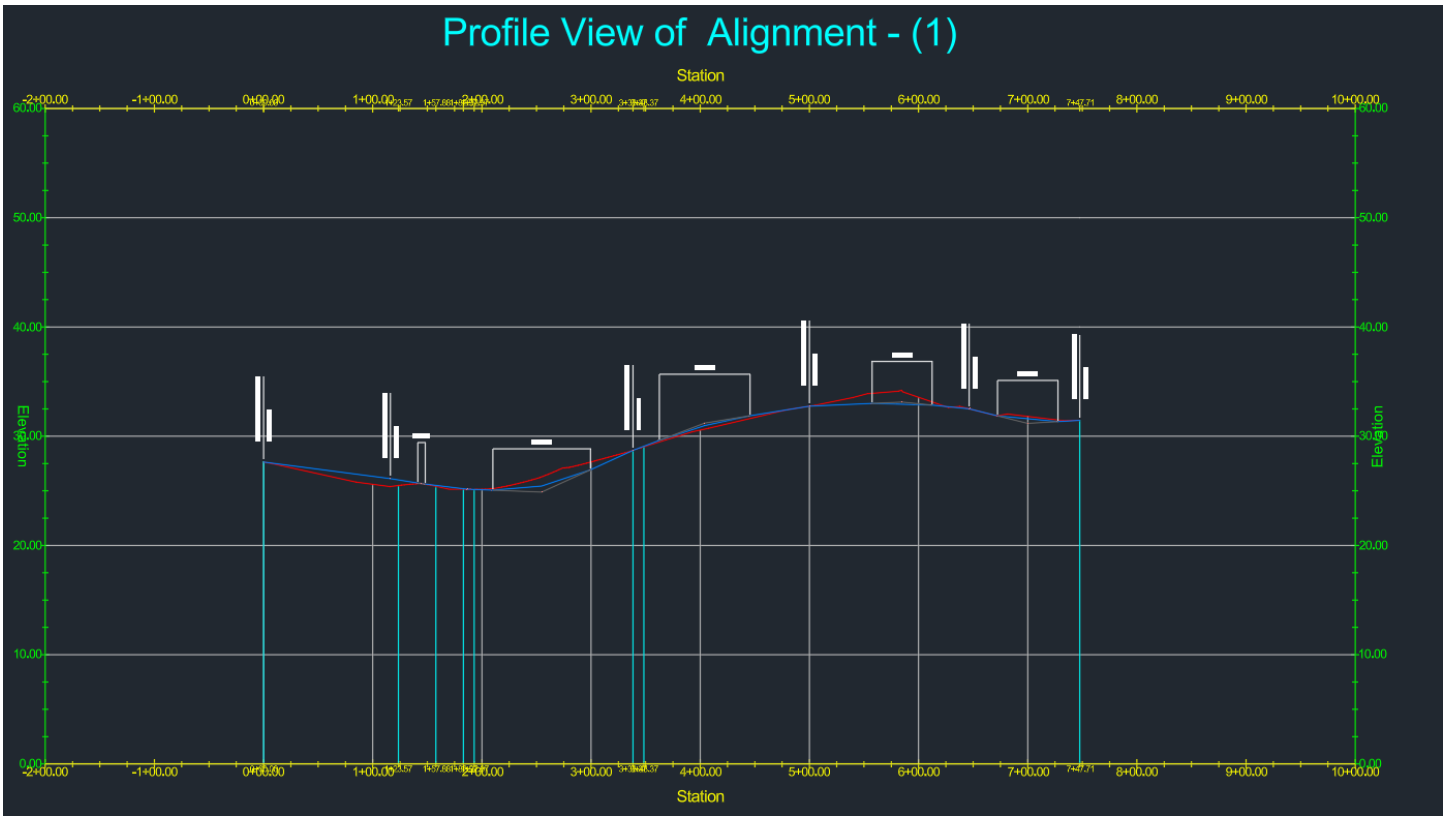
Road Vertical Profile in Civil 3D

Road · https://civilwhiz.com/docs/road-vertical-profile-in-civil-3d/

Vertical Profile & Its Role in Road Design

A Profile is much more than just a simple 2D line drawn across the Profile View (the grid or graph) in Civil 3D. It is the **vertical backbone of your road** -if the horizontal alignment shows you the road stretch going left or right across the terrain, the vertical profile will show how your **road ascends or descends against the terrain**.

In Civil 3D road design, the vertical profile is ***is required for creating the corridor surface***. Without a profile, the design lacks road elevation information, making it impossible for road software to determine the assemblies' vertical positions at every point along the road.



Components of the Vertical Profile

There are a few geometrical components of the profile that we need to understand to ensure a smooth vertical transition of the road.

Detailed explanation can be referred **here**

How Do We Create The Road Vertical Profile in Civil 3D?

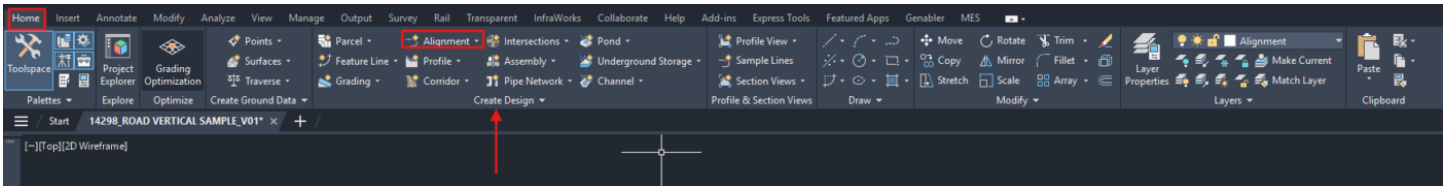
Step 1: Horizontal Alignment

Create the horizontal alignment (Centerline) for the road.

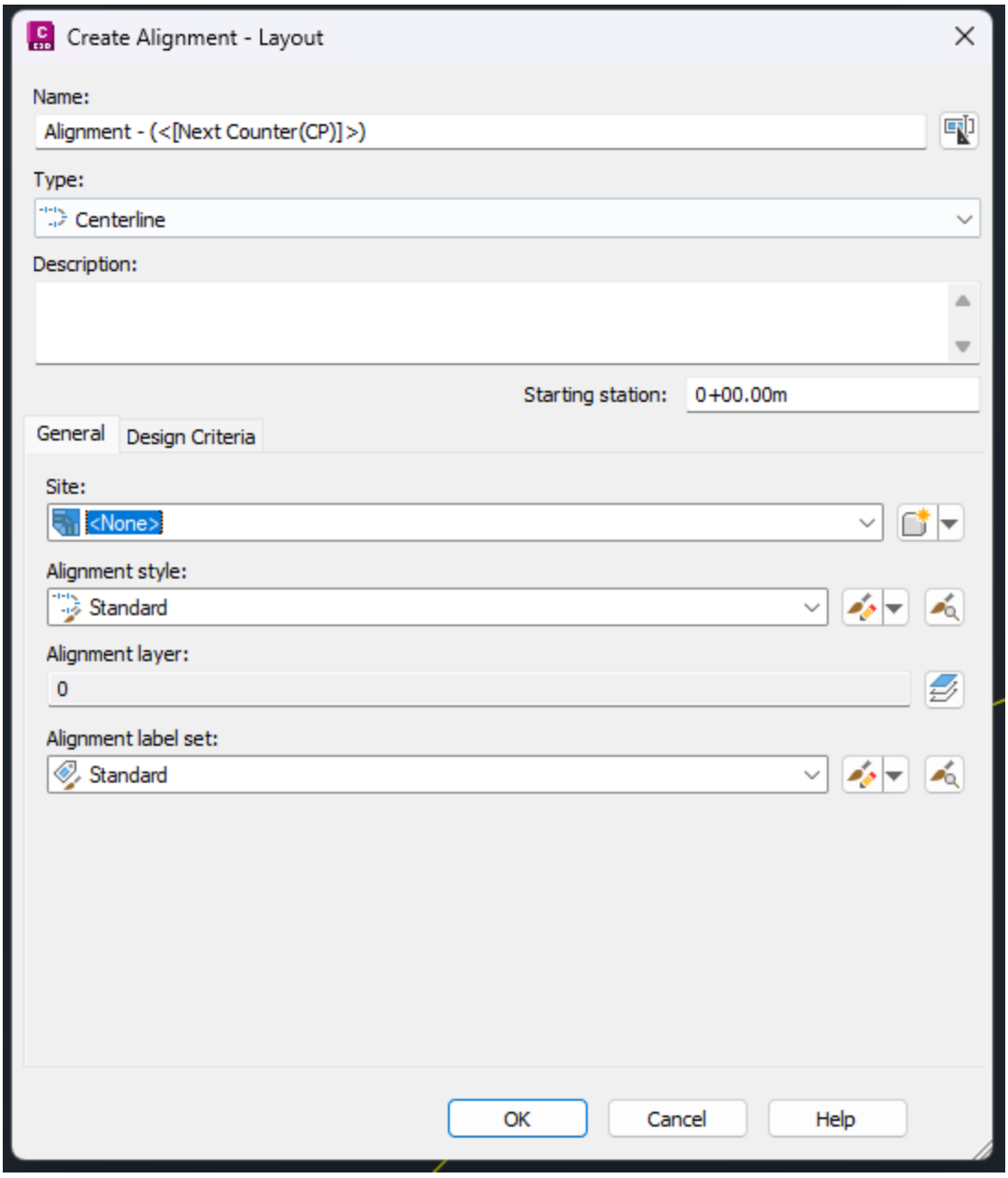
This step is a must as the profile is the sub-object of the alignment -the software will prompt users to select the alignment when we try to create the profile later on.

Steps:

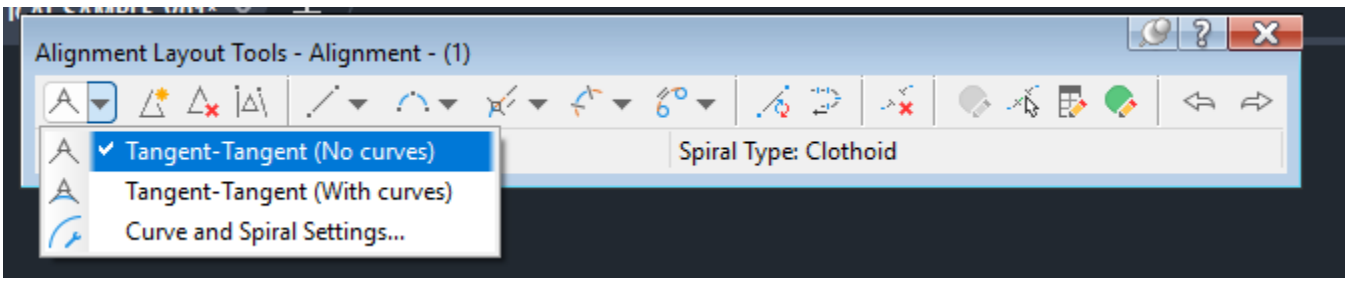
1. Go to Home tab > Under the Create Design section, click on **Alignment** > Select **Alignment Creation Tools**.



