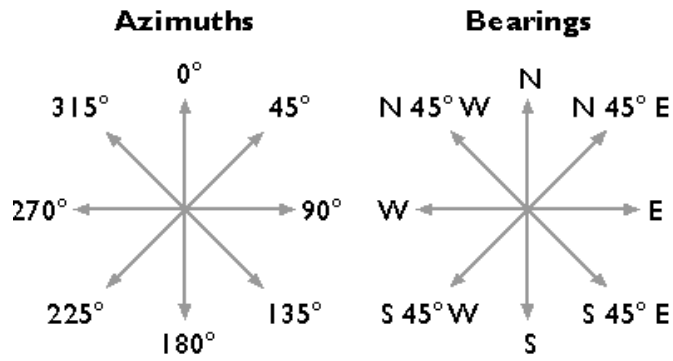


## Definiton of Tangents in Civil 3D



## Horizontal curves used in Civil 3D

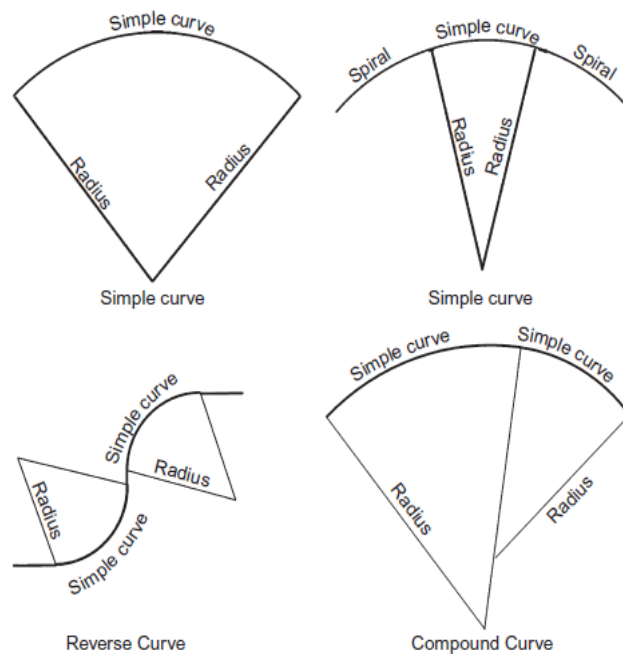


Figure 2.18: Different types of horizontal curves.

## Simple Circular Curve

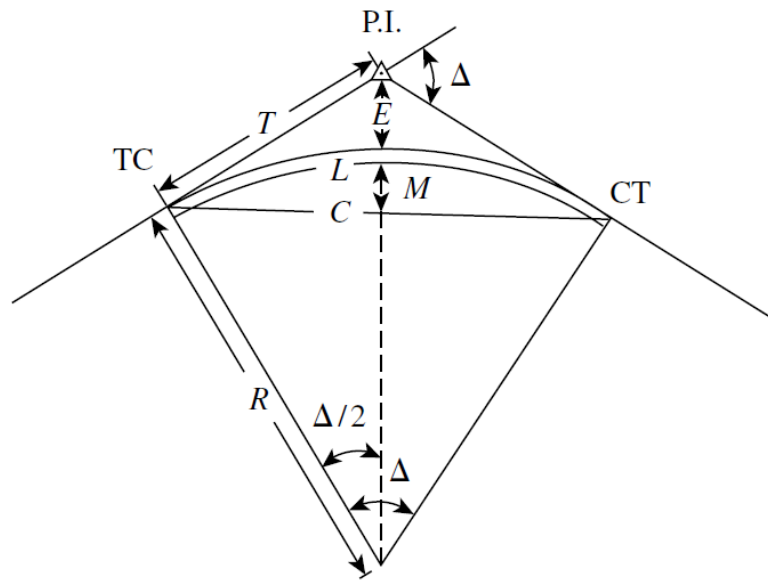


Figure 2.19: Elements of simple circular curve.

