Surveying I.

Traversing

deflection angle

d_{S1}

d_{12}

d_{23}

1

2

3
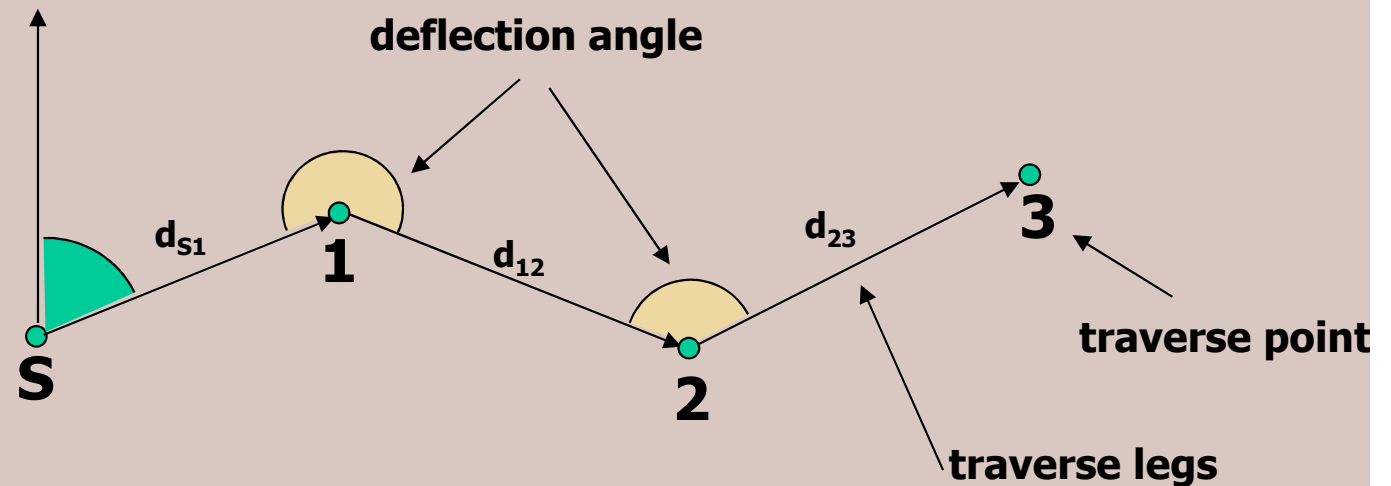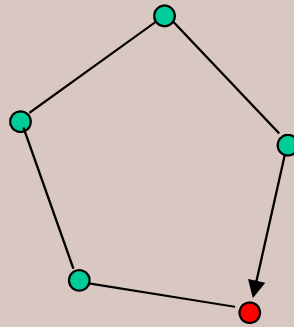
S

N

traverse point

traverse legs

- Determine the WCB of the first leg;
- measure the length of the first leg;
- compute the coordinates of the traverse point No. 1, using the 1st fundamental task of surveying;
- measure the deflection angle at point 1;
- compute the WCB of the second leg;
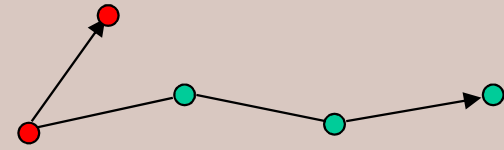- continue with step 2.

