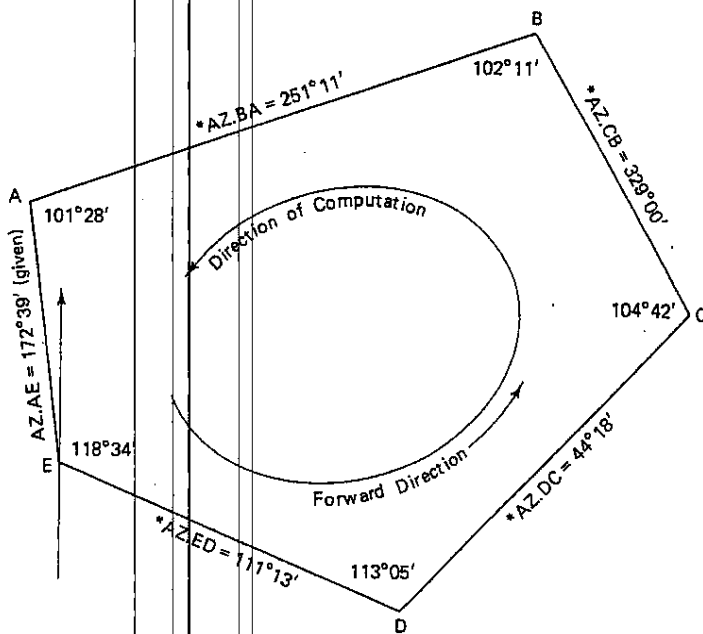


TRAVERSE ADJUSTMENTS

- (1) Balance Field Angles SUM = $180(n-2)$
 - Equally
 - Arbitrarily
 - Field Conditions
 - Does angle error meet standard?
- (2) Compute azimuth of each leg
- (3) Convert azimuths to bearings
- (4) Compute latitude (Northing) and departure (Easting) of each leg
 - Latitude = $\cos(\text{brng}) \cdot \text{distance}$
 - Departure = $\sin(\text{brng}) \cdot \text{distance}$
- (5) Compute linear closure error
 - Does it meet standard?
- (6) Compass Rule Adjustment to Latitudes and Departures
 - Compute latitude and departure corrections
 - Proportional to length of legs
 - After Adjustment Latitude must sum to zero; Departure must sum to zero
- (7) Compute coordinates of each point
- (8) Compute adjusted (final) bearings and distances
- (9) Calculate area

Two Methods of Adjusting Field Angles

| Station | Field Angle | Arbitrarily Balanced | Equally Balanced |
|---------|---------------------|----------------------|-----------------------|
| A | 101°28' | 101°28' | 101°27'48" |
| B | 102°11'30" | 102°11' | 102°11'18" |
| C | 104°42' | 104°42' | 104°41'48" |
| D | 113°05'30" | 113°05' | 113°05'18" |
| E | 118°34' | 118°34' | 118°33'48" |
| | <u>538°120'60"</u> | <u>= 538°120'</u> | <u>= 538°117'180"</u> |
| | <u>= 540°01'00"</u> | <u>= 540°00'</u> | <u>= 540°00'00"</u> |



$$\begin{aligned}
 &AZ.AE = 172^{\circ}39' \text{ Forward Azimuth} \\
 &\quad + 180^{\circ} \\
 &AZ.EA = 352^{\circ}39' \text{ Back Azimuth} \\
 &\quad + E \quad 118^{\circ}34' \text{ Interior Angle} \\
 &AZ.ED = 470^{\circ}73' \text{ Forward Azimuth} \\
 &\quad \downarrow \text{OR } -360^{\circ} \\
 &*AZ.ED = 111^{\circ}13' \text{ Forward Azimuth} \\
 &\quad + 180^{\circ}00' \\
 &AZ.DE = 291^{\circ}13' \text{ Back Azimuth} \\
 &\quad + D \quad 113^{\circ}05' \text{ Interior Angle} \\
 &AZ.DC = 404^{\circ}18' \text{ Forward Azimuth} \\
 &\quad \downarrow \text{OR } -360^{\circ} \\
 &*AZ.DC = 44^{\circ}18' \text{ Forward Azimuth} \\
 &\quad + 180^{\circ} \\
 &AZ.CD = 224^{\circ}18' \text{ Back Azimuth} \\
 &\quad + C \quad 104^{\circ}42' \text{ Interior Angle} \\
 &*AZ.CB = 329^{\circ}00' \text{ Forward Azimuth} \\
 &\quad - 180^{\circ} \\
 &AZ.BC = 149^{\circ}00' \text{ Back Azimuth} \\
 &\quad + B \quad 102^{\circ}11' \text{ Interior Angle} \\
 &*AZ.BA = 251^{\circ}11' \text{ Forward Azimuth} \\
 &\quad - 180^{\circ} \\
 &AZ.AB = 71^{\circ}11' \text{ Back Azimuth} \\
 &\quad + A \quad 101^{\circ}28' \text{ Interior Angle} \\
 &*AZ.AE = 172^{\circ}39' \text{ [CHECK] Forward Azimuth}
 \end{aligned}$$

