TRANSIT BOOK

Engineer's Field Transit Book

MADE IN U.S.A.

Check levels Mulberry Rd Bridge

Aug 1967	Pg 4&5
July 1968	Pg 6&7
May 1970	Pg 8&9

Base Line	W. abut	8
"	E. "	17

3-14-66
H. Patterson
R. Diedrich

Check Levels
Mulberry Rd.

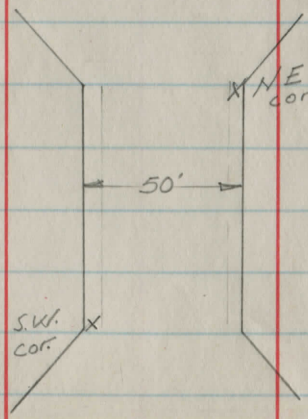
	+	H.I.	−	Bridge Elev.	
BM # 2	8.52	937.85		929.33	Hort. spk S. side CEI # 380303
T.P.	0.17	925.99	12.03	925.82	
			6.37	919.62	12' E. of SW. Wing Wall
			9.10	16.89	15' " " " "
			10.53	15.46	18' " " " "
			11.79	14.20	25' " " " "
T.P.	5.52	919.30	12.21	913.28	
			8.76	10.54	37' " " " " & creek
			9.91	09.39	50' " " " "
			10.20	09.10	56' " " " " "
			10.71	05.59	60' " " " " "
			9.37	09.93	67' " " " " at base of footer
			4.43	915.87	69' " " " " on footer
			8.60	10.70	18' W. of NE. Wingwall
			10.00	09.30	35' " " " " & creek
			10.90	08.40	39' " " " " "
			10.55	08.75	42' " " " " "
			10.24	09.06	48' " " " " "
			9.55	09.75	50' " " " " "

		919.30		
TP	12.78	929.01	3.07	916.23
T.P	9.63	937.85	0.79	928.22
BM #2			8.53	929.32

Check Elev. Mulberry Rd Bridge

1967

	+	HI	−	elev
BM	0.51	929.84		929.33
T.P.	0.51	918.88	10.47	918.37
			4.60	
			8.70	
			9.93	
			10.31	
			10.60	
			9.40	
			8.96	
			7.70	
			1.37	



Bob Kosie
Don Kosie
Paul Ranney

Spk S. side CEI # 380303

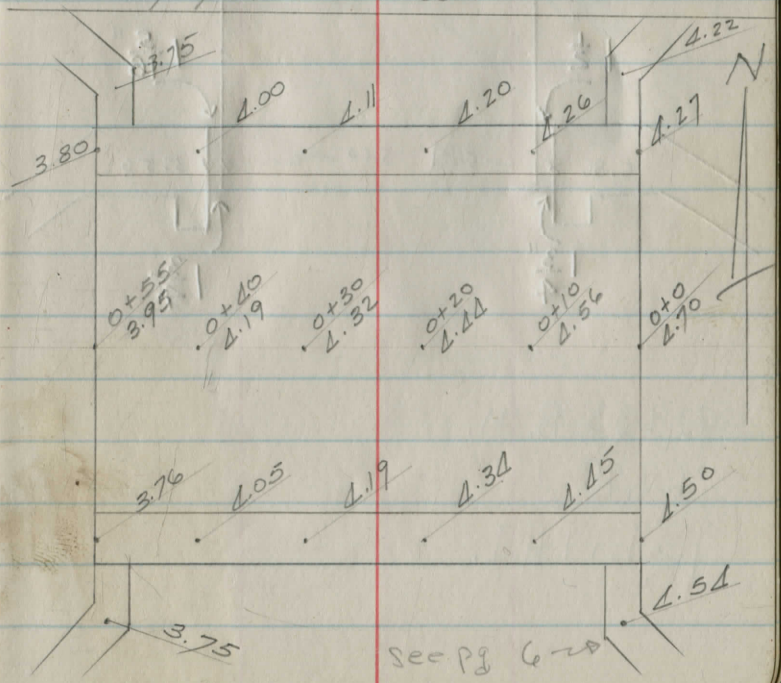
Top footer N.E. Cor.
Bottom " " " " base
18' W of N.E. cor. (face of wall)
21' " " " " " " edge creek
35' " " " " " " " "
39' " " " " " " "
42' " " " " " " edge creek
46' " NW cor Bott. footer base
50' Top footer NW cor.

See following page for S. end

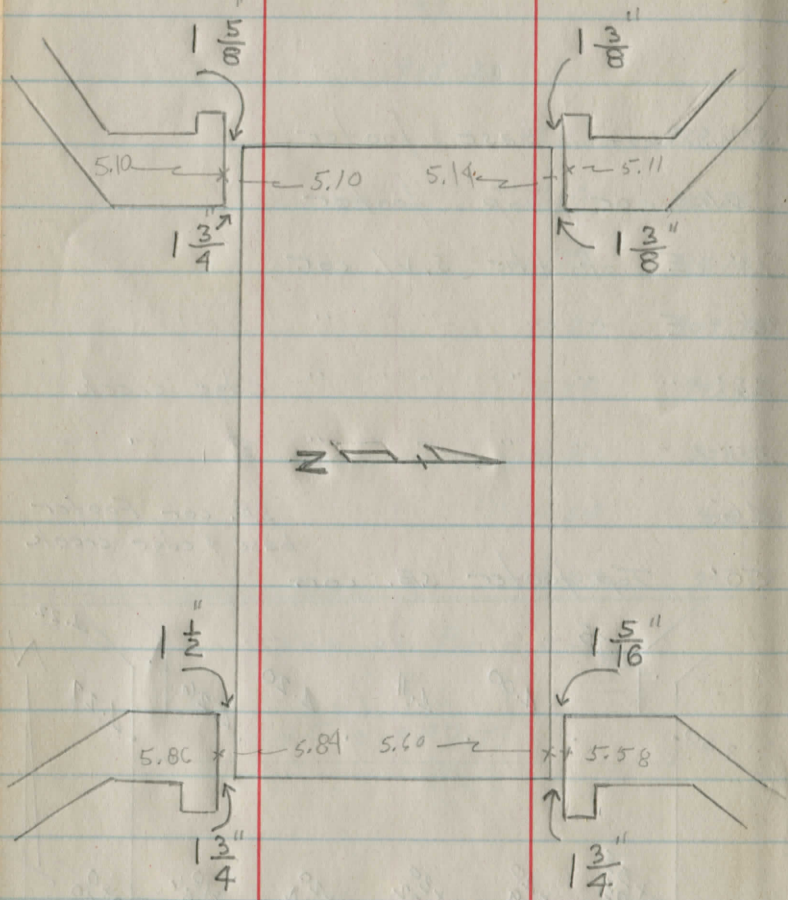
+	HI	−	elev.	
	918.88			
		5.11	913.77	S.W. cor base footer
		4.10	915.78	S.W. cor Top footer
		6.72	913.16	12' E. of the S.W. cor.
		10.20	909.68	24' E. " " " "
		10.25	909.63	28' " " " " " " edge creek
		10.80	909.08	35' " " " " " " ℄ "
		11.25	908.63	46' S.E. cor Footer base & edge creek
		4.60	915.28	50' Top footer S.E. cor.

Top of Bridge

HI = 937.77



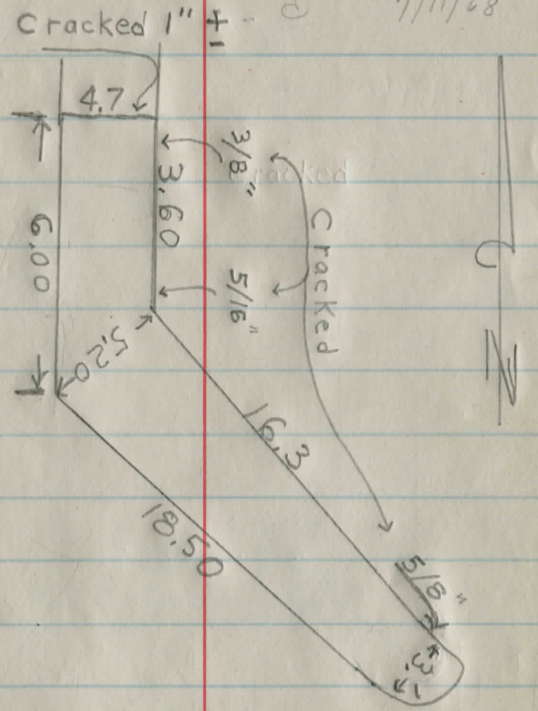
See pg 6 →



929.33 B. M.
+9.78
939.11 H.I.

⑥ Bob Kosie
Don Kosie
Bob Dedrich
7/11/68

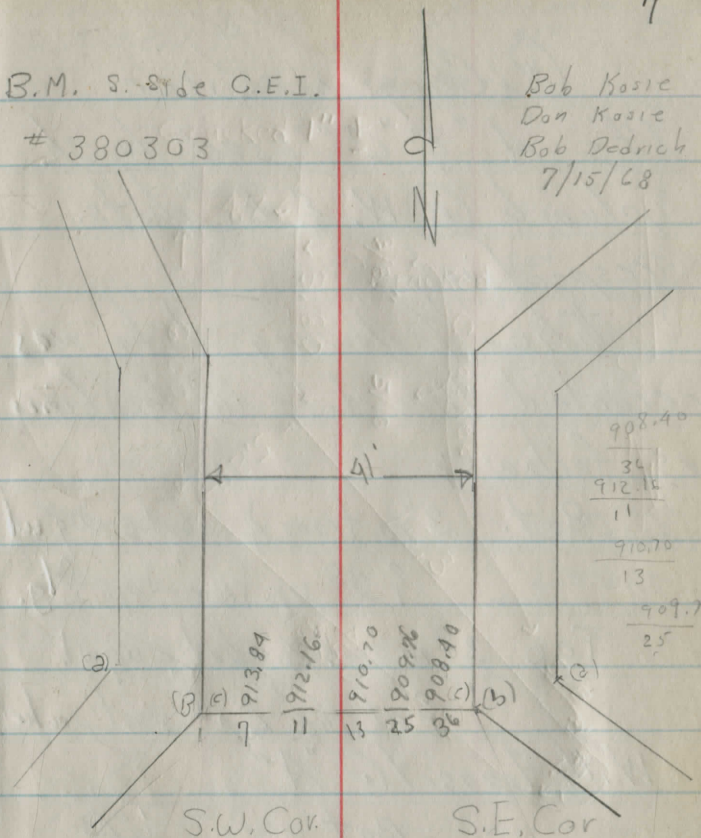
S.E. Cor. Bridge



914.96
6.40
908.56

B.M. S. Side C.E.I.
380303

Bob Kosie
Don Kosie
Bob Dedrick
7/15/68



(a) Top Footer + Facewall 915.87
(b) Top Footer East 915.60
(c) Base Footer + Edge Creek bed 914.68

(a) Top Footer + Face wall 915.37
(b) Top Footer West 914.96
(c) Base Footer + edge creek 908.56

#39 Bridge

@ Chagrin River

Pts "A" & "C" used to ck plumb @ W. & E. abuts. respectively.

