QuickStart for Civil Geometry - Road

This course is for the **2021 Release 1** *version of:*

OpenSite Designer CONNECT Edition

OpenRoads Designer CONNECT Edition

OpenRail Designer CONNECT Edition

About this Practice Workbook...

- This workbook is designed for use in Live instructor-led training and for OnDemand self study. OnDemand videos for this course are available on the *LEARNserver* and through *CONNECT Advisor*.
- This PDF file includes bookmarks providing an overview of the document. Click on a bookmark to quickly jump to any section in the file.
- Both Imperial and Metric files are included in the dataset. Throughout this practice workbook Imperial values are specified first and the metric values second with the metric values enclosed in square brackets. For example: *12.0' [3.4m]*.
- This course workbook uses the *Training and Examples* WorkSpace and the *Training-Imperial* or *Training-Metric* WorkSet delivered with the software.
- The terms "Left-click", "Click", "Select" and "Data" are used interchangeably to represent pressing the left mouse button. The terms "Right-click" and "Reset" are also used interchangeably to represent pressing the right mouse button. If your mouse buttons are assigned differently, such as for left-handed use, you will need to adjust accordingly.

Have a Question? Need Help?

If you have questions while taking this course, search in *CONNECT Advisor* for related courses and topics. You can also submit questions to the Civil Design Forum on Bentley Communities where peers and Bentley subject matter experts are available to help.

Bentley Institute

Edition: **08-01**

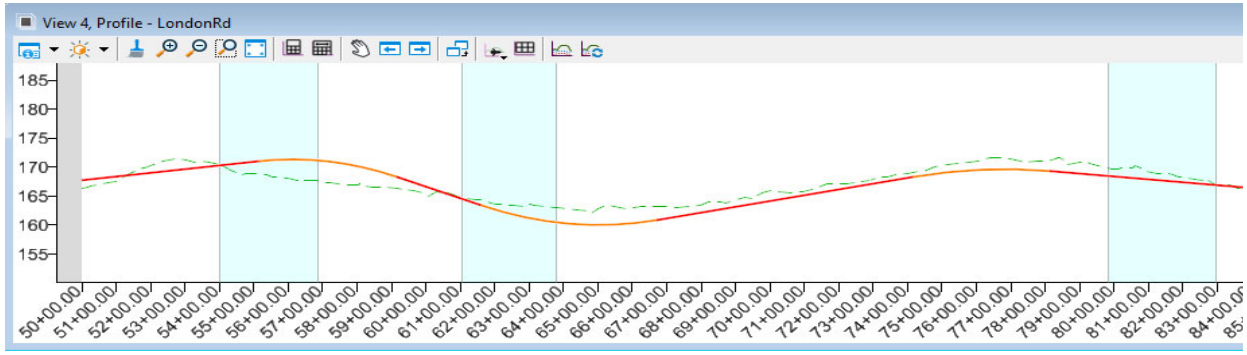
Course Level: **Fundamental**

Course Overview

The goal of this course is to quickly get you started using the OpenRoads Designer Civil Geometry tools to create horizontal and vertical geometry elements.

In this course, you are going to be working on a roadway improvement project for a road named London Rd. You will be creating the horizontal and vertical alignment for London Rd. using the OpenRoads Designer Civil Geometry tools.

You will learn how to create, edit, annotate and review civil geometry elements using the OpenRoads Designer Civil Geometry tools. You will also learn how to attach an existing terrain model and aerial imagery as well as define 2D and 3D views.

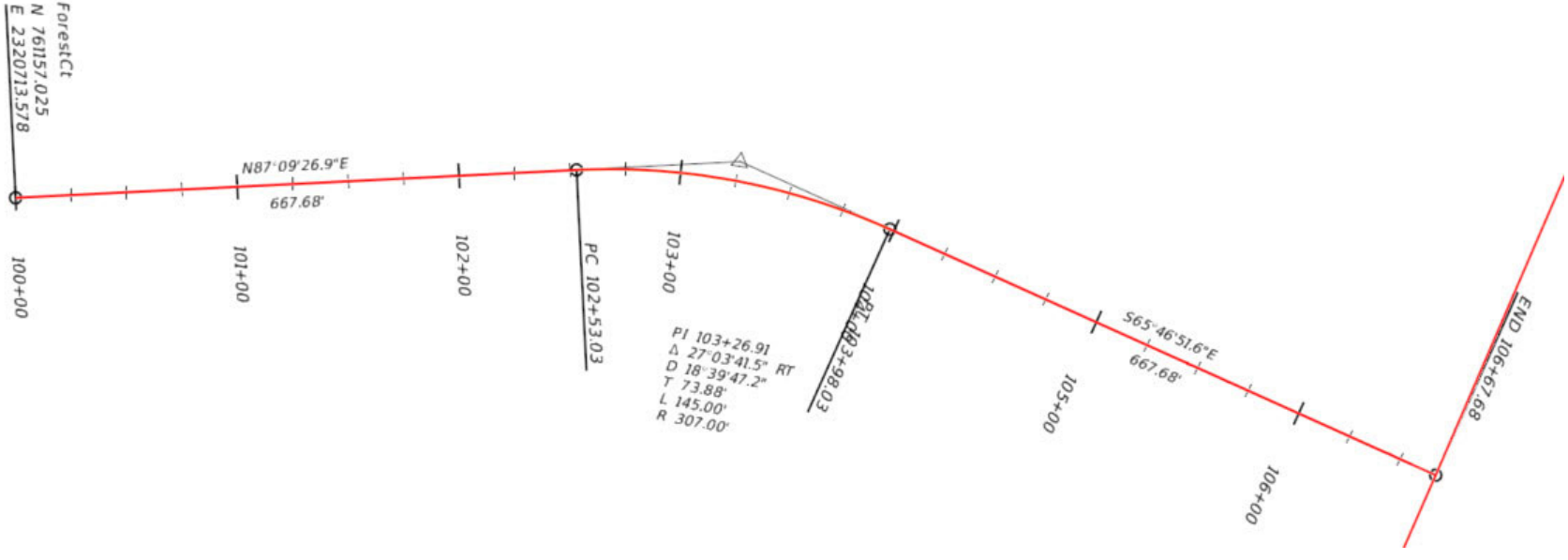


Civil Geometry Overview

The civil geometry tools are a dynamic, interactive and rules-based approach to geometry. Civil Geometry or geometric rule-based elements are created intelligently as the tools are used and elements are constructed.

Rule-based elements provide *Design Intent* that builds associations and relationships between civil elements. Object information (how, where, and by what method it was created) is stored with the object to insure the original intent is retained and honored in the design. If an element is modified, any related elements will recreate themselves based on these stored relationships.

All geometric data is stored directly in the design file (**.DGN**) and can be easily edited and reviewed via the drag handles, dynamic dimensions, text manipulators, etc.



Exercise 1: Create a New File and Review the Interface

In this exercise, you will learn how to select a WorkSpace and WorkSet, create a new 2D design file, and review the ribbon interface.

Skills Taught

- Selecting a WorkSpace and WorkSet
- Create a 2D Design File
- Review the Ribbon Interface

Select the WorkSpace & WorkSet and Create a New 2D Design File

In this section, you will select the training WorkSpace and WorkSet, and create a new 2D design file. Always start in a 2D design file when creating and working with geometry.

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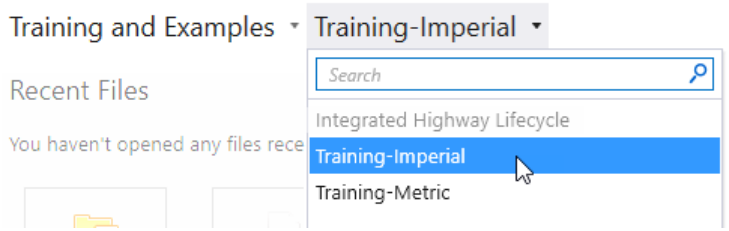
1. Start the software.
2. Set the WorkSpace and WorkSet.

   The WorkSpace and WorkSet define standards that are used by the software, and the ones used for this training are installed during the software installation.

   Typically, the WorkSpace contains organizational standards and the WorkSet contains project standards.

   a. Select **Training and Examples** from the *WorkSpace* drop-down menu.

   b. Select **Training-Imperial** *[Training-Metric]* from the *WorkSet* drop-down menu.



3. Create a new 2D design file.

   a. Select **New File**.

   b. Browse to *c:\Bentley Training\QuickStart for Civil Geometry* or other folder where you unzipped the dataset files.

   c. Set the *Seed* to **Seed2D - Imperial Training.dgn**

   d. Create a new file named **Geometry.dgn**

      NOTE: The **.DGN** file format is the standard file format used by the *OpenRoads Designer* software as well as other Bentley products such as *MicroStation*.

      If you get a message stating “Incompatible Civil Data”, this is because the training files are “aligned” to OpenSite Designer. Clicking *Yes* will align the file to the software you are using (OpenRoads Designer or OpenRail Designer). This will have zero impact for training. Full information is available at *Bentley Communities - Product Realignment*.

Review the Interface

In this section, you will learn how to work with the OpenRoads Designer interface.

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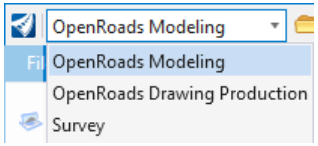
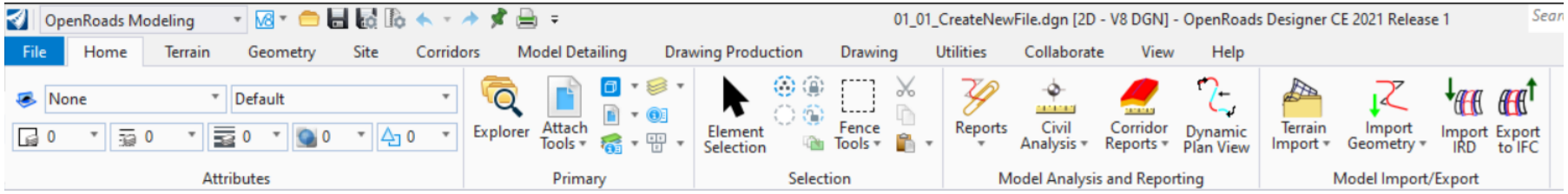
1. Select the **OpenRoads Modeling** workflow from the pick list in the upper left corner if it is not already active.

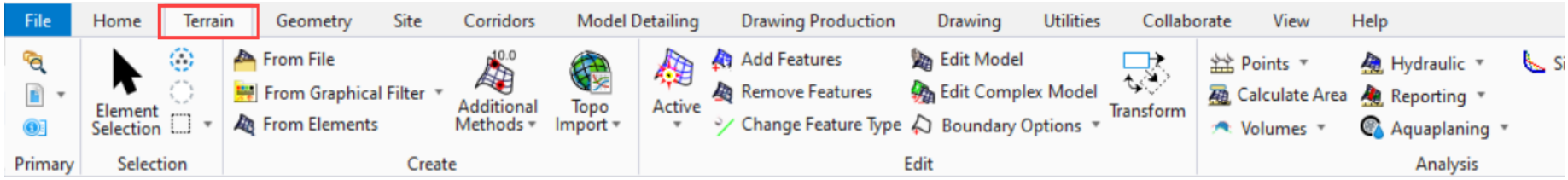
   

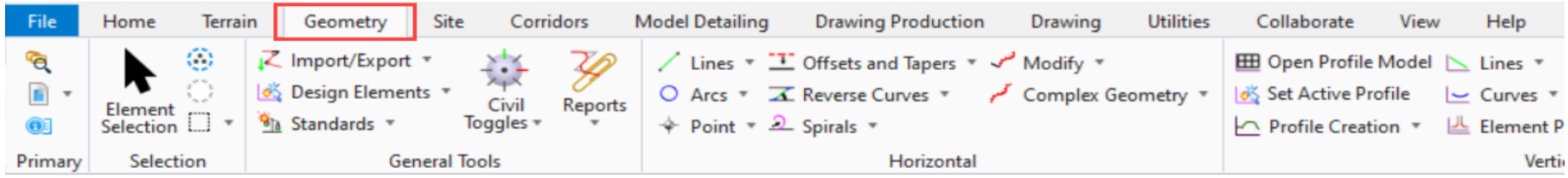
   The ribbon menu will change to the **OpenRoads Modeling** tools. The tools are organized on ribbon tabs with the tools grouped into categories on each tab.



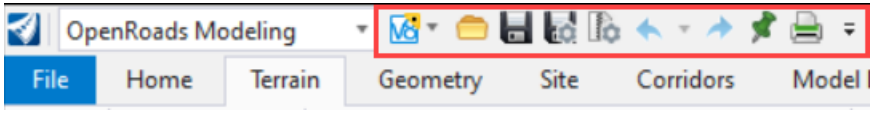
   - **Home** - Common tools such as Attributes, Explorer, Attach Reference Tools, Models, Level Display and Element Selection.
   - **Terrain** - Element selection and terrain modeling tools.
   - **Geometry** - Element selection, Civil AccuDraw and geometry tools.
   - **Site** - Parking, Parceling, Pad, Pathways, Grading Proposed, Modify and other tools are available.
   - **Corridors** - Element selection, superelevation and corridor modeling tools.
   - **Model Detailing** - Element selection, Civil Cells and 3D tools (Linear Templates, Surface Templates, etc.).
   - **Drawing Production** - Element selection, saved views, notes, text, annotations, and plans production (cross section, plan, and profile) tools.
   - **Drawing** - Commonly used MicroStation drawing tools. To access the complete set of MicroStation tools change the active work flow to Drawing, Modeling (3D file only) or Visualization (3D file only).
   - **Utilities** - Additional miscellaneous tools such *Geographic Coordinate Systems* and *Item Types.*
   - **Collaborate** - Collaboration and Markup tools.
   - **View** - Commonly used view control tools.

2. **Click** on each of the ribbon tabs and notice how each tab has a different set of categories and tools.

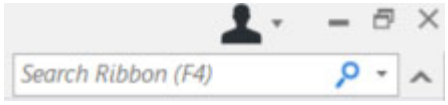


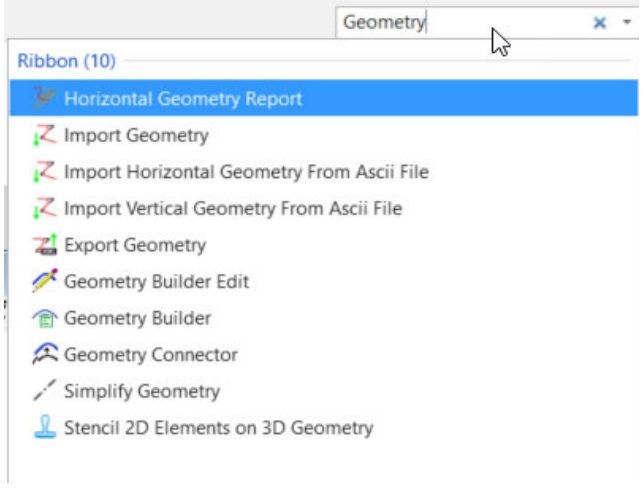


3. Also note the tools to the **right** of the workflow drop down list. Tools such as Open File, Save Settings Compress File, Undo, Redo, Print, Explorer and Properties can be found here.

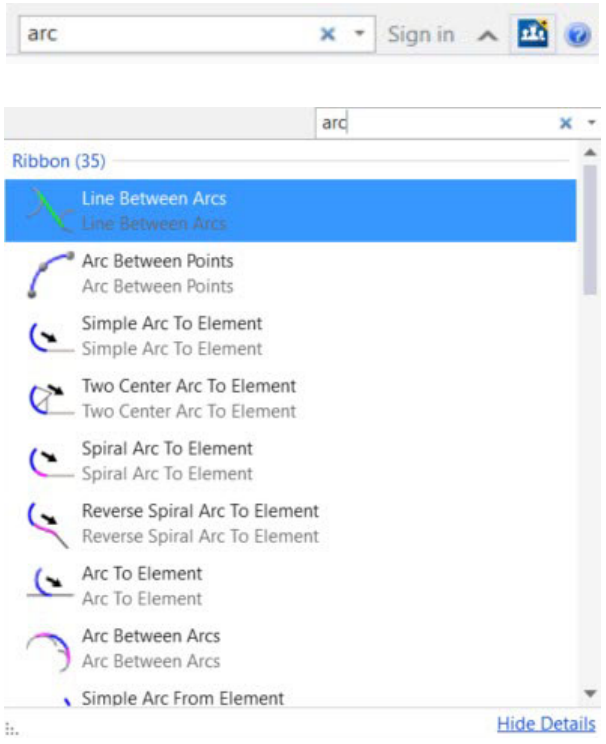


A *Search Ribbon* tool is also available to assist with finding tools on the ribbon interface. When you are not sure where to find a tool on the ribbon interface simply key in the command in the *Search Ribbon* field and a search will be performed across all ribbon menus.





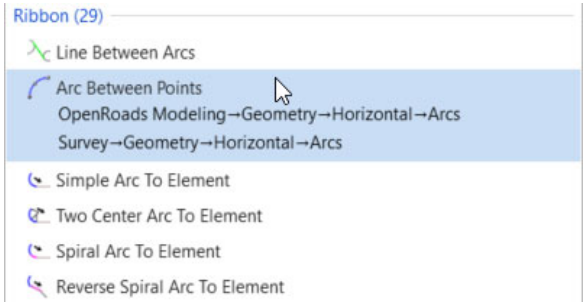
4. Search for a tool using the search ribbon. Key in **Arc** in the *Search Ribbon* field.



