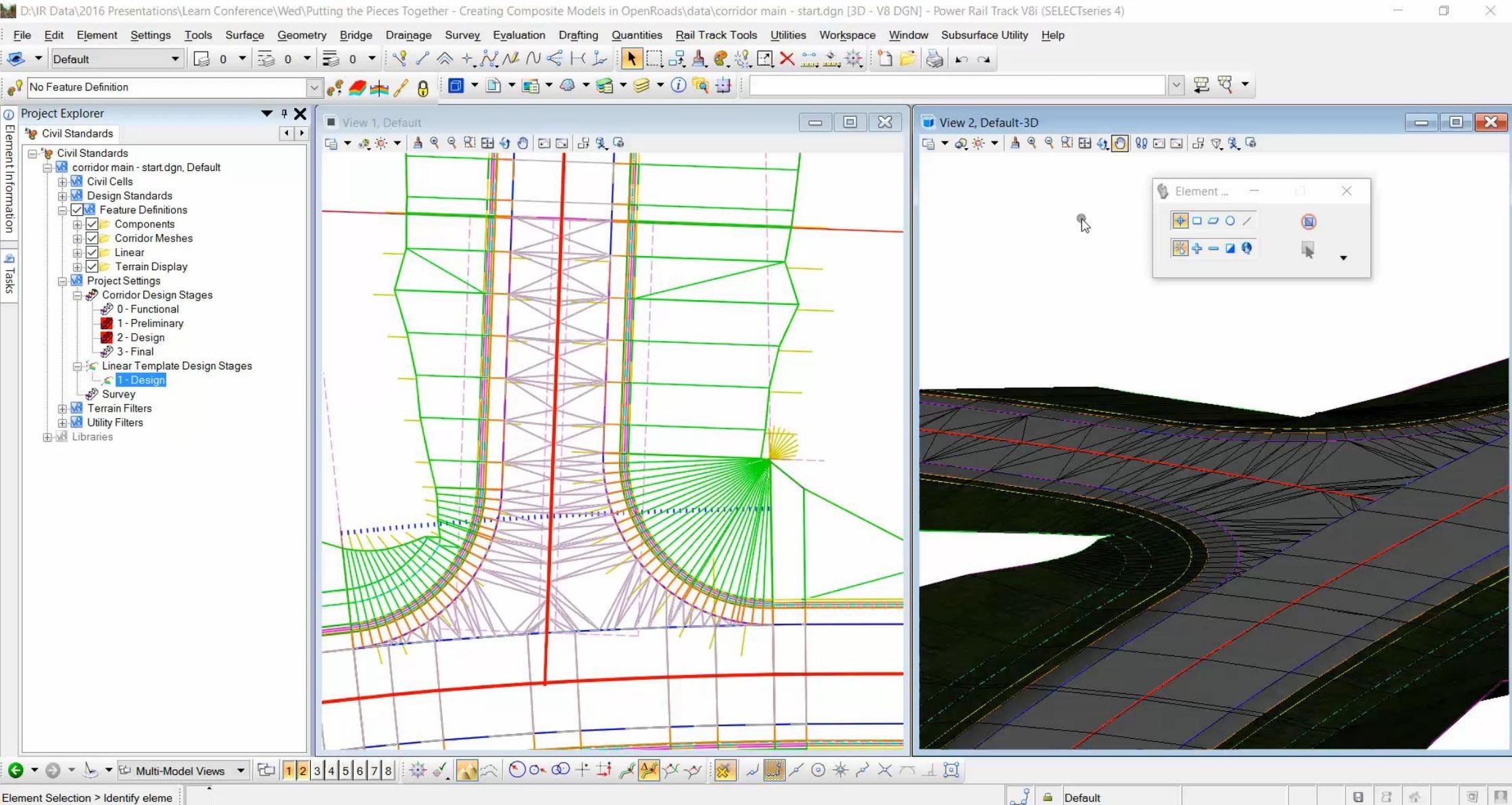
Area Templates

Area Templates are commonly used in Civil Cells but do not have any design stages associated to them.

So how can we create sub surfaces for these complex and detailed areas ?



