APPENDIX B

SAMPLE NOTES (CONSTRUCTION SURVEY)

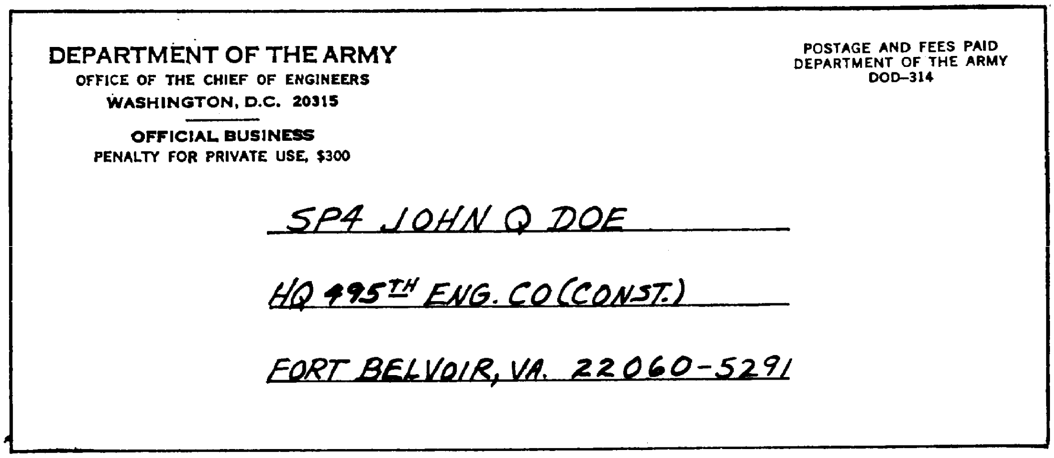
LIST OF FIGURES

INTRODUCTION

Keeping good notes is not only an art, it is a science as well. Notes must not only be legible, but also correct and meaningful. You must decide, before you go into the field, how you want to run your survey and how to record your observations. You must also decide which information you must record in order to make your notes meaningful. Keep in mind that extraneous entries in your notes can do just as much harm as omission of pertinent data. Before making any entry in your notebook, make certain that the entry, sketch, or remark is necessary and wil contribute to the completeness of the notes. On the following pages are samples of notes which the construction surveyor may be required to keep. They are only samples of how they may be kept, not of how they must be kept. When assigned to a unit in the field, you will determine what to record and how to do it. Most of the time, the chief of the party will prescribe how notes on the project are to be kept. Above all, decide on your notekeeping procedures and format before you go out on your survey. Your headings, members of party, instrument identification, and weatherman all be entered before you leave for the field.

LABELING AND MAILING PROCEDURES

The surveyor normally fills out the mailing label in front of the notebook to the unit conducting the project(s) (figure B-l).



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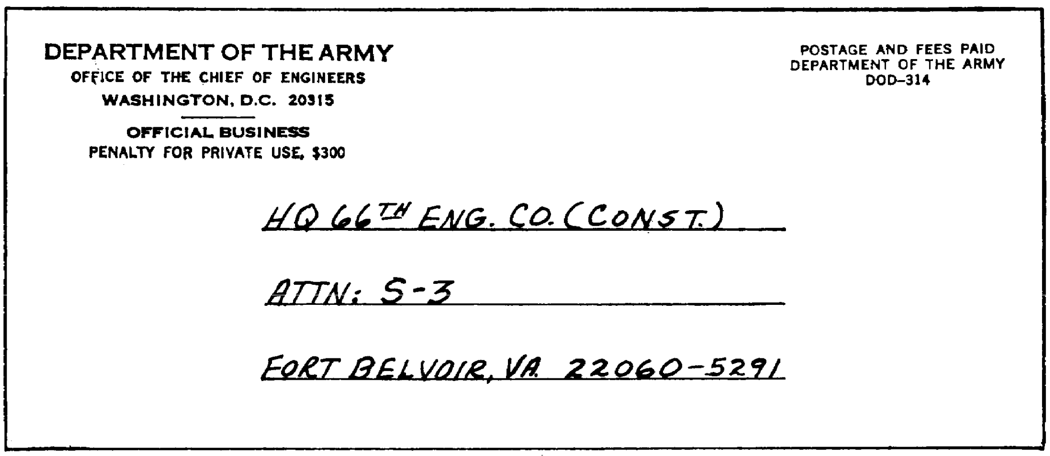

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Figure B-1. Mailing label

The front page is to be filled out as required by the unit (figure B-2).

DEPARTMENT OF THE ARMY

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LEVEL, TRANSIT, AND GENERAL SURVEY
RECORD BOOK

FORT BELVOIR, VA.
LOCALITY

BLDG & ROAD LAYOUT, NORTH POST
PROJECT

BOOK 2 OF 4

THEODOLITE WILD T16
INSTRUMENT

SFC W.J. BROWN
CHIEF OF PARTY

IMPORTANT

On the opposite page, print the address to which this book is to be returned, if lost.