## Curve parameters and their terminology

$$D = \frac{36,000}{2\pi R} = \frac{5729.58}{R}$$

$$E = \frac{R}{\cos(\Delta/2)} - R$$

$$L = \frac{2\pi R \Delta}{360^\circ} = R \Delta_{\text{rad}}$$

$$C = 2R \sin\left(\frac{\Delta}{2}\right)$$

$$T = R \tan \frac{\Delta}{2}$$

$$\text{TC station} = \text{PI station} - T$$

$$\text{CT station} = \text{TC station} + L$$

$$M = R - R \cos\left(\frac{\Delta}{2}\right)$$

where

R= radius of curve

L= length of curve

T= tangent length/distance

M= middle ordinate

Delta= central angle (deflection angle)

D= degree of curvature

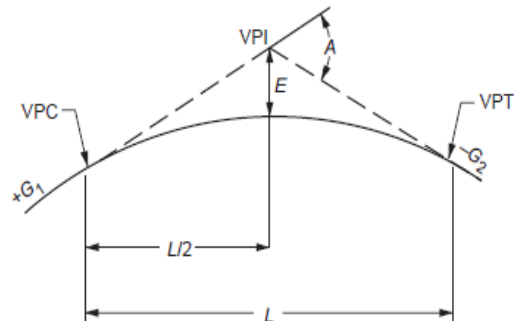
C=chord length.

PI=point of intersection

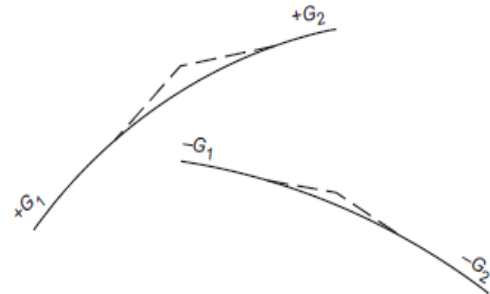
TC= tangent to curve point (or PC, point of curvature)

CT =curve to tangent point (or PT, point of tangency)

## Vertical curves and their terminology

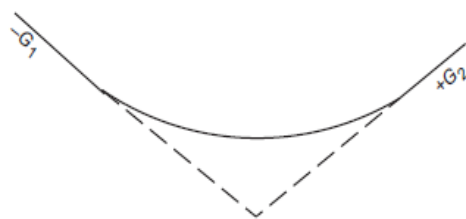


Type I

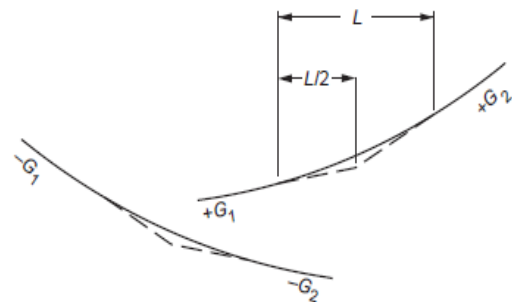


Type II

Crest Vertical Curves

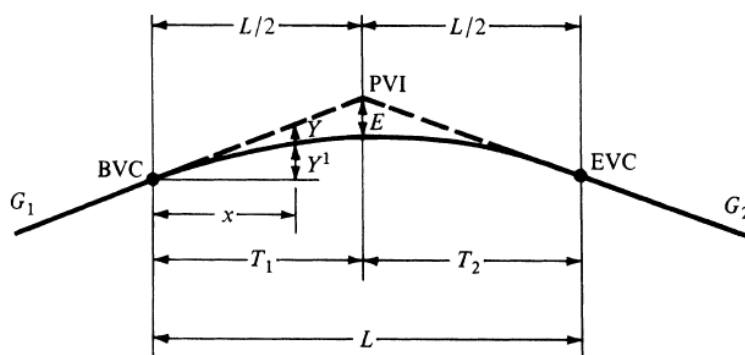


Type III



Type IV

Sag Vertical Curves



PVI = point of vertical intersection

BVC = beginning of vertical curve (same point as PVC)

EVC = end of vertical curve (same point as PVT)

$E$  = external distance

$G_1, G_2$  = grades of tangents (%)

