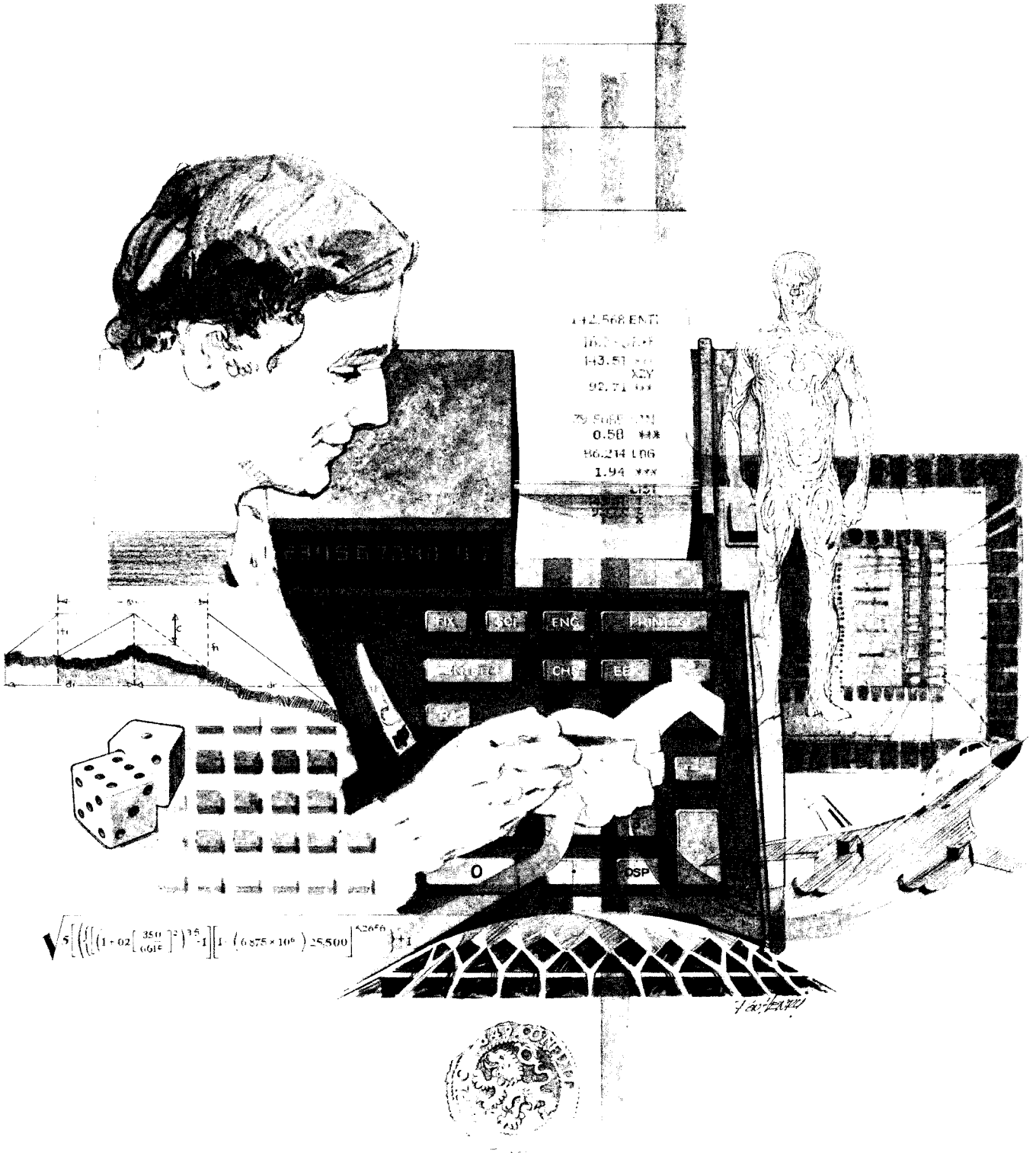
HEWLETT-PACKARD

HP-67/HP-97

Users' Library Solutions

COGO–Surveying



INTRODUCTION

In an effort to provide continued value to it's customers, Hewlett-Packard is introducing a unique service for the HP fully programmable calculator user. This service is designed to save you time and programming effort. As users are aware, Programmable Calculators are capable of delivering tremendous problem solving potential in terms of power and flexibility, but the real genie in the bottle is program solutions. HP's introduction of the first handheld programmable calculator in 1974 immediately led to a request for program **solutions** — hence the beginning of the HP-65 Users' Library. In order to save HP calculator customers time, users wrote their own programs and sent them to the Library for the benefit of other program users. In a short period of time over 5,000 programs were accepted and made available. This overwhelming response indicated the value of the program library and a Users' Library was then established for the HP-67/97 users.

To extend the value of the Users' Library, Hewlett-Packard is introducing a unique service—a service designed to save you time and money. The Users' Library has collected the best programs in the most popular categories from the HP-67/97 and HP-65 Libraries. These programs have been packaged into a series of low-cost books, resulting in substantial savings for our valued HP-67/97 users.

We feel this new software service will extend the capabilities of our programmable calculators and provide a great benefit to our HP-67/97 users.

A WORD ABOUT PROGRAM USAGE

Each program contained herein is reproduced on the standard forms used by the Users' Library. Magnetic cards are not included. The Program Description I page gives a basic description of the program. The Program Description II page provides a sample problem and the keystrokes used to solve it. The User Instructions page contains a description of the keystrokes used to solve problems in general and the options which are available to the user. The Program Listing I and Program Listing II pages list the program steps necessary to operate the calculator. The comments, listed next to the steps, describe the reason for a step or group of steps. Other pertinent information about data register contents, uses of labels and flags and the initial calculator status mode is also found on these pages. Following the directions in your HP-67 or HP-97 **Owners' Handbook and Programming Guide,** "Loading a Program" (page 134, HP-67; page 119, HP-97), key in the program from the Program Listing I and Program Listing II pages. A number at the top of the Program Listing indicates on which calculator the program was written (HP-67 or HP-97). If the calculator indicated differs from the calculator you will be using, consult Appendix E of your **Owner's Handbook** for the corresponding keycodes and keystrokes converting HP-67 to HP-97 keycodes and vice versa. No program conversion is necessary. The HP-67 and HP-97 are totally compatible, but some differences do occur in the keycodes used to represent some of the functions.

A program loaded into the HP-67 or HP-97 is not permanent—once the calculator is turned off, the program will not be retained. You can, however, permanently save any program by recording it on a blank magnetic card, several of which were provided in the Standard Pac that was shipped with your calculator. Consult your **Owner's Handbook** for full instructions. A few points to remember:

> The Set Status section indicates the status of flags, angular mode, and display setting. After keying in your program, review the status section and set the conditions as indicated before using or permanently recording the program.
>
> REMEMBER! To save the program permanently, **clip** the corners of the magnetic card once you have recorded the program. This simple step will protect the magnetic card and keep the program from being inadvertently erased.

As a part of HP's continuing effort to provide value to our customers, we hope you will enjoy our newest concept.

SPECIAL NOTE

This Library Solutions book is based entirely on a set of HP-65 programs submitted by Carl M. King of Sarasota, Florida and translated for the HP-67/97 by Hewlett-Packard. Special thanks are due to Mr. King for this complete set of interrelated programs.

TABLE OF CONTENTS

Program Description I

Program Title COGO - SURVEYING: GENERAL DESCRIPTION AND INSTRUCTIONS

This Hewlett-Packard translation is based on the COGO Series of HP-65 programs written by

CARL M. KING
2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables These COGO programs constitute a comprehensive and self consistent series that solve all the CoOrdinate GeOmetry relationships regularly employed by surveyors and plat designers. The raw data from the surveyors' field notes are reduced to rectangular coordinates for ease of plotting and for detection of errors. From any given PAIR of coordinates, you advance a direction and a distance to a new POINT, identified by a new PAIR of computed coordinates. ALL the programs in this COGO series have certain features in COMMON, so that you can switch from one program to another without losing the thread of your calculations. The BEARING TRAVERSE and the DEFLECTION ANGLE traverse are common to all. The INVERSE TRAVERSE is shared by eight of them. When proceeding around a CLOSED traverse, along straight legs and circular arc segments, they automatically accumulate the AREA. In addition to the COMMON options, each program has a SPECIALTY:

COGO-01:	SIDE SHOTS	COGO-07:	COMPASS RULE ADJ.
COGO-02:	BRG.-BRG. INTERSECT'N	COGO-08:	ROTATION OF AXES
COGO-03:	BRG.-DIST. INTERSECT'N	COGO-09:	CRANDALL'S RULE ADJ.
COGO-04:	DIST.-DIST.INTERSECT'N	COGO-10:	TRANSIT RULE ADJ.
COGO-05:	TRAVERSE OF CURVE	COGO-11:	TO INSCRIBE CURVE
COGO-06:	INVERSE OF CURVE	COGO-12:	SLOPE SHOT TRAVERSE

These programs are based upon the HP-65 User's Library COGO series submitted by Carl M. King.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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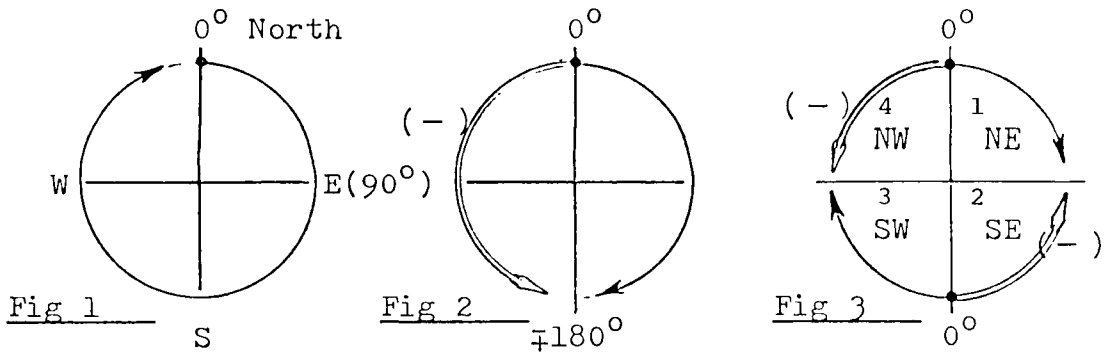
Program Description II



Three systems for denoting HEADINGS in angular degrees:

Fig 1 - This is how a navigator reads his compass, and surveyors call it North AZIMUTH. It is a positive angle reading from the North 0° to 360°.

Fig 2 - Also with the zero point at the North, you can read the W'ly quadrants as a negative (-) angle. This is equivalent AZIMUTH, and this is how the CALCULATOR displays its answers. It reads the whole circle from -180° to 0° to +180°.

Fig 3 - Shows two zero points, at North and South points, and angles are read either CW or CCW, depending on the "quadrant". Headings read in this fashion are called BEARINGS, and their numerical values never exceed 90°.

Systems #1 and #2 are mathematically equivalent. The calculator produces the same answers for input expressed in either of these ways.

System #3 is equivalent only in the NE quadrant. However the relationships in the other quadrants are exceedingly simple. NW and SE bearings turn CCW. Think of them as negative (-) angles. SE and SW bearings face opposite to the N'ly quadrants. Think of their distances as negative numbers. YOU CAN INDEED ENTER BEARING AND DISTANCE DATA DIRECTLY INTO THESE PROGRAMS. You merely attach a negative (-) sign to the proper numbers (press [CHS]), as follows:

Quadrant no.	Quadrant	Bearing	Distance
1	NE	+	+
2	SE	-	-
3	SW	+	-
4	NW	-	+

IMPORTANT: Calculator output must at first be read as AZIMUTH. For the Users' convenience, routines for inputting bearing/quadrants, converting Azimuths to bearings and calculating supplementary angles have been included in these programs.

GENERAL DISCUSSION

This COGO series has been designed to provide you with a convenient means of closing and balancing a traverse, and for computing an entire subdivision plat, with a minimum of program CARD changes. Data entry and data read out are consistent throughout. It is as though it were one continuous program.

Each program CARD provides some specialized function, but it also contains many of the standard options for advancing the traverse. Thus, having selected a CARD, you can usually continue the traverse until you have need for a different special function. The standard options are as follows:

Key [A] stores Northings and Eastings (coordinates) of the Point of Beginning (P.O.B.) and initializes the program.

Key [f] [A] converts Azimuth outputs to bearing/quadrants.

Key [f] [C] calculates the supplement of an angle. This is useful for converting Bearings to Azimuths; or Interior Angles to Deflection Angles; and vice versa.

Key [B] calculates the traverse to a new set of coordinates, when the Azimuth and distance are given.

Key [f] [B] performs the above traverse using bearing/quadrant inputs.

Key [C] calculates (in seven of the programs) the inverse traverse. The Azimuth and distance are calculated when the respective coordinates are input.

Key [C], otherwise, initiates the special option, which is characteristic of the respective program.

Key [D] calculates the traverse to a new set of coordinates, when the Deflection Angle (Field Angle) and distance are given.

Key [E] is the ROLL DOWN print function which provides you with convenient single-key means of manipulating and reading the data in the "stack". The answers are always in the same relative order as follows:

x = Northings; y = Eastings; z = Azimuth; t = distance

Key [f] [E] in most of the programs, recalls the area enclosed by the travers.

NOTES:

(1) In these COGO programs angles are always entered and read out in Degrees, Minutes, Seconds (the DD.MMSS format).

(2) Except for the "side shot", you are advanced to the new point after each traverse calculation, ready to advance again from the new coordinates and to utilize the completed backsight, all of which data are stored in the calculator.

(3) Every COGO program accumulates AREA as you go, so that when you close upon the P.O.B., you can recall the enclosed area immediately. Areas of curve segments enclosed along the way are also included.

STANDARDIZED DATA ENTRY & TRAVERSE OPTIONS

COGO is a closely knit family of programs, and a diligent effort has been made to standardize the data entry procedures within the family. However, certain Traverse Options could not be included in every program. Following is a listing indicating which options were omitted from the respective programs. The missing options are indicated with an X:

COGO NO.	SPECIALTY	fC Supplement	B Bearing	C Inverse	D Deflection
-01	BASIC w/SIDE SHOTS	=	=	=	=
-02	BRG.-BRG. INTERSECT'N	=	=	X	=
-03	BRG.-DIST. INTERSECTION	=	=	X	=
-04	DIST.-DIST. INTERSECTION	=	=	=	=
-05	TRAVERSE OF CURVE	=	=	X	=
-06	INVERSE OF CURVE	=	=	=	=
-07	COMPASS RULE ADJUST	=	=	=	=
-08	ROTATION OF AXES	=	=	=	=
-09	CRANDALL'S RULE ADJUST	=	=	=	=
-10	TRANSIT RULE ADJUST	X	=	=	=
-11	TO INSCRIBE CURVE	=	=	X	=
-12	SLOPE SHOT TRAVERSE*	=	=	=	=

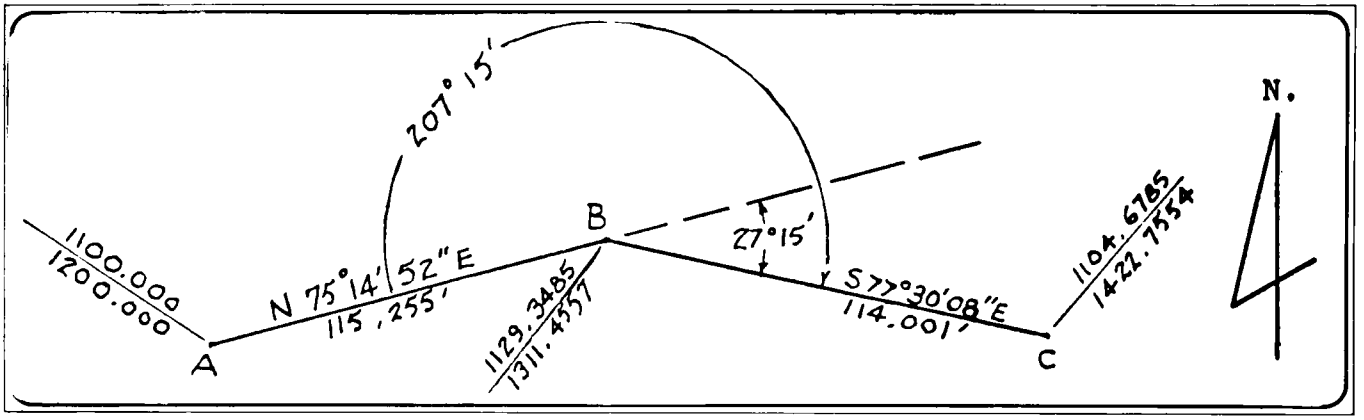
*Note: In the Slope Shot (COGO-12) the "B" and "D" routines are modified for slope data entry.

Another interesting feature of all these COGO programs, which you should be aware of, has to do with turning to a new heading while remaining at the same point. If you enter a Bearing angle, and attempt to traverse exactly a zero (0) distance, the calculated "backsight" will always be exactly N 0°00'00"E. In other words, you cannot establish a new heading by traversing exactly a zero (0) distance.

However, establishing a new heading while remaining at the same point is an operation that you occasionally wish to perform, and a provision has been designed into the COGO programs to make it easy for you. You enter the heading information in the usual fashion, (when you press [B] for "Bearing" or press [D] for "Deflection"), and at the STOP where you enter the distance, the programs always provide you with a reading that is a very small number (an infinitesmal) equal to 10^{-9}. This number will serve in lieu of zero, and will introduce no error. Unlike zero, though, it performs normally in the calculator, and you can attach a negative sign to it, if need be.

When this small number is referred to elsewhere in these User Instructions, it is represented by 1.0000-09.

Program Description 11



Sample Problem(s) Deflection Angles can be turned either to the right (CW) or the left (CCW). CW angles are always positive (+), and CCW angles are negative (-).

"Azimuth Angles" also known as "Angles Right" are turned from a backsight. In this case a negative (-) value is used for the traverse distance; or alternatively you can find the equivalent deflection angle, which numerically is its supplement. Always refer to your sketch to get the signs correct.

Given:

Point "A": Northings = 1100.000
Eastings = 1200.000

Thence run N75°14'52"E, 115.255'; thence deflect 27°15'00", 114.001' to point "C".

Solution(s)

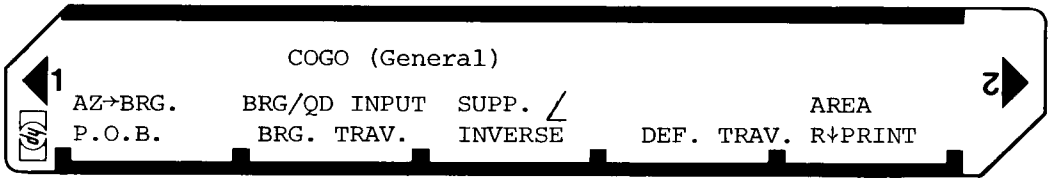
	Field Angle	distance	Bearing	Northings	Eastings	Point
	---	---	----	1100.000	1200.000	"A" (Given)
	---	115.255	N75°14'52"E	1129.3485	1311.4557	"B"
	+27°15'00"	114.001	S77°30'08"E	1104.6785	1422.7554	"C"
Alternate:	---	---	---	1100.000	1200.000	"A"
	---	115.255	N75°14'52"E	1129.3485	1311.4557	"B"
	+207°15'00"	-114.001	S77°30'08"E	1104.6785	1422.7554	"C"

(Azimuth Angle calls for negative distance.)

IMPORTANT: Always start from a set of given or assumed coordinates.

ALWAYS make at least one BEARING TRAVERSE before proceeding with DEFLECTION ANGLE traverses.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load card, sides 1 and 2			
2	Input point of beginning (P.O.B.)	Northing	ENT↑	
		Easting	A	180
	Bearing Traverse:			
3	enter Bearing* OR Azimuth.	DD.MMSS		
4	IF angle is CCW (negative):		CHS	±DD.MMSS
5	with proper sign attached:		B*	1.0000-09
6	Enter distance.	d_2		
7	IF angle is SE or SW Bearing:		CHS	$\pm d_2$
8	with proper sign attached:		R/S	North'gs
9	roll down to read: Eastings		E	Eastings
10	roll down to read: Azimuth		E	Azimuth
3'	*If bearing/quadrants are input	±bearing	ENT↑	
		quadrant	f B	1.0000-09
	Deflection Angle or Angles Right:			
11	enter ANGLE.	DD.MMSS		
12	IF angle is CCW (negative):		CHS	±DD.MMSS
13	with proper sign attached:		D	1.0000-09
14	enter distance.	d_2		
15	IF angle is from BACKSIGHT:		CHS	$\pm d_2$
16	with proper sign attached:		R/S	North'gs
17	roll down to read Eastings		E	Eastings
18	roll down to read Azimuth		E	Azimuth
19	Inverse Traverse: enter Northings	N_n	ENT↑	
20	enter Eastings	E_n	C	North'gs
21	roll down to read Eastings		E	Eastings
22	roll down to read Azimuth		E	Azimuth
23	roll down to read distance		E	distance
	Angle Supplement Routine: for converting 2nd or			
	3rd quadrant AZIMUTHS to BEARINGS, INTERIOR			
	ANGLES to DEFLECTION ANGLES, and vice versa.			
24	(Output = 180° - input) (DD.MMSS) Azimuth		f C	Bearing
25	TO READ enclosed AREA, traverse to POB, then		f E	Sq. Ft.
26	To convert Azimuth to bearing/quadrants	AZ	f A	Bearing
				Quadrant

Program Description I

Program Title COGO-01: BASIC TRAVERSE, INVERSE, & SIDE SHOTS

This Hewlett-Packard translation is based on program 02825A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables COGO-01 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION I., hereof. The special option of this program is the SIDE SHOT, which can be exceedingly useful when there are numerous structures and objects in the field to be located. Having set up the instrument and taken a "backsight", you can then take numerous readings from the same set-up, without relocating the instrument. Each of the SIDE SHOTS has no bearing on the area that you might enclose in your traverse, and they are unrelated to each other; i.e., they do not alter the "backsight" setting.

Any traverse leg can be a SIDE SHOT. You merely set the program "mode switch" to the correct mode and then it is treated as a SIDE SHOT. If you wish to make just one SIDE SHOT, you press 1[f] [D] and the program automatically cancels the side shot flag after the shot. If you wish to make several SIDE SHOTS, you press 2 [f] [D] and then all subsequent traverses are SIDE SHOTS from the same originating point and from the same "backsight". When you wish to move the instrument, and advance the traverse again,you will need to reset the "mode switch" to traverse mode. Just press 0 [f] [D]

This program is a modification of the Users' Library Program #02825A submitted by Carl M. King.