The following data was recorded this date @ locations as follows:

Bot. 3° in from ∠ abut & wgwl & 2° up from top ftg.

Top 3° in from ∠ abut & wgwl & at the ∠ of seat pocket.

With transit @ "A"

	Bot	Top
S.W.	0.215	0.195
N.W.	0.200	0.140

With π @ "C"

S.E.	0.135	0.200
N.E.	0.400	0.495

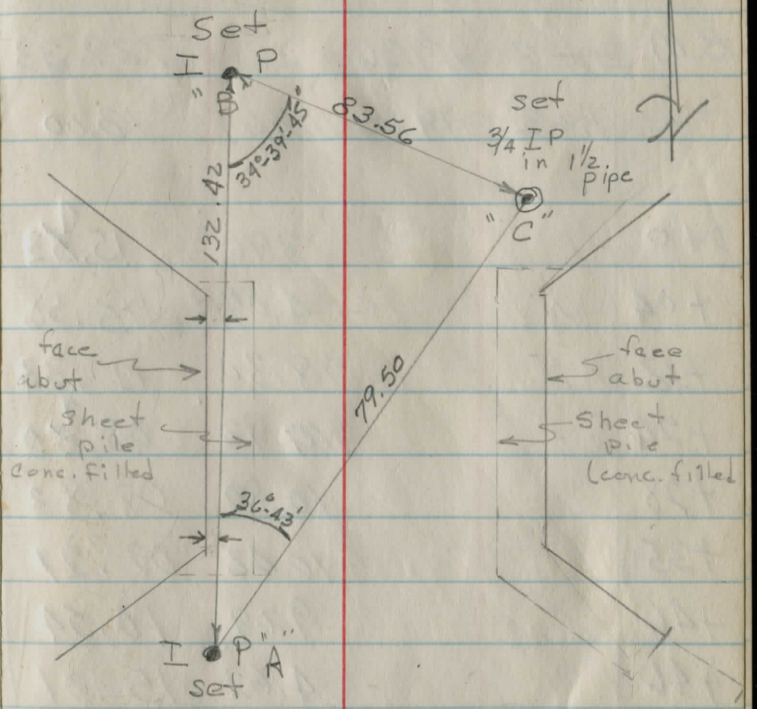
Design fce to fce abut - 50.75'

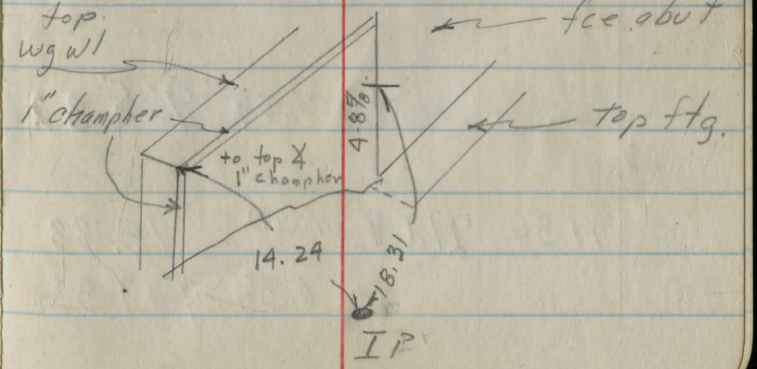
R.A. Davidson
S.A. Merrith

Sunny - warm 75°

8

May 14, 1970





	#39 @ X Sect.	Chagrin River Stream	@ S. edge deck (= drip line)	R.A. Davidson S.A. Merritt Pt.cldy-warm 75° 5/15/70	
B.M	0.03	929.36	929.33	Hd. spk. S. side C.E.I. #380303	
	1.63	19.63	11.36	18.00	040 = fce W. abut top ftg.
040			3.90	15.73	
+04			4.07	15.56	
+12			8.30	11.33	
+24			10.93	08.70	
+28			10.80	08.83	
+35			10.42	09.21	
+46			9.09	10.54	dn
+40			4.62	15.01	up
+50			4.52	15.11	
		+	5.69	925.32	Top stl pile ref well @ S.E X.
	11.36	29.69	1.30	18.33	
BM			0.38	929.31	ck 0.02

#39 @ Chagrin River

Davidson
Merritt
8/26/70

Sunny warm. 10
75°

Ref pts. as pg 8
dated 5/14/70

@ S.W. & seat
6" below bot deck
Spall 0.17 open
from bkwl.

With T @ "C"

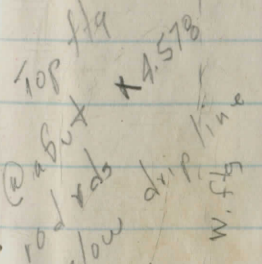
	Bot	Top
N.E.	0.400	0.495
S.E.	0.171	0.200

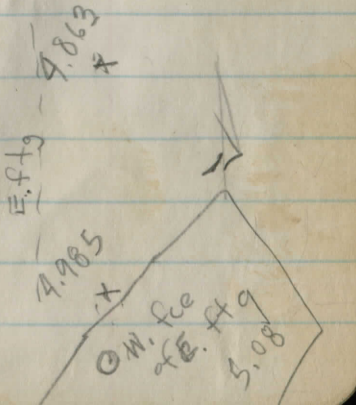
no change since 5/14/70.

With T @ "A"

N.W.	0.200	0.140
S.W.	0.215	0.191

no change since 5/14/70





#39-4.35-4

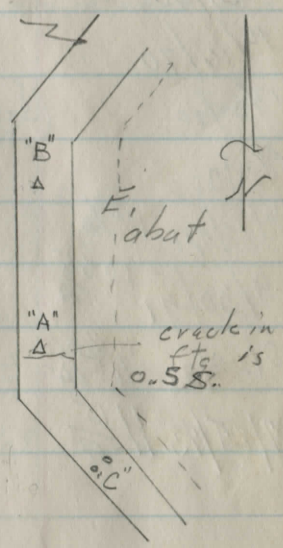
Fce to Fce obs. dim.

Date	Temp	N.	Corr	S.	Corr
8/31/70	69°	50.53	—	50.35	—
10/19/70	48°	50.54	50.53	50.35	50.34
12/30/70	1:30 P ±25°	No meas. this date - no viz change evident			
4/5/71	1:35 P	no fce to fce meas taken			
4/13/71	12:50 P	55° 50.53	-0.004 50.526	50.35	-0.004 50.346

(11)

@ Δ wgwl to abut - top of exstg ftg.

Date	Dist. Ref "A" Pt. to Fce sht.	Loc.
8/31/70	1.495	pk nail 4' N. of S.F.A
10/16/70	1.500	
12/30/70	(see opp. pg.)	
4/7/71	1.530	(1:35 P)
6/11/71	1.530	11:20 A
9/30/71	1.530	10:55 A
2/29/72	1.535	11:20 A ±40°
4/25/73	~~1.565~~ 1.55	11:45 A 75°



(11a) 39-4.35-4

Obs. Dim @ E. abut See pg 11

Date	Dist. Ref PT "B" to fce sht	Loc.
8/31/70	1.510	PK nail 7.18' S of NE X
10/16/70	1.505	
12/30/70	(See pg 11)	
4/7/71	1.535	
6/11/71 11 20/A	1.540	
9/30/71 10 55/A	1.535	
2/29/72 11 20/A	1.61	±40°
7/25/73 11 15/A	1.55 1.545	75°

39-4.35-4 (11b)

Obs. Dim @ E. abut See pg 11

Date	Dist. Ref PT "C" to fce sht	Loc. From fce. abut. wg to fce. sht. pile 6.14' S.E. of S.E X.
8/31/70	3.855	
10/16/70	3.910	
12/30/70	(See pg 11)	
4/7/71	3.900	
6/11/71 11 20/A	3.910	
6/11/71 11 00/A	3.905	
2/29/72 11 20/A	3.95	±40°
7/25/73 11/15/A	3.95	75°

#39 @ Chagrin River

X sec stream @ S.

BM.	8.87	938.20		929.33	
	0.46	27.85	10.81	927.39	
	2.72	19.06	11.51	16.34	
0+0			3.33	15.73	
+04			3.51	15.55	up
+04			4.60	14.46	dn
+12			7.79	11.27	
+24			10.09	08.97	
+28			10.17	08.89	
+35			9.83	09.23	
+46			9.25	09.81	dn
+46			4.06	15.00	up.
+50			3.97	15.09	
	11.51	27.85	2.72	16.34	
	10.69	38.07	0.47	27.38	
BM.			8.74	929.33	ck - 0.00

R.A. Davidson
S.A. Merritt

Pt. Cloudy
cool. 50°

(12)

10/16/70

edge deck (drip line)

spk. pole #380303

Note: gravel bar N. of struct.

remove to pt. ± 150 N. of N. side struct.

F39 @ Chegrin River

Ref pts. as pg 8 dated 5/14/70

With ⊼ @ "C"

	Bot	Top
NE.	0.400	0.495
SE.	0.721	0.190

With ⊼ @ "A"

	Bot	Top
N.W.	0.200	0.130
S.W.	0.215	0.189

Dist. from Base Line	A-B	
N.W	2.012	1.930
S.W.	1.178	1.165

Cldy-cool 50°
Davidson
Merritt
10/16/70

(13)

Top. ftg @ abut - rod readings

0.815
x

x 1.100 11

x 1.215

x
0.600

#39 @ Chagrin River

Ptly Cldy - Warm — 4/13/71 — (14)

Davidson
Merritt

Ref. pts as pg. 8.

