

# **CMT SA3**

## **Surveyor's Assistant Owner's Manual**

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# Section 1 – Getting Started

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The **CMT SA3 (Surveyor's Assistant Version 3)** software application program was designed to operate in the Microsoft Windows CE® environment. When loaded into a mobile device such as the Panasonic Toughbook 01 or the Compaq iPAQ that is connected to a total station, it serves as the controller of a survey data collection system. With the CMT SA3, you may perform the following tasks in the field:

- Collect field data.
- Use coordinate geometry (COGO) functions to compute the location of new points based on existing points.
- Stake out points, lines and areas.
- See the survey data displayed in the on-screen map while you are collecting the data.
- View and edit the data records.
- Reduce data and adjust the traverses and side-shots.

You may transfer the collected data to your desktop PC or notebook computer using the optional **CMT CogoCAD 2.5** or the optional **CMT-SURVEY 6.5** software package. These application programs contain additional functions for enhancing and plotting your survey map. In addition to conventional surveying, the CMT-SURVEY 6.5 also provides functions for GPS surveying and real-time navigation. Contact CMT for information about the CMT CogoCAD 2.5 and the CMT-SURVEY 6.5 software packages.

## 1.1 Hardware and Software Requirements

To effectively operate the CMT SA3, the following configuration is suggested:

1. Microsoft Windows® CE - Mobile Device
2. A minimum of 32 Megabytes of RAM
3. At least 1 Megabyte of free program storage space on your Windows CE device is required.
4. A PC software program such as CMT COGOCAD 2.5 or CMT-SURVEY 6.5 that accepts the CMT SA3 data files for printing, plotting and additional processing

## 1.2 Installing CMT SA3 on your Mobile Device using Windows

The CMT SA3 application package comes with the utility for installing SA3 onto the Windows CE® mobile unit.

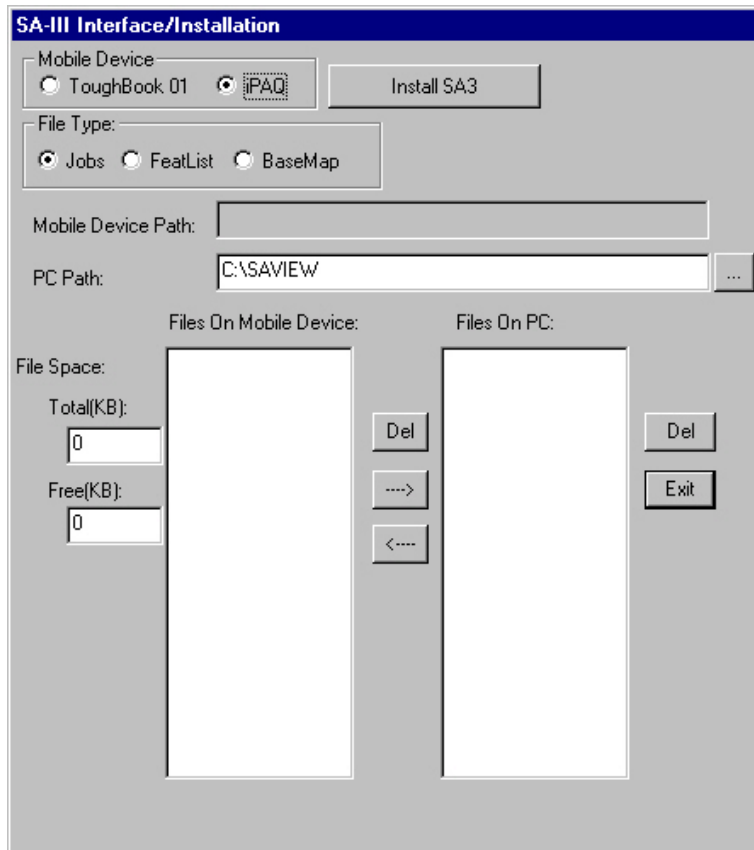
**Before installing SA3, please do the following:**

1. Uninstall any previously installed SA3 CE software from your Mobile Device by deleting the "cmtapp" folder found under the 'Program Files' folder on your Mobile Device.
2. Make sure that no applications are open on your PC and in your Mobile Device.
3. Connect your Mobile Device to your desktop PC using the communication cable supplied with your Mobile Device.

**Follow these steps to install SA3:**

Insert the installation CD-ROM into your CD-ROM drive. This CD-ROM contains the following software:


- **Microsoft® Active Sync 3.5** – This software is used for communication between SA3 and your PC. You may already have this software installed on your PC if you already own and have been using your Mobile Device.
  - **CMT SAVIEW for SA3** – This software is used to install the SA3 software on your Mobile Device.
1. Upon inserting the installation CD-ROM in your PC, the installation should automatically start. If it does not, click **Start** and then click the **Run** option. In the Run dialog box, enter the appropriate CD-ROM drive designation and “AUTORUN” in the “Command Line” or “Open” field and click on the OK button. (Example: D:\AUTORUN). A screen will be displayed to show the installation options.
  2. If Microsoft® Active Sync is not already installed on your PC, please click on the “**Install Microsoft Active Sync 3.5**” button to start the installation program. Follow the installation instructions on the PC. If Microsoft Active Sync is already installed on your PC, please go to the next step.
  3. To install SA3, click on the “**Install CMT SAVIEW for SA3**” button. Follow the installation instructions on your PC to complete the installation.
  4. After SAVIEW has been installed on your PC, you are ready to install SA3 onto your Mobile Device. Start SAVIEW by double-clicking on the “**SAVIEW**” icon found on your desktop, and the following screen will be displayed:

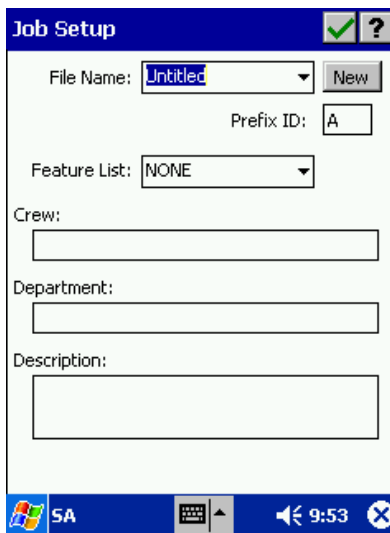




5. Select the model of Mobile Device that you have. For example, if you are using a Compaq iPAQ, then select “iPAQ”.
6. Click on the “**Install SA3**” button to install SA3 onto your Mobile Device. After installation of SA3, you will see a message indicating that it was installed successfully. You can exit the SAVIEW software by clicking on the “Exit” button. You are now ready to run SA3.

### 1.3 Starting SA3

After installing SA3 on your Mobile Device, tap on the Windows Icon  and select “**SA**” from the list. SA3 will start and the Job Setup screen will be displayed for you to set up your project.



### 1.4 Validation Number for SA3

The CMT SA3 application program is protected by a “software key”.

Without obtaining a valid validation number from CMT, you may only run the software a limited number of times. After that, the program will prompt you for a validation number. A “**User Key**” number associated with your Mobile Device will be shown in the Validation dialog box. Copy this number down so you may submit it to CMT to request a **Validation Number** for SA3. Once you have obtained and entered the validation number, the program will start without prompting you for it again.

To obtain your validation number, please complete and submit the Online Validation Form posted at [www.cmtinc.com](http://www.cmtinc.com). You can also e-mail the requested information to us.

**Please make sure that you include the User Key number as well as the software serial number printed on the program CD.**

### 1.5 Getting Help in SA3

SA3 provides Help for many screens. Help may be accessed by tapping on the “?” icon in the upper right corner of the screen.

## 1.6 Technical Support for SA3

Technical assistance for SA3 is available via World Wide Web:

- Web site: <http://www.cmtinc.com>

CMT offers a Software User's Discussion Board for technical support where users may ask questions and answer questions posted by other users.

## Section 2 – SA3 Fundamentals

---

In this section, the basic terminology and major concepts behind SA3 (Surveyor's Assistant version 3) are presented. It is highly recommended you read through this section thoroughly for a clear understanding of the fundamental concepts. The ideas and examples presented will be used and built upon in subsequent sections.

If you are eager to see how to use SA3 to do a survey job, you may go to Section 8 (Tutorial) after reading this section.

### 2.1 Data Organization

Each SA3 job file contains Feature data, Field data (measurement data) and Figures. These three types of data are organized in the form of databases that may be accessed for editing.

**Feature data** is tied to a specific location defined by a set of coordinates (e.g. Northing, Easting and Elevation). It is referred to as spatial data. SA3 automatically displays a plot of all the recorded features. The hierarchical structure of Feature Data is described in the following two subsections.

**Field data** consists of raw measurement data records. The distance and angle measurements made between the occupied station and the back-sight and foresight locations are used for computing the Feature coordinates. You may manually enter the survey measurement data, or read the data automatically from an electronic instrument (total station). As field data is collected, feature coordinates are automatically computed and stored in the memory of your mobile device. SA3 can be configured to display the traverse path and side-shots. This allows you to quickly determine the presence of any gross error, or check the traverse closure in the field.

A **Figure** is a group of Features. This device is used for grouping a number of Features together so they may be displayed and operated on as one entity.

#### 2.1.1 Features, Attributes and Values

Spatial data includes coordinates as well as descriptive Geographic Information Systems (GIS) terms such as Features, Attributes, and Values.

A **Feature** is a GIS term used to describe an object. A Feature is tied to a specific coordinate position or a set of coordinates and therefore is spatial data. For example, a Feature could be a Tree at a specific coordinate location.

Three Feature types can be defined in SA3: **Point** Features, **Line** Features and **Area** Features. A Point Feature is an object with one associated coordinate position such as a tree. A Line Feature is an object associated with a series of coordinates connected together such as a stream. An Area Feature is an object associated with a series of coordinates connected together to form a closed area such as the boundary of a parcel of land.



Additionally, you may characterize the Features with optional **Attributes** and **Values**. An Attribute is a specific descriptor such as Species. The Value is a quantitative or qualitative description for the corresponding Attribute, such as Douglas Fir. The Attribute represents the question you are asking about the Feature, and the Value represents the answer.

**Example:** A fir tree might be recorded as follows:

|              |             |   |
|--------------|-------------|---|
| Feature:     | Tree        | ● |
| Attribute:   | Species     |   |
| Value:       | Douglas Fir |   |
| Coordinates: | 44 33 46 N  |   |
|              | 123 15 45 W |   |

You may define more than one Attribute for each Feature. For the above fir tree, you could assign “Age” as another Attribute and “30” as the corresponding Value.

## 2.1.2 Feature Topics and Individual Features

In general, it is advantageous to place Features with same attributes in a group referred to as a **Feature Topic**. You may create a number of different Feature Topics in each job file. At any moment, you may designate one Feature Topic as the active Feature Topic. All data collected or added to the Map View will be placed in that Feature Topic until another Feature Topic is made active.

The rules that define a Feature Topic are:

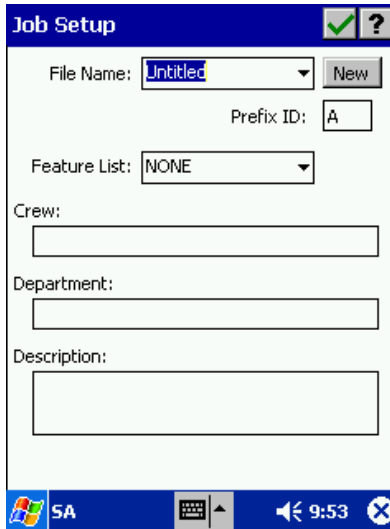
1. A Feature Topic is a grouping of one or more individual Features that are defined by a common set of Attributes.
2. Individual features grouped together under a Feature Topic should be of the same type: Point, Line or Area.
3. The Feature Name is used as the Feature Topic name.
4. Each feature within a Feature Topic is assigned a unique identification number. For example, the first feature in the TREE Feature Topic will be assigned the Feature ID **TREE001**.


## 2.2 Job Setup

SA3 can be configured with specific instrument selection, measurement units, measurement systems, measurement conditions, repetition setup, map display setup, and others. The system configuration remains the same until you use the “Configure” function to change the settings. Many of the data entry fields for setup information provide options that you can select by using the stylus on your mobile device.

Normally, the very first thing you do after starting the SA3 program is to specify a job (project) name. All subsequent operations are then tied with that job until you select a different job.

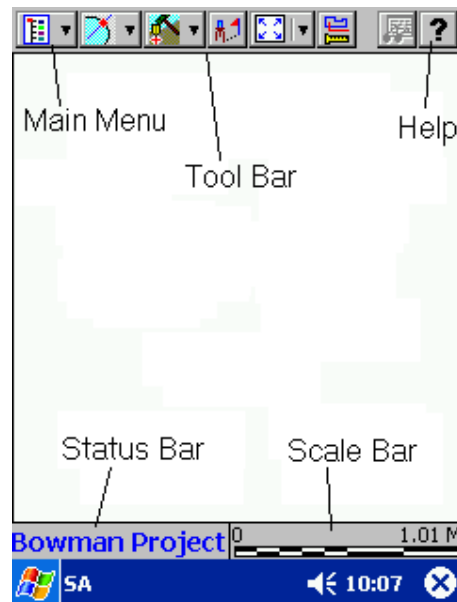
A couple sample jobs are provided with SA3. They are: **cmttut.psa** and **2lots.psa**. Feel free to open either job and navigate through the functions provided by SA3.




To name your job, tap on the Keyboard function at the bottom of the screen and type in the name of your job. Use the keyboard function to also type in the name of the Crew, Department and a brief description of the job if you wish. The Feature List may be selected to assist in classifying newly collected data with Features, Attributes and Values that have been pre-defined. When finished, tap on  to continue to the main SA3 screen. Other system configuration screens are discussed in Section 4.

## 2.3 Working with SA3 Tools and Menus


The main SA3 screen is shown below with the menus and tool bars labeled:

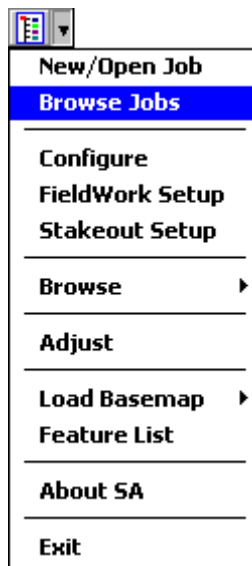


### 2.3.1 Main Menu Button

The Main Menu Button is located at the top of the main SA3 window: 

The Main Menu Button provides access to most of the active SA3 commands and functions. The menu options can be activated by first tapping on the Main Menu button to pull down the menu list then tapping on the desired selection.

**Please note:** In this manual the convention “Menu option/Submenu option” will be used. For example, “**Menu/Browse Jobs**” means you should pull down the Menu option by tapping on  then tapping on “Browse Jobs”. Following is an example.



### 2.3.2 Tool Bar

The Tool Bar is located at the top of the SA3 main screen:



The Tool Bar contains standard Windows button icons for quick access to SA3 functions. Simply tap on an active button icon to access the associated SA3 function. An inactive button icon will appear dull and gray.

### 2.3.3 Map Scale

The Map Scale bar is located at the bottom of the SA3 display. The current Map display scale bar is shown in this box.



### 2.3.4 Status Bar

The status bar is located at the bottom of the SA3 display to the left of the Map Scale Bar. This bar shows current Job information and current Feature Topic information for adding data manually.

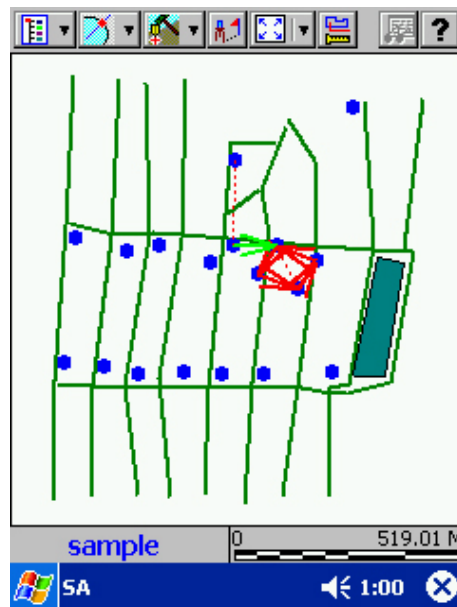



## 2.4 Viewing Data in SA3

Data in the Job file can be viewed and edited using different view modes. The default view mode is the Map View.

### 2.4.1 Map View

The Map View provides a graphic representation of the Job file. All spatial data (Features), traverse paths and BaseMap data may be represented in the Map View. Following is an example showing some feature data and measurement paths:



When you work in another screen and wish to return to Map View, tap the Map View icon  or exit that screen and any other function screens until Map View is displayed.

## Displaying Data in the Map View

Features are displayed in the Map View according to the rules below. When you first open your Job file, the default point symbol or line/area pattern will be used.

**Point Features:**  (Default Symbol)

A Point Feature, such as a House, is represented in the Map View by a small colored circle as shown above. A Point Feature can be selected from the Map View by tapping on the map representation of the individual Point Feature.

**Line Features:**  (Default Pattern)

A Line Feature, such as a Stream, is represented in the Map View by solid line as shown above. The line will be connected via all of the nodes (coordinates) within the Line Feature. A Line Feature can be selected from the Map View by tapping on the map representation of the individual Line Feature.

**Area Features:**  (Default Pattern)





An Area Feature, such as a Land Plot, is represented in the Map View by a solid “area” in the shape of the Feature bounded by a thin black border. An Area Feature can be selected from the Map View by tapping on the map representation of the individual Area Feature.

## Symbols and Patterns for your Features

SA3 offers a number of special point symbols and two line styles. Area features are represented as solid areas. You may select different colors for the point, line and area features. For information on using symbols and patterns, see Section 3.5.3 in this manual.

## Zoom Tools in the Map View

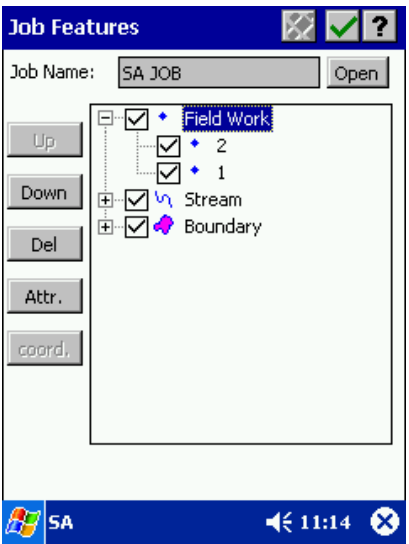
SA3 provides four different tools for viewing your data at different levels of magnification. These tools are found in the **Map Tools** pull-down menu in the Tool Bar.

- |  |   |
|--|---|
|  Zoom Fit | Zoom to fit all of the objects on the page.             |
|  Zoom In  | Zoom-in to the selected area.                           |
|  Zoom Out | Zoom out from the current view.                         |
|  Pan      | Drag the map to bring the region of interest into view. |

## **2.4.2 Job Features Screen - Feature Topic Order**

Features in your Map are organized into Feature Topics or layers. The Feature Topics in the Map are listed in the Job Features Screen. The order in which Feature Topics are listed affects the display of Features in the Map View. To access the Job Features Screen, choose **Menu/Browse Jobs**. A screen similar to the following will be displayed:



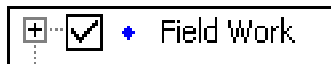


In general, Feature Topics should be arranged by type and size. Point Feature Topics and Line Feature Topics should be listed first. Small or medium size Area Feature Topics should be listed next. Large Area Feature Topics should be listed last. (An Area Feature Topic on top of a Point Feature Topic may prevent you from seeing the Points.)

You can **change the order** of the Feature Topics by tapping on the desired Feature Topic name and then tapping the “**Up**” or “**Down**” button to move the Feature Topic to a different location in the list of Feature Topics.

**Marking Feature Topics for Display in the Map View**

The mark box to the left of each Feature Topic name listed in the Job Features screen is used to specify which Feature Topics are displayed in the Map View. When you first open your Job file, all of the Feature Topics in the Job Features screen will be marked with a check and all of the Features assigned to that Feature Topic would be displayed in the Map View.



Field Work Feature Topic toggled ON



Field Work Feature Topic toggled OFF

You can toggle the display of a Feature Topic ON or OFF by tapping on the mark box. Toggling the Feature Topic mark box OFF will hide the Features of the Feature Topic in the Map View. Upon exiting SA3 or opening a different Job file, SA3 will automatically store the Feature Topic display information for your current file.




**Feature Topic Icons**

A Feature Topic icon, representing the Feature type, is located to the left of each Feature Topic name. The default icons for Point Feature Topics, Line Feature Topics and Area Feature Topics are shown below.

### Icons as shown in the Browse Jobs View:



### Icon Definitions:

-  Point Feature Topics
-  Line Feature Topics
-  Area Feature Topics

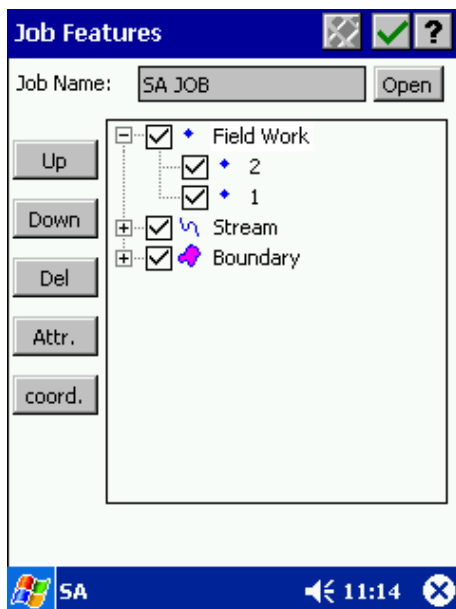
## 2.4.3 Job Features Screen - Feature Order

The Features associated with each Feature Topic may be viewed in the Job Features Screen. To access the listing of features associated with a Feature Topic, either tap twice on the Feature Topic name or tap on the “+” sign next to the Feature Topic name. A branched listing of all the features listed under the Feature Topic will be displayed. Editing functions for the features listed under each Feature Topic only apply to the selected Feature.

The Feature records in the Job Features screen for the active Feature Topic will be numbered beginning with number one (1). The Feature number, displayed with each Feature record, is for reference only. The Feature number represents the current order of the Features in the active Feature Topic. The order of Features in a Feature Topic may be changed by highlighting the Feature Record and then using the “Up” or “Down” buttons to move the feature record up or down in the list. This is useful for proper display or selection of area features when several overlapping areas of different sizes are all listed in the same Feature Topic.

## 2.4.4 View Attributes/Values

The Job Features screen also provides access to the Attributes and Values for Feature Topics and individual features.



### Options for Job Features screen

**Up:** Move the selected feature or Feature Topic up one position (if possible).

**Down:** Move the selected feature or Feature Topic down one position (if possible).

**Del:** Delete the selected feature or Feature Topic

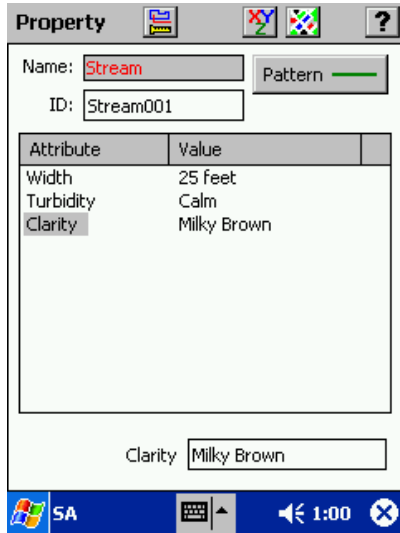
**Attr. / Value:** If a Feature Topic is selected, the **Attr.** button will be displayed. Tap on that button to go to the Attribute Editor screen for the selected Feature Topic.

If a Feature is selected, the **Value** button is displayed. When you tap that button, the Feature Properties “Attribute and Value” information will be displayed.

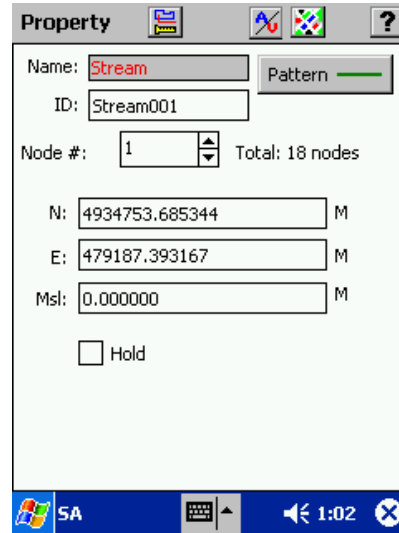
**Coord:** Coordinate information can be accessed for a selected feature by tapping on the **coord.** button.

For example, tap on the Feature record for which you want to see information and then tap on the “**Value**” button. The Attributes and Values for the specified Feature ID will be displayed. To see the coordinate information for the Feature, tap on the “**coord.**” button.

For the SA3 job displayed above, the **Attribute/Value view** for the Stream001 Feature lists Width as “25 feet”, Turbidity as “Calm” and Clarity as “Milky Brown”. The **Coordinate information view** displays the coordinates for the selected feature as well as the current symbol/pattern assignment.



**Attribute/Value view**



**Coordinate information view**



## Section 3 - Working with SA3 Data Files

This section provides information about how to open, view, edit, manage and transfer SA3 data files. You will be working with the following types of data files.

### **SA3 Job Files**

Data in SA3 is stored in Job files (\*.PSA). A Job file may contain Feature data, Field measurement data and Figures. You may use SA3 to adjust the traverse and side-shot points generated from the measurement data.

### **Feature List Files**

Pre-defined lists of Features, Attributes and Values can be stored in a Feature List file (\*.FBR) to assist in data collection. This useful tool greatly reduces the amount of data entry that must be manually typed in while collecting data in the field.

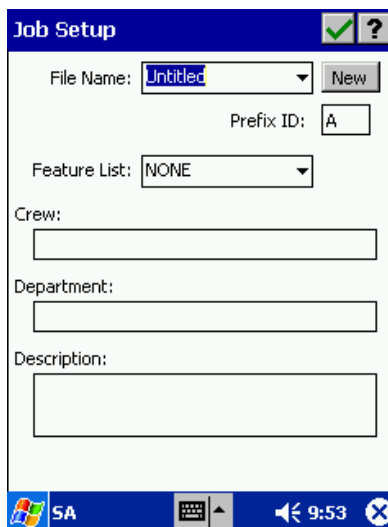
### **BaseMap Files**

BaseMap files (\*.PBM) are files that contain background information such as streets, hydrology, city limits, etc. to assist in navigation and data collection. The BaseMap file can be loaded along with your Job file in the Map View.


For information on converting BaseMap files to SA3 format, please refer to the built-in help for the optional PC-GPS, PC-MAP, PC-MAPPER or CMT-SURVEY software packages.


## 3.1 Opening your Job file

Use the **Menu/New/Open Job** option to open a new or existing SA3 Job file on your Mobile Device. The Job Setup screen is shown below:

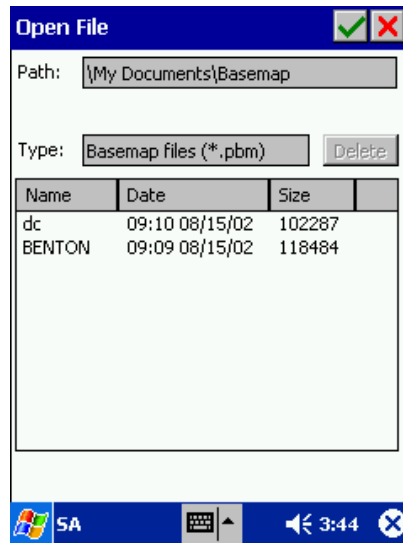



Select a Job file to open by either entering the file name in the File Name box or by tapping on the drop-down arrow to the right of the File Name and selecting the appropriate file name listed in the drop-down list. A Feature List may also be selected in this screen to assist in data collection. (See Section 3.8.) Optional information such as “Crew”, “Department”, and “Description” may be

typed in here to help identify the job. A Keyboard icon  is available at the bottom of the screen to enter information into these fields.

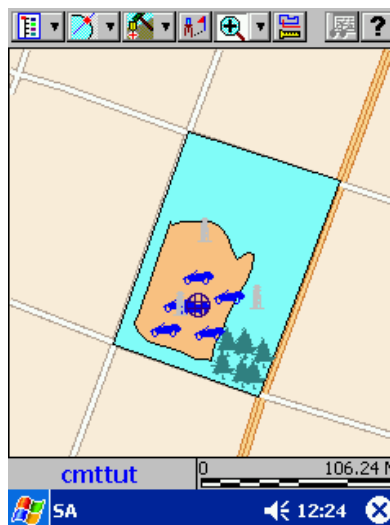
Once the proper files have been selected and any optional information has been typed in to the available fields, tap  in the Tool Bar and your file will be displayed. This will close any file you had open before.

