

DEDICATION

The Benchmark for Windows Project and Program are dedicated to the memory of **Steve Moore**, long time associate, fellow employee, friend, and, especially, inspiration during his long battle with cancer, which ultimately took him much too soon at the age of 47.

Steve had much to do with the functionality that got included in Benchmark over the years. His unfailing good humor when dealing with some of life's "bad hands" will be long remembered. I can never think about Steve without smiling about some long filed away remembrance of the times we spent together and the sometimes "twisted" humor all of us shared at Computersmith.

- Dusty Smith

ACKNOWLEDGEMENTS

Our special thanks to **Tim Osborn**, long time keeper of the Benchmark program code, for coming out of "arcane program code retirement" to take on the project of turning Benchmark into an application that will actually function effectively in a Windows environment. Tim's dedication to getting this out in a timely manner is much appreciated; his retained knowledge of how this program worked and his ability to find tools to migrate it to Windows are unique: Benchmark for Windows wouldn't exist without his fine efforts.

Thanks also to **Christopher Juliano**, whose unrelenting pressure to get us to do this is one of the reasons it now exists, and to **Suzanne Smith** for her untiring assistance mucking thru and editing the hundreds of pages of documentation that are the manual for Benchmark.

LEGAL STUFF

This publication, or parts thereof, may not be reproduced in any form, by any method, for any purpose without the express written consent of **Applied Spatial Technologies**.

Applied Spatial Technologies makes no representations or warranties with respect to the contents hereof and specifically disclaims any implied warranties of merchantability or fitness for any particular purpose.

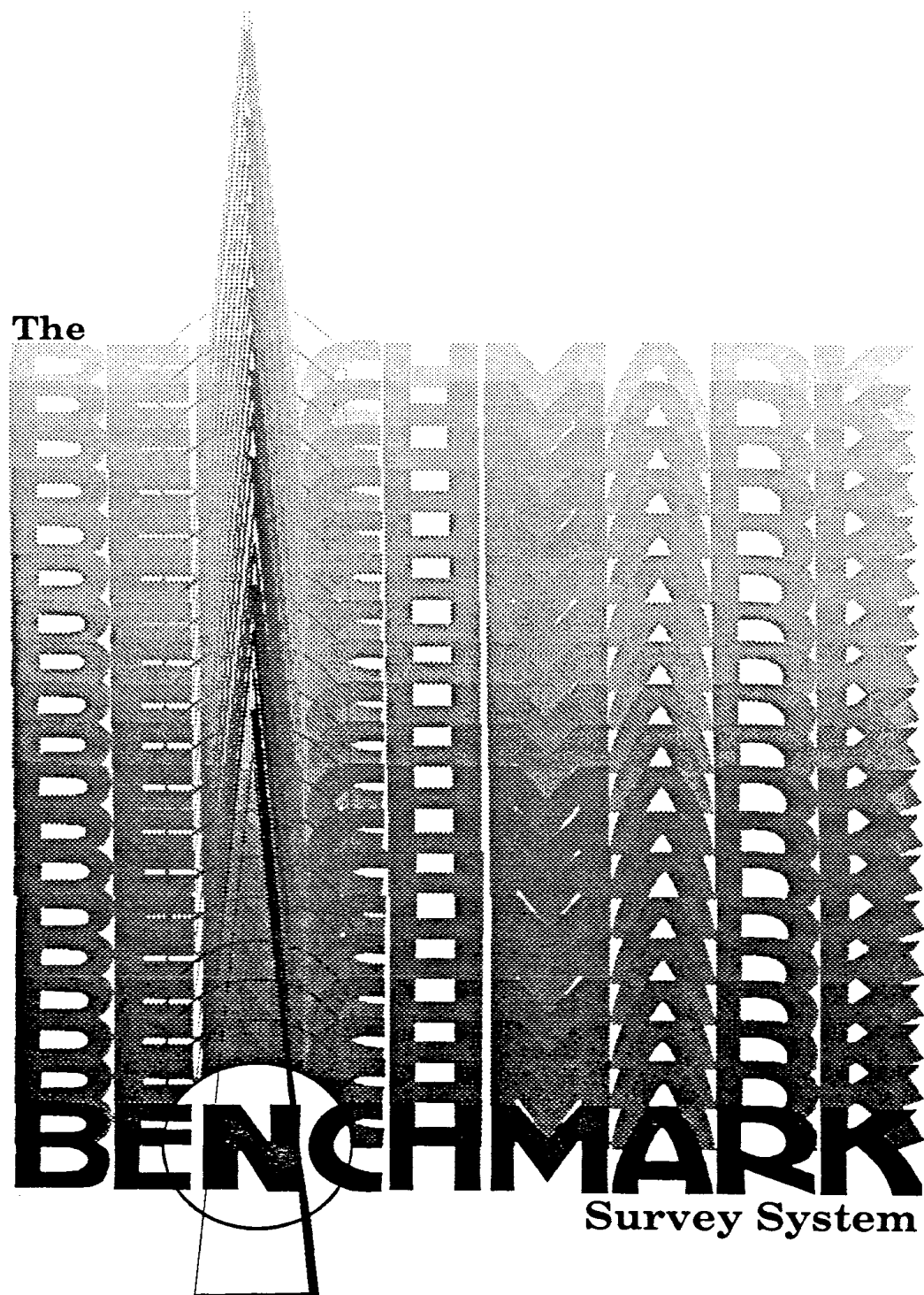
Applied Spatial Technologies reserves the right to revise and improve its products as it sees fit. This publication describes the state of this product at the time of its publication, and may not reflect the product at all times in the future.

This manual was published in March 2004 based on version 8.0 of the Benchmark Survey System for Windows. The manual was prepared using Microsoft Word word-processing software. Illustrations were produced with Autodesk's AutoCAD and merged with Microsoft Word output using proprietary software. Some graphics were produced with Adobe Illustrator. Finally this PDF file you are now reading was produced by converting the edited WORD document with Adobe Acrobat 6.0

IBM is a registered trademark of International Business Machines Corporation. **PostScript** and Adobe Illustrator are registered trademarks of Adobe Systems Incorporated. Apple is a trademark of Apple Computer, Inc. Microsoft is a registered trademark of Microsoft Corporation. **AutoCAD** is a **registered trademark of Autodesk, Inc.**



SPECIAL NOTE: INDEXED CHAPTERS AND OTHER ITEMS HIGHLIGHTED IN RED INDICATE COMPONENTS OF THE SOFTWARE NOT CURRENTLY OPERATIONAL. THESE WILL BECOME FUNCTIONAL IN FUTURE RELEASES.



User Reference

Benchmark Survey System for Windows-v.8.0

March 2004

AST

Copyright 1982,1985,1988,1990,2004. All rights reserved.

Applied Spatial Technologies ,Inc.

Introduction, Index & Preface

Intro-3

Table of Contents

Preface

What Is Benchmark?	ii
Features of The Field Data Editor	ii
Features of Coordinate Geometry	iii
Hardware Requirements	iii
Hardware Supported	iii
Update Policy	iv
How to Use This Manual	iv

Chapter 1 - Installing and Starting Benchmark

Installing Benchmark for Windows	1-2
Configuration Routine	1-3
If You Have AutoCAD	1-3
The Benchmark Main Menu	1-4
Entering Commands	1-6
Escaping from Benchmark Routines	1-6
The Benchmark Pop-Up Menu System	1-8
The Benchmark Help System	1-8
What's New in Benchmark for Windows??	1-9
What's not in this release??	1-9

Chapter 2 - Storing and Retrieving Job Data

Jobs and Job Disks	2-2
Preparing Disks for Job Storage	2-2
Benchmark and Subdirectories	2-3
Initialize a Subdirectory for Job Storage	2-4
Change Logged Subdirectory for Job Storage	2-6
Change Disk Drive for Job Storage	2-8
Make New Job	2-9
Load Job	2-11
Close Current Job	2-11
Store Coordinate Data	2-12
List Jobs	2-13
Delete Job	2-14
Rename a Job	2-14
Show Available Space on Job Disk	2-15
Tips on Saving and Loading Data in Coordinate Geometry	2-16

Chapter 3 - Using the Setup Menu and Entering Description Codes

Temporary vs. Permanent Default Settings	3-2
Setup Menu	3-3
(1-, 2-, 5-) Printer Settings	3-4
(6-, 7-, 8-) Set Direction Output	3-4
(16-) Two-up Point Listing Toggle	3-4
(18-) Set Slope Angle Request	3-5
(26-, 27-, 260-, 261-) Set Slope Reduction Method	3-5
(32-) Speaker On/Off	3-6
(29-) Select South/North Azimuth	3-6
(35-) Select Angle Entry Format	3-6
(37-) Select Single/Double Line Feed	3-7
(44-, 46-, 48-) Leveling Modes	3-7
(47-) Default Benchmark Elevation Setting	3-8
(49-) Display of Occupied Station in Side Shot Mode	3-8
(86-) Select Automatic/Manual Point Numbering	3-9
(87-) Rounding to Even Numbers	3-10
(88-, 89-) Area Rounding Options	3-10
(90-, 94-, 95-, 96-) Rounding Options	3-11
(400-) Select Auto/Manual Pagination	3-11
(401-) Toggle Staggered Printing	3-11
(402-) Toggle Printing of Date and Time in Heading	3-12
(403-) Toggle Printing of Company Title in Heading	3-12
(404-) Change Company Title	3-13
(410-) Graphic text size in pixels	3-13
(411-) Graphic point size in pixels	3-13
(412-) Default point symbol mode	3-13
(420-) Default AutoCAD Parameter File	3-13
(421-) :Default Master DXF File	3-14
(4-) Save Settings or Quit	3-13
Edit/Display Descriptions	3-14
About Descriptions	3-14
Using Descriptions	3-14
Free-form Descriptions	3-14
Description Key Delimiter	3-16

Chapter 4 - Field Data Editor

Field Data Main Menu	4-2
Main Menu Selections	4-3
Edit Mode Navigation Tips	4-4
Edit/Job Header Record	4-5
Edit/Environment	4-7
Edit/Page	4-10
File	4-17
Process	4-21
Options Menu	4-24
Defaults Menu	4-25
Tolerances Menu	4-26
Field Data Editor Example	Special Section

Chapter 5 - Introduction to Coordinate Geometry

Field Data Editor vs. Coordinate Geometry	5-2
Bypassing The Field Data Editor	5-2
Features of Coordinate Geometry	5-3
Controlling the Mode of Operation	5-4

Chapter 6 - Traverse Mode Commands

(10-) Define Setup Location/Enter Traverse Mode	6-2
(4-) Return to (Benchmark) Main Menu	6-2
(330-) Re-Enter Traverse Mode	6-3
(20-,21-,23-,24-) Entering Direction and Distance	6-4
(18-) Set Slope Angle Request	6-6
(51-, 52-, 53-) Enter Multiple Slope Angles and Distances	6-7
(26-,27-) Select Slope Reduction Method	6-8
(50-) Enter a Temperature	6-8
(54-) Convert Meters to Feet	6-8
(35-) Select Angle Entry Format	6-9
(37-) Select Single/Double Line Feed	6-9
(86-,13-) Point Numbering	6-10
(86-) Select Manual/Automatic Point Numbering	6-10
(13-) Change Storage Point Sequence	6-12
(40-, 41-, 42-) Copy Direction and/or Distance	6-13
(40-) Copy Direction	6-13
(41-) Copy Distance	6-13
(42-) Copy Direction and Distance	6-13
(30-, 31-, 33-) Side Shots	6-15
(30-) Side Shot Mode	6-15
(31-) Single Side Shot	6-15
(33-) 90 Degree Offset	6-16
(19-) Display Accumulated Area	6-17
(12-) Enter Coordinates	6-18
(223-) Print Screen	6-19
(81-, 68-, 82-) Inversing	6-19
(81-) Consecutive Inverse Routine	6-19
(68-) Inverse through Curve	6-20
(82-) Radial Inverse Routine	6-21
(91-, 92-, 93-, 70-, 71-) Intersections	6-23
(91-,92-,93-) Line Intersection Routines	6-23
(70-) Offset Intersection on a Line	6-27
(71-) Offset Intersection on an Arc	6-29

Chapter 7A – Introduction to Boundary Traverse

Features of Boundary Traverse	7A-2
Entering Traverse Data: General Procedures	7A-3
The Boundary Traverse Screen	7A-4
Traverse Types	7A-5
Entering Traverse Legs: Sides and Points	7A-6
Methods of Entering Direction	7A-7
Coordinates in Boundary Traverse	7A-9
Ending Traverse Entry	7A-9
Adjustment Commands	7A-10
Saving Data	7A-11
Traverse Entry	7A-12

Chapter 7B – Boundary Traverse Commands

Traverse Selection	7B-2
(10-) Enter Closed-Loop Traverse	7B-2
(11-) Enter Closed-Connecting Traverse	7B-5
Angle Selection	7B-7
Side Selection	7B-8
(86-) Select Automatic/Manual Point Numbering	7B-8
(30-) Enter Side Shot Mode	7B-9
(330-) Revert to Regular Traverse Leg Entry	7B-10
(31-) Enter One Side Shot	7B-12
(60-) Radius Curve	7B-13
(62-) Hold Angle Constant	7B-19
(65-) Hold Side Constant	7B-21
(365-) Direction into Chord, Chord Length, and Radius	7B-22
Length Adjustments	7B-25
(18-) Set Slope Angle Request	7B-26
(26-, 27-) Select Slope Reduction Method	7B-27
(50-) Enter a Temperature	7B-28
(51-) Enter Multiple Slope Angles and Distances	7B-29
(54-, 57-) Convert Meters to Feet	7B-31
End of Entry Routines	7B-32
Adjustment Options	7B-34
(101-) Distribute Angular Error Automatically	7B-34
(102-) Distribute Angular Error Manually	7B-35
(110-, 111-, 112-) Traverse Adjustment Routines	7B-36
Searching for Errors	7B-40
(114-) Search for Angular Error	7B-40
(115-) Search for Linear Error	7B-41
Correcting Input Errors	7B-43
(12-) Change a Side	7B-44
(13-) Delete a Side	7B-46
(14-) Insert a Side	7B-47
(25-) Restart a Traverse	7B-48

Chapter 8 - Elevation Commands

Features of Coordinate Geometry's Elevation Mode	8-2
Tailoring Elevation Mode . ..	8-2
Turning Elevation Mode On and Off	8-2
Abbreviations used in Elevation Mode	8-3
Multiple Slope Angles	8-3
Prompts in Elevation Mode	8-4
(10-) Setup Routine	8-5
(30-,31-) Side Shot Mode	8-7
(320-) New Benchmark Elevation	8-8
(321-) Adjust Datum Elevation . ..	8-9
(322-) Turning Point from the Backsight to the Occupied Point	8-10
(323-) Turning Point to the Foresight from the Occupied Point	8-12
(324-) Measure Up	8-15
(325-) Measure Down	8-16
(326-) Mean Reciprocal Observations	8-17
(327-) Update Foresight Elevation Only , ...	8-18
(39-) Side Shot Mode Update Elevation Only	8-19
Example 1	8-20
Example 2	8-22
Example 3	8-23
Example 4	8-24
Example 5	8-26

Chapter 9 - Curve Commands

(60-) Direction into Radius and Length	9-2
(61-) Direction into Tangent and Length	9-4
(62-) Radius Point and Arc Length	9-6
(63-) Radius Length and Arc Length	9-7
(64-) Chord Bearing and Length	9-9
(65-) Chord Direction, Length and Radius	9-11
(66-) P.I., Two Directions, and Radius	9-13
(67-) P.I., Two Directions, and Tangent	9-15
(69-) Any Two Knowns on Curve	9-17
(97-, 98-, 99-) Curve Solver	9-19

Chapter 10 - Street Design Commands

Conventions Used in this Chapter	10-2
(140-, 141-) Parallel Lines	10-3
(180-, 185-, 186-) Offsets from Center Line	10-4
(163-, 164-, 165-, 166-, 167-) Cul-De-Sac Routines	10-6
(163-) Curved Entry to Cul-De-Sac, Center Point Known	10-6
(164-) Curved Entry to Cul-De-Sac, Offset Point Known	10-9
(165-) Straight Entry to Cul-de-Sac, Center Point Known	10-11
(166-) Straight Entry to Cul-de-Sac, Offset Point Known	10-14
(167-) Bend with Cul-de-Sac	10-16
(170-, 171-, 172-) Straight Street Intersection Routines	10-18
(170-) Four-Way Intersection	10-18
(171-) Three-Way Intersection	10-20
(172-) Two-Way Intersection.	10-22
(173-, 174-, 175-, 176-, 177-) Curved Street Intersection Routines	10-24
(173-) Curved Into Straight	10-24
(174-) Two-Way Straight Into Curved	10-26
(175-) Four-Way Straight & Curved	10-28
(176-) Two-Way Curve with Curved Entry	10-30
(177-) Four-Way Curve	10-32

Chapter 11 - Group Commands

What are Groups?	11-2
(130-) Edit Group Data	11-3
The Group Menu	11-5
Edit Window	11-7
(142-) Store Group Data	11-11
(144-) Convert lot file	11-12
(136-) List Lot Description Files	11-13
(137-) Delete Lot Description File	11-14

Chapter 12 - Lot Sizing Commands

General Procedure	12-2
(190-) Begin Lot Sizing	12-3
(20-, 21-, 23-, 24-) Traverse Routines	12-4
(40-, 41-, 42-) Copy Direction and Distance	12-4
(81-) Consecutive Inverse Routine	12-5
(68-) Inverse Radius Curve.... ..	12-6
(192-) Radial Lot Design, Minimum Arc at Setback	12-8
(193-) Radial Lot Sizing, Minimum Chord at Setback	12-9
(194-) Lot Sizing by Sliding Bearing	12-10
(191-) Lot Sizing by Bearing Swing	12-12
(195-) Lot Sizing, Parallel	12-14

Chapter 13 - Transformation and Rotation Commands

(152-) Coordinate Transformation by Points	13-2
(151-) Coordinate Transformation by Angle Rotation	13-4
(153-) Coordinate Transformation by Bearing	13-5

Chapter 14 - Point Utility and Display Commands

(200-) Deleting Point	14-2
(210-) List Points	14-3
(220-) Copy Point(s)	14-4
(213-, 214-, 222-) Listing Point Numbers	14-5
(213-) List Used Point Numbers	14-5
(214-) List Unused Point Numbers	14-5
(222-) List Extremes	14-6
(223-) Print Screen	14-7
(224-) Enter Comments	14-7

Chapter 15 - Miscellaneous Coordinate Geometry Commands

(72-, 74-, 77-) Divide an Arc	15-2
(72-) Divide an Arc by Interval	15-2
(74-) Divide an Arc by Divisor	15-3
(77-) Divide an Arc by Segments	15-5
(73-, 75-, 79-) Divide a Line	15-6
(73-) Divide a Line by Interval	15-6
(75-) Divide a Line by Divisor	15-7
(79-) Divide a Line by Segments	15-8
(156-) Radial Stakeout Range of Points	15-9
(159-) Radial Stakeout Individual Points	15-10
(157-) Compute Angle from Stored Points	15-11
(158-) Compute Angle Given Two Bearings	15-12
(138-) Linear Regression	15-13
(245-) Triangle Solver	15-14
(227-) Three-Point Problem	15-15
(228-) Circular Curve through Three Points	15-16
(59-) Spiral Curve	15-17
(500-) Free Memory Command	15-19
(501-) Shell to DOS	15-20
(502-) Redirect Printer Output	15-20
(9-) Print Heading	15-21
(118-) Shrink a Job	15-21
(510-) Open a Command Log File	15-22
(511-) Close a Command Log File	15-22
(515-) Open a Log File	15-22
(516-) Close a Log File	15-22
(520-) View a Text File	15-23
(550-) Find Centroid of Lots	15-21

Chapter 16 - Utility I Programs

(10-) Curve Staking	16-2
(20-, 21-, 22-, 23-) Elevation Reduction	16-4
(20-) Stadia Note Reduction	16-4
(21-) Reduce Slope Angle and Distance	16-4
(22-) Create a Turning Point	16-4
(23-) Reduce Level Notes	16-4
(26-, 27-) Select Slope Reduction Method	16-6
(26-) Stadia Method of Slope Reduction	16-6
(27-) Vertical Angle Method for Slope Reduction	16-6
(40-, 36-, 37-, 38-, 39-) Vertical Curve Solver	16-7
(245-) Triangle Solver	16-8
(50-, 51-, 52-) Earthwork by Average End Areas	16-9

Chapter 17 - Utility II Programs

(225-) Circular Curve Given Two Chords and Included Angle	17-2
(228-) Circular Curve through Three Points	17-3
(226-, 227-) Solving Three-Point Problems	17-4
(226-) Three Angles and Two Lengths	17-4
(227-) Three Sets Of Coordinates And Two Angles	17-5
(229-) Vertical Curve Solver	17-6
(230-) Tangent Grades	17-8
(235-, 234-, 233-, 250-) Curve Staking Routines	17-10
(235-) Offsets from Tangent	17-10
(234-) Angles from P.C., Chords from Stake to Stake	17-12
(250-) Angles from P.C., Chords from Stake to Stake & Long Chords	17-12
(233-) Angles and Chords from Stake to Stake	17-14
(240-, 241-, 242-, 243-) Spiral Curve Stakeout	17-16

Chapter 18 - Job Copy and Directory Utilities

General Procedures	18-2
Copy Benchmark Job File	18-3
Show Directory of Jobs	18-4
Delete a Job	18-5
Merge Two Benchmark Coordinate Job Files	18-6
DOS Directory	18-6
Backup a Subdirectory	18-7
Restore a Subdirectory	18-7
Delete a Subdirectory	18-9
Copy Lot Description File	18-10
Show Directory of Lot Description Files	18-11

Chapter 19 - Benchmark Import/Export File Routines

(128-) Import File Routine	19-2
(129-) Export File Routine	19-3

Chapter 20 Benchmark <-> AutoCAD Interface

(127-) Creating a Transfer (.DXF) File	20-2
Changing the Default Parameters	20-9
Sending Tick Marks to AutoCAD	20-12
Loading a Benchmark Generated Drawing into AutoCAD	20-13
Beginning a New Drawing.	20-14
Layers Used in the Benchmark to AutoCAD Transfer	20-15
Setting up the Master DXF File	20-16
Earlier versions of Benchmark	20-20
The Benchmark/AutoCAD Menu	20-21
Bench Menu Commands	20-23

Chapter 21 - Benchmark <-> Lietz SDR2 Data Exchange

Benchmark <-> Lietz SDR Data Exchange	21-2
Benchmark <-> SDR Main Menu	21-3
Download Data Dump from SDR	21-3
F - Extract Field Data from Data Dump	21-5
C - Extract Coordinates from Data Dump	21-6
Print Formatted Dump Report	21-7
Alter Printer Output Routing	21-9
Upload Coordinates to the SDR	21-10
Go To File Menu	21-11
View/Set Communications Parameters	21-12

Chapter 22 - Benchmark <-> Zeiss REC500 Data Exchange

Benchmark <-> Zeiss REC500 Data Exchange	22-2
Download Data Dump from REC500	22-4
F - Extract Field Data from Data Dump	22-5
C - Extract Coordinates from Data Dump	22-6
Upload Coordinates to the REC500	22-7
Go To File Menu	22-8
View/Set Communications Parameters	22-9

Chapter 23 - Benchplot II

Installation	23-2
Operation	23-2
Configuring the Printer	23-2
Point Display Mode	23-3
Table of point representations	23-3

Benchmark Numeric Command List

Appendix A - Data Files in a Benchmark Subdirectory

Job File Data	A-2
Description Codes	A-2
Lot Description Files	A-2
Group Files	A-2
Job Directories List	A-3
Temporary Files	A-3

Appendix B - Creating Script Files

What Are Script Files?	B-2
Creating Script Files	B-2
Pause for Input (&)	B-2
Non-Alphanumeric Keystrokes	B-3
Entering Comments... ..	B-3
(450-, 451-) Executing Script Files	B-4
(DELAY) Changing the Speed of Execution	B-4
(452-) Chaining Script Files	B-4
(F10) Halting Execution of a Script File	B-4
Script Example	B-5

Appendix C - Apple to IBM Transfer

NO CONTENT IN THIS SECTION!!!

Appendix D - Installing Benchmark on a Network

Appendix E - Benchmark Environment Variables

Appendix F - Field Data Editor Tutorial

List of Abbreviations

Index

What Is Benchmark?	16
Features of the Field Data Editor	16
Features of Coordinate Geometry	17
Hardware Requirements	17
Update Policy	18
How to Use This Manual	18

What Is Benchmark?

Benchmark is a coordinate geometry program used principally by land surveyors. The Benchmark System consists of several integrated programs:

- **The Boundary Traverse Program** lets you enter, correct, close, and balance traverse data. Coordinate data generated in Boundary Traverse is then used in the Coordinate Geometry program.
- **Coordinate Geometry** lets you perform a variety of calculations on the coordinate data created in the Field Data Editor.
- **Utility I and II** consist of stand-alone routines to perform a range of calculations such as stadia reduction, curve solvers, curve staking, and triangle solving.
- **Job Copy Utility** offers a complete set of DOS and directory utilities which let you maintain, backup, delete, copy, and merge the job files you create with Benchmark.

Features of the Field Data Editor (Future Release)

- Enter multiple distances and angles for open, closed, or closed connecting traverses.
- **Works** with repeated and doubled angles.
- Display entered field data.
- Correct input errors by changing, deleting, or inserting field data.
- Calculate closure data.
- Search for linear or angular errors.
- Distribute angular error automatically.
- Adjust a traverse by Compass Rule, Crandall's Rule or Least Squares Method.
- Reduces elevation data.
- Accepts field data input from our Lietz SDR and Zeiss REC500 data collection software.

Features of Coordinate Geometry

With the routines in Coordinate Geometry you can:

- Enter coordinate or traverse data
- Enter consecutive or radial inverses
- Enter side shots and 90-degree offsets
- Enter elevation data
- Generate curve data from known points. Most of the curve commands also generate new points.
- Design streets and intersections
- Describe lots from known points
- Design lots to meet a minimum square footage
- Transform points from one coordinate system to another
- Display, print, clear, copy, and move coordinate points
- Solve a variety of problems, such as multiple points on a line, radial stakeouts, linear regression, three-point problems, circular curves, spiral curves
- With the Advanced Graphics Option, create and view your lots and points on the graphics screen.
- Capacity of up to 32,000 points in a single job file.

Hardware Requirements

The Benchmark system can be run on any system supporting the Windows 2000 or Windows XP Platforms

Update Policy

Applied Spatial Technologies values suggestions from users to improve the program. This makes for a better product that serves our customers' needs. Consequently, Benchmark is updated regularly. Updates will be offered at a nominal charge thereafter.

How to Use This Manual

This manual has been designed to serve both the beginner's and advanced user's needs. There are four major divisions in this manual.

Getting Started contains a Preface and three chapters that will show you how to install Benchmark, start the system, and set up the Benchmark environment to reflect your hardware configuration and working methods.

Field Data Editor (Chapter 4) includes an introduction to the Field Data Editor program and a reference-style guide to all the Field Data Editor commands.

Coordinate Geometry Commands (Chapters 7-16) contain chapters organized by logical groups of Benchmark commands. Chapter 6 introduces you to the Coordinate Geometry program. Chapters 7-16 each describe in detail a different subset of Benchmark commands. Everyone should read Chapters 6 and 7. After that, you can read chapters according to what you want to do with Benchmark.

Utility Commands (Chapters 17 and 18) describe the routines available in the Utility I and II programs. These include a variety of curve-solving and calculation routines.

Command descriptions include standard sections (Purpose, Procedure, Notes, and Examples) so that you can find what you want to know about a command or procedure as quickly as possible.

Wherever possible, the manual has included figures and drawings to make procedures as clear as possible.

Finally, in addition to the main body of chapters, you will find a complete index and glossary at the back of this manual.

Installing and Starting Benchmark

Installing Benchmark for Windows	1-2
Configuration Routine	1-3
If You Have AutoCAD	1-3
The Benchmark Main Menu	1-4
Entering Commands	1-6
Escaping from Benchmark Routines	1-6
The Benchmark Pop-Up Menu System	1-8
The Benchmark Help System	1-8
What's New in Benchmark for Windows??	1-9
What's not in this release??	1-9

WHAT'S IN THIS CHAPTER?

This chapter explains how to install the Benchmark software on your computer, configure it for your hardware, and start it up.

Installing Benchmark

This section describes how to get Benchmark set up for use with your computer and peripherals. Please follow the instructions carefully. The entire process will take no more than fifteen minutes. If you are installing Benchmark on a network please see Appendix D "Installing Benchmark on a Network".

TO INSTALL BENCHMARK ON YOUR SYSTEM:

1. Turn your system on.
2. Insert the Benchmark for Windows CD in your CD drive.
3. Follow the prompts on your screen to install Benchmark; it will create a Windows Desktop icon you can use to start the program.

INSTALLATION NOTES:

- In most cases you can simply accept the defaults that the installation suggests to complete the installation
- You may want to skip the installation of the provided copy of VoloView Express if you already have it installed on your system.
- You will need a copy Adobe Acrobat Reader which you can download for free at www.adobe.com.
- This version of Benchmark has been tested on both Windows 2000 and Windows XP. Results may vary on other Windows platforms.
- This version of Benchmark will run for 30 days without an authorization code. When you install Benchmark it will generate a number sequence that you will need to email to us. Upon receipt of that sequence we will send you an authorization code that you will enter into your system that will disarm the 30 day self destruct sequence.

Configuration Routine

The first time you start Benchmark, you will be required to configure the program. In addition, if your configuration should change (e.g. if you add a color monitor), you must reconfigure Benchmark. Select "Configuration Menu" from the Benchmark Main Menu. You will receive the following bar menu (see The Benchmark Main Menu later in this chapter if you need instructions on using this type of bar menu):

```
The Benchmark System
Configuration Menu

Choose One
Do configuration
Show current configuration
Return to Main Menu

Press ESCape to Exit
```

All prompts are self explanatory.

NOTE:

You can return to the configuration menu by selecting "Configuration Menu" from the Main Menu anytime if you want to modify any of the settings. The current settings will always be displayed as defaults whenever you select "Do Configuration".

If You Have a REALLY OLD DOS version of AutoCAD

If you have the computer-aided design package AutoCAD® from Autodesk® there is an additional step you must take to ensure that your system is set up to use the Benchmark to AutoCAD transfer utility and the Benchmark design routines which work within AutoCAD.

If you do not use AutoCAD or have a Windows version you may skip this page.

The following two statements must be executed before running AutoCAD with the Benchmark design routines:

```
SET LISPHEAP=39000
SET LISPSTACK=6000
```

There are three ways to accomplish this; all have the same effect:

1. Type the two statements in each time the machine is booted.
2. Benchmark provides a batch file SETACAD.BAT which contains these two statements. You may run SETACAD each time the machine is booted and the correct environment will be established.
3. **(Recommended)** Add the two statements

```
SET LISPHEAP=39000
SET LISPSTACK=6000
```

to your autoexec.bat file. They will automatically run each time the machine is booted, and the proper environment will be established without any further intervention on your part.

The Benchmark Main Menu

When Benchmark begins the following menu is displayed on the screen (it may be different than yours depending upon version number and optional software installed).

The Benchmark Survey System for Windows v.8.0 All Rights Reserved

```
-----Press ESCape to exit Benchmark-----  
Boundary Traverse  
Coordinate Geometry  
Initialize a Subdirectory for Job Storage  
Utility Programs I  
Utility Programs II  
Job Copy and Subdirectory Utilities  
Setup Menu  
Configuration Menu  
Edit/Display Descriptions
```

We call this type of menu a bar menu. Whenever you are presented with a bar menu in Benchmark, you make your selection by pressing RETURN when the option you wish to choose is highlighted. You move the highlight bar with the arrow keys or by pressing the first letter of the choice. When the option you wish to choose has the same first letter as another choice, you move the highlight bar to it by simply pressing the letter two or more times, until your choice is highlighted. The *Home* and *PgUp* keys move you to the start of the list and the *End* and *PgDn* keys move you to the end. It does not matter if Num Lock is on, the arrows on the numeric keypad will always work.

Whenever you are presented with a bar menu in Benchmark you can usually exit the menu by pressing **ESCape**. For example, when at the Benchmark Main Menu, pressing the **ESCape** key will exit you to DOS. During some commands in Coordinate Geometry, **ESCape** will not allow you to exit from a bar menu. In those instances, use **F10** to cancel the command.

The Benchmark Main Menu

Each option on the Main Menu is described briefly below. The option is covered in detail in the chapter given in parentheses.

Boundary Traverse (Chapter 7A &7B)

The Boundary Traverse program lets you enter field data for traverses. It allows you to check traverse closures and, if necessary, balance a traverse by Compass Rule or Crandall's Rule. Boundary Traverse has many useful editing tools to help find and correct traverse errors.

Coordinate Geometry (Chapters 5&6, 8-15)

The Coordinate Geometry program lets you perform a variety of operations on the coordinate data generated in Boundary Traverse.

Initialize a Subdirectory for Job Storage (Chapter 2)

You must use this routine before you can use Benchmark the first time.

Utility I (Chapter 16)

This option contains a variety of calculation routines, such as a triangle solver and a ten-chord spiral curve solver.

Utility II (Chapter 17)

This option includes more calculation routines, including routines to solve three-point problems, vertical curves, and tangent grades.

Job Copy Utility (Chapter 18)

These routines let you copy, list, merge, and delete jobs, subdirectories, and lot descriptions.

Setup Menu (Chapter 3)

Lets you tailor Benchmark to suit your work habits by setting the system defaults. These options allow you to select defaults for output formats, rounding, and angle entry format, among others.

Edit/Display Descriptions (Chapter 3)

This option allows you to create a table of up to 1000 description codes for annotating field data.

Configuration Menu (Chapter 1)

This option allows you tell Benchmark what type of hardware you have and to set colors.

Field Data Editor (Chapter 4 – FUTURE ADDITION)

The Field Data Editor program lets you enter field data for traverses and topography. It allows you to check traverse closures and, if necessary, balance a traverse by Compass Rule, Crandall's Rule or Least Squares method. The Field Data Editor can reduce elevation data and can work with repeated angles and distances as well as doubled angles.

Press **ESCape** to exit Benchmark for Windows.

Entering Commands

Commands are one, two or three-digit numbers followed by a minus sign (for example, 51-). To enter a command, type the number that corresponds to the command followed by a minus sign and press RETURN. You must enter both the number and the minus sign (-).

NOTES

1. The minus sign (-) used as the first character of an entry represents a negative number, not a command (that is, -22 means negative 22, whereas 22- is a command entry. All entries are executed with the RETURN key (on the IBM PC, this is labeled Enter).
2. Depending on which option you select from the Main Menu, you are limited to a subset of all commands. For example, if you are using the Utility I programs, you cannot use certain commands from the Coordinate Geometry program. If you attempt to use a command in the wrong program, you will get the error message: INVALID OPTION.
3. Because all commands are numeric, you can enter any command from the Numeric Keypad.
4. To accommodate script files (see Appendix B) all toggle commands have been modified to work with extensions as follows:

command-	toggle that toggle
command--	turn that toggle off
command+-	turn that toggle on
command*-	show that toggle.

5. Numerical commands are not used in the Field Data Editor. It is controlled by a system of menus instead.
6. To repeat a command, just press ENTER. The last command used will be displayed and repeated.

Escaping from Benchmark Routines

Occasionally you will find the need to escape from a Benchmark routine. In most situations, although not all, you can either press F10 to escape from a routine and return to the COMMAND prompt, or enter another command. You can also use F10 to escape from a script file (see Appendix B).

In the Field Data Editor and the Group Editor, the F10 key is used as an "accept" key instead of an escape key. In both of these situations the ESCAPE key is used to cancel or escape from an operation. In certain other situations, such as Job Copy routines, a line is displayed at the top of the screen stating that entering 4- at any time will cancel an operation.

Defaults and Prompts

When Benchmark is waiting for input from you, in most cases you will see some text followed by an equals sign (=). For example, when no command is in progress, Benchmark simply waits for you to invoke one by displaying:

Command=

When a command is invoked, the prompts are usually self-explanatory. For example, at the beginning of the 10- command in Coordinate Geometry, the prompt asks for the point to occupy:

Occupied Point=

In many instances, Benchmark will display a default value with a prompt. Default values are displayed in reverse video. Whenever a default is supplied, there are several ways you can respond:

1. Accept the default value by pressing ENTER.
2. Type in a new value and press ENTER. As soon as you begin typing, the default will disappear, making room for what you type.

Defaults and Prompts

3. Press ESCape to cause the default to disappear.
4. Edit the default value and press ENTER.

Editing the default can be done with the standard editing and cursor keys:

Arrow keys	-	move cursor left and right
Home/End	-	move to beginning/end of line
Backspace	-	destructive backspace-delete
Delete	-	delete character at cursor
Insert	-	toggle insert/overtyping mode
Ctrl-End	-	Delete to end of line
ESCape	-	Delete whole line
Ctrl-Arrow	-	move cursor to next/previous word

There is a special prompt in Coordinate Geometry that is used whenever Benchmark can accept one or more point numbers as input. It looks like this:

Point#, Start#—End# or G#=

When you see this prompt, you can enter either a single point number, a range of point numbers (for example, 1-250), or the letter G followed by a group number. In some instances a default range will appear that includes all the points in the current job.

In many commands in which Benchmark requires you to make a choice, a bar menu will pop up detailing the choices available. Use the arrow keys, or press the first letter of the line to highlight a choice, then press ENTER.

In other commands in which Benchmark requires you to make a choice, a numbered menu of choices will appear detailing the choices available. To make a choice, type the number of the choice you want, then press ENTER.

The Benchmark for Windows Pop Up Menu System

Right clicking your mouse in any program will display a menu of available commands within that program. You can then either enter the command or click on it to begin the action.

Benchmark for Windows Help System

The first release will include the technical manual in both PDF and DOC formats. In a future release we will incorporate a more complete help system that functions similar to the instructions below that cover how the current DOS version HELP system works.

(F1) HELP

Pressing the F1 key in Coordinate Geometry or Utility Programs I or II will cause a Help screen to appear.

A status line at the bottom of the help-screen indicates which keys will assist you in viewing the help file (Arrows, PgUp/PgDn/Home/End). To exit from Help just press, ESCape.

There are two kinds of Help available: Help-on-help and Context-sensitive help.

HELP-ON-HELP

When you first enter Coordinate Geometry or Utility Programs I or II, pressing the F1 key will pop up "Help-on-help", which contains instructions on how to use Help, and some general information on defaults, line editing, etc. "Help-on-help" can be summoned anytime by typing HELP- or just the minus sign (-) without pressing ENTER, then pressing F1.

Context-Sensitive HELP

Context-sensitive Help is summoned in any one of three ways:

1. If you are in the middle of, or have just finished, executing a Benchmark command and press F1, you will receive help with that command.
2. If you type a Benchmark command but have not yet pressed ENTER, pressing F1 will summon help with that command.
3. If you highlight a command on a pull-down menu and press F1 you will receive help with that command.

Notes

1. Help files are ASCII text files stored in subdirectories of the Benchmark program directory with the file extension .HLP. If the Benchmark program files were stored in C:\BENCH, then the help files would be stored as follows:

C:\BENCH\COGOHELP - Coordinate Geometry help files
C:\BENCH\UTHELP - Utility I help files
C:\BENCH\UTIIHELP - Utility II help files

The exception to this rule is HELP.HLP (Help-on-help), which is stored in the same subdirectory as the Benchmark program files.

2. You may create your own help files or edit the ones supplied with Benchmark using any text editor that creates pure ASCII files. For example if you created a file called TOPO.HLP in the \<benchprogram>\COGOHELP subdirectory, you could type TOPO- in Coordinate Geometry, then press F1 to view the TOPO.HLP file.
3. If you prefer not to have help available in order to save disk space you can delete all files in the subdirectories described above that have the .HLP extension.

What's New in Benchmark for Windows

1. First, even though it maintains the DOS version's "look & feel" as far as using commands and entering data, it is a real Windows application as far as memory management, mouse behavior, and printing functions go.
2. When you are in any of the menu choices, Benchmark for Windows operational screen is a continuously scrolling window that holds all the information you generate for the entire session. If you desire, you can "copy & paste" this entire session to a text editor as a record of what you did.
3. Full support of windows printers. The printing utility we are distributing with Benchmark creates a running print file that accumulates all your entries and results. The 1- and 5- Commands tell Benchmark to begin sending data to the printer file; When you're ready to print, just click the 2- command and all your results will go to hard copy via your designated Windows printer. Finally, remember that 2-, in addition to dumping the file to the printer, also shuts down sending data to the printer file, so remember to re-activate printing with either the 1- or 5- commands if that's what you want to do.
4. Support for VoloView Express to generate annotated drawings via the Benchmark to AutoCAD transfer routine. Of course, you can still use AutoCAD to do this if you like, but VoloView Express is more lightweight, faster, and IT'S FREE!!! This combination replaces the old SCREEN PLOT function that was part of AGO in the DOS version of Benchmark.

What's Not in this Release of Benchmark for Windows

1. **The Field Data Editor.** Don't worry... it's coming. For technical reasons it wasn't possible to get it done for this release; we expect to have it done soon and all purchasers of this version will be updated at no charge.
2. **AGO.** We likely won't bother with AGO because the results from VoloView Express are far superior.
3. **Data Collector Support.** The data collectors supported in the DOS version were very dated. Most total station manufacturers provide adequate tools to transfer their data; both TDS and Carlson provide robust data collection applications that they are committed to keeping current. We either already can or will soon be able to exchange data with both these applications.

Storing and Retrieving Job Data

Jobs and Job Disks	2-2
Preparing Disks for Job Storage	2-2
Benchmark and Subdirectories	2-3
Initialize a Subdirectory for Job Storage	2-4
Change Logged Subdirectory for Job Storage	2-6
Change Disk Drive for Job Storage	2-8
Make New Job	2-9
Load Job	2-11
Close Current Job	2-11
Store Coordinate Data	2-12
List Jobs	2-13
Delete Job	2-14
Rename a Job	2-14
Show Available Space on Job Disk	2-15
Tips on Saving and Loading Data in Coordinate Geometry	2-16

WHAT'S IN THIS CHAPTER?

This chapter explains the process of storing and retrieving job data in Benchmark. This chapter will tell you how to:

- Initialize a subdirectory for job storage.
- Specify which subdirectory you want to use for the current Benchmark session.
- Open a job that you can use to save field data or coordinate data.
- List and delete jobs.

Jobs and Job Disks

In Benchmark, a Job is either field data or coordinate data stored as a file on a job disk. The job disk may be a floppy disk or a directory on a hard disk.

The data that you generate with Benchmark remains in computer memory until you store it to a job disk. In order to store data, there must be an "active" job. Only then can you store the data in memory to that job's data file on the job disk. There are two ways to make a job active. You can load an existing job or make a new job. In the Field Data Editor this can be done from the File menu. In Coordinate Geometry you can load an existing job with the 124- command, or you can make a new job with the 122- command. The active job number and job name are displayed in the upper left-hand corner of your screen.

Preparing Disks for Job Storage

Before you can use Benchmark to store job data, you must "prepare" a job disk (either a floppy disk or a directory on a hard disk). To do this, select **Initialize a Subdirectory for Job Storage** from the Main Menu. This process copies a file named LABELS.DAT to the specified disk or directory (see Appendix B for a description of the files which Benchmark creates). An initialized directory contains 20 blank (or unused) jobs that you can use for data storage. Depending on whether you are using a floppy diskette or a hard disk for data storage, the procedure is somewhat different.

- For a floppy disk, the initialization routine prepares the disk in the specified drive. ***The floppy disk must already be formatted.***
- For a hard disk, the initialization routine first creates a directory, and then prepares it.
- An initialized directory can be expanded to hold more than 20 jobs as necessary.
- For more about "Initialize a Subdirectory for Job Storage", see page 2-4.

Benchmark and Subdirectories

Benchmark lets you store job data in different subdirectories. In the Field Data Editor, you can change the directory from the file menu. In Coordinate Geometry, you can change the directory for data storage within a Benchmark session by using the **301-** command, explained later in this chapter.

Benchmark allows you control over the location of the subdirectories, which it creates for job storage. For example, you might choose to have a top-level directory for each person using Benchmark, with subdirectories below each for the various jobs for which each person is responsible. For example, you might create a directory structure, which looks like this:

c:\bobby	<i>Top-level directory for Bobby</i>
c:\bobby\hwy64	<i>Bobby's job files for highway 64</i>
c:\bobby\alvirne	<i>Bobby's job files for Alvirne</i>
c:\bobby\bighill	<i>Bobby's job files for Bighill subdivision</i>
c:\sue	<i>Top-level directory for Sue's jobs</i>
c:\sue\circum	<i>Sue's work on the circumferential highway</i>

NOTE

Older versions of Benchmark (through version 5.6) created subdirectories which automatically had the extension ".DIR". To access these old subdirectories you will need to include the ".DIR", as well as the backslash whenever you are asked for the subdirectory name. For example, if the old subdirectory is called "1985JOBS", to call that subdirectory now you would enter "\1985JOBS.DIR".

Initialize a Subdirectory for Job Storage

PURPOSE

This option lets you initialize a job disk (a floppy or a directory on a hard disk) for job storage.

- If you want to store jobs on a floppy disk, this step initializes the disk in the specified drive. **The disk must already be formatted.** Note that Benchmark does not support subdirectories on a floppy disk.
- If you want to store jobs on your hard disk, this step will both create and initialize a directory to be used for job storage.

PROCEDURE

1. Select "Initialize a Subdirectory for Job Storage" from the Benchmark Main Menu. You will receive the following menu:

```
Benchmark Subdirectory/Floppy Initialization
Initialize a Hard Disk Subdirectory
Initialize a Floppy
Return to Benchmark Main Menu
```

2. Select either **Initialize a Floppy** or **Initialize a Hard Disk Subdirectory**, according to whether you want to store job data on a floppy diskette in Drive A: or B: or on a hard disk (drive C:, or any valid drive).
Each option is described below.

FLOPPY DISK

1. If you select Initialize a floppy, you will receive this prompt: DISK DRIVE
FOR DATA STORAGE <ENTER 4- TO QUIT>= A
2. Enter **A** or **B**, depending on which disk drive you are using to store job data. You will receive this prompt:

```
Insert formatted disk in drive A:
Any Benchmark job data on this new disk in drive A:
will be WIPED CLEAN
Press RETURN to continue. <ENTER Q TO QUIT>
```

NOTE: If there are any Benchmark jobs on this disk, they will be deleted. However, no other files will be deleted.

3. If you press **RETURN**, the program will create 20 unused jobs in the disk in the designated drive. Then you will be returned to the Benchmark Main Menu.
4. If you enter **Q**, you will be returned to the Benchmark Main Menu, and no action will be performed on the floppy disk.

Initialize a Subdirectory for Job Storage

HARD DISK

1. If you select Initialize a Hard Disk Subdirectory, Benchmark will prompt:

DISK DRIVE FOR DATA STORAGE <ENTER 4- TO QUIT>=

3. Enter the drive letter of your hard disk (usually C). Benchmark will prompt:

ENTER NEW DIRECTORY NAME <ENTER 4- TO QUIT>=

If you are in a subdirectory other than the root directory, Benchmark will prompt:

**ENTER NEW SUBDIRECTORY NAME <ENTER 4- TO QUIT>=
[DEFAULT=<path>] -**

Where <path> is the currently active directory. (i.e. the directory from which you entered Benchmark or the directory made active by the 301- command). Enter the DOS path name where you want job data to be stored, or just press RETURN alone to set up the current directory for job storage.

3. Enter the directory name where you want job data to be stored.
4. If you enter an existing directory name that is already being used for job storage, Benchmark will prompt:

**THE SUBDIRECTORY YOU HAVE REQUESTED ALREADY EXISTS
IF THERE ARE ANY JOBS IN THIS SUBDIRECTORY, THEY WILL BE
DELETED!
DO YOU WISH TO:
1. CONTINUE
2. QUIT
ENTER OPTION:**

5. Enter 1 or 2.
 - If you select 1 Benchmark erases any existing Benchmark jobs in the selected directory and creates a new LABELS.DAT file (no other files will be deleted). Then you go back to the Main Menu.
 - If you select 2, Benchmark returns to the Main Menu but does not create a directory.

Note: Remember in creating nested subdirectories that the higher-level directories must exist before those below them can be created.

Change Logged Subdirectory for Job Storage

PURPOSE

To let you select the directory you wish to work within.

PROCEDURE

In the Field Data Editor, you select Change Logged Subdirectory from the File menu. In

Coordinate Geometry enter **301-**.

At the prompt, **Subdirectory=?**, you have three choices:

1. You can enter the name of the subdirectory you wish to work within.
2. You can press ENTER for the default, which is a question mark (?). A window will pop up listing available subdirectories. You can select the one you want by using the arrow keys or mouse, then press ENTER (or double-click with a mouse).
3. You can enter two question marks (??). This is similar to entering a single question mark (?), except it will rebuild the list of subdirectories that appear in the window.

NOTES

1. Benchmark will look for the subdirectory exactly as you enter the path name, e.g., \BOB\HWY61
2. Subdirectories created with older versions of Benchmark (5.6 and before) may require you to include a ".DIR" extension at the end of the name, e.g. \BOB\HWY61.DIR
3. Benchmark creates a subdirectory on the current drive called \BMCNTROL, which contains a file called JOBDIRS.LST. This file contains the list of subdirectories containing Benchmark jobs, which appears in the subdirectory window when you enter a question mark (?). When you enter a question mark (?), JOBDIRS.LST is automatically created if it doesn't already exist. JOBDIRS.LST is also updated when you enter two question marks (??) and whenever you initialize a Subdirectory for Job Storage.

Change Logged Subdirectory for Job Storage

EXAMPLE

In the examples, you'll note that the currently logged subdirectory is displayed on the right side of the heading.

```
Job->Unopened
Bearing      Distance      Pnt.  Northing  Easting  Type
-----07-03-1990-----11:44:34-----C:\
Command= 301-
Subdirectory= \BOB
```

```
Job->Unopened
Bearing      Distance      Pnt.  Northing  Easting  Type
-----07-03-1990-----11:44:34-----C:\BOB
Command= 301-
Subdirectory= ?
```

\BOB
\BOB\HWY61

 |Select from window

```
Job->Unopened
Bearing      Distance      Pnt.  Northing  Easting  Type
-----07-03-1990-----11:44:34-----C:\BOB\HWY61
Command=
```

Change Disk Drive for Job Storage

PURPOSE

To let you select the disk drive you wish to work within.

PROCEDURE

In the Field Data Editor, you select Change Logged Drive from the File menu.

In Coordinate Geometry:

1. Enter **300-**. You will be prompted:

DISK DRIVE=

2. Enter any valid drive name (A, B, C, etc).
3. If you enter A or B, the default drive will change to the specified drive. Henceforth, Benchmark will look for and store jobs to the diskette in that drive. The drive is displayed on the right side of the heading.
- 4 . If you enter any other valid drive letter (C, D, etc.), you will be prompted:

SUBDIRECTORY=

You respond to this prompt exactly as you would during the 301- command (See preceding page).

NOTE: While Benchmark has the ability to work on floppy disks, experience has shown that, in general, hard disks are more reliable and less susceptible to damage and failure. Hard disks are usually much quicker and less apt to run out of available disk space, as well. When you load an existing job, Benchmark creates and works with a temporary copy of the job and updates that copy about once every minute. As you add points to a job, the job file grows in size accordingly. For these reasons you are encouraged to do your work on the hard disk. When you finish working on a job in Benchmark, you can copy the job to a floppy disk (or two) easily with the Benchmark Job Copy menu.

Make New Job

PURPOSE

Make New Job lets you open a new job on the current job drive and directory and lets you enter a descriptive name of up to 250 characters.

PROCEDURE

In Field Data Editor, select **Make New Job** from the File menu.

In Coordinate Geometry, enter **122-**.

NOTES

1. Remember that making a new job does not store data. After you open a job, you must store the data with **121-** (coordinate data), or Save Field/Coordinate Data in the Field Data Editor.
2. If the new job number is higher than the highest job in the subdirectory the user will be given an opportunity to expand the job directory.

EXAMPLE

```
Command 122-                | Create a new job
New Job Number= 30          | Job number 30
This job number is higher than the highest job number
presently stored in this subdirectory!
Do you wish to CANCEL this operation?
  1. Yes
  2. No
Option [Default= 2]         | Expand subdirectory to hold 30 jobs
Input Job Name= Section 4a9-8z3 Rudolph
Job disk C: is 80% full. 6807552 Bytes free on disk.
Highest Point for new file= 100 | Job file will initially hold 100 points
Initializing...
```

```
Choose Mode of Operation
Northing and Easting
Descriptions, Northing and Easting
Elevations, Northing and Easting
Elevations, Descriptions, Northing and Easting |Choose
```

```
Reading...
Job->#30 Section 4a9-8z3 Rudolph
Bearing Distance Elevation Description Point Northing Easting Type
-----C:\HWY123
```

Make New Job

PROCEDURE (COORDINATE GEOMETRY)

The procedure for 122- is different according to whether or not there is data in memory, as shown in the following examples:

EXAMPLE

Command 122- | *No data in memory*
New Job Number? 20
Input Job Name Rhone Estate

Choose Mode of Operation
Northing and Easting | *Choose Coordinates*
Descriptions, Northing and Easting
Elevations, Northing and Easting
Elevations, Descriptions, Northing and Easting

EXAMPLE

Command 122- | *Data in memory*

Choose Mode of Operation
Northing and Easting | *Choose Coordinates*
Descriptions, Northing and Easting
Elevations, Northing and Easting
Elevations, Descriptions, Northing and Easting

New Job Number? 20 | *Enter new job number*
Input Job Name Rhone Estates | *... and job name*

Choose Mode of Operation
Northing and Easting | *Choose Coordinates*
Descriptions, Northing and Easting
Elevations, Northing and Easting
Elevations, Descriptions, Northing and Easting

Job #20	Rhone Estates				
Bearing	Distance	Point	Northing	Easting	Type
-----10-13-1986-----15:31:57-----C:bench					

Command 122-

Which do you wish to do
Save current job and clear memory
Retain points for new job without saving current job

New job number? 19 | *Keep points in memory, but don't save current job*
Input Job Name Randall's Avenue | *Enter new job number*
Job #19 Randall's Avenue | *... and name*

Bearing	Distance	Point	Northing	Easting	Type
-----10-13-1986-----15:32:45-----C:bench					

Also see the examples for the 121- command for further details on creating new jobs in Coordinate Geometry.

Load Job

PURPOSE

To load coordinate data from a job file into computer memory.

PROCEDURE

In Field Data Editor, select **Load Field Data File** from the File menu.

In Coordinate Geometry:

1. Enter **124-** at the **COMMAND** prompt
2. In response to the prompt **OLD JOB NUMBER?**, enter a valid job number. If the job number you select is marked as **UNUSED**, you will see the message **UNUSED**.
3. If the job number you select contains coordinates, you will be asked to select the mode of operation from a pop-up menu.

EXAMPLE

```
Command 124-          | Load coordinate data into Coordinate Geometry
Old Job Number= 10    | Job number 10
Sample [31]           | Coordinates
Choose Mode of Operation
Northing and Easting
Descriptions, Northing and Easting
Elevations, Northing and Easting
Elevations, Descriptions, Northing and Easting | Choose Mode
Reading...
Job->#10 Sample [31]
Bearing Distance Elevation Description Point Northing Easting Type
-----03-07-1989-----10:56:13-----C:\BENCH\DATA
Command 124-          | Attempt to load field data within Coordinate Geometry
Old Job Number= 11    | Job number 11 - Attempt fails
McIntosh              | Field data
Job Number 11 is field data
Command               | User is returned to the COMMAND prompt
```

Close Current Job

PURPOSE

Allows the user to close a job without going back to the Benchmark Main Menu, loading a different job or using 301-/300- to switch subdirectories. This is especially useful for diskette users who want to make sure that all files on a given floppy have been closed before swapping to a new diskette.

PROCEDURE

In Field Data Editor, select **Close Job File**, from the File menu.

In Coordinate Geometry, enter 119-.

Store Coordinate Data

PURPOSE

Stores the coordinate data in memory to the active job.

PROCEDURE

In Field Data Editor, select **Load Field Data File** from the File menu.

In Coordinate Geometry, enter **121-**. The coordinate data in memory will be saved to the active job. If there is no active job, you will be prompted to create a new job file.

The following are examples of opening a new job in Coordinate Geometry and storing coordinate data in this new job.

The first scenario is for creating a new job when there is a job file open at the time.

EXAMPLE

```
Job->#17 Little Cogo File [4]
Bearing      Distance  Elevation Description Point Northing Easting      Type
-----
-----03-07-1989-----10:43:59-----C:\BENCH\DATA
Command 210-  | The open job contains four points
Point#, Start#-End# or G#= 1-4
              1      5000.0000    5000.0000
              2      5100.0000    5000.0000
              3      5100.0000    5100.0000
              4      5000.0000    5100.0000

Command 122-  | The user wants to copy these points to a new job
              | Which do you wish to do
              | Save current job and clear memory
              | Retain points for new job without saving current job
              | Retain points in memory for the new job
New job number= 14 | New job number
Input job name= Holmes | After entering the name the heading reflects the new job
Job->#14 Holmes
Bearing      Distance  Elevation Description Point Northing Easting      Type
-----
-----03-07-1989-----10:44:15-----C:\BENCH\DATA
Job disk C: is 62% full. 30613504 Bytes free on disk.
Reading...
Command 210-  | To list the coordinates for job 14
Point#, Start#-End# or G#= 1-4
              1      5000.0000    5000.0000
              2      5100.0000    5000.0000
              3      5100.0000    5100.0000
              4      5000.0000    5100.0000

Command 121-  | To save the points in memory to job 14
Saving...
Job disk C: is 62% full. 30613504 Bytes free on disk.
Command
```

List Jobs

PURPOSE

Lists jobs for the active job disk (currently selected directory).

PROCEDURE

In Field Data Editor, select **List Job Directory/ Disk Space**.

In Coordinate Geometry, enter **123-** from any prompt. The program lists jobs in the currently selected directory.

NOTES

1. Jobs listed as **UNUSED** are empty, and can be used to store new jobs. But you must open a job with **122-** before you can store data in it.
2. Benchmark job files contain either **field data** or **coordinate data**.
3. Jobs labeled **FIELD DATA** contain data created in the Field Data Editor program.
4. If a file contains coordinate data, it is labeled coordinates. The number in square brackets represents the highest point number in the file.

EXAMPLE

```
Command 123-          | Display jobs on the selected subdirectory/disk
Starting Job Number= 1
Ending Job Number= 5
1   Class Field Data
2   Coordinates from Class Field Data          [8]   Field data
3   Coordinates from Class Field Data after Side shots [95] V6.0 Coord's
4   UNUSED                                     Coordinates
5   Topo                                     [127] Coordinates
Command=
```


Delete Job

PURPOSE

To delete a job file

PROCEDURE

In Field Data Editor, Select Delete Job from the File menu. In Coordinate Geometry:

1. Enter **125-** at the **COMMAND** prompt. You are prompted for a job number.
2. Enter the job number to be deleted. Benchmark requests confirmation before actually deleting the job.

EXAMPLE

```
COMMAND 125-          | Delete a job
DELETE JOB NUMBER? 20 | Enter job number
Harkness Hill
DO YOU WANT TO DELETE THIS JOB?
  1. Yes
  2. No
    OPTION= 1          | Confirm deletion
```

Rename a Job

PURPOSE

To assign a new job name or edit an existing (or unused) job name.

PROCEDURE

In Field Data Editor, select **Rename Job File** from the File menu.

In Coordinate Geometry, enter **302-** at the **COMMAND** prompt. In response to Benchmark's prompt, enter a job number. Benchmark displays the existing job name (UNUSED if the job is not in use). Edit the new job name in response to the prompt. You may use arrow keys Home, End, Delete, and Backspace during editing. Insert will toggle between Insert-mode and Overtypemode. When finished, press ENTER.

NOTES

1. When prompted for Job Name, if you want to modify the default, use one of the editing keys (arrow keys, etc) as your first keystroke. If you hit a character key or the ESCape key as your first keystroke, the default will disappear entirely to allow all new text to be entered.
2. If you get fouled up, you can always cancel with the F10 key.
3. You can also rename a job that is marked as **UNUSED**.

Rename a Job

EXAMPLE

```
Command 302-          | Enter Rename Job command
Job number? 8         | Enter job number
Job # 8 is Sample 2 Field Data. | Benchmark displays existing job name
Job name= King's Path field data | Enter new job name
```

Show Available Space on Job Disk

PURPOSE

Reports on the available space on the current job disk, whether a hard disk or floppy diskette

PROCEDURE

In Field Data Editor, select `List Job Directory/ Disk Space`.

In Coordinate Geometry, enter **139-**. The percentage of used disk capacity and the number of bytes free for the current job disk is displayed.

NOTE

The **139-** command shows you the percentage of disk capacity used and the number of bytes free for all the files on your disk, whether they are Benchmark files or not.

EXAMPLE

```
job #
SD.#   Shot Type/Error      Point   Angle      Length
-----08-04-1986-----14:46:04-----C:\WORD
Command 139-
Job disk C: is 90% full      421800 bytes free on disk
```

Tips on Saving and Loading Data in Coordinate Geometry

Coordinate files are kept in a temporary file until you load a different job or return to the Benchmark Main Menu. You can save this type of data permanently to a floppy disk or hard disk by using **121-**.

- When you use **121-**, you save the coordinate and group data to the currently open job.
- Creating a job with **122-** does NOT store data. After you open a job, you must store the data with **121-**.
- If you try to open an existing job with **122-**, the job name and number are displayed, and you are returned to the COMMAND prompt. You must use **125-** to delete an existing job before you can create a job with this same number.
- In order to store data, there must be an active job. You will be prompted to create a new job file with **122-** if you enter **121-** with no job open.
- If you do not use **121-** to save a job and have made any changes since the job was last saved, Benchmark will prompt you when you try to exit or close the job, giving you the option to save the current job.

The Setup Menu and Description Codes

Temporary vs. Permanent Default Settings	3-2
Setup Menu	3-3
(1-, 2-, 5-) Printer Settings	3-4
(6-, 7-, 8-) Set Direction Output	3-4
(16-) Two-up Point Listing Toggle	3-4
(18-) Set Slope Angle Request	3-5
(26-, 27-, 260-, 261-) Set Slope Reduction Method	3-5
(32-) Speaker On/Off	3-6
(29-) Select South/North Azimuth	3-6
(35-) Select Angle Entry Format	3-6
(37-) Select Single/Double Line Feed	3-7
(44-, 46-, 48-) Leveling Modes	3-7
(47-) Default Benchmark Elevation Setting	3-8
(49-) Display of Occupied Station in Side Shot Mode	3-8
(86-) Select Automatic/Manual Point Numbering	3-9
(87-) Rounding to Even Numbers	3-10
(88-, 89-) Area Rounding Options	3-10
(90-, 94-, 95-, 96-) Rounding Options	3-11
(400-) Select Auto/Manual Pagination	3-11
(401-) Toggle Staggered Printing	3-11
(402-) Toggle Printing of Date and Time in Heading	3-12
(403-) Toggle Printing of Company Title in Heading	3-12
(404-) Change Company Title	3-13
(410-) Graphic text size in pixels	3-13
(411-) Graphic point size in pixels	3-13
(412-) Default point symbol mode	3-13
(420-) Default AutoCAD Parameter File	3-13
(421-) Default Master DXF File	3-14
(4-) Save Settings or Quit	3-14
Edit/Display Descriptions	3-15
About Descriptions	3-15
Using Descriptions	3-15
Free-form Descriptions	3-15
Description Key Delimiter	3-17

WHAT'S IN THIS CHAPTER?

This chapter describes the commands on the Setup Menu. The purpose of the Setup Menu is to let you customize Benchmark to suit your work habits.

For example, you can choose the method of slope reduction you will generally be using, specify the number of places to round coordinates, and select a style of direction output (bearing, azimuth, or angle right). Your selections on the Setup Menu will be activated whenever you start up Benchmark and will remain in effect until you change them. :::

Temporary vs. Permanent Default Settings

Most default settings can be changed temporarily (i.e. during the current Benchmark session) without going to the Setup Menu. Exceptions are noted as being available from the Setup Menu only. To change a default that will hold beyond the current session the change must be made in the Setup Menu.

For example, suppose you have set coordinates to be rounded to two places on the Setup Menu. For a particular job, you might want to round coordinates to four places. You can do this by entering **94-** within the Coordinate Geometry program. Coordinates will now be rounded to four places until you leave the Coordinate Geometry program. But the next time you enter the Coordinate Geometry program; the rounding of coordinates will revert to two places, as specified on the Setup Menu. Both the Field Data Editor and Coordinate Geometry obtain their initial settings from the Setup Menu defaults.

Remember:

- To set your working environment to defaults that reflect your normal working procedures, enter commands on the Setup Menu.
- To make temporary changes to default settings, use individual commands within Benchmark.

Setup Menu

Select **Setup Menu** from the Benchmark Main Menu. To change a setting, enter the appropriate number at the COMMAND prompt. Enter **4-** to save the new settings.

EXAMPLE

The following defaults are in effect

```
Printer off ..... (1-,2-,5-)
Bearing output ..... (6-,7-,8-)
Two-up Printing in Northing,Easting Mode is off ..... (16-)
Manual slope request ..... (18-)
Va method of slope reduction ..... (26-,27-,260-,261-)
Buzzer prompt off ..... (32-)
North azimuth used ..... (29-)
DDMMSS.S angle entry ..... (35-)
Single line feed printing ..... (37-)
Three wire method is off ..... (44-)
Trig. leveling is off ..... (46-)
Default benchmark elevation is at occupied station ..... (47-)
Level at station is off ..... (48-)
Printing of occupied station in ss mode is on ..... (49-)
Automatic point numbering ..... (86-)
```

```
Show page # 2 defaults ..... (<RETURN>)
Command (4- to Save/Quit)
```

The following defaults are in effect

```
Rounding to even numbers is off ..... (87-)
Acres rounded to 2 place(s) ..... (88-)
Square feet rounded to 0 place(s) ..... (89-)
Distances rounded to 2 place(s) ..... (90-)
Coord's. rounded to 4 place(s) ..... (94-)
Bearings rounded to nearest second ..... (95-)
Elev's rounded to 2 place(s) ..... (96-)
Auto pagination is off ..... (400-)
Staggered printing is on ..... (401-)
Printing of date and time in heading is on ..... (402-)
Printing of company title is off ..... (403-)
Company title is:
Amazing Surveyors and Engineers, Inc.
..... (404-)
Graphic text size in pixels is 15 ..... (410-)
Graphic point size in pixels is 10 ..... (411-)
Default point symbol mode is 64 ..... (412-)
```

```
Show page # 1 defaults ..... (<RETURN>)
Command (4- to Save/Quit)
```

Setup Menu

(1-, 2-, 5-) Printer Settings

1- turns the printer on. Everything entered or displayed on the Benchmark screen will simultaneously be sent to the printer.

2- turns the printer off. All entries and output will be displayed on the screen only. This is the default mode.

5- activates the printer for output only. All data that Benchmark calculates and displays will be simultaneously sent to the screen and printer. User input will appear on the screen only.

NOTE: *To feed the paper to the top of the page, use the 3- **command** in the Field Data Editor, Coordinate Geometry, and the Utility programs.*

(6-, 7-, 8-) Set Direction Output

6- sets the direction output format to bearings. All directions will be displayed as bearings.

7- sets the direction output format to azimuths.

8- sets the direction output format to angles right. All directions will be displayed as angles right from backsight on last occupied point.

NOTE: *Angle right output not valid when in side shot mode.*

(16-) Two-up Point Listing Toggle

16- allows you to list two points to a line with the point printing command (210-) while in Northing and Easting mode (see Controlling the Mode of Operation in Chapter 5 "Introduction to Coordinate Geometry" for further information on the Mode of Operation). When two-up point listings are off, points will be printed one to a line when in Northing and Easting mode.

In Coordinate Geometry:

16- toggles two-up listings.

16+- sets two-up listings to on.

16-- sets two-up listings to off.

16*- displays the current two-up setting.

Setup Menu

(18-) Set Slope Angle Request

The **18-** command switches between manual and automatic slope request. In manual mode, Benchmark prompts for distance only; you must use **51-** to enter a slope angle (see Chapter 6). In automatic mode, Benchmark will prompt for slope angle and distance for each traverse leg or side shot.

In Coordinate Geometry:

- 18- toggles between Auto and Manual Slope Request
- 18+- sets Auto Slope Request
- 18-- sets Manual Slope Request
- 18*- displays the current slope request setting

(26-, 27-, 260-, 261-) Set Slope Reduction Method

- 26- sets stadia method of slope reduction (cosine squared X distance).
- 27- sets vertical angle method of slope reduction (cosine X distance). This is also known as EDM/tape reduction mode.
- 260- sets difference in elevation mode.
- 261- sets direct entry of elevation mode.

*NOTE: The difference in elevation mode (260-) and the direct entry of elevation mode (261-) is only effective with Coordinate Geometry's elevation commands (see Chapter 8). If **you** have selected one of these options in the Setup Menu the vertical angle method (27-) will be the default at all times except when using Coordinate Geometry's elevation commands.*

Setup Menu

(32-) Speaker On/Off

32- turns the speaker audio prompt on or off. With the speaker on, you will hear a beep whenever Benchmark requires input from you.

(29-) Select South/North Azimuth

29- toggles between north and south azimuth orientation

In Coordinate Geometry:

29- toggles between north and south azimuth orientation

29+- sets south azimuth orientation

29-- sets north azimuth orientation

29*- displays the current azimuth orientation

(35-) Select Angle Entry Format

35- toggles between the two angle entry formats supported by Benchmark. The standard entry format is in the form DDDMMSS.S, where D = degrees, M = minutes, S = seconds, and .S = tenths of a second. For example, enter 1251500 for an angle entry of 125°15'00".

The alternate format is (Q)DD(D).MMSSS. If you are entering a bearing, you would enter 447.25 for the bearing N47°25'W. If you were entering an angle, you would enter 125.25 for an angle of 125°25'.

Outside the Setup Menu:

35- toggles angle entry method

35+- sets (Q)DD(D).MMSSS method

35-- sets DDDMMSS.S method

35*- displays the current angle entry format

Setup Menu

(37-) Select Single/Double Line Feed

37- alternates between single and double line feed for all output to the Screen or printer.

In Coordinate Geometry:

37- toggles between single and double line feed printing

37+- sets dual line feed printing

37-- sets single line feed printing

37*- displays the current line feed printing mode

(44-, 46-, 48-) Leveling Modes

The leveling mode commands (44-, 46-, 48-) let you alternate among three different leveling methods. For more detailed information on leveling modes and elevation entry, refer to Chapter 8.

44- turns the three-wire method on and off.

46- turns trigonometric leveling mode on and off.

48- alternates between standard direct differential leveling mode and alternate direct differential leveling mode.

In standard direct differential leveling mode backsight is the first observation.

In alternate direct differential leveling mode, foresight is the first observation. The theodolite is used as a level and set up on traverse stations.

Setup Menu

(47-) Default Benchmark Elevation Setting

When working in coordinate geometry elevation mode, this setting determines where the default elevation is taken from on a new occupied station setup. The default elevation can be taken from the occupied station or the backsight station.

The following examples illustrate the process with both setting values:

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type
							C:\MYDIR
Command 47-							
Default benchmark elevation is at occupied station							
Command 10-							
Occupied Point= 1							
		501.00	IP	1	5000	5000	OCC
Backsight Point= 2							
		502.00	UP	2	5100	5000	BS
S00-00-00.0W 100							
		501.00	IP	1	5000	5000	OCC
Storage Point= 200							
Benchmark Elevation (Default = 501) =							
Slope Distance= 324-							
HI+= 5							
Height of Instrument=506.00							
Command 47-							
Default benchmark elevation is at backsight							
Command 10-							
Occupied Point= 1							
		501.00	IP	1	5000	5000	OCC
Backsight Point= 2							
		502.00	UP	2	5100	5000	BS
S00-00-00.0W 100							
		501.00	IP	1	5000	5000	OCC
Storage Point (Default = 201) =							
Benchmark Elevation (Default = 502) =							
Slope Distance= 100							
Slope Angle =							
Target Height (Default = 5) =							
Height of Instrument=507.00							
HI-= 6							
		501.00	IP	1	5000	5000	OCC

NOTE: When used in coordinate geometry 47-- causes the default to be taken from the backsight and 47+- caused the default to be taken from the occupied station. 47*- displays the current setting. 47- toggles between the two.

(49-) Display of Occupied Station in Side Shot Mode

49- alternates between printing and not printing the occupied station in side shot mode. In Coordinate Geometry, the point number and coordinates of the occupied point will display after each side shot when this command is set on.

In Coordinate Geometry:

- 49- toggles between display methods
- 49+- turns occupied station printing on
- 49-- turns occupied station printing off
- 49*- displays whether occupied station printing is off or on

Setup Menu

(86-) Select Automatic/Manual Point Numbering

86- alternates between automatic and manual point numbering.

When automatic point numbering is set, point numbers are assigned automatically, beginning with the storage point number and continuing sequentially thereafter.

With manual point numbering, Benchmark requests a point number before each coordinate is stored.

NOTES: *Benchmark protects storage point numbers that have already been assigned coordinates. When you give Benchmark a storage point number that is already in use, you will receive a message to that effect and be prompted again for a storage point number. When this happens you have three options:*

1. Press ENTER. Benchmark will look sequentially for the next available storage point number.
2. Enter a different point number. Benchmark will alert you if it is already in use.
3. Enter a storage point number preceded by a minus sign (as a negative number) to override the existing point.

In Coordinate Geometry:

86- toggles between manual and automatic point numbering

86+- turns automatic point numbering on

86-- turns automatic point numbering off

86*- displays the current point numbering method

EXAMPLE

```
Command 86-
Manl. Point Numbering
Command 10-
Occupied Point= 2

Backsight Point= 1                2      5003.8899      5445.7362      OCC
N89-30-00E  445.75                1      5000.0000      5000.0000      BS
Storage Point= 3                  2      5003.8899      5445.7362      OCC
Point # 3 is occupied by
4992.4130
5446.4750
Storage Point= 3
Bearing= 24-
Angle= 30-
Angle= 450000
Distance= 152.35
N45-30-00W  152.35                5110.6734      5337.0725      SS
Storage Point= 3
Point 3 is occupied by
4992.4130
5446.4750
Storage Point= -3
N45-30-00W  152.35                3      5110.6734      5337.0725      TRASS
                                   2      5003.8899      5445.7362      OCC
```

(Continues)

Setup Menu

Angle= 86-
Auto. Point Numbering
Command= 30-
Angle= 552000
Distance= 115.65
Point 4 is occupied by
4755.6187
5461.7208
Storage Point=
S55-20-00W 115.65

| Press ENTER to use next available point number.

19	4938.1080	5350.6169	TRASS
2	5003.8899	5445.7362	OCC

The next available storage point number was 19.

(87-) Rounding to Even Numbers

With rounding to even numbers turned on, any numbers with just the digit 5 to the right of the number of digits to be rounded to, have the number rounded up if the number is odd and rounded down if the number is even. For example, assuming we are rounding to 2 places, 12.15 and 12.25 would round to 12.2 but 12.251 would round to 12.3. This is done to prevent the bias that is caused by always rounding up.

When rounding to even numbers is turned off, the numbers are rounded up. For example 12.15 would become 12.2 and 12.25 would become 12.3.

NOTE: All Rounding Options affect only the way numbers are displayed. Precision is not affected.

(88-, 89-) Area Rounding Options

88- sets acreage rounding

89- sets square footage rounding

When you enter either 88- or 89- you will receive the following prompt:

Number of decimal places(0-4) [Default= 1]=

1. Use rounding
2. Use truncation

Option [Default= 1]=

The defaults will be dependent upon the current setting for the given setting.

Setup Menu

(90-, 94-, 95-, 96-) Rounding Options

90- sets distance rounding

94- sets coordinate rounding

95- sets bearing rounding

96- sets elevation rounding

When you enter **90-**, **94-**, or **96-**, you will receive this prompt:

Number of decimal places (0–4)=
Enter a number from 0-4.

*NOTE: When you enter a **distance rounding value**, all **distances** will **be displayed with** the specified **number** of places. For example, if you set distance **rounding** to four places, a distance of 25 feet will be **displayed** as 25.0000.*

When you enter **95-**, you will receive this prompt:

Type of bearing rounding:
1. Nearest degree
2. Nearest 15 minutes
3. Nearest Minute
4. Nearest 10 seconds
5. Nearest second
6. Nearest 10th of a second
Option=

Enter a number from 1-6.

(400-)Select Auto/Manual Pagination

The 400- command switches between automatic and manual pagination modes. In automatic mode, Benchmark will skip to a new page at the end of 66 lines. This command works from the Setup Menu only.

(401-)Toggle Staggered Printing

The 401- command turns staggered printing on and off. When staggered printing is turned on, bearings and distances will be displayed between the from and to points. With staggered printing off, bearings and distances will be displayed on the same line as the to point (see the example below). This command works from the Setup Menu only.

Setup Menu

EXAMPLE

Command= 156-		<i>With staggered printing off</i>			
Setup Point= 3					
		3	4992.4130	5446.4750	OCC
Backsight Point= 2					
		2	5003.8899	5445.7362	BS
Point#, Start#-End# or G#= G3					
Maximum Distance= 1000					
196-29-11 504.61		78	4500.3535	5334.6531	
201-23-03 477.39		34	4537.6283	5301.3276	
196-18-01 448.85		80	4554.3969	5348.4318	
184-31-18 405.27		81	4587.1883	5440.5453	
Command=					

Command= 156-		<i>With staggered printing on</i>			
Setup Point= 3					
		3	4992.4130	5446.4750	OCC
Backsight Point= 2					
		2	5003.8899	5445.7362	BS
Point#, Start#-End# or G#= G3					
Maximum Distance= 1000					
196-29-11 504.61					
		78	4500.3535	5334.6531	
201-23-03 477.39					
		34	4537.6283	5301.3276	
196-18-01 448.85					
		80	4554.3969	5348.4318	
184-31-18 405.27					
		81	4587.1883	5440.5453	
Command=					

(402-) Toggle Printing of Date and Time in Heading

The 402- turns the display of date and time in the heading line on and off. You can use this command in the Setup Menu only.

(403-) Toggle Printing of Company Title in Heading

Turns the printing of the company title in the heading line on and off. This only affects printed output. Company title is not displayed on the screen.

In Coordinate Geometry:

403- toggles printing of company title

403+- turns printing of company title
on

403-- turns printing of company title
off

403*- displays current company title
mode

Setup Menu

(404-) Change Company Title

404- lets you change the company title.

When 403- is set to "on", the company name will be printed when you direct output to the printer. The company name will not be displayed on the screen. You can use this command in the *Setup Menu* only.

(410-) Graphic Text Size in Pixels

410- lets you enter the graphic text size in pixels if you have the Advanced Graphics Option (AGO). Text includes point numbers, descriptions and elevations.

You can set a value between 5 and 100. A value between 10 and 15 is a good place to start. You can use this command in the *Setup Menu* only.

(411-) Graphic Point Size in Pixels

411- lets you enter the graphic point size in pixels if you have the Advanced Graphics Option (AGO). The point size you like best may depend on the point symbol mode you choose (see below).

You can set a value between 5 and 100. A value between 10 and 15 is a good place to start. You can use this command in the *Setup Menu* only.

(412-) Default Point Symbol Mode

412- lets you choose the default point symbol to be used in the Advanced Graphics Option (AGO) and in Benchplot II. For a simple cross through each point enter **2**. For more details about all of the possible symbol modes available, see the chapters on AGO and Benchplot II. You can use this command in the *Setup Menu* only.

(420-) Default AutoCAD Parameter File

420- allows you to specify a default pathname for the AutoCAD Parameter File (see chapter 20). You can use this command from the *Setup Menu* only.

Setup Menu

(421-) Default Master DXF File

421- allows you to specify a default pathname for the Master DXF File (see chapter 20). The extension DXF is assumed. You can use this command from the Setup Menu only.

(4-) Save Settings or Quit

When you have made all setting changes, enter 4-. You will be asked if you want to save the settings. If you save them, they will become the defaults each time you enter Benchmark. If you do not save them, the changes you just made will be ignored.

Edit/Display Descriptions

About Descriptions

Whenever you create a point in Benchmark, you can assign a text description up to 16 characters in length to the point that can be displayed with the point and can be sent to AutoCAD, AGO and Benchplot with the point. A description can be matched to an AutoCAD Block to cause a block to be inserted with any point having that description. A description can be matched to a specific AutoCAD Layer Name to cause any point having that description to be placed on that layer. Descriptions are set up in the Description Code Table via the Edit/Display Descriptions choice on the Benchmark Main Menu.

Using Descriptions

During point creation, descriptions can be entered either by entering the code number set up in the Description Code Table or by entering the description text directly. You can edit the description text using the standard editing keys before confirming it with ENTER. In Coordinate Geometry, you may enter a question mark (?) when prompted for a description to pop up a window containing an alphabetical list of all descriptions. You can select a description from the window using the arrow keys or by typing the first letter of the description. Mouse users can move through the list by using the scroll bar on the right side of the window or by dragging through the list (moving the mouse cursor up and down in the window with the button depressed).

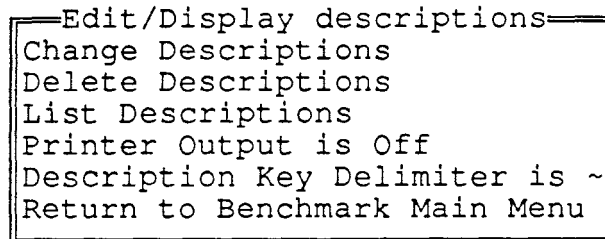
Free-form Descriptions

Any time you are prompted for a description you can enter any text you want or you can add to the text of a predetermined description. Points retain whatever descriptions are assigned to them regardless of whether the descriptions are entered numerically or as text. Descriptions are not linked to the Description Table after they are assigned to points. Keep in mind, however, that descriptions must match those in the Description Table for any points that you want Benchmark to match with AutoCAD blocks or layers. To take advantage of free-form descriptions and still match descriptions with blocks and layers, a Description Key Delimiter may be used (See page 3-16).

Edit/Display Descriptions

The Benchmark Main Menu option "Edit/Display Descriptions" lets you edit a table of 1000 description codes that you can associate with points. Each description code can have a character description assigned to it composed of from 1 to 16 characters.

To edit descriptions select "Edit/Display Descriptions" from the Main Menu. You will see the following bar menu



Change Descriptions lets you edit descriptions. Description codes are pre-assigned numbers from 1 to 1000. You can assign a text description of up to 16 characters to each number. If a number is already assigned, the description associated with that number is displayed when you attempt to change it. If you have purchased the optional Benchmark<->AutoCAD Transfer Software, you may also enter an AutoCAD block name and layer name that the given description will be associated with.

A description may be between 1 and 16 characters long and can be upper case, lower case or a combination.

The block name is optional. If you leave it blank, no block will be associated with the description. If you enter a name, it MUST be the name of a block that you have previously created in any Master DXF files you will be referencing (see Chapter 20, Benchmark/AutoCAD Interface). During the 127- command (create a .DXF file), Benchmark will insert the block at the same location as the point whenever it encounters the associated description.

The layer name is also optional. If you leave it blank, no layer will be associated with the description. If you enter a layer name, any points having the associated description will be placed on that layer, overriding the "layer name for POINTS" named during the 127- command. If the layer exists in your Master DXF file(s), the color and line-type in the Master DXF files) will be honored. Otherwise, the color will be white and the line-type continuous.

NOTES:

1. You may wish to keep your descriptions short for two reasons:
 - A. You will be able to add additional text to the descriptions at the time you create points in Coordinate Geometry up to a total of 16 characters, so you may want to leave some blank space to take advantage of that feature.
 - B. If you plot points with descriptions, you will reduce crowding by having shorter descriptions.
2. If you want to change an existing description, block or layer to nothing (blank), you must replace it with a single space (using the spacebar on your keyboard).

Delete Descriptions lets you delete a description from the table.

List Descriptions lets you list all descriptions, or a specified range of descriptions.

Edit/Display Descriptions

Description Key Delimiter is to allow you to supply a special character that can be used to separate text defined in the Description Code table from free-form text. This can be any legal character, but we recommend using a character that is little used or unusual. During the Create a DXF routine (127-) Benchmark will use this character to separate text found in the description code table from free-form text added when the points are created, in order to be able to make use of any block names or layer names you have associated with your descriptions in the Descriptions Table. An example may best explain how this works:

EXAMPLE

The following conditions exist for this example:

The Description Key Delimiter is ~ (called the "tilde")

In the Benchmark Description File Listing, a code is defined for IP.

Desc. Code	---Description---	Block Name	Layer Name
1	IP	ZIP	MONUMENT

The following three points were created in Coordinate Geometry:

Description	Pnt.	Northing	Easting
-----07-12-1990-----	14:39:20-----		
Command= 210-			
Point#, Start#-End# or G#= 1-33			
IP~ 1"x1.2'	1	5000.0000	5000.0000
IP~ 1-3/4"x.4'	2	5104.2365	4999.2100
IP 1"x2.2'	3	5542.3256	4875.2111

For the three points above, Benchmark would insert the block "ZIP" at the same location as points 1 and 2, but would insert no block with point 3. Points 1 and 2 would be placed on layer MONUMENT and point 3 would be placed on whatever layer is specified for points during the Create a DXF routine (127-).

When Benchmark creates a DXF file (127-), it will examine any description to determine what Block Name and/or Layer Name, if any, is associated with it. If Benchmark finds text followed by the description key delimiter the "tilde" in this case), it will look in the description code table to find a matching description, then add any corresponding block name for insertion into the AutoCAD drawing. Benchmark will then place the point (not the block) on the layer specified in the Layer Name column. If no block is specified, no block will be inserted. If no layer is specified, the point is placed on whatever layer name for points is specified during the Create a DXF routine (127-).

NOTES:

1. Use of the description key delimiter is optional. However, if free form descriptions are used, the description key delimiter is the only means by which Benchmark can successfully match block names and layer names to descriptions.

2. The delimiter will not appear in the AutoCAD drawing, so you may want to add a space between the delimiter and any free form description you add for readability.

3. The 128- command will also make use of the delimiter if you export with numerical descriptions.

Printer Output is Off or **Printer Output is On** displays the current printer output status. Choose "Printer Output is On" to have "List Descriptions" send its' output to the printer.

