OpenRoads Designer User Manual

U.S. Department of Transportation
Federal Highway Administration

Chapter 6

DRAWING TOOLS

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Chapter 6 Drawing Tools

This chapter discusses the tools found under the Drawing tab in the Ribbon.

Drawing tools are used to create MicroStation Elements, which are appropriate for conventional drafting. For creating Alignments, Profiles, and other civil modeling features, see *Chapter 7 – Geometry*.

This chapter also discusses how to utilize AccuDraw to accurately place elements.

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6A – INTRODUCTION TO DRAWING TOOLS

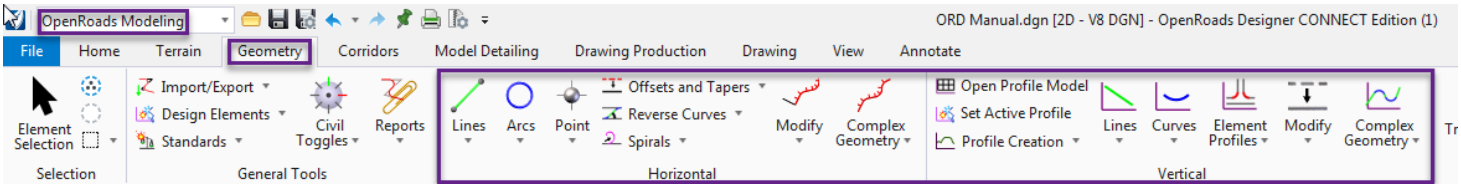
6A.1 MicroStation Tools vs ORD Tools

There are two types of tools used to created elements: **ORD Tools** and **MicroStation Tools**.

ORD Tools: These tools create **ORD Elements**. ORD Elements contain Feature Definitions and Names. ORD Tools are used to create civil features, such as Alignments, Profiles, Terrain Models, and Corridors. If an element is being drawn for civil modeling purposes, then an ORD Tool should be used. ORD Tools are found in the **Geometry** tab. ORD Tools are discussed in *Chapter 7 – Geometry*.

ORD Tools are found in the following location in the Ribbon:

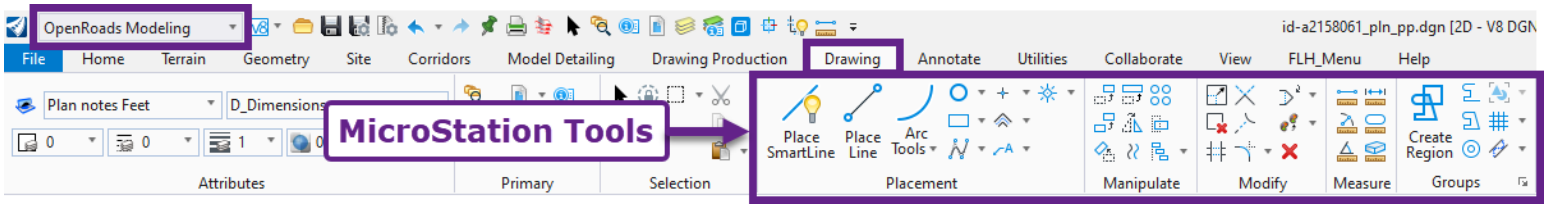
OpenRoads Modeling workflow → **Geometry** tab → **Horizontal** and **Vertical** panel



MicroStation Tools: These tools create **MicroStation Elements**. MicroStation Elements are simple and have less functionality than ORD Elements. MicroStation Tools should be used to draft basic linework. Tools for creating geometry with MicroStation tool are found in the Drawing tab. This chapter discusses all tools found in the **Drawing** tab.

MicroStation Tools are found in the following location in the Ribbon:

OpenRoads Modeling workflow → **Geometry** tab → **Horizontal** and **Vertical** panel



TIP: To determine if an element is an ORD Element or MicroStation Element, select it and view its Properties. ORD Elements will have the **Feature Drop-Down** shown in the Properties. MicroStation elements do NOT contain this drop-down. For the location of the Feature drop-down, see *1F.1 Properties Box Overview*.

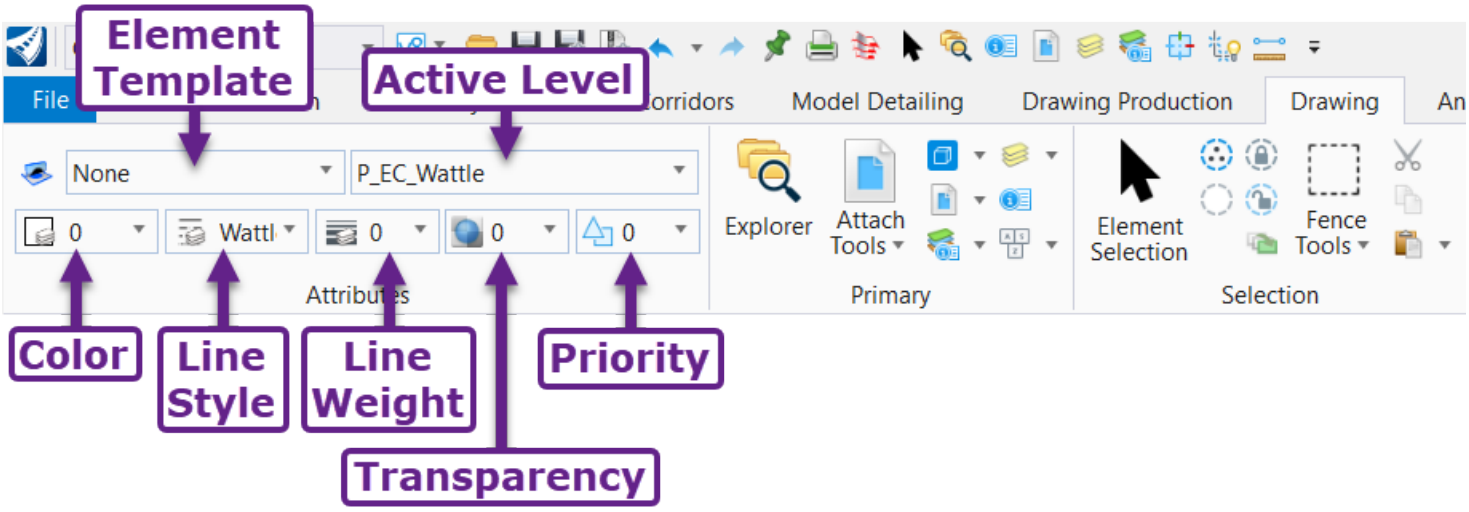
6A.2 Set the Active Level and Attributes Before Drawing Elements

Before using a Drawing Tool, set the *active* Level and Attributes. In the Ribbon, the Attribute group shows the *active* Level and Attributes.

NOTE: The term Attributes refers to Color, Line Style, and Line Weight. Each Level has a set of default Attributes which are designed as *ByLevel*.

The Attributes group is found in three different Ribbon locations:

OpenRoads Modeling workflow → **Home** tab → **Attributes** group
OR
OpenRoads Modeling workflow → **Drawing** tab → **Attributes** group
OR
Drawing workflow → **Home** tab → **Attributes** group



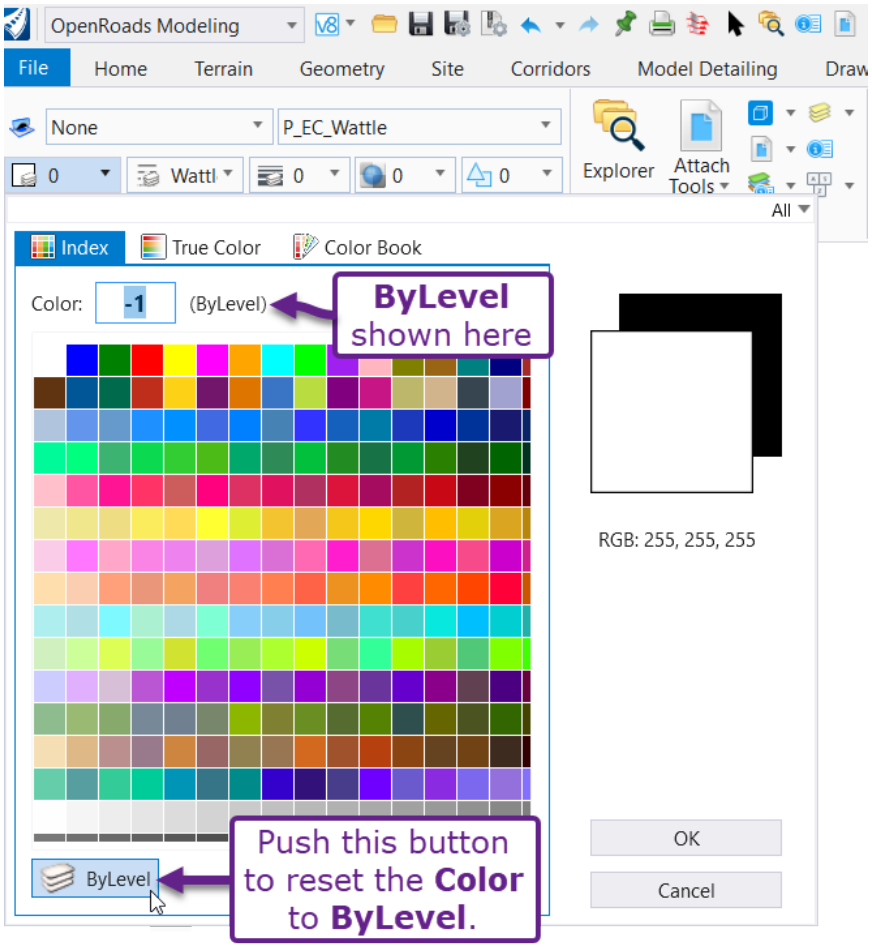
Element Template: The Element Template automatically sets the Level, Attributes, and miscellaneous settings, such as Text Style and Dimension Style. Typically, Element Templates are NOT used for drawing operations. However, Element Templates should be used in the creation of Annotations. For more information on Element Templates and creating annotation elements, see *15A.3 Element Templates*.

Active Level: Each Level has a default Color, Line Style, and Line Weight, which are designated as *ByLevel*. When the *active* Level is changed, the appropriate *ByLevel* attributes will be set. To conform with FLH drafting standards, the *ByLevel* attributes settings should be used.

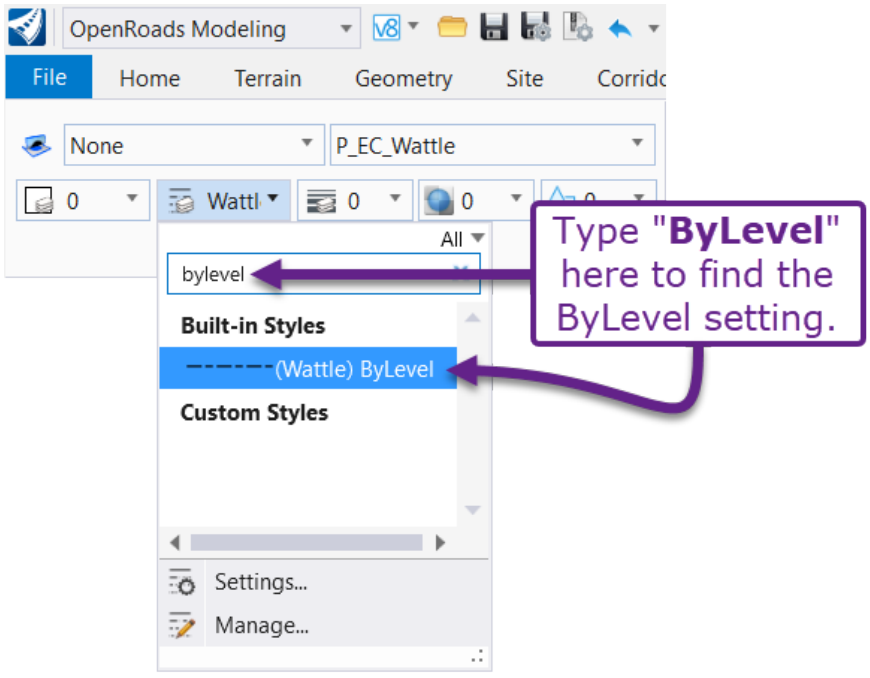
> ***IMPORTANT:*** If left unchanged, Color, Line Style, and Line Weight is set to *ByLevel*. Manually setting a Color, Line Style, and Line Weight results in an override. The overridden attribute will remain set, even if the *active* Level is changed.
>
> ***TIP:*** The *active* Level can also be set by double-clicking on a Level in the Level Display box.
>
> ***TIP:*** The *ByLevel* attributes for each Level is shown and can be edited from the Level Manager.

More information on Levels can be found at *1G – Levels*.

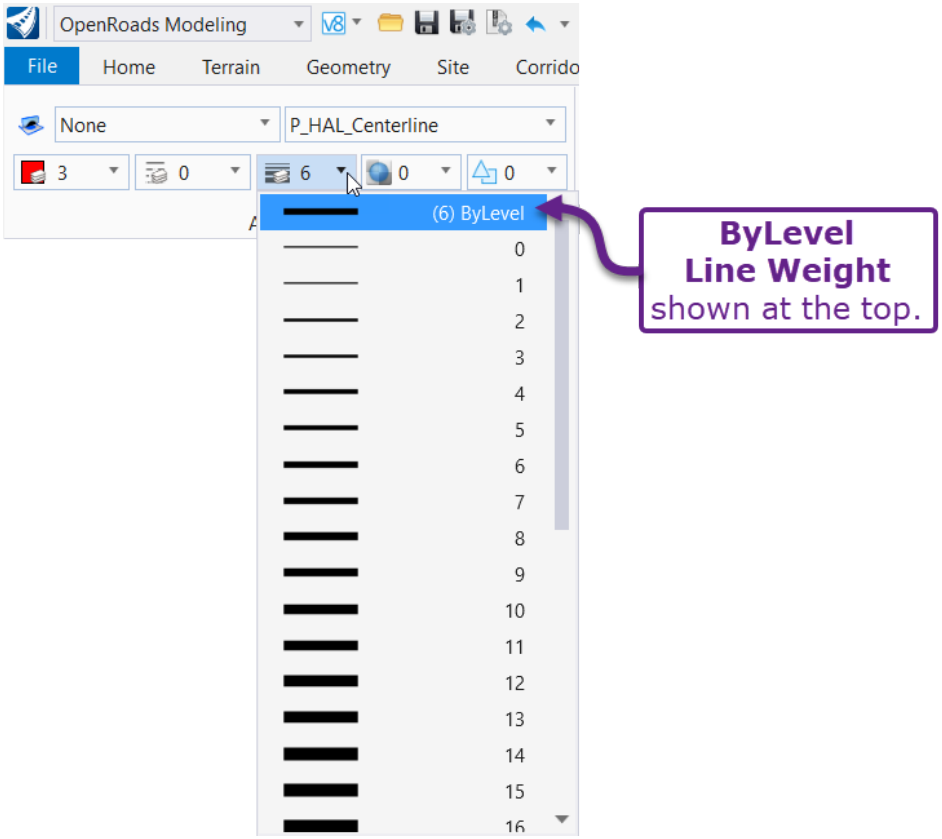
Color: When the Color is set to *ByLevel*, it is indicated at the top of the drop-down menu. If the term (ByLevel) is NOT shown at the top, then an overridden Color is active. Push the *ByLevel* button at the bottom to reset the color to the ByLevel setting.



Line Style: The Line Style drop-down menu does NOT indicate if the Line Style is currently set to the *ByLevel* setting. To check or reset the *ByLevel* setting, type "ByLevel" into the search bar shown at the top:



Line Weight: The *ByLevel* Line Weight setting is indicated at the top of the drop-down menu:



Transparency – If the transparency is set to 0, then the element is shown as a solid color. Increasing the transparency value makes an element opaquer.

> ***NOTE:*** The Transparency attribute is typically NOT used in FLH drafting practices. Keep the Transparency value set to 0.

Priority – The Priority establishes how elements are visually layered on to each other. The element with the highest Priority will be shown on top. If multiple elements have the same Priority value, then the most recently drawn element is shown on top.

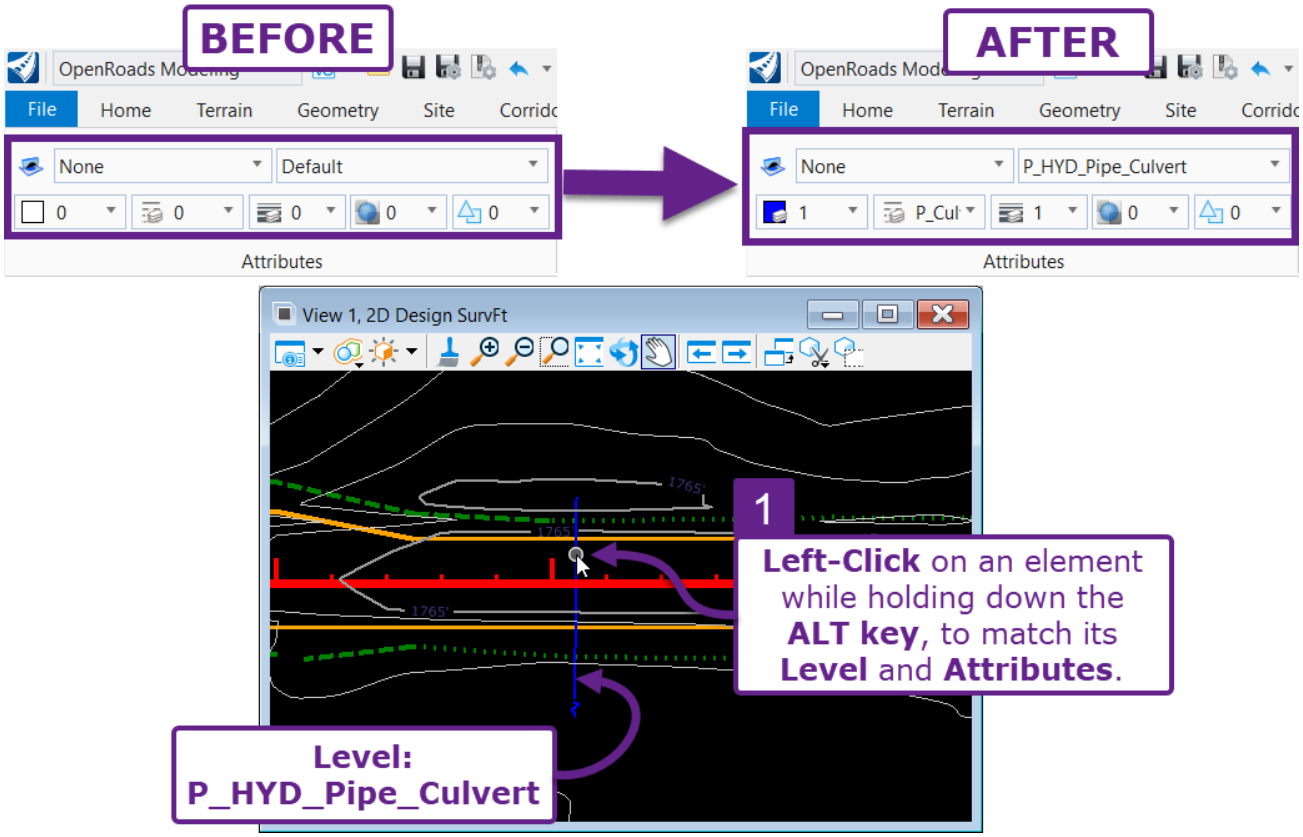
> ***NOTE:*** Manipulating an element's Priority value is NOT advised. In printing, the FLH Pen Table assigns Priority to elements based on the Level. Manually setting the Priority value may conflict with the Priority set by the FLH Pen Table. Keep the Priority value set to 0.

6A.2.a Tips and Tools for Setting the Active Level and Attributes

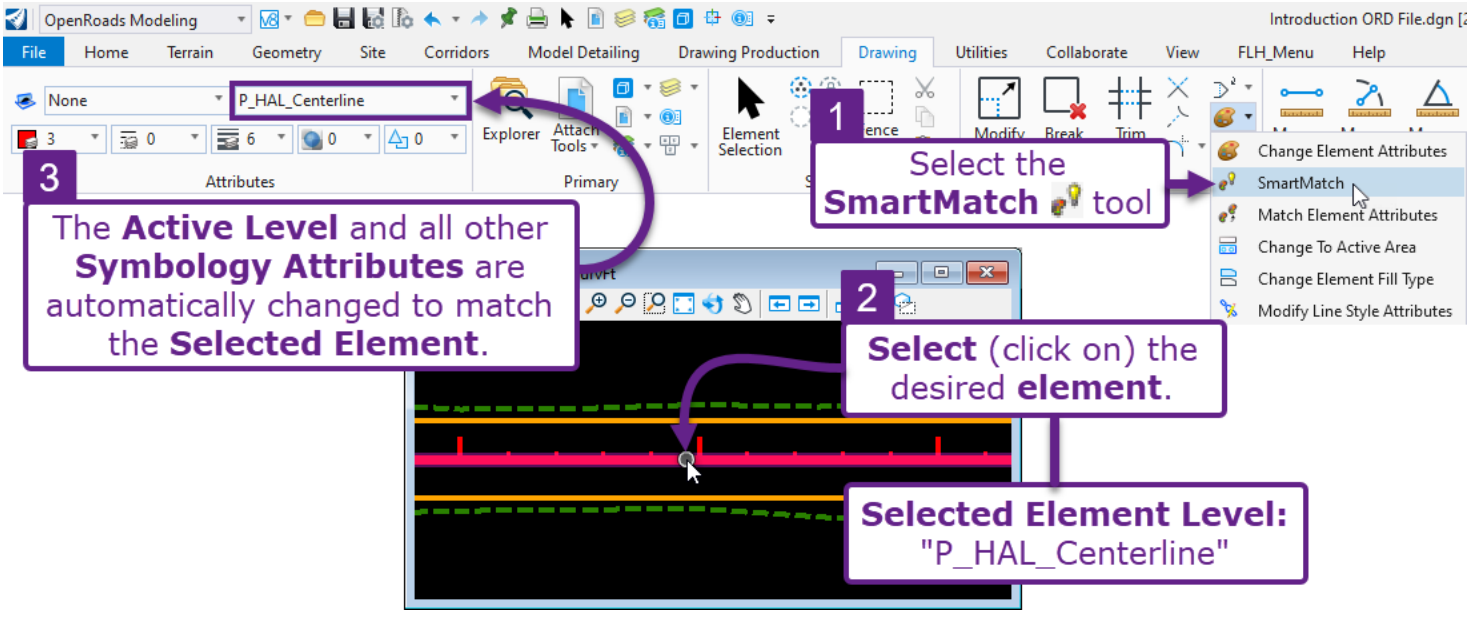
If the desire is to match the Level and Attributes of an existing element, then hold down the ALT key and left-click on an element. The Level and Attributes of the existing element will be set as active.

IMPORTANT: The ALT key must be held down while left-clicking on the element.

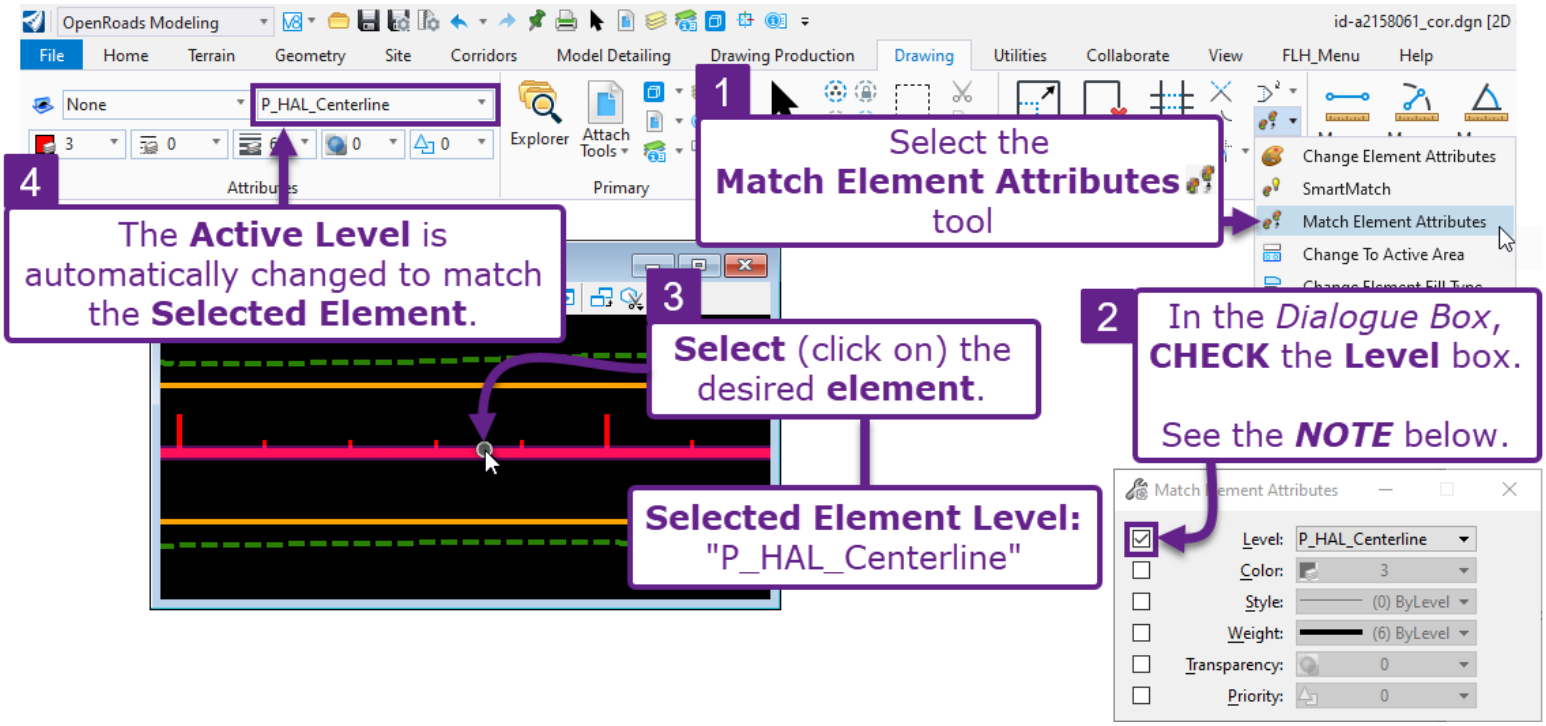
TIP: This action can be performed in the middle of a drawing tool operation.



The *SmartMatch* tool functions the same as the procedure shown above. This tool works by selecting an element. The Level and Attributes of the selected element will become *active*.



The *Match Element Attributes* tool works very similar to the *SmartMatch* tool shown above. However, the *Match Element Attributes* tool has additional configuration options to set the specific attributes to be changed.



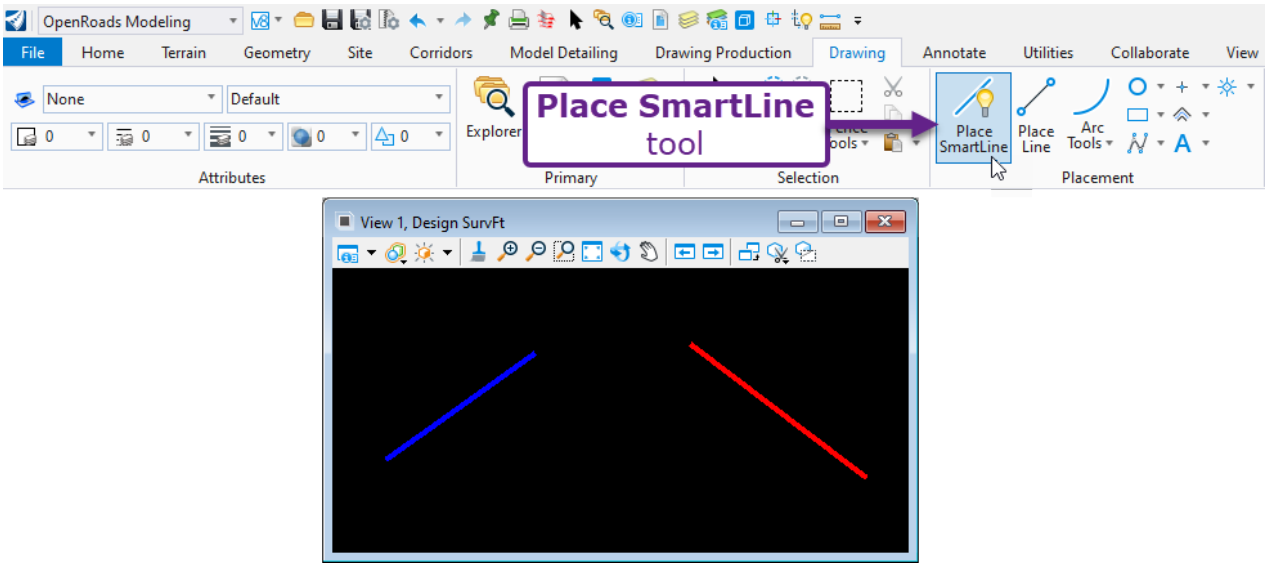
NOTE: For the *Match Element Attributes* tool to have any effect, at least ONE box has to be CHECKED in the *Dialogue Box*. Typically, it is ONLY necessary to check the **Level** box. For future elements to be drawn, the "By Level" (default) symbology attributes will be used.

TIP: Additional tips for manipulating Levels and Attributes are shown in *1G.4 Change the Level of an Element*.

6A.3 Basic Drawing Tools Workflow

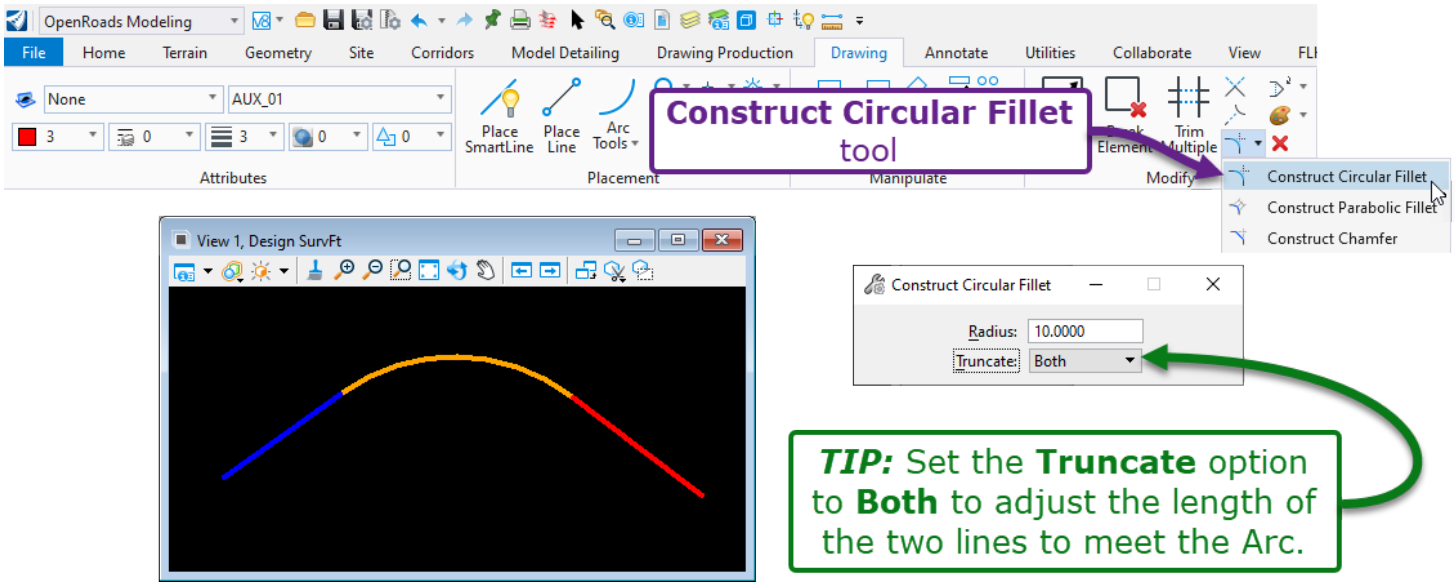
This section demonstrates commonly used MicroStation Drawing tools. All tools shown in this section are discussed in greater detail later in this chapter. ***IMPORTANT:*** Always set an Active Level before drawing elements.

Draw Lines with the *Place SmartLine* tool or ***Place Line tool:***



NOTE: The *Place Line* tool creates a single line element. The *Place SmartLine* tool can create multiple, connected line segments. For more information on the *Place SmartLine* tool, see *6C.1.b SmartLine tool*.

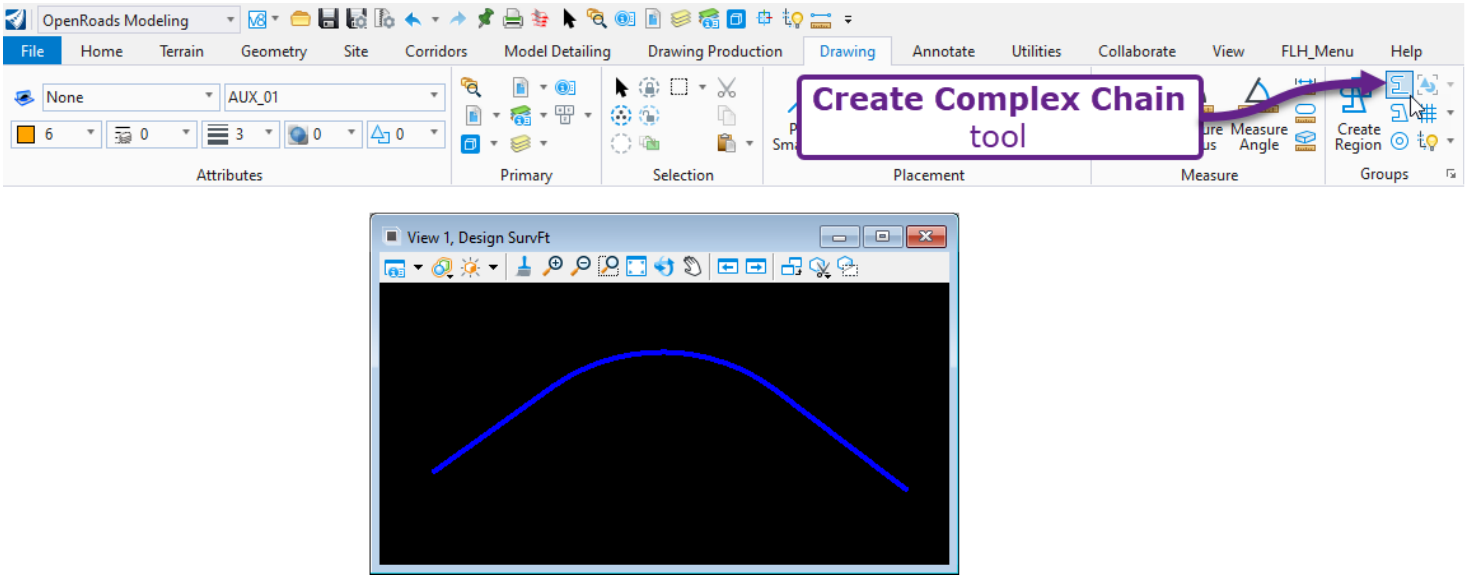
Create an Arc between Line Elements with the *Construct Circular Fillet* tool:



NOTE: The *Construct Circular Fillet* tool creates a tangential arc between two elements. The *Place Arc* tool creates a stand-alone arc element, which is NOT necessarily tangent to the adjacent elements. For more information on the *Construct Circular Fillet* tool, see *6F.6 Construct Circular Fillet tool*.

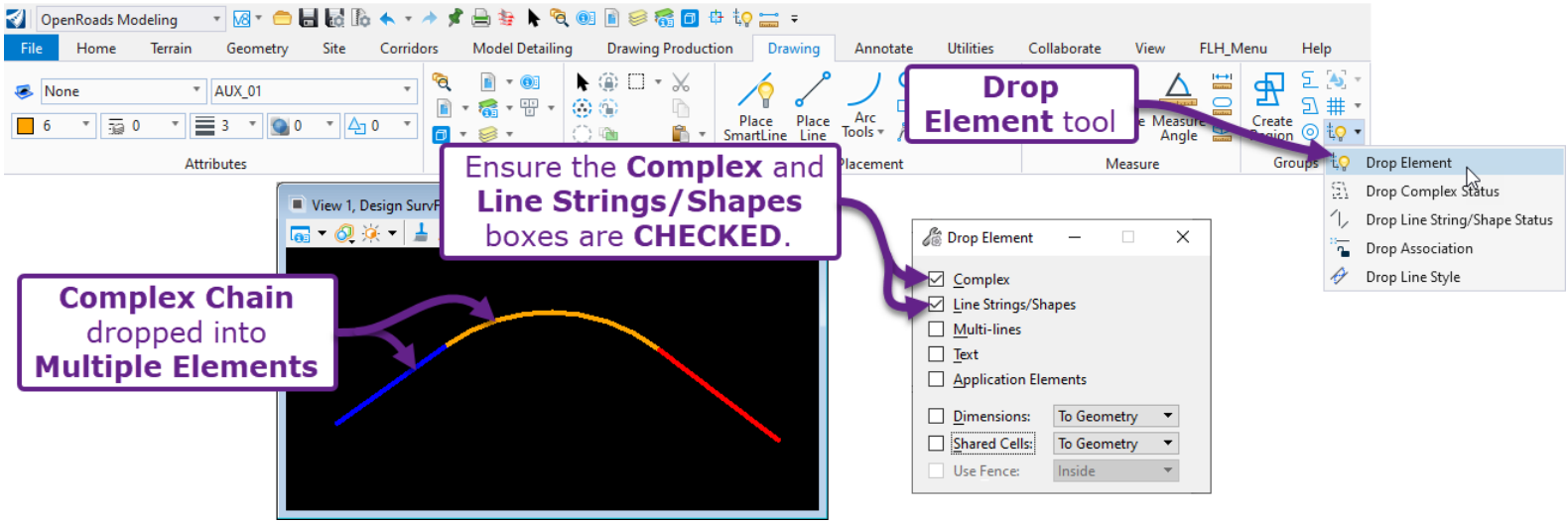
NOTE: After the *Construct Circular Fillet* tool is used, the resulting arc is NOT joined with the adjacent Line elements into a single element. As shown on the next page, the *Create Complex Chain* tool is used to join multiple elements into a single element.

Join the Connected Elements together with the *Create Complex Chain* tool:



NOTE: The *Create Complex Chain* tool is used to join multiple elements into an open-ended element. The ***Create Complex Shape*** and ***Create Region* tools** are used to join multiple elements into a closed element. For more information on the *Create Complex Chain* tool, see *6H.2 Create Complex Chain tool*.

Break an Element into Individual Components with the *Drop Element* tool:



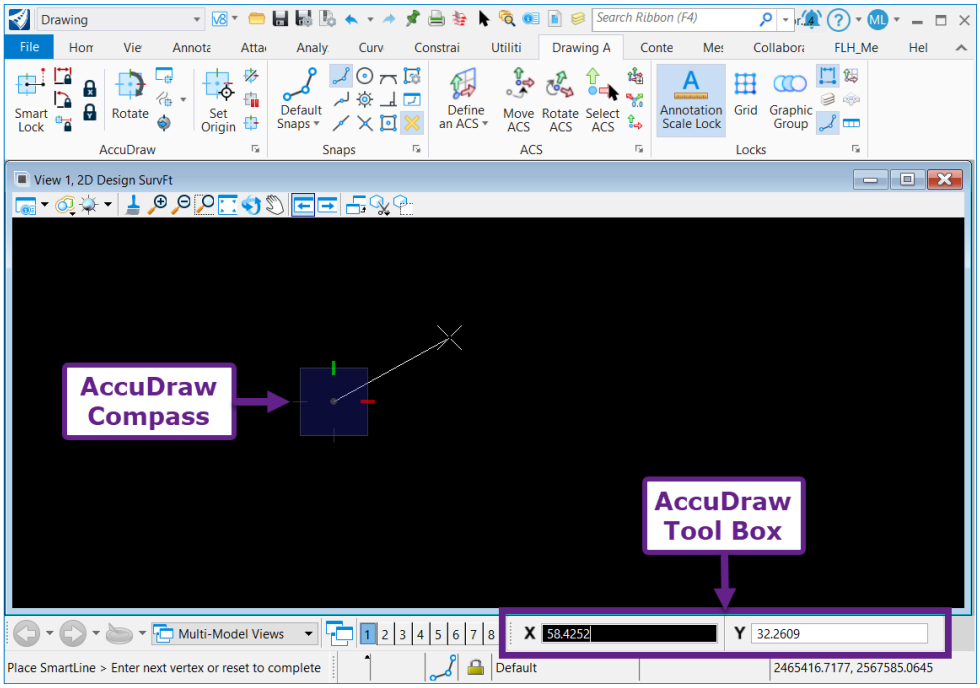
The *Drop Element* breaks down a single Complex Chain element into multiple base geometry segments. The *Drop Element* can also be used on other element types, such as Cells, to breakdown an element into simpler geometry and text segments. For more information on the *6H.7 Drop Element tool*.

6B – ACCUDRAW

AccuDraw is a floating compass and coordinate system used to draw and manipulate elements in a precise manner.

NOTE: AccuDraw and Civil AccuDraw are two different functions in the ORD Software. AccuDraw is intended for placing MicroStation Elements (i.e., common drafting elements). Civil AccuDraw is for placing ORD Elements (i.e., Alignments and Profiles).

AccuDraw has two main components: the Compass and the Tool Box. Assuming AccuDraw is toggled ON, the Compass is shown during a drawing or manipulation operation and the Tool Box is shown at all times.



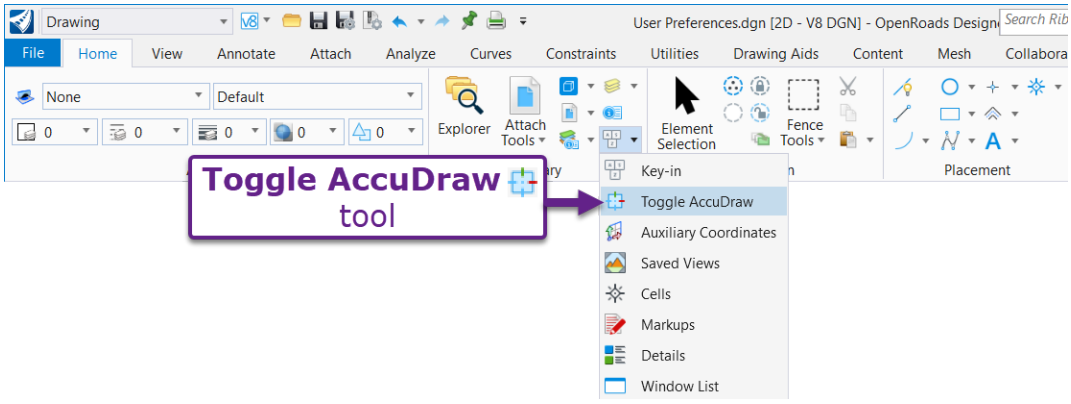
NOTE: Manipulating the AccuDraw Compass and Tool Bar is most conveniently accomplished with Keyboard Shortcuts. For more information on Keyboard Shortcuts, see *4C – Keyboard Shortcuts*. In this section, the default Keyboard Shortcuts are used to manipulate AccuDraw. If custom Keyboard Shortcuts were created, then Keyboard Shortcuts may differ.

The *Toggle AccuDraw* is used to toggle AccuDraw ON/OFF. The *Toggle AccuDraw* tool is found in many locations in the Ribbon. Two common Ribbon locations are:

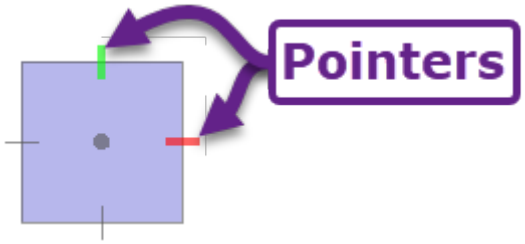
OpenRoads Modeling workflow → **Home** tab → **Primary** panel

OR

Drawing workflow → **Home** tab → **Primary** panel



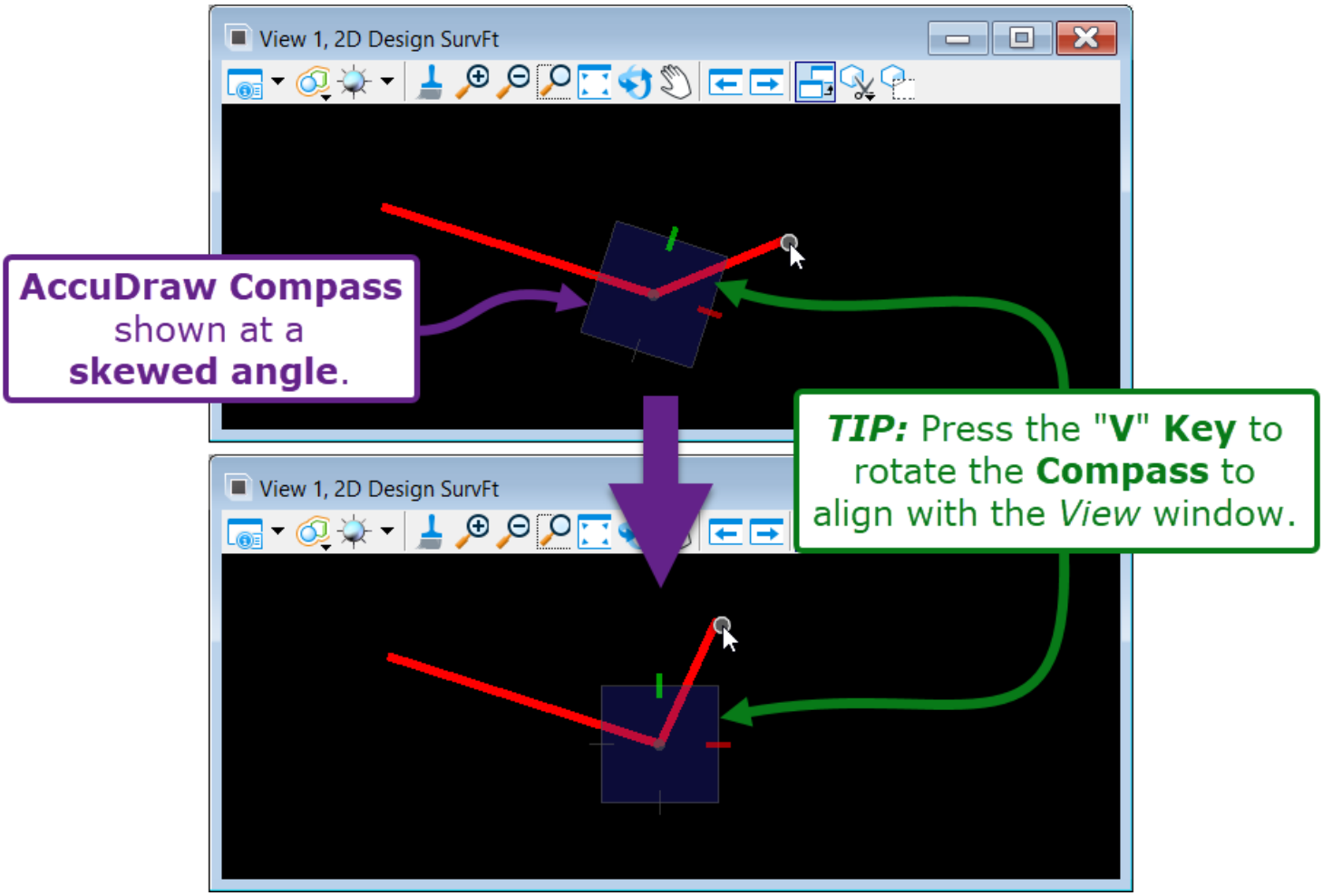
The AccuDraw Compass contains two **Pointers**. The mouse-cursor will snap/lock on to the Pointer axis when close.



The AccuDraw Compass is rotatable. Using Keyboard Shortcuts, the Pointers can be rotated to any direction.

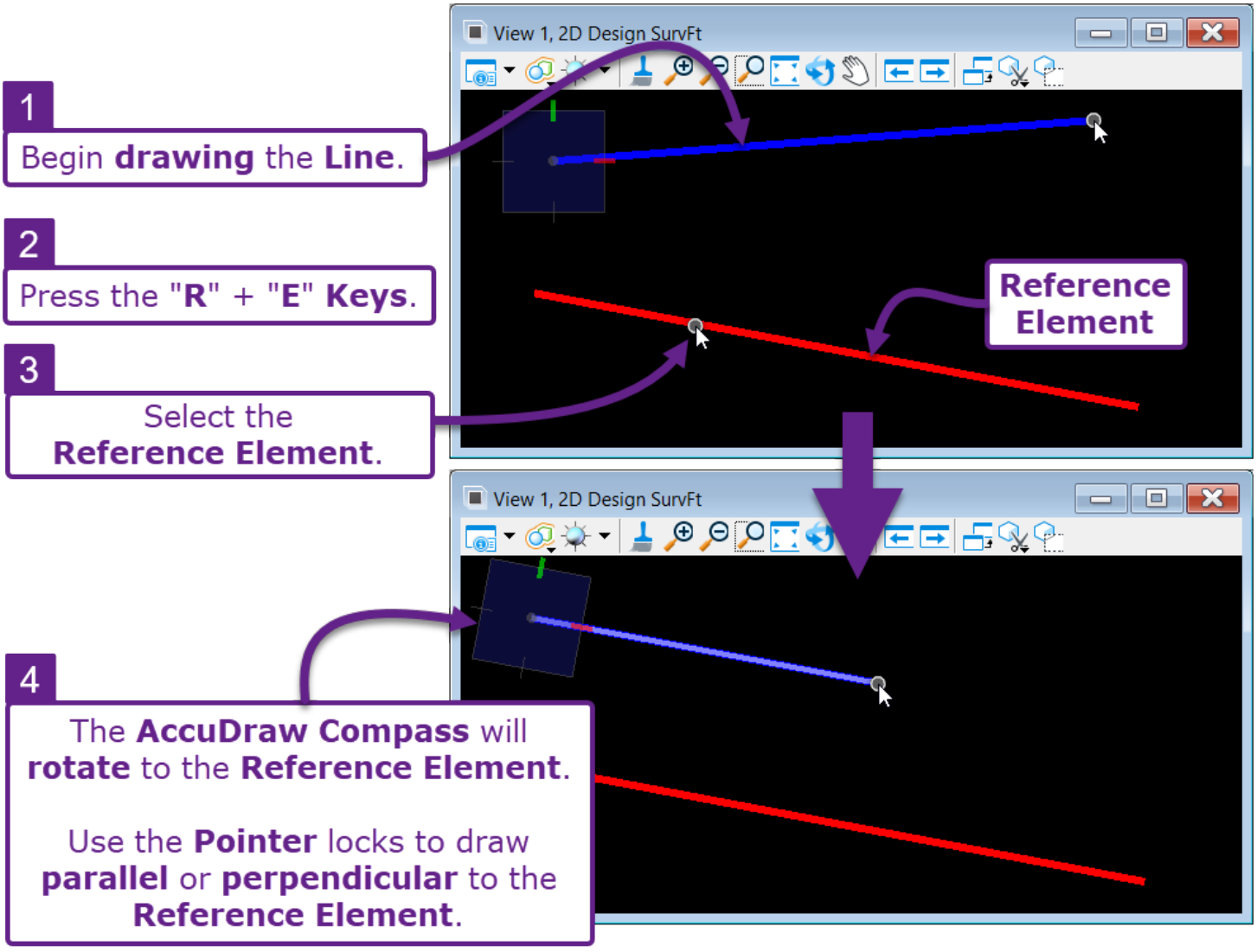
NOTE: Using Keyboard Shortcuts, rotate the AccuDraw Compass while using a drawing or manipulation tool. Do NOT rotate the AccuDraw Compass before using a drawing or manipulation tool because the Compass will reset to the default orientation when the tool is executed.

TIP: If the AccuDraw Compass is shown at a skewed angle, then press the "V" key to rotate the Compass to align with the *View* window (i.e., straight up-down, left-right).

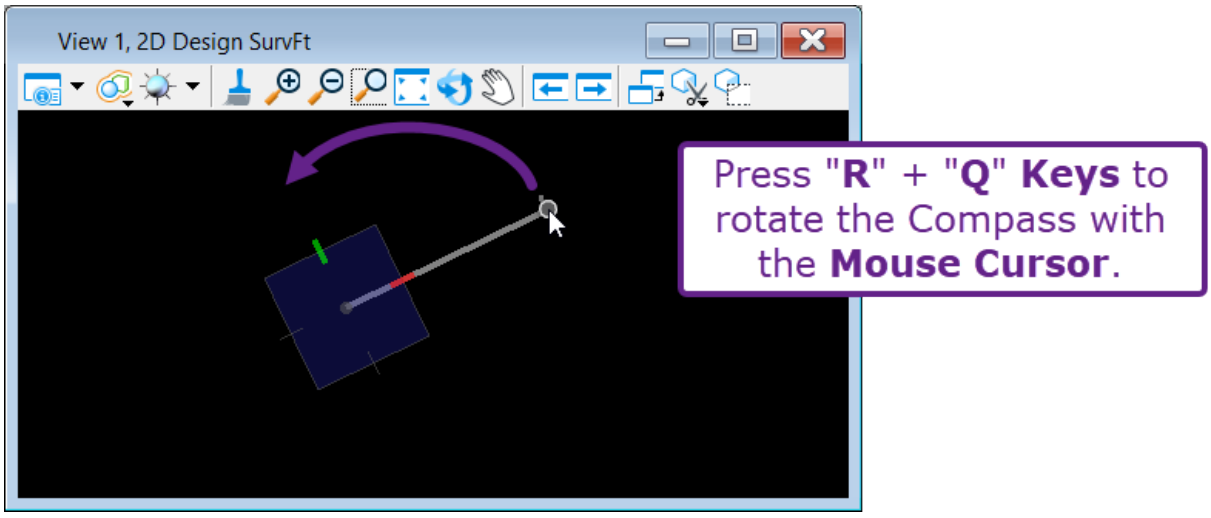


TIP: If the *View* window is rotated, press "R" + "C" keys to rotate the AccuDraw Compass to align with true north.

During the operation of a tool, press the "R" + "E" keys to rotate the AccuDraw Compass to align with a reference element. The Pointers will then be oriented parallel and perpendicular to the reference element. This technique can be used to draw exactly parallel to a reference element.



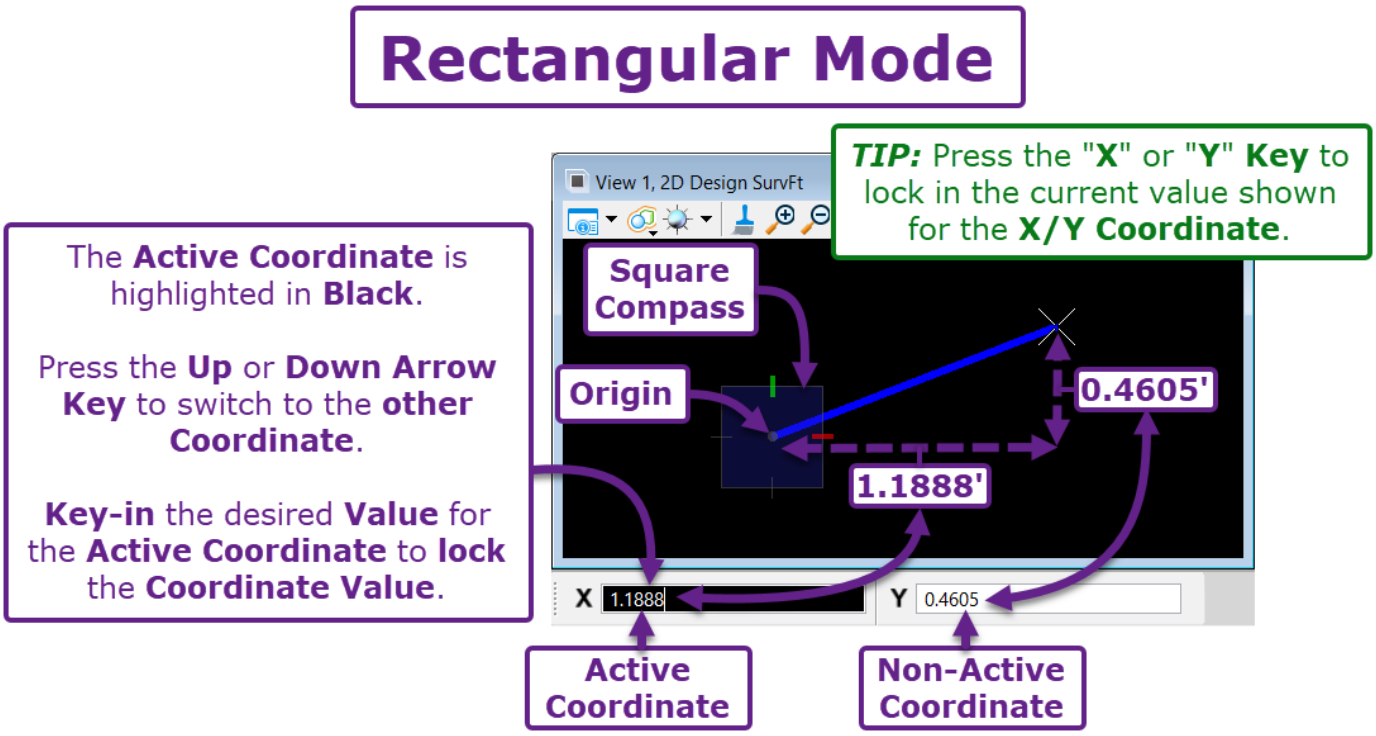
TIP: Press the "R" + "Q" keys to rotate the AccuDraw Compass in a free-hand manner with the mouse cursor. After this Keyboard Shortcut is executed, the AccuDraw Compass will follow the mouse cursor.



By default, the AccuDraw Compass is shown as a square and X/Y Coordinates are shown in the AccuDraw Tool Box. This configuration is referred to as **Rectangular Mode**.

The values shown in the X/Y Coordinate boxes are measured relative to the **Origin** point of the AccuDraw Compass. ***TIP:*** Press the "O" key to move the **Origin** point to a different location.

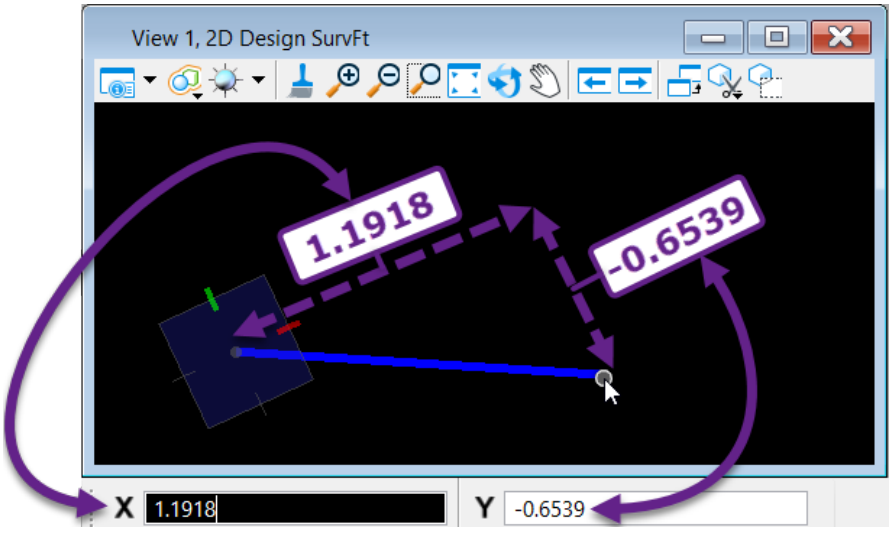
The X coordinate is measured along the **Red** Pointer axis. The Y coordinate is measured along the **Green** Pointer axis.



To enter a specific value into the X/Y Coordinate box, first, ensure the desired Coordinate is **Active**. The **Active Coordinate** is highlighted in black. Press the Up/Down Arrow keys or the Tab key to switch between coordinates.

With the appropriate coordinate active, type in the desired value and it will automatically be entered and locked into the Active Coordinate box. There is NO need to click on an X or Y coordinate.

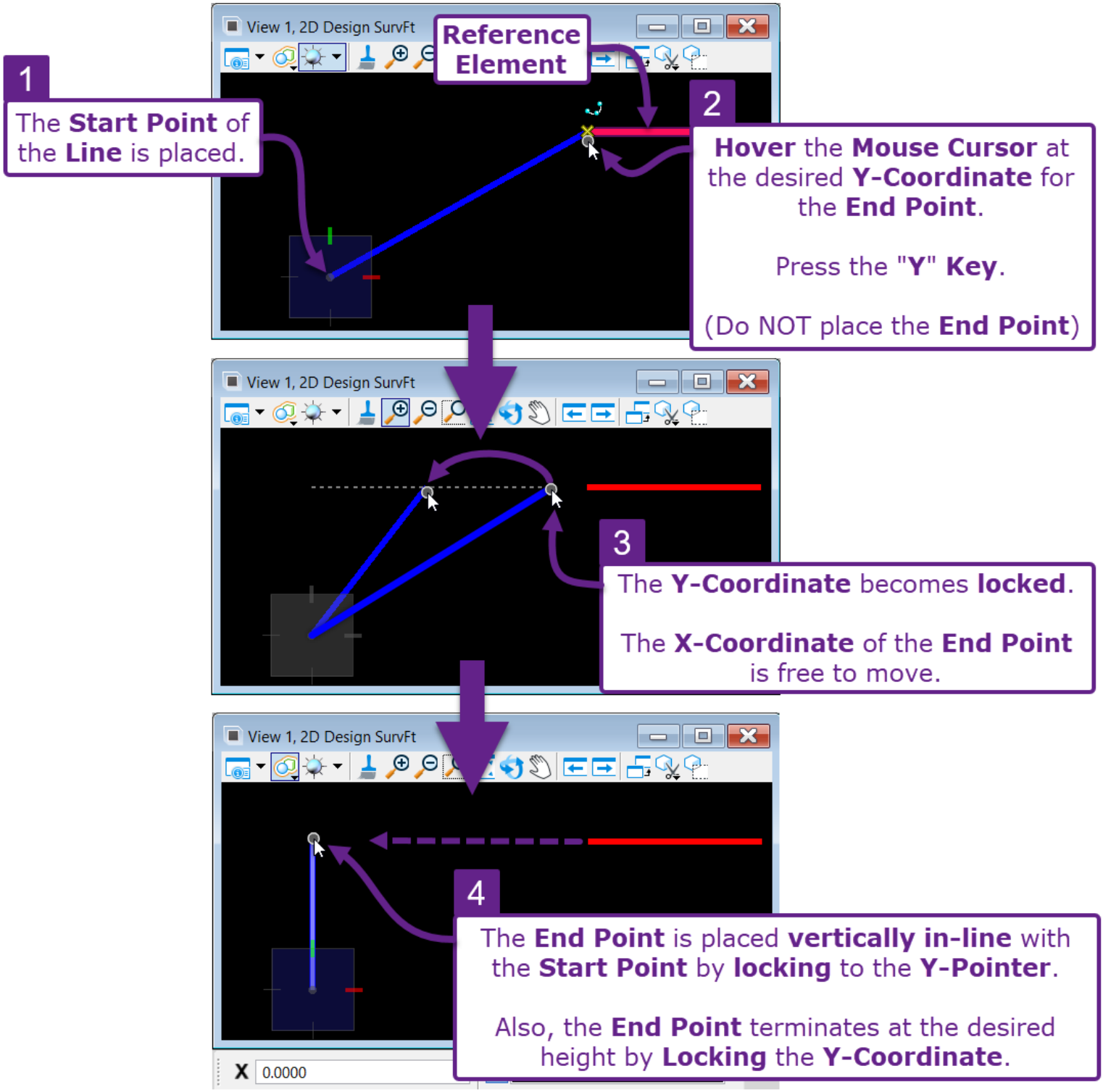
NOTE: When the AccuDraw Compass is rotated, the X/Y Coordinates area measured in the direction of the Pointer axis:



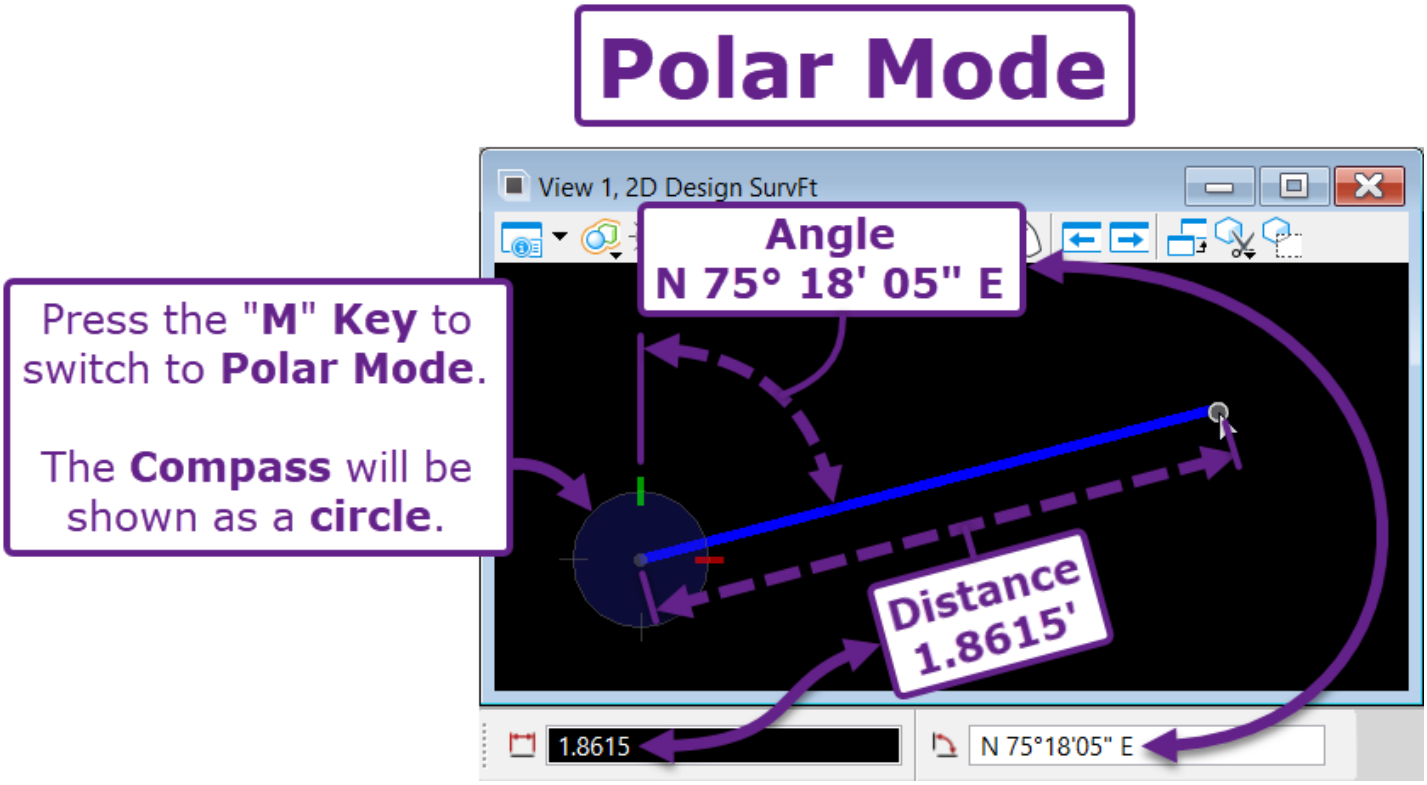
TIP: Press the "X" key to lock the current value shown in the X coordinate box. When this happens, the end point of the line is locked to the X coordinate, but is free to move along the Y-axis.

Conversely, press the "Y" key to lock the Y coordinate, and allow the end point to move freely along the X-axis.

In the example shown below, the desire is to place a line that is vertical but terminates at the same height as the red, reference element. First, place the start point of the line. Next, hover the mouse cursor over the end point of the reference element and push the "Y" key. Lastly, move the mouse cursor towards the Y-Pointer axis until the Pointer locks. Left-click to accept the End Point position for the Line.



Press the "M" key to switch between **Polar Mode** and **Rectangular Mode**. In **Polar Mode**, the Compass is shown as a circle. The current **Angle** and **Distance** are shown in the Tool Box.



TIP: Press the "A" key to lock the current Angle shown in the AccuDraw Tool Box. Press the "D" Key to lock the current Distance.

TIP: The Angle value along the **Green** Pointer axis always measures to N 00° 00' 00" E. The Angle value along the **Red** Pointer axis measures to N 90° 00' 00" E.

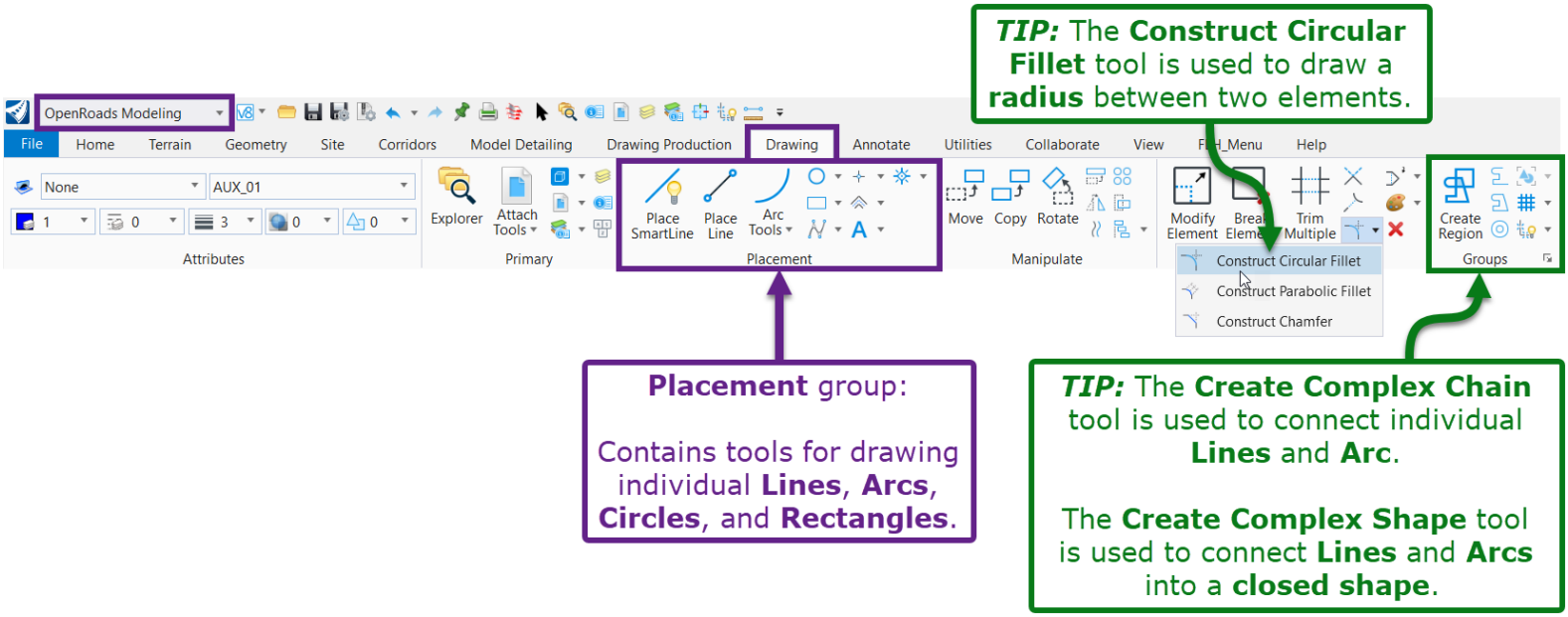
WARNING: The Angle value shown in the AccuDraw Tool Box is relative to the rotation orientation of the AccuDraw Compass. The Angle value may NOT correspond with true north and real-world bearing angles. The Angle value corresponds with real-world bearing angles ONLY when both the *View* window and AccuDraw Compass are unrotated.

TIP: If the *View* window is rotated, press "R" + "C" keys to rotate the AccuDraw Compass to align with true north. ***NOTE:*** The "R" + "C" command rotates the Compass to align with the Auxiliary Coordinate System (ACS) orientation. By default, the ACS is aligned with true north. However, the orientation of the ACS can be changed to a custom orientation. A practical use for the ACS is to rotate it to a custom angle. Whenever, the "R" + "C" command is used, the AccuDraw Compass will rotate the custom ACS angle. Operation and manipulation of the ACS is discussed in *6I.3 Auxiliary Coordinate System (ACS)*.

6C – PLACEMENT TOOLS

The tools found in the Placement group are used to draw MicroStation Elements. Placement tools are found at two main locations in the Ribbon:

1. **OpenRoads Modeling** workflow → **Drawing** tab → **Placement** group
2. **Drawing** workflow → **Home** tab → **Placement** group

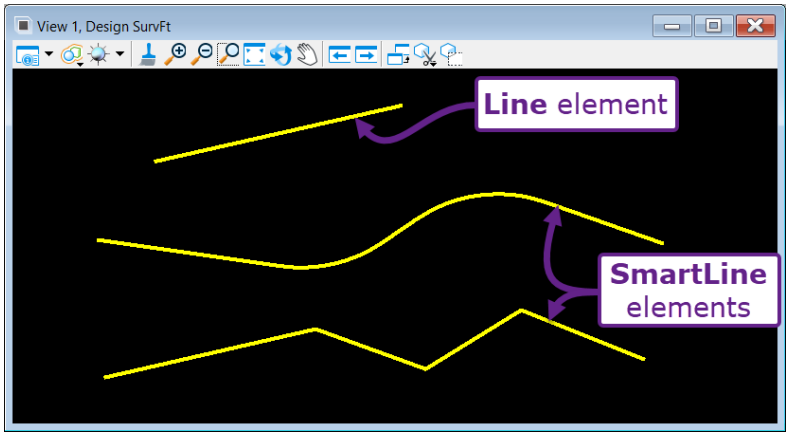


WARNING: Do NOT use these MicroStation Drawing Tools to create Alignments (i.e., proposed centerline of road, culvert alignments) and Profiles. Instead, use tools described in *Chapter 7 – Geometry*.

6C.1 Line and SmartLine Elements

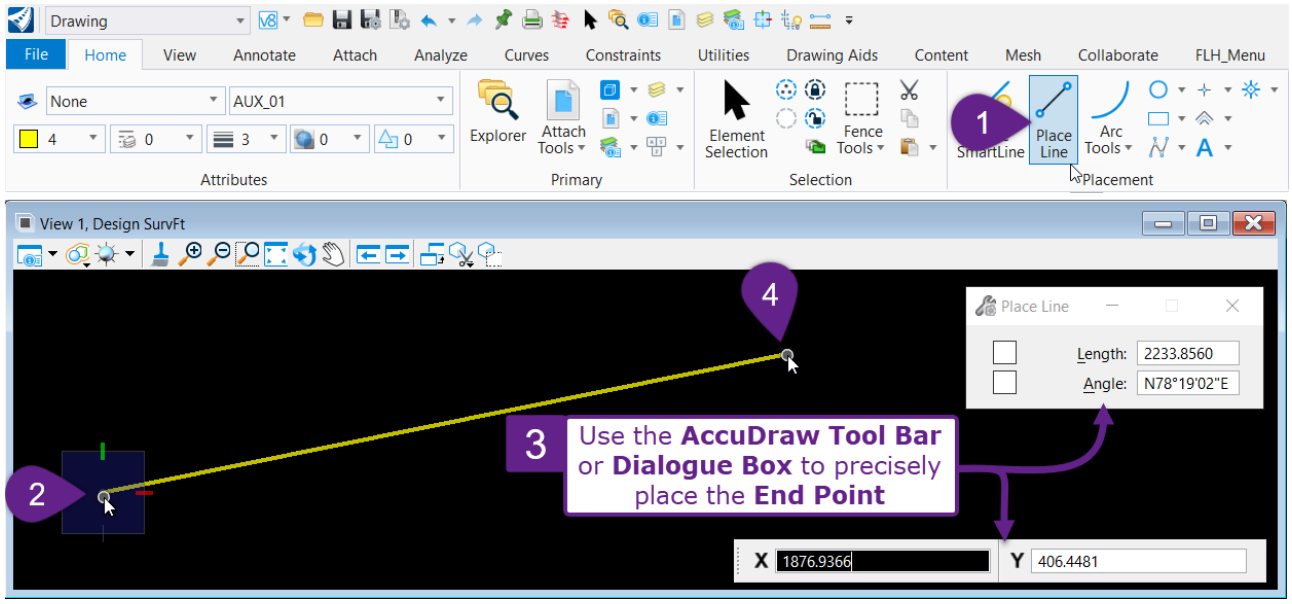
The *Place Line* tool is used to create a single Line element.

The *Place SmartLine* tool is used to create a series of lines and or curves that are automatically joined into a single element.



6C.1.a Place Line tool

This tool creates a simple, standalone Line element. The workflow below shows the basic operation procedure for the *Place Line* tool.



1	From the Ribbon, select the *Place Line* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Placement***].
2	*Prompt: Identify the start of the line* – Left-Click at the desired location for the start point of the Line element.
3	OPTIONAL: Use the AccuDraw Tool Bar or the Dialogue Box to determine the End Point placement. ***NOTE:*** The Angle value shown in the Dialogue Box is relative to the current rotation orientation of the AccuDraw Compass.
4	*Prompt: Identify end of the line* – Left-Click at the desired location for the end point of the Line element.

6C.1.b SmartLine tool

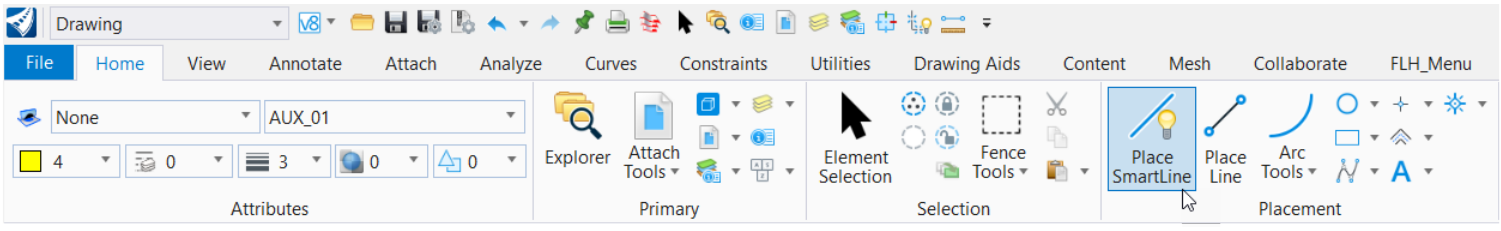
The *SmartLine* tool is used to create a series of connected lines and/or arc segments.

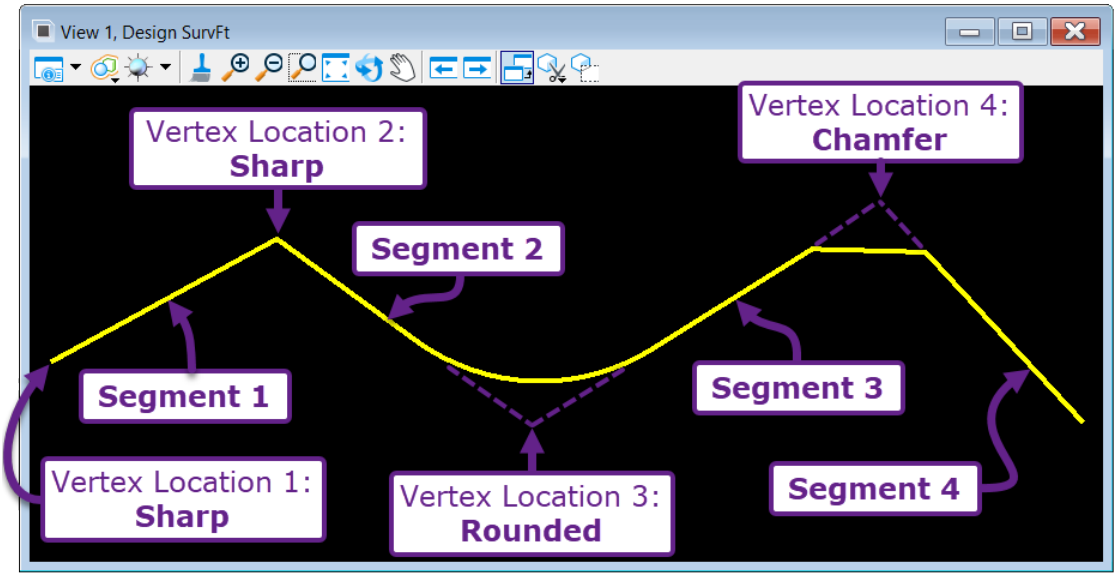
NOTE: The Vertex and Radius/Offset settings shown in the Dialogue Box applies to the next segment to be drawn. Each segment can be drawing using different Vertex settings and Radius/Offset values.

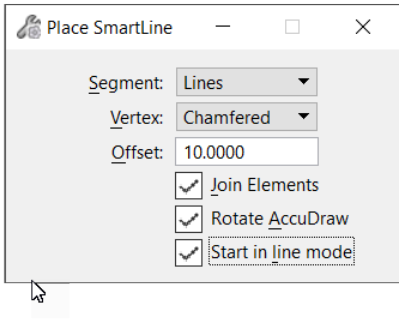
NOTE: Right-Click (reset) to complete the placement of the SmartLine.

TIP: While operating the tool, press the *Undo* button or CTRL +"Z" to undo the last drawn segment.

TIP: After the SmartLine is drawn, use the *Modify Element* tool to edit the radius, chamfer offset value, or deflection point position. The *Modify Element* tool is discussed in *6F.1 Modify Element tool*.

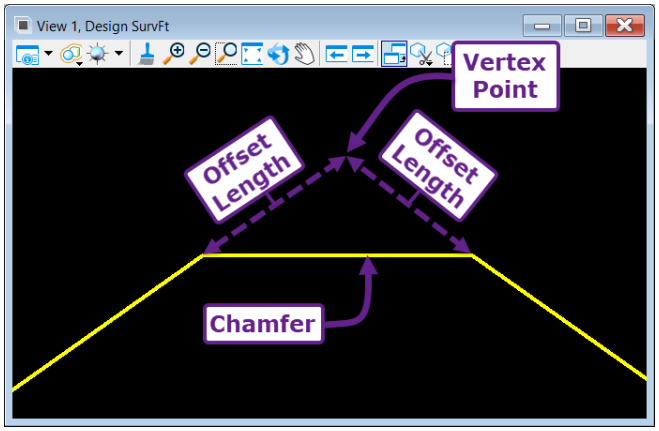






1	From the Ribbon, select the *Place SmartLine* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Placement***].
2	*Prompt: Enter first Vertex* – Left-Click at the desired location for the start point of the first segments
3	Configure the Dialogue Box settings as desired. See the next page for an explanation of each setting.
4	*Prompt: Enter next vertex or reset to complete* – Left-Click at the desired location for the next vertex. Between this vertex and the previous, a segment is created.
5	Repeat steps 3-4 until satisfied with the appearance of the SmartLine. Right-Click (reset) to complete placement of the SmartLine.