Figure B-2. Front page of notebook

SURVEY NOTES

The backsight (BS) and foresight (FS) distances are determined by stadia and should be balanced. A page check (PC) is made (figure B-3) for each page. REMEMBER: Page checks only check the accuracy of your mathematics, not the accuracy of the survey.

INDEX

DESIGNATION ____________ DATE ________ 19__

PAGE	PROJECT	DATE	LOCATION
2	DIFF LEVELING-15TH CSM MAINT	17JAN84	NORTH POST FT. BELVOIR, VA.
3	HORIZ TAPING -	"	" " " " "
4	STA ∠ TRAV - " " "	19 JAN 84	" " " " "
5	STA ∠ W/HORIZ CLOSURE-TRAV #2	" " "	SOUTH POST " " "
6	DEFL ∠ TRAV - TRAV 12-A	23JAN84	" " " " "
7	TRAN STADIA-TANK ROAD	24JAN84	54-A AREA " " "
8	PLANETABLE MAP-AREA K	" " "	AREA-K " " "
9	PROFILE & X-SEC-MS COY AVE EXT'D	25JAN84	NORTH POST " " "
10	SLOPE STAKES- " " "	" " "	" " " " "
11	HORIZ CURVE-JONES ROAD	26JAN84	" " " " "
12	BLDG LAYOUT-BLDG T-2855	27JAN84	" " " " "
13	SEWER LINE-BLDG T-2815	30JAN84	" " " " "
14	HT. OF ACCESSABLE PT. FLAG POLE	31JAN84	SOUTH POST " " "
15	ELEV/DIST INACCESSABLE PT-WT	" " "	" " " " "

Figure B-3. Index

The error of closure (EC) is equal to the computed elevation minus the starting or fixed elevation. For total correction (TC), change the sign of the EC. The allowable error (AE) maybe given in the project specifications. The following formulas can be used when the BS and FS distances are balanced as near as possible.

For normal construction work — AE = ± 0.1 ft miles or ± 24mm kilometers

Third order (figure B-4) — AE = ± 0.05 ft miles or ± 12mm kilometers

Elevations for fixed points are adjusted by dividing the TC by the total distance and multiplying the result by the distance from the beginning station to the station being adjusted. This value is then algebraically added to the station's computed elevation.

DIFFERENTIAL LEVELING
15TH CSH MAINT BLDG
DESIGNATION ____________ DATE 17 JAN 1984

R BONE — INST. K+E DUMPY
Ψ McGUINNESS — NO. 5354
Ø NELSON

STA	BS (+)	HI	FS (-)	ELEV	DIST BS/FS	CORR +/-	ADJ ELEV	REMARKS
BM 1	4.71			100.00'	75	0.00	100.00'	
		104.71						+42.73 100.03
TP 1	6.03		0.79	103.92	110 70			-42.70 - 100.00
		109.95						+0.03 +0.03
TBM 2	12.06		3.68	106.27	94 110	0.00	106.27	↑ ↑
		118.33						PC
TP 2	2.20		4.49	113.84	240 96			
		116.04						EC = +0.03
TP 3	1.43		7.12	108.92	163 242			TC = -0.03
		110.35						
TBM 3	5.05		10.37	99.98	93 166	-0.02	99.96	AE = ± 0.05 $\sqrt{MILES}$
		105.03						
TP 4	3.64		2.99	102.04	110 95			
		105.68						AE = .05 $\sqrt{\frac{2491}{5280}}$
TBM 4	3.86		3.16	102.52	156 112	-0.02	102.50	
		106.38						AE = ± 0.03
TP 5	3.75		5.49	100.89	203 152			
		104.64						
BM 1			4.61	100.03	204	-0.03	100.00	
	+42.73		-42.70		1244/1247			
			TOTAL DISTANCE =		2491			

Figure B-4. Differential leveling

This set of horizontal taping notes (figure B-5) shows the proper way to record distances between points. The lines are taped in both the forward (FWD) and backward (BKWD) direction. The difference between the forward and backward total distances equals the error of closure (EC). The allowable error (AE) is computed by dividing the mean distance (MEAN) by 5,000. Do not round the AE up. This AE will give an accuracy ratio of 1 in 5,000 or third order accuracy. The AE must equal or exceed the EC for the taping to be acceptable.