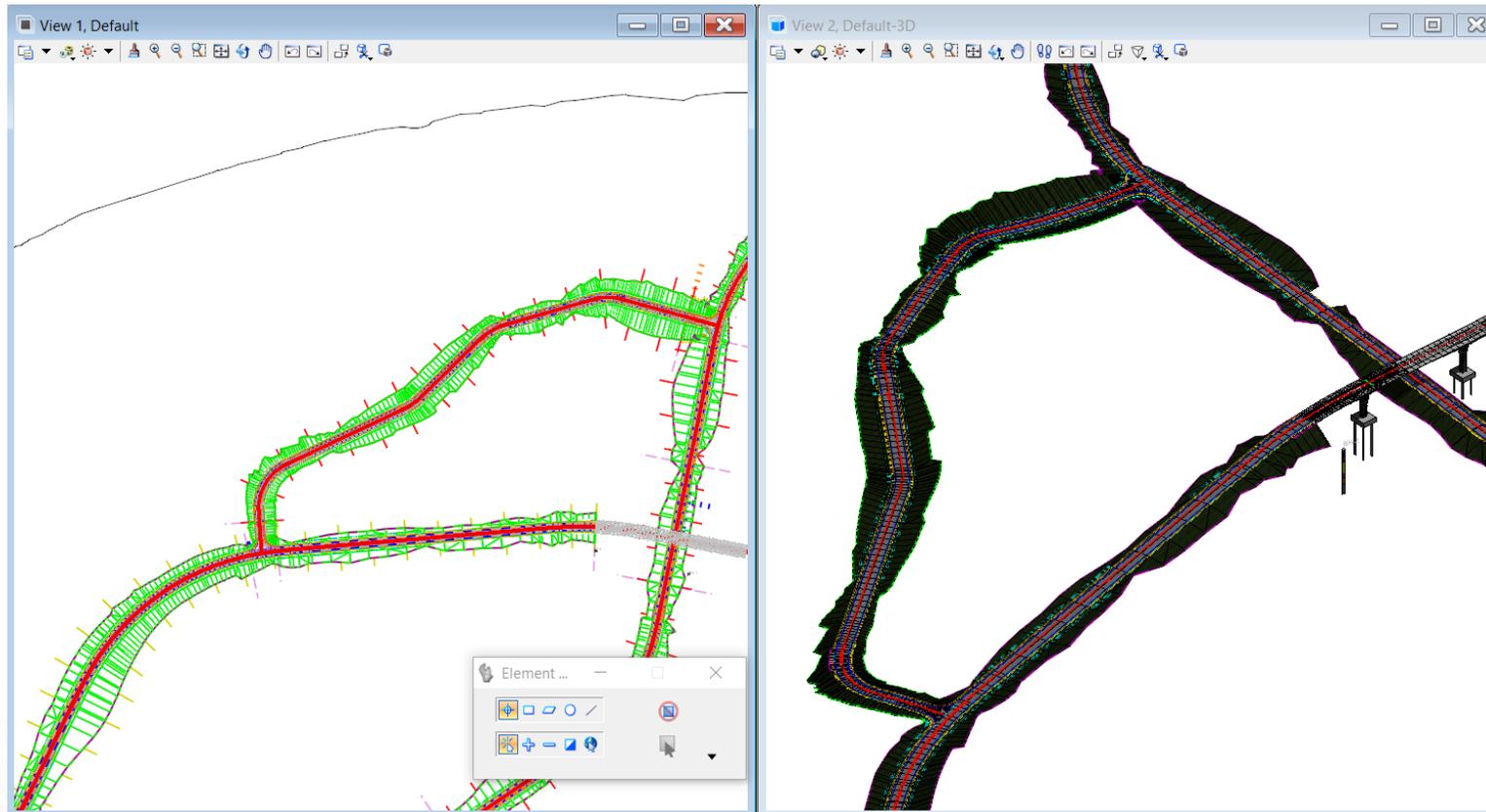
Area Template



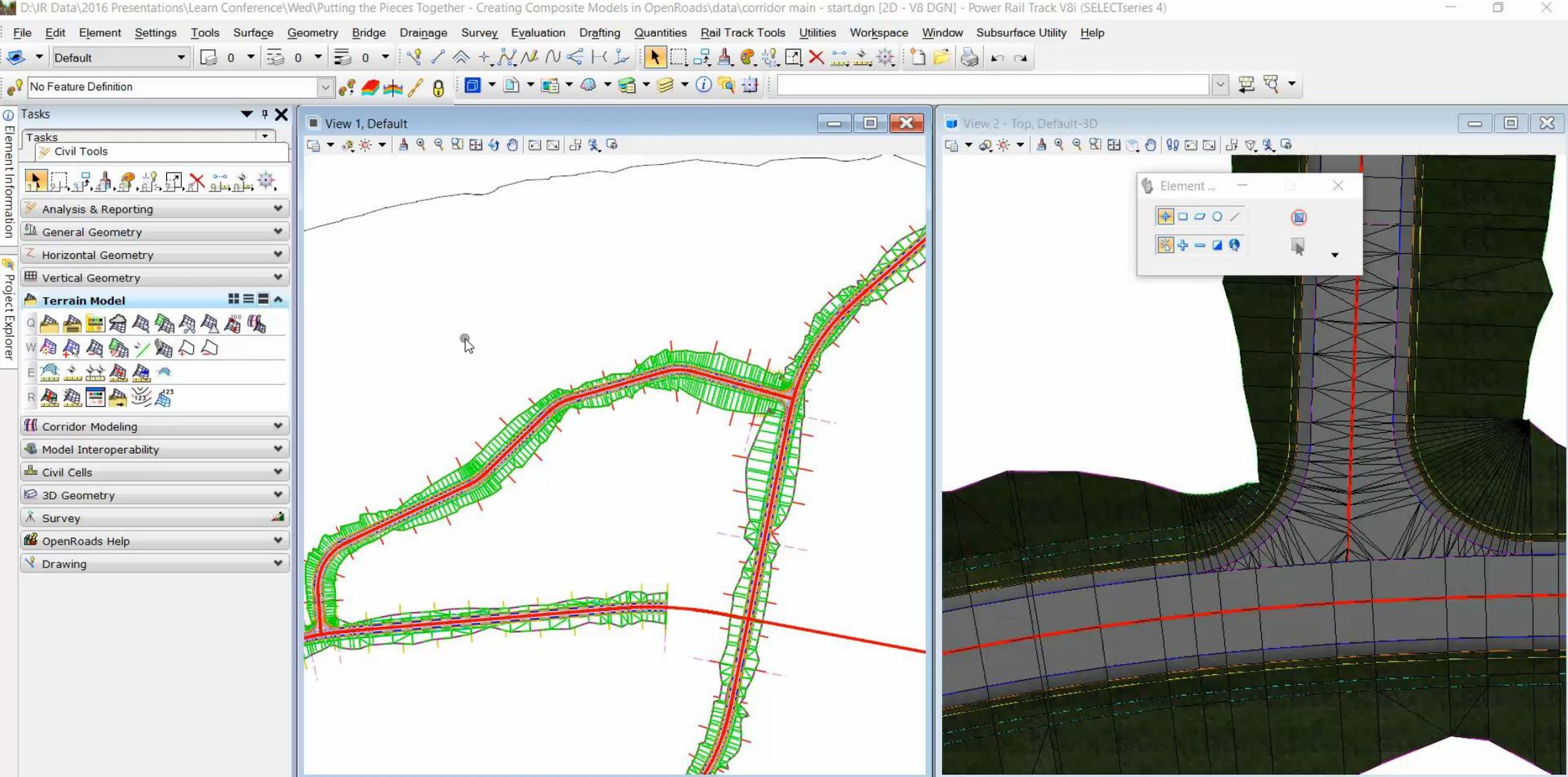
Creating Complex Terrains

So far we've looked at individual objects – corridors/linear templates/area templates

How can top or bottom surface terrains be created for more complex situations with multiple objects?



Graphical Filters



Graphical Filters – Best practice

Create and store graphical filters as part of the workspace for your templates.

Utilise boundary should help prevent sprawling terrains where standard trimming methods may not always work.

Graphical filters work over references and so turning the reference off helps constrain the area.