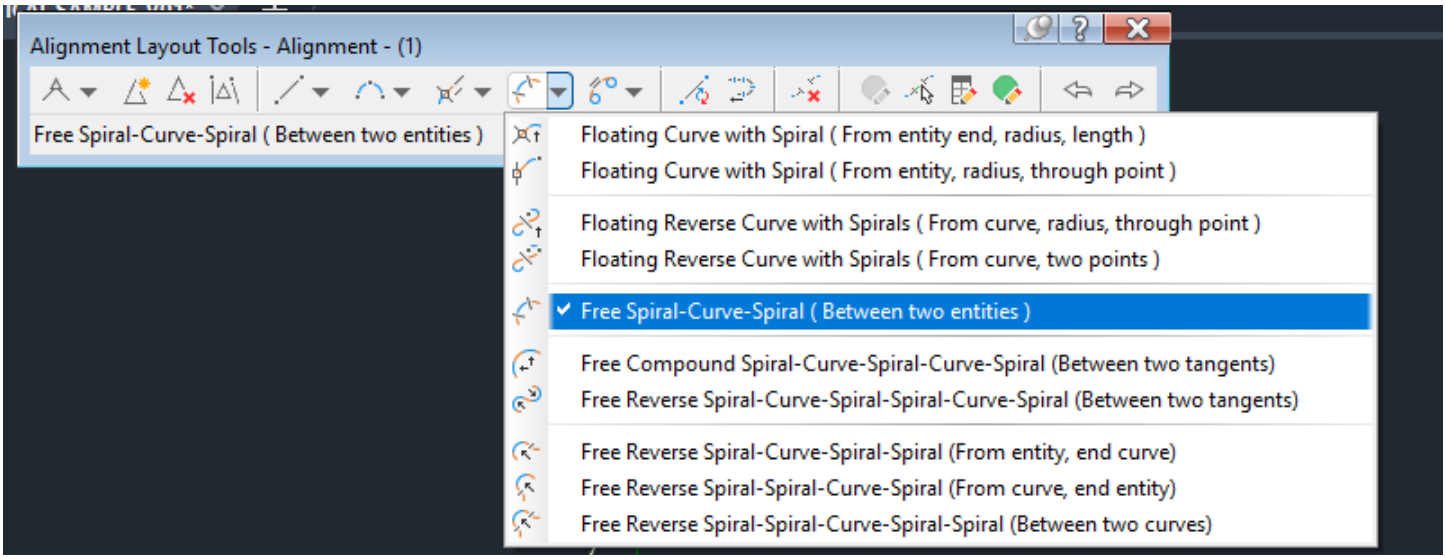
2. Set the Name, Type, General Settings, and Design Criteria to apply to the alignment > Click OK.



3. In the Alignment Layout Tools dialog, select the command for ***Tangent-Tangent (no curves)*** > Lay out the IP (Intersection Point) to create the tangents along the road.



4. For horizontal curves, select the command ***Add Free Spiral-Curve-Spiral (Between Two Entities)*** > Select the tangent before and after the IP > Set the radis and spiral length according to your design.

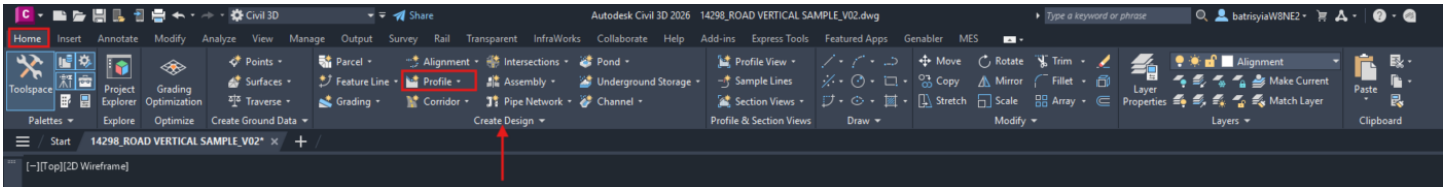


Step 2: Create Surface Profile

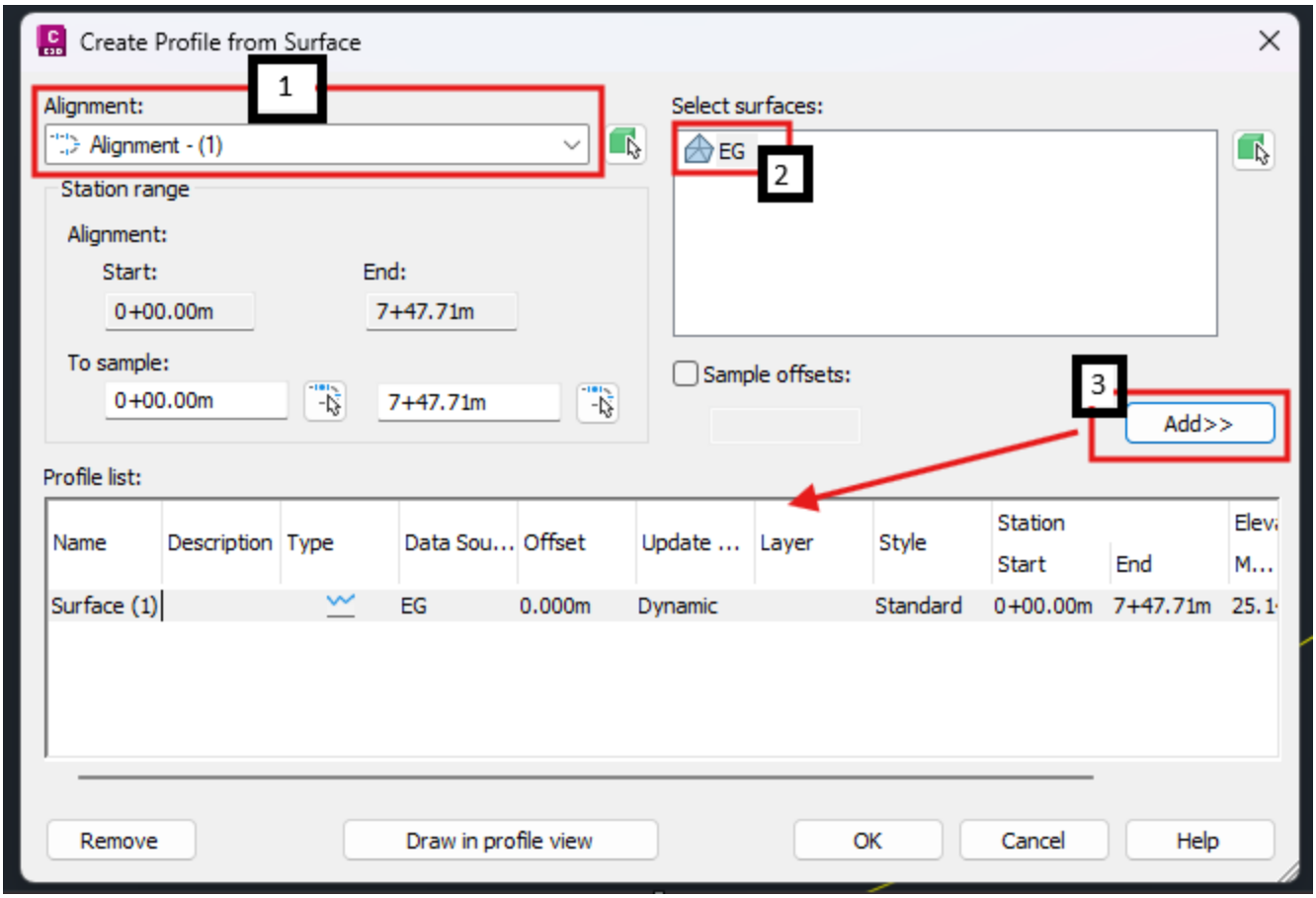
For this section, the drawing must contain the surface for the Existing Ground.

Steps:

1. Go to Home Tab > Under the Create Design section, click on **Profile** > Select **Create Surface Profile**.



2. Under the **Create Profile for Surface dialog**, select the correct Alignment from the dropdown > Select Surface representing the existing ground > Click on the '*Add*>>' button. The surface will be **listed under the Profile List**.



3. Click the '*Draw in profile view*' button > The software will display the **Create Profile View – General dialog** > Set the following parameters accordingly:

