SURVEYING

Surveying is normally regarded as the most fundamental base, or more precisely, the art and science of map making. It is defined as an art to determine the relative positions on, above or beneath the surface of the earth, with respect to each other, by measurements of horizontal and vertical distances, angles and directions.

Common Terminologies:-

1. **Level surface:-** It refers to any surface parallel to the mean spheroidal surface of the earth. Any line contained in the level surface is termed as a level line.
2. **Datum:-** It refers to any arbitary assumed level surface or line from which vertical distances or elevations are measured.
3. **Bench mark:-** It refers to a fixed reference point of known elevation above sea level. Depending upon the permenency and precision bench mark may be of four types; viz., a) Great Trigonometric survey Bench Mark (G.T.S.B.M.).
   b) Permenent Bench Mark.
   c) Arbitary Bench Mark.
   d) Temporary Bench Mark.
4. **Line of collimation:-** It is the line passing through the intersection of the cross hairs to the optical centre of the object glass of the telescope.

5. Change point :- It denotes the shifting of the leveling instrument. It is a point on which both the fore sight of the former set-up and the back sight of the new set-up are observed.

6. Leveling :- Leveling may be defined as the art of determining the relative heights or elevations of points or objects on the earth surface. It deals with the measurement in a vertical plane.

7. Back sight :- It is a staff reading taken in a point of known elevation, as on a bench mark or a change point. It is called a plus sight. It is the first staff reading taken after the level is set up and levelled.

8. Fore sight :- It is a stuff reading on a point, whose elevation is to be determined as on a change point. It is also called a minus sight. It is the last stuff reading denoting the shifting of the instrument.

9. Intermediate sight :- It is a stuff reading taken on a point of unknown elevation between backsight and foresight.

10. Parallax :- It is the aperent movement of the image relative to the cross hairs when the image formed by the objective does not fall in the plane of the diaphragm.

11. Traversing :- A traverse survey is one in which the frame work consist of a series of connected lines, the lenths and directions of which are measured with a chain or a tape and with an angular instrument respectively.

A traverse may be classified as - a) closed traverse, and
b) Open traverse.

12. Fore & Back bearing :- Every line has two bearings, one observed at each end of the line. The bearing of a line in the direction of the progress of the survey is called the "fore or forward bearing (F.B.)', while its bearing in the opposite direction is known as the 'Back bearing (B.B.)'. The fore and back bearings of a line differ exactly by one 180°.

13. Closing error :- It is the distance by which the end of a traverse falls short in coinciding with the starting point of the traverse.

14. Local attraction :- It refers to the deflection of a magnetic needle caused by external disturbances induced by the proximity of magnatic substances.

15. Contouring :- The elevations and depressions of the surface of the ground are shown on a map by means of contour lines. A contour may be defined as the line of intersection of a level surface with the surface of the ground.

All points on any one contour have the same elevation above the datum surface. The line joining these points on the map is called 'contour lines' or 'contour'. The vertical distance between two consecutive contours is called the 'contour interval', and the horizontal distance between any two consecutive contour is termed as 'horizontal equivalent'.

The more broken the ground, the greater must be the contour interval; otherwise the contours will to close to each other. If the interval is smaller the amount of field work is greater.

Common Equipments of Surveying :-

1. Transit Theodolite :- It is the most intricate instrument by which horizontal and vertical angles can be determined with great precision. The size of it varies from 8 to 25 cm. Sometimes, a compass is fitted on the theodolite to note the bearings. The instrument is mounted on a tripod made of solid legs.

2. Prismatic Compass :- It is used in wooded country rough traverses, filling in details preliminary survey for a road, military purposes, such as, sketching and night marching etc. It is unreliable in places abounding in magnetic rock or iron ore. It is less aquate than theodolite.

3. Dumpy Level :- This is the most widely used direct leveling instrument. It consist of a telescope which is rigidly fixed to its support. It can neither be rotated about its longitudenal axis nor can it be removed from its support. It is very advantageous when several observations to be made with one set up of the instrument.

Other common accessories are -

4. Levelling Staff :- Made up of wood or alluminum and may have graduations either in feet & metre ; **5. Tape :-** Used in measuring short lengths ;

