

## DETERMINING THE CENTERLINE OF AN EXISTING ROADWAY BY FIELD SURVEY LOCATED POINTS, A PRIMER FOR DESIGNERS

First some background information:

Before actually proceeding with the process, it is important to understand the methodology utilized in acquiring the field location points. In most cases it is merely the interpretation of the person “holding the stick”, which begs the question, “how do they know where to hold it?” This of course depends partly on the type of roadway that is being located. In cases of a dirt or hard surfaced road that is unmarked, it could be what looks to be halfway between the edges, as judged at the point of location or having a second person some distance away indicating the location, or actually measure the width and divide (if this method is utilized, it is usually not at every location and may only be at one), or was there some way to ascertain a crown and that is what is located. Another method for this type of roadway would be to just locate the edges and split them in the office. Below is an example of an unpaved road of varying width. Where is the centerline? The best indication is where it is worn by traffic. (Note: this road was an unmarked paved road at the time it was located, but was scarified for a utility installation prior to the project to repave the road.



Here's a picture of the same section prior to the utility work, as you can see the edges are not well defined, hence tougher to determine the centerline.



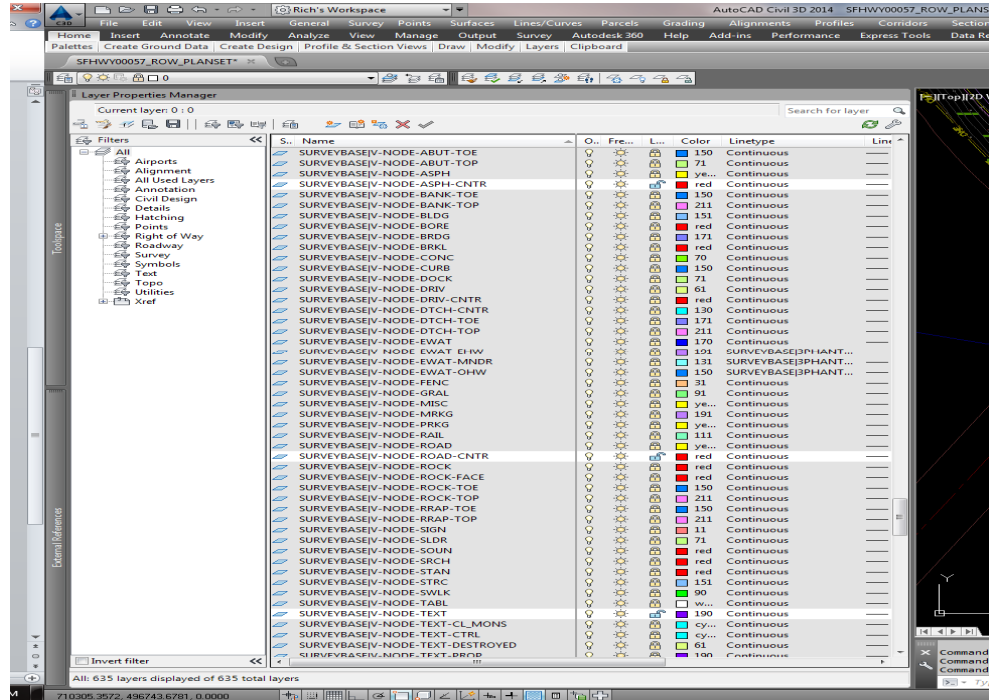
For a marked roadway, did they locate a crown, a seam created by the paving machine (which would most likely also be the crown) or did they simply follow the centerline marking? Most likely it would be the latter, which is also the best for designers trying to fit designs into existing traveled way alignments.

The point of these statements being, there are a lot of variables in the location of a road centerline and it should not be treated as an absolute definition.