HORIZONTAL TAPING
15TH CSH MAINT BLDG
DESIGNATION ________ DATE 17 JAN 1984

STA	FWD	BKWD	MEAN		
BM 1	100.00	100.00		EC=0.04	
	100.00	100.00		AE=0.07	
	100.00	100.00			
	65.31	65.27			
TBM 2	365.31	365.27	365.290		
TMB 2	100.00	100.00		EC=0.14	
	100.00	100.00		AE=0.19	
	100.00	100.00			
	100.00	100.00			
	100.00	100.00			
	100.00	100.00			
	100.00	100.00			
	100.00	100.00			
	100.00	100.00			
	99.97	99.83			
TBM 3	999.97	999.83	999.900		
TBM 3	100.00	100.00		EC=0.05	
	100.00	100.00		AE=0.08	
	100.00	100.00			
	50.00	60.00			
	60.47	50.42			
TBM 4	410.47	410.42	410.445		

M LYMAN
HT GUESS — INST: 100' STEEL TAPE
RT RAWLINGS — TENSION: 20 LBS

		REMARKS	
WEATHER:		FAIR	
WIND:		N 10	
TEMP		25° F	

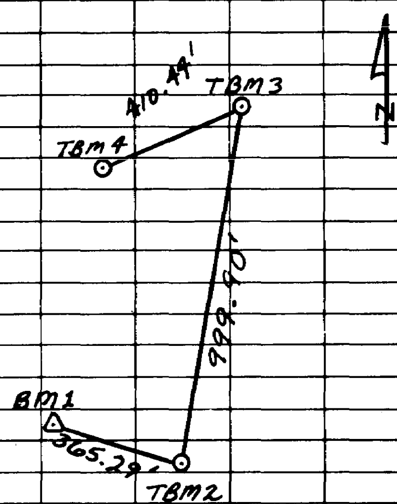


Figure B-5. Horizontal taping

The station angles in figure B-6 were first measured with the instrument's telescope in the direct (D) position. The angle is then doubled by measuring it again with the telescope in the reverse (R) position. The mean angle (MEAN) is found by dividing the R value by 2. The mean angle must be within ± 30 seconds of the D value. The total of the mean angles should equal N-2(180 degrees); N is the number of station angles within the loop traverse. When using a one-minute instrument, an error of ± 30 seconds per station angle is acceptable. The distances recorded were obtained by a separate survey and copied here for completeness.

STATION ANGLE TRAVERSE
16TH CSH MAINT BLDG
DESIGNATION ______ DATE 19 JAN 1984

⊼ GLEASON
BLANTON INST: WILD T-16
Ø PATTON NO: 12683

STA	T/L	STA	∡	MEAN	DIST
Ⓞ4 ← Δ1	D	98°	03'		
				98°02'30"	365.29'
Ⓞ2	R	196°	05'		
Δ1 ← Ⓞ2	D	80°	30'		
				80°30'00"	999.90'
Ⓞ3	R	161°	00'		
Ⓞ2 ← Ⓞ3	D	56°	58'		
				56°58'30"	410.44'
Ⓞ4	R	113°	57'		
Ⓞ3 ← Ⓞ4	D	124°	30'		
				124°29'30"	715.03'
Δ1	R	248°	59'		
			TOTAL	360°00'30"	