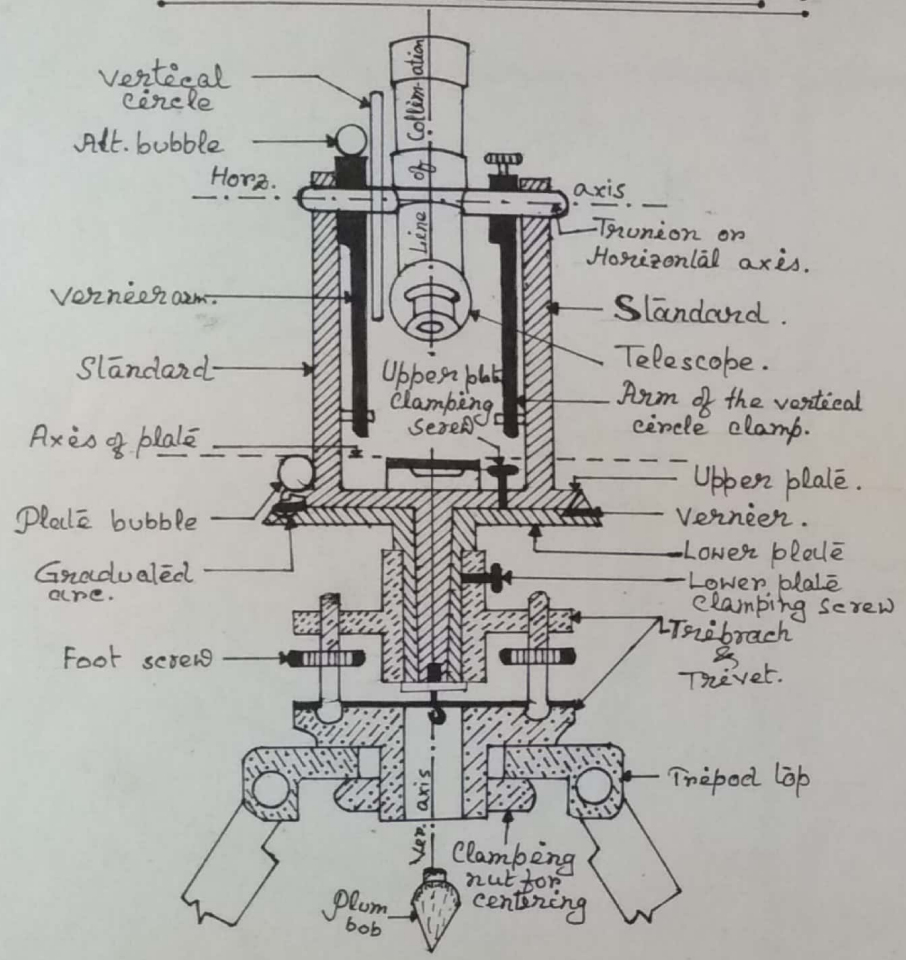
6. Pin :- Used in chaining and in marking the stations with a tag on it ;

7. Ranging Rod :- Used in station marking and setting out lines ;

8. Plumbbob :- Used mainly for aquate Centering ; etc.

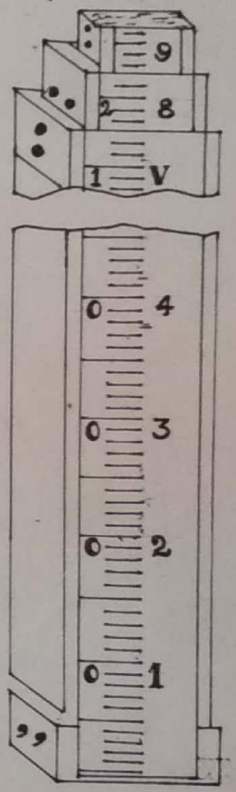
EQUIPMENTS OF THEODOLITE SURVEY

A TRANSIT THEODOLITE



A PLUMB BOB

A LEVELLING STAFF

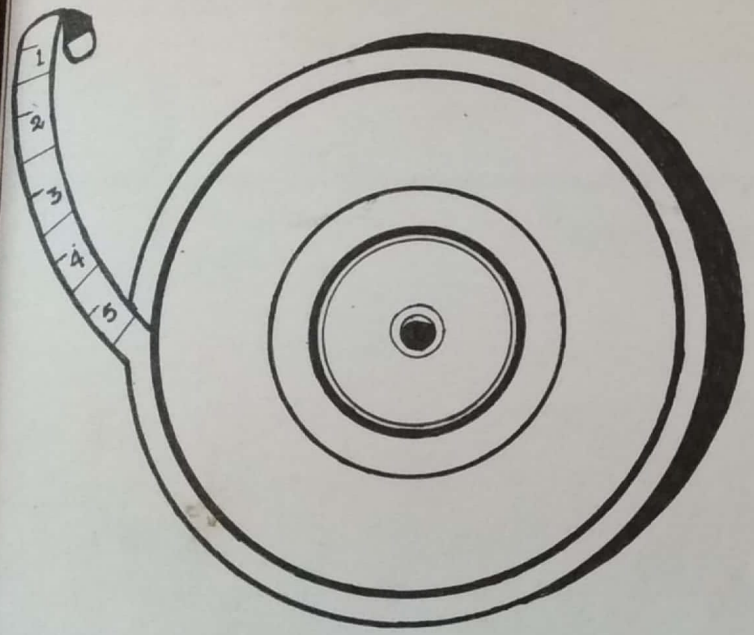


22.9.

