

TRAVERSE

Traverse Computation and Map Generation

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Copies of this document and the TRAVERSE program disk for the IBM PC are available from the authors, c/o the Department of Forest Resources, University of Minnesota, St Paul, MN 55108.



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TO: Users of TRAVERSE
FROM: Thomas R. Zeisler and Terry D. Droessler
SUBJECT: Version 5.1

Version 5.1 of TRAVERSE is similar to previous versions. The major modifications and refinements in the new version are:

1. Border and title change.
2. Allowance for 300 sides of input.
3. Expanded viewing of data when editing.
4. Unbalanced latitudes and departures are no longer printed.
5. North and east coordinates are printed.
6. Splitting the program into two chained executable programs.
7. A slight time delay (7 seconds) between data entry and map generation allows the printer to form feed before the mapping program begins.
8. Conversion of input units to/from English/metric.
9. Correction of map scale error when using yards.
10. Correction of various minor problems noted by users.

In particular, the expanded viewing of data when editing feature allows the user to specify a range of sides to be scrolled to the screen to check for errors. This is handy if a large number of sides have been typed in. We advise users to view 20 at a time, correct any errors and continue by viewing the next 20, etc. To continue with TRAVERSE, simply enter a "0" for the "SIDE TO BE CORRECTED" prompt and an "N" for the "VIEW MORE DATA" prompt.

Version 5.1 is geared for the EPSON FX-80 printer. It can be easily modified for the OKIDATA MICROLINE 92/93 printers by following the substitution guide in the TRAVERSE documentation. All modifications for the OKIDATA and other printers occur in the mapping portion of the program referenced below.

A temporary file named ZCOMMONZ.TMP is written to disk before the data input and specification portion of TRAVERSE ends. This file is read from disk when TRAVMAP begins. This should cause no problem unless there is insufficient disk space available or the disk is write protected. ZCOMMONZ.TMP is deleted from disk after being read by TRAVMAP.

The two executable programs are TRAVERSE, which is the data entry portion and TRAVMAP, which is the mapping portion. To start VERSION 5.1, simply type TRAVERSE.

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Contents

	<u>Page</u>
1. <u>Introduction</u>	1
2. <u>Instructions For Using TRAVERSE</u>	2
3. <u>Storage of Traverse Data on a Disk File</u>	6
4. <u>Traverse Mapping Routine</u>	8
Appendix A. TRAVERSE Program Listing, Epson Printer Version. . .	A-1
Appendix B. OKIDATA Printer Version of TRAVERSE.	B-1
Appendix C. Epson FX-80 Printer Graphics Information	C-1
Appendix D. Okidata - microline 92 and 93 Printer Graphics Information.	D-1
Appendix E. Contents of Distribution Diskette.	E-1
Appendix F. Sample TRAVERSE Record	F-1

Traverse Computation and Map Generation

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1. Introduction

TRAVERSE is a computer program written for the IBM personal computer in Microsoft Basic. It can process both closed and open traverses. For closed traverses, it calculates the linear error of closure (using the compass rule), the area enclosed and the precision of the traverse. For each traverse, the side lengths and azimuths, along with the latitudes and departures, are printed. In addition a four inch square map is drawn of the traverse at a scale selected by the user.

Input data required for the program consists of the number of sides in the traverse, the side lengths and the angles. Lengths may be measured in feet, yards or meters with the area printed in square feet, square yards and square meters, respectively. An option allows conversion of input data from feet or yards to meters, or from meters to feet. The area is then printed in the converted units. Area is also printed in acres for the English system of measure and hectares for the metric system of measure. The side lengths may be individual side lengths or cumulative side lengths such as might be obtained by walking the perimeter of an area with a hip chain. The angles may be in terms of azimuth readings (where north is zero degrees) or bearings (e.g. N30E).

