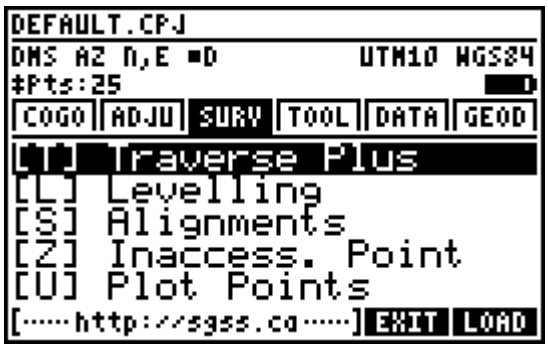
7 Surveying Menu



7.1 Traverse Plus

Traverse Plus simulates data collection and field calculations based on input of measured values.

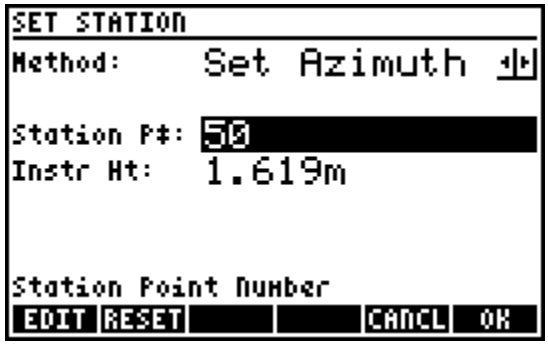
Setup

Similar to a total station workflow, Traverse Plus requires a station and orientation. Three different setup methods are possible:

1. Set Azimuth
2. Known Backsight Point
3. Resection
4. Helmerts

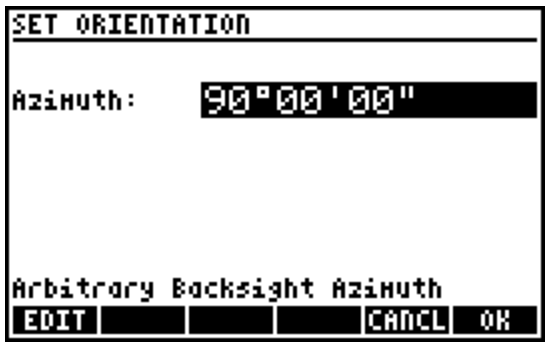
Set Azimuth

A "Set Azimuth" setup method refers to setting up on a point with known coordinates and sighting a known or unknown point and setting an arbitrary azimuth to this point.



Select "Set Azimuth" as the setup *Method* and input the *Station Point Number* and *Height of Instrument*.

NOTE: AN INPUT FORM WILL OPEN TO ALLOW ENTERING COORDINATES FOR THE STATION POINT IF THE POINT DOES NOT EXIST IN THE CURRENT JOB.

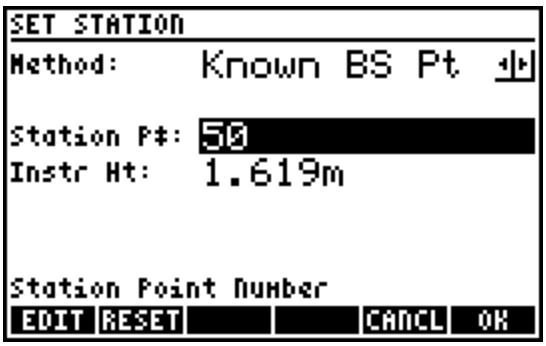


Next, enter an arbitrary backsight azimuth to set your orientation.

This setup method is generally used on the first setup of a survey when control does not exist in the survey area.

Known Backsight Point

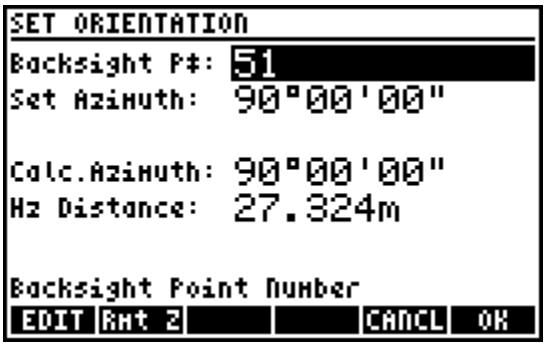
A "Known Backsight Point" setup method refers to setting up on a point with known coordinates and sighting another known point.



Select "Known BS Pt" as the setup *Method* and input the *Station Point Number* and *Height of Instrument*.

NOTE: AN INPUT FORM WILL OPEN TO ALLOW ENTERING COORDINATES FOR THE STATION POINT IF THE POINT DOES NOT EXIST IN THE CURRENT JOB; HOWEVER, THE STATION AND BACKSIGHT POINTS SHOULD BOTH EXIST IN THE CURRENT JOB FOR THIS SETUP METHOD.

Next, enter the *Backsight Point Number* to calculate the azimuth and distance to the backsight point. The calculated information is displayed on the screen for reference. A *Set Azimuth* field is provided should the user wish to set an azimuth to the backsight that differs from the calculated azimuth.

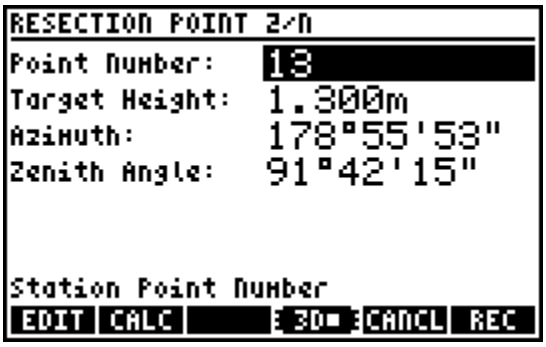


Resection

A "Resection" setup method refers to setting up on an unknown point and sighting at least three known points to compute the station point coordinates. When more than three points are used in a resection, an iterative least squares adjustment method is used to calculate the best estimates for the station coordinates.

Select "Resection" as the setup *Method* and input a *Station Point Number* and *Height of Instrument*. The point number entered for the *Station Point Number* cannot exist in the current job database.

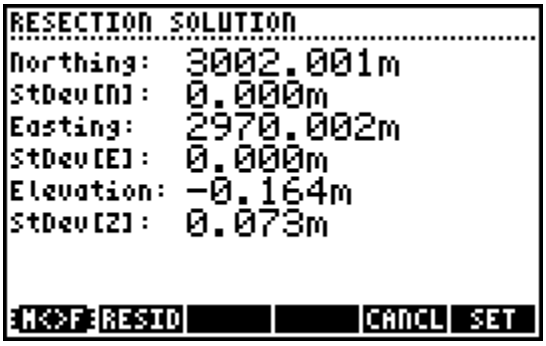
Observation Input Screen



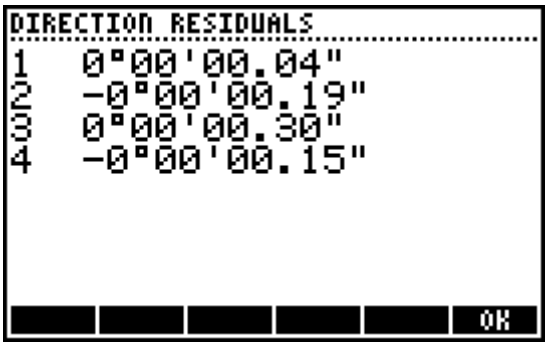
The input screen displays the count of the current input at the top of the screen. Enter a known control point number and the arbitrary observed azimuth to the point. The menu:

1. F1 **EDIT** – Edit the current field.
2. F2 **CALC** – When all observations have been entered press this softkey to calculate the resection.
3. F4 **2D** or **3D** – Toggle between 2D and 3D mode. The 3D mode allows zenith observations to be entered which will be used to calculate an elevation for the station.
4. F5 **CANCL** – Exit the observation input screen and return to the main Set Station screen.
5. F6 **REC** – Record the observation as entered to use in the resection calculation.

Resection Solution

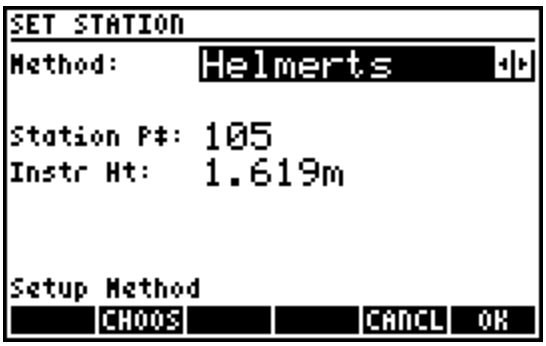


The current iteration is displayed when a least squares adjustment is possible. If a solution fails to converge in 10 iterations, the program displays the error and returns to the Set Station screen. When a solution does not converge, it is most likely due to incorrect control points entered for the observed azimuth(s). The solution coordinates and their standard deviations are displayed. The menu:



1. F1 **M<>F** - Toggles metric/imperial.
2. F2 **RESID** - Display the direction residuals to each observed control point.
3. F5 **CANCL** - Cancel the resection and return the main Set Station screen.
4. F6 **SET** - Store the station with the solved coordinates and return to the main Setup screen where a suggested "Known BS Pt" setup *Method* is set. Generally, at this time one of the control points used in the resection would be used as the known backsight point to complete the orientation.

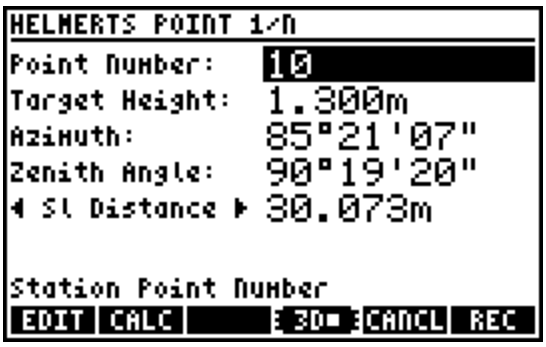
Helmerts



A "Helmerts" setup method refers to setting up on an unknown point and measuring at least two known points to compute the station point coordinates. A coordinate transformation is computed from the measurements for a least squares best-fit to the known points.