   a. General

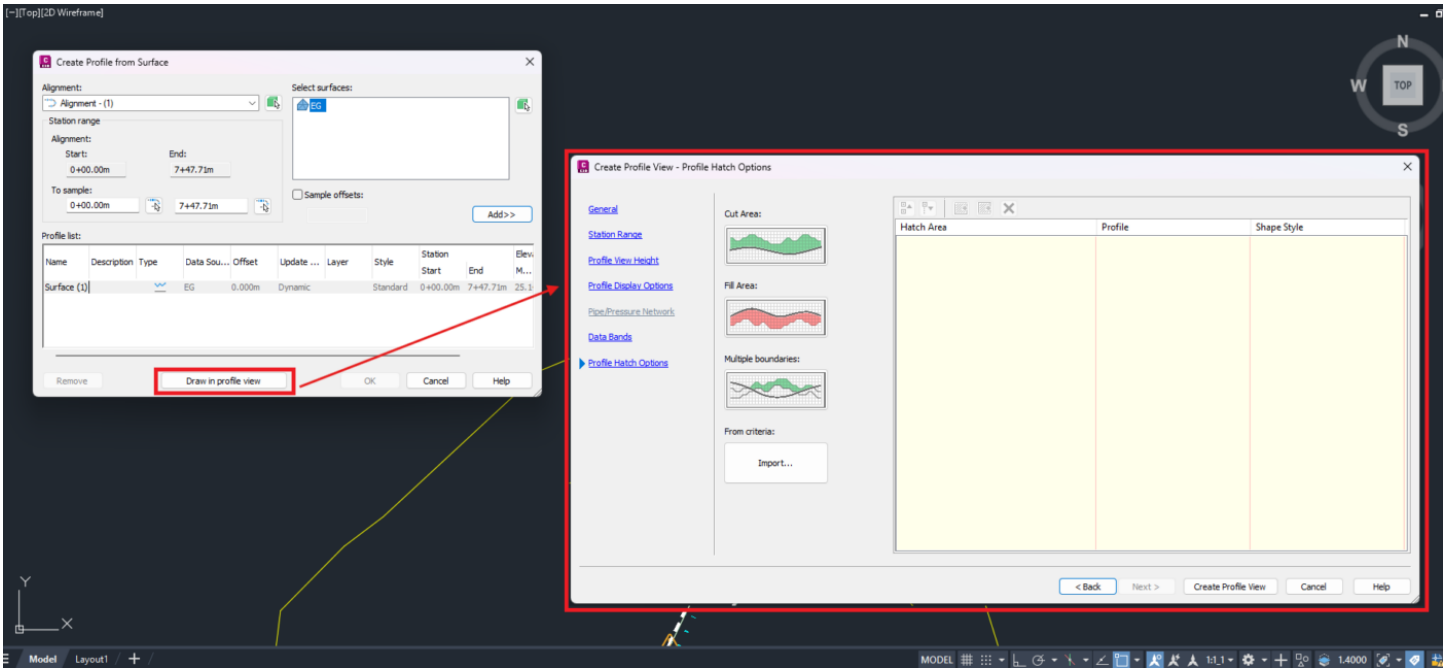
   b. Station Range

   c. Profile View Height

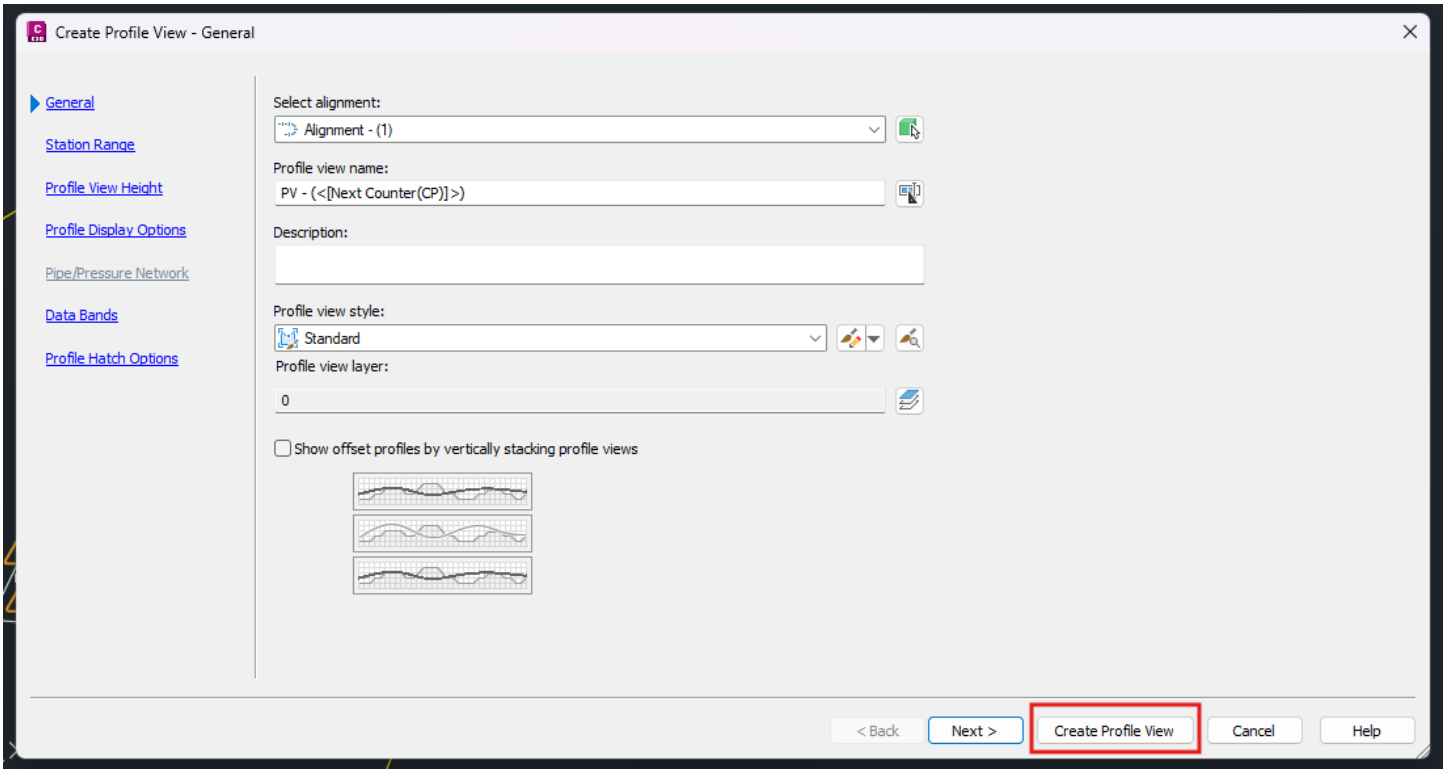
   d. Profile Display options

   e. Data Bands

   f. Profile Hatch Options

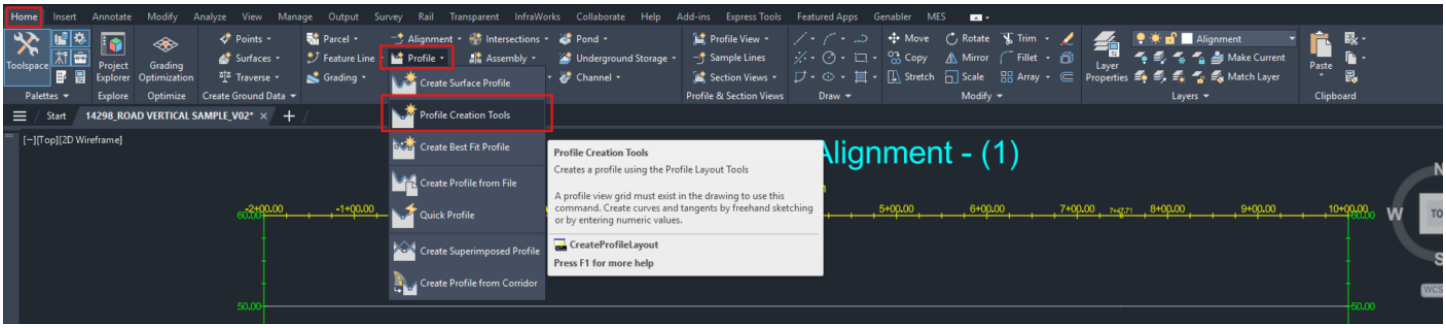


4. Click on the '*Create Profile View*' button > The software will prompt users to set the origin for the profile view (placement of the profile view grids in your drawing)



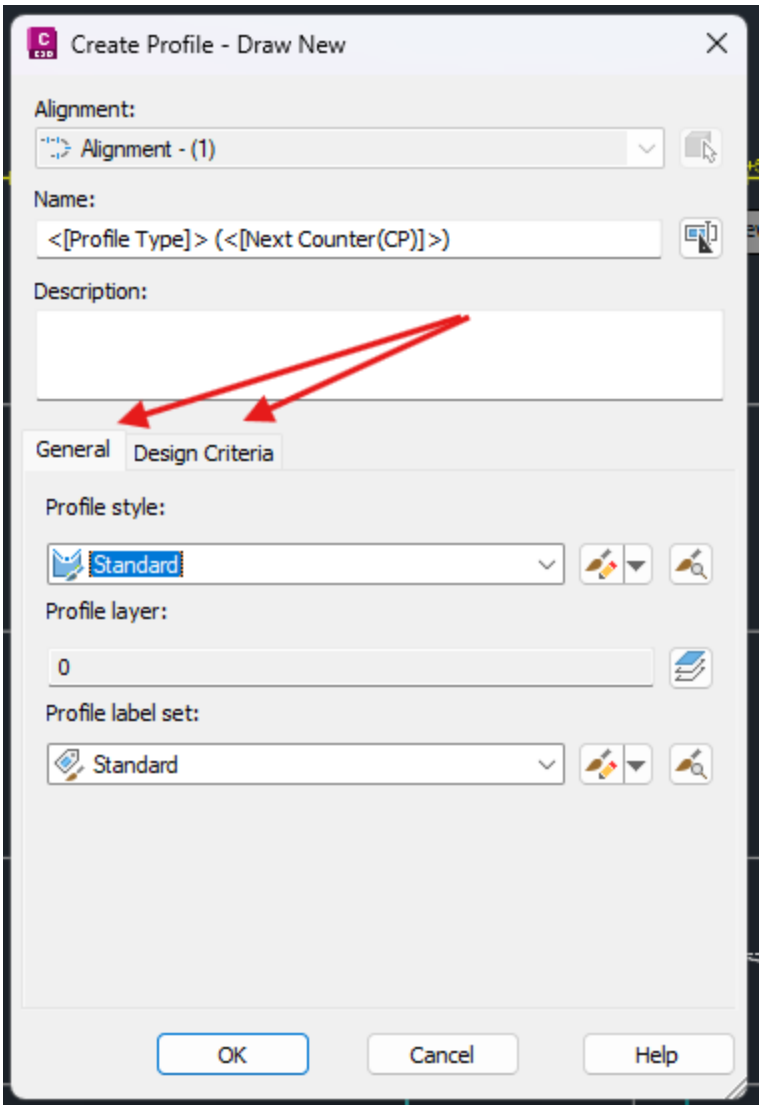
Step 3: Drawing The Road Profile Line

1. Go to Home tab > Under the Create Design section, click on **Profile** > Select the **Profile Creation Tools**.

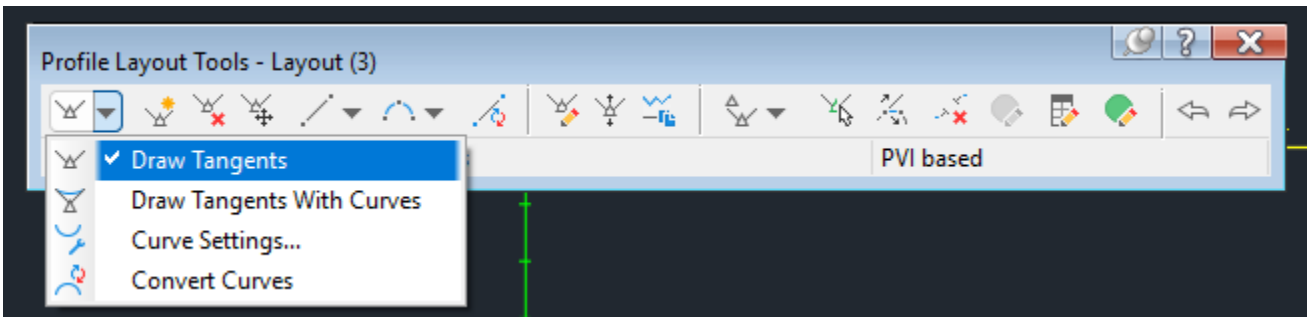


2. The software will prompt the user to select the Profile View (Graph/Grid) that contains the surface profile created in ***Step 2: Create Profile Surface View*** above.

