Online Surveying FE 208

Lectures 17
Inverse Computations and Area Calculations

Learning Objectives for this Lecture

1. **Be able to compute course lengths from coordinates using inversing**
2. **Be able to compute course bearings from coordinates**
3. **Know the different methods for computing area from coordinates**
4. **Be able to compute area from Double Meridian Distance method**
5. **Be able to compute area from Coordinate method**

Inverse Computations

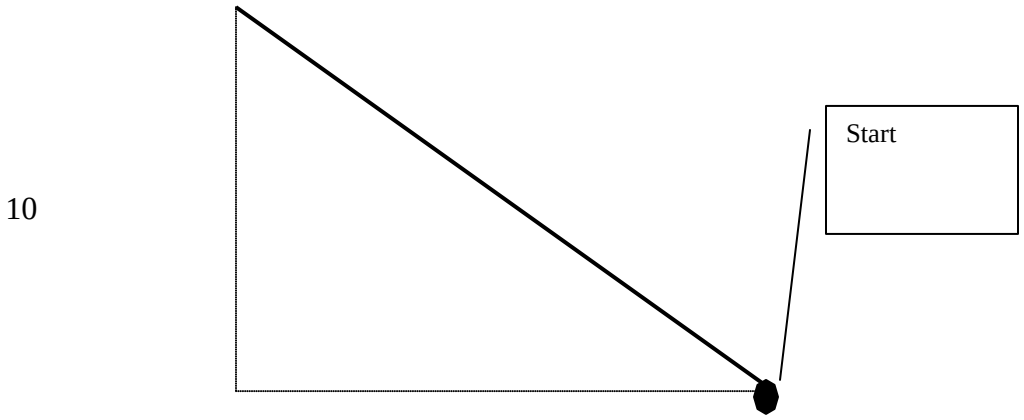
In previous lecture, we learned how to determine the latitude and departure of a line given its HD and bearing.

Given: The departure and latitude of a line. You can derive the length of a line

Tan azimuth (or bearing) = departure / latitude
Azimuth (or bearing) = $\tan^{-1}$ (departure / latitude)

$$length = \sqrt{(departure)^2 + (latitude)^2}$$

You can prove this easily with a right triangle



Tan azimuth (or bearing) = departure / latitude
Tan azimuth (or bearing) = -10/10

Azimuth (or bearing) = $\tan^{-1}$ (-10/10)
Azimuth (or bearing) = -45
Azimuth (or bearing) = 315^0 or N45W

$$length = \sqrt{(departure)^2 + (latitude)^2}$$

$$length = \sqrt{(-10)^2 + (10)^2}$$

$$length = 14.14$$

Area Calculations

Issue: Given departures & latitudes or coordinates: derive traverse area

Methods of measuring area

1. Split into simple shapes (triangles, rectangles, trapezoid)
   - calculate using formulas
2. Planimeters
3. Counting grids

Three methods used when all sides are straight lines.

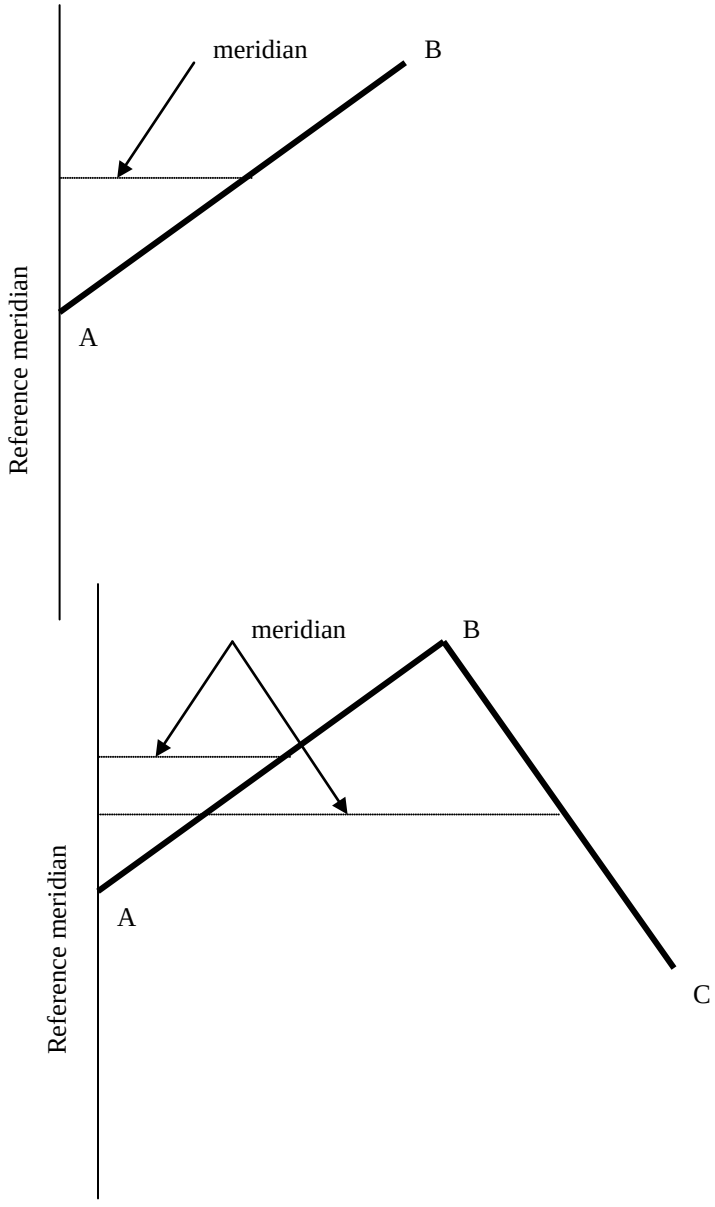
1. DMD – Double meridian distance
2. DPD – Double parallel distance
3. Coordinate method- used by many computer software programs