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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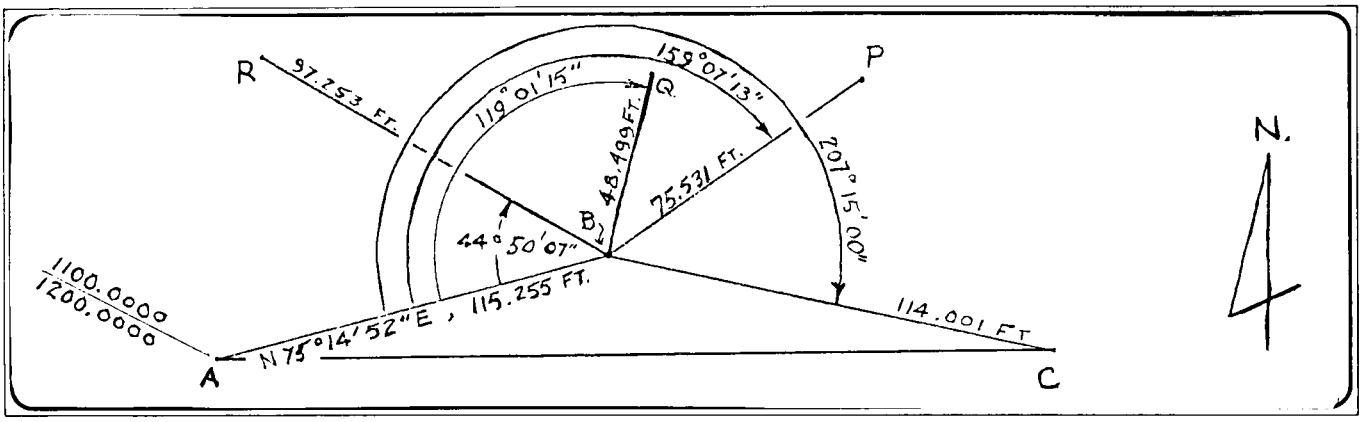
Program Description 11



Sample Problem(s) Commence at point A, for a P.O.B. Traverse to point B; make SIDE SHOTS (set multiple side shot mode) to points P, Q. Continue traverse (reset to traverse mode) to point C. Make inverse traverse to close on point A.

For calls $\overline{BP}$, $\overline{BQ}$, & $\overline{BC}$, use DEFLECTION TRAVERSE. (i.e., "angles right" and negative distance.)

For call $\overline{CA}$ use INVERSE TRAVERSE.

See solutions below. Quantities in parentheses are calculated; others are given as shown in sketch.

	Leg	Angles Right	Azimuth	Distance	Northings	Eastings
	P.O.B.	--	--	--	1100.0000	1200.0000
Brg.Trav.	$\overline{AB}$	--	75°14'52"	115.255	(1129.3485)	(1311.4557)
Side shots	$\overline{BP}$	159°07'13"	(54°22'05")	-75.531	(1173.3510)	(1372.8455)
	$\overline{BQ}$	119°01'15"	(14°16'07")	-48.499	(1176.3513)	(1323.4092)
	$\overline{BC}$	207°15'00"	(102°29'52")	-114.001	(1104.6785)	(1422.7554)
Inv.Trav.	$\overline{CA}$	--	(-91°12'11")	(222.805)	1100.0000	1200.0000

Area enclosed in triangle $\overline{ABC}$ = 3008.0442

Solution(s)

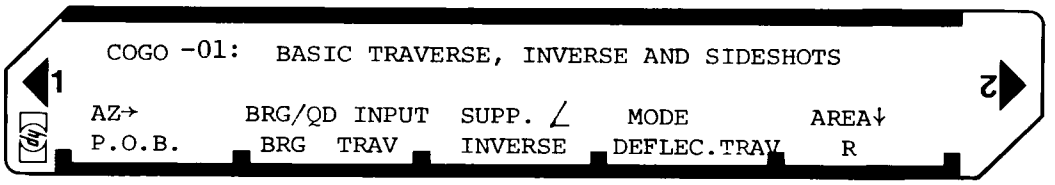
0[f] [D]* 1100 [ENT↑] 1200 [A] 75.1452 [B] 115.255 [R/S] → 1129.3485, N_B
[E] → 1311.4557, E_B

2 [f] [D]* 159.0713 [D] 75.5310 [CHS] [R/S] → 1173.3510, N_P;
[E] → 1372.8455, E_P; [E] → 54.2205, AZ $\overline{BP}$
119.0115 [D] 48.499 [CHS] [R/S] → 1176.3513, N_Q; [E] → 1323.4092, E_Q
[E] → 14.1607, AZ $\overline{BQ}$.
0 [f] [D] * 207.15 [D] 114.001 [CHS] [R/S] → 1104.6785, N_C;
[E] → 1422.7554, E_C; [E] → 102.2952, AZ $\overline{BC}$,
1100[ENT↑] 1200 [C] → 1100.0000; N_A; [E] → 1200.0000; E_A:
[E] → -91.1211, AZ. $\overline{CA}$; [E] → 222.8045, DIST. $\overline{CA}$.
[f] [E] → 3008.0442, AREA.

*setting "Mode Switch" for traverse, multiple sideshots and back to traverse, respectively.

Reference(s) This program is a modification of the Users' Library Program #02825A submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load sides 1 and 2			
2	Input point of beginning (P.O.B.)	Northing	ENT↑	
		Easting	A	180
	For Bearing Traverse:			
3	Set mode switch for traverse:	0	f D	0
4	Follow instructions on "General COGO User			
	Instruction Sheet" Step 3. or Step 10.			
	For Deflection Angle Traverse or Angles Right:			
5	If needed, set mode switch for traverse.*	0	f D	0
6	Go to "General COGO instruction sheet" Step 11			
	For Inverse Traverse:			
7	Go to "General COGO instruction sheet" Step 19.			
	For Side Shots:			
8	Set mode switch for side shots: single-	1	f D	1
	multiple	2	f D	2
9	Go to "Deflection Angle Traverse" instructions",			
	(i.e. use angles right and negative distances)	A.R.	D	1.0000-09
		-dist.	R/S	N_{pt}
			E	E_{pt}
			E	AZ_{pt}
10	To return to traverse after side shots, reset			
	to traverse mode and continue traverse.	0	f D	0
11	After closing traverse obtain area.		f E	Area
	See "General COGO" instructions for use of			
	other options: i.e., AZIMUTH →BEARING,			
	SUPPLEMENTARY ANGLE, etc.			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	P.O.B.
002	STO2	35 02	Easting
003	R↓	-31	
004	STO1	35 01	Northing
005	CLX	-51	
006	STO6	35 06	
007	1	01	
008	8	08	
009	0	00	
010	STO9	35 09	Initialize
011	RTN	24	
012	*LBLC	21 13	Inverse
013	RCL2	36 02	
014	-	-45	Dep.
015	X≠Y	-41	
016	RCL1	36 01	
017	-	-45	Lat.
018	GTO0	22 00	Go to calc. SBR.
019	*LBL6	21 16 12	Bearing/qd input
020	X≠Y	-41	
021	HMS→	16 36	Bearing
022	X≠Y	-41	
023	ENT↑	-21	
024	ENT↑	-21	
025	2	02	
026	÷	-24	
027	INT	16 34	
028	RCL9	36 09	
029	×	-35	
030	X≠Y	-41	
031	RCL9	36 09	
032	×	-35	
033	COS	42	
034	R↑	16-31	
035	×	-35	
036	-	-45	Azimuth
037	GTO2	22 02	Go to calc. SBR.
038	*LBLB	21 12	Azimuth input
039	HMS→	16 36	
040	GTO2	22 02	
041	*LBLD	21 14	Deflection angle input
042	HMS→	16 36	
043	RCL5	36 05	
044	+	-55	
045	*LBL2	21 02	Calc. SBR.
046	EEX	-23	
047	CHS	-22	
048	9	09	
049	CF3	16 22 03	
050	R/S	51	Distance input
051	F3?	16 23 03	Was distance input
052	GSB8	23 08	Yes
053	→R	44	
054	*LBL0	21 00	Calc. SBR
055	STO8	35 08	
056	X≠Y	-41	
057	STO7	35 07	
058	RCL2	36 02	
059	+	-55	
060	RCL8	36 08	
061	RCL1	36 01	
062	+	-55	
063	RCL7	36 07	
064	RCL8	36 08	
065	→P	34	
066	STO4	35 04	
067	R↓	-31	
068	→HMS	16 35	
069	STO3	35 03	
070	F1?	16 23 01	Multiple sideshots?
071	GTO1	22 01	
072	F2?	16 23 02	Single sideshot?
073	GTO1	22 01	Yes
074	LSTX	16-63	No, set up for traverse
075	STO5	35 05	
076	R↓	-31	
077	R↓	-31	
078	STO1	35 01	
079	R↓	-31	
080	STO2	35 02	
081	RCL7	36 07	
082	2	02	
083	÷	-24	
084	-	-45	
085	RCL8	36 08	
086	×	-35	
087	ST-6	35-45 06	
088	RCL2	36 02	
089	RCL1	36 01	
090	RCL3	36 03	
091	*LBL1	21 01	Setup for side shots
092	RCL4	36 04	
093	X≠Y	-41	
094	R↓	-31	
095	*LBLE	21 15	Rolldown & print
096	R↓	-31	
097	PRTX	-14	
098	RTN	24	
099	*LBL8	21 08	Distance entry set up
100	X≠Y	-41	
101	R↓	-31	
102	RTN	24	
103	*LBL∝	21 16 11	Azimuth →Bearing
104	HMS→	16 36	
105	ENT↑	-21	
106	SIN	41	
107	SIN⁻¹	16 41	
108	X<0?	16-45	
109	CHS	-22	
110	→HMS	16 35	Bearing
111	PRTX	-14	
112	R↓	-31	

REGISTERS

0	1 N	2 E	3 A Z	4 d	5 A Z	6 AREA	7 dep	8 lat	9 180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	9	09	
114	0	00	
115	÷	-24	
116	1	01	
117	+	-55	
118	INT	16 34	
119	PRTX	-14	
120	RTN	24	
121	*LBLa	21 16 14	Quadrant
122	STOI	35 46	Mode Switch
123	GTOi	22 45	
124	*LBL0	21 00	
125	CF1	16 22 01	Traverse Mode
126	CF2	16 22 02	
127	RTN	24	
128	*LBL1	21 01	
129	SF2	16 21 02	Single sideshot
130	CF1	16 22 01	
131	RTN	24	
132	*LBL2	21 02	Multiple sideshot
133	SF1	16 21 01	
134	CF2	16 22 02	
135	RTN	24	
136	*LBLe	21 16 15	Area
137	RCL6	36 06	
138	ABS	16 31	
139	PRTX	-14	
140	RTN	24	
141	*LBLc	21 16 13	Supplementary angle
142	ABS	16 31	
143	RCL9	36 09	
144	X≷Y	-41	
145	CHS	-22	
146	HMS+	16-55	
147	RTN	24	
150			
160			
170			
180			
190			
200			
210			
220			

LABELS				
A P.O.B.	B AZIMUTH IN	C INVERSE	D DEFLEC.∠	E R↓PRINT
a AZ→BRG.	b BRG. INPUT	c SUPP.∠	d MODE	e AREA
0 USED	1 USED	2 USED	3	4
5	6	7	8 DATA SETUP	9

FLAGS	
0	
1 MULT. SIDE.	
2 SING. SIDE	
3 DATA ENTRY	

SET STATUS		
FLAGS	TRIG	DISP
ON OFF	DEG ☒	FIX ☒
0 ☐ ☒	GRAD ☐	SCI ☐
1 ☐ ☒	RAD ☐	ENG ☐
2 ☐ ☒		n 4
3 ☐ ☒		

Program Description I

Program Title COGO-02: BEARING-BEARING INTERSECTION & TRAVERSE

This Hewlett-Packard translation is based on program 02826B written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables

UNKNOWN DISTANCE

An important feature of all these COGO programs is the method employed when taking a sighting on a new heading, when the distance is unknown. This situation comes up in the INTERSECTION routines.

You enter the Azimuth or heading information in the usual fashion, (when you press [B] for Azimuth or press [D] for "Deflection"), but at the STOP where you would normally enter the distance, the program automatically provides you with a reading of 1.0000-09. This number (i.e.an infinitesimal) will serve in lieu of zero (0), and will introduce no error. At the same time it performs normally in the calculator, AND YOU SHOULD USE IT TO REPRESENT THE UNKNOWN DISTANCE in the calculations, rather than absolute zero. The INFINITESMAL(1.000-09) may be given a negative sign, with proper significance, if you are making a "backsight".

When this number is referred to in the User Instructions, it is represented by 1.0000-09.

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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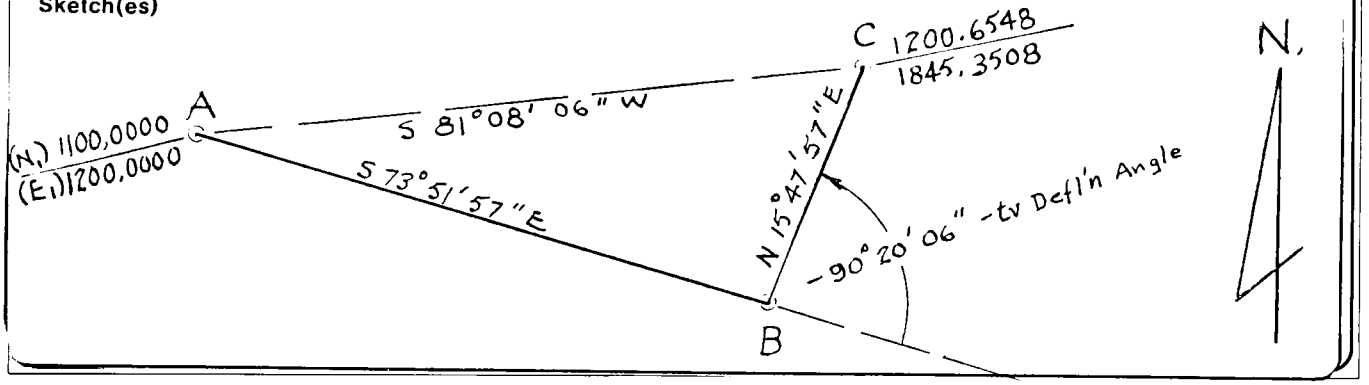
Program Description II

Sketch(es)



Sample Problem(s)

Start at point A, Enter P.O.B. coordinates. Make 1.0000-09 distance BEARING traverse toward point B. (Azimuth = +106°08'03"). Imagine that you are at point B. Make 1.0000-09 distance BEARING traverse toward point C. (Azimuth= +15°47'57") (or you may use DEFLECTION ANGLE routine). Enter point C coordinates using [C]. READ: Coordinates of point B and length of side $\overline{AB}$. REPEAT, moving toward point C.

Make 1.0000-09 distance BEARING traverse toward point C. Imagine that you are at point C. Make 1.0000-09 distance BEARING traverse toward point A. Enter point A coordinates, using [C]. READ: Coordinates of point C and length of side $\overline{BC}$. Change to another COGO program having INVERSE capability, (i.e. COGO-01) and complete the triangle, C to A, and recall the AREA, [f] [E].

SIDE $\overline{AB}$: Azimuth =+106°08'03", Length = 593.5759.

Point B: Coordinates: Northings = 935.0526, Eastings = 1770.1971

Side $\overline{BC}$: Azimuth =+15°47'57", Length = 276.0300

Side $\overline{CA}$: Azimuth = -98°51'54", Length = 653.1534

AREA = -81921. sq. ft.

Notes: (1) Negative sign occurs when counter-clockwise turns enclose area, as in this example. (2) If measured distances were in meters, the area would be interpreted in square meters.

Reference(s)

Program Description II

Sketch(es)

Solution(s)

Using Bearing/Quadrant Inputs:

1100[ENT↑] 1200 [A] 73.5157 [ENT↑] 2 [f] [B] [R/S]

15.4757 [ENT↑] 1 [f] [B] [R/S]

1200.6548 [ENT↑] 1845.3508 [C] → 935.0526, N_B;

[E] →1770.1971, E_B; [E] →106.0803 AZ $\overline{AB}$

[E] →593.5759, Dist. $\overline{AB}$

Continue, now using Azimuth inputs:

15.4757 [B] [R/S] 98.5154 [CHS] [B] [R/S] 1100 [ENT↑]

1200 [C] →1200.6554, N_A; [E] → 1845.3510, E_A;

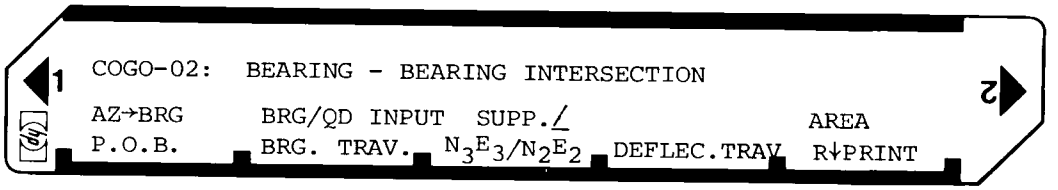
[E] → 15.4757, AZ $\overline{BC}$; [E] → 276.0307, Dist $\overline{CA}$.

If desired, change to COGO-01 with inverse capability, complete the traverse and obtain the area. (81921.1828 sq. ft.)

Reference(s) Davis, R.E., Foot, F.S., Kelly, J.W., SURVEYING THEORY AND PRACTICE. 5th Edition. 1966. McGraw-Hill Book Co. (Bearings & Azimuth page 260); (Deflection Angles page 262).

This program is a modification of the Users' Library Program #2826B submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load sides 1 and 2			
2	Input point of beginning	Northing	ENT↑	
		Easting	A	180
	For Bearing Traverse:			
3	Follow instructions on "General COGO User Instruction" sheet, step 3.			
	For Deflection Angle Traverse or Angles Right:			
4	Go to general "COGO User Instruction" sheet, step 11.			
	For Bearing-Bearing Intersection:			
5	Do two bearing traverses with no distance inputs; with azimuths	azimuths	B	1.0000-09
			R/S	Northing
	or with bearing quadrants	bearing	ENT↑	
		QD	f B	1.0000-09
	(Deflection angles; using [D], also work)		R/S	Northing
	(Repeat above, for second traverse)			
6	Enter coordinates of terminal points	N_3,Northing	ENT↑	
		E_3,Eastings	C	Northing
7	Read results		E	Easting
			E	Azimuth
			E	Distance
8	If desired, change to another COGO program with inverse capability, complete traverse and obtain area.			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	P.O.B. N+E
002	STO2	35 02	
003	R↓	-31	
004	STO1	35 01	
005	CLX	-51	
006	STO6	35 06	
007	1	01	
008	8	08	
009	0	00	
010	STO9	35 09	Initialize
011	RTN	24	
012	*LBLC	21 13	Terminal Coord
013	RCL2	36 02	
014	-	-45	
015	X≠Y	-41	Dep.
016	RCL1	36 01	
017	-	-45	
018	→P	34	Lat.
019	X≠Y	-41	
020	STO4	35 04	
021	RCL8	36 08	
022	-	-45	
023	RCL5	36 05	
024	RCL4	36 04	
025	-	-45	
026	+	-55	
027	LSTX	16-63	
028	SIN	41	
029	X≠Y	-41	
030	SIN	41	
031	÷	-24	
032	×	-35	
033	RCL8	36 08	
034	X≠Y	-41	
035	GTO1	22 01	Go to calc. SBR.
036	*LBLb	21 16 12	Bearing/Qd input
037	X≠Y	-41	Brg.
038	HMS→	16 36	
039	X≠Y	-41	Qd.
040	ENT↑	-21	
041	ENT↑	-21	
042	2	02	
043	÷	-24	
044	INT	16 34	
045	RCL9	36 09	
046	×	-35	
047	X≠Y	-41	
048	RCL9	36 09	
049	×	-35	
050	COS	42	
051	R↑	16-31	
052	×	-35	
053	-	-45	
054	→HMS	16 35	
055	*LBLB	21 12	Az.
056	SF1	16 21 01	Azimuth input
057	*LBLD	21 14	Deflection angle
058	HMS→	16 36	traverse
059	RCL5	36 05	
060	STO8	35 08	
061	F1?	16 23 01	
062	CLX	-51	
063	+	-55	
064	EEX	-23	
065	CHS	-22	
066	9	09	
067	CF3	16 22 03	
068	R/S	51	Input distance
069	F3?	16 23 03	Was dist. input?
070	GTO8	22 08	Yes
071	SF2	16 21 02	No - nonprint
072	*LBL1	21 01	Calculation subroutine
073	→R	44	
074	STO3	35 03	
075	X≠Y	-41	
076	STO4	35 04	
077	2	02	
078	÷	-24	
079	RCL2	36 02	
080	+	-55	
081	×	-35	
082	ST-6	35-45 06	
083	RCL4	36 04	
084	RCL2	36 02	
085	+	-55	
086	STO2	35 02	
087	RCL3	36 03	
088	RCL1	36 01	
089	+	-55	
090	STO1	35 01	
091	RCL4	36 04	
092	RCL3	36 03	
093	→P	34	
094	STO4	35 04	
095	X≠Y	-41	
096	STO5	35 05	
097	→HMS	16 35	
098	STO3	35 03	
099	R↓	-31	
100	CF1	16 22 01	Roll down
101	*LBLE	21 15	
102	R↓	-31	
103	F2?	16 23 02	Display only
104	R/S	51	Print
105	PRTX	-14	
106	RTN	24	
107	*LBL8	21 08	Input setup
108	X≠Y	-41	
109	R↓	-31	
110	GTO1	22 01	
111	*LBLa	21 16 11	Azimuth →Bearing
112	HMS→	16 36	

REGISTERS

0	1 N	2 E	3 A°	4 Used, d	5 A_2	6 AREA	7	8 A_1	9 180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	ENT↑	-21	
114	SIN	41	
115	SIN⁻¹	16 41	
116	X<0?	16-45	
117	CHS	-22	
118	→HMS	16 35	BRa
119	PRTX	-14	
120	R↓	-31	
121	9	09	
122	0	00	
123	÷	-24	
124	1	01	
125	+	-55	
126	INT	16 34	
127	PRTX	-14	QD.
128	RTN	24	
129	*LBLc	21 16 13	Supplementary angle
130	ABS	16 31	
131	RCL9	36 09	
132	X≠Y	-41	
133	CHS	-22	
134	HMS+	16-55	
135	RTN	24	
136	*LBLe	21 16 15	Area
137	RCL6	36 06	
138	ABS	16 31	
139	PRTX	-14	
140	RTN	24	
141	R/S	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS
170			
180			
190			
200			
210			
220			

LABELS					FLAGS	SET STATUS		
A P.O.B.	B BRG.TRAV	C N_3E_3/N_2E_2	D DEF. TRAV.	E R↓	0	FLAGS	TRIG	DISP
a AZ→BRG	b BRG/QDINPUT	c T SUPP.ANG.	d	e AREA	1 USED	ON OFF		
0	1 CALC.SBR	2	3	4	2 NON PRINT	0 ☐ ☒	DEG ☒	FIX ☒
5	6	7	8 DATA SETUP	9	3 DATA INPUT?	1 ☐ ☒	GRAD ☐	SCI ☐
						2 ☐ ☒	RAD ☐	ENG ☐
						3 ☐ ☒		n 4

Program Description I

Program Title COGO-03: BEARING-DISTANCE INTERSECTION AND TRAVERSE

This Hewlett-Packard translation is based on program 02827A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables

UNKNOWN DISTANCE:

An important feature of all these COGO programs is the method employed when taking a sighting on a new heading, when the distance is unknown. This situation comes up in the INTERSECTION routines.