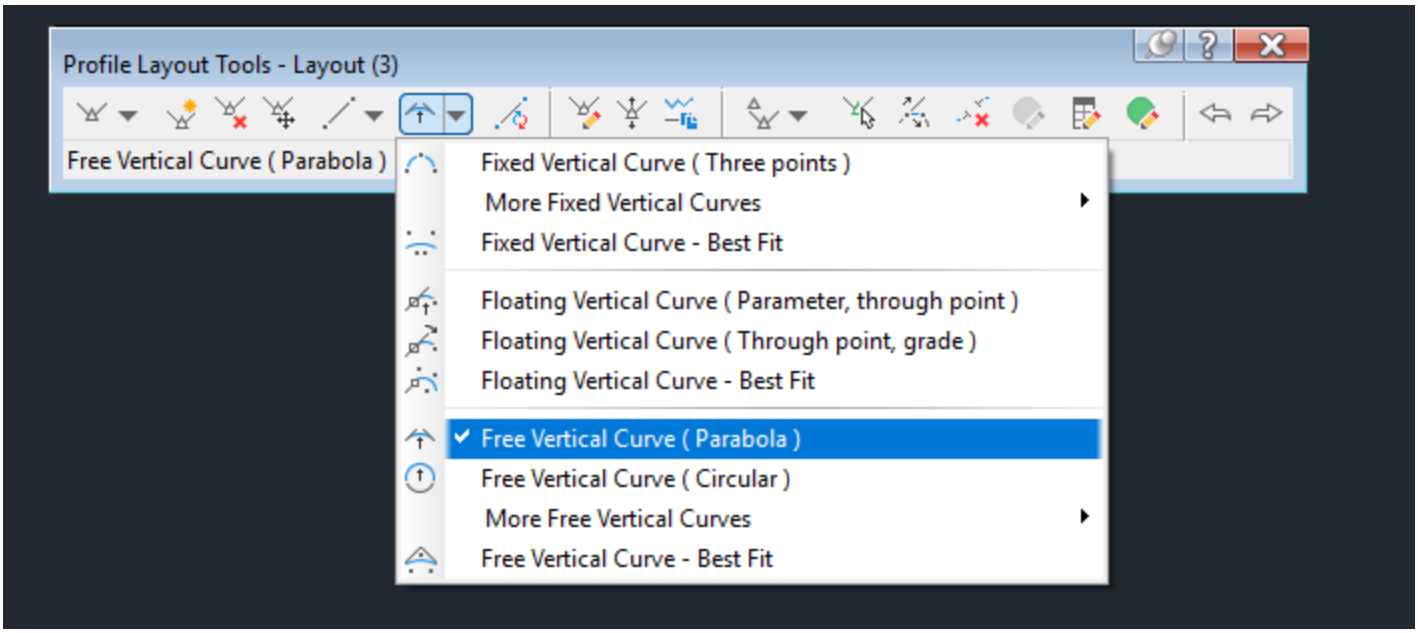
3. **Create Profile – Draw New** dialog will appear > Properly set the General and Design Criteria parameters to be applied to the profile > Click OK



4. Under the **Profile Layout Tools**, select the ***Draw Tangents Without Curve*** function to lay out the PVI (Points of Vertical Intersection) along the road, this creating the tangents for the curves.



5. Select ***Draw Free Vertical Curve (Parabola)*** function > Select the first tangent, followed by the second tangent from the profile line drawn in (4).

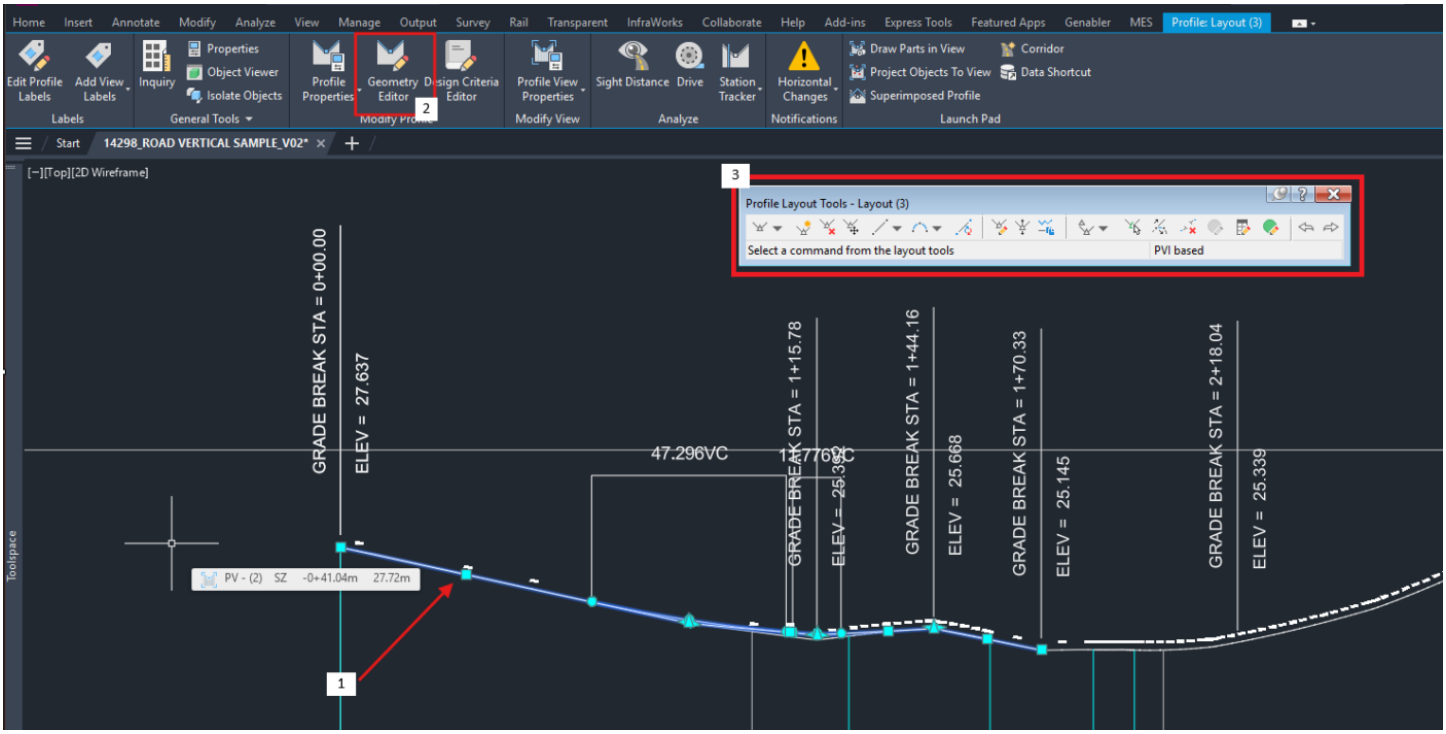


6. Software will prompt to input the Radius/Length/Passthrough/K value > Choose K value or Radius > Input the value as per your design (You can adjust these parameters later on)

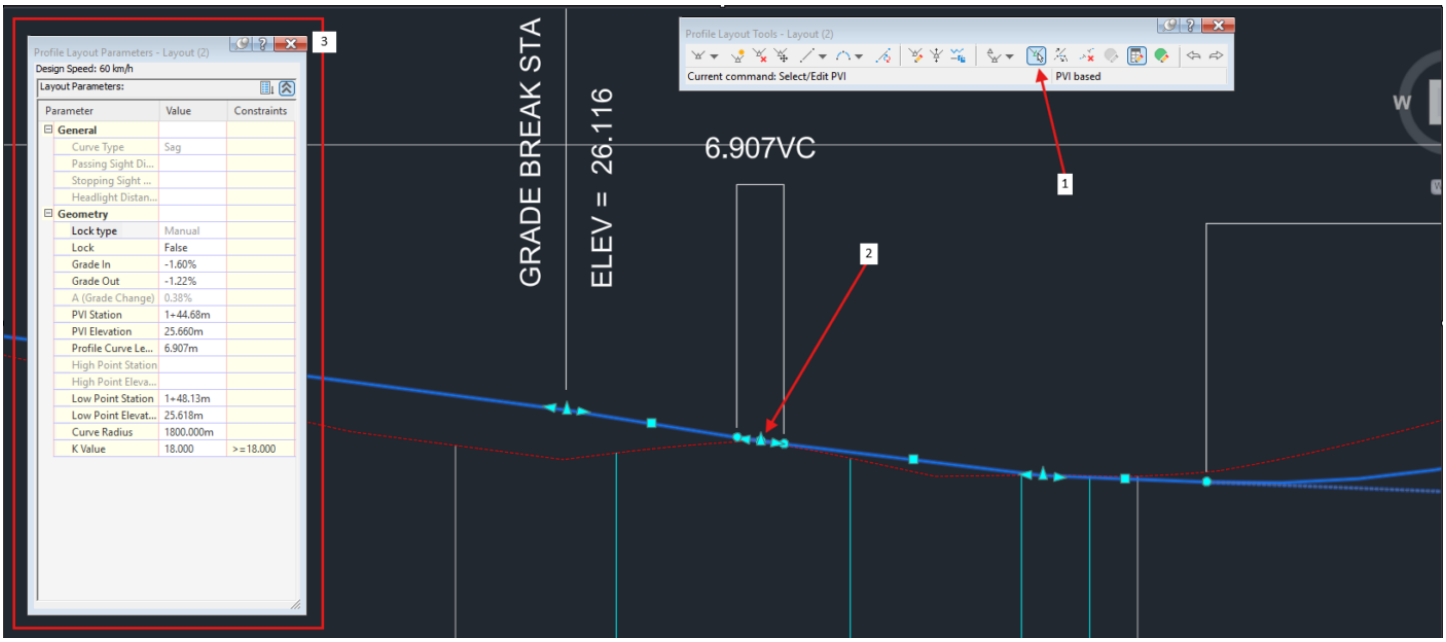
How Do We Adjust The Parameters of The Crests or Sags?

For the profile line drawn in ***Step 3: Drawing the Road Profile Line***, we may need to adjust the parameters such as the elevation, curve radius, or the K values. To do so,

1. Select the **Profile Line drawn** on the Profile View > Click on the **Geometry Editor** under the Modify Profile section > The software will open up the **Profile Layout Tools** dialog.



2. Click on the ***Select PVI*** function > The software will open up the **Profile Layout Parameter** dialog > Click on the PVI that requires adjustments on the parameters. The Profile Layout Parameters will display the related parameters.