The mapping routine is designed such that it can be converted for use with any dot matrix printer with pin addressable graphics capability. Versions are available for the Epson FX-80 and Okidata Microline 92 & 93 printers.

2. Instructions For Using TRAVERSE

After inserting the disk with the TRAVERSE software on it into drive A:, type one of the following:

TRAVERSE for Okidata 92 & 93 printers and
 for Epson FX-80 printers, etc.

TRAVERSE will display on the screen:

TRAVERSE

HOW IS THE DATA TO BE ENTERED?
F) FROM A FILE ON DISK
K) FROM THE KEYBOARD

F OR K:

If you are going to enter your side lengths and azimuth angles directly into the program, type "K". If the length and angle data has been entered into a disk data file and this file is to be read into the program, type "F". Data file creation is explained section 3.

If data is to be entered from the keyboard, TRAVERSE displays the following series of prompts:

ENTER TRAVERSE IDENTIFICATION:

followed by a hi-lighted box. You may type into that box any kind of information you wish. This information will subsequently appear on the top of each page of the TRAVERSE output.

MEASUREMENT UNITS

1. FEET
2. YARDS
3. METERS

ENTER NUMBER OF UNIT: ?

Enter the number (1, 2 or 3) which corresponds to the units the traverse side lengths were measured in.

OPEN OR CLOSED TRAVERSE (O OR C):

If the traverse is a closed traverse (ending point is the same as the starting point) enter "C". If the traverse is of a linear feature or is not to be closed (different ending and starting points) enter "O".

ENTER NUMBER OF SIDES IN THE TRAVERSE:

Enter the number of sides taken in the traverse. Currently the program allows for 60 sides and angles.

AZIMUTHS OR BEARINGS (A OR B)?

If the angles were measured as azimuths (0-360° clockwise from north) enter "A". If the angles are bearings (e.g. N30°E) enter "B".

CUMULATIVE OR INDIVIDUAL SIDE LENGTHS (C OR I):

If the length of each side in the traverse is known, enter "I". If the length recorded for each side is the accumulation of the side lengths from the starting point, enter "C". Cumulative side lengths might be obtained by walking the traverse with a hip chain or similar device.

TRAVERSE now clears the screen and displays the data entry screen. For azimuths it appears as follows:

ENTER NUMBER FOLLOWED BY <RETURN>

SIDE	AZIMUTH DEGREES	LENGTH (FEET)
------	--------------------	-------------------

1- 2

If bearings are being entered the following screen appears instead:

ENTER NUMBER FOLLOWED BY <RETURN>

SIDE	BEARING N/SangleE/W	LENGTH (FEET)
------	------------------------	-------------------

1- 2

For each side of the traverse enter the appropriate data in the hi-lighted box as it is displayed. Press the return key after each value entered. If you make a mistake before pressing the return key use the cursor left key (the 7/4 key on the number pad to the right) to back over the value and retype. If you catch a mistake after the return key has been pressed, note which side is in error and continue entering the data. After all the data has been entered you have the option of reentering any sides which are in error.

Azimuths are entered in degrees. Decimal parts of a degree may be entered (e.g. 75° 30' may be entered as 75.5). Bearings are entered with N or S followed by the angle (may have a decimal part) followed by E or W. Note, there must be no spaces separating the direction (N, S, E or W) from the angle (N 75° 30' E would be entered as N75.5E). Note that North is

entered as NOE or NOW, South as SOE or SOW, East as N90E or S90E and West as N90W or S90W.

After all sides and angles have been entered, TRAVERSE will ask if the data is to be edited. If there are errors to be corrected enter "Y". Enter the beginning station number of the side to be corrected (e.g. if side 3-4 is in error enter 3). The original data for the side will be displayed. Reenter the correct data in the same format as before. Note, both the angle and the side length must be entered, whether in error or not.