Edit/Display Descriptions

Return To Benchmark Main Menu allows you to save the changes and exit to the Benchmark Main Menu. When you choose this option you will receive the following menu:

```
Save Changes
Return To Benchmark Main Menu Without Saving Changes
Go Back to Edit/Display Descriptions Menu
```

Choose the appropriate option from the above menu.

EXAMPLE

```
---Edit/Display descriptions---
Change Descriptions
Delete Descriptions
List Descriptions
Printer Output is Off
Description Key Delimiter is ~
Return to Benchmark Main Menu
```

| *Choose Change Descriptions*

```
Enter 4- at ANY prompt to return to Edit/Display Descriptions Menu
Change description code= 4          | Enter code number
Change description to= GB          | Enter description
Change block to= ZGB              | Enter block name
Change layer to= MONUMENT         | Enter layer name
Change description code= 4-
```

```
---Edit/Display descriptions---
Change Descriptions
Delete Descriptions
List Descriptions
Printer Output is Off
Description Key Delimiter is ~
Return to Benchmark Main Menu
```

| *Choose List Descriptions*

```

                          Benchmark Description File Listing
Desc. Code  ---Description--  Block Name  Layer Name
1           IP               ZIP
2           UP               ZUP
3           STATION          ZSTATION
4           GB               ZGB          MONUMENT
5           T-PIT            ZTPIT
Press <RETURN> to Continue=
```

Page #1

Edit/Display Descriptions

```
—Edit/Display descriptions—  
Change Descriptions  
Delete Descriptions  
List Descriptions  
Printer Output is Off  
Description Key Delimiter is ~  
Return to Benchmark Main Menu
```

| *Choose Exit to Main Menu*

```
Save Changes  
Return To Benchmark Main Menu Without Saving Changes  
Go Back to Edit/Display Descriptions Menu
```

| *Choose
to save
changes*

Field Data Main Menu	4-2
Main Menu Selections	4-3
Edit Mode Navigation Tips	4-4
Edit/Job Header Record	4-5
Edit/Environment	4-7
Edit/Page	4-10
File	4-17
Process	4-21
Options Menu	4-24
Defaults Menu	4-25
Tolerances Menu	4-26

WHAT'S IN THIS CHAPTER?

This chapter provides a brief introduction to the Field Data Editor program.

Field Data Main Menu

To execute the program select "Field Data Editor" from the Benchmark main menu. When you enter the Field Data Editor the following menu is displayed on the screen:

Field Data Main Menu

C:\TESTDATA
Memory left=100%

```

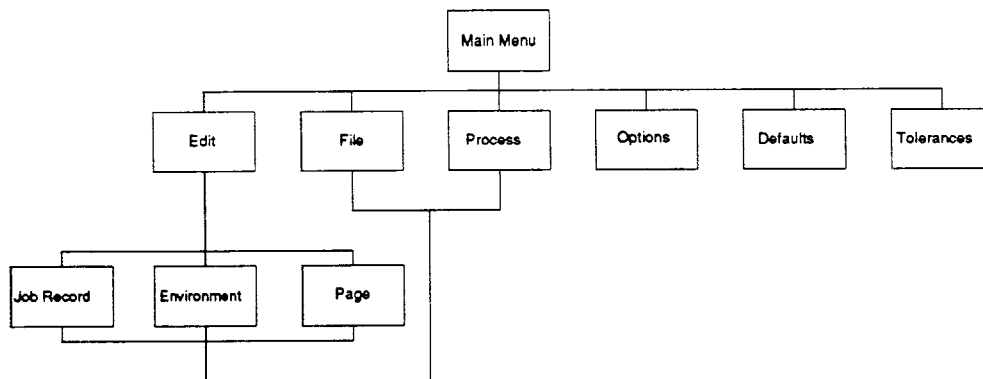
Edit
File
Process
Options
Defaults
Tolerances
Return to Benchmark Main Menu

```

See the "The Benchmark Main Menu" section of the manual for instructions on how to use this type of bar menu.

The following chart displays the navigation paths available in the Field Data Editor. When the user exits the File and Process menus the program will automatically return to the prior (Job, Environment, Page or Main) menu .

Field Data Editor Menu Structure



The Main Menu selections are each described in further detail in the following pages.

Main Menu Selections

RETURN TO THE BENCHMARK MAIN MENU

Select this or press **ESCape** to exit the Field Data Editor. If you have any unsaved coordinates or field data the program will display an appropriate warning, giving you an opportunity to return to the Field Data Main Menu.

EDIT

Selecting this puts the user in edit mode, which provides access to the Job Record, Environment Record, and observation data.

FIELD DATA EDITOR DATABASE LAYOUT

A field data file contains one Job Record. The Job Record holds data such as starting and ending coordinates, reference direction and job description. A field data file contains at least one and possibly many Environment Records. The Environment Records contain information such as the slope angle type, elevation reduction type and other such things that typically remain the same for a whole job but on occasion do change within the same job. Most users will never need to have more than one Environment Record in a job. All observations from a given station to a given target point are stored in a group called a "Page". Pages that are grouped under a given Environment Record are said to be subordinate to that Environment Record.

Edit Mode Navigation Tips

EDIT SCREEN MOVEMENT:

Whenever you are in edit mode the program will display messages in the message window at the bottom of the screen that will indicate to you what possible screen movement actions are available at the time.

<ESC> cancels the edit of that particular screen. Any changes made on that particular screen will be lost.

<F10> accepts the data currently displayed on the screen. On screens which only contain one data entry field, <RETURN/ENTER> will also work.

CHOOSING ITEMS FROM A HORIZONTAL MENU:

Horizontal menus are menus that appear in the message window on the bottom of the screen to allow you to navigate your way around the Field Data Editor's various edit screens. They also appear when you must choose between a set of named options. To choose options from a horizontal menu you press the capitalized letter from the choice you wish to make, the highlight bar will move to that choice. You may also use the arrow keys to move forward or backward through the list. The <HOME> and <END> keys will move the highlight bar to the beginning and end of the list respectively. When the horizontal menu is in the message window the program will display a short description of the currently highlighted choice on the second line. Once the highlight bar is on the proper item, press <RETURN/ENTER> to activate the choice.

FIELD MOVEMENT:

- To move the cursor to the next field press <RETURN/ENTER>.
- With alphanumeric fields the <HOME> and <END> keys jump to beginning and end of the field respectively.
- With alphanumeric fields the <BACKSPACE> either deletes the previous character or, if you are at the beginning of the field, moves you to the previous field. For horizontal menus, the <BACKSPACE> key will move you to the previous field.
- The <TAB> key moves the cursor to the next major group or field.
- The <SHIFT> <TAB> key combination moves the cursor to the previous major group or field.
- The <INSERT> key toggles insert mode.
- The <DELETE> key toggles delete mode.
- <F5> and <F6> move the cursor on field to the left and right respectively.
- <F7> and <F8> move the cursor up and down respectively.

Edit/Job Header Record

The first time you select, EDIT from the Field Data Editor Main Menu, the program shows you the Job Header Record. This allows you to enter the following data that applies to the job as a whole:

JOB COMMENT - lets you describe the project you are working on. You may use up to 160 characters to identify this project.

STARTING POINT NUMBER - any number from 1 to 32000 may be entered. It should be the same as the occupied point number entered on the first traverse page. If you are entering topographical or side-shot data only, this field is optional.

STARTING NORTHING AND STARTING EASTING COORDINATES - Enter this data if you are entering either an Open, a Closed or Closed Connecting Traverse. This value will be pulled from the Coordinate Reference File if one is assigned and the starting point exists (See the Assign Coordinate Reference file in the File Menu section for more information).

STARTING ELEVATION - Enter this data if you are entering either an Open, a Closed or Closed Connecting Traverse and you will be working with elevation data. This value can also be pulled from the Coordinate Reference File.

STARTING DESCRIPTION - may be a numeric description code or any text up to 16 characters. If a numeric code is used, it will be converted to text when you press <RETURN/ENTER>. With either method, the text may be edited at any time. See section on Descriptions in chapter 3 for more about descriptions.

REFERENCE DIRECTION - a known azimuth or bearing to a reference object from the starting point. You do not need to enter this if the first leg of the traverse is in a known direction or if the first backsight is to a point contained in the Coordinate Reference File.

REFERENCE QUADRANT - when using a reference bearing, enter the quadrant as 1, 2, 3, or 4 (NE, SE, SW, NW respectively).

ENDING NORTHING AND ENDING EASTING COORDINATES - for a Closed Connecting Traverse.

ENDING ELEVATION - for a Closed Connecting Traverse.

TYPE OF TRAVERSE:

- Open - The traverse does not close or the field data contains side-shots only.
- Closed - The traverse starts and ends on the same point.
- Closed Connecting - The traverse starts from one known point and ends on another known point.

HORIZONTAL DISTANCE REDUCTION - allows horizontal distances to be reduced to sea level values.

TEMPERATURE TYPE - Fahrenheit or Celsius

Edit/Job Header Record

NOTES

Distance Units for length measurements is feet or meters

To save any changes you have made, press <F10>. To exit without making any changes, press <ESC>.

Following either exit key, the following horizontal menu will be displayed in the message window (see "Choosing Items From a Horizontal Menu" above, if you need to know how to use this type of menu):

Env. Page pRocess File Main
Edit Environment Record

When the above menu is on the screen you may press ESCape if you wish to return to editing the Job Record. If you were creating a new job the default action would be the most logical; press <RETURN/ENTER> to create an Environment Record. Otherwise, select the appropriate choice.

Edit/Environment

The Environment Records contain information such as the slope angle type, elevation reduction type and other such things that typically remain the same for a whole job but on occasion do change within the same job. The choices made in the Environment Record control the edit format and processing of all subordinate Page Records. The following explains the fields contained in the Environment Record:

ENVIRONMENT COMMENT

You can enter a description of an instrument or job conditions of up to 23 characters.

TYPE OF LEVELING

Select the elevation mode you will be using. Specify the vertical control option:

- No Elevations - No vertical control used.
- Trigonometric Leveling - Uses slope or stadia distances, vertical or zenith angle and target height or rod reading.
- Direct Entry of Elevations - The instrument produces a level distance and the foresight elevations.
- Difference in Elevation - The instrument produces a level distance and the difference in elevation.

SLOPE ANGLE TYPE

Select the desired slope angle mode (must be consistent with the Type of Leveling chosen):

- None - No slope angles.
- Vertical - Vertical angles are measured from the horizontal plane.
- Zenith - Zenith angles are measured from upward vertical.

TYPE OF SLOPE REDUCTION

Select reduction formula:

- VA/EDM - Formula used is sine of the VA times the slope distance equals the difference in elevation. For Horizontal Distance, the formula is cosine of the VA times the slope distance.
- Stadia Method - Formula used is the sine of the VA times the cosine of the VA times the stadia distance equals the difference in elevation. For Horizontal distance, the formula is the cosine squared of the VA times the stadia distance.

TEMPERATURE CORRECTION

For steel tape expansion and contraction.

CURVATURE AND REFRACTION

Corrects observation for the Earth's curvature and the refraction of light. Do not use this correction if your instrument already corrects for this.

Edit/Environment

EDM CONSTANT

Enter any correction to distance measurements for EDM constant errors. This distance is added as a correction to measured slope distances. Do not use this correction if your instrument already corrects for this.

PRISM CONSTANT

Enter the distance representing the optical distance from the plumb-line to the reflective surface of the prism. This distance is added as a correction to measured slope distances. Do not use this correction if your instrument already corrects for this.

EDM OFFSET/PRISM OFFSET

EDM offset is the vertical distance the EDM is above or below the telescope as in a standards mounted EDM. The Prism offset is the vertical distance the prism is above or below the reflector target. Together these are used to correct the vertical angle and difference in elevation via the following formulas:

$$VA = VA - ((EDM \text{ Offset} - Prism \text{ Offset}) * 57.29577951) / Slope \text{ Distance}$$

$$Diff. \text{ in Elev.} = Slope \text{ Dist.} * Sine(VA) + (EDM \text{ Offset} - Prism \text{ Offset})$$

Do not enter these offsets if your instrument already makes these corrections. These corrections are ignored if you choose the Stadia Method of Slope Reduction.

NOTES

To save any changes you have made, press <F10>. To

exit without making any changes, press <ESC>.

Following either exit key, the following horizontal menu will be displayed in the message window (see "Choosing Items From a Horizontal Menu" if you need to know how to use this type of menu):

Page	Env.	Job	pRocess	File	Main
Go to Page Menu					

When the above menu is on the screen you may press ESCape if you wish to return to editing the Environment Record. If you are creating a new job the default action would be the most logical; press <RETURN/ENTER> to go to the Page Menu. Otherwise, select the appropriate choice. If you have more than one Environment Record or you wish to create additional Environment Records, you may select "Env." to get to the Environment Menu.

Edit/Environment

WORKING WITH THE ENVIRONMENT MENU

Most users will never need to have more than one Environment Record in a single field data file, but there will be occasions when this may become necessary. For example, you may do part of a traverse with an instrument that gives you slope distance, vertical angle and rod reading and another part with an instrument which gives you a horizontal distance and difference in elevation. Also if for some reason you need to merge two field data files into one (see the File Menu section) the job will contain two, perhaps identical, Environment Records. In this later case, the only thing you may wish to do with the second Environment Record is to delete it in order to make program edit mode navigation simpler.

The Environment Menu displays a list of the Environment Records within the job. The left hand column shows the record number with the currently selected record highlighted. You move the highlight bar with the arrow keys to select the proper record number. When you have highlighted the proper record press <RETURN/ENTER> and the program will display the following horizontal menu in the message window at the bottom of the screen:

Change Insert Delete mOve Page Job pRocess File Main Change an Environment Record

Change allows you to make changes to the selected Environment Record.

Insert allows you to insert an Environment Record that will follow the selected record.

Delete allows you to delete an Environment Record. If there are any pages subordinate to this Environment Record, you will be given a chance to either append these pages to the previous Environment Record's pages or delete the subordinate pages. If it is the only Environment Record in the job and it contains subordinate pages, you will not be allowed to delete the record.

Move allows you to move an Environment Record and all subordinate pages.

Page allows you to edit pages that are subordinate to the currently selected Environment Record.

Job allows you to edit the Job record. The selected Environment Record is left as the Current Environment Record (see Edit/Page below for a discussion of the Current Environment Record").

Process, File and **Main** allow you to go to the respective menu while leaving the selected Environment record the Current Environment Record. When you return to the edit mode you will return to the Environment Menu with the current record selected.

Edit/Page

Whenever you reach the Page Menu the pages that are accessible are those that are subordinate to the "Current Environment Record". The Current Environment Record number is displayed at the top of the screen as long as you are editing pages. As most users will never need to have more than one Environment Record in a job the Current Environment Record will almost always be record number one. See "Working With the Environment Menu" above for a discussion of having more than *one* Environment Record. For those times that you do have more than one, keep in mind that you will need to return to the Environment Menu if you want to access those pages that are subordinate to records other than the Current Environment Record.

If there are no pages subordinate to the Current Environment Record, you will automatically be placed into insert mode in Page Record number one. If there are pages subordinate to the Current Environment Record, you will be placed in change mode in the Current Page Record. The Current Page Record is the last one accessed. To get to the Page Menu which is a list of all pages, as opposed to the Page Screen, see the section "Storing and Exiting the Page Screen" following.

The Page Screen consists of three sections. You move between the three sections using the <F3> key. Each section is described in detail following.

The Sd. Type section is in the form of a horizontal menu and determines the side type. The list of choices you will see depends upon settings in the Current Environment Record. The choices are limited to the following:

TRAV	Traverse	Field data entered will be calculated from the instrument station to the F.S. point. The F.S. point is assumed to be next instrument station.
SS	SideShot	Field data calculated from the instrument station to the F.S. point. The foresight point is assumed to be a side shot.
H-Side	Hold Side	The field data entered from instrument station to F.S. point will not be changed during traverse adjustment.
H-Angle	Hold Angle	The horizontal angle or direction from the instrument station to the F.S. point will not be changed during traverse adjustment.

Closing	Closing Side	If you are going to check angular closure and/or automatically balance angular error, the closing horizontal angle from the last traverse station to the reference object is entered as a closing side type. Upon entering the last traverse page, occupy the last traverse point and enter the closing angle to the reference object. CLOSING SIDE NOTES: • You will not be prompted for distances when you select a closing side type. • For Closed Traverses where the reference object is the last occupied station, the program will assume a closing turned angle of 0 degrees if no closing side is entered. • For Closed Traverses where the first traverse leg is in a known direction, the reference object is considered the traverse foresight from the starting station. If the reference direction was entered in the Job Record, the reference object is the object used as the backsight from the starting station. • For Closed Connecting Traverses you must enter both a closing angle and a closing direction when you want to check angular closure. The closing direction must be to an object that is in a known direction from the last traverse point. The closing direction is entered as a closing side type on the page following the page containing the closing angle.
DD SS	Double Determined Side Shot	The field data entered from two traverse stations to the same side shot. The coordinates generated from the second traverse station will be meaned with the coordinates generated from the first.
TP On	Turning Point On-Line	The field data entered here follows the horizontal angle entered on the previous page. The routine takes the previous page's horizontal angle, the present page's slope distance and angle, and subsequent page's slope angle and distance to calculate the coordinates of the next traverse point. For example, this would be used when measuring a side with a tape to a TP and back to the TP from the next station.

Edit/Page

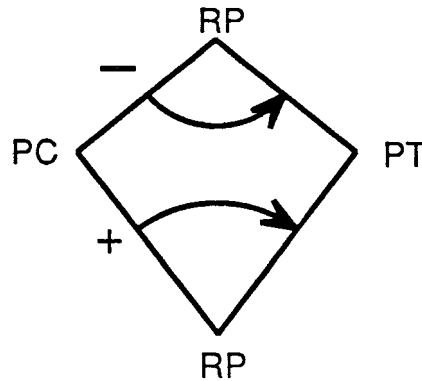
TP Off	Turning Point Off-line	The field data entered follows horizontal information to the next traverse station. This allows the vertical information to be generated from FS HI to TP to BS HI without a measure up.
Backin-HI	Backin the Height of Instrument	The field data entered follows horizontal angle and distance information. to a traverse station. It allows the HI to be established from a B.S. station. The elevation is not updated for the instrument station.
Backin HI+Ground	Backin the Height of Instrument and Ground Elevation	The field data entered follows horizontal angle and Distance information to a traverse station. This allows both the HI and the Ground elevation of the instrument station to be updated.
Recip	Reciprocal	The field data entered follows a FS observation from one instrument station to another. The horizontal distance is calculated in both directions and meaned to give the correct coordinates. Elevations of both FS and BS observations are meaned during a trigonometric leveling traverse.
RadCry	Radius Curve	Useful for map checks. The direction or angle and distance is from the PC to the radius point followed on the next page by the direction or angle from the radius point to the PT.
TanCry	Tangent Curve	Useful for map checks. The direction or angle and distance from the PC to the PI followed on the next page by the direction or angle and distance to the PT.

Edit/Page

ChordCrv

Chord Curve

Used for map checks. The data needed is the radius of the curve (positive for a clockwise curve and negative for a counter-clockwise curve), the direction or angle and distance from the PC to the PT.



The **Horiz. Type** section contains horizontal menus for choosing horizontal angle type (Horiz. Type) and elevation type (Elev.Type) when elevation data is entered. The exact form of this section depends upon settings in the Current Environment Record and the **Sd. Type** section.

For **horizontal** angle type you have the following options:

Bearing - The number of the quadrant is entered followed by the bearing angle.

Azimuth - The North or South azimuth is entered, depending upon the setting in the Options Menu.

Turned Angle - The field angle turned from a backsight is entered. A minus sign precedes left or counter clockwise angles. When entering multiple side-shots from the same station, the program will hold the backsight circle reading from page to page.

Deflection angle - The angle deflected right or left from the prolongation of a line passing from the backsight thru the occupied station. Deflection angles to the left are preceded by a minus sign.

For **elevation** type there are two choices:

- None - No elevations are computed for the foresight.
- Assign Elevation to FS - Elevations are computed for the foresight.

Edit/Page

The data entry section of the page menu allows for the entry of field data. Field data may be manually keyed in or imported from an electronic field book ("data collector"). The fields that appear in the data entry section depend on the **Current Environment Record** and the **Sd. Type** and **Horiz. Type** sections. Whenever you are entering observation data in the data entry section you can move the cursor from the observation block to the first field following the block with <TAB>. <SHIFT><TAB> can be used to move the cursor to the field preceding the observation block.

OCC	Occupied Point	The point number of the instrument station.
Instrument Height		The vertical difference between the telescope's horizontal cross hair and the ground point the instrument is set on.
BS	Backsight	The point number of the station being backsighted from the instrument station.
FS	Foresight	The point number of the foresight observed from the instrument station. Point numbers from 1 to 32000 are valid.

Bearing/Azimuth/Turned Angle/Deflection Angle - The prompt depends upon the horizontal angle type set in the **Horiz. Type** section. Depending on the setting in the options menu, horizontal and vertical angles may be entered with the decimal point between the second and tenth of a second, or between degrees and minutes.

For example:

3 degrees, 25 minutes, 33.5 seconds - 32533.5 or 3.25335.
1 minute 55 seconds - 155 or .0155
45 degrees - 450000 or 45.

For **turned and deflection** angles, the program sums the difference of each foresight/backsight pair and means the total. If there are more backsights entered than foresights, the additional backsights are ignored. If there are more foresights than backsights, the program assumes that a repeating instrument is being used and the missing backsights are taken to be the same as the prior foresight reading.

For **bearings and azimuths**, the resulting direction is the mean of the directions entered.

Horizontal angles turned to the left or counter clock wise must be preceded by a minus sign.

For example:

left field angle 15 degrees, 25 minutes is either -152500 or -15.25

Zenith Angle/Vertical Angle - Zenith angles are measured from upward vertical. Vertical angles are measured from the horizontal plane. If this field is left blank, the distance is assumed to be parallel to the horizontal plane. Negative angles must be preceded by a minus sign.

For example:

Negative 2 degrees 5 minutes: -20500 or -2.05

Edit/Page

Distance

The prompt for horizontal distance is Distance.

The prompt for slope distance is Slope Distance.

The prompt for stadia distance is Stadia Distance. The stadia distance to be entered is the difference between the upper and lower stadia hair observations times 100. For example:

upper hair	=	6.3
lower hair	=	4.0
difference	=	2.3
Stadia distance	=	230

Target height - The vertical difference between the prism/reflector target's horizontal line and the ground point.

Rod Reading - The reading of the telescopes horizontal cross hair on the stadia rod.

Difference in Elevation - Negative DE's must be preceded by a minus sign.

For example:

negative 25.61 is expressed as -25.61

Elevation - Used for entering ground elevations from a total station.

Description - May be a numeric description code or any text up to 16 characters. If a numeric code is used, it will be converted to text when you press <RETURN/ENTER>. With either method, the text may be edited at any time. See section on Descriptions in chapter 3 for more about descriptions.

Least Squares Input

Expected Angular Error (in seconds)

Expected Linear Error (in decimals of a foot)

See "Least Squares Balance" in the Process Menu section below for more details.

STORING AND EXITING THE PAGE SCREEN:

To store any changes you have made on the current page, press <F10> and the next page will be displayed. In change mode you may also use <SHIFT><F10> to store the page and move to the prior page.

To exit without storing any changes, press <ESC> and the following horizontal menu will be displayed in the message window (see "Choosing Items From a Horizontal Menu" if you need to know how to use this type of menu):

Page	Env.	Job	pRocess	File	Main
Go to Page Menu					

When the above menu is on the screen you may press ESCape if you wish to return to editing the Current Page. The first option (Page), allows you to get to the Page Menu. This and the remaining options are discussed in the "Working with the Page Menu" section below.

Edit/Page

WORKING WITH THE PAGE MENU:

The Page Menu displays a list of the Page Records subordinate to the Current Environment Record. The left hand column shows the record number with the currently selected record highlighted. You move the highlight bar with the arrow keys to select the proper record number. The Home key moves you to the beginning of the list. The End key moves you to the end of the list. The PgUp and PgDn keys move you one screens worth in the respective direction. This menu allows you to quickly get to specific pages without needing to <F10> or <SHIFT><F10> your way thru each page. When you have highlighted the proper record press <RETURN/ENTER> and the program will display the following horizontal menu in the message window at the bottom of the screen:

Change Insert Delete jUmp mOve Env Job pRocess File Main Change a Page

Change puts you into change mode with the selected Page Record displayed on the screen.

Insert allows you to insert a Page Record that will follow the selected record. You will stay in insert mode until you exit by pressing ESCape

Delete allows you to delete a Page Record.

jUmp allows you to move the highlight bar directly to a specific page number. This may be quicker than moving the highlight bar via the cursor movement keys if you have many pages in the job.

mOve allows you to move a Page Record.

Environment and **Job** allows you to edit the selected record type. The selected Page Record is left as the Current Page Record so when you return to the Page Menu or Screen it will be the selected Page Record.

pRocess, **File** and **Main** allow you to go to the respective menu while leaving the selected Page Record the Current Page Record. When you return to the edit mode you will return to the Page Menu with this record selected.

NOTES:

- The program will not automatically dump each page's data as you enter it. To print a particular display screen of data, use <SHIFT> <PRT SC> To list all the field data go to the Process Menu and use the List Field Data option.
- The program means each field independently so that the user does not need to enter equal numbers of readings for each field. For example if each distance measured is equal than only one distance needs to be entered regardless of how many horizontal or vertical angles are entered.

File

When you select "File" from the main menu you will be presented with the following menu.

File Menu

C:\TESTDATA
Memory left=100%

```
Load Field Data File
Save Field Data File
Save Coordinate File
Save Lot Description File
Make New Job
Assign Coordinate Reference File
Delete Job File
Rename Job File
List Job Directory/Disk Space
Change Logged Subdirectory
Change Logged Drive
Close Job File
Clear Field Data from Memory
Exit File Menu
```

Each of the menu selections is described following:

LOAD FIELD DATA FILE

This option allows you to recall previously stored field data as well as field data generated by our Benchmark<->Lietz SDR Data Exchange software. Enter the job number you wish to recall and press <CR>.

NOTES:

- If there is field data presently in memory you may clear it prior to recalling a job, or append the recalled data to the data already in memory.
- You must be logged onto the proper disk drive and subdirectory prior to loading the job.
- When appending existing field data consider the following information:

You may append the current field data file with other field data files in the sequence the traverse was run.

The first field data file's Environment Records list before successive field data file's Environment Records.

If successive Environment Records are the same as the first Environment Record they may be deleted. This allows all pages to be listed under one Environment Record.

You may make a new job and store the combined field data in it; otherwise the field data will be stored in the currently opened job.

File

SAVE FIELD DATA FILE

Use this option to store your field data to disk. You must first create a job using the Make New Job option before you can store field data.

SAVE COORDINATE FILE

Use this option to store coordinates computed from your field data. You must open a job using the Make New Job option prior to storing coordinates. You may merge coordinates with an existing coordinate job by assigning a coordinate reference file (see below). You cannot store both field data and coordinates in the same job.

SAVE LOT DESCRIPTION FILE

Whenever coordinates are generated in the Process Menu, a lot description file is generated that represents a figure of the surveyed data. This option allows the user to save this figure as a lot description file that can be recalled in Coordinate Geometry via the 144- command. From there the user can send the figure directly to screen plotting, the Advanced Graphics Option (AGO) or to AutoCAD in the form of a DXF file via the 127- command.

MAKE NEW JOB

Use this option to create a new job number and name. If you aren't sure of available job numbers use the List Job Directory/Disk Space Option.

File

ASSIGN COORDINATE REFERENCE FILE

Use this option to reference an existing coordinate job file. You can then use the points of the coordinate job file to locate occupied and backsight points. One of the key reasons for this option is to allow the user to enter topographical field data and other side-shot field data independent of any traverse data. By using this option, the Field Data Editor is able to locate station and backsight coordinates by looking in the Coordinate Reference File and "pulling" the values. When assigning a coordinate reference file consider the following information:

- The reference job must be in the currently logged subdirectory.
- When saving coordinates, any newly created points will be added to the Coordinate Reference File.
- When a newly created point has the same number as a point in the Coordinate Reference File, but not the same coordinate values, the user will be given a warning at generation time and at coordinate save time. The points are not actually added to the Reference File until the user selects "Save Coordinate File".
- When searching for coordinate values for occupied points and backsights, the program first looks at any newly created points and, if not found, it then looks in the Coordinate Reference File.
- You may copy the original coordinate job file to another job (using the job copy utilities) prior to assigning it as a Coordinate Reference File. This will prevent overwriting of points if duplicate point numbers are used in both files.
- On networks, the Coordinate Reference File will be locked to access by other users until the user unassigns it either by closing the current job, loading a new job or exiting the Field Data Editor.

DELETE JOB FILE

Use this option to delete old jobs from the current logged drive and subdirectory.

RENAME JOB FILE

Use this option to change the name of an existing job.

LIST JOB DIRECTORY/DISK SPACE

Use this option to list out the jobs on the current drive/subdirectory. The amount of storage capacity remaining on the drive will be displayed at the top of the screen.

File

CHANGE LOGGED DRIVE

Use this option to change from one disk drive to another. If you enter a hard disk drive letter the subdirectory is asked for.

CHANGE LOGGED SUBDIRECTORY

use this option to change from one subdirectory to another. You enter the subdirectory name in the same format that you would when using the DOS CD (or CHDIR) command.

NOTE: In the preceding two options the field data and new created coordinates that are in memory will be retained as you change drives or subdirectories. This allows you to store information in areas other than the currently logged drive/directory.

CLEAR FIELD DATA FROM MEMORY

Use this option to clear existing field data. You may wish to do this if you've entered data incorrectly and it would be more difficult to edit or change than to start over. You may also have started one set of field data and are ready to enter another set.

EXIT FILE MENU

Selecting this option or pressing ESCape will return you to the menu that you entered the File Menu from.

Process

When you select "Process" from the main menu you will be presented with the following menu:

Process Menu

C:\TESTDATA
Memory left=100%

```
Calculate Closure
Automatic Angle Adjustment
Generate Unbalanced Coordinates
Least Squares Balance
Compass Rule Balance
Crandall's Rule Balance File
List Field Data
Graphics
Angular Error Search
Linear Error Search
Printer Output is Off
Side Shot Printing is On
Exit Process Menu
```

Each of the menu selection is described below:

CALCULATE CLOSURE

Use this option to calculate the closure of your traverse. You must do this before you use any of the adjustment, balance or search routines; otherwise you may proceed to "Generate Unbalanced Coordinates" below.

AUTOMATIC ANGLE ADJUSTMENT

Use this option to distribute random angular errors equally about the traverse. You may recalculate the closure if the results are undesirable. See "Closing Side" in the Edit/Page section for information on entering closing data to achieve angular closure.

GENERATE UNBALANCED COORDINATES

Use this option to generate unbalanced coordinates.

LEAST SQUARES BALANCE

A least squares balance finds the most probable adjustment of the observed quantities by finding the combination of those adjustments that yields the lowest possible sum of the squares of the residuals (the residuals are the adjustments made to the observed quantities). When combined with weights of the observed quantities the least squares finds the lowest possible sum of the squares of the residuals times the weights.

Our least squares balance routine is a weighted one that uses the condition equation method. The conditions to be satisfied are the latitude, departure, and angular closure conditions.

Process

The least squares balance routine works the same as the other balance routines from a user point of view with two exceptions:

1. The least squares balance requires the user to enter an expected error for angles and distances on traverse sides that have such adjustable data. The expected error is entered in the same units as the associated observation.

The expected error is a plus or minus quantity that tells the least squares program how to weight the quality of the associated observation. The weight of an observation is the RELATIVE quality of that observed quantity in relation to all the other observations within a traverse. The expected error is an estimate that is used to establish weights of the observations. The higher the expected error, the lower the weight. The lower the weight, the higher the correction that will be applied to the associated observation.

2. The least squares balance prints out residuals for each adjusted observation. The residual is the correction applied to the observations by the least squares routine.

NOTES:

- A side held constant contains no adjustable data and therefore does not prompt for an expected error, a side with angles held constant only prompts for an expected error for distance and closing sides only prompt for an expected error for angles.
- The word "observation" is used above to represent the mean of all angles or distances for a given side.

COMPASS RULE BALANCE

Use this option to adjust the traverse by the compass rule method.

CRANDALL'S RULE BALANCE

Use this option to adjust the traverse by the Crandall's rule method.

LIST FIELD DATA

Use this option to list your raw field data. If printer output is on, the field data will be sent to the printer as well as the screen.

GRAPHICS

Use this option to generate a picture representing the figure of the survey data. This option should be used after using one of the coordinate generation options. Use the <F1> key to toggle between displaying point numbers and not displaying point numbers.

ANGULAR ERROR SEARCH

Use this option to help find an angular error in the traverse. The program applies the total angular error to each leg of the traverse and calculates the linear error and precision for each leg. The page number that contains the lowest error and highest precision is the place to start looking for the error.

Process

LINEAR ERROR SEARCH

Use this option to help find a distance error in the traverse. The program applies the total linear error to each traverse leg both adding and subtracting the error to the leg. The linear error and precision are displayed for each leg. The page that contains the smallest error and highest precision is the place to start looking for the error.

PRINTER OUTPUT IS OFF/ON

Use this option to activate the printer for any of the above options.

SIDESHOT PRINTING IS OFF/ON

This option controls whether side-shots are printed or not during coordinate generation. When side-shot printing is off, side-shots points are still generated, but they are not printed.

BATCH EDITING:

The Process Menu performs a batch edit whenever you enter it after making changes or loading a new field data file. This batch edit is performed for the following reasons:

- Since the user is allowed to move and delete Page Records, occupied and backsight points numbers that were correct at page store time may now be inconsistent.
- To allow the user to alter Tolerance Menu settings to check, or recheck at higher tolerances, multiple observation data. See Tolerances Menu for more information.
- To allow data collection users, such as our Benchmark<->Lietz SDR Data Exchange Software, to take advantage of the page editing feature.

Options Menu

The options menu allows you to make temporary changes to your Setup Menu options. These temporary changes will be lost upon exiting to the Benchmark Main Menu. The Options Menu is accessible from the Field Data Editor's Main Menu. The following is an example of the Options Menu:

```
Options Menu                                C:\TESTDATA
                                           Memory left=100%

Printer Status          Off          On
Printer Output Routed to lpt1
Angles will be output as Bearings    Azimuths    Angles Right
Distance rounded to    0 1 2 3 4 places
Coordinates rounded to 0 1 2 3 4 places
Bearings rounded to nearest Degree      15 Minutes    Minute
                        10 Seconds    Second      10th Second
Elevations rounded to 0 1 2 3 4 places
Staggered printing is  Off          On
Date and time in heading is Off        On
Angle entry format      DDDMSS.S    (Q/D) DD.MMSSS
Point numbering is      Automatic    Manual
Meters to feet conversion is Off      On
Azimuth type is         North        South
Printing of Company Title is Off      On
Printer Output Routed to lpt1
```

Press ESCape to exit -- F10 to accept

The highlighted items are the current defaults. The exact defaults that you see when you enter the Options Menu the first time reflect the values set in the Setup Menu. You change most of the items via a horizontal menu (see "Choosing Items From a Horizontal Menu" if you need to know how to use this type of menu). PgUp and PgDn move to the beginning and end of the menu respectively. Press <RETURN/ENTER> to move to the next item in the list and Backspace to move to the prior item.

The "Printer Output Routed to" item is controlled by the BNPRN environment variable. It allows you to route printed output to files and devices other than the default LPT1. See "Benchmark Environment Variables" in the appendix for more information on this.

To store your changes press <F10>.

To exit without storing changes press <ESC>.

Defaults Menu

The Defaults Menu controls which fields will be copied from the prior page entered. It is used to make Page Record data entry more convenient when certain fields remain the same from page to page. The Defaults Menu is accessible from the Field Data Editor's Main Menu. The following is an example of the Defaults Menu:

```
Defaults Menu                                C:\TESTDATA
                                              Memory left=100%

VA/Zenith   (will/will not) default to last one entered during
           editing.
Rod reading (will/will not) default to last one entered during
           editing.
Description (will/will not) default to last one entered during
           editing.
```

Press ESCape to exit -- F10 to accept

The highlighted items are the current defaults. The exact defaults that you see when you enter the Defaults Menu depend upon any changes you previously made. You change the items via a horizontal menu (see "Choosing Items From a Horizontal Menu" if you need to know how to use this type of menu)

To store your changes press <**F10**>. The changes made will hold until the next time you change them via the Defaults Menu.

To exit without storing changes press <**ESC**>.

Tolerances Menu

The Tolerances Menu allows you to set Page Record editing criteria for checking multiple observation data against one and other. It is used to trap blunders in data entry and field notes. The Tolerances Menu is accessible from the Field Data Editor's Main Menu. The following is an example of the Tolerances Menu:

Tolerances Menu

C:\TESTDATA
Memory left=100%

Tolerance Checking is	Off	On
Horizontal Angle	10000.0	
VA/Zenith	10000.0	
Distance	1	

Press ESCape to exit -- F10 to accept

You move from item to item by pressing <RETURN/ENTER>. The angle and distance units that you use depend upon your Angle Entry Format Options Menu setting and the Job Record Distance Units setting. If you turn tolerance checking on, multiple observation data will be checked when you store Page Records in edit mode. Also, since the Process Menu performs a batch edit whenever you enter it after making changes or loading a new field data file, tolerances can be checked at any time by simply turning tolerance checking on and proceeding to the Process Menu.

Field Data Editor Tutorial

Field Data Editor Tutorial

Following are the steps to enter a five-sided traverse. You will enter the traverse field data, calculate the closure, balance the angular error, adjust the coordinates by the compass rule, and store the coordinates in a Benchmark job file.

Before entering the Field Data Editor, a subdirectory must be initialized for job storage.

Then, from the Benchmark Main menu, highlight **Field Data Editor** using the arrow keys or by typing F followed by pressing the <Enter> key.

You are now at the Field Data Main Menu.

Press the <Enter> key to select Edit.

You are now in the Job Header Record.

Type **Sample Traverse** and press the <Enter> key two times to highlight the Starting Point **Number**. Press the <Enter> Key to select 1.

Type **5000** for the starting Northing and Press the <Enter> key.

Type **5000** for the starting Easting and press the <Enter> key. The rest of the defaults are already set for a closed traverse in feet. Press the <F10> key to accept the information.

Press the <Enter> key to select Env.

You are now in Environment Record Number 0001.

Type **Test** and press the <Enter> key.

Press the <F10> key to accept the defaults and the information entered.

Press the <Enter> key to select Page.

You are now at page number 0001. The display shows that you are in Traverse mode, that the horizontal angle is set for bearings, the occupied point is 1, the foresight point is 2, and you are being prompted to enter a Quadrant for the Bearing from 1 to 2.

Type **4** to select the northwest quadrant.

Type **301510** and press the <Enter> key.

Type **599.23** and press the <Enter> key.

Press the <F10> key to accept the page.

You are now on Page number 0002.

Press the <F3> key twice to activate the **Horiz. Type** section. Press the <right arrow> key twice to highlight **Turned Angle**. Press the <F3> key. Notice the prompts have changed to represent a field angle traverse.

Type **2722000** and press the <Enter> Key.

Type **722 .65** and press the <F10> key to accept the page.

You are now on page number 0003.

Type **2623512** and press the <Enter> key.

Type **483.6** and press the <F10> key. You

are now on page Number 0004.

Type **1954025.2** and Press the <Enter> key.

Type **475.212** and Press the <F10> key. You

are now on page 0005.

Press the <Backspace> Key *or* the <left arrow> key to highlight **FS 6**. Type **1** and press the <Enter> key.

Type **2883715** and press the <Enter> Key.

Type **776.31** and press the <F10> key. You

are now on page 0006.

Press the <F3> key to activate the **Sd. Type** section. Type **c** to highlight **Closing**. Press the <F3> key twice.

Type **2404637** and Press the <F10> key to accept the closing angle.

You are now on page 0007.

Press the <Escape> key to activate the bottom menu. Type **R** to highlight **pRocess** . Press the <Enter> Key. You are now in the Process Menu. Press the <Enter> Key to Calculate the closure. The closure data should be as follows:

Number of sides	=	5
Angular Error	=	-31 Seconds
Northing Error	=	-0.1158
Easting Error	=	0.0044
Absolute Error	=	0.1159
Direction of Error	=	S02-10-36.7E
Perimeter	=	3057.0020
Precision	=	1 foot in 26374

Press any key to return to the Process Menu.

Field Data Editor Tutorial

Type **A** and press the <Enter> key to balance the angular error. Press any key to return to the Process Menu. Type **C** and press the <Enter> key to do a compass rule adjustment Of the coordinates. Press any key to return to the Process Menu.

Type **L** twice and press the <Enter> key to List the field data. Press any key to view the next screen of information. Press any key to return to the Process Menu. Press the <Escape> Key to exit the Process Menu. Press the <Escape> Key again.

Type **F** and press the <Enter> Key to access the File Menu.

If the subdirectory displayed in the upper right corner of the screen has not been initialized, Type **c** , press the <Enter> key, and type in the name of an Initialized Subdirectory.

Type **L** and press the <Enter> key to list any used jobs in the current subdirectory. Make note of a job number listed as unused. Press the <EScape> Key to return to the File Menu. Type **M** and press the <Enter> Key to create a new job. Type in an unused job number. Type **Sample Traverse Balanced Coordinates** and press the <F10> key. Type **S** twice to highlight **Save Coordinate File**. Press the <Enter> Key to store the corrdinates.

You have now completed the Field Data Tutorial.

To return the main Field Data Menu, press the <Escape> key twice, type **m** , and press the <Enter> key. To return to the Main Benchmark Menu, type **R** and press the <Enter> key. Press the <Enter> key again.

You are now back at the Main Benchmark Menu.

Introduction to Coordinate Geometry

Field Data Editor vs. Coordinate Geometry	5-2
Bypassing The Field Data Editor	5-2
Features of Coordinate Geometry	5-3
Controlling the Mode of Operation	5-4

WHAT'S IN THIS CHAPTER?

This chapter provides an introduction to the Coordinate Geometry commands. You will learn the general scope of the program here. Following chapters cover logical groupings of the Coordinate Geometry commands in detail.

Field Data Editor vs. Coordinate Geometry

When you enter traverse data in the Coordinate Geometry program, your entries are processed immediately by Benchmark and displayed as coordinate points. That is, for each direction and distance you enter, the direction is immediately re-displayed as a bearing, azimuth, or angle to the right (depending on the default output settings); and the coordinate pair determined by the direction and distance is also displayed.

This is in contrast to the Field Data Editor program, where you work with field data (angles and distances only). Coordinate points are not displayed until you use one of the balancing routines or generate unbalanced coordinates.

Typically, you will enter traverse data in the Field Data Editor program, correct and balance the traverse, and then store it as coordinate points. Then you move the job to Coordinate Geometry, and perform further operations on the coordinate points there. You can also enter traverse data and points directly with Coordinate Geometry, but you cannot perform balancing operations or calculate closure in Coordinate Geometry.

Also keep in mind that you cannot load field data job files in the Coordinate Geometry program nor can you load coordinate point files in the Field Data Editor program. Read the chapters "Storing and Retrieving Job Data" and "Introduction to the Field Data Editor" for more information on the difference between field and coordinate data files.

Bypassing The Field Data Editor

There are times when you may go directly to the Coordinate Geometry program without first entering field data in the Field Data Editor program.

- When you have data that does not need to be balanced (using the Compass Rule, Least Squares or Crandall Method), you can enter the data directly within Coordinate Geometry. Keep in mind, however, that correction procedures are more forgiving in the Field Data Editor than in Coordinate Geometry. In the Field Data Editor, you can change, insert, and delete sides.
- When your field data has been processed and balanced with other software or another computer, you can enter these coordinate points directly, or import them in ASCII file form.

Features of Coordinate Geometry

Here are some of the things you can do in Coordinate Geometry:

- Enter coordinate or traverse data (Traverse Mode Commands Chapter)
- Enter consecutive or radial inverses (Traverse Mode Commands Chapter)
- Enter side shots and 90-degree offsets (Traverse Mode Commands Chapter)
- Enter elevation data (Elevation Commands Chapter)
- Generate curve data from known points. Most of the curve commands also generate new points (Curve Commands chapter)
- Design streets and intersections (Street Designs Chapter)
- Describe groups from known points (Group Commands Chapter)
- Design lots to meet a minimum square footage (Lot Sizing Commands chapter)
- Transform points from one coordinate system to another (Transformation and Rotation Commands Chapter)
- Display, print, clear, copy, and move coordinate points (Point Utility and Display Commands Chapter)
- Solve a variety of problems, such as multiple points on a line, radial stakeouts, linear regression, three-point problems, circular curves, spiral curves (Miscellaneous Coordinate Geometry Commands Chapter)
- Transfer Groups of points to the Advanced Graphics Option and see your lots and points on the graphics screen. You can use most of the Coordinate Geometry commands within the Advanced Graphics option (Advanced Graphics Option Chapter).

Controlling the Mode of Operation

When you first enter Coordinate Geometry from the Benchmark Main Menu, the mode of operation is undefined. The first time that you enter a command that creates or loads coordinates, you will receive the following bar menu:

```

      Choose Mode of Operation
      Northing and Easting
      Descriptions, Northing and Easting
      Elevations, Northing and Easting
      Elevations, Descriptions, Northing and Easting

```

The mode of operation determines the type of data that you will enter, create and output. For example, if you choose Northing and Easting mode, any elevation and description data that is attached to existing points will not be displayed.

If you wish to reduce elevation data, then you should choose either, "Elevations, Northing and Easting" or "Elevations, Descriptions, Northing and Easting". See the chapter "Elevation Commands" for further details.

If you wish to enter description codes, then you should choose either, "Descriptions, Northing and Easting" or "Elevations, Descriptions, Northing and Easting". When you create points with descriptions on you will be prompted for a description to assign to each newly created point.

CHANGING THE MODE OF OPERATION (17-)

If you wish to switch the mode of operation use the 17- command. It will present you with the "Choose Mode of Operation" bar menu where you can select the desired mode.

PRODUCING A TWO-UP POINT LISTING (16-)

You can list two points to a line with the point printing command (210-) while in Northing and Easting mode by using the 16- command. When two-up point listings are off, points will be printed one to a line when in Northing and Easting mode. The default for this toggle setting is controllable from the Setup Menu (see the chapter on "The Setup Menu and Description Codes" for further details).

AGO AND THE MODE OF OPERATION

AGO only works in Northing and Easting mode so it ignores the current mode of operation. When you exit AGO the program will return to the mode of operation that was in effect at the time you entered AGO.

BENCHMARK BASIC VERSION AND THE MODE OF OPERATION

In Benchmark Basic Coordinate Geometry, the Mode of Operation only affects the data that is displayed. You may only create Northing and Easting data, although any elevation and description data will be displayed when in the appropriate mode. Such elevation and description data can be generated by the Field Data Editor and imported or exported via the 128- and 129-commands respectively.

Traverse Mode Commands

(10-) Define Setup Location/Enter Traverse Mode	6-2
(4-) Return to (Benchmark) Main Menu	6-2
(330-) Re-Enter Traverse Mode	6-3
(20-,21-,23-,24-) Entering Direction and Distance	6-4
(18-) Set Slope Angle Request	6-6
(51-, 52-, 53-) Enter Multiple Slope Angles and Distances	6-7
(26-,27-) Select Slope Reduction Method	6-8
(50-) Enter a Temperature	6-8
(54-) Convert Meters to Feet	6-8
(35-) Select Angle Entry Format	6-9
(37-) Select Single/Double Line Feed	6-9
(86-,13-) Point Numbering	6-10
(86-) Select Manual/Automatic Point Numbering	6-10
(13-) Change Storage Point Sequence	6-12
(40-, 41-, 42-) Copy Direction and/or Distance	6-13
(40-) Copy Direction	6-13
(41-) Copy Distance	6-13
(42-) Copy Direction and Distance	6-13
(30-, 31-, 33-) Side Shots	6-15
(30-) Side Shot Mode	6-15
(31-) Single Side Shot	6-15
(33-) 90 Degree Offset	6-16
(19-) Display Accumulated Area	6-17
(12-) Enter Coordinates	6-18
(223-) Print Screen	6-19
(81-, 68-, 82-) Inversing	6-19
(81-) Consecutive Inverse Routine	6-19
(68-) Inverse Through Curve	6-20
(82-) Radial Inverse Routine	6-21
(91-, 92-, 93-, 70-, 71-) Intersections	6-23
(91-,92-,93-) Line Intersection Routines	6-23
(70-) Offset Intersection on a Line	6-27
(71-) Offset Intersection on an Arc	6-29

WHAT'S IN THIS CHAPTER?

Chapter 5 introduced the Coordinate Geometry program. This chapter is a reference to the traverse commands available in Coordinate Geometry.

(10-) Define Setup Location/Enter Traverse Mode

PURPOSE

Use the 10- command to define your setup location and enter traverse mode.

PROCEDURE

1. Enter 10-. Benchmark responds:
Occupied point=
2. Enter the point you want the program to occupy. Benchmark responds:
Backsight point=
3. Enter the point number you want to use as a backsight. If an operation does not require a backsight, just press RETURN with no entry. Benchmark responds:
Storage point=
4. Enter the point number where you want to start storing the coordinates you are about to create. If you are performing an operation that isn't going to create any new points, select another command at the prompt. The program will automatically go to traverse mode under normal operation.
5. You will now enter the traverse routine and can enter direction and distance data as explained in "Entering Direction and Distance."

NOTES

1. Frequently you will use the 10- command just to occupy a point.
2. The 10- command clears the accumulated area perimeter, latitude and departure (see the command description for 19-).
3. In Coordinate Geometry Traverse mode the last point displayed is the currently occupied point. The only exception to this rule is when doing side shots with the "printing of occupied station in side shot mode" flag (49-) set to off (see Chapter 3: The Setup Menu for further details on the 49- command).
4. The 10- command automatically clears side-shot mode if it was previously set with 30-.

(4-) Return to (Benchmark) Main Menu

The 4- command will return you to the Benchmark Main Menu.

(330-) Re-Enter Traverse Mode

PURPOSE

Lets you re-enter traverse mode from another mode and resume entry from where you left off.

PROCEDURE

Enter **330-** to re-enter traverse mode.

You will receive one of the four direction prompts

(Bearing=, Angle=, Azimuth=, or Deflection Angle=)

depending on how the default direction mode is set. Note that, unlike the 10- command, you are not prompted for backsight, occupied, or storage points. If the program is set for automatic point storage (see 86-), the next sequential point number will be used for storage.

NOTES

1. You can use the 330- routine to switch between traverse and inverse or side-shot operations.
2. The 330- command does not clear the accumulated area, perimeter, latitude and departure (see the command description for 19-).

Bearing	Distance	Point	Northing	Easting	Type
-----11-03-1986-----15:32:36-----C:\MYDIR					
Command 10-					
Occupied Point= 1		Occupy point 1			
			1 5000.0000	5000.0000	OCC
Backsight Point=		No backsight used			
			1 5000.0000	5000.0000	OCC
Storage Point = 300		Start storage a point 300			
Bearing= 30-		Enter side-shot mode			
Bearing= 450000					
Quadrant= 1					
Distance = 100					
N45-00-00.0E 100.00			300 5070.7107	5070.7107	TRA SS
			1 5000.0000	5000.0000	
Bearing= 450000		Do another side-shot			
Quadrant= 2					
Distance = 100					
S45-00-00.0E 100.00			301 4929.2893	5070.7107	TRA SS
			1 5000.0000	5000.0000	
Bearing= 330-		Re-enter traverse mode			
Bearing= 450000		Traverse leg			
Quadrant= 3					
Distance = 100					
S45-00-00.0W 100.00			302 4929.2893	4929.2893	TRA
Bearing=		Continue with traverse...			

(20-,21-,23-,24-) Entering Direction and Distance

Depending on the direction mode you select, you will receive one of the four prompts shown in the table below.

Standard Format (35-) (D)DDMMSS.S		Alternate Format (35-) (Q) (D)DD.MMSSS
Bearing (20-)	Bearing=DDMMSS.S Quadrant= (1-4)	Bearing= QDD.MMSSS
Azimuth (21-)	Azimuth= DDDMMSS.S	Azimuth= DDD.MMSSS
Deflect. Angle (23)	Deflection Angle= DDDMMSS.S	Deflection Angle= DD.MMSSS
Turned Angle (24-)	Angle= DDDMMSS.S	Angle= DDD.MMSSS

You can get from any of the prompts in the above table to any of the other prompts in the above table by issuing the commands listed in the appropriate row and column. Once you select a direction mode, it remains in effect until changed. After responding to the above prompts you will receive the following distance prompts:

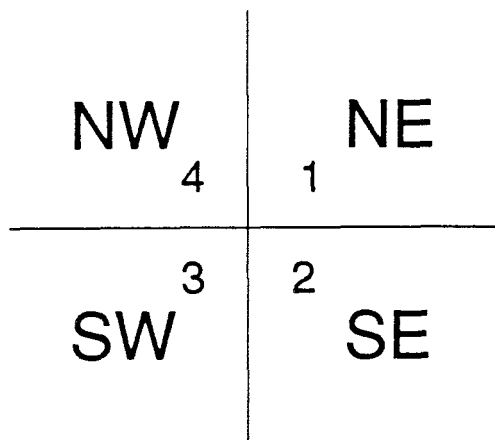
Horizontal Distance (18-)		Sloped Distance (18-,51-)
Stadia (26-)	Distance=	Stadia Distance= Slope Angle=
VA (27-)	Distance=	Slope Distance= Slope Angle=

(20-,21-,23-,24-) Entering Direction and Distance

ENTERING BEARINGS

Bearings are entered in two steps:

1. Enter bearing as DDMMSS.S (degrees, minutes, seconds, tenths of a second).
2. Enter the quadrant (1, 2, 3, or 4). Use the following quadrant codes:



Note: Leading zeros are not necessary.

ALTERNATE ANGLE/DIRECTION FORMAT

An additional option for the format of angles, azimuths, and bearings has been provided:

QDD.MMSST for bearings

where

Q = quadrant (1,2,3 or 4)

D = degrees M

= minutes

S = seconds

T = tenth of a second

DDD.MMSST for angles and azimuths

where

D = degrees

M = minutes

S = seconds

T = tenth of a second

The default format is selected by default in the Setup Menu. You can toggle between the two entry formats using the 35- command. Trailing zeros are not necessary in the alternate entry format.

(18-) Set Slope Angle Request

PURPOSE

18- switches between manual and automatic slope request. In manual mode, Benchmark prompts for distance only; you must use 51- to enter a slope angle. In automatic mode, Benchmark prompts for slope angle and distance for each traverse leg.

PROCEDURE

To switch modes, enter 18- at the distance prompt. You can set the default mode on the Setup Menu (Chapter 3).

18+- sets automatic slope request

18-- sets manual slope request

18*- displays the current slope request

NOTES

1. In slope mode, you can enter only one slope angle and one distance per traverse leg.
2. In manual mode, you can enter multiple slope angles and distances.

(51-, 52-, 53-) Enter Multiple Slope Angles and Distances

PURPOSE

51- permits entry of multiple slope angles and distances along the same horizontal direction.

PROCEDURE

1. Make sure you are in manual slope mode.
2. Enter **51**— at the **Distance=** prompt. You will receive these prompts:

Vertical Angle Method (27-)	Stadia Method (26-)
Slope Distance= Slope Angle=	Stadia Distance= Slope Angle=

3. Enter as many angles and distances as you want. These prompts repeat until you enter another command.
4. You can complete the 51- routine in two ways:
 - Enter **52**— to tell the program to use the average of the entered distances as the distance of the traverse leg.
 - Enter **53**— to tell the program to use the sum of the entered distances as the distance of the traverse leg.

NOTES

1. You can enter slope angles from whatever reference point you want (0, 90, 270, etc.). The program normalizes the slope angle to +/- 45 degrees before performing the reduction calculation. This means that no slope angle can be greater than +/- 45 degrees from whatever reference you are using.
2. For a level measured distance, just press RETURN with no entry at the **Slope Angle=** prompt.
3. These commands are only effective in manual slope request mode (see 18-).

(26-, 27-) Select Slope Reduction Method

PURPOSE

Use 26- to select the stadia method for reducing slope distances (cosine squared X distance).

Use 27- to select vertical angle method (also known as EDM or "taping") for reducing slope distances (cosine X distance).

PROCEDURE

Enter 26- or 27- at the Command prompt, before you begin traverse entry.

To continue traverse entry, use the appropriate direction mode command (20-, 21-, 22-, 23-).

NOTE

Slope reduction mode is a system default that can be established on the Setup Menu.

(50-) Enter a Temperature

PURPOSE

Use 50- to enter a temperature in degrees Fahrenheit. The specified temperature is held until you change it.

PROCEDURE

Enter 50- at the distance prompt.

(54-) Convert Meters to Feet

PURPOSE

54- switches between conversion and no conversion of feet to meters.

PROCEDURE

Enter 54- at the distance prompt.

54+- turns the conversion on | 54-- turns the conversion off | 54*- displays the current setting

(35-) Select Angle Entry Format

35- switches between the two angle entry formats supported by Benchmark. The standard entry format is in the form DDDMMSS.S, where D = degrees, M = minutes, S = seconds, and .S = tenths of a second. For example, 1251500 for an angle entry of 125°15'00".

The alternate format is (Q/D)DD(D).MMSSS. If you are entering a bearing, you would enter 447.25 for the bearing N47°25'W. If you are entering an angle, you would enter 125.25 for an angle of 125°25'.

35+- sets (Q/D)DD(D).MMSSS format

35-- sets DDDMMSS.S format 35*-

displays the current format

(37-) Select Single/Double Line Feed

37- alternates between single and double line feed for all output to the screen or printer.

37+- sets single line feed printing

37-- sets double line feed printing

37*- displays the current line feed setting

(86-,13-) Point Numbering

The 86- and 13- commands control how point numbers are assigned to coordinate data.

(86-) Select Manual/Automatic Point Numbering

PURPOSE

86- lets you switch between manual and automatic point numbering.

PROCEDURE

Enter **86-** at the **COMMAND** prompt, or any direction prompt. Benchmark responds by displaying either:

Manual Point Numbering or Automatic Point Numbering

(always the reverse of the previous mode).

With manual storage point numbering, you are prompted to enter each point number before each new coordinate is stored.

With automatic point numbering, point numbering is automatic and sequential.

86+- sets automatic point numbering

86-- sets manual point numbering

86*- displays the current point numbering method

NOTES

1. When you revert to automatic point numbering from manual mode, point numbering will continue sequentially from the last entered point number.
2. The default mode is established in the Setup Menu (see Chapter 3).
3. If you try to store a point using a number that has already been used, Benchmark responds with

Point *n* is occupied by
n o r t h i n g
e a s t i n g

There are three ways of responding to this prompt:

- To override an existing point number, enter the point number negatively and press **RETURN** (for example, **-100**).
- To store the point at another location, enter the new point number. The program will check to see if that point number has been used.
- To tell Benchmark to use the next available point number, press **RETURN** without typing anything. Points will be assigned sequentially thereafter.

Point Numbering

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-02-1986-----20:47:24-----C:\MYDIR					
Command 86- Change point numbering mode to manual from automatic					
Manual Point Numbering					
Command 10-					
Occupied Point= 1					
		1	5000.0000	5000.0000	OCC
Backsight Point=					
		1	5000.0000	5000.0000	OCC
Notice that 10- does not ask for storage point number					
in manual point numbering mode					
Bearing= 450000					
Quadrant= 1					
Distance = 100					
Storage Point= 2 Assign new point number					
N45-00-00.0E	100.00	2	5070.7107	5070.7107	TRA
Bearing= 450000					
Quadrant= 2					
Distance = 100					
Storage Point= 5 Assign new point number					
S45-00-00.0E	100.00	5	5000.0000	5141.4214	TRA
Bearing= 86- Change point numbering mode to automatic from manual					
Automatic Point Numbering					
Command 10- Re-start traverse					
Occupied Point= 5					
		5	5000.0000	5141.4214	OCC
Backsight Point=					
		5	5000.0000	5141.4214	OCC
Storage Point= 10 Auto-number from point 10					
Bearing= 450000					
Quadrant= 3					
Distance = 100					
S45-00-00.0W	100.00	10	4929.2893	5070.7107	TRA
Bearing= 450000					
Quadrant= 4					
Distance = 100					
N45-00-00.0W	100.00	11	5000.0000	5000.0000	TRA
Bearing= Continue with traverse...					

Point Numbering

(13-) Change Storage Point Sequence

PURPOSE

Use 13- to establish a new point from which to begin sequential point storage.

PROCEDURE

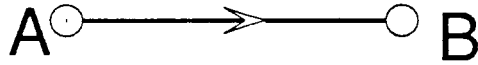
In automatic point numbering mode (86-), when you establish the storage point number with the 10- command, points are stored sequentially thereafter. If you want to alter the sequence, select 13- and specify the point number to begin storage. Henceforth, the point numbers will be numbered sequentially beginning with the point number you specified. The 13- command does not eject you from a traverse routine, so you can enter it at any point and continue with traverse entry.

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-02-1986-----20:22:53-----C:\MYDIR					
Command 10-		Occupy point 1			
Occupied Point= 1					
		1	5000.0000	5000.0000	OCC
Backsight Point=		1	5000.0000	5000.0000	OCC
Storage Point = 2		Start auto point storage sequence at point 2			
Bearing= 250905					
Quadrant= 2					
Distance = 100					
S25-09-05.0E 100.00		2	4909.4812	5042.5012	TRA
Bearing= 450000					
Quadrant= 1					
Distance = 100					
N45-00-00.0E 100.00		3	4980.1919	5113.2118	TRA
Bearing= 13-		Change point numbering sequence			
Point= 10		Start new storage sequence at point 10			
Bearing= 250905					
Quadrant= 3					
Distance = 100					
S25-09-05.0W 100.00		10	4889.6731	5070.7107	TRA
Bearing=		Continue with traverse...			

(40-, 41-, 42-) Copy Direction and/or Distance

The 40-, 41-, and 42- commands let you copy direction and distance for new points from existing points.



(40-) Copy Direction

PURPOSE

The 40- command specifies that a direction entry is to be copied from two existing points.

PROCEDURE

1. Enter **40-** at the direction prompt.
2. Enter the point numbers of A and B.
3. If the desired direction is perpendicular to the direction A to B, add 0.1 to the point number of B to indicate a direction 90° to the right or add 0.3 to indicate a direction 90° to the left.
4. Add 0.2 to the point number of B to specify a direction of B to A.
5. Add 0.4 to the point number of B, then enter any angle you choose. This angle is added to the derived bearing to calculate the actual bearing to be used in the calculation.

(41-) Copy Distance

PURPOSE

The 41- command specifies that a distance is to be copied from two existing points.

PROCEDURE

1. Enter **41-** at the distance prompt.
2. Enter the point numbers of A and B. The distance between A and B is used as the distance entry. In some routines where the distance should be input as a negative number, input the point number of B as a negative number.

(42-) Copy Direction and Distance

PURPOSE

The 42- command specifies that both the direction and distance are to be copied from two existing points.

PROCEDURE

1. Enter **42-** at the direction prompt.
2. Enter the point numbers of A and B. The direction and distance A to B are used as the direction and distance for the current point.

Copy Direction and/or Distance

This example demonstrates the use of the copy direction and/or distance commands (40-, 41-, 42-).

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-03-1986-----17:18:23-----C:\MYDIR					
Command 10-					
Occupied Point= 1					
		1	5000.0000	5000.0000	OCC
Backsight Point=					
		1	5000.0000	5000.0000	OCC
Storage Point = 2					
Bearing= 452703					
Quadrant= 2					
Distance = 445.73					
S45-27-03.0E	445.73	2	4687.3110	5317.6489	TRA
Bearing= 40-					Begin define bearing routine
Point= 1					Use the same direction as from point 1 to 2
Point= 2					
Distance = 500					
S45-27-03.0E	500.00	3	4336.5505	5673.9733	TRA
Bearing= 500000					
Quadrant= 4					
Distance = 41-					
Point= 1					Begin define length routine
Point= 2					Use same distance as from point 1 to 2
N50-00-00.0W	445.73	4	4623.0602	5332.5243	TRA
Bearing= 42-					Begin define bearing and length routine
Point= 1					Use same direction and distance as from point 1 to 2
Point= 2					
S45-27-03.0E	445.73	5	4310.3713	5650.1732	TRA

(30-, 31-, 33-) Side Shots

There are two types of side shots:

- (30-, 31-) Standard side shot
- (33-) Side shot at right angles to the basic direction from backsight to occupied point

(30-) Side Shot Mode

PURPOSE

30- lets you enter a series of side shots in traverse mode.

PROCEDURE

Enter 30— at the direction prompt. The direction prompt will be displayed again. Continue entry. The display of the new point is labeled SS.

The area summation is not changed by a side shot. The point occupied and program remains in side shot mode until you enter another command.

NOTE

1. To deactivate side shot mode, enter **330-** at the direction prompt. The direction prompt will again display and you can proceed with traverse entry.
2. The 10- command automatically clears side-shot mode and returns to traverse mode.

(31-) Single Side Shot

PURPOSE

Lets you enter one side shot in traverse mode.

PROCEDURE

The procedure is the same as for 30- above. The point occupied remains the same and the program exits side shot mode automatically.

Side Shots

(33-) 90 Degree Offset

PURPOSE

The 33- command allows you to enter a side shot at right angles to the basic direction from backsight to occupied point.

PROCEDURE

1. Enter 33-.
2. Enter the distance. For side shots to the right, enter the distance positively. For side shots to the left, enter the distance negatively.
3. The program displays the direction and distance to the side shot, and its point number and coordinates. The display of the new point is labeled SS.
4. The area summation is not changed by this routine.
5. This routine automatically does a 30- command upon completion. To deactivate side shot mode enter 330- at the direction prompt. The direction prompt will redisplay and you can proceed with traverse entry.

This example demonstrates the use of the three side-shot commands (30-, 31-, 33-)

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-03-1986-----18:09:31-----C:bench					
Command 10-					
Occupied Point= 1					
		1	5000.0000	5000.0000	OCC
Backsight Point= 2					
		2	5070.7107	5070.7107	BS
S45-00-00.0W	100.00	1	5000.0000	5000.0000	OCC
Storage Point = 3					
Angle= 30-					
Angle= 200000					
Distance = 100					
N65-00-00.0E	100.00	3	5042.2618	5090.6308	TRA SS
		1	5000.0000	5000.0000	
Angle= 220000					
Distance = 100					
N67-00-00.0E	100.00	4	5039.0731	5092.0505	TRA SS
		1	5000.0000	5000.0000	
Angle= 330-					
Angle= 375050					
Distance = 200					
N82-50-50.0E	200.00	5	5024.9031	5198.4435	TRA
Angle= 31-					
Angle= 220030					
Distance = 150					
N75-08-40.0W	150.00	6	5063.3606	5053.4573	TRA SS
		5	5024.9031	5198.4435	
Angle= 330000					
Distance = 225					
N64-09-10.0W	225.00	7	5122.9970	4995.9526	TRA
Angle= 33-					
Distance = 160					
N25-50-50.0E	160.00	8	5266.9906	5065.7083	TRA OS
		7	5122.9970	4995.9526	
Angle= 330-					
Angle=					

| Enter side-shot mode

| Re-enter traverse mode

| To enter a single side-shot

| Calculate 90 degree offset side-shot

| No more 90 degree offset side-shots to calculate

| Continue with traverse...

(19-) Display Accumulated Area

PURPOSE

All traverse and inverse routines automatically accumulate area, perimeter, latitude and departure as you work. The 19- command displays this data. In order to get a valid area you must close back to the starting point. The inverse routines can be used to do this without creating a new point.

PROCEDURE

Enter **19-**. The latitude, departure, perimeter and area displays and you return to the COMMAND prompt.

NOTE

The 10- command clears accumulated area, perimeter, latitude and departure.

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-03-1986-----20:33:16-----C:bench					
Command 10- Occupied Point= 1 Start traverse and clear out accumulators					
			1	5000.0000	OCC
			1	5000.0000	OCC
Backsight Point=					
Storage Point (Default = 2) =					
Bearing= 450000					
Quadrant= 1					
Distance = 100					
N45-00-00.0E	100.00		2	5070.7107	TRA
Bearing= 24-					
Angle= 900000					
Distance = 100					
N45-00-00.0W	100.00		3	5141.4214	TRA
Angle= 900000					
Distance = 100					
S45-00-00.0W	100.00		4	5070.7107	TRA
Angle= 19- Display accumulators so far					
Sum of Lat. = 70.71					
Sum of Dep. = -70.71					
Perimeter = 300.00					
Final Area = 12500.00 Square Feet					
0.29 Acres					
Command 81- Inverse routine					
Point= 1 Inverse back to starting point - close area					
S45-00-00.0E	100.00		1	5000.0000	INV
Point= 19- Display final accumulator values					
Sum of Lat. = 0.00					
Sum of Dep. = 0.00					
Perimeter = 400.00					
Final Area = 10000.00 Square Feet					
0.23 Acres					

(12-) Enter Coordinates

PURPOSE

Use 12- to enter coordinate pairs directly. That is, you enter a point number followed by a north and east coordinate.

PROCEDURE

1. Enter 12-. In response to the prompts Point=, Northing=, and Easting=, enter point number, north coordinate, and east coordinate. You will also be prompted for descriptions if descriptions are in use and elevations if elevations are in use.
2. With automatic point numbering turned on point numbers will be assigned sequentially after the first point number is entered. thereafter.

NOTES

1. If the point number is in use, the present coordinates (and/or description and/or elevation) are displayed as defaults. They may then be accepted or overridden, as desired.
2. You can switch back and forth between the automatic and manual point numbering modes for the direct entry of coordinates by using the 86- command.

This example shows the use of the 12- and 86- command with coordinates only (no elevations and/or descriptions)

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----C:\MYDIR					
Job->#18 adfa	[199]				
Point= 86--					Turn manual point numbering on
Manual Point Numbering					
Command 12-					Enter coordinates directly
Point= 1					Point number 1
N (Default = 5000) =					Press <RETURN> to accept the default
E (Default = 5000) = 5001					Change Easting value only
Point= 300					Point number 300
Northing = 5020.444					Northing
Easting = 5030.555					Easting
Point= 86+-					Turn automatic point numbering on
Automatic Point Numbering					
Command 12-					Enter coordinates directly
Point= 321					Start at point number 321
Northing = 5444.555					Northing
Easting = 5357.545					Easting
Point= 322					
Northing = 5489.5479					Northing
Easting = 4897.0057					Easting

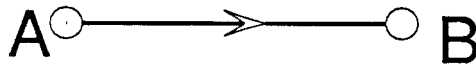
(223-) Print Screen

PURPOSE

223- prints the contents of the screen. Available in the Coordinate Geometry and Utility programs only. This command is the equivalent of the DOS **Print Screen (PrtSc)** command.

(81-, 68-, 82-) Inversing

(81-) Consecutive Inverse Routine



PURPOSE

81- lets you find the bearing and distance from the occupied point A to another point B.

PROCEDURE

1. Occupy point A, then enter **81-**.
2. Enter the point number of B.

OUTPUT

After you complete the 81- routine, Benchmark displays:

- Bearing and distance from the occupied point A to B
- Point number and coordinates of **B**

NOTES

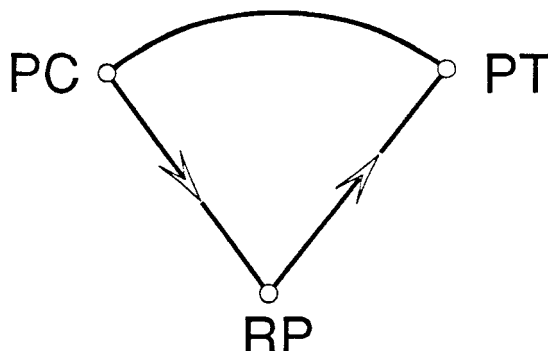
- 1, After 81-, the occupied point is **B** and the direction is A to **B**.
2. The line is labeled differently depending on how the direction output default is set.

If direction output is set to:	Label is:
Bearings (6-)	INV
Azimuths (7-)	INV AZ
Angles Right (8-)	INV AR

3. The routine repeats until a new command selection is made at the **P o i n t =** prompt.

Inversing

(68-) Inverse Through Curve



PURPOSE

68- lets you inverse through a curve.

PROCEDURE

1. Occupy the point of curvature (P.C.), then enter **68-**.
2. Enter the radius point (R.P.) number. Benchmark displays the bearing and distance from the P.C. to the R.P. and the R.P.'s coordinates.
3. Enter the point of tangency (P.T.). Benchmark displays the coordinates of point of tangency, and the bearing and distance from the radius point.

OUTPUT

- After you enter the point of tangency (P.T.), Benchmark displays the following curve data:

Delta
Radius
Arc Length
Tangent
Chord

- The line is labeled differently depending on how the direction output default is set:

If direction output is set to:	Label is:
Bearings (6-)	INV RC
Azimuths (7-)	INV AZRC
Angles Right (8-)	INV ARRC

NOTES

1. After you complete the 68- routine, you are returned to the `Point—` prompt, where you can continue inversing or select another command.
2. Within lot sizing (190-), the 81- command does not insert the label "INV" after displayed coordinates.

Inversing

This example demonstrates the 81- and 68- routines.

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-04-1986-----08:16:53-----C:\MYDIR					
Command 10-		New set up			
Occupied Point= 37		On point 37			
			37	4386.2275	5167.9006 OCC
Backsight Point= 81-		Begin inverse			
Point= 75		To point 75			
N00-35-52.9W 110.00			75	4496.2215	5166.7525 INV
Point= 68-		To inverse thru a curve			
Radius Point= 73		Point 73 is the radius point			
N89-24-06.6E 15.00			73	4496.3781	5181.7517 INVRC
Point of Tangency= 74		Point 74 is the end of the curve (PT)			
N00-35-53.5W 15.00			74	4511.3772	5181.5951 INV
Delta = 90-00-00.0					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-24-07.2E	21.21				
Point= 67		Continue with inverse			
N89-24-06.9E 68.77			67	4512.0950	5250.3566 INV

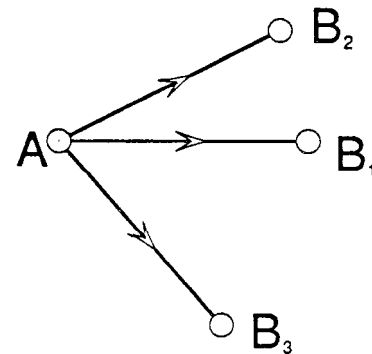
(82-) Radial Inverse Routine

PURPOSE

Use 82- to find the bearing and distance from the occupied point to several other points.

PROCEDURE

1. Occupy point A, then enter 82-.
2. Enter the point number of the point B.
3. Repeat step 2 as needed.



OUTPUT

After you complete the 82- routine, Benchmark displays:

- Bearing and distance A to B
- Point number and coordinates of B
- Point number and coordinates of A
- The line is labeled differently depending on how the direction output default is set

If direction output is set to:	Label is:
Bearings (6-)	INV SS
Azimuths (7-)	INV AZ SS
Angles Right (8-)	INV AR SS

Inversing

NOTES

1. The area summation is not changed by a radial inverse.
2. The point occupied and backsight direction are also unchanged.
3. The routine repeats until you make a new selection.

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-04-1986-----08:16:53-----C:\MYDIR					
Command 10-		New set up			
Occupied Point= 37		Occupy point 37			
		37	4386.2275	5167.9006	OCC
Backsight Point= 82-		Start radial inverse			
Point= 75		Inverse from point 37 to point 75			
N00-35-52.9W 110.00		75	4496.2215	5166.7525	INVSS
		37	4386.2275	5167.9006	
Point= 73		Inverse from point 37 to point 73			
N07-10-01.7E 111.02		73	4496.3781	5181.7517	INVSS
		37	4386.2275	5167.9006	
Point= 74		Inverse from point 37 to point 74			
N06-14-41.1E 125.90		74	4511.3772	5181.5951	INVSS
		37	4386.2275	5167.9006	

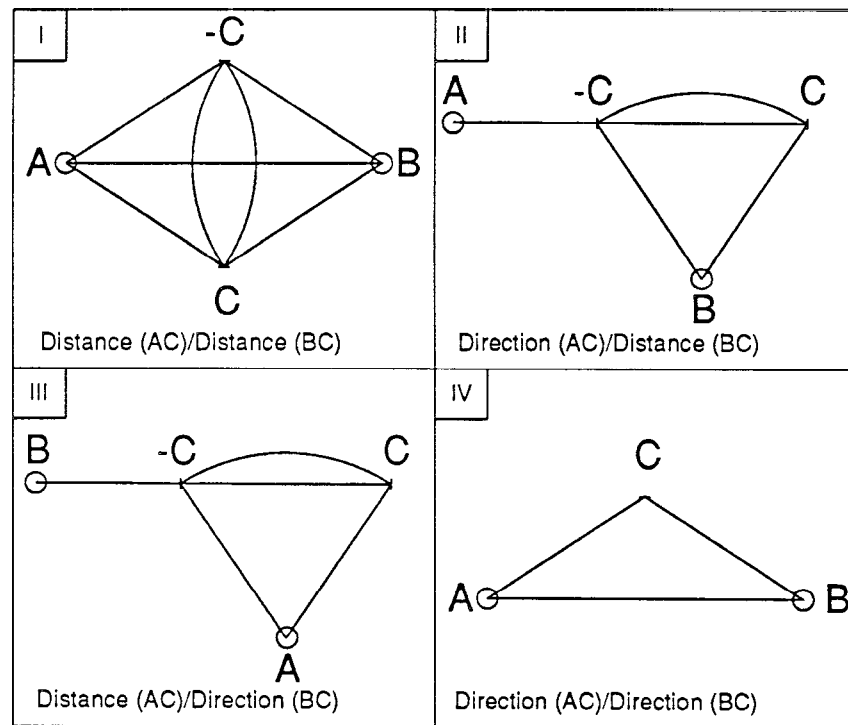
(91-, 92-, 93-, 70-, 71-) Intersections

(91-, 92-, 93-) Line Intersection Routines

PURPOSE

There are three intersection routines that compute the intersection of two lines by entering a combination of direction and distance data. As shown below, the occupied point is different after the completion of each routine:

- After **91-**, B is the occupied point.
- After **92-**, A is the occupied point
- After **93-**, C is the occupied point.



Each intersection routine prompts for the direction and distance from the occupied point (point A), point B, and the direction and distance from point B. You supply Benchmark with the knowns that it needs and answer with zero (0) or ENTER at the other prompts. The following table summarizes the various types of intersections and the input required from you:

Intersections

	Dir-Dir	Dir-Dist	Dist-Dir	Dist-Dist
Occupy A	Yes	Yes	Yes	Yes
Direction	Yes	Yes	0	0
Distance	0	0	Yes	Yes
Point B	Yes	Yes	Yes	Yes
Direction	Yes	0	Yes	0
Distance	0	Yes	0	Yes

Whenever there are 2 solutions to an intersection, Benchmark will display them as temporary coordinates, then let you select whether you want to accept the first, second, both or none of the solutions.

NOTE

When entering known directions or distances, you may use 40- (copy direction) and 41- (copy distance) to maintain accuracy and simplify the entry.

PROCEDURE

1. Occupy point A.
2. Enter **91-**, **92-**, or **93-**. As shown in the figure:
 - A is the currently occupied point.
 - B is the known point at the other end of the intersection.
 - C is the desired intersection point.
3. You will be prompted for the following input:
 - Direction from A to C
 - Distance from A to C
 - Point number of B
 - Direction from B to C
 - Distance from B to C
 - C - storage number
4. Depending on how you choose to define an intersection, use the appropriate entry method below:
 - a. To define an intersection by two distances (See drawing I on previous page):
 - Enter the direction from A to C as (0) RETURN with no entry.
 - Enter the distance from A to C.
 - Enter the direction from B to C as (0) RETURN with no entry.
 - Enter the distance from B to C.
 - Enter the point number for C.
 - Select the desired solution.

Intersections

- b. To define an intersection when the direction from A to C is known and the distance from B to C is known (See drawing II on previous page):
 - Enter the direction from A to C.
 - Enter the distance from A to C as (0) RETURN with no entry.
 - Enter the direction from B to C as (0) RETURN with no entry.
 - Enter the distance from B to C.
 - Enter the point number for C.
 - Select the desired solution.
- c. To define an intersection when the distance from A to C is known and the direction from B to C is known (See drawing III on previous page):
 - Enter the direction from A to C as (0) RETURN with no entry.
 - Enter the distance from A to C.
 - Enter the direction from B to C.
 - Enter the distance from B to C as (0) RETURN with no entry.
 - Enter the point number for C.
 - Select the desired solution.
- d. To define an intersection when two directions are known (See drawing IV on previous page):
 - Enter the direction from A to C.
 - Enter the distance from A to C as (0) RETURN with no entry.
 - Enter the direction from B to C.
 - Enter the distance from B to C as (0) RETURN with no entry.
 - Enter the point number for C.
5. For the 91- routine, the display will show the points of the traverse running from A to C and C to B. The occupied point is point B, and the basic direction is C to B.
6. For the 92- routine, the coordinates of A are displayed again. The basic direction is not changed and the occupied point is A.
7. For the 93- routine, the coordinates of C are displayed again. The basic direction is unchanged and the occupied point is C.
8. All routines repeat until a new command is given.

Intersections

EXAMPLE

```

Command= 10-
Occupied Point= 105
Backsight Point= 91-
Bearing= 40-
Point= 103
Point= 105
Distance= 0
Point B= 53
Bearing= 0
Quadrant= 0
Distance= 41-
Point= 53
Point= 56
N89-33-44E 84.83
S89-33-44W 130.93
0=None, 1=First, 2=Second, 3=Both= 1
N89-33-44E 84.83
N64-28-01W 120.00
Bearing=

Command= 10-
Occupied Point= 79
Backsight Point= 92-
Bearing= 40-
Point= 79
Point= 78
Distance=
Point B= 80
Bearing= 40-
Point= 81
Point= 80
Distance=
N41-47-54W 199.36
N70-24-17E 50.00

```

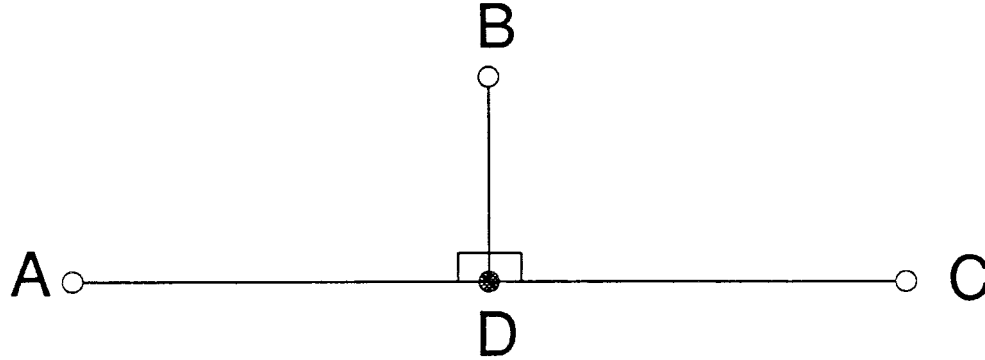
				Direction-Distance intersection...
105	4865.4762		5190.4875	OCC
				Start intersection routine
				Define direction from A to C by points (103 and 105)
				Enter 0 for unknown distance from A to C
				Enter known point B (53)
				Enter 0 for unknown Bearing from B to C
				Enter 0 for unknown Quadrant
				Define distance from B to C by points (53 and 56)
				Two possible solutions are displayed
	4866.1245		5275.3171	Temp
	4864.4757		5059.5593	Temp
				Choose solution desired, in this case, the first
		106	4866.1245	5275.3171 INT
		53	4917.8482	5167.0366 OCC
				Benchmark displays intersection point C (106) and
				occupied point B (53)
				Direction-Direction intersection...
				Occupy point A (79)
	79	4389.0071	5434.2024	OCC
				Start intersection routine
				Define direction from A to C by points (79 and 78)
				Press ENTER for unknown distance from A to C
				Enter known point B (80)
				Define direction from B to C by points (81 and 80)
				Press ENTER for unknown distance from B to C
		108	4537.6283	5301.3276 INT
		80	4554.3969	5348.4318 OCC
		79	4389.0071	5434.2024
				Benchmark displays intersection point C (108),
				point B (80), and occupied point A (79).

Intersections

(70-) Offset Intersection on a Line

PURPOSE

Use 70- to find a point on a line nearest to a given point.



PROCEDURE

1. Occupy point A (the first point on the line).
2. Specify a point for storage
3. Enter 70-.
4. Enter the point number of B (the offset point).
5. Enter the point number of C (the second point on the line).

OUTPUT

After step 4, Benchmark displays:

- The bearing and distance A to D, the point number and coordinates of D.
- The bearing and distance D to **B**, the point number and coordinates of **B**. The offset point will be labeled OS L for offsets to the left and OS R for offsets to the right.

The bearing and distance D to C, the point number and coordinates of C.

NOTES

1. At the end of the routine, The point occupied is C, the direction is A to C.
2. The routine will continue looking for offset points until you enter a command (see example).
3. The offset points do not need to be within the line bounded by A and C. For the purpose of creating intersection points the line is considered to continue to infinity in both directions (A to C and C to A).

