

White Bear Road
23-52 - "7"

ENGINEERS'
FIELD BOOK
No. 10403

EUGENE DIETZGEN CO.

DRAWING MATERIALS, MATHEMATICAL and
SURVEYING INSTRUMENTS

Chicago New York San Francisco New Orleans Pittsburg Toronto

Distances from Center of Roadway for Cross-Sectioning
Roadway 16 feet wide. Side Slopes 1 on 1.
For Single Track Embankment.

H	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	H
0	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	0
1	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	1
2	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	2
3	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	3
4	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	4
5	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	5
6	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	6
7	15.0	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	7
8	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	8
9	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	9
10	18.0	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	10
11	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	11
12	20.0	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	12
13	21.0	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9	13
14	22.0	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	14
15	23.0	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	15
16	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	16
17	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	17
18	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	18
19	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	19
20	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	20
21	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	21
22	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	22
23	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.8	31.9	23
24	32.0	32.1	32.2	32.3	32.4	32.5	32.6	32.7	32.8	32.9	24
25	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8	33.9	25
26	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	26
27	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	27
28	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.7	36.8	36.9	28
29	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7	37.8	37.9	29
30	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8	38.9	30
31	39.0	39.1	39.2	39.3	39.4	39.5	39.6	39.7	39.8	39.9	31
32	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.7	40.8	40.9	32
33	41.0	41.1	41.2	41.3	41.4	41.5	41.6	41.7	41.8	41.9	33
34	42.0	42.1	42.2	42.3	42.4	42.5	42.6	42.7	42.8	42.9	34
35	43.0	43.1	43.2	43.3	43.4	43.5	43.6	43.7	43.8	43.9	35
36	44.0	44.1	44.2	44.3	44.4	44.5	44.6	44.7	44.8	44.9	36
37	45.0	45.1	45.2	45.3	45.4	45.5	45.6	45.7	45.8	45.9	37
38	46.0	46.1	46.2	46.3	46.4	46.5	46.6	46.7	46.8	46.9	38
39	47.0	47.1	47.2	47.3	47.4	47.5	47.6	47.7	47.8	47.9	39
40	48.0	48.1	48.2	48.3	48.4	48.5	48.6	48.7	48.8	48.9	40

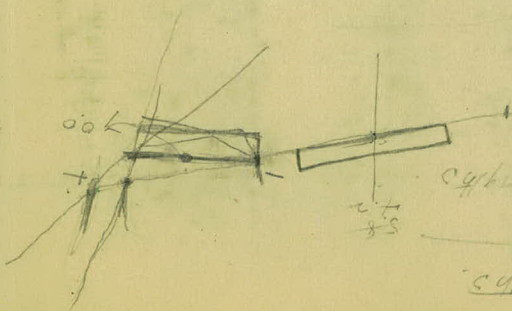
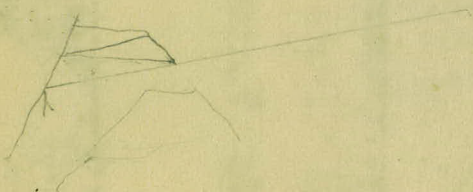
Example—If point is 22.6 ft. above grade, how far should it be from center line to be a slope stake point? Ans. from Table 30.6. For same slopes but other widths of roadbed, correct above figures by one-half difference in width of roadbed; thus in example above, for 20 ft. roadbed distance will be $30.6 + (20 - 16) \times 2$ or 2 ft. added to $30.6 = 32.6$. For slopes of 1 on $1\frac{1}{2}$ see inside of back cover.

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Silver Lake # 70

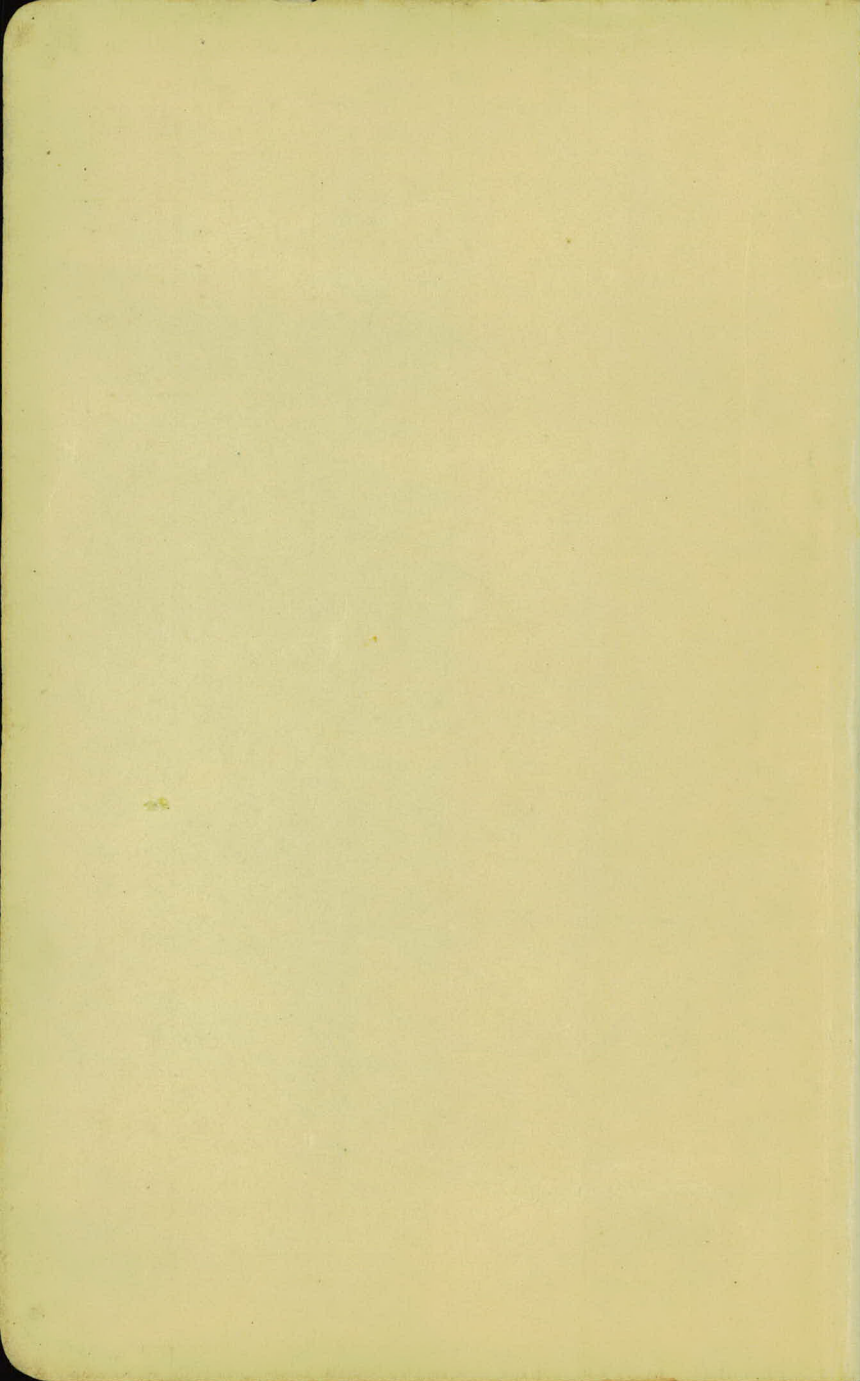
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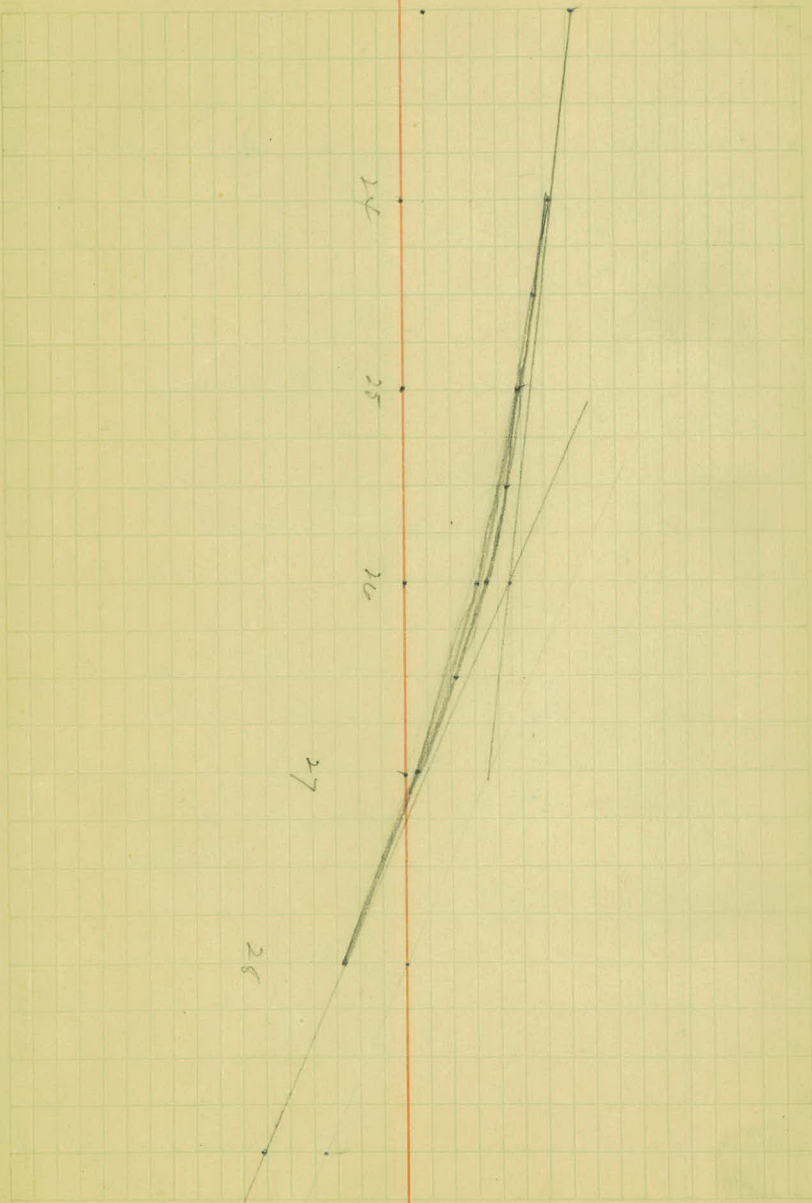
6660



2000 - 7500 lbs

2000 - 3500 lbs





5-24-23

Job (23-52)
Old White Bear Road.

Station	+	H.I.	-	Plan. Elevation	Check Elevation
B.M.	3.97	250.76		(246.79)	
T.P.	9.15	259.38	0.53	250.23	
T.P.	8.96	268.17	0.07	259.31	
B.M.			4.25	(263.92)	
T.P.	9.61	277.16	0.62	267.55	
T.P.	9.42	286.10	0.48	276.68	
B.M.			2.76	(283.34)	
T.P.	2.30	284.17	4.23	281.87	
T.P.	3.72	280.26	7.63	276.54	
B.M.			0.82	(279.52)	279.44
T.P.	0.49	268.64	12.11	248.15	
T.P.	0.97	257.07	12.54	256.10	
B.M.			4.39	(252.68)	
T.P.	0.87	246.98	10.96	246.11	
T.P.	0.51	234.85	12.64	234.34	
T.P.	0.65	222.74	12.76	222.09	
B.M.			7.40	(215.31)	215.34
T.P.	4.50	218.82	8.42	214.32	
T.P.	10.62	226.79	2.65	216.17	
T.P.	5.61	230.57	1.83	224.96	
B.M.			3.12	(227.43)	227.45

~~N.E. Cor. Co. Rd. "A" R.R. spike in E.P.~~

On. Spike in 36" Poplar Rt. About Sta 10+00

Nail in T.P. Left About Sta 17+50

S.W. Cor. Int. Co Rd. A²

R.R. spike in T.P. Left About Sta. 32+50

Nail in T.P. Left Sta. 42+15

Nail in T.P. S.W. Cor. Int. Co Rd. "B"

Station	+	H.I.	-	Plan. Elev.	check Elev
B.M. T.P.	9.05	236.50			227.45
T.P.	3.34	234.66	5.18	231.32	
B.M.			4.69	229.96	224.47
T.P.	5.36	234.19	5.83	229.83	
T.P.	4.31	234.26	4.24	229.45	
B.M.			4.14	230.12	230.12
T.P.	10.56	240.67	4.15	230.11	
T.P.	10.67	250.86	0.28	240.19	
B.M.			2.17	248.64	89
T.P.	4.33	252.15	3.04	247.82	
B.M.			3.56	248.57	248.51
T.P.	0.14	246.26	6.03	246.12	
B.M.			8.86	237.34	237.40
T.P.	4.70	239.37	11.59	234.67	
T.P.	3.51	235.19	7.70	231.67	
B.M.			5.35	227.26	227.83
B.M.			2.63	232.55	89
T.P.	3.43	234.33	4.28	230.90	
T.P.	7.72	237.67	4.38	229.95	
B.M.			4.91	232.66	232.76
T.P.	4.03	237.89	3.81	238.86	
T.P.	6.99	239.37	5.51	232.38	
B.M.			4.82	234.55	89
T.P.	7.93	244.67	2.63	236.74	
B.M.			4.97	239.61	239.70

R.R. spike in T.P. left Sta 60+75

R.R. spike in T.P. Right Sta. 67+33

R.R. spike in T.P. S.E. Cor Int. Castle Ave.

R.R. spike in T.P. L Sta 80+75

R.R. spike in T.P. Rt Sta 87+40

R.R. spike in T.P. Rt. Sta 97+75 (Pole leaning. 13.M. Abandoned)
Set New B.M.

R.R. spike in T.P. Rt. Sta. 99+00

R.R. spike in T.P. S.W. Cor Int. Co. Rd. "C"

R.R. spike in T.P. left Sta. 120+35

R.R. spike in T.P. left Sta. 127+35

Station.	+	H.I.	-	Plan. Elev.	Check Elev.
		244.67			
T.P.	8.97	249.63	4.01	240.66	
T.P.	4.21	248.82	5.02	244.61	
B.M.			2.20	246.48	246.59
T.P.	5.91	252.76	1.97	246.85	
T.P.	7.72	257.79	2.69	250.07	
B.M.				255.49	255.60
T.P.	5.16	260.78		255.60	
^{5/31} T.P.	5.14	260.82	5.10	255.68	
B.M.			1.20	259.50	259.62
T.P.	4.80	263.59	2.03	259.79	
T.P.	3.39	257.32	9.66	253.93	
T.P.	4.20	255.90	5.62	251.90	
B.M.			4.34	251.42	251.56
T.P.	5.71	257.16	4.45	251.45	
T.P.	1.09	249.89	9.16	249.00	
B.M.			7.65	241.19	^{5/31}
T.P.	5.71	246.48	8.32	240.77	
B.M.			6.83	239.44	239.65
T.P.	7.84	252.54	1.78	244.90	
T.P.	6.28	256.05	2.77	249.77	
T.P.	2.45	252.36	6.14	249.91	
B.M.			0.90	251.27	251.46
T.P.	6.79	253.21	5.92	246.44	

R.R. Spike on T.P. Rt. Sta. 139+25

R.R. Spike on T.P. Rt. Sta. 151+00

R.R. Spike in T.P. Rt. Sta. 158+40

Sp. in T.P. Rt. Sta. 169+50

Sp. in Tree Rt. Sta. (179+50)

R.R. Spk. in T.P. Rt. Sta. 183+75

Sp. in T.P. Rt. Sta. 197+60

Station	+	H. I	-	Plan. Elev.	check Elev.
		253.21			
T.P.	9.78	261.57	1.62	251.59	
B.M.			2.90	256.47	256.47
T.P.	4.29	264.23	1.43	259.94	
T.P.	3.10	259.39	7.94	256.29	
B.M.			6.31	257.92	253.08
T.P.	4.26	257.34		253.08	
B.M.			7.40	249.89	249.94
T.P.	8.70	258.64		249.94	
T.P.	6.05	261.95	2.74	255.90	
B.M.			4.06	257.89	257.89
T.P.	6.83	264.80	3.98	257.97	
T.P.	4.00	264.15	4.65	260.15	
B.M.			2.23	261.76	261.92
T.P.	2.77	261.28	5.64	258.51	
B.M.			4.66	256.62	256.62
T.P.	3.00	255.55	8.73	252.55	
T.P.	5.21	257.43	3.53	252.02	
B.M.			2.67	254.60	254.76
T.P.	0.76	248.94	9.25	248.18	
B.M.			5.59	243.20	243.35
T.P.	6.06	249.41		243.35	
T.P.	6.34	251.50	4.25	245.14	
B.M.			2.81	248.55	248.67

261.72
2.75
264.47
6.28
258.39

Spike in T.P. Right Sta { Apex }
210+50

Spike in T.P. Rt. Sta. 220+15

Spike in T.P. Sta 224+45 h.cft.

Nail in T.P. Rt. Sta { Apex }
233+00

B.M. Nail in T.P. Right Sta. 240+00

Nail in T.P. Right Sta. 247+00

Nail in T.P. Right 255+45

~~A~~ Spike in T.P. Right Sta. 264+00

B.M. # Spike in T.P. Right Sta. 274+00

Station	+	H.I.	-	Plan. Elev.	Check Elev.
		251.50			
T.P.	5.36	252.82	4.04	247.46	
T.P.	4.81	252.32	5.31	247.51	
B.M.			5.85	246.62	246.77
T.P.	6.17	253.59	4.90	247.42	
B.M.			2.81	250.64	250.78
T.P.	2.61	251.35	4.82	248.77	
B.M.			9.45	241.77	241.73
B.M.				248.05	
B.M.				242.38	4/5
B.M.				278.15	4/5
B.M.				260.36	4/6
B.M.				213.60	4/5
B.M.				222.31	4/6
B.M.				230.73	4/11
B.M.				230.66	4/11
B.M.				250.66	
B.M.				242.42	4/22
B.M.				235.60	4/22
B.M.				230.20	4/22
B.M.				233.77	4/22
B.M.				233.15	4/22 253.15
B.M.				256.93	257.00

227.45
5.6
273.05
2.33
230.73

Top Mont - 254.67
 $\Delta 0^{\circ} 20' R.$

Nail in T.P. bett sta 280+65


Spike in T.P. bett sta 287+35

Top Hyd. bett sta 0-33

Nail in Fence Post. Rt Sta. 17+50

So. End. Wall of Penitentiary Sta 24+43 - 15' R

Spike in T.P. Rt. Sta 31+20

On West Side Head Wall & Culvert Sta. 40+36 

Spike 10" Oak. bett Sta 49+75

Spike in T.P. 50' Rt. Sta. 53+10

Nail in Tree Rt. Sta. 67+60

R.R. Sp. in 4" Stump bett Sta 79+03 (Top Stamp)

Spike in 12" Oak Rt. Sta 84+60

Nail in 10" Oak bett Sta 90+05

Spike in T.P. bett Sta 95+90

Nail in Stump Rt Sta 99+15

Spike in T.P. Rt Sta 109+50

N.W. Cor. Lower. St. School House Co. Rd. "E."