REMARKS

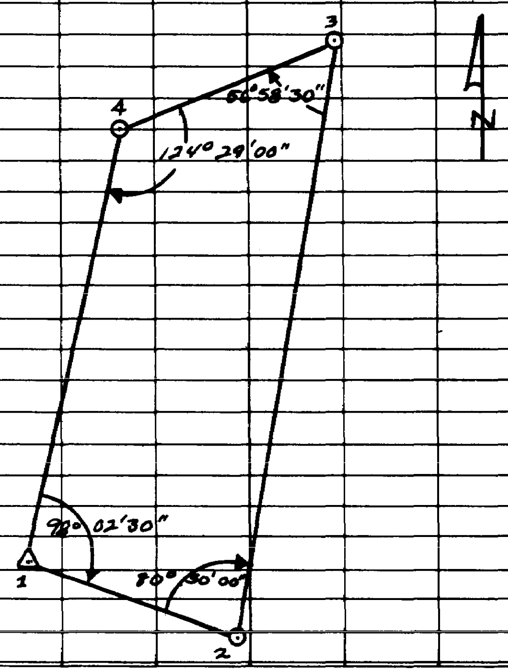
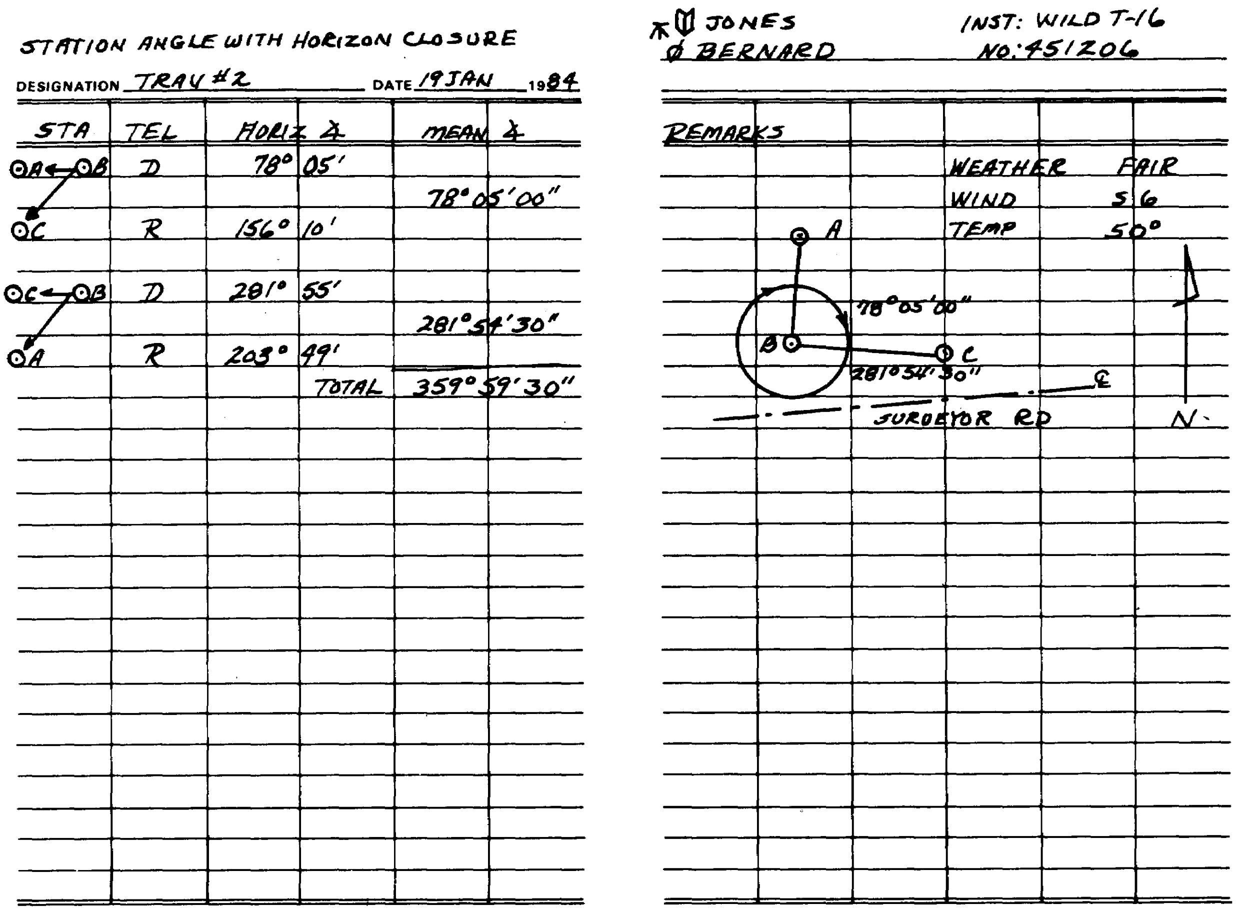


Figure B-6. Station angle traverse

The station angle in figure B-7 was measured as described on the preceding page. The explement angle is similarly measured and meaned, thus closing the horizon.

Note: When the explement angle was measured in direct (D), its value exceeded 180 degrees. To compute the MEAN first, add 360 degrees to the reverse (R) value and divide the result by 2.

Any mean angle must be within ± 30 seconds of its D value. The total of both MEAN angles for a station must be within ± 30 seconds of 360 degrees to be acceptable.



STATION ANGLE WITH HORIZON CLOSURE

DESIGNATION TRAV #2 DATE 19 JAN 1984

STA	TEL	HORIZ ∡		MEAN ∡	
⊙A ← ⊙B	D	78°	05'		
				78°05'00"	
⊙C	R	156°	10'		
⊙C ← ⊙B	D	281°	55'		
				281°54'30"	
⊙A	R	203°	49'		
			TOTAL	359°59'30"	

⊼ JONES INST: WILD T-16

Ø BERNARD NO: 451206

REMARKS

WEATHER FAIR

WIND 5-6

TEMP 50°

Figure B-7. Station angle with horizon closure

Figure B-8 shows deflection angles. When the direct (D) value for direction exceeds 180 degrees—

- The deflection angle is computed by subtracting the D value from 360 degrees. The difference is a left deflection angle and is preceded by the letter L.
- The mean deflection angle is computed by subtracting the reverse (R) value from 360 degrees and dividing the difference by 2. The mean deflection angle is also preceded by the letter L.

When the direct (D) value for direction is less than 180 degrees—

- The deflection angle is the same as the D value and is preceded by the R for right deflection angle.
- The mean deflection angle is computed by dividing the reverse (R) value by 2. The mean deflection angle is also preceded by the letter R. Deflection angles never exceed 180 degrees. Any mean deflection angle must be with ±30 seconds of its D value. The distances (DIST) were obtained from a separate survey.