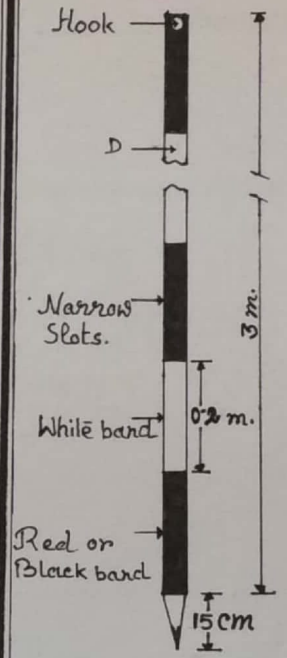
Contd.→

EQUIPMENTS OF THEODOLITE SURVEY

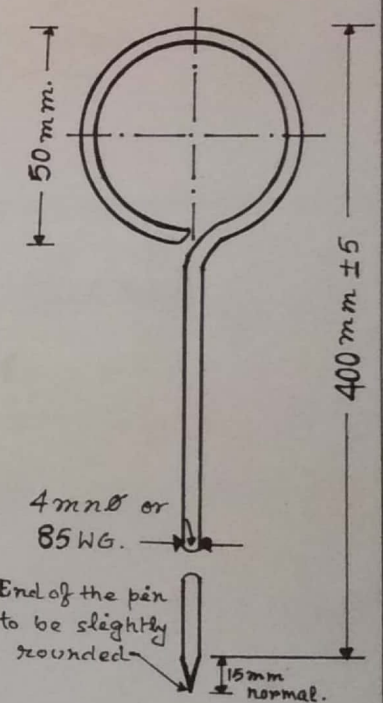
A MEASURING TAPE



A RAINGING ROD



A GROUND PIN



22.9.2020

Field book

DETERMINATION OF HEIGHT & DISTANCE BY TRANSIT THEODOLITE

Base : Accessible

*Date : 1/9/2000.

*Place : Chandernnagore College ground.

*Time : 2 PM to 3 PM.

*Instrument No : 55607.

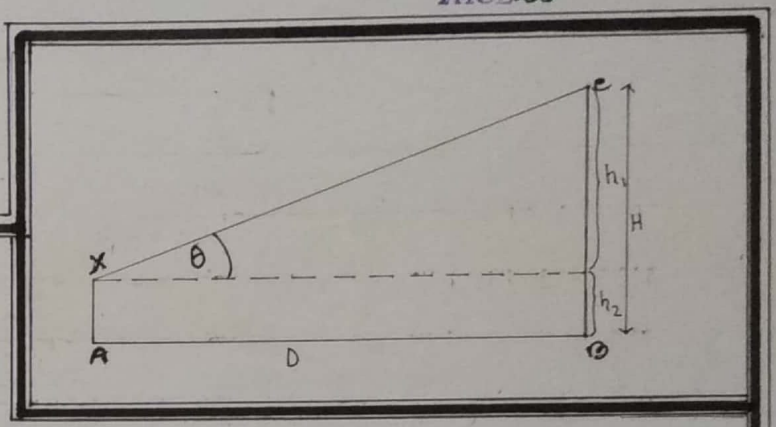
*Object : Telephone tower.

*Surveyor : Roll No. : 404/AH–010027. (Group–A).

FACE	VERNIER READING			REMARKS
	VC	VD	MEAN	
LEFT	18°28′	18°30′	18°29′	1. Instrumental height = 1·330 metre 2. Known Distance = 13.50 metre.
RIGHT	18°30′	18°34′	18°32′	
GRAND MEAN ANGLE	———	———	18°30′30″	22.9.xxx

CALCULATION OF HEIGHT & DISTANCE

BASE : ACCESSIBLE



1. $\angle\theta = 18°30'30''$
2. The instrumental height or the height of the collimation, $h_2 = 1.33$ metre.

3. CALCULATION OF GROUND DISTANCE:-

* A. By Stadia method →.

Total ground distance, D = (Lower stadia − Upper stadia) × 100
= {(1.395 − 1.260) × 100} metre.
= 13.50 metre.

* B. By 1° elevation method →

Total ground distance, D = (Reading at 1° − Reading at 0°) × cot 1°
= {(1.565 − 1.330) × cot 1°} metre; = 13.46 metre.

4. Height of the object above the line of collimation $h_1 = D\tan\theta$ = {13.50 × tan 18°30'30"} metre
= (13.50 × 0.334757054) metre
= 4.519 metre.

5. Height of the object above the ground surface, $H = (h_1 + h_2)$ = (4.519 + 1.330) metre
= 5.85 metre.

PLOTTING OF HEIGHT & DISTANCE BY TRANSIT THEODOLITE

Base : Accessible

DATE : 28/8/2000.