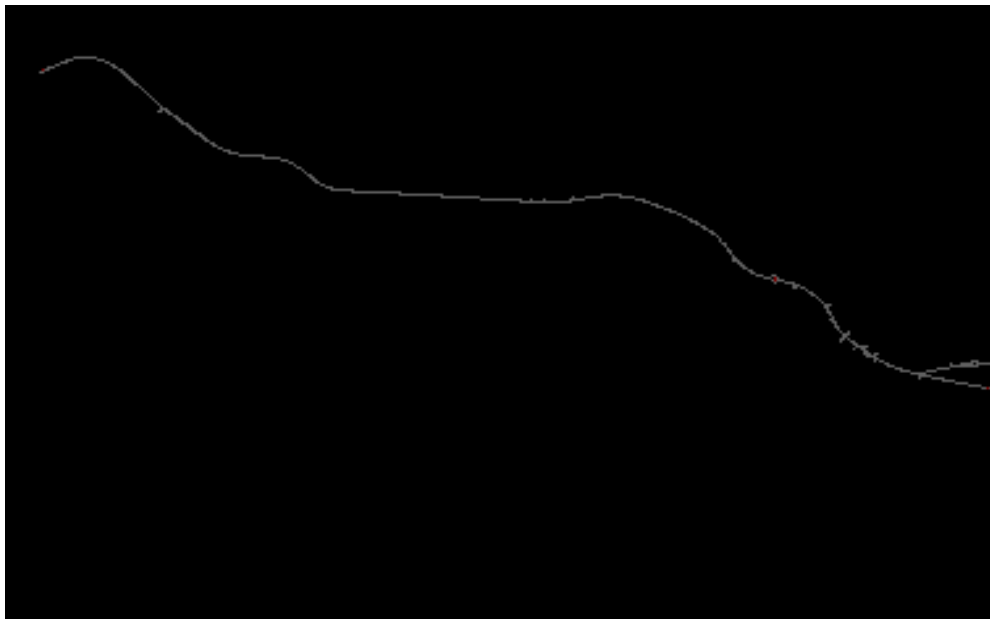
The Procedure:

- 1) Isolate the centerline points, there are different ways to accomplish this, here's my preferred method:
  - a. Open the Layers Properties Manager and select the All filter.

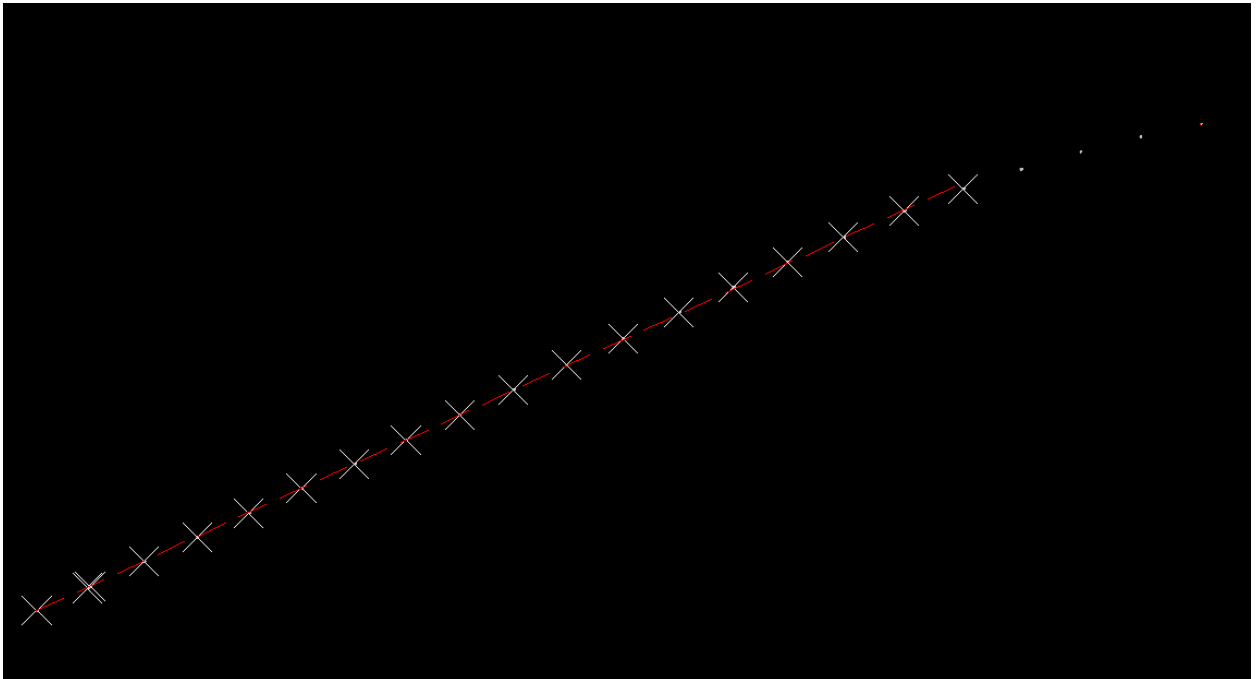
- b. Select the layer(s) that you want to see and ensure that they are thawed and on (in this case I have chosen V-NODE-ASPH-CNTR, V-NODE-ROAD-CNTR & V-NODE-TEXT, All within the SURVEYBASE | external reference), also select the layer that the external reference is on. While these are highlighted, right click on mouse, on the pop up menu pick “Invert Selection”.



- c. If none of the now highlighted layers that appear in the window are thawed, scroll to one and pick the freeze button, the drawing area should look something like this image, which is zoomed out, what is shown is not a line, but a series of points.