Intersections

EXAMPLE

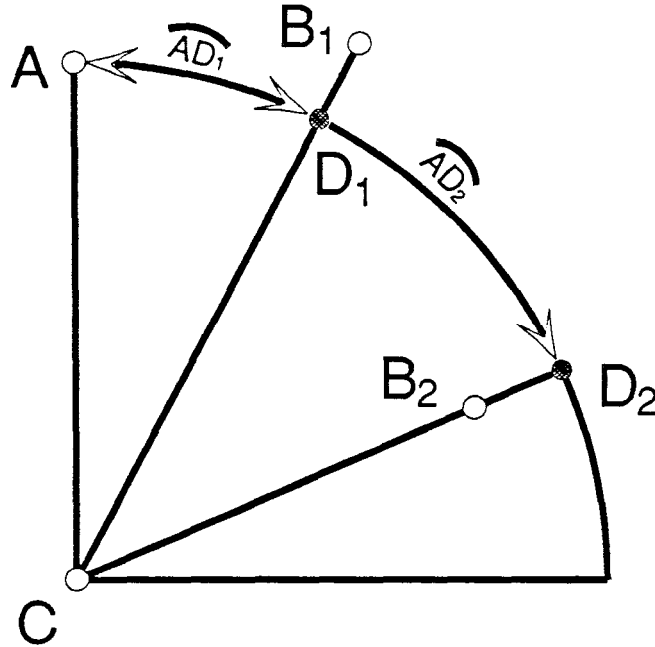
Bearing	Distance	Point	Northing	Easting	Type
-----	-----	12-11-1986	-----	17:47:26	-----
Command 10-			I <i>occupy</i> point A (the beginning of the line)		
Occupied Point= 36			Enter As point number		
			36	4385.7057	5117.9033
					OCC
Backsight Point=			I No backsight used		
			36	4385.7057	5117.9033
					OCC
Storage Point = 150			I <i>Start storage intersection points at 150</i>		
Bearing= 70-			I <i>Offset intersection command</i>		
Point B= 73			I <i>Enter B's point number (offset point)</i>		
Point C= 65			I <i>Enter C's point number (the end of the line)</i>		
N49-58-13.1E 120.07			150	4462.9343	5209.8439
N40-01-46.9W 43.68			73	4496.3781	5181.7517
			150	4462.9343	5209.8439
			65	4497.0958	5250.5132
					END D
N49-58-13.1E 53.11			I <i>Enter another point B (offset point)</i>		
Point B= 11			151	4447.9618	5192.0192
N49-58-13.1E 96.79			11	4393.4516	5237.8069
S40-01-46.9E 71.19			151	4447.9618	5192.0192
			65	4497.0958	5250.5132
					END D
N49-58-13.1E 76.39			I <i>Continue with 70- or enter another command</i>		
Point B=					

Intersections

(71-) Offset Intersection on an Arc

PURPOSE

Given a point on an arc (A), the offset point (B) and the radius point (C), the 71- command computes where a line originating at the radius point and passing through the offset point intersects the arc.



PROCEDURE

1. Occupy point A (A point on the arc).
2. Enter 71-.
3. In response to Benchmark's prompts, enter offset point (B) and radius point (C).

OUTPUT

After step 2, Benchmark displays:

- the coordinates of existing points B and C
- the coordinates of the created point D
- Curve data (DELTA, RADIUS, ARC LENGTH, TANGENT CHORD) between the intersection point (D) and the original occupied point.

NOTE

The 71- routine (like its counterpart, 70-) keeps prompting for an offset point (B) until you enter a command to escape.

Intersections

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
		12-12-1986	11:47:17	C:\MYDIR	
Command 10-			New Setup Command		
Occupied Point= 76			To occupy a point on the arc (A)		
			76	4490.3129	5285.1645 OCC
Backsight Point=			No backsight - Press RETURN		
			76	4490.3129	5285.1645 OCC
Storage Point = 150			Start storage at point 150		
Bearing= 71-			Offset Intersection on an Arc command		
Point B= 5			Enter first offset point (B)		
Point C= 34			Enter the radius point (C)		
N18-51-37.6E	50.00		34	4537.6283	5301.3277 RP
N89-22-14.4E	134.88		5	4539.1097	5436.1949 OFFST
S89-22-14.4W	84.88		150	4538.1775	5351.3246 POC
Delta = 109-29-23.2					
Radius = 50.00					
Arc Length= 95.55					
Tangent = 70.73					
Chord = 81.66					
Point B= 33			Enter another offset point (B)		
S89-24-07.2W	160.00		33	4535.9584	5141.3364 OFFST
N89-24-07.2E	110.00		151	4537.1065	5251.3305 POC
Delta = 70-32-29.6					
Radius = 50.00					
Arc Length= 61.56					
Tangent = 35.36					
Chord = 57.74					
Point B=			Continue entering offset points or enter a command to escape from this routine		

Chapter 7A

Boundary Traverse - Introduction

Features of Boundary Traverse	7A-2
Entering Traverse Data: General Procedures	7A-3
The Boundary Traverse Screen	7A-4
Traverse Types	7A-5
Entering Traverse Legs: Sides and Points	7A-6
Methods of Entering Direction	7A-7
Coordinates in Boundary Traverse	7A-9
Ending Traverse Entry	7A-9
Adjustment Commands	7A-10
Saving Data	7A-11
Traverse Entry	7A-12

WHAT'S IN THIS CHAPTER?

This chapter provides a brief introduction to the Boundary Traverse program, the first option on the Benchmark Main Menu. Here, you will learn what the program can do, and how, in general, to do it. At the end of this chapter, you will find a brief example illustrating how to input, adjust, and save traverse data. For a comprehensive discussion of every command available in the Boundary Traverse program, see Chapter 5.

Features of Boundary Traverse

Using the Boundary Traverse Program, you can:

- Enter distance and direction data for closed or open traverses. This includes regular traverse legs or side shots. You can enter up to 400 traverse legs. You can also enter slope angles.
- Display entered field data.
- Correct input errors by changing, deleting, or inserting traverse legs.
- Generate closure data.
- Adjust the traverse by either the Compass Rule or Crandall's Rule.
- Distribute angular error equally among the traverse angles. You can also manually distribute the angular error.
- Search for linear or angular errors.
- Hold sides or angles constant.

Entering Traverse Data: General Procedures

The general steps required to enter traverse data within the Boundary Traverse program are shown below. At the end of this chapter, there is a step-by-step example of a traverse entry session. For detailed treatment of the commands listed in these steps, refer to Chapter 5.

1. Select Boundary Traverse (selection 1 on the Main Menu).
2. At the **COMMAND** prompt, enter **10-** for a closed-loop traverse or **11-** for a closed-connecting traverse.
3. Enter a starting point number. For a closed-loop traverse, enter starting North and East coordinates. For a closed-connecting traverse, enter both starting and ending North and East coordinates.
4. Enter the sides of the traverse. These can be traverse legs or sideshots. You can choose to enter directions as angles to the right, deflection angles, bearings, or azimuths. You can also enter radius or tangent curves.
5. You will prompted for direction and distance data until you give a command that escapes from the traverse entry routine.
6. When you have completed entering your field data, use **99-** to calculate closure.
7. Distribute the angular error automatically (**101-**) or manually (**102-**).
8. To generate coordinate data with no adjustment, use the **110-** command. To generate coordinate data and adjust the traverse, use either **111-** (Compass Rule) or **112-** (Crandall Method).
9. You can display the data with the **113-** command. Check for errors.
10. To correct traverse sides, you can use the **12-** (replace side), **13-** (delete side), or **14-**(insert side) commands.
11. To save your data, you must first open a job (**122-**). Then use **120-** to save the original field data, or **121-** to save the generated coordinate data. You can load coordinate data only within the Coordinate Geometry program (option 2 on the Main Menu). You may want to create two separate jobs to store the field data in one and the coordinate data in the other.

CAUTION! Field data and coordinate data cannot be saved in the same job file.

The Boundary Traverse Screen

To start the Boundary Traverse program, select 1 from the Benchmark Main Menu. The command screen shown below appears.

Take a moment to examine this screen:

- Note the prompt JOB # at the top left of the screen. When you load a job, the job name and description appear here.
- The next line on the screen is the status line. When you display data (for example, with the 113- command), the displayed data falls under the appropriate column headings. Depending on your data and the command you issue, the headings on the status line will change.
- If desired, the date and time can be displayed just below the status line (using the 402- command).
- The dashed line across the screen divides the status line from the COMMAND prompts and displayed data. On the right end of this line, the default drive and directory being used for data storage is displayed in the format <drive : directory>. For example, C :BENCH means that the default drive is C: and the default subdirectory is BENCH . DIR. (If you used the 300- command to instruct Benchmark to observe DOS subdirectory conventions, the directory display will be in the format C:\BENCH.DIR. See Chapter 3 for more details about the 300- command.)

EXAMPLE

```
COMMAND 113-
JOB # 8 Sample 2 Field Data.
SIDE #          SHOT TYPE/ERROR          PT#          ANGLE          LENGTH
-----06-19-1986-----09:33:03-----C:BENCH
START 5000 5000 1
1      BEARING          2      N89-30-00E          445.89
2      TURNED ANG -SIDE SHOT 3      - 93-11-00          11.5
3      TURNED ANG          4      - 93-11-00          248.77
4      TURNED ANG          5      - 169-35-30         217.98
5      TURNED ANG          6      - 187-16-39         150.06
6      TURNED ANG -SIDE SHOT 7      - 264-12-29         199.89
7      TURNED ANG -SIDE SHOT 8      + 89-59-26          99.95
8      TURNED ANG          9      - 87-30-17          101.75
9      TURNED ANG         10     - 187-28-49          98.46
10     TURNED ANG -SIDE SHOT 11     - 84-56-23           10.47
11     TURNED ANG         12     - 174-07-47         243.22
12     TURNED ANG         13     - 90-02-47          252.92
13     TURNED ANG         14     - 179-37-36         362.78
14     TURNED ANG         15     - 91-09-19           0
COMMAND
```

Traverse Types

The Benchmark System accommodates the entry of closed-loop, closed-connecting, or open traverses.

Use the 10- command to enter a closed-loop traverse. You will be prompted for a starting point number and starting North and East coordinates. The x-y pairs that represent starting and ending points will reflect whatever coordinate system you are working with.

Use the 11- command to enter a closed-connecting traverse. You will be prompted for a starting point number and both starting and ending North and East coordinates.

You can enter an open traverse as a closed-loop traverse. However, if you use **99—**, the results will be meaningless. Use **110-** to display coordinate data.

After these initial steps, entry procedures are identical for all traverse types.

Entering Traverse Legs: Sides and Points

In Boundary Traverse, you may enter up to 400 sides (legs) of a traverse in one job. A side of a traverse is defined as a direction and a distance. Each side has a beginning and ending point, but these are not defined as coordinate pairs. They are used solely to identify traverse stations. Here, a "point" means simply the beginning or ending position of a measured distance and direction. Thus, you can delete sides in Boundary Traverse, but not points.

When you adjust a traverse (110-, 111-, or 112-), x-y coordinates are displayed on the screen. You can save this coordinate data (121-).

*Note: Once you save coordinate data, you can no longer load the coordinate data within the **Boundary** Traverse program. You must use the Coordinate Geometry program to access coordinate data.*

Typically, you will enter traverse data in the Boundary Traverse program, proof and correct the data, balance and adjust the traverse as necessary, and finally, store the resulting coordinate data. Thereafter, you will use the Coordinate Geometry program to manipulate your coordinate data.

When you display traverse data, side numbers are listed sequentially, starting with 1. When you make a correction, you specify a side number to correct and a storage point number. If you delete a side (13—), the sides are renumbered automatically.

This is not the case with point numbers, which you may assign out of numerical sequence. Point numbers may be assigned sequentially by the program or manually by the operator (use **86—** on the Setup Menu to establish the default method). Either way, a point number must be an integer between 1 and 400 inclusive. Many users number traverse stations sequentially and sideshots randomly.

To summarize:

- Side numbers are numbered sequentially starting at 1.
- Side numbers are used as references for making corrections (not point numbers).
- You can select automatic or manual point numbering (see 86- Command).
- A point number must be an integer between 1 and 400 inclusive. Many users prefer to number traverse stations sequentially and sideshots randomly.

Methods of Entering Direction

Boundary Traverse supports a variety of entry methods, according to the field method employed. Directions can be entered as bearings, azimuths, deflection angles, or angles turned from backsight. Unless you specify otherwise, the program expects entry by bearing. However, you can change this default to any other method with a single command (as shown in Figure 4-2).

To change the prompt, select one of the four direction modes. Your selection will be held until you change it.

<u>Method of Entry</u>	<u>Prompt</u>	<u>Select Mode with</u>
Bearing (default)	BEARING=	20-
Azimuth	AZIMUTH=	21-
Deflected angle (angle to right, left)	DEFLECTION ANGLE=	23-
Angle turned from backsight	ANGLE=	24-

ENTERING ANGLES AND AZIMUTHS

Angles (other than bearings) and azimuths are entered as follows:

+/- DDDMMSS.S

where

D = degrees

M = minutes

S = seconds

.S = tenths of a second

To enter negative angles, precede the entry with a minus sign (-9515200).

The leading zeros for an angle less than 100° may be dropped, but zeros must be entered as place holders for minutes and seconds. If you enter 55, it is interpreted as 00°00'55".

Here are some angle entries and their interpretations:

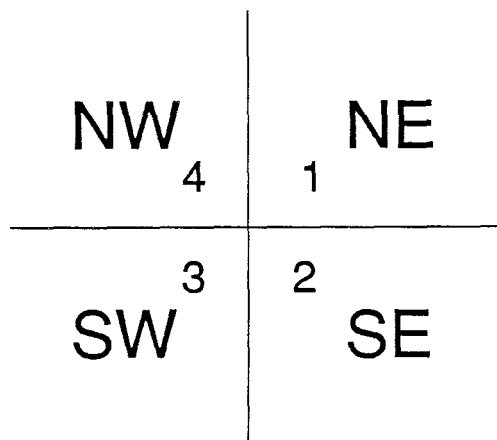
<u>For</u>	<u>You Enter</u>
95°	950000
0°0'55"	000055
0°1'30.9"	130.9
180°	1800000
15°00"	1500

Methods of Entering Direction

ENTERING BEARINGS

Bearings are entered in two steps:

1. Enter bearing as DDMMSS.S (degrees, minutes, seconds, tenths of a second).
2. Enter the quadrant (1, 2, 3, or 4). Use the following quadrant codes:



ALTERNATE ANGLE/DIRECTION FORMAT

An additional option for the format of angles, azimuths, and bearings has been provided. This format is selected with the **34-** command and is as follows:

(Q)(D)DD.MMSSS for bearings where:

Q = quadrant
D = degrees
M = minutes
S = seconds

DDMMSS.S for angles and azimuths where:

D = degrees
M = minutes
S = seconds
.S = seconds in tenths

The default format is selected by default in the Setup Menu.

Coordinates in Boundary Traverse

In the Boundary Traverse program, when you enter the closed-loop traverse routine (10-), you are prompted for starting North and East coordinates. When you enter the open traverse routine (11-), you are prompted for both starting and closing north and east coordinates. These X-Y pairs will reflect whatever coordinate system you are working with. This is the only time you will enter coordinate pairs in Boundary Traverse.

Ending Traverse Entry

You will be prompted for direction and distance data until you issue a command that escapes from the traverse entry routine. The most common ways to do this are:

- Calculate standard closure data (99-).
- Use 101- to distribute angular error.
- Balance the traverse (110-, 111-, 112-). (These three commands are of special interest because they generate coordinate data, which can be saved and used in the Coordinate Geometry program.)
- Display raw field data (113-).

Adjustment Commands

There are a variety of traverse adjustment commands that you can use after you calculate closure with **99-**. These are listed briefly below and discussed in detail in Chapter 5.

After **99-**, use either of the following commands to distribute angular error:

- 101- Automatic distribution of angular error among all angles
- 102- Manual distribution of angular error

After **99-**, use any of the following routines to generate coordinate data:

- 110- Display unbalanced traverse data
- 111- Display balanced traverse data (Compass Rule)
- 112- Display balanced traverse data (Crandall's Rule)

NOTES

1. **102-** changes the angles stored in memory.
2. **101-** does not change the angles stored in memory.
3. **99-** re-computes closure using the field data currently stored in memory.

Saving Data

When you are working within the Boundary Traverse program, the field data you enter or load is kept in the memory of your computer. Recall that field data consists of direction and distance information. When you use a balancing routine (such as 110-, 111-, or 112-), coordinates are generated. Note that both the raw field data and the balanced traverse data are kept in memory at the same time.

You can save either the raw field data (120-) or the coordinate data (121-). Of course, all data in memory will be lost if you exit Benchmark without saving anything.

CAUTION! When you use the 121- command, you save the coordinate data to the currently open job. Unless your field data is stored as a separate job, the raw field data will be lost. When you save coordinate data with the 121- command, this data can no longer be loaded within the Boundary Traverse program. Therefore, if you plan to work further with data in the Boundary Traverse program, always maintain a copy of your field data in a separate job.

Here is a typical scenario for saving data in Boundary Traverse:

1. Open a job with **122-**.
2. Enter field data.
3. Save field data to open job with **120-**.
4. Generate coordinate data with balancing routines (**110-**, **111-**, **112-**).
5. Open another job with **122-**.
6. Save coordinate data to open job with **121-**.

Traverse Entry

The following shows the entry of a simple traverse. Note that the first entry in a closed traverse is a bearing or azimuth. The prompts for distance and direction will continue until you give a command that escapes from the 1 0 - routine. In this example, 1 1 3 - (display data) was used to escape from the 1 0 - routine. Then a 1 1 1 - was issued to balance the traverse according to the Compass Rule.

EXAMPLE

```

COMMAND 10-
DO YOU WISH TO USE DESCRIPTIONS?
  1. YES
  2. NO
OPTION = 2

SHOULD ALL TRAVERSE DATA BE CLEARED FROM MEMORY ??(Y/N) y

STARTING PT. # = 1          | Enter starting point
STARTING NORTH= 1500       | Enter starting coordinates
STARTING EAST= 1500

SIDE #= 1                  | Enter data for traverse legs
ASSIGN AS PT. # 2
B= 755750                  | Using bearings (the default)
Q= 3
DISTANCE= 824.57

SIDE #= 2
ASSIGN AS PT. # 3
B= 713355
Q= 4
DISTANCE= 632.47

SIDE #= 3
ASSIGN AS PT. # 4
B= 120943
Q= 2
DISTANCE= 711.89

SIDE #= 4
ASSIGN AS PT. # 5
B= 845000
Q= 2
DISTANCE= 1154.65

SIDE #= 5
ASSIGN AS PT. # 6
B= 011730
Q= 1
DISTANCE= 806.19

SIDE #= 6
ASSIGN AS PT. # 7
B= 113-                    | Display field data
JOB #
SIDE #      SHOT TYPE/ERROR      PT#      ANGLE      LENGTH
-----06-18-1986-----23:18:26-----C:BENCH
START 1500 1500 1
1      BEARING      2      S75-57-50W      824.57
2      BEARING      3      N71-33-55W      632.47
3      BEARING      4      S12-09-43E      711.89
4      BEARING      5      S84-50-00E      1154.65
5      BEARING      6      N01-17-30E      806.19

```

(continued)

Traverse Entry

EXAMPLE

```
COMMAND 99-                                     | Generate closure data
# OF SIDES= 5
JOB #
SIDE #          SHOT TYPE/ERROR                PT#          ANGLE          LENGTH
-----06-18-1986-----23:18:26-----C:BENCH
ANGULAR ERROR= 0 SECONDS
ERROR NORTH= 6.11
ERROR EAST=-81.86
ABSOLUTE ERROR= 82.08
DIRECTION OF ERROR=N85-43-53.7W
PERIMETER= 4129.77
PRECISION=1 FOOT IN 50

COMMAND 111-                                     | Balance traverse using Compass Rule
JOB #
BEARING          DIST                PT#          NORTHING    EASTING      TYPE
-----06-18-1986-----23:18:46-----C:BENCH
COMPASS RULE
1              1500
S75-35-57.7W   809.03                2              1298.79      716.39
N71-16-51.9W   620.29                3              1497.86      128.91
S13-14-52.9E   716.02                4              800.9        293
S84-51-03E     1177.6                5              695.21      1465.85
N02-25-47.9E   805.52                6              1500        1500
AREA(SQUARE FEET)= 814631.34
AREA(ACRES)= 18.7
COMMAND
```


Chapter 7B

Boundary Traverse Commands

Traverse Selection	7B-2
(10-) Enter Closed-Loop Traverse	7B-2
(11-) Enter Closed-Connecting Traverse	7B-5
Angle Selection	7B-7
Side Selection	7B-8
(86-) Select Automatic/Manual Point Numbering	7B-8
(30-) Enter Side Shot Mode	7B-9
(330-) Revert to Regular Traverse Leg Entry	7B-10
(31-) Enter One Side Shot	7B-12
(60-) Radius Curve	7B-13
(62-) Hold Angle Constant	7B-19
(65-) Hold Side Constant	7B-21
(365-) Direction into Chord, Chord Length, and Radius	7B-22
Length Adjustments	7B-25
(18-) Set Slope Angle Request	7B-26
(26-, 27-) Select Slope Reduction Method	7B-27
(50-) Enter a Temperature	7B-28
(51-) Enter Multiple Slope Angles and Distances	7B-29
(54-, 57-) Convert Meters to Feet	7B-31
End of Entry Routines	7B-32
Adjustment Options	7B-34
(101-) Distribute Angular Error Automatically	7B-34
(102-) Distribute Angular Error Manually	7B-35
(110-, 111-, 112-) Traverse Adjustment Routines	7B-36
Searching for Errors	7B-40
(114-) Search for Angular Error	7B-40
(115-) Search for Linear Error	7B-41
Correcting Input Errors	7B-43
(12-) Change a Side	7B-44
(13-) Delete a Side	7B-46
(14-) Insert a Side	7B-47
(25-) Restart a Traverse	7B-48

Boundary Traverse lets you enter field data describing open or closed traverses, both regular traverse legs and side shots. You can calculate closure data and adjust the traverse using either the Compass Rule or Crandall's Rule. This chapter explains every command unique to the Boundary Traverse program. The default commands common to all Benchmark programs are explained in Chapter 3.

Traverse Selection

(10-) Enter Closed-Loop Traverse

PURPOSE

Use 10- command to enter a closed-loop traverse (a traverse with the same starting and ending points).

PROCEDURE

Enter 10- at the COMMAND prompt. Benchmark requests the starting point number and north and east coordinates. After you enter these, you are prompted for direction and distance data. Depending on how the system defaults are set (see Chapter 3), you can enter direction by bearing, azimuth, angles turned from backsight, or deflection angles.

PROMPTS

After you enter 10-, you will receive the following prompts:

DO YOU WISH TO USE DESCRIPTIONS?

- 1. YES
- 2. NO

OPTION =

If you enter 1, you are prompted for a description code to associate with each traverse leg.

SHOULD ALL TRAVERSE DATA BE CLEARED FROM MEMORY ?

- 1. YES
- 2. NO

ENTER OPTION=

You will receive this prompt only if you enter 10- with data in memory.

If you enter 1, all data is erased from memory and you can start with a clean slate. If you answer N, the data in memory remains there and new data is appended to the job. In either case, Benchmark now prompts for a starting point.

STARTING PNT =

Enter the point number to which you want to assign your starting coordinates. The point number must be an integer between 1 and 399 inclusive. If there was data in memory when you entered 10-, the default starting point is given in parentheses. Press RETURN without making an entry to accept the default.

STARTING PNT (DEFAULT = 2) =

STARTING NORTH (DEFAULT = 2500) =
STARTING EAST (DEFAULT = 1000) =

Enter your starting North and East coordinates.

This X-Y pair will reflect whatever coordinate system you are working with. This is the only time you will enter coordinate pairs in the Boundary Traverse program. The default in parentheses will appear only if you entered 10- with data in memory. Press RETURN with no entry to accept the defaults.

(10-) Enter Closed-Loop Traverse

```
SIDE #= 1
ASSIGN AS PNT <point #>
```

The side number will be displayed automatically (this will be an integer from 1 to 399). The point number will also be displayed automatically unless you requested random input of point numbers (see 15- and 16-).

The next prompt will be one of four requests for direction, according to how the system defaults are set:

BEARING=
QUADRANT=
DISTANCE=

NOTE: The first traverse leg must be either a bearing or an azimuth.

Enter Bearing in the format DDDMMSS.bearing entry format
Enter Quadrant (1-4)
Enter distance (feet or meters)

AZIMUTH=
DISTANCE=

Enter Azimuth in the format DDDMMSS.S
Azimuth:entry format
Enter distance (in feet or meters).

DEFLECTION ANGLE=
DISTANCE=

Enter deflection angle in the format DDDMMSSangles:entry formats
Enter distance (feet or meters) (see 54- and 57- in this chapter)

ANGLE=
DISTANCE=

Enter angle turned from backsight in the format DDDMMSS
Enter distance (feet or meters)

If you requested descriptions in response to the 10- command, after the distance prompt Benchmark requests:

DESC. CODE=

Enter a description code. (See Chapter 3 for more information on how to edit description codes.)

NOTES

1. You can continue entering traverse legs or sideshots (using the 30-command) up to 399 legs. A typical way to end this sequence is by issuing the 99- command to display closure data. This will return you to the COMMAND prompt.
2. You can then display field data to end the traverse entry sequence (113-), or any one of the balancing commands (101-, 102-, 110-, 111-, or 112-).

(10-) Enter Closed-Loop Traverse

COMMAND 10- | *Begin closed-loop traverse*
DO YOU WISH TO USE DESCRIPTIONS?
1. YES
2. NO
ENTER OPTION= 2 | *No descriptions*
JOB #
SD.# SHOT TYPE/ERROR PNT ANGLE LENGTH
-----10-24-1986-----11:00:47-----C:\EXAMP

STARTING PNT = 1 | *Starting point number*
STARTING NORTH = 5000 | *Starting north coordinate*
STARTING EAST = 5000 | *Starting east coordinate*

SIDE # = 1
ASSIGN AS PNT 2
BEARING = 893000 | *Starting bearing*
QUADRANT = 1 | *NE quadrant*
DISTANCE = 50- | *Set temperature*
TEMP. = 76 | *76 degrees Fahrenheit*
DISTANCE = 445.87 | *Level distance*

SIDE # = 2
ASSIGN AS PNT 3
BEARING = 24- | *Invoke angle turned from backsight*
ANGLE = 30- | *Invoke side shot entry*
ANGLE = -931100 | *Angle turned left*
DISTANCE = 11.5 | *Level distance*

SIDE # = 3
ASSIGN AS PNT 4
ANGLE = -931100 | *Angle turned left*
DISTANCE = 18- | *Invoke automatic slope data input*
AUTO. SLOPE ANGLE REQUEST
SLOPE DISTANCE = 248.79 | *Slope distance*
SLOPE ANGLE = 5800 | *Slope angle*

SIDE # = 4 | *Continue with traverse entry...*

EXAMPLE

(11-) Enter Closed-Connecting Traverse

PURPOSE

A closed-connecting traverse is defined as one in which the starting and ending coordinates are known but are not the same.

PROCEDURE AND PROMPTS

The procedure and prompts for the 11- routine are basically the same as for the 10- command. But with the 11- command, after you enter starting north and east coordinates, Benchmark prompts for ending north and east coordinates:

ENDING NORTH=
ENDING EAST=

In addition, the program requests:

INPUT DIRECTION FROM BACKSIGHT PT. TO STARTING PT.

If required, enter a reference bearing or azimuth. If not, press RETURN without making an entry.

Then proceed with traverse entry as in the 10- routine.

NOTES

1. Sometimes in a closed traverse your reference bearing is not a traverse leg. In order to deal with this situation you can "lie" to the computer and say that the traverse leg is open by entering the same starting and ending coordinates. Then enter your reference bearing when the prompt appears.
2. If you enter an 11- command without clearing the data in memory, Benchmark displays the default starting point, and starting and ending north and east coordinates in parentheses. In addition, Benchmark requests the direction from backsight, again displaying the default bearing in parentheses. This is shown in the following segment from a Benchmark session.

(11-) Enter Closed Connecting Traverse

EXAMPLE

```
COMMAND 11-
DO YOU WISH TO USE DESCRIPTIONS?
  1. YES
  2. NO
ENTER OPTION= 2
JOB # 2 Open Traverse Demo.
SD.#          SHOT TYPE/ERROR          PNT    ANGLE          LENGTH
-----09-25-1986-----21:21:21-----C:BENCH

SHOULD ALL TRAVERSE DATA BE CLEARED FROM MEMORY ?
  1. YES
  2. NO
ENTER OPTION= 2                                | Retain data in memory
STARTING PNT (DEFAULT = 1) =                    | Press RETURN without an entry to accept defaults
STARTING NORTH (DEFAULT = 5378.26) =
STARTING EAST (DEFAULT = 2982.17) =
ENDING NORTH (DEFAULT = 5349.75) =
ENDING EAST (DEFAULT = 3828.08) =

INPUT DIRECTION FROM BACKSIGHT PNT TO STARTING PNT
BEARING (DEFAULT = 150000) 274000                | Enter new bearing
QUADRANT (DEFAULT = 1) =                        | Same quadrant
COMMAND
```

EXAMPLE

```
COMMAND 11-                                | Start open traverse
DO YOU WISH TO USE DESCRIPTIONS?
  1. YES
  2. NO
OPTION = 2                                | No descriptions in this example

SHOULD ALL TRAVERSE DATA BE CLEARED FROM MEMORY ?
  1. YES
  2. NO
ENTER OPTION= 1                                | Clear data from memory
STARTING PNT = 1                                | Start traverse at Pt #1
STARTING NORTH= 5378.26                        | Starting north coordinate
STARTING EAST= 2982.17                         | Starting east coordinate
ENDING NORTH = 5349.75                        | Known ending north coordinate
ENDING EAST = 3828.08                         | Known ending east coordinate

INPUT DIRECTION FROM BACKSIGHT PNT TO STARTING PNT
BEARING= 480037                                | Bearing from backsight into starting point
QUADRANT= 1                                    | Quadrant (1 = NE)
```

Angle Selection

The following table summarizes the different methods of entering directions.

<u>Method of Entry</u>	<u>Prompt</u>	<u>Select Mode with</u>
Bearing	BEARING=	20- (the default)
Azimuth	AZIMUTH=	21-
Deflected angle (angle to right,left)	DEFLECTION ANGLE=	23-
Angle turned from backsight	ANGLE=	24-

Side Selection

(86-) Select Automatic/Manual Point Numbering

86- alternates between automatic and manual point numbering.

When automatic point numbering is set, point numbers are assigned automatically, beginning with the storage point number and continuing sequentially thereafter.

With manual point numbering, Benchmark requests a point number before each coordinate is stored.

NOTES

With manual point numbering set, Benchmark prompts for each storage point number. If you enter a point that is currently in use, you will receive a message stating that the point number is assigned. This message repeats until you enter an unassigned point number. In Boundary Traverse, you cannot override an existing point number (in Coordinate Geometry you can, by preceding the point number with a minus sign).

EXAMPLE	SIDE #= 18		Assigned point number
	ASSIGN AS PNT= 15		
	PNT 15 IS ASSIGNED.		
	ASSIGN AS PNT= 16		Assigned point number
	PNT 16 IS ASSIGNED.		
	ASSIGN AS PNT= 17		Unassigned point number
	BEARING = 102000		
	QUADRANT = 2		
DISTANCE = 1500			

(30-) Enter Side Shot Mode

PURPOSE

The 30- command serves notice to Benchmark that the traverse leg you are about to enter is a side shot.

PROCEDURE

1. Enter 30- at the direction prompt. Benchmark re-displays the direction prompt.
2. After you enter the side shot, the program reverts to regular traverse mode. You must enter 30- prior to each side shot.

NOTE

1. When you display data, side shots are labelled with SIDE SHOT.
2. To revert to regular traverse entry, enter 330-.
3. To enter just one side shot, and return to regular traverse mode automatically, use the 31- command.

EXAMPLE

```
SIDE #= 3
ASSIGN AS PNT 4
DA= 30- | Enter side shot command at direction prompt
DA= 750000
DISTANCE= 100

SIDE #= 4
ASSIGN AS PNT 5
DA= 1820000 | Benchmark reverts to traverse routine
DISTANCE= 75

SIDE #= 5
ASSIGN AS PNT 6
DA=

COMMAND 113- | Side shot is labelled when field data is displayed
START 1500 1500 1
1 DEFLECTED 2 + 140-15-00 25
2 DEFLECTED 3 + 55-10-00 52
3 DEFLECTED -SIDE SHOT 4 + 75-00-00 100
4 DEFLECTED 5 + 182-00-00 75
COMMAND
```

(330-) Revert to Regular Traverse Leg Entry

PURPOSE

330- serves two purposes:

- to revert you from sideshot entry mode (invoked with 30-) to regular traverse leg entry
- to return a side back to a traverse leg from any other side type (for example, a side shot or a radius curve) & how many side types are there, and should they be categorized somewhere?

PROCEDURE TO REVERT TO TRAVERSE LEG ENTRY MODE

At the direction prompt, enter 330-. You are now in regular traverse mode and can continue with traverse leg entry.

EXAMPLE	SIDE # = 5	
	ASSIGN AS PNT 6	
	ANGLE = 30-	Invoke side shot mode
	ANGLE = -881910	Angle turned left (-)
	DISTANCE = 164.7	Enter level side shot distance
	SIDE # = 6	
	ASSIGN AS PNT 7	
	ANGLE = -1000857	Angle turned left (-)
	DISTANCE = 197.73	Enter level side shot distance
	SIDE # = 7	
	ASSIGN AS PNT 8	
	ANGLE = 330-	Cancel side shot entry
	ANGLE = 1503243	Angle turned right
	DISTANCE = 195.48	Level distance
	SIDE # = 8	
ASSIGN AS PNT 9		
ANGLE = -1590511	Angle turned left (-)	
DISTANCE = 82.8	Level distance	
SIDE # = 9		
ASSIGN AS PNT 10		
ANGLE = -1694332	Angle turned left (-)	
DISTANCE = 87.37	Level distance	

PROCEDURE TO RETURN A SIDE TO A TRAVERSE LEG

1. Enter the 12- command (Change Side).
2. At the direction prompt, enter 330-.
3. The direction prompt will re-display. Enter a new direction if you wish; otherwise, press RETURN without making an entry. The side will now be a regular traverse leg.

(330-) Revert to Regular Traverse Leg Entry

EXAMPLE

```

COMMAND 113-                               | Display data to be changed

JOB # 1 Field Data for Closed Traverse.
SD.#      SHOT TYPE/ERROR      PNT      ANGLE      LENGTH
-----09-23-1986-----15:44:28-----C:BENCH
START  4500  2500  14
1      BEARING                  2      N39-59-13.0E      286.10
2      TURNED ANG -SIDE SHOT    3      +69-11-31.0      172.20
3      TURNED ANG -SIDE SHOT    4      -24-02-30.0      25.74
4      TURNED ANG                5      -140-59-26.0     259.35
5      TURNED ANG -SIDE SHOT    6      +45-30-43.0      274.60
6      TURNED ANG -SIDE SHOT    7      -10-14-49.0      204.86
7      TURNED ANG -SIDE SHOT    8      -18-51-19.0      220.15
8      TURNED ANG                9      -45-18-23.0     407.95
9      TURNED ANG              10      -42-26-10.0      32.51
10     TURNED ANG -RAD. CURVE   11      +172-19-07.0     848.53
11     TURNED ANG -RAD. CURVE   12      -15-08-36.0     848.53
12     DEFLECTED                13      +29-07-25.0      0.00
13     BEARING                  14      N00-00-00.0E      0.00

COMMAND 12-                               | Enter change side command
CHANGE SIDE # = 10
ASSIGN AS PNT (DEFAULT = 11) =
ANGLE (DEFAULT = 1721907) = 330-          | At direction prompt, enter 330-
ANGLE (DEFAULT = 1721907) =              | Press RETURN to accept default angle
DISTANCE (DEFAULT = 848.53) =            | ...and distance
SIDE # = 14
ASSIGN AS PNT (DEFAULT = 15) = 113-      | re-display data to verify
                                          | that side has become a regular traverse leg

JOB # 1 Field Data for Closed Traverse.
SD.#      SHOT TYPE/ERROR      PNT      ANGLE      LENGTH
-----09-23-1986-----15:44:57-----C:BENCH
START  4500  2500  14
1      BEARING                  2      N39-59-13.0E      286.10
2      TURNED ANG -SIDE SHOT    3      +69-11-31.0      172.20
3      TURNED ANG -SIDE SHOT    4      -24-02-30.0      25.74
4      TURNED ANG                5      -140-59-26.0     259.35
5      TURNED ANG -SIDE SHOT    6      +45-30-43.0      274.60
6      TURNED ANG -SIDE SHOT    7      -10-14-49.0      204.86
7      TURNED ANG -SIDE SHOT    8      -18-51-19.0      220.15
8      TURNED ANG                9      -45-18-23.0     407.95
9      TURNED ANG              10      -42-26-10.0      32.51
10     TURNED ANG                11      +172-19-07.0     848.53
11     TURNED ANG -RAD. CURVE   12      -15-08-36.0     848.53
12     DEFLECTED                13      +29-07-25.0      0.00
13     BEARING                  14      N00-00-00.0E      0.00

```


(31-) Enter One Side Shot

PURPOSE

Use 31- to enter one side shot only. After you enter the side shot, you are returned automatically to regular traverse entry mode.

PROCEDURE

Enter 31- at the direction prompt. The direction prompt re-displays. Enter the direction and distance. Benchmark will process this entry as a side shot.

EXAMPLE

```
SIDE #= 1
ASSIGN AS PNT 2
BEARING = 250000
QUADRANT = 1
DISTANCE = 771.25

SIDE #= 2
ASSIGN AS PNT 3
BEARING = 24-
BEARING = 31-          | Enter one side shot
ANGLE = 150250
DISTANCE = 981.25

SIDE #= 3
ASSIGN AS PNT 4
ANGLE = 450505         | Back to regular traverse entry
DISTANCE = 250.19
```

(60-) Radius Curve

PURPOSE

Use the **60-** command to indicate that the direction of the traverse leg you are about to enter is from the point of curvature (P.C.) to the radius point, or from the radius point to the point of tangency (P.T.).

PROCEDURE

1. At the direction prompt, enter 60-.
2. Enter a direction and distance to describe the traverse leg to the radius point of the curve.
3. Enter **60-** again and enter the traverse leg from the radius point to the point of tangency (PT).

NOTES

1. When you display field data with 113-, radius curves are labeled.
2. When you balance a traverse, curve data is displayed for the radius curve.

EXAMPLE

```
COMMAND 11- | Start open traverse
DO YOU WISH TO USE DESCRIPTIONS?
  1. YES
  2. NO
ENTER OPTION= 2 | So descriptions in this example
JOB #
SD.#          SHOT TYPE/ERROR          PNT    ANGLE          LENGTH
-----09-23-1986-----22:08:02-----C:BENCH

STARTING PNT = 1 | Start traverse at pt.#1
STARTING NORTH = 5378.26 | Starting north coordinate
STARTING EAST = 2982.17 | Starting east coordinate
ENDING NORTH = 5349.75 | Known ending north coordinate
ENDING EAST = 3828.08 | Known ending east coordinate

BEARING = 480037 | Input direction from backsight point to starting point
QUADRANT (DEFAULT = 1) = 1 | Bearing from backsight into starting point
                               | Quadrant (1 = NE)

SIDE # = 1
ASSIGN AS PNT 2
BEARING = 24- | Set direction to turned angle from backsight
ANGLE = 1800000 | Turned angle
DISTANCE = 82.38 | Level distance

SIDE # = 2
ASSIGN AS PNT 3
ANGLE = 60- | Select radius curve option
ANGLE = -651716 | Angle turned left (-)
DISTANCE = 250 | Distance (radius)
```

(60-) Radius Curve

EXAMPLE

```

SIDE #= 3
ASSIGN AS PNT 4
ANGLE = 60-
ANGLE = 243925
DISTANCE = 250
| Indicates 2nd leg of radius curve
| Turned angle (delta of the curve)
| Distance (radius - must = previous distance)

SIDE #= 4
ASSIGN AS PNT 5
ANGLE = -860140
DISTANCE = 126.5
| Angle turned left (-)
| Level distance

SIDE #= 5
ASSIGN AS PNT 6
ANGLE = 30-
ANGLE = -881910
DISTANCE = 164.7
| Entry of multiple side shots
| Angle turned left (-)
| Level side shot distance

SIDE #= 6
ASSIGN AS PNT 7
ANGLE = -1000857
DISTANCE = 197.73
| Angle turned left (-)
| Level side shot distance

SIDE #= 7
ASSIGN AS PNT 8
ANGLE = 330-
ANGLE = 1503243
DISTANCE = 195.48
| Cancel side shot entry
| Angle turned right
| Level distance

SIDE #= 8
ASSIGN AS PNT 9
ANGLE = -1590511
DISTANCE = 82.8
| Angle turned left (-)
| Level distance

SIDE #= 9
ASSIGN AS PNT 10
ANGLE = -1694332
DISTANCE = 87.37
| Angle turned left (-)
| Level distance

SIDE #= 10
ASSIGN AS PNT 11
ANGLE = 1651710
DISTANCE = 132.63
| Angle turned right
| Level distance

SIDE #= 11
ASSIGN AS PNT 12
ANGLE = -1202005
DISTANCE = 128.24
| Angle turned left (-)
| Level distance

SIDE #= 12
ASSIGN AS PNT 13
ANGLE = -2173552
DISTANCE = 0
| Closing angle (instrument on end point)
| 0 distance indicates closing angle

SIDE #= 13
ASSIGN AS PNT 14
ANGLE = 21-
AZIMUTH = 1102639
DISTANCE = 0
| Selects azimuth input
| Known direction away from end point
| 0 distance indicates closing direction

SIDE #= 14
ASSIGN AS PNT 15
AZIMUTH = 99-
| Output of raw closure data

# OF TRAVERSE SIDES= 7
ANGULAR ERROR = -20 SECONDS
ERROR NORTH = -.1931
ERROR EAST = -.2249
ABSOLUTE ERROR = 0.2965
DIRECTION OF ERROR = S49-21-08.9W
PERIMETER = 835.40
PRECISION = 1 FOOT IN 2818

```

(60-) Radius Curve

EXAMPLE

```
COMMAND 113- | List original field data for checking
JOB #
SD.#          SHOT TYPE/ERROR          PNT    ANGLE          LENGTH
-----09-23-1986-----22:08:32-----C:BENCH
START 5378.26 2982.17 1
END 5349.75 3828.08
1      TURNED ANG          2      +180-00-00.0      82.38
2      TURNED ANG -RAD. CURVE 3      -65-17-16.0      250.00
3      TURNED ANG -RAD. CURVE 4      +24-39-25.0      250.00
4      TURNED ANG          5      -86-01-40.0      126.50
5      TURNED ANG -SIDE SHOT 6      -88-19-10.0      164.70
6      TURNED ANG -SIDE SHOT 7      -100-08-57.0     197.73
7      TURNED ANG          8      +150-32-43.0     195.48
8      TURNED ANG          9      -159-05-11.0     82.80
9      TURNED ANG         10     -169-43-32.0     87.37
10     TURNED ANG         11     +165-17-10.0     132.63
11     TURNED ANG         12     -120-20-05.0     128.24
12     TURNED ANG         13     -217-35-52.0      0.00
13     AZIMUTH            14     110-26-39.0      0.00

COMMAND 115- | Distance error search
JOB #
SD.#          SHOT TYPE/ERROR          PNT    ANGLE          LENGTH
-----09-23-1986-----22:08:35-----C:BENCH
1      3714
2      3100
3      2818
4      40506
7      6553
8      35502
9      28260
10     18029
11     3643

| Distance error search suggests that side 1 has the error
COMMAND 12- | Change an existing side
CHANGE SIDE # = 1 | Change side #1
ASSIGN AS PNT (DEFAULT = 2) = | Return to accept default point storage #
ANGLE (DEFAULT = 1800000) = | Return to accept same angle as originally entered
DISTANCE (DEFAULT = 82.38) = 82.68 | Enter corrected distance
COMMAND 99- | Compute new closure

# OF TRAVERSE SIDES = 7
ANGULAR ERROR = -20 SECONDS
ERROR NORTH = 0.0076
ERROR EAST = -.0020
ABSOLUTE ERROR = 0.0078
DIRECTION OF ERROR = N14-35-15.0W
PERIMETER = 835.70
PRECISION = 1 FOOT IN 106835

COMMAND 101- | Compute closure with angle balance

# OF TRAVERSE SIDES = 7
ANGULAR ERROR = 0 SECONDS
ERROR NORTH = -.0223
ERROR EAST = -.0107
ABSOLUTE ERROR = 0.0247
DIRECTION OF ERROR = S25-37-02.6W
PERIMETER = 835.70
PRECISION = 1 FOOT IN 33835
```

(60-) Radius Curve

EXAMPLE

```

COMMAND 111-                               | Output traverse balanced by compass rule
JOB #
BEARING      DIST                PNT  NORTHING      EASTING      TYPE
-----09-23-1986-----22:08:44-----C:BENCH
COMPASS RULE
                                1    5378.2600      2982.1700
N48-00-34.7E 82.68              2    5433.5749      3043.6242
S17-16-39.0E 250.00             3    5194.8555      3117.8742
N07-22-46.0E 250.00             4    5442.7848      3149.9841

      DELTA      = 24-39-25.0
      RADIUS      = 250.00
      ARC LENGTH  = 107.59
      TANGENT     = 54.64
      CHORD       = N85-03-03.5E      106.76

S78-38-57.1E 126.50              5    5417.8875      3274.0108
S13-01-52.9W 164.70              6    5257.4290      3236.8734  SS
                                5    5417.8875      3274.0108
S01-12-05.9W 197.73              7    5220.2010      3269.8642  S
                                5    5417.8875      3274.0108
N71-53-50.3E 195.48              8    5478.6285      3459.8186
S87-11-19.0E 82.80               9    5474.5673      3542.5198
S76-54-48.5E 87.37              10   5454.7846      3627.6213
N88-22-24.9E 132.63             11   5458.5491      3760.1997
S31-57-37.0E 128.24             12   5349.7500      3828.0800
AREA (SQUARE FEET) = 55588.2525
AREA (ACRES)      = 1.2761
COMMAND 126-      | To screen plot the traverse
COMMAND= QUIT;    | To go to non-graphics mode
JOB #
SD.#      SHOT TYPE/ERROR      PNT  ANGLE      LENGTH
-----09-23-1986-----22:08:54-----C:BENCH
COMMAND 4-      | To exit boundary traverse
CAUTION!! MAKE SURE YOUR DATA IS STORED; PRESS RETURN TO CONTINUE
              | Return with no entry to confirm selection

```

(61-) Tangent Curve

PURPOSE

Works like the **60-** command except the direction is from the point of curvature (P.C.) to the point of intersection of the tangents (P.I.), then from the P.I. to point of tangency (P.T).

PROCEDURE

During traverse entry, enter **61-** at the direction prompt.

NOTES

1. When you display field data with **113-**, tangent curves are labeled TAN CURVE.
2. When you balance a traverse, *curve* data is displayed for the tangent curve (see example below).

(61-) Tangent Curve

EXAMPLE

```

SIDE #= 1
ASSIGN AS PT. # 2
B= 24- | Set direction mode to angle turned FROM BACKSIGHT
A= 1800000 | Turned angle
DISTANCE= 82.38 | Level distance

SIDE #= 2
ASSIGN AS PT. # 3
A= 61- | Select tangent curve option
A= 2044244 | Turned angle
DISTANCE= 54.64 | Distance (tangent)

SIDE #= 3
ASSIGN AS PT. # 4
A= 23- | Indicates second leg of tangent curve
DA= 61- | Set deflection angle input
DA= 243925 | Turned angle (delta of the curve)
DISTANCE= 54.64 | Tangent distance (must = previous tangent distance)
SIDE #= 4
ASSIGN AS PT. # 5
DA= 24- | Set angle from backsight input
A= -1760140 | Angle turned left (-)
DISTANCE= 126.5 | Level distance
-----
COMMAND 113- | List original field data for checking
JOB #
SD.# SHOT TYPE/ERROR PT# ANGLE LENGTH
-----06-23-1986-----15:33:35-----F:\DUSTY\BMTEST
START 5378.26 2982.17 1
END 5349.75 3828.08
1 TURNED ANG 2 + 180-00-00 82.38
2 TURNED ANG -TAN. CURVE 3 + 204-42-44 54.64
3 DEFLECTED -TAN. CURVE 4 + 24-39-25 54.64
4 TURNED ANG 5 - 176-01-40 126.50
5 TURNED ANG -SIDE SHOT 6 - 88-19-10 164.70
6 TURNED ANG -SIDE SHOT 7 - 100-08-57 197.73
7 TURNED ANG 8 + 150-32-43 195.48
8 TURNED ANG 9 - 159-05-11 82.80
9 TURNED ANG 10 - 169-43-32 87.37
10 TURNED ANG 11 + 165-17-10 132.63
11 TURNED ANG 12 - 120-20-05 128.24
12 TURNED ANG 13 - 217-35-52 0.00
13 AZIMUTH 14 110-26-10 0.00
COMMAND

```

(62-) Hold Angle Constant

PURPOSE

Use 62- to prevent a traverse angle from being adjusted when you use the Automatic Angle Balance routine (101-). This is especially useful when describing a P.O.L. (point-on-line), where you usually need to hold a 180° angle.

PROCEDURE

Enter 62- at the direction prompt.

EXAMPLE

```
SIDE #= 2
ASSIGN AS PNT 3
BEARING= 24-          | Invoke angles turned from backsight
ANGLE= 900010         | Turned angle right
DISTANCE= 100.01      | Level distance

SIDE #= 3
ASSIGN AS PNT 4
ANGLE= 900020         | Turned angle right
DISTANCE= 50          | Level distance

SIDE #= 4
ASSIGN AS PNT 5
ANGLE= 62-            | Hold next angle (will not be adjusted)
ANGLE= 1800000        | Turned angle right
DISTANCE= 50          | Level distance

SIDE #= 5
ASSIGN AS PNT 6
ANGLE= 900030         | Turned angle right
DISTANCE= 100.03      | Level distance

SIDE #= 6
ASSIGN AS PNT 7
ANGLE= 900000         | Closing angle
DISTANCE= 0           | 0 distance to mark closing angle

SIDE #= 7
ASSIGN AS PNT 8
ANGLE= 99-            | Calculate closure

# OF SIDES           = 4
ANGULAR ERROR        = 60 SECONDS
ERROR NORTH          = -.0243
ERROR EAST           = -.0054
ABSOLUTE ERROR       = .0249
DIRECTION OF ERROR= S12-37-03W
PERIMETER            = 300.04
PRECISION=1 FOOT IN 12067
```


(62-) Hold Angle Fixed

EXAMPLE

```

COMMAND 101-          | Automatic angle balance routine

# OF SIDES             = 4
ANGULAR ERROR          = 0 SECONDS
ERROR NORTH            = -.0173
ERROR EAST             = .0139
ABSOLUTE ERROR         = .0222
DIRECTION OF ERROR     = S38-52-11.3E
PERIMETER              = 300.04
PRECISION=1 FOOT IN 13498

COMMAND 113-          | Display field data
JOB #
SD.#                   SHOT TYPE/ERROR          PT#    ANGLE                      LENGTH
-----06-23-1986-----17:16:40-----F:\DUSTY\BMTEST
START 5000 5000 1
1      BEARING -HOLD SIDE                      2      N25-15-10E          100.00
2      TURNED ANG                             3      + 90-00-10          100.01
3      TURNED ANG                             4      + 90-00-20           50.00
4      TURNED ANG -HOLD ANGLE                  5      + 180-00-00          50.00
5      TURNED ANG                             6      + 90-00-30          100.03
6      TURNED ANG                             7      + 90-00-00           0.00
COMMAND 110-          | Display unbalanced traverse output
JOB #
BEARING                DIST                    PT#    NORTHING                EASTING                TYPE
-----06-23-1986-----17:16:45-----F:\DUSTY\BMTEST
NO BALANCE
N25-15-10E 100.00                      1      5000                    5000
N64-44-55W 100.01                      2      5090.4434                5042.6613
S25-15-10W 50.00                       3      5133.1068                4952.2077
S25-15-10W 50.00                       4      5087.8851                4930.8771
S64-44-35E 100.03                      5      5042.6633                4909.5465
AREA (SQUARE FEET) = 10001.4852
AREA (ACRES)       = .2296
COMMAND            | Note that bearings 3 to 4 and 4 to 5 are identical

```

(65-) Hold Side Constant

PURPOSE

65- tells Benchmark that the traverse leg to be entered next should not be adjusted during any subsequent balancing routine.

PROCEDURE

Enter 65- at the direction prompt and proceed with normal traverse entry.

(365-) Direction Into Chord, Chord Length, and Radius

PURPOSE

The 365- command lets you compute a traverse side by entering chord direction and length, and radius length.

PROCEDURE

1. Occupy point A.
2. Enter 365- at the direction prompt. Then enter the chord direction and length.
3. At the R= prompt, enter the radius length (positive for the curve clockwise from B; negative if counter-clockwise).

OUTPUT

When you balance the traverse, the program displays the following curve data:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

AREA (SQUARE FEET)
AREA (ACRES)

NOTES

1. When you balance the traverse, all curve data for the radius curve is displayed. The area is adjusted for the curve.
2. The point occupied is point C, the direction is B to C.
3. The sides created with 365- are labeled as RADIUS CURVE.

(365-) Direction Into Chord, Chord Length, and Radius

EXAMPLE

```

COMMAND 10-          | Start closed traverse
DO YOU WISH TO USE DESCRIPTIONS?
  1. YES
  2. NO
OPTION = 2           | No descriptions

SHOULD ALL TRAVERSE DATA BE CLEARED FROM MEMORY ?? (Y/N)
Y                   | Clear all old data

STARTING PNT 1       | Starting point #
STARTING NORTH= 4500 | Starting North Coordinate
STARTING EAST= 2500  | Starting East Coordinate

SIDE #- 1
ASSIGN AS PNT 2
BEARING= 395913      | Starting bearing
QUADRANT= 1          | NE quadrant
DISTANCE= 286.10     | Level distance

SIDE #- 2
ASSIGN AS PNT 3
BEARING= 785947      | Bearing
QUADRANT= 1          | NE quadrant
DISTANCE= 259.35     | Level distance

SIDE #- 3
ASSIGN AS PNT 4
BEARING= 334124      | Bearing
QUADRANT= 3          | SW quadrant
DISTANCE= 407.95     | Level distance

SIDE #- 4
ASSIGN AS PNT 5
BEARING= 365-        | Curve - chord data & radius known
BEARING= 713347      | Chord bearing
QUADRANT= 4          | NW quadrant
DISTANCE= 223.62     | Chord length
R= -848.53           | (-) indicates CCW arc swing
SIDE #- 5
ASSIGN AS PNT 6

SIDE #- 6
ASSIGN AS PNT 7
BEARING= 99-         | Calculate closure data

# OF SIDES           = 3
ANGULAR ERROR        = 0 SECONDS
ERROR NORTH          = -.0034
ERROR EAST           = .0018
ABSOLUTE ERROR       = .0039
DIRECTION OF ERROR= S28-23-41.3E
PERIMETER             = 953.40
PRECISION            = 1 FOOT IN 247371

```

(365-) Direction Into Chord, Chord Length, and Radius

EXAMPLE

```
COMMAND 113-          List Field Data
JOB # 11 365- DEMO FILE
SD.#          SHOT TYPE/ERROR          PT#    ANGLE          LENGTH
-----06-26-1986-----11:21:29-----F:\DUSTY\BMTEST
START 4500 2500 1
1          BEARING          2          N39-59-13E          286.10
2          BEARING          3          N78-59-47E          259.35
3          BEARING          4          S33-41-24W          407.95
4          BEARING -RAD. CURVE 5          S26-00-31.6W          848.53
5          BEARING -RAD. CURVE 6          N10-51-54.4E          848.53
COMMAND 111-          | Calculate and balance points with Compass Rule
JOB # 11 365- DEMO FILE
BEARING      DIST          PT#    NORTHING      EASTING      TYPE
-----06-26-1986-----11:21:33-----F:\DUSTY\BMTEST
COMPASS RULE
1          4500          2500
N39-59-12.2E 286.10      2          4719.2082      2683.8511
N78-59-46.2E 259.35      3          4768.7115      2938.4324
S33-41-24.7W 407.95      4          4429.2778      2712.1421
S26-00-31.6W 848.53      5          3666.681       2340.0543
N10-51-54.4E 848.53      6          4500          2500

      DELTA      = 15-08-37.2
      RADIUS      = 848.53
      ARC LENGTH  = 224.27
      TANGENT     = 112.79
      CHORD       = N71-33-47W          223.62

AREA (SQUARE FEET) = 66254.5445
AREA (ACRES)       = 1.521
```

Length Adjustments

After you enter the direction of the traverse leg, the Boundary Traverse program requests distance data. The following commands are related to length adjustments.

- Slope Mode (18-). Alternate between slope and no-slope mode with 18-.
- Select Slope Reduction Method (26- for stadia method; 27- for EDM method)
- Enter a Temperature (50-)
- Convert Meters to Feet (54-, 57-). Enter 54- to begin meters-to-feet conversion. 57- halts conversion.

These commands are explained in greater detail on the following pages.

(18-) Set Slope Angle Request

PURPOSE

18- switches between manual and automatic slope request. In manual mode, Benchmark prompts for distance only; you must use 51- to enter a slope angle. In automatic mode, Benchmark prompts for slope angle and distance for each traverse leg.

18- functions in both the Boundary Traverse and Coordinate Geometry programs.

PROCEDURE

To switch modes, enter 18- at the DISTANCE= prompt. You can set the default mode on the Setup Menu (Chapter 3).

NOTES

1. In slope mode, you can enter only one slope angle and one distance per traverse leg.
2. In manual mode, you can enter multiple slope angles and distances.

EXAMPLE	SIDE #= 15	
	ASSIGN AS PNT 16	
	BEARING = 18-	Set automatic slope angle request
	AUTO. SLOPE ANGLE REQUEST	
	SLOPE DISTANCE = 250	
	SLOPE ANGLE= 152505	
	SIDE #= 16	
	ASSIGN AS PNT 17	
	BEARING = 18-	Set manual slope angle request
MANL. SLOPE ANGLE REQUEST		
DISTANCE = 577.11		

(26-, 27-) Select Slope Reduction Method

PURPOSE

Use 26- to select the stadia method for reducing slope distances (cosine squared X distance).

Use 27- to select vertical angle method (also known as EDM or "taping") for reducing slope distances (cosine X distance).

PROCEDURE

Enter 26- or 27- at the COMMAND prompt, before you begin traverse entry.

To continue traverse entry, use the appropriate direction mode command (20-, 21-, 22-, 23-).

NOTES

1. Slope reduction mode is a system default that can be established on the Setup Menu (Chapter 8). If you do not enter either 26- or 27-, Boundary Traverse uses the default mode.
2. When you enter 26- or 27- during traverse entry, you are returned to the COMMAND prompt. Select the appropriate direction command to resume data entry.

(50-) Enter a Temperature

PURPOSE

Use 50- to enter a temperature in degrees Fahrenheit. The specified temperature is held until you change it.

PROCEDURE

Enter 50- at the distance prompt, or (in automatic slope mode) the SLOPE DISTANCE= prompt.

EXAMPLE	SIDE # = 8	
	ASSIGN AS PNT 9	
	ANGLE = -873017	<i>Turned angle left</i>
	SLOPE DISTANCE = 50-	<i>Enter new temperature</i>
	TEMP. = 74	<i>74 ° Fahrenheit</i>
	SLOPE DISTANCE = 101.87	<i>Slope distance</i>
	SLOPE ANGLE = 25200	<i>Slope angle</i>

(51-) Enter Multiple Slope Angles and Distances

PURPOSE

51- permits entry of multiple slope angles and distances along the same horizontal direction.

PROCEDURE

1. Make sure you are in manual slope mode.
2. Enter 51- at the **DISTANCE=** prompt. You will receive these prompts:

 SLOPE DISTANCE=
 SLOPE ANGLE=
3. Enter as many angles and distances as you want. These prompts repeat until you enter another command.
4. You can complete the 51- routine in two ways:
 - Enter 52- to tell the program to use the average of the entered distances as the distance of the traverse leg.
 - Enter 53- to tell the program to use the sum of the entered distances as the distance of the traverse leg.

NOTES

1. You can enter slope angles from whatever reference point you want (0, 90, 270, etc.). The program normalizes the slope angle to +/-45 degrees before performing the reduction calculation. This means that no slope angle can be greater than +/- 45 degrees from whatever reference you are using.
2. For a level measured distance, just press RETURN with no entry at the **SLOPE ANGLE=** prompt.

(51-) Enter Multiple Slope Angles and Distances

EXAMPLE

```

SIDE # = 11
ASSIGN AS PNT 12
ANGLE = -1740747 | Turned angle left
SLOPE DISTANCE = 50- | Enter new temperature
TEMP. = 76 | 76 degrees Fahrenheit
SLOPE DISTANCE = 244.37 | Slope distance
SLOPE ANGLE = 53500 | Slope angle

SIDE # = 12
ASSIGN AS PNT 13
ANGLE = -900247 | Turned angle left
SLOPE DISTANCE = 17- | Invoke manual slope data request
DISTANCE = 51- | Multiple slope data entry
SLOPE DISTANCE = 252.92 | 1st slope distance
SLOPE ANGLE = 3700 | 1st slope angle
SLOPE DISTANCE = 252.88 | 2nd slope distance
SLOPE ANGLE = 893000 | 2nd slope angle
SLOPE DISTANCE = 52- | Exit slope routine (distances averaged)

SIDE # = 13
ASSIGN AS PNT 14
ANGLE = -1793736 | Turned angle left
DISTANCE = 51- | Multiple slope data entry
SLOPE DISTANCE = 239.87 | First slope distance
SLOPE ANGLE = 11300 | First slope angle
SLOPE DISTANCE = 122.95 | 2nd slope distance
SLOPE ANGLE = 0 | 2nd slope angle (0 indicates level shot)
SLOPE DISTANCE = 53- | Exit slope routine (distances accumulated)

SIDE # = 14
ASSIGN AS PNT 15
ANGLE = -910919 | Turned angle left
DISTANCE = 0 | 0 distance indicates closing angle

```

```

SIDE # = 15
ASSIGN AS PNT 16
ANGLE = 113- | List field data
JOB # 8 Sample 2 Field Data.
SD.# SHOT TYPE/ERROR PT# ANGLE LENGTH
-----06-24-1986-----17:05:27-----F:\DUSTY\BMTEST
START 5000 5000 1
1 BEARING 2 N89-30-00E 445.89
2 TURNED ANG -SIDE SHOT 3 - 93-11-00 11.50
3 TURNED ANG 4 - 93-11-00 248.77
4 TURNED ANG 5 - 169-35-30 217.98
5 TURNED ANG 6 - 187-16-39 150.06
6 TURNED ANG -SIDE SHOT 7 - 264-12-29 199.89
7 TURNED ANG -SIDE SHOT 8 + 89-59-26 99.95
8 TURNED ANG 9 - 87-30-17 101.75
9 TURNED ANG 10 - 187-28-49 98.46
10 TURNED ANG -SIDE SHOT 11 - 84-56-23 10.47
11 TURNED ANG 12 - 174-07-47 243.22
12 TURNED ANG 13 - 90-02-47 252.90
13 TURNED ANG 14 - 179-37-36 362.78
14 TURNED ANG 15 - 91-09-19 0.00
COMMAND 99- | Calculate closure data

```

(54-, 57-) Convert Meters to Feet

PURPOSE

54- specifies that distances entered in meters will be converted to feet.

57- halts meters-to-feet conversion.

PROCEDURE

Enter 54- or 57- at the direction prompt.

NOTE

If you start another traverse with the 10- routine, Benchmark reverts automatically to the default mode (distance assumed to be feet).

EXAMPLE

```
STARTING PNT = 1
STARTING NORTH= 1500
STARTING EAST= 1500
```

```
SIDE #= 1
ASSIGN AS PNT 2
BEARING= 23-
DEFLECTION ANGLE=250700
DISTANCE= 54-
DISTANCE= 100
```

| *Begin meters-to-feet conversion*

```
SIDE #= 2
ASSIGN AS PNT 3
DEFLECTION ANGLE= -250010
DISTANCE= 205
```

```
SIDE #= 3
ASSIGN AS PNT 4
DEFLECTION ANGLE= 150000
DISTANCE= 422
```

```
SIDE #= 4
ASSIGN AS PNT 5
DEFLECTION ANGLE= 750010
DISTANCE= 95.51
```

```
SIDE #= 5
ASSIGN AS PNT 6
DEFLECTION ANGLE= 1850100
DISTANCE= 500
```

```
SIDE #= 6
ASSIGN AS PNT 7
DEFLECTION ANGLE= 113-
START 1500 1500 1
```

```
1 DEFLECTED
2 DEFLECTED
3 DEFLECTED
4 DEFLECTED
5 DEFLECTED
COMMAND
```

2	+	25-07-00	328.08
3	-	25-00-10	672.57
4	+	15-00-00	1384.51
5	+	75-00-10	313.35
6	+	185-01-00	1640.42

| *Distances entered as meters are converted to feet*

End of Entry Routines

(113-) Display Field Data

PURPOSE

113- displays field data. Distance data is adjusted for slope and temperature.

PROCEDURE

Enter 113- at the COMMAND prompt.

EXAMPLE

```
SIDE #= 15
ASSIGN AS PNT 16
ANGLE= 113-
JOB # 8 Sample 2 Field Data.
SD.#          SHOT TYPE/ERROR          PT#    ANGLE          LENGTH
-----06-24-1986-----17:05:27-----F:\DUSTY\BMTEST
START  5000  5000  1
1      BEARING          2      N89-30-00E          445.89
2      TURNED ANG -SIDE SHOT  3      - 93-11-00          11.50
3      TURNED ANG          4      - 93-11-00          248.77
4      TURNED ANG          5      - 169-35-30          217.98
5      TURNED ANG          6      - 187-16-39          150.06
6      TURNED ANG -SIDE SHOT  7      - 264-12-29          199.89
7      TURNED ANG -SIDE SHOT  8      + 89-59-26          99.95
8      TURNED ANG          9      - 87-30-17          101.75
9      TURNED ANG         10      - 187-28-49          98.46
10     TURNED ANG -SIDE SHOT  11     - 84-56-23          10.47
11     TURNED ANG          12     - 174-07-47          243.22
12     TURNED ANG          13     - 90-02-47          252.90
13     TURNED ANG          14     - 179-37-36          362.78
14     TURNED ANG          15     - 91-09-19           0.00
COMMAND  99-          | Calculate closure
```

(99-) Calculate Closure

PURPOSE

Use 99- to calculate closure of a traverse and displays standard closure data (see Output section).

PROCEDURE

Enter 99- after completion of traverse data entry.

OUTPUT

After you enter 99-, Benchmark displays the following data:

```
# OF SIDES
ANGULAR ERROR (in seconds)
ERROR NORTH (latitude)
ERROR EAST (departure)
ABSOLUTE ERROR (linear misclosure)
DIRECTION OF ERROR
PERIMETER
PRECISION
```

NOTES

1. To check angular closure in a closed-loop traverse, your last entry must be a closing angle or bearing with a zero distance.
2. To get a valid check for angular closure in a closed-connecting traverse, you must enter both a closing angle with a zero distance and a closing bearing or azimuth with a zero distance.

EXAMPLE	COMMAND	99-		Calculate closure data
	# OF SIDES	=	9	
	ANGULAR ERROR	=	16 SECONDS	
	ERROR NORTH	=	.1224	
	ERROR EAST	=	.3112	
	ABSOLUTE ERROR	=	.3344	
	DIRECTION OF ERROR	=	N68-31-44.6E	
	PERIMETER	=	2121.82	
	PRECISION	=	1 FOOT IN 6344	

Adjustment Options

There are several ways to go about finding and distributing linear and angular error in your traverse.

(101-) Distribute Angular Error Automatically

PURPOSE

The 101- command automatically distributes the angular error equally among the angles in the traverse.

NOTE

1. The 101- command automatically executes a 99- command following the distribution of angular error.
2. If the angular error is zero and you enter 101-, the system will respond NO ANGULAR ERROR and will not attempt to perform the adjustment.

EXAMPLE	COMMAND	101-		<i>Automatic angle balance</i>
	# OF SIDES	=	9	
	ANGULAR ERROR	=	0 SECONDS	
	ERROR NORTH	=	.1023	
	ERROR EAST	=	.2811	
	ABSOLUTE ERROR	=	.2991	
	DIRECTION OF ERROR	=	N69-59-54.7E	
	PERIMETER	=	2121.82	
	PRECISION	=	1 FOOT IN 7093	

(102-) Distribute Angular Error Manually

PURPOSE

Use the 102- command to manually distribute the angular error.

PROCEDURE

1. After you have used **99-** to calculate closure data, enter 102-.
2. At the prompt SIDE #=, enter the side number you want to correct.
3. At the prompt # OF SECONDS=, enter the number of seconds of error you want to put in the selected angle.

NOTES

1. If the angular error is negative, enter the number of seconds negatively.
2. After **102-**, you generally enter **99-** to recalculate closure.

(110-, 111-, 112-) Traverse Adjustment Routines

PURPOSE

The aim of adjusting a traverse is to compute a mathematically closed figure by distributing the linear misclosure (latitudes and departures) equally throughout the traverse. This is sometimes called "balancing" the traverse. Benchmark supports two methods for correction misclosure: the Compass Rule and Crandall's Rule.

(111-) COMPASS RULE

The Compass Rule (111-) will yield the best results when angles and distances have been measured with approximately equal precision.

(112-) CRANDALL'S RULE

Crandall's Rule (112-) adjusts distances only. Use this method when linear measurements are not as accurate as angular measurements (as in stadia traverses).

(110-) NO ADJUSTMENT

You can display an unbalanced traverse with 110-.

PROCEDURE

Enter 110-, 111-, or 112- after you have entered all your traverse data.

(110-, 111-, 112-) Traverse Adjustment Routines

OUTPUT

When Benchmark balances a traverse, it computes coordinates from your field data. (This is explained in more detail in Chapter 4.)

No matter which balancing routine you use, Benchmark displays the following information for each traverse leg:

- Direction. The direction output will be in the form specified in the Setup Menu. You can specify output by bearings, azimuths, or angles right. The appropriate command numbers follow.

6- to specify bearing output

7- to specify azimuth output. You can further enter either 29- for north azimuth or 28- for south azimuth

8- to specify angles right output

NOTE: You can enter the direction commands either on the Setup Menu, or at the COMMAND prompt within Benchmark. If you enter them on the Setup Menu, they will take effect whenever you start Benchmark. If you enter them at the COMMAND prompt within Benchmark, they will remain in effect only during the current session (that is, until you exit Benchmark or make another selection from the Main Menu). Chapter 3 discusses the options on the Setup Menu in greater detail.

- Distance. Length of each traverse leg in feet.
- Point number. Assigned point number.
- Northing and Easting. These are the coordinate pairs you can work with in the Coordinate Geometry program.
- Type. of entry (regular traverse leg, side shot, radius curve)
- Area in square feet
- Area in acres

NOTE

The balancing routines do not alter your field data, so you can use these command repeatedly during a session to see what effect each one has on the traverse.

(110-, 111-,112-) Traverse Adjustment Routines

```

COMMAND 113-          | Display traverse data
START 5000 5000 1
1          BEARING      2          N89-30-00E      445.89
2          TURNED ANG -SIDE SHOT 3          - 93-11-00      11.5
3          TURNED ANG      4          - 93-11-00      248.77
4          TURNED ANG      5          - 169-35-30      217.98
5          TURNED ANG      6          - 187-16-39      150.06
6          TURNED ANG -SIDE SHOT 7          - 264-12-29      199.89
7          TURNED ANG -SIDE SHOT 8          + 89-59-26      99.95
8          TURNED ANG      9          - 87-30-17      101.75
9          TURNED ANG     10          - 187-28-49      98.46
10         TURNED ANG -SIDE SHOT 11         - 84-56-23      10.47
11         TURNED ANG      12         - 174-07-47      243.22
12         TURNED ANG      13         - 90-02-47      252.92
13         TURNED ANG      14         - 179-37-36      362.78
14         TURNED ANG      15         - 91-09-19        0

```

EXAMPLE

```

COMMAND 110-          | Display unbalanced traverse
NO BALANCE
1          5000          5000
N89-30-00E 445.89      2          5003.89      5445.88
S03-41-00E 11.5        3          4992.41      5446.61      SS
2          5003.89      5445.88
S03-41-00E 248.77      4          4755.64      5461.86
S06-43-30W 217.98      5          4539.16      5436.33
S00-33-09E 150.06      6          4389.1        5437.78
S84-45-38E 199.89      7          4370.85      5636.83      SS
6          4389.1        5437.78
N89-26-17E 99.95      8          4390.08      5537.72      SS
6          4389.1        5437.78
N88-03-26W 101.75     9          4392.55      5336.09
S84-27-45W 98.46     10         4383.05      5238.09
N00-28-38W 10.47     11         4393.52      5238          SS
10         4383.05      5238.09
N89-40-02W 243.22     12         4384.46      4994.87
N00-17-11E 252.92     13         4637.38      4996.13
N00-39-35E 362.78     14         5000.14      5000.31
AREA (SQUARE FEET)= 277619.05
AREA (ACRES)= 6.37

```

(110-, 111-, 112-) Traverse Adjustment Routines

EXAMPLE	COMMAND 111-		Display traverse balanced by .i.Compass Rule			
	COMPASS RULE					
			1	5000	5000	
	N89-30-13.4E	445.83	2	5003.86	5445.81	
	S03-40-46.6E	11.5	3	4992.38	5446.55	SS
			2	5003.86	5445.81	
	S03-40-28.9E	248.78	4	4755.59	5461.76	
	S06-43-58.5W	218	5	4539.1	5436.2	
	S00-32-38.6E	150.07	6	4389.03	5437.62	
	S84-45-07.6E	199.89	7	4370.75	5636.68	SS
			6	4389.03	5437.62	
	N89-26-47.4E	99.95	8	4390	5537.5	SS
			6	4389.03	5437.62	
	N88-03-40.6W	101.76	9	4392.48	5335.92	
	S84-27-34.4W	98.48	10	4382.97	5237.9	
	N00-28-48.6W	10.47	11	4393.44	5237.82	SS
			10	4382.97	5237.9	
	N89-40-15.8W	243.26	12	4384.36	4994.65	
	N00-16-40.8E	252.9	13	4637.26	4995.88	
	N00-39-04.9E	362.76	14	5000	5000	
	AREA (SQUARE FEET) = 277745.15					
	AREA (ACRES) = 6.38					
	COMMAND 112-		Display traverse balanced by the .i.Crandall's Rule			
	CRANDALL'S RULE					
			1	5000	5000	
	N89-30-00E	445.74	2	5003.89	5445.72	
	S03-41-00E	11.5	3	4992.41	5446.46	SS
			2	5003.89	5445.72	
	S03-41-00E	248.79	4	4755.62	5461.7	
	S06-43-30W	218.01	5	4539.1	5436.17	
	S00-33-09E	150.08	6	4389.03	5437.62	
	S84-45-38E	199.89	7	4370.78	5636.68	SS
			6	4389.03	5437.62	
	N89-26-17E	99.95	8	4390.01	5537.56	SS
			6	4389.03	5437.62	
N88-03-26W	101.78	9	4392.48	5335.9		
S84-27-45W	98.5	10	4382.98	5237.86		
N00-28-38W	10.47	11	4393.45	5237.78	SS	
		10	4382.98	5237.86		
N89-40-02W	243.31	12	4384.39	4994.56		
N00-17-11E	252.89	13	4637.28	4995.82		
N00-39-35E	362.74	14	5000	5000		
AREA (SQUARE FEET) = 277745.66						
AREA (ACRES) = 6.38						
COMMAND						

Searching for Errors

(114-) Search for Angular Error

PURPOSE

Use the 114- command to search for angular error. The error of closure in seconds is added separately to each traverse side. The relative error of closure is computed and displayed for each traverse side.

EXAMPLE

COMMAND 114-		Angular error search	
JOB # 8 Sample 2 Field Data.			
SD.#	SHOT TYPE/ERROR	PT#	ANGLE
-----06-24-1986-----17:05:39-----F:\DUSTY\BMTEST			
3	6795		
4	9742		
5	16973		
8	25965		
9	48798		
11	948802		
12	16963		
13	16859		
14	6344		

Searching for Errors

(115-) Search for Linear Error

PURPOSE

Use the 115- command to search for linear error. This command adds to or subtracts from each traverse side the absolute length error, then displays the relative error of closure.

Searching for Errors

AZIMUTH = 99-

| Output of raw closure data

OF TRAVERSE SIDES= 7
 ANGULAR ERROR = -20 SECONDS
 ERROR NORTH = -.1931
 ERROR EAST = -.2249
 ABSOLUTE ERROR = 0.2965
 DIRECTION OF ERROR = S49-21-08.9W
 PERIMETER = 835.40
 PRECISION = 1 FOOT IN 2818

COMMAND 113-

| List original field data for checking

JOB #	SD.#	SHOT TYPE/ERROR	PNT	ANGLE	LENGTH
		-----09-23-1986-----	22:08:32		C:BENCH
	START 5378.26	2982.17 1			
	END 5349.75	3828.08			
1		TURNED ANG	2	+180-00-00.0	82.38
2		TURNED ANG -RAD. CURVE	3	-65-17-16.0	250.00
3		TURNED ANG -RAD. CURVE	4	+24-39-25.0	250.00
4		TURNED ANG	5	-86-01-40.0	126.50
5		TURNED ANG -SIDE SHOT	6	-88-19-10.0	164.70
6		TURNED ANG -SIDE SHOT	7	-100-08-57.0	197.73
7		TURNED ANG	8	+150-32-43.0	195.48
8		TURNED ANG	9	-159-05-11.0	82.80
9		TURNED ANG	10	-169-43-32.0	87.37
10		TURNED ANG	11	+165-17-10.0	132.63
11		TURNED ANG	12	-120-20-05.0	128.24
12		TURNED ANG	13	-217-35-52.0	0.00
13		AZIMUTH	14	110-26-39.0	0.00

COMMAND 115-

| Distance error search

JOB #	SD.#	SHOT TYPE/ERROR	PNT	ANGLE	LENGTH
		-----09-23-1986-----	22:08:35		C:BENCH
1		3714			
2		3100			
3		2818			
4		40506			
7		6553			
8		35502			
9		28260			
10		18029			
11		3643			

COMMAND 12-

CHANGE SIDE # = 1

ASSIGN AS PNT (DEFAULT = 2) =

ANGLE (DEFAULT = 1800000) =

DISTANCE (DEFAULT = 82.38) = 82.68

COMMAND 99-

| Distance error search suggests that side 1 has the error

| Change an existing side

| Change side #1

| Return to accept default point storage #

| Return to accept same angle as originally entered

| Enter corrected distance

| Compute new closure

OF TRAVERSE SIDES= 7
 ANGULAR ERROR = -20 SECONDS
 ERROR NORTH = 0.0076
 ERROR EAST = -.0020
 ABSOLUTE ERROR = 0.0078
 DIRECTION OF ERROR = N14-35-15.0W
 PERIMETER = 835.70
 PRECISION = 1 FOOT IN 106835

EXAMPLE

Handwritten notes:
 This example shows that side 1 has the error. The distance error search suggests that side 1 has the error. The distance error search suggests that side 1 has the error.

Correcting Input Errors

There are several ways to make corrections to traverse sides. You can:

- Correct a Side (12-)
- Delete a Side (13-)
- Insert a Side (14-)

These commands are covered individually on following pages.

(12-) Change a Side

PURPOSE

Use the 12- command to correct the data for a traverse side.

PROCEDURE

1. Enter 12-.
2. At the prompt `CHANGE SIDE# =`, enter the side number you want to correct.
3. Benchmark displays the default point number, direction, and distance data. To change any of these, make an entry. To accept the defaults, press RETURN with no entry.
4. Use 99- to re-calculate the closure data.

NOTES

1. If you notice an error before the next side number is displayed, you can give a direction command (20-, 21-, 23-, or 24-), then re-enter the data for the current side.
2. If you notice an error on a side other than the one you are currently entering, you can correct it immediately or after you have completed entering all your data. To correct it immediately, use the change side command (12-). After you have made the correction, Benchmark returns to the side number you were working on before you entered 12-.

(12-) Change a Side

EXAMPLE

```

COMMAND 113- | Display data to be edited
JOB # 1 Field Data for Closed Traverse.
SD.#          SHOT TYPE/ERROR          PNT    ANGLE          LENGTH
-----09-23-1986-----15:47:21-----C:BENCH
START 4500 2500 1
1      BEARING          2      N39-59-13.0E      286.10
2      TURNED ANG -SIDE SHOT 3      +69-11-31.0      172.20
3      TURNED ANG -SIDE SHOT 4      -24-02-30.0      25.74
4      TURNED ANG          5      -140-59-26.0     259.35
5      TURNED ANG -SIDE SHOT 6      +45-30-43.0     274.60
6      TURNED ANG -SIDE SHOT 7      -10-14-49.0     204.86
7      TURNED ANG -SIDE SHOT 8      -18-51-19.0     220.15
8      TURNED ANG          9      -45-18-23.0     407.95
9      TURNED ANG -SIDE SHOT 10     -42-26-10.0     32.51
10     TURNED ANG -RAD. CURVE 11     +172-19-07.0    848.53
11     TURNED ANG -RAD. CURVE 12     -15-08-36.0    848.53
12     DEFLECTED          13     +29-07-25.0     0.00

COMMAND 12- | Invoke change side routine
CHANGE SIDE # = 10 | Enter side name to change
ASSIGN AS PNT (DEFAULT = 11) = | Benchmark displays default point number
ANGLE (DEFAULT = 1721907) = 1621907 | Enter new angle
DISTANCE (DEFAULT = 848.53) = | Press RETURN to accept default
COMMAND 99- | Re-calculate closure

# OF TRAVERSE SIDES = 3
ANGULAR ERROR      = -35993 SECONDS
ERROR NORTH        = -37.9123
ERROR EAST         = -9.0482
ABSOLUTE ERROR     = 38.9770
DIRECTION OF ERROR = S13-25-23.4W
PERIMETER          = 953.40
PRECISION          = 1 FOOT IN 24

```

(13-) Delete a Side

PURPOSE

PROCEDURE

1. Enter 13-.
2. At the prompt DELETE SIDE #, enter the side number you want to delete. The side is deleted.

NOTE

When you delete a side, note that the remaining side numbers are renumbered automatically in sequential order. Point numbers are not renumbered.

EXAMPLE	COMMAND	13-		Enter delete side command
	DELETE SIDE #	11		Enter side number to be deleted
	COMMAND	113-		Side numbers are renumbered sequentially
	START	5000 5000 1		
	1	BEARING	2	N89-30-00E 445.89
	2	TURNED ANG -SIDE SHOT	3	- 93-11-00 11.5
	3	TURNED ANG	4	- 93-11-00 248.77
	4	TURNED ANG	5	- 169-35-30 217.98
	5	TURNED ANG	6	+ 180-16-25 150.06
	6	TURNED ANG -SIDE SHOT	7	- 264-12-29 199.89
	7	TURNED ANG -SIDE SHOT	8	+ 89-59-26 99.95
	8	TURNED ANG	9	- 87-30-17 101.75
	9	TURNED ANG	10	- 187-28-49 98.46
10	TURNED ANG -SIDE SHOT	11	- 84-56-23 10.47	
11	TURNED ANG	13	- 90-02-47 252.92	
12	TURNED ANG	14	- 179-37-36 362.78	
13	TURNED ANG	15	- 91-09-19 0	

(14-) Insert a Side

PURPOSE

Use 14- to insert a traverse side.

PROCEDURE

1. Enter 14-.
2. At the prompt INSERT SIDE #, enter the number of the side to be inserted.
3. At the prompt, ASSIGN AS PT. #, enter the new point number to be used.
4. Enter traverse data for the new side.
5. Use 99- to re-calculate closure data.

NOTES

1. When you insert a side, and then use 113- to display the data, note that the side numbers are renumbered automatically in sequential order. But point numbers are not renumbered.
2. Do not assign the same point number twice. If you do, you may get a good closure but your final coordinates will be unpredictable. Before you make corrections, it is a good idea to use the 113- command to display the field data.

EXAMPLE

```
COMMAND 14-
INSERT SIDE # 10
ASSIGN AS PNT 16
BEARING= 1250100
QUADRANT= 2
DISTANCE= 152
COMMAND 113-
START 5000 5000 1
1 BEARING 2 N89-30-00E 445.89
2 TURNED ANG -SIDE SHOT 3 - 93-11-00 11.5
3 TURNED ANG 4 - 93-11-00 248.77
4 TURNED ANG 5 - 169-35-30 217.98
5 TURNED ANG 6 + 180-16-25 150.06
6 TURNED ANG -SIDE SHOT 7 - 264-12-29 199.89
7 TURNED ANG -SIDE SHOT 8 + 89-59-26 99.95
8 TURNED ANG 9 - 87-30-17 101.75
9 TURNED ANG 10 - 187-28-49 98.46
10 BEARING 16 N54-59-00E 152
11 TURNED ANG -SIDE SHOT 11 - 84-56-23 10.47
12 TURNED ANG 13 - 90-02-47 252.92
13 TURNED ANG 14 - 179-37-36 362.78
14 TURNED ANG 15 - 91-09-19 0
COMMAND 14-
```

(25-) Restart a Traverse

PURPOSE

25- allows you to restart traverse entry at the next consecutive side number. Sometimes a traverse is large enough that you may want to enter the field data over several sessions.

PROCEDURE

1. Open a job (122-), enter as much field data as you want, and store it with 120-. You can now safely exit Boundary Traverse even though you have not entered all your traverse data.
2. Use **124-** to retrieve the old job.
3. Enter **25-** and continue entering your traverse data.

NOTE

Benchmark will automatically begin the traverse with the side number following the last entered side. This means that you do not have to remember where you left off.

EXAMPLE

```
COMMAND 124- | Re-load unfinished job
OLD JOB NUMBER? 1
Field Data for Closed Traverse.
DO YOU WISH TO USE DESCRIPTIONS?
  1. YES
  2. NO
ENTER OPTION= 2
COMMAND 113- | Re-display field data (optional)
JOB # 1 Field Data for Closed Traverse.
SD.#          SHOT TYPE/ERROR          PNT    ANGLE          LENGTH
-----09-23-1986-----16:55:36-----C:BENCH
START 4500 2500 1
1      BEARING                          2      N39-59-13.0E      286.10
2      TURNED ANG -SIDE SHOT            3      +69-11-31.0       172.20
3      TURNED ANG -SIDE SHOT            4      -24-02-30.0        25.74
4      TURNED ANG                        5      -140-59-26.0       259.35
5      TURNED ANG -SIDE SHOT            6      +45-30-43.0       274.60
6      TURNED ANG -SIDE SHOT            7      -10-14-49.0       204.86
7      TURNED ANG -SIDE SHOT            8      -18-51-19.0       220.15
8      TURNED ANG                        9      -45-18-23.0       407.95
9      TURNED ANG -SIDE SHOT           10      -42-26-10.0        32.51
10     TURNED ANG -RAD. CURVE           11      +172-19-07.0      848.53
11     TURNED ANG -RAD. CURVE           12      -15-08-36.0      848.53
12     DEFLECTED                        13      +29-07-25.0        0.00
COMMAND 25- | Enter Restart Traverse command
RESTART TRAVERSE
SIDE #= 13 | Benchmark displays next side automatically
ASSIGN AS PNT 14 | Continue with traverse entry...
BEARING = 520510
QUADRANT = 2
DISTANCE = 1500.21

SIDE #= 14
```

Elevation Commands

Features of Coordinate Geometry's Elevation Mode	8-2
Tailoring Elevation Mode	8-2
Turning Elevation Mode On and Off	8-2
Abbreviations used in Elevation Mode	8-3
Multiple Slope Angles	8-3
Prompts in Elevation Mode	8-4
(10-) Setup Routine	8-5
(30-,31-) Side Shot Mode	8-7
(320-) New Benchmark Elevation	8-8
(321-) Adjust Datum Elevation	8-9
(322-) Turning Point from the Backsight to the Occupied Point	8-10
(323-) Turning Point to the Foresight from the Occupied Point	8-12
(324-) Measure Up	8-15
(325-) Measure Down	8-16
(326-) Mean Reciprocal Observations	8-17
(327-) Update Foresight Elevation Only	8-18
(39-) Side Shot Mode Update Elevation Only	8-19
Example 1	8-20
Example 2	8-22
Example 3	8-23
Example 4	8-24
Example 5	8-26

WHAT'S IN THIS CHAPTER?

