OpenRoads Designer User Manual

U.S. Department of Transportation
Federal Highway Administration

Chapter 12

CIVIL CELLS

2021 R2 Update 10 – Version 10.10.21.04 – WorkSpace 10.10.1V
December 2022

Chapter 12 Civil Cells

A Civil Cell is a pre-packaged modeling feature, used for such things as approach intersections or ADA sidewalk ramps. This chapter discusses placement of the Civil Cells found in the FLH WorkSpace and the creation of custom Civil Cells.

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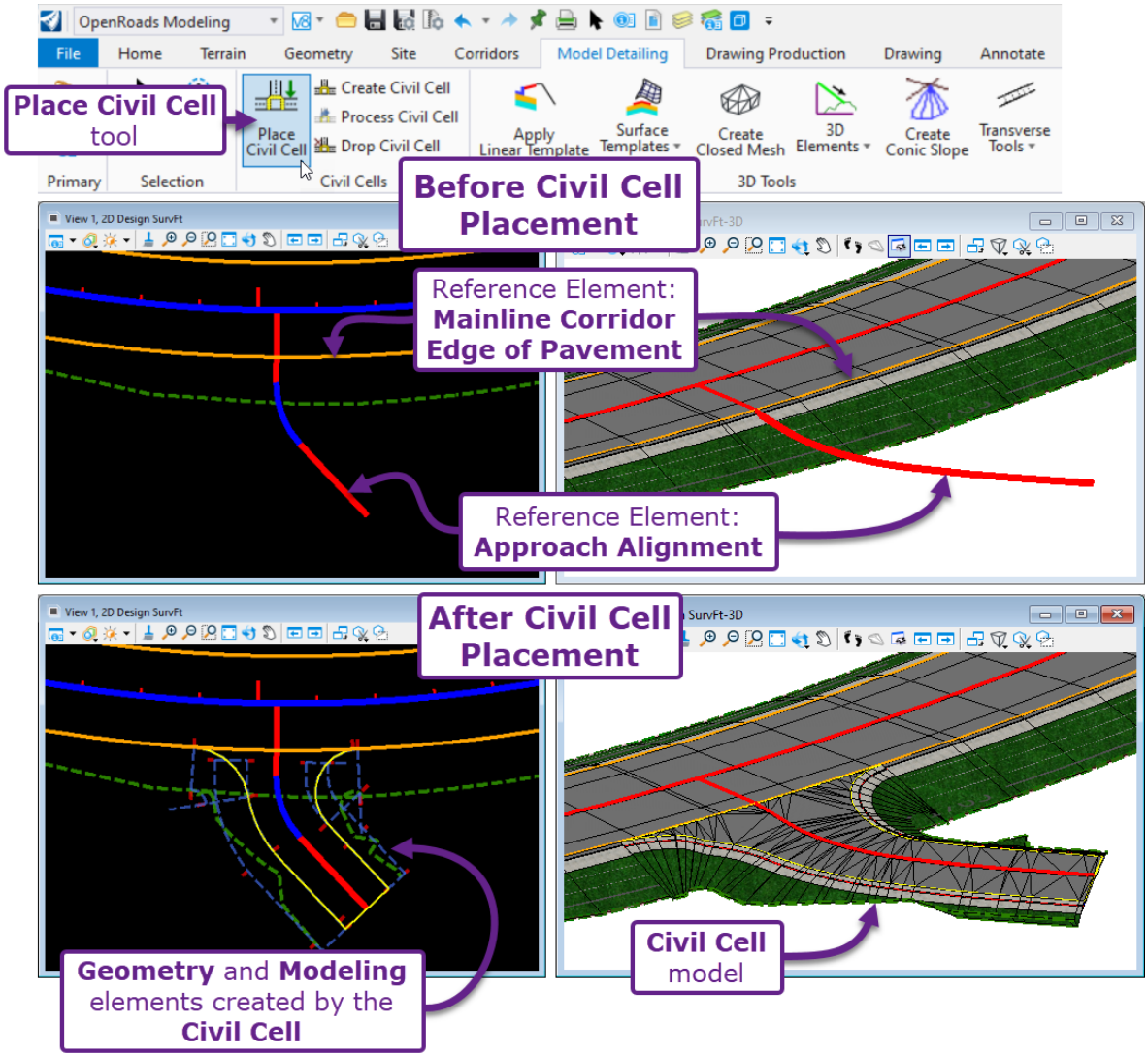
12A – INTRODUCTION TO CIVIL CELLS

A Civil Cell is a pre-packaged modeling feature, such as an approach intersection or an ADA sidewalk ramp. FLH has a Civil Cell Library for modeling common roadway design and site layout features. Alternatively, a new, custom Civil Cell can be created using the procedure shown in *12C - Create a Custom Civil Cell*.

To place a Civil Cell, Reference Elements must be selected. The Civil Cell model is constructed around the horizontal and vertical geometry of the Reference Elements.

In the graphic below, a T-Intersection Civil Cell is shown. The Mainline Corridor Edge of Pavement and Approach Alignment are selected as the Reference Elements.



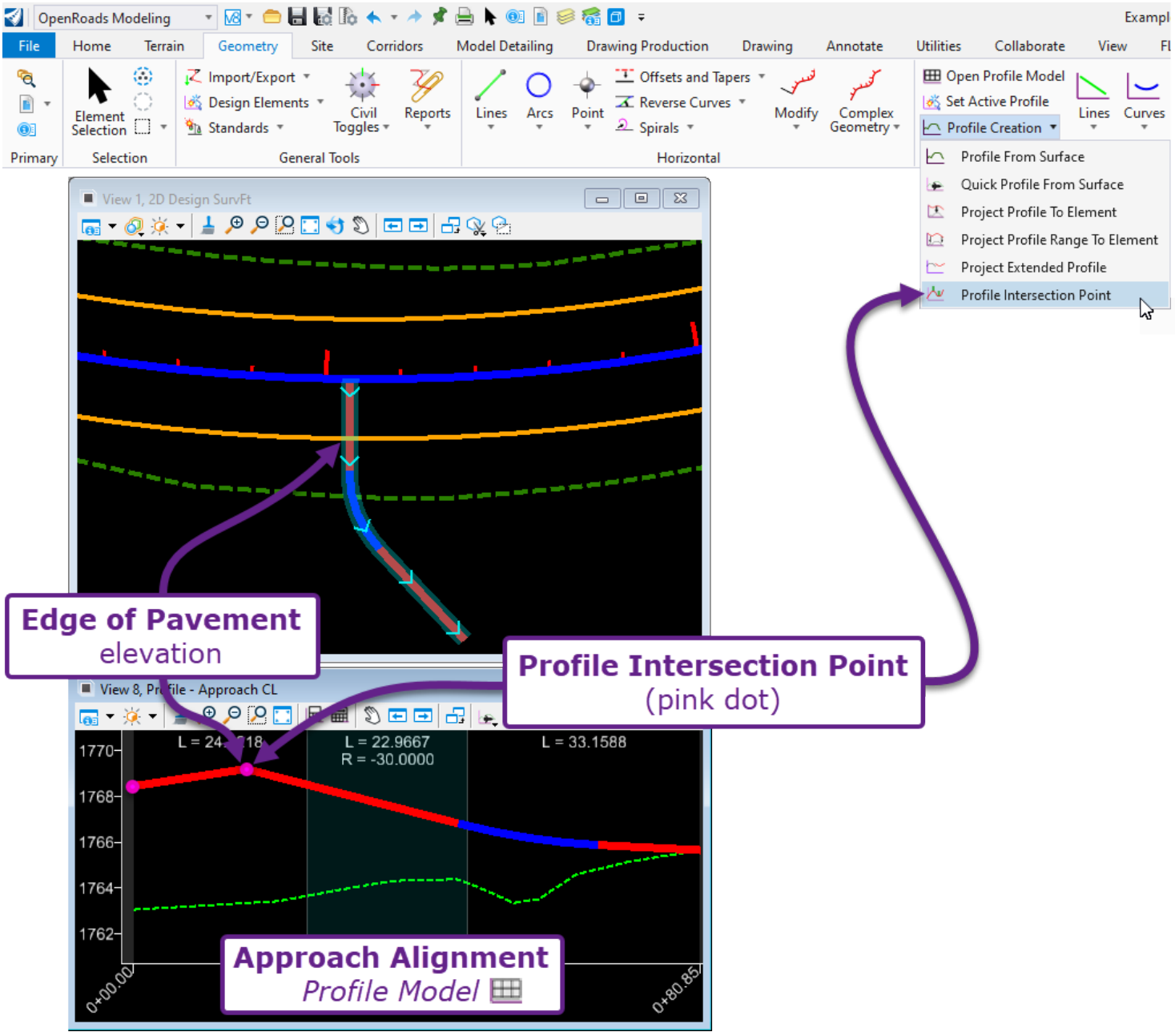
As shown above, Civil Cells produces Horizontal/Vertical geometry elements, Linear Templates, Terrain Models, and/or Surface Templates.

Reference Elements: Civil Cells require one or more Reference Elements to be selected. Typically, the Reference Elements must contain an Active Profile.

In most cases, one or more of the Reference Elements is produced by a Corridor or Linear Template. In the graphic shown above, the Edge of Pavement Line produced by the mainline Corridor is selected.

Typically, the other Reference Element is manually drawn by the User. In the graphic above, the Approach Alignment is selected as a Reference Element. The horizontal and vertical (Profile) geometry for this element was manually drawn and designed by the User.

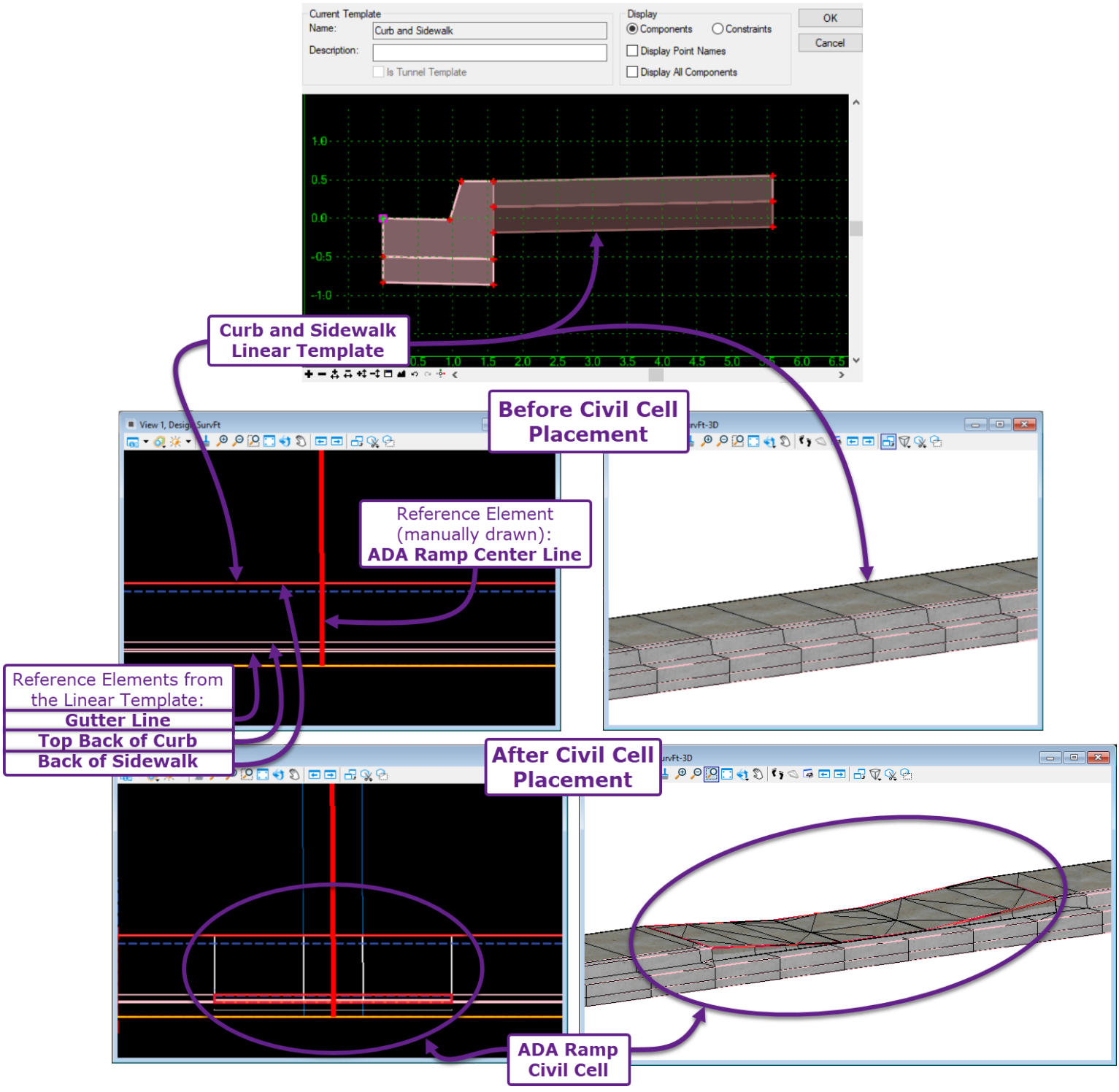
TIP: When manually drawing the Profile for a Reference Element, use the *Profile Intersection Point* tool to coordinate the intersecting elevation with the Corridor/Linear Template Reference Element. At the intersection point of the Reference Elements, the two Profiles should be at the same elevation.



An example of an ADA Ramp civil cell is shown below. This civil cell is specifically designed for use with a Curb and Sidewalk Linear Template.

Elements produced by the Linear Template must be selected as Reference Elements for placement of the Civil Cell. Reference Elements from the Linear Template include the Gutter Line, Back Top of Curb Line, and Back of Sidewalk Line.

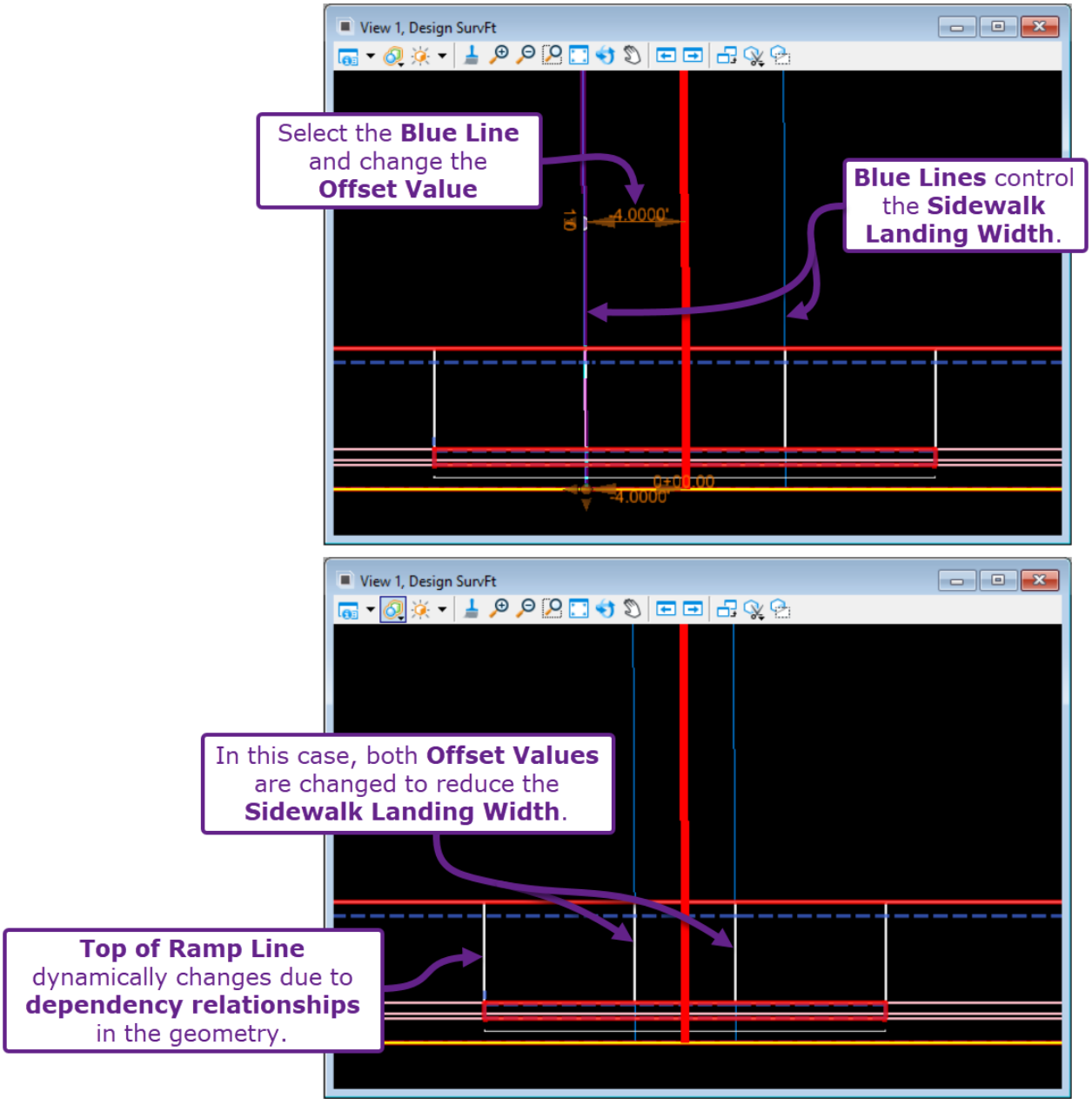
The horizontal position of the ADA Ramp is determined by a manually drawn ADA Ramp Center Line element, which is also selected as a Reference Element. The ADA Ramp Center Line does NOT require an *Active* Profile. For this Civil Cell, all vertical geometry depends on the Curb and Sidewalk Linear Template elements.



After a Civil Cell is placed, the geometry and modeling elements can be modified to fit project conditions.

For example, in the case of the ADA Ramp civil cell, the width of the Sidewalk Landing is controlled by the Blue Lines. By default, these Blue Lines are offset 4 feet from the Reference Element – which creates an 8-foot Sidewalk Landing.

To modify the Sidewalk Landing Width, select the Blue Lines and change the Offset Value. In the graphic shown below, the Offset Values are reduced to 2 feet to create a Sidewalk Landing Width of 4 feet.



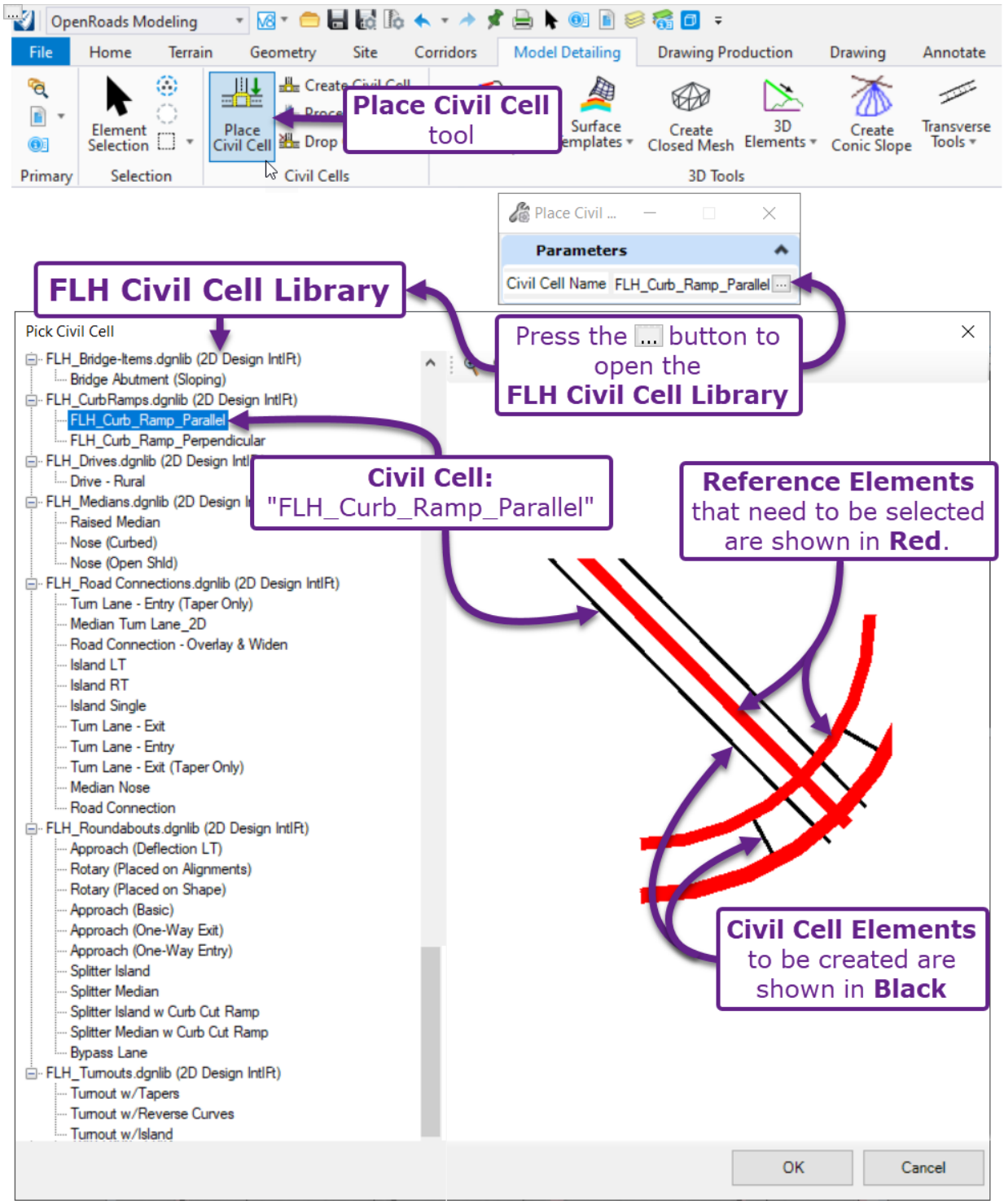
Civil Cell geometry and modeling elements are dynamic and constructed with dependency relationships. For example, changing the Sidewalk Landing Width affects other elements in the Civil Cell. The Top of Ramp Line is automatically shifted to remain a fixed distance away from the Sidewalk Landing.

TIP: Typically, Civil Cells contain overlapping elements. Left-Clicking on overlapping elements will select the top element (which is the last element that was drawn). To select underlying elements, first Right-Click on overlapping elements. When the desired element is highlighted, Left-Click to select it. If more than two elements are overlapping, then Right-Click multiple times to cycle through the underlying elements.

12A.1 FLH Civil Cell Library

When the *Place Civil Cell* tool is used, the FLH Civil Cell Library is presented after the **Civil Cell Name** … button is pushed in the *Dialogue Box*.

When a Civil Cell is selected (highlighted), a preview is shown. The preview ONLY shows the necessary Reference Elements (shown in red) and the horizontal geometry elements that will be created by the Civil Cell (shown in black). Not shown are the vertical geometry elements, Linear Templates, Terrain Models, and Surface Templates that the Civil Cell will create.



TIP: The Reference Elements need to be created prior to placing a Civil Cell.

12B – LIMITATIONS OF CIVIL CELLS

In many cases, using Civil Cells is more time consuming and problematic than manually drawing and modeling a design feature.

Before placing a pre-made FLH Civil Cell or creating a custom Civil Cell, consider the following disadvantages associated with Civil Cells:

Civil Cells are NOT flexible: The FLH Civil Cell Library contains a variety of Civil Cells. However, a Civil Cell may NOT be appropriate for the situation, even if a corresponding FLH Civil Cell is available.

Civil Cells are pre-made, which gives the User limited control over the resulting geometry and modeling elements. Civil Cells elements can be modified to a certain extent. However, modifications are typically limited to changing offset widths and radii values. For more information, see *12E – Modify a Civil Cell after Placement*.

On a real-world project, it is unlikely that a design feature can be characterized with a pre-made Civil Cell.

For example, in the case of a T-Intersection, it is typically necessary to draw custom geometry for the approach centerline and all approach pavement edges. For a T-Intersection Civil Cell, ONLY the approach centerline (Reference Element) is manually drawn by the user. The horizontal geometry for the pavement edges are automatically created as simple offsets from the approach centerline (Reference Element). The vertical geometry for the edges is the approach centerline profile projected at a -2.0000% slope, which creates a crown in the T-Intersection. The crowned roadway geometry may NOT be appropriate in the vicinity of the T-Intersection.

Instead of modifying and deconstructing a Civil Cell, it is typically quicker to manually draw and model the design feature. Manually modeling a design feature gives the User control over the fine details of the model.

Civil Cell Geometry contain Dependency Relationships that are difficult to Decipher: The geometry elements in a Civil Cell are built using Civil Rules and Persist Snaps, which create dependency relationships to the Reference Elements and/or other Civil Cell elements. Tracing and understanding the dependency relationships is challenging, especially with complicated Civil Cell models. For more information, see *12C.1.b Dynamic Relationships formed by Persist Snaps and Civil Rules*.

In the process of manipulating or deconstructing a Civil Cell, it is possible to overwrite or break a dependency relationship. If this happens, the Civil Cell model will likely breakdown beyond repair.

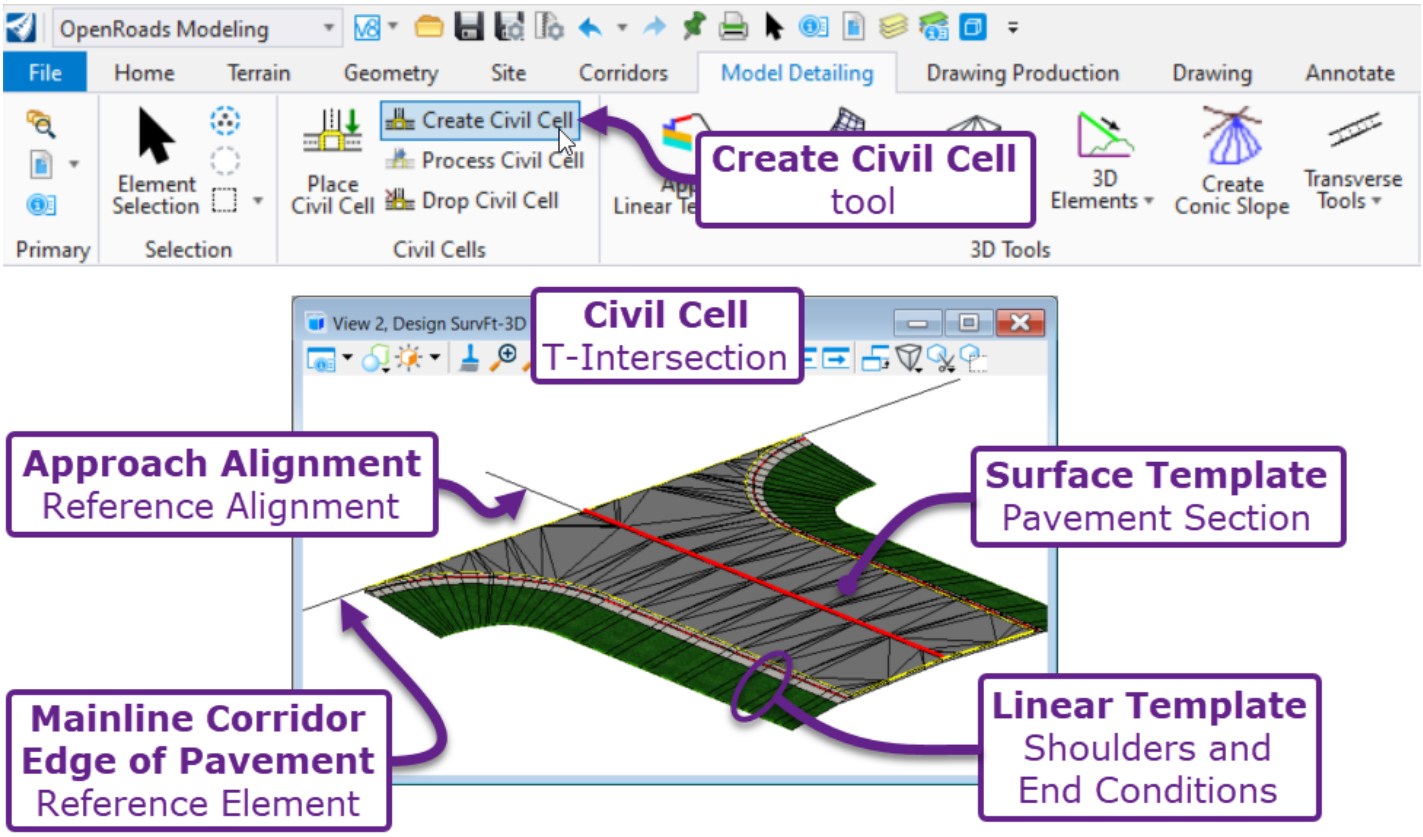
When placing and/or modifying a Civil Cell, it is recommended that the general process for creating a custom Civil Cell is understood. Understanding Civil Cell creation will help diagnose and assess the capabilities and limitation of a Civil Cell. For more information, see *12C – Create a Custom Civil Cell*.

Is Civil Cell Automation Necessary?: A highway project may contain many approach intersections. The design concept will likely vary for each approach intersection. It is unlikely that a pre-made Civil Cell design will be an appropriate fit for each intersection on the project.

Before placing a pre-made FLH Civil Cell or creating a custom Civil Cell, assess whether the Civil Cell is appropriate for use and flexible enough to be placed in separate locations.

12C – CREATE A CUSTOM CIVIL CELL

This workflow demonstrates how to create a custom Civil Cell to model a simple T-intersection.



Creating a custom Civil Cell is eventually accomplished with the *Create Civil Cell* tool. However, before this tool is used, a dynamic model must be created using Horizontal/Vertical Geometry elements, Corridors, Surface Templates, and/or Linear Templates.

Civil Cell creation requires proficiency and prerequisite knowledge of the following topics:

- Persist Snaps – see *7C.1 Persist Snaps*
- Civil Rules – see *7C.2 Civil Rules*
- Horizontal and Vertical Geometry tools – see *Chapter 7 – Geometry*
- Terrain Models and Surface Templates - see *11A.2 Surface Templates and Terrain Models – Process Overview*
- Linear Templates – see *11A.3 Linear Templates – Process Overview*.

WARNING: When creating Civil Cells, all elements should be assigned an appropriate **Feature Definition** and **Name**. Both the Feature Definition and Name help other Users understand the construction of the Civil Cell in placement, modification, and analysis.

12C.1 WARNINGS and Considerations before Civil Cell Creation

12C.1.a Decide Which ORD File to Create the Civil Cell in

Before creating a custom Civil Cell, decide which ORD File to create it in.

A custom Civil Cell can ONLY be placed in the ORD File that it was created in. A custom Civil Cell CANNOT be placed in different ORD Files.

BEST PRACTICE: Create the Civil Cell in the Design ORD File that it needs to be used in.

Adding Custom Civil Cells to the FLH WorkSpace:

Only Civil Cells created in .dgnlib files and stored on the FLH WorkSpace are available for placement in multiple ORD Files.

WARNING: **Coordinate with your Engineering Systems Manager to add a custom Civil Cell to the Library. Adding .dgnlib files to the FLH WorkSpace should ONLY be done by the Engineering System Manager.**

To create a Civil Cell in a .dgnlib file and place it in the FLH WorkSpace:

- Create a regular, new ORD File (.dgn file).
- Create the Civil Cell.
- Perform a Save-As of the file. From the *Save as Type* drop-down, select "DGN Library Files (*.dgnlib)".
- Deliver the .dgnlib file to your Engineering System Manager. The Engineering System Manager will place the .dgnlib file into the WorkSpace.