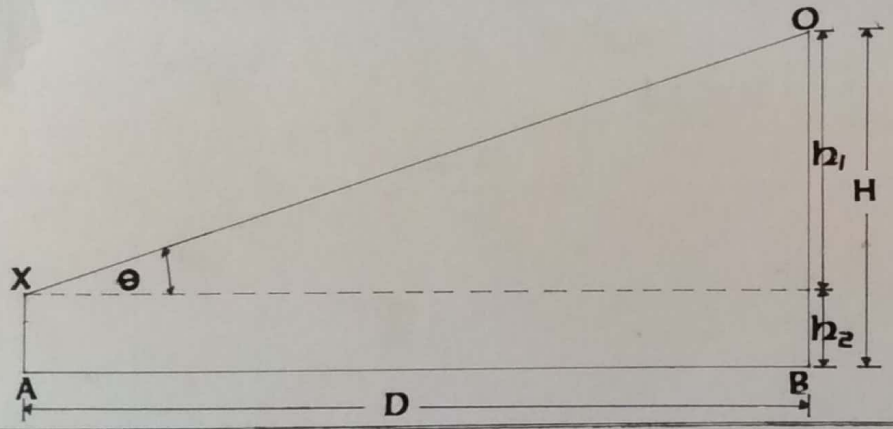
PLACE : CHANDERNNAGORE COLLEGE GROUND.

TIME : 12.00 NOON TO 1.40 PM.

INSTRUMENT NO. : 55607.

OBJECT : TELEPHONE TOWER.

SURVEYOR : ROLL NO. → 404/AH—010027. (GROUP-A).



SCALE

Horizontal
Vertical
1 : 100.

1 0·5 0 1 2 3 4 5
Metre.

★ **Index**

h_1 ⇒ Height of the Object above the Line of Collimation.

h_2 ⇒ Height of the Collimation.

H ⇒ Height of the Object above Ground Surface.

D ⇒ Total ground distance.

$\angle\theta \Rightarrow 18^\circ 30' 30''$.

11.9.2000

Field Book

DETERMINATION OF HEIGHT & DISTANCE
BY
TRANSIT THEODOLITE
Base : Inaccessible

DATE : 28/8/2000.

PLACE : CHANDERNNAGORE COLLEGE GROUND.

TIME : 12.00 NOON. TO 1.40 P.M.

INSTRUMENT NO : 55607.

OBJECT : RAIN WATER PIPE.

SURVEYOR : ROLL NO. : 404/AH-010027. (GROUP-A).

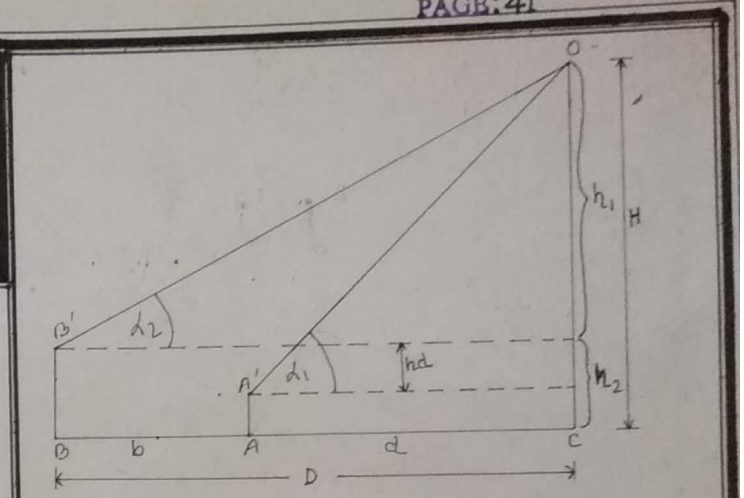
STATION	FACE	VERNIER READING			REMARKS
		VC	VD	MEAN	
Station-'A'	Left	32°46′	32°45′	32°45′30″	1. Instrumental height at Station A = 1·38 metre
	Right	32°40′	32°40′	32°40′	
	GRAND MEAN ANGLE	———	———	32°42′45″	2. Instrumental height at Station B = 1·45 metre
Station-'B'	Left	25°29′	25°30′	25°29′30″	3. Known distance = 6·20 metre.
	Right	25°25′	25°26′	25°25′30″	
	GRAND MEAN ANGLE	—	—	25°27′30″	

22.9.2000

CALCULATION OF HEIGHT & DISTANCE

Base : Inaccessible.

ALB



1. Known distance, $b = 6.20$ metre.
2. $\angle\alpha_1 = 32°42'45''$; $\angle\alpha_2 = 25°27'30''$
3. Height of the instrument at station - A = 1.38 metre.
   Height of the instrument at station - B = 1.45 metre.

∴ The collimation difference, $hd = (1.45 - 1.38)$ metre ; $= 0.07$ metre.