*Computed Counterclockwise Forward Azimuth

Technique for Counterclockwise Solution:
 Back Azimuth of Previous Course + Interior Angle = Forward Azimuth

Azimuth computation, counterclockwise solution.

Closed Traverse Computations

| Course | Distance | Bearing | Azimuth | Latitude | Departure |
|---------------|----------|------------|---------|------------------------------|------------------------------|
| AB | 164.95' | N 71°11' E | 71°11' | +53.20 | +156.13 |
| BC | 88.41' | S 31°00' E | 149°00' | -75.78 | + 45.53 |
| CD | 121.69' | S 44°18' W | 224°18' | -87.09 | - 84.99 |
| DE | 115.89' | N 68°47' W | 291°13' | +41.94 | -108.03 |
| EA | 68.42' | N 7°21' W | 352°39' | +67.86 | - 8.75 |
| $P = 559.36'$ | | | | $\Sigma \text{ lat} = +0.13$ | $\Sigma \text{ dep} = -0.11$ |

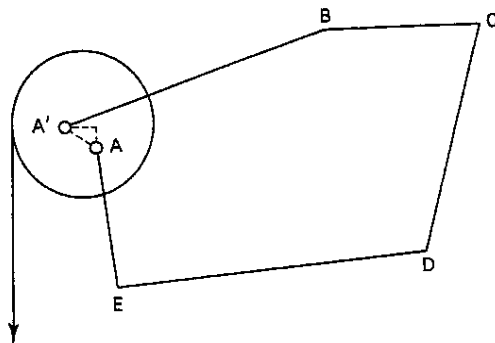
$$E = \sqrt{\Sigma \text{ lat}^2 + \Sigma \text{ dep}^2}, \quad E = \sqrt{0.13^2 + 0.11^2}, \quad E = 0.17'$$

where E is the linear error of closure.

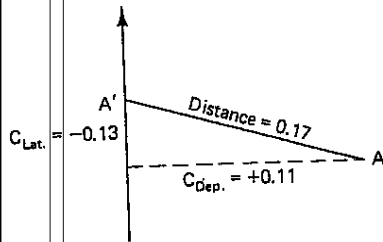
$$\text{Accuracy ratio} = \frac{E}{P} \text{ (where } P = \text{ the perimeter of the traverse)}$$

$$\text{Accuracy ratio} = \frac{0.17}{559.36} = \frac{1}{3290} = \frac{1}{3300}$$

Traverse Computation Began at A, and Terminated at A'



*Closure Error = AA'
 Closure Correction = A'A



$$A'A = \sqrt{C_{\text{Lat.}}^2 + C_{\text{Dep.}}^2} = 0.17$$

Bearing of A'A can be Computed from the Relationship:

$$\tan \text{ Bearing} = \frac{C_{\text{Dep.}}}{C_{\text{Lat.}}} = \frac{0.11}{-0.13}$$

$$\text{Bearing Angle} = 40.23636^\circ$$

$$\text{Bearing A'A} = \text{S.}40^\circ14'11''\text{E}$$

- * $\Sigma \text{ lat.}$ = error in latitudes
- $\Sigma \text{ dep.}$ = error in departures
- C lat. = required correction in latitudes
- C dep. = required correction in departures

