

# Fieldwork Surveying FS01

## 9. Lecture

### Setting-out of buildings and land survey for construction industry I

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# Setting-out of buildings and land survey for construction industry

**Setting-out of a building** – marking of a building position, size and shape in terrain.

**Setting-out plan** – plan where a projected building is drawn and numeric values of setting-out elements are written.

# Land survey for setting-out:

1. creation of a setting-out net (measurement, calculation and marking of survey stations which can be used for setting-out)
2. setting-out of the spatial position of a building = setting-out of the building main position line (= frontage), setting-out of the axis or the main points of a linear structure (road, railway, watercourse)
3. detailed setting-out = setting-out of a building size and shape.

# Setting-out nets:

- 1. planimetric networks** – an aligning base, a traverse or an orthogonal setting-out net. The net is usually connected to points of S-JTSK (the coordinate system of Křovák's projection).
- 2. altimetric networks** – either independent of the planimetric network or the points of the planimetric network are used.

Setting-out accuracy is given and it is judged according to the standards:

- ČSN 73 0420 – 1: Accuracy of setting out of constructions. Fundamental requirements.
- ČSN 73 0420 – 2: Accuracy of setting out of constructions. Setting out deviations.

# Setting-out of a position

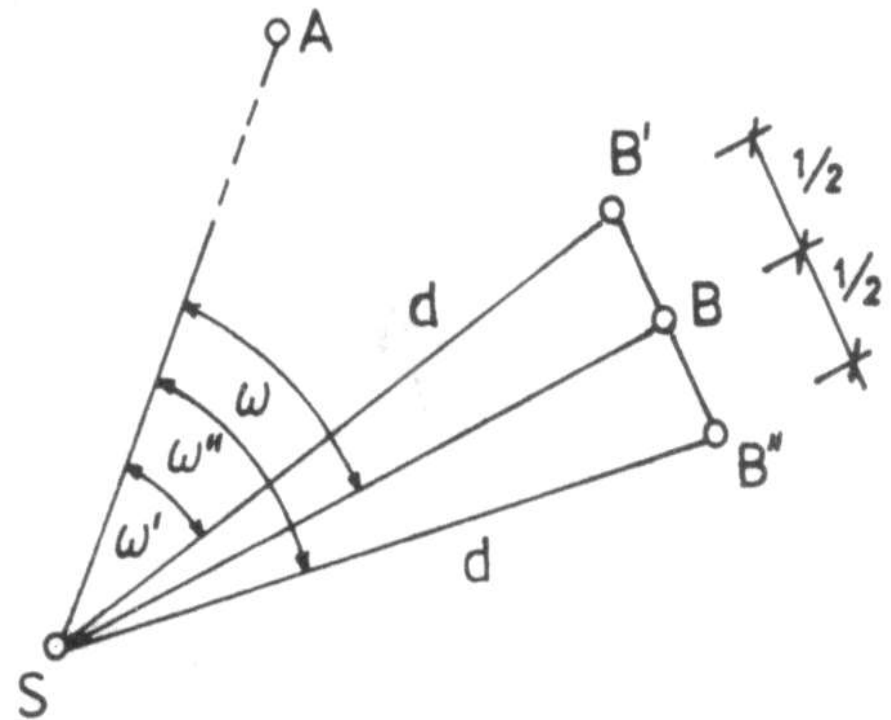
1. Setting-out of an angle
2. Setting-out of a point position
3. Setting-out of a straight line
4. Setting-out of a circular arc

# 1. Setting-out of an angle

## 1. 1 Setting-out of a general angle

- by means of a theodolite or a total station

task: horizontal angle  $\omega$  should be set out at the survey station S from point A