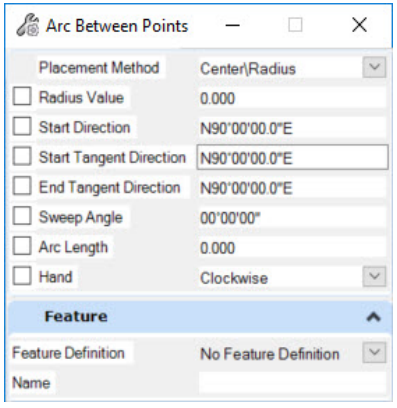
5. Notice the results of the ribbon search are displayed in a dialog below the *Search Ribbon* field.

6. **Hover** over **Arc Between Points.**

   The search results expand showing where the **Arc Between Points** tool is located on the ribbon: **OpenRoads Modeling -> Geometry -> Horizontal -> Arcs**



7. From the search results dialog, **Left click**, *Arc Between Points* to launch the command.

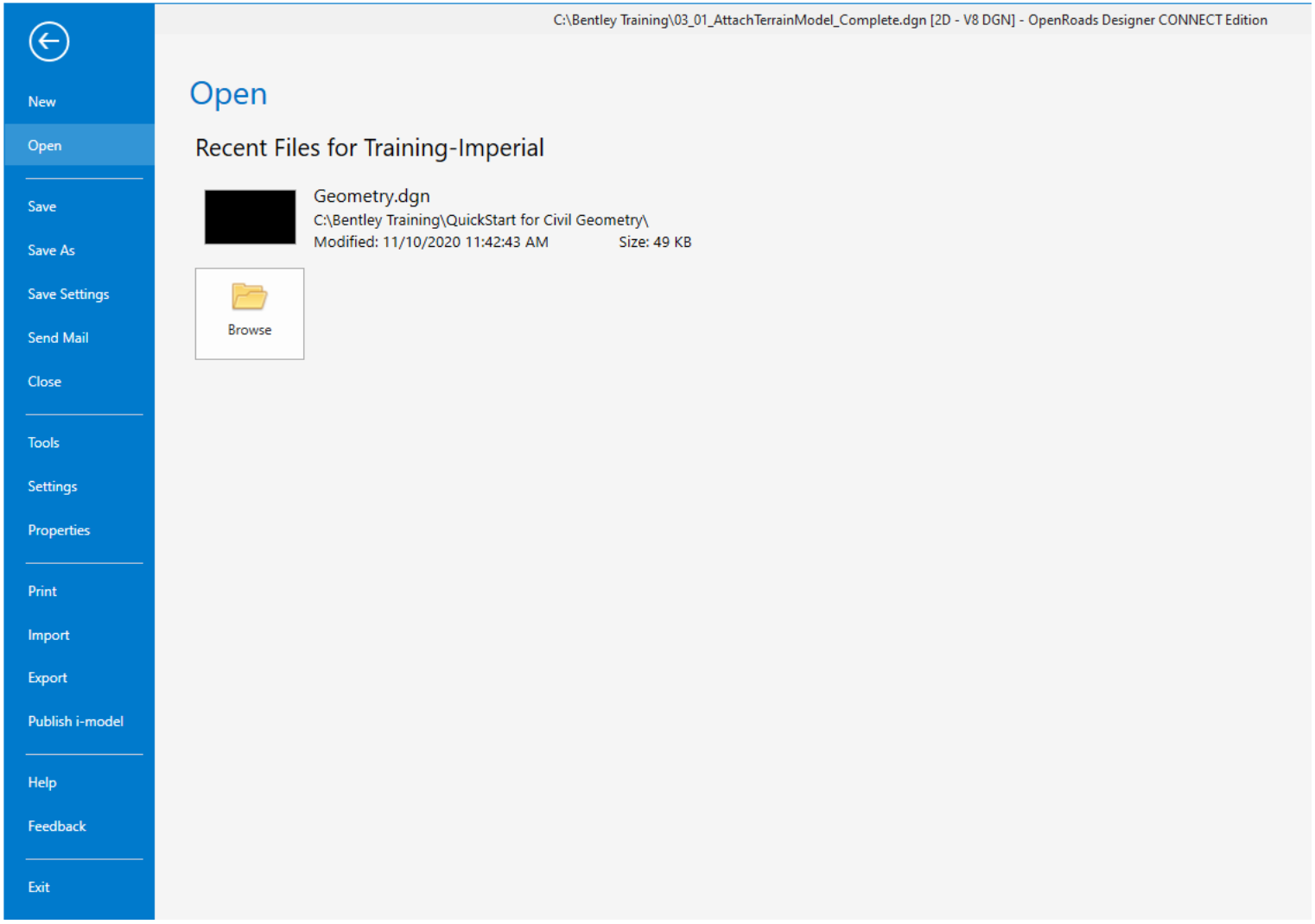


8. **Right click** to close the *Arc Between Points* toolbox.

9. Introduction to the *BackStage View*.

a. Activate the *BackStage View* by clicking **File** in the ribbon menu.

b. Notice the various other options on this screen such *New*, *Open*, *Save*, *Save settings*, etc. Whenever you need to create a new file you will have to access the *BackStage View*.



c. **Click** the Arrow in the upper left corner to return to the main ribbon interface.

Exercise 2: Create the Horizontal Alignment

In this exercise, you will learn how to create a horizontal alignment for London Rd. using the horizontal geometry tools.

Skills Taught

- Attach Aerial Imagery Reference File
- Create Horizontal Geometry Lines
- Create Horizontal Geometry Curves
- Create the Horizontal Alignment
- Define the Start Station
- Annotate the Horizontal Alignment
- Review Geometry with the Explorer Tool
- Create Horizontal Alignment Report

Attach Reference File

In this section, you will learn how to attach the *Aerial_Topo.dgn* as a reference file to your design file. The *Aerial_Topo.dgn* file contains the PI locations (point of intersection) that you will use to create the tangent elements of the alignment.

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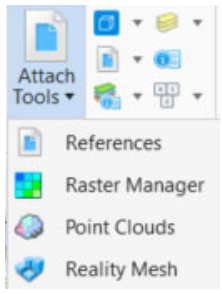
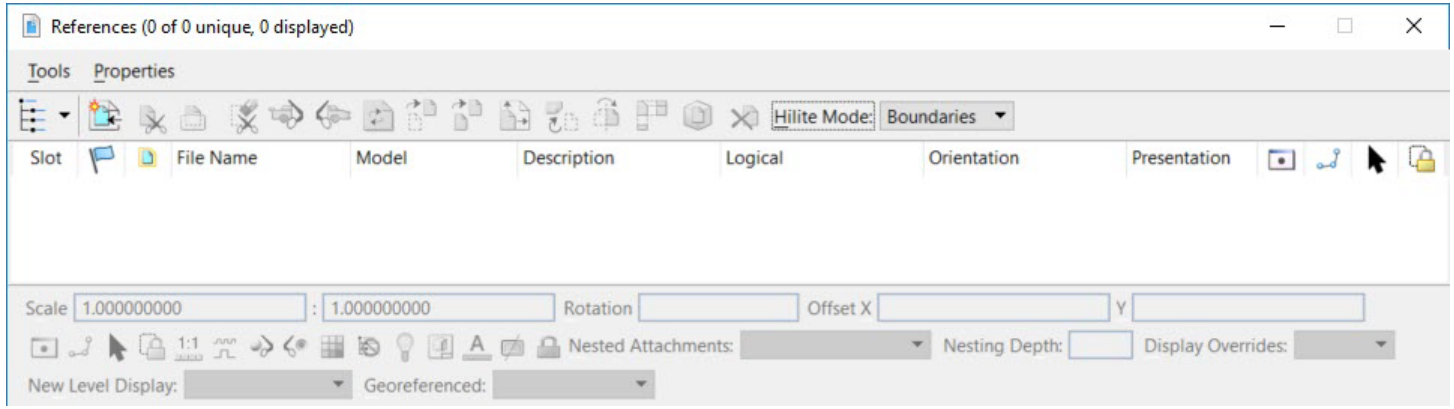
1. Attach *Aerial_Topo.dgn* as a reference.

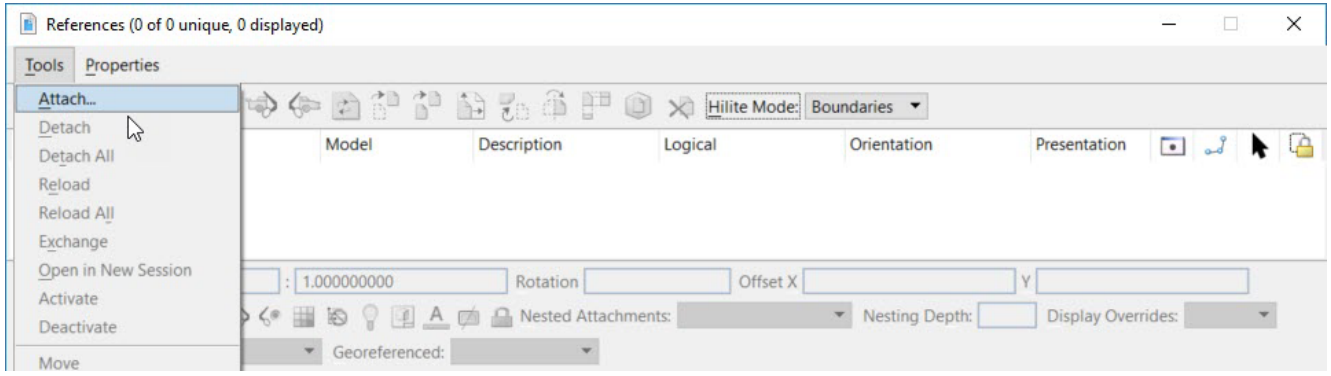
   a. Click on **Home > Primary > Attach Tools** and select **References**.



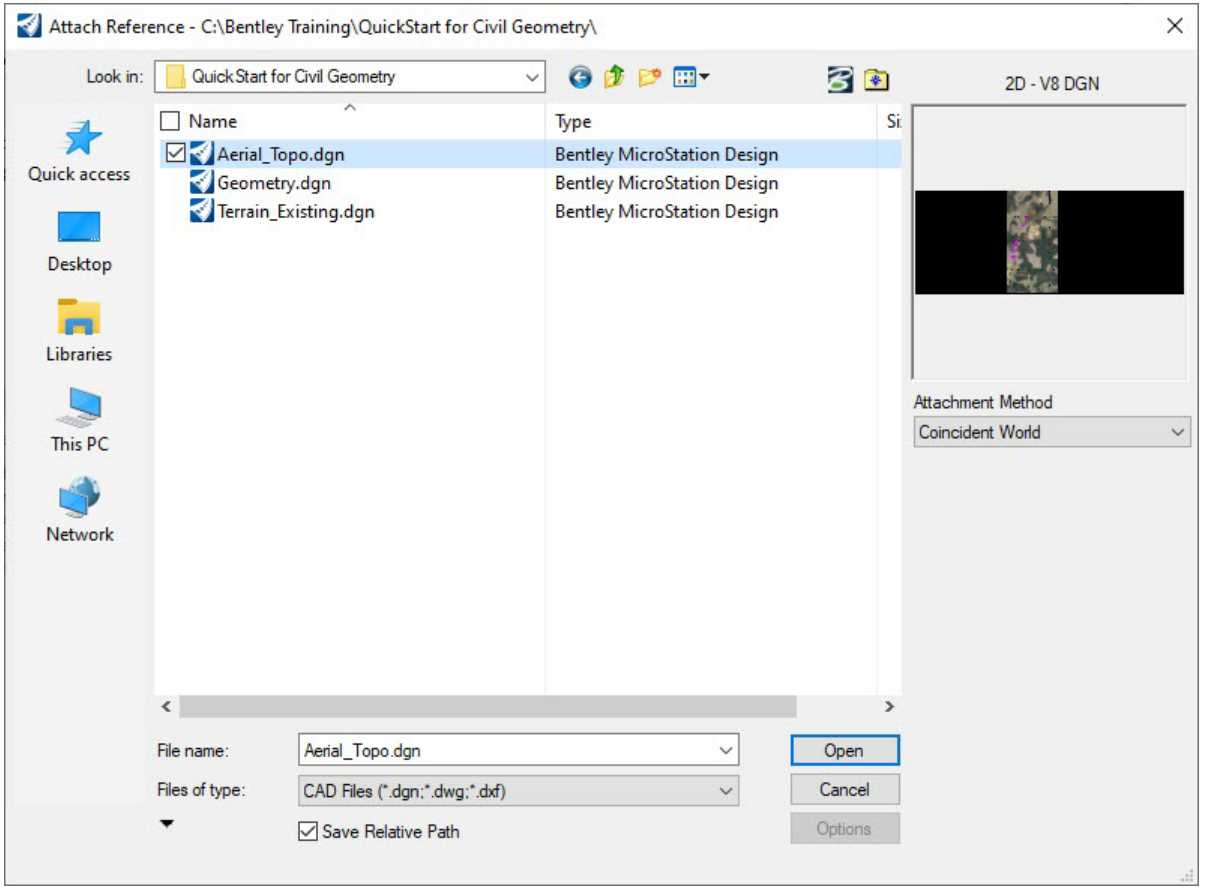


The References dialog will now appear as shown above. You use this dialog to attach reference files to design files.

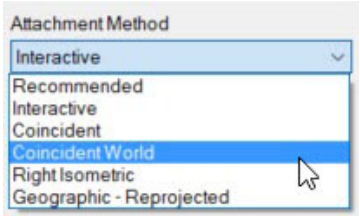
   b. In the *References* dialog, **Click** on **Tools** and choose **Attach**.



c. The **Attach Reference** dialog will appear, **browse** to the location of *Aerial_Topo.dgn* and **Left click** on it.

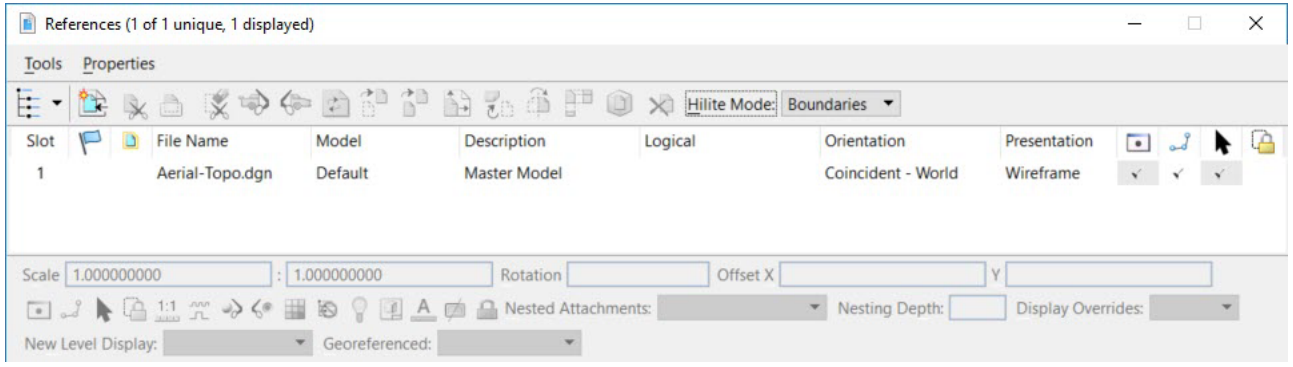


d. Change the *Attachment Method* to **Coincident World**.



e. **Click** *Open* to attach the file as a reference.

The *Aerial_Topo.dgn* will now be attached to the active file and displayed in the References Dialog.

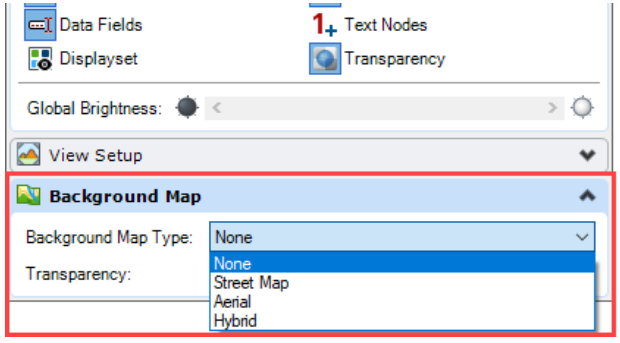


f. **Close** the Reference dialog.

g. **Click** the *Fit* view icon so you can see all of the graphics in the design file.

h. Locate and review the magenta circles drawn in the *Aerial_Topo.dgn.* The magenta circles represent the PI points that will be used to place tangent lines between.

TIP: The software also provides the ability to display a background map directly from Bing Maps. This option can be found under the *View Attributes > Background Map* panel.



Create Horizontal Geometry Lines

In this section, you will be creating the tangent lines for *London Rd.* (see image below).