You enter the Azimuth or heading information in the usual fashion, (when you press [B] for "Bearing" or [D] for "Deflection"), but at the STOP where you would normally enter the distance, the program automatically provides you with a very small number (an infinitesmal) equal to 0.000000001. This number will serve in lieu of zero (0), and will introduce no error. At the same time it performs normally in the calculator, and YOU SHOULD USE IT TO REPRESENT THE UNKNOWN DISTANCE in the calculations, rather than absolute zero.

When this number is referred to in the User Instructions, it is represented as 1.0000-09. The INFINITESMAL(1.0000-09) may be given a negative sign, with proper significance, if you are making a "backsight".

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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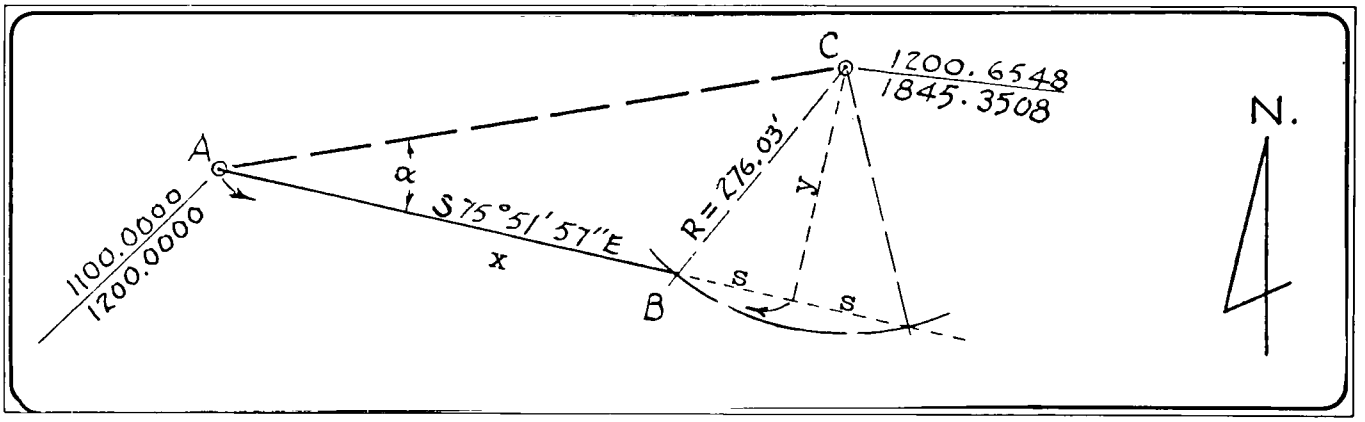
Program Description II



Sample Problem(s)

Start at point A. (Enter P.O.B. coordinates.) Take sighting on point B. (Azimuth = +104°08'03" , press [B], [R/S].) Enter coordinates of point C. (Northings = 1200.6548, press [ENT↑], Eastings = 1845.3508, press [C], Radius = 276.03, press [R/S].)

READ x = 496.0369 ; or y = 706.4322

Select one value to remain in the x-register.

Press: [R/S]. Program completes TRAVERSE to selected point.

Having found point B, change to another COGO program having INVERSE capability, and complete the traverse: B to C to A, and recall the AREA.

Side	Bearing	Azimuth	distance	Northings	Eastings	Point
				1100.0000	1200.0000	A
$\overline{AB}$	S75°51'57"E	+104°08'03"	(496.0369)			
				(978.8711)	(1681.0202)	(B)
				1200.6458	1845.3508	C

Change programs, and complete closure. AREA = 63291.6476

Note: Quantities above in parentheses are calculated in the program.

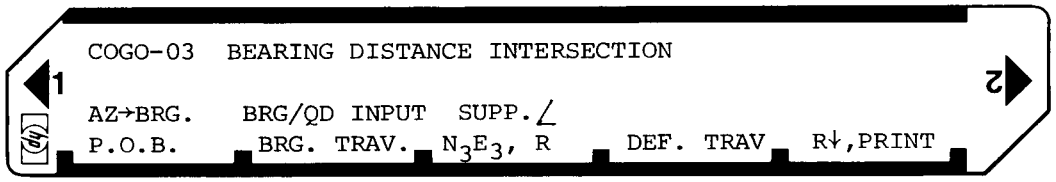
Solution(s) 1100[ENT↑] 1200 [A] 104.0803 [B] → 1.0000-09
[R/S] → 1100.0000 } (Display only ignore)
1200.6548 [ENT↑] 1845.3508 [C] → 601.2346 }
276.03 [R/S]→ 496.0369, d
[E] → 706.4322, d'
choose d [R↑]→ 496.0369 (Display only)
[R/S]→ 978.8711 Northing
[E] →1681.0202 Easting

OR for Bearing/Qd input 1100[ENT] 1200 [A] 75.5157 [ENT] 2 [f] [B] → etc.

Reference(s) This program is a modification of the Users' Library Program #02827A submitted by Carl M. King.

SURVEYING THEORY AND PRACTICE - 5th Edition - 1966 - McGraw-Hill Bk.Co.
Raymond E. Davis (Bearings & Azimuth page 260
Francis S. Foote (Deflection Angles page 262
Joe W. Kelly (Rectangular Coords. page 454

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load side 1 & side 2			
2	Input point of beginning	Northing	ENT↑	
		Easting	A	180
	For Bearing Traverse:			
3	Follow instructions on "General COGO User Instruction" sheet, step 3.			
	For Deflection Angle Traverse:			
4	Go to "General COGO User Instruction" sheet, step 11.			
	For Bearing-Distance Intersection:			
5	Take "Sighting" for point of intersection and input Azimuth	AZ	B	1.0000-09
	(or bearing, quadrant)	BRG	ENT↑	Northings
		QD	f B	1.0000-09
	use 1.0000-09 distance	1.0000-09	R/S	Northings
6	For radius point: input Northings	N_3	ENT↑	
	input Eastings	E_3	C	"X"
	input Radius	R	R/S	d
			E	d'
	X=d, y=d' (Take your choice depending on problem geometry)			
7	If d' is chosen		R/S	Northing
8	If d is chosen		R↑ R/s	$Northing_2$
			E	$Easting_2$
	Note: COGO-03 does not have inverse capability.			
	If no more intersections are to be calculated you will want to enter another COGO program card such as COGO-01 for inversing.			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	P.O.B. N & E
002	STO 2	35 02	
003	R↓	-31	
004	STO 1	35 01	
005	CLX	-51	
006	STO 6	35 06	Clear area
007	1	01	
008	8	08	
009	0	00	
010	STO 9	35 09	Initialize
011	RTN	24	
012	*LBL C	21 13	Radius point
013	RCL 2	36 02	distance calc.
014	-	-45	Dep.
015	X≷Y	-41	
016	RCL 1	36 01	
017	-	-45	Lat.
018	→P	34	
019	X≷Y	-41	
020	RCL 5	36 05	
021	-	-45	
022	X≷Y	-41	
023	→R	44	
024	R/S	51	Enter radius
025	ENT↑	-21	
026	×	-35	
027	R↑	16-31	
028	R↑	16-31	
029	×	-35	
030	-	-45	
031	√x	54	
032	+	-55	
033	X≷Y	-41	
034	LSTx	16-63	
035	-	-45	
036	0	00	
037	ENT↑	-21	
038	R↓	-31	
039	*LBL E	21 15	Roll down and
040	R↓	-31	
041	F2?	16 23 02	
042	R/S	51	Display or
043	PRTx	-14	Print
044	R/S	51	
045	RCL 5	36 05	
046	X≷Y	-41	
047	GTO 2	22 02	
048	*LBL 6	21 16 12	BRG/QD input
049	X≷Y	-41	BRG
050	HMS→	16 36	
051	X≷Y	-41	QD
052	ENT↑	-21	
053	ENT↑	-21	
054	2	02	
055	÷	-24	
056	INT	16 34	
057	RCL 9	36 09	
058	×	-35	
059	X≷Y	-41	
060	RCL 9	36 09	
061	×	-35	
062	COS	42	
063	R↑	16-31	
064	×	-35	
065	-	-45	Azimuth
066	→HMS	16 35	
067	*LBL B	21 12	Azimuth input
068	0	00	
069	STO 5	35 05	CLR 5
070	+	-55	
071	*LBL D	21 14	Deflection ∠
072	HMS→	16 36	
073	*LBL 1	21 01	
074	RCL 5	36 05	
075	+	-55	
076	EEX	-23	
077	CHS	-22	
078	9	09	
079	CF 3	16 22 03	
080	R/S	51	Input dist.
081	*LBL 0	21 00	
082	F3?	16 23 03	Was dist. input?
083	GTO 8	22 08	Yes
084	SF 2	16 21 02	No, input 10^{-9} and
085	*LBL 2	21 02	set for non print
086	→R	44	
087	STO 8	35 08	Calculation sub-
088	X≷Y	-41	routine
089	STO 7	35 07	
090	2	02	
091	÷	-24	
092	RCL 2	36 02	
093	+	-55	
094	×	-35	
095	ST- 6	35-45 06	
096	RCL 7	36 07	
097	RCL 2	36 02	
098	+	-55	
099	STO 2	35 02	
100	RCL 8	36 08	
101	RCL 1	36 01	
102	+	-55	
103	STO 1	35 01	
104	RCL 7	36 07	
105	RCL 8	36 08	
106	→P	34	
107	STO 4	35 04	
108	X≷Y	-41	
109	STO 5	35 05	
110	→HMS	16 35	
111	STO 3	35 03	
112	R↓	-31	

REGISTERS

0	1 N	2 E	3 A° (DMS)	4 d	5 A_2	6 AREA	7 DEP.	8 LAT.	9 180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	GTOE	22 15	Display
114	*LBL8	21 08	Input setup
115	X≠Y	-41	
116	R↓	-31	
117	GTO2	22 02	
118	*LBLa	21 16 11	Azimuth to
119	HMS→	16 36	Bearing/QD
120	ENT↑	-21	
121	SIN	41	
122	SIN⁻¹	16 41	
123	X<0?	16-45	
124	CHS	-22	
125	→HMS	16 35	
126	PRTX	-14	
127	R↓	-31	
128	9	09	
129	0	00	
130	÷	-24	
131	1	01	
132	+	-55	
133	INT	16 34	
134	PRTX	-14	
135	RTN	24	
136	*LBLc	21 16 13	Supplementary angle
137	ABS	16 31	
138	RCL9	36 09	
139	X≠Y	-41	
140	CHS	-22	
141	HMS+	16-55	
142	RTN	24	
143	R/S	51	

LABELS

A P.O.B.	B BRG.TRAV	C BRG.-DIST	D DEFLECTION	E R↓,PRINT
a AZ→BRG	b BRG INPUT	c SUPM'T ∠	d	e
0 DATA INPUT	1 USED	2 CALC	3	4
5	6	7	8 DATA SETUP	9

FLAGS

0	
1	
2	PRINT?
3	DISTANCE INPUT

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG	
DEG	☒
GRAD	☐
RAD	☐

DISP	
FIX	☒
SCI	☐
ENG	☐
n	____

Program Description I

Program Title COGO-04: DISTANCE - DISTANCE INTERSECTION AND TRAVERSE.

This Hewlett-Packard translation is based on program 2828A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables COGO-04 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION I., hereof. The special option of this program is the DISTANCE - DISTANCE INTERSECTION or the CURVE - CURVE INTERSECTION, which ever way you want to think of it.

THE PROBLEM: to calculate the coordinates of a point and the heading and distance of a line to it, when the coordinates and respective distances of two known points are given. In general two circles intersect in two points. When you swing arcs about two known points, if they intersect at all, they are most apt to have two intersection points.

When you proceed from one known point to another by way of an intermediate point, you have a choice. You can either go in the direction that provides a clockwise (CW) deflection at the intermediate point, or going in the opposite direction a (CCW) deflection.

In this program we shall always choose the CW deflection, and thereby calculate the intersection point so identified.

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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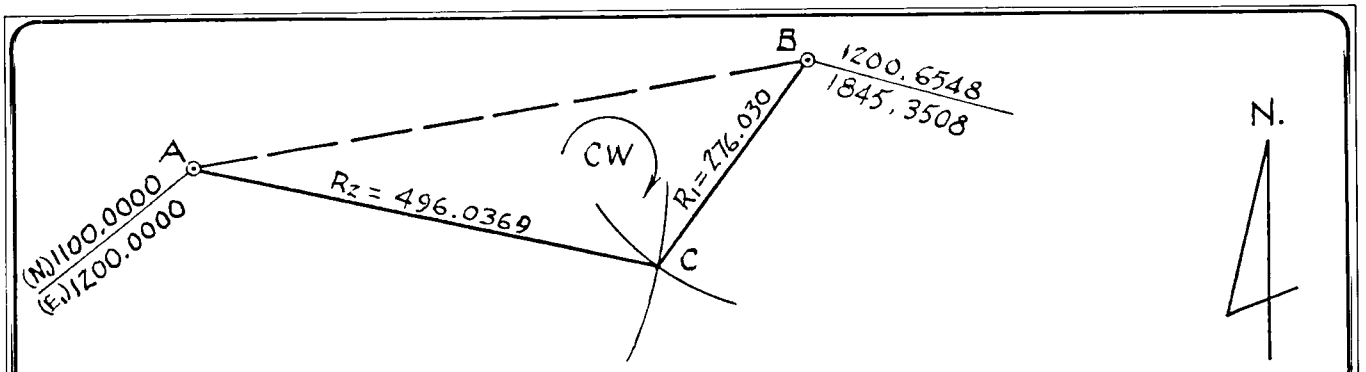
Program Description II



Sample Problem(s)

Start at known point A, (Enter P.O.B. coordinates.)

Make INVERSE TRAVERSE to known point B. (Use defined function [C].)

Enter radius length R_1; press [R/S].

Enter radius length R_2; press [R/S]. Program completes traverse to C.

READ: Northings, Eastings and Azimuth and distance of side $\overline{BC}$.

Make INVERSE TRAVERSE to point A.

Read area.

Note: Sequence of points A, B, C must be in clockwise (CW) order.

Side	Bearing	Azimuth	distance	Northings	Eastings	Point
				1100.0000	1200.0000	A
$\overline{AB}$	N81°08'06"E	(+81°08'06")	(653.1532)			
				1200.6548	1845.3508	B
$\overline{BC}$	S36°32'12"W	(-143°27'48")	276.0300			
				(978.8711)	(1681.0202)	(C)
$\overline{CA}$	N75°51'57"W	(- 75°51'57")	496.0369			

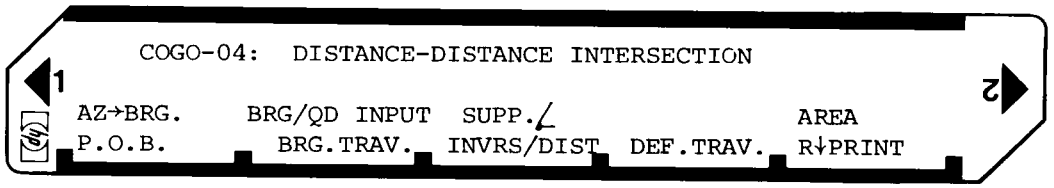
AREA = 63293.8059

Note: Quantities in parentheses tabulated above are calculated in the program.

Solution(s) 1100 [ENT↑] 1200 [A] 1200.6548 [ENT↑] 1845.3508 [C] → 1200.6548, NB;
[E] → 1845.3508, E_B, [E] → 81.0806, AZ $\overline{AB}$
[E] → 653.1532. Dist AB
276.03 [R/S] 496.0369 [R/S]→ 978.8711, N_C
[E] →1681.0202, E_C
[E] →-143.2748, AZ $\overline{B}_C$
[E] → 276.03, Dist. $\overline{B}_C$
1100 [ENT↑] 1200 [C] → 1100.0000, N_A
[E] → 1200.0000, E_A
[E] → -75.5157, Az $\overline{CA}$
[E] → 496.0369, Dist. $\overline{CA}$
[f] [E] → 63293.8059, AREA

Reference(s) This program is a modification of the Users' Library Program #02828A submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load sides 1 & 2			
2	See "General COGO User Instruction" sheet for			
	Bearing & Deflection angle traverses			
	For Distance-Distance Intersection:			
3	Plan sequence of points, so that as you move			
	from #1 to #2 to #3, you make a clockwise			
	(CW) circuit.			
4	~~Complete~~ inverse ~~traverse~~, point #1 to point ~~#2~~			
	See "General COGO Instructions"			
	then:			
	input first distance (Bearing right,CW)	R_1	R/S	$(R_1)^2$
	input second distance	R_2	R/S	Northing
			E	Easting
			E	Azimuth
			E	Distance
5	Complete traverse as desired and obtain area,			
	(see general instructions)			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	P.O.B. N & E
002	STO 2	35 02	
003	R↓	-31	
004	STO 1	35 01	
005	CLX	-51	
006	STO 6	35 06	Clear area
007	1	01	
008	8	08	
009	0	00	
010	STO 9	35 09	Initialize
011	RTN	24	
012	*LBL C	21 13	Inverse traverse
013	RCL 2	36 02	
014	-	-45	
015	X≷Y	-41	Dep.
016	RCL 1	36 01	
017	-	-45	Lat.
018	*LBL 0	21 00	Calculation sub-
019	STO 8	35 08	routine
020	X≷Y	-41	
021	STO 7	35 07	
022	2	02	
023	÷	-24	
024	RCL 2	36 02	
025	+	-55	
026	×	-35	
027	ST-6	35-45 06	
028	RCL 7	36 07	
029	RCL 8	36 08	
030	→P	34	
031	STO 4	35 04	
032	X≷Y	-41	
033	STO 5	35 05	
034	→HMS	16 35	
035	STO 3	35 03	
036	RCL 7	36 07	
037	RCL 2	36 02	
038	+	-55	
039	STO 2	35 02	
040	RCL 8	36 08	
041	RCL 1	36 01	
042	+	-55	
043	STO 1	35 01	
044	RCL 4	36 04	
045	*LBL E	21 15	Rolldown/print
046	R↓	-31	
047	PRTX	-14	
048	R/S	51	
049	STO 3	35 03	Input R_1
050	X^2	53	
051	R/S	51	Input R_2
052	X^2	53	
053	-	-45	
054	RCL 4	36 04	
055	X^2	53	
056	+	-55	
057	RCL 4	36 04	
058	RCL 3	36 03	
059	×	-35	
060	2	02	
061	×	-35	
062	÷	-24	
063	CHS	-22	
064	COS^{-1}	16 42	
065	RCL 5	36 05	
066	+	-55	
067	RCL 3	36 03	
068	GTO 1	22 01	
069	*LBL b	21 16 12	Bearing/QD input
070	X≷Y	-41	Bearing
071	HMS→	16 36	
072	X≷Y	-41	QD
073	ENT↑	-21	
074	ENT↑	-21	
075	2	02	
076	÷	-24	
077	INT	16 34	
078	RCL 9	36 09	
079	×	-35	
080	X≷Y	-41	
081	RCL 9	36 09	
082	×	-35	
083	COS	42	
084	R↑	16-31	
085	×	-35	
086	-	-45	Azimuth
087	→HMS	16 35	
088	*LBL B	21 12	Azimuth input
089	0	00	
090	STO 5	35 05	Clear 5
091	+	-55	
092	*LBL D	21 14	Deflection angle
093	HMS→	16 36	
094	RCL 5	36 05	
095	+	-55	
096	EEX	-23	
097	CHS	-22	
098	9	09	
099	CF 3	16 22 03	Input distance
100	R/S	51	
101	F3?	16 23 03	Was dist. input?
102	GSB 8	23 08	Yes
103	*LBL 1	21 01	No, input 10-9
104	→R	44	
105	GTO 0	22 00	Go to calculation
106	*LBL 8	21 08	Input setup SBR
107	X≷Y	-41	
108	R↓	-31	
109	RTN	24	
110	*LBL e	21 16 15	Area
111	RCL 6	36 06	
112	ABS	16 31	

REGISTERS

0	1	2	3	4	5	6	7	8	9
	N	E	R_1,A°	C=d	A_2	AREA	DEP	LAT	180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	PRTX	-14	
114	RTN	24	
115	*LBLa	21 16 11	Azimuth to
116	HMS→	16 36	Bearing/Qd
117	ENT↑	-21	
118	SIN	41	
119	SIN⁻¹	16 41	
120	X<0?	16-45	
121	CHS	-22	
122	→HMS	16 35	
123	PRTX	-14	Bearing
124	R↓	-31	
125	9	09	
126	0	00	
127	÷	-24	
128	1	01	
129	+	-55	
130	INT	16 34	
131	PRTX	-14	QD
132	RTN	24	
133	*LBLc	21 16 13	Supplementary angle
134	ABS	16 31	
135	RCL9	36 09	
136	X≷Y	-41	
137	CHS	-22	
138	HMS+	16-55	
139	RTN	24	
140	R/S	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS
150			
160			
170			
180			
190			
200			
210			
220			

LABELS					FLAGS	SET STATUS		
A P.O.B.	B BRG.TRAV.	C INVERSE	D DEF.ANG	E ROLL DOWN	0	FLAGS	TRIG	DISP
a AZ→BRG	b BRG.INPUT	c SUPP.ANG.	d	e AREA	1	ON OFF		
0 CALC.SBR	1 USED	2	3	4	2	0 ☐ ☒	DEG ☒	FIX ☒
5	6	7	8 DATA SETUP	9	3 DIST.INPUT?	1 ☐ ☒	GRAD ☐	SCI ☐
						2 ☐ ☒	RAD ☐	ENG ☐
						3 ☐ ☒		n 4

Program Description I

Program Title COGO-05: TRAVERSE OF CURVE

This Hewlett-Packard translation is based on program 02829A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables

COGO-05 is a member of the coordinate geomtry series described in the GENERAL DESCRIPTION I., hereof. The special option of this program is the calculation of a curve as a part of a subdivision boundary or legal description.