B.M.	232.77	
B.M.	245.33	
T.D.	240.04	
B.M.	239.71	
B.M.	245.43	
T.D.	240.02	
B.M.	248.31	
B.M.	255.20	7/21
B.M.	254.16	7/3
B.M.	252.23	
B.M.	240.17	
B.M.	249.85	
B.M.	247.64	
B.M.	259.61	
B.M.	258.96	
B.M.	158.39	7/3
B.M.	259.70	
B.M.	250.05	7/12
B.M.	245.44	7/9
B.M.	246.87	
B.M.	240.33	
B.M.	248.93	7/9

Φ

258.70
0.20
268.04
2.01
258.43

Spike in T.P. left sta. 117+30

Spike in 18" tree Rt 142+50

Nail in T.P. Right sta 124+00

Spike in T.P. left Sta 127+35

Nail in T.P. " " " 135+25

" " " " " 139+25

Spike in T.P. " " " 146+30

Spike in T.P. Rt " " 155+25

Tree Rt sta. 164+95

Rt sta 172+75 Tel. Pole

Spike in 8" Willow Rt sta 185+60

Nail in T.P. Right sta 193+45

Spike in T.P. Rt sta 201+90

Spike in T.P. Rt sta 210+30

" " " " " 222+75

Spike in 20" Tree Left sta 241+57

Nail in T.P. R Sta. 45+50

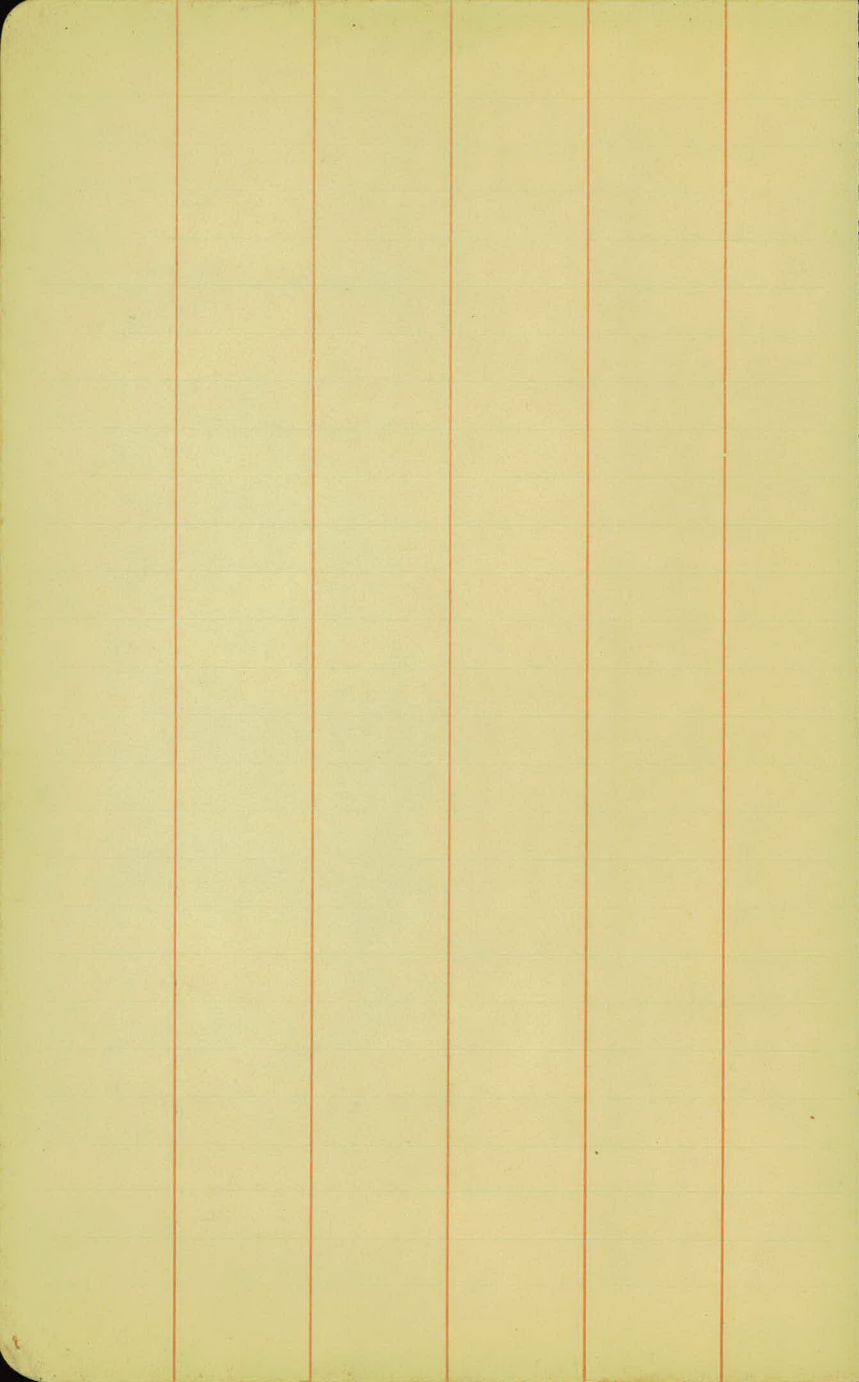
Nail in T.P. Right sta 52+60

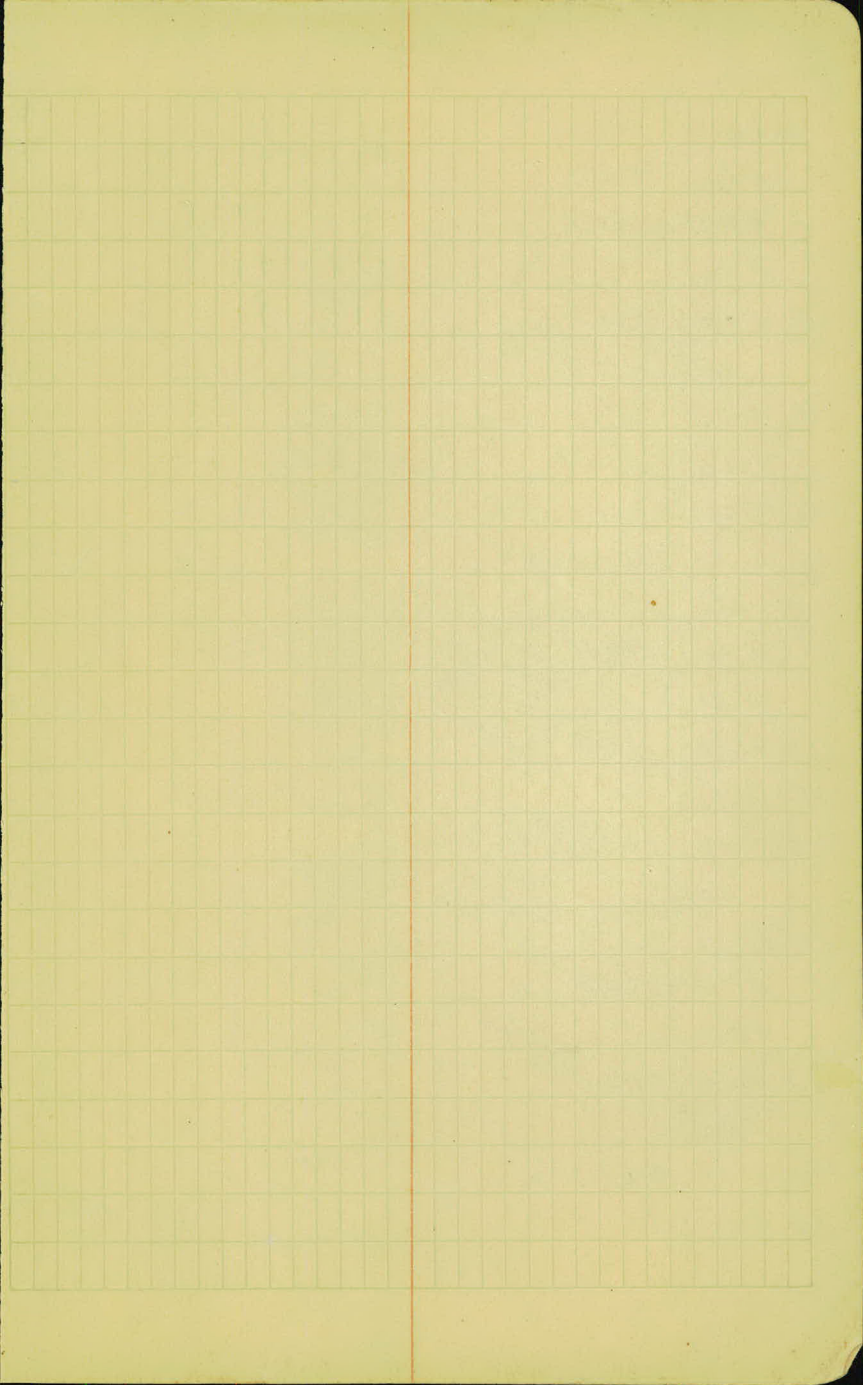
Spike in 16" Oak 33 Left sta 260+45

" " T.P. Right sta 264+00

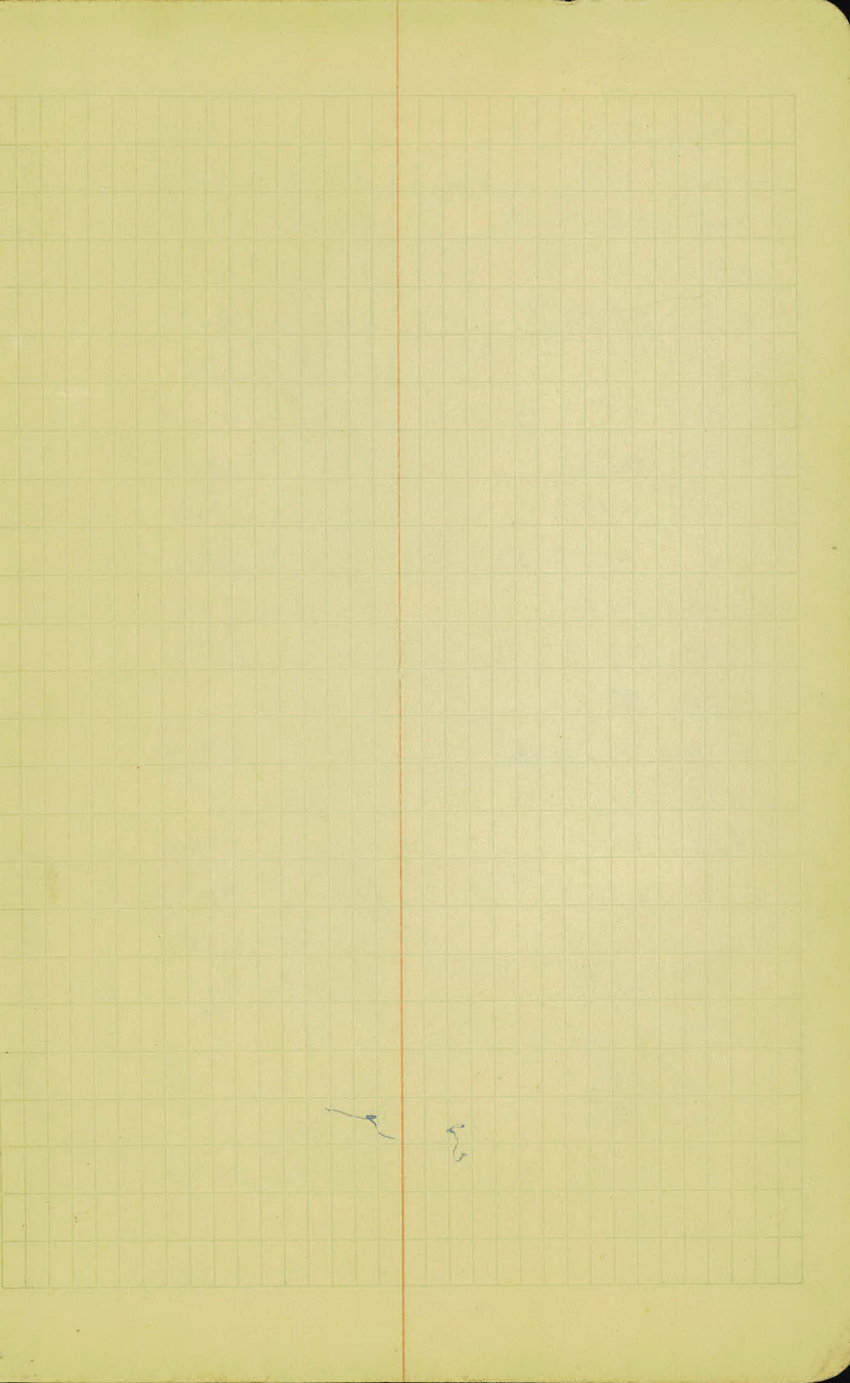
Tree Rt sta 268+35

Spike in 12" Oak 35 Right sta 272+75

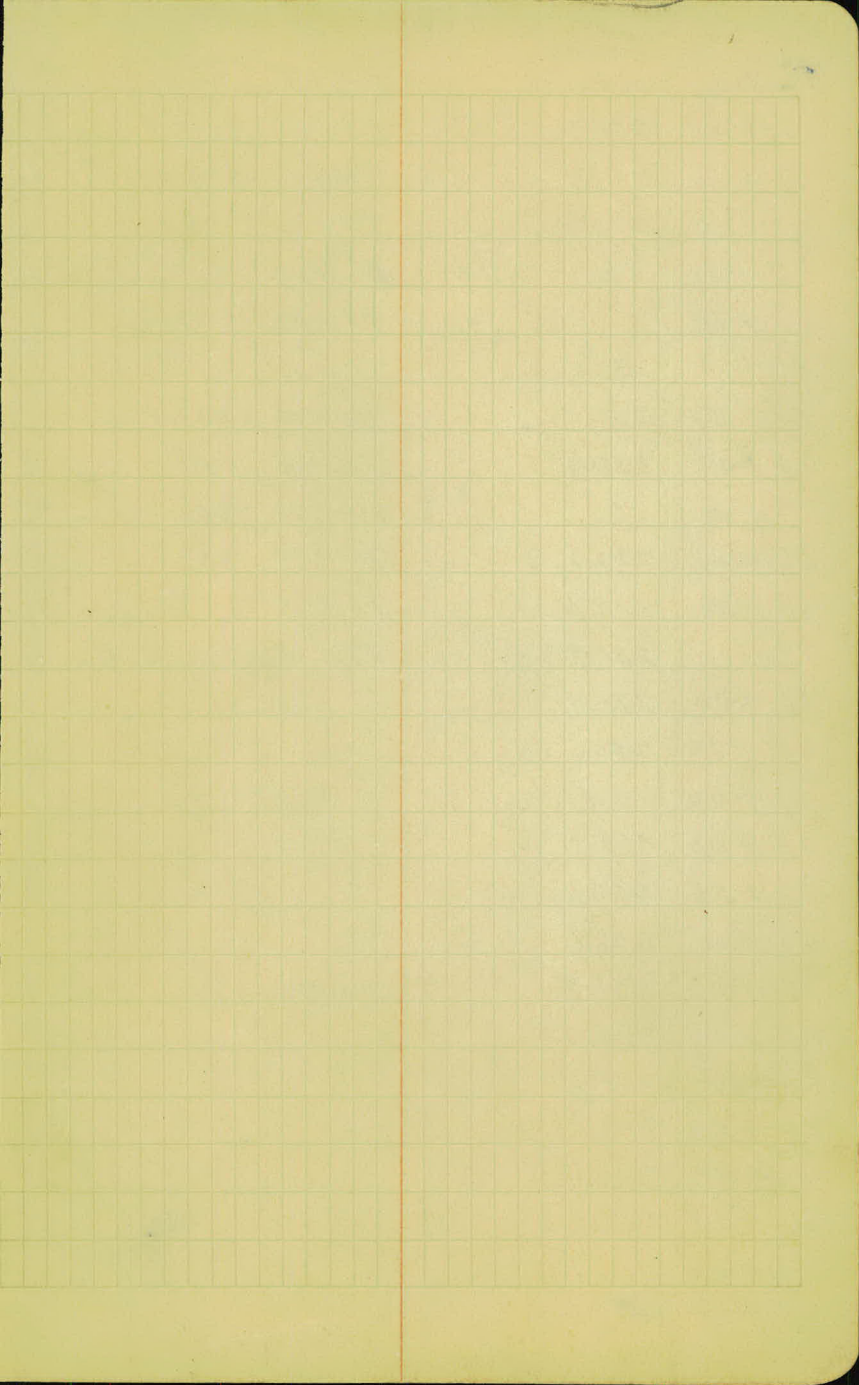




Station	Profile Grade	
0+00	245.3	
1+00	247.2	
2+00	249.1	x
+50		
3+00	251.1	
+50		
4+00	253.2	x
5+00	255.4	
6+00	257.6	
7+00	259.8	xx
+50		
8+00	261.9	
+50		
9+00	263.8	xx
+50		
10+00	265.7	
+50		
11+00	267.7	x
12+00	269.8	x
+50		
13+00	272.0	
+50		
14+00	274.3	x
15+00	276.7	

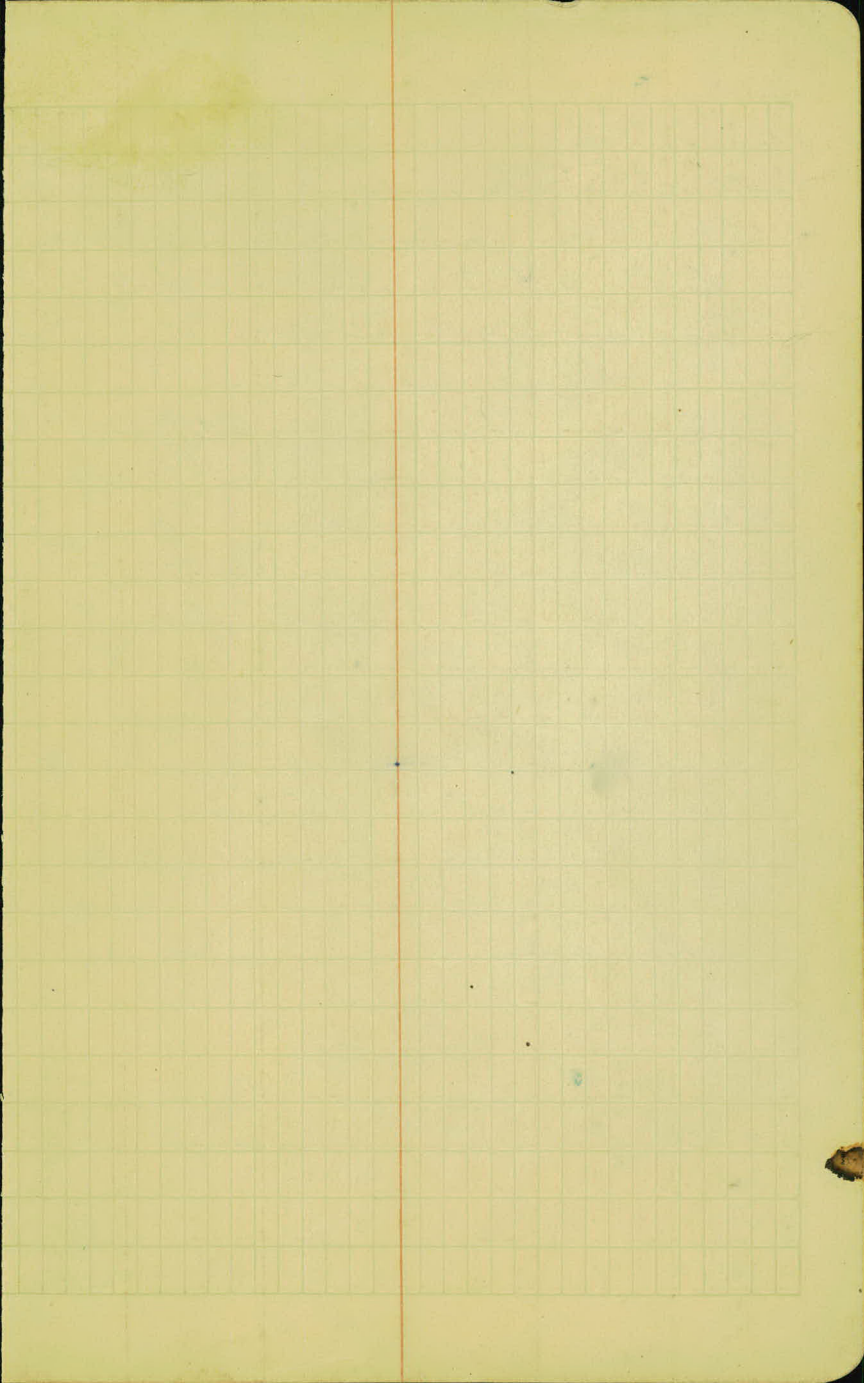


Station	Profile Grade		Station	Profile Grade	
16 + 00	279.1	x	31 + 00	256.8	
+ 50			32 + 00	252.9	
17 + 00	280.8		33 + 00	249.0	
+ 50			34 + 00	245.1	x
18 + 00	281.5		35 + 00	241.1	
+ 50			36 + 00	237.1	
19 + 00	281.2	x	37 + 00	233.1	
20 + 00	280.2		38 + 00	229.1	
21 + 00	279.2		39 + 00	225.1	
+ 50	278.7	x	40 + 00	221.1	x
22 + 00	278.2		+ 50		
+ 50			41 + 00	217.7	
23 + 00	277.5		+ 50		
+ 50	277.3	x	42 + 00	215.6	
24 + 00	277.1	x	+ 50		
+ 50			43 + 00	214.6	x
25 + 00	276.3		44 + 00	214.3	
+ 50			45 + 00	214.0	
26 + 00	274.6		46 + 00	213.7	x
+ 50			+ 50		
27 + 00	272.1		47 + 00	214.1	
+ 50			+ 50		
28 + 00	268.5	x	48 + 00	215.4	
29 + 00	264.6		+ 50		
30 + 00	260.7		49 + 00	217.5	x



Station	Profile Grade	
50+00	220.3	
51+00	223.1	
52+00	225.9	} Eq.
	226.1	
53+00	228.7	
+50		
54+00	231.0	
+50		
55+00	232.3	
+50		
56+00	232.6	
+50		
57+00	231.9	x
58+00	230.7	
59+00	229.5	x
+50		
60+00	228.7	
+50	228.6	
61+00	228.6	x
62+00	228.9	
63+00	229.2	
64+00	229.5	
65+00	229.8	x
+50		
66+00	230.0	
+50		
67+00	229.8	x

Station	Profile Grade	
68+00	229.5	
69+00	229.2	
70+00	228.9	x
+50		
71+00	229.4	
+50		
72+00	231.4	x
73+00	234.2	
74+00	237.0	
75+00	239.8	
76+00	242.6	
77+00	245.4	x



W-42 Culvert No. 6t. Pau

	+	41	-	Red	Elev
B.M.	2.38	270.60 ✓			267.22
T.P.	4.98	271.76 ✓	3.80		266.90
0+00	East End	Culvert.		8.50	263.3 ✓
+05				5.50	266.3 ✓
+15				5.70	266.4 ✓
+35				5.40	266.4 ✓
+50				5.1	266.7 ✓
+65				4.8	267.0 ✓
+75		6' Wide		5.2	266.6 ✓
1+00				6.6	265.2 ✓
+12				7.2	264.6 ✓
+24				8.2	263.6 ✓

53.7' left

Right } 115' length of Bibl

	Grade	Ground	cut	
0+00	61.70	63.3	1.6	✓
+05	61.70	66.3	4.6	✓
+15	61.60	66.1	4.5	✓
+35	61.50	66.4	4.9	✓
+50	61.30	66.7	5.4	✓
+65	61.20	67.0	5.8	✓
+75	61.20	66.6	5.4	✓
1+00	61.00	65.2	4.2	✓
+12	60.90	64.6	3.7	✓
+21	60.8	63.6	2.8	✓

10.43
2.74
7.69

OK
5.65

10.08
5.35
4.73

9.8
8.0

237.65
9.05

71.78
9.2

247.70
240.22

21
7
147

67.28
61.70

261.58 = W. Side

71.78
61.70
10.08
2.28
6.80
71.78
61.30
10.43

+100 - 61.70 = Bottom Exc. at Intake
0.7 Grade

+50 - 61.35

+100 - 61.00

+21 - 60.85 = Bottom Exc. at Invert

71.78
60.85
10.93
5.92
5.00

±

Ang. h Ang. R.

