Civil Cells
Best Practice – Lesson Learned

Presented by Todd Holt – Senior Consultant I (Civil)
Bentley Systems

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Agenda

- What is a Civil Cell
- Basic Civil Cell Creation
- Civil Cell Workflow
- Best Practices and Limitations
- Considerations for creating a civil cells

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What is a Civil Cell

Ruled Horizontal & Vertical Geometry, Terrains, and Surface/Linear Templates that are grouped into one element.

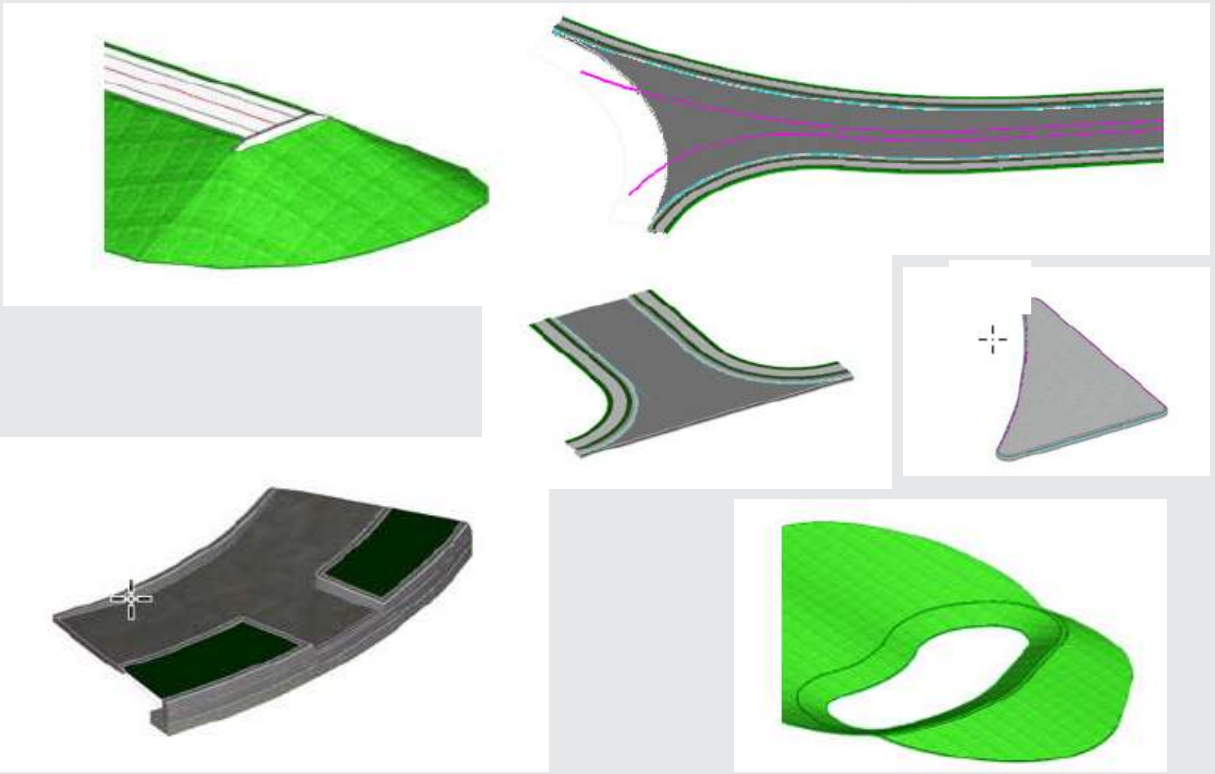
They are built on geometry references and can be placed on different geometry references. (i.e., Build on a line, place on a curve)

Benefits

- Rapid Placement of geometry & modeling and then geometry and template edits to match project/site specific criteria.

Examples

- Intersections, Driveways, Curb Ramps, Roundabouts, Islands, Median Items, Bridge Abutments, Ponds, etc.



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Basic Civil Cell Creation

The creation of civil cells depends solely on understanding, evaluating, and constructing the proper relationships between the elements which you desire to be included within the civil cell. Creating civil cells can be described as programming elements with the proper rules, relationships, and constraints so that they respond and adjust appropriately when placed in varying configurations and design scenarios.

We are programing the elements to interact with one another in a defined, consistent, yet flexible manner. This means that some for-thought must be given to the desired results and the methods that will be used to create the civil cell.

Also, it's important to realize that a trial-and-error approach must be used to validate the “code” embedded within each element at regular intervals throughout the creation process. Think of civil cells as "graphical macros" in which you code how the elements respond to references.

Basic Civil Cell Creation Workflow

The basic steps to create a civil cell are:

1. Determine and then draw reference elements. (Reference Geometry)
    - Consider direction
    - Be consistent
    - Reference elements cannot be dependent on each other.
    - Try to use at least one element with a Radius
2. Define the Dependent Geometry
    - Children of the reference geometry
    - Using the Geometry tools (Horizontal and Vertical)(Snaps) This is the code writing or rule building step
3. Validate the Rules
    - Make checks regularly
    - Involves trial and error

Basics of Civil Cell Creation

Validate the Dependent Geometry

The most important thing to realize here is that we are building a relationship between the elements and the references. This relationship has two fundamental parts:

- The hierarchical relationship between the elements (the parent/child relationship) AND
- The rules (or constraints) that govern the interaction between the parent and child elements.

However, in addition to these two fundamental principles, we must also consider a third component of the elemental relationship when creating civil cells.

It is imperative to evaluate whether the child elements are fully constrained (or ruled) to the parent element. When creating a civil cell, the elements must have enough constraints (or rules) back to the parent, so that the relationship between them can be fully resolved and stored in a civil cell.

Important Note:

It's important to verify these 3 parts of the relationship at every step as you construct a civil cell.

Best Practices & Limitations

- Default-3D model: Make sure the Default-3D model display is turned off in the Default model.
- Negative Coordinates: Do not create civil cells in negative coordinate areas in a DGN file.
- Test, Test, Test. From 1st element on. If the 1st element is not ruled correctly, the remainder will not be ruled correctly.
- The Quick Test: Test choosing the Create Civil Cell command and choosing the references to make sure elements are highlighted. Cancel the cell creation process with resets after the last ref is selected and then continue building the cell.
- Stations do not hold up in civil cells so use length in geometry commands.
- Template Geometry - If you draw an element horizontally, don't draw a template produced plan element on top of it (use a template feature that doesn't draw a plan view element if it already exists as a geometry element).
- Templates on References - You can't place a template on a reference element because the reference element is not in the cell.
- Points as References: Points can be used as references in Civil Cells if they are featured. Points are ideal for length controls, specifying an intersection location when there are multiple, and for specifying the Thru Point for an arc.
- Terrains graphics: Terrains can be created from linear template produced 2D graphics (islands).

Best Practices & Limitations - Continued

- Intervals: Intervals generally cause no issues in civil cells but test thoroughly when used. Another alternate is not to trim but place a partial offset on top of the element that would be trimmed.
- Snaps: KeyPoint, Intersection, Mid, Origin, and Perpendicular all work well in civil cells but try to use Origin Snap and Intersection Snap whenever possible.
- Civil AccuDraw: Stations do not hold up in civil cells so limit use of Civil AccuDraw in civil cells to only Delta Station Offset mode.
- Target Aliasing & Clipping do not hold up in civil cells but can be performed after placement.
- Create 3D automatically: Take advantage of this command when building civil cells. It can be used when performing an offset partial of an element that is profiled and also placing a line between two profiled elements.
- Modular Approach: Instead of building numerous versions of one massive civil cell, build cells as pieces that are meant to be used together to construct the needed configuration. This will generally reduce the total number of cells and make the cells easier for users (i.e. T-Intersections, Roundabouts, etc.)
- Consider Stroking Tolerances
- Replace Reference & Remove Trim (Access in Project Explorer on the element the element in question) may possibly be useful for problem elements.
- Remove Item types

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Prepare for Creating Civil Cells - Planning

Where do we start and what type of information to gather.

