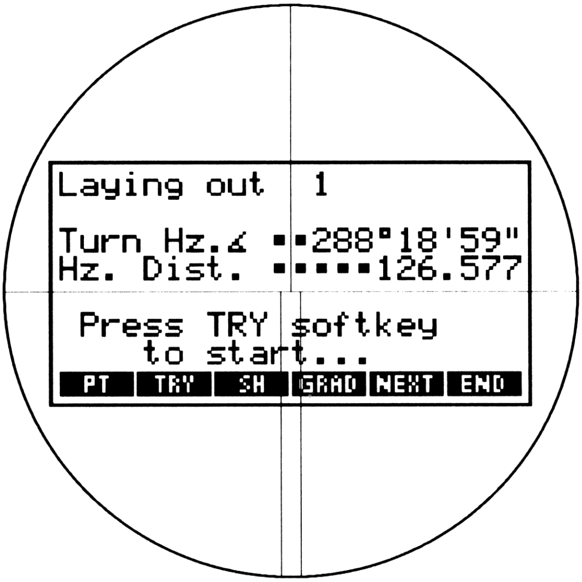
SURVcalc™

surveying software for the HP 48SX/GX

Version 2.0



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user's manual

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The HP 48 displays in this manual were captured using the Hewlett-Packard HP 48 Display Grabber.

Version 2.0: First printing July 1994
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Introduction

Thank you for purchasing SURVcalc 2.0.

We would appreciate any comments or suggestions you have regarding the design and operation of the software. Also, please fill out and return the enclosed product registration card.

SURVcalc has been designed to help you make the most of your calculation and stakeout time. We have tried to design useful, reasonably priced software that gets the most out of the amazing HP 48SX/GX calculators.

If you are new to the HP 48, please take some time to work through the introductory parts of the HP manual. Most sections of the SURVcalc manual show keyboarding examples but they assume the reader has some familiarity with the HP 48.

About This Manual

This manual has been designed so that you can start with any of the routines after going through the Menu Exploration & Initial Setup chapter. The SURVcalc Changes paragraphs in that chapter describe the major changes and additions to SURVcalc. Detailed descriptions of the changes and additions are also given at the beginning of the routine and whenever the change or addition is encountered in an example.

When preliminary data for an example is needed, it will be shown at the beginning of the chapter or you will be told in which chapter it can be found so you can load it into the calculator before you begin.

In long routines arbitrary breaks will be suggested. You can of course keep working through the example but if you decide to take a break remember that you can just let the HP 48 turn itself off. Then when you turn the HP 48 back on you will be ready to go with the last SURVcalc display visible.

Technical Support

Technical support is free to registered users from 8 am to 5 pm P.S.T., Monday to Friday. The customer is responsible for any long distance charges. Call (604)540-7973.

A lot of effort was put into providing software that is bug free. If you think you have found a bug in SURVcalc, before calling technical support, please double check the data used then go through the following check list:

1) Make sure you know the exact point at which the bug occurs; re-run the routine if there is any doubt.

2) Did you change any system or user flags from within a routine? If you did, re-start SURVcalc and see if the bug disappears.

3) Did you EDIT/VISIT a data file used by the routine in which the problem was noticed? If you did, check the data file to make sure you didn't inadvertently add or delete an element.

If the bug still appears after going through the checklist, please call us at the number listed above.

Installation

Hardware Requirements

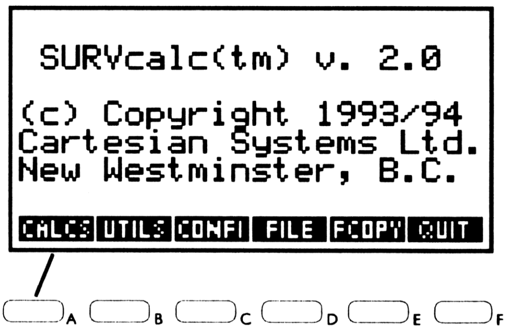
To run SURVcalc you need an HP 48SX/GX. The SX needs a 128 Kbyte ram card. (Remember that you have to *merge* ram card and calculator memory: see the HP manual for directions.)

You also need an IBM PC compatible computer or an Apple System 7.x computer and an HP serial interface cable. (If you have the HP Program Development Link or Serial Interface Kit then you already have this cable.)

Key Conventions

In this manual, when directions for key presses are given, the following key symbols are used:

• Softkeys are represented by the display's softkey name in a rectangle. For example at the **program main** menu and title display shown below, the softkey used to get to the **first calculation** menu will be shown as $\boxed{\text{CALCS}}$.



When told to press the CALCS softkey you would press the white-faced **A** key directly below it.

• All other keyboard keys are represented by the character or symbol on the key face. (Alphanumeric characters are shown in small upper case bold characters.) For example when told to press the ENTER key it will appear as **ENTER**.

• PC/Mac keys and characters are shown in **bold** lettering.

Note: The HP 48GX has some keyboard changes. Where the GX keys differ from the SX keys, both procedures are shown. For example if you saw the following:

...press the **left** (↰) shift key, *either* the **PRG** *or* the **G1** key...

The above key press sequence would indicate that on *both* the SX and GX you start by pressing the **left** (↰) shift key. As the **I/O** function is located on different keys on the SX/GX the first bold key name (**PRG**) shows where to find I/O on the SX. The second bold key name (**G1**) with the G attached indicates that on the GX the I/O function is found on the **1** key.

All the SURVcalc routines have been thoroughly tested on the GX.

From now on the calculator will be referred to as an **HP 48**.

Read the following sections appropriate to your computer type. The type follows the title in brackets. e.g. Kermit Setup (IBM)

Preparing the HP 48

SURVcalc is supplied as an HP library on both 3.5" and 5.25" disks. (These disks are in MS-DOS format but you can download from a system 7.x Apple computer using Apple File Exchange and the Mac version of Kermit.) **Kermit** (KERMIT.EXE) communications software (IBM) is also supplied.

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Make sure the HP serial interface cable is plugged into your calculator and into a serial port on your computer.

Check the HP 48 I/O (input/output) setup by pressing the **left** (↰) shift key, *either* the PRG *or* G1 key, then *either* the SETUP *or* G IOPAR softkey. (Refer to the HP manual if you are not sure how to set the parameters.) Make sure the IR/wire field is **wire**, the baud field is **9600**, and the parity field is **none 0**. The HP 48 changes the ASCII/binary field to **binary** automatically when receiving libraries.

Preparing the Computer (IBM)

On your PC, put the diskette in the appropriate drive and make that drive current by typing its drive letter with a full colon, then press the **Enter** key. For example, if you are using the **A** drive, type **A:** then press **Enter**. (From now on when data entry is needed pressing the **Enter** key will usually not be mentioned.)

If you want to copy the SURVcalc and Kermit files to your hard drive type **copy *.* c:\surv** assuming your hard drive is **c:** and you have a directory called **surv**.

If you want to do the installation from your hard drive, make that drive current. The rest of the installation routine applies to both types of drives.

Preparing the Computer (Mac)

As mentioned above the SURVcalc disks are in MS-DOS format but if you have a system 7.x Mac you can use **Apple File Exchange** to get the **SURVcalc** file into your computer.

Start by opening the **Apple File Exchange** Folder. (If it has been installed it should be in the **system** folder: if it isn't on your hard drive it can be found on the **Tidbits** system disk; copy the folder to your hard drive if necessary.)

Double click the **Apple File Exchange** icon. The Apple File Exchange window will open. The file list on the left will show your hard drive files and folders. The file list on the right will be empty.

Put the 3.5" SURVcalc disk in the floppy drive. Your computer will read the disk and display the files. Notice at the top of the screen that two new menu items appear. You can translate from **Mac to MS-DOS** or **MS-DOS to Mac**. We will be using the latter method.

Press on **MS-DOS to Mac** and drag down to **Default Translation**. Then highlight the **SURVcalc** file and just click the **Translate** button. Choose **Quit** from the **File** menu. The SURVcalc disk will be ejected and you will be returned to the Apple File Exchange folder. Click the **Close** button. Copy the SURVcalc file to the Kermit folder.

Kermit Setup (IBM)

Type **kermit**. Kermit starts and displays the version, copyright notice, and how to get help.

At the **Kermit-MS>** prompt type **?**. Kermit displays, in alphabetical order, a list of commands.

Kermit starts with default parameters. Type **status** to see them.
For this file transfer we are concerned only with the first two parameters. (If you installed the MSKERMIT.INI file you should see 9600 for the baud and COM1 for the port.)

We set the baud rate to 9600 on the HP 48, so let's do the same with Kermit. Type **help** now to see an introduction to Kermit.

As shown, you use the **SET** command to set most parameters in Kermit. Type **?** again. To set the baud rate type **set baud 9600**.

The only other parameter that might need changing is the communications (serial/com) port. Kermit defaults to **COM1** so if your computer has only one serial port the default is probably OK. On some computers with more than one serial port, the ports are numbered.
If you have to change the COM port, type **set port 2**.

Type **status** to confirm the change(s).

Kermit Setup (Mac)

Note: The Mac version of Kermit is *not* supplied on the SURVcalc disks. If you have the Mac version of the HP serial interface kit you will find Mac Kermit there; if not you can get a copy from a Mac user group or bulletin board.

Start Kermit by double clicking the icon. Open the **Settings** menu item and drag down to **Communications...**

Set the baud rate to **9600**.
Set the parity to **none**.

Sending the SURVcalc Library (IBM & Mac)

When you are ready to try sending the library, on the HP 48 press the **left** (↰) shift key, *either* the PRG *or* the G1 key and the RECV softkey. The HP 48 display will contain a **Connecting** message.

• On an **IBM** enter **s survcalc**. (In Kermit most commands can be abbreviated: in this case the **s** stands for **send**.)

• On a **Mac** choose **File** from the menu and drag down to **Send file...** Highlight the SURVcalc file in the list. Click the **Binary** button. Then click the **Send** button.

If all the parameters are OK you will see a lot of activity on both the computer and calculator displays. Kermit keeps track of the transfer status and will ring the computer bell when it is done.

Note: If you have the wrong COM port number (IBM) Kermit will keep trying to transfer SURVcalc until it times out or until you press Ctrl + C or Ctrl + E. (Hold down the **Ctrl** key, then press the **C** or **E** key.)

Try re-setting the COM port, then start again at Sending the SURVcalc Library above.

When the transfer is complete *either* type **q** (quit) at the **Kermit-MS>** prompt on an IBM *or* choose **File** then **Quit** on the Mac.

Press the **VAR** key on the HP 48 and you should see SURVC in the left end of the softkey menu. Press the SURVC softkey to place the SURVcalc library on the stack. In stack level one you should see:

1: Library 932: SURV...

Purging the SURVcalc Object

When the SURVcalc library is on the stack as above you can purge the SURVcalc object from the softkey menu. Start by pressing the **'** (**M**) key, the SURVC softkey again and the **ENTER** key. The stack should now look like this:

2: Library 932: SURV...
1: 'SURVCALC'

Press the **left** (↰) shift key then *either* the **DEL** (PURGE) *or* the **GEEX** (PURG) key.

Storing the SURVcalc Library

In the next step we store SURVcalc in port **0** (zero). (Depending on your calculator type and its memory configuration there are other port numbers that can be used. Please refer to the SX/GX user manual and substitute another number for **zero** in this and the following paragraphs if you wish.)

With the library number and name back in stack level one, enter **0** (zero) onto the stack then press the **STO** key.

Turn the HP 48 off then back on. The calculator will flash a bit but it's harmless.

Attaching the Library

Now we **ATTACH** the SURVcalc library to a directory. You can attach the library to the **{ HOME }** directory or you can create a directory.

Note: If you attach SURVcalc to the **{ HOME }** directory, you may find that when installing or removing a **ROM** card the SURVcalc library becomes detached. You can avoid this problem by attaching SURVcalc to a subdirectory.

If the library ever does become detached just re-attach it using the information in the following paragraphs.

With an SX make sure to install the ROM card as per the manufacturer's instructions, install and *merge* the RAM card and finally install, store and **ATTACH** SURVcalc.

If you want to create a subdirectory (**SURV** for example)...

Press the ' (M) key, then press the α (ALPHA) key twice to lock in alpha mode and type **SURV**. Press the ENTER key. Stack level one should look like this:

1: 'SURV'

Press the **left** (↰) shift key, the VAR key, the G[DIR] softkey (GX only), then the [CRDIR] softkey to create the directory. Press the VAR key and you should see your directory name in the left-most softkey. Press that softkey to make your new directory current.

Press the **right** (↱) shift key, the + (::) key, then type **0** (zero) for the port number.

Press the **right** cursor (▶) key and type **932**. Press the ENTER key. Level one of the stack should look like this:

1: 0: 932

Press the **left** (↰) shift key then *either* the VAR *or* the G2 key, the NXT key and the [ATTAC] (attach) softkey.

SURVcalc is now ready to use.

Note: SURVcalc uses the HP 48's system and user flags extensively. Each time SURVcalc starts it stores the list of two binary integers that represent the system and user flag status that it needs at start-up.

If you want to preserve the pre-SURVcalc flag state, you may want to store it in a variable. (See the references to the **RCLF** and **STOF** operations in the HP manual.) This should be done *before* starting SURVcalc.

The Kermit Initialization File (IBM)

There is a file on the SURVcalc disks called **MSKERMIT.INI**. Kermit looks for and will read this file each time it starts. You can use this file to have Kermit *automatically* set the communication parameters that we set manually in the Kermit Setup section above.

You can load this file into a text editor and edit the file to suit your system. A sample file might look like this:

set baud 9600
set port 1

Make sure you save the file in ASCII format.

If you want more information about Kermit, see Appendix E, Suggested Reading.

Menu Exploration & Initial Setup

If you are new to SURVcalc we suggest you work through the entire manual. You can skip the SURVcalc Changes paragraphs.

If you have upgraded make sure to read the following changes.

SURVcalc Changes

• The file system has been changed. You are no longer limited to one control file. Now you can define a **current job file** name for each project that will contain most of the points created by the routines.

• There is now a configuration routine where you choose to work in horizontal/slope distances, choose a default unit and apply optional curvature/refraction and grid factor corrections.

• You can create an optional vertical alignment for each horizontal alignment. (v. 1.0 horizontal alignments are compatible.)

• You can change/create alignments from within the alignment routine.

• You can find the station and hinge point of any point in an alignment.

• You can do vertical curve/straight grade calculations in an alignment.

• You can calculate an area automatically using any job file.

• You can use the edit routine on any sideshots/layout/transformation file. Now also view and print points to an infrared printer.

• You can do simultaneous transformation/rotation/scaling of coordinates from a file or manually. You can also save the setup data for each transformation.

• You can calculate intersections, predetermined areas, minimum clearances, radius points/circular curve data and triangle solutions.

Other minor changes will be described as they are encountered.

Starting SURVcalc

Note: Make sure you understand the HP 48 directory structure. It can be confusing for people who are familiar with the MS-DOS structure where all directories are visible from the root directory. The opposite is true in the HP 48.

For the most part the HP 48 directory structure is convenient. For example if SURVcalc was attached to the HOME directory you could start the program from *any* subdirectory. The only problem is any files and variables created by SURVcalc would be stored in the *current* subdirectory.

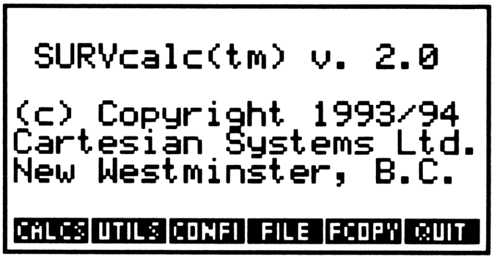
If you next started the program from the HOME directory the files you created in the subdirectory would *not* be visible. Also there will be some memory wasting as SURVcalc will have to re-create its default global variables.

To start the program make sure you are in the directory to which SURVcalc was attached. Put the calculator in **ALPHA** lock mode (press the α (ALPHA) key twice), type **S.P** and press the ENTER key. (The HP 48 is case sensitive so you have to use UPPER case characters: if you type **s.p** the program will not start.)

As this is the first time the program has been run it takes a few seconds to initialize. The display in Figure 1.1 will appear.

Notice the **.P** MS-DOS style file extension in the program name. All the objects created by the program use this file naming format with different extensions.

Figure 1.1



The file extensions are used to minimize the possibility of:

- overwriting a data file or global variable created by the program.
- overwriting one of your variables created outside the program.

Following is a list of file extensions used:

- **Global** variable objects have a **.V** extension.
- **Layout/Sideshots** (current job) files have a **.SLO** extension.
- **Horizontal Alignment** files have a **.ALN** extension.
- **Program** objects have a **.P** extension.
- **Transformation Setup** files have a **.TRS** extension.
- **Adjusted Traverse** files have a **.TRA** extension.
- **Unadjusted Traverse** files have a **.TRU** extension.
- **Vertical Alignment** files have a **.ALG** extension.

You need to type an extension only when you start the program as you did above or when you use HP editing commands. As you will see, in the SURVcalc environment only the file **name** is entered; the program adds the extension.

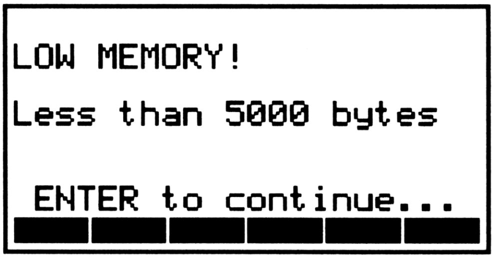
Menus and Softkeys

SURVcalc uses the HP softkeys to execute the program routines. The softkeys are the six white-faced keys (A-F) along the top of the keyboard. As mentioned earlier, these six keys correspond vertically to the six rectangles at the bottom of the display. Try pressing the [QUIT] softkey (the F key) now.

When you leave the program environment always [QUIT] from the **program main** menu as above. This gives the program a chance to do some housekeeping, clear USER status, do a memory check and leave a clean stack.

If the memory check finds less than 5000 bytes free you will see the Figure 1.2 display. (This display will also appear with low memory when the program is started.)

Figure 1.2



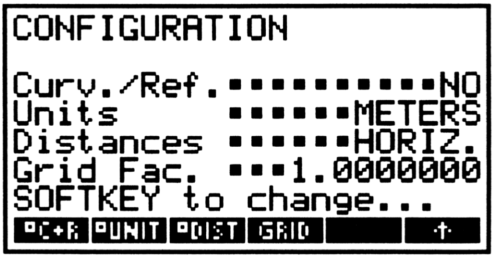
As the program has been initialized, the next time you enter **S.P** to start the program you *don't* have to press the α key twice. The program sets the system flag which locks in **ALPHA** mode with one key press. Press the α key and enter **S.P** to start the program now.

SURVcalc Configuration

At the program title display in Figure 1.1 press the [CONFI] softkey. Figure 1.3 appears below with the **configuration** display and menu.

All the fields contain default values which are stored in a variable named **CFG.V**. Each time the program starts it checks to see if this variable exists. If it is found SURVcalc configures itself using the *current* CFG.V values. If it is not found the program will create it using the *default* values shown in Figure 1.3.

Figure 1.3



Notice that the first three softkeys, starting from the left, contain a small square symbol. This symbol means that pressing the softkey will display (toggle) one of two values. Try pressing any or all three of these softkeys now, watching the changes in the corresponding values to the right.

Try pressing the GRID softkey. You can change the grid factor or just press the ENTER key to accept the default. Press the ENTER key this time.

The Configuration Fields

• The **Curv./Ref.** (curvature/refraction) field can be either NO which is the default or YES if you want a correction applied.
• The **Units** field can be either METERS, which is the default, or FEET: The curvature and refraction constant is unit-dependent. Units also affect how stationing is displayed; stationing will be shown relative to kilometers or hundreds of feet.
• The **Distances** field can be either HORIZontal or SLOPE.
• As mentioned above, you can enter an appropriate **grid** factor. The grid factor is composed of the scale and elevation factors and can be found in tables for your grid system. (You can use just a scale factor if you wish.)

Note: Make sure to check your EDM/Total Station manual before applying corrections for curvature/refraction and the grid factor. Some instruments apply these corrections.

SURVcalc will apply these corrections even when you are using horizontal distances.

Before leaving the configuration menu, make any changes necessary to make your display match Figure 1.3.

Notice the [↑] softkey. It moves you toward the beginning of the program. The [↑] softkey is always on the far right. Try pressing the [↑] softkey now. The title display and **program main** menu re-appear.

Press the [CALCS] (calculations) softkey. The Figure 1.4 display will appear with the **first calculations** menu.

This menu contains the Sideshots, 2 Point Resection, Layout, and Alignment routines.

Whenever a [↓] softkey is visible there is at least one more menu available.

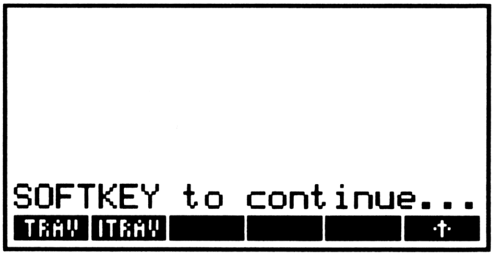
Figure 1.4

You will see the **SOFTKEY to continue...** message whenever the mnemonics are straightforward. In cases where the softkey names may not be easily understood more detailed messages will appear. Press the [↓] softkey now to get to the **second calculations** menu.

The **second calculations** menu in Figure 1.5, contains the Traverse and Inverse Traverse routines.

Press the [↑] softkey twice to get back to the **program main** menu and title display in Figure 1.1.

Figure 1.5



Press the [UTILS] softkey to get to the **first utilities** menu.

This **first utilities** menu in Figure 1.6 contains the Area, Volume, Vertical Curve and File Editing routines.

Before leaving the **first utilities** menu, press the [EDIT] softkey to get to the **file editing** menu in Figure 1.7.

Now press the [EDIT] softkey again. As no points are in the file the calculator will beep and you will see the display in Figure 1.8 below.

(You will also see the Figure 1.8 display if you try pressing the [PURG] or [VIEW] softkeys with an empty file.)

Figure 1.6

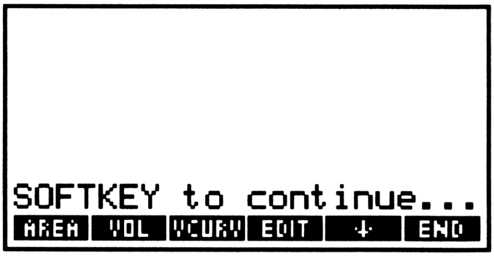
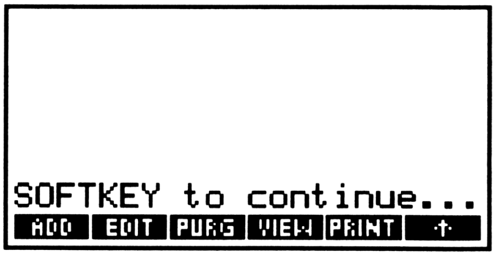


Figure 1.7



If you haven't already done so, press the ENTER key to get back to the Figure 1.7 display.

Then press the [↑] and [END] softkeys to get back to the **program main** menu.

Figure 1.8

```
No points in file!


 ENTER to continue...
 ADD | EDIT | PURG | VIEW | PRINT | ↑
```

Note: This is not a complete tour of the menus. The other menus will be described as they are encountered.

Defining the Current Job File

As noted earlier, one of the major changes made in this version is the file system. In SURVcalc version 1.0 there was only one control point file (**M.CTL**) allowed. In this version you define a *current* job file that will contain control file points as well as sideshots, layout and other points created by the program.

Note: Job files have the same format as the **M.CTL** file. If you have upgraded and wish to use the **M.CTL** file just store the **M.CTL** data in a variable with a **.SLO** extension.

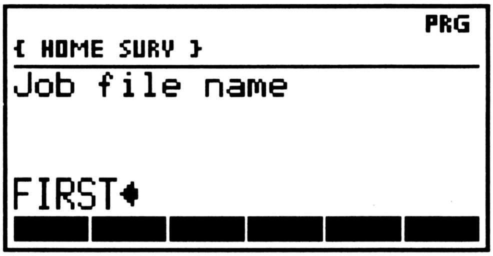
From now on when softkeys are to be pressed the word *press* will be followed only by the softkey symbol.

If you are not at the **program main** menu in Figure 1.1, *either* work your way back to it by pressing [↑] and [END] *or* start the program by pressing the α (ALPHA) key, typing **S.P** and pressing ENTER.

From the **program main** menu as in Figure 1.1 press [FILE].

Figure 1.9 displays the **Job file name** prompt along with the default FIRST name. You will see this name whenever the program is installed or if the variable that contains the current job file is deleted.

Figure 1.9



You can use this default file name for the current job file if you wish. This time press the ON key to clear the command line and enter **JOB1**.

The **JOB1** file is created and the Figure 1.1 display will reappear. (If the **JOB1** file had existed it would have been loaded.)

Note: Files created in SURVcalc must follow the HP variable naming convention. For example the first character can't be a number. See the HP manual for more information.

Remember that **Job file** names have a **.SLO** extension which the program adds. (In this case the complete file name is **JOB1.SLO**.) In SURVcalc, whenever you are prompted for a file name, you should *never* type the extension.

It is a good idea to get in the habit of checking the current configuration and current job file name before beginning a new project.

The File Copy Feature

Notice the FCOPY softkey. You can use this softkey to make a copy of the current job file. If you want to make the copied file the *current* job file you have to press the FILE softkey and enter its name.

Try pressing the FCOPY softkey now. The calculator will beep and the program will let you know that the current file is empty. You will be returned to the **program main** menu.

You should use the FCOPY feature when you want to use only some of the points in the current file. For example you may want to use only the control points in the current file for a new project. Or, you may want to use only the points picked up in a sideshots session (and not the control points) to calulate an area.

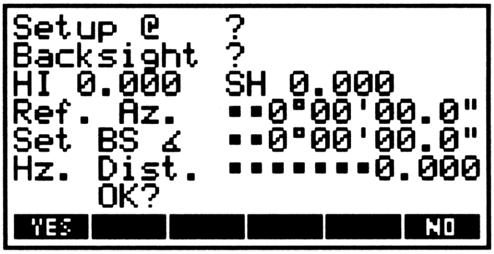
For an example of using the file copy feature, see File Editing.

Entering the First Control Points

From the **program main** menu in Figure 1.1, press CALCS to get to the **first calculations** menu as in Figure 1.4.

Press ALIGN (Alignments). The Figure 1.10 **setup** display will appear with an **OK?** prompt on the last line and a **YES/NO** menu.

Figure 1.10



All the fields contain default values. You will see the question marks in the Setup @ and Backsight fields whenever you change the current job file, edit/purge one of the current points in the File Editing routine or when one of the variables containing the Setup/Backsight points is purged using the HP 48 purge routine.

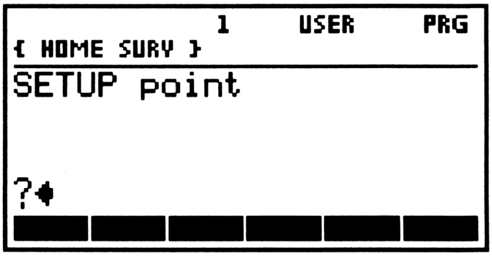
Press [NO] to enter the current setup data from the **setup change** menu in Figure 1.11.

Figure 1.11

From the left in Figure 1.11, the first five softkeys change the corresponding setup display fields. [VIEW] re-displays the setup data so you can see the changes and give your confirmation before continuing with the routine.

The only time the order of changes is critical is when [SETAZ] (to set the **backsight** azimuth) is pressed. If more than one change is to be made, **always** make the **azimuth** change last.

Figure 1.12



Press [SETUP] to enter the first control point.

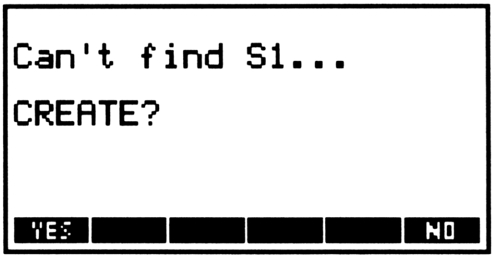
The Figure 1.12 **data input** display, with different prompts, is used in all data input situations.

The last-used control point name appears on the command line as a default. (Whenever you want to use the default just press the ENTER key.) In this case we want to enter a new name. There are two ways to do this.

You can enter a name by editing the existing name. Try this now by pressing the ← (backspace) key once. Then press the α key, type **S1** (one) and press the ENTER key.

(From now on, whenever data is to be entered, pressing the **ENTER** key will usually not be mentioned.) The calculator will beep and the Figure 1.13 **CREATE?** display appears.

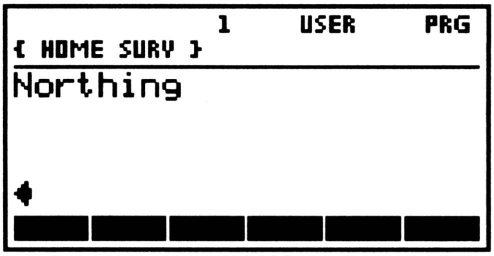
Figure 1.13



When the name you type is correct press [YES]: when you make a typo press [NO]. Try pressing [NO] now. The original default name is shown again in case you want to use it.

This time use the second command line clearing method. Press the **ON** key to clear the ? name, then press the α key and re-enter **S1**. The calculator will again beep and the **CREATE?** display will re-appear.

Figure 1.14



Press [YES]. The Figure 1.14 data input display appears prompting you for the Northing of **S1**. (Similar displays will appear for the Easting, Elevation and Description.)

Enter:

18185.248 for the northing.
26850.000 for the easting.
125.390 for the elevation.
Press the α key and enter **HUB** for the description.

Note: To conserve memory you should keep the descriptions brief.

After entering the description, the **setup change** menu re-appears. Press [BSITE] (Backsight).

Press the ON key to clear the command line, then press the α key and enter **B1**. (From now on pressing the α key will usually not be mentioned when *alpha* data is to be entered.)

Once again as point **B1** is not in the control file, the calculator will beep and the **CREATE?** display will appear. Press [YES] and enter:

18142.317 for the northing.
27234.107 for the easting.
135.480 for the elevation.

The description prompt appears with the previous description as a default. Press the ENTER key to accept it. (If you don't generally use descriptions you can just press the ENTER key to store a null string.)

Press [HI] (Height of Instrument) and enter **5.65**: press [SH] (Signal Height) and again enter **5.65**.

Press [VIEW] to see the changes. We changed all the fields except the backsight angle. As shown in Figure 1.15, the **Set BS ∡** field defaults to zero degrees.

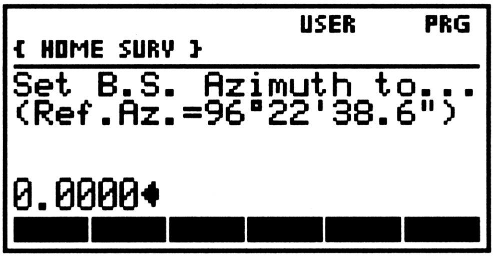
Figure 1.15

```
Setup @       S1
Backsight     B1
HI 5.650      SH 5.650
Ref. Az.      ■96°22'38.6"
Set BS ∡      ■■0°00'00.0"
Hz. Dist.     ■■■■■386.499
    OK?
YES                      NO
```

Note: In SURVcalc the azimuth is *always* calculated **from** the setup **to** the backsight/foresight.

If you prefer you can backsight with the instrument set to the actual (inversed) azimuth.

Figure 1.16

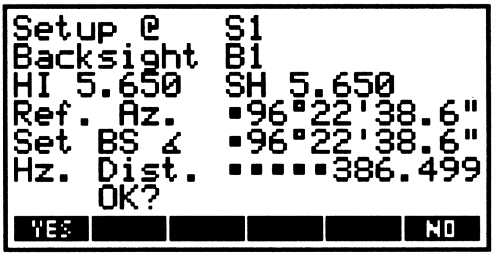


To illustrate press NO then press SETAZ. The Figure 1.16 display appears.

Notice that the inversed azimuth **(Ref.Az. = 96°22'38.6")** is shown as a reminder should you wish to use it (as we do now) instead of the 0.0000 default.

Although the reference azimuth is shown to the nearest tenth of a second, you need only key it in to the nearest second. Clear the default command line and enter **96.2238**.

Figure 1.17



Press VIEW to see that the **Set BS ∡** field in Figure 1.17 now contains a Ref. Az. identical twin.

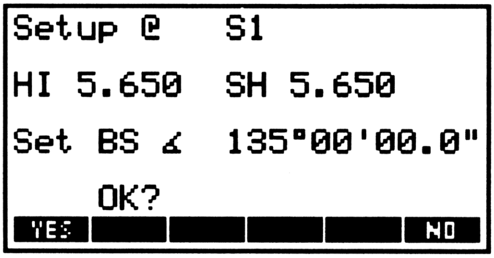
One more option with SETAZ allows you to enter an **arbitrary** azimuth.

This feature could be used when the coordinates for only one point (sometimes called the **work point**) along with a bearing/azimuth to/from the point are given on a drawing. (Remember that the azimuth used must be **away** from the setup and that a bearing must be **converted** to an azimuth.)

To illustrate this option, press [NO] then [SETAZ]. Enter **135** for the backsight azimuth then press [VIEW].

The slimmed-down setup display in Figure 1.18 appears.

Figure 1.18



Some of the lines are blanked when you use an arbitrary azimuth to show just the relevant information, and to remind you that neither a zero nor an inversed azimuth was used. This feature can be thought of as an instant polar/rectangular function.

Press [NO] then [SETAZ] and enter **zero** for the backsight azimuth.

Press [VIEW] and make sure your display matches Figure 1.15: press [YES] when everything is OK.

The Figure 1.19 **Alignment file name** prompt will appear.

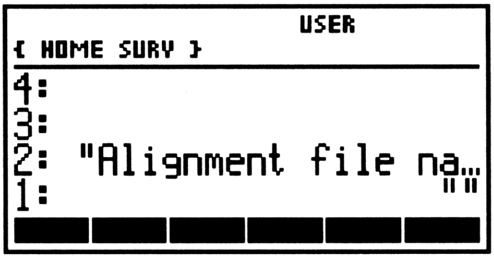
Figure 1.19

Before we end this look at the initial setup, let's take a look at breaking out of the program when you are in an *input* situation as in Figure 1.19.