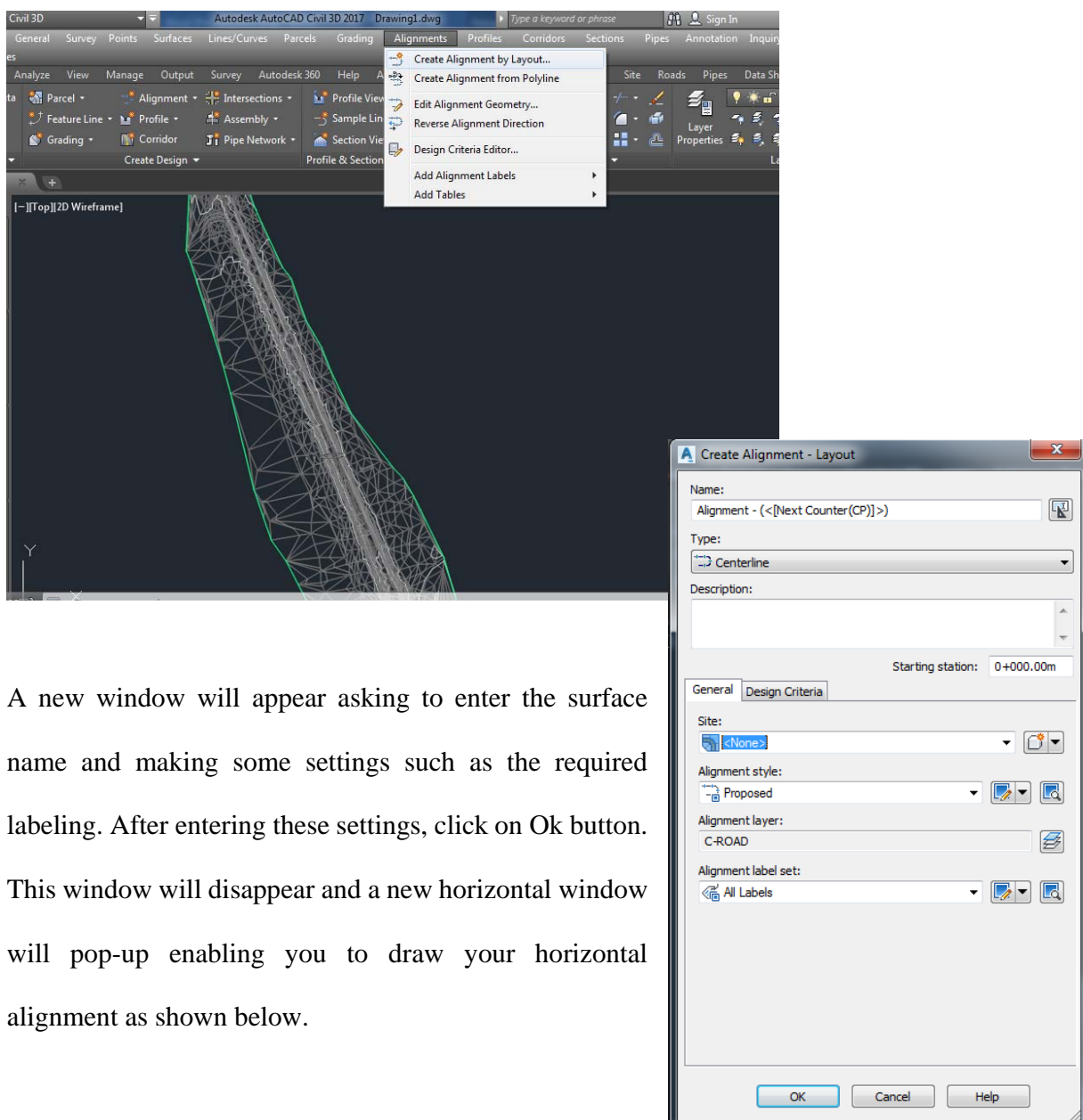
$L$  = length of curve

$A$  = algebraic difference of grades,  $G_1 - G_2$

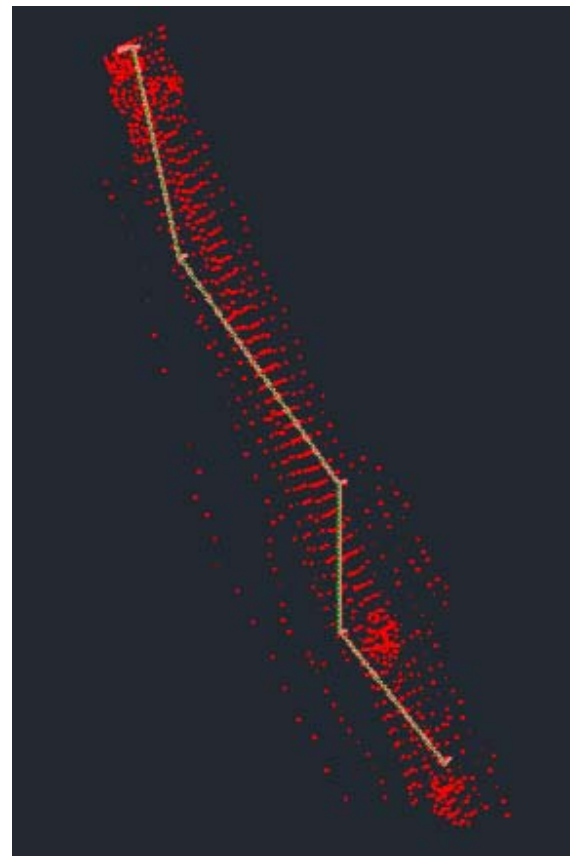
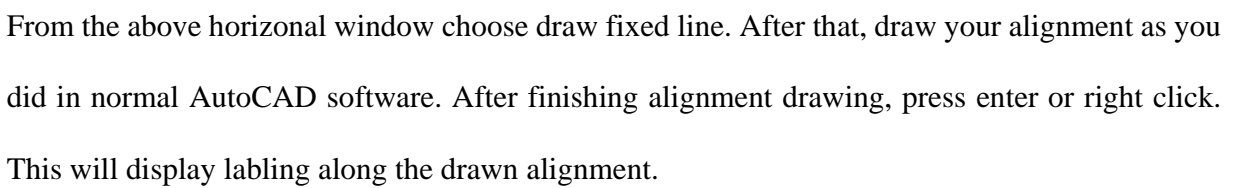
## 6 Alignments

### 5.1 Alignment creation

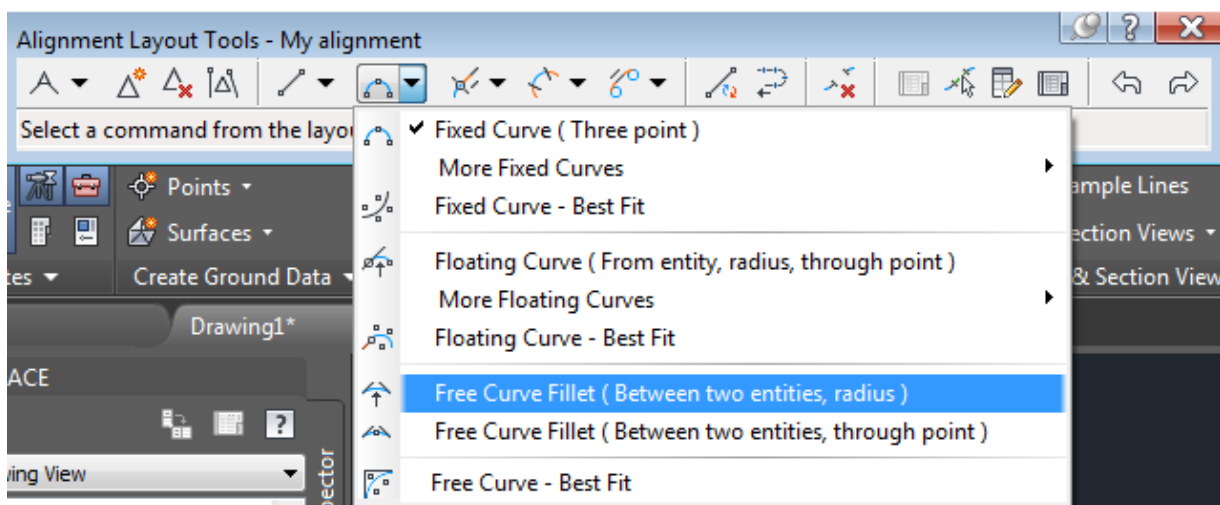
Civil 3D allows user to create the horizontal alignment for the highway section. There are several methods to do so. One of them is by selecting alignment from the menu bar and choose *create alignment by layout* as shown in figure below.