4. Unknown distance, $d = \dfrac{(b + hd\cot\alpha_2)\tan\alpha_2}{(\tan\alpha_1 - \tan\alpha_2)}$

$= \left[\dfrac{\{6.20 + (0.70 \times \cot 25°27'30')\}\tan 25°27'30'}{(\tan 32°42'45'' - \tan 25°27'30'')}\right]$ metre.

$= \dfrac{\{6.20 + (0.07 \times 2.10)\} \times 0.476083}{(0.6422967 - 0.476083)}$ metre.

$= \dfrac{6.34703313 \times 0.476083}{0.16621354}$ metre.

$= 18.180$ metre.

∴ The total distance $D = (b + d) = (18.180 + 6.20)$ metre ; $= 24.380$ metre.

5. Height of the object above the line of Collimation, $h_1 = D\tan\alpha_2$
$= (24.380 \times \tan 25°27'30'')$ metre.
$= (24.380 \times 0.476083)$ metre.
$= 11.607$ metre.

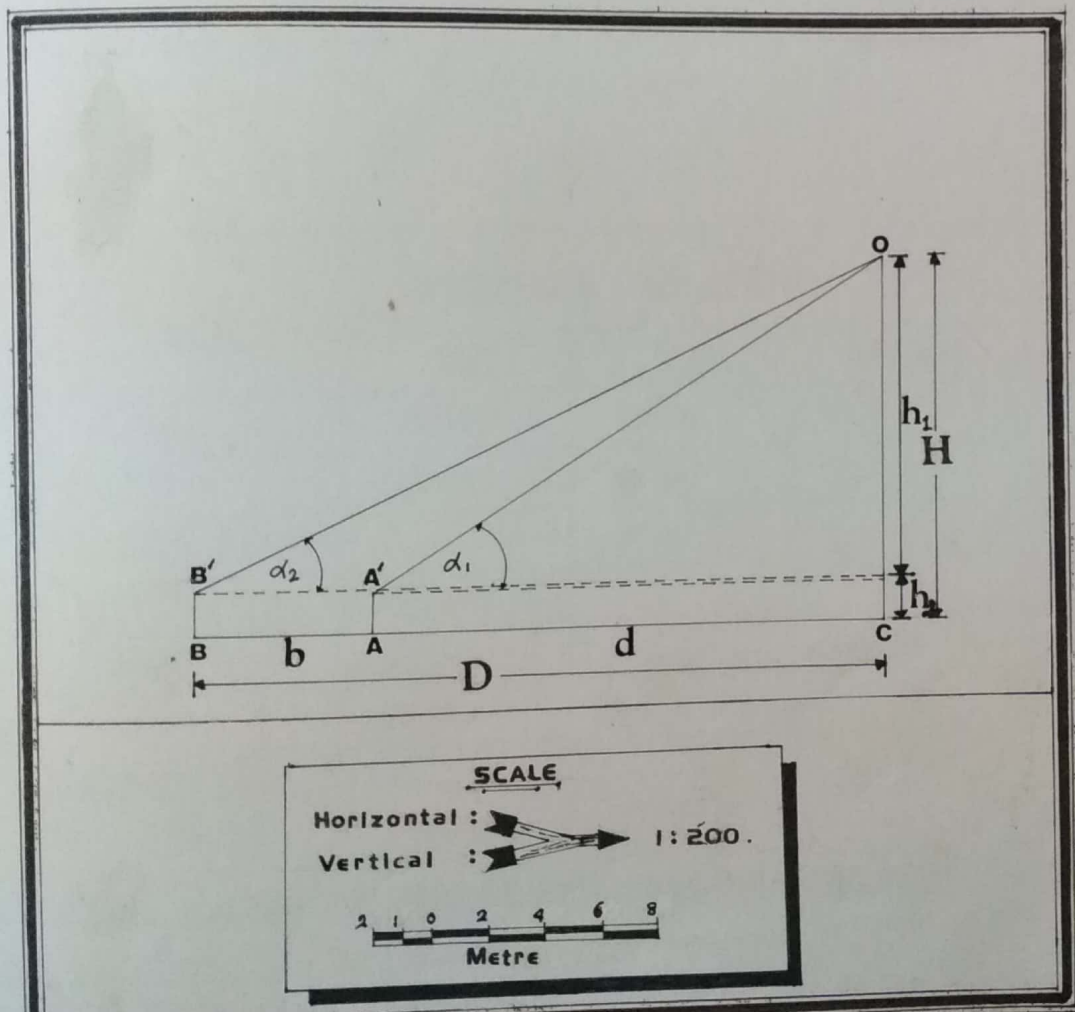
∴ The total Height of the object above the ground surface, $H = (h_1 + h_2)$
$= (11.607 + 1.45)$ metre.
$= 13.057$ metre.

