Surveying-II Lab Manual

II-YEAR II-Sem B.Tech,

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DEPARTMENT OF CIVIL ENGINEERING

SREE CHAITANYA COLLEGE OF ENGINEERING

(AFFILIATED TO JNTU UNIVERSITY)

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LABORATERY MANUAL

LIST OF EXERCISES:

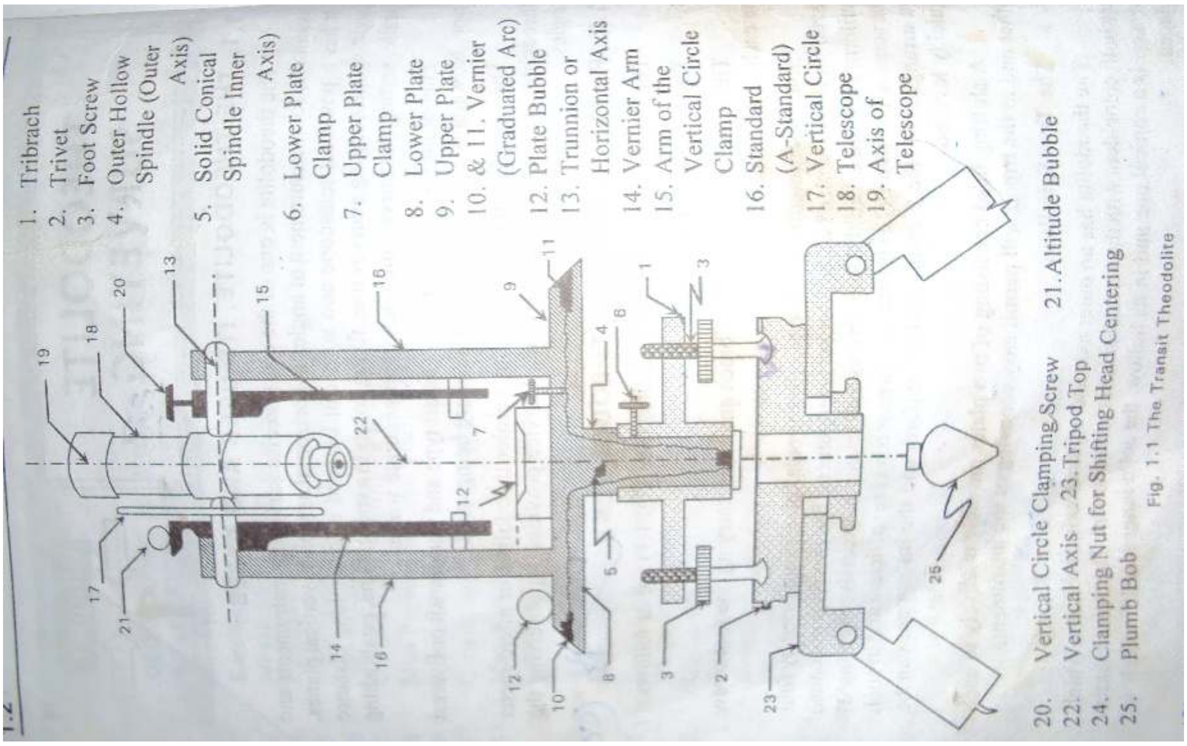
1) Study of theodolite in detail – practice for measurement of horizontal and vertical angles.
2) Measurement of horizontal angles by method of repetition and reiteration.
3) Trigonometric leveling –heights and distances problem (two exercises).
4) Heights and distance using principles of tacheometric surveying (two exercises).
5) Curve setting- different methods. (two exercises)
6) setting out works for buildings and pipe lines.
7) Determine of area using total station.
8) Traversing using total station.
9) Contouring using total station.
10) Determination of remote height using total station.
11) Stake out using total station.
12) Distance , gradient ,diff, height between two inaccessible points using total station.

13)

EXPERIMENT NO -1

STUDY OF THEODOLITE IN DETAIL – PRACTICE FOR MEASUREMENT OF HORIZONTAL AND VERTICAL ANGLES.

THEODOLITE **TRIPOD**



The theodolite is one of the most precise surveying instruments and is suitable for measurement of angles in horizontal as well as vertical planes.