Select Menu/Load Basemap/Auto Load to automatically load the basemap for your job or choose Manual Load to select a BaseMap from the list of available BaseMaps to be loaded with the job:



For manual loading, tap on the BaseMap file you wish to load with the Job file and tap  in the Tool Bar.

The following main SA3 window is displayed when you open the job file **CMTTUT.PSA** with the Benton County, Oregon BaseMap:




## 3.2 Saving your Data

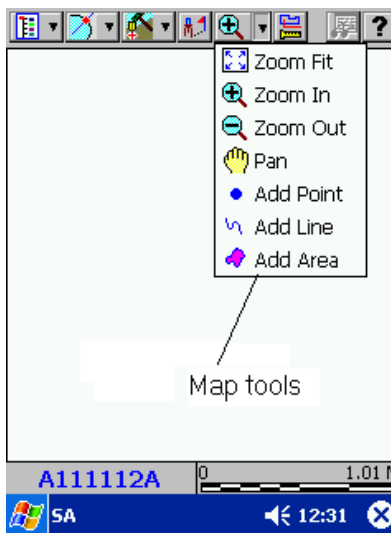
New data or changes in your Job file are saved automatically in one of four situations:

- 1) When you exit the SA3 software.
- 2) When you change current Job files using the **Menu/New/Open Job** function.
- 3) If either of the above methods of saving data has not been performed after 10 minutes, SA3 will automatically save your Job file.
- 4) When transferring your Job file to your PC using CogoCAD 2.5 or CMT-SURVEY, SA3 will automatically save your Job first.

## 3.3 Adding Features to Your Map

You may use the **Map Tools** to manually add new Features to the current Job file. You can add a new Point, a new Line or a new Area Feature.

The Map Tools can be accessed from the Map View and defaults to the Zoom Fit button . The following diagram shows the **Map Tools**:



### 3.3.1 Adding Point Features

The **Map Tool/Add Point** option is used to add a new Point to the Map.

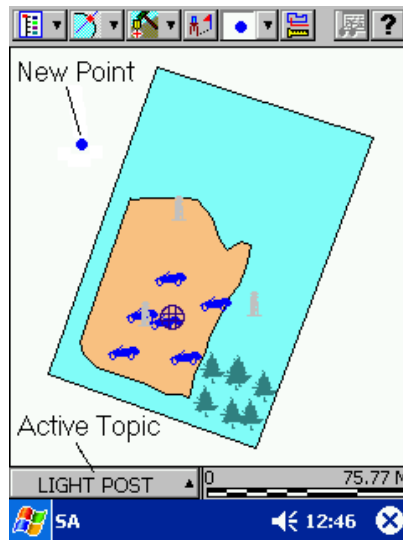
#### Steps for the Add Point function

1. Select the **Map Tool** pull-down list and choose **Add Point**.
2. Select a Feature Topic for the new Point on the Status bar at the bottom of the screen. Tap on the Feature Topic name at the bottom to see a pop-up list of all Feature Topics for the current job. Select a Feature Topic from the list, or choose "**NEW**" to create a new Feature Topic for your feature.
3. Tap the stylus on the location for the new Point. Multiple points may be added by tapping on the locations of the new Point features in Map View.
4. Tap on the **Map Tool** button again to de-activate this function.

Immediately, your Map file will be changed in three ways:

- 1) A new Point will be displayed at the coordinates of the stylus tap in the Map View.
- 2) A blank Feature record will be appended to the Attribute/Value View for the Feature.
- 3) The new Feature will be added to the active Feature Topic and the Feature ID will be listed under that Feature Topic.

Following is an example of the Map View after using the Add Point function to add a new point:



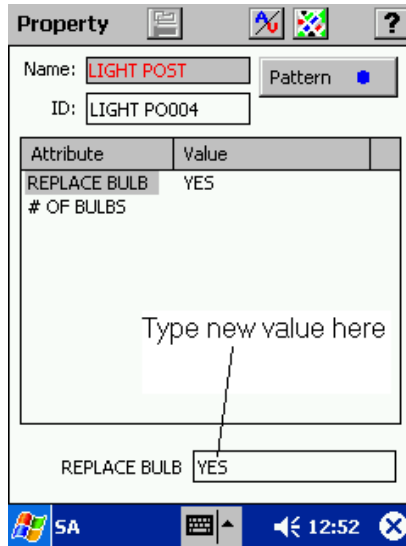
**Example:** A new Light Post Feature has been added to the Light Post Feature Topic in the example CMTTUT.PSA. A new Feature record has been added to the Attribute/Value View.

### 3.3.2 Completing the new Feature Record in the Attribute/Value View

The Feature record for each Feature in the Map can be viewed in the Attribute/Value View. The Attribute/Value screen can be viewed by selecting the feature, then tapping on the Feature Properties button. Then Attribute/Value screen or Coordinate Information screen will be displayed. If the coordinate information screen is displayed, you can toggle to the Attribute/Value screen by using the Attribute/Value View icon.

When a new Feature is added to the Map file, a blank record is appended to the Attribute/Value Screen of the active Feature Topic. To complete the Feature record, tap on the blank Attribute cell of the Feature record and enter the appropriate Value at the bottom of the screen (see the following example).





**Example:** The above screen is for the example CMTTUT.PSA. A new Point Feature has been added to the Houses Feature Topic. You may update the record by highlighting the attribute name and then typing in the appropriate value information at the bottom of the screen.

### 3.3.3 Adding Line Features and Area Features

The **Map Tool/Add Line** option is used to add a new Line Feature to the Job file. The **Map Tool/Add Area** option is used to add a new Area Feature to the Job file.

The procedure for adding a Line or Area Feature is outlined below:

#### Steps for the Add Line or Add Area function

1. Select the **Map Tool** pull-down list and choose: **Add Line or Add Area**.
2. Select a Feature Topic for the new Line or Area by tapping on the pull-up arrow in the Status bar and selecting the appropriate Feature Topic name. Select <<New>> to create a new topic.
3. Tap the stylus on the starting position of the Line or Area in the Map View, then move the stylus to each subsequent coordinate position and tap once with the stylus.
4. At the last coordinate position, tap on the **Map Tool** button again to de-activate this function.
5. Complete the Feature record for the new Feature as described previously in Section 3.3.2.

## 3.4 Selecting Data for Edits

In order to edit a Feature, the Feature must first be selected. An individual Feature can be selected by tapping once on the Feature in the Map View, by using the Menu/Browse/Features function or by using the Menu/Browse Jobs function.


### 3.4.1 Selecting a Feature from the Map View

When you tap once on a Feature displayed in the Map View, the selected Feature will be displayed in orange and the Feature Name and the coordinates will be displayed briefly.

BaseMap features can be selected in the same manner. The BaseMap feature selected will be displayed in orange and the BaseMap Feature name will be displayed briefly.


**Please note:** The default selection color for Features in the Map View is ORANGE. You may change it by using the **Selection Color** option under **Menu/Configure/Color/Pattern Setup**.


SA3 will also temporarily display coordinates for any location (non-feature related) in the Map View. To obtain the coordinates for a location on the map, simply tap once on the map at the location and the coordinates will be displayed for a few seconds. The coordinates shown will reflect the specified Coordinate System in the **Menu/Configure/Coordinate System** screen. (See Section 4.1.)

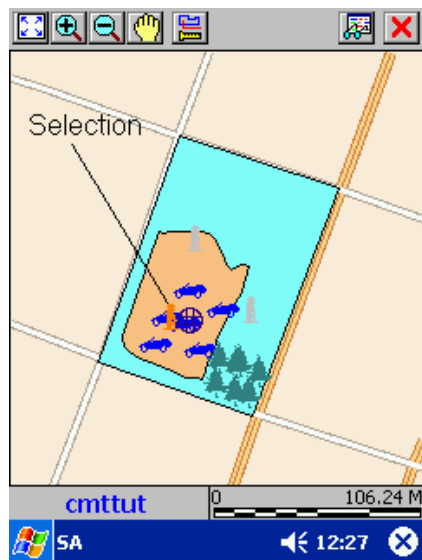
Once a feature is selected, the properties of the feature may be edited by using the Feature Properties button  found on the Tool Bar. Details about editing data in Map View are provided in Section 3.5 of this manual.




### 3.4.2 Selecting a Feature via Menu/Browse/Features

When you select **Menu/Browse/Features**, all the Feature Topics in the currently open job will be listed in the **Browse Features** screen.

Tap twice on the Feature Topic of interest or tap on the associated “+” symbol to see a listing of all the features in that Feature Topic. Tap on one of these features and tap on  in the Tool Bar to go to the “**View Selection**” window. The “View Selection” window is dedicated to viewing and editing the selected Feature.

**Example:** To select the third Light Post in the example file CMTTUT.PSA, tap on the ID: LIGHT PO003 in the Browse Features screen. Then, tap on  to go to the “View Selection” window. The Feature ID: LIGHT PO003 is highlighted in orange in the following screen.



It is now easy to get important Feature Property information about this feature by tapping on the Feature Properties button . (See section 3.5.1.) Alternatively, you can use the zoom tools to get a closer look at the feature. If the selected feature is a line or area, you can use the “Measure Length/Area” button  to get length or area information about the feature. To toggle back to the “Browse Features” screen, tap on the  button.

### 3.4.3 Selecting a Feature via Menu/Browse Jobs

When you select **Menu/Browse Jobs**, the **Job Features** screen will be displayed. You may work with the features in the currently open job, or tap on the **Open** button to temporarily open another job to edit. If you open another job, that job will be closed as soon as you exit the Job Features screen. The displayed Map View will be for the original active job.












The method of selecting a feature to edit is identical to that for the **Menu/Browse/Features** function described in Section 3.4.2.

## 3.5 Viewing and Editing Feature Properties


The properties of Features can be easily viewed using the methods described in the following sections.

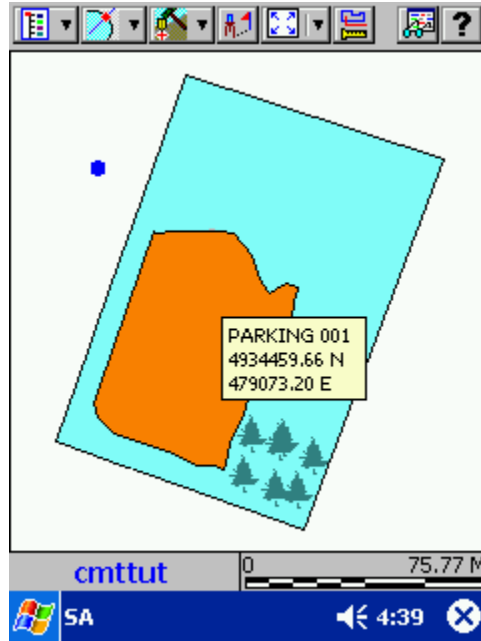
### 3.5.1 Feature Properties - Checking & Changing

The properties of your Features can be viewed or modified using the functions of the Feature Properties button. The table below summarizes the methods for accessing Feature property functions after the desired feature has been selected in the Map View or the View Selection screen.

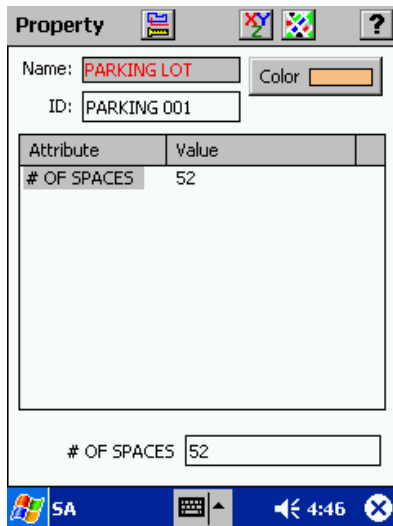
| Feature Property Function                                    | Steps for Accessing Function                    | Tool Bar icon  |
|--|---|--|
| <b>Color</b>   | 1. Select Feature Properties button.            | 1.   |
|  | 2. Select <b>Pattern</b> button.                | 2.  |
|  | 3. Select <b>Color</b> button.                  | 3.  |
| <b>Symbol/ Pattern (only available for points and lines)</b> | 1. Select Feature Properties button.            | 1.  |
|  | 2. Select <b>Pattern</b> button                 | 2.  |
| <b>Coordinate Information</b>                                | 1. Select Feature Properties button.            | 1.  |
|  | 2. Select <b>Coordinate Information</b> button. | 2.  |
| <b>Attributes/Value Information</b>                          | 1. Select Feature Properties button.            | 1.  |
|  | 2. Select Attributes/Values button.             | 2.  |
| <b>Area/Length Information</b>                               | 1. Select Feature Properties button.            | 1.  |
|  | 2. Select <b>Area/Length</b> button.            | 2.  |

### Using the Feature Properties button

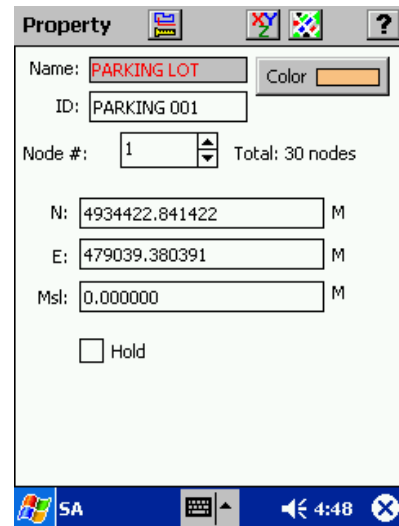
You can access the **Property** screen by tapping on a Feature in the Map View and then tapping on the Feature Properties button . An example of this process follows.



**Example:** The example file CMTTUT.PSA is displayed. The Parking Lot Feature is selected. When the **Feature Properties** button is tapped, the Feature Properties information for the selected Parking Lot Feature will be displayed:




**Attribute/Value view**



**Coordinate Information view**

The Feature Name and Feature ID are listed in the Name and ID fields, respectively. Feature property functions will apply to the highlighted Feature only.

### 3.5.2 Coordinate Information

The coordinates of the selected Feature are listed in the coordinate position fields shown in the Coordinate Information view in the **Property** screen described in Section 3.5.1. For a Point Feature, only one coordinate position will be listed. For a Line or Area Feature the coordinates of each node will be listed. The coordinates of each node may be viewed by using the “Up” and “Down” arrows in the **Node #** box. Coordinate positions may be edited in SA3 by simply tapping on the coordinate and typing in the new coordinate value using the keyboard function .

**Example:** For the Coordinate Information dialog box displayed on the previous page, the position and properties of the coordinate fix are listed. In this case, the coordinate node is one of thirty nodes with the Northing, Easting and Elevation displayed underneath.

The coordinate information is displayed for an individual coordinate node or Point Feature.

**Coordinates:** The coordinate information and units of measurement based upon the Coordinate System selected under **Menu/Configure/Coordinate System** will be listed in this section.

**Hold:** When this box is marked, the point is then considered a “hold” point, i.e. a control point with fixed coordinates. All points of a particular job will be changed to “hold” points after performing an adjustment of the job. When you attempt to adjust a “hold” point, SA3 will prompt you to confirm that you really wish to overwrite its coordinates with the new values.


### 3.5.3 Feature Symbols and Patterns

Point features in your Map can be displayed in a variety of symbols. SA3 provides a library of point symbols for Point Features that are shared by all features and all jobs. A simple library of two different line styles is available for Line Features. There is no library of fill patterns for Area Features in SA3.

**Assigning Symbols and Patterns:**  

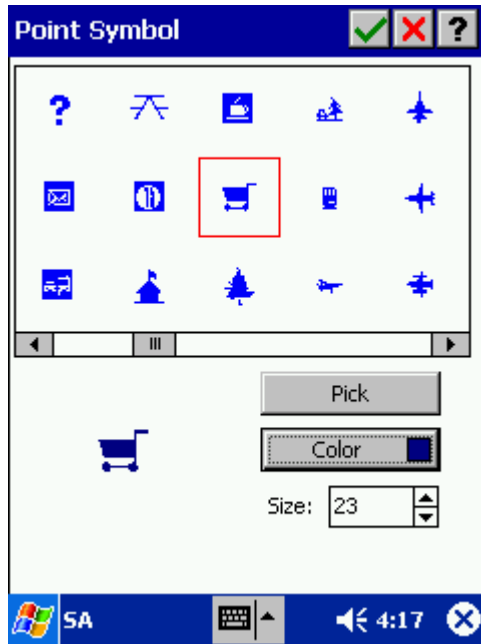
When you select a Point or Line feature and tap the Feature Properties button, the Coordinate Information screen for your Point or Line will be displayed. From the Coordinate Information screen, you may select a symbol or pattern and a display color by tapping on the “Pattern” button.

#### **Summary of steps for selecting Symbols or Patterns for your Features**

1. Select your Feature and display the Coordinate Information screen.
2. From the Coordinate Information screen tap on the “Pattern” button. The selected symbol will be highlighted with a selection box. Scroll through the displayed symbol library until the desired symbol is found. Tap on the desired symbol so it is highlighted with the selection box.
3. Tap on the Color button to select a symbol display color.
4. Tap on the  button to accept the symbol.

## Symbols for Point Features

When the Feature you have selected is a Point, tap on the Feature Properties button and then the **Pattern** button to display the Point Symbol Page:






### Options for Point Symbols:

**Pick:** Displays available point symbol libraries.

**Color:** Tap on the color button to select a symbol display color.

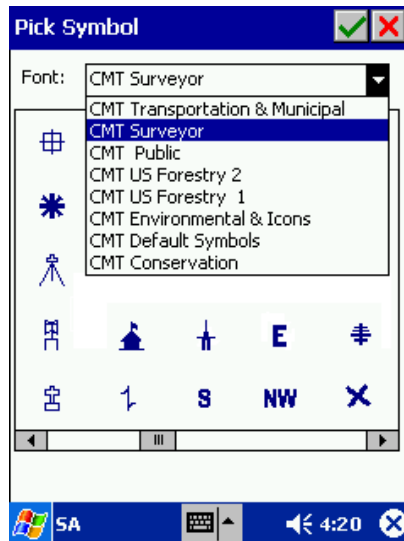
**Size:** Input a symbol size between 1 and 32.



**To select a symbol:** Tap on the symbol you wish to use. The selected symbol will be indicated by a selection square. If desired, tap on the Color button to assign a different display color to the selected symbol. Tap on the  button to save your selection and return to the Feature Properties screen.

**To change your Point Symbol Page:** When you add a new symbol, one of the existing symbols will be replaced. First, select a symbol to “forfeit” from the symbol palette. The selected symbol will be highlighted with a red box. Tap on the “**Pick**” button to go to the Symbol Library to choose the new symbol. Choose the new symbol from the library and choose . The new symbol will be displayed in the Custom Symbol Page. Tap  to return to the Feature Properties screen.

**Please note:** Avoid changing the symbol that is set to be the default point symbol via the Setup/Color/Pattern/ Default Point Pattern function (section 4.4). The chosen symbol will be used globally in all \*.PSA files. When the content of the Point Symbol Page is changed, all point features referenced to the changed symbol will be affected.

**To pick a different symbol library:** If the desired symbol is not found in the currently displayed library, a different point symbol library may be chosen. Tap on the “Pick” button to go to the symbol library page. You may change the library by tapping on the pull-down menu and picking another font library from the list as shown. There are several different point symbol libraries to choose from:



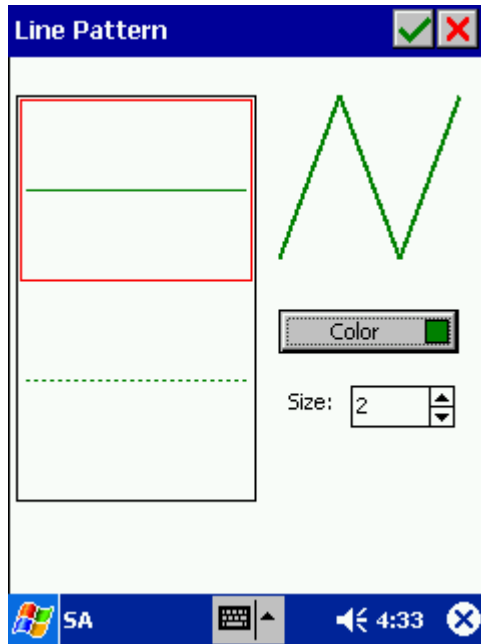
Tap on the desired symbol and tap the  button to accept the library and return to the Point Symbol dialog box. The newly selected symbol will be displayed with the selection square. Tap  to accept this symbol and return to the Feature Properties screen.

**Please note:** CMT-SURVEY 6.5 and CogoCAD 2.5 will use the same symbol library index as SA3. This is to ensure that symbol assignment will not change when opening \*.PSA files on your PC. When replacing a symbol in SA3, please be sure to also change the corresponding symbol on your PC.

Symbol libraries may be restored to the original Symbol Library included with SA3, by deleting the SAP00.LIB file in the ‘CMTAPP’ folder of your Mobile Device. To restore the Point Symbol Library originally included with CMT-SURVEY 6.5 or CogoCAD 2.5, delete the CMTPTNT00.LIB file in the ‘SURVEY65’ or ‘CogoCAD’ folder on your PC.

## Patterns for Line Features

When the Feature you have selected is a Line, tap on the Feature Properties button and then the Pattern button to display the Line Pattern dialog box:



### Options for Line Patterns:

**Color:** Tap on the color button to select a line pattern display color.


**Size:** For solid line patterns, input a size between 1 and 5. Size may not be changed for dashed line patterns.

**To select a pattern:** Tap on the pattern you wish to use. The selected pattern will be indicated by a selection square. If desired, tap on the Color button to assign a different display color to the selected pattern. A preview of the line pattern is displayed in the upper right area of the Line Pattern Dialog Box. Tap on the  button in the Line Pattern dialog box to save your selection and return to the Feature Properties screen.

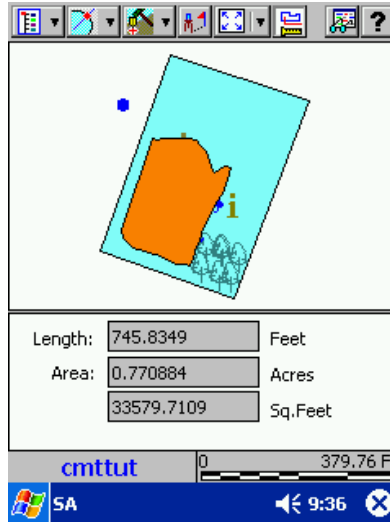
## Patterns for Area Features

The area features are displayed with a solid fill pattern. You may change the color of an area feature by tapping on it and then tapping on the Feature Properties button. Select the new color after tapping on the **Color** button.


### **3.5.4 Accessing Length/Area Information**

SA3 provides the capability of displaying **length** or **area measurements** for a selected line or area feature. The Measure Area/Length button  is available in Map View, in the Feature Properties screen and in the View Selection screen. When tapped, it will provide length and area information for the selected line or area feature. The screen below shows the Area/Length information for the previously selected Area feature **Parking Lot1** (when accessed from the Map View).





When you tap the Measure Length/Area button from the Map View, you will see the area/length measurement appear in the lower portion of the Map View. This is a dynamic display that will automatically update the length and area information as you tap on another line or area feature.

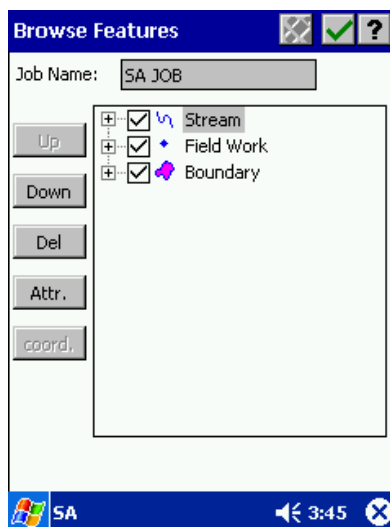
To turn off the length and area information, simply tap on the Measure Length/Area button  again.

## 3.6 Browse Options

SA3 offers three convenient browsing functions for the following types of data: Feature Topics, Field Data and Figure Data.


### 3.6.1 Browse/Features

The **Menu/Browse/Features** function is used to browse the current Job file. Selecting this function displays the following dialog:



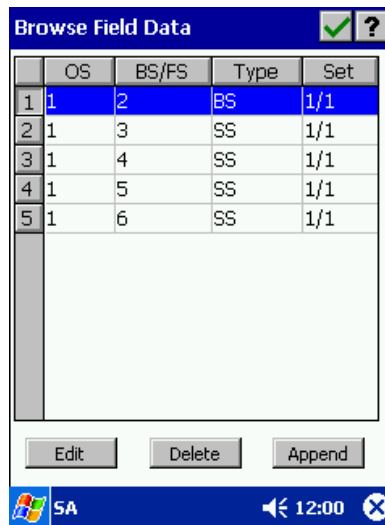
You can use this function to change the order of the Feature Topics by tapping on the desired Feature Topic name and then tapping on the “Up” or “Down” button to move the Feature Topic to a different location in the Feature Topic List.

You can also use the mark box to the left of each Feature Topic name listed in the Browse Features screen to specify which Feature Topics you want displayed in the Map View.

The Browse Features function also lets you quickly select Features in your job for editing and reviewing coordinate information or attributes/values. Tap twice on the Feature Topic of interest or tap on the associated “+” symbol to see a listing of all the features in that Feature Topic. Tap on a feature listed under the Feature Topic and tap on the  icon in the Tool Bar to go to the “View Selection” window. For more information on selecting data from the Browse Features screen, see Section 3.4.2.

### 3.6.2 Browse Field Data

The Browse Field Data function provides a spreadsheet listing of all of the collected Field Data in your Job. You may access the Field Data View by choosing **Menu/Browse/Field Data**. The Field Data View will be blank if your Job does not contain raw measurement data (data taken from a Total Station for example). You can edit the data in the Field Data View or enter Field Data using the buttons available at the bottom of the Field Data View. Editing field data is not encouraged.



|   | OS | BS/FS | Type | Set |
|---|----|-------|------|-----|
| 1 | 1  | 2     | BS   | 1/1 |
| 2 | 1  | 3     | SS   | 1/1 |
| 3 | 1  | 4     | SS   | 1/1 |
| 4 | 1  | 5     | SS   | 1/1 |
| 5 | 1  | 6     | SS   | 1/1 |

**Edit** Displays the “Foresight” or “Backsight” dialog window for editing of the current data record.

**Append** Appends a record to the raw data view.

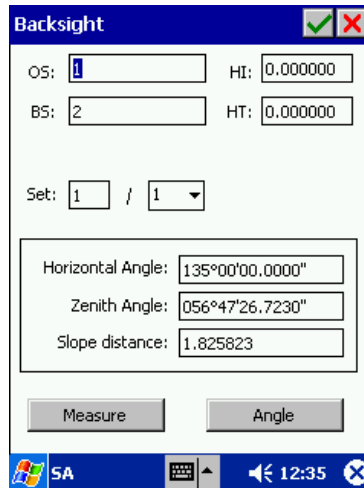
**Delete** Deletes the selected data record.



Saves changes and exits the Field Data View.

## Editing records

For editing a record, highlight the desired row and tap on the Edit button. If editing a Backsight point, the Backsight dialog will be displayed:



The Backsight dialog displays the Occupied Station number as well as the Backsight number. Height of Instrument (HI) and Height of Target (HT) fields are available for editing on this screen.

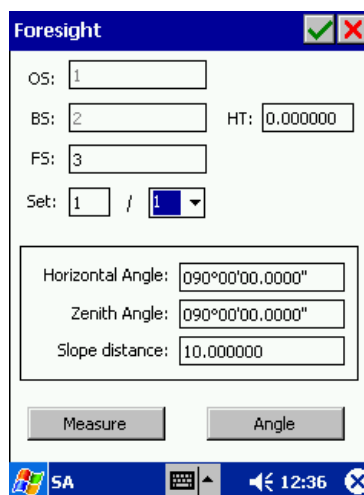
If the job contains repetition data, the applicable set number will be displayed on this screen. You may edit other sets by tapping on the pull-down arrow to the right of the set number.

Horizontal and zenith angles are displayed at the bottom of the screen along with slope distance. These fields may be edited by manually typing in new information using the keyboard function



Alternatively, you can use the “Measure” or “Angle” buttons at the bottom of the screen to get new measurement information from your instrument. The Measure button will record both angle and distance information. The Angle button will only record angle information from the instrument.

If you are editing a Side-shot or Traverse point, the Foresight dialog will be displayed:

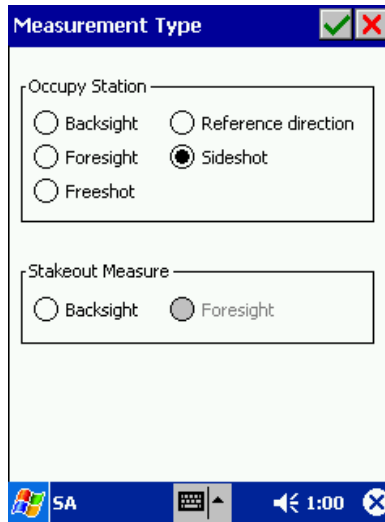



In this window, the fields for Occupied Station (OS) and Backsight (BS) may not be changed. Also, HI is not available, but HT is available for editing.