After this process, the .dgnlib file and Civil Cell is shown in the FLH Civil Cell Library and available for placement in any ORD File.

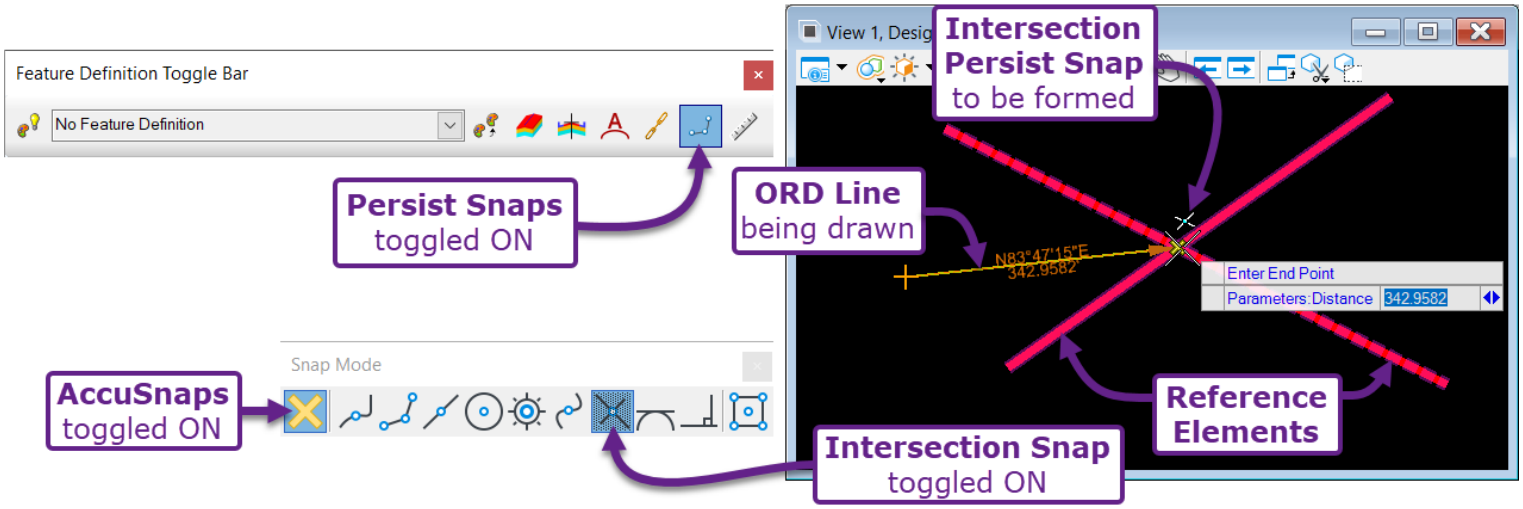
12C.1.b Dynamic Relationships formed by Persist Snap and Civil Rules

To create a custom Civil Cell, the concepts of Persist Snaps and Civil Rules must be fully understood. Persist Snaps and Civil Rules are ONLY applicable to Horizontal and Vertical ORD Tools (i.e., tools found in the **Geometry** tab).

> ***NOTE:*** Civil Cells must be created entirely from ORD Elements. Do NOT use MicroStation Tools to create Civil Cells.

Persist Snaps: A Persist Snap relationship is automatically formed when both the Persist Snap and AccuDraw toggles are ON. The type of Persist Snap to be formed depends on the toggled AccuSnap.

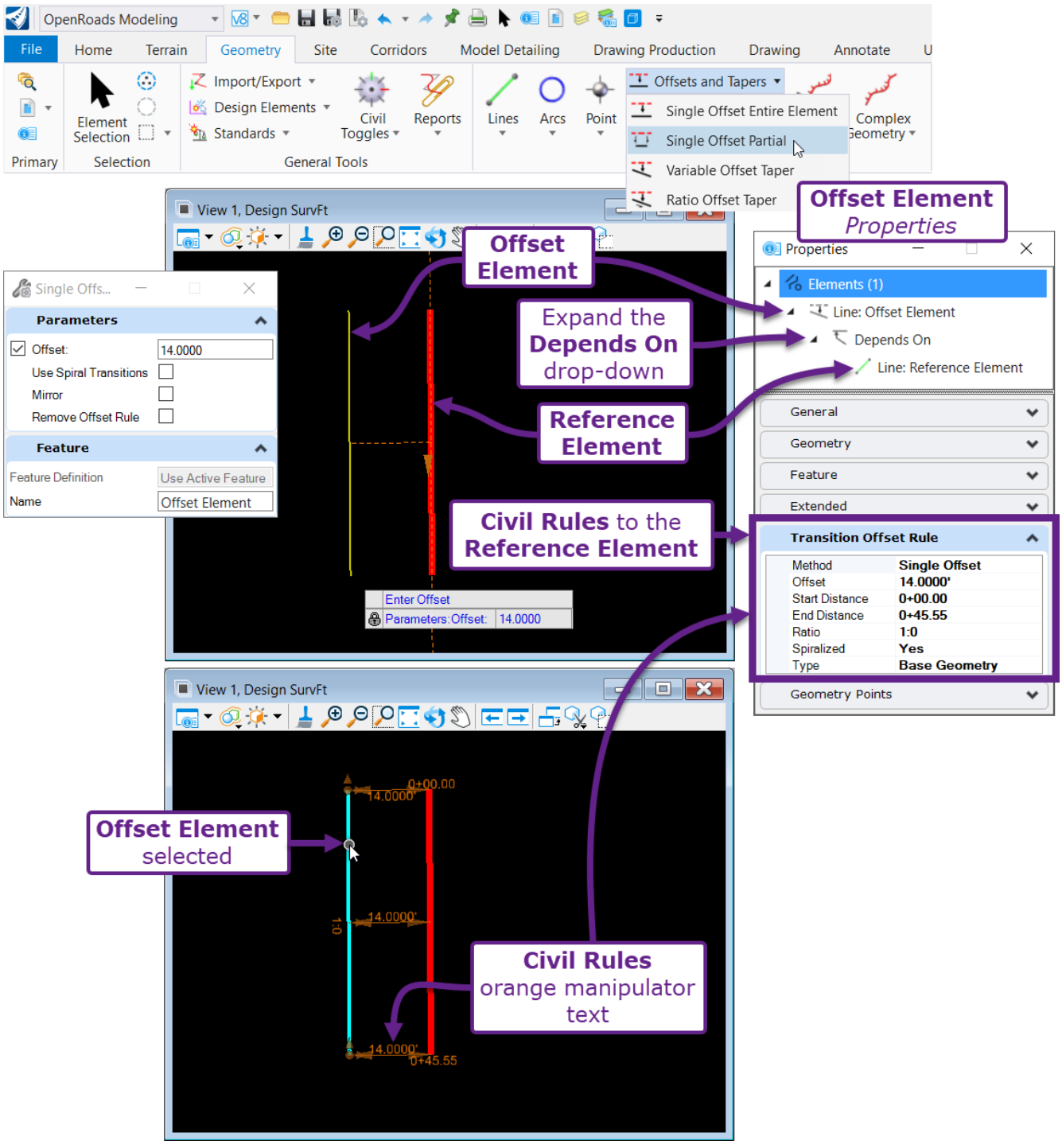
In the example below, an ORD Line is drawn to the intersection of two reference elements. In placement of the ORD Line, hovering the mouse cursor over the intersection shows the Intersection AccuSnap symbol. If the location is accepted (i.e., left-click when the symbol is shown), then a Persist Snap relationship is automatically created. If either of the Reference Elements are moved (which would cause the intersection location to change), then the end point of the ORD Line will automatically move to new intersection location.



Persist Snaps are discussed in more detail in *7C.1 Persist Snaps*.

Civil Rules: Civil Rules relationships are automatically formed when ORD Tools are used.

For example, when the *Single Offset Partial* tool is used, the resulting Offset Element is dependent on the selected Reference Element. The dependency relationship is listed in the top portion of the Properties box when the "Depends On" drop-down is expanded.

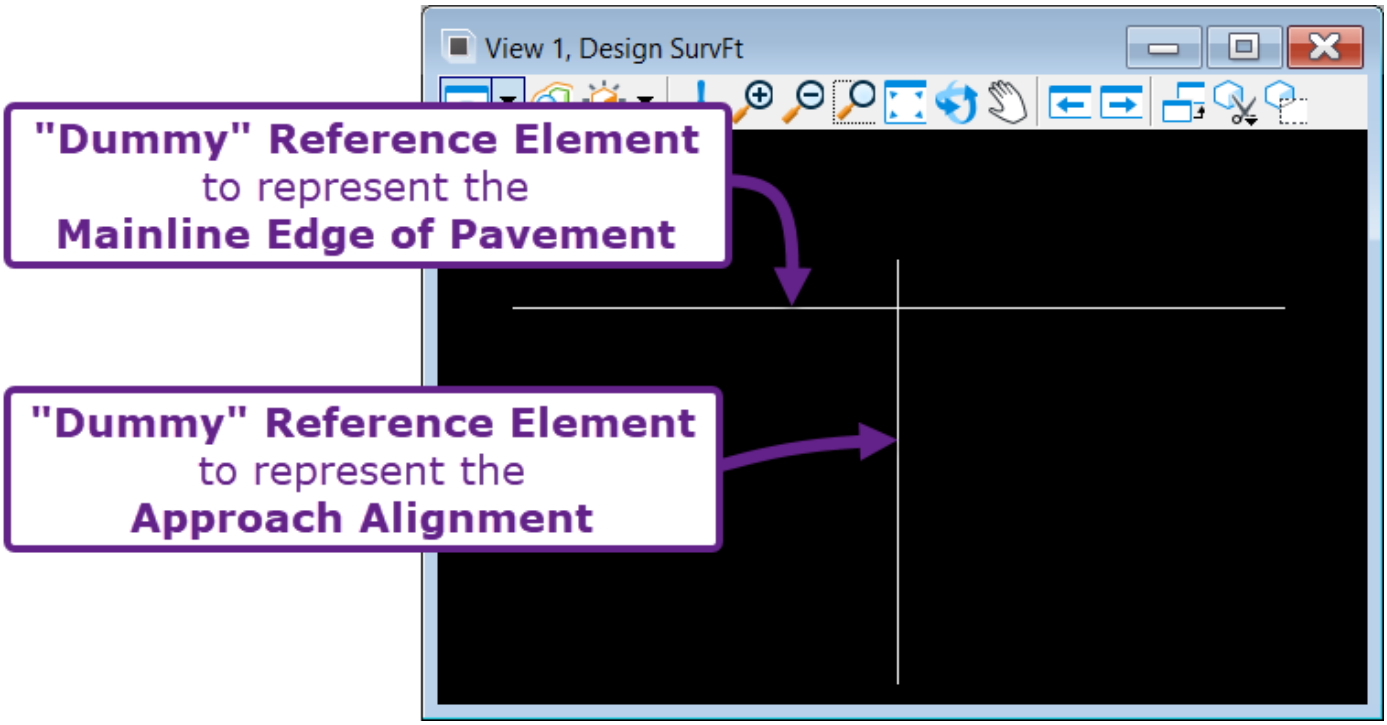


Also shown in the Properties box are parameter values and settings relating to the Civil Rules relationship. As shown above, the **Transition Offset Rule** drop-down controls position of the Offset Element in relation to the Reference Element.

Also, when the Offset Element is selected, orange manipulator text is shown. Orange manipulator text directly corresponds with Civil Rules shown in the Properties box.

12C.2 Civil Cell Creation - Overview

In placement of a Civil Cell, the User is prompted to select one or more Reference Elements. When creating a Civil Cell, "Dummy" Reference Elements must be drawn to represent the elements to be selected in placement the Civil Cell.



For a T-Intersection, the Mainline Corridor Edge of Pavement Line and the Approach Alignment will serve as the Reference Elements.

NOTE: In placement of the Civil Cell, the Mainline Corridor Edge of Pavement Line is automatically generated by the Corridor. The Approach Alignment must be manually drawn by the User.

For simplicity, "Dummy" Reference Elements are drawn as ORD Lines using the *Line Between Points* tool. Even though the "Dummy" Reference Elements are idealized as Line elements, the Reference Element selected in Civil Cell placement can be any configuration of linear elements. For example, in placement of the Civil Cell, the selected Approach Alignment can be a Complex Element that contains both lines and curves.

Also, as shown above, the "Dummy" Reference Elements are drawn perpendicularly to each other. In placement of the Civil Cell, the intersection angle is inconsequential. The Civil Cell will mold to any intersection angle, given the appropriate dependency relationships are established within the Civil Cell geometry.

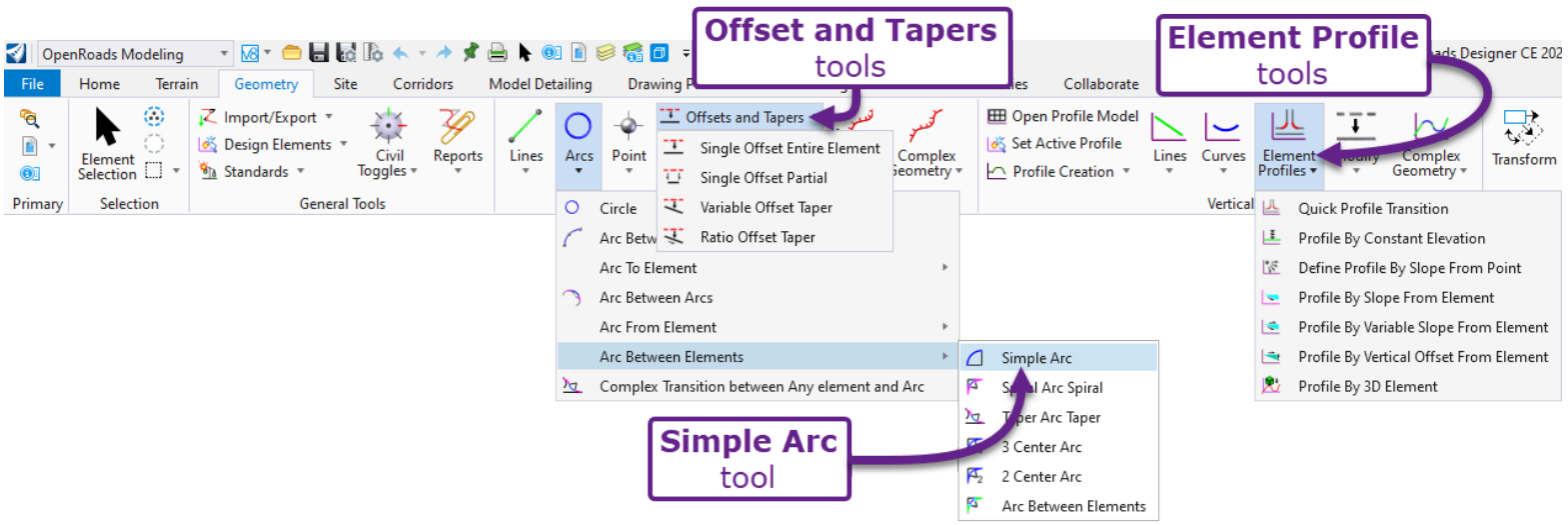
Vertical Geometry for the "Dummy" Reference Elements: The "Dummy" Reference Elements must be assigned a "Dummy" Profile. The "Dummy" Profile is also inconsequential. In placement of the Civil Cell, the Profile of the selected Reference Elements is used as the basis for the Civil Cell elements.

In the following workflow, the "Dummy" Reference Elements are assigned an arbitrary Profile using the *Profile By Constant Elevation* tool. The elevation that the "Dummy" Profiles is inconsequential. However, in the case of the T-Intersection, the Mainline Edge of Pavement and Approach Alignment should intersect at the same elevation.

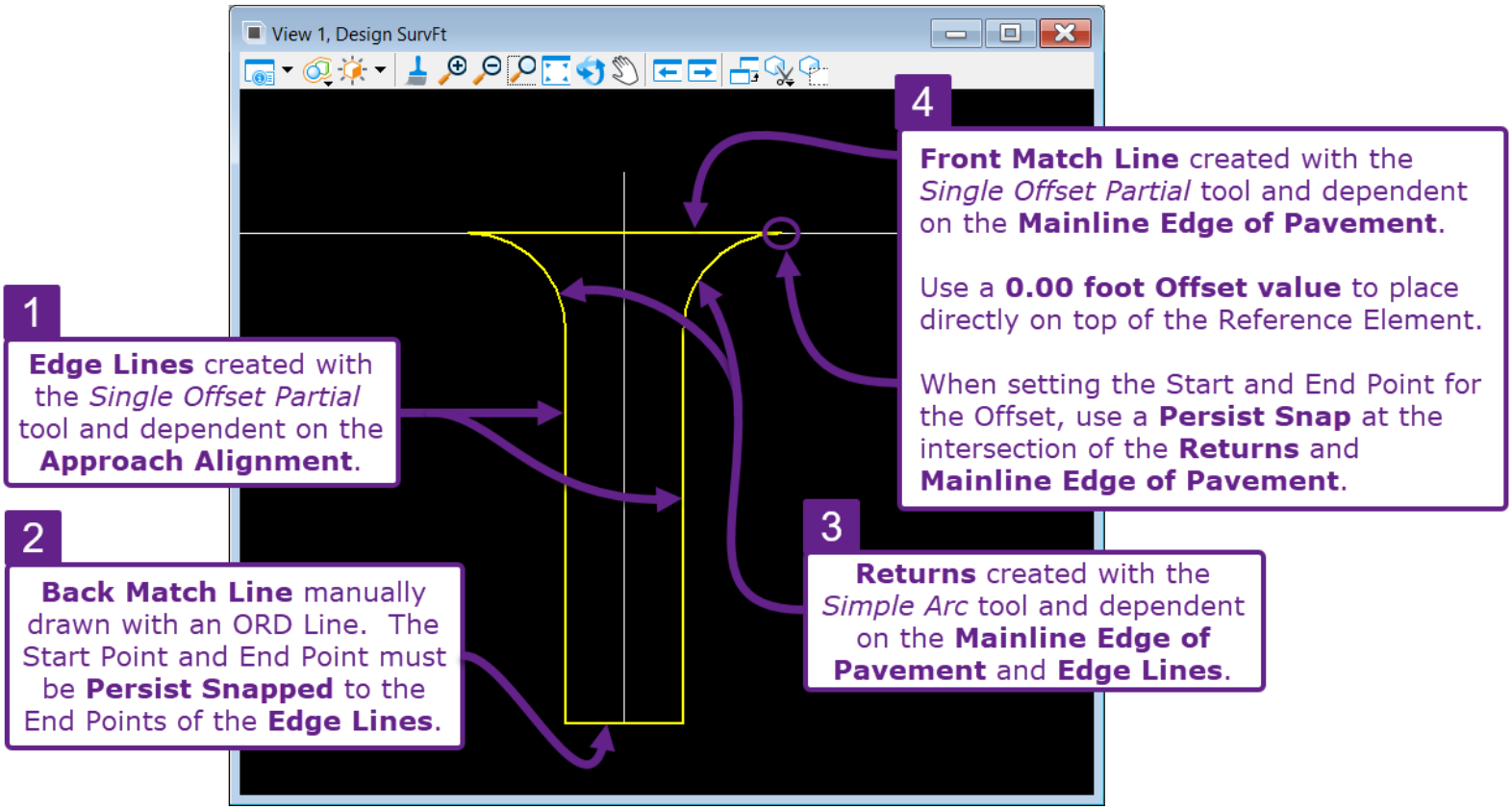
Civil Cell Elements: All Elements that comprise the Civil Cell geometry must have dependency relationships that trace back to the "Dummy" Reference Elements. This is primarily accomplished by using ORD Tools that require the Reference Element to be selected to create a dependent element.

For example, the tools found in the **Offset and Tapers** drop-down and the *Simple Arc (Arc Between Elements)* tool are commonly used create Horizontal Geometry elements for the Civil Cell.

The tools found in the **Element Profiles** drop-down are commonly used to create Vertical Geometry elements for the Civil Cell elements.



The graphic below shows the dependency relationships for the T-intersection. All horizontal Civil Cell elements are directly or indirectly dependent to the "Dummy" Reference Elements:

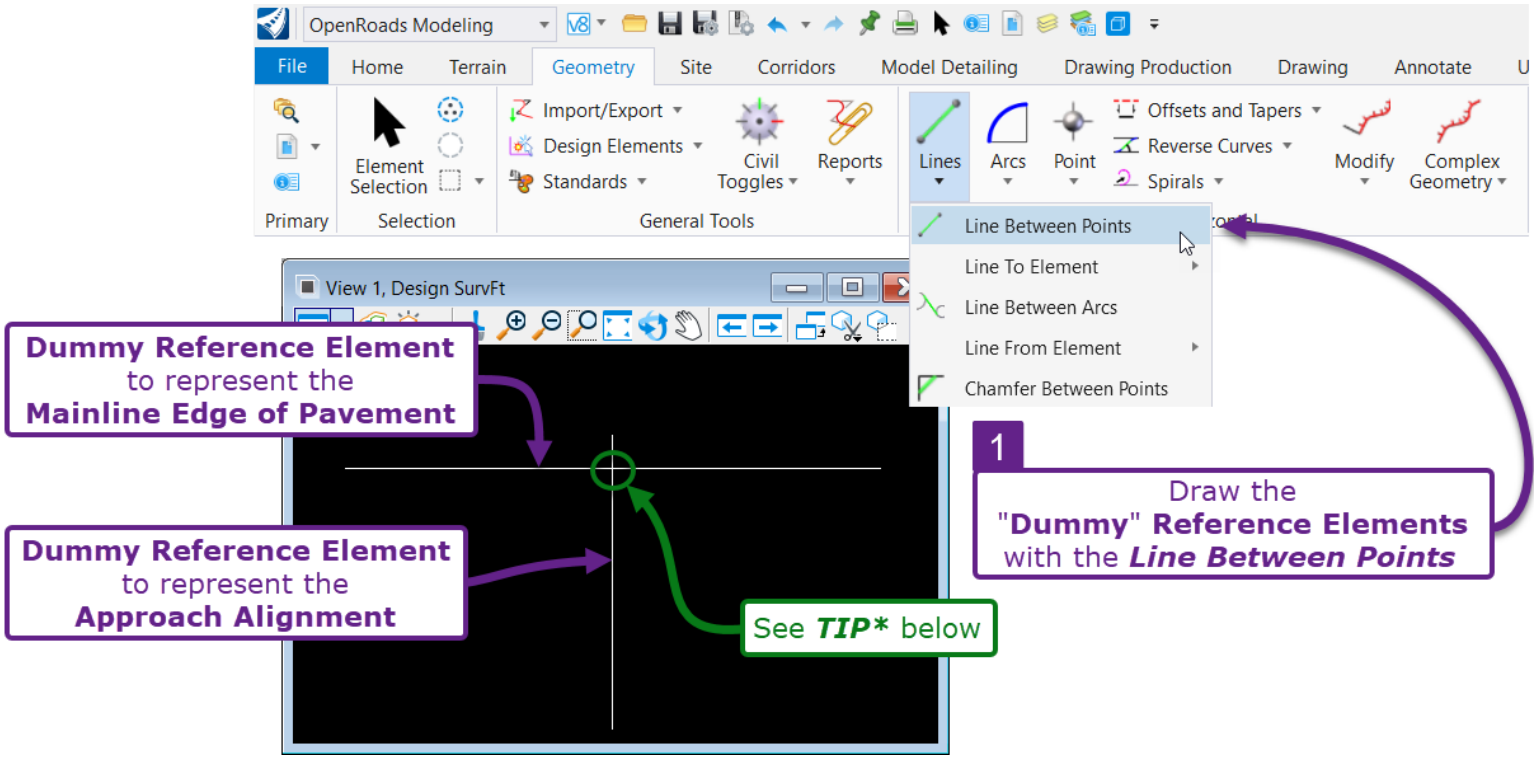


12C.3 Draw the "Dummy" Reference Elements

The first step in Civil Cell creation is to draw the "Dummy" Reference Elements. The "Dummy" Reference Elements correspond with Reference Elements to be selected when placing the Civil Cell. In this case, the **Mainline Edge of Pavement** and **Approach Alignment** are drawn as a "Dummy" Reference Elements.

For simplicity, the "Dummy" Reference Elements are drawn and conceptualized as ORD Lines. Even though the "Dummy" References are drawn as Lines, they will adjust to whatever geometry is selected in placement of the Civil Cell.

1	Using the *Line Between Points* tool, draw the approximate geometry of the "Dummy" Reference Elements. ***NOTE:*** The Feature Definition assigned to the "Dummy" Refence Elements is inconsequential. Assign the "Dummy" Reference Elements to the "No Feature Definition" setting. Elements that comprise the actual Civil Cell geometry should ALWAYS be assigned an appropriate Feature Definition. Placing the "Dummy" Reference Elements to the "No Feature Definition" setting allows the "Dummy" elements to be easily distinguished from the Civil Cell geometry elements.



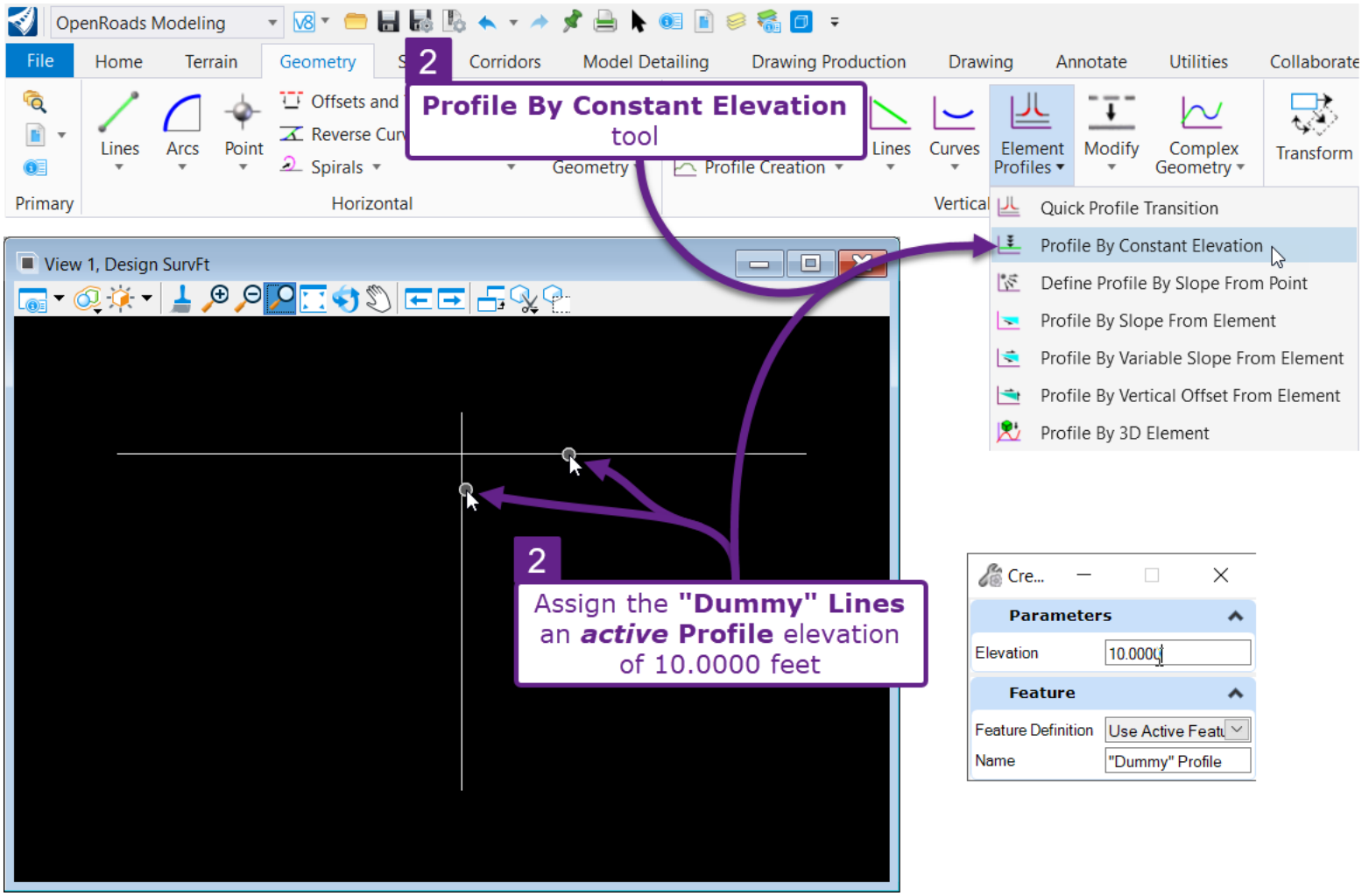
TIP*: The "Dummy" Reference Elements should NOT have dependencies to each other. Do NOT Persist Snap the "Dummy" Lines together. Do NOT offset a "Dummy" Line to create a different "Dummy" Line. In the case of the T-intersection shown above, the **Approach Alignment** should extend past the **Mainline Edge of Pavement** as to NOT form a Persist Snap dependency.

Create Vertical Profiles for the "Dummy" Reference Elements: The "Dummy" Reference Elements must contain an *active* Profile for 3D Modeling purposes.

> ***NOTE:*** It is possible to create 2D Civil Cells that rely ONLY on horizontal dependency relationships. If that is the desire, then it is unnecessary to draw a Profile for the "Dummy" Reference Elements.

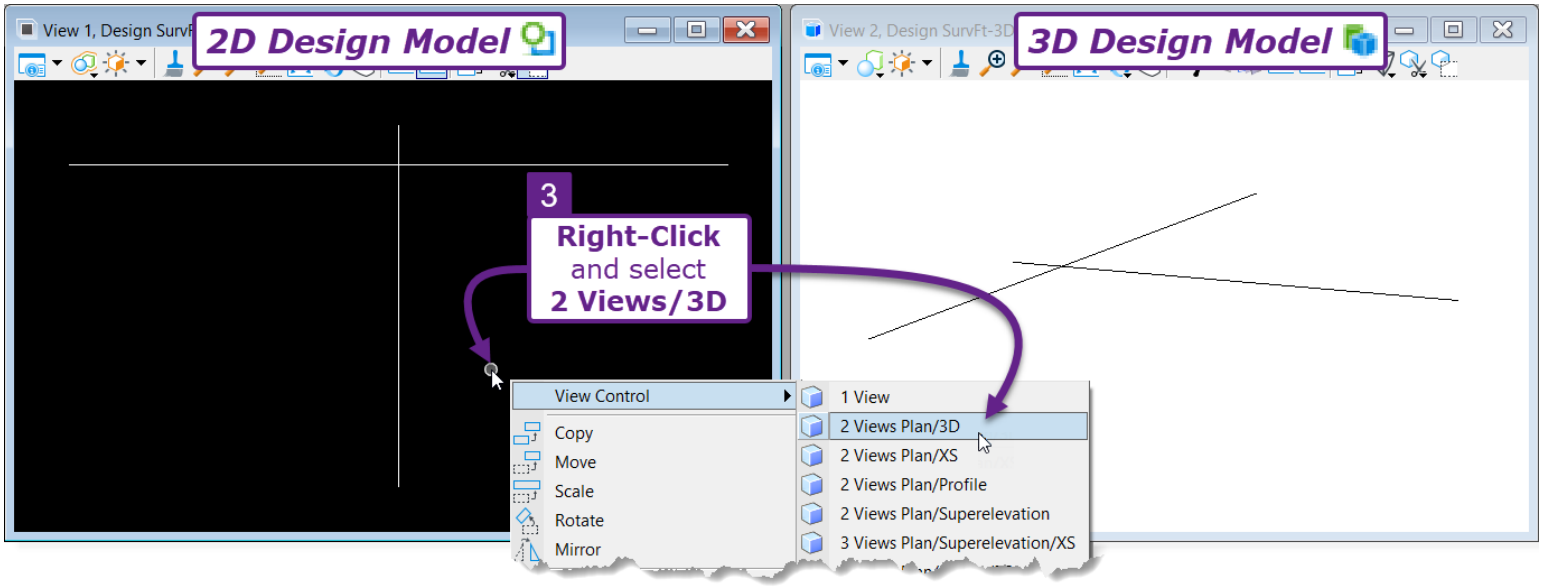
The Profile given to the "Dummy" Reference Elements is arbitrary. In actual placement of the Civil Cell, the Profile of the selected Reference Element is used.

