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Typography

We will be using the following typography to distinguish items in the text:

[Enter] Brackets indicate keys on the keyboard.

* flexibility * Italics are used to highlight words for more emphasis.

Lot 2 Numbers or text that you enter.

System Requirements
This version of TPC Desktop requires Windows 10 / 8.1 / 8 or later. We recommend you have 2 GB of RAM (32-bit OS) 4 GB RAM (64-bit OS) and 60 MB of free hard disk space in which to install the program. **An internet connection is required for program validation.**

**Important Licensing Information**

Our License Agreement allows you to use TPC on only one computer at a time unless you purchase additional licenses. We do offer one courtesy installation for an additional home or field computer, *but not for a second user* and assuming that the two programs are not being used at the same time. To request a courtesy license contact Traverse PC.
This chapter demonstrates:

- Entering Horizontal Curves in the Traverse View
- Entering a Horizontal Curve with Chord Bearing and Distance
- Horizontal Curve Dialog Box
- Non-Tangent Curves
- Entering Horizontal Curves using PIs
- Estimating the Radius
- Entering Horizontal Curves using Radius Points
- Creating Cul-de-Sacs

Overview

TPC gives you numerous ways to enter Horizontal Curves. They can be entered directly in the Traverse View or you can use the Horizontal Curve dialog box. You can enter curves using Radius Points or PIs. However you want to do it, TPC can help.

Getting started

1) From the Tasks Manager choose Sample Surveys.
2) Double-click the LEARN CURVES.TRV file.
3) Choose File | Save Survey As then enter the name Curves and choose Save.
4) If prompted to replace the existing file, choose Yes.
**Entering Horizontal Curves in the Traverse View**

Traverse PC allows you to format the Traverse View with any fields you choose to display. We will start out in the **Curves** traverse. It is already set up using the Deed with Curves format.

1) Double-click the **Curves** traverse in the Traverses Manager. TPC opens its Traverse View.

2) From its Traverse View, choose **Tools** | **Draw This Traverse Only**. The Drawing View will display just this traverse. This command is a toggle you can turn On / Off.

The road centerline has already been defined through point 13. You can see the curve data for the two existing curves; from point 9 to 10 and point 12 to 13.

We will continue to enter the centerline of this road using several methods to create the curves.

3) Press the down arrow cursor key on your keyboard until Traverse PC inserts point 24 after point 13.

4) Click in the **Radius** field and enter 450.

5) Enter 200 in the **Arc Length** Field.

Because we entered a positive number in the **Radius** field, TPC creates a clockwise or right-hand curve. TPC also assumed that the curve would be tangent to the previous curve. A glance at the Drawing View confirms this. The Traverse View displays the inverse data between points 13 and 24.

6) Press the Enter key on your keyboard multiple times until Traverse PC inserts point 25 after point 24. Your cursor should be in the **Bearing** field of point 25.

7) Press the Space Bar in the **Bearing** field and hit the Enter key on your keyboard. TPC recalls the outgoing tangent bearing from the curve 13 to 24.

8) Enter 200 in the **Horiz Dist** field and TPC creates point 25 tangent to the previous curve, 200 feet away, and adds point 26 to the traverse.
Entering a Horizontal Curve with Chord Bearing and Distance

Now let’s work with a curve where we know the Chord Bearing and Distance as well as the Radius.

1) Enter the Chord Bearing 117.4352 (N17°43’52"E) in the Bearing field of point 26.
2) Enter the Chord Distance of 244.719 in the Horiz Dist field of point 26.
   Traverse PC creates point 26 at the bearing and distance specified and adds point 27 to the traverse.
3) Click in the Radius field of point 26 and enter -350.
   TPC makes point 25 a PC, point 26 a PT and creates the counter-clockwise (left) curve with a radius of 350 feet between points 25 and 26.

   Note that because we entered the chord bearing, this curve could be tangent or non-tangent. In this case, it is a tangent curve.

This is a good time to save your file before we move on to using the Horizontal Curve dialog box.
Horizontal Curve Dialog Box

Your cursor should still be in the Arc Length field of point 26. If it is not, click anywhere on point 26 to select it.

1) Choose COGO | Horizontal Curve.