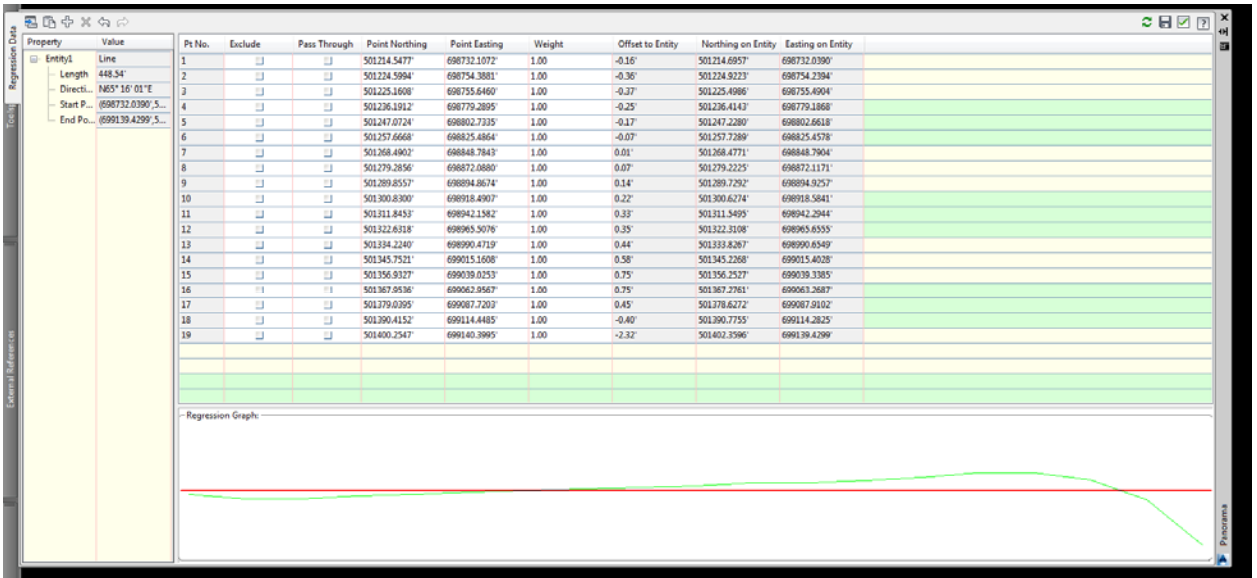


- 2) Ensure that Node is one of the selected Osnap options. Zoom to an area where you would like to start. On the menu bar select Lines/Curves – Create best Fit Entities – Create Line. On the pop up menu – Input options, select “by clicking on the screen” (since the points are in an external reference, none of the other options are valid for this exercise), click OK. Select the points that appear to create one of the tangents, even select a few past where the tangent appears to end. As points are selected, a dashed line appears and changes with each new selection, which is the best fit of the selected points (Note that on the Command line there is the option to undo, in case an errant point gets picked).