2	Use the *Profile By Constant Elevation* tool to assign an arbitrary Profile to the "Dummy" Lines. ***TIP:*** This tool is discussed in more detail in *7F.5.b Profile By Constant Elevation*. In this case, the "Dummy" Lines are assigned a constant Profile Elevation of 10.0000 feet.



In separate *View* Windows, open the *2D Design Model* and *3D Design Model*: Watch and analyze the progress of the Civil Cell model as it is being built by opening a *View* window that displays the *3D Design Model*.

3	Right-Click anywhere in the *View* window and select **View Control 2** → **Views Plan/3D**.



NOTE: If creating a Civil Cell from a new ORD File, then the *3D Design Model* is ONLY available after the 2D "Dummy" Lines are assigned an *active* Profile (i.e., with the *Constant Profile By Elevation* tool).

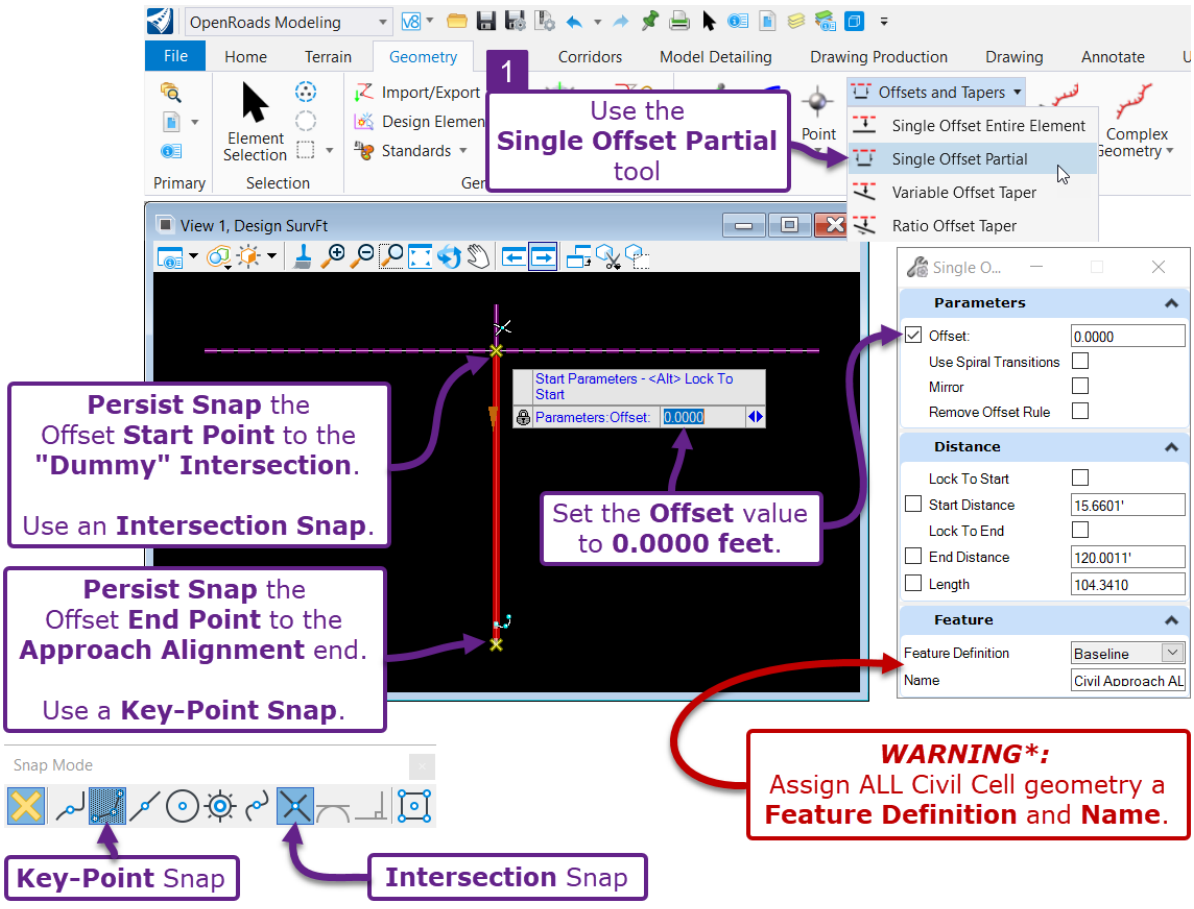
12C.4 Draw the Horizontal and Vertical Geometry for the Civil Cell

All Civil Cells geometry must be directly or indirectly dependent to the "Dummy" Reference Elements.

> ***WARNING*:** When creating Civil Cells, all elements should be assigned an appropriate **Feature Definition** and **Name**. Both the Feature Definition and Name help other Users understand the construction of the Civil Cell in placement, modification, and analysis.

Approach Alignment Element – Horizontal Geometry: In the case of T-intersection, an Offset Alignment Element (shown in red below) must be created directly atop of the **Approach Alignment** "Dummy" Line. Use the *Single Offset Partial* tool with the offset set to 0.0000 feet. The Start Point of the Offset Element is **Persist Snapped** to the intersection of the two "Dummy" Reference Lines. The End Point is Persist Snapped to the end point of the Approach Alignment.

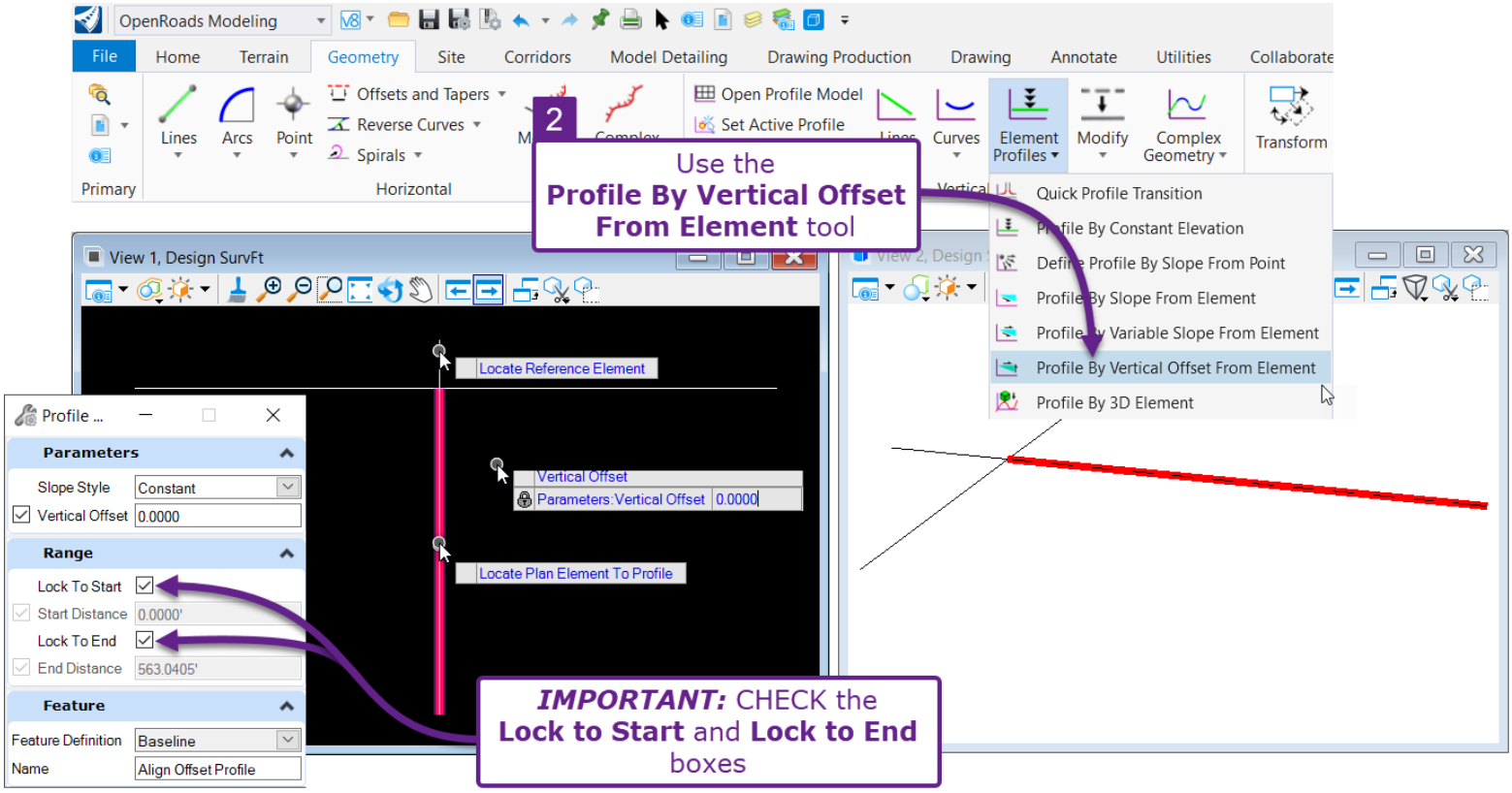
1	Use the *Single Offset Partial* tool to place an Offset Approach Alignment Element directly atop of the **Approach Alignment**. This tool is discussed in *7D.3.b Single Offset Partial*. Use an **Offset** value of 0.0000 feet. Use an **Intersection Persist Snap** to snap the start point of the Offset Alignment Element at the intersection of the two "Dummy" Reference Elements Use a **Key-Point Persist Snap** to snap the end point to the End Point of the "Dummy" Lines.



NOTE: The Approach Alignment element created in this step could be a simple ORD Line. However, the *Single Offset Partial* tool is more flexible. In placement of the Civil Cell, the selected Reference Element may be a Complex Element that contains both lines and curves. The *Offset* tool will mimic whatever geometry is selected for the Reference Element.

Approach Alignment Element – Vertical Geometry: Similar to the horizontal geometry, the Profile for the Alignment Element (red) line should exactly match the Profile for the "Dummy" Line. This is accomplished by using the *Profile By Vertical Offset from Element* tool with the Vertical Offset value set to 0.0000 feet. Using this tool, the profile of the Offset Element and Approach Alignment are linked.

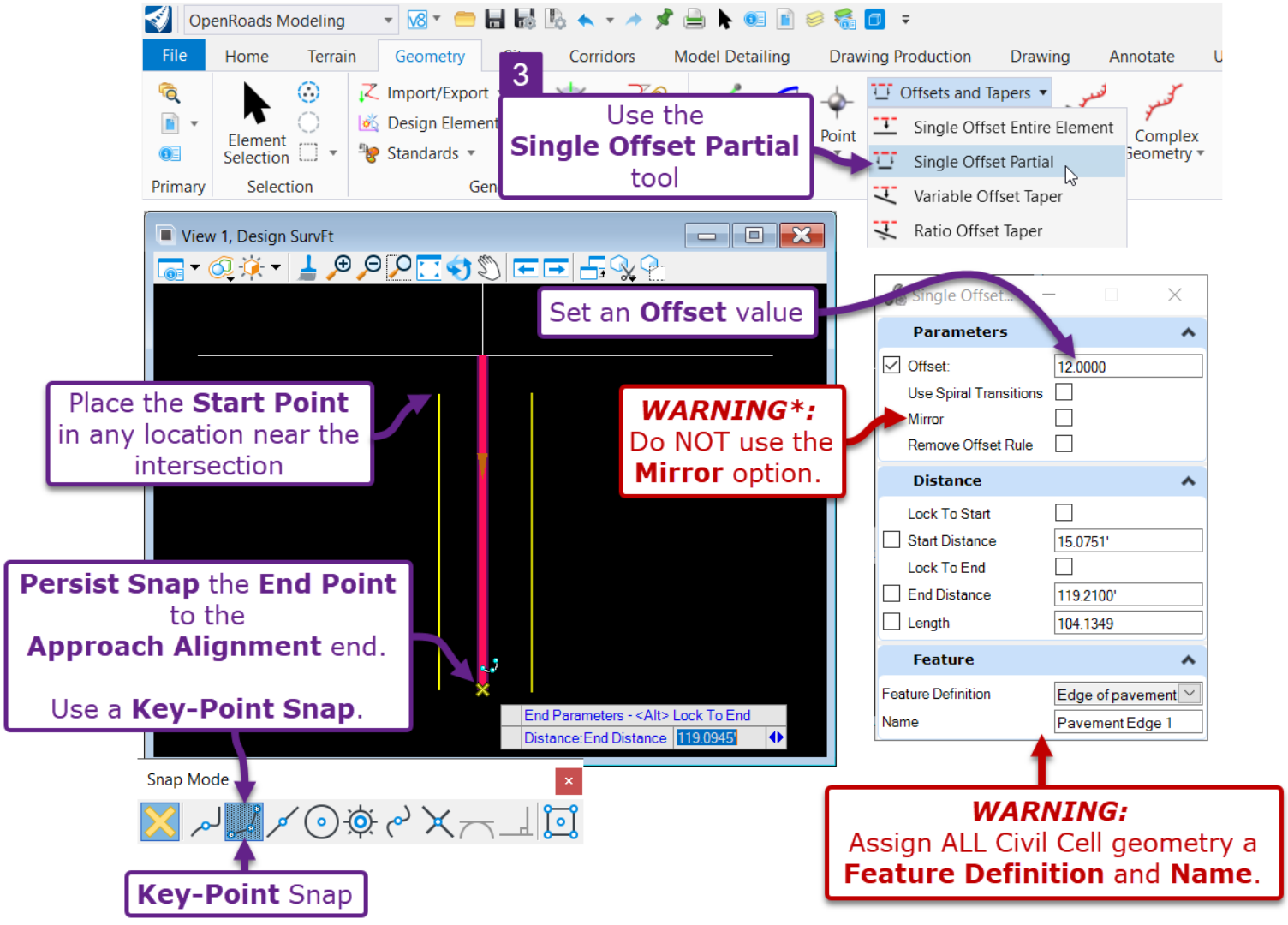
2	Use the *Profile By Vertical Offset From Element* tool. This tool is discussed in *7F.5.f Profile By Vertical Offset From Element*. Select the Approach Alignment Element as the "Locate Plan Element to Profile". Select the "Dummy" Reference Element as the "Locate Reference Element". Set the Vertical Offset Value to 0.0000 feet. ***IMPORTANT:*** CHECK the "Lock to Start" and "Lock to End" boxes in the *Dialogue Box*. This ensures that the entire Alignment Element is profiled.



Pavement Edge Lines - Horizontal Geometry: Use the *Single Offset Partial* tool to create the Pavement Edge Lines (shown in yellow below) by offsetting the Approach Alignment.

3	Use the *Single Offset Partial* tool to offset the Approach Alignment (shown in red below) and create the Pavement Edge Lines. This tool is discussed in *7D.3.b Single Offset Partial*. In this case an **Offset** value of 12.0000 feet is used. See ***NOTE:*** below Place the Start Point in any location near to the "Dummy" Lines intersection. The Start Point is inconsequential because in later steps the **Approach Returns** arc element will fillet and trim down the length. Use a **Key-Point Persist Snap** to snap the end point to the End Point of the Approach Alignment (red line). ***WARNING*:** Do NOT use the **Mirror** option to create the opposite Pavement Edge Line. The Persist Snap will ONLY form between the first Pavement Edge Line and NOT apply to the mirrored Pavement Edge Line. Reuse this tool to create the opposite Pavement Edge Line.

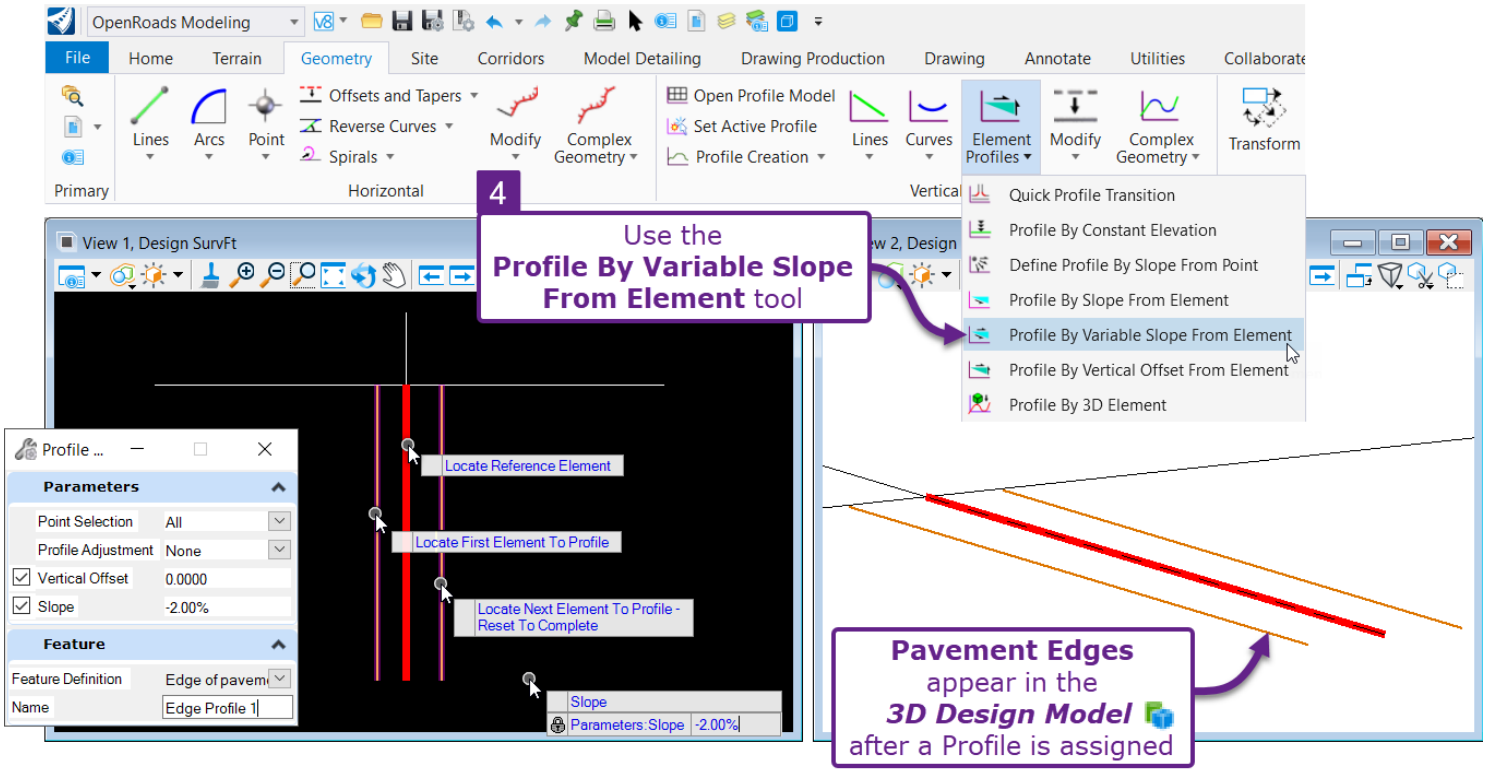
NOTE: The Offset value is inconsequential. After the Civil Cell is placed, the Offset value can be modified to any width value.



Pavement Edge Lines – Vertical Geometry: Use the *Profile By Variable Slope from Element* to project the profile of the Approach Alignment (red) on to the Pavement Edge Lines (yellow). In this case, the Approach Alignment profile is projected downwards at a -2.0000% to form a crown in the pavement surface.

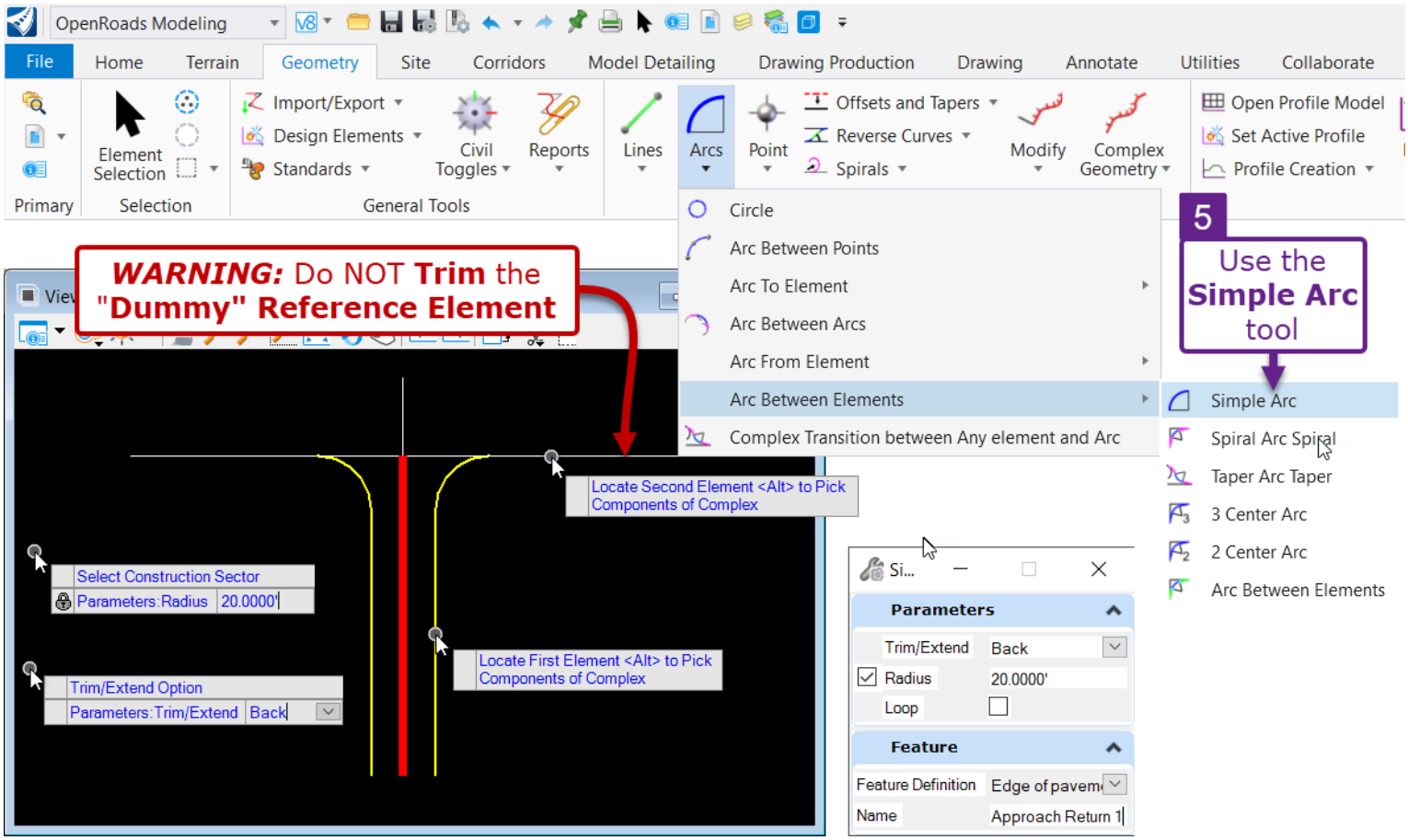
4	Use the *Profile By Variable Slope from Element* tool. This tool is discussed in *7F.5.e Profile By Variable Slope From Element*. Select the **Pavement Edge Lines** as the "Elements to Profile". Select the **Approach Alignment** (red line) as the "Reference Element". Specify a projection **Slope**. In this case, -2.0000% is used. ***TIP:*** Use a negative slope value to project the Approach Alignment downwards.

NOTE: The projection Slope value is inconsequential. After the Civil Cell is placed, the projection Slope value can be changed to any value.



Approach Returns – Horizontal Geometry: Use the *Simple Arc* (Arc Between Elements) to create a circular fillet between the **Pavement Edge Lines** and the **Mainline Pavement Edge** ("Dummy" Reference Element).

5	Use the *Simple Arc* (Arc Between Elements) tool. This tool is discussed in *7D.1.b.vi(a) Simple Arc*. Select the **Pavement Edge Lines** as the "First Element". Select the **Mainline Pavement Edge ("Dummy" Reference Element)** as the "Second Element". Specify a **Radius** value. ***NOTE:*** The radii value is inconsequential and can be changed after the Civil Cell is placed. Use the **Back** option to **Trim/Extend** the **Pavement Edge Line**. ***WARNING:*** Do NOT Trim the "Dummy" Reference Element.

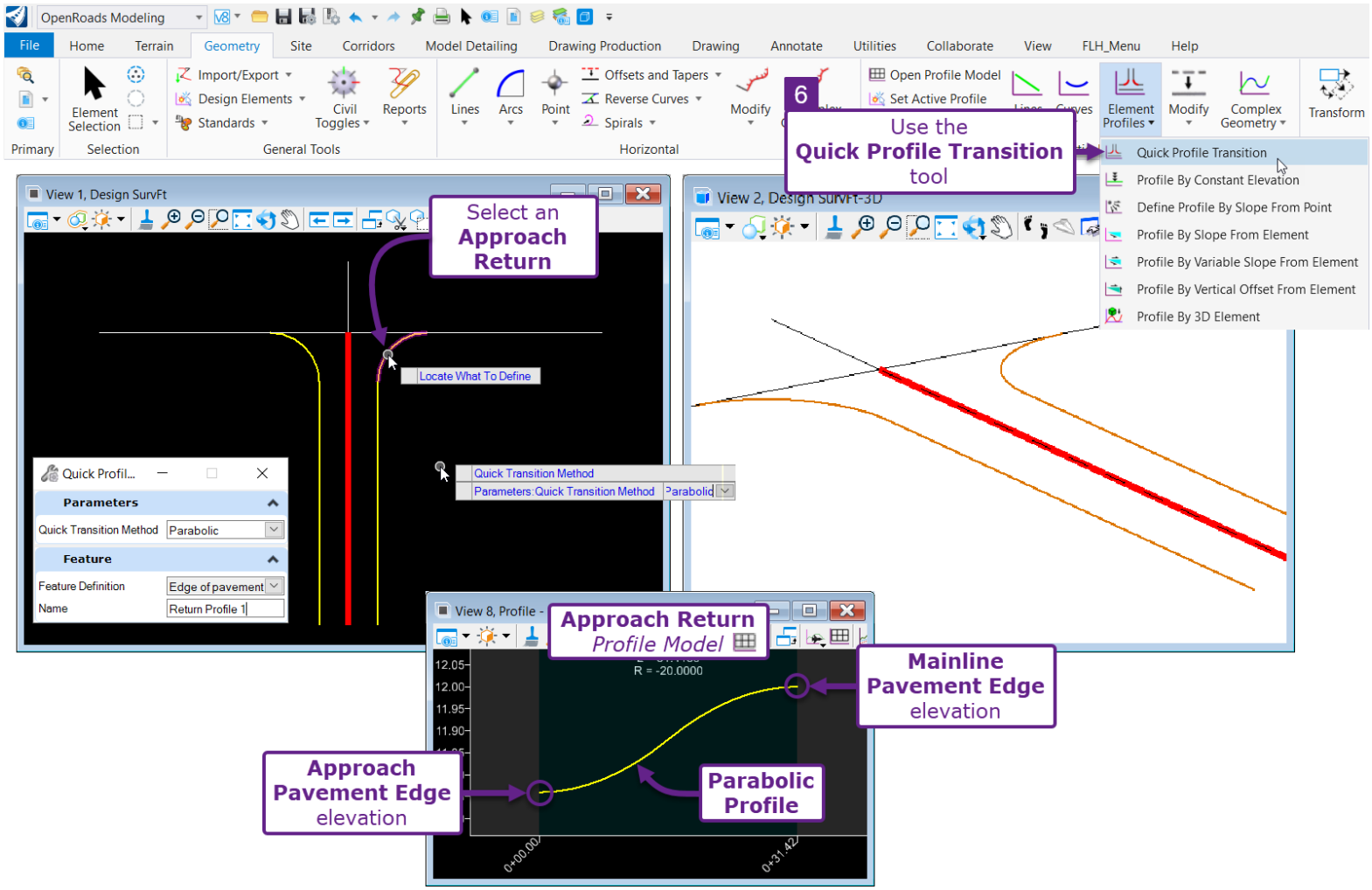


Approach Returns – Vertical Geometry:

OPTION 1: Use the *Quick Profile Transition* tool to automatically create Profiles for the Approach Returns. The *Quick Profile Transition* tool is specifically designed to profile a *Simple Arc* element created between two Lines that contain *active* Profiles.

This tool works by selecting a horizontal Approach Return element. This tool analyzes the dependent elements to automatically draw the arc Profile.

6	Use the *Quick Profile Transition* tool. This tool is discussed in *7F.5.a Quick Profile Transition*. Select the **Approach Return** as the "Locate What To Define". Select **Parabolic** as the "Quick Transition Method".



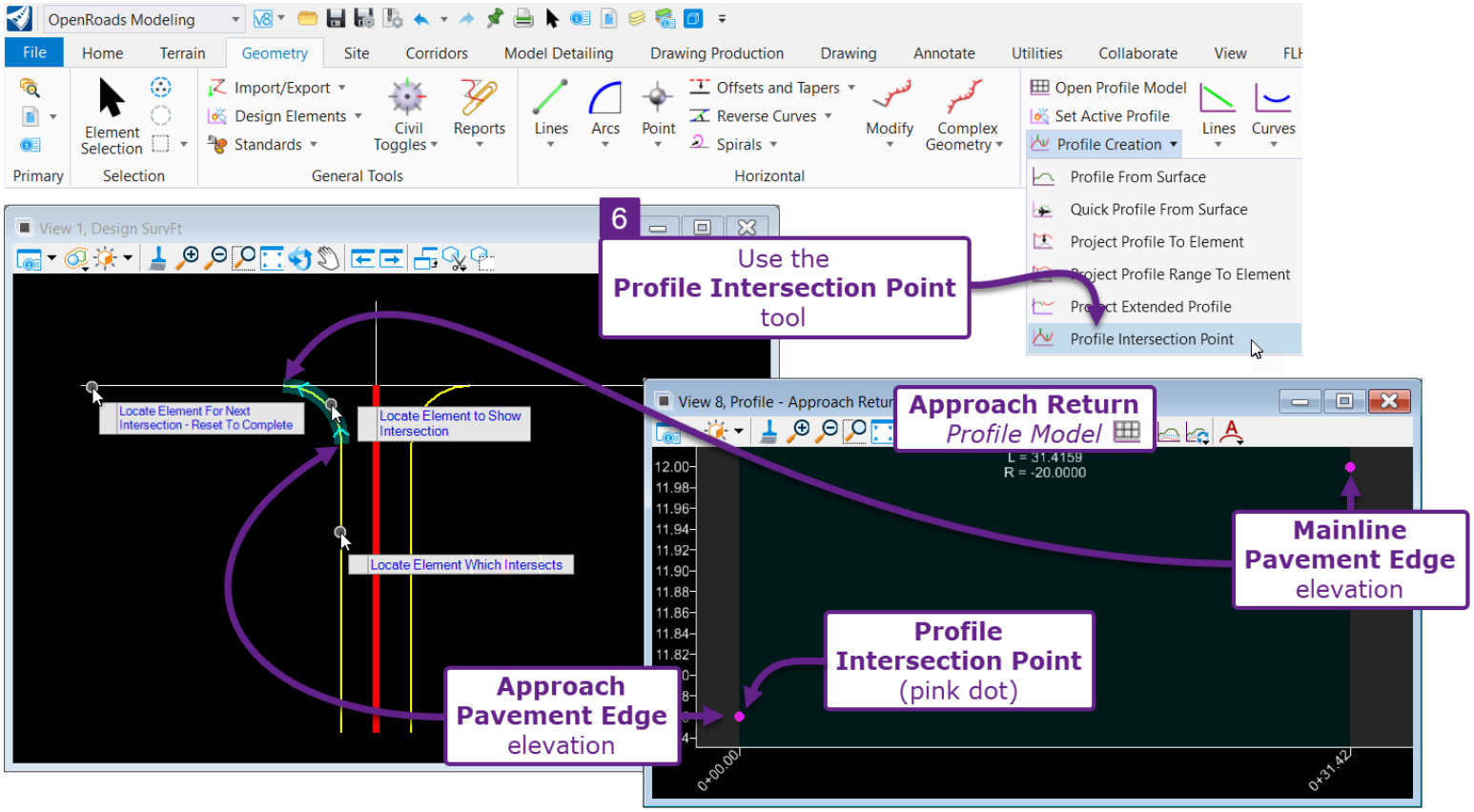
OPTION 2: Manually draw the profile using Profile Lines and Curve tools. For the Profile elements to be dynamic, use **Persist Snaps** in conjunction with the *Profile Intersection Point* tool.

