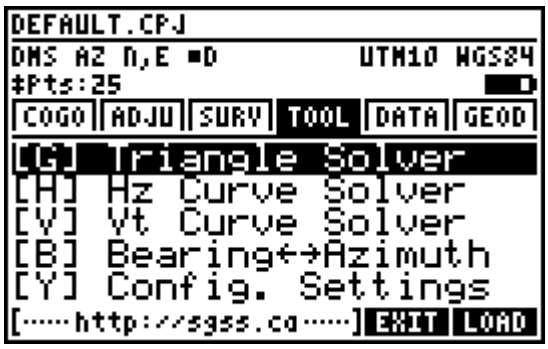
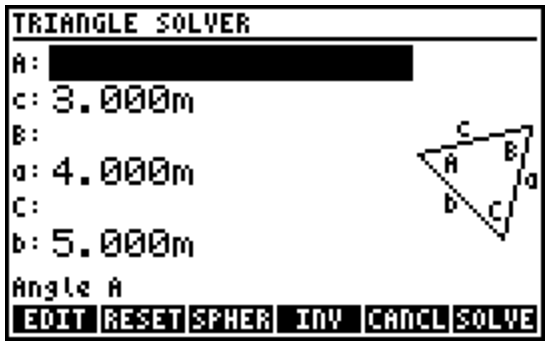
8 Tools Menu



8.1 Triangle Solver

The triangle solver accepts three known values (at least one of which must be a side) and solves for the remaining values, as well as the triangle area and perimeter.



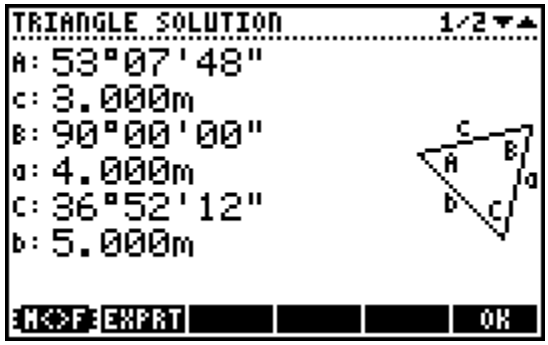
For side value inputs, any of the standard distances input options are accepted to allow the user to inverse points in the current job database to calculate distances for triangle sides, as well as any of the other operations.

The F3 **SPHER** softkey accesses the Spherical Triangle Solver.

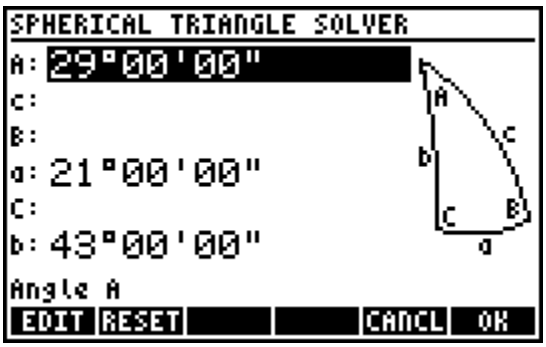
For angle value inputs, the F4 **INV** softkey allows the user to inverse an angle as defined by three points in the job database.

The output screen displays the solved values. The menu:

1. F1 **M<>F** toggles metric/imperial.
2. F1 **EXPRT** exports the solution to the stack or writes them to an ASCII file.



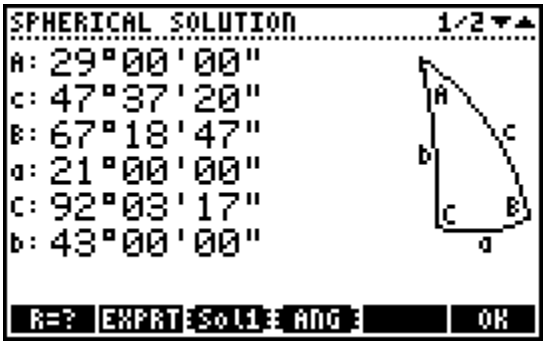
Spherical Triangle Solver



The spherical triangle solver accepts three known values to solve for the remaining values.

The radius value of the sphere is not a mandatory input, and therefore can be entered from the solutions screen.

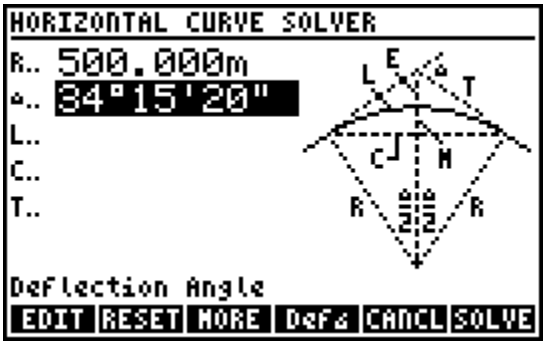
The menu on the solutions screen gives access to a few more options.



1. F1 **R=?** - Enter a radius value to facilitate the calculation of the surface area of the spherical triangle, and also to enable a toggle to show the "sides" of the spherical triangles as angular values or distance values computed from the radius of the sphere.
2. F2 **EXPRT** - Export the solution to the stack or write them to an ASCII file.
3. F3 **Sol1** or **Sol2** - When an ambiguous case is encountered, this softkey toggles between the two solutions.
4. F4 **ANG** or **DIST** - When a radius value has been entered, this softkey toggles the display of angles or distances for the "sides" of the spherical triangle.

8.2 Horizontal Curve Solver

The horizontal curve solver main interface solves simple circular curves and provides access to three additional solvers described below.

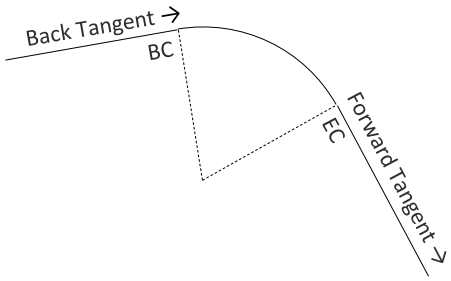


The solver requires two known curve elements and solves for the rest. Acceptable input combinations include:

- The radius and any of the other accepted inputs.
- The deflection angle and any of the other accepted inputs.
- The arc length and the chord length. NOTE: THIS TYPE OF SOLUTION INVOKES THE ITERATIVE NEWTON'S METHOD TO SOLVE FOR THE REMAINING VALUES. THE RESULT ACCURACY DEPENDS ON THE INPUT PRECISION.

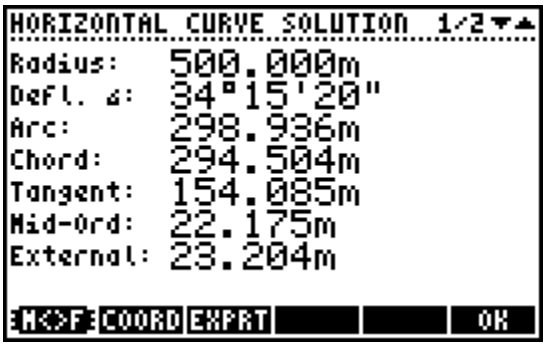
The F3 **MORE** softkey provides access to additional solvers as described on the following pages.