Types of traverse lines

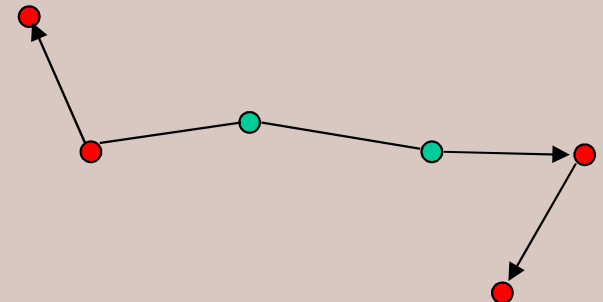## Closed Loop

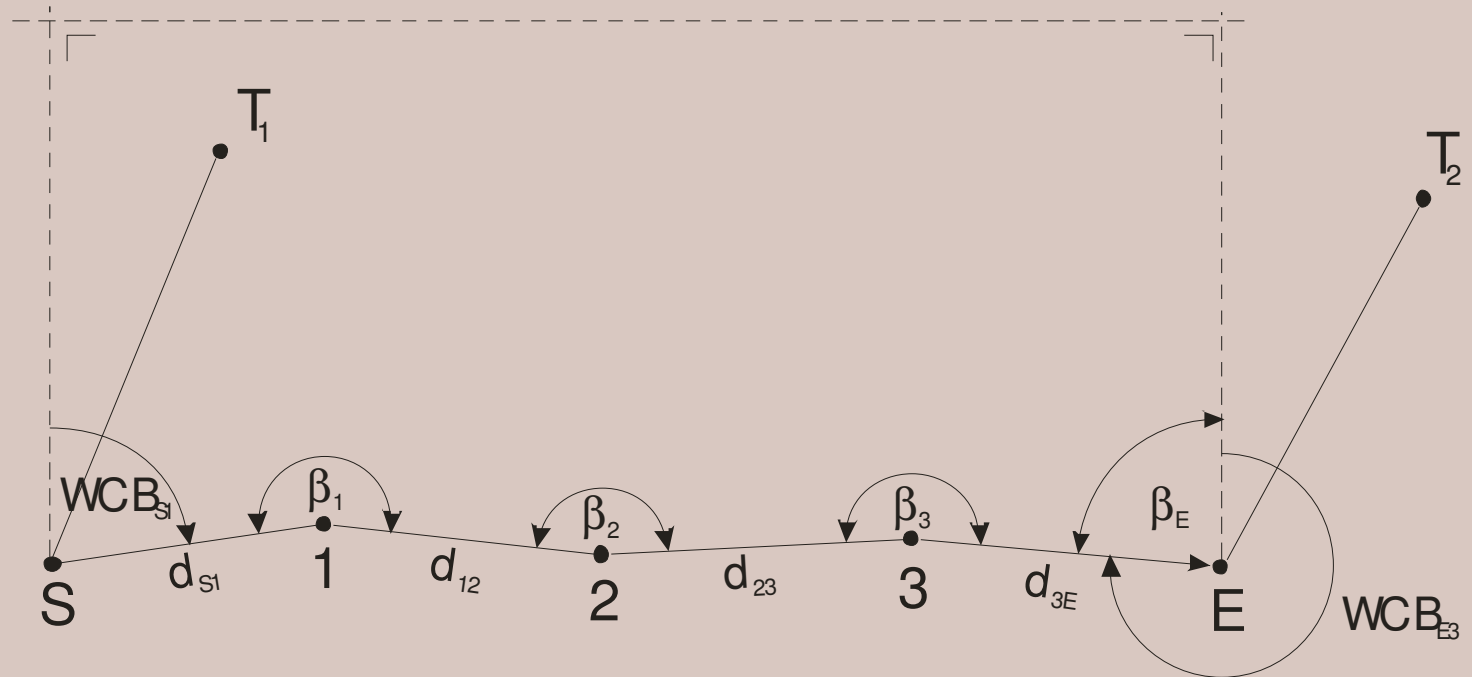## Unclosed

- **Free traverse**

- **Inserted traverse**

- **Closed line traverse**

Computation of the closed line traverse

Controlling the angular observations:
- sum of the inner angles

$$WCB_{S1} + \beta_1 + \beta_2 + \beta_3 + \beta_E + 90° + 90°$$

- theory

$$\left[(n+2)-2\right]\cdot 180°$$

Computation of the closed line traverse

Angular misclosure:

$$\Delta\beta = n \cdot 180° - \left(WCB_{S1} + \beta_1 + \beta_2 + \beta_3 + \beta_E + 90° + 90°\right)$$