As shown below, *Profile Intersection Points* (pink dots) mark the elevation and position of the Mainline Pavement Edge and Approach Pavement Edge. When drawing Profile Lines and Curves, place Persist Snaps on the *Profile Intersection Points*.

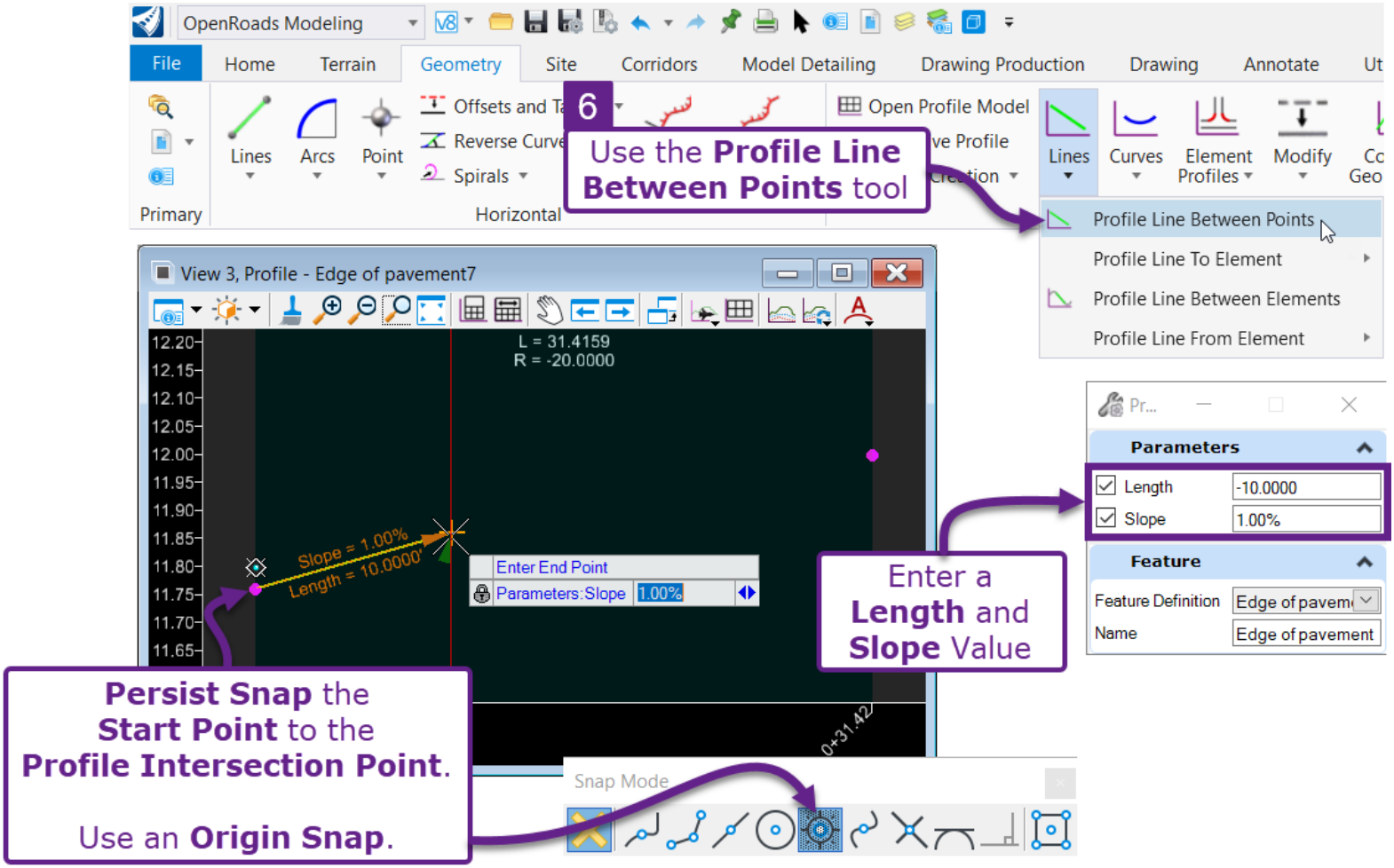
Profile Intersection Points are dynamic. If the intersection locations are changed (i.e., by changing the radius of the Approach Return), then the Profile Intersection Points will move to accommodate the new elevations. Elements that are Persist Snapped to the Profile Intersection Points will also move.

IMPORTANT: Use the **Origin Point** snap type when snapping to the *Profile Intersection Point*. Other snap types (i.e., Key-Point Snap or Nearest Snap) will NOT form a dynamic Persist Snap relationship to the *Profile Intersection Point*.

6	Open the *Profile Model* for the Approach Return in a different *View* window. Use the *Profile Intersection Point* tool. This tool is discussed in *7F.4.f Profile Intersection Point*. Select the Approach Return as the "Element to Show Intersection". Select the **Mainline Pavement Edge** ("Dummy" Reference Element) and the **Approach Pavement Edge** as the "Elements which Intersects".



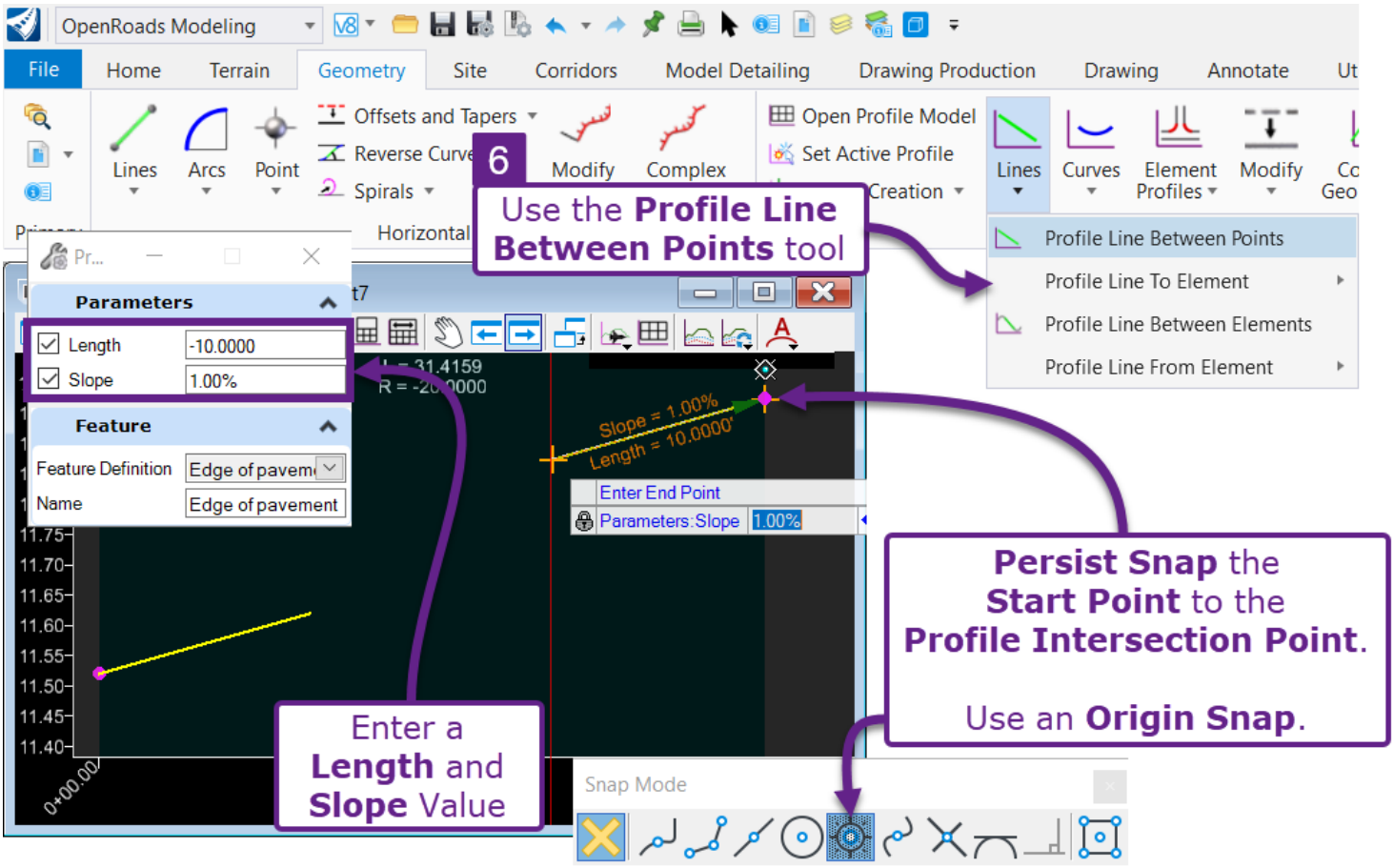
As shown below, the *Profile Line Between Points* tool is used to snap the Start Point to the Profile Intersection Point using an **Origin Point** snap.



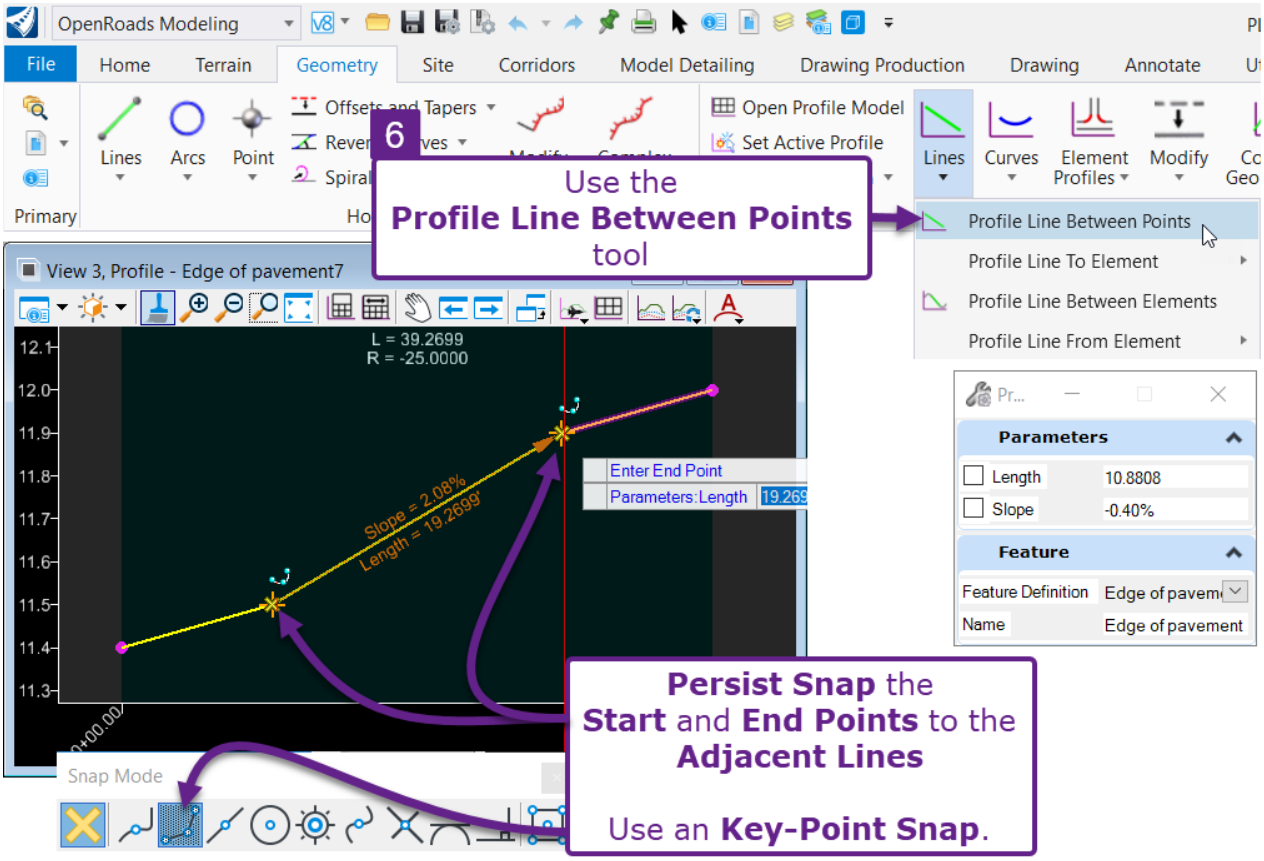
TIP: In the Dialogue Box, enter a Length and Slope for the Line. When the Length and Slope boxes are CHECKED, then Civil Rules are created to maintain the Length and Slope values if the Profile Intersection Point is to move. In the graphic above, the Profile Line will ALWAYS be 10 feet in length and set at 1.00% slope if the Profile Intersection Point was to move because the Length and Slope boxes are CHECKED.

Repeat the same procedure to create a Profile Line from the other Profile Intersection Point.

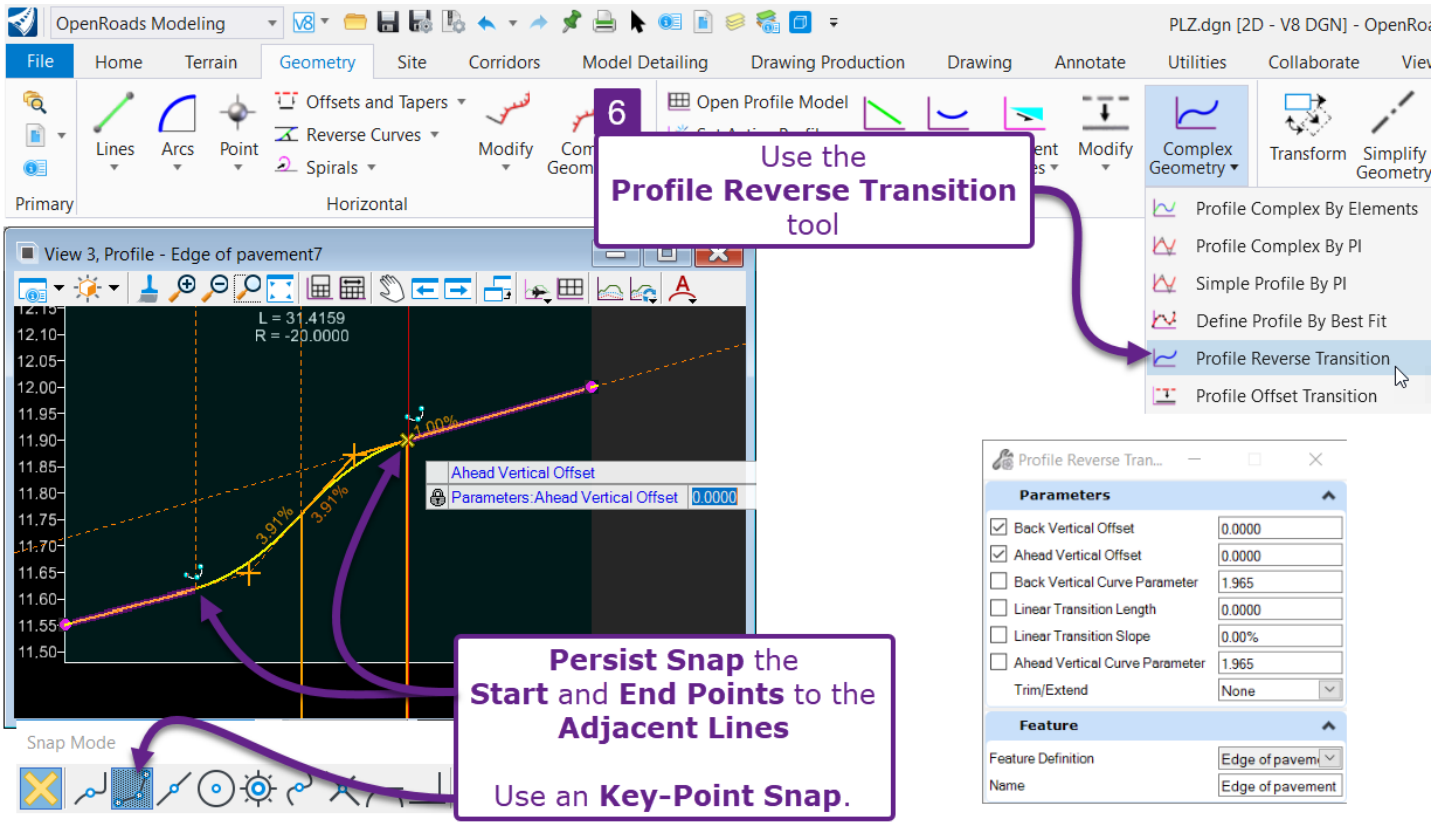
For this Profile Line at the end of the Profile Model, *Profile Model* begin by placing Start Point at the Profile Intersection Point. Draw the Profile Line from right to left.



Connect the two lines. This can be accomplished by drawing an additional line, that is **Persist Snapped** to the adjacent lines.

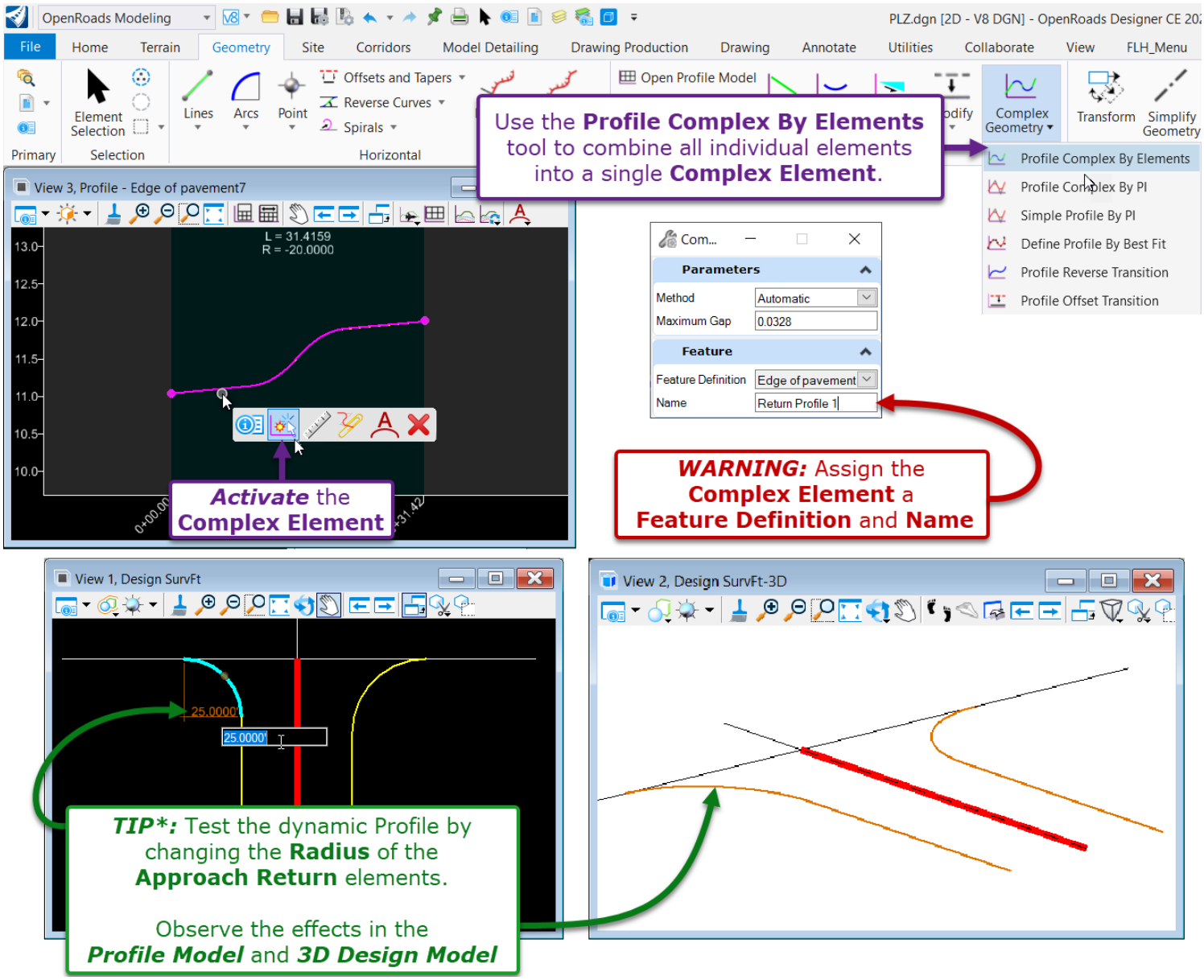


Alternatively, use the *Profile Reverse Transition* tool to create a sag/crest curve between the adjacent lines. **Persist Snap** the begin and end of the *Profile Reverse Transition* element to the adjacent lines.



Use the *Profile Complex By Elements* tool to combine all individual Profile elements into a single Complex Element. Then, *active* the Complex Element.

WARNING: Assign the Complex Element a Feature Definition and Name.

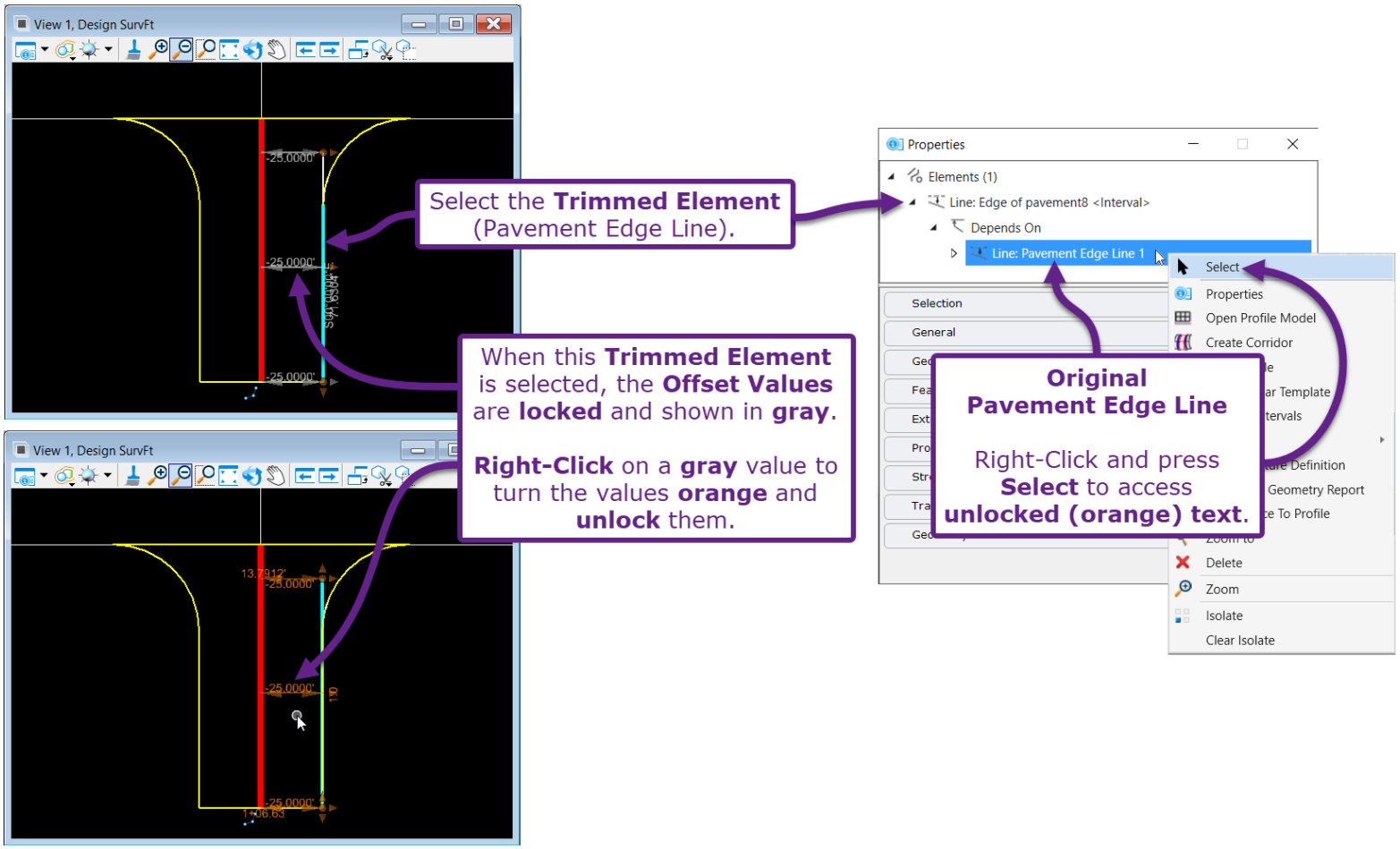


***TIP*:** After creating the Approach Return Profile, test the dynamic Profile. In the *2D Design Model*, select an **Approach Return** element and change its radius. Observe the dynamic effects in the *Profile Model* and *3D Design Model*.

If the Approach Return Profile was created with the appropriate **Persist Snaps** and **Civil Rules**, then the Profile will dynamically adjust.

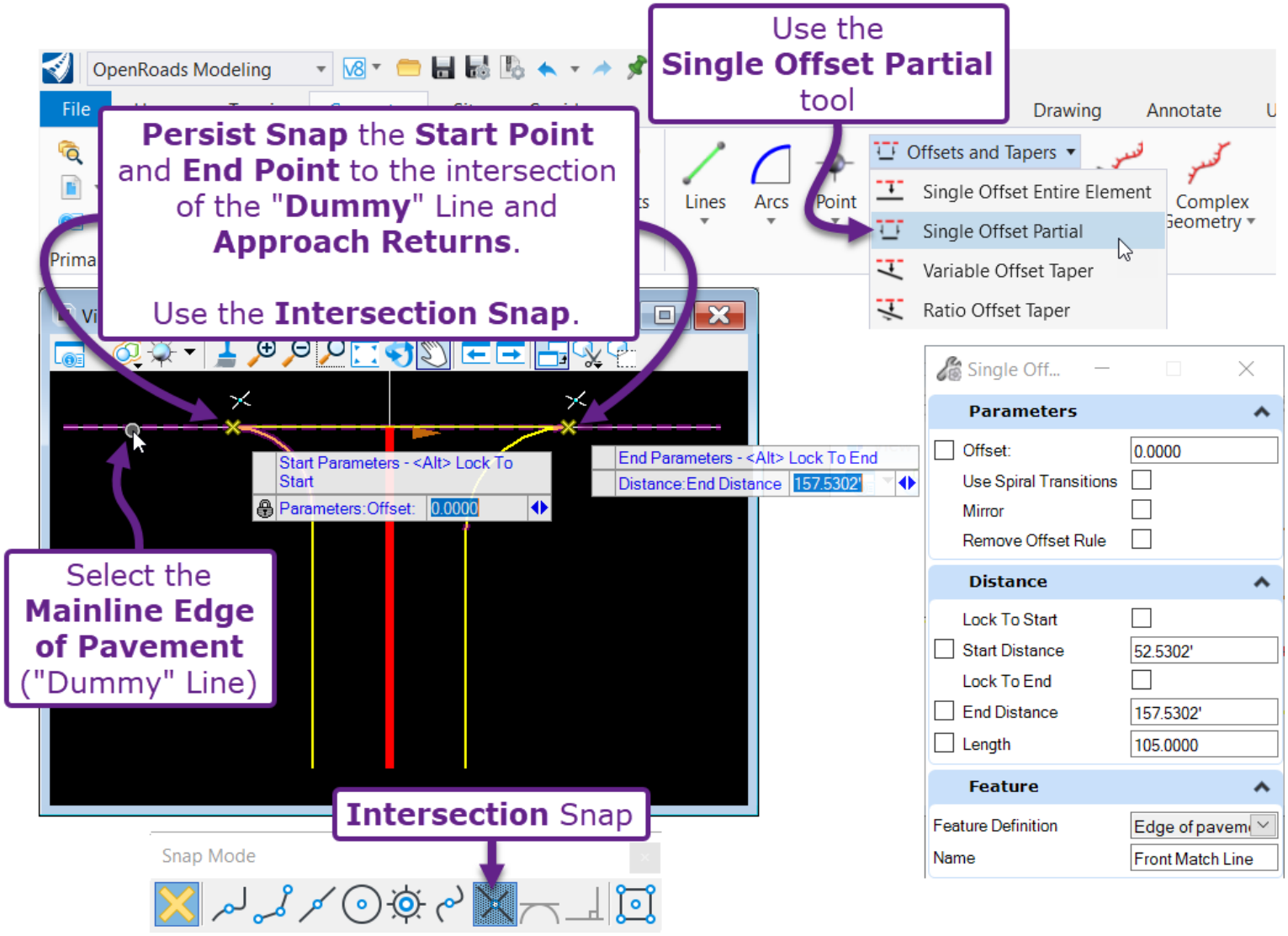
Also, test the dynamic geometry by changing the Offset Value for the **Pavement Edge Lines**. Initially, when a Pavement Edge Line is selected, the Offset values (manipulator text) are shown in gray and locked. Right-Click on the gray text to unlock it and turn it orange. When the manipulator text is orange, the Offset values can be changed.

BACKGROUND INFORMATION: After the **Approach Return** is created with the *Simple Arc* tool, the **Pavement Edge Line** is trimmed. The trimming operation causes the original Pavement Edge Line element to be covered up by an Interval element. The original Pavement Edge Line element is NOT deleted, it is simply underneath the Interval element. The original Pavement Edge Line element is shown in the Properties box by expanding the "Depends On" drop-down.



Front Match Line – Horizontal Geometry: Use the *Single Offset Partial* tool to create the **Front Match Line** from the **Mainline Pavement Edge** ("Dummy" Reference Element). Use an **Offset** value of 0.0000. The Start and End Point must be **Persist Snapped** to the intersection of the "Dummy" Reference Element and Approach Returns.