For the *Radius* field a softkey F4 **A/C** is available to solve for the radius using the arc definition or the chord definition. Enter the degree of curve to solve for the radius in a separate input form.



For the *Deflection Angle* field a softkey F4 **Def_** is available to calculate the deflection angle from the back and forward tangents and the curve direction.

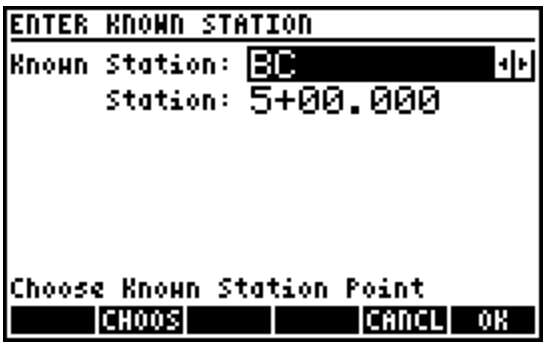
The solution is displayed on two pages. The first page lists all the elements of the circular curve, while the second page displays the sector, segment and fillet areas. The menu on the solution screens:



1. F1 **M<>F** toggles metric/imperial.
2. F2 **COORD** solves the coordinates for any station and offset on the curve.
3. F3 **EXPRT** exports the results to the stack, the calculator clipboard or to an ASCII file.

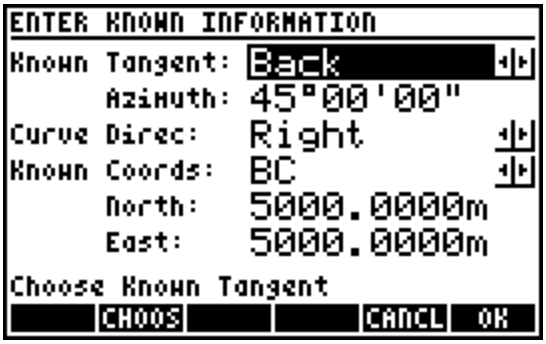
Solve COORDinates

By providing some defining parameters for the curve stationing and coordinates, it is possible to solve for the coordinates of any station and offset on the curve that was solved.

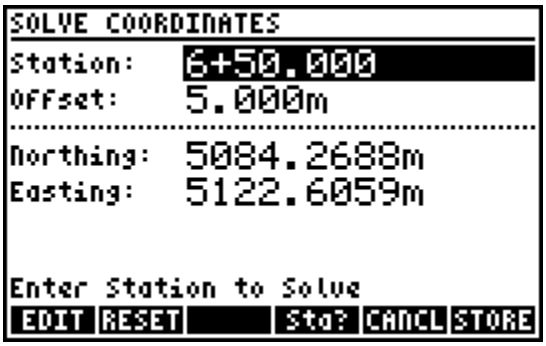


First, choose a known station, either the beginning of curve, point of intersection, or the end of curve, and then enter the station.

Next, choose the known tangent and enter the azimuth/bearing of the known tangent, choose the curve direction right/left, choose the station with known coordinates and enter the coordinates for the station. These parameters set up the required information to calculate any coordinates along the curve. NOTE: REFER TO THE DIAGRAM ON THE PREVIOUS PAGE FOR BACK/FORWARD TANGENT DIRECTION CONVENTION.



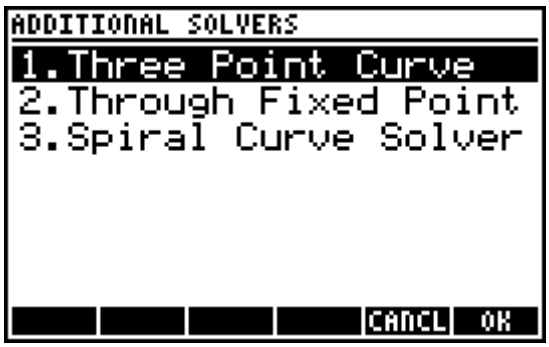
The solver input form accepts the station and offset to solve. The coordinates are displayed on the screen for the values entered.



Use F4 **Sta?** to choose the beginning of curve, point of intersection, end of curve, mid-point of curve or the radius point to solve. The station field is automatically updated to reflect the station that was chosen, and the label for the softkey displays which point was solved. The label changes back to **Sta?** as soon as changes are made to the input values.

Use F6 **STORE** to store the solved coordinates as a point in the current job database.

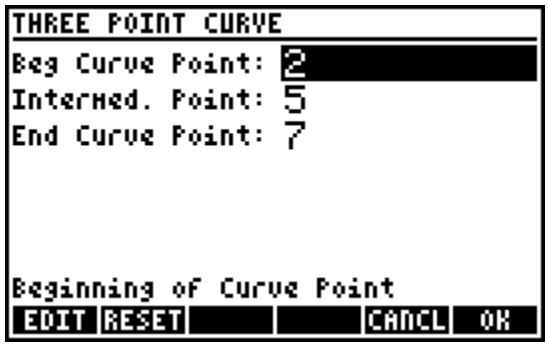
MORE Solvers



From the main horizontal curve solver screen select F3 **MORE** to run additional horizontal curve solvers. Available solvers include:

- Three Point Curve solver to solve a curve that passes through three points
- Through Fixed Point solver to solve a curve that passes through a fixed point, with known point of intersection coordinates and known tangent azimuths/bearings
- Spiral Curve Solver for solving spiral transition curves, including coordinates

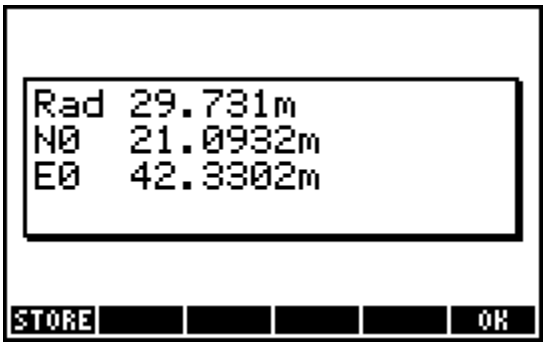
Three Point Curve Solver



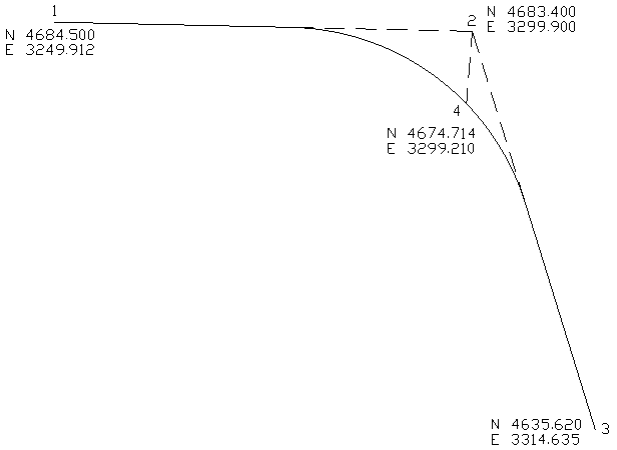
The Three Point Curve solver accepts three points that are stored in the current job database as input to solve for the radius and radius point coordinates of the circular curve that passes through the three points.