The applicable set number, horizontal and zenith angles are also displayed. These fields may be edited by manually typing in new information using the keyboard function or by using the “Measure” or “Angle” buttons at the bottom of the screen.

### **Appending records**

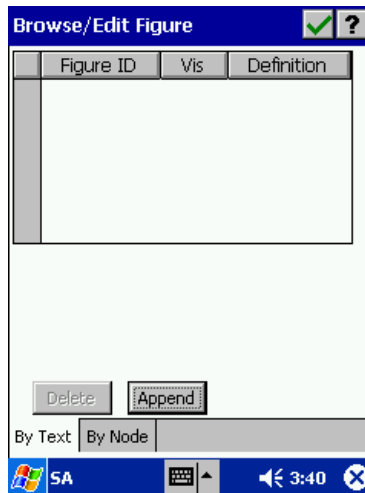
When you tap on the Append button, you will be asked to confirm the “Measurement Type” in the following dialog:



Choose from the available options and tap on the  button to continue on to the Foresight or Backsight window to complete the measurement.

### **3.6.3 Browse Figure Data**

Figures in the Job are listed in the Browse Figure dialog box. To get to the Browse Figure dialog, choose **Menu/Browse/Figure** Data. The following dialog is displayed:



The Figures are listed in the order in which they were created or collected. The Figure List section of the Browse Figures dialog box shows the Figure ID number and whether or not the Figure is marked for viewing in the Map View. The definition column shows how the figure is defined (i.e. from which point to which point, etc.).

**Append** The Browse Figure Append button is used to append a new Figure to the Figure list. By default, the newly appended Figure will be defined from PointID 1 to PointID 2. Change the definition using the “By Text” or “By Node” tabs at the bottom of the screen.


**Delete** The Delete button is used to Delete the selected Figure.

**Pattern** When you tap on the Pattern button for a Figure, the Line Pattern dialog box will be displayed which allows you to specify the line pattern, color and size. This button is only available when there is a Figure in the list.

### **Steps for appending a new Figure**

1. Tap the Append button.
2. A new Figure is added to the list. The default definition will be from Point 1 to 2.
3. If desired, change the Figure ID at the bottom of the screen.
4. Check or uncheck the “Vis” box next to the Figure ID to indicate if the Figure will be shown in the Map View or not.
5. Pick a pattern and color for the figure by tapping on the Pattern button at the bottom of the screen.
6. Define the figure.

### **Defining your Figure By Text**

The default Figure definition method is “By Text”. This method involves typing the definition in the Definition box at the bottom of the screen using the keyboard function .

Begin a Figure definition with the letter “L:”. Then enter the point numbers separated by commas, blank spaces or dashes. A dash denotes a consecutive sequence of points (either in ascending or descending order, but not a combination of both); a comma or a space separates individual or groups of points. Please also note that point number may be alphanumeric.

**Example:** “L:1,2” means the figure will go from point number 1 to point number 2. A definition of “L: P1,P2” means the figure will go from point number P1 to point number P2.

Figures may also contain arcs or curves. If a segment of the line is an arc, you may identify the arc by the two end points plus either one point on the arc or the radius point of the arc. If a point on the arc is used, put an “A:” before the point number. If the radius point of the arc is used, put a “C:” before that point number.

**Example:** “L:1,2,A:3,4,5” defines a straight line from point 1 to point 2, then an arc begins at point 2, **passes through point 3**, and ends on point 4, then another straight line from point 4 to point 5.

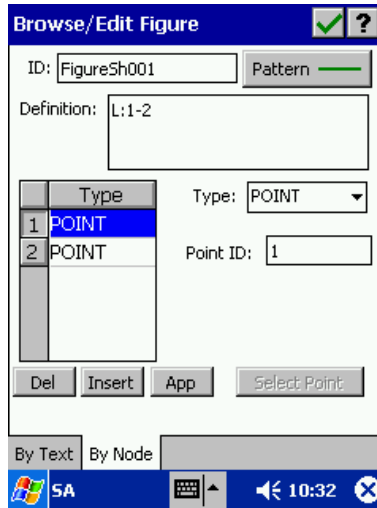
The curve based on a radius point always goes clockwise from the beginning point to the end point. Therefore, which way the curve faces depends on which point you specify as the beginning and the end points of the curve as well as the location of the radius point. If you must interrupt a

line in order to define a curve that faces the correct way, enter the curve as a new line, as in "L:1,2,L4,C:3,2,L:4,5".

Please make sure that the location of the radius point is consistent with the location of the beginning and end points of the curve, so that the curve will pass through the specified beginning and end points.


### **Defining your Figure By Node**

Figures may also be defined "By Node". To access this option, tap on the "By Node" tab at the bottom of the Browse/Edit Figure Dialog. The following dialog will be displayed:

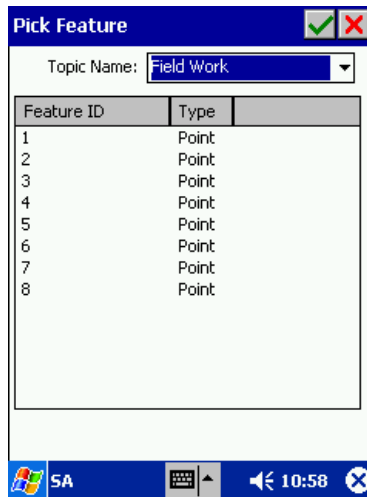



In this window, the Figure ID is displayed at the top along with the selected Pattern and color of the Figure. The current Figure Definition is also displayed at the top of the window.

A small spreadsheet is shown at the left of the screen. Points may be deleted, inserted or appended to the end of the list by using the buttons at the bottom of the spreadsheet. The highlighted row corresponds to the Point ID listed at the right of the screen. You may choose a

different Point ID by tapping in the **Point ID** box and using the keyboard function .

Alternatively, you can tap on the "Select Point" button at the bottom of the screen to choose your points. This button only becomes active when you tap in the Point ID box. When you tap on the "Select Point" button, the following dialog is displayed:



The current Topic is displayed at the top of the screen. A different Topic may be selected by tapping on the pull-down arrow to the right of the Topic Name. All available Points for the selected Topic will be listed by Feature ID and Feature Type. Tap on the desired Feature ID to select it and then tap  to return to the previous screen.

Once the desired points have been selected, the final step is to choose the Figure Type for the selected Point ID. Choose a Figure type from the pull-down list at the right of the screen. Available options are: POINT, ARC, and CURVE. The Figure Definition will automatically be updated based on your selection of Figure Type. For more information about proper syntax of the Figure Definition, please refer to the above sub-section “Defining your Figure By Text”.


### 3.7 BaseMaps

SA3 comes with the ability to display BaseMap information. Optional BaseMap CDs are available for all the States in the USA. The BaseMap data contains useful background information such as: roads, hydrology, points of interest, city/county boundaries, etc.

Before a BaseMap can be used in SA3, it must be transformed using another optional software package such as PC-GPS, PC-MAP, PC-MAPPER or CMT-SURVEY. Portions of an entire county BaseMap may be converted and transferred to your Mobile Device for use with SA3. Please refer to the help found in the PC-GPS, PC-MAP, PC-MAPPER or CMT-SURVEY software for information on converting and transferring BaseMap files to SA3.

Once the BaseMap has been transferred to SA3, it is ready to be loaded into your Map View to assist in Stakeout or Field Work. BaseMaps may be either loaded with a job automatically or manually loaded separately.

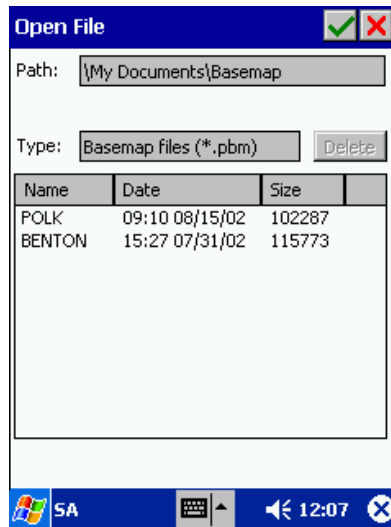
#### **Steps for loading a BaseMap with a Job (Auto Load)**


1. Load the job by choosing **Menu/New/Open Job**. Select the job from the list and choose .
2. Load the BaseMap by choosing **Menu/Load Basemap/Auto Load**. After choosing this option, the BaseMap corresponding to your Job will be automatically loaded.
3. The BaseMap may then be turned off at any time by choosing **Menu/Load BaseMap/Off** option.

**Please note:** If the BaseMap is not displayed with the Job data after choosing the Auto Load option, it may be because the BaseMap file does not cover the same geographical area as the Job. Check the BaseMap in the PC-GPS, PC-MAP, PC-MAPPER or CMT-SURVEY software that was used to convert the BaseMap and make sure the BaseMap is large enough to cover the extent of the Job data.

### **Steps for loading a BaseMap manually (Manual Load)**

1. Load the BaseMap by choosing **Menu/Load Basemap/Manual Load**. After choosing this option, the following dialog is displayed:



2. Select one of the BaseMaps in the list by tapping on it once so it is highlighted in blue then choose .
3. The BaseMap will be loaded and displayed along with your current job. After the BaseMap is loaded, it may be toggled OFF time by choosing **Menu/Load BaseMap/Off** option.

**Please note:** If the BaseMap is not displayed with the Job data after manually loading the BaseMap, it may be because the BaseMap file does not cover the same geographical area as the Job. Check the BaseMap in the PC-GPS, PC-MAP, PC-MAPPER or CMT-SURVEY software that was used to create the BaseMap and make sure the BaseMap is large enough to cover the Job data.

## **3.8 Feature Lists, Attributes and Values**

A Feature List is a file listing the Features, Attributes, and Values that can be used to describe the positions collected by the instrument or those locations that are digitized manually. Each position can be described by a Feature name as well as Attributes and Values.

|                  |  |
|------------------|--|
| <b>Feature</b>   | An identifying name for the position - Examples: Tree, Road, Field, etc. |
| <b>Attribute</b> | A characteristic of the Feature- Examples: Species, Age, Height, etc.    |
| <b>Value</b>     | A specific description of the Attribute - Examples: Fir, 30, 35, etc.    |



A Feature may have multiple Attributes, each of which may have any number of Values. **However, Attributes and Values are not essential for data logging.**

**A Feature may be one of three types: POINT, LINE, or AREA.** A POINT is a discrete item, such as a telephone pole. A LINE is a series of connected points, such as a road. An AREA is a region enclosed by a boundary, such as a football stadium.

Feature Lists can be created within SA3. Feature lists can also be created in PC-GPS, PC-MAPPER and CMT-SURVEY and then downloaded to SA3. The file created by the Feature List function has the file extension **.FBR**.

SA3 gives you the capability of storing a large number of Feature Lists for use with different Jobs.

When you set up a new Job, you may specify a Feature List to be associated with it (Section 3.1). The Feature List serves as a "look-up" table that makes it very easy to attach descriptions to the position information you collect.

The following example illustrates the relationship among the Features, Attributes, and Values in a typical Feature List.

| <b>FEATURE</b> | <b>TYPE</b> | <b>ATTRIBUTES</b> | <b>VALUES</b>            |
|----------------|-------------|-------------------|--------------------------|
| Tree           | Point       | Species           | Oak, Maple, Pine, Other  |
|                |             | Age               | Old, Intermediate, Young |
|                |             | Cut?              | Yes, No                  |
| Road           | Line        | Lanes             | 1, 2, 4, Superhighway    |
|                |             | Paved?            | Yes, No                  |
|                |             | Travel            | Heavy, Moderate, Light   |
| Marsh          | Area        | Size              | <1 ac., 1-5 ac., 5 ac.   |
|                |             | Beaver?           | Yes, No                  |

### 3.8.1 Maintaining Feature Lists

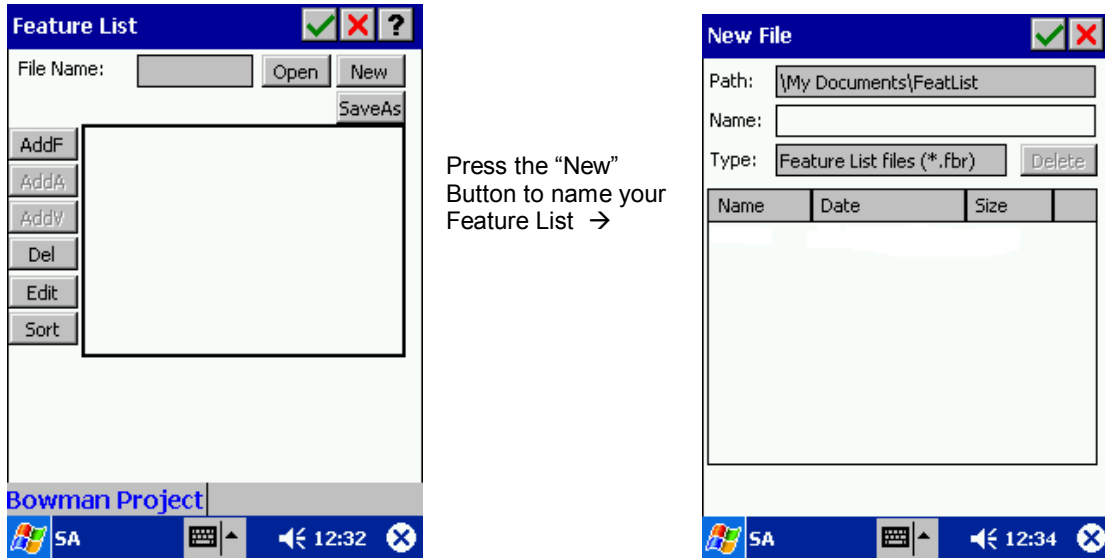
#### **Creating a new Feature List/selecting an existing Feature List:**

To create a new Feature List or select an existing Feature List, select **Menu/Feature List**. The Open File Dialog will be displayed if there are any existing Feature Lists. This screen will look like the following and will allow you to select a Feature List to be edited.



Tap twice on the file you wish to edit, or tap once on it and then tap the  button.

The following dialog will be displayed if no Feature Lists exist in the specified Feature List directory:

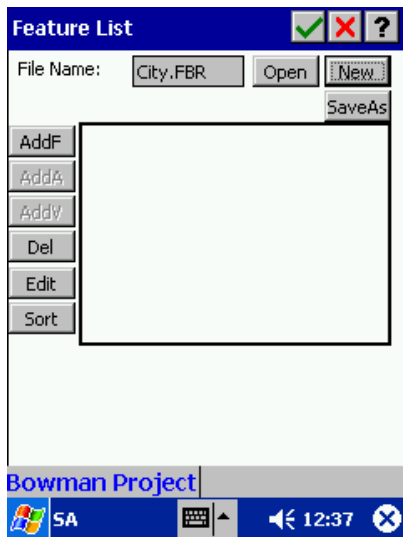


Tap the "NEW" button to name your Feature List in the "New File" dialog window. Type the name of your Feature List in the "Name:" box using the keyboard function . Enter up to eight characters or digits as a name for the Feature List. SA3 will reject duplicate Feature List file names or names containing a "/>. Tap on to create your Feature List file.

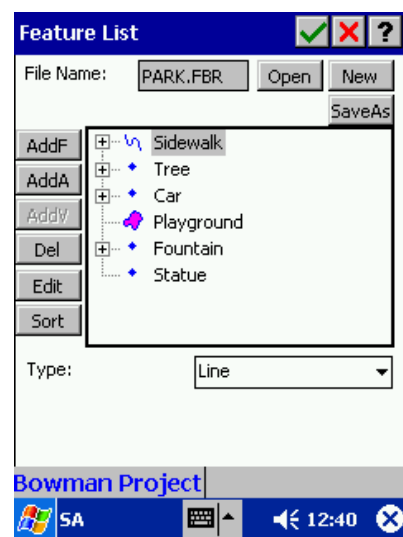
The EDIT Feature List screen will be displayed. The EDIT Feature List screen is described in the following subsection.

### **Editing a Feature List**

The EDIT Feature List screen is displayed when you highlight an existing Feature List and tap , or after you select "NEW" and enter a new file name and tap .



**Editing a new feature list**



**Editing an existing feature list**


## Field Descriptions

- File Name:** This is the name of the selected Feature List. This field is for display only.
- Open:** Display the “Open Feature List” dialog window to select a different Feature List.
- New:** This button will display the “New File” dialog to create a new Feature List file.
- Save As:** Save changes to the selected Feature List by saving to an existing Feature List file (select one from the list) or by typing in a new file name.
- AddF:** Use this button to add a new Feature Topic to the Feature List. For a Feature List already containing Feature Topics, the new Feature Topic will be inserted below the currently selected Feature Topic. Up to **15** characters may be entered for each Feature Topic name. When adding a new feature, the Feature type, Mode and session can be entered at the bottom of the screen.
- AddA:** Use this button to add a new Attribute for the selected Feature Topic. This button is only active when the Feature List contains Feature Topics.
- AddV:** Use this button to add a new Value for the selected Attribute. This button is only active when the selected Feature Topic contains one or more Attributes.
- Del:** Delete the selected Feature Topic, Attribute or Value.
- Edit:** Activate the editing function for the name of the selected Feature Topic, Attribute or Value.
- Sort:** Sort the selected item alphabetically. To sort Feature Topics, tap on one of the Feature Topics so it is selected and then tap on the **Sort** button. To sort the Attributes for a specific Feature, tap on one of the Attributes listed under that Feature and then tap on the **Sort** button. To sort the Values for a specific Attribute, tap on one of the Values listed under that Attribute and then tap on the **Sort** button.

If an existing feature list is opened, there will be additional information about the highlighted feature at the bottom of the screen:

- Type:** This field describes the type of feature. The available options are: Point, Line or Area.

## Common Operations

**To edit a Feature in a Feature List**, move to the field to be changed then tap the Edit button and type over the existing information. **Tap on  if you wish to save the changes in this screen.**

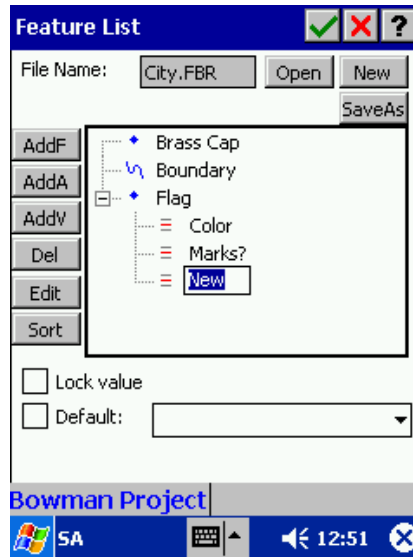
**To append a new Feature to the Feature List**, move the cursor to the last Feature in the Feature List, then tap the “AddF” button. This adds a new blank Feature to the list, on which you may define the new Feature.


**To delete a Feature**, simply highlight it and then tap the “Del” button.

If you wish, you may further characterize each Feature with Attributes and Values (Sections 3.8.2 and 3.8.3).

### 3.8.2 Defining Attributes



To add an Attribute to a Feature or to modify one of the existing Attributes of the Feature, first highlight the Feature record in the Feature List screen. Then tap the “AddA” button to add an Attribute or tap “Edit” to modify the Attribute. A listing of any existing attributes for the selected Feature will be shown in a directory tree style with the New Attribute at the end of the list:



Use the keyboard function  to enter the name of the Attribute. Up to 19 characters may be entered for each Attribute name.

The “Lock Value” option lets you lock the associated Values for the Attribute from further editing. When this option is chosen, the user will not be able to alter or add to the existing set of Values listed for the Attribute.

The “Default” option lets you define a default value. **The default Value you specify must be from the Values list for the selected Attribute.** The default Value will be automatically assigned to the associated Attribute when you tag a Feature with this Attribute.

Choose  to save any changes and return to the Map View or tap  to abandon the data.

**To edit a displayed Attribute**, tap on the Attribute name to be changed, then press the “Edit” button and type over the existing Attribute name.

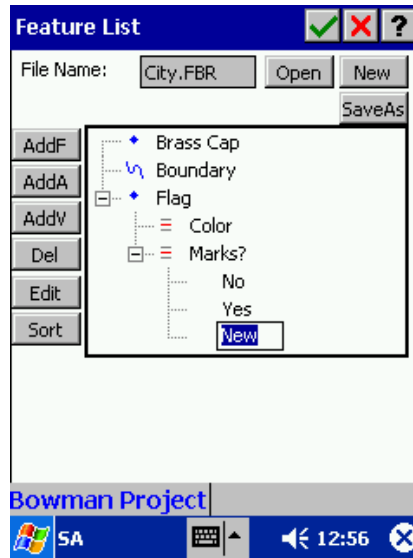
**To append a new Attribute to the displayed list of Attributes**, tap on the last Attribute in the list then tap the “AddA” button. This adds a blank attribute to the list.

**To delete an Attribute**, simply tap on the Attribute and then tap the “Del” button.

**To assign one or more Values to an Attribute**, tap on the Attribute name, then tap the “AddV” button (See Section 3.8.3.)

### 3.8.3 Defining Values

To assign an additional Value to an Attribute or to modify one of the existing Values for an Attribute, highlight the Attribute in the “Feature List” screen and then tap the “AddV” button to add a Value or tap “Edit” to modify the value. A listing of existing Values (if any) for the selected Attribute will be shown in a directory tree style with the New Value at the end of the list:





Use the keyboard function to enter the name of the Value. Up to 19 characters may be entered for each Value name.


**To edit a Value**, tap on the Value name to be changed, then tap the “Edit” button and type over the existing Value name.

**To append a new Value**, tap on the last Value in the list then tap the “AddA” button. This adds a blank attribute to the list.

**To delete a Value**, simply tap on the Value and then tap the “Del” button.

Choose  to save any changes and return to the Map View or tap  to abandon the data.

### 3.8.4 Saving the Feature List

After you have entered the Feature, Attribute, Value records into your Feature List, you may save the Feature List by tapping on the  button or the Save As button. The Save As function allows you to save the Feature List under a different file name.

## 3.9 File Transfer

Files may be easily transferred between the CMT SA3 and your PC by the following methods.

### 3.9.1 File Transfer Using SAVIEW

The SAVIEW utility provides an interface between your mobile device and your PC. With the Microsoft® ActiveSync running on your PC, you can install the CMT SA3 program onto your mobile device; you can also transfer files back and forth between the selected folders on your PC and your mobile device.

To transfer job files, click the **Jobs** button. Select the appropriate PC folder for **PC Path** and select the appropriate folder for **Mobile Device**. Highlight one or more job files, then click on → or ← to transfer the files in the corresponding direction. If a file with the same name already exists in the destination folder, you will be prompted to overwrite it or to cancel the file transfer.

Similarly, click the **FeatList** button for transferring Feature Lists, or click the **BaseMap** button for transferring BaseMap files.

### 3.9.2 File Transfer Using the Microsoft® ActiveSync

With the Microsoft® ActiveSync running on your PC, you can use Windows Explorer to copy files back and forth between the selected folders on your PC and your mobile device. For example, to access the files on your iPAQ mobile device, double-click on **Mobile Device** in Windows Explorer then double-click on **My Pocket PC**. The job files are stored in the **Jobs** folder; the Feature List files are stored in the **FeatList** folder; and the BaseMap files are stored in the **BaseMap** folder. Copy one or more files that you wish to transfer to the PC and then paste them to the appropriate folder on your PC. Similarly, you can copy files from your PC and paste them into the appropriate folder on your mobile device.

### 3.9.3 File Transfer Using the CMT CogoCAD 2.5 or the CMT-SURVEY 6.5

To view the data files stored in the mobile device or to transfer various types of files, select **Utilities/Mobile Device Interface** in CMT-SURVEY 6.5 or CogoCAD 2.5.

Specify the appropriate folders on the PC and the Mobile Device.

Select the appropriate file type (such as **Jobs**). Select the appropriate PC folder for **PC Path** and select the appropriate folder for **Mobile Device**. Highlight one or more files, then click on → or ← to transfer the files in the corresponding direction.

Please see the manuals for CogoCAD 2.5 or CMT-SURVEY 6.5 for details about the Mobile Device Interface function.

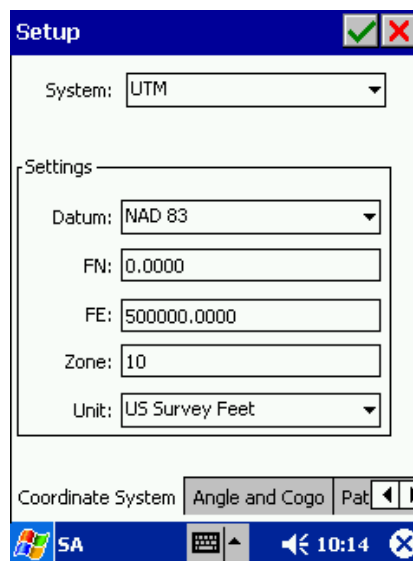
## Section 4 – Configuring SA3

The **Menu/Configure** option is used to customize your SA3 software to meet your needs. You may use it to configure coordinate system and units of measurement, angle and COGO measurement systems, file path setup for data storage, color/pattern setup as well as graphic display options for measurement data.


Information about setting up the SA3 for Field Work and Stakeout are provided in Section 5 and Section 7, respectively.

### 4.1 Coordinate System

The **Menu/Configure/Coordinate System** option is used to change the coordinate system, datum and units of measurement in which your Map is displayed and stored. When the Menu/Configure/Coordinate System option is selected, the following Coordinate System Information dialog box will be displayed:



The screenshot shows a 'Setup' dialog box with a blue title bar and standard Windows window controls. The 'System' dropdown is set to 'UTM'. Below it is a 'Settings' section with several fields: 'Datum' is 'NAD 83', 'FN' is '0.0000', 'FE' is '500000.0000', 'Zone' is '10', and 'Unit' is 'US Survey Feet'. At the bottom of the dialog, there are three tabs: 'Coordinate System' (selected), 'Angle and Cogo', and 'Pat'. The Windows taskbar at the bottom shows the 'SA' application icon, a system tray with a clock showing '10:14', and other standard icons.

To change the coordinate system of your Map, simply select the coordinate system, datum and unit of measure you wish to use. After you tap on the  button, your Map will be converted into the coordinate system, datum and unit of measurement selected.

**Coordinate System:** SA3 offers four coordinate system options: **UTM** (Universal Transverse Mercator), **SPC** (State Plane Coordinates), **NEZ** and **User Defined**.

**UTM:** Select this option if you wish to use the Universal Transverse Mercator (UTM) coordinate system. Specify the Datum, False Northing (FN), False Easting (FE), Zone and Unit of measure in the corresponding the UTM Coordinate Information fields. In most cases, the default FN and FE are correct.

**State Plane:** Select this option if you wish to use the State Plane Coordinate (SPC) system. Specify the Datum, State, Region, Zone, and Unit of measurement in the corresponding State Plane Coordinate Information fields.


**NEZ:** The NEZ coordinate system option allows you to use a local Northing, Easting, Z-value plane, as often used in surveying work. The NEZ plane must first be created in PC-GPS, PC-MAPPER or CMT-SURVEY and then transferred to your Mobile Device.

#### **User Defined**

**Coordinate System:** The User Defined option allows you to select a user-defined coordinate system or datum that was created in PC-GPS, PC-MAPPER or CMT-SURVEY.

- For information on creating User Defined Coordinate System or NEZ planes, see the Help Topics in PC-GPS, PC-MAP, PC-MAPPER or CMT-SURVEY and search on “Coordinate Systems and Datums”.

### **Steps for converting the Coordinate System, Datum, and Unit of Measure**


1. Open your Job file using the Menu/New/Open Job option.
2. Use the **Menu/Configure** option and then tap on the **Coordinate System** tab at the bottom of the screen. The current Coordinate System, Datum and Unit of the Map will be shown in the Coordinate System dialog box.
3. Select a different Coordinate System by tapping on the pull-down menu to the right of the Coordinate System name. If you select SPC or UTM, you will also need to enter the corresponding SPC or UTM Zone in the Settings box.
4. Select a different Datum by pulling down the arrow to the right of the Datum field and tapping on the Datum name.
5. Select a different Unit of Measurement by pulling down the arrow to the right of the Unit field and tapping on the Unit desired. SA3 supports US Survey Feet, International Feet, Meters, Miles, and Kilometers.
6. Tap on  button to convert your Map to the selected Coordinate System, Datum and Unit of Measure and return to the Map View.

**Please note:** Changing the Coordinate System will also change the default Coordinate System of SA3. This function affects the current Job file as well as any new Job files created in the future.

### **NEZ Planes for your Map**

The Menu/Configure Coordinate System, **NEZ** option is used to define a local plane that allows you to work in an XY plane instead of latitude, longitude. NEZ planes are supported by the CMT-Z33 dual frequency system. NEZ planes can be created in PC-GPS, PC-MAPPER, CMT-SURVEY and CMT Field 4.x.