PARTS OF VERNIER THEODOLITE:

1) **<u>THE LEVELING HEAD</u>**: this usually consists of a tribach and trivet carrying one foot screw on each of its three arms.
2) **<u>THE TWO SPINDLES</u>**: the theodolite has an outer axis and an inner axis of rotation which are both coincident with the vertical axis of the instruments.
3) **<u>THE LOWER PLATE AND UPPER PLATE</u>**: the outer axis is attached to the lower plate which is also called the scale plate. This plate is circular in shape and beveled at the edge. It is graduated from 00 to 3600 in the clock wise direction
   The inner axis is attached to the upper plate which is also known as the vernier plate. The upper clamp and upper tangent screw facilitate fixing it to the lower plate at any desired position.
4) **<u>PLATE LEVEL TUBES:</u>** two level tubes are provided on the vernier plate at right angles to one another. These are known as Plate level.
5) **<u>STANDERDS:</u>**a pair of uprights or standards is placed on the vernier plate they support the horizontal axis they are in the shape of letter A.
6) **<u>TELESCOPE:</u>** the telescope is fixed to a transverse horizontal axis also known as trunion axis. The trunnion rests in bearings on the standards. The telescope can be rotated in a vertical plane about the horizontal axis.
7) **<u>VERTICAL CIRCLE:</u>** A vertical graduated circle is rigidly attached to the telescope and rotates along with it. It is graduated from 00 to3600 continuously or from 00 to 900 in each quadrant.
8) **<u>T-FRAME:</u>** Its horizontal arm called index bar has two verniers, one at each end. The vertical leg called the clipping arm has clips screws at its lower end.
9) **<u>CAMPASS:</u>** the tubular compass contains a magnetic needle fitted in a metal tube. When the pointer lines exactly midway between these two vertical lines, the magnetic will be defined.
   <u>PLUMB BOB:</u> the Plumb bob is suspended from the hook fitted to the bottom central vertical axis.
10) **<u>THE TRIPOD:</u>** this is the one on which the whole instrument rests when it is on use.

EXPERIMENT NO -2

MEASUREMENT OF HORIZONTAL ANGLE BY THE METHOD OF REPETITION:

AIM: Measurement of horizontal angle by the method of repetition

INSTRUMENTS REQUIRED: Theodolite, tape, r anging rods. tripod etc

PROCEDURE:

1) Set up the instrument over 'O' and level it accurately.
2) With the instrument on the left face, set verniers A to 3600 and with the aid of the lower champ and tangent screw, bisect signal A.
3) Check the reading on verniers A&B and note it.
4) Release the upper plate, swing the telescope to the right and bisect the right hand signal B with the upper clamp and tangent screw bisect single A.
5) Release the lower clamp, swing instrument to the right and turn to signal A. Clamp the lower motion and with lower tangent screw bisect signal A.
6) Release upper clamp, swing instrument to the right and again bisect signal B accurately with the upper clamp and tangent screw. The vernier reading will be twice the angle AOB.
7) Repeat the procedure until the angle is repeated the required number of times.
8) Change face to right and repeat the above procedure.
9) The average horizontal angle AOB will be the mean of the value of the angle as determined on both the faces.

OBSERVATIONS:

TABLE 1.2

Measurement of Horizontal Angle by Repetition

Inst. at	Sight to	Left Face 0^0 Right Swing											Face Right 0^0 Left Swing														Angle
		A			B		Mean			Horizontal angle			A			B		Mean			Horizontal angle			Average angle			
		°	'	"	'	"	°	'	"	°	'	"	°	'	"	'	"	°	'	"	°	'	"	°	'	"	
O	A	360	00	00	00	00	360	00	00				360	00	00	00	00	360	00	00							
										63	26	20									63	26	20	63	26	20	AOB
	B	63	26	20	26	20	63	26	20				63	26	20	26	20	63	26	20							
B after 3 rep.		190	18	40	19	00	190	18	50	63	26	16.7	190	19	00	19	00	190	19	00	63	26	20	63	26	18.35	A O B

EXERCISE-2

MEASUREMENT OF HORIZONTAL ANGLE S BY REITERATION:

AIM: Measurement of horizontal angle by the method of repetition

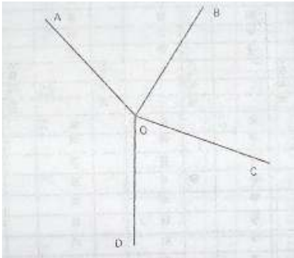


Fig. 1.3

INSTRUMENTS REQUIRED: Theodolite, tape, r anging rods. tripod etc

POCEDURE:

1) Set up the instrument exactly over O and level it accurately.
2) Let singal A be the referring object. Direct the telescope to A and bisect it with the help of the lower clamp and tangent screw . note the reading of both the verniers.
3) Release the upper plate and turn the telescope clock wise and bisect signal B accurately with the help of the upper clamp and tangent screw.note the readings of verniers A&B. their mean gives the angle AOB.
4) Similarly bisect signals C,D etc. in order using the upper clamp and tangent screw and each time note the reading on verniers A&B.
5) Finally site referring object A. if the final reading on signal A is the same as the initial reading , there is no error . otherwise the error should be distributed equally among all the angles abserved at the station if it is with in permissible limits. If the error is large the readings have to be taken fresh.