Select "Helmerts" as the setup *Method* and input a *Station Point Number* and *Height of Instrument*. The point number entered for the *Station Point Number* cannot exist in the current job database.

Observation Input Screen



The input screen displays the count of the current input at the top of the screen. Enter a known control point number and the measured observations to the point.

The menu:

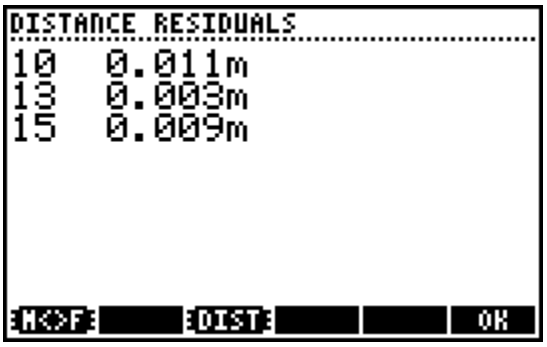
1. F1 **EDIT** – Edit the current field.
2. F2 **CALC** – When all observations have been entered press this softkey to calculate the Helmerts solution
3. F4 **2D** or **3D** – Toggle between 2D and 3D mode. The 3D mode allows zenith observations and the option of entering slope or horizontal distance to be entered which will be used to calculate an elevation for the station.
4. F5 **CANCL** – Exit the observation input screen and return to the main Set Station screen.
5. F6 **REC** – Record the observation as entered to use in the Helmerts calculation.

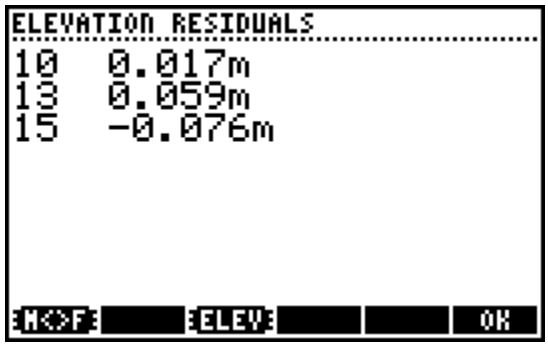
Helmerts Solution

The solution coordinates and their standard deviations are displayed. The menu:

1. F1 **M<>F** - Toggles metric/imperial.
2. F2 **RESID** - Display the distance and, if applicable, the elevation residuals to each observed control point.
3. F5 **CANCL** - Cancel the Helmerts and return the main Set Station screen.

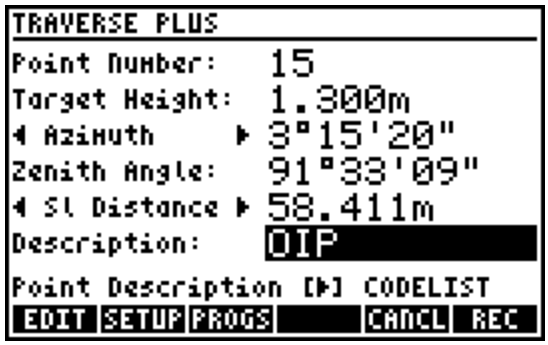
4. F6 **SET** - Store the station with the solved coordinates and return to the main Setup screen where a suggested "Known BS Pt" setup *Method* is set. Generally, at this time one of the control points used in the resection would be used as the known backsight point to complete the orientation.





Enter and Record

Enter measurement data in the main **Traverse Plus** input form to calculate and record 3D coordinates. It is possible to toggle three of the six input fields to accept different types of input.



'Point Number' Field

This field accepts the point number to use for the next record and automatically increments the number by one after each record.

"Target Height' Field

This field accepts the height of the target. The value does not change unless changed by the user.

'Azimuth' / 'Angle Right' / 'Angle Left' Field

The ◀ and ▶ cursor keys toggle this field between three possible input types. An *Azimuth* measurement is the true azimuth within the coordinate system unless a backsight azimuth different from the calculated azimuth was set during a "Known BS Pt" setup method. The backsight point provides the basis for *Angle Right* or *Angle Left* measurements.

'Zenith' Field

A *Zenith* measurement is the vertical angle measured from the zenith.

‘Hz Distance’ / ‘Sl Distance’ Field

The ◀ and ▶ cursor keys toggle this field between two possible input types. A *Hz Distance* measurement is the horizontal distance from the instrument to the target. A *Sl Distance* measurement is the slope distance from the instrument to the target.

‘Description’ Field

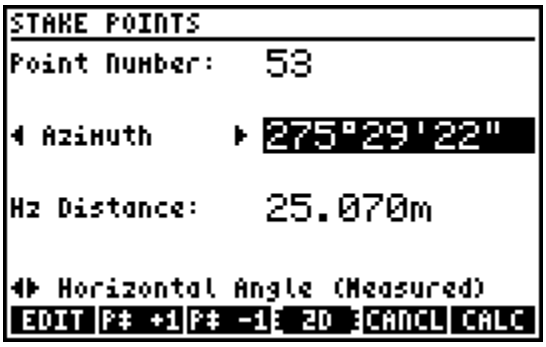
This field accepts a point description to be stored with the record. The ▶ cursor key opens the codelist to choose a code while this field is current. When the codelist translation toggle is set, the user can enter any defined code in the codelist and the program will automatically look up the description and store the code’s description.

The Menu

1. F1 **EDIT** – Edit the current field.
2. F2 **SETUP** – Perform a setup and orientation to update the station and backsight points.
3. F3 **PROGS** – Choose to open the Stake Points, Stake Alignment, Reference Line, or Reference Arc sub-program.
4. F5 **CANCL** – Exit **Traverse Plus** and return to the main interface.
5. F6 **REC** – Record a 3D point using the entered information.

Stake Points

Points that are stored in the current job can be staked from the station setup point. By entering the measured values to a position, the program will calculate orthogonal offsets to the stakeout point from the perspective of the station point. A 2D/3D toggle is available to adjust the number of input fields for the desired calculation.

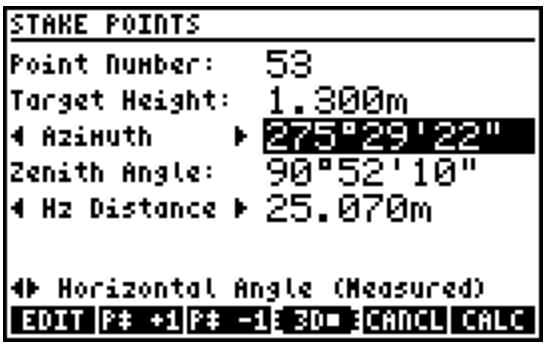


‘Point Number’ Field

This field accepts the point number to stake. A popup message box displays the calculated horizontal angle and distance to the stake point after a valid point number input. These calculated values are also automatically entered into the horizontal angle field and the distance field when a new point number is entered.

'Target Height' Field (3D mode only)

This field accepts the height of the target when 3D mode is enabled.



'Azimuth' / 'Angle Right' / 'Angle Left' Field

The ◀ and ▶ cursors keys toggle this field between three possible input types. Enter the horizontal angle to the current target position.

'Zenith' Field (3D mode only)

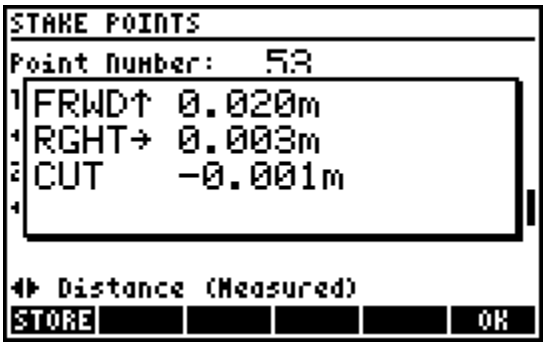
This field is only available in 3D mode. Enter the vertical angle to the target.

Distance Field

The ◀ and ▶ cursor keys toggle this field between *Hz Distance* and *Sl Distance* when in 3D mode. Only *Hz Distance* is available in 2D mode. Enter the distance to the target.

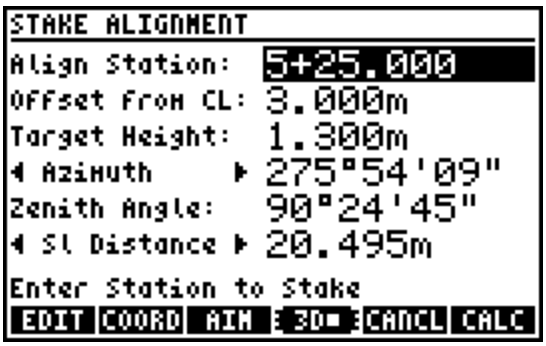
The Menu

1. F1 **EDIT** – Edit the current field.
2. F2 **P# +1** – Increase the stake *Point Number* by one and updates the horizontal angle and distance fields with newly calculated values.
3. F3 **P# -1** – Decrease the stake *Point Number* by one and updates the horizontal angle and distance fields with newly calculated values.
4. F4 **2D** or **3D** – Toggle between 2D and 3D mode.
5. F5 **CANCL** – Exit the Stake Point sub-program and return to the main **Traverse Plus** program.
6. F6 **CALC** – Calculate orthogonal offsets, *FRWD↑ / BACK↓*, *RGHT→ / LEFT←* and *CUT / FILL*, to the stake points when all input is entered. Offsets are from the perspective of the setup point. Press F1 **STORE** to store the current position as a point in the job database.



Stake Alignment

Choose an existing alignment to stake any station. Essentially this program works very much like the Stake Points program but instead of staking a coordinate value from stored points, you enter a station and offset along an alignment. The program calculates the coordinate values for the parameters given and features a different menu from the Stake Points program.



'Align Station' Field

This field accepts any station value, which must be within the limits of the alignment to perform calculations.

'Offset from CL' Field

This field accepts an offset from centerline value, +Right, or –Left. For 3D calculations, this value must be within the width of the cross section template assigned.

'Target Height' Field (3D mode only)

This field accepts the height of the target when 3D mode is enabled.

'Azimuth' / 'Angle Right' / 'Angle Left' Field

The ◀ and ▶ cursors keys toggle this field between three possible input types. Enter the horizontal angle to the current target position.