A solution is calculated when all three points are found in the current job and they are not in a straight line. The program displays the solution radius of the curve and the coordinates of the radius point.

Press F1 **STORE** to store the calculated coordinates as a point in the current job database.

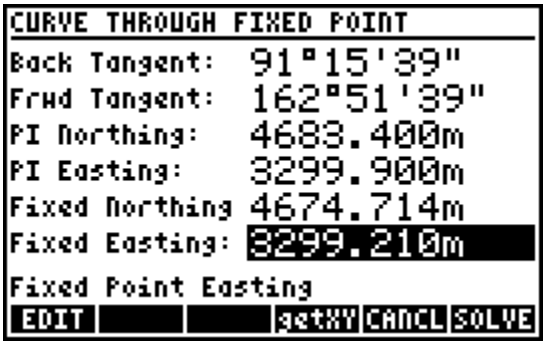


Curve through Fixed Point Solver

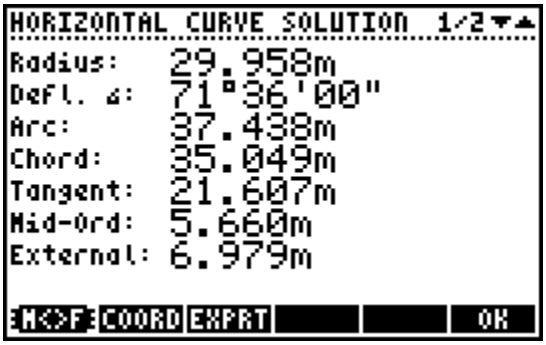


The Curve through Fixed Point solver solves a curve that is required to fit fixed tangents and a fixed point. In the diagram to the right, let's assume that the back tangent from Point 1 to Point 2 is a street curb line, and the forward tangent from Point 2 to Point 3 is also a street curb line. A curve is required so that the curb will pass through Point 4, which represents the back of a catch basin, for example.

In the input form enter the back and forward tangents using any of the standard directions input options, and enter the coordinates for the curve point of intersection (Point 2 in the diagram) and the coordinates for the fixed point (Point 4 in the diagram). For the coordinate entry fields use F4 **getXY** to retrieve the coordinates from a point stored in the current job database.



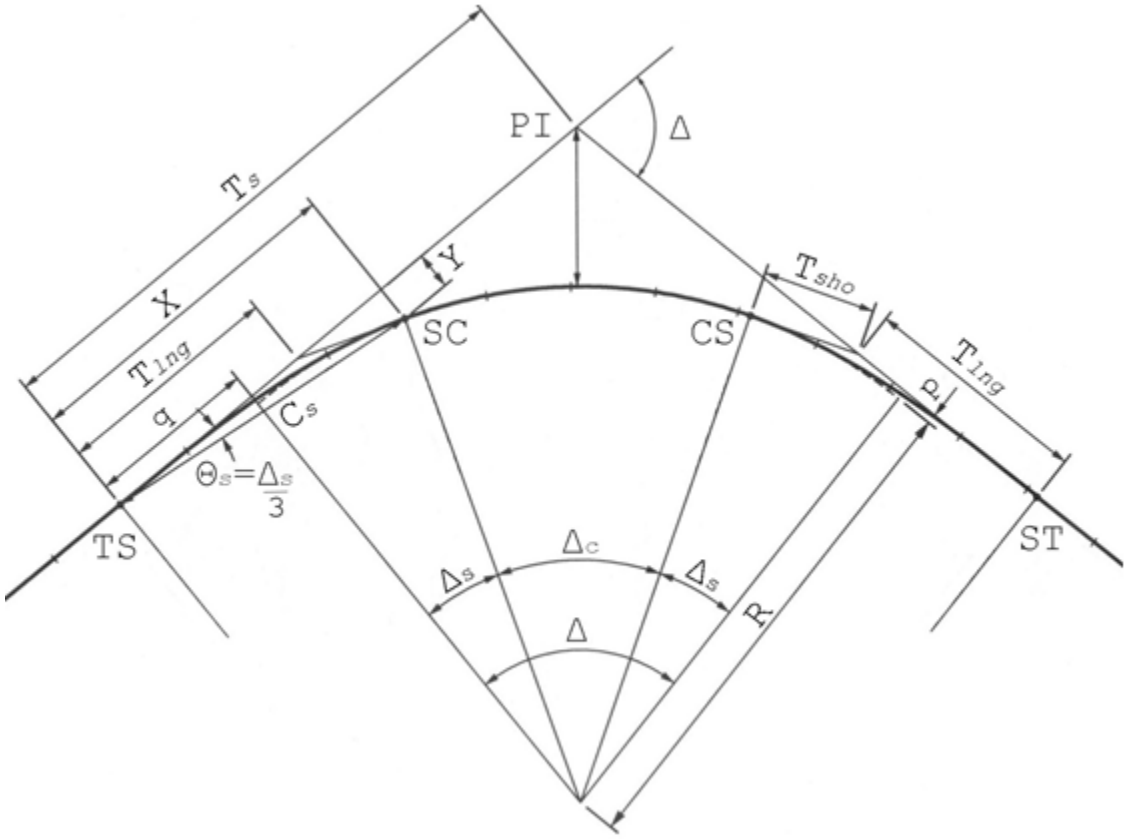
The curve solution is presented on two pages in the same manner as the standard horizontal curve solver. The first page lists all the elements of the circular curve, while the second page displays the sector, segment and fillet areas. The menu on the solution screens:



1. F1 **M<>F** toggles metric/imperial.
2. F2 **COORD** solves the coordinates for any station and offset on the curve.
3. F3 **EXPRT** exports the results to the stack, the calculator clipboard or to an ASCII file.

Spiral Curve Solver

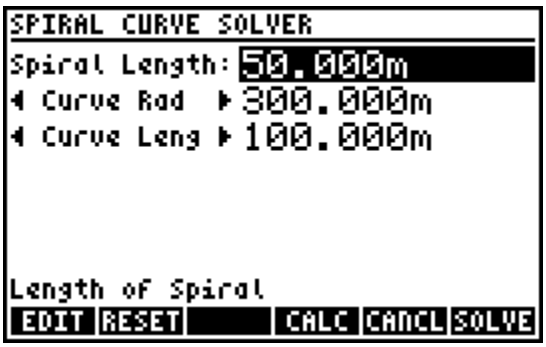
The Spiral Curve Solver solves spiral transition curves and is able to solve coordinates for any station and offset along the transition curve. The diagram below illustrates the spiral geometry and associated symbols.



Below is a table legend of the spiral parameter symbols.