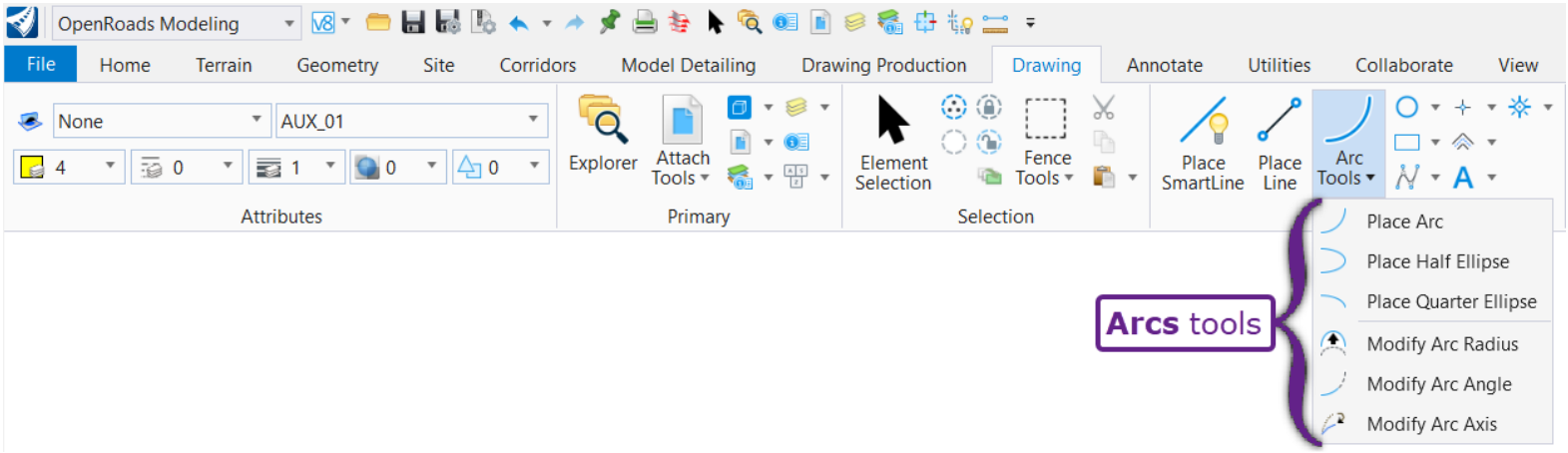
The table below explains all settings available for the *SmartLine* tool:

SmartLine Dialogue Box Settings	
Setting	**Description:**
Segment: Line	The next segment to be drawn will be a Line.
Segment: Arc	The next segment to be drawn will be an Arc.
Vertex: Sharp	There is no rounding or chamfering at the vertex between segments.
Vertex: Rounded	A circular fillet is placed between the last segment drawn and the next segment. The Radius value determines the size of the circular fillet.
Vertex: Chamfered	A symmetrical chamfer is created between the last segment drawn and the next segment. The Offset value determines the length between the vertex point and the beginning/end of the chamfer. 
Radius/Offset	If the Vertex is set to Sharp, then this box is greyed out. If the Vertex is set to **Rounded**, then the **Radius** box is shown. The value entered into this box determines the radius between current and next line segment to be drawn. If the Vertex is set to **Chamfered**, then the **Offset** box is shown. This value determines the length (offset) between the vertex point and beginning/end of the chamfer.
Join Elements	If this box is CHECKED, then all segments drawn are joined as a single element. If UNCHECKED, then all segments drawn are separate, individual elements.
Rotate AccuDraw	If this box is CHECKED, then the AccuDraw Compass will automatically rotate after each segment drawn. The AccuDraw Compass will rotate to be parallel with the last drawn segment. If UNCHECKED, the AccuDraw Compass does NOT automatically rotate during operation of the tool.
Start in line mode	If this box is CHECKED, then the Segment setting will always default to Lines when the tool is executed. If UNCHECKED, then the last used Segment setting will be used when the tool is executed. For example, if the Segment was previously set to Arc, then it will remain set to Arc for the next time the *SmartLine* tool is used (assuming this box is UNCHECKED).

6C.2 Arc tools

Circle and Ellipse tools are found in the Ribbon at the following locations:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Arcs** drop-down
OR
Drawing workflow → **Home** tab → **Placement** group → **Arcs** drop-down



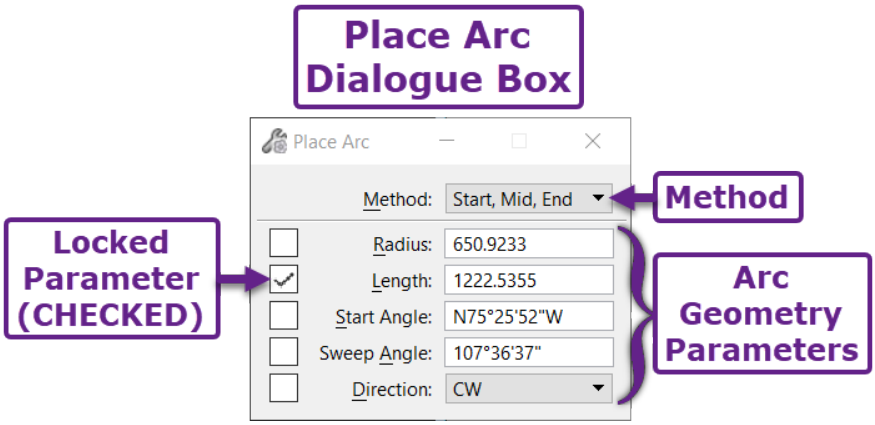
6C.2.a Place Arc tool

This tool has 4 different Methods to create a circular arc:

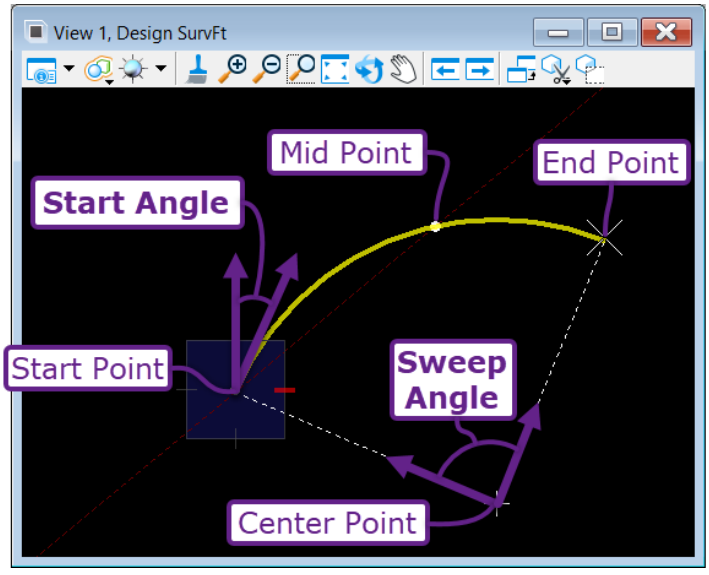
Place Arc Methods	
Method:	**Description:**
Start - Center	The first click determines the start point of the arc. The second click determines the center and radius length.
Center – Start	The first click determines the center point of the arc. The second click determines the start point and radius length.
Start – Mid – End	The first click determines the start point of the arc. The second click determines a through point along the arc. The third point determines the end point of the arc.
Start – End – Mid	The first click determines the start point of the arc. The second click determines the end point of the arc. The third click determines a point along the arc.

NOTE: The messages shown in the *Prompt* bar differs depending on the selected Method.

The remaining *Dialogue Box* options are used to set the geometry parameters for the arc. To lock a geometry parameter: click in the value box, type in the desired value, and press the Enter key.



NOTE: The geometry of an arc becomes fully constrained when two parameters are locked (CHECKED). When the geometry of an arc is fully constrained, the remaining parameters will be greyed out.



Place Arc Geometry Parameters	
Method:	**Description:**
Radius	Distance between the arc center point and any point along the arc.
Length	Length measured along the path of the arc.
Start Angle	Angle between the AccuDraw pointer and the start tangent of the arc. ***NOTE:*** The Start Angle is dependent on the current rotational orientation of the AccuDraw Compass.
Sweep	Angle between the Start Point, Center Point, and End Point of the arc.
Solution	If two or more geometric parameters are locked, then the geometry of the arc is fully constrained. However, there may be two arc configurations (solutions) that satisfy the geometric constraints. Press the ALT + TAB key to switch between the two solutions. Alternatively, select 0 or 1 from the drop-down to switch between the two solutions.

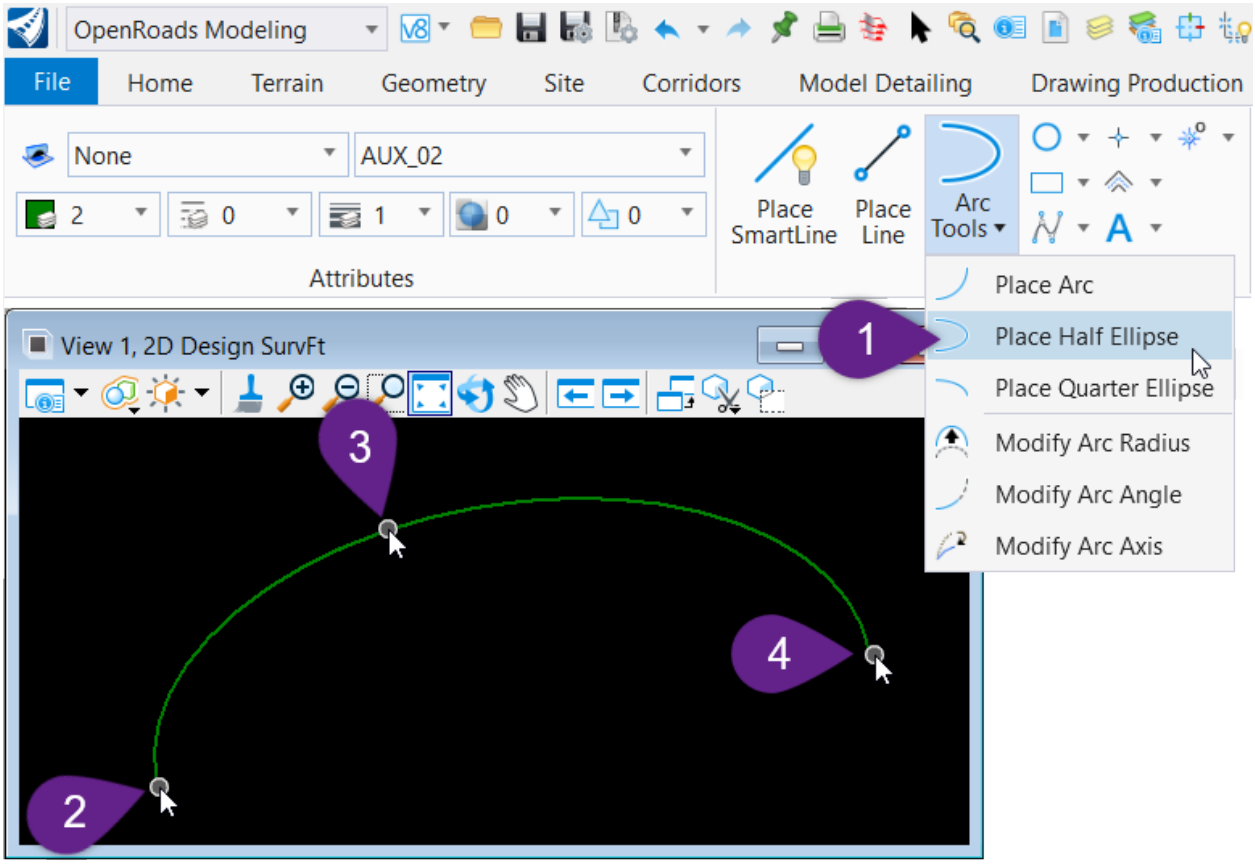
TIP: After creating an Arc, use the *Modify Arc Radius* tool to change the radius of the arc WITHOUT affecting the position of the start and end points. The Arc radius can also be changed in the Properties by entering a new value. However, this will change the position of the start/end points.

TIP: The *Modify Arc Angle* tool is used to extend/contract the length of the arc. However, this action can also be performed by selecting the arc and dragging the start or end point grip-edit handle.

TIP: The *Modify Arc Axis* tool will transform the circular arc into an elliptical arc.

6C.2.b Place Half Ellipse tool

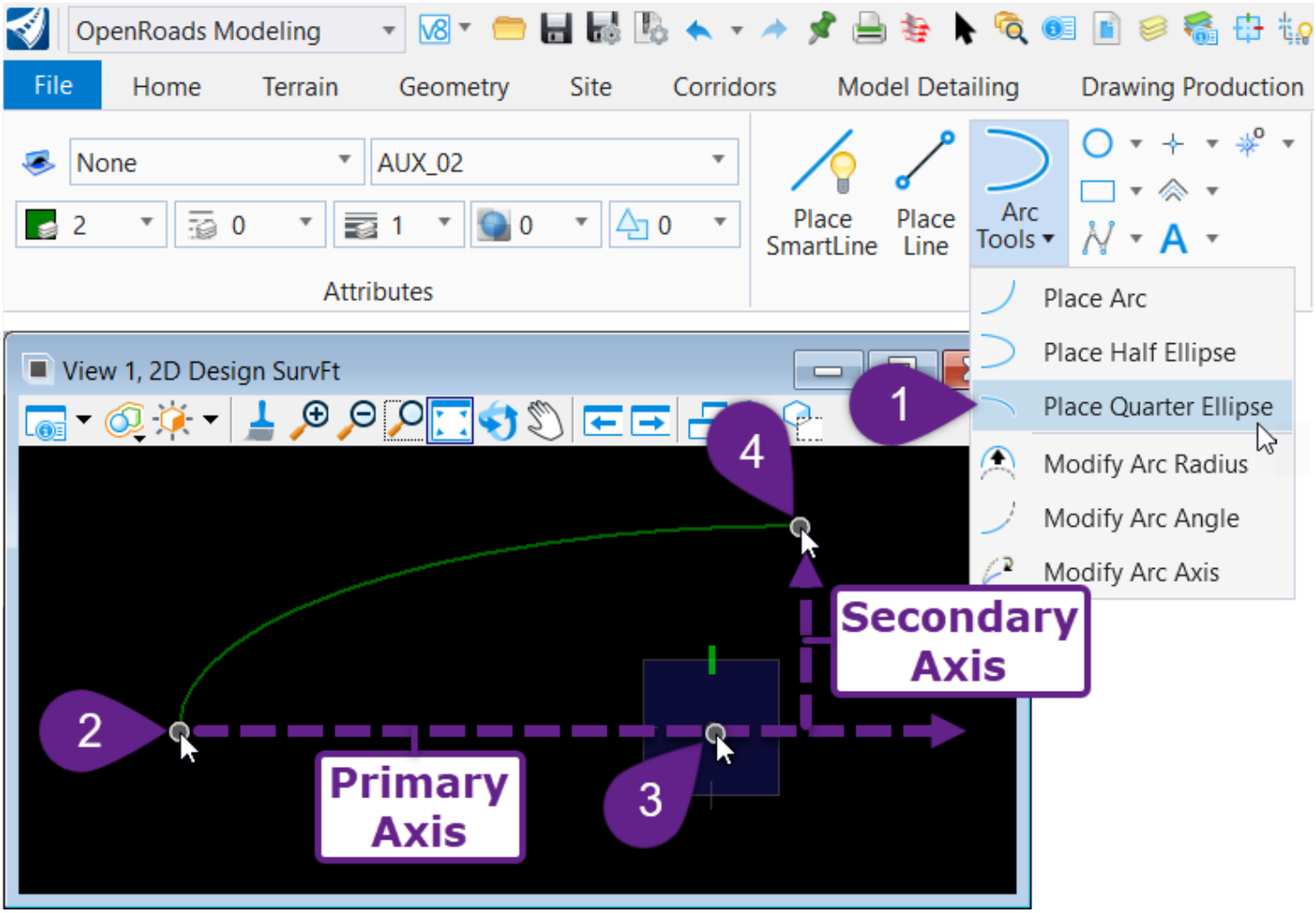
This tool creates a half of an ellipse using a **Start – Mid – End** placement method.



1	From the Ribbon, select the *Place Half Ellipse* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Placement*** → ***Arc Tools***].
2	*Prompt: Enter point on axis* – Left-Click at the start point of the half ellipse element.
3	*Prompt: Enter any point on the ellipse* – Left-Click at any point along the perimeter of the half ellipse element.
4	*Prompt: Enter other end of axis* – Left-Click at the end point of the half ellipse element.

6C.2.c Place Quarter Ellipse tool

This tool creates a quarter of an ellipse.



1	From the Ribbon, select the *Place Quarter Ellipse* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Placement*** → ***Arc Tools***].
2	*Prompt: Enter one end of ellipse quarter* – Left-Click at the start point of the quarter ellipse element.
3	*Prompt: Enter point on axis* – Left-Click on a point along the ellipse axis. The imaginary line between the this point and the first point establishes an ellipse axis. In the graphic shown above, the first and second click establishes the primary axis.
4	*Prompt: Enter endpoint* – Left-Click at the end point of the quarter ellipse element.

6C.2.d Modify Arc Radius tool

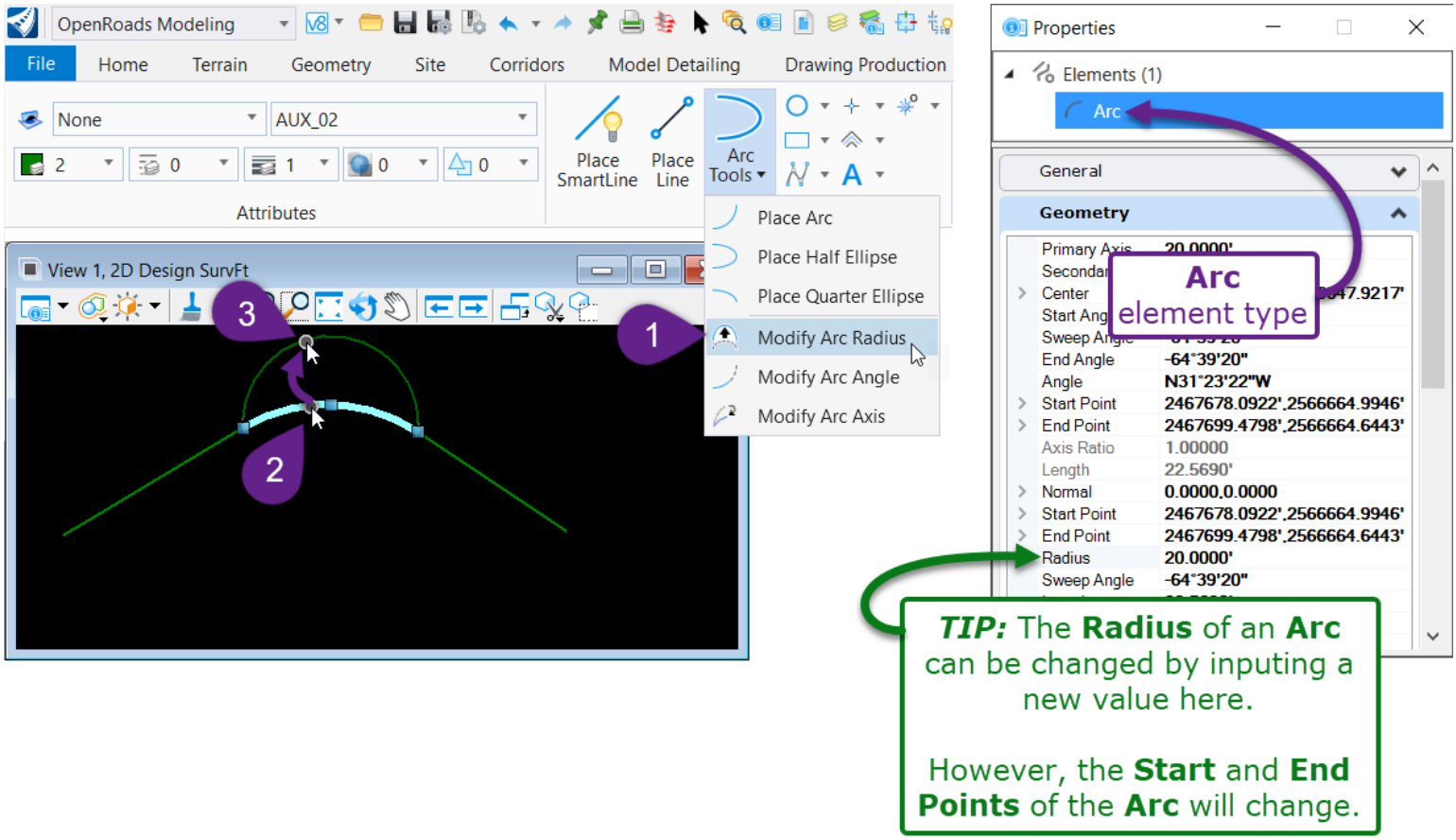
This tool is used to graphically edit the radius of an Arc element. This tool is useful because the start and end points of the Arc do NOT change.

NOTE: An Arc radius can also be changed in the Properties by entering a new value. However, this method will change the position of the start/end points.

NOTE: For this tool to function, the element must be designated as an Arc in the Properties box.

TIP: The *Construct Circular Fillet* produces Arc elements. Circular Fillets are compatible with the *Modify Arc Radius* tool.

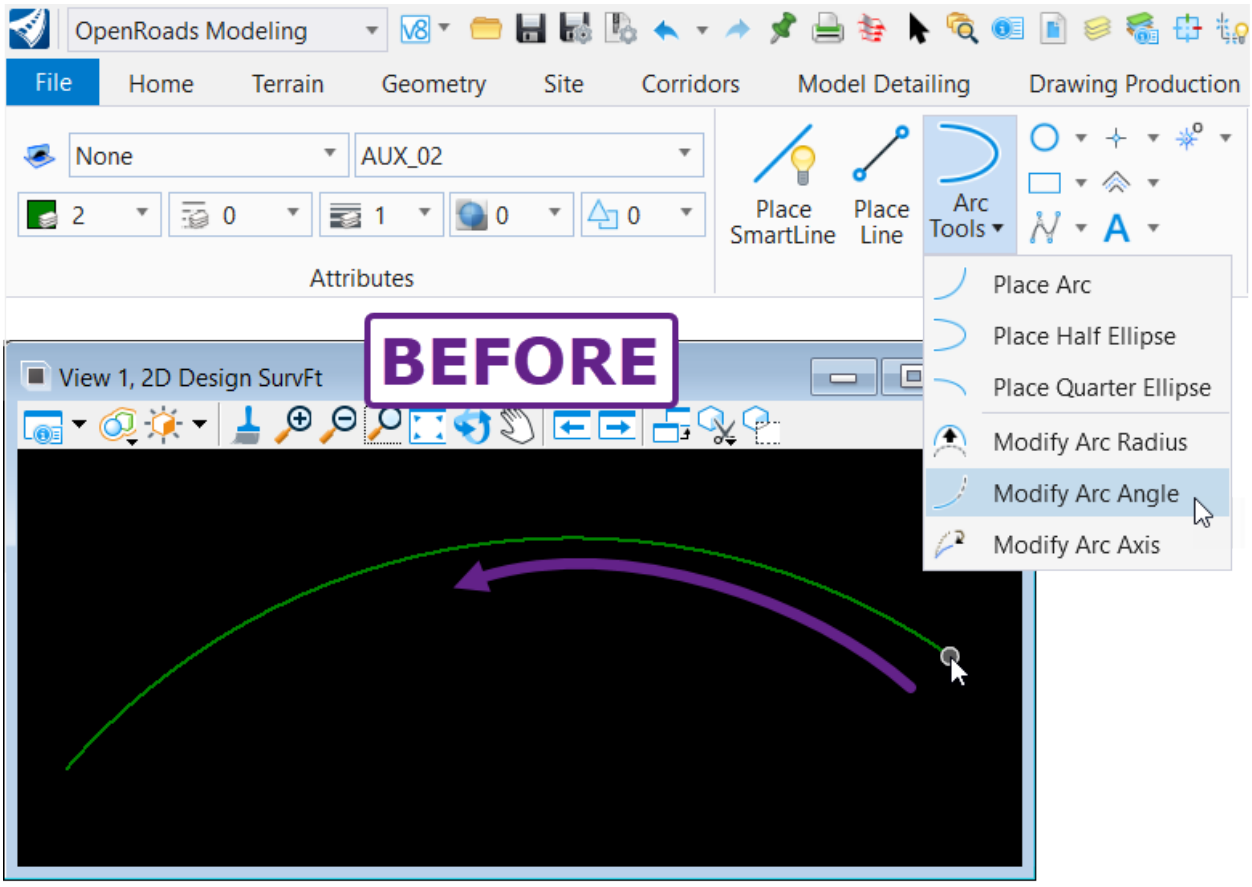
WARNING: If an Arc has been joined with other elements into a *Complex Chain* element, then the *Modify Arc Radius* tool CANNOT be used. The *Complex Chain* element must be "dropped" (using the *Drop Element* tool) to edit the arc radius with this tool.

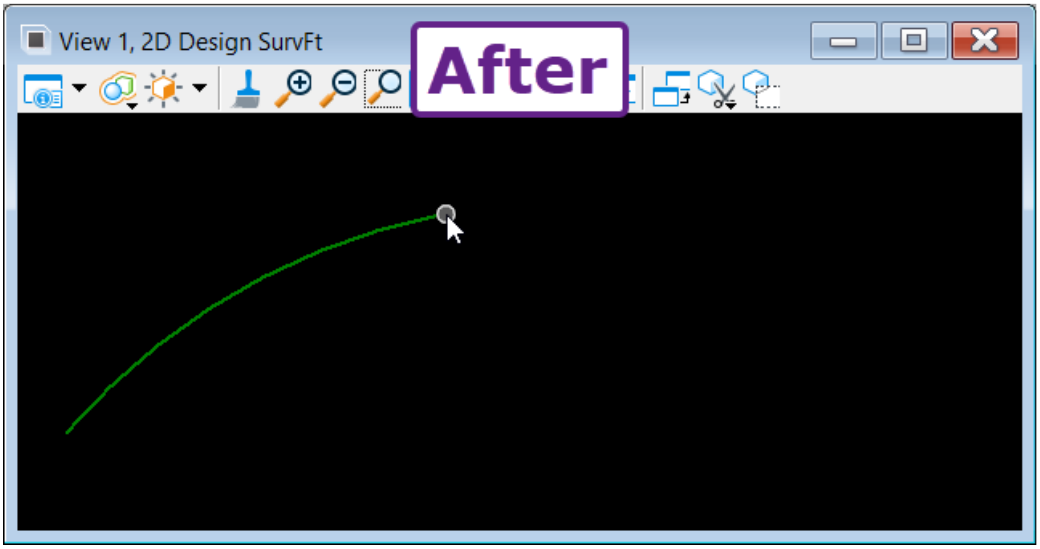


1	From the Ribbon, select the *Modify Arc Radius* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Placement*** → ***Arc Tools***].
2	*Prompt: Identify element* – Left-Click on the Arc element.
3	*Prompt: Accept/Reject* – Use the mouse cursor to position the arc radius as desired. Left-Click to accept the new arc radius.

6C.2.e Modify Arc Angle tool

This tool shortens or extends the length of an Arc element. This tool does NOT affect the radius or center point of the arc.

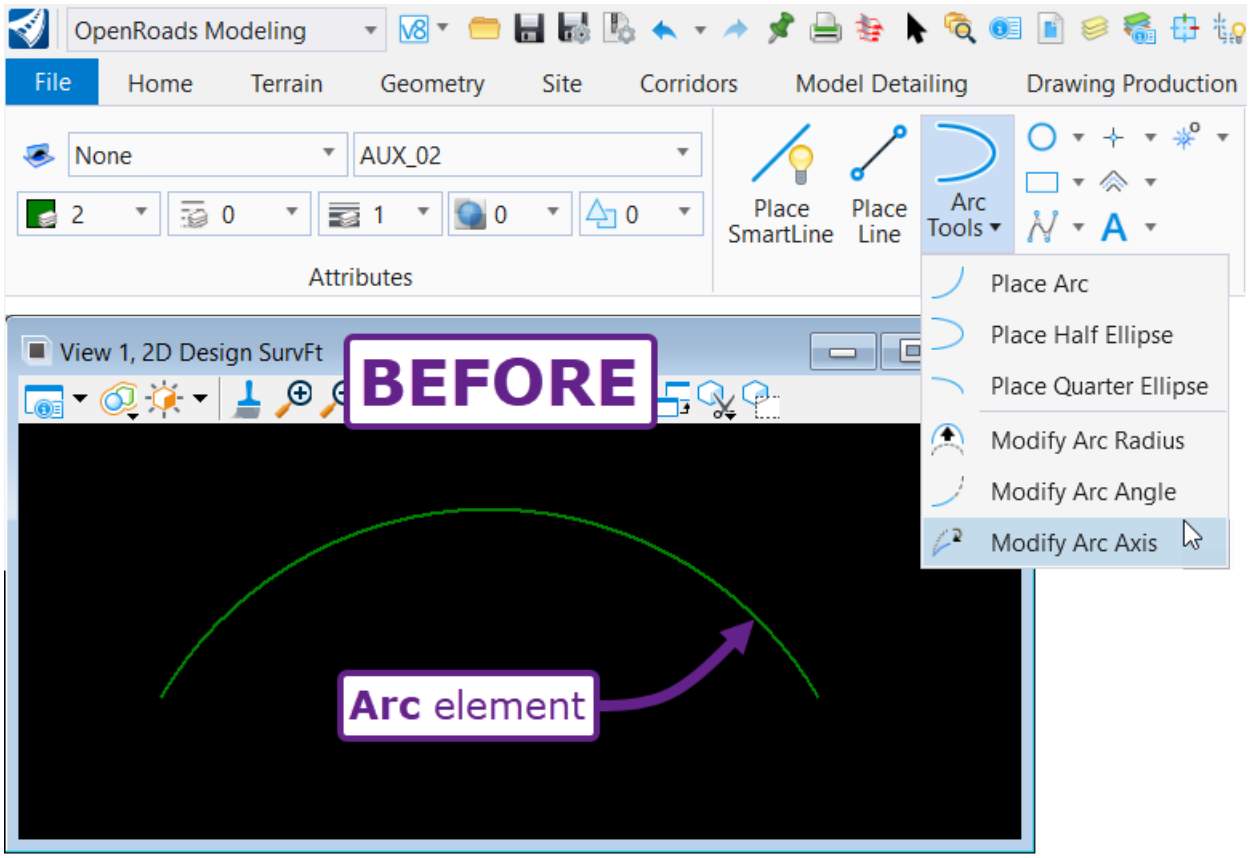


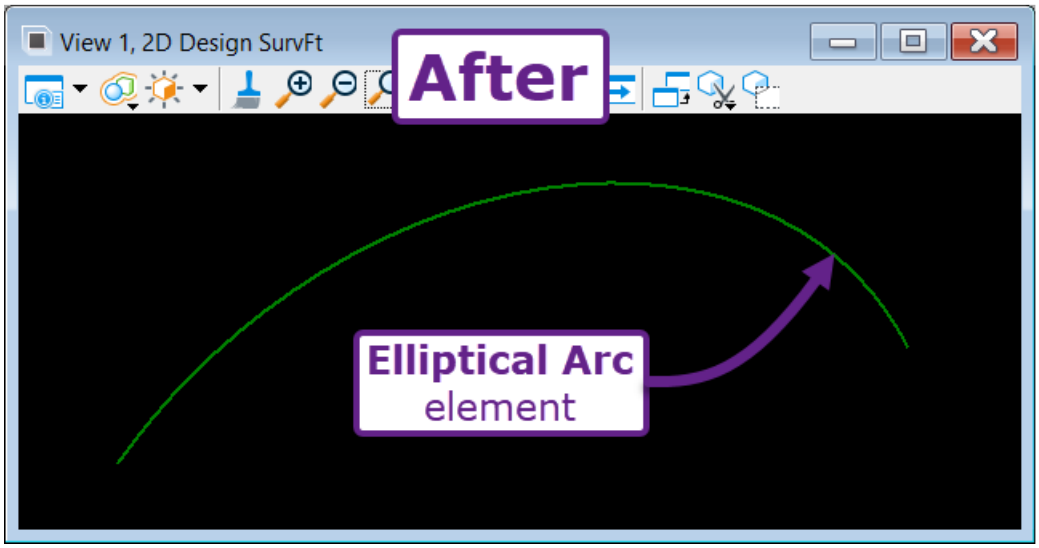


6C.2.f Modify Arc Axis tool

If this tool is used on an Arc element, then it will convert it to an elliptical arc. This tool can also be used to change the axis positioning for elliptical arc elements.

NOTE: Elliptical Arcs and Circular Arcs are both designated as Arcs in the Properties box. However, for Circular Arcs, the Primary and Secondary Axis are set to the same value. For Elliptical Arcs, the Primary and Secondary Arcs are set to different values.





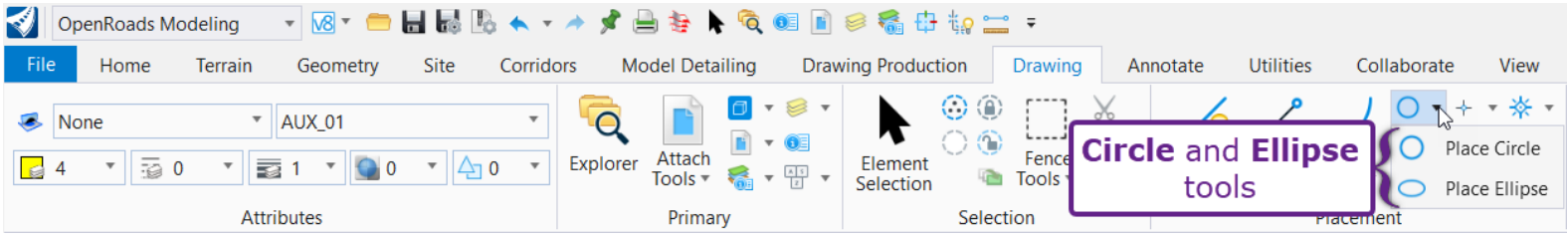
6C.3 Circle and Ellipse tools

Circle and Ellipse tools are found in the Ribbon at the following locations:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Circle** drop-down

OR

Drawing workflow → **Home** tab → **Placement** group → **Circle** drop-down



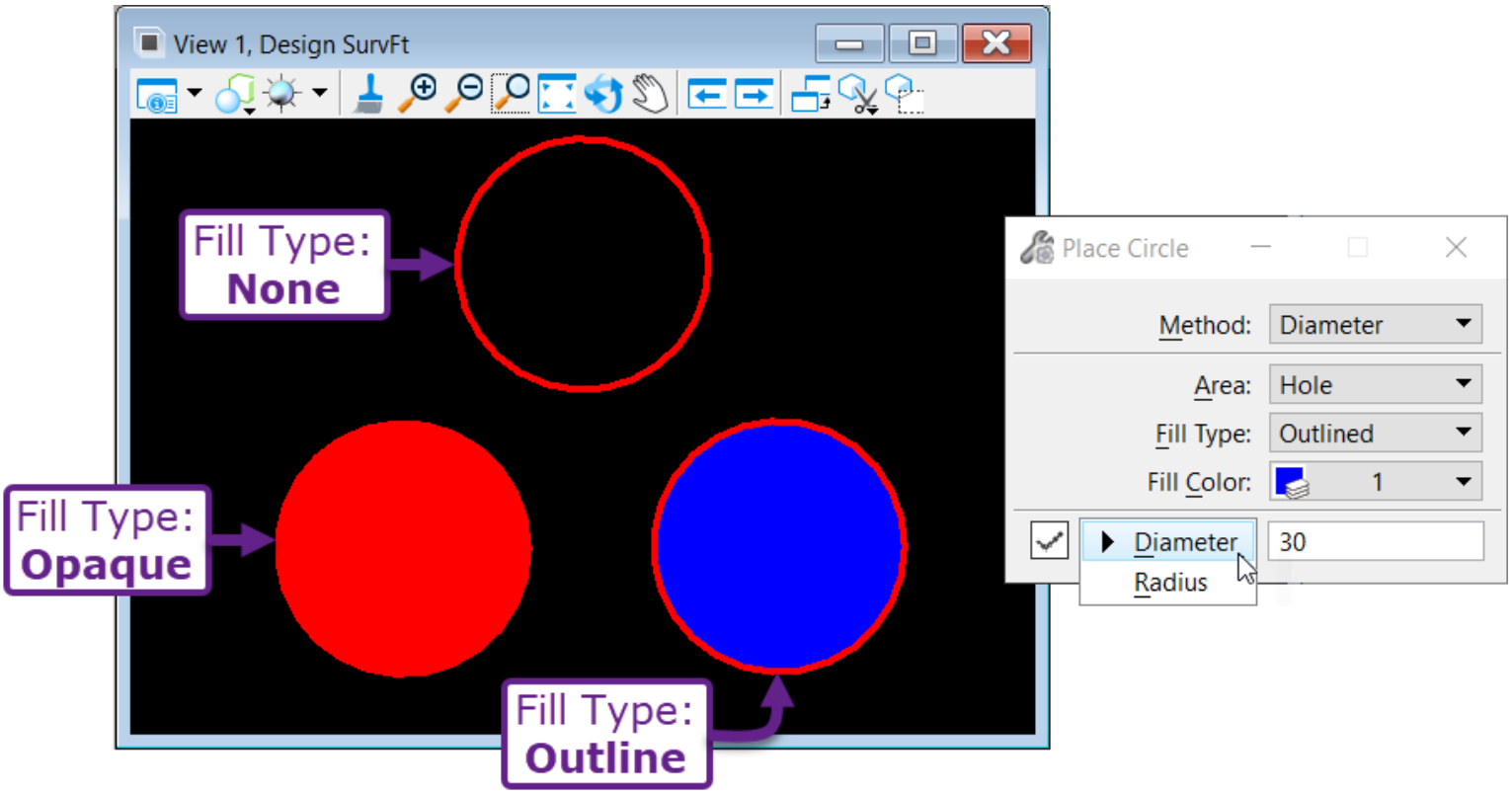
6C.3.a Place Circle tool

There is 3 different Methods for creating a Circle element:

Place Circle Methods	
Method:	**Description:**
Center	The first click determines the center point of the circle. The second click determines the radius.
Edge	This method uses three clicks. Each click corresponds with a point along the diameter of the circle.
Diameter	This method uses two clicks. The first click corresponds with a point along the diameter of the circle. The second click is directly across from the first click along the diameter of the circle. This absolute distance between the first and second clicks determines the diameter length of the circle.

NOTE: The messages shown in the *Prompt* bar differs depending on the selected Method.

TIP: Use the **Diameter** box in the Dialogue Box to enter a diameter value for the circle. Alternatively, use the drop-down to enter a **Radius** for the circle.



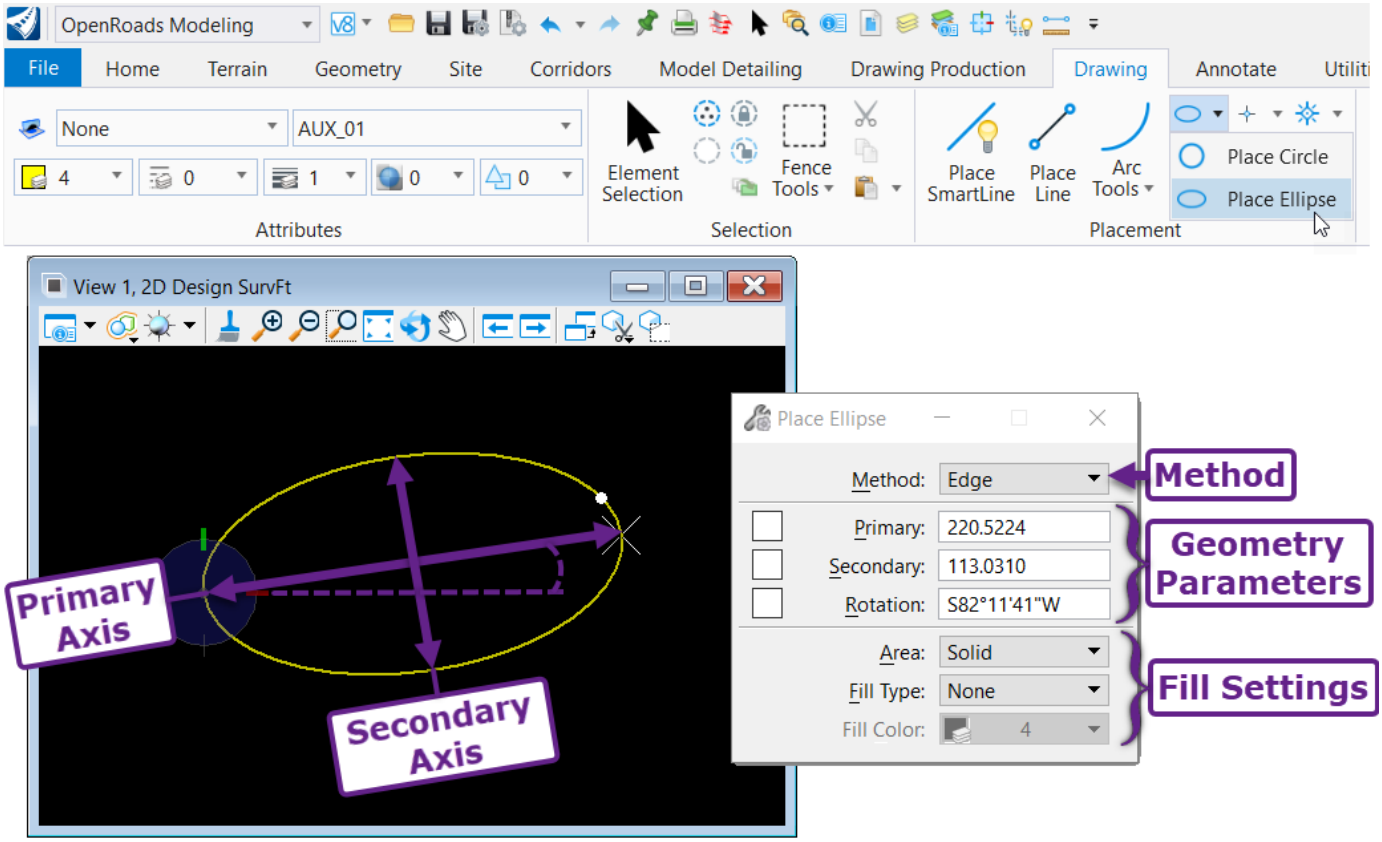
For more information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

6C.3.b Place Ellipse tool

This tool has 3 different Methods to create an Ellipse element:

Place Ellipse Methods	
Method:	**Description:**
Center	The first click determines the center point of the ellipse. The second click determines the vertex point for the major or minor axis. The third click determines the vertex point for the other axis.
Edge	The first click determines the vertex point for the major or minor axis. The second point determines any point along the perimeter of the ellipse. The third point will be at the opposite vertex point and along the same axis as the first click.
Ends	The first click determines the vertex point for the major or minor axis. The second point will be at the opposite vertex point and along the same axis as the first click. The third click determines the vertex point for the other axis.

NOTE: The messages shown in the *Prompt* bar differs depending on the selected Method.



The remaining *Ellipse Geometry* options are used to set the geometry parameters for the Ellipse. To lock a geometry parameter: click in the value box, type in the desired value, and press the Enter key.

Place Ellipse Geometry Parameters	
Method:	**Description:**
Primary	Sets the length of the primary axis of the Ellipse element
Secondary	Sets the length of the secondary axis of the Ellipse element
Rotation	Sets the rotation angle of the primary axis.

NOTE: The geometry of an arc becomes fully constrained when two parameters are locked (CHECKED). When the geometry of an arc is fully constrained, the remaining parameters will be greyed out.

For more information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

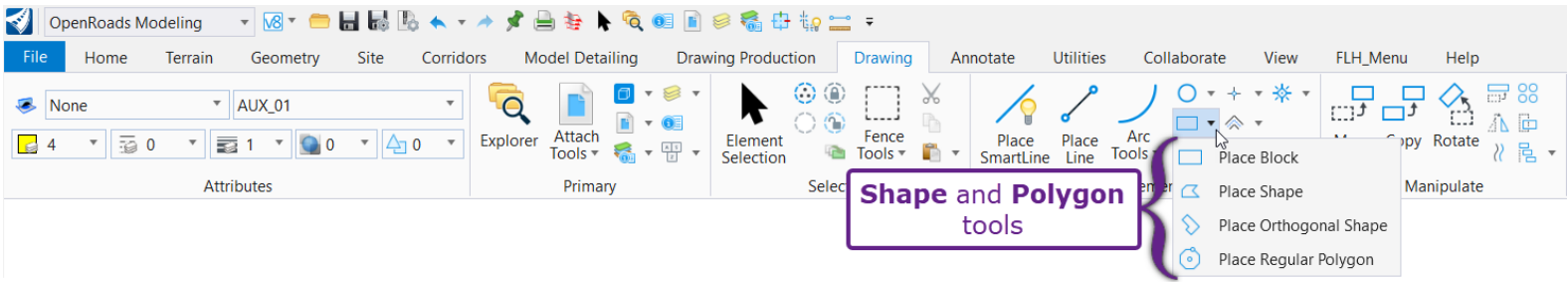
6C.4 Shape and Polygon tools

Shape and Polygon tools are found in the Ribbon at the following locations:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Shape** drop-down

OR

Drawing workflow → **Home** tab → **Placement** group → **Shape** drop-down



6C.4.a Place Block tool

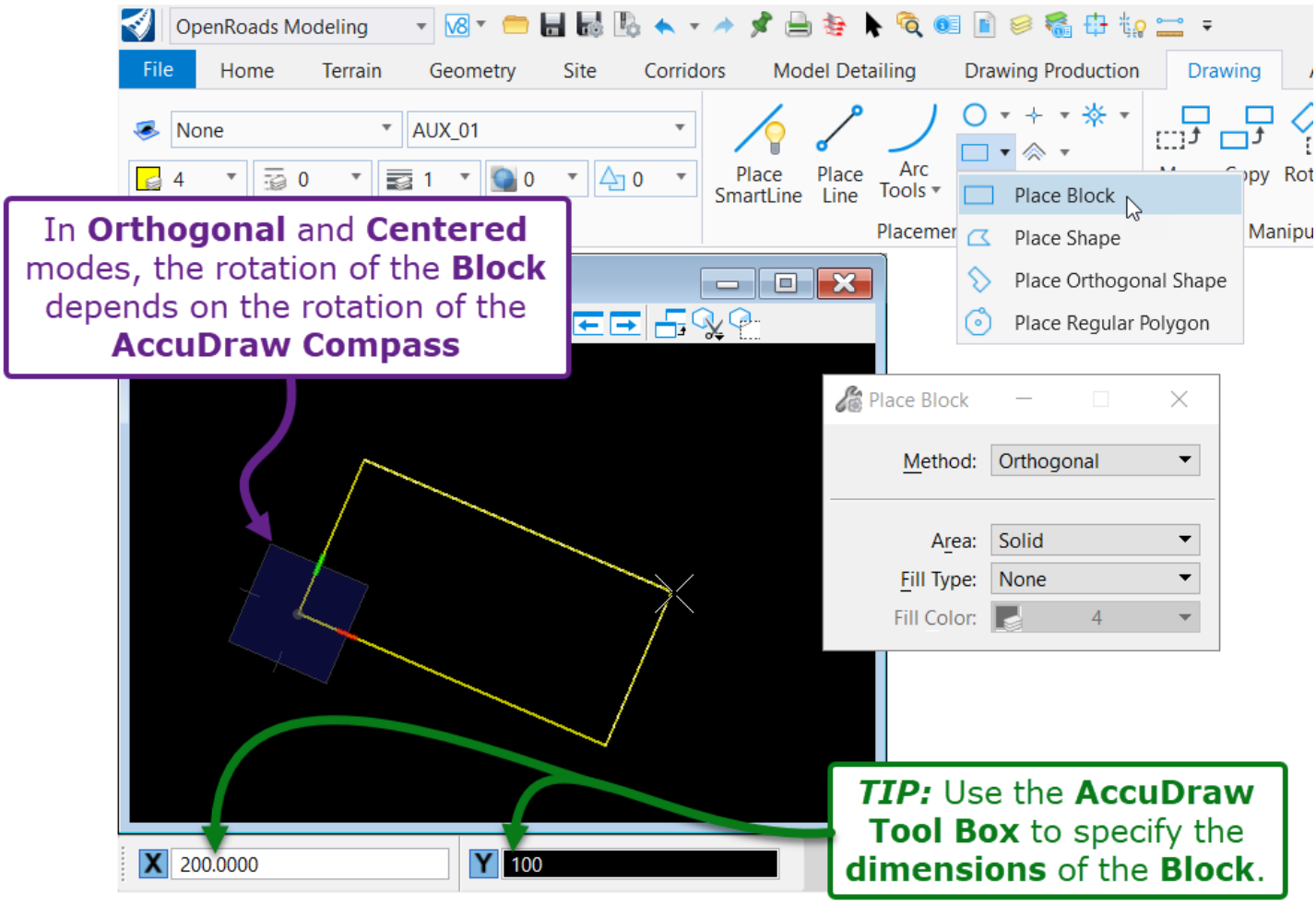
A Block is a rectangle or square shaped element. There is 3 different Methods for creating a rectangular element:

Place Block Methods	
Method:	**Description:**
Orthogonal	The rectangle is drawn parallel to the current rotational orientation of the AccuDraw Compass. The geometry of the rectangle is established by choosing two opposing corner points.
Rotated	The first and second clicks demine the length and angle for one edge of the rectangle. The third click determines the length of the adjacent edges.
Centered	The first click determines the center point of the rectangle. The second click determines the angle and position of an edge. The distance between the first and second click is half the length of the edge. The third click determines the length of the adjacent edges.

NOTE: The messages shown in the *Prompt* bar differs depending on the selected Method.

TIP: Use AccuDraw Tool Box to specify the exact dimensions of the rectangle element.

NOTE: The resulting rectangular is considered a Shape element in the Properties box.



For more information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

6C.4.b Place Shape tool

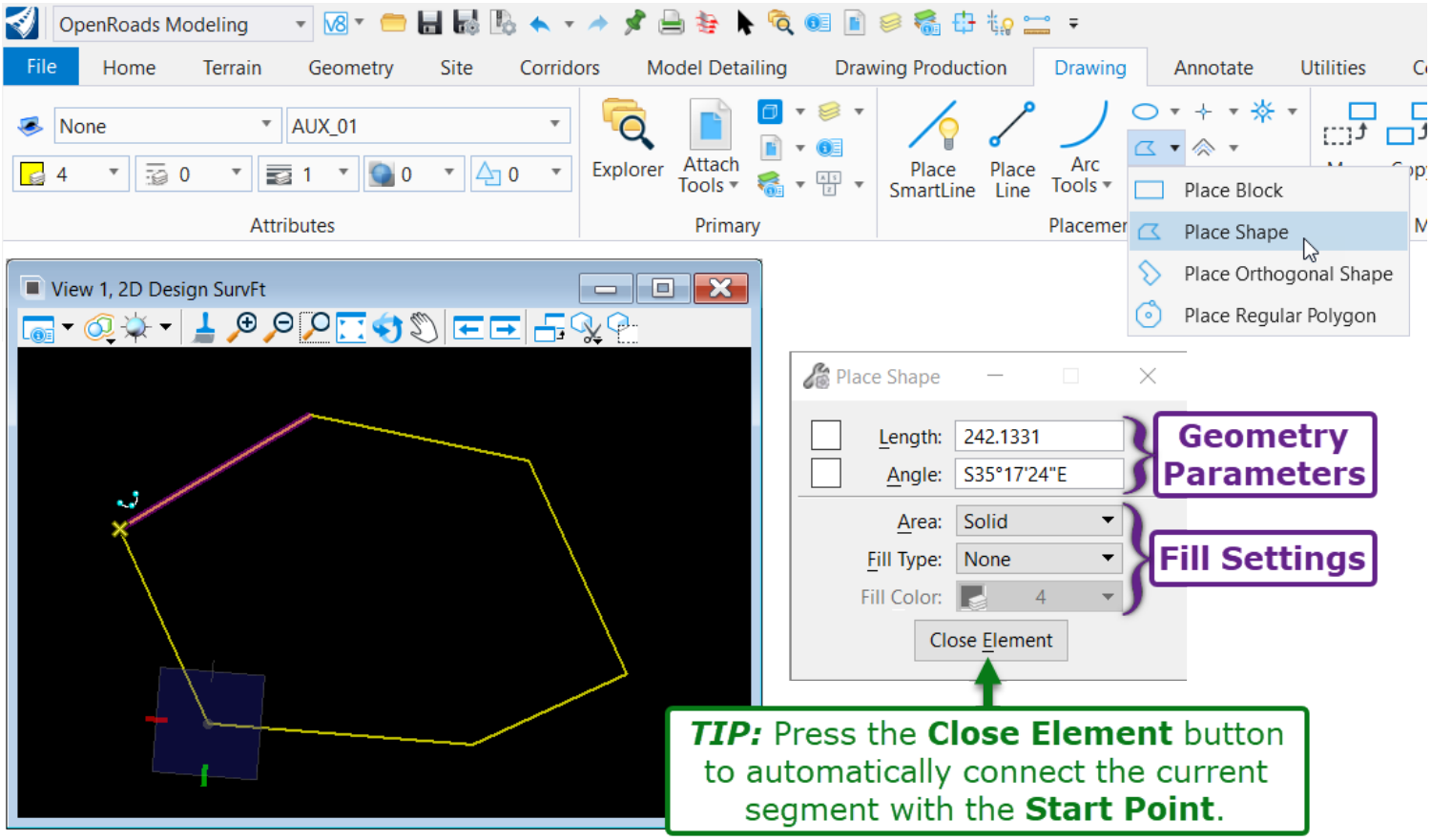
This tool creates polygons.

NOTE: The resulting polygon is designated a **Shape** element in the Properties box. Shape elements consists of connected line segments. Shape elements are created with the *Place SmartLine*, *Place Block*, or the *Place Shape* tool. A **Complex Shape** is different element type. A Complex Shape consists of connected line and arc segments. The individual line and arc segments are drawn separately and joined into a Complex Shape with the *Create Complex Shape* tool.

Place Shape Geometry Parameters	
Method:	**Description:**
Length	Sets the length of the current segment being drawn.
Angle	Sets the angle of the current segment being drawn. ***NOTE:*** The Angle value shown in the Dialogue Box is relative to the current rotation orientation of the AccuDraw Compass.

TIP: After two segments are drawn, press the **Close Element** button to automatically connect the current segment to the Start Point. Alternatively, snap to the Start Point to the close the Shape element. If the segments are NOT manually closed, then the command will quit and the shape will NOT be drawn.

TIP: Use AccuDraw Tool Box to specify the exact X and Y coordinates for each segment.

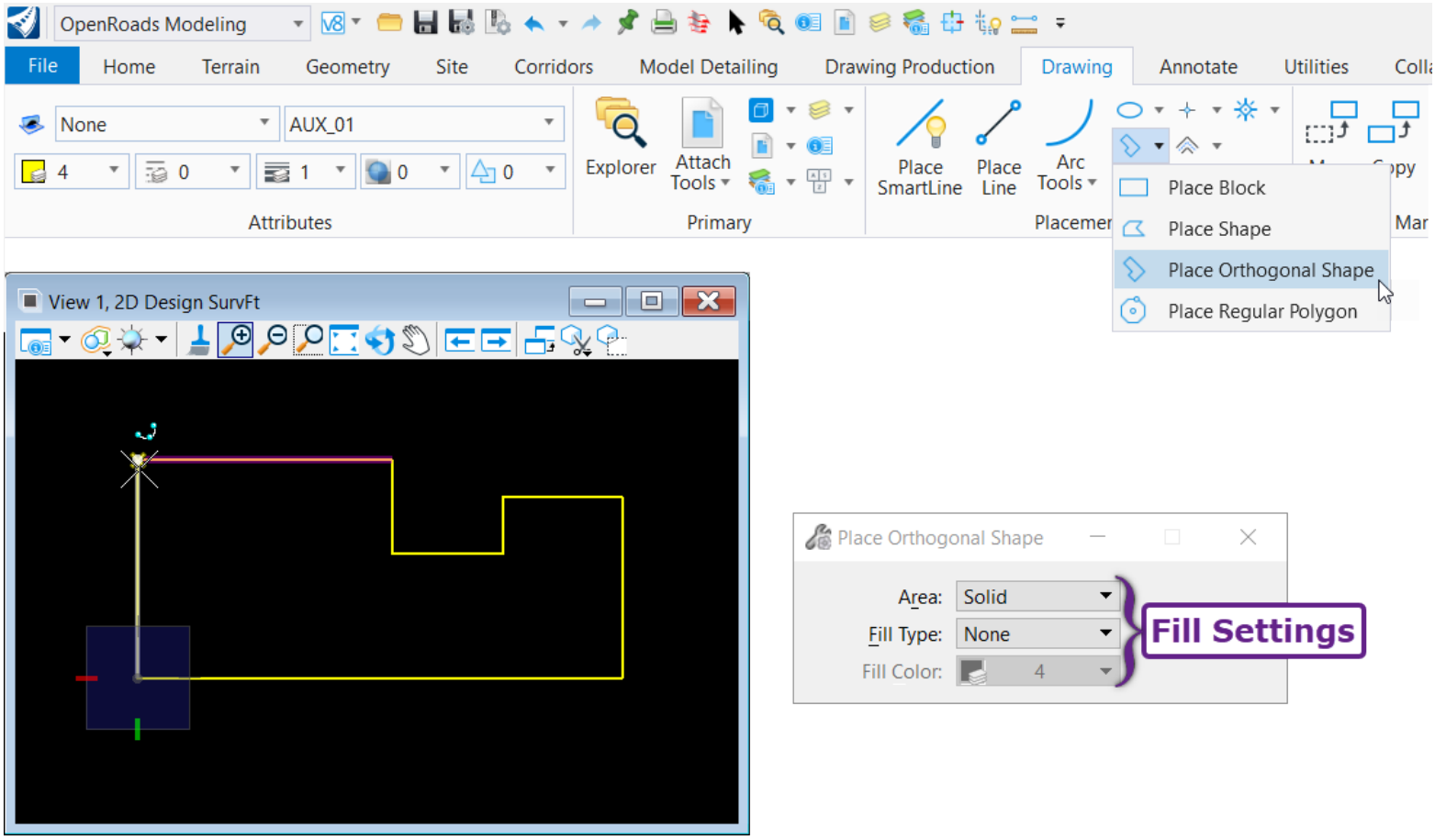


For more information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

6C.4.c Place Orthogonal Shape tool

This tool creates a polygon with the angle between all segments being exactly perpendicular. This tool does NOT allow non-perpendicular angles between adjacent segments.

TIP: Use AccuDraw Tool Box to specify the exact X and Y coordinates for each segment.



For more information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

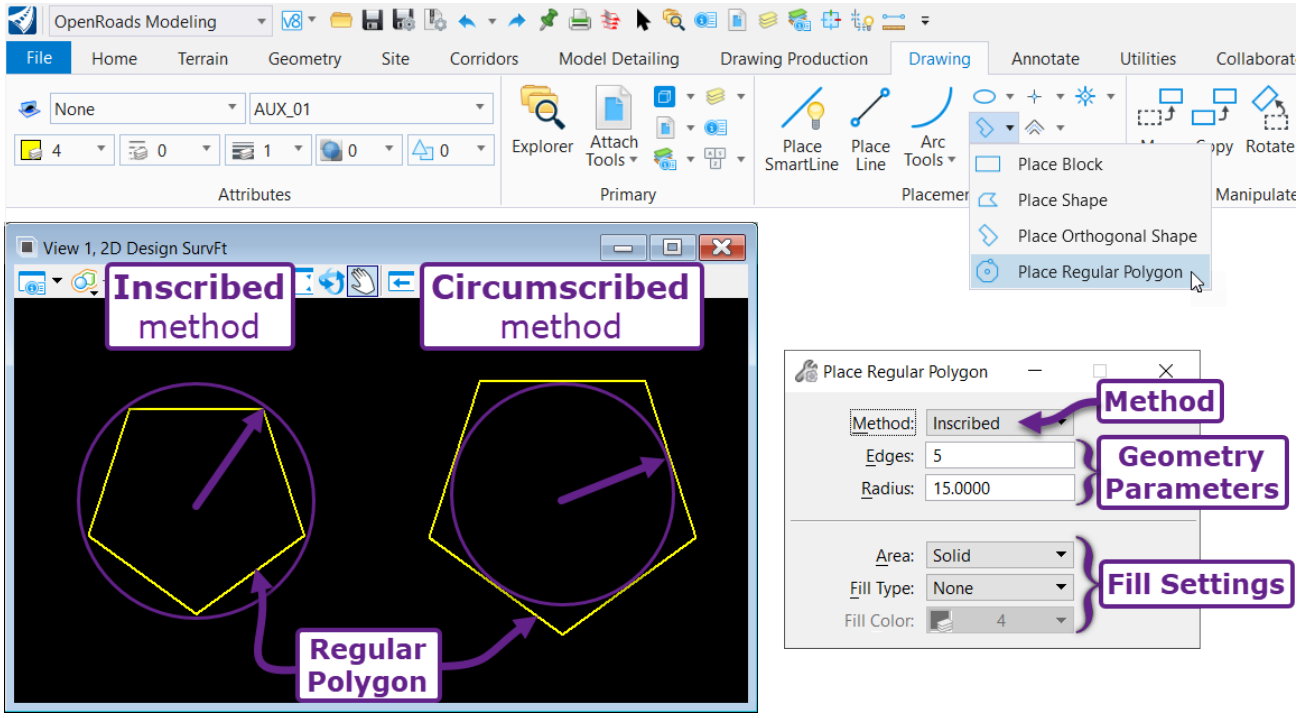
6C.4.d Place Regular Polygon tool

This tool creates a polygon with equal-length edges. The polygon can be created with any number of edges.

TIP: Set the Edges box to 3 to create an equilateral triangle.

Place Regular Polygon Methods	
Method:	**Description:**
Inscribed	The polygon fits exactly inside a circle of the specified **Radius**.
Circumscribed	A circle of the specified **Radius** fits exactly inside the polygon.
By Edge	The polygon geometry is determined by determining the length of on one edge. The first click determines an edge vertex. The second click determines the length of the edge and placement of an adjacent vertex.

In the graphic below, a regular polygon is created with the **Inscribed** method (left) and the **Circumscribed** method (right). Both polygons are created with the same **Edges** value (5 foot) and **Radius** value (15 foot). The **Inscribed** polygon fits inside the 15 foot radius circle. The **Circumscribed** polygon fits the 15 foot radius circle within its edges.



Place Regular Polygon Geometry Parameters	
Method:	**Description:**
Edges	Sets the number of edges or sides that the resulting polygon will contain.
Radius	If the **Inscribed** method is used, sets the distance between the center point of the polygon and the vertexes. If the **Circumscribed** method is used, sets the distance between the center point and the edge midpoints of the polygon.

For more information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

6C.5 Spline and Irregular Curve tools

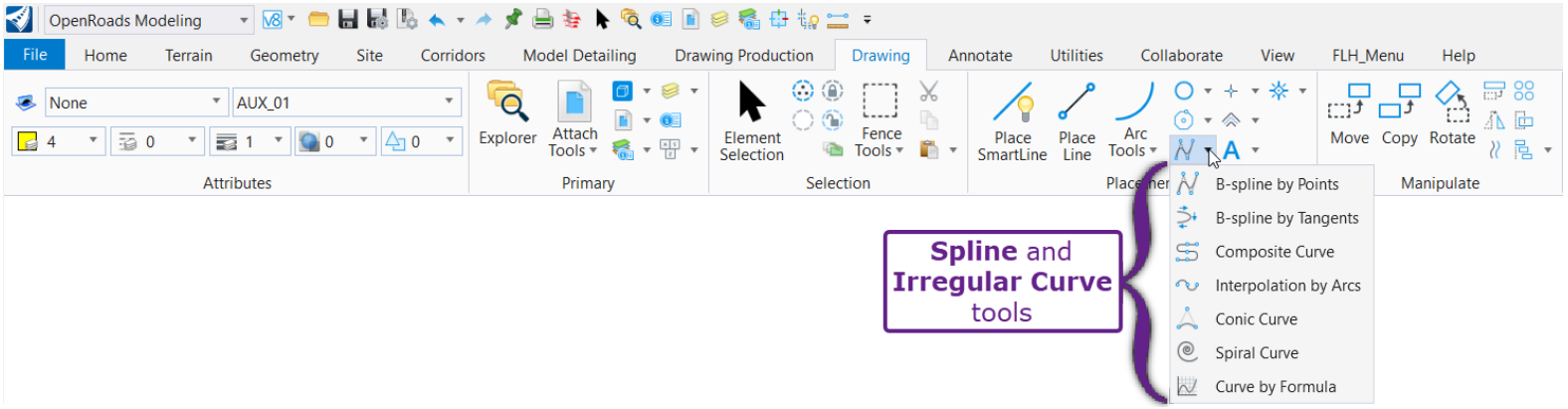
The Spline and Irregular Curve tools create compound curvilinear elements. The resulting element is a series of spines.

Spline and Irregular Curve tools are found in the Ribbon at the following locations:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Create Curves** drop-down

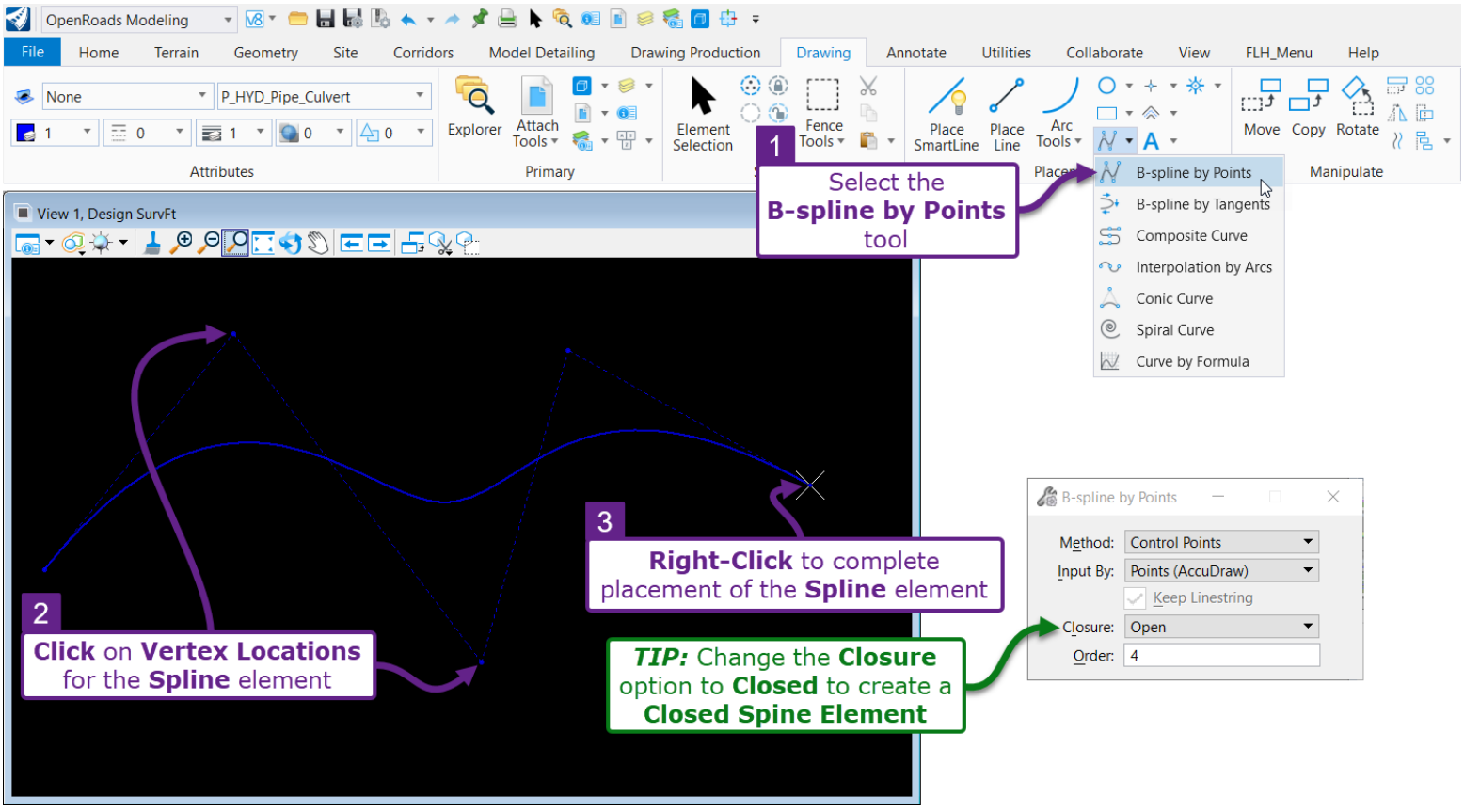
OR

Drawing workflow → **Home** tab → **Placement** group → **Create Curves** drop-down

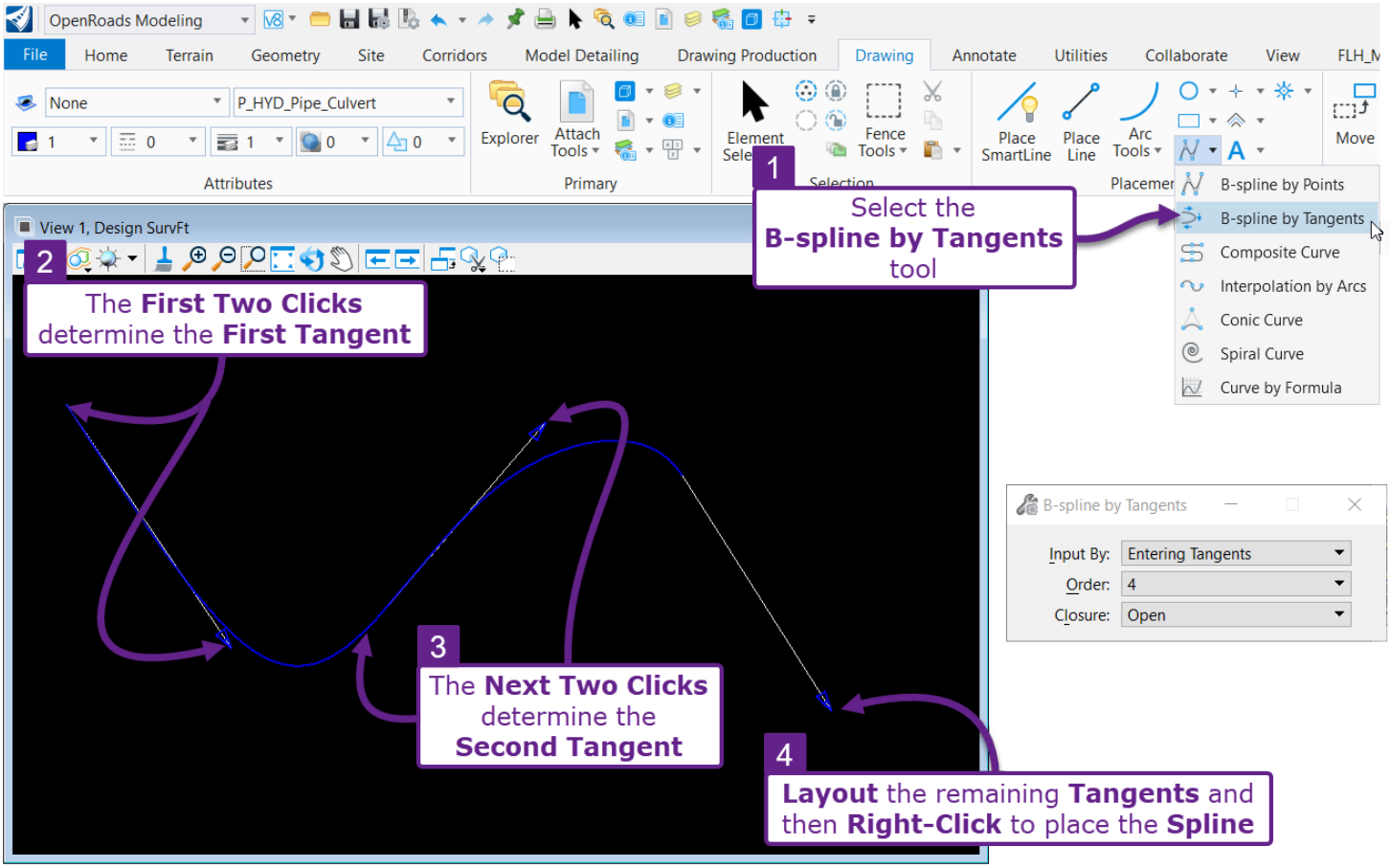


NOTE: Drawing splines for use in road alignments should be performed with ORD Tools. Do NOT use the MicroStation Tools shown above for road alignments. Drawing splines with ORD Tools is accomplished with the **Arc** tools, which are discussed in *7D.1.b Arcs*.

B-Spline by Points tool: The *B-Spline by Points* tool creates a spine element by clicking on vertex locations. The resulting spline element smoothly weaves between the vertex locations.



B-Spline by Tangents tool: This tool creates a spline element by laying out tangents. The resulting spline element will curve as necessary to smoothly join the tangents.



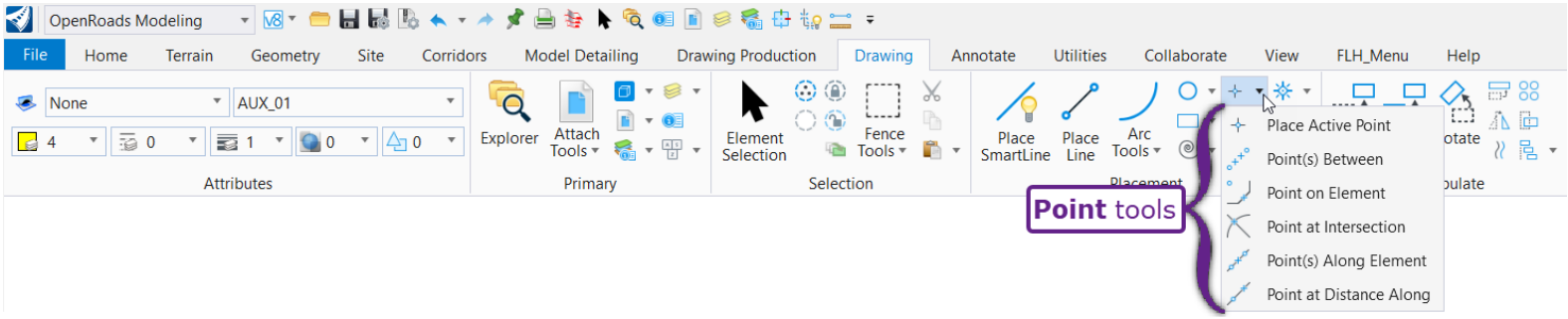
6C.6 Points tools

Point tools are found in the Ribbon at the following locations:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Point** drop-down

OR

Drawing workflow → **Home** tab → **Placement** group → **Point** drop-down



6C.6.a Place Active Point tool

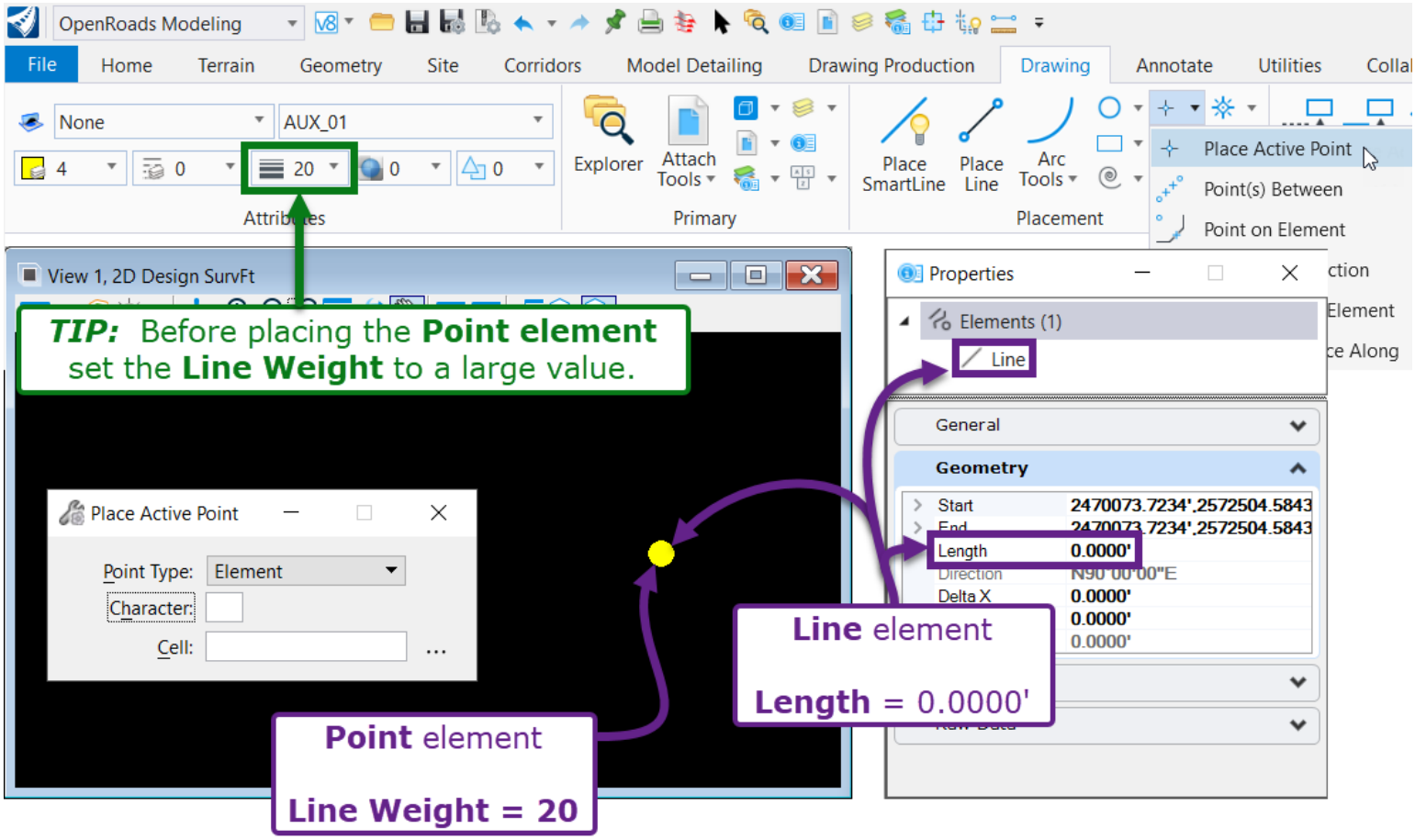
This tool creates a point element, single character of text, or a cell element.

WARNING: This tool is NOT adequate for the creation of construction layout points. Use the ORD Point tool to create layout points. See *7D.4 Points*.

This tool has three **Point Types:**

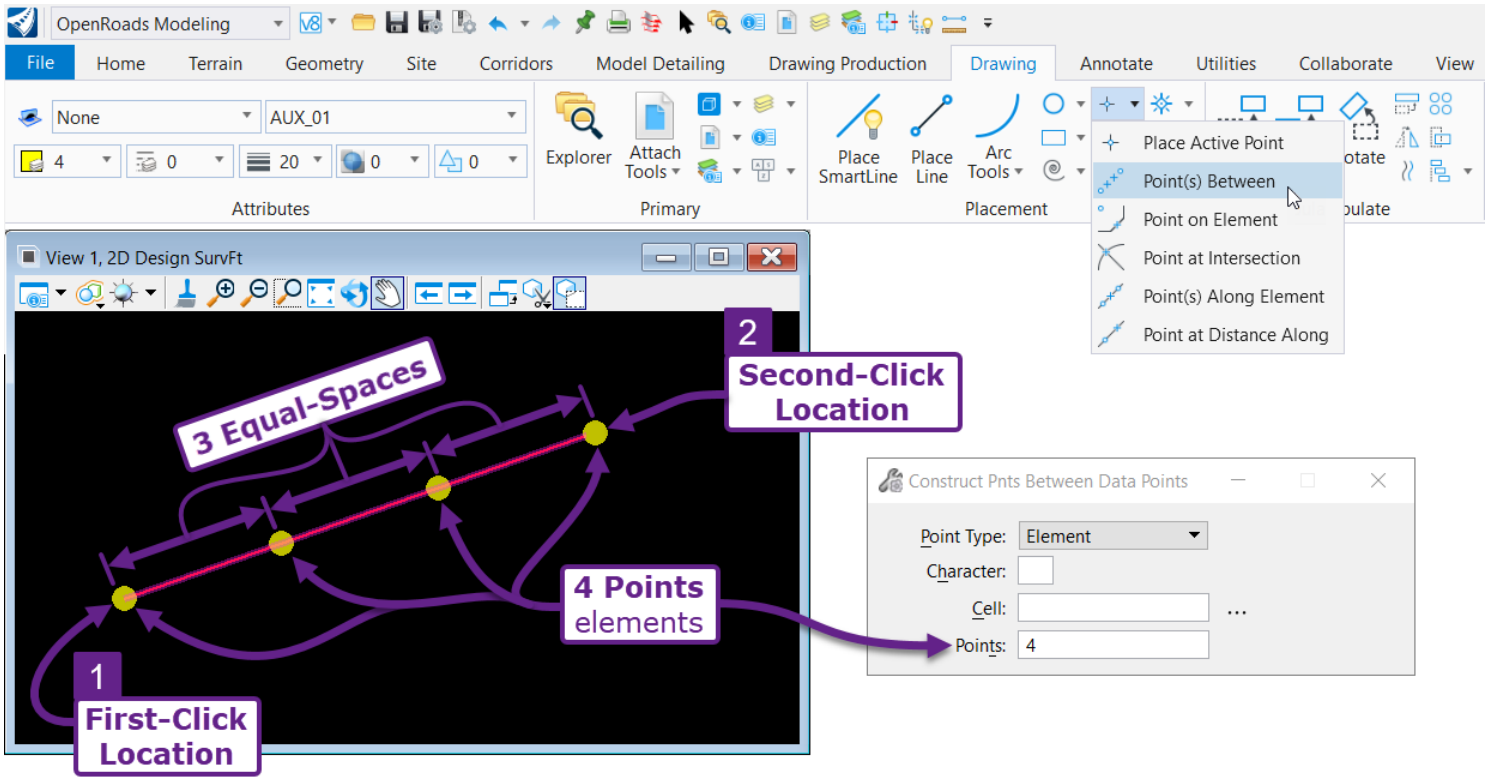
Point Types	
Point Type:	**Description:**
Element	Creates a **Line** element. The resulting **Line** element is set to a length of 0.0000' – which makes the Line element resemble a point.
Character	Places a single character of text. Use the **Character** box to set the text character to be placed.
Cell	Places the currently active Point Cell. Press the ... to open the Cell Library. In the Cell Library, Right-Click on the desired Cell and select *Place Point Cell* – which sets the active Point Cell.