A new window will appear asking to enter the surface name and making some settings such as the required labeling. After entering these settings, click on Ok button. This window will disappear and a new horizontal window will pop-up enabling you to draw your horizontal alignment as shown below.



To draw horizontal curves connecting these straight lines, choose *free curve fillet* as shown in figure below. Then, select the first line and the second line and enter the desired radius. This will draw curve between the selected line. Repeat these steps for all your required curve locations. Finally press ESC key to finish curve creating process. This will re-label the entire alignment but in this time will take in consideration the curved parts.










### 5.2 Editing design of curves

Sometime, it is necessary to edit radii of curves. This can be done by choosing *alignment grid view*

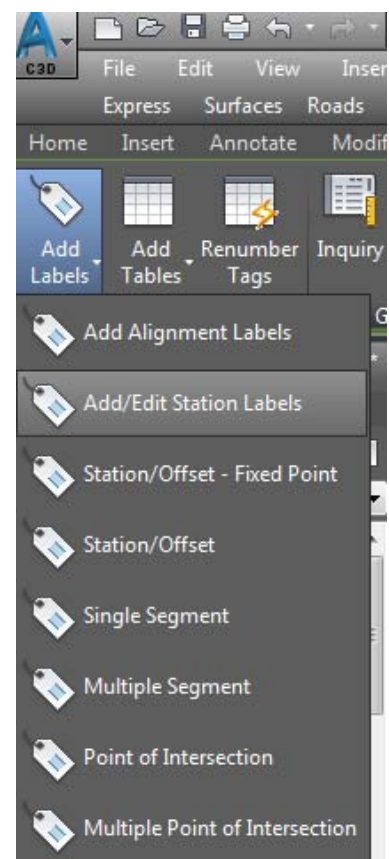


A new panorama window will appear and from which you can do the necessary changes as shown in figure below.

No.	Type	Tangency Constraint	Parameter Constrai...	Parameter C...	Length	Radius	Di
1	Line	Not Constrained (Fixed)		Two points	374.903m		S
2	Curve	Constrained on Both Sides (Free)		Radius	757.436m	1899.782m	
3	Line	Not Constrained (Fixed)		Two points	413.512m		S
4	Curve	Constrained on Both Sides (Free)		Radius	367.757m	600.000m	
5	Line	Not Constrained (Fixed)		Two points	118.639m		S
6	Curve	Constrained on Both Sides (Free)		Radius	402.045m	600.000m	
7	Line	Not Constrained (Fixed)		Two points	389.298m		S

### 5.3 Editing alignment labeling

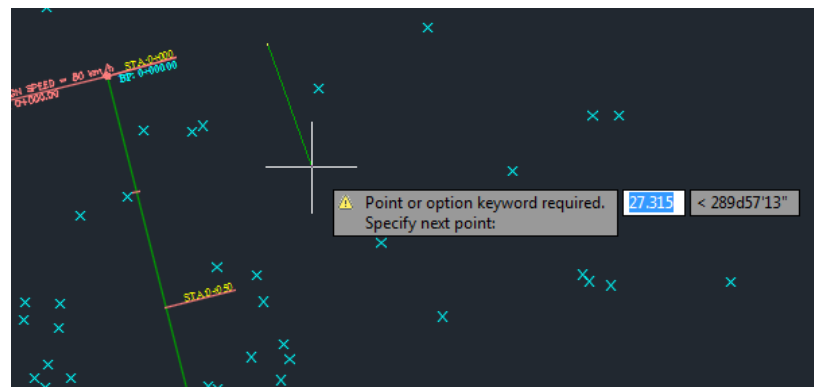
In most case, the designer needs to modify the labeling of the alignment based on the topography or department of transportation requirements. This can be conducting by selecting your alignment and choosing add/edit label (from the related ribbons). A new window will pop-up enabling you to modify the labeling interval and style.



