جامعة الفرات الاوسط التقنية /المعهد التقني سماوة

قسم / تقنيات المساحة

المحاضرة الثانية

اسم المادة / المساحة-٢

المرحلة الدراسية / الثانية

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TRAVERSE COMPUTATIONS

- In dealing with a closed traverse, we have computations in:
- 1) Determining latitudes and departures
- 2) Calculating total error of closure
- 3) Balancing the survey
- 4) Determining adjusted positions of traverse stations
- 5) Area computation
- 6) Area subdivision

LATITUDE and DEPARTURE

1- **Latitude**

- Projection of a line onto a reference
- meridian or North-South line ⟶
- Lines with Northerly bearings ⟶ (+) LAT
- Lines with Southerly bearings (-) LAT
- Equal to distance*cosine of bearing angle
    - Latitude = d*Cosß

LATITUDE and DEPARTURE

- **Departure**
- Projection of a line onto a reference parallel
- or East-West line →
- Lines with Easterly bearings → (+) DEP
- Lines with Westerly bearings (-) DEP
- Equal to distance*sine of bearing angle

$$Departure = d * Sin\ \beta$$

Traverse Adjustment

- Adjustment Methods to remove random
- errors
- – Compass Rule*
- – Transit Rule
- – Crandall Method
- – General Least Squares Method

Traverse Adjustment via Compass Rule

$$C_{Li} = -\frac{\sum \text{lat}}{\sum \text{HD}} \cdot \text{HD}_i = \text{correction to a latitude}$$

$$\text{note: } -\frac{\sum \text{lat}}{\sum \text{HD}} = \text{Correction per ft.}$$

$$C_{Di} = -\frac{\sum \text{dep}}{\sum \text{HD}} \cdot \text{HD}_i = \text{correction to a departure}$$

$$\text{note: } -\frac{\sum \text{dep}}{\sum \text{HD}} = \text{Correction per ft.}$$

$$\text{bal. lat.} = \text{lat.} + C_L$$

$$\text{bal. dep.} = \text{dep.} + C_D$$

Traverse Adjustment (cont.)

Example calculation for line 1-2

$$C_L = -\frac{0.056}{552.784} \cdot 104.919 = -0.011$$

$$C_D = -\frac{0.050}{552.784} \cdot 104.919 = -0.009$$

$$\text{bal. lat.} = 98.592 + (-0.011) = 98.581$$

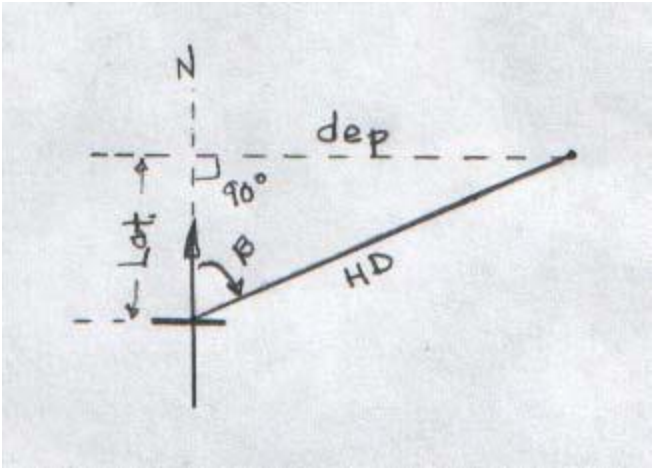
$$\text{bal. dep.} = -35.884 + (-0.009) = -35.893$$

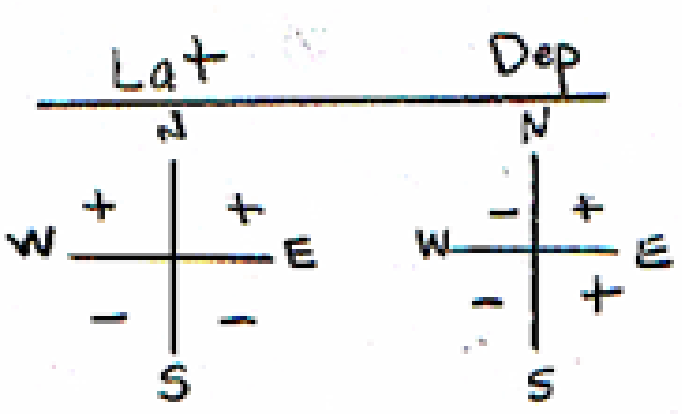
Traverse Adjustment (cont.)