**Please Note:** If a Job is collected using an NEZ plane in SA3, the plane information will be sent to the PC when the Job is downloaded.

To select an NEZ plane, first use the **Menu/Configure Coordinate System** option. The Coordinate System Information dialog will be displayed. Tap on the NEZ pull-down option. A pull-down selection field will be displayed. Use the pull-down arrow to view the list of established NEZ planes. Select one of the available planes by tapping on the plane name. The selected plane will be highlighted in blue. Tap on the  button to return to the Map View.



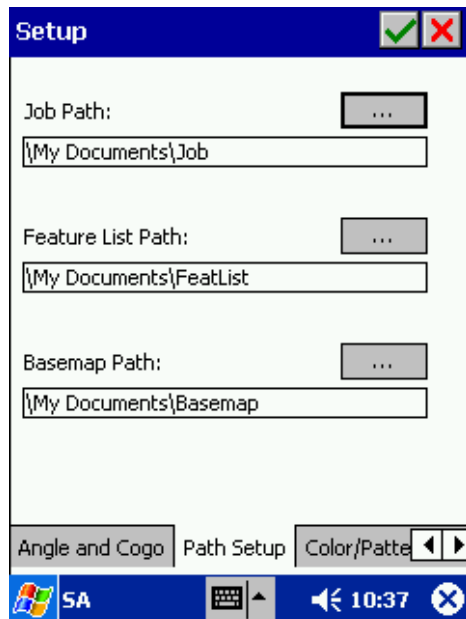
## 4.2 Angle and Cogo

The **Menu/Configure/Angle and Cogo** page is used to define the measurement units and measurement types for Survey angles and distances. Tapping on the “Angle and Cogo” tab at the bottom of the Menu/Configure window will access the Setup screen. The different options are explained below:

- Angle Unit** Specify the angle units for your survey by choosing D.M.S. (Degrees, Minutes, Seconds), Degree (Decimal degrees), Miles or Grads. Please note: D.M.S. data entry format: DD-MM-SS.ssss.
- Azimuth System** Specify the azimuth system for your survey by selecting either North or South.
- Angle Direction** Specify the horizontal angle direction for your survey by selecting either Right or Left.
- Vertical System** Specify the vertical system for your survey by selecting Zenith, Nadir, Transit or Vertical Distance.
- Angle System** Specify the angle system for your survey by selecting Azimuth or Bearing.

## 4.3 Path Setup

File storage can be set so SA3 will remember where to store and access your data. Select **Menu/Configure** and tap on the Path Setup tab at the bottom of the screen to access the following dialog:



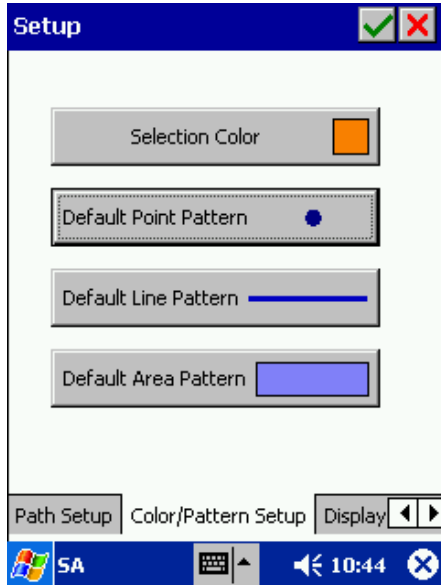
**Job Path:** Sets the directory path for Job files (\*.PSA) to be stored and accessed.

**Feature List Path:** Sets the directory path for Feature List files (\*.FBR) to be stored and accessed.

**Basemap Path:** Sets the directory path for Basemap files (\*.PBM) to be stored and accessed.

## 4.4 Color/Pattern Setup

You can change the default color and pattern information by choosing the **Menu/Configure** option and then choosing the **Color/Pattern Setup** tab at the bottom of the screen.



**Selection Color:** Used to change the default Map View selection color. When a Feature on the Map View is selected, the map representation of that Feature (Point, Line or Area) will be displayed in the selection color. The default selection color is orange.

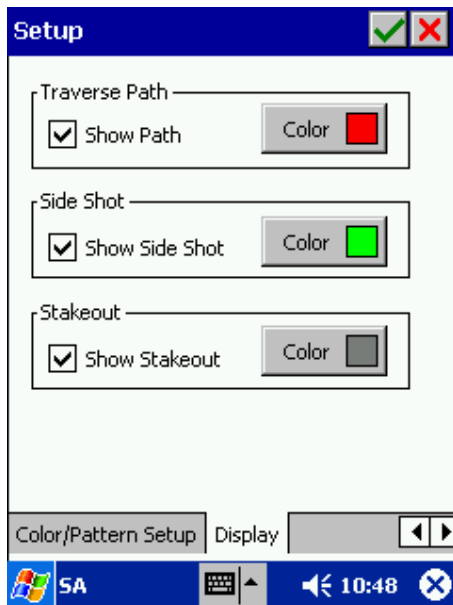
**Default Point Pattern:** Chooses the default symbol and color to be used for points when adding point features to your map.

**Default Line Pattern:** Chooses the default pattern and color to be used for lines when adding line features to your map.

**Default Area Pattern:** Chooses the default color to be used for areas when adding area features to your map.

## 4.5 Display Settings

The Display dialog is used to toggle on/off and assign colors to your main Traverse, Side-shot, and Stakeout paths. Select **Menu/Configure** and then scroll to and tap on the **Display** tab at the bottom of the screen.



**Traverse Path:** Check or uncheck the “Show Path” box to toggle the display of all Traverse Paths in your survey on or off. Tap the Change button to change the color of all Traverse Paths.

**Side Shot:** Check or uncheck the “Show Side Shot” box to toggle the display of all side-shots in your survey on or off. Tap the Change button to change the color of all side-shots.

**Stakeout:** Check or uncheck the “Show Stakeout” box to toggle the display of all Stakeouts in your survey on or off. Tap the Change button to change the color of the Stakeouts.

## Section 5 – Field Work

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The "Field Work" routine handles all data collection activities in SA3. The following discussion covers some basic concepts and practices used in surveying as well as the Field Work data input screens. Traverse adjustment is also described in this section.

To see how the fieldwork and stakeout functions are put to practical use, please work through the examples in the tutorial provided in Section 8 of this manual.

### 5.1 General Notes on Data Collection


Field measurement data (raw data) may be entered by hand or recorded from a survey instrument. As data is entered, you can see the instrument point, the back-sight control point and the foresight point clearly marked with the corresponding symbols in Map View.

SA3 automatically computes the coordinates of a survey point whenever sufficient measurement data has been recorded for that point and immediately displays the survey points in Map View.

After collecting field data, you may wish to adjust the survey to minimize errors or to take into account the averaged data in the measurements. **Survey Adjustment** is discussed in Section 5.4.

Following are the general survey data collection convention and procedures adopted by SA3. The actual fieldwork setup and data collection screens will be described in later subsections.

#### 5.1.1 Data Collection Sequence

Before setting out to collect data, first make sure your data collector has sufficient power for the field session. Then tap on  and select **New/Open Job** to create a new job or open an existing job file.


Use the **FieldWork Setup** function described in Section 5.2 to set up the instrument, measurement conditions and repetition mode. Also, select the desired angle system, coordinate system and units of measurement using the options under the **Configure** menu.

The field data entry section has three main data entry screens. The OCCUPY STATION screen is discussed in Section 5.3.1. The BACKSIGHT screen is discussed in Section 5.3.2. The FORESIGHT screen is discussed in Section 5.3.3.

**The general procedure is to enter data into each screen, then tap a function button to execute the corresponding command.**

Following is a brief outline of the steps involved in recording fieldwork data.

1. **Start the Field Work Function**

Tap  from the SA3 Map View.

2. **Occupy Station**

In the **Occupy Station** screen, enter the station point number and instrument height (if elevations are being carried) then tap the **Go** button to advance to the BACKSIGHT screen.

3. **Record Backsight**

When the **Backsight** screen is displayed, enter the backsight point number. Tap the **Store** button to advance to the Foresight screen. (See Section 5.3.6 about recording repeated sets of measurements.)

#### 4. **Record Side-shot or Traverse Point**

The **Foresight** screen is used for recording measurements to side-shot points as well as traverse points. Enter or measure the foresight data. Tap the **Side** button to record a side shot. Repeat the process to record additional side shots. To record a traverse point, enter or measure the foresight data, then tap on the **Traverse** button. This will take you to the next OCCUPY STATION screen.

#### 5. **Repeat the Process**

Continue to record measurements to side-shot points and traverse points as the job requires.

### 5.1.2 Horizontal Angle Measurements

The data to be entered into the "horizontal angle" data fields in the SA3 is the conventional angle right or angle left measurement. Angle right is the angle in the horizontal plane measured clockwise from the backsight direction to the foresight direction. On the other hand, a deflection angle measures the angle between the foresight direction and the direction from the backsight point to the occupied station. So if the deflection angle of a foresight target is 0, then the foresight target and the backsight target are on opposite sides of the instrument. Put another way, the difference between the angle right measurement and the deflection angle measurement is half a circle, or 180°.

Deflection angles are commonly used for roadway design and surveys that proceed along a fairly straight course, so deflection angles are usually quite small. If you employ the deflection angle system, use the following method for taking the measurements. To conform to the procedures used by the SA3 for measuring horizontal angles, a backsight measurement must be taken before the foresight measurement. Use the face opposite from the one that is normally used for the backsight measurement. Use the normal face for the foresight measurement. This will have the effect of reversing the foresight and backsight readings. That is, the backsight reading will be 180°, and the foresight reading will be close to 0. With a transit, it is customary to record a deflection angle as a small, positive angle value followed by a right or left designator, e.g. 7.5 R or 10 L. With a theodolite, however, the angles right - angles left setting is typically set just once for an entire job. In this case, when an angle deflecting to the left is measured, for example 10L, it will appear as 350° when in angle right mode. The same is true for an angle deflecting to the right when in angles left mode.

### 5.1.3 Vertical Angle Measurements

Select the appropriate vertical system for displaying collected fieldwork data. When you do a stakeout job, SA3 always uses the vertical distance system to display the data.

SA3 assumes that the total station is set to output zenith angle and slope distance. When you select the Vertical Distance mode, SA3 will compute the horizontal and vertical distances. Therefore, please set your total station to measure zenith angle and slope distance even when you have selected Vertical Distance as the vertical system to use in SA3.


### 5.1.4 Point ID in Measurement Data

The Point IDs in the measurement data records are the Feature IDs of the survey points. Although you may easily change the Feature ID of a survey point, it is not advisable to do so. When you change the Feature ID of a survey point via its Feature Properties screen, the Point ID of the survey point in the measurement data stays unchanged. You could edit the measurement data to change the Point ID, but generally we do not recommend altering the measurement data.

## 5.2 FieldWork Setup

The FieldWork Setup screen presents a number of options for setting the interface between SA3 and an electronic total station or EDM. Other setup options include: Instrument Condition Setup, Repetition and BS/FS settings.

Some of the setup functions such as Instrument Setup, Instrument Condition Setup and Environment Setup affect raw measured data. Specify the corrections to be made if the conditions (e.g. curvature of the earth, atmospheric refraction, pressure, temperature, scale factor, etc.) affect the measurement accuracy and therefore need to be taken into consideration. This correction is applied to the raw data obtained from the total station when you issue the **Measure** command. The corrected data displayed on the Data Collector will be different from the data displayed on your total station. **If the instrument itself is correcting for these conditions, then the data collector should not be correcting for the same.**

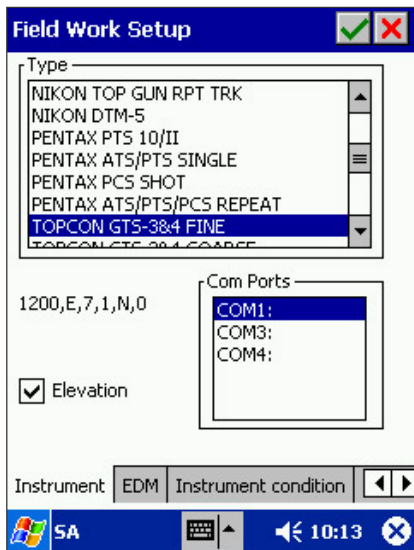
To call up the FieldWork Setup screen from Map View, select **Menu/FieldWork Setup**. While in a FieldWork screen, you may tap  to access the setup screens.

Initially, the Instrument Setup screen is displayed. **To select another setup option, tap the corresponding tab at the bottom of the screen.**

In each setup screen, make the selections or enter data as appropriate. When you tap , the settings are saved and remain effective until you change them again.

### 5.2.1 Instrument Setup

Use this screen to specify elevations, instrument port and the instrument type.



**Type:** Choose the instrument ID by scrolling through the list.

**COM Ports:** Enter 1, 3 or 4 to specify that the port to which the instrument is connected.

**Elevations:** Enter a check mark by tapping in the box to globally enable all references to elevation or height fields and measurements.

Tap  to save the settings; tap  to cancel.

## 5.2.2 EDM Setup

The EDM SETUP screen will permit you to enter data for EDM correction.

**EDM Type:** Pick the EDM Type from the dropdown menu.

**EDM Mode:** Select the desired EDM mode.

**PENTAX:** PM-81, MD, OTHERS

**GEODIMETER:** 710,6BL,8, 6A, 6000, OTHERS

**H.P.:** 3800,3805, 3808,3820, 3810

**KERN:** 500, 501, OTHER

**K&E:** AR I, AR S,II

**NIKON:** ALL

**P.I.:** BEETLE, CITATION

**SOKKISHA:** RED MINI 2, RED 1, SDM-1C, OTHERS

**TOPCON:** DM-C2, OTHERS

**WILD:** DI3S,TC1,DI4, DI20, DI5S, DI1000, DI2000, DI3000,TC2000, TC1600, DI3

**ZEISS:** ELDI 1,2,3,SM4, ELTA 2,4, ELTA

3,20,46R,SM41, E-ELTA 3,4,6, ELDI 4, ELDI 10

**OTHER:** Other types of equipment

Tap to save the settings; tap to cancel.

**Wave length:** If you have selected a particular EDM type and mode, the wavelength for the EDM selection will be automatically supplied and cannot be altered by you. However, if you have selected "OTHER" as the EDM type, then you are free to enter an appropriate wavelength value.

**Refractive Index:** If you have selected a particular EDM type and mode, the refractive index for the EDM selection will be automatically supplied and cannot be altered by you. However, if you have selected "OTHER" as the EDM type, then you are free to enter an appropriate refractive index value.

## 5.2.3 Instrument Condition Setup

Optionally, enter data for the instrument condition setup into the following screen.

**Collimation:** This field allows you to specify whether the collimation values in the following two fields will be used to correct measured data. This correction will modify the horizontal and vertical angles. If the data is not measured in a set or is measured in an odd set, the collimation values will be added to the measured data; otherwise, they will be subtracted from the measured data.

**Horz. collimation error:** Enter the instrument horizontal collimation error. If desired, you can get this value from actual measurements.

**Vert. collimation error:** Enter the instrument vertical collimation error. If desired, you can get this value from actual measurements.

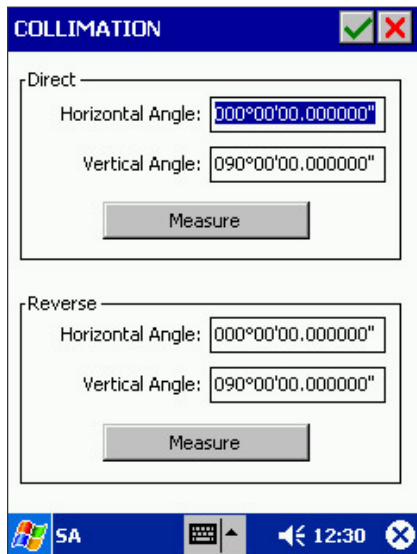
Tap to save the settings; tap to cancel.


**EDM Offset:** Enter the vertical offset from the scope to the EDM, in feet or meters depending on the unit setup. This value is used for EDM correction.


**Prism Offset:** Enter the vertical offset from prism in feet or meters depending on the unit setup. This value is used for EDM correction.

**Prism Constant (mm):** Enter the distance addition constant for the prism. The unit used for this value is always millimeters. This correction will modify the slope distance received from the total station when the **Measure** button is tapped. This correction is always applied if the prism constant is not set to zero.

You can tap the **COLLIMATION** button to set the collimation value using actual measurements.

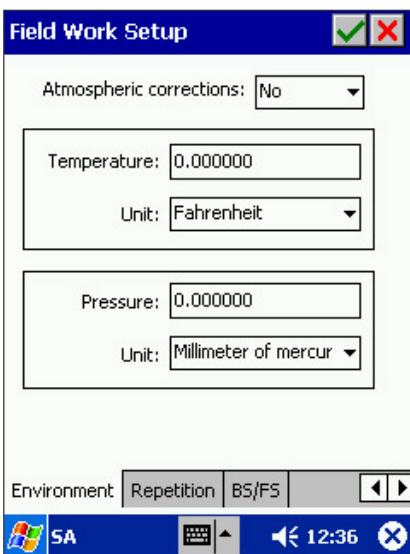


To obtain the collimation value, you will need to make two measurements. First, move the cursor to either the Direct Horizontal Angle or the Direct Vertical Angle field and tap on **Measure**. The data will be automatically entered into these two fields. Then, repeat the process with the cursor at either the Reverse Horizontal Angle or the Reverse Vertical Angle field. Now, when you tap , the difference between the direct and reverse measurements will be computed and automatically entered into the **Horz. collimation error** and **Vert. collimation error** fields in the INSTRUMENT CONDITION SETUP screen.

Tap  if you do not wish to save these collimation error values.

## 5.2.4 Atmospheric Corrections

Optionally, you may specify environmental conditions that SA3 should correct for.



**Atmospheric Corrections:** Choose “Yes” to enable atmospheric corrections, or “No” to disable it.

**Temperature:** Enter the temperature.

**Unit:** Specify the temperature units by choosing Fahrenheit or Celsius.

**Pressure:** Enter the pressure.

**Unit:** Specify the pressure units by choosing inches of mercury, millimeters of mercury, or millibars.

Tap  to save the settings; tap  to cancel.

## 5.2.5 Repetition Setup

Use the Repetition Setup screen to specify how multiple measurement data sets are to be collected.

The screenshot shows the 'Field Work Setup' screen with the following fields:

- Measure Sequence: BFFB
- Measure Type: Average
- Turns: 2
- H-Angle Tolerance: 000°03'00.000000"
- V-Angle Tolerance: 000°03'00.000000"
- Distance Tolerance: 0.030480

At the bottom, there are tabs for 'Environment' and 'Repetition', with 'Repetition' selected. Below the tabs is a status bar showing 'SA', a signal strength indicator, and the time '12:44'.

**Measure Sequence:** Tap the dropdown menu to see the available options.

The **BFBF** sequence collects with face 1, a backsight and then the foresights, then collects with face 2 the backsight again and then the foresights again.

The **BFFB** sequence collects with face 1 a backsight and then the foresights, but then collects with face 2 the foresights in reverse order and then the backsight.

The **BBFF** sequence first collects all the backsight measurements, alternating face 1 with face 2; then it collects all foresight measurements, again alternating face 1 with face 2. This sequence is primarily used where working conditions prevent ease of movement around the instrument (mining, for example).

### Measure Type:

Tap the dropdown menu to choose between single distance measurements and average distance measurements.

If single distance mode is selected then a distance measurement is made on the first measurement set only; the other sets just measure angles. If average distance mode is selected then a distance measurement is made with each measurement.

### Turns:

Tap the dropdown menu to select the total number of measurement sets to take. **Note that each BFFB, BFBF or BBFF measurement sequence involves two turns (sets).** Therefore, only an even number of turns is permitted, from 2 to 16.

### H-Angle Tolerance:

Enter the maximum horizontal angle error that will be tolerated. Make sure you enter the tolerance value in the same unit system you are using for horizontal angle measurements. Keep in mind that the tolerance criterion will be applied to the horizontal angles, not the horizontal measurements (readings). A horizontal angle is the difference between the horizontal measurements to two different points. When working with a horizontal angle measurement set, the difference between the first horizontal angle value and the value for the same horizontal angle obtained in any subsequent turns are checked against the specified tolerance. For example, the following BFFB measurement set meets the tolerance specification of 0.02 decimal degrees even though there is a large difference between the first and second measurement readings for each point.



| Point | Measurement | Horizontal Angle         |
|-------|-------------|--------------------------|
| BS 2  | 10.00       |                          |
| FS 3  | 30.00       | 30.00 - 10.00 = 20.00    |
| FS 4  | 140.00      | 140.00 - 30.00 = 110.00  |
| FS 5  | 270.00      | 270.00 - 140.00 = 130.00 |
| FS 5  | 290.01      |                          |
| FS 4  | 160.00      | 290.01 - 160.00 = 130.01 |
| FS 3  | 49.99       | 160.00 - 49.99 = 110.01  |
| BS 2  | 30.01       | 49.99 - 30.01 = 19.98    |

If the difference between the first horizontal angle value and the value for the same horizontal angle obtained in any subsequent turns exceeds the specified tolerance, a warning beep will be sounded. You then have the option of retaking the measurement or accepting the data anyway.

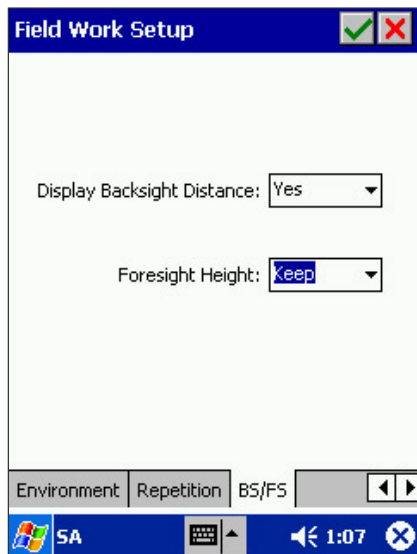
**V-Angle Tolerance:** Enter the maximum vertical (angle or distance) error that will be tolerated. Make sure you enter the tolerance value in the same unit system you are using for vertical angle measurements. If the difference between the first measurement of a vertical angle and a subsequent measurement of the same vertical angle exceeds the tolerance you specified, the latter measurement is deemed out of tolerance.

**Distance Tolerance:** Enter the maximum distance (slope or horizontal) error that will be tolerated. Make sure you enter the tolerance value in the same unit system you are using for distance measurements. If the difference between the first distance measurement and a subsequent distance measurement for the same point exceeds the tolerance you specified, the latter distance measurement is deemed out of tolerance.

Tap  to save the settings; tap  to cancel.

## 5.2.6 BS/FS Setup

Use the following screen to specify the settings for Backsight and Foresight data collection.



**Display Backsight Distance:** Choose **Yes** to have SA3 prompt you for the backsight distance data. Choose **No** if you do not wish to measure backsight distance data. For high precision surveying, and to provide a check that the correct backsight point is sighted, use backsight distances. If the distance measured to the backsight point does not agree with the computed distance, a tolerance warning will be displayed. **(The tolerance used here is the distance tolerance specified in the REPETITION SETUP)**


**Foresight Height:** Choose **Keep** to keep the rod height value the same. This field will not be visible if field elevations are disabled. Data that is KEPT may still be changed before you record the foresight point.

If instead this field is set to **Clear**, then it will be made 0 when you advance to a new foresight point.










Tap  to save the settings; tap  to cancel.

## 5.3 Fieldwork Data Collection

The **FieldWork** function is used for entering raw field data. Radial topography (side-shots) and traverses, or combinations of both, may be entered into a single job file.

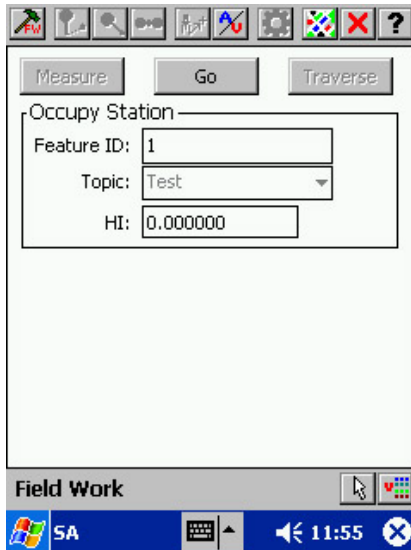
Tap the  icon to start Fieldwork.



The icons shared by the various SA3 data collection screens are described below:

-  Change the fieldwork setup.
-  View or change the feature attributes and/or values.
-  Go to Map View temporarily. Tap on  to return to the fieldwork screen.
-  Select a Point Feature from Map View.
-  Pick an existing point from the Pick Feature screen.
-  Set the instrument to work in the auto-tracking mode. This will only work for instruments with auto-track capability.
-  End auto-tracking.
-  Go back to the previous screen.

### 5.3.1 Occupy Station

Fieldwork begins with the Occupy Station dialog.



**Feature ID:** Accept the displayed Point ID or enter another Point ID for the occupied station (**OS**). You may use  or  to pick an existing point from Map View or the Pick Feature screen.

**Topic:** The default topic is **Field Work**. You may select from the list of available topics in the pull-down menu or tap **New** to enter a new topic name.

**HI:** Enter the height of the instrument if elevations are being carried.

Tap on **Go** to advance to the Backsight screen.

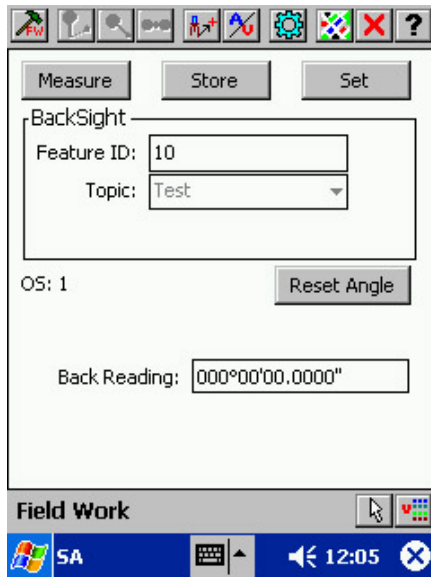
If you wish to exit to Map View, then tap .



If the station point has not been previously defined, SA3 will prompt you to create the point.

If the coordinates of the occupied station point are not known, use assumed northing, easting and elevation values that are consistent with the active coordinate system.

### 5.3.2 Backsight

The Backsight screen is for entering the backsight reading and point number.



**Feature ID:** Accept the displayed Point ID or enter another Point ID for the backsight point (**BS**). You may use  or  to pick an existing point from Map View or the Pick Feature screen.

**Topic:** Use the displayed topic name or select from the list of available topics. You may select from the list of available topics in the pull-down menu or tap **New** to enter a new topic name.

**Back Reading:** Enter the back angle or tap on **Measure** to obtain the reading from the instrument. To reset the back angle to 0, tap on **Reset Angle**.

Tap on  to select a different OS point, if necessary.

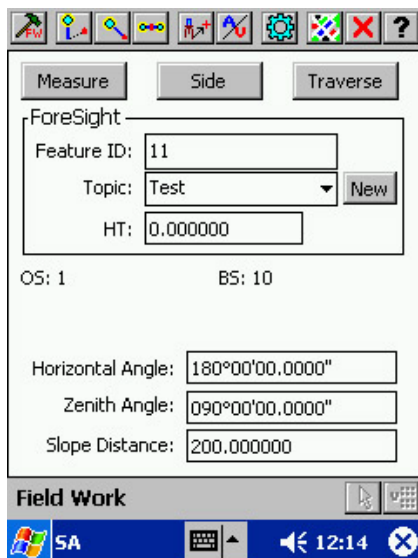
If sets of foresight measurements will be taken, tap on **Set**. Section 5.3.6 outlines the various procedures to use for recording sets of measurements.



Tap on **Store** to advance to the Foresight screen.

When you tap on the **Store** button, if the backsight point has not been previously defined, SA3 will prompt you to enter the backsight **coordinates** or a **backsight reference direction**. If you enter a reference direction, the backsight point will be created at an assumed distance of **100 feet** from the instrument point.

### 5.3.3 Foresight

The Foresight screen is used to record measurements to side-shot points as well as traverse points.



**Feature ID:** Accept the displayed Point ID or enter another Point ID for the foresight point. You may use  or  to pick an existing point from Map View or the Pick Feature screen.

**Topic:** Use the displayed topic name or select from the list of available topics. You may select from the list of available topics in the pull-down menu or tap **New** to enter a new topic name.

**HI:** Enter the height of the instrument if elevations are being carried.

**Horizontal Angle, Zenith Angle, Slope Distance:** Enter the foresight data or tap on the **Measure** button to obtain the reading from the instrument. If the vertical distance system is used, the distance fields displayed will be **Vertical Distance** and **Horizontal Distance**.