PLOTTING OF HEIGHT & DISTANCE BY TRANSIT THEODOLITE

Base : Inaccessible

DATE : 28/8/2000
PLACE : Chandernnagore College ground
TIME : 12 Noon To 1.40 P.M.

INSTRUMENT NO : 55607
OBJECT : Rain Water Pipe
SURVEYOR : Roll-No. 404/AH-010027 (Group-A)



EXAMINED

Department of Geography
VIVEKANANDA MAHAVIDYALAYA
BURDWAN.

Index.

b ⇒ Known distance.
d ⇒ Unknown distance.
D ⇒ Total Ground distance.
h_1 ⇒ Height of the Object above the line of Collimation
h_2 ⇒ Collimation height
H ⇒ Total Height of the Object above Ground surface
AA' ⇒ Instrumental Height at Station – A
Instrumental Height at Station – B
$\angle\alpha_1$ ⇒ 32°42′45″
$\angle\alpha_2$ ⇒ 25°27′30″

11.9.2000

Field Book

DETERMINATION OF HEIGHT & DISTANCE
BY
TRANSIT THEODOLITE
Base : Inaccessible

DATE : 28/8/2000.

INSTRUMENT NO : 55607.

PLACE : CHANDERNNAGORE COLLEGE GROUND.

OBJECT : RAIN WATER PIPE.

TIME : 12 NOON TO 1.40 P.M.

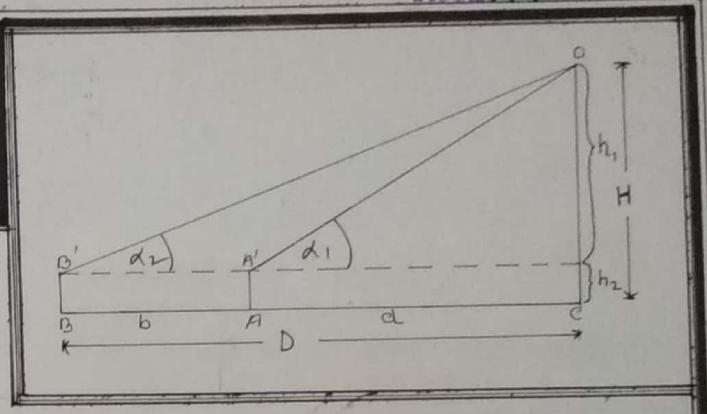
SURVEYOR : ROLL NO. : 404/AH-010027. (GROUP-A).

STATION	FACE	VERNIER READING			REMARKS
		VC	VD	MEAN	
Station-'A'	Left	32°46′	32°45′	32°45′30″	1. Instrumental height at station A & B = 1·38 metre.
	Right	32°40′	32°40′	32°40′	
	GRAND MEAN ANGLE	———	———	32°42′45″	2. Known distance = 6·20 metre.
Station-'B'	Left	25°40′	25°40′	25°40′	
	Right	25°39′	25°37′	25°38′	
	GRAND MEAN ANGLE	———	———	25°39′	

22.9.00

CALCULATION OF HEIGHT & DISTANCE

Base: Inaccessible.



1. Known distance, $b = 6.20$ metre.
2. $\angle\alpha_1 = 32°42'45''$; $\angle\alpha_2 = 25°39'$.
3. Height of the instrument at both [Same height] station A & B, $(h_2) = 1.38$ metre.

4. Unknown distance, $d = \dfrac{b \tan\alpha_2}{\tan\alpha_1 - \tan\alpha_2}$; $= \dfrac{6.20 \times \tan 25°39'}{\tan 32°42'45'' - \tan 25°39'}$ metre.

$= \dfrac{6.20 \times 0.48019316}{0.6422967 - 0.48019316}$ metre.

$= \dfrac{2.97719794}{0.16210356}$ metre.

$= 18.366$ metre.

∴ The total ground distance, $D = (b+d) = (6.20 + 18.366)$ metre;

$= 24.566$ metre.

5. Height of the object above the line of Collimation, $h_1 = D\tan\alpha_2 = 24.566 \times \tan 25°39'$ metre.

$= (24.566 \times 0.48019316)$ metre

$= 11.796$ metre.