1923. 7.15. 1923. 7.15.

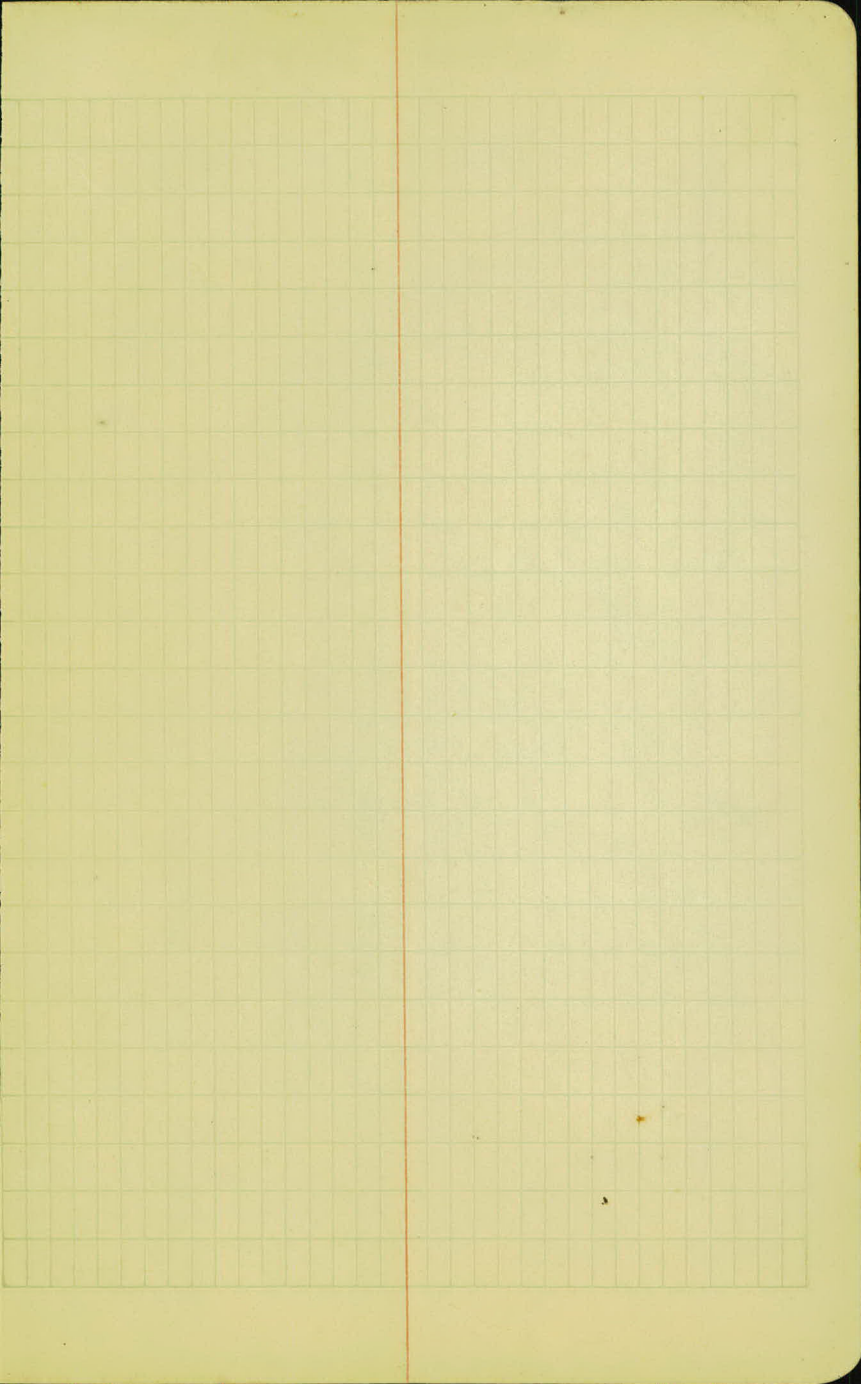
1923. 7.15. 1923. 7.15.

1923. 7.15. 1923. 7.15.

1923. 7.15. 1923. 7.15.

1923. 7.15. 1923. 7.15.

1923. 7.15. 1923. 7.15.



Station Ang. h. $\frac{L}{R}$ Ang. R.

55+69.4 P.O.T

P.O.T

= 52+85.1

82+74.3

Mont. Co. Rd. "B"

= { 38+57.0
38+67.0 } E. Soo. Ry

Equation $26+87.8 = 27+00$ { Short Sta. }

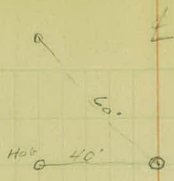
$\left. \begin{array}{l} 26+35.9 \\ 26+23.1 \end{array} \right\}$ Mont.

0010'

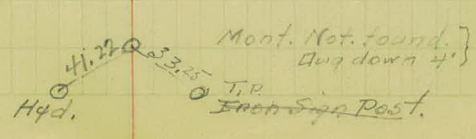
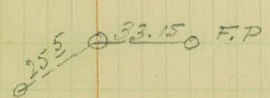
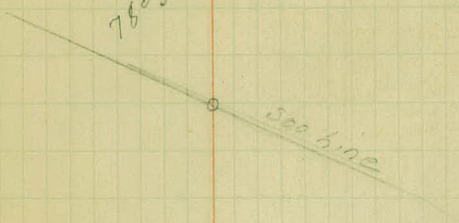
Co. Rd. "A2"

18+80 P.O.T.

0+00 E. Carpenter Ave.



76°50'



Mont. Not. found. }
Dug down 4'

From Sign Post.

Station

 $\frac{E}{\text{Ang. h.}} \quad \text{Ang. R}$
(76+43⁶ = 76+43⁹ Equation)76+43⁶ E.C.74+98⁰ P.I. 27° 51'73+45¹ B.C.62+86³ = 62+81¹ Equation.62+82² E.C.61+68⁹ P.I.

48° 45'

60+38² B.C.

Sta. - Def.

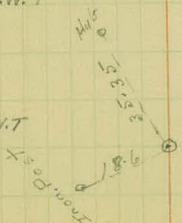
- 73+45.1 - 0°00'
- +95.1 - 20°30' E.W.T.
- 74+00 - 20°44' 1/2
- +50 - 5°14' 1/2
- 75+00 - 70°44' 1/2
- +50 - 10°14' 1/2
- +93.6 - 12°25' 1/2 E.W.T.
- 76+00 - 12°44' 1/2
- +43.6 - 14°55' 1/2



100 Curve left
 $\Delta = 29°51'$
 S.T. = 152.9
 B.C. = 73+45.1
 length 298.5
 E.C. 76+43.6

Sta. - Def.

- 60+38.3 = 0°00'
- +50 = 10°10'
- +88.2 = 50°00' E.W.T.
- 61+00 = 6°10'
- +50 = 11°10'
- 62+00 = 16°10'
- +82.3 = 19°24' E.W.T.
- +50 = 21°10'
- +82.3 = 24°24'



20° Curve Right
 $\Delta = 48°48'$
 S.T. = 130.6
 B.C. = 60+38.3
 length = 244.0
 E.C. = 62+82.3

Station

Ang h ^{1.02}
Ang R ^{1.02}

89+112 F.C.

84+933 P.I 16050'

84+00 P.O.C.

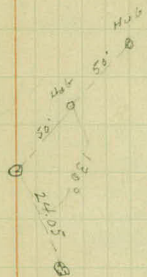
80+693 B.C.

78+522 P.O.T

27.5 80+69.3 40+67.3 6-8-23
 80.05 70.75 26.25 131.05 42.00 15.00 27.00

Sta. Def

- 80+69.3 - 0000'
- +50 - 0018' ✓
- 81+00 - 0018' ✓
- +50 - 0048' ✓
- 82+00 - 1018' ✓
- +50 - 1048' ✓
- 83+00 - 2018' ✓
- +50 - 2048' ✓
- 84+00 - 3018' ✓
- +50 - 3048' ✓
- 85+00 - 4018' ✓
- +50 - 4048' ✓
- 86+00 - 5018' ✓
- +50 - 5048' ✓
- 87+00 - 6018' ✓
- +50 - 6048' ✓
- 88+00 - 7018' ✓
- +50 - 7048' ✓
- 89+00 - 8018' ✓
- +110 - 8025'



2° Curve Lett.
 $\Delta = 16' 50''$
 S.T. = 423.9
 B.C. = 80+69.3
 Length 841.7
 F.C. = 89+11.0

dump 1/2
 1/2

Ang. h & Ang. R

110+62² P.I 0° 55'

101+74² E.C.

Sta.	Dist.
100+08 ²	0° 00'
+50	10 02'
101+00	20 17'

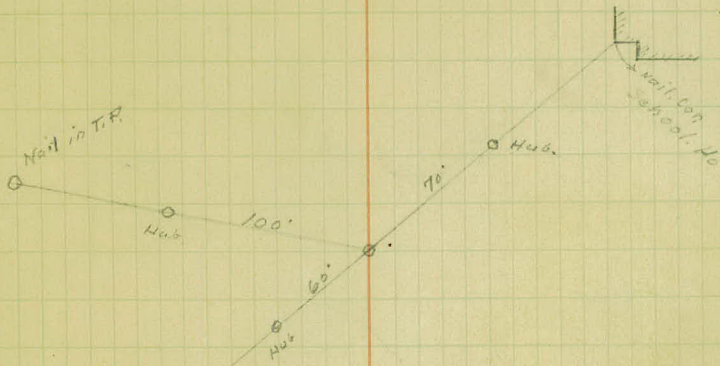
100+91² P.I

8° 17'

+50	30 32'
+74 ²	40 08 1/2'

100+08² B.C.

±



±

Ang. L Ang. R

141+23.9 E.C.

140+65.3 P.I. 3° 31'

Sta.	Def.
140+06.3	0° 00'
+50	0° 39'
141+00	1° 24'
+23.9	1° 45½'

140+06.1 B.C.

=
140+05.2

128+50.3 P.O.T

125+09.2 E.C.

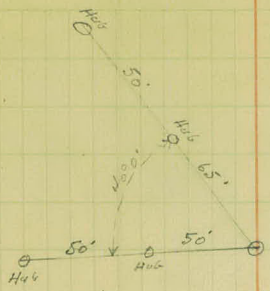
Sta.	Def.
123+48.4	0° 00'
124+00	1° 17'
+50	2° 32'
125+00	3° 47'
+09.2	4° 02'

124+29.2 P.I. 8° 04'

{ 123+48.4 B.C.
= 123+49.9

74.9
75.1
50.0

±



3° Curve length
 $\Delta = 3.031'$
 $S.T. = 58.4$
 $B.C. = 140 + 062$
 $length = 117.2$
 $F.C. = 141 + 232$



5° Curve length
 $\Delta 8.004'$
 $S.T. = 80.8$
 $B.C. = 123 + 484$
 $length = 161.3$
 $F.C. = 125 + 092$

\pm

Ang. h Ang. R

160+65⁵ E. C.

159+16³ P. I. 12° 00'

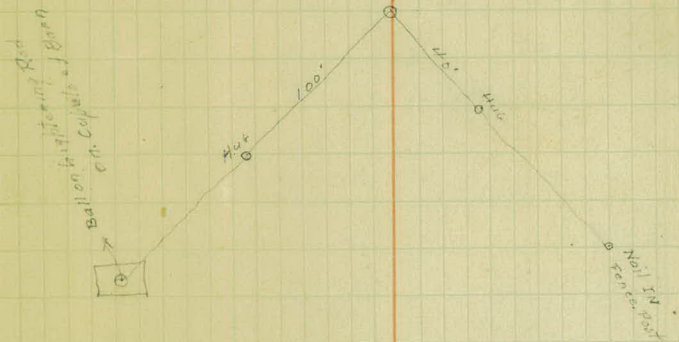
157+65² B. C.

152+71⁸ F. C.

150+21 P. I. 10° 54'

147+68⁷ B. C.

E



Sta Det.

- 147+68.7 = 0°00'
- 148+00 = 0°20'
- 149+00 = 1°25'
- 150+00 = 2°30'
- 151+00 = 3°35'
- 152+00 = 4°40'
- + 71.8 = 5°27'

2°10' Curve Rt.

$\Delta = 10°54'$

S.T. 2523

B.C. = 147+68.7

length 503.1

E.L. = 152+71.8



Ang. h. ^d Ang. R

= 193 + 132
193 + 152

P.O.T Mont

191 + 272 E.C.

187 + 82.0 P.I. 31° 53'

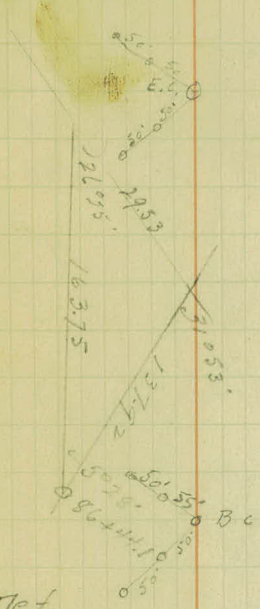
184 + 182 B.C.

178 + 813 E.C.

176 + 00 P.I.

34° 53'

172 + 999 B.C.



4°30' Curve left.

$$\Delta = 31053'$$

$$S.T. = 363.5$$

$$B.C. = 184 + 182$$

$$\text{Length} = 708.5$$

$$E.C. = 191 + 270$$

Sta. Def.

172+99.9 - 0000'

173+00 - 0000'

+ 43.65 - 1° 18 1/2'

+ 50 - 1030'

74+00 - 3000'

+ 50 - 4030'

75+00 - 6000'

+ 50 - 7030'

76+00 - 9000'

+ 50 - 10030'

77+00 - 12000'

+ 50 - 13030'

78+80 - 15000'

+ 50 - 16030' 160° 15'

+ 813 - 17076 1/2'

6° Curve Rt.

$$\Delta = 34053'$$

$$B.C. = 172 + 99.9$$

$$\text{Length} = 581.4$$

$$E.C. = 178 + 813$$

$$S.T. = 300.1$$



Ang h $\frac{1}{2}$ Ang R.

50
17.0
30.0

272+192 Mont

260+00 P.O.T.

245+88 Mont.

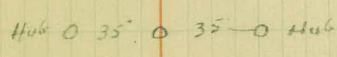
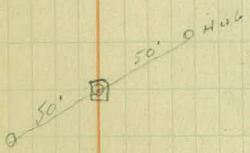
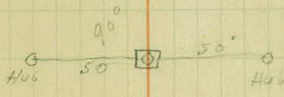
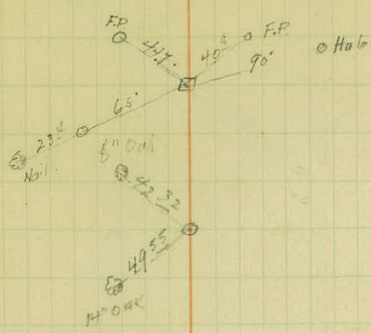
219+54 $\frac{1}{2}$ Mont 0°19'N

214+00 P.O.T.

205+00 P.O.T.

N

65
65
230



Station.