DEFLECTION ANGLE TRAVERSE

DESIGNATION TRAV #12-A DATE 23 JAN 1984

STA	T/L	DIRECTION		DEFL ∠		DIST
⊙F←⊙A	D	280°	30'	L	79° 30'	
⊙B	R	200°	59'			
MEAN				L	79°30'30"	125.05'
⊙A←⊙B	D	65°	32'	R	65°32'	
⊙C	R	131°	03'			
MEAN				R	65°31'30" ~~65°32'30"~~	145.69'
⊙B←⊙C	D	272°	31'	L	86°29'	
⊙D	R	185°	02'			
MEAN				L	87°29'00" ~~86°29'00"~~	225.05'
⊙C←⊙D	D	269°	57	L	90° 03'	
⊙E	R	179°	54'			
MEAN				L	90°03'00" ~~90°30'00"~~	375.10'
⊙D←⊙E	D	287°	37'	L	72°23'	
⊙F	R	215°	13'			
MEAN				L	72°23'30"	380.42'
⊙F←⊙F	D	263°	54'	L	96°06'	
⊙A	R	167°	49'			
MEAN				L	96°05'30"	175.96'

⊼ ZIERES INST T16

Ψ FREEZE NO 495

φ BYERS

REMARKS

WEATHER FAIR

WIND N8

TEMP 23°

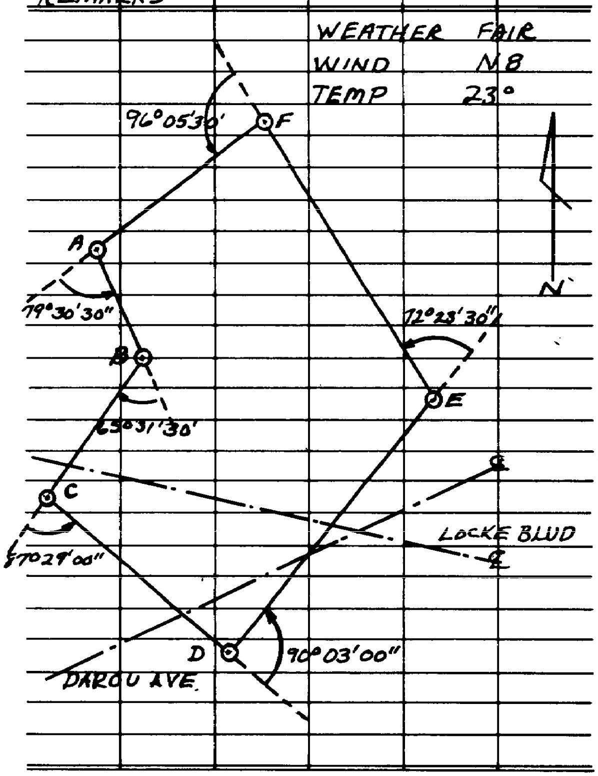


Figure B-8. Deflection angle traverse

The rod intercept (RI) is the difference between the top and bottom stadia crosshairs. The rod correction (RC) is the value of the center crosshair rod reading. Figure B-9 shows notes for RI and RC.

Product (PROD) is determined by multiplying the RI by the difference in elevation value extracted from table A-2 using the vertical angle as the argument. For level shots, the PROD is zero. The PROD can also be computed using the formula: PROD = (RI x 100) ½ Sin 2 Vertical Angle. The PROD has the opposite sign of the vertical angle when backlighting and the same sign when foresighting. Difference in elevation (DE) is determined by algebraically adding the RC to the PROD. Height of instrument is determined by making a level backsight to a point and adding the RC to the point's known elevation or by determining the vertical angle and the RC, computing the PROD and the DE, then algebraically adding the DE to the known elevation. Zenith distance (ZD) is the angular value between zenith and the RC. Vertical angle (VERT ANGLE) is the angular value between a level line of sight and the RC. Its value and sign are determined by subtracting 270 degrees from the ZD. Horizontal angle (HORIZ ANGLE) is the angle from a beginning reference point to the observed point. Horizontal distance (DIST) is determined for level shots by multiplying the RI by 100. For inclined shots, multiply the RI times the horizontal distance value from table A-2 using the vertical angle as the argument. The DIST can also be computed using the formula: Horizontal Distance = (RI x 100) Cos^2 Vertical Angle. ELEV is the elevation of the station. When not given, it is determined by algebraically adding the DE to the HI. Remarks (RMKS) is used to give a brief description of the occupied or observed station.

TRANSIT-STADIA SURVEY

DESIGNATION TANK ROAD DATE 24 JAN 1984

STA	RI	RC	PROD	DE	HI
⊙1 → ⊙2	2.87	+5.12	—	—	87.19'
1	0.56	-5.8	0	-5.8	
2	0.71	-6.3	-0.6	-6.9	
3	0.44	-1.2	+7.2	+6.0	
4	0.58	-4.3	+9.0	+4.7	
5	0.32	-5.7	-7.3	-13.0	
6	0.62	-4.3	+10.0	+5.7	
SP1	1.91	-5.96	-1.78	-7.74	

⊼ HAYWARD
⊍ CUMMINGS
ϕ PARMELE

INST: T-16 #66236
WEATHER: CLOUDY
WIND: NW 10
TEMP: 38°F

ZD	VERT ANGLE	HORIZ ANGLE	DIST	ELEV	RMKS
270° 00'	0° 00'	0° 00'	287'	82.07'	ELEV ⊙2
270° 00'	0° 00'	256° 39'	56	81.4	2' RED OAK
269° 30'	-0° 30'	349° 05'	71	80.3	SPOT ELEV (SPE)
279° 32'	+9° 32'	277° 50'	43	93.2	(SPE)
279° 04'	+9° 04'	329° 31'	57	91.9	(SPE)
256° 27'	-13° 33'	311° 25'	30	74.2	℄ RAVINE
279° 27'	+9° 27'	291° 19'	60	92.9	(SPE)
269° 28'	-0° 32'	252° 29'	191	79.45	2x2 HUB

Figure B-9. Transit-stadia survey

Correct horizontal distance (CORR H DIST) is determined by multiplying the H SCALE by the RI (figure B-10).