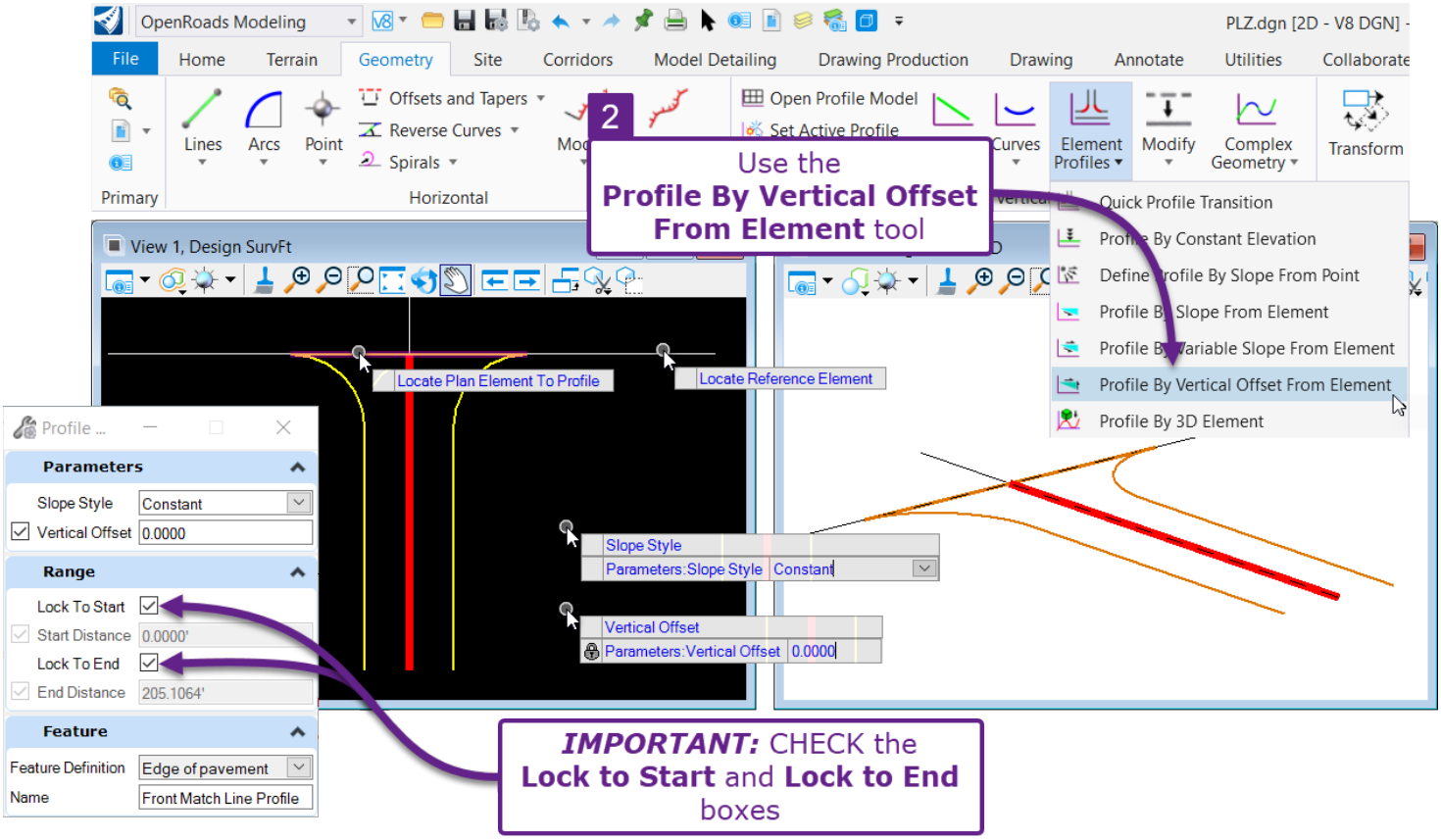
1	Use the *Single Offset Partial* tool to place the **Front Match Line** directly on top of the **Mainline Pavement Edge** ("Dummy" Reference Element). This tool is discussed in *7D.3.b Single Offset Partial*. Use an **Offset** value of 0.0000 feet. Use an **Intersection Persist Snap** to snap the Start and End points to the intersection of the of the "Dummy" Reference Element and Approach Returns.



NOTE: In this step, the *Single Offset Partial* tool is used instead of the *Line Between Points* tool. The *Single Offset Partial* tool is preferred because it will mimic the exact geometry of the **Mainline Pavement Edge** during placement of the Civil Cell. For example, if the selected Mainline Pavement Edge was on a curve, then the **Front Match Line** will be created as a circular element.

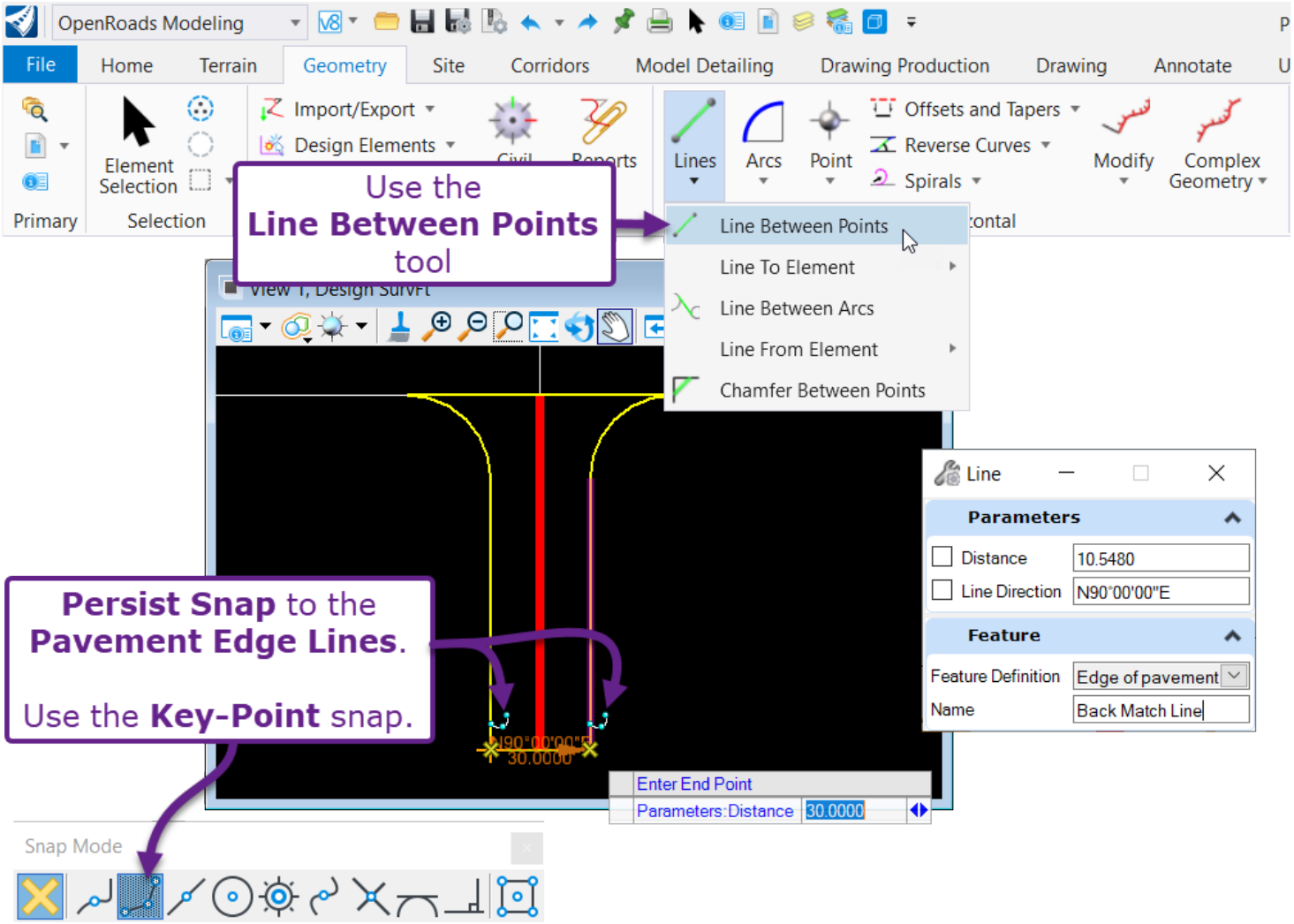
Front Match Line – Vertical Geometry: The Profile for the Front Match Line should exactly match the "Dummy" Line profile. This is ensured by using the *Profile By Vertical Offset from Element* tool with the Vertical Offset value set to 0.0000 feet. Using this tool, the profile of the Front Match Line and "Dummy" Line are linked.

2	Use the *Profile By Vertical Offset From Element* tool. Select the Front Match Line as the "Locate Plan Element to Profile". Select the "Dummy" Reference Element as the "Locate Reference Element". Set the Vertical Offset Value to 0.0000 feet. ***IMPORTANT:*** CHECK the "Lock to Start" and "Lock to End" boxes in the *Dialogue Box*. This ensures that the entire Front Match Line is profiled.



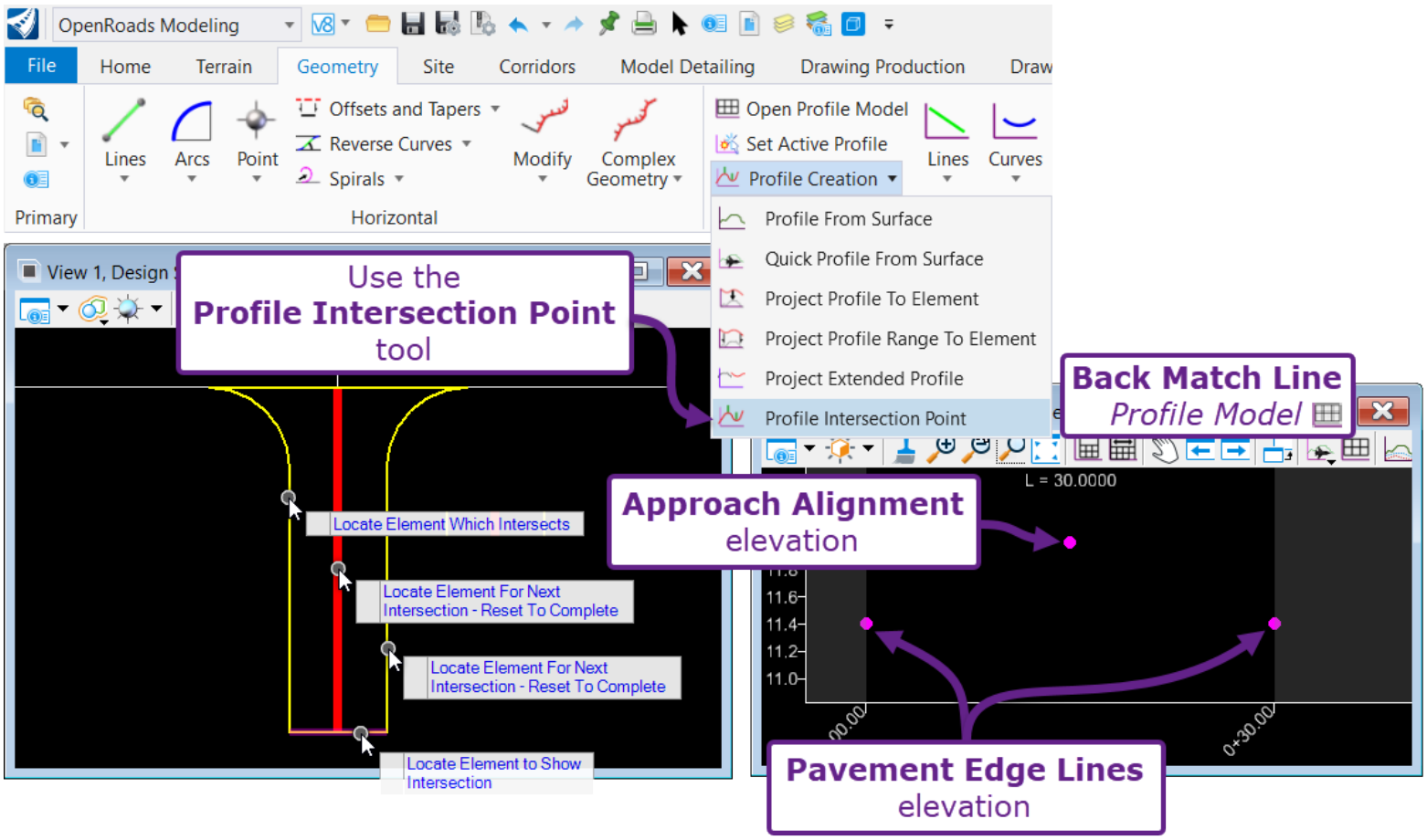
Back Match Line – Horizontal Geometry: Use the *Line Between Points* tool to create the **Back Match Line**. To create the Line element, **Persist Snap** to the End Points of the **Pavement Edge Lines**.

1	Use the *Line Between Points* tool. Persist Snap to the End Points of the Pavement Edge Lines.



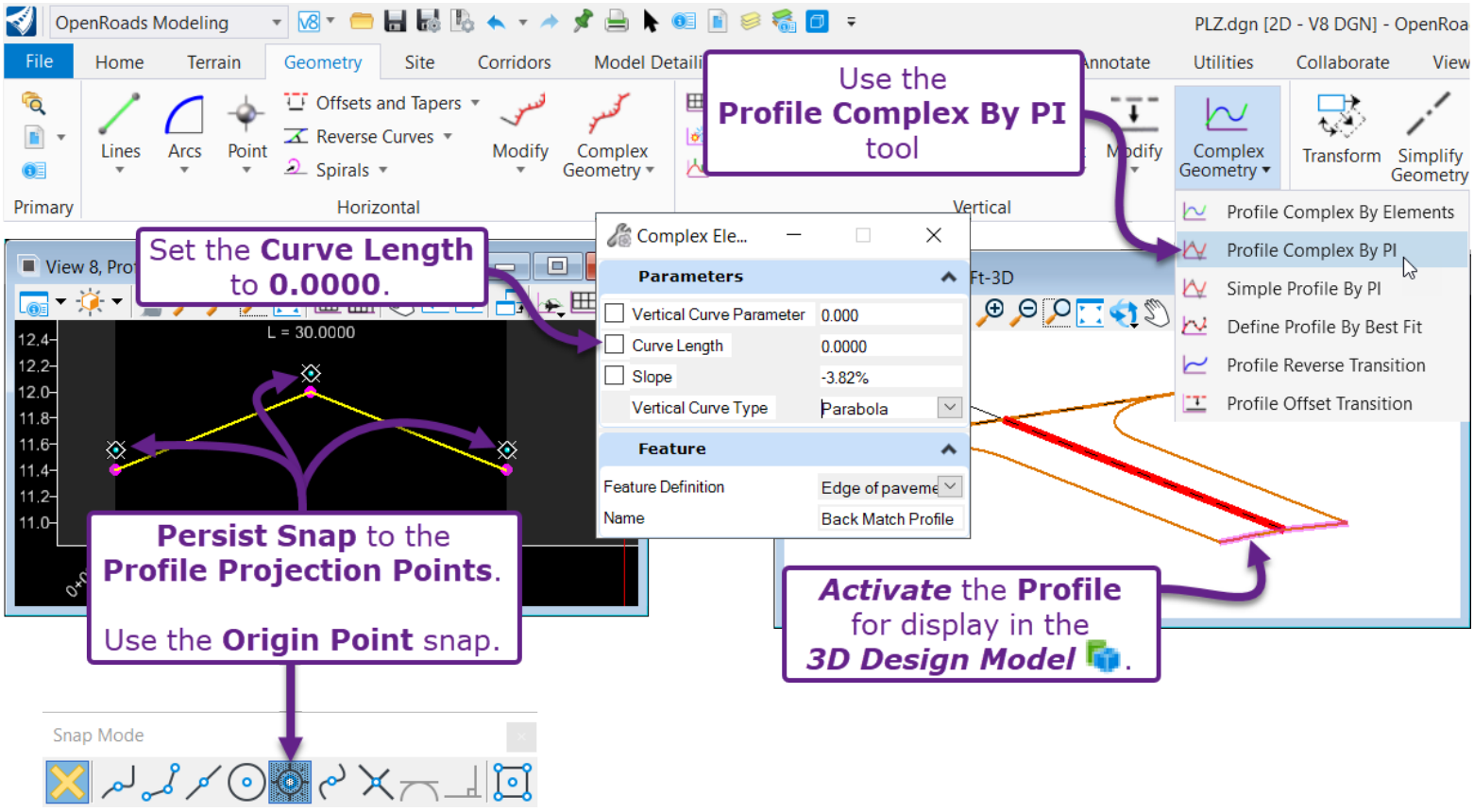
Back Match Line – Vertical Geometry: The Profile for the **Back Match Line** is dependent on the elevations of the **Pavement Edge Lines** and **Approach Alignment**. Use the *Profile Intersection Point* tool to project the elevations of the Pavement Edge Lines and Approach Alignment into the *Profile Model* of the **Back Match Line**

1	Open the *Profile Model* for the Back Match Line in a different *View* window. Use the *Profile Intersection Point* tool. Select the Back Match Line as the "Element to Show Intersection". Select the **Pavement Edge Lines** and **Approach Alignment** as the "Elements which Intersects".



Use the *Profile Complex By PI* tool to draw a Profile element for the **Back Match Line**. When using this tool, set the **Curve Length** to 0.000 to create a sharp deflection point between the adjacent line segments.

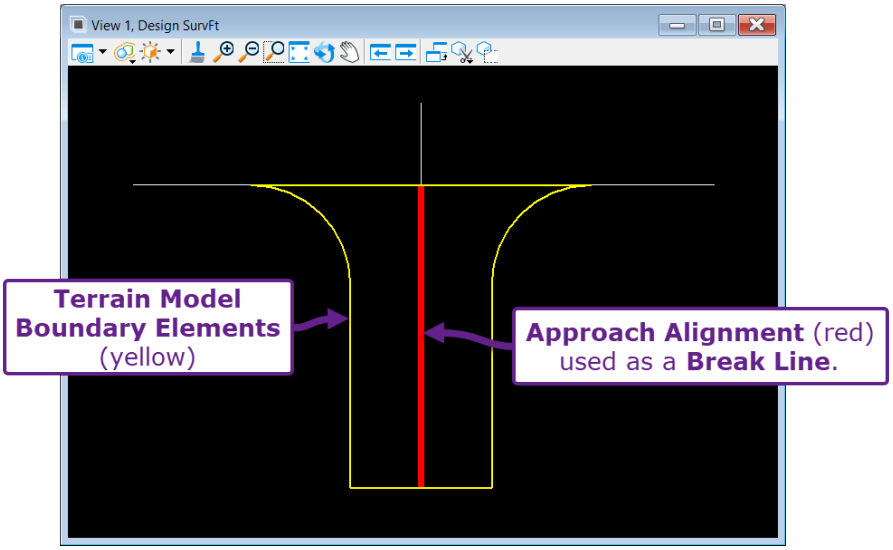
1	Use the *Profile Complex By PI* tool. Set the **Curve Length** to 0.0000. **Persist Snap** to the *Profile Projection Points*. Use the **Origin Point** snap type when snapping to the *Profile Projection Points*.



12C.5 Create the Terrain Model and Surface Template

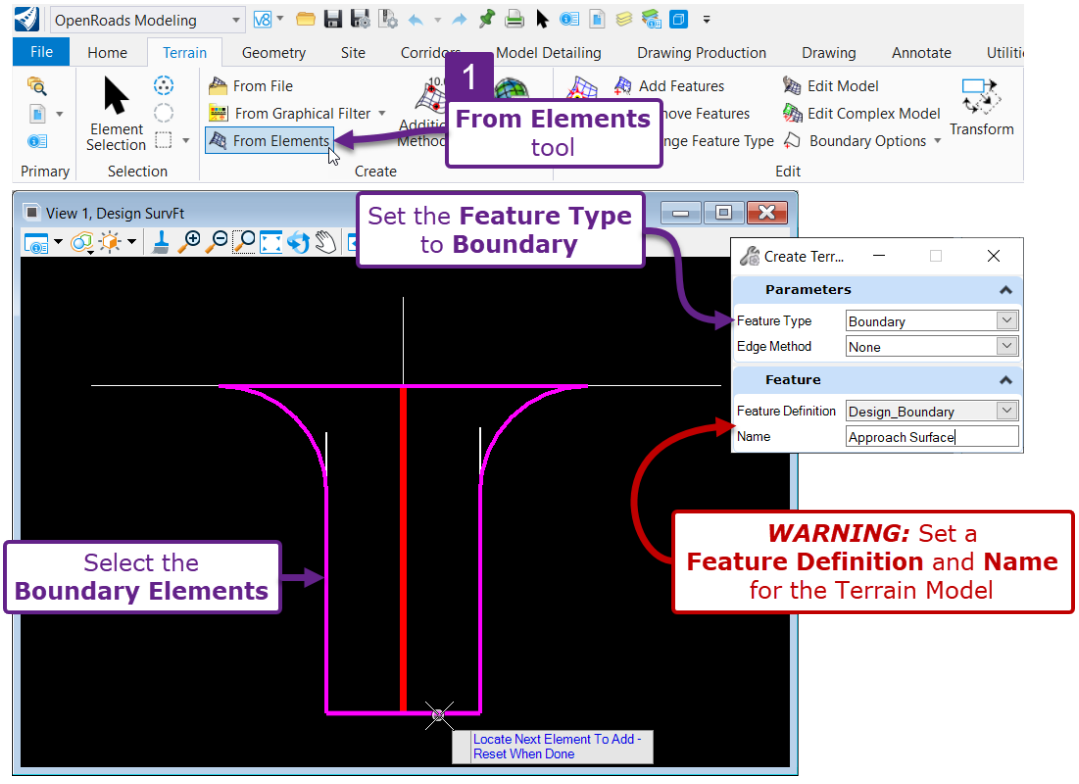
A Terrain Model and Surface Template is used to model the pavement surface of the approach.

For more information on Terrain Models and Surface Template creation, see *11A.2 Surface Template and Terrain Models – Process Overview*.



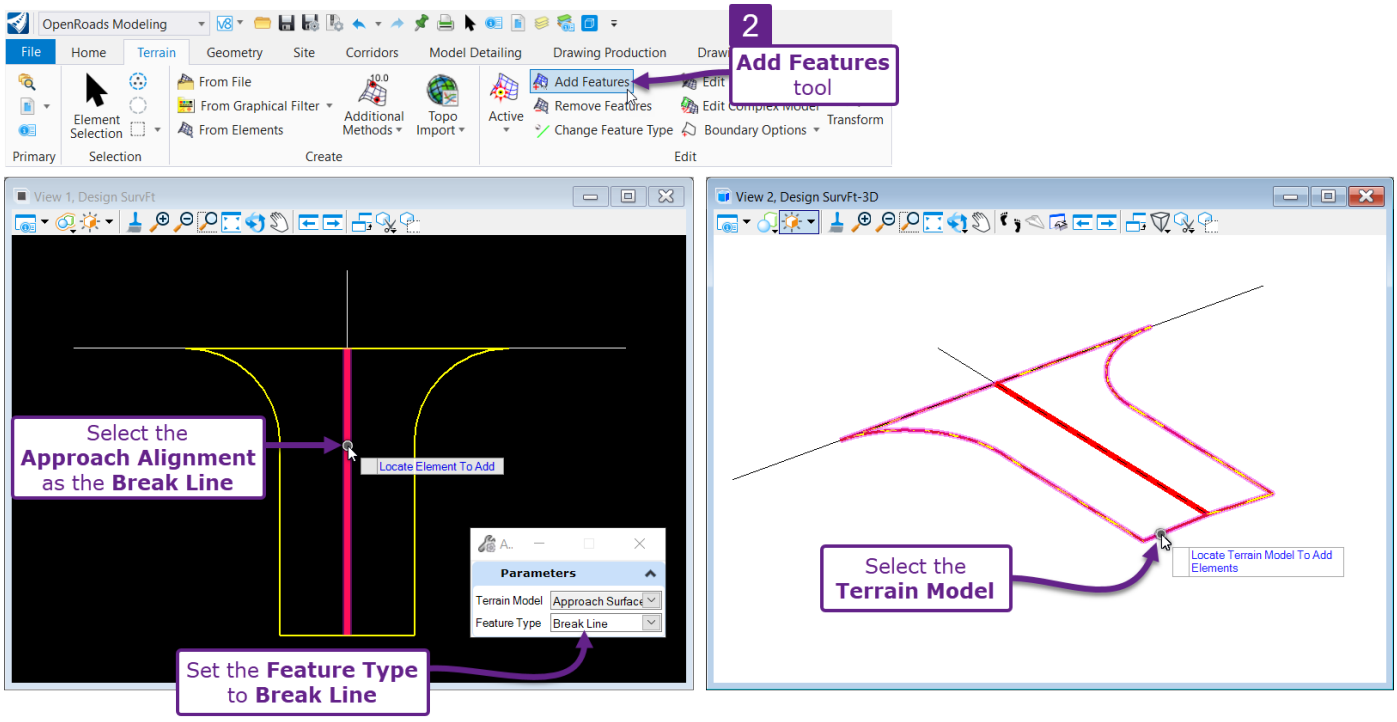
Creating the Terrain Model:

1	From the Ribbon, select the *From Elements* tool: [***OpenRoads Modeling*** → ***Terrain*** → ***Create***]. Set the Feature Type to Boundary. Select the Boundary Elements (shown in pink below).

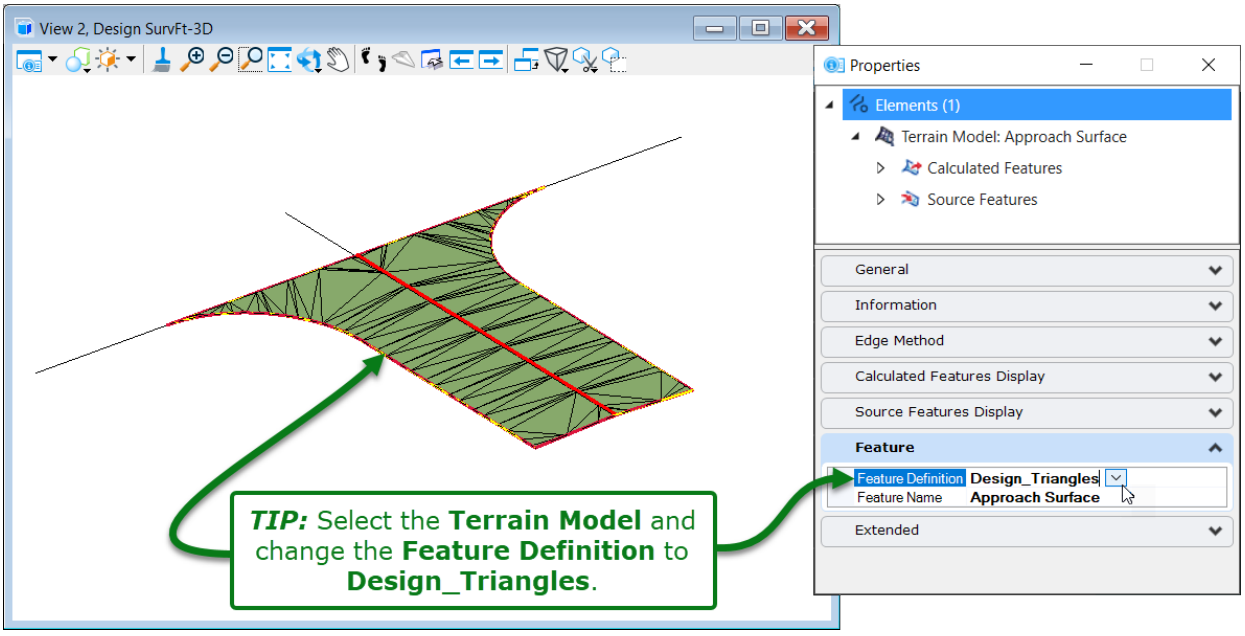


Add the Approach Alignment to the Terrain Model as a Break Line:

2	From the Ribbon, select the *Add Features* tool: [***OpenRoads Modeling*** → ***Terrain*** → ***Edit***]. Select the **Terrain Model**. ***NOTE:*** The Terrain Model can be directly selected from the *3D Design Model*. Set the **Feature Type** to **Break Line**. Select the **Approach Alignment** as the **Break Line**.



TIP: Ensure the Terrain Model is triangulating correctly by changing the **Feature Definition** to **Design_Triangles**.



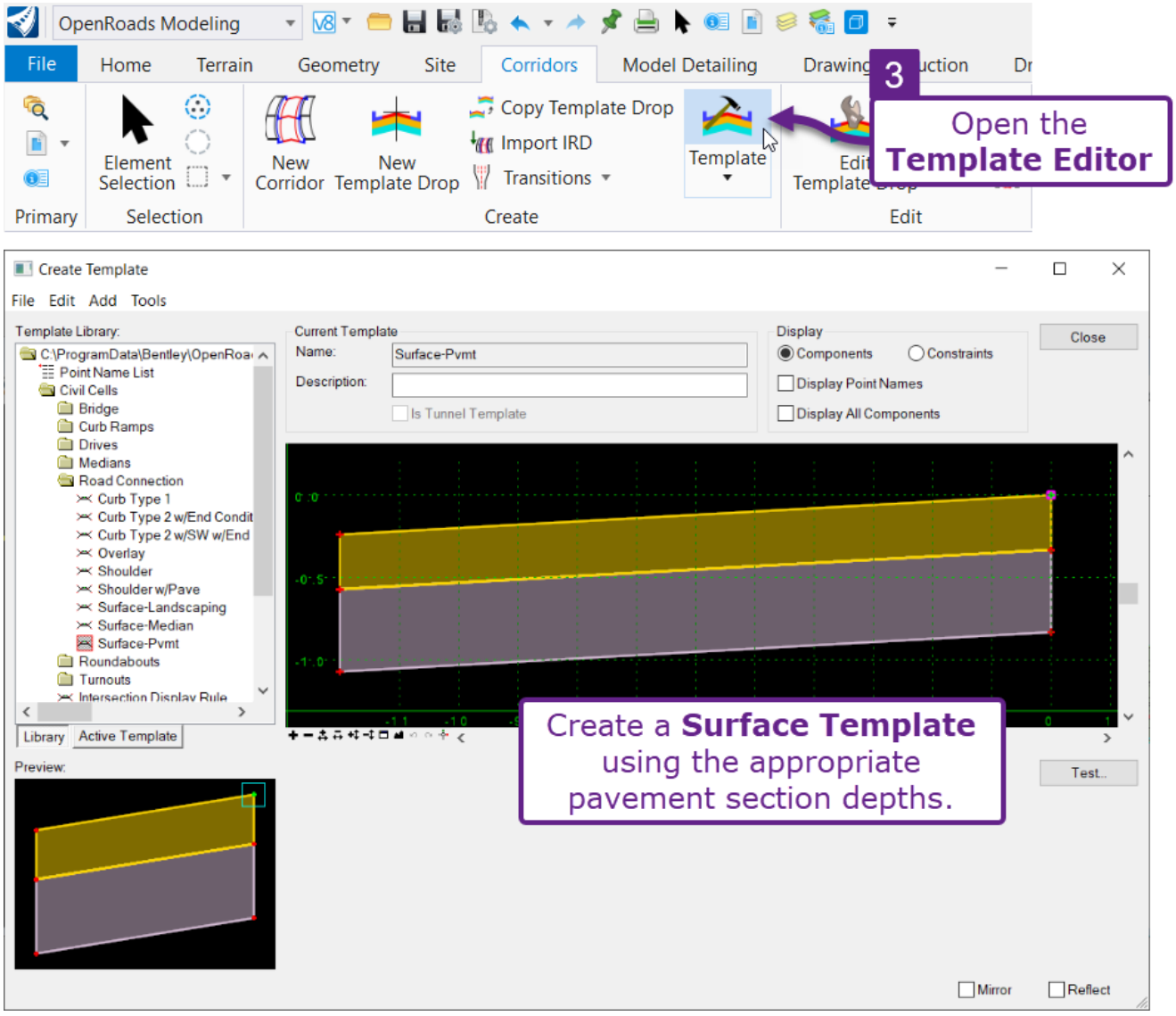
Create the Surface Template for the Terrain Model: A Surface Template is applied to the Terrain Model to represent the pavement section.