INVERSE TRAVERSE is not included in this program. However all the other COGO traverse functions operate the same as in the other COGO programs.

In the usual situation you approach a curve tangentially. You are given the DELTA angle (or central angle) and the RADIUS length. These two quantities are positive (+) if bearing to the right, and negative (-) if bearing to the left. At the "point-of-curvature" (PC) you enter the DELTA angle, press [C]; enter the RADIUS, press [R/S], (giving each the same sign); and the program computes the chord (CHD) traverse to the "point-of-tangency". Read the data for that leg; press [R/S], and the program accumulates the area of the arc segment, and displays the Tangent (TAN) and the arc (ARC) lengths.

Operating Limits and Warnings

You may wish to use Cogo-01 to continue this traverse. If so, when loading Cogo-01, be sure to convert the contents of Register 5, which is in Radians in this program. To degrees. The following keystroke procedure will accomplish this: RCL5, R→D, STO 5.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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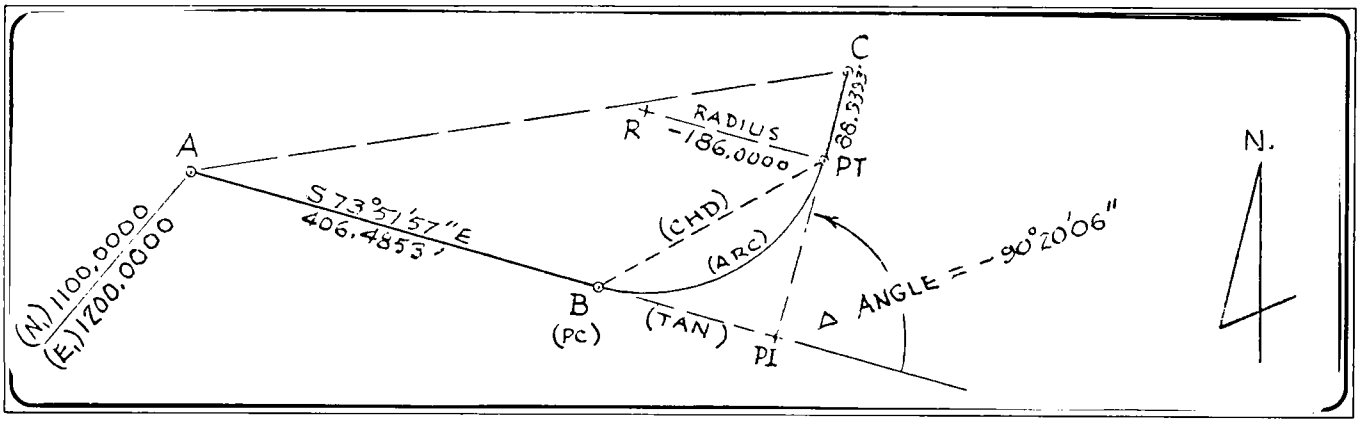
Program Description II



Sample Problem(s)

1) Start at point A, for a P.O.B.
2) Make a BEARING TRAVERSE to point B, utilizing above data.
3) Obtain coordinates of B, also known as Point-of-Curvature (PC).
4) Enter: DELTA angle + -90°20'06" , press: [C].
5) Enter: RADIUS = -186.0000, press: [R/S].
6) Obtain PT coordinates and CHD Azimuth and length.
7) Press: [R/S]; obtain: TAN and ARC. DO NOT neglect this step!
8) Find coordinates of Pt.C by doing 0° deflection angle traverse
9) Load COGO-01 program card to complete traverse.
10) Make SIDE SHOTS to calculate the radius point (R) and to the (PI).
11) Return to traverse mode and complete traverse of figure. Make zero angle DEFLECTION ANGLE traverse to point C, and INVERSE TRAVERSE to close on point A.

Side	Bearing	Azimuth	Distance	Northings	Eastings	Point
				1100.0000	1200.0000	A
$\overline{AB}$	S73°53'57"E	+106°08'03"	406.4853			
				(987.0428)	(1590.4753)	(B)
$\overline{B(PT)}$	N60°58'00"E	(+60°58'00")	(263.8116)			
				(1115.0754)	(1821.1357)	(PT)
		Curve Parts:	TAN =(187.0907);	ARC =(293.2556)		
$\overline{(PT)C}$	N15°47'57"E	(+15°47'57"	88.9393			
				(1200.6548)	(1845.3508)	(C)
$\overline{CA}$	S81°08'06"W	(-98°51'54")	(653.1532)			
				1100.0000	1200.0000	A

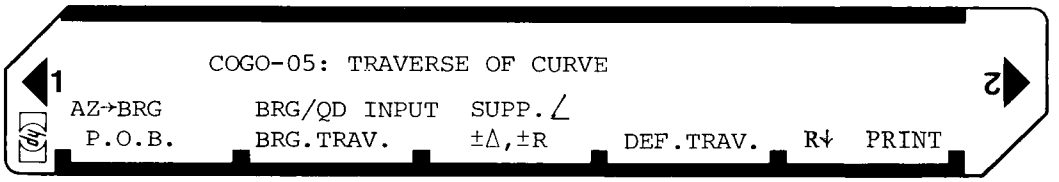
AREA enclosed in figure = (74394.8968)

Note: Quantities in parentheses are calculated in the programs.

Solution(s): 1100 [ENT↑] 1200 [A] 73.5157 [ENT↑] 2 [f] [B] 406.4853 [R/S]→987.0428, N_B
[E]→1590.4753, E_B; [E]→106.0803,AZ; [E]→406.4853,Dist
90.2006 [CHS] [C] 186 [CHS] [R/S]→1115.0754, N_{PT}; CHD.
[E]→1821.1357, E_{PT}; [E]→60.5800, AZ; [E]→263.8116,
[R/S]→187.0907, TAN; [E]→293.2556, ARC.
0 [D] 88.9393 [R/S]→1200.6548, N_C; [E]→1845.3508, E_C,
[E]→15.4757,AZ; [E]→88.9393, Dist. PT to C.
Then load COGO-01 and inverse to point A and obtain AREA = 74394.8968

Reference(s) This program is a modification of the Users' Library Program #02829A submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load card sides 1 & 2			
2	Input point of beginning	Northing	ENT↑	
		Easting	A	180
3	For Bearing or Deflection angle			
	traverses: see "COGO General Instructions"			
	sheet			
	TRAVERSE OF CURVE:			
	Note: The curve is made tangent to the			
	traverse leg most recently completed. Therefore			
	at least one traverse leg must have been calculated			
	prior to calculating a curve with this program.			
4	Input Delta angle	±Δ	C	1.0000-09
5	Input Radius (same sign as Δ)	±R	R/S	Northing
	Read Easting		E	Easting
	Read Azimuth		E	Azimuth
	Read Chord		E	CHD
	Calculate tangent length		R/S	TAN
	Read ARC length		E	ARC
	Note: After completing step 5, you will be ready			
	to continue your traverse. For greater convenience			
	you will probably wish to switch to another program CARD.			
	Having completed the curve calculations, you can calculate			
	the PI and the radius point each as a SIDE SHOT. The PI			
	is a 180° deflection, and the radius point is ±90°			
	deflection.			
	To continue the traverse forward, use a 0° deflection			
	angle.			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	P.O.B.
002	STO2	35 02	E.
003	R↓	-31	
004	STO1	35 01	N.
005	CLX	-51	
006	STO6	35 06	
007	1	01	
008	8	08	
009	0	00	
010	STO9	35 09	Initialize
011	RTN	24	
012	*LBLC	21 13	Traverse of curve,
013	HMS→	16 36	input ±Δ
014	D→R	16 45	
015	RAD	16-22	
016	2	02	
017	÷	-24	
018	STO7	35 07	
019	RCL5	36 05	
020	+	-55	
021	EEX	-23	
022	CHS	-22	
023	9	09	
024	R/S	51	Input ±R
025	X≷Y	-41	
026	R↓	-31	
027	STO8	35 08	
028	RCL7	36 07	
029	SIN	41	
030	×	-35	
031	2	02	
032	×	-35	
033	GTO1	22 01	GTO calc. SBR
034	*LBLb	21 16 12	BRG/QD input
035	DEG	16-21	
036	X≷Y	-41	BRG
037	HMS→	16 36	
038	X≷Y	-41	
039	ENT↑	-21	QD
040	ENT↑	-21	
041	2	02	
042	÷	-24	
043	INT	16 34	
044	RCL9	36 09	
045	×	-35	
046	X≷Y	-41	
047	RCL9	36 09	
048	×	-35	
049	COS	42	
050	R↑	16-31	
051	×	-35	
052	-	-45	Azimuth
053	→HMS	16 35	
054	*LBLB	21 12	Azimuth input
055	0	00	
056	STO5	35 05	
057	+	-55	
058	*LBLD	21 14	Deflection angle
059	RAD	16-22	input
060	HMS→	16 36	
061	D→R	16 45	
062	RCL5	36 05	
063	+	-55	
064	EEX	-23	
065	CHS	-22	
066	9	09	
067	CF3	16 22 03	
068	R/S	51	
069	*LBL0	21 00	Calc. SBR
070	F3?	16 23 03	Data input?
071	GSB8	23 08	Yes
072	*LBL1	21 01	No
073	→R	44	
074	STO3	35 03	
075	X≷Y	-41	
076	STO4	35 04	
077	2	02	
078	÷	-24	
079	RCL2	36 02	
080	+	-55	
081	×	-35	
082	ST-6	35-45 06	
083	RCL4	36 04	
084	RCL2	36 02	
085	+	-55	
086	STO2	35 02	
087	RCL3	36 03	
088	RCL1	36 01	
089	+	-55	
090	STO1	35 01	
091	RCL4	36 04	
092	RCL3	36 03	
093	→P	34	
094	X≷Y	-41	
095	STO5	35 05	
096	R→D	16 46	
097	→HMS	16 35	
098	R↓	-31	
099	GTOE	22 15	Print northing
100	*LBL8	21 08	
101	X≷Y	-41	Data input setup
102	R↓	-31	
103	RTN	24	
104	*LBLE	21 15	
105	R↓	-31	Rolldown & print
106	PRTX	-14	
107	R/S	51	
108	RCL7	36 07	Calc. TAN & ARC
109	ENT↑	-21	
110	ST+5	35-55 05	
111	SIN	41	
112	RCL7	36 07	

REGISTERS

0	1 N	2 E	3 (n)	4	5 A_2(RAD)	6 AREA	7 Δ/2	8 ± R	9 180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	COS	42	
114	×	-35	
115	-	-45	
116	RCL8	36 08	
117	X²	53	
118	×	-35	
119	ST+6	35-55 06	
120	0	00	
121	RCL7	36 07	
122	2	02	
123	×	-35	
124	RCL8	36 08	
125	×	-35	
126	RCL8	36 08	
127	RCL7	36 07	
128	TAN	43	
129	×	-35	
130	PRTX	-14	Print tan
131	R/S	51	
132	*LBLa	21 16 11	AZ→BRG
133	DEG	16-21	
134	HMS→	16 36	Azimuth
135	ENT↑	-21	
136	SIN	41	
137	SIN⁻¹	16 41	
138	X<0?	16-45	
139	CHS	-22	
140	→HMS	16 35	
141	PRTX	-14	BRG
142	R↓	-31	
143	9	09	
144	0	00	
145	÷	-24	
146	1	01	
147	+	-55	
148	INT	16 34	
149	PRTX	-14	QD
150	RTN	24	
151	*LBLc	21 16 13	Supp. Angle
152	ABS	16 31	
153	RCL9	36 09	
154	X≷Y	-41	
155	CHS	-22	
156	HMS+	16-55	
157	RTN	24	
158	R/S	51	
160			
170			
180			
190			
200			
210			
220			

LABELS

A P.O.B	B BRG.TRAV.	C CURVE TRAV	D DEF. TRAV	E R↓PRINT
a AZ→BRG	b BRG/QD INP.	c SUPP. ∠	d	e AREA
0 CALC.SBR	1 USED	2	3	4
5	6	7	8 DATA SETUP	9

FLAGS

0	
1	
2	
3 DATA ENTRY	

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG		DISP	
DEG	☒	FIX	☐
GRAD	☐	SCI	☐
RAD	☐	ENG	☐
		n = 4	

Program Description I

Program Title COGO-06: CURVE INVERSE AND TRAVERSE

This Hewlett-Packard translation is based on program 02830A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables COGO-0 6 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION I., hereof. The special option of this program is the calculation of a curve of given radius between two known points in the coordinate plane.

The standard options operate the same in this program as in other members of the COGO series.

In this program, whenever you have completed a traverse leg, you may consider the point just left as the PC and the new point arrived at as the PT of a curve. You then enter the radius of curvature that you want. (Make it positive, if it bears right. Make it negative if it bears left.) Press: [R/S], and the program computes the TAN, ARC and DELTA angle, and you display them in that order, using the rolldown - print routine, [E]. The CHD is the distance between the PC and the PT, which you have just completed. The program accumulates the AREA enclosed by the curved boundary.

After completing a curve, you will find it convenient to reload COGO-01, and use the SIDE SHOT routine to find the PI and the radius point.

This program is a modification of the Users' Library Program #02830A submitted by Carl M. King.

Operating Limits and Warnings You may wish to use Cogo-01 to continue this traverse. If so, when loading Cogo-01, be sure to convert the contents of Register 5, which is in Radians in this program. To degrees. The following keystroke procedure will accomplish this: RCL 5, R →D, STO 5.

This program has been verified only with respect to the numerical example given in *Program Description II.* User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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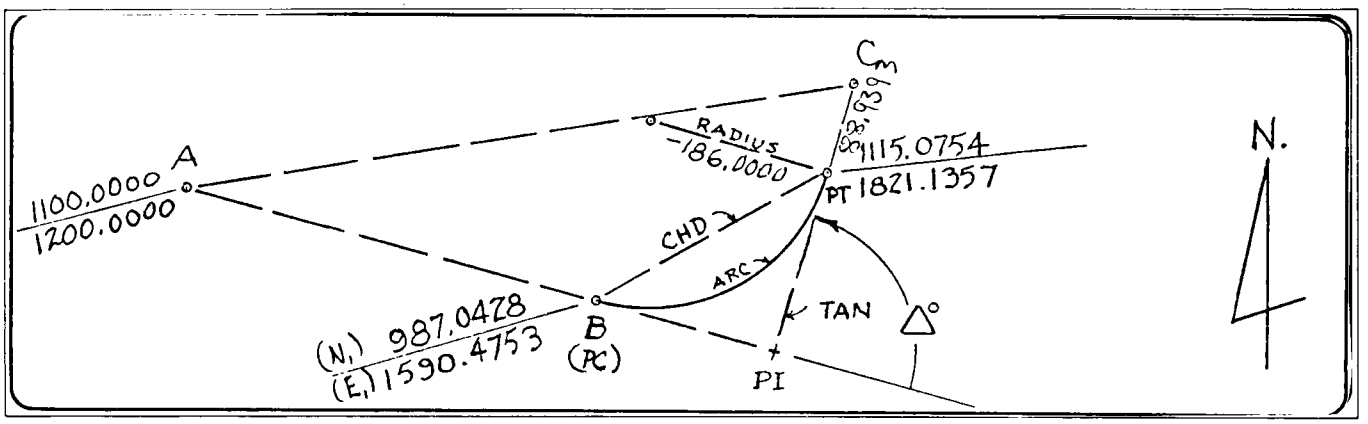
Program Description 11



Sample Problem(s)

1) Start at point B, for a P.O.B. (Or you could be continuing from B).
2) Make an INVERSE TRAVERSE to the PT.
3) Obtain the chord (CHD) Azimuth and length.
4) Enter: RADIUS = -186.0000 (Use negative sign, since curving left.)
5) Press: [R/S]; obtain: TAN, ARC and DELTA angle.
6) Continue traverse with zero deflection angle to point C.
7) Complete figure with INVERSE traverses to point A, and finally close on point B.
   HINT: If you were to switch to program CARD: COGO-01 after step 6 you could calculate the PI and radius points as SIDE SHOTS.
8) After closing on the P.O.B., read the AREA: press [f] [E].

Side	Bearing	Azimuth	distance	Northings	Eastings	Point
				987.0428	1590.4753	B
$\overline{B(PT)}$	N60°58'00"E	(+60°58'00")	(263.8116)			
				1115.0754	1821.1357	(PT)

CURVE PARTS

RADIUS = -186. TAN = (187.0907) ARC = (293.2557) DELTA = (-90°20'06")

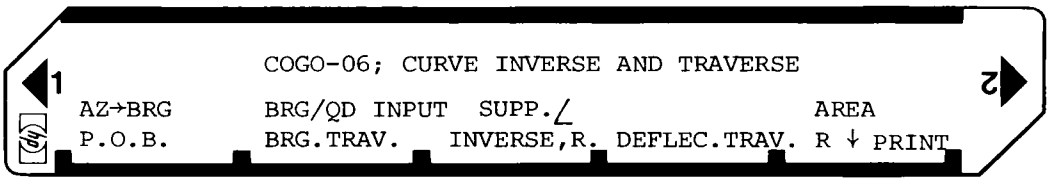
$\overline{(PT)C}$	N15°47'57"E	(+15°47'57")	88.9393			
				(1200.6547)	(1845.3509)	C
$\overline{CA}$	S81°08'06"W	(-98°51'54")	(653.1532)			
				1100.0000	1200.0000	A
$\overline{AB}$	S73°51'57"E	(+106°08'03")	(406.4853)			
				987.0428	1590.4753	B

AREA enclosed in figure = (74394.9005)

Note: Quantities in parentheses are calculated in the programs.

Solution(s): 987.0428 [ENT↑] 1590.4753 [A] 1115.0754 [ENT↑] 1821.1357 [C]→1115.0754, N_B; [E]→1821.1357, E_B; [E]→60.5800, A_Z; [E]→263.8116, Chord Length.
186 [CHS] [R/S]→187.0907, TAN; [E]→293.2557, ARC; [E]→ -90.2006, DELTA.
0 [D] 88.9393 [R/S]→1200.6547, N_C; [E]→1845.3509, E_C; [E]→15.4757, AZ; [E]→88.9393, DIST.
1100 [ENT↑] 1200 [C]→1100, N_A; [E]→ 1200, E_A; [E]→ -98.5154, AZ $\overline{CA}$ [E]→653.1532, DIST. $\overline{CA}$
987.0428 [ENT↑] 1590.4753 [C]→987.0428, N_B; [E]→1590.4753, E_B; [E]→106.0803, AZ $\overline{AB}$; [E]→ 406.4853, DIST $\overline{AB}$.
[f] [E] →74394.9005, AREA

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load sides 1 & 2			
2	Enter point of Curvature (P.C.) as P.O.B.	Northing	ENT↑	
		Easting	A	180
	or traverse in usual manner from point of			
	beginning to beginning point of curve (see STD			
	options)			
3	Input PT coordinates	Northing	ENT	
		Easting	C	Northing $_{PT}$
			E	Easting $_{PT}$
			E	AZ_{PT}
			E	Length of Chord
4	Input radius of curve			
	(+if curving right, -if left)	±R	R/S	TAN
			E	ARC
			E	±DELTA
5	Continue with zero deflection			
	angle traverse to next point	0	D	1.0000-09
		Distance	R/S	Northing
			E	Easting
			E	AZ.
			E	Dist.
6	Complete traverse & close on P.O.B. then			
	obtain area		f E	AREA

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	P.O.B.
002	STO2	35 02	Easting
003	R↓	-31	
004	STO1	35 01	Northing
005	CLX	-51	
006	STO6	35 06	
007	1	01	
008	8	08	
009	0	00	
010	STO9	35 09	Initialize
011	RTN	24	
012	*LBLb	21 16 12	BRG/QD input
013	DEG	16-21	
014	X≷Y	-41	Bearing
015	HMS→	16 36	
016	X≷Y	-41	QD
017	ENT↑	-21	
018	ENT↑	-21	
019	2	02	
020	÷	-24	
021	INT	16 34	
022	RCL9	36 09	
023	×	-35	
024	X≷Y	-41	
025	RCL9	36 09	
026	×	-35	
027	COS	42	
028	R↑	16-31	
029	×	-35	
030	-	-45	
031	→HMS	16 35	Azimuth
032	*LBLB	21 12	Azimuth input
033	0	00	
034	STO5	35 05	Clr R_5
035	+	-55	
036	*LBLD	21 14	Deflection angle traverse
037	RAD	16-22	
038	HMS→	16 36	
039	D→R	16 45	Convert to radians
040	RCL5	36 05	
041	+	-55	
042	EEX	-23	
043	CHS	-22	
044	9	09	
045	CF3	16 22 03	
046	R/S	51	
047	F3?	16 23 03	Distance input?
048	GSB8	23 08	Yes
049	→R	44	
050	GTO0	22 00	Go to calc.routine
051	*LBLC	21 13	Inverse inputs
052	RCL2	36 02	
053	-	-45	Dep.
054	X≷Y	-41	
055	RCL1	36 01	
056	-	-45	Lat.