For example, if you think that you may have used the wrong setup point, just press the ON key. Try pressing the ON key now.

The **file name** prompt is returned to stack level 2 and a null string is returned to stack level 1 as in Figure 1.20.

Figure 1.20



Notice the USER message in the upper right of the display. This version has three key assignments. They will be described in the Alignment and File Editing chapters.

When you break out of the SURVcalc environment like this, it is a good idea to get out of USER mode. To do so just clear system flag -62. Try it now by entering **62** onto the stack, press the **+/-** (change sign) key and enter **CF** (CLEAR FLAG). (If you now wanted to re-start the program to check the setup you would just enter **S.P.**)

Data Entry Errors

In most of the SURVcalc routines, when you make a data entry error that stops calculations, you generally don't have to re-start the routine to continue.

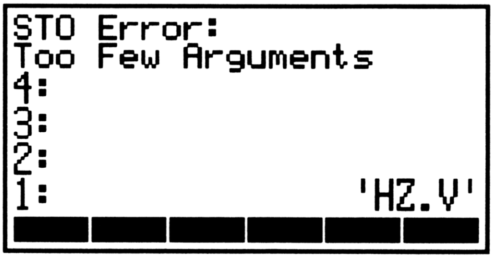
To illustrate, start the program by entering **S.P**. Press CALCS, SS and YES. (The current setup doesn't matter.)

Press SHOOT and just press the ENTER key at the **Horizontal ∠** prompt. The calculator will beep and you will see the Figure 1.21 display below.

The Figure 1.21 display contains an HP error message and a SURVcalc global variable.

In this case the softkey menu is blank but you can get the menu back by using the HP **last menu** function.

Figure 1.21

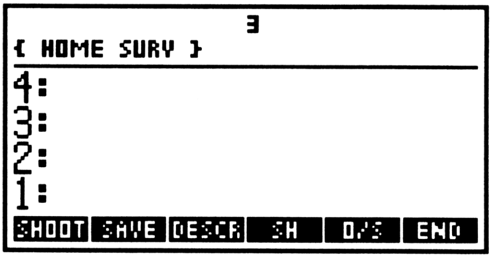


Just press the ON key and clear the display. Press the **right** (↱) shift key then *either* the 3 key *or* the NXT key.

You can see in Figure 1.22 that the sideshots menu has re-appeared with a clean stack.

You could now just press SHOOT to continue.

Figure 1.22



Sometimes after an error the routine softkey menu will still be visible. In that case you can usually just clear the display and continue.

Note: There may be times in some of the routines when the softkey menu will not re-appear; in that case the program will have to be re-started by entering **S.P**.

Printing the Display

On the **SX**, if you want to print any of the displays to the infrared printer, you can do so easily (without affecting the display) by pressing the ON and MTH keys *simultaneously* and then releasing them.

On the **GX**, press and hold down the ON key, press and release the 1 (one) key, then release the ON key.

There is also a current job file *print* routine in the **edit** menu. It will be described in the File Editing chapter.

Now that you have explored the SURVcalc menu system and entered the first control points you can move to the routine you are most interested in.

Press [END] then [QUIT] to leave the SURVcalc environment.

Sideshots

Data needed...

Current job file: JOB1
Control points: S1 (setup @) & B1 (backsight):
(see Figure 1.15, Menu Exploration & Initial Setup)

Changes...

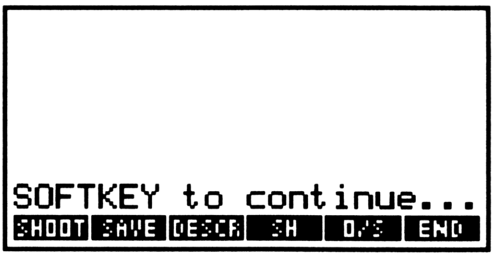
• When points are **saved** they are now stored in the *current* job file.
• You can now calculate coordinates at an offset *perpendicular to* the line of sight.
• The description, signal height and offset values can be changed *after* a shot is taken. When the signal height and/or offset are changed the shot is re-calculated.

Configuration...

Use the default values as shown in Figure 1.3

Start the program by entering **S.P** then press CALCS to get to the **first calculations** menu. From this menu press SS to start the Sideshots routine. Make sure your setup display matches Figure 1.15. Make any required changes then press YES to see the Figure 2.1 **sideshots** menu.

Figure 2.1



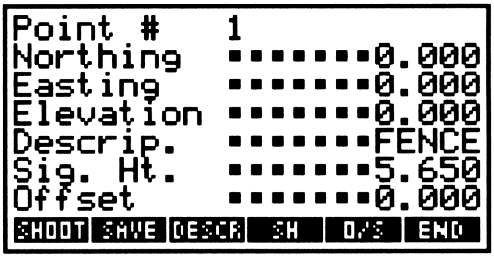
We will be picking up four corners of a fence line starting with a check shot to the backsight point.

When the Figure 2.1 display appears you can start by pressing SHOOT or you can make changes using any or all of the DESCR, SH and O/S softkeys before taking any shots.

To illustrate press DESCR now and enter **FENCE**.

The **sideshots calculation** display appears in Figure 2.2. As a shot was not taken the calculation fields have zeros for placeholders.

Figure 2.2

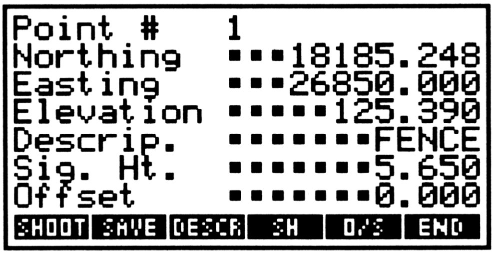


If you change either the **Sig. Ht.** or **Offset** fields in this situation, the calculation fields will be filled with the current setup point values modified by the new signal height or offset. To illustrate press SH then press the ENTER key to accept the 5.65 default.

In this case the coordinate fields in Figure 2.3 contain the data for setup point **S1**.

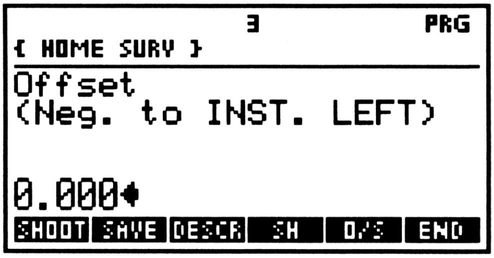
To see how the re-calculation works press O/S to see the **Offset** prompt display in Figure 2.4 below.

Figure 2.3



Clear the zero default. (Notice the reminder that the offset should be **negative** to the instrumentman's left.)

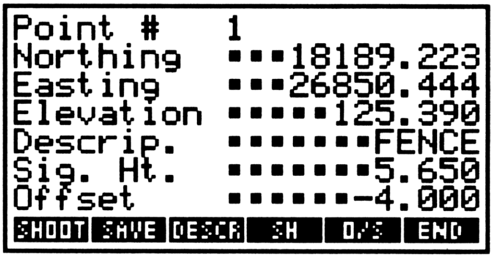
Figure 2.4



Type **4** and press the **+/-** (change sign) key then enter the value.

You can see in Figure 2.5 that the Northing and Easting have been re-calculated.

Figure 2.5



(Remember that the offset calculation is done *perpendicular* to the line of sight.)

Note: The offset stays in effect until you change it.

Press [O/S] now and re-enter zero. (Notice that the coordinates once again match Figure 2.3.)

Sideshots Point Numbering

In SURVcalc version 1.0, control points were stored in a separate file. In this version most of the points created by the program are stored in the *current* job file.

When you take the first shot the point number, regardless of how many points are already in the file, is **1** (one).

When you press [SAVE] the program will check the *current* job file for the largest point number and increment the saved point number by one. For example, if the largest point number in the current job file was 33, the first point saved would be 34.

If, as in this case, the only points in the current file are *alpha* (**S1** & **B1**) then the first shot saved will be point **1** (one).

For the first shot we will do a check to the **B1** backsight.

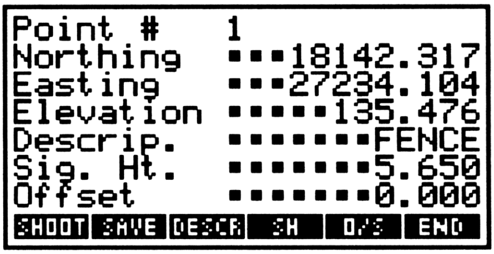
Press [SHOOT] and enter:

0 for the horizontal angle.
10.086 for the Δ elevation.
386.496 for the horizontal distance.

Notice that as we have not yet saved a point the **Point #** is still 1. As this is just a check shot we won't save it either.

If you compare these coordinates for B1 to the actual coordinates used to create the point in the Menu Exploration & Initial Setup chapter you will see that the differences are very small.

Figure 2.6



(This type of check is not meant to be a substitute for a tie to a third point.)

Now we can shoot in the four fence corners. Press SHOOT and enter:

288.1859 for the horizontal angle.
-15.13 for the Δ elevation.
126.577 for the horizontal distance.

When your display matches Figure 2.7, press SAVE. (Whenever you make a data entry error, just re-enter the data.) The first fence corner is saved to the current file (**JOB1.SLO**) and the **SOFTKEY to continue...** message appears.

Figure 2.7

```
Point #      1
Northing     ■■■18300.250
Easting      ■■■26902.880
Elevation    ■■■■■110.260
Descrip.     ■■■■■■■FENCE
Sig. Ht.     ■■■■■■■5.650
Offset       ■■■■■■■0.000
SHOOT SAVE DESCR SH O/S END
```

For the second fence corner press SHOOT and enter:

239.4100 for the horizontal angle.
-11.30 for the Δ elevation.
245.632 for the horizontal distance.

Having saved the last shot, the Point # in Figure 2.8 has been incremented. When your display matches Figure 2.8 press SAVE.

Figure 2.8

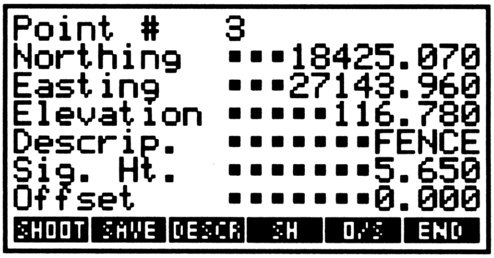
```
Point #      2
Northing     ■■■18409.750
Easting      ■■■26750.330
Elevation    ■■■■■114.090
Descrip.     ■■■■■■■FENCE
Sig. Ht.     ■■■■■■■5.650
Offset       ■■■■■■■0.000
SHOOT SAVE DESCR SH O/S END
```

Press SHOOT and enter the data for the third fence corner as given below.

314.2450 for the horizontal angle.
-8.61 for the Δ elevation.
379.377 for the horizontal distance.

When your display matches Figure 2.9 press SAVE.

Figure 2.9

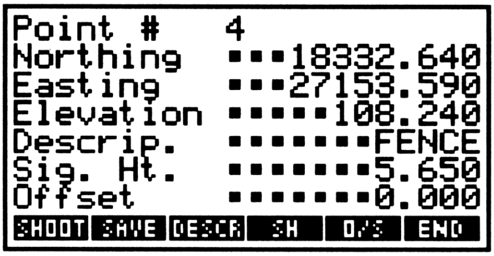


For the fourth and last corner press SHOOT and enter:

327.4334 for the horizontal angle.
-17.15 for the Δ elevation.
337.478 for the horizontal distance.

When your display matches Figure 2.10 press SAVE.

Figure 2.10



Before leaving the sideshots routine let's have another look at the effects of changing the signal height and offset *after* getting a shot.

Changes After a Shot

Press SHOOT and enter:

317.0524 for the horizontal angle.
-16.39 for the Δ elevation
220.095 for the horizontal distance.

The Figure 2.11 point was calculated as an example only; it shouldn't be saved.

Figure 2.11

```
Point #     5
Northing    ■■■18316.266
Easting     ■■■27026.850
Elevation   ■■■■■109.000
Descrip.    ■■■■■■■FENCE
Sig. Ht.    ■■■■■■■■5.650
Offset      ■■■■■■■■0.000
SHOOT SAVE DESCR  SH  O/S  END
```

Let's change both the signal height and offset.

Press SH and enter **4.65**.
Press O/S and enter **5.0**.

Figure 2.12

```
Point #     5
Northing    ■■■18312.249
Easting     ■■■27029.827
Elevation   ■■■■■110.000
Descrip.    ■■■■■■■FENCE
Sig. Ht.    ■■■■■■■■4.650
Offset      ■■■■■■■■5.000
SHOOT SAVE DESCR  SH  O/S  END
```

Notice that the northing, easting and elevation have changed to reflect the new signal height and offset.

You can change these values as often as you want before saving the shot. Change the values back to **5.65** for the signal height and **zero** for the offset. You should see the values in the Figure 2.11 display again.

Remember that the changes stay in effect until you reset the values.

Using a Job File With Another Routine

When using the sideshots routine, keep in mind that some of the other routines will accept a file as input so it is a good idea to plan a pickup in sequence. For example, we shot in the 4 fence corners in order because we will be using this file to calculate the fence-line area in the Areas routine.

Press END then QUIT to leave the SURVcalc environment.

Layouts

Data needed...

Current job file: JOB1 with fence corners 1-4 from Sideshots. (If you haven't gone through the Sideshots chapter, you can add the points as they appear.)

Control points: S1 (setup @) & B1 (backsight): (see Figure 1.15, Menu Exploration & Initial Setup)

Changes...

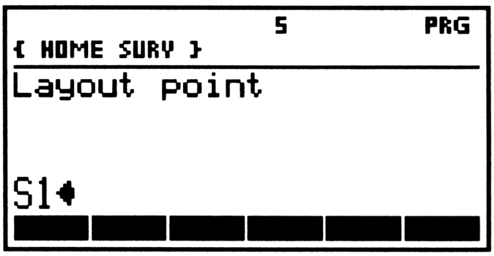
• Points can now be layed out serially using the NEXT feature.

Configuration...

Use the default values as shown in Figure 1.3.

If necessary start the program by entering **S.P**. Press CALCS, L/O and make changes to your display until it matches Figure 1.15. Press YES to get to the **Layout point** prompt in Figure 3.1.

Figure 3.1



When the routine starts it gets the first point in the file as the default. If **S1** was the point you wanted to start with you could just press the ENTER key to accept the default.

In this case we want to start the layout with point **1** so press the ON key to clear the command line and enter **1**.

Figure 3.2

```
L/O Point   1
Northing    ▪▪▪18300.250
Easting     ▪▪▪26902.880
Elevation   ▪▪▪▪▪110.260
Descrip.    ▪▪▪▪▪▪▪FENCE

 ENTER to continue...
```

The routine searches the file and displays the point as in Figure 3.2. (If you don't have the point in the file, the routine will display the **CREATE?** prompt. Just press [YES] and use the Figure 3.2 display data to add the point.)

The routine displays the data for each point so you can verify the coordinates. As per the message at the bottom of the display press the **ENTER** key to continue.

Figure 3.3

```
Laying out   1

Turn Hz.∡   ▪▪288°18'59"
Hz. Dist.   ▪▪▪▪▪126.577

 Press TRY softkey
    to start...
 PT | TRY | SH | GRAD | NEXT | END
```

If point **1** wasn't the point you wanted, you could now just press [PT] to use a different point or [NEXT] if you wanted to layout the *next* point in the file.

The Figure 3.3 display shows you the layout data for the current point. You turn the indicated horizontal angle and tell the rodman the approximate distance to pace.

Note: You can use a non-zero backsight in layouts if you wish. If you do, the **Turn Hz. ∡** title will be replaced by a **Set Az.** (set azimuth) title.

As per the message in the Figure 3.3 display, press [TRY] and enter:

-15.65 for the Δ elevation.
126.52 for the horizontal distance.

The Figure 3.4 display shows you that the rodman has paced very well. He only has to move about 0.06 farther away from the instrument.

Figure 3.4

```
Laying out   1

Turn Hz.∡  ▪▪288°18'59"
Hz. Dist.  ▪▪▪▪▪126.577

Away       ▪▪▪▪▪▪▪▪0.057
Fill       ▪▪▪▪▪▪▪▪0.520
 PT | TRY | SH | GRAD | NEXT | END
```

For these fence corners we are not too concerned about the elevation but you can see that this shot is only 0.52 below the point **1** elevation.

Note: We started off this layout session using the default horizontal distance setting in the configuration routine. You can use slope distances in layouts if you wish. If you do, you will be prompted for zenith angles and slope distances when you press [TRY]. The required layout distance will of course still be shown as a horizontal.

Using the NEXT Feature

As we are working this layout sequentially, press [NEXT] now for the next point in the file.

Figure 3.5

```
L/O Point  2
Northing   ▪▪▪18409.750
Easting    ▪▪▪26750.330
Elevation  ▪▪▪▪▪114.090
Descrip.   ▪▪▪▪▪▪▪FENCE

 ENTER to continue...
```

The NEXT feature can be a real time saver. It pays to take a little time to think how you will be doing a layout when a layout file is created or downloaded from your

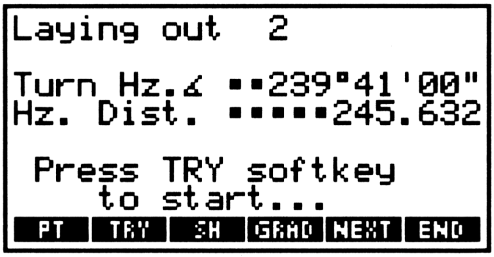
PC or Mac. (See the File Conversion chapter.)

Press the **ENTER** key to see the point **2** layout data in Figure 3.6.

Press [TRY] and enter:

-10.7 for the Δ elevation.
248 for the horizontal distance.

Figure 3.6



This time the Figure 3.7 display shows that the rodman didn't pace quite as well. He has to move about **2.4 to**ward the instrument.

Figure 3.7

The grade shows a cut of **0.6** to get to the point 2 elevation.

After the rodman moves the approximate distance, press [TRY] and enter:

-11.04 for the Δ elevation.
245.80 for the horizontal distance.

Figure 3.8

Figure 3.8 shows that the rodman can now measure about **0.17 to**ward the instrument and bang in the stake.

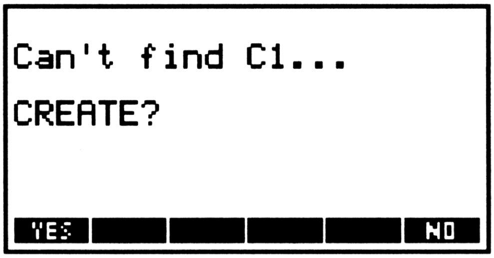
You can use the NEXT feature to cycle through the entire file. When you are at the last point pressing [NEXT] will display the first point to begin a new cycle.

Using the PT (point) Feature

To get to a non-serial point or to add a point on the fly, use the PT feature. Press [PT] now and enter **C1**. (In SURVcalc you can use alphanumeric point names.)

The Figure 3.9 display and **CREATE?** prompt appear to verify that you really do want to create point C1.

Figure 3.9



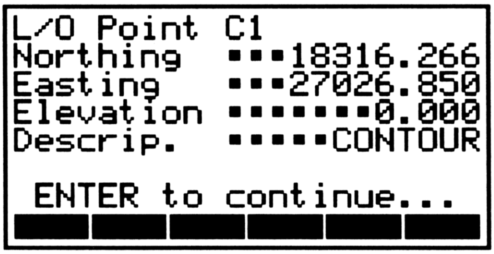
Press [YES] now and enter:

18316.266 for the northing.
27026.850 for the easting.
0.000 for the elevation. (We are using a **zero** elevation for the GRAD [grade] feature example to follow.)
CONTOUR for the description.

The Figure 3.10 display appears so you can confirm that the data you entered for the point is correct.

As usual press the ENTER key to see the layout data.

Figure 3.10



Using the GRAD (grade) Feature

When you want to set points at a particular elevation (a contour for example) you can use the **GRAD** feature.

When you enter a zero elevation as we did above, you will see the point elevation instead of a cut/fill value.

Figure 3.11

Note: In SURVcalc v. 1.0 when using the GRAD feature you had to press TRY at least once before pressing GRAD. In this version you can press GRAD at any time.

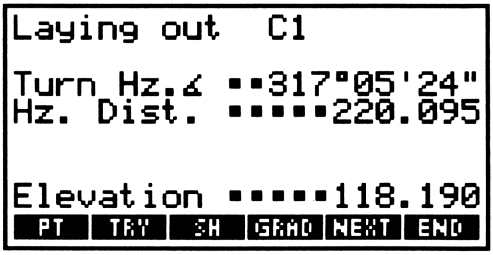
We will try staking the **120** contour. Press GRAD and enter:

-7.2 for the Δ elevation. (The GRAD feature is concerned only with the grade so you won't be prompted for the horizontal distance.)

Figure 3.12 shows that the rodman has to move about **1.8** higher to get to the **120** contour.

For the second shot press GRAD and enter:

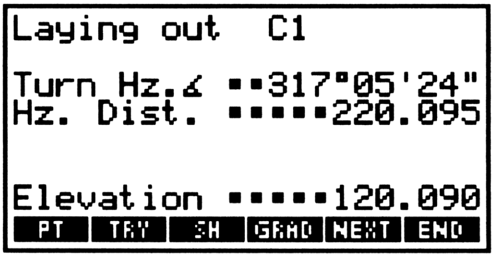
Figure 3.12



-5.3 for the Δ elevation.

Figure 3.13 shows you that the rodman is now very close so the stake can be moved down slightly and banged in.

Figure 3.13



Note: If you forget to change the signal height before entering the data, you don't have to re-enter it. Just press [SH] and enter the new value. The routine will recalculate and display the updated elevation.

As mentioned above you can use the File Conversion utility to convert a comma or space delimited file output from your PC survey software to SURVcalc format. (See the File Conversion chapter.)

You can then use Kermit to send the converted file to your HP 48 to use in the Layout routine.

Press [END] then [QUIT] to leave the SURVcalc environment.

Traverse

Data needed...

Current job file: JOB1 (The only points needed are the control points listed below.)

Control points: S1 (setup @) & B1 (backsight): (See Menu Exploration & Initial Setup) Enter **5.34** for the HI and **5.59** for the SH.

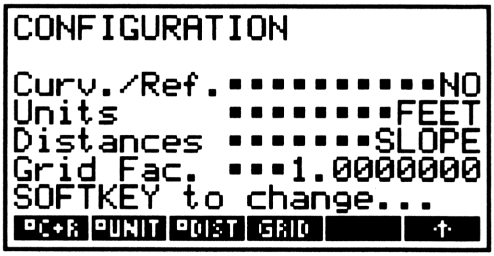
Changes...

• The only traverse change is in the file continuation feature. The OVERWRITE option has been replaced by an EXIT option.

Configuration...

Enter **S.P** to start the program. Press [CONFI] then [▫DIST] to toggle SLOPE distances. Press [↑] to get back to the **program main** menu when your display matches Figure 4.1.

Figure 4.1

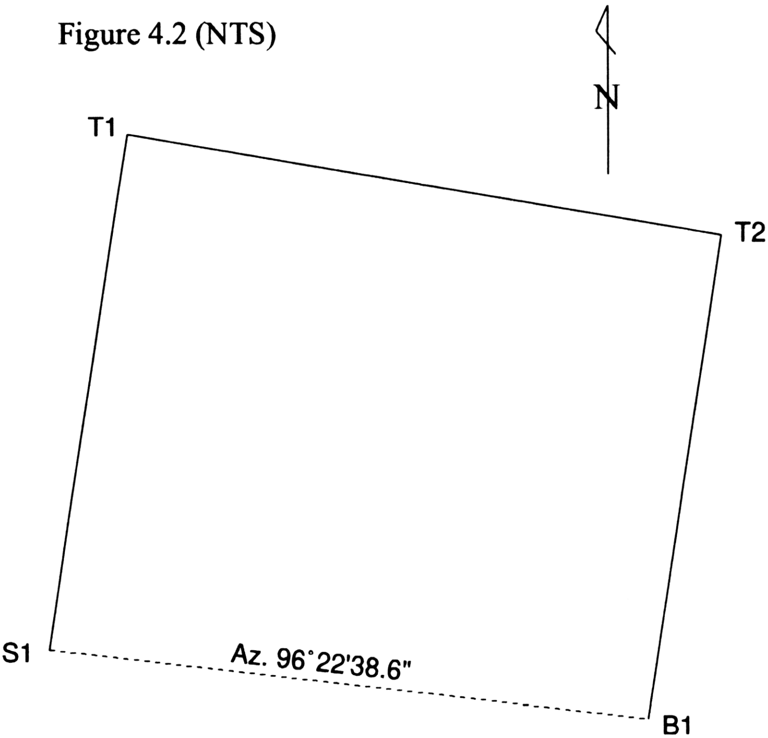


You can run an open or closed traverse with as many legs as calculator memory will allow.

Closed traverses feature an automatic closure and compass rule adjustment. Open traverses can be stopped and re-started.

For the example we will tie in the two new stations shown in the following sketch:

Figure 4.2 (NTS)

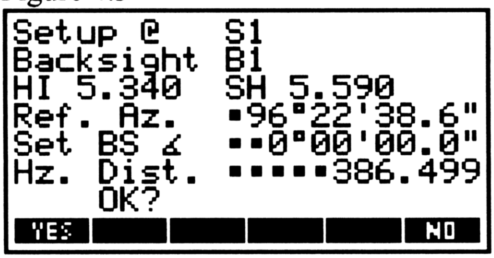


Press CALCS, ↓ and TRAV.

Make sure your setup display matches Figure 4.3.

Before starting the traverse press NO.

Figure 4.3



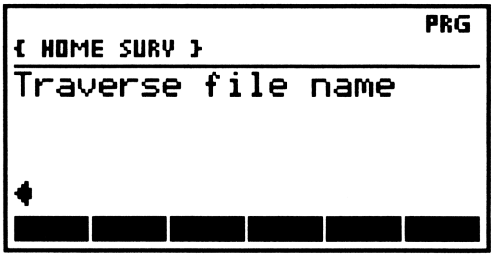
Notice in the Figure 4.4 **traverse setup change** menu that a [SETAZ] softkey does not appear. The Traverse and Two Point Resection routines don't allow a non-zero backsight.

Figure 4.4

Press [VIEW]. If your display matches Figure 4.3, press [YES].

At the **Traverse file name** prompt in Figure 4.5, enter **TRAV1**. As usual you shouldn't enter an extension; the routine will add it.

Figure 4.5



The Traverse File System

The traverse routine uses the *current* job file for the initial setup and backsight data. The preliminary points are stored in a file with a **.TRU** extension. (In our example the file would be TRAV1.TRU.)

When you run an open traverse this file is the *only* one created by the routine. When you run a closed traverse the routine will also create a file containing the adjusted coordinates. It uses the same name but adds a .TRA extension. In our example it would be TRAV1.TRA.

When ending either type of traverse the routine will prompt you to save each new point to the *current* job file.

SURVcalc doesn't purge the traverse files so you should make a point of purging them when you are sure you no longer need them.

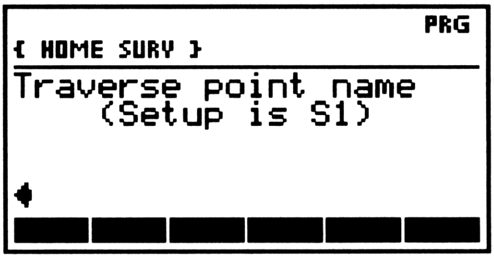
As open traverse files can be stopped and re-started, if an existing **TRAV1** file was found you would see the Figure 4.13 display.

For more information about traverse files see Appendix A, File Formats.

Entering Traverse Data

At the **Traverse point name** prompt in Figure 4.6, enter **T1**. (Notice the **Setup is** reminder.)

Figure 4.6

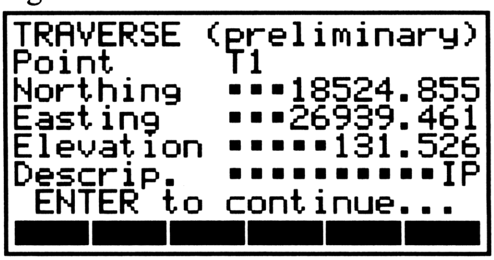


Enter the following data as the prompts appear:

278.2250 for the horizontal angle.
88.5730 for the zenith angle. (Zenith angles can be entered relative to 90° or 270°.)
351.251 for the slope distance.
IP for the description.

The preliminary data for each traverse point is displayed as in Figure 4.7. As per the message at the bottom of the display, press the ENTER key.

Figure 4.7



The Figure 4.8 **traverse option** display will appear after each preliminary calculation is displayed.

Figure 4.8

```
TRAVERSING: press...

▶QUIT to end OPEN TRAV
▶CLOSE to do ANGULAR
 closure

▶NEXT to continue...
QUIT |      |CLOSE|      |      |NEXT
```

You could press:

- QUIT to END an open traverse or temporarily stop a closed traverse.
- CLOSE to do the ANGULAR closure. (Press this softkey *after* you get the DISTANCE tie.)
- NEXT to enter the data for the NEXT point.

This time press NEXT. The routine assumes you are using the forced centering method and offers the previous SH as the new HI. Accept the displayed HI (**5.59**) and enter:

5.44 for the SH. (Notice that the default SH shows only the integer from the previous HI.)
T2 for the point name. (Notice that the **Setup is** reminder shows **T1**.)
271.0840 for the horizontal angle.
92.4935 for the zenith angle.
389.737 for the slope distance.
IP for the description.

The **traverse calculation** display in Figure 4.9 appears showing the preliminary data for point **T2**.

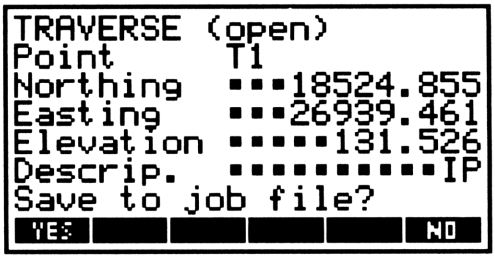
Figure 4.9

```
TRAVERSE (preliminary)
Point          T2
Northing    ▪▪▪18418.198
Easting     ▪▪▪27313.827
Elevation   ▪▪▪▪▪112.458
Descrip.    ▪▪▪▪▪▪▪▪▪▪IP
 ENTER to continue...
```

To illustrate a handy feature of the traverse routine, after pressing the **ENTER** key, press QUIT. Although QUIT is used to end an *open* traverse you can also use it to temporarily end a *closed* traverse.

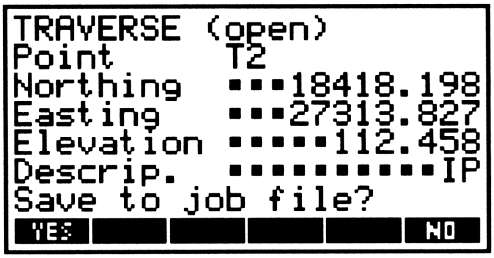
The traverse calculation display re-appears. (Make sure your displays match Figure 4.10 & Figure 4.11.) This time, after the traverse title, **(open)** is shown to remind you that the data is not adjusted.

Figure 4.10



The last line in the display gives you the option of saving each point to the *current* job file. As we are going to continue this traverse later, press NO now and once more after the T2 data is displayed. You will end up at the **program main** menu.

Figure 4.11

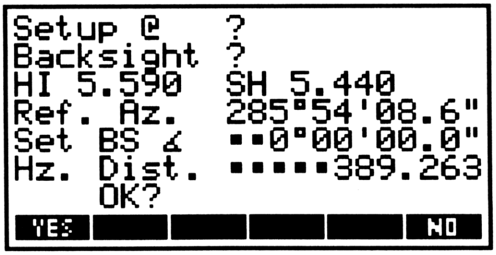


Continuing a Traverse

Let's go back to the traverse. Press CALCS, ↓ and TRAV. The **traverse setup** display appears in Figure 4.12.

Notice the **?**'s in the setup and backsight fields.

Figure 4.12



In this version you will see question marks in the setup display after you leave the traverse routine. This is to remind you that the last traverse points *may not be* in the current job file.

When you continue a traverse you don't have to worry about having the correct setup and backsight points in their respective fields. The routine will get the points from the traverse file. However, you do have to make sure you enter the correct **HI** and **SH**.

To illustrate this feature we will enter different points. Press [NO], then [SETUP] and enter **B1**. Press [BSITE] and enter **S1**. Press [HI] and enter **5.44**, then press [SH] and enter **5.61**.

Press [VIEW] and check that the HI and SH are correct. Press [YES]. At the **Traverse file name** prompt enter **TRAV1**.

The calculator beeps and the Figure 4.13 display appears. (If you use the name of an existing *adjusted* traverse file the calculator will beep and a **File not valid!** message will appear.)

Figure 4.13

```
TRAV1 exists!
 press...

▶ADDTO to continue
▶NEW for another name

▶↑ to EXIT
ADDTO    NEW              ↑
```

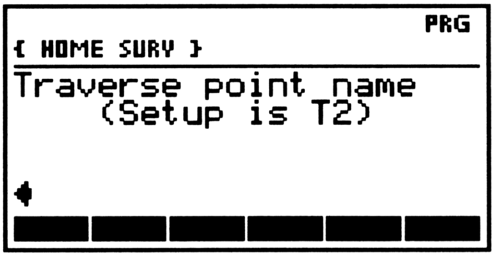
Referring to Figure 4.13 you could now press:

- [ADDTO] to continue traverse calculations with this file.
- [NEW] to enter another name.
- [↑] to return to the **program main** menu.

This time press [ADDTO].

Under the **Traverse point name** prompt, the **Setup is** reminder should now contain **T2** (which is the last point we tied in) even though we entered **B1** as the starting setup.

Figure 4.14

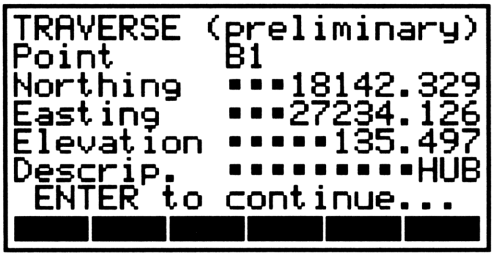


Now enter:

B1 for the point name.
270.1244 for the horizontal angle.
85.2245 for the zenith angle.
288.088 for the slope distance.
HUB for the description.