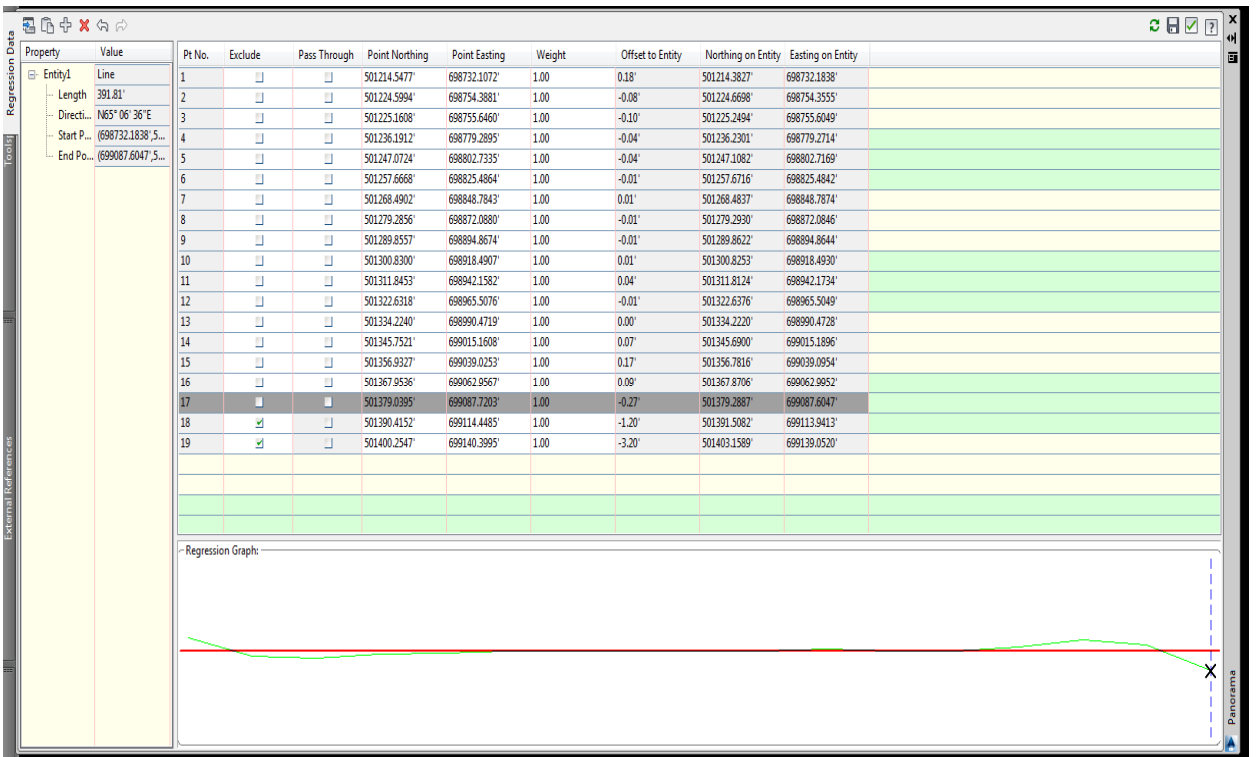


When all points have been selected, right click the mouse or press enter.

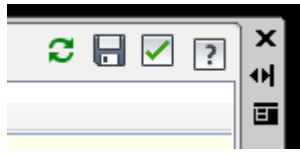
- 3) A new window opens with the values of the line in the left pane and a list of the selected points with options. A graph at the bottom shows the points with reference to the created line. If not enough points were selected initially there is a + icon in the upper left corner of the panorama that allows the user to add more points.



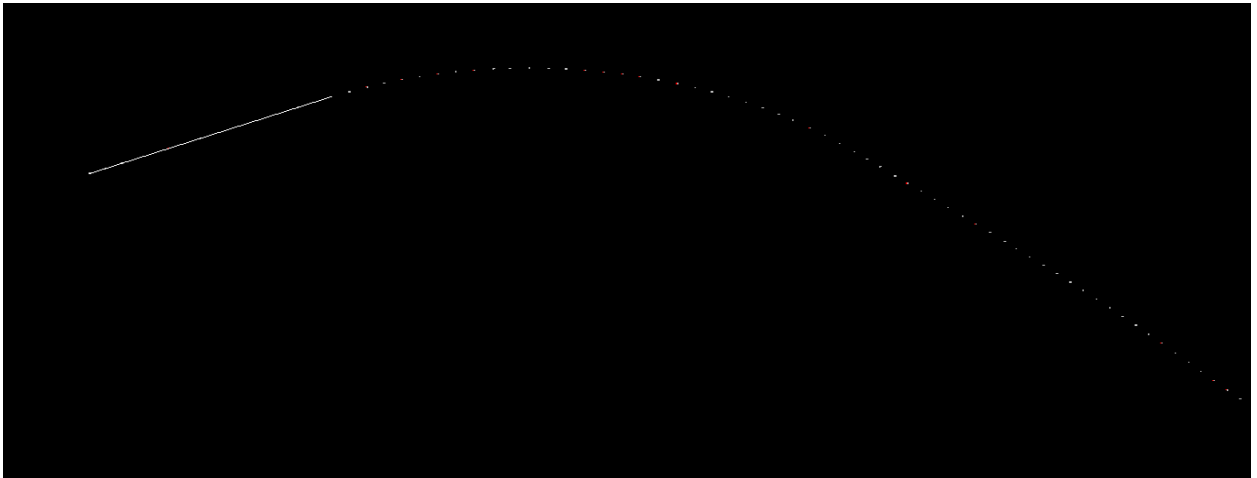
Now the line can be refined by using the information in the Offset to Entity Column and picking boxes in the Exclude column. In this case exclude point 19 (-2.32' offset) and notice the changes to the data, all of the points with the exception of number 18 (now -0.94' offset) are close to an acceptable tolerance, so exclude point 18. The table now shows that the worst point offset is 0.27' (point 17), this point could also be excluded but will not make much difference once the curve is placed. Acceptable tolerances are up to the user, taking into consideration the type of roadway that exists. The roadway in this exercise is a paved and marked, so tolerances can be fairly tight, within 0.5' of either side of the created entity should suffice. Notice the difference in the bearings of the two lines.