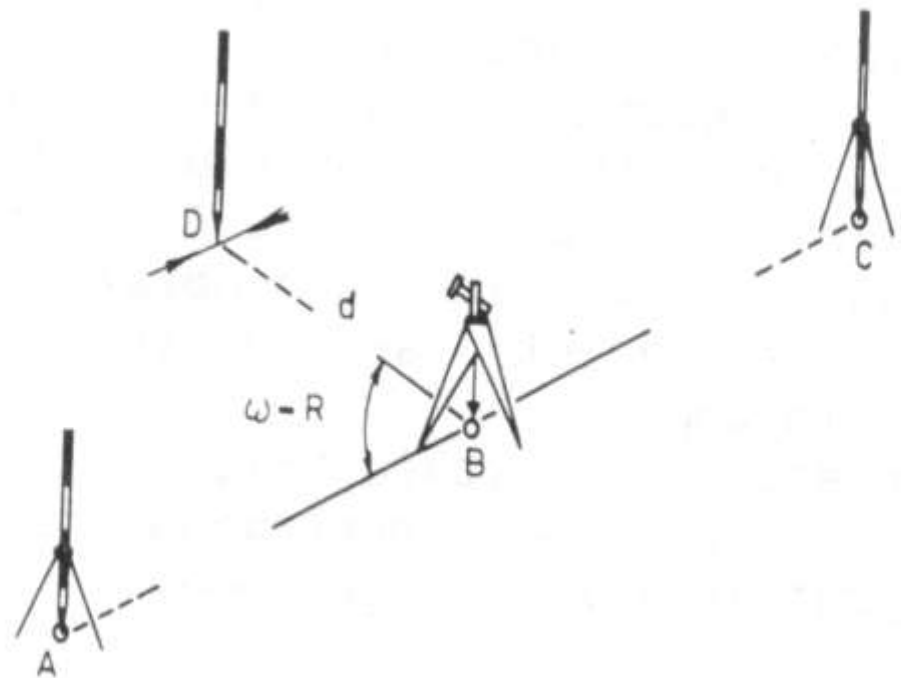
# Procedure

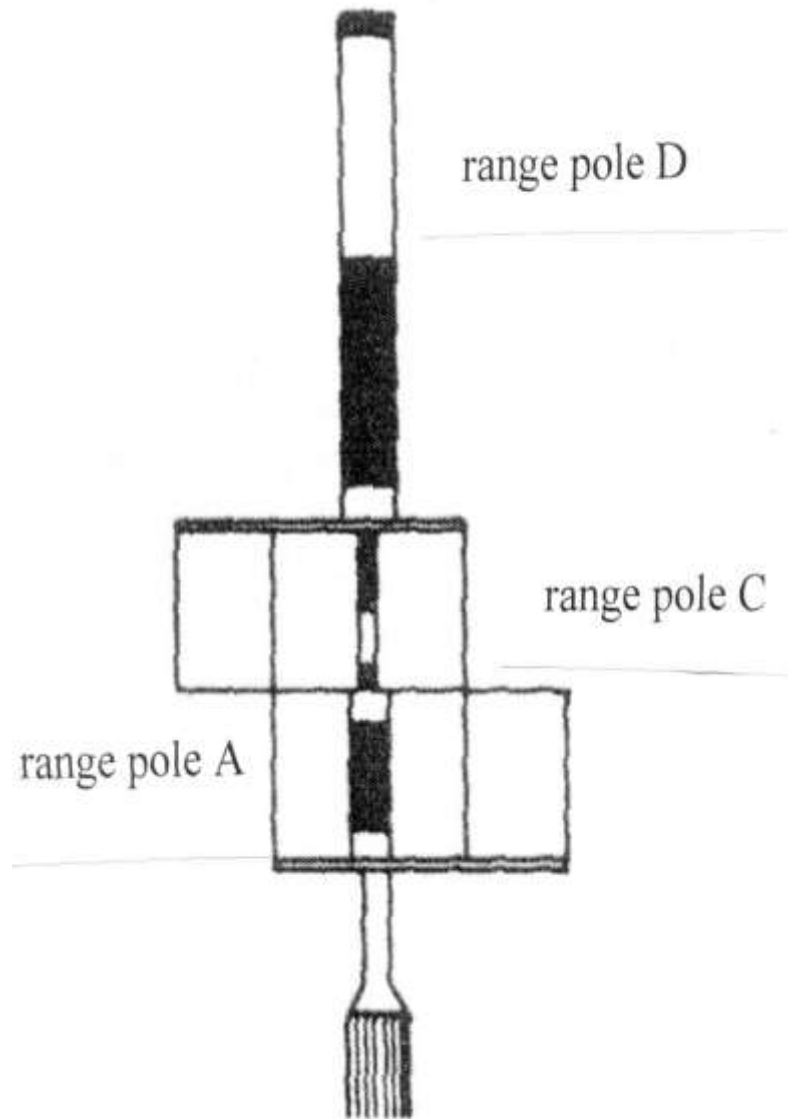
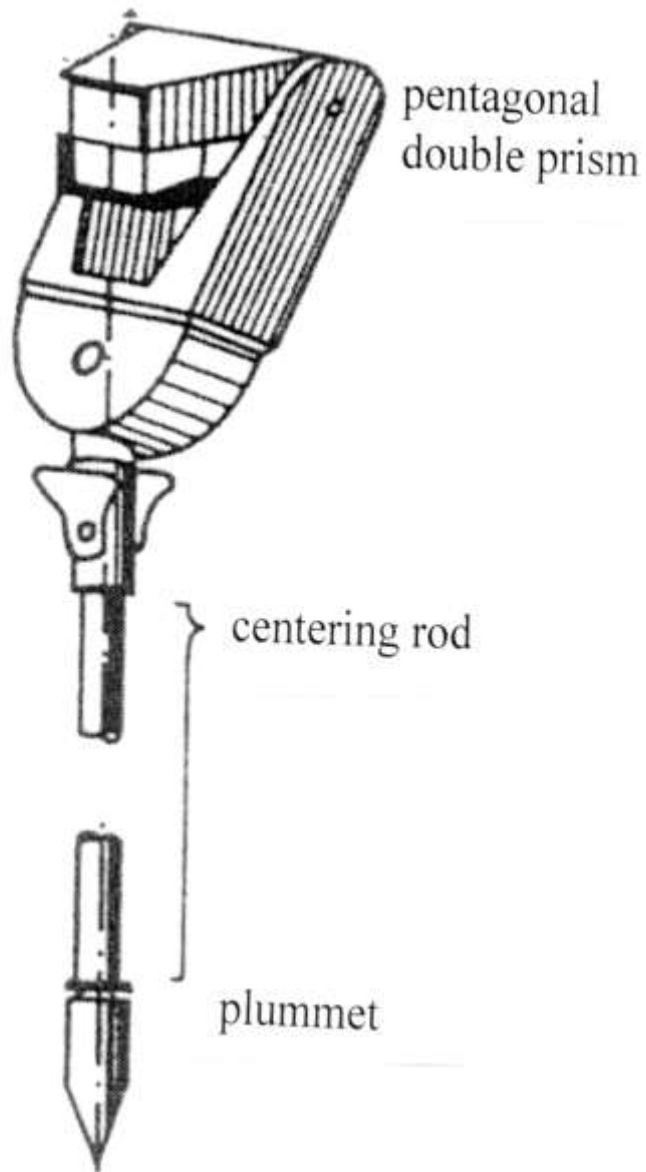
- centering and levelling of the instrument at the survey station S
- pointing at A in the face left position of the telescope and horizontal circle reading
- adding the angle  $\omega$  to this reading and „setting“ calculated value by means of the alidade turning
- marking of point B' in this direction in required distance  $d$  (if high accuracy is not necessary  $\rightarrow$  result)
- if high accuracy is demanded, setting-out of the angle  $\omega$  has to be repeated in the face right position of the telescope and point B'' is marked. In the middle of points B' and B''  $\rightarrow$  B (result).



