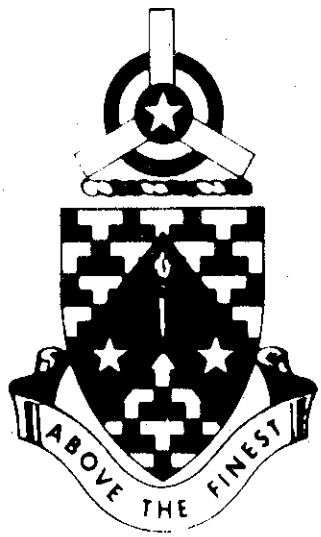
PROGRAMED TEXT

MAP READING
Part VI
DIRECTIONS - (INTERSECTION,
RESECTION, POLAR COORDINATES)

WD-41



AUGUST 1968

UNITED STATES ARMY
PRIMARY HELICOPTER SCHOOL
FORT WOLTERS, TEXAS

PROGRAMED TEXT

PROGRAM TEXT

FILE NO: WD-41

PROGRAM TITLE
Map Reading
Part VI
Directions-(Intersection, Resection, Polar Coordinates)

POI SCOPE: Converting azimuths using declination diagram; plotting azimuths; determining location by resection, intersection, and polar coordinates.

INSTRUCTOR REFERENCES:

FM 21-26

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August 1968

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PREFACE

The instruction presented in this text (Part VI) teaches you how to convert magnetic azimuths to grid azimuths utilizing the declination diagram. It also teaches you three methods of determining locations: (1) Intersection, (2) Resection, (3) Polar Coordinates.

The following materials are essential in answering the frames in this text:

Map of LEAVENWORTH, KANSAS, 1:50,000

Map of LIPAN, TEXAS, 1:50,000

Aeronautical Plotter

Coordinate Scale

PERFORMANCE OBJECTIVES

Upon completion of Part VI you will be able to:

A. Convert magnetic azimuths to grid azimuths.

B. Convert grid azimuths to magnetic azimuths.

C. Plot grid azimuths.

D. Solve problems by using intersection and resection.

E. Plot locations utilizing polar coordinates.

PART VI

DIRECTIONS (INTERSECTION, RESECTION, POLAR COORDINATES

Set 1. CONVERSION OF AZIMUTHS

FRAME 1

Refer to your Leavenworth map. Use your plotter to measure the grid azimuth from BM 761 at coordinate 4195 4915 to BM 972 at coordinate 4895 5160. The grid azimuth is 71 °.

(90 degrees) (See figure C, Frame 10) (11)

FRAME 12

Panel 4-13 indicates how intersection is accomplished. To perform intersection, you must take sightings on the unmapped object from at least 2 known locations.

(129°) (22)

FRAME 23

Plot the grid azimuth of 129° from position B.

FRAME 34

You are standing on the Burlington and Quincy railroad, somewhere between IATAN (295 712) and WESTON (3664). You make a compass sighting on the church steeple in the town of KICKAPOO at 3028 6295 and read a magnetic azimuth of 215°, which is a grid azimuth of 225°.

(71°) (When measuring azimuths with the plotter, read the value to the nearest whole degree.) (1)

FRAME 2

After determining the grid azimuth from BM 761 to ~~BM 972~~ to be 71°, you can determine the magnetic azimuth by (adding) (subtracting) the G-M angle.

(two) (12)

FRAME 13

In the event you sight an unmapped enemy field fortification which is not identified on your map, you would locate it on the map as follows: (Select one response)

a. First take an azimuth from your known position, then move to a new location which can be located on the map.

b. First take an azimuth from your known position, then move to a near-by location.

(Go on to the next frame) (23)

FRAME 24

Extend the two azimuths until the lines intersect. The grid coordinate of the enemy gun emplacement is 15S UP 4718 6770 68

(225°) (34)

FRAME 35

Plot the back azimuth of 225°, which is 45°, from the church to the railroad. 180 - 45

(subtracting) (Note the conversion rules for converting grid and magnetic azimuths, which are printed adjacent to the declination diagram at the bottom of your Leavenworth map.) (2)

FRAME 3

When using the declination diagram to convert azimuths from one type to another, the angular values are "rounded off" to the nearest whole degree. When you have less than 30 minutes, you drop them off; 30 minutes or more, you round up to the next whole degree. The magnetic azimuth from BM 761 to BM 972 is 62° .