- Design Standards (Standard Plans)
  - ✓ Ask for the Standard plan to get an understanding of the geometry
  - ✓ What control do you want to build in the Civil cell
- User input
  - ✓Ask about current workflows
  - ✓What are the expectations
  - ✓Think about the user experience
- Workspace Resources
  - ✓Are the specific levels for civil cells
  - ✓Is there Element Templates, Feature Definitions, Feature Symbology
  - ✓Organization

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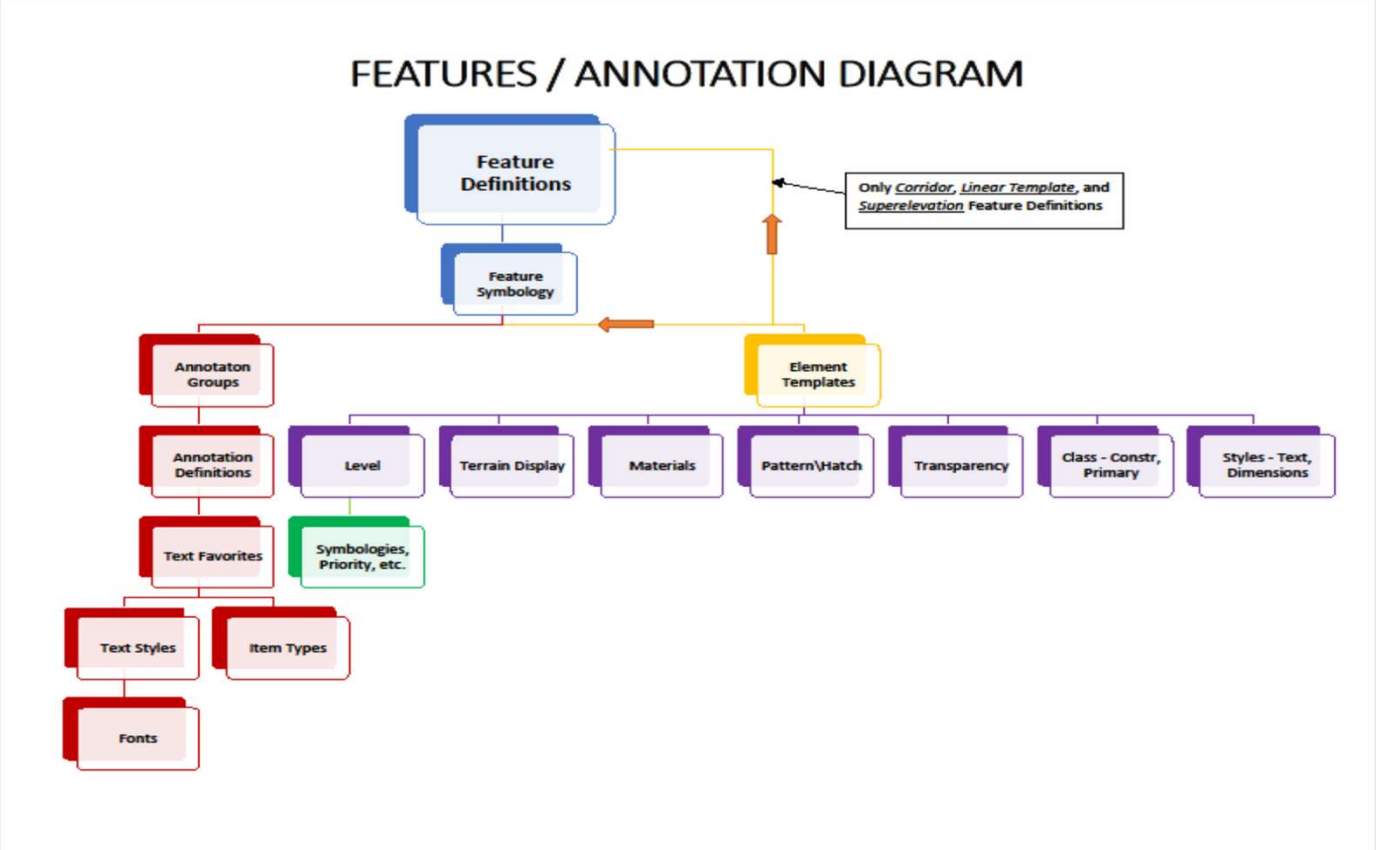
Feature Definitions



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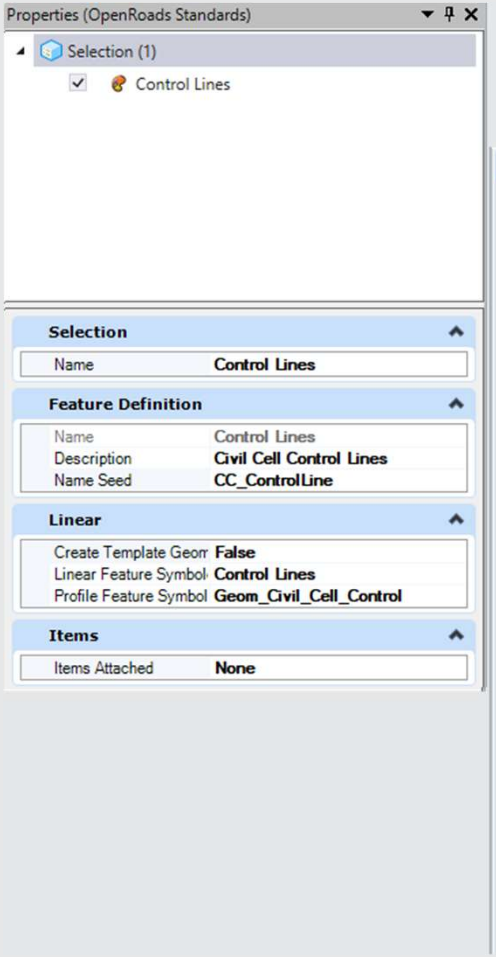
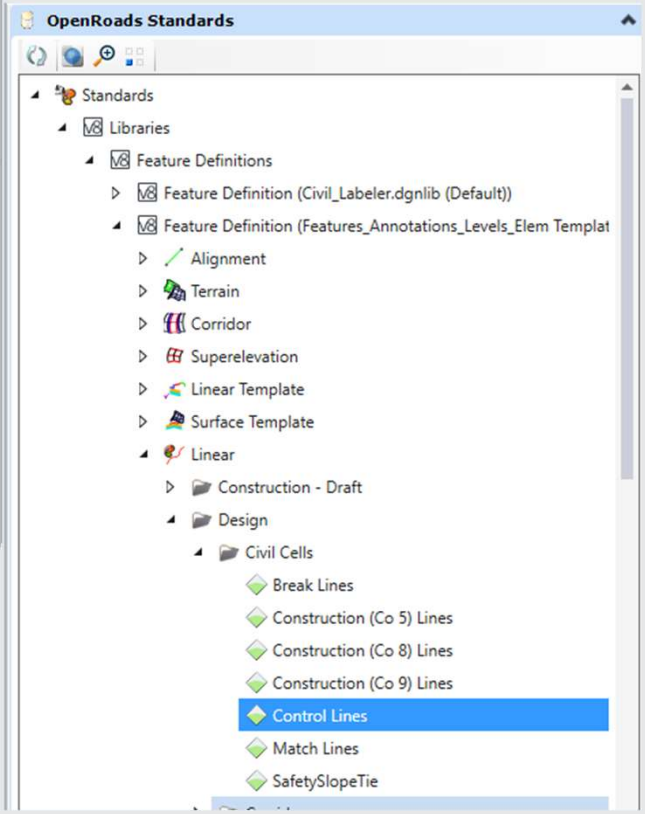
Workspace Resources

Feature Definition defines "**WHAT**" an Element is

Feature Definitions

- Name and organization
- Primary Geometry
- Secondary or Construction
  - ✓ Name
  - ✓ Description
  - ✓ Name Seed





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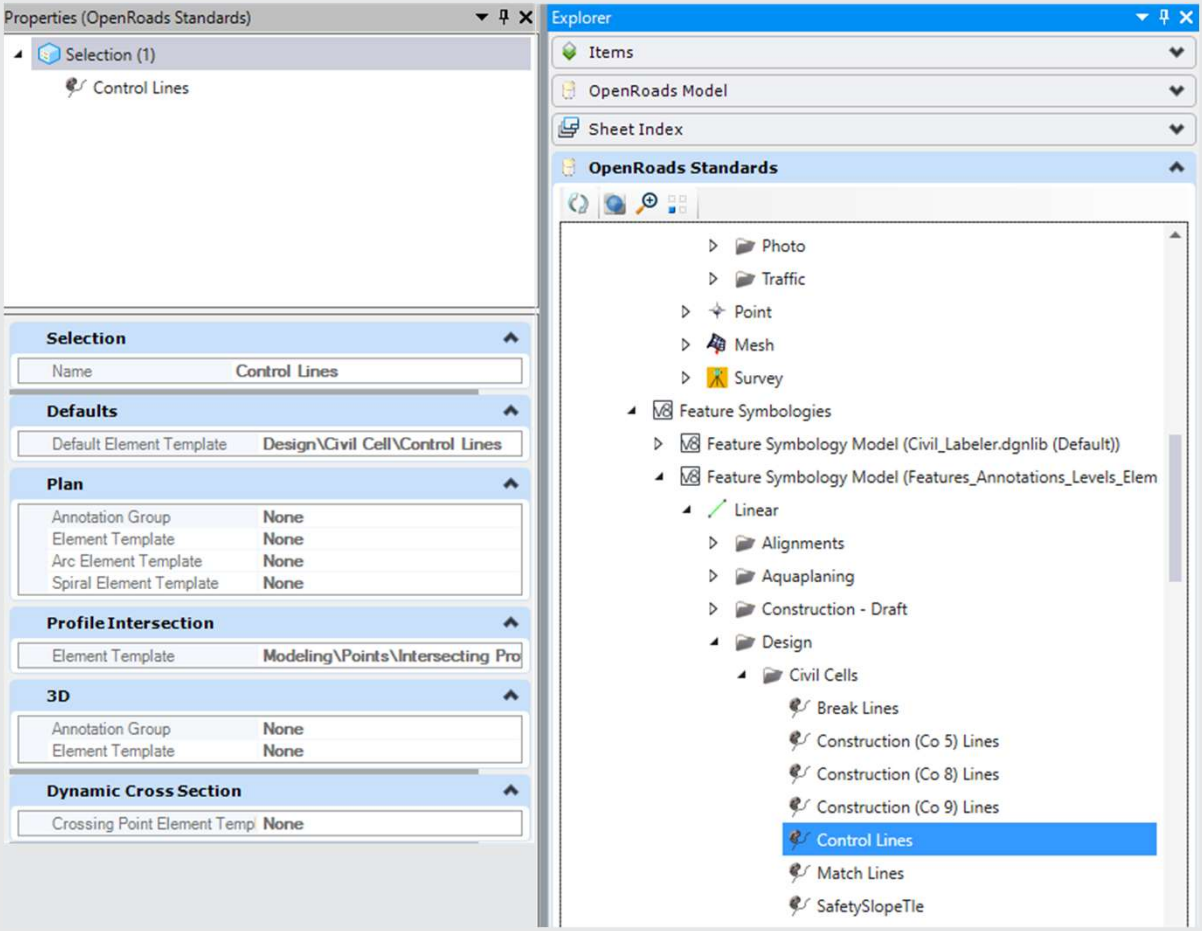
Workspace Resources