## 1.2 Setting-out of the right angle

1. by means of a theodolite
2. by means of a pentagonal double prism (if high accuracy is not demanded)





- images of the range poles at points A and C have to create one vertical line in the field of view of the pentagonal prism → then the prism is above point B
- the range pole at point D (it is observed by eye closely above or under the prism) has to be in the same vertical line
- angular accuracy of the setting-out is 0,04 gon, therefore the prism is used for the maximum distance 40 m

## 2. Setting-out of a point position

2.1 setting-out from rectangular coordinates,

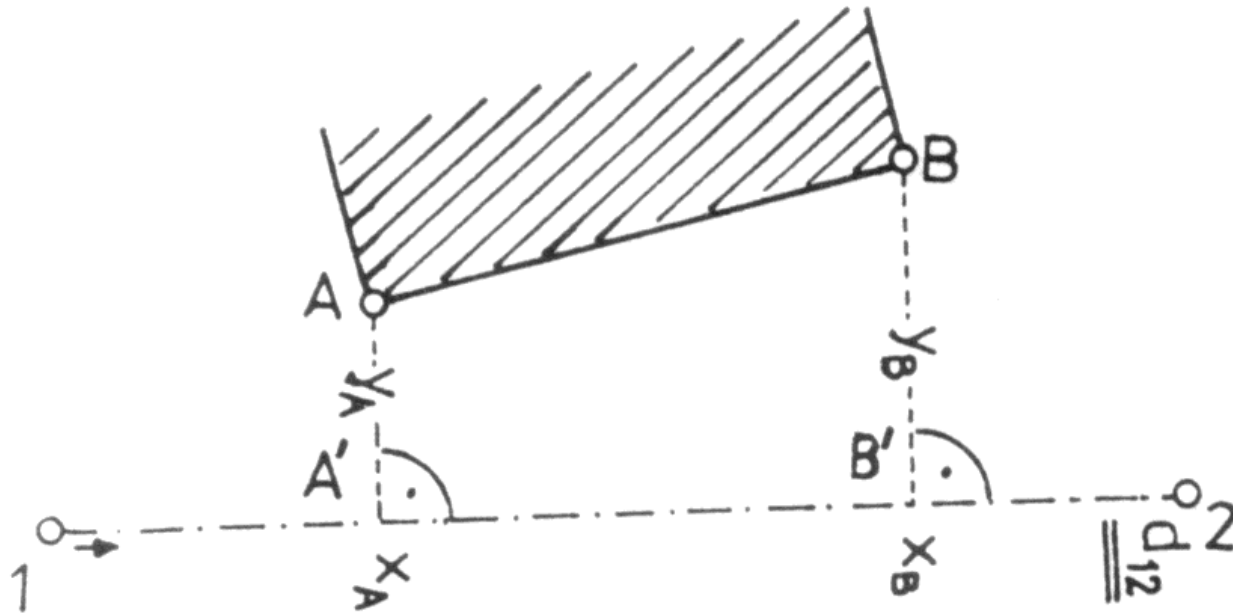
2.2 setting-out from polar coordinates,

2.3 setting-out of a point by forward intersection,

2.4 setting-out of a point as the intersection of two straight lines.

## 2.1 Setting-out from rectangular coordinates

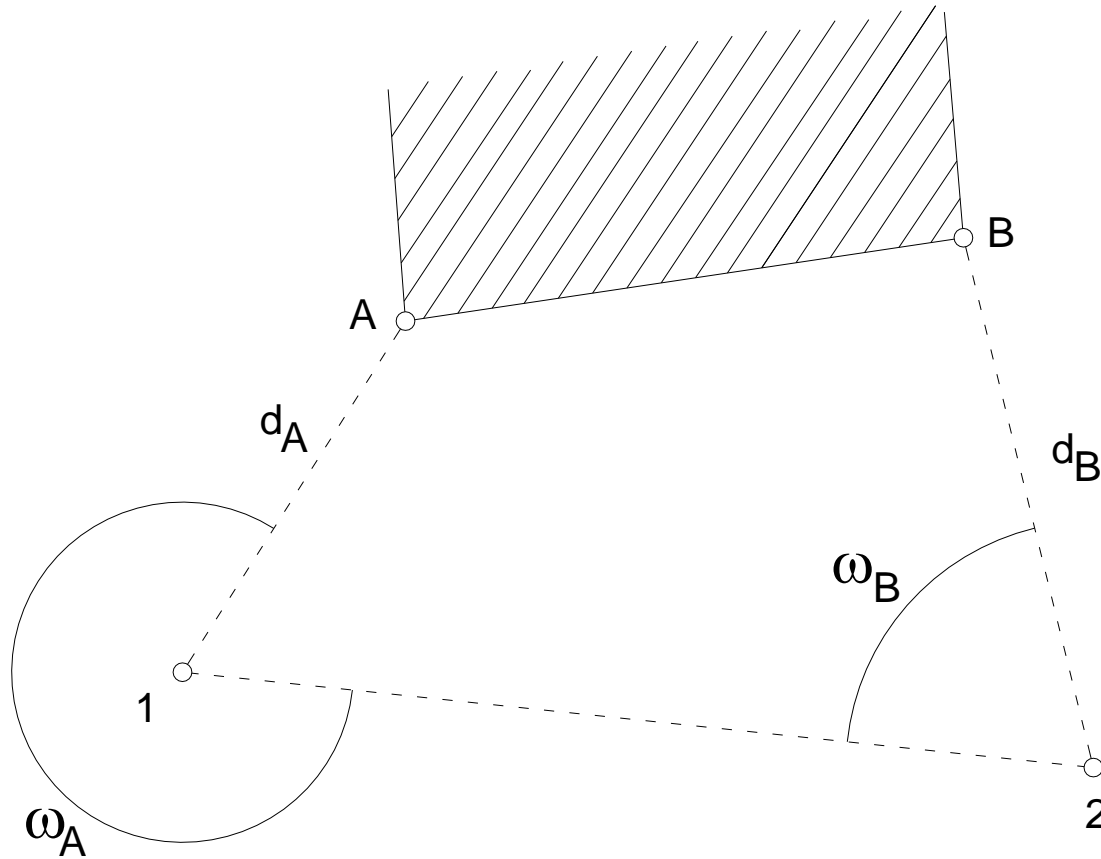
Task: setting-out of the building main position line defined by points A and B. Rectangular coordinates  $x_A$ ,  $x_B$ ,  $y_A$ ,  $y_B$  in reference to a part of setting-out network given by points 1 and 2 are known.