'Zenith' Field (3D mode only)

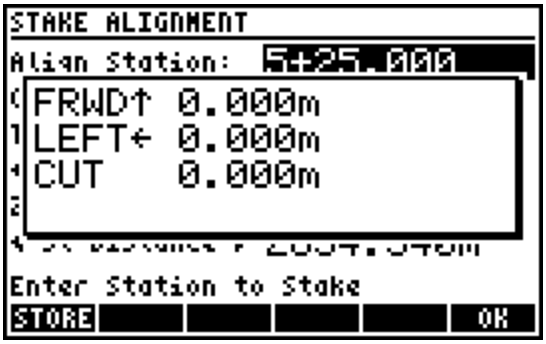
This field is only available in 3D mode. Enter the vertical angle to the target.

Distance Field

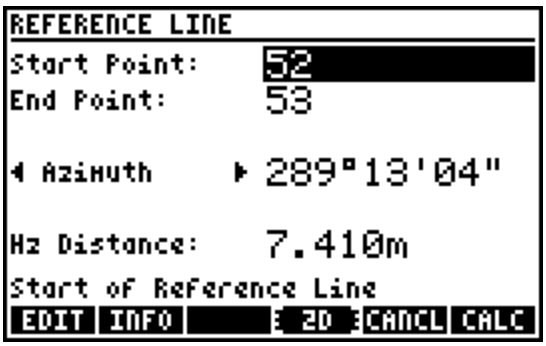
The ◀ and ▶ cursor keys toggle this field between *Hz Distance* and *Sl Distance* when in 3D mode. Only *Hz Distance* is available in 2D mode. Enter the distance to the target.

The Menu

1. F1 **EDIT** - Edit the current field.
2. F2 **COORD** - Displays the coordinates for the station and offset entered.
3. F3 **AIM** - Calculates the horizontal and vertical angles, and the distance to the calculated point on the alignment, and populates the input fields with the calculated values.
4. F4 **2D** or **3D** – Toggle between 2D and 3D mode.
5. F5 **CANCL** – Exit the Stake Alignment sub-program and return to the main **Traverse Plus** program.
6. F6 **CALC** – Calculate orthogonal offsets, *FRWD↑ / BACK↓*, *RGHT→ / LEFT←* and *CUT / FILL*, to the station when all input is entered. Offsets are from the perspective of the setup point. Press F1 **STORE** to store the current position as a point in the job database.

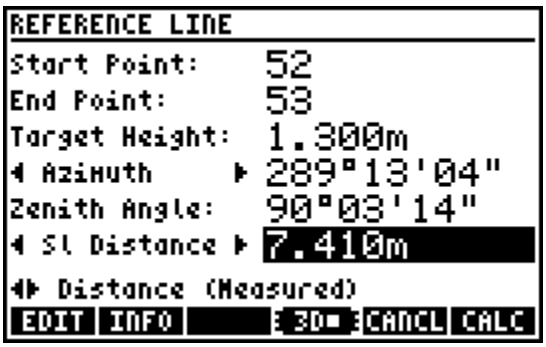


Reference Line



Positions can be calculated relative to a reference line as defined by two points in the job database. By entering the measured values to a position, the program will calculate the offset from the line and the distance along the line of the current position, as well as a distance along the entered horizontal angle to go forward or back to intersect the line. A 2D/3D toggle is available to adjust the number of input fields for the desired calculation. When 3D information is provided a cut/fill calculation is also performed.

'Start Point' Field



This field accepts the point number that defines the beginning of the reference line.

'End Point' Field

This field accepts the point number that defines the end of the reference line.

'Target Height' Field (3D mode only)

This field accepts the height of the target when 3D mode is enabled.

'Azimuth' / 'Angle Right' / 'Angle Left' Field

The ◀ and ▶ cursors keys toggle this field between three possible input types. Enter the horizontal angle to the current target position.

'Zenith' Field (3D mode only)

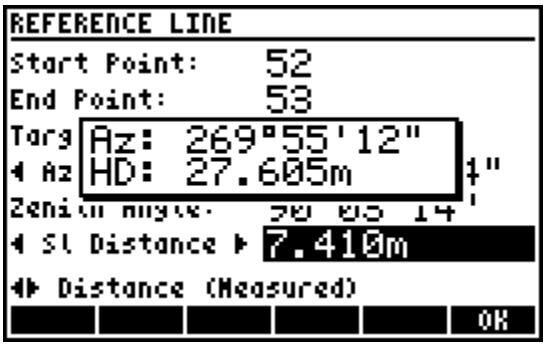
This field is only available in 3D mode. Enter the vertical angle to the target.

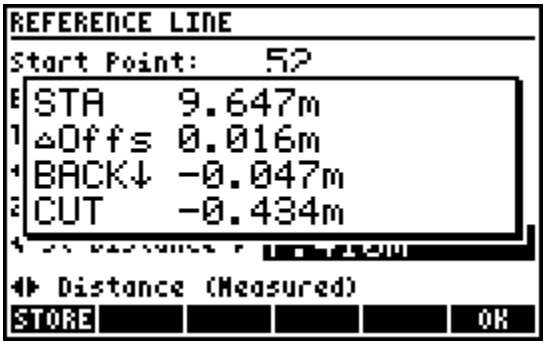
Distance Field

The ◀ and ▶ cursor keys toggle this field between *Hz Distance* and *Sl Distance* when in 3D mode. Only *Hz Distance* is available in 2D mode. Enter the distance to the target.

The Menu

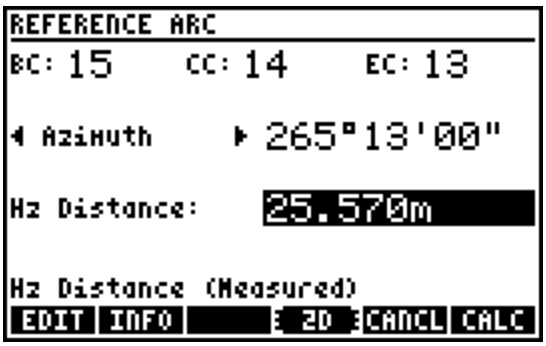
1. F1 **EDIT** – Edit the current field.
2. F2 **INFO** – Displays the azimuth/bearing and the horizontal distance of the reference line as defined by the *Start Point* and *End Point*.
3. F4 **2D** or **3D** – Toggle between 2D and 3D mode.
4. F5 **CANCL** – Exit the Reference Line sub-program and return to the main **Traverse Plus** program.
5. F6 **CALC** – Calculate the current position relative to the reference line. Some notes regarding the calculated values:





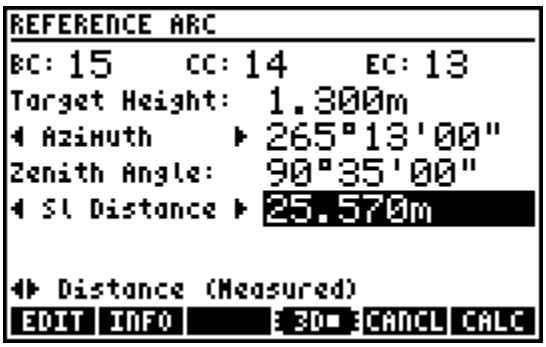
- ***STA*** – Is the distance along the reference line that the current position is perpendicular to, measured from the *Start Point*.
- ***ΔOffs*** – Is the perpendicular offset from the reference line to the current position. A positive distance indicates the current position is on the **RIGHT** side of the reference line while a negative distance indicates the current position is to the **LEFT** of the reference line.
- ***FRWD↑ / BACK↓*** – Is the distance along the current horizontal angle to go forward or back to intersect with the reference line.
- ***CUT / FILL*** – Is the cut or fill required to intersect with a 3D line of constant grade that passes through the *Start Point* and *End Point*.
- Press F1 **STORE** to store the current position as a point in the job database.

Reference Arc



Positions can be calculated relative to a reference arc as defined by two points on the arc (BC + EC) and a radius point (CC) in the job database. By entering the measured values to a position, the program will calculate the offset from the arc/circle and the distance along the arc/circle of the current position, as well as a distance along the entered horizontal angle to go forward or back to intersect the arc/circle. A 2D/3D toggle is available to adjust the number of input fields for the desired calculation. When 3D information is provided, a cut/fill calculation is also performed.

'BC' Field



This field accepts the point number that defines the beginning of the reference arc, or the first point on the circle.

'CC' Field

This field accepts the radius point, or curve center point.

'EC' Field

This field accepts the point number that defines the end of the reference arc, or the second point on the circle.

'Target Height' Field (3D mode only)

This field accepts the height of the target when 3D mode is enabled.

'Azimuth' / 'Angle Right' / 'Angle Left' Field

The ◀ and ▶ cursors keys toggle this field between three possible input types. Enter the horizontal angle to the current target position.

'Zenith' Field (3D mode only)

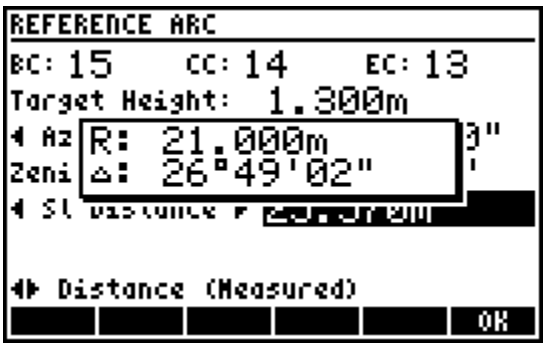
This field is only available in 3D mode. Enter the vertical angle to the target.

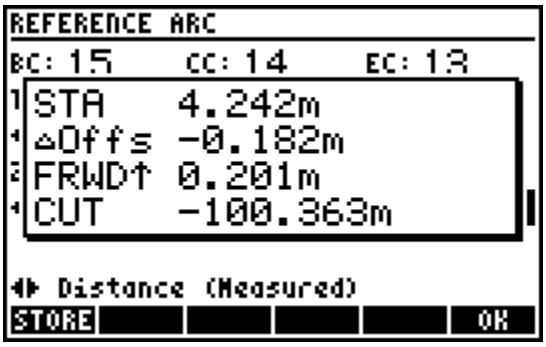
Distance Field

The ◄ and ► cursor keys toggle this field between *Hz Distance* and *Sl Distance* when in 3D mode. Only *Hz Distance* is available in 2D mode. Enter the distance to the target.