71°00' - 9°30' = -10°

61°30' = 62°

(a.) (13)

FRAME 14

After observing the unmapped object at Point A in Panel 4-13, you would then orient the map and ~~orientate~~ locate your location

(47186768) (The fourth and eighth digits of the grid coordinate may vary ± 5. This results from pencil line thickness, slight errors in measuring angles, etc.) (24)

Set 3. RESECTION

FRAME 25

Panel 4-14 (page 25) indicates how resection is accomplished. To perform resection, you must take sightings on 2 or more objects of known location from your unknown location.

(45°) (35)

FRAME 36

Your location on the railroad is determined by the intersection of the grid back azimuth line of 45° with the railroad. You are located on the railroad at coordinate 15 54 up 3564 . 6631

(61°) (The G-M angle of 9°30' is rounded up to 10° to make this conversion on your Leavenworth map.) (3)

FRAME 4

Refer to your Leavenworth map. You are located at Fancy Bottoms School at coordinate 3395 6470. The grid azimuth from your position to Coffin School, at coordinate 3065 6002, is ~~275~~ °. 216°

(determine your location) (14)

FRAME 15

Once your location has been determined, you would then take a sighting on the unmapped object and then mark the azimuth on your map.

(two) (25)

FRAME 26

Study Panel 4-14. The first thing you should do when performing resection is to orient the map.

(3362 6631) (The fourth and eighth digits may vary by ± 5.) (36)

FRAME 37

Unless you can identify on the map a linear feature on which you are located, at least 2 features must be sighted from your unknown location to accurately accomplish resection.

(216°) (4)

FRAME 5

The magnetic azimuth of the line from Fancy Bottoms School to Coffin School is 206 °.

216°
-10°
206

(plot [draw], azimuth [sighting]) (15)

FRAME 16

You then move to a second known point, take another azimuth on the unmapped object, then plot the second azimuth on your map.

(orient, map) (26)

FRAME 27

Do the following exercises in resection on your Leavenworth map. From your present, unknown location you can take a compass sighting on the road junction at 3938 5180. Mark the road junction on the map, point A. The magnetic azimuth to point A is 281°. This means the grid azimuth will be 291° °.

281°
+10°
291°

(linear, two) (37)

Set 4. POLAR COORDINATES

FRAME 38 INFORMATION FRAME

Often a requirement exists to give direction from one point to another. Rather than say: "Fly to the next curve in the road and turn left, then go about halfway to the lake, turn right and you will cross over the C. P." It is best to say: "The C. P. is located 4000 meters from the Zion Hill Church on an azimuth of 325°." Directions given in this manner are called "Polar Coordinates."

(206°) (See conversion rule adjacent to declination diagram on Leavenworth map.) (5)

FRAME 6

The magnetic azimuth of a line from Coffin School to Fancy Bottoms School is 26°.

206°
-180
26°

(sighting, plot [draw], azimuth [sighting]) (16)

FRAME 17

The grid coordinate of the unmapped object can be determined from the point at which the two azimuths plotted on the map intersect.

(291°) (27)

FRAME 28

What is the grid back azimuth of 291°? 180 111°

FRAME 39

Use your plotter and the bar scale on your Leavenworth map to determine what is located at polar coordinate 333° (grid azimuth) 3,650 meters from the Hackberry School in grid square 4158.

(26°) (This is the back magnetic azimuth of the magnetic azimuth you calculated in the previous frame; therefore, it may be obtained as 206° - 180° = 26°.) (6)

FRAME 7

Refer to your Leavenworth map. You are located at Coffin School at coordinate 3065 6002 and take a compass sighting to the water tower located at coordinate 3335 5890. If your compass reading is 103°, the grid azimuth to the water tower is 113°.