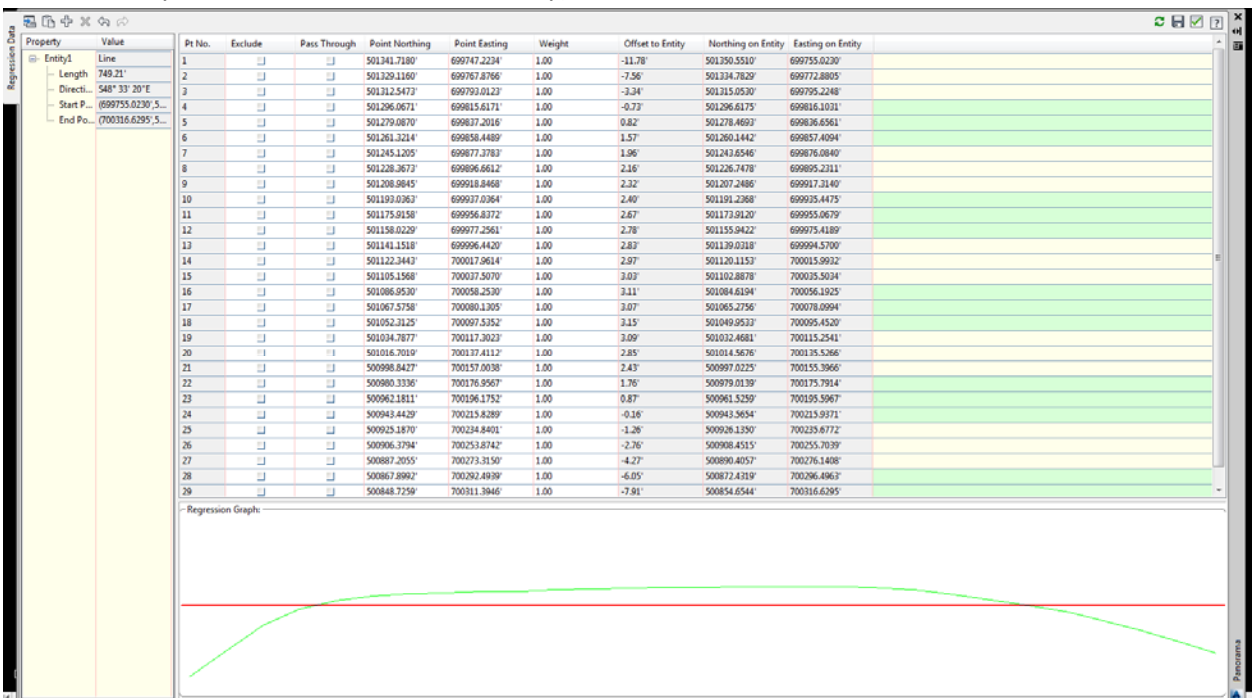
When satisfied with the data the icons in the upper right corner of the Panorama offer a few