The **traverse calculation** display in Figure 4.15 appears showing the preliminary data for the distance tie to point **B1**.

Figure 4.15



Press the ENTER key and we'll take a few minutes to describe how the routine handles a closure.

Traverse Closure Methods

When entering data for a **closed** traverse keep pressing NEXT until the data for the **distance** tie has been entered as we did above.

To complete the closure, you have to enter the closure *angle*.

The routine will recognize, and react accordingly, to three closure scenarios:

1) Starting at **A** backsighting **B**, then distance closing back to **A** and sighting **B** for the closure angle. (Distance closing to the origin line **setup**.)

In this case the routine searches the traverse file for **A** (the distance tie) and when found will assume that you are sighting **B** for the closure angle and will prompt you for that angle.

2) Starting at **A** backsighting **B**, then distance closing to **B** and sighting **A** for the closure angle. (Distance closing to the origin line **backsight** as we did above.)

In this case the routine searches the traverse file for **B** (the distance tie) and when found will assume that you are sighting **A** for the closure angle and will prompt you for that angle.

3) Starting at **A** backsighting **B**, then distance closing to **C** and sighting **D** for the closure angle. (Closing to a different line.)

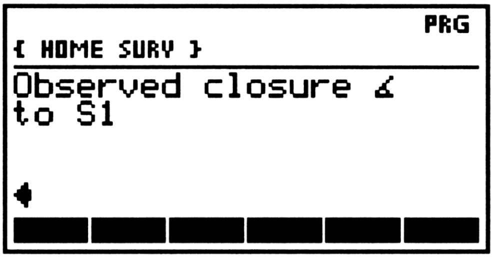
In this case the routine searches the file for **C** (the distance tie) but as you closed to a different line **C** will not be found.

The routine would then search for **C** in the *current* job file.
If **C** is not found there you will be prompted for the data and the point will be added to the current job file. (Ditto for point **D**.)

Press CLOSE now and the Figure 4.16 display will appear.

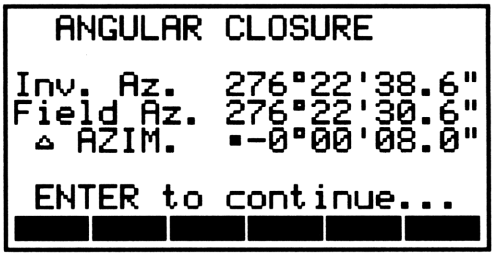
As mentioned above, we used the **second** scenario for this traverse, so the routine assumes you are going to turn the closure angle to **S1**.

Figure 4.16



Enter **260.1538** for the closure angle. The display in Figure 4.17 will appear.

Figure 4.17



- The **Inv. Az.** field contains the azimuth from **B1** to **S1** calculated using the true coordinates of both points.

- The **Field Az.** field contains the azimuth from **B1** to **S1** calculated using the field coordinates of **B1** and the true coordinates of **S1**.

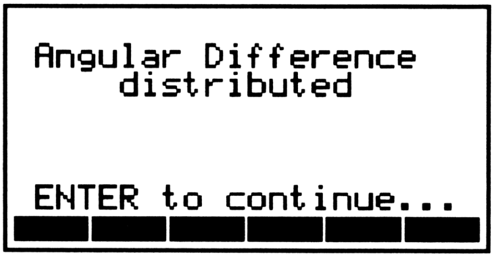
- The **Δ AZIM.** field shows that we closed eight seconds less than the inversed azimuth. (An angular closure that is greater than the inversed azimuth will be positive.)

As the last line in the display prompts, press the **ENTER** key to distribute the angular difference.

After a few seconds the Figure 4.18 message display appears.

The angular difference is distributed by dividing the difference by the number of angles turned. The remainder, if any, is applied to the last angle.

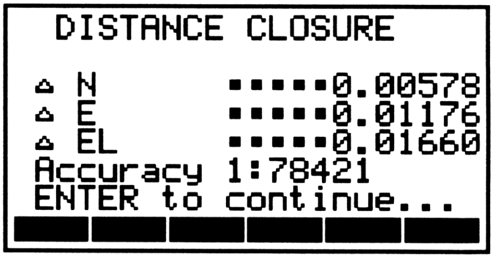
Figure 4.18



Note: If you want to distribute the angular difference arbitrarily, you can calculate the angular closure *before* starting the traverse routine, apply your arbitrary angular difference distribution, then use the *adjusted* angles when you start the traverse calculations.

Press the **ENTER** key to view the **distance closure** display in Figure 4.19.

Figure 4.19

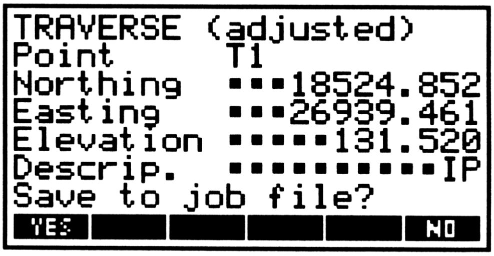


The routine uses the **compass rule adjustment**. When you press the **ENTER** key, the differences will be distributed proportionally to the length of each traverse leg.

If you haven't yet done so, press the **ENTER** key now.

Each adjusted point in the traverse will be displayed as in Figure 4.20.

Figure 4.20

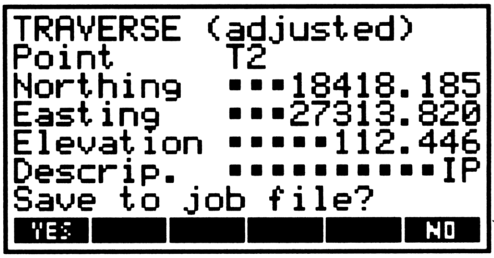


The message at the bottom of the display gives you the option to save each point to the current job file. (Even if you don't save the points at this time, you can add the points to your current job file manually from the *adjusted* traverse file using the File Editing routine.) If your display matches Figure 4.20 press [YES]; press [NO] otherwise.

Once again if your display matches Figure 4.21 press [YES]; press [NO] otherwise.

After the last point is displayed you will be returned to the **program main** menu.

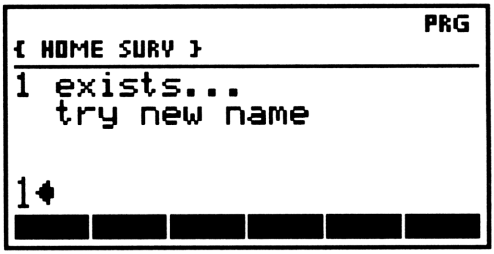
Figure 4.21



Using Existing Point Names

If a traverse point being saved has the same name as a point already in the current job file, the calculator will beep and you will see the Figure 4.22 display.

Figure 4.22



Just enter a new name or add a modifier to the existing name. For example you could add an **A** to **1** in Figure 4.22.

Press [QUIT] to leave the SURVcalc environment.

Inverse Traverse

Data needed...

Current job file: JOB1 (Adjusted points **T1** & **T2**, from the traverse routine, can be loaded when you start the inverse traverse if they are not already in the file.)

Control points: S1 (setup @) & B1 (foresight):
(see Menu Exploration & Initial Setup)

Changes...

• The units can now be set in the configuration routine. Areas will be shown relative to the current unit. (F^2 for feet and M^2 for meters.)

• The [▫AREA] softkey can now be toggled to show *either* F^2/acres *or* M^2/hectares.

Configuration...

Enter **S.P** to start the program. Press [CONFI] then [▫UNIT] to toggle FEET. When your display matches Figure 5.1, press [↑] to get back to the **program main** menu.

Figure 5.1

```
CONFIGURATION

Curv./Ref.▪▪▪▪▪▪▪▪▪▪▪NO
Units     ▪▪▪▪▪▪▪▪▪FEET
Distances ▪▪▪▪▪▪▪▪SLOPE
Grid Fac. ▪▪▪1.0000000
SOFTKEY to change...
▫C+R ▫UNIT ▫DIST GRID      ↑
```

Press [CALCS], [↓] and [ITRAV] to get to the Figure 5.2 display below. (Your display may contain **?'s** if you have come from the Traverse routine; just enter **S1** & **B1** as in Figure 5.2)

The inverse traverse routine calculates azimuths, distances, differences in elevation, areas and total distance traversed using the coordinates of points found in the current job file.

Figure 5.2

```
Setup @      S1
Foresight    B1
Azimuth      ■96°22'38.6"
Hz. Dist.    ■■■■■386.499
Δ Elev.      ■■■■■■10.090

SETUP F.SITE       START        ↑
```

When a point is not found the program will beep and give you the opportunity to create it. After the data for the new point is entered the point will be added to the current job file and the inverse data will be displayed.

We will inverse traverse around the figure used in the Traverse chapter.

Notice that the display in Figure 5.2 above is similar to the standard **calculation setup change** display. Where previously the **Backsight** field was on the second line we now see a **Foresight** field. In an inverse traverse the term Backsight is irrelevant; using the term Foresight also helps to clarify the direction in which the calculations are done.

As usual, the azimuth shown is calculated *from* the Setup *to* the Foresight.

The Δ **Elev.** field contains the difference in elevation. Like the azimuth, the Δ Elev. is calculated *from* the Setup *to* the Foresight, so in this case, as B1 is higher than S1, it is shown as positive.

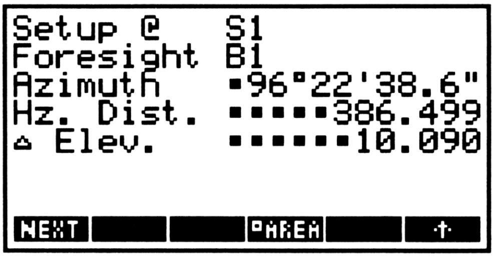
Press START to continue.

In Figure 5.3 below, notice that a new softkey menu appears.

Figure 5.3 contains the first leg of the inverse traverse.

When you press NEXT the current **Foresight** will become the new **Setup** and the routine then prompts you for the *new* Foresight.

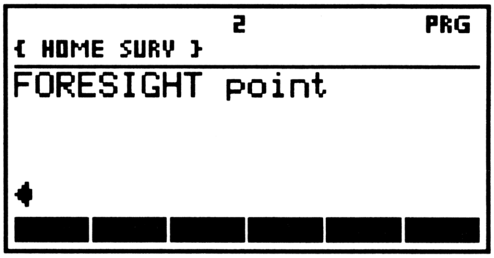
Figure 5.3



If you haven't yet done so, press NEXT.

At the prompt in Figure 5.4, enter **T2**. (If T2 and/or T1 are not in your calculator, enter the data given below when you see the **CREATE?** prompt.)

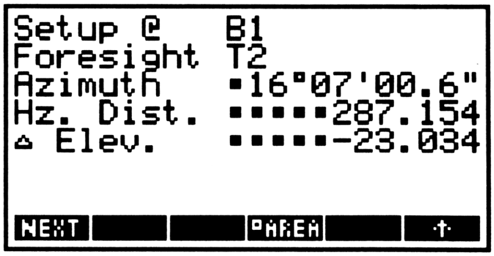
Figure 5.4



T1	N **18524.852**	E **26939.461**	EL **131.520**	Description **IP**
T2	N **18418.185**	E **27313.820**	EL **112.446**	Description **IP**

Notice in Figure 5.5, that **B1** is now in the **Setup @** field. The display shows the inverse data for the line **B1** to **T2**.

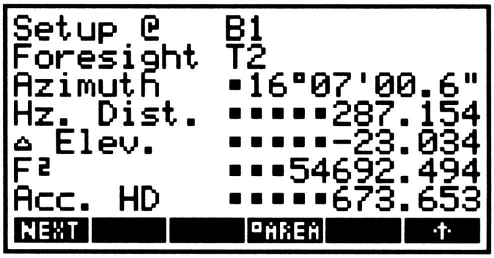
Figure 5.5



We now have the triangular figure **S1 B1 T2** so we can display the current area and the accumulated distance. (You don't have to re-enter the point of origin to calculate the area; the routine will close the figure from the last point entered to the point of origin.) Press [□AREA].

The last two lines of the display in Figure 5.6 now contain the **area** in square feet (**F²**) and the **Acc. HD**. (Accumulated horizontal distance.)

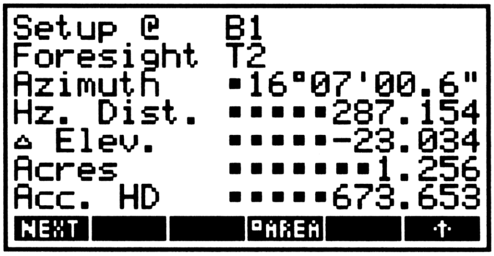
Figure 5.6



As mentioned at the beginning of this chapter, the [□AREA] softkey is now a *toggle*. In this case, if you press [□AREA] again (press it now) you will see the equivalent area in acres as in Figure 5.7.

You can press [□AREA] as often as you want but you need to have at least two legs traversed or you will get a zero area.

Figure 5.7



Press [NEXT] and enter **T1**. (Create using the data above if necessary.)

Figure 5.8 shows the inverse data from **T2** to **T1**. The Δ elevation indicates that T1 is a little more than 19' higher than T2.

Press [□AREA].

Figure 5.8

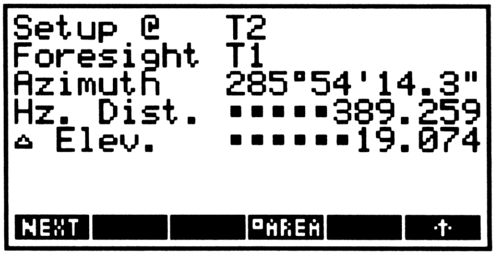
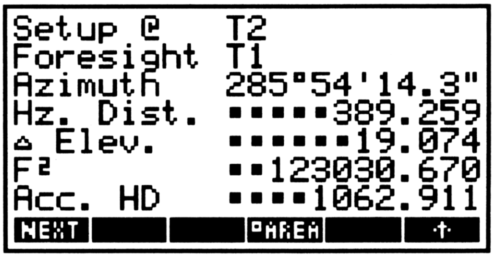


Figure 5.9 now displays the area of the complete figure (**S1 B1 T2 T1**). Press [▫AREA] to see the acreage if you like. (This display is not shown.)

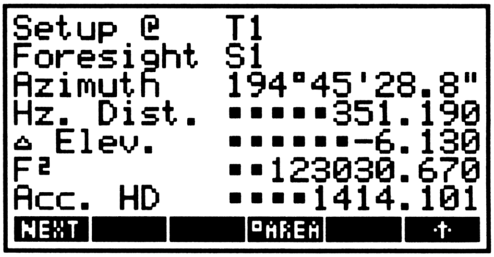
Figure 5.9



When you want to see the accumulated horizontal distance of the perimeter, you have to re-enter the point of origin. Press [NEXT], enter **S1** then press [▫AREA].

Notice in Figure 5.10 that the area hasn't changed, but now the accumulated HD has been increased by the length of the T1-S1 leg.

Figure 5.10



Reversing Direction

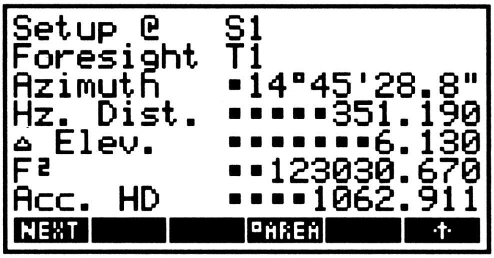
You can press [▫AREA] as often as you wish. You can get intermediate areas and accumulated HD's as you traverse and you can even re-trace your steps if you go past a point where you wanted to calculate an area.

For example let's work anticlockwise back to **S1**. (Remember that when you press [NEXT] the current Foresight is moved into the Setup @ field.)

Press [NEXT] now, enter **T1** then press [▫AREA].

Notice in Figure 5.11 that the area is unchanged but the accumulated horizontal distance is now back to 1062.911 as in Figure 5.9. Also, compare the **Azimuth** and **Δ Elev.** fields to Figure 5.10.

Figure 5.11



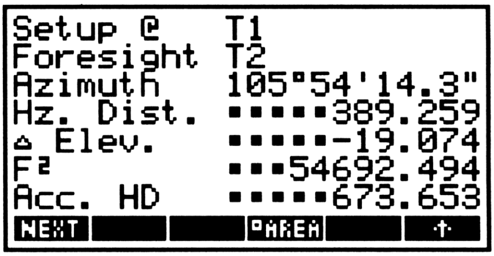
Note: The area is calculated from the **Setup** origin along the inverse traverse path to the *current* **Foresight**. In this case the figure formed by **S1 B1 T2 T1**. So even though we changed direction we are still using the same figure to do the calculations.

The accumulated horizontal distance has been reduced by the length of the **S1-T1** leg. The routine checks for a turn-a-round situation and when it detects one it changes the sign of the HD to be added algebraically to the accumulated horizontal distance.

Press [NEXT] again, enter **T2** then press [□AREA].

As Figure 5.12 shows, this time both the area and the accumulated HD have been reduced because **T2** is now the Foresight. (The figure is now **S1 B1 T2**.)

Figure 5.12



Press [NEXT] again, enter **B1** then press [□AREA].

Now in Figure 5.13, the area is **0.0** and the accumulated horizontal distance is just the **S1 B1** distance.

The area in this case is zero as the figure from which the area is calculated is the line **S1** (the origin Setup) to **B1** (the current Foresight).

Figure 5.13

```
Setup @     T2
Foresight   B1
Azimuth     196°07'00.6"
Hz. Dist.   ▪▪▪▪▪287.154
△ Elev.     ▪▪▪▪▪▪23.034
F²          ▪▪▪▪▪▪▪▪0.000
Acc. HD     ▪▪▪▪▪386.499
NEXT |  |  | ºAREA |  | ↑
```

Try experimenting with the routine if you like. See what happens when you enter **S1** for the next point. Also, try turning around again and see how the area and accumulated horizontal distances fields respond.

Note: When inverse traversing, you have to be careful that you don't go past the point of origin. The routine will not notice that you have passed the starting point and it will just keep incrementing the area and the accumulated horizontal distance even though you are entering the same points.

You can inverse traverse as many legs as your calculator has memory. The routine creates a temporary file for area calculation which is purged when the routine is ended. As this file size increases, area calculation time will increase.

Press [↑] three times to get to the **program main** menu. Press [QUIT] to leave the SURVcalc environment.

Two Point Resection

Data needed...

Current job file: JOB1

Control points: B1 will be used for the check point.
(see Menu Exploration & Initial Setup)
Points **T1** & **T2**, are shown near Figure 6.4 below.
They can be loaded when you start two point resection if they are not already in the file.

Changes...

• The confirmation prompt when answering **NO** to the **Save resected point?** prompt has been removed. Now when you answer NO the routine will return to the **program main** menu.

Configuration...

Start the program if necessary by entering **S.P**. From the **program main** menu, press [CONFI] then [▫DIST] to show SLOPE. When your display matches Figure 6.1, press [↑] to get back to the **program main** menu.

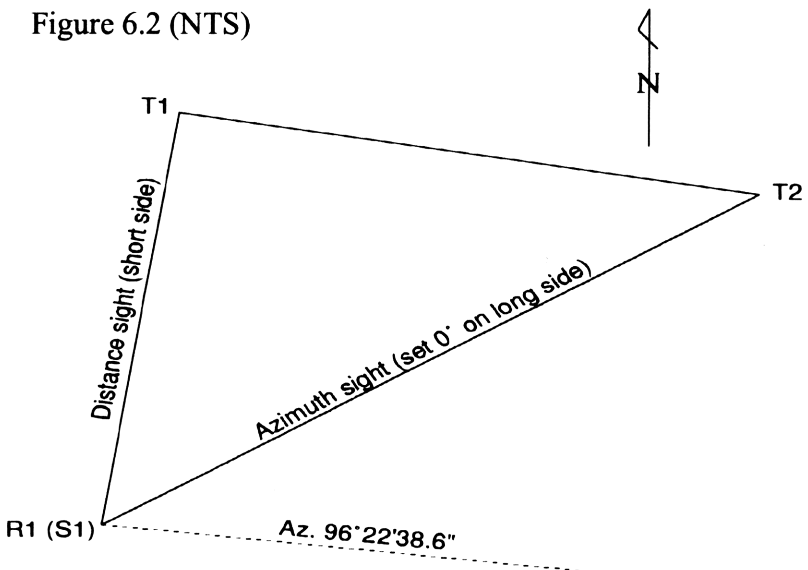
Figure 6.1

```
CONFIGURATION

Curv./Ref.▪▪▪▪▪▪▪▪▪▪▪▪NO
Units     ▪▪▪▪▪▪▪▪▪FEET
Distances ▪▪▪▪▪▪▪▪SLOPE
Grid Fac. ▪▪▪1.0000000
SOFTKEY to change...
▫C+R ▫UNIT ▫DIST GRID       ↑
```

The two point resection routine gives a survey crew the ability to quickly *set* and *verify* a three dimensional control point in the best place for a particular project.

It is especially effective for earthwork and many mining applications. For example, in open pit mining very temporary points are often set for blast pickups. There isn't much point in setting a permanent point on a bench that will soon be blasted. In a situation like this the resection routine is ideal.

Figure 6.2 (NTS)



As you see in the sketch in Figure 6.2 above, we are using traverse points **T2** and **T1** as the azimuth and distance points respectively. The point to be resected (**R1**) is coincident with point **S1**, so that we can make an immediate comparison of the resected coordinates and elevation with the actual data.

Press [CALCS] and [2PT] to get to the **resection setup** display in Figure 6.3.

Your display may not match Figure 6.3; it is shown as a preliminary setup only.

Notice the differences from the standard setup display.

Figure 6.3

```
Dist. Pt. S1
Azim. Pt. B1
HI 5.610  SH 5.610
Azimuth    ▪96°22'38.6"
(Dist. Pt.→ Az. Pt.)
Hz. Dist. ▪▪▪▪▪386.499
    OK?
YES                NO
```

• The **Setup @** and **Backsight** fields have been replaced by **Dist. Pt.** and **Azim. Pt.** fields respectively.

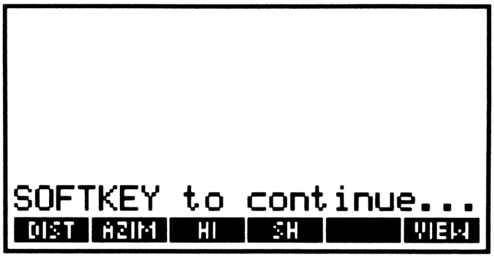
• The **Ref. Az.** field has been replaced by an **Azimuth** field which contains the azimuth *from* the distance point *to* the azimuth point.

• The **Set BS ∡** field has been replaced by a **(Dist. Pt. → Az. Pt.)** reminder. This is shown to indicate the direction in which the azimuth *between the sight points* is calculated.

Press [NO] to view the **resection setup change** menu.

The menu in Figure 6.4 corresponds to the Figure 6.3 setup display. Notice that Two Point Resection is one of the routines in which the SETAZ softkey (to set a non-zero backsight azimuth) does not appear.

Figure 6.4



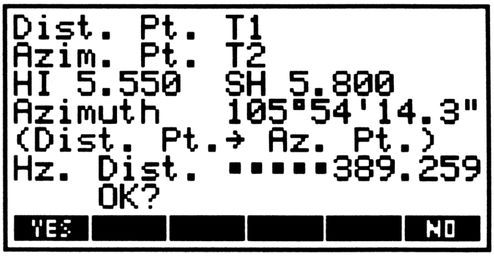
Press DIST to enter **T1** for the distance point; press AZIM and enter **T2** for the azimuth point. (If these points aren't in your file, enter them when the **CREATE?** prompt appears using the data below.)

T1	N **18524.852**	E **26939.461**	EL **131.520**	Description **IP**
T2	N **18418.185**	E **27313.820**	EL **112.446**	Description **IP**

When doing a two point resection, besides trying to use azimuth and distance points which, with the point to be resected, yield a strong figure, the most important thing to remember is that the distance from the resected point to the azimuth point **must** be greater than the distance from the resected point to the distance point. (The routine checks for this situation as will be illustrated.)

Press HI to enter **5.55** and SH to enter **5.80**. Then press VIEW and make sure your display matches Figure 6.5. Press YES to start.

Figure 6.5



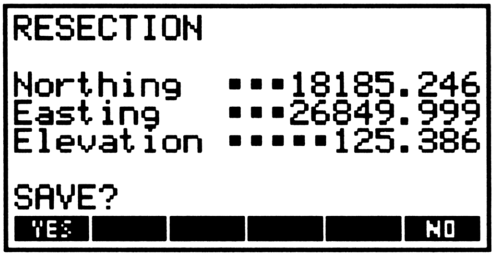
Enter the following data. (The prompt displays are not shown.)

311.2529 for the horizontal angle.
271.0229 for the zenith angle. (Zenith angles can be entered relative to 90° or 270°.)
351.250 for the slope distance.

The **resection calculation** display in Figure 6.6 appears.

If the internal check routine mentioned previously does not find a problem, the result of the resection calculation is displayed. As you will see, the routine will abort the calculations if it finds a problem.

Figure 6.6



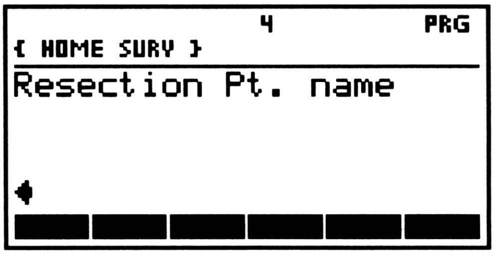
The data for the resection in Figure 6.6 is very close to the actual data for point **S1**. (We will see just how close when we do the distance check.)

If you felt the data entered was OK, you could save this point to the *current* job file. We do want to save this point so press [YES].

At the **Resection Pt. name** prompt try entering **T1** which is already in the current job file.

The calculator will beep and the **OVERWRITE?** display in Figure 6.8 below will appear.

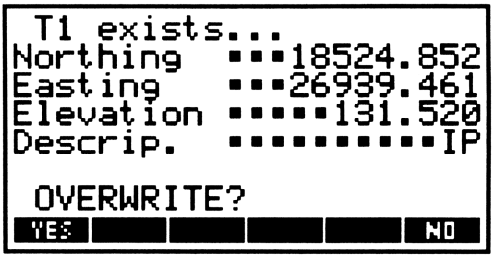
Figure 6.7



If you did want to overwrite T1 you could press [YES] and the old point T1 values would be overwritten by the new.

This time press [NO] to return to the display in Figure 6.7. Enter **R1**.

Figure 6.8

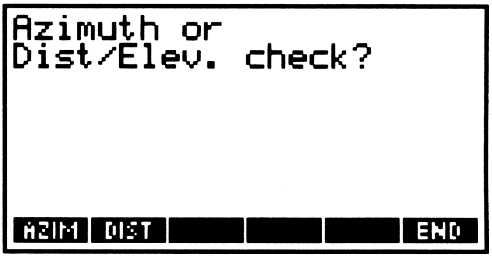


As R1 is not in the current job file a **Descrip.** (point description) prompt appears. Enter **HUB** and point R1 is saved to the job file.

The display in Fig. 6.9 appears prompting for the type of check you want to do.

Just as you should *always* close a traverse, so you should *always* get a check to a third point after a resection. We will use both methods.

Figure 6.9



Press [AZIM]. At the **Check point name** prompt enter **B1**. (If the check point is not found the calculator will beep and you will see the usual **CREATE?** prompt.)

At the **Horizontal ∡** prompt enter **33.0239**. The Figure 6.10 **AZIMUTH CHECK** display will appear below.

• The **Inv. Az.** (inversed azimuth) shown in Figure 6.10 is calculated from the *resected* coordinates of **R1** and the *actual* coordinates of **B1**.

Figure 6.10

```
AZIMUTH CHECK

Inv. Az.    ▪96°22'37.4"
Field Az.   ▪96°22'39.3"
 Δ AZIM.    ▪▪0°00'01.9"

 ENTER to continue...
```

• The **Field Az.** is calculated by adding the *observed* horizontal angle to the *inversed* azimuth from the resection point to the azimuth point (T2 in this case).

• The Δ **AZIM.** (difference in azimuth) will be shown as negative when the field azimuth is less than the inversed azimuth.

Although the azimuth check is better than none at all, the distance check is preferred as it yields a three dimensional tie.

Press the ENTER key then press [DIST]. At the **Check Point name** prompt enter **B1** again. As this is a distance check the next prompt is for the signal height with a default shown. Press the ENTER key to accept the default. Then enter:

33.0239 for the horizontal angle.
271.3202 for the zenith angle.
386.639 for the slope distance.

The **DIST./ELEV. CHECK** display appears in Figure 6.11.

Figure 6.11

```
DIST./ELEV. CHECK

 Δ N          ▪▪▪▪▪▪-0.004
 Δ E          ▪▪▪▪▪▪▪0.000
 Δ EL         ▪▪▪▪▪▪▪0.006

 ENTER to continue...
```

• The Δ **N**, **E** & **EL** values are the differences between the actual and calculated coordinates of the check point. (B1 in this case.) The tie was very good in all three dimensions so you could feel confident of the location of point R1.

You can use the check routine as many times as you wish.

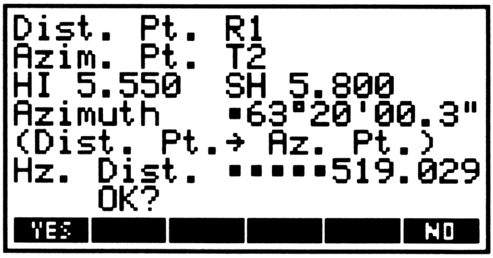
Press the ENTER key, then [END] to return to the **program main** menu.

Using the Short Side for the Azimuth Sight

Let's run through an example to illustrate how the routine reacts when it detects the problem mentioned at the beginning of this chapter. (Using the short side of the figure for the azimuth sight.)

Press [CALCS] and [2PT].

Figure 6.12



Notice that the **Dist. Pt.** field in Figure 6.12 now contains the resection point **R1**.

Whenever you do a resection the program assumes that you will be using the new point in one of the other routines so the resected point is put in the Dist. Pt./Setup @ field.

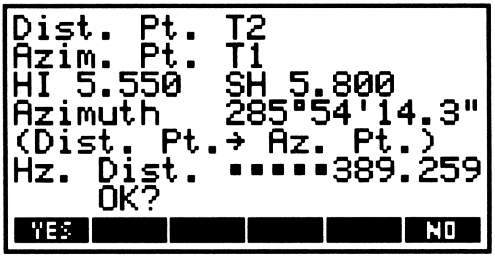
Remember that you should always use the longest side of the resection figure for the azimuth point to which you will zero the instrument. In this example we will break this rule. Press [NO].

Press [DIST] to enter **T2** for the distance point; press [AZIM] and enter **T1** for the azimuth point. Press [VIEW]. When your display matches Figure 6.13 press [YES].

Enter the following:

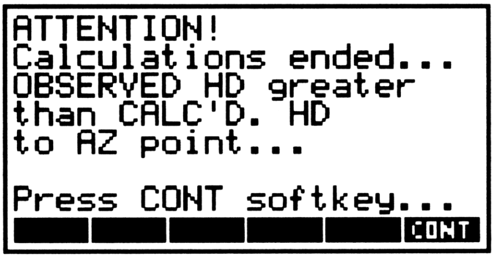
48.3431 for the horizontal angle. (As we are now using T1 for the azimuth point we enter the *interior* angle.)
268.5727 for the zenith angle.
519.177 for the slope distance.

Figure 6.13



The calculator beeps and the Figure 6.14 display appears.

Figure 6.14



The message in Figure 6.14 tells you that the routine discovered a problem with the distance point and azimuth point distances (which we expected) having used the shorter side of the resection figure for the azimuth point.

Note: If you *don't* complete a resection session, when you start a new routine, check the **HI** and **SH** fields as they may be negative.

Press [CONT] to return to the main menu. Press [QUIT] to leave the program environment.

Alignments

Data needed...

Current job file: JOB1

Control points: S1 (setup @) & B1 (backsight):
(see Menu Exploration & Initial Setup)

Changes...

• You now have the option of creating a vertical alignment for each horizontal alignment.
• Horizontal alignment creation has been streamlined.
• You can now change or create alignments from within the routine.
• You can now find the station and hinge point of any point.
• Stationing will be shown in either imperial or metric notation depending on the units chosen in configuration.

Configuration...

Start the program if necessary by entering **S.P**. At the **program main** menu, press [CONFI] then [▫DIST] to show HORIZ. Also make sure the units are FEET.

When your display matches Figure 7.1, press [↑] to get back to the **program main** menu.

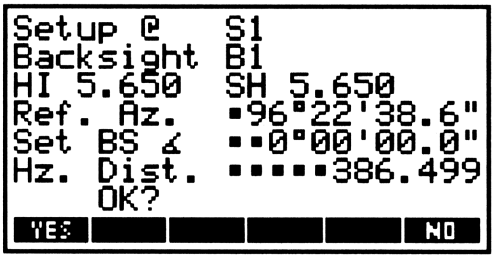
Figure 7.1

```
CONFIGURATION

Curv./Ref.▪▪▪▪▪▪▪▪▪▪▪NO
Units      ▪▪▪▪▪▪▪▪▪FEET
Distances ▪▪▪▪▪▪HORIZ.
Grid Fac.  ▪▪▪1.0000000
SOFTKEY to change...
▫C+R ▫UNIT ▫DIST GRID      ↑
```

Press CALCS and ALIGN. Make any changes necessary so that your display matches Figure 7.2.

Press YES when you are ready.

Figure 7.2



Why Use Alignments?

The alignment routine simplifies the staking of projects that can be defined in terms of any logical combination of tangents, circular curves and spiral curves.

You enter the station, hinge point and elevation (or, if you are carrying a vertical alignment, the percent crossfall), and the routine takes care of the rest. You can use either the traditional *direct* layout method or the *indirect* trial and error method.

The Alignment routine can improve your productivity on any project. You no longer have to pre-calculate individual point coordinates. Simply create the alignment and let the routine do the layout calculations for any station at any hinge point.

Layouts are done remotely so you can locate control points well away from the construction area. (If you prefer you can set up directly on the alignment.)