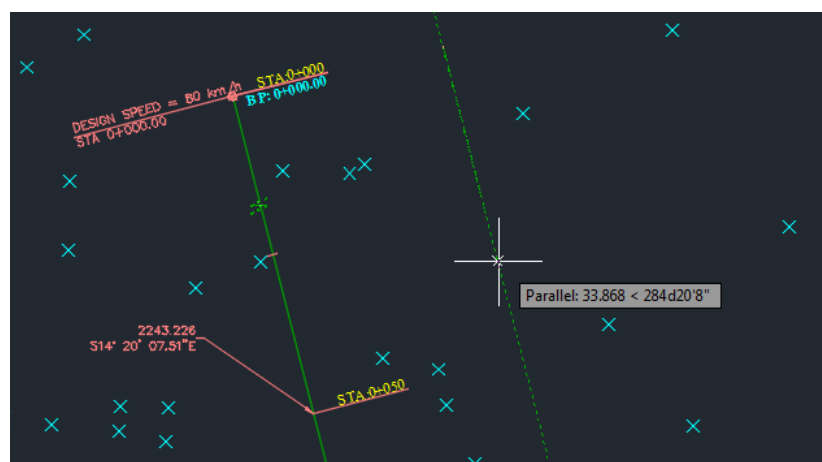


## 5.4 Drawing alignment for specific length and angle

Alignment can be drawn precisely based on specified PI points or based on lengths and directions. This can be done by writing the first point in the command line (or roughly clicking on the working area on screen). Then, either entering length of the straight part and < and an angle or entering a point coordinates. The first one can be written also on the spaces shown on screen as illustrated in the figure below

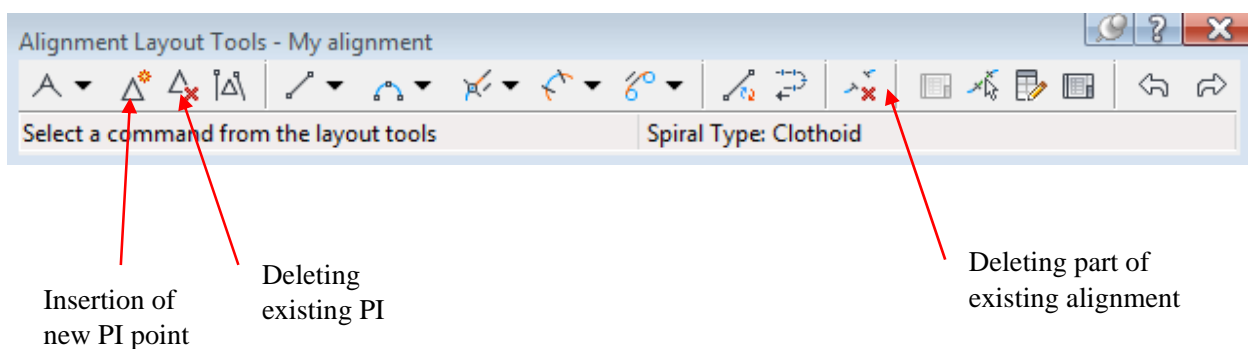


Note that there is a difference between the angle defined by the software and the bearing definition as shown in the figure below