Feature Symbology defines "**How**" an element is displayed.

Feature Symbology

- Name and organization
  - ✓ Name
  - ✓ Element Templates
  - ✓ Annotation Groups



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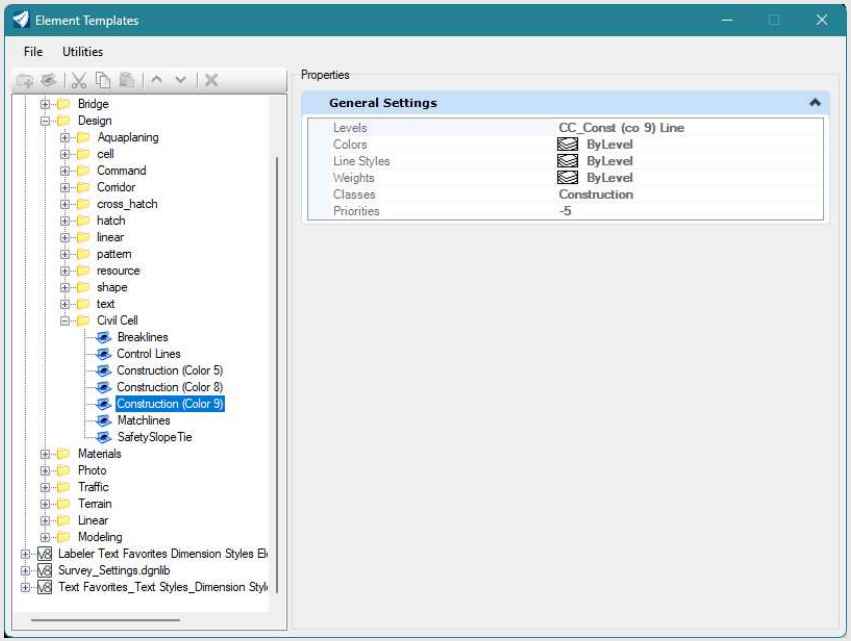
Workspace Resources

Element Templates defines the "**Why**" detailed display settings.

Element Templates

- Name and Organization
  - Levels (Name)
  - Symbology
  - Setting a priority
  - Primary Geometry
  - Secondary Geometry



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Document the Civil cell

dgnlib	Civil cell Names	Reference Elements	Standard PlanNumber	Surface Template	Linear Template or Corridor	Notes
Drive Arpon Civil Cells_A_1_A_2.dgnlib	Residential 6 Inch Curb A-1	Mainline Eop (Profiled) Mainline Curb Flow line (Profiled) Mainline Curb Back Top (Profiled) Mainline Sidewalk Front (Profiled) Mainline Sidewalk Back (Profiled) Mainline Shoulder Tie In (Profiled) Centerline Drive	A-1	Linear Templates\Drives Civil Cells\Drive Concrete Linear Templates\Drives Civil Cells\Drive Concrete	Linear Templates\Drives Civil Cells\9032B TP 2 Curb and Gutter Linear Templates\Drives Civil Cells\Curb Type 2 (Transition)	
	Residential 6 Inch Curb Island	Mainline EOP (Profiled) Mainline Curb Flow line (Profiled) Mainline Curb Back Top (Profiled) Mainline Sidewalk Front (Profiled) Mainline Sidewalk Back (Profiled) Mainline Shoulder Tie In (Profiled) Mainline Island Tie In (Profiled) Centerline Drive	A-1	Linear Templates\Drives Civil Cells\Drive Concrete Linear Templates\Drives Civil Cells\Drive Concrete	Linear Templates\Drives Civil Cells\9032B TP 2 Curb and Gutter	
	Valley Gutter with Curb A-2 (6 or 8 inch)	Mainline Eop (Profiled) Mainline Curb Flow line (Profiled) Mainline Curb Back Top (Profiled) Mainline Sidewalk Front (Profiled) Mainline Sidewalk Back (Profiled) Centerline Drive	A-2	Linear Templates\Drives Civil Cells\Drive Concrete	Linear Templates\Drives Civil Cells\Curb and Gutter Type 2 (Header)	
	Driveway Curb Ramp Right	Driveway EOP (Profiled) Driveway CBT (Profiled) Mainline SWF (Profiled) Mainline SWB (Profiled)	A-3	Linear Templates\Drives Civil Cells\Sidewalk Linear Templates\Drives Civil Cells\Detectable Warning	Linear Templates\Drives Civil Cells\Curb Type 2 (Transition) Curb Ramp	
	Driveway Curb Ramp Left	Driveway EOP (Profiled) Driveway CBT (Profiled) Mainline SWF (Profiled) Mainline SWB (Profiled)	A-	Linear Templates\Drives Civil Cells\Sidewalk Linear Templates\Drives Civil Cells\Detectable Warning	Linear Templates\Drives Civil Cells\Curb Type 2 (Transition) Curb Ramp	

Modification Date	WS Version	Folder(s) and/or File(s)	Product	Change Details
Tuesday, August 19, 2025	2023 (23.00.01.11)	"C:\Custom Configuration 2023\Organization-Civil\GDOT_Org_Civil_Standards\Dgnlib\Feature Definitions***GDOT_Features_Annotations_Survey_Settings_Levels_Element Templates.dgnlib***"	ORD	added Element Templates to call levels and set attributes for elements of civil cells created Feature Definitions, Feature Symbology to point to element Templates fro elements the awill be used for creattion of civil cells.
Thursday, September 25, 2025	2023 (23.00.01.11)	"C:\Custom Configuration 2023\Organization-Civil\GDOT_Org_Civil_Standards\Materials***materials.dgnlib***" "C:\Custom Configuration 2023\Organization-Civil\GDOT_Org_Civil_Standards\Materials\pattern***Truncated_Domes.jpg***"	ORD	create new material in dgnlib for Detectable Warning Mesh. Added a jpg named Truncated_Dome.jpg in the pattern folder. This will be applied as a surface template for the detectable warning surface in 3D.
Thursday, September 25, 2025	2023 (23.00.01.11)	"C:\Custom Configuration 2023\Organization-Civil\GDOT_Org_Civil_Standards\Dgnlib\Civil Cells***GDOT_Drive Apron Civil Cell_A_1_A_2.dgnlib***"	ORD	created new civil cells for placement from GDOT Standard plans A-1, A-2,A-3. See Civil Cell GDOT tab for more details.