The Menu

1. F1 **EDIT** – Edit the current field.
2. F2 **INFO** – Displays the radius and deflection angle of the reference arc as defined by the BC, CC and EC points.
3. F4 **2D** or **3D** – Toggle between 2D and 3D mode.
4. F5 **CANCL** – Exit the Reference Arc sub-program and return to the main **Traverse Plus** program.
5. F6 **CALC** – Calculate the current position relative to the reference arc. Some notes regarding the calculated values:





- ***STA*** – Is the distance along the reference arc that the current position is perpendicular to, measured from the *BC* point.
- ***ΔOffs*** – Is the radial/perpendicular offset from the reference arc to the current position. A positive distance indicates the current position is on the **RIGHT** side of the reference arc (inside the circle in a clockwise defined curve) while a negative distance indicates the current position is to the **LEFT** of the reference arc (outside the circle in a clockwise defined curve).
- ***FRWD↑ / BACK↓*** – Is the distance along the current horizontal angle to go forward or back to intersect with the reference arc.
- ***CUT / FILL*** – Is the cut or fill required to intersect with a 3D curve of constant grade that passes through the *BC* and *EC* points.
- Press F1 **STORE** to store the current position as a point in the job database

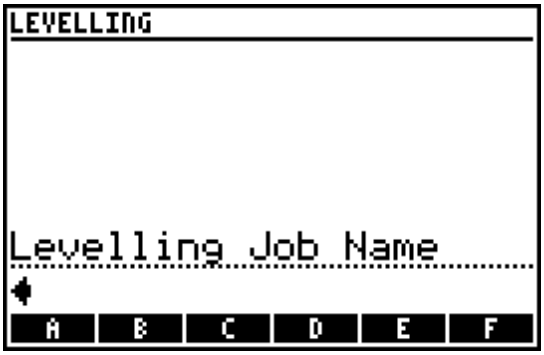
7.2 Levelling

COGO+ Pro includes a **Levelling** program to manage multiple levelling jobs. Each job consists of backsight, foresight and intermediate foresight observations. Edit, review and adjust observations, and perform calculations such as cuts/fills using observed or adjusted data.

Manager

The Levelling Jobs manager always opens when running the **Levelling** program. Here you can create new jobs, delete existing jobs or load a job for editing and review. The menu:

1. F1 **NEW** – Create a new job.
2. F2 **DEL** – Delete the selected job.
3. F3 **INFO** – Display information about the selected job. The number of stations, start and end elevations, job file size and available memory are displayed.
4. F4 **OPTS** – Read and write jobs to and from the SD card COGOPLUS\JOBS directory, or rename an existing job.
5. F5 **CANCL** – Exit the Levelling program.
6. F6 **LOAD** – Load the selected job.



Create a New Job

Press F1 **NEW** to create a new job. Enter a name for your levelling job as prompted, and the new job will be created with a *.CPL name extension to differentiate it from a ***COGO+*** job or **Alignments** job.

Delete a Job

Press F2 **DEL** to delete the currently selected job. A confirmation is requested prior to the job actually being deleted.

Levelling Options

1. Import Level - Copy a levelling job from the SD card to the calculator.
2. Backup Level – Store a copy of the selected Levelling job to the COGOPLUS\JOBS directory.

3. Backup All – Stores copies of all the Levelling jobs created on the calculator to the COGOPLUS\JOBS directory.
4. Move Level – Move the selected Levelling job to the COGOPLUS\JOBS directory, thereby deleting the job from the calculator.
5. Rename Level – Rename the selected Levelling job.

Load a Job

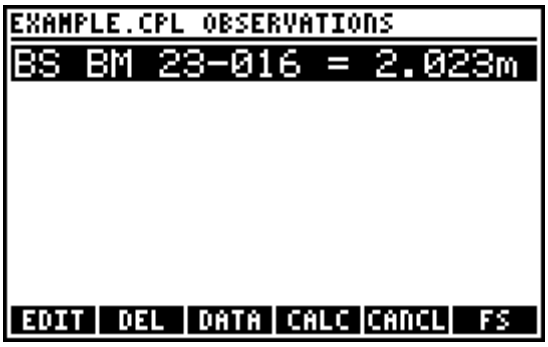
Press F6 **LOAD** to load the currently selected job for editing, reviewing and calculating.

Working with a Levelling Job

Loading a new Job

When loading a new job for the first time, it is necessary to initialize it by providing a starting station and elevation and an initial backsight reading to the starting station. NOTE: IT IS POSSIBLE TO EDIT THIS INFORMATION LATER IF NECESSARY.

Once the job is initialized the main observations screen is displayed showing the entered observations, which consists of just the backsight reading to the starting station when loading a new job for the first time. The menu:



1. F1 **EDIT** edits the currently selected observation.
2. F2 **DEL** deletes the currently selected observation.
3. F3 **DATA** brings up a few options to review data derived from the observations.
4. F4 **CALC** brings up a few calculation options.
5. F5 **CANCL** returns to the Levelling Manager screen.
6. F6 **FS** or **BS** opens up an input form to add a new foresight or backsight, depending on what the last entered observation was.

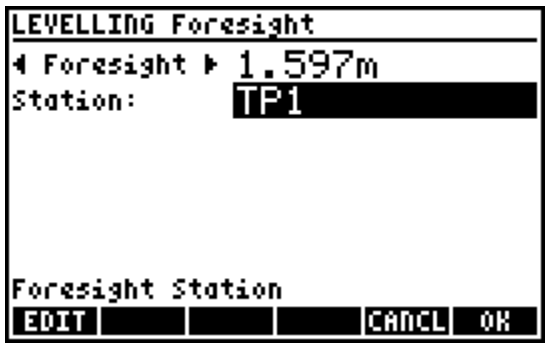
Adding Observations

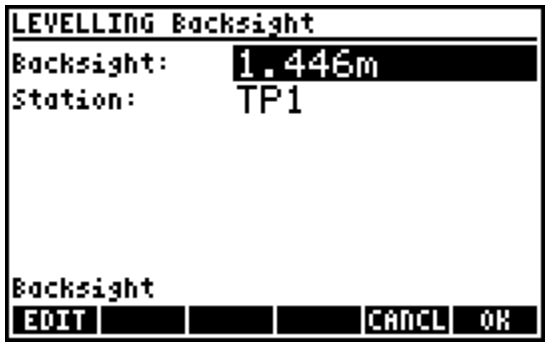
Since this action is the most commonly used action when working with a levelling job, it has been assigned to the F6 or ENTER key.

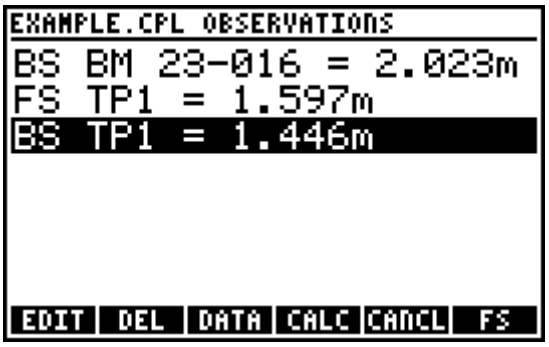
The label **FS** or **BS** on F6 depends on what the next possible observation is. When entering a foresight observation it is possible to define the observation as an *Intermediate Foresight* by using the ◀ and ▶ cursor keys to toggle the label on the first field of the input form. All intermediate foresight observations from a setup are entered prior to the foresight to the next turning point or benchmark. The F6 label will not change to **BS** until a foresight observation has been entered. The station name for each foresight and intermediate foresight can be entered as necessary, or the program will automatically suggest TP# names. The backsight station is always the last foresight station.

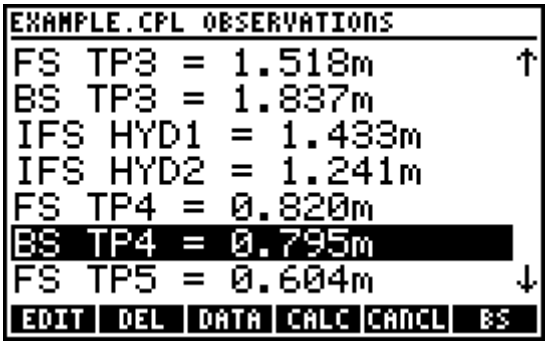
The observations screen updates to show each observation type, station and observation, for example:

- *FS TP1 = 1.597m* A foresight observation to station TP1 of 1.597m
- *BS TP1 = 1.446m* A backsight observation to station TP1 of 1.446m
- *IFS HYD1 = 1.433m* A intermediate foresight observation to HYD1 of 1.433m









Editing Observations

Select any observation to edit the observation. The station names can be changed for:

- The Starting Station
- Intermediate Foresights Stations
- Foresight Stations, which also updates the following backsight station name (if existing)

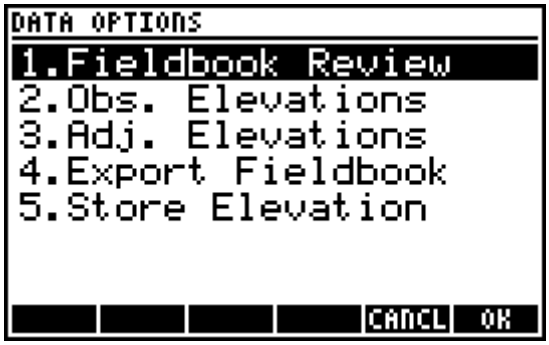
When an observation has been edited the entire dataset is recalculated to update elevations and heights of instrument at each setup, which is critical for data review and calculations.

Deleting Observations

Select an Intermediate Foresight observation or the last observation entered to delete it. A confirmation ensures that observations are not deleted unintentionally.