Benchmark lets you calculate elevations and add descriptions to points in coordinate geometry. Elevation calculations can be done while traversing or in side shot mode. The elevation option should be used only to calculate x,y,z coordinates from field observations and not be used while designing roads, curves, lots, etc.

Features of Coordinate Geometry's Elevation Mode

- Support of trigonometric leveling, differential leveling, stadia leveling and three wire leveling.
- Entry of difference of elevation and direct entry of elevation for users of instruments that supply the data in pre-reduced format.
- Choice of EDM (cosine * distance) or stadia (cosine squared * distance) slope reduction formulas. (EDM = Electronic Distance Measurement)
- Multiple vertical or zenith angle observations in direct or reverse face and/or reciprocal observations.
- Curvature and refraction adjustments applied to the elevation reductions.

Tailoring Elevation Mode

Before working with the elevation mode it is suggested that you tailor Benchmark to your needs with the Setup menu. The following is a summary of the Setup menu commands that effect the operation of the elevation mode.

26-	Sets stadia method of slope reduction.
27-	Sets vertical angle (EDM) method of slope reduction.
44-	Toggles between three wire method on and off.
44+-	Turns three wire method on.
44--	Turns three wire method off.
44*-	Displays the current three wire method setting.
46-	Toggles between trigonometric leveling and differential leveling
46+-	Turns trigonometric leveling on.
46--	Turns trigonometric leveling off.
46*-	Displays the current leveling method setting.
47-	Toggles between using the backsight and occupied station for the default elevation for new setups (See 10-).
47+-	Sets the backsight point as the default elevation.
47--	Sets the occupied station as the default elevation.
47*-	Displays the current setting of this toggle.
48-	Toggles between level at station and level not at station for differential leveling.
48+-	Turns level at station on.
48--	Turns level at station off.
48*-	Displays the current setting of this toggle.
260-	Sets difference in elevation mode.
261-	Sets direct entry of elevation mode.

Please note that all of the above commands are available to you in the elevation mode so that you may override the settings made in the Setup Menu. Once you have tailored the system via the Setup Menu the program will remember these settings and always operate the same until you change or override these settings.

Turning Elevation Mode On and Off

The mode of operation within coordinate geometry is switchable with the 17- command. For further details please see "Controlling the Mode of Operation" in the chapter "Introduction to Coordinate Geometry".

Abbreviations used in Elevation Mode

The table below lists abbreviations used in the following tables:

Abbreviation	Meaning
BM	Benchmark
BOT	Bottom
BS	Backsight
DESC	Description code
DIF. EL	Difference in elevation
DIST	Distance
ELEV	Elevation
FS	Foresight
HI	Elevation of the instrument
HI+	Measure up. The distance from the instrument to the ground
HI-	Measure down. The distance from the instrument to the ground.
MID	Middle
RR	Rod reading of center cross-hair
Stadia Dist.	Stadia intercept x 100
TH	Target height
TP	Turning point

NOTE: When you see the HI— prompt the program is telling you that it knows the HI and needs the instrument height above the ground level to calculate the elevation of the point. When you see the HI+ prompt the program is telling you that it knows the elevation of the point and needs the instrument height above the ground level to calculate the HI. For more information on the HI+ and HI- prompts see the 324- and 325- commands respectively.

Multiple Slope Angles

The multiple slope angle commands (51-,52-,53-) are available in the elevation mode. Please see Chapter 6 for more details on the use of these commands.

Prompts in Elevation Mode

You can get into traverse mode either via the setup routine (10-) described above or by reentering traverse mode from side-shot mode by issuing the 330- command. The table below is to describe the prompts that will follow the angle or direction prompts:

	Trig. Leveling 46-	Diff. Leveling 46-, 48-	Diff. Leveling 46-, 48-
Vertical angle 27-	Slope Dist= Slope Angle= TH= Desc Code= HI+	Slope Dist= Slope Angle= Desc Code= BS TH ON TP= FS TH ON TP= HI+	Slope Dist= Slope Angle= Desc Code= FS TH ON TP= BS TH ON TP= HI-
Stadia 26-, 44-	Stadia Dist= Slope Angle= RR= Desc Code= HI+	Slope Dist= Slope Angle= Desc Code= BS RR ON TP= FS RR ON TP= HI+	Slope Dist= Slope Angle= Desc Code= FS RR ON TP= BS RR ON TP= HI-
Stadia 3-Wire 26-, 44-	Bot Wire= Top Wire= Mid Wire= Slope Angle= Desc Code= HI+	Bot Wire= Top Wire= Mid Wire= Slope Angle= Desc Code= TP BS Bot Wire= Top Wire= Mid Wire= TP FS Bot Wire= Top Wire= Mid Wire= HI+	Bot Wire= Top Wire= Mid Wire= Slope Angle= Desc Code= TP FS Bot Wire= Top Wire= Mid Wire= TP BS Bot Wire= Top Wire= Mid Wire= HI-
Diff in Elev. 260-	Distance= Dif. El= TH= Desc Code= HI+		
Direct Elev. 2601-	Distance= Elev= Desc Code=		

For more information on the turning point prompts for the two differential leveling modes shown in the above table, see the 323- command.

(10-) Setup Routine

PURPOSE

Use 10- to setup the occupied point, storage point, benchmark elevation, elevation of the instrument (HI), elevation of the occupied point and optional backsight point.

PROCEDURE

1. Enter **10-**.
2. You will receive the following prompts:

- Occupied Point=

Enter the point you want the program to occupy.

- Backsight Point=

Enter the point number you want to use as a backsight. If the operation does not require a backsight, just press <RETURN>.

- Storage Point =

Enter the point number where you want to start storing the coordinates you are about to create or press RETURN to accept the default.

- Benchmark Elevation =

Enter the benchmark elevation or press return to accept the default. The elevation entered may be a benchmark, a backsight station, or the occupied station.

(10-) Setup Routine

3. The next prompts you receive are dependent upon the way you have tailored the system for your use. The following table is to show you the prompts you will receive:

	Trig. Leveling 46-	Diff. Leveling 46-, 48-	Diff. Leveling Level at Stn 46-, 48-
Vertical angle 27-	Slope Dist= Slope Angle= TH=	BS TH=	BS TH=
Stadia 26-, 44-	Stadia Dist= Slope Angle= RR=	BS RR=	BS RR=
Stadia 3-Wire 26-, 44-	Bot Wire= Top Wire= Mid Wire=	Bot Wire= Top Wire= Mid Wire=	Bot Wire= Top Wire= Bot Wire=
Diff in Elev. 260-	Dif. El= TH=		
Direct Elev. 261-	Skip to step 5 below		

- If you make a mistake during entry of any of the above data you may use 320- (New Benchmark Elevation) to return to the Benchmark Elevation = prompt.
 - If you wish to work from an HI obtained by a measure up from a ground point or station elevation you can enter 324- before responding to any of the prompts in the above table. See the 324- command (Measure up) for further details.
 - If you have turning points between the occupied point and the benchmark you can enter 322- before responding to any of the prompts in the above table. See the 322- (Turning Point from the Backsight to the Occupied Point) for further details.
4. After computing and displaying the height of the instrument (HI) **you** will receive the prompt: **HI -=** .
- **If** you enter the distance from the instrument to the ground, the program will display the coordinates and new elevation of the occupied point.
 - **If you** enter a command (such as 24- or 30-), the elevation of the occupied point will remained unchanged.
 - If you enter zero (0) or just hit ENTER, the elevation of the occupied point will be changed to the same as the HI .

(10-) Setup Routine

5. You will now be in the traverse mode and will receive one of the direction or angle prompts.
The behavior of the elevation routines in traverse mode is described below.

NOTE: There are complete examples of the elevation mode at the end of this chapter.

(30-,31-) Side shot Mode

When you enter a side shot command (30- or 31-) you will receive one of the direction or angle prompts. The table below is to describe the prompts that will follow the angle or direction prompts:

Vertical angle 27-	Slope Dist= Slope Angle= TH= Desc Code=
Stadia 26-,44-	Stadia Dist Slope angle= RR= Desc Code=
Stadia 3-Wire 26-,44-	Bot Wire= Top Wire= Mid Wire= Slope Angle= Desc Code=
Diff in Elev. 260-	Distance= Dif. El= TH= Desc Code
Direct Elev. 261-	Distance= Elev= Desc Code=

(320-) New Benchmark Elevation

PURPOSE

The command is used to:

- establish a new benchmark elevation, height of instrument (HI) and elevation of the occupied point
- correct errors made when using the 10- command
- establish the HI from a backsight (see example 3 at the end of this chapter)
- establish the elevation of the occupied point using reciprocal observations (see the 326- command).

This command will return you to the **Benchmark Elevation=** prompt. See the 10- (Setup Routine) above for further details.

NOTE

A byproduct of the 320- command (and 322-) can be used to compute a simple differential level loop right in Coordinate Geometry. With trigonometric leveling off, enter 320- and enter a Benchmark Elevation. Then enter 322- and enter the Backsight target height or rod reading. The HI is displayed. Next you will be prompted for Foresight target height or rod reading. The Elevation will be displayed. These two prompts repeat until you enter a new command.

(321-) Adjust Datum Elevation

PURPOSE

This command is used to adjust elevations by a specified value for points within a user selectable range.

PROCEDURE

1. Enter **321-**. You will receive the prompt:

Elevation Adjustment=

2. Enter the amount you want to change the elevation by. If you wish to subtract an amount, enter the amount preceded by a minus sign.
3. Enter the point, range of points, or group number you wish to adjust.

EXAMPLE

```
Bearing   Distance  Elevation Description Point Northing  Easting      type
-----C:BENCH
Command= 210-
Point#, Start#-End# or G#= 1-3
502.70      STATION           1      10000.0000   10000.0000
482.99      STATION           2      9729.5201   9688.8527
473.96      STATION           3      9420.6543   9341.7561

Point#, Start#-End# or G#=-

Command= 321-
Elevation Adjustment= -100
Point#, Start#-End# or G#= 1-3
Command= 210-
Point#, Start#-End# or G#= 1-3
402.70      STATION           1      10000.0000   10000.0000
382.99      STATION           2      9729.5201   9688.8527
373.96      STATION           3      9420.6543   9341.7561
```

(322-) Turning Point from the Backsight to the Occupied Point

PURPOSE

This command is used to allow you to establish the elevation of the occupied point and the HI when there are turning points from the backsight point or benchmark.

PROCEDURE

This command would normally be entered just after entering the benchmark elevation (see the 10- command above) or to correct mistakes made during a previous 322- prompt sequence.

All turning point prompt sequences expect pairs of backsights and foresights. The turning point prompts will continue until you end the sequence. You end the sequence by pressing return at the first prompt of the turning point backsight. You will then receive the HI+ prompt. See the 324-command (measure up) for more information on this.

The table which follows the example is to show you the prompts that you will receive when you enter the 322- command.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type
C:\BIN\DOC							
Command 10-							
Occupied Point= 2							
Backsight Point= 1							
N89-30-00.0E 445.75							
Storage Point= 4							
Benchmark Elevation = 6269.19							
Slope Distance= 322-							
Backsight Turning Point:							
Slope Distance= 4000.23							
Slope Angle= 872015							
Target Height= 5.00							
Height of Instrument=6088.04							
Foresight Turning Point:							
Slope Distance= 400							
Slope Angle= 872015							
Target Height = 5							
Elevation of Target Point=6101.62							
Backsight Target Point:							
Slope Distance=							
HI+ = 5.23							
Height of Instrument=6106.85							
Bearing=							

(322-) Turning Point from the Backsight to the Occupied Point

	Trig. Leveling 46-	Diff. Leveling 46-, 48-	Diff. Leveling Level at stn 46-, 48-
Vertical angle 27-	TP BS: Slope Dist= Slope Angle= TH= TP FS: Slope Dist= Slope Angle= TH= HI+	BS TH ON TP= FS TH ON TP= HI+	BS TH ON TP= FS TH ON TP= HI+
Stadia 26-, 44-	TP BS: Stadia Dist= Slope Angle= RR= TP FS: Stadia Dist= Slope Angle= RR= HI+	BS RR ON TP= FS RR ON TP= HI+	BS RR ON TP= FS RR ON TP= HI+
Stadia 3-Wire	TP BS: Top Wire= Bot Wire= Mid Wire= Slope Angle= TP FS: Top Wire= Bot Wire= Mid Wire= Slope Angle= HI+	TP BS: Top Wire= Bot Wire= Mid Wire= TP FS: Top Wire= Bot Wire= Mid Wire= HI+	TP BS: Top Wire= Bot Wire= Mid Wire= TP FS: Top Wire= Bot Wire= Mid Wire= HI+
Diff in Elev 260-	TP BS: Distance= Dif. El= TH= TP FS: Distance= Dif. El= TH= HI+		
Direct Elevation mode (261-) is not applicable			

(323-) Turning Point to the Foresight from the Occupied Point

PURPOSE

This command is used to allow entering of turning point information when you have turning points between the occupied station and the foresight. This command can also be used to restart the turning point prompt sequence in cases where an error is made during entry of turning point information. Since differential leveling traversing automatically uses turning points, this command is unnecessary in that situation, although it could be used to make corrections as described above.

This command can also be used to run an "elevation only" traverse (see the 327- command for more details).

PROCEDURE

For trigonometric leveling this command should be issued at the first prompt following the direction or angle prompt since the turning point is part of the distance calculation. For traversing with differential leveling this command would normally be issued only to correct an error made while entering turning point data since, in this mode, turning point prompts are automatic.

All turning point prompt sequences expect pairs of foresights and backsights or backsights and foresights. The turning point prompts will continue until you end the sequence. You end the sequence by pressing return at the first prompt of the turning point pair. For Trigonometric leveling and differential leveling with the level at the station you would press RETURN at the first prompt of the foresight. For standard differential leveling (level not at the station) you would press RETURN at the first prompt of the backsight.

The table following is to show you the prompts you will receive when you enter the 323- command.

(323-) Turning Point to the Foresight from the Occupied Point

	Trig. Leveling 46-	Diff. Leveling 46-, 48-	Diff. Leveling Level at atn 46-, 48-
Vertical angle 27-	TP FS: Slope Dist= Slope Angle= TH= TP BS: Slope Dist= Slope Angle= TH= Desc Code= HI-	BS TH ON TP= FS TH ON TP= HI+	FS TH ON TP= BS TH ON TP= HI-
Stadia 26-, 44-	TP FS: Stadia Dist= Slope Angle= RR= TP BS: Stadia Dist= Slope Angle= RR= Desc Code= HI-	BS RR ON TP= FS RR ON TP= HI+	FS RR ON TP= BS RR ON TP= HI-
Stadia 3-Wire	TP FS: Bot Wire= Top Wire= Mid Wire= Slope Angle= Bot Wire= Top Wire= Mid Wire= Slope Angle= Desc Code= HI-	TP BS: Bot Wire= Top Wire= Mid Wire= TP FS: Bot Wire= Top Wire= Mid Wire= HI+	TP FS: Bot Wire= Top Wire= Mid Wire= TP BS: Bot Wire= Top Wire= Mid Wire= HI-
Diff in Elev 260-	TP FS: Distance= Dif. El= TH= TP BS: Distance= Dif. El= TH= HI-		
Direct Elevation mode (261-) is not applicable			

(323-) Turning Point to the Foresight from the Occupied Point

EXAMPLE

Bearing	Distance	Elevation	Point	Northing	Easting	Type
-----C:\BIN\DOC						
Command 10-						
Occupied Point= 1			1	5000.0000	5000.0000	OCC
Backsight Point=			1	5000.0000	5000.0000	OCC
Storage Point= 2						
Benchmark Elevation= 1000						
Slope Distance= 100						
Slope Angle = 895000						
Target Height= 4						
Height of Instrument=1003.71						
HI= 5			1	5000.0000	5000.0000	OCC
	998.71	UP				
Bearing= 340000						
Quadrant= 2						
Slope Distance= 323-						
Foresight Turning Point:						
Slope Distance 100						
Slope Angle=870000						
Target Height= 4						
Elevation of Target Point =1004.94						
Backsight Turning Point:						
Slope Distance = 200						
Slope Angle= 870000						
Target Height= 4						
Height of Instrument=998.47						
Foresight Turning Point:						
Slope Distance=						
HI= 4						
S34-00-00.0E	299.59	994.47	2	4751.6296	5167.5280	TRA
Bearing=						

(324-) Measure Up

PURPOSE

This command is used to compute the HI when the ground elevation at the occupied point (instrument station) is known. It can also be used to correct a mistake to a prior HI+ prompt.

PROCEDURE

1. Enter 324-. You will receive the prompt:

HI+=

2. Enter the distance from the ground elevation to the instrument height (the measure up). The program will compute and display the new HI.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type
-----C:BENCH							
Command 10-							
Occupied Point= 1							
		500.00	IP	1	5000.0000	5000.0000	OCC
Backsight Point=		500.00	IP	1	5000.0000	5000.0000	OCC
Storage Point= 2							
Benchmark Elevation= 500							
Backsight Target Height= 324-							
HI+= 5.5							
Height of Instrument=505.50							
Bearing= 200000							
Quadrant= 1							
Slope Distance= 100							
Slope Angle= 2000							
Description= IP							
Backsight Target Height on Turning Point= 5							
Height of Instrument=505.00							
Foresight Target Height on Turning Point= 6							
Elevation of Target Point =499.00							
Backsight Target Height on Turning Point=							
HI+= 4							
Height of Instrument=503.00							
N20-00-00.0E 100.00		499.00	IP	2	5093.9677	5034.2014	TRA
Bearing= 324-							
HI+= 4.5							
Height of Instrument=503.50							
Bearing=							

(325-) Measure Down

PURPOSE

This command is used to compute the ground elevation of the occupied point (instrument station) when the HI is known. It can be used to correct a mistake to a prior HI-.

PROCEDURE

1. Enter 325-. You will receive the prompt:

HI—"

2. Enter the distance from the instrument height to the ground elevation. The program will compute the ground elevation and display the occupied point.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type:
-----C:BENCH							
Command 10-							Setup command
Occupied Point= 1							Occupy point 1
		496.01	UP	1	5000.0000	5000.0000	OCC
Backsight Point=		496.01	UP	1	5000.0000	5000.0000	OCC
Storage Point = 2							Press RETURN for no backsight
Benchmark Elevation= 496.01							Press RETURN to accept the default
Backsight Target Height= 4							Press RETURN to accept the default
Height of Instrument=500.01							Enter the target height of the benchmark
HI-= 6.2							Enter the measure down at point 1
		493.81	UP	1	5000.0000	5000.0000	OCC
Bearing= 325-							To correct measure down
HI-= 6		494.01	UP	1	5000.0000	5000.0000	OCC
							To traverse to new point
Bearing= 200000							
Quadrant= 1							
Slope Distance= 100							
Slope Angle= 202020							
Description= IP							
Backsight Target Height on Turning Point= 4							Enter backsight target height
Elevation of Target Point =498.01							
Foresight Target Height on Turning Point= 6							Enter foresight target height
Height of Instrument=492.01							
Backsight Target Height on Turning Point=							Press RETURN to end turning point sequence
HI+= 5.83							Enter measure down at point 2
N20-00-00.0E 93.77		492.01	IP	2	5088.1106	5032.0696	TRA
Bearing= 325-							To correct measure down
HI-= 5.82							Correct measure down is 5.82 feet
		492.02	IP	2	5088.1106	5032.0696	OCC
Bearing=							Continue with traverse...

(326-) Mean Reciprocal Observations

PURPOSE

This command is used to mean the computed elevation with the current elevation of the occupied point.

PROCEDURE

This command is issued at either the **HI+** or **HI-** prompt and will return the user to the same prompt that it is issued from. Once the measure up or measure down is entered the computed elevation will be meaned with the current elevation of the occupied point. The occupied point will be displayed, showing the new elevation value.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type:
-----C:\MYDIR							
Point = 10-							Occupy a point
Occupied Point= 1							Enter the point number
				1	5000.0000	5000.0000	OCC
Backsight Point=							Press RETURN for no backsight
				1	5000.0000	5000.0000	OCC
Storage Point = 2							Enter the next point for storage
Benchmark Elevation = 1807.04							Enter the benchmark elevation
Slope Distance= 324-							Measure up command
HI+=5.24							Enter the instrument height at station 1
Height of Instrument=1812.28							
		1807.04		1	5000.0000	5000.0000	OCC
Bearing= 101520							Enter the bearing to station 2
Quadrant= 1							Enter quadrant
Slope Distance= 10632.54							Enter the foresight dist. to 2
Slope Angle= 852541							Enter the zenith angle
Target Height = 5.44							Enter the target height at 2
Description = 1							Enter the description code
HI+= 4.95							Enter the instrument height at 2
Height of Instrument=2661.63							
N10-15-20.0E 10598.71 2656.68 IP				2	15429.3766	6886.9834	TRA
Bearing= 320-							To use point 1 as the benchmark
Benchmark Elevation = 1807.04							Enter the elevation of station 1
Slope Distance= 10632.54							Enter the backsight distance to 1
Slope Angle=943425							Enter the zenith angle
Target Height= 6.25							Enter the target height at 1
Height of Instrument=2658.81							
HI-= 326-							Mean reciprocal observations
HI-= 4.95							Enter the instrument height at 2
		2655.27 IP		2	15429.3766	6886.9834	OCC
Bearing=							Continue with traverse...

(327-) Update Foresight Elevation Only

PURPOSE

This command is used to update the elevation of the foresight point when the Northing and Easting coordinates are already known.

PROCEDURE

This command is used to end an "elevation only" traverse which is started with the 323-command. After entering the 327- the program will either prompt HI+ or HI- depending upon whether or not turning points were used. Once the measure up or measure down is entered the computed elevation will be assigned to the foresight point. The foresight point will be displayed showing the new elevation value. The Northing and Easting coordinates will **remain** unchanged.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type:
-----C:\MYDIF							
Command 10-							
Occupied Point= 2							
				2	5003.8899	5445.7362	OCC
Backsight Point=							
				2	5003.8899	5445.7362	OCC
Storage Point = 4							
Benchmark Elevation= 6101.62							
Slope Distance= 324-							
HI+= 5.23							
Height of Instrument=6106.85							
		6101.62		2	5003.8899	5445.7362	OCC
Bearing= 323-							
Foresight Turning Point:							
Slope Distance= 249							
Slope Angle= 952000							
Target Height= 5							
Elevation of Target Point =6078.71							
Backsight Turning Point:							
Slope Distance= 327-							
HI+= 5.21							
Height of Instrument=6083.92							
		6078.71		4	4755.6187	5461.7209	TRA
Bearing=							

(39-) Side Shot Mode Update Elevation Only

PURPOSE

To calculate and update elevations for existing side shot points.

PROCEDURE

The user should issue this command at a direction prompt. Once issued the program will stay in this mode until the user issues another command to exit. This command works very much like the 30- routine except it does not prompt or calculate any horizontal data.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type
-----C:BENCH							
Command 10-							
Occupied Point= 1		500.00	IP	1	5000.0000	5000.0000	OCC
Backsight Point=		500.00	IP	1	5000.0000	5000.0000	OCC
Storage Point= 2							
Benchmark Elevation= 500							
Slope Distance= 324-							
HI+= 5.5							
Height of Instrument=505.50							
Bearing= 39-							
Slope Distance= 100							
Slope Angle = 850000							
Target Height = 4							
Description= UP		510.22	UP	2	5050.0000	5050.0000	SS
		500.00	IP	1	5000.0000	5000.0000	
Slope Distance= 330-							
Bearing=							

Example 1 - Demonstrates a trigonometric leveling traverse with side shots.

EXAMPLE

```

Command 124- | Load an existing job
Old Job Number? 18 | Enter the job number
18-Sample Subdivision [108]

Choose Mode of Operation
Northing and Easting
Descriptions, Northing and Easting
Elevations, Northing and Easting
Elevations, Descriptions, Northing and Easting | Choose this one

Job #18 Sample Subdivision (Sequential [108])
Bearing Distance Elevation Description Point Northing Easting Type
-----C:\MYDIR
Command 27- | Sets VA (EDM/taping) formulas
VA
Command 10- | Occupy a point
Occupied Point= 2 | Enter the point number to be occupied
2 5003.8899 5445.7362 OCC
Backsight Point= 1 | Enter the backsight point number
1 5000.0000 5000.0000 BS
N89-30-00.0E 445.75 IP 2 5003.8899 5445.7362 OCC
Storage Point = 200 | Enter beginning storage point #
Benchmark Elevation = 6288.00 | Enter benchmark elevation
Slope Distance= 5280 | Enter slope distance to the benchmark
Slope Angle = 853020 | Enter zenith or vertical angle
Target Height = 5.00 | Enter target height
Height of Instrument=5878.68
HI= 5.31 | Enter inst. height above ground point
2 5003.8899 5445.7362 OCC
5873.37
Bearing= 24- | Select field angle mode
Angle= 31- | Set single side shot mode
Angle= 102000 | Enter field angle
Slope Distance= 350.12 | Enter distance
Slope Angle= 853020 | Enter zenith angle
Target Height= 5 | PRESS RETURN to accept the default
Description = 1 | Enter description code
N80-10-00.0W 349.04 5901.12 IP 200 5063.5005 5101.8207 TRASS
5873.37 2 5003.8899 5445.7362 OCC
Angle= 10- | Occupy a new point
Occupied Point= 4 | Enter the point number
4 4755.6187 5461.7209 OCC
Backsight Point= 3 | Enter the backsight point number
3 4992.4131 5446.4751 BS
S03-41-01.9E 237.28 4 4755.6187 5461.7209 OCC
Storage Point= 201 | Enter the next point for storage
Benchmark Elevation = 5201.397 | Enter the elevation of station 4
Slope Distance= 324- | Set inst. height
HI= 5.21 | Enter inst. height above ground point
Height of Instrument=5206.61
5201.40 4 4755.6187 5461.7209 OCC
Angle= 30- | Set multiple side shot mode
Angle= 3212015.1 | Enter field angle
Slope Distance= 652.152 | Enter distance
Slope Angle= 992030.2 | Enter zenith or vertical angle
Target Height = 5.00 | Enter target height
Description = 3 | Enter description code
N42-20-46.8W 643.50 5095.76 STATION 201 5231.2232 5028.2507 TRASS
5201.40 4 4755.6187 5461.7209 OCC

```

continued

Example 1

EXAMPLE

Angle= 950210		Enter next side shot field angle
Slope Distance= 45.8		Enter distance
Slope Angle=12500		Enter vertical angle
Target Height = 6.8		Enter target height
Description = 2		Enter description code
88-38-51.9E 45.79 5200.94 UP	202	4754.5382 5507.4941 TRASS
5201.40	4	4755.6187 5461.7209 OCC
Angle= 10-		Occupy a new point
Occupied Point= 5		Enter the point number to be occupied
	5	4539.1097 5436.1949 OCC
Backsight Point = 4		Enter the backsight point
5201.40	4	4755.6187 5461.7209 BS
S06-43-26.5W 218.01	5	4539.1097 5436.1949 OCC
Storage Point= 205		Enter next point for storage
Benchmark Elevation= 5201.4		Press RETURN to accept the default
Slope Distance= 219		Enter distance to point 4
Slope Angle= -20020		Enter vertical angle
Target Height = 5.05		Enter target height
Height of Instrument=5214.11		
HI= 5.3		Enter inst. height above ground point
	5	4539.1097 5436.1949 OCC
Angle=		Continue with traverse...

Example 2 - Demonstrates trigonometric leveling elevation only traverse between stations.

EXAMPLE

Command 124-
Old Job Number? 18
18-Sample Subdivision [108]

| Load an existing job
| Enter job number

Choose Mode of Operation

Northing and Easting
Descriptions, Northing and Easting
Elevations, Northing and Easting
Elevations, Descriptions, Northing and Easting

| Choose this one

Job #18	Sample Subdivision (Sequential [108])	Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type
-----C:\MYDIR									
Command 27-									
VA									
Command 10-									
Occupied Point= 2									
Backsight Point= 1									
					IP				
N89-30-00.0E	445.75								
Storage Point = 4									
Benchmark Elevation=	6269.19								
Slope Distance=	322-								
Backsight Turning Point:									
Slope Distance=	4000.23								
Slope Angle=	872015								
Target Height =	5.00								
Height of Instrument=	6088.04								
Foresight Turning Point:									
Slope Distance=	400								
Slope Angle=	872015								
Target Height=	5								
Elevation of Turning Point =	6101.62								
Backsight Turning Point:									
Slope Distance=									
HI+=	5.23								
Height of Instrument=	6106.85								
	6101.62								
Bearing=	323-								
Foresight Turning Point:									
Slope Distance=	249								
Slope Angle =	952000								
Target Height=	5								
Elevation of Turning Point=	6078.71								
Backsight Turning Point:									
Slope Distance=	327-								
HI+=	5.21								
Height of Instrument=	6083.92								
	6078.71								
Bearing=	323-								
Foresight Turning Point:									
Slope Distance=	51-								
Slope Distance=	2640.52								
Slope Angle=	950010								
Target Height=	5								
Slope Distance=	2640.54								
Slope Angle=	2650011								
Target Height=	5								
Slope Distance=	52-								
Elevation of Turning Point=	5848.93								
Backsight Turning Point:									
Slope Distance=	327-								
HI+=	4.98								
Height of Instrument=	5853.91								
	5848.93								
Bearing=									

Example 3 - Demonstrates a trigonometric leveling traverse with side shots. Northing, Easting and elevation coordinates are computed for all points.

EXAMPLE

Bearing	Distance	Elevation	Point	Northing	Easting	Type
-----C:\MYDIR						
Command 12-						Enter point data
Point= 1						Enter the first point number
Northing = 5000						Enter the starting North coordinate
Easting = 5000						Enter the starting East coordinate
Elevation = 1212.01						Enter the ground elevation
Point= 27-						Set VA (EDM/Taping) slope reduction
VA						
Command 10-						Occupy a point
Occupied Point= 1						To occupy point 1
	1212.01		1	5000.0000	5000.0000	OCC
Backsight Point=	1212.01		1	5000.0000	5000.0000	OCC
						Press RETURN for no backsight
Storage Point= 2						Enter the next point for storage
Benchmark Elevation= 1212.01						Press RETURN to accept the default
Slope Distance= 324-						Set the inst. height above the ground point
HI+= 5.22						Enter the inst. height at point 1
Height of Instrument=1217.23						
Bearing= 652010						Enter the bearing from 1 to 2
Quadrant= 2						The SE quadrant
Slope Distance= 561.83						Enter the distance
Slope Angle = 881250						Enter the zenith angle
Target Height = 5.00						Enter the target height at point 2
HI+= 5.31						Enter the inst. height at point 2
Height of Instrument=1235.06						
S65-20-10.0E 561.56	1229.75		2	4765.6654	5510.3270	TRA
Bearing= 24-						Set field angle mode
Angle= 30-						Set multiple side shot mode
Angle= 3484000						Enter the horizontal angle
Slope Distance= 52.3						Enter the distance
Slope Angle= -12000						Enter the zenith angle
Target Height= 5						Press RETURN to accept the default
N76-40-10.0W 52.29	1228.84		3	4777.7209	5459.4499	TRASS
	1229.75		2	4765.6654	5510.3270	OCC
Angle= 521000						Enter the horizontal angle
Slope Distance= 666.66						Enter the distance
Slope Angle= -12000						Enter the vertical angle
Target Height= 7.65						Enter the new target height
N13-10-10.0W 666.48	1211.91		4	5414.6169	5358.4818	TRASS
	1229.75		2	4765.6654	5510.3270	OCC
Angle= 330-						Return to traverse mode
Angle= 704955						Enter the horizontal angle to station 5
Slope Distance= 10560						Enter the distance
Slope Angle= 2695033						Enter the face 2 zenith angle
Target Height= 4.99						Enter the target height
HI+=						RETURN, for no inst. height HI=1203.34
N05-29-45.0E 10559.96	1203.34		5	15277.0831	6521.6899	TRA
Angle= 320-						Enter the elev. of station 2
Benchmark Elevation= 1229.75						Backsight obs. to 2, Creates HI at 5
Slope distance= 10560						Backsight to station 2. Enter the dist.
Slope Angle= 895130						Enter the zenith angle
Target Height = 6.5						Enter the target height at station 2
Height of Instrument=1207.84						
HI-= 24-						No measure down is entered, the elevation of point 5 is unchanged.
Angle=						Continue with traverse...

Example 4 - Shows reciprocal trigonometric leveling, two-face instrument observation, turning point traverse, elevations added to existing x,y data, and datum adjustment.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type
-----C:\MYDIR							
Command 27-							Set VA (EDM/Taping) slope reduction
VA							
Command 12-							Key in coordinate data
Point= 1							Enter the point number
Northing = 5000							Enter northing coordinate
Easting = 5000							Enter easting coordinate
Description = 0							Enter 0 for no description
Elevation =							Press RETURN to skip by the elevation
Point= 10-							Occupy a point
Occupied Point= 1							Enter the point number
				1	5000.0000	5000.0000	OCC
Backsight Point=							Press RETURN for no backsight
				1	5000.0000	5000.0000	OCC
Storage Point = 2							Enter the next point for storage
Benchmark Elevation= 1848.12							Enter the benchmark elevation
Slope Distance= 51-							Set multiple slope observation mode
Slope Distance= 1200.22							Enter the first dist. to the BM
Slope Angle = 880210							Enter the face 1 zenith angle
Target Height = 5.32							Enter the target height
Slope Distance = 1200.25							Enter the second dist. to the BM
Slope Angle= 2715750							Enter the face 2 zenith angle
Target Height= 5.32							Press RETURN to accept the default
Slope Distance= 52-							Average the two observations
Height of Instrument=1812.28							
HI= 5.24							Enter the instrument height at station 1
	1807.04			1	5000.0000	5000.0000	OCC
Bearing= 101520							Enter the bearing to station 2
Quadrant= 1							Enter quadrant
Slope Distance= 10632.54							Enter the foresight dist. to 2
Slope Angle= 852541							Enter the zenith angle
Target Height = 5.44							Enter the target height at 2
Description = 1							Enter the desc. code
HI+= 4.95							Enter the instrument height at 2
Height of Instrument=2661.63							
N10-15-20.0E 10598.71 2656.68 IP				2	15429.3766	6886.9834	TRA
Bearing= 320-							New benchmark elevation command
Benchmark Elevation = 1807.04							Enter the elevation of station 1
Slope Distance= 10632.54							Enter the backsight distance to 1
Slope Angle= 943425							Enter the zenith angle
Target Height= 6.25							Enter the target height at 1
Height of Instrument=2658.81							
HI= 326-							Average the reciprocal observations
HI= 4.95							Enter the instrument height at 2
	2655.27 IP			2	15429.3766	6886.9834	OCC
Bearing= 30-							Set side shot mode
Bearing= 24-							Set field angle mode
Angle= 102000							Enter the field angle
Slope Distance= 100.5							Enter the distance
Slope Angle= 752010							Enter the zenith angle
Target Height= 5.2							Enter the target height
Description = 2							Enter the desc. code
S20-35-20.0W 97.23	2679.05 UP			3	15338.3602	6852.7927	TRASS
	2655.27 IP			2	15429.3766	6886.9834	OCC

continued

Example 4

EXAMPLE

Angle= 504000				Enter the field angle to the side shot
Slope Distance= 1000				Enter slope distance
Slope Angle= 1002500				Enter the zenith angle
Target Height= 5.2				Press RETURN to accept the default
Description= 3				Enter the desc. code
S60-55-20.0W 983.52	2472.82 STATION	4		14951.3900 6027.4264 TRASS
	2655.27 IP	2		15429.3766 6886.9834 OCC
Angle= 13-				Next point for storage
Point= 3				Enter the point # to have elev. changed
Angle= 39-				Sets elevation only mode for side shots
Slope Distance= 100.5				Enter the distance to 3
Slope Angle= 752010				Enter the zenith angle
Target Height= 5.2				Enter the target height
Description= 2				Enter the desc. code
	2679.05 UP	3		15338.3602 6852.7927 TRASS
	2655.27 IP	2		15429.3766 6886.9834 OCC
Slope Distance= 1000				Enter the distance to 4
Slope Angle= 1002500				Enter the zenith angle
Target Height= 5.2				Press RETURN to accept the default
Description= UP				Press RETURN to accept the default
	2472.82 STATION	4		14951.3900 6027.4264 SS
	2655.27 IP	2		15429.3766 6886.9834 OCC
Slope Distance= 210-				List points
Point#, Start#-End# or G#= 1-4				Press RETURN to accept the default
	1807.04	1		5000.0000 5000.0000
	2655.27 IP	2		15429.3766 6886.9834 TRA
	2679.05 UP	3		15338.3602 6852.7927 TRA
	2472.82 STATION	4		14951.3900 6027.4264 TRA
Point#, Start#-End# or G#= 321-				Select elevation datum adjustment
Elevation Adjustment= 1000				Enter the ammount of the adjustment
Point#, Start#-End# or G#= 1-4				Enter the range of points for adjustment
Command= 210-				List points
Point#, Start#-End# or G#= 1-4				Press RETURN to accept the default
	2807.04	1		5000.0000 5000.0000
	3655.27 IP	2		15429.3766 6886.9834 TRA
	3679.05 UP	3		15338.3602 6852.7927 TRA
	3472.82 STATION	4		14951.3900 6027.4264 TRA

Example 5 - Shows how to enter pre-reduced elevation data when either differences in elevation or elevations are taken from total station instruments.

EXAMPLE

Bearing	Distance	Elevation	Description	Point	Northing	Easting	Type
-----C:\MYDIR							
Command 124- Load an existing job							
Old Job Number? 18 Enter job number							
18-Sample Subdivision (Sequential [108])							
Choose Mode of Operation							
Northing and Easting Descriptions, Northing and Easting Elevations, Northing and Easting Elevations, Descriptions, Northing and Easting							
Choose this one							
Job #18 Sample Subdivision (Sequential [108])							
-----C:\MYDIR							
Command 260- Set the difference in elevation entry mode							
Difference in Elevation							
Command 10- Occupy a point							
Occupied Point= 1 Occupy point 1							
		1.00	IP	1	5000.0000	5000.0000	OCC
Backsight Point= 2 Backsight point 2							
				2	5003.8899	5445.7362	BS
S89-30-00.0W	445.75	1.00	IP	1	5000.0000	5000.0000	OCC
Storage Point = 200 Start storage at point 200							
Benchmark Elevation= 1000 Enter the benchmark elevation							
Difference in Elevation = 25 Enter the Dif. el. from the BM to station 1							
Target Height = Press RETURN for no target height							
Height of Instrument=975.00							
HI= 5				1	5000.0000	5000.0000	OCC
		970.00	IP				
Bearing = 24- Set field angle mode							
Angle= 30- Set side shot mode							
Angle= 2415010 Enter the field angle to side shot							
Distance = 109.56 Enter the distance							
Difference in Elevation= 35.89 Enter the difference in elevation							
Target Height = 5.00 Enter the target height							
Description = 0 Enter 0 for no desc. code							
N28-39-50.0W	109.56	1005.89		200	5096.1333	4947.4473	TRASS
		970.00	IP	1	5000.0000	5000.0000	
Angle= 235000 Enter the field angle to 201							
Distance = 5000 Enter the distance							
Difference in Elevation = -25.36 Enter the difference in elevation							
Target Height= 5 Press RETURN to accept the default							
Description = 1 Enter the desc. code							
S66-40-00.0E	5000.00	944.64	IP	201	3019.6011	9591.0805	TRASS
		970.00	IP	1	5000.0000	5000.0000	
Angle= 330- Set traverse mode							
Angle= 852015 Enter the field angle to 202							
Distance = 825.24 Enter the distance							
Difference in Elevation= -10.88 Enter the difference in elevation							
Target Height= 0 Enter 0 for no target height							
Description= 4 Enter the desc. code							
HI+= 5 Enter the instrument height at 202							
Height of Instrument=969.12							
S05-09-45.0E	825.24	964.12	GB	202	4178.1076	5074.2557	TRA
Angle= 13- Change next point for storage							
Point= 200 Enter 200, the next point							
Angle= 39- Set "elevation only" side shot mode							
Difference in Elevation= 10 Enter the difference in elevation							
Target Height = Press RETURN for no target height							
Description= 0 Enter 0 for no desc. code							
		979.12		200	5096.1333	4947.4473	SS
		964.12	GB	202	4178.1076	5074.2557	

continued

Example 5

EXAMPLE

Difference in Elevation= -15				Enter the difference in elevation	
Target Height =				Press RETURN for no target height	
Description =				Press RETURN to accept the default	
	954.12	IP		201 3019.6011 9591.0805	SS
	964.12	GB		202 4178.1076 5074.2557	
Difference in Elevation= 261-				Set elevation entry mode	
Elevation Entry					
Command 10-				Occupy a point	
Occupied Point= 1				Occupy point 1	
	970.00	IP		1 5000.0000 5000.0000	OCC
Backsight Point= 2				Backsight point 2	
				2 5003.8899 5445.7362	BS
S89-30-00.0W 445.75	970.00	IP		1 5000.0000 5000.0000	OCC
Storage Point= 203				Enter the next point for storage	
Angle= 30-				Set side shot mode	
Angle= 234530				Enter the field angle to 203	
Distance = 400				Enter the distance	
Elevation= 2645.444				Enter the elevation of 203	
Description = 2				Enter the desc. code	
S66-44-30.0E 400.00	2645.44	UP		203 4842.0490 5367.4935	TRASS
	970.00	IP		1 5000.0000 5000.0000	
Angle= 782010				Enter the field angle to 204	
Distance = 4512.2				Enter the distance	
Elevation= 2654.3				Enter the elevation of 204	
Description = 0				Enter 0 for no desc. code	
S12-09-50.0E 4512.20	2654.30			204 589.1039 5950.7599	TRASS
	970.00	IP		1 5000.0000 5000.0000	
Angle= 13-				Change next point for storage	
Point= 203				Change to 203	
Angle= 39-				Elevation only for a side shot	
Elevation= 100				Enter 100, the elevation of 203	
Description =				Press RETURN to accept the default	
	100.00	UP		203 4842.0490 5367.4935	TRASS
	970.00	IP		1 5000.0000 5000.0000	
Elevation= 105.56				Enter the elevation of 204	
Description= 0				Enter 0 for no desc. code	
	105.56			204 589.1039 5950.7599	SS
	970.00	IP		1 5000.0000 5000.0000	
Elevation =				Continue with side shots...	

(60-) Direction into Radius and Length	9-2
(61-) Direction into Tangent and Length	9-4
(62-) Radius Point and Arc Length	9-6
(63-) Radius Length and Arc Length	9-7
(64-) Chord Bearing and Length	9-9
(65-) Chord Direction, Length and Radius	9-11
(66-) P.I., Two Directions, and Radius	9-13
(67-) P.I., Two Directions, and Tangent	9-15
(69-) Any Two Knowns on Curve	9-17
(97-, 98-, 99-) Curve Solver	9-19

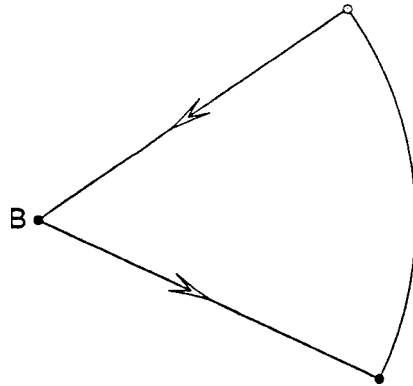
WHAT'S IN THIS CHAPTER?

The curve commands let you solve curves for several curve types, assuming a variety of unknowns. All curve commands adjust the area summation, and assume an occupied point and backsight point have been specified.

(60-) Direction into Radius and Length

PURPOSE

Given radius length and the angle or direction in and out of the radius point of the curve, the 60-command finds direction and distance AB, the coordinates of B, and the direction and distance BC, and coordinates of C.



PROCEDURE

1. Occupy the point of curvature (A).
2. Enter **60-**.
3. Enter the direction Or angle and distance from the P.C. to the radius point (B). Benchmark displays the direction and distance A to B and the point number and coordinates Of B.
4. Enter the direction Or angle B to C. Benchmark displays the direction and distance B to C and the point number and coordinates Of C.

OUTPUT

After step 4, Benchmark **displays** the following curve data:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

NOTES

1. The area summation is adjusted for the curve.
2. The central angle (Delta) is assumed to be less than 180 °.
3. C is Occupied and the backsight direction is B to C.

(60-) Direction into Radius and Length

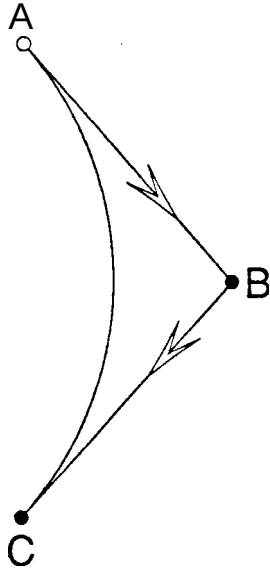
EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
		11-12-1986	09:58:51	C:BENCH	
Command 10-					
Occupied Point= 1					
Occupy A (the PC)					
		1	4496.2214	5166.7524	OCC
Backsight Point=					
		1	4496.2214	5166.7524	OCC
Storage Point = 2					
Enter RETURN to accept default					
Bearing= 60-					
Radius curve command					
Bearing= 892407.1					
Enter direction A to B (PC to RP)					
Quadrant= 1					
Enter radius length					
Distance = 15					
Enter direction B to C (RP to PT)					
N89-24-07.1E 15.00					
Bearing= 3553					
Quadrant= 4					
N00-35-53.0W 15.00					
		3	4511.3771	5181.5950	TRA
Delta = 89-59-59.9					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-24-07.1E 21.21					
Bearing=					
Continue with traverse...					

(61-) Direction into Tangent and Length

PURPOSE

Given the point of curvature (A), the direction and distance AB and BC, 61- computes data for the curve tangent to A and C, and generates points B and C.



PROCEDURE

1. Occupy the point of curvature (P.C.), A.
2. Enter **61-**.
3. Enter the direction or angle and distance A to B. Benchmark displays the direction and distance A to B, and the point number and coordinates of **B**.
4. Enter the direction or angle B to C. Benchmark displays the direction and distance B to C, and the point number and coordinates of C.

OUTPUT

After step 4, Benchmark displays the following curve data:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

NOTES

1. The area summation is adjusted for the curve.
2. The central angle is assumed to be less than 180° .
3. C is the occupied point and the backsight direction is B to C.

(61-) Direction into Tangent and Length

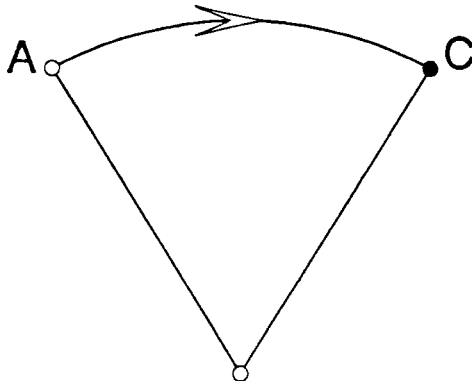
EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-12-1986-----10:35:50-----C:\MYDIR					
Command 10-					
Occupied point= 1		Occupy A (the PC)			
		1	4496.2215	5166.7525	OCC
Backsight Point=					
		1	4496.2215	5166.7525	OCC
Storage Point = 2		Press RETURN to accept default			
Bearing= 61-		Tangent curve command			
Bearing= 3553.4		Enter direction A to B (PC to PI)			
Quadrant= 4					
Distance = 15					
N00-35-53.4W 15.00		2	4511.2207	5166.5959	TRAPI
Bearing= 892406.5		Enter direction B to C (PI to PT)			
Quadrant= 1					
N89-24-06.5E 15.00		3	4511.3773	5181.5951	TRA
Delta = 89-59-59.9					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-24-06.6E	21.21				
Bearing=		Continue with traverse...			

(62-) Radius Point and Arc Length

PURPOSE

Given a radius point (B) and arc length, 62- finds direction and distance A to B and B to C, and coordinates of C.



PROCEDURE

1. Using the routines of the program occupy point A and specify a storage point.
2. Enter **62-**.
3. Enter the point number of the radius point (B).
4. Enter arc length (positive if clockwise from B, negative if counter clockwise).

OUTPUT

After step 4, Benchmark displays:

- The direction and distance A to B and the point number and coordinates of B.
- The direction and distance B to C and the point number and coordinates of C.
- The following curve data:

DELTA
RADIUS
ARC LENGTH TANGENT
CHORD

(62-) Radius Point and Arc Length

EXAMPLE					
Bearing	Distance	Point	Northing	Easting	Type
		11-12-1986	10:59:18	C:\MYDIR	
Command 10-	Occupy A (PC)				
Occupied Point= 2					
	2	4496.2215	5166.7525	OCC	
Backsight Point=	Press RETURN for no backsight				
	2	4496.2215	5166.7525	OCC	
Storage Point = 4	Press RETURN to accept the default				
Bearing= 62-	Radius point and arc length command				
Radius Point= 3	Enter B (RP)				
Arc Length= 23.56	Enter arc length				
N89-24-06.6E 15.00	3	4496.3781	5181.7517	RP	
N00-36-20.6W 15.00	4	4511.3773	5181.5931	TRAPT	
Delta = 89-59-32.9					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-23-53.1E 21.21					
Bearing=	Continue with traverse...				

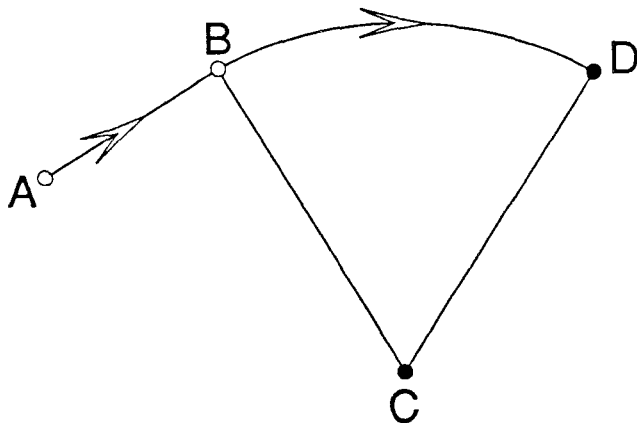
NOTES

1. The area summation is adjusted for the curve.
2. Point C is the occupied point.
3. The backsight direction is B to C.

(63-) Radius Length and Arc Length

PURPOSE

Given a radius and arc length, 63- finds direction and distance B to C and C to D, and coordinates of C and D. This routine creates points C and D.



Radius Length and Arc Length

PROCEDURE

1. Using the routines of the program, set the backsight direction to A to B, occupy B, and specify a storage point.
2. Enter 63-.
3. Enter the radius (assumed to be perpendicular to direction A-B).
4. Enter the arc length (positive for clockwise, negative for counter clockwise).

OUTPUT

After step 4, Benchmark displays:

- The direction and distance B to C and the point number and coordinates of C.
- The direction and distance C to D and the point number and coordinates of D.
- The following curve data:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

NOTES

1. The area summation is adjusted for the curve.
2. Point D is the point occupied and the backsight direction is C to D.

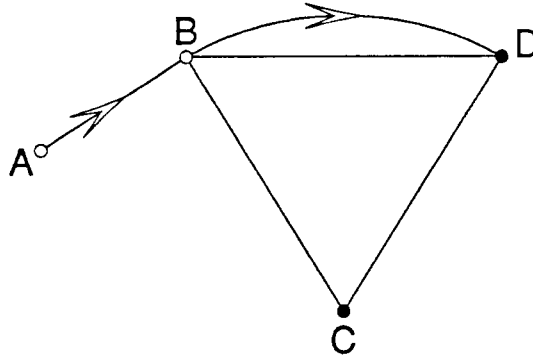
EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
		11-12-1986	11:08:04		C:\MYDIR
Command 10-					
Occupied Point= 2			Occupy B (PC)		
			2	4496.2215	5166.7525 OCC
Backsight Point= 1			Backsight A		
			1	4386.2275	5167.9006 BS
N00-35-52.9W	110.00		2	4496.2215	5166.7525 OCC
Storage Point = 3			Press RETURN to accept default		
Bearing= 63-			Radius length and arc length command		
Radius Length= 15			Enter radius length		
Arc Length= 23.56			Enter arc length		
N89-24-07.1E	15.00		3	4496.3781	5181.7517 TRARP
N00-36-19.6W	15.00		4	4511.3772	5181.5932 TRAPT
Delta = 89-59-33.3					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-23-53.7E			21.21		
Bearing=			Continue with traverse...		

(64-) Chord Bearing and Length

PURPOSE

Given chord bearing and length, 64- finds direction and distance B to C, C to D, and the coordinates of C and D, and generates curve data.



PROCEDURE

1. Using the routines of the program, set the backsight direction to A to B, occupy B, and specify a storage point.
2. Enter **64-**,
3. Enter the chord length.
4. Enter the radius length (positive for the curve clockwise from C, negative if counter clockwise) assumed to be perpendicular to direction AB).

OUTPUT

After step 4, Benchmark displays:

- The direction and distance B to C and the point number and coordinates of C.
- The direction and distance C to D and the point number and coordinates of D.
- The following curve data:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

NOTES

1. The area summation is adjusted for the curve.
2. Point D is the point occupied and the backsight direction is C to D.

(64-) Chord Bearing and Length

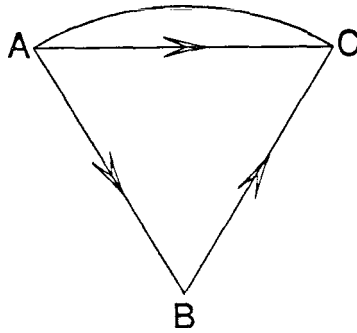
EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-12-1986-----11:18:40-----C:BENCH					
Point= 10-					
Occupied Point= 1			Occupy B (PC)		
		1	4512.0949	5250.3566	OCC
Backsight Point= 20			Backsight A		
		20	4511.3772	5181.5950	BS
N89-24-07.2E 68.77		1	4512.0949	5250.3566	OCC
Storage Point = 21			Press RETURN to accept the default		
BEARING= 64-			Chord length and radius command		
Chord Length= 13.16			Enter chord length		
Radius Length= 15			Enter radius length (positive radius length		
			indicates the curve is clockwise from B [PC])		
S00-35-52.8E 15.00		21	4497.0957	5250.5132	TRARP
N51-26-22.8E 15.00		22	4506.4458	5262.2424	TRAPT
Delta = 52-02-15.6					
Radius = 15.00					
Arc Length= 13.62					
Tangent = 7.32					
Chord = S64-34-45.0E	13.16				
Bearing=			Continue with traverse...		

(65-) Chord Direction, Length and Radius

PURPOSE

Given chord direction, length and radius, 65- finds direction and length **A** to **B**, **B** to **C**, and coordinates of **B** and **C**.



PROCEDURE

1. Occupy point **A** and specify a beginning storage point. If occupied and storage points are already set, you can skip this step,
2. Enter **65-**,
3. Enter the chord direction or angle and length.
4. Enter the radius length (positive for the curve clockwise from **B**, negative if counter clockwise).

OUTPUT

After step 4, Benchmark displays:

The output is:

- The direction and length **A** to **B** and the point number and coordinates of **B**. •

- The direction and length **B** to **C** and the point number and coordinates of **C**. •

The following curve data:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

NOTE

1. The point occupied is point **C**, the backsight direction is **B** to **C**.
2. The area summation is adjusted for the curve.

(65-) Chord Direction, Length and Radius

EXAMPLE

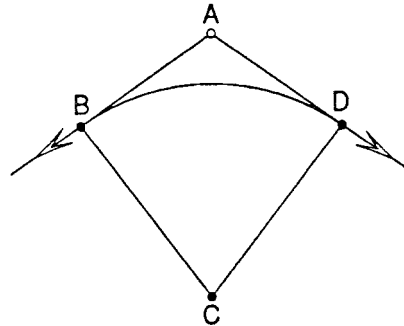
Bearing	Distance	Point	Northing	Easting	Type
-----11-12-1986-----		11:41:18			C:BENCH
Command 10-					
Occupied Point= 1			Occupy A (PC)		
			1	4496.2215	5166.7525 OCC
Backsight Point= 65-			Chord bearing, length and radius command		
			length command		
Bearing= 442406.6			Enter chord direction		
Quadrant= 1					
Distance = 21.21			Enter chord length		
Radius Length= 15			Enter radius length (positive radius length		
			indicates the curve is clockwise from B [PC])		
N89-24-37.8E 15.00			2	4496.3758	5181.7517 TRARP
N00-36-24.5W 15.00			3	4511.3750	5181.5928 TRAPT
Delta = 89-58-57.7					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-24-06.6E 21.21					
Bearing=			Continue with traverse...		

(66-) P.I., Two Directions, and Radius

PURPOSE

Given point of intersection (A), two directions (AB, AD), and radius (BC), 66- finds:

- direction and distance A to B and the point number and coordinates of **B**
 - direction and distance B to C and the point number and coordinates of **C** •
 - direction and distance C to D and the point number and coordinates of **D**
- This command creates points B, C, and D.



PROCEDURE

1. Occupy A,
the intersection of the tangents.
2. Enter **66-**.
3. Enter direction A to B.
4. Enter direction A to D.
5. Enter radius length. (Positive for a curve clockwise from B, negative if counterclockwise.)

OUTPUT

After step 5, Benchmark displays:

- Direction and distance A to B and the point number and coordinates of **B**. •
- Direction and distance B to C and the point number and coordinates of **C**.
- Direction and distance C to D and the point number and coordinates of **D**.
 - The following curve data is displayed:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

NOTES

1. This routine generates three points:
 - Point of curvature (PC)
 - Radius point (RP)
 - Point of tangency (PT)
2. If you specified manual point storage, you will be prompted for each of three storage point numbers after step 5 in the procedure. Otherwise, Benchmark will assign sequential storage points automatically.

(66-) P.1., Two Directions, and Radius

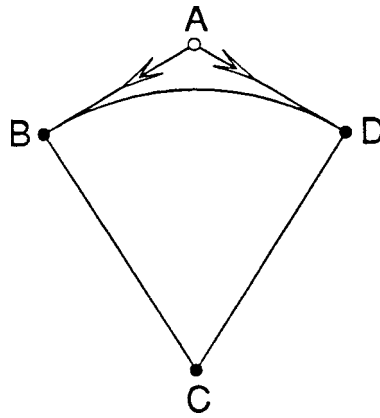
EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-12-1986-----11:54:43-----C:BENCH					
Command 10-					
Occupied Point= 1		Occupy A (PI)			
		1	4511.2207	5166.5959	OCC
Backsight Point= 66-		PI, two directions and radius command			
Bearing= 3553.4		Enter direction A to B (PI to PC)			
Quadrant= 2					
Bearing= 892406.5		Enter direction A to D (PI to PT)			
Quadrant= 1					
Radius Length= 15		Enter radius length			
S00-35-53.4E 15.00		2	4496.2215	5166.7525	TRAPC
N89-24-06.6E 15.00		3	4496.3781	5181.7517	TRARP
N00-35-53.5W 15.00		4	4511.3773	5181.5951	TRAPT
Delta = 89-59-59.9					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-24-06.6E	21.21				
Bearing=		Continue with traverse...			

(67-) P.I., Two Directions, and Tangent

PURPOSE

Use 67- to solve a curve given point of intersection, direction to point of curvature (P.C.), direction to end of curve (P.T.), and tangent length.



PROCEDURE

1. Occupy A.
2. Enter 67-.
3. Enter the direction AB.
4. Enter the direction AD.
5. Enter tangent length.

OUTPUT

After step 5, Benchmark displays:

- Direction and distance AB and the point number and coordinates of B.
- Direction and distance BC and the point number and coordinates Of C.
- Direction and distance CD and the point number and coordinates of D.
- The following curve data is displayed:

DELTA
RADIUS
ARC LENGTH
TANGENT
CHORD

NOTES

1. This routine generates three points:
 - Point of curvature (PC)
 - Radius point (RP)
 - Point of tangency (PT)
2. If you specified manual point storage, you will be prompted for each of three storage point numbers after step 5 in the procedure. Otherwise, Benchmark will assign sequential storage points automatically.

(67-) P.I., Two Directions, and Tangent

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-12-1986-----		12:01:18	-----C:BENCH		
Command 10-					
Occupied Point= 1			Occupy A (PI)		
			1	4511.2207	5166.5959 OCC
Backsight Point= 67-			PI two directions and tangent command		
Bearing= 3553.4			Enter direction A to B (PI to PC)		
Quadrant= 2					
Bearing= 892406.5			Enter direction A to D (PI to PT)		
Quadrant= 1					
Tangent Length= 15			Enter tangent length		
S00-35-53.4E 15.00			2	4496.2215	5166.7525 TRAPC
N89-24-06.6E 15.00			3	4496.3781	5181.7517 TRARP
N00-35-53.5W 15.00			4	4511.3773	5181.5951 TRAPT
Delta = 89-59-59.9					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-24-06.6E	21.21				
Bearing=			Continue with traverse...		

(69-) Any Two Knowns on Curve

PURPOSE

Use 69- to solves a curve given any two knowns. This routine generates curve data and creates two coordinate points.

PROCEDURE

1. Occupy the P.C.
2. Enter **69-**. The following prompts appear, with slight variations depending on what actions you take.

Radius Point=

If you know the radius point, enter it and go to step 3. If not, press RETURN with no entry.

Radius Bearing=

Quadrant=

If you know the radius bearing and quadrant, enter them. Then go to step 3. If not, press RETURN with no entry for each of the prompts. You can also use the define bearing (40-) option here.

Chord Bearing=

Quadrant=

If you know the chord bearing and quadrant, enter them. If not, press RETURN with no entry for each of the prompts. You can also use the define bearing (40-) option here.

3. You are only required to respond to two of the following prompts:

Delta=

Enter the delta angle if you know it. Press RETURN with no entry if you do not.

Radius Length=

Enter the radius length or press RETURN with no entry. Note that this step will be skipped if you entered a value in step 2.

Arc Length=

Enter the arc length or press RETURN with no entry.

Chord Length=

Enter the chord length or press RETURN with no entry.

Tangent Length=

Enter the tangent length or press RETURN with no entry.

Benchmark displays all curve data.

NOTES

1. If you do not enter any data in step 2, Benchmark will assume the radius is 90° to the bearing into the P.C. There must be a backsight direction defined to use the routine this way.
2. You may indicate that the curve is CCW (left) by assigning a negative value at the prompts Radius Length=, Arc Length=, Chord Length=, Tangent Length=.

(69-) Any Two Knowns on Curve

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----11-12-1986-----		12:42:53-----		-----C:BENCH	
Command 10-					
Occupied Point= 2		Occupy the PC			
		2	4496.2215	5166.7525	OCC
Backsight Point= 69-		Any 2 knowns on a curve command. No backsight is necessary as radius bearing is known.			
Radius Point=		Radius point does not exist yet			
Radius Bearing= 892406.6		Enter radius direction (PC to RP)			
Quadrant= 1		You MUST answer 2 of the next 5 prompts			
Delta=		Unknown delta			
Radius Length= 15		Known radius length			
Arc Length=		Unknown arc length			
Chord Length= 21.21		Known chord length			
Tangent Length=		Unknown tangent length			
N89-24-06.6E 15.00		5	4496.3781	5181.7517	RP
N00-36-55.7W 15.00		6	4511.3772	5181.5906	PT
Delta = 89-58-57.7					
Radius = 15.00					
Arc Length= 23.56					
Tangent = 15.00					
Chord = N44-23-35.5E 21.21					
Bearing=		Continue with traverse...			

Bearing	Distance	Point	Northing	Easting	Type
-----12-25-2001-----		12:00:00-----		-----C:BENCH	
In this example the direction from the PC to the RP is assumed to be 90/to the bearing into the PC (5 to 67)					
Command= 10-					
Occupied Point= 67		Occupy the PC			
		67	4512.0949	5250.3566	OCC
Backsight Point= 5		Backsight point 5			
		5	4496.3781	5181.7517	BS
N77-05-48.1E 70.38		67	4512.0949	5250.3566	OCC
PNT STORAGE (DEFAULT = 7) = 68		Start storage at point 68			
Bearing= 69-		Any 2 knowns on a curve command			
Radius Point=		Radius and chord directions are not known			
Radius Bearing=					
Quadrant=					
Chord Bearing=					
Quadrant=					
You MUST answer 2 of the next 5 prompts					
Delta= 520112.4		Known delta			
Radius Length= 15		Known radius length (positive radius indicates the curve is clockwise from the PC)			
Arc Length=		Unknown arc length			
Chord Length=		Unknown chord length			
Tangent Length=		Unknown tangent length			
S12-54-11.9E 15.00		68	4497.4737	5253.7062	RP
N39-07-00.5E 15.00		69	4509.1116	5263.1697	PT
Delta = 52-01-12.4					
Radius = 15.00					
Arc Length= 13.62					
Tangent = 7.32					
Chord = S76-53-35.7E 13.16					
Bearing=		Continue with traverse...			

(97-, 98-, 99-) Curve Solver

PURPOSE

These routines solve curves given any two of five knowns. These are strictly utility routines. None of the routines creates points.

- Use 97- for the normal routine.
- For railroad curves, use 98- for Degree of Curve-Arc basis or 99- for Degree of Curve-Chord basis.

PROCEDURE FOR 97-

1. Enter **97-**.
2. You will be prompted as shown below.

```
Delta=  
Radius Length=  
Arc Length=  
Chord Length=  
Tangent Length=
```

3. Enter any two of the five known. To skip unknown values, just press RETURN without typing anything.

OUTPUT

Following step 3, Benchmark will display the following curve data:

```
Delta  
Radius Length  
Arc Length  
Chord Length  
Tangent Length  
External  
Middle Ordinate  
Sector Area  
Segment Area Arc-  
tangent Area  
Triangle Area
```

(97-, 98-, 99-) Curve Solver

PROCEDURE FOR 98- AND 99-

1. Enter 97-.
2. You will be prompted as shown below.

Delta=
Radius Length= Arc
Length=
Chord Length=
Tangent Length=

3. Enter the central angle if known, or press RETURN without making an entry if unknown.
4. At the Radius Length= prompt, enter **98-** for Degree of Curve-Arc basis or **99-** for Degree of Curve-Chord basis. Then press RETURN.
5. You will receive one of the following prompts:

Degree of Curve-Arc Basis (for 98-) Degree of
Curve-Chord Basis (for 99-)

6. Enter the degree of curve in decimal degrees. For example, for a 2 degree curve you would enter 2; for a 2-1/2 degree curve you would enter 2.5.
7. Enter any of the remaining knowns (arc length, chord length, or tangent). To skip unknown values, just press RETURN without typing anything.

OUTPUT

After step 7, Benchmark will display the following curve data:

Delta
Radius Length Arc
Length
Chord Length
Tangent Length
External
Middle Ordinate
Sector Area Segment
Area Arc-tangent
Area Triangle Area

(97-, 98-, 99-) Curve Solver

EXAMPLE

Command 97-
Circular Curve Solver

| Circular curve solver command

Delta=
Radius Length= 2865
Arc Length= 100
Chord Length=
Tangent Length=
Delta = 01-59-59.5
Radius = 2865.00
Arc Length = 100.00
Chord = 99.99
Tangent = 50.01
External = 0.44
Middle Ordinate = 0.44
Sector Area = 143250.00
Segment Area = 29.08
Arc-Tangent area= 14.55
Triangle Area = 143220.92

| Unknown delta
| Known radius length
| Known arc length
| Unknown chord length
| Unknown tangent length

Command 97-
Circular Curve Solver

| Circular curve solver command

Delta=
Radius Length= 98-
Degree of Curve-Arc Basis= 2
Arc Length= 100
Chord Length=
Tangent Length=
Delta = 02-00-00.0
Radius = 2864.79
Arc Length = 100.00
Chord = 99.99
Tangent = 50.01
External = 0.44
Middle Ordinate = 0.44
Sector Area = 143239.45
Segment Area = 29.09
Arc-Tangent Area= 14.55
Triangle Area = 143210.36

| Unknown delta
| Railroad curve - degree of curve (arc)
| Degree of curve
| Known arc length
| Unknown chord length
| Unknown tangent length

Command 97-
Circular Curve Solver

| Circular curve solver command

Delta=
Radius Length= 99-
Degree of Curve-Chord Basis= 2
Arc Length= 100
Chord Length=
Tangent Length=
Delta = 01-59-59.6
Radius = 2864.93
Arc Length = 100.00
Chord = 99.99
Tangent = 50.01
External = 0.44
Middle Ordinate = 0.44
Sector Area = 143246.72
Segment Area = 29.09
Arc-Tangent Area= 14.55
Triangle Area = 143217.64

| Unknown delta
| Railroad curve - degree of curve (chord)
| Degree of curve
| Known Arc length
| Unknown chord length
| Unknown tangent length

Street Design Commands

Conventions Used in this Chapter ...	10-2
(140-, 141-) Parallel Lines	10-3
(180-,185-,186-) Offsets from Center Line	10-4
(163-,164-,165-,166-,167-) Cul-De-Sac Routines	10-6
(163-) Curved Entry to Cul-De-Sac, Center Point Known	10-6
(164-) Curved Entry to Cul-De-Sac, Offset Point Known	10-9
(165-) Straight Entry to Cul-de-Sac, Center Point Known	10-11
(166-) Straight Entry to Cul-de-Sac, Offset Point Known	10-14
(167-) Bend with Cul-de-Sac	10-16
(170-,171-,172-) Straight Street Intersection Routines	10-18
(170-) Four-Way Intersection	10-18
(171-) Three-Way Intersection	10-20
(172-) Two-Way Intersection	10-22
(173-,174-,175-,176-,177-) Curved Street Intersection Routines	10-24
(173-) Curved Into Straight	10-24
(174-) Two-Way Straight Into Curved	10-26
(175-) Four-Way Straight & Curved	10-28
(176-) Two-Way Curve with Curved Entry	10-30
(177-) Four-Way Curve	10-32

WHAT'S IN THIS CHAPTER?

This chapter describes the Benchmark commands used in street designs. These routines create points and generate curve data for:

- parallel lines
- offsets from center line
- cul-de-sac routines
- curved streets
- straight street intersections (including two-, three-, and four-way intersections)

Conventions Used in this Chapter

The street design commands create points and generate data for a variety of street types, both straight and curved. Most of the commands in this chapter are accompanied by a figure. In these figures, points are represented either by a solid or a hollow dot.

Hollow dots denote existing point numbers that are used as input in the routines.

Solid dots denote points created by the routine.

In PROCEDURE sections, when the output of a command is listed, the numbers in parentheses refer to the point numbers in the EXAMPLE section.

(140-, 141-) Parallel Lines

PURPOSE

Creates points on lines parallel to specified lines.

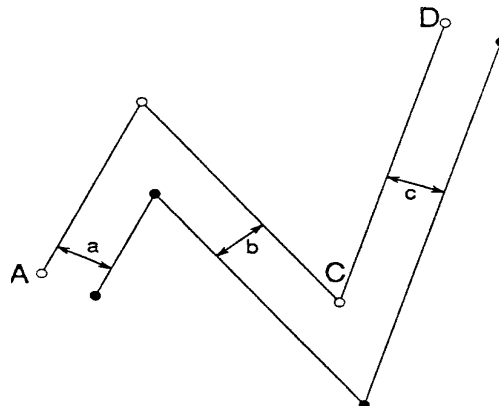
PROCEDURE

1. Occupy the starting point (A), then enter **140-**.
2. Enter the offset distance (a) from A (right +, left -).
3. Enter the point number of the next point (B). Benchmark creates a point at the given offset on the line parallel to A-B and displays its number and coordinates.
4. Enter the offset distance (b) from point **B**.
5. Enter the next point number (C). Again, Benchmark creates a point at the given offset on the line parallel to A-B and displays its number and coordinates.
6. Repeat steps 3 and 4 as many times as necessary.
7. Enter **141-** to create and display the last point on the line.

EXAMPLE

Bearing	Distance	Pnt.	Northing	Easting	Type
-----07-24-1990-----12:14:42-----D:\BENCH70					
Command= 210-					
Point#, Start#-End# or G#= 5-12					
5	5000.0000	4857.0000	12	4877.0800	5004.0368
Point#, Start#-End# or G#= 10-					
Occupied Point= 2					
Backsight Point=					
Storage Point = 100					
Bearing= 140-					
1ST Offset Distance= 15					
Point B= 5					
N52-32-17.5E 15.00					
Next Offset Distance= 15					
Point C= 12					
N37-27-42.5W 101.76					
Next Offset Distance= 141-					
S39-53-42.0W 15.00					

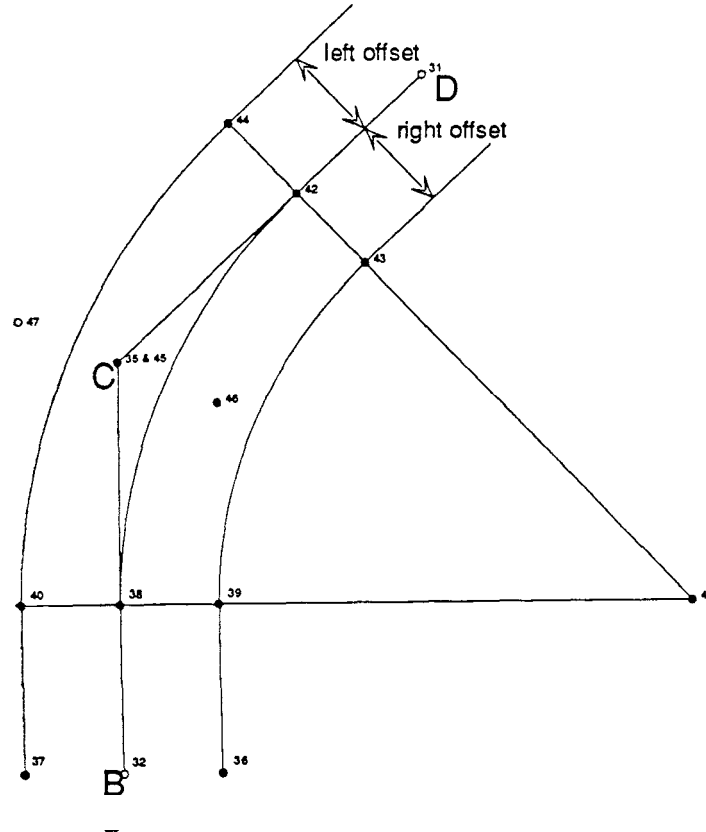
To list some points that will be used					
in the example below					
Occupy the starting point (A)					
2	4811.7500	5001.2500	OCC		
2	4811.7500	5001.2500	OCC		
Define starting storage point					
Parallel line routine command					
Enter offset A					
Enter point B					
100	4820.8735	5013.1564			
Enter offset B					
Enter point C					
101	4901.6484	4951.2612			
Last point on parallel line command					
102	4865.5717	4994.4161			



(180-,185-,186-) Offsets from Center Line

PURPOSE

The 180- and associated routines (185-, 186-) create street sidelines, both straight and through curves. Benchmark creates a point for each offset point it computes along the centerline.



PROCEDURE

1. Use the 10- routine to define the occupied and storage point numbers.
2. Enter **180-**, then enter the right and left offset distances.
3. Enter point numbers along the centerline as needed. Benchmark creates and displays the sideline coordinates.
4. Repeat step 3 as many times as you want.
5. To calculate offsets on a curve, enter **185-** if you know the radius or **186-** if you know the tangent length.
6. Enter a point anywhere on the first tangent (B).
7. Enter the tangent intersection (C).
8. Enter a point somewhere on the centerline of the street going out of the curve anywhere on second tangent (D).
9. Enter the radius (if you are using **185-**) or tangent length (if you are using **186-**).

Note: If the curve goes clockwise around the radius point, the radius or tangent length (step 9) is positive; if counter clockwise, this length is negative. Failure to observe the sign rules will cause errors.

(180-) Offsets from Center Line

EXAMPLE

Bearing	Distance	Pnt.	Northing	Easting	Type
-----07-24-1990-----12:41:29-----D:\BENCH70					
Command= 210- <i>List points used in the example below</i>					
Point#, Start#-End# or G#= 31-35					
31	4856.3858	5312.5107	32	4385.9665	5142.9020
35	4690.9499	5139.7185			
Point#, Start#-End# or G#= 10- <i>New set up</i>					
Occupied Point= 35 <i>On Pt 35</i>					
			35	4690.9499	5139.7185 OCC
Backsight Point= <i>Press RETURN for no backsight</i>					
			35	4690.9499	5139.7185 OCC
Storage Point= 36 <i>Start storage at Pt 36</i>					
Bearing= 180- <i>Offsets from centerline command</i>					
Right Offset Distance= 25 <i>Right offset length</i>					
Left Offset Distance= 25 <i>Left offset length</i>					
Point= 32 <i>Compute offsets of Pt 32</i>					
S89-24-07.0W	25.00		36	4385.7056	5117.9034
N89-24-07.0E	25.00		37	4386.2274	5167.9006
Point= 185- <i>Compute offsets for curve command</i>					
Point B= 32 <i>Point anywhere on 1st tangent (B)</i>					
Point C= 35 <i>Tangent intersection point (C)</i>					
Point D= 31 <i>Point anywhere on 2nd tangent (D)</i>					
Radius Length= 145 <i>Radius of curve</i>					
S00-35-53.0E	62.81		38	4628.1401	5140.3741 PC
			39	4628.4011	5165.3728 PC-R
			40	4627.8792	5115.3755 PC-L
N89-24-07.0E	145.00		41	4629.6536	5285.3662 RP
N43-45-14.5W	145.00		42	4734.3893	5185.0894 PT
			43	4716.3314	5202.3785 PT-R
			44	4752.4472	5167.8003 PT-L
S46-14-45.5W	62.81		45	4690.9499	5139.7185 PI
			46	4680.3816	5164.8302 PI-R
			47	4701.5183	5114.6068 PI-L
Center					
Delta	= 46-50-38				
Radius Length	= 145.00				
Arc Length	= 118.55				
Tangent Length	= 62.81				
Chord Length	= N22-49-26E	115.28			
Right					
Delta	= 46-50-38				
Radius Length	= 120.00				
Arc Length	= 98.11				
Tangent Length	= 51.98				
Chord Length	= N22-49-26E	95.40			
Left					
Delta	= 46-50-38				
Radius Length	= 170.00				
Arc Length	= 138.99				
Tangent Length	= 73.64				
Chord Length	= N22-49-26E	135.15			

163-,164-,165-,166-,167-) Cul-De-Sac Routines

The cul-de-sac routines compute the coordinates and curve data for cul-de-sacs with both circular and straight access roads.

This section covers all the cul-de-sac commands (163-, 164-, 165-, 166-, 167-) and provides an example for each command.

(163-) Curved Entry to Cul-De-Sac, Center Point Known

PURPOSE

The 163- command creates points and generates curve data for cul-de-sacs with circular access roads. Coordinate points are stored sequentially beginning with the specified storage point number.

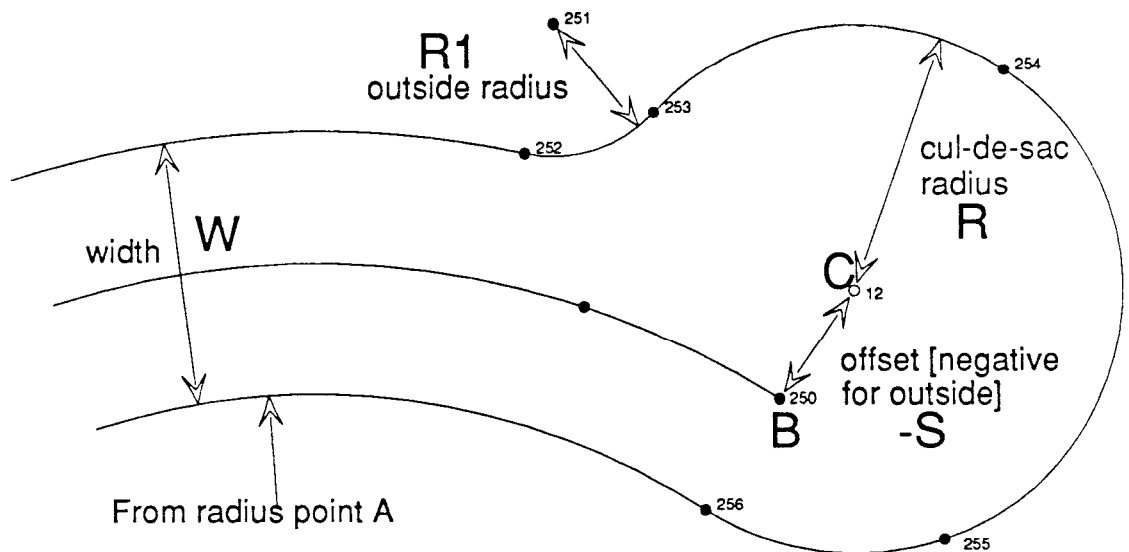
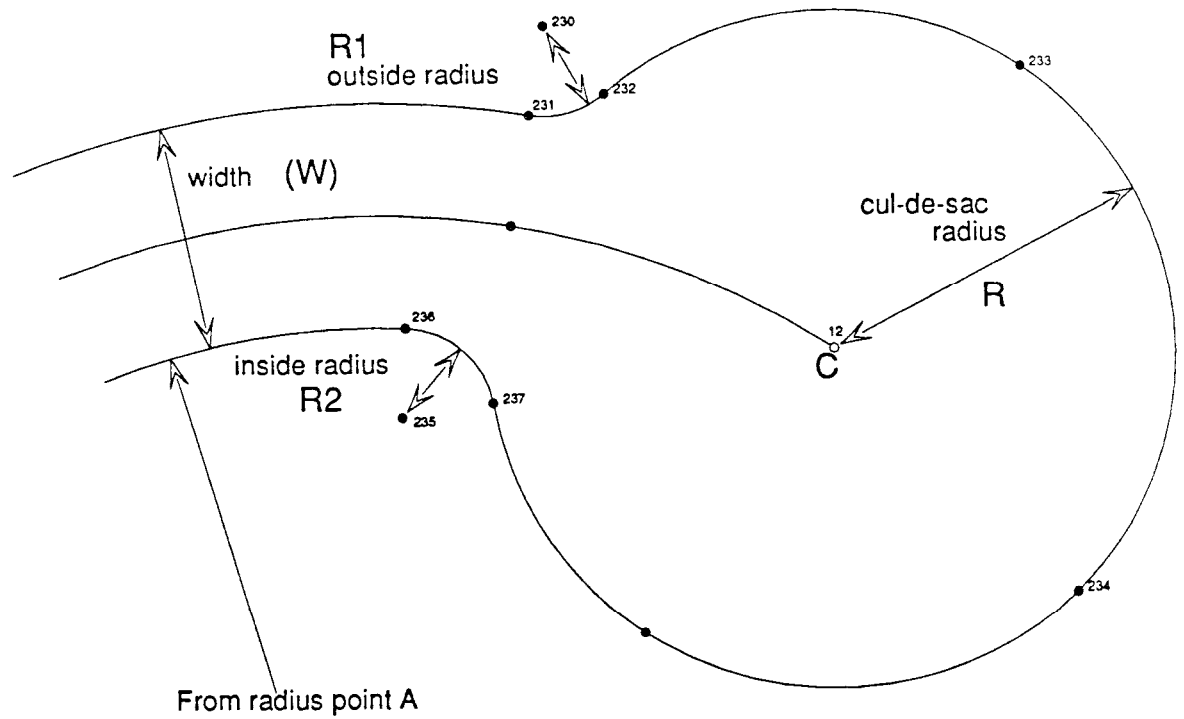
PROCEDURE

1. Enter **163-** (center point known).
2. Enter the starting point number for storage.
3. Enter the point number of A (positive if the street runs clockwise from the cul-de-sac, negative if counter clockwise).
4. Enter the point number of the center of the cul-de-sac (C).
5. Enter the offset distance (S) from C to center line of the street. Enter the Offset distance negatively if C is outside the center line. Press `RETURN` with no entry if C is on the center line of the street. Benchmark creates the point number and coordinates of **B**.
6. Enter the radius of the cul-de-sac (R).
7. Enter the street width (W).
8. Enter the Outside radius (R1). You will not be prompted for R1 if the cul-de-sac is tangent to the Outside of the street. ERROR displays if there is no cul-de-sac possible with the data provided. After you enter R1, Benchmark displays:
 - the point numbers and coordinates of: - the radius point Of the curve (213) - the points of tangency with the street and cul-de-sac (214, 215)
 - all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
 - the point numbers and coordinates of: - the point On the cul-de-sac radial from A-C (216) - the point where the center line of the street meets the large circle (217)

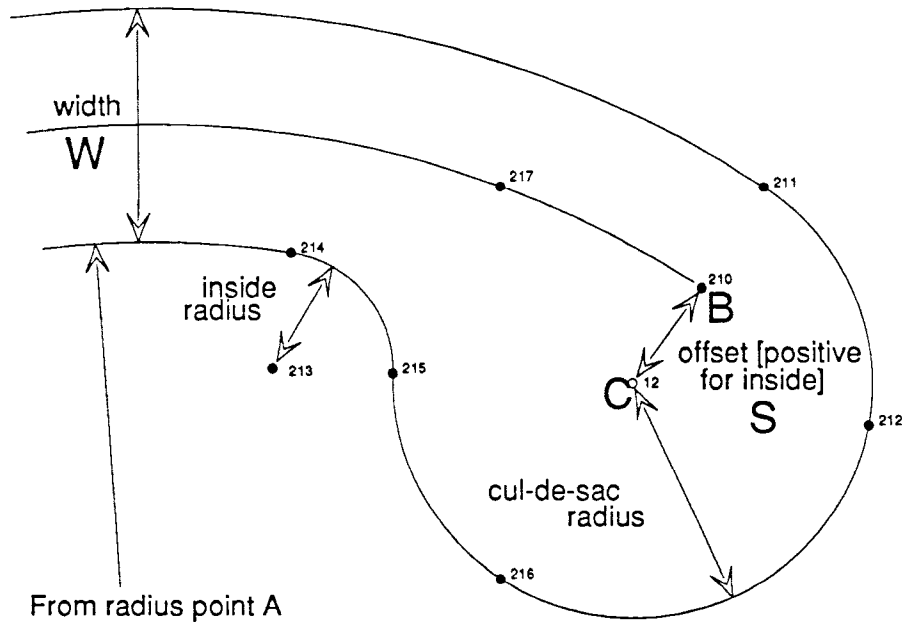
See following example.