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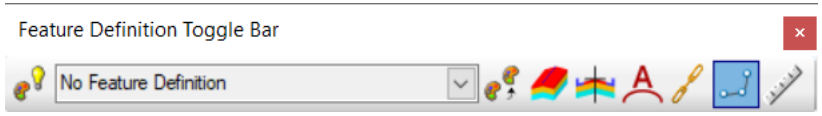
1. Set a **Feature Definition** to be used with your civil geometry elements.

   Feature Definitions are used to control symbology, annotation, and various other properties that are applied to the geometric elements. The feature definitions are used to:

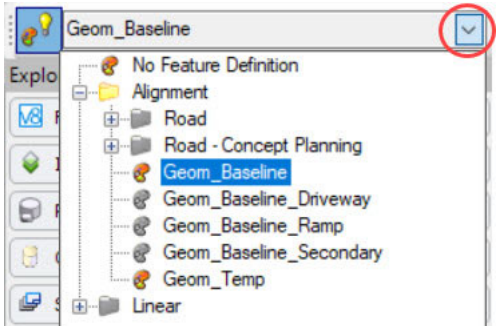
   - Define what the geometric elements actually are. What is being modeled such as curb, centerline, edge of pavement, etc.
   - Control symbology in various views, including capability to define differing symbology in plan, profile, and 3D spaces
   - Define terrain modeling attributes (spot, break line, void, etc.)
   - Define surface display characteristics

   Feature Definitions are defined and stored in a DGN library delivered with the WorkSpace.

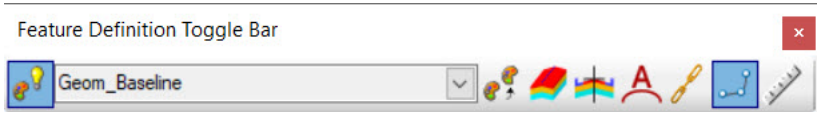
   a. Open the *Feature Definition Toggle Bar* tool by going to **Geometry > General Tools > Standards > Feature Definition Toolbar**.



   b. Set the active feature to **Geom_Baseline** by pressing the down arrow.



c. **Click** on the **Use Active Feature Definition** tool on the *Feature Definition Toggle Bar* to toggle it **ON**.



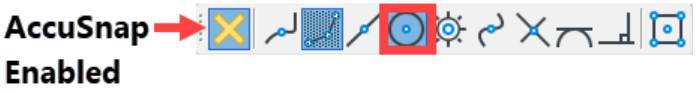
- Setting the **Active Feature Definition** ensures that all geometric elements created will have the selected feature definition assigned to them as you create geometric elements.

2. Create the tangent lines between known PI points (magenta circles). Use the image to the right as a guide.

a. From the ribbon menu select **Geometry > Horizontal > Lines > Line Between Points**

Notice the heads up display attached to your cursor will be prompting you for a start point.

b. **Left click** on the *Center Snap* tool. Be sure AccuSnap is enabled as shown below.



c. **Snap** to the center of **PI#1** and **Left click** to accept.

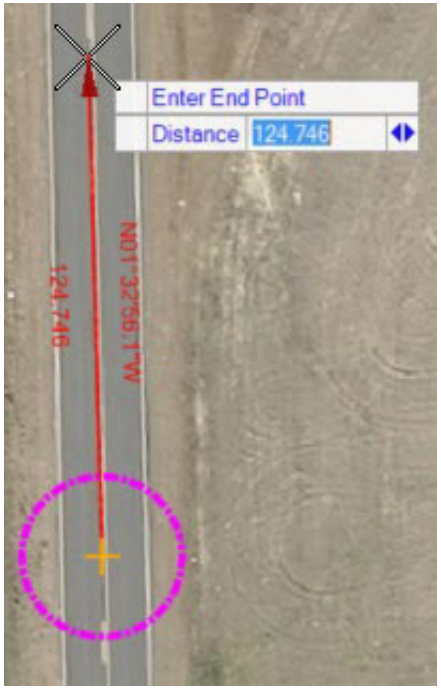
Hint: If you have trouble snapping to the center just approximate the center point and move on to the next step.

A Note About Snaps and Design Intent:

When you snap to elements, the software remembers how you snapped to elements and what type of snap was used. Thus, a relationship exists between the elements. This is an example of *Design Intent.*

Design Intent builds associations and relationships between civil elements. Object information (how, where, and by what method it was created) is stored with the object to insure the original intent is retained and honored in the design. This is a very important concept to remember as you work with the product.

The heads up prompt changes and gives you the option to key in the distance and/or direction as needed. Pressing the *Right arrow* or *Left arrow* on your keyboard will toggle between *Distance* and *Line Direction* input fields.



d. Define the Distance, key in **546.00** in the *Distance* field and press **Enter** to lock the value.

e. Press the **Right Arrow** on your keyboard to switch to the *Line Direction* field.

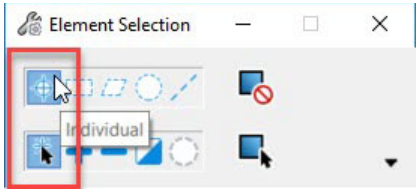
f. In the *Line Direction* field, key in: **N01:33:00:W**, press **Enter** to lock the value.

g. **Left click** to accept.

3. Select the **Element Selection** tool.

   - The **Element Selection** tool is used to select elements so they can be edited or manipulated with other commands.
   - It can also be used to exit out of a command.

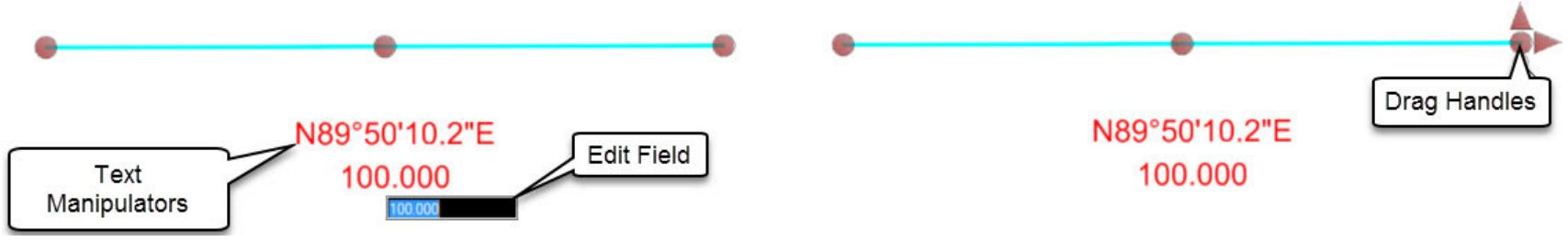
4. Set the **Element Selection** tool to the individual mode by selecting the Individual and New icons in the Element Selection tool setting window.



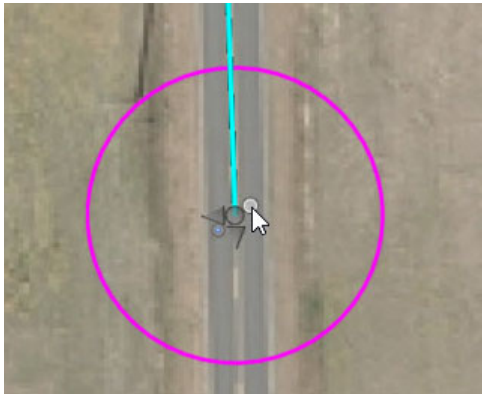
a. **Select** the line you just created.

Recall, geometric elements are rule-based elements that provide *Design Intent*. Notice the line has a distance and direction associated with it. The distance and direction represent the rules associated to the element.

Also, note the *Drag Handles* as well as the *Text Manipulators* (direction/distance) attached to the line. These provide the ability to quickly modify the line. If you need to modify the distance and/or direction you can simply click on distance/direction *Text Manipulators* and key in new values in the edit fields. You can use the *Drag Handles* to trim/extend, rotate or move the line.



b. **Hover** your cursor over the beginning point of the line, the *Drag Handle* arrows will appear as well as the center point snap indicator.



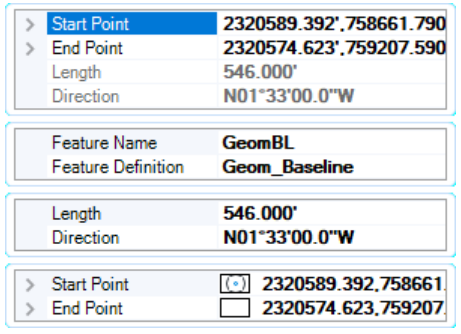
The *Drag Handle* arrows give you the ability to dynamically adjust the end point of the line. By selecting the *Drag Handle* arrows you can extend or trim the line and also change the location of the end point.

The center snap indicator shows that the beginning point of the line was placed by snapping to the center of the circle. This is an example of *Design Intent*. A relationship exists between the beginning point of the line and the circle. Be aware, if the circle is moved the line will move. If the circle is deleted the relationship will be removed but the line will remain. This is an important concept to understand with regards to snaps.

c. Next, **Hover** your cursor over the line for a few seconds. A *context sensitive menu* will appear giving you access to other tools related to the element. Context sensitive menus appear if you hover your cursor over OpenRoads Designer elements or objects.

d. Select the **Properties** tool and review the properties of the line.

Note that the line can be edited within the **Properties** dialog. The *Length*, *Direction*, *Start Point*, *End Point*, *Feature Name* and *Feature Definition* can all be modified within this dialog if needed.



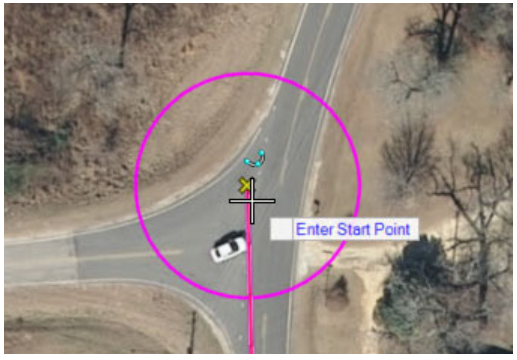
e. **Left click** anywhere in the view to de-select the line.

5. Continue placing tangent lines.

a. **Click** the *Chain Commands* tool on the *Feature Definition Toggle Bar*. When the *Chain Commands* tool is enabled, the next element is automatically connected to the previous element without having to select the start point each time.

b. Re-select the **Geometry > Horizontal > Lines > Line Between Points** tool.

c. **Snap** to the end point of the first tangent line to place the start point of the second tangent line.



d. **Left click** to accept.

e. **Left click** near the center of the circle at **PI #3** to complete placing the tangent line between **PI #2** and **PI #3**.

f. **Left click** near the center of the at **PI #4** to place the tangent line between **PI #3** and **PI #4**.

g. **Left click** near the center of the at **PI #5** to place the tangent line between **PI #4** and **PI #5**.

h. **Right click** to complete.

i. From the *Feature Definition Toggle Bar*, turn **OFF** the *Chain Commands* tool.

Your geometric elements should look like the image to the right once you have completed placing all tangent lines.

Create Horizontal Geometry Curves

In this section, you will learn how to place the horizontal curves that will be used to create the London Rd. alignment.

1. Create horizontal curves between tangent lines using the **Simple Arc tool**.

   a. From the ribbon menu select **Geometry > Horizontal > Arcs > Arc Between Elements > Simple Arc**

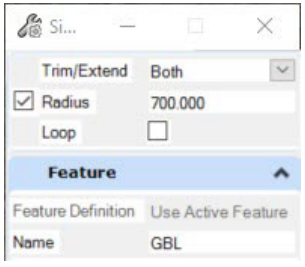
   b. Following the heads up prompts, locate and select first tangent element (line between **PI #1** and **PI #2**).

   c. Locate and select second tangent element (line between **PI #2** and **PI #3**).

   d. Define the arc *Radius* as **600**, press **Enter** to lock the value and **Left click** to accept.

   e. Set the *Trim/Extend* option to **Both** and **Left click** to trim both tangent elements.

   NOTE: In lieu of using the heads up prompts, you can also key in values in the toolbox dialog but you still need to *Left click* to accept the values entered.



2. Create remaining curves for **PI#3** and **PI#4** using the same methods described in steps **1a.** through **1e.** on the previous page. The radius values are given below:

   - **Curve 2** at **PI#3** *Radius* = **10000** (curve to the right). **Take care when placing this curve, since it has a very flat radius. It must curve to the right.**
   - **Curve 3** at **PI#4** *Radius* = **2100** (curve to the left)

3. Modify the first horizontal curve radius.

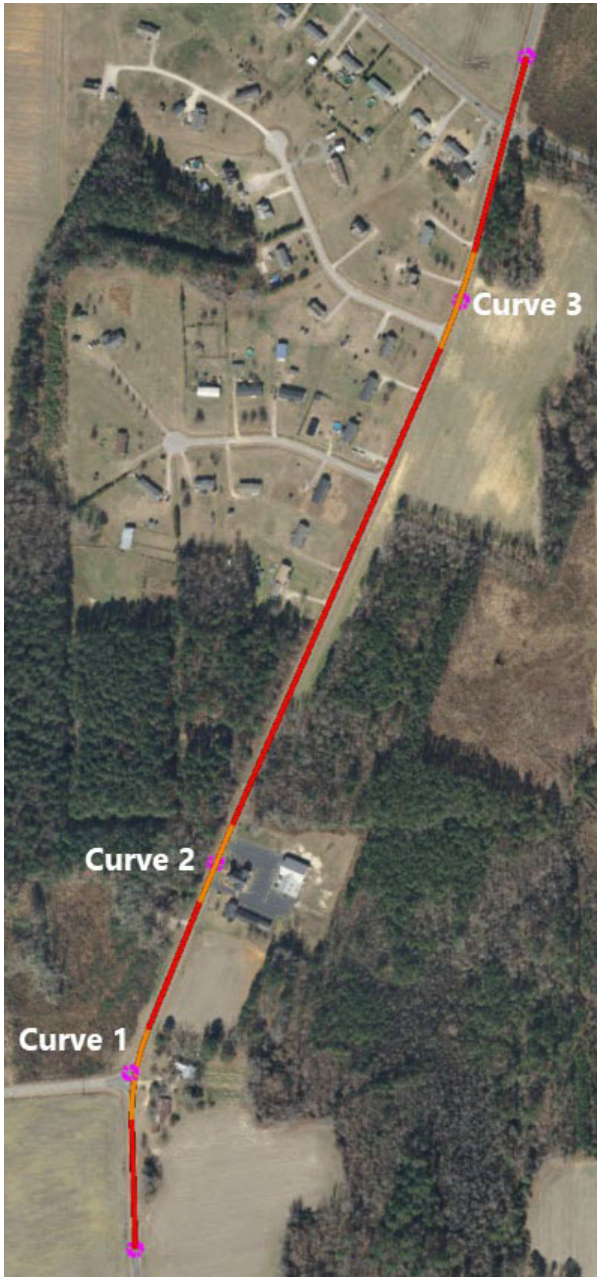
   a. Select the **Element Selection** tool.

   b. **Select** the first horizontal curve, notice the radius is displayed as **600'**.

   c. **Left click** the **600'** value, the edit field will appear.

   d. Key-in **700** in the edit field and press **Enter** (or **Left click**) to change the radius.

      The curve will update with the new radius and the tangent lines adjust automatically to maintain their relationship with the curve. This is another example of *Design Intent* and the rules and relationships that exist between civil geometry elements. The software remembers that the original curve was placed between the two tangents and when the radius value changed the geometry adjusted itself to maintain the geometric relationship.



Create the Horizontal Alignment

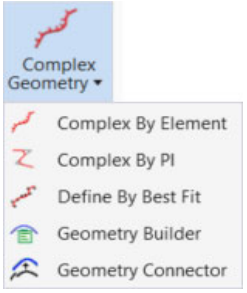
Now that you have all of your horizontal geometry created, you need to combine them together into an alignment. You will do this by using the **Complex By Elements** tool.

---

1. Use **Complex By Elements** tool to create the horizontal alignment for *London Rd.*

   a. From the ribbon menu select **Geometry > Horizontal > Complex Geometry > Complex By Element**

   b. In the dialog box, set the following parameters:

   - *Method:* **Automatic**
   - *Maximum Gap:* **0.033**
   - *Name:* **LondonRd**

   c. Following the heads up prompts:

   - *Locate First Element:* **Select** the first tangent line (between **PI#1** and **PI#2**) near the beginning.
   - *Accept Complex:* **Left click** to accept and create the complex profile element.

   NOTE: *Where* you select the element is important. Each element has a midpoint. Notice when selecting the element near the start point an arrow appears pointing north, indicating the direction the alignment will be created. If you select the element near the end point, the arrow will change direction, pointing south and will not create the alignment in the proper direction.

The completed complexed horizontal alignment should look like the image to the right. The alignment is made up of 4 tangents lines and 3 horizontal curves.

d. **Hover** over the alignment and **select** it to display the element information and the edit handles. Note that the full alignment is highlighted and is a complex element named **LondonRd**.

e. *Right click* to de-select the alignment.

Define the Start Station

In this section, you will learn how to define the start station value and assign it to the horizontal alignment.

---

1. From the ribbon menu select **Geometry > Horizontal > Modify > Start Station**
2. Following the heads up prompts:
   a. *Locate Element:* **Select** the *London Rd.* alignment.
   b. *Start Distance:* **0**, press **Enter** to lock the value and **Left click** to accept.
   c. *Start Station:* **50+00**, **Left click** to accept.
3. Review the stationing.
   a. **Click** the **Element Selection** tool.
   b. **Select** the alignment, notice the alignment displays the new beginning station value.