TIP: Before placing a point using the **Element** type, set the **Line Weight** to a large value. If the Line Weight is set at a low value, then it may be difficult to locate the point element. After placement, reset the Line Weight to the ByLevel setting.



6C.6.b Point(s) Between tool

This tool creates multiple, equal-spaced Point elements between two clicking locations. In the Dialogue Box, the **Points** box determines how many Point elements are created.



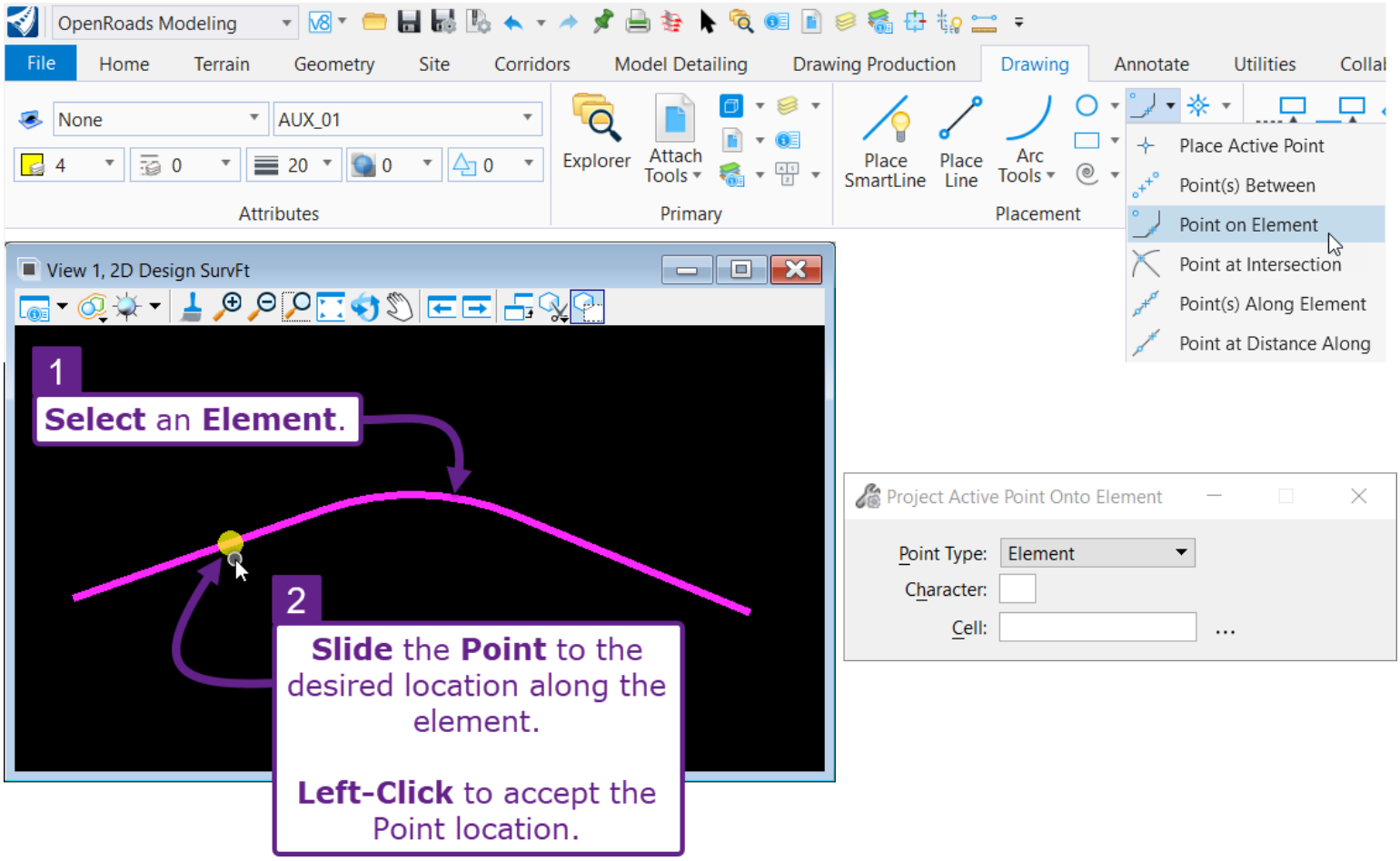
TIP: Before placing a point using the **Element** type, set the **Line Weight** to a large value. If the Line Weight is set at a low value, then it may be difficult to locate the point element. After placement, reset the Line Weight to the ByLevel setting.

This tool has three **Point Types:**

Point Types	
Point Type:	**Description:**
Element	Creates a **Line** element. The resulting **Line** element is set to a length of 0.0000' – which makes the Line element resemble a point.
Character	Creates a single character of text. Use the **Character** box to set the text character to be placed.
Cell	Places the currently active Point Cell. Press the … to open the Cell Library. In the Cell Library, Right-Click on the desired Cell and select *Place Point Cell*. This procedure sets the active Point Cell.

6C.6.c Point on Element tool

This tool creates a Point at a specified location along an element.



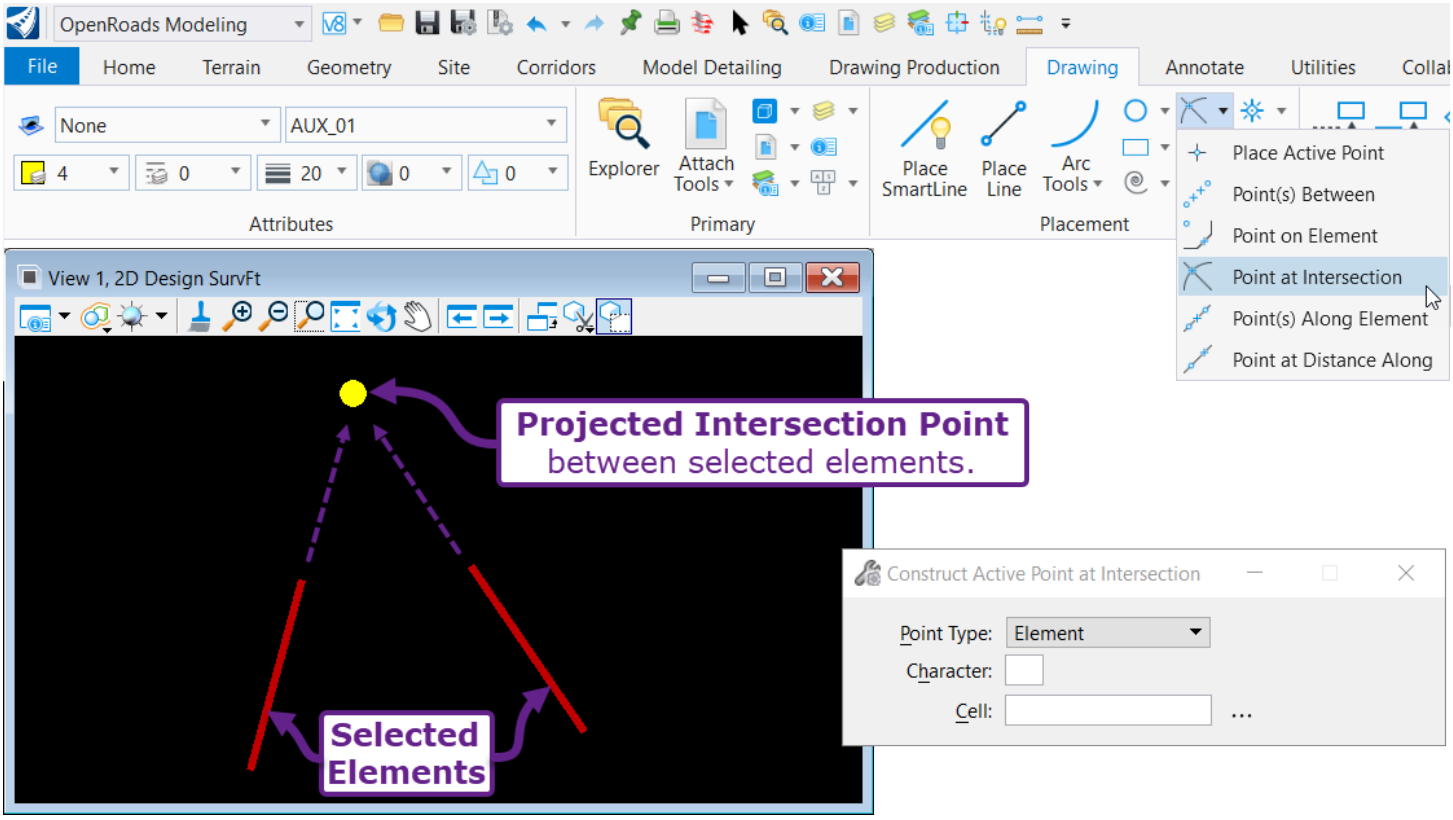
TIP: Before placing a point using the **Element** type, set the **Line Weight** to a large value. If the Line Weight is set at a low value, then it may be difficult to locate the point element. After placement, reset the Line Weight to the ByLevel setting.

This tool has three **Point Types:**

Point Types	
Point Type:	**Description:**
Element	Creates a **Line** element. The resulting **Line** element is set to a length of 0.0000' – which makes the Line element resemble a point.
Character	Creates a single character of text. Use the **Character** box to set the text character to be placed.
Cell	Places the currently active Point Cell. Press the … to open the Cell Library. In the Cell Library, Right-Click on the desired Cell and select *Place Point Cell*. This procedure sets the active Point Cell.

6C.6.d Point at Intersection tool

This tool creates a Point at the intersection OR projected intersection of two elements.



TIP: Before placing a point using the **Element** type, set the **Line Weight** to a large value. If the Line Weight is set at a low value, then it may be difficult to locate the point element. After placement, reset the Line Weight to the ByLevel setting.

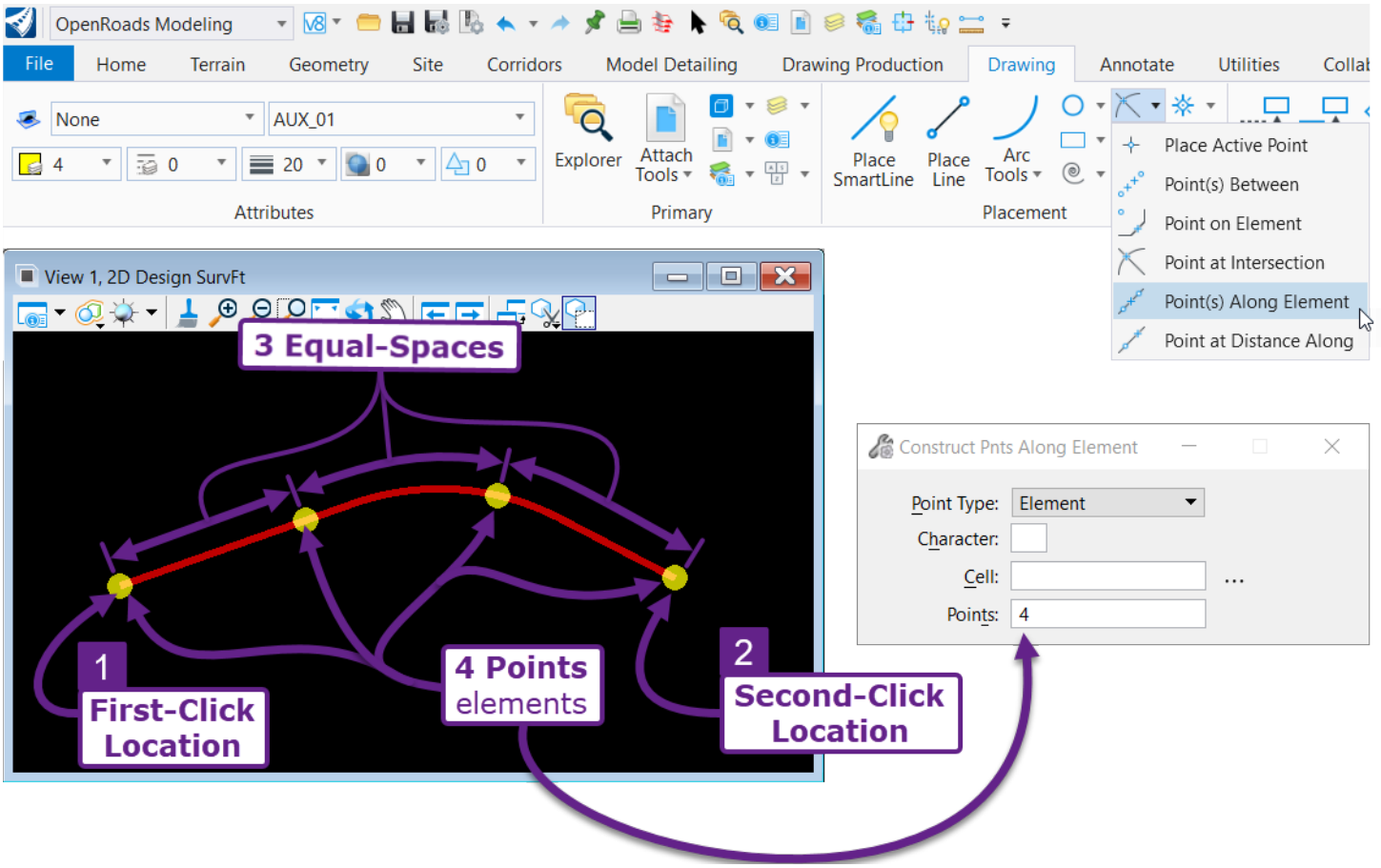
This tool has three **Point Types:**

Point Types	
Point Type:	**Description:**
Element	Creates a **Line** element. The resulting **Line** element is set to a length of 0.0000' – which makes the Line element resemble a point.
Character	Creates a single character of text. Use the **Character** box to set the text character to be placed.
Cell	Places the currently active Point Cell. Press the … to open the Cell Library. In the Cell Library, Right-Click on the desired Cell and select *Place Point Cell*. This procedure sets the active Point Cell.

6C.6.e Point(s) Along Element tool

This tool creates multiple, equal-spaced Points along an element. In the Dialogue Box, the **Points** box determines how many Points are created.

This tool requires two clicking locations along the element. The first click determines the location for the first point. The second click determines the location for the last point. Click on the Start Point and End Point of the element to place equal spaced Points along the entire length of the element.



TIP: Before placing a point using the **Element** type, set the **Line Weight** to a large value. If the Line Weight is set at a low value, then it may be difficult to locate the point element. After placement, reset the Line Weight to the ByLevel setting.

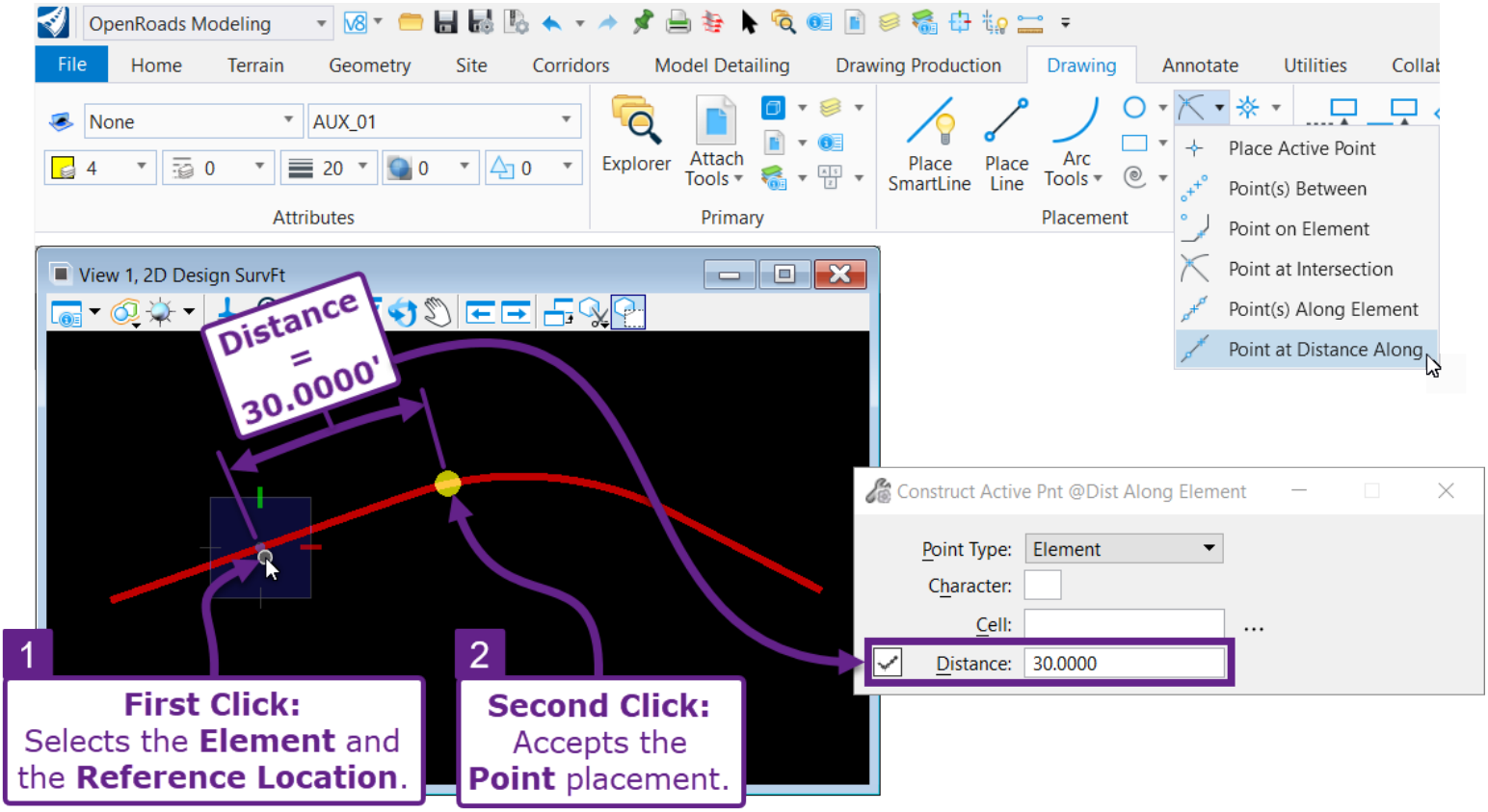
This tool has three **Point Types:**

Point Types	
Point Type:	**Description:**
Element	Creates a **Line** element. The resulting **Line** element is set to a length of 0.0000' – which makes the Line element resemble a point.
Character	Creates a single character of text. Use the **Character** box to set the text character to be placed.
Cell	Places the currently active Point Cell. Press the … to open the Cell Library. In the Cell Library, Right-Click on the desired Cell and select *Place Point Cell*. This procedure sets the active Point Cell.

6C.6.f Point at Distance Along Element tool

This tool creates a Point along an element at a specified distance from a reference location.

The first click determines the element to place the Point along. The first click also determines the reference location. The Point will be placed at the specified **Distance** from the reference location.



TIP: Before placing a point using the **Element** type, set the **Line Weight** to a large value. If the Line Weight is set at a low value, then it may be difficult to locate the point element. After placement, reset the Line Weight to the ByLevel setting.

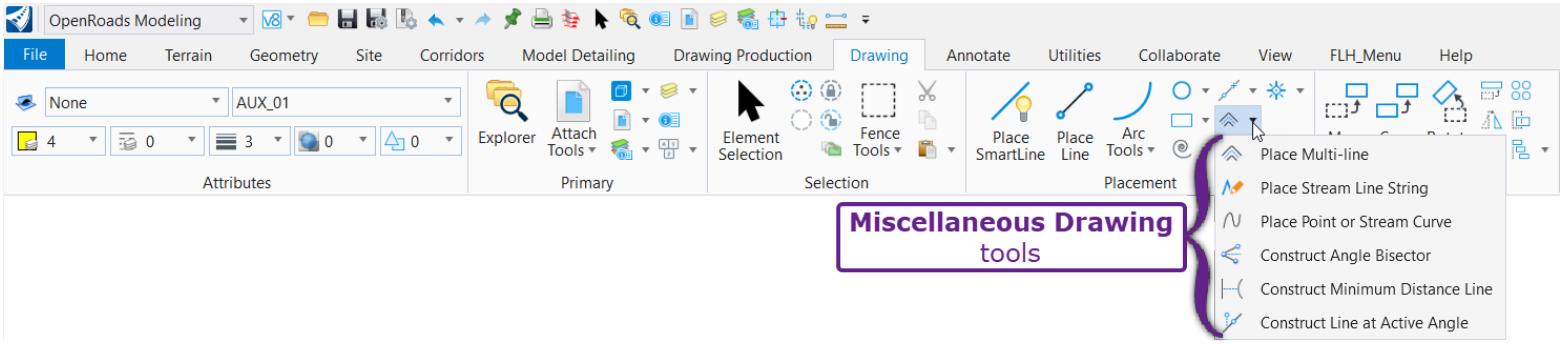
This tool has three **Point Types:**

Point Types	
Point Type:	**Description:**
Element	Creates a **Line** element. The resulting **Line** element is set to a length of 0.0000' – which makes the Line element resemble a point.
Character	Creates a single character of text. Use the **Character** box to set the text character to be placed.
Cell	Places the currently active Point Cell. Press the … to open the Cell Library. In the Cell Library, Right-Click on the desired Cell and select *Place Point Cell*. This procedure sets the active Point Cell.

6C.7 Miscellaneous Drawing tools

Miscellaneous tools are found in the Ribbon at the following locations:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Miscellaneous** drop-down
OR
Drawing workflow → **Home** tab → **Placement** group → **Miscellaneous** drop-down



6C.7.a Place Multi-Line tool

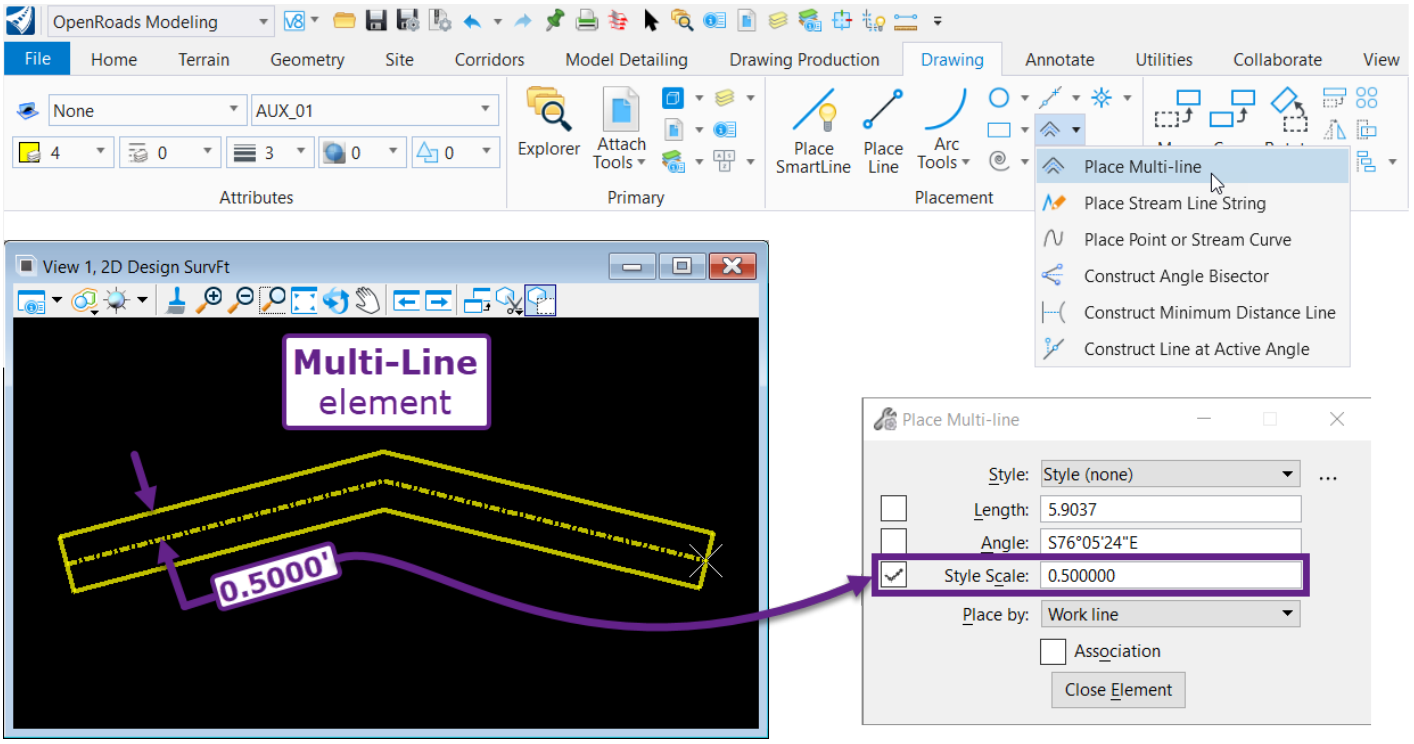
This tool draws a series of parallel lines segments.

WARNING: This tool is NOT appropriate for drawing a roadway alignment and edge of road linework. ORD tools should be used to draw roadway features. See *Chapter 7 – Geometry*.

WARNING: It is NOT possible to add fillets or curves between Multi-Line segments. Multi-Line segments will always contain sharp deflection at the vertex locations. ONLY straight lines can be drawn with this tool.

TIP: Instead of using this tool, create Lines, Arcs, or Complex Chains using other drawing tools. Use the *Move Parallel* tool to offset the element and create parallel linework.

NOTE: The FLH WorkSpace does NOT contain Styles for drawing Multi-Line elements. In general, this tool is NOT recommended for conventional FLH drafting.



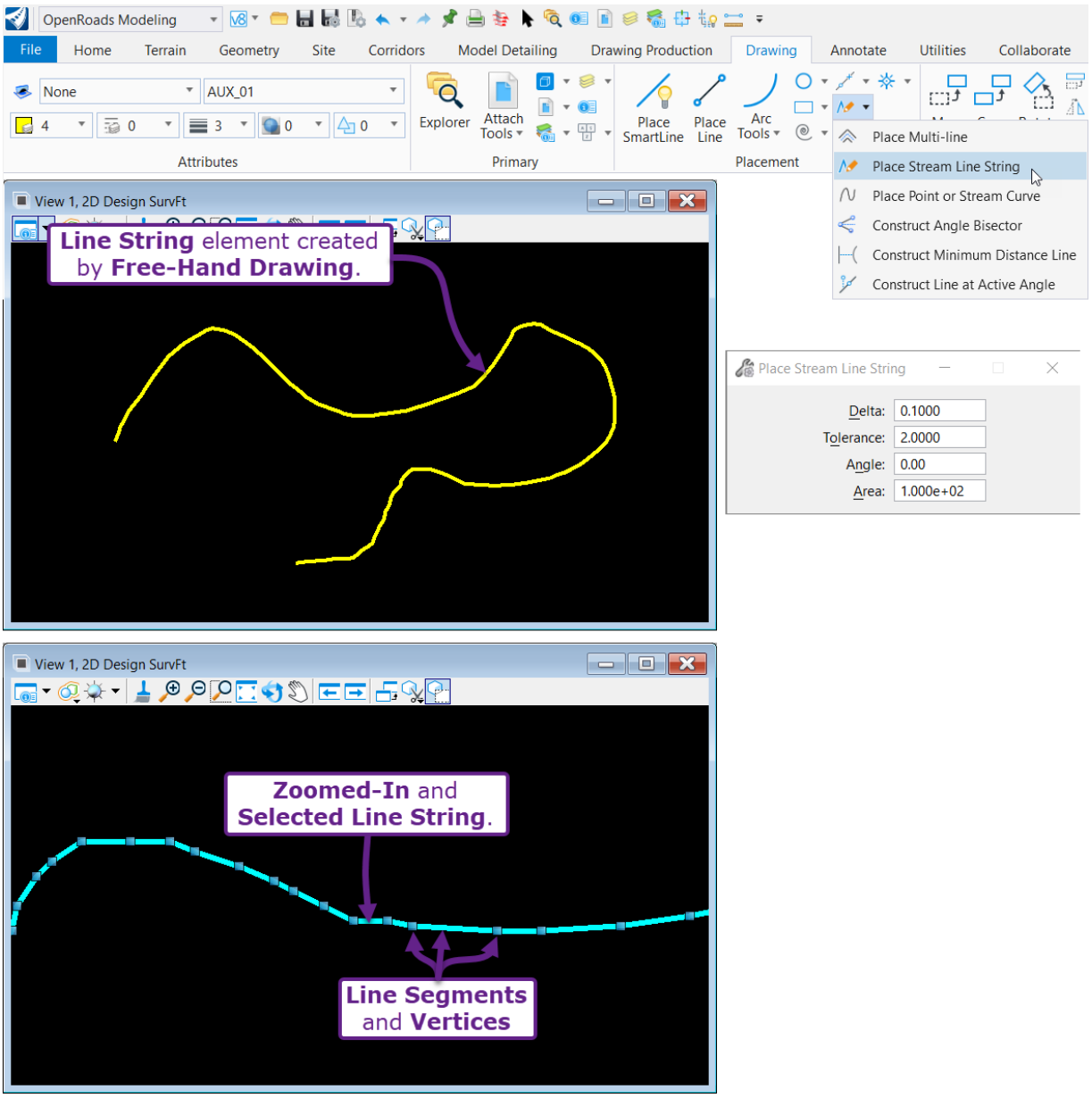
Place Multi-Line Methods	
Method:	**Description:**
Style	Sets the appearance and configuration of the Multi-Line. The FLH WorkSpace does NOT contain Styles for drawing Multi-Line elements.
Length	Sets the length of the current segment being drawn.
Angle	Sets the angle of the current segment being drawn. ***NOTE:*** The Angle value shown in the Dialogue Box is relative to the current rotation orientation of the AccuDraw Compass.
Style Scale	Sets the overall width of the Multi-Line element. For the *Style (none)* configuration, this value sets the distance between the centerline and offset lines. If set to 1, then the offsets lines will be 1.0000' off from centerline. If set to 0.5, then the offset lines will be 0.50000' off from the centerline.
Place By: Work Line	Each Style contains a base point (Work Line) for the Style. If this option is used, the Multi-Line is placed relative to the Work Line point.
Place By: Center	The Multi-Line is placed relative to the midpoint for the Style configuration.
Place By: Maximum	The Multi-Line is placed relative to the top of the Style configuration.
Place By: Minimum	The Multi-Line is placed relative to the bottom of the Style configuration.
Association	If this box is CHECKED, then snapping the Multi-Line to a reference element will create an association. If the reference element is moved, then the Multi-Line will automatically move to honor the snap configuration. This association is similar to Persist Snaps used with ORD elements. See *7C.1 Persist Snaps*.
Close Element	Push this button to automatically close the Multi-Line. The current segment will automatically snap to the start point location.

6C.7.b Place Stream Line String tool

This tool is used to draw free-hand. The resulting Line String element will follow the path of the mouse cursor.

TIP: This tool is useful for tracing images for digitization.

The resulting Line String element is a series of lines and vertices. The Dialogue Box setting determines the distance between vertices.

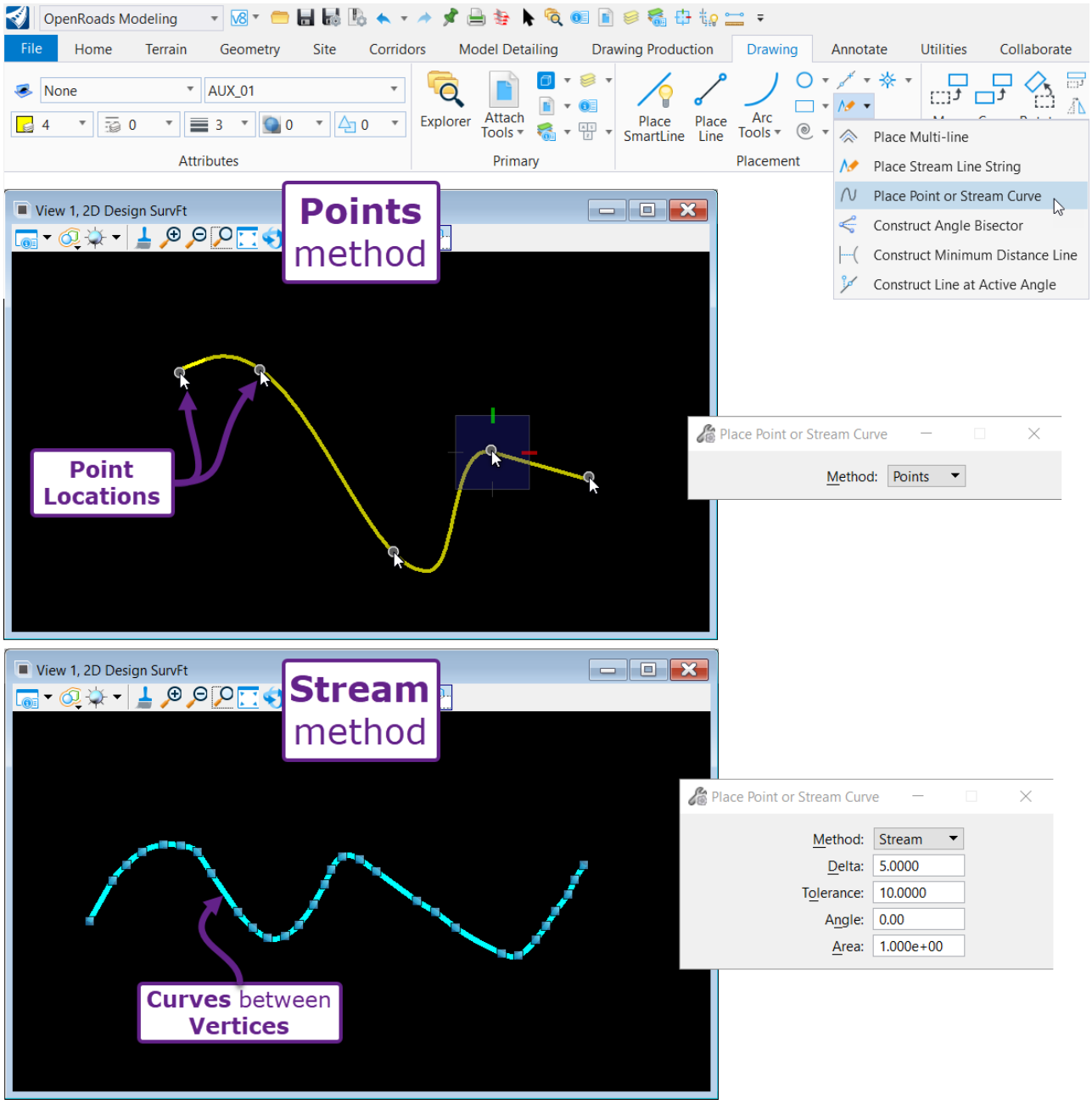


Place Stream Line String Settings	
Point Type:	**Description:**
Delta	Sets the minimum distance between vertices.
Tolerance	Sets the maximum distance between vertices.
Angle	Sets the minimum deflection angle of the mouse cursor to invoke a vertex.
Area	Sets the minimum area between adjacent vertices before a vertex is created.

6C.7.c Place Point or Stream Curve tool

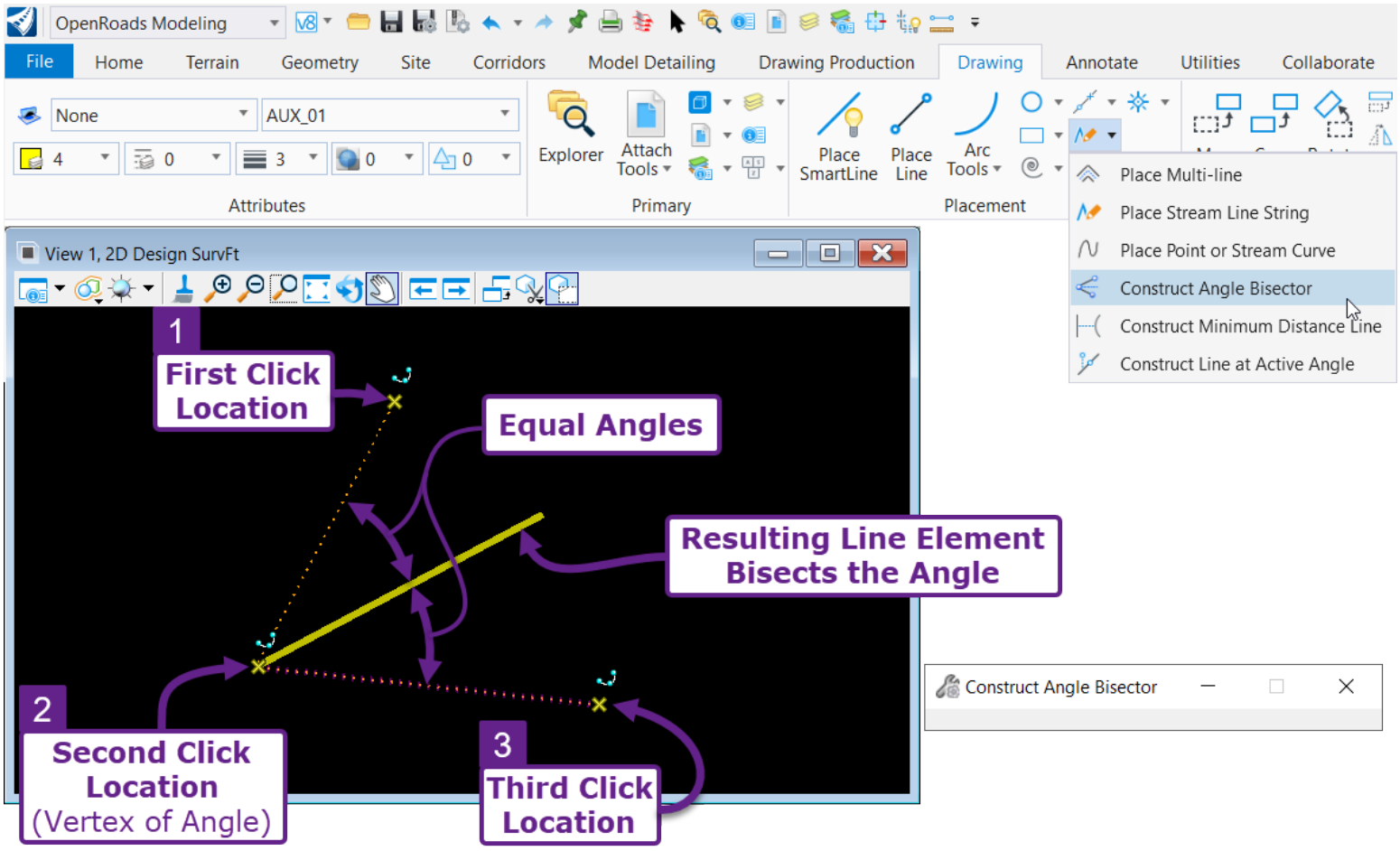
This tool creates a series of curves and vertices. There are two methods for placing the curve string:

Place Point or Stream Curve Methods	
Method:	**Description:**
Points	With this method, the curve string is formed by clicking at point locations. The resulting curve string will bend as necessary to pass through each point location.
Stream	The mouse cursor is used to draw a free-hand curve string. ***NOTE:*** With this method, the tool operates similar to the *Place Stream Line String* tool (shown on the previous page). The difference is that the resulting element is a series of curves and vertices. There will be NO line segments found along the resulting element. ***NOTE:*** The Dialogue Box options for this method (i.e., Delta, Tolerance, Angle and Area) is the same as shown on the previous page.



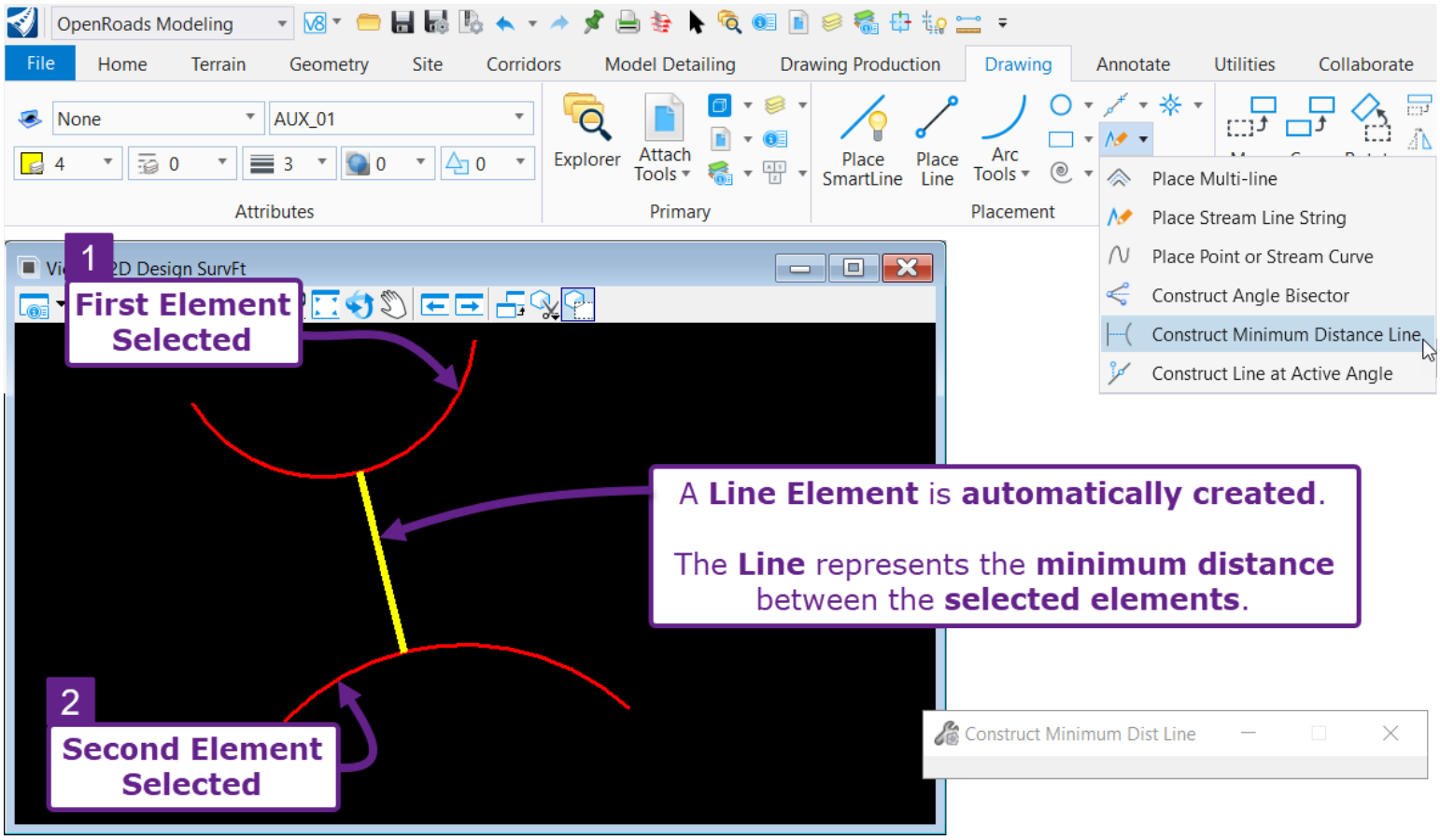
6C.7.d Construct Angle Bisector tool

Three separate point locations are defined - which defines an angle. A Line is automatically created which bisects the angle.



6C.7.e Construct Minimum Distance Line tool

With this tool, two elements are selected. A Line element, which represents the smallest distance between the two elements, is automatically created.

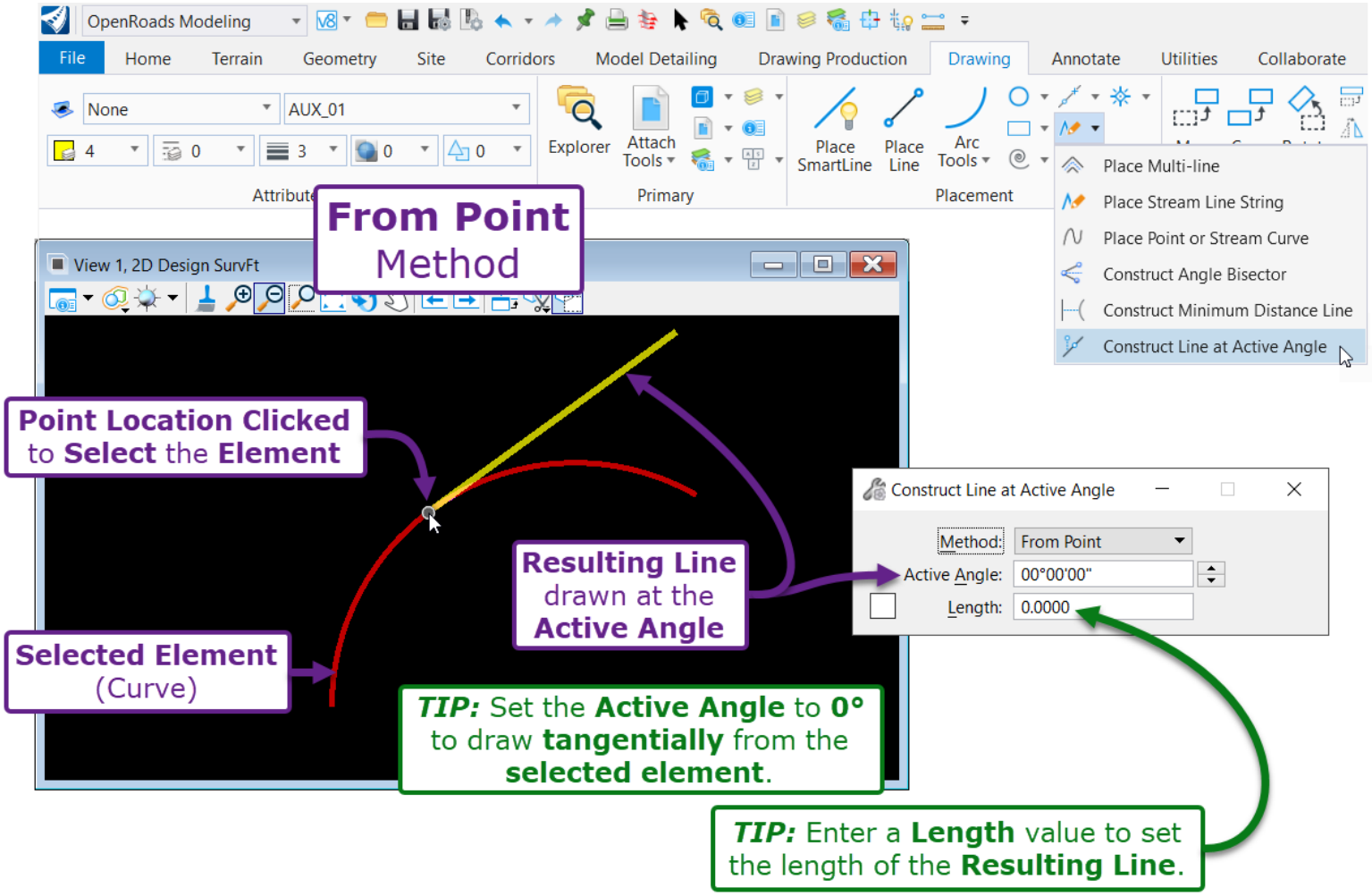


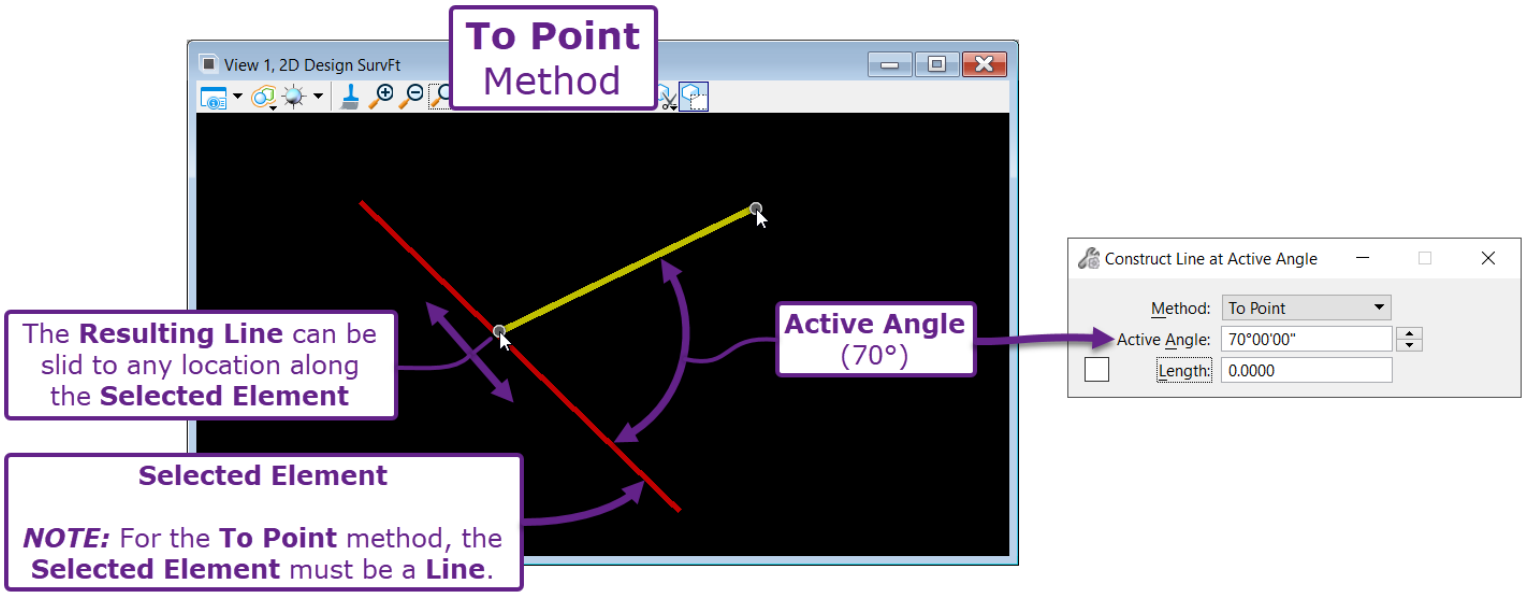
6C.7.f Construct Line at Active Angle tool

With this tool, an element is selected and an Active Angle is specified in the Dialogue Box. A Line that sprouts from the selected element at the selected element is created.

There are two methods for operating this tool:

Construct Line at Active Angle Methods	
Method:	**Description:**
From Point	The Line element sprouts from the selected element at the exact point location clicked on. With this method, the selected element can be a Line, Curve, or Complex Chain. In general, any MicroStation Element type can be selected with this method. ***TIP:*** Set the Active Angle to 0° to create a Line element that is tangential to a Curve element at the selected point location.
To Point	With this method, the selected element must be a Line element. After an element is selected and Active Angle is specified, then the resulting Line can be placed at any location along the selected element.




To Point
Method
View 1, 2D Design SurvFt
The **Resulting Line** can be slid to any location along the **Selected Element**
Active Angle
(70°)
Construct Line at Active Angle
Method:
To Point
Active Angle:
70°00'00"
Length:
0.0000
Selected Element
NOTE: For the **To Point** method, the **Selected Element** must be a **Line**.

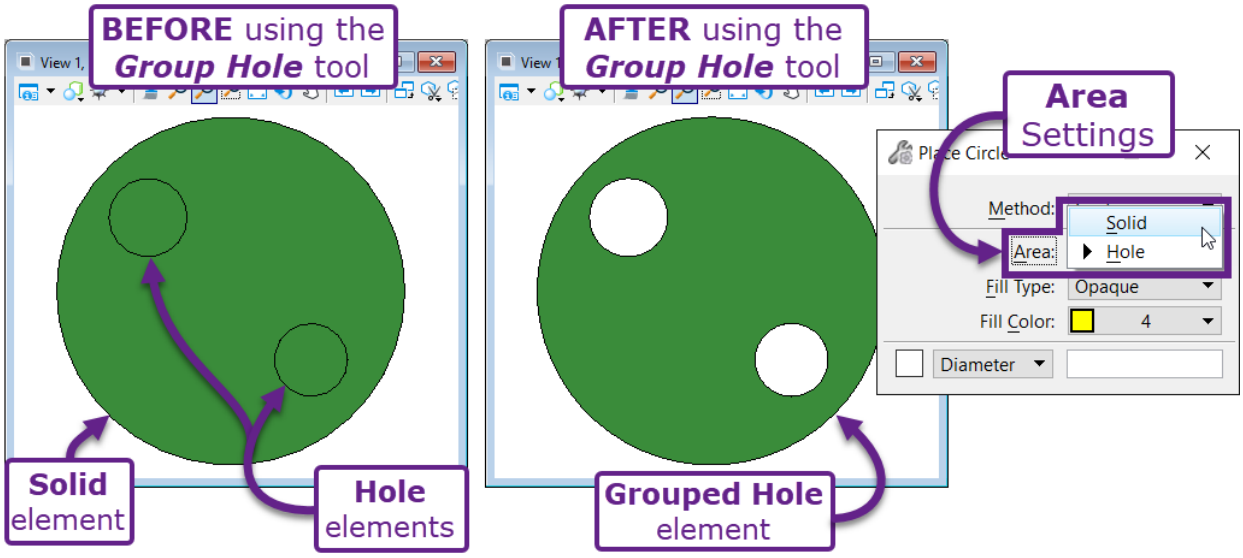
6C.8 Area and Fill Settings for Closed Shape Element Types

All tools used to create a closed shape element contain options for **Area** and **Fill**.

Area: A closed shape element type can be placed as either a **Hole** or **Solid**. For most civil design and quantity calculation purposes, both options behave and appear identically. Using the Hole or Solid option is inconsequential for most applications.

The **Hole** or **Solid** option is ONLY important when using the *Group Hole* tool – which is discussed in *6H.4 Group Hole tool*. A Grouped Hole element is a **Solid** element with interior **Hole** elements removed.

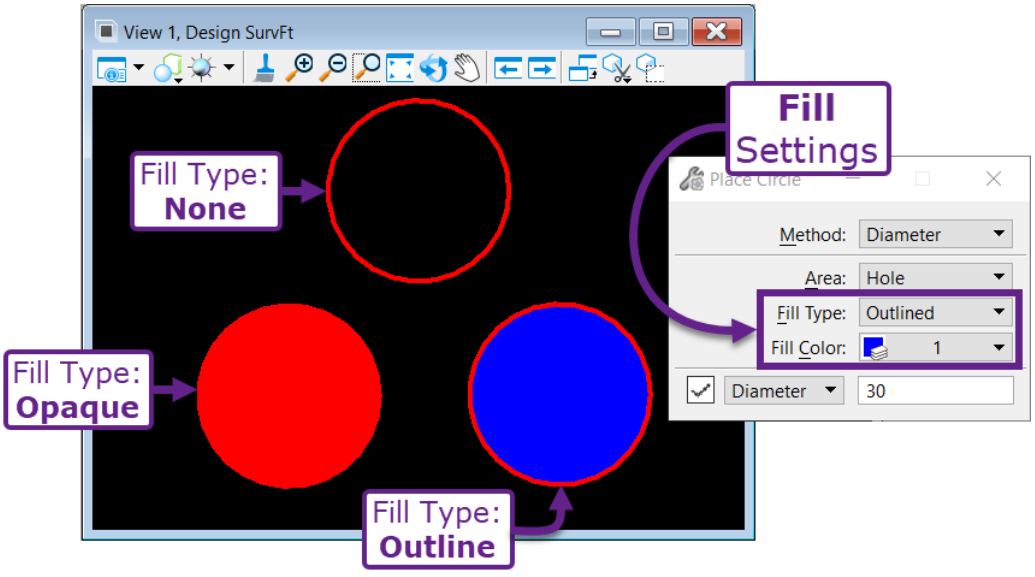
NOTE: Solid and Hole elements both appear as Solid shapes until the *Group Hole* tool is used. After using this tool, the Hole elements are visually shown as Holes.



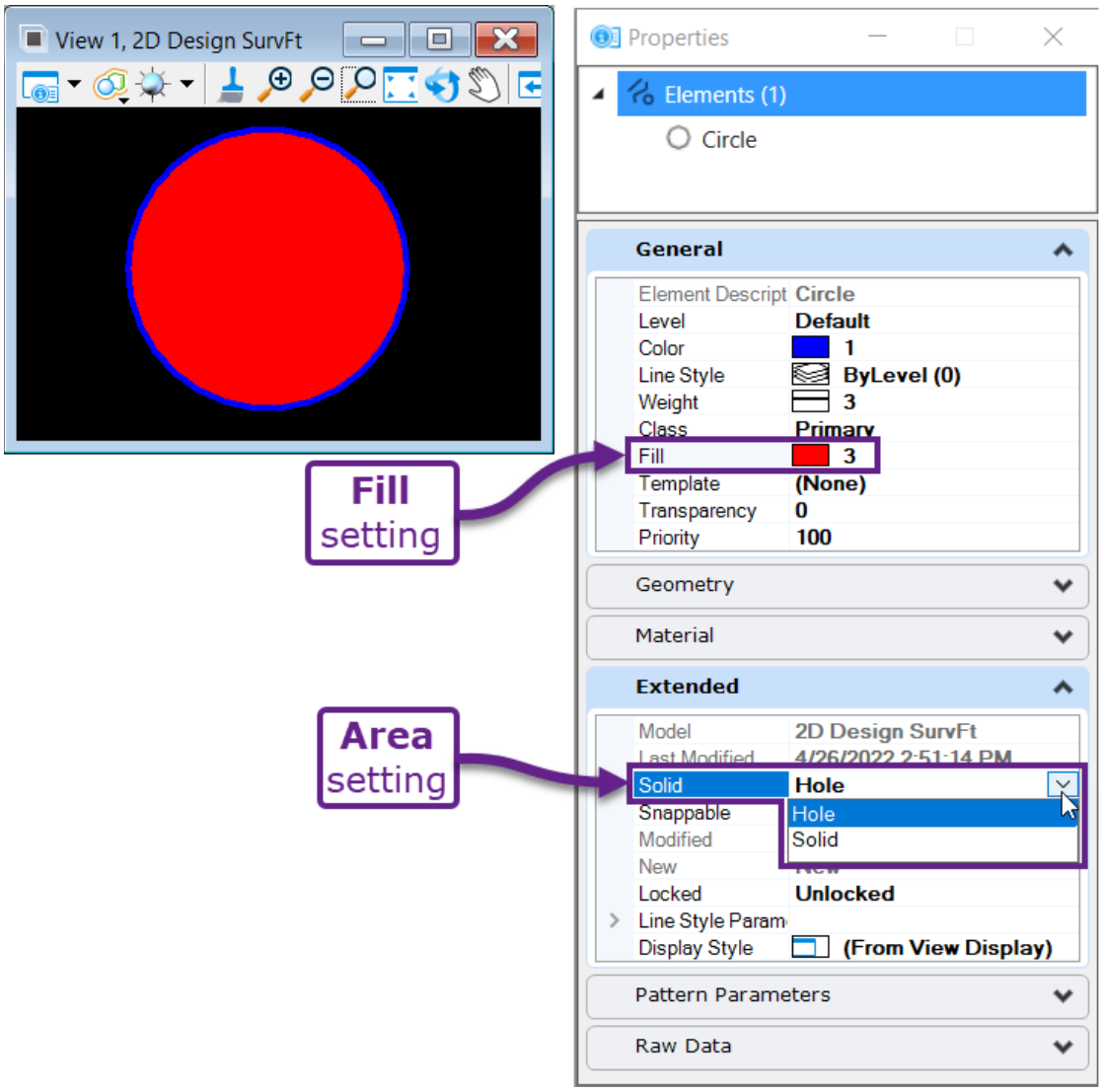
Fill: Setting the **Fill Type** to **Opaque** or **Outlined** will allow the closed shape element to be infilled with a color.

The **Opaque** option sets both the perimeter and infill to color specified in the **Fill Color** box.

The **Outlined** option allows the perimeter and infill to be set to different colors. The perimeter color is determined by the *active* Level and Color attribute. The **Fill Color** option sets the color for the infill.



After a closed shape element is created, the **Area** and **Fill** settings can be changed from the Properties box:



TIP: The **Fill** settings for a closed shape element can be changed with the *Change Element Fill Type* tool. See *6F.16 Change Element Fill Type tool*.

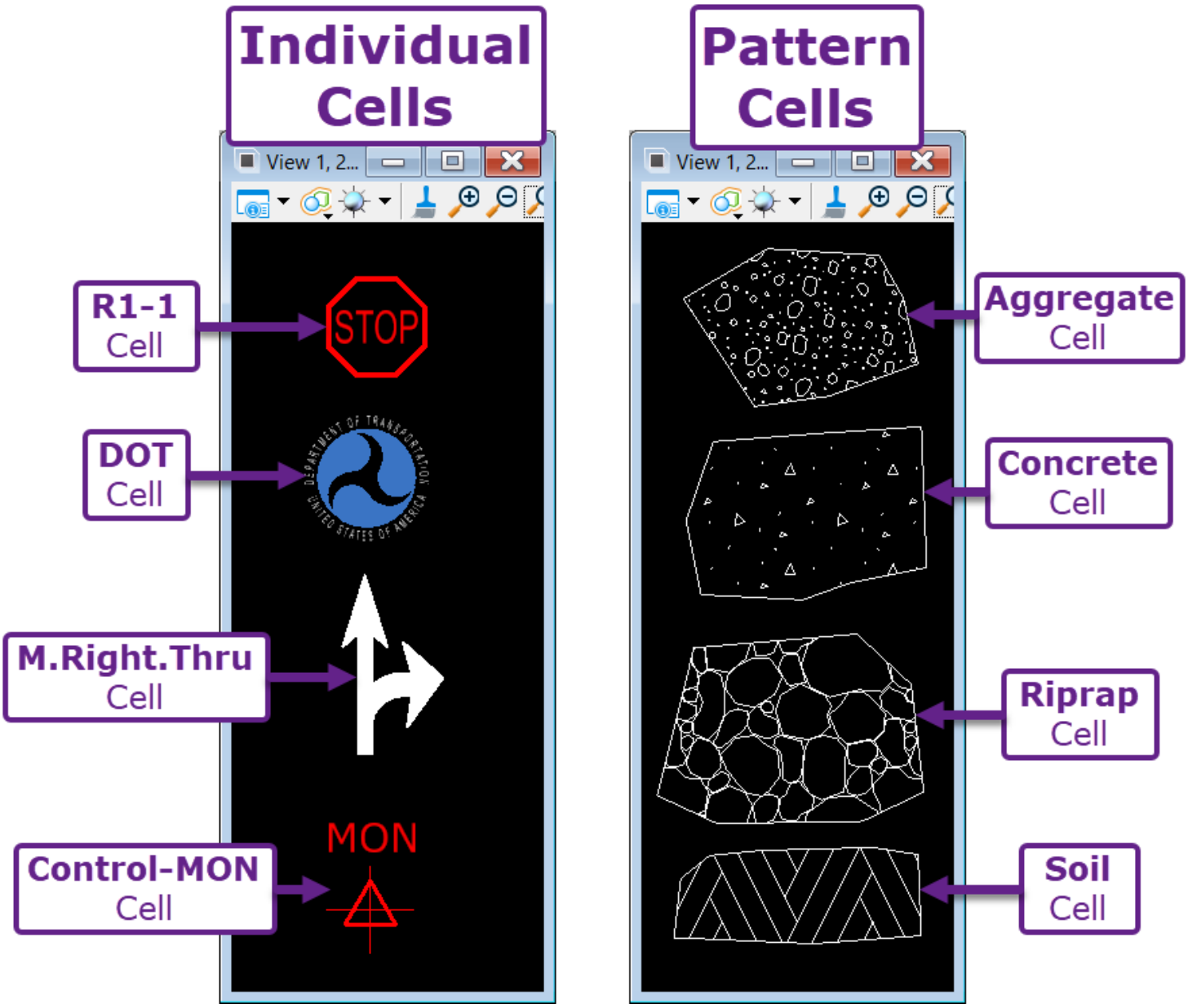
TIP: The **Area** settings for a closed shape element can be changed with the *Change to Active Area* tool. See *6F.15 Change to Active Area tool*.

6D – CELLS

A *Cell* is a pre-packaged group of graphical and/or text elements.

Cells are stored in Cell Libraries. A Cell Library is an external file with a ".cel" extension. For FLH plan set drafting, there are multiple Cell Libraries found in the FLH WorkSpace.

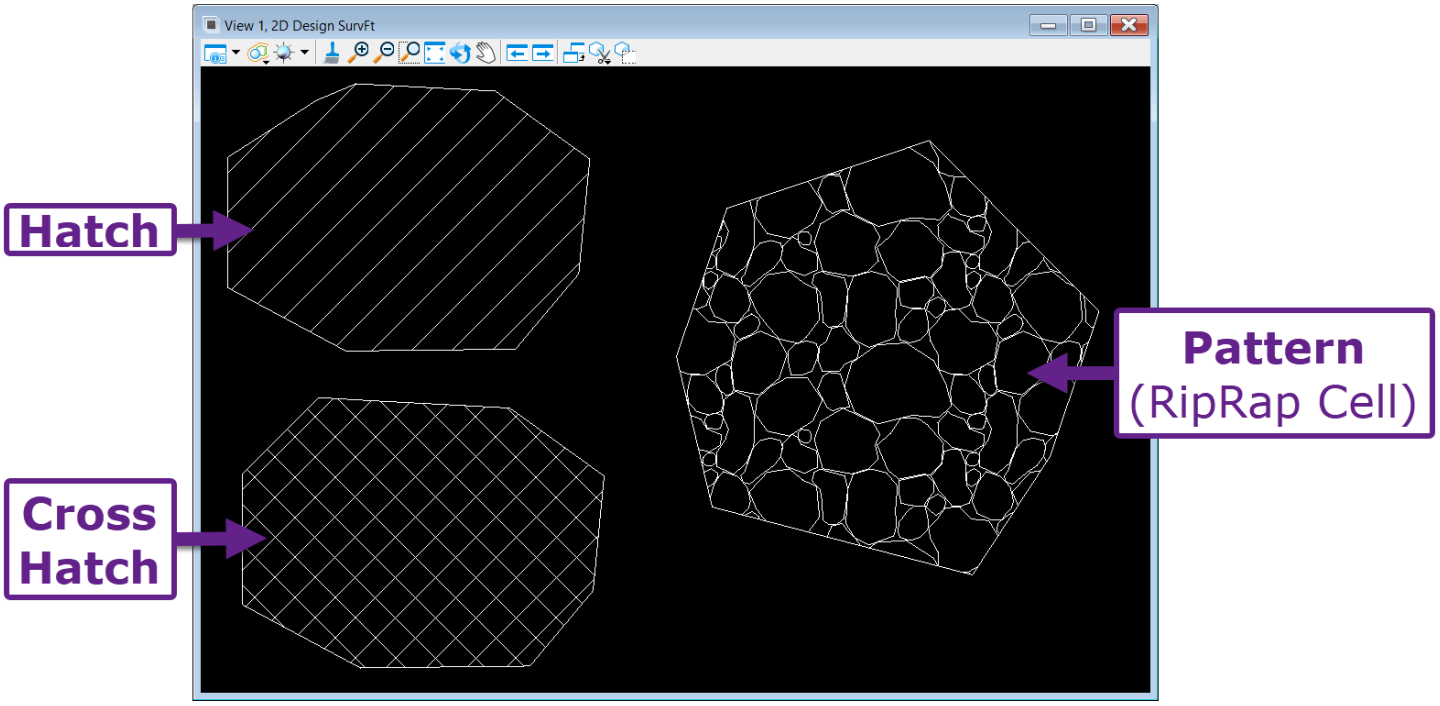
The two most common types of Cells are **Individual Cell** and **Pattern Cell:**



Individual Cells are placed with the *Place Active Cell* tool. **Pattern Cells** are placed with the *Place Pattern* tool.

NOTE: The placement of a Pattern Cell requires an enclosed area. The Pattern Cell will repeat as necessary to fill the enclosed area. The enclosed area can be any type of closed shape element, such as a Circle, Ellipse, Shape, or Complex Shape. Alternatively, multiple elements that intersect/overlap to form an enclosed area can be filled using the Flood placement method.

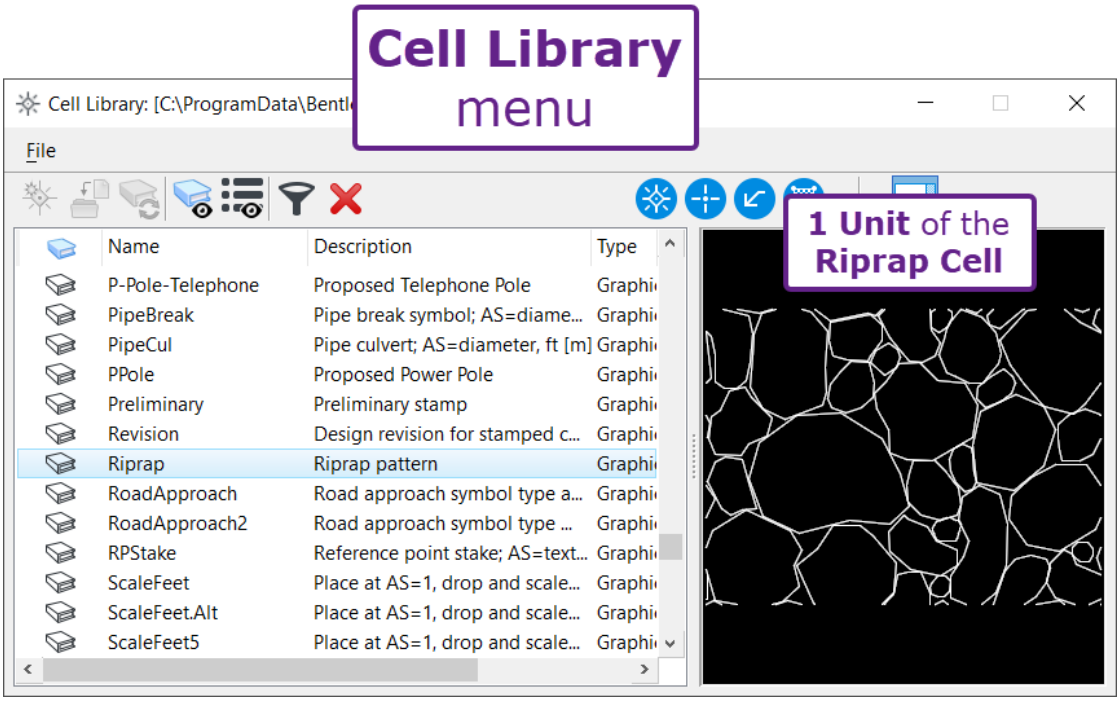
IMPORTANT DISTINCTION: The terms Pattern and Hatch are NOT interchangeable. A Hatch is a repeating set of parallel or crossing lines that is used to fill an enclosed area. A Pattern is a repeating Cell that is used to fill an enclosed area.



TIP: Hatch and Cross Hatches are created with the *Hatch Area* and *Cross Hatch Area* tools. See *6I.2 Infill an Enclosed Area with a Hatch or Cross Hatch*.

The graphic below shows the **Cell Library** menu with the Riprap Cell selected. The preview on the right shows 1 unit of the Riprap Cell. To fill an enclosed space, the Riprap Cell is repeated as necessary.

NOTE: Any Cell found in the Cell Library can be placed as a Single Cell or a Pattern Cell. However, Cells appropriate for Patterns are found in the "Work_dd.cel" Library and are designated as patterns in the Description column.



6D.1 Access and Attach FLH Cell Libraries

The Cell Library menu is accessed through the *Place Active Cell* tool.

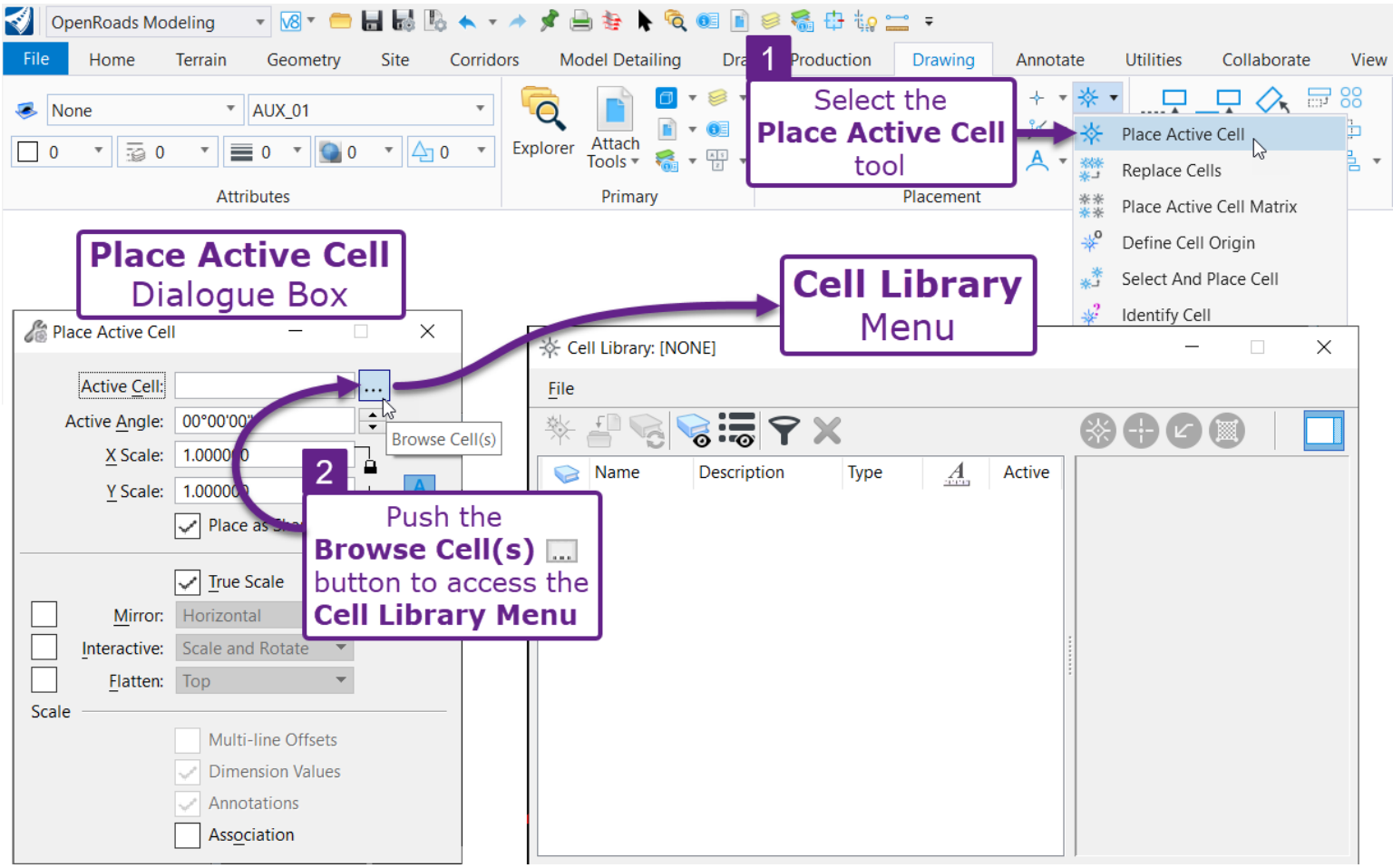
The *Place Active Cell* tool is found at many locations in the Ribbon. Two common Ribbon locations are:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Cell** drop-down

OR

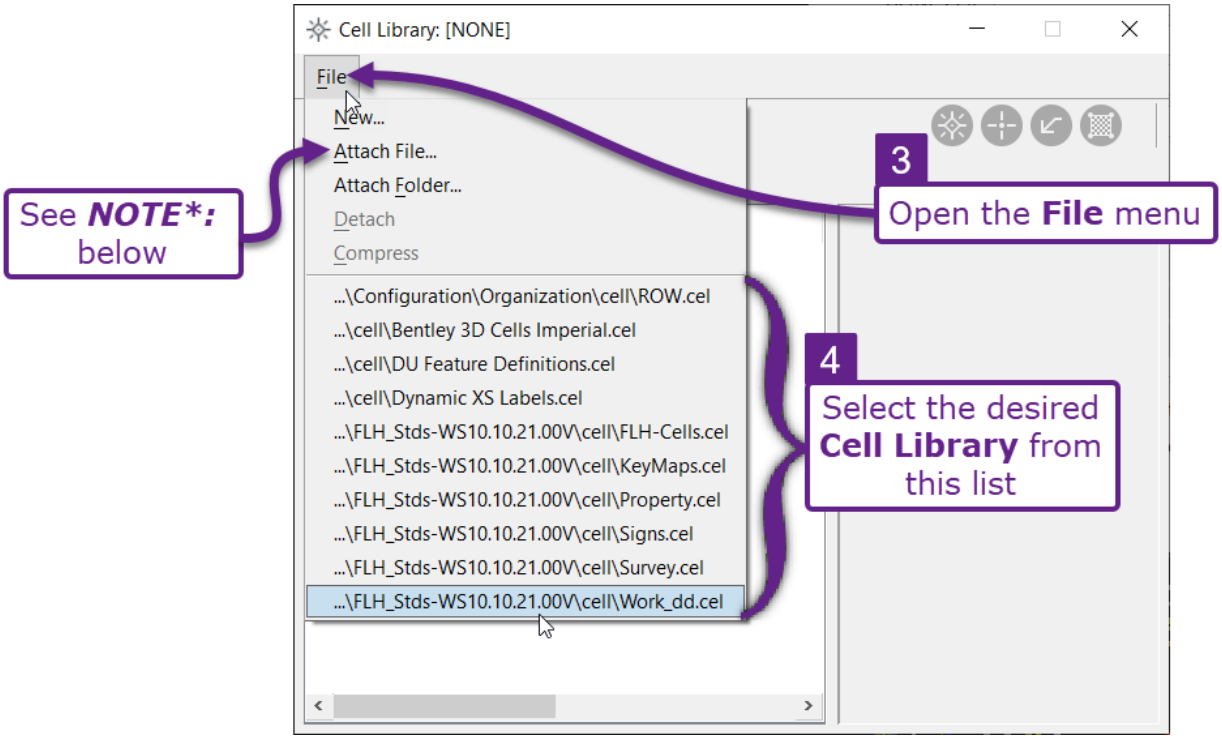
Drawing workflow → **Home** tab → **Placement** group → **Cell** drop-down

In the *Place Active Cell* dialogue box, press the **Browse Cell(s)** button to access the Cell Library menu.



The Cell Library menu will be blank if a Cell Library is NOT attached.

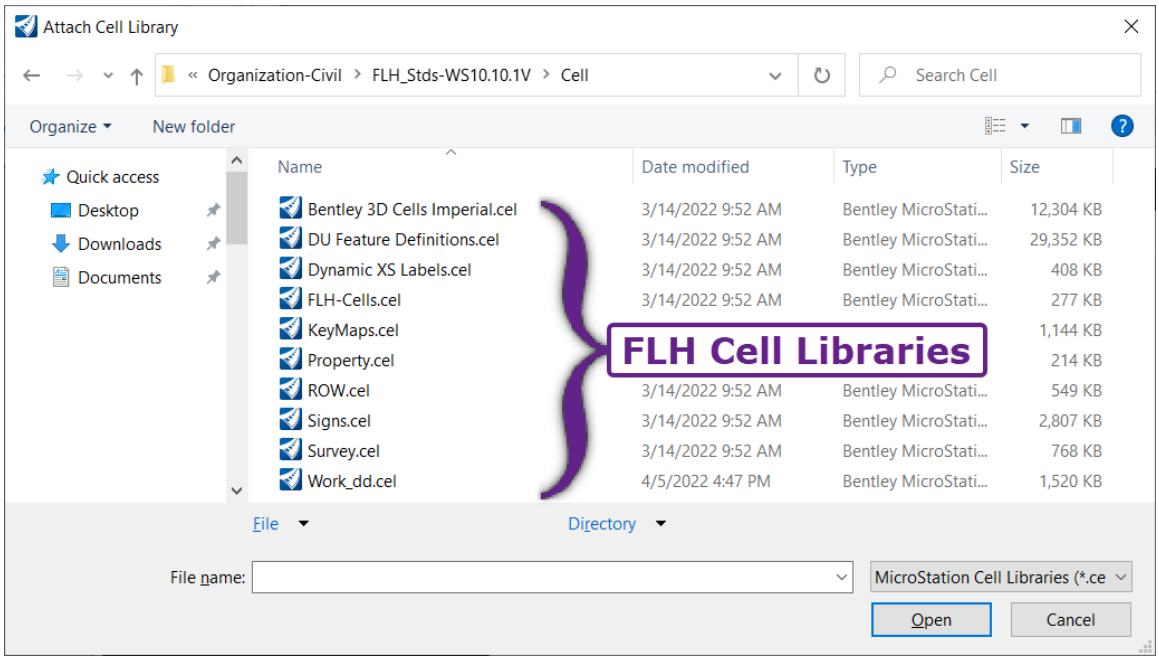
To attach a Cell Library, open the **File** menu. All Cell Libraries are shown at the bottom of the **File** menu:



WARNING: If the list shown above is blank, then the FLH WorkSpace is possibly unconnected. See you Engineering Systems Manager.

NOTE*: Cell Libraries can be manually attached with the *Attach File* tool. Within the FLH WorkSpace, Cell Libraries are found in the following location:

…\OpenRoads Designer CE 10.10\Configuration\Organization-Civil\FLH_Stds-WS10.10.1V\Cell



6D.2 FLH Cell Libraries

There are many FLH Cell Libraries. Each FLH Cell Library contains a collection of related Cells.