9. Enter the radius (R2) of the inside curve. (You will not be prompted for R2 if the cul-de-sac is tangent to the inside Of the curve.) Benchmark generates the same data listed in step 8.

(163-) Curved Entry to Cul-De-Sac, Center Point Known



(163-) Curved Entry to Cul-De-Sac, Center Point Known



The following example refers to the above drawing.

EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
Command 163-					C:BENCH
Storage Point = 210					
Point A= -11					
		11	5000.0000	5000.0000	
Point C= 12		12	5150.0000	5100.0000	
Offset Distance= 25		210	5170.8013	5113.8675	OS
Radius Length= 50		211	5191.6025	5127.7350	POC
Street Width= 50		212	5141.0066	5149.1845	POC
Radius Length 2= 25		213	5153.2404	5025.0700	RP
		214	5177.9124	5029.1064	PT
		215	5152.1603	5050.0467	PT
Delta = 83-11-06.0					
Arc Length= 36.30					
Tangent = 22.19					
Chord = S39-06-58.5E	33.19				
		216	5108.3975	5072.2650	POC
		217	5191.9421	5072.7812	POC

(163-,164-,165-,166-,167-) Cul-De-Sac Routines

(164-) Curved Entry to Cul-De-Sac, (Offset Point Known)

PURPOSE

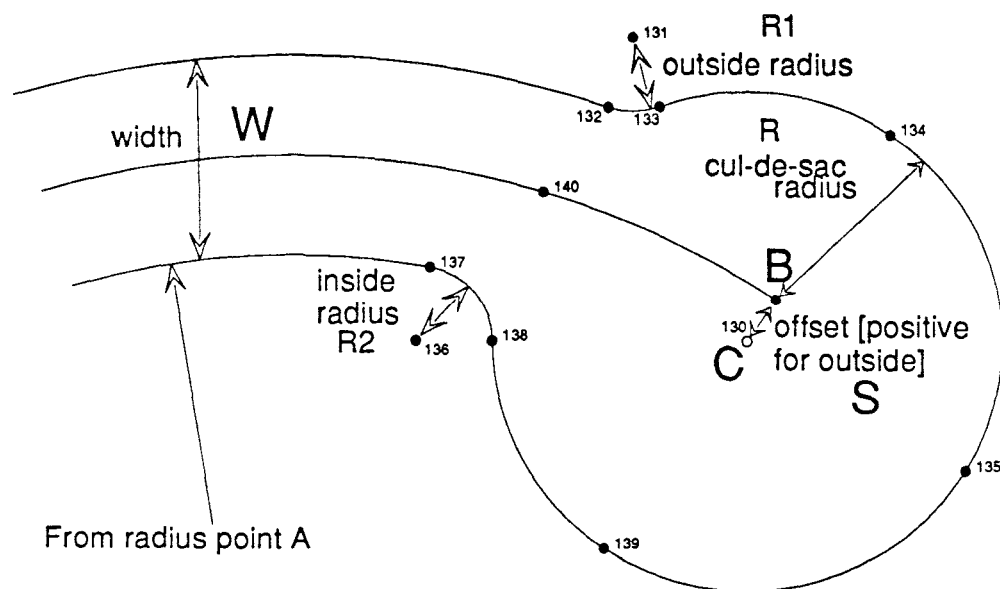
The 164- command creates coordinates and curve data for cul-de-sacs with circular access roads. Created coordinates are stored sequentially by point number.

PROCEDURE

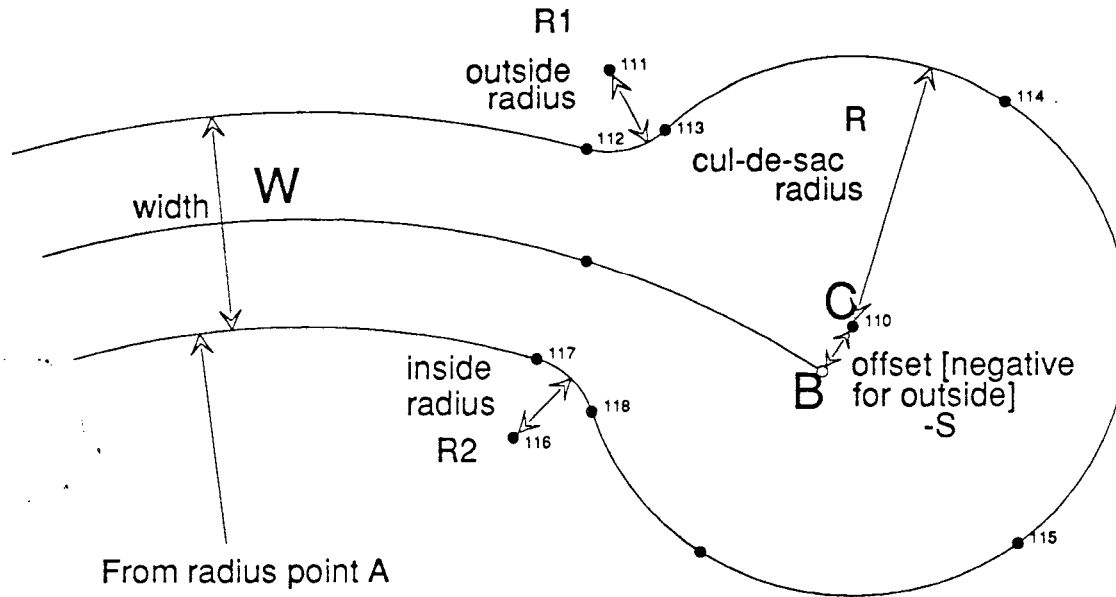
1. Enter **164-**.
2. Enter the starting storage point number.
3. Enter the point number of A (positive if the street runs clockwise from the cul-de-sac, negative if counter clockwise).
4. Enter the point number B (offset point).
5. Enter the distance, **S** (negative if C is outside the center line of the street). Benchmark creates and displays the point number and coordinates of C.
6. Enter the radius of the cul-de-sac (**R**).
7. Enter the street width (**W**).
8. Enter the outside radius (**R1**). (You will not be prompted for R1 if the cul-de-sac is tangent to the outside of the street.) Benchmark displays:
 - the point numbers and coordinates of: - the radius point of the curve (111) - the points of tangency with the street and cul-de-sac (112, 113)
 - all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
 - the point numbers and coordinates of: - the point on the cul-de-sac radial from A-C (114) - the point where the center line of the street meets the large circle (115)

NOTE: Benchmark reports *ERROR* if there is no cul-de-sac possible with the data provided.

9. Enter the radius (**R2**) of the inside curve. (You will not be prompted for R2 if the cul-de-sac is tangent to the inside of the curve.) Benchmark generates the same data listed in step 8.



(164-) Curved Entry to Cul-De-Sac, Offset Point Known



The following example refers to the above drawing.

EXAMPLE

```

Command 164-
Storage Point= 110
Point A= -1
Point B= 2
Offset Distance= -10
Radius Length= 50
Street Width= 40
Radius Length 1= 15

Delta      = 58-42-00.5
ARc Length= 15.37
Tangent    = 8.43
Chord      = N76-23-47.2E      14.70

111 5000.0000 5000.0000
112 5141.6795 5094.4530
113 5150.0000 5100.0000 OS
114 5191.6025 5127.7350 POC
115 5109.9902 5129.9869 POC
116 5129.7630 5038.2306 RP
117 5144.1516 5042.4697 PT
118 5134.4331 5052.4850 PT
119 5108.3975 5072.2650 POC
120 5162.2919 5051.5344 POC

Begin cul-de-sac design - offset point known
Select point number for storage
Negative RP# to define street CCW from the cul-de-sac
Enter offset point
Distance negative if C is outside the center line of street
Enter the radius of the cul-de-sac
Enter the street width
Enter the outside radius
Enter the inside radius

```


(163-,164-,165-,166-,167-) Col-De-Sac Routines

(165-) Straight Entry to Cul-de-Sac, (Center Point Known)

PURPOSE

The 165- routine creates coordinates and computes curve data for cul-de-sacs where the access road is straight. This routine requires that the center point be known. Generated points are stored sequentially by point number.

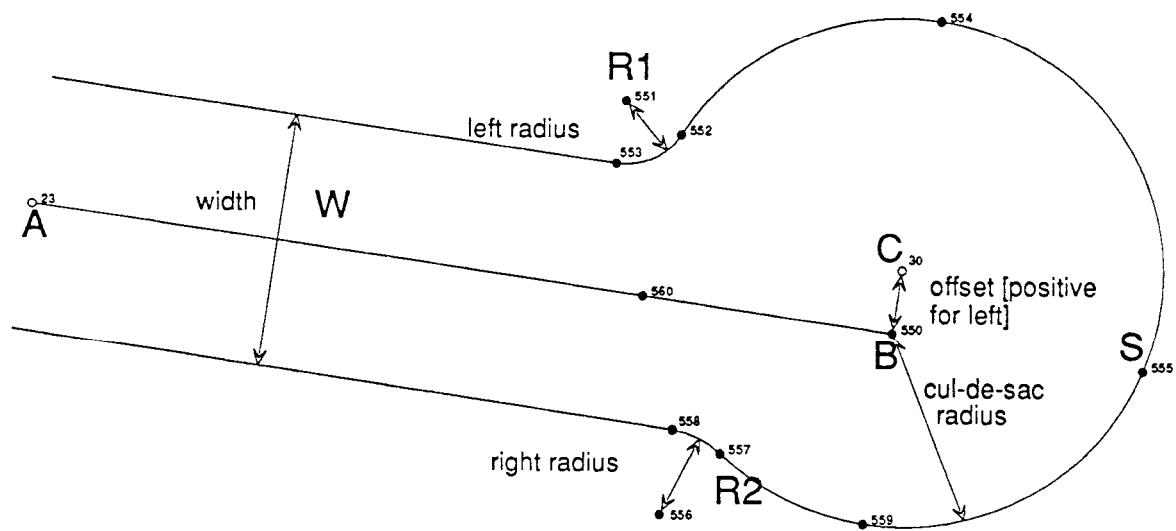
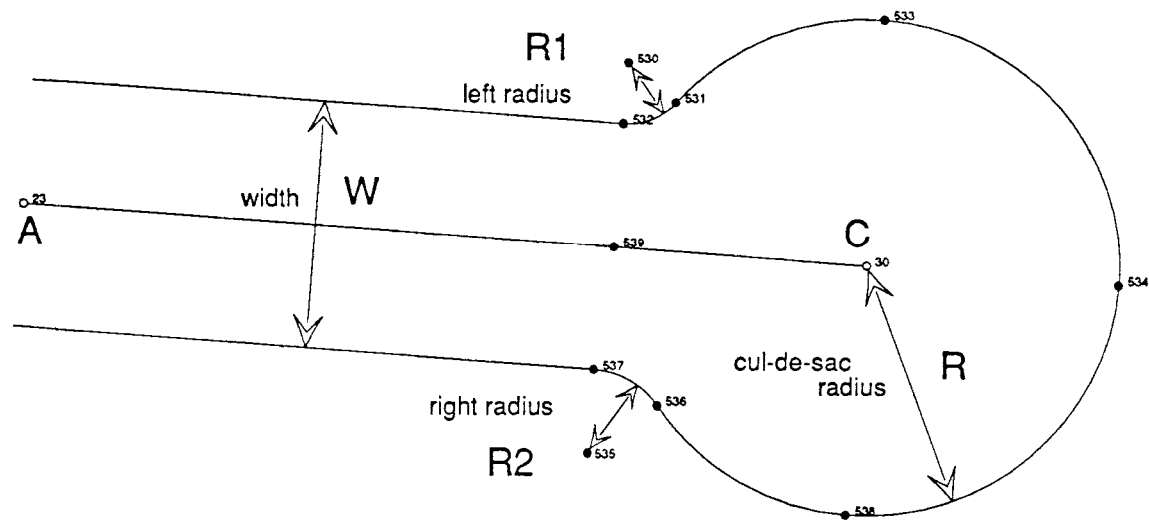
PROCEDURE

1. Enter **165-** (center point known).
2. Enter the point number for start of storage.
3. Enter the point number of center line of road (A).
4. Enter the point number of center of cul-de-sac (C).
5. Enter offset distance, S (negative if right from A to B). Benchmark displays the point numbers and coordinates of B.
6. Enter the radius (R) of the cul-de-sac.
7. Enter the street width (W).
8. Enter the radius of the small circle (R1). This is the circle opposite the offset direction. You are not prompted for R1 if the cul-de-sac is tangent to the road, opposite the offset. If there is no solution, the routine displays the message ERROR and returns you to the COMMAND prompt. See drawing on page 11-14.

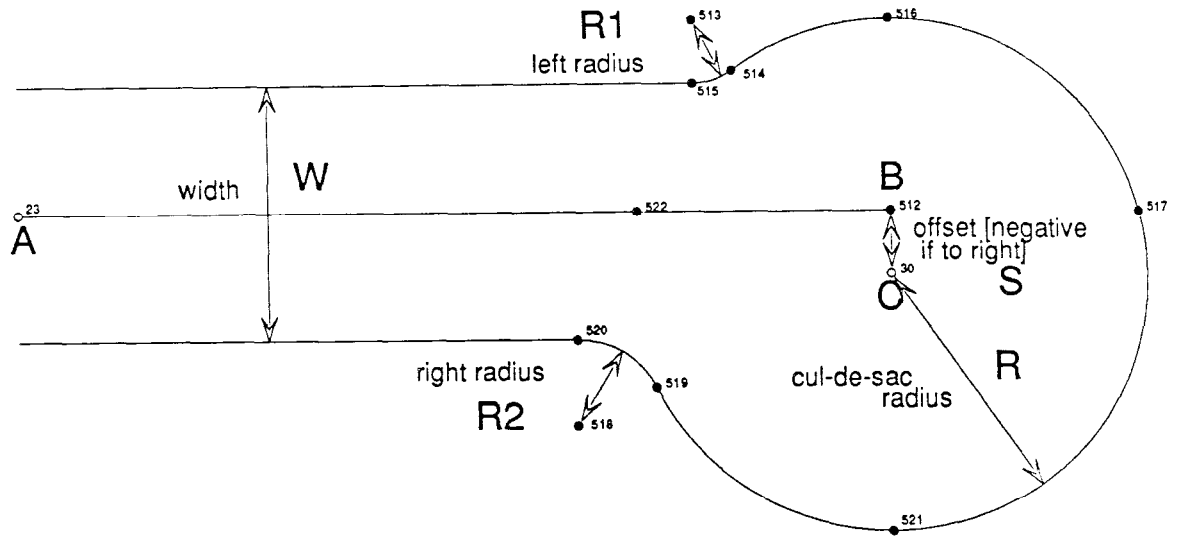
Benchmark displays:

- the point numbers and coordinates of:
 - the center point of the small circle (513)
 - the point of tangency of the small circle with the cul-de-sac (514) -
 - the point of tangency of the small circle with the street (515)
 - all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
 - the point numbers and coordinates of:
 - the intersection of the cul-de-sac with the line through C (521)
 - the point of the intersection of the cul-de-sac and the center line of the road (522)
9. Enter the radius of the small circle (R2). Benchmark generates the same data listed in step 8. Finally, you are returned to the COMMAND prompt.

(165-) Straight Entry To Cul-De-Sac Center Point Known



(165•) Straight Entry To Cul-De-Sac Center Point Known



The following example refers to the above drawing.

EXAMPLE

Command 165-
Storage Point= 512
Point A= 23

Point C= 30

Offset Distance= -15

Radius Length= 60
Street Width= 60
Radius 1= 15

Delta = 36-52-11.6
Arc Length= 9.65
Tangent = 5.00
Chord = N71-33-54.2E

Radius 2= 20

Delta = 64-03-19.9
Arc Length= 22.36
Tangent = 12.51
Chord = S57-58-20.1E

| Begin cul-de-sac design - center point known

| Select point number for storage

| Enter the point number of - A

23 4500.0000 4500.0000

| Enter the point number of - C

30 4485.0000 4700.0000

| Offset distance - negative if right from B to A

512 4500.0000 4700.0000 OS

| Enter the radius of the CUL - R

| Enter the street width - W

| Enter the radius of the small circle - R1

513 4545.0000 4655.0000 RP

514 4533.0000 4664.0000 PT

515 4530.0000 4655.0000 PT

516 4545.0000 4700.0000 INT

517 4500.0000 4758.0948 INT

| Enter the radius of the small circle - R2

518 4450.0000 4628.0625 RP

519 4458.7500 4646.0469 PT

520 4470.0000 4628.0625 PT

521 4425.0000 4700.0000 INT

522 4500.0000 4641.9052 INT

(163-,164-,165-,166-,167-) Cul-De-Sac Routines

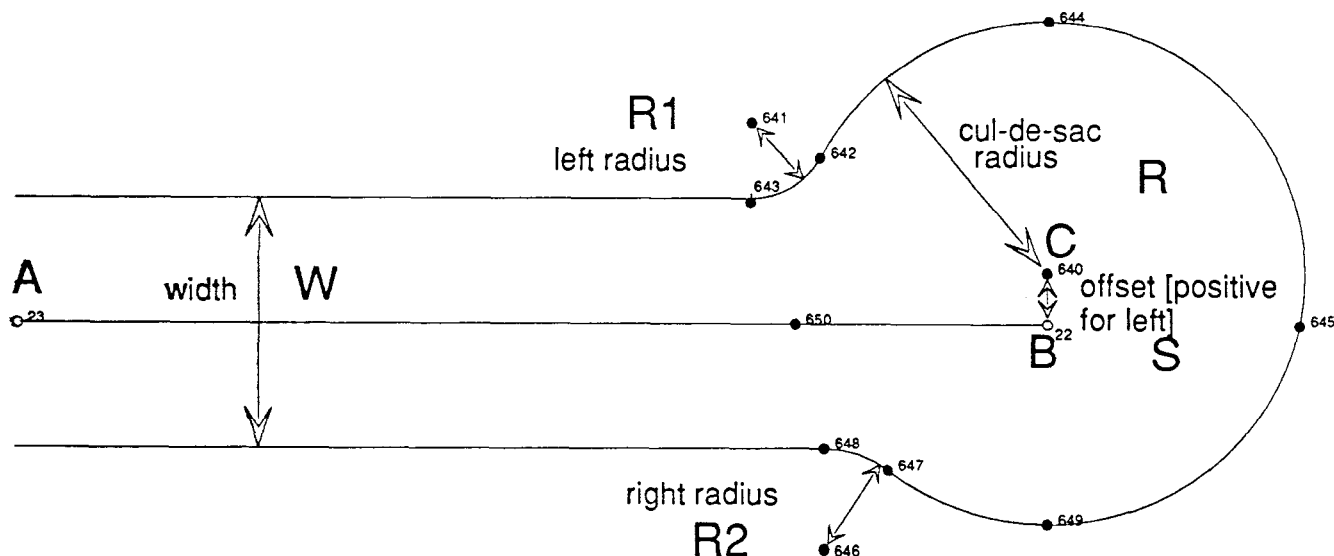
(166-) Straight Entry to Cul-de-Sac, (Offset Point Known)

PURPOSE

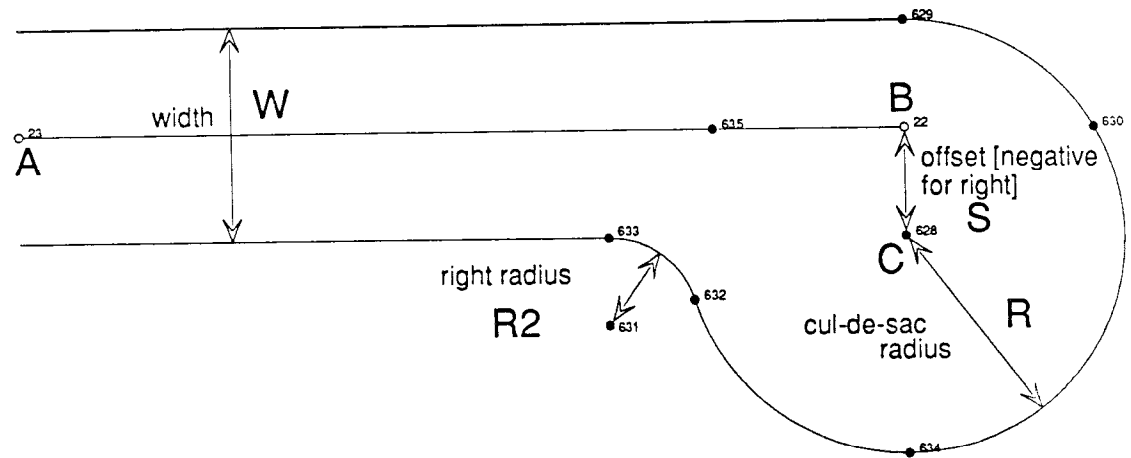
The 166- routine creates the coordinates and curve data for cul-de-sacs where the access road is straight. This routine requires the offset point to be known. Created points are stored sequentially by point number.

PROCEDURE

1. Enter **166-**.
2. Enter the point number for start of storage.
3. Enter a point on the center line of the road (A).
4. Enter the number of the offset point (B).
5. Enter the offset distance, S (negative if right of the line A to B). Benchmark responds by displaying the point number and coordinates of C.
6. Enter the radius (R) of the cul-de-sac.
7. Enter the street width (W).
8. Enter the radius of the small circle (R1). Note that you are not prompted for R1 if the cul-de-sac is tangent to the road opposite the offset. If there is no solution, Benchmark reports ERROR and you are returned to the COMMAND prompt. Benchmark displays:
 - the point numbers and coordinates of: (see example below) - the center point of the small circle (641)
 - the point of tangency of the small circle with the cul-de-sac (642)
 - the point of tangency of the small circle with the street (643)
- all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
- the point numbers and coordinates of the intersection points of the cul-de-sac with the line through C, perpendicular to the road (644, 649)
0. Enter the radius of the small circle (R2). Benchmark displays the data for the small circle listed in Step 8.
1. Finally, you are returned to the COMMAND prompt.



(166-) Straight Entry To Cul-De-Sac, Offset Point Known



The following example refers to the above drawing.

EXAMPLE

Command 166-	Begin cul-de-sac design - offset point known		
Storage Point (Default = 523) = 628	Select point number for storage		
Point A= 23	Enter a point on the center line of the road (A)		
	23	4500.0000	4500.0000
Point B= 22	Enter the point number of (B)		
	22	4500.0000	4700.0000
Offset Distance= -25	Offset distance - negative if right from A to B		
	628	4475.0000	4700.0000 OS
Radius Length= 50	Enter the radius of the cul-de-sac - R		
Street Width= 50	Enter the street width - W		
	629	4525.0000	4700.0000 INT
	630	4500.0000	4743.3013 INT
Radius 2= 20	Enter the radius of the small circle - R2		
	631	4455.0000	4632.9180 RP
	632	4460.7143	4652.0843 PT
	633	4475.0000	4632.9180 PT
Delta = 73-23-54.4			
Arc Length= 25.62			
Tangent = 14.91			
Chord = S53-18-02.8E 23.90			
	634	4425.0000	4700.0000 INT
	635	4500.0000	4656.6987 INT

(163-,164-,165-,166-,167-) Cu'-De-Sac Routines

(167-) Bend with Cul-de-Sac

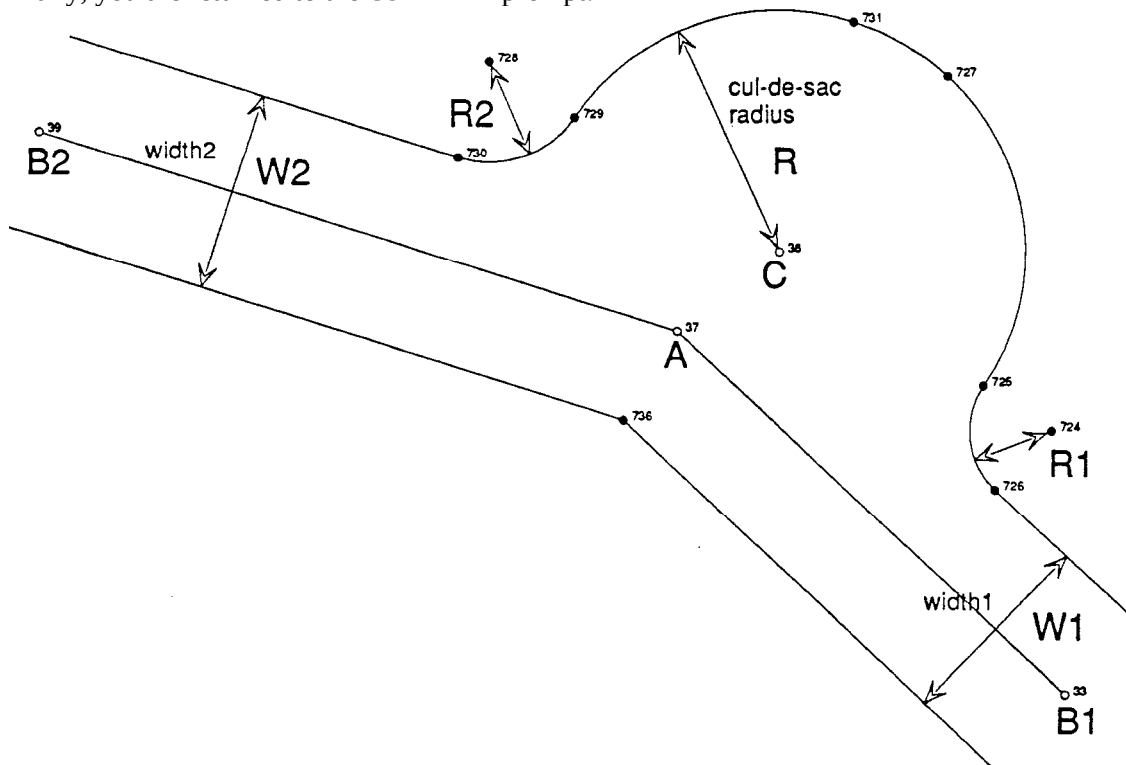
PURPOSE

The 167- routine creates coordinates and curve data for cul-de-sacs in the bend of a road. Created coordinates are stored sequentially by point number.

PROCEDURE

1. Enter **167-**.
2. Enter the point number for start of storage.
3. Enter the point number of the intersection of the two streets (A).
4. Enter the center point of the cul-de-sac (C).
5. Enter the radius of the cul-de-sac, R.
6. Enter the point number of B1.
7. Enter the width, W1.
8. Enter the radius, R1. Benchmark displays: (see example on following page)
 - the point numbers and coordinates of:
 - the center point of the small curve (724)
 - the point of tangency of the small circle with the cul-de-sac (725) -
 - the point of tangency of the small circle with the street (726)
 - all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
 - the point numbers and coordinates of the intersection point of the cul-de-sac with the line through AC.
9. Repeat steps 6 thru 8 for B2. Again, Benchmark displays the created points and curve data listed in step 8.

Finally, you are returned to the COMMAND prompt.



(167-) Bend With Cul-De-Sac

EXAMPLE

Command 167-
Storage Point= 724
Point A= 37

Point C= 38

Radius Length= 60
Point B1= 33

Street Width 1= 50
Radius Length 1= 20

Delta = 80-26-21.6
Arc Length= 28.08
Tangent = 16.91
Chord = N06-19-42.5W 25.83

Point B2= 39

Street Width 2= 50
Radius Length 2= 25

Delta = 74-05-49.3
Arc Length= 32.33
Tangent = 18.87
Chord = N70-49-48.6E 30.12

| Begin cul-de-sac design - bend with cul-de-sac
| Select point number for storage
| Enter the point number of intersection of streets
37 4500.0000 4655.0000
| Enter center point of cul-de-sac
38 4520.0000 4680.0000
| Enter the radius of the cul-de-sac
| Enter a point on centerline on one street
33 4410.0000 4750.0000
| Enter the width of the street
| Enter the radius of the small curve
724 4475.3906 4746.4078 RP
725 4486.5430 4729.8059 PT
726 4460.8716 4732.6530 PT

727 4563.5572 4721.2647 POC
| Enter the point number - B2
39 4550.0000 4500.0000
| Enter the width - W2
| Enter the radius - R2
728 4567.2625 4609.3512 RP
729 4553.3618 4630.1302 PT
730 4543.4698 4601.6761 PT

731 4577.1025 4698.4202 POC

(170-,171-,172-) Straight Street Intersection Routines

Routines 170-, 171-, and 172- let you calculate fillet data for intersecting straight streets, including two-, three-, and four-way intersections.

Routines 173- through 177- calculate fillet data for the intersections of two curved streets or a curved and a straight street, including two- and four-way intersections.

(170-) Four-Way Intersection

PURPOSE

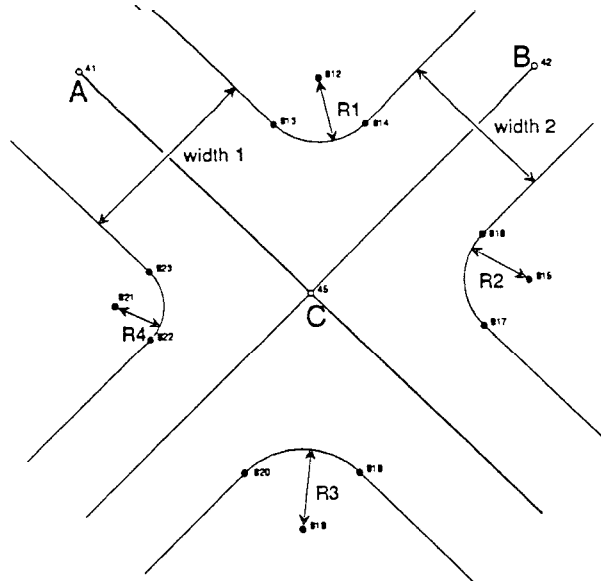
170- creates points and calculates fillet data for the intersection of two straight streets.

PROCEDURE

1. Enter 170-
2. Enter the point number of the first storage point.
3. Enter the point number of the intersection point, C.
4. Enter the point number of a point on the center line, A.
5. Enter the point number of a point On the center line clockwise from A (here, B).
6. Enter the width of the first road, W1.
7. Enter the width of the second road, W2.
8. Enter the radius of the first curve (R1). Benchmark displays:
 - the pOint number and coordinates for:
 - the radius point of the fillet (812)
 - the point Of tangency on the right and left sides (813, 814)
 - all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
9. Enter the radii R2, R3, and R4 in turn to generate the points and data for remaining curves. At the end of the routine, you are returned to the `COMMAND` prompt.

(170-, 171-, 172-) Straight Street Intersection Routines

(170-) Four-Way Intersection



EXAMPLE

Command 170-
Storage Point= 812
Point C= 45

Point A= 41

Point B= 42

Street Width 1= 60
Street Width 2= 50
Radius Length 1= 20

Delta = 90-00-00.0
Arc Length= 31.42
Tangent = 20.00
Chord = S90-00-00.0E
Radius Length 2= 20

Delta = 90-00-00.0
Arc Length= 31.42
Tangent = 20.00
Chord = S00-00-00.0W
Radius Length3= 25

Delta = 90-00-00.0
Arc Length= 39.27
Tangent = 25.00
Chord = S90-00-00.0W
Radius Length 4= 15

Delta = 90-00-00.0
Arc Length= 23.56
Tangent = 15.00
Chord = N00-00-00.0E

| Begin 4-way street intersection design

| Enter storage point

| Enter the number of the intersection point

45 4510.0000 4610.0000

| Enter the point # of a point on the center line

41 4580.0000 4540.0000

| Enter the point # of a point on the center line

42 4580.0000 4680.0000

| Enter the width of the first street

| Enter the width of the second street

| Enter the radius of the first curve

812 4577.1751 4613.5355 RP

813 4563.0330 4599.3934 PT

814 4563.0330 4627.6777 PT

28.28

| Enter the radius of the second curve

815 4513.5355 4677.1751 RP

816 4527.6777 4663.0330 PT

817 4499.3934 4663.0330 PT

28.28

| Enter the radius of the third curve

818 4435.7538 4606.4645 RP

819 4453.4315 4624.1421 PT

820 4453.4315 4588.7868 PT

35.36

| Enter the radius of the fourth curve

821 4506.4645 4549.8959 RP

822 4495.8579 4560.5025 PT

823 4517.0711 4560.5025 PT

21.21

(170-,171-,172-) Straight Street Intersection Routines

(171-) Three-Way Intersection

PURPOSE

The 171- routine creates points and calculates fillet data for the intersection of three straight streets.

PROCEDURE

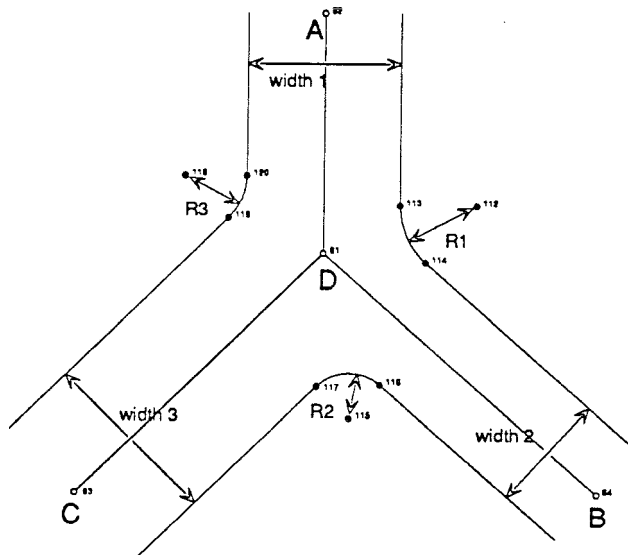
1. Enter 171-.
2. Enter the point number Of the first storage point.
3. Enter the point number of the intersection of the three streets (D).
4. Enter the point number Of a point on the center line of the first street (A).
5. Enter the point number of a point on the center line of the street clockwise from A (here, B).
6. Enter the point number of a point on the center line of the third street (C).
7. Enter the first, second, and third street widths (W1, W2, W3).

Benchmark displays the resulting curve data in clockwise order starting with the curve between A and B.

8. Enter the radius of the first curve (R1). Benchmark displays: •

the point number and coordinates of:

- the radius point of the fillet (112)
 - the point of tangency on the right and on the left (113, 114)
- all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
9. Enter the radii R2 and R3, to generate the same data for the other curves. At the end of this routine, Benchmark returns you to the COMMAND prompt.



(171-) Three-Way Intersection

EXAMPLE

Command 171-
 Storage Point= 112
 Point D= 61

 Point A= 62

 Point B= 64

 Point C= 63

 Street Width 1= 50
 Street Width 2= 40
 Street Width 3= 60
 Radius Length 1= 25

Delta = 48-21-59.3
 Arc Length= 21.10
 Tangent = 11.23
 Chord = S24-10-59.6E 20.48

Radius Length 2= 15

Delta = 86-38-00.7
 Arc Length= 22.68
 Tangent = 14.14
 Chord = S88-19-00.4W 20.58

Radius Length 3= 20

Delta = 45-00-00.0
 Arc Length= 15.71
 Tangent = 8.28
 Chord = N22-30-00.0E 15.31

| Begin 3-way street intersection design
 | Enter the point number for storage
 | Enter the point number of the intersection-D
 61 4510.0000 4620.0000
 | Enter a centerline point of the first road-A
 62 4590.0000 4620.0000
 | Enter a centerline point of the road Clockwise from A (B)
 64 4430.0000 4710.0000
 | Enter a centerline point of the last street (C)
 63 4430.0000 4540.0000
 | Enter the first road width W1
 | Enter the second road width W2
 | Enter the third road width W3
 | Enter the radius of the first curve R1
 112 4525.7635 4670.0000 RP
 113 4525.7635 4645.0000 PT
 114 4507.0783 4653.3909 PT

| Enter the radius of the second curve R2
 115 4455.2604 4628.9000 RP
 116 4466.4716 4638.8655 PT
 117 4465.8670 4618.2934 PT

| Enter the radius of the third curve R3
 118 4535.7107 4575.0000 RP
 119 4521.5685 4589.1421 PT
 120 4535.7107 4595.0000 PT

(170-, 171-, 172-) Straight Street Intersection Routines

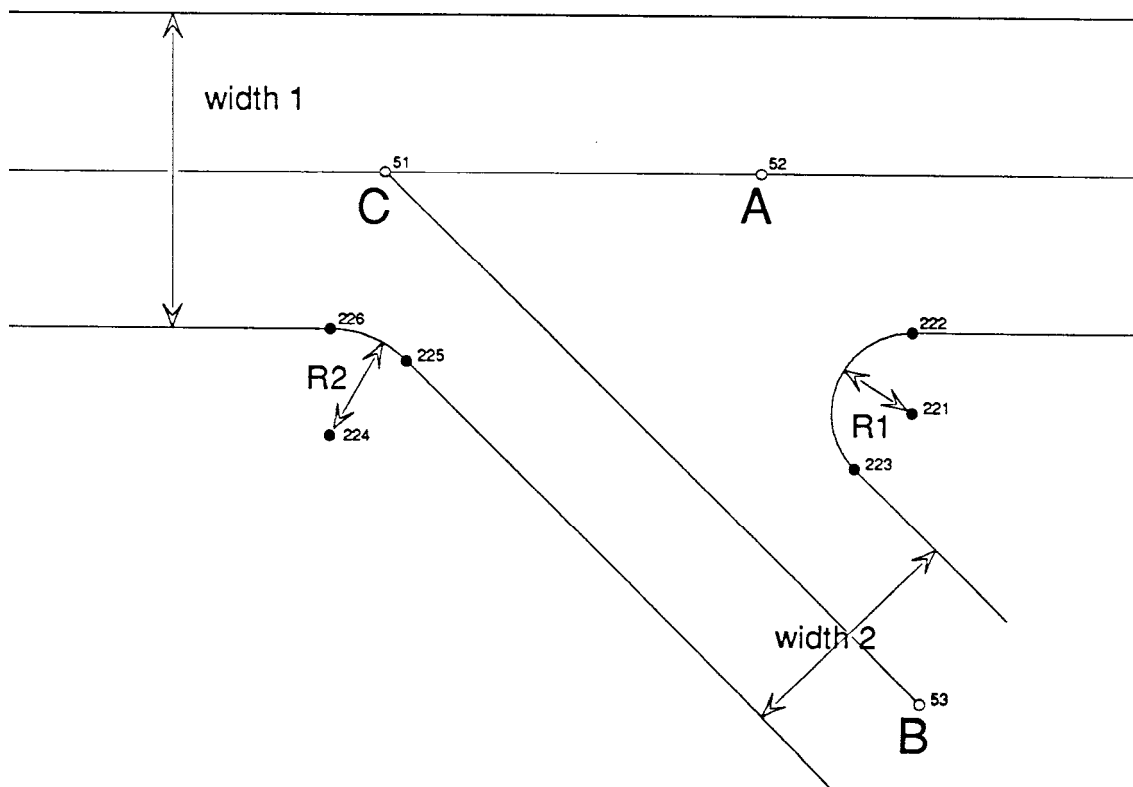
(172-) Two-Way Intersection

PURPOSE

172- creates points and calculates fillet data for one straight street merging into another.

PROCEDURE

1. Enter **172-**.
2. Enter the point number of the first storage point.
3. Enter the point number of the intersection point, C.
4. Enter the point number of a point on the center line of the main street, A. This point must be counter-clockwise from B.
5. Enter the point number of a point on the center line of the side street, B.
6. Enter the width of the main street, W1.
7. Enter the width of the side street, W2.
8. Enter R1, the radius of the first curve.
Benchmark displays:
 - the point numbers and coordinates for:
 - the radius point of the fillet (221)
 - the points of tangency on the right and left (222, 223)
 - all curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
9. Enter the radius, R2, to generate the same data for the second curve. At the end of the routine, you are returned to the COMMAND prompt.



(172-) Two-Way Intersection

EXAMPLE

```
Command 172-      | Begin 2-way street intersection design
Storage Point= 221 | Select the point number for storage
Point C= 51       | Enter the point # of the intersection point
                  | 51  4560.0000  4630.0000
Point A= 52       | Enter a centerline point of the main street
                  | 52  4560.0000  4700.0000
Point B= 53       | Enter a centerline point of the side street
                  | 53  4460.0000  4730.0000
Street Width 1= 60 | Enter the width of the main street W1
Street Width 2= 45 | Enter the width of the side street W2
Radius Length 1= 15 | Enter the radius of the first curve R1
                  | 221 4515.0000  4728.0330  RP
                  | 222 4530.0000  4728.0330  PT
                  | 223 4504.3934  4717.4264  PT

Delta      = 135-00-00.0
Arc Length= 35.34
Tnagent    = 36.21
Chord      = S22-30-00.0W  27.72

Radius Length 2= 20 | Enter the radius of the second curve R2
                  | 224 4510.0000  4619.8959  RP
                  | 225 4524.1421  4634.0381  PT
                  | 226 4530.0000  4619.8959  PT

Delta      = 45-00-00.0
Arc Length= 15.71
Tangent    = 8.28
Chord      = N67-30-00.0W  15.31
```

(173-, 174-, 175-, 176-, 177-) Curved Street Intersection Routines

The curved street routines (173- through 177-) calculate fillet data for the intersections between two curved streets or one curved and one straight street. There are routines for both two- and four-way intersections.

(173-) Curved Into Straight

PURPOSE

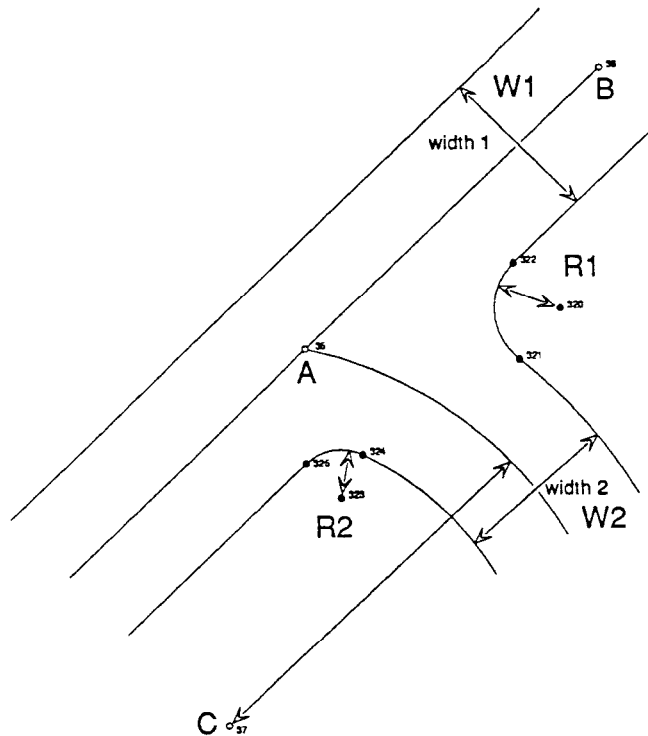
The **173-** routine creates points and calculates fillet data for the entry of a curved into a straight street.

PROCEDURE

1. Enter **173-**.
2. Enter the point number of the first storage point.
3. Enter the point number of the intersection point (A).
4. Enter the point number of a point on the center line of the straight street (B).
5. Enter the point number of the radius point of the curved street (C). Enter this point number negatively if the curved street runs counter clockwise from the straight street.
6. Enter the width of the straight street (W 1).
7. Enter the width of the curved street (W2).
8. Enter the radius of the first curve (R1). Benchmark displays:
 - the point numbers and coordinates of:
 - the radius point of the curve (320)
 - the point of tangency with the curved street (321) -
 - the point of tangency with the straight street (322)
 - curve data (DELTA, RADIUS, ARC LENGTH, TANGENT CHORD)
9. Enter R2 to generate the same data for the other curve.

The routine ends by returning to the COMMAND prompt.

(173-) Curved Into Straight



EXAMPLE

```

Command 173-
Storage Point= 320      | Begin curved into straight intersection design
                        | Select the point number for storage

Point A= 35             | Enter the point # of the intersection point-A
                        | 35  4493.0000  4630.0000
Point B= 36             | Enter a centerline point of the straight street-B
                        | 36  4580.0000  4720.0000
Point C= 37             | Enter the radius point # of the curved street-C
                        | 37  4377.0924  4605.5959

Street Width 1= 50      | Enter the width of the straight street W1
Street Width 2= 50      | Enter the width of the curved street W2
Radius Length 1= 20     | Enter the radius of the first curve R1
                        | 320  4505.0856  4707.2485  RP
                        | 321  4489.4241  4694.8101  PT
                        | 322  4519.4654  4693.3481  PT

Delta      = 97-30-51.5
Radius     = 20.00
Arc Length= 34.04
Tangent    = 22.81
Chord      = N02-47-10.1W  30.08

Radius Length 2= 15     | Enter the radius of the second curve R2
                        | 323  4447.4054  4640.3853  RP
                        | 324  4460.8498  4647.0373  PT
                        | 325  4458.1902  4629.9600  PT

Delta      = 70-21-15.2
Radius     = 15.00
Arc Length= 18.42
Tangent    = 10.57
Chord      = S81-08-53.3W  17.28
  
```

(173-, 174-, 175-, 176-, 177-) Curved Street Intersection Routines

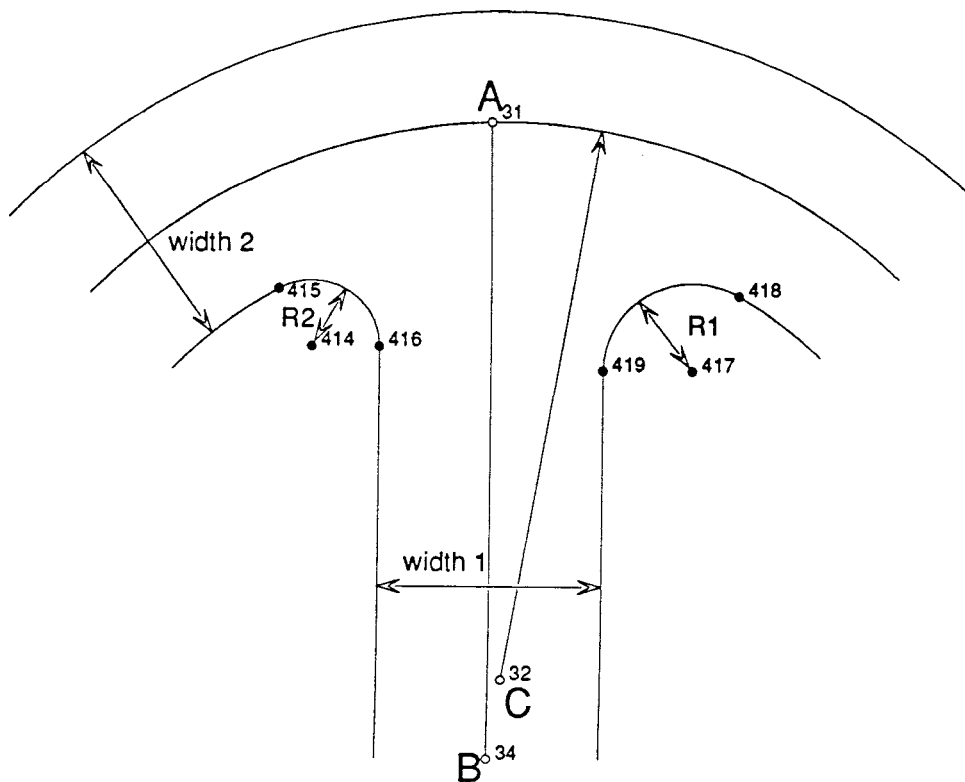
(174-) Two-Way Straight Into Curved

PURPOSE

The 174- routine creates point and fillet data for the entry of a straight into a curved street.

PROCEDURE

1. Enter 174-.
 2. Enter the point number of the first storage point.
 3. Enter the point number of the intersection point (A).
 4. Enter the point number of a point on the straight street (B).
 5. Enter the point number of the radius point of the curved street (C).
 6. Enter the width of straight street (W1).
 7. Enter the width of the curved street (W2).
 8. Enter R1, the radius of the first curve. Benchmark displays:
 - the point numbers and coordinates for:
 - the radius point of the curve (414)
 - the point of tangency with the curved street (415)
 - the point of tangency with the straight street (416)
 - all curve data (DELTA, RADIUS, ARC LENGTH, TANGENT, CHORD)
 9. Enter the radius R2 to generate the same output for the second curve.
- Finally, you are returned to the COMMAND prompt.



(174-) Two-Way Straight Into Curved

EXAMPLE

```

Command 174-      | Begin 2-way straight/curved intersection design
Storage Point = 414 | Establish new beginning storage point

Point A= 31       | Enter the point # of the intersection point
                  31  4565.0000  4630.0000
Point B= 34       | Enter a centerline point on the straight street
                  34  4420.0000  4630.0000
Point C= 32       | Enter the radius point # of the curved street
                  32  4438.0599  4632.8389

Street Width 1= 50 | Enter the width of the straight street W1
Street Width 2= 50 | Enter the width of the curved street W2
Radius Length 1= 15 | Enter the radius of the first curve R1
                  414  4513.7496  4590.0000  RP
                  415  4526.8038  4582.6116  PT
                  416  4513.7496  4605.0000  PT

Delta      = 119-30-32.5
Radius     = 15.00
Arc Length= 31.29
Tangent    = 25.73
Chord      = S59-45-16.2E      25.92

Radius Length 2= 20 | Enter the radius of the second curve R2
                  417  4508.3580  4675.0000  RP
                  418  4525.5098  4685.2867  PT
                  419  4508.3580  4655.0000  PT

Delta      = 120-57-11.2
Radius     = 20.00
Arc length= 42.22
Tangent    = 35.32
Chord      = S60-28-35.6W      34.81

```

(173-, 174-, 175-, 176-, 177-) Curved Street Intersection Routines

(175-) Four-Way Straight & Curved

PURPOSE

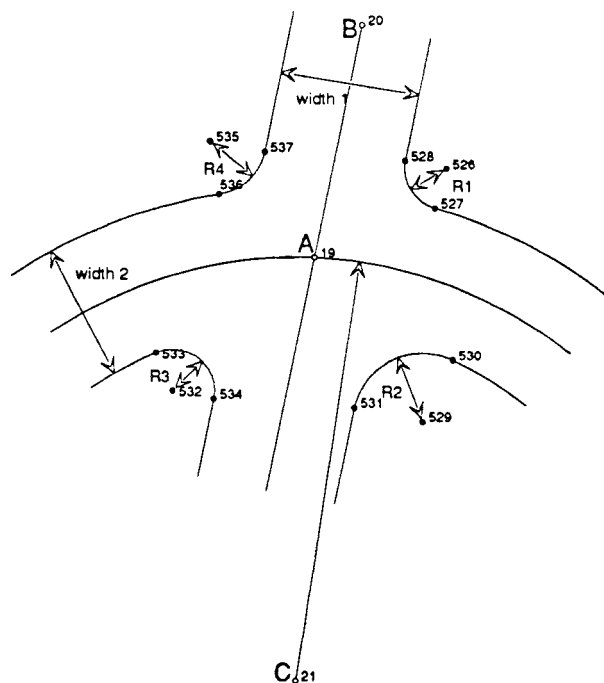
The 175- routine creates points and calculates fillet data for the four-way intersection of a straight and a curved street.

PROCEDURE

1. Enter 175-.
2. Enter the storage point number.
3. Enter the point number of the intersection point (A).
4. Enter the point number of a point on the center line of the straight street (B).
5. Enter the point number of the radius point of the curved street (C).
6. Enter the width of the straight street (W 1).
7. Enter the width of the curved street (W2).
8. Enter the radius of the first curve (R1). Benchmark displays:
 - the point numbers and coordinates of:
 - the radius point of the curve (526)
 - the point of tangency with the curved street (527)
 - the point of tangency with the straight street (528)
 - all curve data (DELTA, RADIUS, ARC LENGTH, TANGENT, CHORD)

NOTE: The curve data is displayed in clockwise order starting from the outside of the curve clockwise of the straight street.

9. To generate the same output for the other curves, enter R2, R3, and R4. At the end of the routine, you are returned to the COMMAND prompt.



(175-) Four-Way Straight/Curved

EXAMPLE

Command 175-
Storage Point= 526

Point A= 19

Point B= 20

Point C= 21

Street Width 1= 50
Street Width 2= 50
Radius Length 1= 15

Delta = 85-25-53.2
Radius = 15.00
Arc Length= 22.37
Tangent = 13.85
Chord = N31-24-20.8W 20.35

Radius Length 2= 25

Delta = 104-10-10.9
Radius = 25.00
Arc Length= 45.45
Tangent = 32.10
Chord = S63-23-41.2W 39.45

Radius Length 3= 15

Delta = 124-30-02.8
Radius = 15.00
Arc Length= 32.59
Tangent = 28.51
Chord = S50-56-25.7E 26.55

Radius Length 4= 20

Delta = 69-32-21.4
Radius = 20.00
Arc Length= 24.27
Tangent = 13.88
Chord = N46-04-46.4E 22.81

| Begin 4-way straight/curved intersection design
| Select the point number for storage

| Enter the point # of the intersection point-A

19 4505.0000 4630.0000

| Enter a centerline point of the straight street-B

20 4590.0000 4647.0000

| Enter the radius point # of the curved street-C

21 4351.1441 4624.2655

| Enter the width of the straight street W1

| Enter the width of the curved street W2

| Enter the radius of the first curve R1

526 4537.7060 4677.3334 RP

527 4523.2783 4673.2294 PT

528 4540.6477 4662.6246 PT

| Enter the radius of the second curve R2

529 4444.9952 4668.9892 RP

530 4467.5637 4679.7440 PT

531 4449.8981 4644.4747 PT

| Enter the radius of the third curve R3

532 4455.8984 4579.3875 RP

533 4469.6864 4573.4806 PT

534 4452.9567 4594.0962 PT

| Enter the radius of the fourth curve R4

535 4547.5747 4592.6238 RP

536 4527.8292 4595.8044 PT

537 4543.6523 4612.2354 PT

(173-, 174-, 175-, 176-, 177-) Curved Street Intersection Routines

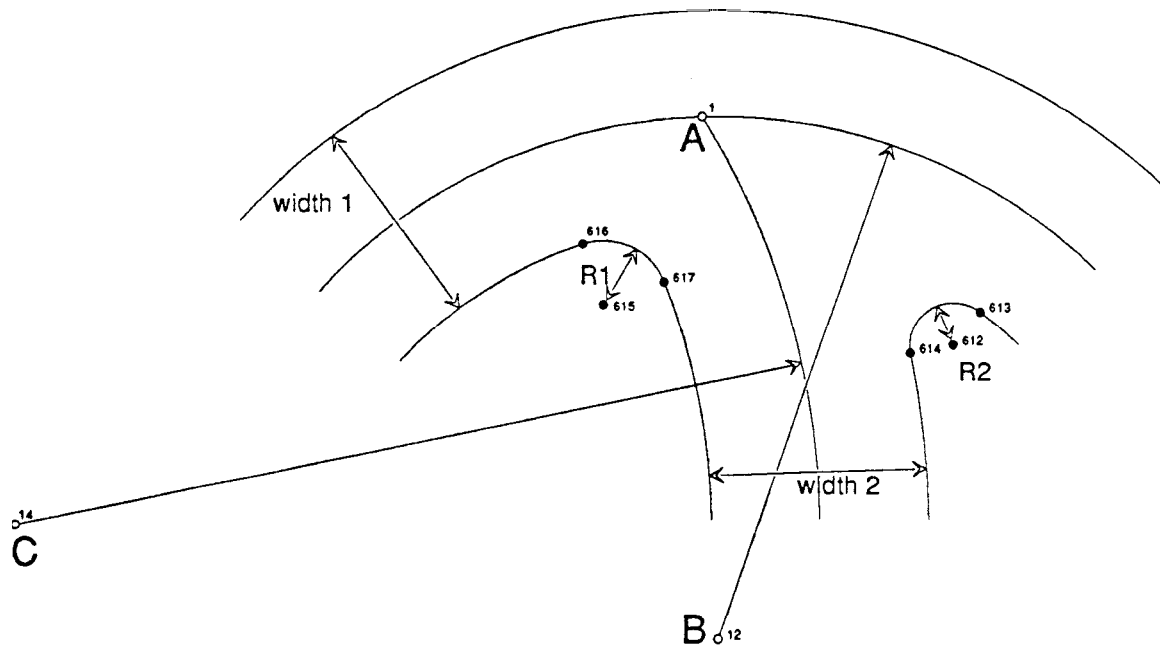
(176-) Two-Way Curve with Curved Entry

PURPOSE

176- calculates fillet data for the entry of one curved street into a two-way curved street. This routine creates the radius point of the curve, and the points of tangency with the main and side streets.

PROCEDURE

1. Enter **176-**.
 2. Enter the point number of the first storage point.
 3. Enter the point number of the intersection point (A).
 4. Enter the point number of the radius point Of the main street (B).
 5. Enter the point number of the radius point of the side street (C). Enter this point number negatively if the side street runs cOunter clockwise from A.
 6. Enter the width of the main street (W1).
 7. Enter the width of the side street (W2).
 8. Enter the radius Of the first curve (R1). Benchmark displays:
 - the point number and coordinates of:
 - the radius point of the curve (612)
 - the point Of tangency with the main street (613)
 - the point of tangency with the side street (614)
 - all curve data (DELTA, RADIUS, ARC LENGTH, TANGENT, CHORD)
 9. Enter R2 to generate the same data for the other curve.
- Finally, Benchmark returns to the COMMAND prompt.



(176-) Two-Way Curve With Curved Entry

EXAMPLE

```
Command 176- | Begin 2-way curve/curve intersection design
Storage Point = 612 | Select the point number for storage

Point A= 1 | Enter the point # of the intersection point
              1 5000.0000 5000.0000
Point B= 12 | Enter the radius point of the main street
              12 4877.0800 5004.0368
Point C= 14 | Enter the radius point of the side street
              14 4903.0000 4842.0000
Street Width 1= 50 | Enter the width of the main street W1
Street Width 2= 50 | Enter the width of the side street W2
Radius Length 1= 10 | Enter the radius of the first curve R1
                    612 4946.5298 5058.0582 RP
                    613 4954.4231 5064.1979 PT
                    614 4944.5548 5048.2551 PT

Delta      = 139-16-06.6
Radius     = 10.00
Arc Length= 24.31
Tangent    = 26.94
Chord      = S58-14-35.6W 18.75

Radius Length 2= 15 | Enter the radius of the second curve R2
                    615 4955.7118 4977.5083 RP
                    616 4969.9247 4972.7132 PT
                    617 4961.1498 4991.4879 PT

Delta      = 87-23-14.9
Radius     = 15.00
Arc Length= 22.88
Tangent    = 14.33
Chord      = S64-56-57.9E 20.72
```

(173-, 174-, 175-, 176-, 177-) Curved Street Intersection Routines

(177-) Four-Way Curve

PURPOSE

177- creates points and calculates fillet data for the intersection of two curved streets.

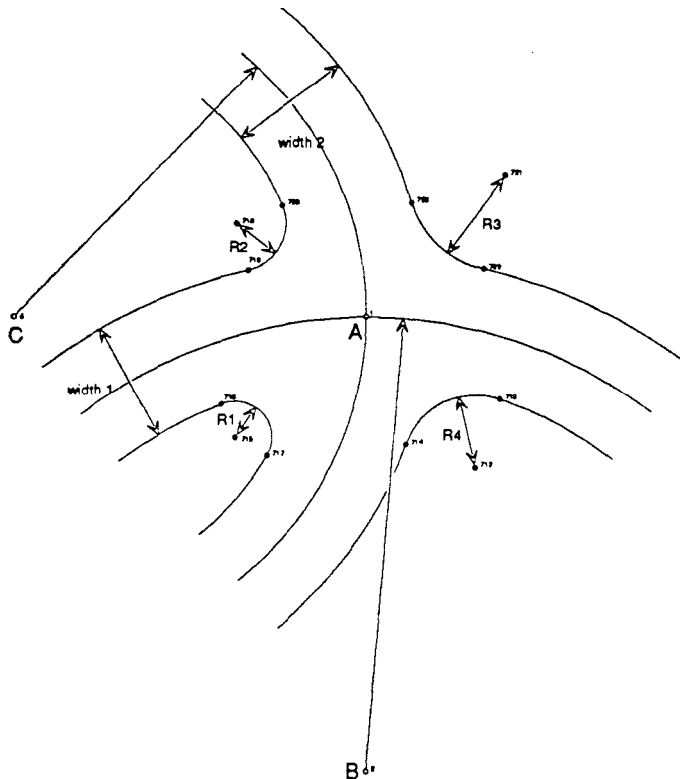
PROCEDURE

1. Enter 177-.
2. Enter the number of the first storage point.
3. Enter the number of the intersection point (A).
4. Enter the number of the radius point of the first curve (B).
5. Enter the number Of the radius point of the second curve (C).
6. Enter the width of the first street (W1).
7. Enter the width of the second street (W2).
8. Enter the radius of the first curve (R1). Benchmark displays:
 - the point numbers and coordinates of:
 - the radius pOint of the curve (712)
 - the point of tangency with the first curve (713)
 - the point of tangency with the second curve (714)
 - all curve data (DELTA, RADIUS, ARC LENGTH, TANGENT, CHORD)

NOTE: The curve data is displayed in a clockwise direction from inside the curve whose center is clockwise from A and inside the curve whose center is counter clockwise from A.

9. To generate the same output for the other curves, enter R2, R3, and R4.

Finally, Benchmark returns to the COMMAND prompt.



(177-) Four-Way Curve

EXAMPLE

Command 177-
Storage Point = 712

Point A= 1

Point B= 2

Point C= 5

Street Width 1= 50

Street Width 2= 50

Radius Length 1= 30

Delta = 90-46-33.1
Radius = 30.00
Arc Length= 47.53
Tangent = 30.41
Chord = S63-44-40.6W 42.71

Radius Length 2= 15

Delta = 140-46-21.2
Radius = 15.00
Arc length= 36.85
Tangent = 42.09
Chord = S41-08-03.2E 28.26

Radius Length 3= 20

Delta = 99-46-45.7
Radius = 20.00
Arc Length= 34.83
Tangent = 23.74
Chord = N26-40-42.5E 30.59

Radius Length 4= 40

Delta = 60-57-03.0
Radius = 40.00
Arc Length= 42.55
Tangent = 23.54
Chord = N46-55-38.2W 40.57

| Begin 4-way curve/curve intersection design
| Select the point number for storage

| Enter the point # of the intersection point

1 5000.0000 5000.0000

| Enter the radius point of the first curve

2 4811.7500 5001.2500

| Enter the radius point of the first curve

5 5000.0000 4857.0000

| Enter the width of the first street W1

| Enter the width of the second street W2

| Enter the radius of the first curve R1

712 4937.6436 5044.9247 RP

713 4965.9865 5054.7573 PT

714 4947.0915 5016.4512 PT

| Enter the radius of the second curve (R2)

715 4949.6688 4946.8653 RP

716 4963.6231 4941.3628 PT

717 4942.3390 4959.9525 PT

| Enter the radius of the third curve R3

718 5038.6239 4947.0677 RP

719 5019.1710 4951.7135 PT

720 5046.5064 4965.4489 PT

| Enter the radius of the fourth curve R4

721 5058.9076 5056.4841 RP

722 5019.8705 5047.7602 PT

723 5047.5792 5018.1218 PT

What are Groups?	11-2
(130-) Edit Group Data	11-3
The Group Menu	11-5
Edit Window	11-7
(142-) Store Group Data	11-11
(144-) Convert lot file	11-12
(136-) List Lot Description Files	11-13
(137-) Delete Lot Description File	11-14

WHAT'S IN THIS CHAPTER?

This chapter describes the Coordinate Geometry commands used to describe groups. The first part of this chapter explains briefly what groups are and how they are created. The next section explains how to use the Group Menu and group Edit Window. The next sections covers commands which access groups.

What are Groups?

Group commands use coordinate data generated in the Field Data Editor or Coordinate Geometry programs. A group describes a shape or a collection of individual points by referencing point numbers. Typical applications include describing lots, roadways, perimeters; groups of points for plotting, export to file, transfer to AutoCad DXF and points for interpolation tick mark generation. You can define and edit one or many groups with the built-in Edit Window. Groups are automatically saved to disk with your job file. Users of the Advanced Graphics Option will use groups to define what is displayed on the graphics screen and can also create and manipulate groups graphically.

NOTES:

1. Groups are an extension of what were known as lot descriptions in versions of Benchmark previous to version 7.0. Lot description files are fully useable within the newer Group format. The Field Data Editor still uses the lot description format to optionally store collections of points on disk that can later be incorporated into a group.
2. Whenever you save a Benchmark Job, any groups you have created are also saved in a separate file. For example, if you are working in Job number 2, the coordinate data is saved to a file called PB2.DAT and the group data is saved to a file called PB2.GRP.
3. If you ever need to save group data only, but do not wish to save the coordinate data, you can use the 142- command (described later in this chapter) to save the group data, then close the job without saving.
4. Groups are numbered with integers from 1 to 32,000. Up to 1,000 groups can be defined in each job.

(130-) Edit Group Data

CREATING A GROUP

Before you define a group, the coordinate data from which you want to define a group should already exist. Typically, you will load a job file (124-) that contains this data. Then you can begin the group edit procedure with the 130- command.

The following steps describe how to define a group:

1. Enter 130-.
2. If no groups have been previously defined in the job, you will receive this prompt, to which you would respond with a number:

Enter New Group Number <1-32000> or <ESCAPE>=

If any groups already exist in the job, the Group Menu will appear, similar to this:

Choose Group

1	Perimeter	Inactive
2	Lot 1	Active
3	Lot 2	Active

ESCAPE-Exit F1-Help F2-Print All F3-Set Default F4-Chg. Status ENTER-Edit

From this screen you can either highlight an existing group to edit or tap the INSERT key to create a new one.

3. When editing a New Group the Edit Window will appear, similar to this:

```
NAME=  
STATUS=1  
TYPE=C  
POINTTEXT=P  
LINELAYER=
```

ESCAPE - Exit F1 - Help F2 - Print F10 - Save Changes

In the Edit Window you can enter point numbers to define a group. Other important settings for the group are also entered in the Edit Window, including NAME, STATUS, TYPE, POINTTEXT and LINELAYER. These will be explained in more detail in following pages.

(130-) Edit Group Menu

Below is a typical group ready to be saved:

```
NAME=Perimeter
STATUS=1
TYPE=C
POINTTEXT=PD
LINELAYER=
406
522
306-309
525
463
404-402
```

| 1: 1 |

ESCape - Exit F1 - Help F2 - Print F10 - Save Changes

4. When the editing is done, F10 saves the group, returning you to the Group Menu.

Some comments about the group in the above example:

The NAME "Perimeter" will be displayed at the beginning of this group during Batch Inverse (134-) and will be used as the Group Name when sending this group to AutoCAD with the 127-command.

Its STATUS is Active (1) so it will be considered for use by Batch Inverse (I34-), AGO/Screen Graphics (126-), Benchplot II(117-) and Create AutoCAD DXF (127-).

The TYPE is a Closed polygon.

POINTTEXT is set to display Point numbers and Descriptions in AGO/Screen Graphics (126-), BenchPlot (117-) and AutoCAD (127-).

LINELAYER is left blank, so the layer specified for lines during Create AutoCAD DXF (127-) will not be overridden when this group is sent to AutoCAD.

The Group Menu

If one or more groups already exist in a job, entering 130- (Edit Group Data) causes the Group Menu will appear, similar to this:

Choose Group

1	Perimeter	Inactive
2	Lot 1	Active
3	Lot 2	Active

ESCape-Exit F1-Help F2-Print All F3-Set Default F4-Chg. Status ENTER-Edit

A command bar at the bottom of the screen lists some of the options available from the Group Menu.

Here is a complete list of options available from the Group Menu:

Enter	Select the highlighted choice for editing
Home/End	Move cursor to start/end of the menu
PgUp/PgDn	Display previous/next page of menu
Up/Down Arrows	Move the highlight bar a single line
Delete	Delete the highlighted group (requires confirmation before it is carried out)
Right-Shift-Delete	Delete the highlighted group to Hold Area. This deletes the group from the list and temporarily stores the group in memory. <Hold Area Active> is displayed at the top of the screen anytime this condition exists.

With a group in the Hold Area, at the next attempt to insert a new group a group number will be requested and the Edit Window will appear containing the group from in the Hold Area. It can be edited and must be saved in order for it to become part of the Group Menu. The Hold Area loses its contents as soon as this occurs. The Hold Area also loses its contents when you Exit from the Group Menu.

Insert	Insert a new group following the highlighted group. Use to create New groups. If there is data in the Right-Shift-Delete Hold Area, it will be placed into this new group.
Escape	Exit back to the Coordinate Geometry screen. Any data in the Hold Area is lost. All groups displayed on the Group Menu are retained. If 130-was issued from AGO, you will exit back to AGO.

The Group Menu

F1	Help
F2	Print All Groups
F3	Set Defaults for new group takes the defaults of the highlighted group and uses them for the next Insert of a new group.
F4	Change Status (Active/Inactive). The Status of a group determines whether the group data will be inversed during Batch Inverse (134-), whether it will be displayed in Screen Graphics (126-), whether it can be sent to AutoCAD (127-) and whether it will be plotted with Benchplot II (117-).

With a mouse you may move the highlight by clicking on the desired item or by holding down the left button while moving the mouse. To open the Edit Window, you double-click on the group you want to edit.

As the Group Menu grows in size, a scroll bar with scroll arrows and scroll diamond appears on the right side. With a mouse the menu may be scrolled by sliding the scroll bar diamonds.

Edit Window

The Edit window is where you define the contents and characteristics of a group. The top lines are where the settings are listed: NAME, STATUS, *TYPE*, *POINTTEXT* and *LINELAYER*. Below these is where point numbers can be entered.

A line may contain one of the following (* marks defaults):

Settings:

NAME=	Text displayed on the Group Menu, during Batch Inverse (134-) and sent to AutoCAD as the Lot Name
*STATUS=1	For an active group.
STATUS=0	For an inactive group.
*TYPE=P	For a group of disconnected points.
TYPE=C	For lines making up a closed polygon.
TYPE=O	For lines that do not make up a closed polygon.
TYPE=TTICKS	For generating elevation tick marks in traverse mode.
TYPE=STICKS	For generating elevation tick marks in side-shot mode.
POINTTEXT=	Determines what information will be sent with the point and point number to AGO, AutoCAD or Benchplot II
*POINTTEXT=P	Label points with a point number only.
POINTTEXT=PE	Label points with point number and elevation.
POINTTEXT=PD	Label points with point number and description.
POINTTEXT=PED	Label points with point number, elevation and desc.
LINELAYER=	Layer name to override the the layer specified in the 127- command for Lines

Points:

Point number	A point number that is to be included in the group.
Start#-End#	A range of point numbers to be included in the group.
RP and PI	Signals inverse of a curve. These are entered on the line just before the RP or PI point number.
RP	Signals that a radius point follows on the next line.
PI	Signals that a point of intersection follows on the next line.

For example, the following would describe a lot with lines connecting points 100 thru 50. Point 50 being a PC, 200 an RP and 201 a PT. Lines would also connect points 201 thru 404. Since this is a closed polygon (TYPE=C), a line will connect points 404 and 100.

```
NAME=Newton's Corner
TYPE=C
POINTTEXT=P
100-50 RP
200-404
```

The Edit Window

You may cut and paste a block from one group into itself or any number of other groups. There is more on marking, cutting and pasting blocks below.

Here is a complete list of options available in the Edit Window:

Arrows	Move cursor right, left, up, down
Home/End	Move cursor to start/end of line
Ctrl-Home/End	Move cursor to top/bottom of screen
PgUp/PgDn	Display previous/next page
Ctrl-PgUp/PgDn	Display first/last page
Ctrl-Left/Right	Move cursor by whole words
Ctrl-Y	Delete the current line
Ctrl-N	Insert a new line above
Escape	Exit edit window without saving changes
F1	Help
F2	Print the current group
F10	Save the changes and exit the edit window

The Edit Window has a certain amount of intelligence. It will beep at you if you enter a setting incorrectly or if you enter unknown text on a point number line.

Use the Right-Shift-Cursor keys to begin a block operation. To mark a column use Right-Shift-Right and then Right-Shift-Down. Once a block has been marked, any key except Escape will capture it into the Paste buffer. If Delete is pressed, the block will be captured and then deleted. Use Shift-Ins to paste the block at a new location. A block may be pasted into another group. A block may be repeatedly pasted and is retained in memory until it is replaced with another block or until you exit from the Group Menu.

USING A MOUSE IN THE EDIT WINDOW

To mark a block with the mouse, simply position the mouse cursor at the beginning of the block and press the left button. While the button is down the cursor may be moved in any direction. If the mouse is first moved up or down, marking is in sentence mode. To mark a block in column mode move left or right first.

The text may be scrolled either by sliding the scroll bar diamonds at the bottom and right, or by pressing on the arrow icons near the bottom right corner.

The window may be resized by pressing on the lower right or top left corners, and then moving the mouse. The window may be zoomed in in out by pressing on the icon at the top right corner.

The Edit Window may be moved by pressing on the bar along the top and moving to a new position.

(134-) Batch Inverse

PURPOSE

134- lists inverses of group data.

PROCEDURE

After one or more groups are defined using Edit Group Data (130-), enter 134- to list inverses. At the prompt Group # =, enter the group number you want to inverse. If you do not supply a group number and just press ENTER, all Active groups will be listed. If you enter the number of an Inactive group, it will not be listed.

OUTPUT

The list displayed by 134- includes:

- the group NAME
- bearing, length and coordinates of each side -
- all curve data
- area in square feet and acres

NOTES

Because 134- will only display Active groups, it is best to examine the status of the groups with Edit Group Data (130-) and change the status of any groups you wish to inverse to Active.

The direction in the output will be in either bearings, azimuths or angles right, depending on whether 6-, 7- or 8- is in effect.

(134-) Batch Inverse

EXAMPLE

Job->#40 foo [159]
Bearing Distance Descrip Pnt. Northing Easting Type
-----06-08-1990-----14:52:58-----D:\BENCH70\DEMO

Command= 134-
Group #=

Parcel #2 -----

		77	4387.0834	5249.9008	TRA
N18-51-37E	109.09	76	4490.3129	5285.1644	PT
N18-51-37E	50.00	34	4537.6283	5301.3276	OS
S41-47-54E	50.00	78	4500.3535	5334.6531	PT

Delta = -60-39-31
Radius Length = 50.00
Arc Length = 52.93
Tangent Length = S71-08-23E N48-12-06E 29.25
Chord Length = N78-31-52E 50.50

S41-47-54E	149.36	79	4389.0071	5434.2024	TRA
S89-24-07W	184.31	77	4387.0834	5249.9008	TRA

Final Area= 12500 Square Feet
0.29 Acres

Parcel #5 -----

		UP	3	4992.4130	5446.4750	
S89-33-44W	110.00		48	4991.5725	5336.4782	OS-R
S00-26-16E	72.43		55	4919.1473	5337.0317	PT-R
S89-33-44W	170.00		53	4917.8482	5167.0366	RP
S79-44-26E	170.00		86	4887.5698	5334.3185	PT

Delta = 10-41-51
Radius Length = 170.00
Arc Length = 31.74
Tangent Length = S00-26-16E S10-15-34W 15.92
Chord Length = S04-54-39W 31.69

S79-44-26E	112.12		87	4867.5998	5444.6486	TRA
N00-50-18E	124.83	UP	3	4992.4130	5446.4750	

Final Area= 12500 Square Feet
0.29 Acres

(142-) Store Group Data

PURPOSE

142- stores group data on the job disk.

PROCEDURE

Enter 142-.

NOTES

Whenever you make modifications to group files, Benchmark will ask you if you want to save the current job when you try to exit from Coordinate Geometry (4-). Occasionally you may want to save the changes only to the Group Data file, which is what I42- does.

(144-) Convert lot file

PURPOSE

144- converts lot description files into groups.

PROCEDURE

Enter 144-. Benchmark requests a lot description file number to convert. Enter a number from 1-9999. If the lot description file exists, each lot within that file is converted to a group and appended to the Group Menu.

NOTES

1. Use 144- to convert lot description files created in the Field Data Editor into groups.
2. Lot description files from previous versions of Benchmark which *contain* more than one lot will lose the lot numbers formerly associated with each lot.
3. Once you have converted a lot description to a group and saved it in the group format, you may wish to delete the lot description file in order to free disk space by using the I37- command.

EXAMPLE

```
Command= 144-  
Lot Description file # to Convert= 955
```

(136-) List Lot Description Files

PURPOSE

Use 136- to display a directory listing of the lot description files in the current subdirectory.

PROCEDURE

1. Make sure you are in the subdirectory you want. If not, use 30I- to change to the correct subdirectory.
2. Enter **13 6—** at the COMMAND prompt. A list of the lot description files in the current subdirectory are displayed.

NOTES

1. 136- lists lot description files created in the Field Data Editor and any created in previous versions of Benchmark. Once you have converted a lot description to a group and saved it in the group format, you may wish to delete the lot description file in order to free disk space by using the 137- command.
2. Lot description files have the format **DESCnnnn.DAT**, where **nnnn** is a 1- to 4-digit number that uniquely names a file. Thus, DESC45.DAT, DESC999.DAT, and DESC44.DAT are valid names.

EXAMPLE

```
COMMAND 136- | List lot description files
JOB #

BEARING      DIST      PNT  NORTHING      EASTING      TYPE
-----10-10-1986-----16:43:30-----C:bench
C:\NEWBENCH
DESCODES.DAT  DESCBLKS.DAT  DESC130 .DAT  DESC12 .DAT
DESC131 .DAT  DESC141 .DAT  DESC18 .DAT  DESC1802.DAT
DESC180 .DAT  DESC5 .DAT    DESC9999.DAT
12201984 Bytes free
COMMAND
```

(137-) Delete Lot Description File

PURPOSE

137- deletes lot description files from the current subdirectory.

PROCEDURE

1. Enter **137-** at the COMMAND prompt.
2. At the prompt DELETE LOT DESCRIPTION FILE NO.=, enter a 1 to 4-digit number that identifies the lot description file.

NOTES

1. Use the 136- command to list lot description files.
2. Once you have converted a lot description to a group and saved it in the group format, you may wish to delete the lot description file in order to free disk space up using the 137- command.

EXAMPLE

```
COMMAND 137-      | Delete lot description file
DELETE LOT DESCRIPTION FILE NO.= 5    | #5
COMMAND
```


Lot Sizing Commands

General Procedure	12-2
(190-) Begin Lot Sizing	12-3
(20-, 21-, 23-, 24-) Traverse Routines	12-4
(40-, 41-, 42-) Copy Direction and Distance	12-4
(81-) Consecutive Inverse Routine	12-5
(68-) Inverse Radius Curve	12-6
(192-) Radial Lot Design, Minimum Arc at Setback	12-8
(193-) Radial Lot Sizing, Minimum Chord at Setback	12-9
(194-) Lot Sizing by Sliding Bearing	12-10
(191-) Lot Sizing by Bearing Swing	12-12
(195-) Lot Sizing, Parallel	12-14

WHAT'S IN THIS CHAPTER?

With the lot sizing commands, you can design a lot to meet a required minimum square footage. First you describe a boundary of a lot, then solve the lot by one of several methods (bearing swing, radial lot sizing, sliding bearing, parallel lines).

General Procedure

You can use the lot sizing commands to design a lot to meet a required minimum square footage. There are three major steps to designing a lot.

Step 1 - Begin lot sizing with the 190- command. This clears area summation and lets you specify an occupied point and a storage point.

Step 2 - Describe the known boundary of the lot with any of the following commands:

- Traverse mode commands (20-, 21-, 23-, 24-)
- copy direction and distance (40-, 41-, 42-)
- Inverse command (81-)
- Inverse radius curve (68-)

Step 3 - After you have described the known boundary, enter a command to solve the lot:

- Lot Sizing by Bearing Swing (191-)
- Radial Lot Sizing, Minimum Arc at Setback (192-)
- Radial Lot Sizing, Minimum Chord at Setback (193-)
- Lot Sizing by Sliding Bearing (194-)
- Lot Sizing, Parallel Lines (195-)

After entering one of the above lot solving routines, you will be prompted for direction entry at certain points. You may use any of the copy direction and distance commands (40-, 41-, 42-) or input a direction and distance directly with the 20-, 21-, 23-, or 24- options.

(190-) Begin Lot Sizing

PURPOSE

The 190- command clears area summation, and prompts you for an occupied point and a storage point.

Before you use the 190- command, you need to load the job containing the data from which you will describe your lot.

PROCEDURE

1. Enter **190-**.
2. Enter the point number of the occupied point. The program displays the coordinates of this point.
3. Enter the point number of the storage point. The program then proceeds to the traverse routine, and prompts for a direction.

EXAMPLE

```
Command 190-
Point Occupied 49

Storage Point = 50
Bearing= 81-
Point= 48
S04-25-52.1W 206.57
Point= 31
S89-49-30.1W 54.13
Point= 68-
Radius Point= 30
N00-10-29.8W 30.00
Point of Tangency= 32
S52-00-11.8W 30.00
Delta          = 52-10-41.6
Radius         = 30.00
Arc Length     = 27.32
Tangent        = 14.69
Chord          = 26.39
Point= 192-
Radius Point= 17
Bearing= 40-
Point= 49
Point= 37
Area (Enter Negative for convex arc)= 25000
Minimum Width= 0
S52-00-11.5W 76.00
N04-15-12.5E 76.00

Delta          = 47-44-59.1
Arc Length= 63.34
Tangent        = 33.64
Chord          = N61-52-18.0W      61.52

N04-15-12.5E 149.98
N83-19-37.6E 137.89
Final Area = 25000 Square Feet
            0.5739 Acres

Lot Sizing Completed !
Command
```

```

| Begin lot sizing
| Enter the point number of the starting point
49 5433.6371 5419.0401
| Select the point number for storage
| Start inversing to describe known part of lot
| Inverse to point 48
48 5227.6813 5403.0801
| Inverse to point 31
31 5227.5160 5348.9502
| Inverse through curve and adjust area
| Inverse to radius point of curve
30 5257.5158 5348.8586
| Continue inverse from radius to end of curve
32 5239.0473 5325.2172

| Radial lot sizing-minimum arc at setback
| Enter the radius point (D)
| Copy direction from two points
| Copy bearing from point 49...
| Toward point 37
| Enter area in sq. ft.
| Enter 0 <return> if no minimum width/setback
17 5192.2604 5265.3258
50 5268.0510 5270.9626 PT

51 5417.6144 5282.0862 TRA
49 5433.6371 5419.0401
```

(20-, 21-, 23-, 24-) Traverse Routines

PURPOSE

Following the 190- command, you enter traverse mode to describe the boundary of the lot.

PROCEDURE

1. Select **20-**, **21-**, **23-**, or **24-**, depending on the method of direction entry you want to use.
2. Enter the direction (or angle) and distance. Note that you can also use **40-**, **41-**, or **42-** to copy direction and distance from existing points.

Benchmark displays the bearing and distance A to B and the point number and coordinates of B.
The occupied point is B and the direction is from A to B.

3. Repeat steps 1 and 2 for each traverse leg.

NOTE: When you use the traverse routines after a 190- command, the label "TRA" does not appear after displayed coordinates. The same is true for the 40-, 41-, and 42- routines.

(40-, 41-, 42-) Copy Direction and Distance

- (40-) Copy Direction
- (41-) Copy Distance
- (42-) Copy Direction and Length

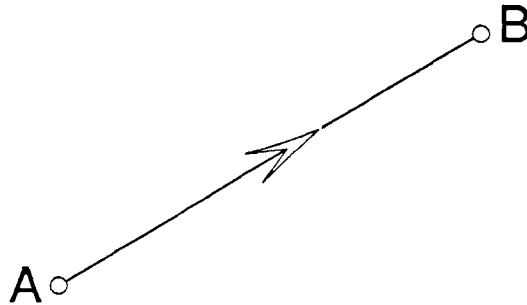
PURPOSE

After 190-, these three commands function just like they do elsewhere in Coordinate Geometry. See Chapter 6 for more detailed explanation of these commands.

(81-) Consecutive Inverse Routine

PURPOSE

To find the bearing and distance from the occupied point **A** to another point **B** when describing a lot boundary. This routine does not create points.



PROCEDURE

1. Occupy point A, then enter **81-**.
2. Enter the point number of B. The output is the bearing and distance from the occupied point A to B, and the point number and coordinates of B. The occupied point is now B and the direction is A to B.

This routine repeats until you enter a new command at the **P o i n t =** prompt.

NOTE:

When used after 190-, the 81- command does not insert the label "INV" after displayed coordinates.

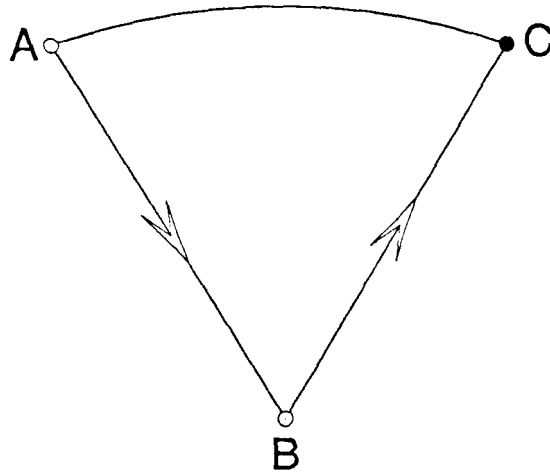
EXAMPLE

Command 190-	<i>Begin lot sizing</i>
Occupied Point= 49	<i>Enter the point number of the starting point</i>
	49 5433.6371 5419.0401
Storage Point = 50	<i>Select the point number for storage</i>
Bearing= 81-	<i>Start inversing to describe known part of lot</i>
Point= 48	<i>Inverse to point 48</i>
S04-25-52.1W 206.57	48 5227.6813 5403.0801
Point= 31	<i>Inverse to point 31</i>
S89-49-30.1W 54.13	31 5227.5160 5348.9502
Point= 68-	<i>Inverse through curve and adjust area</i>
...	