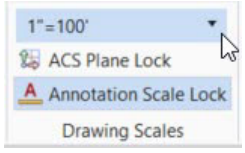
The begin station is dynamic text which can be adjusted by simply selecting the begin station value and keying in a new value. The stationing of the alignment will then update.

Annotate Horizontal Alignment

In this section, you will learn how to annotate the horizontal alignment.

---

1. From the ribbon menu select **Drawing Production > Drawing Scales > Annotation Scale Lock** and set the scale to **1”=100’**

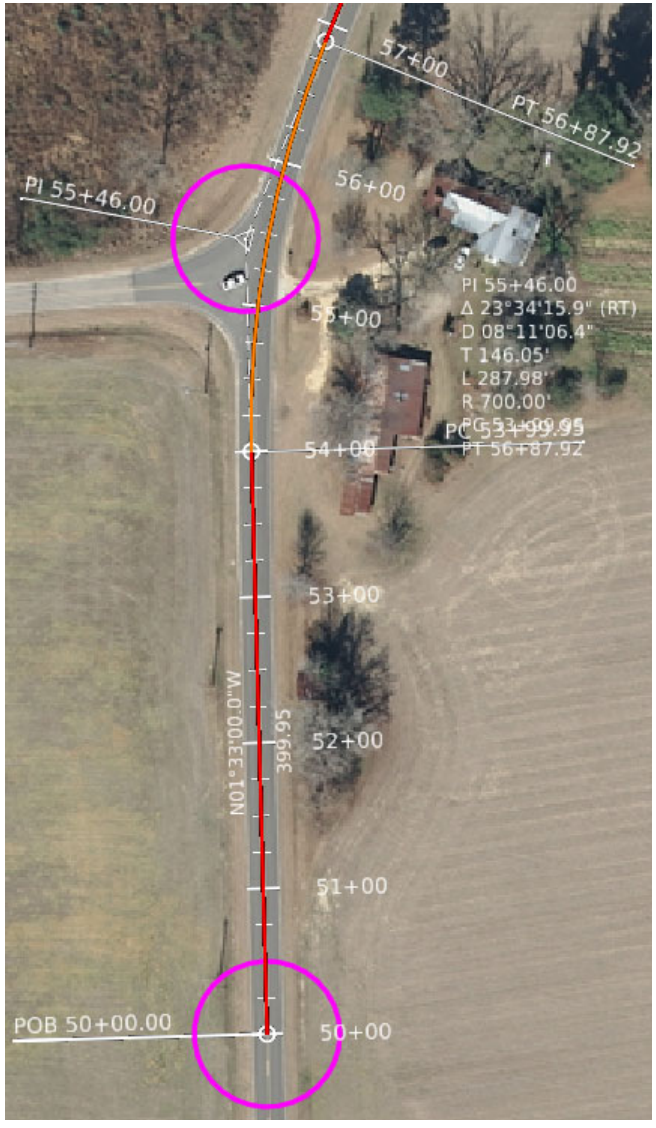


2. From the ribbon menu select **Drawing Production > Annotations > Element Annotation > Annotate Element**

3. At the prompt *Locate Elements - Reset to Complete*, **select** the alignment and then **Right click** to complete.

   The alignment is now annotated. The annotation is also dynamic and associated to the alignment. Any changes made to the alignment will update the annotation.

   The annotation is defined by an *Annotation Group* which is associated with the *Feature Definition*. The text size is controlled by the *Annotation Scale Lock*.



Review Geometry with the Explorer Tool

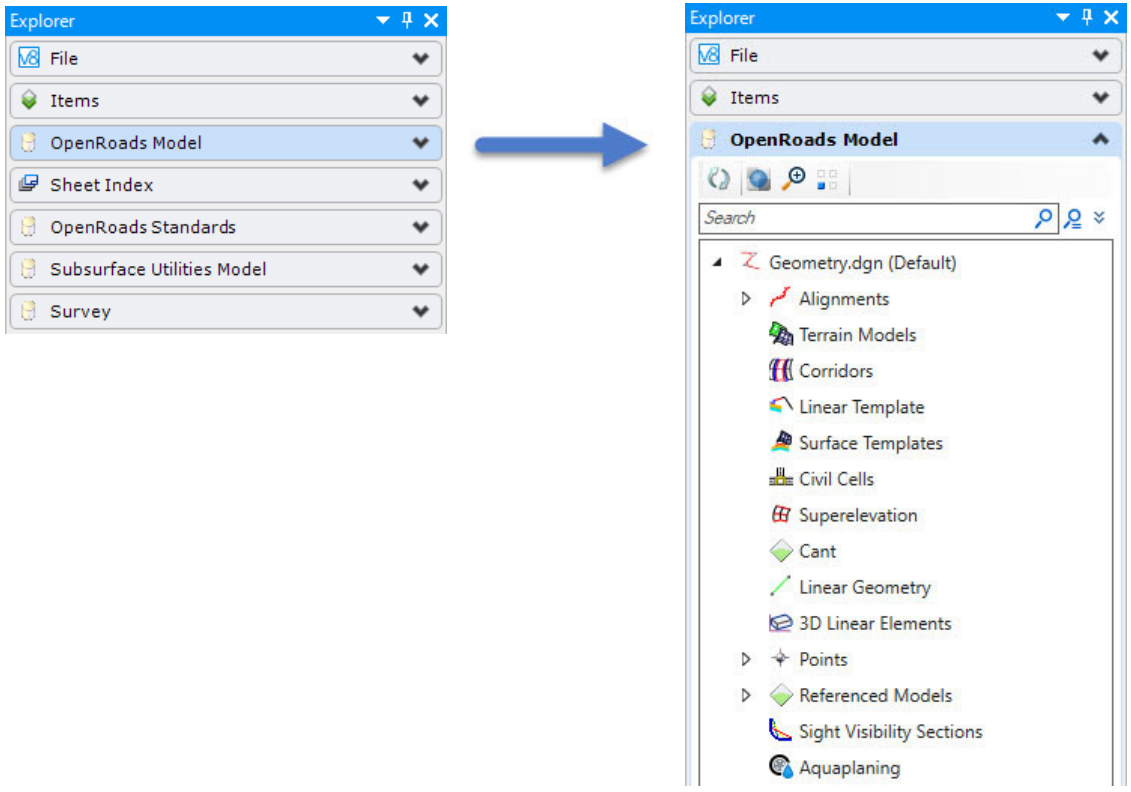
In this section, you will learn how to review geometry with the **Explorer** tool. The **Explorer** tool can be used to browse and manage data in the design file. You can also use it to review, search, zoom to and isolate data. All data is organized and displayed in the **Explorer** tool under the **OpenRoads Model** panel. As the design progresses, the information is automatically created and updated.

---

1. Review geometric elements in the **Explorer** window.

   a. Select **Home > Primary > Explorer** to display the Explorer window.

   Expand the **OpenRoads Model** group by pressing the down arrow.

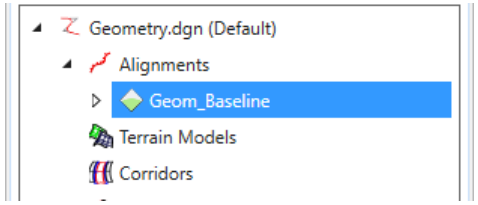


TIP: It is recommended to always have **Explorer** open when working in the software.

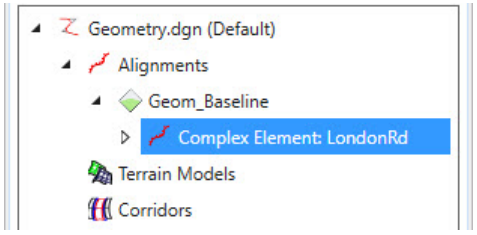
Geometric elements associated with alignments are grouped under the *Alignments* category. To see which elements are part of the *Alignments* category simply click on the small arrow next to the category to expand the list.

b. **Click** the small arrow next to *Alignments* to expand the list to see next item in the list.

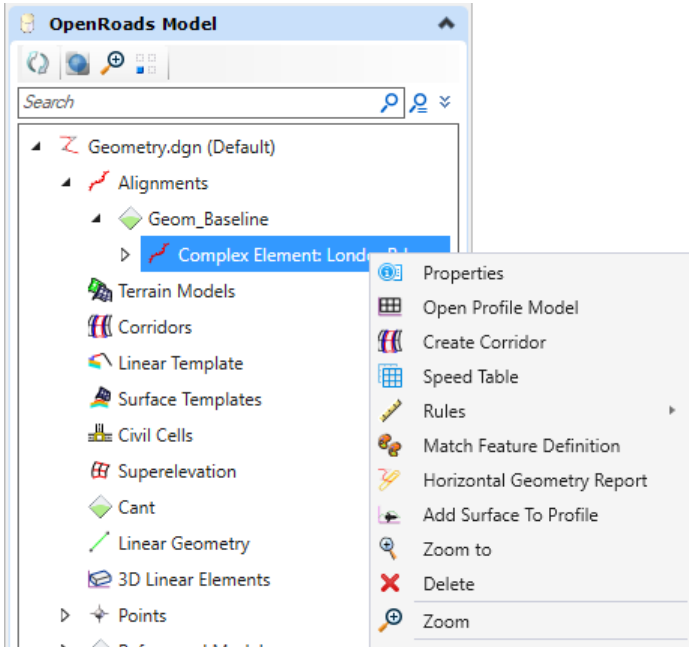
c. **Click** the small arrow next to *Geom_Baseline* to the expand the list (recall *Geom_Baseline* was the feature definition you used to create your geometry.



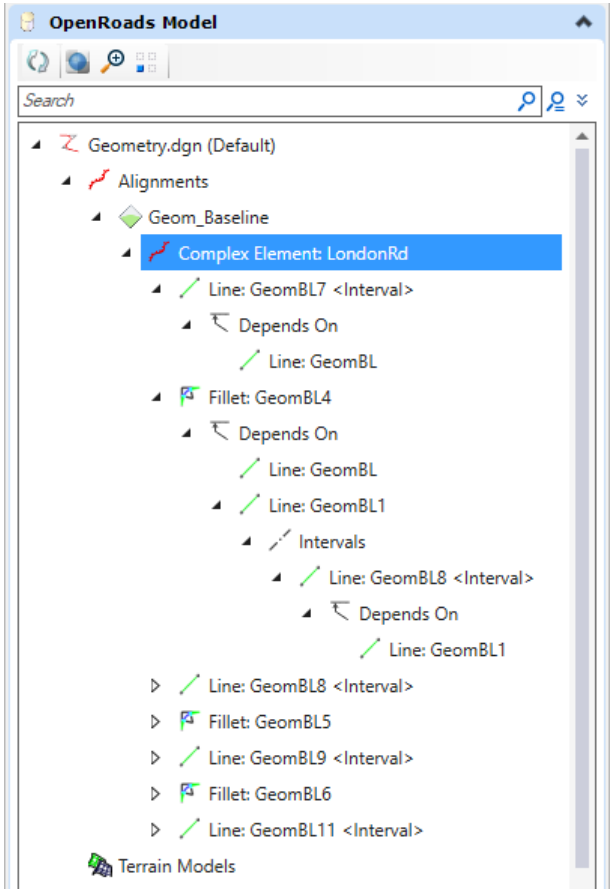
d. **Select** *Complex Element: LondonRd*, observe that the London Rd. alignment is highlighted in *View 1*. This is an example of how **Explorer** can be used to locate and select an alignment in the design file.



e. **Right click** on *Complex Element: LondonRd* to review other tools related to the alignment. You can Left click on any item in the list to gain access to other tools that can be used.



f. **Click** the small arrow next to *Complex Element: LondonRd* to expand the list to see the geometric elements associated with the alignment. Continue to expand the list to see the details and dependencies.

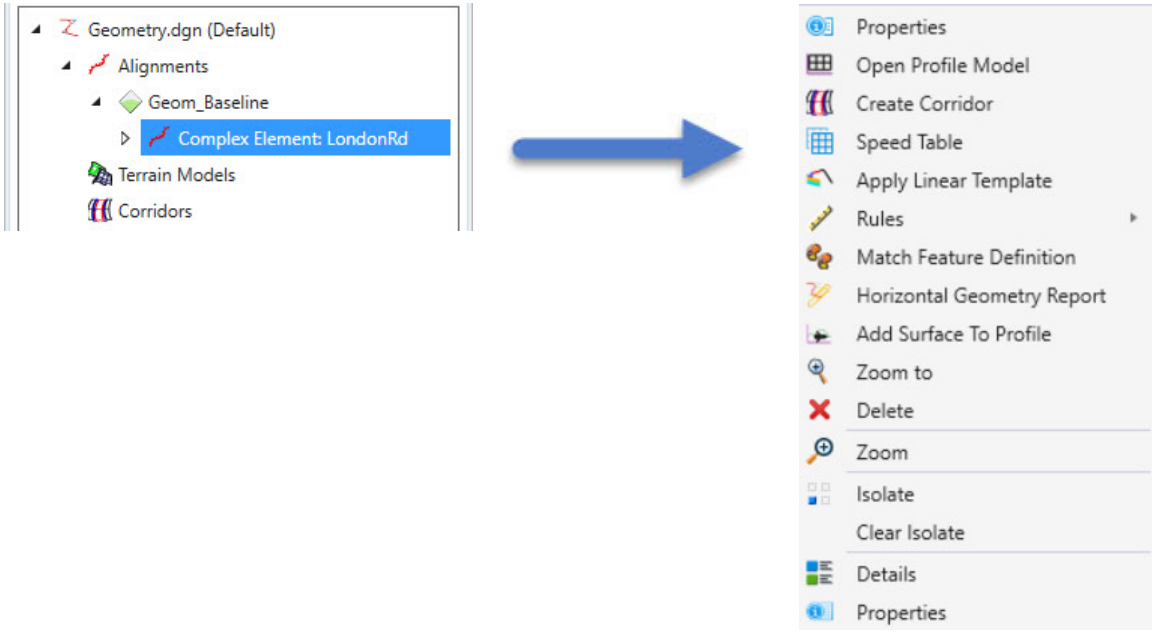


Create the Horizontal Alignment Report

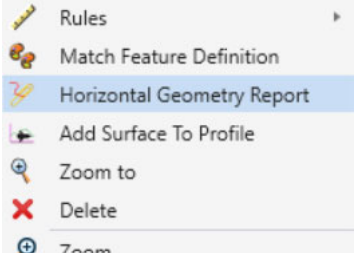
In this section, you will learn how to create the horizontal alignment report for London Rd.

---

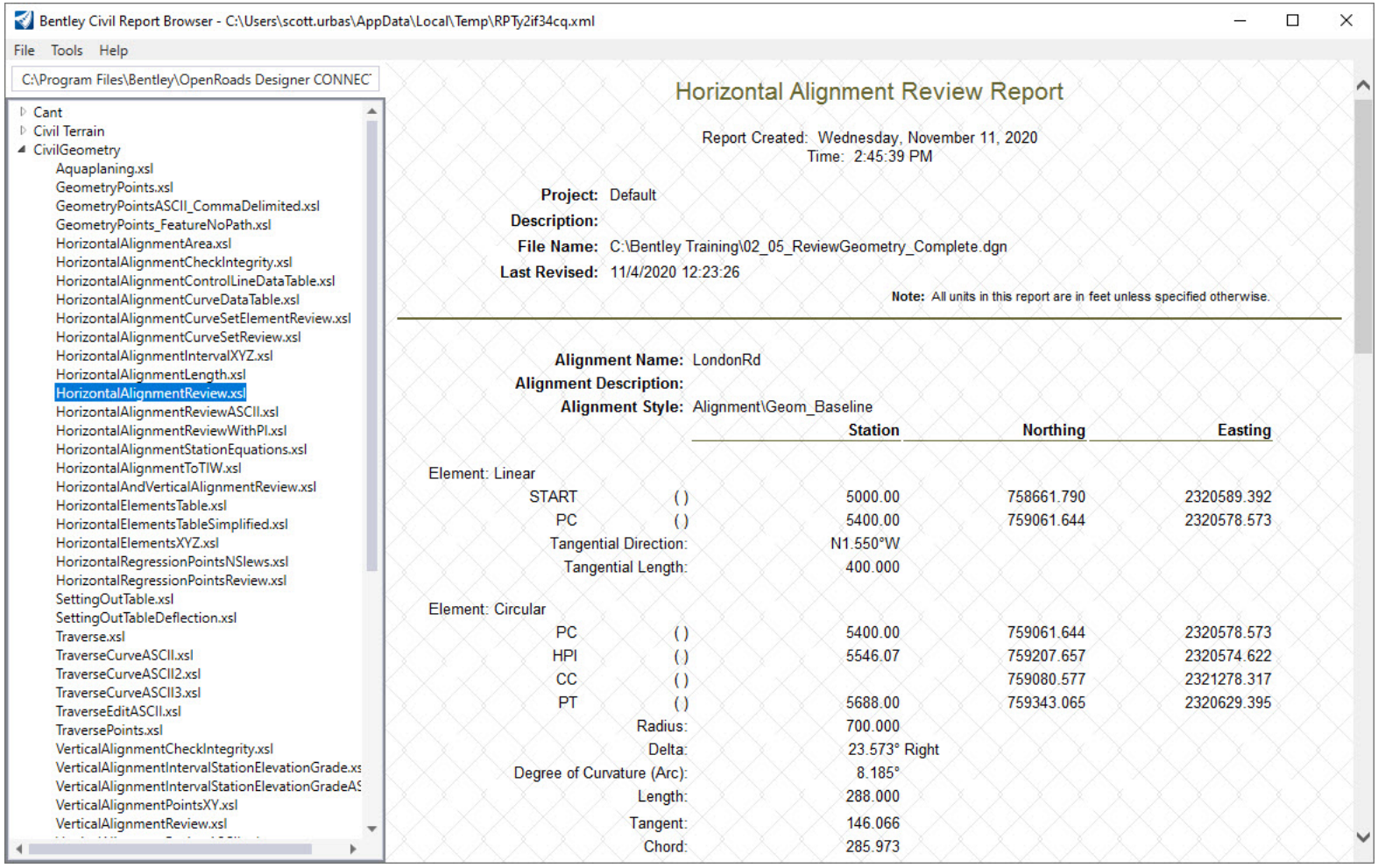
1. From the **OpenRoads** panel, **Right click** on *Complex Element: London Rd*. to access the *Horizontal Geometry Report*