$$\Downarrow$$

$$\Delta\beta = (n-1) \cdot 180° - \left(\sum_{i=0}^{n-1} \beta_i\right),$$
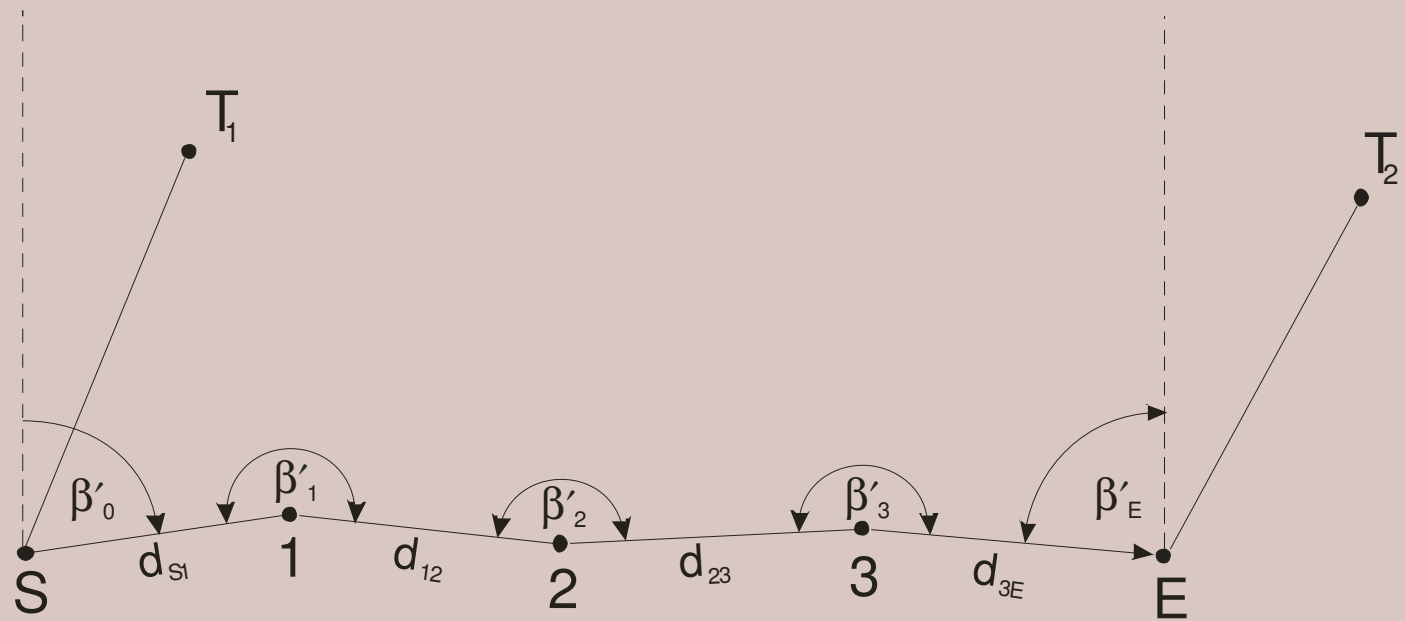
$$where \quad \beta_0 = WCB_{S1}$$

How to correct for the angular error?

The accuracy of the angular observations can supposed to be at the same level, therefore the same correction should be applied to each observed angle *(n)*.

$$v\beta = \frac{\Delta\beta}{n} \qquad \beta_i' = \beta_i + v\beta$$

Computation of the closed line traverse

Controlling the distance observations:
• the computed coordinate differences between S and E should be equal to the known coordinate differences

Computation of the closed line traverse

Compute the provisional WCB of the traverse legs:

$$WCB_{i,i+1} = WCB_{i-1,i} + \beta_i \mp 180°$$

Easting and Northing coordinate differences:

$$\Delta E_{i,i+1} = d_{i,i+1} \cdot \sin WCB_{i,i+1},$$
$$\Delta N_{i,i+1} = d_{i,i+1} \cdot \cos WCB_{i,i+1}.$$

The coordinate misclosure:

$$\Delta\Delta E = \left(E_E - E_S\right) - \sum_{i=0}^{n-2} d_{i,i+1} \cdot \sin WCB_{i,i+1}$$

$$\Delta\Delta N = \left(N_E - N_S\right) - \sum_{i=0}^{n-2} d_{i,i+1} \cdot \cos WCB_{i,i+1}$$

The linear misclosure:

$$\Delta L = \sqrt{\Delta\Delta E^2 + \Delta\Delta N^2}$$

Computation of the closed line traverse

How to correct for the coordinate misclosure?
• coordinate error is caused by the distance observations;
• the accuracy of distance observations is proportional with the distance.