(68-) Inverse Radius Curve

PURPOSE

68- corrects the area summation for curves when you are describing a lot boundary. This routine does not create points.



PROCEDURE

1. Before you begin, occupy the point of curvature (P.C.) (A).
2. Enter **68-**.
3. At the prompt **Radius Point=**, enter the point number of the radius point, **B**. Benchmark computes the bearing and distance, A to B, and displays the point number and coordinates of **B**.
4. At the prompt **Point of Tangency=**, enter the point number of C, the end of the curve. Benchmark computes the direction and distance from B to C and displays the point number and coordinates of C, and all curve data (DELTA, RADIUS, ARC LENGTH, TANGENT, CHORD).

NOTES

1. The central angle (DELTA) is assumed to be less than 180°.
 2. After step 4 above, the occupied point is C and the direction is B to C.
- (68-) Inverse Radius Curve

EXAMPLE

```

Command 190-
Occupied Point 49

Storage Point = 50
Bearing= 81-
Point= 48
S04-25-52.1W 206.57
Point= 31
S89-49-30.1W 54.13
Point= 68-
Radius Point= 30
N00-10-29.8W 30.00
Point of Tangency= 32
S52-00-11.8W 30.00
Delta      = 52-10-41.6
Radius     = 30.00
Arc Length = 27.32
Tangent    = 14.69
Chord      = 26.39
Point= 192-
Radius Point= 17
Bearing= 40-
Point= 49
Point= 37
Area (Enter Negative for convex arc)= 25000
Minimum Width= 0
S52-00-11.5W 76.00
N04-15-12.5E 76.00

Delta      = 47-44-59.1
Arc Length= 63.34
Tangent    = 33.64
Chord      = N61-52-18.0W      61.52

N04-15-12.5E 149.98
N83-19-37.6E 137.89
Final Area = 25000 Square Feet
              0.5739 Acres

Lot Sizing Completed !
Command

```

```

| Begin lot sizing
| Enter the point number of the starting point
49 5433.6371 5419.0401
| Select the point number for storage
| Start inverting to describe known part of lot
| Inverse to point 48
48 5227.6813 5403.0801
| Inverse to point 31
31 5227.5160 5348.9502
| Inverse through curve and adjust area
| Inverse to radius point of curve
30 5257.5158 5348.8586
| Continue inverse from radius to end of curve
32 5239.0473 5325.2172

| Radial lot sizing-minimum arc at setback
| Enter the radius point (D)
| Copy direction from two points
| Copy bearing from point 49...
| Toward point 37
| Enter area in sq. ft.
| Enter 0 <return> if no minimum width/setback
17 5192.2604 5265.3258
50 5268.0510 5270.9626 PT

```

```

51 5417.6144 5282.0862 TRA
49 5433.6371 5419.0401

```

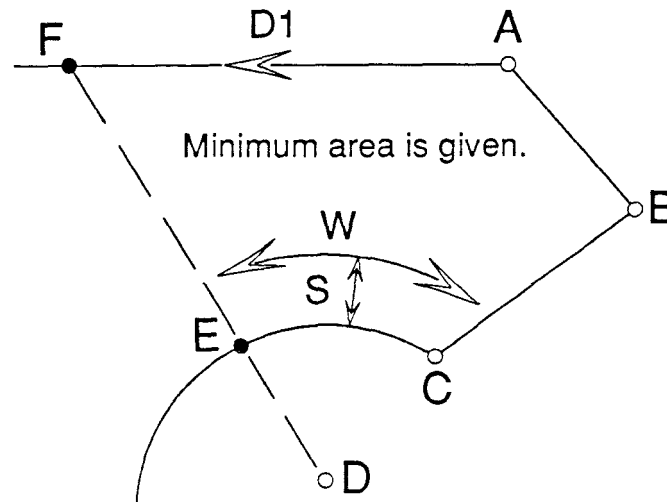
(192-) Radial Lot Design, Minimum Arc at Setback

PURPOSE

Given:

- Starting point A
- Direction D1 from A
- Partial boundary A through C
- Radius point D
- Minimum area
- Minimum width (W, arc length) at setback S

Create points E and F such that line E-F is radial from D and the lot has specified minimum area and minimum width (W).



PROCEDURE

1. Start with **190-**, to clear any previous area accumulation. Then describe the partial boundary A through C using the routines for traverse, inverse, and radius curves.
2. Enter **192-**.
3. Enter the point number of the radius point (D).
4. Enter the direction (D1).
5. Enter the minimum area in sq. ft. Enter the area negatively if the arc is bent out.
6. Enter the minimum arc length, or width (W), at setback (S). For no minimum width, enter 0 (or just press RETURN with no entry).

Benchmark displays:

- Direction and distance, C to D, the point number and coordinates of D
- Direction and distance, D to E, the point number and coordinates of E
- Curve data (DELTA, ARC LENGTH, TANGENT, CHORD)
- Direction and distance, E to F, the point number and coordinates of F
- Direction and distance, F to A, the point number and coordinates of A
- Final area (in square feet and acres)

See the example on previous page.

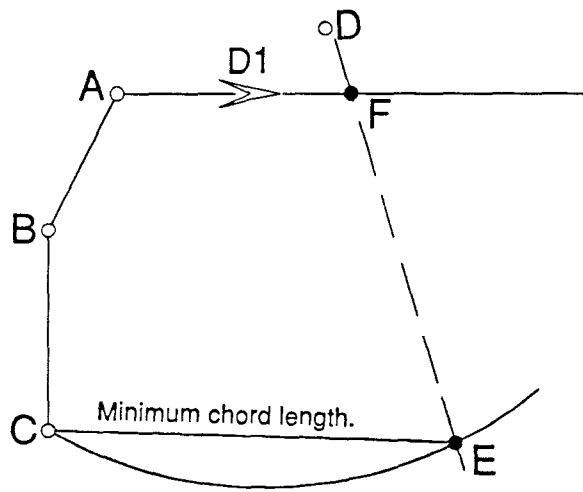
(193-) Radial Lot Sizing, Minimum Chord at Setback

PURPOSE

Given:

- Starting point A
- Direction D1 from A
- Partial boundary A through C
- Radius point D
- Minimum area
- Minimum width (W, chord length) at setback S

Create points E and F such that line E-F is radial from D, and the lot has specified minimum area and minimum width (W).



PROCEDURE

The 193- command follows the same procedure as the 192- command. The only difference is that the value for W is the minimum chord length. With 192-, W is the minimum arc length.

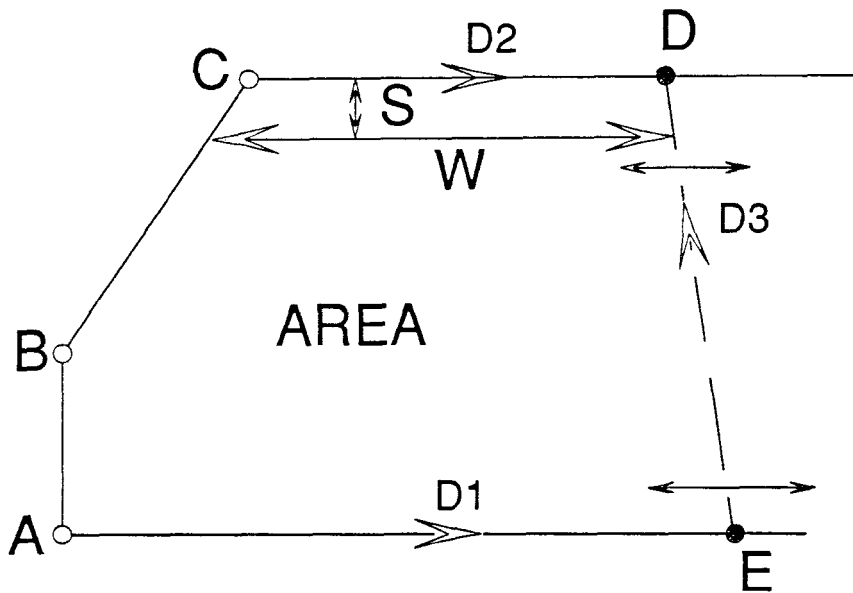
(194-) Lot Sizing by Sliding Bearing

PURPOSE

Given:

- Partial boundary A through C
- Directions
 - D1 from A
 - D2 from C
 - D3 from E to D
- Minimum area
- Enter minimum width (W) at setback S

Create points D and E such that lot has specified minimum area and minimum width (W).



PROCEDURE

1. Begin with **190-** to clear any previous area accumulation. Then describe the partial boundary A through C using the traverse, inverse, and radius curve commands.
2. Enter **194-**.
3. Enter the desired area in square feet.
4. Enter the direction D1.
5. Enter the direction D2.
6. Enter the direction D3.
7. Enter the minimum width (W). If no minimum width (W) on setback is required, enter 0 (or just RETURN with no entry).
8. Enter the setback (S). If no setback, enter 0.

(194-) Lot Sizing By Sliding Bearing

OUTPUT

After step 8, Benchmark displays:

- Direction and distance C to D, point number and coordinates of D •
- Direction and distance D to E, point number and coordinates of E
- Direction and distance E to A, point number and coordinates of A
- Final area

EXAMPLE

Command 190-	Begin lot sizing		
Point Occupied = 7	Enter the point number of the starting point		
	7	5472.0943	5598.1643
Storage Point= 44	Press RETURN to select default point number		
Bearing= 81-	Start inverse to describe known part of lot		
Point= 42	Inverse to point 42		
N00-00-00.0E 52.00	42	5524.0924	5598.1643
Point= 41	Continue inverse to point 41		
N83-19-30.1E 148.16	41	5541.3145	5745.3235
Point= 194-	Lot sizing by sliding bearing		
Area= 21780	Enter the desired minimum area in square feet		
Bearing= 40-	Define direction D1 using two points		
Point= 7	Define bearing FROM point 7		
Point= 43	Toward point 43		
Bearing= 40-	Define direction D2 using two points		
Point= 41	Define bearing from point 41		
Point= 24	Toward point 24		
Bearing= 40-	Copy direction D3 from two points		
Point= 42	Copy bearing from point 42...		
Point= 41	Toward point 41		
Minimum Width= 100	Enter the minimum width		
Setback = 20	Enter the required setback		
S00-00-00.0E 149.09	44	5392.2228	5745.3235 TRA
S83-19-30.1W 144.84	45	5375.3869	5601.4647 TRA
N01-57-16.6W 96.76	7	5472.0943	5598.1643
Final Area = 21780 Square Feet			
0.5000 Acres			
Command			

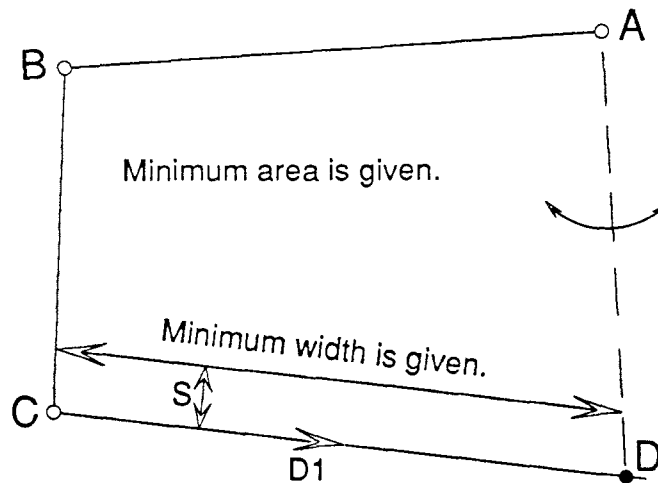
(191-) Lot Sizing by Bearing Swing

PURPOSE

Given:

- Partial boundary A through C
- Direction D1 from C
- Minimum area
- Minimum width (W) at setback S

Create point D such that lot A-B-C-D has minimum width W and specified minimum area.



PROCEDURE

1. Start with **190-** to clear any previous area accumulation. Describe the partial boundary A through C using routines for traverse, inverse, and radius curves.
2. Enter **191-**.
3. Enter the desired area in square feet.
4. Enter the direction D1.
5. Enter the minimum width W. If no minimum width is required, just press RETURN with no entry.
6. Enter setback S if width W is greater than 0.

OUTPUT

After step 6, Benchmark displays:

- Direction and distance C to D, point number and coordinates of D.
- Direction and distance D to A, point number and coordinates of A.
- Final area.

NOTE:

In Step 1 above, the partial boundary may be described in either a clockwise or counterclockwise manner, as needed.

(191-) Lot Sizing By Bearing Swing

EXAMPLE

```

Command 190-
Point Occupied= 7

Storage Point= 43
Bearing= 81-
Point= 42
N00-00-00.0E 52.00
Point= 41
N83-19-30.1E 148.16
Point= 24
S00-00-00.0W 282.68
Point= 68-
Radius Point= 22
N90-00-00.0W 30.00
Point of Tangency= 23
S00-10-29.8E 30.00
Delta          = 89-49-30.2
Radius         = 30.00
Arc Length     = 47.03
Tangent        = 29.91
Chord          = 42.36
Point= 191-
Area= 43560
Bearing = 894930
Quadrant= 3
Minimum Width= 0
S89-49-30.0W 108.93
N01-57-16.6W 243.93
  Final Area = 43560 Square Feet
                1.0000 Acres
Command

```

```

| Begin lot sizing
| Enter the point number of the starting point
|   7   5472.0943   5598.1643
| Enter the point number for storage
| Start inversing to describe known part of lot
| Inverse to point 42
|   42   5524.0924   5598.1643
| Continue inverse to point 41
|   41   5541.3145   5745.3235
| Continue inverse to point 24
|   24   5258.6351   5745.3235
| Command to inverse through curve and adjust area
| Inverse into the radius point
|   22   5258.6351   5715.3235
| Continue inverse out to the end of the curve
|   23   5228.6353   5715.4151

| Lot sizing by bearing swing
| Enter the desired area in sq.ft.
| Enter the direction D1
| Enter quadrant of above bearing
| Enter 0 or press RETURN if no minimum width required
|   43   5228.3026   5606.4843   TRA
|   7   5472.0943   5598.1643

```

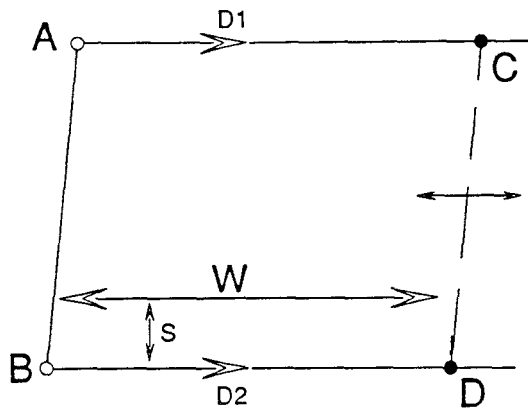
(195-) Lot Sizing, Parallel

PURPOSE

Given:

- Points A and B
- Directions D1 from A and D2 from B
- Minimum area
- Minimum width (W) at setback S

Create points C and D such that line DC is parallel to line AB.



PROCEDURE

1. Enter **190-**, then **195-**.
2. Enter the point number of A.
3. Enter the direction D1.
4. Enter the storage point number of C.
5. Enter the point number of B.
6. Enter the direction D2.
7. Enter the storage point number of D.
8. Enter the minimum area.
9. Enter the minimum width W. If no minimum width is required, just press RETURN with no entry.
10. Enter the setback S.

(195-) Lot Sizing, Parallel Output

After step 10, Benchmark displays:

- Direction and distance A to D, the point number and coordinates of D
- Direction and distance D to C, the point number and coordinates of C
- Direction and distance C to B, the point number and coordinates of B
- Direction and distance B to A, the point number and coordinates of A
- Final area

NOTE

The 195- routine is unique among the lot solution commands because it requires no traverse input before selection.

EXAMPLE

Command 190-	Begin lot sizing
Point Occupied= 195-	Lot sizing-parallel
Point= 13	Enter the point number of A
Bearing= 40-	Copy direction D1 using two point numbers
Point= 13	Define bearing from point 13...
Point= 7	Toward point 7
Storage Point= 42	Enter the storage point number for C
Point= 14	Enter the point number of B
Bearing= 40-	Copy direction D2 using two point numbers
Point= 14	Define bearing from point 14...
Point= 24	Toward point 24
Storage Point= 41	Enter the point storage number for D
Area= 21780	Enter the area in sq. ft.
Minimum Width= 0	Enter 0 (or press RETURN) if no minimum width required
S00-00-00.0W 148.00	42 5524.0924 5598.1643 TRA
N83-19-30.1E 148.16	41 5541.3145 5745.3235 TRA
N00-00-00.0E 148.00	14 5689.3175 5745.3235
S83-19-30.1W 148.16	13 5672.0954 5598.1643
Final Area = 21780 Square Feet	
0.5000 Acres	
Command	

Transformation and Rotation Commands

(152-) Coordinate Transformation by Points	13-2
(151-) Coordinate Transformation by Angle Rotation	13-4
(153-) Coordinate Transformation by Bearing	13-5

WHAT'S IN THIS CHAPTER?

There are three routines to transform coordinates from one system to another.

- The **152-** command works by requesting the coordinates of two points in the old system and the corresponding two points in the new system.
- The **151-** command requests a base point in the old system, a rotation angle, and a scale factor to transform points to the new system. This method also allows for reduction to sea level equivalents.
- **153-** is similar to **151-** but requests entry of a bearing instead of a rotation angle.

(152-) Coordinate Transformation by Points

PURPOSE

The 152- routine lets you set up points to be transformed to a new coordinate system. You enter the coordinates of two points in the old system and the coordinates of the corresponding two points in the new system. Based on these parameters, you can then transform single points, a range of points, or a group.

PROCEDURE

Refer to the drawing below as you read the following procedure. Here, point A is transformed into point C; and point B into point D.

1. Enter **152-**.
2. Enter the point number of A. Benchmark displays the coordinates.
3. Enter either the point number or the coordinates of point C (Northing, Easting). A will map onto C. Note that you can accept the defaults displayed by Benchmark by pressing RETURN.
4. Enter the point number of B. The coordinates are displayed.
5. Enter either the point number or the coordinates of point D (Northing, Easting). B will map onto D.
6. Enter either a single point, a range of points or a group number to be transformed. The prompt for points to be transformed will be repeated until you cancel the command or enter another command.

NOTE

It is important to understand that 152- will, in effect, apply a scale factor to the new points. Referring to the diagram on the next page, the scale factor applied is based on the ratio of distance C-D to distance A-B. If you do not wish to stretch or shrink your job, you may be better off using one of the other Transform/Rotate commands.

(152-) Coordinate Transformation by Points

EXAMPLE

Command **152-**

Point=34

Point# or Northing, Easting= 5000, 5000

Point= 62

Point# or Northing, Easting= 4537, 4211

Transform point(s)

Point#, Start#-End# or G#= 68-72

Storage Point= 168

Transform point (s)

Point#, Start#-End# or G#=#

Command=

Begin transformation routine

Enter point number of A in old system

34 4537.6283 5301.3276

Enter coordinates of A in new system (C)

Enter point number of B in old system

62 4538.1502 5351.3249

Enter coordinates of B in new system (D)

Enter range of points to be transformed

Enter beginning storage point number

168 5479.9993 7263.9995

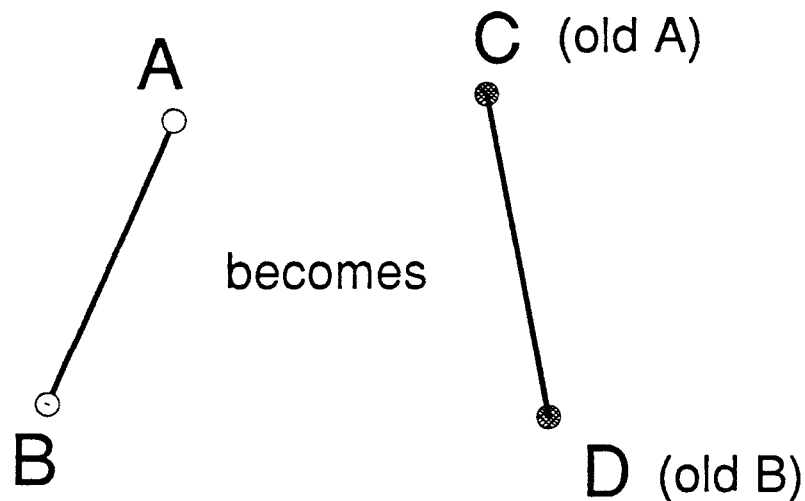
169 5618.8983 7500.7003

170 5716.6976 7125.0999

171 6742.3984 6523.2009

172 6505.6985 6662.1015

Specify more points or cancel command



(151-) Coordinate Transformation by Angle Rotation

PURPOSE

The 151- command lets you select a base point and enter its coordinates in the new coordinate system. You will enter a rotation angle and scale factor such that, for selected coordinate points, their direction and distance from the base point in the old system are rotated and scaled to get the direction and distance from the base point in the new system. Finally, you may compute a factor for distance reduction to sea level.

PROCEDURE

1. Enter **151-**.
2. Enter the point number of the base point. The coordinates are displayed.
3. Enter either the point number or the coordinates of this point in the new system as Northing, Easting.
4. Enter the rotation angle. Each line from the base point is rotated by this angle.
5. Enter the scale factor as a decimal number. Each line from the base point will be multiplied by this number. Note that a scale factor of 1 produces no change in distances.
6. Enter the average feet above sea level if you want distances to be reduced to their sea level equivalent. Enter 0 or press ENTER with no entry to produce no change in distances.
7. Enter either a single point, a range of points or a group number to be transformed. The prompt for points to be transformed will be repeated until you cancel the command or enter another command.

EXAMPLE

Command= 151-	<i>Begin transformation routine</i>
Base Point= 34	<i>Enter point number of the base point</i>
	34 4537.6283 5301.3276
Point# or Northing,Easting= 5000,5000	<i>Enter coordinates of the base point in new system</i>
Rotation Angle= 900000	<i>Enter the rotation angle</i>
Scale Factor= 1	<i>Enter the scale factor</i>
Height Above Sea Level= 0	<i>Enter height above sea level (0 for no change in distances)</i>
Transform point(s)	
Point#, Start#-End# or G#= 68-72	<i>Enter range of points to be transformed</i>
Storage Point= 168	<i>Enter beginning storage point number</i>
	168 5120.4110 5038.7453
	169 5135.4102 5038.5888
	170 5120.2544 5023.7462
	171 5119.5760 4958.7497
	172 5119.7326 4973.7489
Transform point(s)	
Point#, Start#-End# or G#= 10-	<i>Specify more points or enter a new command</i>
Occupied Point=	

(153-) Coordinate Transformation by Bearing

PURPOSE

The 153- routine is almost identical to the 151- command. The difference is that you enter a bearing rather than an angle of rotation.

PROCEDURE

1. Enter **153-**.
2. Enter the point number of the setup point. The coordinates are displayed.
3. Enter the point number of the backsight point. The coordinates are displayed.
4. Enter either the point number or the North and East coordinates of the setup point in the new system as Northing, Easting.
5. Enter the bearing to use for the rotation angle. This will become the new bearing from the setup point to the backsight point (for the purpose of computing the rotation angle). Each line from the base point is rotated by this angle. You can use 40- (Copy direction) to define the bearing by points.
6. Enter the scale factor as a decimal number. Each line from the base point will be multiplied by this number. Note that a scale factor of 1 produces no change in distances.
7. Enter the average feet above sea level if you want distances to be reduced to their sea level equivalent. Enter 0 or press ENTER with no entry to produce no change in distances.
8. Enter either a single point, a range of points or a group number to be transformed. The prompt for points to be transformed will be repeated until you cancel the command or enter another command.

EXAMPLE

Command 153-		Begin transformation routine
Setup Point=34		Enter setup point
		34 4537.6283 5301.3276 OCC
Backsight Point= 62		Enter backsight point
		62 4538.1502 5351.3249 BS
		34 4537.6283 5301.3276
Point# or Northing,Easting= 5000,5000		Enter coordinates of the base point in new system
Bearing= 3553		Enter bearing to use for rotation
Quadrant= 2		Enter quadrant
Scale Factor= 1		Enter scale factor
Height Above Sea Level=		Press ENTER to skip height above sea level
Transform point(s)		
Point#, Start#-End# or G#= 68-72		Enter range of points to be transformed
Storage Point= 168		
		168 5120.4110 5038.7453
		169 5135.4102 5038.5888
		170 5120.2544 5023.7462
		171 5119.5760 4958.7497
		172 5119.7326 4973.7489
Transform point(s)		
Point#, Start#-End# or G#= 10-		Specify more points or enter a command
Occupied Point=		

Point Utility and Display Commands

(200-) Deleting Point	14-2
(210-) List Points	14-3
(220-) Copy Point(s)	14-4
(213-, 214-,222-) Listing Point Numbers	14-5
(213-) List Used Point Numbers	14-5
(214-) List Unused Point Numbers	14-5
(222-) List Extremes	14-6
(223-) Print Screen	14-7
(224-) Enter Comments	14-7

WHAT'S IN THIS CHAPTER?

This chapter describes the Benchmark point utility and display commands. These commands allow you to monitor the points you are entering and make corrections as you go along. Here you will find commands to:

- Delete a single point or a range of points
- Display a single point or a range of points
- Assign coordinate pairs to new point numbers
- List used and unused points
- Display the four extremes in a coordinate file (the most north, south, east, and west coordinates)
- Print the screen
- Enter comments on print-outs

(200-) Deleting Point

PURPOSE

Use 200- to delete points from a job.

PROCEDURE

1. Enter 200-.
2. At the prompt, enter a point, a range of points or a group number. A range is entered as 2 numbers separated by a hyphen. A group is entered as G# (for example, G3 would specify group number 3).
3. A menu will pop up asking you if you are sure. Select Skip to cancel the deletion. Select Continue to execute the deletion.

EXAMPLE

```
Command= 200- | Delete points
Clear point(s)
Point#, Start#-End# or G#= 2 | Delete point 2
Are you sure?
Skip
Continue | Select Continue to delete point 2
```

```
Command= 200-
Clear point(s)
Point#, Start#-End# or G#= 1-100 | Delete points 1 through 100
Are you sure?
Skip
Continue | Select Continue to delete point 2
```

NOTE

Until you save the job, any points you delete are only deleted from the job in memory. So if you should ever accidentally delete some data, you could always exit the job without saving. Of course, any data created since the job was last saved would also be lost in such a situation.

(210-) List Points

PURPOSE

Use 210- to list points in a job.

PROCEDURE

1. Enter 210-.
2. At the prompt, enter a point, a range of points or a group number. The default is a range representing all used points in the job. A range is entered as 2 numbers separated by a hyphen. A group is entered as G# (for example, G3 would specify group number 3).
3. The command automatically repeats until you cancel or enter another command.

EXAMPLE

```
Command= 210- | List points
Point#, Start#-End# or G#= 1-10 | List a range of points 1 through 10
2      5003.8899      5445.7362      3      4992.4130      5446.4750
4      4755.6187      5461.7208      5      4539.1098      5436.1948
6      4389.0431      5437.6458      7      4370.7945      5636.7028
8      4390.0259      5537.5860      9      4392.4900      5335.9263
10     4382.9816      5237.8946

Point#, Start#-End# or G#= G3 | List points in Group number 3
6      4389.0431      5437.6458      79     4389.0071      5434.2024      TRA
78     4500.3535      5334.6531      PT     34     4537.6283      5301.3276      OS
80     4554.3969      5348.4318      PT     81     4587.1883      5440.5453      TRA

Point#, Start#-End# or G#= 101 | List point 101
101    4864.0088      4998.4577      TRA

Point#, Start#-End# or G#= 1-127 | Cancel or enter another command to end

Command=
```


(220-) Copy Point(s)

PURPOSE

Use 220- to copy points to different point numbers. The original point numbers retain there values.

PROCEDURE

1. Enter 220-.
2. At the prompt, enter a point, a range of points or a group number. A range is entered as 2 numbers separated by a hyphen. A group is entered as G# (for example, G3 would specify group number 3).
3. Enter the starting point for storage. The first point will be copied to this point number and any others will be stored sequentially following the first point.

NOTE

If there are unassigned points in a range being copied, the mapping of these points is preserved in the copying operation. The following example illustrates this.

EXAMPLE

```
Command= 220-
Point#, Start#-End# or G#= 16-31      | Copy points
Storage Point= 216                     | Copy points 16 through 31
Command= 210-                           | Start storage at number 216
Point#, Start#-End# or G#= 16-31      | List points 16 through 31
16    4989.0004    4999.9035    SS    17    4984.1206    4999.8607    SS
18    4384.4009    4992.9101    INT    30    4991.3814    5311.4789    TRA
31    4856.3854    5312.5106    TRA

Point#, Start#-End# or G#= 216-231    | List points 216 through 231
216   4989.0004    4999.9035    SS    217   4984.1206    4999.8607    SS
218   4384.4009    4992.9101    INT    230   4991.3814    5311.4789    TRA
231   4856.3854    5312.5106    TRA

Point#, Start#-End# or G#= 1-233
```

(213-, 214-, 222-) Listing Point Numbers

With the 213- and 214- commands, you can list used or unused point numbers. In addition, you can print the extremes of a point file (222-).

213- List Used Point Numbers

PURPOSE

Display a list of used point numbers. The program will scan the coordinate file and list all coordinate points with non-zero values.

PROCEDURE

Enter **213-** to list point numbers in use.

EXAMPLE

```
COMMAND  213-                | List used point numbers
Point #  1 TO  2
Point #  5 TO  5
Point # 12 TO 12
Point # 14 TO 14
Point # 19 TO 21
Point # 31 TO 32
Point # 34 TO 37
Point # 41 TO 43
Point # 45 TO 45
Point # 51 TO 53
Point # 61 TO 64
Point # 75 TO 76
Point # 79 TO 79
Point # 86 TO 86
Point # 88 TO 88
Point # 93 TO 95
```

214- List Unused Point Numbers

PURPOSE

214- displays a list of unused point numbers.

PROCEDURE

Enter **214—**. Benchmark shows a list of all unused point numbers.

NOTES

1. Blocks of unused point numbers are listed as ranges.

EXAMPLE

```
COMMAND  214-                | List unused points by range
Point #  3 TO  4
Point #  6 TO 11
Point # 13 TO 13
Point # 15 TO 18
Point # 22 TO 30
Point # 33 TO 33
Point # 38 TO 40
Point # 44 TO 44
Point # 46 TO 50
Point # 54 TO 60
Point # 65 TO 74
Point # 77 TO 78
Point # 80 TO 85
Point # 87 TO 87
Point # 89 TO 92
Point # 96 TO 1200
COMMAND
```

2. Benchmark displays unused point numbers up to the highest point in the file (32,000 maximum).

(213-, 214-, 222-) Listing Point Numbers

(222-) List Extremes

PURPOSE

Use 222- to display the four extremes within a coordinate file. This routine scans the point file and print the most NORTH, SOUTH, EAST and WEST coordinate values. You can use these values to set up a grid sheet for plotting purposes.

PROCEDURE

1. Enter 222- to list the most NORTH, SOUTH, EAST and WEST coordinates.
2. At the prompt, enter a point, a range of points or a group number. The default is a range representing all used points in the job. A range is entered as 2 numbers separated by a hyphen. A group is entered as G# (for example, G3 would specify group number 3).

EXAMPLE

```
Command= 222-          | List extremes
Point#, Start#-End# or G#= 1-23 | Specify a range
Most North= 5003.8899 @ point 2
Most South= 4370.7945 @ point 7
Most East = 5636.7028 @ point 7
Most West = 4992.9101 @ point 18
Command= 222-          | List extremes
Point#, Start#-End# or G#= G3   | Specify Group 3
Most North= 4587.1883 @ point 81
Most South= 4389.0071 @ point 79
Most East = 5440.5453 @ point 81
Most West = 5301.3276 @ point 34
Command=
```

(223-) Print Screen (not functional in Windows Version)

PURPOSE

223- prints the entire screen display. Equivalent to the DOS SHIFT-PrtSc command.

PROCEDURE

Enter 223- to print the screen.

(224-) Enter Comments

PURPOSE

224- lets you enter comments between commands. In this way, you can annotate a Benchmark session that you can send to the printer

EXAMPLE

```
COMMAND 224- | Enter Comment command
COMMENT= This shows the points for the redesigned Lot #55
COMMAND
```

JRN, the

ons, read

Miscellaneous Coordinate Geometry Commands

(72-, 74-, 77-) Divide an Arc	15-2
(72-) Divide an Arc by Interval	15-2
(74-) Divide an Arc by Divisor	15-3
(77-) Divide an Arc by Segments	15-5
(73-, 75-, 79-) Divide a Line	15-6
(73-) Divide a Line by Interval	15-6
(75-) Divide a Line by Divisor	15-7
(79-) Divide a Line by Segments	15-8
(156-) Radial Stakeout Range of Points	15-9
(159-) Radial Stakeout Individual Points	15-10
(157-) Compute Angle from Stored Points	15-11
(158-) Compute Angle Given Two Bearings	15-12
(138-) Linear Regression	15-13
(245-) Triangle Solver	15-14
(227-) Three-Point Problem	15-15
(228-) Circular Curve through Three Points	15-16
(59-) Spiral Curve	15-17
(500-) Free Memory Command	15-19
(501-) Shell to DOS	15-20
(502-) Redirect Printer Output	15-20
(9-) Print Heading	15-21
(118-) Shrink a Job	15-21
(510-) Open a Command Log File	15-22
(511-) Close a Command Log File	15-22
(515-) Open a Log File	15-22
(516-) Close a Log File	15-22
(520-) View a Text File	15-23
(550-) Find Centroid of Active Groups	15-23

WHAT'S IN THIS CHAPTER?

This chapter describes the Benchmark calculation commands available in the Coordinate Geometry program. Here you will find commands to:

- Divide arcs and lines
- Calculate a radial stakeout
- Perform a linear regression
- Solve triangles
- Solve three-point problems
- Calculate circular curve through three points

(72-, 74-, 77-) Divide an Arc

(72-) Divide an Arc by interval

PURPOSE

Given the start, end, and radius points of an arc, 72- lets you create points on the arc at a specified interval.

PROCEDURE

1. Occupy the start of the curve, then enter 72-.
2. Benchmark requests points for the end of curve (B) and the radius point (C). Enter these.
3. Enter the left and right offsets. (Press RETURN with no entry to omit offsets).
4. Enter the interval at the `I n t e r v a l =` prompt, (negative if the curve runs counter-clockwise). Benchmark displays:
 - chord direction and distance from the last point
 - point number and coordinates of the next point

At the end of the routine, Benchmark returns to the traverse routine.

NOTES

1. The routine repeats until the point B is reached.
2. At the end of the routine, B is the occupied point, and the direction is that of the last chord. The area summation is not affected.

EXAMPLE

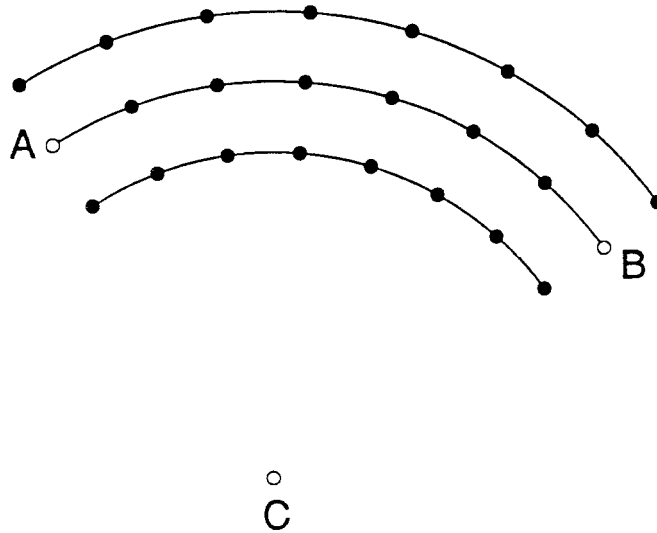
Command 10-			Use 10- to occupy starting point	
Occupied Point=7				
Backsight Point=72-			7	5472.09 5598.16 OCC
End of Curve Point=17			Start multiple point routine	
Radius Point=22			Enter end of curve	
Right Offset Distance=5			Enter radius point	
Left Offset Distance=5			Enter right and left offsets	
Interval=125			Specify interval	
S28-45-38.2E 5			103	5467.71 5600.57 TRAPOC-R
N28-45-38.2W 5			104	5476.48 5595.76 TRAPOC-L
N75-56-45E 123.63			105	5502.12 5718.1 TRAPOC
S00-39-08.2W 5			106	5497.12 5718.04 TRAPOC-R
N00-39-08.2E 5			107	5507.12 5718.15 TRAPOC-L
S74-38-28.6E 123.63			108	5469.37 5837.31 TRAPOC
S30-03-54.7W 5			109	5465.04 5834.81 TRAPOC-R
N30-03-54.7E 5			110	5473.7 5839.82 TRAPOC-L
S45-13-42.1E 123.63			111	5382.3 5925.08 TRAPOC
S59-28-41.1W 5			112	5379.76 5920.77 TRAPOC-R
N59-28-41.1E 5			113	5384.84 5929.39 TRAPOC-L
S15-48-55.7E 123.63			114	5263.35 5958.78 TRAPOC
S88-53-27.5W 5			115	5263.25 5953.78 TRAPOC-R
N88-53-27.5E 5			116	5263.44 5963.77 TRAPOC-L
N81-36-33.7E 5			117	5192.99 5270.27 TRAPOC-R
S81-36-33.7W 5			118	5191.53 5260.38 TRAPOC-L
Command				

(72-, 74-, 77-) Divide an Arc

(74-) Divide an Arc by Divisor

PURPOSE

Given the start, end, and radius points of an arc, 74- lets you divide the arc into a specified number of segments and create points along the arc.



PROCEDURE

1. Occupy start of the curve, then enter 72-.
2. Benchmark requests points for the end of curve (B) and the radius point (C). Enter these.
3. Enter the left and right offsets. (Press RETURN with no entry to omit offsets).
4. At the Interval= prompt, enter 74-. Benchmark responds with Divisor= . Enter the divisor (negative if the curve runs counter-clockwise).

OUTPUT

Benchmark divides the arc into the specified number of segments and creates points along the arc.

(72-, 74-, 77-) Divide an Arc

EXAMPLE

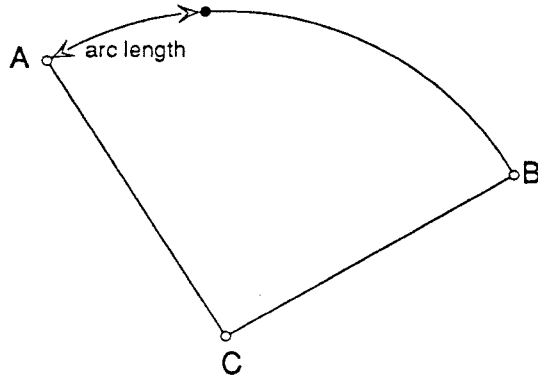
Command 10-		Occupy starting point		
Occupied Point=7				
		7	5472.09	5598.16 OCC
Backsight Point=72-		Start multiple point routine		
End of Curve =17		Enter end of curve		
Radius Point=22		Enter radius point		
Right Offset Distance=15		Enter right and left offsets		
Left Offset Distance=15				
Interval=74-		Enter 74- to specify divisor		
Divisor=5		Enter divisor		
S28-45-38.2E 15		81	5458.94	5605.38 TRAPOC-R
N28-45-38.2W 15		82	5485.24	5590.95 TRAPOC-L
N73-53-15.5E 106.63		83	5501.69	5700.61 TRAPOC
S03-27-50.8E 15		84	5486.72	5701.52 TRAPOC-R
N03-27-50.8W 15		85	5516.66	5699.7 TRAPOC-L
S80-48-57.1E 106.63		86	5484.67	5805.88 TRAPOC
S21-49-56.6W 15		87	5470.74	5800.3 TRAPOC-R
N21-49-56.6E 15		88	5498.59	5811.46 TRAPOC-L
S55-31-09.8E 106.63		89	5424.3	5893.78 TRAPOC
S47-07-43.9W 15		90	5414.09	5882.79 TRAPOC-R
N47-07-43.9E 15		91	5434.5	5904.77 TRAPOC-L
S30-13-22.4E 106.63		92	5332.16	5947.46 TRAPOC
S72-25-31.3W 15		93	5327.63	5933.16 TRAPOC-R
N72-25-31.3E 15		94	5336.69	5961.76 TRAPOC-L
N81-36-33.7E 15		95	5194.45	5280.17 TRAPOC-R
S81-36-33.7W 15		96	5190.07	5250.49 TRAPOC-L
Command				

(72-, 74-, 77-) Divide an Arc

(77-) Divide an Arc by Segments

PURPOSE

Given the start, end, and radius points of an arc, create a point from the start of the arc at the specified length along the arc.



PROCEDURE

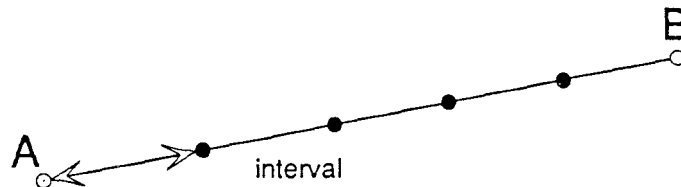
1. Occupy the start of the curve, then enter **72-**.
2. Benchmark requests points for the end of curve (B) and the radius point (C). Enter these.
3. Enter the left and right offsets. (Press **RETURN** with no entry to omit offsets).
4. At the **Interval=** prompt, enter **77-**. Benchmark prompts for a length (**Length=**). Enter the length (negative if the curve runs counter-clockwise). Benchmark displays the bearing, number, and coordinates of the arc point.
5. The **Length=** prompt keeps repeating until you enter another command.
6. Enter **78-** to return you to the **Interval=** prompt where you can divide the remainder of the curve by a specified interval. Enter **74-** to divide the remainder of the curve by a divisor.

(73-, 75-, 79-) Divide a Line

(73-) Divide a Line by Interval

PURPOSE

The 73- routine lets you create points on a line at specified intervals.



PROCEDURE

1. Occupy the start of the line, then enter 73-. Benchmark prompts:

Point=

2. Enter the number of the end point of the line. Benchmark requests:

Right Offset Distance=
Left Offset Distance=

4. Enter the right and left offsets. Benchmark now requests an interval (Interval=).
5. Enter the desired interval. Benchmark displays the created points.
6. You are returned to the COMMAND prompt. Enter 330- to re-enter the traverse.

OUTPUT

For each new point on the line, Benchmark displays:

- The direction and distance from the last point.
- The point number and coordinates of the next point.

NOTES

At the completion of the 73- routine:

- The end point of the line is the occupied point
- The direction is the same as that of the line
- The area summation is adjusted for this side

EXAMPLE

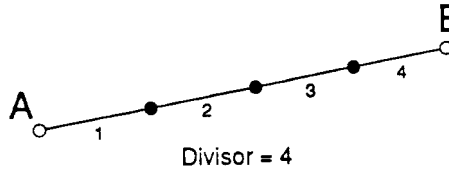
Command 10-				
Occupied Point= 5	Occupy start of line			
	5	5000.0000	4857.0000	OCC
Backsight Point= 73-	Begin divide a line routine			
Point= 14				
Right Offset Distance=				
Left Offset Distance=				
Interval= 25				
S08-47-26.0W 25.00	124	4975.2937	4853.1794	TRA
S08-47-26.0W 25.00	125	4950.5873	4849.3589	TRA
S08-47-26.0W 25.00	126	4925.8810	4845.5383	TRA

(73-, 75-, 79-) Divide a Line

(75-) Divide a Line by Divisor

PURPOSE

With the 75- routine, you can divide a line into the specified numbers of segments and create corresponding points.



PROCEDURE

1. Occupy the start of the line, then enter 73-. Benchmark prompts for a point number (Point=) .
2. Enter the number of the end point of the line. Benchmark requests:
Right Offset Distance=
Left Offset Distance=
3. Enter the right and left offsets. Benchmark now requests an interval (Interval=) .
4. Enter 75- at the Interval= prompt. Benchmark prompts:
Divisor=
5. Enter a divisor. Benchmark divides the line into the requested number of segments and displays the created points.

EXAMPLE

Command 10-	Enter starting point of line			
Occupied Point= 5	5	5000.0000	4857.0000	OCC
Backsight Point= 73-	Begin divide line routine			
Point= 14	Enter end point of line			
Right Offset Distance=	No offsets here, just press RETURN			
Left Offset Distance=				
Interval= 75-	Switch to divide a line into segments routine			
Divisor= 5	Divide line into five segments			
S08-47-26.0W 19.63	97	4980.6000	4854.0000	TRA
S08-47-26.0W 19.63	98	4961.2000	4851.0000	TRA
S08-47-26.0W 19.63	99	4941.8000	4848.0000	TRA
S08-47-26.0W 19.63	100	4922.4000	4845.0000	TRA
Command				

(73-, 75-, 79-) Divide a Line by Segments

(79-) Divide a Line by Segments

PURPOSE

Use the 79- to divide a line into segments.

PROCEDURE

1. Follow the procedure for 73- until you reach the Interval= prompt.
2. Enter **79-** at the Interval= prompt. You will be prompted: Length=
3. Enter the length. Benchmark displays the newly generated points.
4. The Length= prompt is displayed again. Enter **80-** at this prompt to return to the Interval= prompt where you can divide the remainder of the line by the interval. Enter **75-** to divide the remainder of the line by a divisor.

OUTPUT

For each new point on the line, Benchmark displays:

- The direction and distance from the last point
- The point number and coordinates of the next point

NOTES

At the completion of the **79-** routine:

- The point occupied is the end point of the line
- The direction is the same as that of the line
- The area summation is adjusted for this side

EXAMPLE

```
Command 10-
Occupied Point=7
7      5472.09      5598.16      OCC

Backsight Point=73-
Point=17
Right Offset Distance=15
Left Offset Distance=15
Interval=79-
Length=100
N40-03-19.6W 15      840      5483.58      5588.51      TRAOS-R
S40-03-19.6E 15      841      5460.61      5607.82      TRAOS-L
S49-56-40.4W 100     842      5407.74      5521.62      TRA
N40-03-19.6W 15      843      5419.22      5511.97      TRAOS-R
S40-03-19.6E 15      844      5396.26      5531.28      TRAOS-L
Length=80-
Interval=100
S49-56-40.4W 100     845      5343.39      5445.08      TRA
N40-03-19.6W 15      846      5354.87      5435.43      TRAOS-R
S40-03-19.6E 15      847      5331.91      5454.73      TRAOS-L
S49-56-40.4W 100     848      5279.04      5368.54      TRA
N40-03-19.6W 15      849      5290.52      5358.88      TRAOS-R
S40-03-19.6E 15      850      5267.55      5378.19      TRAOS-L
S49-56-40.4W 100     851      5214.68      5292          TRA
N40-03-19.6W 15      852      5226.16      5282.34      TRAOS-R
S40-03-19.6E 15      853      5203.2       5301.65      TRAOS-L
N40-03-19.6W 15      854      5203.74      5255.67      TRAOS-R
S40-03-19.6E 15      855      5180.78      5274.98      TRAOS-L
Command
```

(156-) Radial Stakeout Range of Points

PURPOSE

Use 156- to set up at a selected coordinate point and find the angle (or azimuth) and distance to specified points or ranges of points within a maximum distance.

PROCEDURE

1. Enter **156-**.
2. Enter the Setup Point.
3. Enter the Backsight Point. If you want Benchmark to output azimuths instead of angles, enter the same point number as the Setup Point.
4. At the prompt, enter a point, a range of points or a group number. A range is entered as 2 numbers separated by a hyphen. A group is entered as G# (for example, G3 would specify group number 3).
5. Enter the Maximum Distance from the Setup Point for which you wish to see results (for example, 200 ft. if you are staking out with a steel tape). Benchmark displays either angles right or azimuth and distances to each point in the range.

EXAMPLE

In the first example Group 3 is staked out from point 9, backsighting point 8, angles and distances within 1000 feet.

In the second example all points between 79 and 81 are staked out from point 9, azimuths and distances within 200 feet.

```
Command 156-
Setup Point= 9

Backsight Point= 8

Point#, Start#-End# or G#= G3
Maximum Distance= 1000
01-14-27      101.78      6      4389.0431      5437.6458
01-19-47      98.34      79      4389.0071      5434.2024
268-37-25     107.87      78      4500.3535      5334.6531
255-53-30     149.21      34      4537.6283      5301.3276
273-43-00     162.39      80      4554.3969      5348.4318
297-33-03     221.03      81      4587.1883      5440.5453
Command= 156-
Setup Point= 9

Backsight Point= 9

Point#, Start#-End# or G#= 79-81
Maximum Distance= 200
92-01-47      98.34      79      4389.0071      5434.2024
04-25-00     162.39      80      4554.3969      5348.4318
Command=
```

In the first example Group 3 is staked out from point 9, backsighting point 8, angles and distances.

PURP

In the second example points are staked out from point 9, azimuths and distances

Use 1:
specif

PROC

1. En

2. En

3. En
the

4. At
car
azi

Command **159-**
Setup Point= **9**

Backsight Point= **8**

Point#= **79**

01-19-47 98.34

Point= **79**

268-37-25 107.87

Point= **80**

273-43-00 162.39

Point= **81**

297-33-03 221.03

Point=

Command= **159-**
Setup Point= **9**

Backsight Point= **9**

Point= **79**

92-01-47 98.34

Point= **78**

359-19-25 107.87

Point= **80**

04-25-00 162.39

Point= **81**

28-15-03 221.03

Point=

9 4392.4900 5335.9263 OCC

8 4390.0259 5537.5860 BS

79 4389.0071 5434.2024

78 4500.3535 5334.6531

80 4554.3969 5348.4318

81 4587.1883 5440.5453

9 4392.4900 5335.9263 OCC

9 4392.4900 5335.9263 BS

79 4389.0071 5434.2024

78 4500.3535 5334.6531

80 4554.3969 5348.4318

81 4587.1883 5440.5453

lter

or

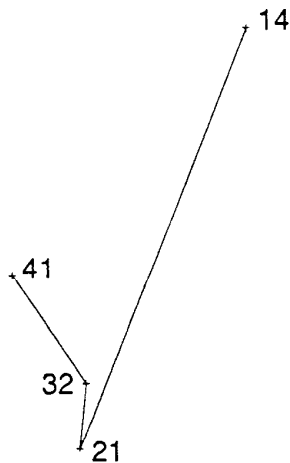
(157-) Compute Angle from Stored Points

PURPOSE

Given a back point, center point, and a third point, 157- computes the angle defined by backcenter-next. This routine does not create points.

PROCEDURE

1. Occupy the back point, and then enter **157-**.
2. Enter the center point. Benchmark displays the azimuth from back to center.
3. Enter the next point number. Benchmark displays the angle defined by back-center-next.
4. You can continue entering "next points." Each time Benchmark will display the described angle.



EXAMPLE

Command 10-	Occupy back point		
Occupied Point= 14	14 4903.0000	4842.0000	OCC
	Start compute angle routine		
Backsight Point= 157-	Occupy center point		
Point= 21	21 4351.1441	4624.2655	INV AZ
201-31-54.1 593.26	Enter next point		
Point= 32	32 4438.0599	4632.8389	INV AR
344-06-06.3 87.34	Enter next point		
Point= 41	41 4580.0000	4540.0000	INV AR
141-10-44.5 169.61			

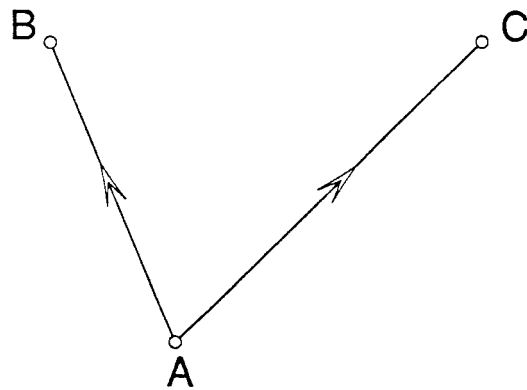
(158-) Compute Angle Given Two Bearings

PURPOSE

With 158-, you can compute an angle, given backward and forward bearings, from a common point. This routine does not create points.

PROCEDURE

1. Occupy the common point (A), then enter **158-**.
2. At-the bearing prompts, enter a backward (B) and forward (C) bearing away from the common point. Benchmark displays the resulting angle.
3. This routine repeats until you enter a command to escape from it.



NOTE: You can also use the 40- (copy direction) command in place of a bearing entry (see EXAMPLE).

EXAMPLE

Command 10-	
Occupied Point= 14	Occupy back point
	14 4903.0000 4842.0000 OCC
Backsight Point= 158-	Start compute angle routine
Bearing=240000	Enter forward direction
Quadrant=1	
Bearing=750000	Enter backward direction
Quadrant=2	
Angle Right= 81-00-00	Benchmark display resulting angle
Bearing=40-	Use 40- to define forward direction
Point=2	Use direction from point 2 to 5
Point=5	
Bearing=40-	Use 40- to define backward direction
Point=21	Use direction from point 21 to 31
Point=31	
Angle Right= 38-59-52.1	Benchmark displays resulting angle

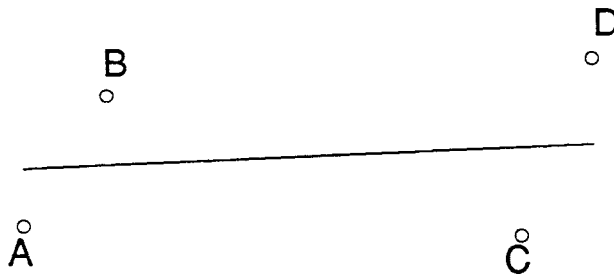
(138-) Linear Regression

PURPOSE

Use 138- to perform a linear regression along a series of points.

PROCEDURE

Enter **138-**. Then enter the points along the line (**A,B,C,D** etc.). Press RETURN when you have entered all points. Benchmark displays the direction of the line (bearing).



EXAMPLE

Bearing	Distance	Point	Northing	Easting	Type
-----12-22-1986-----09:53:25-----C:\MYDIR					
Command	138-		Start linear regression routine		
Point=	1		Enter first point number		
Point=	2		Enter next point number		
Point=	3		Enter next point number		
Point=			Press RETURN when all points entered		
Direction of Line = S89-45-38.7E					
First point on Line= 5000.0095,5000.0000					

(245-) Triangle Solver

PURPOSE

With 245-, you can solve triangles given any three of the six possible knowns.

PROCEDURE

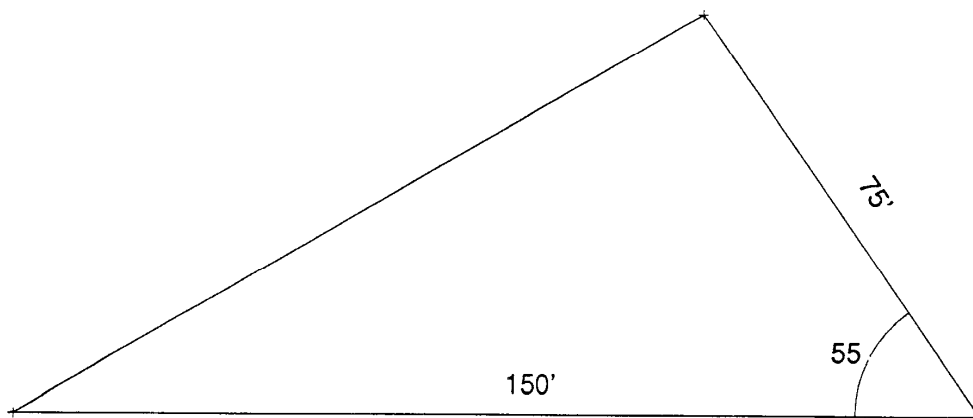
Enter **245-**. You will be prompted for lengths and angles. Enter any three of the six possible knowns. Benchmark calculates and displays the lengths, angles, and area for the solved triangle.

NOTES

1. To skip prompts, press RETURN without making an entry. For example, if you want to enter three lengths, press RETURN at each ANGLE prompt.
2. This command is also available in the Utilities I program (option 4 on the Benchmark Main Menu).

EXAMPLE

Command 245-	<i>Invoke triangle solver</i>
Triangle Solver	
Length=150	<i>Enter any three knowns</i>
Angle=550000	
Length=75	
Angle=	<i>Press RETURN</i>
Length=	<i>Press RETURN</i>
Angle=	<i>Press RETURN</i>
	<i>Benchmark displays solution</i>
Length	Angle
150	55-00-00
75	95-07-57.2
123.37	29-52-02.8
Area (Sq.Feet)= 4607.73	
Command	



(227-) Three-Point Problem

PURPOSE

227- solves a three-point problem from known points and generates a resection point.

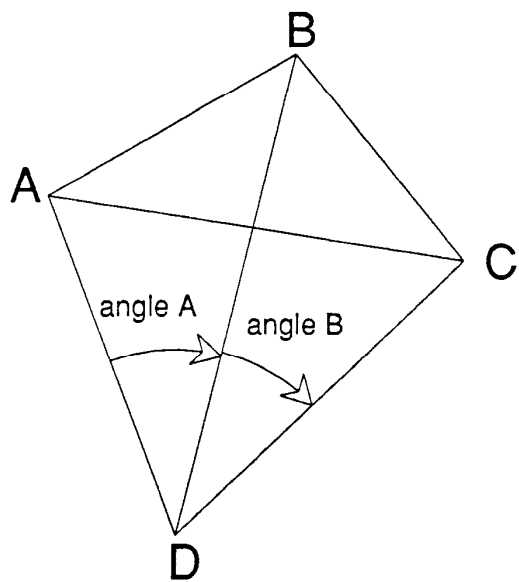
PROCEDURE

- 1. Enter 227-. Benchmark requests the three known points.
- 2. Enter the point numbers of A, B, and C. After you enter each point's number, the coordinates are displayed.
- 3. Benchmark requests the angles at A and B. Enter these.
- 4. If you have not already setup a storage point, Benchmark requests one now. The resection point's coordinates are displayed.

NOTE

You can use 13- to establish the storage point before entering 227-.

EXAMPLE					
Bearing	Distance	Point	Northing	Easting	type
-----11-20-1986-----		-----11:16:56-----		-----C:BENCH-----	
Command 227-		Three Point Problem command			
Point A= 1		Enter point A			
		1	1400.0000	900.0000	
Point B= 2		Enter point B			
		2	1500.0000	1200.0000	
Point C= 3		Enter point C			
		3	1300.0000	1300.0000	
Angle A= 355015.6		Enter angle at A			
Angle B= 231154.9		Enter angle at B			
		5	999.9999	1000.0007	



(228-) Circular Curve through Three Points

PURPOSE

Given three points, 228- computes the center point.
PROCEDURE

- 1. Enter **22 8 -**. You are prompted for the three known points.
- 2. Enter points A, B, and C. After you enter the number of each point, its coordinates are displayed.
- 3. If you have not set up a storage point, Benchmark requests one now.

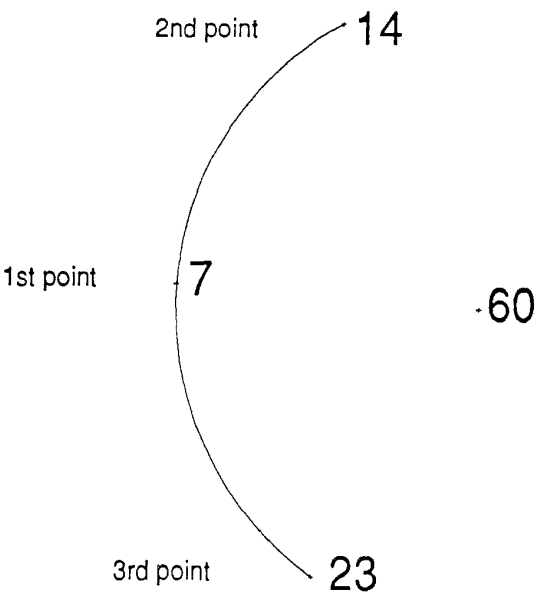
OUTPUT

The resection point's coordinates are displayed.

NOTE: You can use 13- to establish the storage point before entering 228-.

EXAMPLE

Command 228-	Solve circular curve through three points			
Point A=7	Enter three points			
		7	5472.09	5598.16
Point B=14		14	5689.32	5745.32
Point C=23		23	5228.64	5715.42
	Coordinates of center point are displayed			
		60	5450.28	5864.26 RP



(59-) Spiral Curve

PROCEDURE

Enter:

1. Tangent to Spiral point (TS) or Spiral to Tangent point (ST) number.
2. Direction of tangent based on a point backsighted from TS or ST.
3. Radius of the circular curve.
4. Length of spiral - positive for a spiral curving to the right and negative for a spiral curving to the left.

Following this step the routine calculates and displays the output below. The routine repeats the following sequence until the user enters a new command.

5. Enter: Length from TS or ST.

Calculates: Coordinates and point number of Point on Spiral (POS) and the radial azimuth.

Enter: Right offset from spiral

Calculates: Coordinates and point number of right offset point.

Enter: Left offset from spiral

Calculates: Coordinates and point number of left offset point.

OUTPUT

Calculates:

- The X (tangent) and Y (offset) of the spiral from the TS or ST to the Spiral to Curve (SC) or Curve to Spiral (CS).
- The spiral angle.
- The short and long tangents of the spiral.
- Coordinates and point number of the Point of Intersection (PI).
- Coordinates and point number of the SC or CS.
- Coordinates and point number of the Radius Point of the circular curve (RP).

(59-) Spiral Curve

EXAMPLE

Command 12-	Create new points with known coordinates
Point= 1	Point number 1
Northing = 1000	Northing coordinate
Easting = 1000	Easting coordinate
Point= 11	Point number 11
Northing = 4869.2462	Northing coordinate
Easting = 4869.2462	easting coordinate
Point= 59-	Spiral curve routine
Point TS/ST= 11	Occupy the tangent to spiral point
Backsight Point = 1	Backsight point along the tangent
	1 1000.0000 1000.0000 BS
	11 4869.2462 4869.2462 TS/ST
N45-00-00.0E 5471.94	The radius of the circular curve
Radius Length= 500	Length of the spiral curve (positive for spiral to the right)
L+/-= 100	
X = 99.9	
Y = 3.331	
Spiral Angle = 05-43-46.5	
Short Tangent = 33.3651	
Long Tangent = 66.7016	
N45-00-00.0E 66.70	12 4916.4114 4916.4114 PI
	11 4869.2462 4869.2462 TS/ST
N46-54-34.9E 99.96	13 4937.5309 4942.2415 SC/CS
S39-16-13.5E 500.00	14 4550.4473 5258.7322 RP
Length from TS/ST= 50	Produce a point on spiral at 50 feet into spiral
Radial AZ. = 136-25-56.6	
N45-28-38.9E 50.00	15 4904.3047 4904.8939 POS
Right Offset Distance= 100	feet to the right of P.O.S.
S43-34-03.4E 100.00	16 4831.8485 4973.8149 OS-R
Left Offset Distance= 100	offset point 100 feet to the left of P.O.S.
N43-34-03.4W 100.00	17 4976.7609 4835.9729 OS-L
Length from TS/ST= 59-	start a new spiral curve
Point TS/ST= 11	Occupy the tangent to spiral point
Backsight Point= 1	Backsight point along the tangent
	1 1000.0000 1000.0000 BS
	11 4869.2462 4869.2462 TS/ST
N45-00-00.0E 5471.94	the radius of the circular curve
Radius Length= 500	length of the spiral curve (negative for spiral to the left)
L+/-= -100	
X = 99.9	
Y = 3.331	
Spiral Angle = 05-43-46.5	
Short Tnagent = 33.3651	
Long Tangent = 66.7016	
N45-00-00.0E 66.70	18 4916.4114 4916.4114 PI
	11 4869.2462 4869.2462 TS/ST
N43-05-25.1E 99.96	19 4942.2415 4937.5309 SC/CS
N50-43-46.5W 500.00	20 5258.7322 4550.4473 RP
Length from TS/ST= 50	Produce a point on spiral at 50 feet into spiral
Radial AZ. = 47-74-43.4	
N44-31-21.1E 50.00	21 4904.8939 4904.3047 POS
Right Offset Distance= 100	Offset point 100 feet to the right of P.O.S.
S46-25-56.6E 100.00	22 4835.9729 4976.7609 OS-R
Left Offset Distance= 100	Offset point 100 Feet to the left of P.O.S.
N46-25-56.6W 100.00	23 4973.8149 4831.8485 OS-L

(500-) Free Memory Command

PURPOSE

This command is designed as a diagnostic tool to determine how much memory Coordinate Geometry has available to it.

PROCEDURE

Enter 500-

OUTPUT

This routine will print out the amount of free string space, the total memory available to the program, and the amount of stack space.

EXAMPLE

```
Command 500-  
Free string space= 65430  Total Free= 195904  Stack space= 36086
```


(501-) Shell to DOS

PURPOSE

This command will allow the user to perform some DOS functions while within COGO.

PROCEDURE

1. Enter 501-. You will be prompted for a DOS Command.
2. At the prompt, you can enter a DOS command or program name. You will be automatically returned to Benchmark when the command is complete.
3. You can also just press ENTER at the DOS Command= prompt. When you finish whatever you are doing in the SHELL, you will need to enter EXIT to return to Benchmark.

NOTES

1. The user can change the current DOS subdirectory without harm, as Benchmark will reset the subdirectory upon re-entry.
2. The user is advised to be cautious with this command. Stay away from file or subdirectory deletes, renames while you are SHELLED out to DOS. Also you should not load any resident programs while SHELLED out. If you need to have resident programs loaded, load them before entering Benchmark.

(502-) Redirect Printer Output

PURPOSE

This command will allow the user to redirect printer output to a file or DOS device. This command allows the user to override the setting of the BNPRN environment variable which is explained in Appendix E.

PROCEDURE

1. Enter 502-. The default will be LPT1 unless the BNPRN environment variable is set to something different, or unless you have previously rerouted printer output.
2. Once you have designated a file or DOS device, use the printer commands (1-, 2-, 5-) to open and close the file or device just as you would open and close your printer.

NOTES

1. If you supply a filename that already exists, output will be appended to the file.
2. When printer output is redirected to a file and the file is open with 1- or 5-, any attempt to view the file may not show all output until the file is closed with the 2- command. The file will be updated with 1- or 5- commands also.
3. As with any of the output redirection commands (502-, **510-**, **515-**), use caution when choosing a filename. You could easily destroy a binary file if you tried to append ASCII text to it.

(9-) Print Heading

PURPOSE

Clears the screen and displays the heading.

PROCEDURE

Enter 9-.

(118-) Shrink a Job

PURPOSE

Shrinks a job down to a size slightly larger than the highest used point number.

PROCEDURE

Enter 118-. Benchmark will determine the highest used point number and de-allocate the space above that number. The job is then automatically saved to disk.

NOTE

118- is particularly useful when you inadvertently allocate space for a much higher point number than you need, and subsequently wish to de-allocate that space in order to speed up searches and save disk space.

EXAMPLE

```
Command= 10-
Occupied Point= 2
                                     2      5003.8899      5445.7362      OCC
Backsight Point= 1
                                     1      5000.0000      5000.0000      BS
N89-30-00E      445.75
Storage Point= 11111 | Accidentally typed 11111 instead of 111
Bearing= 2
Quadrant= 2
Distance= 22
S00-00-02E      22.00
                                     11111 4981.8899      5445.7364      TRA
Bearing= 200- | Delete point number 11111
Clear point(s)
Point#, Start#-End# or G#= 11111
Command= 118- | Shrink Job
Searching...
Saving...
Job disk D: is 91% full. 774144 Bytes free on disk.
Command=
```

(510-, 511-) Open, Close Command Log File

PURPOSE

To record your keystrokes to an ASCII file.

PROCEDURE

1. Enter 510- to open a Command Log File. Enter a filename at the prompt. If the file already exists, keystrokes will be appended to the file.
2. To close the Command Log File, enter 511-.

NOTES

1. 510- is a handy way to create a Benchmark script file (or at least to lay the foundation).
2. As with any of the output redirection commands (502-, 510-, 515-), use caution when choosing a filename. You could easily destroy a binary file if you tried to append ASCII text to it.
3. Attempts to view the Command Log File while it is still open may not show all of its contents. Close the file (511-) first.
4. You can use the printer at the same time you are recording to a log file.

(515-, 516-) Open, Close Log File

PURPOSE

To record a work session to a Log File which can be viewed at any time

PROCEDURE

1. Enter 515- to open a Log File. Enter a filename at the prompt. If the file already exists, text will be appended to the file.
2. To view the Log File at any time, press the Up Arrow key. This will bring up the log file in Benchmark's file viewer. Use the arrow keys, Home, End, PageUp and PageDown to scroll through the log file. ESCape will put you back into Coordinate Geometry.
3. To close the Log File, enter 516-.

NOTES

1. As with any of the output redirection commands (502-, 510-, 515-), use caution when choosing a filename. You could easily destroy a binary file if you tried to append ASCII text to it
2. After a Log File is closed (516-), it can still be viewed by pressing the Up Arrow key.
3. You can use the printer at the same time you are recording to a log file.

(520-) View a Text File

PURPOSE

To view a text file.

PROCEDURE

1. Enter 520-.
2. Enter the name of the file you wish to view. This will bring up the file in Benchmark's file viewer. Use the arrow keys, Home, End, PageUp and PageDown to scroll through the file. ESCape will put you back into Coordinate Geometry.

(550-) Find Centroid of Active Groups

PURPOSE

This routine will find and create points for the centroids of all Active groups in the job.

PROCEDURE

1. Make all groups Inactive except those for which you want to find the centroid.
2. Enter 550-.

OUTPUT

Benchmark will generate a new point at the centroid of each Active group.

EXAMPLE

Command 550-		(Groups 1-6 are active)
Storage Point= 200		Find centroid of Active groups
Centroid for group number 1 :	200	4449.1612 5225.9585
Centroid for group number 2 :	201	4443.7184 5342.0516
Centroid for group number 3 :	202	4488.0987 5387.5985
Centroid for group number 4 :	203	4621.3957 5378.8568
Centroid for group number 5 :	204	4631.3687 5243.0719
Centroid for group number 6 :	205	4688.4979 5267.7303

(10-) Curve Staking	16-2
(20-,21-,22-,23-) Elevation Reduction	16-4
(20-) Stadia Note Reduction	16-4
(21-) Reduce Slope Angle and Distance	16-4
(22-) Create a Turning Point	16-4
(23-) Reduce Level Notes	16-4
(26-,27-) Select Slope Reduction Method	16-6
(26-) Stadia Method of Slope Reduction	16-6
(27-) Vertical Angle Method for Slope Reduction	16-6
(40-,36-,37-,38-,39-) Vertical Curve Solver	16-7
(245-) Triangle Solver	16-8
(50-,51-,52-) Earthwork by Average End Areas	16-9

WHAT'S IN THIS CHAPTER?

This chapter explains the Utility I Programs options.

(10-) Curve Staking

PURPOSE

Use 10- to display deflection angles and chord lengths.

PROCEDURE

1. Enter 10-.
2. At the Radius Length= prompt, enter the radius.
3. Enter the inside and outside offsets.
4. Enter starting station.
5. Enter length of curve.
6. Enter distance between stations.

OUTPUT

After step 6, Benchmark displays the deflection angles and chord lengths.

NOTES

1. 10- lets you develop staking data for both the center line of the curve and the sidelines.
2. The radius length entered is from the radius point to the center line of the street.
3. The inside and outside offsets are the distances from the center line to each side of the street
4. If you are staking a counter-clockwise curve, give the radius a negative value. This will cause 360° minus the deflection angle to be printed.

(10-) Curve Staking

EXAMPLE

Command 10-
Radius Length=477.76 | *Enter radius*
Inside Offset=5 | *Enter inside and outside offsets*
Outside Offset=5
Starting Station=890 | *Enter starting station*
Length of Curve=971.67 | *Enter length of curve*
Distance Between Stations=200 | *Enter distance between stations*

Station 10+ 0:
Short Chord Data
Angle Inside Center Outside
6-35-45.3 108.6085 109.7572 110.9059
Long chord Data
Angle Inside Center Outside
6-35-45.3 108.6085 109.7572 110.9059

Station 12+ 0:
Short Chord Data
Angle Inside Center Outside
11-59-33.3 196.465 198.5428 200.6207
Long Chord Data
Angle Inside Center Outside
18-35-18.6 301.4027 304.5904 307.7781

Station 14+ 0:
Short Chord Data
Angle Inside Center Outside
11-59-33.3 196.465 198.5428 200.6207
Long Chord Data
Angle Inside Center Outside
30-34-51.9 481.0403 486.1278 491.2154

Station 16+ 0:
Short Chord Data
angle Inside Center Outside
11-59-33.3 196.465 198.5428 200.6207
Long Chord Data
Angle Inside Center Outside
42-34-25.3 639.68 646.4454 653.2107

Station 18+ 0:
Short Chord Data
Angle Inside Center Outside
11-59-33.3 196.465 198.5428 200.6207
Long Chord Data
Angle Inside Center Outside
54-33-58.6 770.397 778.5449 786.6928

Station 18+ 61.67:
Short Chord Data
Angle Inside Center Outside
3-41-52.5 60.9822 61.6272 62.2722
Long Chord Data
Angle Inside Center Outside
58-15-51.1 804.1482 812.653 821.1578

(20-, 21-, 22-, 23-) Elevation Reduction

PURPOSE

These routines reduce level notes and stadia/EDM notes. There are four commands:

- 20- Stadia Note Reduction
- 21- Reduce slope angle and distance
- 22- Create a turning point
- 23- Reduce level notes

NOTES

Use 26- to select the stadia method for reducing slope distances (cosine squared X distance).

Use 27- to select vertical angle method for reducing slope distances (cosine X distance). This is the most common method.

EXAMPLE

```
Command 20- | Begin stadia note reduction
Begin from New Benchmark = 20- | Elevation Reduction = 21-
Create Turning Point = 22- | Level Note Reduction = 23-
Benchmark Elevation =1000
Backsight Rod reading =5.25
Elevation of Instrument = 1005.25
Rod Reading =5.15
Elevation = 1000.1

Rod Reading =7.25
Elevation = 998

Rod Reading =8.42
Elevation = 996.83

Rod Reading =9.11
Elevation = 996.14

Rod Reading =2.55
Elevation = 1002.7

Rod Reading =4.51
Elevation = 1000.74

Rod Reading =8.75
Elevation = 996.5

Rod Reading = 21- | Reduce slope angle and distance
Elevation of Instrument = 1005.25

Slope Distance=150
Rod Reading =7.25
Slope Angle =150000

Hor. Dis. Vert. Dist. Elevation
144.8889 38.8229 1036.8229

Slope Distance=275
Rod Reading =19.25
Slope Angle =50000

Hor. Dis. Vert. Dist. Elevation
273.9535 23.9678 1009.9678
```

continued

(20-, 21-, 22-, 23-) Stadia Note Reduction

EXAMPLE

Slope Distance = **22-** | *Create a turning point*
Elevation of Instrument = 1005.25

Foresight Rod Reading on Turning Point = 7.21
Elevation of Turning Point = 998.04

Backsight Rod Reading = **6.25**
Elevation of Instrument = 1004.29

Rod Reading = **8.15**
Elevation = 996.14

Rod Reading = **4.22**
Elevation = 1000.07

Rod Reading = **5.54**
Elevation = 998.75

Rod Reading = **2.15**
Elevation = 1002.14

Rod Reading = **23-** | *Reduce level notes*
Rod Reading = 10.77
Elevation = 993.52

Rod Reading = 11.15
Elevation = 993.14

Rod Reading = **15.25**
Elevation = 989.04

Rod Reading = **7.51**
Elevation = 996.78

Rod Reading = **26-** | *Set stadia method for slope reduction*
Command 21- | *Reduce slope angle and distance*
Elevation of instrument - 1004.29

Stadia Distance=52 Rod
Reading = 7.11 Slope
Angle = **150000**

Hor. Dis.	Vert. Dist.	Elevation
48.5167	13.0000	1010.1800

Stadia Distance= **142** Rod
Reading = **6.20** Slope
Angle = **-33000**

Hor. Dis.	Vert. Dist.	Elevation
141.4708	-8.6527	989.4373

(26-, 27-) Select Slope Reduction Method

PURPOSE

Use 26- to select the stadia method for reducing slope distances (cosine squared X distance).

Use 27- to select vertical angle method for reducing slope distances (cosine X distance). This is the most common method.

PROCEDURE

Enter **26—** or **27—** at the `COMMAND` prompt..

NOTES

1. Slope reduction mode is a system default that can be set on the Setup Menu (see Chapter 3).
2. 26- and 27- are discussed in greater detail in Chapter 3.

(40-, 36-, 37-, 38-, 39-) Vertical Curve Solver

PURPOSE

Given:

- the rate of change of two tangents to a vertical (parabolic) curve,
- the station of the PI,
- elevation of the PI,
- and the length of the vertical curve,

this program will output the station and elevation of the BVC and EVC. In addition, the distance to the curve at the PI station, and distance from the projected tangent to EVC at EVC station. The crest or sag point may also be computed, as well as stations at fixed intervals or at random points.

PROCEDURE

1. Enter **40-** to start.
2. Enter rate of change into PI (+ or -). For example, a 2.5% grade is entered as 2.5.
3. Enter rate of change leaving PI (+ or -).
4. Enter the PI station (34 + 28 entered as 3428).
5. Enter the PI elevation.
6. Enter length of vertical curve.
7. Output is self-explanatory.
8. Select **36-** to compute station and elevation at desired distance from BVC.
9. Select **37-** to compute sag or crest point station, elevation and distance from BVC.
10. Select **39-** to compute station and elevation at fixed intervals from BVC.
11. Select **38-** to compute elevation and distance from BVC at selected Stations.

(245-) Triangle Solver

PURPOSE

With 245-, you can solve triangles given any three of the six possible knowns.

PROCEDURE

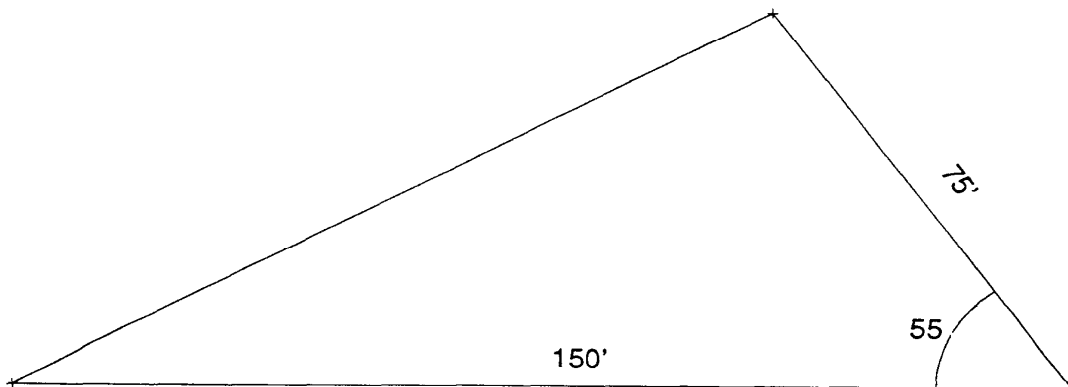
Enter **245-**. You will be prompted for lengths and angles. Enter any three of the six possible knowns. Benchmark calculates and displays the lengths, angles, and area for the solved triangle.

NOTES

1. To skip prompts, press RETURN without making an entry. For example, if you want to enter three lengths, press RETURN at each Angle prompt.
2. This command is also available in the Coordinate Geometry program

EXAMPLE

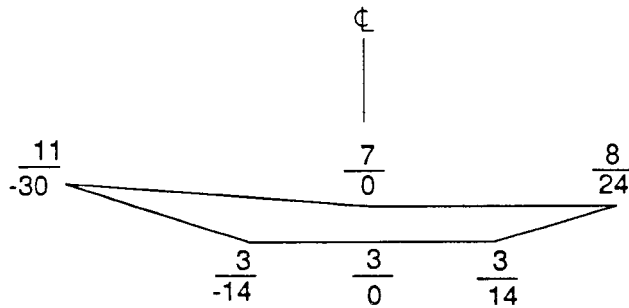
Command 245-	Invoke triangle solver
Triangle Solver	
Length=150	Enter any three knowns
Angle=550000	
Length=75	
Angle=	Press RETURN
Length=	Press RETURN
Angle=	Press RETURN
	Benchmark displays solution
Length	Angle
150	55-00-00
75	95-07-57.2
123.37	29-52-02.8
Area (Sq.Feet)= 4607.73	
Command	



(50-, 51-, 52-) Earthwork by Average End Areas

PURPOSE

50- computes earthwork volumes using the average-end-area formula.



PROCEDURE

1. Enter **50-** to begin computation routine.
2. Enter elevation and distance from center line for each point on the profile.

Note: Enter distances to the left of center line negatively, distances to the right of center line positively, in either a clockwise or counter-clockwise direction. Enter zero for points on the center line.

3. Enter **52-** when first profile is complete. The profile area is displayed.
4. Repeat step 2 for the next profile.
5. Enter **52-** when next profile is complete. The profile area is displayed.
6. Respond to the prompt **LENGTH BETWEEN SECTIONS** by entering the distance between profiles.
7. When you press RETURN, the section volume and the total volume are displayed in cubic yards.
8. Repeat steps 4 to 6 for each section.
9. If you make an error while entering a profile, enter **51-** and start the profile over again.

(50- , 51-, 52-) Earthwork by Average End Areas

EXAMPLE

```
Command 50- | Begin earthwork computation routine
Earthwork by Average Eng Areas

Elevation=7 | Enter elevation and
Distance from Center (+,-)=0 | Distance from center line for each point on profile

Elevation=8
Distance from Center (+,-)=24

Elevation=3
Distance from Center (+,-)=14

Elevation=3
Distance from Center (+,-)=0

Elevation=3
Distance from Center (+,-)=-14 | Enter negative distance if left of center line

Elevation=11
Distance from Center (+,-)=-30

Elevation=52- | Enter 52- when profile is complete
SECTION AREA = 199 | Profile area is displayed

Elevation=8 | Enter elevation and distance data for next profile
Distance from Center (+,-)=0

Elevation=8
Distance from Center (+,-)=24

Elevation=3
Distance from Center (+,-)=14

Elevation=3
Distance from Center (+,-)=0

Elevation=3
Distance from Center (+,-)=-14

Elevation=14
Distance from Center (+,-)=-30

Elevation=52-
Section Area = 247

Length Between Sections=100 | Enter distance between profiles
Section Volume= 825.9259

Total Volume = 825.9259

Elevation=16 | Enter data for next section
Distance from Center (+,-)=0

continued...
```

(50-, 51-, 52-) Earthwork by Average End Areas

EXAMPLE

```
Elevation=13
Distance from Center (+,-)=24

Elevation=4
Distance from Center (+,-)=14

Elevation=4
Distance from Center (+,-)=0

Elevation=4
Distance from Center (+,-)=-14

Elevation=14
Distance from Center (+,-)=-30

Elevation=52-
Section Area = 457

Length Between Sections=100
Section Volume= 1303.7037

Total Volume= 2129.6296

Elevation=                                | Loops until you enter next command
```


Utility II Programs

(225-) Circular Curve Given Two Chords and Included Angle	17-2
(228-) Circular Curve through Three Points	17-3
(226-, 227-) Solving Three-Point Problems	17-4
(226-) Three Angles and Two Lengths	17-4
(227-) Three Sets Of Coordinates And Two Angles	17-5
(229-) Vertical Curve Solver	17-6
(230-) Tangent Grades	17-8
(235-, 234-, 233-, 250-) Curve Staking Routines	17-10
(235-) Offsets from Tangent... ..	17-10
(234-) Angles from P.C., Chords from Stake to Stake. ..	17-12
(250-) Angles from P.C., Chords from Stake to Stake & Long Chords	17-12
(233-) Angles and Chords from Stake to Stake	17-14
(240-, 241-, 242-, 243-) Spiral Curve Stakeout	17-16

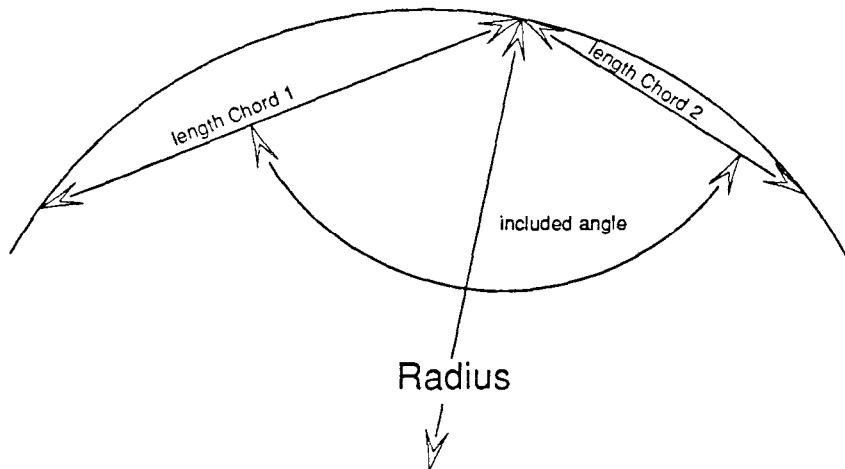
WHAT'S IN THIS CHAPTER?

This chapter describes the Utility II Programs routines.

(225-) Circular Curve Given Two Chords and Included Angle

PURPOSE

Given the lengths of two chords of a circle and the included angle between them, 225- computes the radius of the circle.



PROCEDURE

1. Enter 225-.
2. Enter the length of the first chord.
3. Enter the length of the second chord.
4. Enter the angle delta (between the chords). The radius is displayed.

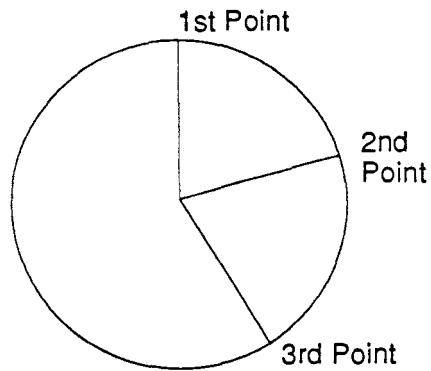
EXAMPLE

```
Command 225-  
Circular Curve, Radius from  
2 Chords and Included Angle  
First Chord      = 100  
Second chord     = 75  
Angle Delta      = 753615  
Radius           = 56.3016
```

(228-) Circular Curve through Three Points

PURPOSE

Given the coordinates of three points on a circle, use 228- to find the center point and the radius length.