Horizontal scale (H SCALE) is read directly on the alidade. Rod intercept (RI) is the difference between the top and bottom crosshairs.
Vertical scale (V SCALE) is read directly on the alidade.
Product (PROD ±) is determined by subtracting 50 from the V-SCALE reading and multiplying the result by the RI.
Rod correction (RC) is the value of the center crosshair rod reading.
The RC is always negative when foresighting.
Difference in elevation (DE) is determined by algebraically adding the (PROD ±) to the RC.
Height of instrument (HI) can be determined by measuring the DE above the occupied station or by making a level backsight to station of known elevation. The RC is positive when backlighting.
Elevation (ELEV) is the elevation of the station. When not given, it is determined by algebraically adding the DE to the HI.
Remarks (RMKS) is used to give a brief description of the occupied or observed station.

PLANE TABLE MAPPING

DESIGNATION AREA K DATE 24 JAN 1984

⊼ LYMAN
Ɏ JONES
Ø BLANTON

INST: K & E ALIDADE NO 6666
WEATHER CLEAR
WIND: N 10
TEMP: 75°

STA	CORR H DIST	H SCALE	RI	V SCALE	PROD ±	RC	DE ±	HI	ELEV	RMKS
A → B	(DE ABOVE STA B)(BOARD ORIENTED ON STA A.)						+ 4.3	116.7	112.4	ELEV STA B
1	625	100	6.25	55	+31.2	-4.6	+26.6		143.3	TOP OF SLOPE
2	160	100	1.60	48	-3.2	-2.8	- 6.0		110.7	BOTTOM OF SLOPE
3	199	97	2.05	68	+36.9	-8.4	+28.5		145.2	℄ ROAD
4	368	98	3.75	62	+45.0	-7.2	+37.8		154.5	℄ ROAD
5	105	100	1.05	54	+4.2	-3.9	+ 0.3		117.0	SPOT ELEV
6	425	100	4.25	47	-12.8	-4.4	-17.2		99.5	SPOT ELEV
7	240	98	2.45	37	-31.8	-7.5	-39.3		77.4	M.H.
8	255	100	2.55	50	0	-5.4	- 5.4		111.3	POWER POLE

Figure B-10. Plane table

Profile and cross-sectional level notes (figure B-11) are best recorded from the bottom of the page up. This method will align the direction of the survey with the notes. The right page shows the elevations of ground shots and their distance from the road centerline.

Ground Elevation	134.7
Rod Reading	3.5
Distance from Centerline	50

The ground elevation is determined by subtracting the rod reading from the HI. The distance from the centerline is measured with a tape.

PROFILE & CROSS-SECTION LEVELING

DESIGNATION MC COY AVE EXTENDED DATE 25 JAN 1984

STA	BS	HI	FS	ELEV	
TP #1			6.08	132.10	
7+50					
7+00					
6+50					
PC 6+09.22					
6+00					
		138.18			
BM #4	3.02			135.16'	

π McGUINNESS
Ψ GUESS — INST: GURLEY DUMPY LEVEL
Ø BONE — NO: 12345

	LEFT		℄	RIGHT	
			WEATHER	FAIR	
			WIND	S 10	
			TEMP	22°	
135.0 / 3.2 / 50		133.7 / 4.5 / 0			132.0 / 6.2 / 50
137.1 / 1.1 / 50		135.9 / 2.3 / 0		134.6 / 3.6 / 20	134.3 / 3.9 / 50
135.1 / 3.1 / 50		134.1 / 4.1 / 0			133.6 / 4.6 / 50
132.3 / 5.9 / 50		134.6 / 3.6 / 0			133.2 / 5.0 / 50
134.7 / 3.5 / 50		134.6 / 3.6 / 0			134.6 / 3.6 / 50
NAIL IN TREE 60' LEFT OF ℄ STA 2+50					

Figure B-11. Profile and cross-section leveling

Slope stake notes (figure B-12) are best recorded from the bottom of the page up. This method aligns the direction of the survey with the notes. Grade elevations are normally given in the construction drawings. The grade rod values are determined by subtracting the grade elevation from the HI. The three-part entries on the right page show the amount of cut (C) or fill (F), the ground rod reading, and the distance of the slope stake from the road centerline. A detailed method of setting slope stakes can be found in chapter 2.