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	*LBL0	21 00	Calculation subroutine for traverse
058	STO3	35 03	
059	X≷Y	-41	
060	STO4	35 04	
061	2	02	
062	÷	-24	
063	RCL2	36 02	
064	+	-55	
065	×	-35	
066	ST-6	35-45 06	
067	RCL4	36 04	
068	RCL2	36 02	
069	+	-55	
070	STO2	35 02	
071	RCL3	36 03	
072	RCL1	36 01	
073	+	-55	
074	STO1	35 01	
075	RCL4	36 04	
076	RCL3	36 03	
077	→P	34	
078	STO4	35 04	
079	X≷Y	-41	
080	STO5	35 05	
081	R→D	16 46	
082	→HMS	16 35	
083	STO3	35 03	
084	R↓	-31	
085	*LBLE	21 15	Rolldown & print results
086	R↓	-31	
087	PRTX	-14	
088	R/S	51	Input radius
089	STO8	35 08	
090	RCL4	36 04	
091	2	02	
092	÷	-24	Calculate curve parameters
093	RCL8	36 08	
094	÷	-24	
095	ENT↑	-21	
096	SIN⁻¹	16 41	
097	STO7	35 07	
098	ST+5	35-55 05	
099	COS	42	
100	×	-35	
101	RCL7	36 07	
102	-	-45	
103	RCL8	36 08	
104	X²	53	
105	×	-35	
106	ST-6	35-45 06	
107	RCL7	36 07	
108	2	02	
109	×	-35	
110	R→D	16 46	
111	LSTX	16-63	
112	X≷Y	-41	

REGISTERS

0	1	2	3	4	5	6	7	8	9
	N	E	n, A°	e, d_2	A_z (RAD)	AREA	±1/2Δ	±R	180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	→HMS	16 35	
114	X≷Y	-41	
115	RCL8	36 08	
116	×	-35	
117	RCL8	36 08	
118	RCL7	36 07	
119	TAN	43	
120	×	-35	
121	R↑	16-31	
122	GTOE	22 15	Go to output
123	*LBL8	21 08	Setup data entry
124	X≷Y	-41	
125	R↓	-31	
126	RTN	24	
127	*LBLe	21 16 15	Recall & print area
128	RCL6	36 06	
129	ABS	16 31	
130	PRTX	-14	
131	RTN	24	
132	*LBLa	21 16 11	Azimuth to bearing conv.
133	DEG	16-21	
134	HMS→	16 36	
135	ENT↑	-21	
136	SIN	41	
137	SIN⁻¹	16 41	
138	X<0?	16-45	
139	CHS	-22	
140	→HMS	16 35	BRG.
141	PRTX	-14	
142	R↓	-31	
143	9	09	
144	0	00	
145	÷	-24	
146	1	01	
147	+	-55	
148	INT	16 34	
149	PRTX	-14	aD
150	RAD	16-22	
151	RTN	24	
152	*LBLc	21 16 13	Supplementary angle
153	ABS	16 31	
154	RCL9	36 09	
155	X≷Y	-41	
156	CHS	-22	
157	HMS+	16-55	
158	RTN	24	

STEP	KEY ENTRY	KEY CODE	COMMENTS
160			
170			
180			
190			
200			
210			
220			

LABELS

A P.O.B.	B AZIM.	C INVERSE,R	D DEFLECT.	E ROLLDOWN	0
a AZ→BRG	b BRG/QD INPUT	c SUPP.∠	d	e AREA	1
TRAVERSE CALCULATION	1	2	3	4	2
5	6	7	8 INPUT SETUP	9	3 DATA ENTRY

FLAGS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

SET STATUS

TRIG		DISP	
DEG	☐	FIX	☒
GRAD	☐	SCI	☐
RAD	☒	ENG	☐

Program Description I

Program Title COGO-07: COMPASS RULE ADJUSTMENT

This Hewlett-Packard translation is based on program 02831A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables COGO-07 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION , hereof. The special option of this program is the COMPASS RULE adjustment, which can be used in an open traverse as well as in a closed traverse. At the end of the traverse you "force" a closure on a point known with precision. During the course of the initial traverse calculations, the latitude (n), departure (e) and length (d) are accumulated, so that the following equations can be evaluated for each traverse leg:

(adjusted latitude) $n_{(aj)} = \pm n + d\left(\frac{\pm n'}{\Sigma d}\right)$; Precision Ratio

(adjusted departure) $e_{(aj)} = \pm e + d\left(\frac{\pm e'}{\Sigma d}\right)$; $P/R = \frac{\Sigma d}{d'}$

$\pm n$ = unadjusted latitude
$\pm e$ = unadjusted departure
n = absolute latitude
e = absolute departure
d' = absolute error

$\pm n'$ = latitude of error of closure
$\pm e'$ = departure of error of closure
Σn = sum of absolute latitudes
Σe = sum of absolute departures
Σd = total perimeter

Operating Limits and Warnings This is a three part program. Part 1 calculates and accumulates summed quantities. Part 2 calculates the error, n', e', the bracketed quotients and the Precision Ratio. Part 3 repeats the traverse, making all the adjustments as it goes. The Azimuth to bearing conversion routine is not included because of program space limitations.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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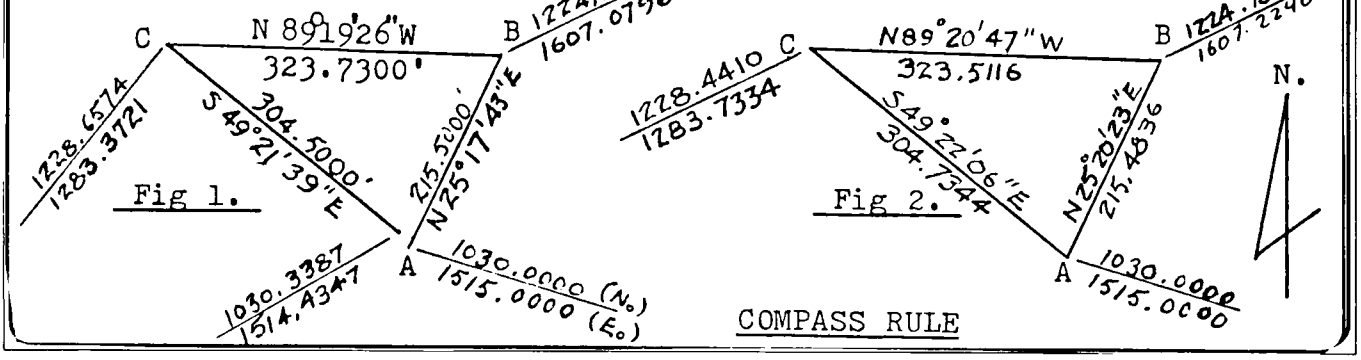
Program Description 11

Sketch(es)



Sample Problem(s)

(1) Initialize the program: set for part 1 (1 [f] [D]).
(2) Start at point A, for P.O.B.
(3) Make BEARING TRAVERSE to point B, utilizing data in Fig. 1.
(4) Continue traverse to succeeding points of figure, using standard options of your choice. (Bearing, Deflection or Inverse Traverses.)
(5) Note: computed coordinates are not identical to known coordinates of closing point. Go to part 2 of program (2 [f] [D]).
(6) Enter known coordinates and make INVERSE TRAVERSE to compute closing error. Press [D] to read PRECISION RATIO.
(7) Set for part 3 of program (3 [f] [D]). Begin at step (2) above, repeat traverse in same order as before, utilizing same data, (Fig 1.) (We chose to use inverse in this example).
(8) Obtain the adjusted coordinates and calls, as in Fig 2.
(9) Recall computed area of closed traverse: press [f] [E].

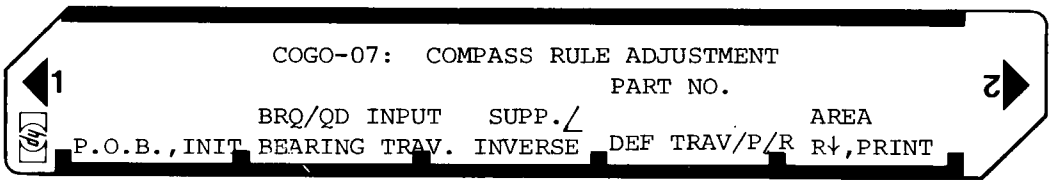
Closing Error: Azimuth = 120°55'34", distance = 0.6590
(Bearing = S 59°04'26"E)
PRECISION RATIO = 1280.3425
Adjusted traverse, as shown in Fig 2., closes precisely.
For CCW traverse, enclosed AREA = 31670.2331 sq. ft.

Solution(s)

(Traverse) 1 [f] [D] 1030 [ENT↑] 1515 [A] 25.1743 [B] 215.5 [R/S]→1224.8374, N_B; [E]→1607.0796, E_B.
89.1926 [ENT↑] 4 [f] [B] 323.73 [R/S]→1228.6574, N_C; [E]→1283.3721, E_C.
49.2139 [ENT↑] 2 [f] [B] 304.5 [R/S]→1030.3387, N_D; [E]→1514.4347, E_D
(Calc. errors)
2 [f] [D] 1030 [ENT↑] 1515 [C]→1030.0000, N_O; [E] → 1515.0000, E_O;
[E]→ 120.5534, AZ_{error}; [E]→ 0.6590, $DIST_{error}$.
[D]→1280.3425,P/R.
(Adjust)
3 [f] [D] 1224.8374 [ENT↑] 1607.0796 [C]→1224.7509, $N_{Bcorr.}$
[E]→ 1607.2240, E_{Bcorr};
1228.6574 [ENT↑] 1283.3721 [C]→1228.4410, $N_{Ccorr.}$; [E]→1283.7334, $E_{Ccorr.}$; [E]→ -89.2047, AZ_{corr}; [E]→ 323.5116, $DIST_{corr}$.
1030.3387 [ENT↑] 1514.4347 [C]→1030.0000, N_A; [E] → 1515.0000, E_A;
[E]→ 130.3754, $AZ_{corr.}$; [E]→304.7344, $DIST_{corr.}$
[f] [E]→31670.2331, AREA

Reference(s): SURVEYING THEORY AND PRACTICE - 5th Edition - McGraw-Hill, 1966 Davis, Foote and Kelly, Pages 461, 462 and 463.
This program is a modification of the Users' Library Program #02831B submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load card, sides 1 and 2			
2	Set to part 1 for initial traverse	1	f D	1
3	Enter P.O.B.	Northing	ENT↑	
		Easting	A	180
4	Proceed with traverse according to "COGO			
	GENERAL INSTRUCTIONS". Until final point			
	has been obtained.			
5	Switch to part 2	2	f D	2
6	Enter coordinates of closing point and	Northing	ENT↑	
	calculate errors	Easting	D	Northing
			E	Easting
	Obtain error Azimuth		E	Error Azimuth
	Obtain error Distance		E	Error Distance
	Obtain precision ratio (P/R)		D	P/R
7	Switch to part 3 & adjust	3	f D	3
	traverse:			
8	If traverse is open, store P.O.B.	Northing	STO 1	
	coordinates	Easting	STO 2	
	and initialize		A	Northing
	(if traverse is closed step 8 may be skipped)			
9	Repeat the traverse leg by leg to the closing			
	point & obtain output data for each adjusted	Northing	ENT↑	
	leg:	Easting	C	$N_{corr.}$
			E	$E_{corr.}$
			E	$AZ_{corr.}$
			E	DIST.corr.
10	Obtain AREA of the adjusted traverse		f E	AREA

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL1	21 01	
002	R/S	51	
003	*LBLc	21 16 13	Calculate supp. angle
004	ABS	16 31	
005	1	01	
006	8	08	
007	0	00	
008	X≠Y	-41	
009	CHS	-22	
010	HMS+	16-55	
011	RTN	24	
012	*LBLb	21 16 12	BRG/QD inputs
013	X≠Y	-41	
014	HMS→	16 36	
015	X≠Y	-41	
016	ENT↑	-21	
017	ENT↑	-21	
018	2	02	
019	÷	-24	
020	INT	16 34	
021	RCLA	36 11	
022	×	-35	
023	X≠Y	-41	
024	RCLA	36 11	
025	×	-35	
026	COS	42	
027	R↑	16-31	
028	×	-35	
029	-	-45	
030	→HMS	16 35	
031	*LBLB	21 12	Bearing input
032	0	00	
033	STO5	35 05	
034	+	-55	
035	*LBLD	21 14	Deflection angle input
036	HMS→	16 36	
037	RCL5	36 05	
038	+	-55	
039	EEX	-23	
040	CHS	-22	
041	9	09	Distance input
042	CF3	16 22 03	
043	R/S	51	
044	F3?	16 23 03	
045	GSB8	23 08	Set subroutine
046	→R	44	number in I register
047	ISZI	16 26 46	
048	ISZI	16 26 46	Go to proper sub-routine
049	ISZI	16 26 46	Program part
050	GTOi	22 45	
051	*LBLd	21 16 14	Go to proper program part
052	STOI	35 46	Program part 1
053	GTOi	22 45	
054	*LBLA	21 11	P.O.B. & initialize
055	CLRG	16-53	
056	STO2	35 02	
057	R↓	-31	
058	STO1	35 01	
059	1	01	
060	STOI	35 46	
061	1	01	
062	8	08	
063	0	00	
064	STOA	35 11	
065	GTO1	22 01	
066	*LBLC	21 13	Inverse
067	RCL2	36 02	
068	-	-45	
069	X≠Y	-41	
070	RCL1	36 01	
071	-	-45	
072	GTO9	22 09	
073	*LBL4	21 04	
074	DSZI	16 25 46	Reset I register
075	DSZI	16 25 46	
076	DSZI	16 25 46	
077	*LBL9	21 09	Calc. SBR. for traverse
078	CF1	16 22 01	
079	ST+1	35-55 01	
080	ABS	16 31	
081	ST+7	35-55 07	
082	CLX	-51	
083	LSTX	16-63	
084	X≠Y	-41	
085	ST+2	35-55 02	
086	ABS	16 31	
087	ST+8	35-55 08	
088	CLX	-51	
089	LSTX	16-63	
090	X≠Y	-41	
091	→P	34	
092	STO4	35 04	
093	ST+3	35-55 03	
094	X≠Y	-41	
095	STO5	35 05	
096	→HMS	16 35	
097	RCL2	36 02	
098	RCL1	36 01	
099	R↑	16-31	
100	GTOE	22 15	
101	*LBL2	21 02	Prog part 2
102	R/S	51	
103	*LBLA	21 11	Initialize
104	CLX	-51	
105	ENT↑	-21	
106	ENT↑	-21	
107	RCL2	36 02	
108	RCL1	36 01	
109	GTO2	22 02	
110	*LBLC	21 13	Enter closing point and calc. error
111	F1?	16 23 01	
112	GTO2	22 02	

REGISTERS

0	1 N	2 E	3 USED	4 d/E_o	5 $A_z/\pm e$	6 AREA	7 USED	8 USED	9 P/R
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I
180					PART NO.

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	SF1	16 21 01	
114	RCL2	36 02	
115	-	-45	
116	ST+2	35-55 02	
117	STO8	35 08	
118	X≷Y	-41	
119	RCL1	36 01	
120	-	-45	
121	ST+1	35-55 01	
122	STO7	35 07	
123	RCL3	36 03	
124	ST÷7	35-24 07	
125	ST÷8	35-24 08	
126	R↓	-31	
127	→P	34	
128	ST÷3	35-24 03	
129	RCL3	36 03	
130	STO9	35 09	
131	R↓	-31	
132	X≷Y	-41	
133	→HMS	16 35	
134	RCL2	36 02	
135	STO4	35 04	
136	RCL1	36 01	
137	STO3	35 03	
138	R↑	16-31	
139	GTOE	22 15	Obtain closure errors Precision ratio
140	*LBLD	21 14	
141	F1?	16 23 01	
142	GTO5	22 05	
143	GTO2	22 02	
144	*LBL5	21 05	
145	CLX	-51	
146	ENT↑	-21	
147	ENT↑	-21	
148	ENT↑	-21	
149	STO6	35 06	
150	RCL9	36 09	P/R
151	R↑	16-31	
152	GTOE	22 15	
153	*LBL3	21 03	Program part 3
154	R/S	51	
155	*LBLA	21 11	Initialize & store
156	0	00	P.O.B.
157	STO6	35 06	
158	RCL2	36 02	
159	STO4	35 04	
160	RCL1	36 01	
161	STO3	35 03	
162	GTO3	22 03	
163	*LBLC	21 13	Input coord. and calc. corrected points (i.e.inverse)
164	RCL4	36 04	
165	-	-45	
166	X≷Y	-41	
167	RCL3	36 03	
168	-	-45	
169	GTO7	22 07	
170	*LBL6	21 06	
171	DSZI	16 25 46	Reset I register
172	DSZI	16 25 46	
173	DSZI	16 25 46	
174	*LBL7	21 07	
175	ST+3	35-55 03	Adjust traverse points
176	X≷Y	-41	
177	ST+4	35-55 04	
178	STO5	35 05	
179	X≷Y	-41	
180	→P	34	
181	ENT↑	-21	
182	ENT↑	-21	
183	LSTX	16-63	
184	X≷Y	-41	
185	RCL7	36 07	
186	×	-35	
187	+	-55	
188	ST+1	35-55 01	
189	RCL8	36 08	
190	R↑	16-31	
191	×	-35	
192	RCL5	36 05	
193	+	-55	
194	ST+2	35-55 02	
195	STO5	35 05	
196	2	02	
197	÷	-24	
198	RCL2	36 02	
199	-	-45	
200	X≷Y	-41	
201	×	-35	
202	ST+6	35-55 06	
203	RCL5	36 05	
204	LSTX	16-63	
205	→P	34	
206	X≷Y	-41	
207	STO5	35 05	
208	→HMS	16 35	
209	RCL2	36 02	
210	RCL1	36 01	
211	R↑	16-31	
212	*LBLE	21 15	Roll down & print routine
213	R↓	-31	
214	PRTX	-14	
215	GTOi	22 45	
216	*LBL8	21 08	Data entry setup
217	X≷Y	-41	
218	R↓	-31	
219	RTN	24	
220	*LBLe	21 16 15	Recall area
221	RCL6	36 06	
222	ABS	16 31	
223	PRTX	-14	
224	R/S	51	

LABELS

A P.O.B./ INITIAL	B BRG.TRAV.	C INV.&CLOSE	D DEFL/P/R	E R↓PRINT	0
a	b BRG/QD	c SUPP. ∠	d PART NO.	e AREA	1 FIRST CLOSURE?
0	1 PART NO.	2 PART NO.	3 PART NO.	4 USED	2
5 USED	6 USED	7 USED	8 DATA SETUP	9 USED	3 DATA ENTRY

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☒	DEG ☒	FIX ☒
1	☐	☒	GRAD ☐	SCI ☐
2	☐	☒	RAD ☐	ENG ☐
3	☐	☒		n 4

Program Description I

Program Title COGO-08: ROTATION OF AXES

This Hewlett-Packard translation is based on program 02832A written by

CARL M. KING

2206 Siesta Drive, Darasota, Florida 33579

Program Description, Equations, Variables COGO-08 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION, hereof. The special option of this program is the ROTATION OF AXES, which may be desirable in order to make a new survey match an earlier one.

When you have closed and balanced the survey, you may find that a line common to an earlier survey has a different computed Azimuth than in the earlier survey. By rotating the new survey in its entirety you can exhibit agreement between the two, and facilitate interconnecting computations.

You start with a given set of coordinates in the calculator as a P.O.B., then you initialize the program by entering the computed Azimuth of the line you wish rotated, followed by the desired Azimuth. The program computes the difference, and stores the constant by which succeeding computations will be rotated. (If you wish to "translate" the traverse as well, you may enter a different pair of P.O.B. coordinates again AFTER initialization, and the coordinates will all be shifted as well as rotated.)

Then you proceed to run your survey calls using any of the standard options, and the result of each TRAVERSE will be rotated by the desired amount, and the common line will be as desired.

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Program Description II

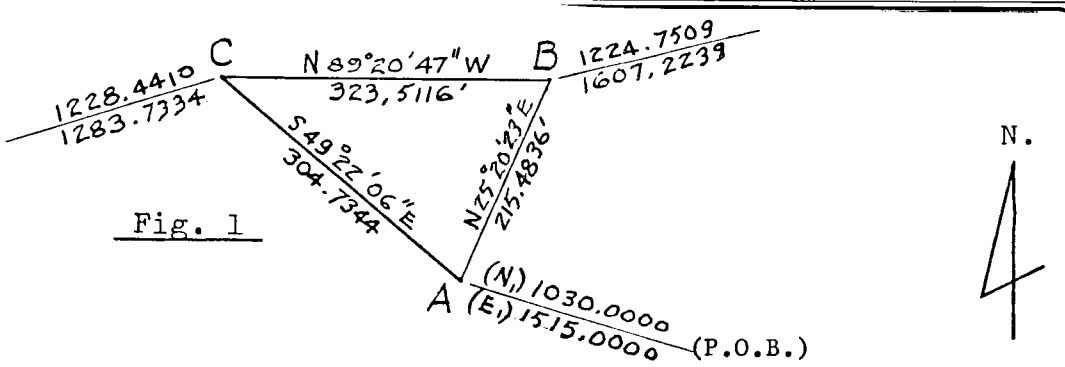


Fig. 1

Sample Problem(s)

(1) Enter coordinates of beginning point.
(2) Enter old and new Azimuths.
(3) Run BEARING traverses or FIELD ANGLE traverses, point A to point B to point C to point A. Traverse should close with reasonable accuracy. (Since we only work with integral seconds, there may be some loss of accuracy.)
(4) Obtain traverse data calculated for each leg as shown in Fig. 2 below. This represents the rotated traverse. All sides remain the original lengths.

Note: Rotation takes place about P.O.B. as center.

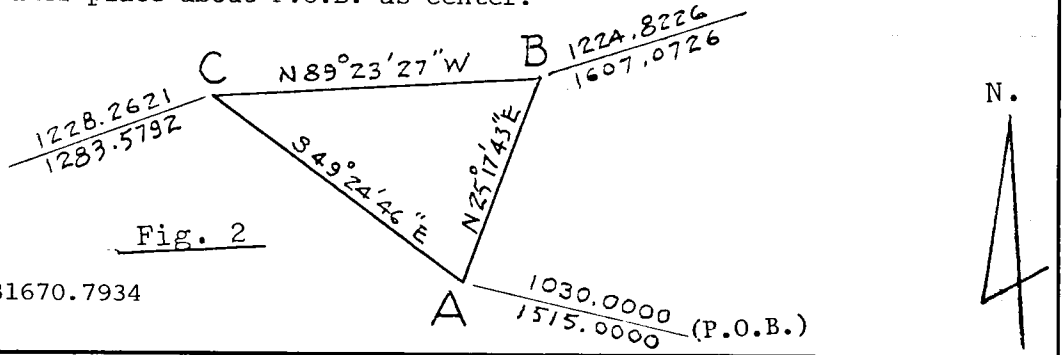


Fig. 2

Enclosed AREA = 31670.7934

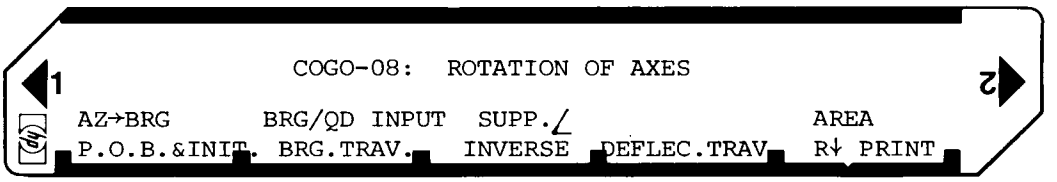
Solution(s)

1030 [ENT↑] 1515 [A] 25.2023 [ENT↑] 25.1743 [R/S]→ -0.0240, Diff. Angle (Display only)
25.2023 [B] 215.4836 [R/S]→1224.8226, N_B; [E]→1607.0726, E_B;
[E]→ 25.1743, AZ.
89.2047 [ENT↑] 4 [f] [B] 323.5116 [R/S]→ 1228.2621, N_C;
[E]→1283.5792, E_C; [E]→ -89.2327, AZ.
49.2206 [ENT↑] 2 [f] [B] 304.7344 [R/S]→ 1030.0004, N_A;
[E]→1514.9995, E_A; [E]→ 130.3514, AZ.
[f] [E]→ 31670.7934, AREA

Reference(s) This program is a modification of the Users' Library Program #02832B submitted by Carl M. King.