NOTE: In addition to the Cell Libraries described below, each FLH Division has a few Cell Libraries that are specifical used by the division. Confirm that your ORD setup includes all necessary Cell Libraries with your Engineering Systems Manager.

TIP: The **Work_dd** Library contains miscellaneous Cells for proposed drafting. This is the most used Cell Library.

FLH Cell Libraries	
Library:	**Description:**
Bentley 3D Cells Imperial	Cells contained in this Library are 3-deminsional. These Cells are NOT to be manually placed by the User. These Cells are linked to Feature Definitions to show guardrail and cable barriers in the *3D Design Model*  . For example, elements assigned to the "Guardrail_Single_Sided_R" Feature Definition will utilize 3D Cells in this library to show 3D Guardrail graphics.
DU Feature Definitions	Cells contained in this Library are linked with Drainage and Utilities tools. These Cells are NOT to be manually placed by the User.
Dynamic XS Labels	Cells contained in this Library are linked to CROSS SECTION Annotation Groups to graphically denote guardrails, fences, and Right-of-Way boundaries.
FLH-Cells	Contains Sheet Border cells.
KeyMaps	Contains Key Maps for States and National Parks found in the CFLHD and WFLHD jurisdictions.
Property	Contains Property and Boundary delineation cells. These Cells are utilized by Surveyors in mapping workflows.
ROW	Contains FLH Logos, Symbol Charts, Scale Bars, and Sheet Borders.
Signs	Contains MUTCD Signs to be shown in Traffic Control Plans.
Survey	Contains Cells that represent existing features (i.e., Electric Junction Box, Sewer Manhole). These Cells are utilized by Surveyors in mapping workflows.
Work_dd	Contains miscellaneous Cells for drafting proposed features. This Cell Library contains Pattern Cells (i.e., Aggregate, Concrete, Riprap). Also contained are Pavement Markings, Scale Bars, and miscellaneous Signage Cells.

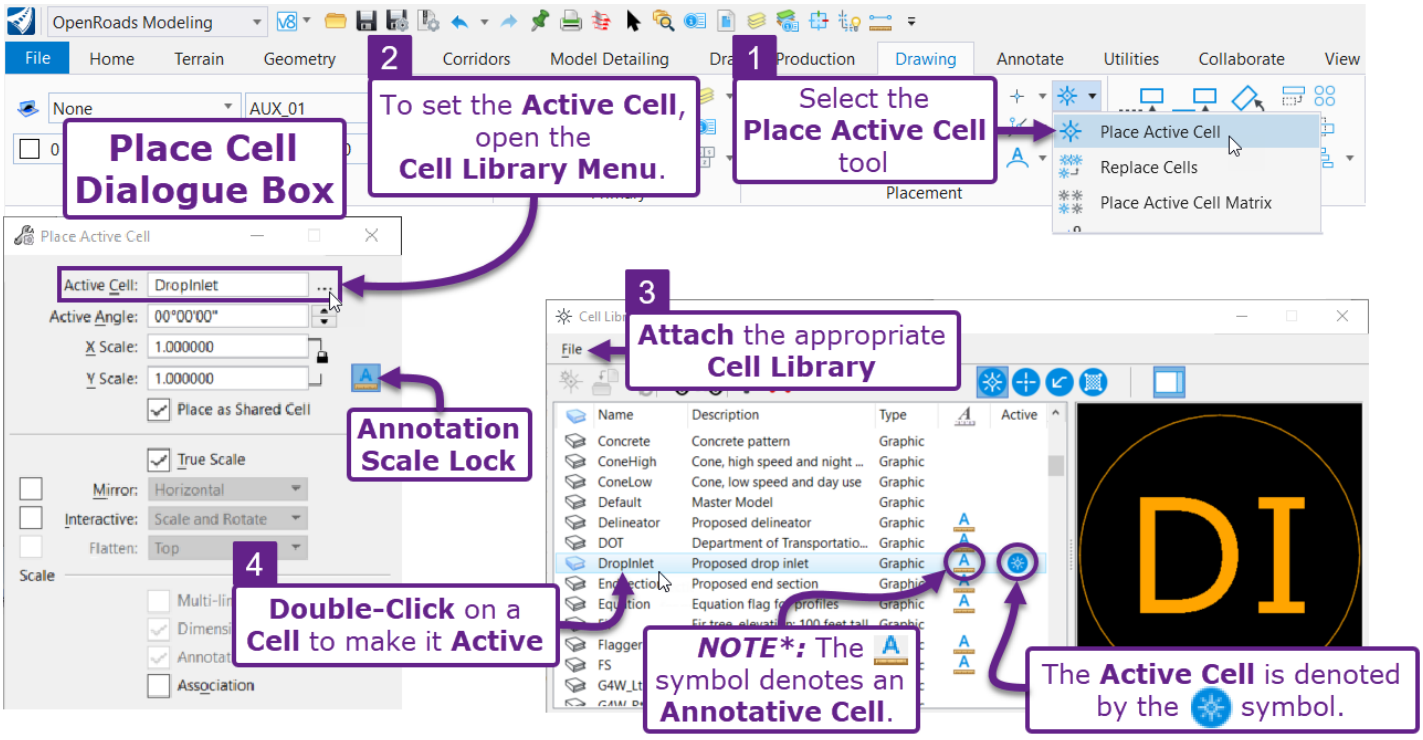
6D.3 Place a Cell (Place Active Cell tool)

Individual Cells are placed with the *Place Active Cell* tool. The *Place Active Cell* tool is found at many locations in the Ribbon. Two common Ribbon locations are:

OpenRoads Modeling workflow → **Drawing** tab → **Placement** group → **Cell** drop-down
OR
Drawing workflow → **Home** tab → **Placement** group → **Cell** drop-down

The graphic below shows how to open the Cell Library menu, attach a Cell Library, and activate a Cell. The file location for FLH Cell Libraries is shown in *6D.1 Access and Attach FLH Cell Libraries*.

TIP: The "Work_dd.cel" library is generally used to place proposed features. The "Signs.cel" library contains the sign faces for MUTCD signs.



After setting the *Active* Cell, configure the *Place Active Cell* dialogue box. The default settings for the dialogue box are shown in the graphic above. See the next page for more information on the Dialogue Box.

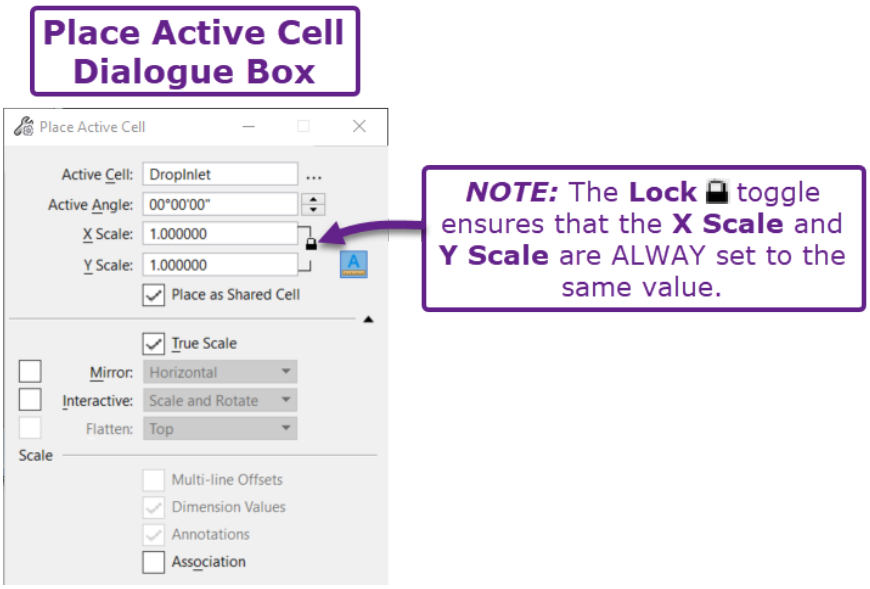
For most situations, the default settings are acceptable and ONLY the **Active Angle**, **X Scale**, and **Y Scale** should be modified.

NOTE* - Annotative Cells: In the Cell Library menu, the A symbol denotes an Annotative Cell. To place an Annotative Cell at an appropriate size, the Annotation Scale Lock must be toggled ON. After placement, Annotative Cells increase or decrease in size when the Annotation Scale is changed An Annotative Cell should ALWAYS be placed with a Scale factor of1. For more information on the Annotation Scale, see *15A.2 Annotation Scale*.

BEST PRACTICE: Keep the Annotation Scale Lock toggled ON during placement of both Annotative and non-Annotative Cells. The Annotation Scale Lock toggle has no effect on the size of non-Annotative Cells.

NOTE: The size of Annotative and Non-Annotative Cells are affected by the X-Scale and Y-Scale. For Annotative Cells, both the X/Y Scales and the current Annotation Scale determines the size of the Cell.

NOTE: The True Scale check box does NOT affect the size of Cells found in the FLH Library. The True Scale setting is used to convert Cells that were created in different units than the current ORD File.



Place Active Cell Dialogue Box	
Setting:	**Description:**
Active Cell	Sets which Cell from the Cell Library is placed.
Active Angle	Sets the Angle which the Cell is placed. If set to 0°, the Cell is placed at the same rotation shown in the Cell Library. If set to 180° the Cell is flipped upside down. ***NOTE:*** The Active Angle is relative to the current rotation of the *View* window.
X Scale	Scales the size of the Cell along its X-axis. ***NOTE:*** By default, the X-Scale and Y-Scale are linked. When linked, The X and Y-Scales are always set to the same value. Press the button to UNLINK the X and Y-Scale values. Unlinking the X and Y-Scales allows the Cell to be exaggerated in the horizontal (X) or Vertical (Y) direction.
Y Scale	Scales the size of the Cell along its Y-axis.
Annotation Scale Lock	If this icon is TOGGLED, then the default size of the Cell is multiplied by the currently set Annotation Scale multiplier. After placement, if the Annotation Scale is changed, then the Cell will increase or decreased in size. ***NOTE:*** The Annotation Scale ONLY applies to Annotative Cells. In the Cell Library menu, Annotative Cells are shown with a symbol next to them. ***BEST PRACTICE:*** Always keep this icon toggled ON.
Place as Shared Cell	If this box is CHECKED, then the entire Cell is placed on the active Level. All attributes (i.e., Color, Line Weight) for the component elements of the Cell are locked for editing. If this box is UNCHECKED, then the Cell is NOT placed on the active Level. Each component of the Cell can have unique Level and Attribute settings. The Level and Attributes for each component can be editing in the Properties box. ***BEST PRACTICE:*** Keep this box CHECKED.

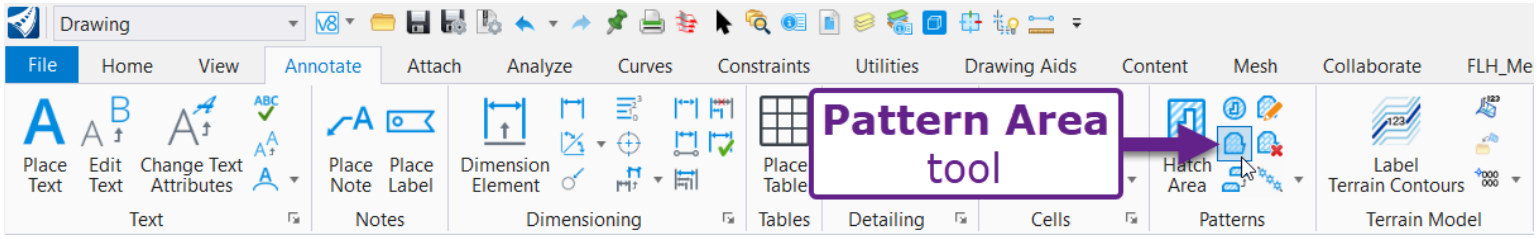
Place Active Cell Dialogue Box	
Setting:	**Description:**
True Scale	If the Cell was created in a Model with different units than the current Model, then the scale of the Cell will automatically be adjusted.
Mirror	This setting is used to flip the position of the Cell over the horizontal or vertical axis.
Interactive	If this box is CHECKED, then the User will be prompted to Rotate and/or Scale the Cell during placement. ***NOTE:*** If this box is CHECKED, then the Active Angle and X/Y-Scales settings will be greyed out.
Flatten	This option is only applicable to 3D Cells – which are typically found in the "Bentley 3D Cells Imperial" library. The 3D Cell is converted to a 2D Cell and flattened along the specified plane.
Multi-Line Offsets	This option is only available if the Place as Shared Cell box is UNCHECKED. This option ONLY affects Cells that were originally created with Multi-Line elements. If CHECKED, then the offsets contained in the Multi-Line element will scale according to the X and Y-Scale values. If UNCHECKED, then Multi-Line offsets will always retain their default value.
Dimension Values	This option is only available if the Place as Shared Cell box is UNCHECKED. This option ONLY affects Cells that were originally created using Dimension Elements. If this box is CHECKED, then the values shown in the Dimension will alter according to the X and Y-Scale values.
Annotations	This option is only available if the Place as Shared Cell box is UNCHECKED. This option affects Cells that were originally created with annotative elements
Association	If this box is CHECKED, then snapping the Cell to a reference element during placement will create an association. If the reference element is moved, then the Cell will automatically move to honor the snap configuration. This association is similar to Persist Snaps used with ORD elements. See *7C.1 Persist Snaps*.

6D.4 Place a Pattern Cell (Pattern Area tool)

The *Pattern Area* tool is typically used to fill an enclosed area with a Riprap, Aggregate, Concrete, Soil, or Wood cell.

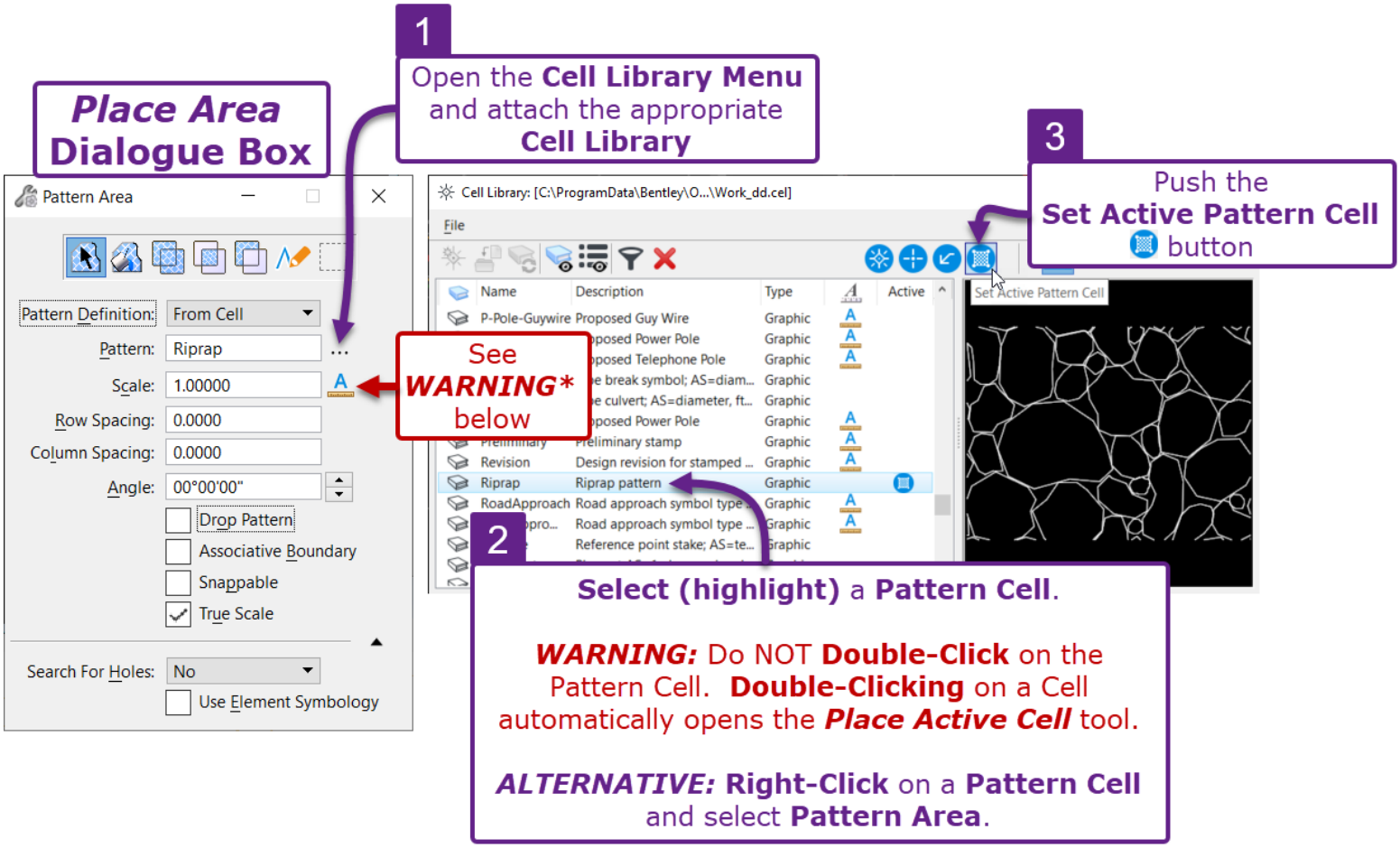
The *Pattern Area* tool is found in the Ribbon at the following location:

Drawing workflow → **Annotate** tab → **Pattern** group



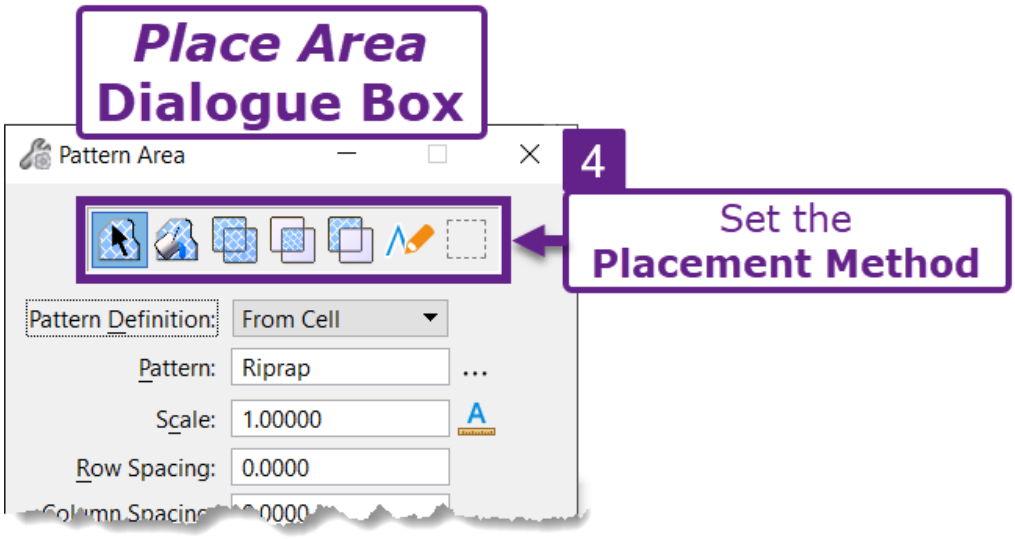
The graphic below shows how to open the Cell Library menu and activate a Pattern Cell. Attaching a Cell Library and the file location for FLH Cell Libraries is shown in *6D.1 Access and Attach FLH Cell Libraries*.

TIP: FLH Pattern Cells are found in the "Work_dd.cel" library.



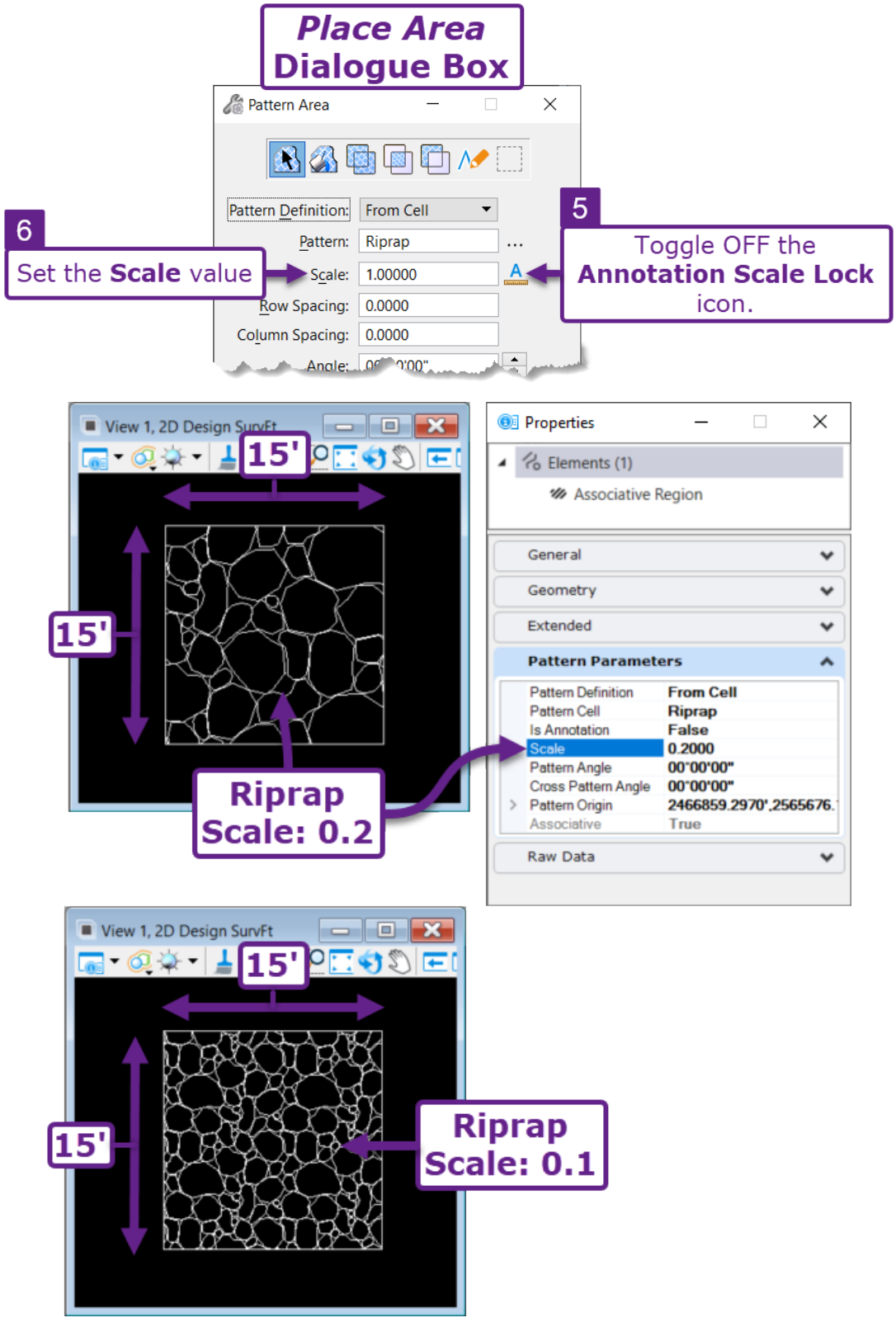
WARNING*: Toggle OFF the **Annotation Scale Lock** when placing FLH Pattern Cells. If toggled ON, then the Pattern Scale is too large and may NOT be visible. FLH Pattern Cells are NOT Annotative.

4	In the *Pattern Area* dialogue box, set the **Placement Method**. The most common placement methods are **Element** and **Flood**.

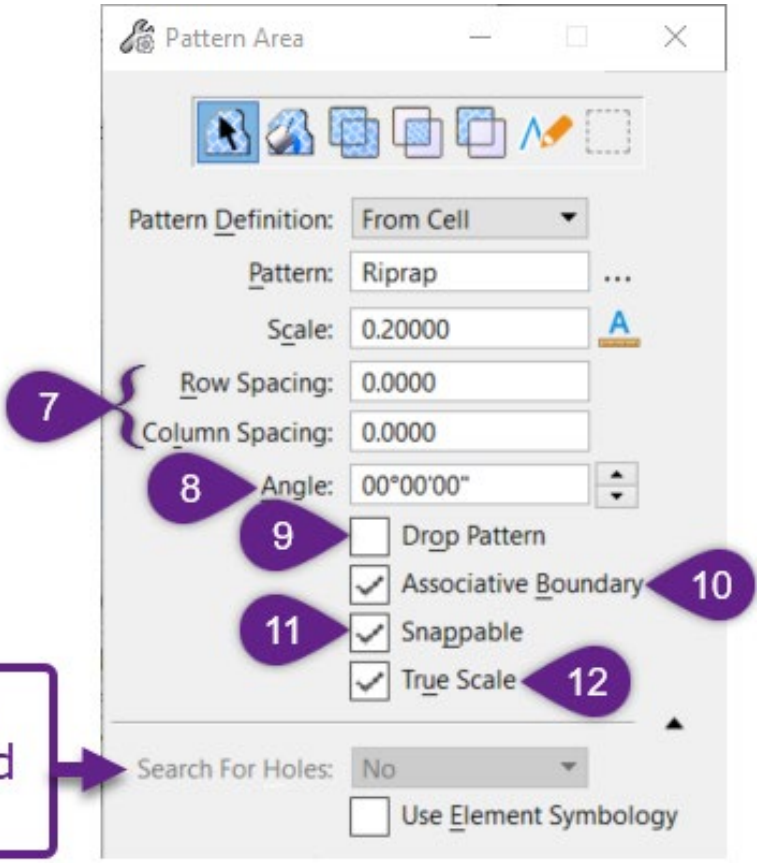


Pattern Area Placement Methods		
Method:		**Description:**
Element		With this option a single closed shape element is selected and the Pattern will fill the interior of the closed element. The following element types are compatible with this method: Circle, Ellipse, Shape, and Complex Shape.
Flood		The inner area formed by intersecting or overlapping elements is filled with the Pattern. ***WARNING:*** Ideally, there should be NO gaps in the between the elements that form the enclosed area. This method has difficulty delineating the closed area if gaps are present between elements. Theoretically, the Maximum Gap setting can be increased to accommodate gaps, but occasionally this mechanism does NOT work. If the Flood setting does NOT work, then modify the settings and check for gaps between elements. ***BEST PRACTICE:*** Manipulate elements that form the enclosed area to ensure NO gaps are present. Ensure that adjacent elements segments overlap or that the start/end points are snapped to each other.
Union		This option is used to Pattern the area of two or more overlapping closed elements. When prompted to *Identify Union Elements* - hold down the left-click button to draw a line. All closed elements that intersect the line will be Patterned.
Intersection		This option is used to Pattern the common area between two overlapping, closed elements.
Difference		This option is used to Pattern the non-overlapping area for one of two elements that overlap.
Points		The User click in several locations to create a closed area. The area delineated is filled with the Pattern.
Fence		This option is ONLY available if an active Fence is set. The Pattern will fill the interior of the active Fence area.

5	Toggle OFF the **Annotation Scale Lock**. If this setting is toggled ON, then the Scale of the Pattern Cell will be too large.
6	Set the **Scale** value. This setting determines the relative size of the Pattern graphics. Initially, set this value between 0.1 – 0.8. After placement of the Pattern Cell, this value can be changed in the Properties box.



Configure the remaining settings in the Dialogue Box:



NOTE: Settings shown here differ on the selected **Placement Method**.

7	**Row Spacing** and **Column Spacing:** Keep these values at 0.0000. If Row and Column Spacing is used, then there will be blank areas in the Pattern with row and column values.
8	**Angle:** Determines the angle rotation of the Pattern. This setting can be kept at 0° for Riprap, Aggregate, and Concrete patterns. For Soil and Wood patterns, the Angle value may need to adjusted to be set at desired orientation.
9	**Drop Pattern:** If this box is CHECKED, then the Pattern is broken down (dropped) to its base elements. The Pattern will NOT be dynamic if the enclosed area elements are edited. If this box is UNCHECKED, then the Pattern is placed as a single element. ***BEST PRACTICE:*** Keep this box UNCHECKED.
10	**Associative Boundary:** This setting works differently for **Element** and **Flood** placement methods. **Element:** If CHECKED, then an Associative Region element is created around the perimeter of the closed shape element. The Associative Region element represents the Pattern and is associated to the geometry of the closed element. If UNCHECKED, then the Pattern Cell definition is applied directly to the closed element. **Flood:** If CHECKED, then an Associative Region element is created around the perimeter of the elements that form the closed area. The Associative Region element is associated to the geometry that forms the closed area. The Associative Region does NOT have grip-edit handles when selected. If UNCHECKED, then a Shape element is created. When selected, the Shape element contains grip-edit handles.

11	**Snappable:** If this box is CHECKED, then the interior linework graphics that form the Pattern can be snapped to. If this box is UNCHECKED, then the interior graphics of the Pattern CANNOT be snapped to.
12	**True Scale:** If the Pattern Cell was created in a Model with different units than the current Model, then the scale of the Pattern Cell will automatically be adjusted. ***NOTE:*** For FLH Pattern Cells, this setting has no effect on the size (scale) of the Pattern.

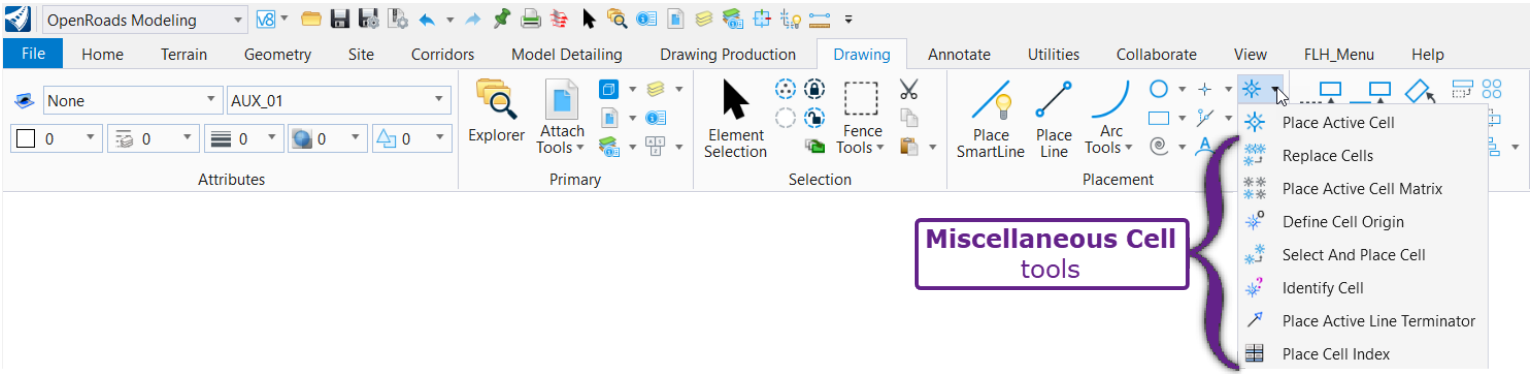
Placing the Pattern Cell:

If the **Element**  placement method is used, then select a closed element type. The following element types are compatible with this method: Circle, Ellipse, Shape, and Complex Shape.

If the **Flood**  placement method is used, then left-click within a closed area formed by multiple overlapping, intersecting, or connected elements.

6D.5 Miscellaneous Cell Tools

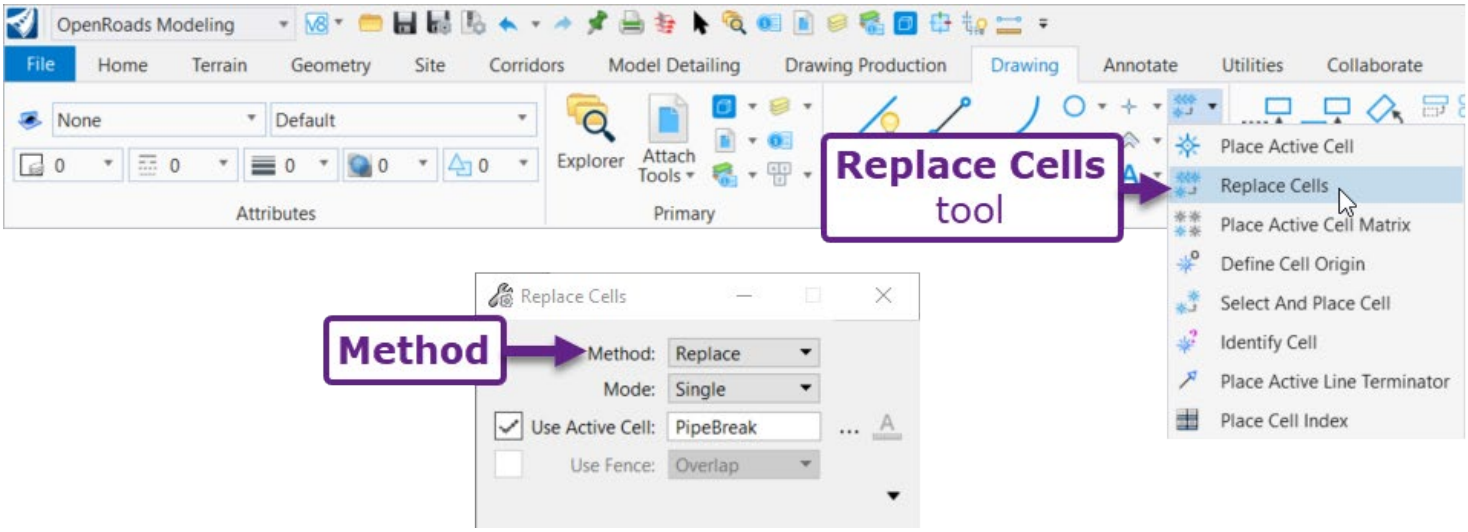
This section covers the remaining Cell tools found in the Cell drop-down.



6D.5.a Replace Cells tool

This tool has two methods:

Replace Cells Methods	
Method:	**Description:**
Update	If the definition of Cell has been changed in the Cell Library, then this method will update the placed Cell to match the Cell Library.
Replace	This method is used to replace a Cell with a different Cell type.

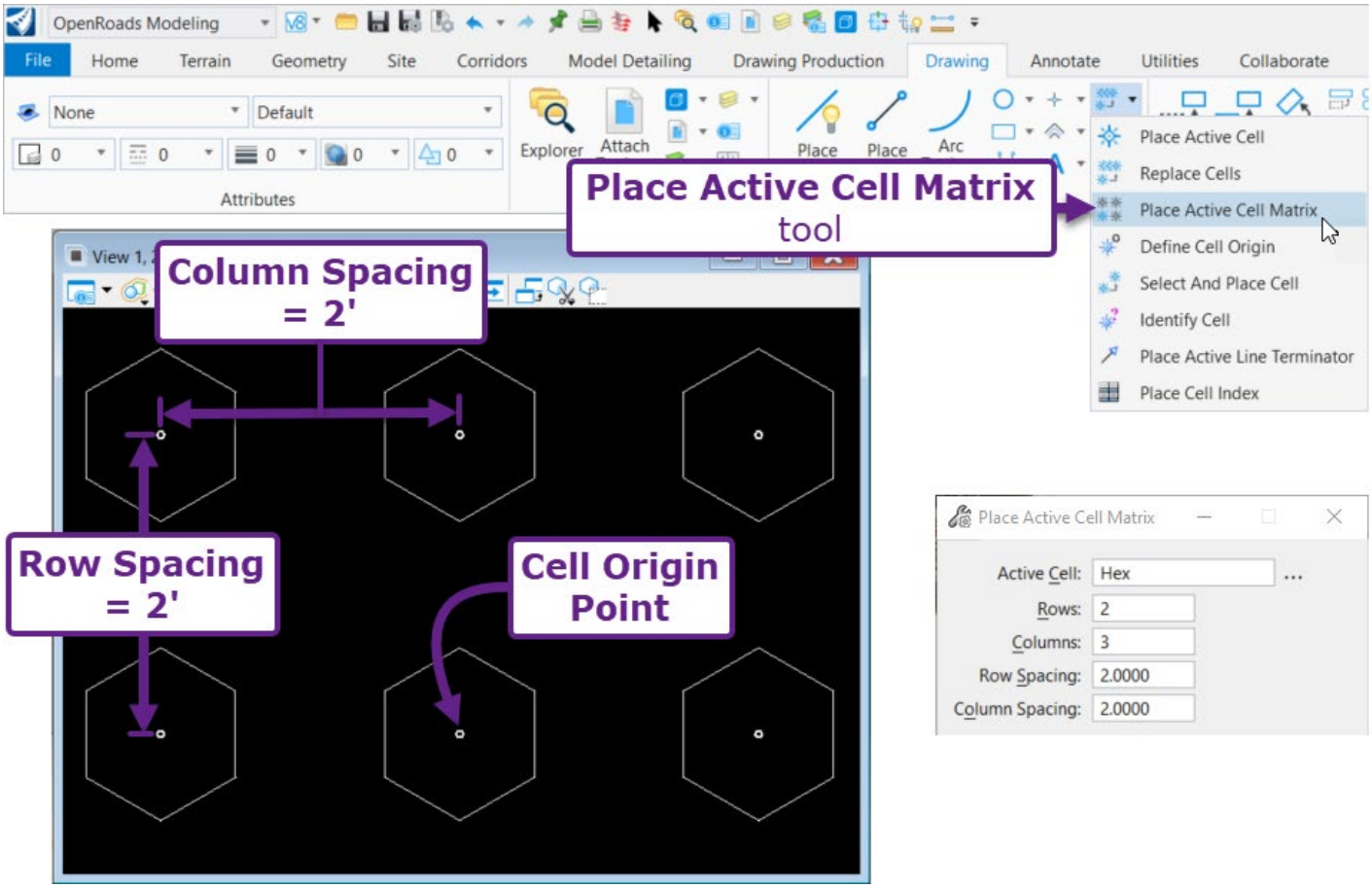


Replace Cells Settings	
Method:	**Description:**
Mode	**Single**: Only the selected Cell is updated or replaced.
	Global: A Cell is selected. All Cells in the ORD File that are the same as selected Cell are updated or replaced.
Use Active Cell	This option is only available when the **Replace** method is used. The Active Cell shown in the box will replace the selected Cell.
Use Fence	If an Active Fence is set, all Cells inside the Active Fence are updated or replaced.

6D.5.b Place Active Cell Matrix

This tool is used to place an array or matrix comprised of multiple Cells.

IMPORTANT: Row Spacing and Column Spacing is measured relative to the Cell's origin location.



6D.5.c Define Cell Origin

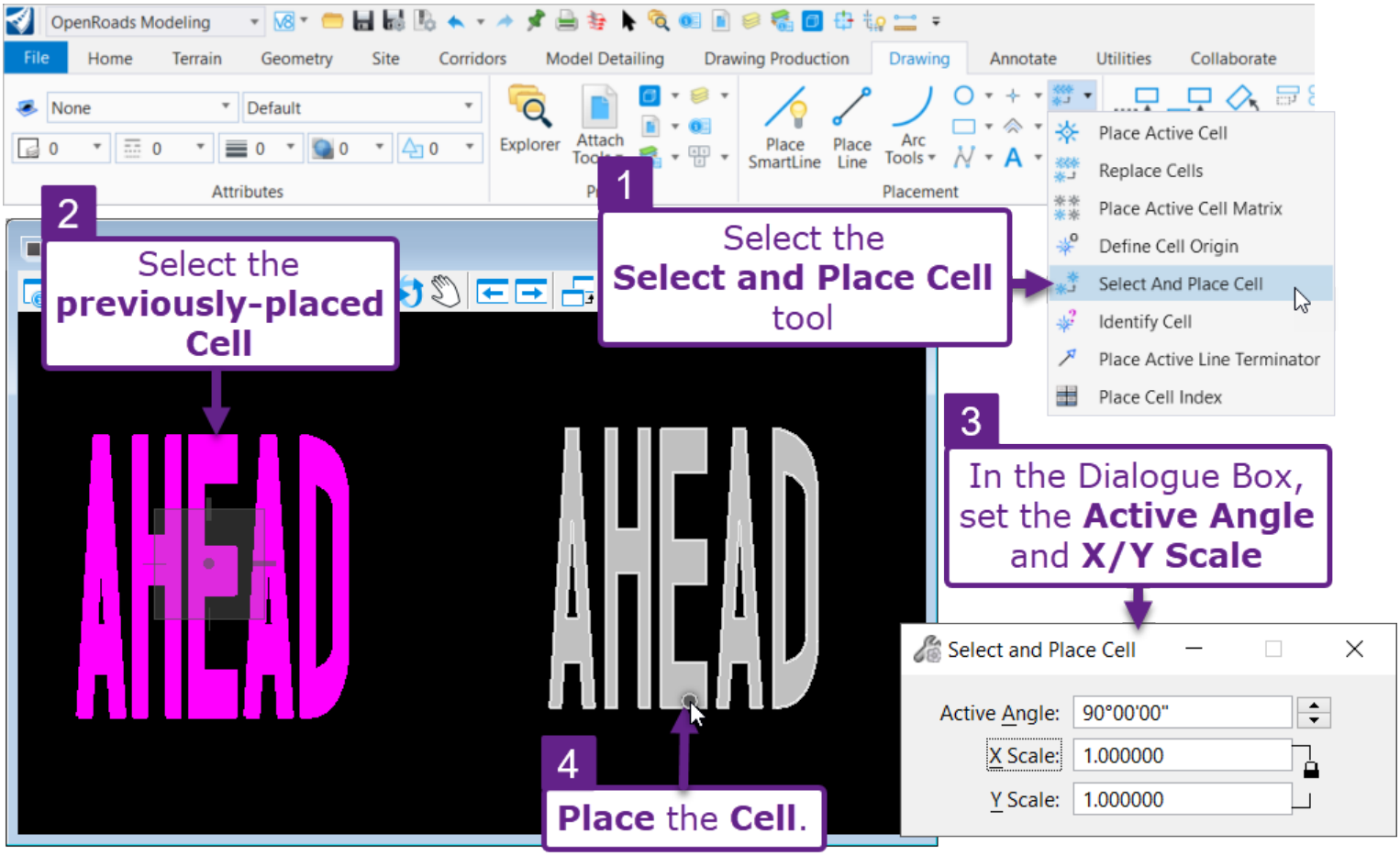
This tool is used in the creation of custom Cells to define the origin (base point location).

NOTE: This tool does NOT change the Origin point of a Cell placed from the Cell Library.

6D.5.d Select and Place Cell tool

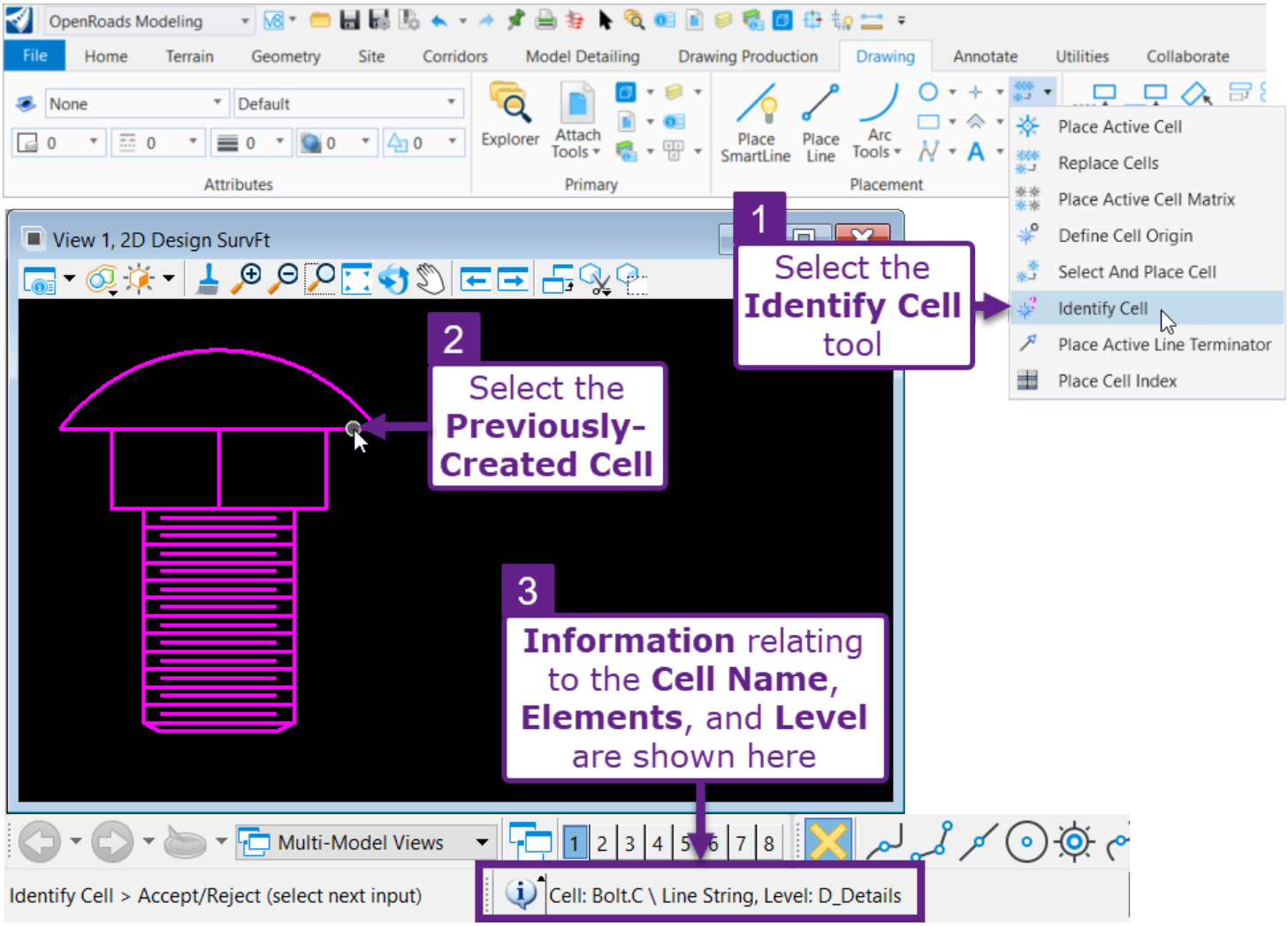
This tool is used to place a Cell that matches a previously-placed Cell. This tool is useful if the name of a Cell is not known and the desire is to create a matching Cell.

TIP: Use the *Identify Cell* tool to reveal the name of a Cell. Alternatively, the name of a Cell is shown in the Properties box.



6D.5.e Identify Cell tool

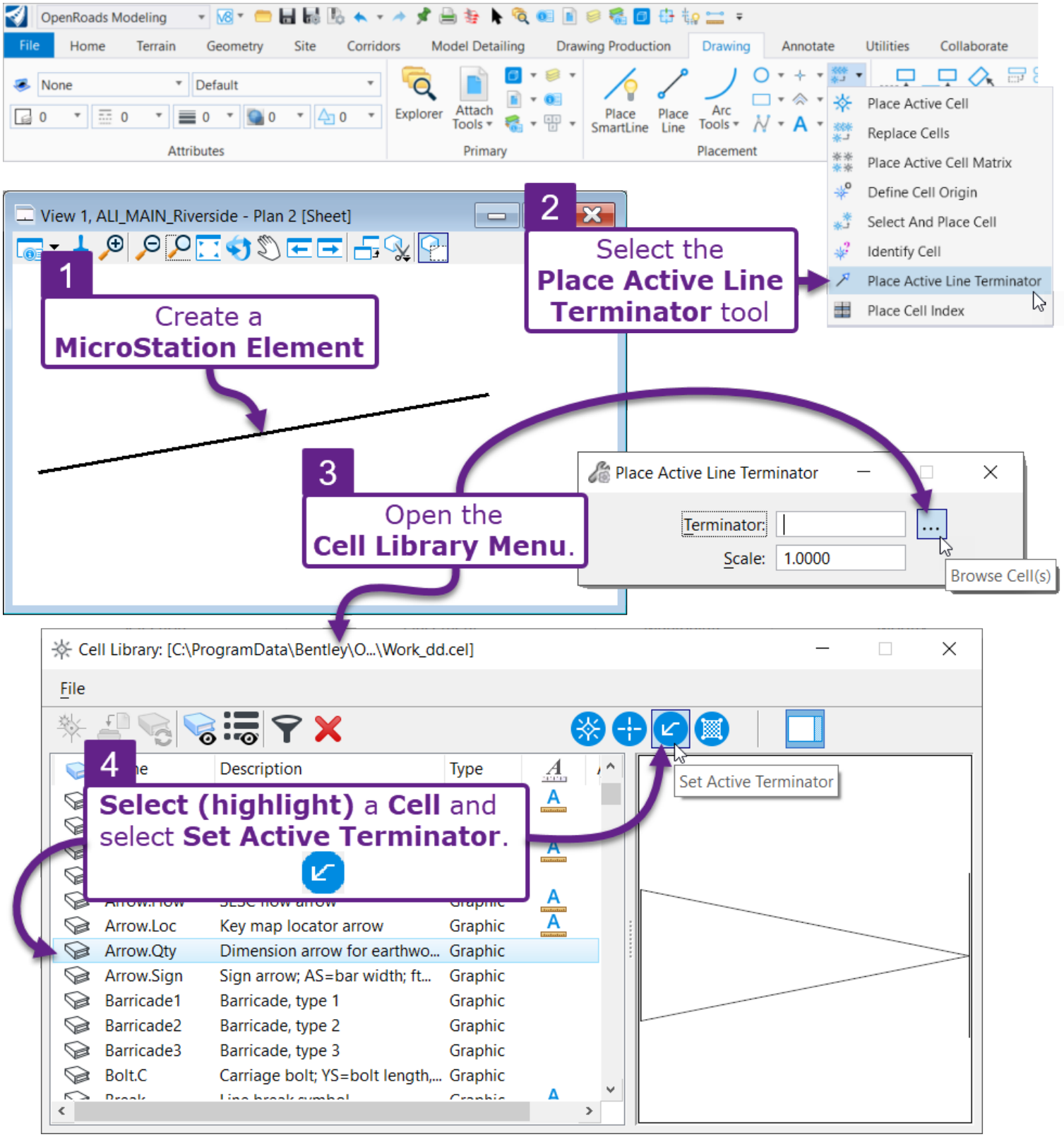
This tool is used to reveal the name of a previously-placed Cell. After a previously-placed Cell is selected, the name of the Cell is shown in the Information Box at the bottom of the software interface window.

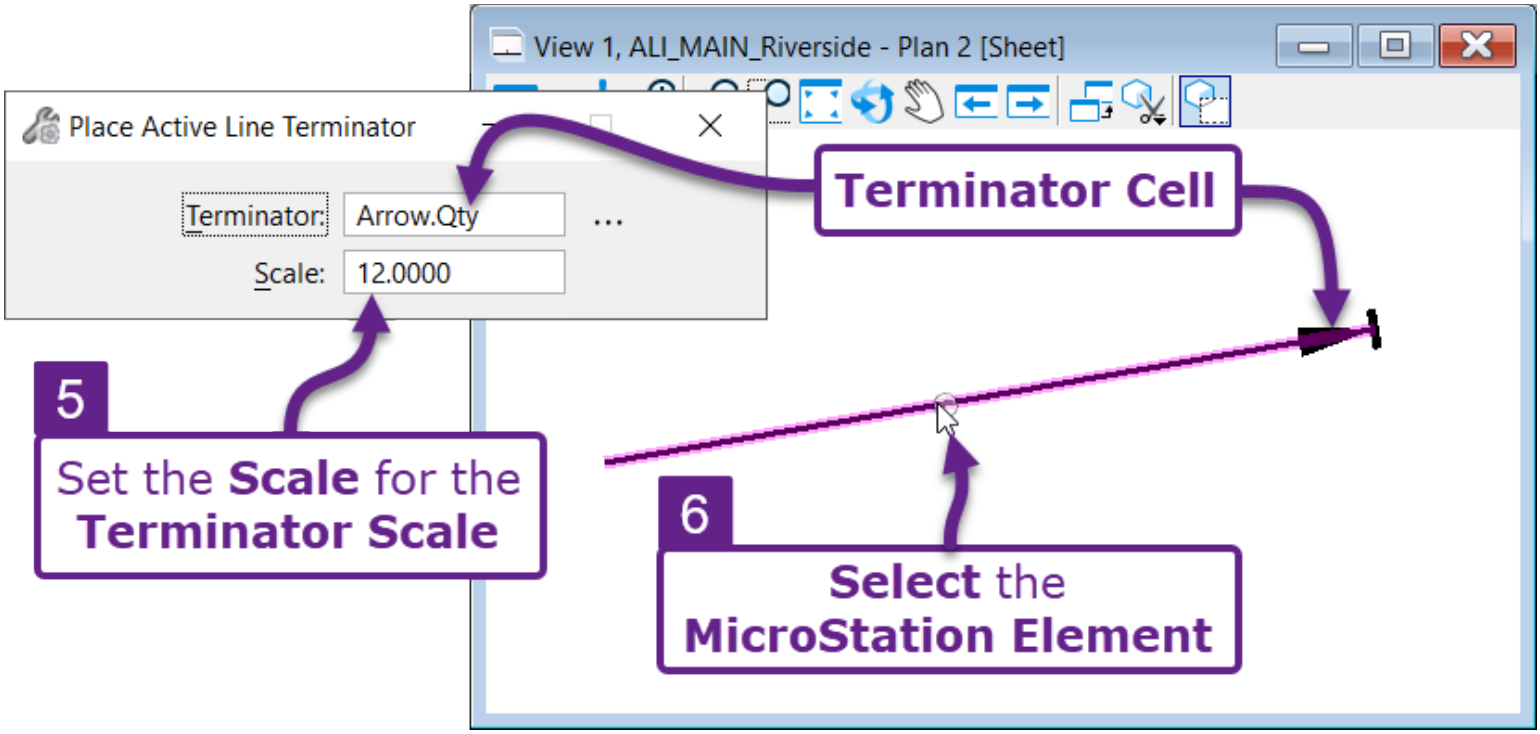


Alternatively, the name of a Cell is shown in the Properties box.

6D.5.f Place Active Line Terminator tool

Terminator Cells are placed at the end of a MicroStation element (i.e., Line, SmartLine, Arc, Complex Chain). In the example below, a Terminator Cell is placed at the end of a SmartLine element.





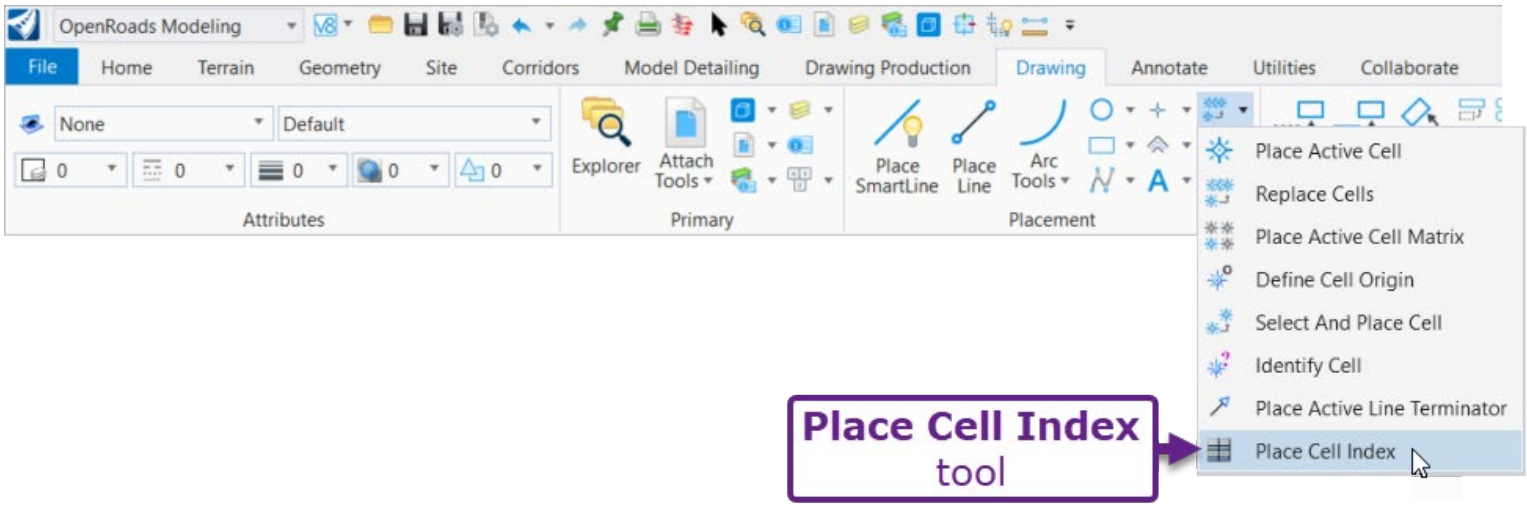
6D.5.g Place Cell Index tool

The purpose of this tool is to create a table that shows each Cell within the Cell Library ORD File. To create the table, the Cell Library ORD File (file extension = .cel) must be open. However, **opening a Cell Library ORD File is strongly discouraged** because there is an opportunity to damage and corrupt the Cell Library. Consult your Engineering Systems Manager before opening a Cell Library ORD File.

WARNING: **This tool should NOT be used under any circumstances**. There are no applicable for this tool for FLH projects

BACKGROUND INFORMATION: Within a Cell Library ORD File (.cel) each Cell is created in a dedicated *2D Design Model* space. Each Cell has it's own *2D Design Model*. This tool functions by arranging all Models in the current ORD File into a table.

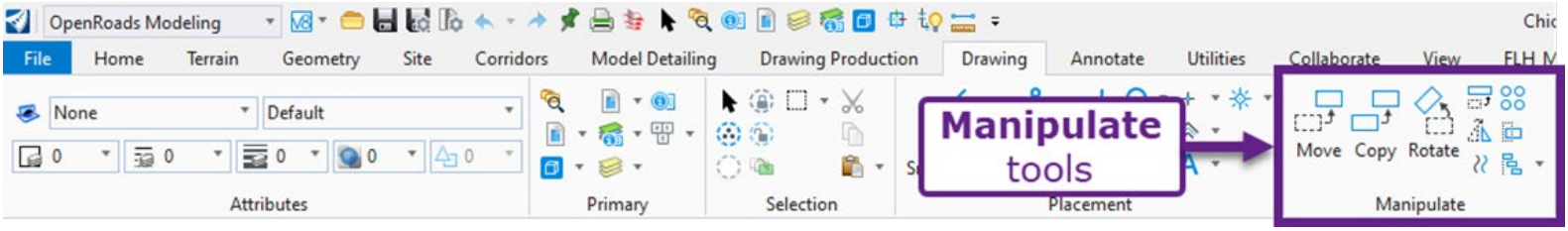
If this tool is used in a Design ORD File, then the graphics of each Model in the ORD File are arranged into a table.



6E – MANIPULATE TOOLS

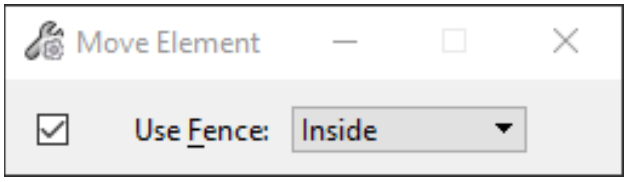
The tools found in the Manipulate group are used to edit or create copies of MicroStation Elements. Manipulate tools are found at two main locations in the Ribbon:

1. **OpenRoads Modeling** workflow → **Drawing** tab → **Manipulate** group
2. **Drawing** workflow → **Home** tab → **Manipulate** group



WARNING: Manipulate Tools are NOT compatible with ORD Elements. Use tools found in the Geometry tab to manipulate ORD Elements.

TIP: Most Manipulation Tools are compatible with an active Fence. If the *Use Fence* box is CHECKED, then all elements location within the active Fence will be selected for manipulation.



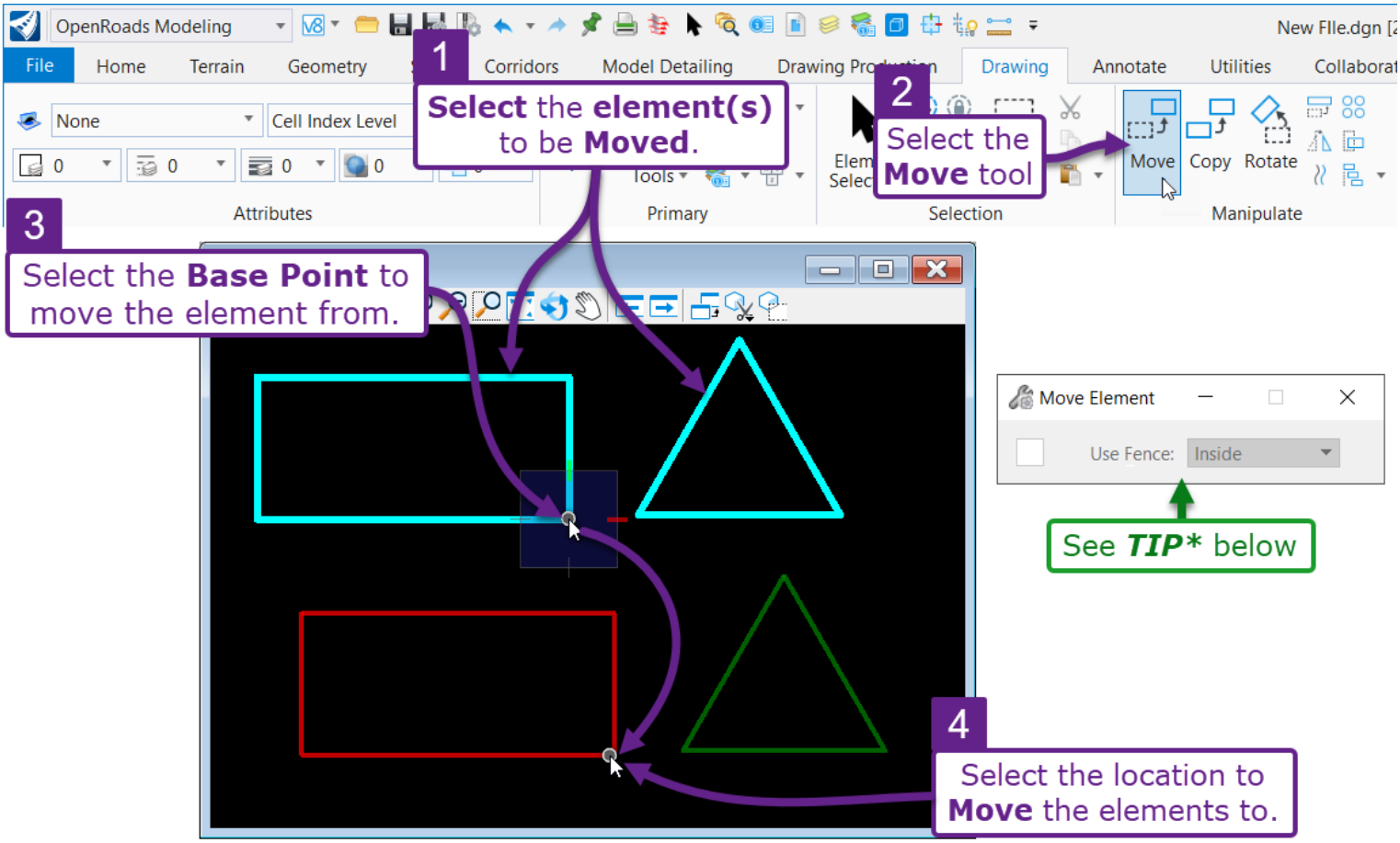
6E.1 Move tool

This tool is used to move MicroStation Elements.

WARNING: This tool is NOT compatible with ORD Elements, such as Horizontal ORD Lines, Vertical ORD Lines, Complex Elements, and Terrain Models. The *Transform* tool can be used to move ORD Elements. See *7E.5.a Transform*.

TIP: To move multiple elements at the same time, select the elements before executing the *Move* tool (hold down the CTRL key to select multiple elements). If there are no elements are selected when the *Move* tool is executed, then only a single element can be moved.

TIP: Instead of using the *Move* tool, a single element can be dragged to a new location by left-clicking and holding the left-click button. Release the left-click button when the element is shown in the desired location. The *Move* command must NOT be in operation to perform this procedure.



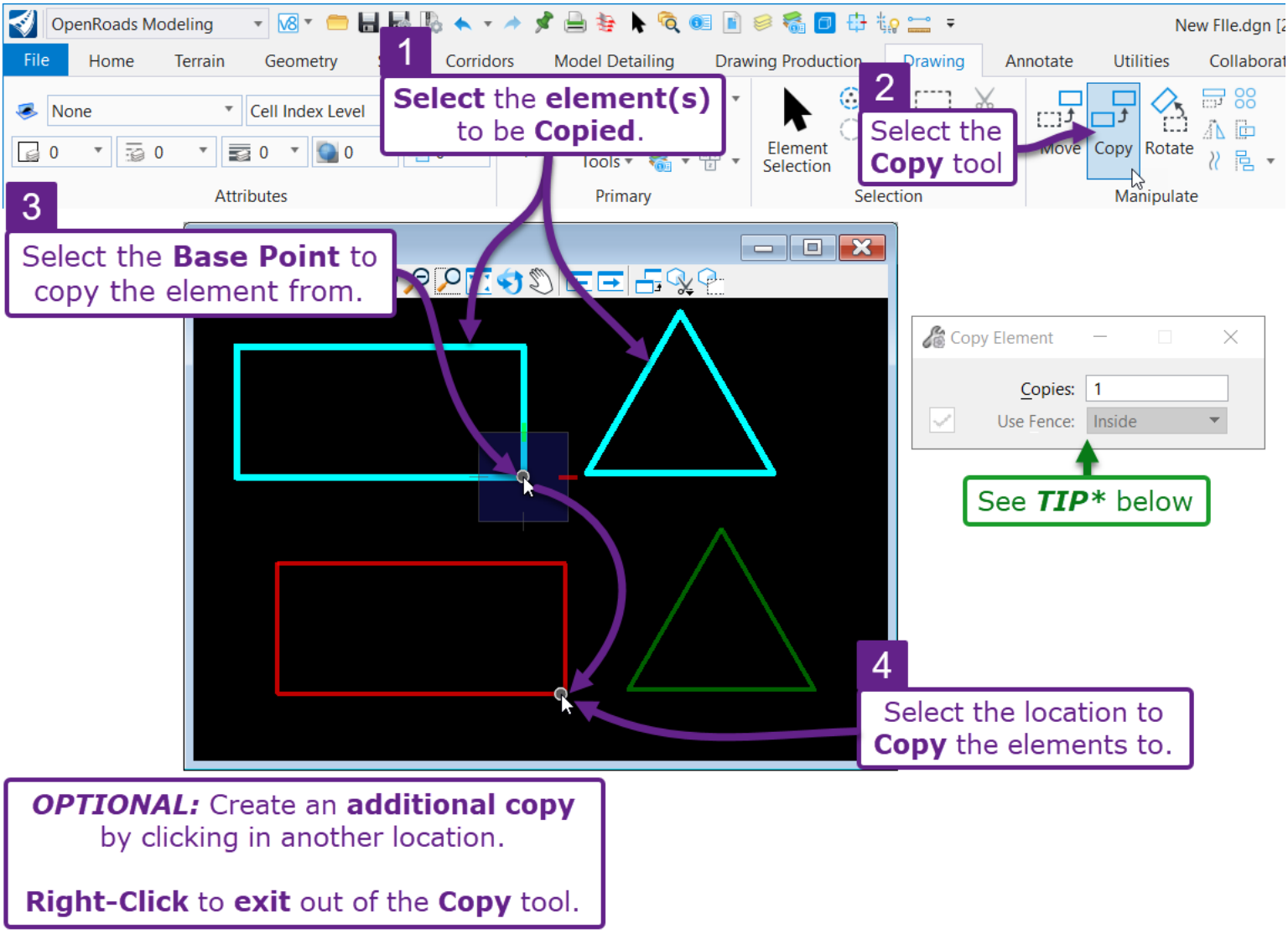
TIP*: Set a Fence and use the Dialogue Box to move all elements inside the Fence.

6E.2 Copy tool

This tool is used to create a copy of a MicroStation Element(s).

WARNING: This tool is NOT compatible with ORD Elements, such as Horizontal ORD Lines, Vertical ORD Lines, Complex Elements, and Terrain Models. The *Transform* tool can be used to copy ORD Elements. See *7E.5.a Transform*.

TIP: To copy multiple elements at the same time, select the elements before executing the *Copy* tool (hold down the CTRL key to select multiple elements). If there are no elements are selected when the *Copy* tool is executed, then only a single element can be copied.



TIP*: Set a Fence and use the Dialogue Box to copy all elements inside the Fence.

TIP*: Set the **Copies** value to create multiple, equal-spaced copies of the element.

6E.3 Rotate tool

This tool is used to rotate the angle of MicroStation Elements.

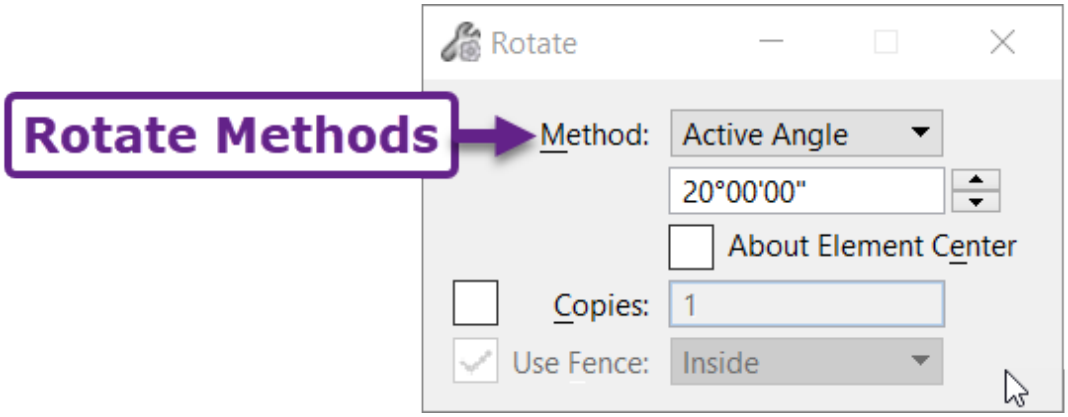
WARNING: This tool is NOT compatible with ORD Elements, such as Horizontal ORD Lines, Vertical ORD Lines, Complex Elements, and Terrain Models. The *Transform* tool can be used to rotate ORD Elements. See *7E.5.a Transform*.

TIP: To rotate multiple elements at the same time, select the elements before executing the *rotate* tool (hold down the CTRL key to select multiple elements). If there are no elements are selected when the *Rotate* tool is executed, then only a single element can be rotated.

This tool has three **Methods** for rotating elements**.**

Rotate Methods	
Method:	**Description:**
Active Angle	The amount the element(s) is rotated by the value set in the Active Angle box.
2 Points	The first point selected determines the base point for rotation. The second point determines the amount the elements are rotated.
3 Points	The first point selected determines the pivot point for rotation. The second point selected creates a vector between the first point. When the third point is selected, the vector is rotated to align with the first and third point.

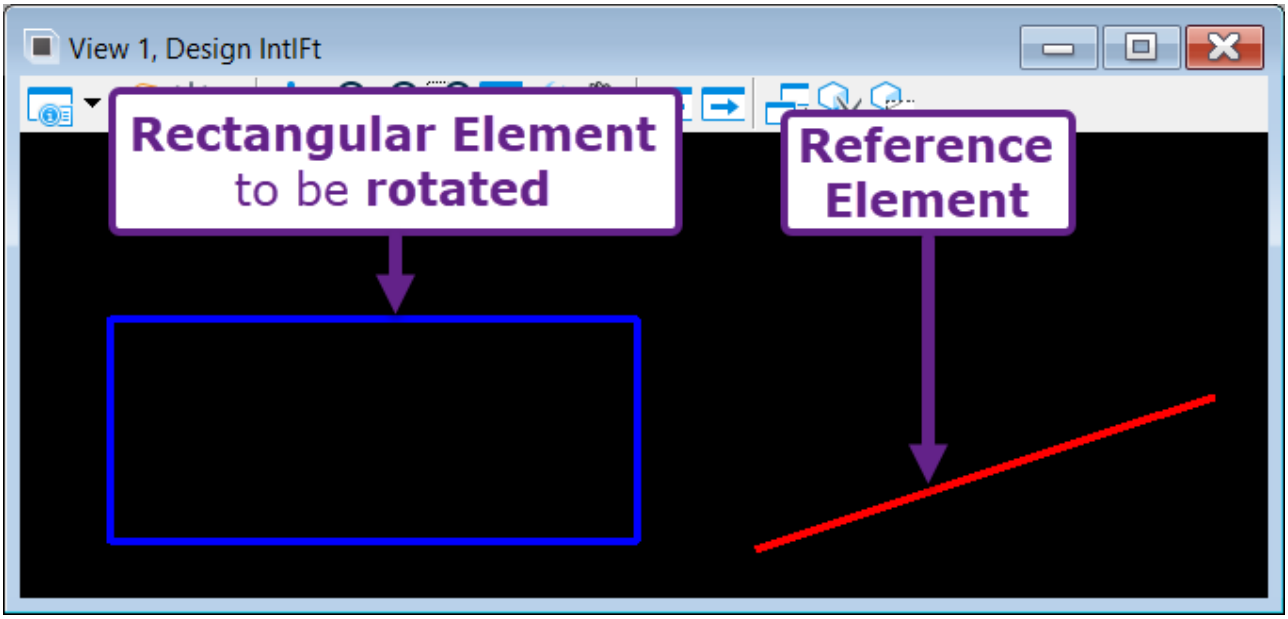
TIP: The **2 Points** and **3 Points** methods can be used to precisily rotate an element to the same angle as a reference element. This process invloves setting the AccuDraw Compass to to align with the reference element using AccuDraw Key-Ins. The **3 Point** method of rotation is shown on the next page.



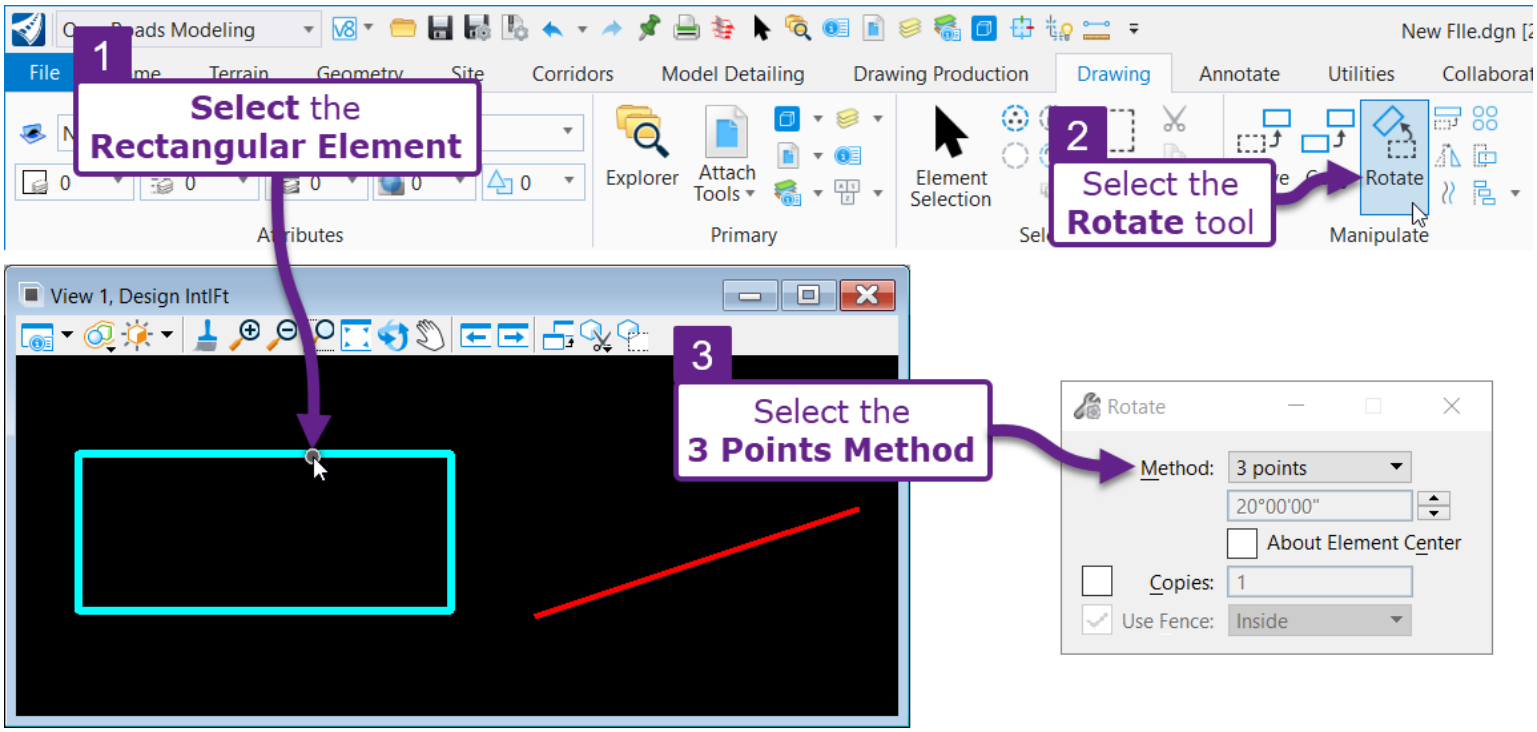
Rotate tool Dialogue Box Settings	
Method:	**Description:**
About Element Center	If this box is CHECKED, the centroid of the element is used as the rotation base point. ***TIP:*** CHECK this box to rotate multiple text elements without changing their position.
Copies	If this box is CHECKED and the Copies value is set to 1, then the selected element is copied and rotated. If this box is CHECKED and the value is set to above 1, then equal-spaced copies of the element are created.
Use Fence	If a Fence is set, then this box can be checked to rotate all elements inside of the Fence.

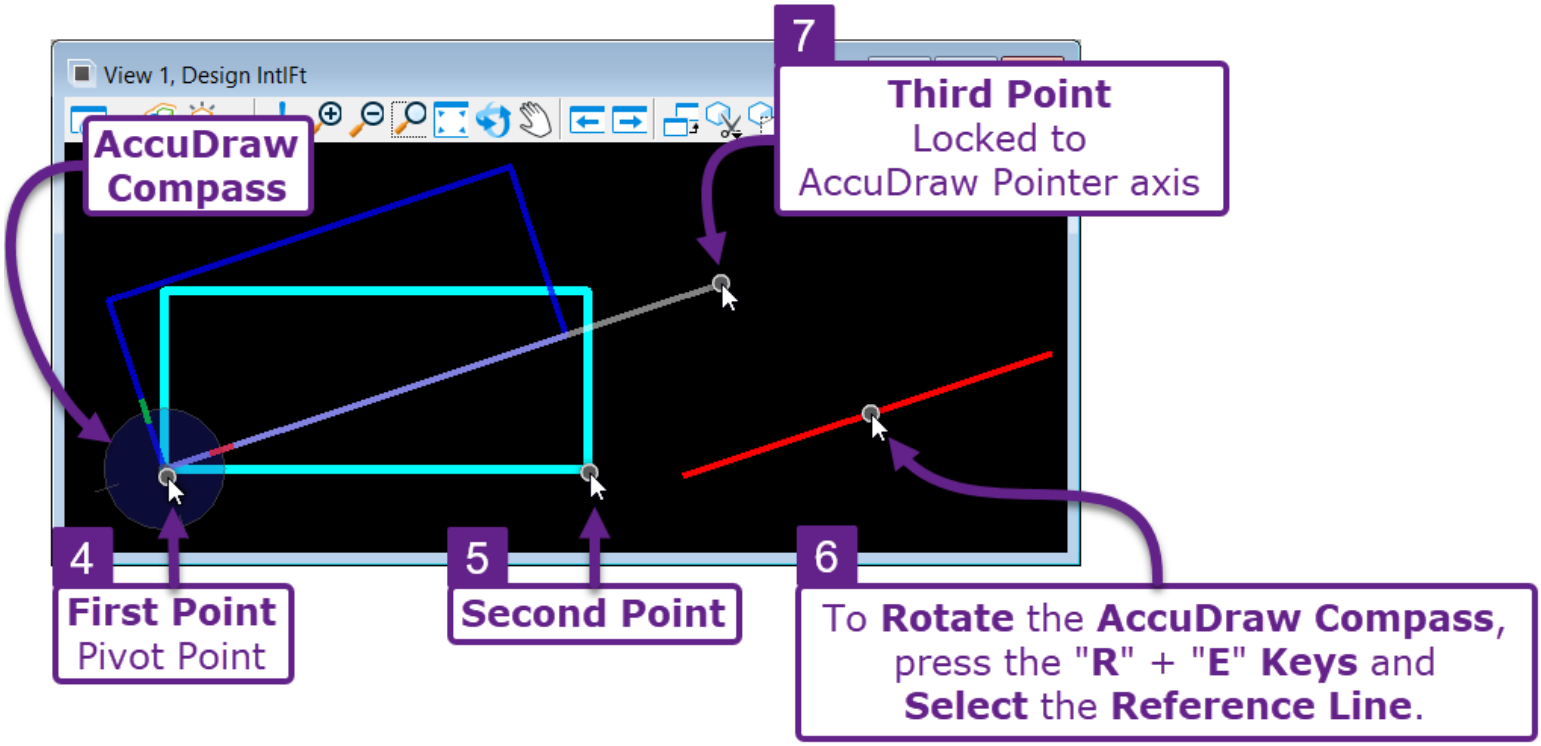
6E.3.a Rotate an Element using the 3 Point Method and AccuDraw

In this workflow, the **3 Point Method** is used to rotate the rectangular element to align with the reference line using AccuDraw. AccuDraw is discussed in *6B – AccuDraw*.



The procedure is as follows:

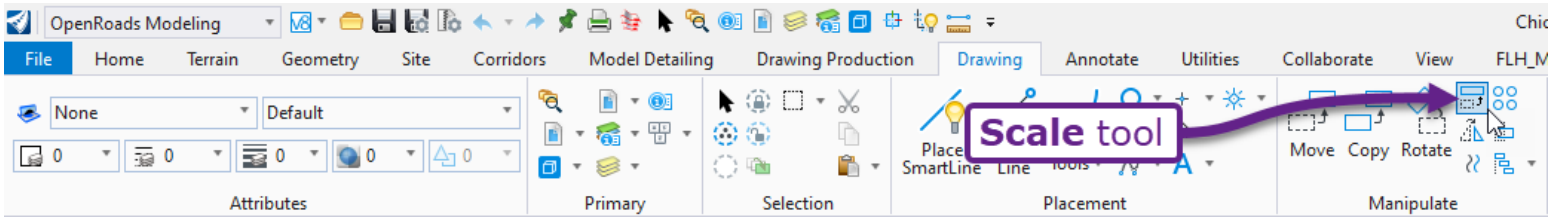




4	*Prompt: Enter pivot point (point to rotate about)* – In this case, the bottom-left corner of the rectangle is chosen as the pivot point.
5	*Prompt: Enter point to define start of rotation* – The bottom-right corner of the rectangle is chosen as the second point. A vector is established between the pivot point and the second point.
6	In this step, the *Rotate* tool is temporarily interrupted in order to rotate the AccuDraw Compass to align with the Reference Line. Press the "R" + "E" Key and then select the Reference Line. After the Reference Line is selected, the AccuDraw Compass is rotated, and the *Rotate* tool is re-engaged.
7	*Prompt: Enter point to define amount of rotation* - Place the mouse cursor along the AccuDraw Pointer axis. Left-Click when the mouse cursor snaps to the AccuDraw Pointer axis.