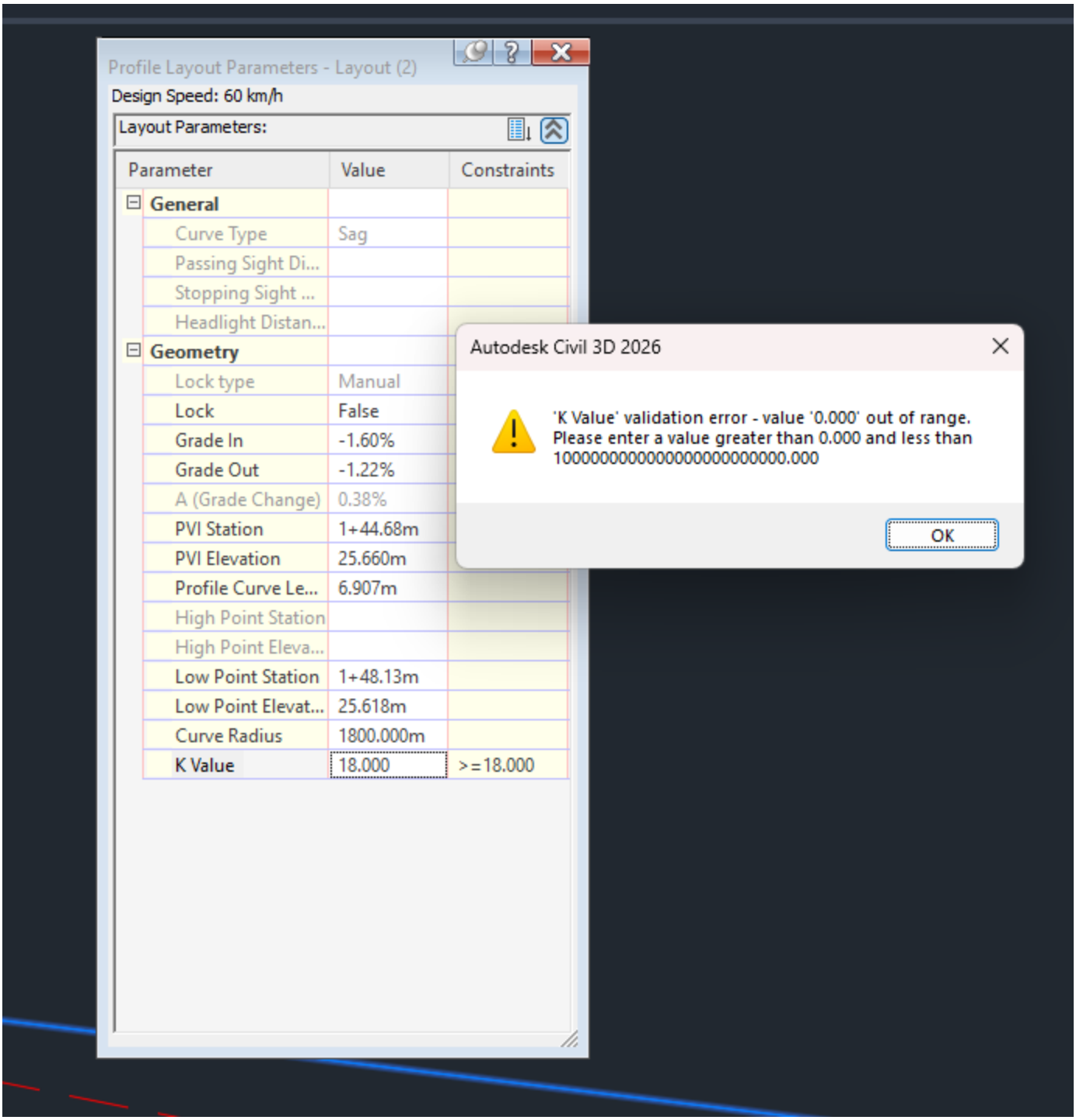


3. Made changes to the parameters accordingly. Press Enter, and the Profile Line drawn will be updated.

Transitioning Curve to A Grade Break Where K Equals 0

In scenarios where road standards are not required, such as when designing a small internal road with minimal elevation changes, it is acceptable to set the K values to 0. This results in no vertical curves at the PVI, creating a sharp but small dip or hump relative to the terrain.

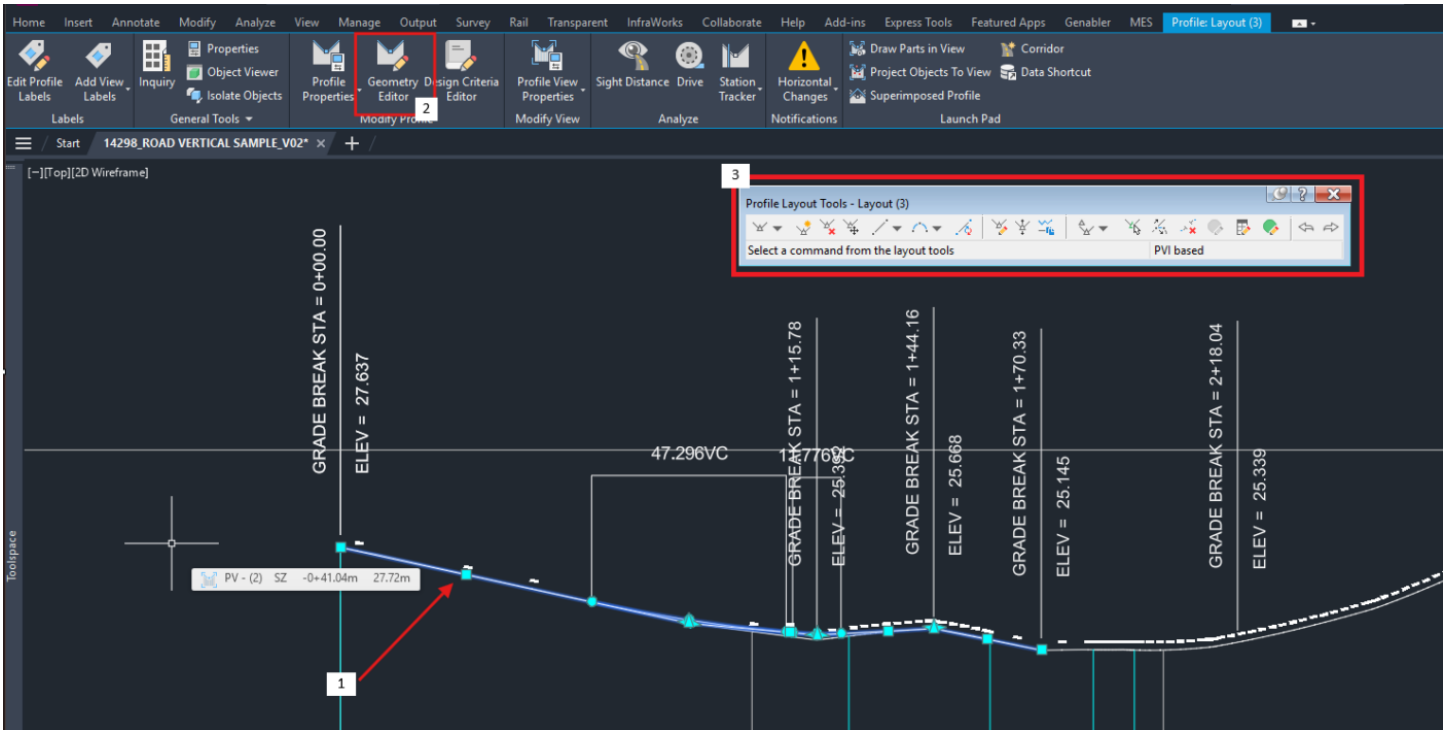
In Civil 3D, when K equals to 0, the PVI is defined as a grade break. Hence, attempting to adjust the K value for the crests or sags to 0 will trigger an *out-of-range error*, as in the image below.



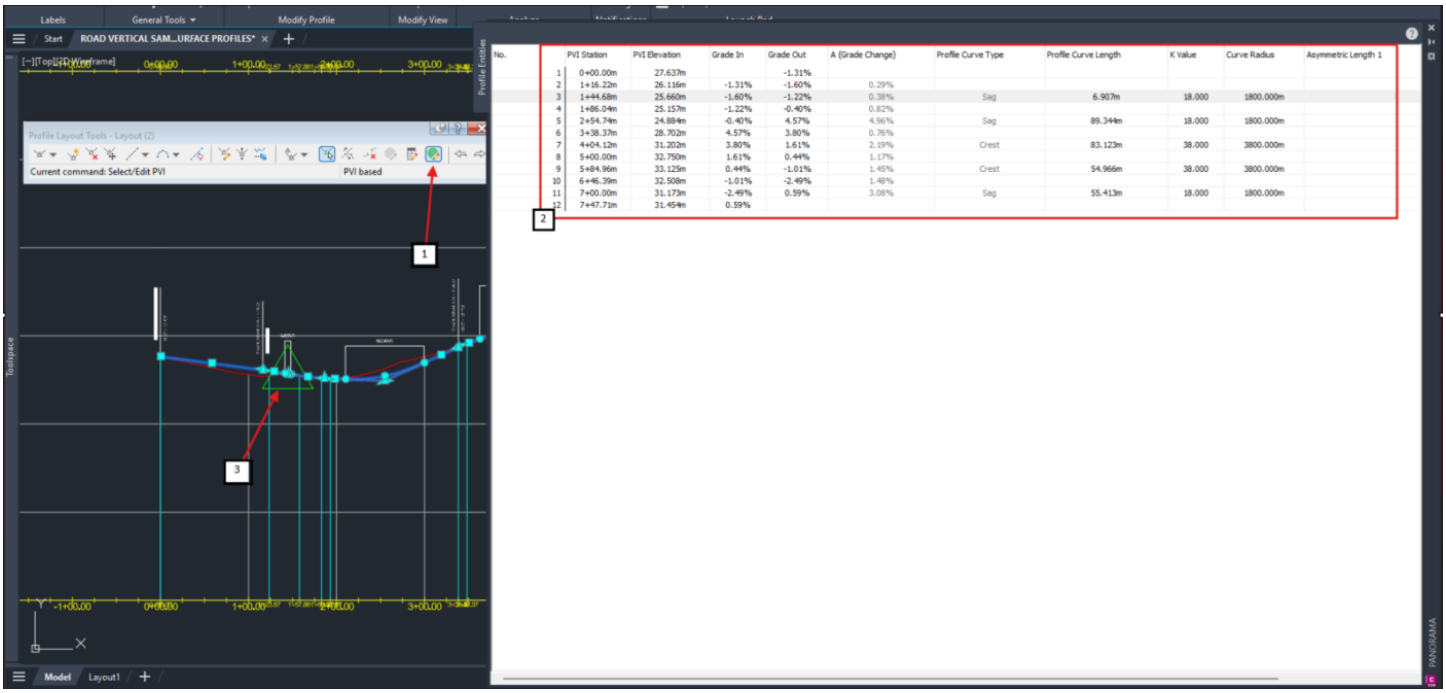
Since Civil 3D requires K values for the crests and sags to be greater than 0, this constraint must be overcome by changing the line type from a curve to a grade break.

