

Ferris State University
Surveying Engineering
Surveying Computation - SURE 215
PROBLEM NUMBER 99
Designed by: S.R. Hashimi

Area Partitioning Problem
By A Line With A Given Azimuth
Write your answers in the spaces provided

Given Data:

<u>POINT NO.</u>	<u>DISTANCE</u>	<u>AZIMUTH in DMS</u>	<u>NORTHING</u>	<u>EASTING</u>
1			6226.562	6841.729
	478.553	222 48 57.6		
2			5875.524	6516.482
	562.348	147 24 27.0		
3			5401.733	6819.397
	626.883	73 5 1.5		
4			5584.139	7419.155
	678.666	359 10 41.0		
5			6262.736	7409.420
	568.842	266 21 14.4		

The Parcel Is To Be Divided Into Two Equal Parts By A Line "AB" Having An Azimuth Of 48 20 35

Compute:

(a). The Coordinates Of The End Points Of The Dividing Line:

Northing Of A = _____, Easting Of A = _____

Northing Of B = _____, Easting Of B = _____

(b). Check By Computing The Areas Of The Two Parcels:

Area of Parcel 1 = _____, Area of Parcel 2 = _____

DIVIDING LINE B5 HAS AZIMUTH OF $48^{\circ}20'35''$
INITIAL ESTIMATE - PLACE ONE END OF LINE AT POINT 5 AND FIND
COORDINATES OF POINT B.

DRAW LINE BETWEEN 2-5 AND SOLVE FOR MISSING ELEMENTS IN
TRIANGLE 2-5-B

$$D_{5-2} = [(X_2 - X_5)^2 + (Y_2 - Y_5)^2]^{1/2} = 973.2787'$$

$$AZ_{5-2} = \tan^{-1} \left[\frac{X_2 - X_5}{Y_2 - Y_5} \right] = \tan^{-1} \left[\frac{-892.938'}{-387.212'} \right] = 246^{\circ}33'23.8''$$

$$\alpha = AZ_{5-2} - AZ_{5-B} = 18^{\circ}12'48.8''$$

$$\beta = AZ_{2-B} - AZ_{2-5} = 80^{\circ}51'03.2''$$

$$\gamma = AZ_{B-5} - AZ_{B-2} = 80^{\circ}56'08.0''$$

$$\alpha + \beta + \gamma = 180^{\circ}00'00'' \quad \checkmark$$

USING SINE LAW: $\frac{D_{5-2}}{\sin \gamma} = \frac{D_{5-B}}{\sin \beta} = \frac{D_{2-B}}{\sin \alpha}$

$$D_{5-B} = \frac{D_{5-2}}{\sin \gamma} \sin \beta = 973.0482'$$

$$D_{2-B} = \frac{D_{5-2}}{\sin \gamma} \sin \alpha = 308.0546'$$

$$X_B = X_2 + D_{2-B} \sin AZ_{2-B} = 6682.4188'$$

$$Y_B = Y_2 + D_{2-B} \cos AZ_{2-B} = 5615.9809'$$

$$X_B = X_5 + D_{5-B} \sin AZ_{5-B} = 6682.4188' \quad \checkmark$$

$$Y_B = Y_5 + D_{5-B} \cos AZ_{5-B} = 5615.9809' \quad \checkmark$$

FROM AREA CALCULATIONS ATTACHED, THE INITIAL ESTIMATED POLYGON
IS TOO SHORT.

$$A_{DEFICIENT} = A_{DESIGNED} - A_{ACTUAL} = 289,160.9103 - 241,762.1226 \\ = 42,398.7877 \text{ SQ. FT.}$$



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DRAW LINE 6-7 PARALLEL TO LINE B-5 AT SOME DISTANCE "X"
 FROM THE INITIAL ESTIMATED DIVISION LINE (B-5). AREA OF
 B-6-7-5 EQUALS THE DEFICIENT AREA, 42,358.7877 SQ. FT.
 DRAW LINE FROM B PERPENDICULAR TO LINE 6-7 & LABEL AS "C"
 DRAW LINE FROM 7 PERPENDICULAR TO LINE B-5 & LABEL AS "D"
 THEN, AREA OF B-6-7-5 IS

