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Civil IV SEM
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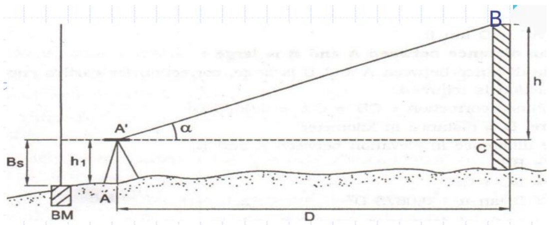
Trigonometric levelling

Definition:
"Trigonometric levelling is the process of determining the differences of elevations of stations from observed vertical angles
and known distances. "The vertical angles are measured by means of theodolite. The horizontal distances by instrument Relative heights are calculated using trigonometric functions.

- This is an indirect method of levelling.
- In this method the difference in elevaţion of the points is determined from the observed vertical angles and measured distances.
- The vertical angles are measured with a transit theodolite and The distances are measured directly (plane surveying) or computed trigonometrically (geodetic survey).
- Trigonometric levelling is commonly used in topographical work to find out the elevation of the top of buildings, chimneys, church spires, and so on.Also, it can be used to its advantage in difficult terrains such as mountaineous areas.
- Depending upon the field conditions and the measurements that can be made with the instruments available, there can be innumerable cases.

METHODS OF DETERMINING THE ELEVATION OF A POINT BY THEODOLITE:
Case 1. Base of the object accessible.
Case 2. Base of the object inaccessible,Instrument stations in the vertical plane as the elevated object.
Case 3. Base of the object inaccessible, Instrument stations not in the same vertical plane as the elevated object.

Case 1. Base of the object accessible:-



Note :- it means we can easily measures the distance between the object and instrument station .

Where

A= Instrument station.

B= Point to be observed.

h= Elevation of B from the instrument axis

D =Horizontal distance between A. and the base of object.

h1= Height of instrument (H. I.)

Bs= Reading of staff kept on B.M.

Alpha = Angle of elevation = angle BAC.

Then

$$h = D \tan \alpha$$

Hence we can find RL

R.L. of B = R.L. of B.M. + Bs + h
= R.L. of B.M. + Bs + D. tan α

If distance is large, then add Cc & Cr

R.L. of B = R.L. of B.M. + Bs + D. tan α + 0.0675 D^2

Elev. of B = Elev. Of A+ hi + h

Case 2. Base of the object inaccessible, Instrument stations in the same vertical plane as the elevated object.There may be two cases.

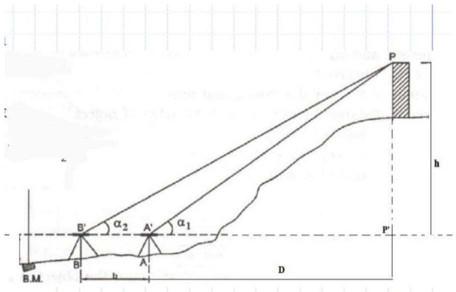
(a) Instrument axes at the same level.

(b) Instrument axes at different levels.

1) Height of instrument axis to the object is lower.

2) Height of instrument axis to the object is higher.

(a) Instrument axes at the same level:-



Then from figure.

Δ PA′P′, h= D tan α_1

Δ PB′P′, h= (b+D) tan α_2

D tan α_1 = (b+D) tan α_2

D tan α_1 = b tan α_2 + D tan α_2

D(tan α_1 - tan α_2) = b tan α_2

$$D = \frac{b \tan \alpha_2}{(\tan \alpha_1 - \tan \alpha_2)}$$

$$h = \frac{b \tan \alpha_2 . \tan \alpha_1}{(\tan \alpha_1 - \tan \alpha_2)}$$

From this we can find out RL

R.L of P = R.L of B.M + Bs + h

Elev. of P = Elev. Of A+ hi + h