Before using the *Apply Surface Template* tool, open the Template Editor and create a Surface Template using the appropriate pavement section depths.

NOTE: The creation and editing of Surface Templates is discussed in *8H – Surface Templates*.

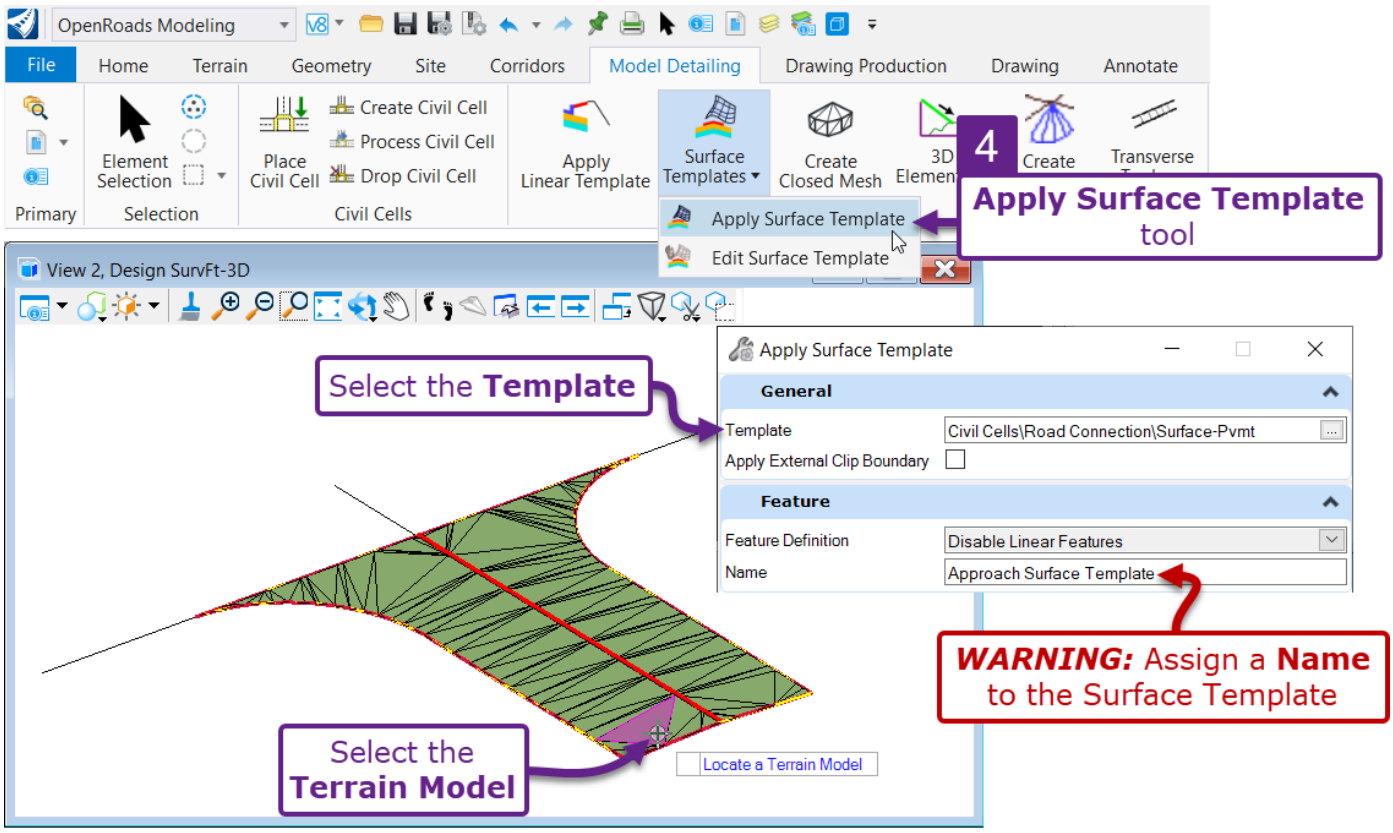
TIP: New Surface Templates configurations should be created by copying and then modifying a pre-made Surface Template found in the FLH Standard Library. See *8H.3 Create a Surface Template Workflow*.

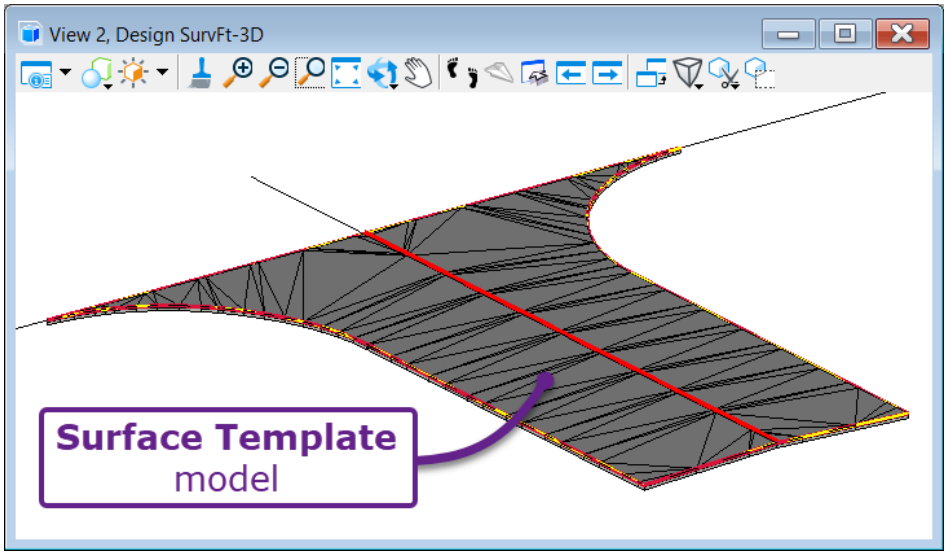
3	Open the **Template Editor** with the *Create Template* tool: [***OpenRoads Modeling*** → ***Corridors*** → ***Create***]. Create a new Surface Template.



Use the *Apply Surface Template* tool:

4	From the Ribbon, select the *Apply Surface Template* tool: [***OpenRoads Modeling*** → ***Modeling Detailing*** → ***3D Tools***]. In the *Dialogue Box*, select the **Template** created in the previous step. Select the **Terrain Model**. ***NOTE:*** The Terrain Model can be directly selected from the *3D Design Model*. ***NOTE:*** Do NOT check the **Apply External Clip Boundary** box. ***NOTE:*** Set the **Feature Definition** to "Disable Linear Features".

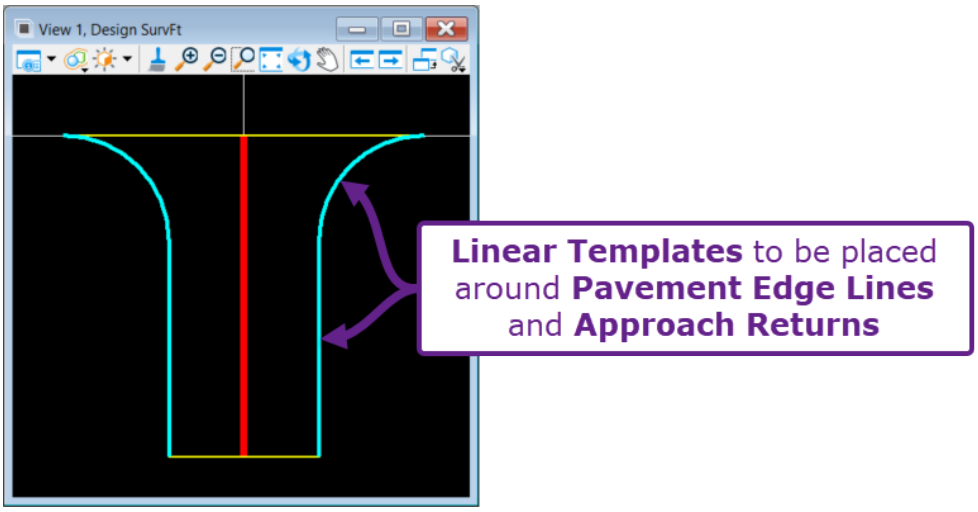




12C.6 Create the Linear Templates

Linear Templates are used to model the pavement safety edge, shoulder, ditches, and cut/fill for the approach. For more information on Linear Template creation, see *11A.3 Linear Template – Process Overview*.

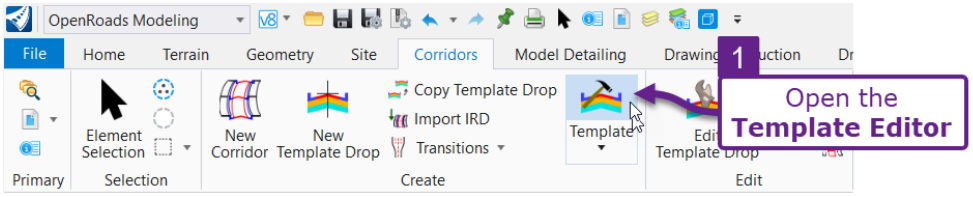
In this case, Linear Templates are applied to the Pavement Edge Lines and Approach Return elements (shown below in blue).

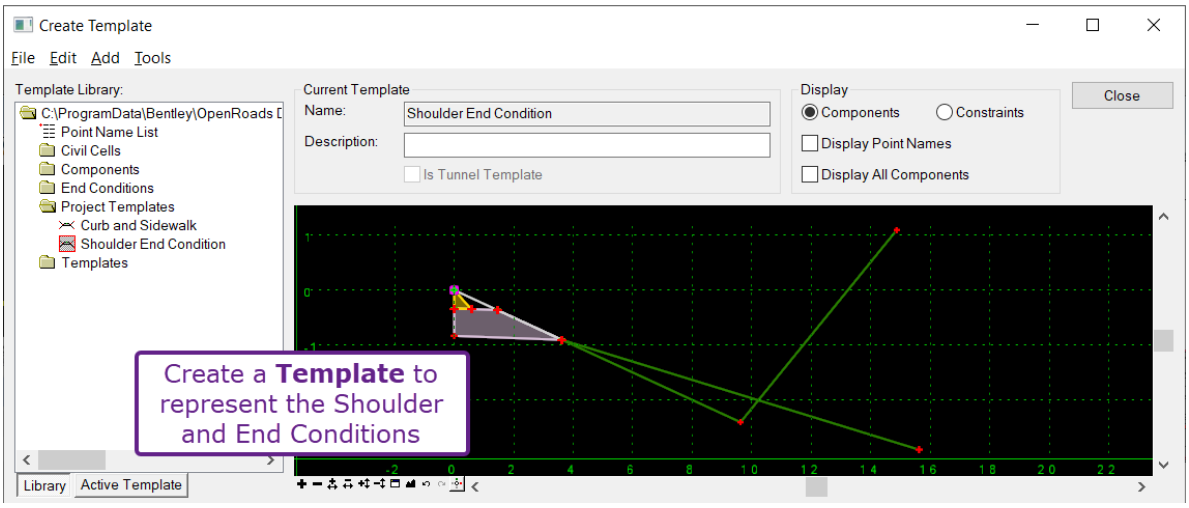


Create the Template in the Template Editor: Before using the *Apply Linear Template* tool, create a custom Template that represents the geometry/configuration of the shoulders and end conditions.

NOTE: Information on creating Templates is found in *Chapter 8 - Template Library*.

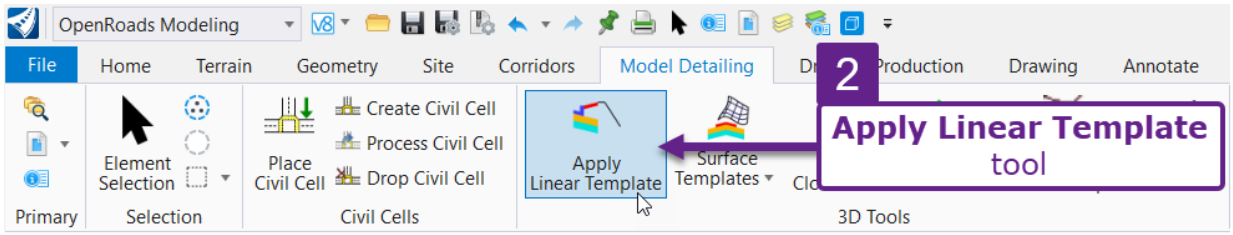
1	Open the **Template Editor** with the *Create Template* tool: [***OpenRoads Modeling*** → ***Corridors*** → ***Create***]. Create a new **Template**.

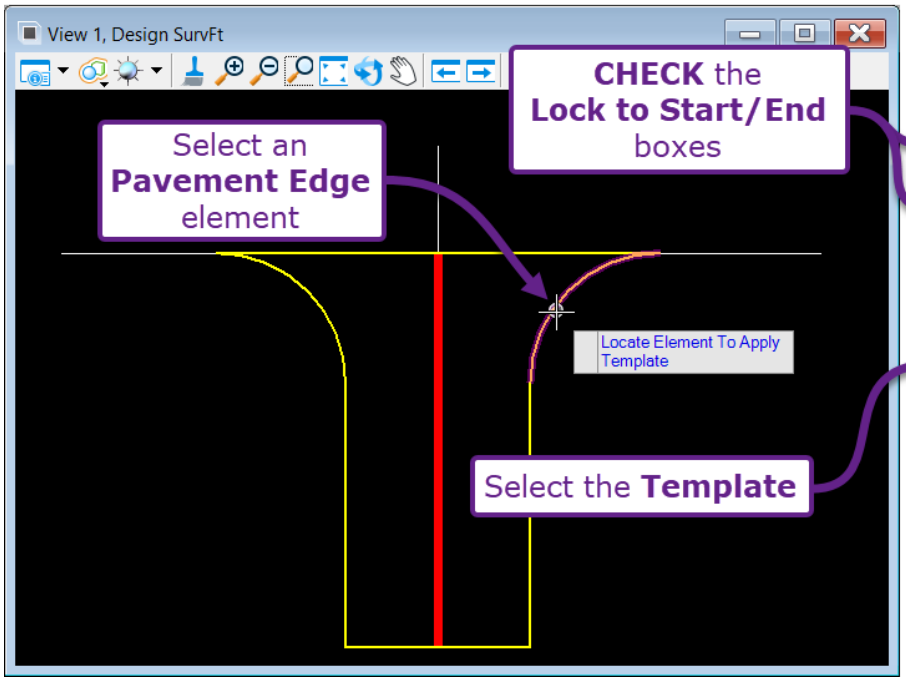


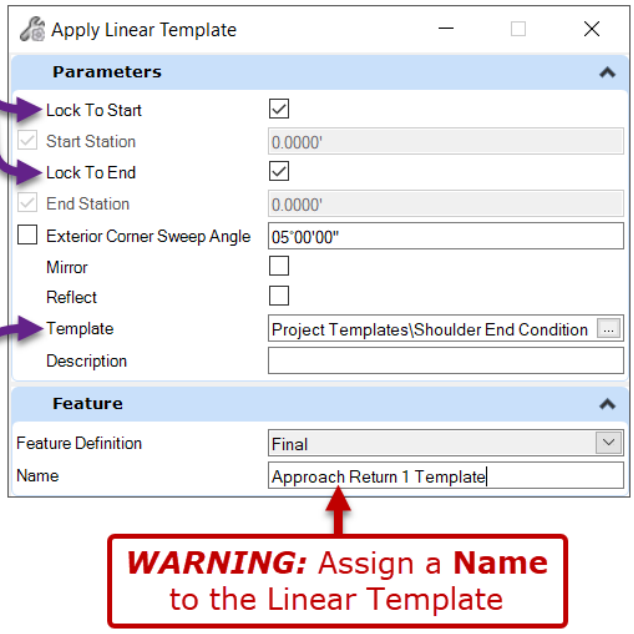


Use the *Apply Linear Template* tool:

2	From the Ribbon, select the *Apply Linear Template* tool: [***OpenRoads Modeling*** → ***Modeling Detailing*** → ***3D Tools***]. In the *Dialogue Box*, select the **Template** created in the previous step. Select a horizontal element to apply the Linear Template to. ***IMPORTANT:*** CHECK both the **Lock to Start** and **Lock to End** boxes. When Locked to the Start/End, the length of the Linear Template will automatically adjust if the horizontal geometry is edited (i.e., changing the radius of an Approach Return). ***NOTE:*** Set the **Feature Definition** to "Final".

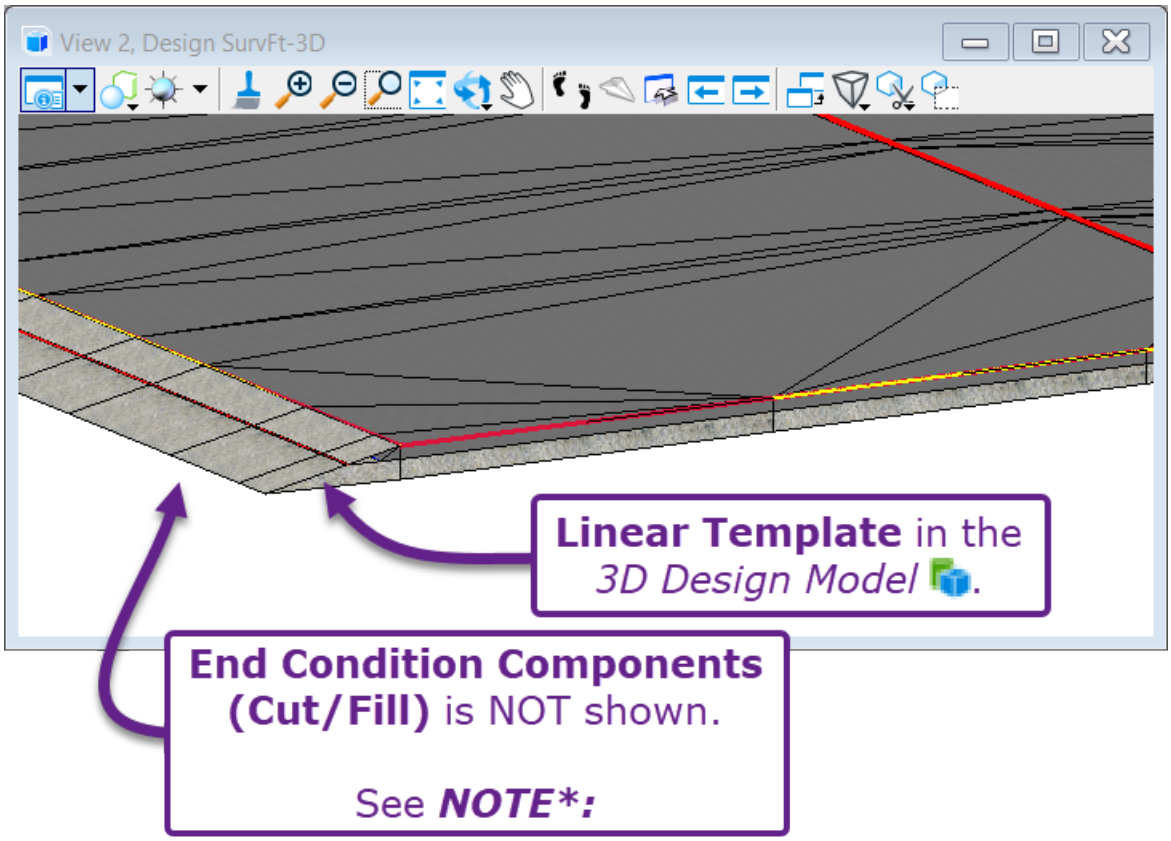






Repeat this process for all Pavement Edge Lines and Approach Returns

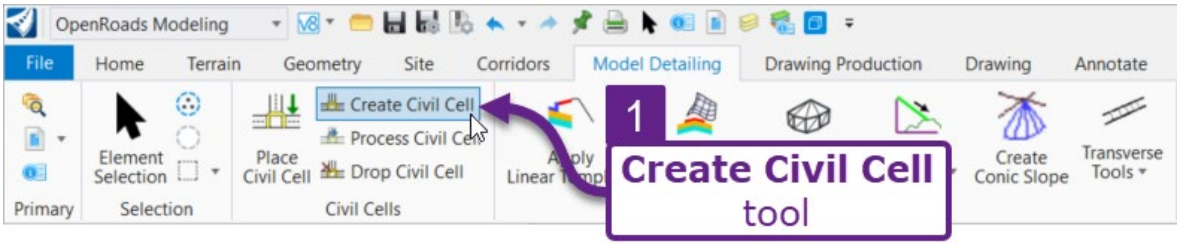
Shown below is the Linear Template from the *3D Design Model* perspective:



NOTE*: The End Condition Components (Cut/Fill) are NOT shown because this new ORD File does NOT contain an *Active* Terrain Model. To find a solution, an End Condition Component requires an *Active* Terrain Model. If there is NO solution available, then the End Condition Component is NOT displayed.

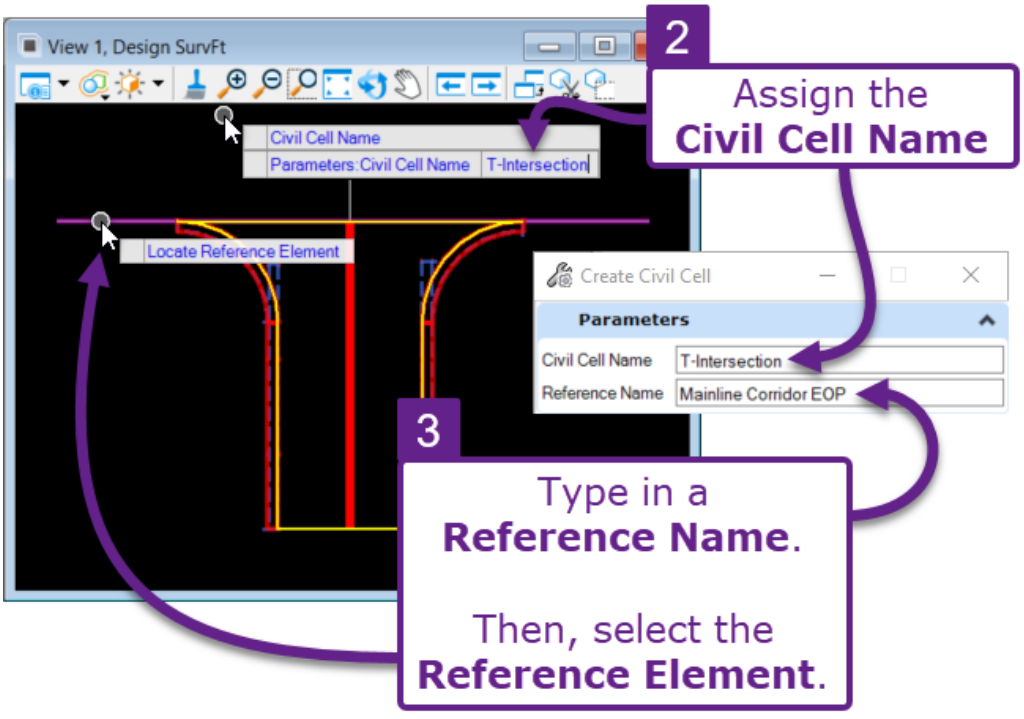
12C.7 Use the Create Civil Cell tool

After all geometry, Terrain Models, Surface Templates, and Linear Templates have been created, then the *Create Civil Cell* tool is used to save the Civil Cell configuration.

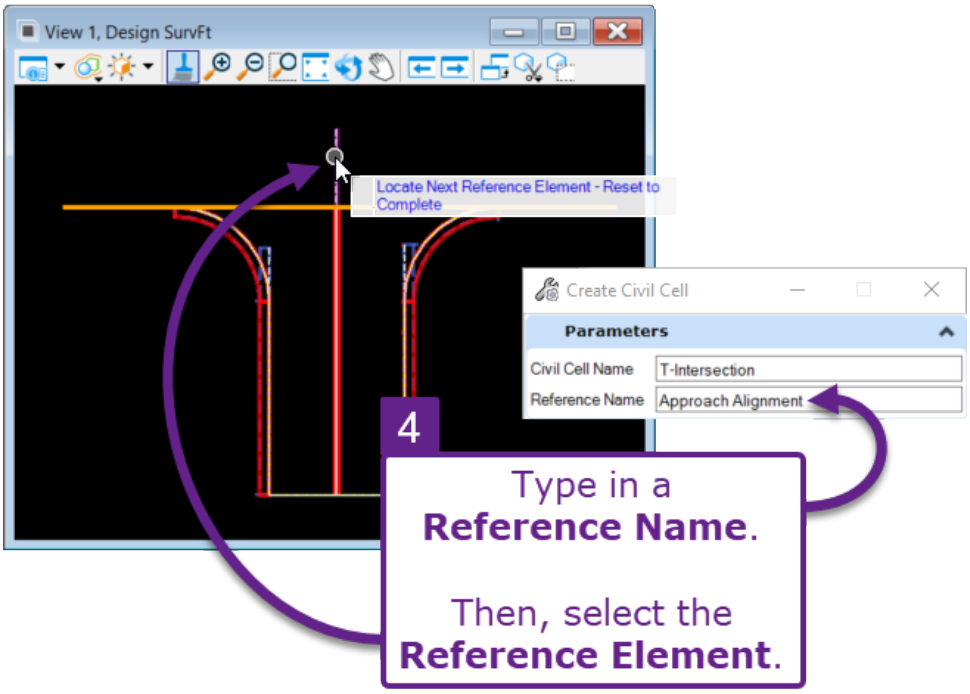


The operation of this tool is very simple. ONLY the "Dummy" Reference Elements need to be selected. All geometry and modeling elements that are directly or indirectly dependent to the "Dummy" Reference Elements are automatically selected for inclusion in the Civil Cell.

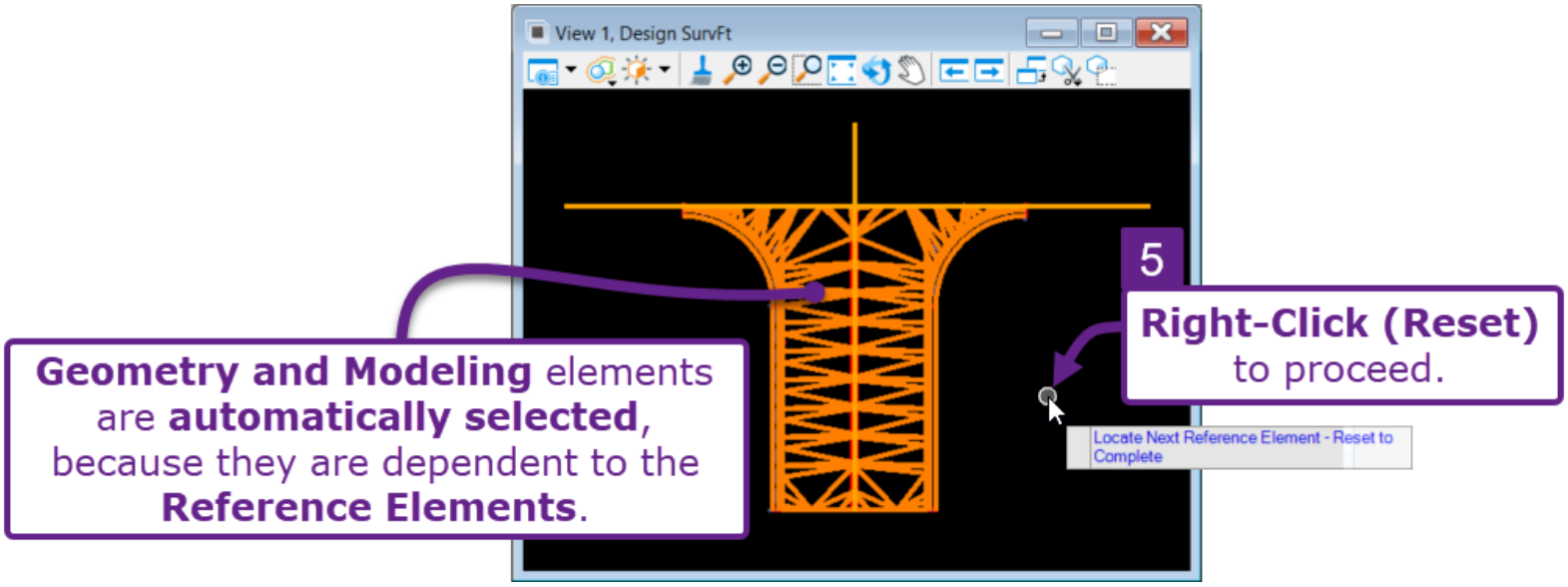
1	From the Ribbon, select the *Create Civil Cell* tool: [***OpenRoads Modeling*** → ***Model Detailing*** → ***Civil Cells***].
2	*Prompt: Civil Cell Name* – Assign the Civil Cell a name. In this case, "T-Intersection" is used.
3	*Prompt: Locate Reference Element* – In this step, the Mainline Pavement Edge "Dummy" element is selected. ***IMPORTANT:*** Before clicking on (selecting) the "Dummy" Reference Element, fill out the **Reference Name** box in the *Dialogue Box*. In placement of the Civil Cell, the **Reference Name** message will appear in the prompt message and provide guidance for selecting the appropriate Reference Element. In this case, the Mainline Pavement Edge "Dummy" element is selected. The specified **Reference Name** is "Mainline Corridor EOP". After the Reference Name is filled out, select the Mainline Pavement Edge "Dummy" element.



4	*Prompt: Locate Next Reference Element* – In this step, the Approach Alignment "Dummy" element is selected. Before selecting the Approach Alignment "Dummy" element, fill out the **Reference Name** box in the *Dialogue Box*.



