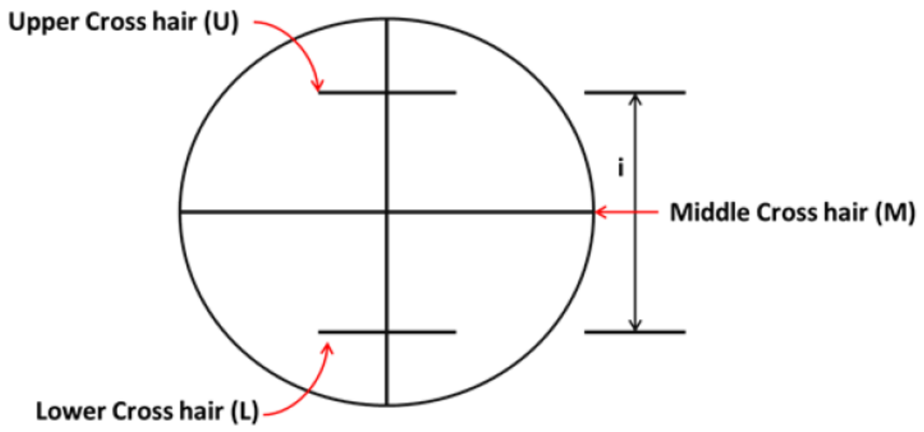
Tacheometry (Stadia Method):

- Tacheometry is a branch of surveying in which horizontal and vertical distances are determined by taking angular observations with theodolite and total station instruments.
- Tacheometric surveying is adopted in rough and difficult terrain where direct levelling and chaining are either not possible or very tedious.
- The principle:
  - The reticule (cross hairs) in the telescope of levels and theodolites are equipped with three horizontal cross hairs. The upper and lower hairs being called stadia hairs (that is upper stadia and lower stadia), and the full line called middle cross hair.



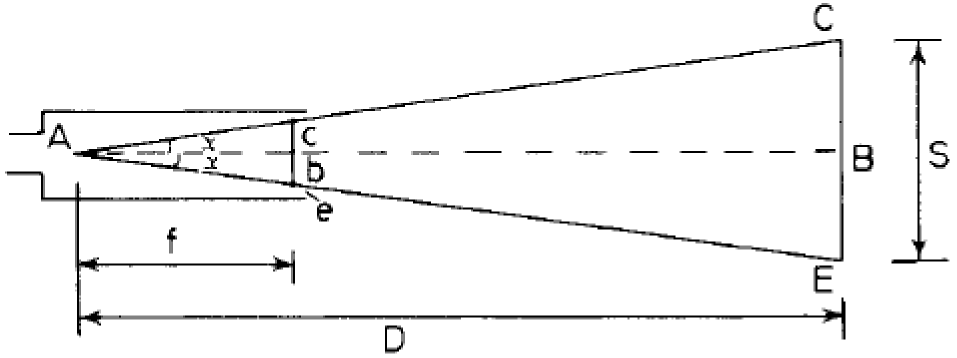
- The principle of this form of tacheometry, in which the parallactic angle 2α remains fixed and the staff intercept *S* varies with distance D.

When the line of sight is horizontal: The parallactic angle is defined by the position of the stadia hairs, *c* and e, each side of the main cross-hair *b,* then by similar triangles:

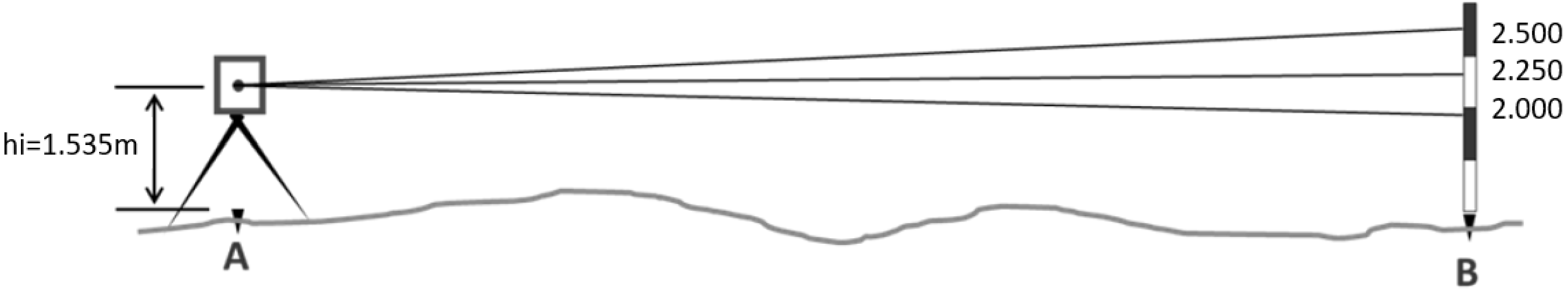
$\frac{AB}{CE} = \frac{Ab}{ce}$ AB=D ce=i CE=S Ab=f