6E.4 Scale tool

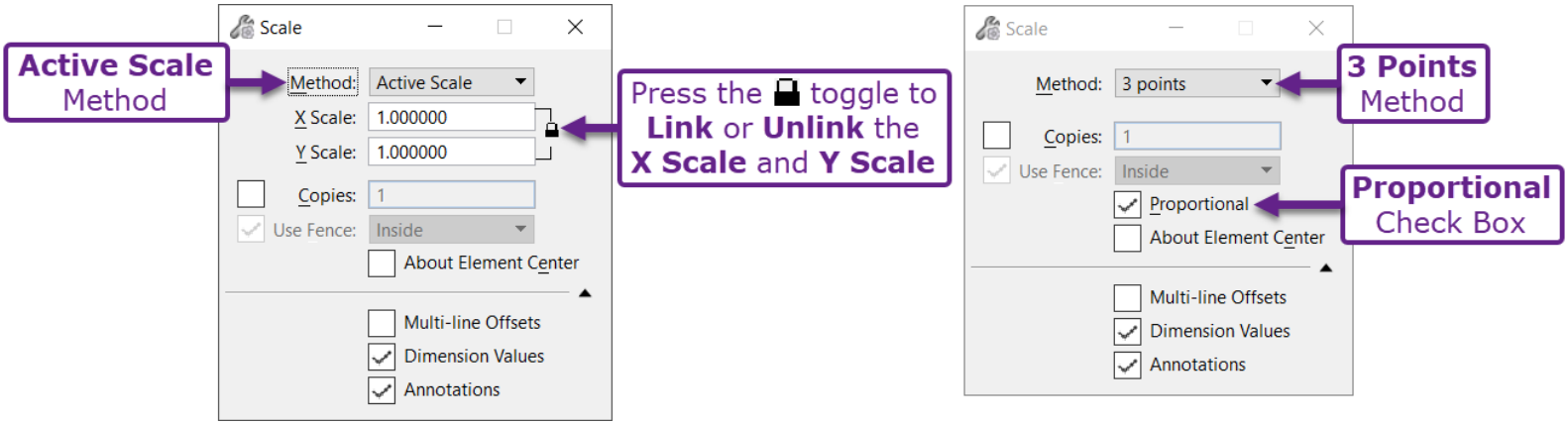
The *Scale* tool is used to increase or decrease the size of a MicroStation Element.



WARNING: This tool does NOT work with ORD Elements, such as Horizontal ORD Lines, Vertical ORD Lines, Complex Elements, and Terrain Models. The *Transform* tool can be used to scale ORD Elements. See *7E.5.a Transform*.

This tool has two **Methods** for scaling elements:

Scale Methods	
Method:	**Description:**
Active Scale	The element is scaled according to the factors shown in the **X Scale** and **Y Scale** boxes. ***NOTE:*** By default, the X-Scale and Y-Scale are linked. When linked, The X and Y-Scales are locked to the same value. Press the 🔒 button to UNLINK the X and Y-Scale values. Unlinking the X and Y-Scales allows element to be scaled disproportionately in the X and Y directions.
3 Points	The first point determines the origin point for scaling. The second point determines serves a handle for stretching or contracting the element about the origin point. The third point determines where how much the element is stretched or contracted. ***NOTE:*** The **Proportional** check box determines if the element is stretched/contracted proportionally. If UNCHECKED, then the element is only stretched/contracted along the axis determined by the first and second points. This method for rotation is demonstrated in *6E.4.a Scale an Element using the 3 Point Method and AccuDraw*.

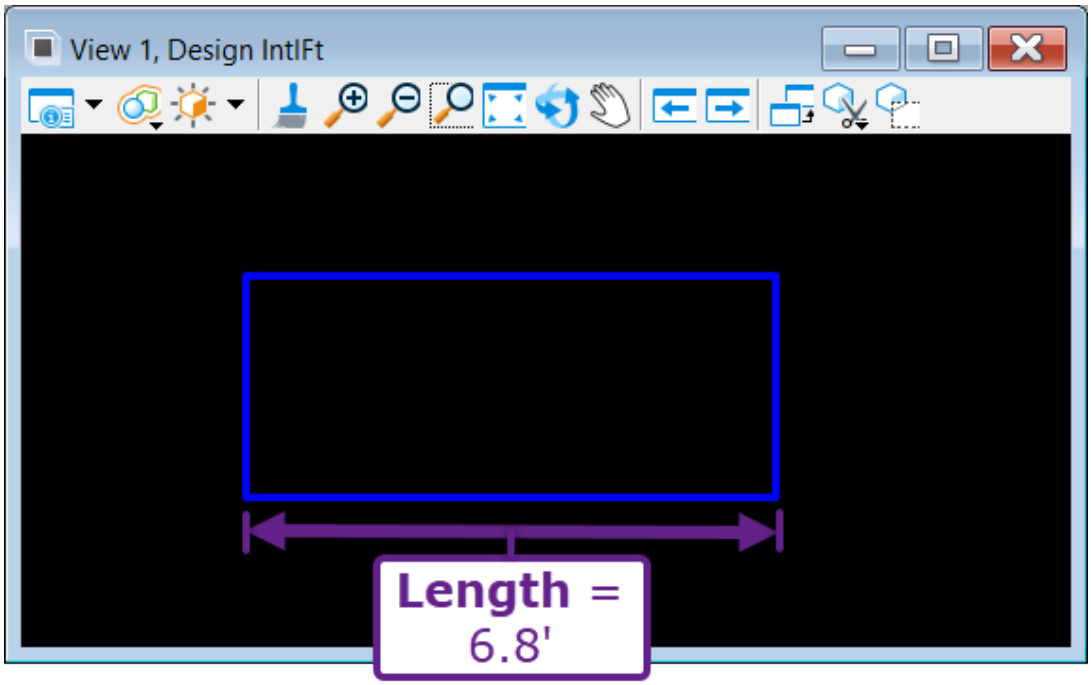


Scale Dialogue Box Settings	
Setting:	**Description:**
Copies	If this box is CHECKED and the Copies value is set to 1, then the selected element is copied and scaled. If this box is CHECKED and the value is set to above 1, then copies of the element are created. Each copy is scaled by two times the scale factor of the last copy.
Use Fence	If an active Fence is set, then this box can be checked to scale all elements inside of the Fence.
Proportional	This option is ONLY shown if the **3 Points** method is selected. If CHECKED, then the element is scaled is proportionately. If UNCHECKED, then the element is only scaled along the axis determined by the first and second points.
About Element Center	If CHECKED, the centroid of the element is used as the scale origin point. ***TIP:*** CHECK this box to scale an element without changing its position.
Multi-Line Offsets	This option is ONLY relevant when scaling Multi-Line elements – which are created with the *Place Multi-Line* tool. If CHECKED, then the offset distance between Multi-Line elements is scaled. If UNCHECKED, then the offset distance does NOT change during the scaling operation.
Dimension Values	This option is only relevant when a Dimension element is selected. If CHECKED, then the measured value is automatically adjusted as the Dimension element is stretched/contracted. If UNCHECKED, then the Dimension element is stretched/contracted, but the measured value remains unchanged.
Annotations	This option is only relevant when an Annotation element is selected. If CHECKED, Annotation elements included in the selection set are scaled. If UNCHECKED, then Annotation elements are unaffected by the scaling operation.

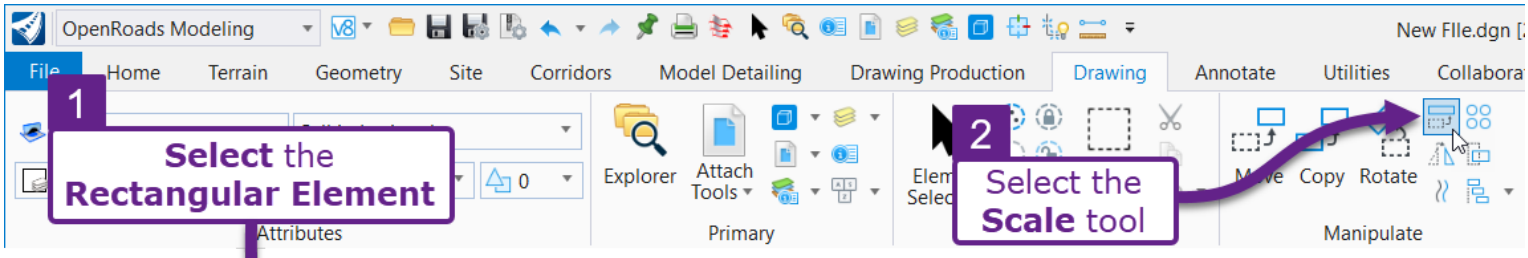
6E.4.a Scale an Element using the 3 Point Method and AccuDraw

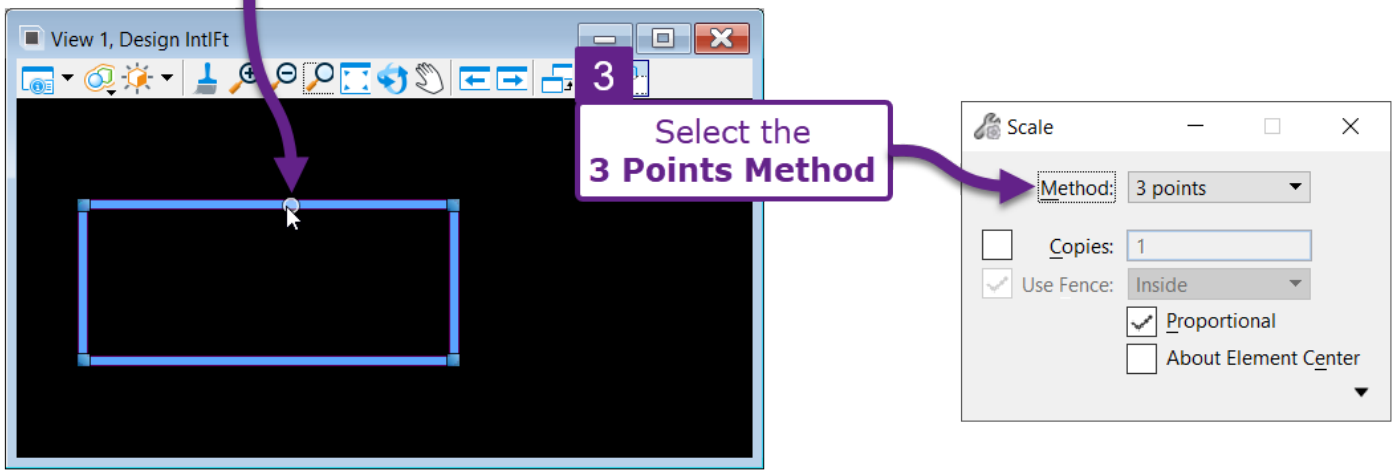
In this workflow, the **3 Point Method** is used to scale the rectangular element to have an exact bottom side length of 10'. The original length of the bottom side is 6.8'.

This workflow utilizes the AccuDraw Toolbox, which is discussed in *6B – AccuDraw*.

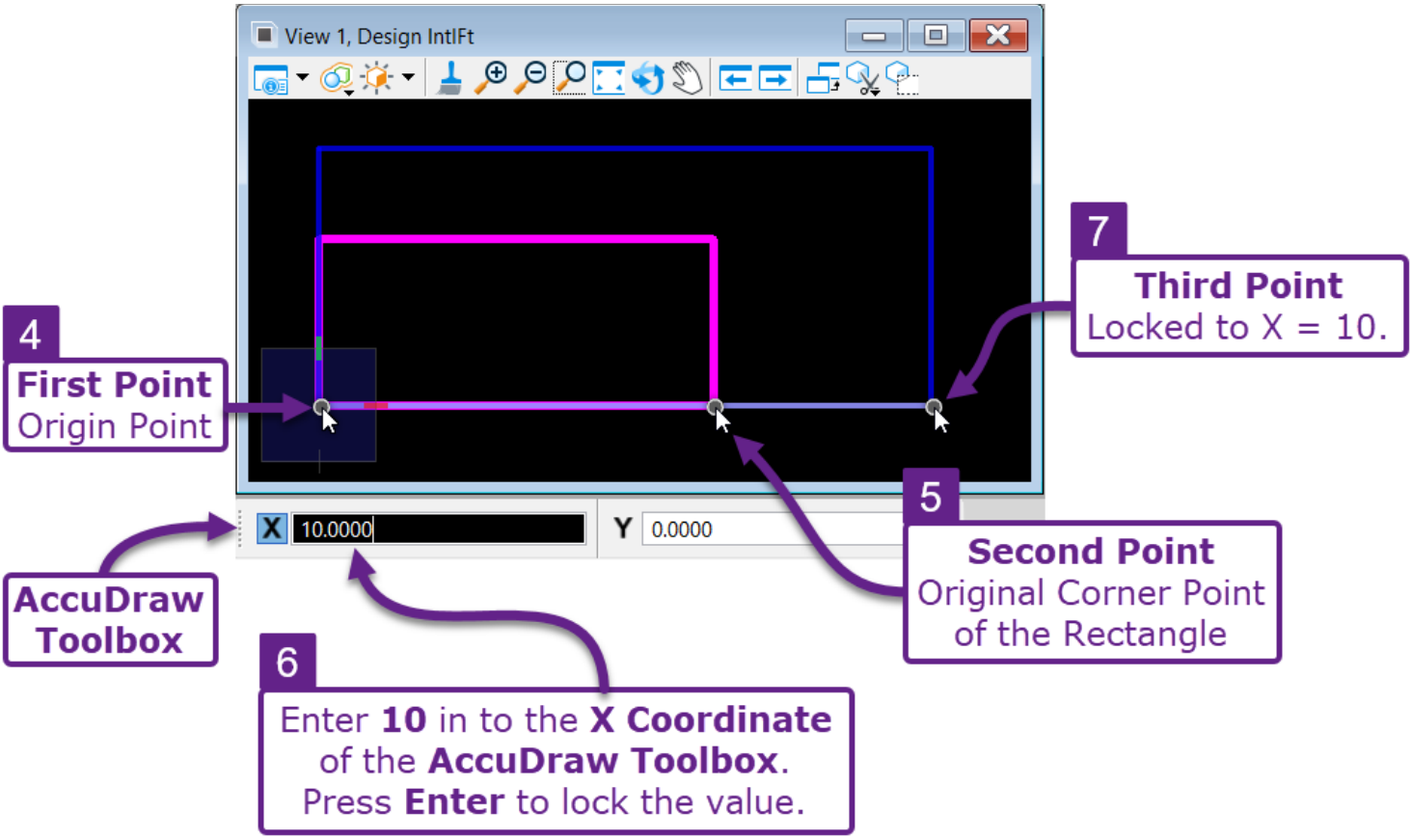


The procedure is as follows:





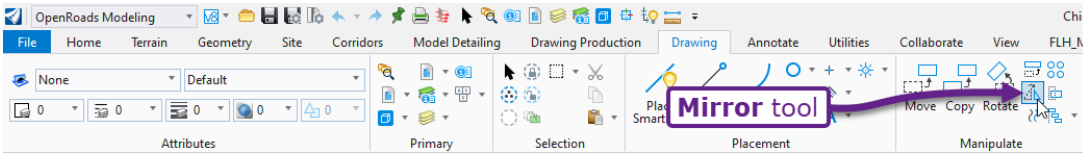
NOTE: If the **Proportional** box is UNCHECKED, then the height of the rectangular element will be unaffected by the scaling operation.

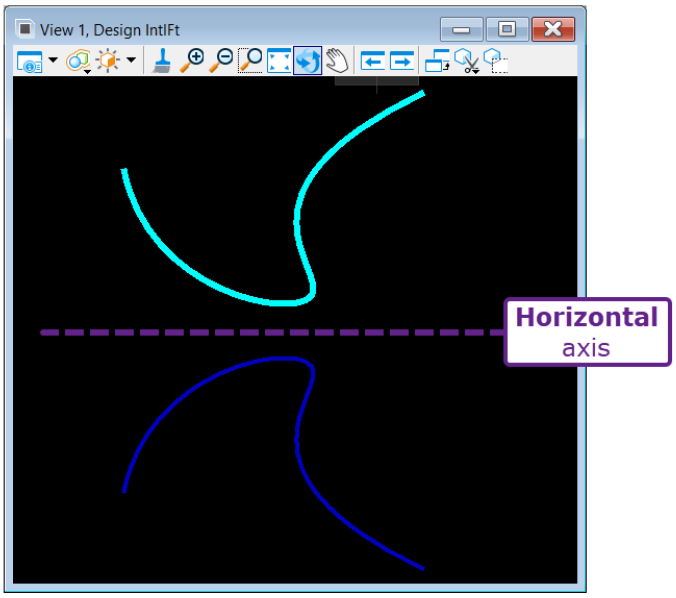


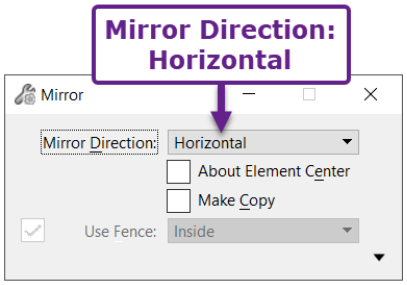
4	*Prompt: Enter origin point (point to scale about)* – In this case, the bottom-left corner of the rectangle is chosen as the origin point.
5	*Prompt: Enter reference point* – The bottom-right corner of the rectangle is chosen as the second point. The rectangle will be stretched from this second point to the third point.
6	In this step, the *Scale* tool is temporarily interrupted in order enter the desired X Coordinate length in the AccuDraw Toolbox. With the X Coordinate Box active (highlighted in black), key-in a value of 10 and press the Enter key. ***NOTE:*** If the X Coordinate Box is NOT active, the press the Tab key to switch between the Y Coordinate and X Coordinate.
7	*Prompt: Enter point to define amount of scaling* - With the X Coordinate locked, left-click to accept the scaling of the rectangular element.

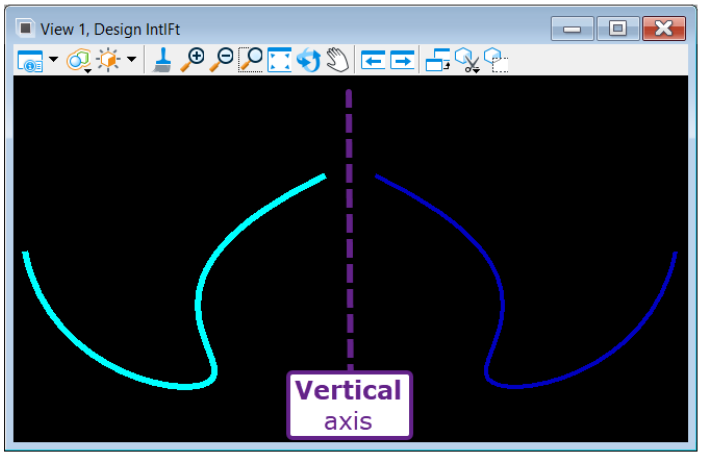
6E.5 Mirror tool

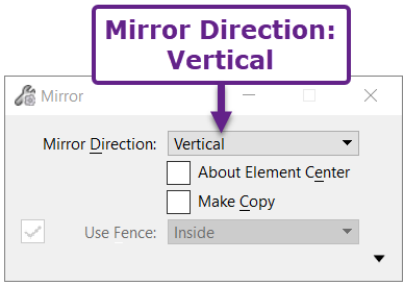
The *Mirror* tool is used to flip the orientation of the selected elements over the horizontal, vertical, or a custom line axis.

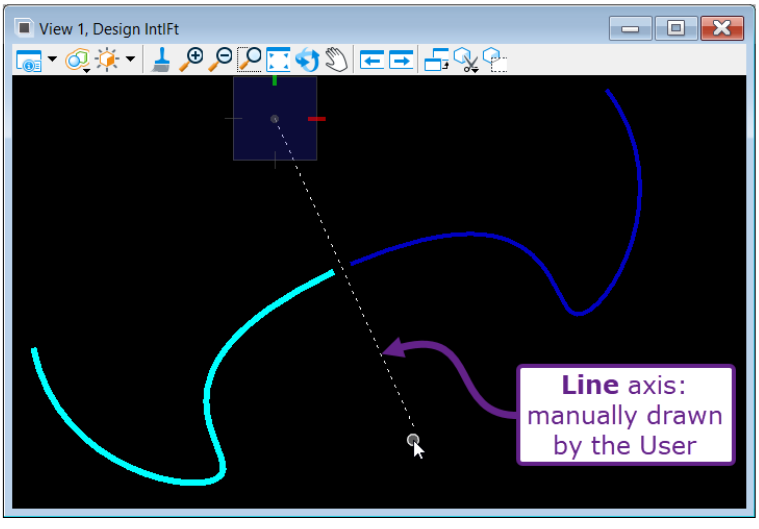


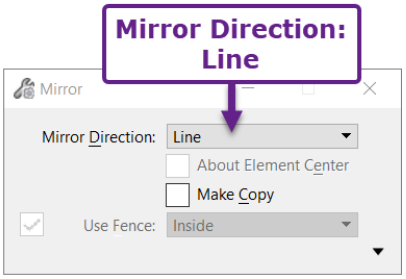


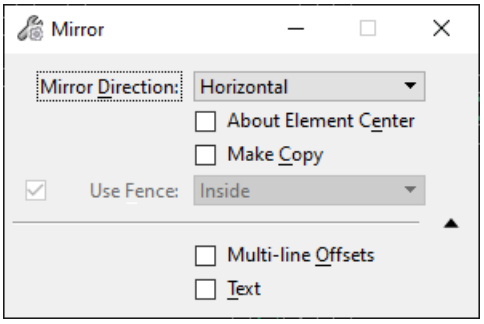








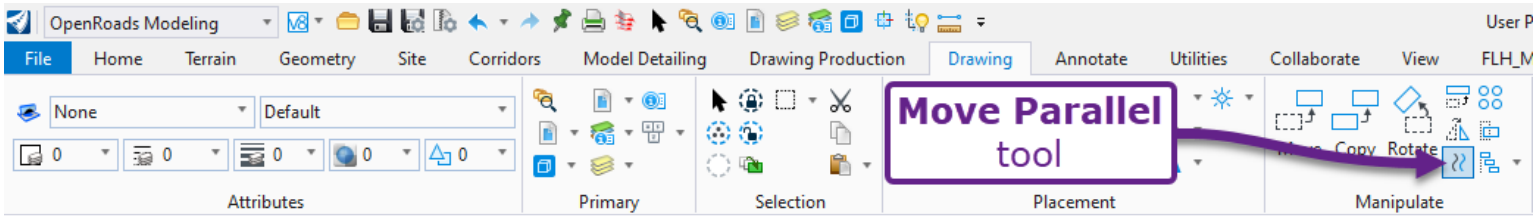




Mirror Dialogue Box Settings	
Setting:	**Description:**
Mirror Direction: Horizontal	The selected element(s) is flipped over the horizontal axis.
Mirror Direction: Vertical	The selected element(s) is flipped over the vertical axis.
Mirror Direction: Line	The selected element(s) is flipped over a User-drawn axis.
About Element Center	If CHECKED, the centroid of the element is used as the Mirror origin point. The selected element is Mirrored in place.
Copies	If CHECKED, the original element is preserved, and a mirrored copy is created. If UNCHECKED, then the original element is repositioned/mirrored, and a Copy is NOT created.
Use Fence	If CHECKED, all elements within the active Fence are selected for the Mirror operation.
Multi-Line Offsets	This option is ONLY relevant when mirroring Multi-Line elements – which are created with the *Place Multi-Line* tool. If CHECKED, then the offset distance between Multi-Line elements is scaled. If UNCHECKED, then the offset distance does NOT change during the scaling operation.
Text	This option is only relevant when Text elements are included in the Mirror selection set. If CHECKED, Text elements are mirrored and reversed. A reversed Text element will read backwards or upside-down. If UNCHECKED, then Text elements are mirrored to the opposite side of the specified axis. However, the text will NOT read backwards or upside down.

6E.6 Move Parallel tool

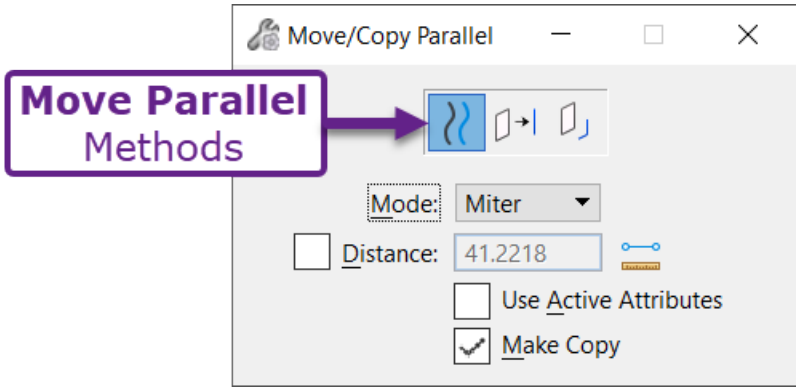
The *Move Parallel* tool is used to create an offset of an element.



WARNING: This tool is NOT compatible with ORD Elements, such as Horizontal ORD Lines, Vertical ORD Lines, and Complex Elements. The *Offset and Taper* tools can be used to copy ORD Elements. See *7D.3 Offsets and Tapers*.

This tool has three **Methods** for offsetting elements:

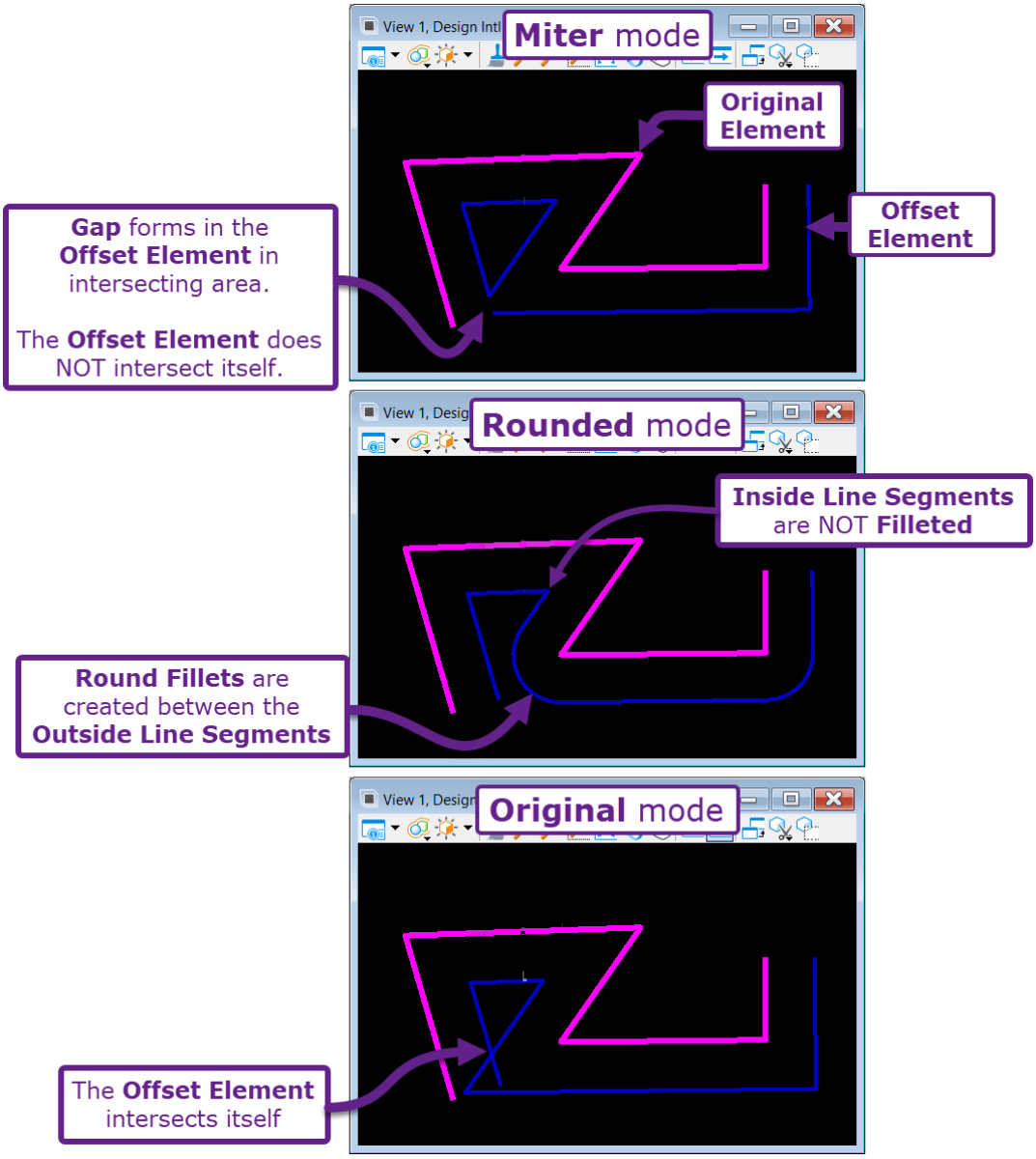
Move Parallel Methods	
Method:	**Description:**
Element	The entire element is offset.
Segment of Element	This method ONLY applies to Line String, Complex Chains, and elements that contain multiple geometric segments. When this method is used, only the segment that is clicked on is offset.
Portion of Element	The User is prompted to select a portion of the element to be offset. The selected portion may include multiple segments and/or a fraction of a segment.



Move Parallel Box Settings	
Setting:	**Description:**
Mode: Miter	This mode does NOT allow the resulting, offset element to overlap with itself.
Mode: Round	When this mode is used on two connected line segments, a round fillet is formed between the resulting, offset lines. ***NOTE:*** Round Fillets are ONLY created for inside line segments.
Mode: Original	This mode does allow the resulting, offset element to overlap with itself.
Distance	If this box is CHECKED, then the element will be offset by the value shown. Type in the desired offset distance into this box.

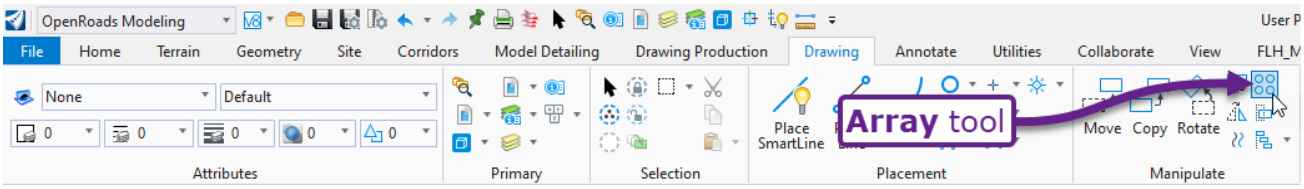
Move Parallel Box Settings	
Setting:	**Description:**
Use Active Attributes	If this box is CHECKED, then the resulting, offset element will use the currently Active Level and symbology attributes. If this box is UNCHECKED, then resulting element will be assigned the same Level and symbology attributes as the original element.
Make Copy	If this box is UNCHECKED, then the original element will be deleted after the *Move Parallel* tool is used. If CHECKED, then the original element is retained (NOT deleted).

The graphic below shows how the different **Modes** affect the resulting, offset element.



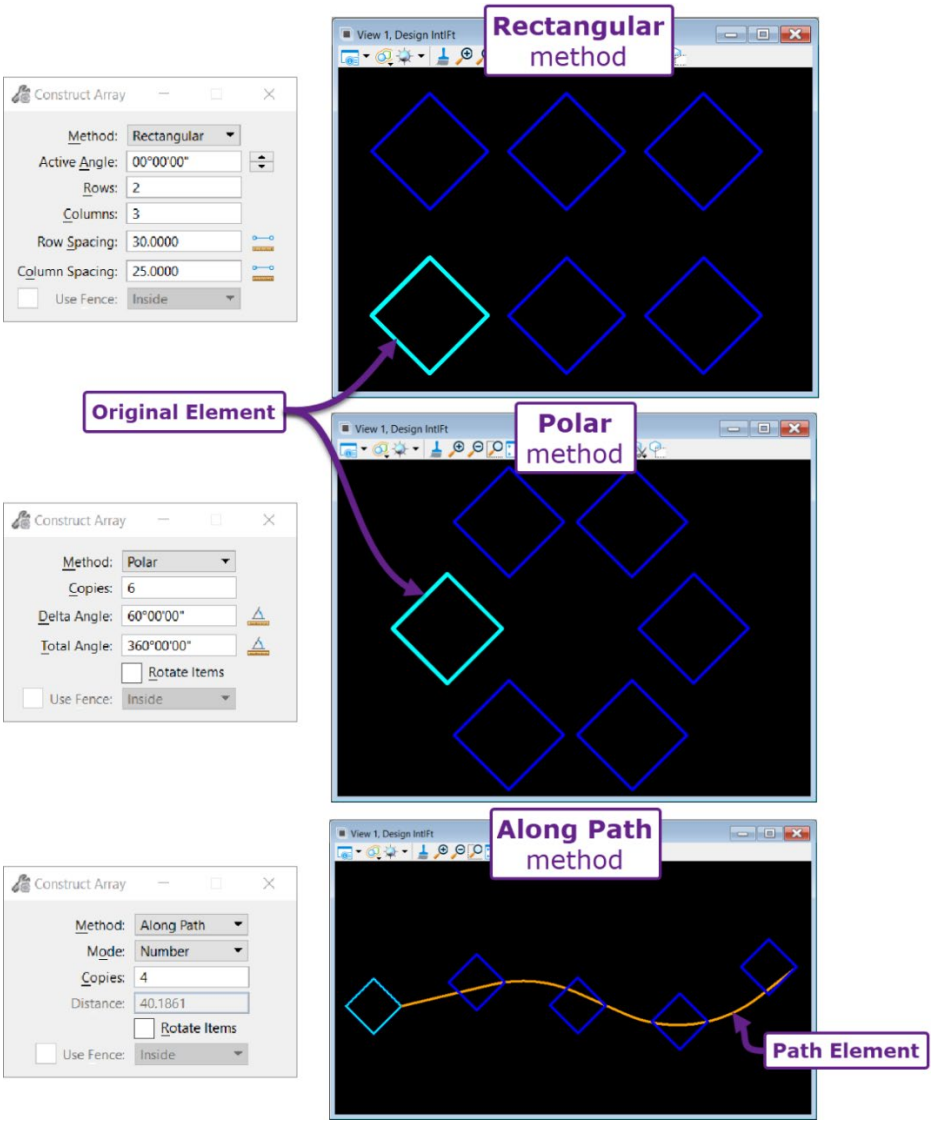
6E.7 Array tool

The *Array* tool is used to make multiple copies of an element and arrange the copies into a rectangular or circular (polar) pattern. Also, this tool can be used to make equal distance copies along the length of a path element.



This tool has three **Methods** for copying and arranging an element**.**

Array Methods	
Method:	**Description:**
Rectangular	The selected element is copied and the copies are arranged into a rectangular grid.
Polar	The selected element is copied. Together, the original element and copies are arranged into a circular formation.
Along Path	The selected element is copied and the copies are placed equal distance along the length of a path element.



Each Method shows a different set of settings in the Dialogue Box:

Rectangular Method Dialogue Box Settings	
Setting:	**Description:**
Active Angle	Determines the rotational orientation of the Rows and Columns that form the Array grid.
Rows	Determines how many Rows the Array grid will contain.
Columns	Determines how many Columns the Array grid will contain.
Row Spacing	Determines the distance between rows that form the grid. ***NOTE:*** The spacing for Row and Column Spacing is measured from the point location where the element is clicked on.
Column Spacing	Determines the distance between columns that form the grid.

Polar Method Dialogue Box Settings	
Setting:	**Description:**
Copies	Determines how many elements are used in the final Polar array. ***NOTE:*** The original element is included in the Copies value. If the Copies value is set to 6, then the original element and 5 additional copies will form the Polar array.
Delta Angle	Determines the deflection angle between each element in the Polar array.
Total Angle	Determines the deflection angle for the entire array. ***NOTE:*** The number of Copies multiplied by the Delta Angle must equal to the Total Angle. If the Total Angle is manually set, then Delta Angle will automatically adjust.
Rotate Items	If CHECKED, then the element is rotated by the value set in the Delta Angle box. If UNCHECKED, then the elements are NOT rotated when formed into a Polar array.

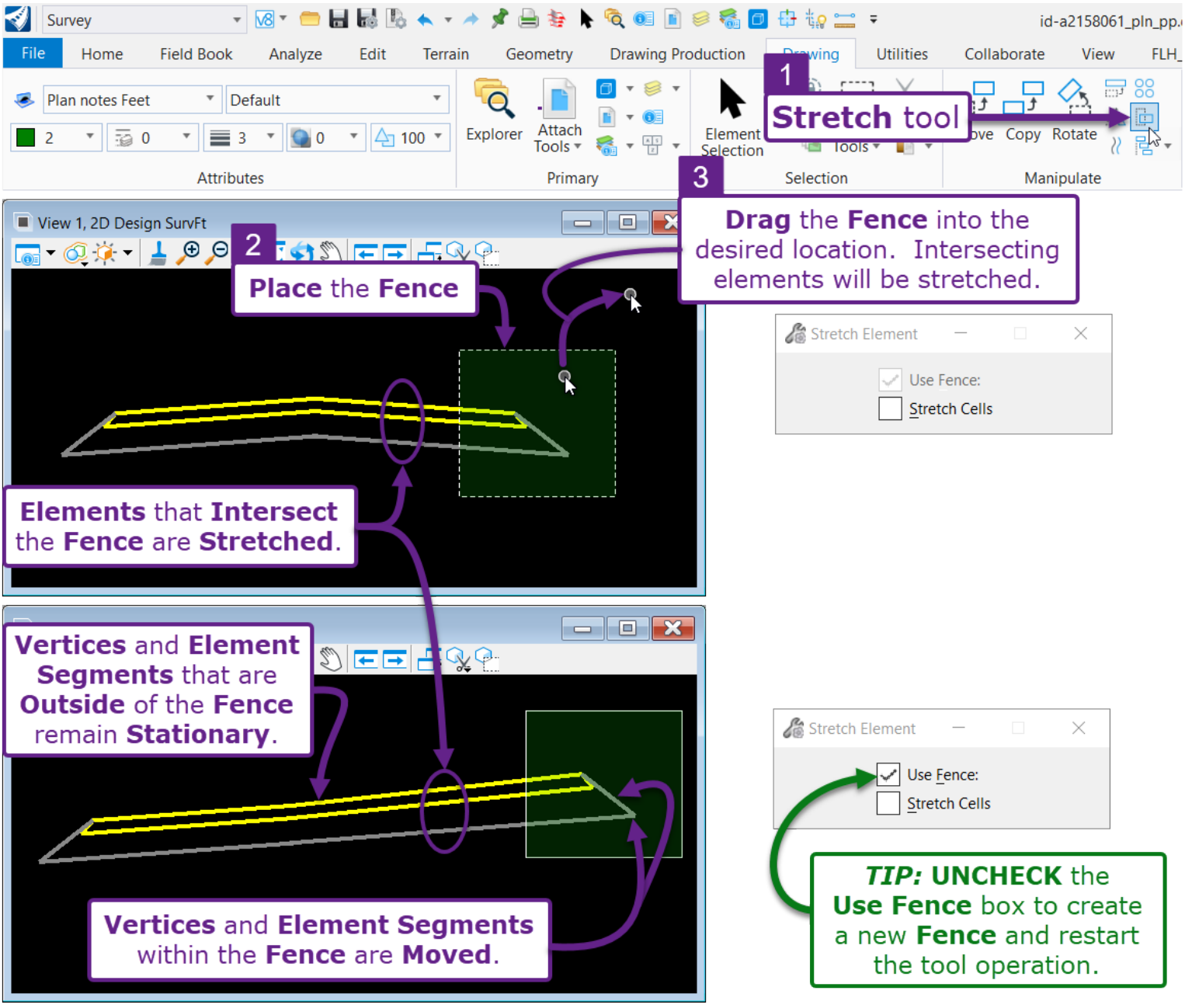
Along Path Method Dialogue Box Settings	
Setting:	**Description:**
Mode: Number	With this Mode, the number of elements (copies) is set and the array elements are automatically placed in equally-spacing along the path element.
Mode: Distance	With this Mode, the distance between array elements is specified. The distance between array elements is measured along the lineal length of the path element.
Mode: Both	With this Mode, both the number of elements (copies) and the distance between elements is specified.
Copies	Determines how many elements are used in the final array. ***NOTE:*** The original element is included in the Copies value. If the Copies value is set to 6, then the original element and 5 additional copies will form the Along Path array.
Distance	Sets the distance between each element in the Along Path array.

6E.8 Stretch tool

This tool is used to stretch or contract the length of element(s).

The element(s) to be stretch are selected by placing a Fence. The element vertices that are NOT within the Fence will remain stationary. Element vertices within the Fence are moved as the Fence is dragged to a new location. If an element or a segment is fully circumscribed by the Fence, then it won't be stretched, only moved.

NOTE: The *Stretch* tool prompts the User to create the Fence. Alternatively, the *Place Fence* tool can be used to create a Fence prior to the operation of this tool.

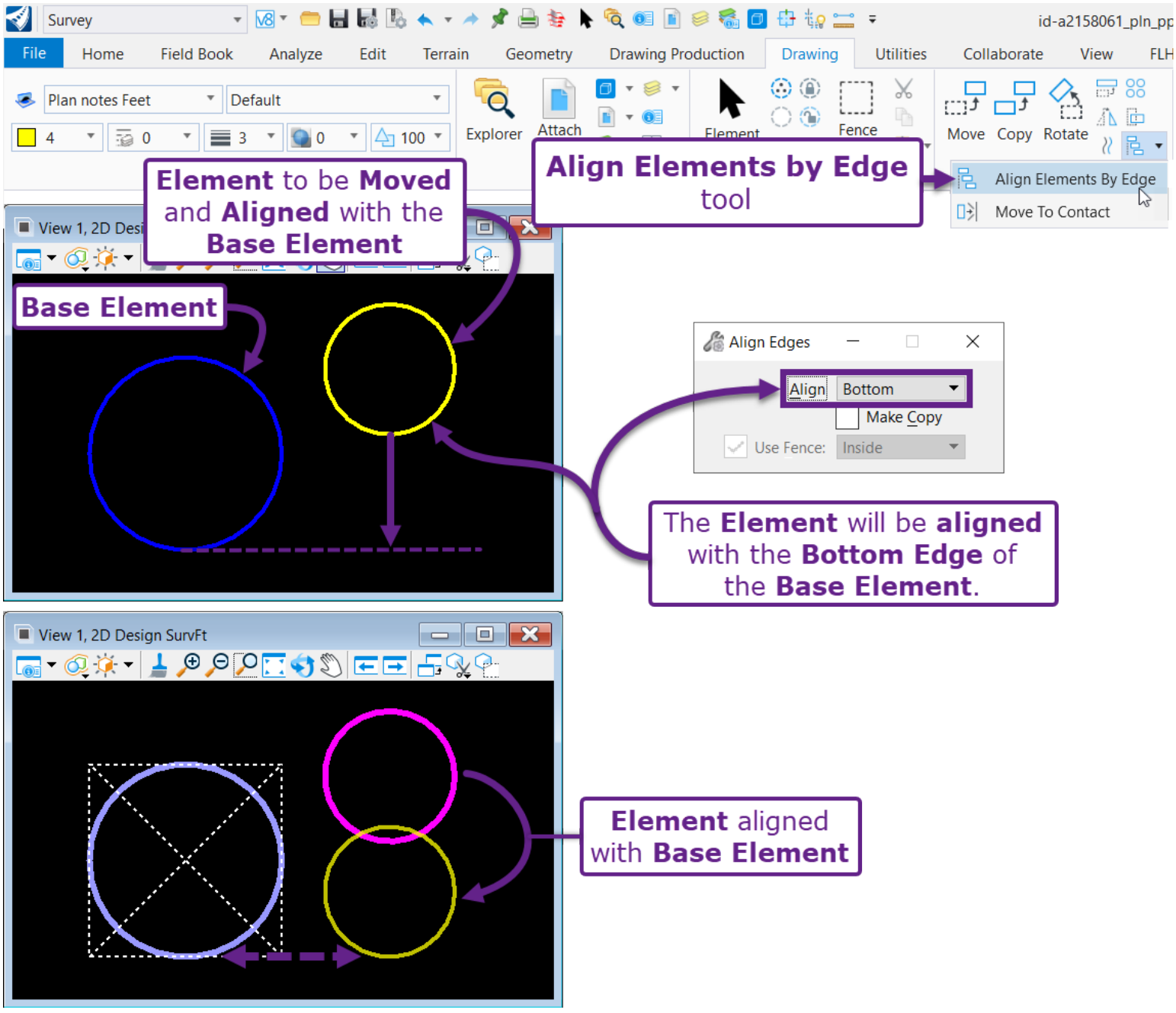


Stretch Tool Dialogue Box Settings	
Setting:	**Description:**
Use Fence	This option will be greyed out if an *Active Fence* is NOT set when the tool is executed. If CHECKED, then the previously-placed *Active Fence* is used to determine which lines and vertices are stretched. If UNCHECKED, then a new *Active Fence* is placed to determine which elements are stretched.
Stretch Cells	If CHECKED, then Cells within the Fence limits are stretched. If UNCHECKED, this tool has no effect on Cells.

6E.9 Align Elements by Edge tool

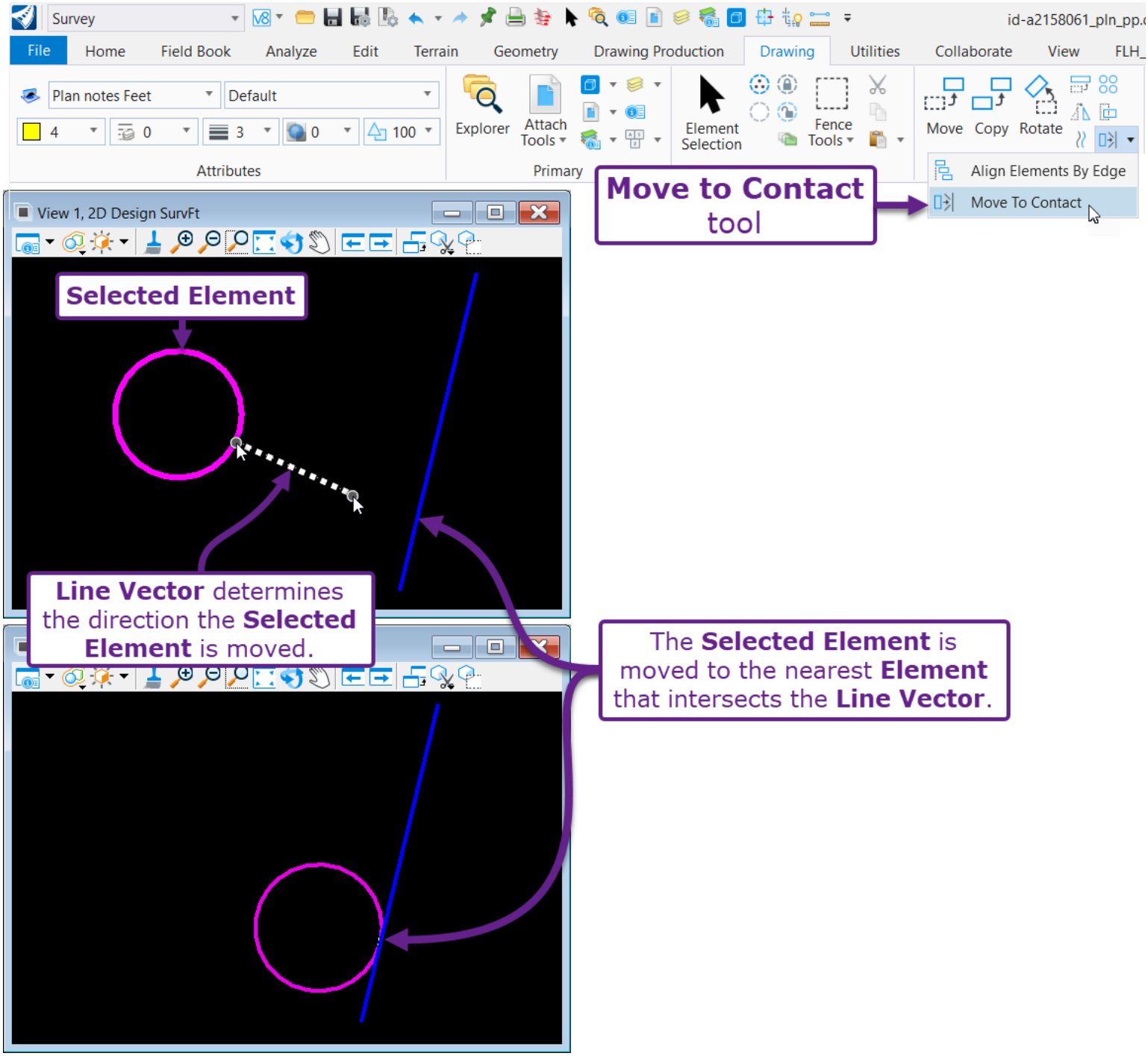
This tool is used to align an Element with the edge of a Base Element. In the example shown below, the yellow circle element is moved to align with the bottom edge of the blue circle element (base element).

Align Elements by Edge Dialogue Box Settings	
Setting:	**Description:**
Align	Specifies which edge of the Base Element is used for alignment. The Edge options available include: Top, Bottom, Left, Right, Horizontal Center, Vertical Center, Both Centers.
Make Copy	If CHECKED, then the selected element is copied. The copy is aligned with the Base Element. The original element remains stationary.



6E.10 Move to Contact tool

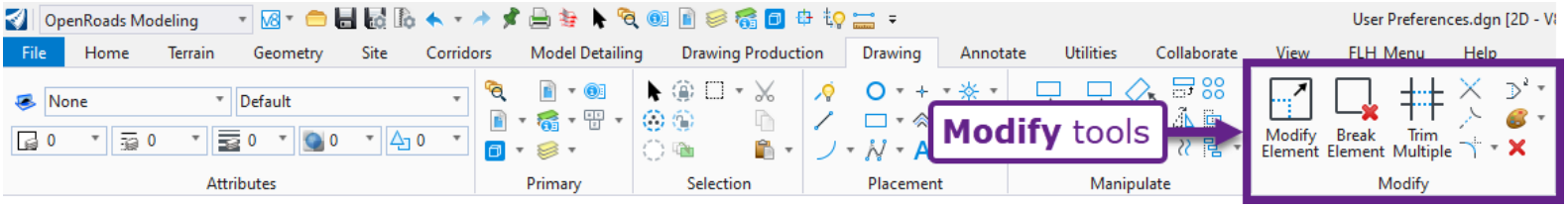
This tool will automatically move the selected element to the nearest contact point with another element. After an element is selected, a line is drawn. The selected element is moved along the vector direction of the line. The selected element is moved to contact the closest element that intersects the line vector.



6F – MODIFY TOOLS

The tools found in the Modify group are used to modify, trim, break, or change the Level/Attributes of MicroStation Elements. Modify tools are found at two main locations in the Ribbon:

1. **OpenRoads Modeling** workflow → **Drawing** tab → **Modify** group
2. **Drawing** workflow → **Home** tab → **Modify** group



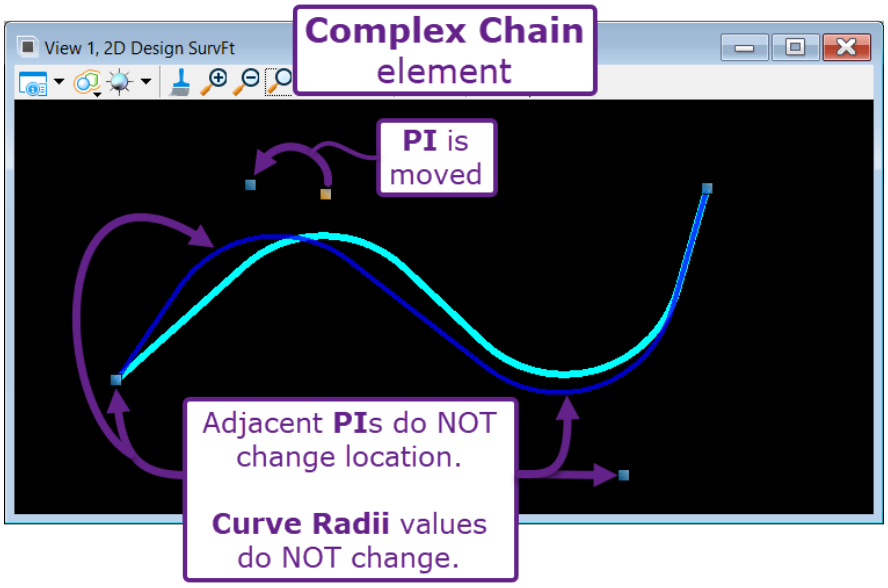
WARNING: Manipulate Tools are NOT compatible with ORD Elements. Use tools found in the Geometry tab to modify ORD Elements.

6F.1 Modify Element tool

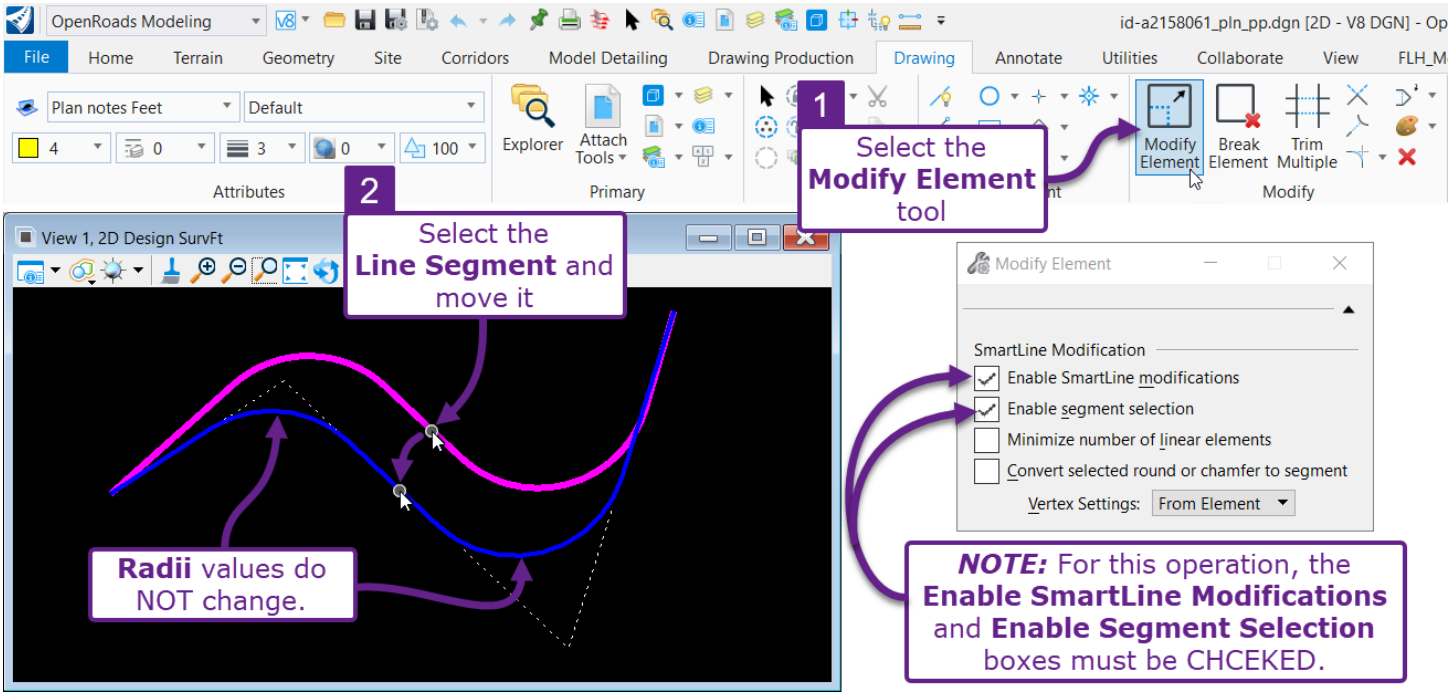
The *Modify Element* tool has a variety of different uses and functionality, primarily pertaining to editing Smart Lines, Complex Chains, and Complex Shape element types. This tool behaves differently, depending on the type of element segment that is selected.

> ***TIP:*** The *Modify Element* tool also contains functionality for editing the position of text within Dimension elements. See *15B.3.g Reposition the Text String and Leader for a Dimension Element* and *15B.3.h Reposition (Move Up or Down) the Dimension Line*.

When a Complex Chain element is directly selected, grip-edit handles are shown at the PI locations. The PI locations can be moved with the grip-edit handles. When a PI is moved, the radius of the corresponding does NOT change. Moving vertices/PIs is the ONLY editing operation available by directly selecting a Complex Chain element.



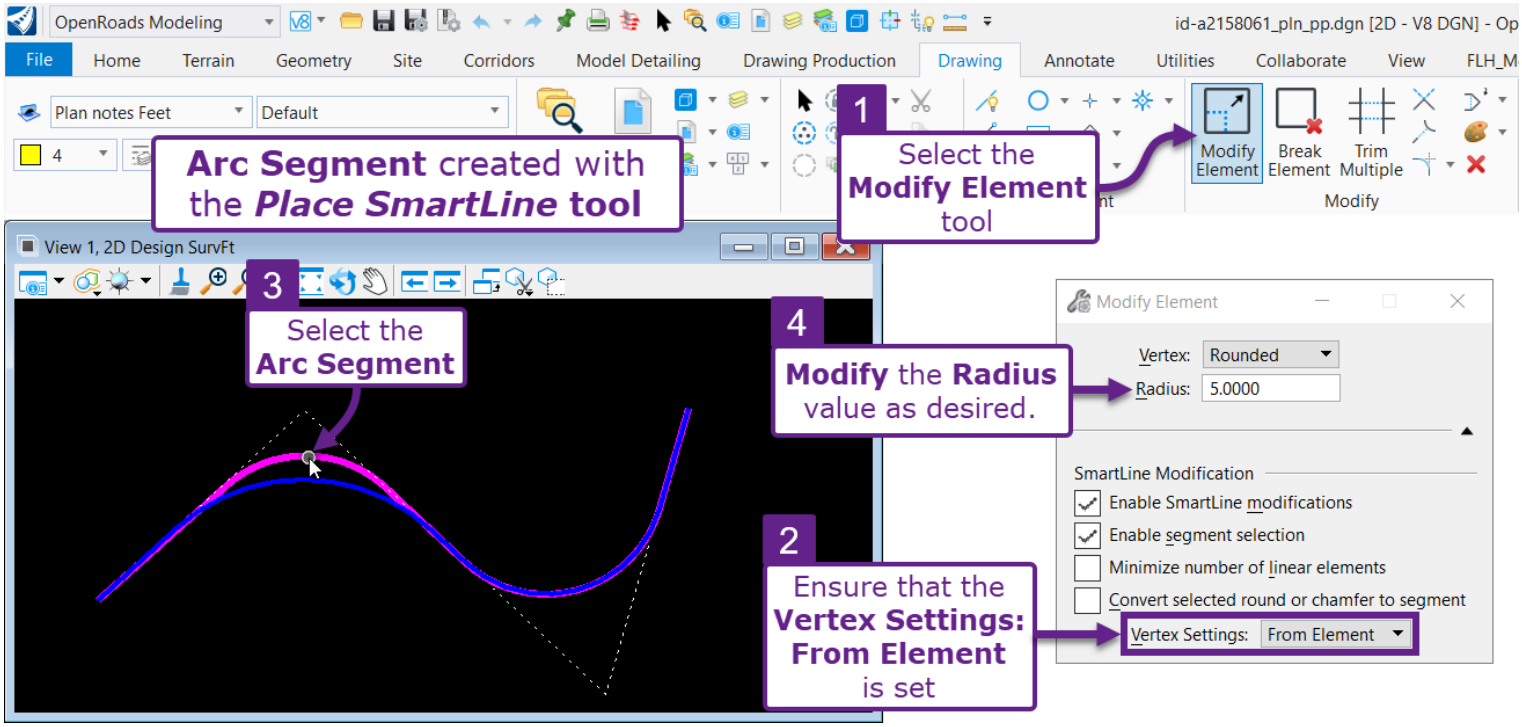
The *Modify Element* tool provides additional editing operations, such as changing the radius of a curve and moving an interior line segment in a parallel manner (shown below).



If an Arc segment is selected with the *Modify Element* tool, then the Dialogue Box options differ depending on how the Arc was created.

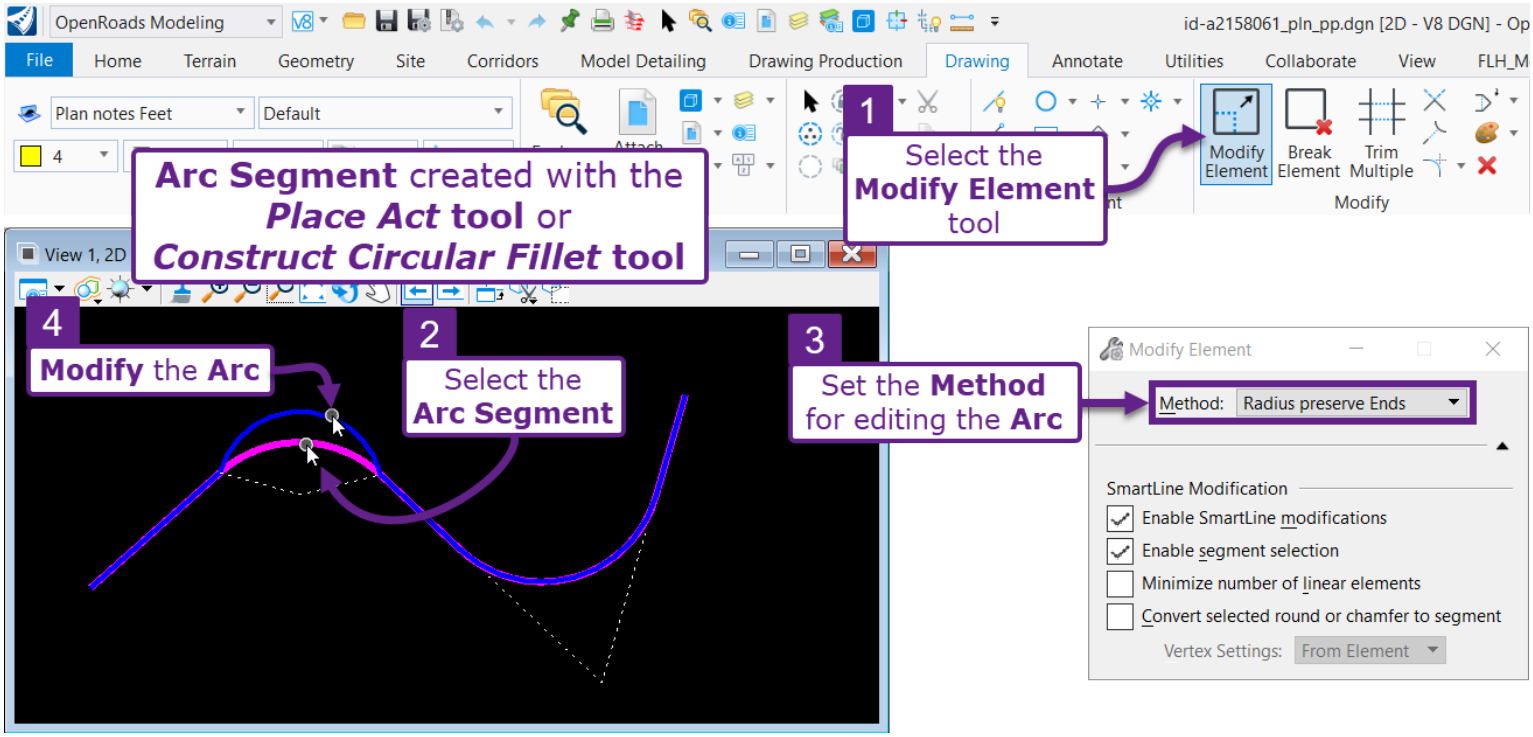
If the Arc Segment was created using the *Place SmartLine* tool, then the options below are shown.

TIP: Using the *Place SmartLine* tool, an Arc Segment is created by setting the Vertex mode to **Rounded**.



Additionally, the **Vertex** of the SmartLine can be changed by switching from Rounded, Chamfer, or Sharp.

If the Arc segment was created with the *Place Arc* tool or the *Construct Circular Fillet* tool, then the options below are shown:



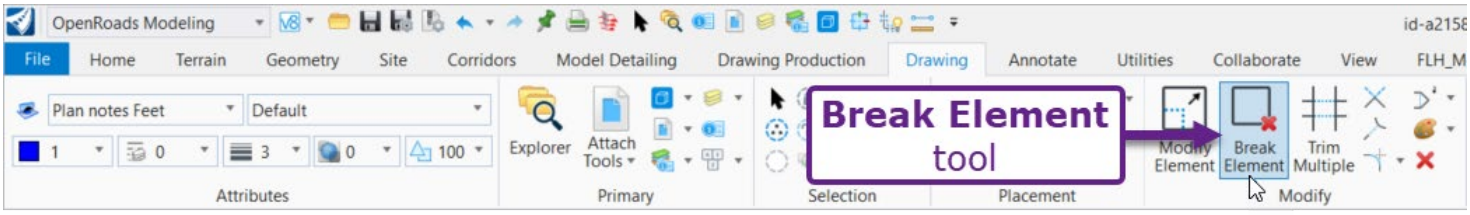
NOTE: If the Arc segment was created with the *Place Arc* tool or *Construct Circular Fillet* tool, then it is NOT possible to change the radius and maintain tangency with the adjacent Line segments.

Arc Modification Methods	
Method:	**Description:**
Move Entire Arc	The position of the Arc segment is moved. The adjacent Line segments are moved to keep the element continuous. However, the adjacent Line segments will NOT maintain tangency with the Arc segment. The Radius of the Arc is NOT changed.
Angle	The length of the Arc segment is lengthened or shortened. The adjacent Line segment will NOT maintain tangency with the Arc segment.
Radius about Center	The radius of the Arc segment is expanded/contracted about the current center point of the Arc segment. The adjacent Line segments are moved to keep the element continuous. However, the adjacent Line segments will NOT maintain tangency with the Arc segment.
Radius Preserve Ends	The radius of the Arc segment is expanded/contracted. The center point of the Arc Segment is moved so that the adjacent end points of the Line segments do NOT move.

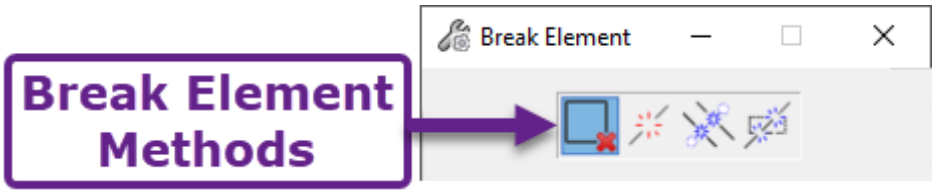
Modify Element Dialogue Box Settings	
Setting:	**Description:**
Enable SmartLine Modifications	If CHECKED, modification to the vertices and segments of SmartLine and Complex Chain elements affect the adjacent segments/vertices. If UNCHECKED, vertices and segments are modified on an individual basis. ***NOTE:*** To activate the remaining *Modify Element* settings, this box must be CHECKED.
Enable segment selection	If CHECKED, individual segments and vertices within the SmartLine or Complex Chain element are editable. If UNCHECKED, ONLY the vertices within the element may be edited.
Minimize number of linear elements	If CHECKED, the software attempts to reduce the number of line segments in a Complex Chain or Complex Shape. If this box is CHECKED, and the element contains adjacent Line elements segments, then the Line element segments are combined into a Line String segment.
Convert selected round or chamfer to segment	If CHECKED, then a Chamfer or Round vertex of a SmartLine is converted into a Line or an Arc element, respectively. As shown in previous examples, Arcs and Lines behave differently than SmartLine vertices when edited with the *Modify Element* tool.
Vertex Settings: From Element	Applies to the editing of SmartLine vertices. The settings configuration of the selected SmartLine vertex (i.e., Round, Radius Value) is shown in the Dialogue Box when the vertex is selected.
Vertex Settings: Last Used	The vertex settings last used with the *Place SmartLine* tool is shown in the Dialogue Box when a vertex is selected.

6F.2 Break Element tool

The *Break Element* tool is used to split an element into two or more separate elements.

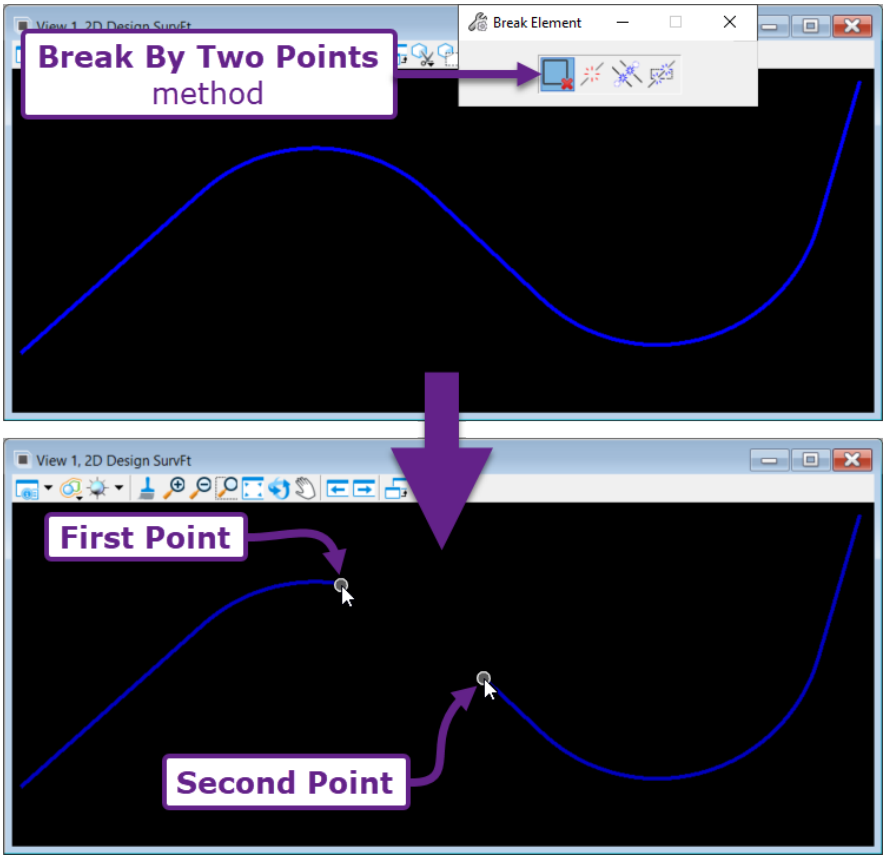


This tool has four **Methods** for splitting an element**:**

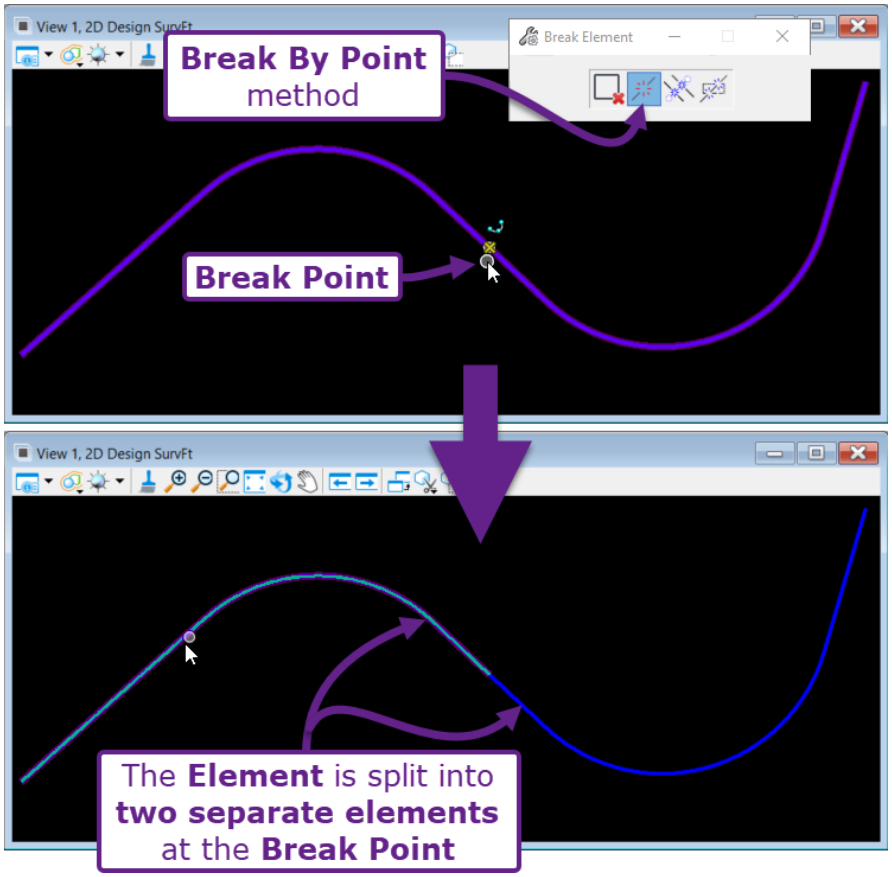


Break Element Methods		
Method:		**Description:**
Break By Two Points		This tool creates a gap in the selected element. The first click determines the start of the gap. The second click determines the end of the gap.
Break By Point		This tool splits a single element into two separate elements by clicking on a specified split location. There is NO gap shown between the resulting, split elements.
Break By Drag Line		The User is prompted to create a drag line. Elements that cross the drag line are split at the drag line intersection point. There is NO gap shown between the resulting, split elements.
Break By Elements		To use this method, two elements that intersect must be selected. The first selected element is used to split the second selected element. The split occurs at the intersection between the elements.

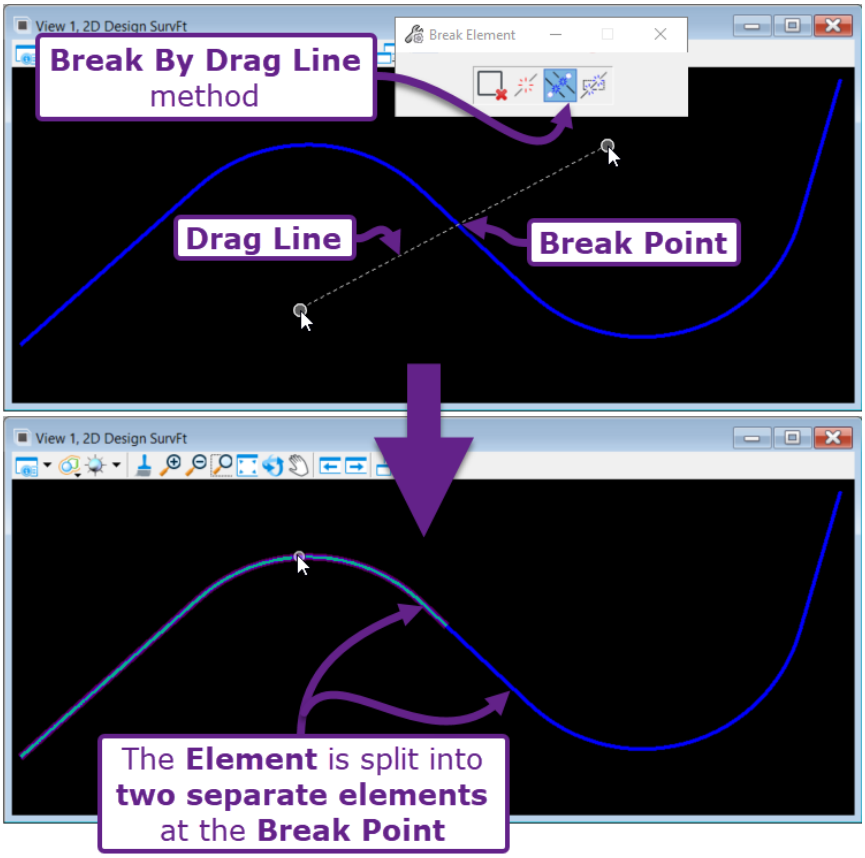
Break By Two Points method:



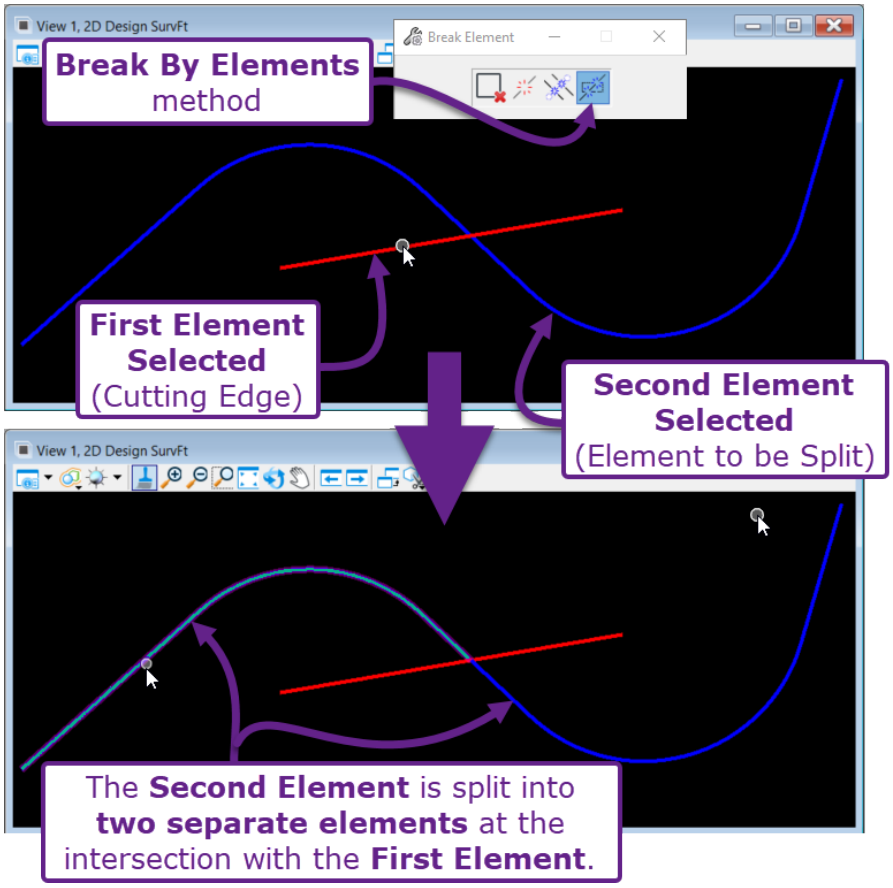
Break By Point method:



Break By Drag Line method:

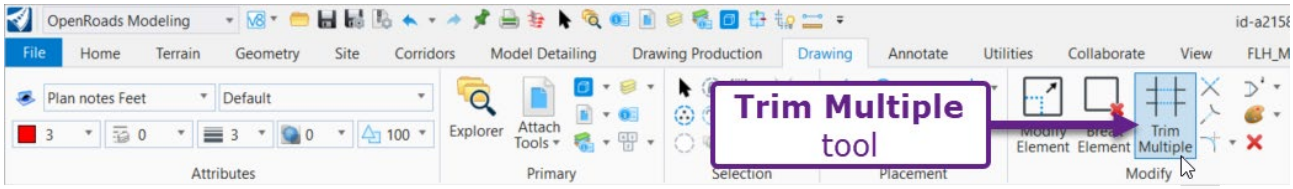


Break By Elements method:

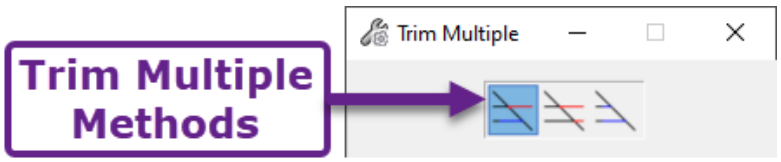


6F.3 Trim Multiple tool

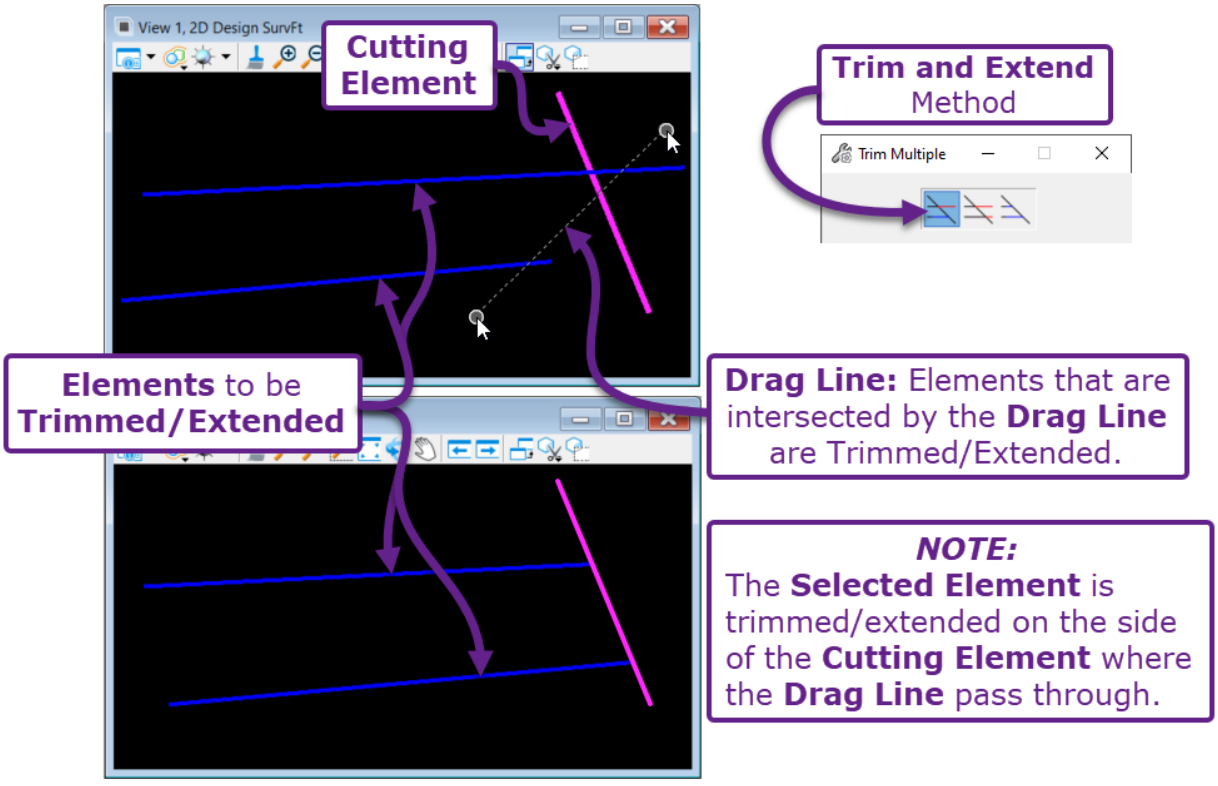
The *Trim Multiple* tool is used to trim or extend an element(s) to terminate at the intersection point with a cutting element.



