

□ "Sextant" □

Objective:- To determine height of building with the help of sextant.

Apparatus Required:- Sextant, Measuring Tape and a Cross mark.

Formula used:- The height, H of building is given by

$$H = h_0 + \frac{d}{\cot \alpha - \cot \beta}$$

where, h_0 = height of cross mark above the ground.

d = distance between two marks above

A and B on ground

α and β = angles of elevation of top of the building at marks A and B respectively.

Procedure:-

- (i) First we find the least count of the sextant.
- (ii) Then we put the Cross mark at the eye level on the wall and measure its height h_0 above ground with the help of measuring tape.

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(iii) Then we mark three points A, B and C at a distance of 5 ft, 7 ft and 9 ft respectively on the ground.

(iv) Now we stand at A, holding the sextant vertically and see the direct image of cross mark in left and note the reading. When for particular reading a similar image in right mirror becomes collinear. This is the zero reading of the sextant at that point.

(v) Next we move the index arm slowly further so that upper parts are seen moving down in right half of field of view till red line on wall is seen collinear with cross mark. The difference of two readings gives angle of elevation at A.

(vi) Repeat the step (iv) and (v) to find the angle of elevation at B and C.

Observations:-

- Height of cross mark above the ground $h_0 = 5.0$ ft
- least count of sextant = $12''$ (12 second)

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• Readings of the measuring tape at position A :-

'a' = 5 ft

S.No	Zero reading (P)			Elevation Reading (Q)			Angle of elevation $\alpha = Q - P$
	MS	VS	Total	MS	VS	Total	
1.	6° 24'	2	6° 24' 24"	43° 24'	2	43° 24' 24"	37° 0' 0"
2.	6° 16'	3	6° 16' 36"	43° 4'	4	43° 4' 48"	36° 48' 12"
3.	6° 26'	4	6° 26' 48"	43° 11'	1	43° 11' 12"	36° 44' 24"
Mean						$\alpha = 36° 50' 52"$	

• Reading of measuring tape at position B = '7 ft' :-

b = 7 ft

S.No	Zero reading (R)			Elevation Reading (S)			Angle of elevation $\beta = S - R$
	MS	VS	Total	MS	VS	Total	
1.	7° 10'	3	7° 10' 36"	34° 10'	3	34° 10' 36"	27° 0' 0"
2.	7° 6'	2	7° 6' 24"	34° 30'	5	34° 31' 0"	27° 24' 36"
3.	7° 7'	4	7° 7' 48"	34° 12'	1	34° 12' 12"	27° 4' 24"
Mean						$\beta = 27° 9' 40"$	

• Reading of measuring tape at position C = '9 ft' :-

c = 9 ft

S.No	Zero reading (t)			Elevation Reading (u)			Angle of elevation $\gamma = u - t$
	MS	VS	Total	MS	VS	Total	
1.	6° 9'	3	6° 9' 36"	29° 9'	2	29° 9' 24"	22° 59' 38"
2.	7° 28'	1	7° 28' 12"	29° 13'	5	29° 14' 0"	21° 45' 48"
3.	7° 22'	1	7° 22' 12"	29° 13'	4	29° 13' 48"	21° 51' 36"
Mean						$\gamma = 22° 12' 20"$	

Calculations :-

from observation table, we have

$$\alpha = 36^\circ 50' 52'' , \beta = 27^\circ 9' 40'' , \gamma = 22^\circ 12' 20''$$

$$\cot \alpha = 1.33 , \cot \beta = 1.91 , \cot \gamma = 2.42$$

Set 1: Position of A and B

$$d_1 = b - a = 2 \text{ ft}$$

$$H_1 = h_0 + \frac{d_1}{\cot \beta - \cot \alpha} = 5 + \frac{2}{(1.91 - 1.33)} \text{ ft}$$

$$H_1 = 8.448 \text{ ft}$$

Set 2: Position B and C

$$d_2 = c - b = 2 \text{ ft}$$

$$H_2 = h_0 + \frac{d_2}{\cot \gamma - \cot \beta} = 5 + \frac{2}{(2.42 - 1.91)} \text{ ft}$$

$$H_2 = 8.921 \text{ ft}$$

Set 3: Position A and C

$$d_3 = c - a = 4 \text{ ft}$$

$$H_3 = h_0 + \frac{d_3}{\cot \gamma - \cot \alpha} = 5 + \frac{4}{(2.42 - 1.33)} \text{ ft}$$