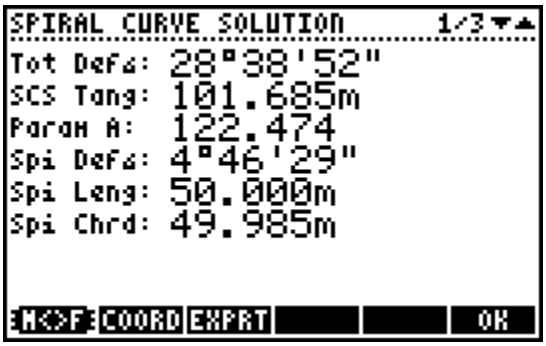
Ts	Tangent of Spiral-Curve-Spiral	**Cs**	Long Chord (Spiral)
X	Distance along Tangent from TS to Point at Right Angle to SC	**Cc**	Curve Chord (not labelled)
Y	Right Angle distance from Tangent to SC	**Δs**	Spiral Delta
Tlng	Long Tangent (Spiral)	**Δc**	Curve Delta
Tsho	Short Tangent (Spiral)	**Δ**	Total Delta
Ls	Length of Spiral (not labelled)	**A**	Spiral Parameter
q	Distance along Tangent to a Point at Right Angle to Ghost BC	**R**	Curve Radius
p	Distance from Tangent that the Curve (Ghost BC) has been Offset	**Lc**	Length of Curve (not labelled)
Tc	Tangent of Curve (not labelled)		

The first input form requires some known parameters to solve the transition curve. There are numerous combinations accepted within three input fields.



1. The first input field requires the *Spiral Length*. The solver works with equal spiral lengths in a spiral-curve-spiral transition curve. Use F4 **CALC** to calculate the spiral length from Parameter A and the Curve Radius.
2. The second input field accepts either the *Curve Radius (R)* or *Parameter A*. Use the ◀ and ▶ cursor keys to toggle the input type accepted for this field.
3. The third input field accepts either the *Curve Delta Angle (Δc)*, the *Curve Length (Lc)*, or the *Spiral Tangent (Ts)*. Use the ◀ and ▶ cursor keys to toggle the input type accepted for this field.

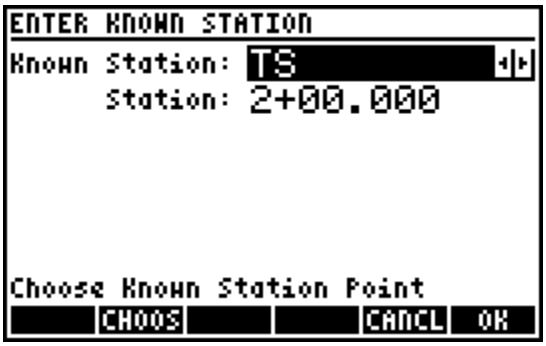
The solution is displayed on three pages. The first two pages report on the overall spiral-curve-spiral parameters and the spiral portion parameters, while the third page reports on the curve portion. The menu on the solution screens:



1. F1 **M<>F** toggles metric/imperial.
2. F2 **COORD** solves the coordinates for any station and offset on the transition curve.
3. F3 **EXPRT** exports the results to the stack, the calculator clipboard or to an ASCII file.

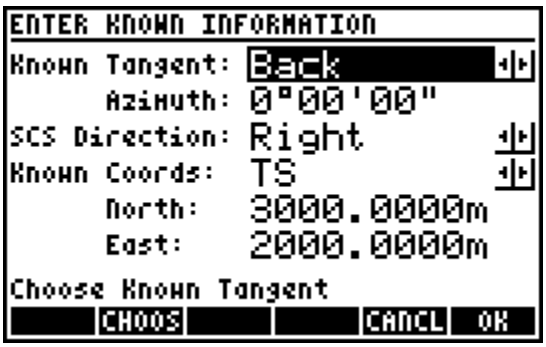
Solve COORDinates

By providing some defining parameters for the transition curve stationing and coordinates, it is possible to solve for the coordinates of any station and offset on the transition curve that was solved.



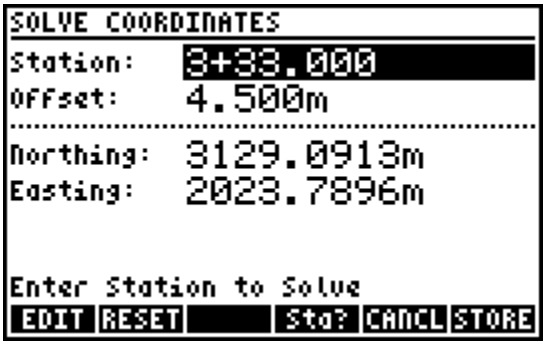
First, choose a known station, either the tangent-spiral (TS), spiral-curve (SC), point of intersection (PI), curve-spiral (CS), or spiral-tangent (ST), and then enter the station.

Next, choose the known tangent and enter the azimuth/bearing of the known tangent, choose the transition curve direction right/left, choose the station with known coordinates and enter the coordinates for the station. These parameters set up the required information to calculate any coordinates along the curve.



NOTE: REFER TO THE circular curve diagram FOR BACK/FORWARD TANGENT DIRECTION CONVENTION.

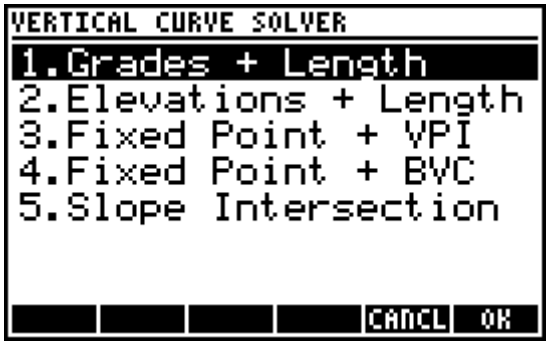
The solver input form accepts the station and offset to solve. The coordinates are displayed on the screen for the values entered.



Use F4 **Sta?** to choose the tangent-spiral (TS), spiral-curve (SC), point of intersection (PI), curve-spiral (CS), spiral-tangent (ST), mid-point of curve or the radius point to solve. The station field is automatically updated to reflect the station that was chosen, and the label for the softkey displays which point was solved. The label changes back to **Sta?** as soon as changes are made to the input values.

Use F6 **STORE** to store the solved coordinates as a point in the current job database.

8.3 Vertical Curve Solver

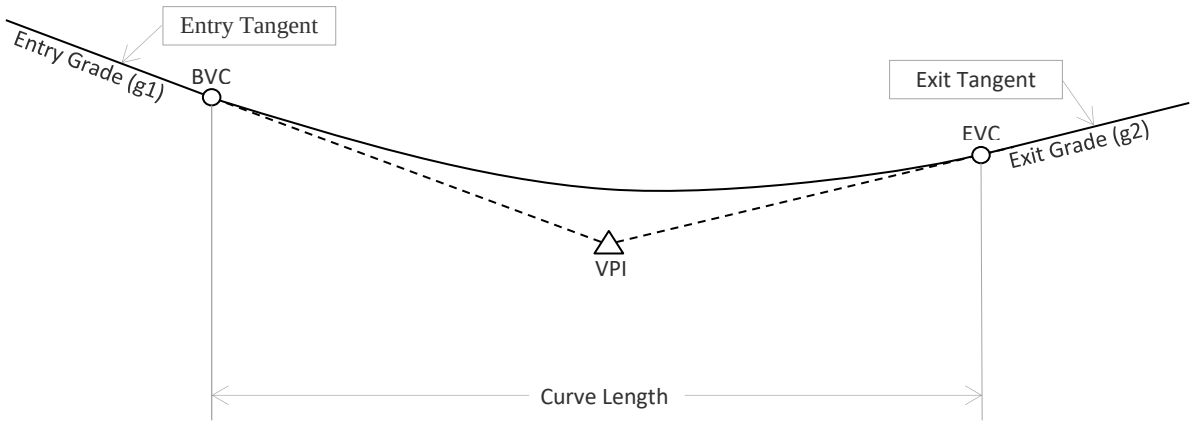


The Vertical Curve Solver solves vertical curves using various combinations of known parameters, including:

1. Grades + Length – Requires a known station at the BVC, VPI or EVC, the vertical curve length, entry and exit grades, and a known elevation at the BVC VPI, EVC or the High/Low point on the curve.
2. Elevations + Length – Requires a known station at the BVC, VPI or EVC, the vertical curve length, and elevations at the BVC, VPI and EVC.
3. Fixed Point + VPI – Requires the station and elevation at the VPI, a fixed point station and elevation, entry and exit grades.
4. Fixed Point + BVC – Requires the station and elevation at the BVC, a fixed point station and elevation, entry and exit grades.
5. Slope Intersection – Requires the vertical curve length, the entry grade, a station with a known elevation on the entry tangent, the exit grade, and a station with a known elevation on the exit tangent.

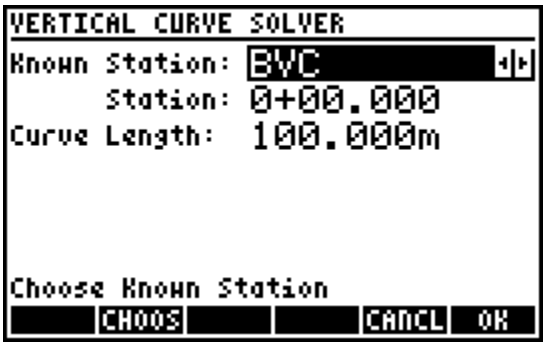
NOTE: BVC = BEGINNING OF VERTICAL CURVE, VPI = VERTICAL POINT OF INTERSECTION, AND EVC = END OF VERTICAL CURVE.

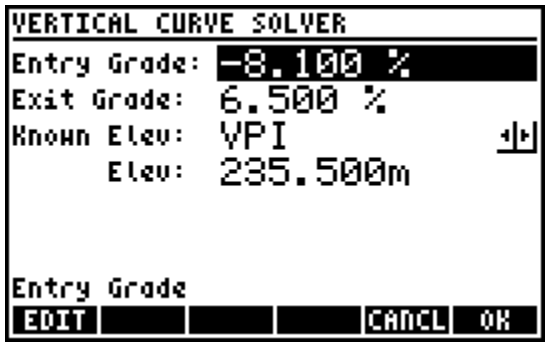
The diagram below illustrates the vertical curve geometry.



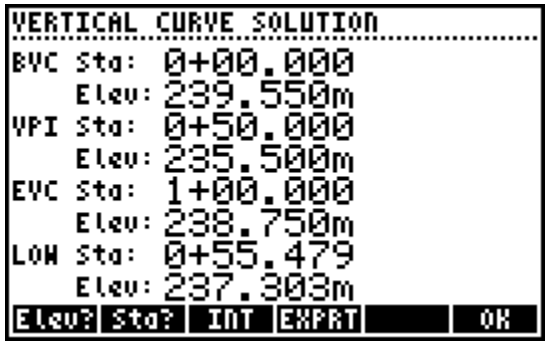
Grades + Length

Curve parameter input is taken in two input forms. In the first form choose a known station (BVC, VPI or EVC) then enter the station for this point, and enter the vertical curve length. The *Curve Length* field features a F4 **Sta?** softkey to calculate the curve length from a second known station. The calculation uses the current station information already entered in the first two fields.

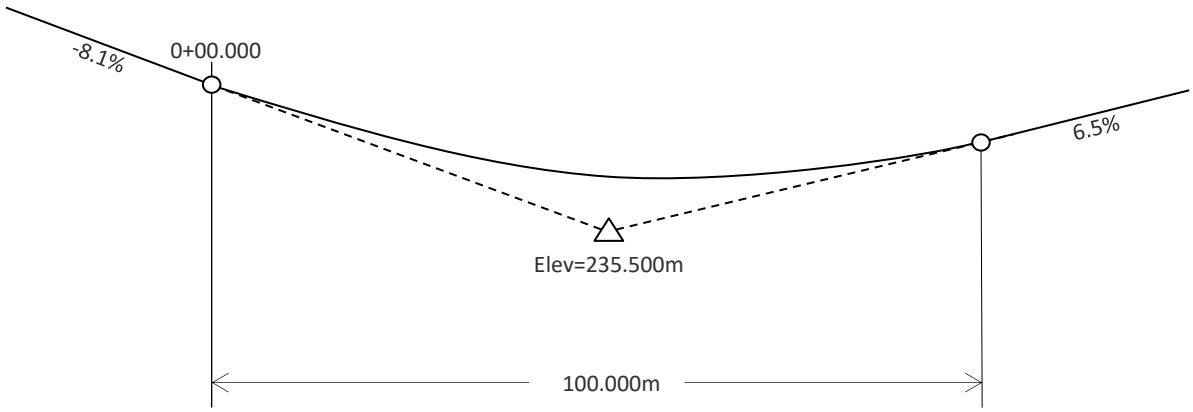




In the second input form enter the entry and exit grades, choose (or enter) a station for which the elevation is known and enter the elevation at the selected/entered station. When choosing a known station, the options are BVC, VPI, EVC or High/Low Point, but you may enter any known station also. The *Elevation* field features a F4 **getZ** softkey to retrieve the elevation from a point in the current job database.

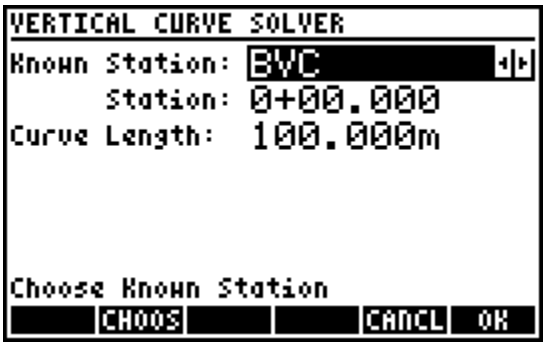


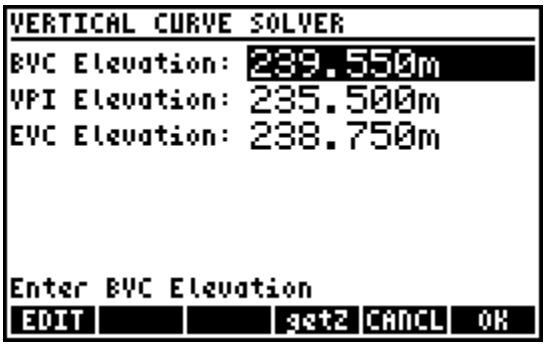
The solution displays the stations and elevations for each the BVC, VPI, EVC and High/Low Point. See the Solution Screen and Calculations section for more information.



