3.4 TANGENTIAL METHOD

In this method, stadia hairs are not used to bisect the staff for observations. Two vanes at a constant distance apart are fixed on the staff. Each vane is bisected by the cross-hair and the staff reading and vertical angle corresponding to each vane are recorded.

This method is preferred when the telescope is not equipped with a stadia diaphragm. Since in this method two manipulations of the instrument and two sights are required for one set of observations, there are more possibilities of error as compared to the stadia and subtense methods of tacheometry. Though the results do not differ much, however, the tangential method should definitely be regarded as inferior to the other two methods of tacheometry.

There are three cases for deducing distance and elevation formulae depending upon the nature of the verticalangles.

DISTANCE AND ELEVATION FORMULAE

Both the Angles are Angles of Elevation Refer to Fig. 7.21. Let

D = distance between instrument station O and staff station P

V = vertical distance between the instrument axis and the lower vane

s = distance between the vanes—staff intercept

θ_1 = vertical angle to the upper vane B

θ_2 = vertical angle to the lower vane C

O' = position of instrument axis

r = height of lower vane C, above the foot of the staff at P and

h = height of the instrument.

From triangle $O'KB$, $\quad V + s = D \tan \theta_1$

From triangle $O'KC$, $\quad V = D \tan \theta_2$

From the above equations

$$s = D(\tan \theta_1 - \tan \theta_2)$$

or

$$D = \frac{s}{\tan \theta_1 - \tan \theta_2}$$

Elevation of station P = elevation of instrument axis + $V - r$

= elevation of station $O + h + V - r$

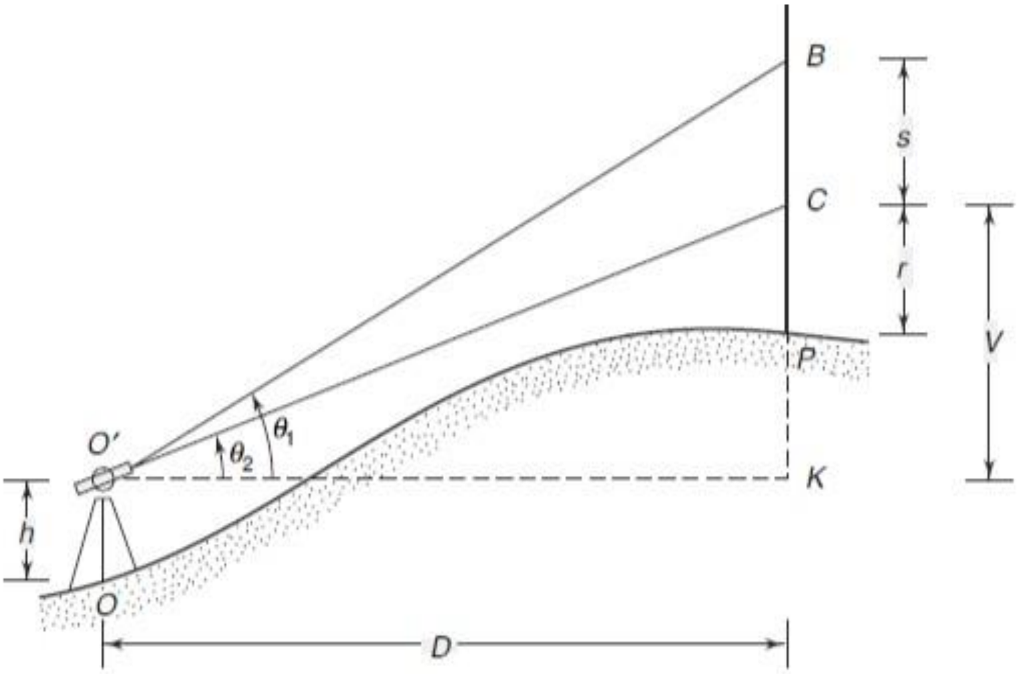

Fig. 7.21 *Tangential method (Elevation angles)*

BOTH THE ANGLES ARE DEPRESSION:

From triangle O' KC (Fig. 7.22),

$V = D \tan \theta_2$

From triangle O' KB,

$V - s = D \tan\theta_1$

From the above equations

$$D \tan \theta_1 + s = D \tan \theta_2$$

or $$D (\tan \theta_2 - \tan \theta_1) = s$$

or $$D = \frac{s}{\tan \theta_2 - \tan \theta_1}$$

But $$V = D \tan \theta_2$$

$$= \frac{s \tan \theta_2}{\tan \theta_2 - \tan \theta_1}$$

Elevation of staff station P = elevation of station $Q + h - V - r$

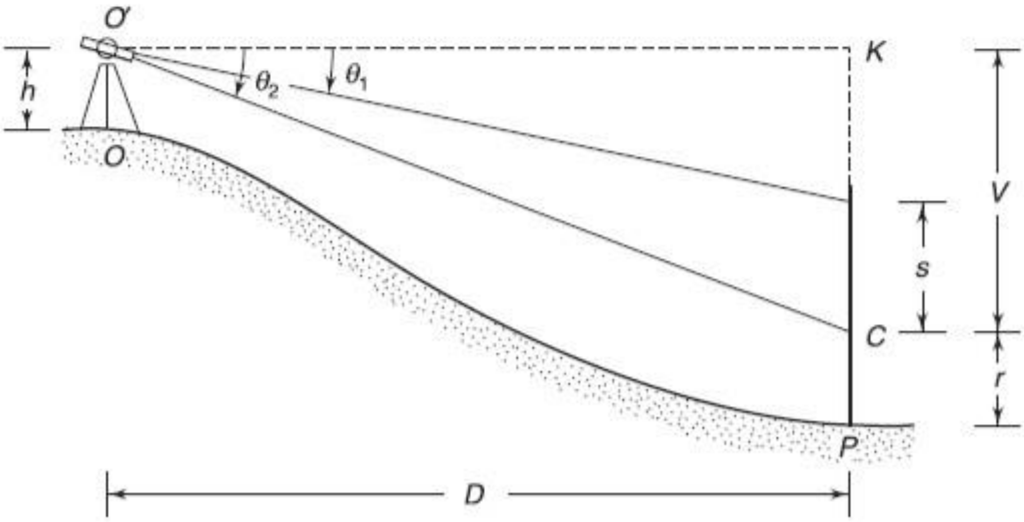

Fig. 7.22 *Tangential method (Depression angles)*

One Angle is Angle of Elevation and the Other Angle is Angle of Depression From triangle $O'KC$ (Fig. 7.23),

$$V = D \tan \theta_2$$

From triangle $O'KB$, $s - V = D \tan \theta_2$

From the above equations

$$s = D \tan \theta_1 + D \tan \theta_2$$

or
$$D = \frac{s}{\tan \theta_2 + \tan \theta_1}$$

But
$$V = D \tan \theta_2$$

$$V = \frac{s \tan \theta_2}{\tan \theta_1 + \tan \theta_2}$$

Elevation of staff station P = elevation of station $O + h - V - r$

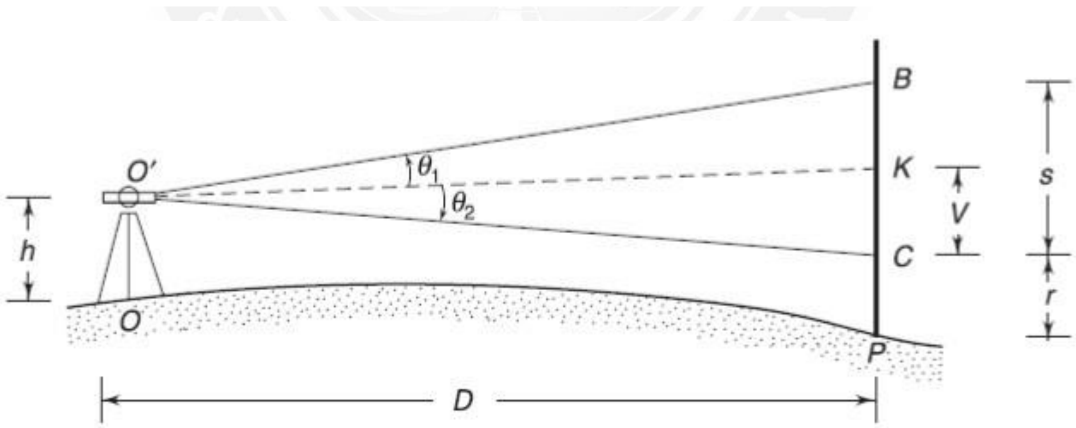

Fig. 7.23 *Tangential method (One angle of elevation and the other angle of depression)*

Example 7.14 In the tangential method of tacheometry, two vanes were fixed 2 m apart, the lower vane being 0.5 m above the foot of the staff held vertical at station A. The vertical angles measured were $+1°12'$ and $-1°30'$. Find the horizontal distance of A from the instrument, if the height of line of collimation is 100 m. Also find the R.L. of A.

Solution

$$D = \frac{s}{\tan \theta_1 + \tan \theta_2} = \frac{2}{\tan 1°12' + \tan 1°30'} = 42.433 \text{ m}$$

$$V = D \tan \theta_2 = 42.433 \tan 1°30' = 1.111 \text{ m}$$

$$\text{R.L. of } A = 100 - V - 0.5 = 100 - 1.111 - 0.5 = 98.388 \text{ m}$$