OBSERVATIONS:

TABLE 1.3

Measurement of Horizontal Angle by the method of reiteration

Inst. at	Sight To	0° Left Face Right Swing										
		A			B		Mean			Incl. Angle		
		°	′	″	′	″	°	′	″	°	′	″
0	A	360	00	00	00	00	360	00	00			
										74	42	22.5
	B	74	42	20	42	20	74	42	20			
									+2.5	75	44	22.5
	C	150	26	40	26	40	150	26	40			
									+5	76	06	2.5
	D	226	32	40	32	40	226	32	40			
									+7.5	133	27	12.5
	A	360	00	00	59	40	359	59	50			
									+10			
									Total	360	00	00

Inst. at	Sight To	180° Right Face Left Swing										
		A			B		Mean			Incl. Angle		
		°	′	″	′	″	°	′	″	°	′	″
0	A	180	00	00	00	00	180	00	00			
										74	42	10
	B	254	42	00	42	20	254	42	10			
										75	44	40
	C	330	26	40	27	00	330	26	50			
										76	05	50
	D	46	32	40	32	40	46	32	40			
										133	27	20
	A	180	00	00	00	00	180	00	00			
									Total	360	00	00

Inst. at	Sight To	90° Left Face Right Swing										
		A			B		Mean			Incl. Angle		
		°	′	″	′	″	°	′	″	°	′	″
0	A	90	00	00	00	00	90	00	00			
										74	41	57.5
	B	164	42	00	42	00	164	42	00			
									-2.5			
						40				75	44	47.5
	C	240	27	00	26	40	240	26	50			
									-5			
										76	06	07.5
	D	316	33	00	33	00	316	33	00			
									-7.5			
										133	27	07.5
	A	90	0	00	0	20	90	00	10			
									-10			
									Total	360	00	00

Inst. at	Sight To	270° Right Face Left Swing											Average Incl. Angle			Angle
		A			B		Mean			Incl. Angle						
		°	′	″	′	″	°	′	″	°	′	″	°	′	″	
0	A	270	00	00	00	00	270	00	00							
										74	42	20	74	42	12.5	AOB
	B	344	42	20	42	20	344	42	0							
										75	44	40	75	44	37.5	BOC
	C	60	27	00	27	00	60	27	00							
										76	05	40	76	05	55	COD
	D	136	32	40	32	40	136	32	40							
										133	27	20	133	27	15	DOA
	A	270	00	00	00	00	270	00	00							
									Total	360	00	00	360	00	00	

EXPERIMENT-3

TRIGONOMETRIC LEVELING –HEIGHTS AND DISTANCES PROBLEM (TWO EXERCISES).

EXECISE NO-1

ELEVATION OF AN INACCESSIBLE POINT WHOSE BASE IS ACCESSIBLE :

In order to determine the elevation of the point of a chimney or church spire etc. whose base is inaccessible proceed as follows:

AIM: to determine the Elevation of an inaccessible point whose base is accessible :

INSTRUMENTS REQUIRED:tTheodolite,tripod ,tape,ranginig rods, plumb bob etc.

POCEDURE:

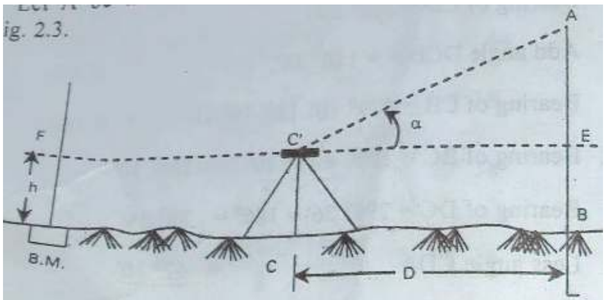


Fig. 2.3

Let A be the inaccessible point whose elevation is required.

Let B be its projection on the ground which is accessible,

1) Set up the theodolite at c at a distance of say D meters from B and level it accurately by the altitude level.
2) Sight to point A and observe the vertical angle α subtended at the line of collimation, both on face left and face right and take the average of the two values.
3) Measure the horizontal distance BC accurately by tape.
4) With the line of sight horizontal ,take a staff reading h on the bench mark established nearby the instrument,

OBSERVATIONS AND CALCULATIONS:

$AE = D \tan \alpha$

R.L of A =R.L of BM+ h + D tan α

If the distance D is large, combined correction for curvature and refraction has to be applied.