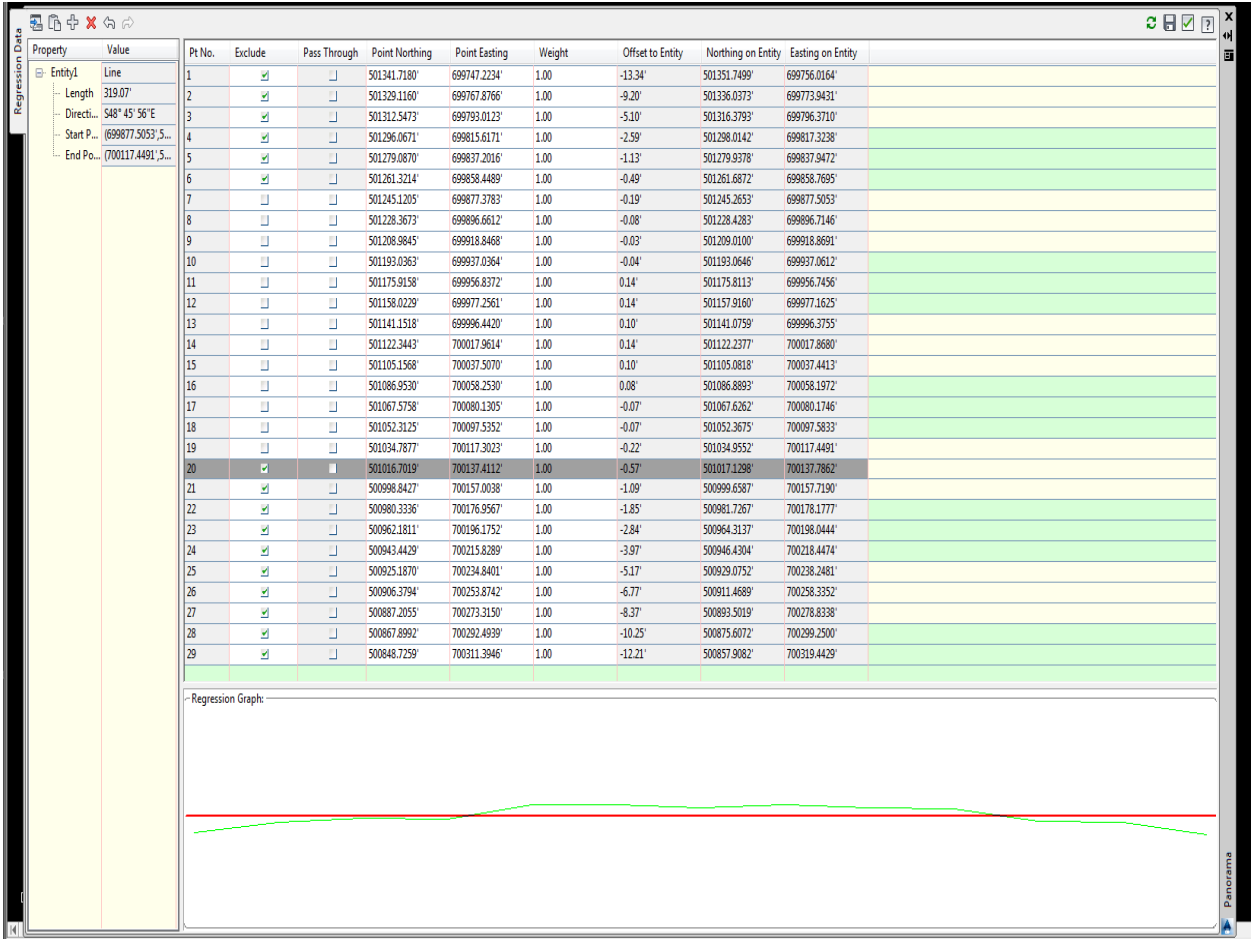
options, hovering over them will give a brief explanation of their individual function. The two arrow circle icon will clear the current regression data and you have to start over, the floppy disc icon will place the currently defined entity in the drawing and leave the data so it can be further edited, the checkbox icon will place the currently defined entity in the drawing and close the Panorama. Pick the checkbox icon and the beginning tangent is created.



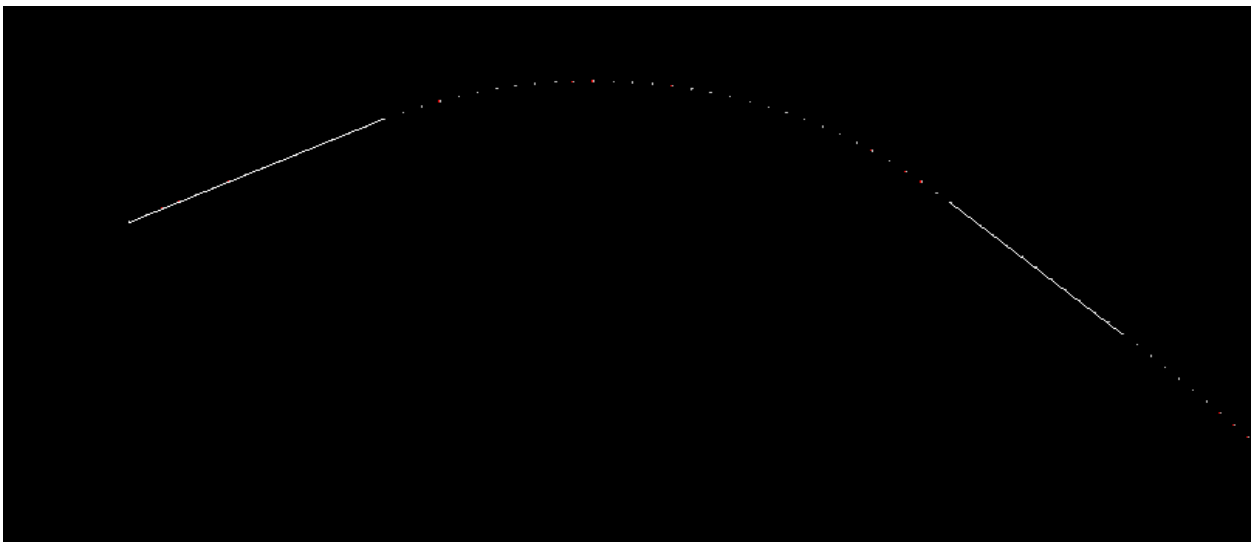
- 4) The second tangent is created in the same fashion with the additional curve on the downstream end, so once point are selected (once again pick some past where the tangents appears to end, as shown they can be excluded from the entity).