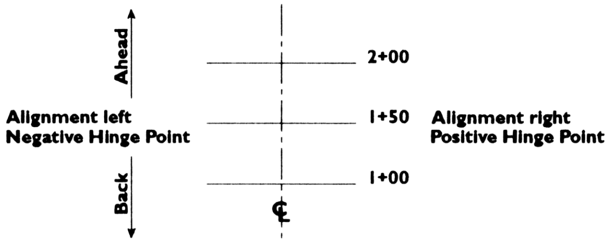
Note: If you have upgraded notice that alignment creation has been streamlined. Data is now entered as partial segments rather than as single elements as in version 1.0.

Alignment Terminology

The routine uses the standard highway definition of the right side of an alignment being to the right of an observer looking along the alignment in the direction of increasing stationing (chainage).

In the trial and error stakeout method the following terms are used.

Figure 7.3 (NTS)



Referring to Figure 7.3:

• **Ahead** and **back** are used to tell the rodman to move toward a **greater** or **lesser** station respectively.

• Offsets from the centerline are referred to as **hinge points**. A hinge point to the **right** of centerline is **positive**; a hinge point to the **left** of centerline is **negative**.

• Right and left are used to tell the rodman to move to **alignment** right or left, not necessarily just to the right or left of centerline.

Note: Avoid using a station that equals one of the coordinates. For example, if a northing is 3500 don't use 3500 for the station. The program may generate an error.

Horizontal Alignment Segments

Tangents, circular curves and spiral curves are the three segment types used to create alignments.

• A **tangent** segment is the smallest possible stand-alone alignment. (Two points: **P.O.T. P.O.T.** [P.O.T.= point on tangent].)
• A **circular curve** segment makes a slightly larger stand-alone alignment. (Three points: **BC R_PT EC** [R_PT = radius point].)

Note: Delta can't be greater than or equal to 180°! If it is SURVcalc will beep and display a message. See Appendix B, Alignment Design Tips. (See this Appendix for information on tangents between circular curves also.)

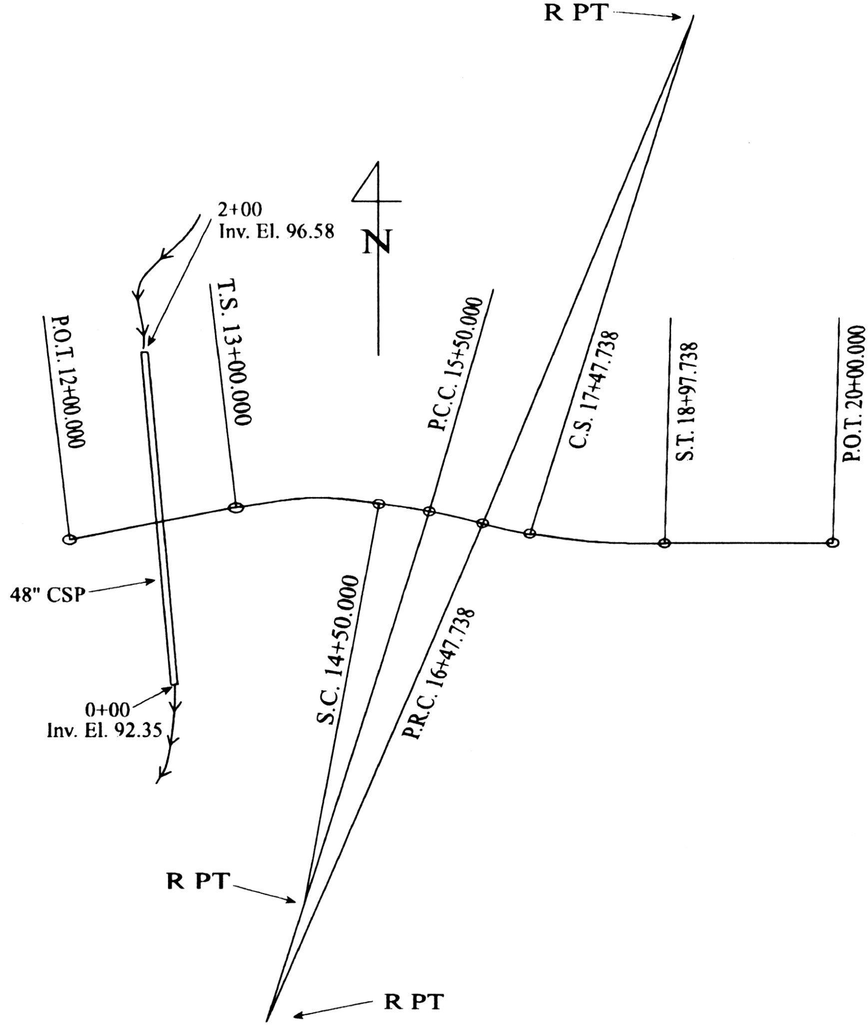
• A **spiral curve** segment (**TS SC** or **CS ST**) must have a P.O.T., radius point, and SC or CS attached. It is the largest **combined** segment. (5 points: P.O.T. **TS SC** R_PT CS for an *entry* spiral or SC R_PT **CS ST** P.O.T. for an *exit* spiral)

Note: If a drawing does not show radius points you can use the SURVcalc Radius Point routine to calculate them.

Horizontal Alignment Creation

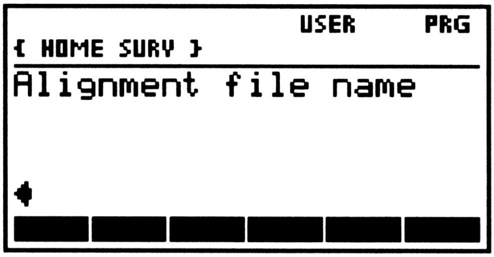
Note: The Figure 7.4 example alignment does not have much connection to the real world. It is designed to demonstrate how flexible SURVcalc is in alignment creation and to show at least one example of all the segment types and variations, including *compound/reverse* curves and *entry/exit* spirals.

Figure 7.4 (NTS)



At the **Alignment file name** prompt enter **NEWROAD**.

Figure 7.5



Note: SURVcalc file names have to meet the HP variable naming convention. For instance, the first character *can't* be a number. (See the HP 48 manual for more information.)

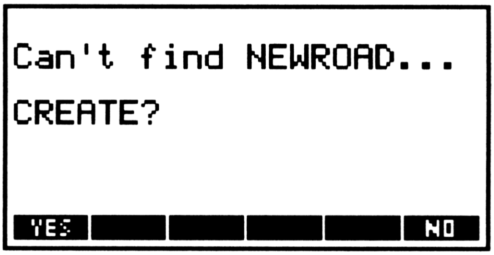
Also, remember that only the file *name* is entered. The routine will add a **.ALN** extension for horizontal alignments: vertical alignments have a **.ALG** extension added.

As file **NEWROAD** does not exist the calculator beeps and a **CREATE?** prompt appears.

If you have entered the wrong name you can press NO to re-enter it.

Press YES to create the file when the name is correct.

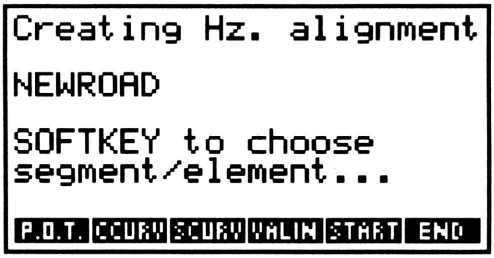
Figure 7.6



The display in Figure 7.7 shows that you are creating alignment **NEWROAD** from the **alignment main** menu.

To enter an element or to change segments you press the appropriate softkey.

Figure 7.7



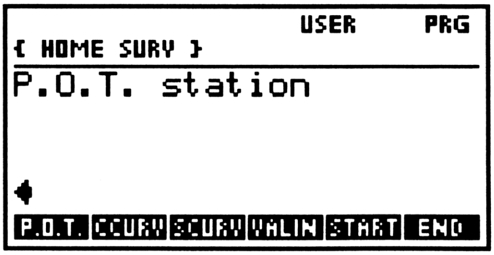
- [P.O.T.] allows you to enter that **element.**
- [CCURV] takes you to the **circular curve** menu.
- [SCURV] takes you to the **spiral curve** menu.
- [VALIN] takes you to the **vertical alignment creation** routine.
- [START] will begin the alignment layout.
- [END] takes you back to the SURVcalc **main** menu.

Press [P.O.T.] now.

At the **P.O.T. station** prompt in Figure 7.8 enter:

1200 for the station.
18300.000 for the northing.
26450.000 for the easting.

Figure 7.8



After the data for each element/segment is entered the Figure 7.7 display re-appears.

The next element in the **NEWROAD** alignment is the **TS** (tangent to spiral) found on the **spiral curve** menu. Press SCURV.

The display in Figure 7.9 is the same as the one in Figure 7.8 but now we see the **spiral curve** menu.

Figure 7.9

```
Creating Hz. alignment
NEWROAD
SOFTKEY to choose
segment/element...
 TS | CCURV | CS |  |  | RTN
```

Press TS now and enter:

1300 for the station.
18308.0552 for the northing.
26549.6750 for the easting.

After entering the **TS** easting you will be prompted for the **SC** (spiral to curve) station. Enter:

1450 for the station.
18314.9099 for the northing.
26699.4451 for the easting.

After entering the **SC** easting you will be prompted for the **R PT** (radius point) northing. Enter:

17598.9203 for the northing.
26682.2006 for the easting.
(Notice that a **Station** prompt does not appear for a radius point.)

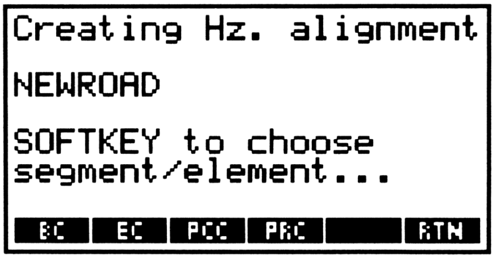
After entering the R PT easting the Figure 7.9 display and **spiral curve** menu re-appear. Data entry stops after the radius point to allow the option of entering one of the compound elements (PCC, PRC) as we are about to do or an EC.

Normally, after entering an entry spiral segment, you would enter the exit spiral elements (**CS**, **ST**, **P.O.T.**). This time press [CCURV] to get to the **circular curve** menu in Figure 7.10.

Press [PCC] (point of compound curvature) and enter:

1550 for the station.
18305.5419 for the northing.
26798.9238 for the easting.

Figure 7.10



[PCC] can be used repeatedly so you can even run a continuous compound circular curve system back-to-back. See Appendix B for an underground spiral ramp example.

Once again you will be prompted for the **R PT** northing. Enter:

17516.2379 for the northing.
26668.5428 for the easting.

Now, as we have a reverse curve coming up, press [PRC] (point of reverse curvature) and enter:

1647.738 for the station.
18283.7691 for the northing.
26894.1439 for the easting.

For the next **R PT** enter:

18894.5510 for the northing.
27073.6716 for the easting.

Now for the exit spiral, press RTN to get back to the **spiral curve** menu, then press CS and enter:

1747.738 for the station.
18263.2045 for the northing.
26991.9016 for the easting.

You will then be prompted for the **ST** data. Enter:

1897.738 for the station.
18255.6741 for the northing.
27141.6193 for the easting.

The last prompt is for the **P.O.T.**. Enter:

2000.000 for the station.
18254.5502 for the northing.
27243.8751 for the easting.

Note: If you choose the wrong *segment* softkey (you press CCURV instead of SCURV for example) just press RTN to get back to the origin menu to select the correct segment.

If you choose the wrong *element* softkey (you press PCC instead of PRC for example) as long as the easting has not been entered, press the ON key, clear the stack, then just press the correct softkey to resume.

Press RTN to get back to the Figure 7.7 **main horizontal alignment creation** menu. If you did not want to create a vertical alignment you could now press START to begin the stakeout or END to go to the **program main** menu.

We *do* want to create a vertical alignment but first let's look at the rules.

Vertical Alignment Segments

The elements used to create vertical alignments are:

• **P.O.G.** (point on grade) used in straight grade segments.
• **BVC** (begin vertical curve)
• **PVI** (point of vertical intersection)
• **PRVC** (point of reverse vertical curve): replaces EVC when joining crest and sag vertical curve segments.
• **EVC** (end vertical curve)

The *first* element of a vertical alignment can be a P.O.G., BVC, PRVC, or even an EVC.

A vertical alignment *must end* with either a P.O.G. or an EVC depending on whether the last segment is a straight grade or vertical curve respectively.

As in a horizontal alignment, the simplest vertical alignment is composed of two elements, **P.O.G. P.O.G.**, which would form a straight grade.

Vertical curve segments can be *symmetric* or *asymmetric*. As mentioned above a **PRVC** is used to join crest and sag vertical curve segments. You can use **PRVC** to string together as many vertical curve segments as you want.

You can also put a straight grade segment or segments **between** vertical curve segments. The last element of the vertical curve meeting the intervening straight grade must be an **EVC**. The next element (for a *single* straight grade segment) would then be a **BVC**. (A **P.O.G.** element isn't needed as the routine knows that a straight grade can begin with an **EVC**.)

The last element of the last vertical curve segment *must be* an **EVC**.

Vertical Alignment Creation

Press [VALIN] to view the Figure 7.11 display and **vertical alignment** menu.

Notice that the vertical alignment is given the same name as the horizontal alignment. The only difference is the invisible extension.

Figure 7.11

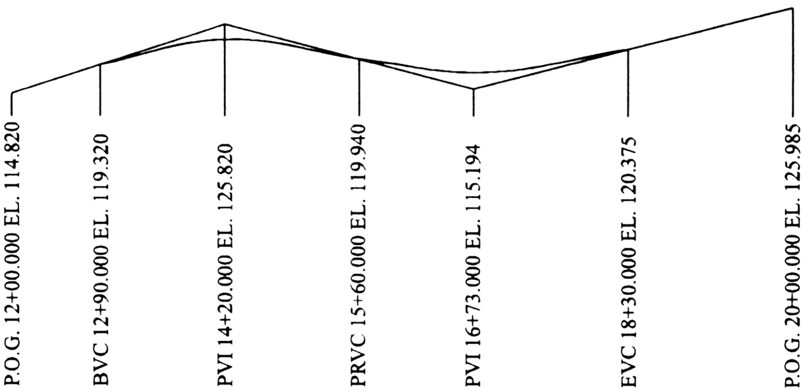
```
Enter all grade change
stations & elevations
for Vert. alignment

NEWROAD

Press RTN when done
P.O.G. | BVC | PRVC | EVC |      | RTN
```

Notice also that the menu contains all the elements except **PVI**. PVI prompts will appear when either [BVC] or [PRVC] is pressed.

Note: Each vertical alignment station does not have to have (and usually won't have) a corresponding horizontal alignment station. But it is important that the vertical alignment *start* and *end* with the same stationing as the horizontal alignment. The routine will generate an error otherwise.

The NEWROAD vertical alignment is shown in Figure 7.12 below.

Figure 7.12 (NTS)



The first segment in the NEWROAD vertical alignment is a straight grade so press [P.O.G.] and enter:

1200 for the station.
114.82 for the elevation.

The next segment is a vertical curve so press [BVC] and enter:

1290 for the station.
119.32 for the elevation.

Having pressed [BVC] a **PVI station** prompt appears. Enter:

1420 for the station.
125.82 for the elevation.

After the PVI data is entered the routine returns to the title display. If you were in the last vertical curve segment, you would enter the EVC data.

In this alignment the next segment is a *reverse* vertical curve so press [PRVC] and enter:

1560 for the station.
119.94 for the elevation.

Once again you are prompted for the PVI data. Enter:

1673 for the station.
115.194 for the elevation.

As we are in the last vertical curve we have to end it with an EVC. Press [EVC] and enter:

1830 for the station.
120.375 for the elevation.

For the last element press [P.O.G.] and enter:

2000 for the station.
125.985 for the elevation.

To get to the **main horizontal alignment creation** menu, press [RTN].

Note: The routine will not let you create a vertical alignment if an existing file with that name is found.

To illustrate press [VALIN] now.

The calculator will beep and you will see the Figure 7.13 display.

Press the ENTER key to get back to the **main horizontal alignment creation** menu.

Figure 7.13

```
File
NEWROAD
 exists!
 ENTER to continue...
```

In a situation like this, if you were *sure* that the NEWROAD vertical alignment was created for this horizontal alignment, you could now press START to begin the stakeout.

This time press END, then press QUIT and take a break if you like.

Alignment Checks

After creating a new alignment and before any stakeout is done, all the elements should be checked. Other than a maximum/minimum station check the routine *does not do* any internal checks.

Enter **S.P** to start the program then press CALCS and ALIGN. Make sure your setup display matches Figure 7.2.; press YES when it does.

Enter **NEWROAD** at the **Alignment file name** prompt. As **NEWROAD** exists you will see a **Please wait...** message while the routine loads *both* the horizontal and vertical alignments.

The following **alignment start** display and main menu will appear.

You could now press:

• COORD to calculate the coordinates of a station/hinge point.

• L/O to use the *direct* layout method.

Figure 7.14

• NEW to use the *indirect* layout method. Press NEW this time.

When the routine starts it gets the lowest station from the current alignment for the default. Press the ENTER key to use **1200**. Then enter:

0 for the hinge point. (Notice that a hinge point to alignment left should be negative.)

As a vertical alignment is being carried, the next prompt is for the **% Xfall** (crossfall): if you were not carrying a vertical alignment you would be prompted for an elevation instead. Notice that when the hinge point elevation is lower than centerline, the crossfall should be negative. Press the ENTER key to accept the 0.000 default.

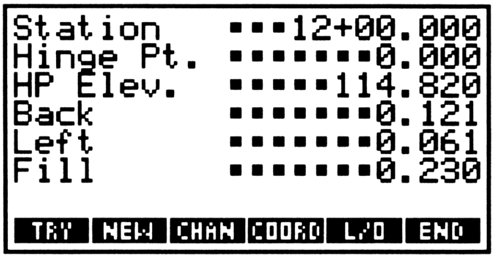
Then enter:

189.3740 for the horizontal angle.
-10.8 for the Δ elevation.
416 for the horizontal distance.

• The first line in Figure 7.15 below shows the station using imperial highway notation. (When you configure for METERS the station will appear in terms of kilometers: e.g. 1200 will appear as 1+200.000)

• The second line shows that we are staking centerline. (Hinge Pt. = **0**.)

Figure 7.15



• The third line shows the *calculated* HP (hinge point) elevation. In this case the elevation should be what we used to create this vertical alignment. (When a vertical alignment is *not* being carried, this line will contain the elevation that you enter.)

• The fourth line tells us that to get to station 12+00 we have to move **Back** 0.121. Being in a tangent segment we know that the shot was taken at 1200 + 0.121 = 12+00.121.

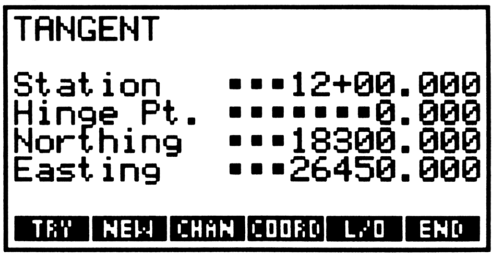
• The fifth line tells us that to get to centerline we have to move 0.061 to alignment **Left**.

• The last line tells us that the shot was 0.23 **below** grade.

Now, to start the element checks, press COORD (coordinate calculation) then press the **ENTER** key twice to accept the defaults.

Notice that the first line in the coordinate calculation display in Figure 7.16 shows the segment (tangent in this case) type.

Figure 7.16



Compare the calculated coordinates for 12+00 to the coordinates used in the alignment creation. You should see an exact match although now and then you may get a 0.001 difference.

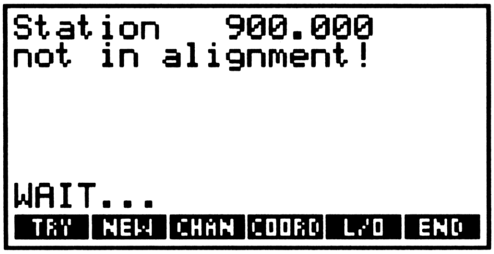
If you notice differences when checking, you can edit **most** of the elements in the alignment file from **within** the routine as long as the softkey menu in Figure 7.16 is visible. Make sure to calculate a station in *another* segment after editing, then re-calculate the problem station.

Note: If you find and edit errors in the stations of *either* the first *or* last alignment elements, you **must re-load** the file before the changes will take effect. (The file can be re-loaded by using the Alignment Change Routine. It is described in the Alignment Routine Key Assignments section.)

You have to re-load the file after changing the first or last stations because at routine start-up, these stations are saved in variables. They are used by the routine as a maximum/ minimum station check.

To illustrate this feature, press COORD and enter **900** for the station. The calculator beeps and the display in Figure 7.17 will appear for a few seconds.

Figure 7.17



You will see the Figure 7.17 display when the station that you enter is **less than** the first station or **greater than** the last station.

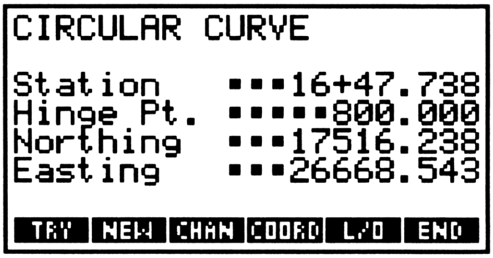
You should always check **all** the elements in a new alignment, but in this example we will do just two more checks. (You should run through all the elements on your own to make sure your results match the manual and for keyboard practice.)

Clear the command line, then enter **1647.738** for the PRC station. Enter **800** (the radius) for the hinge point.

At the PRC we can check the radius point on both sides.

Press COORD and this time press the ENTER key to accept the default station.

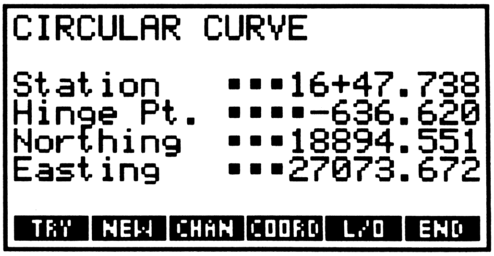
Figure 7.18



Clear the default hinge point, type **636.62** and press the **+/-** key to change the hinge point sign before entering it.

The displays in Figures 7.18 and 7.19 should show good correlations between the calculated coordinates and the coordinates used to create the alignment.

Figure 7.19



Make sure all the elements in your alignment are OK then take a break if you like. When you are ready we can have a look at the *indirect* layout method.

Indirect Alignment Layout

The *indirect* layout method was designed primarily for slope staking as you can stake any station without having to set reference stakes. But if the rodman is a good pacer it also works well for setting regular grade stakes. Its advantage lies in the fact that you don't have to *set* the horizontal angle.

The rodman just paces off the required stationing and you take the shot. The routine shows how far the rodman has to move Ahead/Back and Right/Left from the shot to get to the desired station and hinge point.

Note: The *move* values shown will only be exact in a *tangent* segment.

Let's try staking station **1400** in the entry spiral with a hinge point of **-26** using the trial and error method. Press [NEW] and enter:

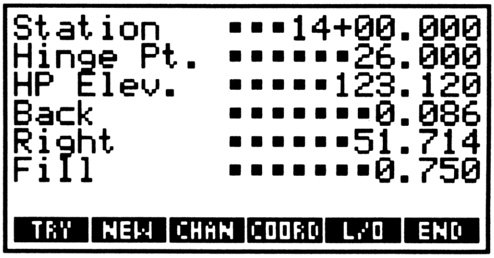
1400 for the station.
(We want a **-26** hinge point but let's make a rare mistake and use a positive this time.)
26 for the hinge point.
2 for the Xfall. (Crossfall)

211.13 for the horizontal angle.
-3.02 for the Δ elevation.
254.1 for the horizontal distance.

We entered a positive hinge point to reinforce the idea that hinge point movement is shown as *to* the right or *to* the left regardless of which side of centerline the shot is taken on.

The shot displayed in Figure 7.20 was taken to the left of centerline but as we used a positive hinge point the routine is correct in telling us that we have to move about **51.7** *to* the **Right**.

Figure 7.20

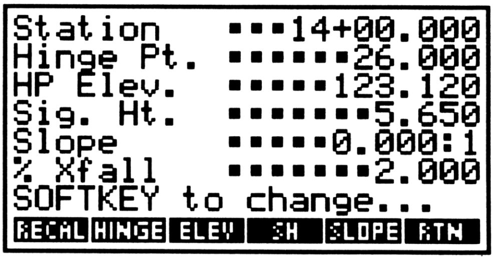


Stationing is very good. The rodman has to move **Back** (to a lesser chainage) only **0.086**.

In a situation where you enter the data for a shot and forget to change one of the variables, you don't have to re-enter the data. As an example, press CHAN (change).

Notice that the display in Figure 7.21 changes to show the **Sig. Ht.**, **Slope** and because we are carrying a vertical alignment the **% Xfall** also. You can change all of the items shown (except the station) by pressing the appropriate softkey.

Figure 7.21



We want to change the hinge point so press HINGE. Press the +/- key to change the sign and enter it.

When HINGE is pressed while carrying a vertical alignment, you will also be prompted for the Xfall. (You have to press HINGE to change the crossfall.) Press the ENTER key to accept the default Xfall.

Press RECAL (re-calculate).

RECAL can be pressed as often as you like but it is fastest to make all changes before pressing it.

Figure 7.22

```
Station     ■■■14+00.000
Hinge Pt.   ■■■■■-26.000
HP Elev.    ■■■■■123.120
Back        ■■■■■■■■0.086
Left        ■■■■■■■■0.286
Fill        ■■■■■■■■0.750

RECAL HINGE ELEV  %H  %SLOPE RTN
```

Vertical Alignment Elevations

It is important to understand that when you are carrying a vertical alignment (as we are now) the **HP Elev.** shown is the *calculated* centerline elevation at the current station, plus or minus the current hinge point multiplied by the current crossfall.

If either the hinge point or the Xfall is zero, then the **HP Elev.** is equal to the *calculated centerline* elevation.

To see the calculated centerline elevation press ELEV now.
You should see **122.600** in the display. (The HP Elev. in Figure 7.22 is 123.12 which is: 122.6 + (26[HP] x 0.02[%Xfall]). You could now enter a new elevation if you wanted to override the calculated elevation.

Press the ENTER key to accept the default elevation. Press RECAL to get back to the Figure 7.22 display.

Figure 7.22 shows that the location is very close when the correct hinge point is used. Notice that you still have to move **Back** 0.086, but now to get to the required hinge point, you have to move to alignment **Left** only 0.286.

The rodman measures **back** about .1 and **left** about .3.

To take another shot press [RTN] (return) to get back to the **alignment main** menu. (Only the station, hinge point and elevation are shown when you return from a change session.) Press [TRY] and enter:

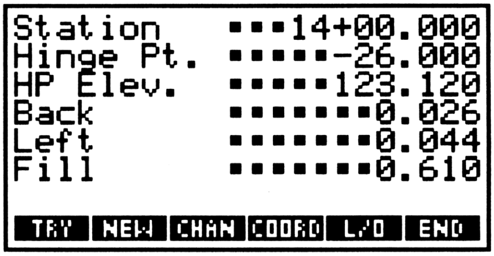
211.15 for the horizontal angle.
-2.88 for the Δ elevation.
254.3 for the horizontal distance.

The display in Figure 7.23 shows that the location is now close enough that the rodman could move the stake **back** and to alignment **left** a bit and bang it in. You could then shoot the top of the stake to mark grade.

Speaking of grades, note that the Cut/Fill shown is the grade at the hinge point.

To clarify press [CHAN] then [HINGE].

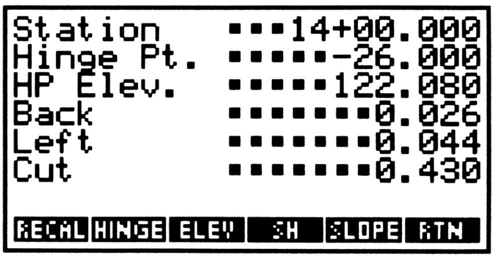
Figure 7.23



Press the **ENTER** key to accept the default hinge point, press **+/-** to change the Xfall sign and press the **ENTER** key again. Then press [RECAL].

You can see in Figure 7.24 that as the Xfall is now -2.0 % the grade at the -26' hinge point has changed from a **Fill** 0.61 to a **Cut** of 0.43.

Figure 7.24



Changing Segments

Generally you will move from one segment to a *bordering* segment during stakeout. This is the quickest and most logical way to move.

Search time increases proportionally to the number of segments moved and to the type of segment moved to. Spiral segments require the longest preparation time; tangents the least.

Carrying a vertical alignment will also slow down calculation time as the routine needs to locate, and prepare the data registers for, the vertical segment also.

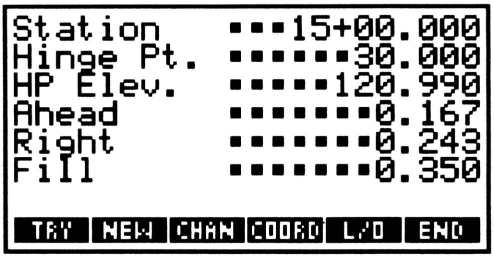
Press [RTN] then [NEW] to try *indirect* staking in the next circular curve segment. Enter:

1500 for the station.
30 for the hinge point.
-3 for the Xfall.

216.46 for the horizontal angle.
-4.75 for the Δ elevation.
142 for the horizontal distance.

The rodman has paced well again. This time he measures about .17 in the direction of increasing chainage and about .24 to alignment **Right**.

Figure 7.25



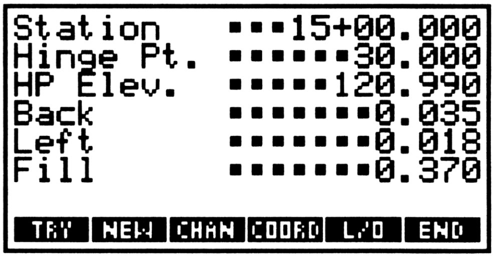
Press TRY to take another shot and enter:

216.44 for the horizontal angle.
-4.77 for the Δ elevation.
141.68 for the horizontal distance.

Figure 7.26 shows that once again the location is very good so the stake can be pounded in.

Take a break if you like and we will look at slope staking when you come back.

Figure 7.26



Slope Staking

Slope staking in SURVcalc is as easy as entering a non-zero slope in the *indirect* stakeout method. You switch back to regular grade staking by making the slope zero.

Let's slope stake station 16+20 illustrated in the cross section in Figure 7.27.

Figure 7.27 (NTS)

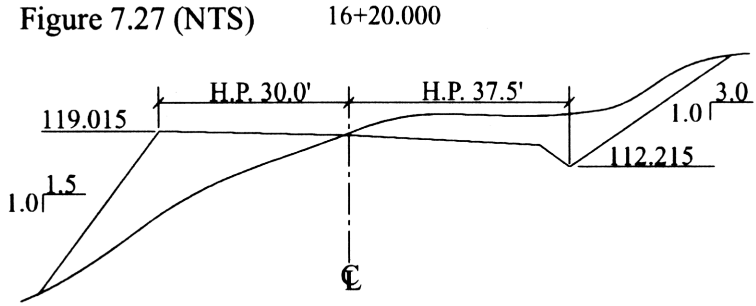
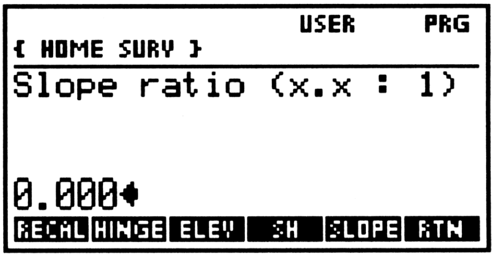


Figure 7.28



Press [CHAN] then press [SLOPE]. As the first line in the display in Figure 7.28 shows, you enter the slope as a ratio.

Enter **1.5** for a slope ratio of 1.5 : 1. Press [RTN] when you are ready.

Slope Staking in Fill

Press [NEW] and enter:

1620 for the station.
-30 for the hinge point.
3 for the Xfall. (In a superelevated segment.)

274.10 for the horizontal angle.
-15.74 for the Δ elevation.
153 for the horizontal distance.

Before we examine the last two lines in Figure 7.29, notice that to get on stationing the rodman has to move **Ahead** about 0.80', and to catch the slope he would have to move about 1.7' to alignment **Right** *at the shot* elevation.

Figure 7.29

```
Station    ▪▪▪16+20.000
Hinge Pt.  ▪▪▪▪▪-30.000
HP Elev.   ▪▪▪▪▪119.015
Ahead      ▪▪▪▪▪▪▪▪0.807
Right      ▪▪▪▪▪▪▪▪1.725
Fill 9.365 @ 44.048
Slope      ▪▪▪▪▪1.500:1
 TRY  NEW  CHAN COORD L/O  END
```

The last two display lines in Figure 7.29 appear whenever the slope ratio is not zero. The second last line contains the standard slope stake notation for the cut/fill at the calculated distance from centerline. The last line reminds you of the slope you are using.

The rodman moves ahead and to the right for the second shot. Press [TRY] and enter:

274.30 for the horizontal angle.
-15.5 for the Δ elevation.
150.6 for the horizontal distance.

Figure 7.30 shows that the rodman now has to move **Back** about .23', and to alignment **Left** about 0.25' at the shot elevation.

As a check before setting the stake you take another shot.

Figure 7.30

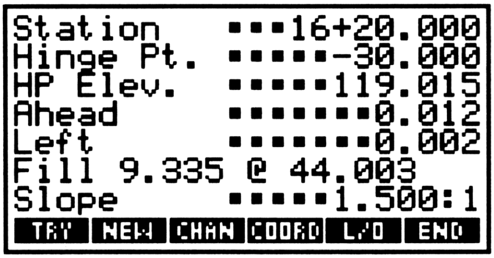
```
Station    ▪▪▪16+20.000
Hinge Pt.  ▪▪▪▪▪-30.000
HP Elev.   ▪▪▪▪▪119.015
Back       ▪▪▪▪▪▪▪▪0.229
Left       ▪▪▪▪▪▪▪▪0.254
Fill 9.125 @ 43.688
Slope      ▪▪▪▪▪1.500:1
 TRY  NEW  CHAN COORD L/O  END
```

Press $\boxed{\text{TRY}}$ and enter:

274.2520 for the horizontal angle.
-15.71 for the Δ elevation.
151.18 for the horizontal distance.