Dist from Baseline A-B

	Top	Bot.
N.W	1.930	2.015
S.W.	1.160	1.173

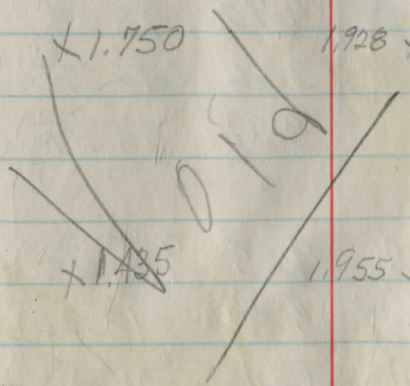
With ℄ @ C

N.E.	0.495	0.395
S.E.	0.190	0.115

@ S.W. ∠ seat + 6" below bot deck spall 0.19 open from bk wl. (see pg 10)

@ N.E. ∠ bk wl. broken from abut. in seat, pocket & @ S.E. ∠ same

Top ftg @ abut - rod readings



#39 @ Chogrin River

39-4.35-4

Davidson
Merritt

Sunny-cool

4/19/71

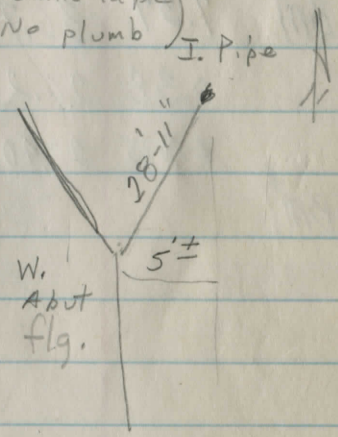
X sec Stream @ S. drip line

BM	7.65	936.98		929.33	SPK in Pole #380303
	0.47	26.18	11.27	25.71	
	3.32	18.77	10.73	15.45	
0+0			3.06	15.71	
+04			3.24	15.53	up
+04			4.34	14.43	dn
+12			7.64	11.13	
+24			8.84	09.93	
+28			9.48	09.29	
+35			9.80	08.97	
+46			9.39	09.38	dn
+46			3.77	15.00	up
+50			3.70	15.07	
+50			3.56	15.21	N. drip line
0+0			3.27	15.50	" " "
TBM#1	8.04	19.76	7.05	911.72	Top 3/4" pipe 4" above grd. Elev. 911.705 see pg 16
	10.81	26.77	3.80	15.96	
	10.86	37.12	0.51	26.26	
BM			7.76	929.36	ck 0.03 N.G. use X sec. TBM Rerun see pg 16

TBM #1 Ref

(Metalic Tape No plumb)

I. Pipe



TBm #1 pg 15

Rerun BM to

BM.	1.200	30.530.		929.330	
	0.030	19.375	11.185	19.345	
	3.540	14.675	8.240	11.135	
TBm #1			3.000	911.675	
	8.830	18.915	4.590	10.085	
	11.725	30.190	0.450	18.465	Ck N.G.
			1.025	29.165	
BM.	7.37	36.70		929.33	
	0.38	26.23	10.85	25.85	
	4.375	20.405	10.20	16.03	
TBm #1			8.70	911.705	described pg. 15
			4.92	915.485	NW. ¼
			5.19	915.215	N.E. ¼
			5.32	915.085	S.E. ¼
	8.49	20.195	8.70	911.705	
	1.73	4	4.485	915.710 ~~16.710~~	S.W. ¼
	10.21	24.675	1.73	17.465	
	9.66	38.72	0.515	28.160	
BM			8.50	29.32	ck 0.01 OK

#39-4.35-4

Mulberry @ Chagrin River

E. abut Base

Observation of dist to face abut taken @ N. E S. drip lines (3° in from X abut & ug E 2° above top ftg.)

D - E

	Top	Bot
1 30/P N. E.	—	0.49 (-)
S. E.	—	0.575 (+)

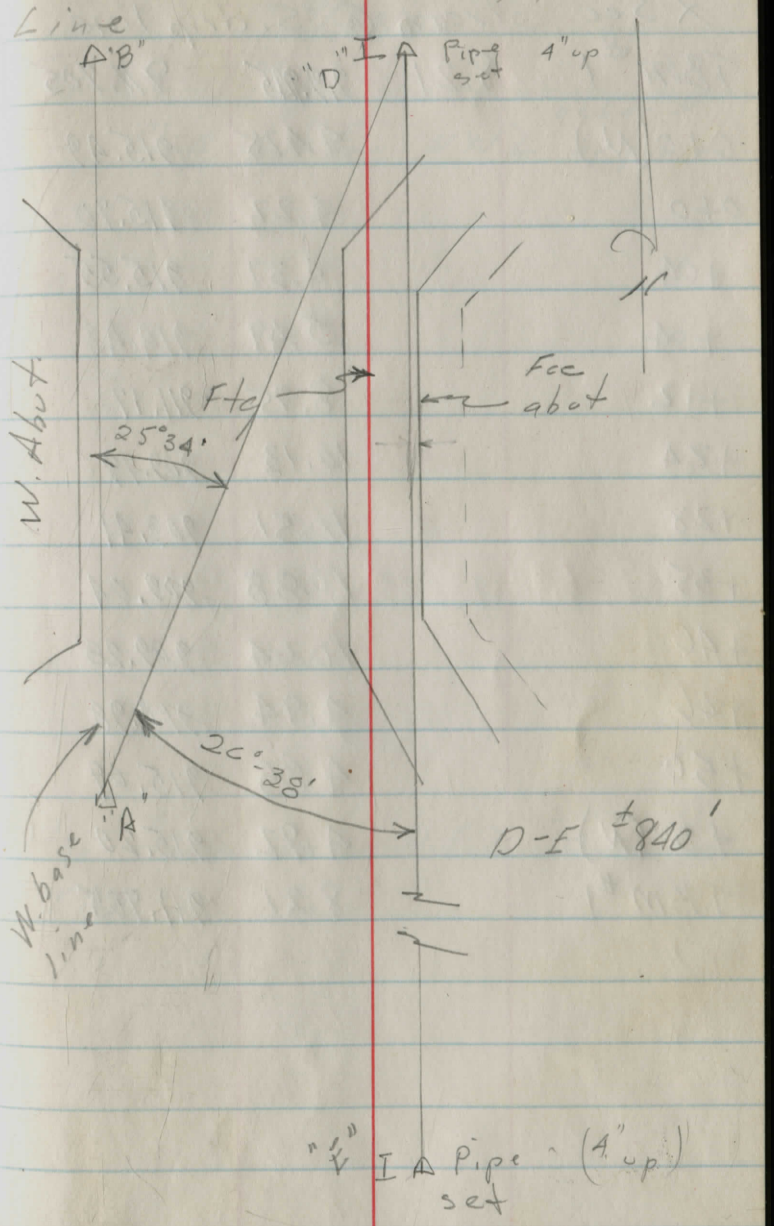
A. B	Top	Bot
45/P N. W	—	2.015 (-)
S. W	—	1.175 (+)

Dan Egan Merrill

Sunny - warm 75°

6/11/71

17



#39 @ Chagrin River

X Sec	Stream @ S. drip line		
TBM #1	8.21	919.915	911.705
0+0(N)		4.425	915.49
0+0		4.22	915.70
+04		4.37	915.55
+04		5.49	914.43
+12		8.75	911.17
+24		10.13	909.79
+28		10.51	909.41
+35		10.88	909.04
+46		10.64	909.28
+44		4.94	914.98
+50		4.85	915.07
+50(N)		4.72	915.20
TBM #1		8.21	911.705

Davidson clear - ht + 18
Merit ± 80°
9/30/71

Top 3/4" I Pipe
top ftg @ abut face NW 4 under N. drip line

up

dn

dn

up

top ftg @ abut face NE 4 under N. drip line

TBM #1

Chagrin River @ #39 Profile Sta. to S.

TBM #1	7.65	19.355	911.705	
		10.28	909.07	✓
		4.37	914.98	✓
0+0		9.65	909.70	✓
		3.91	915.44	✓
+50		9.45	909.90	✓
1+0		9.19	910.16	✓
2+0		8.66	910.69	✓
2+50=T.P. 2	6.48	18.365 7.47	911.885	✓
3+0		6.82	911.54	✓
+50	?	7.95	910.41	✓
4+0		6.93	911.43	✓
+50		6.95	911.41	✓
5+0		6.58	911.78	✓
+50		6.33	912.03	✓
6+0		6.98	911.38	✓
+50		6.96	911.40	✓
T.P. 3=T+0	5.24	17.775 5.83	912.535	✓
		4.78	.995	

Cldy - cool 2/29/72

Davidson
Merritt ± 40°

see pg 15 for description

@ N. drip line ± ℄ stream

E. ftg. top @ fce under S drip line

@ S. drip line ± ℄ str.

W. ftg. top @ fce under S. drip line

℄ River 0+0 = S. drip line

" 2 sta. paced dist. to S.

"

"

"

"

"

"

"

"

" ± Peterson S. ℄ on W. side

± 6' E ℄ River @ str. from W.

Profile to S.

17.775

7+50			6.10	911.67	℄ River
8+0			5.16	912.61	"
+50			5.02	912.75	"
9+0			5.00	912.77	"
+50			5.00	912.77	"
10+00			4.95	912.82	"
TP_3	5.55	20.155	3.17	914.605	"
+50			7.16	912.99	"
11+0			6.95	913.20	"
+50			7.50	912.65	"
12+0			6.44	913.71	"
+50			5.70	914.45	"
13+0			6.03	914.12	" ± 600 to 700' S.W. Whitings Bldgs.
TP_4	2.96	17.42	5.69	914.46	
TP_5	3.25	16.43	4.24	913.18	
TBM #1			4.78	911.65	ck 0.05 ℄

2/29/72

TABLE I

Deflections for Sub Chords for Short Radius Curves.

Degree of Curve	Radius 50 / sin. def. ang.	½ sub chord / R = sin. of def. angle				Length of arc for 100 ft.
		12.5 Ft.	15 Ft.	20 Ft.	25 Ft.	
30°	193.18	1° 51′	2° 17′	2° 58′	3° 43′	101.15
32°	181.39	1° 59′	2° 25′	3° 10′	3° 58′	101.33
34°	171.01	2° 06′	2° 33′	3° 21′	4° 12′	101.48
36°	161.80	2° 13′	2° 41′	3° 33′	4° 26′	101.66
38°	153.58	2° 20′	2° 49′	3° 44′	4° 40′	101.85
40°	146.19	2° 27′	2° 57′	3° 55′	4° 54′	102.06
42°	139.52	2° 34′	3° 05′	4° 07′	5° 08′	102.29
44°	133.47	2° 41′	3° 13′	4° 18′	5° 22′	102.53
46°	127.97	2° 48′	3° 21′	4° 29′	5° 36′	102.76
48°	122.92	2° 55′	3° 29′	4° 40′	5° 50′	103.00
50°	118.31	3° 02′	3° 38′	4° 51′	6° 04′	103.24
52°	114.06	3° 09′	3° 46′	5° 02′	6° 17′	103.54
54°	110.11	3° 16′	3° 54′	5° 13′	6° 31′	103.84
56°	106.50	3° 22′	4° 02′	5° 23′	6° 44′	104.14
58°	103.14	3° 29′	4° 10′	5° 34′	6° 57′	104.43
60°	100.00	3° 35′	4° 18′	5° 44′	7° 11′	104.72

CURVE FORMULAS

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin } D}$

$\text{Sin } D = \frac{50}{R}$

$\text{Sin } D = \frac{50 \tan \frac{1}{2} I}{T}$

$R = T \cot \frac{1}{2} I$

$R = \frac{50}{\text{Sin } D}$

$E = R \text{ exsec } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

$\text{Chord def} = \frac{\text{chord}^2}{R}$

$\text{No. chords} = \frac{\frac{1}{2} I}{D}$

Tan. def. = ½ chord def.