0+00

0+00

+50

1+00

+50

2+00

+50

3+00

+50

4+00

+50

5+00

+50

6+00

+50

7+00

+50

8+00

+50

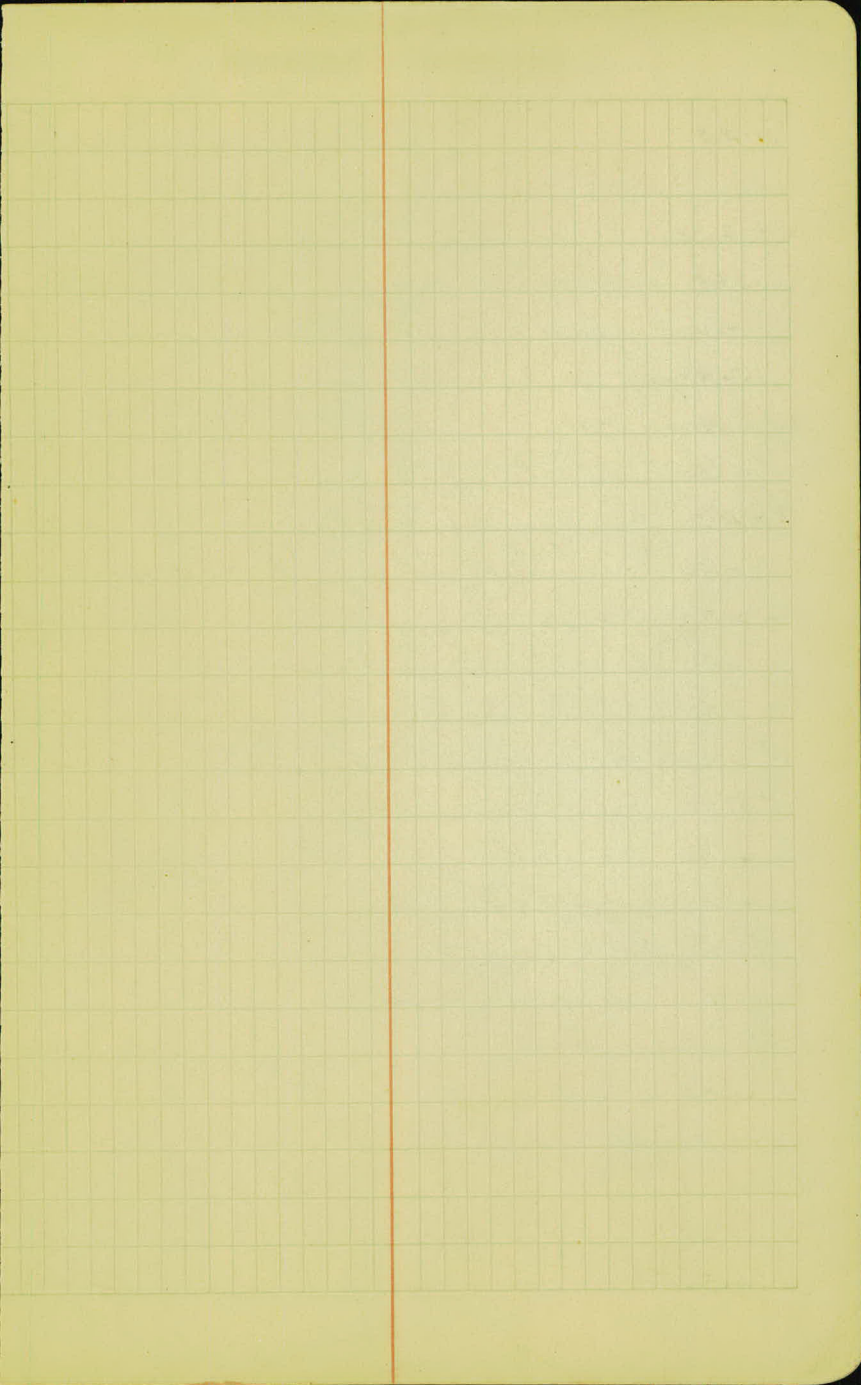
9+00

+50

10+00

+50

11+00



11 + 50

x 12 + 00 269.8

+ 50

13 + 00 272.0

+ 50

14 + 00 274.8

+ 50

15 + 00 276.7 ✓

+ 50

x 16 + 00 279.1 ✓

+ 50

17 + 00 ✓ 280.8

+ 50

18 + 00 281.5

+ 50

x 19 + 00 281.7

+ 50

20 + 00 280.2

+ 50

21 + 00 279.2

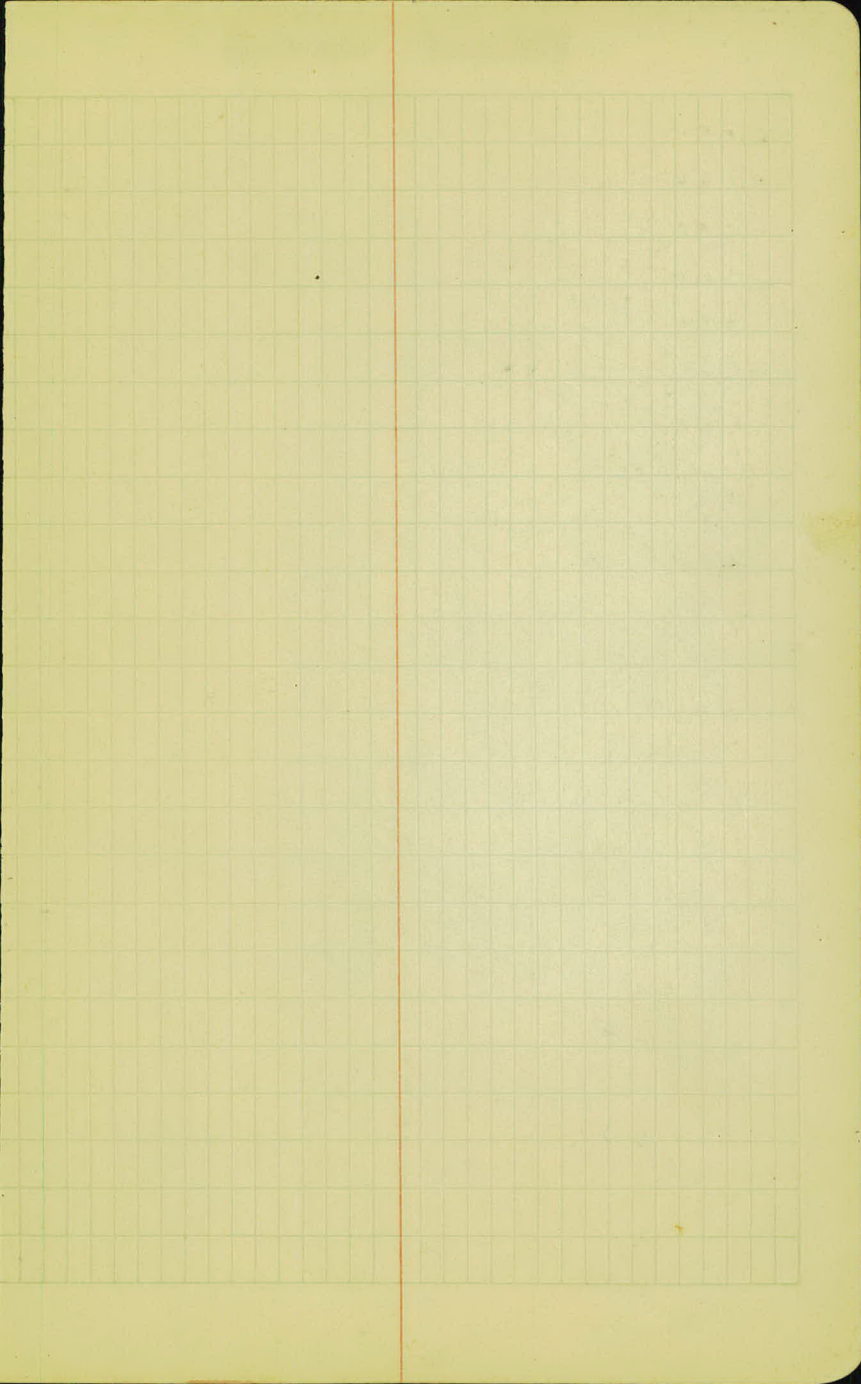
x + 50 278.7

22 + 00 278.2

+ 50

23 + 00 277.5

x + 50 277.3



x 24 + 00 277.1

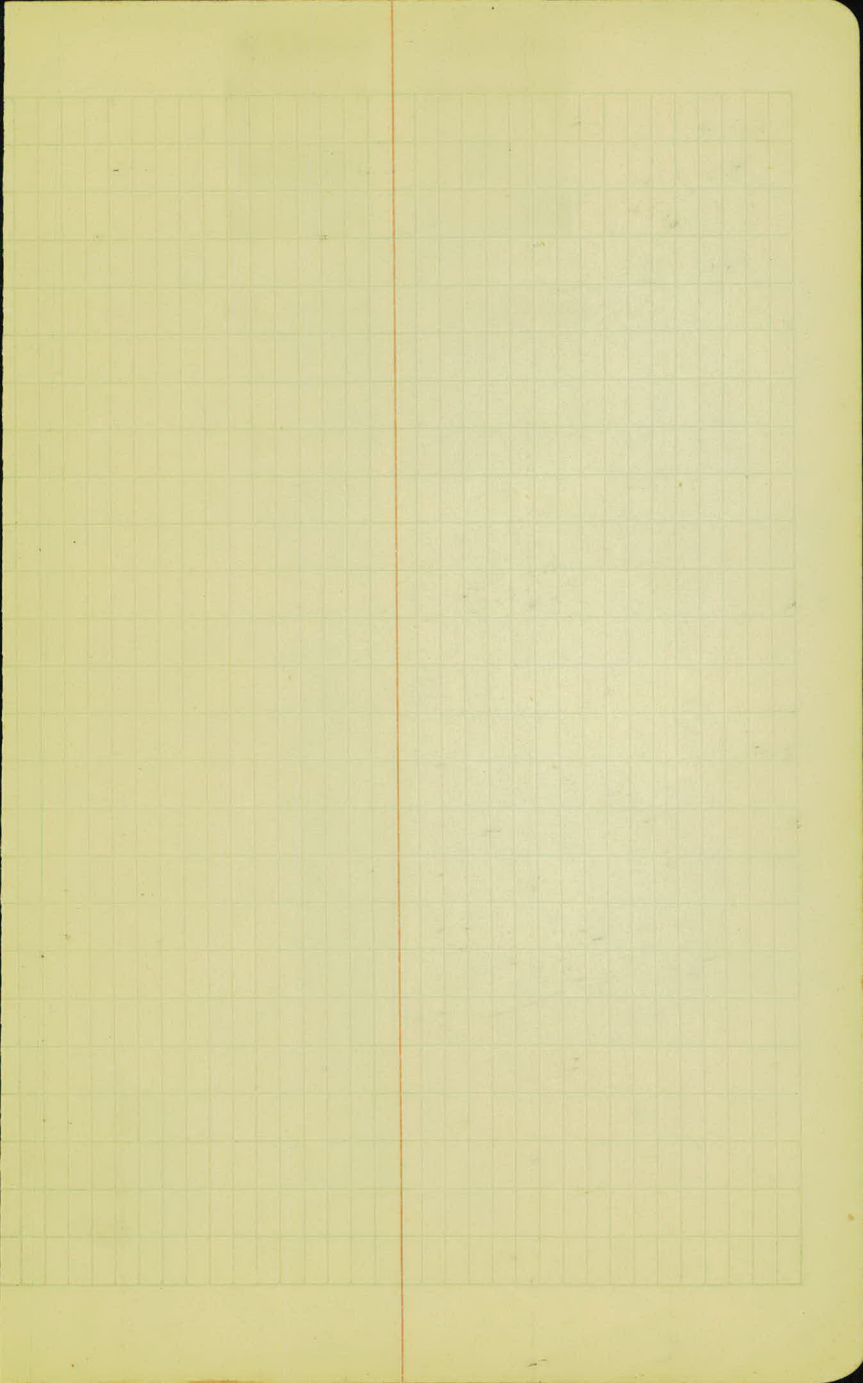
+ 50

25 + 00 276.3

+ 50

26 + 00 274.6

+ 50



Station	+	H. I.	-	Rod	Elev.
B.M.	3.22	281.27			278.05
24+00					277.1
25+00				6.0	275.4
26+00				7.9	273.5
27+00				10.5	270.9
T.R.	0.70	270.27	11.80		269.57
28+00				2.8	267.5
29+00				6.2	264.1
30+00				10.0	260.3
31+00				13.7	256.6

$$\begin{array}{r}
 67.5 \\
 56.6 \\
 \hline
 3 \overline{) 109} \quad 3.63 \\
 \underline{9} \\
 19 \\
 \underline{18} \\
 19
 \end{array}$$

280

270

260

24

250



25

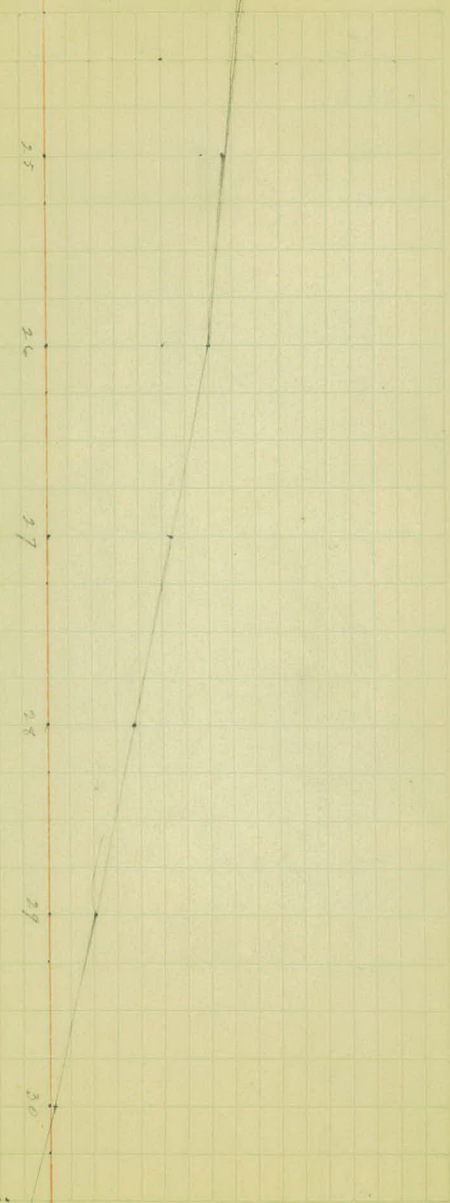
26

27

28

29

30



	+	∩	-	Red	
B.M.	1.94	232.67			<u>230.73</u>
53+00				4.60	225.10
+50				3.60	229.1
54+00				2.90	229.6
+50				2.50	230.2
55+00				1.90	230.8
+50				1.40	231.3
56+00				1.20	231.5
T.P.	4.36	235.93	1.10		<u>231.57</u>
+50				4.4	231.5
57+00				4.4	231.5
+50				4.5	231.4
58+00				5.0	230.9
+50				5.7	230.2
59+00				6.5	229.4
+50				7.4	228.5
+883				7.5	228.4
60+383				7.5	228.4
+983				7.3	228.6
T.P.	4.14	234.10	5.97		229.16
61+50				5.6	228.5
62+00				4.9	229.2
+823				4.7	229.4
63+342				4.5	229.6
64+342				4.5	229.6

229.81 235.93
5.97 5.97
229.96

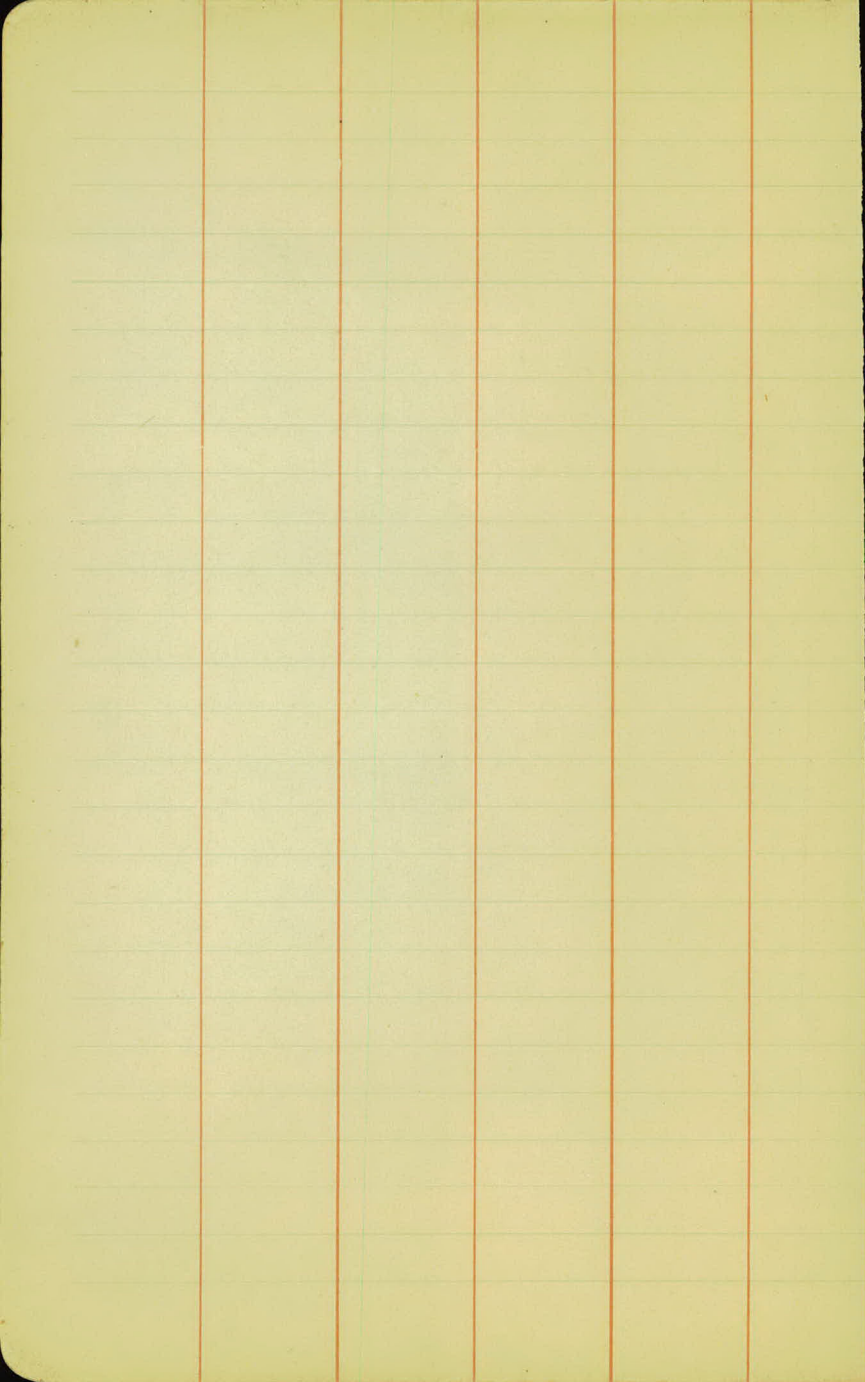
The page contains a large grid of graph paper. A vertical red line runs down the center of the grid, dividing it into two equal halves. The grid consists of approximately 20 columns and 30 rows of small squares.

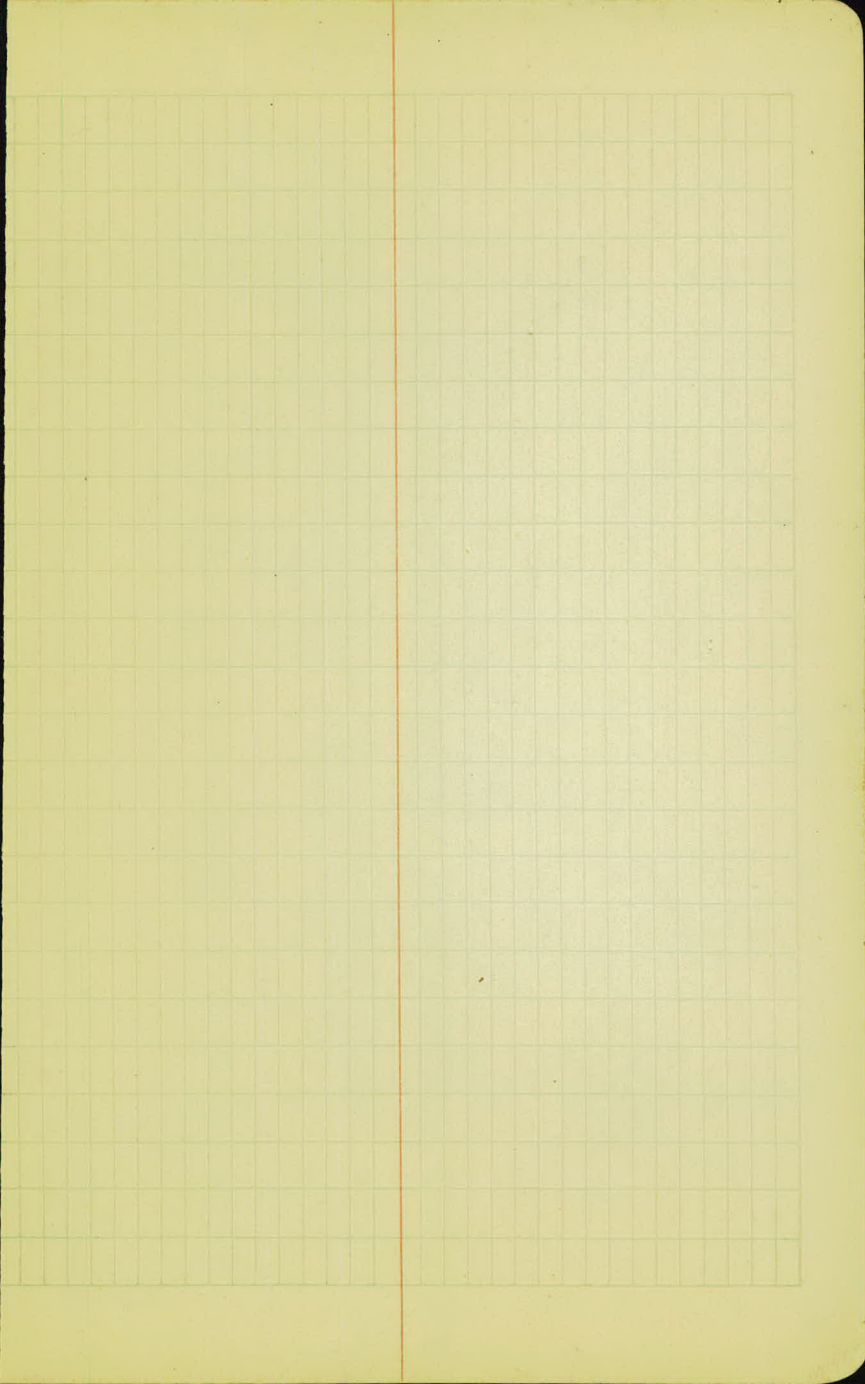
234.10

65+00				4.2	229.9
66+00				4.1	230.0
67+00				4.2	229.9
T.P.	4.25	234.05	4.20		229.8
68+00				4.5	229.5
69+00				4.7	229.3
70+00				4.9	229.1
71+00				4.4	229.6
71+95'				2.6	229.4
+45'				1.3	232.7
T.P.	11.26	243. ⁶ ₉₈	1.33		232.72
72+95'				7.7	234.3
73+45'				8.3	235.7
74+00				6.9	237.1
+50				5.6	238.4
75+00				4.5	239.5
+50				2.6	241.9
75+93'				1.4	242.6
T.P.	9.21	250.97	1.22		242.76
76+43'				7.0	244.0
+93'				5.5	245.5

250.47 30.55 220.66
 .37 8.56
250.60 30.59

The page contains a large grid of graph paper. A vertical red line runs down the center of the grid, dividing it into two equal halves. The grid consists of small squares, typical of graph paper used for calculations or plotting.





Sta. Def

66+00 50 18'

+50 40 48'

85+00 40 18'

+50 30 48'

T.P. 84+00 30 18' P.O.C.