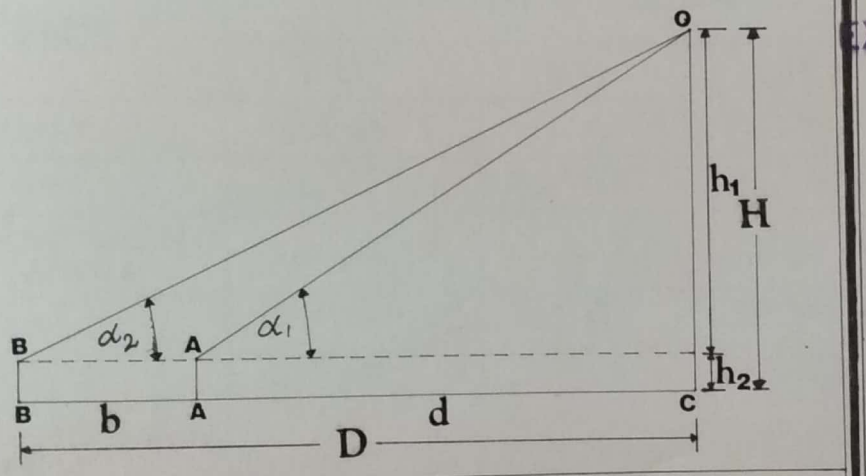
∴ Height of the object above ground surface, $H = (h_1 + h_2) = (11.796 + 1.38)$ metre

$= 13.176$ metre.

PLOTTING
OF
HEIGHT & DISTANCE
BY
TRANSIT THEODOLITE
Base : Inaccessible

DATE : 28/8/2000.
PLACE : CHANDERNNAGORE COLLAGE GROUND.
TIME : 12.00 NOON TO 01.40 P M.

INSTRUMENT NO : 55607.
OBJECT : RAIN WATER PIPE.
SURVEYOR : ROLL - NO. 404/AH-010027.
(GROUP - A).



Scale
Horizontal
Vertical
1 : 200
2 1 0 2 4 6 8
Metre

★ Index ★

- b ⇒ Krown Distance.
- d ⇒ Unknown Distance.
- D ⇒ Total Ground Distance.
- h_1 ⇒ Height Of the Object above Line Of Collimation.
- h_2 ⇒ Collimation Height.
- H ⇒ Height Of the Object above Ground Surface.
- $\angle\alpha_1 \Rightarrow 32°42'45''$.
- $\angle\alpha_2 \Rightarrow 25°39'$.

11.9.2000

Field Book

DETERMINATION OF HEIGHT & DISTANCE
by
TRANSIT THEODOLITE
Base : Inaccessible

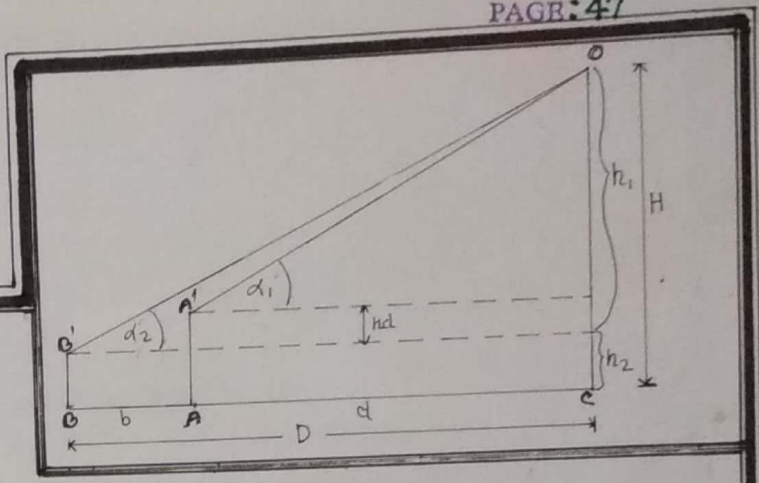
- **Date** : 28/8/2000.
- **Place** : Chandernnagore College ground.
- **Time** : 12 Noon to 1.40.P.M.
- **Instrument No** : 55607.
- **Object** : Rain water pipe.
- **Surveyor** : ROLL NO. : 404/AH – 010027. (Group – A).

STATION	FACE	VERNIER READING			REMARKS
		VC	VD	MEAN	
Station - 'A'	Left	32°46′	32°45′	32°45′30″	1. Instrumental height at Station - A = 1·38 metre.
	Right	32°40′	32°40′	32°40′	2. Instrumental height at Station - B = 1·26 metre.
	GRAND MEAN ANGLE	———	———	32°42′45″	3. Known distance = 6·20 metre.
Station - 'B'	Left	25°45′	25°45′	25°45′30″	
	Right	25°45′	25°45′	25°45′	
	GRAND MEAN ANGLE	———	———	25°45′15″	EXAMINED

22.9.

CALCULATION OF HEIGHT & DISTANCE

BASE : INACCESSIBLE



1. Known distance, $b = 6.20$ metre.

2. $\angle\alpha_1 = 32°42'45''$; $\angle\alpha_2 = 25°45'15''$

3. Height of the instrument at station - A = 1.380 metre.
   Height of the instrument at station - B = 1.26 metre.

∴ The collimation difference, $hd = (1.38 - 1.26)$ metre ; $= 0.12$ metre.

4. Unknown distance, $d = \dfrac{\{b - (hd \cot\alpha_2)\}\tan\alpha_2}{\tan\alpha_1 - \tan\alpha_2}$; $= \dfrac{\{6.20 - (0.12 \times \cot 25°45'15'')\}\tan 25°45'15''}{(\tan 32°42'45'' - \tan 25°45'15'')}$ metre.