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

Table II. contains Tangents and Externals to a 1° curve. Tan. and Ext. to any other radius may be found, nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and External: Divide Ext. opposite the given Central Angle by the given External.

To find Natural Tangent and Natural Exsecant for any angle by Table II.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Natural Tangent or Natural Exsecant.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.), and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance: Multiply the angle by .01745, and the product by the distance.

Right Angle Triangles.—Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. 10. $10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. 25. $25^2 \div 200 = 3.125$. $100 - 3.125 = 96.875$ = Base

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

TABLE II. Tangents and Externals to a 1° Curve

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
1°	50.00	.218	**11°**	551.70	26.500	**21°**	1061.9	97.577
10′	58.34	.297	10′	560.11	27.313	10′	1070.6	99.155
20′	66.67	.388	20′	568.53	28.137	20′	1079.2	100.75
30′	75.01	.491	30′	576.95	28.974	30′	1087.8	102.35
40′	83.34	.606	40′	585.36	29.824	40′	1096.4	103.97
50′	91.68	.733	50′	593.79	30.686	50′	1105.1	105.60
2°	100.01	.873	**12°**	602.21	31.561	**22°**	1113.7	107.24
10′	108.35	1.024	10′	610.64	32.447	10′	1122.4	108.90
20′	116.68	1.188	20′	619.07	33.347	20′	1131.0	110.57
30′	125.02	1.364	30′	627.50	34.259	30′	1139.7	112.25
40′	133.36	1.552	40′	635.93	35.183	40′	1148.4	113.95
50′	141.70	1.752	50′	644.37	36.120	50′	1157.0	115.66
3°	150.04	1.964	**13°**	652.81	37.070	**23°**	1165.7	117.38
10′	158.38	2.188	10′	661.25	38.031	10′	1174.4	119.12
20′	166.72	2.425	20′	669.70	39.006	20′	1183.1	120.87
30′	175.06	2.674	30′	678.15	39.993	30′	1191.8	122.63
40′	183.40	2.934	40′	686.60	40.992	40′	1200.5	124.41
50′	191.74	3.207	50′	695.06	42.004	50′	1209.2	126.20
4°	200.08	3.492	**14°**	703.51	43.029	**24°**	1217.9	128.00
10′	208.43	3.790	10′	711.97	44.066	10′	1226.6	129.82
20′	216.77	4.099	20′	720.44	45.116	20′	1235.3	131.65
30′	225.12	4.421	30′	728.90	46.178	30′	1244.0	133.50
40′	233.47	4.755	40′	737.37	47.253	40′	1252.8	135.35
50′	241.81	5.100	50′	745.85	48.341	50′	1261.5	137.23
5°	250.16	5.459	**15°**	754.32	49.441	**25°**	1270.2	139.11
10′	258.51	5.829	10′	762.80	50.554	10′	1279.0	141.01
20′	266.86	6.211	20′	771.29	51.679	20′	1287.7	142.93
30′	275.21	6.606	30′	779.77	52.818	30′	1296.5	144.85
40′	283.57	7.013	40′	788.26	53.969	40′	1305.3	146.79
50′	291.92	7.432	50′	796.75	55.132	50′	1314.0	148.75
6°	300.28	7.863	**16°**	805.25	56.309	**26°**	1322.8	150.71
10′	308.64	8.307	10′	813.75	57.498	10′	1331.6	152.69
20′	316.99	8.762	20′	822.25	58.699	20′	1340.4	154.69
30′	325.35	9.230	30′	830.76	59.914	30′	1349.2	156.70
40′	333.71	9.710	40′	839.27	61.141	40′	1358.0	158.72
50′	342.08	10.202	50′	847.78	62.381	50′	1366.8	160.76
7°	350.44	10.707	**17°**	856.30	63.634	**27°**	1375.6	162.81
10′	358.81	11.224	10′	864.82	64.900	10′	1384.4	164.86
20′	367.17	11.753	20′	873.35	66.178	20′	1393.2	166.95
30′	375.54	12.294	30′	881.88	67.470	30′	1402.0	169.04
40′	383.91	12.847	40′	890.41	68.774	40′	1410.9	171.15
50′	392.28	13.413	50′	898.95	70.091	50′	1419.7	173.27
8°	400.66	13.991	**18°**	907.49	71.421	**28°**	1428.6	175.41
10′	409.03	14.582	10′	916.03	72.764	10′	1437.4	177.55
20′	417.41	15.184	20′	924.58	74.119	20′	1446.3	179.72
30′	425.79	15.799	30′	933.13	75.488	30′	1455.1	181.89
40′	434.17	16.426	40′	941.69	76.869	40′	1464.0	184.08
50′	442.55	17.065	50′	950.25	78.264	50′	1472.9	186.29
9°	450.93	17.717	**19°**	958.81	79.671	**29°**	1481.8	188.51
10′	459.32	18.381	10′	967.38	81.092	10′	1490.7	190.74
20′	467.71	19.058	20′	975.96	82.525	20′	1499.6	192.99
30′	476.10	19.746	30′	984.53	83.972	30′	1508.5	195.25
40′	484.49	20.447	40′	993.12	85.431	40′	1517.4	197.53
50′	492.88	21.161	50′	1001.7	86.904	50′	1526.3	199.82
10°	501.28	21.887	**20°**	1010.3	88.389	**30°**	1535.3	202.12
10′	509.68	22.624	10′	1018.9	89.888	10′	1544.2	204.44
20′	518.08	23.375	20′	1027.5	91.399	20′	1553.1	206.77
30′	526.48	24.138	30′	1036.1	92.924	30′	1562.1	209.12
40′	534.89	24.913	40′	1044.7	94.462	40′	1571.0	211.48
50′	543.29	25.700	50′	1053.3	96.013	50′	1580.0	213.86

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

TABLE II. Tangents and Externals to a 1° Curve

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
31°	1589.0	216.3	**41°**	2142.2	387.4	**51°**	2732.9	618.4
10′	1598.0	218.7	10′	2151.7	390.7	10′	2743.1	622.8
20′	1606.9	221.1	20′	2161.2	394.1	20′	2753.4	627.2
30′	1615.9	223.5	30′	2170.8	397.4	30′	2763.7	631.7
40′	1624.9	226.0	40′	2180.3	400.8	40′	2773.9	636.2
50′	1633.9	228.4	50′	2189.9	404.2	50′	2784.2	640.7
32°	1643.0	230.9	**42°**	2199.4	407.6	**52°**	2794.5	645.2
10′	1652.0	233.4	10′	2209.0	411.1	10′	2804.9	649.7
20′	1661.0	235.9	20′	2218.6	414.5	20′	2815.2	654.3
30′	1670.0	238.4	30′	2228.1	418.0	30′	2825.6	658.8
40′	1679.1	241.0	40′	2237.7	421.4	40′	2835.9	663.4
50′	1688.1	243.5	50′	2247.3	425.0	50′	2846.3	668.0
33°	1697.2	246.1	**43°**	2257.0	428.5	**53°**	2856.7	672.7
10′	1706.3	248.7	10′	2266.6	432.0	10′	2867.1	677.3
20′	1715.3	251.3	20′	2276.2	435.6	20′	2877.5	682.0
30′	1724.4	253.9	30′	2285.9	439.2	30′	2888.0	686.7
40′	1733.5	256.5	40′	2295.6	442.8	40′	2898.4	691.4
50′	1742.6	259.1	50′	2305.2	446.4	50′	2908.9	696.1
34°	1751.7	261.8	**44°**	2314.9	450.0	**54°**	2919.4	700.9
10′	1760.8	264.5	10′	2324.6	453.6	10′	2929.9	705.7
20′	1770.0	267.2	20′	2334.3	457.3	20′	2940.4	710.5
30′	1779.1	269.9	30′	2344.1	461.0	30′	2951.0	715.3
40′	1788.2	272.6	40′	2353.8	464.6	40′	2961.5	720.1
50′	1797.4	275.3	50′	2363.5	468.4	50′	2972.1	725.0
35°	1806.6	278.1	**45°**	2373.3	472.1	**55°**	2982.7	729.9
10′	1815.7	280.8	10′	2383.1	475.8	10′	2993.3	734.8
20′	1824.9	283.6	20′	2392.8	479.6	20′	3003.9	739.7
30′	1834.1	286.4	30′	2402.6	483.4	30′	3014.5	744.6
40′	1843.3	289.2	40′	2412.4	487.2	40′	3025.2	749.6
50′	1852.5	292.0	50′	2422.3	491.0	50′	3035.8	754.6
36°	1861.7	294.9	**46°**	2432.1	494.8	**56°**	3046.5	759.6
10′	1870.9	297.7	10′	2441.9	498.7	10′	3057.2	764.6
20′	1880.1	300.6	20′	2451.8	502.5	20′	3067.9	769.7
30′	1889.4	303.5	30′	2461.7	506.4	30′	3078.7	774.7
40′	1898.6	306.4	40′	2471.5	510.3	40′	3089.4	779.8
50′	1907.9	309.3	50′	2481.4	514.3	50′	3100.2	784.9
37°	1917.1	312.2	**47°**	2491.3	518.2	**57°**	3110.9	790.1
10′	1926.4	315.2	10′	2501.2	522.2	10′	3121.7	795.2
20′	1935.7	318.1	20′	2511.2	526.1	20′	3132.6	800.4
30′	1945.0	321.1	30′	2521.1	530.1	30′	3143.4	805.6
40′	1954.3	324.1	40′	2531.1	534.2	40′	3154.2	810.9
50′	1963.6	327.1	50′	2541.0	538.2	50′	3165.1	816.1
38°	1972.9	330.2	**48°**	2551.0	542.2	**58°**	3176.0	821.4
10′	1982.2	333.2	10′	2561.0	546.3	10′	3186.9	826.7
20′	1991.5	336.3	20′	2571.0	550.4	20′	3197.8	832.0
30′	2000.9	339.3	30′	2581.0	554.5	30′	3208.8	837.3
40′	2010.2	342.4	40′	2591.0	558.6	40′	3219.7	842.7
50′	2019.6	345.5	50′	2601.1	562.8	50′	3230.7	848.1
39°	2029.0	348.6	**49°**	2611.2	566.9	**59°**	3241.7	853.5
10′	2038.4	351.8	10′	2621.2	571.1	10′	3252.7	858.9
20′	2047.8	354.9	20′	2631.3	575.3	20′	3263.7	864.3
30′	2057.2	358.1	30′	2641.4	579.5	30′	3274.8	869.8
40′	2066.6	361.3	40′	2651.5	583.8	40′	3285.8	875.3
50′	2076.0	364.5	50′	2661.6	588.0	50′	3296.9	880.8
40°	2085.4	367.7	**50°**	2671.8	592.3	**60°**	3308.0	886.4
10′	2094.9	371.0	10′	2681.9	596.6	10′	3319.1	892.0
20′	2104.3	374.2	20′	2692.1	600.9	20′	3330.3	897.5
30′	2113.8	377.5	30′	2702.3	605.3	30′	3341.4	903.2
40′	2123.3	380.8	40′	2712.5	609.6	40′	3352.6	908.8
50′	2132.7	384.1	50′	2722.7	614.0	50′	3363.8	914.5