The Horizontal Curve dialog box displays all of the curve data for the curve that point 26 is the PT of. If point 26 were also the PC of the next curve, the dialog would still display the curve information of the curve from 25 to 26. The Horizontal Curve dialog is used to enter curve data on the PT of a curve or to view the curve data at the PT of a curve.

Notice that the PC, PC -> PT, PT, Radius and Chord Length buttons are a different color (light blue in this example). This means that these fields are locked because they contain the raw data that created the curve. If you wanted to change any of the information in this dialog box that would affect any of these fields, you would need to unlock them (click the button) first.

2) Choose Cancel.

3) Press the down arrow cursor key on your keyboard so that point 27 is selected.

4) Choose COGO | Horizontal Curve.

Notice that the PC -> PI and the PC buttons are depressed or locked. The PC -> PI is displaying the outgoing tangent bearing of the previous curve. TPC is once again assuming that this will be a tangent curve. We can now enter or edit anything we choose to define our new curve.

5) Enter 500 in the Radius and 250 in the Chord Length.

Notice that the Radius and Chord Lengths are locked after you enter them.

6) Choose OK.

TPC has created the new curve as we have defined it.
Horizontal Curves

Non-Tangent Curves

As you have seen, tangent curves happen automatically in Traverse PC. Let’s take a look at some non-tangent curves.

1) Press the down arrow cursor key on your keyboard until point 28 is inserted in the traverse and is selected.

2) Click on the **Bearing** field of point 28 and enter **463.4656 (N63°46'56"W)**.

Note that if we had pressed the space bar and the enter key, TPC would have recalled the outgoing tangent bearing from the previous curve. Because we entered a different bearing, this will be a non-tangent curve.

3) Enter **200** in the **Horiz Dist** field.

4) Click in the **Radius** field for point 28 and enter **250**.

You have just entered a non-tangent curve. We simply had to tell TPC what direction we wanted the curve to go. Now, let’s edit this curve using the Horizontal Curve dialog box.

5) Choose **COGO | Horizontal Curve**.

6) Click on the **PC -> PT** and the **PT** buttons to release them.

7) Highlight the **PC -> PT** bearing and enter **175 (N75°00'00"E)**.

8) Choose **OK**.

Your curve has now swung around toward the east and is still non-tangent. We could have changed the **PC -> PI** bearing in the Horizontal Curve dialog or edited the **Bearing** in the Traverse View to accomplish the same thing. Once again, there are several different ways you can achieve the results you are after. Use the tool that makes sense to you.

9) Close the Traverse View.
Entering Horizontal Curves Using PIs

TPC can float curves and spirals at PIs (horizontal Points of Intersection). The PC and PT of the PI curve get inserted and updated automatically based on the tangent bearings in and out of the PI (the Delta) and any additional curve information you enter, like a radius or arc length.

1) Double-click the Tangents traverse in the Traverses Manager.
2) In the Traverse View, choose View | Single Row per Point then choose Tools | Draw This Traverse Only.
3) Choose Edit | Traverse Drawing Settings.
   a) On the Control Points tab,
      i) Turn off Distance and Direction in the Lines section.
      ii) Set Symbols to Tick and the size to 0.10.
      iii) Change the Color to Red.
   b) On the Side Shots tab,
      i) Click the None buttons to the right of Line and to the right of Distance and Direction in the Lines section.
   c) Choose OK to return to the Traverse View.
4) Select the Point Label of point 202 and choose Edit | Point Type | PI=Point of Intersection.
5) Click in the Radius field of point 202 and enter 100.

Close the Traverse View. If prompted to save the temporary drawing, choose No.
Fitting a Horizontal Curve

TPC can fit a curve to consecutive points in a traverse, assuming that the first point selected is the PC of the resulting curve and the last point selected is the PT.

1) Double-click the Tangents traverse in the Traverses Manager.

2) In the Traverse View, choose View | Single Row per Point then choose Tools | Draw This Traverse Only.

3) In the Drawing View, look at the line segments between points 101 and 105. These look like they are on a curve between points 101 as the PC and 105 as the PT of the curve.

With the curve fitting routines, it is important to select appropriate PCs and PTs. However, you can easily repeat these steps with different points selected and compare the computed best fit radii to help you select your final PC and PT points.