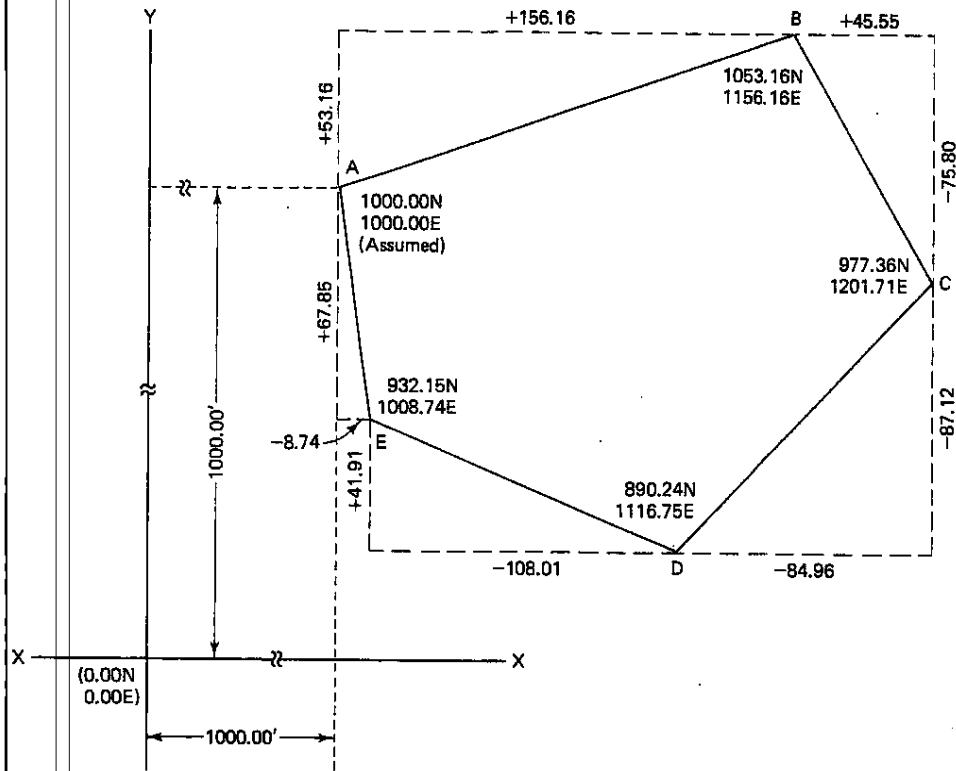
Figure 6-17 Closure error and closure correction.

Compass Rule Adjustments

| Course | Distance | Bearing | Latitude | Departure | C lat. | C dep. | Bal- anced Lati- tudes | Balanced Depar- tures |
|---------------|----------|------------|------------------------------|------------------------------|-------------------------|-------------------------|---------------------------------|-----------------------------|
| AB | 164.95' | N 71°11' E | +53.20 | +156.13 | -0.04 | +0.03 | +53.16 | +156.16 |
| BC | 88.41' | S 31°00' E | -75.78 | + 45.53 | -0.02 | +0.02 | -75.80 | + 45.55 |
| CD | 121.69' | S 44°18' W | -87.09 | - 84.09 | -0.03 | +0.03 | -87.12 | - 84.96 |
| DE | 115.89' | N 68°47' W | +41.94 | -108.03 | -0.03 | +0.02 | +41.91 | -108.01 |
| EA | 68.42' | N 7°21' W | +67.86 | - 8.75 | -0.01 | +0.01 | +67.85 | - 8.74 |
| $P = 559.36'$ | | | $\Sigma \text{ lat} = +0.13$ | $\Sigma \text{ dep} = -0.11$ | $C \text{ lat} = -0.13$ | $C \text{ dep} = +0.11$ | 0.00 | 0.00 |

Adjustment of Original Distances and Bearings

| Course | Balanced Latitude | Balanced Departure | Adjusted Distance | Adjusted Bearing | Original Distance | Original Bearing |
|--------|----------------------|-----------------------|----------------------|---------------------|----------------------|---------------------|
| AB | +53.16 | +156.16 | 164.96 | N 71°12'01" E | 164.95 | N 71°11' E |
| BC | -75.80 | + 45.55 | 88.43 | S 31°00'10" E | 88.41 | S 31°00' E |
| CD | -87.12 | - 84.96 | 121.69 | S 44°16'51" W | 121.69 | S 44°18' W |
| DE | +41.91 | -108.01 | 115.86 | N 68°47'34" W | 115.89 | N 68°47' W |
| EA | +67.85 | - 8.74 | 68.41 | N 7°20'24" W | 68.42 | N 7°21' W |
| | 0.00 | 0.00 | $P = 559.35'$ | | $P = 559.36'$ | |