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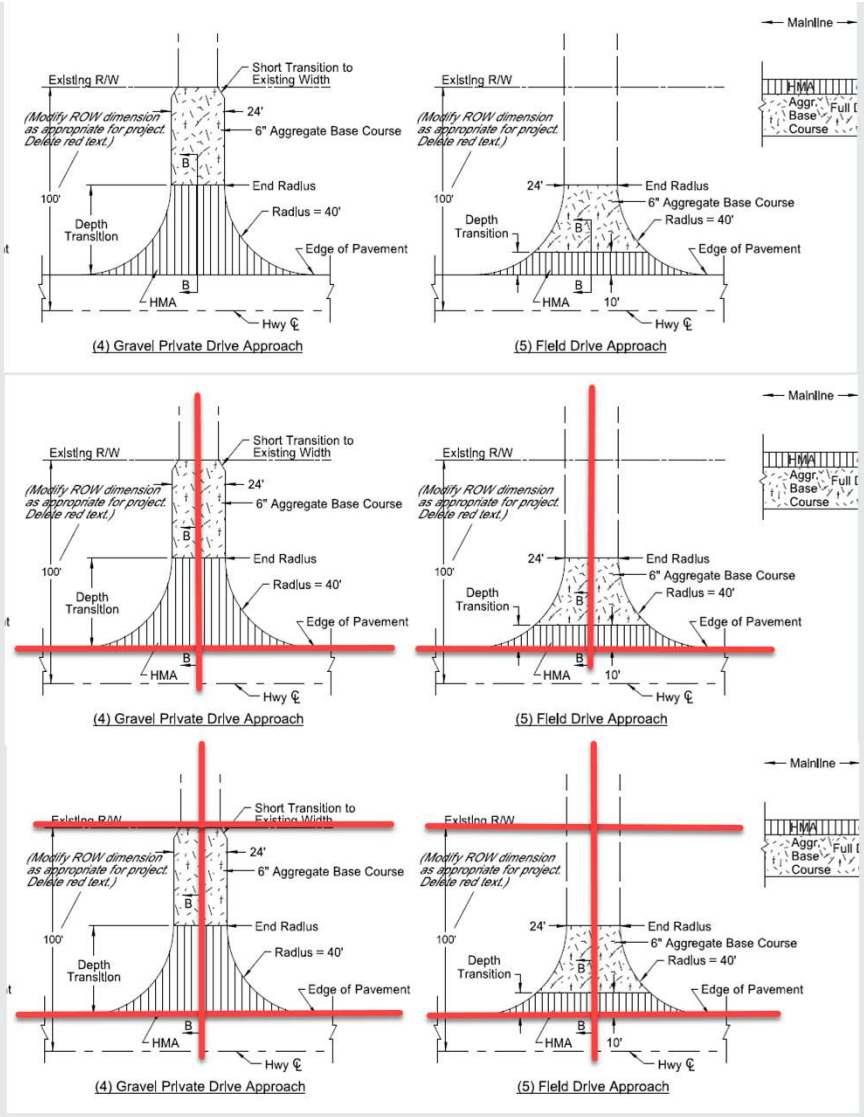
Testing

Test, Test Test during the build process, Not after everything is complete

The Quick Test

- Choose the Create Civil cell command
- Don’t need to worry about reference Names
- Build the Civil Cell up to the point of Accepting
- Make sure all Civil Cell Elements Highlight
- If they do, Reset (Right mouse) to not create the Civil Cell
- Continue building the Civil Cell



Considerations for Creating Civil Cells

- Reference Geometry
- Control Geometry
- Number of Cells

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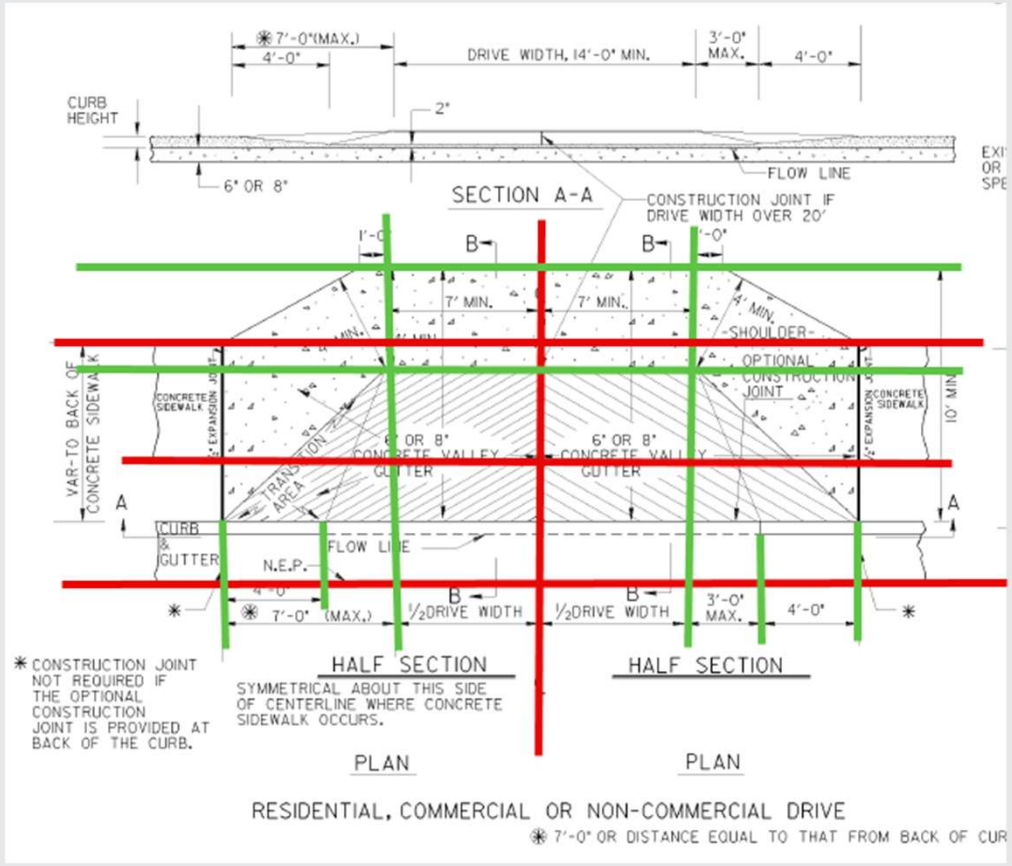
Considerations for Creating Civil Cells



- Reference Geometry
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Considerations for Creating Civil Cells

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- Control Geometry
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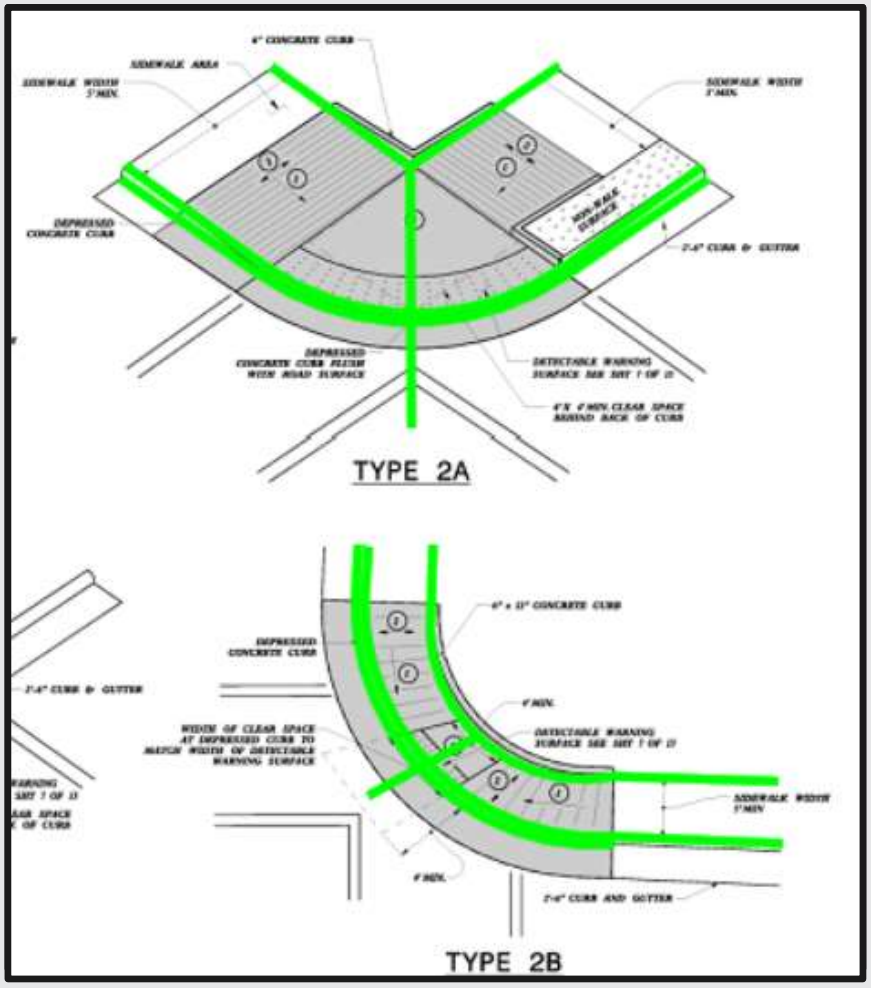

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Setting up a Civil Cell File

Always start in a 2D Seed file from the workspace

- This is needed for the 2D Geometry
- Use DNC element to create a terrain, Create a temporary terrain to help target End Conditions

  (This will also create your Default-3D model)
- Turn off the display of the Default-3D Model