SLOPE STAKES

DESIGNATION MISCOY AVE EXTENDED DATE 25 JAN 1984

STA	BS	HI	FS	ELEV	GRADE ELEV
TP#1			3.10	133.10	
2+50					132.1
2+00					132.6
1+50					133.1
1+00					133.6
0+50					134.1
		136.20			
BM#4	1.04			136.16'	

T CUMMINGS	
V BYERS	INST: DUMPY LEVEL
Ø RAWLINGS	NO: 1453

GRADE ROD	LEFT	℄	RIGHT	
		WEATHER	CLOUDY	
		WIND	S 10	
		TEMP	40°	
	TOP OF HUB STA 3+00			
4.1	C 0.3 / 3.8 / 23.0	GRADE / 4.1 / 0	F 0.8 / 4.9 / 16.7	
3.6	C 2.0 / 1.6 / 25.5	F 1.1 / 4.7 / 0	F 3.0 / 6.6 / 20.0	
3.1	C 2.6 / 0.5 / 26.4	F 2.9 / 6.0 / 0	F 4.1 / 7.2 / 21.6	
2.6	C 1.0 / 1.6 / 24.0	F 0.5 / 3.1 / 0	F 1.5 / 4.1 / 17.8	
2.1	F 1.0 / 3.1 / 17.0	F 1.6 / 3.7 / 0	F 2.1 / 4.2 / 18.6	
NAIL IN TREE 60' LEFT OF ℄ AT STA 0+50				

Figure B-12. Slope stakes

The right deflection angles (R DEFL) (figure B-13) were extracted from the curve computations (chapter 3). When a road curves to the left, the left deflection angles (L DEFL) are determined by subtracting the R DEFL from 360 degrees. The R DEFL are used to "back-in" a left curve from the point of tangency (PT). When a curve is to the right, the L DEFL need not be computed.

8+50	50.00	9° 38'	350° 22'	PI =	7+45.00
				T =	135.78'
8+00	50.00	7° 38'	352° 22'	PC =	6+09.22
				L =	268.33'
7+50	50.00	5° 38'	354° 22'	PT =	8+77.55
				R =	716.25'
7+00	50.00	3° 38'	356° 22'	E =	12.75'
				M =	12.52'
6+50	48.78	1° 38'	358° 22'	C_1 =	40.78'
				C_2 =	27.55'
6+09.22	0.00	0° 00'	360° 00'	C_{STD} =	50.00'
				D_1 =	1° 38'
				D_2 =	1° 06'
				D_{STD} =	2° 00'

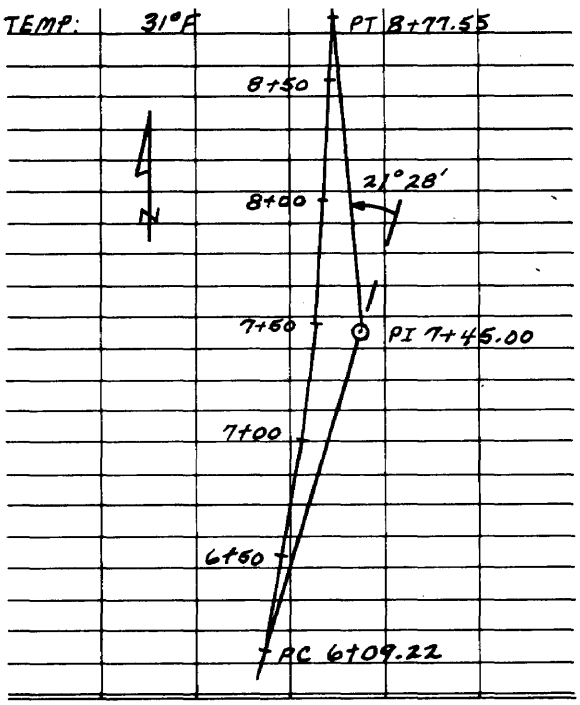


Figure B-13. Horizontal curve layout

The building corner numbers in the sketch must agree with the corner numbers on the left page. In this example, (figure B-14) the building foundation is required to be 1.5 feet above the ground at the highest corner. The batter board elevation (BATTER ELEV) is determined by adding 1.5 feet to the ground elevation (ELEV) of the highest corner. The difference between the BATTER ELEV and the HI equals the grade rod. When a batter board elevation is given, the ground shots are not necessary. The grade rod equals the HI minus the given batter board elevation.