+50 20 48'

83+00 20 18'

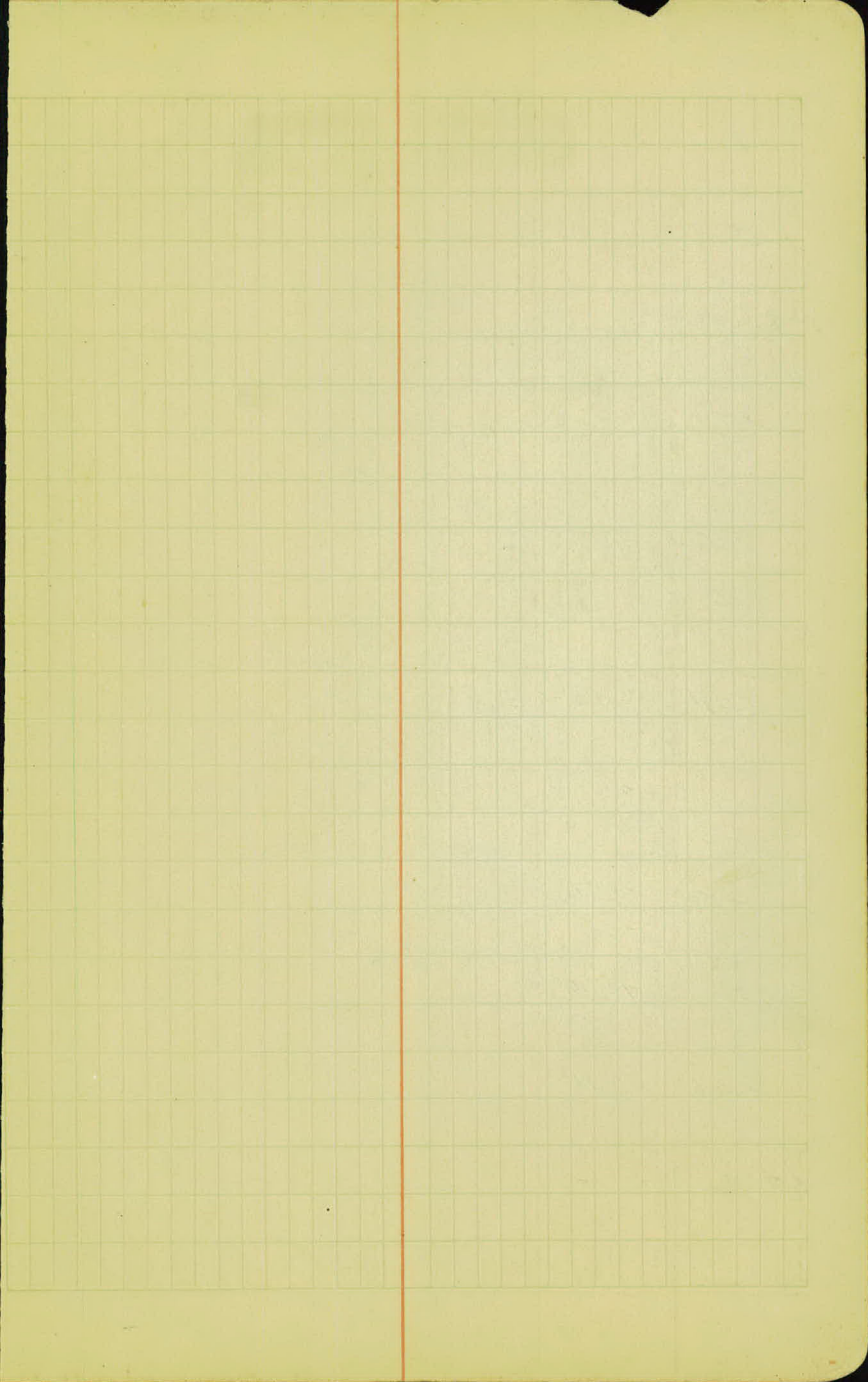
+50 10 48'

82+00 10 18'

+50 00 48'

81+00 00 18'

80+69.3 0° 00' B.C.



+11 8° 25' E.C.

89+80 8° 18'

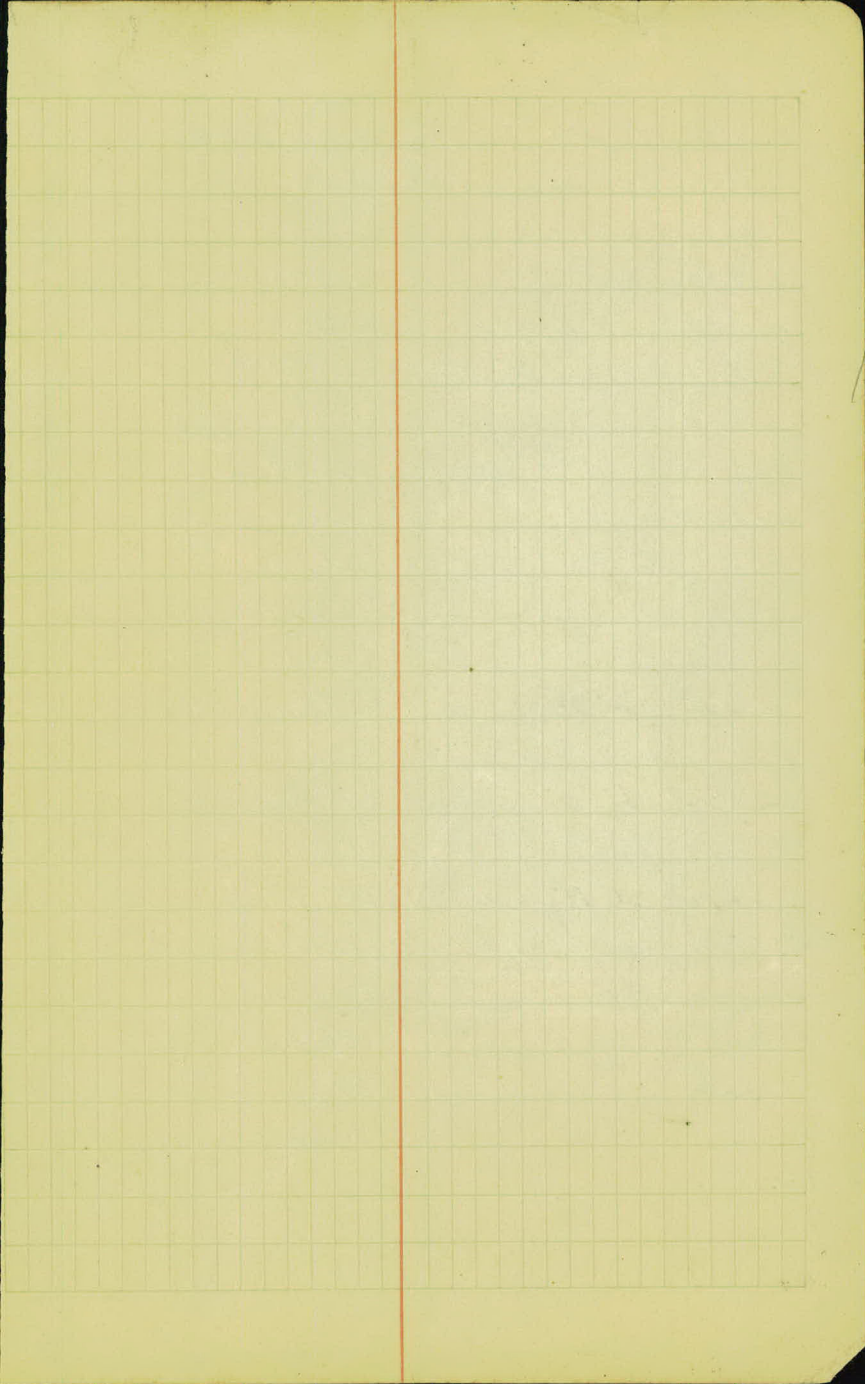
+50 7° 48'

88+100 7° 18'

+50 6° 48'

87+100 6° 18'

86+150 5° 48'



20.77

20° Curve Sta 61+68³ P.I.

Station	Def	Point	Sta	Profile Grade	Super. Pen. foot.	Extra Width
58+88 ³		B.S.T	0	229.64	-0.08	
59+13 ³			25	229.35	+0.00	
59+38 ³			50	229.09	-0.08	
59+63 ³			75	228.89	+0.17	
59+88 ³		B.W.T	100	228.73	-0.26	0.0
60+13 ³			125	228.62	+0.35	0.4
60+38 ³	0°00'	B.C.	150	228.55	-0.44	1.84
60+63 ³	2°30'		175	228.54	+0.53	3.30
60+88 ³	5°00'	E.S.T E.W.T	200	228.62	+0.62	3.72
61+13 ³	7°30' ✓			228.64	✓✓	✓✓
61+38 ³	10°00' ✓			228.71	✓✓	✓✓
61+63 ³	12°30' ✓			228.79	✓✓	✓✓
61+88 ³	15°00' ✓			228.86	✓✓	✓✓
x62+13 ³	17°30' ✓			228.94	✓✓	✓✓
x62+32 ³	19°24'	E.S.T E.W.T	200	229.00	+0.62	3.72
+57 ³	21°54'		175	229.07	+0.53	3.30
+82 ³	24°24'	E.C.	150	229.15	+0.44	1.84
Equation	62+86 ³ =	62+89 ³				
63+09 ³			125	229.23	+0.35	0.4
63+34 ³		B.W.T	100	229.30	-0.26	0.0
63+59 ³			75	229.38	+0.17	
63+84 ³			50	229.45	-0.08	
64+09 ³			25	229.53	+0.00	
64+34 ³		B.S.T	0.0	229.60	-0.08	

L. ^{11.54}
₂
₁₃₅ ♀

R

10'	Elev.	Elev.	Elev.	10'
10'	229.56	229.64	229.56	rv
10'	229.35	229.35	229.27	rv
10'	229.17✓	229.09	229.01✓	rv
10'	229.06✓	228.89	228.72✓	rv
rv	228.99✓	228.73	228.47✓	rv
rv	228.97✓	228.62	228.26	10.4
rv	228.99✓	228.55	228.03	11.84
rv	229.07✓	228.54	227.84	13.30
rv	229.24✓	228.62	227.77	13.72
rv	229.26✓	228.64	227.79	rv
rv	229.33✓	228.71	227.86	rv
rv	229.41 ✓	228.79	227.94	rv
rv	229.48 ✓	228.86	228.01	rv
rv	229.56✓	228.94	228.09	rv
rv	229.62✓	229.00	228.15	13.72
rv	229.60✓	229.07	228.37	13.30
rv	229.59✓	229.15	228.63	11.84
rv	229.58✓	229.23	228.87	10.4
rv	229.56✓	229.30	229.01	10.0
rv	229.55✓	229.38	229.21	rv
rv	229.53✓	229.45	229.37	rv
rv	229.53✓	229.53	229.45	rv
rv	229.52	229.60	229.52	rv

2010 Curve Sta. 147+68.7 - 152+

Station	Def.	Point	Profile Grade	Super. Per. foot.
147+12.45		B.S.T	250.92	-008
		19.75		-008
147+31.2			250.38	-008
		37.5		+004
147+49.95			250.56	-008
		56.25		+010
147+68.7	0°00'	B.C.	250.75	-010
		75		+017
147+87.45	00 12'	E.S.T	250.95	-017
148 + 25	00 36'		251.40	}
+ 50	00 52 1/2'		251.70	
149 + 00	10 25' ✓		252.30	
+ 50	10 57 1/2'		252.90	
150 + 00	20 30'		253.50	
+ 50	30 02 1/2'		254.10	
151 + 00	30 35'		254.70	
+ 50	40 07 1/2'		255.70	
152 + 00	40 40'		255.50	
+ 53.05	50 15'	E.S.T	255.50	
		56.25		-017
152+71.8	5°27'	E.C.	255.50	+010
		37.5		-010
+ 90.55			255.50	+004
				-008
153 + 09.3		187.5	255.54	-002
				-008
+ 28.05		B.S.T.	255.61	-008
				-008

Left.

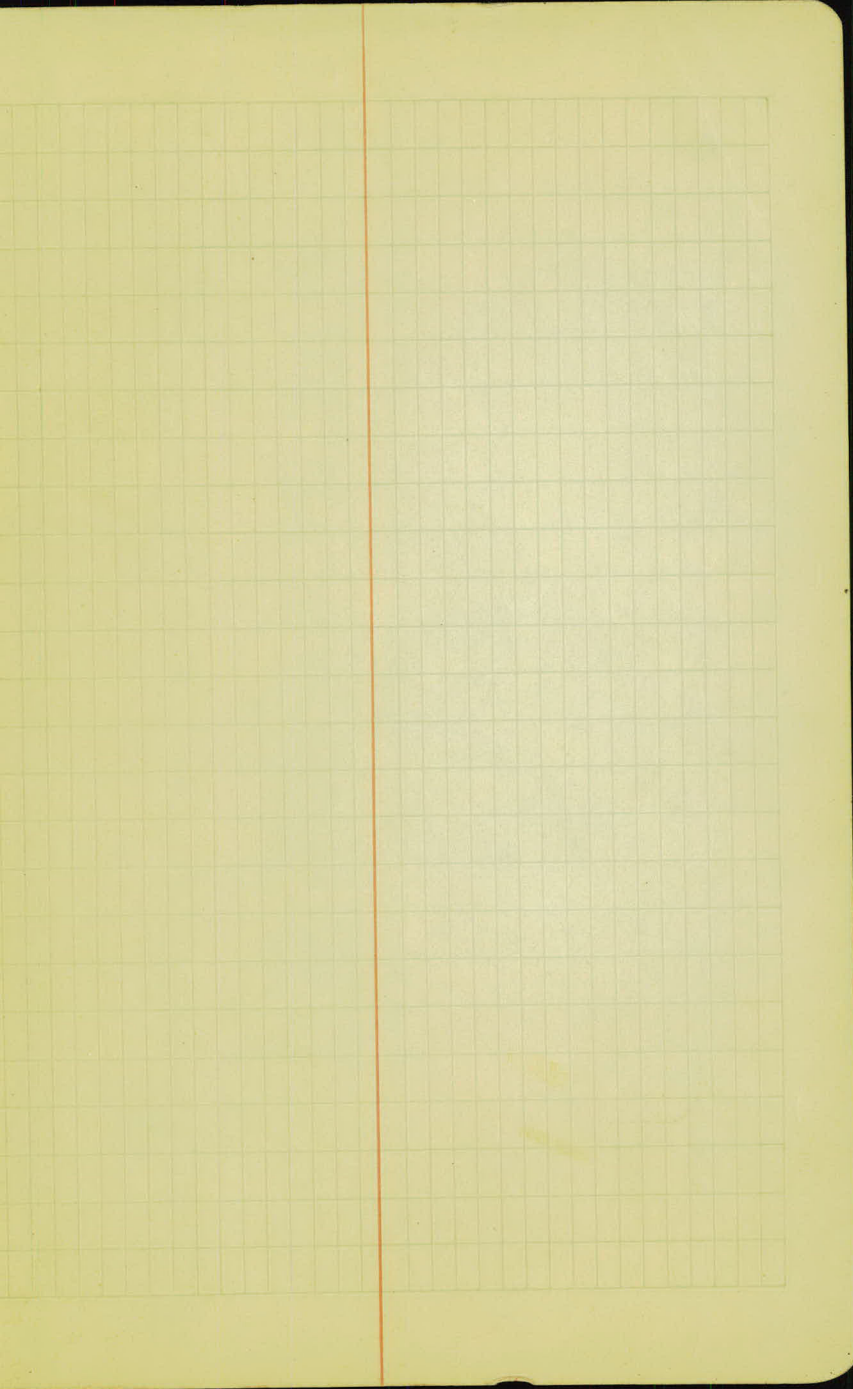
£

Right

250.14 ✓	250.22	250.14 ✓
250.36 ✓	250.38	250.30 ✓
250.60 ✓	250.56	250.48 ✓
250.85 ✓	250.75	250.65 ✓
251.12 ✓	250.95	250.78 ✓
251.57 ✓	251.40	251.23 ✓
251.87 ✓	251.70	251.53 ✓
252.47 ✓	252.30	252.13 ✓
253.07 ✓	252.90	252.73 ✓
253.67 ✓	253.50	253.33 ✓
254.27 ✓	254.10	253.93 ✓
254.87 ✓	254.70	254.53 ✓
255.37 ✓	255.20	255.03 ✓
255.67 ✓	255.50	255.33 ✓
255.67 ✓	255.50	255.33 ✓
255.60 ✓	255.50	255.40 ✓
255.54 ✓	255.50	255.42 ✓
255.52 ✓	255.54	255.46 ✓
255.53 ✓	255.61	255.53 ✓

6° Curve Right

171+68 <u>65</u>		B.S.T	
171+93 <u>65</u>			25
172+18 <u>65</u>			50
172+43 <u>65</u>			75
172+68 <u>65</u>			100
172+93 <u>65</u>			125
+99 <u>9</u>	0°00'	B.C.	
173+18 <u>65</u>			150
+43 <u>65</u>		E.S.T	175



430' Curve Sta 187+82-191+

Station	Def Point	Profile Grade	Super Elev Per foot
183+06.0	B.S.T	41.40	-0.00
183+43.5	37.5		-0.08
183+81.0	75.0		+0.07
184+18.5	112.5	42.07	-0.07
184+56.0	150	42.40	+0.00
	0000 B.C.		-0.04
	0050 1/2 E.S.T		+0.04
+75			
185+00	10 50' ✓	42.80 ✓	+0.04
+25			-0.04
+50	20 51 1/2' ✓	43.25 ✓	
+75			
186+00	40 05' ✓	43.70 ✓	
+25			
+50	50 17 1/2' ✓	44.15 ✓	
+75			
187+00	60 20' ✓	44.60 ✓	
+25			
+50	70 27 1/2' ✓	45.05 ✓	
+75			
188+00	80 35' ✓	45.50 ✓	
+25			
+50	90 42 1/2' ✓	45.95 ✓	
+75			
189+00	100 50' ✓	46.30 ✓	

£

Left

Right

41.31 ✓

41.39

41.31 ✓

41.43 ✓

41.51

41.55 ✓

41.57 ✓

41.74

41.91 ✓

41.77 ✓

42.07

42.37 ✓

41.96 ✓

42.40

42.84 ✓

42.36

42.80

43.24 ✓

42.81 ✓

43.25

43.69 ✓

43.26 ✓

43.70

44.14 ✓

43.71 ✓

44.15

44.59 ✓

44.16 ✓

44.60

45.04 ✓

44.61 ✓

45.05

45.49 ✓

45.06 ✓

45.50

45.94 ✓

45.51 ✓

45.95

46.39 ✓

45.86 ✓

46.36

46.74 ✓

Station	Inf. Point	Profile	Super. Elev.	Grade	Per. feet
189+25					
+50	11° 57 1/2'			46.65	
+75					
190+00	13° 05'			47.1	✓
+25					
+50	14° 12 1/2'			47.55	
+89.5	15° 06'	E.S. T. 50		47.90	-0.44 +0.44
191+77	15° 56 1/2'	E.C. 112.5		48.25	+0.30 -0.30
+64.5		75		48.58	+0.17 -0.17
192+02.0		37.5		48.92	+0.04 -0.08
+39.5		B.S.T. 0			+0.08 -0.08
+60					

Left.

E

Right.

46.21 ✓	46.65	47.09 ✓
46.66 ✓	47.10	47.54 ✓
47.11 ✓	47.55	47.99 ✓
47.46 ✓	47.90	48.34 ✓
47.95 ✓	48.25	48.55 ✓
48.41 ✓	48.58	48.75 ✓
48.84 ✓	48.92	48.96 ✓
49.18	49.26	49.18
	49.62	

6° Curve Right - Sta. 176+00 T.I.