The foot of a perpendicular  $A'$  is set out by means of a theodolite at point 1. Point  $A'$  is in the distance  $x_A$  from point 1. This distance is called **stationing** and it is measured by a tape. The right angle is set out by a theodolite at point  $A'$  and distance  $y_A$  (called **offset**) is measured by a tape. The same procedure is used for setting-out of point B.

If high accuracy is not demanded, points A and B can be set out by means of a pentagonal double prism and a tape.

## 2.2 Setting-out from polar coordinates



- setting-out elements = the horizontal angles  $\omega_A, \omega_B$  and the horizontal distances  $d_A, d_B$
- the procedure of horizontal angles setting-out is described in 1.1 (setting-out of a general angle)
- this is the most frequent method of setting-out of a point position especially if a total station is available



# Calculation of polar setting-out elements using coordinates

**Given:** rectangular coordinates of points

$P_1$ ,  $P_2$  and  $P_3$ :

$P_1$  – survey station,

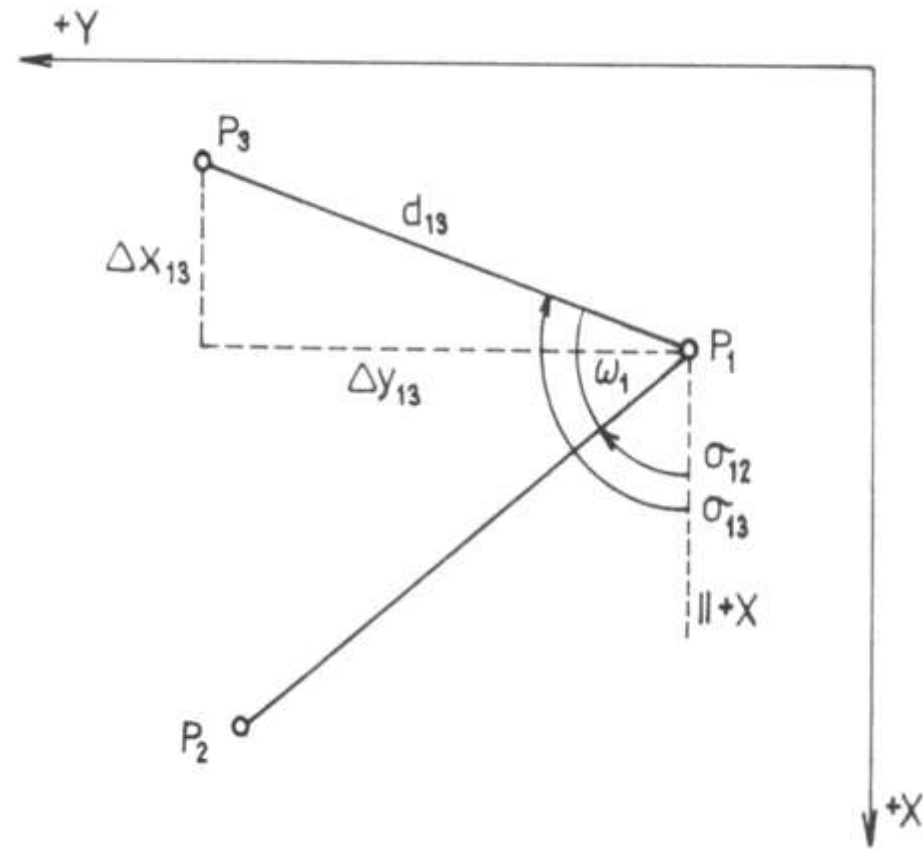
$P_2$  – orientation point,

$P_3$  – point which is set out.

**Calculate:**

horizontal distance  $d_{13}$ ,

horizontal angle  $\omega_1$



First of all the bearings  $\sigma_{12}$  and  $\sigma_{13}$  are calculated using coordinates of the points  $P_1$ ,  $P_2$  and  $P_3$  (see lecture 2).