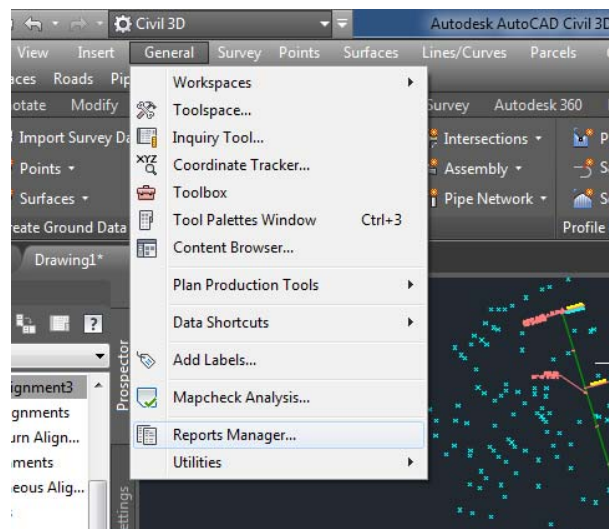
### 5.5 Editing PI points (addition, deleting)

Sometimes, it is necessary to change an alignment to avoid an obstacle for example. This may necessitate to delete an existing PI point or even adding new PI point. This can be done by selecting the alignment then choose geometry editor from the ribbons tools. The alignment layout tool will appear which will permit you to select one of the tools as shown in the next figure.

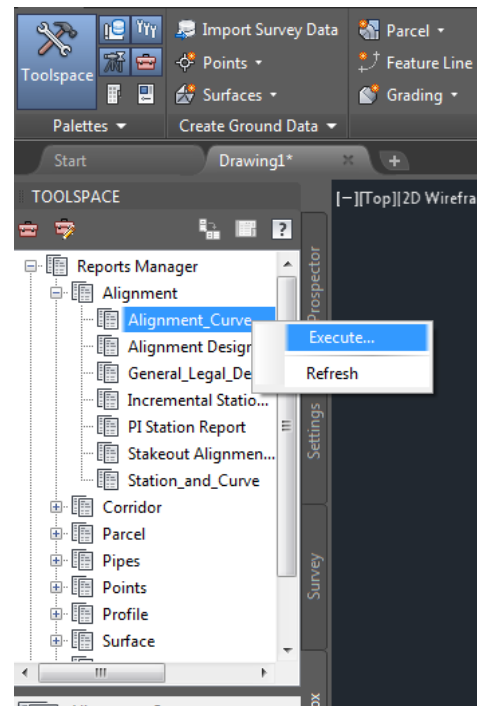


### 5.6 Design reports

To generate design report which consists design parameters and other information that is used to set out the alignment, choose report manager from general menu.



A new set of reporting option will appear under Toolspace. From these option you can generate the report that you are interested in then right click and choose Execute. This will generate a report in any extension you select.