The last shot in Figure 7.31 is excellent so the rodman marks up and drives in the slope stake.

Figure 7.31



Overriding the Vertical Alignment Elevation

When carrying a vertical alignment you can override the *calculated centerline* elevation by simply pressing $\boxed{\text{ELEV}}$ from the change menu and entering the elevation that you want to use. You will have to do this when slope staking in cut as will be illustrated in the following example.

Two important points to keep in mind when you do this are:

1) The change stays in effect until you press $\boxed{\text{NEW}}$ or $\boxed{\text{L/O}}$. If you are working on a section similar to our example, always slope stake the **Fill** side first. If ever in doubt about the design centerline elevation it pays to press $\boxed{\text{NEW}}$ and recalculate the current station.

2) Make sure to change the Xfall to zero.

Slope Staking in Cut

Before starting the right side slope stake in cut, press [CHAN] and make the following changes:

37.5 for the hinge point. (Bottom of ditch.)
0 for the Xfall. (As mentioned it is important to make the Xfall zero.)
112.215 for the elevation. (Override the design centerline elevation.)
3 for the slope ratio.

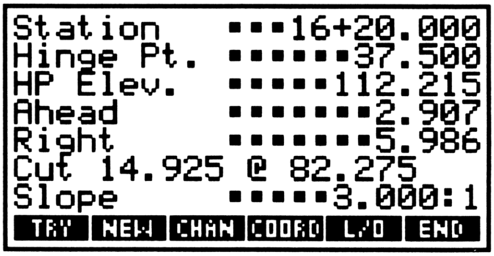
Note: In transition areas, when going from cut to fill or fill to cut, the routine will change the **Fill/Cut** part of the message in the second last line of the display; keep an eye on this line so you can enter the correct slope ratio.

Press [RTN] then [TRY] and enter:

256.00 for the horizontal angle.
1.75 for the Δ elevation.
33 for the horizontal distance.

Figure 7.32 tells us that the rodman has to move about 2.9' toward a greater station and about 6' to alignment **Right** at the shot elevation. As the ground rises to the right the rodman compensates by moving a little more than 6' right.

Figure 7.32

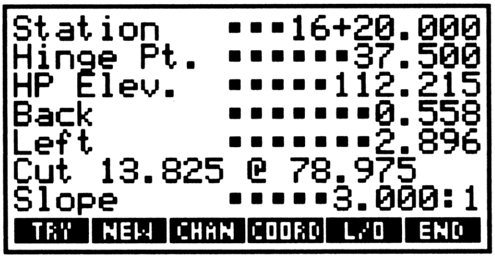


Press [TRY] and enter:

258.25 for the horizontal angle.
.65 for the Δ elevation.
26.55 for the horizontal distance.

The shot in Figure 7.33 is close for stationing but now the rodman has to move just under 3' to alignment **Left** at the shot elevation.

Figure 7.33

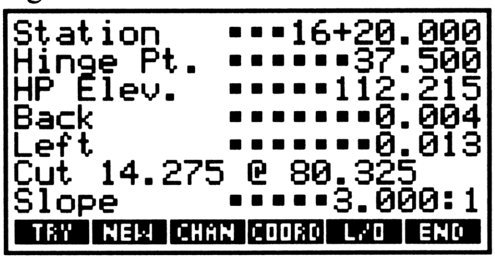


Press [TRY] and enter:

258.24 for the horizontal angle.
1.1 for the Δ elevation.
28.18 for the horizontal distance.

The shot in Figure 7.34 is very good so the stake can be marked up and driven in.

Figure 7.34



Note: In a situation where you want to slope stake directly to the alignment (zero hinge point) you have to cheat a little.

Instead of zero enter a very small hinge point, say -.001(left) or .001(right), so the routine will know to which side of the alignment you want to stake.

Take a break now if you like. Let the calculator turn itself off; when you turn the calculator on you will see the Figure 7.34 display.

Direct Alignment Layout

For most non-slope stake work you will probably want to use the *direct* layout method. The routine is accessed by pressing [L/O] from the **alignment main** menu; you can switch back and forth whenever you want.

Before running through the examples, press [CHAN] then [SLOPE] from the **change** menu to enter **zero** for the slope ratio. (You *can't* do slope staking in *direct* layout mode.)

We will look at staking subgrade shoulder at 18+00 in the exit spiral. Press [RTN] then press [L/O] and enter:

1800 for the station.
30 for the hinge point.
2 for the Xfall.

In Figure 7.35 we see the *direct* layout display.

• The third and fourth lines contain the data to layout the displayed station and hinge point.

Figure 7.35

• The fifth line appears only when a vertical alignment is being carried. (Notice that the softkey menu does not change.)

To begin the layout you turn the indicated horizontal angle and tell the rodman the approximate distance that you need. After putting the rodman on line at the paced distance, press [TRY] and enter:

-5.955 for the Δ elevation.
195.43 for the horizontal distance.

The last two lines in Figure 7.36, tell you that the rodman has to move **Away** from the instrument 1.465' and that the shot is 0.64' below subgrade shoulder.

Figure 7.36

Station	▪▪▪18+00.000
Hinge Pt.	▪▪▪▪▪▪30.000
Turn Hz.∡	▪▪340°57'10"
Hz. Dist.	▪▪▪▪▪196.895
% Xfall	▪▪▪▪▪▪▪▪2.000
Away	▪▪▪▪▪▪▪▪1.465
Fill	▪▪▪▪▪▪▪▪0.640

TRY | NEW | CHAN | COORD | L/O | END

The rodman measures about 1.47' farther from the instrument. For the check shot press [TRY] and enter:

-5.655 for the Δ elevation.
196.91 for the horizontal distance.

The display in Figure 7.37 shows you that the shot is very close for location; the rodman would only have to move **To**ward the instrument about 0.02.

Figure 7.37

Station	▪▪▪18+00.000
Hinge Pt.	▪▪▪▪▪▪30.000
Turn Hz.∡	▪▪340°57'10"
Hz. Dist.	▪▪▪▪▪196.895
% Xfall	▪▪▪▪▪▪▪▪2.000
To	▪▪▪▪▪▪▪▪0.015
Fill	▪▪▪▪▪▪▪▪0.340

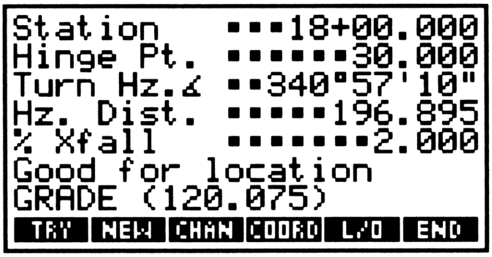
TRY | NEW | CHAN | COORD | L/O | END

Next, to see how the routine reacts, let's enter the exact layout values. Press [TRY] and enter:

-5.315 for the Δ elevation.
196.895 for the horizontal distance.

For practice and to see how the **change** menu works in *direct* mode, let's stake subgrade shoulder at 18+00 left.

Figure 7.38



Press [L/O], then press the **ENTER** key to accept the default station. Change the hinge point sign to **-30** for the left shoulder and press the **ENTER** key again to accept the +2% default Xfall. (We need a -2% Xfall here but we will enter a + to show how the change works.)

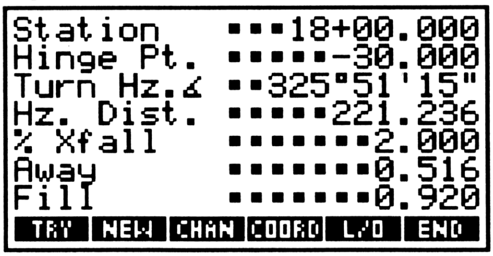
Your display should match Figure 7.39. Press [TRY] and enter:

-6.235 for the Δ elevation.
220.72 for the horizontal distance.

Figure 7.39

When the Figure 7.40 display appears, you notice that the Xfall is wrong. Press [CHAN].

Figure 7.40



The Figure 7.41 **layout change** display is the same as the *indirect* display.

To change the Xfall you have to press [HINGE]. Press it now, accept the default -30 hinge point and press the +/- key to make the the Xfall negative.

Then press [RECAL]. Figure 7.42 now shows a cut of 0.28.

Figure 7.41

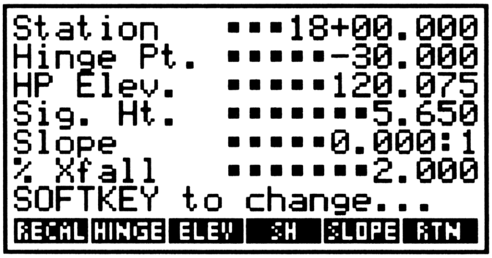
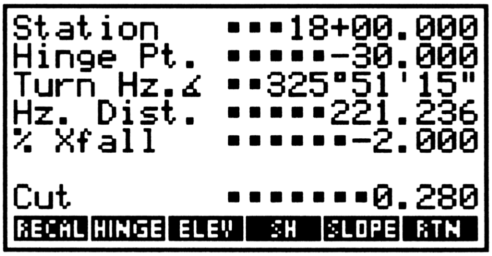


Figure 7.42



Overriding Vertical Alignment Elevations

As in the *indirect* layout method you can override the *calculated* centerline elevation. (Simply press [ELEV] from the change menu and enter the new elevation.)

Again, as in the *indirect* method, the override elevation stays in effect until you press [L/O] or [NEW]. You can press [TRY] as often as you want using the *override* elevation.

Take a break. When you get back we will look at the Alignment routine key assignments.

The Alignment Routine Key Assignments

This version of SURVcalc has two key assignments accessed from the **alignment main** menu. As a memory aid think of the softkey row split between the C and D keys with keys A-C on the *left* side of the keyboard and D-F on the *right* side of the keyboard.

• The Alignment Change routine has been assigned to the **left-shifted** 'C' (CHAN) softkey. You access this routine by first pressing the **left** shift (↰) key then the CHAN softkey. (The **left** shift key is used because the 'C' key is on the left side of the softkey row.)

• The Station & Hinge Point Find routine has been assigned to the **right-shifted** 'D' (COORD) softkey. You access this routine by first pressing the **right** (↱) shift key then the COORD softkey. (This time the **right** shift key is used because the 'D' key is on the right side of the softkey row.)

Note: If you press the wrong combination of keys or if you press an unassigned key the calculator will beep. Just press the correct combination to continue.

The Alignment Change Routine

You can easily change or create alignments from within the routine. The change/creation can be done while using the **indirect** or **direct** method.

You can access the subroutine from the **main** or the **change** menu. To make sure there is no confusion for the example, make sure you are at the **alignment main** menu. (Press RTN if you are at the **change** menu.)

Press the **left** (↰) shift key (the stack will be visible) then [CHAN]. You will see the **Alignment file name** prompt. In this case we will be creating a new file.

Enter **CULVERT**. The calculator will beep and you will see the **CREATE?** prompt. Press [YES]. We will create an alignment for the culvert (48" CSP) shown in Figure 7.4.

Press [P.O.T.] and enter:

0 for the station.
18254.007 for the northing.
26535.124 for the easting.

Press [P.O.T.] again and enter:

200 for the station.
18447.192 for the northing.
26483.360 for the easting.

This time we *won't* create a vertical alignment so we can go through an example of entering an elevation.

Press [START]. When the **READY** display appears press [L/O].

Press the ENTER key to accept the default zero station, then enter:

0.0 for the hinge point.
(Notice that as we aren't carrying a vertical alignment you are now prompted for the elevation.)
92.35 for the invert elevation at 0+00.

Figure 7.43 shows the zero station layout data. (Notice that the **Xfall** field does not appear.)

As CULVERT is a new alignment all the elements should be checked.

Figure 7.43

On your own, press COORD and check stations **0** and **200** with a **0** hinge point.

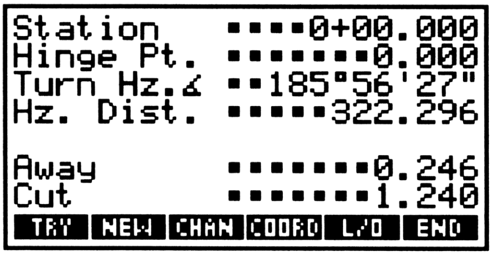
Let's try staking 0+00 with a hinge point of **0**. Press L/O and enter:

0 for the station.
Press the ENTER key twice to accept the **0** hinge point and the **92.35** elevation.

Your display should match Figure 7.43 above. Press TRY and enter:

-31.8 for the Δ elevation.
322.05 for the horizontal distance.

Figure 7.44



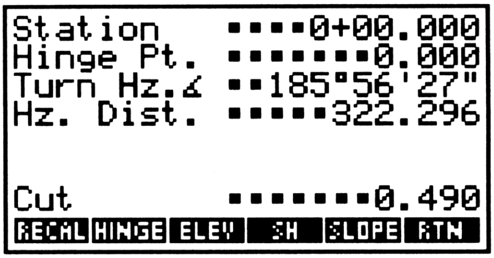
The shot in Figure 7.44 is very close for distance but the rodman radios you to let you know he had used a signal height of **6.4**.

Once again you don't have to re-enter the shot data. Just press CHAN then press SH and enter **6.4**. Press RECAL.

Figure 7.45 now shows a cut of only 0.49 when the correct signal height is used.

Press SH and re-enter **5.65**.

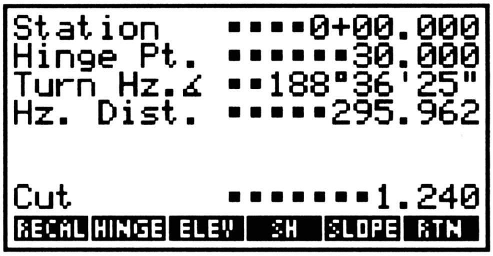
Figure 7.45



While we are at the **change** menu, let's try changing the hinge point. Press HINGE and enter 30. (Notice that as we are not carrying a vertical alignment, a **% Xfall** prompt does *not* appear.) Press RECAL.

Note: It's a good idea to make the crossfall zero when changing alignments. But, when there isn't a *vertical* alignment for the alignment that you change to, the HP Elev. *won't* be affected by a non-zero Xfall.

Figure 7.46



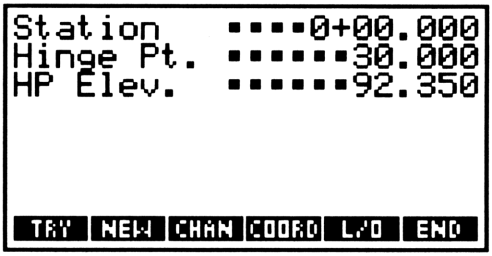
Notice in Figure 7.46 that the **Turn Hz. ∠** and **Hz. Dist.** fields have been updated to show the layout values for the new hinge point. The **Cut** field has also been updated as we changed back to a 5.65 signal height and the **To/Away** field does not appear after a recalculation.

For practice, let's change back to the **NEWROAD** alignment.

Press RTN.

As you see in Figure 7.47 only the station, hinge point and hinge point elevation are shown when you return from a change session.

Figure 7.47



Now press the **left** (↰) shift key then [CHAN]. At the **Alignment file name** prompt, enter **NEWROAD**.

At the **READY** display press [L/O].

Press the **ENTER** key three times to accept the default station, hinge point and Xfall. (Station 12+00 is loaded as the routine gets the lowest station from the new file as the default; in this case the routine also loads the **NEWROAD** vertical alignment so you will once again see the Xfall field.)

Figure 7.48

Press [END] to get back to the **program main** menu then [QUIT] to leave the program.

The change subroutine can be used as often as you wish and you don't have to return to the original alignment. For instance, after doing the culvert stakeout, we could have created another new alignment or changed to another existing alignment.

Take a break if you like. When you are ready we will look at the other Alignment routine key assignment.

The Station and Hinge Point Find Routine

With this routine you can find the station and hinge point of any point in the *current* segment. The station and hinge point found in a tangent *or* in a circular curve are exact; in spirals the *initial* station and hinge point are approximate.

You can enter the coordinates of the point or the angle/distance data. We will use both methods. Start the program by entering **S.P**. Then press CALCS and ALIGN. Make sure your display matches Figure 7.2. Press YES when it does.

Enter **NEWROAD** for the file name. At the **READY** display press NEW and enter:

1720 for the station.
0 for the hinge point.
0 for the Xfall.
317.58 for the horizontal angle.
-7.2 for the Δ elevation.
140.9 for the horizontal distance.
(The display for this calculation is not shown.)

We will be finding the station and hinge point of what in reality is station **18+00** at a **100'** hinge point in the exit spiral, but we calculated a point in the previous circular curve to stress that the find routine works on points in the *current* segment.

To access the routine first press the **right** (↱) shift key. (When you press either shift key the stack will appear.) Now press the 'D' (COORD) softkey.

The display in Figure 7.49 appears. Notice in the second line the reminder that the routine will find the station & hinge point in the *current* segment.

Figure 7.49

```
Find STATION & HP in
 current segment by
    COORDinates
        or
    CALCulation

SOFTKEY to continue...
COORD                 CALC
```

Finding by CALCulation

Press CALC. Enter:

1.4230 for the horizontal angle.
189.719 for the horizontal distance.

Although the display in Figure 7.50 tells us that the current segment is a circular curve, the *station* shown is actually in the exit spiral.

Figure 7.50

```
CIRCULAR CURVE
Northing   ■■■18158.563
Easting    ■■■27037.833
         at
Station    ■■■17+98.759
Hinge Pt.  ■■■■■100.240
 ENTER to continue...
```

Always check the station and the display title to make sure that the point found is in the *current* segment.

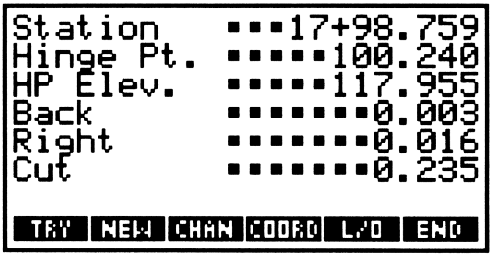
The coordinates shown are the true coordinates of the point so you can use this routine to do a sideshot even if you aren't interested in the station and hinge point.

The last line tells you to press the ENTER key to check. The station and hinge point should *always* be checked.

Press the **ENTER** key now.

You are returned to the *indirect* display in Figure 7.51. Be aware that the values in the last four lines (HP Elev. to Cut) are *not* valid for the *initial* station and hinge point. They are the values that were in the data registers when we entered the shot. (Your display may not match Figure 7.51.)

Figure 7.51



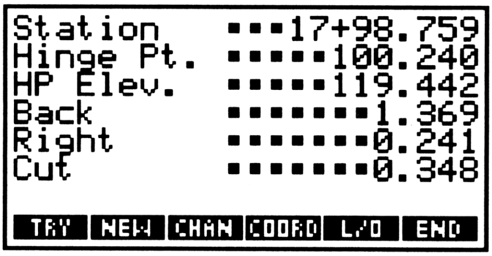
To check you have to press [NEW] when using the *calculation* method.

Press [NEW]. Press the **ENTER** key three times to accept the initial approximate station, hinge point and Xfall values, then enter:

1.4230 for the horizontal angle.
-5.6 for the Δ elevation. (We aren't really concerned with the elevation difference so we will just enter a consistent value.)
189.719 for the horizontal distance.

Notice that the last four lines in Figure 7.52 have been updated. The critical dimension is the stationing.

Figure 7.52



The display tells us that to get to station 1798.759 we have to move **Back** about 1.37. In other words, the shot location is close to 1798.76 + 1.37 = 1800.13.

The hinge point movement is shown as **Right** about 0.24 so the initial hinge point is close to 100.24 - 0.241 = 99.999 or 100.

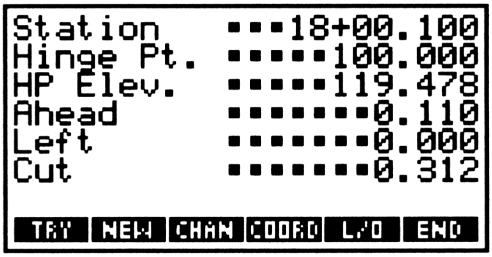
Press [NEW] this time entering:

1800.1 for the station. (Rounded to the nearest .1)
100 for the hinge point.

Press the ENTER key to accept the **0** Xfall. As the data registers have been initialized, the current angle/distance data now appear as defaults. Just press the ENTER key three more times to accept them. (When you complete a station/hinge point find, pressing [TRY] will clear the defaults.)

In Figure 7.53 you can see that we now have to move **Ahead** only 0.11 to get to station 1800.1. This means we must be very close to 1800.1 - 0.11 = 1799.99 or 1800.

Figure 7.53



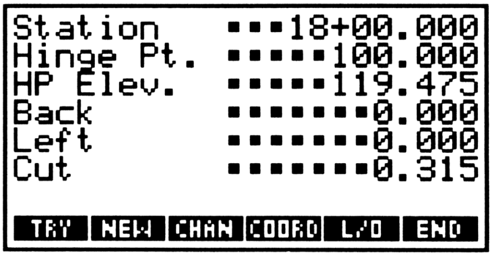
In most cases (depending on hinge point size and the end use for the point) the last calculation would be close enough. But for this example let's try one more.

Press [NEW] and enter 1800.0 for the station. Press the ENTER key five more times to accept the default values.

The Figure 7.54 display appears below.

Figure 7.54 shows that you could now be confident in calling this station 1800.

Figure 7.54



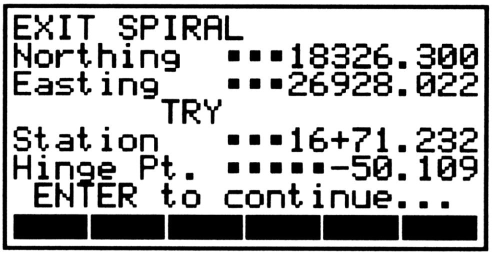
Finding by COORDinates

For this example we will find the station and hinge point of what in reality is station **1670** at a **-50'** hinge point in the previous circular curve. Once again to access the routine press the **right** (↱) shift key, then COORD. The display in Figure 7.49 will appear. Press COORD and enter:

18326.300 for the northing.
26928.022 for the easting.

Figure 7.55 shows that the initial calculated station and hinge point are not in the *current* segment. The title is EXIT SPIRAL but the calculated station is in the previous circular curve.

Figure 7.55



As we already know what the station and hinge point are in this case, we can see that this initial calculation was fairly close. It is within 1.2 in stationing and .1 in hinge point.

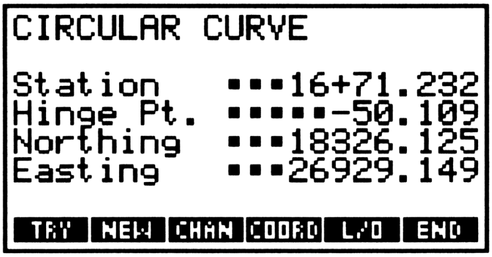
As usual press the **ENTER** key to check.

When using the COORDinate method press COORD instead of NEW to do the check.

Press COORD now, then press the ENTER key twice to accept the station and hinge point.

Notice that the Figure 7.56 title is now CIRCULAR CURVE.

Figure 7.56



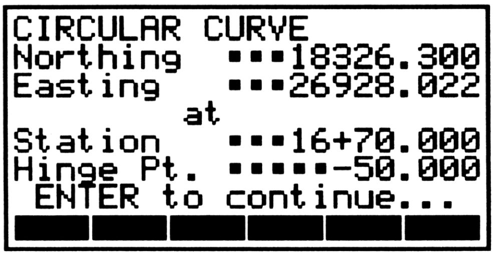
As we are now in the correct segment, to access the Find routine press the **right** (↱) shift key, then COORD. The display in Figure 7.49 will appear. Press COORD then press the ENTER key twice to accept the default coordinates.

Figure 7.57 should now contain the exact station and hinge point as we began the calculation from the *current* segment. In this case we know what the station and hinge point of these coordinates should be. But as usual you should always do a check.

To check, press the ENTER key then press COORD. Press the ENTER key two more times to accept the defaults.

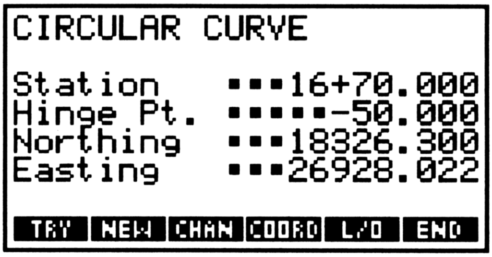
The Figure 7.58 display below confirms that this is the correct station and hinge point.

Figure 7.57



Press [END] then [QUIT] to leave the program.

Figure 7.58



Finding the Current Setup

When you want to find the station and hinge point of the point you are currently occupying, use the calculation method and just enter:

0 for the horizontal angle.
0 for the horizontal distance.

As usual the initial calculation in a spiral will be approximate; in a tangent or circular curve the initial calculation will be exact provided that the find is done in the *current* segment.

Vertical Curves

Data needed...

• Current job file: Not required.

• Control points: N/A

Changes...

• You can now do calculations in a single segment or in a vertical alignment. The routine will also *create* vertical alignments.

• The XFALL feature has been incorporated into the regular display so it is always visible.

• NEXT and INTERval features are now available to do calculations on regularly spaced stations.

Configuration...

• Start the program if necessary by entering **S.P.** Press CONFI and choose FEET from the configuration menu. The stationing will be shown in terms of *hundreds* of feet. (Choosing METERS will show stationing in terms of *kilometers*.)

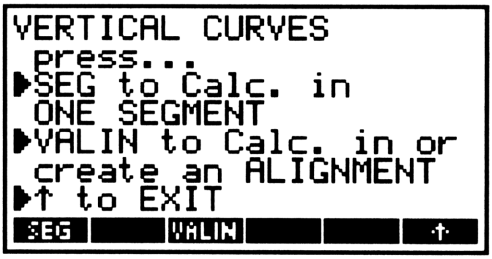
Press ↑ to get back to the **program main** menu.

The routine allows you to do calculations in symmetric or asymmetric vertical curves and straight grades.

Press UTILS. Press VCURV to get to the **vertical curve options** menu.

As the Figure 8.1 display illustrates, depending on the situation, you can calculate in one segment or in an existing alignment.

Figure 8.1

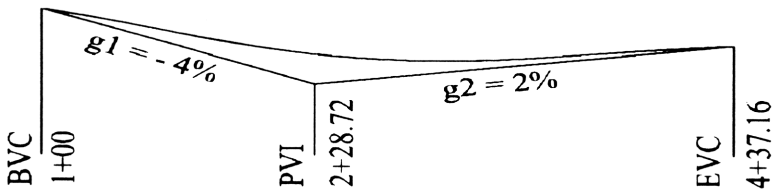


You can also create a new alignment.

Even in most single segment vertical curves it is often worth creating an alignment. Use the single segment option when you are calculating on a one-time basis.

We will first take a look at doing calculations on a single segment using the asymmetric vertical curve in Figure 8.2.

Figure 8.2 (NTS)



Single Segment Calculations

Press [SEG] now. Enter the following vertical curve data when the station and elevation prompts appear.

100.000 for the BVC station, **106.53** for the elevation.
228.720 for the PVI station, **101.381** for the elevation.
437.160 for the EVC station, **105.550** for the elevation.

When you finish entering the vertical curve data, the routine takes a few seconds to initialize, then the Figure 8.3 display appears.

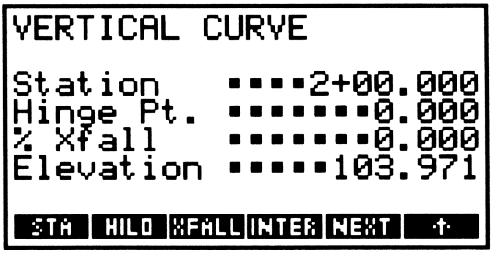
Figure 8.3

People who have upgraded will notice two new softkeys in this menu. They are for the INTERval and NEXT features which will be described later in this chapter.

Press [STA] and enter **200** at the **Vert. curve station** prompt.

The Figure 8.4 display indicates that at station 200 the elevation will be 103.971.

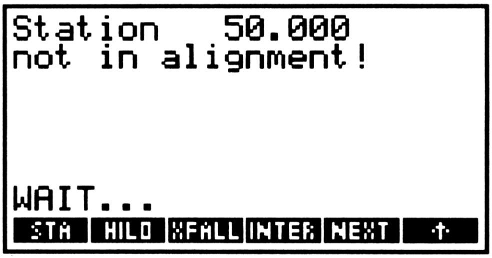
Figure 8.4



Press [STA] and enter **50** this time.

The calculator beeps and the Figure 8.5 display will appear. This is the same display that appears when you enter a station that is not in a *horizontal* alignment.

Figure 8.5

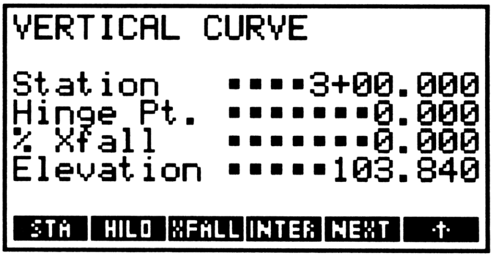


To carry on just enter an existing station. Try entering **300** this time.

People who have upgraded will notice that the hinge point and % Xfall are now always visible.

The VERTICAL CURVE title will be replaced by a STRAIGHT GRADE title when not in a curve.

Figure 8.6



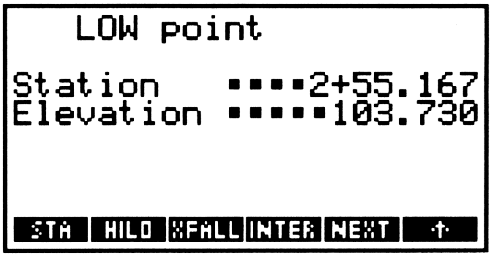
The HILO Feature

Press HILO .

The HILO (HIGH/LOW point) feature calculates the HIGH or (as in this case) LOW point station and elevation of the curve.

Note: In a situation where **g1** and **g2** have the same sign, (both positive or both negative) you will see a message display. It will be described in the vertical alignment section.

Figure 8.7



The Xfall (crossfall) Feature

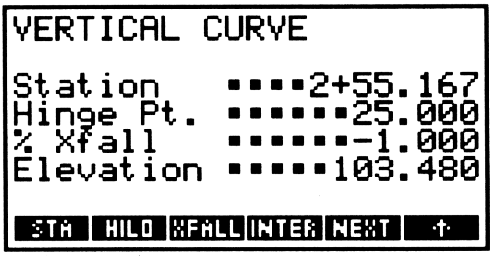
Let's try calculating the shoulder elevation of the LOW point using a 25' hinge point with a -1% Xfall. (In version 1.0 you couldn't do an immediate Xfall calculation on the HIGH/LOW point.)

Press XFALL and enter **25** for the hinge point and **-1** for the Xfall.

Notice that the elevation is now .25 lower than the LOW point elevation in Figure 8.7.

The hinge point and Xfall are now always visible due to the addition of the Interval feature which will be described next.

Figure 8.8

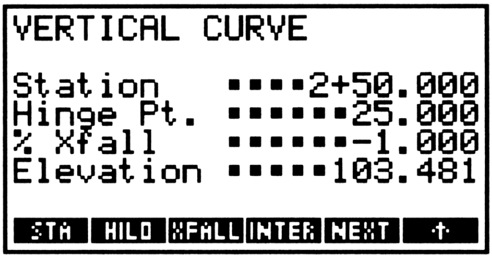


The INTERval Feature

The interval feature speeds up calculations of regularly spaced stations in a single segment or in an alignment.

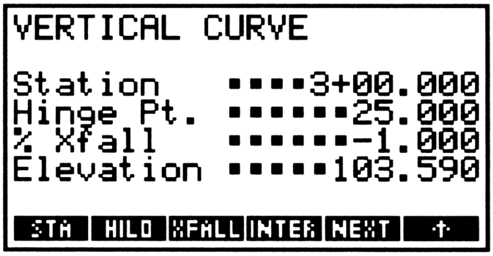
To start off with an even station, press [STA] and enter **250**.

Figure 8.9



Press [INTER] enter **50**, then press [NEXT] to see the next station and Xfall elevation in Figure 8.10.

Figure 8.10



Press [NEXT] until station 400 appears. Then try pressing [NEXT] one more time.

Station 400 will be the last station displayed with a 50' interval because station 437.16 is the largest station in this segment.

Press [INTER] now and press the **+/-** key to make the current interval negative. Then press [NEXT] until you get to station 100. (These displays are not shown.)

If you try pressing [NEXT] one more time the routine will react just as it did for a too large station. In this case 100 is the smallest station in the segment.

Note: When doing crossfall calculations you should enter positive hinge points; if you do enter a negative hinge point, the routine will make it positive.

Calculating Straight Grades

You can easily calculate a straight grade in the single segment routine by entering a pseudo-PVI and average elevation at the mid-point. For example if the end points of a grade are:

A (BVC) @ 1+00 with an elevation of 200 and
B (EVC) @ 2+00 with an elevation of 210.

The pseudo-PVI for this grade would be **x** (Mid-point) @ **1+50** with an elevation of **205**.

Press [↑] to get back to the **vertical curve options** menu. (If you would like to take a break, press [↑], [END] and [QUIT] to leave the SURVcalc environment.)

Alignment Calculations

Using vertical alignment files gives you a great deal of flexibility in vertical curve and/or straight grade calculations. The creation process is the same as from within the Horizontal Alignment routine; the creation rules described in the horizontal alignment chapter also apply.

You should use the vertical alignment method when:

• Doing calculations in more than one segment.
• Creating a vertical alignment for an *existing* horizontal alignment.

If the program has to be started enter **S.P.** Press [UTILS] and [VCURV] to get to the **vertical curve options** menu in Figure 8.1. Then press [VALIN].

At the **Vert. Align. file name** prompt enter **NEWROAD**. (The NEWROAD vertical alignment was created in the Alignments chapter. If you don't have this alignment in your calculator you can create it now by pressing [YES] at the **CREATE?** prompt. Refer to the Vertical Alignment Creation section in the Alignments chapter.)

If the NEWROAD file exists the program will take a few moments to initialize and the Figure 8.3 display will appear.

You calculate in a vertical alignment just as you would in a single segment, with the added advantage of being able to move easily from one segment to another. As in the horizontal alignment routine, you just enter the station and the routine will find the correct segment.