2. **Select** *Horizontal Geometry Report*

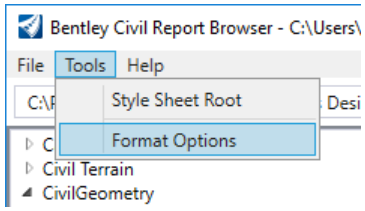


3. The *Bentley Civil Report Browser* dialog will appear and the report will be displayed. **Review** the report.

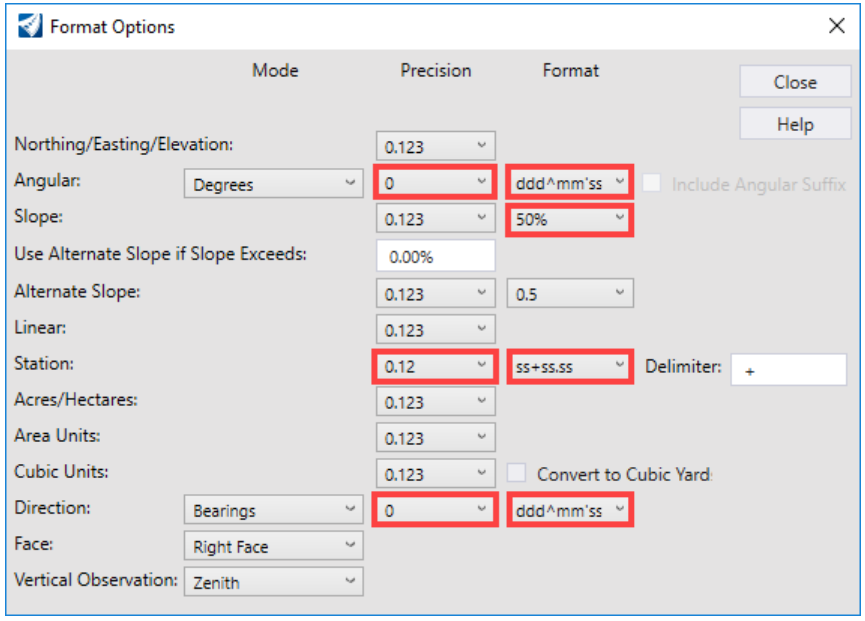


After reviewing the report you may want to adjust the precision and format of distances, angles, bearings, etc. You can easily adjust the report with the *Format Options* tool.

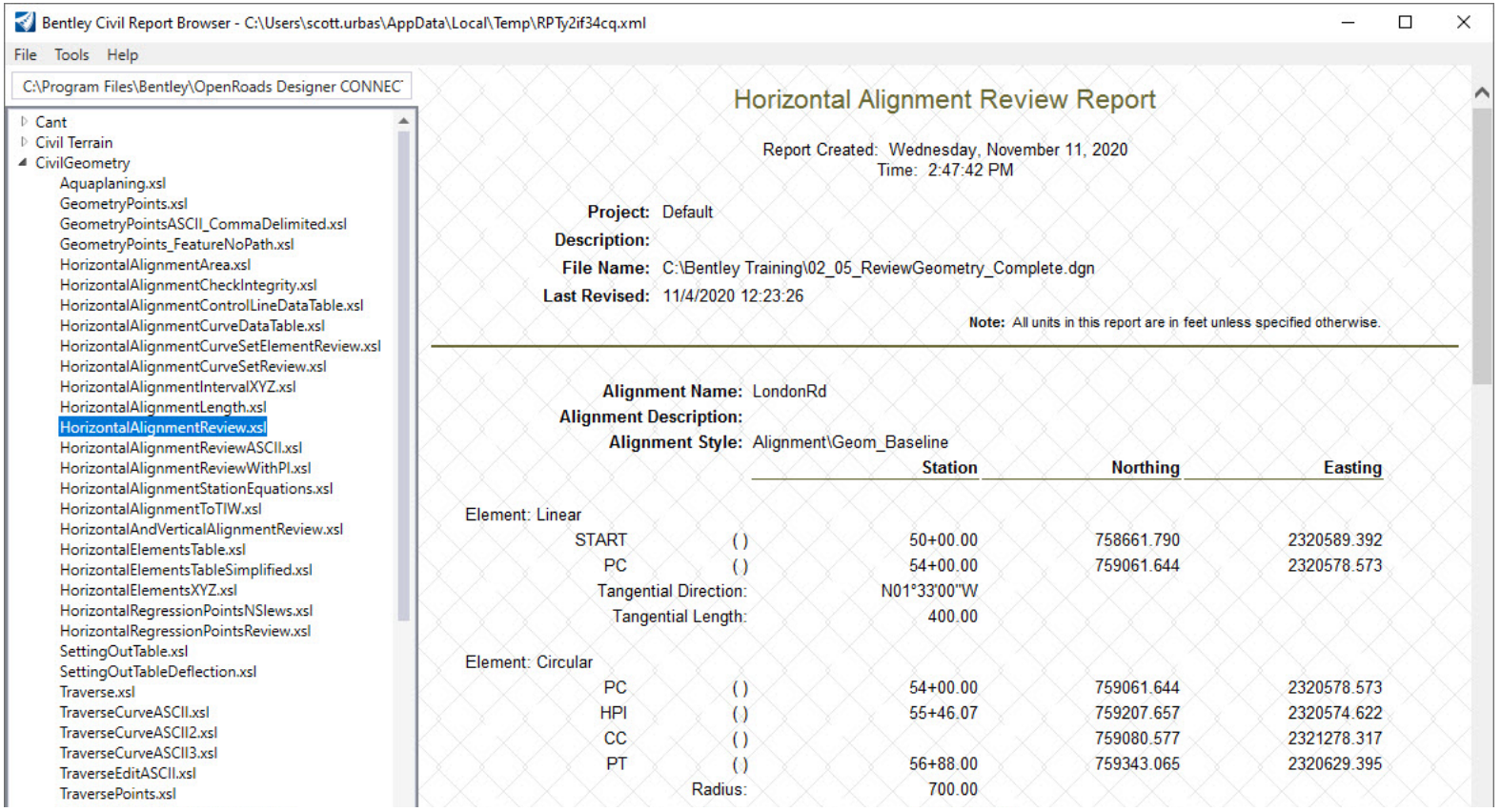
4. Go to **Tools > Format Options** in the *Bentley Civil Report Browser*.



5. Change the **Format Options** as follows:
   - *Angular - Precision:* **0**
   - *Angular - Format:* **ddd^mm'ss.s"**
   - *Slope - Format:* **50%**
   - *Station - Precision:* **0.12** *[0.123]*
   - *Station - Format:* **ss+ss.ss** *[s+sss.ss]*
   - *Direction - Precision:* **0**
   - *Direction - Format:* **ddd^mm'ss.s"**
6. Close the **Format Options** window.



7. **Review** the report to ensure the formatting has been adjusted.



8. Save the report.

   a. In the *Bentley Civil Report Browser* window, select **File > Save As**.

      - **Browse** to *C:\Bentley Training\QuickStart for Civil Geometry* or other folder where you unzipped the dataset files
      - *File name:* Key in **LondonRd**
      - *Save as type:* choose **Doc File (*.doc).**
      - **Click Save**, to save the report.

   NOTE: You can also print the report by going to **File > Print** or Right click in the report window and choose **Print**.

Exercise 3: Existing Terrain Model and Define 2D & 3D Views

Skills Taught

- Attach Terrain Model
- Set Terrain Model Active
- Review Design File Models
- Define 2D & 3D Views

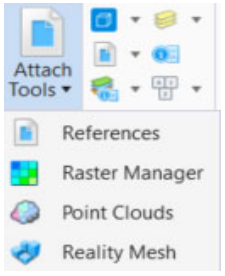
Attach Terrain Model

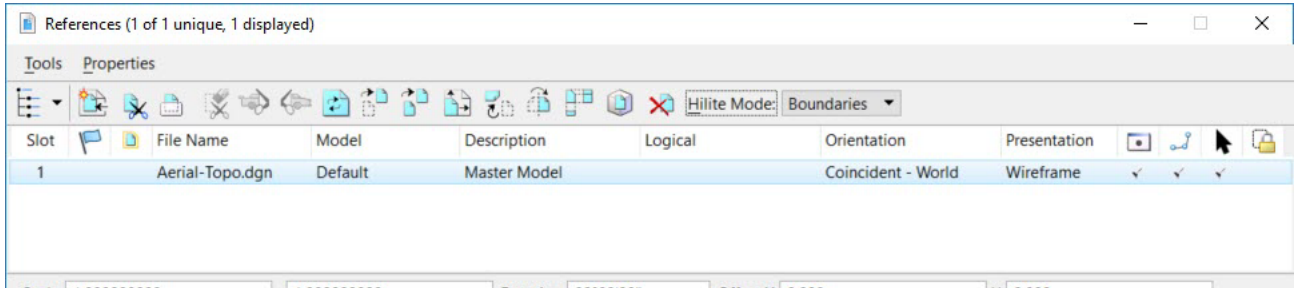
In this section, you will learn to attach a the existing ground terrain model to your design file. Terrain models are stored in 3D design files. Any time you need to use a terrain model within your design file, you just need to attach the terrain model as a reference.

---

1. Attach *Terrain_Existing.dgn* as a reference.

a. **Click** on **Home > Primary > Attach Tools > References**.





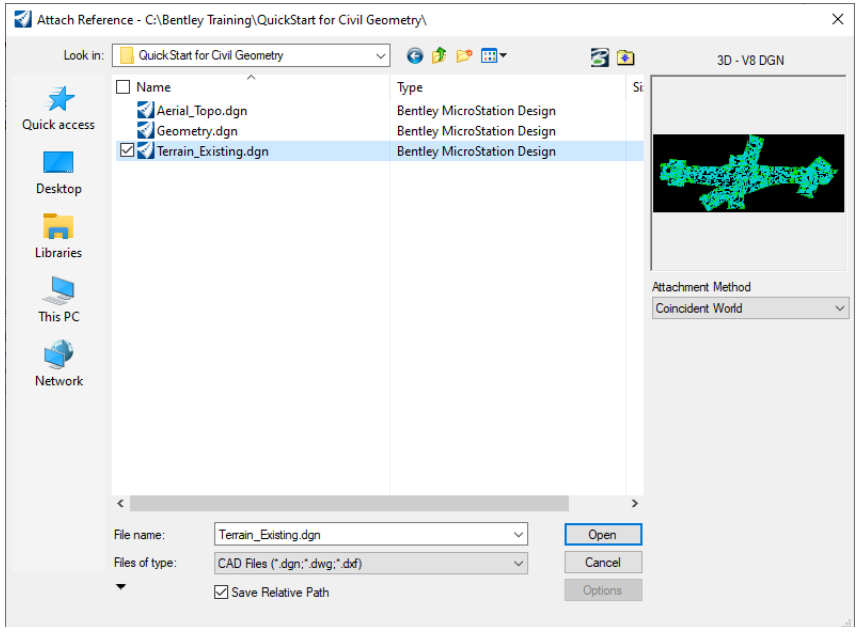
The References dialog will now appear as shown above. You use this dialog to attach reference files to dgn files.

b. From the References dialog, select the **Attach Reference** icon or **Tools > Attach...**

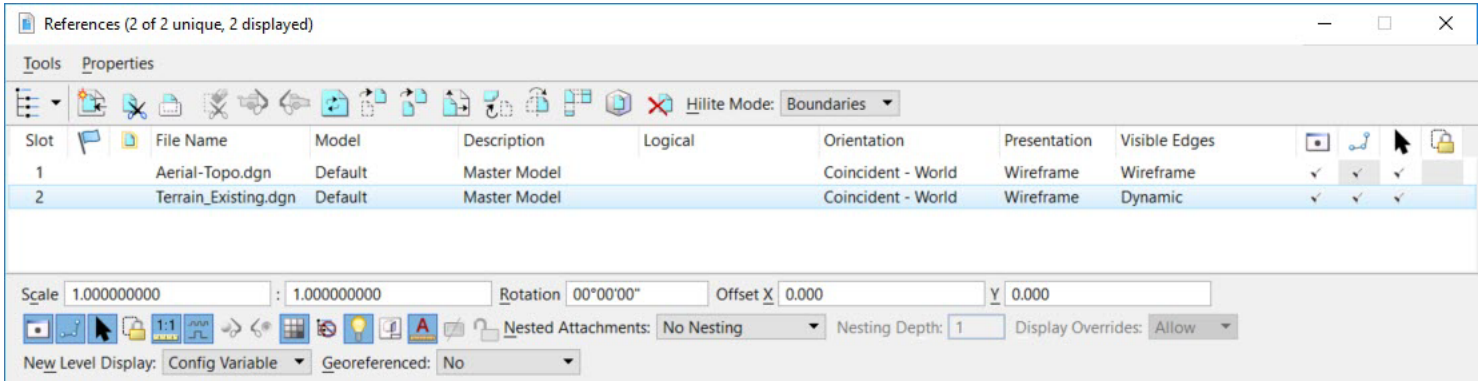
c. **Select** the file *Terrain_Existing.dgn*

d. Set the *Attachment Method* to **Coincident-World**.

e. **Click** *Open*

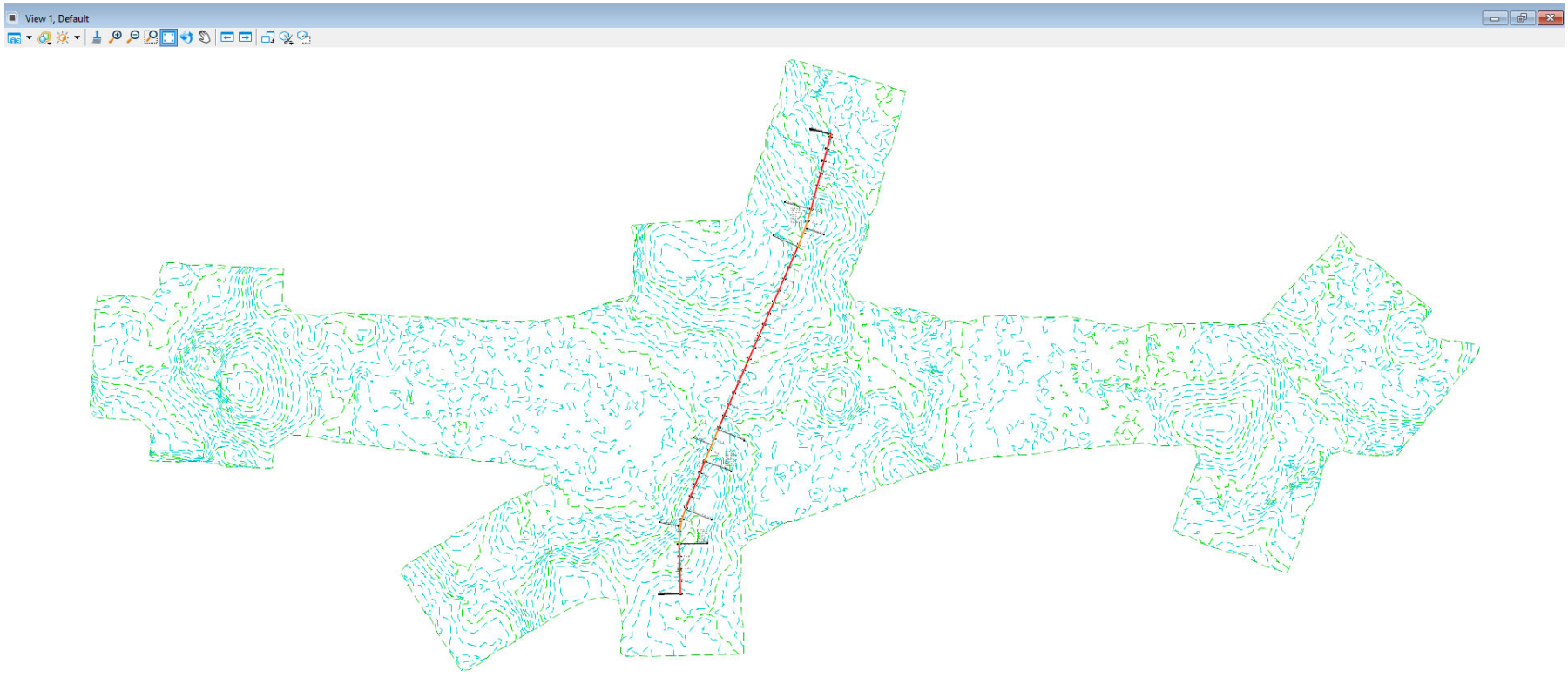


f. The terrain model, *Terrain_Existing.dgn* is now attached to the file.



g. **Close** the *References* dialog box.