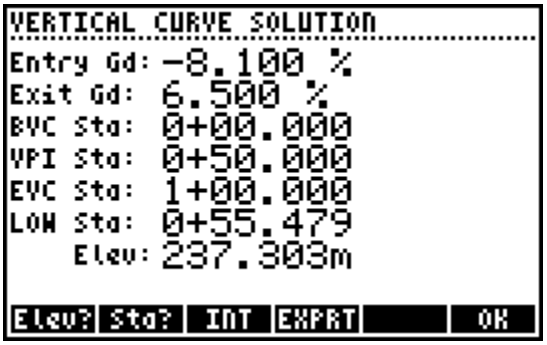
Elevations + Length

Curve parameter input is taken in two input forms. In the first form choose a known station (BVC, VPI or EVC) then enter the station for this point, and enter the vertical curve length. The *Curve Length* field features a F4 **Sta?** softkey to calculate the curve length from a second known station. The calculation uses the current station information already entered in the first two fields.

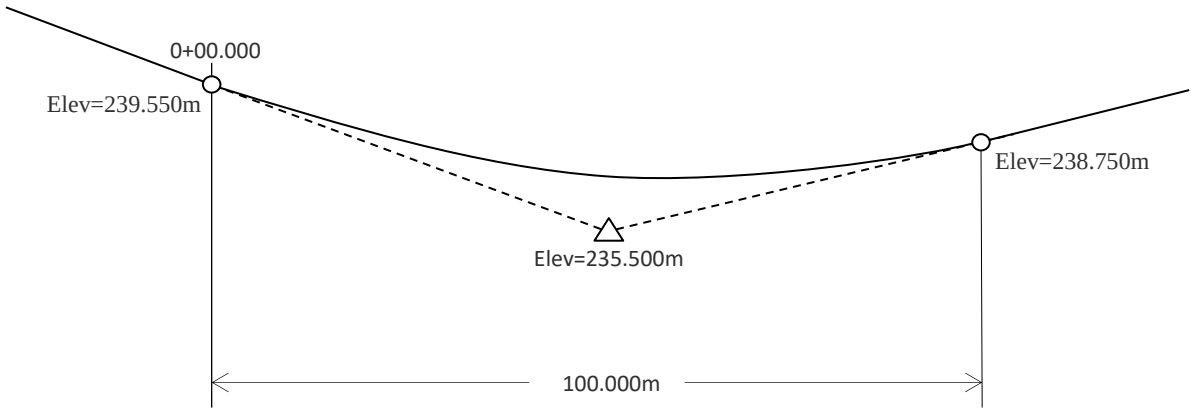




In the second input form enter the elevations for each the BVC, VPI and EVC. Use the F4 **getZ** softkey for each field to retrieve the elevation from a point in the current job database.

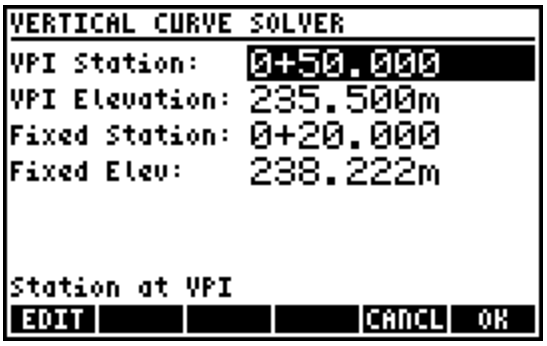


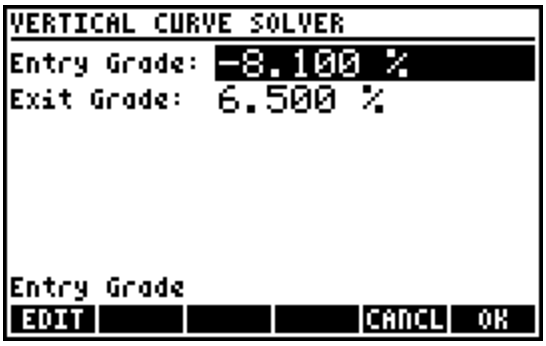
The solution displays the entry and exit grades, the stations for the BVC, VPI and EVC, and the High/Low Sation and elevation. See the Solution Screen and Calculations section for more information.



Fixed Point + VPI

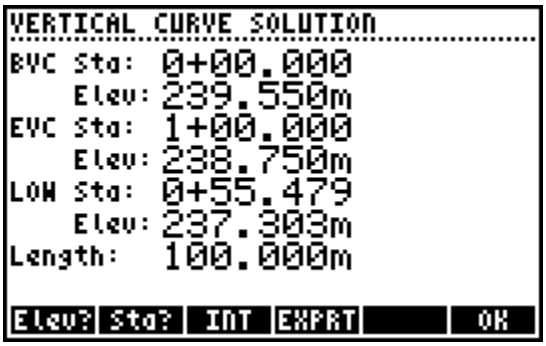
Curve parameter input is taken in two input forms. In the first input form enter the VPI station and elevation, and enter the fixed point station and elevation. A F4 **getZ** softkey is available for the Elevation fields to retrieve the elevation from a point in the current job database.

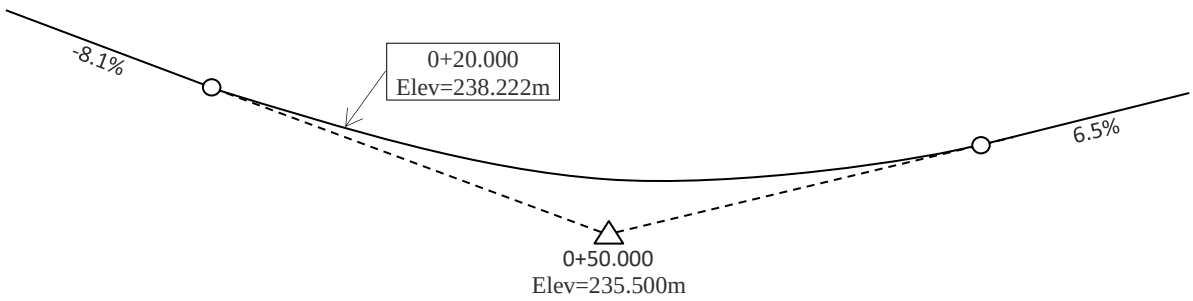




In the second input form enter the entry and exit grades.

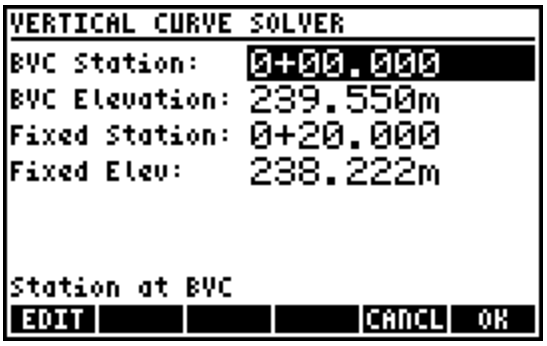
The solution displays the station and elevation for the BVC, EVC and the High/Low point, and the vertical curve length. See the Solution Screen and Calculations section for more information.