TRAVERSE will now allow the conversion of input data from feet or yards, to meters, or from meters to feet. This conversion is useful if a hip-chain is metric and English units are desired or vice-versa. If no conversion is desired, simply enter a "1" for the selection. If a conversion is desired, enter in the appropriate number corresponding to your choice. The conversion prompt is as follows:

```

SELECT UNITS CONVERSION FOR SIDE LENGTHS
  1. NO CONVERSION
  2. TO METERS
ENTER THE NUMBER OF YOUR SELECTION: ?

```

After the requested conversion is completed, TRAVERSE will print out a summary table of the traverse. This table will contain the azimuths, individual side lengths, total perimeter length and the latitudes and departures. In addition, for the closed traverse the balanced latitudes and departures are printed along with the error of closure, precision and area. A description of this information may be found in many elementary surveying texts. An example of this summary output appears in Figure 1.

When the summary output is completed TRAVERSE proceeds to generate a map of the traverse. Prior to printing the map TRAVERSE will ask the user to select the scale at which the map will be drawn. For English units of measure the selection menu appears as follows:

```

SELECT MAP SCALE:
  1. 4 INCHES = 1 MILE
  2. 8 INCHES = 1 MILE
  3. FILL 4 INCH SQUARE
  4. USER SELECT

```

```

ENTER NUMBER OF SELECTION: ?

```

Selection 1 and 2 are self explanatory. The map will be drawn in the 4 inch square box at 4 or 8 inches to the mile. Selection 3 will cause TRAVERSE to calculate a scale so that the map of the traverse will fill the 4 inch square. The scale is printed upon completion of the map. With selection 4 the user

will be asked to enter a scale in number of inches to the mile. Note, that with selections 1, 2 and 4 if the traverse drawn at the selected scale is too large to fit in the 4 inch square box, an error message will be displayed and the user will be asked to select another scale. An example of the map for the data shown in Figure 1, is shown in Figure 2.

After a map is printed, the user has the option of printing another map at the same or a different scale.

Before completion of TRAVERSE, the data entered may be saved on a disk file for future use. The name this file is to have must be entered when asked for and may be any valid IBM PC file name (see the IBM DOS manual for more information on file names).

TRAVERSE COMPUTATION AND ADJUSTMENT (COMPASS RULE)
 FOR: *This is where the identification information appears*

COURSE	AZIMUTH	LENGTH	UNBALANCED		BALANCED	
			LAT	DEP	LAT	DEP
1 - 2	26 0	285.000	256.156	124.936	255.941	125.018
2 - 3	104 30	610.000	-152.732	590.570	-153.193	590.745
3 - 4	195 30	720.000	-693.814	-192.412	-694.358	-192.205
4 - 5	358 0	203.000	202.876	-7.084	202.723	-7.026
5 - 1	307 0	647.000	389.375	-516.717	388.886	-516.531
		2465.000	1.861	-0.707		

CLOSURE = 1.991 FEET

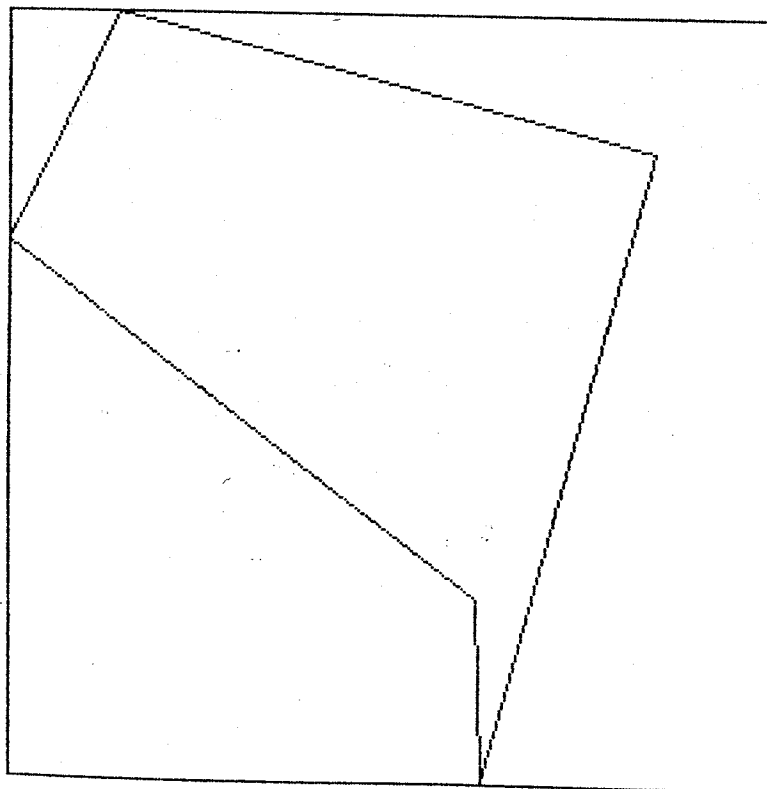
PRECISION = 1 IN 1238 (0.1%)