Line	Lat. (ft.)	Dep. (ft.)	Correction (ft.)		Bal. Lat.(ft.)	Bal. Dep(ft.)
			Lat	Dep		
1-2	+98.592	-35.884	-0.011	-0.009	+98.581	-35.893
2-3	+50.012	+211.819	-0.022	-0.020	+49.990	+211.799
3-1	-148.548	-175.885	-0.023	-0.021	-148.571	-175.906
sums	+0.056	+0.050	-0.056	-0.050	0.000	0.000

Calculate Latitude and Departure

- Latitude = lat = HD · Cos(β)= HD · Cos(Az)
- • Departure = dep = HD · Sin (β) = HD· Sin (Az)



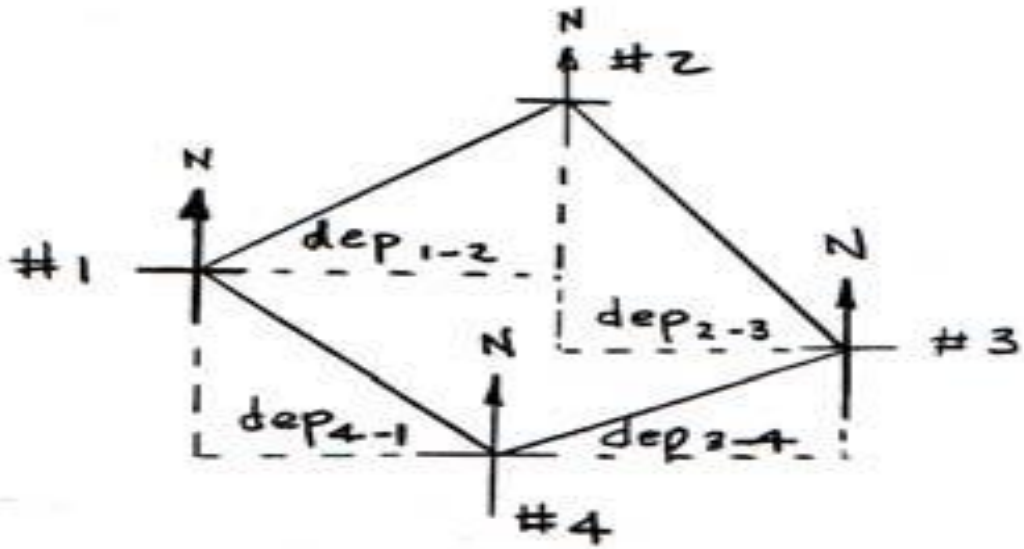


Latitudes and Departures (cont.)

Traverse type	**Mathematical Condition**	
	latitudes	departures
Loop	Σ lat = 0	Σ dep = 0
Connecting	Σ lat = ΔN	Σ dep = ΔE

Latitude and Departure (cont.)

- Loop Traverse

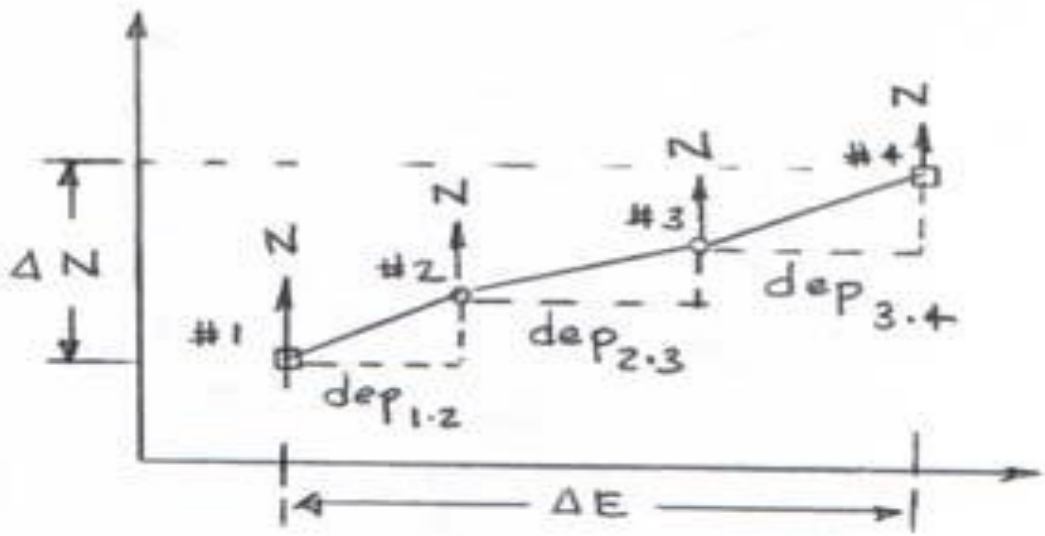


$$\sum dep = dep_{1-2} + dep_{2-3} + dep_{3-4} + dep_{4-1} = 0$$

$$\sum Lat = 0$$

Latitude and Departure (cont.)