To record a Side-shot (**SS**), enter or measure the foresight data then tap **Side** to store the data. The next available foresight point number is automatically displayed. Continue to use the **Side** button for each side-shot point measured.

When the side-shot measurements are completed and the next point is a traverse point (**FS**), measure or enter the data, then tap the **Traverse** button. The measurement will be recorded and the program will advance to the next **Occupy Station** screen and the last foresight point will be set to be the current OS point.

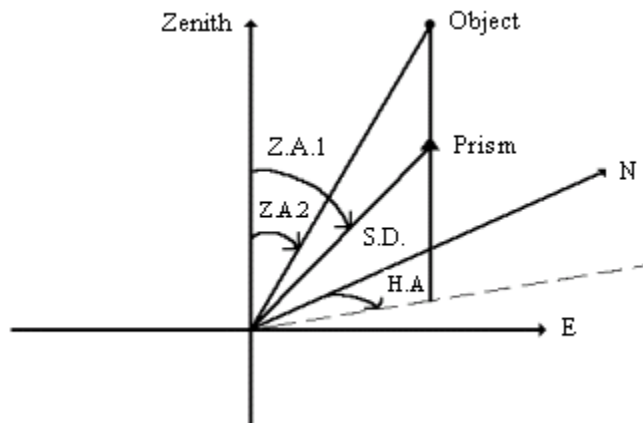
To improve the accuracy of a traverse containing side-shots, you may want to take a measurement to the next traverse point as soon as you have set up on the station, before taking the side-shot measurements. To use this method, simply record the foresight point as a "**temporary side-shot**" point and then take the actual side-shot measurements. After taking all side-shots, traverse to the "temporary side-shot" point by entering its point number and then tapping **Traverse**; do not enter the measurement data again (it will be ignored if you do).


If the prism cannot be placed at the object or at the desired distance, you may use the **remote object method** or **offset shot method** to collect the required data. (See Sections 5.3.4 and 5.3.5, respectively.)

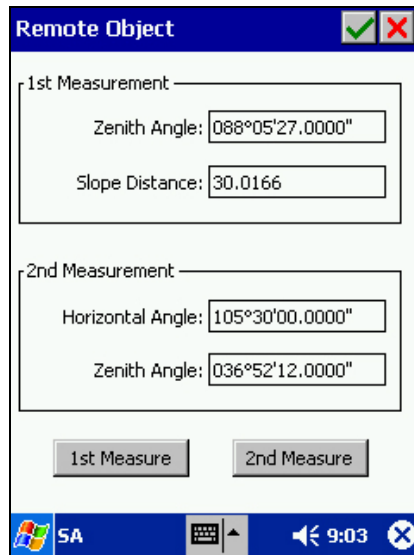
### 5.3.4 Remote Objects

When you cannot place the prism at an object because it is out of reach, you can use the **remote object** method to record its position if you can place the prism at the same horizontal distance as the object.

You will make a measurement to the prism and then record the direction to the object. SA3 will calculate the correct angle and distance values from the instrument to the object.



Suppose the next point you need to record is the tip of a tall pole and you don't feel like climbing up there to place the prism. From the foresight screen tap  to access the remote object screen.



Following is an outline of the procedure for using the Remote Object function:

1. Place the prism beneath the object (say, at breast height on the pole) then use  to get the zenith angle and slope distance measurements. The data will be automatically entered into the first two fields (Zenith Angle and Slope Distance). If the vertical system used is Vertical Distance, then measurements are still taken of zenith angle and slope distance in order to compute the vertical distance.
2. Point the instrument directly at the object (the tip of the pole) and use  to get the true horizontal and vertical angle measurements to the object. These values will be automatically entered into the 3rd and 4th fields (Horizontal Angle and Zenith Angle).
3. Tap  to compute the true distance to the object and return to the Foresight screen. The computed value will be automatically entered into the Slope Distance field of the Foresight screen. The data in the Horizontal Angle field and the second Zenith Angle field of the Remote Object screen will be copied to the corresponding fields of the Foresight screen. Tap on the **Side** button to store the data.

**Example 1:**

You need a measurement to the center of a large tree. Assume the angle right to the tree center is 105.3 degrees and the distance to the tree center is 25.9 feet.

First enter "0" into the "HT:" field in the Foresight screen. Place the prism beside the tree at the correct distance from the instrument. Tap on  from the Remote Object screen to measure the distance to the prism. The slope distance reading is 25.9. (Assume the zenith angle reading is 89.5.)

Next, aim the instrument at the center of the tree and tap on  to get the angle measurements. The Horizontal Angle reading is 105.3. (Again, assume the zenith angle reading is 89.5.)


Now, tap on  to place the calculated distance into the Foresight screen. The horizontal measure will show 105.3, the vertical measure will show 89.5, and the distance measure will


show 25.9. All of the data has been combined properly to give a result that would have been obtained if the prism had been set inside the tree.


### **Example 2:**

You need a measurement to the top of a power pole. Assume the power pole is 30 feet away from you, and has a height of 40 feet. (If you could put a prism on top of such a pole, you would find the slope distance is 50 feet and the zenith angle is 36.5212).

First enter "0" into the "HT:" field in the Foresight screen. Place the prism at the base of the pole.

Tap on  from the Remote Object screen to measure the distance to the base of the pole. If, for example, the prism is one foot higher than the instrument, then the zenith angle reading will be 88.0527, and the slope distance reading will be 30.0166.



Next, aim the instrument at the top of the pole and tap on  to get the angle measurements. Here, the zenith angle reading is 36.5212; let's assume the horizontal angle reading is 105.3.

Now, tap  to place the calculated distance into the Foresight screen. The horizontal angle will show 105.3 (same as was measured), the vertical angle will show 36.5212 (same as was measured), and the slope distance will show 49.9997 (this value is computed from the input data). The Remote Object screen combines both sets of measured data to produce the result that would have been obtained if the prism had been set atop the pole.

### **5.3.5 Offset Shots**

Use the **offset shot** method when the prism cannot be placed at the object but its position relative to the object can be determined (e.g. by taping).

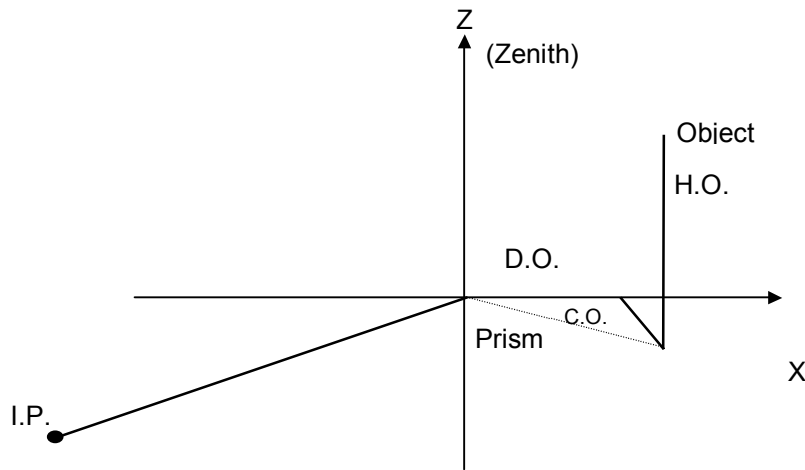
Two methods are provided for making an offset shot. The "One Prism" method lets you record the measurements to the prism and manually enter the offset data. The "Two Prism" method makes use of a pole on which two prisms are mounted at a known distance from each other. Separate measurements are made to the two prisms from which the location of the inaccessible point is calculated.

To use an offset shot method, **first enter "0" into the "HT:" field in the Foresight screen** then tap  to display the One Prism Offset or  the Two Prism Offset screen


#### **Offset Method Using One Prism**

With the "One Prism" method, the foresight measurement data determines the location of the prism. The offset data "relocates" that point to the location of the object. To get the **distance offset**, project the horizontal distance between the prism and the object onto the vertical plane containing the instrument point and the prism. To get the **cross offset**, project the horizontal distance between the prism and the object onto the plane that contains the object and is perpendicular to the distance offset. The **height offset** is the vertical distance between the prism and the object. All three offsets are used in calculating the position of the offset target.

The following diagram illustrates the position of the object in relation to the prism. The instrument point (I.P.) lies in the plane defined by the X-axis and the Z-axis. The distance offset (D.O.), cross offset (C.O.) and height offset (H.O.) are mutually perpendicular.



**Note:** To obtain correct results from offset computation, it is necessary that you set the rod height to zero before selecting the Offset tool icon. After doing the offset shot, re-enter the correct rod height into the Foresight screen.

Select  (**One Prism**) to display the following screen.


**Dist Offset:** This is the distance between the object and the prism projected onto the line of intersection between the horizontal plane and the vertical plane defined by the prism and the instrument point. Enter a positive value if the object is further away from the instrument point than the prism; otherwise, enter a negative value.


**Cross Offset:** This is the distance between the object and the vertical plane defined by the prism and the instrument point. Enter a positive value if the object is

located to the right of the prism as viewed from the instrument point; otherwise, enter a negative value.

**Height Offset:**


This is the difference in height between the object and the prism. Enter a positive value if the object is higher than the prism; otherwise, enter a negative value.

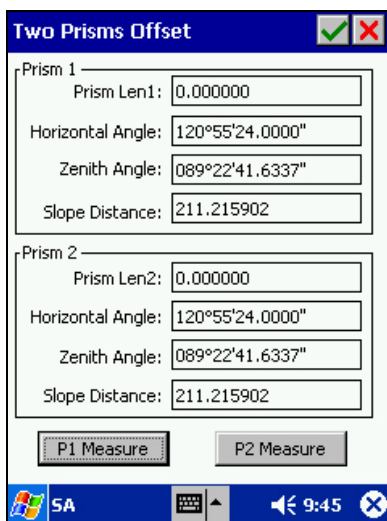
Tap on  to get the angle and distance measurements of the prism. These will be automatically placed into the "Horizontal Angle", "Zenith Angle" and "Slope Distance" fields




Tap on  to compute the adjusted measurement values based on the measured values of the prism and the offsets entered. The computed values are automatically placed into the "Foresight" screen. Use the **Side** button to store the data if it is acceptable.

**Offset Method Using Two Prisms**

The "Two Prisms" method uses a pole with two prisms mounted a known distance apart on it. You take a measurement to one of the prisms then you take another measurement to the other prism. Based on this information, SA3 will determine the measurement values to the hidden point at the tip of the pole.

Select  (**Two Prisms**) to display the following screen.



Enter the distance from the far prism to the tip of the pole then tap on  to take a shot at that prism. When done, enter the distance from the near prism to the tip of the pole then tap on  to take a shot at that prism. Tap  to return to the Foresight screen. The adjusted measurement values will be displayed in the Foresight screen. Tap **Side** to store the data if it is acceptable.



### 5.3.6 Using Sets to Improve Accuracy

A number of different methods are used to improve the accuracy of a survey by taking more than one measurement to a point. Two methods, and the data entry procedures to use with the SA3, are described below. The data recorded for the multiple measurements will be used when you execute an adjustment function. Within the Field Work function, no adjustment or angle averaging is performed on the measurement sets.

#### Repetition Angles

Measure a **repetition angle** (also called an **accumulation angle**) by taking repeated measurements to the backsight and foresight targets that define the **single angle** to be measured. Begin with a backsight reading of 0, then use the previous foresight angle for each new backsight reading so as to double, triple, quadruple, etc. the measured angle. The repetition angle method can only be used on theodolites with upper and lower motions (clamps).

The procedure for measuring a repetition angle with SA3 is shown below:

1. Select **FieldWork/Setup/Repetition**. Set the **Measure Sequence** to **BFBF**, and enter the desired number of turns.
2. From the Backsight screen tap on **Set** to begin a set of measurements.
3. Aim at the backsight target, clear the horizontal reading to 0, and record the backsight measurement. Tap on **Store** to advance to the Foresight screen.
4. With the UPPER motion, aim at the foresight target and tap on **Side** to record the foresight measurement. This is the angle right (left) measurement from the backsight to the foresight.
5. Tap on **EndSet** from the Foresight screen to end the first turn (set) and begin the second turn (set) of measurements. The program will prompt you to reverse the instrument and then return to the Backsight screen.
6. Plunge the scope (to minimize collimation error), then with the LOWER motion aim at the backsight target and record the backsight measurement. This measurement should be the same as the previous foresight measurement. Tap on **Store** to proceed to the Foresight screen.
7. With the UPPER motion, aim at the foresight target and record the foresight measurement. This measurement will be double the previous foresight measurement. If the angle computed from the measurement is not within tolerance, you will be notified to take corrective action. Tap on **Side** to record the measurement and return to the Backsight screen.
8. Steps 6 and 7 are repeated for the number of turns specified in step 0.

#### Direction Sets

When multiple readings are used to improve accuracy, the direction set method of measuring angles makes the most of the measured data. With this method, you can take measurements for any **number of foresight points** within a measurement set. Up to 16 measurement sets (8 measurement sequences) can be made for each collection of points. The measurement sequence can be BFFB, BFBF or BBFF. Therefore, you may specify only an even number of measurement sets to be taken. The lower motion is not used for direction sets, so any type of theodolite may be used for direction sets.

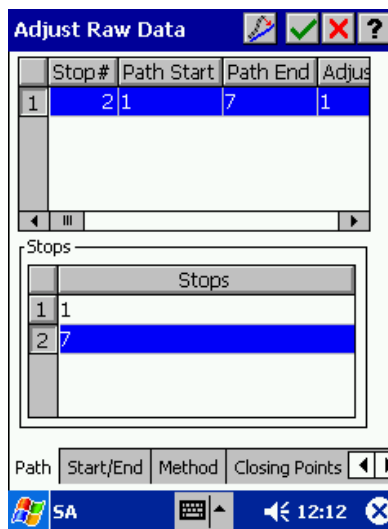
Following is the procedure for measuring direction sets with the SA3:

1. Select **FieldWork/Setup/Repetition**. Check that the repetition mode (BFBF, BFFB, or BBFF) and an even number of turns (sets) to be taken in the measurement are specified as desired.
2. From the Backsight screen, select the **Set** button to begin taking the first set (turn) of measurements.

3. Aim at the backsight target, and record a backsight measurement. The backsight measurement may have any value, including 0. Tap on **Store** to advance to the Foresight screen.
4. Aim at a foresight target and take foresight measurement. This is the angle right (left) measurement from the backsight to the foresight. **Use the Side button to record the measurement.** The point number will automatically advance to the next available one.
5. Repeat step 4 for each foresight point in the measurement set. When all foresight points have been measured, tap on **Endset** to end the first set (turn) and begin the next set of measurements. The program will prompt you to reverse the instrument and then continue with the next measurement set. The distance and angle values obtained from this first measurement set will be used as a reference for determining if the values obtained from subsequent measurement sets are within tolerance.
6. Plunge the scope (to minimize collimation errors) and, depending on the sequence selected in the setup screen, sight the backsight (for BFBF) or the last foresight (for BFFB).
7. Make sure you cover all the foresight points when taking the foresight measurements. If a distance or angle value is not within tolerance, you will be notified to take corrective action.
8. When the second measurement set is finished, the program will prompt you for the third measurement set, and the process continues until all the measurement sets have been taken.

## 5.4 Traverse Adjustment

The **Menu/Adjust** option is used to adjust a traverse and balance any measurement errors that have occurred. **Only the point coordinates are changed; the raw field data measurements are always preserved.** When you first access the Adjust function, the current "Path" is displayed:



The **Path** screen lists and summarizes the traverse paths in the currently active job. It shows the number of Stops in the path, the start and ending point of the path, the start and ending points of the adjustment, the closing point number, the type of the traverse adjustment as well as the list of points (stops) in the path.


Tap on another tab at the bottom of the screen to specify the parameters for the selected traverse path or to view the closing point location and closing errors. Tap on the arrows to scroll the tabs.

## 5.4.1 Adjustment Method and Setup

Before performing a traverse adjustment, first specify the traverse type and set up the angle and distance tolerances. To do so, choose **Menu/Adjust** then tap on the “**Method**” tab at the bottom of the screen. The following dialog is displayed:

The screenshot shows the 'Adjust Raw Data' dialog box. The title bar includes icons for back, check, close, and help. The dialog contains the following fields and controls:

- Traverse Type: End Tied (dropdown menu)
- Adjust Method: Compass (dropdown menu)
- Angle Adjust
- Elevation Adjust
- Adjust Setting section:
  - Distance Tolerance: 0.030480
  - Angle Tolerance: 000°03'00.0000"
- Bottom navigation tabs: Path, Start/End, Method (selected), Closing Points
- Windows taskbar at the bottom shows 'SA' and the time '11:20'.

- Adjust Setting:** Enter the angle and distance tolerance values here. If the adjustment results in changes that exceed the specified tolerances, SA3 will issue a warning message.
- Traverse Type:** Select from the available options in the pull-down menu: **OPEN TRAVERSE**, **CLOSED LOOP** or **END TIED** traverse type. Generally, SA3 will determine the traverse type for you.
- Adjust Method:** Select an Adjustment Method: Compass, Transit and Least-Squares.
- Angle Adjust:** Place a check mark in this box if angle adjustment is desired. If an adjustment method other than Compass or Transit is selected, then angle adjustment will automatically be performed as is appropriate for the adjustment method. If angle adjustment is selected for Compass or Transit, the angular error is distributed evenly to each angle in the traverse. In this case, no angle error will be reported in the Error Summary screen.
- If angle adjustment is not selected, then the total angle error will be shown in the horizontal angle error (HA-E) field of the Error Summary display. To get an idea of the size of the angle error, you may wish to uncheck the angle adjustment and view the total error in the Error Summary screen. Then go back to the Method screen and place a check mark in the angle adjustment box. When you tap  to actually perform the adjustment, the error will be distributed to each of the measured angles.
- Elevation Adjust:** Place a check mark in this box if elevation adjustment is desired. This field works in the same manner as the Angle Adjust field. When no elevation adjustment is selected, the total elevation error is shown in the Error Summary screen and no error distribution is performed. When elevation adjustment is selected, the elevation error is distributed to each leg of the traverse, and 0 elevation error is shown in the Error Summary screen.
- Tolerances** Specify the **Distance Tolerance** and **Angle Tolerance** values.

## 5.4.2 Start/End Points for Adjustment

Select the Start/End tab to specify the beginning and ending traverse points. SA3 will automatically select these for you, but they may be changed in the Start/End Dialog:

The screenshot shows the 'Adjust Raw Data' dialog box with the following fields and values:

|                  |                 |
|------------------|-----------------|
| Start OS:        | 1               |
| Start BS:        | 2               |
| Start Direction: | 043°56'20.7179" |
| End OS:          | 7               |
| End FS/SS:       | 8               |
| Ref Direction:   | 268°56'20.7179" |
| Close Point:     | 7               |
| End Direction:   | 268°56'20.7179" |

At the bottom, there are tabs for 'Start/End', 'Method', 'Closing Points', and 'Error'. The 'Start/End' tab is currently selected. The system tray at the bottom shows 'SA', a keyboard icon, and the time '12:19'.

If desired, change the Start OS point by tapping on the pull-down menu to the right of the field. When a different Start OS is selected the Start BS and Start Direction will automatically be updated based on the associated BS reference.

The End OS may also be changed. Any change will automatically update the End FS/SS field and the Ref Direction field. SA3 will recognize any changes in these fields and automatically select the appropriate traverse type.

## 5.4.3 Closing Points

Coordinates for the starting and ending points may be viewed by tapping on the "Closing Points" tab at the bottom of the screen. This is a display-only screen.

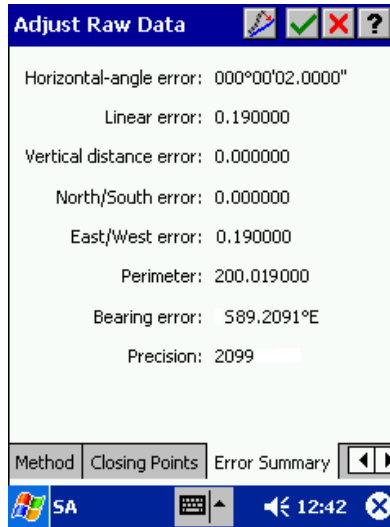
The screenshot shows the 'Adjust Raw Data' dialog box with the 'Closing Points' tab selected. It displays the following coordinate data:

| Coordinate Type | Start Point    | End Point      | Actual Point   |
|-----------------|----------------|----------------|----------------|
| Northing        | 4934458.800000 | 4934558.782858 | 4934558.782858 |
| Easting         | 479078.540000  | 479076.688466  | 479076.688466  |
| Orthometric     | 40.000000      | 40.000000      | 40.000000      |


At the bottom, there are tabs for 'Start/End', 'Method', 'Closing Points', and 'Error'. The 'Closing Points' tab is currently selected. The system tray at the bottom shows 'SA', a keyboard icon, and the time '12:27'.

## 5.4.4 Error Summary

Tap on the Error Summary tab to view the closing errors. This is a display-only screen.





## 5.4.5 Performing the Adjustment

If the closure information is satisfactory, then perform the adjustment by tapping on the  button at the top of the Adjust Raw Data screen. If there are any “hold” points in the adjustment path, you will be prompted to overwrite them with the new adjusted points. If you are sure about the adjustment, then select “Overwrite” or “Overwrite All”.

“Hold points” are points computed from a previous adjustment or points for which you have manually set the Hold (hold point) status (i.e. with fixed coordinates). When performing an adjustment, you will want to think about whether you want those points overwritten

### Summary of Steps to Adjust a Traverse

1. Select **Menu/Adjust**.
2. Specify the beginning and ending traverse points. For a closed-loop traverse, the first and last points are the same. For an end-tied traverse, the last point must be a control point.
3. Select adjustment options, then tap on Closing Point and Error Summary to see the raw closure information.
4. If it looks good, then tap  to adjust the coordinates. Tap on  to return to the Map View.

In order to be successfully adjusted, a closed-loop or end-tied traverse needs to meet certain requirements on how the ending measurements are taken. Keep these requirements in mind when you are collecting data using SA3 in the field.

Please keep the following things in mind:

- Last OS of closed loop traverse with internal BS must be the same as the internal BS.
- Last OS of closed loop traverse with external BS must be the same as the first OS point.
- End-ties traverse must have last OS at a control point.
- Last FS of closed loop traverse with internal BS must be the same as the first OS point.
- Last FS of closed loop traverse with external BS must be the same as the first BS.
- End-tied traverse must end with FS to an azimuth mark.






## Section 6 – COGO Functions




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The coordinate geometry (COGO) operations let you define new points by various mathematical techniques. The available COGO functions are:



|                        |   |                            |  |
|------------------------|---|----------------------------|--|
| <b>Traverse</b>        | Traverse by direction and distance, or by Scale factor.       | <b>Inverse</b>             | Determine direction and distance between Points.                                   |
| <b>Scale</b>           | Scale Features or Figures to a fixed Point.                   | <b>2 Point Resection</b>   | Use angle and distance data to two known Points to get coordinates of a new Point. |
| <b>Rotate</b>          | Rotate Features or Figures around a fixed Point.              | <b>3 Point Resection</b>   | Use angle data to 3 known Points to get coordinates of a new Point.                |
| <b>Translate</b>       | Move Features, Figures or your entire Job.                    | <b>Horizontal Curve</b>    | Define and place a Horizontal Curve.   |
| <b>Corner Angle</b>    | Find the corner angle defined by 3 Points.                    | <b>3 Point Curve</b>       | Define a Horizontal Curve using 3 known Points.                                    |
| <b>Multiple Points</b> | Define new Points along a line at even intervals.             | <b>Curve bet. Tangents</b> | Determine the Curve between two Tangent lines.                                     |
| <b>Direction Cut</b>   | Determine the cut Points for a specific area by direction.    | <b>Curve by Radius</b>     | Define a curve by using a known point as the PI.                                   |
| <b>Hinge Cut</b>       | Determine the cut Point for a specific area by a hinge Point. | <b>Vertical Curve</b>      | Define and place a Vertical Curve.   |
| <b>Station Offset</b>  | Create Stakeout Points from your Figures and Features.        | <b>Spiral Curve</b>        | Define and place a Spiral Curve.   |
| <b>Intersection</b>    | Distance, direction and Line intersections.                   | <b>Bench mark</b>          | Determine the elevation of a Point by measuring to a known Point.                  |
|                        |   | <b>Earthwork</b>           | Calculate earth volumes  |


To open the COGO menu to select a COGO function, simply tap on .

In many COGO screens, you will need to specify a known angle, direction or Feature. You may tap on  then type in the required information. You may use the pointer  button to select a feature from the Map View, or use the features  button to pick the desired feature from the list. In the remainder of Section 6, these procedures for selecting a feature may be referred to as “Specify the Feature/Figure” or “Specify the Point”.

The  icon will be available when there are newly created point or points to store. Selecting this icon displays the **Store Feature** screen. You may then select  to confirm or select  to cancel the action of storing the new point. In the remainder of Section 6, the above sequence may be simply referred to as “Store the new point”.

Some types of COGO points must be specifically solved for. In those COGO screens, select the  icon to generate the new points. This will be referred to as: **“Solve for the new point”**. If you make any changes, you must tap this icon again to update the solution.

Use  to view and check the solution in Map View. This will be referred to as: **“View the solution.”** The solution points will be temporarily displayed as black dots. Tap  to return to the COGO screen.

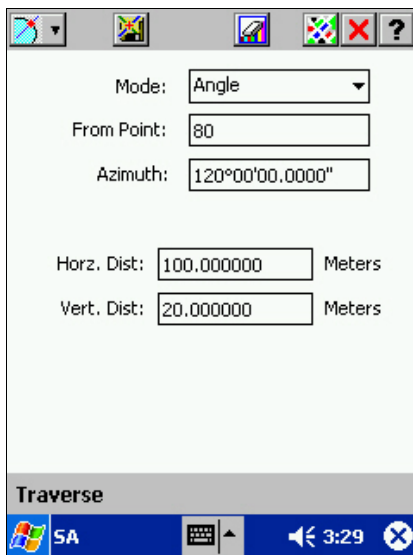
Tap  if you wish to erase all data that you have entered into the current screen.

Mark the **With Elevation** check box if you are working with three-dimensional data.

Leave the **Delete Original Data** check box unmarked if you wish to keep the original Features along with the newly created Features. If you mark this box, the original Features will be deleted.

## 6.1 COGO/Traverse


This function is used to create a new point by a traverse method. When you select COGO/Traverse, the following screen will be displayed:



**Mode:** Select a Traverse Mode: Angle, Horizontal Angle or Scale Factor.

**From Point:** Enter the Point Number of the From Point by tapping on it once or by typing in the Point Number.

You may also use  or  to select the From Point.

Tap on  to store the new traverse point.

### For Angle Mode



1. Enter the Azimuth or Bearing by using the keypad or select two points (P1 and P2) to define the angle.
2. Enter the Horizontal distance from the known point by typing the distance with your keypad.
3. Enter the Vertical distance. A positive number reflects a higher elevation than the known point; a negative number reflects a lower elevation.
4. Store the new point.



### **For Horizontal Angle Mode**

1. Key in the back angle with your keypad or select the Back Point.
2. Enter the horizontal angle at which you wish to move from the line formed by the From Point to the Back Point.
3. Enter the Horizontal distance from the known point by using your keypad.
4. Enter the Vertical distance. A positive number reflects a higher elevation than the known point; a negative number reflects a lower elevation.
5. Store the new point.

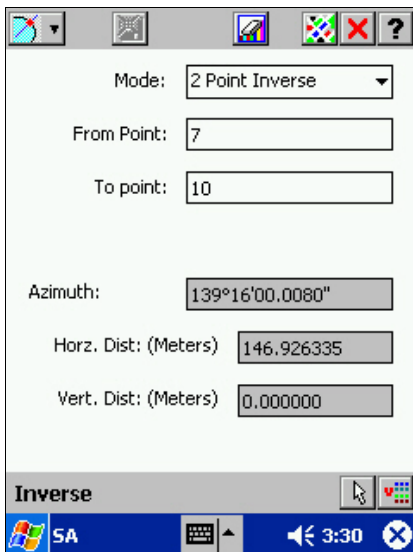
### **For Scale Factor Mode**

1. Enter the Point Number of the To Point or use  or  to pick the To Point. This, with the From Point, will form a line. The new point will be placed along this line.
2. Enter a scale factor using the following rules: A scale factor of .5 will place the new point halfway between the From and To points, a scale factor of 1 will place the new point on the To Point, and a scale factor of 2 will place the new point such that the To Point is halfway between the From Point and the new point.
3. If you are working in three dimensions, tap on the box for Scale with Elev.
4. Store the new point.

## **6.2 Inverse**

Use COGO Inverse to show the direction and distance between two points or to define the perpendicular displacement from a point to a line.