4) Click on point 101 and Shift + click on point 105.

5) Choose COGO | Fit Horizontal Curve.

6) With Least Squares selected in the Options section, choose Compute. The dialog tells us that the Radius is 161.11.

7) Change this to 160.0 since that was more likely design radius and choose Apply Radius.

TPC inserts a curve between the PC and PT points, making the rest of the points PC (Points on Curve).

Refining the Radius Estimate

1) In the Traverse View, select points 101 to 105 and left-click the refresh button to the right of the What list.

2) Choose Compute and the Least Squares Radius changes to 169.07. So, if you think point 102 might be the correct PC of the desired curve, then a radius of 170.0 would be more appropriate than the 160.0 previously applied.

When you select items in a dockable view, the What list updates automatically to indicate what you have selected. When you work in the Traverse View, you may need to manually refresh the list. Either way, you can experiment with different data for your radius estimate. In this example, where there is not a clear indication of where the curve actually begins and ends, selecting different First and Last points can give a pretty good idea of what the acceptable range of radii might be.
**Entering Horizontal Curves using Radius Points**

There are times when you will have a legal description or drawing that provides the bearing and distance from the PC to the radius point and the bearing from the radius point to the PT of the curve. You could bring up the Horizontal Curve dialog box and enter the data there, or you can enter the data directly in the Traverse View. This is the quickest and easiest way to enter these curves. These curves may be tangent or non-tangent curves.

1) Double-click the **Radius Points** traverse in the Traverses Manager.
2) In its Traverse View, choose **Tools | Draw This Traverse Only**.

Because this **Traverse View** is not formatted for PC to PR and PR to PT bearings, we will need to modify its format.

3) Choose **View | Format View** and left-click the **Format** tab.
4) Insert “**cr**” in the **Display Sequence** so it reads “**BHRCrYXD**” and choose **OK**.
5) Note that the “**cr**” is lower-case.
6) Back at the **Traverse View**, press the down arrow key on your keyboard until TPC inserts point 29 after point 23.
7) Click in the **Radius** field of point 29 and enter **450**.
8) Press the Enter key until the **PC -> PR** field is active and enter **277.1615 (S 77° 16’ 15” E)**.
9) In the **PR -> PT** field enter **451.4822 (N 51° 48’ 22” W)**.

You have just entered a horizontal curve using the radius point. Let’s move on to another one.

10) Press the down arrow key on your keyboard and TPC adds point 30 to the traverse.
11) Click in the **Bearing** field of point 30, press your space bar and then the Enter key. TPC recalls the outgoing tangent of the previous curve, **N 38° 11’ 38” E**.
12) Enter **200** in the **Horiz Dist** field and TPC adds point 31 to the traverse.
Horizontal Curves

13) Click in the **Radius** field of point 31 and enter **-350**.
14) Press the Enter key until the **PC -> PR** field is active and enter **451.4822 (N 51° 48' 22" W)**.
15) In the **PR -> PT** field enter **187.1606 (N 87° 16' 06" E)**.

Using radius points, we have just entered the same two curves we first entered in the **Curves** traverse earlier. As you can see, there are many ways to do what you need to do in Traverse PC.

Note: In this example, the dockable views have been Auto Hidden on the left edge of the desktop to make more room to work with both the traverse and the drawing in the desktop.
Creating Cul-de-Sacs

It is easier to create a cul-de-sac than you might expect.

1) Double-click the Cul-de-Sac traverse in the Traverses Manager.

2) From its Traverse View, choose Tools | Draw This Traverse Only.

3) Click on point 18 to select it.

4) Choose COGO | Horizontal Curve.

5) Enter 60 in the Radius field, choose Counter Clockwise in Direction, turn on Delta > than 180 Degrees and choose OK.

In a normal horizontal curve, Traverse PC is expecting the delta angle to be 180 degrees or less. By turning on the Delta > than 180 Degrees toggle in the Horizontal Curve dialog box, you tell TPC to create a larger delta angle curve.