+10°
113°

(intersect) (17)

FRAME 18

Do the following exercise in intersection on your Leavenworth map. Your first known location is at 4485 6625. This coordinate identifies your location as being at Flintlock Chapel. Mark this position A.

(111°) (28)

FRAME 29

Plot the grid back azimuth of 111° from point A and extend the line toward the general direction of your location. The next step in resection is to locate another point and take a magnetic sighting.

(Hazelwood School) (39)

FRAME 40

What are the polar coordinates from the Lanter School (grid square 4550) to the Moore School (grid square 4546)?

Answer: 180° 3525

(113°) (Compass readings provide magnetic azimuths, therefore grid azimuth = magnetic azimuth plus the G-M angle (rounded off). See note adjacent to declination diagram.) (7)

FRAME 8

Refer to your Leavenworth map. You are standing in the road junction at coordinate 3074 5780 and observe six radio towers at coordinate 3285 5860. What is the magnetic azimuth of a line of sight from your position to the center radio tower?

a. 61°
b. 71°
c. 81°

(Flintlock Church) (18)

FRAME 19

From your position at the church you take a compass sighting of 53° to an enemy gun emplacement. Using the declination diagram on your map, you convert this magnetic azimuth to a grid azimuth of 63 °.

(Take a compass sighting on a second identified feature) (29)

FRAME 30

You now sight on the second identified feature, a road junction at 4260 5225. Mark this road junction as point B. You then determine the magnetic azimuth to point B to be 33°. What is the grid azimuth? 43°

(180° at 3550 meters) (40)

FRAME 41

If you were flying a gun ship and a ground commander requested that you fire on a target which is on a compass heading of 50° and 4000 meters from his position (15S UP 3057 6272), he would be requesting that you fire at the Tracy Battery School.

50°
+10°
60°

(a. 61°) (The grid azimuth is 71°. To convert from grid to magnetic azimuth on this map, the G-M angle is subtracted. Therefore, the magnetic azimuth = 71° - 10° = 61°.)

Set 2. INTERSECTION

FRAME 9 INFORMATION FRAME

INTERSECTION is a method by which you can determine the location of an enemy gun, defensive position, etc, by plotting intersecting azimuths on a map. Accuracy in determining the location depends, in part, on the degree of angle at the point of intersection of the azimuths that you draw on your map.

(63°) (19)

FRAME 20

Use your plotter and plot the grid azimuth of 63° from position A.

(43°) (30)

FRAME 31

What is the grid back azimuth of 43°? 223°

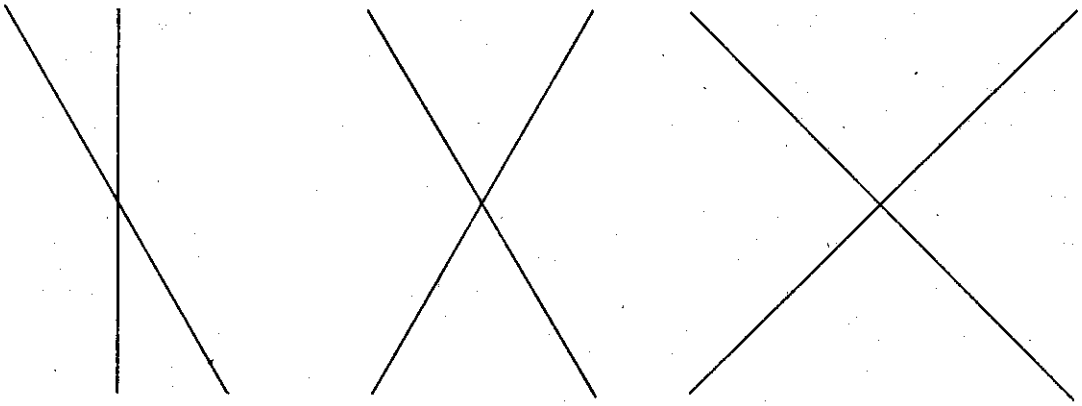
(Fancy Bottoms School) (41)