PROCEDURE

1. Enter 228-.
2. Enter the coordinates of the first point number.
3. Enter the coordinates of the second point number.
4. Enter the coordinates of the third point number. The coordinates of the center point and the radius length are displayed.

EXAMPLE

```
Command 228-
Center and Radius Thru 3 Given Points
A's North Coordinate= 1100
A's East Coordinate = 800
B's North Coordinate= 1300
B's East Coordinate = 900
C's North Coordinate= 1300
C's East Coordinate = 1200

S's North Coordinate= 1100.0000
S's East Coordinate = 1050.0000
Radius              = 250.0001
```

(226-,227-) Solving Three-Point Problems

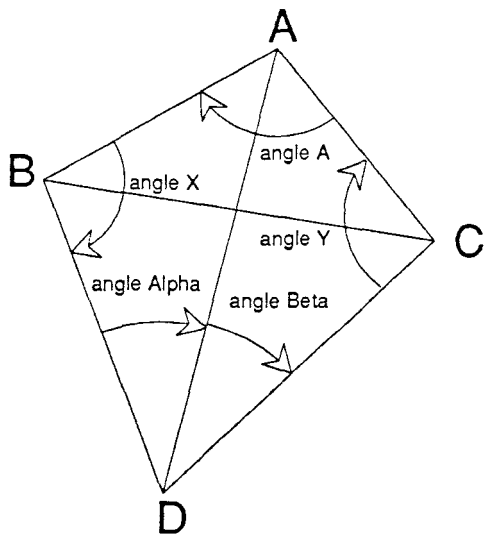
You can solve a three-point problem using one of two methods:

- Three angles and two lengths (226-)
- Three sets of coordinates and two angles (227-)

(226-) Three Angles and Two Lengths

PURPOSE

226- solves a three-point problem given three angles and two lengths.



PROCEDURE

1. Enter 226-.
2. Enter angle A.
3. Enter angle Alpha.
4. Enter angle Beta.
5. Enter distance A - C.
6. Enter distance A - B.

OUTPUT

After step 6, Benchmark lists the values of ANGLE X and ANGLE Y.

EXAMPLE

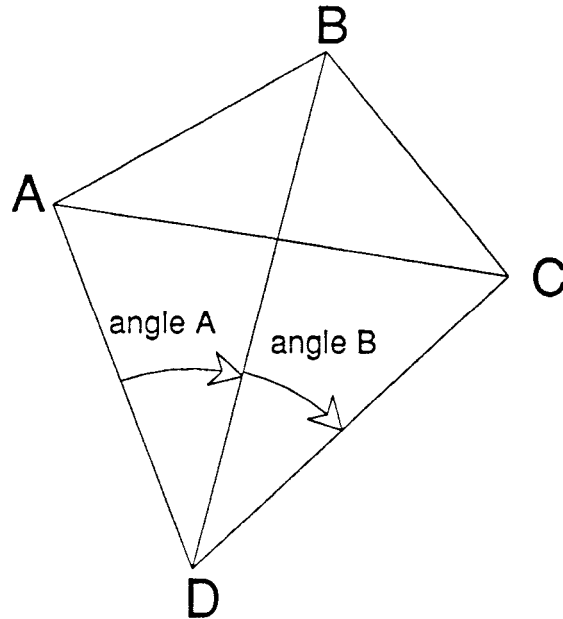
```
Command 226-  
The Three Point Problem  
Angle A           = 980748  
Angle Alpha       = 355015  
Angle Beta        = 231155  
Distance A-C      = 223.6  
Distance A-B      = 316.2  
Angle X           = 94-23-29.4  
Angle Y           = 108-26-32.5
```

Solving Three Point Problems

(227-) Three Sets Of Coordinates And Two Angles

PURPOSE

227- solves a three-point problem given three sets of coordinates and two angles.



PROCEDURE

1. Enter 227-.
2. Enter North and East coordinates for A, B, and C.
3. Enter angle A.
4. Enter angle B. Benchmark reports the coordinates of D.

EXAMPLE

```
Command 227-  
Three Point Problem - Coordinates Given  
A's North Coordinate= 1400  
A's East Coordinate= 900  
B's North Coordinate= 1500  
B's East Coordinate= 1200  
C's North Coordinate= 1300  
C's East Coordinate= 1300  
Angle A           = 355015.6  
Angle B           = 231154.9  
North Coordinate   = 999.9999   | D's coordinates are displayed  
East Coordinate    = 1000.0007
```

(229-) Vertical Curve Solver

PURPOSE

Use 229- to solve a vertical curve given the rate of change entering and leaving the point of intersection (PI), the station at the point of vertical intersection (PVI), the elevation at the PVI station, and the length of the vertical curve.

PROCEDURE

1. Enter 229-.
2. Enter rate of change into PI (+ or -). For example, a 2.5% grade is entered as 2.5.
3. Enter rate of change leaving PI (+ or -).
4. Enter the PVI (point of vertical intersection) station (34+28 entered as 3428).
5. Enter the elevation at the PVI station.
6. Enter the length of the vertical curve. Benchmark displays:
CREST PT. STATION
CREST PT. ELEVATION
PVI STATION PVI
ELEV
LVC
MO
SSD
BVC STATION BVC
ELEV
EVC STATION EVC
ELEV
7. Next, Benchmark requests:
1 = AUTOMATIC
2 = MANUAL
OPTION:
8. Select either automatic or manual mode. The procedure for each mode is explained below.

AUTOMATIC MODE

1. Select 1 (AUTOMATIC) to compute station and elevation at fixed intervals from BVC.
2. Enter first station.
3. Enter end station.
4. Enter increment desired. The station numbers and elevations are displayed.

MANUAL MODE

1. Select 2 (MANUAL) to compute station and elevation at desired distance from BVC.
2. Enter station desired. The elevation at that station is displayed.
3. Repeat step 2 as needed.

NOTE

Use 231- to switch between manual and automatic vertical curve modes.

(229-) Vertical Curve Solver

EXAMPLE

Command **229-Vertical Curves**

Enter Grade 1(%) = **2**
Enter Grade 2(%) = **- 1.5**
Enter PVI Station = **15123.65** Enter PVI
Elevation = **50**
Enter LVC = **400**
Crest Point Station = **151+52.2214**
Crest Point Elevation = **48.2858**
PVI Station = **151+23.6500**
PVI Elevation = **50.0000**
LVC = **400.0001**
MO = **-1.7500**
SSD = **399.7142**
BVC Station = **149+23.6500**
BVC Elevation = **46.0000**
EVC Station = **153+23.6500**
EVC Elevation = **47.0000**
1= Automatic
2= Manual
Option: **1**
Enter 1st Station **14950**
Enter End Station **15323.65**
Enter Increment **50**
Station = **149+50.0000**
Elevation = **46.4967**
Station = **150+00.0000**
Elevation = **47.2720**
Station = **150+50.0000**
Elevation = **47.8286**
Station = **151+00.0000**
Elevation = **48.1665**
Station = **151+50.0000**
Elevation = **48.2855**
Station = **152+00.0000**
Elevation = **48.1859**
Station = **152+50.0000**
Elevation = **47.8675**
Station = **153+00.0000**
Elevation = **47.3303**
Station = **153+23.6500**
Elevation = **47.0000**

Select automatic mode

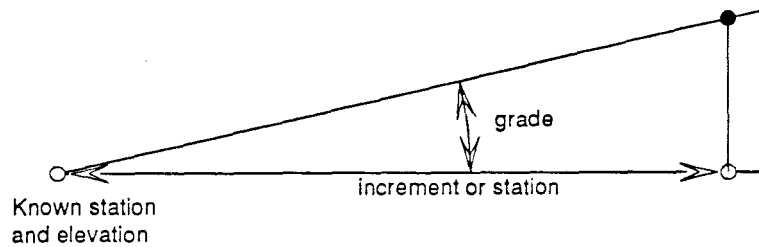
Stations and elevations are displayed

(230-) Tangent Grades

PURPOSE

Given a known station, elevation, and grade, 230- computes either:

- Station and elevation at specified increments
- Elevation at specified station.



PROCEDURE

1. Enter 230-.
2. Enter known station.
3. Enter known elevation.
4. Enter percent of grade (+ or -).
5. At this point, you can select either AUTOMATIC or MANUAL mode.

AUTOMATIC MODE

1. Select 1 for AUTOMATIC mode.
2. Enter the starting station.
3. Enter the end station.
4. Enter the increment distance. The resulting station numbers and corresponding elevations display.

MANUAL MODE

1. Select 2 (MANUAL).
2. Enter the station for which you want elevation data. The elevation at that station is displayed.
3. Repeat step 2 as needed.

NOTE

Use 231- to alternate between MANUAL and AUTOMATIC modes.

(230-) Tangent Grades

EXAMPLE

```
Command 230-                               | Begin tangent grade routine
Tangent Grades
Enter Known Stat.      15000
Enter Known Elevation  50
Enter Grade +/- (%)    -2.5
1= Automatic
2= Manual
Option:                1                   | Select AUTOMATIC mode
Enter Start Stat.      15200
Enter End Station      15600
Enter Incr. Dist.      50

Station      = 152+00.0000
ELEVATION    = 45.0000

Station      = 152+50.0000
ELEVATION    = 43.7500

Station      = 153+00.0000
ELEVATION    = 42.5000

Station      = 153+50.0000
ELEVATION    = 41.2500

Station      = 154+00.0000
ELEVATION    = 40.0000

Station      = 154+50.0000
ELEVATION    = 38.7500

Station      = 155+00.0000
ELEVATION    = 37.5000

Station      = 155+50.0000
Elevation    = 36.2500

Station      = 156+00.0000
Elevation    = 35.0000

1= Automatic
2= Manual
Option:                2                   | Select MANUAL mode
Enter Station      15223.65               | Enter station
Elevation          = 44.4088               | Elevation is displayed

Enter Station      15015.36
Elevation          = 49.6161

Enter Station      15123.65
Elevation          = 46.9088
```

(235-, 234-, 233-, 250-) Curve Staking Routines

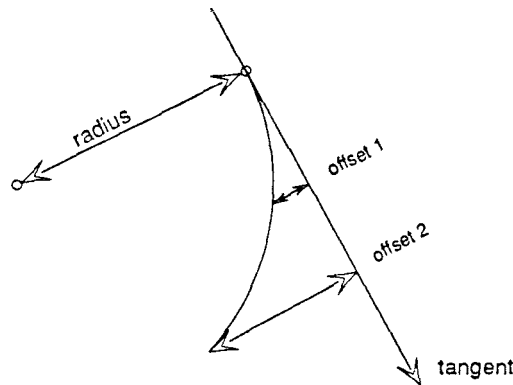
The curve staking routines compute, for a circular curve of given radius, the data necessary to stake a curve by one of the following methods:

- Offsets from the tangent (235-).
- Angle from point of curve, chords from stake to stake (234-).
- Angles and chords from stake to stake (233-).

(235-) Offsets from Tangent

PURPOSE

For a circular curve of given radius, 235- computes the data necessary to stake a curve using offsets from the tangent.



PROCEDURE

1. Enter 235-.
2. Enter radius.
3. At this point, you can choose to:
 - Specify the increment at which to compute the station and offset data (1= INCREMENTS)
 - Enter the length from P.C. and see the resulting station and offset data (2= RANDOM STATIONS)

INCREMENTS

1. Enter 1 (INCREMENTS).
2. Enter the curve length.
3. Enter the desired increment between stations. The station and offset at specified increment are displayed.

RANDOM STATIONS

1. Enter 2 (RANDOM STATIONS).
2. Enter length from point of curvature (P.C.). The station and offset at specified distance is displayed.
3. Repeat step 2 as often as you want.

NOTE

Use 236- command to alternate between curve staking manual and increment modes.

(235-, 234-, 233-, 250-) Curve Staking Routines

EXAMPLE

```

Command 235-                               | Begin offsets from tangent routine
Curve Staking - Offsets from Tangent
Enter Radius                               5000

1= Increments
2= Random Stations
Option:                                   1      | Select increment method
Enter Curve Length                         250
Enter Increment                           25

Station      = 25.0000 | Station and
Offset       = 0.0626 | Offset at specified increment is displayed
Station      = 50.0000
Offset       = 0.2501
Station      = 75.0000
Offset       = 0.5626
Station      = 1+00.0000
Offset       = 1.0002
Station      = 1+25.0000
Offset       = 1.5628
Station      = 1+50.0000
Offset       = 2.2506
Station      = 1+75.0000
Offset       = 3.0635
Station      = 2+00.0000
Offset       = 4.0017
Station      = 2+25.0000
Offset       = 5.0651
Station      = 2+50.0000
Offset       = 6.2540
Angle        = 02-51-57.5
1= Increments
2= Random Stations
Option:                                   2      | Select random stations

Length From PC = 25      | Enter length from P.C.
Station        = 25.0000 | Benchmark displays station,
Offset         = 0.0626 | offset, and
Angle          = 00-17-11.3 | angle

Length From PC = 50
Station        = 50.0000
Offset         = 0.2501
Angle          = 00-34-22.7

Length From PC = 200
Station        = 2+00.0000
Offset         = 4.0017
Angle          = 02-17-32.8

```

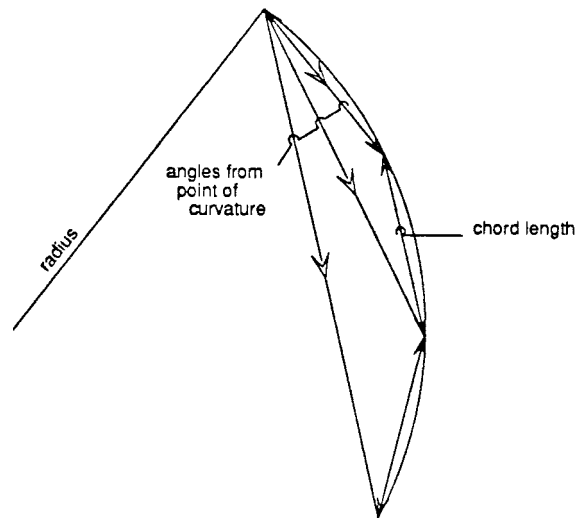
(235-, 234-, 233-, 250-) Curve Staking Routines

(234-) Angles from P.C., Chords from Stake to Stake

(250-) Angles from P.C., Chords from Stake to Stake & Long Chords

PURPOSE

For a circular curve of given radius, 234- calculates the data necessary to stake a curve using angles from point of curvature and chords from stake to stake. Use 250— to perform the same routine as 234- with the additional output of long chord data.



PROCEDURE

1. Enter **234-**.
2. Select option 1, 2 or 3.
 - If 1, enter radius.
 - If 2, enter the degree of arc.
 - If 3, enter the degree of chord.
 - If you choose options 2 or 3, the radius is displayed.
3. Enter the P.C. station.
4. Enter 0 (NO OFFSETS) or 1 (OFFSETS). If you select 1, enter inside and outside offsets in response to the prompts.
5. At this point, you can select the Increment or Random Station method.
6. If you selected 1 (INCREMENTS), enter the curve length, then the desired increment. The station number and corresponding angle and chord data will be displayed.
7. If you selected 2 (RANDOM STATIONS), you are prompted for the chord length from P.C. When you enter this distance, the resulting angle and chord data for that station are displayed. Repeat as needed.

NOTES

1. If you specified offsets, center, inner, and outer chord data are displayed.
2. Use 236- to switch between curve staking manual and increment modes.
3. To stake a curve that runs counter-clockwise from the PC, enter a negative radius (or degree of curve). Angles will be printed as 360 degrees minus the deflection angle.
4. To stake a curve in reverse from the PT, enter a negative curve length

(235-, 234-, 233-, 250-) Curve Staking Routines

EXAMPLE

```
Command 234- | Begin curve staking routine
Curve Staking - Angles From P.C.
Chords From Stake to Stake
1=Radius
2=Degree of Curve Arc
3=Degree of Curve Chord
Option:      1 | Select radius method

Enter Radius      1000
Enter P.C. Station 1675.67
0=No Offsets
1=Offsets
Option:      1 | Calculate offsets
Enter Inside Offset 16.5
Enter Outside Offset 16.5
1= Increments
2= Random Stations
Option:      1 | Use increment method
Enter Curve Length 93.83
Enter Increment    25 | Enter increment from P.C. station
Station           = 17+00.0000 | Resulting data is displayed...
Angle             = 00-41-49.2
Center Chord      = 24.3294
Inner Chord       = 23.9280
Outer Chord       = 24.7309

Station           = 17+25.0000
Angle             = 01-24-47.5
Center Chord      = 24.9994
Inner Chord       = 24.5869
Outer chord       = 25.4119

Station           = 17+50.0000
Angle             = 02-07-45.8
Center Chord      = 24.9994
Inner Chord       = 24.5869
Outer Chord       = 25.4119

Station           = 17+69.5000
Angle             = 02-41-16.9
Center chord      = 19.4997
Inner Chord       = 19.1780
Outer Chord       = 19.8215
1= Increments
2= Random Stations
Option:      2 | Select Random Stations method

Length from P.C.   = 50 | Enter length from point of curvature
Station           = 17+25.6700 | Calculated data is displayed...
Angle             = 01-25-56.6
Center Chord      = 49.9948
Inner Chord       = 49.1699
Outer Chord       = 50.8198

Length from P.C.   = 75

Station           = 17+50.6700
Angle             = 02-08-54.9
Center Chord      = 24.9994
Inner Chord       = 24.5869
Outer Chord       = 25.4119
```

(235-, 234-, 233-, 250-) Curve Staking Routines

(233-) Angles and Chords from Stake to Stake

PURPOSE

For a circular curve of given radius, 233- calculates the data necessary to stake a curve using angles and chords from stake to stake.

Note that the only difference between 233- and 234- is the output. 233- reports the angle at each station from stake to stake rather than from the point of curvature (in 234-).

PROCEDURE

1. Enter **233-**.
2. Select option 1, 2 or 3.
 - If 1, enter radius.
 - If 2, enter the degree of arc.
 - If 3, enter the degree of chord.
 - If you choose options 2 or 3, the radius is displayed.
3. Enter the P.C. station.
4. Enter 0 (NO OFFSETS) or 1 (OFFSETS). If you select 1, enter inside and outside offsets in response to the prompts.
5. At this point, you can select the Increment or Random Station method.
6. If you select 1 (INCREMENTS), enter the curve length, then the desired increment. The station number and corresponding angle and chord data will be displayed.
7. If you select 2 (RANDOM STATIONS), you are prompted for the length from P.C. When you enter this distance, the resulting angle and chord data for that station are displayed. Note that the angle at each station is given from stake to stake rather than from the point of curvature (as in 234-).

Repeat as needed.

NOTES

1. If you specified offsets, center, inner, and outer chord data are displayed.
2. Use 236- to switch between curve staking manual and increment modes.
3. To stake a curve that runs counter-clockwise from the PC, enter a negative radius (or degree of curve). Angles will be printed as 360 degrees minus the deflection angle.
4. To stake a curve in reverse from the PT, enter a negative curve length.

(235-, 234-, 233-, 250-) Curve Staking Routines

EXAMPLE

```
Command 233- | Begin curve staking routine
Curve Staking - Angles and Chords
From Stake to Stake
1=Radius
2=Degree of Curve Arc
3=Degree of Curve Chord
Option: 2 | Select degree of curve arc method

Enter Degree of Arc 1.5
Radius = 3819.7187 | Radius displays
Enter P.C. Station 1675
0=No Offsets
1=Offsets
Option: 0 | Select no offsets option
1= Increments
2= Random Stations
Option: 1
Enter Curve Length 696.23
Enter Increment 250 | Enter increment between stations

Station = 17+50.0000
Angle = 00-33-45.0
Chord = 74.9988

Station = 20+00.0000
Angle = 01-52-30.0
Chord = 249.9554

Station = 22+50.0000
Angle = 01-52-30.0
Chord = 249.9554

Station = 23+71.2300
Angle = 00-54-33.2
Chord = 121.2250
```

(240-, 241-, 242-, 243-) Spiral Curve Stakeout

PURPOSE

Use 240- to solve a spiral curve stakeout problem.

PROCEDURE

1. Enter **240-**.
2. Enter the tangent to spiral (TS) or spiral to tangent (ST) station number.
3. Enter the spiral to curve (SC) or curve to spiral (CS) station number.
4. Enter the radius of the circular *curve*. Enter as positive if the curve spirals to the right and negative if the curve spirals to the left.
5. Select setup option **1, 2** or **3**. Setup option 1 is to occupy the TS/ST station and backsight the SC/CS station. Setup option 2 is to occupy the SC/CS station and backsight the TS/ST station. Setup option 3 is to occupy and backsight specified stations.
6. If you selected setup option 3 enter the occupied and backsight station numbers.
7. Enter the station interval for stationing by intervals or enter **243-** for stationing by random stations.
8. If you selected stationing by intervals enter the starting and ending station numbers. If you selected stationing by random stations enter the random station number. The routine will print the station number, turned angle, distance and short chord for each station.
9. To use the same spiral with a new setup, enter **241-** at the `COMMAND` prompt and proceed with step 5 above.
10. To use the same spiral with a new interval, starting and ending station, enter **242-** at the `COMMAND` prompt and proceed to step 7 above.

(240-, 241-, 242-, 243-) Spiral Curve Stakeout

EXAMPLE

Command	240-		Spiral curve stake out command
TS/ST Station	= 15217.125		Tangent to spiral station
SC/CS Station	= 15337.125		Spiral to curve station (TS is less than SC)
Length of Spiral	= 120.0000		
Radius +R/-L	= 500		Positive radius - Spirals to the right
Offset	= 5.5		Positive offset - Offset is to the right

----- Setup Option -----

1. OCC. TS/ST, BS SC/CS		
2. OCC. SC/CS, BS TS/ST		
3. OCC. and BS Specified Stations		
Option	= 1	Occupy TS and backsight SC
Interval	= 25	25 foot stations
Starting Station	= 15225	Starting station
Ending Station	= 15337.125	Ending station

Station	= 152+25.0000
Angle	= 357-43-28.8
Distance	= 7.8722
Short Chord	= 7.8722

Station	= 152+50.0000
Angle	= 357-53-12.0
Distance	= 32.8253
Short Chord	= 24.9532

Station	= 152+75.0000
Angle	= 358-14-49.8
Distance	= 57.7195
Short Chord	= 24.8956

Station	= 153+00.0000
Angle	= 358-48-20.8
Distance	= 82.5482
Short Chord	= 24.8378

Station	= 153+25.0000
Angle	= 359-33-43.7
Distance	= 107.2968
Short Chord	= 24.7798

Station	= 153+37.1250
Angle	= 360-00-00.0
Distance	= 119.2637
Short Chord	= 11.9981

Command	240-		New spiral
TS/ST Station	= 15217.125		Tangent to spiral station
SC/CS Station	= 15337.125		Spiral to curve station (TS is less than SC)
Length of Spiral	= 120.0000		
Radius +R/-L	= -500		Negative radius - Spirals to the left
Offset	= 5		Positive offset - Offset is to the right

----- Setup Option -----

1. OCC. TS/ST, BS SC/CS		
2. OCC. SC/CS, BS TS/ST		
3. OCC. AND BS Specified Stations		
Option	= 1	Occupy TS and backsight SC
Interval	= 25	25 foot stations
Starting Station.	= 15225	Starting station
Ending Station.	= 15337.125	Ending station

Station	= 152+25.0000
Angle	= 02-17-14.6
Distance	= 7.8776
Short Chord	= 7.8776

Station	= 152+50.0000
Angle	= 02-07-30.5
Distance	= 32.9199
Short Chord	= 25.0424

continued...

EXAMPLE

Station	=	152+75.0000	
Angle	=	01-45-48.7	
Distance	=	58.0126	
Short Chord	=	25.0942	
Station	=	153+00.0000	
Angle	=	01-12-08.2	
Distance	=	83.1491	
Short Chord	=	25.1457	
Station	=	153+25.0000	
Angle	=	00-26-28.2	
Distance	=	108.3145	
Short Chord	=	25.1970	
Station	=	153+37.1250	
Angle	=	360-00-00.0	
Distance	=	120.5227	
Short Chord	=	12.2399	
Command 240-			<i>New spiral</i>
TS/ST Station	=	1750	<i>Spiral to tangent station</i>
SC/CS Station	=	1650	<i>Curve to spiral stn. (ST is higher than CS)</i>
Length of Spiral	=	100.0000	
Radius +R/-L	=	400	<i>Positive radius - Spirals to the right</i>
Offset	=	10	<i>Positive offset - Offset to the right</i>
----- Setup Option -----			
1. OCC. TS/ST, BS SC/CS			
2. OCC. SC/CS, BS TS/ST			
3. OCC. AND BS Specified Stations			
Option	=	2	<i>Occupy ST and backsight CS</i>
Interval	=	20	<i>20 foot stations</i>
Starting Station.	=	1675	<i>Starting station</i>
Ending Station.	=	1750	<i>Ending station</i>
Station	=	16+75.0000	
Angle	=	356-51-10.4	
Distance	=	24.4501	
Short Chord	=	24.4501	
Station	=	16+80.0000	
Angle	=	357-08-45.6	
Distance	=	29.3575	
Short Chord	=	4.9094	
Station	=	17+00.0000	
Angle	=	358-11-59.4	
Distance	=	49.0444	
Short Chord	=	19.6993	
Station	=	17+20.0000	
Angle	=	359-03-47.9	
Distance	=	68.8247	
Short Chord	=	19.7997	
Station	=	17+40.0000	
Angle	=	359-44-08.5	
Distance	=	88.7035	
Short Chord	=	19.8999	
Station	=	17+50.0000	
Angle	=	360-00-00.0	
Distance	=	98.6817	
Short Chord	=	9.9875	

continued...

EXAMPLE

Command	240-			<i>New spiral</i>
TS/ST Station	=	27505.76		<i>Tangent to spiral station</i>
SC/CS Station	=	27805.76		<i>Spiral to curve station</i>
Length of Spiral	=	300.0000		
Radius +R/-L	=	1800		<i>Spirals to the right</i>
Offset	=	10		<i>Offset to the right</i>

```
----- Setup Option -----
```

1. OCC. TS/ST, BS SC/CS
2. OCC. SC/CS, BS TS/ST
3. OCC. AND BS Specifie

Option	= 3	Occupy and backsight odd stations
OCC. Station	= 27650	Occupied station
BS Station	= 27505.76	Backsight station
Interval	= 25	25 foot stations
Starting Station.	= 27525	Starting station
Ending Station.	= 27650	Ending station

```

Station      = 275+25.0000
Angle        = 00-03-20.4
Distance     = 124.8089
Short Chord  = 124.8089

```

```

Station      = 275+50.0000
Angle        = 00-08-51.2
Distance     = 99.8242
Short Chord  = 24.9853

```

```

Station      = 275+75.0000
Angle        = 00-15-41.5
Distance     = 74.8511
Short Chord  = 24.9737

```

```

Station      = 276+00.0000
Angle        = 00-23-51.5
Distance     = 49.8893
Short Chord  = 24.9621

```

```

Station      = 276+25.0000
Angle        = 00-33-20.9
Distance     = 24.9390
Short Chord  = 24.9506

```

```

Station      = 276+50.0000
Angle        = 179-37-56.4
Distance     = 0.0000
Short Chord  = 24.9390

```

Command 241- | Same spiral, new setup

```
----- Setup Option -----
```

1. OCC. TS/ST, BS SC/CS
2. OCC. SC/CS, BS TS/ST
3. OCC. AND BS Specified Stations

Option	=	3	Occupy and backsight odd stations
OCC. Station	=	27650	
BS Station	=	27805.76	
Interval	=	25	
Starting Station.	=	27675	
Ending Station.	=	27805.76	

```

Station      = 276+75.0000
Angle        = 358-34-56.3
Distance     = 24.9274
Short Chord  = 24.9274

```

```

Station      = 277+00.0000
Angle        = 358-48-24.2
Distance     = 49.8428
Short Chord  = 24.9158

```

continued...

(240-, 241-, 242-, 243-) Spiral Curve Stakeout

EXAMPLE

Station	=	277+25.0000	
Angle	=	359-03-11.5	
Distance	=	74.7456	
Short Chord	=	24.9042	
Station	=	277+50.0000	
Angle	=	359-19-18.1	
Distance	=	99.6349	
Short Chord	=	24.8926	
Station	=	277+75.0000	
Angle	=	359-36-44.1	
Distance	=	124.5095	
Short Chord	=	24.8810	
Station	=	278+00.0000	
Angle	=	359-55-29.5	
Distance	=	149.3677	
Short Chord	=	24.8694	
Station	=	278+05.7600	
Angle	=	360-00-00.0	
Distance	=	155.0926	
Short Chord	=	5.7283	
Command	242-		<i>Same setup, new interval</i>
Interval	=	50	<i>50 foot stations</i>
Starting Station.	=	27675	<i>Starting station</i>
Ending Station.	=	27805.76	<i>Ending station</i>
Station	=	276+75.0000	
Angle	=	358-34-56.3	
Distance	=	24.9274	
Short Chord	=	24.9274	
Station	=	277+00.0000	
Angle	=	358-48-24.2	
Distance	=	49.8428	
Short Chord	=	24.9158	
Station	=	277+50.0000	
Angle	=	359-19-18.1	
Distance	=	99.6349	
Short Chord	=	49.7961	
Station	=	278+00.0000	
Angle	=	359-55-29.5	
Distance	=	149.3677	
Short Chord	=	49.7494	
Station	=	278+05.7600	
Angle	=	360-00-00.0	
Distance	=	155.0926	
Short Chord	=	5.7283	
Command	243-		<i>Same setup, random stations</i>
STATION	=	27800	<i>Random station</i>
Station	=	278+00.0000	
Angle	=	359-55-29.5	
Distance	=	149.3677	
Short Chord	=	149.3677	
Station	=	27803	<i>Random station</i>
Station	=	278+03.0000	
Angle	=	359-57-49.9	
Distance	=	152.3495	
Short Chord	=	2.9836	

Job Copy and Directory Utilities

General Procedures	18-2
Copy Benchmark Job File	18-3
Show Directory of Jobs	18-4
Delete a Job	18-5
Merge Two Benchmark Coordinate Job Files	18-6
DOS Directory	18-6
Backup a Subdirectory	18-7
Restore a Subdirectory	18-7
Delete a Subdirectory	18-9
Copy Lot Description File	18-10
Show Directory of Lot Description Files	18-11

WHAT'S IN THIS CHAPTER?

This chapter describes the Job Copy and Directory Utilities. Here, you will find a variety of routines to copy, list, merge, and delete jobs, subdirectories, and lot descriptions.

General Procedures

The steps required for using the options on the Job Copy and Directory Utilities Menu are straightforward and the prompts are generally self-explanatory. In fact, the prompts for many of these routines are almost identical. Here is a typical series of prompts, taken from the **Copy Benchmark Job** routine.

```
Enter source drive= D
Enter source subdirectory= \bench70\demo Enter source job
number= 40
Enter destination drive= D
Enter destination subdirectory= \bench70\demo Enter destination job
number= 36
Input job name= Sample Subdivision 5
```

Note that:

Source Drive is the drive from which you are copying.
Source Subdirectory is the subdirectory from which you are copying. Source
Job Number is the job file on the source drive and subdirectory.

Destination Drive, Subdirectory, and Job Number represent the target of your copying operation.

Default values are given in reverse video. To accept these values, press RETURN without making an entry. Defaults may be edited using the standard editing keys (see chapter 1). A question mark (?) may be entered when prompted for a subdirectory to cause a selection window to pop up from which you can select a subdirectory.

You can enter **4-** at almost any prompt to return to the Job Copy Menu. Exceptions are the backup and restore routines, which you should not to try escape from.

```
Job Copy and Directory Utilities
Copy Benchmark Job File
Show Directory of Jobs
Delete a Job
Merge Two Job Files
DOS Directory
Backup a Subdirectory
Restore a Subdirectory
Delete a Subdirectory
Copy Lot Description File
Show Directory of Lot Description Files
Return to Benchmark Main Menu
```

Your selection is made by pressing <RETURN> when the option you wish to pick is highlighted. You move the highlight bar with the arrow keys or by pressing the first character of the choice. The Home and PgUp keys move you to the end. It does not matter if Num Lock is on.

Copy Benchmark Job File

PURPOSE

Makes back-ups or duplicate copies of Benchmark job files.

PROCEDURE

1. Select "Copy Benchmark Job File" from the Job Copy and Directory Utilities Menu and respond to the following prompts:

Enter source drive= D

Enter source subdirectory= \bench70\demo Enter

source job number= 40

Enter destination drive= D

Enter destination subdirectory= \bench70\demo Enter

destination job number= 36

Input job name= Sample Subdivision 5

2. To accept the default values, press RETURN without making an entry.

NOTE

Groups are automatically copied with Benchmark job files.

Show Directory of Jobs

PURPOSE

Displays a directory of jobs and their file types on the specified disk drive.

NOTES

1. Benchmark job files contain either field data or coordinate data.
2. If a file contains coordinate data, it is labeled Coordinates. The number in square brackets represents the highest point number in the file.
3. Empty jobs are listed as UNUSED.
4. Field data files are labeled Field Data.

EXAMPLE

```
Enter 4- at ANY prompt to return to Job Copy Menu
Enter source drive= D
Enter source subdirectory= \bench\class
Starting Job Number= 1
Ending Job Number= 20
1   Class Field Data                               Field data
2   Coordinates from Class Field Data               [8]   V6.0 Coord's
3   Coordinates from Class Field Data after Side shots [95]  Coordinates
4   UNUSED
5   Topo                                           [127]  Coordinates
6   UNUSED
7   UNUSED
8   UNUSED
9   UNUSED
10  UNUSED
11  UNUSED
12  UNUSED
13  UNUSED
14  UNUSED
15  UNUSED
16  UNUSED
17  UNUSED
18  UNUSED
19  UNUSED
20  UNUSED
Press <RETURN/ENTER> to continue=
```

Delete a Job

PURPOSE

This option erases a job from the specified drive and subdirectory.

PROCEDURE

1. Select "Delete a Job" from the Job Copy and Directory Utilities Menu. Job copy requests the following information:

```
Enter source drive= D
Enter source subdirectory= \BENCH\DEMO Enter source
job number= 3
JOB #3 IS Cul-de-sac Demo File
Are you sure you want to delete this job?
1.  Yes
2.  No
Option=
```

2. Enter drive, subdirectory, and job number. After you enter the source job number, you will be asked to confirm the deletion.

Merge Two Benchmark Coordinate Job Files

To merge two job files follow the prompts, as shown in the example. Note that you must select a drive and subdirectory, and the numbers of the two jobs to merge. The default selections are presented in reverse video. Press RETURN without making an entry to select the defaults. When you have responded to all the prompts, the two job files are merged.

EXAMPLE

```
Merge Two Coordinate Job Files
Enter 4- at ANY prompt to return to Job Copy Menu
Enter drive= D
Enter subdirectory= \bench70\demo
Enter first source job number= 40
Enter second source job number= 35
Enter destination job number= 35
Input job name= SAMPLE SUBDIV, SAMHILL STREET, CONCORD FIELDBOOK 432 5/23/90
Working...
```

NOTES

1. The destination job number will default to the same as the second source job number. You can supply an unused job number as the destination, or you can supply the first source job number. or you can use the default.
2. The destination job name will default to the same as the second source job name. You can edit the name in the usual manner.
3. If the first and second source jobs contain any common used point numbers, the points in the second source file will take precedence. In other words, the common used point numbers will end up with the coordinates of the second source job. You should move points to new numbers beforehand (in Coordinate Geometry) if you want common points to all be preserved in the merged job.
4. Groups files are also merged during a job merge. Common used Group numbers are simply given new group numbers in the destination job. All groups are preserved.

DOS Directory

PURPOSE

Performs the DOS DIR command.

PROCEDURE

Select "DOS Directory" from the Job Copy and Directory Utilities Menu. Enter the File Specification or press ENTER to view all files in the current directory.

See your DOS manual for more information on the DIR command.

Backup a Subdirectory

PURPOSE

With this option, you can create a backup of an entire subdirectory, either to floppy diskettes, another hard disk, or a tape backup unit. You enter a source drive and subdirectory and a destination (target) drive. Any existing data on the target drive will be erased.

If you are using floppy disks, you will be prompted to insert additional floppy disks as needed. Make sure you have a supply of formatted diskettes ready, as you cannot stop in midstream to format a disk.

PROCEDURE

1. Select "Backup a Subdirectory" from the Job Copy and Directory Utilities Menu and respond to the prompts:
Enter 4- at ANY prompt to return to Job Copy Menu Enter source drive= D
Enter source subdirectory= \BENCH\CLASS
Enter destination drive^s A
Any data on the disk in Drive A: will be erased!!
Make sure you have enough formatted floppies available! Press <RETURN/ENTER> to
continue-
2. You are prompted to insert fresh floppy disks if your data exceeds the capacity of one disk. As the message warns, make sure you have a supply of formatted floppy disks on hand before you begin the routine, as you cannot interrupt the program to format disks.

NOTE: In order to use this option you must have the file BACKUP.COM (BACKUP.EXE on some systems) in the directory you are running Benchmark from or you must include the directory which contains BACKUP.COM as part of your DOS path.

Restore a Subdirectory

PURPOSE

Use the **Restore a Subdirectory** option to restore the files that have been backed up with **Back Up a Subdirectory**. You can request to be prompted before the routine restores any file that has changed since the last backup. In this way, you can restore files selectively.

PROCEDURE

1. Select "Restore a Subdirectory" from the Job Copy and Directory Utilities Menu. You will see:
Do you wish to be prompted before restoring files that have been changed
since they were last backed up?
 1. Yes
 2. NoOption = 1
Enter Source Drive = A
Enter Destination Drive = C
2. If you want to selectively restore files, respond with "1" to this prompt. During the restore procedure, you will be asked to confirm whether you want files that have been changed to be restored.

Restore a Subdirectory

3. Next, you are prompted:
Insert backup diskette 01 in drive A:
Strike any key when ready
4. Press any key to start the process. File names are displayed as they are restored.

EXAMPLE

Do you wish to be prompted before restoring files that have been changed since they were last backed up?

1. Yes
2. No

Option: = 1

Enter Source Drive = A

Enter Destination Drive = C

\LOTS.DIR\DESCODES.DAT
\LOTS.DIR\SETUP.DAT
\LOTS.DIR\BNCHDISK.DAT
\LOTS.DIR\ACADSTYL.DAT
\LOTS.DIR\ACADPARM.DAT
\LOTS.DIR\DESCBLKS.DAT
\LOTS.DIR\BNCHDG.DAT
\LOTS.DIR\CONFBNCH.DAT
\LOTS.DIR\PB19.DAT
\LOTS.DIR\DESC130.DAT
\LOTS.DIR\PB15.DAT
\LOTS.DIR\DESC12.DAT
\LOTS.DIR\DESC131.DAT
\LOTS.DIR\PB13.DAT
\LOTS.DIR\PB11.DAT
\LOTS.DIR\PB14.DAT
\LOTS.DIR\PB3.DAT
\LOTS.DIR\PB4.DAT
\LOTS.DIR\PB5.DAT
\LOTS.DIR\PB6.DAT

Warning! File \LOTS.DIR\PB1.DAT
was changed after it was backed up
Replace the file (Y/N)? Y

\LOTS.DIR\DESCODES.DAT
\LOTS.DIR\SETUP.DAT

NOTE: In order to use this option you must have the file RESTORE.COM (RESTORE.EXE on some systems) in the directory you are running Benchmark from or you must include the directory which contains RESTORE.COM as part of your DOS path.

Delete a Subdirectory

PURPOSE

This option deletes every file in the specified Benchmark subdirectory and then deletes the subdirectory itself.

PROCEDURE

1. Select "Delete a Subdirectory" from the Job Copy and Directory Utilities Menu and respond to the prompts:

```
Enter 4- at ANY prompt to return to Job Copy Menu
You have requested to delete a Benchmark Subdirectory!
Enter Source Drive (Default =C) =
Enter Source Subdirectory (Default =\Bench.DIR) =\demo2\junk
ALL FILES ON THE C:\demo2\junk Subdirectory WILL BE ERASED!
Enter (Q)uit or (C)ontinue followed by <RETURN/ENTER> =
```

2. When you press RETURN, the specified subdirectory is deleted. IMPORTANT! A subdirectory deleted with this selection is UNRECOVERABLE. Use with caution.

Copy Lot Description File

PURPOSE

This option lets you copy lot description files.

NOTE

1. Every lot description file has the format DESCnnnn.DAT, where nnnn is a 1- to 4-digit number that uniquely names a file. Thus, DESC45.DAT, DESC999.DAT, and DESC44.DAT are valid names.
2. This selection is for Lot Description files, not for Groups. Groups are copied with Job files during the Copy Benchmark Job File process.

PROCEDURE

1. Select "Copy Lot Description" from the Job Copy and Directory Utilities Menu. You will receive these prompts in succession:

```
Enter Source Drive =D =  
Enter Source Subdirectory =\BENCH\CLASS  
Source Lot Description file number = 3  
Enter Destination Drive =D  
Enter Destination Subdirectory = \BENCH70\DEMO  
Destination Lot Description file number = 303
```

2. Enter the requested information, or press RETURN with no entry to accept the defaults.
3. At the prompt Source Lot Description File Number =, enter a 1- to 4-digit number.
4. At the prompt Destination Lot Description File Number, enter a 1- to 4-digit number.

Show Directory of Lot Description Files

PURPOSE

This options displays a list of lot description file names.

NOTES

1. Every lot description file has the format DESCnnnn.DAT, where nnnn is a 1- to 4-digit number that uniquely names a file. Thus, DESC45.DAT, DESC999.DAT, and DESC44.DAT are valid names.
2. This selection is for Lot Description files, not for Groups. Groups can be listed within a Benchmark job in Coordinate Geometry using the 130- command.

PROCEDURE

1. Select "Show Directory of Lot Description Files" from the Job Copy and Directory Utilities Menu. The list of job description names is displayed.
2. Press RETURN to get back to the Job Copy and Directory Utilities Menu.

EXAMPLE

Press <RETURN> to continue =

Volume in drive C is Henry Sanders
Directory of C:\Bench.DIR

DESCODES	DAT	DESCBLKS	DAT	DESC130	DAT	DESC12	DAT	DESC131	DAT
DESC141	DAT	DESC18	DAT	DESC1802	DAT	DESC180	DAT		
9 File(s) 12531712 bytes free									

128-, 129- Benchmark Import/Export File Routines

(128-) Import File Routine	19-2
(129-) Export File Routine	19-3

WHAT'S IN THIS CHAPTER?

Benchmark is capable of reading information encoded in a variety of formats. These routines allow you to describe the format of coordinates and to merge the data into an existing or new job.

Alternately, Benchmark coordinate data may be written to a file in a user selected ASCII format. This provides a means to send Benchmark coordinate data to other CAD software such as DCA, LandImprove, and AutoMAP.

(128-) Import File Routine

PURPOSE

The 128- command lets you read data files into the Benchmark coordinate geometry program. Point number, X, **Y**, Z coordinates, and descriptions in the following formats are allowed.

1. Northing, Easting
2. Easting, Northing
3. Northing, Easting, Elevation
4. Easting, Northing, Elevation
5. Northing, Easting, Elevation, Description
6. Easting, Northing, Elevation, Description
7. From AutoCAD <TOBENCH>

- The Description may be numeric or alpha and must exist in your Benchmark Description Code File.
- All the above formats may be preceded by a point number or not. If you are importing a file without point numbers, the behavior of the program depends upon whether or not you have manual or automatic point numbering turned on (86-). With automatic point numbering the program will prompt for a starting point number and place all points in the file sequentially from that point. With manual point numbering, the program will prompt for a point number for every point in the imported file.
- The delimiter may be a space, a comma, or a carriage return/line feed between the values.
- Any information beyond the description is ignored.
- The Subdirectory and file name must follow MS DOS rules, e.g.,
Subdirectory = **=\SAMPLE**
Import File Name = **GRIZZ.BAR**
- From AutoCAD option is to used to import files created with the AutoCAD Benchmark menu option "TOBENCH".

PROCEDURE

1. Enter Benchmark Coordinate Geometry.
2. Call up existing or new job.
3. Enter 128 –

If you are merging points to an existing coordinate file, Benchmark warns you if duplicate point numbers are encountered. The program will compare the X and Y values, and if a difference is detected, it prompts for a different point number. The current point number may be overlaid by entering the point number preceded by a minus sign. The program doesn't screen for changes in elevation or descriptions.

(129-) Export File Routine

PURPOSE

The 129-command lets you export Benchmark coordinate data files in the following formats:

1. Northing, Easting
 2. Easting, Northing
 3. Northing, Easting, Elevation
 4. Easting, Northing, Elevation
 5. Northing, Easting, Elevation, Description
 6. Easting, Northing, Elevation, Description
- The Descriptions may be either numeric or alpha.
 - The above formats may be preceded by a point number.
 - The field delimiter may be a space, a comma*, or a carriage return/line feed.
 - Points with zero elevation may be eliminated.
 - Northings, Eastings and elevations may be rounded.
 - The file storage must follow MS DOS rules for subdirectory and file names.

* When exporting to LDT, use commas as the delimiter.

PROCEDURE

1. Enter the Benchmark Coordinate Geometry.
2. Call up existing job.
3. Enter **129-** and select the options.
4. Select a point, range of points, or group number to export. The point prompt will repeat. When you are finished, enter a new command or cancel to end the process.

Benchmark <-> AutoCAD Interface (Optional Software)

(127-) Creating a Transfer (.DXF) File	20-2
Changing The Default Parameters	20-9
Sending Tick Marks to AutoCAD	20-12
Loading a Benchmark Generated Drawing into AutoCAD	20-13
Beginning a New Drawing	20-14
Layers Used in the Benchmark to AutoCAD Transfer	20-15
Setting Up the Master DXF File	20-16
Earlier versions of Benchmark	20-20
The Benchmark/AutoCAD Menu	20-21
Bench Menu Commands	20-23

WHAT'S IN THIS CHAPTER

This chapter details the options for transferring data between Benchmark and AutoCAD. Coordinate data along with design information such as labels, tickmarks and description code symbols may be inserted into an AutoCAD drawing.

Benchmark provides a set of design routines for use within AutoCAD. These are described under "Bench Menu Commands".

(127-) Creating a Transfer (.DXF) File

Benchmark has the ability to send data to AutoCAD through the use of the Benchmark to AutoCAD Transfer and receive data from AutoCAD through the use of custom menus and AutoLisp macros which are provided with the Benchmark/AutoCAD Interface Option.

FEATURES

- The Benchmark to AutoCAD transfer has the ability to send the following types of data to AutoCAD:
 1. Point numbers and point symbols
 2. Lines
 3. Curves
 4. Bearings - six different rounding options
 5. Distance - rounded from 0 to 4 places
 6. Arrows - to show the direction of a bearing
 7. Descriptions
 8. User defined symbols (blocks)
 9. Elevation data
 10. Interpolated tick marks for contouring
 11. Curve tables
 12. Lot areas
 13. Lot names
 14. Choice of DCA-type point blocks or traditional Benchmark-type
- Auto Labeling greatly simplifies the process of sending bearing and distance labels to AutoCAD. With Auto Labeling, you tell Benchmark whether you want bearings or distances, bearings and distances, or just bearings or just distance labels. You are next prompted for which side of the lots the labels go (inside or outside). Benchmark takes it from there.
- Full control is available over: text styles; layer names, colors and linetypes; points and symbols and their associated layers.
- Drawing scale, base point and rotation are fully compatible with DCA Engineering programs. Optional use of DCA-type point blocks provides for full DCA compatibility.

OVERVIEW

Benchmark builds an AutoCAD DXF (Drawing Interchange) file with data supplied by Benchmark Groups. In addition, Benchmark looks to the information in the Descriptions Table for layer and block information. The "Group Commands" section (Chapter 11) and the "Entering Description Codes" section (Chapter 3) provide complete information on these features. You are strongly urged to gain an understanding of those procedures before proceeding with this chapter.

Benchmark also gets information for building a DXF file from a "Master DXF" file which you can create and modify to your liking. The Master DXF gives Benchmark details about layers, linetypes, blocks and text styles that you want in your drawings. The Master DXF is explained later in this chapter.

(127-) Creating a Transfer (.DXF) File

PROCEDURE

1. You must build a group using the Edit Group Data (130-) routine (Chapter 11) to describe the data you wish to send to AutoCAD. The Create DXF File (127-) routine will send any and all Active Groups to AutoCAD. Be sure to make any groups you want to send Active and any you do not want to send Inactive.
2. Enter **127-**. If there is no group defined, the Command= prompt will reappear and nothing will happen. If a group is found, the following prompt will appear:

Master DXF file [less DXF extension]= C:\ACAD\BENCH\BNCLIB

The name here will vary depending on where your AutoCAD files are stored or whether you have specified a file name from the Setup Menu (see chapter 3). Press ENTER for the default or enter the name of an existing Master DXF file.

A Master DXF file called BNCLIB is shipped with Benchmark. See section later in this chapter for more about creating and modifying Master DXF files.

Next, the following prompt will appear:

AutoCAD Parameter file= D:\BENCH70\ACADPARM.DAT.

The name here will vary depending on where your Benchmark program files are stored, or whether you have specified a file name from the Setup Menu (see Chapter 3).

This refers to the file in which default parameters for 127- are stored. Press ENTER for the default filename (ACADPARM.DAT) or enter a different filename if you have one or wish to create one.

If you enter a different filename and it is not found, Benchmark responds like this:

Parameter file not found – you must make changes and save to create new file.

If you then make any changes and save the results, they will be saved in the file you specified. In this way you may create several sets of default parameters

(127-) Creating a Transfer (.DXF) File

3. Next the default parameters are displayed:

```
The following defaults are in effect
Acreage Rounded to 2 places
Square footage Rounded to 0 places
Bearings rounded to nearest Second
Distances rounded to 2 places
Elevations rounded to 1 places
Bearings have arrows
Style for Bearings and Distance is SMOOTH.....Size=0.1 In.
Style for Point Numbers is SMOOTH.....Size=0.1 In.
Style for Areas is SMOOTH.....Size=0.2 In.
Style for Group Names is SMOOTH.....Size=0.1 In.
Style for Descriptions is STANDARD.....Size=0.1 In.
Style for Elevations is SMOOTH.....Size=0.1 In.
Plotter Paper Height/Width= 21/33
Duplicate Labels eliminated= yes
DCA compatibility mode is on
Layer for Lines is LINES                Layer for Labels is LABELS
Layer for Group Names is LOT             Layer for Areas is AREA
Layer for Points is POINT                Layer for Tables is LABELS
Layer for Elev Dots is DOT               Layer for Arrows is ARROW
```

Do you wish to change anything (1=Yes,2=No)?= 2

The last prompt asks if you would like to make any changes to the default parameters. If you wish to change anything, turn to the section in this chapter on "Changing the Default Parameters" and return here when you are done. Otherwise, answer NO to the prompt and proceed.

4. At the following prompt, enter a full pathname:

```
AutoCAD DXF file name [Less DXF extension]=
```

A pathname means the drive, subdirectory and name of the DXF file to be created. Do not include the extension (.DXF) - Benchmark will add it for you. C:\DWG\TEMP is an example of a pathname.

There is a DOS environment variable (see Appendix E) available (BNDXF) which allows you to have a default path or pathname appear at this prompt every time.

You may prefer to use the same DXF filename each time you send data to AutoCAD, in order to cut down on disk space use. The DXFIN process in AutoCAD will allow any DXF filename to be specified, regardless of the name of your drawing.

(127-) Creating a Transfer (.DXF) File

5. If any Active Groups contain lines (TYPE C or 0), the following menu will appear:

```
Choose labeling method
Auto Labeling
Manual Labeling
Send all labels to table
Return to Command Prompt
```

- Choose Auto Labeling to have all Active groups containing lines labeled the same.
- Choose Manual Labeling to be asked how each line and curve generated should be labeled.
- Choose "Send all labels to table" to have all labels placed in a Line/Curve table.

6. If any Active Groups contain lines and you chose either Auto or Manual Labeling, the following two menus will appear:

```
Select placement of distances and curve labels
Inside of closed groups
Outside of closed groups
No labels
Return to Command Prompt
```

```
Select placement of bearing labels
Inside of closed groups
Outside of closed groups
No labels
Return to Command Prompt
```

- You may select the same placement for both types of labels (for example, Outside/Outside) if you wish.
- If output is set to Azimuth (7-) or Angle Right (8-), then azimuths or angles will be substituted for bearings.
- Select "No labels" on both menus to send just lines and point data to AutoCAD.

7. The next prompt is:

```
Do you wish to plot all active groups?
Yes
No
```

If you answer No you will be prompted for each individual Active group immediately after the Rotatc/Transform prompt.

(127-) Creating a Transfer (.DXF) File

8. The next prompt is:

```
Do you wish to Rotate/Transform the drawing?  
Yes  
No
```

- If you answer No, then the Base point of your AutoCad drawing will be 0,0 (X,Y) and the drawing will not be rotated (North will be towards the top of your screen). Benchmark will proceed to the next prompt.
- If you answer Yes, you will be prompted as follows:

Angle of rotation -Left/+Right [DDMMSS.S]=

- The angle you supply here is equivalent to DCA's "North Rotation". The drawing will be rotated but text will be oriented to 12 o'clock on the screen so you won't end up with upside-down text (bearings, distances etc.). The Benchmark and DCA custom AutoCad menus are programmed to recognize a rotated drawing so that points and bearings generated by those menus will be corrected for rotation.

The next prompt is:

```
Base point Northing=  
Base point Easting=
```

- The base point prompts will supply defaults based on the computed center of your drawing. You can use the defaults but you may find it easier to pick numbers somewhere nearby but rounded to a nice even number. For example, if Benchmark suggests Base point Northing= 4323.2365 and Base point Easting= 5876.8911, you might reply with 4000 and 6000, respectively. These numbers are easier to remember and will always have the same accuracy if used for possible future drawings.

After entering the Northing and Easting, you are prompted:

```
Base point X=  
Base point Y=
```

- The default X value will be the same number you supplied as Easting.
- The default Y value will be the same number you supplied as Northing.

Using the numbers suggested in the last paragraph, the whole Base point sequence might go something like this:

```
Base point Northing= 4000  
Base point Easting= 6000  
Base point X= 6000  
Base point Y= 4000
```

- If you will be working with Benchmark-type points and using the Benchmark/AutoCAD menus, you should enter the default values for X and Y.
- If you will be working with DCA, you can enter any values for X and Y. They do not need to be the same as the Easting and Northing. See the AutoCAD manual and the DCA manuals for further information concerning Base point/North rotation.

(127-) Creating a Transfer (.DXF) File

9. At the prompt:

```
MAX. SCALE IS 32 FEET PER INCH  
ENTER INCHES=FEET= 1=32
```

Enter the drawing scale in feet per inch. For example to have a drawing generated at twenty feet per inch you would enter 1=20.

- Benchmark calculates an estimated maximum scale based upon the sheet size you supply in the default parameters. You can enter any scale you want--the estimate is supplied only as a guide.
- The scale affects text size and symbol size. You should specify the scale at which you intend to plot the drawing.

10. When Benchmark has all the information it needs from you it will begin processing. The top row of the screen displays a status line while it is processing. The status line has one of the following three forms, depending on the type of data that is being processed:

- Processing point *n*
- Processing line from point *n* to point *n*
- Processing curve from point *n* to point *n*

When processing is finished, if it is found that any of the bearings or distances could not fit on their respective lines, Benchmark will display the following message:

```
n% of labels did not fit - Press <RETURN/ENTER> to continue=
```

Any line labels that do not fit are placed in a table which becomes part of the drawing. Line labels are tagged sequentially "L1" through "Ln". All curve labels are automatically placed in a curve table and are tagged sequentially "C1" through "Cn".

(127-) Creating a Transfer (.DXF) File

NOTES

1. If any of the groups you are sending are composed of open polygons, you will see the additional prompts:

Which side of line should distances & curve labels be placed on

1. Right of line
2. Left of line

Option=

Which side of line should bearings be placed on

1. Right of line
2. Left of line

Option=

2. If any of the groups you are sending are designated as TYPE=TTICKS or STICKS, you will be prompted for the contour interval and tick mark label interval:

Contour interval=

How many tick marks should be labeled with the elevation

Every 1 in <Enter zero for no labels>=

See section on Sending Tick Marks to AutoCAD later in this section.

3. The following information is sent to AutoCAD as Variables and is compatible with DCA:

Horizontal Scale	= USERR2, LTSCALE, USERR1, DIMSCALE
North Rotation	= USERR3 (in radians)
Base point Northing	= USERR4
Base point Easting	= USERR5
Base point X,Y	= INSBASE
Current point number	= USERI1

Changing the Default Parameters

When the 127- command displays the default parameters, you are asked if you want to make any changes:

Do you wish to change anything (1=Yes,2=No)?=

If you answer **yes**, you will be prompted for the items one at a time and given the chance to change them. If you press ENTER for any of the items the current default, which is displayed, will be taken and no changes will be made to that item. It is important to understand that any changes you make can either be applied only to the drawing being created, or they can be made permanent default parameters. You will be able to make that decision after running through all the items.

At the first three prompts:

```
Acreage rounding
Number of decimal places(0-4)= 2
  1. Use rounding
  2. Use truncation
Option= 1
```

```
Square footage rounding
Number of decimal places(0-4)= 0
  1. Use rounding
  2. Use truncation
Option= 1
```

```
Type of bearing rounding:
  1. Nearest degree
  2. Nearest 15 minutes
  3. Nearest minute
  4. Nearest 10 seconds
  5. Nearest second
  6. Nearest 10th of a second
Option = 5
```

Select your preferences or press ENTER to accept the defaults. At the prompts:

```
Round distances to= 2
Round elevations to= 1
```

Enter a value of 0 through 4 or press ENTER to accept the default. At the prompt:

```
Do you wish to have arrows on your bearings?
  1. Yes
  2. No
Option= 1
```

Enter 1 (Yes) if you want an arrow placed above each bearing label.

Changing the Default Parameters

The next series of prompts are for text styles and text sizes. Styles are defined in the Master DXF file (see section on *Setting Up the Master DXF File* later in this chapter). If a style is not found in the Master DXF file, a list of valid styles will be displayed and the prompt will be repeated. Text Size means the height in inches at plot time. Benchmark will multiply the size you enter by the scale of the drawing to make the height the correct number of drawing units.

```
Text Style for Bearings and Distances= SMOOTH
Text Size in Inches= 0.1
Text Style for Point Numbers= SMOOTH
Text Size in Inches= 0.1
Text Style for Group Names= SMOOTH
Text Size in Inches= 0.32
Text Style for Areas= SMOOTH
Text Size in Inches= 0.2
Text Style for Descriptions= STANDARD
Text Size in Inches= 0.1
Text Style for Elevations= SMOOTH
Text Size in Inches= 0.1
```

NOTE

Text styles sent in the DXF file you are creating with the 127- command are of necessity "zero height" styles. This means that if you normally work with many similar "fixed height" styles in AutoCAD (which differ from each other only in name and height), you may only need to refer to one style here. Fixed height styles will still operate normally after you have created your drawing with 127- (see section on *Setting Up the Master DXF File* later in this chapter for more information about text styles).

At the prompts:

```
Plotter paper height= 21
Plotter paper width= 33
```

Enter the height and width of your plotter paper. These values will not directly affect plotting. Rather, they are used only to help Benchmark estimate an approximate maximum drawing scale.

At the prompt:

```
Do you want duplicate labels eliminated?
1. Yes
2. No
Option= 1
```

Enter 1 (Yes) if you want Benchmark to show only one label on lines which are inversed twice (for example, between two adjoining lots). Enter 2 (No) if you want to send all labels.

At the prompt:

```
Do you wish to use DCA compatibilty mode?
1. Yes
2. No
Option= 1
```

Enter 1 (Yes) to send DCA-type point blocks for all points. Enter 2 (No) to send Benchmark-type points.

anging the Default Parameters

TE

DCA-type point blocks are the same type used by, and are fully compatible with DCA Engineering's AutoCAD add-on modules. Benchmark- type points are the same type as used in versions of Benchmark previous to 7.0, and are designed to work with the Benchmark/AutoCAD menu. Both point types allow symbols to automatically be inserted and both point types access the Master DXF file for entity information. (See section on Setting Up the Master DXF File later in this chapter.)

The next series of prompts ask you for Layer names for some of the entities to be sent to AutoCAD. If Benchmark finds the layer in the Master DXF file, its color and linetype characteristics will be utilized. If the layer you name is not found in the Master DXF file, a the layer will be created in the DXF file you are sending, with a color of white (7) and a continuous linetype. (See section on Setting Up the Master DXF File later in this chapter.)

Layer for Lines is LINES	Layer for Labels is LABELS
Layer for Group Names is LOT	Layer for Areas is AREA
Layer for Points is POINT	Layer for Tables is LABELS
Layer for Elev Dots is DOT	Layer for Arrows is ARROW

NOTES

1. If a name is specified in the LINELAYER setting in any group, the layer for lines will be overridden with that name, for that group only (see Chapter 11, Group Commands).
2. The layer for Points is the layer that points are inserted on unless a different layer is named in the Edit/Display Descriptions Table (see Chapter 3, Using the Setup Menu and Entering Description Codes). In the case of DCA-type points, the DCA point block itself is inserted on the layer specified. In the case of Benchmark-type points, a block named BNCHPNT (see page 20-18) is inserted on the layer specified.
3. Labels refers to Bearings, Distances, Azimuths and Curve data. The next prompt is:

Save the changes?

Yes

No

If you just want to apply the changes you made to this drawing only (the one you are creating now), answer No. The changes will be reflected in this drawing but will not alter the default parameters in the AutoCAD parameter file.

If you want the changes you made to become a permanent part of the default parameters, answer Yes. The changes will be applied to the drawing you are creating now, and the AutoCAD parameter file will be updated to reflect the changes for the future.

Sending Tick Marks to AutoCAD

You can send interpolated tick marks to AutoCAD through the use of TYPE=TTICKS and TYPE=STICKS settings in groups. See the "Group Commands" section (Chapter 11). When TYPE=TTICKS is set in a group (traverse mode), interpolated tick marks are placed between each point in the group. When TYPE=STICKS is set in a group (side-shot mode), interpolated tick marks are placed between the first point in the group and all other points in the group.

When you send tick marks to AutoCAD the following prompts will appear as part of the 127-command:

```
Contour interval=
```

Enter the contour interval for tick mark interpolation.

```
How many tick marks should be labeled with the elevation  
Every 1 in <Enter zero for no labels>=
```

Enter the frequency of tick mark labeling. For example, if you wanted every fifth tick mark to have an elevation label next to it you would enter 5. If you wanted tick marks with no labels you would enter 0.

NOTE

Tick marks are sent to AutoCAD as blocks called TICK, composed of a small X (two intersecting lines) with a point at the center. The "X" is sent on a layer named TICK and the point is sent on layer TICKNODE. Elevation labels are sent on a layer named ELEVT.

Loading a Benchmark Generated Drawing into AutoCAD

First, a word about Prototype drawings...

To be able to bring the DXF file into AutoCAD you will need to start with a "blank slate", that is, you must start in a drawing that contains no entities, styles or layers. Whenever you begin a new drawing, AutoCAD starts with a prototype drawing as a model for the new drawing. You can specify which prototype drawing you want AutoCAD to use by naming the prototype when you "Begin a NEW Drawing". You can also configure AutoCAD to use the same prototype drawing every time (See Task 8. Configure operating parameters in the AutoCAD Configuration Appendix for further details).

A benefit of using a prototype is that you can set up your drawing environment by setting AutoCAD modes and variables to the settings that you want to start with whenever you begin a new drawing. For example, in AutoCAD Release 10, the variable FLATLAND should be set to I in order for the DCA programs to work properly. You may prefer to set a particular APERTURE or PICKBOX setting, and you will probably prefer to set REGENAUTO to OFF. See the AutoCAD reference manual for more information on modes and variables. Another benefit of using a prototype drawing is that you can return to it later to change modes and settings as your drawing environment needs change.

It is recommended that you use either the BENCH.DWG prototype drawing provided with the Benchmark/AutoCAD Interface or a prototype drawing similar to BENCH.DWG. You may also specify NO prototype, but there are some drawbacks to this which are discussed below.

The BENCH.DWG prototype will automatically cause the Benchmark/AutoCAD menus to be loaded. You can modify the settings in BENCH.DWG if you like, as long as you don't add any entities, styles or layers.

Using some other drawing as a prototype is perfectly fine as long as it is free of entities, styles or layers.

Specifying NO prototype (by using an equals sign (=) with nothing after it) is, in effect, the same as starting with ACAD.DWG as a prototype (a "clean slate" drawing). The drawback to starting this way is that modes and variables are set automatically by AutoCAD to the same values that are found in the ACAD.DWG prototype that is shipped with AutoCAD. Two undesirable ones that come to mind (and there are probably many others) are FLATLAND, set to 0, and REGENAUTO, set to ON.

Loading a Benchmark Generated Drawing into AutoCAD

BEGINNING A NEW DRAWING

To call up a Benchmark generated DXF file (Drawing Interchange) in AutoCAD you should use the "Begin a NEW Drawing" selection from the AutoCAD Main Menu.

At the prompt:

Enter NAME of drawing:

You can use any legal drawing name.

To specify the BENCH.DWG prototype, enter:

name=\ACAD\BENCH

To specify some other prototype, enter:

name=prototype

To specify no prototype, enter:

name=

As soon as the Command: prompt appears, enter DXFIN, or select it from the menu.

When DXFIN prompts you for a filename, enter the same name you specified for "AutoCAD DXF file name" during the 127- command in Benchmark.

NOTE

If you get the message:

Not a new drawing -- only ENTITIES section will be input

or if you get some other error message, it probably means that you did not start with a "blank slate" prototype drawing.

Layers Used in the Benchmark to AutoCAD Transfer

Layer colors and linetypes can be customized to your preferences via the Master DXF file and layer names can be controlled directly from Benchmark in the Description Codes Table and during transfer to AutoCAD with 127-. While you have control over the naming of most layers sent from Benchmark, there are a few exceptions. *

The following table defines layer names that are automatically used by Benchmark-type points (DCA compatibility 01-1):

<u>Layer Name</u>	<u>Description</u>
DESCR	Description text
ELEVC	Elevation text
NODE	Node (point) sent with each point
POINTNO	Point number text, number to the right of point
POINTNOC	Point number text, number below the point

The following table defines layer names that are automatically used when sending interpolated tick marks to AutoCAD from Benchmark:

<u>Layer Name</u>	<u>Description</u>
ELEVT	Elevation labels
TICK	Tick mark
TICKNODE	Node (point) sent with each tick mark

An additional group of layers, TICKO through TICK10, and CONTOURO through CONTOUR10 will only be created if you utilize the contour or tick routines on the Bench Menu in AutoCAD. If you plan on using those routines frequently, you may want to include them in the Master DXF along with a logical color sequence. A menu selection on the "CONTOUR" submenu called "Colored Layers" will also set up these layers for you.

NOTE

Since blocks referenced in the Description Code Table are automatically added to drawings with corresponding descriptions, it makes the most sense to keep blocks on different layers than points so you will be able to control the visibility of points and blocks using the LAYER command. See the section on Setting Up the Master DXF File for more information on creating blocks.

* While these layer names cannot be changed with the 127- command, the information is stored in the AutoCAD Parameter file, which can be edited (carefully) with a pure ASCII text editor such as DOS's EDLIN.

Setting Up the Master DXF File

The Master DXF file is a file that is created in AutoCAD and used by Benchmark to get information it needs to create a DXF file (127-). The Master DXF gives you complete flexibility to customize the Benchmark/AutoCAD interface to your needs. Layers and their associated colors and linetypes, text styles and blocks used in the 127- routine are all defined in the Master DXF file. Additional layers, styles and blocks may also be included in the Master DXF file if so desired. A Master DXF file is provided to you with the Benchmark/AutoCAD interface, but you are free to modify it and add to it as your needs dictate. You can have multiple Master DXF files and refer to them as needed.

PROCEDURE

To create or modify a Master DXF file:

1. Edit an existing Master DXF drawing in AutoCAD. (see notes below to create a Master DXF drawing for the first time)
2. Create or modify any layers, linetypes, text styles and blocks you want in the Master DXF.
3. Perform the DXFOUT command. Use the default precision.
4. SAVE the drawing.

CREATING A MASTER DXF DRAWING FOR THE FIRST TIME

A Master DXF is shipped with Benchmark called BNCLIB.DXF and is installed in \ACAD\BENCH on your hard disk. To create a Master DXF drawing for the first time:

1. From the AutoCAD Main Menu choose 1. Begin a new drawing.
2. For drawing name enter \ACAD\BENCH\BNCLIB=

Be sure to include the equals (=) sign.

For example:

Enter selection: 1

Enter NAME of drawing: \ACAD\BENCH\BNCLIB=

3. At the Command: prompt, enter DXFIN. Press Enter to use the default file name.
4. SAVE so that you have a drawing file stored on the hard disk. Don't forget to DXFOUT and SAVE if you make any modifications, also.

Setting Up the Master DXF File

GUIDELINES FOR MASTER DXF FILES LAYERS

Any layers you wish to refer to in the 127- routine, the Description Code Table or the Group Edit Window may be present in the Master DXF. These layers can have any valid color or linetype. You may also have other layers and linetypes present, even if they are not accessed by Benchmark. You can opt to have no extra layers defined in the Master DXF, in which case Benchmark will assign color 7 (white) and continuous linetype to any layers it sends to AutoCAD. Layers may be left frozen or off.

TEXT STYLES

Any text style you refer to in the 127- routine must be present in the Master DXF file. The style characteristics *style name*, *font name*, *width factor*, and *obliquing angle* are used by Benchmark. The characteristics *height*, *backwards*, *upside-down* and *vertical* are ignored by Benchmark, so you can set these to any value you want.

NOTES

1. If you create a fixed-height style in the Master DXF, it *will* be converted into a zero-height style in any DXF file created by the 127- command. This inherent limitation of the DXF transfer process should present no problem, as you can create additional text styles after you DXFIN, and even re-use style names without affecting existing text.
2. When you first enter 127-, if any styles named in the default parameters file are not found in the Master DXF file, Benchmark will automatically use the Standard style.

BLOCKS

Any blocks sent to AutoCAD with 127- must be defined in the Master DXF beforehand. This includes any blocks assigned to descriptions in the Description Code table and a few blocks used by Benchmark for points, arrows, etc. All blocks utilized by the 127- command are drawn in the Master DXF drawing at 1"=1'. When Benchmark builds a DXF file, the same blocks will be automatically placed in the drawing at a scale factor equal to the scale of the drawing.

Notes

1. In the Master DXF, blocks should be defined on the "current layer" into which you want them inserted when you create drawings from Benchmark. For example, if you have a square with a point in the center that you use to denote granite bounds, and you want it to always reside on layer "monument", be sure that the entities are on layer "monument" and that the current layer is "monument" when you define the block with AutoCAD's BLOCK command.
2. Since blocks referenced in the Description Code Table are automatically added to drawings with corresponding descriptions, it makes the most sense to keep blocks on different layers than points so you will be able to control the visibility of points and blocks using the LAYER command.
3. It is best to create blocks from "raw" AutoCAD entities, that is any entity that is not already a block. This makes keeping track of what layer a block is defined on much simpler.

Setting Up the Master DXF File

4. If you are bringing blocks into your Master DXF from disk:

- a. Either insert them with an asterisk (*) in front of the name or explode them after insertion so that they will be reduced to their "raw" entities.
- b. Use the LAYER command to set the correct "current layer".
- c. Change the entities to the correct layer with CHPROP or CHANGE.
- d. Define (or re-define) the block within the drawing using the BLOCK command.

5. Many third-party block libraries (like DCA) come with blocks defined on Layer 0. By being defined on layer 0, these blocks can be inserted into drawings on any "current" layer and acquire the characteristics of that layer (for this reason they are sometimes called "chameleon" blocks). These "chameleon" blocks can be used in your Master DXF, and if you pay attention to the following procedure, you can save time and skip the steps outlined in Note 4 above.

- a. Set the correct "current" layer BEFORE the first insertion of a "chameleon" block.
- b. Insert the block in the usual manner (no asterisk!) and the block will be correctly defined in the drawing.

While this method works for the first insertion of a "chameleon" block, if there is any doubt, you should follow the steps outlined in Note 4 above to be sure that the block will be defined on the correct layer.

6. "Symbols" vs. "Parts":

In AutoCAD, a "Symbol" is a block that is used to represent something (like a utility pole or a granite bound), and it is always plotted the same size in inches, no matter what scale the drawing is. For example, you might want a granite bound to always appear on paper as a small 1/8 inch square with a dot in the center.

A "Part" is a block that is used to show true dimensions (such as a building footprint), and will always scale correctly when plotted at different scales, but will vary in its actual size in inches.

The Benchmark to AutoCAD transfer process utilizes "Symbols". Because the Master DXF is a 1"=1' drawing, you can draw the blocks at the actual size in inches (drawing units) that you want them to be plotted. For example, for the granite bound mentioned above, you would draw a square 0.125 drawing units (1/8 ") on a side. Each time Benchmark uses the block, it will insert the block at a scale factor equal to the drawing scale. For example, in a 1"=50' drawing, the granite bound mentioned above would be inserted at a scale factor of 50. This means that it will actually be 6.25 drawing units square in the drawing. When plotted at 1"=50', it will scale 6.25' across with an Engineer's scale. However, with a ruler it will measure 1/8 inch, which is the desired end result.

7. There are 5 example blocks included in the Master DXF shipped with Benchmark that you can use to get a feel for this process. They all have names beginning with the letter "Z" so you can tell which ones they are.

8. After you use the BLOCK command to define a block in the Master DXF, it is a good idea to insert the block in the Master DXF drawing so you have a visual representation for future reference. It is also helpful to label the block with some text to help you remember the block name.

Setting Up the Master DXF File

9. The following blocks are part of the Master DXF shipped with Benchmark. They should be present in all Master DXF files. These blocks all are defined on layer 0 and should remain that way. Otherwise, these blocks may be modified, with caution. Insertion points are important. The blocks used in tables must fit together.

<u>name</u>	<u>description</u>
BNCHPNT	the cross used in Benchmark-type points
LHEADBD	line-table header
LLINEBD	line-table additional line
CHEAD	curve-table header
CLINE	curve-table additional line
DOT	fat decimal point in Benchmark-type elevations
ARROWR	arrow right above bearings
ARROWL	arrow left above bearings

10. The following four blocks are also part of the Master DXF shipped with Benchmark. They should be present in all Master DXF files. These blocks contain attributes and **SHOULD NOT BE MODIFIED** at all.

POINT	DCA point block
PNTVARS	part of Benchmark-type points
BNCHVARS	invisible info for Benchmark/AutoCAD menus
BASEP	invisible info for Benchmark/AutoCAD menus

Notes to Users of Benchmark 6.0c or Earlier

TEXT STYLES

Versions of Benchmark 6.0c and earlier utilized a different system for defining text styles to be sent to AutoCAD (**Define AutoCAD Text** Styles from the Main Menu). If you have styles already defined in that system, you will need to create similar styles in the Master DXF. If you had several similar styles that differed only in the "*Height Factor*" parameter, you only need to create one style in the Master DXF.

The 127- command now prompts for the true text size in inches for each item that involves text. The true 1"=1' text size in inches intended by the "*Height Factor*" in the old Text Styles Table can be determined by multiplying the "*Height Factor*" (from the old Text Styles Table) by the "TEXT SIZE IN INCHES" which you previously supplied the 127- command.

BLOCKS

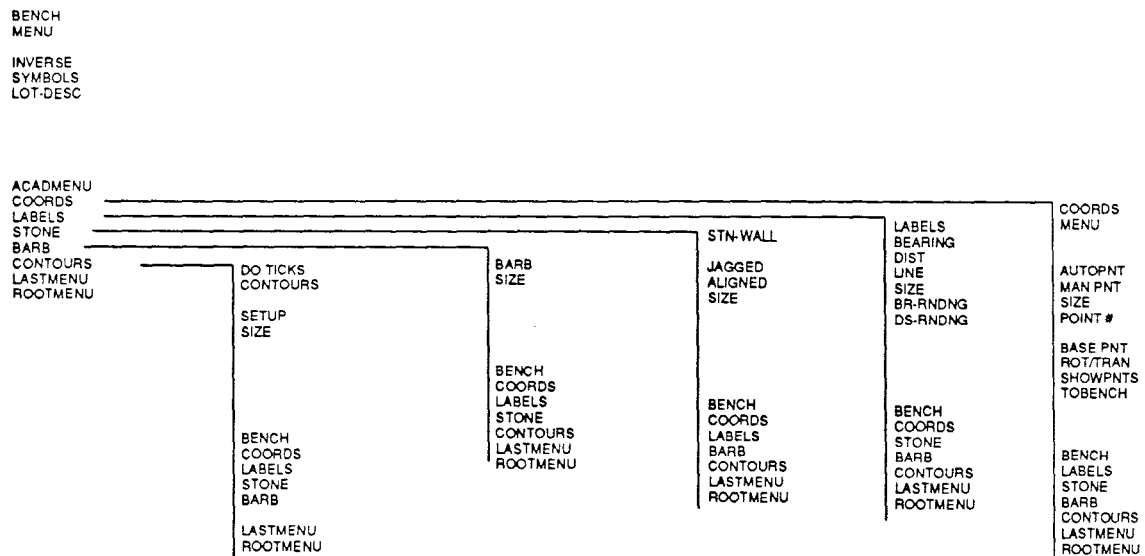
Versions of Benchmark 6.0c and earlier utilized a different system for automatically adding symbols (blocks) to drawings (i.e., **Description Dependent Layering, Symbols**). If you have blocks already set up for that system, you will have to bring them into the Master DXF to use them with this version of Benchmark. When you insert them into the Master DXF, you will need to insert them at a scale factor equal to the "*TEXT SIZE IN INCHES*" which you previously supplied the 127- command. This will make them true 1"=1' blocks.

The Benchmark/AutoCAD Menu

The Benchmark/AutoCAD menu offers the user the following functions:

1. Compute and draw bearing and distance labels
2. Inverse between points
3. Set and number points to be sent back to Benchmark coordinate geometry routines
4. Draw stone walls
5. Draw barb wire fences
6. Replace standard cross hair symbol with user defined symbols
7. Rotate and translate the drawing without losing the original coordinate system
8. Interpolate elevation tick marks and draw contour lines (only available to users of AutoCAD 2.5 or greater)
9. Interface with the DCA software package
10. Insert lot description text output into drawings

The structure of the Benchmark/AutoCAD menu is shown below. A description of each function follows.



NOTE: You must have Advanced Drafting Extension 3 (ADE-3) to make use of the Benchmark/AutoCAD Menu.

The Benchmark/AutoCAD Menu

If you do not have AutoCAD's Advanced Drafting Extensions Package 3 (ADE-3), you will not be able to make use of the Benchmark/AutoCAD menu. You will, however, be able to use the standard AutoCAD menu (ACAD.MNU) and load Benchmark generated DXFs (Drawing Interchange Files) via AutoCAD's DXFIN command.

You must have the following system variables set at the DOS level before attempting to use the BENCH menu.

```
SET LISPHEAP=39000
SET LISPSTACK=6000
SET ACADFREERAM=24
```

You can simplify this process by including these SET commands in your AUTOEXEC.BAT file which will automatically execute these commands when you turn your computer on. If you try to use the BENCH menu before issuing these SET commands you will receive the message:

```
*Invalid*
error: insufficient node space
```

To access the Benchmark/AutoCAD menu:

If you use the \ACAD\BENCH prototype when you "Begin a New Drawing", the Benchmark/AutoCAD menu will automatically be loaded.

To call the Benchmark/AutoCAD menu from any other menu, enter MENU at the COMMAND: prompt; for a menu name, enter \ACAD\BENCH.

The Benchmark/AutoCAD Menu

Bench Menu Commands

DXFIN AND GO

Whenever the BENCH menu is loaded you will see two options, DXFIN and GO. To load a Benchmark generated DXF format drawing for the first time use DXFIN. Any other time that you see this menu you should use the GO option. DXFIN is ONLY for loading in a Benchmark generated DXF. After doing DXFIN, do GO and the following menu items will appear:

INVERSE

The inverse routine knows if the drawing is rotated and compensates for the rotation angle. If the user hits the RETURN key (or the space bar, or the second button on the digitizing device), the routine will prompt for a radius point. The user can either point to a radius point or hit the RETURN key to print the accumulated area and escape from the inverse routine. Use the appropriate OSNAP override to ensure proper point selection.

LOT-DESC

In Benchmark, the 135- command produces a text script file that contains output which is the equivalent of the 134- command. This menu item is used to insert that output into the current drawing. The text file lists coordinates of points, the bearing and distance between points, and the area of the group.

COORDS

This menu item calls up a sub-menu that is described below:

- AUTOPNT - This command is used to set coordinate points within the drawing. The point numbering is automatic and sequential based upon the current point number. The coordinates for this point are stored in attributes of the inserted block and are adjusted for any rotation or translation done either in the Benchmark 127- command, DCA menu or with the BASE PNT or ROT/TRANS menu items within this sub-menu.
- MAN PNT - This command works like AUTOPNT except the user must supply the point number.
- SIZE - This command sets the text size in inches. The text size defaults to the text size set in the default condition of the 127- command.
- POINT# - This command allows the user to change the current point number for use with the AUTOPNT command. The current point number defaults to one higher than the highest point in the coordinate file at the time the 127- command is done.
- BASE PNT - This command sets the base point for coordinate rotation and transformation. The base point defaults to that specified by the user in the 127- command. For drawings generated with versions of Benchmark prior to 5.5 the base point is always 0,0.
- ROT/TRAN - This command is used to rotate the drawing about the base point. The angle used for specifying the rotation is the AutoCAD counterclockwise angle.

The Benchmark/AutoCAD Menu

- **SHOWPNTS** - This command is used to list on the screen all the points either sent to AutoCAD with the 127- command or set with either MAN PNT or AUTOPNT. For drawings generated with versions of Benchmark prior to 5.5 the points sent to AutoCAD with the 127- command will not appear.
- **TOBENCH** - This command is used to write out a file of all the points either sent to AutoCAD with the 127- command or set with either MAN PNT or AUTOPNT. The file has a .txt extension. For drawings generated with versions of Benchmark prior to 5.5 the points sent to AutoCAD with the 127- command will not be written to the file. After you create a file in AutoCAD you can recall the file in the Benchmark Coordinate Geometry routine. Recall the Benchmark job using the 124- command, then enter 128- to recall the AutoCAD file. The name, drive, and subdirectory of this .txt file is then requested.

LABELS

This menu item calls up a sub-menu that is described below:

- **LABELS** - Pick labels once the following settings have been selected. You are prompted to pick the next point or return to the end. Move the cursor, point to the location on the screen for the point using the appropriate OSNAP mode if applicable.
- **BEARING** - This command is used to toggle off and on bearing labeling. The default is on.
- **DIST** - This command is used to toggle off and on distance labeling. The default is on.
- **LINE** - This command is used to toggle off and on line drawing during labeling. The default is on.
- **SIZE** - This command sets the text size in inches. The text size defaults to the text size set in the default condition of the 127- command. The text style selected for this routine must have a height greater than 0 for the routine to work.
- **BR-RNDNG** - This command is used to set the bearing rounding. The default is whatever the bearing rounding was set to when the 127- command was given.
- **DS-RNDNG** - This command is used to set the distance rounding. The default is whatever the distance rounding was set to when the 127- command was given.

STONE

This menu item calls up a sub-menu that is described below:

- **JAGGED** - This command is used to draw stone walls that are drawn in a pattern that repeats every three stones. Use the pick button to select the beginning and end of the wall.
- **ALIGNED** - This command is used to draw stone walls where every stone is pointed in the same direction. Use the pick button to select the beginning and end of the wall.
- **SIZE** - This command sets the text size in inches. The text size defaults to the text size set in the default condition of the 127- command.

BARB

This command is used to draw barbed wire fences. Use the pick button to select the beginning and end of the fence.

The Benchmark/AutoCAD Menu

CONTOURS

Before using the contouring routine make the following layer selections:

Current layer set to node

Layers to be turned ON:

ELEV

ELEV

TICKNODE

TICK0 thru TICK10

CONTOUR0 thru CONTOUR10

Layers to be frozen: All other layers that could interfere with the OSNAP selecting the elevation node, i.e. POINTC.

TICKSTRA - use this routine to select elevation points in a sequential mode.

TICKSTAD - use this routine to select elevation points radially from the first selected point

SETUP - Give the desired contour interval and tickmark labelling interval.

CONTOURS - Move the cursor to an elevation tick mark to start the routine. The remaining points do not have to be tick marks.

Colored Layers - Creates layers TICK0 thru TICK10 and CONTOUR0 thru CONTOUR10 with a logical color sequence.

Benchmark <-> Lietz SDR Data Exchange (Optional Software)

Benchmark <-> Lietz SDR Data Exchange	21-2
Benchmark <-> SDR Main Menu	21-3
Download Data Dump from SDR	21-3
F - Extract Field Data from Data Dump	21-5
C - Extract Coordinates from Data Dump	21-6
Print Formatted Dump Report	21-7
Alter Printer Output Routing	21-9
Upload Coordinates to the SDR	21-10
Go To File Menu	21-11
View/Set Communications Parameters	21-12

WHAT'S IN THIS CHAPTER?

This chapter describes the Benchmark <-> Lietz SDR Data Exchange software, which enables you to exchange and process data with Benchmark and the Lietz data collector.

Benchmark <-> Lietz SDR Data Exchange

This documentation is based on Version 1.6 of the Benchmark <-> Lietz SDR Data Exchange. V1.6 of the Benchmark <-> Lietz SDR Data Exchange is intended to be used with version 7.0 Benchmark or greater. It will not work with lower versions of Benchmark.

INSTALLATION

The Benchmark<->Lietz SDR Data Exchange should be installed after installing the Benchmark System. Please refer to the Benchmark System installation instructions for further details on that procedure.

The subdirectory that you have installed Benchmark into is referred to as the ***Benchmark Subdirectory***. You must know the name of your Benchmark Subdirectory in order to continue. You should be at the DOS prompt with the drive containing the Benchmark Subdirectory showing as the current drive.

Type CD followed by the Benchmark Subdirectory name.

Then press RETURN or ENTER.