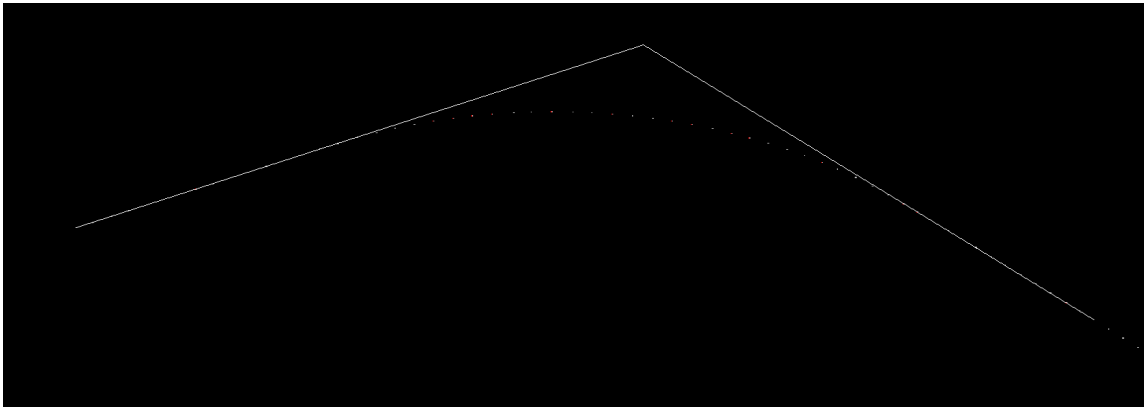
As shown there are points included that really skew this line, so points can be excluded from both ends. As point are excluded be attentive to the data, more points may need to be excluded from one end over the other. The exclusion can be dithered with, i.e. unexclude from one end while excluding from the other. Click the checkbox icon when satisfied with the data.



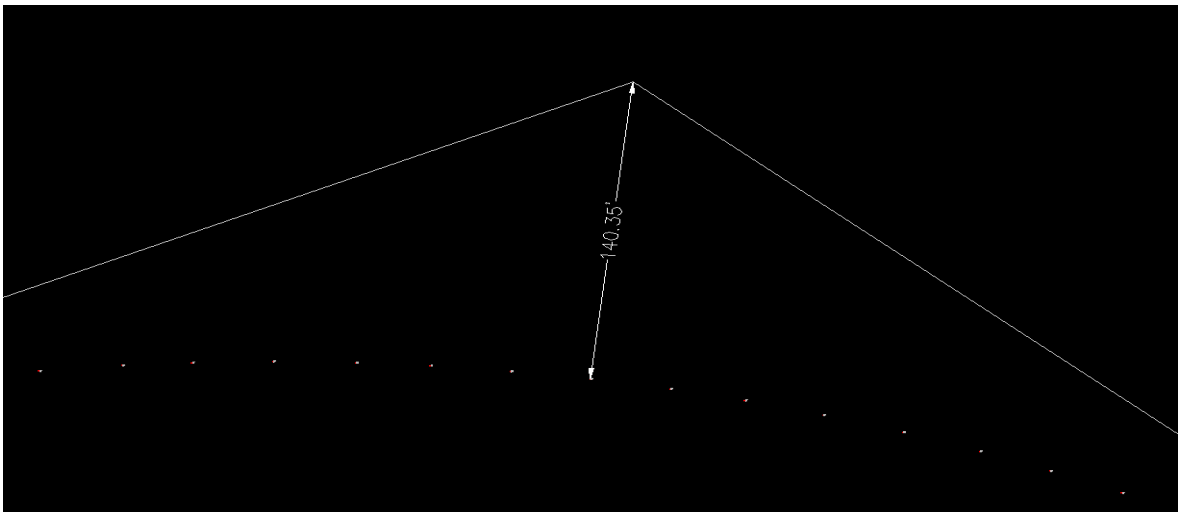
5) Now the two tangents for the first curve are created.



Create the point of intersection of the tangents, (there are several methods to achieve this, I simply use the Fillet command with a "0" radius).



- 6) Create the curve between the tangents. My preferred method is to measure from the PI to the point nearest the mid point of the curve.