Then (f/i) S=KS

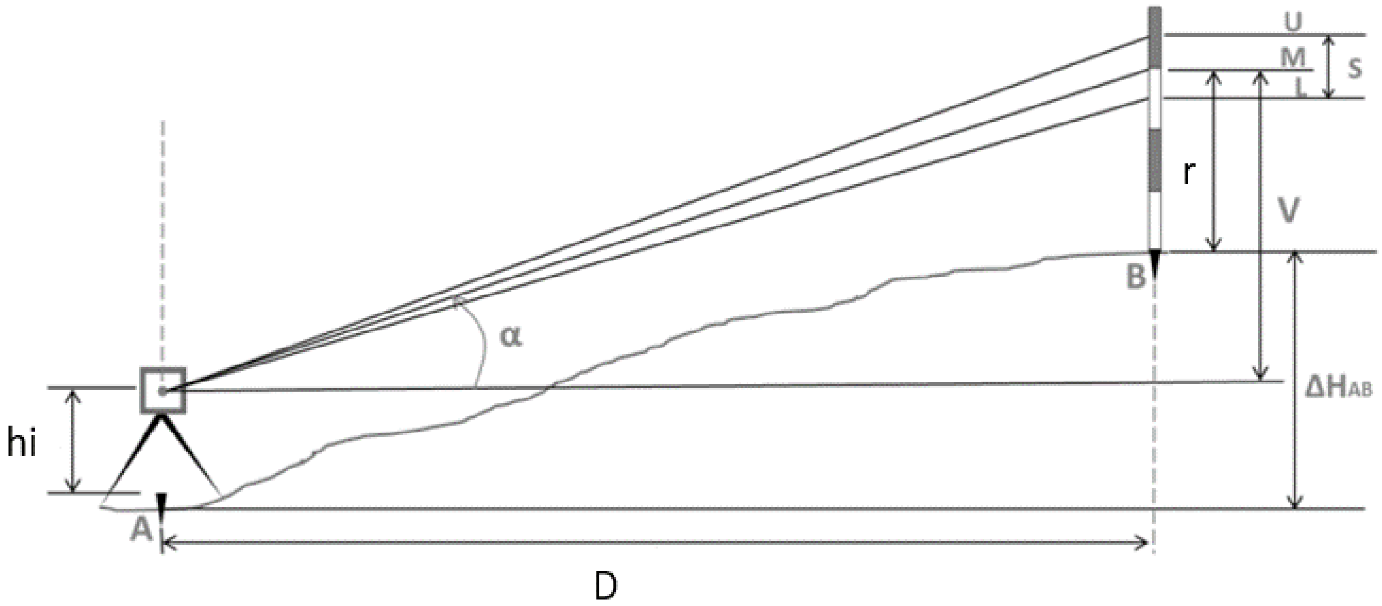
In modern telescope f and i are arranged that K=100, So D = 100 S.