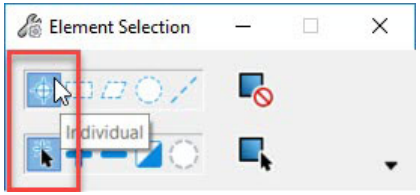
h. **Click** the *Fit View* icon in the top of the view window so you can see all of the graphics in the design file.



Setting the Active Terrain Model

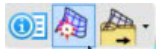
Setting the terrain model active instructs the software to use the active terrain model as the default terrain model when using other OpenRoads Designer tools. In this section, you will learn how to set the terrain model active.

1. **Click** the **Element Selection** tool
2. Set the **Element Selection** tool to the individual mode by selecting the **Individual** and **New** icons in the *Element Selection* tool setting window.



3. **Left click** anywhere on the green shape that outlines the terrain model.

4. **Hover** the cursor at this location for a few seconds and context sensitive toolbar appears displaying tools commonly used with terrain models. More terrain model tools can be found on the Terrain ribbon menu.



5. **Select** the *Set As Active Terrain Model* tool.

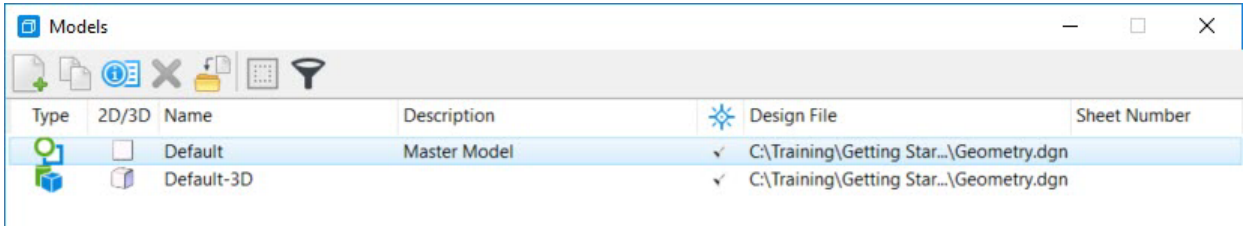
   Setting the terrain model active instructs the software to use the active terrain model as the default terrain model when using other OpenRoads Designer tools. You can always change or clear the active terrain model at any time.

   Also, when setting the Active Terrain Model the software will **automatically** create a 3D model inside of your 2D design file. The 3D model will be used for the display of 3D data.

Review Design File Models

A single design file can contain multiple models (2D Models and 3D Models). One of the ways to see how many models are in a design file is to access the **Models** dialog. In this section, you will learn how to review the 2D and 3D models using the **Models** dialog.

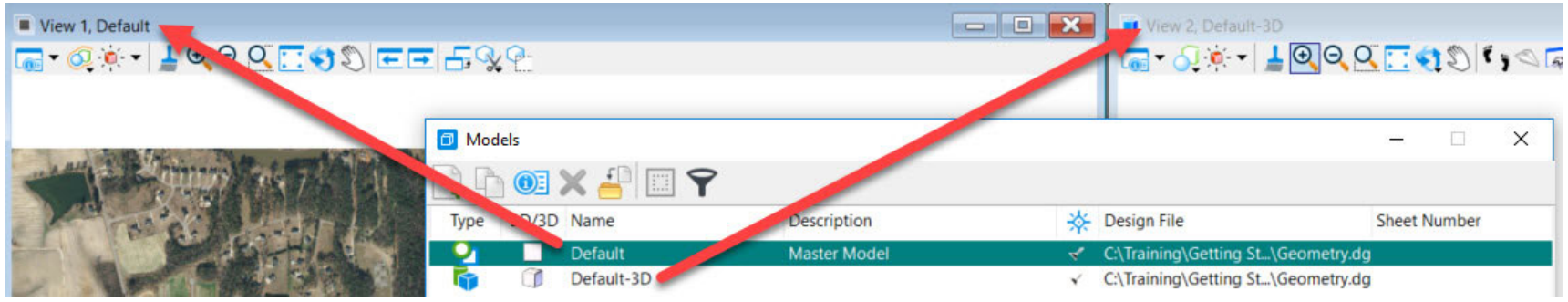
1. From the ribbon menu select **Home > Primary > Models**
2. Review the **Models** dialog, notice there are 2 models available, *Default* and *Default-3D*.



Models can be 2D or 3D. It's very important to realize that even though you started with a 2D design file it is possible to have a 3D model also available in the same design file. As a rule, civil geometry should be created in a 2D Model and 2D design file and terrain models are created and stored in a 3D model.

Recall that setting a terrain model active *automatically* creates a 3D model for you when working in a 2D file. The 3D model must be created by the product. Do not create your own model named *Default-3D*, it will not work properly.

Also, the 2D and 3D models are directly related to the model views, recall *View 1* is named *Default* and *View 2* is named *Default-3D*.



3. **Close** the *Models* dialog.

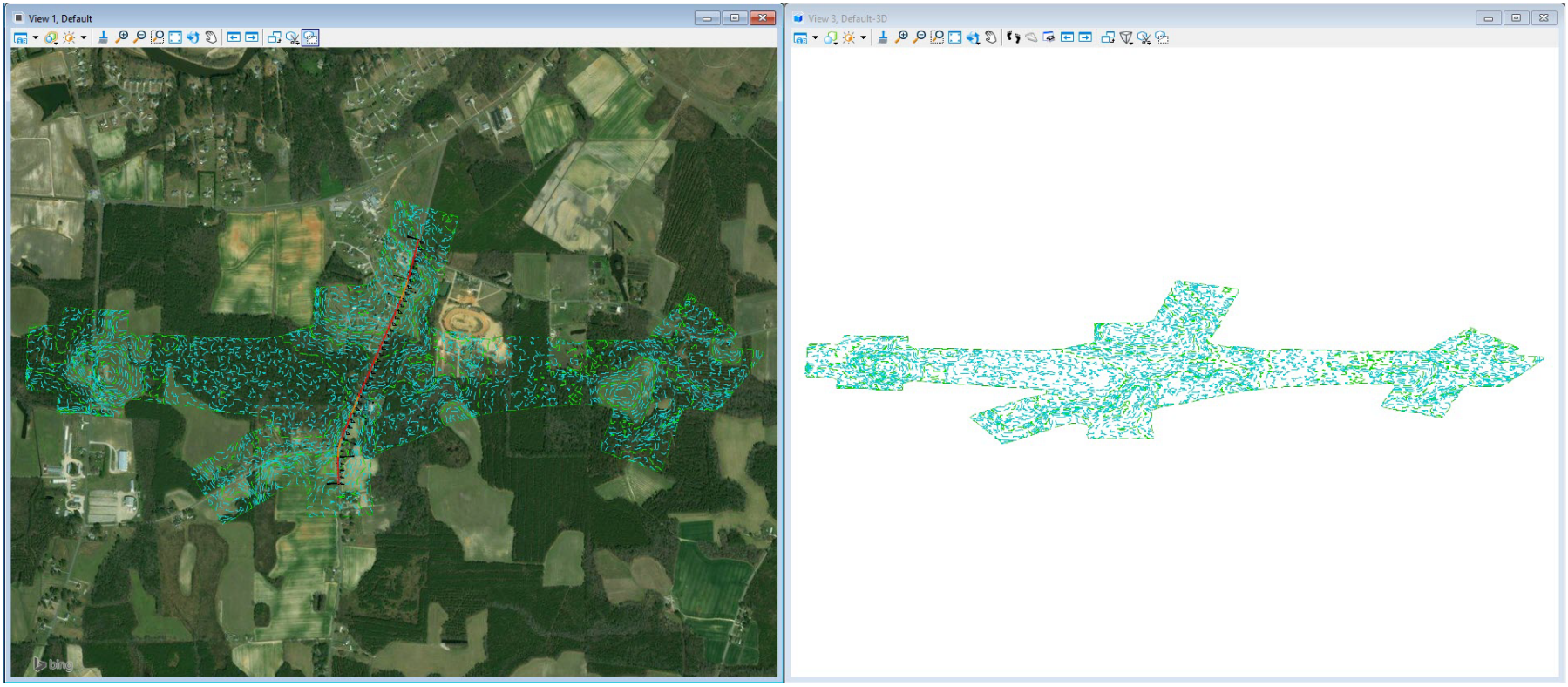
Setting Up Views

In this section, you will learn how to define the 2D and 3D model views.

---

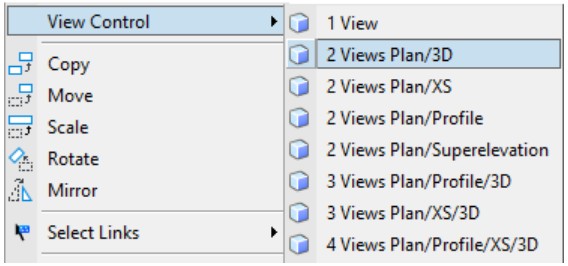
1. Press **F9** on your keyboard.

   Notice the views change, you now have 2 view windows open. *View 1* on the left is the 2D model view that you started with and *View 2* on the right is the 3D model view. Pressing the **F9** key automatically configures this particular view setup for you, 2D on the left and 3D on the right. This will come in handy as you move through the design process.

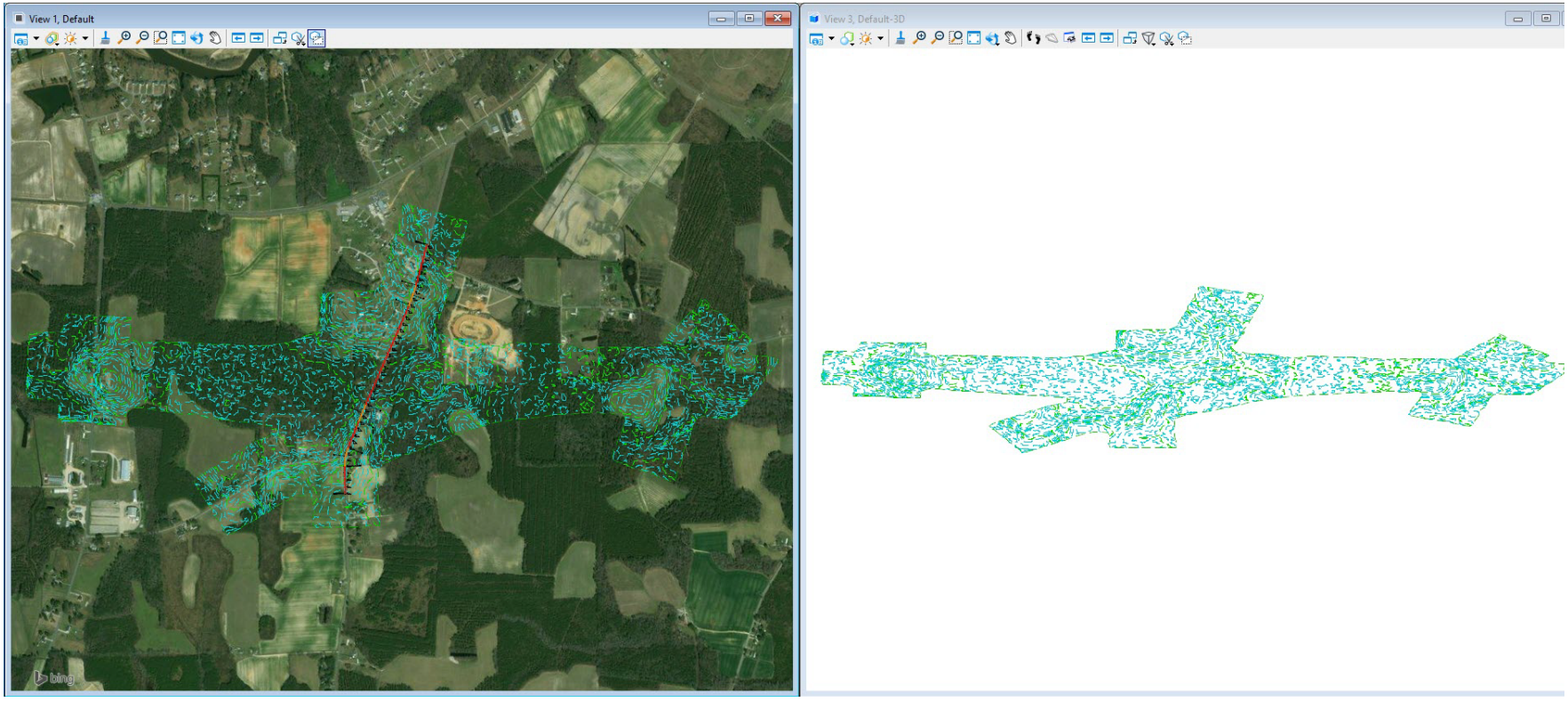


   Also, observe the existing terrain model boundary and contours are displayed in 2D and 3D. The terrain model triangles are not displayed at this time. Triangles, breaklines, feature spots and contours can be displayed via the terrain model properties as needed.

2. If pressing **F9** does not configure the views, then in *View 1* **Right click** and **hold down** the right mouse button to access special view control tools.



a. **Select** *View Control > 2 Views Plan/3D*.



b. **Click** the *Fit View* icon in the top of the view windows so you can see all of the graphics in both views.

Exercise 4: Creating Vertical Geometry

In this exercise, you will learn how to create the vertical alignment for London Rd. using the vertical geometry tools.

Skills Taught

- Define Profile Model View
- Create Vertical Geometry Lines
- Create Vertical Geometry Curves
- Create the Vertical Alignment
- Create the Vertical Alignment Report

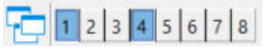
Define Profile Model View

Vertical geometry elements are displayed and managed in the Profile Model View. Prior to creating vertical geometry elements you must first define a Profile Model View to display the vertical geometry into. In this section, you will learn how to define a Profile Model View and display the existing ground profile along the London Rd. alignment.

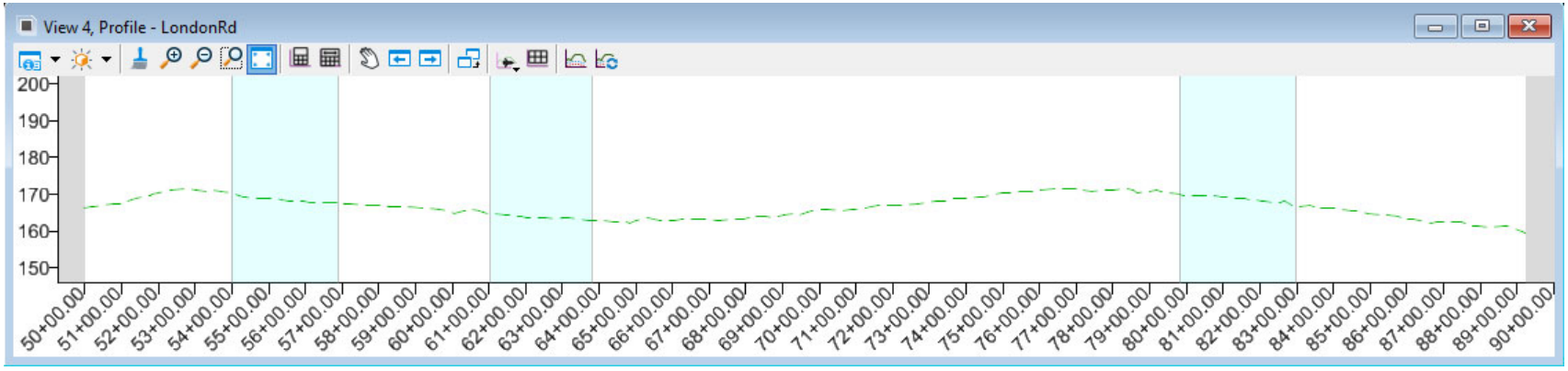
---

1. **Click** in *View 1* to make it active.
2. **Click** the *Fit View* icon in the top of the *View 1* window so you can see all of the graphics in the design file.
3. **Click** the **Element Selection** tool.
4. **Select** the *horizontal alignment*. **Hover** your cursor over the alignment until the context sensitive menu appears.

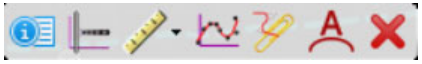
5. **Select** the *Open Profile Model* icon, the heads up display will prompt you to *Select or Open View*.
6. Open *View 4* by selecting the view 4 button from the views toggle menu at the bottom of the screen. Profiles can be displayed in any view.



7. **Click** inside of the *View 4* window. *View 4* is now defined as the profile model view. Only one profile model view can be active at a time.
8. In *View 4*, **click** *Fit View*. You should now see the existing ground profile (green dashed line).