AREA = 6.263 ACRES
 272806.876 SQUARE FEET

Figure 1. TRAVERSE closure output example.

MAP OUTPUT FOR:

This is where the identification information appears



MAP SCALE: 1 INCH = 212.9 FT.
 3.23 CHAINS

Figure 2. TRAVERSE map example.

3. Storage of Traverse Data on a Disk File

Rather than entering the data collected for a traverse directly into the TRAVERSE program as described in the previous section, it may be typed into a disk file using any text editor. One text editor which may be used is the IBM supplied EDLIN which is described in the IBM DOS manual. TRAVERSE also will save data in the described format.

TRAVERSE compatible files must have the following format:

- Line 1: Traverse identification information as described in the previous section.
- Line 2: Unit of measure: FEET, YARDS or METERS
- Line 3: Open or closed traverse: OPEN or CLOSED
- Line 4: Number of sides in the traverse.
- Line 5: Type of angle measure: AZIMUTHS or BEARINGS
- Line 6: Type of length measure: CUMULATIVE or INDIVIDUAL

Following line 6 there is one line for each side in the traverse. These lines contain the angle and the side length, in that order. Separate the angle from the length by a comma. Bearings are entered in the same manner as described in section 2, without spaces between the directions and the angle (e.g. N30W). Decimals may be used on the angles.

The file for the data shown in the previous section would appear as follows:

```

This is where the identification information appears
FEET
OPEN
5
AZIMUTHS
INDIVIDUAL
26,285
104.5,610
195.5,720
358,203
306,647

```

To have the data file read into the TRAVERSE program, type in an "F" where the program asks "HOW IS THE DATA TO BE ENTERED?". TRAVERSE will respond with "ENTER FILE NAME: ?". At

this point type in the name of the data file you wish to have read into the program (e.g., b:traverse.dat).

After the data is read in to TRAVERSE, you have the option of editing the data. The data is edited in the same manner as outlined in section 2.

4. Traverse Mapping Routine

The map of the closed traverse is "drawn" into an array of 288 X 288 pixels. Each of these pixels corresponds to a dot on a dot matrix printer and each pixel is represented by one bit in a computer word. Depending on the printer being used, 7 or 8 bits (pixels) are stored in one computer word. This word corresponds to a column, one dot wide and 7 or 8 dots long on the printer. This map array may be visualized as in Figure 3. For the bit numbering scheme within a word, see the printer descriptions in appendices C and D.

The map is "drawn" into this array by setting the appropriate bits (pixels) to "1". When completed, the map array is sent to the printer one word at a time with the appropriate carriage returns and line feeds embedded.