Station	Let. Point	Profile Grade	Super. Percent
171+68 ⁶⁵	B.S.T	0	51.53
+93 ⁶⁵		25	51.51
172+18 ⁶⁵		50	51.51
+43 ⁶⁵		75	51.51
+68 ⁶⁵		100	51.51
+93 ⁶⁵		125	51.51
+99 ⁹	0°00' T.B.C.		
173+18 ⁶⁵	00°33' 1/2	150	51.48
+43 ⁶⁵	10°18' 1/2	E.S.T 175	51.46
+70	20°06' ✓		51.43
174+00	30°00' ✓		51.40
+50	40°30' ✓		
175+00	60°00' ✓		51.30
+50	70°30' ✓		
176+00	90°00' ✓		
+50	100°30' ✓		
177+00	120°00' ✓		
+50	130°30' ✓		
178+00	150°00' ✓		
+37 ⁵⁵	16°07' 1/2	E.S.T 175	
+62 ⁵⁵	16°52' 1/2	150	
+81 ³⁰	17°26' 1/2	E.C	
+87 ⁵⁵		125	
179+12 ⁵⁰		100	

70
23.5
26.33

99.9

h

E

R

Elev.	Elev.	Elev.
51.45	51.53	51.45
51.51	51.51	51.43
51.59	51.51	51.43
51.68	51.51	51.34
51.77	51.51	51.25
51.86	51.51	51.16
51.92 ✓	51.48	51.04 ✓
52.00 ✓	51.46	50.92 ✓
51.97 ✓	51.43	50.89 ✓
51.94 ✓	51.40	50.86 ✓
51.89 ✓	51.35	50.81 ✓
51.84 ✓	51.30	50.76 ✓
51.79 ✓	51.25	50.71 ✓
51.74 ✓	51.20	50.66 ✓
51.54 ✓	51.00	50.46 ✓
51.44 ✓	50.60	50.06 ✓
50.44 ✓	49.90 /	49.36 ✓
49.44 ✓	48.90	48.36 ✓
48.61 ✓	48.07	47.53 ✓
47.96 ✓	47.52	47.08 ✓
47.32 ✓	46.97	46.62 ✓
46.68 ✓	46.42	46.16 ✓

$$179 + 37 \overline{55}$$

$$+ 62 \overline{55}$$

$$+ 87 \overline{55}$$

$$180 + 12 \overline{55}$$

75

50

25

0

+ 017

- 017

+ 008

- 008

+ 000

- 008

- 008

- 008

h c p

46.04v

4587

45.70v

45.40v

4532

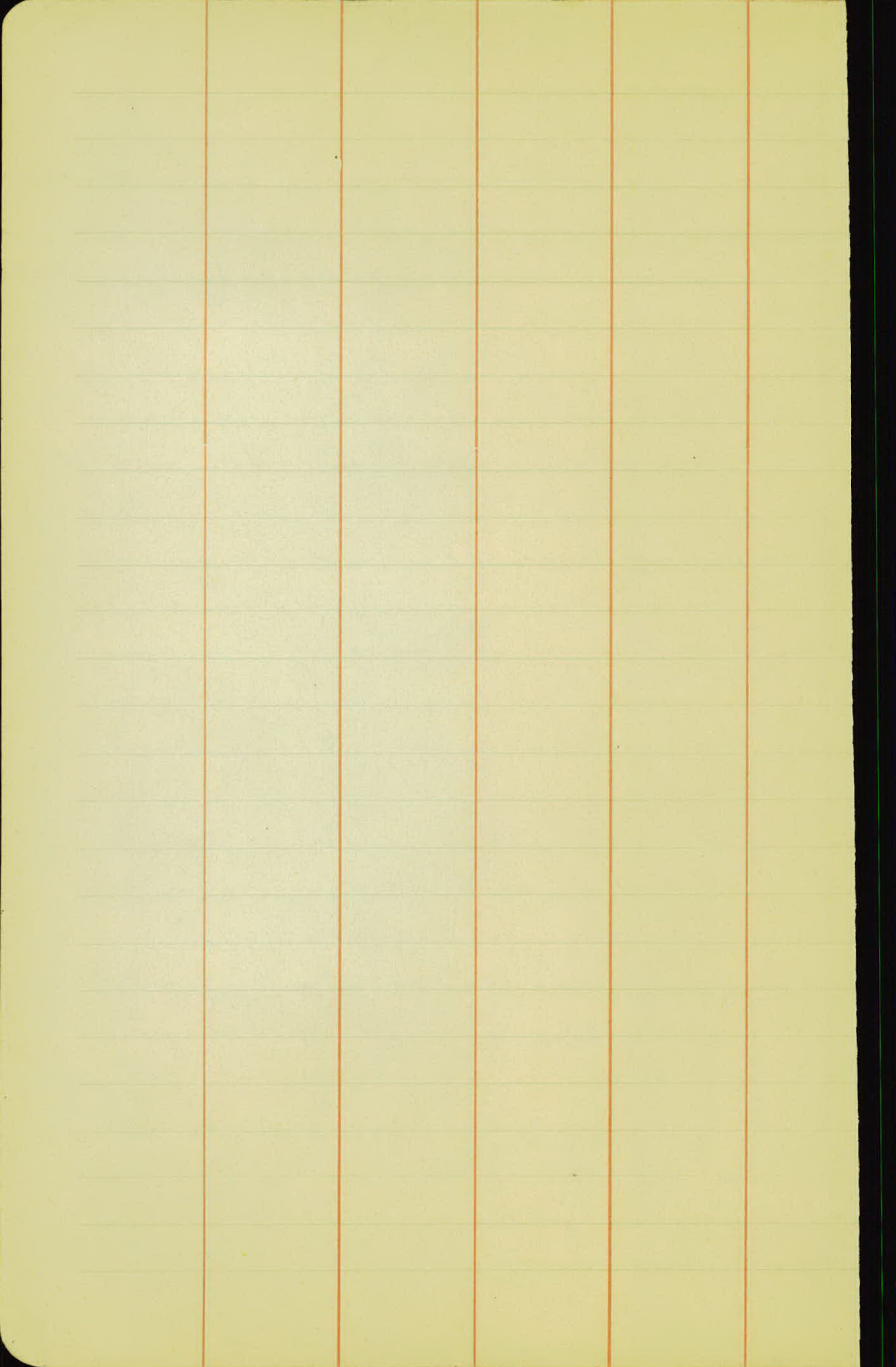
45.24v

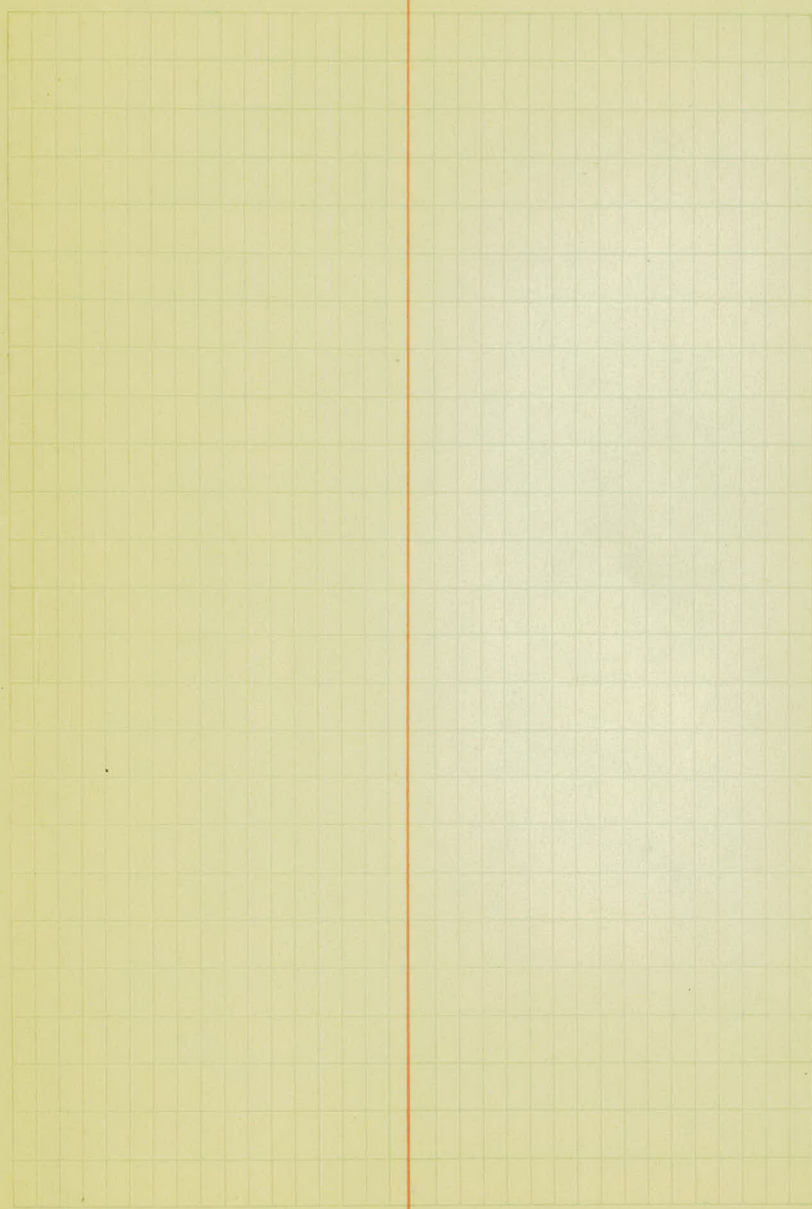
44.77

44.77

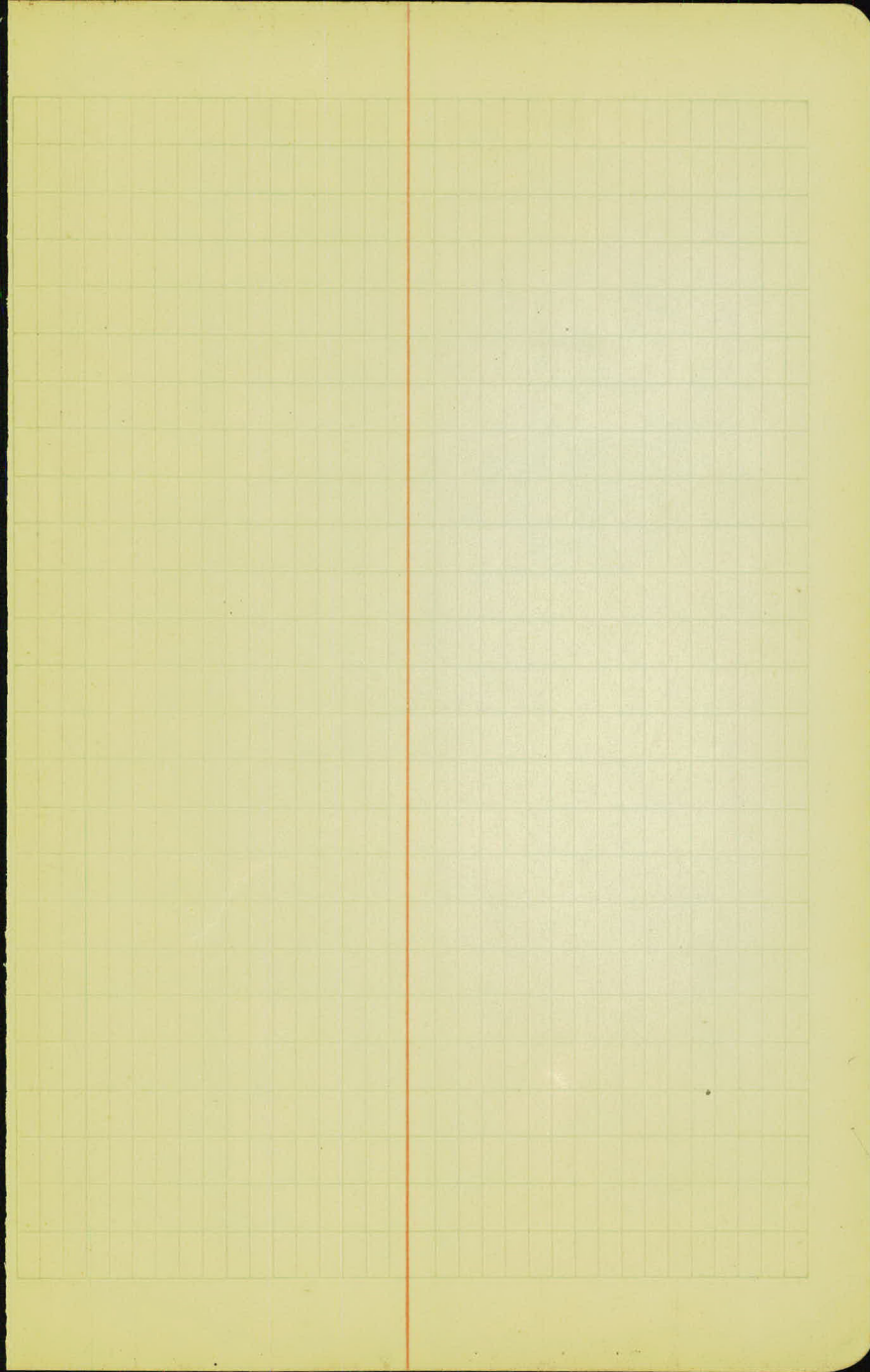
44.69v

44.22





0+00	61.80	5.82
+50	61.65	7.24
1+00	61.80	5.92
+20	61.44	

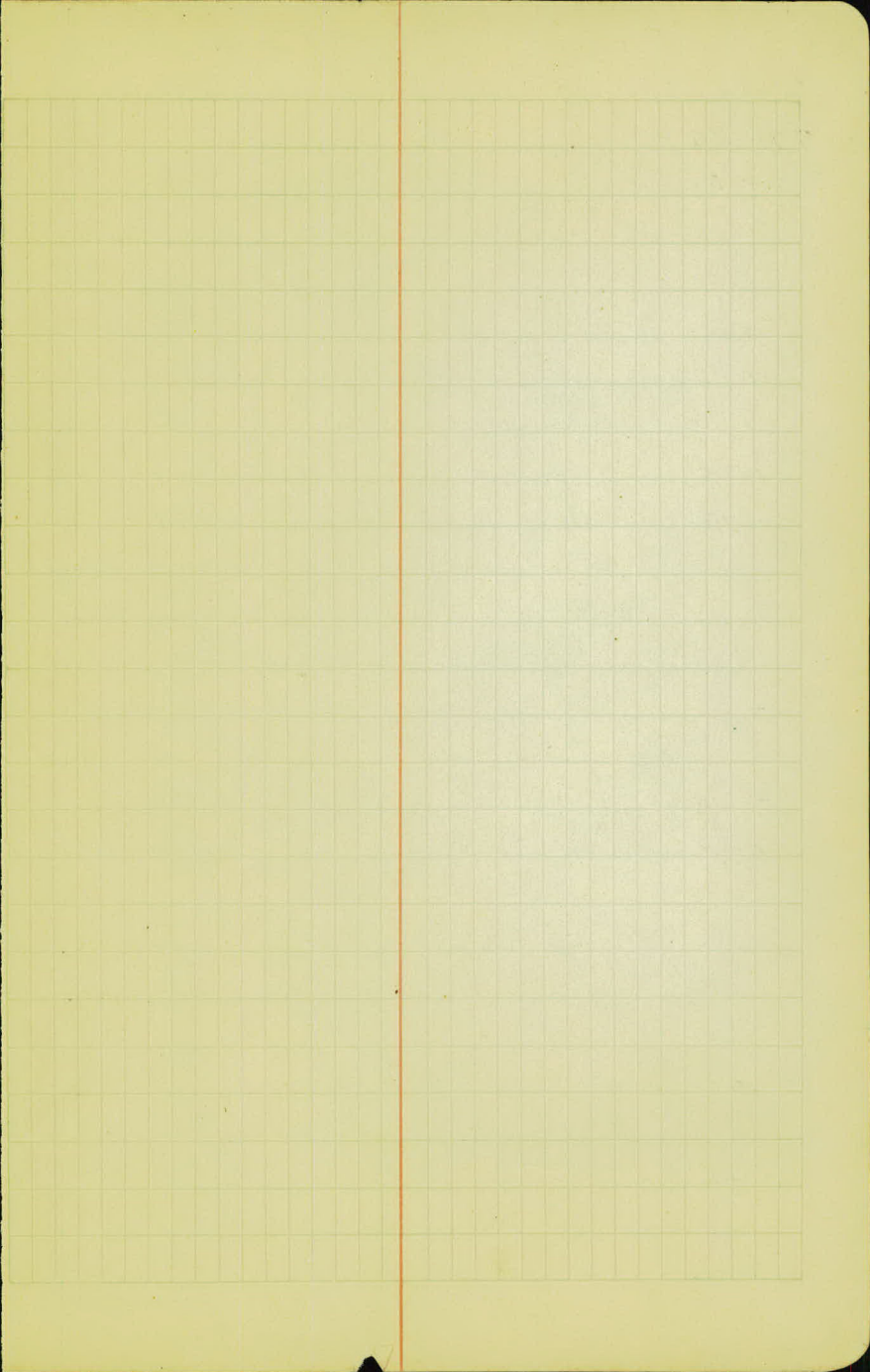


Profile

Grade

Station

x 77 + 00	245.4
+ 25	
+ 50	246.7
+ 75	
78 + 00	247.4
+ 25	
+ 50	247.8
+ 75	
x 79 + 00	248.0
80 + 00	247.8
81 + 00	247.6
92 + 00	247.4
+ 50	247.3
x 83 + 00	247.2
+ 25	
+ 50	246.9
+ 75	
84 + 00	246.3
+ 25	
+ 50	245.3
+ 75	
x 85 + 00	244.0



85 + 50

242.5

86 + 00

241.0

+ 50

239.5

x 87 + 00

239.0

+ 25

+ 50

236.7

+ 75

88 + 00

235.6

+ 25

+ 50

235.2

+ 75

x 89 + 00

234.7

90 + 00

234.4

+ 25

+ 50

+ 75

91 + 00

234.1

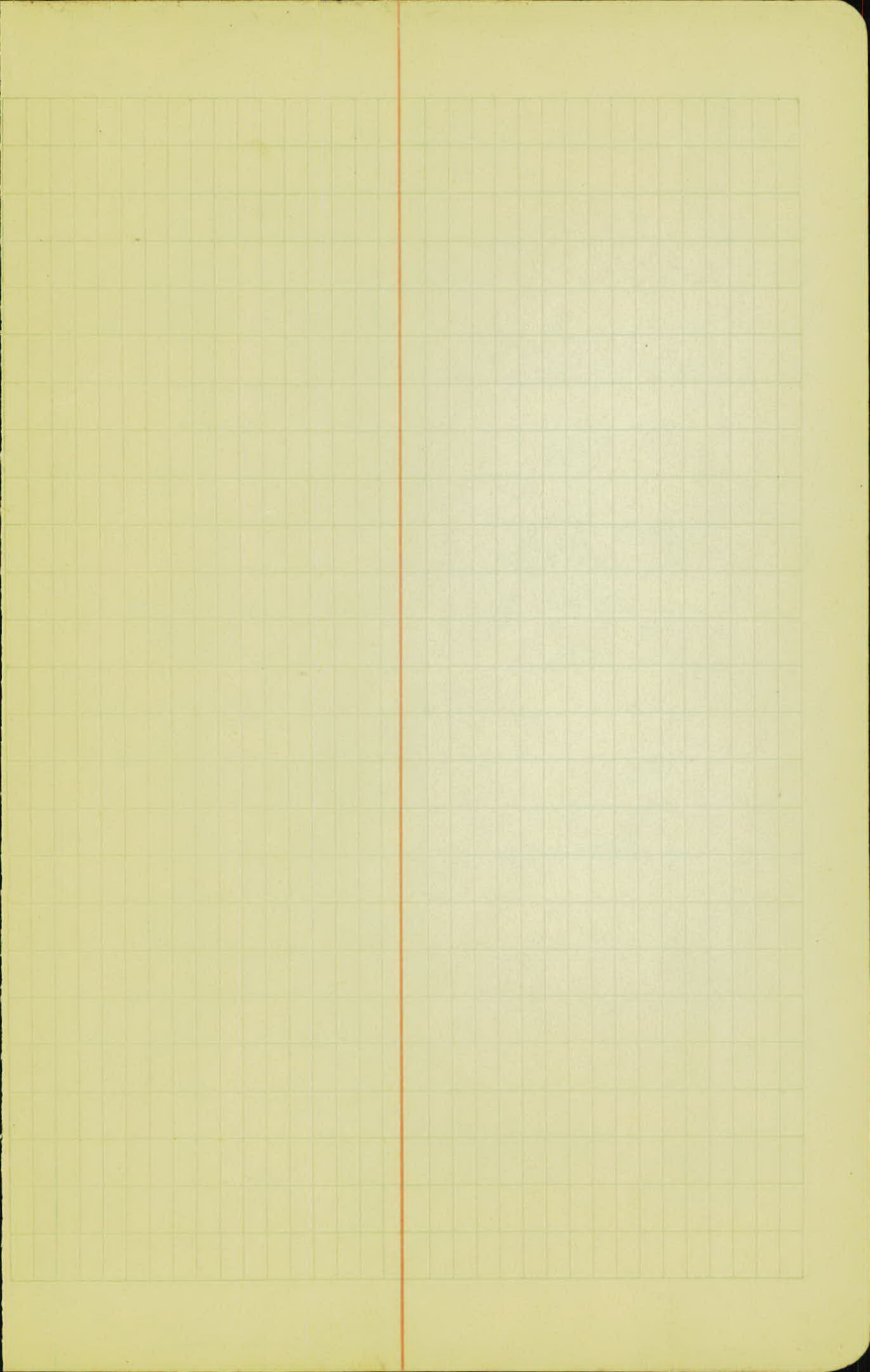
+

+ 50

- + 75

92 + 00

233.8



Profile
Grade

Station	+	H.I.	-	T.P.	
80+25 B.M	3.73	252.32		248.59	
77+40					246.2
78+00					247.4

L.