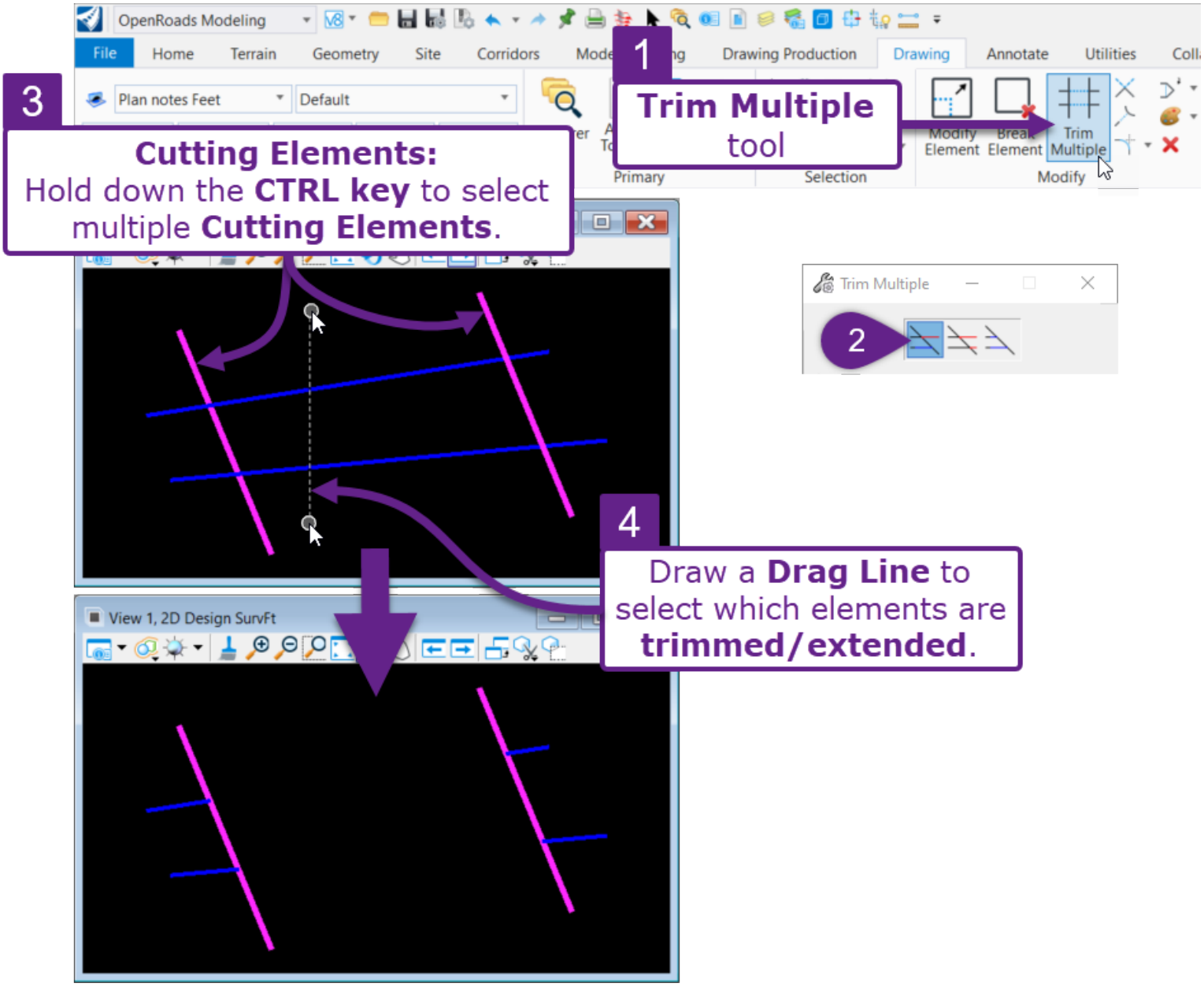
This tool has three **Methods** for trimming or extending an element**:**



Trim Multiple Methods		
Method:		**Description:**
Trim and Extend		First, a cutting element is selected. Next, one or more elements are selected. The selected elements are extended or trimmed to terminate along the intersection point with the cutting element.
Trim		With this option, the selected elements are trimmed to terminate at the intersection point with the cutting element. Selected elements are NOT extended to meet with the cutting element.
Extend		With this option, the selected elements are extended to terminate at the intersection point with the cutting element. Selected elements are NOT trimmed to terminate along the cutting element.



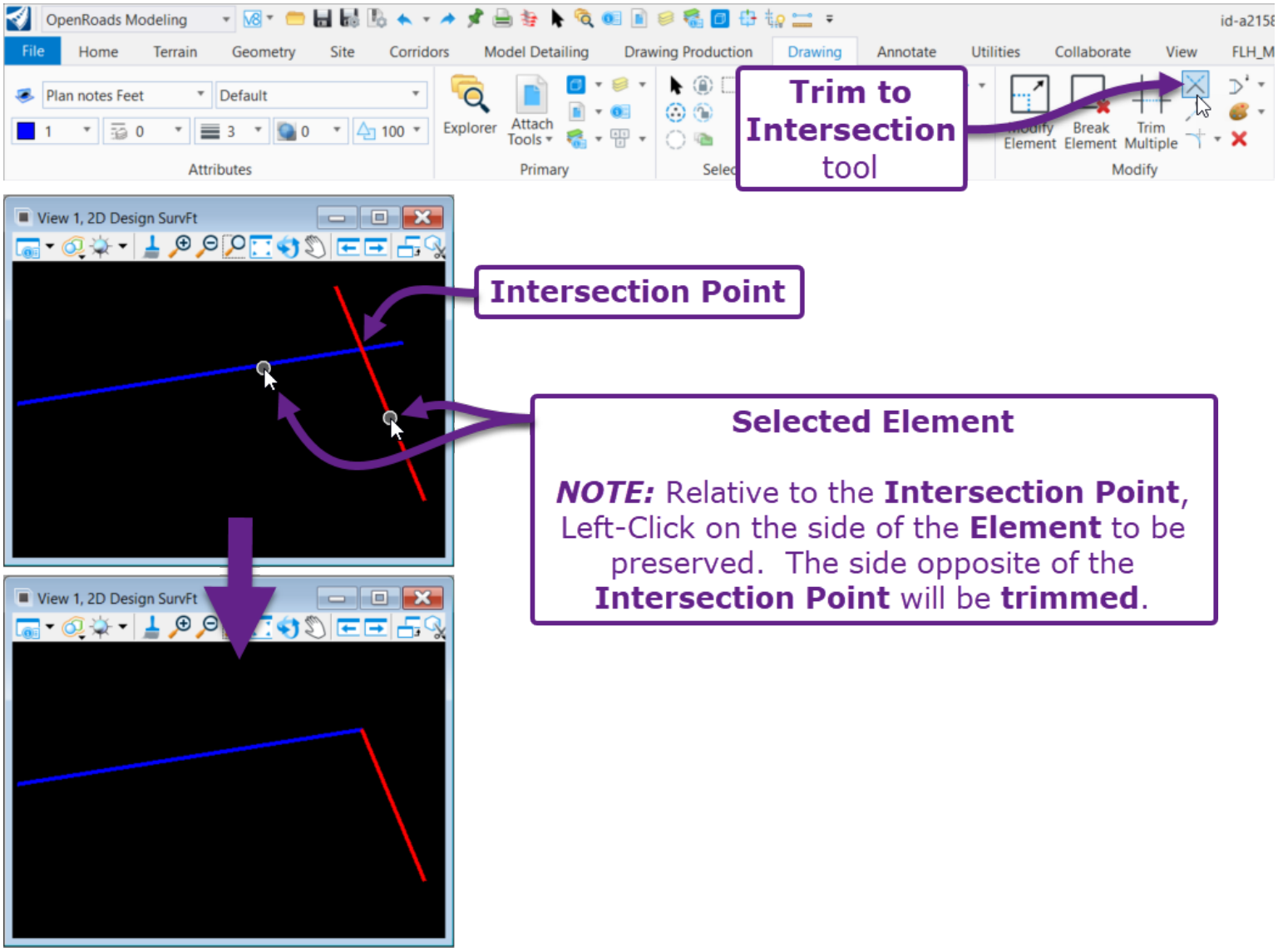
Trim Multiple Workflow: In this workflow, two cutting elements are selected. Two cutting elements are selected by holding down the CTRL key. The two cutting elements must be selected before this tool is executed.

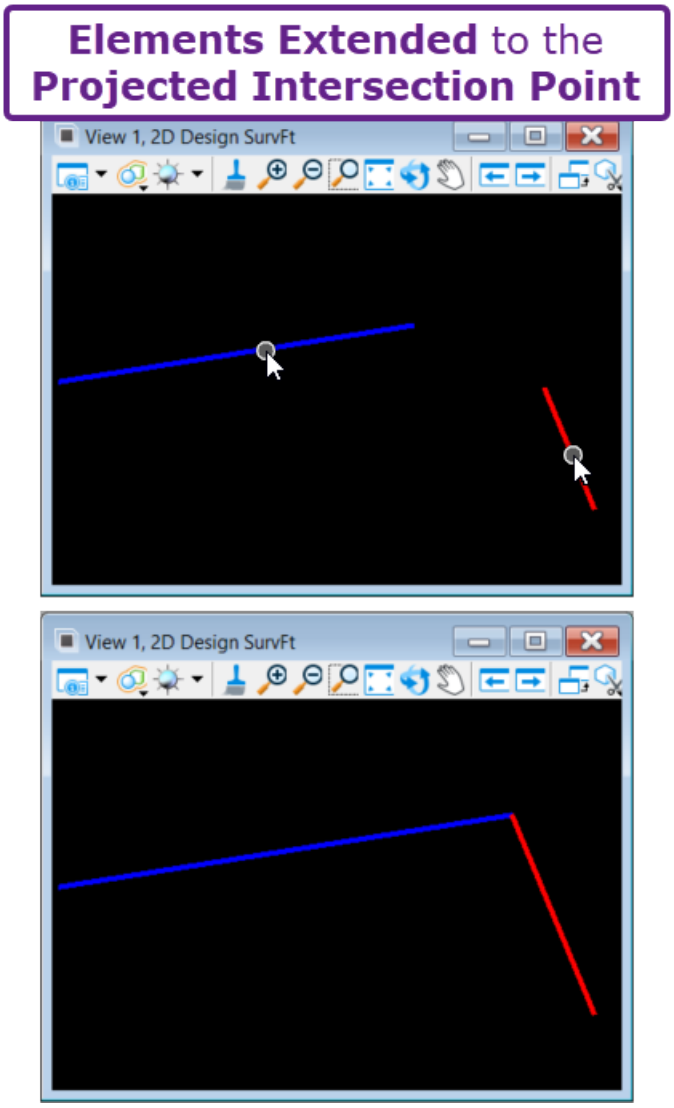


1	From the Ribbon, select the *Trim Multiple* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Modify***].
2	Select the *Trim Multiple* method. In this case, the **Trim and Extend** method is used.
3	*Prompt: Identify cutting elements / edges* – With the CTRL key held down, select the first cutting element. Continue to hold down the CTRL key and select the second cutting element.
4	*Prompt: Identify elements to trim / extend* – Left-click in a location to start the **Drag Line**. With the Left-Click button held down, determine the end location for the **Drag Line**. Release the Left-Click button to accept the end location for the **Drag Line**. **ALTERNATIVE:** Left-Click on each element to be trimmed/extended.

6F.4 Trim to Intersection tool

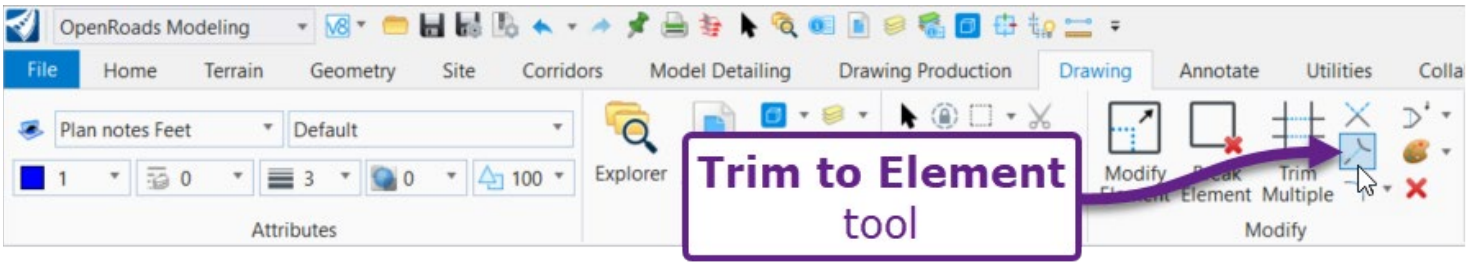
With this tool, two elements are selected. Both elements are trimmed or lengthened to meet at the intersection point.





6F.5 Trim to Element tool

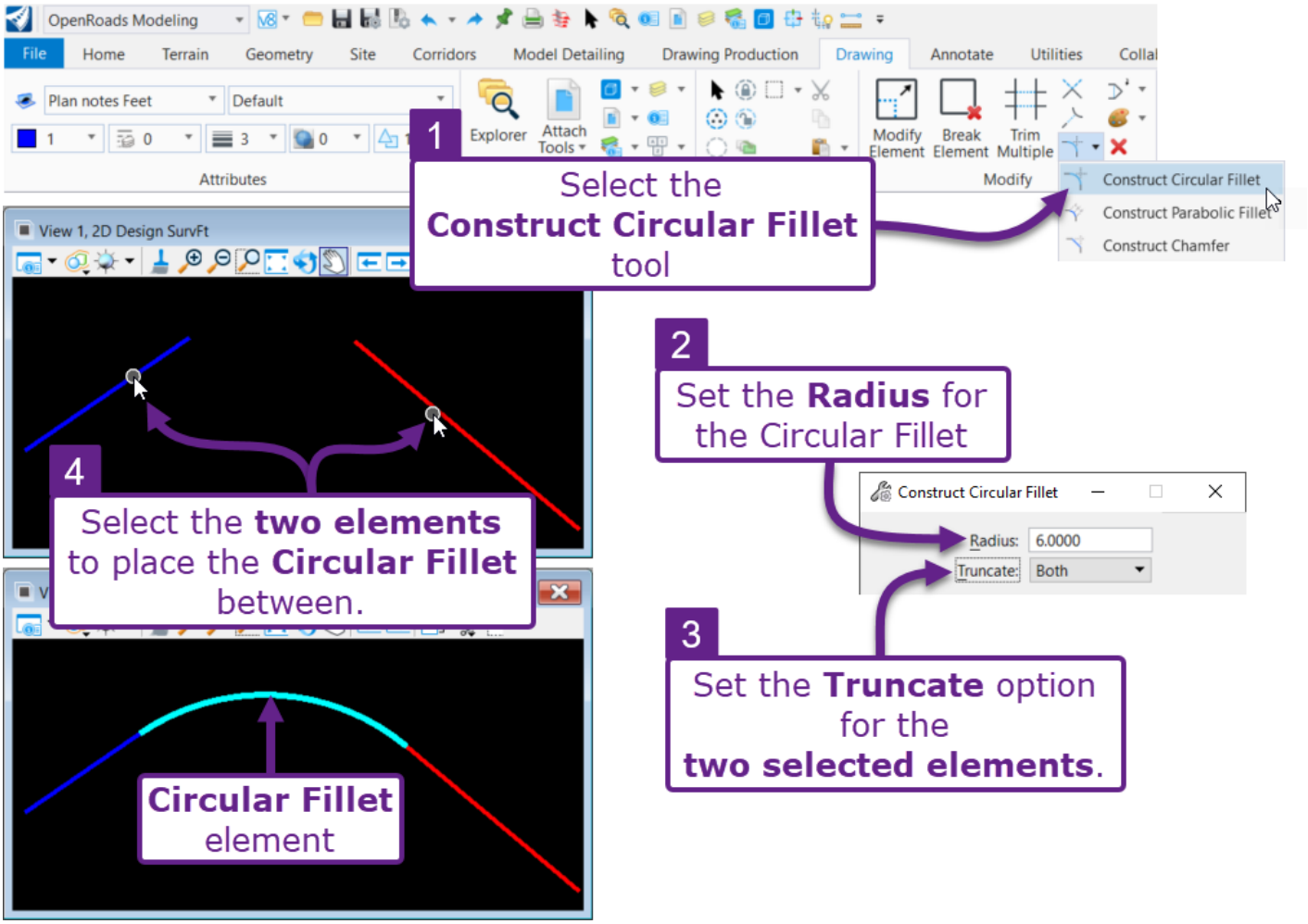
The *Trim to Element* tool is used to trim or extend an element to terminate at the intersection point with a cutting element. This tool operates identiacally to the *Trim Multiple* tool. However, this tool is intended to trim/extend one element at a time.



6F.6 Construct Circular Fillet tool

A circular fillet is an arc placed between two elements. The circular fillet is tangent to the selected elements at both ends.

Typically, a circular fillet is created between two Line elements. However, this tool can be used between a Line and a Circular element to create a compound curve shape. Similarly, this tool can be used between two circular elements.



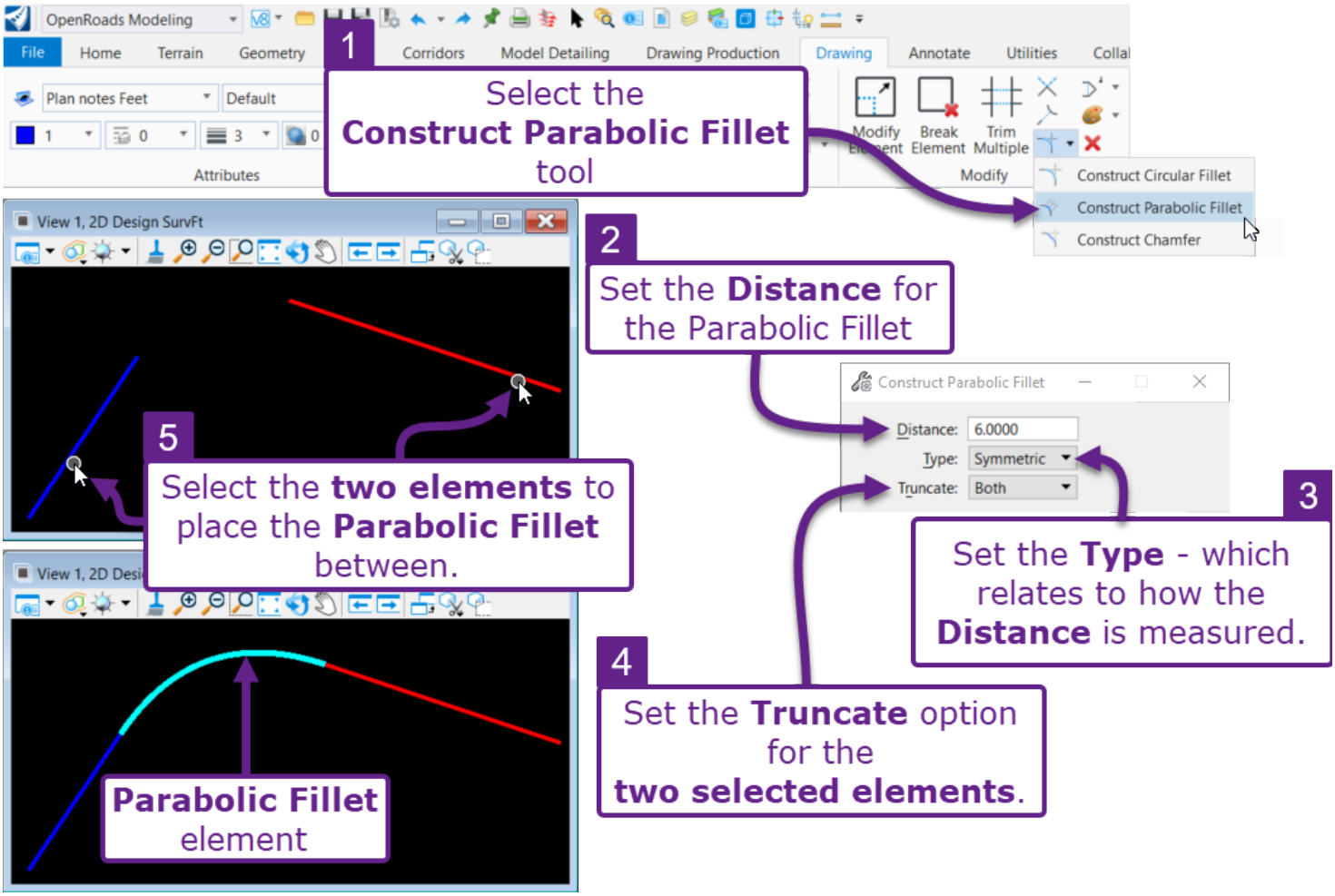
NOTE: After the fillet operation, the Circular Fillet element is NOT joined together with the adjacent elements. The *Create Co*mplex Chain tool must be used to join the Circular Fillet and adjacent elements into a single element.

The Truncate settings determine whether the selected elements are trimmed/extended to terminate at the start/end point of the Circular Fillet element.

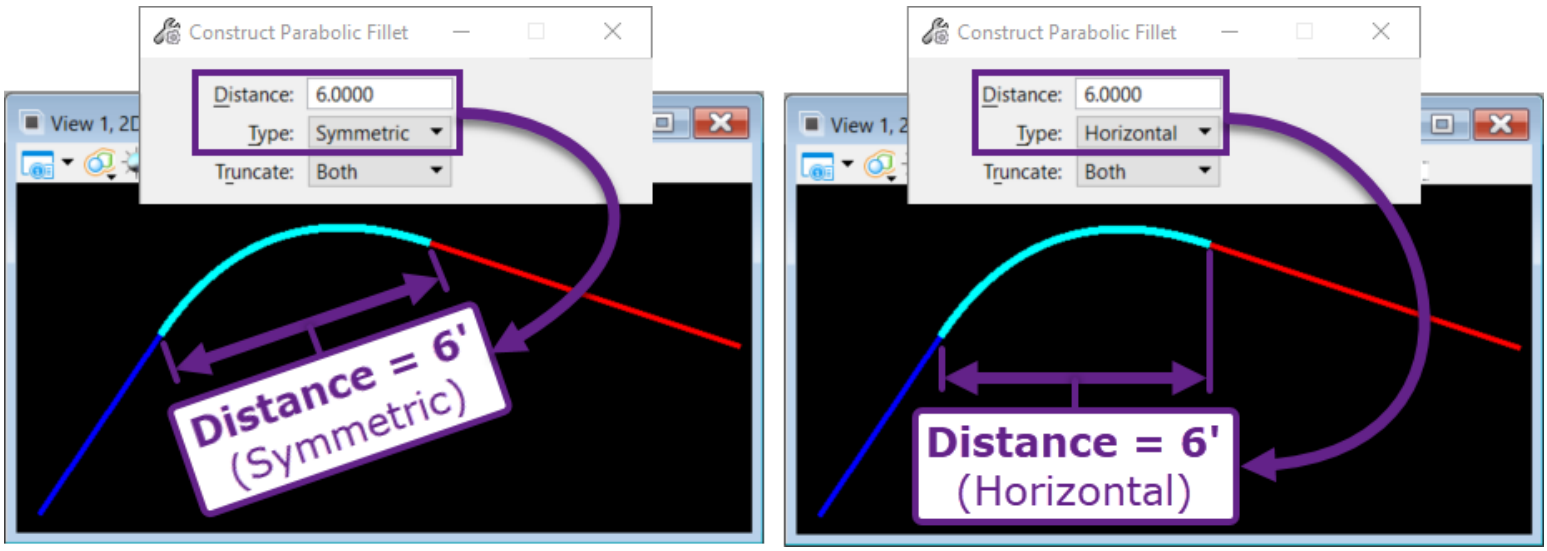
Truncate Settings	
Setting:	**Description:**
None	The length of the two selected elements is unaffected after the fillet operation.
First	The first selected element is trimmed or extended to terminate at the exact point where the circular fillet starts.
Both	Both selected elements are trimmed or extended to terminate at the end points of the fillet.

6F.7 Construct Parabolic Fillet tool

This tool creates a parabolic curve between two elements.



The **Distance** and **Type** settings work in conjunction to determine the length of the parabolic fillet. There are two settings for **Type**: **Symmetric** and **Horizontal**.



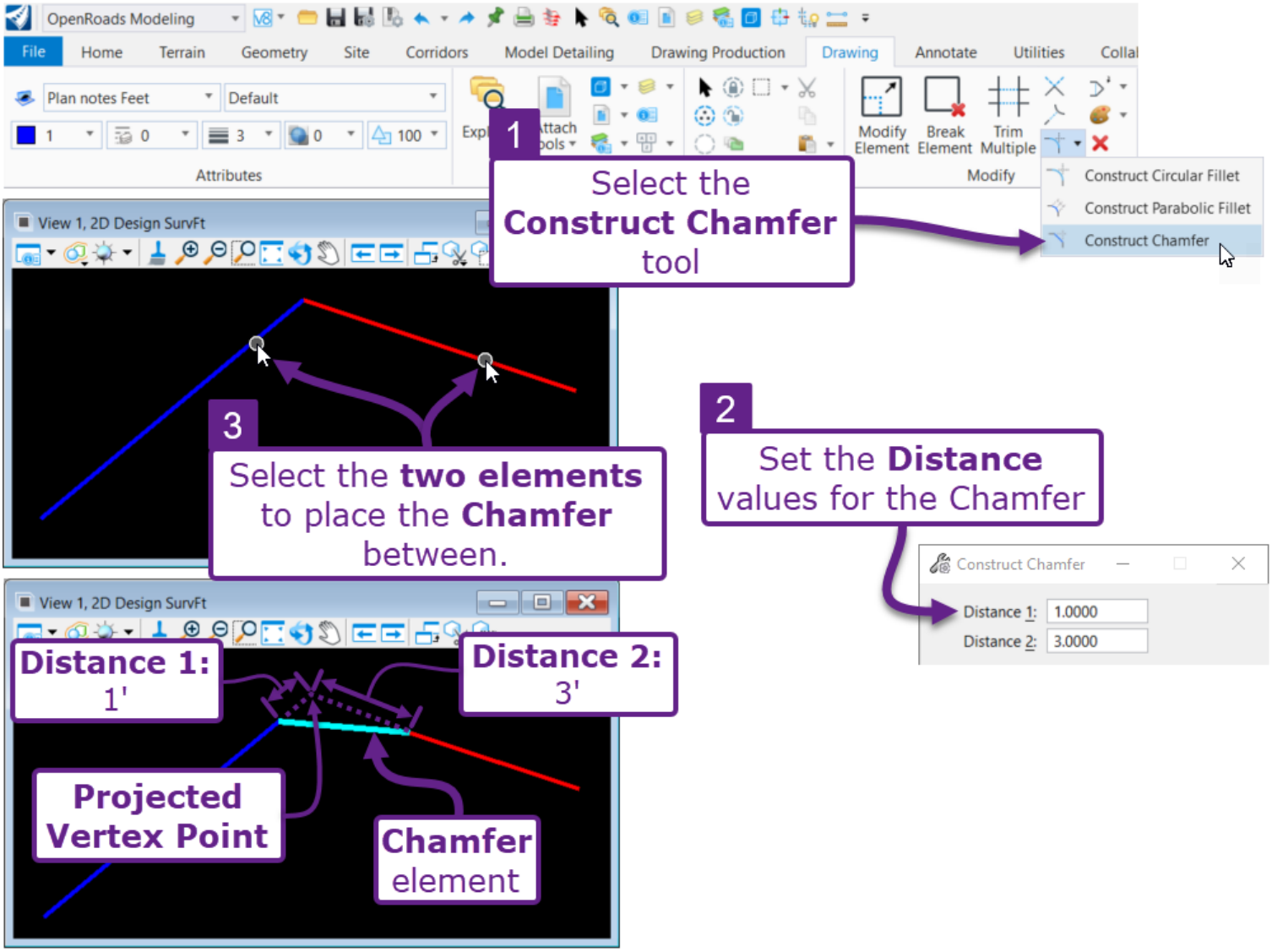
See the previous page for an explanation of the **Truncate** settings.

6F.8 Construct Chamfer tool

A chamfer is a Line element that is placed between two selected elements.

The **Distance 1** and **Distance 2** values sets the size of the chamfer. The **Distance** values are measured from the projected vertex point to beginning/end of the chamfer.

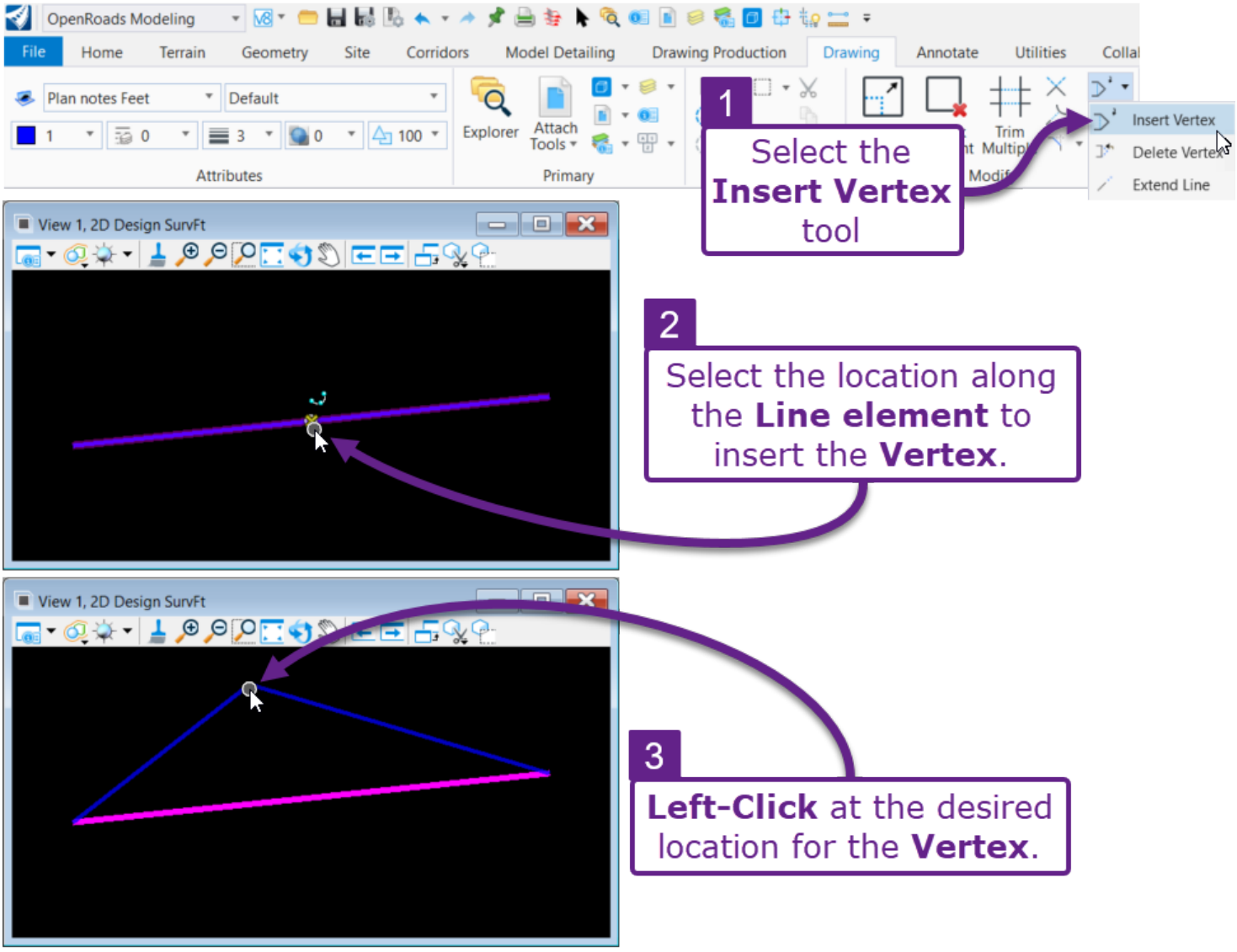
Distance 1 corresponds with the first element selected for the chamfer operation. **Distance 1** is measured from the projected vertex point to the beginning of the chamfer.



6F.9 Insert Vertex tool

This tool inserts a vertex into a previously-created element. With this tool, a vertex can be inserted into a line, curve, or a spine element.

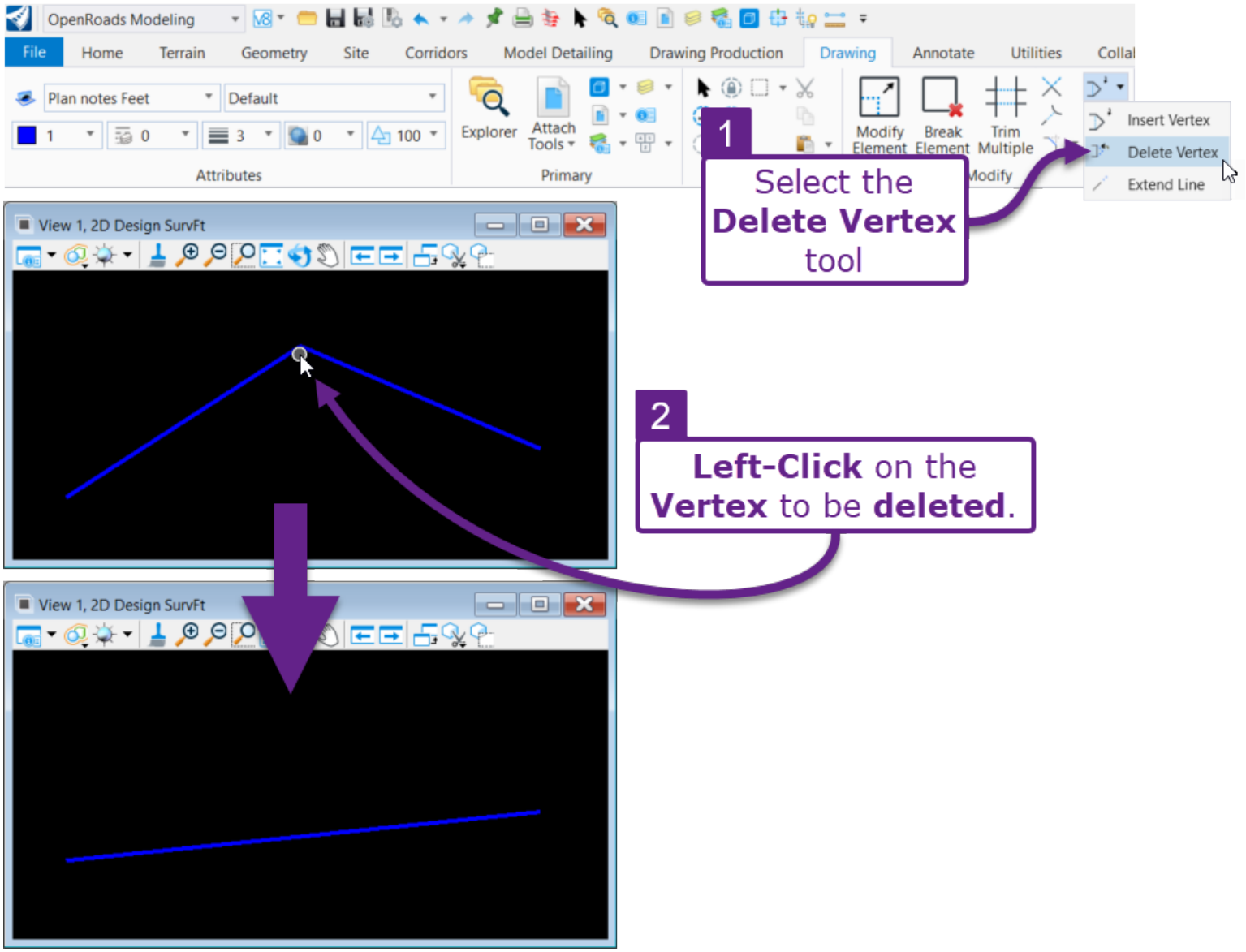
TIP: The *Insert Vertex* tool works on both MicroStation and ORD Elements. This tool could be used to insert a vertex into a Complex Element (i.e., a road centerline alignment).



6F.10 Delete Vertex tool

This tool deletes a vertex from a previously-created element.

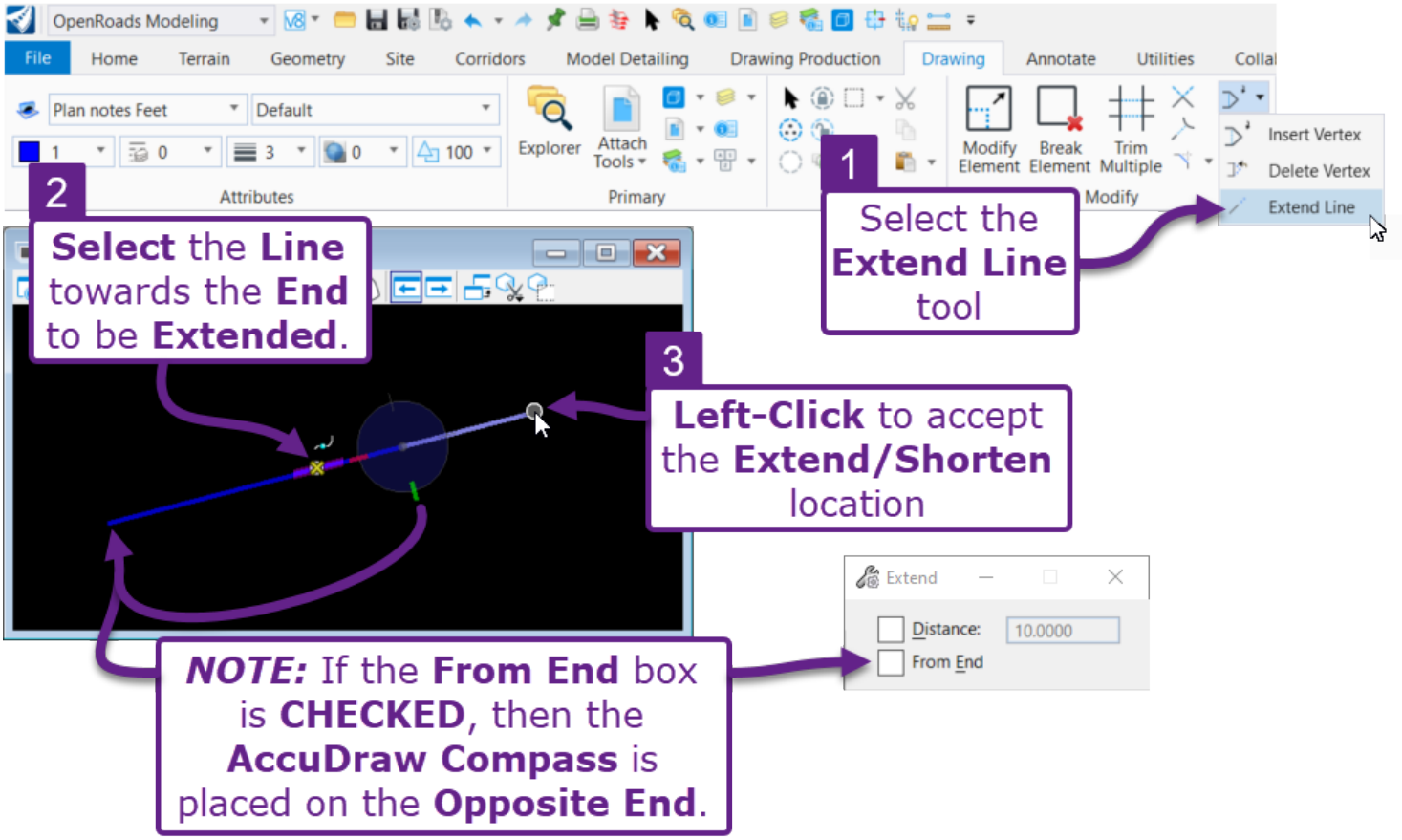
TIP: The *Delete Vertex* tool works on both MicroStation and ORD Elements. This tool could be used to delete a vertex from a Complex Element (i.e., a road centerline alignment).



6F.11 Extend Line tool

This tool is used to extend or shorten the length of a Line element or segment. The Line can be extended/shortened by a specified value or graphically.

NOTE: The location where the Line element is selected determines the end to be extended/shortened. Select the Line element near the end that is to be extended/shortened.

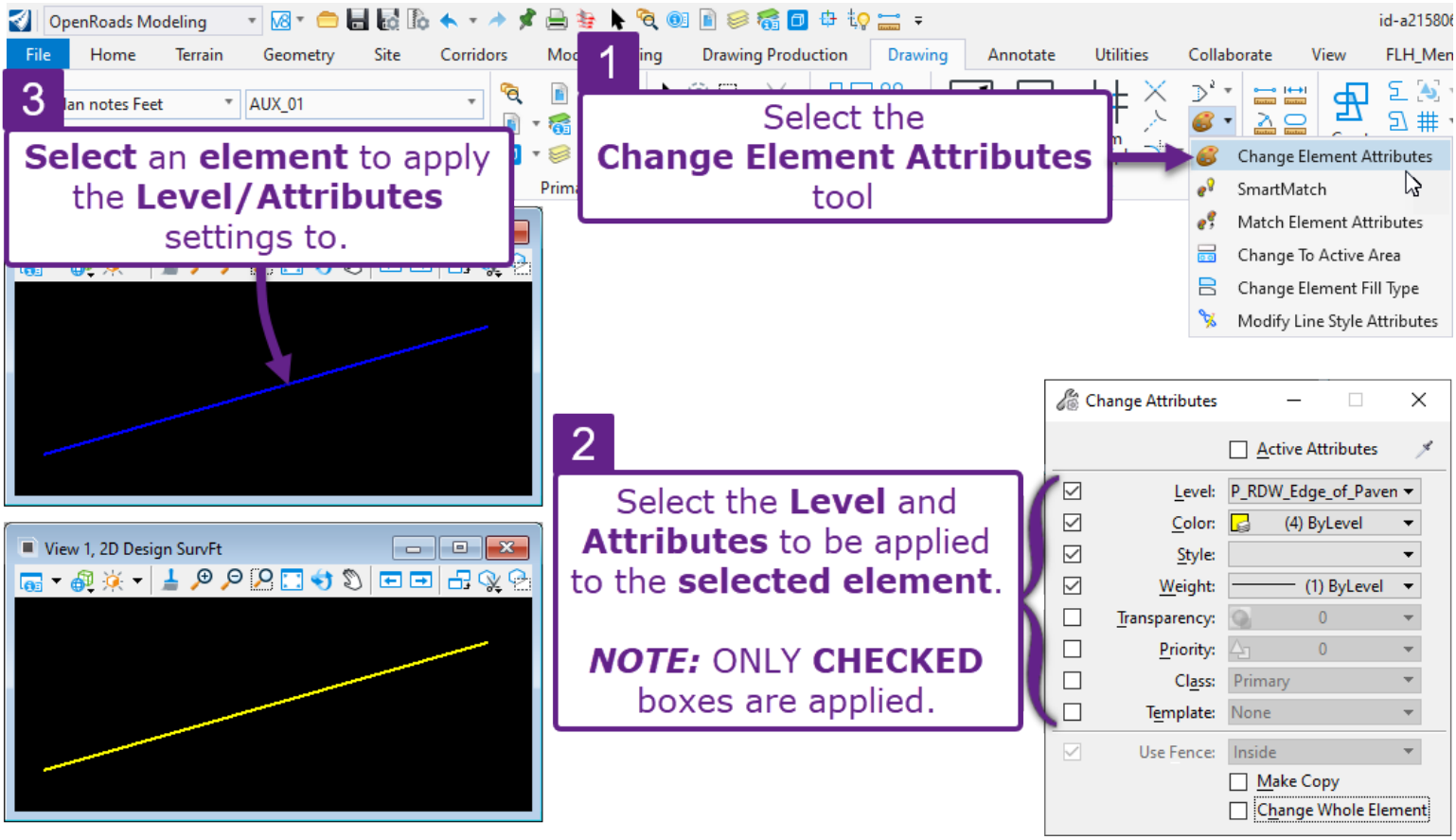


Extend Line Dialogue Box Settings	
Setting:	**Description:**
Distance	If CHECKED, then the Line element or segment is extended/shortened by the value shown in the Distance box. Inputting a negative value will shorten the Line element.
From End	Determines where the AccuDraw Compass is placed. If CHECKED, then the AccuDraw Compass is placed at the beginning of the Line element. The desired total length for the Line element can be specified in the AccuDraw Toolbox with the X Coordinate value. If UNCHECKED, then the AccuDraw Compass is placed at the end that is being extended. The desired extension length can be specified with the AccuDraw Toolbox.

6F.12 Change Element Attributes tool

The *Change Element Attributes* tool is used to change the Level and/or Attributes of an element.

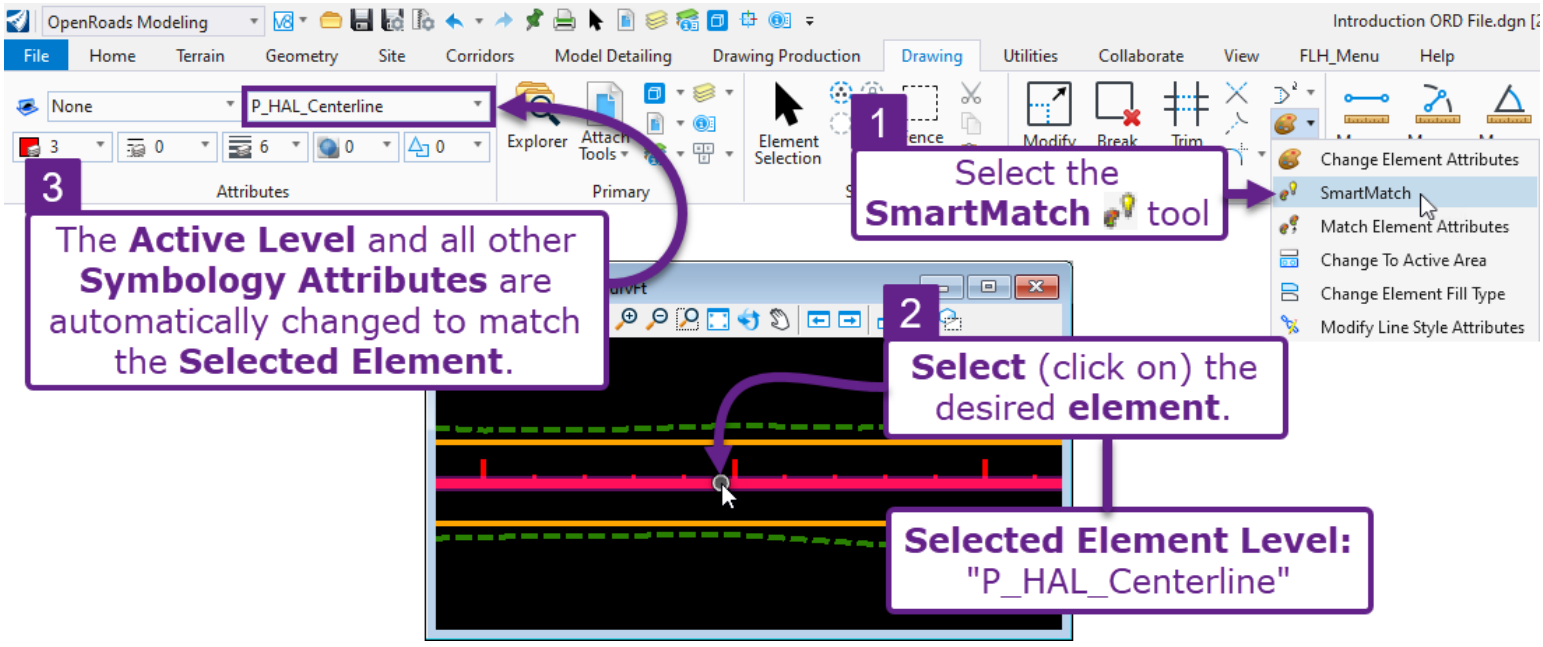
IMPORTANT: ONLY the Levels and Attributes boxes that are CHECKED, will be applied to the selected element.



Drop Element Dialogue Box Settings	
Setting:	**Description:**
Active Attributes	If CHECKED, then the Dialogue Box will be populated by the currently active Level and Attributes. The Dialogue Box and active Level/Attributes become linked. If a change is made in the Dialogue Box, then active Level/Attributes configuration changes in kind. If UNCHECKED, then the active Level/Attributes and Dialogue box are independent. Changes made in the Dialogue Box do NOT affect the active Level/Attributes configuration. ***NOTE:*** The currently active Level and Attributes are shown in the Ribbon. See *6A.2 Set the Level and Attributes Before using Drawing tools*.
Match Element Attributes	This button is used to populate the Dialogue Box with the Level/Attributes of a previously-created element. Push this button, then select a previously-created element.
Make Copy	If CHECKED, then the selected element is copied in place. There will be two overlapping elements. The original element is unchanged. The copy element will contain the Level/Attributes shown in the Dialogue Box.

6F.13 SmartMatch tool

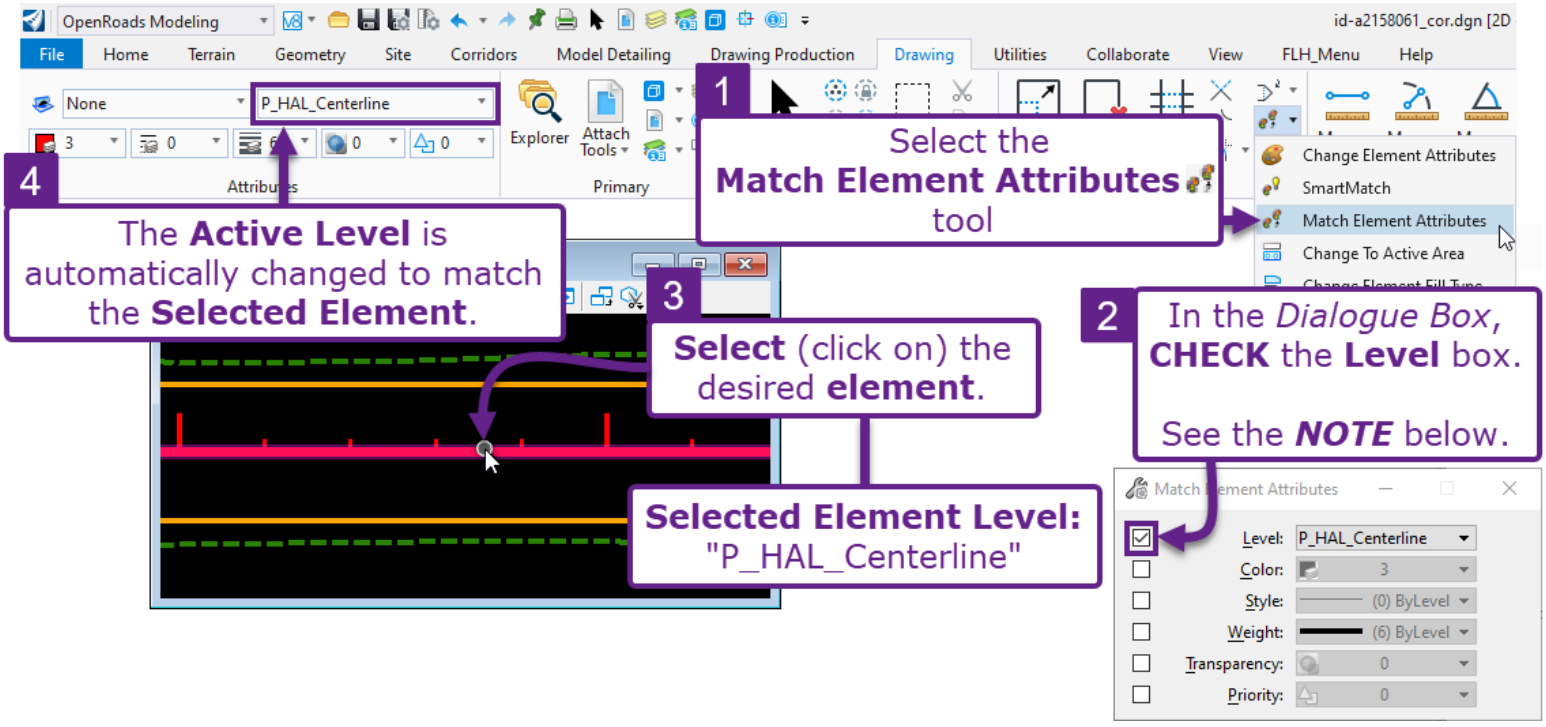
The *SmartMatch* tool functions by selecting an element. Then, the *Active Level* and *Attributes* are automatically changed to match the selected element.



6F.14 Match Element Attributes tool

The *Match Element Attributes* tool works very similar to the *SmartMatch* tool shown on the previous page. However, the *Match Element Attributes* tool allows the User to specify which Attributes will become active.

IMPORTANT: In the Dialogue Box, ONLY the CHECKED Attributes boxes will become active.



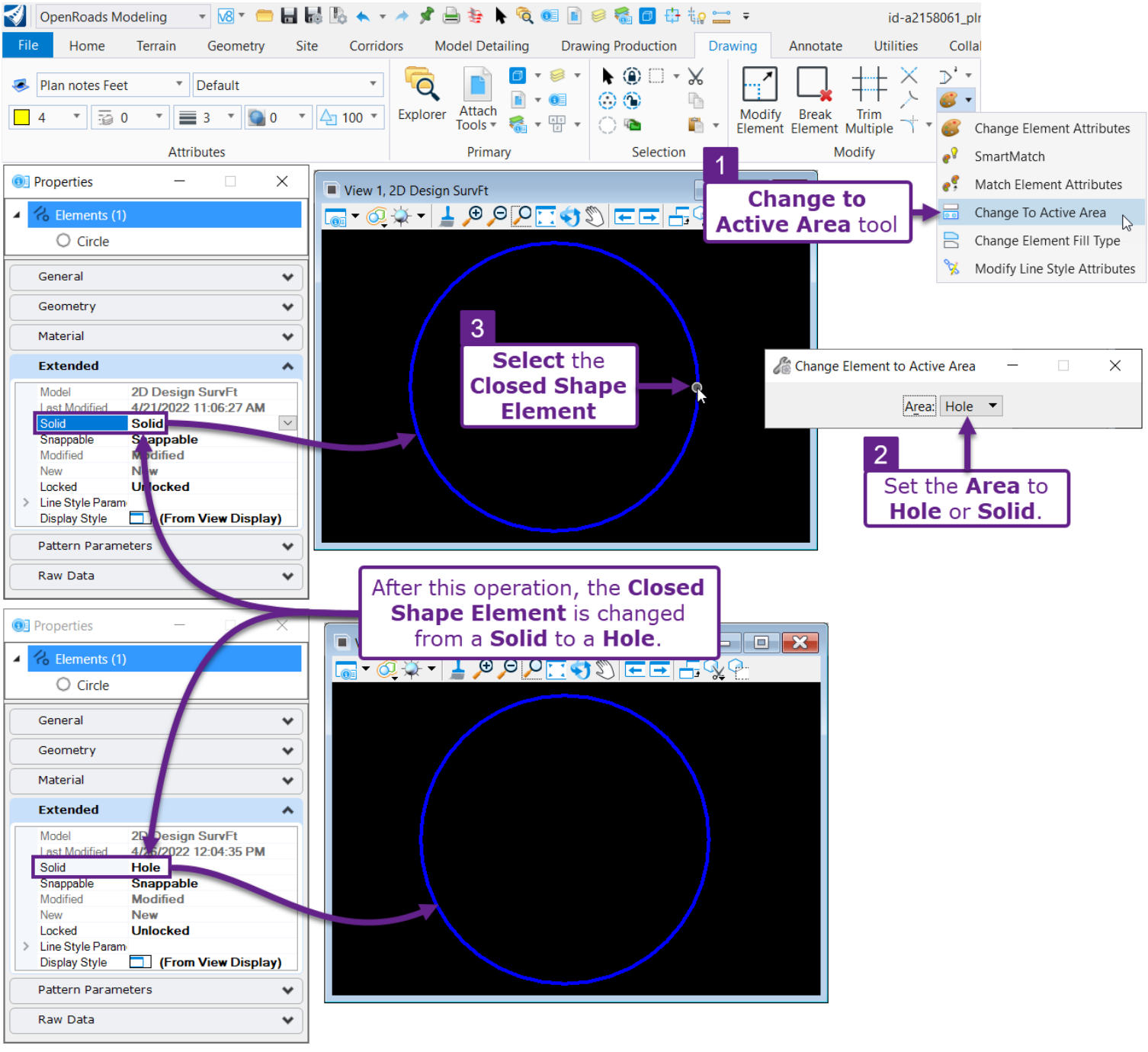
NOTE: For the *Match Element Attributes* tool to have any effect, at least ONE box has to be CHECKED in the *Dialogue Box*. Typically, it is ONLY necessary to check the **Level** box. For future elements to be drawn, the "By Level" (default) symbology attributes will be used.

6F.15 Change to Active Area tool

This tool is used with closed shape elements types (i.e., Circle, Ellipse, Shape, Complex Shape). The Area for a Closed shape element is designated as either a **Solid** or a **Hole**. This tool will change a **Solid** closed shape element into a **Hole** closed shape element – or vice-versa. In the example shown below, the closed shape element is initially a Hole, but is changed to a Solid with the *Change to Active Area* tool.

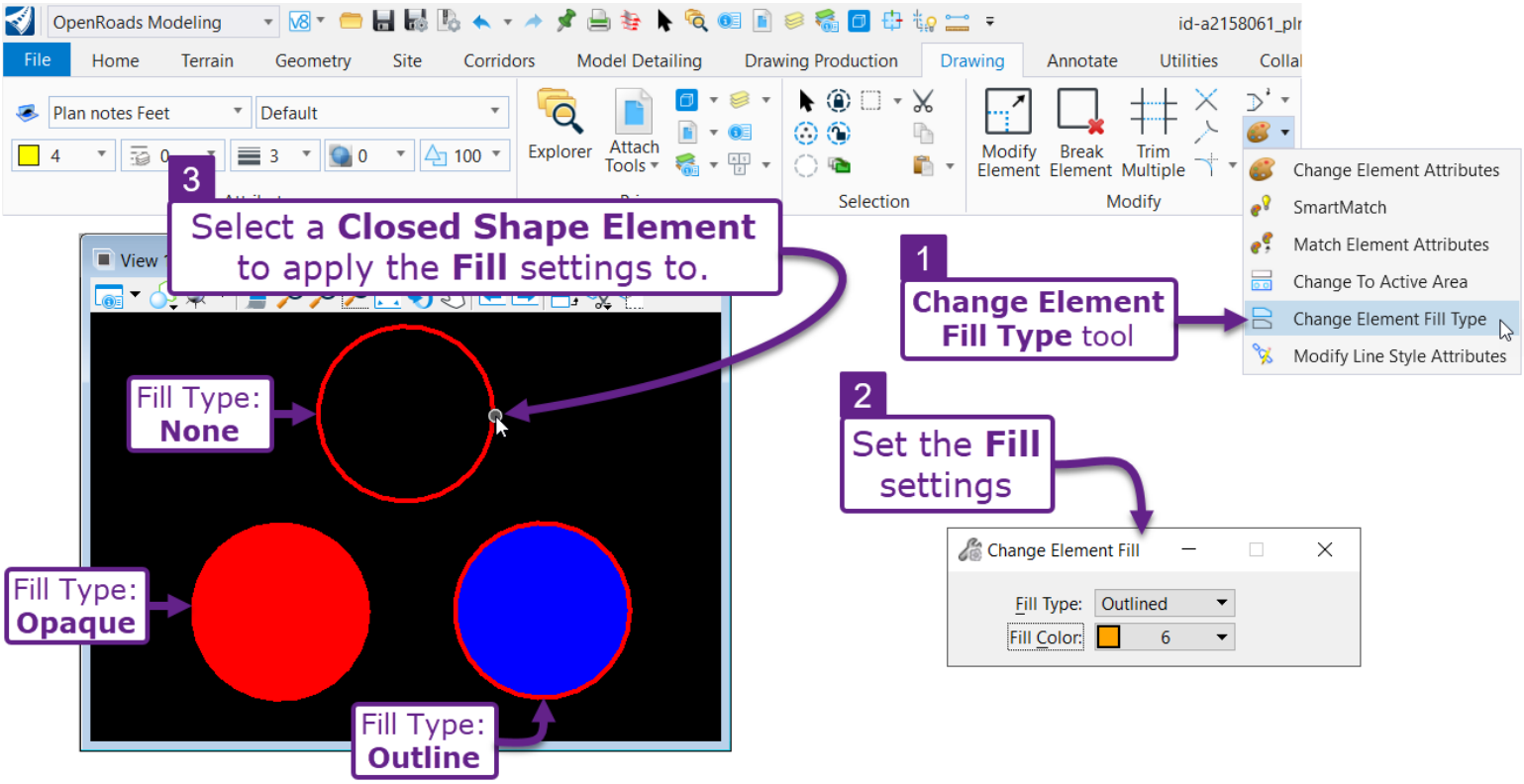
BACKGROUND INFORMATION: Solid and Hole elements are displayed and behave identically. The Solid/Hole setting does NOT affect the behavior of the closed shape element for conventional civil design and quantity calculations task. Either setting is acceptable. The Solid/Hole setting is important when using the *Group Hole* tool – which is discussed in *6H.4 Group Hole tool*.

TIP: The Solid/Hole setting for a closed shape element is displayed and can be edited through the Properties box.



6F.16 Change Element Fill Type

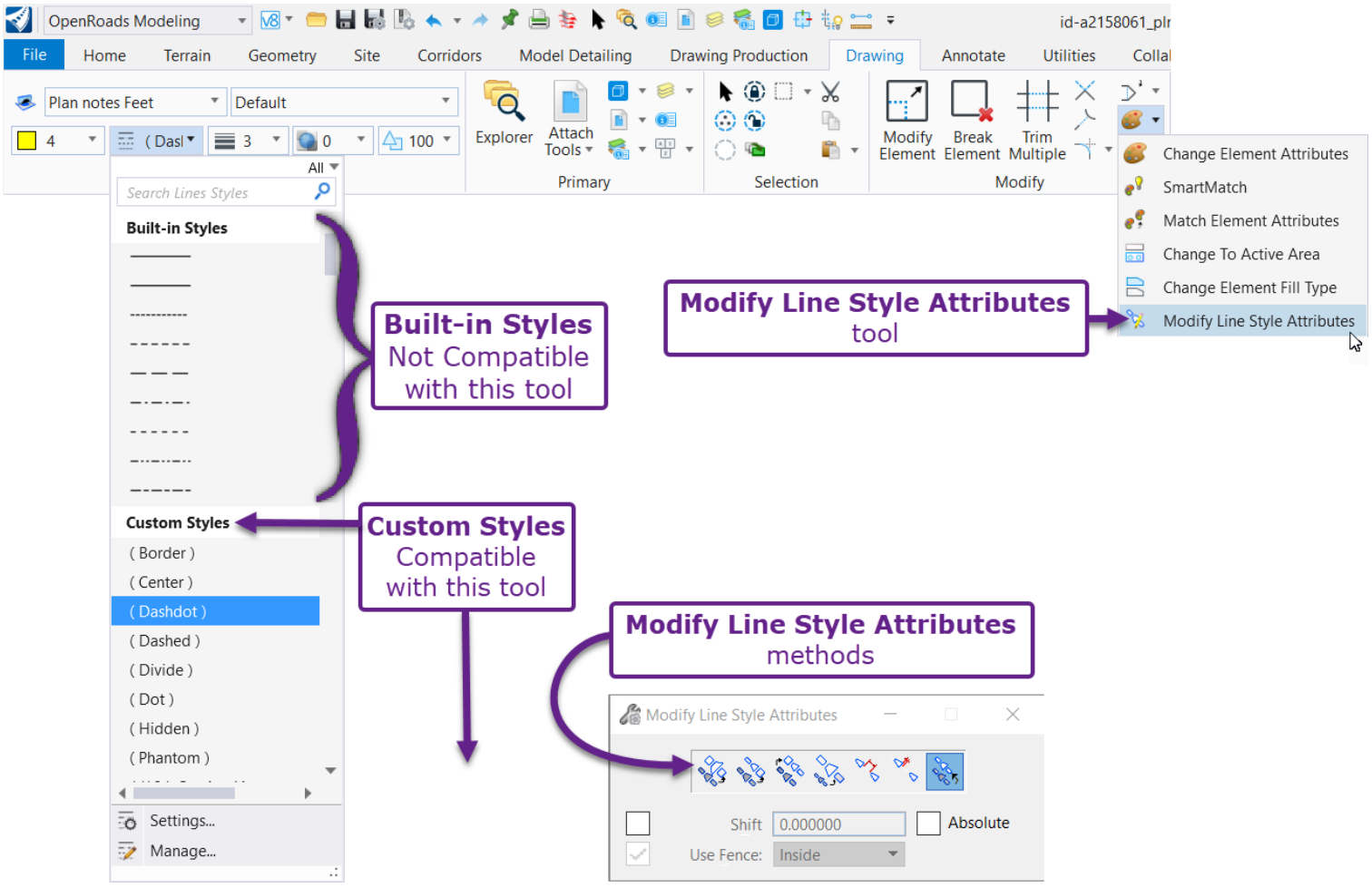
This tool is used to change the Fill or assign a color Fill for a closed shape element.



For more information on **Fill Type** and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

6F.17 Modify Line Style Attributes tool

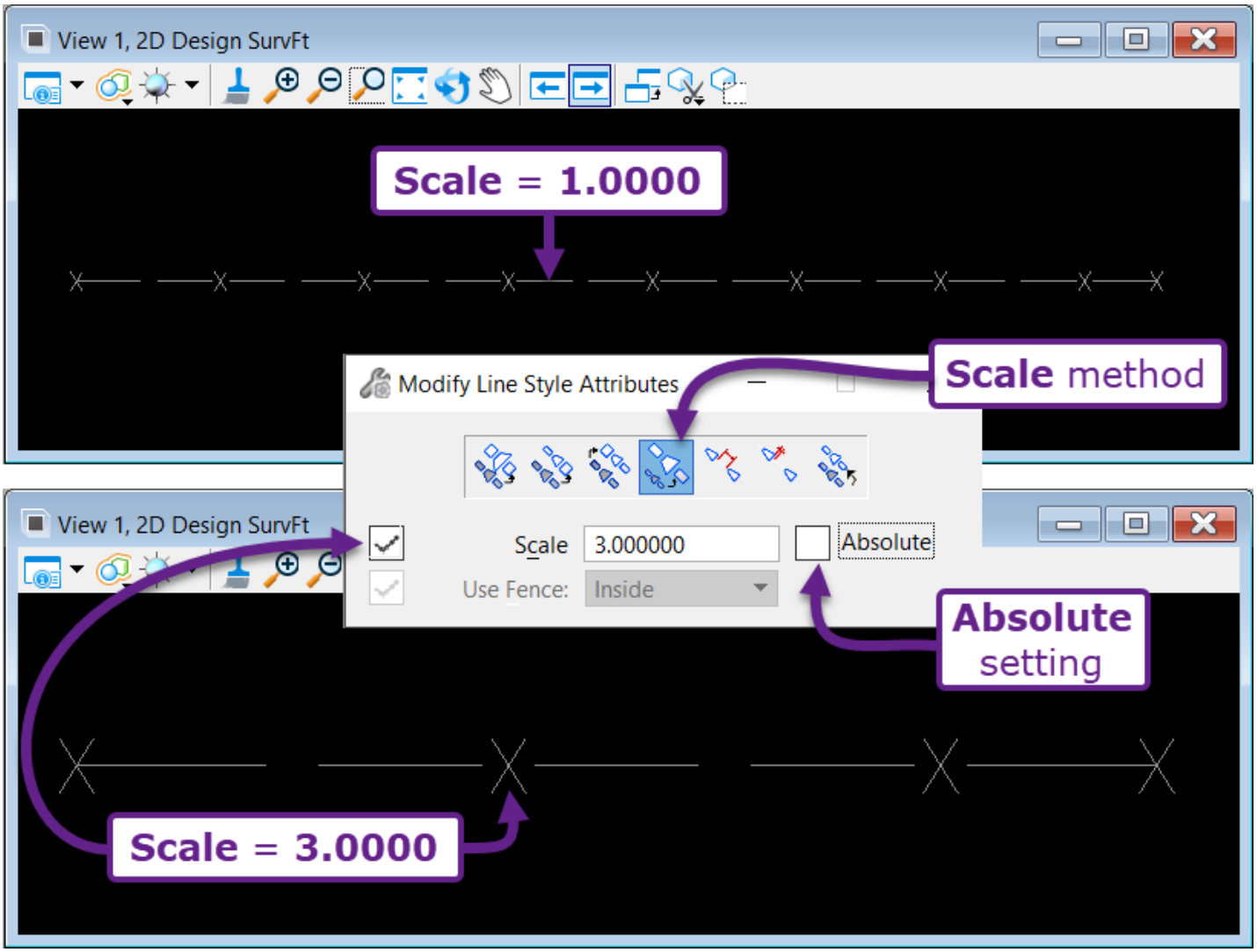
This tool is used edit appearance parameters of Custom Line Styles.



NOTE: Most methods used with this tool have no effect on Line Styles found in the FLH WorkSpace. ONLY the **Scale** and **Shift** methods affect FLH Line Styles.

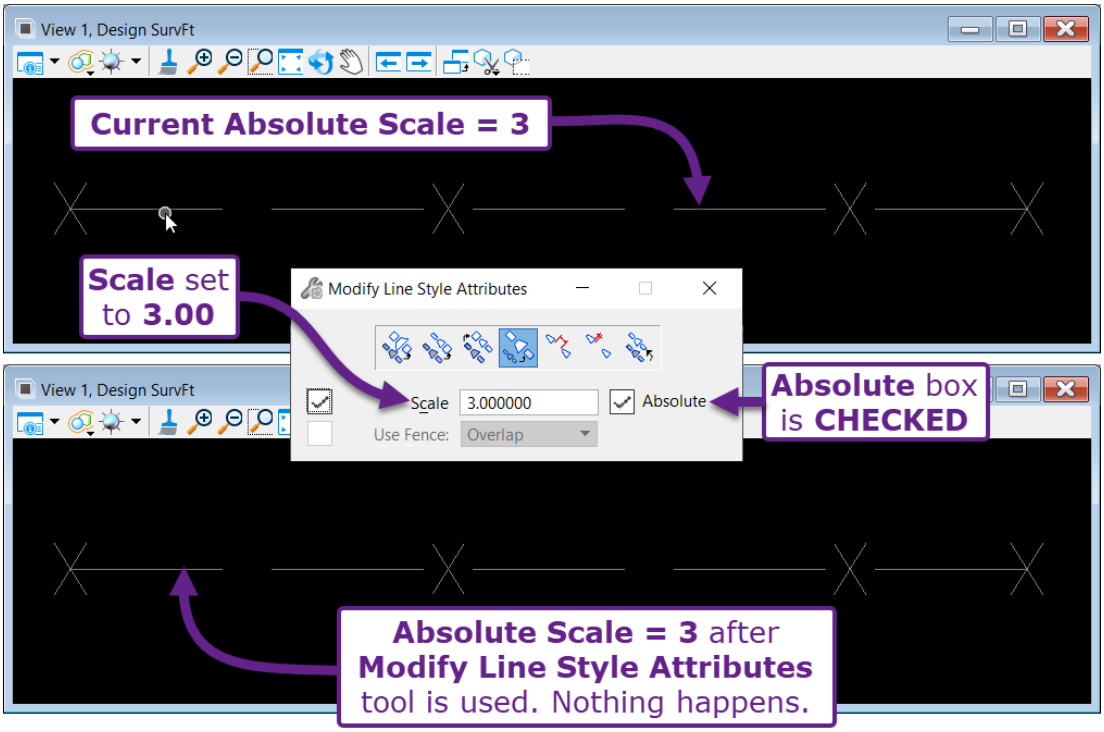
Modify Line Style Methods		
Method:		**Description:**
Width		Uniformly changes the Width of the Line Style. ***WARNING:*** This method is NOT compatible with FLH Line Styles.
Start Width		Changes the starting Width of the Line Style. ***WARNING:*** This method is NOT compatible with FLH Line Styles.
End Width		Changes the ending Width of the Line Styles. ***WARNING:*** This method is NOT compatible with FLH Line Styles.
Scale		Shrinks or enlarges the entire Line Style by a specified factor.
Dash Scale		Changes the length of dashes found in the Line Style. ***WARNING:*** This method is NOT compatible with FLH Line Styles.
Gap Scale		Changes the length of dashes found in the Line Style. ***WARNING:*** This method is NOT compatible with FLH Line Styles.
Shift		Shifts the repeating portion of a Line Style by a specified distance.

Scale **:** As shown below, the Scale method can be used to shrink or enlarge the Line Style.

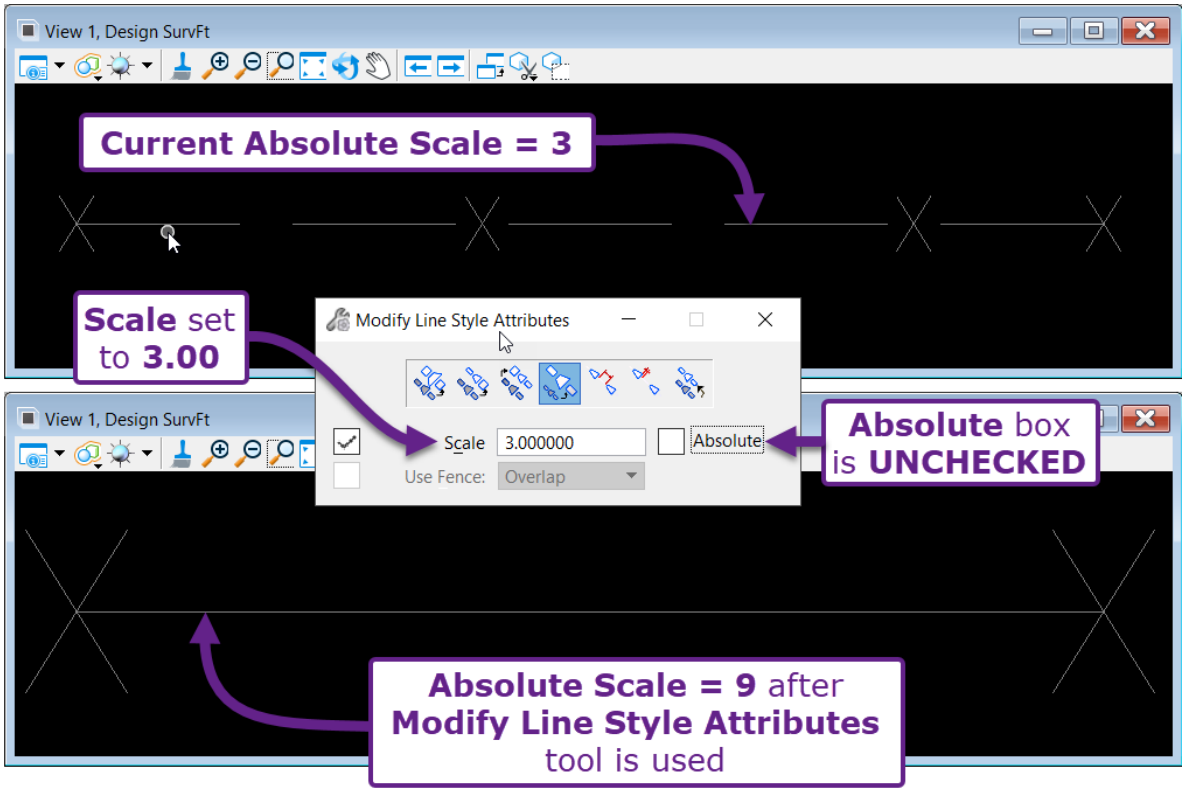


NOTE: The **Absolute** option determines if the current scale factor is multiplied or if the absolute scale factor is used.

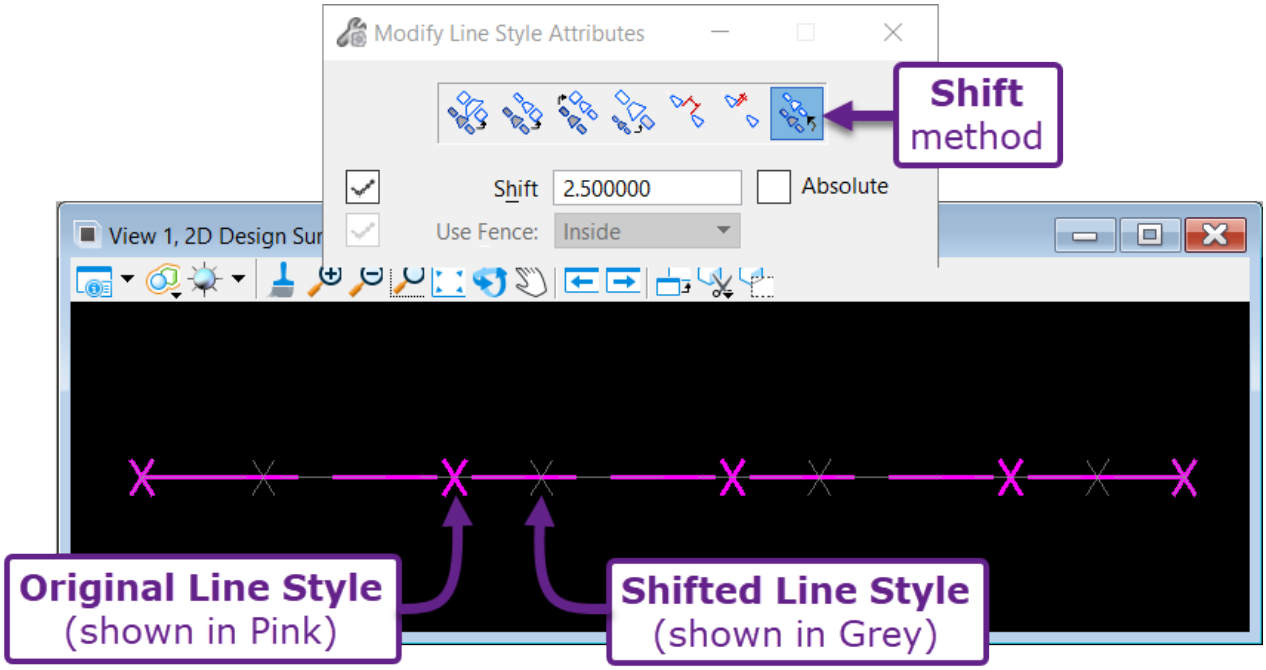
As an example, the absolute scale for the Line Style shown below is currently set to 3. The *Modify Line Style Attributes* tool is used with the Absolute box CHECKED and the Scale set to 3. Nothing happens because the absolute scale is already set to 3.



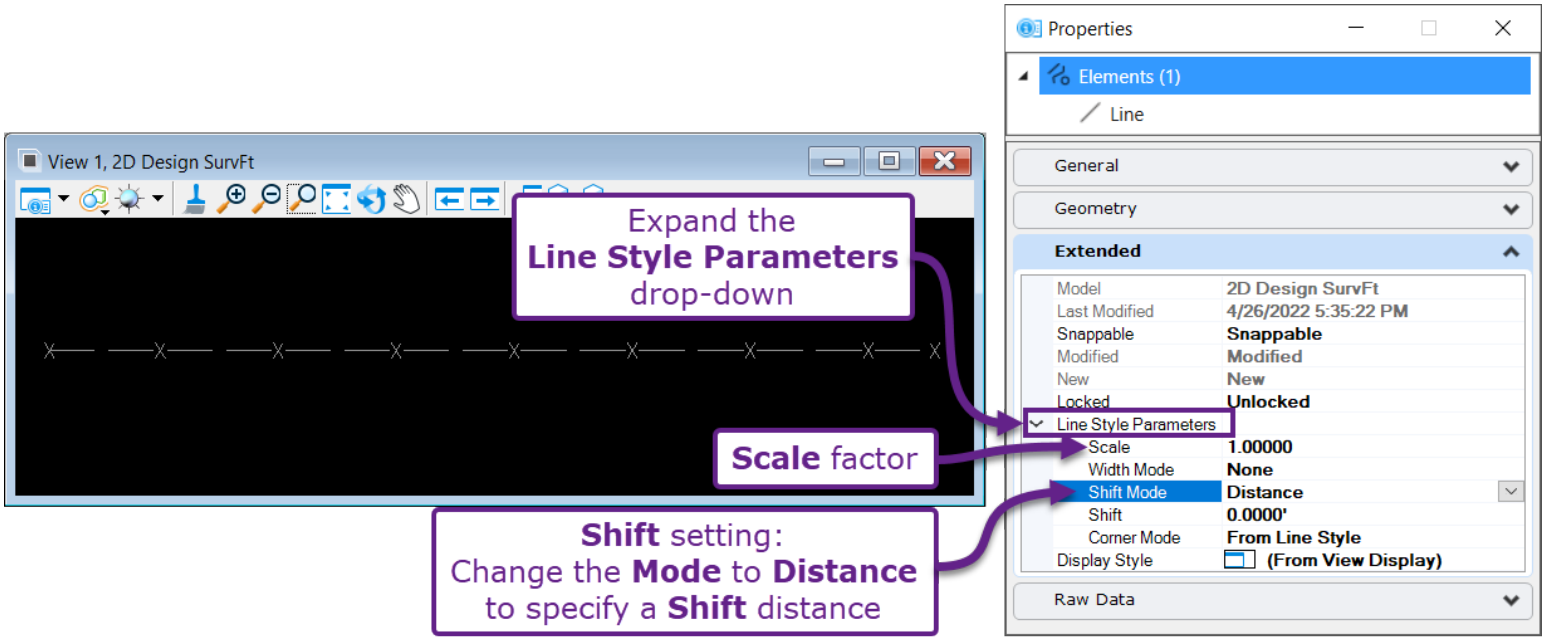
In this same situation, if the Absolute box is UNCHECKED, then the Line Style is enlarged by a factor of 3. After using the tool, the Line Style has an absolute scale factor of 9.