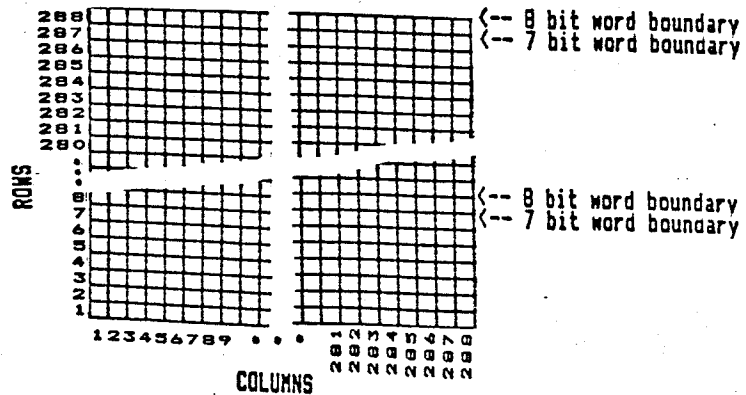


Figure 3. Traverse Map Storage Array.

Appendix A. TRAVERSE Program Listing, Epson Printer Version

100 REM #LINESIZE: 132
 105 REM #PAGESIZE: 88
 110 REM #TITLE: TRAVERSE.EPS -- VERSION 4.0
 120 REM TRAVERSE IS A PROGRAM FOR TRAVERSE COMPUTATIONS USING THE COMPASS RULE
 130 REM
 140 REM WRITTEN FOR USE IN BASIC ON THE IBM PC BY THOMAS R. ZEISLER AND
 150 REM ALAN R. EK, DEPARTMENT OF FOREST RESOURCES, UNIVERSITY OF MINNESOTA.
 160 REM 1984
 170 REM
 180 REM THE CLOSURE COMPUTATIONS WERE ADAPTED FROM A PROCEDURE IN:
 190 REM BRINKER, R. C. AND P. R. WOLF. 1977.
 200 REM ELEMENTARY SURVEYING. 6TH EDITION.
 210 REM IEP-A DUN-DONNELLEY PUBLISHER, NY.
 220 REM (PAGE 231)
 230 REM THE PROGRAM CALCULATES THE LINEAR ERROR OF CLOSURE, THE AREA
 240 REM ENCLOSED AND THE PRECISION OF THE TRAVERSE.
 250 REM IT ALSO PRINTS A MAP OF THE TRAVERSE ON AN EPSON PRINTER
 260 REM
 270 REM DATA MAY BE READ FROM THE KEYBOARD OR FROM A DISK FILE. THIS
 280 REM INPUT IS FORMAT FREE AND ITS STRUCTURE IS AS FOLLOWS:
 290 REM LINE DESCRIPTION
 300 REM ---- -----
 310 REM 1 TRAVERSE IDENTIFICATION OR DESCRIPTION
 2 UNIT OF MEASUREMENT (FEET, YARDS OR METERS)
 3 OPEN OR CLOSED TRAVERSE (OPEN OR CLOSED)
 4 NUMBER OF SIDES IN THE TRAVERSE
 5 'AZIMUTHS' OR 'BEARINGS' ANGLE MEASUREMENTS
 6 '1' INDICATING WHETHER OF NOT LENGTHS OF
 7 ENTERED AS CUMULATIVE LENGTHS OR EACH
 8 ENTERED INDIVIDUALLY.
 9 TRAVERSE THERE IS A LINE
 10 AZIMUTH MINUTES

This code has
 been revised.
 See latest floppy
 disk copies
 AR Ek

Appendix C. Epson FX-80 Printer Graphics Information.

The following information may be useful for user's contemplating the use of other printers. For a complete description of Epson printer graphics, see chapters 11-16 in the Epson FX-80 Printer User's Manual. Page references are for the 1983 manual.

a) Printer control codes (ASCII decimal)

27 42 05 32 01	Set printer to 1:1 ratio graphics mode, with 288 dots per line. This set of codes is sent before each graphics line printed.
27 65 08	Set line spacing to 8/72 inch (page 81).

b) Pin numbering

Eight vertical pin (dot) positions.