All should give same answers provided that rounding is consistent
Can be used as checks against each other

DMD method – Double Meridian Distance

Requires balanced departures and latitudes

The meridian is defined as the perpendicular distance from the midpoint of the course to some reference point usually placed through the most westerly point of the traverse to take care of problems with signs.



We can calculate the double meridian distance of each traverse line and calculate the traverse area by using the following formulas:

1. $DMD_{\text{each course}} = DMD_{\text{preceding course}} + \text{departure}_{\text{preceding course}} + \text{departure}_{\text{course}}$

2. Double area (DA) of each course = (the DMD of the course) * (the latitude of the course)

WATCH SIGNS!!!
3.

$$area = \frac{\left| larger_{\sum DA} - smaller_{\sum DA} \right|}{2}$$

Example

$DMD_{\text{each course}} = DMD_{\text{preceding course}} + \text{departure}_{\text{preceding course}} + \text{departure}_{\text{course}}$

Double area of each course = DMD x LAT

				Course Double Areas	
Sta	LAT_{adj}	DEP_{adj}	DMD	+ Double area	- Double area
A					
	-70.80	+416.04	+416.04		29455.63
F					
	+216.12	-176.90	+655.18	141597.50	
E					
	+405.79	+200.48	+678.76	275434.02	
D					
	-489.82	-738.35	+140.89		69010.74
C					
	-388.08	-57.61	-655.07	254219.57	
B					
	+326.79	+356.34	-356.34		116448.35
A					
	0.00	0.00			
				671251.09	214914.72

***check: final DMD should be same as final dep but with opposite sign**

$$area = \frac{\left| larger_{\sum DA} - smaller_{\sum DA} \right|}{2}$$

$$area = \frac{|671251.09 - 214914.72|}{2}$$

$$area = 228168.19 = 5.24 \ \ acres$$

DPD method

This method is similar to the DMD method except that it uses the latitudes instead of departures.

$DPD_{\text{each course}} = DPD_{\text{preceding course}} + \text{latitude}_{\text{preceding course}} + \text{latitude}_{\text{course}}$

Pay careful attention to the signs!

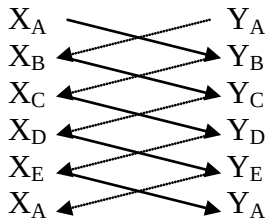
Coordinate method- the most commonly used method

Requires that coordinates be known and balanced.

Used by most computerized CAD and mapping systems.

General form of the equation is shown on page 306

Best remembered as lining up the x coordinates on one side and the y coordinates on the other repeating the coordinates as the last measurements to close the traverse.



			Coordinate Double Areas		
Sta	Northing	Easting	XY	YX	
A	10000.00	10000.00			
F	10070.80	9583.96	95,839,600.00	100,708,000.00	
E	9854.68	9760.86	98,299,668.89	94,446,858.93	
D	9448.89	9560.38	94,214,485.58	92,229,292.45	
C	9938.71	10298.73	97,311,566.91	95,017,844.31	
B	10326.79	10356.34	102,928,659.93	106,352,821.98	
A	10000.00	10000.00	103,267,900.00	103,563,400.00	
			591,861,881.31	592,318,217.67	456,336.36

Large Coordinate Double Area – Small Coordinate Double Area = double area
592,318,217.67 – 591,861,881.31 = 456,336.36 = double area

area = 456,336.36 / 2 = 228,168.18

acres = 228,168.18 / 43,560 = 5.24 acres

Checks with DMD method.