Shift  **:** As shown below, the Shift method can be used to move the Line Style pattern along the element.



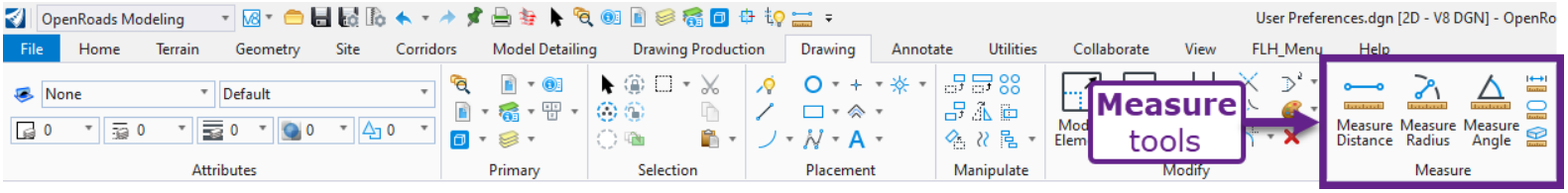
TIP: Line Style Parameters can be edited in the Properties box when an element is selected. Line Style Parameters are found under the **Extended** drop-down:



6G – MEASURE TOOLS

The tools found in the Measure group are used to measure the length, radius, angle, area, and volume of elements or between specified point locations. Measure tools are found in the Ribbon at the following location:

OpenRoads Modeling workflow → **Drawing** tab → **Modify** group



6G.1 Measure Distance tool

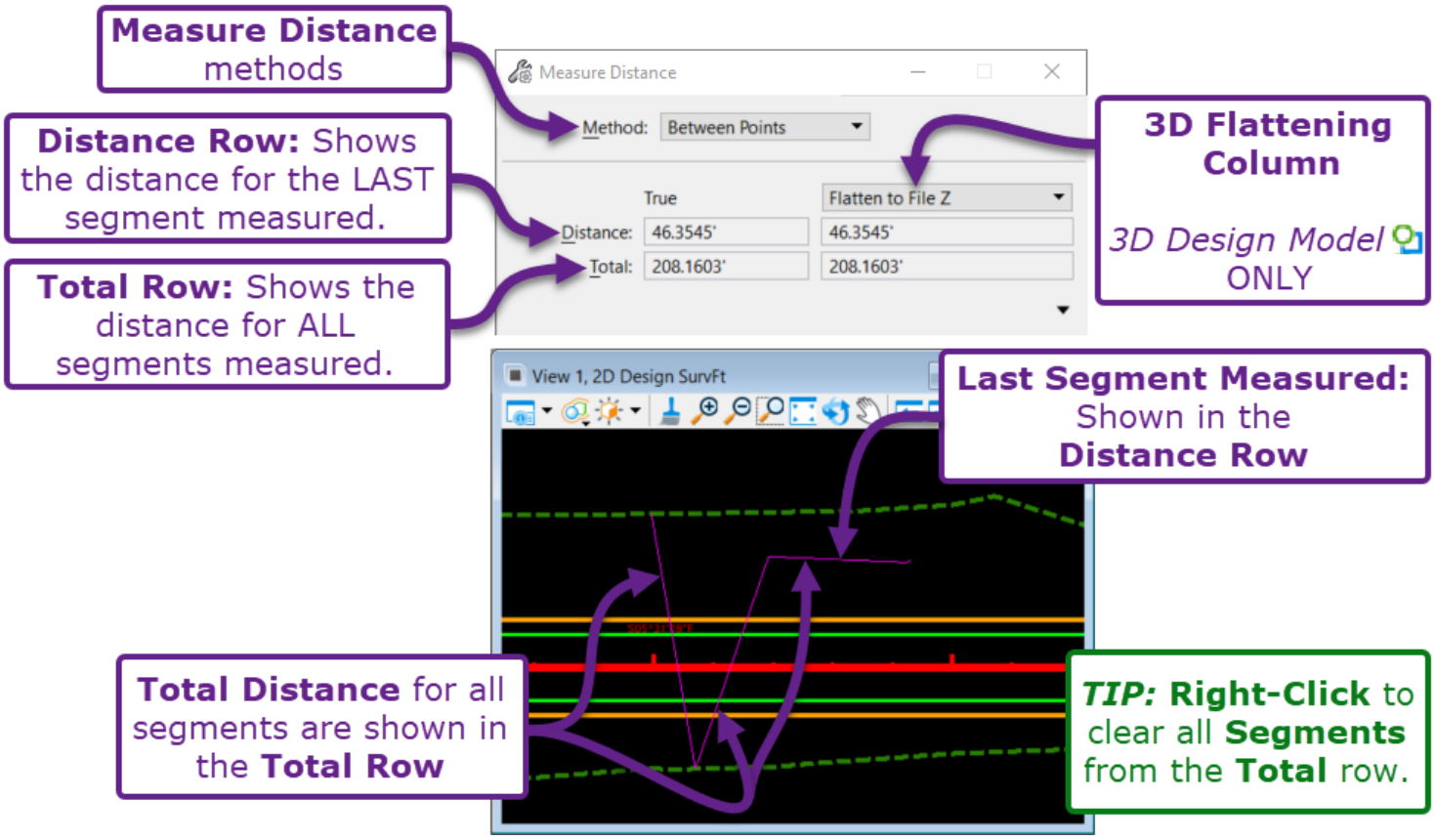
This tool has 5 different methods for measuring distances:

Measure Distance Methods	
Method:	**Description:**
Between Points	Used to measure the distance between two arbitrary point locations.
Along Element	Used to measure the lineal distance between two point locations along a selected element.
Perpendicular	Used to measure perpendicularly relative to a selected element. First, an element is selected. Next, a point location is specified. The reported measurement is the perpendicular distance from the element to the point location.
Minimum Between	Two elements are selected. The smallest possible distance between the two elements is reported.
Maximum Between	Two elements are selected. The largest possible distance between the two elements is reported.

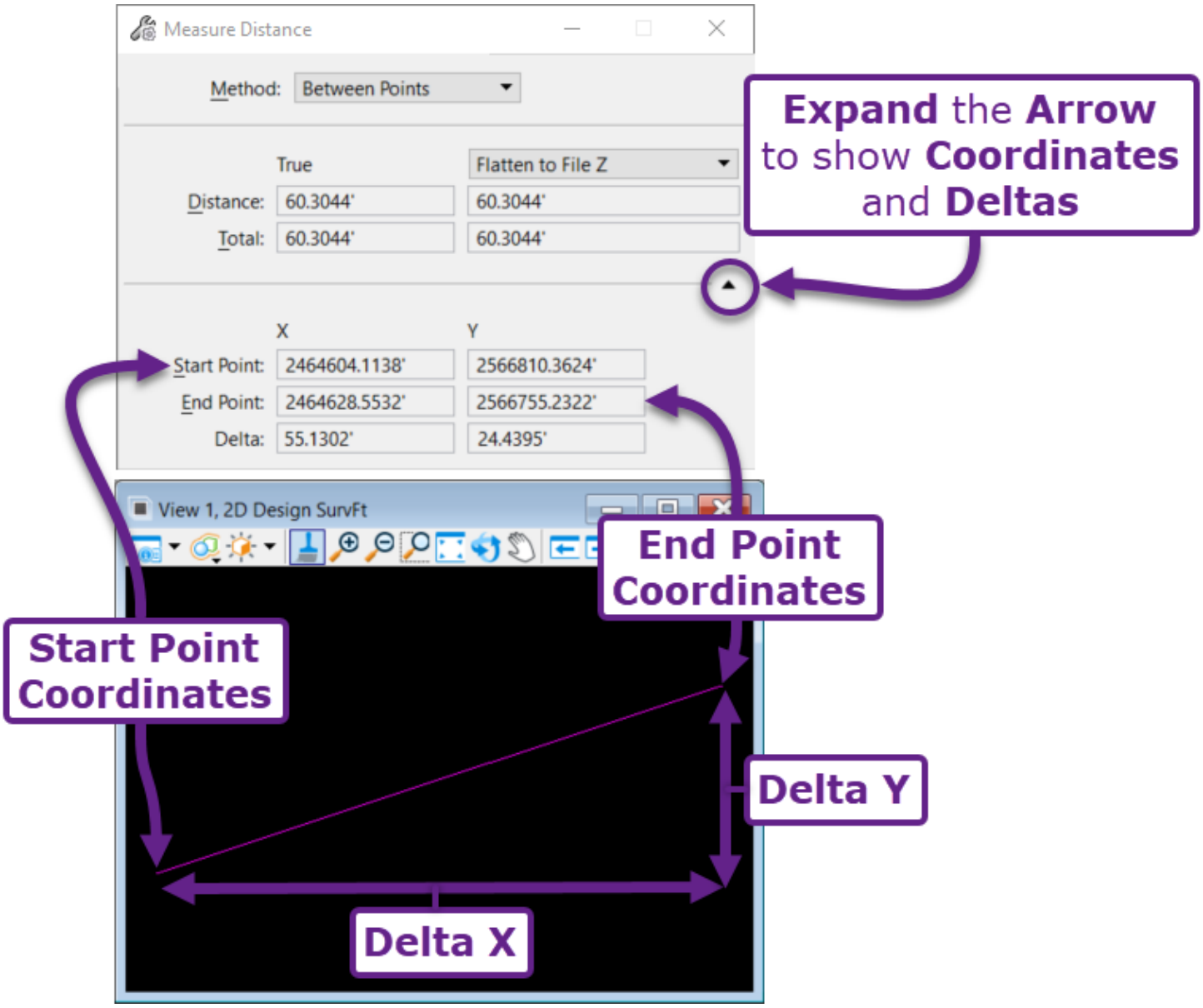
There are two columns shown in the Dialogue Box: the **True** column and the **3D Flattening** column.

True: This column reports the actual distance between the measured points. When measuring in the *2D Design Model*, the measurements shown in this column should be used.

3D Flattening: This column is ONLY consequential when measuring in the *3D Design Model*. The distances shown in this column is projected and measured along the specified plane. When measuring in the *2D Design Model*, the measurements shown in this column should be ignored.



In the Dialogue Box, expand the ▼ arrow to show the Coordinate values and Delta of the last measured segments.

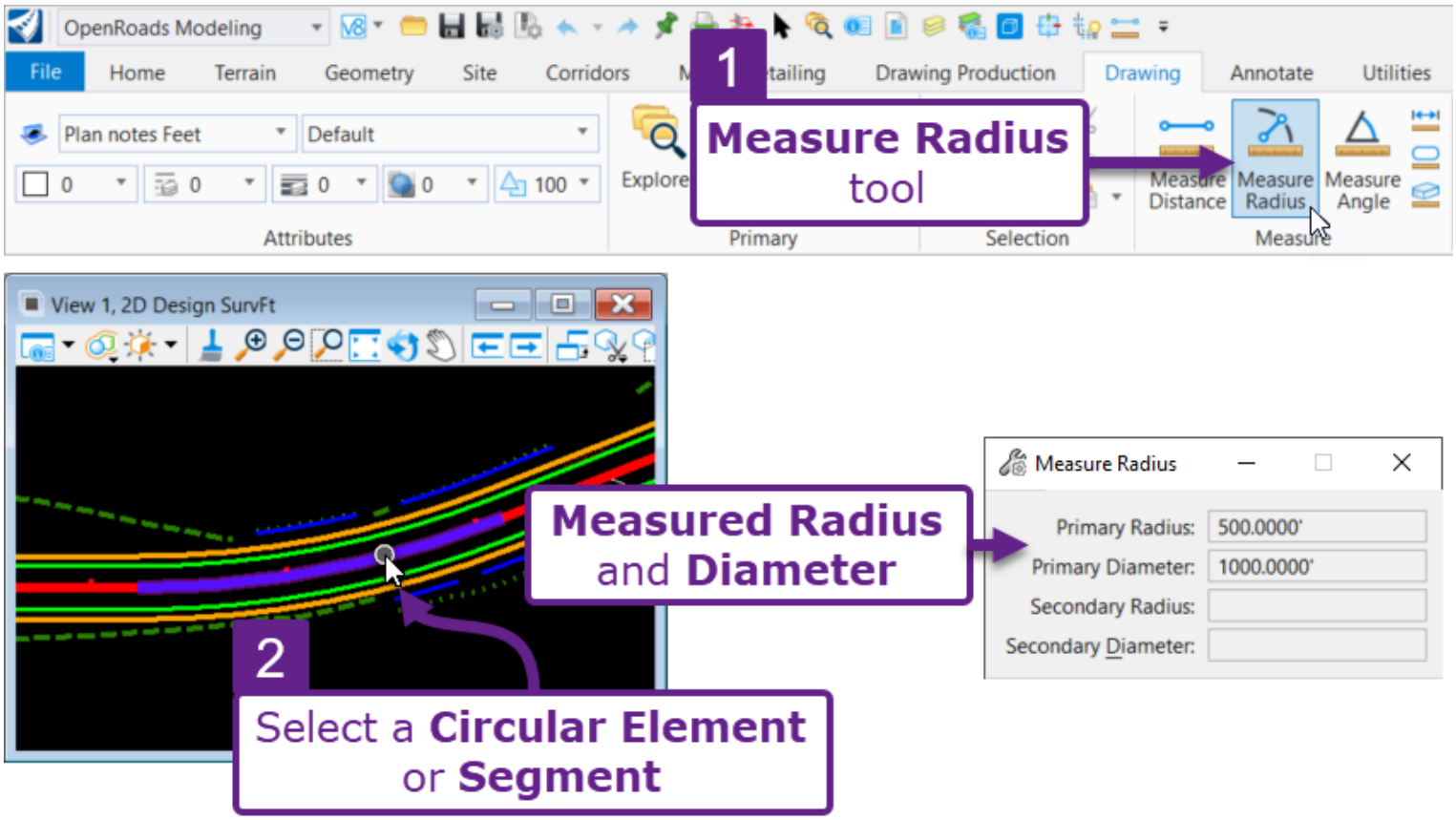


6G.2 Measure Radius tool

This tool is used to measure the radius and diameter of Arc, Circle, and Elliptical elements.

TIP: An individual Arc or Fillet segment within a SmartLine, Complex Chain, Complex Shape, or Complex Element can be selected with this tool.

NOTE: Secondary Radius and Secondary Diameter values are only shown for Ellipse and Elliptical Arc elements.



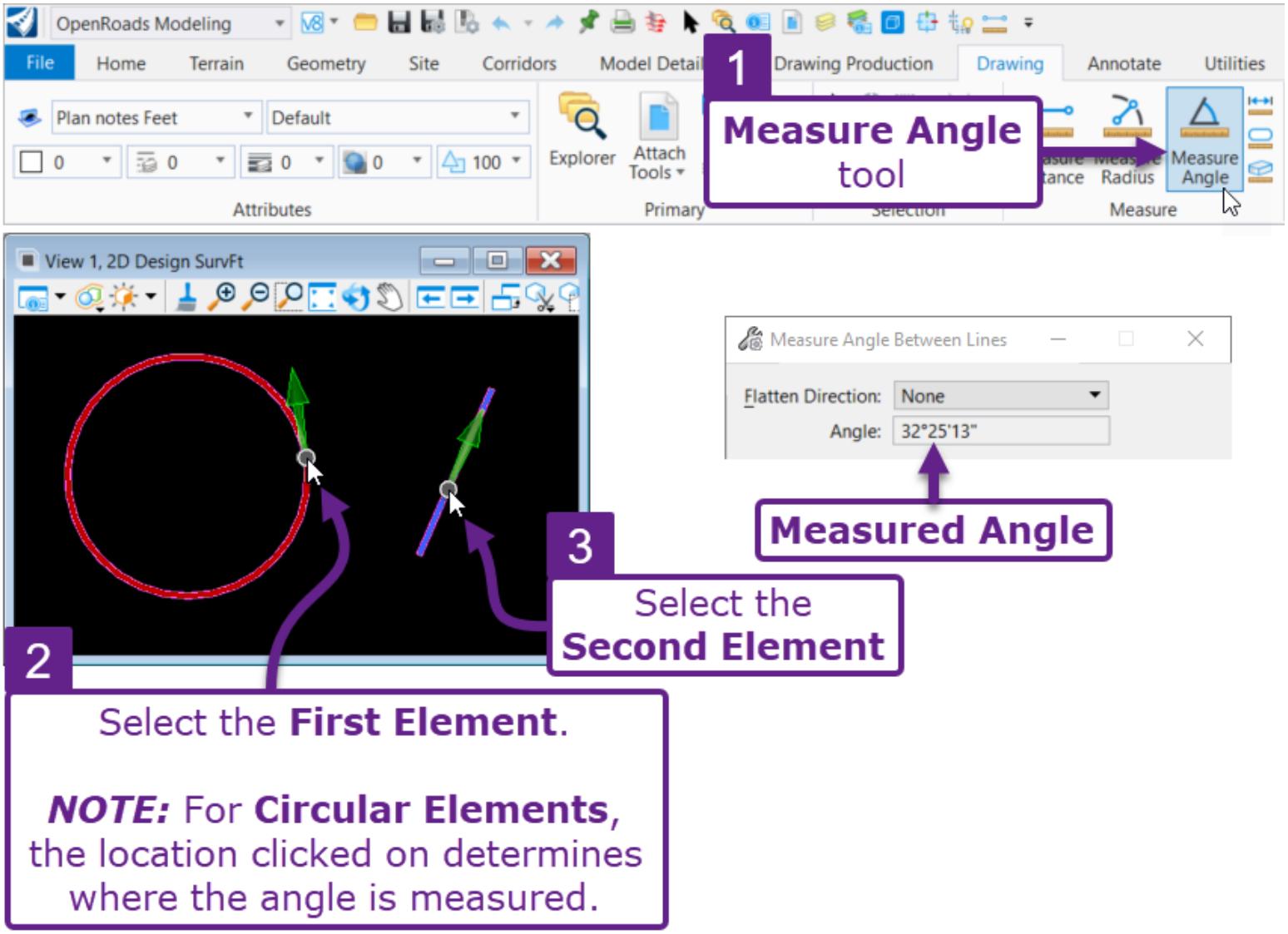
6G.3 Measure Angle tool

This tool is used to measure the angle between any two elements.

NOTE: The two selected elements do NOT have to intersect, overlap, or contain common end points. The two selected elements do NOT have to be in contact with each other.

TIP: If a Circle or Arc element is selected, then the point location where the element selected is analyzed. The angle measurement is tangential to the point location on the Circle or Arc element.

TIP: When an element is selected, a green or red arrow is shown. The measurement is relative to the arrow direction. The arrow direction can be flipped by left-clicking on the arrow.

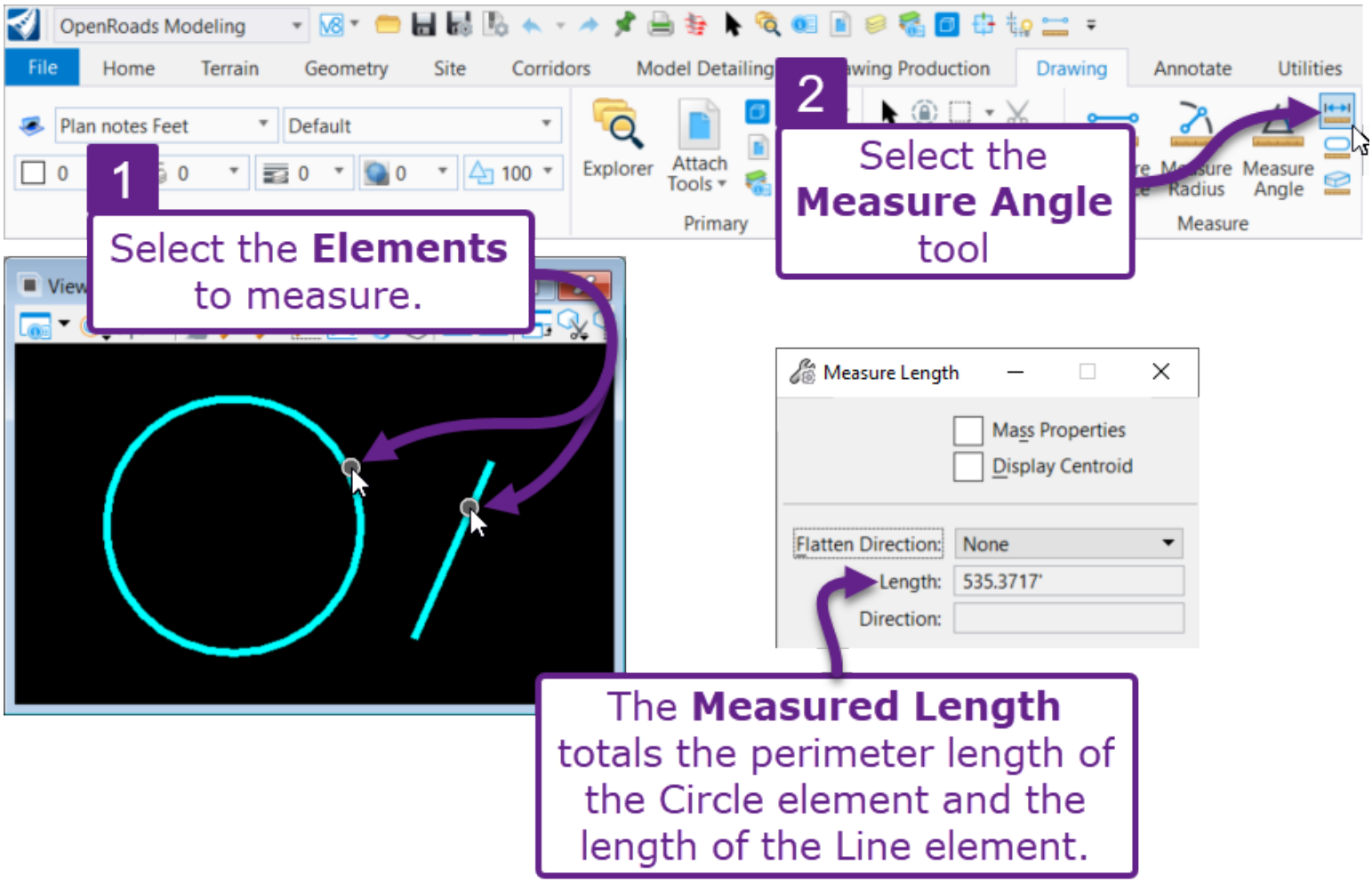


Flatten Direction: This option is ONLY relevant when measuring angles in the *3D Design Model*. If a Flatten Direction is specified, then the Angle value is projected and measured along the *active* View window plane.

6G.4 Measure Length tool

This tool is used to measure the lineal length of a selected element(s).

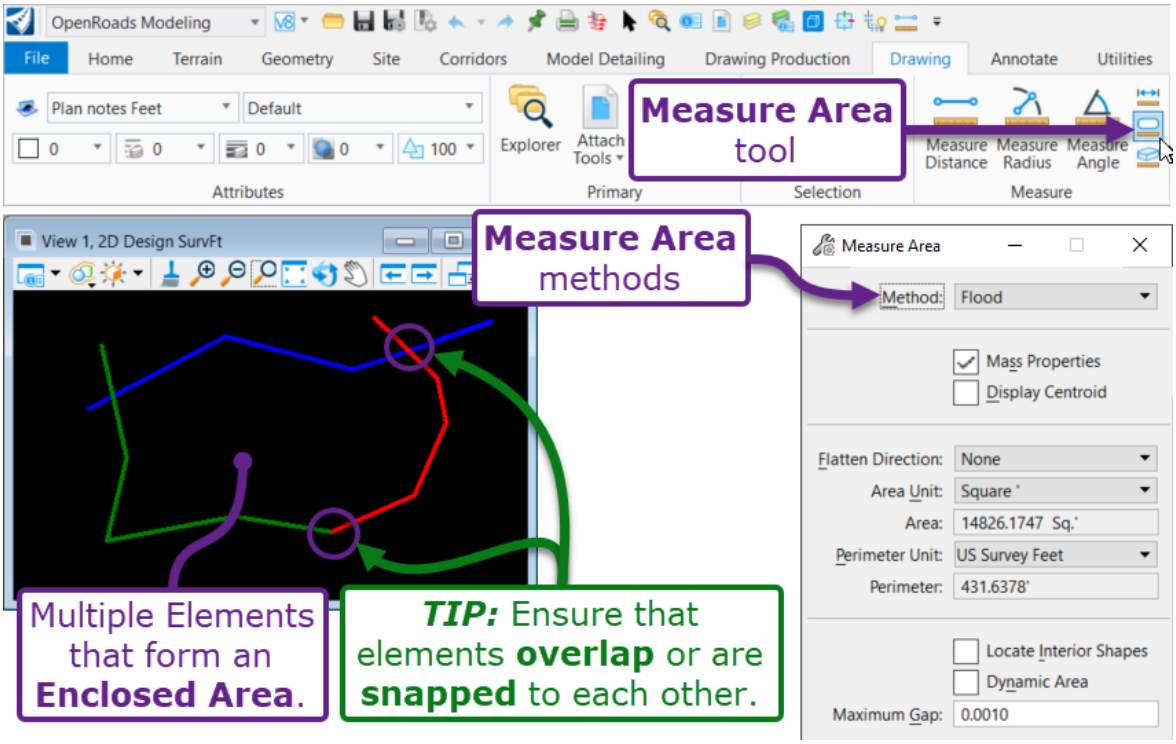
TIP: The total length of multiple elements can be measured by selecting multiple elements BEFORE executing the *Measure Length* tool.



Measure Length Dialogue Box Options	
Option:	**Description:**
Mass Properties	If CHECKED, then a separate information box is opened. The information box contains information relating to Centroid, Mass, Moment of Inertia, Product of Inertia, and Radii of Gyration for the selected element.
Display Centroid	If CHECKED, then a symbol is shown that represents the centroid of the selected element(s).
Flatten Direction	This option is ONLY relevant when measuring lengths in the *3D Design Model* . If a Flatten Direction is specified, then the Length is projected and measured along the specified plane.
Direction	If a Line element is selected, then this box shows the Bearing angle direction of the Line.

6G.5 Measure Area tool

This tool measures the area and perimeter of a closed shape element (Element method) or an area that is enclosed by multiple elements (Flood method).



Measure Area Methods	
Method:	**Description:**
Element	With this option a single closed shape element is selected and the area is measured. The following element types are compatible with this method: Circle, Ellipse, Shape, and Complex Shape.
Fence	This option is ONLY available if an active Fence is set. The total area of the active Fence is measured.
Intersection	The common area between two overlapping, closed elements is measured.
Union	Measures the total area of two or more overlapping closed elements. ***TIP:*** When prompted to *Identify Union Elements* - hold down the left-click button to draw a line. All closed elements that intersect the line will be measured.
Difference	Measures the non-overlapping area of two or more overlapping elements.
Flood	The enclosed area formed by multiple elements is measured. ***WARNING:*** Ideally, there should be NO gaps in the between the elements that form the enclosed area. This method has difficulty delineating the closed area if gaps are present between elements. Theoretically, the Maximum Gap setting can be increased to accommodate gaps. However, this setting typically has no effect. ***BEST PRACTICE:*** Manipulate elements that form the area to ensure NO gaps are present. Ensure that adjacent elements segments overlap or that the start/end points are snapped to each other.
Points	The User click in several locations to create a closed area. When the last point is place upon the first point (area is closed), an area measurement is provided.

Measure Area Dialogue Box Options	
Option:	**Description:**
Mass Properties	If CHECKED, then a separate information box is opened. The information box contains information relating to Centroid, Mass, Moment of Inertia, Product of Inertia, and Radii of Gyration for the enclosed area.
Display Centroid	If CHECKED, then a symbol is shown that represents the centroid of the measured area.
Flatten Direction	This option is ONLY relevant when measuring areas in the *3D Design Model* . If a Flatten Direction is specified, then the area is measured along the *active* View window plane.

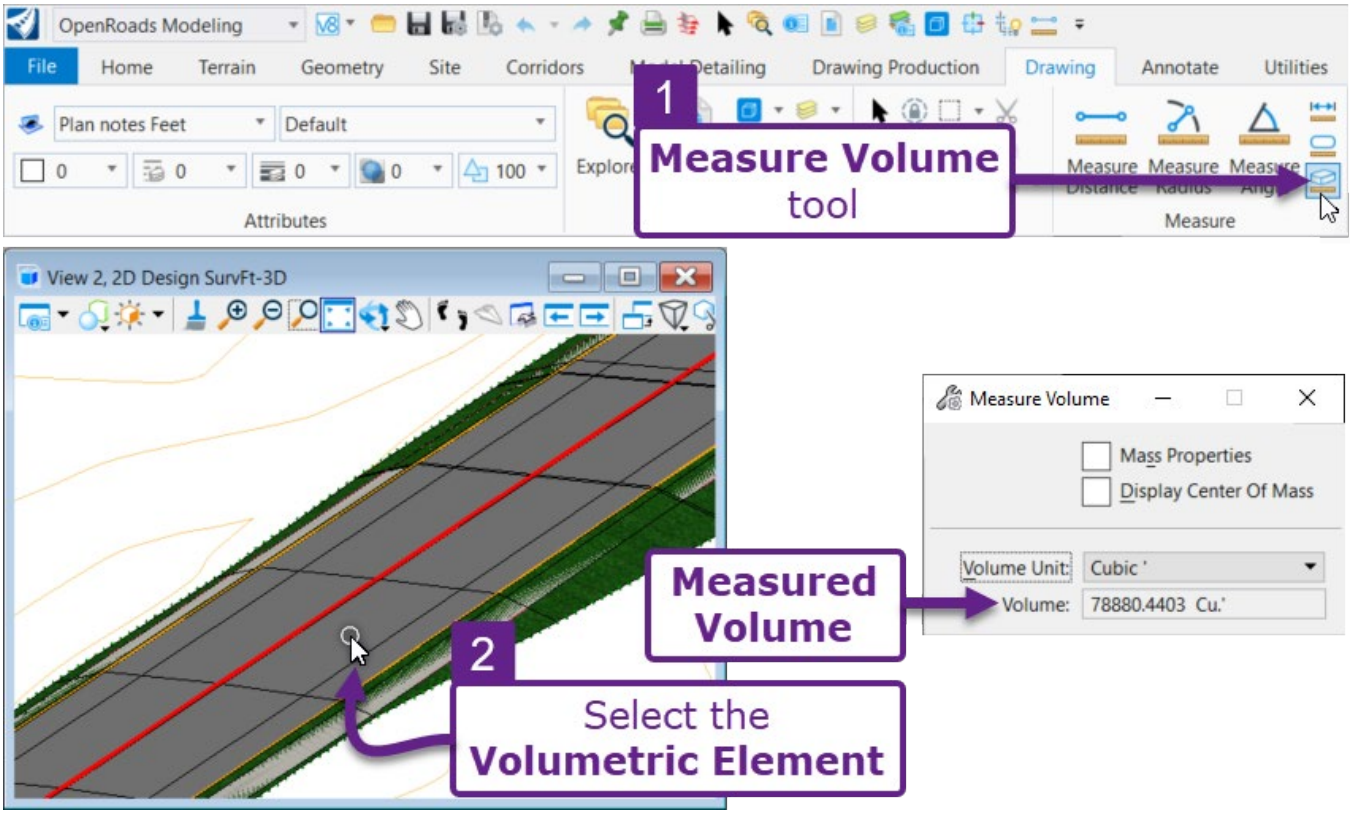
Flood Method Dialogue Box Options	
Option:	**Description:**
Locate Interior Shapes	If CHECKED, then closed shapes and areas that are located inside of the measured area are NOT calculated into the measurement.
Dynamic Area	If CHECKED, then enclosed areas are shown by hovering the mouse cursor over them. Left-Click in the area to obtain a measurement.
Maximum Gap	Sets the maximum acceptable distance between adjacent elements for an area measurement to register.

6G.6 Measure Volume

This tool measures the volume of 3D elements.

TIP: This tool is compatible with volumetric Template Components found in the *3D Design Model* . For example, the "Pavement Layer 1" Component can be selected with tool to measure an Asphalt quantity.

Similarly, after using the *Create Cut Fill Volumes* tool, a cut or fill component can be selected for direct measurement. Using the *Create Cut Fill Volumes* tool to measure earthwork quantities is discussed in *20B – Create Cut Fill Volume tool and Earthwork Calculations*.

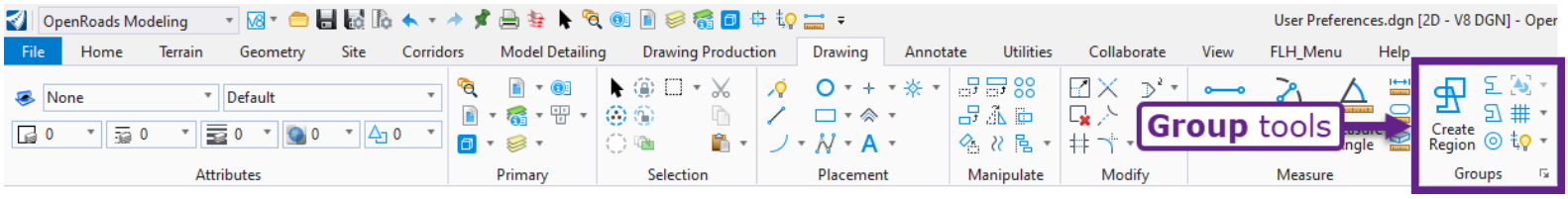


Measure Volume Dialogue Box Options	
Option:	**Description:**
Mass Properties	If CHECKED, then a separate information box is opened. The information box contains information relating to Centroid, Mass, Moment of Inertia, Product of Inertia, and Radii of Gyration of the volume.
Display Centroid	If CHECKED, then a symbol is shown that represents the centroid of the measured volume.

6H – GROUPS TOOLS

The tools found in the Group group are generally used to combine multiple elements into a single element. The *Drop Element* tool is used to break up a single element into multiple component elements. Group tools are found at two main locations in the Ribbon:

1. **OpenRoads Modeling** workflow → **Drawing** tab → **Group** group
2. **Drawing** workflow → **Home** tab → **Group** group

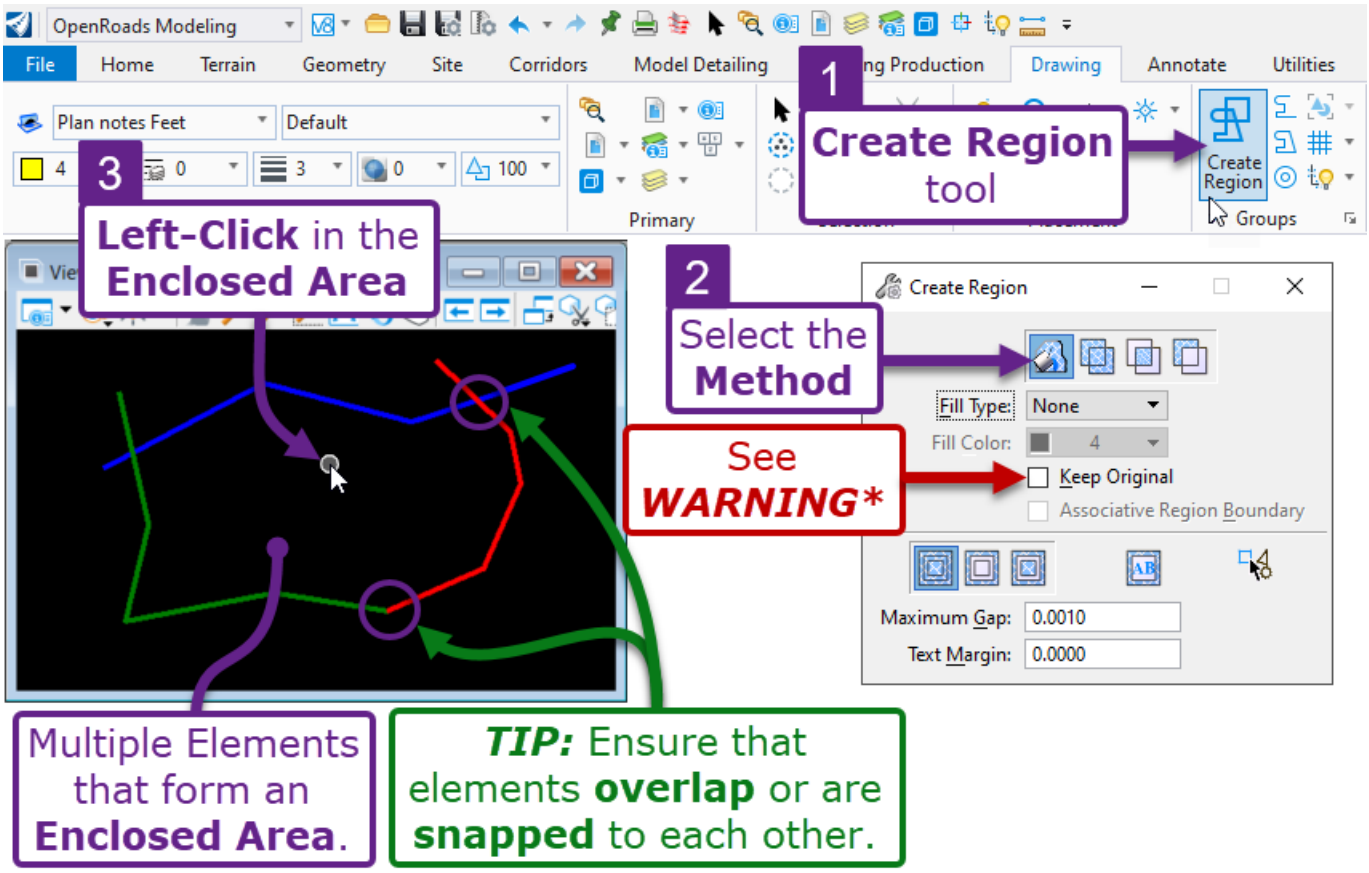


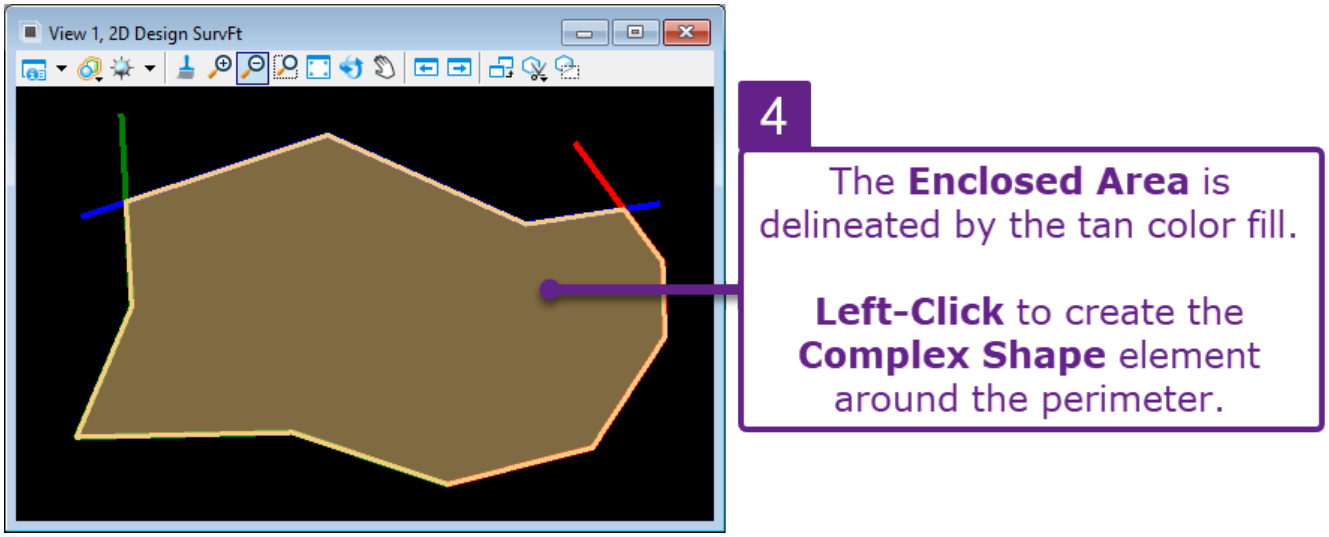
6H.1 Create Region tool

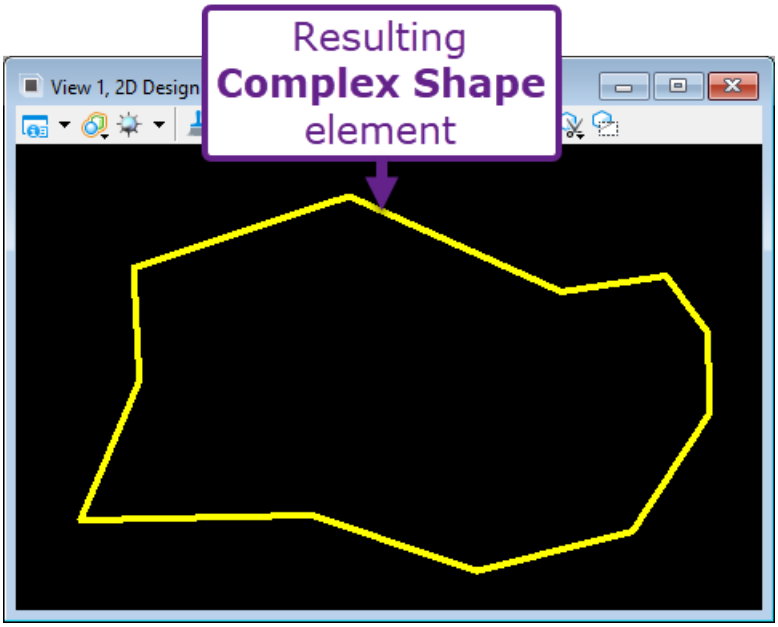
This tool creates a Complex Shape element around the perimeter of an enclosed area that is formed by multiple, overlapping elements.

NOTE: This tool and the *Create Complex Shape* tool both create a Complex Shape element. The difference between these two tools pertains to how the contributing elements are initially setup. This tool uses a Flood method to determine a closed area and then creates a Complex Shape around the perimeter. With the *Create Complex Shape* tool, the elements that form the shape must be continuous (i.e., each adjacent element must be snapped to each other).

WARNING*: If the **Keep Original** box is UNCHECKED, then the contributing elements will be deleted. CHECK this box to NOT delete the contributing elements.







The primary method for this tool is the **Flood** method. However, there are 4 methods in total:

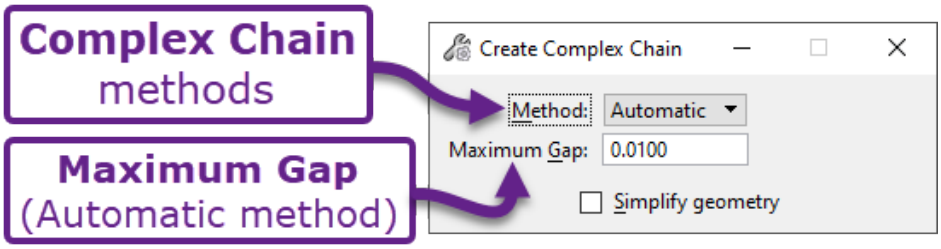
Create Regions Methods		
Method:		**Description:**
Flood		A Complex Shape element is created around the enclosed area formed by multiple elements. ***WARNING:*** Ideally, there should be NO gaps in the between the elements that form the enclosed area. This method has difficulty delineating the closed area if gaps are present between elements. Theoretically, the Maximum Gap setting can be increased to accommodate gaps. However, this setting typically has no effect. ***BEST PRACTICE:*** Manipulate elements that form the area to ensure NO gaps are present. Ensure that adjacent elements segments overlap or that the start/end points are snapped to each other.
Union		Creates a Complex Shape element around the perimeter of two or more overlapping closed elements. When prompted to *Identify Union Elements* - hold down the left-click button to draw a line. All closed elements that intersect the line will be used.
Intersection		The common area between two overlapping, closed elements is used. The Complex Shape element is created around the perimeter of the common area
Difference		A non-overlapping area of two elements is selected and used. The Complex Shape element is created around the perimeter of the selected non-overlapping area.

For more information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

Flood Method Dialogue Box Options		
Option:		**Description:**
Ignore Interior Shapes		A Complex Shape element is created around the exterior of the enclosed area.
Locate Interior Shapes		If toggled ON and interior shapes are found within the enclosed area, then a Grouped Hole element is created. For more information on Grouped Hole elements, see *6H.4 Group Hole tool*.
Identify Alternating Interior Shapes		If toggled ON and a series of interior shapes are found within the enclosed area, then a Grouped Hole element is created.
Locate Interior Text		If toggled and Text elements are found within the enclosed area and a Grouped Hole element is created.
Dynamic Area Locate		If toggled ON, then enclosed areas are shown when hovering the mouse cursor over them.
Maximum Gap		Sets the maximum acceptable distance between adjacent elements for an area measurement to register.
Text Margin		This option is only relevant if **Locate Interior Text** is toggled ON. The interior shape created around the text element is offset outwards by the specified value.

6H.2 Create Complex Chain tool

This tool creates a Complex Chain element by joining multiple elements together. Ideally, the contributing elements should be continuous (i.e., each adjacent element must be snapped to each other at the end points). If there is a gap between the selected elements to be joined together, then the gap is automatically spanned. However, unpredictable results may occur in the automatic spanning process.

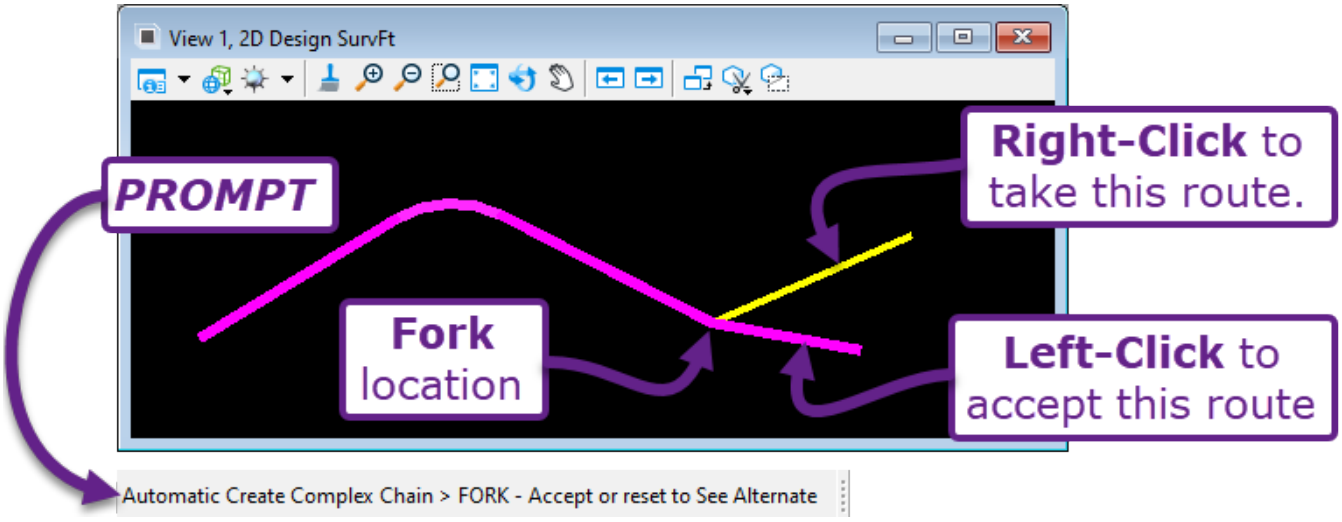


This tool has two Methods creating a Complex Chain element:

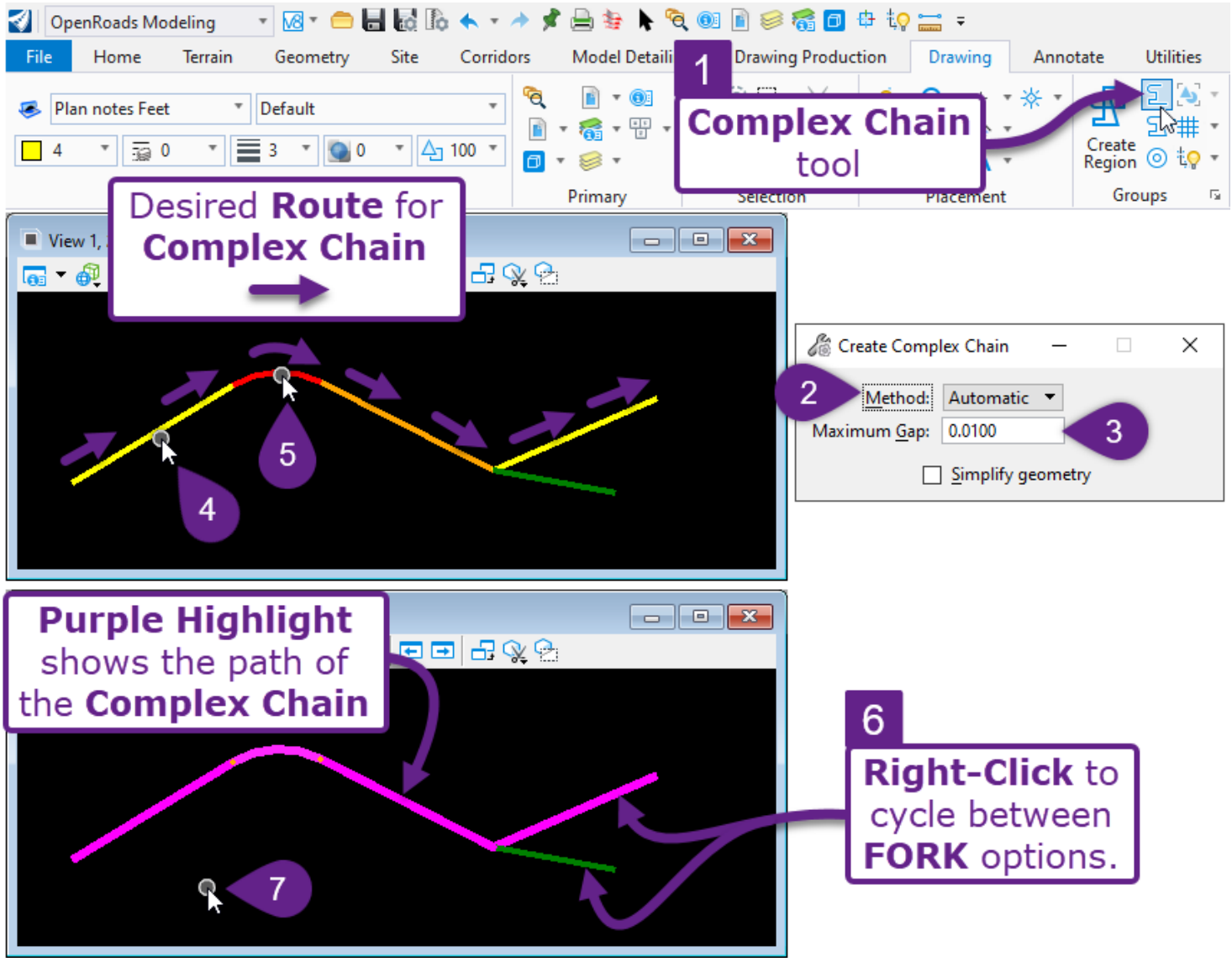
Create Complex Chain Methods	
Method:	**Description:**
Manual	Each element used to form the Complex Chain is manually selected by the User.
Automatic	The first element to form the Complex Chain is selected. All elements connected to the first element are automatically selected to form the Complex Chain.

Create Complex Chain Dialogue Box Settings	
Setting:	**Description:**
Maximum Gap	This option is ONLY available if the **Automatic** method is used. Sets the maximum acceptable distance between adjacent elements for inclusion in the Complex Chain.
Simplify Geometry	If CHECKED, then adjacent Line elements are incorporated as Line String sub-components within the resulting Complex Chain. If the contributing elements are ALL Line elements, then the resulting element type is a Line String.

IMPORTANT: Pay close attention to *Prompts* shown at the bottom of the ORD Software window. If there are multiple possible routes for the Complex Chain to follow, then the following message is shown: *Prompt: FORK – Accept or reset to See Alternative*. If shown, left-click to accept the route that is highlighted in purple OR right-click to cycle between the other possible routes.



The workflow for creating a Complex Chain element is as follows:



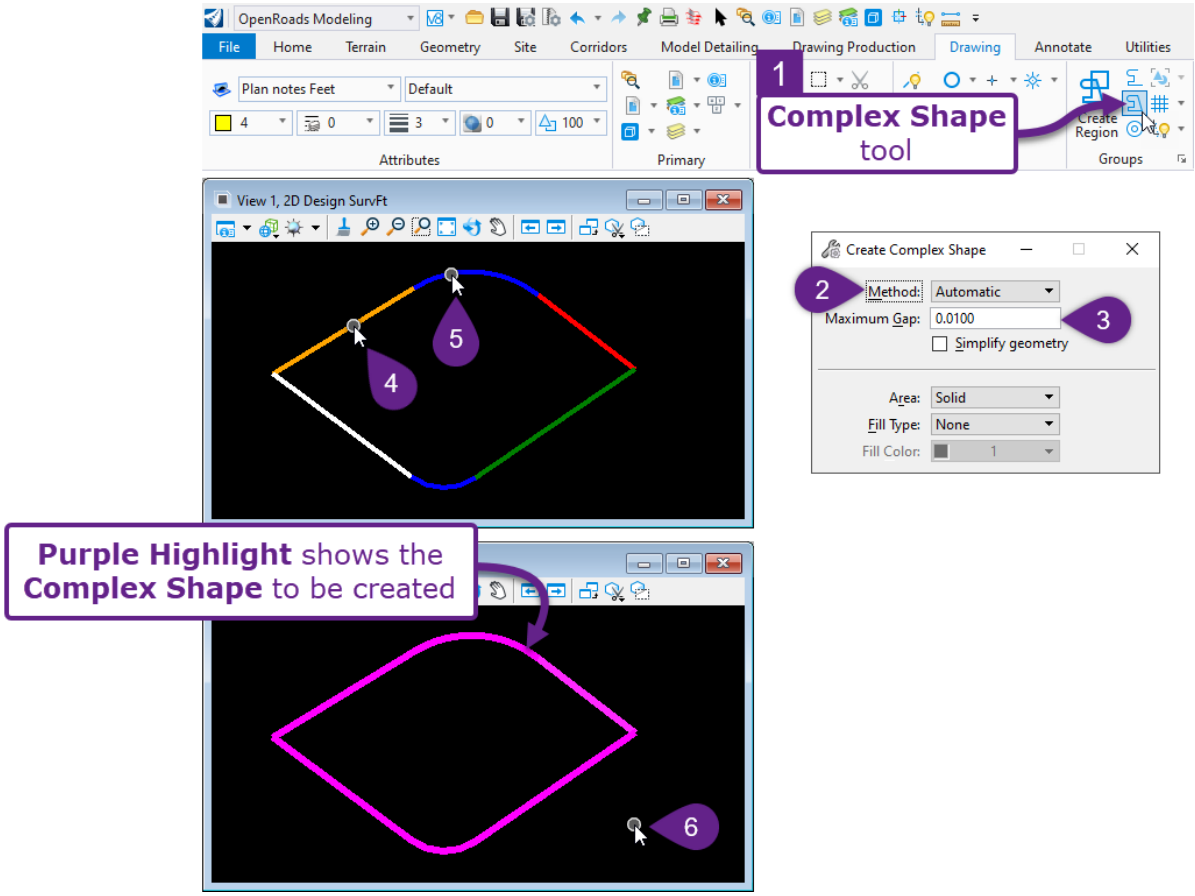
1	From the Ribbon, select the *Create Complex Chain* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Groups***].
2	Set the **Method**. In this case, the Automatic method is used.
3	Specify the **Maximum Gap** value. In this case, the default value (0.0100) is used because the contributing elements are snapped to each other.
4	*Prompt: Identify Element* – Left-Click on the first element to be included in the Complex Chain.
5	*Prompt: Accept/Reject (select next input)* – Left-Click on the next element in the sequence to be included in the Complex Chain.
6	*Prompt: FORK – Accept or reset to See Alternative* – Right-Click to cycle between the other possible routes that arise because of the fork location. Left-Click to accept the highlighted route.
7	*Prompt: Accept Chain Element* – Left-Click anywhere in the *View* window to create/accept the Complex Chain element.

6H.3 Create Complex Shape tool

This tool creates a Complex Shape element by joining multiple elements together. Ideally, the contributing elements should be continuous (i.e., each adjacent element must be snapped to each other at the end points). If there is a gap between the selected elements to be joined together, then the gap is automatically spanned. However, unpredictable results may occur in the automatic spanning process.

The contributing elements should form a continuous, closed shape. However, if the shape is open, then the tool will automatically close the shape by creating a line between the first and last element.

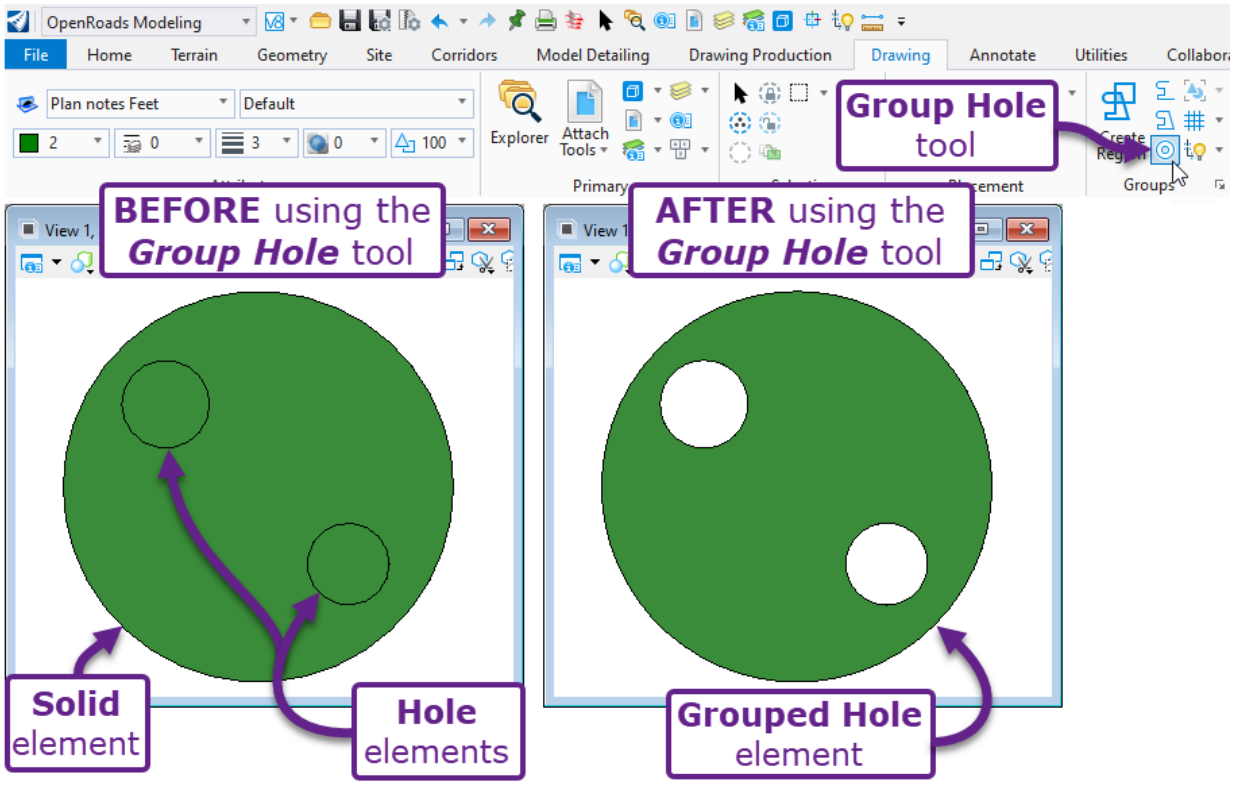
NOTE: The Dialogue Box options for this tool function identically to the *Create Complex Chain* tool. See *6H.2 Create Complex Chain tool*. For information on the **Area**, **Fill Type**, and **Fill Color** settings shown in the Dialogue Box, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.



1	From the Ribbon, select the *Create Complex Shape* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Groups***].
2	Set the **Method**. In this case, the Automatic method is used.
3	Specify the **Maximum Gap** value. In this case, the default value (0.0100) is used because the contributing elements are snapped to each other.
4	*Prompt: Identify Element* – Left-Click on the first element to be included in the Complex Shape.
5	*Prompt: Accept/Reject (select next input)* – Left-Click on the next element in the sequence to be included in the Complex Shape.
6	*Prompt: Shape Closed* – Left-Click anywhere in the *View* window to create/accept the Complex Shape element.

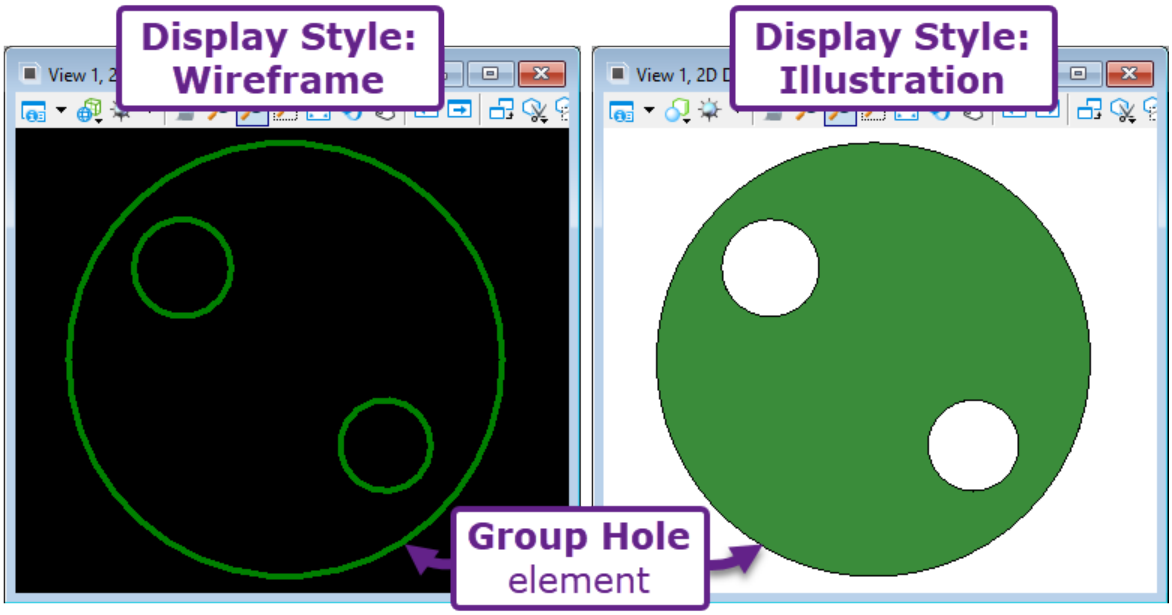
6H.4 Group Hole tool

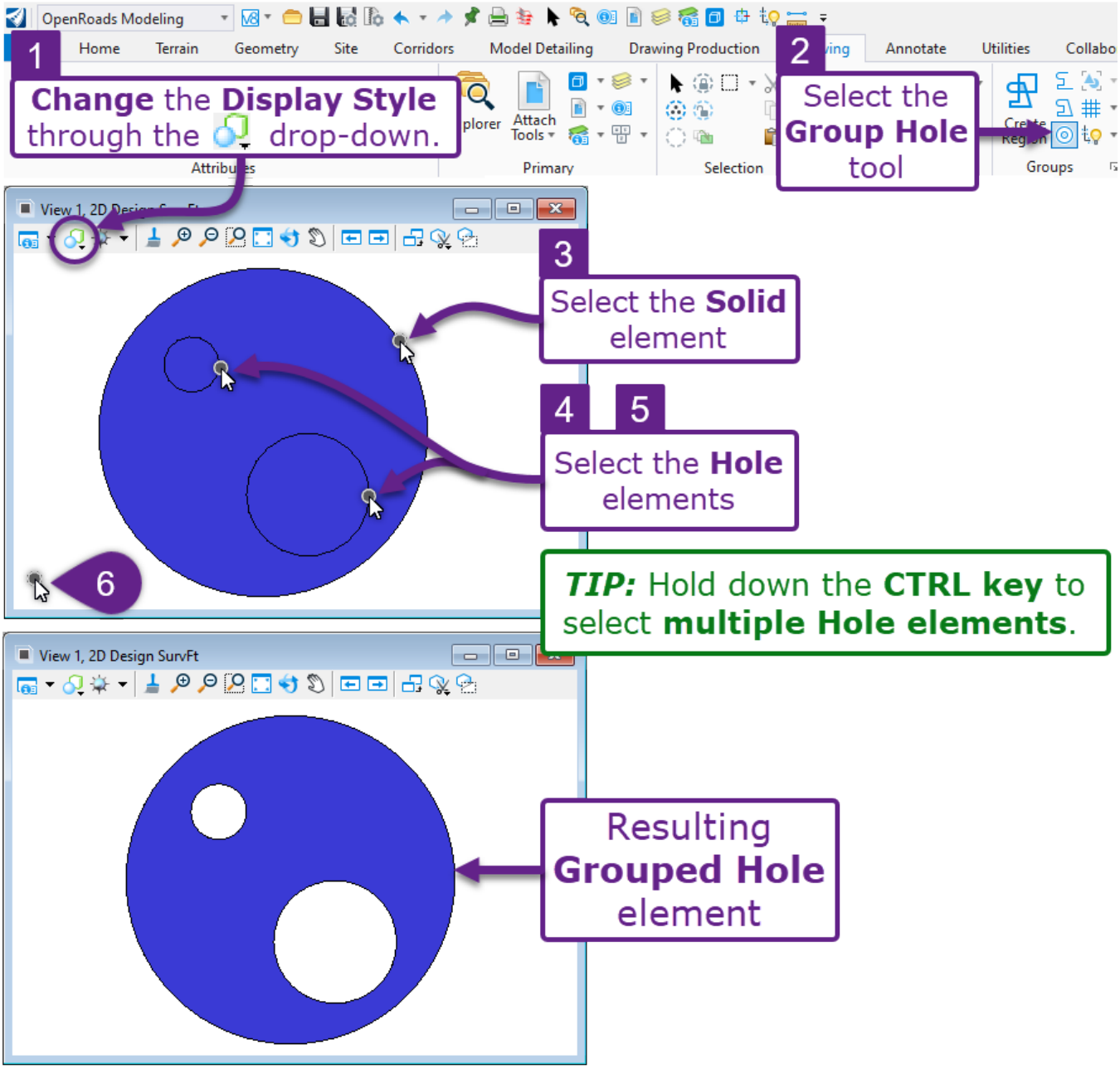
This tool creates a Grouped Hole element from a single **Solid** element and interior-located **Hole** elements. A Grouped Hole element is a Solid element with the interior Holes removed:



BACKGROUND INFORMATION: When a closed shape element type is created, the option to create a Solid or Hole element is presented. Before creating a Grouped Hole element, Solid and Hole elements behave and are displayed identically. For more information on the Solid and Hole settings, see *6C.8 Area and Fill Settings for Closed Shape Element Types*.

WARNING: By default, the *2D Design Model* is set to the "Wireframe" Display Style which makes it visually impossible to distinguish between solid and hole portion of a Grouped Shape element. Change the Display Style to a different style to review a Grouped Hole element.





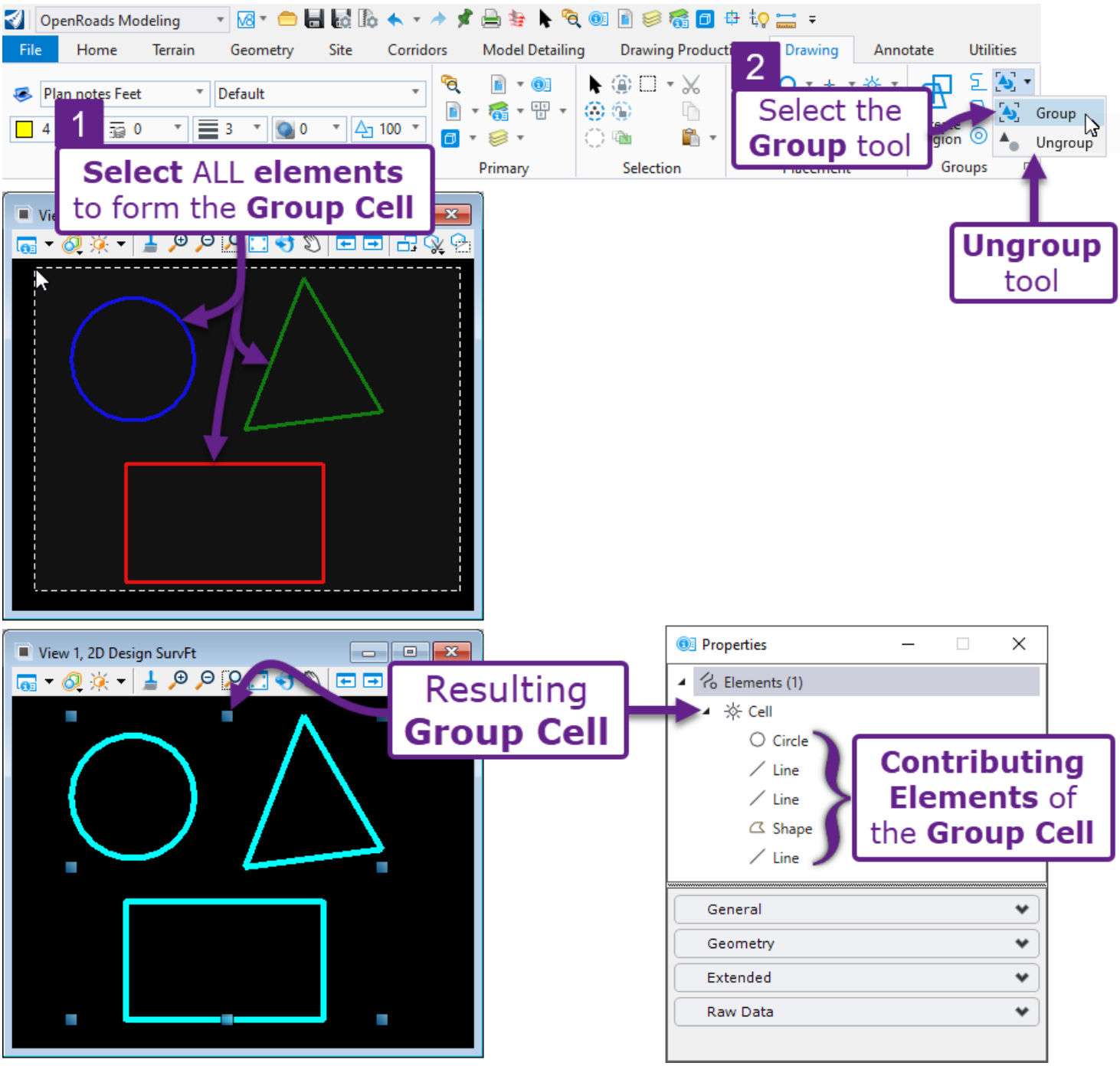
1	Change the **Display Style** of the *View* window, so the Grouped Hole element can be reviewed after creation. In this case, the Display Style is changed to "Illustration". For more information on changing the Display Style, see *1C.3 View Window Tools*.
2	From the Ribbon, select the *Group Hole* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Groups***].
3	*Prompt: Identify Element* – Left-Click on the exterior **Solid** element.
4	*Prompt: Identify Element* – Left-Click on the first **Hole** element to be included.
5	*Prompt: Accept/Reject (CTRL+Data to select)* – While holding down the CTRL key, left-click on the next **Hole** element to be included.
6	*Prompt: Accept/Reject (CTRL+Data to select)* - If no more Hole elements need to be added, Left-Click anywhere in the *View* window to create the Grouped Hole element.

6H.5 Group and Ungroup tools

With the *Group* tool, multiple elements can be quickly formed into a Cell. The resulting Cell is NOT added to the Cell Library. The *Group* tool is intended to lock together a set of elements.

The entire Group Cell can be Moved, Rotated, Copied, and Scaled. However, the geometry of contributing elements in a Group CANNOT be individually edited.

ALTERNATE: To quickly create a Group Cell: select all elements to be included and press CTRL+G.

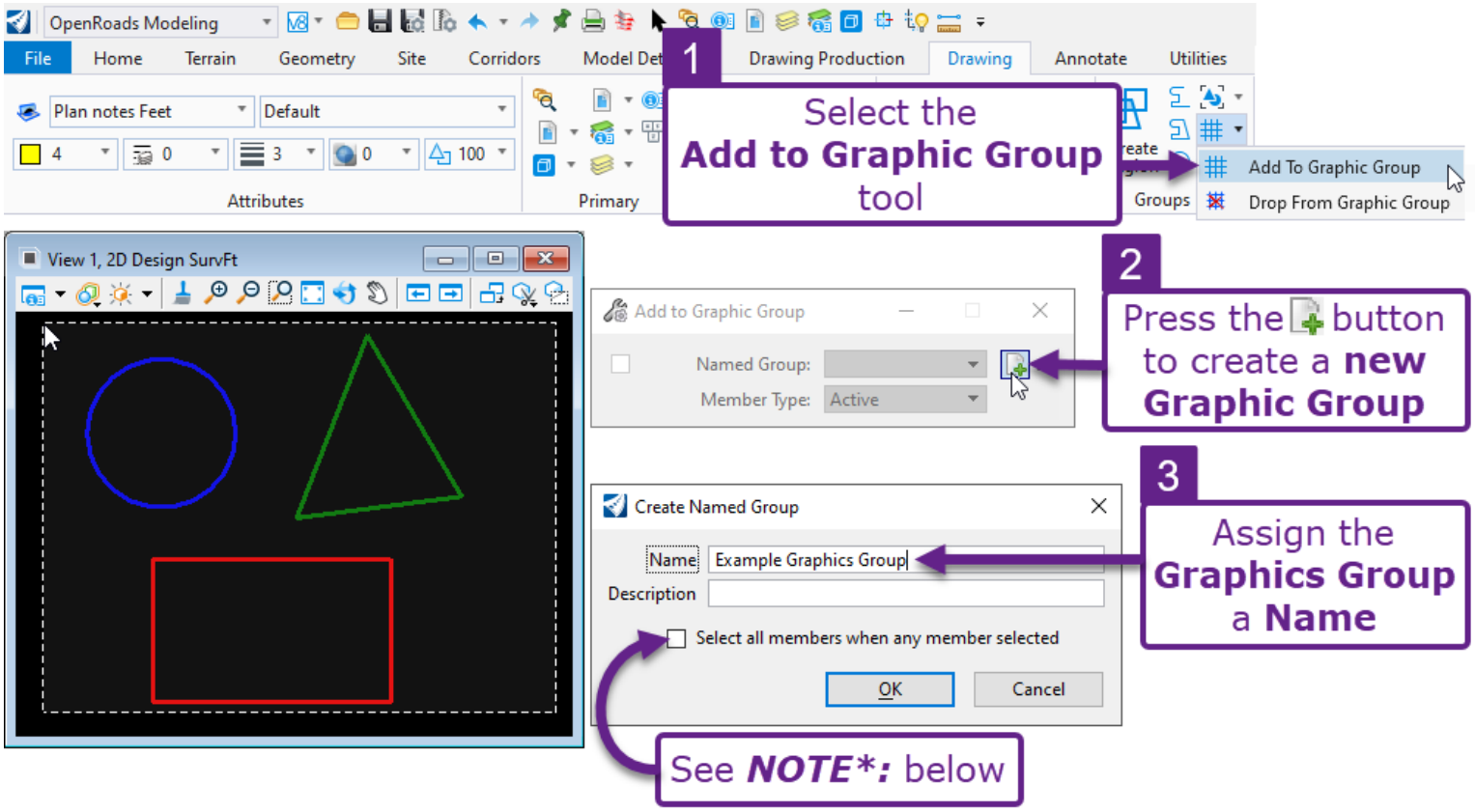


The *Ungroup* tool is used to unlock the contributing elements in a Group Cell. After the *Ungroup* tool is used, the individual elements can be edited.

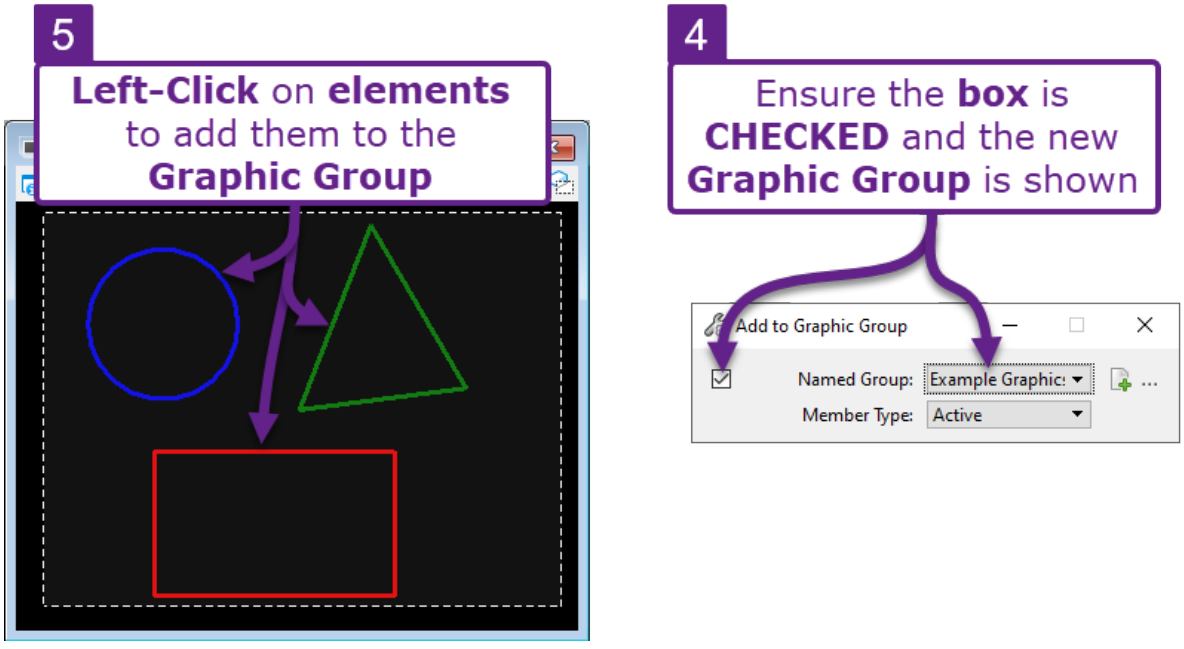
ALTERNATE: To quickly ungroup a Group Cell: select the it and press CTRL+U.

6H.6 Add to Graphic Group tool

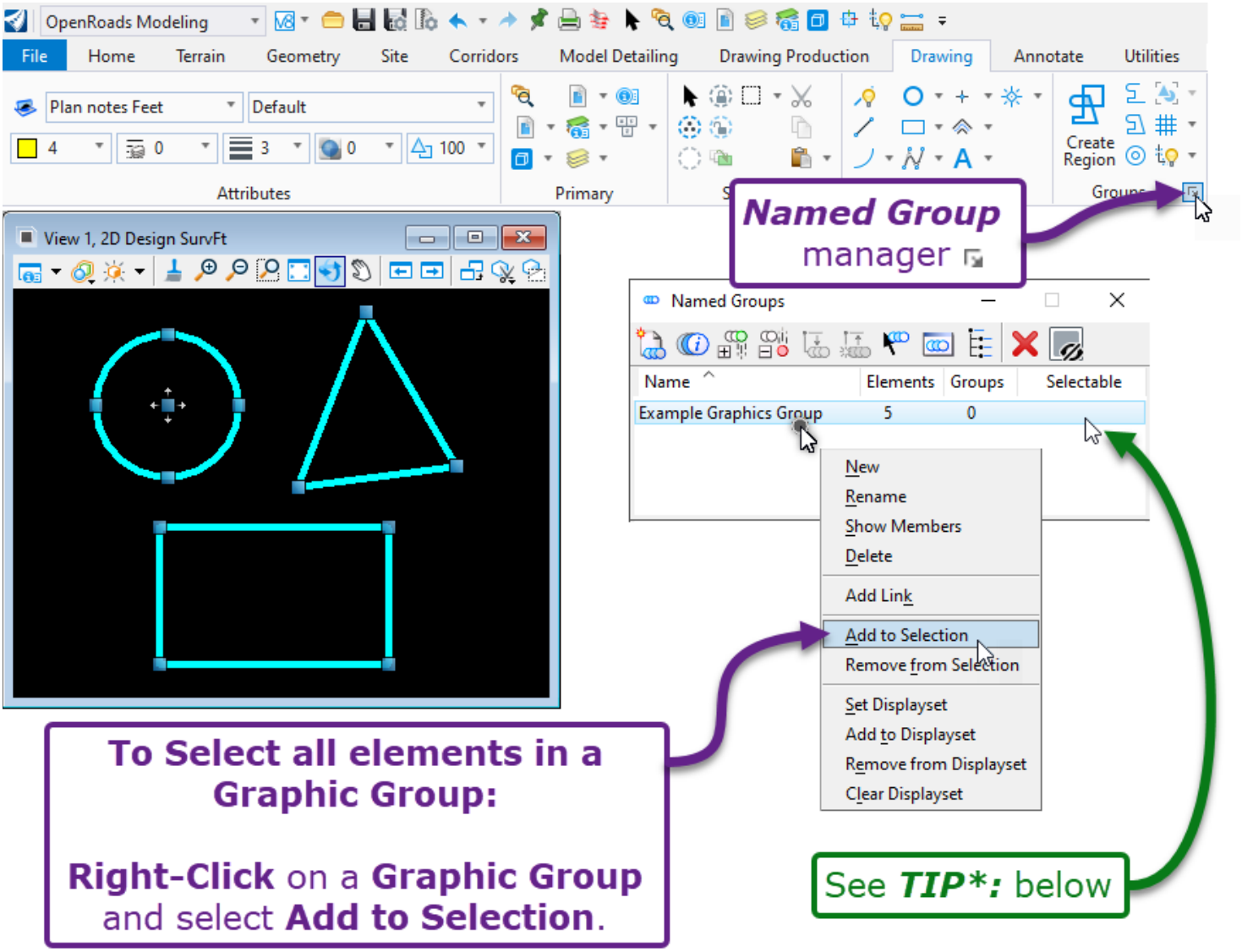
This tool is used to create Graphic Group. Unlike *Groups* (discussed on the previous page), the contributing elements in a Graphic Group can be individually edited. Through the *Named Group* manager, all elements in a Graphic Group can be selected.