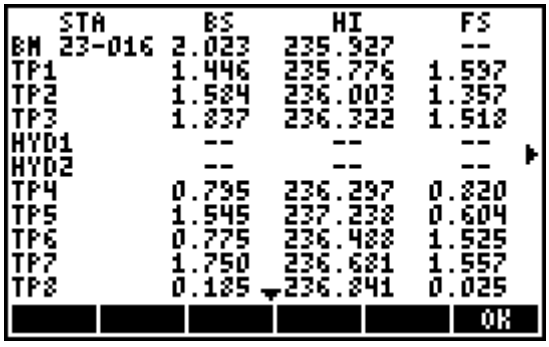
Data Review

Observations can be reviewed in a fieldbook style printout on the screen, observation derived elevations and adjusted elevations for all stations can be reviewed on the screen, a fieldbook ASCII file can be written to the SD card or the HOME directory, and station elevations can be stored to points in the current ***COGO+*** job.



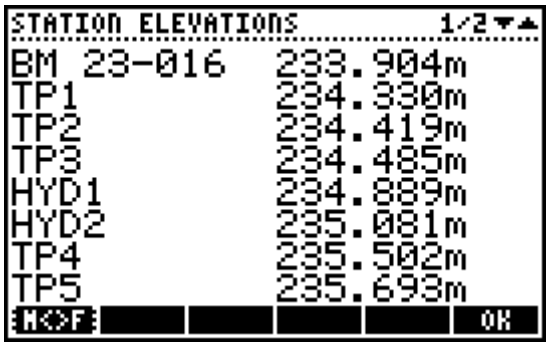
Fieldbook Review and Export Fieldbook

Both options create a formatted string of all the observations with HI's and Elevations (including adjusted if available) as would typically be entered into a fieldbook. The fieldbook review option displays data on the screen while the export fieldbook option exports the string as an ASCII file.



Observation Elevations

Displays every levelling station and its observed elevation. Multiple pages of results may exist depending on the number of stations. Use F1 **M<>F** to convert the elevations between metric and imperial.



Adjusted Elevations

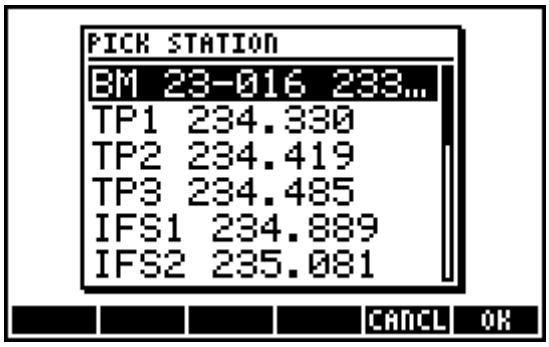
This option works in the same way as displaying observation elevations; except the adjusted elevations are displayed. NOTE: AN ADJUSTMENT CALCULATION IS REQUIRED TO BE DONE PRIOR TO REVIEWING THE ADJUSTED ELEVATIONS.

Store Elevation

Stores the observed or adjusted elevation of any station in the levelling job to a point in the current job database.

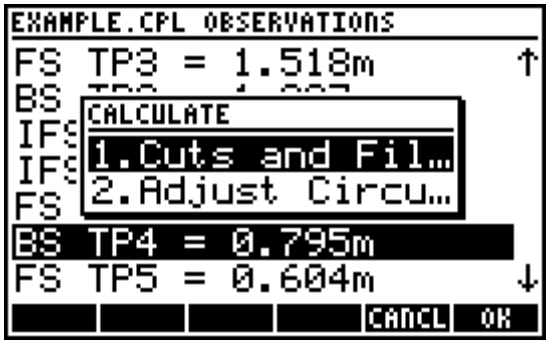
First, pick a station from a list of every station in the levelling job.

Next, enter the point number to store the selected station elevation to.



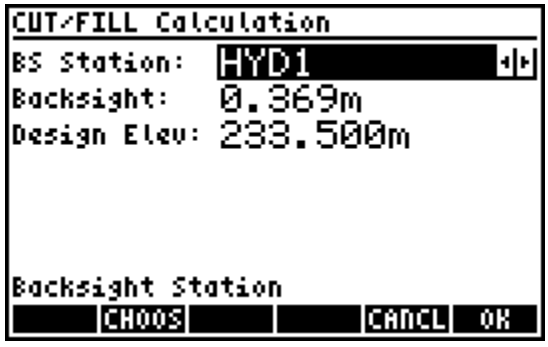
Calculations

Calculate cuts and fills by choosing any station from the available list of defined stations to backsight, or calculate the circuit error of a levelling circuit and adjust station elevations by distributing the error throughout the circuit.

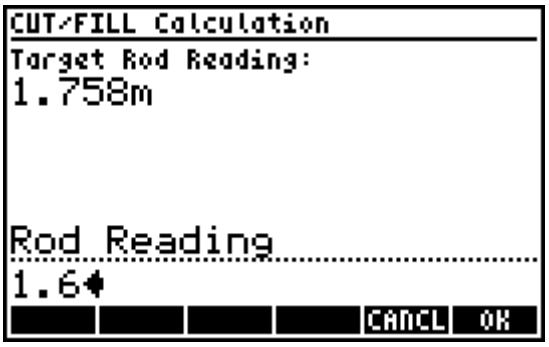


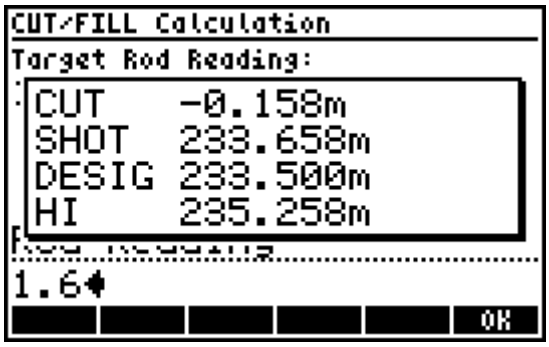
Cuts and Fills

Calculate cuts and fills from observed or adjusted elevations. When a circuit has been adjusted, the user is presented a choice of using observed elevations or adjusted elevations for cut/fill calculations. Next, choose the station to backsight, and enter the backsight rod reading and the design elevation. This sets up the parameters for the cut/fill calculations.



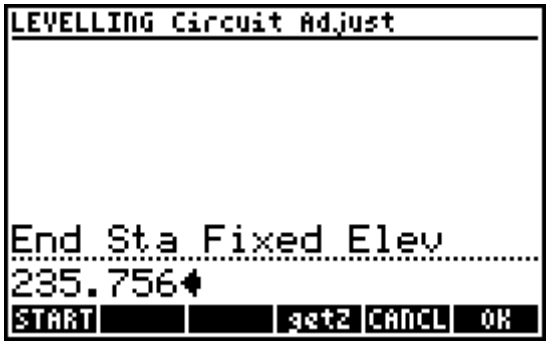
The following input screen displays the target rod reading to meet the design elevation, and prompts the user to input the actual rod reading. The calculation displays the CUT or FILL value and the observed SHOT elevation. The DESIGn elevation and HI values are also displayed for reference purposes.



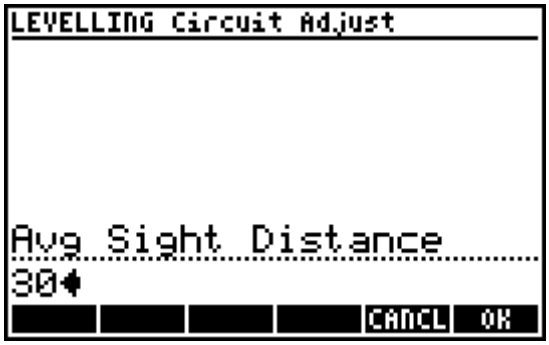


Adjust Circuit Error

The first input screen for the adjustment requires a fixed elevation for the end station. If adjusting a loop, this value will be the starting point elevation, a value that can automatically entered by pressing F1 **START** in the input screen. Use F4 **getZ** to retrieve an elevation from a point in the current job database.

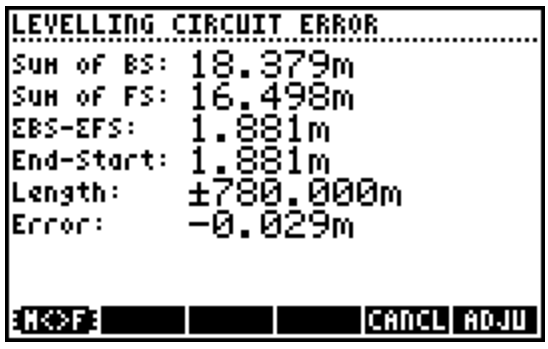


The second input screen asks for an average sight distance to calculate the approximate overall circuit length.



The output screen displays the sum of all backsight observations, the sum of all foresight observations, the difference between the sums, the difference between the starting station elevation and end station elevation, the approximate circuit length and the circuit error.

Press F6 **ADJU** to calculate adjusted elevations for all the stations within the Levelling job circuit. The circuit error is distributed evenly through each leg of the circuit assuming equal sight distances.



7.3 Alignments

COGO+ Pro includes an **Alignments** program to manage multiple complex 3D alignments. Each alignment consists of horizontal, vertical and cross section components. The horizontal centerline of the alignment is the only mandatory definition for any alignment. Various calculations are possible with alignments.

Alignment Manager

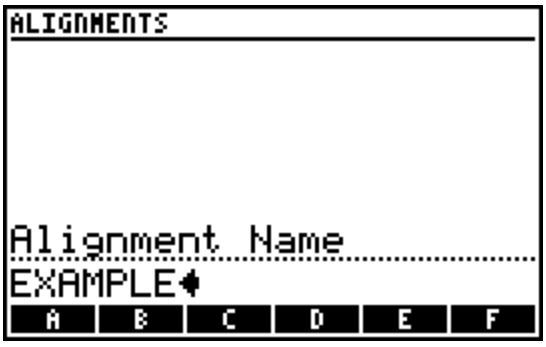
The Alignment Manager always opens when running the **Alignments** program. Here you can create new alignments, delete existing alignment or load an alignment for editing, review and calculations.

The menu:

1. F1 **NEW** – Create a new alignment.
2. F2 **DEL** – Delete the selected alignment.
3. F3 **INFO** – Display information about the selected alignment. The start and end stations, overall length, the number of horizontal, vertical and cross section parts defined, alignment file size and available memory are displayed.
4. F4 **OPTS** – Read and write alignments to and from the SD card COGOPLUS\JOBS directory, or rename an existing alignment.
5. F5 **CANCL** – Exit the **Alignments** program.
6. F6 **LOAD** – Load the selected alignment.