**The the horizontal angle  $\omega_1$ :**

$$\omega_1 = \sigma_{13} - \sigma_{12} .$$

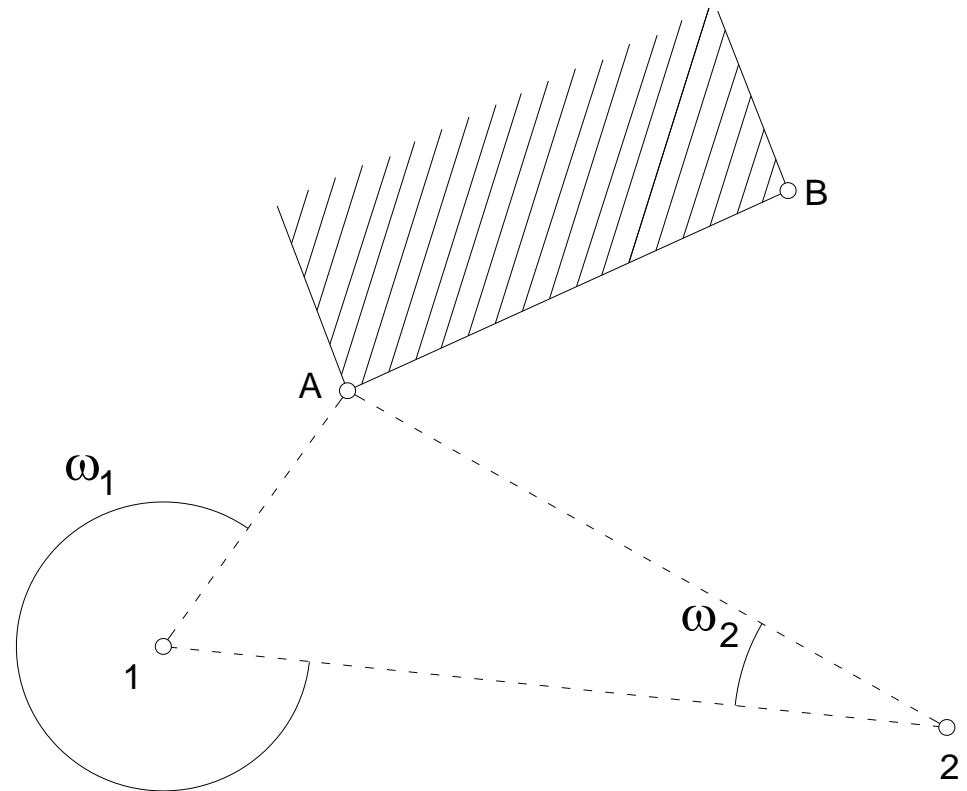
**The horizontal distance  $d_{13}$ :**

$$d_{13} = \sqrt{\Delta x_{13}^2 + \Delta y_{13}^2}$$

## 2.3 Setting-out of a point by forward intersection

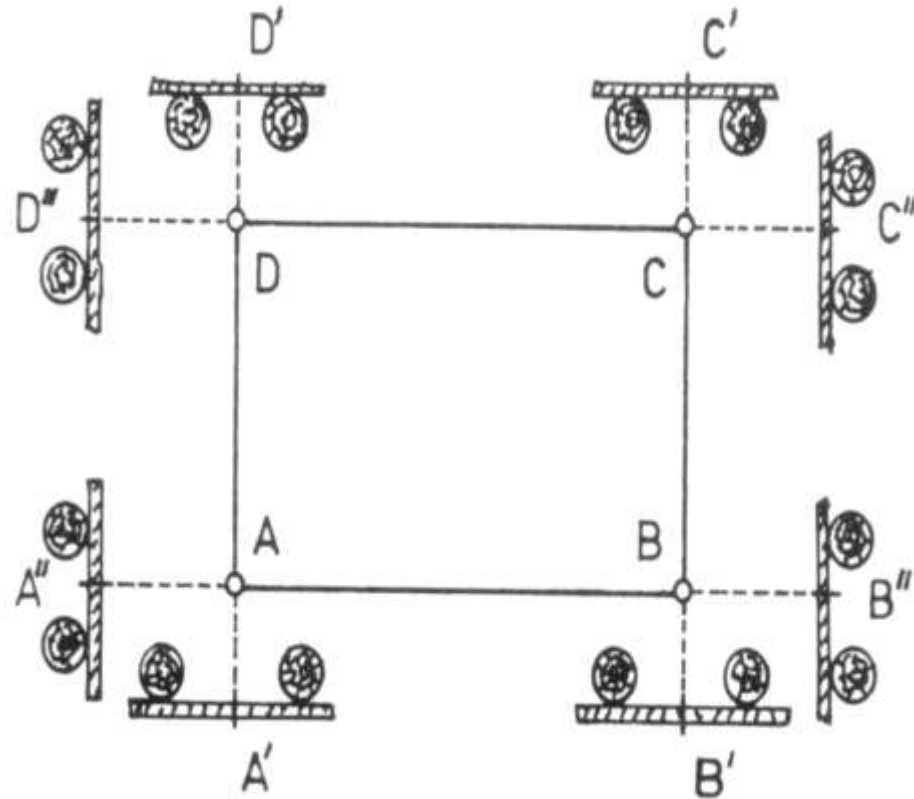
Setting-out elements = the horizontal angles  $\omega_1$  and  $\omega_2$ .