FRAME 42 INFORMATION FRAME

Throughout this text you have been measuring azimuths to the nearest whole degree and "rounding off" the G-M angle before computing azimuth conversions. This is the procedure that you should follow in solving problems on your Map Reading examinations. This procedure is normally accurate enough to solve the usual problems that you will encounter in flying. However, if you should find that you need a higher degree of accuracy, you will find that you can read azimuths to the nearest 15'(15', 30', 45') by interpolating between the whole degree marks on your plotter and then use the exact value of the G-M angle for your conversions.

FRAME 10

Which set of azimuth lines plotted below, produces the most accurate angle of intersection? c



a. b. c.

(Go on to the next frame.) (20)

FRAME 21

You would now move to a second known position, for example to coordinate 4500 6945. Label this position B.

(223°) (31)

FRAME 32

Plot the grid back azimuth of 223°. Extend the plotted line to intersect with the back azimuth line you have drawn from point A. You are located at the intersection of these two lines which is at coordinate 153 UP 4163 6102 +3

END OF PART VI

TURN TO PAGE 26 FOR SELF EVALUATION EXERCISE

(c) (10)

FRAME 11

Refer again to the figure in Frame 10. As a general rule, the most accurate intersection is obtained when azimuth sightings are approximately 90° degrees apart.

RETURN TO BOTTOM OF PAGE 2 FOR FRAME 12

(Go on to the next frame.) (21)

FRAME 22

From your new location at the road junction (position B), you take a compass sighting of 119° to the gun emplacement. You convert this to a grid azimuth of 129°.

RETURN TO TOP OF PAGE 3 FOR FRAME 23

(4146 5102) (The fourth and eighth digits of the grid coordinate may vary ± 5.) (32)

FRAME 33 INFORMATION FRAME

In rare instances, where you are standing on a linear feature, which can be identified on your map, (e.g. a railroad, road, river bank, etc.) it may only be necessary to sight on one identified feature to perform resection. Use your Leavenworth map to perform the following resection problem to illustrate how only one azimuth need be drawn to locate your position when you are standing on an identified linear feature.

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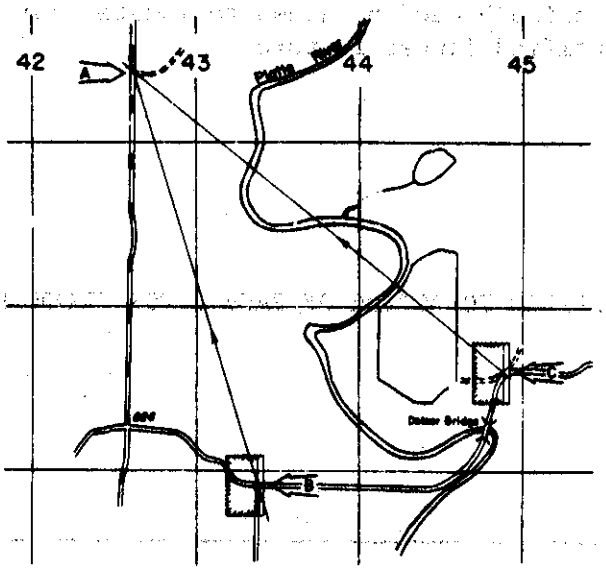
PANEL 4-13

PERFORMING INTERSECTION

Locating an unknown point by successively occupying two (or more) known positions and sighting on the unknown point is called INTERSECTION.