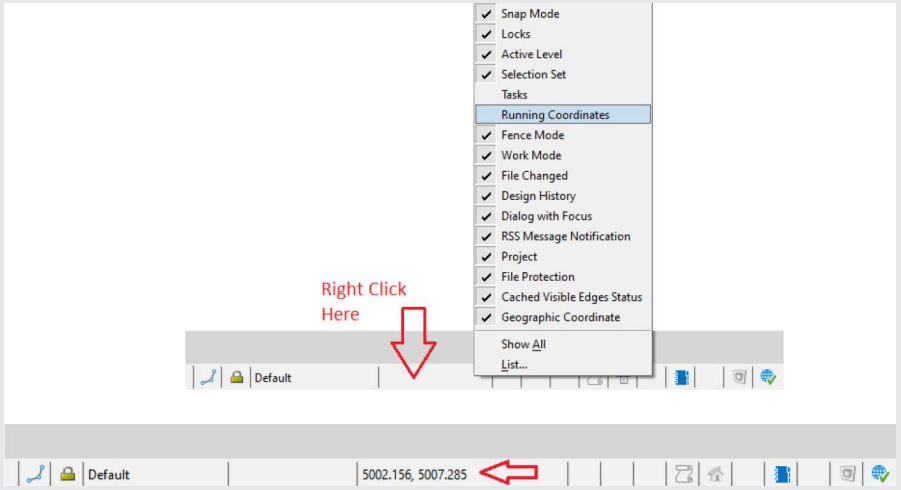
  (This will help in not selecting 3D elements by mistake)

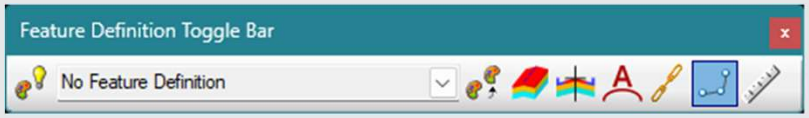
  IMPORTANT NOTE: DO NOT DRAW IN NEGATIVE COORDINATES

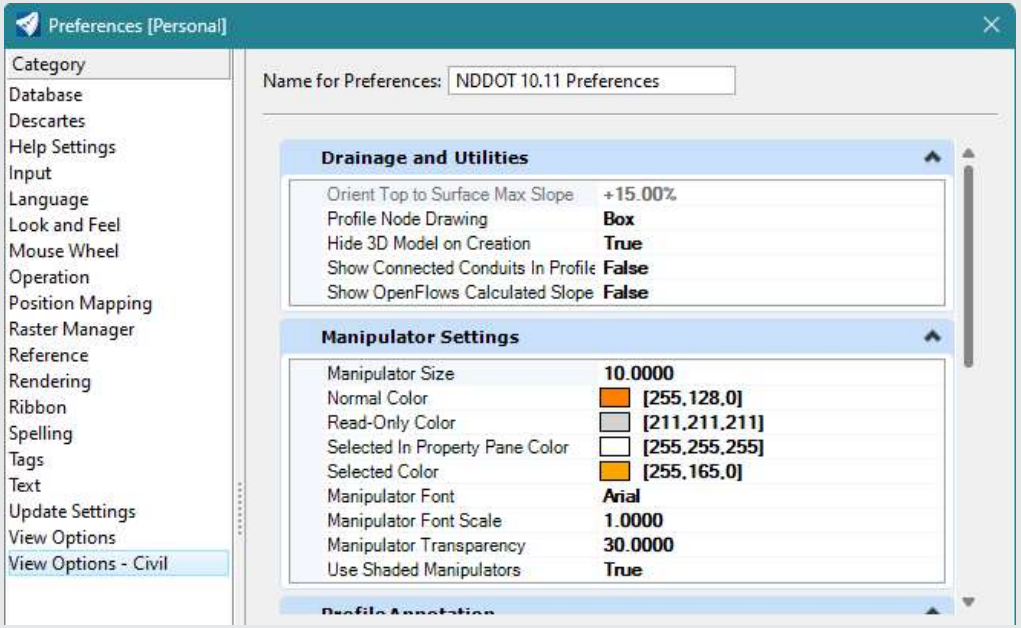
Setting up a Civil Cell File

Helpful User Settings

- Running coordinates
- Snap mode
- Feature Definition tool bar
- Manipulator Settings
- Button Assignments – Tentative snap







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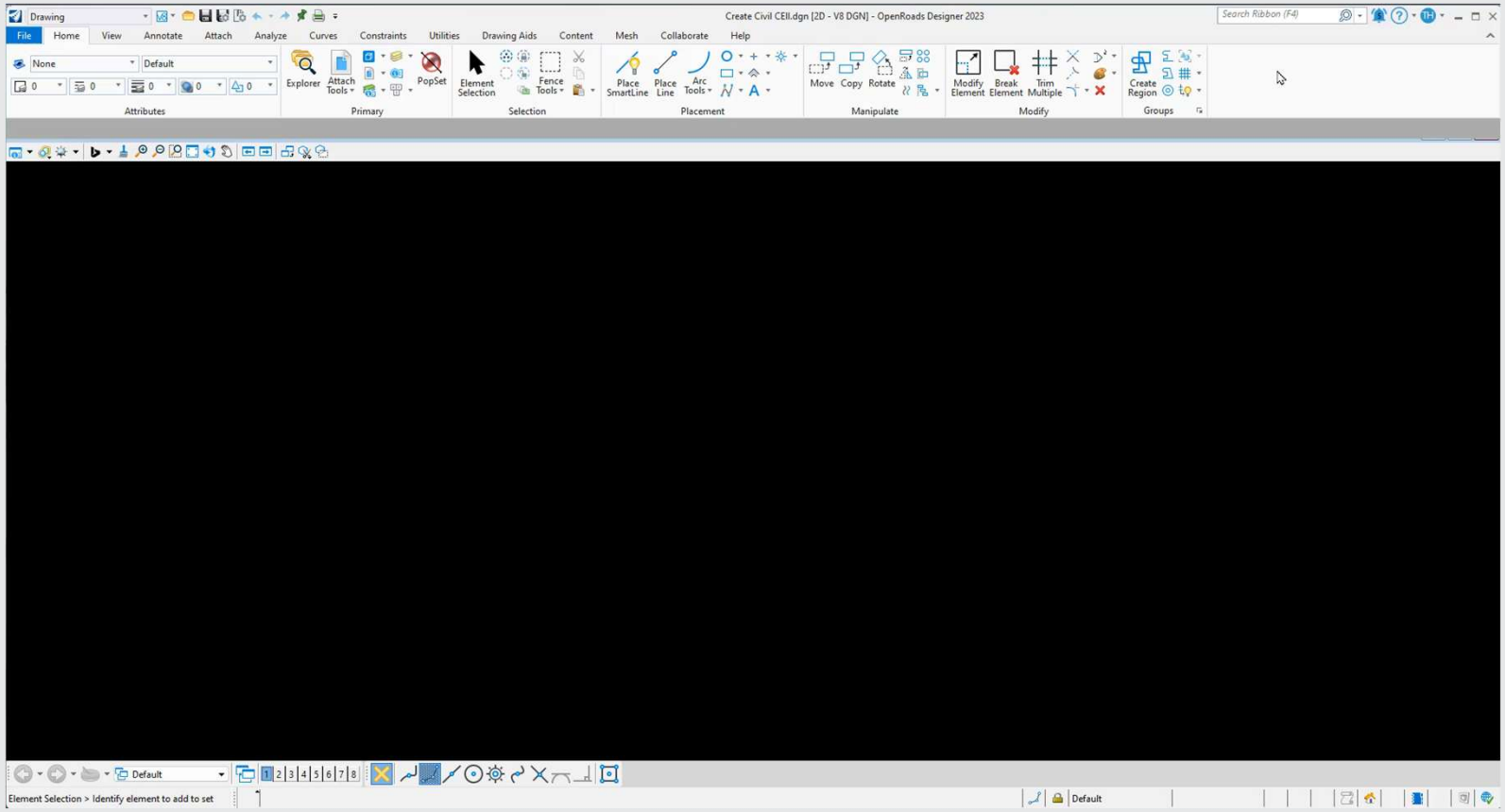
Setup File



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Horizontal Geometry Commands

Key Commands or Tools

Single Offset Partial

- Very valuable tool in Civil cells
  - Switch to length instead of End Station to control length. Even when using snaps