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

TABLE II. Tangents and Externals to a 1° Curve

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
61°	3375.0	920.2	**71°**	4086.9	1308.2	**81°**	4893.6	1805.3
10′	3386.3	925.9	10′	4099.5	1315.6	10′	4908.0	1814.7
20′	3397.5	931.6	20′	4112.1	1322.9	20′	4922.5	1824.1
30′	3408.8	937.3	30′	4124.8	1330.3	30′	4937.0	1833.6
40′	3420.1	943.1	40′	4137.4	1337.7	40′	4951.5	1843.1
50′	3431.4	948.9	50′	4150.1	1345.1	50′	4966.1	1852.6
62°	3442.7	954.8	**72°**	4162.8	1352.6	**82°**	4980.7	1862.2
10′	3454.1	960.6	10′	4175.6	1360.1	10′	4995.4	1871.8
20′	3465.4	966.5	20′	4188.5	1367.6	20′	5010.0	1881.5
30′	3476.8	972.4	30′	4201.2	1375.2	30′	5024.8	1891.2
40′	3488.3	978.3	40′	4214.0	1382.8	40′	5039.5	1900.9
50′	3499.7	984.3	50′	4226.8	1390.4	50′	5054.3	1910.7
63°	3511.1	990.2	**73°**	4239.7	1398.0	**83°**	5069.2	1920.5
10′	3522.6	996.2	10′	4252.6	1405.7	10′	5084.0	1930.4
20′	3534.1	1002.3	20′	4265.6	1413.5	20′	5099.0	1940.3
30′	3545.6	1008.3	30′	4278.5	1421.2	30′	5113.9	1950.3
40′	3557.2	1014.4	40′	4291.5	1429.0	40′	5128.9	1960.2
50′	3568.7	1020.5	50′	4304.6	1436.8	50′	5143.9	1970.3
64°	3580.3	1026.6	**74°**	4317.6	1444.6	**84°**	5159.0	1980.4
10′	3591.9	1032.8	10′	4330.7	1452.5	10′	5174.1	1990.5
20′	3603.5	1039.0	20′	4343.8	1460.4	20′	5189.3	2000.6
30′	3615.1	1045.2	30′	4356.9	1468.4	30′	5204.4	2010.8
40′	3626.8	1051.4	40′	4370.1	1476.4	40′	5219.7	2021.1
50′	3638.5	1057.7	50′	4383.3	1484.4	50′	5234.9	2031.4
65°	3650.2	1063.9	**75°**	4396.5	1492.4	**85°**	5250.3	2041.7
10′	3661.9	1070.2	10′	4409.8	1500.5	10′	5265.6	2052.1
20′	3673.7	1076.6	20′	4423.1	1508.6	20′	5281.0	2062.5
30′	3685.4	1082.9	30′	4436.4	1516.7	30′	5296.4	2073.0
40′	3697.2	1089.3	40′	4449.7	1524.9	40′	5311.9	2083.5
50′	3709.0	1095.7	50′	4463.1	1533.1	50′	5327.4	2094.1
66°	3720.9	1102.2	**76°**	4476.5	1541.4	**86°**	5343.0	2104.7
10′	3732.7	1108.6	10′	4489.9	1549.7	10′	5358.6	2115.3
20′	3744.6	1115.1	20′	4503.4	1558.0	20′	5374.2	2126.0
30′	3756.5	1121.7	30′	4516.9	1566.3	30′	5389.9	2136.7
40′	3768.5	1128.2	40′	4530.4	1574.7	40′	5405.6	2147.5
50′	3780.4	1134.8	50′	4544.0	1583.1	50′	5421.4	2158.4
67°	3792.4	1141.4	**77°**	4557.6	1591.6	**87°**	5437.2	2169.2
10′	3804.4	1148.0	10′	4571.2	1600.1	10′	5453.1	2180.2
20′	3816.4	1154.7	20′	4584.8	1608.6	20′	5469.0	2191.1
30′	3828.4	1161.3	30′	4598.5	1617.1	30′	5484.9	2202.2
40′	3840.5	1168.1	40′	4612.2	1625.7	40′	5500.9	2213.2
50′	3852.6	1174.8	50′	4626.0	1634.4	50′	5517.0	2224.3
68°	3864.7	1181.6	**78°**	4639.8	1643.0	**88°**	5533.1	2235.5
10′	3876.8	1188.4	10′	4653.6	1651.7	10′	5549.2	2246.7
20′	3889.0	1195.2	20′	4667.4	1660.5	20′	5565.4	2258.0
30′	3901.2	1202.0	30′	4681.3	1669.2	30′	5581.6	2269.3
40′	3913.4	1208.9	40′	4695.2	1678.1	40′	5597.8	2280.6
50′	3925.6	1215.8	50′	4709.2	1686.9	50′	5614.2	2292.0
69°	3937.9	1222.7	**79°**	4723.2	1695.8	**89°**	5630.5	2303.5
10′	3950.2	1229.7	10′	4737.2	1704.7	10′	5646.9	2315.0
20′	3962.5	1236.7	20′	4751.2	1713.7	20′	5663.4	2326.6
30′	3974.8	1243.7	30′	4765.3	1722.7	30′	5679.9	2338.2
40′	3987.2	1250.8	40′	4779.4	1731.7	40′	5696.4	2349.8
50′	3999.5	1257.9	50′	4793.6	1740.8	50′	5713.0	2361.5
70°	4011.9	1265.0	**80°**	4807.7	1749.9	**90°**	5729.7	2373.3
10′	4024.4	1272.1	10′	4822.0	1759.0	10′	5746.3	2385.1
20′	4036.8	1279.3	20′	4836.2	1768.2	20′	5763.1	2397.0
30′	4049.3	1286.5	30′	4850.5	1777.4	30′	5779.9	2408.9
40′	4061.8	1293.6	40′	4864.8	1786.7	40′	5796.7	2420.9
50′	4074.4	1300.9	50′	4879.2	1796.0	50′	5813.6	2432.9

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

TABLE II. Tangents and Externals to a 1° Curve

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
91°	5830.5	2444.9	**101°**	6950.6	3278.1	**111°**	8336.7	4386.1
10′	5847.5	2457.1	10′	6971.3	3294.1	10′	8362.7	4407.6
20′	5864.6	2469.3	20′	6992.0	3310.1	20′	8388.9	4429.2
30′	5881.7	2481.5	30′	7012.7	3326.1	30′	8415.1	4450.9
40′	5898.8	2493.8	40′	7033.6	3342.3	40′	8441.5	4472.7
50′	5916.0	2506.1	50′	7054.5	3358.5	50′	8468.0	4494.6
92°	5933.2	2518.5	**102°**	7075.5	3374.9	**112°**	8494.6	4516.6
10′	5950.5	2531.0	10′	7096.6	3391.2	10′	8521.3	4538.8
20′	5967.9	2543.5	20′	7117.8	3407.7	20′	8548.1	4561.1
30′	5985.3	2556.0	30′	7139.0	3424.3	30′	8575.0	4583.4
40′	6002.7	2568.6	40′	7160.3	3440.9	40′	8602.1	4606.0
50′	6020.2	2581.3	50′	7181.7	3457.6	50′	8629.3	4628.6
93°	6037.8	2594.0	**103°**	7203.2	3474.4	**113°**	8656.6	4651.3
10′	6055.4	2606.8	10′	7224.7	3491.3	10′	8684.0	4674.2
20′	6073.1	2619.7	20′	7246.3	3508.2	20′	8711.5	4697.2
30′	6090.8	2632.6	30′	7268.0	3525.2	30′	8739.2	4720.3
40′	6108.6	2645.5	40′	7289.8	3542.4	40′	8767.0	4743.6
50′	6126.4	2658.5	50′	7311.7	3559.6	50′	8794.9	4766.9
94°	6144.3	2671.6	**104°**	7333.6	3576.8	**114°**	8822.9	4790.4
10′	6162.2	2684.7	10′	7355.6	3594.2	10′	8851.0	4814.1
20′	6180.2	2697.9	20′	7377.8	3611.7	20′	8879.3	4837.8
30′	6198.3	2711.2	30′	7399.9	3629.2	30′	8907.7	4861.7
40′	6216.4	2724.5	40′	7422.2	3646.8	40′	8936.3	4885.7
50′	6234.6	2737.9	50′	7444.6	3664.5	50′	8965.0	4909.9
95°	6252.8	2751.3	**105°**	7467.0	3682.3	**115°**	8993.8	4934.1
10′	6271.1	2764.8	10′	7489.6	3700.2	10′	9022.7	4958.6
20′	6289.4	2778.3	20′	7512.2	3718.2	20′	9051.7	4983.1
30′	6307.9	2792.0	30′	7534.9	3736.2	30′	9080.9	5007.8
40′	6326.3	2805.6	40′	7557.7	3754.4	40′	9110.3	5032.6
50′	6344.8	2819.4	50′	7580.5	3772.6	50′	9139.8	5057.6
96°	6363.4	2833.2	**106°**	7603.5	3791.0	**116°**	9169.4	5082.7
10′	6382.1	2847.0	10′	7626.6	3809.4	10′	9199.1	5107.9
20′	6400.8	2861.0	20′	7649.7	3827.9	20′	9229.0	5133.3
30′	6419.5	2875.0	30′	7672.9	3846.5	30′	9259.0	5158.8
40′	6438.4	2889.0	40′	7696.3	3865.2	40′	9289.2	5184.5
50′	6457.3	2903.1	50′	7719.7	3884.0	50′	9319.5	5210.3
97°	6476.2	2917.3	**107°**	7743.2	3902.9	**117°**	9349.9	5236.2
10′	6495.2	2931.6	10′	7766.8	3921.9	10′	9380.5	5262.3
20′	6514.3	2945.9	20′	7790.5	3940.9	20′	9411.3	5288.6
30′	6533.4	2960.3	30′	7814.3	3960.1	30′	9442.2	5315.0
40′	6552.6	2974.7	40′	7838.1	3979.4	40′	9473.2	5341.5
50′	6571.9	2989.2	50′	7862.1	3998.7	50′	9504.4	5368.2
98°	6591.2	3003.8	**108°**	7886.2	4018.2	**118°**	9535.7	5395.1
10′	6610.6	3018.4	10′	7910.4	4037.8	10′	9567.2	5422.1
20′	6630.1	3033.1	20′	7934.6	4057.4	20′	9598.9	5449.2
30′	6649.6	3047.9	30′	7959.0	4077.2	30′	9630.7	5476.5
40′	6669.2	3062.8	40′	7983.5	4097.1	40′	9662.6	5504.0
50′	6688.8	3077.7	50′	8008.0	4117.0	50′	9694.7	5531.7
99°	6708.6	3092.7	**109°**	8032.7	4137.1	**119°**	9727.0	5559.4
10′	6728.4	3107.7	10′	8057.4	4157.3	10′	9759.4	5587.4
20′	6748.2	3122.9	20′	8082.3	4177.5	20′	9792.0	5615.5
30′	6768.1	3138.1	30′	8107.3	4197.9	30′	9824.8	5643.8
40′	6788.1	3153.3	40′	8132.3	4218.4	40′	9857.7	5672.3
50′	6808.2	3168.7	50′	8157.5	4239.0	50′	9890.8	5700.9
100°	6828.3	3184.1	**110°**	8182.8	4259.7	**120°**	9924.0	5729.7
10′	6848.5	3199.6	10′	8208.2	4280.5	10′	9957.5	5758.6
20′	6868.8	3215.1	20′	8233.7	4301.4	20′	9991.0	5787.7
30′	6889.2	3230.8	30′	8259.3	4322.4	30′	10025.0	5817.0
40′	6909.6	3246.5	40′	8285.0	4343.6	40′	10059.0	5846.5
50′	6930.1	3262.3	50′	8310.8	4364.8	50′	10093.0	5876.1