When you select COGO/INVERSE, the following screen will be displayed:



The screenshot shows a software interface for the 'Inverse' function. At the top, there is a toolbar with several icons. Below the toolbar, the 'Mode' is set to '2 Point Inverse'. The 'From Point' is entered as '7' and the 'To point' is entered as '10'. The 'Azimuth' is displayed as '139°16'00.0080"'. The 'Horz. Dist: (Meters)' is '146.926335' and the 'Vert. Dist: (Meters)' is '0.000000'. At the bottom of the screen, there is a status bar with the word 'Inverse' and a small icon.

**From Point:** Select the point or enter its Point Number.

**Mode:** Select the Mode: 2 Point Inverse or Inverse to Line.

#### **To Point:**

**For 2 Point Inverse,** select the TO POINT or enter its Point Number. SA3 will automatically compute the Bearing, Horizontal Distance and Vertical distance between the two points.

**For Inverse on Line,** specify two points on the straight line. SA3 will automatically compute the Angle (Bearing or Azimuth), Horizontal Distance and Vertical distance between the From Point and the line.

No new point will be created for the 2-Point Inverse function.

For Inverse on Line, a new point will be created and you may store the solution point.

## 6.3 Translate/Rotate/Scale

The COGO Translate/Rotate/Scale function allows you to perform the following three functions on Point, Line and Area Features.

**Translate:** The translation operation takes a set of points and moves them a fixed distance in the x, y, and z directions. The distance moved may be specified with relative or absolute quantities.

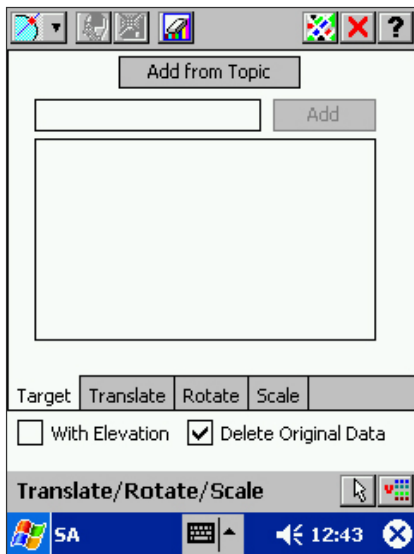
**Rotate:** The rotation operation turns a Figure or Point around a pivot point. The amount of turn can be specified as an absolute or relative quantity.



**Scale:** In the scale operation, the selected Figure or group of points is rescaled.

You can use the combined Translate/Rotate/Scale function to transform your job from one coordinate system to another if you have the following information:

- the displacement of the origin of one system with respect to the other
- the orientation of one system with respect to the other and
- the length conversion scale factor.

When you select COGO/Translate/Rotate/Scale, the following screen is displayed and the Target tab is active.



Use  or  to select the target Features. The IDs of the selected Features will be displayed in the large target list box.

You can also enter an ID number and tap the **Add** button to add that Feature to the list. Select **Add from Topic** if you wish to include all points in the selected Feature Topic.

**To remove an item from the target list, tap twice on the corresponding ID.**

Tap on the **Translate** tab to use the Translate function

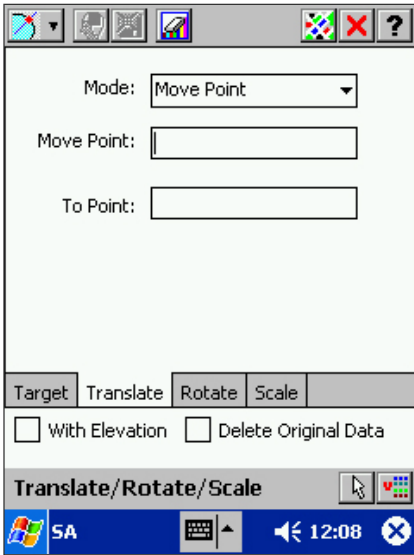
Tap on the **Rotate** tab to use the Rotate function.

Tap on the **Scale** tab to use the Scale function.

To select a different set of targets, tap on **Target**.

### 6.3.1 Translate

The translation operation takes a set of points and moves them a fixed distance in the x, y, and z directions. The distance moved may be specified with relative or absolute quantities. When you tap the **Translate** tab the following screen will be displayed.



**Mode:** You can translate in one of three modes.

For the **Move Point** mode specify the representative **Move Point** that will be moved to a new point location. In the **To Point** field, specify the point to which the Move Point should be relocated. All the target features will be moved the same amount.

For the **Adjust Point** mode specify the amount of adjustment to be made to the coordinates of the target Features.

For the **Coordinate** mode, specify the representative **Move Point** that will be moved to a new coordinate location. Enter the new coordinates for the Move Point. All the target features will be moved the same amount.

### Some useful applications for the Translate function

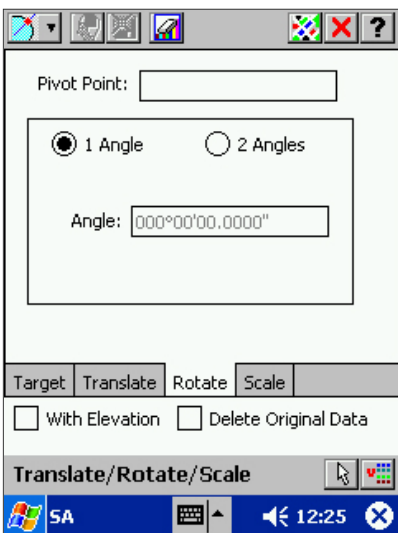
You can easily relocate your job with an assumed origin of 1000,1000,0 to the actual location.

You can easily change the elevation of all the points in your job.

You can replicate a Line or Area Feature. Do not mark the "Delete original data" option so that the original figure stays intact when the translated figure is stored.

### 6.3.2 Rotate

The rotation operation turns a Line or Area Feature or a group of Point Feature around a pivot point. The amount of turn can be specified as an absolute or relative quantity. When you tap the **Rotate** tab, the following screen will be displayed:



After selecting a **Pivot Point**, you can choose "1 Angle" or "2 Angles" mode.

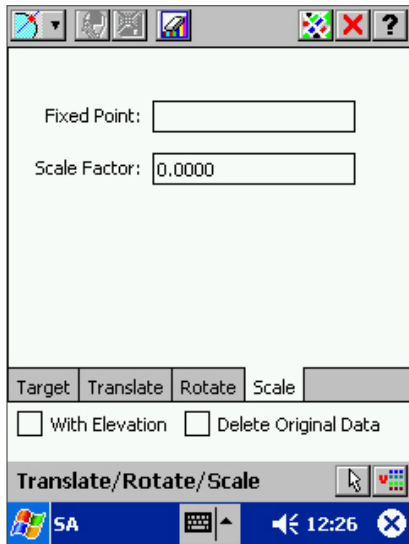
For the **1 Angle** mode, enter the angle using your keypad and solve for the new point.

For the **2 Angles** mode, the rotation angle is the difference between the two angles that you specify.

### 6.3.3 Scale

In scaling, the size of a Line or Area Feature or the spread of a group of Points is rescaled. The location of the resultant Feature or group of points is determined from the distance between the first node/point of the target and a fixed point that you specify.

When you tap the **Scale** tab the following screen will be displayed.




**Fixed Point:** Specify the point to be used as the fixed reference point for scaling the target Features.

**Scale Factor:** Enter a value greater than 1 to enlarge the target, or enter a fraction to reduce the target size.

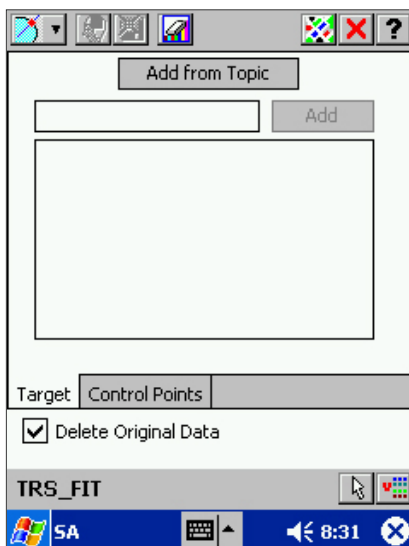
Tap on  to compute the solution.

Tap  to view the solution.

Use  to store the scaled Features.

### 6.4 T/R/S Least Squares Fit


The TRS-LS Fit function is useful when you need to adjust the job with respect to known bench marks, or when you need to combine the data points from 2 jobs that have been collected in two different coordinate systems. When you select Cogo/T/R/S/ Least Squares Fit, the following screen is displayed and the **Target** tab is active.




Specify the target Features. The IDs of the selected Features will be displayed in the large target list box.

**To remove an item from the target list, tap twice on the corresponding ID.**

Tap the **Control Points** tab to specify the control points. Specify a control point for the **Target Point** field. Specify the corresponding reference point for the **Reference Point** field. Then tap on **Add** to add this pair of points to the list of control and reference points. Repeat to add additional pairs of control point and reference point.

Tap on  to fit the set of control points to the reference points. The Target Features will be translated, rotated and scaled accordingly. The adjustment errors will be displayed.

Use  to save the adjusted coordinates of the Target Features.

## 6.5 Corner Angle

Use this function to calculate the angle between two points using a third point as your corner/hinge point. When you select COGO/Corner Angle, the following screen will be displayed.

Corner Angle

**First Point:** Enter the Point Number of a point on the first leg of the angle to be computed.

**Corner Point:** Enter the point number of the corner/hinge point.

**End Point:** Enter the point number of a point on the second leg of the angle to be computed.

SA3 will automatically compute and display the internal and external corner angles.

## 6.6 Intersection

COGO Intersection takes two points and a direction (and optional offset) or distance from each to calculate the point of intersection. When you select COGO/INTERSECTION, the following screen will be displayed.

Intersect

**Point 1:** Specify the first known point.

**Mode:** Specify the data to be entered for the first known point: Distance or Angle.

**Point 2:** Specify the second known point.

**Mode:** Specify the data to be entered for the second known point: Distance or Angle.

Enter the Distance, Bearing or Azimuth as appropriate.

Tap  to view the solution.

Store the new points if they are properly situated.

## 6.7 Multiple Points

The Cogo/Multiple Points function is used to generate a series of Points along a line formed by two existing Points. You may specify the desired number of points or the desired spacing interval between the new points. SA3 will calculate the positions for you based on the most recent entry of the specifications.

When you select Cogo/Multiple Points, the following screen is displayed.

The screenshot shows the 'Multiple Points' dialog box in 'To Point' mode. The 'Mode' dropdown is set to 'To Point'. The 'From Point' is 14 and the 'To Point' is 5. The horizontal distance is 155.572383 meters and the vertical distance is 0.000000 meters. Under the 'Spacing' section, 'Horizontal' is selected with a spacing of 20.000000 meters. Under the 'First Dist: (Meters)' section, 'Horizontal' is selected with a distance of 0.000000 meters. The dialog box has a title bar with icons for help, back, forward, and close. The Windows taskbar at the bottom shows the time as 3:33.

Select the **Mode** you wish to use: **To Point** or **Angle**.

**From Point:** Specify the Point that will define the starting point of the line along which the new points will be generated.

**For To Point mode:**

**To Point:** Specify the Point Number which will define the ending Point of the line along which the new points will be generated.

Enter the number of new Points that you would like to create. SA3 will then calculate the interval between the new Points. Alternatively, you may enter the **Horizontal** or **Vertical** spacing between the new Points and SA3 will determine the number of new Points for you.

**First Dist.:** Enter the distance from the From Point to the first new point (zero means the first new point is the same as the From Point).

Solve for and store the new points.

The screenshot shows the 'Multiple Points' dialog box in 'Angle' mode. The 'Mode' dropdown is set to 'Angle'. The 'From Point' is 14 and the 'Azimuth' is 200°00'00.0000". The interval is 20.000000 meters and the offset is 5 meters. The number of points is 20. Under the 'First Dist: (Meters)' section, 'Horizontal' is selected with a distance of 10.000000 meters. The dialog box has a title bar with icons for help, back, forward, and close. The Windows taskbar at the bottom shows the time as 4:47.

**For Angle mode:**

Specify the **Azimuth or Bearing** by typing the angle with your keypad, or by choosing two points (P1 and P2) to define the angle.

**Interval:** Enter the distance interval between the new points

**Offset:** Enter the distance offset for the new points (positive value for right offset, negative value for left offset).

**# of Points:** Enter the number of new points to be created.

**First Dist.:** Enter the distance from the From Point to the first new point (zero means the first new point is the same as the From Point).

Solve for and store the new points.

## 6.8 Area Cut

The options available for Area cut operations are Direction Cut and Hinge Cut. These functions will work on an **Area Feature** or a predefined **Figure**.

### 6.8.1 Direction-Cut Area

Direction-Cut Area will find the location of two new points on a Figure or Area Feature that define a line that goes in the direction you specify and cuts out a size of area that you specify. When you select COGO/Direction Cut, the following screen will be displayed.

**Target Feature:** Specify the Area Feature or Figure of interest. Its area will be displayed in the **Total Area** field.

**Area Unit:** Choose from Sq. Feet, Sq. Meters, Hectares and Acres.

**Cut Area:** Enter the size of area that you would like to cut.

**Mode:** Select **Single** to calculate points for a single cut. Select **Multiple** to calculate points for multiple cuts.

**Direction:** Specify the direction of the dividing line or lines by entering the angle with your keypad or by choosing two points (P1 and P2).

Solve for, view and store the solution lines and points.

### 6.8.2 Hinge-Cut Area

Hinge-Cut Area calculates the location of a new point that delimits a region of a specific size when a line is drawn from a fixed point (the hinge point) to the new point. When you select COGO/HINGE CUT AREA, the following screen will be displayed.

**Target Feature:** Specify the Area Feature or Figure of interest. Its area will be displayed in the **Total Area** field.

**Area Unit:** Choose from Sq. Feet, Sq. Meters, Hectares and Acres.

**Cut Area:** Enter the size of area that you would like to cut.

**Hinge Node #:** Specify the point or node that will be the origin of the division line.

**Include Point in List:** Selecting **Previous** will make the node previous to the Hinge node part of the enclosed area. Selecting **Next** will make the node after the Hinge node part of the enclosed area. When the area is not cut exactly into two halves, the result you get will depend on the selection of the point to include in the cut area.

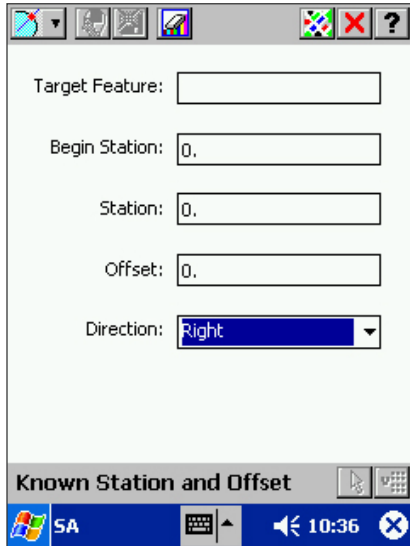
Solve for, view and store the solution line and points.

## 6.9 Station Offsets

Given a set of points that defines a centerline either by a defined **Figure** or by an **Area Feature**, you can define the coordinate values of new points with a defined offset from the centerline. Menu. The **COGO\Station Offset** function provides four options from which to select: Known Station and Offset, Known Coordinates, Known Offset and Known Measurement.

### 6.9.1 Known Station and Offset

This routine enables you to calculate the coordinates of a new point by specifying a known station on a Line/Area Feature or a Figure and then applying an offset to that station. When you select COGO\Station Offset/Known Station and Offset, the following screen is displayed.



**Target Feature:** Specify the Line/Area Feature or Figure.

**Begin Station:** Enter the station value to assign to the first point of the specified Feature or Figure. Subsequent stations are automatically set up at intervals of one unit of distance measure, such as 1 foot or 1 meter. Their station values are assigned accordingly.

**Station:** Enter the station value of the point or node of interest in the Feature or Figure specified above.

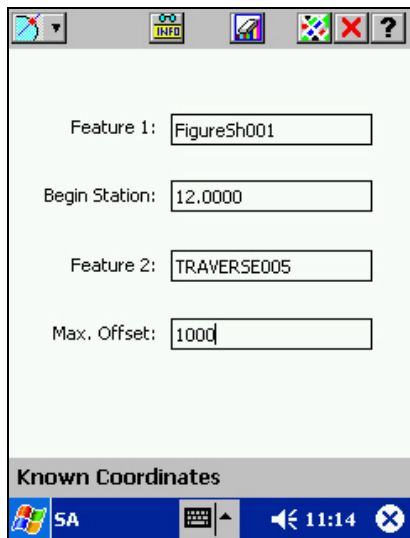
**Offset:** Specify how far from the Feature or Figure the new point will be.

**Direction:** Specify whether the new will be on the left or right side of the Feature or Figure with respect to the direction of increasing station numbers.

Solve for, view and then store the new Point.

### 6.9.2 Known Coordinates

This routine determines from the known coordinates of an offset Feature its station value and offset value. Select COGO/Station Offset/Known Coordinates to display the following screen.




**Feature 1:** Specify the reference Line/Area Feature or Figure.

**Begin Station:** Enter the station value to assign to the first point of the specified Feature or Figure. This may be an arbitrary number. Subsequent stations are automatically set up at intervals of one unit of distance measure, such as 1 foot or 1 meter. Their station values are assigned accordingly.

**Feature 2:** Specify the target for which you will be determining the offset values. This may be a Figure or a Point, Line or Area Feature.

**Max. Offset:** Enter the maximum allowable offset. This value serves to limit the possible solutions, as it cannot be exceeded.

Tap the  icon to view the station and offset information.



### 6.9.3 Known Offset

The Known Offset function is used to create new Points that are offset from an existing Line/Area Feature or Figure. Select COGO/Station Offset/Known Offset to display the following screen.

Target Feature:

Interval:

Offset:

Direction:

Known Offset

**Target Feature:** Specify the reference Line/Area Feature or Figure.

**Interval:** Enter the interval at which you would like to place the offset points.

**Offset:** Enter the distance at which you would like to offset the new points from the Feature or Figure.

**Direction:** Enter the direction of the offset: Right, Left, Center, or R+L+C (all three). The direction of the offset is defined with respect to the direction of increasing station numbers.

Solve for and view the locations of the offset points. These will generally follow the outline of the reference Feature or Figure.

Store the new points.

### 6.9.4 Known Measurements

This function uses known measurement information to determine station and offset information from the selected Line/Area Feature or Figure. Select COGO/Station Offset/Known Measurement to display the following screen.

Target Feature:

Max. Offset:

OS:

BS:

HI:

HT:

BS Angle:

FS Angle:

FS Zenith:

FS Slope Dist.:

Known Measurement

**Target Feature:** Specify the reference Line/Area Feature or Figure.

**Max. Offset:** Enter the maximum allowable offset. This value serves to limit the possible solutions, as it cannot be exceeded.

**OS, BS:** Enter the OS Point and BS Point that you are using to take your measurements.

Enter the measurement data into the remaining fields.

Solve for, view and then store the new Point.

## 6.10 Resection

For 2-Point Resection and 3-Point Angle Resection, the point of interest is an unknown position. Distance and/or angle measurements are made to the known points to determine the unknown position. In the case of 2-point resection, the elevation of the unknown point is also determined.

### 6.10.1 2-Point Resection

2-Point resection is used to determine your position when angle and distance measurements can be made to two points with known coordinates. When you select COGO/2 Point Resection, the following screen will be displayed.

The screenshot shows the '2 Point Resection' software interface. It features a toolbar at the top with icons for navigation and help. The main area contains several input fields:

- Instrument Ht: 0.000000
- P1: 3
- Height: (Meters): 0.000000
- Horz Angle: 000°00'00.0000"
- Zenith Angle: 090°00'00.0000"
- Slope Dist: (Meters): 0.000000
- P2: 9
- Height: (Meters): 0.000000
- Horz Angle: 000°00'00.0000"
- Zenith Angle: 090°00'00.0000"
- Slope Dist: (Meters): 0.000000

The title bar at the bottom of the window reads '2 Point Resection'. The Windows taskbar at the very bottom shows the time as 8:49.

**Instrument Ht:** Enter the Instrument Height.

**P1:** and **P2:** Specify the two known points.


Enter the following data for each of the two known points.

**Height:** Enter the Height of Target for the known point.

**Horizontal Angle:** Enter the Horizontal Angle to the known point.

**Zenith Angle:** Enter the Zenith Angle to the known point.

**Slope Dist.:** Enter the Slope Distance to the known point.

You may use  to obtain the distance and angle measurements from the instrument.

Solve for, view and store the new point.

### 6.10.2 3-Point Angle Resection


3-Point Angle resection allows you to determine a location by sighting three known points and measuring the angle from each of them. When you select COGO/3 Point Resection, the following screen will be displayed:

The screenshot shows the '3 Point Resection' software interface. It features a toolbar at the top with icons for navigation and help. The main area contains several input fields:

- Point 1: 9
- Angle 1: 120°00'00.0000"
- Point 2: 80
- Angle 2: 220°00'00.0000"
- Point 3: 12
- Angle 3: 045°00'00.0000"

The title bar at the bottom of the window reads '3 Point Resection'. The Windows taskbar at the very bottom shows the time as 11:50.

**Point 1:**, **Point 2:** and **Point 3:** Specify the three known points.

**Angle 1:**, **Angle 2:** and **Angle 3:** Enter the Horizontal Angle to each of the known points or use  to take the measurements.

Solve for, view and store the new point. This is the projection of the solution point onto the plane at 0 elevation.

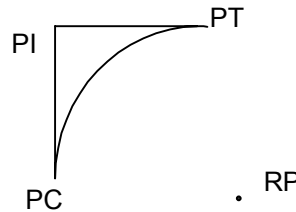
## 6.11 Curves

SA3 supports seven fundamental types of curves: Horizontal Curves, 3 Point Curves, Curve between Tangents, Curve by Radius, Vertical Curves and Spiral Curves.

### 6.11.1 Horizontal Curve

Use COGO/Horizontal Curve to create points that define a horizontal curve based on your specifications.

For a horizontal curve, the following terms are used to specify the reference and solution points: The **PI** is the point of intersection; this is the point where the curve tangents intersect. The **PC** is the point of curvature, or where the curve begins. The **PT** is the point of tangency, or where the curve ends. The **RP** is the radius point, i.e. the center of curvature of the curve described.



The following screen lets you specify two parameters for the curve and where to place the curve in your map.

The screenshot shows the 'Horizontal Curve' dialog box in the SA3 software. The dialog has a title bar with standard window controls. Below the title bar, there are two input fields: 'Radius' with a dropdown arrow and a text box containing '0.0000', and 'Center Angle' with a dropdown arrow and a text box containing '0.0000'. Below these are three more input fields: 'Known Point:' with a dropdown menu showing 'PI' and an empty text box below it; 'PI--PC direction:' with a text box containing 'N00°00'00.0000"E'; and 'Direction:' with a dropdown menu showing 'Right'. At the bottom of the dialog, there are tabs for 'Layout' and 'Info', and a 'Horizontal Curve' label with a mouse cursor icon and a color selection icon. The Windows taskbar at the bottom shows the 'SA' application icon, a keyboard icon, and a clock showing '12:24'.

**Radius:** and **Center Angle:** By default, SA3 asks you for the Radius and Central Angle. The other curve parameters are determined from the two entered pieces of information.

**External:** The distance from PI to where the line RP-PI intersects the arc PC-PT

**Middle Ordinate:** The distance from where the line RP-PI intersects the line PC-PT to where the line RP-PI intersects the arc PC-PT

**Chord:** The straight-line distance from PC to PT

**Arc:** The arc distance from PC to PT

**Tangent:** The distance from PC to PI (or from PI to PT)

**Degree:** The angle subtended at RP by a 100-ft long arc on the arc PC-PT

Once the two curve parameters have been entered, specify the **Known Point** that will be used to tie the curve to your Job. Tell SA3 whether it is to be used as the **PI**, **PC**, **PT** or **RP** for the curve.

Enter the azimuth or bearing from the PI to the PC into the **PI—PC Direction:** field. This determines the curve orientation. Also tell Sa3 whether the curve is to turn **Right** or **Left**.

Solve for, view and store the three new points that, along with the Known Point, define the curve.

### 6.11.2 Three Point Curve

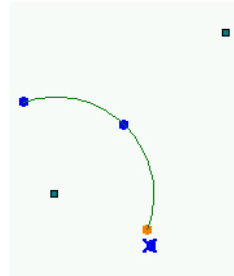
This function allows you to define a curve by specifying three points through which the curve will pass. When you select COGO/3 Point Curve, the following screen will be displayed.

**First Point:**, **Second Point:** and **Third Point:** Specify the three points through which the curve will pass.

The solution is available as soon as the three points have been specified.

SA3 will also calculate the curve sector area and segment area.

View and store the PI and RP solution points.



### 6.11.3 Curve Between Tangents

This function lets you define two lines, each passing through a known point and having a known angle, and calculate a horizontal curve tangent to the two lines.

**First Point:** Specify the Point Feature through which the first tangent line will pass.

**Second Point:** Specify the Point Feature through which the second tangent line will pass

**Direction:** Specify the direction by entering the angle or choosing two points (P1 and P2) that define the direction. The tangent lines should point toward the point of intersection.

If you know the point of tangency, then select **Tangent** and enter the distance from PC to PI or the distance from PI to PT.

If the point of tangency is unknown, you may enter the curve **Radius** or specify the **Point on Arc**. For Point on Arc, specify the point number of a known point through which the circular arc should pass.

View and store the solution points that define the curve.

### 6.11.4 Curve by Radius

Use COGO/Curve by Radius to define a curve by using a known point as the PI then supplying the direction to the PC and PT as well as the radius or the tangent of the curve.

PI: 5  
PI -> PC: 045°00'00.0000"  
PI -> PT: 120°00'00.0000"

Tangent  
 Radius 90.000000

Radius: Meters  
Segment: 3510.013048 (M<sup>2</sup>)  
Sector Area: 7422.012644 (M<sup>2</sup>)

Curve By Radius

SA 2:54

**PI:** Specify the point of intersection.

**PI->PC:** Specify the direction from the PI to PC by entering the angle with your keypad or by choosing two points (P1 and P2) that define the direction.

**PI->PT:** Specify the direction from the PI to PT by entering the angle with your keypad or by choosing two points (P1 and P2) that define the direction.

**Tangent or Radius:** Enter either the tangent or the radius of the curve.

The solution is available as soon as the above fields have been filled with proper information.

SA3 will also calculate and display the sector area and segment area.

View and store the solution points.

### 6.11.5 Radius Point

The COGO\Radius Point function calculates the location of the Radius Point of a horizontal curve that you specify.

PC: 7  
PT: 10

Direction  
 Left Turn  Right Turn

Radius 80.000000  
Meters

Arc Selection  
 Small One  Large One

Radius Points

SA 3:04

**PC, PT:** Specify the PC and PT points.

**Direction:** Specify if the curve will turn right or left.

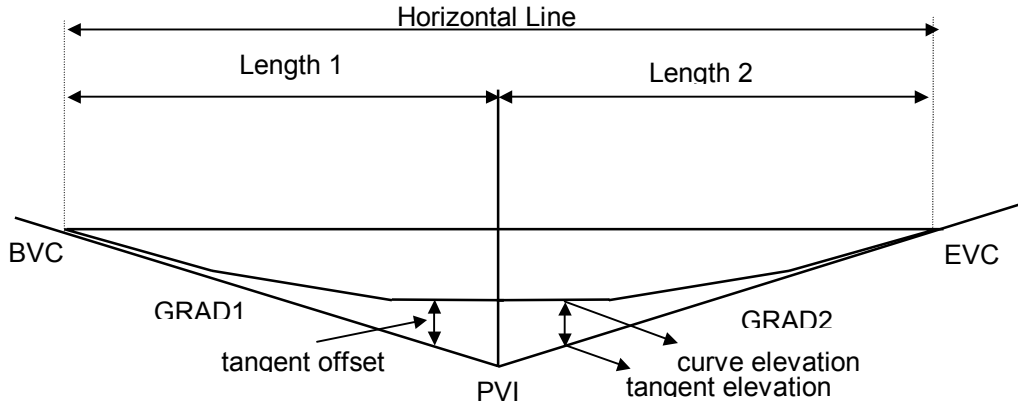
Select **Radius, Central Angle, or Tangent** and enter the appropriate data.

In general, there will be two solutions. Select **Small One** or **Large One** to get the radius point for the smaller or larger arc, respectively.

View and store the Radius Point.

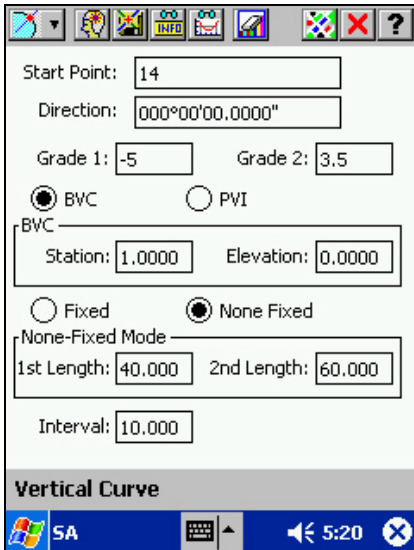
## 6.11.6 Vertical Curves

The vertical curve operation allows you to create either a symmetrical or non-symmetrical vertical curve, including the high or low point of the curve and where the curve stops. The following diagram will help you understand the layout and reference points for vertical curves.