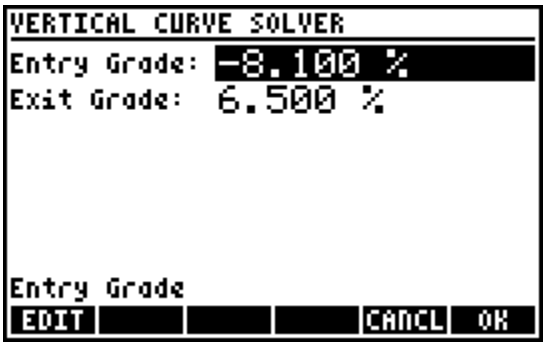




Fixed Point + BVC

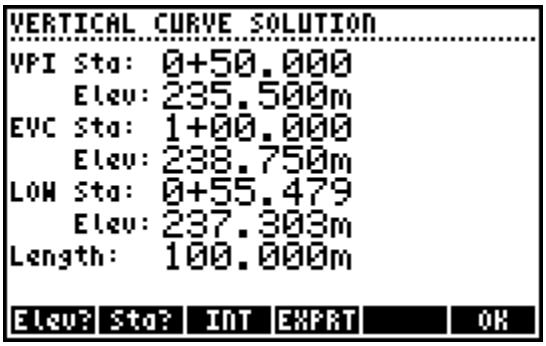
Curve parameter input is taken in two input forms. In the first input form enter the BVC station and elevation, and enter the fixed point station and elevation. A F4 **getZ** softkey is available for the Elevation fields to retrieve the elevation from a point in the current job database.

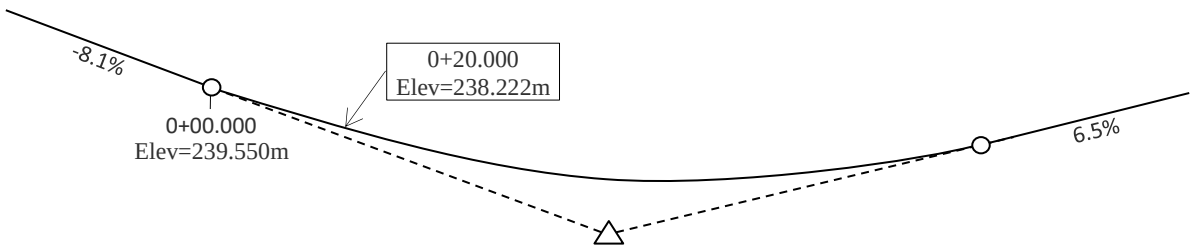




In the second input form enter the entry and exit grades.

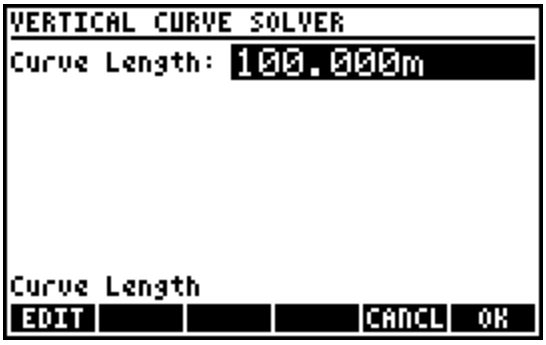
The solution displays the station and elevation for the VPI, EVC and the High/Low point, and the vertical curve length. See the Solution Screen and Calculations section for more information.

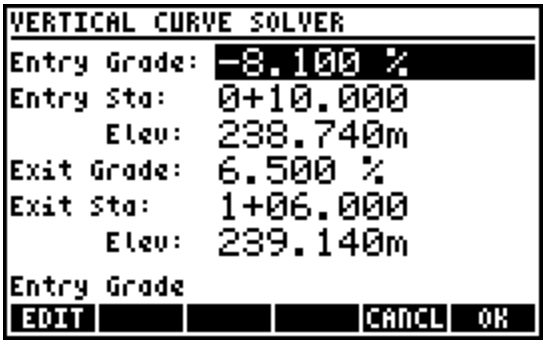




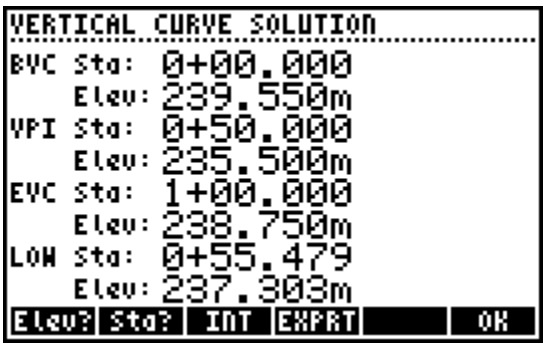
Slope Intersection

Curve parameter input is taken in two input forms. In the first input form enter the vertical curve length.

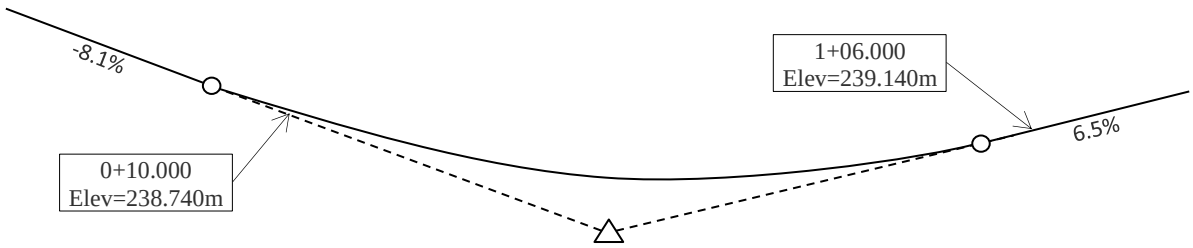




In the second input form enter the entry grade, a station along the entry tangent and the elevation at the station, the exit grade, a station along the exit tangent and the elevation at the station. The *Elevation* fields feature a F4 **getZ** softkey to retrieve the elevation from a point in the current job database. Stations along the entry and exit tangents can be inside or outside of the limits of the vertical curve.

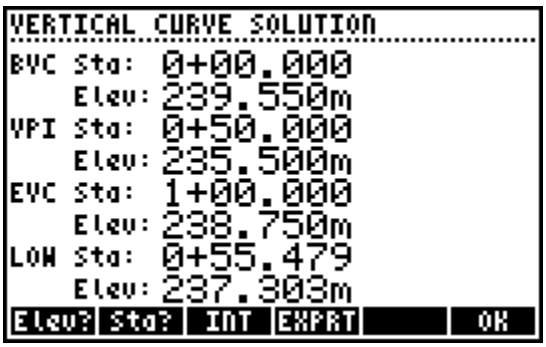


The solution displays the stations and elevations for each the BVC, VPI, EVC and High/Low Point. See the Solution Screen and Calculations section for more information.