Create a New Alignment

Press F1 **NEW** to create a new alignment. Enter a name for your alignment as prompted, and the new alignment will be created with a *.CPA name extension to differentiate it from a ***COGO+*** job or **Levelling** job.



Delete an Alignment

Press F2 **DEL** to delete the currently selected alignment. A confirmation is requested prior to the alignment actually being deleted.

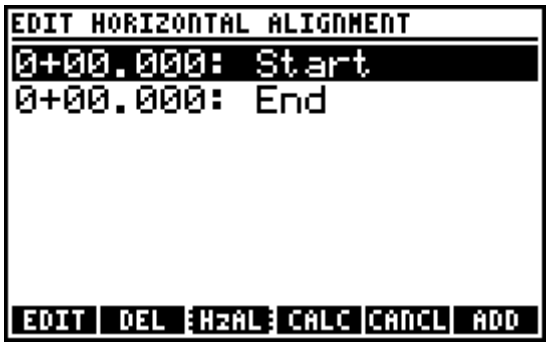
Alignment Options

1. Import Alignment – Copy an alignment from the SD card to the calculator.
2. Backup Alignment – Store a copy of the selected alignment to the COGOPLUS\JOBS directory.
3. Backup All – Stores copies of all the alignments created on the calculator to the COGOPLUS\JOBS directory.
4. Move Alignment – Move the selected alignment to the COGOPLUS\JOBS directory, thereby deleting the alignment from the calculator.
5. Rename Alignment – Rename the selected alignment.

Load an Alignment

Press F6 **LOAD** to load the currently selected alignment for editing, reviewing and calculating. A check is performed to ensure that any cross section assignments involve only templates that exist on the calculator. If an error message is displayed, create the missing template(s) to load the alignment.

Working with an Alignment



The EDIT HORIZONTAL ALIGNMENT screen is displayed by default when loading an alignment. You can toggle between editing horizontal, vertical and cross section components by pressing F3. The menus:

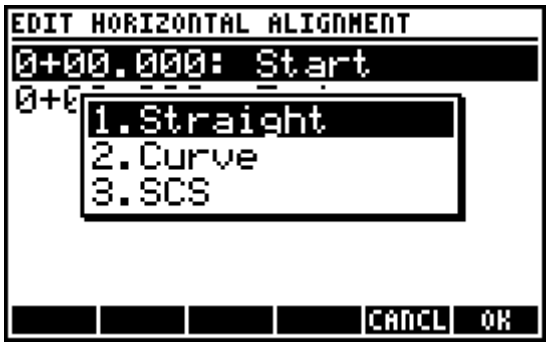
1. F1 **EDIT** – Edit the selected component.
2. F2 **DEL** – Delete the selected component.
3. F3 **HzAL** or **VtAL** or **XSec** – Toggles editing horizontal, vertical and cross sections.
4. F4 **CALC** – Perform calculations with the alignment data.
5. F5 **CANCL** – Return to the Alignment Manager.
6. F6 **ADD** – Add a component to the alignment. The available options reflect the current screen; horizontal, vertical or cross sections. The ENTER key does the same thing.

Horizontal Alignment

A new alignment is created by default to have a starting station of 0 (displayed as 0 or 0+00 or 0+000 depending on the user setting), and starting coordinates at 0,0. These parameters can be edited at any time; the entire horizontal alignment is updated to reflect any starting point station and coordinates changes.

Add a Segment

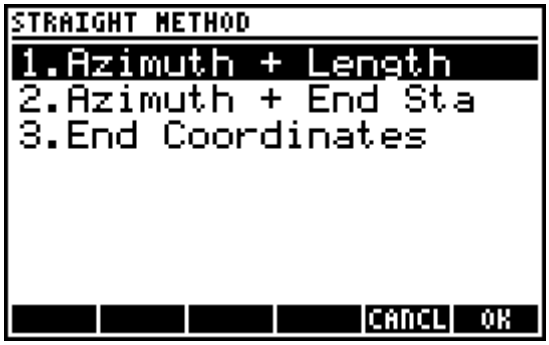
Press F6 **ADD** to add a new horizontal segment. All segment are added to the end of the list of already defined segments. The end coordinates of the existing alignment are used as the starting coordinates for the new segment. The available options for horizontal segments are Straight, Curve and Spiral-Curve-Spiral.



Straight

A straight segment consists of a starting point and an ending point. The end point can be defined by one of three methods:

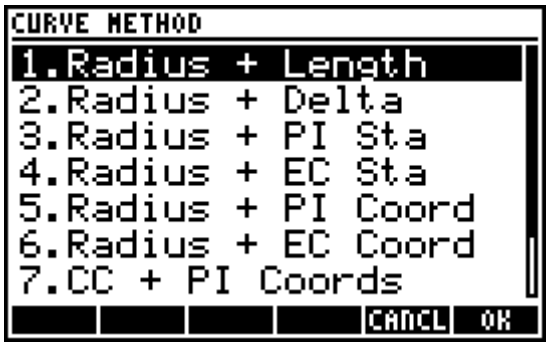
1. A azimuth/bearing and length
2. A azimuth/bearing and end station
3. End coordinates



For option 3 a softkey F4 **getXY** is available to retrieve coordinates from a point in the current job database to use as the coordinates for the end point.

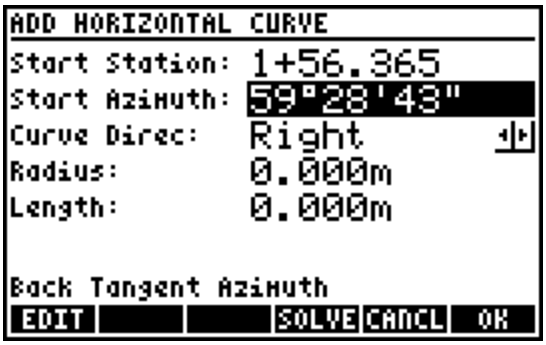
Curve

A curve segment consists of a starting point, curve direction, radius, and length. The curve parameters may be defined by one of nine methods:

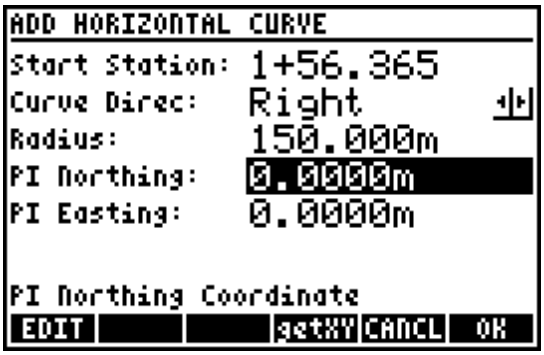


1. A radius and curve length. NOTE: ALSO REQUIRES THE BACK TANGENT AZIMUTH/BEARING AND THE CURVE DIRECTION RIGHT/LEFT.
2. A radius and curve delta angle. NOTE: ALSO REQUIRES THE BACK TANGENT AZIMUTH/BEARING AND THE CURVE DIRECTION RIGHT/LEFT.
3. A radius and the point of intersection station. NOTE: ALSO REQUIRES THE BACK TANGENT AZIMUTH/BEARING AND THE CURVE DIRECTION RIGHT/LEFT.
4. A radius and the end of curve station. NOTE: ALSO REQUIRES THE BACK TANGENT AZIMUTH/BEARING AND THE CURVE DIRECTION RIGHT/LEFT.

5. A radius and coordinates at the point of intersection. NOTE: ALSO REQUIRES THE CURVE DIRECTION RIGHT/LEFT.
6. A radius and coordinates at the end of curve. NOTE: ALSO REQUIRES THE CURVE DIRECTION RIGHT/LEFT.
7. Curve center and point of intersection coordinates
8. Curve center and end of curve coordinates
9. 3 point curve definition by providing coordinates at a point on the curve and the end of curve

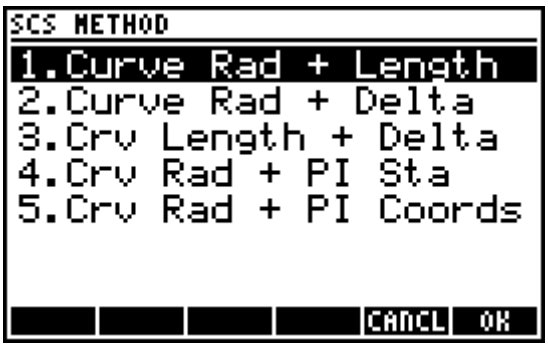


For curves, the back tangent azimuth/bearing is automatically calculated from the last segment in the alignment, unless the curve is the first segment defined in which case the value needs to be entered. This ensures curves are tangential to the preceding segment and only applies to methods 1 through 4 where the back tangent azimuth/bearing is user entered. Also for methods 1 through 4, a softkey F4 **SOLVE** is available to open the horizontal or vertical curve solver to solve for a value. From within the solvers it is possible to export solved values to the clipboard, which can then be pasted into any of the fields in the alignment definition input form.



For methods 5 through 9, a softkey F4 **getXY** is available to retrieve coordinates from a point in the current job database to use as the coordinates for the point whose northing or easting field is current. NOTE: FOR OPTIONS 7 THROUGH 9 THERE ARE TWO SETS OF COORDINATE PAIRS REQUIRED, YOU MUST SELECT THE NORTHING OR EASTING COORDINATE FIELD OF THE POINT YOU WISH TO RETRIEVE FROM THE DATABASE.

Spiral-Curve-Spiral



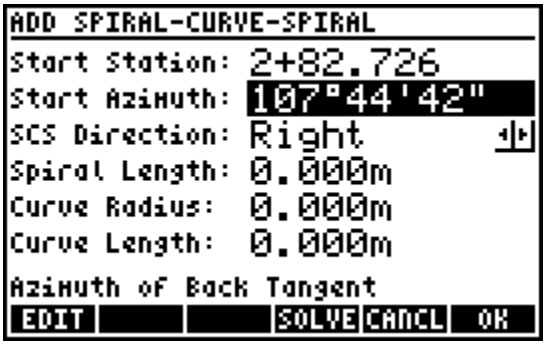
A spiral-curve-spiral transition curve consists of a starting point, curve direction, spiral length, circular curve radius and length. The spiral-curve-spiral parameters may be defined by one of five methods:

1. Circular curve radius and length
2. Circular curve radius and delta angle

3. Circular curve length and delta angle
4. Circular curve radius and point of intersection station of transition curve
5. Circular curve radius and point of intersection coordinates of transition curve

Each of the five methods also requires the back tangent azimuth/bearing, the curve direction and the spiral length. For spiral-curve-spiral transition curves, the back tangent azimuth/bearing is automatically calculated from the last segment in the alignment, unless the curve is the first segment defined in which case the value needs to be entered.

