TRAVERSING

OBJECTIVE

- To conduct traversing in a given plot and take various details by total station and theodolite
- To be familiar with using procedures of total station and theodolite and concept of latitude and departure.

INSTRUMENTS AND ACCESSORIES

1) Total station - 1
2) Tripod stand - 1
3) Prism pole - 2
4) Staff - 1
5) Plumb-bob - 1
6) Measuring tape (30m) - 1
7) Pegs - 10
8) Hammer - 1
9) Prism 2
10) Ranging rod - 1

THEORY

A traverse is a type of survey in which a number of connected straight lines form a framework where directions and lengths of survey lines are measured with the help of angle measuring instruments, viz. compass, theodolite EDM, etc.

Importance of traversing

1. To establish control points for:
   (i) mapping
   (ii) photographic work
   (iii) alignment of road, canal, bridges, etc.
2. To ascertain the co-ordinates of reference points with respect to national and international grid system.

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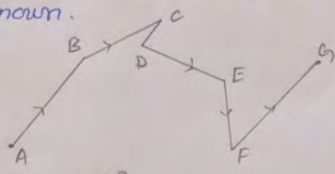
Types of traverse

1. Open traverse:

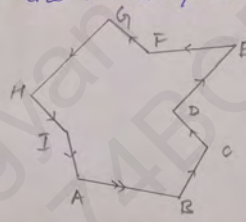
A traverse which originates from position which is known or unknown but terminates to the point whose position is not known.



[known point] [unknown point]

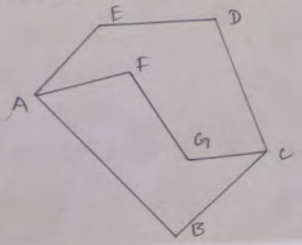
2. Closed traverse:

When a traverse originates from a known position and also terminates to the known position is closed traverse



3. Link traverse

It is a type of traverse where lines may start and end at different points (geometrically open but analytically closed) but both points are required to have a high degree of positional accuracy. It can be made to join two points of major traverse for inner or outer detailing.



ABCDEA → Major traverse

AFGC → Link traverse

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Field Work in Traversing

A. Reconnaissance and selection of stations.

Reconnaissance (Recci) is an overall view and planning made in order to perform a survey. following criteria influence the selection of stations.

(1) Location should be such that the working from whole to part can be applied.

(2) Lengths of traverse legs must be made longer to reduce centering errors.

B. Fixing stations marks and signals

Usually station marks and signals are fixed on raised surface so that the intervisibility is better and pin point observation is possible.

c. Angular Observation and Linear Measurement

The relative direction and length of the lines of traverse are determined by measuring the angles between the successive lines and lengths by using tape or EDM. A closed traverse may run clockwise or anticlockwise.

D. Booking field measurement

When booking field measurements, a separate theodolite book is used to record angles and a field book for locating details and linear measurements.

E. Picking up details:

It is better not to concentrate on picking up details in important traverse except essential items that can be picked upt by offsets.

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F. Traverse computation

In order to perform traverse computation, the calculation of coordinates of the individual stations and control points is very much essential. From a raw data, obtained from field, the computation is carried out in the following sequential order:

(1) Performing independent checks of field observations

(2) Computation of all traverse angles and the use of $(2n-4)\times 90°$ formula to check the sum of internal angles and apply correction.

(3) Use of bearing and traverse length to calculate latitude and departure of stations

(4) If Σlatitude and Σdeparture are not equal to 0 in a closed traverse, then

Δl = error in latitude

Δd = error in departure

And, closing error $(e) = \sqrt{(\Delta l)^2 + (\Delta d)^2}$

The direction is given by: $\tan\theta = \frac{\Delta l}{\Delta d}$

(5) To balance the consecutive co-ordinates, we use Bowditch's rule:

$$\text{Correction in latitude} = \frac{\text{length of traverse leg}}{\text{Total perimeter}} \times (-\Delta l)$$

$$\text{Correction in departure} = \frac{\text{length of traverse leg}}{\text{Total perimeter}} \times (-\Delta d)$$

Eventually, by applying the corrections in coordinates, we transfer the coordinates to the stations and plot on a grid sheet on a suitable scale. We need to plot the traverse at the centre of the sheet.