$$A = A_1 + A_2 - A_3$$

WHERE: $A_1 = A_{B-C-L} \Rightarrow$ RECOGNIZE $\tan \gamma = \frac{X}{D_{C-L}} \Rightarrow D_{C-L} = \frac{X}{\tan \gamma}$

$$A_1 = \frac{1}{2}(\text{base})(\text{height}) = \frac{1}{2} \left(\frac{X}{\tan \gamma} \right) X$$

$$= \frac{X^2}{2 \tan \gamma}$$

$$A_2 = (D_{B-5})(X)$$

$A_3 = A_{S-D-7} \Rightarrow$ RECOGNIZE $\tan \phi = \frac{X}{D_{S-D}} \Rightarrow D_{S-D} = \frac{X}{\tan \phi}$

$$A_3 = \frac{1}{2}(\text{base})(\text{height}) = \frac{1}{2} \left(\frac{X}{\tan \phi} \right) X$$

$$= \frac{X^2}{2 \tan \phi}$$

Therefore,

$$A = \left(\frac{1}{2 \tan \gamma} \right) X^2 + D_{B-5} X - \left(\frac{1}{2 \tan \phi} \right) X^2$$

$$2A = (\cot \gamma - \cot \phi) X^2 + D_{B-5} X$$

$$(\cot \gamma - \cot \phi) X^2 + D_{B-5} X - 2A = 0$$

$$Q = A \angle_{S-B} - A \angle_{S-7} = 49^\circ 05' 54''$$

$$a = \cot \gamma - \cot \phi = -0.704705783$$

$$b = 2D_{B-5} = 1946.0964$$

$$c = -2A = -84,797.5754$$

$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \underline{44.2833} \text{ or } 2,717.2896$$

↳ NOT VALID SOLUTION
TO PROBLEM



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$$\sin \gamma = \frac{X}{D_{B-L}} \Rightarrow D_{B-L} = \frac{X}{\sin \gamma} = 44.0433'$$

$$\sin \phi = \frac{X}{D_{S-7}} \Rightarrow D_{S-7} = \frac{X}{\sin \phi} = 50.5297'$$

$$X_6 = X_B + D_{B-L} \sin A_{Z_{B-L}} = 6706.5741'$$

$$Y_6 = Y_B + D_{B-L} \cos A_{Z_{B-L}} = 5578.1994'$$

$$X_7 = X_5 + D_{S-7} \sin A_{Z_{S-7}} = 7410.2596'$$

$$Y_7 = Y_5 + D_{S-7} \cos A_{Z_{S-7}} = 6204.2123'$$

$$D_{3-6} = D_{2-3} - D_{2-B} - D_{B-L} = 209.4501'$$

$$X_6 = X_3 + D_{3-6} \sin A_{Z_{3-6}} = 6706.574' \checkmark$$

$$Y_6 = Y_3 + D_{3-6} \cos A_{Z_{3-6}} = 5578.200' \checkmark$$

$$D_{4-7} = D_{4-5} - D_{S-7} = 620.1363'$$

$$X_7 = X_4 + D_{4-7} \sin A_{Z_{4-7}} = 7410.259' \checkmark$$

$$Y_7 = Y_4 + D_{4-7} \cos A_{Z_{4-7}} = 6202.211' \checkmark$$

FINAL CHECK, CALCULATE AREA OF POLYGON 1-2-6-7-5
TO SEE IF IT COMES OUT WITH THE DESIRED AREA
-AREA CHECKS, SEE ATTACHED.