Steps:

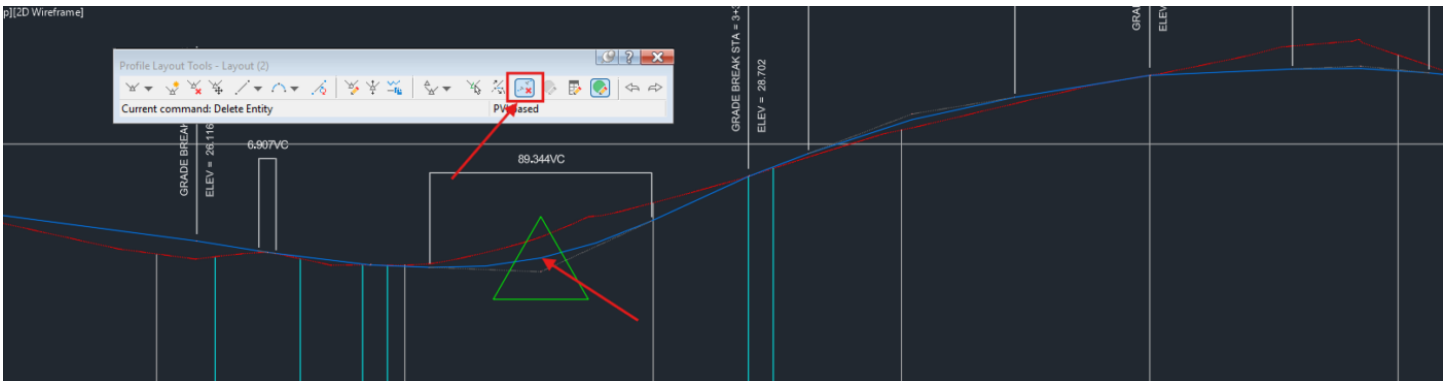
1. Select the **Profile Line** > Under the Modify Profile section, click on **Geometry Editor**.



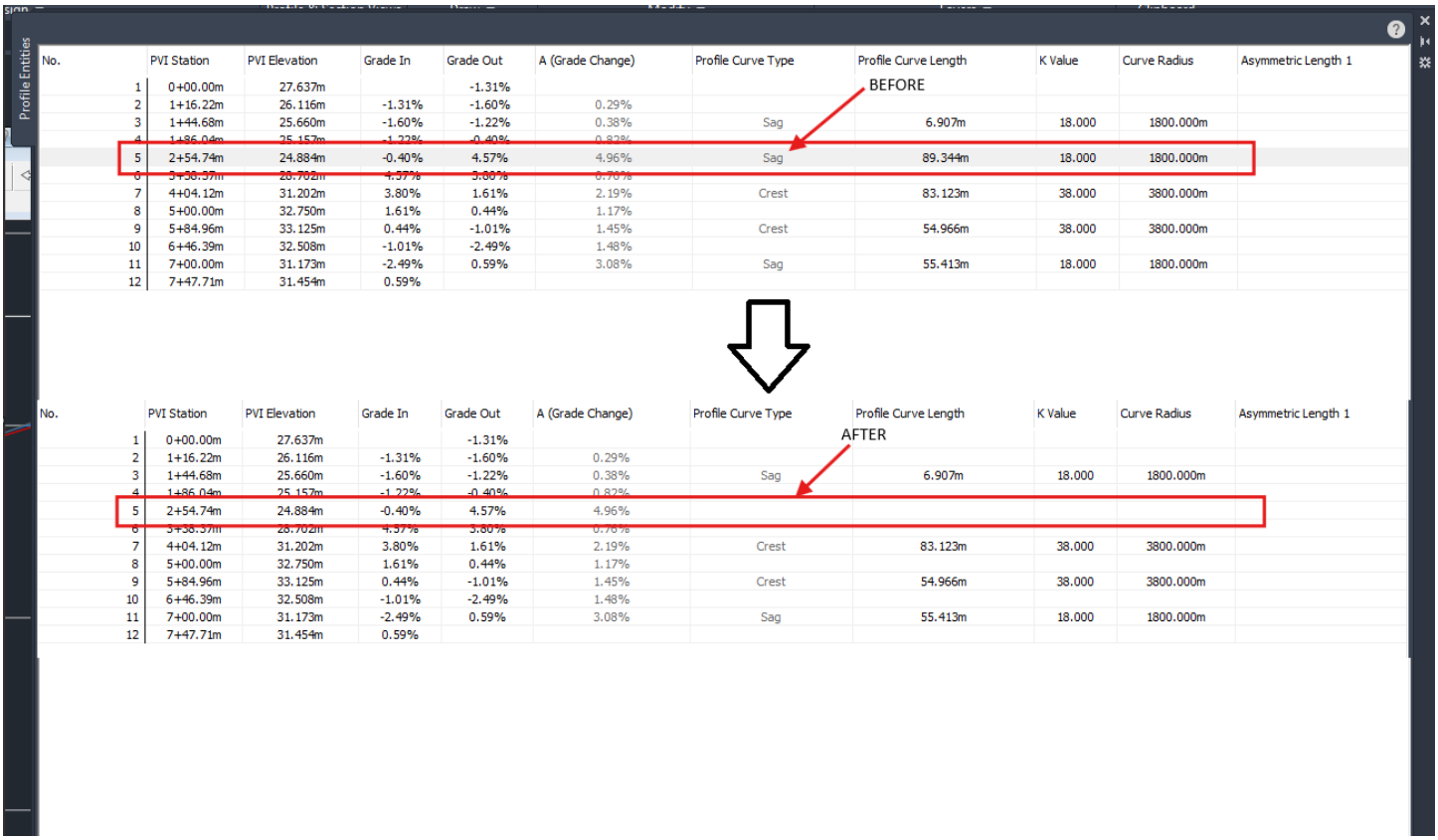
2. On the **Profile Layout Tools** dialog, click on the ***Profile Grid View*** function to open up the **Profile Entities** dialog > Select the PVI that should be converted to a grade break. The PVI will be highlighted on the drawing.



3. Click on the ***Delete Entity*** function under the **Profile Layout Tools** dialog > Select the crest or sag of the PVI selected in (2).



4. Under the **Profile Entities**, the PVI will no longer be of a crest or a sag, and the K value is automatically considered as 0.



No.	PVI Station	PVI Elevation	Grade In	Grade Out	A (Grade Change)	Profile Curve Type	Profile Curve Length	K Value	Curve Radius	Asymmetric Length 1
1	0+00.00m	27.637m		-1.31%						
2	1+16.22m	26.116m	-1.31%	-1.60%	0.29%					
3	1+44.68m	25.660m	-1.60%	-1.22%	0.38%	Sag	6.907m	18.000	1800.000m	
4	1+86.04m	25.157m	-1.22%	-0.40%	0.82%					
5	2+54.74m	24.884m	-0.40%	4.57%	4.96%	Sag	89.344m	18.000	1800.000m	
6	3+38.57m	28.702m	4.57%	3.80%	0.76%					
7	4+04.12m	31.202m	3.80%	1.61%	2.19%	Crest	83.123m	38.000	3800.000m	
8	5+00.00m	32.750m	1.61%	0.44%	1.17%					
9	5+84.96m	33.125m	0.44%	-1.01%	1.45%	Crest	54.966m	38.000	3800.000m	
10	6+46.39m	32.508m	-1.01%	-2.49%	1.48%					
11	7+00.00m	31.173m	-2.49%	0.59%	3.08%	Sag	55.413m	18.000	1800.000m	
12	7+47.71m	31.454m	0.59%							

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4	1+86.04m	25.157m	-1.22%	-0.40%	0.82%					
5	2+54.74m	24.884m	-0.40%	4.57%	4.96%					
6	3+38.57m	28.702m	4.57%	3.80%	0.76%					
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10	6+46.39m	32.508m	-1.01%	-2.49%	1.48%					
11	7+00.00m	31.173m	-2.49%	0.59%	3.08%	Sag	55.413m	18.000	1800.000m	
12	7+47.71m	31.454m	0.59%							

How to Generate Road Plan and Profile Output

After completing the horizontal alignment and vertical profile, the next step is to prepare the drawing output. The output consist of a plan view showing the horizontal alignment together with the longitudinal profile showing the vertical alignment.

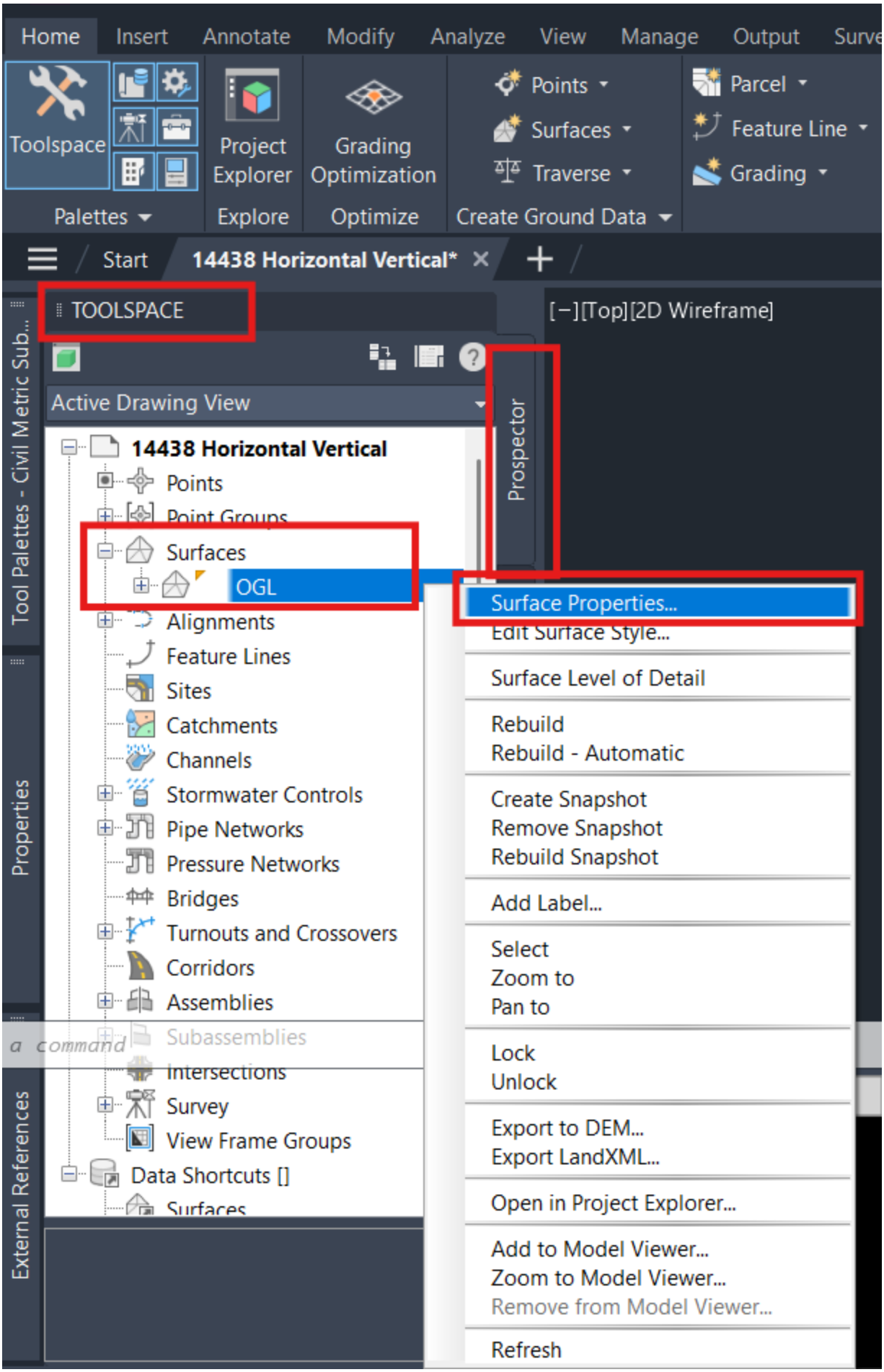
The example below illustrates the expected output, with the road alignment presented in plan view and the longitudinal profile arranged below.