Method:

A. Orient map.

B. Determine your location (at B), take sighting to unknown point (A), plot azimuth (B-A) on your map.

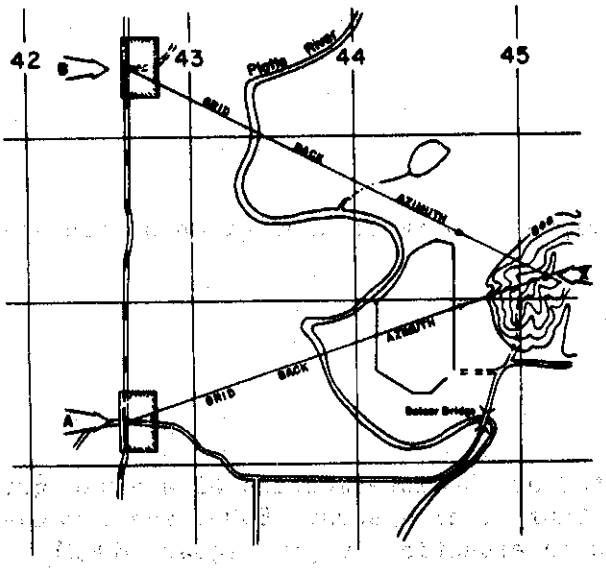
C. Move to new point (C), determine location, sight on A, plot azimuth (C-A) on your map.

D. Intersection of azimuths (B-A and C-A) on your map pinpoints map location of previously unknown point A.

PANEL 4-14

PERFORMING RESECTION

Locating your own position by sighting on two known features is called RESECTION.



Method:

A. Orient map.

B. Identify two (or more) prominent terrain features (A and B) and locate these on the map.

C. Take compass sightings on features A and B.

D. Plot back grid azimuths of the compass sightings on A and B, on your map.

E. Intersection of the back azimuths on your map pinpoints your previously unknown position (X).

SELF EVALUATION EXERCISE
Part VI

This exercise will test what you have learned from this programed text. Read each question carefully and select the correct answer.

Use Lipan map.

1. What is the grid back azimuth when given a magnetic azimuth of 28°?

   a. 208°
   b. 199°
   c. 137°
   d. 217°

2. What is the magnetic azimuth when given a grid azimuth of 155°?

   a. 164°
   b. 146°
   c. 335°
   d. 324°

3. What is located at the intersection of a given grid azimuth of 228° from the Live Oak Church, grid square 8503, and a magnetic azimuth of 114° from the road intersection in grid square 8003?

   a. Pond
   b. American Legion Memorial Highway
   c. Road intersection
   d. Windmill

4. What is the coordinate of your position if you see the church in grid square 8307 on a magnetic azimuth of 291° and you see the Live Oak Church on a magnetic azimuth of 214°

   a. 14S NL 0545 8745
   b. 14S NL 8750 0630
   c. 14S NM 8745 0545
   d. 14S NM 0630 8750

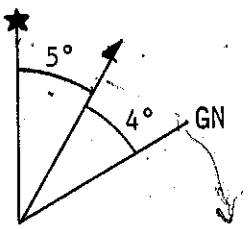
5. You are somewhere along the American Legion Memorial Highway (Highway 281) and you obtain a magnetic azimuth of 321° to the Fairview Church in grid square 8220. What is the coordinate of your position?

   a. 14S NM 8395 1835
   b. 14S NM 8374 1797
   c. 14S NM 8405 2010
   d. 14S NM 1835 8395

6. What are the Polar Coordinates from the Dobbs Valley Church (8415) to the Soda Springs Church (8816)?

a. From Dobbs Valley Church, magnetic azimuth 77°, 4,500 m.
b. From Dobbs Valley Church, grid azimuth 77°, 4,000 yds.
c. From Dobbs Valley Church, magnetic azimuth 68°✓ 4,900 yds.
d. From Soda Springs Church, magnetic azimuth 257°, 4,900 yds.

X 7. In order to convert a grid azimuth to a magnetic azimuth using the following diagram, you would



grid to mag add G-M ∠ of 9°
mag to grid add G-M ∠ of 9°

a. subtract the G-M angle.
b. know the value of grid declination.
c. know the value of magnetic declination.
d. add the G-M angle.

8. When finding a position using polar coordinates, you must have

a. point of origin.
b. distance.
c. direction.
d. all of the above.

ANSWERS TO SELF EVALUATION EXERCISE - PART VI

1. d
2. b
3. d
4. c
5. b
6. c
7. d
8. d