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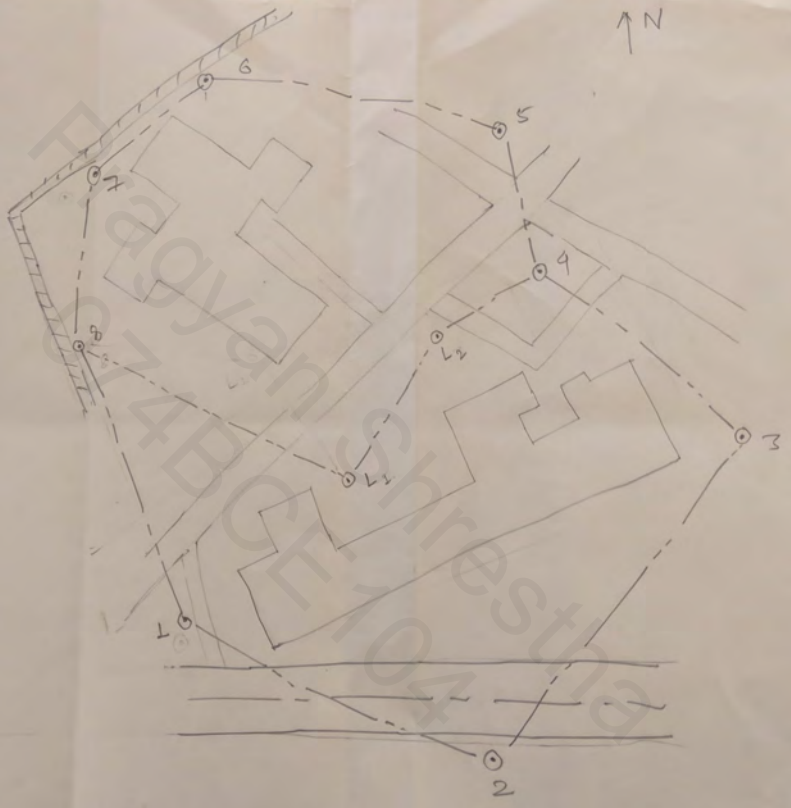

Fig:- INDEX SKETCH

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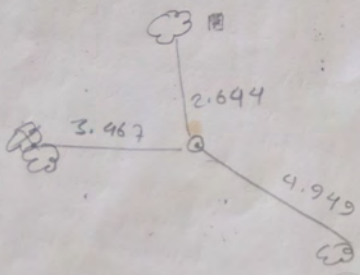
St-3



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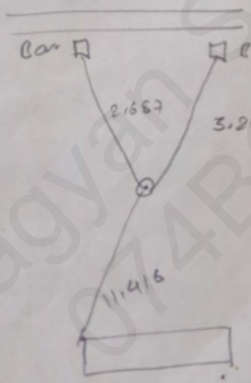

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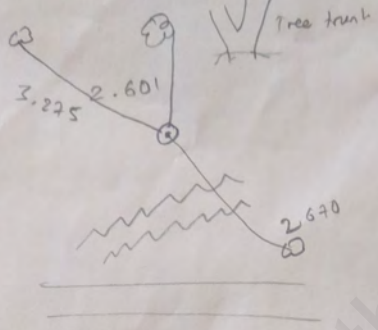
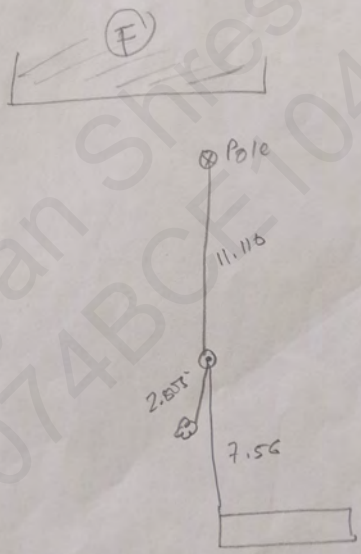
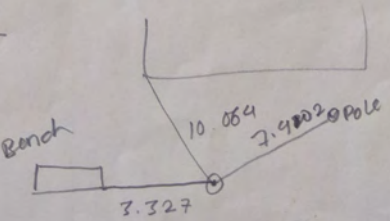
St.5



St.6



St-7



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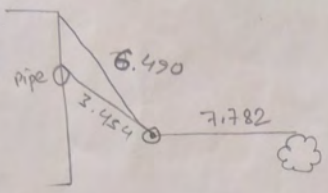
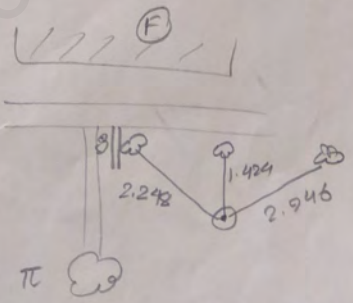
L-3