$= \dfrac{\{6.20 - (0.12 \times 2.07)\} \times 0.482432385}{0.642296716 - 0.482432385}$ metre.

$= \dfrac{2.871080788}{0.159864331}$ metre.

$= 17.959$ metre.

∴ The total ground distance, $D = (b + d) = (6.20 + 17.959)$ metre
$= 24.159$ metre.

5. Height of the object above the line of collimation, $h_1 = D\tan 25°45'15''$
$= (24.159 \times 0.482432385)$ metre
$= 11.655$ metre.

∴ The total height of the object above the ground surface, $H = (h_1 + h_2) = (11.655 + 1.260)$ metre
$= 12.916$ metre.

PLOTTING OF HEIGHT & DISTANCE BY TRANSIT THEODOLITE

Base : Inaccessible

★ DATE : 28/8/2000.

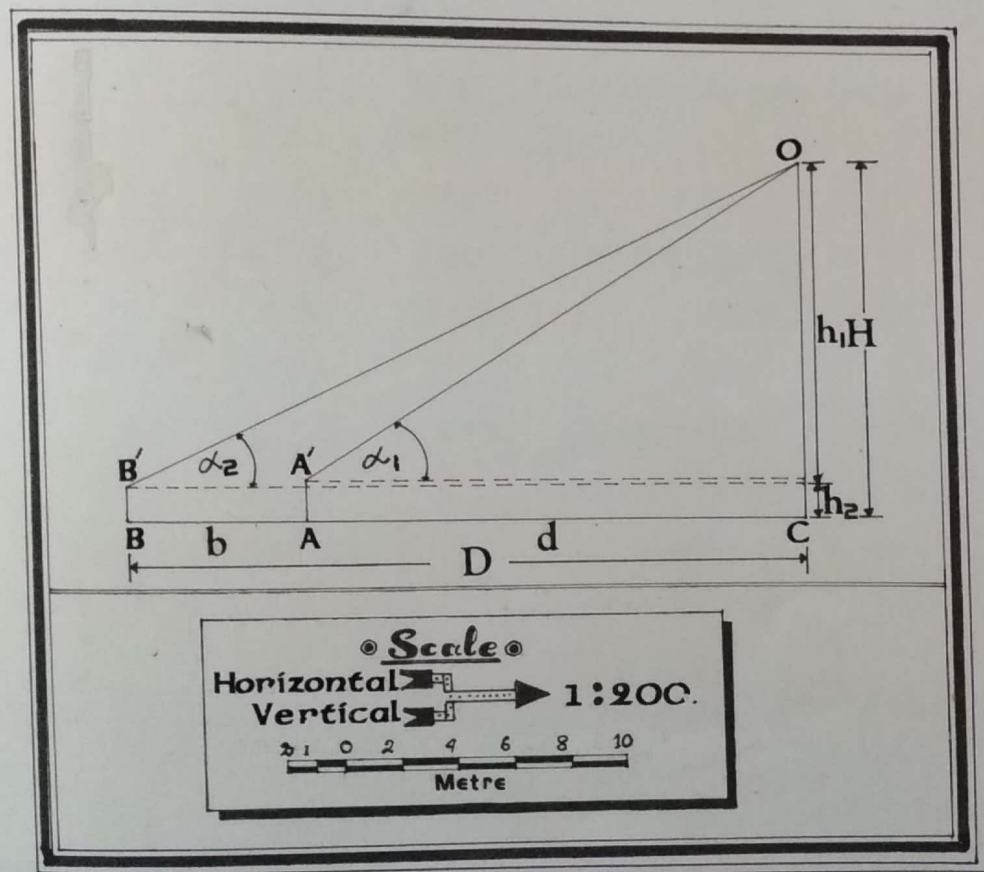
★ PLACE : CHANDERNNAGORE COLLAGE GROUND.

★ TIME : 12.00 NOON TO 1.40 P.M.

★ INSTRUMENT NO : 55607.

★ OBJECT : RAIN WATER PIPE.

★ SURVEYOR : ROLL NO. → 404/AH—010027. (GROUP-A).



★ Index ★

b ⇒ Known Distance.
d ⇒ Unknown Distance.
D ⇒ Total Ground Distance.
h_1 ⇒ Height of the Object above, the Line of Collimation.
h_2 ⇒ Collimation Height.
H ⇒ Height of the Object above Ground Surface.
AA' ⇒ Instrmental Height at Station-A.
BB' ⇒ Instrumental Height at Station-B.
$\angle\alpha_1 \Rightarrow 32^0 42' 45''$.
$\angle\alpha_2 \Rightarrow 25^0 45' 15''$

11.9.2000