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

TABLE III. CORRECTIONS FOR USE WITH TABLE II

For Tangents Add
Degree of Curve

Angle	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46
15°	.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.53	.58	.63	.68
20°	.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90
25°	.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14
30°	.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39
35°	.11	.22	.34	.47	.58	.69	.70	.81	.92	1.04	1.29	1.42	1.54	1.66
40°	.13	.26	.40	.53	.67	.80	.93	1.06	1.20	1.34	1.49	1.64	1.79	1.94
45°	.15	.30	.44	.60	.76	.91	1.06	1.21	1.37	1.52	1.70	1.87	2.04	2.21
50°	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.54	1.72	1.91	2.10	2.29	2.48
55°	.19	.38	.57	.76	.95	1.14	1.32	1.52	1.72	1.92	2.14	2.35	2.56	2.77
60°	.21	.42	.63	.84	1.05	1.27	1.49	1.71	1.94	2.17	2.38	2.60	2.83	3.07
65°	.23	.46	.69	.93	1.16	1.40	1.64	1.88	2.13	2.38	2.63	2.88	3.13	3.39
70°	.25	.51	.76	1.02	1.28	1.54	1.80	2.06	2.33	2.60	2.88	3.16	3.44	3.72
75°	.27	.56	.83	1.12	1.40	1.69	1.98	2.27	2.57	2.87	3.16	3.47	3.78	4.09
80°	.30	.61	.91	1.22	1.53	1.84	2.15	2.46	2.78	3.10	3.44	3.78	4.12	4.46
85°	.33	.66	1.00	1.33	1.68	2.02	2.36	2.70	3.05	3.40	3.77	4.14	4.55	4.89
90°	.36	.72	1.09	1.45	1.83	2.20	2.57	2.94	3.32	3.70	4.10	4.50	4.91	5.32
95°	.39	.79	1.19	1.55	2.00	2.40	2.80	3.20	3.61	4.02	4.49	4.98	5.38	5.83
100°	.43	.86	1.30	1.74	2.18	2.62	3.06	3.50	3.95	4.40	4.88	5.37	5.85	6.34

For Externals Add
Degree of Curve

Angle	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.001	.003	.004	.006	.007	.008	.009	.011	.012	.014	.015	.017	.018	.020
15°	.003	.007	.010	.014	.018	.023	.027	.029	.032	.035	.039	.043	.047	.051
20°	.006	.011	.017	.022	.028	.034	.038	.045	.051	.057	.063	.070	.076	.083
25°	.009	.018	.027	.036	.046	.056	.065	.074	.083	.093	.106	.120	.127	.135
30°	.013	.025	.038	.051	.065	.078	.090	.103	.116	.129	.149	.170	.179	.188
35°	.018	.035	.054	.072	.086	.109	.131	.153	.175	.197	.213	.230	.247	.264
40°	.023	.046	.070	.093	.117	.141	.172	.203	.234	.265	.277	.290	.315	.341
45°	.030	.060	.093	.119	.153	.184	.216	.254	.289	.325	.351	.378	.411	.445
50°	.037	.075	.116	.151	.189	.227	.266	.305	.345	.384	.425	.467	.508	.550
55°	.046	.093	.142	.188	.236	.283	.332	.381	.420	.479	.530	.582	.641	.700
60°	.056	.112	.168	.225	.283	.340	.398	.457	.516	.575	.636	.697	.774	.851
65°	.067	.135	.204	.273	.343	.412	.483	.554	.625	.697	.711	.845	.922	1.01
70°	.080	.159	.240	.321	.403	.485	.568	.652	.735	.819	.906	.994	1.08	1.17
75°	.095	.182	.286	.383	.480	.578	.678	.777	.877	.977	1.07	1.18	1.29	1.39
80°	.110	.220	.332	.445	.558	.671	.787	.903	1.02	1.13	1.25	1.38	1.50	1.62
85°	.128	.259	.391	.524	.657	.790	.926	1.06	1.20	1.34	1.47	1.62	1.76	1.91
90°	.149	.299	.450	.603	.756	.910	1.07	1.22	1.38	1.54	1.70	1.87	2.03	2.20
95°	.174	.350	.522	.706	.985	1.06	1.25	1.43	1.62	1.80	1.99	2.18	2.38	2.58
100°	.200	.401	.604	.809	1.01	1.22	1.43	1.64	1.85	2.06	2.28	2.50	2.73	2.96

TABLE IV

Radii, Ordinates and Deflections.

Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot
0° 10′	34377.	.036	.145	.291	0.05′	7°	819.0	1.528	6.105	12.21	2.10′
20	17189.	.073	.291	.582	0.10	20′	781.8	1.600	6.395	12.79	2.20
30	11459.	.109	.436	.873	0.15	30	764.5	1.637	6.540	13.08	2.25
40	8594.4	.145	.582	1.164	0.20	40	747.9	1.673	6.685	13.37	2.30
50	6875.5	.182	.727	1.454	0.25	8	716.8	1.746	6.976	13.95	2.40
1	5729.6	.218	.873	1.745	0.30	20	688.2	1.819	7.266	14.53	2.50
10	4911.2	.255	1.018	2.036	0.35	30	674.7	1.855	7.411	14.82	2.55
20	4297.3	.291	1.164	2.327	0.40	40	661.7	1.892	7.556	15.11	2.60
30	3819.8	.327	1.309	2.618	0.45	9	637.3	1.965	7.846	15.69	2.70
40	3437.9	.364	1.454	2.909	0.50	20	614.6	2.037	8.136	16.27	2.80
50	3125.4	.400	1.600	3.200	0.55	30	603.8	2.074	8.281	16.56	2.85
2	2864.9	.436	1.745	3.490	0.60	40	593.4	2.110	8.426	16.85	2.90
10	2644.6	.473	1.891	3.781	0.65	10	573.7	2.183	8.716	17.43	3.00
20	2455.7	.509	2.036	4.072	0.70	30	546.4	2.292	9.150	18.30	3.15
30	2292.0	.545	2.181	4.363	0.75	11	521.7	2.402	9.585	19.16	3.30
40	2148.8	.582	2.327	4.654	0.80	30	499.1	2.511	10.02	20.04	3.45
50	2022.4	.618	2.472	4.945	0.85	12	478.3	2.620	10.45	20.91	3.60
3	1910.1	.655	2.618	5.235	0.90	30	459.3	2.730	10.89	21.77	3.75
10	1809.6	.691	2.763	5.526	0.95	13	441.7	2.839	11.32	22.64	3.90
20	1719.1	.727	2.908	5.817	1.00	30	425.4	2.949	11.75	23.51	4.05
30	1637.3	.764	3.054	6.108	1.05	14	410.3	3.058	12.18	24.37	4.20
40	1562.9	.800	3.199	6.398	1.10	30	396.2	3.168	12.62	25.24	4.35
50	1495.0	.836	3.345	6.689	1.15	15	383.1	3.277	13.05	26.11	4.50
4	1432.7	.873	3.490	6.980	1.20	30	370.8	3.387	13.49	26.97	4.65
10	1375.4	.909	3.635	7.271	1.25	16	359.3	3.496	13.92	27.84	4.80
20	1322.5	.945	3.781	7.561	1.30	30	348.5	3.606	14.35	28.70	4.95
30	1273.6	.982	3.926	7.852	1.35	17	338.3	3.716	14.78	29.56	5.10
40	1228.1	1.018	4.071	8.143	1.40	18	319.6	3.935	15.64	31.29	5.40
50	1185.8	1.055	4.217	8.433	1.45	19	302.9	4.155	16.51	33.01	5.70
5	1146.3	1.091	4.362	8.724	1.50	20	287.9	4.374	17.37	34.73	6.00
10	1109.3	1.127	4.507	9.014	1.55	21	274.4	4.594	18.22	36.44	6.30
20	1074.7	1.164	4.653	9.305	1.60	22	262.0	4.814	19.08	38.16	6.60
30	1042.1	1.200	4.798	9.596	1.65	23	250.8	5.035	19.94	39.87	6.90
40	1011.5	1.237	4.943	9.886	1.70	24	240.5	5.255	20.79	41.58	7.20
50	982.6	1.273	5.088	10.18	1.75	25	231.0	5.476	21.64	43.28	7.50
6	955.4	1.309	5.234	10.47	1.80	26	222.3	5.697	22.50	44.99	7.80
10	929.6	1.346	5.379	10.76	1.85	27	214.2	5.918	23.35	46.69	8.10
20	905.1	1.382	5.524	11.05	1.90	28	206.7	6.139	24.19	48.38	8.40
30	881.9	1.418	5.669	11.34	1.95	29	199.7	6.360	25.04	50.07	8.70
40	859.9	1.455	5.814	11.63	2.00	30	193.2	6.583	25.88	51.76	9.00