Corrections of the computed coordinate differences:

$$v\Delta E_{i,i+1} = \frac{d_{i,i+1} \cdot \Delta\Delta E}{\displaystyle\sum_{i=0}^{n-2} d_{i,i+1}},$$

$$v\Delta N_{i,i+1} = \frac{d_{i,i+1} \cdot \Delta\Delta N}{\displaystyle\sum_{i=0}^{n-2} d_{i,i+1}}.$$

Computation of the closed line traverse

Computing the corrected coordinate differences:

$$\Delta E'_{i,i+1} = \Delta E_{i,i+1} + v\Delta E_{i,i+1},$$

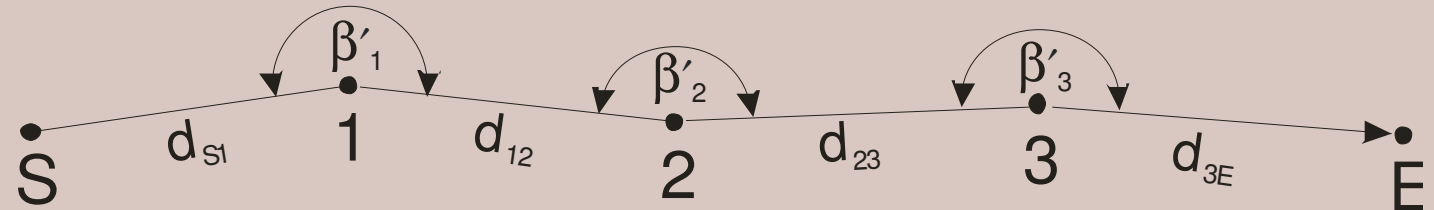$$\Delta N'_{i,i+1} = \Delta N_{i,i+1} + v\Delta N_{i,i+1}.$$

Computing the final coordinates:

$$E_{i+1} = E_i + \Delta E'_{i,i+1},$$

$$N_{i+1} = N_i + \Delta N'_{i,i+1}.$$
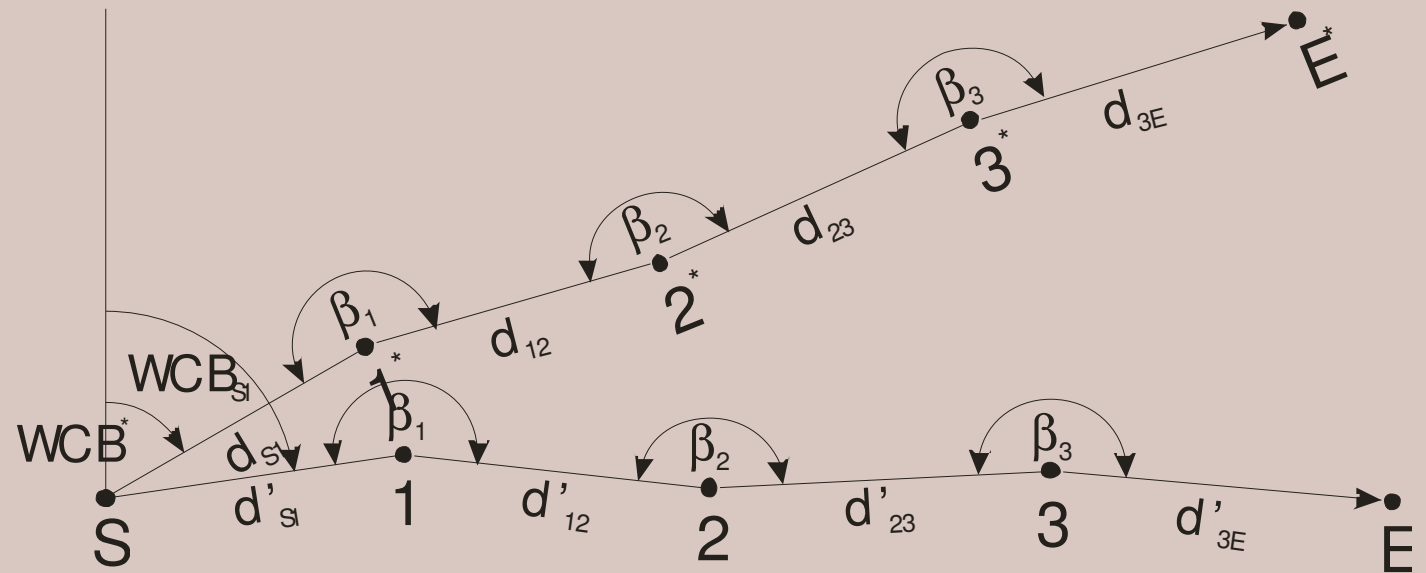
Computation of the inserted traverse

S and E are known, the distances and the deflection angles are measured.