E

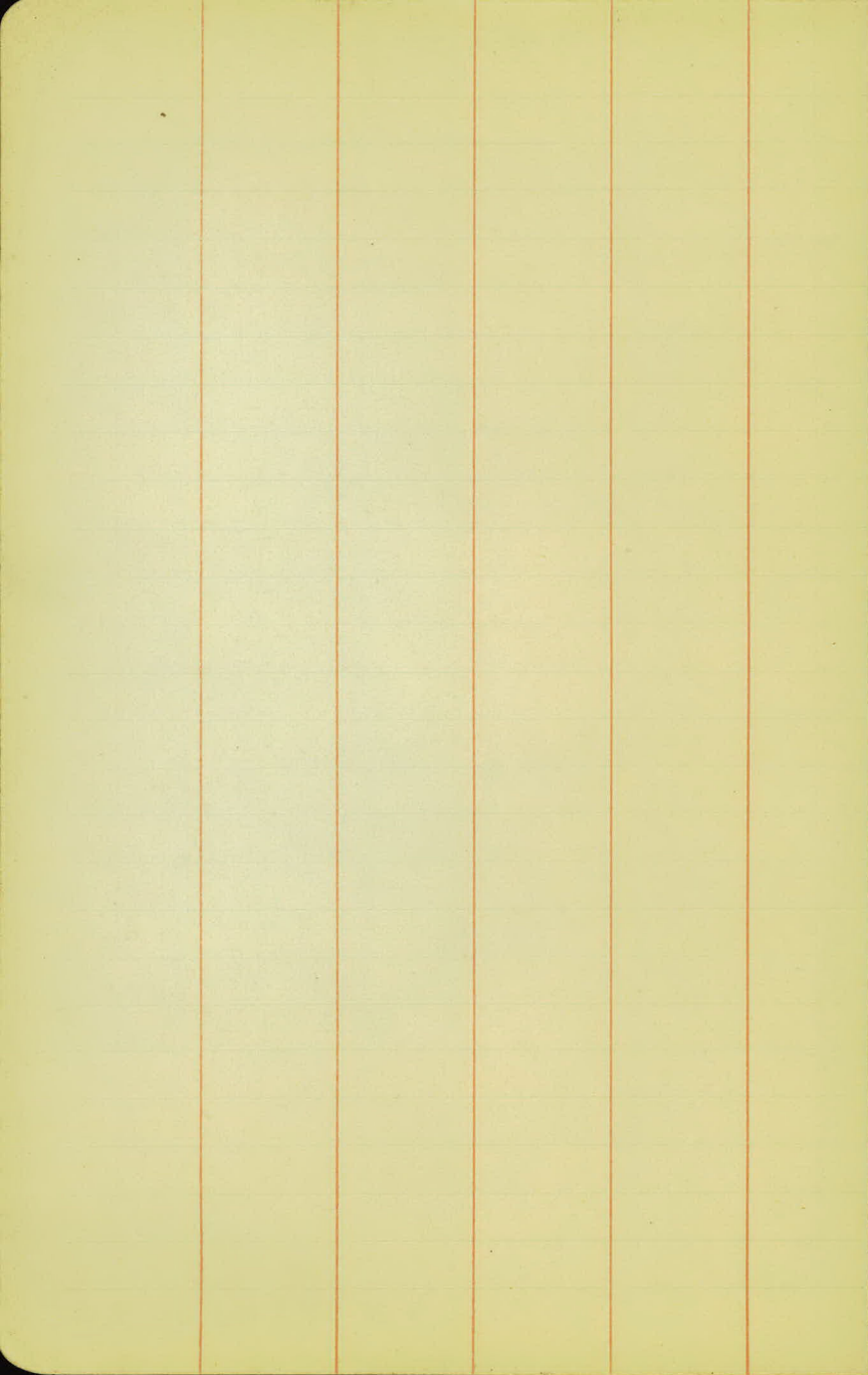
R

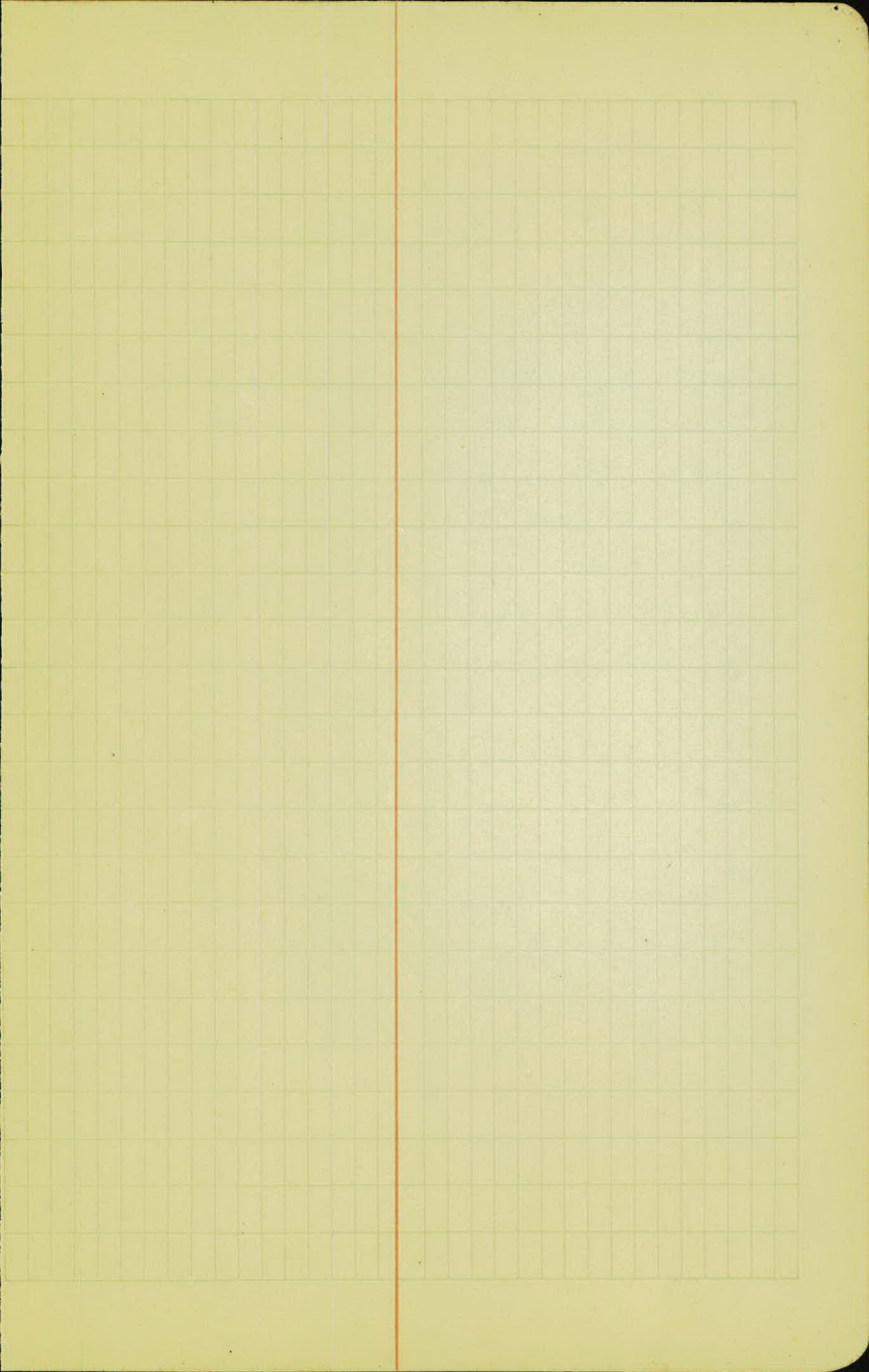
X							
$\frac{25}{33.0}$	$\frac{3.3}{26.3}$	$\frac{3.5}{16.0}$	$\frac{6.1}{12.8}$	$\frac{6.7}{12.0}$	$\frac{6.7}{11.0}$	$\frac{6.4}{9.0}$	6.0

$\frac{6.3}{12.0}$	$\frac{6.2}{15.0}$	$\frac{6.3}{16.3}$	$\frac{5.0}{33.0}$
--------------------	--------------------	--------------------	--------------------

X						
$\frac{3.5}{33.0}$	$\frac{3.6}{28.0}$	$\frac{4.2}{23.7}$	$\frac{4.9}{19.0}$	$\frac{5.7}{16.0}$	$\frac{5.6}{12.0}$	4.9

X			
$\frac{5.4}{10.0}$	$\frac{5.5}{15.0}$	$\frac{5.9}{17.5}$	$\frac{7.0}{20.0}$
			$\frac{7.0}{26.0}$
			$\frac{6.4}{29.0}$
			$\frac{6.6}{33.0}$





Station	+	H.I	-	T.P.	Profile Grade
{ B.M 10+00	10.92	274.84		263.92	
13+00					272.0
T.P.	10.26	284.78	0.32	274.52	
13+75					
14+00					274.3
+50					
15+00					276.7
16+00					279.1
+75					
17+00					280.8

G

E

R

$\frac{2.4}{33.0}$	$\frac{2.5}{33.5}$	$\frac{2.6}{16.0}$	$\frac{3.7}{12.0}$	$\frac{2.8}{7.5}$	$\frac{2.9}{7.0}$	3.0
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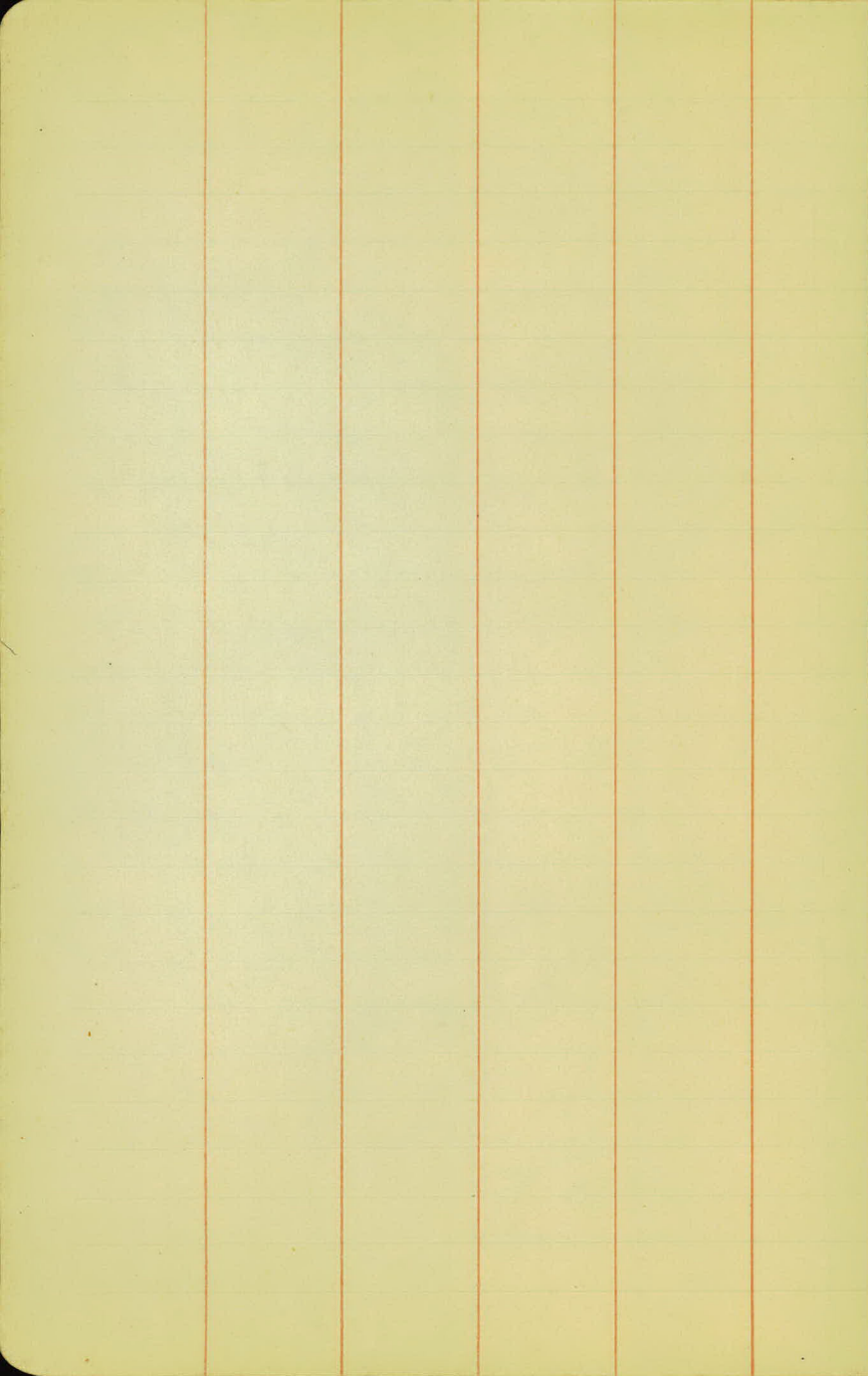
Macedo		
$\frac{3.2}{11.0}$	$\frac{3.3}{20.0}$	$\frac{4.8}{33.0}$

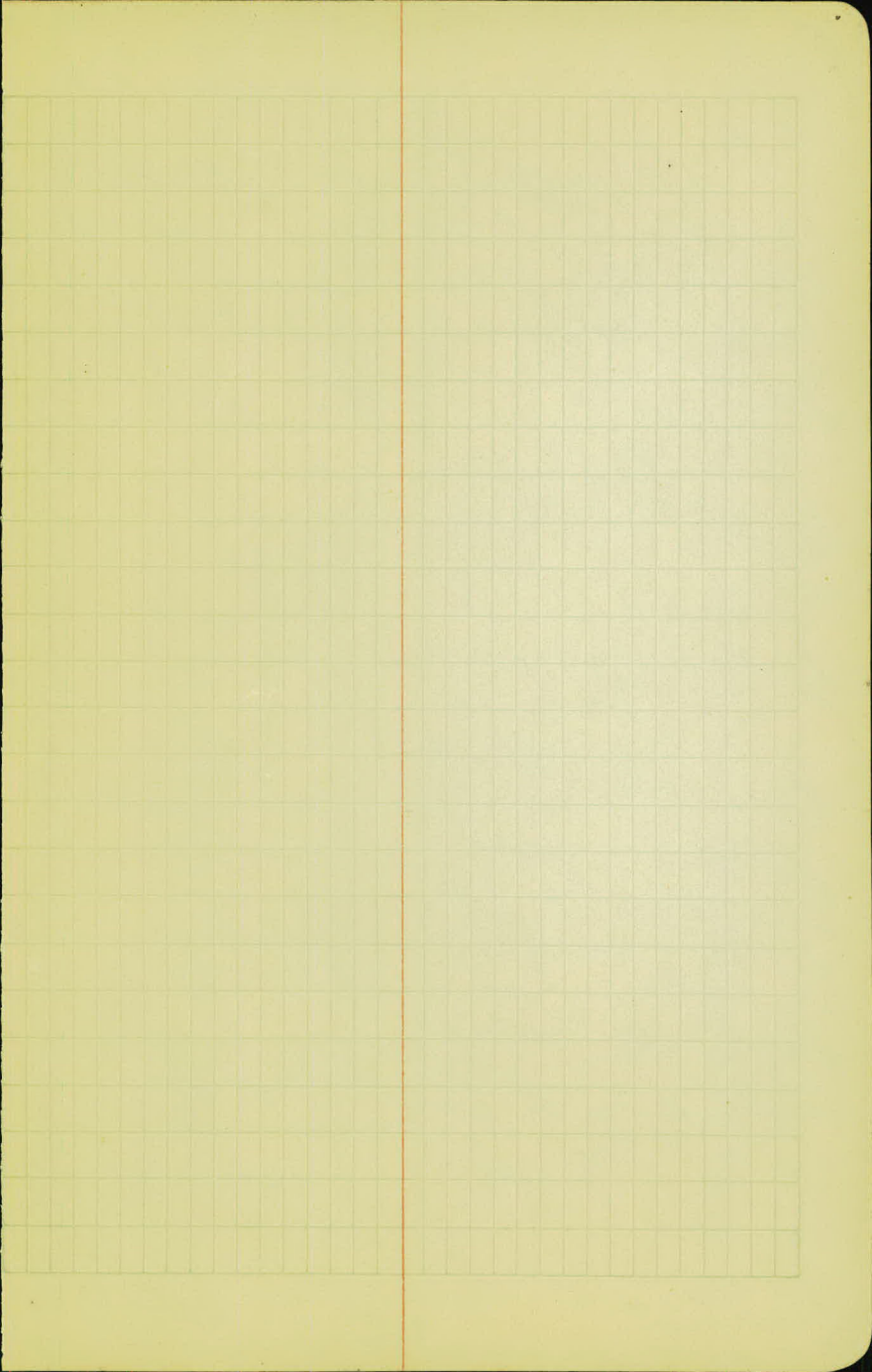
$\frac{7.6}{33.0}$	$\frac{10.1}{27.0}$	$\frac{19.7}{21.0}$	$\frac{10.1}{17.0}$	$\frac{10.9}{14.0}$	$\frac{10.5}{11.5}$	$\frac{10.3}{9.0}$	10.1	$\frac{12.7}{12.0}$	$\frac{11.2}{15.0}$	$\frac{11.0}{18.0}$	$\frac{11.8}{21.0}$	$\frac{12.0}{27.5}$	$\frac{11.8}{33.0}$
$\frac{8.5}{30.0}$	$\frac{9.2}{27.0}$	$\frac{10.3}{23.0}$	$\frac{10.4}{22.0}$	$\frac{10.2}{16.0}$	$\frac{10.0}{12.0}$	$\frac{9.3}{9.0}$	9.2	$\frac{10.1}{12.5}$	$\frac{10.5}{16.0}$	$\frac{10.1}{18.0}$	$\frac{10.5}{20.0}$	$\frac{10.0}{27.0}$	$\frac{9.5}{27.5}$

$\frac{9.1}{33.0}$	$\frac{9.7}{29.5}$	$\frac{9.2}{21.5}$	$\frac{8.2}{15.0}$	$\frac{8.8}{13.0}$	$\frac{8.7}{10.0}$	7.6	$\frac{7.8}{5.5}$	$\frac{8.5}{15.0}$	$\frac{8.8}{17.5}$	$\frac{9.1}{22.0}$	$\frac{8.9}{27.0}$	$\frac{3.2}{33.0}$	
$\frac{8.2}{31.0}$	$\frac{9.2}{27.0}$	$\frac{9.0}{21.5}$	$\frac{8.7}{16.9}$	$\frac{8.1}{15.0}$	$\frac{8.0}{14.8}$	$\frac{7.7}{10.0}$	6.7	$\frac{6.6}{3.5}$	$\frac{7.7}{13.0}$	$\frac{8.1}{15.2}$	$\frac{8.2}{16.8}$	$\frac{8.6}{19.5}$	$\frac{5.8}{23.0}$