$$H_3 = 8.669 \text{ ft}$$

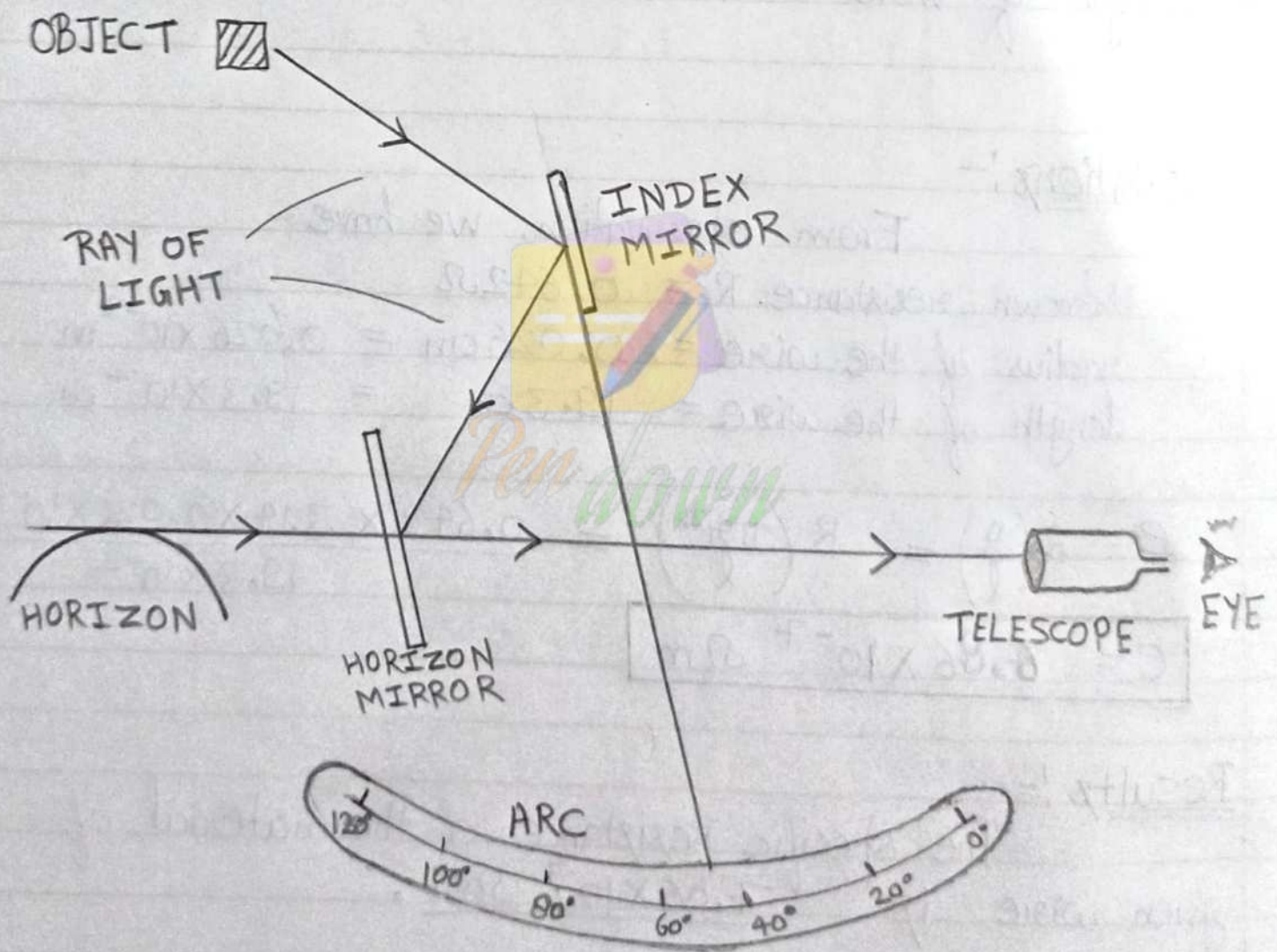
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$$\begin{aligned}\text{Mean height} &= \frac{H_1 + H_2 + H_3}{3} \\ &= \frac{0.448 + 0.921 + 0.669}{3} = 0.679 \text{ ft}\end{aligned}$$

Result :- The height till red line on wall = 0.679 ft

Precautions :- (i) Always hold the sextant in right hand.
(ii) Make appropriate adjustments for the zero error. if it isn't perfectly adjusted it can create side error and index error.

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Ray diagram of working of Sextant