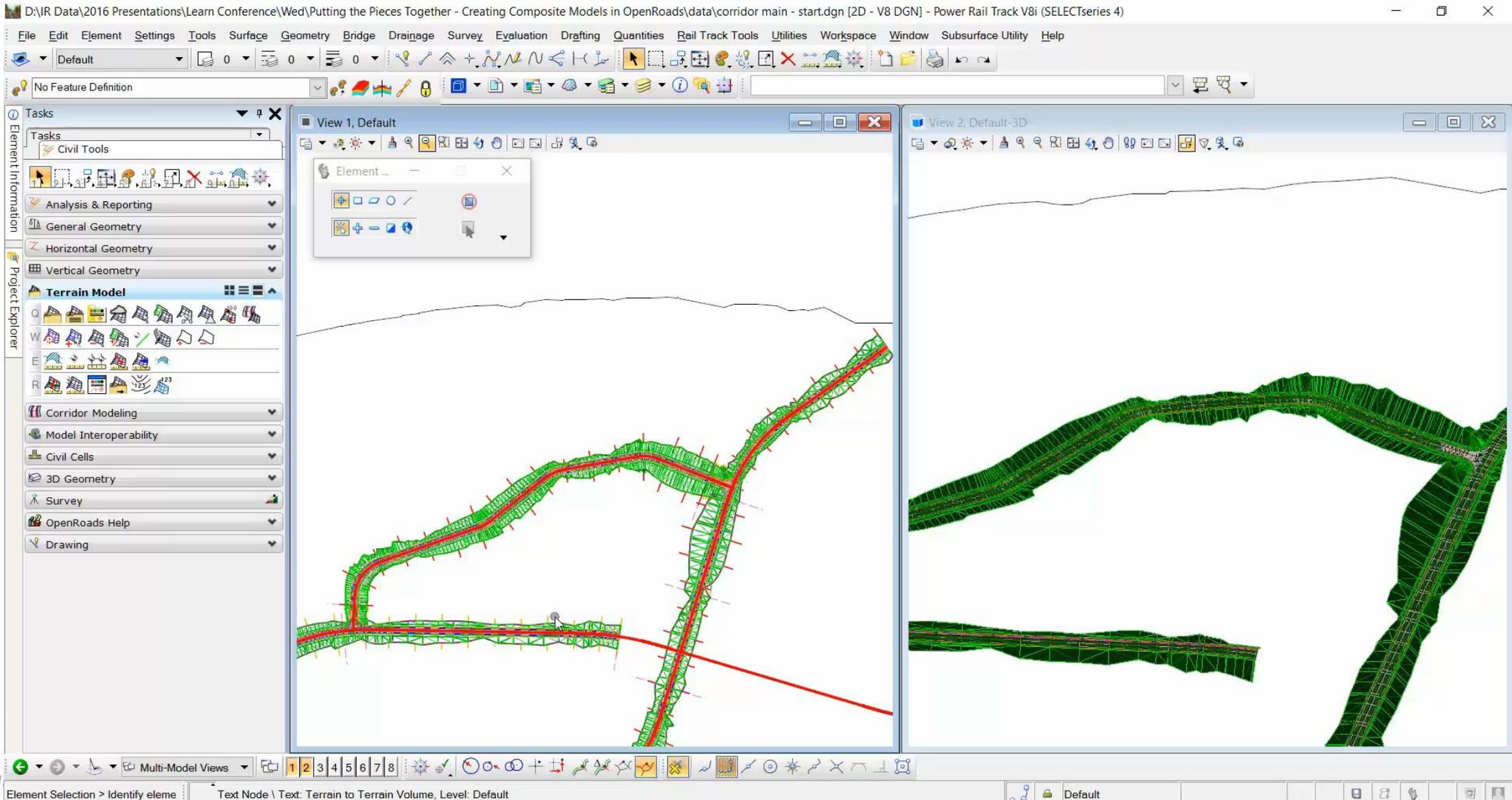
Graphical filters work with the Fence command to help constrain the area.

Volume Extraction from the model

Traditionally we have used End Area Volumes to extract volumetric information.

With the data rich model we have several methods of extracting volumes, between terrain models, from component meshes.

Volume Extraction from the model



Volume Extraction from the model

Corridor Component Quantities – provides single corridor report but does not take account of clipping in the model.

Element Component Quantities – extracts the mesh volumes for all selected civil objects and provides detailed and summary reports. Note dropped Civil Cells require all constituent parts to be selected. #

Volume between Terrains – requires a composite top surface model to be created and the results can be stored as graphics #

Create Cut/Fill volumes – creates mesh between terrains

```
Terrain to Terrain Volume  
Terrain Composite surface To Terrain GROUND  
Cut Factor = 1.00000  
Fill Factor = 1.00000  
Cut = 57890.39474 m3  
Fill = 156084.85909 m3  
Balance = 98194.46435 m3
```

Preferred



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