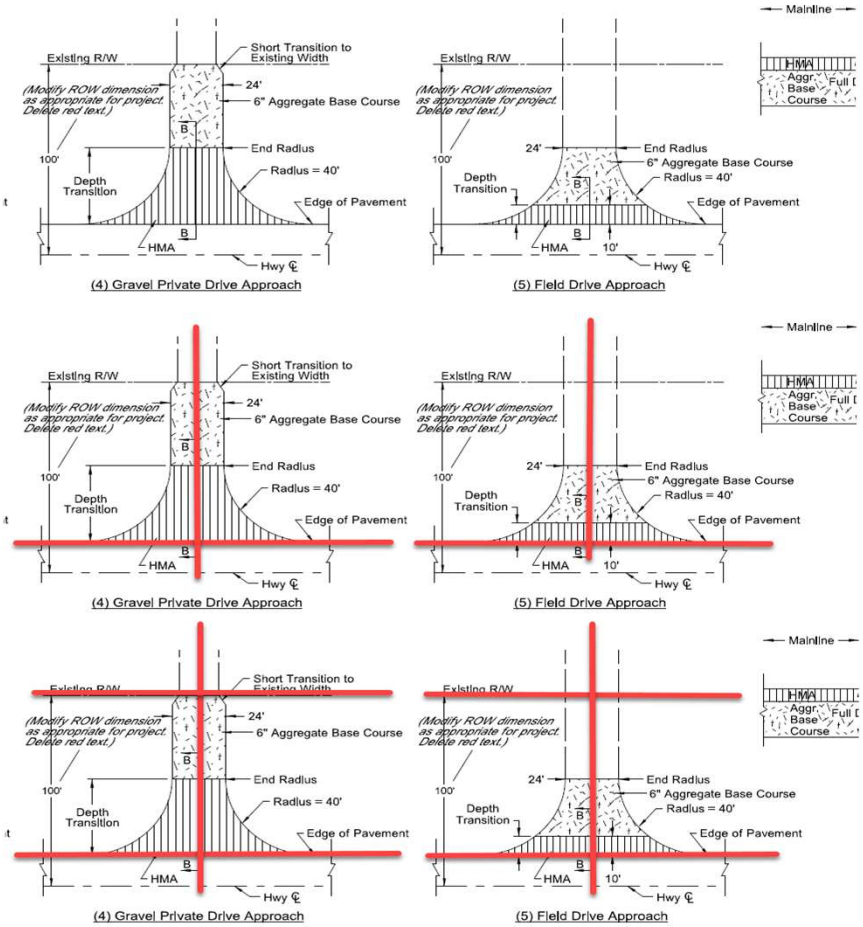
Single Arc Between Elements

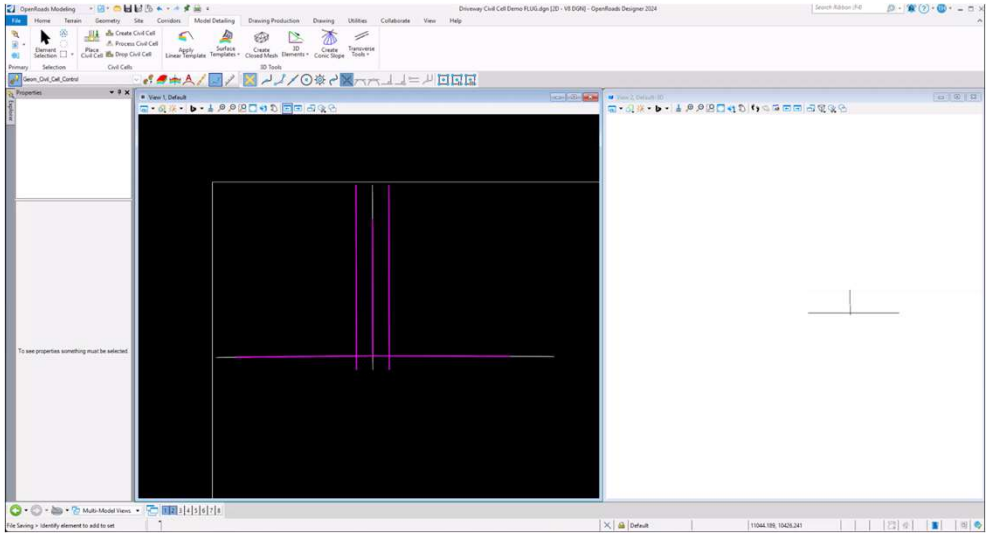
- Can be changed to 2-Center or 3-Center Curves
- Tapers/spirals can be added after placement of cell
- Back and Ahead Offsets are available

Complex Elements

- Ideal to complex adjoining elements to apply one linear template instead of multiple
- Remember if we complex a horizontal, we need to complex the vertical and then make the vertical active.

Demo – Reference and Controls





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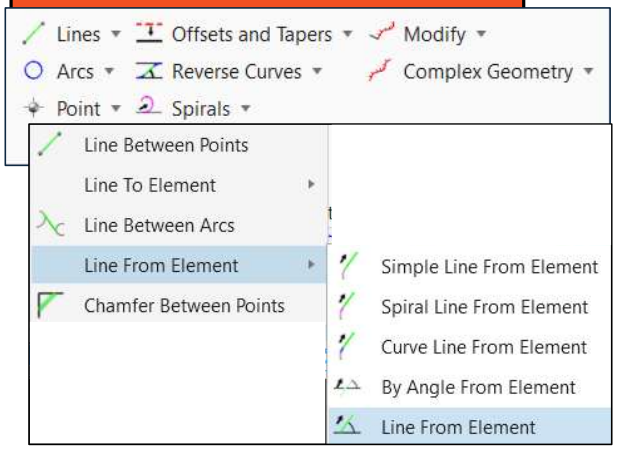
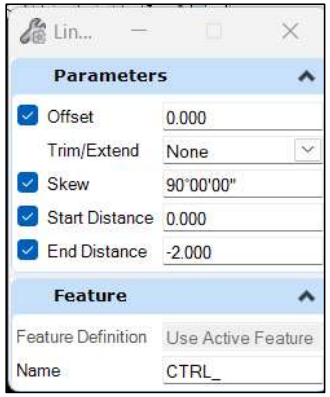
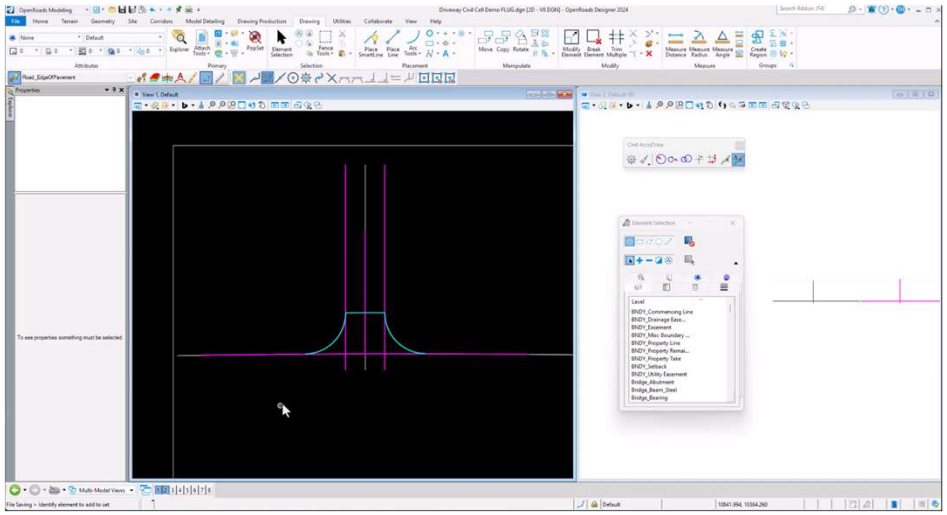
Curb Control lines
Civil Accudraw and Delta station offset

OpenRoads Modeling > Geometry > Horizontal







Use **Line From Element** with **Civil Accudraw Delta Station-Offset** to construct Control Lines. Allows you to better control **Control Line lengths** and positions than using **Single Offset** Tools.