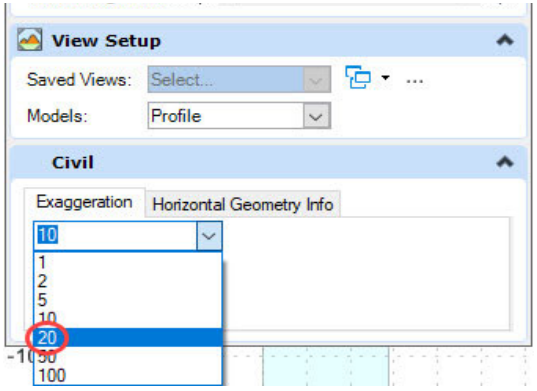
9. **Select** the **Element Selection** tool.
10. **Select** the existing *ground profile line* (green dashed line).
11. **Hover** your cursor over the existing ground profile line until the context sensitive menu appears.



12. **Click** the *Set As Active Profile* icon to set the existing ground line as the active profile.

    Setting the existing ground profile active associates it with the horizontal alignment. It also draws the profile in the 3D model. This will be the default profile for now until you design the proposed vertical alignment. The active profile can be changed at any time.

13. In *View 4*, select **View Attributes** in the upper left corner of the view window.
14. Set the profile view *Exaggeration* to be **20**.

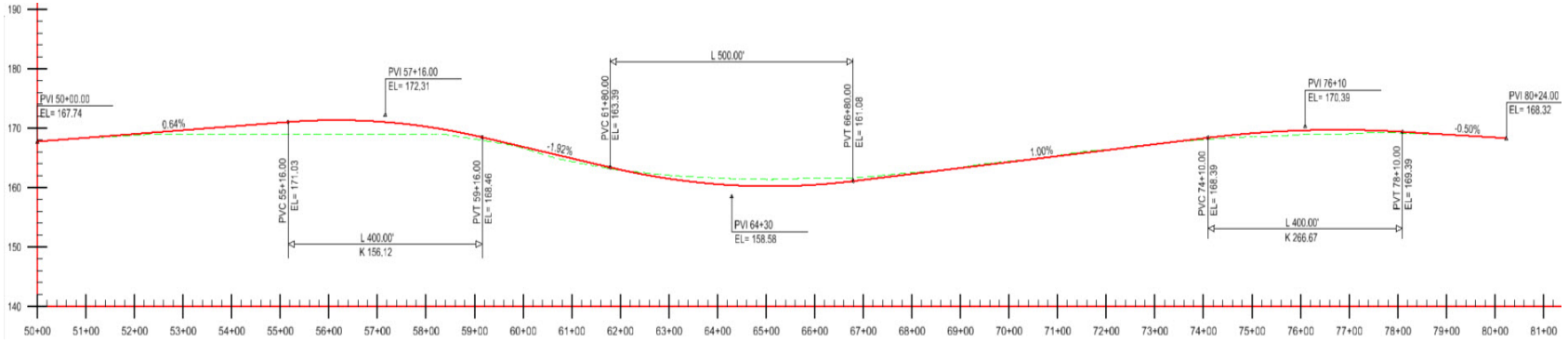


    Notice how the profile view dynamically adjusts itself to reflect the new vertical exaggeration. The vertical exaggeration can be changed at any time.

15. **Click** the **Fit View** icon again in *View 4* to re-center the graphics.

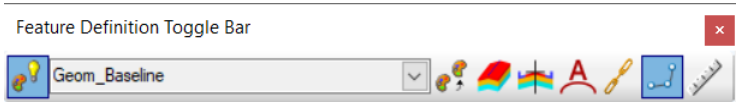
Create Vertical Geometry Lines

In this section, you will be creating the vertical geometry tangent lines that will be used to create the vertical alignment for *London Rd.* (see image below). The vertical alignment will be made up of 4 tangents and 3 vertical curves. You will first define the tangent lines and then add vertical curves in the next section.



---

1. Prior to placing elements, on the *Feature Definition Toggle Bar* ensure that
   - *Active Feature Definition* is still set to **Alignment > Geom_Baseline**
   - *Use Active Feature Definition* toggle is **On**

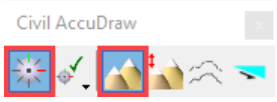


2. **Click** the **Chain Commands** tool on the *Feature Definition Toggle Bar.*
   - When the Chain Commands tool is enabled the next element is automatically connected to the previous element without having to select the start point each time.

3. Select **Geometry > General Tools > Civil Toggles > Civil Accudraw** to display the *Civil AccuDraw* toggle bar.
   - *Civil AccuDraw* is used for precision input with civil geometry and will be used to place profile elements by station and elevation.

   a. **Click** the **Toggle Civil AccuDraw** icon on the toggle bar.

   b. **Click** the **Z** (elevation) icon on the toggle bar.



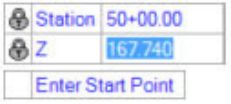
4. Create first vertical geometry tangent line.

   a. From the ribbon menu select **Geometry > Vertical > Lines > Profile Line Between Points**

   a. Move your cursor into *View 4*, notice the heads up prompts for *Station* and *Z (elevation).* These are the **Civil AccuDraw** input fields.

   b. In the *Station* field key in **50+00** and press **Enter**. Notice the station value is now locked.

   c. In the *Z* field key in **167.74** and press **Enter**.



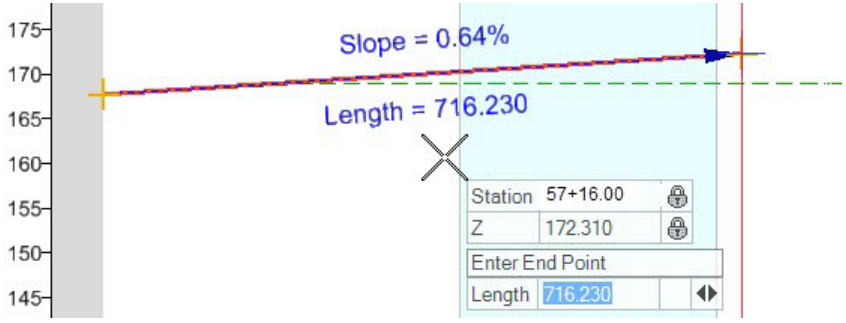
   d. **Left click** to accept.

5. Continue following the heads up prompts to place the end point of the profile tangent line.

   a. Key in **57+16.00** in the *Station* field and press **Enter**.

   b. Key in **172.31** in the *Z* field and press **Enter**.

   c. **Left click** to accept. The first tangent line is now placed.



Note the dynamic display showing the slope and length as you place the line. In addition to placing the line by station and elevation you can also place it using a length and slope.

6. Select the **Civil AccuDraw** tool to turn off **Civil AccuDraw**.

   We will now place profile tangent elements by length and slope.

7. Follow the heads up prompt to place the next profile tangent #2

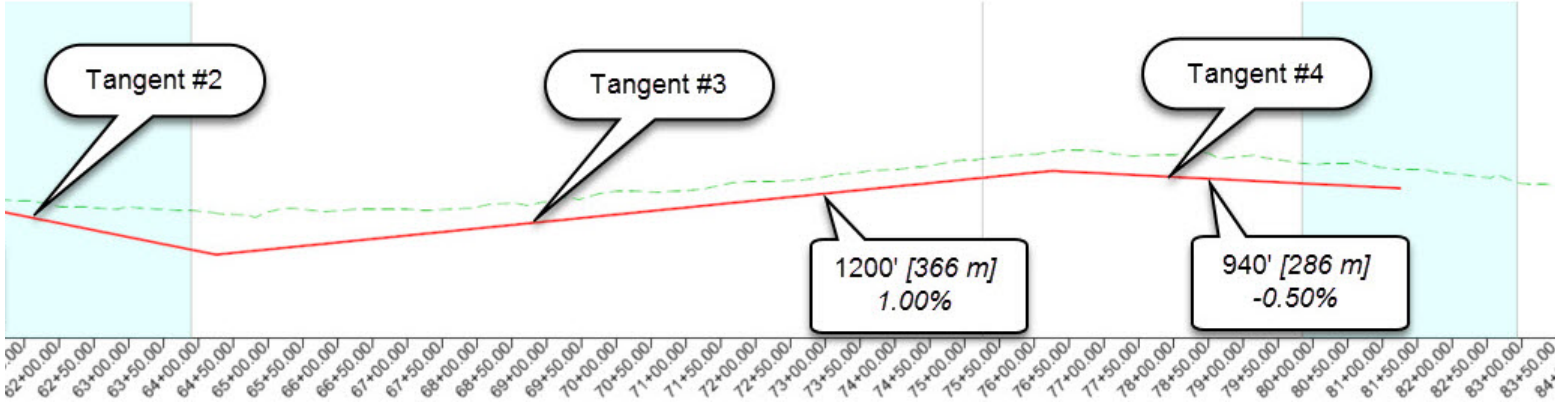
   a. In the *Length* field enter **700**, press **Enter** to lock the value.

   b. Press the **right arrow** to toggle to the *Slope* field and enter **-2.0%**, press **Enter** to lock the value.

   c. **Left click** to accept and move to the next prompt.

8. Create the remaining tangent elements (**#3** and **#4**) using the previous step and the image below as a guide.

   - If you are having trouble keying in values, you can approximate the lengths and slopes.
   - If you make a mistake you can use the **Undo** button to get back to the previous steps.



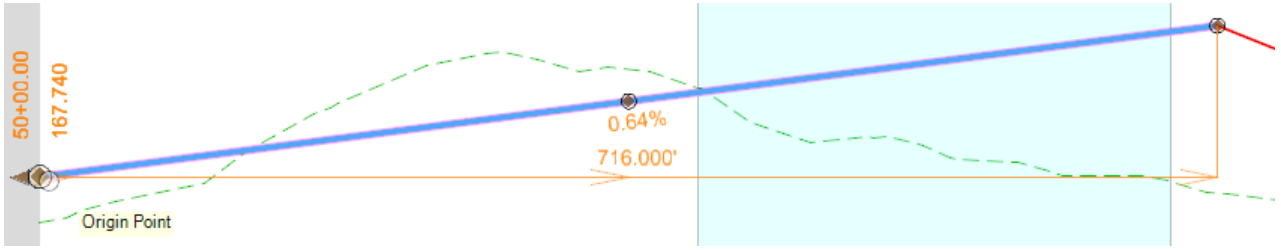
9. After the last tangent line is placed, **Right click** to complete.

10. Press the **ESC** key to exit the command.

11. From the *Feature Definition Toggle Bar*, turn **OFF** the *Chain Commands* tool.

12. Review the tangent lines.

    a. Use the **Element Selection** tool and **Left click** on profile tangent line #1 and notice the slope and length are displayed as well as the *Drag Handles* and *Text Manipulators*. Clicking on the slope, length, station or elevation will enable you to enter new values at any time. Adjusting the *Drag Handles* will trim/extend or move the line.



    b. **Right click** to de-select the line or **Left click** anywhere in the view.

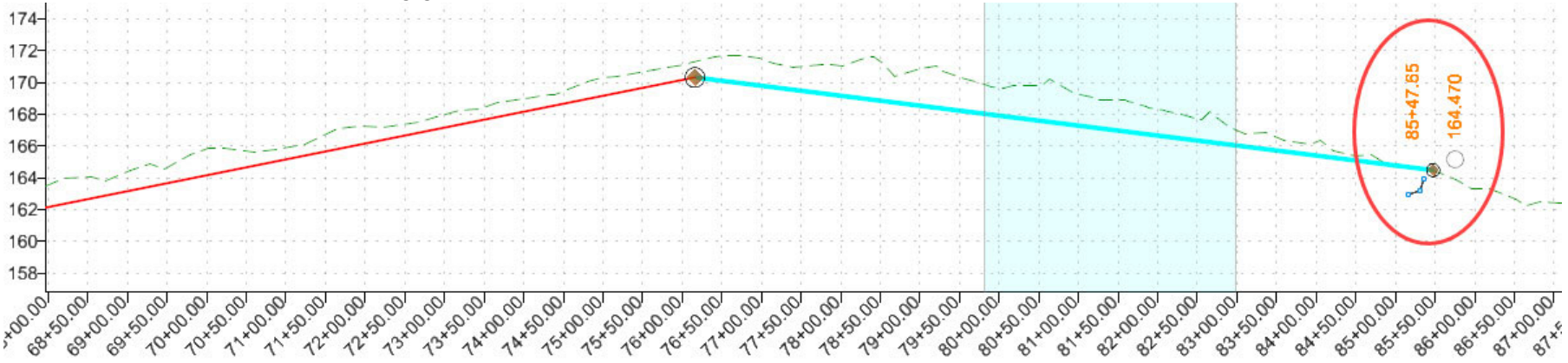
13. Review the remaining tangent lines using the procedures described in the above step.

14. Adjust the last tangent line so that it ties into the existing ground profile.

    a. Zoom in closer to where the last tangent line was placed.

    b. Select the tangent line.

    c. Grab onto the end point of the line and move the end point to match the existing ground profile at the same horizontal location (approximately **85+47.85**, elevation **164.470**). Let the *Key Point Snap* snap to the existing ground profile to define the approximate elevation to match the existing ground profile.



15. **Click** the **Fit View** icon again in *View 4* to re-center the graphics.

Create Vertical Geometry Curves

In this section, you will learn how to create the vertical curves.

---

1. Define the Vertical Curves.

   a. Define a **300'** vertical curve between tangent lines #1 and #2.

   b. Select **Geometry > Vertical > Curves > Profile Curve Between Elements > Parabola Between Elements**

   c. Following the heads up prompts, **select** *tangent line #1* and when prompted **select** *tangent line #2*.

      (Be sure to keep your cursor below the tangent lines to ensure a crest curve will be created).

   d. Following the heads up prompts, in the *Length* field key in **300** and press **Enter** to lock the value.

   e. **Left click** to accept and move to the next prompt.

   f. Set the *Trim/Extend* option to **Both** and **Left click** to complete the command.

      A **300'** vertical curve is now placed between tangent lines #1 and #2.

2. Define a vertical curve with a K value of **171.00** between tangent lines #2 and #3.

The **Geometry > Vertical > Curves > Profile Curve Between Elements > Parabola Between Elements** tool should still be active, if not, re-select it.

a. Following the heads up prompts, **select** *tangent line #2* and when prompted **select** *tangent line #3*.

b. Following the heads up prompts, press the **Left Arrow** key to toggle to *Vertical Curve Parameter.*

c. Key in **171.00** in the *Vertical Curve Parameter* field and press **Enter** to lock the value.

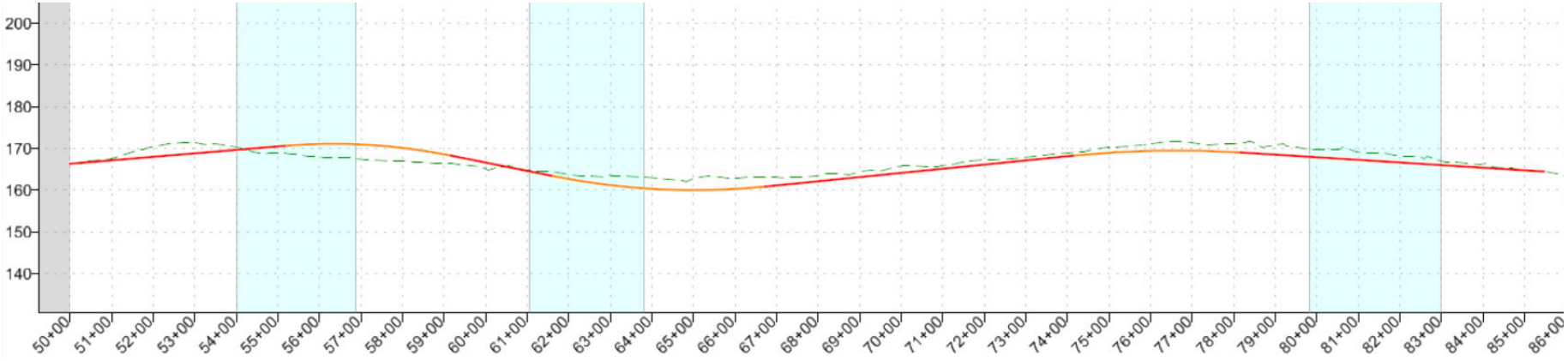
d. **Left click** to accept and move to the next prompt.

e. Set the *Trim/Extend* option to **Both** and **Left click** to complete the command.

A vertical curve with a K value of **171.00** is now placed between tangent lines #2 and #3.

3. Using the same process described in **the previous steps to** create a **400'** vertical curve between the remaining tangent lines #3 and #4.

   The completed vertical geometry elements should look like the image below.

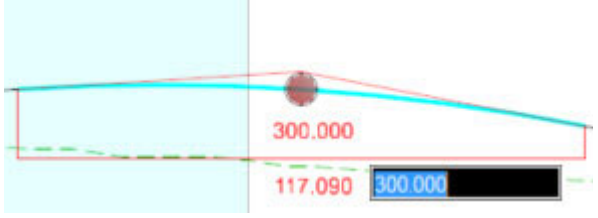


4. Modify the length of vertical curve #1 to be **400'**

   a. **Select** vertical curve #1, notice the curve length **300.000** is displayed as well as the K value.

   b. **Left click** on the curve length value (*300.000*), enter **400** in the edit field and press **Enter**.