Press [STA] then press the **ENTER** key to accept the 1200 station default.

(When the routine starts it loads the lowest station as the default.)

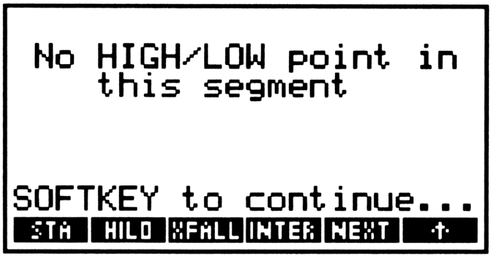
Figure 8.11

```
STRAIGHT GRADE

Station    ···12+00.000
Hinge Pt.  ·······0.000
% Xfall    ·······0.000
Elevation  ·····114.820

 STA | HILO |%FALL|INTER| NEXT |  ↑
```

Figure 8.11 tells you that the current segment is a straight grade and that the elevation at 12+00 is 114.82. Try pressing [HILO].

Figure 8.12 below contains the message display referred to in the Alignment routine. This display will appear when g1 and g2 have the same sign or, as in this case, you are working in a straight grade segment.

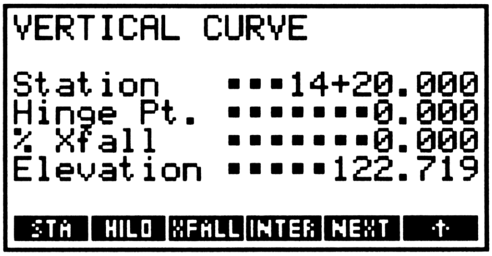
Figure 8.12



Press [STA] and enter **1420**.

Figure 8.13 shows that we have moved into a vertical curve segment.

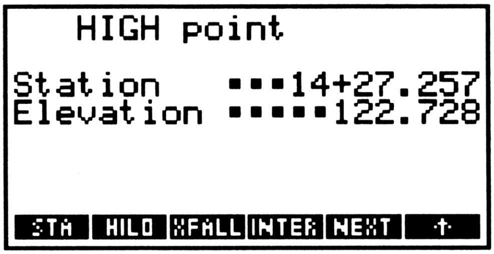
Figure 8.13



Now press [HILO].

We have changed segments so Figure 8.14 displays the HIGH point in the next (crest) vertical curve.

Figure 8.14



That covers using an existing vertical alignment. We won't do any Xfall examples as the Xfall subroutine is exactly the same as in a single segment. You can practice using all the routine features on your own. Take a break if you like. Then we can take a look at *creating* a vertical alignment.

After you finish doing practice calculations, press [↑] to get back to the **vertical curve options** menu.

Vertical Alignment Creation

As mentioned at the start of this chapter, creating a vertical alignment in this routine is identical to its creation in the horizontal alignment routine.

Use this routine when you want to create a vertical alignment for an existing horizontal alignment. When the alignment routine loads an existing horizontal alignment, it checks for a vertical alignment with that name. If a vertical alignment is found it loads its data.

Note: Horizontal alignments created by version 1.0 of SURVcalc are compatible with this version.

If you are not at the **vertical curve options** menu in Figure 8.1, enter **S.P** to start the program. Press [UTILS] then [VCURV].

Press [VALIN] to start the routine. At the **Vert. Align. file name** prompt enter **ROAD2**. The vertical alignment creation display and menu will appear in Figure 8.15.

Figure 8.15

```
Enter all grade change
stations & elevations
for Vert. alignment

ROAD2

Press RTN when done
P.O.G. | BVC | PRVC | EVC |  | RTN
```

Before entering any elements, try pressing [RTN].

The display in Figure 8.16 appears when you try exiting the creation process with an empty file.

Just press the **ENTER** key to add the elements.

Figure 8.16

```
File
ROAD2
is empty!
 ENTER to continue...
P.O.G. | BVC | PRVC | EVC |  | RTN
```

For the **ROAD2** alignment we will use just one straight grade segment and one vertical curve segment. (For more detailed information on vertical alignment creation see the Vertical Alignment Segments and Elements section of the Alignments chapter.)

The first segment is a straight grade so press [P.O.G.] and enter:

1200 for the station.
114.82 for the elevation.

To both end the straight grade and start the vertical curve press [BVC] and enter:

1290 for the station.
119.32 for the elevation.

When either [BVC] or [PRVC] is pressed you will automatically be prompted for the **PVI** data. So enter:

1420 for the station.
125.82 for the elevation.

If the next segment were a reverse vertical curve you would press [PRVC]. In this case we are ending the vertical curve so press [EVC] and enter:

1560 for the station.
119.94 for the elevation.

Now press [RTN]. The Figure 8.3 display will appear.

We won't do any example calculations with this alignment. You can practice on your own if you like.

Vertical Alignment for an Existing Horizontal Alignment

If you were now to start the alignment routine to use an existing *horizontal* alignment named ROAD2, the routine would also load the *vertical* ROAD2 alignment. (Remember to make sure that the start and end stations of both alignments are the same.)

When you finish practicing press [↑] twice. Then press [END] and [QUIT] to leave the program.

File Editing

Data needed...

Current job file: JOB1 with fence corners 1-4. (These points are in the Sideshots chapter. If they are not in your calculator you can add them when we look at the ADD routine.)

Control points: N/A

Changes...

• You can now edit *any* sideshots/layout file.

• Points can now be viewed and printed.

• Before editing you can use the FCOPY (file copy) feature to make a backup.

Configuration...

N/A

You can edit all the data files that SURVcalc creates, using the HP EDIT/VISIT commands but, for editing the current job file, it is much more convenient and faster to use this routine. (For information on SURVcalc data files see Appendix A, File Formats.)

Copying the Current Job File

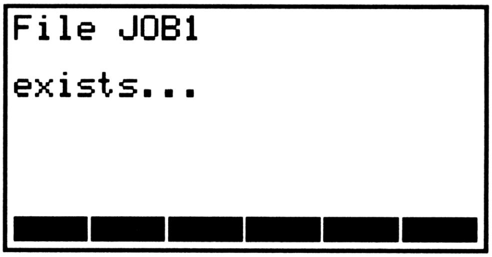
Before starting an editing session, you should always use the FCOPY feature to make a quick copy of the *current* job file.

If you are not at the **program main** menu enter **S.P** to start the program. First press FILE and make sure your *current* job file is **JOB1**.

Press FCOPY and try entering **JOB1** at the **New file name** prompt.

The calculator will beep and the Figure 9.1 display will appear for a few moments. The routine won't let you overwrite an existing file so you will be returned to the **program main** menu.

Figure 9.1

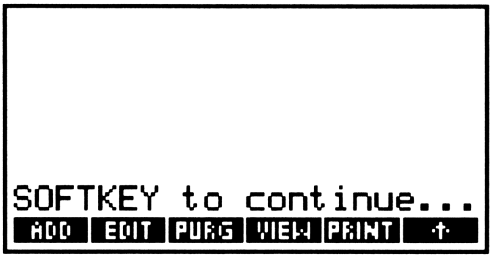


Press FCOPY again this time entering **JOB1BAK** at the **New file name** prompt. File JOB1BAK (with a .SLO extension) will be created and you will be returned to the **program main** menu.

Having made the JOB1BAK copy of JOB1, you can now use any of the File Editing routines with confidence; if a mistake is made you will have an original version of the JOB1 file to go back to.

Press UTILS then EDIT to get to the Figure 9.2 **file edit** menu with the standard **SOFTKEY to continue...** message.

Figure 9.2

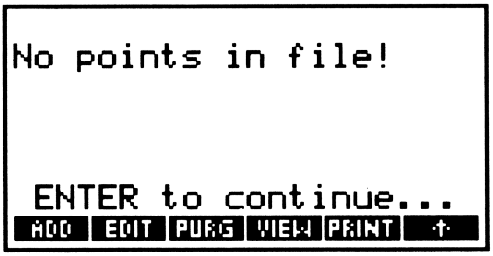


Viewing Points

You can use the VIEW feature when you want to see *all* the points in the *current* job file. The points will appear serially from first to last each time VIEW is pressed; you can then note which points you might want to *purge*, *edit* or, as you will see below, *print*.

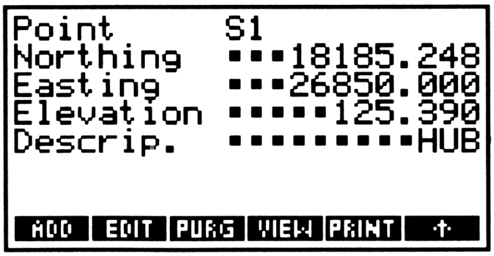
Press VIEW.

Figure 9.3



If there aren't any points in your file, the calculator will beep and Figure 9.3 will appear. Just press the ENTER key, then go to the ADD feature below.

Figure 9.4



If you have points in your current file the routine will display the first point as in Figure 9.4. (Your first point may not be **S1**.)

If you have an HP 82240B printer you can print the displayed point.

Printing Points

To print the currently displayed point, make sure the printer is on and aligned to the HP 48 infrared port, then just press [PRINT]. The point will be printed and the next point in the current job file will appear. (If you press [PRINT] with the printer off or without a printer, the HP 48 will try to send the data, time-out, and the next point will be displayed.)

Press [VIEW] and/or [PRINT] until the Figure 9.2 display re-appears.

Printing All Points

Using the third key assignment you can print *all* the points in the current job file. This feature is assigned to the **right** (↱) shifted [PRINT] (E) key.

Once again, as in the alignment routine key assignments, you use the **right** shift key because the E key is on the **right** side of the keyboard.

You can try printing all the points even if you don't have a printer. (This is a good way to view all the points with one key press.)

From the Figure 9.2 display press the the **right** (↱) shift key. (As usual the stack will appear.) Then just press [PRINT]. All the points in the current file will be printed and the Figure 9.2 display will appear.

If the points do not print properly refer to the HP manual as you may have to experiment with the delay time. (The 1.8 second default usually works well.)

Adding Points

Use the ADD feature to add points to the current job file when you are in the field or when you are in the office and you only have a few points to enter.

When you have to store a lot of points you will probably want to use the **PC File Conversion Utility**. See the File Conversion chapter.

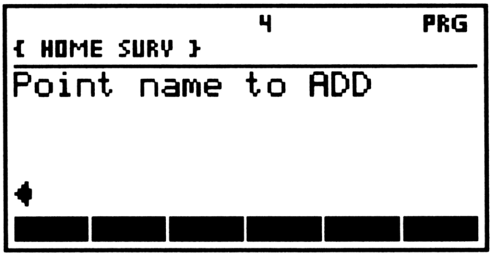
Note: You should make sure fence corners 1-4 from the Sideshots routine are in your calculator if you are planning on going through the Areas chapter.

Press [ADD].

At the **Point name to ADD** prompt in Figure 9.5, enter **S1**.

As point **S1** is already in the file, the calculator will beep and the display in Figure 9.6 will appear.

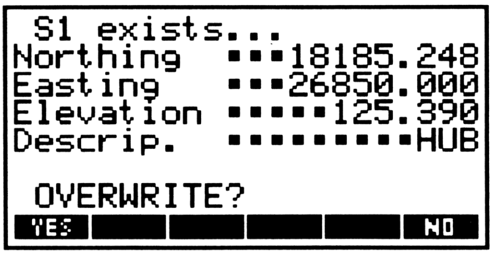
Figure 9.5



When you don't want to overwrite press [NO].

Pressing [YES] will display the current point data, so if you press [YES] by mistake, just press the ENTER key to accept the data. Press [NO] this time.

Figure 9.6



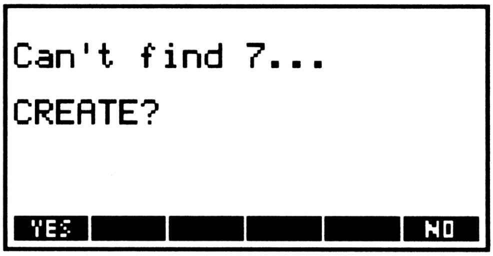
Note: In this version whenever a File Editing operation is performed on either the *current* setup or the *current* backsight, the **Setup @** and **Backsight** names will be replaced by **?'s** to remind you to enter new points.

If you edit the current job file using the HP editor, when you start a routine, **ALWAYS** press [NO] at the **OK?** prompt (even if the setup and backsight *names* are OK), then press [SETUP] and [BSITE]. Doing this will recalculate the reference azimuth using the values from the current job file or tell you that one (or both) of the points does not exist.

When the **Point name to ADD** prompt appears, enter 7.

The display in Figure 9.7 appears to confirm that you really do want to create this point.

Figure 9.7



Press [YES] now to create 7. Then enter **1000**, **1000**, **100** and **HUB** respectively when the standard Northing, Easting, Elevation and Description prompts appear. The point will be added and the display and menu in Figure 9.2 will appear.

Editing Points

Press [EDIT]. A **Point name to EDIT** prompt appears. We know that 7 is in the current job file so try entering **77**. The calculator will beep and the Figure 9.8 message will appear briefly.

Figure 9.8

```
77 not found!
try another name...
```

This time at the **Point name to EDIT** prompt, enter 7.

The display and softkey menu in Figure 9.9 will appear.

With the **edit** feature you can change any or all of the fields. (If you don't want to make any changes, just press [SAVE] to return to the **edit main** menu.)

Figure 9.9

```
Point        7
Northing     ....1000.000
Easting      ....1000.000
Elevation    .....100.000
Descrip.     ..........HUB

SOFTKEY to EDIT...
NAME NORT EAST ELEV DESCR SAVE
```

Let's start with the **Point name** field. Press [NAME]. At the **Point name** prompt try entering **S1**. Once again the calculator will beep and the Figure 9.10 message will appear briefly.

Figure 9.10

```
Point S1
is in job file:
use another name...
NAME NORT EAST ELEV DESCR SAVE
```

You will be returned to the **edit main** menu. Press [EDIT] and enter **7**. The display and softkey menu in Figure 9.9 will re-appear.

Press [NAME] then type **7** to change the name to **77** and enter it. The **Point** field should show 77. Pressing [NORT], [EAST], [ELEV] and [DESCR] enter **3000**, **3000**, **300** and **CN** (concrete nail) respectively.

When all the fields have been changed, press [SAVE] to store the edited version of point 7 (now **77**) and return to the **edit main** menu.

Purging Points

Press [PURG]. A **Point name to PURGE** prompt will appear. Enter **7** this time.

The calculator beeps and the Figure 9.11 display will appear for a few seconds.

This time enter **77**.

When a point is found in the current job file, the display in Figure 9.12 appears showing the point data to make sure that you really do want to purge the point.

Press [NO] when you don't want to purge the point. Press [YES] now to purge 77.

Figure 9.11

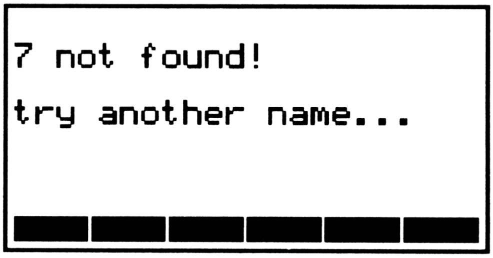
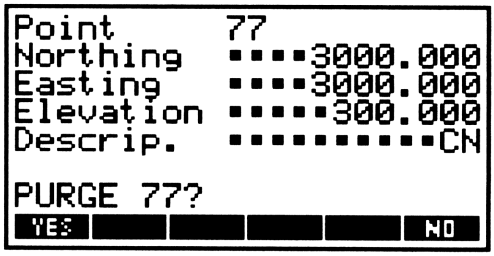


Figure 9.12



Press [↑], [END] and [QUIT] to leave the SURVcalc environment.

Areas

Data needed...

- Current job file: JOB1 file with fence corners 1-4. (See the Sideshots chapter.)

- Control points: N/A

Changes...

- You can now automatically calculate an area using either *all* the points in a given sideshots/layout file or *some* of the points in sequence.

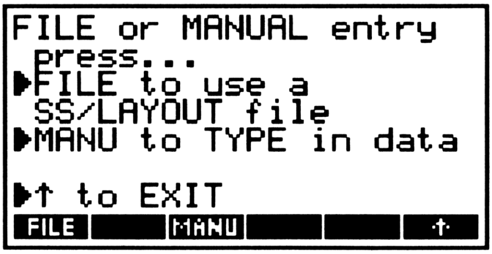
- Areas are now identified with the unit chosen from the configuration menu.

Configuration...

- At the program main menu, press [CONFI] and make sure the *units* field is FEET. Press [↑] to get back to the **program main** menu.

Press [UTILS] then [AREA]. The Figure 10.1 display appears with the **area option** display and menu.

Figure 10.1



As Figure 10.1 illustrates, you can now calculate an area directly from an *existing* file or you can enter the data for each point manually.

Area From a File

The quickest way to calculate an area is to use all or some of the points that are already in one of your job files. The process is automatic; all you have to do is provide a valid file name.

Keep the following points in mind:

• Make sure the points used for the calculation are in order in the file. For example, if points 1,2,3 & 4 define the perimeter of the area in question then that is the order in which they should be entered in the calculator. Also valid would be 4,3,2 & 1 etc. An ordering of 1,3,2 & 4 will yield an incorrect area.
• If you want to use the entire file, use the File Editing routine to purge any points that aren't part of the perimeter.
• You can use point numbers or alpha names.

Area Using a Point Sequence

Press [FILE]. Figure 10.2 gives you the option to use a sequence of points or all the points in the file to be chosen.

This time press [BLOC]. At the **SS-L/O file** prompt enter **JOB1**.

Figure 10.2

```
 press...
▶BLOC for a sequence
▶FILE for all Pt's.

BLOC                     FILE
```

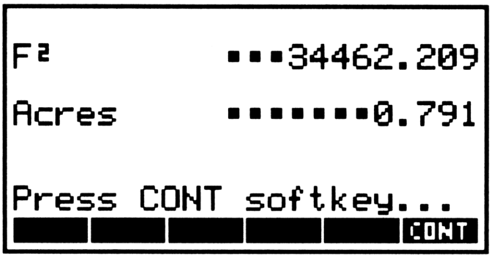
(When a file is not found the calculator will beep and display a message. You will be returned to the **utilities** menu.)

As we are using a sequence of points, the next prompt is for the **First Pt.#/Name**. Enter **1** for the first fence corner.

At the **Last Pt.#/Name** prompt enter **4**. The result appears in Figure 10.3.

As mentioned at the beginning of this chapter, area calculations are now unit-specific.

Figure 10.3



We set the units to FEET in the configuration routine so the first line in the Figure 10.3 display shows the fence line area in square feet. (If you added points 1-4 manually the first line calculation may differ.) The second line shows the equivalent area in acres.

When you work in meters the first line will show the area in M^2 and the second line will show the equivalent area in hectares. Press CONT.

When using the BLOC feature, the routine won't complete the calculations if the First Pt.#/Name is located after the Last Pt.#/Name in the file. A message will appear and you will be returned to the first utilities menu when you press ENTER.

Area Using All Points

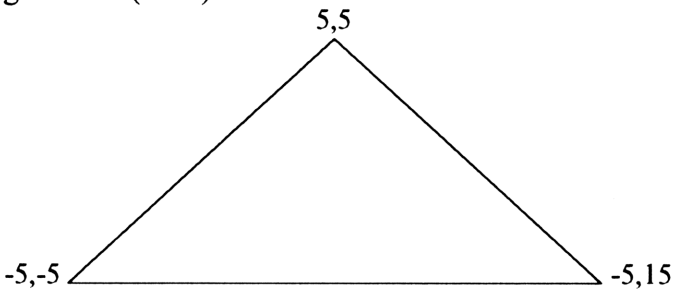
When you choose to use all the points in the file (you press FILE at the Figure 10.2 menu) you will see only the **SS-L/O file** name prompt. When you enter a valid file name the area will be calculated and the Figure 10.3 display will appear.

If you try to use a file that has less than 3 points the calculator will beep and you will see a **Not enough points** message for a few moments. Once again you will be returned to the **first utilities** menu.

Area by Manual Entry

We will use the Figure 10.4 triangle sketch in the manual entry example.

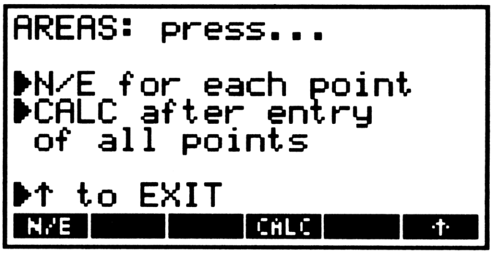
Figure 10.4 (NTS)



From the **utilities** menu press AREA then MANU to view the **manual entry** menu and display in Figure 10.5.

The data entry softkey is titled **N/E** and the prompts are for Northing and Easting, but you can use any y/x or x/y pair.

Figure 10.5



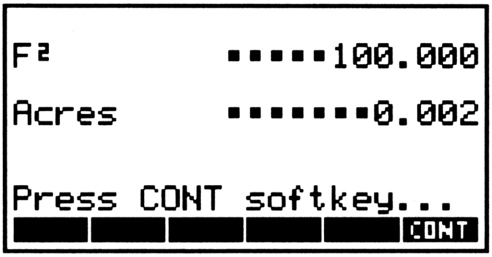
Pressing [N/E] for *each* coordinate pair enter:

Northing	Easting
5	**5**
-5	**-5**
-5	**15**

Press [CALC].

Figure 10.6 shows that the triangle area is 100 square feet or .002 acres.

Figure 10.6



Note: Unlike the inverse traverse routine, you *can't* calculate intermediate areas. [CALC] can only be pressed once for each area.

The area you calculate can have as many points as your calculator memory will allow. A temporary area file is created, then purged when you press [CONT] and a new area file is begun the next time [N/E] is pressed.

Note: You never need to re-input the origin when calculating areas. The figure will be closed from the last point entered to the origin when you press [CALC].

Press [CONT], [↑], [END] and [QUIT].

Volumes

Data needed...

• Current job file: N/A

• Control points: N/A

Changes...

• Volumes are now identified with the unit chosen from the configuration menu.

Configuration...

• Start the program if necessary by entering **S.P**. Press [CONFI] and make sure the *units* field is FEET. Press [↑] to get back to the **program main** menu.

Press [UTILS] then [VOL]. Figure 11.1 contains the **volumes** display and menu.

The Volume routine works like manual Area calculation. The [N/E] softkey has been replaced by a [STA] softkey.

Press [STA] now.

Figure 11.1

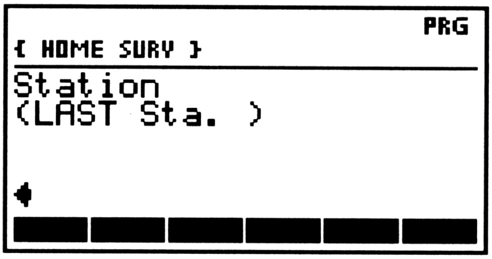
```
VOLUMES: press...

▶STA to enter data
▶CALC after entry
 of each section

▶↑ to EXIT
STA | | | CALC | | ↑
```

The Figure 11.2 **Station** prompt below appears whenever you *start* a new section.

The **(LAST Sta.)** reminder usually shows the previous station, but as we have just started the routine, there is no previous station.

Enter **-10** for the station.

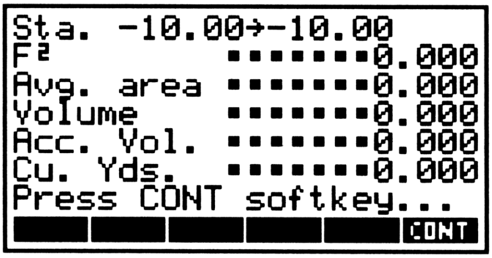
Figure 11.2



Then enter **0** for the Elevation and **0** for the Offset. (When you have a zero end area section, after entering the station, just enter one coordinate pair as illustrated, then press [CALC].)

Press [CALC] now.

Figure 11.3

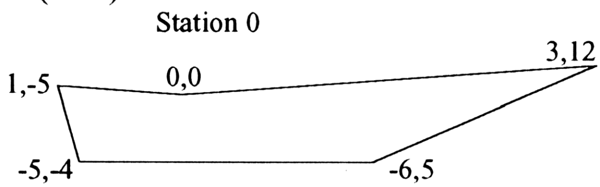


This being the first section, with no end area, all of the fields in Figure 11.3 contain zeros.

The first line shows that you are in the first section, as the **from** and **to** stations are identical. (-10 to -10)

We will enter the section at station zero in Figure 11.4 next.

Figure 11.4 (NTS)



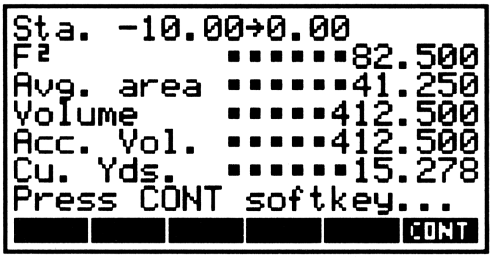
Press the [CONT] softkey, then the [STA] softkey. Notice that this time the **(LAST Sta.)** reminder contains **-10.0**. Enter **0** at the **Station** prompt.

Using the sketch in Figure 11.4 above, enter **0** for the first Elevation and **0** for the first Offset. Then working clockwise or anticlockwise press the [STA] softkey to enter the remaining coordinate pairs. (As in the Area and Inverse Traverse routines, you don't have to re-enter the **origin** pair.) Press [CALC] after the last coordinate pair is entered.

• In Figure 11.5, the first line tells you that the volume was calculated between stations -10.0 and 0.

• The second line contains the area for station 0 (the current station) and in this case it is shown in square feet.

Figure 11.5



• The average area is of course half the sum of the current and previous areas. (The area at -10 was 0.)

• In this case, being the second station calculated, the volume and the accumulated volume are the same.

• We are working in feet so the cubic yards conversion is applicable. (412.5 ÷ 27): the conversion is done on the **accumulated volume**.

Press [CONT], then [STA] and enter **10** at the **Station** prompt. Then enter **0** for the first elevation and **0** for the first offset.

Pressing [STA] each time, enter the remaining coordinate pairs from Figure 11.6, then press [CALC].

Figure 11.6 (NTS)   Station 10

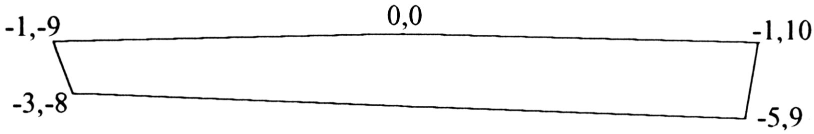
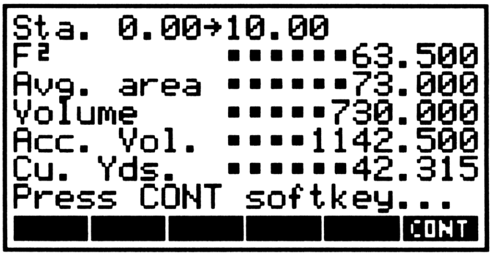


Figure 11.7 shows the area and volume calculated between stations **0** and **10**.

Notice that the accumulated volume now consists of the current volume and the previous volume.

Figure 11.7



The cubic yards value is increased proportionally to the increased accumulated volume.

Note: As a permanent data file is not created, you can calculate as many sections as you wish.

Press [CONT], [↑], [END] and [QUIT].

Coordinate Transformation

Data needed...

- Current job file: JOB1 with fence corners 1-4.
- Control points: N/A

Changes...

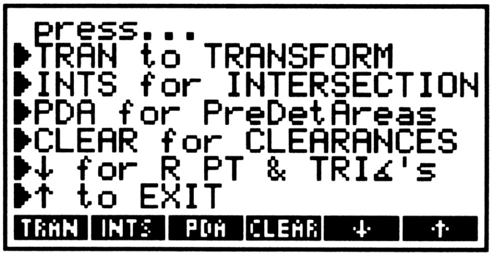
- N/A (New routine)

Configuration...

- N/A

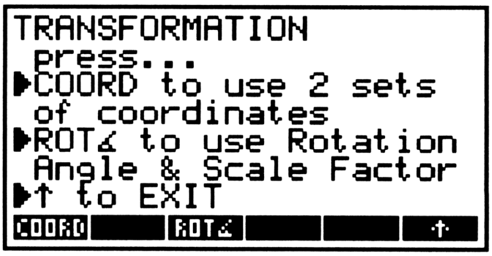
Enter **S.P** to start the program. Press [UTILS] then [↓] to get to the **second utilities** menu in Figure 12.1.

Figure 12.1



Press [TRAN] to see the **main transformation options** menu in Figure 12.2.

Figure 12.2



You can do the transformation using two sets of coordinates from each grid system or use the rotation angle and scale factor and one set of coordinates from each system.

Transformation Setup: Rotation Angle

This time press [ROT∠] to view the **transformation setup** menu.

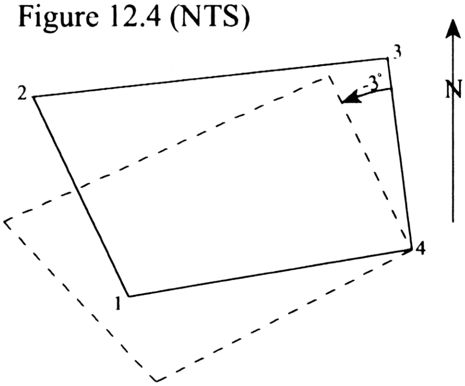
From this menu you can choose to use an existing setup file or create a new setup.

Figure 12.3

For this example we will be creating a new setup for the Figure 12.4 sketch. Press [MAKE].

We will be rotating and translating the fence line figure about point 4. The rotated figure is shown in dashed lines.

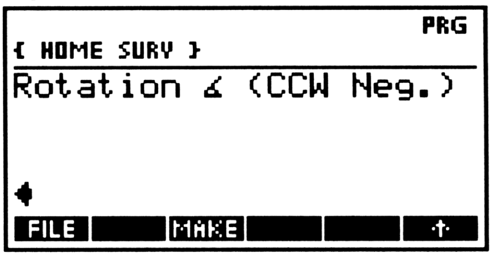
Figure 12.4 (NTS)



A **Rotation** ∠ prompt appears. Notice the reminder in brackets that a **CCW** (counterclockwise) rotation angle should be negative.

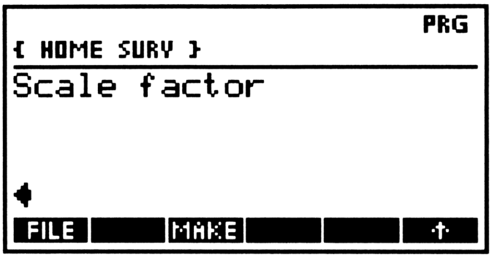
Type **3** and press the +/- key to change the sign before you enter it.

Figure 12.5



At the **Scale factor** prompt in Figure 12.6 enter **1**.

Figure 12.6

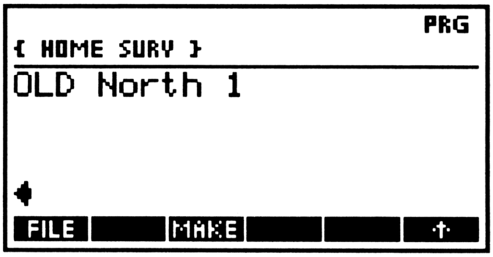


The next prompts will be for the **OLD** northing and easting of the system *from* which you are transforming.

Enter:

18332.64 for the northing.
27153.59 for the easting.

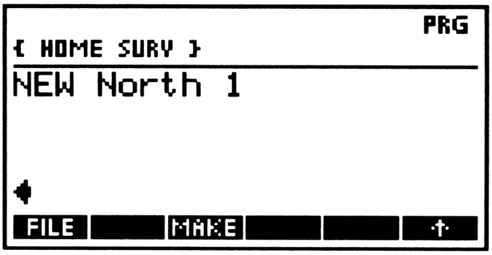
Figure 12.7



When the **NEW North 1** prompt appears as in Figure 12.8 enter:

25000 for the northing.
43000 for the easting.

Figure 12.8



After the easting has been entered you will be prompted to save the setup as in Figure 12.9 below.

Press [YES] this time.

Enter **ROT1** for the file name; the setup will be saved. (If the file exists you will be warned and given a chance to overwrite it.)

Figure 12.9

Note: A *rotation angle/scale factor* setup file is identical to a *coordinate* setup file. They only differ in their creation. The setup file will have a **.TRS** extension.

When the Figure 12.10 display appears you can press [FILE] to transform some or all of the points in an existing sideshots/layout file or [MANU] to enter the coordinates manually.

This time press [MANU].

Figure 12.10

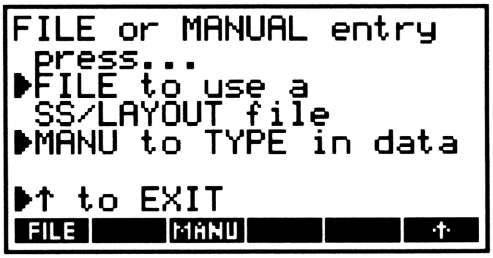
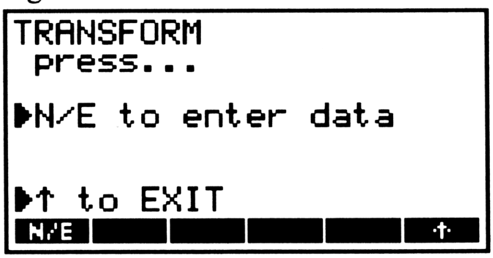


Figure 12.11 shows the **manual data entry** menu.

Press [N/E] to enter the first coordinates to transform.

This being the first time [N/E] was pressed, the display in Figure 12.12 below appears.

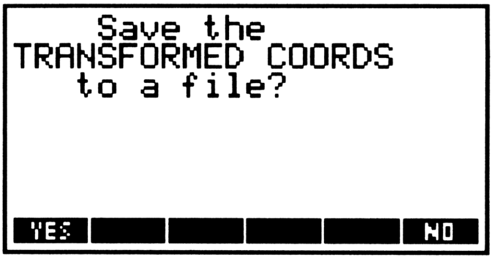
Figure 12.11



Even if you don't save your *setup* data, you can still save the *transformed* coordinates to a file.