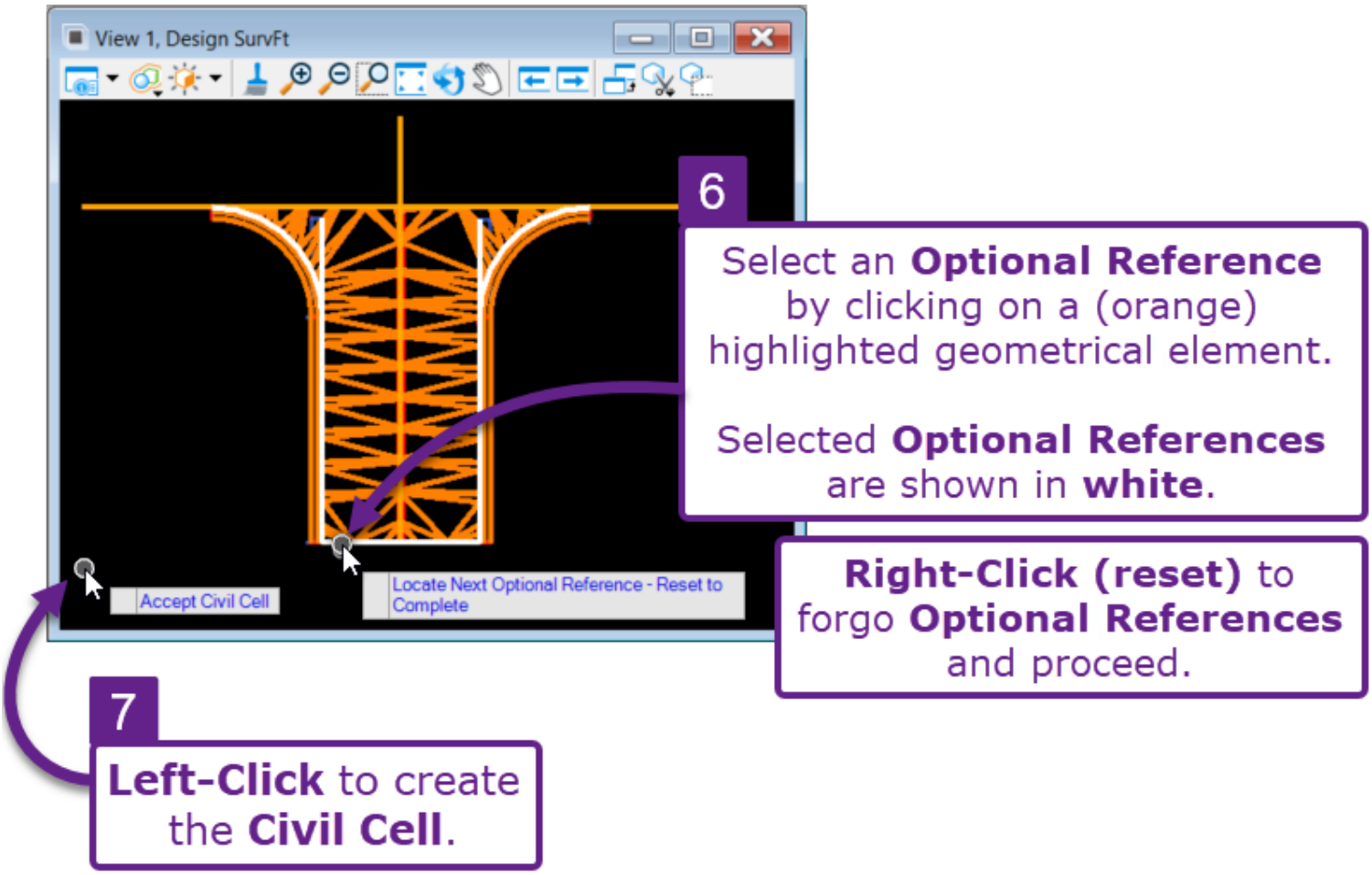
After selecting both Reference Elements, all geometry and modeling elements that comprise the Civil Cell should be automatically selected and shown in orange.



WARNING: If an element is NOT automatically selected, than that element is NOT directly or indirectly dependent on the Reference Elements. In which case, the Civil Cell creation process should be restarted.

5	*Prompt: Locate Next Reference Element – Reset to Complete* – After selecting all the Reference Elements, right-click (reset) to advance to the next *Prompt*.

6	*Prompt: Locate Optional Reference – Reset to Complete* – Geometric elements (shown in orange) that are dependent to the Reference Elements can be selected as Optional References. For example, the Approach Pavement Edges and Returns can be selected as Optional References. Before placement of the Civil Cell, the User can manually draw custom Approach Pavement Edges and Returns geometry. In placement of the Civil Cell, the custom geometry can be selected as Optional References. The custom geometry will be incorporated in the Civil Cell. If NO Optional References are selected in placement of the Civil Cell, then the default Approach Pavement Edges and Returns geometry are used. If Optional References are NOT desired, then Right-Click (reset) to forgo Optional References and advance to the next *Prompt*.
7	*Prompt: Accept Civil Cell* – Left-Click anywhere in the *View* window to accept and create the Civil Cell.



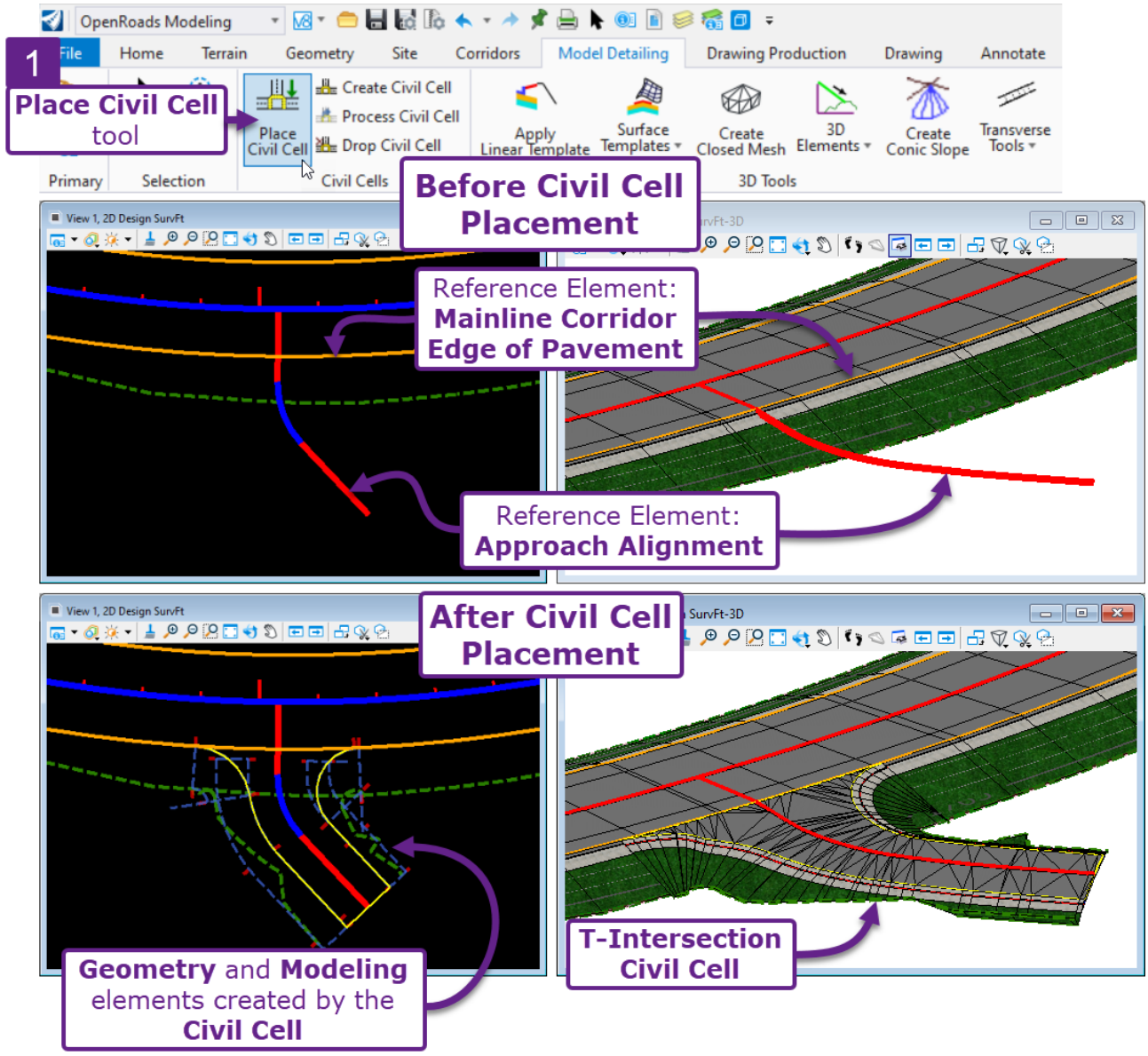
12D – PLACE A CIVIL CELL

Civil Cells are placed with the *Place Civil Cell* tool.

IMPORTANT: Civil Cells should be placed in a dedicated Civil Cell ORD File. Before placing a Civil Cell, create a new ORD File and reference in all relevant ORD Files (i.e., the Corridor and Alignment ORD Files). Civil Cells are processing intensive, so placing them in the same file as the Corridor may drastically increase processing speeds in the Corridor ORD File.

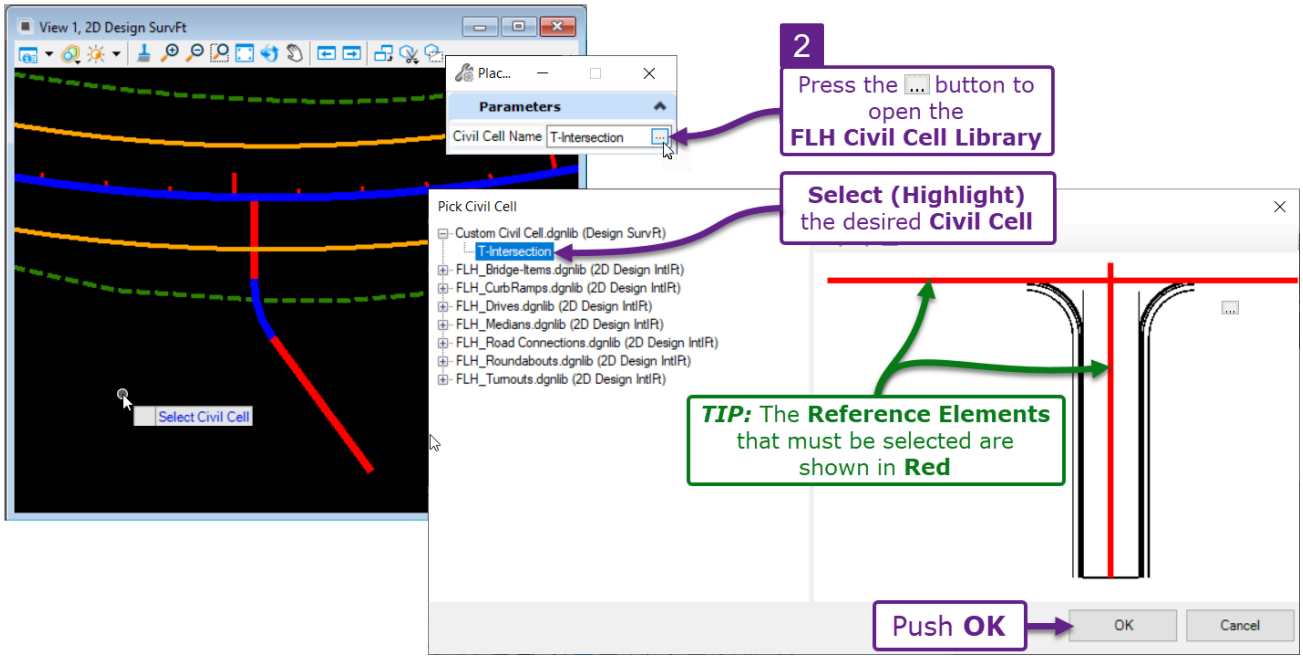
In this workflow, the T-Intersection civil cell created in *12C – Create a Custom Civil Cell* is placed. ***NOTE:*** Each Civil Cell found in the FLH Civil Cell Library is unique and require a different set of Reference Elements to be created/selected.

Before placing this Civil Cell, a Road Corridor must be created. The Edge of Pavement Line generated from the Road Corridor will be selected as a Reference Element. Also, an Approach Alignment that contains an *Active* profile must be drawn and will be selected as the other Reference Element.



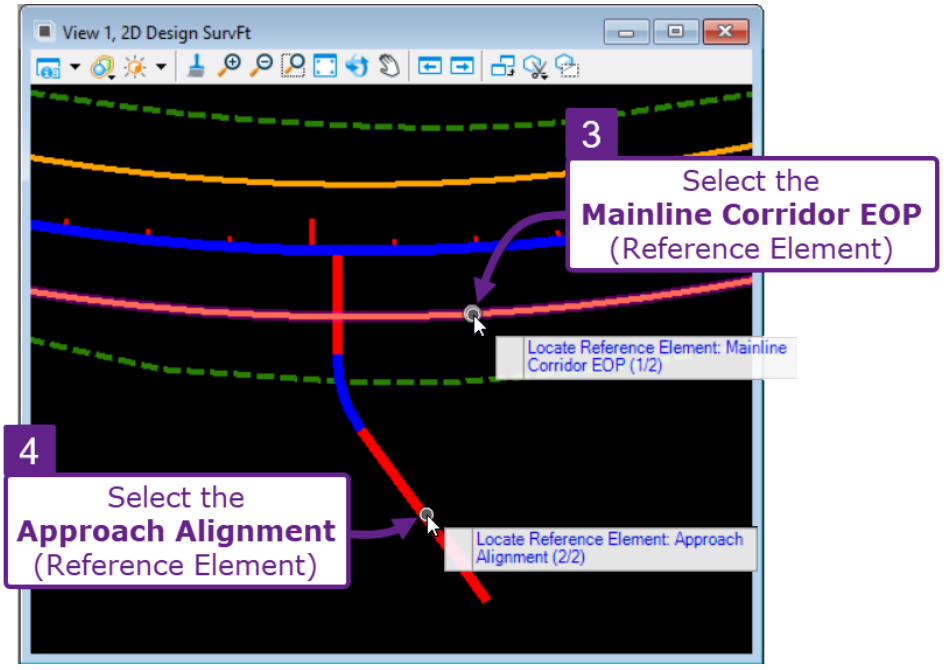
1	From the Ribbon, select the *Place Civil Cell* tool: [***OpenRoads Modeling*** → ***Model Detailing*** → ***Civil Cells***].

2	*Prompt: Select Civil Cell* – In the *Dialogue Box*, click on the … button shown next to open the FLH Civil Cell Library. From the Library, select (highlight) the desired Civil Cell. Push the OK button.



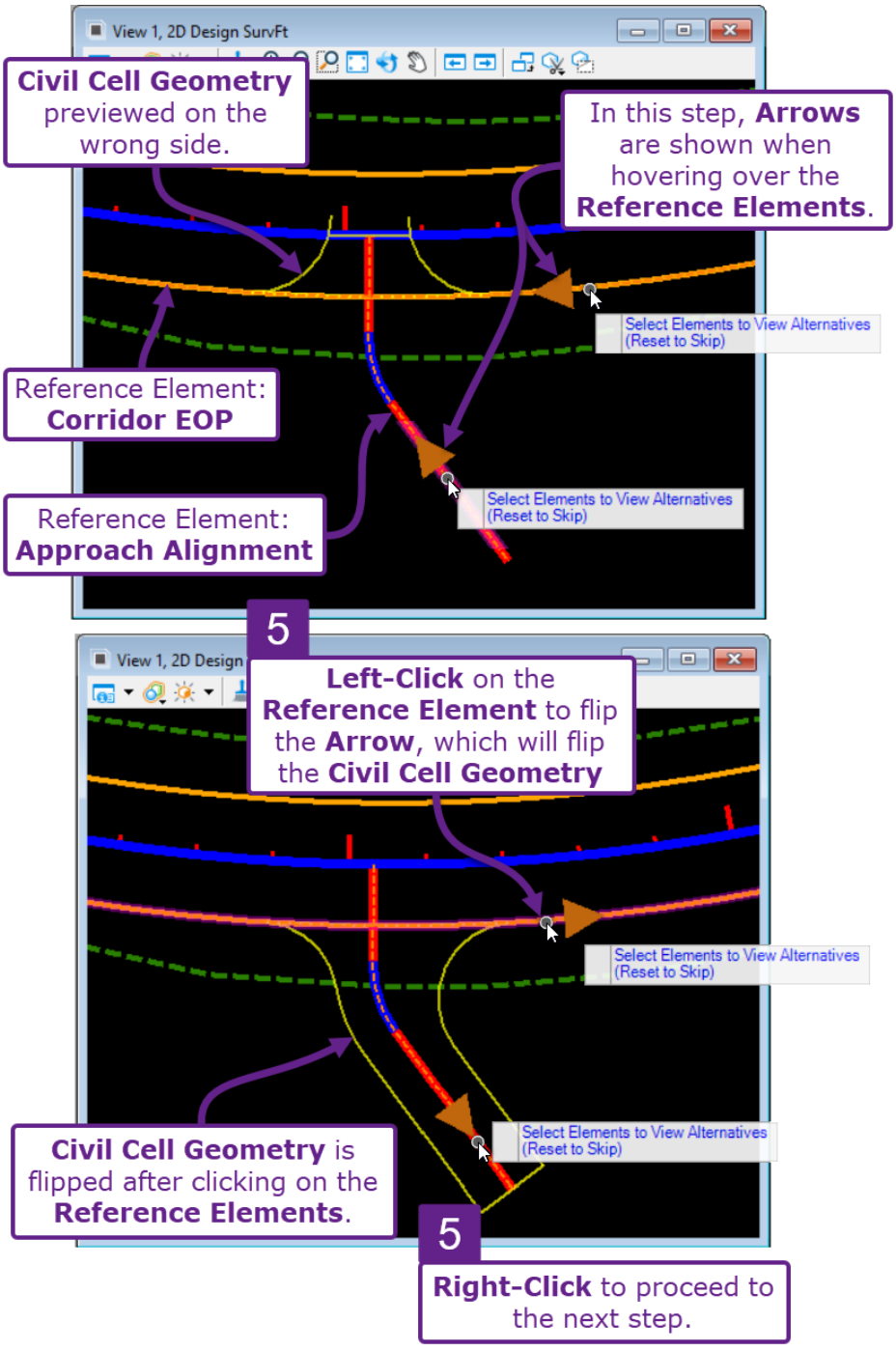
In step 3 and 4, the Reference Elements for the Civil Cell are selected. Each Civil Cell requires a different configuration of Reference Elements to be selected. The *Prompt* messages shown are unique to the selected Civil Cell and inform to which Reference Elements should be selected. ***NOTE:*** The custom *Prompt* messages are programmed in creation of the Civil Cell.

3	*Prompt: Locate Reference Element:* ***Mainline Corridor EOP (1/2)*** – Left-Click on the Mainline Corridor EOP (Reference Element).
4	*Prompt: Locate Reference Element:* ***Approach Alignment (2/2)*** - Left-Click on the Approach Alignment (Reference Element).

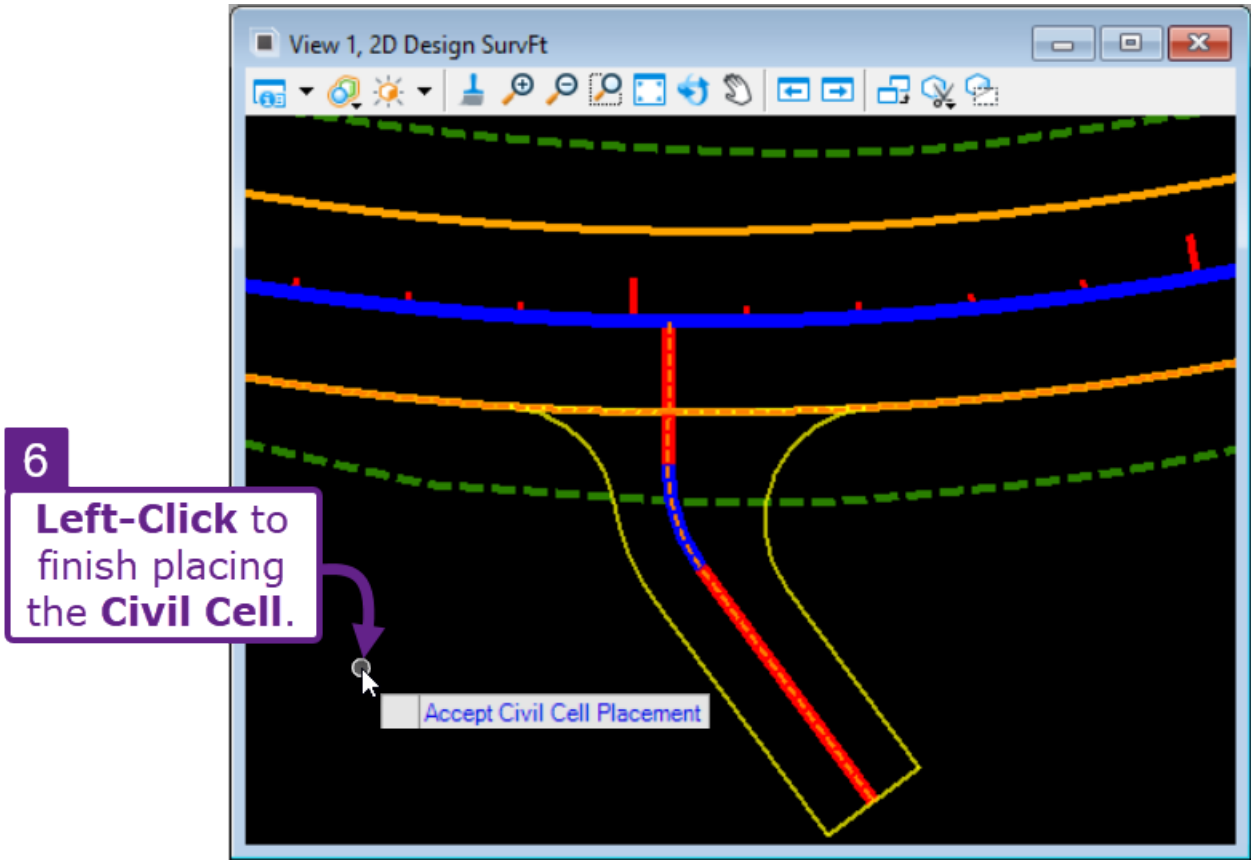


In this step, the Civil Cell Geometry is previewed. If the Civil Cell Geometry is shown on the wrong side, it can be flipped by left-clicking on one or more the Reference Elements.

5	*Prompt: Select Elements to View Alternatives (Reset to Skip)* – Ensure the Civil Cell Geometry preview is shown in appropriate position. To re-position to the Civil Cell Geometry on the appropriate side, hover the mouse-cursor over a Reference Element to reveal an Arrow. Left-Click on the Reference Element to flip the arrow, which causes the Civil Cell Geometry to flip. In the T-Intersection Civil Cell example shown below, the arrows on BOTH Reference Elements are flipped to position the Civil Cell correctly. When the Civil Cell Geometry is shown in the appropriate position, right-click (reset) to proceed to the next step.



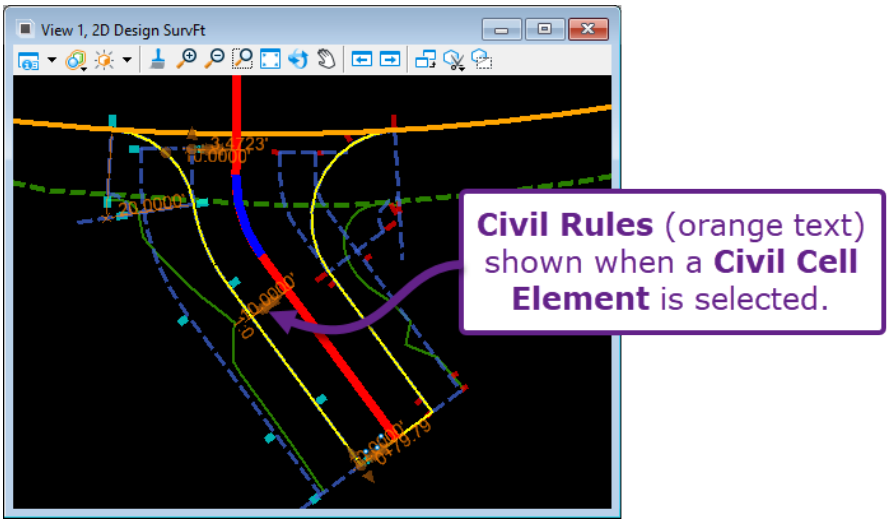
6	*Prompt: Accept Civil Cell Placement* – Left-Click in the *View* window to finish placing the Civil Cell.



12E – MODIFY A CIVIL CELL AFTER PLACEMENT

After placement, a Civil Cell can be modified to fit project conditions. The geometric elements in a Civil Cell are dependent to the Reference Elements and/or other elements in the Civil Cell. When an element is modified, all dependent elements will be affected.

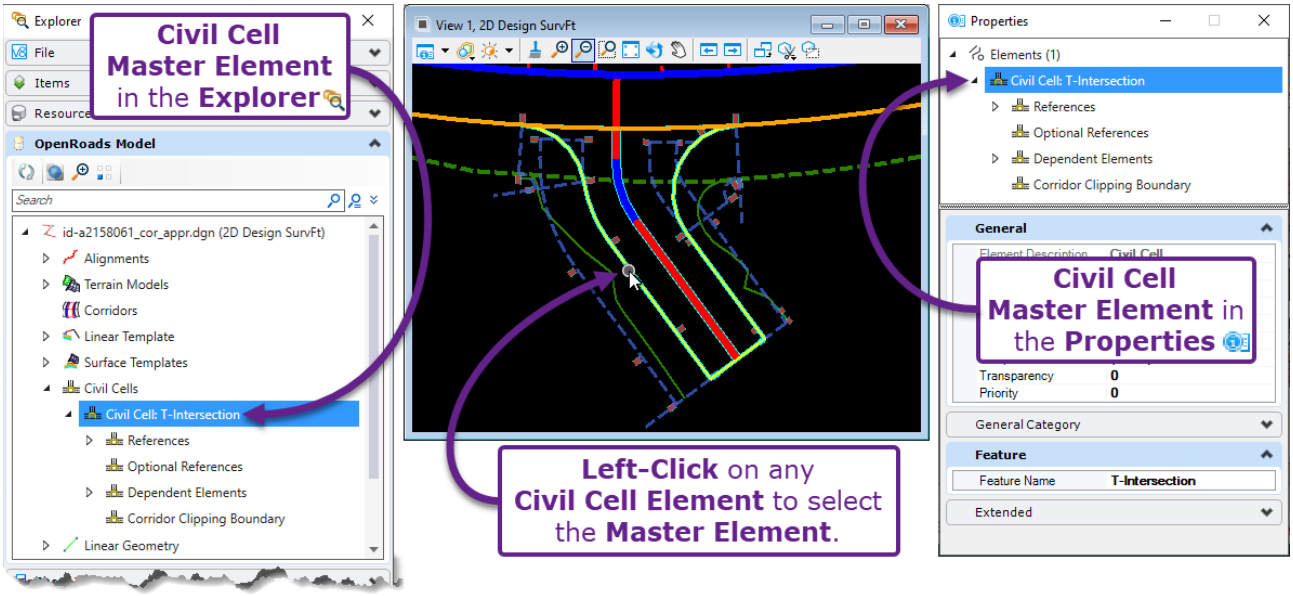
Geometry Edits: Manipulating horizontal and vertical geometry elements in a Civil Cell should be limited to changing Civil Rules values. Civil Rules are shown directly on a selected element in orange text. Alternatively, Civil Rules are listed and editable through the Properties box when an element is selected.



TIP: Civil Cells typically contain multiple elements that are stacked directly on top of each other. To select underlying elements Right-Click and then Left-Click. If three or more elements overlap, then Right-Click multiple times to cycle through the underlying elements. Left-Click when the desired element is highlighted.

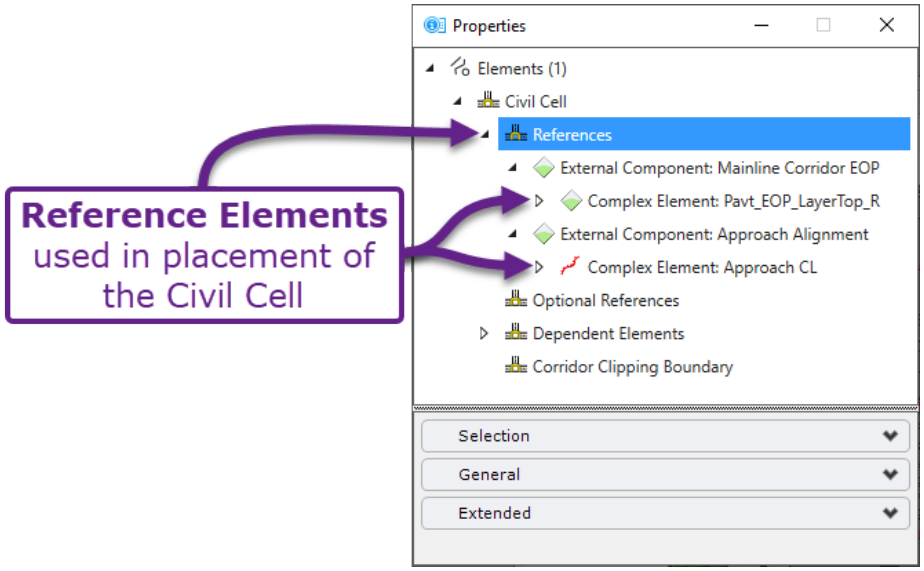
The **Civil Cell Master Element** is typically placed on top of the Civil Cell elements and spans the entire area of the Civil Cell. The Civil Cell Master Element is invisible, but is selected when left-clicking on any element in the Civil Cell.

TIP: The Civil Cell Master Element is also selectable through the Explorer menu, under the *OpenRoads Model* drop-down.

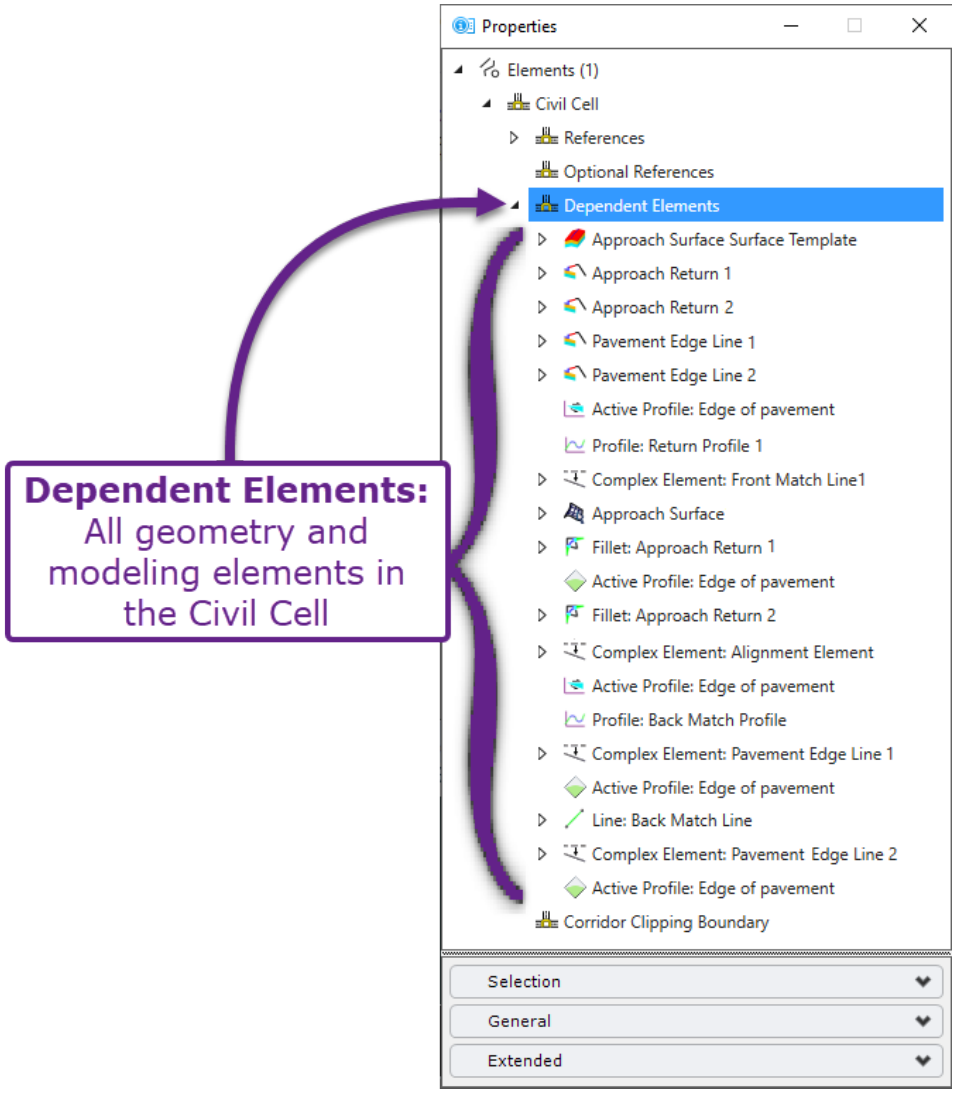


In the Properties box, all elements that contribute to the construction of the Civil Cell are listed.

