Surveying I.

Tacheometry

Principle of tacheometry

Tacheometry

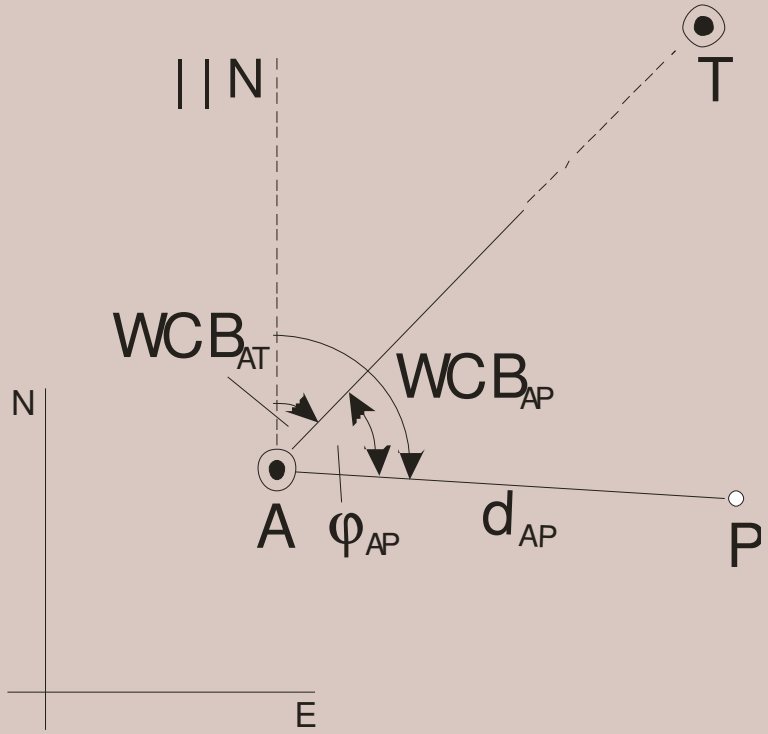
„Fast measurement" – measurement of horizontal and vertical coordinates of detail points in one step.

Principle of tacheometry

The horizontal position of the detail point is computed using the polar coordinates (WCB & d_h), while the elevation is measured using trigonometric heighting.

Principle of tacheometry

Horizontal coordinates:



- (N_A,E_A) and (N_T,E_T) are known;
- φ_{AP}, t_{AP} is measured.

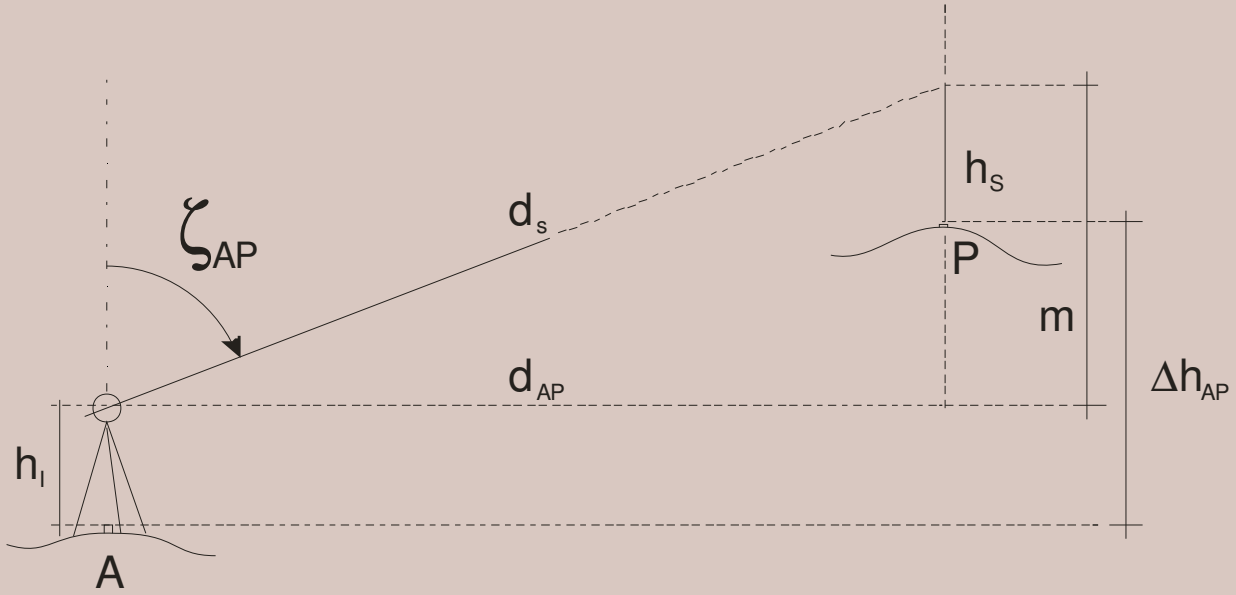
Exercise: compute the coordinates of **P**