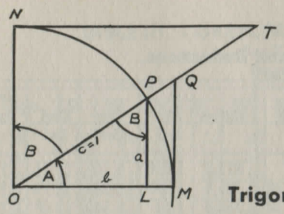


TABLE V

Trigonometric Formulae

$\angle A = \angle MOP \qquad \angle B = \angle PON = \angle OPL$

$R = OP = c = 1$

$$\sin A = \frac{a}{c} = \frac{a}{1} = a = \cos B = LP$$

$$\cos A = \frac{b}{c} = \frac{b}{1} = b = \sin B = OL$$

$$\tan A = \frac{a}{b} = \frac{MQ}{OM} = \frac{MQ}{1} = MQ = \cot B = MQ$$

$$\cot A = \frac{NT}{ON} = \frac{NT}{1} = NT = \tan B = NT$$

$$\sec A = \frac{OQ}{OM} = \frac{OQ}{1} = OQ = \csc B = OQ$$

$$\csc A = \frac{OT}{ON} = \frac{OT}{1} = OT = \sec B = OT$$

$$\text{vers } A = \frac{LM}{OP} = LM = \text{covers } B$$

$$\text{covers } A = \frac{OP - LP}{OP} = OP - LP = \text{vers } B$$

$$\text{exsec } A = PQ = \text{coexsec } B$$

$$\text{coexsec } A = PT = \text{exsec } B$$

$$\sin \tfrac{1}{2} A = \sqrt{\frac{1 - \cos A}{2}} \qquad \cos \tfrac{1}{2} A = \sqrt{\frac{1 + \cos A}{2}}$$

$$\sin 2A = 2 \sin A \cos A \qquad \cos 2A = \cos^2 A - \sin^2 A$$

Law of Sines $\dfrac{\sin A}{a} = \dfrac{\sin B}{b} = \dfrac{\sin C}{c}$

Law of Cosines $c^2 = a^2 + b^2 - 2ab \cos C$

Law of Tangents $\dfrac{a+b}{a-b} = \dfrac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)}$

In any triangle:

Given a, b, C; to find c, B, A.

Use Law of Sines.

Given A, B, c; to find a, b, C.

Use Law of Sines.

Given a, b, c; to find A, B, C.

Let $\dfrac{a+b+c}{2} = s$: $\sqrt{\dfrac{(s-a)(s-b)(s-c)}{s}} = r$

Trigonometric Formulae (continued)

$$\cos \tfrac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}} \qquad \tan \tfrac{1}{2} B = \frac{r}{s-b}$$

$$\tan \tfrac{1}{2} A = \frac{r}{s-a} \qquad \tan \tfrac{1}{2} C = \frac{r}{s-c}$$

Area of a triangle: Area $= \frac{1}{2} ab \sin C = \sqrt{s(s-a)(s-b)(s-c)}$

Prismoidal Formula

$$\text{Vol.} = \frac{h}{6}(B + b + 4M)$$

h = altitude; b, B = bases; M = midsection

TABLE VI

Minutes in Decimals of a Degree.

0′ 30″	.00833	10′ 30″	.17500	20′ 30″	.34167	30′ 30″	.50833	40′ 30″	.67500	50′ 30″	.84167
1 00	.01667	11 00	.18333	21 00	.35000	31 00	.51667	41 00	.68333	51 00	.85000
30	.02500	30	.19167	30	.35833	30	.52500	30	.69167	30	.85833
2 00	.03333	12 00	.20000	22 00	.36667	32 00	.53333	42 00	.70000	52 00	.86667
30	.04167	30	.20833	30	.37500	30	.54167	30	.70833	30	.87500
3 00	.05000	13 00	.21667	23 00	.38333	33 00	.55000	43 00	.71667	53 00	.88333
30	.05833	30	.22500	30	.39167	30	.55833	30	.72500	30	.89167
4 00	.06667	14 00	.23333	24 00	.40000	34 00	.56667	44 00	.73333	54 00	.90000
30	.07500	30	.24167	30	.40833	30	.57500	30	.74167	30	.90833
5 00	.08333	15 00	.25000	25 00	.41667	35 00	.58333	45 00	.75000	55 00	.91667
30	.09167	30	.25833	30	.42500	30	.59167	30	.75833	30	.92500
6 00	.10000	16 00	.26667	26 00	.43333	36 00	.60000	46 00	.76667	56 00	.93333
30	.10833	30	.27500	30	.44167	30	.60833	30	.77500	30	.94167
7 00	.11667	17 00	.28333	27 00	.45000	37 00	.61667	47 00	.78333	57 00	.95000
30	.12500	30	.29167	30	.45833	30	.62500	30	.79167	30	.95833
8 00	.13333	18 00	.30000	28 00	.46667	38 00	.63333	48 00	.80000	58 00	.96667
30	.14167	30	.30833	30	.47500	30	.64167	30	.80833	30	.97500
9 00	.15000	19 00	.31667	29 00	.48333	39 00	.65000	49 00	.81667	59 00	.98333
30	.15833	30	.32500	30	.49167	30	.65833	30	.82500	30	.99167
10 00	.16667	20 00	.33333	30 00	.50000	40 00	.66667	50 00	.83333	60 00	1.00000

TABLE VII

Inches and Fractions of an Inch in Decimals of a Foot

	0	1	2	3	4	5	6	7	8	9	10	11	
1/16	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219	1/16
1/8	.0104	.0938	.1771	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271	1/8
3/16	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323	3/16
1/4	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375	1/4
5/16	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427	5/16
3/8	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479	3/8
7/16	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531	7/16
1/2	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583	1/2
9/16	.0469	.1302	.2135	.2969	.3803	.4635	.5469	.6302	.7135	.7969	.8802	.9635	9/16
5/8	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688	5/8
11/16	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740	11/16
3/4	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792	3/4
13/16	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844	13/16
7/8	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896	7/8
15/16	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948	15/16
1	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	1.000	1
	0	1	2	3	4	5	6	7	8	9	10	11	

TABLE VIII

Sines, Cosines, Tangents, Cotangents

deg.	sin 0′	tan 0′	sin 10′	tan 10′	sin 20′	tan 20′	sin 30′	tan 30′	sin 40′	tan 40′	sin 50′	tan 50′	deg.
0	0000	0000	0029	0029	0058	0058	0087	0087	0116	0116	0145	0145	89
1	175	0175	0204	0204	0233	0233	0262	262	291	291	320	320	88
2	349	349	378	378	407	407	436	437	465	466	494	495	87
3	523	524	552	553	581	582	610	612	640	641	669	670	86
4	698	699	727	729	756	758	785	787	814	816	843	864	85
5	872	875	901	904	929	934	958	963	987	992	1016	1022	84
6	1045	1051	1074	1080	1103	1110	1132	1139	1161	1169	190	198	83
7	219	228	248	257	279	287	305	317	334	346	363	376	82
8	392	405	421	435	449	465	478	495	507	524	536	554	81
9	564	584	593	614	622	644	650	673	679	703	708	733	80
10	736	763	765	793	794	823	822	853	851	883	880	914	79
11	908	944	937	974	965	2004	994	2035	2022	2065	2051	2095	78
12	2079	2126	2108	2156	2136	186	2164	217	193	247	221	278	77
13	250	309	278	339	306	370	334	401	363	432	391	462	76
14	419	493	447	524	476	555	504	586	532	617	560	648	75
15	588	679	616	711	644	742	672	773	700	805	728	836	74
16	756	867	784	899	812	931	840	962	868	994	896	3026	73
17	924	3057	952	3089	2979	3121	3007	3153	3035	3185	3062	217	72
18	3090	249	3118	281	3145	314	173	346	201	378	228	411	71
19	256	443	283	476	311	508	338	541	365	574	393	607	70
20	420	640	448	673	475	706	502	739	529	772	557	805	69
21	584	839	611	872	638	906	665	939	692	973	719	4006	68
22	746	4040	773	4074	800	4108	827	4142	854	4176	881	210	67
23	907	245	934	279	961	314	987	348	4014	383	4041	417	66
24	4067	452	4094	487	4120	522	4147	557	173	592	200	628	65
25	226	663	253	699	279	734	305	770	331	806	358	841	64
26	384	877	410	913	436	950	4462	986	488	5022	514	5059	63
27	540	5095	566	5132	592	5169	617	5206	643	243	669	280	62
28	695	317	720	354	746	392	772	430	797	467	823	505	61
29	848	543	874	581	899	619	924	658	950	696	975	735	60
30	5000	774	5025	5812	5050	851	5075	890	5100	930	5125	969	59
31	150	6009	175	6048	200	6088	225	6128	250	6168	275	6208	58
32	299	249	324	289	348	330	5373	371	398	412	422	453	57
33	446	494	471	536	495	577	519	619	544	661	568	703	56
34	592	745	616	787	640	830	664	873	688	916	712	959	55
35	736	7002	760	7046	783	7089	807	7133	831	7177	854	7221	54
36	878	265	901	310	925	355	948	400	972	445	995	490	53
37	6018	536	6041	581	6065	627	6088	673	6111	720	6134	766	52
38	157	813	180	860	202	907	225	954	248	8002	271	8050	51
39	293	8098	316	8146	338	8195	361	8243	383	292	406	342	50
40	428	391	450	441	472	491	494	541	517	591	539	642	49
41	561	693	583	744	604	796	626	847	648	899	670	952	48
42	691	9004	713	9057	734	9110	756	9163	777	9217	799	9271	47
43	820	325	841	380	862	435	884	490	905	545	926	601	46
44	947	657	967	713	988	770	7009	827	7030	884	7050	942	45
45	7071	1.0000	7092	1.0058	7112	1.0117	133	1.0176	153	1.0235	173	1.0295	44
deg.	60′ cos	60′ cot	50′ cos	50′ cot	40′ cos	40′ cot	30′ cos	30′ cot	20′ cos	20′ cot	10′ cos	10′ cot	deg.