References drop-down: All Reference Elements used in the placement of the Civil Cell are listed here.



Dependent Elements drop-down: All Horizontal/Vertical Geometry, Linear Templates, Terrain Models, and Surface Templates are listed and editable here.

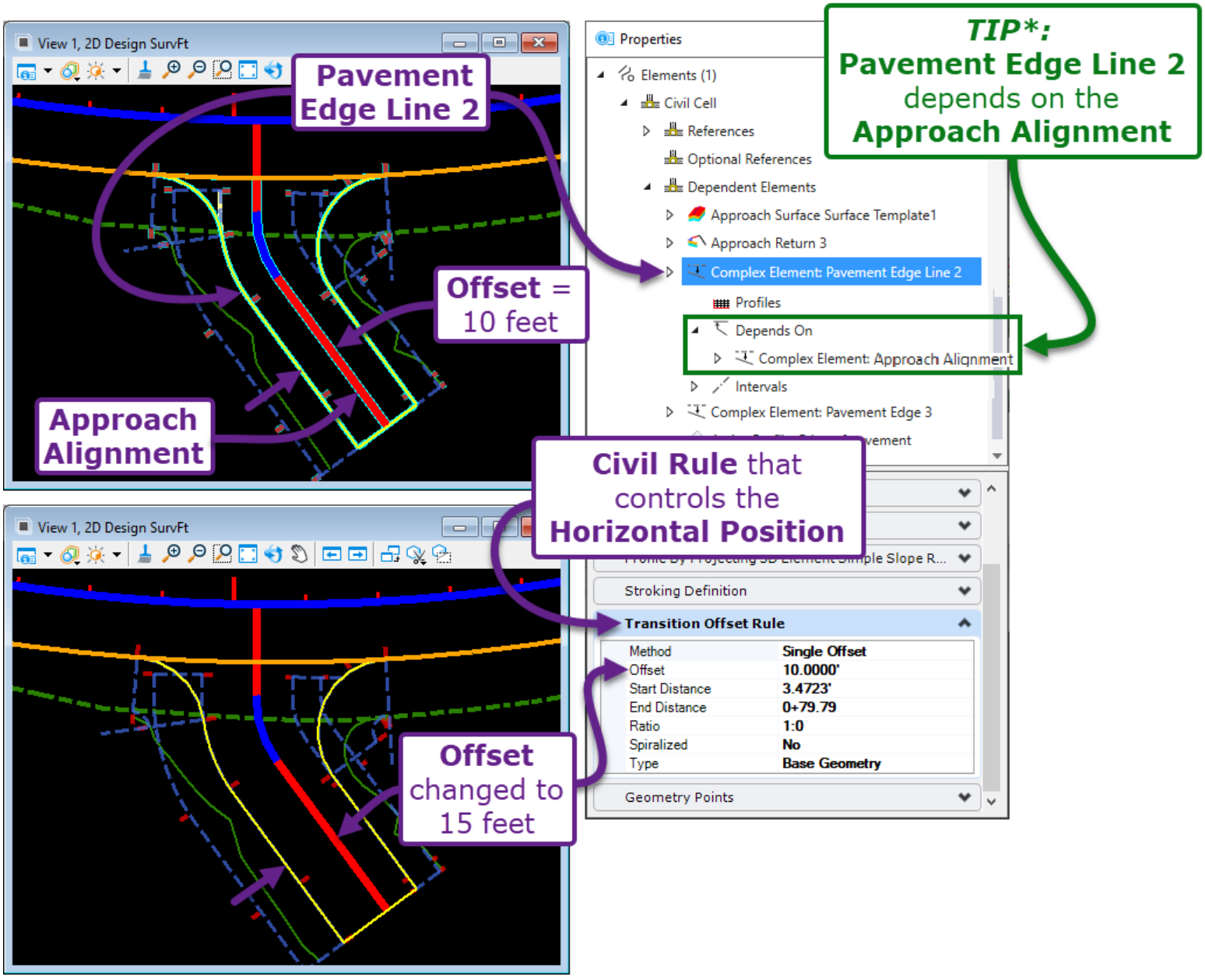


Editing an Element through the Dependent Elements drop-down: The preferred and simplest way to make modifications to a Civil Cell is by selecting the desired element in the Dependent Elements drop-down.

TIP*: Expand a Civil Cell element drop-down to see which element it is **Depends On**. For example, the left edge of pavement (Complex Element: Pavement Line 2) is directly dependent to the Approach Alignment.

Horizontal Geometry Edits: The Civil Rules that control the position of Horizontal Geometry elements are listed in the Properties box.

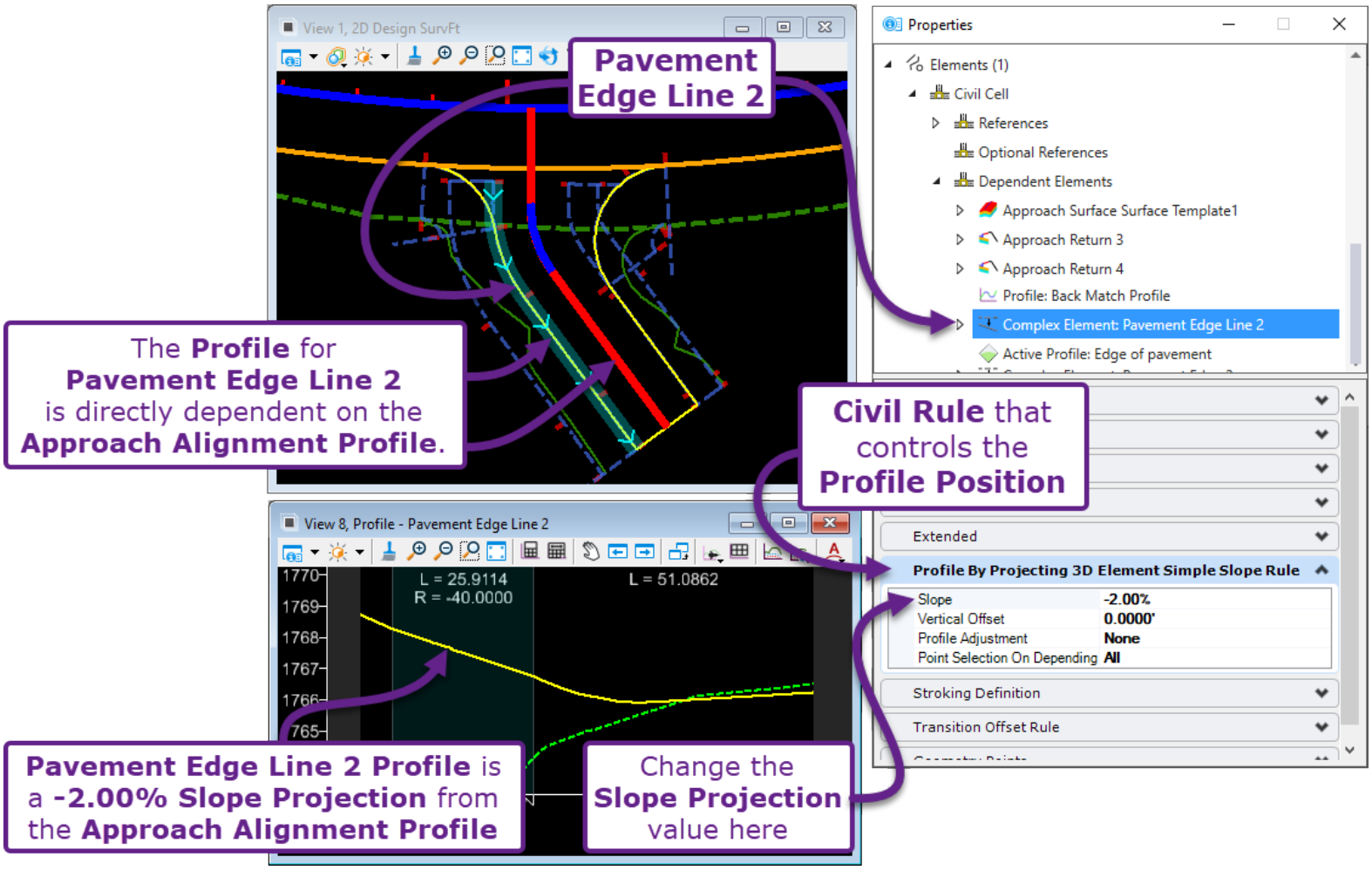
In the example shown below, the Offset value for the left edge of pavement (Complex Element: Pavement Edge Line 2) is modified from 10' to 15'.



Vertical Geometry Edits: The Civil Rules relating to the Profile of Civil Cell geometry elements are also accessed and edited by selecting the Horizontal Element.

In the example shown below, the Profile for the left edge of pavement (Complex Element: Pavement Edge 2) directly depends on the Approach Alignment Profile. In creation of the Civil Cell, the profile for the left edge of pavement is set at a -2.00% slope projection from the Alignment Profile.

Change the slope projection value to shift the left edge of pavement profile up or downwards.



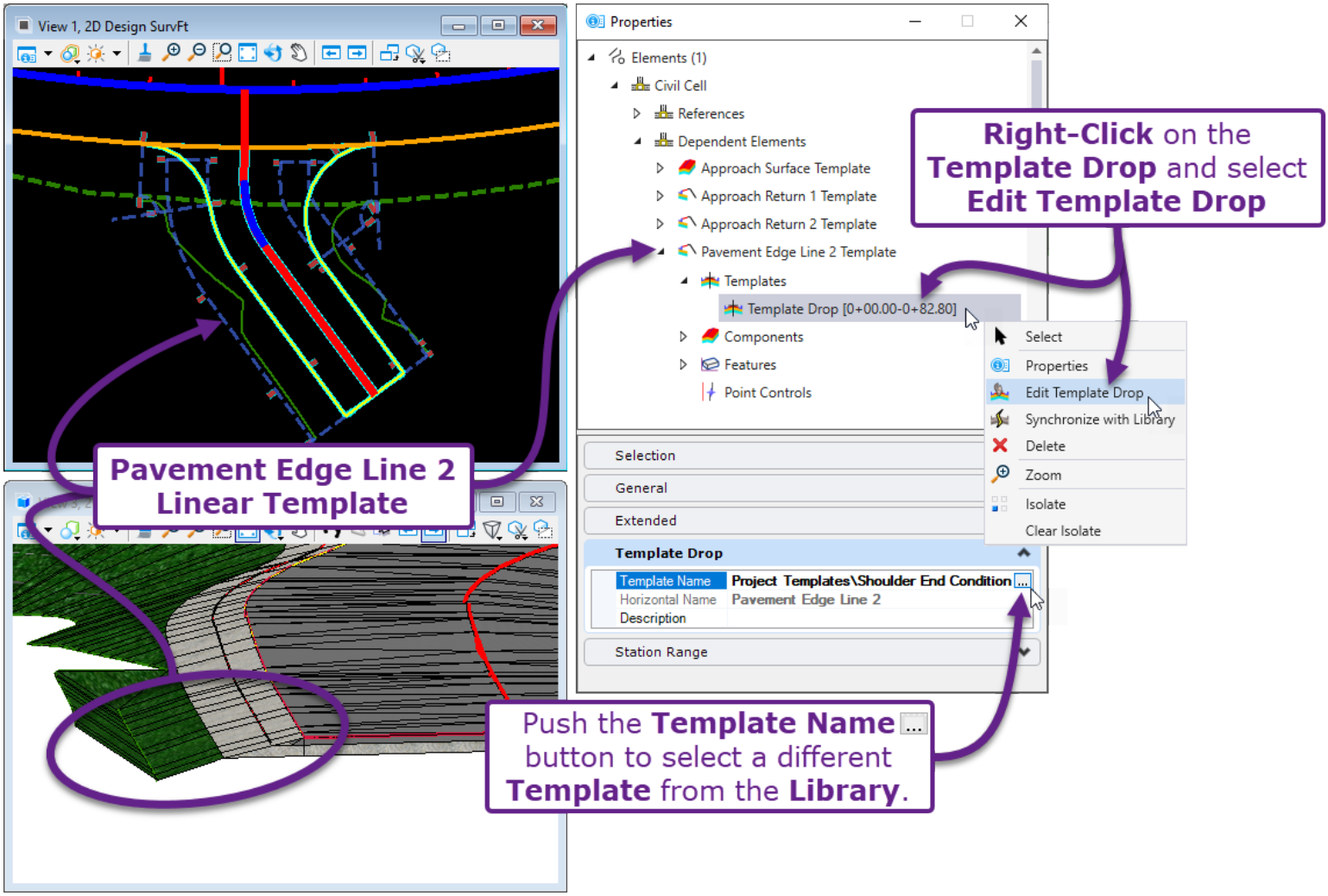
NOTE: It is possible to draw and *activate* a custom Profile for the left edge of pavement. However, this show ONLY be done if the adjacent and dependent geometry will dynamically adjust to the custom Profile. Before drawing a custom Profile, consider how dependent element will be affected.

Linear Template/Surface Template Edits: It may be necessary to change or edit Linear Templates and/or Surface Templates to fit project conditions.

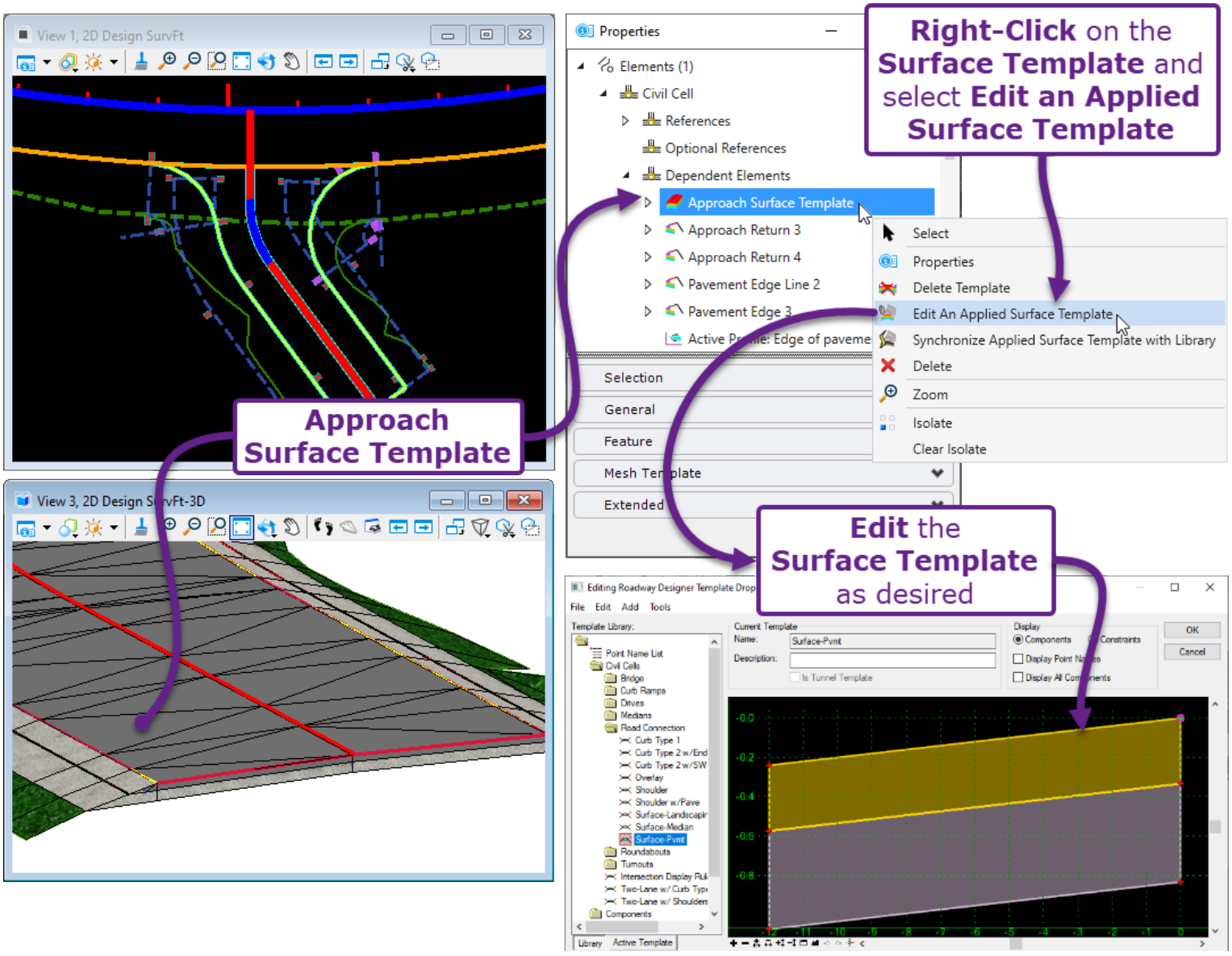
Linear Templates can be edited in place or changed out for a different Template from the Template Library. Both operations require the Linear Template to be in the Civil Cell Master Element properties. Expand the Linear Template element drop-down and the "Templates" drop-down. Locate and select the "Template Drop" entity.

To edit the Linear Template in place, right-click on the "Template Drop" and select *Edit Template Drop*.

To change the Linear Template, push the Template Name ... button in the bottom portion of the Properties box. Pushing this button will open the Template Library for selection of a new Template.



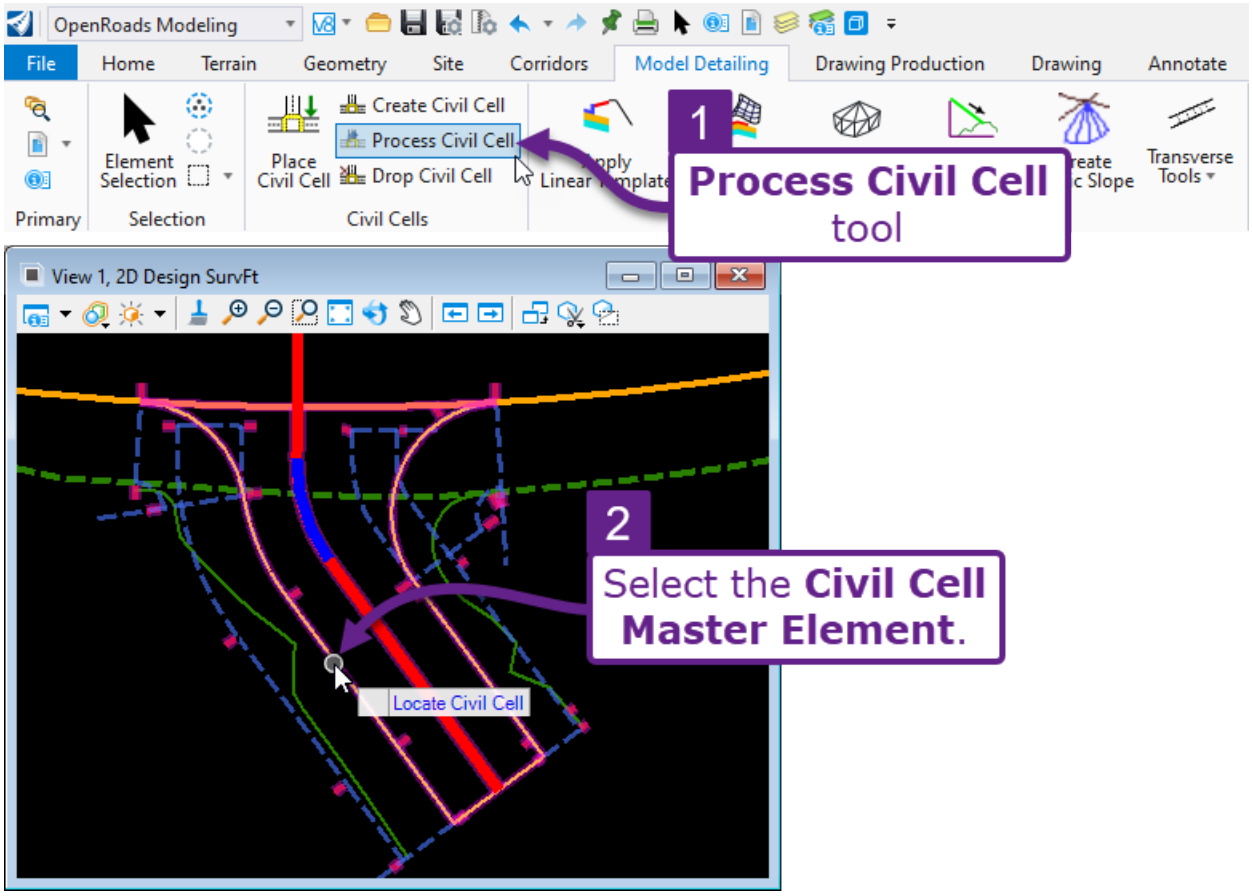
Surface Templates can only be edited in place. ***NOTE:*** A Surface Template CANNOT be changed out for a different Template from the Template Library.



12E.1 Process Civil Cell tool

The *Process Civil Cell* tool has a singular purpose. This tool re-processes every Linear Template and Surface Template in the selected Civil Cell.

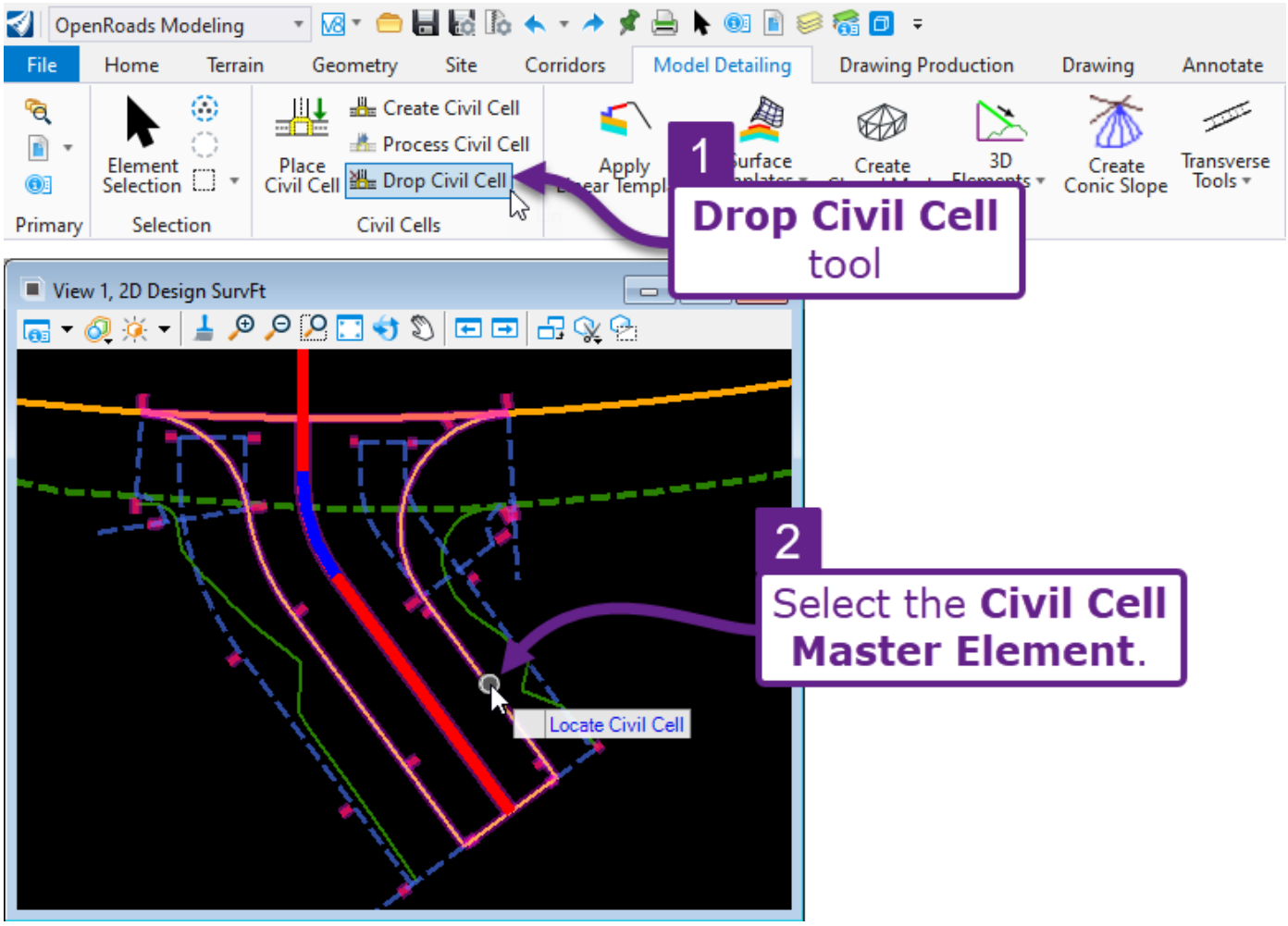
NOTE: Linear Templates and Surface Templates in the Civil Cell may need to be re-processed if modifications are made to horizontal and vertical geometry. However, re-processing usually occurs automatically after a modification.



12E.2 Drop Civil Cell tool

The *Drop Civil Cell* tool will ungroup the elements that comprise a Civil Cell. The Civil Cell geometry and modeling elements are NOT deleted when this tool is used.

This tool is primarily used to delete a component from the Civil Cell. For example, a Linear Template can ONLY be deleted after the *Drop Civil Cell* tool is used.

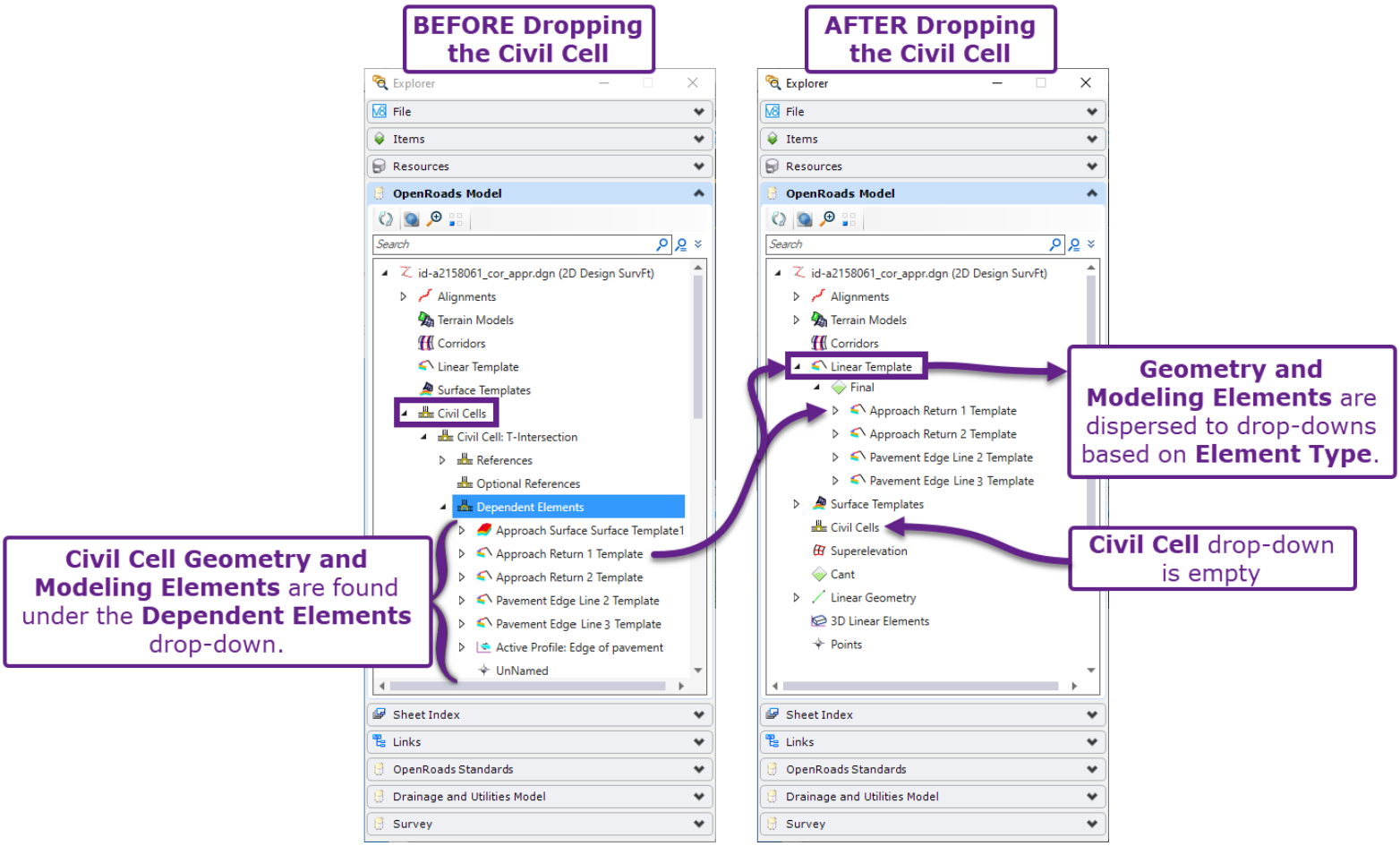


The dependency relationships amongst the geometry and modeling elements are kept intact after the Civil Cell is dropped. The geometry and modeling elements remain dynamic. Edits to the geometry and modeling elements behave in the same manner after the Civil Cell is dropped.

This tool has the following effects:

- The Civil Cell Master Element is removed. This means that the *Process Civil Cell* tool can NO longer be used.
- In the Explorer (OpenRoads Model drop-down), the Civil Cell components are removed from the Civil Cells drop-down and dispersed into the appropriate drop-downs based on element type. See the next page.

In general, the *Drop Civil Cell* tool does NOT affect the behavior of the geometry and modeling elements. However, dropping the Civil Cell results in additional clutter in the Explorer.


BEFORE Dropping the Civil Cell
AFTER Dropping the Civil Cell
Explorer
File
Items
Resources
OpenRoads Model
Search
id-a2158061_cor_appr.dgn (2D Design SurvFt)
Alignments
Terrain Models
Corridors
Linear Template
Surface Templates
Civil Cells
Civil Cell: T-Intersection
References
Optional References
Dependent Elements
Approach Surface Surface Template1
Approach Return 1 Template
Approach Return 2 Template
Pavement Edge Line 2 Template
Pavement Edge Line 3 Template
Active Profile: Edge of pavement
UnNamed
Final
Superelevation
Cant
Linear Geometry
3D Linear Elements
Points
Sheet Index
Links
OpenRoads Standards
Drainage and Utilities Model
Survey
Civil Cell Geometry and Modeling Elements are found under the Dependent Elements drop-down.
Geometry and Modeling Elements are dispersed to drop-downs based on Element Type.
Civil Cell drop-down is empty