Solution Screen and Calculations

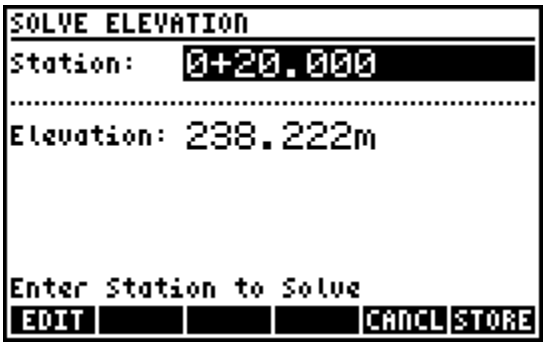
For each of the combinations of known parameters to solve a vertical curve; the solution screen displays the unknown solved parameters, and the menu on the solution screen is the same for all combinations, offering the same functionalities:



1. F1 **Elev?** – Calculate elevations on the vertical curve by entering a station.
2. F2 **Sta?** – Calculate stations on the vertical curve by entering an elevation.
3. F3 **INT** – Calculate elevations at all stations at a given interval.
4. F4 **EXPRT** – Export the solution to the stack, an ASCII file, or to the calculator clipboard.

Calculate Elevations

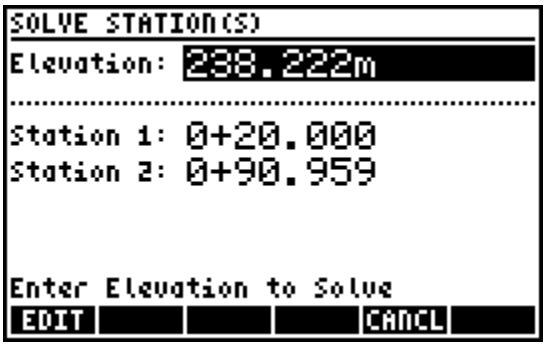
Enter any station to solve its elevation on the vertical curve. When entering a station lower than the BVC station, the elevation is preceded by the "<" character indicating that elevation is on the entry tangent before the BVC. Likewise, stations greater than the EVC will result in the elevation preceded by the ">" character indicating the elevation is on the exit tangent after the EVC.



Use F6 **STORE** to store the solved elevation to a point in the current job database.

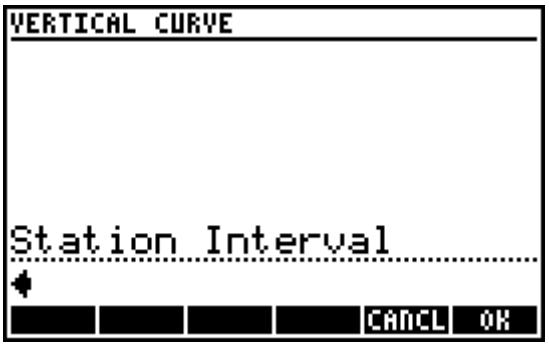
Calculate Stations

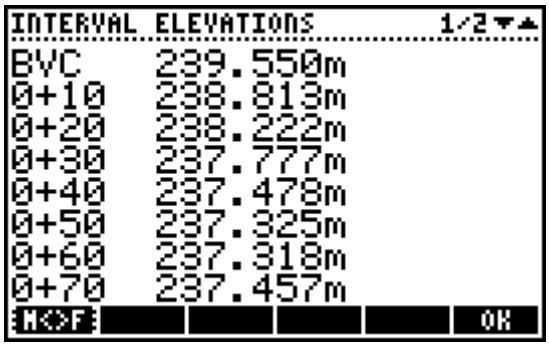
Enter an elevation to solve the station(s) on the vertical curve. Both solutions are displayed when two solutions exist. Only stations between the BVC and EVC are solved.



Calculate Intervals

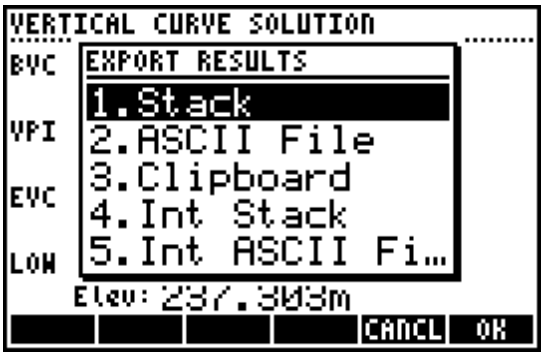
Enter a station interval to solve the elevations for each station at the given interval. The BVC and EVC elevations are always solved, regardless of their station. Results are displayed on as many pages as required, a maximum of eight stations per page. Use F1 **M<>F** to convert the elevations between metric and imperial.





Export Solution

The vertical curve solution may be exported in various ways for further use.



1. Export Solution to Stack – Places all the solved parameters on the calculator stack. Each parameter is tagged with a label.
2. Export Solution to ASCII file – Writes an ASCII file of the solved parameters to save to the SD card COGOPLUS\ASCII directory or to the HOME directory on the calculator.
3. Export to Clipboard – Choose any of the solved parameters to copy to the calculator clipboard. The value stored on the clipboard can be pasted into any input form or screen.
4. Export Intervals to Stack – Places a string of the solved interval elevations on the stack. This option is only available when an Interval Calculation has been performed.
5. Export Intervals to ASCII file – Writes an ASCII file of the solved interval elevations to save to the SD card COGOPLUS\ASCII directory or to the HOME directory on the calculator. This option is only available when an Interval Calculation has been performed.

8.4 Bearing<>Azimuth

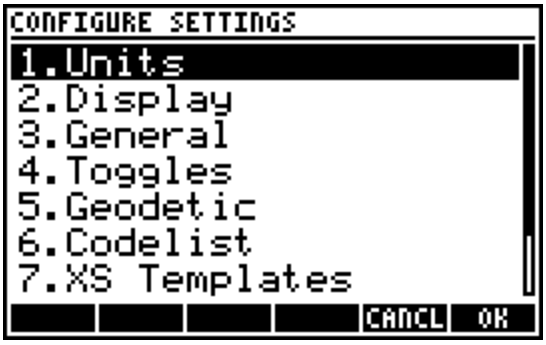
The **Bearing<>Azimuth** conversion program converts directions between quadrant bearings and azimuths.

Enter a value in the current field to convert to the corresponding direction format. Use any of the standard directions input options. The current field remains current until the field toggle is initiated.

The menu:

1. F1 **EDIT** – Edit the current field.
2. F5 **CANCL** – Exit the program.
3. F6 **B->A** or **A->B** – Toggle between bearing or azimuth input. When the command line is not active the ENTER key will do the same thing.

8.5 Configure Settings



User settings options 1 through 7 are described in Chapter 3.

Saving and restoring settings to and from Flash memory serves the purpose of quickly restoring ***COGO+*** settings following an intentional factory reset with ON + F1 + F6.

Save to Flash

This option stores all user settings to a safe place in Flash memory. A message indicates that the settings are stored to Flash. NOTE: THIS PROCEDURE SHOULD PRECEDE A HARD RESET.

Restore from Flash

This option restores the previously saved user settings from Flash. A message indicates that the settings have been restored from Flash. NOTE: THIS PROCEDURE SHOULD FOLLOW A HARD RESET.