      The vertical curve updates and displays the new curve length and K value.



Create the Vertical Alignment

In this section, you will learn how create the vertical alignment for London Rd.

---

1. Group the *London Rd.* vertical geometry elements into a single complex element to create the vertical alignment.

   a. **Select** the **Geometry > Vertical > Complex Geometry > Complex by Elements** tool.

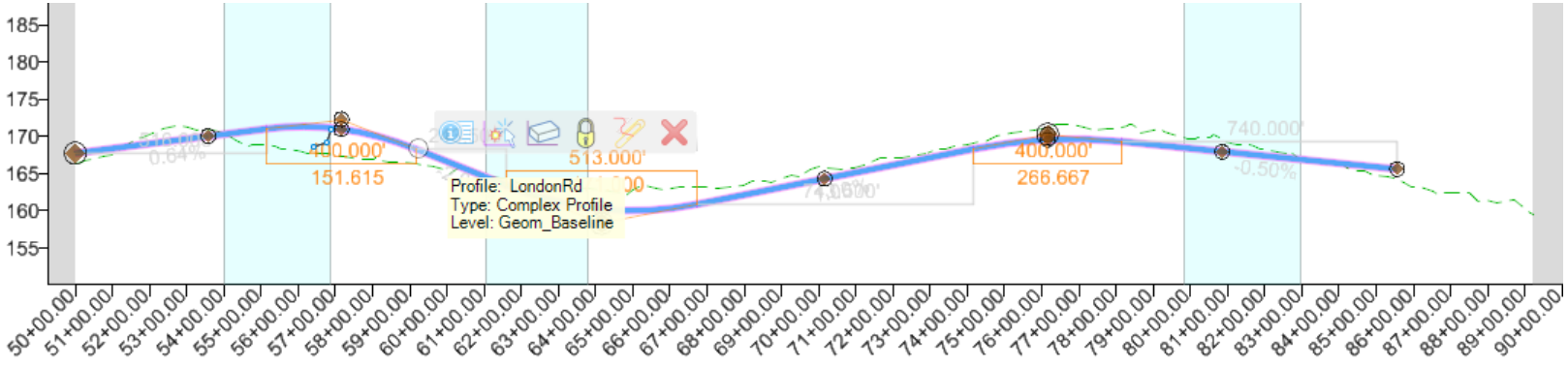
   b. In the dialog box, set the following parameters:

      - *Method:* **Automatic**
      - *Maximum Gap:* **0.033**
      - *Name:* **LondonRd**

   c. Following the heads up prompts,

      - *Locate First Element:* **Select** tangent line #1 near the beginning and then **Left click** to accept it
      - *Accept Complex:* **Left click** to accept and create the complex profile element

   d. Select the vertical (profile) alignment and note that all the elements are now a complex profile.



2. Set the newly designed profile as the active profile.

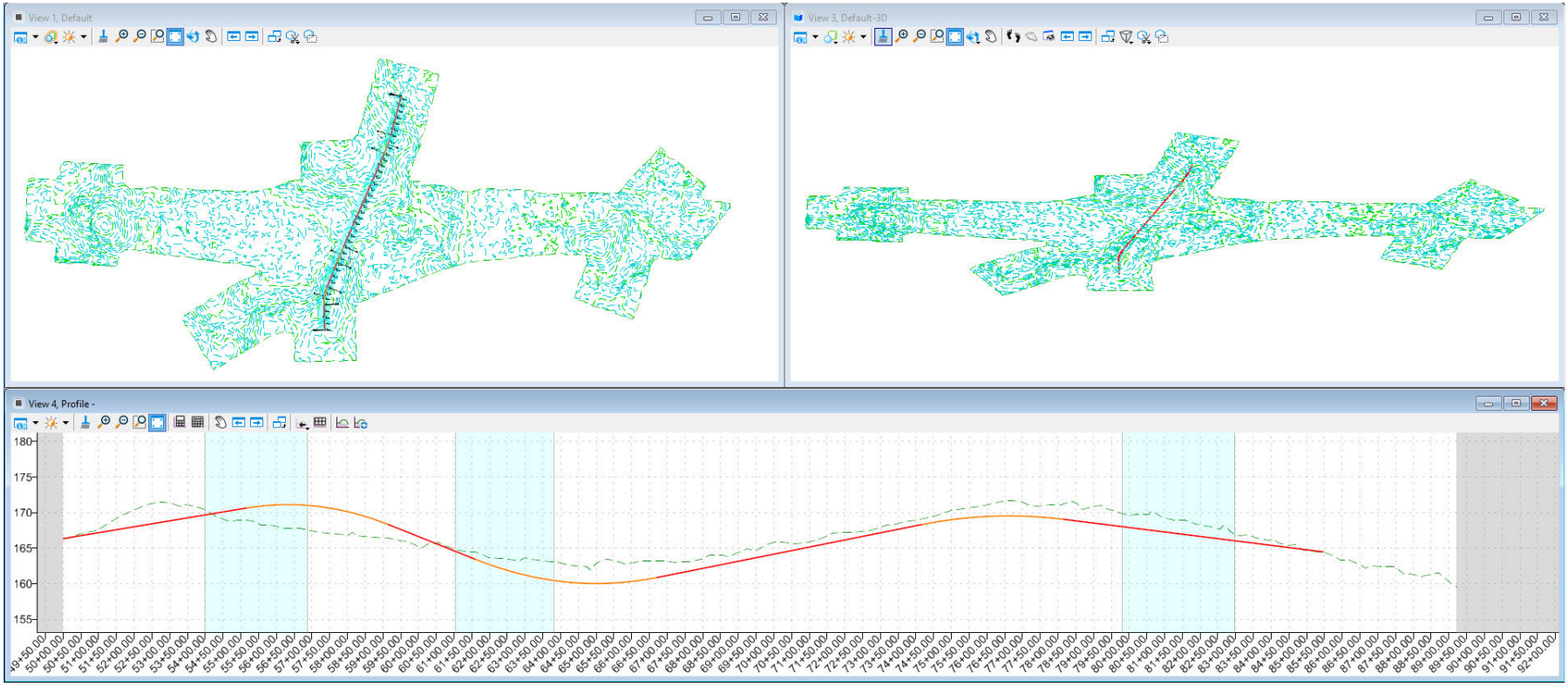
a. **Select** the **Element Selection** tool.

b. **Select** the complex profile element and **hover** your cursor over it until the context sensitive menu appears.

c. **Select** the **Set As Active Profile** tool.

The newly designed vertical alignment will now be the active vertical alignment associated with the horizontal alignment. A relationship now exists between the horizontal and vertical geometry. Be aware that deleting the horizontal geometry or dropping the horizontal geometry will impact the vertical geometry.

Whenever you set a profile active a 3D feature which represents that profile will automatically be displayed in the 3D Model view.



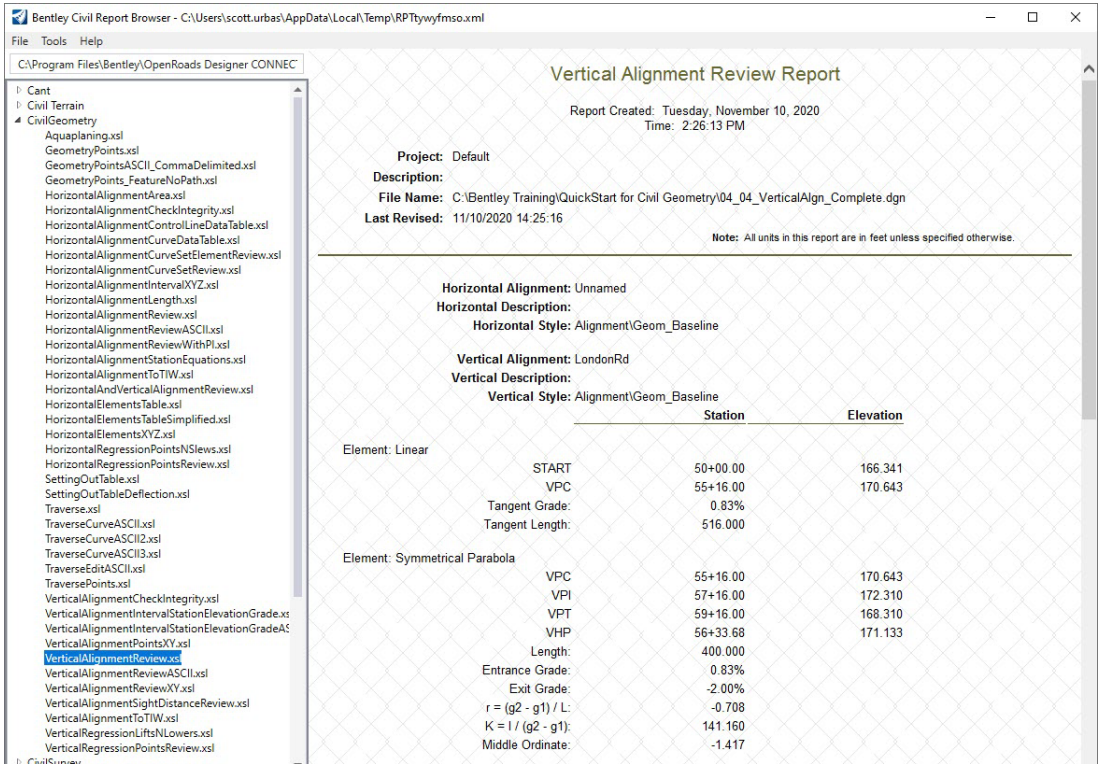
Create the Vertical Alignment Report

In this section, you will learn how to create the vertical alignment report.

---

1. **Select** the **Element Selection** tool.
2. **Select** the complex profile element and **hover** your cursor over it until the context sensitive menu appears.

3. **Select** the **Profile Report** tool.
4. **Review** the Vertical Alignment report and adjust the report formatting as needed using **Tools > Format Options** from the report dialog menu bar.



5. **Close** the report window. Congratulations, you have now completed the course.

Skills Assessment

The questions below will test your retention of the skills covered in this course.

---

1. Geometry should always be created in a 2D dgn?
   a. True
   b. False
2. What controls the symbology and display of geometric elements?
   a. Feature Definitions
   b. Element Attributes
   c. Level Manager
   d. OpenRoads Model Explorer
3. Setting the Active Feature Definition ensures all geometric elements will have the selected feature definition assigned to them as you create geometric elements.
   a. True
   b. False
4. How does the default 3D Model get created?
   a. Setting the Active Terrain Model will automatically create the Default-3D Model.
   b. When you create vertical geometry elements, it is created automatically.
   c. When you create a new 2D dgn a new Default-3D Model will also be created.
5. Curve radii can be changed easily via the text manipultors and edit fields?
   a. True
   b. False

6. Where is all of the OpenRoads Designer Geometry data stored?
    a. .ALG File
    b. .XML File
    c. .DGN file
    d. OpenRoads Model Explorer
7. Individual geometric elements must be complexed together in order to create an alignment?
    a. True
    b. False

Skills Assessment - Answers

The answers to the skills assessment questions are highlighted below.

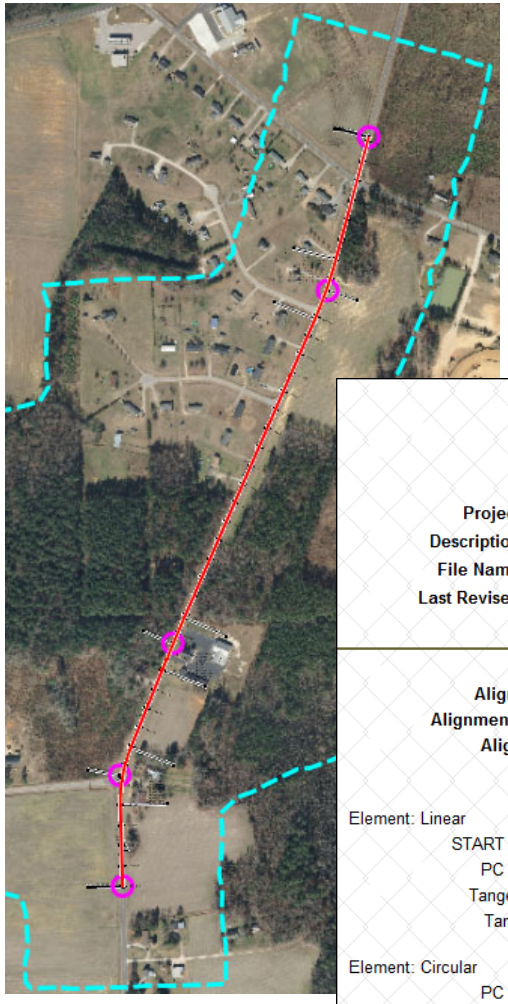
---

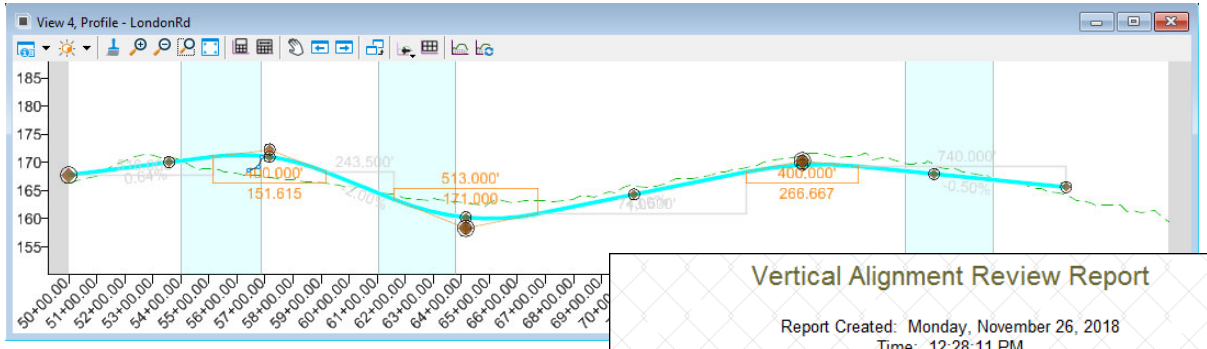
1. Geometry should always be created in a 2D dgn?
   a. **True**
   b. False
2. What controls the symbology and display of geometric elements?
   a. **Feature Definitions**
   b. Element Attributes
   c. Level Manager
   d. OpenRoads Model Explorer
3. Setting the Active Feature Definition ensures all geometric elements will have the selected feature definition assigned to them as you create geometric elements.
   a. **True**
   b. False
4. How does the default 3D Model get created?
   a. **Setting the Active Terrain Model will automatically create the Default-3D Model.**
   b. When you create vertical geometry elements, it is created automatically.
   c. When you create a new 2D dgn a new Default-3D Model will also be created.
5. Curve radii can be changed easily via the text manipultors and edit fields?
   a. **True**
   b. False

6. Where is all of the OpenRoads Designer Geometry data stored?
   a. .ALG File
   b. .XML File
   c. **.DGN file**
   d. OpenRoads Model Explorer
7. Individual geometric elements must be complexed together in order to create an alignment?
   a. **True**
   b. False

Summary

In this course, you have learned how to create a new file, attach an existing terrain model and aerial imagery as well as define 2D and 3D views. You have also learned how to create, edit, annotate and review geometric elements, and how to create horizontal and vertical alignments for London Rd. using the civil geometry tools.





Horizontal Alignment Review Report

Report Created: Monday, November 26, 2018
Time: 12:25:45 PM

Project: Default
Description:
File Name: C:\Bentley Training\QuickStart for Geometry\Geometry.dgn
Last Revised: 11/26/2018 11:25:28

Note: All units in this report are in feet unless specifie

Alignment Name: LondonRd
Alignment Description:
Alignment Style: Alignment\Geom_Baseline

		Station	Northing	
Element: Linear				
START	( )	50+00.00	758661.790	23
PC	( )	53+99.95	759061.590	23
Tangential Direction:		N01°33'00"W		
Tangential Length:		399.947		
Element: Circular				
PC	( )	53+99.95	759061.590	23
HPI	( )	55+46.00	759207.590	2320574.623
CC	( )		759080.525	2321278.318
PT	( )	56+87.92	759342.988	2320629.386
Radius:		700.000		
Delta:		23°34'16" Right		

Vertical Alignment Review Report

Report Created: Monday, November 26, 2018
Time: 12:28:11 PM

Project: Default
Description:
File Name: C:\Bentley Training\QuickStart for Geometry\Geometry.dgn
Last Revised: 11/26/2018 11:25:28

Note: All units in this report are in feet unless specified otherwise.

Horizontal Alignment: LondonRd
Horizontal Description:
Horizontal Style: Alignment\Geom_Baseline

Vertical Alignment: LondonRd
Vertical Description:
Vertical Style: Alignment\Geom_Baseline

	Station	Elevation
Element: Linear		
START	50+00.00	167.740
VPC	55+16.00	171.033
Tangent Grade:	0.006	
Tangent Length:	516.000	
Element: Symmetrical Parabola		
VPC	55+16.00	171.033
VPI	57+16.00	172.310