Then,

R.L of A= R.L of B.M + h +D tan α-0.0673(D/1000)^2

EXERCISE-2

ELEVATION OF AN INACCESSIBLE POINT WHEN BASE IS NOT ACCESSIBLE

AIM: to determine the Elevation of an inaccessible point when base is not accessible :

INSTRUMENTS REQUIRED: Theodolite, tripod, tape , ranging rods, plumb bob etc.

PROCEDURE:

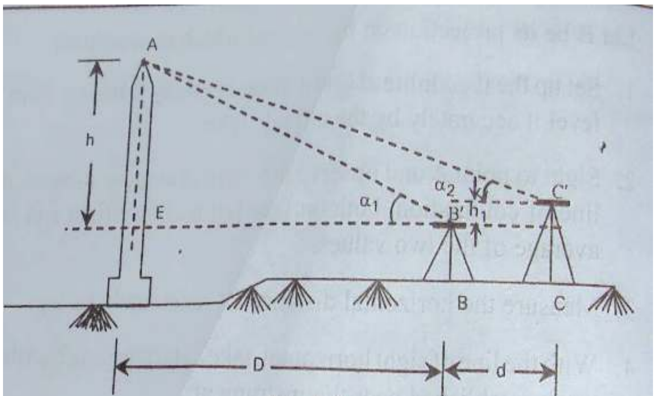


Fig. 2.4

Let A be the inaccessible point A whose elevation is to be determined

1) Set up the theodolite at station B at a convenient position so that the object A can be sighted and level the instrument accurately by the altitude level.
2) Sight the object and read the vertical angle EB'A=α_1.
3) With both motions of plates clamped, plunge the telescope and mark a station C in the line of sight at a suitable distance d from B so that points, A, B, C lie in the same vertical plane.
4) With line of sight horizontal, take the staff readings s_1 on a nearby B.M. to establish the R.L. of the plane of collimation.
5) Shift the instrument and set it up exactly over C and level it accurately.
6) With line of sight horizontal, take the staff reading s_2 on the B.M. to establish the level of plane of collimation at C.
7) Sight object A, bisect it accurately and read the vertical angle α_2 to A form C,

   $h=AE.\tan\alpha_1$

   $h= (h_1+d \tan \alpha_2) \tan \alpha_1/\tan\alpha_1-\tan \alpha_2$

   R.L of A =R.L of B.M + staff reading s_1+h

Note: if line of collimation is higher at B than at C,value of d must be taken as negative.

EXPERIMENT -4

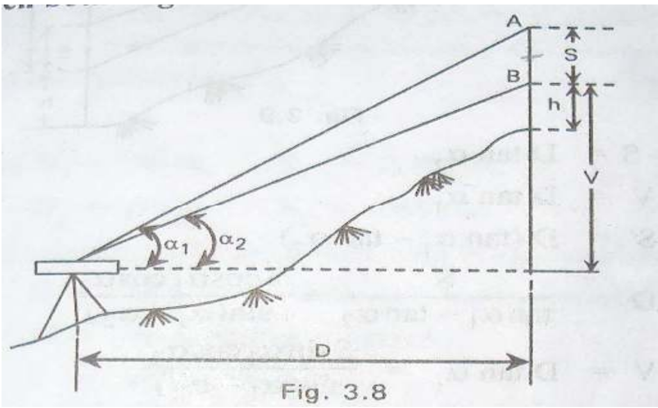
HEIGHTS AND DISTANCE USING PRINCIPLES OF TACHEOMETRIC SURVEYING (TWO EXERCISES).

EXECISE -1

This method is used when the theodolite is not equipped with a stadia diaphragm. in this method ,angular observations are made for two vanes at a fixed vertical distance between them usually 3 m and the horizontal and the vertical distances are computed.

CASE: 1

WHEN BOTH ANGLES ARE IN ELEVATION.



Let S be the vertical distance between the vanes A and B.

V the vertical distance between instrument axis and lower vane ,h staff reading to lower vane: D horizontal distance of staff station from instrument,$\alpha_1$and $\alpha_2$vertical angles to vanes A and B respectively.