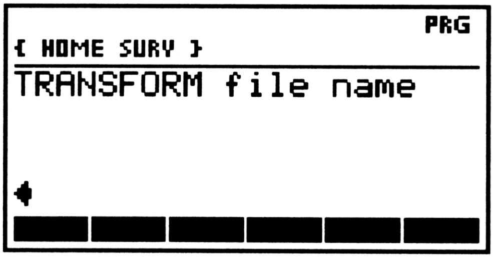
The file name you enter will have a **.SLO** extension tacked on to it so you can use it as a current job file.

Figure 12.12



Press YES to view the Figure 12.13 **TRANSFORM file name** prompt.

Figure 12.13



If you try to use an existing name the calculator will beep and the Figure 12.13 display will re-appear.

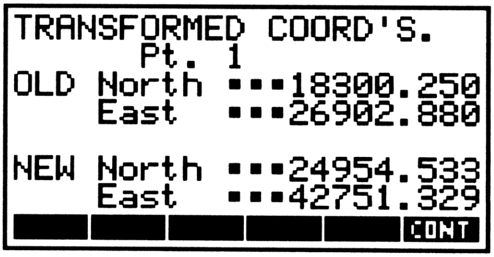
Enter **NEWFENCE** for the filename. You will then be prompted for the northing of the first point to be transformed. Enter:

18300.25 for the northing.
26902.88 for the easting.

Figure 12.14 shows both the original and transformed coordinates of fence corner 1.

Press CONT now to save the new coordinates to the **NEWFENCE** file.

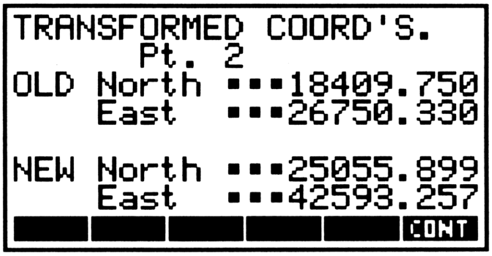
Figure 12.14



You will be returned to the Figure 12.11 display ready for the next transformation. Press [N/E] and enter:

18409.75 for the northing.
26750.33 for the easting.

Figure 12.15



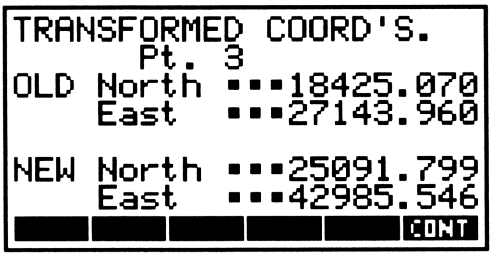
Notice in Figure 12.15 that the Pt. number has been incremented. When you do *manual* transformations the transformed points are numbered starting with **1** and, if you are saving the points to a file, these numbers will appear in the file's *name* field.

There will also be a zero in the elevation field and a null string ("") in the description field as placeholders. If you wish you can use the File Editing routine to change the point names and add elevations and descriptions.

Let's transform points 3 and 4. Press [CONT] and [N/E]. Enter:

18425.07 for the northing.
27143.96 for the easting.

Figure 12.16



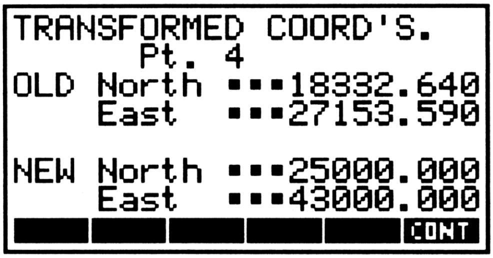
Once again press [CONT] and [N/E]. For point 4 enter:

18332.64 for the northing.
27153.59 for the easting.

Point 4 is really just a check as this is the pivot point used in the transformation setup.

Press [CONT], [↑], [END] and [QUIT] to leave the SURVcalc environment.

Figure 12.17



Transformation Setup: Coordinates

For the example of a transformation using the coordinates of two points in each system, we will do the calculations from the new system to the old. This will let us use the **NEWFENCE** file created above in the rotation angle example to illustrate transformations from a file. (If you haven't created a **NEWFENCE** file it is probably quickest to go through the first part of this chapter.)

If necessary start the program by entering **S.P**. Then press [UTILS], [↓] and [TRAN]. This time press [COORD] then [MAKE].

Now instead of a rotation angle prompt the first prompt that you see will be for the **OLD** North 1. Enter:

25000 for the OLD North 1.
43000 for the OLD East 1.

(The *current* OLD system was the NEW system in the rotation angle example.)

18332.64 for the NEW North 1.
27153.59 for the NEW East 1.

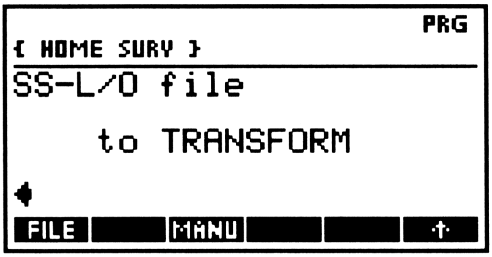
25091.799 for the OLD North 2.
42985.546 for the OLD East 2.

18425.07 for the NEW North 2.
27143.96 for the NEW East 2.

As usual when you complete data entry you are asked if you want to save the setup. This time press NO and you will once again see the **FILE or MANUAL entry** display in Figure 12.10. This time press FILE.

At the Figure 12.18 prompt enter **NEWFENCE**. The file will be loaded and you will be prompted to see if you want to save the transformed coordinates to a file. Press YES and enter **OLDFENCE** at this prompt.

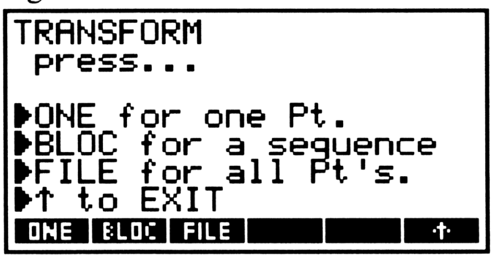
Figure 12.18



Note: For information on how the transformed coordinates are stored see The Transformed File paragraphs at the end of this chapter.

From the Figure 12.19 menu you can transform one point at a time, a sequence of points or an entire file.

Figure 12.19



Single Point Transformation

Press [ONE] and enter **2**.

Compare the NEW Pt. 2 coordinates in Figure 12.20 to those used in the rotation angle example. You will notice a slight difference in the easting.

Figure 12.20

```
TRANSFORMED COORD'S.
       Pt. 2
OLD North ▪▪▪25055.899
    East  ▪▪▪42593.257

NEW North ▪▪▪18409.750
    East  ▪▪▪26750.328
                  CONT
```

Differences will appear when using different setup methods.

• When you use the **rotation angle** method, you *supply* the rotation angle and scale factor.
• When you use the **coordinate** method the routine *calculates* the rotation angle and scale factor. Press [CONT].

Block Transformation

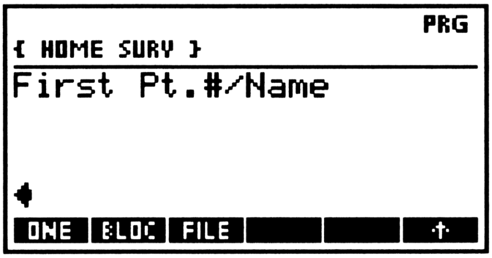
When you have a block (sequence) of points in a file to transform all you have to do is enter the first and last points in the sequence. For example if you only want to transform points 7-11 in a 40 point file you would just enter **7** for the first point and **11** for the last point.

Note: The routine will transform *all* points between the first and last points. Using the example above your sequence might be 7,9,11. (The routine doesn't require that this sequence be 7,8,9,10,11; it uses whatever points it finds.)

It will also use alpha names. For example the sequence above could be 7,**A1**,88,**B1**,**A2**,11.

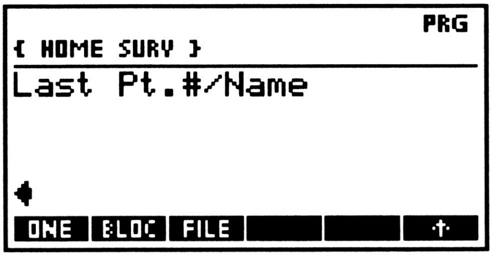
Press [BLOC] and enter **3** at the **First Pt.#/Name** prompt. (If you use a non-existent name the calculator will beep and let you know.)

Figure 12.21



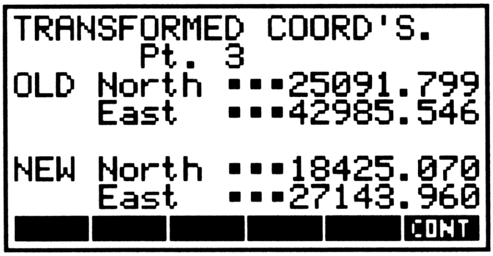
At the **Last Pt.#/Name** prompt enter **4**.

Figure 12.22



After you enter the last point name the first point in the sequence will be transformed and displayed as in Figure 12.23.

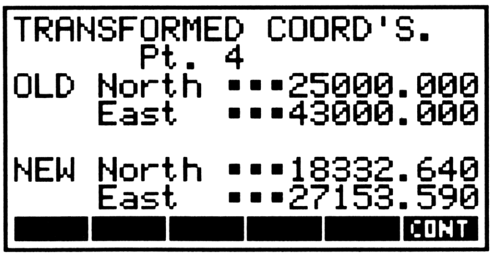
Figure 12.23



Press [CONT] to see the next (in this case also the last) point in the sequence as in Figure 12.24.

After viewing the last point and pressing [CONT] you will be returned to the Figure 12.19 display.

Figure 12.24



File Transformation

Press [FILE] now. (The displays will not be shown.) The first transformation will appear. Press [CONT] to view the rest of the transformed points.

As usual after the last point is viewed you will be returned to the Figure 12.19 display.

The Transformed File

When you transform from an existing file and you decide to save the transformed coordinates to a file, the routine makes a *copy* of the original file and stores it with the name you give; the original file is *never* changed.

And, because the transformation is done from a file, the original elevations and descriptions are also stored in the copied file. (Unlike manual transformation where **zero** and "" placeholders are used.)

You should use either ONE or BLOC when you only want to transform *some* of the points. (e.g. You may have both lot corner and house corner points in a file in which you only want to transform the house corners.)

When you use FILE *all* the points are transformed but, as mentioned above, the *original* file remains unchanged.

Remember that when you want to do layouts with the *transformed* file you have to make it the *current* job file.

Press [↑], [END] and [QUIT].

Intersections

Data needed...

• Current job file: JOB1.

• Control points: (New points will be added.)

Changes...

• N/A (New routine)

Configuration...

• N/A

Enter **S.P** to start the program. Press [UTILS] then [↓] to get to the **second utilities** menu in Figure 13.1.

Press [INTS] to see the setup display in Figure 13.2. (Your display may not match.)

We will use points **A** and **B** in Figure 13.3 below for points 1 and 2 respectively.

Figure 13.1

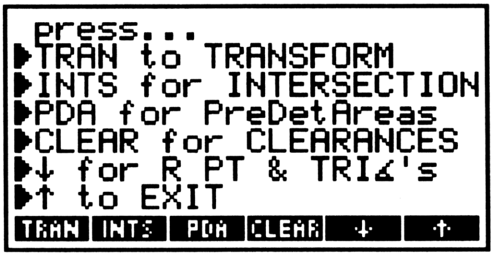


Figure 13.2

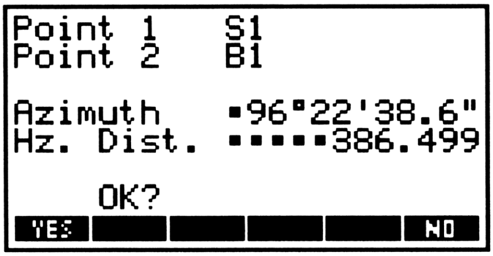
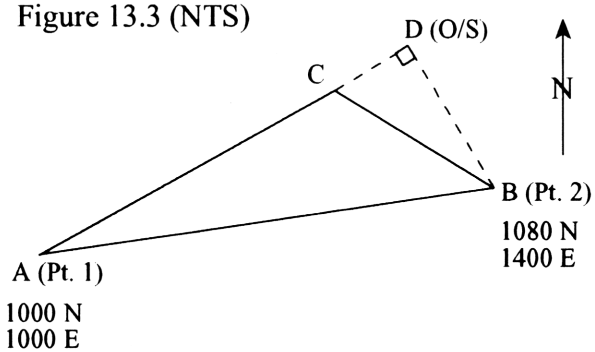


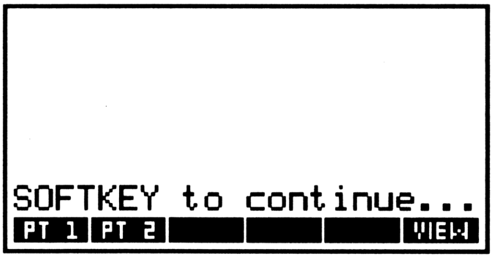
Figure 13.3 (NTS)



Press [NO] to view the **inter-sections setup change** menu in Figure 13.4.

It doesn't matter how a triangle figure is oriented as long as the point 1 & 2 inputs are consistent.

Figure 13.4



Whenever you are prompted for an azimuth or a distance you should enter the value *from* point 1 or 2 *toward* the unknown point.

Press [PT 1] and enter **A** at the **FIRST point** prompt. The calculator will beep and you will see the usual **CREATE?** prompt. Press [YES] and enter:

1000 for the northing.
1000 for the easting.
100 for the elevation.
Press the **ENTER** key to store a null string for the description.

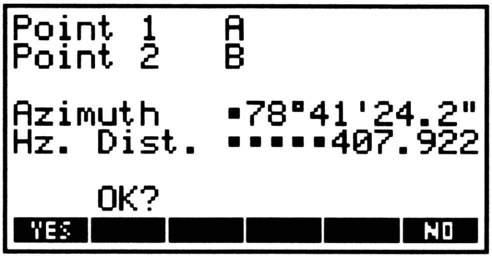
Press [PT2] and enter **B**. Once again the calculator will beep and display the **CREATE?** prompt. Press [YES] and enter:

1080 for the northing.
1400 for the easting.
100 for the elevation.
Press the **ENTER** key to store a null string for the description.

Press [VIEW]. If your display matches Figure 13.5 press [YES] to get to the **intersection options** menu in Figure 13.6.

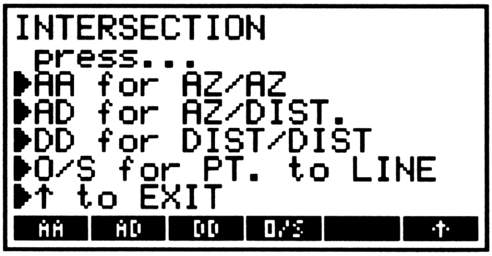
Otherwise try re-entering the point 1 & 2 data using different names. (e.g. A1)

Figure 13.5



Press [AA] to do an azimuth/azimuth intersection.

Figure 13.6



The first prompt is for the **Az.(imuth) away from Pt. 1.** Enter **56.18358**.

At the **Az. away from Pt. 2** prompt enter **320.11399**.

Figure 13.7

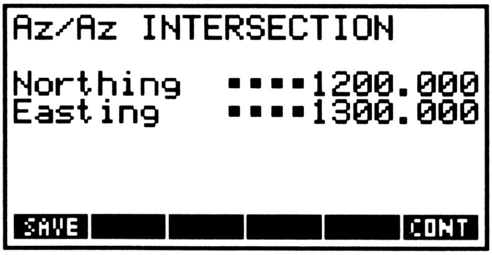


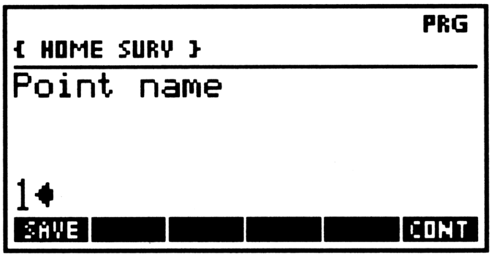
Figure 13.7 contains the coordinates of the azimuth/azimuth intersection.

Notice the menu in the Figure 13.7 display. When you are confident that the calculated coordinates are correct you can press [SAVE]; if you think you may have entered the wrong data just press [CONT].

This time press [SAVE]. The Figure 13.8 display will appear with point **1** as a default. You could just press the ENTER key to use the default if it is not in the file.

We know point A is in the file so try entering **A** now.

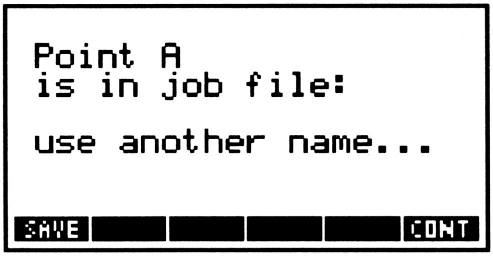
Figure 13.8



The calculator will beep and you will see the Figure 13.9 display for a few moments.

The routine won't let you overwrite a point in this situation so you have to enter a new point name when the Figure 13.8 display re-appears.

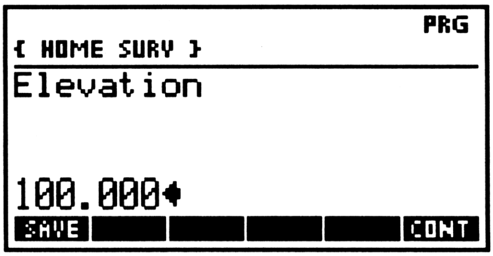
Figure 13.9



Try typing 1 to make the point name A1. After the name is entered you will be prompted for an elevation as in Figure 13.10.

Just press the ENTER key to accept the default.

Figure 13.10



(You often won't need an elevation for the intersected point but the file needs a placeholder so you can just enter zero if you want.)

At the description prompt you can just press ENTER again. The point will then be saved to the current job file.

Press [AD] to try an azimuth/distance intersection. At the **Az. away from Pt. 1** prompt, enter **56.18358**. This time a **Distance 2** prompt appears. In this case you would enter the distance from Pt. 2 (**B**) to the intersection point. Enter **156.205**.

The azimuth/distance result is displayed in Figure 13.11.

Figure 13.11

```
Az/Dist  INTERSECTION
  Solution 1
Northing   ....1218.462
Easting    ....1327.693
  Solution 2
Northing   ....1200.000
Easting    ....1299.999
SAVE                CONT
```

This type of intersection yields two possible solutions and in this case the two sets of coordinates do not differ by very much.

Press [SAVE] to view the Figure 13.12 display.

Figure 13.12

```
Save solution 1 or
     solution 2?

1                      2
```

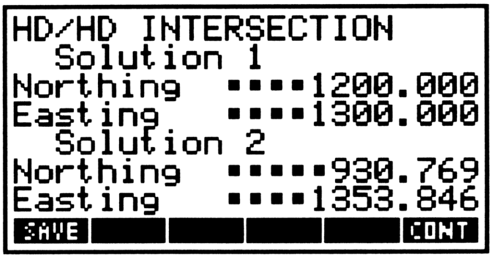
You can only save one of the solutions. This time press [2].

When the **Point name** prompt appears **2** is shown as the default to remind you that you chose to save the second solution. Enter **A2** for the point name and press the ENTER key twice to accept the default elevation and description. Point A2 is saved.

Press [DD] to try a distance/distance intersection. The first prompt is for **Distance 1**. (The distance from Pt. 1 (**A**) to the intersection point.) Enter **360.555**. At the **Distance 2** prompt (the distance from Pt. 2 (**B**) to the intersection) enter **156.205**.

As Figure 13.13 illustrates, there are two solutions with this method also. The proper distance/distance solution is generally much more obvious than the proper solution with the azimuth/distance method.

Figure 13.13

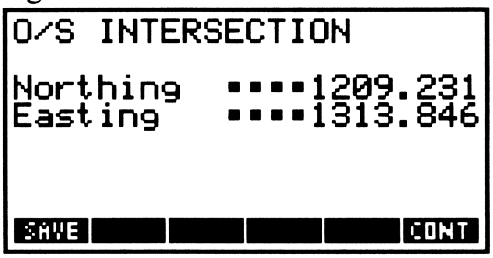


We won't save this time so just press [CONT] to get to the **intersections options** menu in Figure 13.6.

For the intersection of a point to a line example, press [O/S]. In this case the first (and only) prompt is for an **Az. away from Pt. 1**. Enter **56.18358**.

The intersection calculation in Figure 13.14 shows the coordinates of a point on the projection of line **AC** at **D** in the Figure 13.3 sketch. Line **BD** is perpendicular to line **AD**.

Figure 13.14



We won't save this time either so press [CONT] to get to Figure 13.6.

Press [↑], [END] and [QUIT].

Predetermined Areas

Data needed...

• Current job file: JOB1.

• Control points: **A** and **B** from Intersections. (These points can be added at the routine setup.)

Changes...

• N/A (New routine)

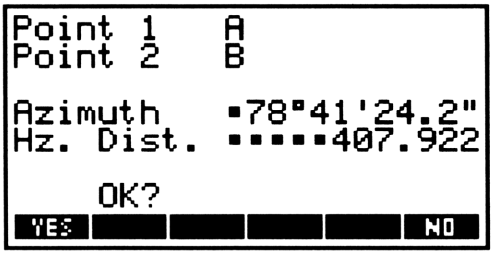
Configuration...

• N/A

Enter **S.P** to start the program. Press [UTILS] then [↓] to get to the **second utilities** menu.

Press [PDA] to see the setup display in Figure 14.1. If necessary enter points **A** and **B**. (The data can be found in Figure 14.3.)

Figure 14.1



When you work with predetermined areas, you will be prompted for azimuths away from points 1 and 2 just as in the Intersections chapter. (Once again it doesn't matter how a triangle or trapezoid figure is oriented as long as the point 1 & 2 inputs are consistent.)

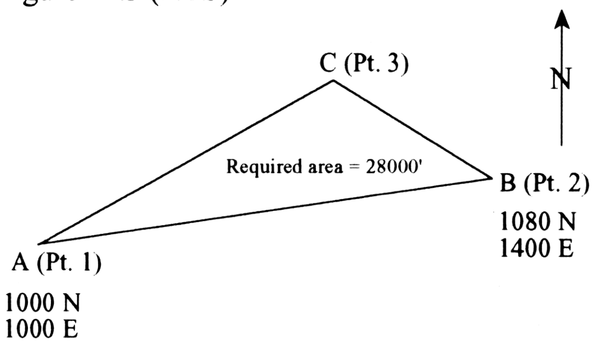
Press [YES] to see the **predetermined area options** display in Figure 14.2.

Figure 14.2

Triangular Parcel

Let's do a triangular calculation first using the sketch in Figure 14.3. Press [TRI∡].

Figure 14.3 (NTS)

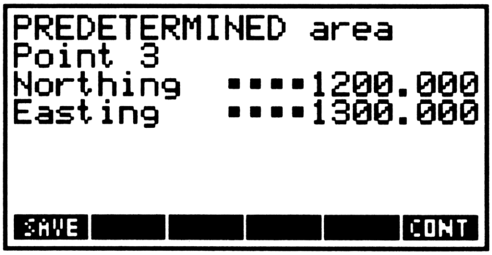


At the **Required area** prompt enter **28000.**

The next prompt is for the **Az. away from Pt. 2**. (In this case Pt. 2 is control point **B.**) Enter **320.1140**.

Figure 14.4 displays the calculated coordinates of the point needed for an area of 28000.

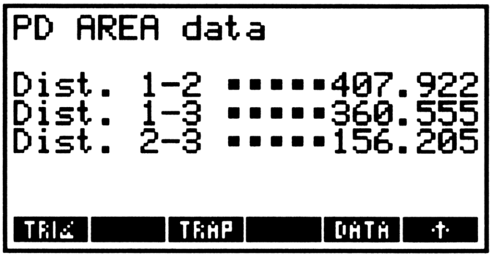
Figure 14.4



We won't save this point so press [CONT] then press [DATA] to see the triangle sides in Figure 14.5.

The distances shown in Figure 14.5 are relative to how you have set up the figure.

Figure 14.5



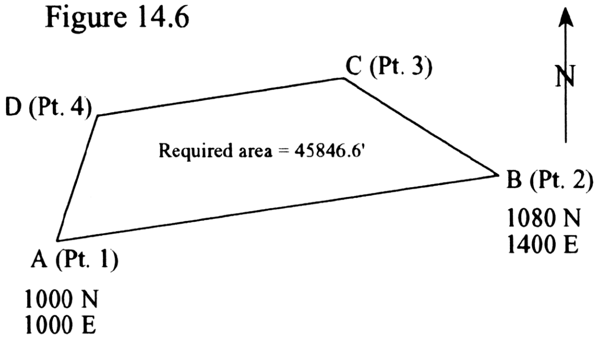
Referring to the Figure 14.3 sketch, in this example:

- the **1-2** distance is **A-B**
- the **1-3** distance is **A-C**
- the **2-3** distance is **B-C**

Trapezoidal Parcel

To save setup time we will use the same baseline points for the trapezoid example in the Figure 14.6 sketch.

Figure 14.6



The trapezoid in Figure 14.6 is composed of the triangle from Figure 14.3 and point **D**. Sides A-B and C-D are parallel.

Press [TRAP] to start.

At the **Required area** prompt enter **45846.6**.
At the **Az. away from Pt. 1** prompt enter **16.4916**.
At the **Az. away from Pt. 2** prompt enter **320.1140**.

Figure 14.7 shows the calculated coordinates of points **3** (C) and **4** (D) that will give an area of 45846.6.

This time we will save the points. Press [SAVE].

Figure 14.7

```
PREDETERMINED area
Point 3
Northing    ▪▪▪▪1200.000
Easting     ▪▪▪▪1300.000
Point 4
Northing    ▪▪▪▪1149.010
Easting     ▪▪▪▪1045.049
SAVE                CONT
```

The **Point name** prompt shows **3** as the default to remind you which point is being saved. Enter **PDA3** for the point name and press the ENTER key twice to accept the default elevation and description.

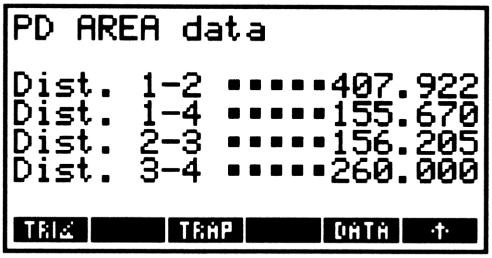
The **Point name** prompt will re-appear this time showing **4** as the default point reminder. Enter **PDA4** for the point name and again press the ENTER key twice to accept the default elevation and description.

Both points will be saved to the current job file and you will be returned to the Figure 14.2 display.

Press [DATA] to see the sides in Figure 14.8. As usual the distances shown are relative to the way the figure is labelled.

In this example:

Figure 14.8



- the **1-2** distance is **A-B**
- the **1-4** distance is **A-D**
- the **2-3** distance is **B-C**
- the **3-4** distance is **C-D**

Press [↑] twice then [END] and [QUIT] to leave the SURVcalc environment.

Clearances

Data needed...

- Current job file: N/A.

- Control points: N/A

Changes...

- N/A (New routine)

Configuration...

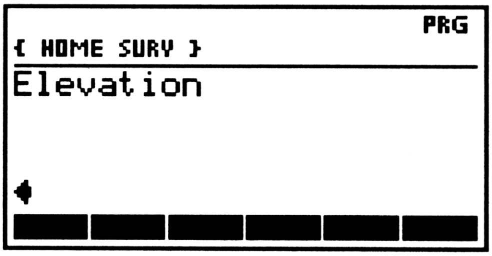
- Enter **S.P** to start the program. Press [CONFI] then [DIST] to toggle SLOPE distances. Press [↑] to get back to the **program main** menu.

We will be checking the minimum clearance in the Figure 15.2 sketch below of a cross section through an ALRT guideway.

Press [UTILS] then [↓] to get to the **second utilities** menu.

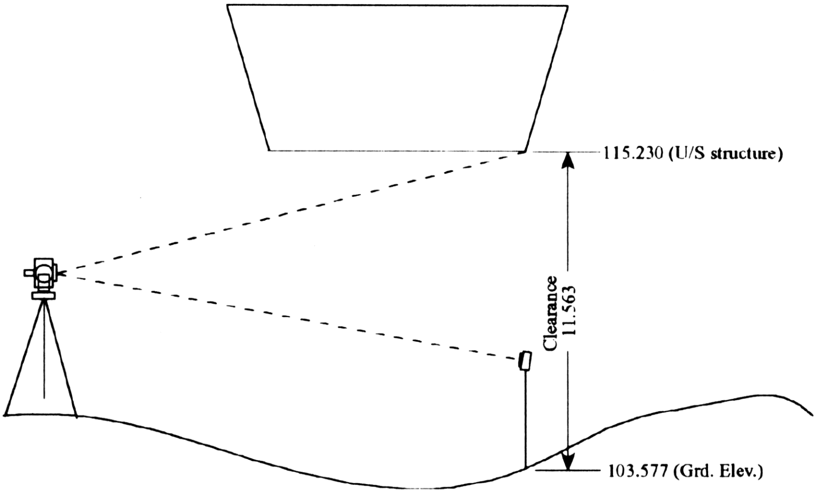
Press [CLEAR]. The first prompt is for the **Elevation** of the setup. If you are not interested in the *actual* ground and U/S of structure elevations you can just enter an arbitrary elevation here.

Figure 15.1



In this example enter **105.29**.

Figure 15.2 (NTS)

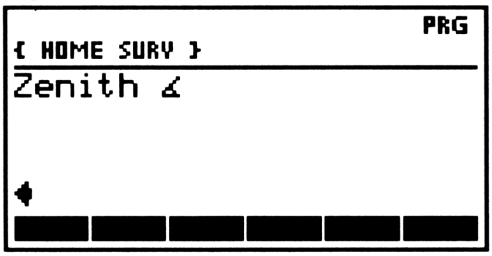


Then enter:

5.72 for the Height of instrument.
5.87 for the Sig. Ht.

The next prompt in Figure 15.3 is for the **Zenith ∡** to the prism. (The rodman should try to find a point on a plumb line with the low point of the structure.)

Figure 15.3



Enter:

92.3125 for the zenith ∡.
35.5 for the slope distance.

Figure 15.4 now prompts you for the zenith ∡ to the low point of the structure.

Enter **83.1252** to see the calculation display in Figure 15.5.

Figure 15.4

```
                              PRG
{ HOME SURV }
Enter Zen. ∡ to low
point of structure
```

Figure 15.5 shows that the U/S (underside) elevation is 115.23, the Grd. (ground) elevation at the prism is 103.577 and the clearance at this point is 11.653.

Press the ENTER key.

Figure 15.5

```
U/S Elev. ▪▪▪▪▪115.230
Grd. Elev.▪▪▪▪▪103.577

Clearance ▪▪▪▪▪▪11.653

 ENTER to continue...
```

Clearances With Horizontal Distances

When you calculate a clearance with the program configured for horizontal distances, you will be prompted for a Δ elevation and horizontal distance instead of a zenith ∡ and slope distance.

The last prompt will still be for a zenith ∡ as in Figure 15.4 above.

Power Line Caution

Be extremely careful when working on power line clearances. Remember that even fibreglass rods are not guaranteed to be non-conductive.

Press [↑] then [END] and [QUIT] to leave the program.

Radius Points & Curve Data

Data needed...

• Current job file: JOB1.

• Control points: A and B from Intersections.

Changes...

• N/A (New routine)

Configuration...

• Enter **S.P** to start the program. Press [CONFI] then [°UNIT] to toggle FEET. Press [↑] to get back to the **program main** menu.

You can use this routine to calculate radius points for circular curves. All the remaining circular curve data will also be shown including the areas of the segment, sector and fillet.

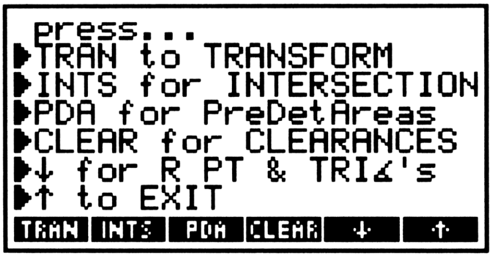
You can also calculate just the curve data using various element combinations. We will look first at the radius point option.

Radius Point Calculation

Press [UTILS] then [↓] to get to the **second utilities** menu.

Notice that the second last line in the Figure 16.1 display indicates that the **R PT** (radius point) routine is found on the next menu.

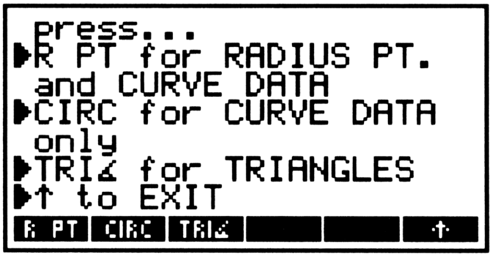
Figure 16.1



Press [↓] to get to the **third utilities** menu in Figure 16.2 below.

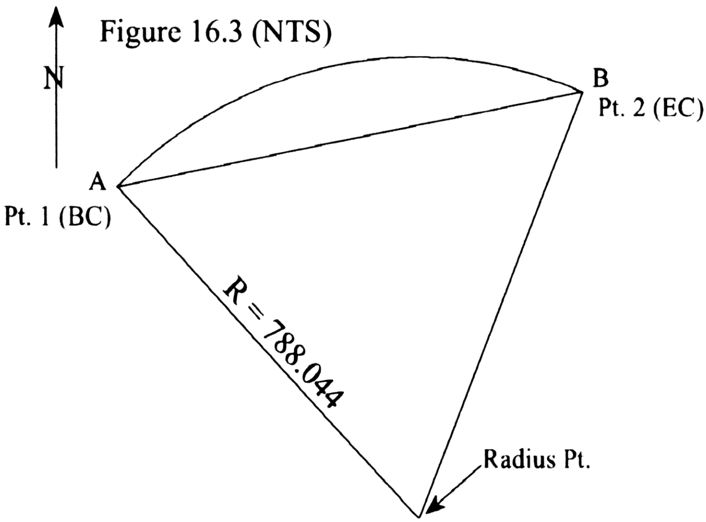
The **third utilities** menu in Figure 16.2 also contains the circular curve data and triangle routines.