L-2

L-B-1



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Department of Civil Engineering

Survey Instruction Committee

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Group No:

Bearing :

Observer :
Recorder :
Instrument :

Date :
Weather:
Temperature:

Major Traverse by Total Station

Horizontal Angle Observation Sheet

Inst st and Ht of Inst	Sighted to	FACE	Set-I HCR Observation d	m	s	Mean m-s	Horizontal Angle d	m	s	Set-II HCR observation d	m	s	Mean m-s	Horizontal Angle d	m	s	Mean Horizontal Angle {(I+II)/2} d	m	s	Horizontal Distance (m)	Vertical Distance ± (m)	Target Height (m)	Remarks
1	8	L	0	0	0	~~125~~ 54				90	0	0	/	125	54	38							
		R	179	59	19	"	125	54	02	270	00	15		125	54	20	128	58	55	51.186			
	2	L	125	54	02	/	125	52	21	215	54	58	/	125	54	39				52.660			
		R	305	51	40	/	125	53	11.5	35	54	35											
2	1	L	0	0	0	/	128	33	56	90	0	0	/	128	35	23				52.640			
		R	179	59	37		128	32	49	269	59	56		128	35	23	128	32	51				
	3	L	128	33	56	/	128	33	22 .5	218	29	16	/	128	35	23				45.444			
		R	308	32	26					38	31	19											
3	2	L	0	0	0	/	77	39	54	90	0	0	/	~~77~~ 77	39	52				48.460			
		R	180	00	31		77	39	12	270	00	12		77	39	33	77	39	40				
	4	L	77	39	57	/	77	39	34 .5	167	39	52	/	77	39	42 .5				51.581			
		R	257	39	48					347	39	45											
4	3	L	0	0	0	/	212	34	39	90	0	0	/	212	34	45				51.559			
		R	180	00	11	/	212	34	26	269	59	53		212	34	32	212	34	35				
	5	L	212	34	39	/	212	34	32 .5	302	34	25	/	212	34	38 .5				30.848			
		R	32	34	39					~~122~~ 270	~~34~~ 00	25											

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Group No:

Bearing :

Observer :
Recorder :
Instrument :

Date :
Weather:
Temperature:

Major Traverse by Total Station

Horizontal Angle Observation Sheet

Inst st and Ht of Inst	Sighted to	FACE	Set-I							Set-II							Mean Horizontal Angle {(I+II)/2}			Horizontal Distance (m)	Vertical Distance ± (m)	Target Height (m)	Remarks
			HCR Observation			Mean	Horizontal Angle			HCR observation			Mean	Horizontal Angle									
			d	m	s	m-s	d	m	s	d	m	s	m-s	d	m	s	d	m	s				
5	4	L	0	0	0	/	145	17	47	90	0	0	/	~~145~~	~~17~~	~~15~~	145	17	15	30.862			
		R	179	59	56		145	18	55	270	00	57		145	16	45							
	6	L	145	17	47	/	145	17	21	285	16	45	/	145	17	33				35.583			
		R	325	16	51					55	17	34		145	17	09							
6	5	L	0	0	0	/	188	19	48	90	0	0	/	188	19	49	188	20	30	35.563			
		R	180	00	02		188	21	18	269	59	14		188	21	03							
	7	L	138	19	48	/	188	20	33	228	19	49	/	188	20	26				28.215			
		R	318	21	20					48	20	17											
7	6	L	0	0	0	/	95	27	55	90	0	0	/	95	27	30	95	27	58	28.251			
		R	179	59	45		95	28	08	269	59	39		95	28	12							
	8	L	95	27	55	/	95	28	1.5	185	27	30	/	95	27	51				50.255			
		R	275	27	53					5	27	49											
8	7	L	0	0	0	/	156	12	12	90	0	0	/	156	12	10	156	12	17	50.265			
		R	179	59	39		156	12	35	270	00	06		156	12	09							
	4	L	156	12	12	/	156	12	23.5	246	12	10	/	158	12	23				51.160			
		R	336	12	14					66	12	15											

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Survey Section
FE-38-066/Prod-069/10-7

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Central Campus, Pulchowk, Lalitpur
DEPARTMENT OF CIVIL ENGINEERING
Survey Instruction Committee

Observer :
Recorder :
Instrument :

TRAVERSE by TOTAL STATION EDM mode
Hz. Angle Observation & Distance measurement Sheet

Weather :
Temperature :
Date :