- BVC:** Beginning of vertical curve.
- PVI:** Point of vertical intersection (where the BVC and EVC intersect).
- EVC:** End of vertical curve.
- GRAD1:** Percent gradient of the tangent line from BVC to PVI.
- GRAD2:** Percent gradient of the tangent line from PVI to EVC.
- LENGTH 1:** Horizontal distance from the BVC point to the PVI point.
- LENGTH 2:** Horizontal distance from the EVC point to the PVI point.

When you select COGO/ Vertical Curve, the following screen will be displayed.



**Start Point:** Specify the beginning point of the curve.

**Direction:** Specify the horizontal orientation of the curve.

**Grade 1:** and **Grade 2:** Enter the percent gradient of the tangent line from BVC to PVI or PVI to EVC, respectively. Enter a negative value for a downward slope.

Enter the station value of **BVC** or **PVI** along the horizontal line. Enter the corresponding elevation.

Select **Fixed** and enter the station and elevation values for a known point if you want the curve to pass through it.

For **None Fixed** mode, enter the horizontal distance from BVC to PVI as **1st Length** and enter the horizontal distance from PVI to EVC as **2nd Length**.

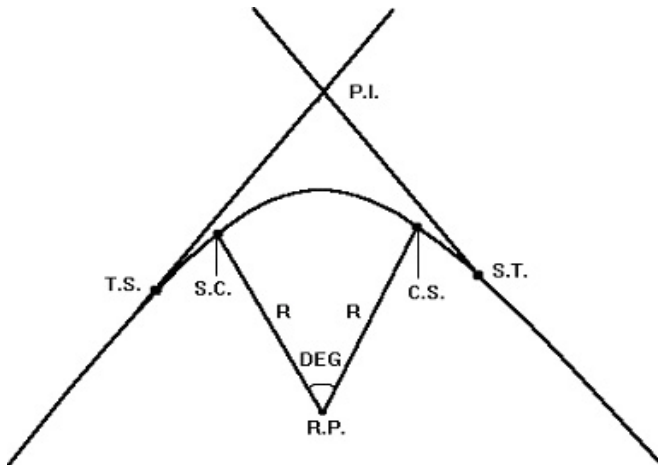
**Interval:** Enter the interval along the horizontal line at which to determine points on the vertical curve.

Tap on to compute the solution. Then tap on to view the station and offset information. Tap on to save the vertical curve solution file.

Tap on to view the vertical curve profile.

## 6.11.7 Spiral Curves

The spiral curves option allows you to design a spiral curve in the horizontal plane. The following diagram defines the notation used in the spiral curve function:



- PI:** Point of intersection
- RP:** Radius point for the circular curve portion
- TS:** Tangent to Spiral interface point
- SC:** Spiral to Circular Curve interface point
- CS:** Circular to Spiral interface point
- ST:** Spiral to Tangent interface point
- R:** Radius of the circular curve portion
- DEG:** Angle subtended by the circular curve portion, in degrees

When you select COGO/Spiral curve, the following screen will be displayed.

**Point 1:** and **Point 2:** Specify the point on the first and second tangent line, respectively.

**Direction:** Specify the direction of each tangent line by entering the angle or by selecting two points (P1 and P2) that define the line. The tangent lines should point toward the point of intersection.


**Radius or Degree:** Enter the Radius of the spiral curve, or the internal angle of the spiral curve.


**Distance 1:** Enter the distance from the TS point (Tangent to Spiral) to the SC point (Spiral to Circular).

**Distance 2:** Enter the distance from the CS point (Circular to Spiral) to the ST point (Spiral to Tangent).

**TS Station:** Enter the station value of the TS point.

**Interval:** Enter the interval between the stakeout station locations.

Tap on  to view the spiral curve solution.

Tap on  to save the spiral curve solution file.

## 6.12 Earth Works

Use the COGO Earth Works functions to calculate earth volumes for simple shapes.

- 1) A shape formed by joining a number of vertical sections parallel to one another, facing the north direction.
- 2) A shape formed by using an arc to join two sections that are at an angle with each other.
- 3) A shape consisting of borrow pits at given base elevations

### 6.12.1 Earth Works/Section

This operation allows you to edit, browse, and define cross sections and borrow pits data.

**Cross Section** volume computations may be performed on two or more **vertical cross sections that are parallel to the east-west direction**. The vertical cross sections are placed at specified stations along a straight line in the **north-south direction**. Use this method to compute the volume of a pile of earth if you can approximate its shape with a train of sections with varying cross section areas. If the sections in your job are not parallel in the east-west direction, you may use COGO/Translate/Rotate/Scale (see Section 6.3) to rotate the group of points for volume calculations.

Use the **Borrow Pits** method when you can approximate the volume by representing it as a number of straight-sided pits or mounds. Borrow-pit volume calculations are performed on **horizontal borrow-pit sections** with specified **base elevations**.

If you have previously created cross section/borrow pits data, a summary of the data for each cross section/borrow pit will be displayed when you select **COGO/Earthworks/Section**.

|   | T | ID | STA/ELEV | AREA  | FIG/FEAT |
|---|---|----|----------|-------|----------|
| 1 | X | 1  | 100.00   | 30.00 |          |
| 2 | X | 3  | 150.00   | 50.00 |          |

ID:  Type:

Mode:  C/F Type:

Station:  Area:

Click on **Append** to add a section record.

Specify that this section is a **XSECTION** (cross-section) or a **BORROW PIT**.

The vertical cross section may be defined by entering an area value (**Direct**) or by specifying a pre-defined Area **Feature**. The Direct mode is not available for borrow pits.

In the **C/F** field, specify if the volume is of "cut" or "fill" type.

Following is a summary of the status fields:

**T:** Type "X" is a cross section. Type "P" is a borrow pit.

**ID:** The section number for this record.

**STA/ELEV:** The cross section's station value or the borrow pit's base elevation.

**AREA:** The area for the cross-section record.

**FIG/FEAT:** ID of the Feature or Figure used.

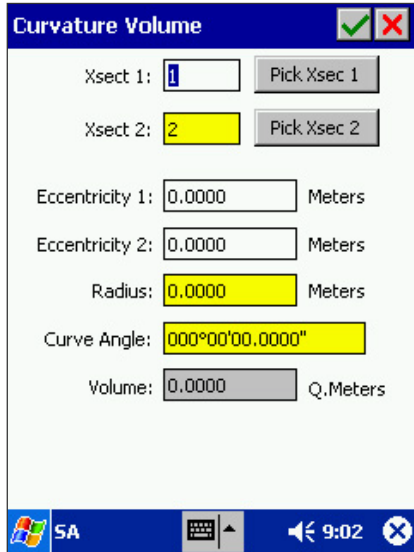
After you have defined the cross-sections or borrow pits, use **COGO/EarthWorks/Volume** to compute the volume defined by the specified section data. (See Section 6.12.3.)



## 6.12.2 Earth Works/Curvature

The Curvature Volume function is used in conjunction with the vertical cross-sections only. This function will calculate a corrected volume if the two cross-sections are separated by a circular curve. **This function only works with cross sections for which you have directly entered the area data in the “Browse Section” screen.**

When you select COGO/Earthworks/Curvature, the following screen will be displayed



**Xsect 1:** Enter the section number of the first cross section for which you have manually entered the area.

**Xsect 2:** Enter the section number of the second cross section for which you have manually entered the area.

**Eccentricity1:** Enter the distance between the centroid of the first cross section and its centerline.

**Eccentricity2:** Enter the distance between the centroid of the second cross section and its centerline.

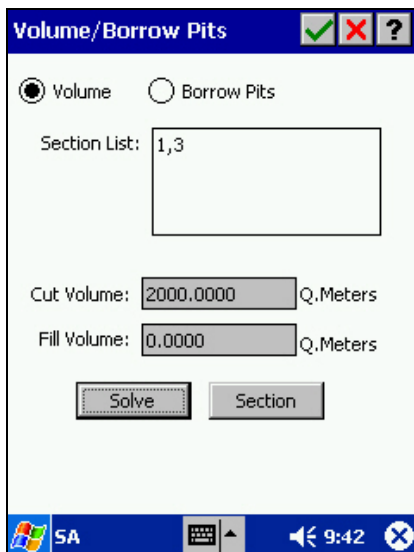
**Radius:** Enter the radius of the circular curve connecting the centers of the two cross sections.

**Curve Angle:** Enter the the angle subtended by the curve from the first to the second cross section.

The volume result is displayed in the **Volume:** field. The unit of volume is determined by the current system setup.

## 6.12.3 Earth Works/Volume

After defining the cross-sections or borrow pits, you may use the COGO/Earthworks/Volume function to calculate the volume defined by the specified section data.



The **Volume** method is based on cross-sections. The **Borrow Pits** method is based on borrow pits.

**Section List:** Enter the ID of each of the cross sections or borrow pits that are to be used for the volume calculation. Use commas to separate the IDs.

Tap on the **Solve** button to compute the volume.

**Cut Volume:** and **Fill Volume:** These fields are for display only. The total cut or fill volume will be calculated for the cross sections listed and automatically entered into the corresponding field. The unit of volume is determined by the current system setup.

Tap on the **Section** button to view or edit the definition of the sections.

## 6.13 Bench Mark

This function lets you determine the elevation of a point with respect to a known benchmark. If the Occupied Station (OS) point is known, then taking a measurement to the Foresight (FS) point will determine the FS elevation. Similarly, if the FS point is known, then taking a measurement to the OS point will determine the OS elevation.

When you select **COGO/Benchmark**, the following screen will be displayed.

The screenshot shows a software interface for the 'Bench Mark' function. It features a toolbar at the top with icons for navigation and help. The main area contains several input fields: 'FS Elevation' (0.000000), 'HI' (0.000000), 'HT' (0.000000), 'Zenith Angle' (090°00'00.0000"), and 'Slope Distance' (0.000000). Below these are 'OS Elevation' (0.000000) and a 'Known Elevation' dropdown menu currently set to 'Known OS'. The interface is titled 'Bench Mark' at the bottom, and a status bar at the very bottom shows 'SA' and a time of '9:09'.


**Known Elevation:** Specify whether the OS or the FS is to be used as the benchmark.

**FS Elevation:** If the FS point is the benchmark, enter its elevation or specify its point number.

**OS Elevation:** If the OS point is the benchmark, enter its elevation or specify its point number.

**HI:** Enter the instrument height.

**HT:** Enter the target height.

Enter the **Zenith Angle** and **Slope Distance** to the FS point, or tap on  to take a measurement to the FS point.

The elevation of the unknown point will be displayed.

## Section 7 – Stakeout

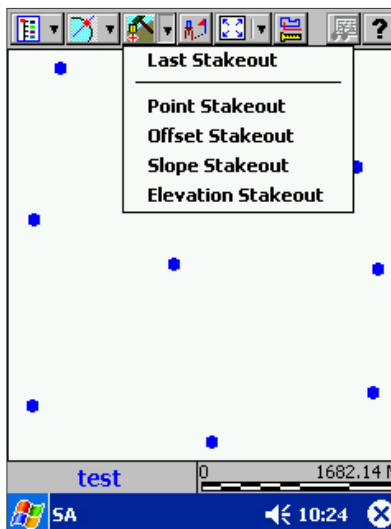
The stakeout routine is used for determining the position of points on the ground with respect to the positions of the points in the current job file. SA3 offers four types of stakeout routines for different stakeout needs: **Point Stakeout**, **Offset Stakeout**, **Slope Stakeout** and **Elevation Stakeout**. Point stakeout is best for staking a set of unrelated points. For example, in construction, the location of building corners may be downloaded from a PC to the data collector for staking. Offset staking is used for staking road boundary along a defined Figure (road centerline). Slope staking is useful for staking the **catch point** along a defined figure that includes a slope as part of the feature. For example, in road construction, a roadside ditch may be included in the stakeout. Elevation staking is to stake a group of points at a specified elevation with respect to the instrument location.

SA3 needs to register the instrument position and height as well as a backsight position and backsight reading to use as a reference for subsequent angle measurements. Once it has this data, you can enter a foresight point number, and the SA3 will compute the angle from the backsight point and the distance from the instrument point. With this angle and distance data, the instrument man can tell the rod man the approximate place to go and at the same time turn the instrument in the correct direction. Once the instrument is pointed in the right direction, the instrument man can direct the rod man to place the rod and measure a distance. If the **horizontal and vertical distances** need to be changed, the instrument man tells the rod man to move accordingly and the procedure is repeated until the rod man has the rod positioned to a location close enough to the exact position. For a compatible instrument with auto-tracking capability, you may set the SA3 to work in the AUTO-TRACK mode and make the stakeout job a one-man operation.

At this time, a stake can be put in the ground and a second check made to verify the position. If an error occurred when putting the stake in the ground, the stake can be adjusted and the procedure repeated. When the actual stake position is within tolerance, the angle and distance to the point are recorded.

For Offset Stakeout and Slope Stakeout, buttons are provided to let you advance to the next station or go back to a previous station.

To access the stakeout routines, tap the  button from the Map View of SA3, and the following STAKEOUT MENU will be displayed:



Following is a summary of some of the frequently used tool icons for the Stakeout screens:



Display the STAKEOUT MENU for selecting a different stakeout routine.



Display the STAKEOUT LOCATION screen that shows how far off you are from the target location.



For Offset Stakeout and Slope Stakeout, go back to the previous station for stakeout. The previous station value is based on the interval specified in Section Setup.



For Offset Stakeout and Slope Stakeout, advance to the next station for stakeout. The next station value is based on the interval specified in Section Setup.



Display the keyboard for entering information into the data fields.



Use this button to select a Feature or Figure from the Map View. This may be referred to as **“Specify the Feature/Figure”** or **“Specify the Point”**.



Use this button to pick the desired feature from the list. This may be referred to as **“Specify the Feature/Figure”** or **“Specify the Point”**.



Take a backsight angle measurement from the total station.



Take a measurement of angles and distances from the total station.



Reset the horizontal angle of the instrument.



Start auto-tracking. This works only for total stations with auto-track capability.



End auto-tracking.





Display catch-point information.



Save the stakeout measurement data. This is different from storing the stake point locations.



Store the stake point location. Selecting this icon displays the **Store Feature** screen. You may then select  to confirm or select  to cancel the action of storing the new point.



Tap this icon to view the instrument and target locations in Map View.



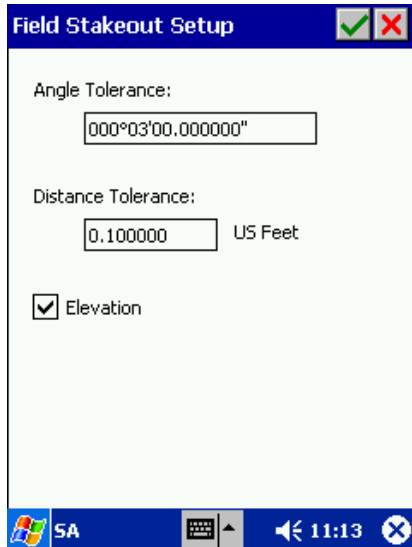
Tap this icon to return to the previous screen.



Tap this icon only if you wish to erase all data that you have entered into the current screen.

## 7.1 Menu/Stakeout Setup

The Stakeout Setup screen is used to specify parameters for the various Stakeout functions. Select **Menu/Stakeout Setup** to display the following dialog:



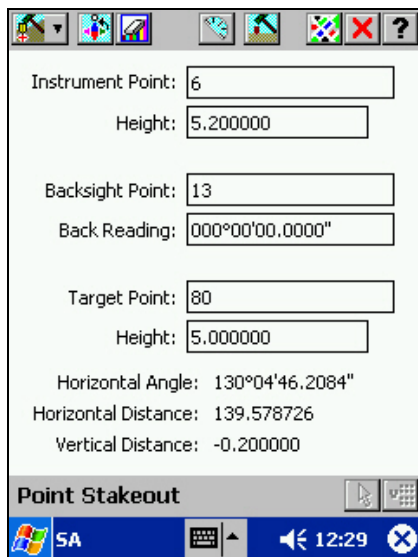
**Angle Tolerance:** Set the maximum allowable angle difference to be used during stakeout operations. The default is set to 3 minutes. To change this setting, simply tap in the angle tolerance box and use the keyboard function to type in the tolerance.

**Distance Tolerance:** Set the maximum allowable distance difference for Stakeout operations. To change the tolerance, simply tap on the distance tolerance field and type in the new value.

**Elevation:** Check the “Elevation” box to apply the above tolerance information to elevation data along with horizontal position data. Uncheck the “Elevation” box if you are just working in the horizontal plane.

## 7.2 Point Stakeout


To perform a random point stakeout, choose Point Stakeout from the STAKEOUT MENU. The following screen will be presented.




**Instrument Point:** Specify the instrument point.

**Height:** Specify the instrument height.

**Backsight Point:** Specify the backsight point.

**Back Reading:** Enter the backsight reading; or, tap  to take the reading from the instrument.

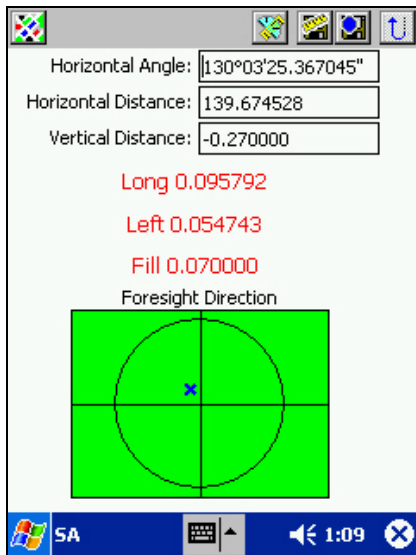
To reset the horizontal angle of the instrument, tap .





**Target Point:** Specify the target point.

**Height:** Specify the rod height.

The Horizontal Angle, Horizontal Distance and Vertical Distance fields display what these values should be when you are on target.

After all data is entered, hit the  button. The STAKEOUT LOCATION screen will be displayed to show how far off you are from the target point.

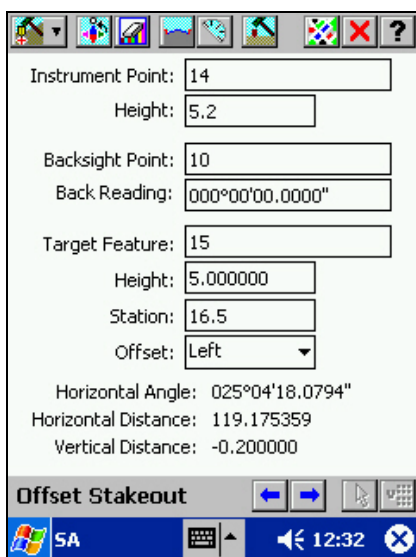



- Use  to take a measurement using the total station.
- Use the differences displayed in SA3 as a guide to move closer to the target point.
- When within the specified tolerances, the graphic display area will turn green.
- When you are on target, drive the stake into ground.
- Use  to store the stake point location, if you wish.
- Tap  to save the stakeout measurement data.
- Tap  to return to the Point Stakeout screen. You may then specify another point for stakeout.


### 7.3 Offset Stakeout

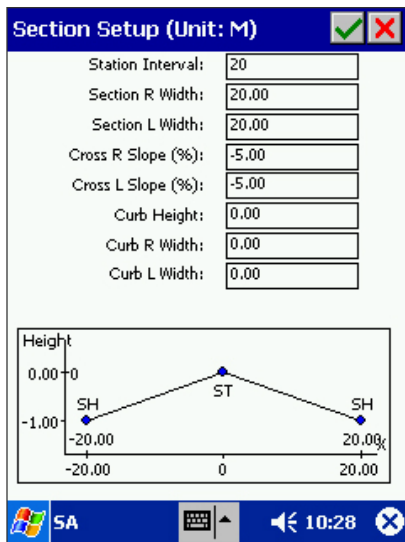
Use the offset stakeout routine when you have a defined figure and need to stake an identical figure at a fixed offset distance. For example, in road design you may have the data recorded for the centerline. To allow you to define the points for the roadsides, enter the width of the road from the centerline to the edge of the road. Enter an interval to specify the distance between the successive points you are staking on the offset.

Select Offset Stakeout from the STAKEOUT MENU to display a screen similar to the following.



- Instrument Point:** Specify the instrument point.
  - Height:** Specify the instrument height.
  - Backsight Point:** Specify the backsight point.
  - To reset the horizontal angle of the instrument, tap .
  - Back Reading:** Enter or measure the backsight reading.
  - Target Feature:** Specify the target Feature or Figure.
  - Height:** Specify the rod height.
  - Station:** The current station value is displayed. You may change it as you wish.
  - Offset:** Left or Right is defined with respect to the direction of the Line or Area Feature.
- The Horizontal Angle, Horizontal Distance and Vertical Distance fields display what these values should be when you are on target.

Tap  from the Offset Stakeout screen to access the **Section Setup** screen. The target points for offset stakeout are determined from the specified centerline as well as the cross-section defined in this screen.



**Section Setup (Unit: M)**

Station Interval: 20  
 Section R Width: 20.00  
 Section L Width: 20.00  
 Cross R Slope (%): -5.00  
 Cross L Slope (%): -5.00  
 Curb Height: 0.00  
 Curb R Width: 0.00  
 Curb L Width: 0.00

Height  
 0.00  
 -1.00  
 -20.00  
 -20.00 0 20.00


**Station Interval:** Specify the distance interval between successive stations for the line stakeout.


**Section R/L Width:** Specify the width of the right and left side of the central segment.

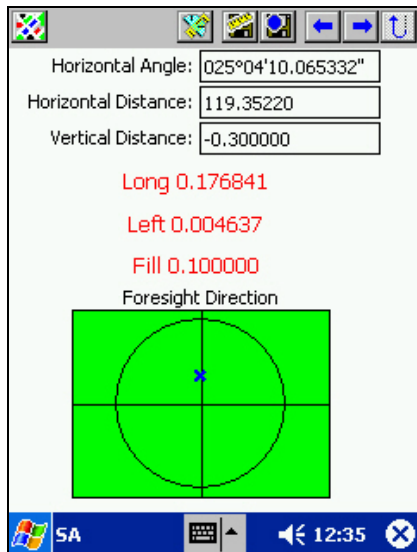
**Cross R/L Slope (%):** Enter the right/left cross-section slope percentage, omitting the percentage sign. This is the ratio between the height of the centerline and the section width, multiplied by 100.

**Curb Height:** Specify the height of the curb. If the curb has no height, enter 0. The unit is IN or CM as determined by the distance unit in the system setup.

**Curb R/L Width:** Specify the width of the curb on the right and left side. If the curb has no width, enter 0.

When you have completed the cross-section definition, tap on  to return to the Offset Stakeout screen.


After verifying the information in the Offset Stakeout screen, tap the  button. The STAKEOUT LOCATION screen will be displayed to show how far off you are from the target point.



Horizontal Angle: 025°04'10.065332"  
 Horizontal Distance: 119.35220  
 Vertical Distance: -0.300000

Long 0.176841  
 Left 0.004637  
 Fill 0.100000


Foresight Direction

Use  to take a measurement using the total station.


Use the differences displayed in SA3 as a guide to move closer to the target point.

When within the specified tolerances, the graphic display area will turn green.

When you are on target, drive the stake into ground.

Use  to store the stake point location, if you wish.

Tap  to save the stakeout measurement data.

After staking a point, tap  to advance to the next stake location.

Tap  to return to the Offset Stakeout screen.

## 7.4 Slope Stakeout

Slope staking is very similar to offset staking with the exception that the section setup provides for multiple cross slopes as well as a positive or negative side slope. Moreover, for Slope Stakeout, there is no fixed target point per se.

Select Slope Stakeout from the STAKEOUT MENU to display a screen similar to the following.

**Slope Stakeout**


Instrument Point: 1  
 Height: 5.20000  
 Backsight Point: 14  
 Back Reading: 000°00'00.0000"  
 Target Feature: FigureSh001  
 Height: 5.000000  
 Station: 20.000000  
 Offset: Left  
 Estimated Cut/Fill: 0.000000  
 Horizontal Angle: 085°44'58.1896"  
 Horizontal Distance: 41.182521  
 Vertical Distance: 6.100000

**Instrument Point:** Specify the instrument point.

**Height:** Specify the instrument height.

**Backsight Point:** Specify the backsight point.

**Back Reading:** Enter or measure the backsight reading.

To reset the horizontal angle of the instrument, tap .

**Target Feature:** Specify the target Feature or Figure.

**Height:** Specify the rod height.

**Station:** The current station value is displayed. You may change it as you wish.

**Offset:** Left or Right is defined with respect to the direction of the Line or Area Feature.

**Estimated Cut/Fill:** Specify the estimated cut/fill for the catch point of the slope stakeout.


The Horizontal Angle, Horizontal Distance and Vertical Distance fields display what their values should be when you are at the estimated target.

Tap  from the Slope Stakeout screen to access the Section Setup screen.

**Section Setup (Unit: M)**

Station Interval: 20  
 Section Width: 20.00  
 Cross Slope (%): -2.00  
 Distance1: 18.00  
 Cross Slope1: -6.00  
 Distance2: 15.00  
 Cross Slope2: -4  
 Ditch Width: 6.00  
 Side Slope: 2.00

Graph: Height vs. X. Points: SH (-53.00, -7.15), ST (0.00, 2.07). Slopes: -20.00, -4.

Use  to toggle between the right and left sides of the cross-section.

**Station Interval:** Specify the interval distance between successive stakes.

**Section Width:** Specify the width of the central segment of the cross-section.

**Cross Slope (%):** Enter the cross slope percentage for the central segment of the road, omitting the percentage sign. This is the ratio of the height of the central segment to the section width, multiplied by 100. Enter a negative value for a downward slope.

► **Distance1:** Use [>] to toggle between DIST1 and ELEV1.

**Cross slope1:** Specify the cross slope that, in combination with DIST1 or ELEV1, defines the next segment of the cross-section. Enter a negative value for a downward slope.

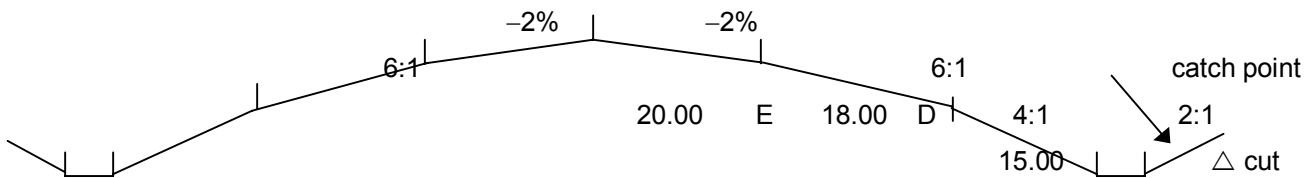
► **Distance2:** and **Cross slope2:** are defined similarly.

**Ditch width:** Enter the ditch width.

**Side Slope:** Specify a positive value for the desired side slope on which to find the catch point. (A side slope of 1 is 45 degrees.)

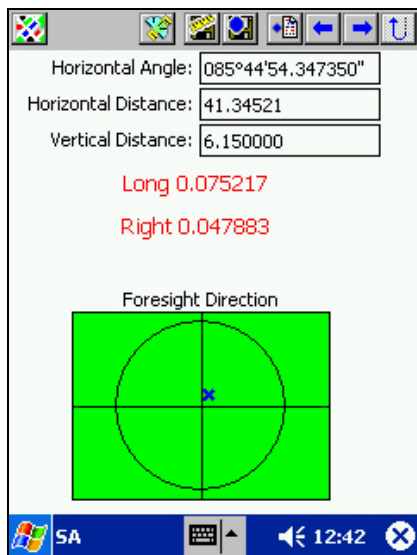


Because the surface of the ground may not be at the same elevation, for a specified side slope, the catch points may not be as regular as the road boundary points. Following is a sample diagram of a full road section.



When you have completed the cross-section definition, tap on to return to the Slope Stakeout screen.

After verifying the information in the Slope Stakeout screen, tap the button. The STAKEOUT LOCATION screen will be displayed to show how far off you are from the estimated target point.



Use to take a measurement using the total station.

Use the technique described below to get close to the catch point.

When within the specified tolerances, the graphic display area will turn green.

When you are at the catch point, drive the stake into ground. Tap to display the **catch-point information**.

Use to store the stake point location, if you wish.

Tap to save the stakeout measurement data.

After staking a point, tap to advance to the next stake location.