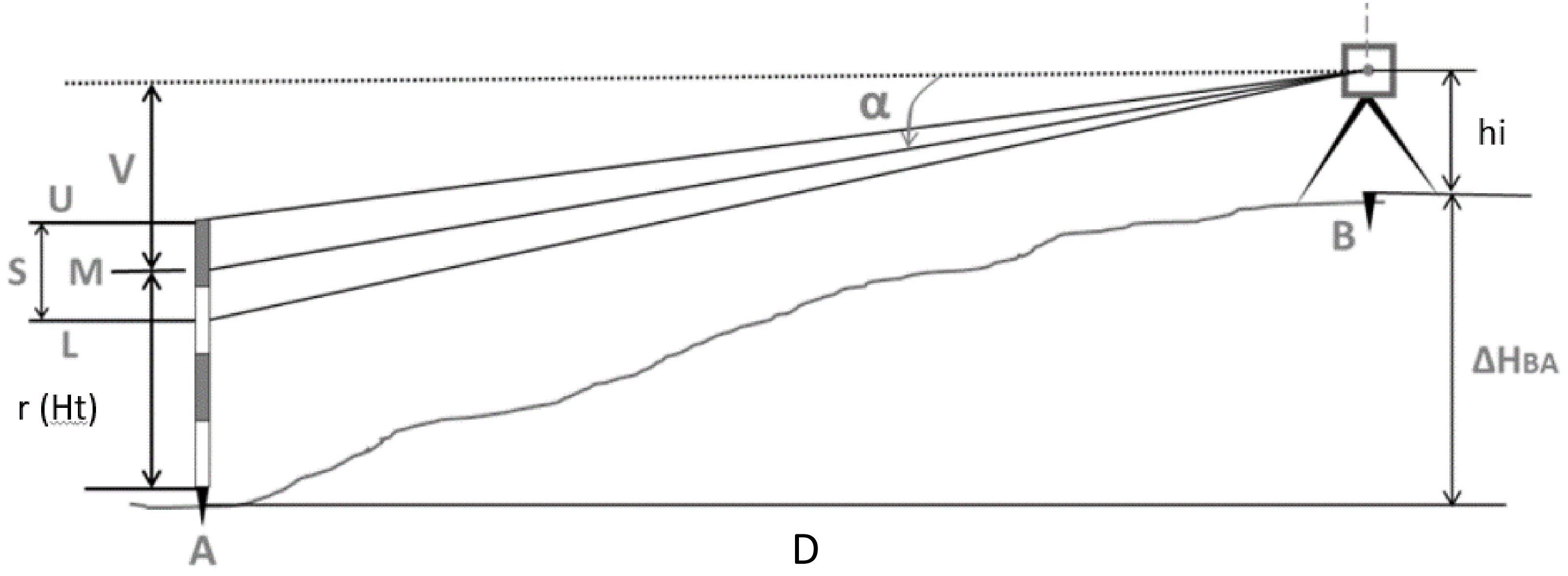
- Example:
- If the stadia reading on a vertical staff held at point B was 2.000. 2.250, 2.500, and the instrument was at A, its height (hi) were 1.535m. calculate the horizontal distance AB, and the difference in elevation between A and B.



- When the line of sight is inclined upward:
- $D = K \times S \times cos^2\alpha$
- $D = 100 \times S \times cos^2\alpha$
- $V = K \times S \times \cos\alpha \times \sin\alpha$
- $V = 100 \times S \times \cos\alpha \times \sin\alpha$
- $\Delta HBA = V + hi - r$
- $Elevation\ of\ B = Elevation\ of\ A + \Delta HBA$



- When the line of sight is inclined downward:
- $D = K \times S \times cos^2\alpha$
- $D = 100 \times S \times cos^2\alpha$
- $V \; = \; K \times S \times \cos\alpha \; \times \; \sin\alpha$
- $V \; = 100 \times S \times \cos\alpha \; \times \; \sin\alpha$
- $\Delta HBA \; = r + \; V - hi$
- $Elevation\ of\ B \; = \; Elevation\ of\ A + \; \Delta HBA$



- Example1:
- *Two points A and B are on opposite sides of a summit. The tacheometer was set up at P on top of the summit, and the following readings were taken.*

Inst. station	Height of inst.	Staff station	Vertical angle	Hair readings	Remark
P	1.500	A	–10°0'	1.150, 2.050, 2.950	RL of P = 450.500 m
P	1.500	B	–12°0'	0.855, 1.605, 2.355	

- *The tacheometer is fitted with an anallatic lens, the multiplying constant*
- *being 100. The staff was held vertical. Calculate:*

1. *Distance between A and B*
2. *The elevations of A and B*

- *Example2:*
- *The following observations were taken with a tacheometer (theodolite or total station) the staff being held vertically. The constant of the tacheometer is 100.*

Int. station	Height of instrument	Staff station	Vertical angle	Staff readings (m)	Remark
P	1.255	BM	–4°20'	1.325, 1.825, 2.325	RL of BM = 255.750 m
P	1.255	A	+6°30'	0.850, 1.600, 2.350	
B	1.450	A	–7°24'	1.715, 2.315, 2.915	

- *Calculate the RL of B and the distance between A and B.*