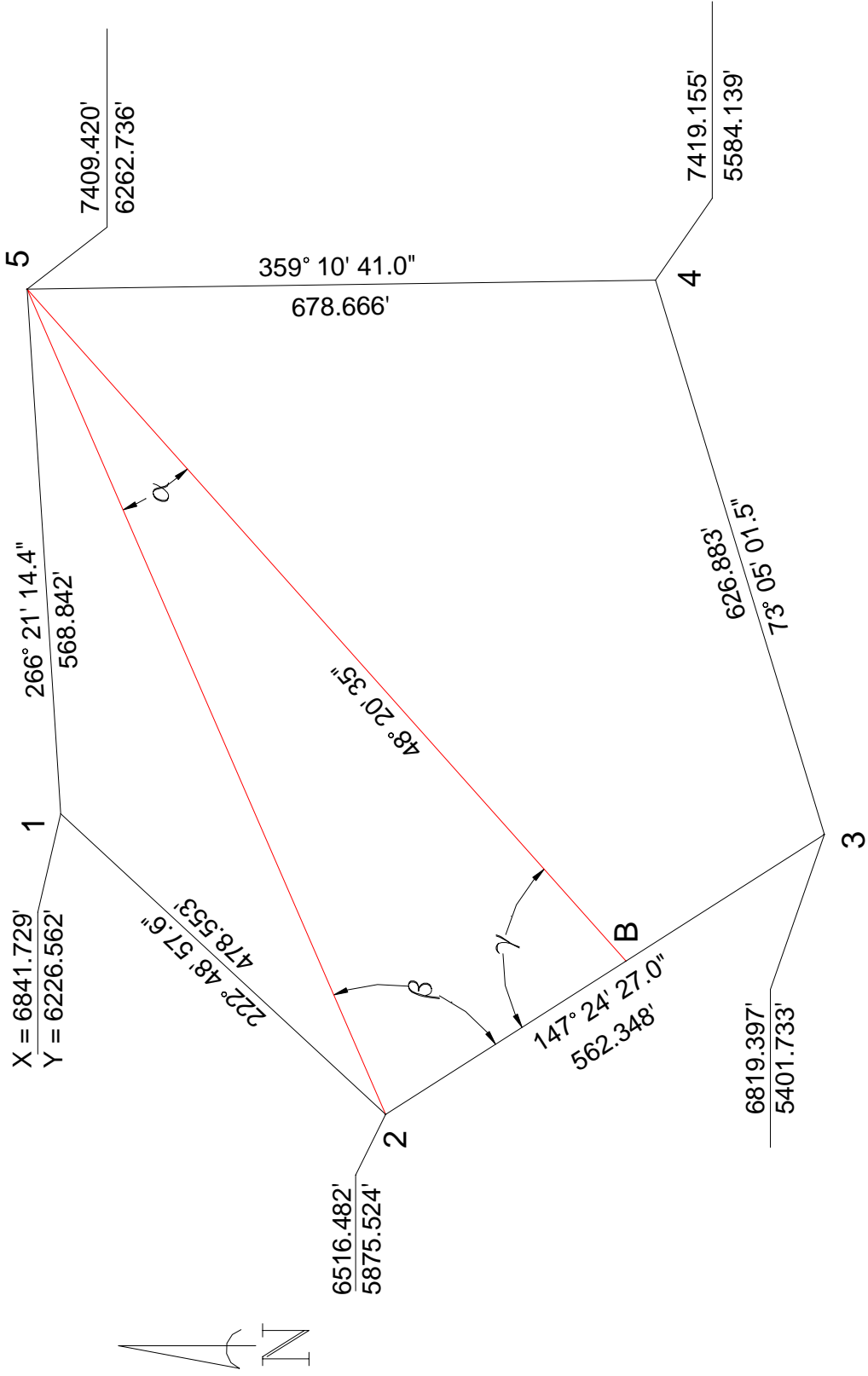


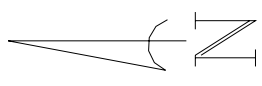
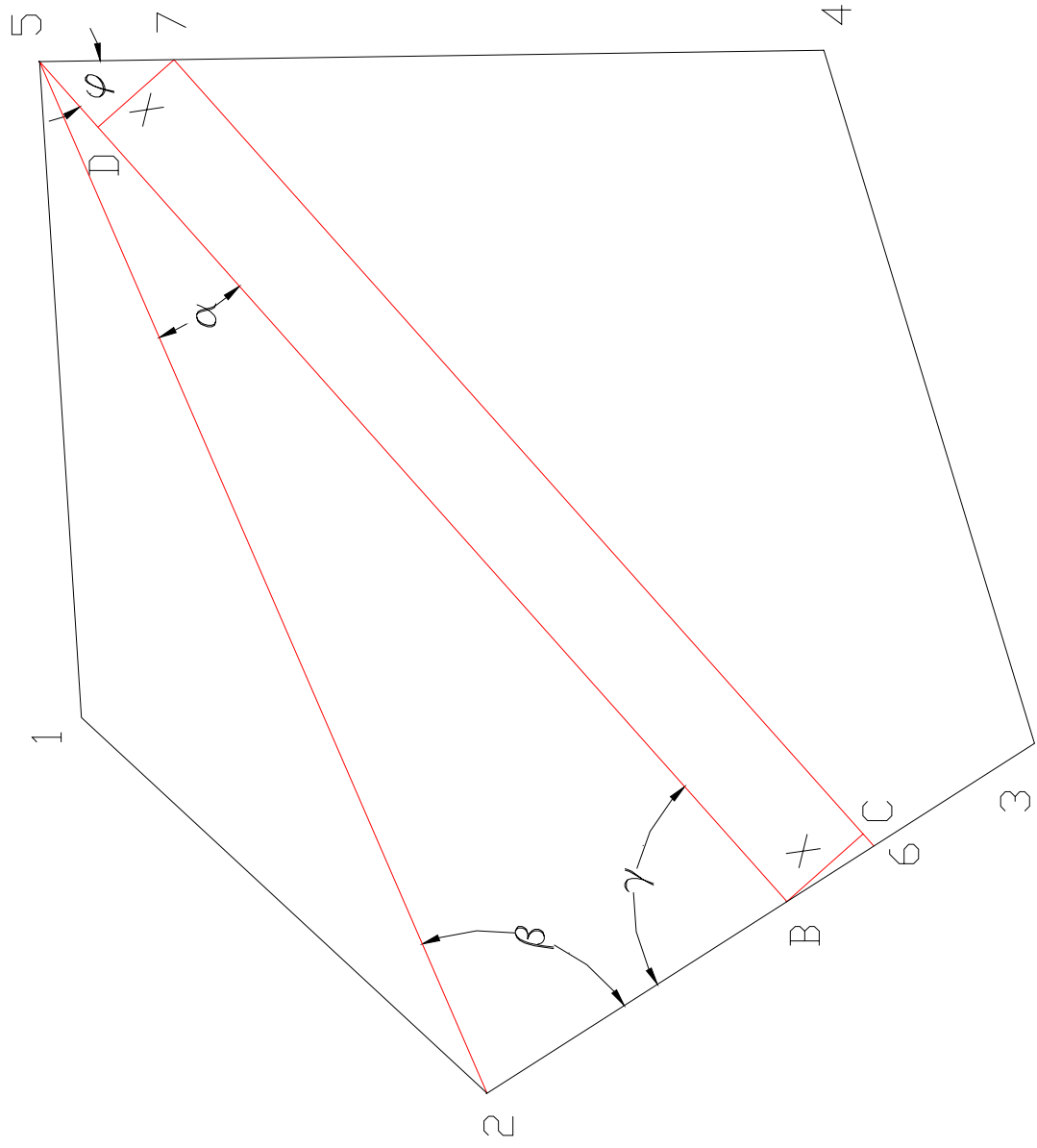
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Area of original polygon 1-2-3-4-5:

Area Calculations

Point	X	Y
1	6841.729	6226.562
2	6516.482	5875.524
3	6819.397	5401.733
4	7419.155	5584.139
5	7409.42	6262.736
1	6841.729	6226.562

Sum #1 = 206078921.6706
Sum #2 = 204942278.0295
2 Area = 1136643.641
Area = 568321.8206

The desired area is $\frac{1}{2}$ the total area of the original polygon = 284,160.9103 sq. ft.

Area of initial estimated polygon 1-2-B-5:

Area Calculations

Point	X	Y
1	6841.729	6226.562
2	6516.482	5875.524
B	6682.4188	5615.9809
5	7409.42	6262.736
1	6841.729	6226.562

Sum #1 = 164780619.1881
Sum #2 = 164297094.9430
2 Area = 483524.2451
Area = 241762.1226

Area of final polygon 1-2-6-7-5:

Area Calculations

Point	X	Y
1	6841.729	6226.562
2	6516.482	5875.524
6	6706.5741	5578.1994
7	7410.2596	6204.2123
5	7409.42	6262.736
1	6841.729	6226.562

Sum #1 = 210701701.0259
Sum #2 = 210133379.1422
2 Area = 568321.8837
Area = 284160.9419