Solution:

- WCB_{AT} is computed (2nd fundamental task of surveying;
- WCB_{AP} is computed by transfering the WCB from AT to AP ($WCB_{AP}=WCB_{AT}+\varphi_{AP}$);
- the horizontal coordinates of P are computed by the 1st fundamental task of surveying

Principle of tacheometry

Vertical coordinates:



h_I – instrument height
h_S – signal height
ζ_{AP} – zenith angle
d_S – slope distance

Measured

Δh_{AP}=?

$$\Delta h_{AP} = h_I + d_S \sin\zeta_{AP} - h_S$$

Measuring the slope distance

Older instruments: use the optical method (stadia lines) to measure the distance. The maximal range is 150-200m, and the accuracy 15-20cm.

Latest instruments: EDMs are used to measure the slope distance. The maximal range is usually 2-3 km, accuracy is 1-2 cm.

Electronic tacheometers (Total Stations)

Important features:

• automated distance measurements and angular observations;

• the observations can be corrected for the effect of systematic error, and reduced to the MSL;

• the data can be recorded for later use;

• observation software enables the instrument to compute coordinates and stake out.

Operation of Total Stations

- Centering and leveling the instrument by the operator

- observing the slope distance (d_s), correcting the effect of the reflector constant, the frequency error and the meteorological correction;

- the horizontal (Hz) and vertical (V) angles are read, and the effects of the collimation and index error are accounted for;

- the horizontal distance (d_h) and the elevation difference is (Δh) is computed (instrument and signal height must be entered previously);

- the data set (d_s, Hz, V) or (Hz, d_h, Δh) is logged.

Important software of Total Stations

1. **Free station establishment**
   The station coordinates are computed using angular and distance observations to known points (resection, arc-section and their combination). In most cases the orientation is also done.
2. **Determination of the elevation of the station**
   by trigonometric heighting to known stations.
3. **Orientation of the horizontal circle**
   by taking horizontal angle observations to known stations.
4. **Computation of rectangular coordinates (N,E)**
   using the polar coordinates (provisional WCB and horizontal distance)

Important software of Total Stations

5. **Tie distance**
   The horizontal distance between two measured detail points can be computed using their coordinates.

6. **Remote object**
   by measuring the horizontal distance to the vertical of a remote object, and the zenith angle.

Detail surveys using tacheometry

Preparation

- densification of control network;
- finding suitable places for free station establishment.

Detail survey

- detail points of:
  - buildings;
  - linear objects (e.g. electric poles);
  - rectangular buildings;
  - arcs;
  - topography.

Detail surveys using tacheometry

Identifying the detail points

- drawing a sketch of the area, and marking the detail points on it with ID numbers;
- recording the coordinates or observations with the same ID numbers;
- ensure that the two numberings are identical;

Mapping the survey

- marking the positions of the detail points in a given scale;
- the elevation of topographic points should be written on the map;
- contour lines are interpolated between the measured topographic points.

Thank You for Your Attention!