Davis, R.E., Foot, F.S., Kelly, J.W., SURVEYING THEORY AND PRACTICE. 5th Edition. 1966. McGraw-Hill Book Co. (Bearings & Azimuth page 260); (Deflection Angles page 262); (Rectangular Coords page 454).

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	Load card, sides 1 & 2				
2	Input point of beginning	Northing	ENT↑		
		Easting	A		Northing
	Then: input Azimuth to be rotated	AZ	ENT↑		
	and desired Azimuth	AZ'	R/S		Diff.Angle
3	If you wish to translate the whole	Northing	STO	1	
	traverse enter new P.O.B. coordinates	Easting	STO	2	
	(otherwise skip this step)				
4	Proceed around the traverse using any of the				
	standard options ("See COGO General Instructions")				
	for advancing the traverse.				
	As each leg is completed the new coordinates				
	and headings can be read out.		E		N,E, ETC.
5	Recall area		f	E	AREA

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	P.O.B. & initialize
002	STO2	35 02	Easting
003	STO4	35 04	
004	R↓	-31	
005	STO1	35 01	Northing
006	STO3	35 03	
007	R/S	51	
008	X⇄Y	-41	AZ
009	CHS	-22	
010	HMS+	16-55	AZ' - AZ
011	HMS→	16 36	
012	STO7	35 07	
013	LSTX	16-63	
014	0	00	Diff. Angle
015	STO6	35 06	Initialize
016	1	01	
017	8	08	
018	0	00	
019	STO9	35 09	
020	+	-55	
021	R↓	-31	
022	RTN	24	Diff. Angle
023	*LBLC	21 13	
024	RCL4	36 04	Inverse
025	-	-45	
026	X⇄Y	-41	
027	RCL3	36 03	
028	-	-45	
029	GTO0	22 00	
030	*LBLb	21 16 12	
031	X⇄Y	-41	Bearing/Quadrant
032	HMS→	16 36	input
033	X⇄Y	-41	
034	ENT↑	-21	
035	ENT↑	-21	
036	2	02	
037	÷	-24	
038	INT	16 34	
039	RCL9	36 09	
040	x	-35	
041	X⇄Y	-41	
042	RCL9	36 09	
043	x	-35	
044	COS	42	
045	R↑	16-31	
046	x	-35	
047	-	-45	
048	→HMS	16 35	Azimuth
049	*LBLB	21 12	Azimuth input
050	0	00	
051	STO5	35 05	
052	+	-55	
053	CF3	16 22 03	
054	*LBLD	21 14	Deflection angle
055	HMS→	16 36	input
056	RCL5	36 05	
057	+	-55	
058	F3?	16 23 03	
059	GSB1	23 01	
060	EEX	-23	
061	CHS	-22	Distance input
062	9	09	Was distance input?
063	CF3	16 22 03	Data setup
064	R/S	51	
065	F3?	16 23 03	
066	GSB8	23 08	Calculation SBR.
067	→R	44	
068	*LBL0	21 00	
069	ST+3	35-55 03	
070	X⇄Y	-41	
071	ST+4	35-55 04	
072	X⇄Y	-41	
073	→P	34	
074	STO8	35 08	
075	X⇄Y	-41	
076	RCL7	36 07	
077	+	-55	
078	STO5	35 05	
079	X⇄Y	-41	
080	→R	44	
081	ST+1	35-55 01	
082	X⇄Y	-41	
083	ST+2	35-55 02	
084	2	02	
085	÷	-24	
086	RCL2	36 02	
087	-	-45	
088	x	-35	
089	ST+6	35-55 06	
090	RCL8	36 08	
091	RCL5	36 05	
092	→HMS	16 35	
093	RCL2	36 02	Rolldown & print
094	RCL1	36 01	routine
095	R↑	16-31	
096	*LBLE	21 15	
097	R↓	-31	
098	PRTX	-14	Azimuth→ bearing
099	RTN	24	
100	*LBL1	21 01	
101	RCL7	36 07	
102	-	-45	
103	RTN	24	
104	*LBLa	21 16 11	
105	HMS→	16 36	
106	ENT↑	-21	
107	SIN	41	
108	SIN⁻¹	16 41	
109	X<0?	16-45	
110	CHS	-22	
111	→HMS	16 35	
112	PRTX	-14	

REGISTERS

0	1 NEW N	2 NEW E	3 OLD N	4 OLD E	5 A'2	6 AREA	7 ROT. ∠	8 d_2	9 180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	PRTX	-14	
114	RTN	24	
115	*LBLe	21 16 15	Recall area
116	RCL6	36 06	
117	ABS	16 31	
118	PRTX	-14	
119	RTN	24	
120	*LBL8	21 08	Data setup SBR.
121	X≷Y	-41	
122	R↓	-31	
123	RTN	24	
124	*LBLc	21 16 13	Supplementary angle
125	ABS	16 31	
126	RCL9	36 09	
127	X≷Y	-41	
128	CHS	-22	
129	HMS+	16-55	
130	RTN	24	
131	R/S	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS
140			
150			
160			
170			
180			
190			
200			
210			
220			

LABELS

A P.O.B.,AZ	B BEARING TRAV.	C INVERSE	D DEFLEC./	E R↓PRINT	0
a AZ→BRG.	b BEARING/QD	c SUPP. ∠	d	e AREA	1
0 CALC. SBR	1	2	3	4	2
5	6	7	8 DATA SETUP	9	3 DATA ENTRY

FLAGS

0
1
2
3

SET STATUS

FLAGS		TRIG		DISP	
	ON OFF				
0	☐ ☒	DEG	☒	FIX	☒
1	☐ ☒	GRAD	☐	SCI	☐
2	☐ ☒	RAD	☐	ENG	☐
3	☐ ☒			n	4

Program Description I

Program Title COGO-09: CRANDALL'S RULE ADJUSTMENT

This Hewlett-Packard translation is based on program 04172A written by

CARL M. KING
2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables

COGO-09 is a member of the coordinate geometry series described in the general description, hereof. The special option of this program is Crandall's Rule Adjustment, which can be used in an open traverse as well as in a closed traverse. At the end of the traverse you "force" a closure on a point known with precision. During the course of the initial traverse calculations (card I, part 1), the latitude (n), departure (e) and length (d) are accumulated.

Equations for Crandall's Rule Adjustment may be found in: Davis, Foote, Kelly "SURVEYING THEORY AND PRACTICE", 5th edition, p. 461, McGraw-Hill, 1966.

Operating Limits and Warnings

This is a 2 card, 3 part program. Part 1 of card I calculates and accumulates summed quantities. Part 2 calculates the error, n',e', the bracketed quotients and the Precision Ratio. Card II repeats the traverse, making all the adjustments as it goes.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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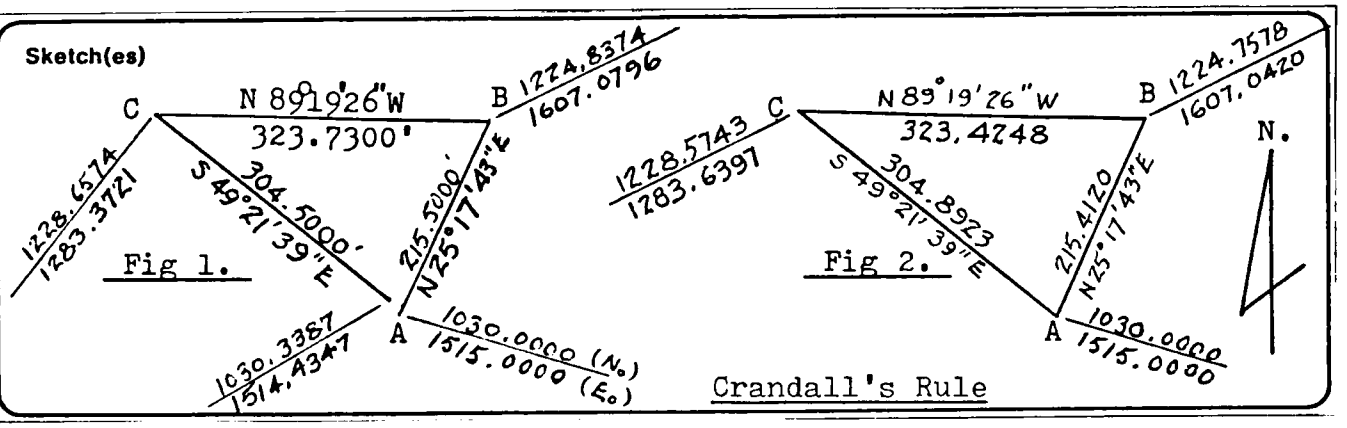
Program Description II

Sketch(es)



Sample Problem(s)

(1) Load Card I and go to Program Part 1
(2) Start at point A, for P.O.B.
(3) Make BEARING TRAVERSE to point B, utilizing data in Fig. 1.
(4) Continue traverse to succeeding points of figure, using standard options of your choice. (Bearing, Deflection or Inverse Traverses.)
(5) Note: computed coordinates are not identical to known coordinates of closing point. Now got to program Part 2.
(6) Enter known coordinates and make INVERSE TRAVERSE to compute closing error. Press [D] to read PRECISION RATIO.
(7) Enter program CARD II. Begin at step (2) above, repeat traverse in same order as before, utilizing same data. (Fig 1.)
(8) Read the adjusted coordinates and calls, as in Fig 2.
(9) Recall computed area of closed traverse: press [f][E].

Closing Error: Azimuth = 120°55'34" , distance = 0.6590
(Bearing = S 59°04'26" E)
PRECISION RATIO = 1280.3425

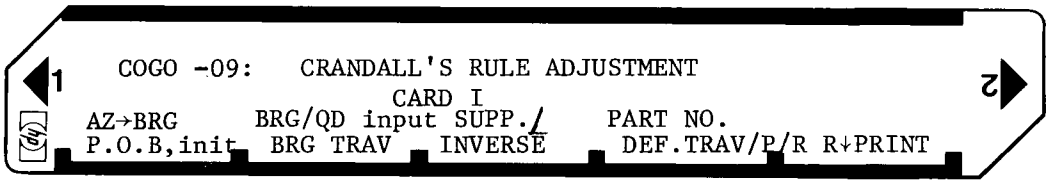
Adjusted traverse, as shown in Fig 2., closes precisely.
For CCW traverse, enclosed AREA = 31668.2018 sq. ft.

Solution(s) CARD I (Traverse)
1[f][D] 1030 [ENT↑] 1515[A] 25.1743[B] 215.5[R/S] → 1224.8374, N_B; [E]→ 1607.0796, E_B.
89.1926[ENT↑] 4[f][B] 323.73[R/S] → 1228.6574, N_C; [E] → 1283.3721, E_C.
49.2139 [ENT↑] 2[f][B] 304.5 [R/S] → 1030.3387, N; [E] → 1514.4347, E.
(Calc. Errors)
2[f][D] 1030[ENT↑] 1515[C] → 1030.0000, N_{CLOSE}; [E] → 1515.0000, E_{CLOSE};
[E] → 120.5534, AZ_{error}; [E] → 0.6590, $DIST._{error}$
[D] → 1280.3425, P/R.
CARD II (Adjust)
25.1743 [B] 215.5 [R/S] → 1224.7578, $N_{corr.}$; [E] → 1607.0420, $E_{corr.}$
[E] → 25.1743, $AZ_{corr.}$; [E] → 215.4120, $DIST._{corr.}$
89.1926 [ENT↑] 4[f][B] 323.73 [R/S] → 1228.5743, $N_{corr.}$; [E] → 1283.6397, $E_{corr.}$
[E] → -89.1926, AZ_{corr}; [E] → 323.4248, $DIST._{corr.}$
49.2139[ENT↑] 2[f][B] 304.5[R/S] → 1030.0000, N_{CLOSE}; [E] → 1515.0000, E_{CLOSE};
[E] → 130.3821, AZ_{CLOSE}; [E] → 304.8923, $DIST_{CLOSE}$
[f][E] → 31668.2018, AREA.

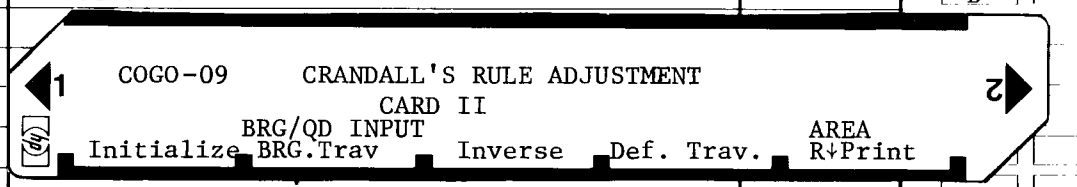
REFERENCE(S) Davis, R.E., Foot, F.S., Kelly, J.W., SURVEYING THEORY AND PRACTICE. 5th Edition. 1966. McGraw-Hill Book Co. Pages 461-463.

This program is a modification of the Users' Library Program #04172A submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load CARD I, sides 1 and 2			
2	Set to part 1 for initial traverse	1	f D	1
3	Enter P.O.B.	Northing	ENT↑	
		Easting	A	180
4	Proceed with traverse according to			
	"COGO General Instructions" until final			
	point is reached			
5	Switch to Part 2	2	f D	2
6	Enter coordinates of closing point	Northing	ENT↑	
	and calculate errors	Easting	C	Northing
			E	Easting
	Read error Azimuth		E	Error Azimuth
	Read error Distance		E	Error Distance
	Precision Ratio		D	P/R



7	Load CARD II, side 1(only) to adjust traverse			
8	If traverse is open store	Northing	STO 1	
	P.O.B. coordinates	Easting	STO 2	
9	Initialize the traverse		A	
	(NOTE: If traverse is closed steps 8 and 9			
	may be skipped)			
10	Repeat the traverse leg by leg to the			
	closing point and obtain output data for	Northing	ENT↑	
	each adjusted leg:	Easting	C	N_{corr}
			E	E_{corr}
			E	AZ_{corr}
			E	$DIST_{corr}$
	(NOTE: You may use Bearing or deflection			
	angle traverse inputs in place of			
	inverse if desired)			
11	Obtain the area of the adjusted traverse		f E	AREA

97 Program Listing I

CARD I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL1	21 01	
002	R/S	51	
003	*LBL6	21 16 12	Bearing/Quadrant
004	X≠Y	-41	
005	HMS→	16 36	
006	X≠Y	-41	
007	ENT↑	-21	
008	ENT↑	-21	
009	2	02	
010	÷	-24	
011	INT	16 34	
012	RCLA	36 11	
013	×	-35	
014	X≠Y	-41	
015	RCLA	36 11	
016	×	-35	
017	COS	42	
018	R↑	16-31	
019	×	-35	
020	-	-45	
021	→HMS	16 35	Azimuth
022	*LBLB	21 12	Azimuth input
023	0	00	
024	STO5	35 05	
025	+	-55	
026	*LBLD	21 14	Deflection angle input
027	HMS→	16 36	
028	RCL5	36 05	
029	+	-55	
030	EEX	-23	
031	CHS	-22	
032	9	09	
033	CF3	16 22 03	
034	R/S	51	Distance input
035	F3?	16 23 03	
036	GSB8	23 08	Data set-up
037	GTO9	22 09	
038	*LBLd	21 16 14	Program part number
039	STOI	35 46	input
040	GTOi	22 45	
041	*LBLA	21 11	Input P.O.B. and
042	CLRG	16-53	initialize
043	STO2	35 02	
044	R↓	-31	
045	STO1	35 01	
046	1	01	
047	STOI	35 46	
048	1	01	
049	8	08	
050	0	00	
051	STOA	35 11	
052	GTO1	22 01	
053	*LBLC	21 13	Inverse traverse
054	RCL2	36 02	
055	-	-45	
056	X≠Y	-41	
057	RCL1	36 01	
058	-	-45	
059	→P	34	
060	*LBL9	21 09	Calculation subroutine
061	ABS	16 31	for traverse
062	STO4	35 04	
063	ST+3	35-55 03	
064	CLX	-51	
065	LSTX	16-63	
066	→R	44	
067	STO9	35 09	
068	ENT↑	-21	
069	ENT↑	-21	
070	RCL4	36 04	
071	÷	-24	
072	×	-35	
073	ST+8	35-55 08	
074	CLX	-51	
075	LSTX	16-63	
076	×	-35	
077	ST+6	35-55 06	
078	CLX	-51	
079	RCL4	36 04	
080	÷	-24	
081	×	-35	
082	ST+7	35-55 07	
083	CLX	-51	
084	RCL2	36 02	
085	+	-55	
086	STO2	35 02	
087	RCL1	36 01	
088	RCL9	36 09	
089	+	-55	
090	STO1	35 01	
091	R↑	16-31	
092	LSTX	16-63	
093	→P	34	
094	X≠Y	-41	
095	STO5	35 05	
096	→HMS	16 35	
097	CF1	16 22 01	
098	R↓	-31	
099	GTOE	22 15	Read results
100	*LBL2	21 02	Program Part 2
101	R/S	51	
102	*LBLA	21 11	Initialize
103	CLX	-51	
104	ENT↑	-21	
105	ENT↑	-21	
106	RCL2	36 02	
107	RCL1	36 01	
108	GTO2	22 02	
109	*LBLC	21 13	Input closing point
110	F1?	16 23 01	and calculate
111	GTO2	22 02	errors.
112	SF1	16 21 01	

REGISTERS

0	1 N	2 E	3 ΣD, N_o	4 d, E_o	5 A_2, e'	6 $\Sigma n^e/d$	7 $\Sigma e^2/d$, A	8 $\Sigma n^2/d$,B	9 P/R
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A 180	B	C	D	E	I Program Part Number

97 Program Listing II

CARD I

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	RCL2	36 02	
114	-	-45	
115	ST+2	35-55 02	
116	STO5	35 05	
117	X⇄Y	-41	
118	RCL1	36 01	
119	-	-45	Calculation of
120	ST+1	35-55 01	errors(continued)
121	STO4	35 04	
122	RCL5	36 05	
123	RCL6	36 06	
124	×	-35	
125	RCL4	36 04	
126	RCL7	36 07	
127	×	-35	
128	-	-45	
129	RCL6	36 06	
130	ENT↑	-21	
131	×	-35	
132	RCL7	36 07	
133	RCL8	36 08	
134	×	-35	
135	-	-45	
136	STO7	35 07	
137	÷	-24	
138	RCL4	36 04	
139	RCL6	36 06	
140	×	-35	
141	RCL5	36 05	
142	RCL8	36 08	
143	×	-35	
144	-	-45	
145	RCL7	36 07	
146	÷	-24	
147	STO8	35 08	
148	X⇄Y	-41	
149	STO7	35 07	
150	RCL5	36 05	
151	RCL4	36 04	
152	→P	34	
153	RCL3	36 03	
154	X⇄Y	-41	
155	÷	-24	
156	STO9	35 09	
157	CLX	-51	
158	LSTX	16-63	
159	X⇄Y	-41	
160	→HMS	16 35	
161	RCL2	36 02	
162	STO4	35 04	
163	RCL1	36 01	
164	STO3	35 03	
165	R↑	16-31	
166	GTOE	22 15	
167	*LBLD	21 14	Obtain closing err.
168	F1?	16 23 01	Precision ratio
169	GTO5	22 05	
170	GTO2	22 02	
171	*LBL5	21 05	
172	CLX	-51	
173	ENT↑	-21	
174	ENT↑	-21	
175	ENT↑	-21	
176	STO6	35 06	
177	RCL9	36 09	
178	R↑	16-31	
179	*LBLE	21 15	Roll down,
180	R↓	-31	print routine
181	PRTX	-14	
182	GTO;	22 45	
183	*LBL8	21 08	Data entry set up
184	X⇄Y	-41	
185	R↓	-31	
186	RTN	24	
187	*LBL∝	21 16 11	Azimuth to
188	HMS→	16 36	Bearing conv.
189	ENT↑	-21	
190	SIN	41	
191	SIN⁻¹	16 41	
192	X<0?	16-45	
193	CHS	-22	
194	→HMS	16 35	
195	PRTX	-14	Bearing
196	R↓	-31	
197	9	09	
198	0	00	
199	÷	-24	
200	1	01	
201	+	-55	
202	INT	16 34	
203	PRTX	-14	Quadrant
204	RTN	24	
205	*LBL∘	21 16 13	Supplementary angle
206	ABS	16 31	
207	RCLA	36 11	
208	X⇄Y	-41	
209	CHS	-22	
210	HMS+	16-55	
211	RTN	24	
212	R/S	51	

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LABELS

A P.O.B.,init	B BRG Trav.	C inv.&close	D Deflec/P/R	E R↓Print
a AZ → BRG	b BRG/QD	c Supp. /	d Prog. Part	e
0	1 part no.	2 part no.	3	4
5 P/R	6	7	8 Data Set up	9 Calc. SBR

FLAGS

0	
1 First Closure?	
2	
3 Data ent?	