- Connecting Traverse



$$\Sigma' dep = dep_{1\cdot2} + dep_{2\cdot3} + dep_{3\cdot4} = \Delta E$$

$$\Sigma' lat = \Delta N$$

Lat and Dep (cont.)

- Example Calculation for lines 1-2 and 2-3
- • Latitude = lat = HD · Cos(β)= HD · Cos(Az)
- • Departure = dep = HD · Sin (β) = HD· Sin (Az)

$$\mathbf{lat = 104.919 \cdot \cos(340^\circ 00'00'') = +98.592}$$

$$\mathbf{dep = 104.919 \cdot \sin(340^\circ 00'00''0 = -35.884}$$

$$\mathbf{lat = 217.643 \cdot \cos(76^\circ 42'55'') = +50.012}$$

$$\mathbf{dep = 217.643 \cdot \sin(76^\circ 42'55'') = +211.819}$$

Lat and Dep (cont.)

Line	Az	HD (ft.)	Lat (ft.)	Dep (ft.)
1-2	340°00’00”	104.919	98.592	- 35.884
2-3	076°42’55”	217.643	50.012	211.819
3-1	229°48’59”	230.222	- 148.548	-175.885
	Totals	552.784	+ 0.056	+ 0.050

Calculate Coordinates

- Usually, the coordinates of the first point are assigned
- arbitrary values so other coordinates w be positive.

$$\mathbf{N_i = N_{i-1} + bal.\ lat_{i-1,\,i}}$$

$$\mathbf{E_i = E_{i-1} + bal.\ dep_{i-1,\,i}}$$

$$\mathbf{N_2 = N_1 + bal.\ lat_{1-2} = 1000.000 + 98.581 = 1098.581}$$

$$\mathbf{E_2 = E_1 + bal.\ dep_{1-2} = 1000.000 + (-35.893) = 964.107}$$

Calculate Coordinates (cont.)

$$N_i = N_{i-1} + \text{bal. lat}_{i-1,i}$$

$$E_i = E_{i-1} + \text{bal. dep}_{i-1,i}$$

Sta	Bal. Lat. (ft.)	Bal. Dep. (ft.)	Coordinates (ft.)	
			Northing	Easting
1			1000.000	1000.000
	+98.581	-35.893		
2			1098.581	964.107
	+49.990	+211.799		
3			1148.571	1175.906
	-148.571	-175.906		
1			1000.000	1000.000

Calculate Area by Coordinates

$$2\ \text{Area} = E_1 \cdot (N_n - N_2) + E_2 \cdot (N_1 - N_3) + \ldots E_n \cdot (N_{n-1} - N_1)$$

- where n = number of sides
- a term is written for each vertex or traverse station
- parenthetical term = (preceding N – following N)

Area by Coordinates (cont.)

- For computational convenience the terms are written in a vertical stack. An example for a 3-sided traverse is as follows:

$$E_1 \cdot (N_3 - N_2)$$
$$E_2 \cdot (N_1 - N_3)$$
$$E_3 \cdot (N_2 - N_1)$$

$$\Sigma = 2 \text{ Area}$$

Area by Coordinates (cont.)

Example calculation:

$$\mathbf{1000.000 \cdot (1148.571 - 1098.581) = 1000.000 \cdot (49.990) = \quad 49990.0000}$$

$$\mathbf{964.107 \cdot (1000.000 - 1148.571) = 964.107 \cdot (-148.571) = -143238.3411}$$

$$\mathbf{1175.906 \cdot (1098.581 - 1000.00) = 1175.906 \cdot (98.581) = \quad \underline{115921.9894}}$$

$$\mathbf{2\ Area = 22673.6483\ ft.^2}$$

Area = 22,673.6483 ft^2 ÷ 2 = 11,336.8242 ft^2

Area in acres = 11,336.8242 ft^2 ÷ 43560 ft^2/acre = 0.26 acres