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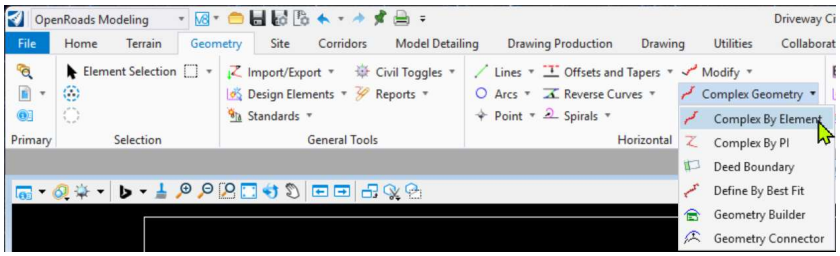
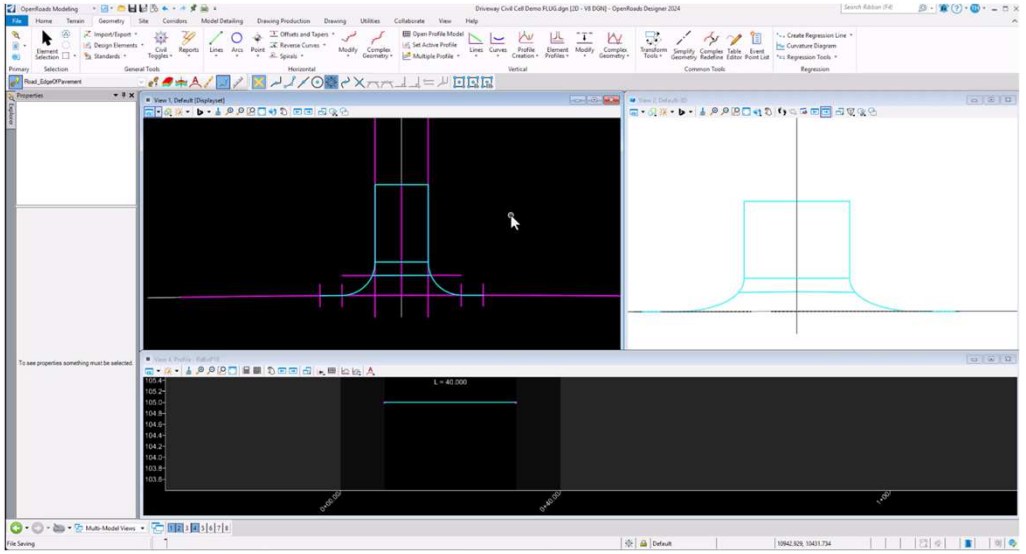
Complex elements





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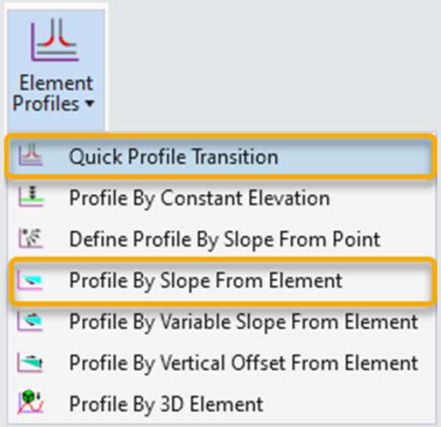
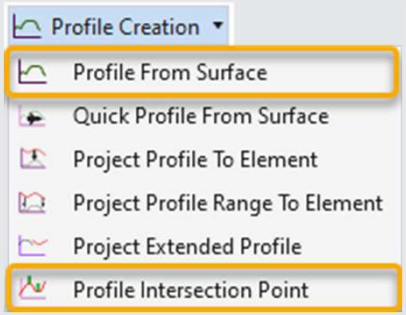
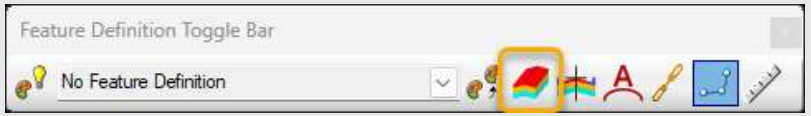
Vertical Geometry Commands

Key Commands or Tools

- **Quick Profile Transition** is good for most profiles for Arcs between Elements
- **Profile by slope from element** is ideal for most profiles as is
- **Profile from Surface** is ideal for most profiles for Arcs Between Elements**.**
- **Profile Intersection Point** is good to build vertical if it crosses an existing vertical element recommend using origin snap allow the snap to create the relationship also could use Profile Complex by PI with no radius
- **Create 3D Automatically** is ideal for creating Vertical for line between Elements command where vertical exists







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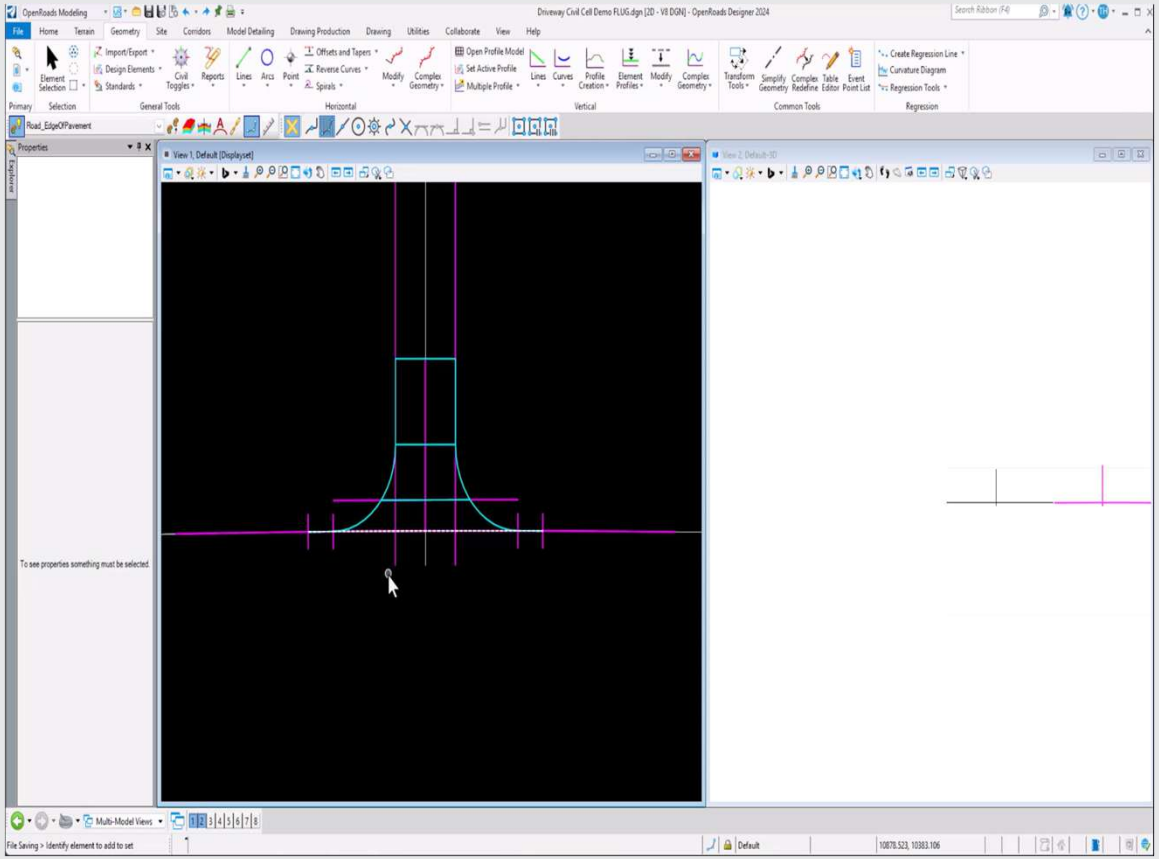
Vertical Geometry and Tools



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Testing

Test, Test Test during the build process, Not after everything is complete

The Quick Test

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- Don’t need to worry about reference Names
- Build the Civil Cell up to the point of Accepting
- Make sure all Civil Cell Elements Highlight
- If they do, Reset (Right mouse) to not create the Civil Cell
- Continue building the Civil Cell

Terrains

Created from Graphical Elements

- Ruled Terrain
- Update Dynamically
- Can be created with an open boundary, but pay attention to the geometry used to create terrain and the impact on the terrain (Other elements maybe needed to close terrain)
- Consider Stroking Tolerances
  - Stroking tolerances are passed forward with placement
  - Set Curve and Profile stroking <= .07 as this will result in “better” surface
  - Set Linear stroking to a small number default is set to 10, <= 2 is a good practice
  - **Drainage Design -** When a cell with a terrain in it is placed, the user should remember changing display characteristics to Contours or Flow Arrows to aid in drainage design

Templates

Surface Templates

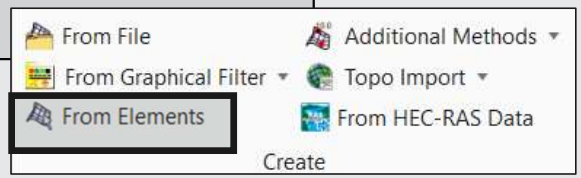
- Generally, use Enable Linear Features

Linear Templates

- **Don’t duplicate 2D geometry already given** (Ex. If EOP is graphically drawn in the Civil cell, don’t place again as a Linear template Point, Change the EOP feature to DNC.)
- **Parametric Constraints and Point Controls** are useful tools in templates in the civil cell but station ranges are not supported so template drop elements should coincide with parametric and Point Control lengths.