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG	
DEG	☒
GRAD	☐
RAD	☐

DISP	
FIX	☒
SCI	☐
ENG	☐
n	4

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	Initialize
002	0	00	
003	STO6	35 06	
004	RCL2	36 02	
005	STO4	35 04	
006	RCL1	36 01	
007	STO3	35 03	
008	RTN	24	
009	*LBLC	21 13	Inverse
010	RCL4	36 04	
011	-	-45	
012	X≠Y	-41	
013	RCL3	36 03	
014	-	-45	
015	STO0	22 00	
016	*LBL6	21 16 12	BRG/Quadrant input
017	X≠Y	-41	
018	HMS→	16 36	
019	X≠Y	-41	
020	ENT↑	-21	
021	ENT↑	-21	
022	2	02	
023	÷	-24	
024	INT	16 34	
025	RCLA	36 11	
026	×	-35	
027	X≠Y	-41	
028	RCLA	36 11	
029	∧	-35	
030	COS	42	
031	R↑	16-31	
032	×	-35	
033	-	-45	Azimuth
034	→HMS	16 35	
035	*LBLB	21 12	Azimuth input
036	0	00	
037	STO5	35 05	
038	+	-55	
039	*LBLD	21 14	Deflection angle input
040	HMS→	16 36	
041	RCL5	36 05	
042	+	-55	
043	EEX	-23	
044	CHS	-22	
045	9	09	
046	CF3	16 22 03	
047	R/S	51	Input distance
048	F3?	16 23 03	Was distance input?
049	GSB8	23 08	Data set up
050	→R	44	
051	*LBL0	21 00	Adjustment calculation subroutine
052	ST+3	35-55 03	
053	X≠Y	-41	
054	ST+4	35-55 04	
055	ENT↑	-21	
056	ENT↑	-21	

CARD II

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	R↑	16-31	
058	→P	34	
059	X≠Y	-41	
060	STO5	35 05	
061	CLX	-51	
062	LSTX	16-63	
063	RCL7	36 07	
064	×	-35	
065	R↑	16-31	
066	RCL8	36 08	
067	×	-35	
068	+	-55	
069	+	-55	
070	ENT↑	-21	
071	ENT↑	-21	
072	RCL5	36 05	
073	X≠Y	-41	
074	→R	44	
075	ST+1	35-55 01	
076	X≠Y	-41	
077	ST+2	35-55 02	
078	2	02	
079	÷	-24	
080	RCL2	36 02	
081	-	-45	
082	×	-35	
083	ST+6	35-55 06	
084	CLX	-51	
085	RCL5	36 05	Adjusted results
086	→HMS	16 35	
087	RCL2	36 02	
088	RCL1	36 01	
089	R↑	16-31	
090	*LBLE	21 15	Roll down and print subroutine
091	R↓	-31	
092	PRTX	-14	
093	RTN	24	
094	*LBL8	21 08	Data entry set up
095	X≠Y	-41	
096	R↓	-31	
097	RTN	24	
098	*LBLe	21 16 15	Area
099	RCL6	36 06	
100	ABS	16 31	
101	PRTX	-14	
102	RTN	24	
103	R/S	51	

110

FLAGS

0
1
2
3 Data entry

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG	
DEG	☒
GRAD	☐
RAD	☐

DISP	
FIX	☒
SCI	☐
ENG	☐
n	4

REGISTERS

0	1 N_{AJ}	2 E_{AJ}	3 N_{UNAJ}	4 E_{UNAJ}	5 A_2	6 Area	7 A	8 B	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

Program Description I

Program Title COGO-10: TRANSIT RULE ADJUSTMENT

This Hewlett-Packard translation is based on program 04173A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables COGO-10 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION I., hereof. The special option of this program is the TRANSIT RULE adjustment, which can be used in an open traverse as well as in a closed traverse. At the end of the traverse you "force" a closure on a point known with precision. (Part II) During the course of the initial traverse calculations (Part I) the latitude (n), departure (e) and length (d) are accumulated, so that the following equations can be evaluated for each traverse leg:

(adjusted latitude) $n_{(aj)} = \pm n + n \left(\frac{\pm n'}{\Sigma n}\right)$; Precision Ratio

(adjusted departure) $e_{(aj)} = \pm e + e \left(\frac{\pm e'}{\Sigma e}\right)$; $P/R = \frac{\Sigma d}{d'}$

$\pm n$	= unadjusted latitude	$\pm n'$	= latitude of error of closure
$\pm e$	= unadjusted departure	$\pm e'$	= departure of error of closure
n	= absolute latitude	Σn	= sum of absolute latitudes
e	= absolute departure	Σe	= sum of absolute departures
d'	= absolute error	Σd	= total perimeter

Operating Limits and Warnings This is a three part program. Part 1 calculates and accumulates summed quantities. Part 2 calculates the error, n', e' and the bracketed quotions and the Precision Ratio. Part 3 repeats the traverse, making all the adjustments as it goes. Neither Azimuth to bearing nor supplementary angle routines are included because of program space limitations.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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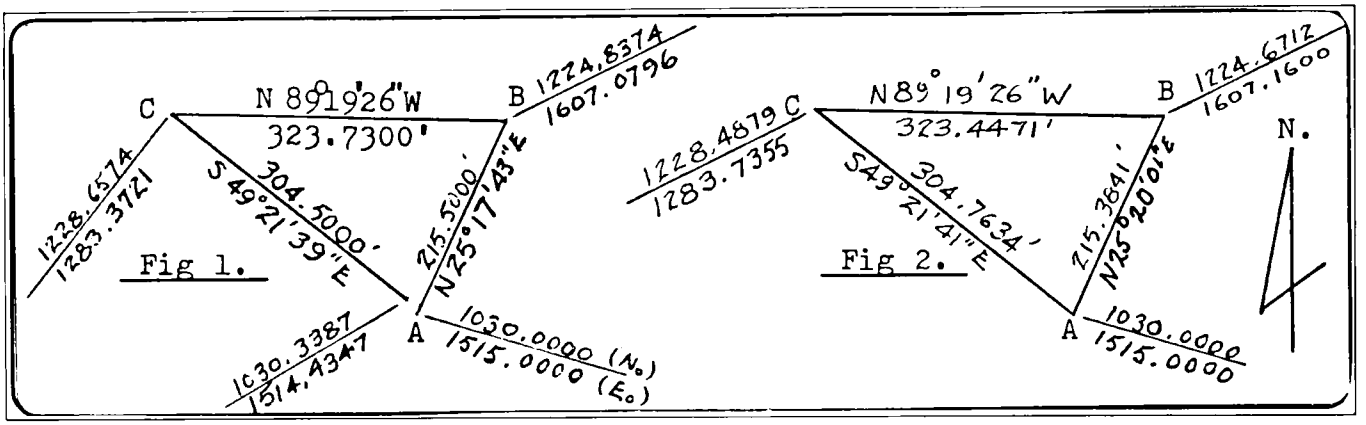
Program Description 11



Sample Problem(s)

(1) Initialize the program: set for part 1 (1 [f] [D])
(2) Start at point A, for P.O.B.
(3) Make BEARING TRAVERSE to point B, utilizing data in Fig 1.
(4) Continue traverse to succeeding points of figure, using standard options of your choice. (Bearing, Deflection or Inverse Traverses.)
(5) Note: computed coordinates are not identical to known coordinates of closing point. Go to part 2 of program (2 [f] [D])
(6) Enter known coordinates and make INVERSE TRAVERSE to compute closing error. Press [D] to read PRECISION RATIO.
(7) Set for part 3 of program (3 [f] [D]) Begin at step (2) above, repeat traverse in same order as before, utilizing same data. (Fig 1.)
(8) Copy the adjusted coordinates and calls, as in Fig 2.
(9) Recall computed area of closed traverse: press [f] [E].

Closing Error: Azimuth = 120°55'34", distance = 0.6590
(Bearing = S 59°04'26"E)
PRECISION RATIO = 1280.3425

Adjusted traverse, as shown in Fig 2., closes precisely.
For CCW traverse, enclosed AREA = 31656.5953 sq. ft.

Solution(s) (Traverse)

1 [f] [D] 1030 [ENT↑] 1515 [A] 25.1743 [B] 215.5 [R/S]→ 1224.8374, N_B
[E]→ 1607.0796, E_B
89.1926 [ENT↑] 4 [f] [B] 323.73 [R/S]→1228.6574,N_C; [E]→ 1283.3721, E_C
49.2139 [ENT↑] 2 [f] [B] 304.5 [R/S]→ 1030.3387,N_A; [E]→1514.4347, E_A

(Calc. Errors)

2 [f] [D] 1030 [ENT↑] 1515 [C]→1030.0000, N_{close}; [E] → 1515.0000, E_{close};
[E] →120.5534, AZ_{error}; [E]→ 0.6590, DIST error [D]→ 1280.3425, P/R

(Adjust)

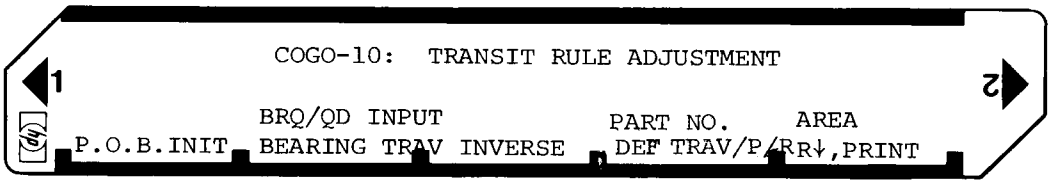
3 [f] [D] 25.1743 [B] 215.5 [R/S]→ 1224.6712, $N_{B_{corr}}$; [E]→ 1607.1600, $E_{B_{corr}}$;
[E]→ 25.2001, $AZ_{corr.}$; [E]→ 215.3841, DIST $_{corr.}$
89.1926 [ENT↑] 4 [f] [B] 323.73 [R/S]→ 1228.4879, $N_{C_{corr.}}$;
[E]→ 1283.7355, $E_{C_{corr.}}$; [E]→ -89.1926, $AZ_{corr.}$; [E]→ 323.4471, $DIST_{corr.}$
49.2139 [ENT↑] 2 [f] [B] 304.5 [R/S]→ 1030, N_{close}; [E]→ 1515, E_{close}
[E]→ 130.3819 $AZ_{corr.}$, [E]→ 304.7634, $DIST_{corr.}$
[f] [E]→ 31656.5953, AREA

Reference(s)

This program is a modification of the Users' Library Program #04173A submitted by Carl M. King.

Davis, R.E., Foot, F.S., Kelly, J.W., SURVEYING THEORY AND PRACTICE.
5th Edition. 1966. McGraw-Hill Book Co., page 461, 462 and 463.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load card, sides 1 & 2			
2	Set to part 1 for initial traverse	1	f D	1
3	Enter P.O.B.	Northing	ENT↑	
		Easting	A	180
4	Proceed with traverse according to "COGO			
	GENERAL INSTRUCTIONS." until final point			
	has been reached			
5	Switch to part 2	2	f D	2
6	Enter coordinates of closing point and	Northing	ENT↑	
	calculate errors	Easting	C	Northing
			E	Easting
	obtain error Azimuth		E	Error Azimuth
	obtain error Distance		E	Error Distance
	obtain precision ratio (P/R)		D	P/R
7	Switch to part 3 & adjust	3	f D	3
	traverse:			
8	If traverse is open, store P.O.B.	Northing	STO 1	
	coordinates	Easting	STO 2	
	and initialize		A	Northing
	(if traverse is closed step 8 may be skipped)			
9	Repeat the traverse leg by leg to the closing			
	point & obtain output data for each	Northing	ENT↑	
	adjusted leg:	Easting	C	$N_{corr.}$
			E	$E_{corr.}$
			E	$AZ_{corr.}$
			E	$DIST._{corr.}$
10	Obtain AREA of the adjusted traverse		f E	AREA

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL1	21 01	
002	R/S	51	
003	*LBLb	21 16 12	BRG/QD input
004	X≠Y	-41	
005	HMS→	16 36	
006	X≠Y	-41	
007	ENT↑	-21	
008	ENT↑	-21	
009	2	02	
010	÷	-24	
011	INT	16 34	
012	RCLA	36 11	
013	×	-35	
014	X≠Y	-41	
015	RCLA	36 11	
016	×	-35	
017	COS	42	
018	R↑	16-31	
019	×	-35	
020	-	-45	
021	→HMS	16 35	Azimuth
022	*LBLB	21 12	Azimuth input
023	0	00	
024	STO5	35 05	
025	+	-55	
026	*LBLD	21 14	
027	HMS→	16 36	Deflection angle input
028	RCL5	36 05	
029	+	-55	
030	EEX	-23	
031	CHS	-22	
032	9	09	
033	CF3	16 22 03	
034	R/S	51	Distance input
035	F3?	16 23 03	
036	GSB8	23 08	
037	→R	44	
038	ISZI	16 26 46	Set subroutine number
039	ISZI	16 26 46	in I register
040	ISZI	16 26 46	
041	GTOi	22 45	GTO proper subroutine
042	*LBLd	21 16 14	Set program part
043	STOI	35 46	
044	GTOi	22 45	
045	*LBLA	21 11	
046	CLRG	16-53	P.O.B. & initialize
047	STO2	35 02	
048	R↓	-31	
049	STO1	35 01	
050	1	01	
051	STOI	35 46	
052	1	01	
053	8	08	
054	0	00	
055	STOA	35 11	
056	GTO1	22 01	

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	*LBLC	21 13	Inverse
058	RCL2	36 02	
059	-	-45	
060	X≠Y	-41	
061	RCL1	36 01	
062	-	-45	
063	GTO9	22 09	
064	*LBL4	21 04	
065	DSZI	16 25 46	Reset I register
066	DSZI	16 25 46	
067	DSZI	16 25 46	
068	*LBL9	21 09	Calc. SBR.for traverse
069	CF1	16 22 01	
070	ST+1	35-55 01	
071	ABS	16 31	
072	ST+7	35-55 07	
073	CLX	-51	
074	LSTX	16-63	
075	X≠Y	-41	
076	ST+2	35-55 02	
077	ABS	16 31	
078	ST+8	35-55 08	
079	CLX	-51	
080	LSTX	16-63	
081	X≠Y	-41	
082	→P	34	
083	STO4	35 04	
084	ST+3	35-55 03	
085	X≠Y	-41	
086	STO5	35 05	
087	→HMS	16 35	
088	RCL2	36 02	
089	RCL1	36 01	
090	R↑	16-31	
091	GTOE	22 15	
092	*LBL2	21 02	Program part 2
093	R/S	51	
094	*LBLA	21 11	Initialize
095	CLX	-51	
096	ENT↑	-21	
097	ENT↑	-21	
098	RCL2	36 02	
099	RCL1	36 01	
100	GTO2	22 02	
101	*LBLC	21 13	Input closing points
102	F1?	16 23 01	& calculate errors
103	GTO2	22 02	
104	SF1	16 21 01	
105	RCL2	36 02	
106	-	-45	
107	ST+2	35-55 02	
108	ENT↑	-21	
109	ENT↑	-21	
110	RCL8	36 08	
111	÷	-24	
112	STO8	35 08	

REGISTERS

0	1 N	2 E	3 Σ d,N_o	4 d,E_o	5 A_2	6 AREA	7 $\Sigma n \frac{n}{\Sigma n}$	8 $\Sigma e \frac{e'}{\Sigma e}$	9 P/R
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A 180	B	C	D	E	I PART NO.

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	R↓	-31	
114	X≷Y	-41	
115	RCL1	36 01	
116	-	-45	
117	ST+1	35-55 01	
118	ENT↑	-21	
119	ENT↑	-21	
120	RCL7	36 07	
121	÷	-24	
122	STO7	35 07	
123	R↓	-31	
124	→P	34	
125	RCL3	36 03	
126	X≷Y	-41	
127	÷	-24	
128	STO9	35 09	
129	CLX	-51	
130	LSTX	16-63	
131	X≷Y	-41	
132	→HMS	16 35	
133	RCL2	36 02	
134	STO4	35 04	
135	RCL1	36 01	
136	STO3	35 03	
137	R↑	16-31	
138	GTOE	22 15	Obtain closing errors
139	*LBLD	21 14	P/R
140	F1?	16 23 01	
141	GTO5	22 05	
142	GTO2	22 02	
143	*LBL5	21 05	
144	CLX	-51	
145	ENT↑	-21	
146	ENT↑	-21	
147	ENT↑	-21	
148	STO6	35 06	
149	RCL9	36 09	
150	R↑	16-31	
151	GTOE	22 15	
152	*LBL3	21 03	Program part 3
153	R/S	51	
154	*LBLA	21 11	Initialize & store P.O.B.
155	0	00	
156	STO6	35 06	
157	RCL2	36 02	
158	STO4	35 04	
159	RCL1	36 01	
160	STO3	35 03	
161	GTO3	22 03	
162	*LBLC	21 13	Input coord. &
163	RCL4	36 04	calculate corrected
164	-	-45	points
165	X≷Y	-41	(i.e.inverse)
166	RCL3	36 03	
167	-	-45	
168	GTO7	22 07	
169	*LBL6	21 06	
170	DSZI	16 25 46	Reset I register
171	DSZI	16 25 46	
172	DSZI	16 25 46	
173	*LBL7	21 07	Adjust traverse points
174	ST+3	35-55 03	
175	X≷Y	-41	
176	ST+4	35-55 04	
177	ENT↑	-21	
178	ABS	16 31	
179	RCL8	36 08	
180	×	-35	
181	+	-55	
182	X≷Y	-41	
183	ENT↑	-21	
184	ABS	16 31	
185	RCL7	36 07	
186	×	-35	
187	+	-55	
188	ST+1	35-55 01	
189	X≷Y	-41	
190	ST+2	35-55 02	
191	2	02	
192	÷	-24	
193	RCL2	36 02	
194	-	-45	
195	X≷Y	-41	
196	×	-35	
197	ST+6	35-55 06	
198	CLX	-51	
199	LSTX	16-63	
200	→P	34	
201	X≷Y	-41	
202	STO5	35 05	
203	→HMS	16 35	
204	RCL2	36 02	
205	RCL1	36 01	
206	R↑	16-31	
207	*LBLE	21 15	Rolldown & print routine
208	R↓	-31	
209	PRTX	-14	
210	GTO;	22 45	
211	*LBL8	21 08	Data entry setup
212	X≷Y	-41	
213	R↓	-31	
214	RTN	24	
215	*LBLe	21 16 15	Recall area
216	RCL6	36 06	
217	ABS	16 31	
218	PRTX	-14	
219	RTN	24	
220	R/S	51	

LABELS

A P.O.B. INIT	B T.BRG.TRAV.	C INV.&CLOSE	D DEFLEC/P/R	E R↓,PRINT
a	b BRG/QD	c	d PART NO.	e AREA
0	1 PART NO.	2 PART NO.	3 PART NO.	4 USED
5 USED	6 USED	7 USED	8 DATA SETUP	9 USED

FLAGS

0	
1	FIRST CLOSURE?
2	
3	DATA ENTRY

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG	
DEG	☒
GRAD	☐
RAD	☐

DISP	
FIX	☒
SCI	☐
ENG	☐

Program Description I

Program Title COGO-11: TO INSCRIBE CURVE

This Hewlett-Packard translation is based on program 04550A written by

CARL M. KING

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Program Description, Equations, Variables

COGO-11 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION, hereof. The special option of this program is the calculation of a curve inscribed at an angle of a traverse, so that the existing point becomes the P.I. (point-of-intersection) of the curve.

The INVERSE TRAVERSE function is not included in this program. However, all the other COGO traverse functions operate the same as in the other COGO programs.

As in the usual situation the curve fits tangentially to the line along which you approach the curve. You are given the heading of the exit tangent and the length of the RADIUS. You take a "sighting" on the new heading, and enter the RADIUS length, press [C], and the program computes the "curve parts". Press [R/S] and the traverse is automatically extended to the P.T. (point-of-tangency). The program computes and accumulates the area enclosed by the ARC as a portion of the total traverse.

Operating Limits and Warnings

You may wish to use Cogo-01 to continue this traverse. If so, when loading Cogo-01, be sure to convert the contents of Register 5, which is in Radians in this program. To degrees. The following keystroke procedure will accomplish this: RCL 5, R →D, STO 5.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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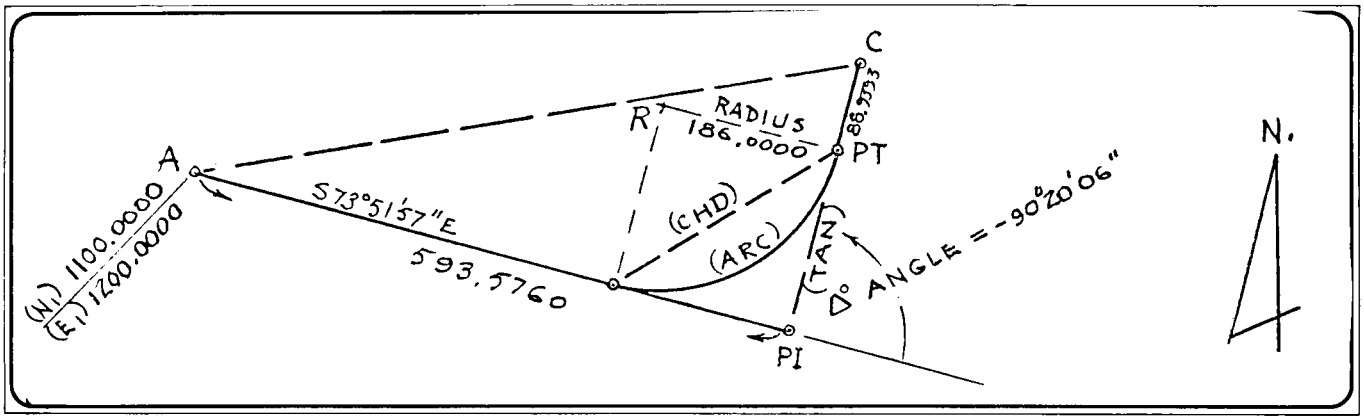
Program Description 11



Sample Problem(s)

(1) Start at point A, as P.O.B.
(2) Make a BEARING TRAVERSE to the PI, utilizing the above data.
(3) Obtain the coordinates of the PI (point-of-intersection)
(4) Enter the deflection angle = -90°20'06", press [D].
(5) You will see 1.0000-09, press [R/S].
(6) Input RADIUS = 186.0000, press [C].
(7) Copy: TAN, ARC, CHD
(8) Press: [R/S; obtain coordinates and traverse to PT (point-of-tangency).
(9) Make DEFLECTION ANGLE TRAVERSE (Δ = 0°) to point C.
(10) Load program COGO-01, make INVERSE TRAVERSE to P.O.B.