Then S+V=Dtan α_1

D=Scosα1cosα2/sin(α_1-α_2)

V=D tan α2=Scos$\alpha_1$sinα_2/sin (α_1-α_2)

Elevation of staff station =El.of inst.axis + V- h

EXERCISE -2

When both angles are of depression:

$V-S=D \tan \alpha_2$

$V=D \tan \alpha_1$

$S=D (\tan\alpha_1-\tan\alpha_2)$

$D=S/\tan\alpha_1-\tan\alpha_2$

$V=d \tan \alpha_1=S\sin\alpha_1\cos\alpha_2/\sin (\alpha_1-\alpha_2)$

Elevation of staff station =El.of inst.axis-V-h

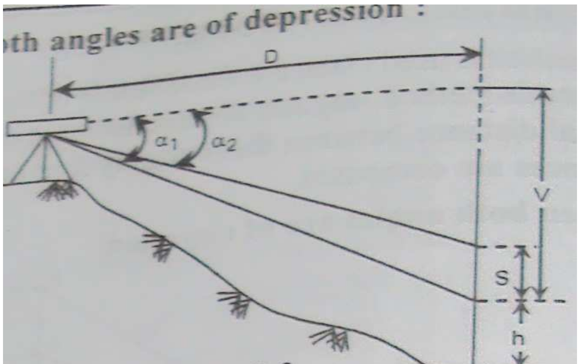


Fig. 3.9

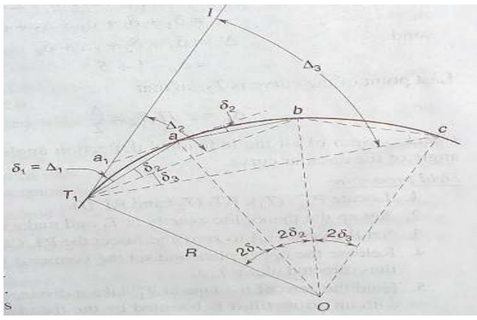
EXPERIMENT-5

CURVE SETTING- DIFFERENT METHODS. (TWO EXERCISES)

AIM: Setting the curve by Rankine's method of deflection angle (one theodolite method)

INSTRUMENTS REQUIRED: Theodolite, tape, tripod etc.

FIELD PROCEDURE:



1) Locate P.C. (T_1), P.T (T_2) and P.I. (I).
2) Set up the theodolite exactly at T_1 and make its temporary adjustments.
3) Set up vernier A to zero and bisect the P.I Clamp the lower plate.
4) Release the upper plate and set the vernier A to read Δ_1. The line of sight is thus directed along T_1a.
5) Hold the zero tape at t_1, take a distance C_1 (T_1a) and swing the tape with an arrow till it is bisected by the theodolite. This establishes the first point in the curve.
6) Set the second deflection angle Δ_2. On the scale so that lime of sight is set along T_1b.
7) With zero of the of the tape held at a and an arrow at the other end (chord distance=ab), swing the tape about a, till the arrow is bisected by the theodolite at b, this establishes the second point b on the curve.
8) The same steps are repeated till the last point T_2 is reached.

EXERCISE 2

TWO- THEODOLITE METHOD

AIM: Setting the curve by two - Theodolites method.

INSTRUMENTS REQUIRED: Two- theodolites, tape, tripod etc.

PROCEDURE :

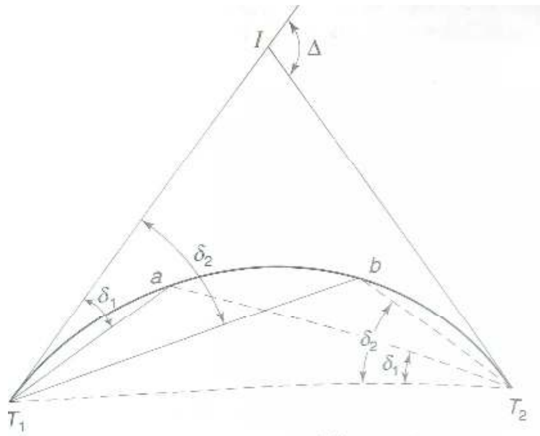


Fig. 11.15 *Two-theodolite method*

1) Set up one theodolite at P.C (T_1) and the other at P.T (T_2).
2) Set the vernier A of both the theodolites to zero.
3) Direct the theodolite at T_1 towards I, and the theodolite at T_2 towards T_1.
4) set angle ∂_1in both the theodolites so as to direct the line of sights towards T_1a and T_2a,thus the point a ,the point of intersection of the two line of sights ,is established on the curve.
5) Similarly, point b is established by setting ∂_2 in both the theodolites and bisecting the ranging rod at b.
6) The same steps are repeated with different values of ∂ to establish more points.

This method is expensive and time consuming, but more accurate.