NOTE*: If the *Select all members when any member selected* box is CHECKED, then selecting an individual element of the Graphics Group will select ALL elements in the Graphics Group. If UNCHECKED, individual elements are selectable and editable. If UNCHECKED, then all elements in the Graphics Group can be selected through the *Named Group* manager.



The **Named Group** manager is used to select all elements contained in a Graphic Group.

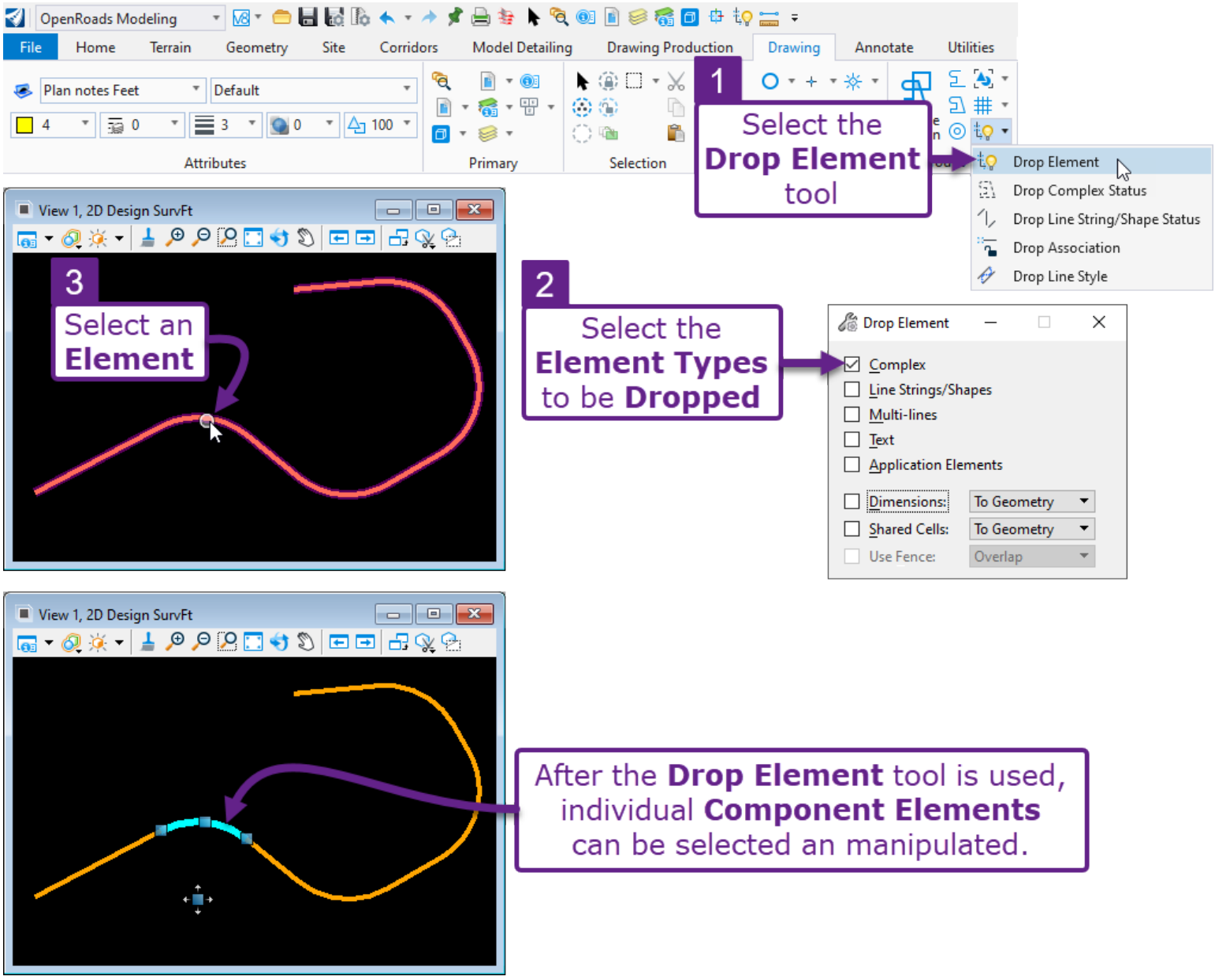


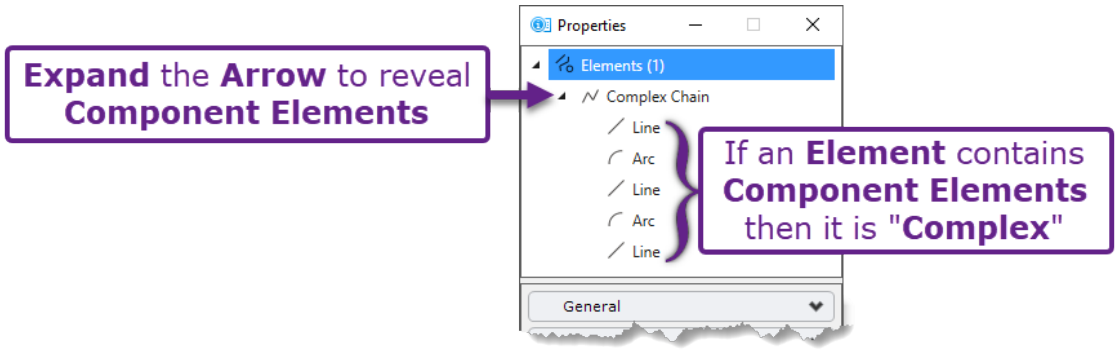
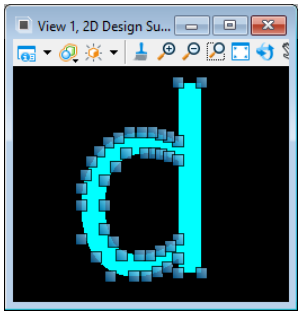
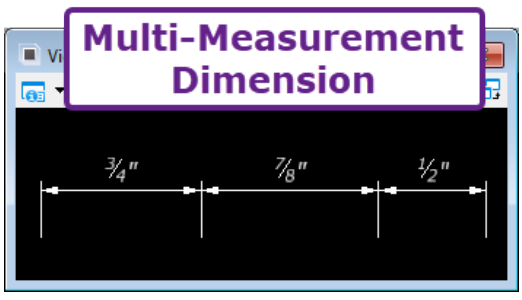
TIP*: Left-Click in the **Selectable** column to place a checkmark. When a checkmark is shown, then selecting an element will select ALL elements in the Graphics Group. When NO checkmark is shown, then elements can be selected individually for editing operations.

6H.7 Drop Element tool

The *Drop Element* tool is used to breakup an element into simpler component elements.

For example, this tool can be used on a Complex Chain to break it up into separate Line and Arc elements.



Drop Element Dialogue Box Settings		
Setting:	**Description:**	
Complex	If CHECKED, Complex type elements are broken down to their Component Elements. ***NOTE:*** Any element that contains Component Elements is considered "Complex". To confirm if an element is Complex, select it and view its Properties.  If UNCHECKED, then Complex type elements included in the selection set are NOT dropped.	
Line Strings /Shapes	Line Strings and Shapes do NOT contain Component Elements, even though they appear to have multiple Line or Arc segments. If CHECKED, then Line String and Shapes are broken down into Line and Arc segments. If UNCHECKED, then Line String and Shape elements included in the selection set are NOT dropped.	
Multi-lines	If CHECKED, then Multi-Line elements are broken down into individual Line elements.	
Text	IF CHECKED, then Text elements are broken down into Lines and other geometrical elements. 	
Dimensions	**To Geometry**	If CHECKED, then Dimension elements are broken down into Text, Lines, and other geometrical elements.
	To Segments	ONLY applies to Multi-Measurement Dimensions.  If CHECKED, then a Multi-Measurement Dimension is broken down into individual Dimension elements.

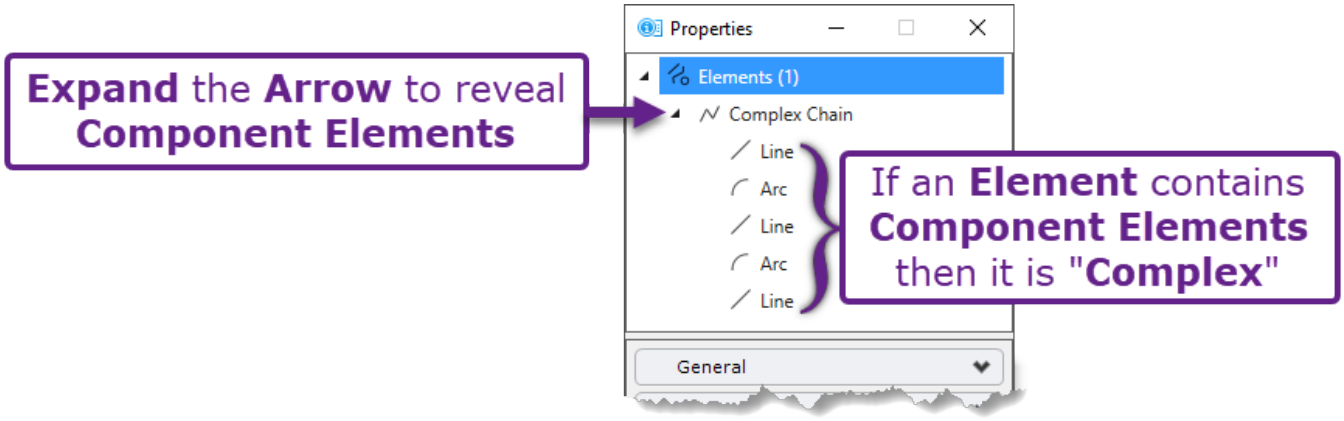
Drop Element Dialogue Box Settings		
Setting:	**Description:**	
Shared Cells	**To Geometry**	If CHECKED, a Shared Cell element is broken down into component elements.
	To Normal Cell	If CHECKED, a Shared Cell element is converted into a Cell. ***NOTE:*** Shared Cells are discussed in *6D.3 Place a Cell (Place Active Cell tool)*.

6H.8 Drop Complex Status tool

This tool is used to break down Complex type elements to their Component Elements.

The operation performed with this tool is equivalent to using the *Drop Element* tool with the "Complex" box CHECKED.

NOTE: Any element that contains Component Elements is considered "Complex". To confirm if an element is Complex, select it and view its Properties .



6H.9 Drop Line Sting/Shape Status tool

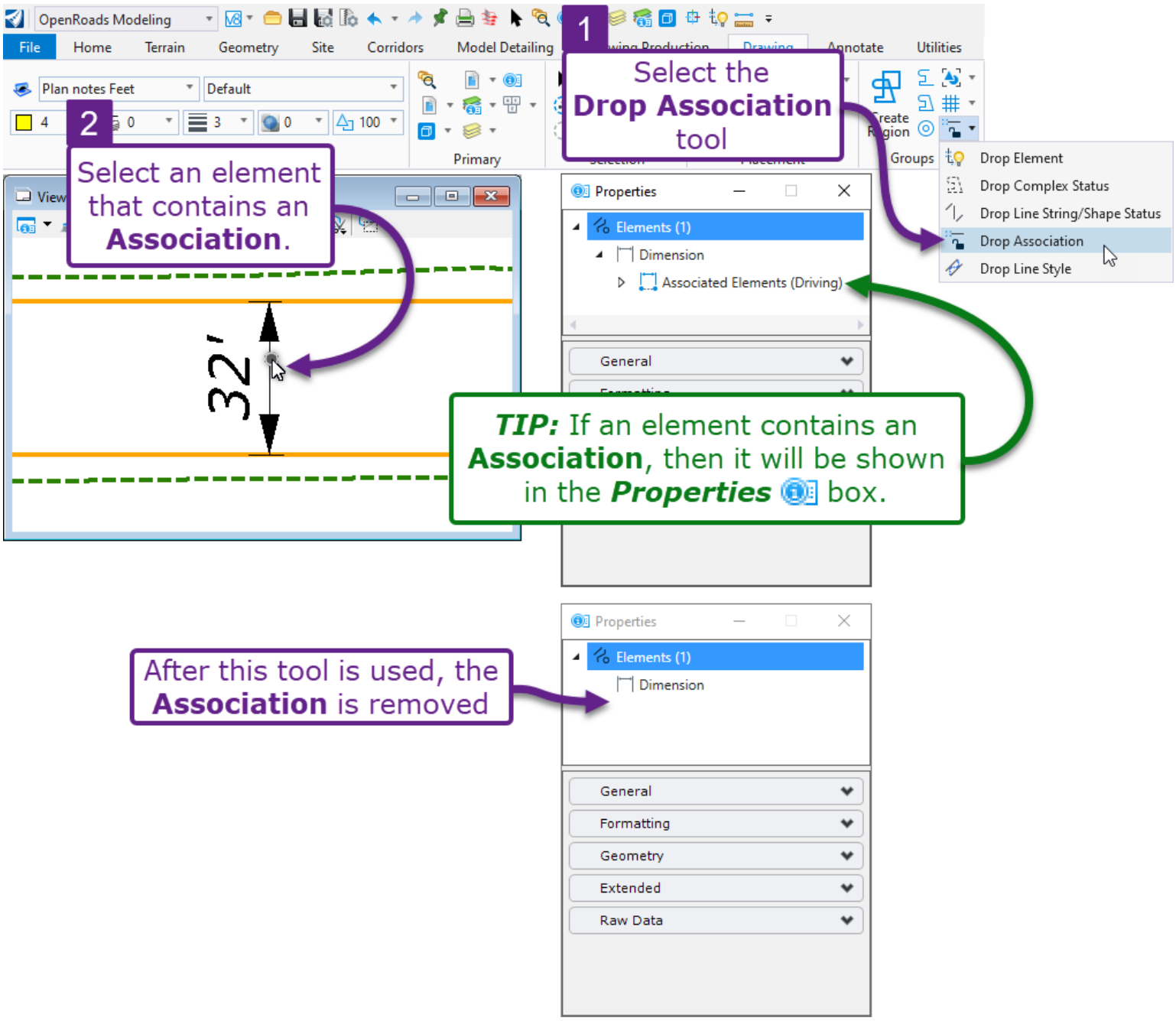
This tool is used to break down a Line String or Shape into multiple Line or Arc segments.

The operation performed with this tool is equivalent to using the *Drop Element* tool with the "Line Strings/Shapes" box CHECKED.

6H.10 Drop Association tool

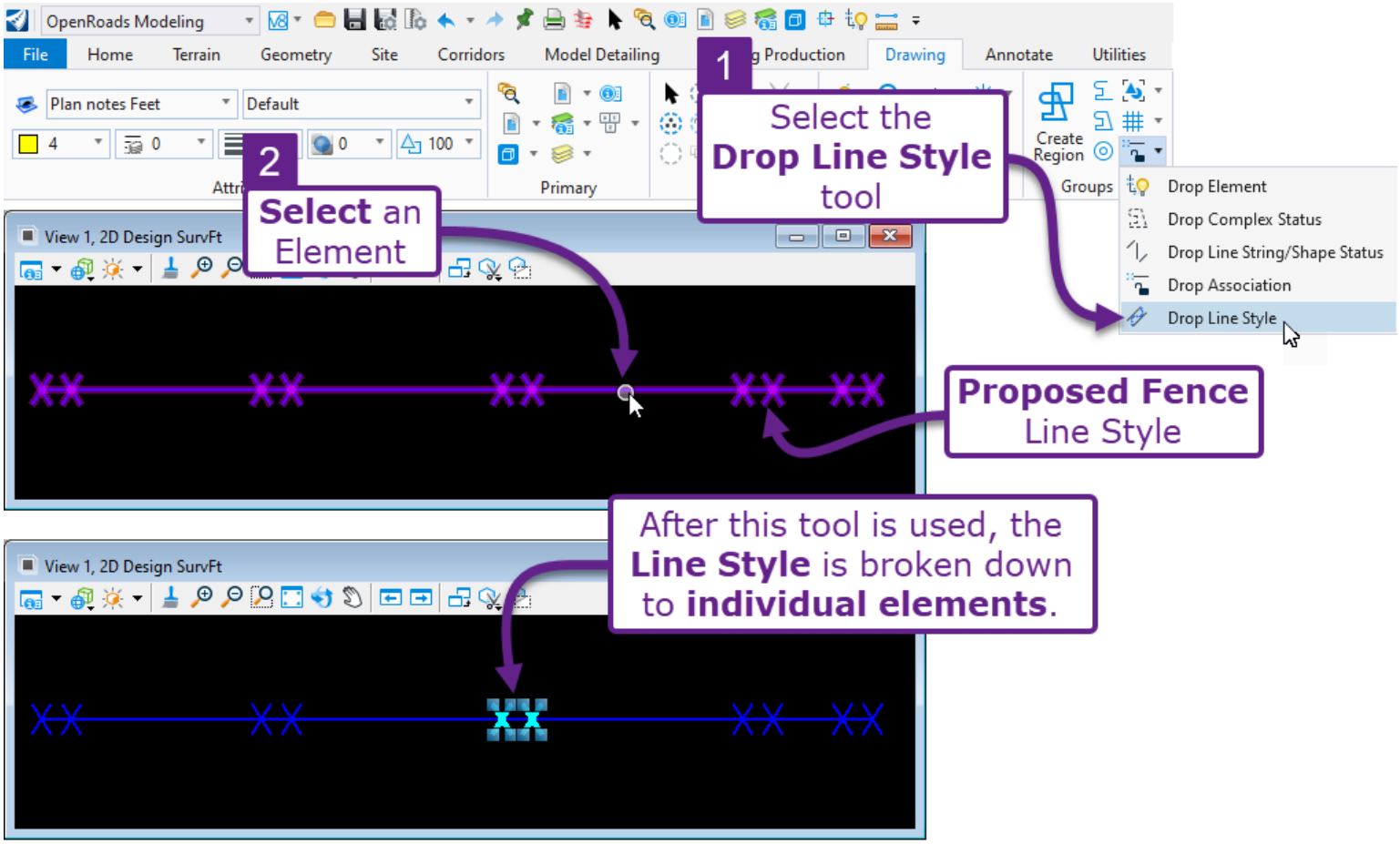
Many types of elements can be created with an association to a reference element(s). For example, a Dimension element can be created with an association to the elements that are being measured. When the measured elements (associated elements) are moved, then the Dimension element automatically adjusts.

The *Drop Association* tool is used to remove the association from an element.



6H.11 Drop Line Style tool

This tool is used to break down a Line Style into individual elements.

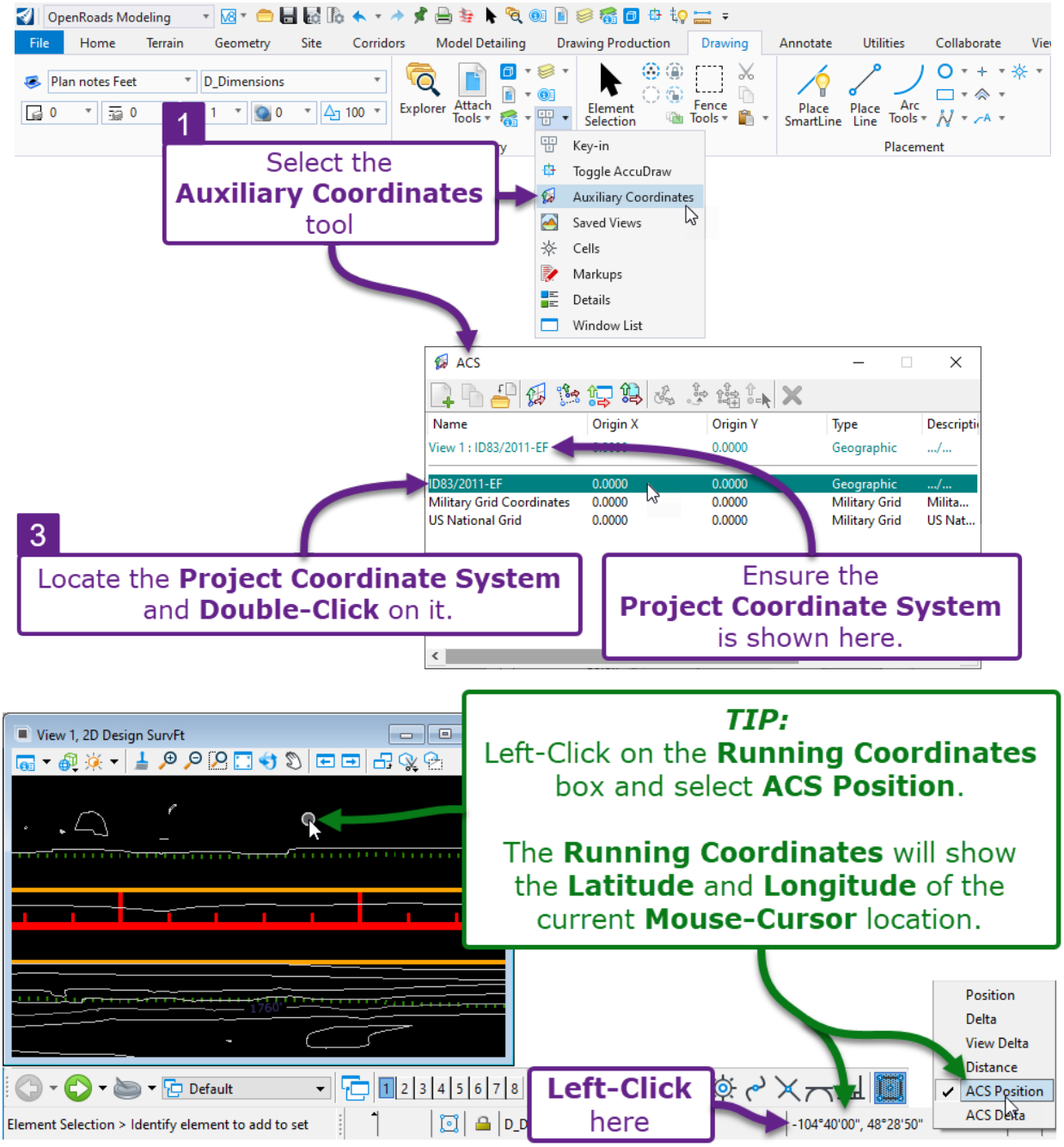


6I – TIPS AND TRICKS FOR DRAWING TOOLS

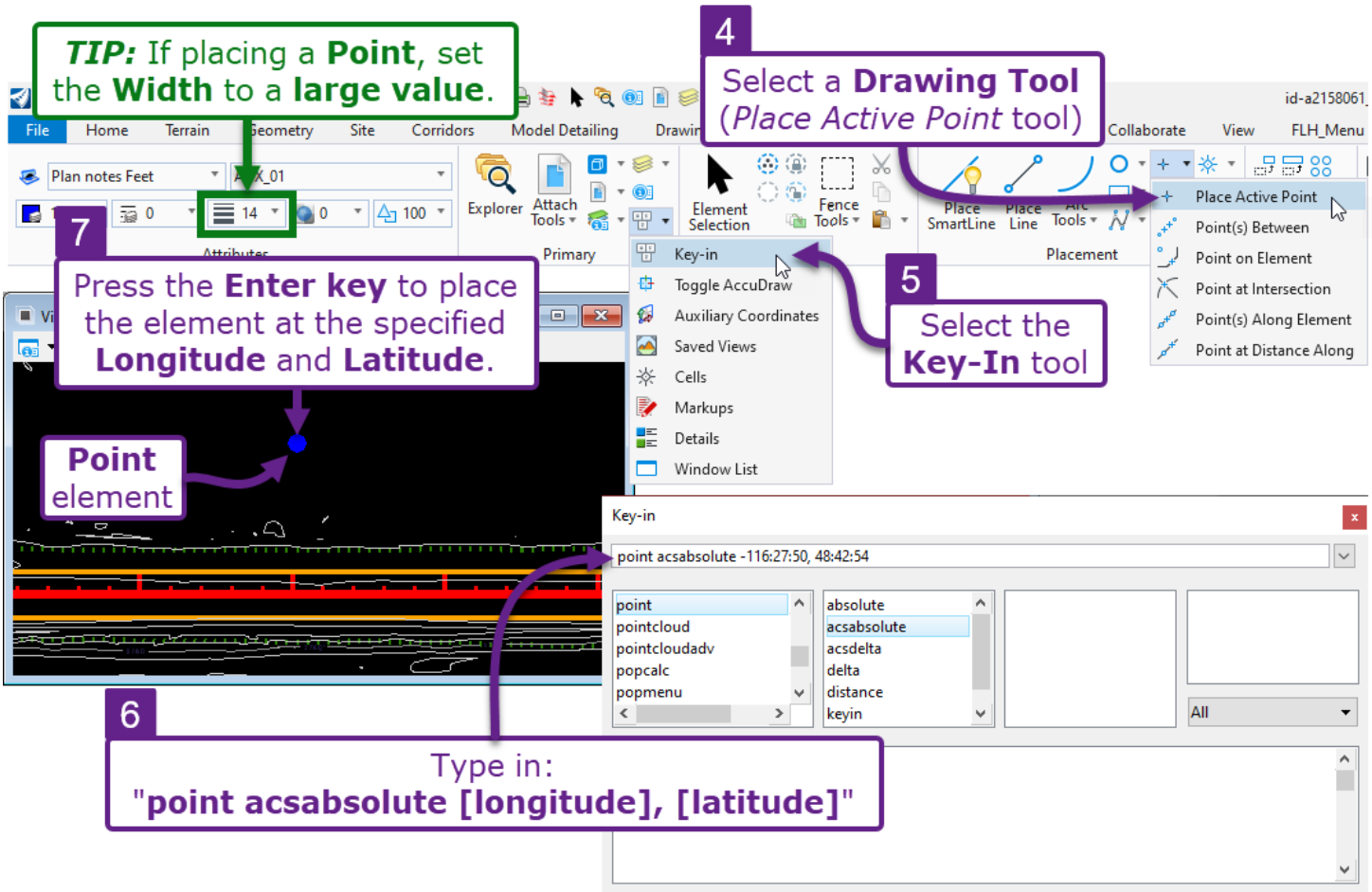
6I.1 Use Longitude and Latitude to Place a Line or Point

If the desire is to place a point or the vertex of a line at a specific Longitude and Latitude, then the following procedures must be performed:

1	Ensure that a Coordinate System has been set for the current ORD File. To set the Coordinate System, see *3D.1 Set the Coordinate System*.
2	The Coordinate System must be applied to the current *View* window with the *Auxiliary Coordinates* tool. From the Ribbon, select the *Auxiliary Coordinates* tool: [***OpenRoads Modeling*** → ***Drawing*** → ***Primary*** → drop-down].
3	In the *Auxiliary Coordinates* manager, double-click on the project Coordinate System to apply it to the active *View* window.



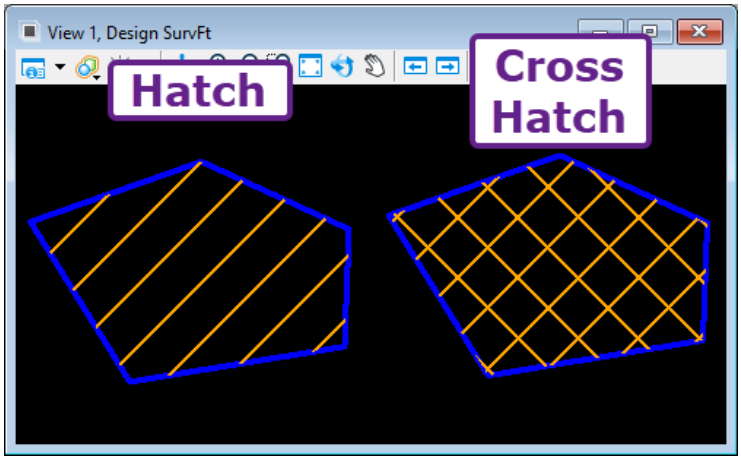
4	Execute a Drawing tool, but do NOT yet draw a line or a point. ***TIP:*** To place a single point, use the *Place Active Point* tool. Before using the tool, change the **Width** attribute to a large value (i.e., 14). If the Width attribute is too small, then the Point element will be difficult to locate. Alternatively, use the *Place SmartLine* tool. The start point of the line will be placed at the specified Longitude and Latitude.
5	With the drawing tool still in use, a **Key-In** must be used to specify the Longitude and Latitude. Open the *Key-in* tool. [***OpenRoads Modeling*** → ***Drawing*** → ***Primary*** → drop-down].
6	In the Key-In box, the term "point acsabsolute" must be entered. The desired longitude and latitude are typed behind the "point acsabsolute" term. Use a : (colon) to separate degrees, minutes, and seconds. Use a , (comma) to separate the longitude from latitude. For example: "**point acsabsolute -116:27:50, 48:42:54**". This represents a Longitude and Latitude of -116°27'50", 48°42'54".
7	Press the **Enter** key to execute the Key-In. The Point element or current line vertex will be placed at the specified latitude and longitude.



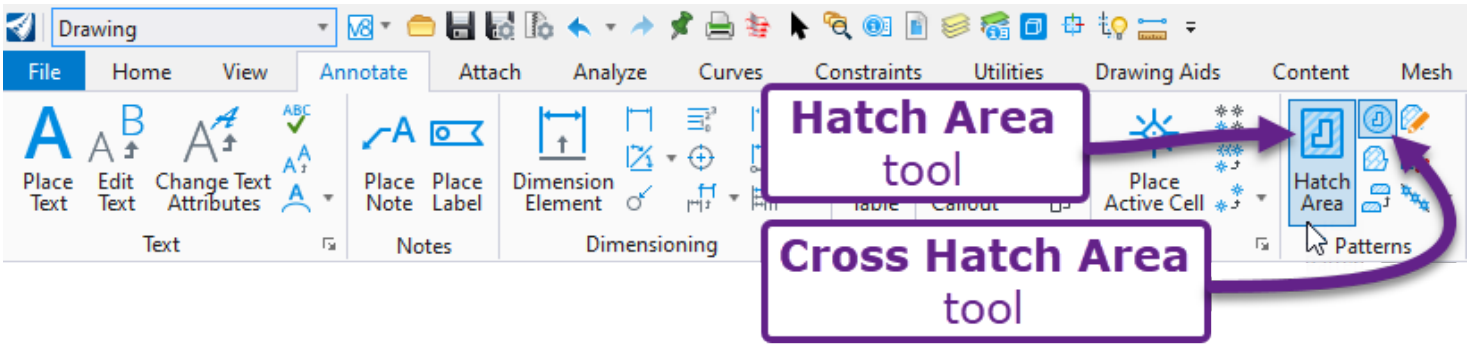
6I.2 Infill an Enclosed Area with a Hatch and Cross Hatch

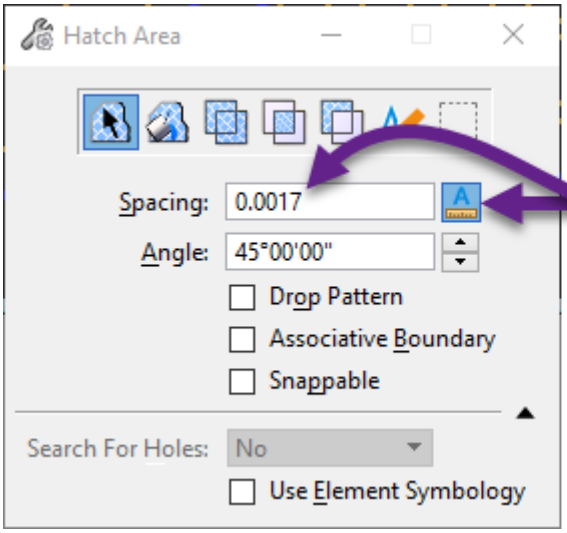
A **Hatch** are parallel, equally-spaced lines that fill in a closed area. A **Cross Hatch** includes line that are running in an opposing direction.

The Cross Hatch lines can be perpendicular or at an oblique angle relative to the Hatch lines. Similarly, the spacing of the Hatch Lines can be set to a different value then the Cross Hatch lines.



Hatches are placed with the *Hatch Area* tool. Cross Hatches are placed with the *Cross Hatch Area* tool:





IMPORTANT: If the **Annotation Scale** button is toggled ON, then the **Spacing** is multiplied by the **Annotation Scale Factor**.

IMPORTANT: If the **Annotation Scale** button is toggled ON, then the **Spacing** value is multiplied by the current Annotation Scale Factor.

Annotation Scale Factors	
Annotation Scale	**Scale Factor**
1” = 10’	**120**
1” = 20’	**240**
1” = 40’	**480**
1” = 50’	**600**
1” = 60’	**720**
1” = 100’	**1200**
1” = 200’	**2400**

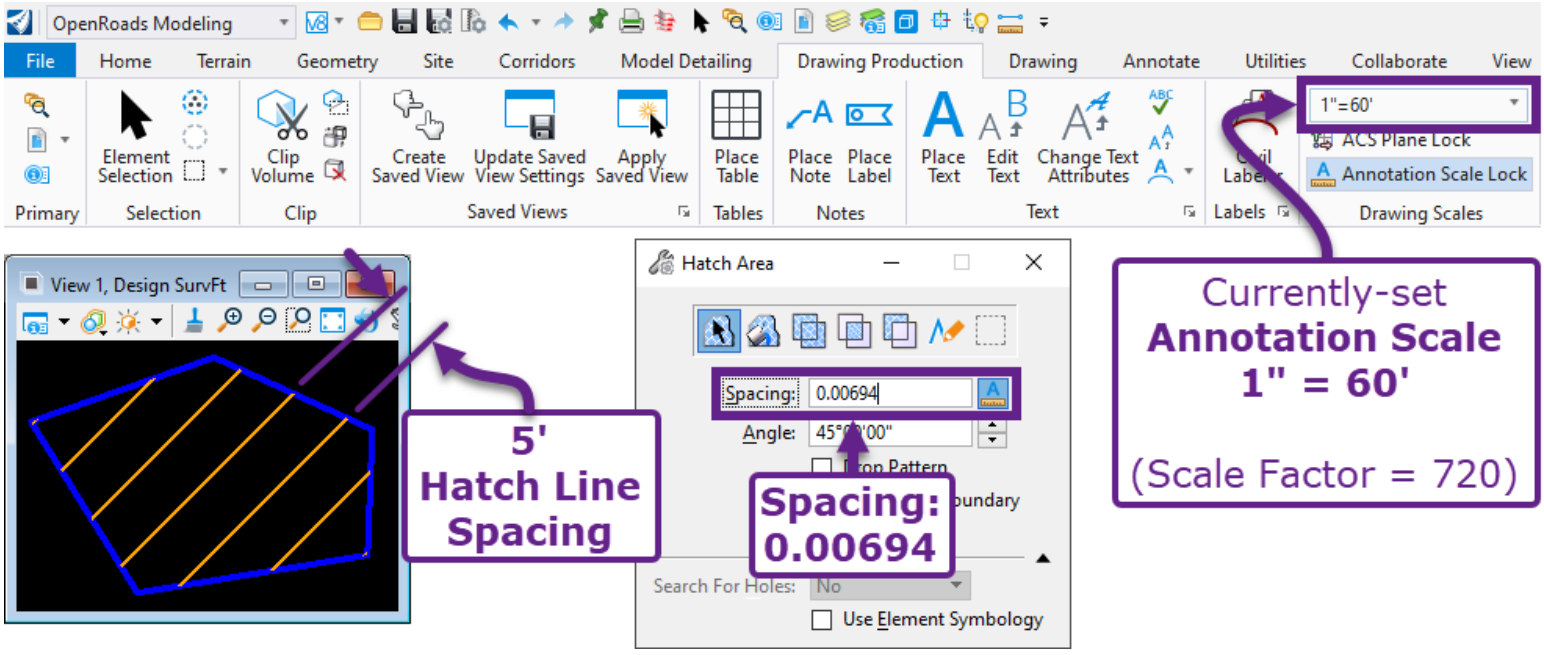
For example, if the Annotation Scale is currently set to 1”=50’ (Scale Factor = 600), and the Spacing is set to 1.0000, then the resulting Hatch lines will be spaced 600’ apart.

The formula for determining the appropriate **Spacing** is as follows:

Spacing = [Hatch Line Spacing] / [Annotation Scale Factor]

For example, to create a Hatch Line Spacing of 5’ for a currently set Annotation Scale of 1”=60’ (Scale Factor = 720), the **Spacing** value must be set to 0.00694.

0.00694 = [5’] / [720]

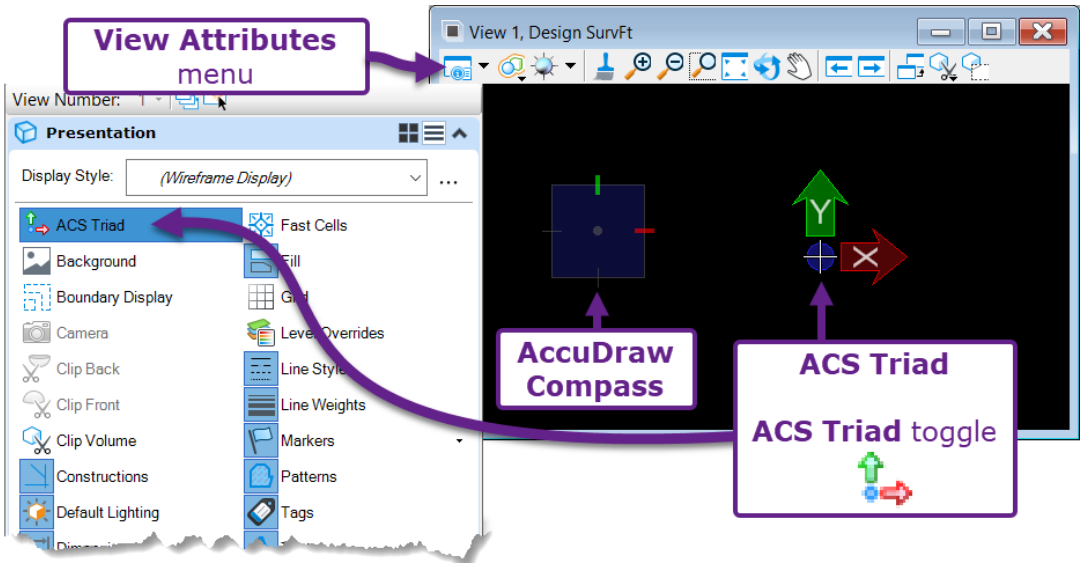


If the Annotation Scale is changed after the Hatch is placed, then the Hatch Line Spacing will alter according to the new Annotation Scale Factor. For more information on the Annotation Scale, see *15A.2 Annotation Scale*.

NOTE: If the **Annotation Scale** button is toggled OFF, then the **Spacing** value is unaffected. For example, a Spacing value of 5.0000 results in a Hatch Lines that are actually spaced at 5’.

6I.3 Auxiliary Coordinate System (ACS)

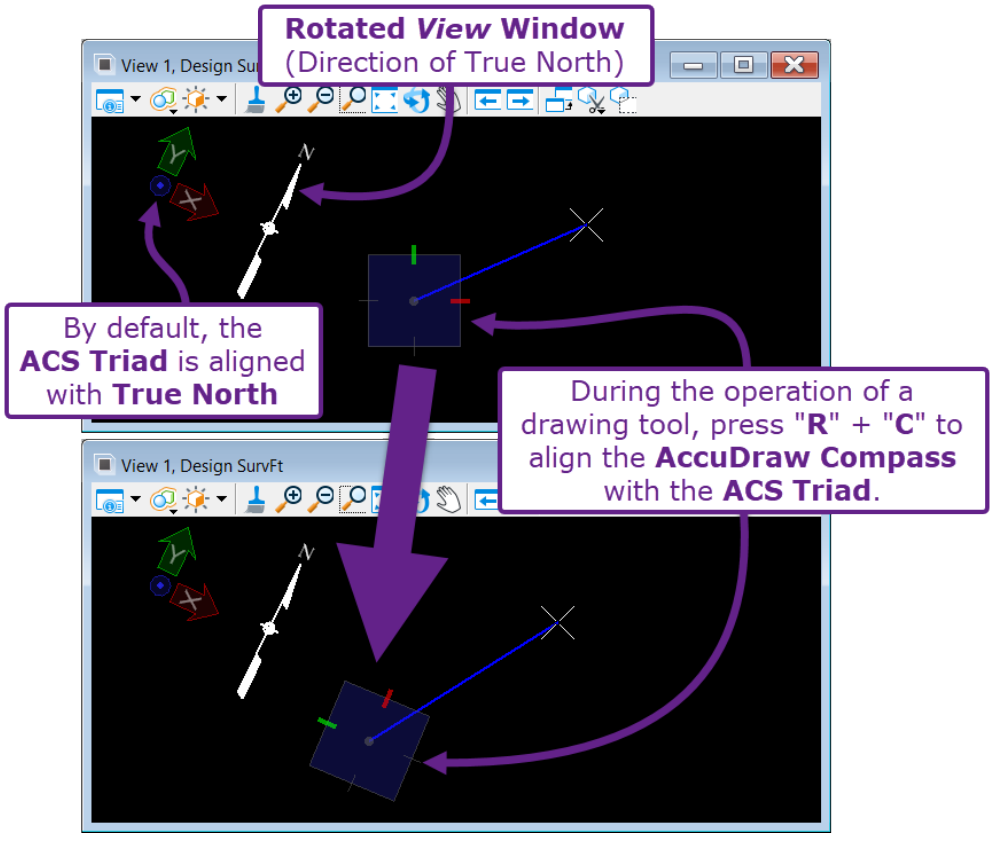
The Auxiliary Coordinate System (ACS) works in conjunction with AccuDraw. The **ACS Triad** denotes the position and orientation of the ACS. The AccuDraw Compass automatically rotates during the operation of a drawing tool, while the ACS Triad remains at fixed angle unless manually rotated by the User.



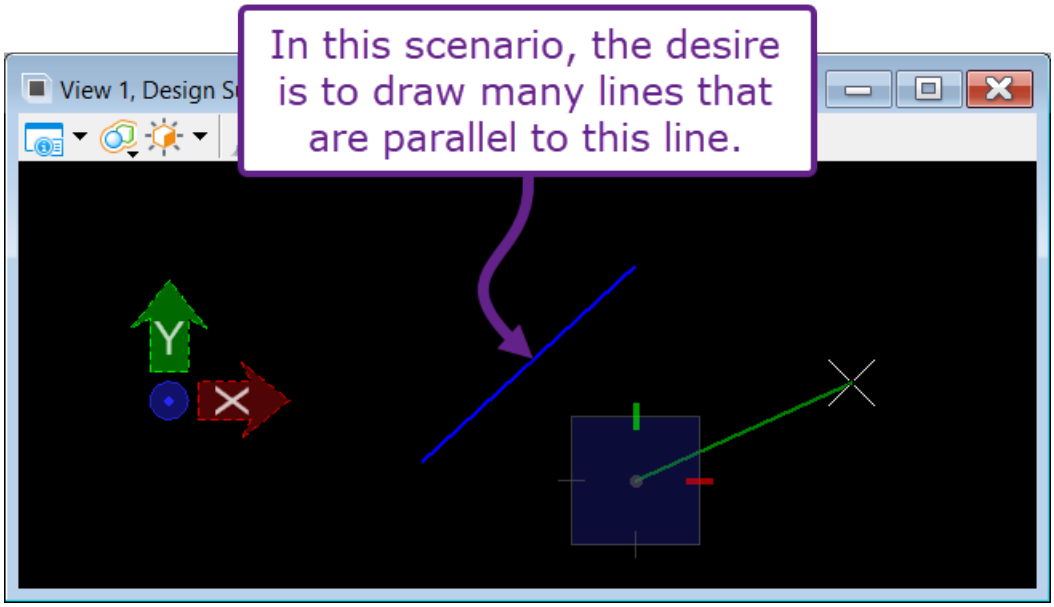
TIP: By default, the ACS Triad is ONLY shown when manipulating its position. To show the ACS Triad at all times, toggle ON the ACS Triad icon from the *View Attributes* menu.

During the operation of a drawing tool, press the "R" + "C" keyboard shortcut to rotate the AccuDraw Compass to align with the ACS Triad.

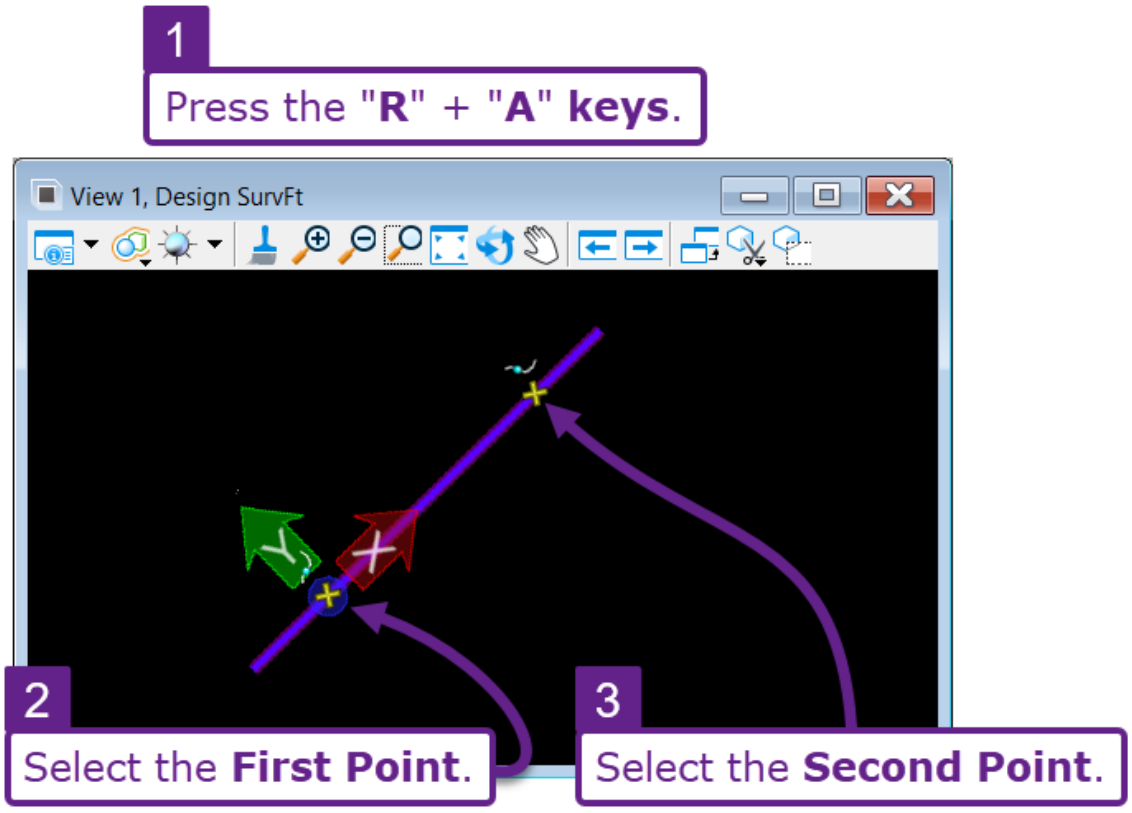
PRACTICAL USE OF THE ACS: By default, the ACS triad is aligned to true north. If the *View* window is currently rotated, then press "R" + "C" to align the AccuDraw Compass with the ACS triad.



PRACTICAL USE OF THE ACS: Rotating the ACS Triad to a custom angle is useful for drawing several lines that point in the same direction.



First, the ACS Triad must be rotated to align with the desired element. Rotate the ACS Triad with the "R" + "A" keyboard shortcut.

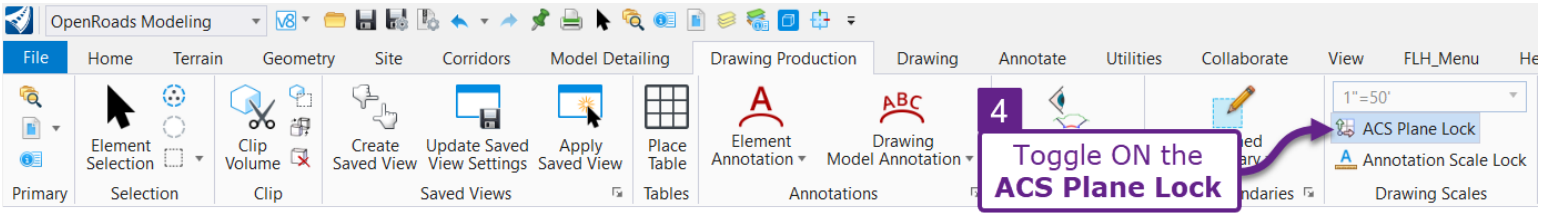


TIP: To rotate the ACS to align with an element, Toggle on the Nearest Snap and select two point locations along the element.

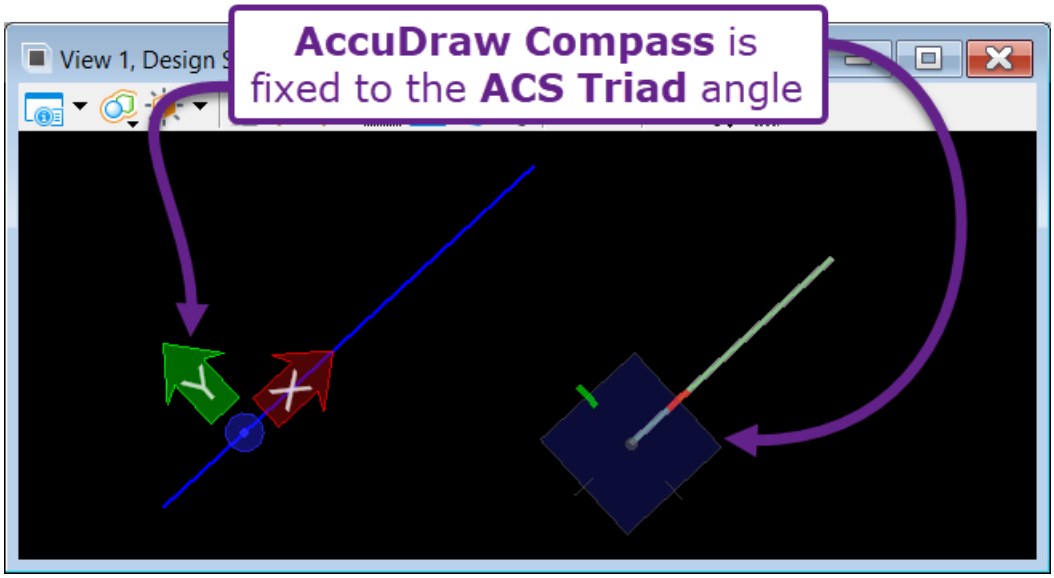
NOTE: The order which the 2-points location are picked affects how the ACS is rotated. If the 2-point locations are picked from left-to-right, then X-axis is pointed to the right and the Y-axis is pointed upwards. If picked right-to-left, then the X-axis points to the left and the Y-axis points downwards.

Next, the **ACS Plane Lock** must be toggled ON. If the ACS Plane Lock is toggled ON, then the AccuDraw Compass will automatically align with the ACS Triad when a drawing tool is executed. If toggled OFF, then the AccuDraw Compass will align with the *View* window (straight up/down and left/right). The ACS Plane Lock toggle is located in the Ribbon in the following location:

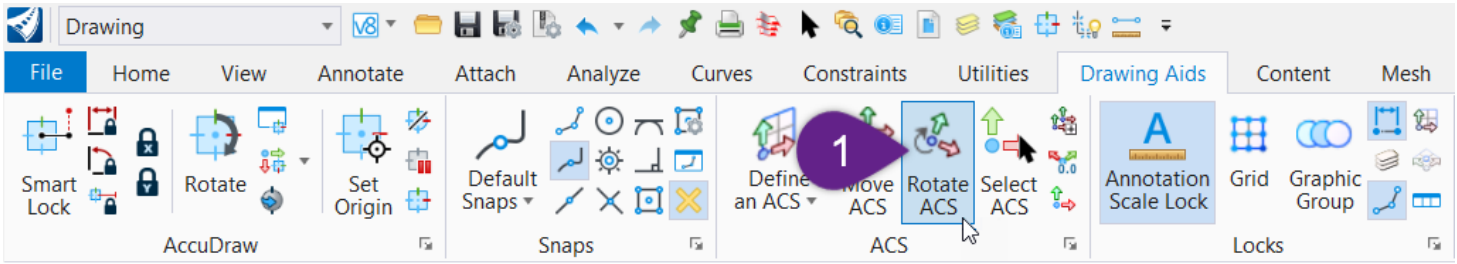
[***OpenRoads Modeling*** → ***Drawing Production*** → ***Drawing Scales***]

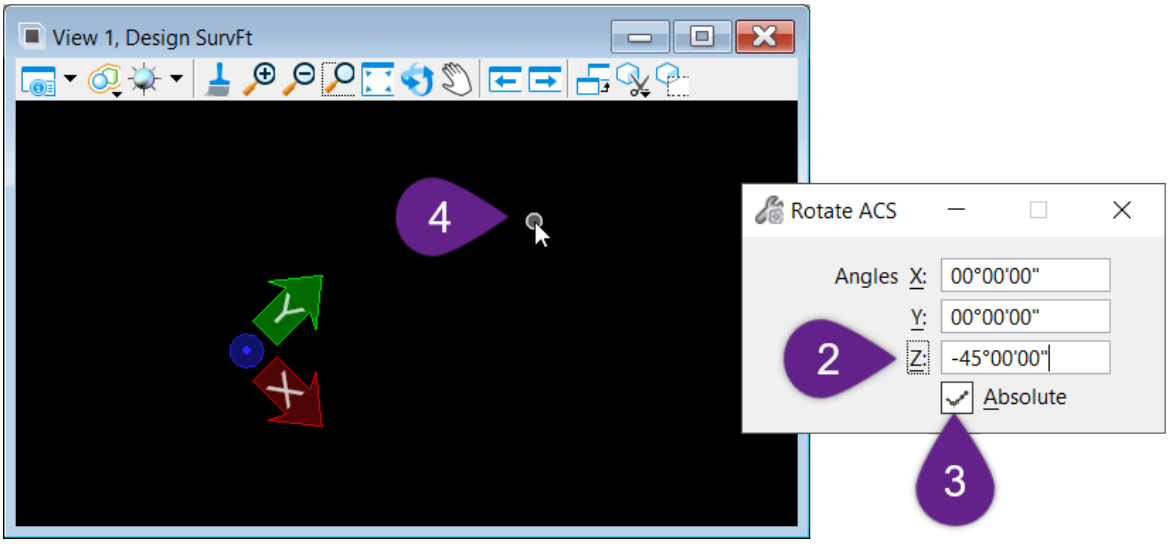


Now, when a drawing tool is executed, the AccuDraw Compass will always align with the rotated ACS Triad angle.



Alternatively, the ACS can be rotated by inputting a bearing angle value into the *Rotate ACS* tool:

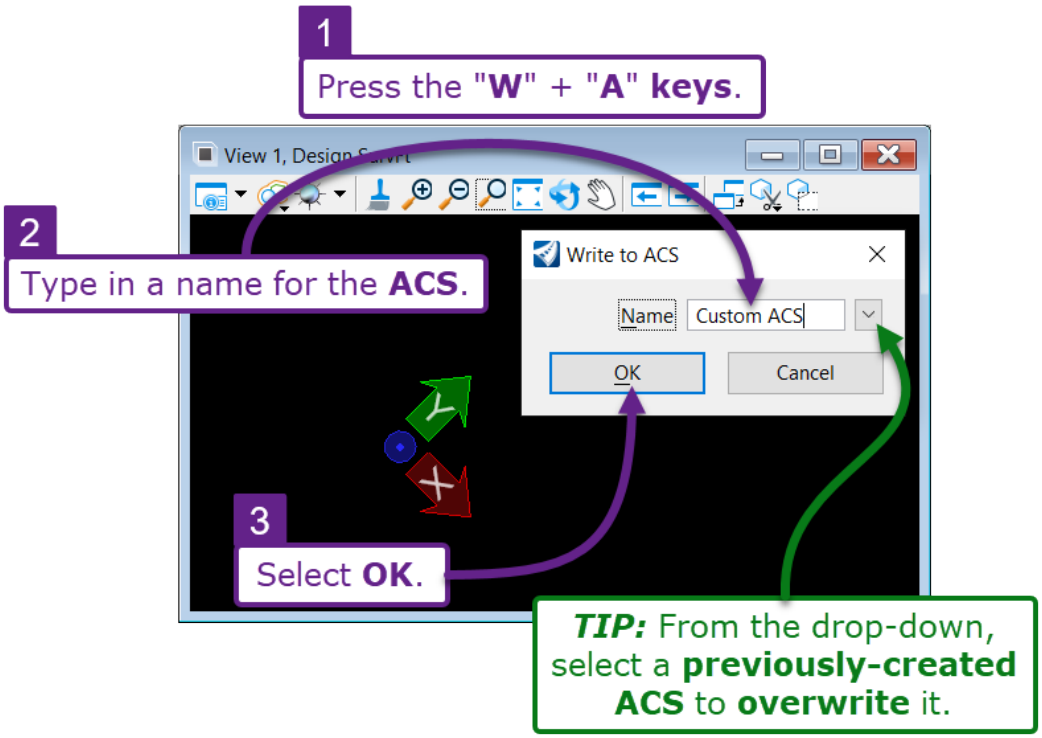




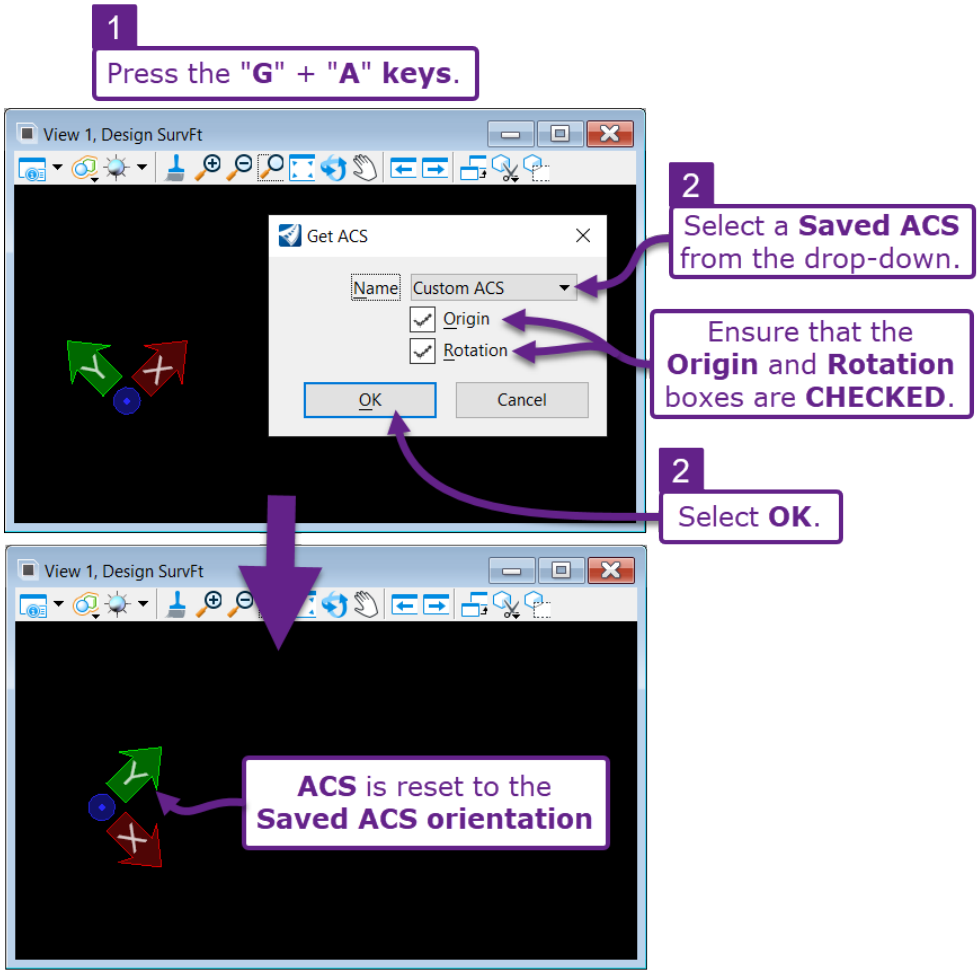
1	From the Ribbon, select the *Rotate ACS* tool: [***Drawing*** → ***Drawing Aids*** → ***ACS***].
2	Enter the desired bearing angle value into the **Z angle** box. In the *2D Design Model*, the ACS is rotated around the Z-axis. ***WARNING:*** When rotating the ACS in the *2D Design Model*, do NOT enter a value in the **X angle** or **Y angle** boxes. This will cause the ACS to rotate to an isometric angle. The **X** and **Y angle** boxes are used to rotate the ACS within a *3D Design Model*.
3	**Absolute** check box: If this box is CHECKED, then ACS is rotated to true bearing angle specified in the **Z angle** box. If this box is UNCHECKED, the ACS is rotated relative to the current orientation. For example, if the ACS is currently positioned at 10°00'00" and the value 45°00'00" is entered with the *Rotate ACS* tool, then the ACS will rotate to 55°00'00".
4	When the desired angle is shown in the, left-click in the *View* window to rotate the ACS.

The orientation of an ACS can be saved by pushing the "W" + "A" keys.

TIP: If frequently changing the ACS, use this Keyboard Shortcut to save commonly used ACS orientations.



Push the "G" + "A" keys to reset the ACS to the Saved ACS orientation:



NOTE: If the **Origin** box is CHECKED and the **Rotation** box is UNCHECKED, then the ACS Triad will translate (move) to the saved Origin Point.

If the **Rotation** box is CHECKED, and the **Origin** box is UNCHECKED, then the ACS Triad will rotate to the saved ACS orientation, but will NOT move.

If both boxes are UNCHECKED, then the ACS Triad will neither move or rotate. Nothing will happen.

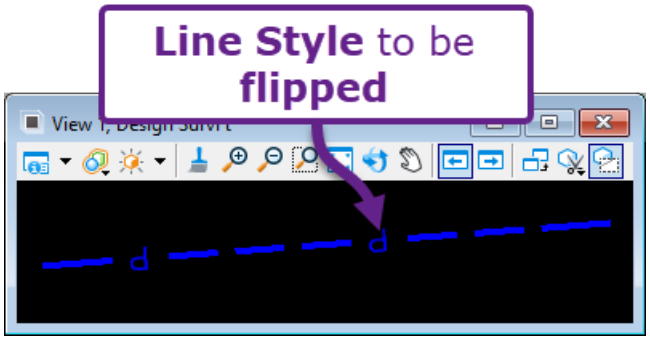
6I.4 Place Fence tool

A Fence is a temporary selection box or shape. Fences can be used in conjunction with many drawing tools. For more information about the *Place Fence* tool, see *1B.4 Place Fence Tool*.

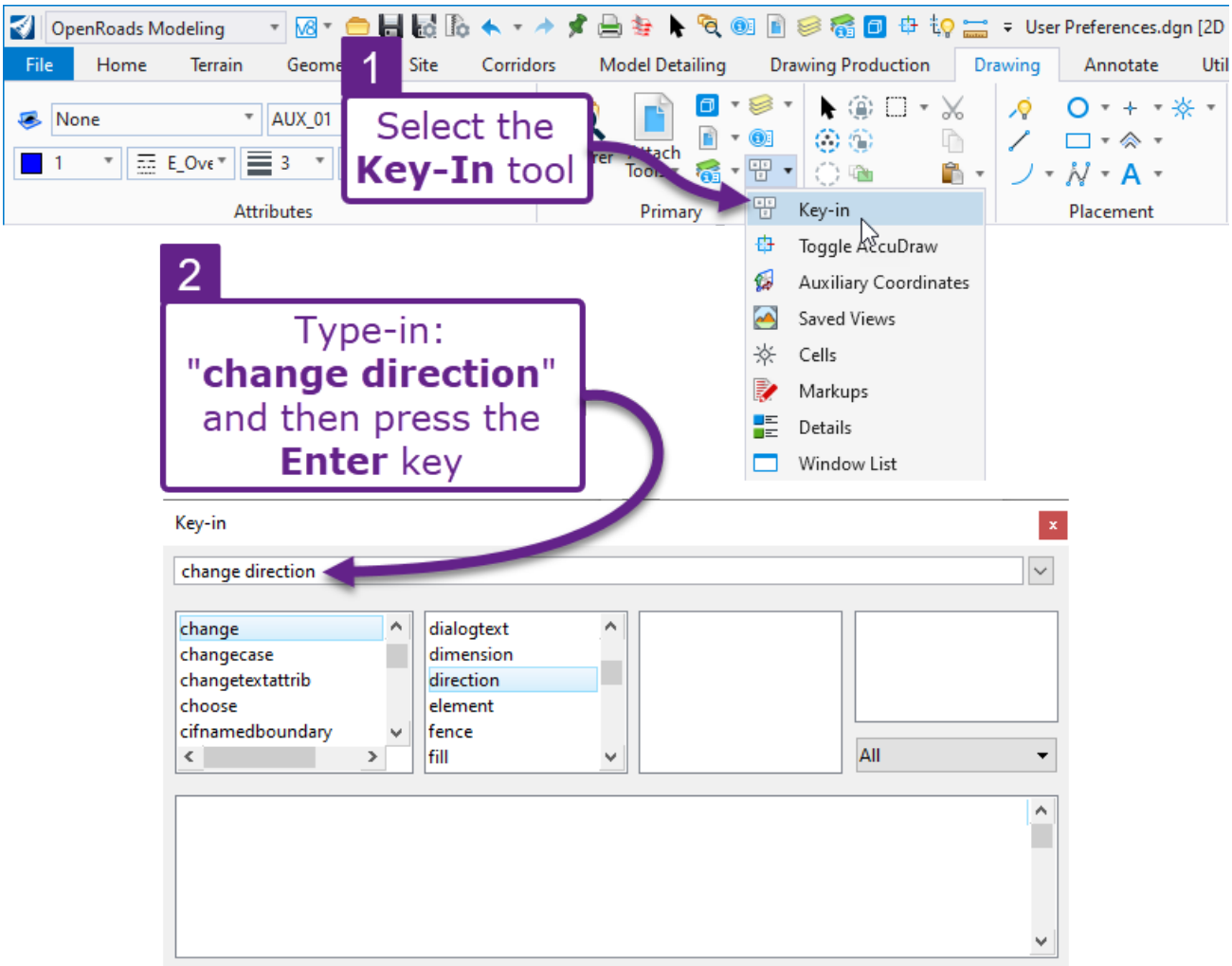
6I.5 Flip the Direction of a Line Style

If the Line Style is shown upside down, then the **change direction** Key-In can be used to flip it.

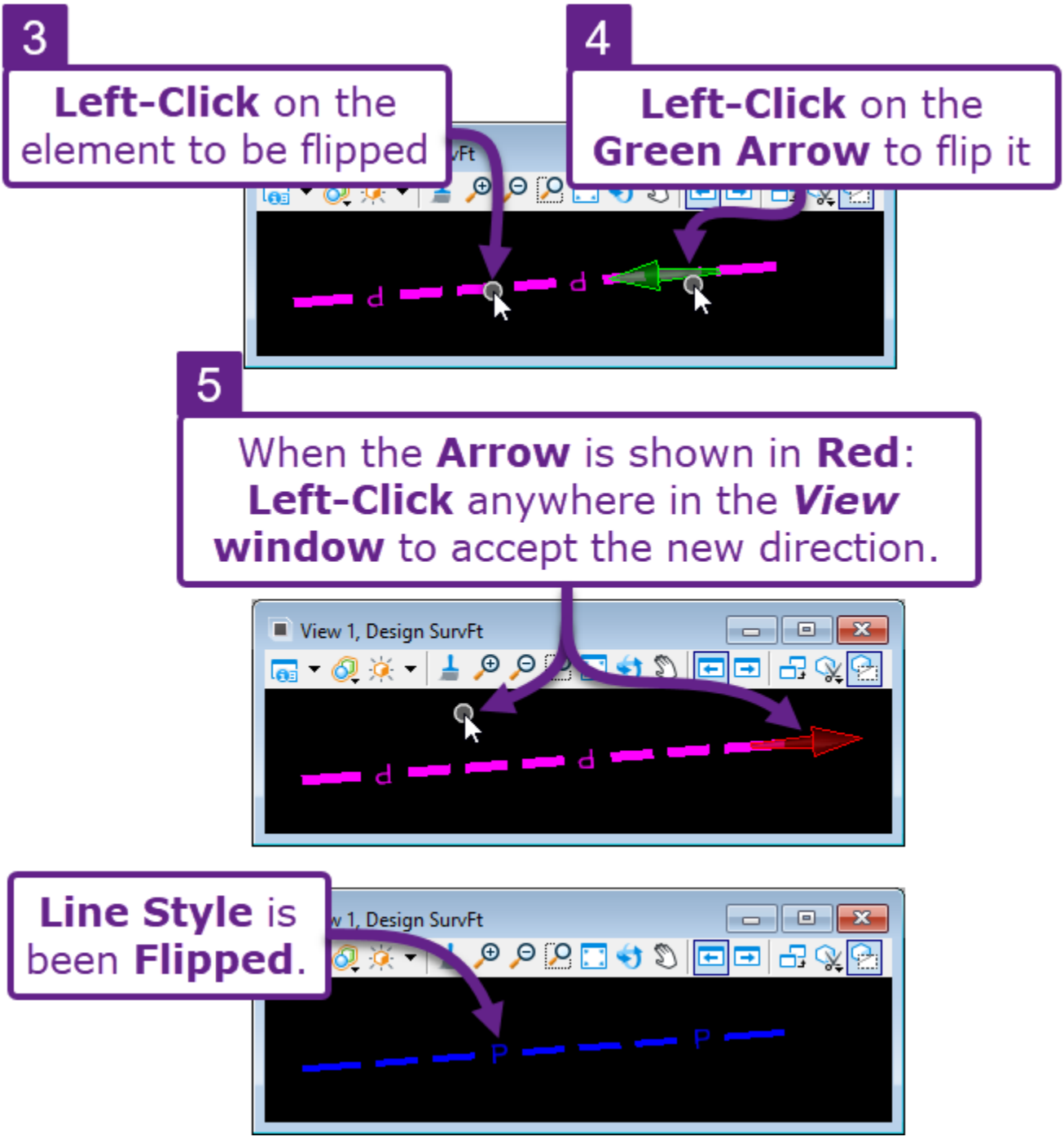
TIP: Key-Ins are discussed in *4C.2 Determine Key-In Names*.



1	From the Ribbon, select the *Key-In* tool: [OpenRoads Modeling → Drawing → Primary → drop-down].
2	In the Key-In box, type in "**change direction**". Press the **Enter** key to execute the Key-In.

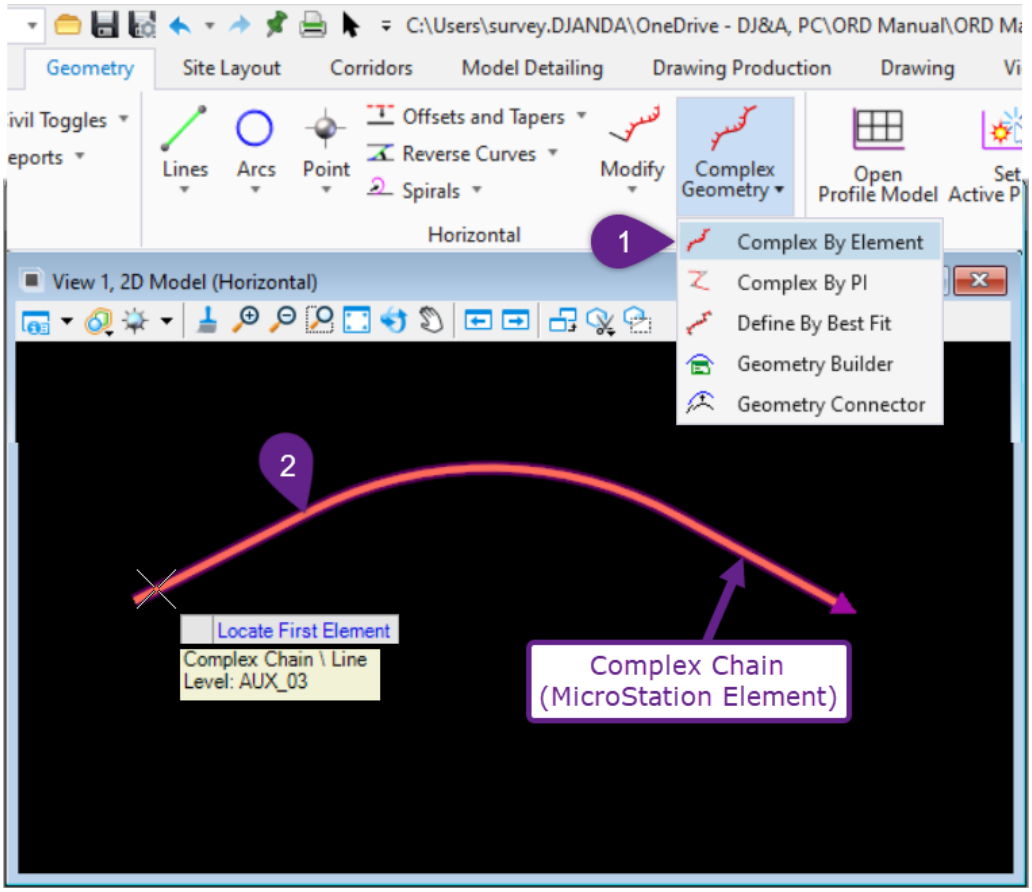


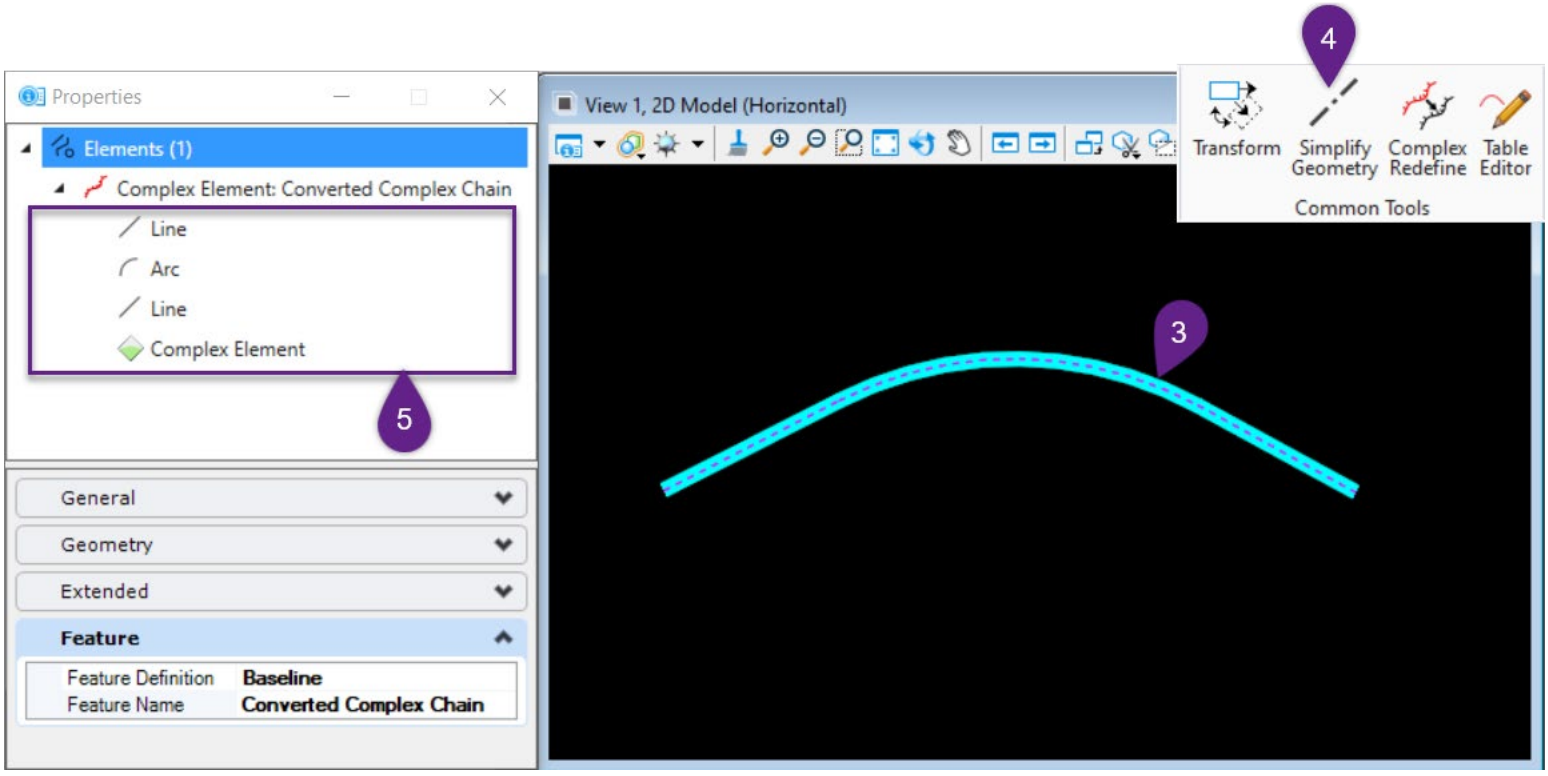
3	Left-Click on the element to be flipped.
4	A **Green Arrow** will be shown which represents the direction of the element. **Left-Click** on the **Green Arrow** to flip it. The Arrow will become red.
5	Left-Click anywhere in the *View* window to complete the flipping operation.

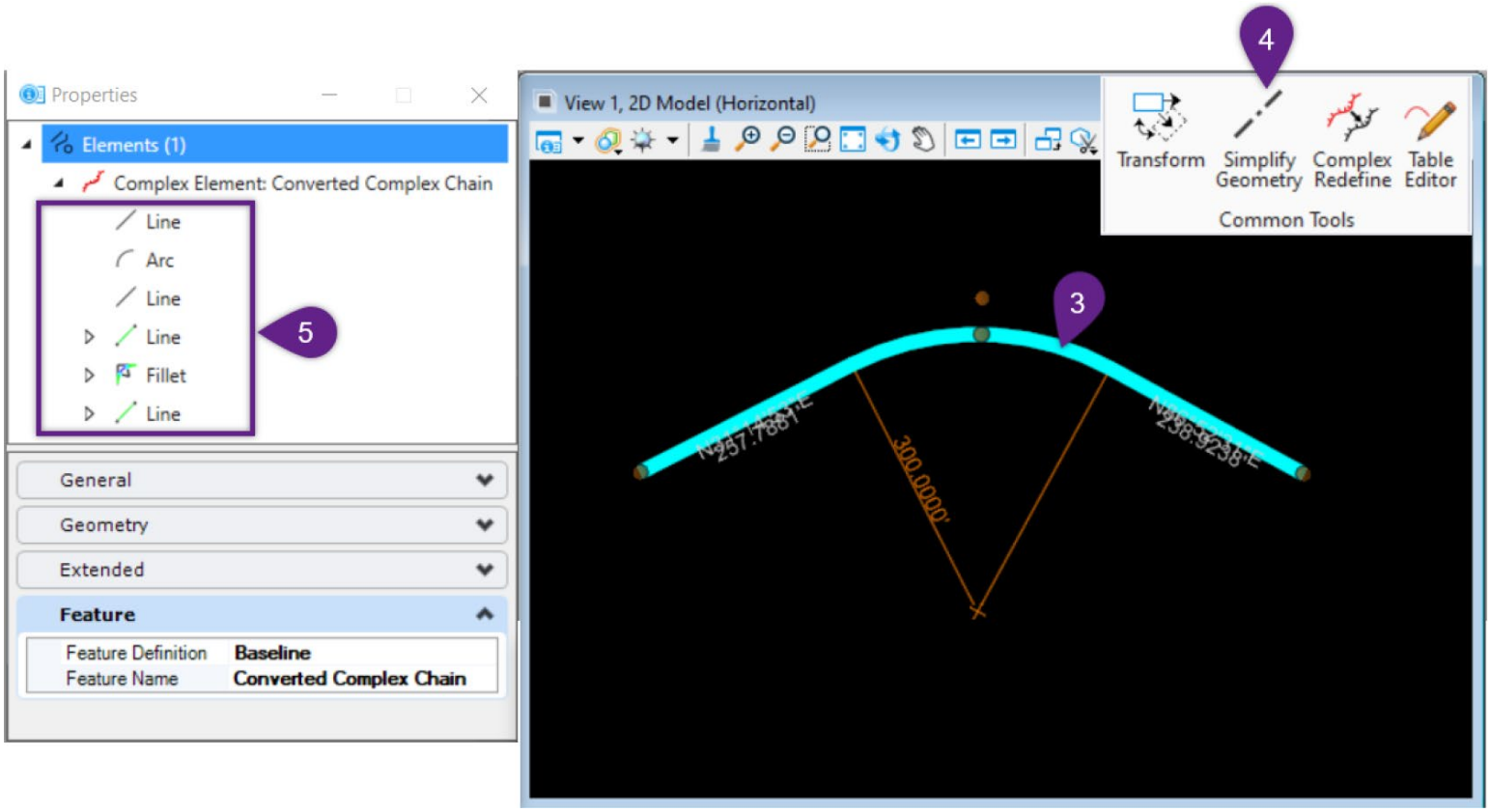


6I.6 Convert a MicroStation Element into an ORD Element

With the *Complex By Elements* tool, it is possible to convert a MicroStation Element into an ORD Element – or in this example – convert a Complex Chain into a Complex Element.







1	Complex By Elements tool location
2	Select the Complex Chain with the *Complex By Elements* tool to convert into a Complex Element
3	The converted Complex Element now has Feature Definition capabilities, **but is missing grip handles to preform Grip-Edits.**
4	To restore grips handles– the *Simplify Geometry tool* is used on the converted Complex Element. Left-Click the *Simplify Geometry* tool and follow the prompts: *Prompt: Locate Element* – Left-Click on the converted *Complex Element* to advance to the next prompt. *Prompt: Maintain Copy of Base Elements – Yes* or *No* No - Complex Element is Simplified. Yes – Complex Element is Simplified AND individual segments (Line, Arc, Spiral) of the Complex Element are additionally created. Left-Click in the View to accept and complete the command.
5	Before using the *Simplify Geometry* tool, the Properties Box contains the Complex Element item The green diamond symbol means that the Complex Element is static. After using the *Simply Geometry* tool, the green diamond symbol disappears and the converted Complex Element will contain ORD Base Elements with appropriate Intervals and Civil Rules.