Type **A : INSTALL** or **B : INSTALL**

Then press RETURN or ENTER

Follow any installation prompts.

STARTING THE SOFTWARE

Once the installation is completed you should start Benchmark and select "Benchmark<->Lietz SDR Data Exchange" from the Benchmark Main Menu to start this software. Before attempting to use the SDR with Benchmark thoroughly familiarize yourself with the SDR's operation and be certain the communication parameters are correctly matched between the SDR and the computer. The "Getting Started" section of the SDR is an excellent place to get familiar with the operation of the SDR. After keying in the examples in "Getting Started" it is recommended that you download them, extract any field data and coordinates and process same with the Field Data Editor.

Benchmark <-> SDR Main Menu

You will see the following bar menu (yours may be different depending upon version number and the current subdirectory):

Benchmark <-> Lietz SDR V1.6 Main Menu

C:\BENCH

```
Download Data Dump from SDR
F - Extract Field Data from Data Dump
C - Extract Coordinates from Data Dump
Print Formatted Dump Report
Alter Printer Output Routing
Upload Coordinates to the SDR
Go To File Menu
View/Set Communications Parameters
Return to Benchmark Main Menu
```

See "The Benchmark Main Menu" in the main section of the Benchmark manual for instructions on how to use this type of bar menu.

Download Data Dump from SDR

PURPOSE

Use this option to download a job or all jobs from the SDR to the computer. When you select this option you will see the following prompt:

PROCEDURE

Enter Dump file name=

Enter a valid DOS file name (i.e. 1988ABC.LTZ or TOPO88.TXT). On the SDR, select the "Comms Output" program. You must see:

```
Waiting for transmission to begin
Press any key to cancel
```

in the message box at the bottom of the computer screen prior to selecting the job on the SDR.

Once you select the job or jobs on the SDR, the SDR should display "Sending..." and you should see the following in the message box at the bottom of the computer screen:

```
Downloading
Press any key to cancel
```

Once the download is complete the program will return to the main menu. It is recommended that the file produced by the Download Data Dump routine be backed up and printed via the "Print Formatted Dump Report" below, prior to deleting the data from the SDR.

Download Data Dump from SDR

DOWNLOAD NOTES

- If the message on the computer screen does not change from "Waiting for transmission to begin..." to "Downloading..." you may have a cabling problem. Check that the cable is connected to the same communications port that is set in "View/Set Communications Parameters" below. A common cabling problem is to have the switch on the SDR twenty-five pin connector set to the wrong position. For most cable connections this switch should be set to "DTE". If you think you've got the connection correct but the "Downloading..." message never appears, try changing the switch setting and performing the download again.
- You may see one of the following error messages

First line bad - Download halted
Press any key to continue

or

Line Overflow Error - Check Communication Parameters
Press any key to continue

for the following reasons:

- The communications parameters do not match. Make sure you have set the SDR and this program to the same parameters. The SDR should be set for ASCII output. See the SDR's documentation on setting communications parameters. See "View/Set Communications Parameters" below for instructions on changing the parameters for this program.
 - The SDR is set for BINARY communications when it should be set to ASCII.
 - The operator started sending data from the SDR before the message "Waiting for transmission to begin..." appeared in the message box as described above.
 - This program is set to the incorrect communications port. Make sure you have chosen the correct communications port. See "View/Set Communications Parameters" below.
- If you receive the following message:

Warning - Checksum Error: Received XXXX, Computed YYYY
Press any key to continue

and are using an SDR2, make sure you have the checksum parameter set to Y (for yes). On newer SDR's the checksum is always generated on output and checked upon input by the SDR. If you are using the SDR2 and have the checksum parameter set to Y or you are using one of the newer SDR's, this error indicates that something was lost during the download. Try performing the download again and see if the error reoccurs. If the error reoccurs, make sure you have set the SDR and this program to the same parameters. If you continue to get this error, it may indicate a hardware related problem.

- If the following message appears:

Waiting for Communications Line to Clear
Press any key to cancel

and it does not go away, you may have assigned the program to a communications port that is in use by some other device (e.g. digitizing tablet).

F - Extract Field Data from Data Dump

PURPOSE

Use this option to create a field data job file that can be edited and processed with the Field Data Editor.

PROCEDURE

When you select this option you will see the following prompt:

Enter Dump File Name=

Enter the previously downloaded file name. If the Dump File is not in the current directory, enter the full DOS path name to the file.

For each SDR job in the dump file that contains field data, the program will display the SDR job name and present the following two prompts:

Enter New Job No.

Job Name:
description of up to 160 characters

Enter an unused Benchmark job number or press
ESCape to skip this SDR job. Enter a job

NOTES:

- **Traverse Mode** - When using the SDR in Traverse Mode, the raw field data consisting of instrument height, horizontal angle(s), zenith angle(s), slope distance(s), target height, prism, reflector and EDM offsets, and environmental factors are reduced into a mean point-to-point azimuth, zenith angle, and slope distance. The zenith angle and slope distance are corrected for the instrument height and target height. This Measurement Corrected (MC) data can be balanced and adjusted in the Benchmark Field Data Editor program. For Traverse Mode the Benchmark <-> Lietz SDR program passes the final MC backsight and foresight azimuth data on to the Field Data Editor as backsight and foresight horizontal circle readings respectively.
- **Topography Mode** - For Topography Mode the SDR may be set to record either coordinates, raw field data, reduced measurements or measurements corrected. Either raw field data or measurement corrected observation data can be extracted to the Field Data Editor job file via this option. To extract coordinates please see "C - Extract Coordinates from Data Dump" below. As this program does not extract reduced measurements, make sure the SDR is set for one of the other Topography Recording Modes.
- **Numeric description codes** to identify points are permitted. Alphanumeric descriptions are permitted but are limited to 16 characters. To take advantage of Benchmark's ability to send blocks to AutoCAD with points and to send points on predetermined layers (see Chapters 3 and 20), alphanumeric descriptions must match descriptions kept in the description code file DESCODES.DAT. Use of the description Key Delimiter (see Chapter 3) is also supported when alphanumeric descriptions are used.

C - Extract Coordinates from Data Dump

PURPOSE

Use this option to extract coordinates that were either generated by the SDR or entered by hand on the SDR.

PROCEDURE

When you select this option you will see the following prompt:

Enter Dump File Name=

Enter the previously downloaded file name. If the Dump File is not in the current directory, enter the full DOS path name to the file.

For each SDR job in the dump file, the program will display the SDR job name and present the prompt:

Enter Job No.

Enter a Benchmark job number or press ESCape to skip this SDR job. If

the job number is unused you will receive the following prompt:

Job Name:

Enter a job description of up to 160 characters. Otherwise, if the job already contains coordinate data the following bar menu will be presented:

EXISTING Points have priority NEW Points have priority CANCEL Extraction

from which you must select and option (ESCape acts the same as choosing "CANCEL Extraction").

NOTES:

- When an SDR dump file contains topo mode shots taken independent of a traverse, and there isn't already a Benchmark coordinate job file that contains the station and backsight points, you will need to extract coordinates regardless of the Topography Recording Mode set on the SDR. If the Topography Recording Mode is either raw field data or measurement corrected, the resulting coordinate file must be used as a Coordinate Reference File when processing the field data with the Field Data Editor. If the station and backsight points were uploaded to the SDR from a Benchmark coordinate job file, you may use that same coordinate job file as the reference file. Please see the Field Data Editor documentation on the use of the Coordinate Reference File.
- Numeric description codes to identify points are permitted. Alphanumeric descriptions are permitted but are limited to 16 characters. To take advantage of Benchmark's ability to send blocks to AutoCAD with points and to send points on predetermined layers (see Chapters 3 and 20), alphanumeric descriptions must match descriptions kept in the description code file DESCODES.DAT. Use of the description Key Delimiter (see Chapter 3) is also supported when alphanumeric descriptions are used.

Print Formatted Dump Report

PURPOSE

Use this option to generate a formatted printout of the RAW data contained in a previously downloaded SDR Dump File.

PROCEDURE

When you select this option you will see the following prompt:

Enter Dump File Name=

Enter the previously downloaded file name. If the Dump File is not in the current directory, enter the full DOS path name to the file.

The following is an example of a formatted dump report produced by this option which is taken from the Open Traverse Example in the SDR Getting Started section:

```
-----SDR Formatted Data Dump to Benchmark-----
              For Dump File opntrv.dmp

SDR2  V02-08S(3)   Serial no 7822      11-Apr-00 10:14
                  Angle : Degrees      Dist : Feet      Press : Inch Hg
                  Temp : Fahrenheit     Coord : N-E-Elv   H.obs : Right

JOB              OPEN TRAV

SCALE            Factor 1.000000000

NOTE =====> Sea level crn:N
NOTE =====> C and R crn : N
NOTE =====> Atmos crn : N

INSTR            EDM Type=1           EDM <No Text>      Serial no 000000
                  Theo <No Text>      Serial no 000000  Mount: Standards
                  V.angle: Zenith     Edm o/s <Null>    Refl o/s <Null>
                  P.C. mm <Null>

POS KI 0004      Nrth 10813.448       East 11856.734    Elv 1100.000
                  Desc

STN TV 0001      Nrth 10000.000       East 10000.000    Elv 1000.000
                  Theo ht <Null>      Desc

OBS MC 0001-0005 Dist <Null>          V.ang <Null>      Azmth 359-54-00.0
                  Desc

OBS F1 0001-0005 Dist <Null>          V.ang <Null>      H.ang 00-00-00.0
                  Desc

OBS F1 0001-0002 Dist 685.828        V.ang 91-48-20.0  H.ang 110-56-10.0
                  Desc

SET TV 0001      Count 002

OBS MC 0001-0005 Dist <Null>          V.ang <Null>      Azmth 359-54-00.0
                  Desc

OBS MC 0001-0002 Dist 685.828        V.ang 91-48-20.0  Azmth 110-50-10.0
                  Desc

POS TV 0002      Nrth 9756.175       East 10640.658    Elv 978.391
                  Desc

STN TV 0002      Nrth 9756.175       East 10640.658    Elv 978.391
                  Theo ht <Null>      Desc
continued
```

Print Formatted Dump Report

OBS F1 0002-0001	Dist <Null> Desc	V.ang <Null>	H.ang 00-00-00.0
OBS F1 0002-0003	Dist 1364.626 Desc	V.ang 86-37-00.0	H.ang 148-47-44.0
SET TV 0002	Count 002		
OBS MC 0002-0001	Dist <Null> Desc	V.ang <Null>	Azmth 290-50-10.0
.. OBS MC 0002-0003	Dist 1364.626 Desc	V.ang 86-37-00.0	Azmth 79-37-54.0
POS TV 0003	Nrth 10001.346 Desc	East 11980.661	Elv 1058.926
STN TV 0003	Nrth 10001.346 Theo ht <Null>	East 11980.661 Desc	Elv 1058.926
OBS F1 0003-0002	Dist <Null> Desc	V.ang <Null>	H.ang 00-00-00.0
OBS F1 0003-0004	Dist 822.621 Desc	V.ang 87-08-10.0	H.ang 91-42-48.0
SET TV 0003	Count 002		
OBS MC 0003-0002	Dist <Null> Desc	V.ang <Null>	Azmth 259-37-54.0
OBS MC 0003-0004	Dist 822.621 Desc	V.ang 87-08-10.0	Azmth 351-20-42.0
NOTE =====>	D.Ang <Null>	D.Dist 0.320	Precn 1:8957.
NOTE =====>	D.Nth 0.136	D.East 0.290	D.Elv 0.027
BKB TV 0003-0004	Azmth 351-20-42.0	H.ang 91-42-48.0	
* END OF REPORT *			

Alter Printer Output Routing

PURPOSE

Use this option to temporarily reroute printer output to a file or device other than the standard LPT1. This could be use, for example, to print the Formatted Dump Report to a file rather than the printer. This default for this item is controlled by the BNPRN environment variable. See "Benchmark Environment Variables" in the appendix of the Benchmark manual for more information on this.

PROCEDURE

When you select this option you will see the following prompt:

Printer Output Routed to=

Enter the DOS device or file name.

Upload Coordinates to the SDR

PURPOSE

Use this routine to transfer coordinates from Benchmark to the SDR.

PROCEDURE

On the SDR you must select "Comms input" and the message "Receiving..." must be showing on the SDR display prior to sending the coordinates from the computer.

When you select this option you will see the following prompts:

```
Starting Point Number=  
Ending Point Number=
```

If you send the whole job the program will return to the main menu when it is done sending the points. If you uploaded a sub-range of points, you will be continually prompted for more ranges until you press the ESCape to return to the main menu. When uploading a sub-range of points, make entries within 30 seconds between groups, otherwise the SDR will time-out and ignore all data received. When the SDR times-out it will display the message "No input". When you have sent the final sub-range, make sure you press the ESCape key within 30 seconds also.

UPLOAD NOTES

- **If** the SDR does not respond to the upload, double check that the communications parameters on the SDR match those set in "View/Set Communications Parameters" below. A common cabling problem is to have the switch on the SDR twenty-five pin connector set to the wrong position. For most cable connections this switch should be set to "DTE". If you think you've got the connection correct but the blinking cursor does not appear on the SDR, try changing the switch setting and performing the upload again.
- Version 1.6 (or greater) Benchmark <-> Lietz SDR Data Exchange software can only upload V7.0 (or greater) Benchmark coordinate files.
- If you receive a checksum error on the SDR after all the points are sent, and you are able to download data from the SDR without any problems, you may have V03-01.5 or lower SDR product. If this is the case, you must use word length 8 and no parity for your communications parameters (see "View/Set Communications Parameters" below).
- If you are using a V03-01.5 or lower SDR product, and you upload a sub-range of points and receive a time-out error as soon as the sub-range is finished uploading, you will need to use a higher baud rate. It is recommended that you use 2400 baud for SDR2's and 4800 baud for the newer SDR products (SDR20, SDR22 and SDR24) on uploads.

Go To File Menu

When you select "Go To File" from the main menu you will be presented with the following menu:

File Menu

C:\BENCH\DATA

Change Logged Subdirectory
Change Logged Drive
Delete Job File
Rename Job File
List Job Directory/Disk Space
DOS Directory
Return to Main Menu

Each of the menu selections is described below:

Change Logged Subdirectory - Use this option to change from one subdirectory to another. You enter the subdirectory name in the same format that you would when using the DOS CD (or CHDIR) command.

Change Logged Drive - Use this option to change from one disk drive to another. If you enter a hard disk drive letter the subdirectory is asked for.

Delete Job File - Use this option to delete old jobs from the current logged drive and subdirectory.

Rename Job File - Use this option to change the name of an existing job.

List Job Directory/Disk Space - Use this option to list out the jobs on the current drive/subdirectory. The amount of storage capacity remaining on the drive will be displayed at the top of the screen.

DOS Directory - Use this to produce a standard DOS directory listing.

Return to Main Menu - Selecting this option or pressing ESCape will return you to the main menu.

View/Set Communications Parameters

PURPOSE

Use this to match up the communications between the SDR and the computer

PROCEDURE

When you select "View/Set Communications Parameters" from the main menu you will be presented with the following menu:

```

                                Communication Parameters Menu                                C:\BENCH\DATA

Serial Port                      COM1 COM2
Input Baud Rate                  110  150  300  600
                                1200 2400 4800 9600
Output Baud Rate                 110  150  300  600
                                1200 2400 4800 9600
Parity                           None Odd  Even
Stop Bits                        1      2
Word Length                      7      8
```

Press ESCape to exit -- F10 to accept

To choose options from this menu use the arrow keys to move forward or backward through the list of choices for a given parameter. The <HOME> and <END> keys will move the highlight bar to the beginning and end of the list respectively. To move the cursor to the next parameter press <RETURN/ENTER> or the down arrow. To move the cursor to the previous parameter press the up arrow. As the message at the bottom of the screen states, press ESCape to exit or F10 to accept.

The input baud rate is the rate used by the "Download Data Dump from the SDR" option of this program. The output baud rate is that used by the "Upload Coordinates to the SDR" option of this program.

NOTES

- If you have an SDR2 the checksum parameter should be set to (Y) yes.
- If your SDR product includes an option for either ASCII or BINARY format communications, select ASCII.
- To avoid problems with uploading coordinates to the SDR, you should use the fastest possible baud rate for that operation, which is 2400 baud for SDR2's and 4800 baud for newer SDR's (e.g. SDR20, SDR22 and SDR24).

The recommended word length is 8 with 1 stop bit and no parity.

Return to Benchmark Main Menu

Use this option, or press ESCape, to exit from the Benchmark<->Lietz SDR Data Exchange program.

Benchmark <-> Zeiss REC500 Data Exchange (Optional Software)

Benchmark <-> Zeiss REC500 Data Exchange	22-2
Download Data Dump from REC500	22-4
F - Extract Field Data from Data Dump	22-5
C - Extract Coordinates from Data Dump	22-6
Upload Coordinates to the REC500	22-7
Go To File Menu	22-8
View/Set Communications Parameters	22-9

Currently only available for Benchmark DOS Version

WHAT'S IN THIS CHAPTER?

This chapter describes the Benchmark <-> Zeiss REC500 Data Exchange software, which enables you to exchange and process data with Benchmark and the Zeiss REC500 data collector.

Benchmark <-> Zeiss REC500 Data Exchange

This documentation is based on Version 1.0 of the Benchmark<->Zeiss REC500 Data Exchange. V1.0 of the Benchmark<->Zeiss REC500 Data Exchange is intended to be used with version 7.0 Benchmark or greater. *It will not work with lower versions of Benchmark.*

INSTALLATION

The Benchmark<->Zeiss REC500 Data Exchange should be installed after installing the Benchmark System. Please refer to the Benchmark System installation instructions for further details on that procedure.

The subdirectory that you have installed Benchmark into is referred to as the Benchmark Subdirectory. You must know the name of your Benchmark Subdirectory in order to continue. You should be at the DOS prompt with the drive containing the Benchmark Subdirectory showing as the current drive.

Type CD followed by the Benchmark Subdirectory name.

Then press RETURN or ENTER.

Type **A: INSTALL** or **B: INSTALL**

Then press RETURN or ENTER

Follow any installation prompts.

STARTING THE SOFTWARE

Once the installation is completed you should start Benchmark and select "Benchmark<->Zeiss REC500 Data Exchange" from the Benchmark Main Menu to start this software. Before attempting to use the REC500 with Benchmark thoroughly familiarize yourself with the REC500's operation and be certain the communication parameters are correctly matched between the REC500 and the computer.

You will see the following bar menu (yours may be different depending upon version number and the current subdirectory):

Benchmark <-> Zeiss REC500 V1.0 Main Menu C:\BENCH

Download Data Dump from REC500 F - Extract Field Data from Data Dump C - Extract Coordinates from Data Dump Upload Coordinates to the REC500 Go To File Menu View/Set Communications Parameters Return to Benchmark Main Menu

See "The Benchmark Main Menu" in the main section of the Benchmark manual for instructions on how to use this type of bar menu.

Download Data Dump from REC500

PURPOSE

Use this option to download a job or all jobs from the REC500 to the computer. When you select this option you will see the following prompt:

PROCEDURE

Enter Dump file name=

Enter a valid DOS file name (i.e. 1988ABC.LTZ or TOP088.TXT). On the REC500, select the "Comms Output" program. You must see:

Waiting for transmission to begin
Press any key to cancel

the message box at the bottom of the computer screen prior to starting the transfer on the REC500.

You should send data from the REC500 using the "Standard Interface Computer" option of the "Transfer of Data" REC500 main menu option. It is recommended that you send all data to avoid sending only part of a job, which will be meaningless to Benchmark. Multiple jobs may be downloaded into one "dump" file. This program will allow you to place any field data and/or coordinates residing in the same "dump" file into separate Benchmark job files. You separate the job file on the REC500 for Benchmark by placing a line **JOB=**, followed by the job name, in the project data and recording same at the start of each job. Once you start sending data from the REC500, the REC500 should display the various records as they are being sent and you should see the following in the message box at the bottom of the computer screen:

Downloading
Press any key to cancel

Once the download is complete the program will return to the main menu. It is recommended that the file produced by the Download Data Dump routine be backed up prior to deleting the data from the REC500.

DOWNLOAD NOTES

- If the message on the computer screen does not change from "Waiting for transmission to begin..." to "Downloading..." you may have a cabling problem. Check that the cable is connected to the same communications port that is set in "View/Set Communications Parameters" below.
- You may see one of the following error messages

Line Overflow Error - Check Communication Parameters
Press any key to continue

or

First line bad - Download halted
Press any key to continue

for the following reasons:

- The communications parameters do not match. Make sure you have set the REC500 and this program to the same parameters. See the REC500's documentation on setting communications parameters. See "View/Set Communications Parameters" below for instructions on changing the parameters for this program.
 - The operator started sending data from the REC500 before the message "Waiting for transmission to begin..." appeared in the message box as described above.
 - This program is set to the incorrect communications port. Make sure you have chosen the correct communications port. See "View/Set Communications Parameters" below.
- If the following message appears:

Waiting for Communications Line to Clear
Press any key to cancel

and it does not go away, you may have assigned the program to a communications port that is in use by some other device (e.g. digitizing tablet).

F - Extract Field Data from Data Dump

PURPOSE

Use this option to create a field data job file that can be edited and processed with the Field Data Editor.

PROCEDURE

When you select this option you will see the following prompt:

`Enter Dump File Name=`

Enter the previously downloaded file name. If the Dump File is not in the current directory, enter the full DOS path name to the file.

For each REC500 job in the dump file that contains field data, the program will display the REC500 job name and present the following two prompts:

`Enter New Job No.`

`Job Name:`

Enter an unused Benchmark job number or press ESCape to skip this REC500 job. Enter a job description of up to 160 characters

NOTE:

Side-shot Mode - For Side-shot Mode the REC500 may be set to record coordinates and/or raw field data. Raw field data can be extracted to the Field Data Editor job file via this option. To extract coordinates please see "C - Extract Coordinates from Data Dump" below.

C - Extract Coordinates from Data Dump

PURPOSE

Use this option to extract coordinates that were either generated by the REC500 or entered by hand on the REC500.

PROCEDURE

When you select this option you will see the following prompt:

Enter Dump File Name=

Enter the previously downloaded file name. If the Dump File is not in the current directory, enter the full DOS path name to the file.

For each REC500 job in the dump file, the program will display the REC500 job name and present the prompt:

Enter Job No.

Enter a Benchmark job number or press ESCape to skip this REC500 job. If

the job number is unused you will receive the following prompt:

Job Name:

Enter a job description of up to 160 characters. Otherwise, if the job already contains coordinate data the following bar menu will be presented:

Existing Points have priority New Points have priority Cancel Extraction

from which you must select an option (ESCape acts the same as choosing "CANCEL Extraction").

NOTES:

When an REC500 dump file contains side-shot mode shots taken independent of a traverse, and there isn't already a Benchmark coordinate job file that contains the station and backsight points, you will need to extract coordinates regardless of the Side-shot Recording Mode set on the REC500. If the Side-shot Recording Mode is raw field data only, the resulting coordinate file must be used as a Coordinate Reference File when processing the field data with the Field Data Editor. If the station and backsight points were uploaded to the REC500 from a Benchmark coordinate job file, you may use that same coordinate job file as the reference file. Please see the Field Data Editor documentation on the use of the Coordinate Reference File.

Upload Coordinates to the REC500

PURPOSE

Use this routine to transfer coordinates from Benchmark to the REC500.

PROCEDURE

On the REC500 you must select "Comms input" and the message "Receiving..." must be showing on the REC500 display prior to sending the coordinates from the computer.

When you select this option you will see the following prompts:

```
Starting Point Number=  
Ending Point Number=
```

If you send the whole job the program will return to the main menu when it is done sending the points. If you uploaded a sub-range of points, you will be continually prompted for more ranges until you press the ESCape key to return to the main menu.

UPLOAD NOTES

If the REC500 does not respond to the upload, double check that the communications parameters on the REC500 match those set in "View/Set Communications Parameters" below

Go To File Menu

When you select "Go To File" from the main menu you will be presented with the following menu:

File Menu

C:\BENCHDATA

```
Change Logged Subdirectory
Changed Logged Drive
Delete Job File
Rename Job File
List Job Directory/Disk Space
DOS Directory
Return to Main Menu
```

Each of the menu selections is described below:

Change Logged Subdirectory - Use this option to change from one subdirectory to another. You enter the subdirectory name in the same format that you would when using the DOS CD (or CHDIR) command.

Change Logged Drive - Use this option to change from one disk drive to another. If you enter a hard disk drive letter the subdirectory is asked for.

Delete Job File - Use this option to delete old jobs from the current logged drive and subdirectory.

Rename Job File - Use this option to change the name of an existing job.

List Job Directory/Disk Space - Use this option to list out the jobs on the current drive/subdirectory. The amount of storage capacity remaining on the drive will be displayed at the top of the screen.

DOS Directory - Use this to produce a standard DOS directory listing.

Return to Main Menu - Selecting this option or pressing ESCape will return you to the main menu.

View/Set Communications Parameters

PURPOSE

Use this to match up the communications between the REC500 and the computer. We recommend using 4800 baud, no parity on the REC500. For this program, you must also set stop bits to 1 and word length to 8 to be compatible with the REC500.

PROCEDURE

When you select "View/Set Communications Parameters" from the main menu you will be presented with the following menu:

```

                                Communication Parameters Menu
C:\BENCH\DATA

Serial Port                      COM1 COM2
Baud Rate                       110  150  300  600
                                1200 2400 4800 9600
Parity                           None Odd  Even
Stop Bits                        1    2
Word Length                      7    8
```

Press ESCape to exit -- F10 to accept

To choose options from this menu use the arrow keys to move forward or backward through the list of choices for a given parameter. The <HOME> and <END> keys will move the highlight bar to the beginning and end of the list respectively. To move the cursor to the next parameter press <RETURN/ENTER> or the down arrow. To move the cursor to the previous parameter press the up arrow. As the message at the bottom of the screen states, press ESCape to exit or F10 to accept.

Return to Benchmark Main Menu

Use this option, or press ESCape, to exit from the Benchmark<->Zeiss REC500 Data Exchange program.

Chapter 23

Benchplot II (Optional Software)

Installation	23-2
Operation	23-2
Configuring the Printer	23-2
Point Display Mode	23-3
Table of point representations	23-3

The Benchmark to AutoCAD transfer connection to VoloView Express
Currently addresses this routine's functions... Proceed to Chapter 20

WHAT'S IN THIS CHAPTER?

Benchplot II allows you to plot groups to a dot matrix printer.

Benchplot II

INSTALLATION:

Benchplot II should be installed after installing the Benchmark Survey System. The subdirectory that you have installed Benchmark into is referred to as the Benchmark Subdirectory.

1. Change into the Benchmark Subdirectory. For example, if your Benchmark Subdirectory is C:\BENCH type C : to make the C: drive the current drive and type CD \BENCH to make the Benchmark Subdirectory your current directory.
2. Type A: INSTALL or B: INSTALL and press RETURN or ENTER.
3. Follow the installation prompts.

OPERATION:

From the coordinate geometry program you may plot any active groups created with the 130-routine. Benchplot II will plot all Active groups (see Chapter 11 for more information about groups). To plot the groups, enter 117-.

Upon entering 117- you will see the following display:
The following defaults are in effect:
Default Point Display Mode= 34
Point Display Size= .025
Text size= .1

and the message
Do you wish to change anything?

You may change any of these parameters before continuing with the plot.

The point display mode uses the same values as the PDMODE variable in AutoCAD (see section following). At the scale prompt, enter the scale in feet you wish the plot to be. i.e. 1=50 For 50 feet to an inch
1=100 For 100 feet to an inch

CONFIGURING THE PRINTER:

You will be asked printer configuration questions the first time you install Benchmark. At any other time you wish to alter your present configuration, select Configuration Menu from the Benchmark main menu.

Simply highlight the correct printer selection with the up/down arrow keys and press enter to select the option.

You may need to calibrate your printer if the printplot gives incorrect lengths. If needed, select **YES** to calibrate and enter the measured length of a vertical and horizontal line and the correct length.

Benchplot II

POINT DISPLAY MODE

When a point is drawn in AutoCAD you may select a representation of the point to be placed in the AutoCAD drawing. Benchplot II supports the same choices that AutoCAD provides as documented in the POINT Command section of the Entity Draw Commands Chapter of the AutoCAD manual.

The prompts "Default Point Display Mode" and "Point Display Size" that follow the 117-command in Benchplot II control the appearance of point entities. You may choose any of the following to occur at the point location:

Value Draws...

- 0 a dot at the point
- 1 nothing
- 2 a cross through the point
- 3 an X through the point
- 4 a vertical line upward from the point

Additionally, you may cause a circle, a square, or both a circle and a square to surround the point by adding the following to the value above:

Value Adds...

- 32 a circle around the point
- 64 a square around the point
- 96 both a circle and a square around the point

TABLE OF POINT REPRESENTATIONS

				
0	1	2	3	4
				
32	33	34	35	36
				
64	65	66	67	68
				
96	97	98	99	100

Numeric Command Index

(1-) printer on	3-4
(2-) printer off	3-4
(3-) printer page feed	3-4
(4-) Return to (Benchmark) Main Menu	6-2
(4-) Return to Job Copy and Directory Utilities Menu	18-2
(4-) Save Settings or Quit	3-14
(5-) printer on, output only	3-4
(6-) Bearing Output	3-4, 6-19, 20, 21
(7-) Azimuth Output	3-4, 6-19, 20, 21
(8-) Angles Right Output	3-4, 6-19, 20, 21
(9-) Print Heading	15-21
(10-) Curve Staking	16-2
(10-) Define Setup Location/Enter Traverse Mode	6-2, 8-5, 8
(12-) Enter Coordinates	6-18
(13-) Change Storage Point Sequence	6-12, 15-15, 16
(16-) Two-up Point Listing Toggle	3-4
(18-) Toggle slope angle request	3-5, 6-6
(19-) Display Accumulated Area	6-3, 17
(20-) Bearing Input	12-4
(20-) Utility Programs - Stadia Note Reduction	16-4
(21-) Azimuth Input	6-4, 12-4
(21-) Utility Programs - Reduce Slope Angle and Distance	16-4
(22-) Utility Programs - Create a Turning Point	16-4
(23-) Deflected Angle Input	6-4, 12-4
(23-) Utility Programs - Reduce Level Notes , ...	16-4
(24-) Angle Turned From Backsight Input	6-4, 12-4
(26-) Set Stadia Method of Slope Reduction	3-5, 6-4, 7, 8, 8-2, 4, 6, 7, 11, 13, 16-4, 6
(27-) Set Vertical Angle Method (EDM) of Slope Reduction	3-5, 6-4, 7, 8 , 8-2, 4, 6, 7, 11, 13, 16-4, 6
(29-) Toggle Azimuth Orientation	3-6
(30-) Side Shot Mode	6-15, 8-7, 19
(31-) Single Side Shot	6-15, 8-7
(32-) Speaker On/Off	3-6
(33-) 90 Degree Offset	6-16
(35-) Toggle Angle Entry Format	3-6, 6-9
(36-) Compute Station and Elevation at Desired Distance from BVC	16-7
(37-) toggle Single/Double Line Feed	3-7, 6-9
(37-) Compute Sag or Crest Point Station, Elevation and Distance from BVC	16-7
(38-) Compute Elevation and Distance from BVC at Selected Stations	16-7
(39-) Compute Station and Elevation at Fixed Intervals from BVC	16-7
(39-) Side Shot Mode Update Elevation Only	8-19
(40-) Copy Direction	6-13, 12-4, 15-12
(40-) Vertical Curve Solver	16-7
(41-) Copy Distance	6-13, 12-4

(42-) Copy Direction and Length	6-13, 12-4
(44-) Three Wire Leveling On/Off Toggle	3-7, 8-2, 4, 6, 7, 11, 13
(46-) Leveling Toggle between Trigonometric and Differential . . .	3-7, 8-2, 4, 6, 11, 13
(47-) Default Benchmark Elevation Setting	3-8, 8-2
(48-) Toggle standard/alternate direct differential leveling	3-7
(48-) Toggle between Level at Station and Level Not at Station	8-2, 4, 6, 11, 13
(49-) Toggle Display of Occupied Station in Side Shot Mode	3-8
(50-) Enter a Temperature	6-8
(50-) Utility Programs - Earthwork by Average End Areas	16-9
(51-) Enter Multiple Slope Angles and Distances	6-7, 8-3
(51-) Utility Programs - Restart Profile	16-9
(59-) Spiral Curve	15-17
(60-) Direction into Radius and Length	9-2
(61-) Direction into Tangent and Length	9-4
(62-) Radius Point and Arc Length	9-6
(63-) Radius Length and Arc Length	9-7
(64-) Chord Length and Radius	9-9
(65-) Chord Direction or Angle and Length	9-11
(66-) P.I., Two Directions, and Radius	9-13
(67-) P.I., Two Directions, and Tangent	9-15
(68-) Radius Curve	12-6
(69-) Any Two Knowns on Curve	9-17
(70-) Offset Intersection	6-27
(71-) Offset Intersection on an Arc	6-29
(72-) Divide an Arc by Interval	15-2, 5
(73-) Divide a Line by Interval	15-6, 7, 8
(74-) Divide an Arc by Divisor	15-3, 5
(75-) Divide a Line by Divisor	15-7, 8
(77-) Divide an Arc by Segments	15-5
(78-) Divide Remainder of Arc by Interval	15-5
(79-) Divide a Line by Segments	15-8
(80-) Divide Remainder of Line by Interval	15-8
(81-) Consecutive Inverse Routine	6-19, 12-5
(82-) Radial Inverse Routine	6-21
(86-) Toggle Automatic/Manual Point Numbering	3-9, 6-3, 10
(88-) sets acreage rounding	3-10
(89-) sets square footage rounding	3-10
(90-) sets distance rounding	3-11
(91-) Occupy Intersection Point B	6-23
(92-) Occupy Intersection Point A	6-23
(93-) Occupy Intersection Point C	6-22
(94-) sets coordinate rounding	3-11
(95-) sets bearing rounding	3-1 1
(96-) sets elevation rounding	3-1 1
(97-) Normal Curve Solving Routine	9-19
(98-) Degree of Curve-Arc Solving Routine	9-19
(99-) Degree of Curve-Chord Solving Routine	9-19
(118-) Shrink a Job	15-21
(121-) Store Coordinate Data	2-12
(123-) List Jobs	2-13
(124-) Load Job	2-11, B-2, 4

(125-)	Delete Job	2-14
(126-)	Enter AGO	7-3
(127-)	Creating a Transfer (.DXF) File	20-2, 3
(128-)	Import File Routine	19-2
(129-)	Export File Routine	19-3
(130-)	Group Menu	7-3, 11-3
(134-)	Batch Inverse	11-9
(135-)	Produces a text script file containing output equal to 134-	20-23
(136-)	List Lot Description Files	11-13
(137-)	Delete Lot Description File	11-14
(138-)	Linear Regression	15-13
(139-)	Show Available Space on Job Disk	2-15
(140-)	Parallel Line Routine	10-3
(141-)	Create and Display Last Point on Line	10-3
(142-)	Store Group Data	11-11
(144-)	Convert Lot File	11-12
(151-)	Coordinate Transformation by Angle Rotation	13-4
(152-)	Coordinate Transformation by Points	13-2
(153-)	Coordinate Transformation by Bearing	13-5
(156-)	Radial Stakeout	15-9
(157-)	Compute Angle from Stored Points	15-11
(158-)	Compute Angle Given Two Bearings Direction	15-12
(159-)	Radial Stakeout Individual Points , ...	15-10
(163-)	Curved Entry to Cul-De-Sac, Center Point Known	10-6
(164-)	Curved Entry to Cul-De-Sac, Offset Point Known	10-9
(165-)	Straight Entry to Cul-de-Sac, Center Point Known	10-11
(166-)	Straight Entry to Cul-de-Sac, Offset Point Known	10-14
(167-)	Bend with Cul-de-Sac	10-16
(170-)	Four-Way Intersection	10-18
(171-)	Three-Way Intersection	10-20
(172-)	Two-Way Intersection	10-22
(173-)	Curved Into Straight	10-24
(174-)	Two-Way Straight Into Curved	10-26
(175-)	Four-Way Straight & Curved	10-28
(176-)	Two-Way Curve with Curved Entry	10-30
(177-)	Four-Way Curve	10-32
(180-)	Offsets from Center Line	10-4
(185-)	Calculate Offsets on a Curve - Radius Known	10-4
(186-)	Calculate Offsets on a Curve - Tangent Length Known	10-4
(190-)	Begin Lot Sizing	12-3
(191-)	Lot Sizing by Bearing Swing	12-12
(192-)	Radial Lot Design, Minimum Arc at Setback	12-8
(193-)	Radial Lot Sizing, Minimum Chord at Setback	12-9
(194-)	Lot Sizing by Sliding Bearing	12-10
(195-)	Lot Sizing, Parallel	12-14
(200-)	Deleting Points	7-6, 14-2
(201-)	Delete Range of Points	7-6
(203-)	Remove Single Points From Screen Not File	7-5
(204-)	Remove Multiple Points From Window Not File	7-5
(210-)	List Points	14-3

(213-)	List Used Point Numbers	14-5
(214-)	List Unused Point Numbers	14-5
(220-)	Copy Points	14-4
(222-)	List Extremes	14-6
(223-)	Print Screen	6-19, 14-7
(224-)	Enter Comments	14-7
(225-)	Circular Curve Given Two Chords and Included Angle	17-2
(226-)	Three Angles and Two Lengths	17-4
(227-)	Three Sets of Coordinates and Two Angles	17-4, 5
(228-)	Circular Curve through Three Points	15-16, 17-3
(229-)	Vertical Curve Solver	17-6
(230-)	Tangent Grades	17-8
(231-)	Manual/Automatic Vertical Curve Modes	17-6, 8
(233-)	Angles and Chords from Stake to Stake	17-14
(234-)	Angles from PC, Chords from Stake to Stake	17-12
(235-)	Offsets from Tangent	17-10
(236-)	Manual/Increment Curve Staking Modes	17-10, 12
(240-)	Spiral Curve Stakeout	17-16
(245-)	Triangle Solver	15-14, 16-8
(250-)	Angles from PC, Chords from Stake to Stake & Long Chords	17-12
(260-)	Set Difference in Elevation Mode	3-5, 8-2, 4, 6, 7, 11, 13
(261-)	Set Direct Entry of Elevation Mode	3-5, 8-2, 4, 6, 7, 11, 13
(301-)	Select Subdirectory for Job Storage	2-3
(302-)	Rename a Job	2-14
(320-)	New Benchmark Elevation	8-8
(321-)	Adjust Datum Elevation	8-9
(322-)	Turning Point from the Backsight to the Occupied Point	8-6, 10
(323-)	Turning Point to the Foresight from the Occupied Point	8-4, 12, 18
(324-)	Measure Up	8-3, 6, 10, 15
(325-)	Measure Down	8-3, 6, 16
(326-)	Mean Reciprocal Observations	8-8, 17
(327-)	Update Foresight Elevation Only	8-12, 18
(330-)	Re-Enter Traverse Mode	6-3, 8-4, 15-2, 7
(400-)	Select Auto/Manual Pagination	3-11
(401-)	Toggle Staggered Printing	3-11
(402-)	Toggle Printing of Date and Time in Heading	3-12
(403-)	Toggle Printing of Company Title in Heading	3-12
(404-)	Change Company Title	3-13
(410-)	Graphic text size in pixels	3-13
(411-)	Graphic point size in pixels	3-13
(412-)	Default point symbol mode	3-13
(420-)	Default AutoCAD Parameter File	3-13
(421-)	Default Master DXF File	3-14
(450-)	Execute Script File	B-4
(451-)	Execute Script File in step mode	B-4
(452-)	Chaining Script Files	B-4

(500-) Free Memory Command	15-19
(501-) Shell to DOS	15-20
(502-) Redirect Printer Output	15-20
(510-) Open a Command Log file	15-22, B-2
(511-) Close a Command Log file	15-22
(515-) Open a Log file	15-22
(516-) Close a Log file	15-22
(520-) View a Text File	15-23
(550-) Find Centroid of Active Groups	15-23

Data Files in a Benchmark Subdirectory

Job File Data	A-2
Description Codes	A-2
Lot Description Files	A-2
Group <i>Files</i>	A-2
Job Directories List	A-3
Temporary <i>Files</i>	A-3

:

'What's In This Chapter?

This chapter briefly describes the data filenames you will find in a Benchmark subdirectory. This information is not required to use Benchmark, but some users may find it helpful to know the formats of the filenames that contain the several types of data used by Benchmark.

Job File Data

Each time you use the **Initialize** a Subdirectory for Job Storage option on the Main Menu, Benchmark copies the file named LABELS.DAT to the specified disk or subdirectory. An initialized subdirectory contains 20 jobs that you can use for data storage. Additional jobs can be added as the need arises.

Filenames for job data have the format:

PBn . DAT

where n is an integer that identifies the job number.

The descriptive names for jobs are contained in LABELS . DAT .

Description Codes

The description codes that you create with the Edit/Display DeScriptions option on the Main Menu are contained in the single file DESCODES . DAT in the Benchmark program directory.

Lot Description Files

Lot description filenames (see Chapter 11) have the format:

DESCn . DAT

where n is a 1- to 4-digit number that uniquely names a file. Thus, DESC45.DAT, DESC999.DAT, and DESC44.DAT are all valid names.

Group Files

Filenames for a job's group data have the format:

PBn . DAT

where n is an integer that identifies the job number.

Job Directories List

On each hard disk where Benchmark data files are stored, a directory is created off the root directory called \BMCNTROL. A file named JOBDIRS.LST is created in \BMCNTROL containing a list of Benchmark data directories (directories containing a LABELS.DAT file) for that drive. Whenever a new directory is initialized, its name is added to the JOBDIRS.LST file. Entering a double question mark (??) at a Sub d i r e c t o r y = prompt also updates this file.

Temporary Files

When a job is opened in Coordinate Geometry, two temporary files are created: PTn.DAT and PTn.GRP, where n is the Job number that is open. These two files begin as exact copies of the job file (PBn.DAT) and the group file (PBn.GRP). As changes are made to the job, Benchmark updates the two temporary files about once every minute. The original job and group files are not updated until you save the job upon exit (4-), or whenever you issue the 121- or 142- commands. The temporary files are deleted when you exit a job properly (4-). If you do not properly exit a job (4-) and the computer is rebooted, the next time you try to load the same job, Benchmark will find the temporary files and give you the following message:

Recovering from abnormal program exit! Press <RETURN> to continue.

When you press RETURN, the job and group files are updated with the contents of the temporary files and new temporary files are opened for the current work session. Thus, Benchmark will retain your data literally "up to the last minute".

Creating Script Files

What Are Script Files?	B-2
Creating Script Files	B-2
Pause for Input (&)	B-2
Non-Alphanumeric Keystrokes	B-3
Entering Comments	B-3
(450-, 451-) Executing Script Files	B-4
(DELAY) Changing the Speed of Execution	B-4
(452-) Chaining Script Files	B-4
(F10) Halting Execution of a Script File	B-4
Script Example	B-5

WHAT'S IN THIS CHAPTER?

This chapter describes Script files, their creation and execution.

What Are Script Files?

Benchmark provides you with the ability to create script files of your Benchmark sessions which you can run with a simple command.

Script files typically contain both Benchmark commands and responses to prompts elicited by those commands. You can use script files within Coordinate Geometry programs (including the Advanced Graphics Option), and the Utilities Programs.

A script file is a text file that you can create with most word processors. You can also create a script file by recording your keystrokes to a file (see Chapter 15) by opening a Command Log file (510-).

You can have a script pause and wait for user input, with a default response supplied by the script.

Creating Script Files

To create a script file, you can use any word processor or text editor that has the ability to create a standard ASCII text file. These text files must be "unformatted." That is, they should contain no special control characters that word processors use for conveying formatting instructions.

Complete these steps to create a script file:

1. Enter a command just as you would enter it at the COMMAND prompt in Benchmark. For example, type **124—** to load a job.
2. Enter responses to each command that you enter. The script file will supply the RETURNS for you.

You can also create a script file by recording keystrokes to a file with the Command Log command (510-). In most instances you will still need to edit the resulting file with your text editor.

Pause for Input (&)

To cause a script to pause for input from the user, make the first character of a line an ampersand (&). Any text after the ampersand will be displayed in reverse video as an editable default. While a line may contain only an ampersand, it is recommended that you include at least one character after the ampersand so that a reverse video default will be displayed at run time. This makes it clear that a script is still running and waiting for input. An underscore character or a period serve this purpose well.

Non-Alphanumeric Keystrokes

Non-alphanumeric keys (such as ESCape, F4, PageDown, and etc.) are represented by their scan Codes preceded by a ~ (called the tilde character) and a space, except for ESCape, which is represented by a ^ (called the caret). Codes for these keys may differ from one keyboard to the next. You can find out the correct codes for your keyboard by opening a command log and hitting keys while in the group editor. The following list was generated in this manner by the author on his own extended keyboard, and will probably be the same codes that most keyboards will generate.

home	~ 71	insert	~ 82
end	~ 79	delete	~ 83
pgup	~ 73	ctrl home	~ 119
pgdn	~ 81	ctrl end	~ 117
up arrow	~ 72	ctrl pgup	~ 132
down arrow	~ 80	ctrl pgdn	~ 118
left arrow	~ 75	ctrl home	~ 119
right arrow	~ 77	ctrl end	~ 117
ctrl right	~ 116		
ctrl left	~ 115		
ESCape	^		
F1 (help)	~ 59		
F2	~ 60		
F3	~ 61		
F4	~ 62		
F10	~ 68		

Entering Comments

You can include comments in your script files which will be displayed on your screen when you execute the script file. After each command or response, type a semi-colon (;) with no space between the command or response and the semi-colon. Then type the comment you want to be displayed. For example:

```
124--;Load existing job
1;    Job Number 1
```

NOTES

1. If you have a monochrome monitor, when the script file is executed comments will be displayed in bright letters.
2. If you are using a color monitor, when the script file is executed comments will be displayed in the same color as normal text but in the opposite brightness.

(450-, 451-) Executing Script Files

There are three ways to execute a script file.

1. Enter the name of the script file followed by a minus sign.
2. Enter 450-. Then supply the name of the script file.
3. Enter 451-. Then supply the name of the script file. The only difference is that 451- executes the script in Step-mode, that is, one step at a time. After each command is executed, you need to press ENTER to move on to the next command in the script.

NOTE

Scripts follow all the same rules that you must follow when running Benchmark. For example, if no job were called up into memory yet, the script would be required to choose the desired mode of operation.

(F10) Halting Execution of a Script File

To halt the execution of a script file, press F10. You will be returned to the COMMAND prompt.

(DELAY) Changing the Speed of Execution

You can specify a value from 1-10 in a script file that will control the speed at which the file is executed. 1 is the slowest and 10 the fastest speed. On a separate line, another DELAY and a number from 1-10 (no space between DELAY and the number). For example, **DELAYS** will delay execution 5 units of time. The actual time will vary depending on the type of computer you are using.

(452-) Chaining Script Files

The 452- command gives you the ability to create a script file that can invoke another script file or even itself, in loop fashion. This latter feature can be used to good advantage in a demonstration program.

To use 452-, include it at the end of the script file. You have to supply the name of the script file just as you would with 450- or 451-, even if you want to loop through the same script file.

EXAMPLE

```
124-;    Load field data
8;       Get job #8
2;       No descriptions
113-;    Display field data
99-;     Calculate closure
111-;    Balance using Compass Rule
452-;    Call another script file
compass; In this case, calls itself
5;       Select speed
```

Script Example

EXAMPLE

This example shows the creation of a script called "BB" to execute bearing-bearing intersections utilizing the copy direction commands. The Command Log feature is also utilized here to help with the process.

First a Command Log is opened in the same subdirectory as the Benchmark program files (so the script will be easily called from any subdirectory). Next, an intersection routine is run.

```
Command= 510-
Log file name=\BENCH70\BB
Command= 10-
Occupied Point= 2
UP      2      5003.8899      5445.7362      OCC

Backsight Point= 91-
Bearing= 40-
Point= 2
Point= 1
Distance= 0
Point B= 3
Bearing= 40-
Point= 3
Point= 2
Distance= 0
Storage Point= 200
Description= 0
S03-41-00E      11.50      UP      200      5003.8899      5445.7362      INT
Bearing= 511-      3      4992.4130      5446.4750      OCC
```

Here is the resulting file (BB):

```
10-
2
91-
40-
2
1
0
3
40-
3
2
0
200
0
511-
```

continued

Script Example

Next the file BB is called up with a text editor and modified as follows:

```
10-; Enter point A          >>> BRG-BRG intersect with copy direction
&.
91-
40-; Copy Direction by 2 known points
&.
&.
0; Enter point B
&.
40-; Copy Direction by 2 known points
&.
&.
^
```

Some comments on the above:

A comment was put in on the first line for future reference and some comments were added to other lines to help the user through the sequence.

Each line that had a point number was replaced with "&.". The ampersand (&) will cause a pause for input and the period (.) is included to cause a reverse-video default to be displayed to remind the user that a script is running and is waiting for a response.

Here is a sample run of the script BB:

```
Command= BB-
Command= 10- Enter point A          >>> BRG-BRG intersect with copy direction
Occupied Point= 100
                                100    4795.2810    4997.6627    OCC
Backsight Point= 91-
Bearing= 40-                      Copy Direction by 2 known points
Point= 100
Point= 101
Distance= 0                        Enter point B
Point B= 105
Bearing= 40-                      Copy Direction by 2 known points
Point= 104
Point= 105
Distance= 0
Description=
```

Installing Benchmark on a Network

WHAT'S IN THIS CHAPTER?

This chapter describes additional requirements needed to run Benchmark on a Network.

Installing Benchmark on a Network

This should be read by the INSTALLER and PURCHASER of this software BEFORE the installation takes place.

After making backup copies of the delivery disks install Benchmark on the network using the following instructions:

1. Make a directory on the network where Benchmark can be installed. This directory will be called the PROGRAM DIRECTORY.

Benchmark should NEVER be installed in the root directory.

2. Make the program directory the current directory with the CD DOS command.
3. Use INSTALL on each Benchmark disk delivered. This should be done with the network drive showing at the DOS prompt. In other words, use A:INSTALL.
4. Each user MUST have a subdirectory that holds a copy of SETUP.DAT (Benchmark default settings copied from disk #1) and ACADPARM.DAT (127- defaults for AutoCAD users - copied from the Benchmark/AutoCAD Interface disk, if delivered). This directory will be called the USER SUBDIRECTORY.
5. Each work-station MUST have a subdirectory that will hold a copy of CONFBNCH.DAT (the benchmark configuration file). This subdirectory will be called the WORK-STATION SUBDIRECTORY.

Although Benchmark will not force users to reconfigure after reinstallation of the network version as it does on other versions, all users MUST reconfigure their work-stations after each time the software is installed. It is the responsibility of the installer to notify users of this requirement. The other alternative is to delete CONFBNCH.DAT from every work-station's subdirectory after installing Benchmark. This will force every work-station to be reconfigured the first time it is used with the Benchmark software.

Upon initial installation every work-station will have to be re-configured the first time they are used with the Benchmark software.

Installing Benchmark on a Network

6. The following DOS/Network commands should be built:

- Each work-station should have an AUTOEXEC.BAT file that includes the following DOS batch commands:

a. SET BNP=

This should be set to a path to the program subdirectory where Benchmark is installed on the network. This is the same for all users.

b. SET BNC=

This should be set to a path to the work-station subdirectory where the Benchmark configuration file will be kept. The intention is to allow more than one person to use a work-station with each user getting a copy of his/her SETUP file data no matter which work-station he/she logs onto.

****NOTE TO INSTALLER**** DO NOT make just one work-station directory and have all work-stations share it even if all machines have the exact same equipment. If all work-stations have the same equipment consider that to be a temporary coincidence! This situation will CHANGE. PLEASE consider those who will have to maintain the network after you leave.

****NOTE TO PURCHASER**** It is your responsibility to make sure your installer follows the above request.

It will save you time and money down the road. Keep in mind we will charge you \$75.00 an hour minimum to untangle problems left by your installer. Do not let the installer out of the building until you are sure this was done right! If your installer can not explain this situation to you DO NOT LET HER/HIM INSTALL THIS SOFTWARE ON YOUR NETWORK! !

- A DOS PATH command or network search that includes the program subdirectory that Benchmark is installed in. This should be the same subdirectory pointed to by the SET BNP= command above. On Novell type networks this should go in the login script because the network search and path are disturbed each time a user logs in.
- SET BND= This should be set to a path to the user subdirectory. This should be unique for each user and should be part of the user's login procedure.

For example on Novell type networks this should be placed in the login script.

7. Keep in mind that if you are going to use AutoCAD on the network you must put it in a directory called \ACAD in order to use it with Benchmark.

Installing Benchmark on a Network

Once the preceding procedure has been followed for each work-station and each user of the network, the users should be able to boot their workstations, login to the network and type HELLO to get into the Benchmark system.

Benchmark uses file level locking so that a Benchmark job file in use on another work-station should be reported as LOCKED on any other work-station that attempts to use that job file. This locking is accomplished by leaving the job file open as long as the user remains in a given job file.

Refer to Appendix A for a description of data files used in Benchmark. Note that user privileges for Read, Write, and Create (R W C) must be given to the \BMCNTROL subdirectory on any drives where Benchmark data subdirectories may be initialized.

****NOTE TO PURCHASER****

If the installer is not a permanent employee of your shop it is requested that time be taken by her/him to make a permanent employee the Network Supervisor. This person should be left with the capability of making new user and work-station subdirectories as well as assigning of security privileges and whatever other responsibilities the given network will require. If your installer will not do this for you consider getting a new installer and/or network.

Benchmark Environment Variables

Benchmark Environment Variables

The operation of Benchmark can be customized through the use of certain environment variables. Environment variables are text strings that are placed in what is known as the DOS command processor's environment. The environment variables are placed and removed from the environment by using the SET command at the DOS prompt. Please refer to your DOS manual for more information on the use of the SET command.

The following is a list of the environment variables used by Benchmark and their function:

<u>Name</u>	<u>Function</u>
BNP	Tells Benchmark where to find its programs. This is automatically placed in your BENCH batch file when you install Benchmark. BNP is the only environment variable that is required to be set in order for Benchmark to run on a single-user system.
BNC	Tells Benchmark where to find the configuration file (CONFBNCH.DAT) and the Apple/IBM Transfer configuration file (CONF.COM.DAT). When the BNC is not set, Benchmark defaults to looking in the same subdirectory as that pointed to by the BNP. This environment variable is designed to facilitate networks where each work station would need to have a unique configuration. Non-network users will probably not want to set this environment variable.
BND	Tells Benchmark where to find the customization files (SETUP.DAT, ACADPARM.DAT). When the BND is not set, Benchmark defaults to looking in the same subdirectory as that pointed to by the BNP. This environment variable is designed to facilitate networks where each user may wish to have a unique SETUP.DAT and ACADPARM.DAT.
BNDESC	Tells Benchmark where to find the description files (DESCODES.DAT, DESCBLKS.DAT). This is designed to allow users to have multiple description code files.

BNPRN

Tells Benchmark where to send printer output. BNPRN can be set to any legal DOS file or device name. The following is a partial list of device names:

LPT 1 ,LPT2,LPT3 , COM 1,COM2,PRN

If the user wants to route printer output to a serial port, the communication parameters must be set first with the MODE command. If no BNPRN environment variable is set, Benchmark defaults to LPT1.

If printed output is routed to a file and the file already exists, the data is appended to the end of the file. If the file name is not fully specified with drive and path name, it will go to the current subdirectory that is logged when the first line is sent to the file.

BNDIR

Tells Benchmark where to find the Benchmark/AutoCAD Interface AutoLisp routines and blocks. It is only effective for Release 10 and higher AutoCAD users. It allows users to access the Benchmark/AutoCAD menu options from a drive other than \ACAD\BENCH on the currently logged drive. If no BNDIR is found, the system defaults to 'ACAD\BENCH.

BNDXF

Causes a default to be displayed when the 127-command prompts for an AutoCAD DXF file name.

Field Data Editor Tutorial

Field Data Editor Tutorial

Following are the steps to enter a five-sided traverse. You will enter the traverse field data, calculate the closure, balance the angular error, adjust the coordinates by the compass rule, and store the coordinates in a Benchmark job file.

Before entering the Field Data Editor, a subdirectory must be initialized for job storage.

Then, from the Benchmark Main menu, highlight **Field Data Editor** using the arrow keys or by typing F followed by pressing the <Enter> key.

You are now at the Field Data Main Menu.

Press the <Enter> key to select Edit.

You are now in the Job Header Record.

Type **Sample Traverse** and press the <Enter> key two times to highlight the Starting Point **Number**. Press the <Enter> Key to select 1.

Type **5000** for the starting Northing and Press the <Enter> key.

Type **5000** for the starting Easting and press the <Enter> key. The rest of the defaults are already set for a closed traverse in feet. Press the <F10> key to accept the information.

Press the <Enter> key to select Env.

You are now in Environment Record Number 0001.

Type **Test** and press the <Enter> key.

Press the <F10> key to accept the defaults and the information entered.

Press the <Enter> key to select Page.

You are now at page number 0001. The display shows that you are in Traverse mode, that the horizontal angle is set for bearings, the occupied point is 1, the foresight point is 2, and you are being prompted to enter a Quadrant for the Bearing from 1 to 2.

Type **4** to select the northwest quadrant.

Type **301510** and press the <Enter> key.

Type **599.23** and press the <Enter> key.

Press the <F10> key to accept the page.

You are now on Page number 0002.

Press the <F3> key twice to activate the **Horiz. Type** section. Press the <right arrow> key twice to highlight **Turned Angle**. Press the <F3> key. Notice the prompts have changed to represent a field angle traverse.

Type **2722000** and press the <Enter> Key.

Type **722 .65** and press the <F10> key to accept the page.

You are now on page number 0003.

Type **2623512** and press the <Enter> key.

Type **483.6** and press the <F10> key. You

are now on page Number 0004.

Type **1954025.2** and Press the <Enter> key.

Type **475.212** and Press the <F10> key. You

are now on page 0005.

Press the <Backspace> Key *or* the <left arrow> key to highlight **FS 6**. Type **1** and press the <Enter> key.

Type **2883715** and press the <Enter> Key.

Type **776.31** and press the <F10> key. You

are now on page 0006.

Press the <F3> key to activate the **Sd. Type** section. Type **c** to highlight **Closing**. Press the <F3> key twice.

Type **2404637** and Press the <F10> key to accept the closing angle.

You are now on page 0007.

Press the <Escape> key to activate the bottom menu. Type **R** to highlight **pRocess** . Press the <Enter> Key. You are now in the Process Menu. Press the <Enter> Key to Calculate the closure. The closure data should be as follows:

Number of sides	=	5
Angular Error	=	-31 Seconds
Northing Error	=	-0.1158
Easting Error	=	0.0044
Absolute Error	=	0.1159
Direction of Error	=	S02-10-36.7E
Perimeter	=	3057.0020
Precision	=	1 foot in 26374

Press any key to return to the Process Menu.

Field Data Editor Tutorial

Type **A** and press the <Enter> key to balance the angular error. Press any key to return to the Process Menu. Type **C** and press the <Enter> key to do a compass rule adjustment Of the coordinates. Press any key to return to the Process Menu.

Type **L** twice and press the <Enter> key to List the field data. Press any key to view the next screen of information. Press any key to return to the Process Menu. Press the <Escape> Key to exit the Process Menu. Press the <Escape> Key again.

Type **F** and press the <Enter> Key to access the File Menu.

If the subdirectory displayed in the upper right corner of the screen has not been initialized, Type **c** , press the <Enter> key, and type in the name of an Initialized Subdirectory.

Type **L** and press the <Enter> key to list any used jobs in the current subdirectory. Make note of a job number listed as unused. Press the <EScape> Key to return to the File Menu. Type **M** and press the <Enter> Key to create a new job. Type in an unused job number. Type **Sample Traverse Balanced Coordinates** and press the <F10> key. Type **S** twice to highlight **Save Coordinate File**. Press the <Enter> Key to store the corrdinates.

You have now completed the Field Data Tutorial.

To return the main Field Data Menu, press the <Escape> key twice, type **m** , and press the <Enter> key. To return to the Main Benchmark Menu, type **R** and press the <Enter> key. Press the <Enter> key again.

You are now back at the Main Benchmark Menu.

List of Abbreviations

B.V.C.	Begin vertical curve.
E.V.C.	End vertical curve.
HI	Height of Instrument
HI+	Measure up. The distance from the ground to the instrument.
HI-	Measure down. The distance from the instrument to the ground.
L.V.C.	Length of vertical curve
M.O.	Middle ordinate
P.C.	Point of curvature. Also known as beginning of curve (B.C.); tangent to curve (T.C.).
P.C.C.	Point of compound curvature
P.I.	Point of intersection of the tangents. Also known as vertex (V).
P.O.C.	Point on curve
P.O.L.	Point on line
P.T.	Point of tangency. Also known as end of curve (E.C.), or curve to tangent (C.T.).
P.V.I.	Point of vertical intersection
S.S.D.	Safe sight distance
T.I.	Tangent intersection
Vertex (V).	Same as P.I. (point of intersection of the tangents).

About Descriptions	3-15
Accumulated area	
displaying (19-)	6-17
Active	11-6, 9
Adjust Datum Elevation (321-)	8-9
Advanced Graphics Option (AGO)	7-2, 11-5
AGO- Advanced Graphics Option.....	7-2, 11-5
Entering from Coordinate Geometry (126-)	7-3
Erasing Points	7-6
Menu Structure	7-6
menu system	7-2
point symbol mode	7-9
table of point representations	7-9
Unique Commands	7-5
AGO: vs. Coordinate Geometry	7-2
Alter Printer Output Routing.....	21-9
Alternate/standard direct differential leveling mode (48-)	3-7
Angle	
compute from stored points (157-)	15-11
compute given two bearings (158-)	15-12
Angle entry	
alternate format	6-5
regular format	6-5
Angle entry format (35-)	3-6, 6-9
Angle Turned From Backsight Input (24-)	12-4
Angles and Chords from Stake to Stake (233-)	17-14
Angles from PC, Chords from Stake to Stake (234-)	17-12
Angles from PC, Chords from Stake to Stake & Long Chords (250-)	17-12
Any Two Knowns on Curve (69-)	9-17
Appendix B - Creating Script Files	B-1 Appendix C
Apple to IBM Transfer	C-1
Apple to IBM Transfer	
Appendix C	C-1
Arc	
divide by divisor (74-).....	15-3
divide by interval (72-)	15-2
divide by segments (77-)	15-5
Area	11-9
Area summation	
and side shots	6-15, 16
ASCII text file	B-2
AutoCAD ... , ...	1-10, 11-6, 20-2
Auto/Manual Pagination (400-)	3-11
Available Space on Job Disk (139-)	2-15
Average-end-area formula	16-9
Azimuth	
Toggle South/North orientation (29-)	3-6
Azimuth Input (21-)	12-4

B

BACKUP.COM	18-7
BACKUP.EXE	18-7
Backup a Subdirectory	18-7
Batch Inverse (134-)	11-6, 9
Bearing Input (20-)	12-4
Bearing swing, lot sizing by (191-)	12-12
Begin Lot Sizing (190-)	12-3
Beginning a New Drawing	20-14
Bench Menu Commands	20-23
Benchmark	
configuration routine	1-5
installing on a hard disk	1-2
Installing on a Network	D-2
main menu	1-11
What Is	ii
Benchmark Environment Variables	E-2
Benchmark to AutoCAD Transfer	
Layers used	20-14
Benchmark <-> AutoCAD Menu	20-21
Benchmark <-> Lietz SDR Data Exchange	21-2
Benchmark <-> SDR Main Menu	21-3
Benchmark <-> REC500 Main Menu	22-2
Benchmark <-> Zeiss REC500 Data Exchange	22-2
Benchplot II , ...	23-2
configuring the printer	23-2
in Group Menu	11-6
installation	23-2
operation	23-2
point display mode	23-3
table of point representations	23-3
Block	11-8
BNC	D-3,E-2
BND	D-3,E-2
BNDESC	E-2
BNDIR	E-3
BNDXF	E-3
BNP	D-3,E-2
BNPRN	E-3
BVC	16-7

C

C - Extract Coordinates from Data Dump	21-6, 22-6
Calculate Offsets on a Curve - Radius Known (185-)	10-4
Calculate Offsets on a Curve - Tangent Length Known (186-)	10-4
Chaining Script Files (452-)	B-4
Change Company Title (404-)	3-13
Change Disk Drive for Job Storage	2-8
Change Logged Subdirectory for Job Storage	2-6
Change Storage Point Sequence (13-)	15-15, 16
Change Storage Point Sequence (13-)	6-12
Changing the Default Parameters	20-9
Changing the Speed of Execution (DELAY)	B-4
Chord Direction or Angle and Length (65-)	9-11
Chord Length and Radius (64-)	9-9
Circular curve	
given two chords and included angle (225-)	17-2
through three points (228-)	17-3
Circular Curve Given Two Chords and Included Angle (225-)	17-2
Circular Curve through Three Points (228-)	17-3
Circular Curve Through Three Points (228-)	15-16
Close a Command Log File (511-)	15-22
Close a Log File (516-)	15-22
Close Current Job	2-11
COGO - Coordinate Geometry	7-2
Command Log file (510-)	B-2
Comments	
entering (224-)	14-7
Compute Angle from Stored Points (157-)	15-11
Compute Angle Given Two Bearings (158-)	15-12
Compute Elevation and Distance from BVC at Selected Stations (38-)	16-7
Compute Sag or Crest Point Station, Elevation and Distance from BVC (37-)	16-7
Compute Station and Elevation at Desired Distance from BVC (36-)	16-7
Compute Station and Elevation at Fixed Intervals from BVC (39-)	16-7
Configuration Routine	1-5
Consecutive Inverse Routine (81-)	12-5
Consecutive Inverse Routine (81-)	6-19
Convert Lot File (144-)	11-12
Convert Meters to Feet (54-)	6-8
Converted	11-13
Coordinate data	
storing (121-)	2-12
Coordinate Geometry	
Elevation Mode	8-2
Features of	iii, 5-3
Introduction	5-2
Make New Job (122-)	2-10
Store Coordinate Data (121-)	2-12
vs. Field Data Editor	5-2
Coordinate Geometry (COGO)	7-2
Coordinate Transformation by Angle Rotation (151-)	13-4
Coordinate Transformation by Bearing (153-)	13-5
Coordinate Transformation by Points (152-)	13-2
Coordinates	
entering directly (12-)	6-18
Copy Bearing and/or Length (40-, 41-, 42-)	6-13

Copy Benchmark Job File 18-3

Copy Direction (40-) 6-13

Copy Direction (40-).....15-12

Copy Direction and Distance (40-, 41-, 42-)	12-4
Copy Direction (40-)	12-4
Copy Direction and Length (42-)	12-4
Copy Distance (41-)	12-4
Copy Direction and Length (42-)	6-13
Copy Distance (41-)	6-13
Copy Lot Description File	18-10
Copy Points (220-)	14-4
Create a Turning Point (22-)	16-4
Create and Display Last Point on Line (141-)	10-3
Creating a Transfer (.DXF) File (127-)	20-2, 3
Creating Script Files	B-2
Appendix B	B-1
Cul-De-Sac	
Bend with, (167-)	10-16
Curved Entry to, Center Point Known (163-)	10-6
Curved Entry to, Offset Point Known (164-)	10-9
Straight Entry to, Center Point Known (165-)	10-11
Straight Entry to, Offset Point Known (166-)	10-14
Curve data	11-9
Curve Solver (97-, 98-, 99-)	9-19
Curve Staking (10-)	16-2
Curve staking	
angles and chords from stake to stake (233-)	17-14
angles from PC, chords from stake to stake (234-)	17-12
computing	17-10
offsets from tangent (235-)	17-10
Curve Staking Routines (235-,234-,233-,250-)	
Angles and Chords from Stake to Stake (233-)	17-14
Angles from PC, Chords from Stake to Stake (234-)	17-12
Angles from PC, Chords from Stake to Stake & Long Chords (250-)	17-12
Offsets from Tangent (235-)	17-10
Curve-solving routines	9-19
Curved Street Intersections	
Curved Into Straight (173-)	10-24
Four-Way Curve (177-)	10-32
Four-Way Straight & Curved (175-)	10-28
Two-Way Curve with Curved Entry (176-)	10-30
Two-Way Straight Into Curved (174-)	10-26
Curves	
any two knowns on a curve	9-17
chord bearing, length, and radius	9-11
direction into radius and length	9-2
direction into tangent and length	9-4
given chord bearing, length, and radius	9-9
given radius point and arc length	9-6
P.I., two directions, and radius	9-13
P.I., two directions, and tangent	9-15
radius and arc length given	9-7

D

Date and time	
in Benchmark Heading line (402-)	3-12
Default Benchmark Elevation Setting (47-)	3-8
Default point symbol mode (412-)	3-13
Default settings	
temporary vs. permanent	3-2
Defaults	1-14
Defaults Menu	4-25
Define Setup Location/Enter Traverse Mode (10-)	6-2
Deflected Angle Input (23-)	12-4
Degree of Curve-Arc Solving Routine (98-)	9-19
Degree of Curve-Chord Solving Routine (99-)	9-19
(DELAY) Changing the Speed of Execution	B-4
Delete a Job	18-5
Delete a Subdirectory	18-9
Delete Job (125-)	2-14
Delete Lot Description File (137-)	11-14
Delete Range of Points (201-)	7-6
Delete Single Points (200-)	7-6
Deleting Points (200-)	14-2
Description Codes	A-2
Description Key Delimiter	3-17
Destination Drive	18-2
Digitizing Tablet	
Using	7-4
Disks, job	2-2
Direction output	
set to angles right (8-)	3-4
set to azimuths (7-)	3-4
set to bearings (6-)	3-4
setting method of	3-4
Display of Occupied Station in Side Shot Mode (49-)	3-8
Direction and distance	
entering	6-4
Direction into Radius and Length (60-)	9-2
Direction into Tangent and Length (61-)	9-4
Display Current Point Numbering Method (86*-)	6-10
Display Current Slope Angle Request (18*-)	6-6
Display Profile Area (52-)	16-9
Displays the current angle entry format (35*-)	6-9
Displays the current leveling method setting (46*-)	8-2
Displays the current setting (54*-)	6-8
Displays the current setting of this toggle (47*-)	8-2
Displays the current setting of this toggle (48*-)	8-2
Displays the current three wire method setting (44*-)	8-2
Distance and direction	
entering	6-4
Divide an Arc (72-,74-,77-)	15-2
divide an Arc by Divisor (74-)	15-3
divide an Arc by Interval (72-)	15-2
divide an Arc by Segments (77-)	15-5
Divide a Line (73-,75-,79-)	15-6
divide a Line by Divisor (75-)	15-7
divide a Line by Interval (73-)	15-6

divide a Line by Segments (79-)	15-8
Divisor	
divide arc by (74-)	15-3
divide line by (75-)	15-7
DOS	
Print Screen (PrtSc) command	6-19
DOS Directory	18-6
DOS Path	18-7
DOS Path option	2-5
Download Data Dump from REC500	22-4
Download Data Dump from SDR	21-3
DXF - Drawing Interchange File	20-2

E

Earlier versions of Benchmark	20-20
Earthwork	
By Average End Areas (50-, 51-, 52-)	16-9
Edit Group Data (130-)	11-3
Edit Mode Navigation Tips	4-4
Edit Window	11-7, 8
Edit/Display Description option	3-16
Edit/Display Descriptions	3-15
Edit/Environment	4-7
Edit/Job Header	4-5
Edit/Page	4-10
EDM method of slope reduction	6-8
Elevation	
Adjust Datum	8-9
New Benchmark	8-8
Elevation Mode	
Abbreviations Table	8-3
Command Reference	8-5
Features of	8-2
On/Off	8-2
Prompts	8-4
Tailoring	8-2
Elevation Reduction (20-,21-,22-,23-)	16-4
Elevation Routine	
Example 1	8-20
Example 2	8-22
Example 3	8-23
Example 4	8-24
Enter AGO (126-)	7-3
Enter Comments (224-)	14-7
Enter Comments in Script Files	B-3
Enter Coordinates (12-)	6-18
Enter Multiple Slope Angles and Distances (51- 52-, 53-)	6-7, 8-3
Enter a Temperature (50-)	6-8
Entering Direction and Distance (20-,21-,23-,24-)	6-4
Escape	1-15, 16, 11-5, 8
EVC	16-7
Execute Script File in step mode (451-)	B-4
Execute Script File with User Response (451-)	B-4
Execute Script File without User Response (450-)	B-4
Export File Routine (129-)	19-3

F

F - Extract Field Data from Data Dump	21-5, 22-5
F1	1-16
F10 key	1-13
Hard Disk	
Installing Benchmark	1-2
(F10) Halting Execution of a Script File	B-4
Field Data Editor	
bypassing	5-2
Features of	ii
vs. Coordinate Geometry	5-2
Field Data Main Menu	4-2
File	4-17
Find Centroid of Active Groups (550-)	15-23
Floppy Disk	
Initialize Subdirectory for Job Storage	2-4
Free Memory Command (500-)	15-19
Free-form Descriptions	3-15

G

General Procedures	18-2
Go To File Menu	21-11, 22-8
Graphic point size in pixels (411-)	3-13
Graphic text size in pixels (410-)	3-13
Group	11-9, 11
Group command	7-3, 5
Group Files	A-2
Group Menu (130-)	7-3, 11-5
Groups	11-2

H

Halting Execution of a Script File (F10)	B-4
Hard Disk	
Initialize Subdirectory for Job Storage	2-5
Hardware	
Requirements	
Supported	
HELP	1-16, 11-6
Hold Area	11-5

I

Import File Routine (128-)	19-2
Inactive	11-6, 9
Insert	11-5
Installing Benchmark on a Network	D-2
Intersections (91-, 92-, 93-, 70-, 71-)	6-23
Inverse routines (81-, 68-)	6-19, 12-5
Inverses	11-9
Inversing (81-, 68-, 82-)	6-19
Interval	
divide arc by (72-)	15-2
divide line by (73-)	15-6

J

Job	
Delete a	18-5
Job Copy Menu	18-2
Job disk	
available space (139-)	2-15
preparing for job storage	2-2
show space	2-15
Job File	
Copy	18-3
Job File Data	A-2
Job Files	
Merge Two Coordinate	18-6
Job Number	18-2
Jobs	
loading	2-16
renaming	2-14
saving	2-16
Show Directory of	18-4

K

Keyboard	1-15

Layer.....	11-7
Layers Used in the Benchmark to AutoCAD Transfer	20-15
Leveling mode	
standard/alternate direct differential	3-7
three-wire method (44-)	3-7
trigonometric (46-)	3-7
Leveling Toggle between Trigonometric and Differential (46-)	8-4, 6, 11, 13
Line	
divide by divisor (75-)	15-7
divide by interval (73-)	15-6
divide by segments (79-)	15-8
Line feed	
display current setting for (37*-)	6-9
selecting single/double (37-)	3-7, 6-9
set double (37+-)	6-9
set single (37--)	6-9
Linear Regression (138-)	15-13
LINELAYER	11-7
List Jobs (123-)	2-13
List Lot Description Files (136-)	11-13
Listing Point Numbers (213-,214-,222-)	14-5
List Extremes (222-)	14-6
List Unused Point Numbers (214-)	14-5
List Used Point Numbers (213-)	14-5
Load Job (124-)	2-11, B-2, 4
Loading a Benchmark Generated Drawing into AutoCAD	20-13
Lot Description	
Copy File	18-10
Show Directory of Files	18-11
Lot description	11-12,13
Delete Lot Description File	11-14
List Lot Description Files	11-13
Lot Description Files	A-2
Lot descriptions	11-2
Lot numbers	11-12
Lot sizing	
Begin (190-)	12-3
By Bearing Swing (191-)	12-12
By Sliding Bearing (194-)	12-10
General Procedure	12-2
Parallel (195-)	12-14

M

Main Menu Selections	4-3
Make New Job	2-9
Make New Job (122-)	
Coordinate Geometry	2-10
Manual	
How to Use	iv
Manual/Auto Pagination (400-)	3-1 1
Manual/Automatic Vertical Curve Modes (231-)	17-6, 8
Manual/Increment Curve Staking Modes (236-)	17-10, 12
Mark	11-8
Mean Reciprocal Observations (326-)	8-8, 17
Measure Down (325-)	8-3, 16
Measure Up (324-)	8-3, 10, 15
Menu bar	1-15
Merge Two Benchmark Coordinate Job Files	18-6
Meters	
convening to feet	6-8
Mouse	1-15, 11-6, 8
Mouse	
Button Assignments	7-4
Using	7-4

N

NAME.....	11-7, 9
Negative numbers, entering	1-13
New Benchmark Elevation (320-)	8-8
Ninety (90) Degree Offset (33-)	6-16
Non-Alphanumeric Keystrokes	B-3
Normal Curve Solving Routine (97-)	9-19
Numeric Keypad	1-13

O

Offset Intersection (70-)	6-27
Offset Intersection on an Arc (71-)	6-29
Offsets from Center Line (180-)	10-4
Open a Command Log File (510-)	15-22
Open a Log File (516-)	15-22
Options Menu	4-24
Output	
printing	3-4

P

Parallel Line Routine (140-)	10-3
Parallel Lines (140-, 141-)	10-3
Paste	11-8
PATH	D-3
Pause For Input (&)	B-2
PI	11-7, 16-7
P.I., Two Directions, and Radius (66-)	9-13
P.I., Two Directions, and Tangent (67-)	9-15
Point	
Entering	7-6
Points	11-7
deleting (200-)	14-2
list (210-)	14-3
listing extremes (222-)	14-6
overriding	3-9
POINTTEXT	
Point of Tangency (P.T.)	6-20
Point number	11-7
Point numbering	
automatic sequential	3-9
automatic vs. manual	3-9
manual	3-9
manual/automatic (86-)	6-10
overriding	6-10
Point numbers	
listing unused (214-)	14-5
listing used (213-)	14-5
Point storage	
changing numbering sequence (13-)	6-12
manual	6-10
Print Formatted Dump Report	21-7
Print Heading (9-)	15-21
Print Screen (223-)	6-19, 14-7
Printer	
off (2-)	3-4
on (1-)	3-4
on, output only (5-)	3-4
page feed (3-)	3-4
Printing	
skipping to a new page (400-)	3-1 1
staggered display of bearings (401-)	3-11
Process	4-21
Prompts	1-14
Prototype Drawings	20-13
Pull-down menus	1-15

Q

Quit or Save Settings (4-)	3-14

Radial Inverse Routine (82-)	6-21
Radial Lot Design	
Minimum Arc at Setback (192-)	12-8
Radial Lot Sizing	
Minimum Chord at Setback (193-)	12-9
Radial Stakeout (156-)15-9	
Radial Stakeout Individual Points (159-)	15-10
Radius Curve (68-)	12-6
Radius Length and Arc Length (63-)	9-7
Radius Point and Arc Length (62-)	9-6
Redirect Printer Output (502-)	15-20
Reduce Level Notes (23-)	16-4
Reduce Slope Angle and Distance (21-)	16-4
Re-Enter Traverse Mode (330-)	6-3
Re-enter Traverse Mode	8-4
Re-Enter Traverse Mode (330-)	15-2,7
Remove Multiple Points From Window Not File (204-)	7-5
Remove Single Points From Screen Not File (203-)	7-5
Rename a Job (302-)	2-14
Restart Profile (51-)	16-9
Restore a Subdirectory	18-7
Return to (Benchmark) Main Menu (4-)	6-2
Return to Job Copy and Directory Utilities Menu (4-)	18-2
Rounding	
of bearing (95-)	3-11
of bearings (95-)	3-11
of coordinates (94-)	3-11
of distance (90-)	3-11
of elevations (96-)	3-11
Rounding options (90-, 94-, 96-, 95-)	3-11
RP	11-7

S

Save Settings or Quit (4-)	3-14
Screen	
printing (223-)	14-7
Screen Graphics	11-6
Script file produced containing output equal to 134- (135-)	20-23
Script Files	
chaining (452-)	B-4
controlling speed of execution	B-4
creating	B-2
defined	B-2
entering comments	B-3
example	B-5
executing (450-, 451-)	B-4
halting execution (F10)	B-4
Scroll bar	11-8
Segments	
divide arc by (77-)	15-5
divide line by (79-)	15-8
Select Auto/Manual Pagination (400-)	3-11
Select Manual/Automatic Point Numbering (86-)	6-10
Select Slope Reduction Method (26-, 27-)	6-8, 16-6
Set Automatic Point Numbering (86+-)	6-10
Set Automatic Slope Angle Request (18+-)	6-6
Set Difference in Elevation Mode (260-)	8-2, 4, 6, 7, 11, 13
Set Direct Entry of Elevation Mode (261-)	8-2, 4, 6, 7, 11, 13
Set Manual Point Numbering (86--)	6-10
Set Manual Slope Angle Request (18--)	6-6
Set Slope Angle Request (18-)	6-6
Set Stadia Method of Slope Reduction (26-)	8-2, 4, 6, 7, 11, 13
Set Vertical Angle Method (EDM) of Slope Reduction (27-)	8-2, 4, 6, 7, 11, 13
Sets DDDMMSS.S format (35--)	6-9
Sets (Q/D)DD(D).MMSSS format (35+-)	6-9
Sets the backsight point as the default elevation (47+-)	8-2
Sets the occupied station as the default elevation (47--)	8-2
Setting Up the Master DXF File	20-15
Setup location	
defining in Coordinate Geometry (10-)	6-2
Setup Routine (10-)	8-5, 8
Side shot mode	
toggling display of occupied station (49-)	3-8
Side Shot (30-, 31-, 33-)	6-15, 8-7
Side Shot Mode (30-)	6-15, 8-7, 19
Side Shot Mode Update Elevation Only (39-)	8-19
Single Side Shot (31-)	8-7
Single Side Shot (31-)	6-15
Shell to DOS (501-)	15-20
Show Available Space on Job Disk (139-)	2-15
Show Directory of Jobs	18-4
Show Directory of Lot Description Files	18-11
Shrink a Job (118-)	15-21
Sliding bearing, lot sizing by (194-)	12-10
Slope Angles	
Multiple	8-3
Slope angle request (18-)	3-5

Slope Reduction	
difference in elevation method (260-)	3-5
elevation method (261-)	3-5
stadia method (26-)	3-5, 6-8
vertical angle method (EDM, "taping") (27-)	3-5, 6-8
Slope reduction method	
selecting (26-, 27-)	16-6
setting	3-5
Slope request	
automatic	6-6
manual	6-6
Slopes	
entering ..	6-7
Solving Three-Point Problems (226-,227-)	17-4
Source Drive	18-2
Source Job Number	18-2
Source Subdirectory	18-2
Speaker On/Off (32-)	3-6
Speed of Execution	
Changing (DELAY)	B-4
Spiral Curve (59-)	15-17
Spiral Curve Stakeout (240-)	17-16
Stadia Method of Slope Reduction (26-)	16-4, 6
Stadia Note Reduction (20-)	16-4
Stakeout	
radial (156-)	15-9
Status	11-6,7,9
Store Coordinate Data (121-)	
Coordinate Geometry	2-12
Store Group Data (142-)	11-11
Stored points	
compute angle from (157-)	15-11
Straight Street Intersections	
Four-Way (170-)	10-18
Three-Way (171-)	10-20
Two-Way Intersection (172-)	10-22
Subdirectory	18-2
backup	18-7
delete	18-9
preparing	2-3
restore	18-7

I

Tangent Grades (230-)	17-8
Taping method of slope reduction	6-8
Temperatures	
entering	6-8
and direct differential leveling mode	3-7
Three Angles and Two Lengths (226-)	17-4
Three-Point Problem (227-)	15-15
solving	17-4
three angles and two lengths (226-)	17-4
three sets of coordinates and two angles (227-)	17-5
Three Sets of Coordinates and Two Angles (227-)	17-4,1)
Three Wire Leveling On/Off Toggle (44-)	8-4, 6, 7, 11, 13
Tick Marks	
Sending to AutoCAD	11-12
Time and date	
in Benchmark Heading line (402-)	3-12
Toggle Automatic/Manual Point Numbering (86-)	3-9
Toggle Azimuth Orientation (29-)	3-6
Toggle between Level at Station and Level Not at Station (48-)	8-4, 6, 11, 13
Toggle Printing of Company Title in Heading (403-)	3-12
Toggle Printing of Date and Time in Heading (402-)	3-12
Toggle Staggered Printing (401-)	3-11
Toggle standard/alternate direct differential leveling mode (48-)	3-7
Toggle three-wire leveling method on/off (44-)	3-7
Toggles backsight and occupied station as the default elevation for new setups (47-)	8-2
Toggles between three wire method on and off (44-)	8-2
Toggles between trigonometric leveling and differential leveling (46-)	8-2
Tolerances Menu	4-26
Traverse entry	
slope mode	6-6
Traverse Leg Distance by Average (52-)	6-7, 8-3
Traverse leg Distance by Sum (53-)	6-7, 8-3
Traverse mode	
re-entering (330-)	6-3
Traverse Routines	
After 190-	12-4
Angle Turned From Backsight Input (24-)	12-4
Azimuth Input (21-)	12-4
Bearing Input (20-)	12-4
Deflected Angle Input (23-)	12-4
Triangle Solver (245-)	15-14, 16-8
Trigonometric leveling on/off (46-)	3-7
Turning Point	
Backsight to Occupied Point (322-)	8-6, 10
Foresight from Occupied Point (323-)	8-4, 12, 18
Turning Point from the Backsight to the Occupied Point (322-)	8-6, 10
Turning Point to the Foresight from the Occupied Point (323-)	8-4, 12, 18
Turns level at station off (48--)	8-2
Turns the conversion from meters to feet off (54--)	6-8
Turns the conversion from meters to feet on (54+-)	6-8
Turns three wire method off (44--)	8-2
Turns three wire method on (44+-)	8-2
Turns trigonometric leveling off (46--)	8-2
Turns trigonometric leveling on (46+-)	8-2
TYPE	11-7

U

Update Foresight Elevation Only (327-)	8-12, 18
Update Policy	iv
Upload Coordinates to the REC500	22-7
Upload Coordinates to the SDR	21-10
Using Descriptions	3-15

V

Vertical Angle Method for Slope Reduction (27-)	16-4, 6
Vertical Curve Solver (40-)	16-7
Vertical Curve Solver (229-)	17-6
View a Text File (520-)	15-23
View/Set Communications Parameters	21-12
View/Set Communications Parameters	22-9

W

Work lines	7-5