Once again, we could have entered the curve data in the Traverse View but we would have had to go to the Horizontal Curve dialog to turn on the Delta > than 180 Degrees option.
This chapter demonstrates:
- Profile mode
- Working with stations
- Profile settings
- Adding a grid
- Extending the grid

Overview

Drawing View and its drawings are just as comfortable working in Profile View as they are in Plan View.

Most of what you learned in the Using the Drawing View and Managing Drawings chapters in the Drawing Learning Guide applies to profiles as well as plan views. You may want to review these chapters before continuing.

Professional Edition

This feature is only in the Professional Edition of TPC Desktop.

To learn more about this topic
1. Choose Help | Search For Help On… and left-click the Index tab.
2. Scroll down to Profiles, highlight it and choose Display.
3. Choose Profiles then choose Display.

Getting Started
1. From the Tasks Manager choose Sample Surveys.
2. Double-click the LEARN PROFILE.TRV file.
3. Choose File | Save Survey As then enter the name Profile and choose Save.
4. If prompted to replace the existing file, choose Yes.
Profile Mode

1. Left-click the Drawing View to make it active. The Drawing View is currently in Plan mode. You see the P-Line and the cross sections at each P-Line station. Plan mode looks at the survey from above.

2. Choose View | Profile Mode.

3. Choose View | Zoom | Zoom Extents. You should see the Profile View of the P-Line traverse. The Profile View looks at the survey from the side.

4. To switch back to Plan View, choose View | Profile Mode again to turn off the check mark and return to Plan View. You will also need to do Zoom Extents.

►Note: Your Plan and Profile Views may look different than those shown based on your program settings. Choose Tools | Drawing Settings to change how it is displayed.

Why Zoom Extents

When you switch between Plan View and Profile View you need to execute the Zoom Extents command because the values used to compute the drawing extents change. In Plan View, the northing and easting values determine the drawing extents. In Profile View, the stationing and elevations determine the extents.

Working with Stations

If you have not yet worked with stationing in any of the traverses, your traverses will all start with the default station 0+00. This will determine the left-most station value in the profile. If you have specified a starting station other than 0+00, that station will be the left most station in the profile. Remember, the profiles plot stationing on the X-axis and elevation on the Y-axis.

To turn on stationing in a traverse

1. Double-click the traverse name in Traverses Manager to open the Traverse View.
2. If your Traverse View does not include the Station column,
   a. Choose View | Format View.
   b. Include the letter N in the Display Sequence and choose OK. The Traverse View will now display the current stationing of each control point in the traverse. These are the station values used in the profile.
Profiles

Profile Settings

Profile Settings are very similar to the Plan View settings you reviewed in the *Using the Drawing View* chapter of the *Drawing Learning Guide*.

1. You need to be in Profile Mode for this next step. Pull down the *View* menu in the Drawing View and make sure *Profile Mode* is checked.

2. Choose Tools | Drawing Settings to display these dialogs.

![Profile Settings Dialog]

Vertical Ratio

The *Vertical Ratio* allows you to exaggerate the vertical scale. Profiles typically use a vertical ratio of 10.

Draw Vertical Curves

Toggle this option on, to draw and label any vertical curves included in the profile.

Drawing Settings vs. Traverse Settings

As with Plan View, you can control all the profiles using the Drawing Settings or turn off *Override Traverse Profiles Settings* on the Drawing Settings – Profile Miscellaneous tab and let each traverse draw its own profile. The *Using the Drawing View* chapter contains a complete discussion of Drawing Settings vs. Traverse Settings.

3. Choose OK to close the dialog.
Adding a Grid

If you plan on using the profile for analysis or measurements, you will probably want to include a grid.

1. Choose Insert | Grid to display the Grid dialog.
2. Select the options shown here then choose OK. The Drawing View draws the grid with your grid settings.

Spend some time with the Grid dialog options. You’ll find options to draw and label the grid just the way you want.

Extending the Grid

By default, the Drawing View draws the grid to the extents of the profile. If you want to work beyond the profile, you can extend the grid.

1. Position the cursor over any grid line until the status bar displays Grid.
2. Right-click and choose Properties.
3. Change the Right value to 200.
4. Change the Top value to 10.
5. Choose OK.

▶ Note: If you want to extend the grid on the Left or at the Bottom, you must use negative numbers. Positive numbers in the Left or Bottom fields will move the grid up or right.