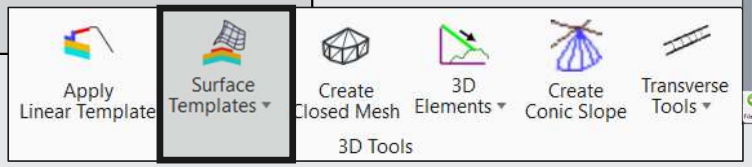
Terrain model and Apply Surface Templates

OpenRoads Modeling > Terrain > Create

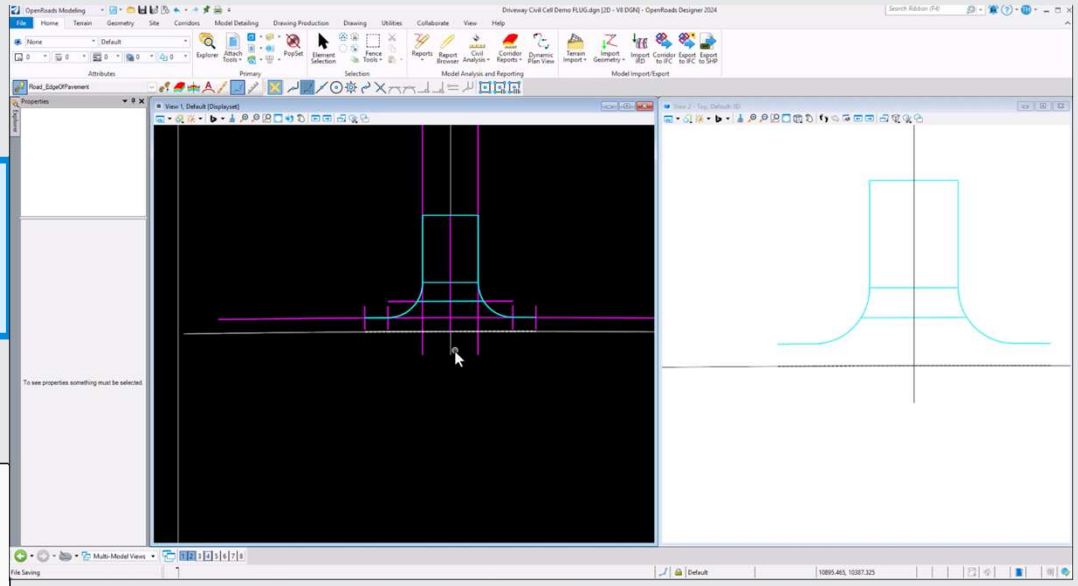


When naming the terrain model hit “tab” key to ensure name persists.

OpenRoads Modeling > Model Detailing > 3D Tools



When placing the surface template Disable Linear Elements since those were previously hand drawn.



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Placing Civil cells - Design File Considerations

Think about the type of civil cell that you are going to place

- How complex is the civil cell
- Will you need to make modifications
- How many are you going to place
  - ✓Example Driveways may limit to ten per file

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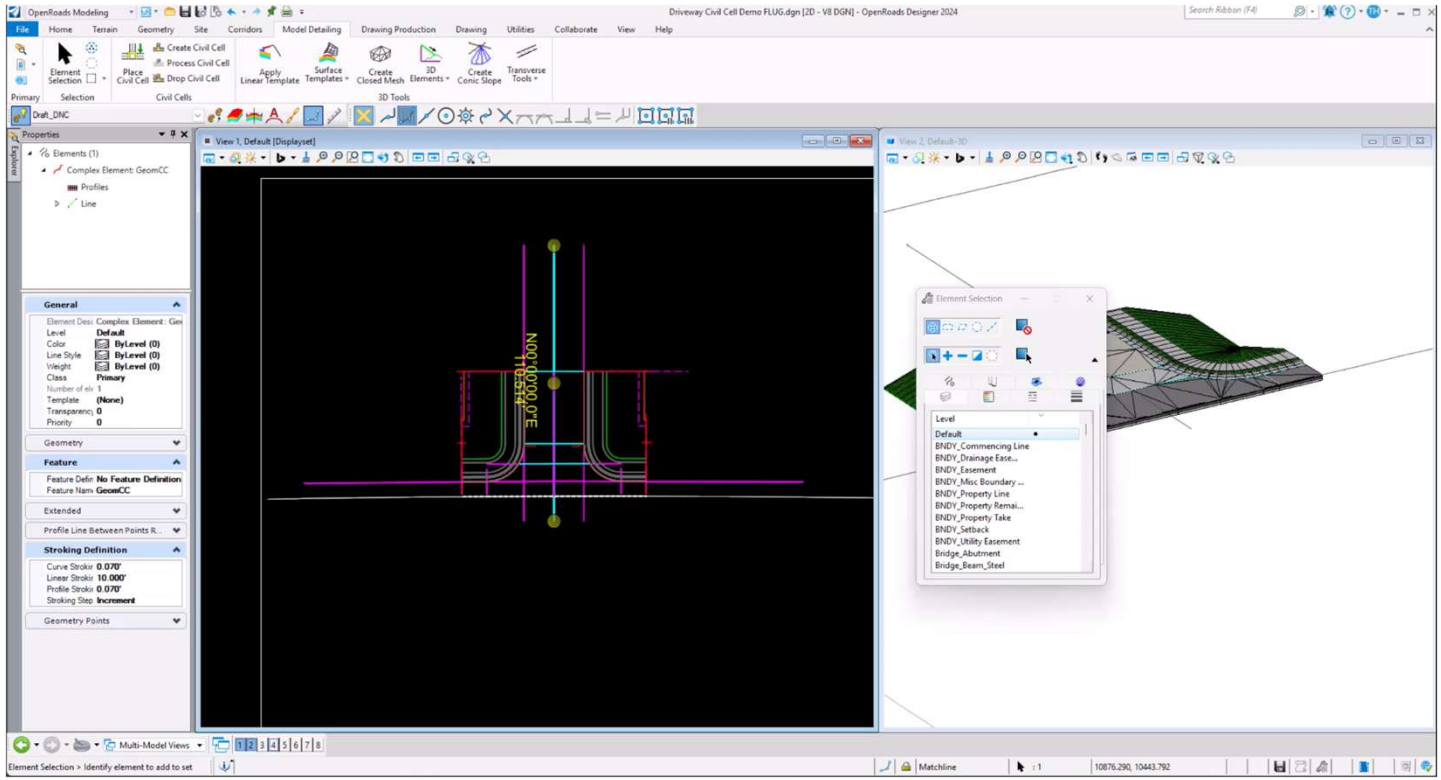
Item Types Removal on Civil Cells

Remove Item types on any elements before the civil cell is created.



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Lessons Learned

- Create Point Control Elements on their own feature to avoid recursive issues.
- Add additional features to the terrain as break lines to enhance the model.
- Add additional reference to enhance cell placement.
- Document how you created the civil cells to make downstream edits easier.
- Add additional features to the civil cell for checking purposes.

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Geotechnical Analysis
Geotechnical Information
MicroStation
OpenRoads
OpenBridge
OpenRail
OpenFlows
OpenBuildings
Plant Design
ProjectWise
RAM
STAAD
SYNCHRO

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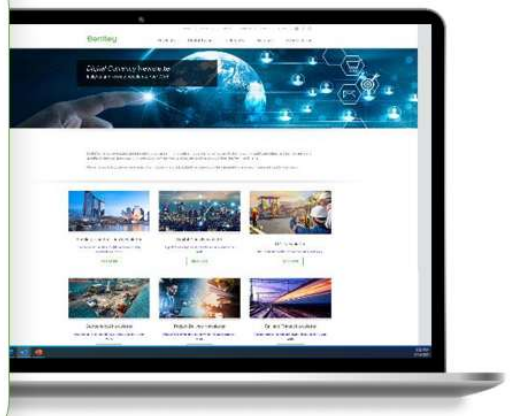

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QUESTIONS?

Questions?

Questions?

Questions?

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Standard Colors

CMYK 100, 78, 45, 49
RGB 0, 42, 68 **WEB** 002a44 **PANTONE** 296

CMYK 100, 42, 00, 14
RGB 0, 108, 173
WEB 006dad
PANTONE 653

CMYK 65, 0, 100, 0
RGB 98, 187, 70
WEB 62bb46
PANTONE 369

CMYK 78, 9, 71, 1
RGB 38, 165, 117
WEB 27a775
PANTONE 7723

CMYK 87, 39, 47, 14
RGB 19, 115, 121
WEB 0e7379
PANTONE 7718

CMYK 80, 25, 24, 0
RGB 16, 150, 178
WEB 2096b2
PANTONE 632

WHITE

BLACK

CMYK 0, 70, 98, 0
RGB 243, 112, 36
WEB f37024
PANTONE 158

Overlay Text Boxes

Divider Lines (Gray color and 0.5 pt thickness)

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Bentley PowerPoint Resources (hyperlinked)

All can be found on Branding Portal

PowerPoint Support Graphics Library

Inventory of graphics aligned with Corporate messaging, which should be proliferated in our presentations for consistency in how we communicate storylines. These graphics are also designed as PowerPoint objects to provide flexibility for color changes as needed.

Pre-made Slide Layouts

Some pre-designed slide layouts for some of the more common use cases (be sure to check the presenter notes for more details on each slide).

Industry Divider Slides

These are now hosted as a separate file to keep this main template simplified and a smaller file size.

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