Each of the five methods also feature the softkey F4 **SOLVE** to open the horizontal or vertical curve solver to solve for a value. From within the solvers it is possible to export solved values to the clipboard, which can then be pasted into any of the fields in the alignment definition input form.



For method 5 a softkey F3 **getXY** is available to retrieve coordinates from a point in the current job database to use as the coordinates for the point of intersection.

Edit a Segment

Press F1 **EDIT** to edit the selected horizontal segment. For each segment type, straight, curve or SCS, the same options are available as when adding a new segment. The current values are automatically inserted into the input form regardless of which method is chosen.

When edits are made to a segment, the segment itself is updated, and any segments following the edited segment are also updated. The relationships between segments are kept intact, any positional shifts or rotations are applied to all segments following the edited segment.

Delete a Segment

Press F2 **DEL** to delete the selected horizontal segment. When a segment is deleted, all segments following the deleted segment are shifted to join the segment preceding the deleted segment. ***No rotation is applied.***

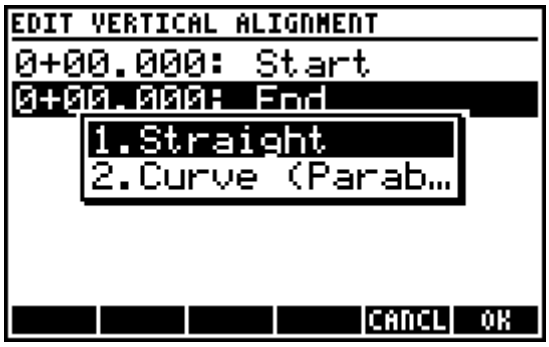
Vertical Alignment

Generally the vertical alignment is defined after the horizontal alignment and the extents of the vertical alignment match the horizontal alignment, however a vertical alignment may start and end within or outside the parameters of the horizontal alignment. By default, the vertical alignment is defined to start at Station 0 and Elevation 0. These parameters may be edited at any time.

When editing the vertical alignment starting station a softkey F4 **HZsta** is available to match the vertical starting station to the horizontal starting station, and when editing the starting point elevation for the vertical alignment the softkey F4 **getZ** is available to retrieve an elevation from a point in the current job database.

Add a Segment

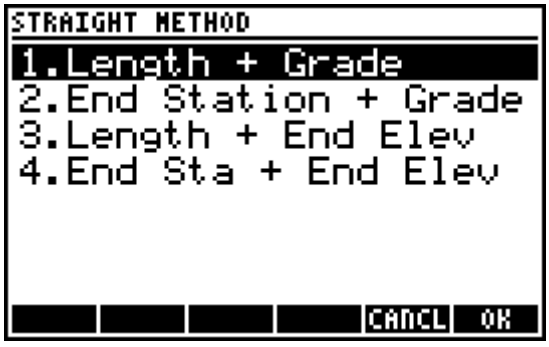
Press F6 **ADD** to add a new vertical segment. All segments are added to the end of the list of already defined segments. The end elevation of the existing vertical alignment is used as the starting elevation for the new segment. The available options for vertical segments are Straight and Curve (Parabola).



Straight

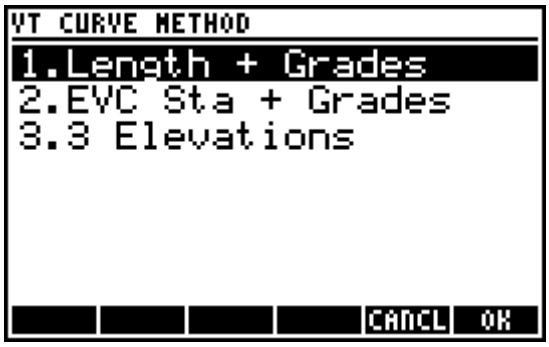
A vertical straight segment consists of a starting elevation, a length and a grade. The length and grade of the segment may be defined by one of four methods:

1. Length and Grade
2. End Station and Grade
3. Length and End Elevation
4. End Station and End Elevation



For each of the four methods; the length and end station fields feature a F4 **endHZ** softkey to automatically insert the length or end station to match the end of the horizontal alignment. For methods 3 and 4, the end elevation fields feature a F4 **getZ** softkey to retrieve an elevation from a point in the current job database.

Curve (Parabola)



A vertical curve consists of a starting elevation, a length, and entry and exit grades. The length and grades of the segment may be defined by one of three methods:

1. Vertical Curve Length and Grades
2. End of Vertical Curve Station and Grades
3. Three Elevations. Since the starting point station and elevation are known, an intermediate and end of vertical curve station and elevation are required. NOTE: PLEASE NOTE THAT THE INTERMEDIATE STATION AND ELEVATION ARE ON THE CURVE, NOT ON THE TANGENT.

Each of the three methods features a F4 **SOLVE** softkey to open the horizontal or vertical curve solver to solve for a value. From within the solvers it is possible to export solved values to the clipboard, which can then be pasted into any of the fields in the alignment definition input form.

Length and end station fields feature a F3 **endHZ** softkey to automatically insert the length or end station to match the end of the horizontal alignment. For method 3, the elevation fields feature a F3 **getZ** softkey to retrieve an elevation from a point in the current job database.

Edit a Segment

Press F1 **EDIT** to edit the selected vertical segment. For each segment type, straight or curve, the same options are available as when adding a new segment. The current values are automatically inserted into the input form regardless of which method is chosen.

When edits are made to a segment, the segment itself is updated, and any segments following the edited segment are also updated. The stations and elevations of any segment following the edited segment are updated to ensure continuity.

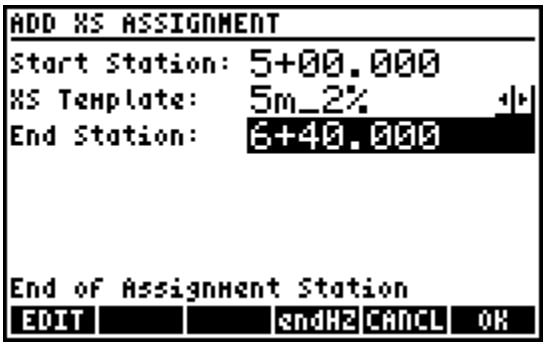
Delete a Segment

Press F2 **DEL** to delete the selected vertical segment. When a segment is deleted, all segments following the deleted segment are shifted to join the segment preceding the deleted segment.

Cross Sections Assignments

Cross Section Templates are created as described in Chapter 3 of this manual. Cross section assignments are only honoured when a vertical alignment for a specified station is defined.

Add an Assignment



Press F6 **ADD** to add a new cross section assignment. Templates can be assigned to portions of alignments by entering a start and end station and choosing the template to use. The first assignment allows the user to enter a starting station, which by default is set to the starting station of the horizontal alignment, but can be changed to any station within or outside the alignment. Subsequent cross section assignments always have the start station set to the end station of the previous assignment.

The Start Station field features a F4 **HZsta** softkey to automatically insert the start station of the horizontal alignment.

The End Station field features a F4 **endHZ** softkey to automatically insert the end station of the horizontal alignment.

Edit an Assignment

Press F1 **EDIT** to edit the selected cross section assignment. When editing a cross section assignment it is possible to change the template and the end station. When the end station is changed, subsequent assignments are adjusted to keep a continuous chain of assignments.

Delete and Assignment

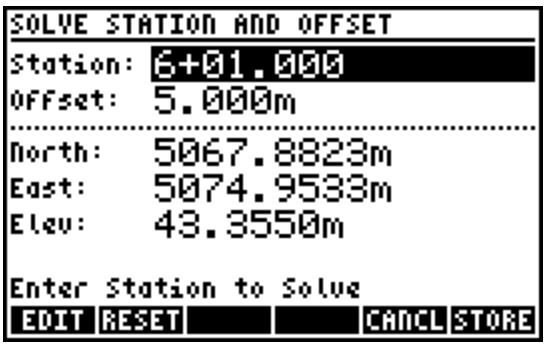
Press F2 **DEL** to delete the selected cross section assignment. When an assignment is deleted, subsequent assignments are adjusted to keep a continuous chain of assignments.

Calculations

Press F4 **CALC** from any of the alignment editing screens to perform calculations using the defined alignment parameters, or to plot the horizontal or vertical alignment. At minimum, a horizontal alignment is required to perform calculations.

Solve Station and Offset

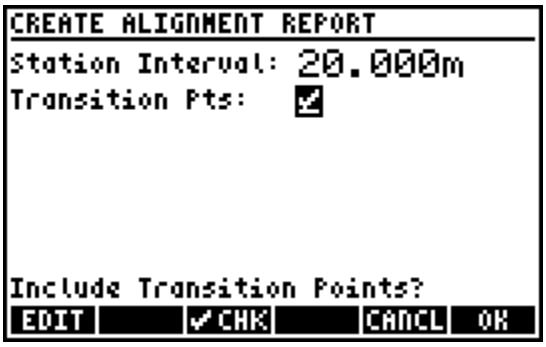
Solve the 3D coordinates for any station and offset simply by entering the station and offset. Some general function notes:



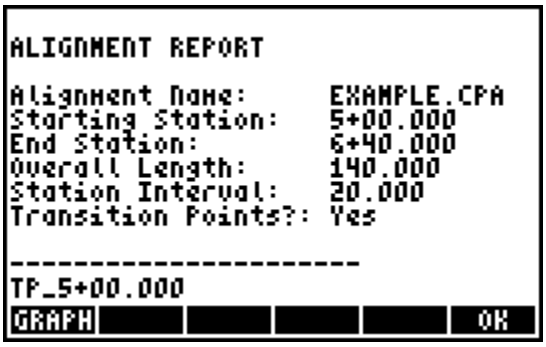
- Elevation values of zero are displayed when a vertical alignment has not been defined for the entered station.
- When the vertical alignment has been defined but no cross section assignment exists; the centerline elevation is displayed regardless of the offset value entered.
- When the vertical alignment and cross section assignment have been defined for a station, but the offset entered exceeds the width of the cross section template, the outermost elevation of the template for the station is displayed.