Inst st and Ht of Inst	Object Sighted to	FACE	Horizontal Angle Observation												Hz. Angle Mean of Set I & II			Horizontal Distance (m)	Vertical Dist (m)	Target Ht (m)	Remark
			Set - I			Mean - I			Set - II			Mean - II									
			d	m	s	d	m	s	d	m	s	d	m	s	d	m	s	EDM	EDM		
	L2	L	127	39	52	84	54	47	219	38	50	84	55	58				17.865			
4		R	307	39	02	84	55	35	37	39	09	84	55	16							
	5	L	212	34	39				302	34	45				84	55	23	30.848			
		R	32	34	37	84	55	11	122	34	25	84	55	35.5							
	L1	L	0	0	0	226	14	38	90	00	00	226	13	49				24.286			
L2	4	R	180	00	36	226	14	11	270	00	11	226	13	36							
		L	226	14	38				316	13	49				226	14	04	19.862			
	41	R	46	14	47	226	14	24.5	136	13	47	226	13	48.5							
		L	0	0	0	88	49	40	90	00	00	88	49	26				43.631			
L1	8	R	179	59	46	88	50	14	270	00	18	88	48	45							
	L2	L	88	49	40				178	49	26				88	49	31	24.288			
		R	268	50	00	88	49	57	358	49	03	88	49	51.5							
	7	L	0	0	0	121	01	35	90	00	00	121	01	32				50.265			
8		R	179	59	39	121	01	56	270	00	06	121	01	40							
	L1	L	121	01	35				211	01	32				121	01	41	48.632			
		R	301	01	35	121	01	48.5	31	01	46	121	01	36							

TryTotalStn.13b

LEG PRECISION CHECK

DISTANCE MEASUREMENT BY TOTAL STATION

Leg ①	Forward Distance (m) ②	Backward Distance (m) ③	Discrepancy (m) ④	Mean (m) ⑤	Precision = ④/⑤ ⑥
MAJOR TRAVERSE					
1-2	52.660	52.640	0.020	52.650	1: 2632.5
2-3	45.444	45.460	0.016	45.452	1: 2840.75
3-4	51.561	51.559	0.002	51.560	1: 25780
4-5	30.848	30.862	0.014	30.855	1: 2203.9
5-6	35.553	35.563	0.010	35.558	1: 3555.8
6-7	28.215	28.231	0.016	28.223	1: 1764
7-8	50.255	50.265	0.010	50.260	1: 5026
8-9	51.160	51.166	0.006	51.163	1: 8527
LINK TRAVERSE					
8-L1	43.632	43.631	0.001	43.632	1: 43631
L1-L2	24.288	24.296	0.008	24.292	1: 3036
L2 4	17.862	17.865	0.003	17.864	1: 5954

From Table,
Total loop distance of major traverse = 345.721m
Required precision was 1 in 2000

HORIZONTAL ANGLE CORRECTION

Bearing of 2-CP = 248°55'34" ∴ Bearing of CP-2 = 68°55'34"

Inst. At	Sight To	Hz. Angle	Correction	Corrected Angle	FB	BB
2	CP	137°29'12"	–	–	248°55'34"	68°55'34"
∴ CP	2	"			68°55'34"	248°55'34"
2	3	*123 128°32'51"	8"	128°32'59"	26°24'48"	206°24'46"
3	4	77°39'40"	5"	77°39'45"	284°04'31"	104°04'31"
4	5	212°34'35"	8"	212°34'43"	316°39'15"	136°39'15"
5	6	145°17'15"	8"	145°17'23"	281°56'38"	101°56'38"
6	7	138°20'30"	8"	138°20'38"	240°17'15"	60°17'15"
7	8	95°27'56"	8"	95°28'04"	155°45'20"	335°45'20"
8	1	156°12'17"	8"	156°12'25"	131°57'44"	311°57'44"
1	2	125°53'55"	8"	125°54'03"	77°51'47"	257°51'47"

Observed sum of Hz. Angle = 1079°58'59"

Theoretical sum = $(2n-4)\times 90°$ = 1080°00'00"

Error = 1079°58'59" − 1080°00'00"

= −0°01'01"

Note: FB of leg = BB of previous leg + included angle.