<u>row</u>	<u>pin</u>	<u>dec</u>	<u>bit</u>	
1	0	128	2^7	most significant bit
2	0	64	2^6	
3	0	32	2^5	
4	0	16	2^4	
5	0	8	2^3	
6	0	4	2^2	
7	0	2	2^1	
8	0	1	2^0	least significant bit

0 ← bottom pin not used

c) Resolution

72 dots per inch vertical and horizontal.

Appendix D. Okidata - microline 92 & 93 Printer Graphics Information.

For a complete description of Okidata graphics capability see the section in the Okidata Printer User's manual on APA (all points addressable) graphics.

a) Printer Control Codes (ASCII decimal)

28	Set horizontal resolution to 72 dots per inch. Send this code before entering graphics mode.
03	Turn on graphics mode, this need only be sent once before graphics printing starts.
03 02	Turn off graphics mode.
03 14	Graphics line feed, advances paper 7/32 of an inch and returns the print head to the left margin.

NOTE: ASCII code 03 must be sent to the printer twice when used as a graphics character, since it is also the graphics control code.

b) Pin numbering

Seven vertical pin (dot) positions.

<u>row</u>	<u>pin</u>	<u>dec</u>	<u>bit</u>
1	0	1	2^0 least significant bit
2	0	2	2^1
3	0	4	2^2
4	0	8	2^3
5	0	16	2^4
6	0	32	2^5
7	0	64	2^6 most significant bit

c) Resolution

72 dots per inch horizontal and vertical.

Appendix E. Contents of Distribution Diskette

The following files are on the TRAVERSE distribution diskette:

Executable files

TRAVEPS.EXE	Epson printer version of TRAVERSE
TRAVOKI.EXE	Okidata printer version of TRAVERSE

BASIC files

TRAVEPS.BAS	Epson printer version of TRAVERSE
TRAVOKI.BAS	Okidata printer version of TRAVERSE

Data files

BEARINGS.DAT	Bearing angle test data
CLOSEDTR.DAT	Closed traverse test data
OPENTR.DAT	Open traverse test data

TRAVEPS.EXE and TRAVOKI.EXE are compiled versions and may be run by typing TRAVEPS and TRAVOKI, respectively. TRAVEPS.BAS and TRAVOKI.BAS are BASIC files and may be run using BASICA.COM.

BEARINGS.DAT, CLOSEDTR.DAT and OPENTR.DAT are test data files which may be read into TRAVERSE by entering an "F" when the program asks "HOW IS THE DATA TO BE ENTERED?" and then entering one of the above file names when asked for. These files are text files and may be looked at and modified by a text editor such as IBM's EDLIN.

TRAVERSE RECORD

Tract Identification: _____

Date: _____

Measurement Units: Feet, Yards or Meters

Traverse: Open or Closed

Number of sides: _____

Crew: _____

Compass readings: Azimuths or Bearings

Side lengths: Individual or Cumulative

Side	Compass Reading	Distance
1 - 2		
2 - 3		
3 - 4		
4 - 5		
5 - 6		
6 - 7		
7 - 8		
8 - 9		
9 - 10		
10 - 11		
11 - 12		
12 - 13		
13 - 14		
14 - 15		
15 - 16		
16 - 17		
17 - 18		
18 - 19		
19 - 20		
20 - 21		
21 - 22		
22 - 23		
23 - 24		
24 - 25		
25 - 26		

Side	Compass Reading	Distance
26 - 27		
27 - 28		
28 - 29		
29 - 30		
30 - 31		
31 - 32		
32 - 33		
33 - 34		
34 - 35		
35 - 36		
36 - 37		
37 - 38		
38 - 39		
39 - 40		
40 - 41		
41 - 42		
42 - 43		
43 - 44		
44 - 45		
45 - 46		
46 - 47		
47 - 48		
48 - 49		
49 - 50		
51 - 52		