Press F6 **STORE** to save the solved coordinates as a point in the current job database.

Create a Report

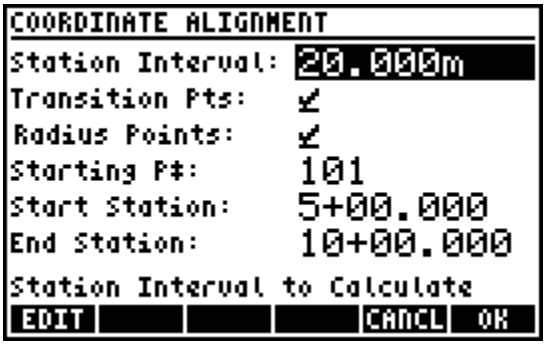


Enter a station interval and select whether or not to include transition points to create a report of the entire alignment. NOTE: TRANSITION POINTS ARE POINTS THAT ARE AT THE BEGINNING/END OF SEGMENTS THAT DO NOT FALL ON AN EVEN STATION INTERVAL. The report includes the coordinates for each offset point as defined by the cross section assignments (including centerline points) for every station at the interval specified, and at all transition points if selected.



The program displays the current station that is being written as the report is compiled. The report may be reviewed on the calculator screen or written to an ASCII file for viewing/printing on a computer.

Create Coordinates



Similar to creating a report, except this program creates points in the current job database for each offset point as defined by the cross section assignments (including centerline points) for every station at the interval specified, and at all transition points if selected. Optionally the curve radius points can also be created.

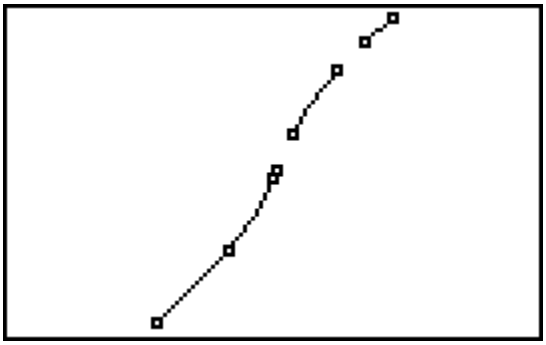
Enter the station interval, select whether or not to include transition points and radius points, enter a starting point number to use, and the start and end station that should be included. Point numbers will be assigned sequentially in a left-to-right pattern across each cross section, progressing from lowest station to highest. Point number conflicts result in the program using the next available number, no points will be overwritten however you may want to ensure that the starting point number you enter is appropriate.

The program displays the point numbers as they are created.

Plot Horizontal Alignments

Plot the horizontal alignment on the calculator screen for a visual confirmation of entered parameters.

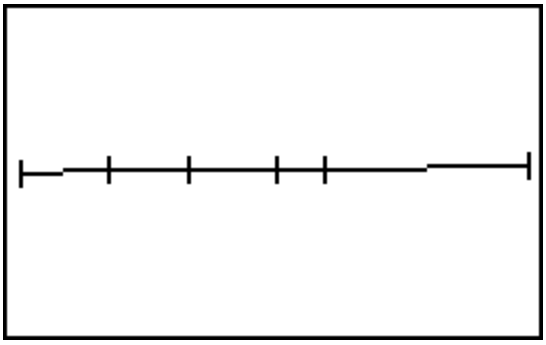
NOTE: Spiral portions of a Spiral-Curve-Spiral segment are not plotted. Transition points are marked with open square markers.



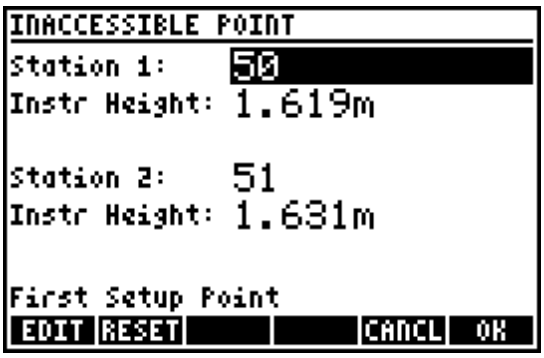
Plot Vertical Alignment

Plot the vertical alignment on the calculator screen for a visual confirmation of entered parameters.

NOTE: Vertical lines mark the transition points between vertical segments.

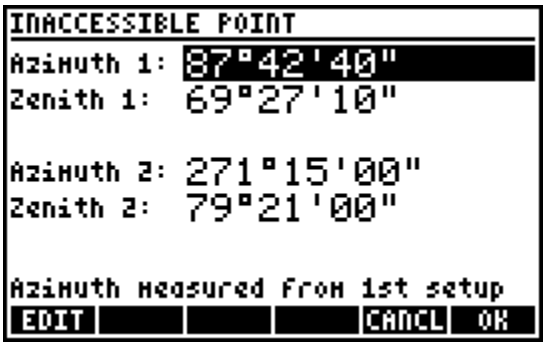


7.4 Inaccessible Point

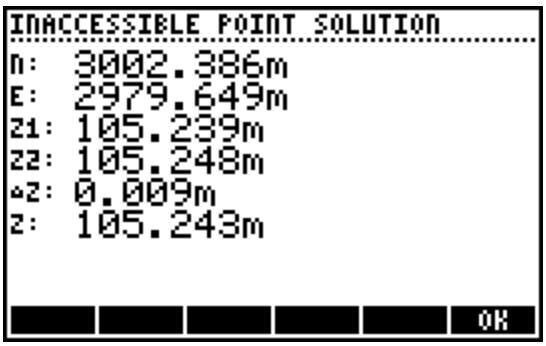


The **Inaccessible Point** program calculates 3D coordinates for points when horizontal and vertical angle observations to the inaccessible point are made from two separate setups.

Enter the point numbers for *Station 1* and *Station 2*, and the height of instrument at each setup in the first input form.

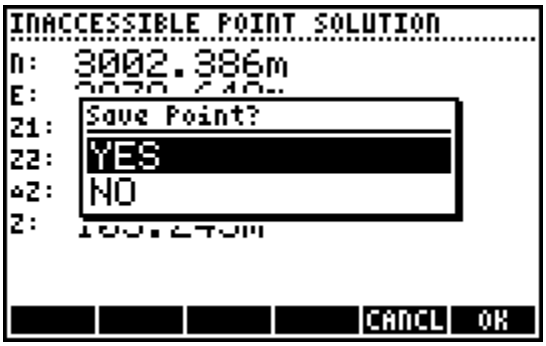


Enter the horizontal and vertical angle observations from each setup in the second input form. *Azimuth 1* and *Zenith 1* are the observations from *Station 1*, while *Azimuth 2* and *Zenith 2* are the observations from *Station 2*.

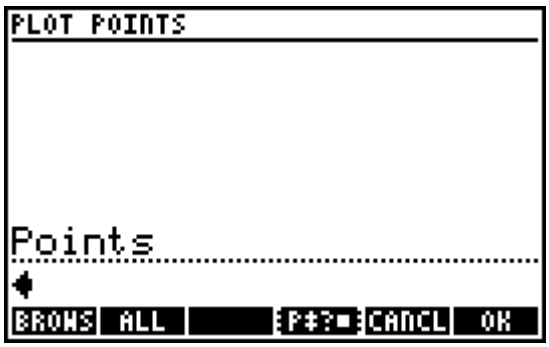


The solution screen displays the coordinates for the solved point, including the calculated elevation values from each observation, the discrepancy between the two calculated elevation values and the average elevation value. The average elevation value is used when storing the coordinates.

Press F6 **OK** to proceed from the solution screen. The option to save the solution as a point in the job database is presented, where choosing YES opens the standard STORE POINT screen to store the calculated point.



7.5 Plot Points

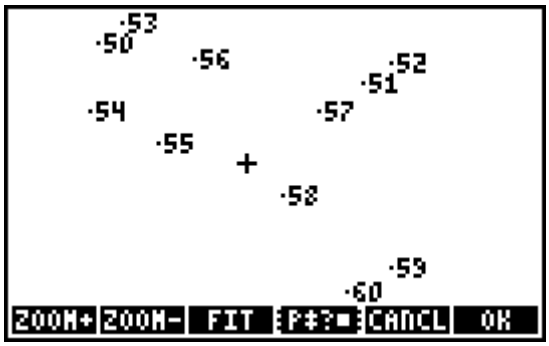


The **Plot Points** program graphically plots points on the screen. The interactive map supports zoom and pan functions, and point numbers can be turned on or off.

In the first input screen, enter the points you wish to plot using any of the point numbers input options. A minimum of two points are required to plot. The menu:

1. F1 **BROWS** – Open the Point Browser to browse/search for specific point numbers.
2. F2 **ALL** – Plot all the points in the current job.
3. F4 **P#?■** – Toggle point number plotting on or off.

Initially, the map plot shows all the points zoomed to fit the screen.



The Menu

The menu provides access to some of the interactive features:

1. F1 **ZOOM+** – Zoom in, the crosshair symbol is the center of the zoom region.
2. F2 **ZOOM-** – Zoom out, the crosshairs symbol is the center of the zoom region.
3. F3 **FIT** – Zoom extents, fit all plotted points on the screen.
4. F4 **P#?■** – Toggle point number plotting on or off.
5. F5 **CANCL** – Exit the map and return to the first screen to enter points to plot.
6. F6 **OK** – Exit the map and the **Plot Points** program to return to the main interface.

Key Assignments

Some of the keys can be used for the interactive features of the map:

1. ▲ / ▼ / ◀ / ▶ cursor keys to pan around the map.
2. + to zoom in, same as F1.
3. − to zoom out, same as F2.
4. ON to exit the map and return to the first screen, same as F5.
5. ENTER to exit the map and the **Plot Points** program, same as F6.