Figure 16.2



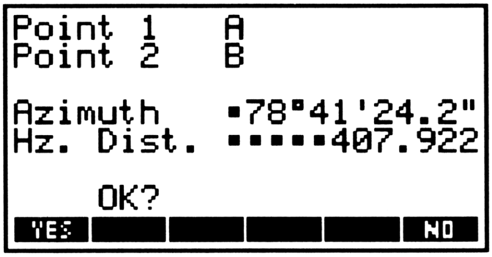
We will be calculating the radius point and curve data using the Figure 16.3 sketch.

Figure 16.3 (NTS)



Press [RPT]. We will use points A and B from the Intersections chapter as the BC and EC respectively. If they are not in your calculator press [NO] and add them now.

Figure 16.4

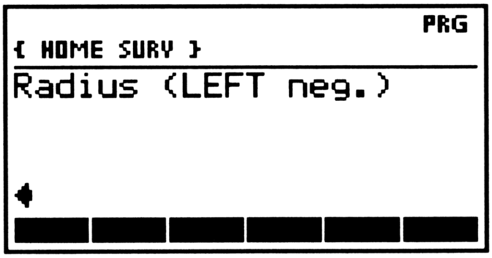


When your display matches Figure 16.4 press [YES].

Notice in Figure 16.5 that a curve left radius should be negative.

Our example is a curve right so just enter **788.044**.

Figure 16.5

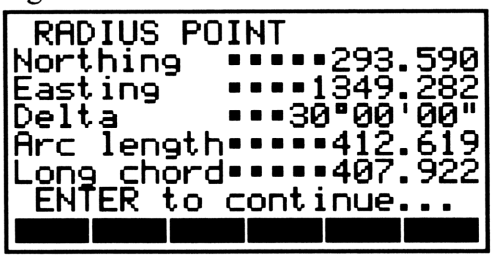


The example has the standard BC-EC naming to show the data entry order. If you are calculating a radius point that is part of a spiral segment just substitute the SC-CS data at these prompts.

Figure 16.6 shows the first page of the calculation. You should always compare any of this data to the corresponding plan data as checks.

As per the last line in Figure 16.6, press the ENTER key to see the remaining circular curve data.

Figure 16.6



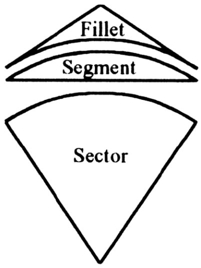
The sector, segment and fillet areas (as indicated in Figure 16.8 below) are shown with an **F²** tag as we configured for FEET. When you have configured for METERS the tag will be **M²**.

Figure 16.7

```
Tangent    ■■■■■211.156
External   ■■■■■■27.799
Mid. Ord.  ■■■■■■26.852
Sector   F²■■162580.914
Segment  F²■■■■7327.577
Fillet   F²■■■■3819.111
 ENTER to continue...
```

Note: You will get the best results when you use as many decimals as appear on the plan.

Figure 16.8



Press the **ENTER** key to view the Figure 16.9 display below.

As in the Intersections and Predetermined Areas routines you have the option to save the radius point to the current job file.

Figure 16.9

```
Save Radius Point?




SAVE                    CONT
```

Press [SAVE]. At the **Point name** prompt enter **RPT1**.

Press the **ENTER** key twice to accept the default elevation and description. The radius point will be saved and you will be returned to the **third utilities** menu in Figure 16.2.

Circular Curve Data Calculation

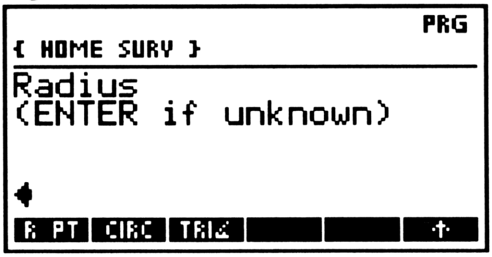
When you don't need the radius point coordinates, you can calculate the circular curve data using various combinations of elements.

At the Figure 16.2 menu press [CIRC].

The first prompt in curve data calculation is for the radius.

Enter **788.044** at the **Radius** prompt in Figure 16.10. (When the radius isn't known just press the ENTER key.)

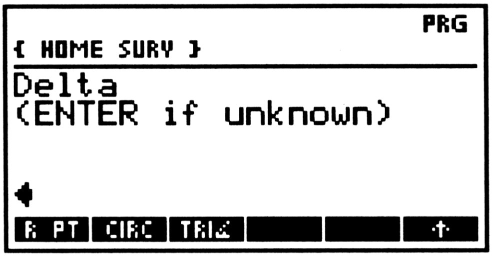
Figure 16.10



You are next prompted for **Delta**. If delta is known the calculations will be done after you enter it.

For this example let's say we don't know delta. Just press the ENTER key.

Figure 16.11

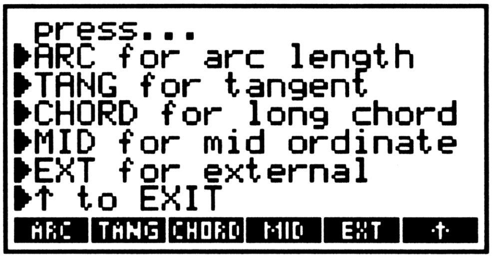


Note: You have to enter at least one of the above. If you just press the ENTER key for both prompts the calculator will beep and a message display will appear. After pressing ENTER you will be returned to the **Radius** prompt.

To complete the calculations you choose one of the elements in Figure 16.12.

We will only do one example calculation. You can practice with the other elements that appear in the calculation displays below.

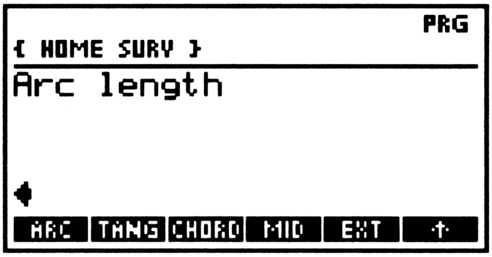
Figure 16.12



Press [ARC]. At the **Arc length** prompt enter **412.619**.

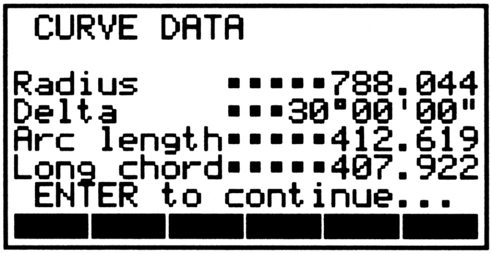
The first calculation display appears in Figure 16.14.

Figure 16.13



As per the last line in the Figure 16.14 display, press the ENTER key to see the second calculation display below.

Figure 16.14



This time when you press the enter key you will be returned to the Figure 16.2 display.

Figure 16.15

Tangent ▪▪▪▪▪211.156
External ▪▪▪▪▪▪27.799
Mid. Ord. ▪▪▪▪▪▪26.852
Sector F^2▪▪162580.964
Segment F^2▪▪▪▪7327.584
Fillet F^2▪▪▪▪3819.114
ENTER to continue...

Note: Using different elements will often result in slight differences in the calculated values. (For example compare the Figure 16.15 areas to the Figure 16.7 areas.)

Press [↑] twice then [END] and [QUIT] to leave the SURVcalc environment.

Triangle Solutions

Data needed...

- Current job file: N/A.
- Control points: N/A.

Changes...

- N/A (New routine)

Configuration...

- Start the program by entering **S.P**. Press [CONFI] then [UNIT] to toggle FEET. Press [↑] to return to the **program main** menu.

Press [UTILS] then [↓] to get to the **second utilities** menu.

Notice that the second last line in the Figure 17.1 display indicates that the **TRI∡** routine is found on the next menu.

Press [↓] to get to the **third utilities** menu in Figure 17.2 below.

Figure 17.1

```
 press...
▶TRAN to TRANSFORM
▶INTS for INTERSECTION
▶PDA for PreDetAreas
▶CLEAR for CLEARANCES
▶↓ for R PT & TRI∡'s
▶↑ to EXIT
TRAN | INTS | PDA | CLEAR | ↓ | ↑
```

The **third utilities** menu in Figure 17.2 also contains the radius point/circular curve data routines.

We will be using the standard triangle in the following sketch.

Figure 17.2

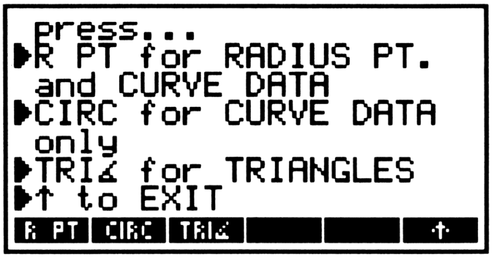
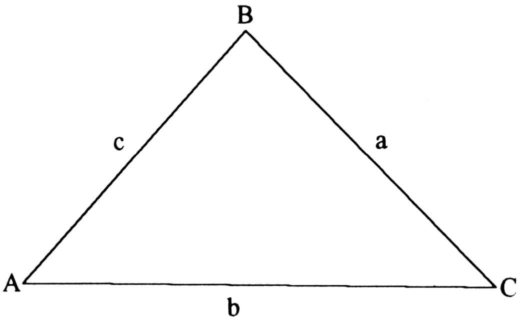


Figure 17.3 (NTS)



- Angles are shown with upper case letters.
- Sides are shown with lower case letters and are located opposite the corresponding angles.

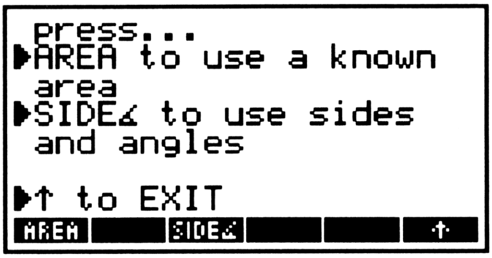
All the calculation methods will prompt you relative to the standard triangle and in the order shown on the softkey. For example, if you are using the **ASA** (angle-side-angle) method you are first prompted for **∡ A** then **Side c** then **∡ B**. (You could substitute *any* two angles and their included side.)

Press [TRI∡] now to view the **triangle main** menu and display in Figure 17.4 below.

The Figure 17.4 menu allows you to use **known area** or **sides and angles** methods.

Let's look at the area methods first. Press [AREA] to view the **area options** display in Figure 17.5.

Figure 17.4



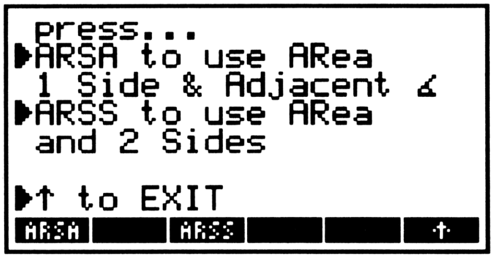
Using Known Areas

The first method uses an area, side and angle.

The second method uses the area and two sides.

The sides and angles used in the examples are shown in the following table.

Figure 17.5



Angle/Side		
A/a	53°54'36"	313.31
B/b	78°44'17"	380.25
C/c	47°21'07"	285.176

Area•Side•Angle Solution

Press [ARSA] . Enter:

43814.03 at the **Area** prompt.
380.25 at the **Side b** prompt.
53.5436 at the ∡ **A** prompt.

The results appear in the Figure 17.6 display.

Press [CONT] to return to the Figure 17.5 display.

Figure 17.6

```
Side a      ▪▪▪▪▪313.310
Side b      ▪▪▪▪▪380.250
Side c      ▪▪▪▪▪285.176
∡ A         ▪▪▪53°54'36"
∡ B         ▪▪▪78°44'17"
∡ C         ▪▪▪47°21'07"
 AREA    F²▪▪▪43814.030
                    CONT
```

Area•Side•Side Solution

Press [ARSS] to try the second *known-area* method.

Enter:

43814.03 at the **Area** prompt.
313.31 at the **Side a** prompt.
380.25 at the **Side b** prompt. (This display is not shown.)

Your display should match Figure 17.6.

Note: This last method will yield incorrect values if the known sides include an **obtuse** angle.

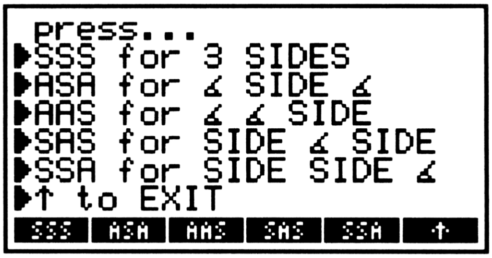
Press [CONT] and [↑] to get back to the Figure 17.4 display.

Using Sides and Angles

Press [SIDE∡] to view the Figure 17.7 sides and angles options display.

We will only use the **SSA** (side-side-angle) method as an example. This is the only method that yields two solutions.

Figure 17.7



You can try the other methods on your own using the values from the table.

Press [SSA]. Enter:

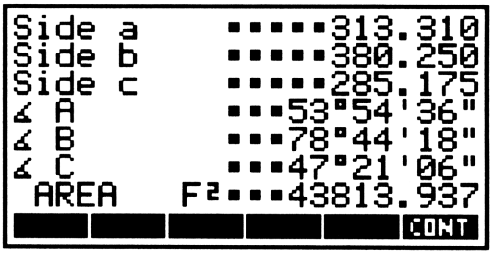
313.31 at the **Side a** prompt.
380.25 at the **Side b** prompt.
53.5436 at the **∡ A** prompt.

Figure 17.8 will appear with the first solution.

Press [CONT] to see the second solution in Figure 17.9 below.

In this example the two solutions are quite far apart so it is fairly easy to see which solution applies to the example triangle.

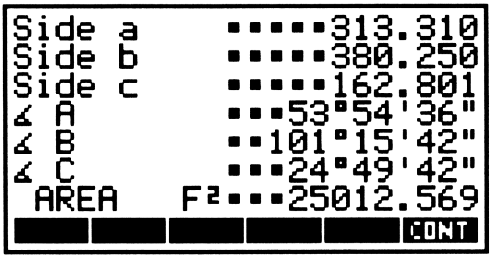
Figure 17.8



You have to be careful to check for the correct solution for the triangle you are working with.

In this case Figure 17.8 has the correct solution for our example triangle.

Figure 17.9



Sometimes the correct solution will be obvious because the incorrect solution will have *negative* values.

All the areas are shown with an **F²** tag as we configured for FEET. When you have configured for METERS the tag will be **M²**.

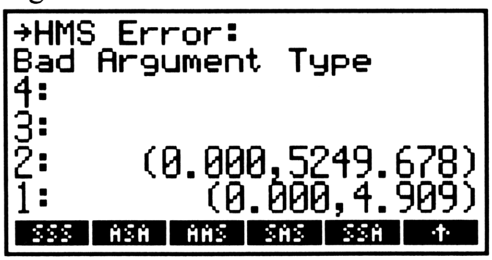
Slight differences will appear (e.g. the area in Figure 17.8 versus the area in Figure 17.6) using different methods.

Sometimes when you enter invalid data the calculator will beep and you will see a display similar to Figure 17.10 with an HP error message and some complex numbers.

You can just clear the display and press a softkey to re-enter the data.

Press CONT to return to the sides and angles menu. Press ↑ three times then END and QUIT to leave the SURVcalc environment.

Figure 17.10



File Conversion

This chapter describes the **IBM** version of the file converter. A **Mac** system 7.x version is available to registered users. Please contact us for more information.

The file conversion utility **PC2SC2.EXE** on disk will convert ASCII files output by your computer survey software to SURVcalc sideshots/ layout format. It will also convert from SURVcalc format to a comma or space delimited file for use by your PC survey software.

People who have upgraded from SURVcalc version 1.0 please note the following changes to this utility:

• The original utility was called PC2SC.EXE; the utility supplied with this version has a **2** tacked on the end of the name. (PC2SC**2**.EXE)

• As the separate control point file (M.CTL) is no longer used the option to create a file with a **.CTL** extension has been removed.

• You can now convert both comma and space delimited PC files to SURVcalc format or convert from SURVcalc format to either comma or space delimited files to be read by your PC survey software.

Two sample files have been provided on disk that you can use in the following examples. **SC1.SLO** is an example of a sideshots/layout file in SURVcalc format. **PC1** is an example of a file output from a PC survey software program in space delimited format.

The utility will search along any path for a file but to keep data entry to a minimum you should keep file PC2SC2.EXE in the directory where your PC output files are kept.

Start the utility by typing **PC2SC2** and press the Enter key. The screen in Figure 18.1 will appear.

Figure 18.1

```
                    CARTESIAN SYSTEMS LIMITED
                  file conversion utility v. 1.02
                    (c) Copyright 1993, 1994



Convert from...


A) PC to SURVcalc
   (Pt# N E EL or Pt#,N,E,El to Name N E EL Description)

or...

B) SURVcalc to PC
   (Name N E EL Description to Pt# N E EL or Pt#,N,E,EL)

Q) Quit

Type choice (A,B or Q) _
```

Whenever you see a menu as above, you make your choice by pressing the appropriate letter: in this case A, B or Q. Letters can be entered in UPPER or lower case and you don't have to press the Enter key.

Notice that the utility expects your PC files to be in Pt# N E EL (space delimited) or Pt#,N,E,EL (comma delimited) format. (When going from SURVcalc to the PC you will be given the option of outputting in either format.)

Converting From the PC to SURVcalc

At the Figure 18.1 display press the **A** key.

Figure 18.2

```
Enter PC file name and optional path to convert to SURVcalc or
type = and hit Enter for MAIN MENU. _
```

The first prompt is for the PC file name to convert. Notice that you have the option to go back to the MAIN MENU by entering an *equals* (=) sign. You will see this option at all file name prompts.

Before doing the actual conversion let's make some entries to see how the program handles errors.

Try entering **pc9** at this prompt. The computer will beep and you will see the Figure 18.3 message.

Figure 18.3

```
File  PC9  not found! Any key to try again...
```

After you press any key you will be returned to the Figure 18.2 display.

This time try entering the following non-existent file path: **c:\ddd\pc9**.

Figure 18.4

```
Path  C:\DDD\PC9 not valid! Any key to try again...
```

The calculator will beep again and you will see the Figure 18.4 message display. Press any key to get back to the Figure 18.2 display.

This time enter **pc1**. Now, provided you have file **pc1** in your current directory, the program accepts the existing file name and the prompt in Figure 18.5 below will appear.

Figure 18.5

```
Enter a name for the SURVcalc output file with optional path or
type = and hit Enter for MAIN MENU. _

(The HP 48 does not allow the FIRST character to be a number.)
```

Notice the reminder in the last line that HP 48 file names must not begin with a number. The program checks to see if you have used a number as the first character. If it finds a number an **A** will be prepended to the file name and if necessary (to meet the DOS 8 character file name maximum) it will drop the last character.

Try entering **sc1**. The computer will beep again and the Figure 18.6 prompt will appear.

Figure 18.6

```
File  SC1.SLO  exists!

Do you want to OVERWRITE it? (Type Y or N) _
```

Notice that the program automatically adds the **.SLO** extension to the file name. In a situation like this you could overwrite the existing file if you were certain that you no longer needed it. This time press **n** and enter **sc2**.

Figure 18.7

```
Conversion complete: any key for menu _
```

The message in Figure 18.7 will appear when the conversion is finished. You can then press any key to return to the main menu.

Converting From SURVcalc to the PC

Converting files in the other direction is basically the same. You provide the utility with a valid SURVcalc file and you can convert it to either a space or a comma delimited file for your PC survey software. At the Figure 18.1 display type **B**. The SURVcalc file name prompt will appear.

Figure 18.8

```
Enter SURVcalc file name and optional path to convert to PC or
type = and hit Enter for MAIN MENU. _

(File extension NOT required.)
```

Notice the reminder in the last line in Figure 18.8 that the file extension is not required.

Enter **sc1**. The Figure 18.9 option display appears.

Figure 18.9

```
   Convert to a...

A) Space Delimited

         or

B) Comma Delimited

       PC file

Type choice (A or B) _
```

Most PC survey software programs will import files in either format. In this case type **B** to output a comma delimited file.

Figure 18.10

```
Enter a name for the PC output file with optional path or
type = and hit Enter for MAIN MENU. _
```

Enter **pc2** to create a new file. The file will be created and the Figure 18.7 display will appear. Press any key to return to the main menu. Press **Q** to return to the DOS prompt.

Note: There may be times when you convert a SURVcalc file that contains one or more alpha names. (eg A1, A2)

When the conversion utility finds an alpha name it will be converted to a number beginning with 8000 plus the current point count.

For example if the point names in a file are 1,2,**A1**,7,8... the third point (A1) will be renamed 8003. (8000+3) You can then edit the file from within your PC survey software to give these points other numeric names.

Viewing and Editing ASCII Files

If you don't have a text editor you can quickly view PC or SURVcalc files in ASCII format by using the DOS **type** command.

To do any editing you have to load the file into a text editor. Most word processors allow you to import ASCII files but you have to make sure to save the file in ASCII format also.

Appendixes

A: File Formats

All data files created by the routines are saved as HP lists. String fields are enclosed in quotes. Remember to type the **extension** when you want to EDIT/VISIT a data file.

The only limit on data file size (or the number of files that can be created) is your calculator's memory configuration.

Horizontal Alignment Files (NAME.ALN)

Each horizontal alignment record contains four fields.

Figure A1

	Element	Station	Northing	Easting
{	"P.O.T."	500	20356.876	35021.568
	"TS"	554	20353.609	35075.467
	"SC"	606	20348.957	35127.325
	"R PT"	""	20052.207	35083.281...}

Notice that a null string replaces the station field in "R PT".

Horizontal alignment files can be edited from within the routine but if either the first or last stations (chainages) are changed the file **must be re-loaded**. (See the Alignment Change routine.)

Vertical Alignment Files (NAME.ALG)

Each vertical alignment record contains three fields.

Figure A2

	Element	Station	Elevation
{	"BVC"	500	156.876
	"PVI"	654	153.609
	"EVC"	849	148.957
	"P.O.G."	955	152.207...}

As with horizontal alignment files, you can edit a vertical alignment from within the routine. After editing do a calculation in a new segment. You can then return to continue calculations in the problem segment.

Sideshots/Layout Files (NAME.SLO)

Sideshots and layout files have the same format and so use the same extension. (Transformed coordinates are also saved to a file with a **.SLO** extension.)

Each record contains five fields.

Figure A3

	Name	North	East	Elev.	Desc.
{	"S1"	19980	35080	105	"HUB"
	"B1"	19970	34950	115	"IP"...}

Before editing points, use the SURVcalc FCOPY feature to make a copy of the file. You could also use Kermit to send a copy of the file to your computer as a backup.

Transformation Setup Files (NAME.TRS)

As mentioned in the Coordinate Transformation chapter even though the creation of a transformation setup by coordinates, differs from its creation by rotation angle, the setup file created in both methods is identical.

The file contains 6 items as illustrated in Figure A4.

Figure A4

OLD N.	OLD E.	NEW N.	NEW E.	Rot.∡	Scale factor
{18332.64	27153.59	25000	43000	-3	1 }

Unadjusted Traverse Files (NAME.TRU)

The first ten items are the setup and backsight station data. Then, for each point tied in, you will see the shot data in the order...

horizontal angle, **difference in elevation** and **horizontal distance**. (There will also be two **null string** ("") fields as placeholders.)

Note: Regardless of whether you run a traverse using horizontal or slope distances, the shot data is always *stored* as an **elevation difference** and a **horizontal distance**.

After the shot data the resulting coordinates will be seen in the usual five field record. (Name, Northing, Easting, Elevation & Description.)

This sequence will be repeated for all points tied in.

An *open* traverse also contains the total distance traversed. This value is used when an open traverse is continued. (When the open file is continued and the traverse is closed, the file loses its 'open' status.)

Adjusted Traverse Files (NAME.TRA)

Adjusted traverse files have the same basic format as unadjusted files. You can use this file to add points to your current job file if the points were not added during the traverse.

The differences in elevation and horizontal distances are overwritten with null strings ("") because the routine does not change the unadjusted values during the adjustment.

The traverse routine does not purge either type of file so you should make sure to purge old files when you do your HP 48 housecleaning.

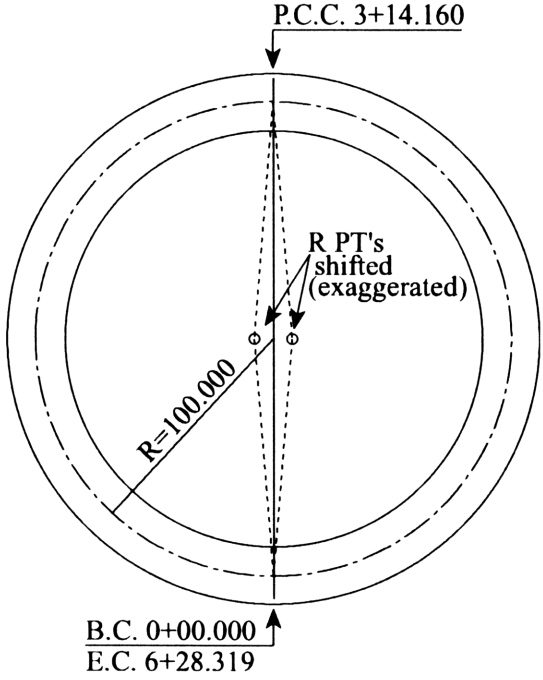
B: Alignment Design Tips

As mentioned in the horizontal alignment chapter, as long as an alignment is created logically, there are an unlimited number of possible designs. Following are some examples of alignments that require a little extra caution during creation and use.

Continuous Circular Curve

Figure B1 illustrates the underground ramp alignment mentioned in the alignment chapter. We will make one revolution.

Fig. B1 (NTS)



As delta **MUST** be less than 180° create the alignment as two semi-circular segments shifting the **R PT** slightly, relative to the curve direction, and perpendicular to the **BC-PCC** diameter.

Referring to Figure B1, to create a clockwise alignment with a 100 foot radius, you would start with a **BC** at 0+00 followed by the **R PT** shifted, say .002, to *alignment* right. (For an anticlockwise alignment you would shift the **R PT** to *alignment* left.)

Then you would enter a **PCC** at 3+14.159 to complete the first semicircle. Next you would re-enter the **R PT** again shifted .002 to *alignment* right. To complete the circle, you would enter an **EC** at 6+28.319 coincident with the origin **BC**. (If you start a stakeout without shifting the R PT's the calculator will beep and you will see the Figure B2 display.)

If the display in Figure B2 appears, press the ENTER key to get to the **alignment main** menu. Use the HP EDIT/ VISIT operation to shift the R PT's. Using the **COORD**inate routine calculate and check an R PT in *another* segment, then return to the problem segment and try another calculation. **DO NOT** do any stakeouts until all segments are checked.

Figure B2

```
Δ is ≥ 180°! Edit the
file to shift R PT's
relative to curve
direction. Then re-do
checks.

 ENTER to continue...
```

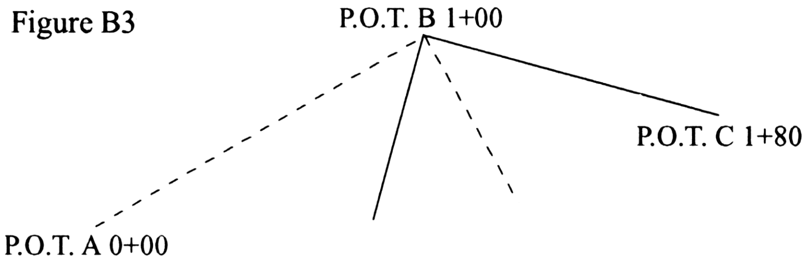
Use the **COORD**inate routine with the radius as the hinge point to check stations in **both** semicircles.

If you want to avoid these kinds of problems with circular alignments you can also divide the alignment into three segments. This way you don't have to shift the radius point; you just have to calculate three stations (and their coordinates) along the circumference and enter one more radius point coordinate pair.

Tangent/Tangent Intersections

Tangent segments can be strung together as in Figure B3.

Figure B3



Notice that there are always two sets of hinge points at each intersection. Hinge points at B can either be perpendicular to line A-B or perpendicular to line B-C. To make sure you use the correct line, either reduce or increase the stationing slightly. For example, if you wanted to stake the hinge point at B relative to line A-B, enter 99.999 at the station prompt.

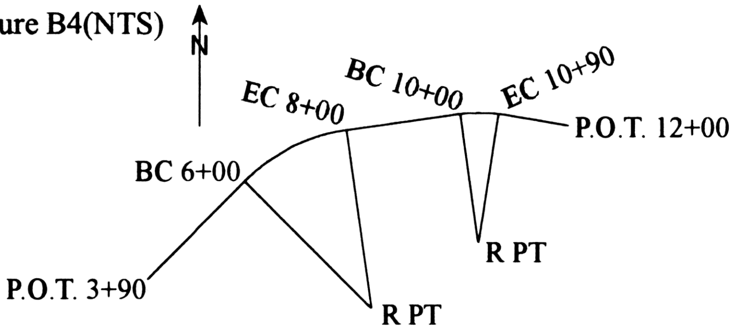
Note: To offset either end of a tangent alignment you can't use the direct method. Instead you can use the indirect method to do a *reverse* layout. Just enter the lowest or highest station, take a test shot and the routine will tell you how far to move ahead/back to get to the lowest/highest station. The rodman can then move toward or away from the station to get to the desired offset.

Tangent/Circular Curve Alignments

Tangent/circular curve alignment creation can be confusing.

Referring to the sketch in Figure B4:

Figure B4(NTS)



If you begin the alignment with a P.O.T. at 3+90, the first circular curve would start with a BC at 6+00. After entering the R PT you would finish the circular curve with an EC at 8+00.

How to handle the tangent segment (8+00 to 10+00 in the Figure B4 sketch) is where the confusion usually arises.

The routine knows that an EC can be the end of a circular curve segment, as well as the beginning of a tangent. And, as in Figure B4 at 10+00, a BC is used to both end this tangent and begin the next circular curve. (You don't need a P.O.T. between the EC/BC.)

Note: To the routine, each segment is a separate alignment. Therefore, **every** segment **must be checked** immediately after alignment creation, and **before** any stakeout.

C: Purging Variables and Files

SURVcalc creates many temporary global variables and data files. If, as mentioned in the Menu Exploration & Initial Setup chapter, you [QUIT] the program from the **program main** menu most of these temporary objects will be purged.

If you press the VAR key after quitting you can then press the NXT key repeatedly to see the remaining global variables and your permanent data files.

All the remaining SURVcalc global variables (those having a **.V** extension) should *not* be purged. These variables contain values that SURVcalc uses at startup. (You can see the data in a variable by simply pressing its softkey.)

To conserve memory, you should regularly purge files that you don't need. If there is any doubt use Kermit to send copies of the files to your computer.

D: Detaching and Purging the Library

To remove the SURVcalc library make sure you are in the directory to which it was attached. Enter **932** on the stack. Press the left (↰) shift key, *either* the VAR *or* G2 key, the NXT key (SX only) then [DETAC].

Type **:n:932** (where n is the port number into which SURVcalc was stored) and press the ENTER key. Press the **left** (↰) shift key then *either* the DEL *or* GEEX key to purge the library. As usual the display will jump around a bit but it's harmless.

E: Suggested Reading

• For the formulas needed to calculate exact x/y values in transition spirals, z values in asymmetrical vertical curves and other values not usually described in most introductory surveying texts, see:

Hickerson, Thomas F. *Route Location And Design*. New York: McGraw-Hill, 1964.

Meyer, Carl F. and David W. Gibson. *Route Surveying and Design*. New York: Harper & Row, 1980.

• Detailed information about Kermit is available in:

da Cruz, Frank. *KERMIT, A File Transfer Protocol*. Bedford MA: Digital Press, 1987.

Gianone, Christine M. *Using MS-DOS Kermit*. Digital Press, 1990

• If you are interested in HP 48 programming:

Donnelly, James. *The HP 48 Handbook*. Corvallis OR: Armstrong Publishing Company, 1993

Coffin, Chris. *An Easy Course in Programming the HP 48G/GX*. Corvallis OR: Grapevine Publications, Inc.

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Version 2.0

Both 3.5" and 5.25" MS-DOS disks included.

Hardware requirements:

- HP 48**SX** with minimum **128k** RAM card or an HP 48GX.
- HP serial interface cable to download.
- IBM PC or compatible computer.
- Downloads from Macintosh system 7.x also: Mac Kermit is **not** supplied.

With the Alignment routine you can create as many permanent, continuous **horizontal** and **vertical** alignment files as memory will allow.

- **slope stake** from within the routine in any segment without setting reference stakes.
- **calculate** the **coordinates** of any station and hinge point.
- stake **remotely** or set up **directly** on the alignment.
- **find** the **station/hinge point** of any point in the current segment by **calculation** or **coordinates**.
- **switch** or **create new alignments** from within the routine.

Using the **separate vertical curve routine** you can:

- create and do grade calculations on a single segment or a continuous vertical alignment.

  Also calculate:
  - the **high/low** point and **crossfall** elevations to any hinge point.
  - elevations of regularly spaced stations using the **interval** function.

Also includes:

- **sideshots** with manual data collection. Also calculate perpendicular offsets.
- **layouts** from a data file or add points on the fly. Now with a **next** feature for sequential layouts.
- **two point resection** with azimuth and distance/elevation checks.
- **traversing** with **auto-close** and **auto-compass rule adjustment**.
- **inverse traversing** with areas using points in the current file; also add points as you traverse.
- **predetermined areas** from triangular and trapezoidal parcels.
- **intersections** (azimuth/azimuth, azimuth/distance, distance/distance and o/s from a point to a line.)
- **7 triangle solutions** including 2 'known area' methods.
- **areas** by **manual entry** or **automatically** using a sequence of points or an entire file.
- **volumes** by average end area.
- **minimum clearances**.
- **radius point** and **circular curve** data calculation.
- **coordinate transformation** with simultaneous **translation**, **rotation** and **scaling**. You can optionally save the transformation setup and transformed coordinates.
- a **file converter** to convert PC files in space/comma delimited format to SURVcalc layout format.
- a **file editor** to **add**, **edit**, **view**, **print** and **purge** current job file points.

Points calculated in the two point resection, traverse, intersections, predetermined areas and radius point routines can be saved directly to the current job file.

Use the **configuration** routine to set defaults for distance type, (slope/horizontal) units(feet/meters), curvature/refraction and grid factor. Chainages will be displayed in terms of 100's of feet or kilometers.

Technical support (not including long distance charges) is free.

 Printed in Canada