No corrections for the angles (due to the lack of orientations at the endpoints).

Corrections to the distance observations can be computed due to the given endpoints.

Computation of the inserted traverse

The coordinates are computed as a free traverse by using an abritrary starting WCB (WCB*).

Computation of the inserted traverse

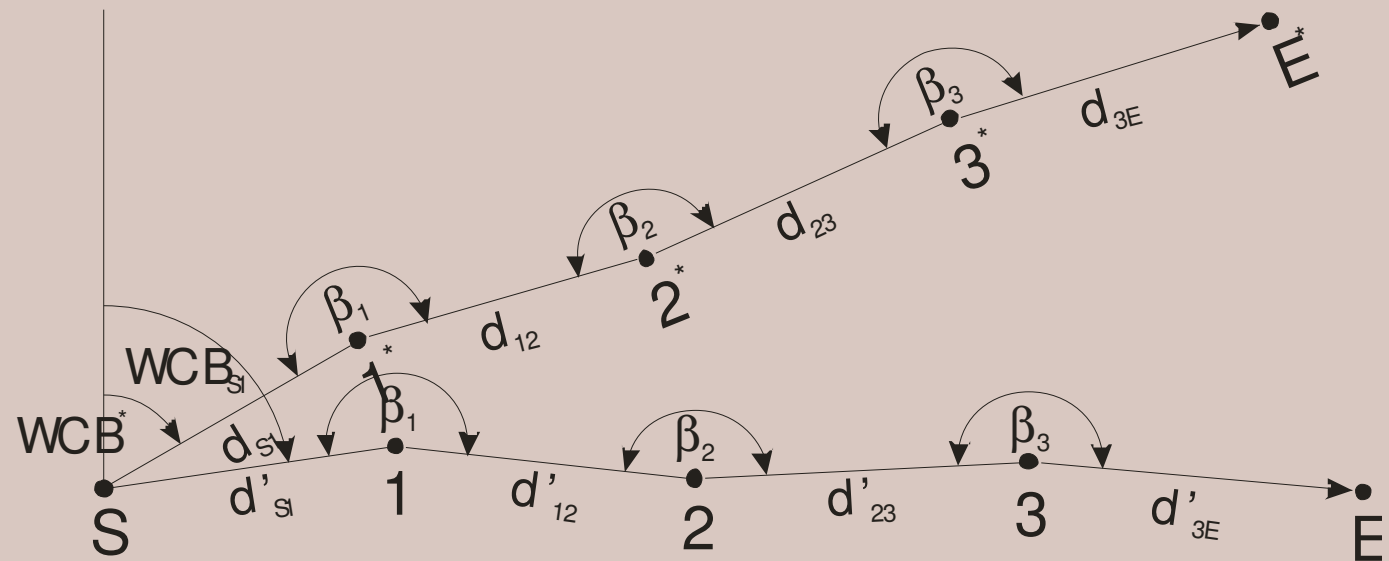Computing the correction to the starting WCB:

$$\Delta WCB = WCB_{SE} - WCB_{SE^*}$$

Computing the correction to the length of the traverse legs (scale factor):

$$m = \frac{d_{SE}}{d_{SE^*}}$$

Computation of the inserted traverse

Computing the coordinates as a free traverse using the following values:

$$WCB_{S1} = WCB^* + \Delta WCB,$$

$$d'_{i,i+1} = m \cdot d_{i,i+1}.$$

Localizing blunders in the observations

Distance observations

Compute the WCB of the linear misclosure. The blunder is made most likely on the traverse leg, which has a similar provisional WCB.

Angular observations

If only one blunder occurs in the observations, it can be localized in case of a closed line traverse.

Compute the traverse as a free traverse in the direction of S->E and E->S as well. The blunder is made at the station, which has similar coordinates in both solutions.

Thank You for Your Attention!