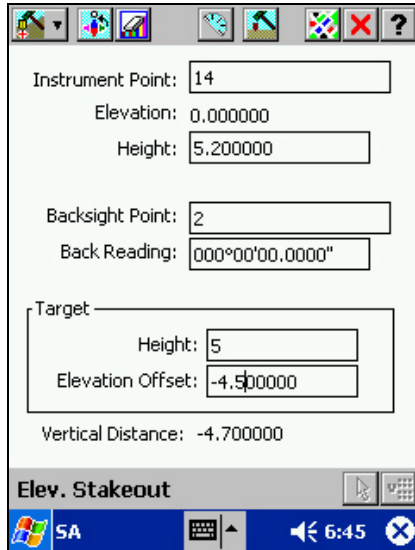
Tap to return to the Offset Stakeout screen.

The technique for finding a **catch point** is a trial and error approach. The measured data must be consistent with the road section. SA3 will tell you the error in the current measured data with respect to the road section. This error will be helpful in locating the catch point but it is not an absolute error such as you find in the other stakeout methods. The error is dependent on the horizontal and vertical distances defining the slope from the boundary point to the catch point. These distances are measured values as well. The boundary point will be a known point after the road section is setup. Find the catch point by trying several stake points. For three-dimensional slope staking, it will be helpful if you can keep one of the variables constant. For example, in the STAKEOUT LOCATION screen, try to keep the horizontal angle the same while moving the stake in or out to the required horizontal distance, then move the stake up or down to the required vertical distance.

## 7.5 Elevation Stakeout

Use this function to do radial staking or leveling at a given elevation offset from the instrument point. The elevation offset may have a positive or a negative value.

Select Elevation Stakeout from the STAKEOUT MENU to display the following screen.



The screenshot shows the 'Elev. Stakeout' screen with the following fields and values:

- Instrument Point: 14
- Elevation: 0.000000
- Height: 5.200000
- Backsight Point: 2
- Back Reading: 000°00'00.0000"
- Target Height: 5
- Elevation Offset: -4.500000
- Vertical Distance: -4.700000


At the bottom, there is a Windows taskbar with 'SA' and a clock showing 6:45.

**Instrument Point:** Specify the instrument point.

**Elevation:** The elevation of the instrument point is displayed automatically.

**Height:** Specify the instrument height.

**Backsight Point:** Specify the backsight point.

**Back Reading:** Enter the backsight reading; or, tap  to take the reading from the instrument.

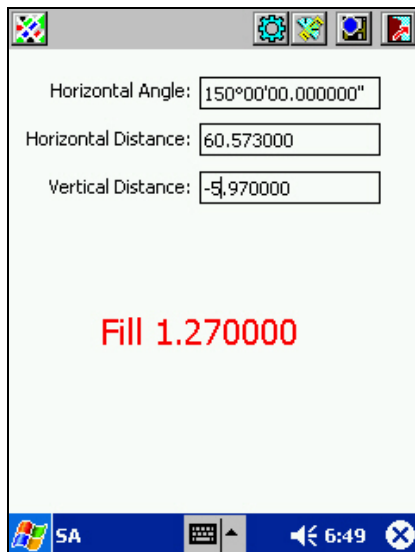
To reset the horizontal angle of the instrument, tap .

**Height:** Specify the rod height.

**Elevation Offset:** Specify the difference between the instrument elevation and the desired stake point elevation. Enter 0 if the stake points are to be level with the instrument point. Enter a negative value if the stake points are to be lower than the instrument point.

The Vertical Distance field displays what its value should be when you are on target.

After you have completed data entry in the Elev. Stakeout screen, tap  to display the following screen.




The screenshot shows the measurement screen with the following fields and values:

- Horizontal Angle: 150°00'00.000000"
- Horizontal Distance: 60.573000
- Vertical Distance: -5.970000

A large red text 'Fill 1.270000' is displayed in the center of the screen.

At the bottom, there is a Windows taskbar with 'SA' and a clock showing 6:49.

Take the rod to the desired location then tap  to take a measurement from the instrument. The measurement data will be displayed in the **Horizontal Angle:**, **Horizontal Distance:** and **Vertical Distance:** fields.

The discrepancy between the measured vertical distance and the target vertical distance will be displayed as a **Fill** or **Cut** value. "Fill" means to move the rod up by the displayed amount.

When you see "Elevation OK", or when the displayed discrepancy in vertical distance is acceptable, put in the stake.

Tap on  to store the stake point location, if you wish.

## Section 8 – Tutorial


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This tutorial takes you on a quick tour through the SA3. It covers the following topics:

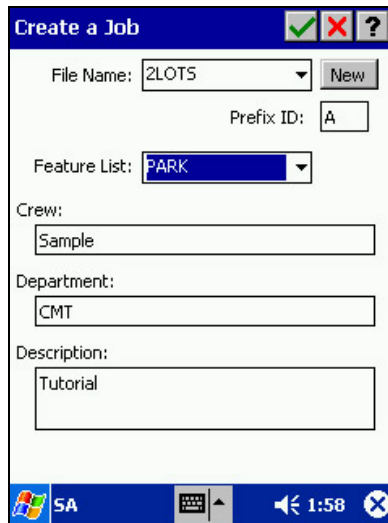
- Create a job named MY2LOTS.
- Traverse a plot of land.
- Do a closed-loop traverse adjustment.
- Use COGO to divide the plot into two sections of equal areas.
- Stake the division point and the dividing line.

For detailed information about the Field Work, Traverse Adjustment and Stakeout functions, please refer to Section 5 and Section 7.


### 8.1 Creating the MY2LOTS Job

Tap on  then select **New/Open Job** to display the **Job Setup** screen. If you have not yet created any job, there will be no job names displayed.

Select **New** to move to the **Create a Job** screen:



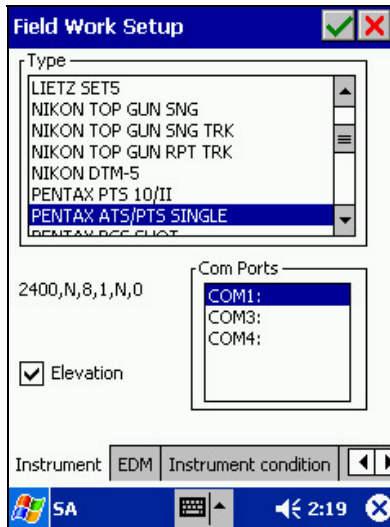
At the File Name field, tap new and type “MY2LOTS”. Choose a Prefix ID to distinguish your job and a Feature List from the drop down menu. Enter crew name, Department and job description.

Press  to create the job and store the information in the above screen.

You will be returned to the Map View and MY2LOTS becomes the currently active job.

## 8.2 System Setup

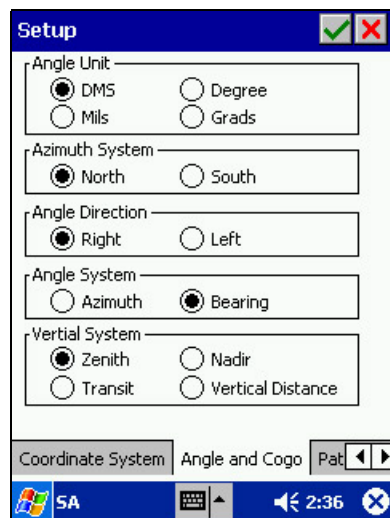
Tap on  then select **FieldWork Setup** to display the FieldWork Setup screen.




In the above screen, choose the **Instrument** tab.

Place a check in the Elevation field to enable elevation. Keep PORT as “COM1”. At the **Type** field, select the appropriate instrument name for this field as if you were doing an actual job using a total station.

To be sure we are working with the same units, select **Menu/Configure** to get to the **Setup** screen. Tap the **Coordinate System** tab and pick **State Plane** for System, **NAD83** for Datum and **Oregon** for State. Set Region to **N**, Zone to **3601** and Unit to **US Survey Ft**. Tap the **Angle and Cogo** tab and make sure that all fields agree with the following screen.

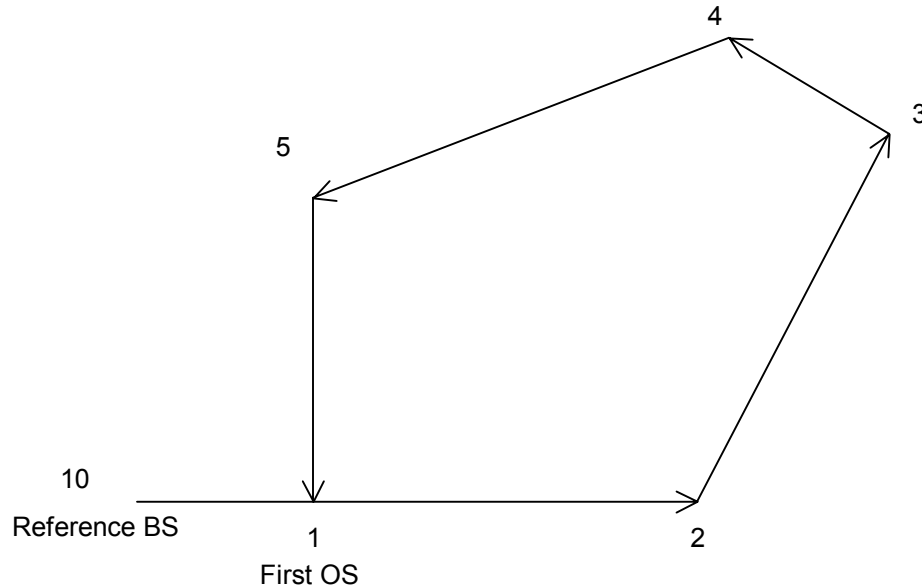


Scroll to the right and select the **Display** tab. Tap on the mark boxes by “Show Path”, “Side Shot” and “Stakeout” to enable the display of traverses as well as side-shot and stakeout indicators in Map View.



Hit the  button to return to the Map View.

## 8.3 Field Work


SA3 allows you to trigger measurements from your total station and input that data directly into the various Field Work screens. For our exercises, we will manually enter the measurement data for the traverse shown below:

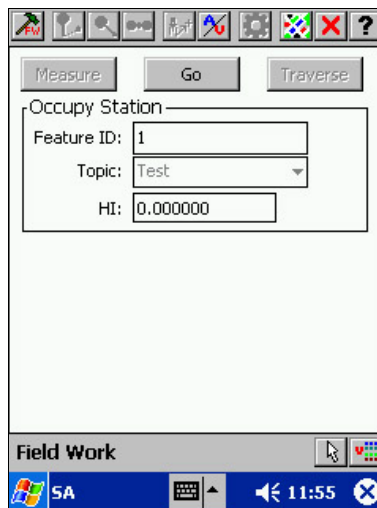


The three primary field data collection screens are: **Occupy Station**, **Backsight** and **Foresight**. For information regarding the other available screens (Remote Object, Offset, etc.), please refer to Section 5.

**Please note:** You can view your data on the map screen at any time by tapping the Map View button  and then return to data entry by tapping the  button.

### Step 1 Record the Occupied Station

Fieldwork performed in SA3 begins in the Occupy Station screen. From the main screen tap  to select **Field Work**, and you will see the following screen:

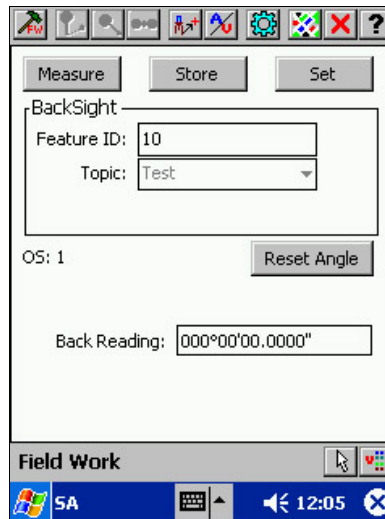


For this tutorial, we will keep the HI and HT (instrument height and target height) fields at “0.000”.

The Feature ID field defaults to “1” for a new fieldwork job. Tap “GO” to store the first OS record. Since this point has not yet been defined, you will be prompted to enter its coordinates. Accept the Field Work topic name. Enter **339200** for the North field and **747500** for the **East** field. Keep the **Orthometric** height at 0. Tap  to store this point and proceed to the Backsight screen.

### Step 2 Record the Backsight

In the Backsight screen, the Feature ID field will default to 2.



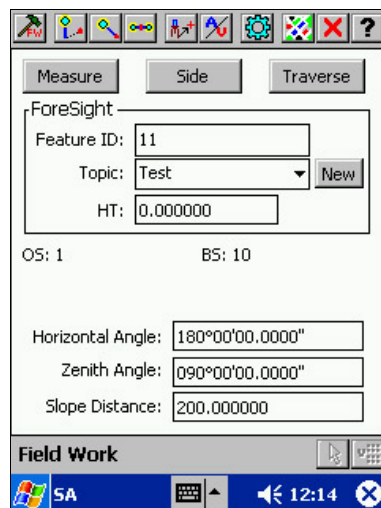
You may enter any unused point number into the Feature ID field. For the MY2LOTS example, type in “10”.

Accept “0.00000” as the back reading. (If you were using a total station to sight the back point, you would tap on **Measure** to get the back angle from the instrument.)

Press the **Store** button to store the BS record and move to the Foresight screen.

Because Point 10 has not yet been established, SA3 will prompt you for its location or the backsight reference direction. Enter **339200** for **North** and **747400** for **East**. Tap  to store this point.

### Step 3 Record the Foresight Point



From the Foresight screen, you can store a traverse record or a side-shot record.

Note that the Feature ID field has automatically advanced to the next point number “11”. Change this Feature ID to “2”.

Enter “180” into the Horizontal Angle field and enter “200” into the Slope Distance field. Then tap on **Traverse** to store Point 2 as a traverse record and move to the next Occupy Station screen.


#### Step 4 Repeat the Process

Notice that “2” is now the default value for the Feature ID field in the new Occupy Station screen. Do not enter any data, but tap on **GO** to store this point as the new Occupied Station (OS). In the next Backsight screen, Feature ID defaults to the previous OS point (Point 1). Again, do not enter any data, but tap **Store** to store this point as the new BS.


In the next FORESIGHT screen, enter “135” into the HORZ ANGLE field and enter “300” into the SLOPE DIST field. Then tap on **Traverse** to store Point 3 as a traverse record and move to the next Occupy Station screen.

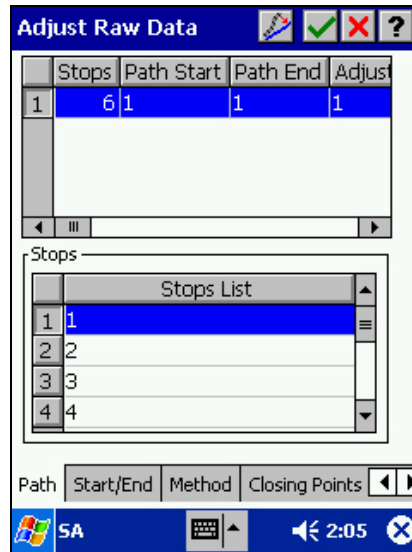
Use the same procedure to complete the remaining traverse legs. The additional values to be entered are listed below. The last record is a side-shot.

| SCREEN    | ID | HEIGHT | HORZ ANGLE | VERT.ANGLE | DISTANCE   | Button          |
|-----------|----|--------|------------|------------|------------|-----------------|
| OCC. STA. | 3  | 0.00   |            |            |            | Go              |
| BACKSIGHT | 2  | 0.00   |            |            |            | Store           |
| FORESIGHT | 4  | 0.00   | 90.000000  | 90.000000  | 100.000000 | <b>Traverse</b> |
| OCC. STA. | 4  | 0.00   |            |            |            | Go              |
| BACKSIGHT | 3  | 0.00   |            |            |            | Store           |
| FORESIGHT | 5  | 0.00   | 125.026000 | 90.000000  | 346.750000 | <b>Traverse</b> |
| OCC. STA. | 5  | 0.00   |            |            |            | Go              |
| BACKSIGHT | 4  | 0.00   |            |            |            | Store           |
| FORESIGHT | 1  | 0.00   | 99.563000  | 90.000000  | 222.750000 | <b>Traverse</b> |
| OCC. STA. | 1  | 0.00   |            |            |            | Go              |
| BACKSIGHT | 5  | 0.00   |            |            |            | Store           |
| FORESIGHT | 10 | 0.00   | 270.000000 | 90.000000  | 0.000000   | <b>Side</b>     |

Finish this session and view your data by tapping on . It should look similar to the traverse in the diagram presented at the beginning of this subsection. (The same data set was used in creating the 2lots.psa that was supplied with the SA3 application program.)

## 8.4 Adjusting a Traverse


Our MY2LOTS job contains minor measurement errors that may be minimized by performing an adjustment. To perform an adjustment to this job, tap on  then select **Adjust**.



SA3 will determine the default start and end points for your Job as well as the type of traverse you are performing. The status of the adjustment path is displayed near the top of the screen. Accept the displayed start and end points as well as the closed loop traverse type. Use [>] to scroll to the other information fields for the path record.

Tap on the **Method** tab then enter Angle Tolerance = 5 minutes and Distance Tolerance = 0.3 ft.

Use the [>] button at the bottom of the screen to scroll to the **Error Summary** tab and tap on it to see the calculated errors.

Since the errors are within the specified angle and distance tolerances, you can go ahead and perform the adjustment by tapping on the  button.

**Adjustment only changes the point coordinates; the field data measurements are always preserved.**

If there are any “hold” points in the adjustment path, you will be prompted to overwrite them with the new adjusted points. Select “Overwrite” or “Overwrite All”.

“Hold points” are points computed from a previous adjustment or points for which you have manually set the Hold (hold point) status (i.e. with fixed coordinates). With an actual survey job, you will want to think about whether you want those points overwritten.

## 8.5 COGO

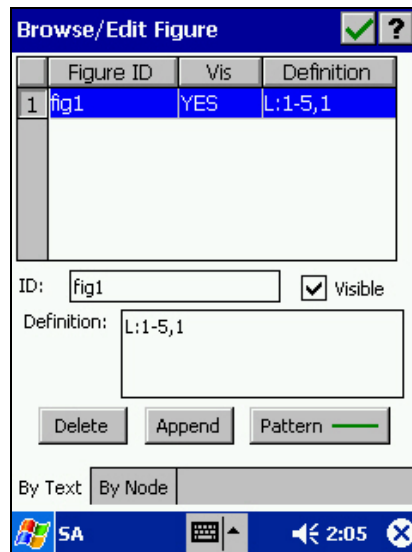
The many useful coordinate geometry (COGO) functions provided by SA3 are described in Section 6 of this manual. We will first view the area enclosed by the MY2LOTS traverse and then use the COGO/Area Cut function to cut the land into two lots.




### 8.5.1 Show Area of a Figure

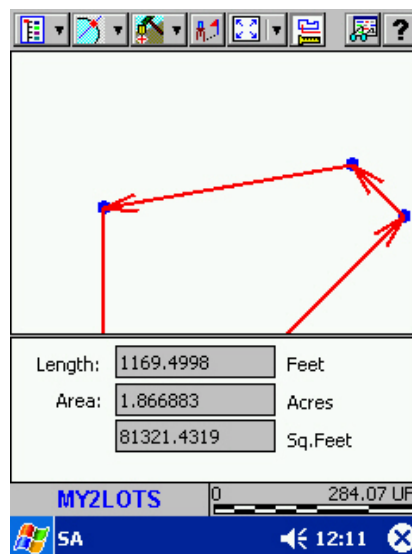
Before you can show the area of a figure, you must create a figure.

To create a figure, tap on  then choose **Browse/Figure Data**.



Tap on the **Append** button to add a Figure. In the ID field enter “**fig1**” to replace the default figure name. Make sure that there is a checkmark in the visible box. In the Definition field type “L:1-5,1”. (Meaning: Start Figure at point 1, join points 1 through 5 and complete the figure at point 1). Check  to save your figure and return to the Map View.

To show the area of your newly created figure, tap on its perimeter and then tap  to display the following screen:

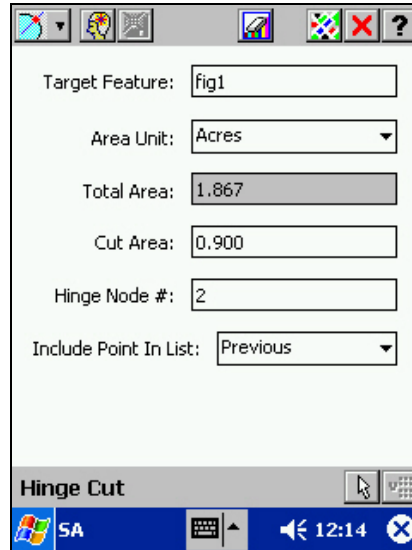



Tap  again to dim this button and hide the area display.




## 8.5.2 Hinge Cut



Now, we wish to cut the area into two pieces, using Point 2 as a hinge for the division line. The piece on the west side is to be exactly 0.9 acres in size.

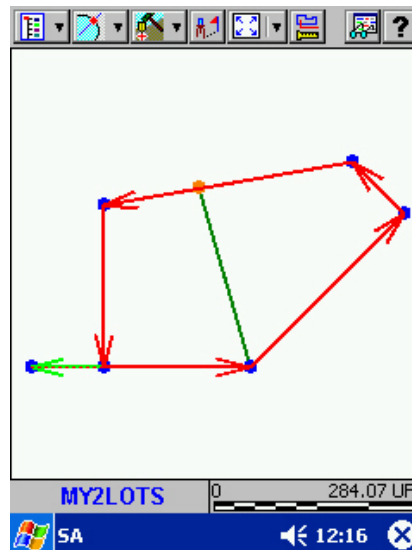
From the Map View, tap on  then select Area Cut/Hinge Cut Area. The following screen will be displayed:



For the Target Feature field, enter “fig1”, or tap on  then tap on the perimeter of the figure in Map View to pick it as the target feature. In the Areas Units choose “**Acres**” and enter “**0.9**” in the Cut Area. For the Hinge Node # enter “**2**”.

Tap  to solve. You can view your data before storing it by tapping on  to go to Map View and then return by using the  icon.

Tap  to store the newly created line and points. Accept the displayed Point ID and Topic Name. Then tap  to exit the Hinge Cut screen and return to Map View. Your screen should look similar to the following:




## 8.6 Point Stakeout


In Section 8.5.2, we created a new point location (Point 8) using the Hinge Cut function. We can use the point stakeout function to help us put a stake on the ground at that location.

From the main Map View, tap on  and select Point Stakeout to display the Point Stakeout screen.

Instrument Point: 1  
Height: 0.000000  
Backsight Point: 10  
Back Reading: 000°00'00.0000"  
Target Point: 8  
Height: 0.000000  
Horizontal Angle: 118°05'20.9852"  
Horizontal Distance: 278.637959  
Vertical Distance: 0.005189

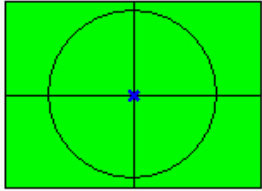
Point Stakeout




Establish the instrument position by entering data into the Instrument Point, Height, Backsight Point and Back Reading fields as shown in the above screen. (A back reading can be triggered from your total station by tapping on  from this screen.)

Move the cursor to the Target point field and enter "8". SA3 promptly displays the foresight angle as well as the horizontal and vertical distances from the occupied station to the target. Tap on  to go to the STAKEOUT LOCATION screen.



Horizontal Angle: 118°05'20.985197"  
Horizontal Distance: 278.637959  
Vertical Distance: 0.005189

Distance OK  
Direction OK  
Elevation OK  
Foresight Direction




The STAKEOUT LOCATION screen initially displays the target data. Your measurements would have these values if the stake were right on target. For an actual job, you would use this information to place your rod-man near the target, and then tap  to take a measurement from the instrument. For our exercise, enter “117” into the Horizontal Angle field and enter “280” into the Horizontal Distance field. Now, SA3 tells you that you need to move about 1.96 ft closer to it and also move about 4.9 ft to the right. You can also tap  to see the location of the rod in relation to the target point. Tap  to return to the STAKEOUT LOCATION screen.

Now, enter “118°03” into the Horizontal Angle field and enter “278.5” into the Horizontal Distance field so the measured position is within tolerance. When doing an actual job, you should place the stake and take one more reading to make sure that no error occurred during placement.

If you wish, you may tap  to store the stake point location. Selecting this icon displays the **Store Feature** screen. Enter attribute data if you wish. Select  to confirm the action of storing the new point.

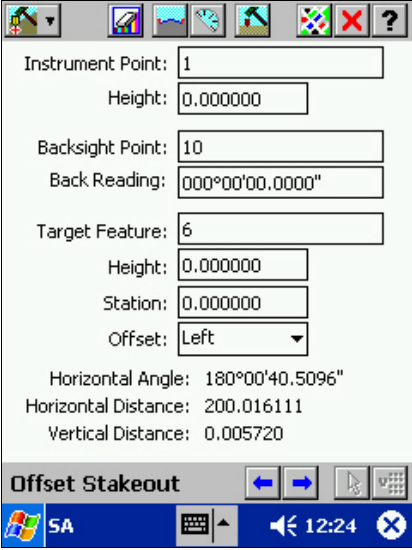
Tap  to return to the Point Stakeout screen.

Tap  to return to the Main Map View.

## 8.7 Offset Stakeout

SA3 provides three stakeout methods: Point Stakeout, Offset Stakeout and Slope Stakeout. If you wish, you could use the offset stakeout function to stake the dividing line (Line 6) of our MY2LOTS example. This line runs from Point 7 (at same location as Point 2) to Point 8.

From the STAKEOUT MENU screen, select **Offset Stakeout**.



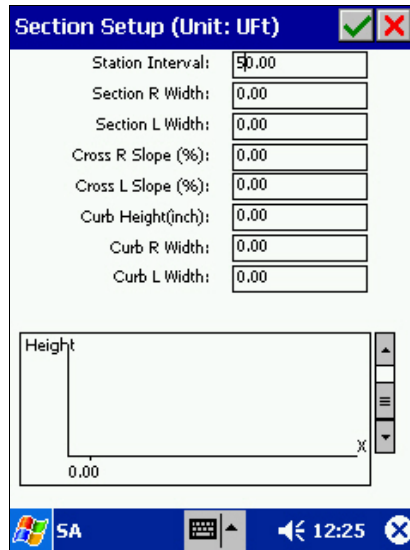
The screenshot shows the 'Offset Stakeout' screen with the following data:

- Instrument Point: 1
- Height: 0.000000
- Backsight Point: 10
- Back Reading: 000°00'00.0000"
- Target Feature: 6
- Height: 0.000000
- Station: 0.000000
- Offset: Left
- Horizontal Angle: 180°00'40.5096"
- Horizontal Distance: 200.016111
- Vertical Distance: 0.005720

At the bottom, the screen is titled 'Offset Stakeout' and shows a Windows taskbar with 'SA' and the time '12:24'.





Enter data as shown above.



Tap  to define the cross-section using the Section Setup screen.





Since we are staking along the centerline, the offset specifications are irrelevant. All we need to define is the stake interval. Enter “50” into the Station Interval field and keep all the other fields at “0”.

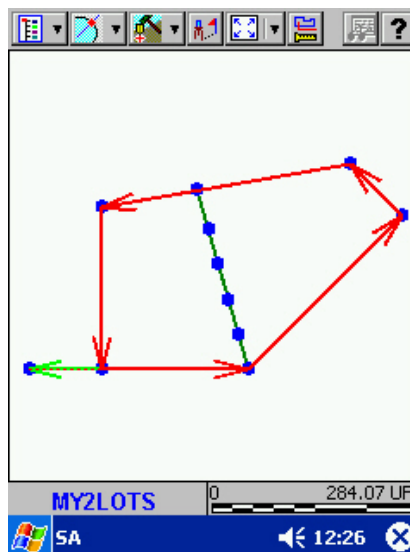
Tap  to save the information and return to the OFFSET STAKEOUT screen.

Tap  to move to the STAKEOUT LOCATION screen to begin staking the point that is 50 ft from Point 3. Suppose your rod-man is within tolerance of that point. Tap  to store it as Point 9 and tap  to return to the STAKEOUT LOCATION screen. Then tap  to return to the OFFSET STAKEOUT screen.

When you tap  from the OFFSET STAKEOUT screen to advance to the next point to stake, SA3 automatically changes the station number to “100.0000”. You can now stake the next point by tapping the  button. Repeat this process to put additional stakes along the division line.

You can tap  to see how far along you are in the stakeout job.

When done staking the line, tap  to get back to the Map View. Your screen should look like this:





## Appendix A - End User License Agreement

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SA3 and SAView End User License Agreement. This is a legal agreement between you, the End User, and Corvallis Microtechnology, Inc. ("Company"). By opening the package containing SA3, SAView and associated programs and installing it on your PC, you are agreeing to be bound by the terms of this agreement.

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This Agreement is governed by the laws of the State of Oregon.

If you have any questions concerning this Agreement, please write to:

Customer Service, Corvallis Microtechnology, Inc., 413 SW Jefferson Avenue, Corvallis, Oregon 97333, USA3.

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