Step 1: Hide the Surface and Survey Points

If you want a clean plan view, the surface and survey points display need to be hided. Without deleting the underlying data, this allows the horizontal alignment to be displayed clearly.

1. Go to **Toolspace** > **Prospector** > Expand **Surfaces**
2. Right click the surface and select **Surface Properties**. Surface Properties dialog box will appear.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Pressure Networks
Bridges
Turnouts and Crossovers
Corridors
Assemblies
Subassemblies
Intersections
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Remove Snapshot
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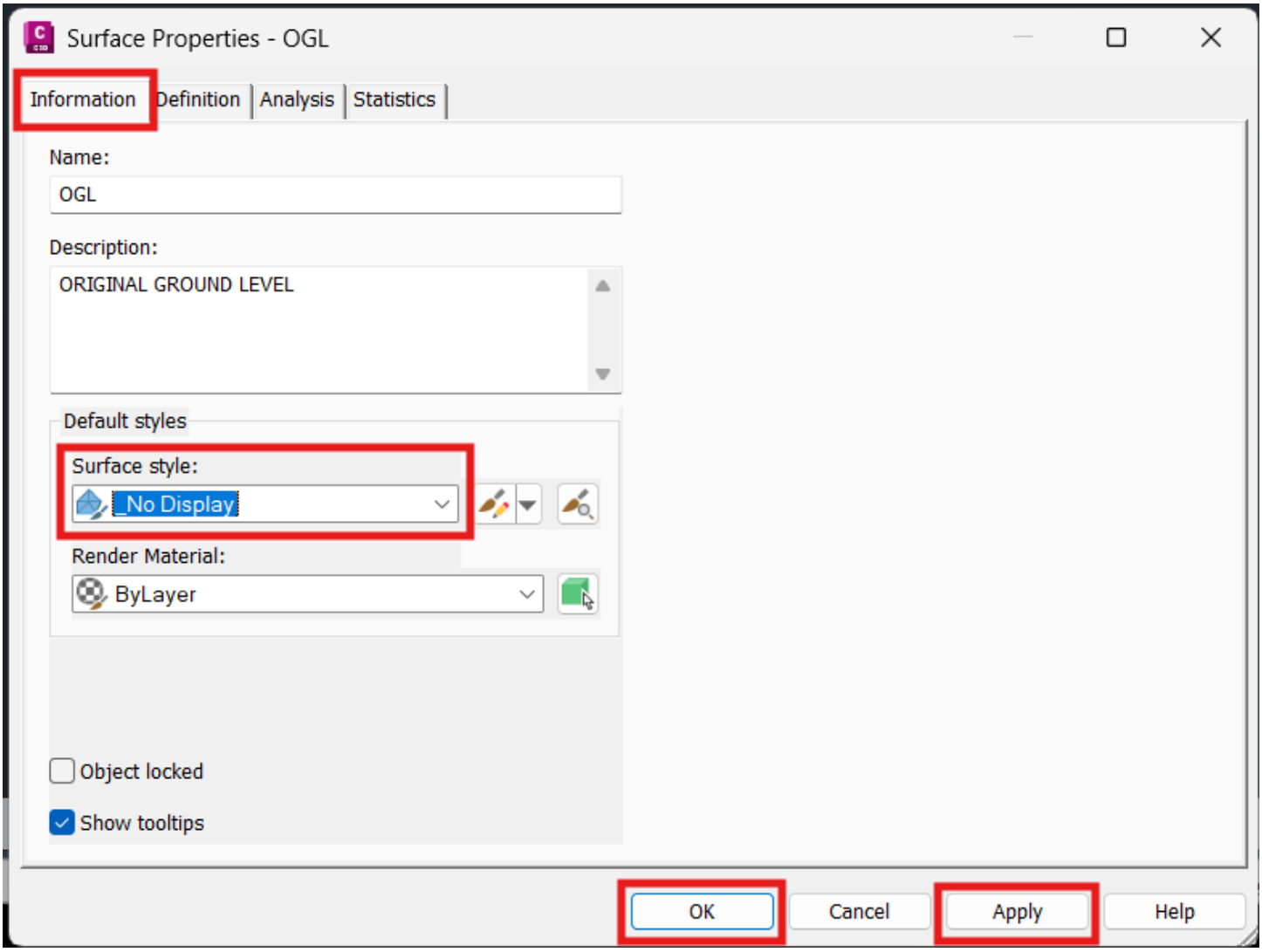
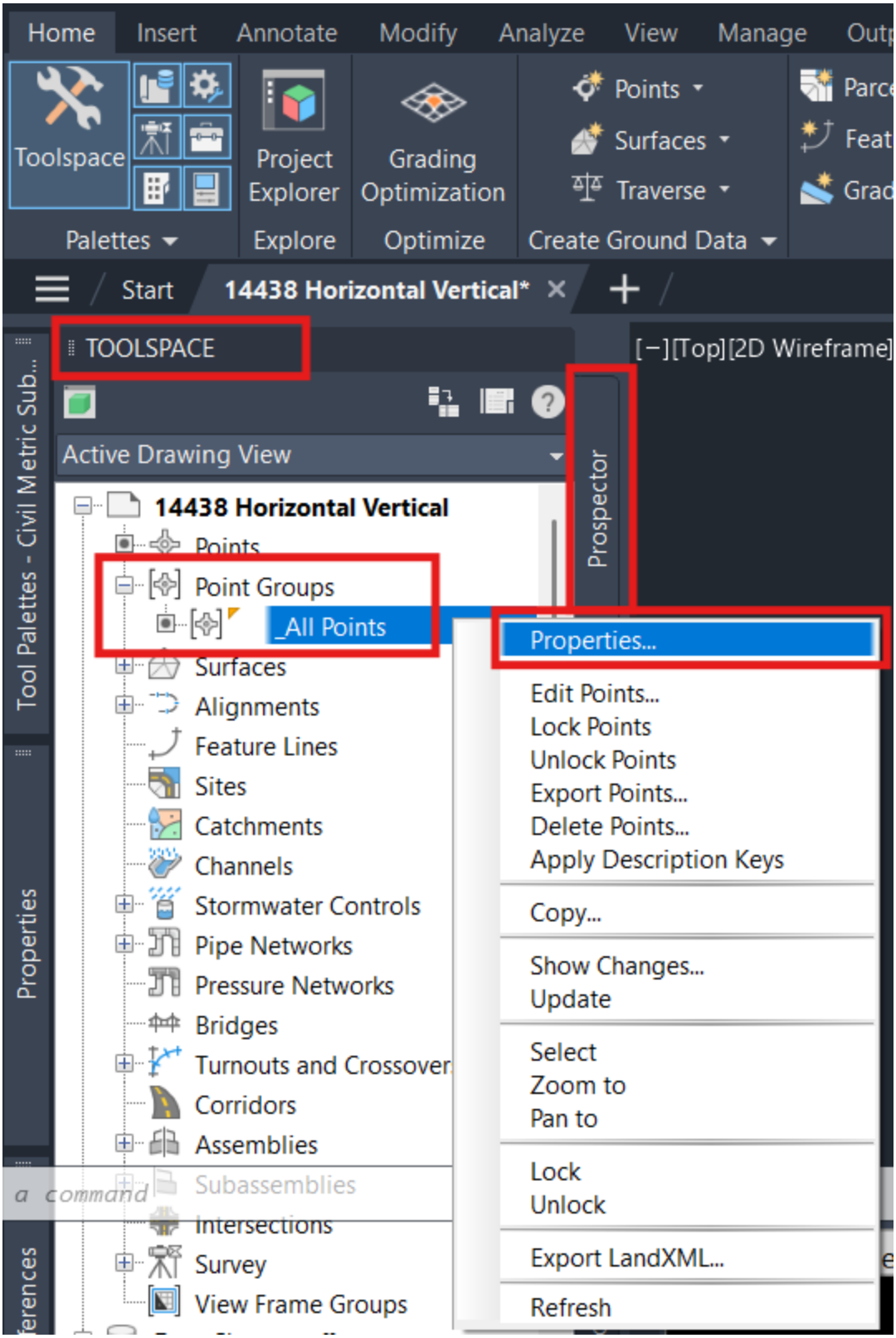
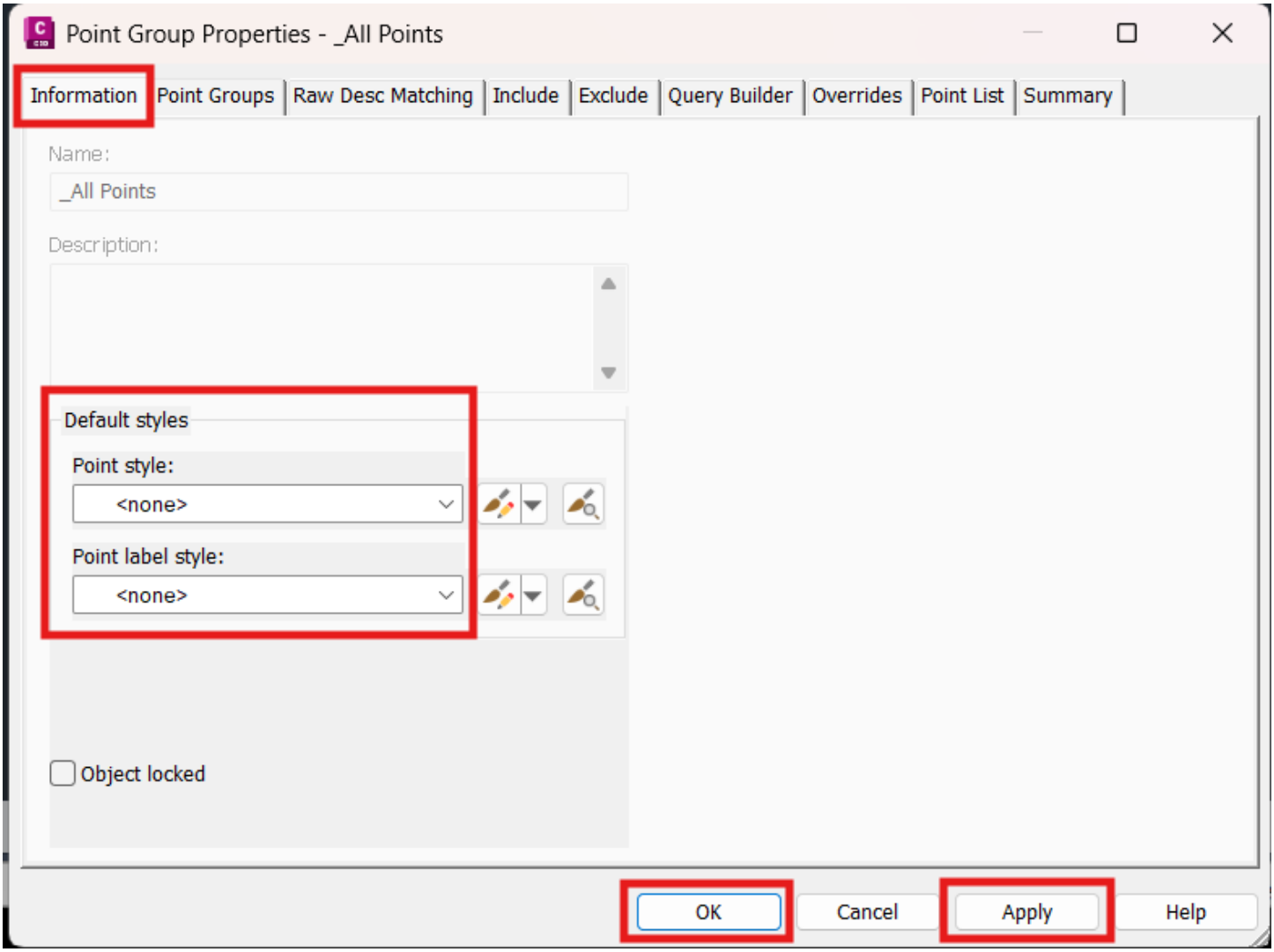
3. Under the **Information** tab, change the **Surface style** to **No Display**, then click **Apply** and **OK**.