Two theodolites placed at the survey stations 1 and 2 are used for setting-out.



## 2.4 Setting-out of a point as the intersection of two straight lines

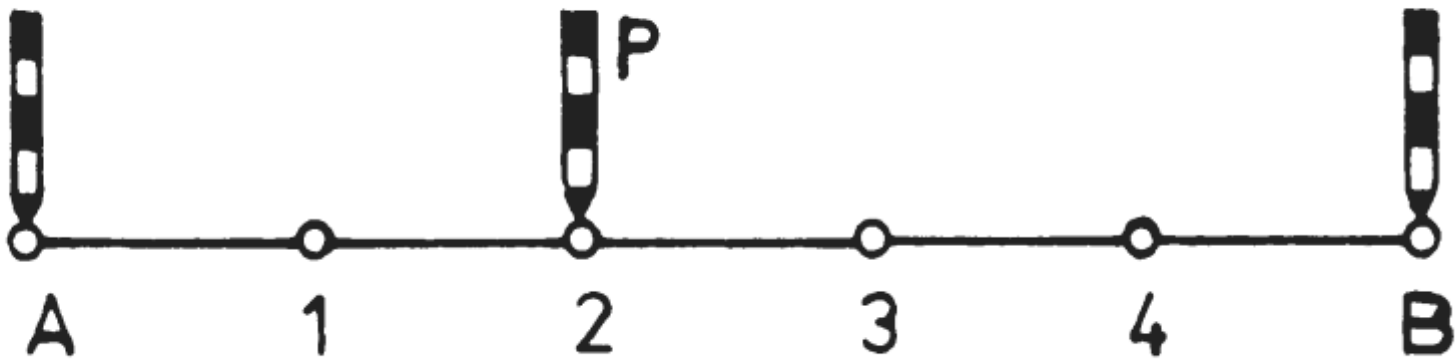
A set-out point is the intersection of two lines of sight which connect permanent marked points.



- points A, B, C, D are set out by one of the previously mentioned methods
- so-called berms (boards nailed up to stakes) are established so that they cannot be damaged by building operations
- a wire is stretched across points AB, AD etc. and points A', A'' etc. are marked by notches at berms
- when earthwork is realized, points A, B, C, D can be set out anytime quickly in the intersections of particular straight lines

