HP-35s Calculator Program   Closure   2

Two Missing Distances (2MD) Calculation

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Date: October, 2007.   **Version**: 3.0   **Mnemonic**:   **M** for Two **M**issing Distances

Line	Instruction	Display	User Instructions
M001	LBL M		Enter known traverse sides using Program A.
M002	CLSTK		Press XEQ M ENTER.
M003	FS? 10		
M004	GTO M008		
M005	SF 1		
M006	SF 10		
M007	GTO M009		
M008	CF 1		
M009	ENTER 1ST AZ		(Key in using EQN RCL E, RCL N, etc.)
M010	PSE		
M011	INPUT U		
M012	RCL U		
M013	HMS→		
M014	STO U		
M015	ENTER 2ND AZ		(Key in using EQN RCL E, RCL N, etc.)
M016	PSE		
M017	INPUT V		
M018	RCL V		
M019	HMS→		
M020	STO V		
M021	RCL U		
M022	RCL− V		
M023	SIN		
M024	ABS		
M025	1/x		
M026	STO S		
M027	RCL P		
M028	ABS		
M029	STO× S		
M030	RCL P		
M031	ARG		
M032	RCL− V		
M033	SIN		
M034	ABS		
M035	RCL× S		
M036	STO A		
M037	1ST DIST		(Key in using EQN 1 RCL S, RCL T, etc.)
M038	PSE		
M039	VIEW A		Length of first missing side displayed

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M040	RCL P		
M041	ARG		
M042	RCL– U		
M043	SIN		
M044	ABS		
M045	RCL× S		
M046	STO B		
M047	2ND DIST		(Key in using EQN 2 RCL N, RCL D, etc.)
M048	PSE		
M049	VIEW B		Length of second missing side displayed
M050	FS? 1		
M051	CF 10		
M052	RTN		

Notes

(1)   Calculator should be in DEGREES mode for this calculation.

(2)   Enter all the known sides of the traverse using the program stored under A, i.e., the closure program with area (Closure 1).

(3)   When all known sides have been entered and processed, press XEQ M ENTER. This will take you to the start of the 2MD program.

(4)   The calculator will prompt with ENTER 1ST AZ, briefly, then prompt with U? Key in the azimuth of the first unknown line, in HP notation (DDD.MMSSss). Press R/S.

(5)   The calculator will prompt with ENTER 2ND AZ, briefly, then prompt with V? Key in the azimuth of the second unknown line, in HP notation (DDD.MMSSss). Press R/S.

(6)   The calculator will show 1ST DIST, briefly, then show A= and the distance for the first missing side. Press R/S.

(7)   The calculator will show 2ND DIST, briefly, then show B= and the distance for the second missing side. Press R/S to finish the program..

(8)   Azimuths are entered and displayed in HP notation, i.e., DDD.MMSS

(9)   All the results are kept in storage, in case the user wants to access them again.

(10)   The program sets Flag 10, so as to be able to display the prompts, and at the end of the program it resets Flag 10 to its previous value. Flag 1 is used to control this process.

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Theory

Once all the known sides have been entered (order does not matter), the resultant vector of the traverse is known. This forms one side of a triangle, with the two unknown lines forming the other two sides. We know the length of the resultant vector, and the azimuths of all three sides. So we can deduce all three angles.

The triangle is solved using the Sine Rule. The ratio of the sine of the angle opposite the resultant vector and the resultant vector's length are stored and used with the sines of the other two angles to compute the lengths of the two missing sides.

Note that all misclosure (errors) in the known part of the traverse will be included in the lengths of the unknown sides. The resulting traverse should close perfectly, but this is meaningless information as far as the traverse is concerned, as there is no redundant data to allow computation of a misclosure.

Sample Computations

1.

Azimuth	Distance
6° 53' 10"	72.00
112° 37' 20"	102.23
185° 39' 50"	29.04
181° 30' 00"	Missing distance 1
283° 54' 30"	Missing distance 2

Results   Missing distance 1   =   27.883

               Missing distance 2   =   102.403

2.

Azimuth	Distance
231° 06' 56"	199.123
7° 07' 30"	201.556
166° 30' 16"	Missing distance 1
63° 26' 06"	Missing distance 2

Results   Missing distance 1   =   128.549

               Missing distance 2   =   111.804

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Storage Registers Used

A   Holds distance of first unknown side at end of computation.

B   Holds distance of second unknown side at end of computation.

P   Vector of known resultant side from program A, stored as a complex number.

S   Sine ratio.

U   Azimuth of first missing side.

V   Azimuth of second missing side.

Plus those used by the Traverse Closure and Area program (A).

Statistical Registers: Not used.

Labels Used

Label **M**   Length =   196   Checksum = 35F0

Use the length (LN=) and Checksum (CK=) values to check if program was entered correctly.
Use the sample computation to check proper operation after entry.