▶ Hints

You may need to re-scale and re-position the drawing on the page to see the extended grid.
Profiles

**Testing Your Skills**

In this task, you’ll test your skill at profiles.

1. Open the `SKILL6.TRV` file in the Samples folder and save it as `TEST15.TRV`.
2. Change the Drawing View to Profile Mode. Remember to Zoom Extents to re-center the drawing based on the profile stationing.
3. Use the drawing settings to set the vertical ratio to 10, include station labels, grades and point numbers.
4. Add a grid with 100' horizontal spacing and 5' vertical spacing.
5. Modify the grid to include labels on the top and right sides of the grid.
6. Choose a scale of 150'/in and center the profile on the page.
7. Print the drawing.
This chapter demonstrates:
- How TPC integrates vertical curve data with alignments
- Working with a copy of the alignment traverse
- Inserting vertical curves automatically
- Inserting vertical curves manually
- Computing the vertical alignment
- Drawing vertical curves

Overview

Vertical curves control the transition from one grade to another. They generally improve the drivability of a road and in some cases improve sight distances.

In TPC, you use the Vertical Curve View to enter, edit and display vertical curve data. Each traverse can have one and only one Vertical Curve View.

Professional Edition

This feature is only in the Professional Edition of TPC Desktop.

To learn more about this topic
1. Choose Help | Search For Help On… and left-click the Index tab.
2. Scroll down to Vertical curves, highlight it and choose Display.
3. Choose Vertical Curves then choose Display.

Getting Started
1. From the Tasks Manager choose Sample Surveys.
2. Double-click the LEARN VERTICAL CURVES.TRV file.
3. Choose File | Save Survey As then enter the name Vertical Curves and choose Save. If prompted to replace the existing file, choose Yes.
Vertical Curves

**How TPC Integrates Vertical Curve Data with Alignments**

In TPC, Vertical Curve data is stored with the traverses. Each traverse has a Vertical Curve View, just like each traverse has a Closure View.

▶ **The Vertical Curve View**
- Displays the current vertical curve data for the traverse.
- Lets you add/delete/edit individual vertical curves.
- Generates vertical curves from the profile.
- Recomputes the vertical alignment of the traverse based on the vertical curve data.

▶ **Recomputing a traverse**

When you choose **Tools | Recompute** from the Traverse View, TPC first computes the alignment using the data stored in the Traverse View. Next, it recomputes the vertical alignment of the traverse using the data stored in the Vertical Curve View.

When you compute vertical alignment from the Vertical Curve View (choose **Tools | Compute Vertical Alignment**), you are only computing the vertical alignment of the traverse.

▶ **BC and EC point types**

When a vertical curve is inserted into a traverse, it creates a BC (Beginning of Curve) and EC (End of Curve) and inserts them into the traverse based on their stationing.

If the vertical alignment is recomputed after the vertical curve data has been edited, you may end up with extra BC and EC points in the traverse. You will need to delete these manually.
**Working With a Copy of the Alignment Traverse**

If your original alignment traverse contains raw data, and you tell TPC to insert the BC and EC of the vertical curves into the traverse, you have in essence changed the alignment data. The next time you recompute the alignment, it will use the inserted BC and EC points in the computation and the alignment will change.

To avoid recomputing the alignment incorrectly, you will want to work with a copy of the alignment that does not contain any raw data. We will use the Insert Other tool to create a copy of the traverse.

1. From the Traverses Manager, right-click the P-LINE SPUR traverse and choose Copy Traverse (shares points). TPC appends a traverse named Copy-P-LINE SPUR to the survey.
2. Double-click the new traverse to display the New Traverse dialog.
3. Change the Name to PLine Alignment, choose Alignment for the Format and Alignments for the Settings.
4. Select Create temporary drawing and choose OK.

TPC will display the Traverse View and temporary drawing for this traverse.
Inserting Vertical Curves Automatically

TPC can insert vertical curves automatically, based on the existing grade breaks in the traverse. Once the vertical curves have been inserted, you can edit them as needed to get the vertical alignment you want.

1. From the Traverse View, choose **Tools** | **Vertical Curve View** to display the Vertical Curve View for this traverse.