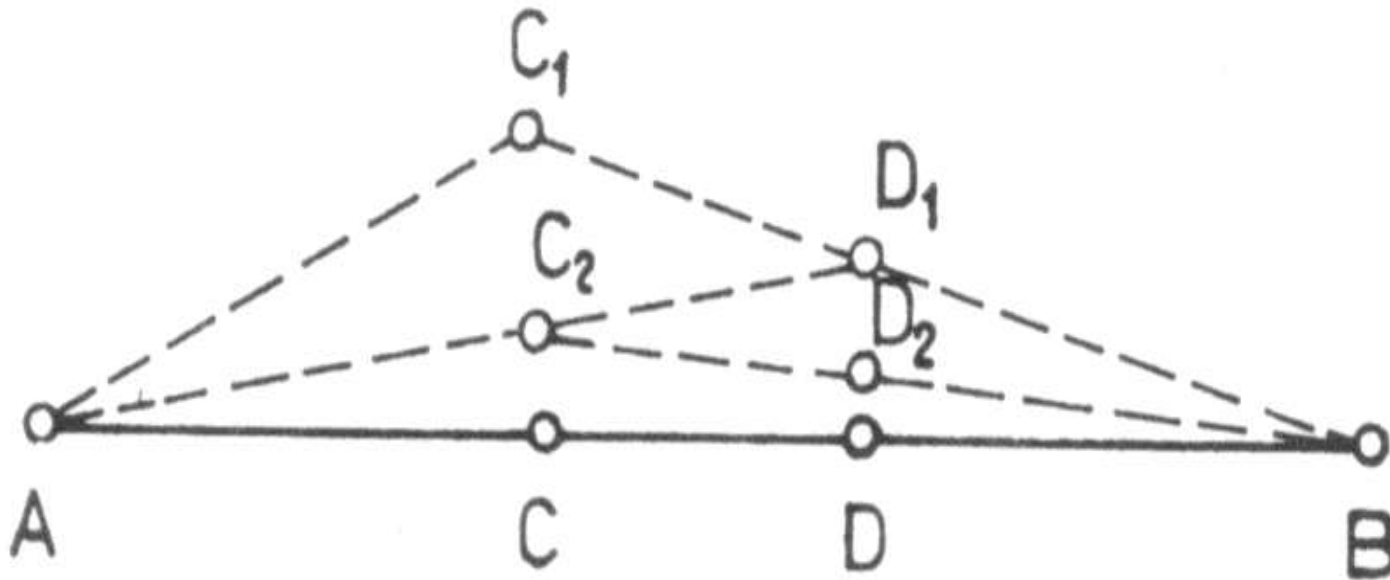
### 3. Setting-out of a straight line

3.1 Setting-out of intermediate points if the end points A and B are accessible and mutually visible.



- high accuracy is required → intermediate points are set out by a theodolite placed at one of the end points
- high accuracy is not necessary → the end points are marked by range poles and the observer stands to extended straight line (several meters behind the range pole at A). Then the observer places a lineman (helper) with a range pole to the alignment of points A and B.

3.2 Setting-out of intermediate points if the end points A and B are inaccessible and if they are not mutually visible

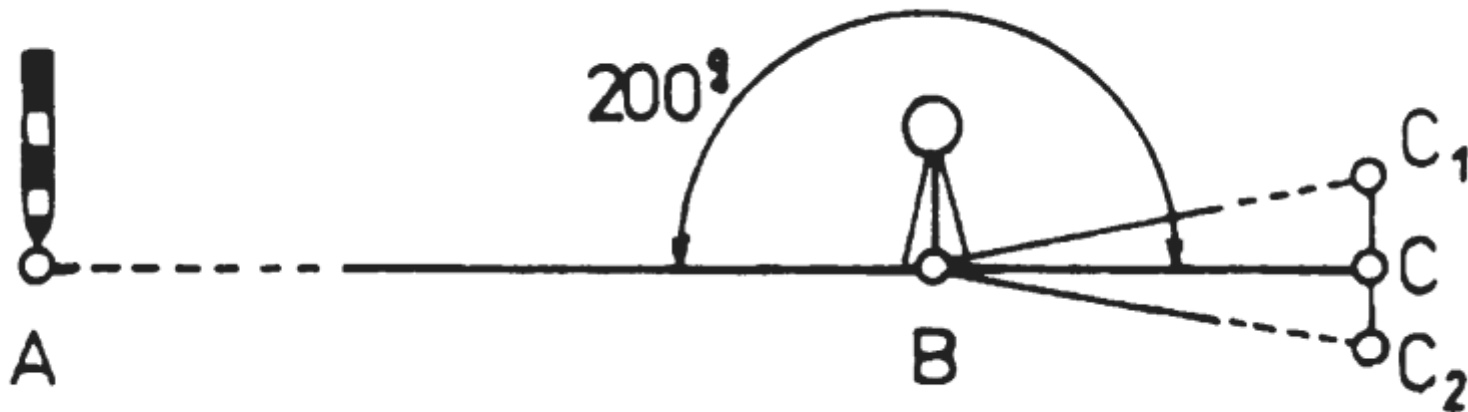




Point  $C_1$  is chosen approximately in the straight line  $AB$  and it is marked by a range pole. Points  $A$  and  $B$  have to be visible from the point  $C_1$ . A lineman with a range pole is placed by sight to the straight line  $C_1 B$  and point  $D_1$  is marked. Then the range pole from the point  $C_1$  is placed by sight to the straight line  $D_1 A$  and point  $C_2$  is marked. Then a range pole is placed by sight to the straight line  $C_2 B$  and point  $D_2$  is marked. This procedure is repeated till the points  $C$  and  $D$  lie in the straight line  $AB$ .

## 3.3 Extension of a straight line

- by turning of the telescope of the theodolite around the horizontal axis (horizontal rough clamp is tightened)
- by setting-out of the straight angle



Thank you for your attention!