TABLE VIII (Continued)

Sines, Cosines, Tangents, Cotangents (continued)

deg.	sin 0′	tan 0′	sin 10′	tan 10′	sin 20′	tan 20′	sin 30′	tan 30′	sin 40′	tan 40′	sin 50′	tan 50′	deg.
46	7193	1.0355	7214	1.0416	7234	1.0477	7254	1.0533	7274	1.0599	7294	1.0661	43
47	314	.0724	333	.0786	353	.0850	373	.0913	392	.0977	412	.1041	42
48	431	.1106	451	.1171	470	.1237	490	.1303	509	.1369	528	.1436	41
49	547	.1504	566	.1571	585	.1640	604	.1708	623	.1778	642	.1847	40
50	660	1.1918	7679	1.1988	7698	1.2059	7716	1.2131	7735	1.2203	7753	1.2276	39
51	771	.2349	790	.2423	808	.2497	826	.2572	844	.2647	862	.2723	38
52	880	.2799	898	.2876	916	.2954	934	.3032	951	.3111	969	.3190	37
53	986	.3270	8004	.3351	8021	.3452	8039	.3514	8056	.3597	8073	.3680	36
54	8090	.3764	107	.3848	124	.3934	141	.4019	158	.4106	175	.4193	35
55	192	.4281	208	.4370	225	.4460	241	.4550	258	.4641	274	.4733	34
56	290	.4826	307	.4919	323	.5013	339	.5108	355	.5204	371	.5301	33
57	387	.5399	403	.5497	418	.5597	434	.5697	450	.5798	465	.5900	32
58	480	.6003	496	.6107	511	.6212	526	.6319	542	.6426	557	.6534	31
59	572	.6643	587	.6753	601	.6864	616	.6977	631	.7090	646	.7205	30
60	660	1.7321	8675	1.7437	8689	1.7556	8704	1.7675	8718	1.7797	8732	1.7917	29
61	746	.8040	760	.8165	774	.8291	788	.8418	802	.8546	816	.8676	28
62	829	.8807	843	.8940	857	.9074	870	.9210	884	.9347	897	.9486	27
63	910	.9626	923	.9768	936	.9912	949	2.0057	962	2.0204	975	2.0353	26
64	988	2.0503	9001	2.0655	9013	2.0809	9026	.0965	9038	.1123	9051	.1283	25
65	9063	.1445	075	.1609	088	.1775	100	.1943	112	.2113	124	.2286	24
66	135	.2460	147	.2637	159	.2817	171	.2998	182	.3183	194	.3369	23
67	205	.3559	216	.3750	228	.3945	239	.4142	250	.4342	261	.4545	22
68	272	.4751	283	.4960	293	.5172	304	.5386	315	.5605	325	.5826	21
69	336	.6051	346	.6279	356	.6511	367	.6746	377	.6985	387	.7228	20
70	397	2.7475	9407	2.7725	9417	2.7980	9426	2.8239	9436	2.8502	9446	2.8770	19
71	455	.9042	465	.9319	474	.9600	483	.9887	492	3.0178	502	3.0475	18
72	511	3.0777	520	3.1084	528	3.1397	537	3.1716	546	.2041	555	.2371	17
73	563	.2709	572	.3052	580	.3402	588	.3759	596	.4124	605	.4495	16
74	613	.4874	621	.5261	628	.5656	636	.6059	644	.6470	652	.6891	15
75	659	.7321	667	.7760	674	.8208	681	.8657	689	.9136	696	.9617	14
76	703	4.0108	710	4.0611	717	4.1126	724	4.1653	730	4.2193	737	4.2747	13
77	744	.3315	750	.3897	757	.4494	763	.5107	769	.5736	775	.6382	12
78	781	.7046	787	.7729	793	.8430	799	.9152	805	.9894	811	5.0658	11
79	816	.1446	822	5.2257	827	5.3093	833	5.3955	838	5.4845	843	.5764	10
80	9848	5.6713	9853	5.7694	9858	5.8708	9863	5.9758	9868	6.0844	9872	6.1970	9
81	877	6.3138	881	6.4348	886	6.5606	890	6.6912	894	.8269	899	.9682	8
82	903	7.1154	907	7.2687	911	7.4287	914	7.5958	918	7.7704	922	7.9530	7
83	925	8.1443	929	8.3450	932	8.5555	936	8.7769	939	9.0098	942	9.2553	6
84	945	9.5144	948	9.7882	951	10.078	954	10.385	957	10.711	959	11.059	5
85	962	11.430	964	11.826	967	12.250	969	12.706	971	13.197	974	13.727	4
86	976	14.300	978	14.924	980	15.605	981	16.350	983	17.169	985	18.075	3
87	986	19.081	988	20.206	989	21.470	990	22.903	992	24.542	993	26.432	2
88	994	28.636	9995	31.242	9996	34.368	997	38.189	997	42.964	9998	49.104	1
89	9998	57.290	9999	68.750	9999	85.940	9999	114.58	1.000	171.88	1.000	343.77	0
deg.	60′ cos	60′ cot	50′ cos	50′ cot	40′ cos	40′ cot	30′ cos	30′ cot	20′ cos	20′ cot	10′ cos	10′ cot	deg.

TABLES FOR EXCAVATIONS AND EMBANKMENTS.

Distances from Center of Roadway for Cross-Sectioning.
Roadway 18 Feet Wide. Side Slopes 1 to 1.
For Single Track Excavation.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	0
1	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	1
2	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	2
3	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	3
4	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	4
5	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	5
6	15.0	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	6
7	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	7
8	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	8
9	18.0	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	9
10	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	10
11	20.0	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	11
12	21.0	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9	12
13	22.0	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	13
14	23.0	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	14
15	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	15
16	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	16
17	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	17
18	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	18
19	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	19
20	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	20
21	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	21
22	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.8	31.9	22
23	32.0	32.1	32.2	32.3	32.4	32.5	32.6	32.7	32.8	32.9	23
24	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8	33.9	24
25	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	25
26	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	26
27	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.7	36.8	36.9	27
28	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7	37.8	37.9	28
29	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8	38.9	29
30	39.0	39.1	39.2	39.3	39.4	39.5	39.6	39.7	39.8	39.9	30
31	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.7	40.8	40.9	31
32	41.0	41.1	41.2	41.3	41.4	41.5	41.6	41.7	41.8	41.9	32
33	42.0	42.1	42.2	42.3	42.4	42.5	42.6	42.7	42.8	42.9	33
34	43.0	43.1	43.2	43.3	43.4	43.5	43.6	43.7	43.8	43.9	34
35	44.0	44.1	44.2	44.3	44.4	44.5	44.6	44.7	44.8	44.9	35
36	45.0	45.1	45.2	45.3	45.4	45.5	45.6	45.7	45.8	45.9	36

TABLES FOR EXCAVATIONS AND EMBANKMENTS (Continued)

Distances from Center of Roadway for Cross-Sectioning.
Roadway 14 Feet Wide. Side Slopes 1½ to 1.
For Single Track Embankment.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	7.0	7.2	7.3	7.5	7.6	7.8	7.9	8.1	8.2	8.4	0
1	8.5	8.7	8.8	9.0	9.1	9.3	9.4	9.6	9.7	9.9	1
2	10.0	10.2	10.3	10.5	10.6	10.8	10.9	11.1	11.2	11.4	2
3	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9	3
4	13.0	13.2	13.3	13.5	13.6	13.8	13.9	14.1	14.2	14.4	4
5	14.5	14.7	14.8	15.0	15.1	15.3	15.4	15.6	15.7	15.9	5
6	16.0	16.2	16.3	16.5	16.6	16.8	16.9	17.1	17.2	17.4	6
7	17.5	17.7	17.8	18.0	18.1	18.3	18.4	18.6	18.7	18.9	7
8	19.0	19.2	19.3	19.5	19.6	19.8	19.9	20.1	20.2	20.4	8
9	20.5	20.7	20.8	21.0	21.1	21.3	21.4	21.6	21.7	21.9	9
10	22.0	22.2	22.3	22.5	22.6	22.8	22.9	23.1	23.2	23.4	10
11	23.5	23.7	23.8	24.0	24.1	24.3	24.4	24.6	24.7	24.9	11
12	25.0	25.2	25.3	25.5	25.6	25.8	25.9	26.1	26.2	26.4	12
13	26.5	26.7	26.8	27.0	27.1	27.3	27.4	27.6	27.7	27.9	13
14	28.0	28.2	28.3	28.5	28.6	28.8	28.9	29.1	29.2	29.4	14
15	29.5	29.7	29.8	30.0	30.1	30.3	30.4	30.6	30.7	30.9	15
16	31.0	31.2	31.3	31.5	31.6	31.8	31.9	32.1	32.2	32.4	16
17	32.5	32.7	32.8	33.0	33.1	33.3	33.4	33.6	33.7	33.9	17
18	34.0	34.2	34.3	34.5	34.6	34.8	34.9	35.1	35.2	35.4	18
19	35.5	35.7	35.8	36.0	36.1	36.3	36.4	36.6	36.7	36.9	19
20	37.0	37.2	37.3	37.5	37.6	37.8	37.9	38.1	38.2	38.4	20
21	38.5	38.7	38.8	39.0	39.1	39.3	39.4	39.6	39.7	39.9	21
22	40.0	40.2	40.3	40.5	40.6	40.8	40.9	41.1	41.2	41.4	22
23	41.5	41.7	41.8	42.0	42.1	42.3	42.4	42.6	42.7	42.9	23
24	43.0	43.2	43.3	43.5	43.6	43.8	43.9	44.1	44.2	44.4	24
25	44.5	44.7	44.8	45.0	45.1	45.3	45.4	45.6	45.7	45.9	25
26	46.0	46.2	46.3	46.5	46.6	46.8	46.9	47.1	47.2	47.4	26
27	47.5	47.7	47.8	48.0	48.1	48.3	48.4	48.6	48.7	48.9	27
28	49.0	49.2	49.3	49.5	49.6	49.8	49.9	50.1	50.2	50.4	28
29	50.5	50.7	50.8	51.0	51.1	51.3	51.4	51.6	51.7	51.9	29
30	52.0	52.2	52.3	52.5	52.6	52.8	52.9	53.1	53.2	53.4	30
31	53.5	53.7	53.8	54.0	54.1	54.3	54.4	54.6	54.7	54.9	31
32	55.0	55.2	55.3	55.5	55.6	55.8	55.9	56.1	56.2	56.4	32
33	56.5	56.7	56.8	57.0	57.1	57.3	57.4	57.6	57.7	57.9	33
34	58.0	58.2	58.3	58.5	58.6	58.8	58.9	59.1	59.2	59.4	34
35	59.5	59.7	59.8	60.0	60.1	60.3	60.4	60.6	60.7	60.9	35
36	61.0	61.2	61.3	61.5	61.6	61.8	61.9	62.1	62.2	62.4	36

50.53 } 69°
50.35 }
.200 .195 .111

1.51 N

.125
1.121

1.495 s .215

3.855 ingwl

	929.33
	915
	14.33

911.703
745
919.355 HI
4.37
914985 Top footer

	929.33
	7.86
	937.19
	3.63
	933.56
	915.
	18.56

919.355
747
911.885
645
914365
543
91253

above 18-6 3/4 =
17-6 3/4