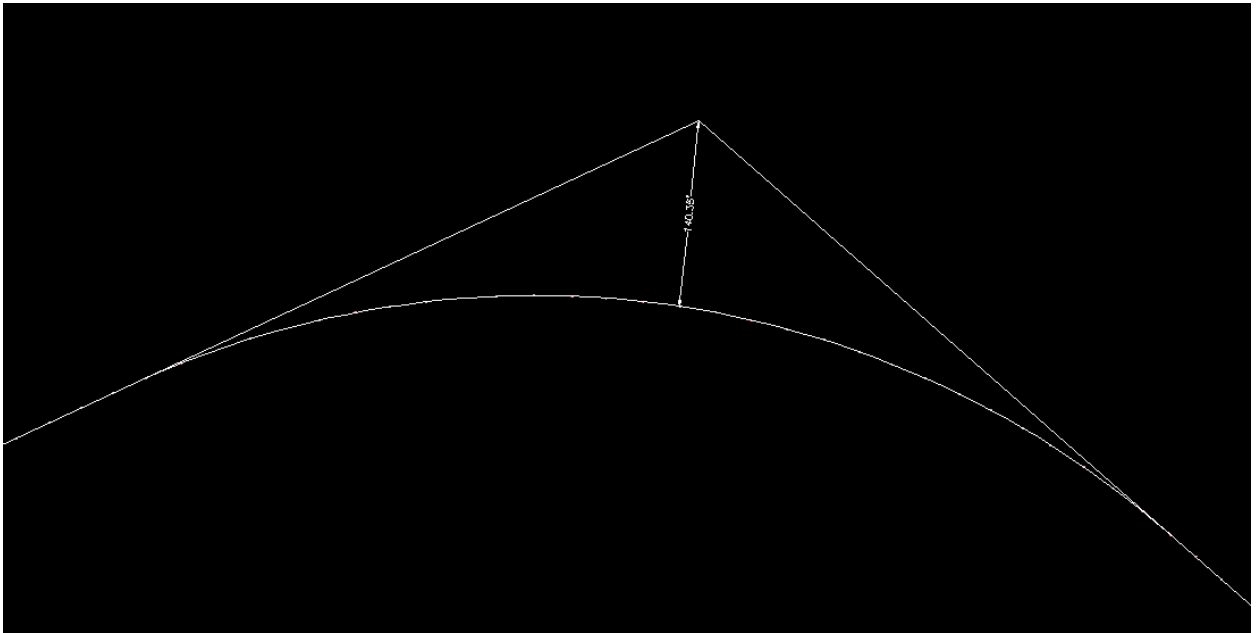


On the menu bar select Lines/Curves – Create Curves – (user preference, I prefer Curve on Two Lines, which leaves the tangents to the PI, while Curve Between Two Lines will trim the tangents at the curve, a further explanation of my preference will be in the ending notes and suggestions). The command line will ask for the first and second tangent lines, pick them (order doesn't matter). The Command line will now ask for the known entity of the curve, Type "E" for External and press enter. The external distance is now requested, enter a number rounded from the measurement taken earlier in this step, in this case 140' and press enter. A curve is created and its data is displayed in the Command line.

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Begin . . . . . North: 501261.6283'          East: 699858.8367'
Radial Point. . North: 500716.7049'         East: 699381.2128'
End . . . . . North: 501374.0149'          East: 699076.2381'
PI . . . . . North: 501572.5394'           East: 699504.1166'
  Tangent: 471.69'          Chord: 790.63'          Course: N81° 49' 40"W
Arc Length: 836.27'        Radius: 724.61'          Delta: 66°07'28"
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Zoom in on the curve to ensure it follows the points and spot check to ensure it is within the tolerances.



If not within tolerance, you can try different curves by using the information obtained by the first curve creation and trying a different tangent length or radius/degree of curve (in this example the degree of the created curve is  $7.9^\circ$ , which could be rounded to  $8^\circ$ , although it probably wouldn't make much difference. Curves and Tangents can also be edited after a Civil3D alignment is created.

- 7) Continue along the project length for the remaining tangents and curves.

## Ending Notes and Suggestions:

- 1) It should not be considered abnormal to have some sporadic points to be outside of tolerance, particularly on a very long tangent. Should a series of points be out of tolerance, then splitting the tangent needs to be explored, with either a PI or a large radius curve.
- 2) In areas where pavement widens, e.g. intersections, it can be difficult to determine the actual centerline points, hence it could be considered normal for points through an intersection not to fall within tolerances.
- 3) Please note that in the process that I have outlined for creating the curves:
  - a. The best fit produces a line, not a polyline.
  - b. The curve creation commands work only with lines not polylines, so do not convert lines to polylines until you are ready to make a Civil3D alignment, which only works with polylines.
- 4) In general, not specifically related to this exercise, when creating Civil3D alignments from existing line work (polyline), I have found the following differences in the editing process:
  - a. When created from a polyline with the curves already placed, the editing of the alignment is mostly done through the Alignment Geometry Editor Panorama, which I consider “not very user friendly” and grip editing is limited.
  - b. When created by just the tangents, then curves created with the Geometry Editor Toolbar, the PI’s and other entities can be grip edited more freely.
- 5) Don’t get caught up in looking for the perfect fit, there are too many variables involved. Set your own personal tolerances, and be prepared to do some trial and error.