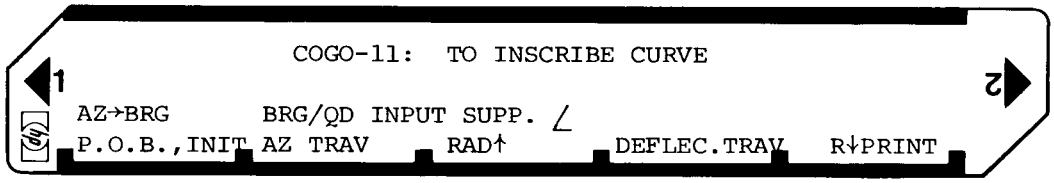
Side	Bearing	Azimuth	distance	Northings	Eastings	Point
				1100.0000	1200.0000	A
A(PI)	S73°53'57"E	+106°08'03"	593.5760			
				(935.0526)	(1770.1972)	(PI)
Δ° = -90°20'06", (+15°47'57") 0						
RADIUS = 186.0000 (TAN = 187.0907; ARC = 293.2556; CHD = 263.8116)						
		(+15°47'57")	(187.0907)	Δ -90°20'06"		
				(1115.0754)	(1821.1357)	(PT)
(PT)C	N15°47'57"E	(+15°47'57")	88.9393			
				(1200.6548)	(1845.3508)	(C)
CA	S81°08'06"W	(-98°51'54")	(653.1532)			
				1100.0000	1200.0000	A

AREA enclosed in figure = (74394.8957)
Note: Quantities in parentheses are calculated in the programs.

Solution(s): 1100 [ENT↑] 1200 [A] 73.5157 [ENT↑] 2 [f] [B] 593.576[R/S]→935.0526,N_{PI};
[E]→1770.1972, E_{PI}: 90.2006 [CHS] [D] [R/S] → 935.0526 (display only, ignore)
186 [C]→ 187.0907, TAN; [E]→ 293.2556, ARC;
[E]→263.8116, CHD; (optional) [E]→ -90.2006,Δ
[R/S]→1115.0754, N_{PT}; [E]→ 1821.1357, E_{PT}; [E]→ 15.4757, AZ;
[E]→187.0907, DIST. PI→PT.
0[D] 88.9393 [R/S]→ 1200.6548, N_C; [E]→ 1845.3508,E_C;
(optional) [E]→ 15.4757, A_Z
Load COGO-01 and complete
1100 [ENT↑] 1200 [C]→ 1100, N_A; [E]→ 1200 E_A; [E]→ -98.5154, AZ
[E]→ 653.1532, DIST.
[f] [E]→ 74394.8957, AREA

Reference(s):
This program is a modification of the Users' Library Program #4550A, submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load card; sides 1 & 2			
2	Enter point of beginning of	Northing	ENT↑	
	Traverse, and initialize	Easting	A	180
	TO INSCRIBE CURVE:			
	Note: The curve is made tangent to the			
	traverse leg most recently completed. Therefore			
	it is necessary to have calculated at least			
	one traverse leg prior to calculating a curve			
	with this program. (This prior leg may have			
	been calculated using any of the other COGO			
	programs of this series.)			
3	Proceed around traverse using "COGO GENERAL			$Northing_{PI}$
	INSTRUCTION" sheet until you reach PI			$Easting_{PI}$
4	Calculate a new "sighting" using either a			
	bearing or deflection angle traverse	Bearing	ENT↑	
		QD	f B	1.0000-09
	OR	Deflec./	D	1.0000-09
	and "zero" distance	1.0000-09	R/S	
5	Input the given radius & read tangent	Radius	C	TAN
	read ARC		E	ARC
	read CHORD		E	CHD
	(optional)read Central Angle		E	±Δ°
6	Complete the traverse to the P.T.		R/S	$Northing_{PT}$
	and read Northing & Easting		E	$Easting_{PT}$
	read Azimuth		E	AZ
	(optional) read Tangent		E	TAN
	(always use a positive value for the radius, in this routine. The direction you are looking has been elected by your new "sighting".)			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	P.O.B.& initialize
002	STO2	35 02	E
003	R↓	-31	
004	STO1	35 01	N
005	CLX	-51	
006	STO6	35 06	Initialize
007	1	01	
008	8	08	
009	0	00	
010	STO9	35 09	
011	RTN	24	
012	*LBLC	21 13	Inscribe radius
013	RAD	16-22	
014	STO8	35 08	Calc. routine
015	ENT↑	-21	
016	×	-35	
017	RCL7	36 07	
018	2	02	
019	÷	-24	
020	TAN	43	
021	STO3	35 03	
022	LSTX	16-63	
023	-	-45	
024	×	-35	
025	ST-6	35-45 06	
026	RCL8	36 08	
027	RCL3	36 03	
028	ABS	16 31	
029	×	-35	
030	STO4	35 04	
031	LSTX	16-63	
032	TAN⁻¹	16 43	
033	STO3	35 03	
034	COS	42	
035	×	-35	
036	2	02	
037	×	-35	
038	RCL3	36 03	
039	ENT↑	-21	
040	+	-55	
041	RCL8	36 08	
042	×	-35	ARC
043	RCL4	36 04	Set up for display
044	RCL7	36 07	
045	R→D	16 46	Δ(RAD)→Δ DMS
046	→HMS	16 35	
047	*LBLE	21 15	R↓ & print
048	R↓	-31	
049	F2?	16 23 02	Print?
050	R/S	51	No
051	PRTX	-14	Yes
052	R/S	51	
053	RCL5	36 05	
054	RCL4	36 04	
055	GTO2	22 02	
056	*LBLb	21 16 12	Bearing,QD input
057	DEG	16-21	
058	X≠Y	-41	BRG
059	HMS→	16 36	
060	X≠Y	-41	QD
061	ENT↑	-21	
062	ENT↑	-21	
063	2	02	
064	÷	-24	
065	INT	16 34	
066	RCL9	36 09	
067	×	-35	
068	X≠Y	-41	
069	RCL9	36 09	
070	×	-35	
071	COS	42	
072	R↑	16-31	
073	×	-35	
074	-	-45	Azimuth
075	→HMS	16 35	
076	*LBLB	21 12	Azimuth input
077	0	00	
078	GTO1	22 01	
079	*LBLD	21 14	Deflection angle input
080	RCL5	36 05	
081	*LBL1	21 01	
082	RAD	16-22	
083	X≠Y	-41	
084	HMS→	16 36	
085	D→R	16 45	
086	+	-55	
087	EEX	-23	
088	CHS	-22	
089	9	09	
090	CF3	16 22 03	
091	R/S	51	Data entry
092	F3?	16 23 03	Was data input?
093	GTO8	22 08	Yes
094	SF2	16 21 02	
095	*LBL2	21 02	If not, set flag for non print
096	→R	44	
097	ST+1	35-55 01	Calc. SBR.
098	STO3	35 03	
099	X≠Y	-41	
100	ST+2	35-55 02	
101	STO4	35 04	
102	2	02	
103	÷	-24	
104	RCL2	36 02	
105	-	-45	
106	×	-35	
107	ST+6	35-55 06	
108	RCL4	36 04	
109	RCL3	36 03	
110	→P	34	
111	X≠Y	-41	
112	RCL5	36 05	

REGISTERS

0	1 N	2 E	3 n,Δ/2	4 e,Tan	5 A_2	6 AREA	7 ±Δ	8 R	9 180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	-	-45	
114	STO7	35 07	
115	RCL5	36 05	
116	+	-55	
117	STO5	35 05	
118	R→D	16 46	Set up display
119	→HMS	16 35	
120	RCL2	36 02	
121	RCL1	36 01	
122	R↑	16-31	
123	GTOE	22 15	Go to print routine
124	*LBL8	21 08	
125	X≷Y	-41	Data set up
126	R↓	-31	
127	GTO2	22 02	
128	*LBLa	21 16 11	Azimuth→Bearing
129	DEG	16-21	
130	HMS→	16 36	
131	ENT↑	-21	
132	SIN	41	
133	SIN⁻¹	16 41	
134	X<0?	16-45	
135	CHS	-22	
136	→HMS	16 35	
137	PRTX	-14	Bearing
138	R↓	-31	
139	9	09	
140	0	00	
141	÷	-24	
142	1	01	
143	+	-55	
144	INT	16 34	
145	PRTX	-14	
146	RTN	24	Quadrant
147	*LBLc	21 16 13	Supp. Angle
148	ABS	16 31	
149	RCL9	36 09	
150	X≷Y	-41	
151	CHS	-22	
152	HMS+	16-55	
153	RTN	24	
154	R/S	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS
170			
180			
190			
200			
210			
220			

LABELS					FLAGS	SET STATUS		
A P.O.B.INIT	B AZIMUTH	C RAD.INPUT	D DEFLEC.∠	E R↓PRINT	0	FLAGS	TRIG	DISP
a AZ→BRG	b BEARING/QD	c SUPP.∠	d	e	1 NON PRINT	ON OFF 0 ☐ ☒ 1 ☐ ☒ 2 ☐ ☒ 3 ☐ ☒	DEG ☒ GRAD ☐ RAD ☐	FIX ☒ SCI ☐ ENG ☐ n 4
0	1 USED	2 CALC.SUBR.	3	4	2			
5	6	7	8 DATA SETUP	9	3 DATA ENTRY			

Program Description I

Program Title COGO -12 SLOPE SHOT TRAVERSE

This Hewlett-Packard translation is based on program 04782A written by

CARL M. KING

2206 Siesta Drive, Sarasota, Florida 33579

Program Description, Equations, Variables COGO-12 is a member of the coordinate geometry series described in the GENERAL DESCRIPTION I, hereof. This program differs from the others in that it contains an extra STOP where you can enter the VERTICAL ANGLE for all those SLOPE SHOTS where you are measuring distances on the slope.

COGO-12 calculates coordinates as projected on a horizontal plane, and accumulates area, also projected on the horizontal plane.

In the substantial majority of surveying instruments the vertical circles measure VERTICAL ANGLE starting from 0° at the horizontal plane. Angles looking up hill are considered positive, and angles looking down hill are negative.

For those users, who have instruments with the vertical circles calibrated to read ZENITH ANGLE rather than vertical angle, the program can be modified. (See Program Listing Addendum)

Operating Limits and Warnings

This program has been verified only with respect to the numerical example given in *Program Description II.* User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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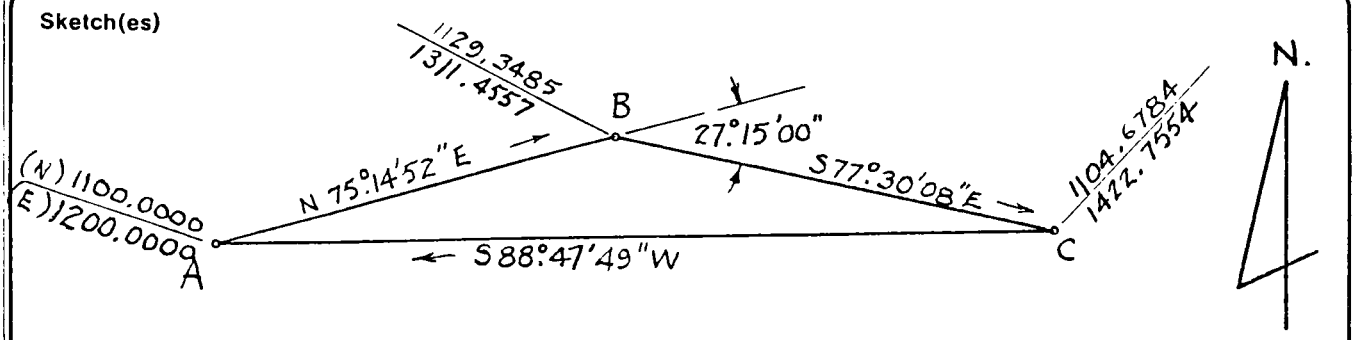
Program Description II

Sketch(es)



Sample Problem(s) Traverse the above figure obtaining results shown below:

SYMBOLS:	SIDE $\overline{AB}$
AZ = Azimuth	AZ = 75°14'52"
d_s = Slope distance	d_s = 116.1812
V_A = Vertical angle (*)	V_A = +7°14'23" (Z_A = 82°45'37")
d = Horizontal distance	d = 115.2550
d' = Vertical distance	d' = +14.6413

SIDE $\overline{BC}$	SIDE $\overline{CA}$
AZ = 102°29'52"	AZ = -91°12'11"
d_s = 114.6091	d_s = 222.8228
V_A = - 5°54'17" (Z_A=95°54'17")	V_A = - 0°43'59" (Z_A = 90°43'59")
d = 114.0010	d = 222.8046
d' = -11.7904	d' = - 2.8508

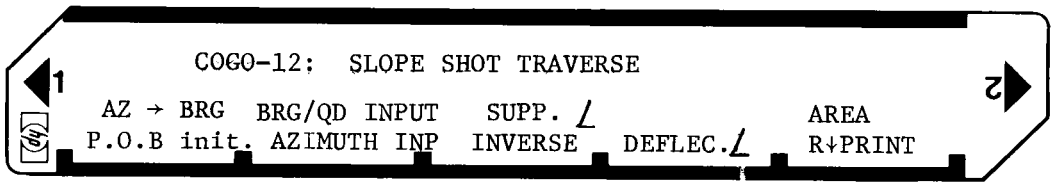
Upon completion of closed traverse, recall the area = 3007.3999

Solution(s)

```
1100[ENT↑] 1200[A] 75.1452[B] 116.1812[R/S]
7.1423[R/S] → 1129.3485 N_B
              1311.4557 E_B
[E] → 75.1452, AZ; [E] → 115.2550, d; [E] → 14.6413, d'.
27.15 [D] 114.6091 [R/S]  5.5417 [CHS][R/S] → 1104.6784, N_C
                                            → 1422.7554, E_C
[E] → 102.2952, AZ; [E] → 114.0010, d; [E] → -11.7904, d'.
88.4749 [ENT↑] 3[f][B] 222.8228[R/S] .4359[CHS][R/S] → 1100.0005, N_A
                                                       1199.9999, E_A
[E] → -91.1211, AZ; [E] → 222.8046, d; [E] → -2.8508, d'.
[f][E] → 3007.3999, AREA
```

Reference(s) This program is a modification of the Users' Library Program #04782A submitted by Carl M. King.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load card, sides 1 and 2			
2	Enter point of beginning and initialize	Northing	ENT↑	
		Easting	A	180
	For Bearing Traverse:			
3	Input Bearing and Quadrant	BRG	ENT↑	
		QD	f B	1.0000 -09
	OR: Azimuth	AZ	B	1.0000 -09
4	Input Slope Distance	d_s	R/S	0
5	Input Vertical Angle	V_A	R/S	Northing
	and read Northings and Eastings			Easting
6	Read Azimuth		E	AZ
7	Read Horizontal distance		E	d
8	Read Vertical distance		E	d'
	For Deflection Angle Traverse:			
9	Input Deflection angle and repeat	$\pm \Delta°$	D	1.0000 -09
	steps 4 through 8			
	For Inverse Traverse:			
10	See "COGO General Instruction" Sheet			
11	After closure of traverse obtain area		f E	AREA
12	NOTE: If you prefer to use Zenith Angles* rather than vertical angles modify the program as shown on the Addendum on Program Listing II (* definition: $Z_A = 90 - V_A$)			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	P.O.B
002	STO2	35 02	E
003	R↓	-31	
004	STO1	35 01	N
005	CLX	-51	Initialize
006	STO6	35 06	
007	1	01	
008	8	08	
009	0	00	
010	STO9	35 09	
011	RTN	24	
012	*LBLC	21 13	Inverse
013	RCL2	36 02	
014	-	-45	
015	X≠Y	-41	
016	RCL1	36 01	
017	-	-45	
018	GTO0	22 00	Go to Calc. SBR.
019	*LBL6	21 16 12	BRG/QD Input
020	X≠Y	-41	BRG.
021	HMS→	16 36	
022	X≠Y	-41	QD
023	ENT↑	-21	
024	ENT↑	-21	
025	2	02	
026	÷	-24	
027	INT	16 34	
028	RCL9	36 09	
029	×	-35	
030	X≠Y	-41	
031	RCL9	36 09	
032	×	-35	
033	COS	42	
034	R↑	16-31	
035	×	-35	
036	-	-45	Azimuth
037	→HMS	16 35	
038	*LBLB	21 12	Azimuth input
039	HMS→	16 36	
040	STO0	35 00	STO AZ
041	GTO1	22 01	
042	*LBLD	21 14	Deflection angle
043	HMS→	16 36	
044	RCL5	36 05	
045	+	-55	AZ
046	STO0	35 00	STO AZ
047	*LBL1	21 01	
048	0	00	
049	STO3	35 03	
050	EEX	-23	
051	CHS	-22	
052	9	09	
053	CF3	16 22 03	
054	R/S	51	Slope Dist. Input
055	F3?	16 23 03	Data input?
056	GSB8	23 08	Yes
057	STO4	35 04	
058	0	00	
059	CF3	16 22 03	
060	R/S	51	Vertical angle input
061	F3?	16 23 03	Data input?
062	GSB8	23 08	Yes
063	HMS→	16 36	
064	X≠Y	-41	
065	→R	44	
066	X≠Y	-41	
067	STO3	35 03	
068	R↓	-31	
069	RCL0	36 00	
070	X≠Y	-41	
071	→R	44	
072	*LBL0	21 00	Calc. SBR
073	STO7	35 07	
074	X≠Y	-41	
075	STO8	35 08	
076	2	02	
077	÷	-24	
078	RCL2	36 02	
079	+	-55	
080	×	-35	
081	ST-6	35-45 06	
082	RCL2	36 02	
083	RCL8	36 08	
084	+	-55	
085	STO2	35 02	
086	RCL1	36 01	
087	RCL7	36 07	
088	+	-55	
089	STO1	35 01	
090	RCL8	36 08	Set up to read
091	RCL7	36 07	
092	→P	34	
093	STO4	35 04	
094	X≠Y	-41	
095	STO5	35 05	
096	→HMS	16 35	
097	SF2	16 21 02	
098	R↓	-31	
099	*LBLE	21 15	Roll down and print
100	R↓	-31	
101	PRTX	-14	
102	F2?	16 23 02	
103	GTO2	22 02	Include vert dist.
104	RTN	24	in stack
105	*LBL2	21 02	
106	R↓	-31	
107	RCL3	36 03	Vertical Dist.
108	GTOE	22 15	in stack
109	RTN	24	
110	*LBL8	21 08	Data Set up
111	X≠Y	-41	
112	R↓	-31	

REGISTERS

0	1	2	3	4	5	6	7	8	9
AZ or A_2	N	E	d'	d	AZ	AREA	n(LAT.)	e(DEP.)	180
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	RTN	24	
114	*LBL a	21 16 11	Azimuth → Bearing
115	HMS→	16 36	
116	ENT↑	-21	
117	SIN	41	
118	SIN⁻¹	16 41	
119	X<0?	16-45	
120	CHS	-22	
121	→HMS	16 35	
122	PRTX	-14	BRG
123	R↓	-31	
124	9	09	
125	0	00	
126	÷	-24	
127	1	01	
128	+	-55	
129	INT	16 34	
130	PRTX	-14	QD
131	RTN	24	
132	*LBL e	21 16 15	Recall AREA
133	RCL 6	36 06	
134	ABS	16 31	
135	PRTX	-14	
136	RTN	24	
137	*LBL c	21 16 13	Supplementary angle
138	ABS	16 31	
139	RCL 9	36 09	
140	X≷Y	-41	
141	CHS	-22	
142	HMS+	16-55	
143	RTN	24	
144	R/S	51	

PROGRAM LISTING ADDENDUM

For those desiring to use Zenith rather than Vertical angles modify program as shown:

063	HMS→	16 36	} Insert these 4 steps
064	9	09	
065	0	00	
066	X≷Y	-41	
067	-	-45	
068	X≷Y	-41	Formerly step 64

LABELS

A P.O.B., init	B Azimuth	C Inverse	D Deflec /	E R↓, Print	0
a AZ → BRG	b BRG/QD	c Supp /	d	e AREA	1
0 Calc SBR	1 Used	2 Vert. Dist	3	4	2 Used
5	6	7	8 Data setup	9	3 Data entry

FLAGS

0	
1	
2 Used	
3 Data entry	

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG	
DEG	☒
GRAD	☐
RAD	☐

DISP	
FIX	☒
SCI	☐
ENG	☐
n	4

NOTES

NOTES

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A one-year subscription to the Library costs $9.00. You receive: a catalog of contributed programs; catalog updates; and coupons for three programs of your choice (a $9.00 value).

Users' Library Solutions Books

Hewlett-Packard recently added a unique problem-solving contribution to its existing software line. The new series of software solutions are a collection of programs provided by our programmable calculator users. Hewlett-Packard has currently accepted over 6,000 programs for our Users' Libraries. The best of these programs have been compiled into 40 Library Solutions Books covering 39 application areas (including two game books).

Each of the Books, containing up to 15 programs without cards, is priced at $10.00, a savings of up to $35.00 over single copy cost.

The Users' Library Solutions Books will compliment our other applications of software and provide you with a valuable new tool for program solutions.

Options/Technical Stock Analysis
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Home Construction Estimating
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Butterworth and Chebyshev Filters
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Medical Practitioner
Anesthesia
Cardiac
Pulmonary
Chemistry
Optics
Physics
Earth Sciences
Energy Conservation
Space Science
Biology
Games
Games of Chance
Aircraft Operation
Avigation
Calendars
Photo Dark Room
COGO-Surveying
Astrology
Forestry

COGO

These COGO (Coordinate Geometry) Surveying programs constitute a comprehensive and self consistent series of programs to solve relationships regularly employed by surveyors and plot designers. All the programs have certain features in common so that they may be used consecutively without loss of continuity.

COGO - SURVEYING: GENERAL DESCRIPTION AND INSTRUCTIONS

COGO - 01: BASIC TRAVERSE, INVERSE AND SIDESHOTS

COGO - 02: BEARING - BEARING INTERSECTION AND TRAVERSE

COGO - 03: BEARING - DISTANCE INTERSECTION AND TRAVERSE

COGO - 04: DISTANCE - DISTANCE INTERSECTION AND TRAVERSE

COGO - 05: TRAVERSE OF CURVE

COGO - 06: CURVE INVERSE AND TRAVERSE

COGO - 07: COMPASS RULE ADJUSTMENT

COGO - 08: ROTATION OF AXES

COGO - 09: CRANDALL'S RULE ADJUSTMENT

COGO - 10: TRANSIT RULE ADJUSTMENT

COGO - 11: TO INSCRIBE CURVE

COGO - 12: SLOPE SHOT TRAVERSE

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