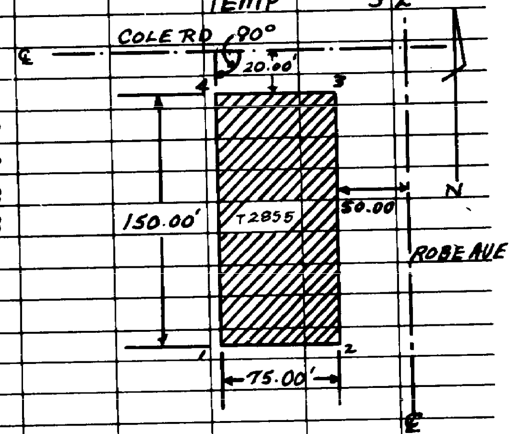
BUILDING LAYOUT

DESIGNATION BLDG T-2855 DATE 27 JAN 1984

STA	BS	HI	FS	ELEV	GRADE ROD
BM 18	5.22	35.22		30.00	
1			4.26	30.96	
2			4.14	31.08	
3			4.68	30.54	
4			4.52	30.70	
1					2.64
2					2.64
3					2.64
4					2.64

⊼ GLEASON
ⓡ RAWLINGS INST: WILD T-16 #7331
Ø STACEY K&E DUMPY LEVEL #846

BATTER ELEV	REMARKS		
		WEATHER	FAIR
		WIND	S 8
		TEMP	52°
32.58			
32.58			
32.58			
32.58			



NOTE: BATTER BOARD ELEVATION 1.5 FT ABOVE HIGHEST CORNER
BATTER BOARD ELEVATION IS TOP OF FOUNDATION.

Figure B-14. Building layout

HEIGHT OF AN ACCESSIBLE POINT

DESIGNATION HEIGHT OF FLAG POLE DATE 31 JAN 19 84

STA	TEL	ZD	VERT ANGLE	DIST	
FP ← ⊙1	D	70°30'	+19°30'	100.000	
	R	289°29'	+19°29'	100.010	
MEAN			+19°29'30"	100.005' METERS	
FP ← ⊙1	D	91°25'	-01°25'		
	R	268°35'	-01°25'		
MEAN			-01°25'00"		
TAN	19°29'30	X 100.005 =		35.397	
TAN	1°25'	X 100.005 =		2.473	
			TOTAL =	37.870	METERS

⊼ HAYWARD
♉ PARMELE
HT CARL
RT CUMMINGS

INST: T16
NO: 2391

REMARKS

WEATHER FAIR
WIND N 8
TEMP 30°

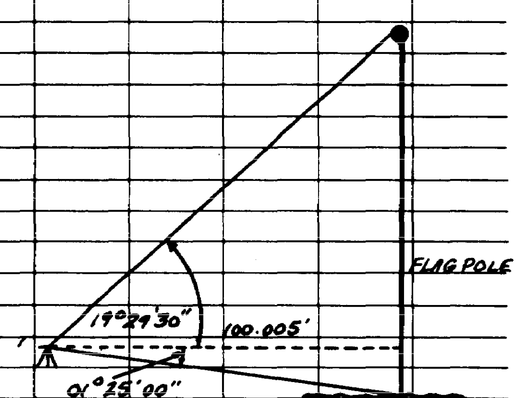


Figure B-16. Height of an accessible point

ELEVATION/DISTANCE TO AN INACCESSIBLE POINT

DESIGNATION WATER TOWER DATE 31 JAN 1984

STA	TEL	HORIZ ∠	ZD	VERT ∠	DIST
WT→⊙1	D	90°00'			300.00'
⊙2					300.01'
MEAN					300.005'
⊙1←⊙2	D	84°10'	86°42'	+03°18'	
WT	R	168°19'	273°18'	+03°18'	
MEAN		84°09'30"		+03°18'00"	
⊙2→TMBC	R	EL=100.00			
		BS=4.75			
		HI=104.75			

300.005 ÷ COS 84°09'30" = 2947.59' DISTANCE

TAN 3°18' x 2947.59 = 169.96 + 104.75 = 274.71 ELEVATION

⊼ Φ BLANTON | INST WILD 1' THEODOLITE
ΦHT NELSON | NO 2439
RT BONE

REMARKS

WEATHER	CLOUDY
WIND	NW 12
TEMP	28°

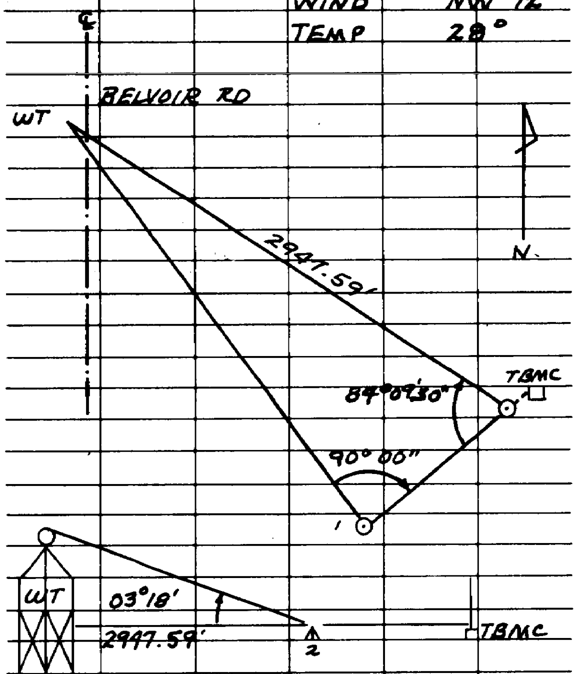


Figure B-17. Elevation/distance to an inaccessible point