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SAMPLE

74MAG
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TRAVERSE COMPUTATION SHEET

Coordinate of Reference Station No.	X	Y	Z
	10109.789m	20109.789m	1109.789m

Bearing: 2-CP = 248°55'34"

Leg: 39.689m ∠CP-2-3 = 139°29'12"

Line/Leg From	Line/Leg To	Distance (m)	Station	Bearing (WCB) d	m	s	Consecutive Coordinate (cm) Lat (+ -)	Dep (+ -)	Correction Lat (+ -)	Dep (+ -)	Corrected (m) Lat (+ -)	Dep (+ -)	COORDINATE (m) N	E	STATION	Final Length of Traverse Leg	Final Bearing (WCB)		
1	2	3	4	9			10	11	12	13	14	15	16	17	18	19	20		
CP	2	39.689	CP	68	55	34					14.231	37.035	20104.789	10109.789	CP	39.689	68	55	34
CP	2												20119.060	10141.824	2				
2	3	45.422	3	26	24	46	40.678	20.214	-0.008	0.016	40.690	20.230	20153.750	10162.054	3	45.441	26	26	06
3	4	51.560	4	284	04	31	12.539	-50.012	-0.009	0.018	12.530	-49.994	20122.279	10112.059	4	51.541	284	04	11
4	5	30.885	5	316	39	14	22.494	-21.165	-0.006	0.011	22.488	-21.154	20194.698	10090.905	5	30.829	316	39	41
5	6	35.563	6	281	56	37	7.360	-34.795	-0.006	0.012	7.354	-34.781	20202.051	10056.124	6	35.550	281	56	16
6	7	28.223	7	240	17	15	-13.989	-24.572	-0.005	0.010	-13.994	-24.582	20188.057	10031.621	7	28.217	240	16	04
7	8	50.260	8	155	48	20	-45.827	20.638	-0.009	0.017	-45.836	20.655	20142.221	10052.277	8	50.295	155	49	32
8	1	51.163	1	181	37	49	-34.210	38.044	-0.009	0.017	-34.219	38.061	20108.002	10090.338	1	51.182	181	37	26
1	2	52.645	2	77	51	47	11.068	51.468	-0.010	0.018	11.058	51.486	20119.060	10141.824	2	52.660	77	52	40
		sum= 345.691					sum+ 0.063	sum+	sum+	sum+ 0.118	sum+ 0.000	sum+ 0.000							
							sum-	sum- 0.118	sum- 0.063	sum-	sum-	sum-							
							error=n	error=e	0	0	0	0							

Closing error = $\sqrt{(n)^2+(e)^2}$
$= \sqrt{0.063^2+0.118^2}$
$= 0.134$

Precision = Total / closed distance (perimeter) / closing error = $\frac{345.691}{0.134} = 2580 > 2000$

Tribhuvan-2012

GALE'S TABLE FOR LINK TRAVERSE

Inst. At	Sight. To	Hz. Angle	Bearing	Cumul. corr.	Corrected Bearing	Mean Distance (m)	Latitude (m)	Departure (m)	Northing (m)	Easting (m)	Corr. Northing (m)	Corr. Easting (m)
8	L1	∠ 7 8 L1 121° 01' 41"	96° 47' 00"	–	96° 47' 00"	43.597	-5.150	43.291	20192.221	10052.277	20192.221	10052.277
L1	L2	∠ 8 L1 L2 88° 49' 31"	5° 36' 32"	- 2' 15"	5° 34' 17"	24.292	24.177 ~~5.571~~	2.358	20187.071	10095.568	20187.063	10098.601
L2	4	∠ L1 L2 4 226° 14' 04"	51° 50' 35"	- 4' 30"	51° 46' 06"	17.864	11.055	14.032	20162.248	10097.926	20161.232	10097.993 ~~1091~~
4	5	∠ L2 4 5 89° 55' 23"	316° 45' 59"	- 6' 44"	316° 39' 15"	30.654	22.424	-21.165	20172.303	10111.958	20172.279	10112.059
But the correct bearing of 4-5 is			316° 39' 15"			But the correct N/E of station 4 is:			20172.279 ~~20175.923~~	10112.059 ~~10121.505~~		
Total Error			0° 06' 44"			Total Error			0.024	-0.102		
Total Correction			-0° 06' 44"			Total Correction			-0.024	0.102		

Leg	Final Leg Distance (m)	Final Bearing
8-L1	43.630	96° 47' 00"
L1-L2	24.287	5° 39' 08"
L2-4	17.885	51° 51' 18"

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CONCLUSION

The traverse was conducted successfully in the given plot. We have been familiar with the handling and operation of total station. Various concepts such as latitude, departure, northing, easting, etc have become clearer through this practical field work. And, the traverse was plotted in the scale 1:200 after applying analytic Bowditch correction.

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