Computation of Coordinates Using Balanced Latitudes and Departures

| Course | Balanced Latitude | Balanced Departure | Station | Northing | Easting |
|--------|-------------------|--------------------|---------|---------------|----------------|
| | | | A | 1000.00 | 1000.00 |
| AB | +53.16 | +156.16 | | <u>+53.16</u> | <u>+156.16</u> |
| | | | B | 1053.16 | 1156.16 |
| BC | -75.80 | +45.55 | | <u>-75.80</u> | <u>+45.55</u> |
| | | | C | 977.36 | 1201.71 |
| CD | -87.12 | -84.96 | | <u>-87.12</u> | <u>-84.96</u> |
| | | | D | 890.24 | 1116.75 |
| DE | +41.91 | -108.01 | | <u>+41.91</u> | <u>-108.01</u> |
| | | | E | 932.15 | 1008.74 |
| EA | +67.85 | -8.74 | | <u>+67.85</u> | <u>-8.74</u> |
| | | | A | 1000.00 | 1000.00 |
| | | | | check | check |

| | Field Angle | Balanced Angle | Azimuth |
|-------|-------------|----------------|---------|
| A | | | 172°39' |
| E | 118°34' | 118°34' | |
| D | 113°05'30" | 113°05' | 111°13' |
| C | 104°42' | 104°42' | 44°18' |
| B | 102°11'30" | 102°11' | 329°00' |
| A | 101°28' | 101°28' | 251°11' |
| <hr/> | | | |
| E | 540°01' | 540° | |

| | Azimuth | Bearing | Field Distance | Lat | Dep | Lat Corr | Dep Corr | Balanced Lat | Balanced Dep | Adj Distance | Adj Bearing | North Coord | East Coord |
|---|---------|----------|----------------|--------|---------|----------|----------|--------------|--------------|--------------|-------------|-------------|------------|
| A | 71°11' | N71°11'E | 164.95 | 53.20 | 156.13 | -0.04 | 0.03 | 53.16 | 156.16 | 164.96 | N71°21'01"E | 1000.00 | 1000.00 |
| B | 149°00' | S31°00'E | 88.41 | -75.78 | 45.53 | -0.02 | 0.02 | -75.80 | 45.55 | 88.43 | S31°00'10"E | 1053.16 | 1156.16 |
| C | 224°18' | S44°18'W | 121.69 | -87.09 | -84.99 | -0.03 | 0.03 | -87.12 | -84.96 | 121.69 | S44°16'51"W | 977.36 | 1201.71 |
| D | 291°13' | N68°47'W | 115.89 | 41.94 | -108.03 | -0.03 | 0.02 | 41.91 | -108.01 | 115.86 | N68°47'34"W | 890.24 | 1116.75 |
| E | 352°39' | N07°21'W | 68.42 | 67.86 | -8.75 | -0.01 | 0.01 | 67.85 | -8.74 | 68.41 | N07°20'24"W | 932.15 | 1008.74 |
| A | | | | | | | | | | | | 1000.00 | 1000.00 |

559.36 0.13 -0.11 -0.13 0.11 0.00 0.00 559.35

Closure Error 0.170294

Area

| | N | E | |
|---------------|---------|---------|--------------|
| | 1000.00 | 1000.00 | |
| 1053160.0000 | 1053.16 | 1156.16 | 1156160.0000 |
| 1129984.5376 | 977.36 | 1201.71 | 1265592.9036 |
| 1069810.3104 | 890.24 | 1116.75 | 1091466.7800 |
| 1040974.5125 | 432.15 | 1008.74 | 898020.6976 |
| 1008740.0000 | 1000.00 | 1000.00 | 932150.0000 |
| | | | <hr/> |
| 5302673.36050 | | | 5343390.3812 |

$$\text{difference} = 40717.0207$$

$$\div 2 = 20358.51 \text{ ft}^2$$

$$\div 43560 = 0.47 \text{ acre}$$