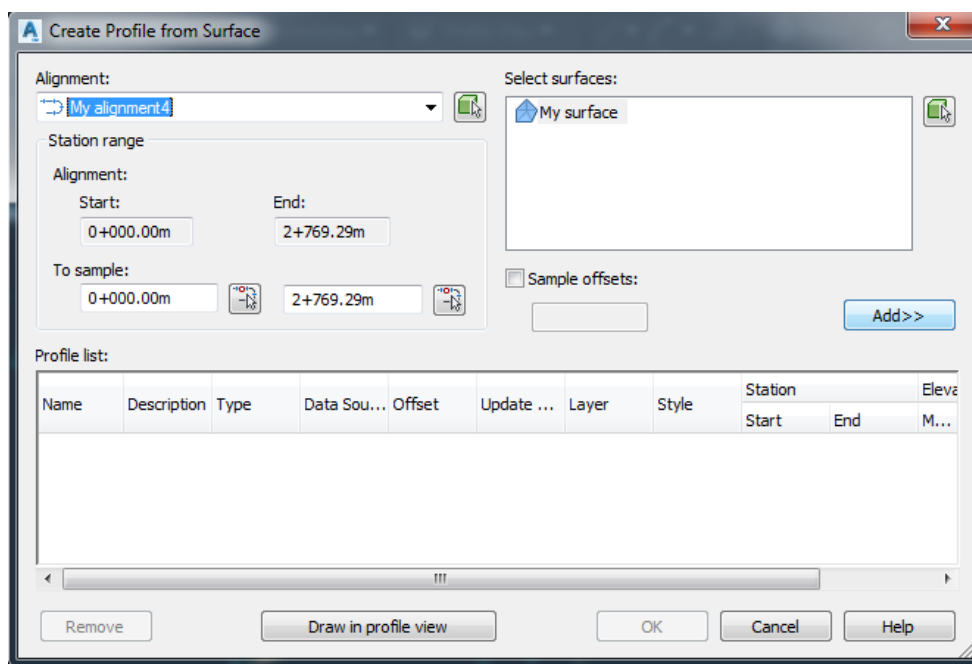


## 6 Profile

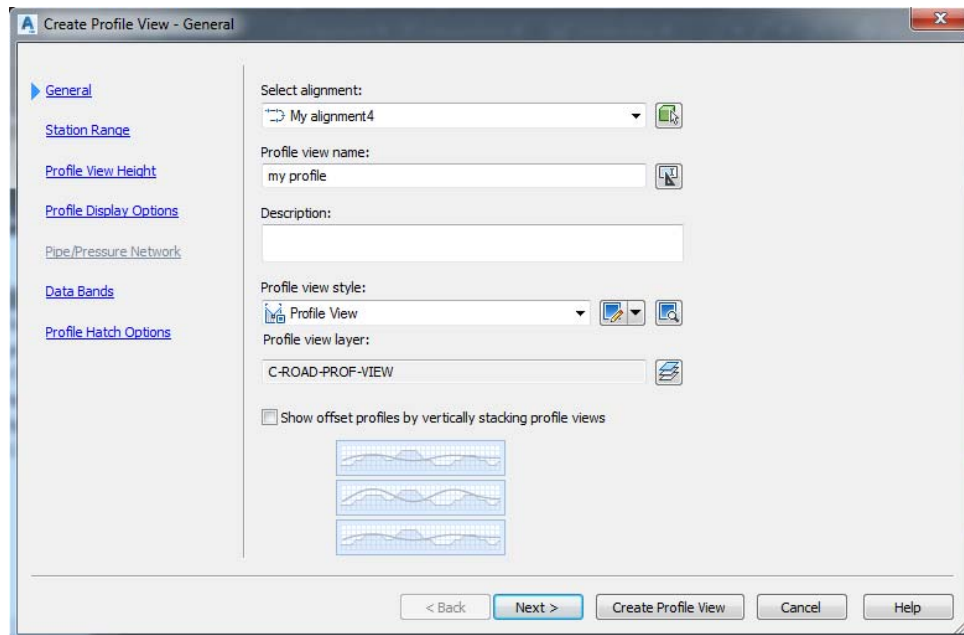
This part deals with the design of vertical alignment of the suggested highway.

### 6.1 Existing ground

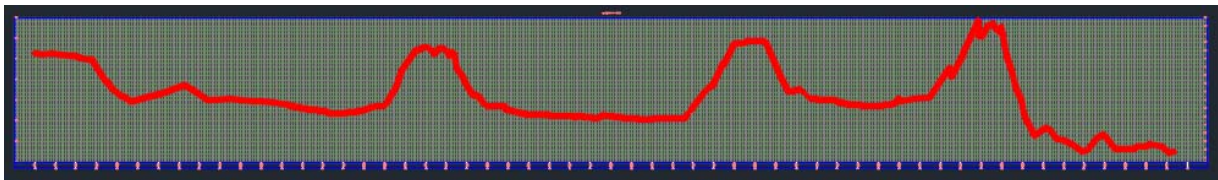
To draw existing ground level along centerline of the roadway being designed, select create profile from surface. A new window will appear allowing user to draw a profile for a specific alignment and surface. After selecting an alignment and surface, choosing the starting and ending stations, press Add button then press draw a profile view button.



Another window will appear asking for certain information such as alignment name, surface name, maximum and minimum elevations, start and end stations.



Finally press create profile view and then select a position on screen in which you want to draw your profile. The resulted profile will be drawn as shown in figure below





### Other learning Sources

1. **Lab lessons:** students should apply Civil 3D fundamentals during **laboratory lessons**.

### Other references

1. Mastering AutoCAD Civil 3D 2017, Autodesk Official Press.
2. AutoCAD Civil 3D Essentials, by Eric Chappell.