4. To hide the survey points, in the **Prospector** > Expand **Point Groups** > Right click and open the **Properties** of the relevant point group. Point Group Properties dialog box will appear.



5. Under the **Information** tab, change the surface style to **No Display**, then click **Apply** and **OK**.



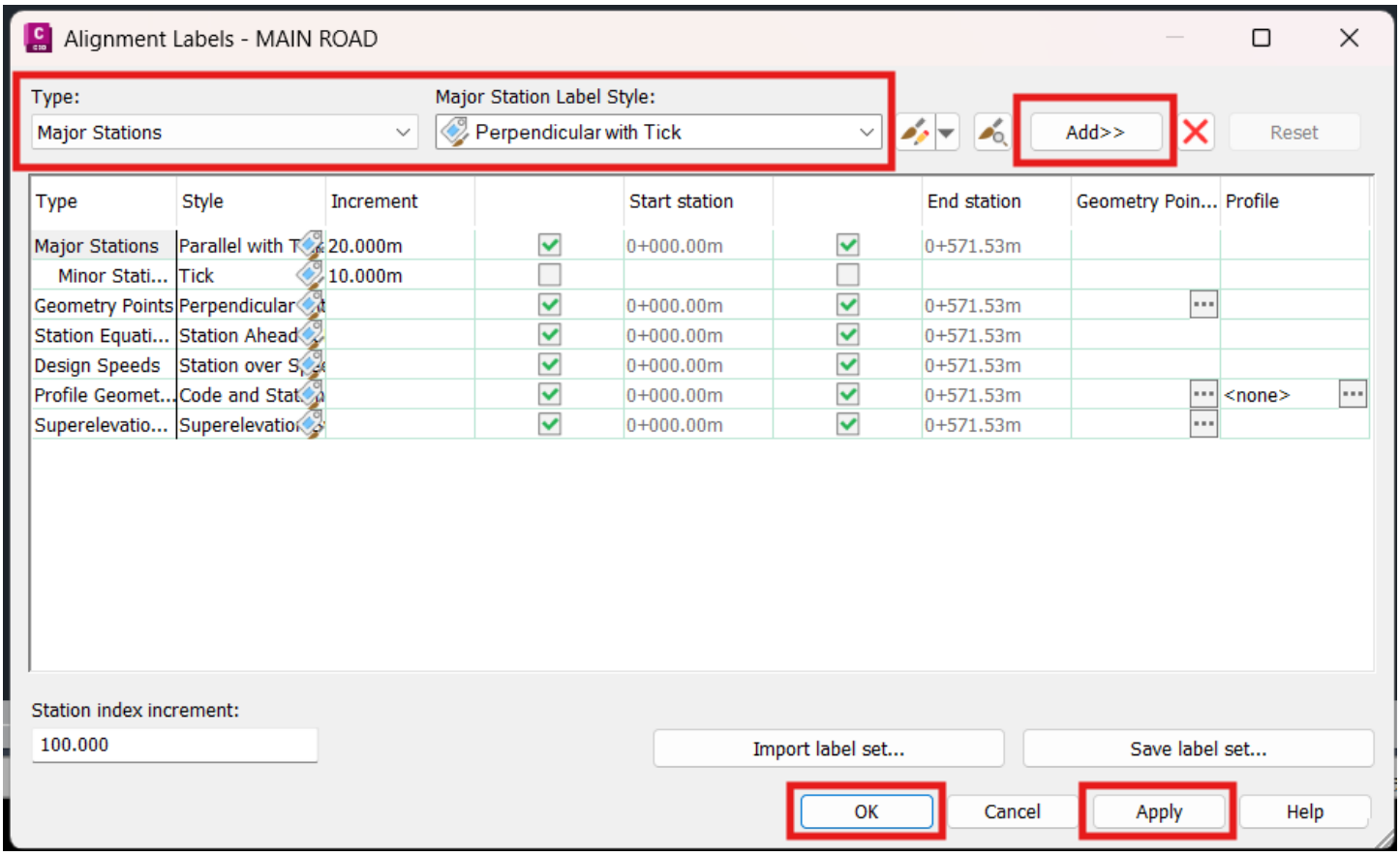
6. Please note that if the survey points are still visible, check whether they are controlled by other point groups or under separate layers.

Step 2: Display the Horizontal Alignment Details

The next step is to display the horizontal alignment details which will display the road geometry in plan view.

1. Select the road alignment > Right click the selected alignment and choose Edit Alignment Labels. The Alignment Labels dialog box will appear.

2. Change the **Type** and **Label Style** accordingly following the details that you need to include in the Horizontal Alignment.



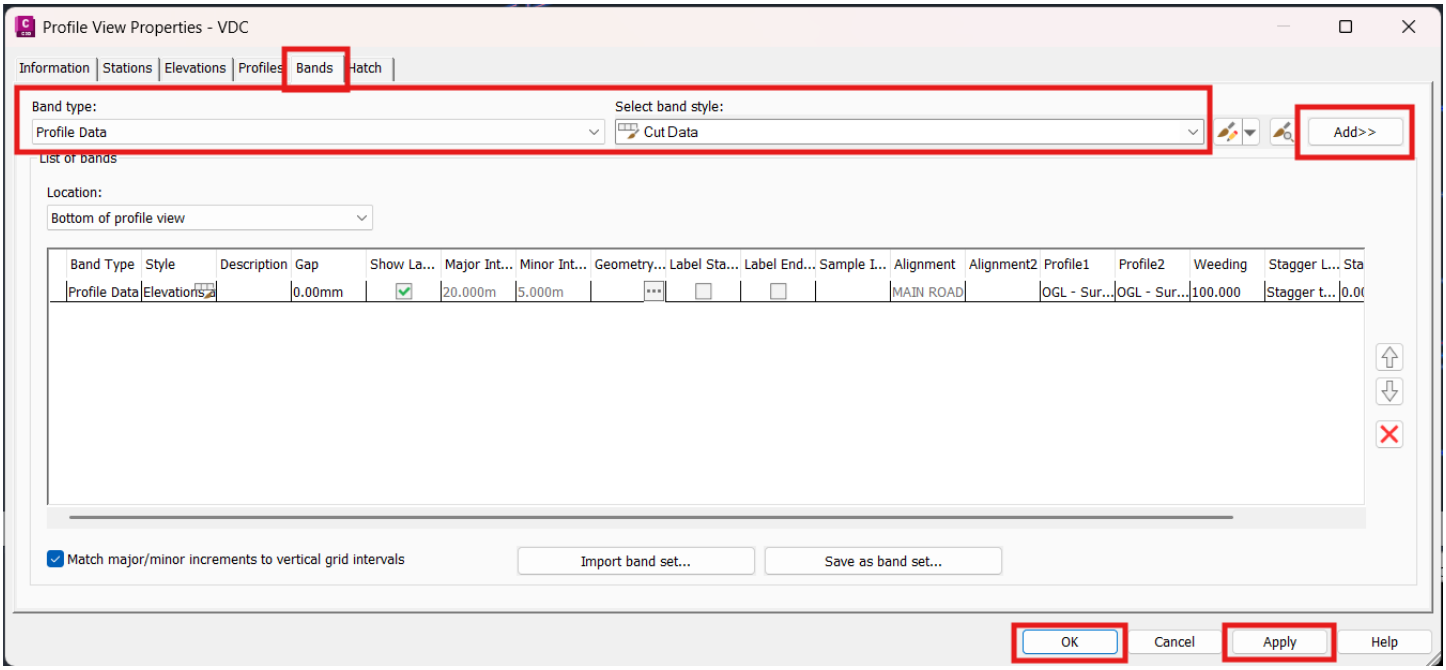
3. Once all the labels are added, review the plan view. Check that the major chainages, horizontal curve information, and important geometry points are visible.

Step 3: Display the Vertical Profile Details

The next step is to display the vertical profile details which will show the proposed road level changes along the alignment.

1. Select the profile view > Right click the selected profile view and choose Profile View Properties. The Profile View Properties dialog box will appear.

2. To configure the required profile view bands, go to the **Bands** tab. Select the suitable **Band type** and **Label style** from the available options, then click Add.



3. Once related bands are added, check the profile presentation. Ensure that the proposed vertical alignment is distinguishable from the existing ground profile, if both are displayed. Confirm that all the included information is readable.

Step 4: Arrange the Plan and Profile in Layout

In Civil 3D, Viewport method can be used to obtain the correct plan view and profile view. This method is useful when preparing engineering drawing output in a layout sheet.

1. Open the **Layout** tab > Delete the generated layout. Separate viewport will be created each for plan and profile view respectively.
2. In the layout, type **MVIEW** and press Enter. Click on the first corner, then the second corner to create rectangular viewport.
3. Double click inside the viewport > Type **PLAN** and press Enter > Choose **W** if prompted. You will find that you are able to zoom and pan inside the viewport.
4. Once the road alignment is positioned correctly, you may set the suitable scale using the viewport scale control which you can find at the bottom-right status bar.
5. To return to the paper space, double click outside the viewport.
6. Repeat Step 2 and Step 3 for profile view viewport.



Ngu Soon Hui

My passion is in sharing knowledge — Civil 3D or otherwise– with the world.

I’m also the benevolent dictator for life at MES Innovation Sdn Bhd.