2. From the Vertical Curve View, choose **Tools** | **Update Vertical PIs** to display the **Default Curve Lengths** dialog. In the example shown here, a **Grade Change** of 5% to 7.99% creates a vertical curve with a **Length** of 50 units (50 feet in this example).

3. Enter the default values as shown here, and choose **OK**.

TPC evaluates each grade break in the traverse and inserts the appropriate vertical curve into the Vertical Curve View as shown here.

► Choosing the best alignment

If we look closely at the BC and EC stations of the Vertical PIs generated for this example, we see a number of curves that overlap. We would not want to compute the vertical alignment of the traverse based on this vertical curve configuration.

As a rule, it’s a good idea to let TPC generate the initial vertical curve configuration. From there, it is up to you to create the best alignment - and the Vertical Curve View makes it easy to do just that.
Inserting Vertical Curves Manually

In addition to having TPC generate the vertical curves automatically, you can enter vertical curves manually. This allows you to use the vertical curve data given in a set of construction drawings for example.

► Deleting the existing vertical curves

First, let’s get rid of the automatic vertical curves from the previous task.

1. Choose Edit | Select All. TPC highlights all the curves in the view.
2. Choose Edit | Delete VPI. When prompted to Delete selected vertical curves?, choose Yes. TPC deletes the existing VPIs and adds a new 0+00 station.

► Entering a vertical curve

1. In the Vertical Curve View, highlight the first Vertical PI displayed as 0+00.
2. Enter the station 8+20 of the vertical curve in the Vertical PI column. TPC repositions the vertical curve you are entering in the Vertical Curve View based on its stationing.
3. Enter the PI Elevation, Length In and Length Out, Grade In and Grade Out shown here. TPC computes the BC and EC information and advances to the next vertical curve.
4. Since we won't be using the second curve, highlight it and choose Edit | Delete VPI. When prompted to Delete selected vertical curves? choose Yes.

Computing the Vertical Alignment

1. From the Vertical Curve View, choose Tools | Compute Vertical Alignment.
2. Turn on Insert BC/EC to insert the BC and EC points into the traverse.
3. Turn off Update Tangents Between Curves.
4. Choose All Curves for Compute What.
5. Choose OK.

TPC will re-compute the vertical position of each point in the traverse based on the vertical curve data. The options in the Compute Vertical Curves dialog control how TPC computes the vertical alignment of the traverse. These are important options.

To learn more about them, press F1 from this dialog.
**Vertical Curves**

**Drawing Vertical Curves**

You will need to tell TPC to draw the vertical curves you just computed.

1. Close the Vertical Curve View and return to the Traverse View.
2. Left-click the Drawing View to activate it. Make sure View | Profile Mode is checked.
3. Right-click any traverse line in the drawing, choose Traverse Settings and match the settings shown here.
4. Choose Tools | Drawing Settings. Make sure Draw Vertical Curves is checked and choose OK.
5. Choose View | Zoom | Zoom Extents.

TPC labels the BC and EC stations because they are now traverse points. It also labels the PI of the vertical curve, even though it is not an existing traverse point.

The Drawing View also approximates the vertical curve with a series of short line segments that roughly match the parabolic shape of the vertical curve.

The profile settings include lots of options for labeling the stations, grades, grid and curves.

▶ Note: You are working in a temporary drawing so you can see the profile view of this traverse. Most of the time you share the current drawing as you work with a traverse but this a good example of when a temporary drawing is useful.
Testing Your Skills

In this task, you'll test your skill at vertical curves.

1. Open the `SKILL6.TRV` file in the Samples folder, save it as `TEST16.TRV` and make a copy of the Centerline 9th Street traverse. You’ll do the computations on this copy.
2. Change the Drawing View to Profile Mode and do Zoom Extents to re-center the drawing based on the profile stationing. Use the drawing settings to include station labels, grades and point numbers.
3. Choose a scale of 150'/in and center the profile on the page.
4. Add a grid with 5' vertical spacing.
5. Create the vertical curves for this alignment using the grade break settings shown in the *Inserting Vertical Curves Automatically* task in this chapter.
6. Compute the vertical alignment of this traverse.
7. Print the drawing.