$\frac{5.2}{33.0}$	$\frac{5.1}{31.0}$	$\frac{6.9}{27.0}$	$\frac{6.7}{17.5}$	$\frac{6.4}{16.0}$	$\frac{6.3}{12.5}$	$\frac{5.7}{10.5}$	$\frac{5.0}{10.0}$	5.1	$\frac{5.3}{6.5}$	$\frac{5.7}{10.8}$	$\frac{5.8}{12.0}$	$\frac{5.7}{14.0}$	$\frac{7.2}{16.0}$	$\frac{7.5}{17.0}$	$\frac{8.1}{19.7}$	$\frac{8.3}{33.0}$
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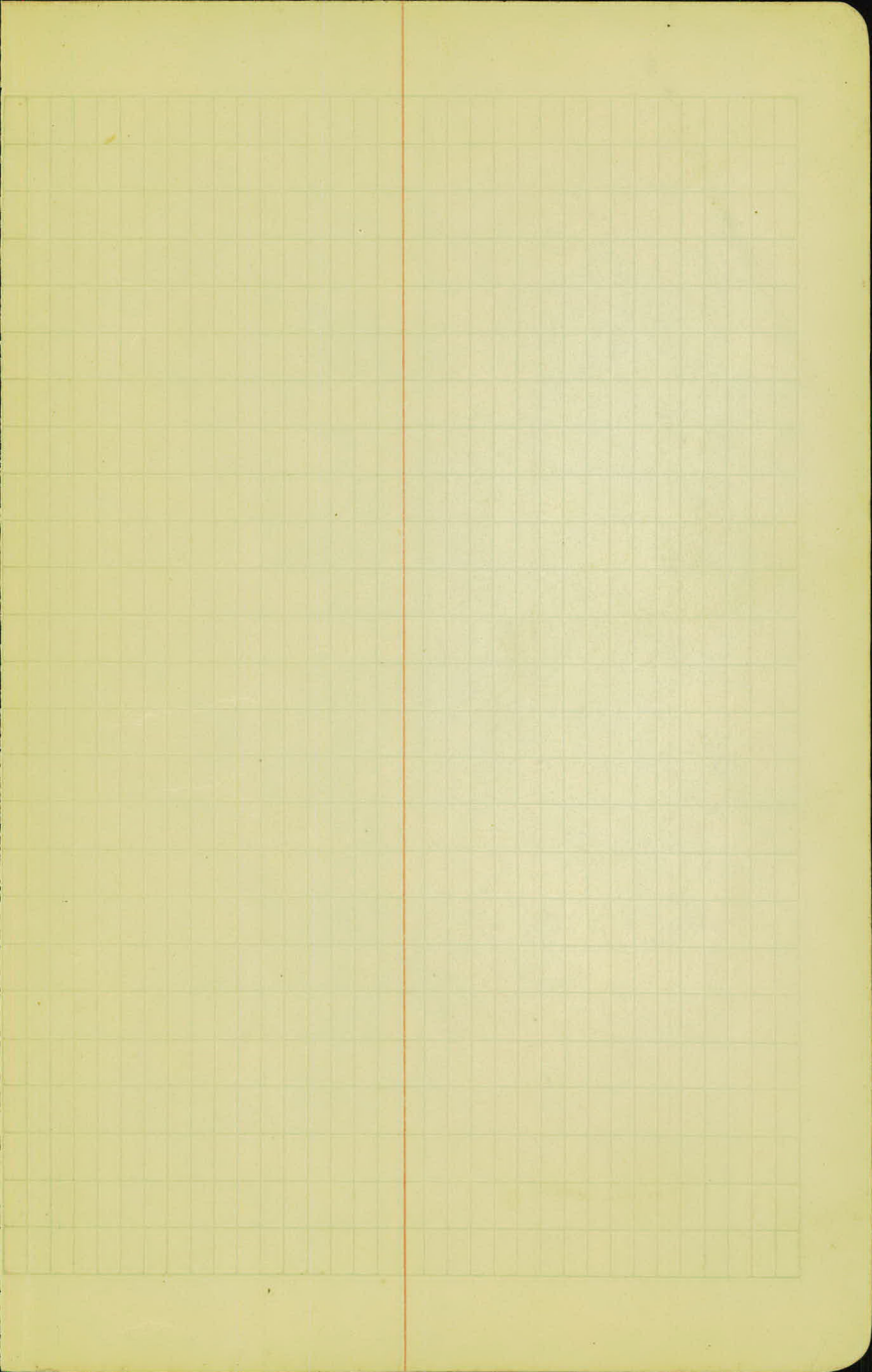
$\frac{2.2}{33.0}$	$\frac{4.0}{23.0}$	$\frac{4.5}{22.0}$	$\frac{4.4}{16.5}$	$\frac{4.9}{15.0}$	$\frac{5.0}{12.5}$	$\frac{4.5}{10.0}$	$\frac{3.8}{3.5}$	3.7	$\frac{3.8}{6.0}$	$\frac{4.3}{12.0}$	$\frac{5.6}{15.0}$	$\frac{6.0}{18.0}$	$\frac{5.3}{20.0}$	$\frac{5.7}{24.0}$	$\frac{6.3}{33.0}$
$\frac{2.34}{3.0}$	$\frac{3.7}{3.0}$	$\frac{4.5}{24.0}$	$\frac{4.5}{21.0}$	$\frac{4.6}{16.8}$	$\frac{4.4}{14.0}$	$\frac{4.0}{12.0}$	$\frac{3.4}{8.5}$	3.4	$\frac{3.5}{8.0}$	$\frac{4.0}{9.5}$	$\frac{4.4}{14.5}$	$\frac{5.4}{16.0}$	$\frac{5.3}{16.0}$	$\frac{4.1}{9.5}$	$\frac{4.6}{33.0}$





In of Intet at sta. 27+87.6

27+87.6 Filter Top Manhole = 268.04
27+87.6 vv flow line = 266.31
28+17.6 vv vv vv = 266.21



103+10 On Willow 75' West.

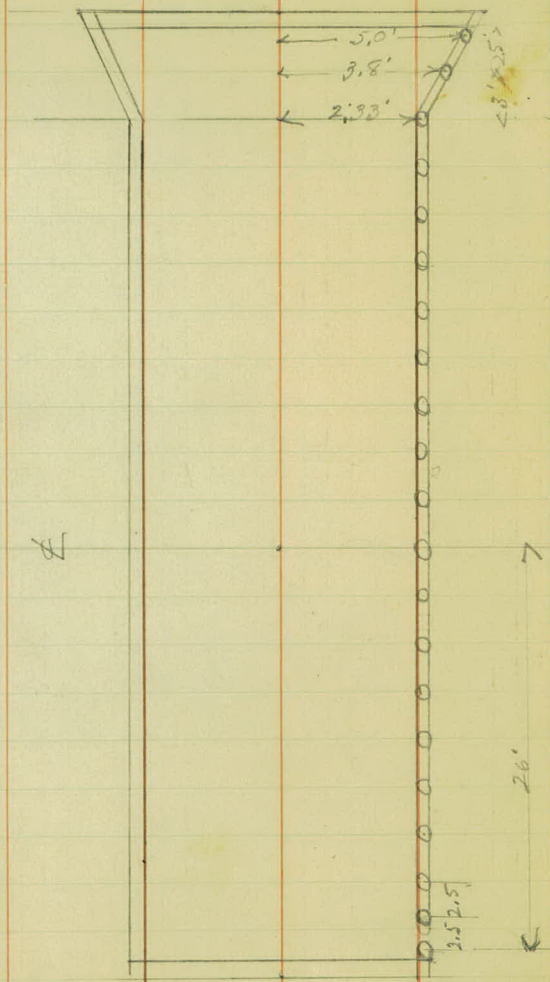
West end. Culvert Bottom Flume

Center vv vv vv

East end vv vv vv

On stake Near fence 75' Rt. Sta. 103+65

7



7

26'

2.5' x 2.5'

Φ

Σ X

27.0

33.75

217.00

216.81

217.08

217.09

217.00

216.45

216.60

216.75

216.00

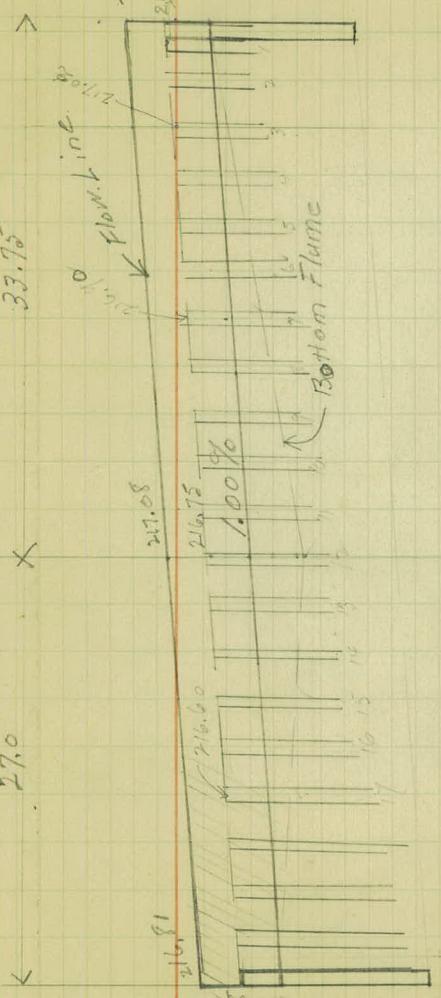
215.00

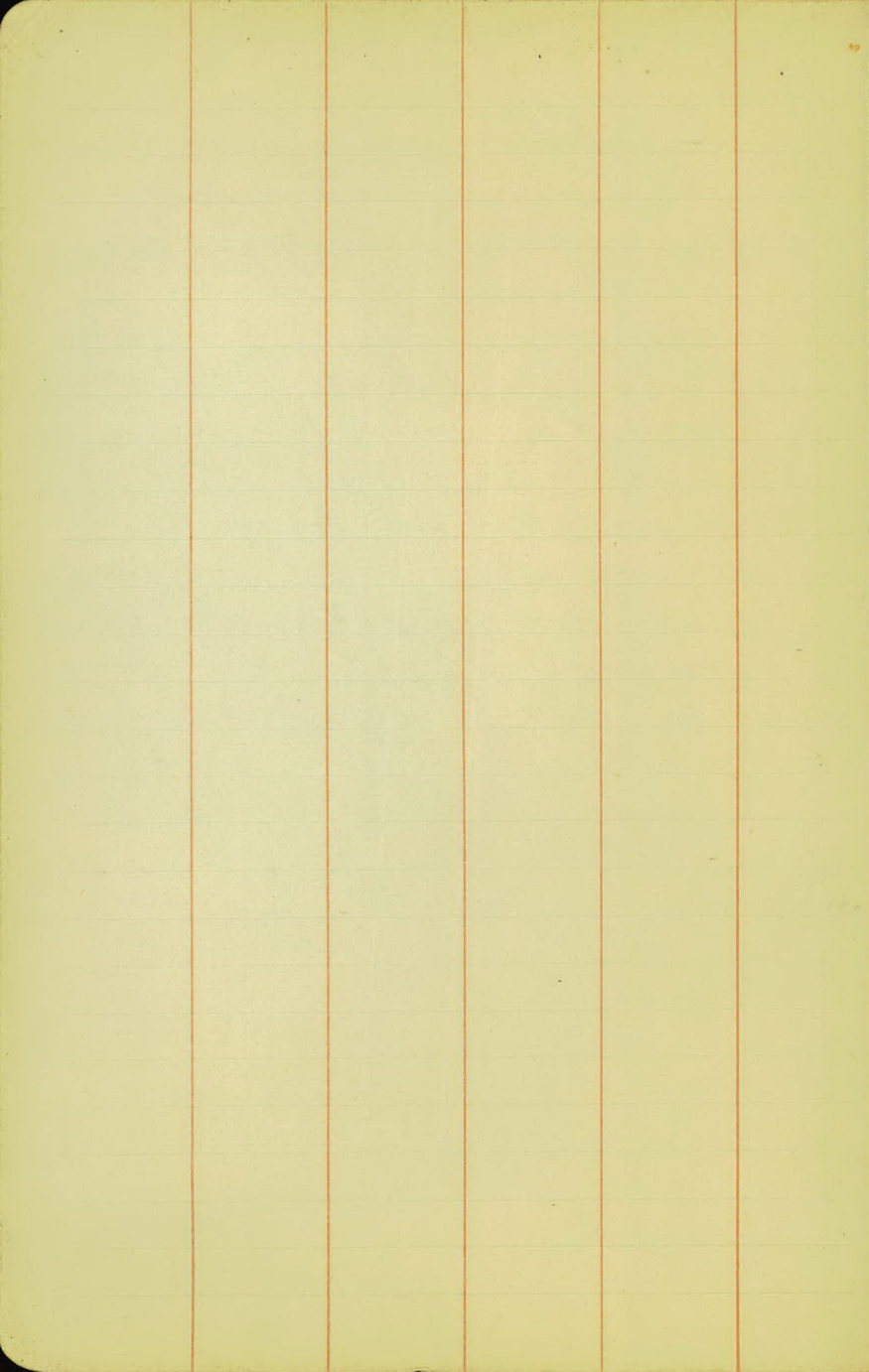
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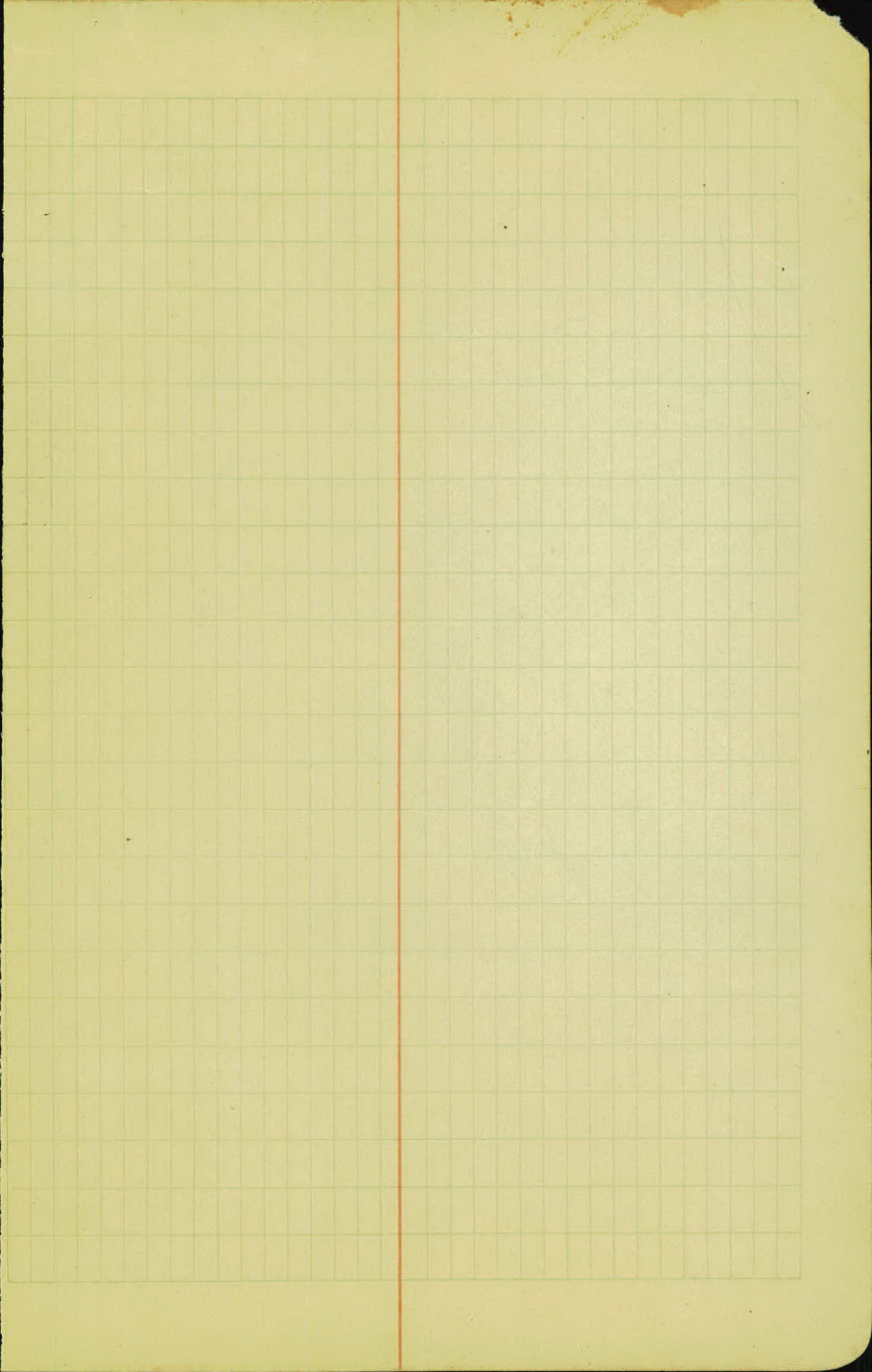
Flow Line

Bottom Flume

1.00%







Curve Ht. Sta. (61+68.2) P.I.
20° Curve Ht.

Station	Det.	Point	Profile Grade	Super. Elevation Per. foot.	Extra Width	
58+88.2		B.S.T.	229.64	+000		
59+13.3			229.35	-008		
59+38.3			229.09	+008		
59+63.2			228.90	-017		
59+88.2		B.W.T	228.70	+026	0.0	
60+13.2			228.60	+035	0.4	
60+38.2	0°00'	B.C.	228.60	-044	1.84	
60+63.2	20°30'		228.60	+053	3.30	
60+88.2	50°00'	E.S.T. E.W.T.	228.60	+062	3.72	
61+00	60°10'		228.6		}	
+25	60°40'		228.67			
+50	110°10'		228.75			
+75	130°40'		228.82			
62+00	160°10'		228.9			
+25	180°40'		228.97			
+32.2	190°24'	E.S.T. E.W.T.	229.00	+062		3.72
+57.2	210°10'		229.05	-053		3.30
+78	230°40'		229.12			
+82.2	240°24'	E.C.	229.15	+044		1.84
Equation	62+86.2 - 67+89.2					
63+09.2			229.22	+035	0.4	
63+34.2		B.W.T	229.30	-026	0.0	
+59.2			229.37	+017		
63+84.2			229.45	-008		
+09.2			229.52	-000		
64+34.2		B.S.T	229.60	-008		

L.

E

R.

Elevation

16'	15'	10'	10'	15'	16'
229.35	229.35	229.35	229.27	229.23	229.22
229.17	229.15	229.07	228.73	228.65	228.63
229.12	229.09	228.96	228.44	228.31	228.28
229.16	229.13	228.95	228.25	227.08	228.04
229.30	229.26	229.04	228.16	227.94	227.90
229.45	229.40	229.13	228.07	227.81	227.75
229.59	229.53	229.22	227.98	227.67	227.61
229.59	229.53	229.22	227.98	227.67	227.61
229.66	229.60	229.29	228.05	227.74	227.68
229.74	229.68	229.37	228.13	227.82	227.76
229.89	229.83	229.52	228.28	227.97	227.91
229.96	229.90	229.59	228.35	228.04	227.98
229.99	229.93	229.62	228.38	228.07	228.01
229.85					228.45
229.72					228.88

Curve at station 74+95 (I.T.)
10° Curve. Left

Station	Def	Point	Prop'd Grade	Super Elev Per cent	Extra Width	
71+95 [±]		B.S.T.	31.28	- .008		
72+20 [±]			31.96	+ .000		
72+45 [±]			32.66	- .008	✓	
72+70 [±]			33.36	+ .017		
72+95 [±]		B.W.T.	34.06	- .026	0.0	
73+20 [±]			34.76	+ .035	0.0	
73+45 [±]	0° 00'	B.C.	35.46	- .044	1.13	
+ 70 [±]	10° 15'		36.16	+ .053	1.99	
73+95 [±]	2° 30'	E.S.T. E.W.T.	36.86	- .062	2.29	
74+00	2° 44½'		37.00		}	
+ 25	3° 59½'		37.70			
+ 50	5° 14½'		38.40			
+ 75	6° 29½'		39.10			
75+00	7° 44½'		39.80			
+ 25	8° 59½'		40.50			
+ 50	10° 14½'		41.20			
+ 75	11° 29½'		41.90			
75+93 [±]	12° 25½'	E.W.T. E.S.T.	42.40	+ .062		2.29
76+18 [±]	13° 40½'		43.10	- .053		1.99
76+43 [±]	14° 55½'	E.C.	43.80	+ .044	1.13	
+ 68 [±]			44.50	- .035	0.29	
+ 93 [±]		B.W.T.	45.20	+ .026	0.0	
77+18 [±]			45.90	- .017	✓	
+ 43 [±]			46.60	+ .008	✓	
+ 68 [±]			47.30	- .000		
77+93 [±]		B.S.T.	47.40	+ .008		

L E R.

16'	15'	10'	10'	15'	16'
231.83	231.84	231.88	231.96	231.96	231.96
232.53	232.54	✓232.58	232.74	✓232.78	232.79
233.09	233.10	✓233.19	233.53	✓233.62	233.64
233.64	233.67	✓233.80	234.32	✓234.45	234.48
234.20	234.23	✓234.41	235.11	✓235.29	235.32
234.76	234.80	✓235.02	235.90	236.12	235.16
235.31	235.36	235.63	236.69	✓236.96	237.01
235.87	235.93	236.24	237.48	✓237.79	237.85
236.01	236.07	236.38	237.62	✓237.93	237.99
236.71	236.77	237.08	238.32	✓238.63	238.69
237.41	237.47	237.78	239.02	✓239.33	239.39
238.11	238.17	238.48	239.72	✓240.03	240.09
238.81	238.87	239.18	240.42	✓240.73	240.79
239.51	239.57	239.88	241.12	✓241.43	241.49
240.21	240.27	240.58	241.82	✓242.13	242.19
240.91	240.97	241.28	242.52	✓242.83	242.89
241.41	241.47	241.78	243.02	✓243.33	243.39
242.25	242.30	242.57	243.63	✓243.90	243.95
243.10	243.14	243.36	244.24	✓244.46	244.50
243.94	243.97	244.15	244.85	✓245.03	245.06
244.78	244.81	244.94	245.46	✓245.59	245.62
245.62	245.64	245.73	✓246.07	✓246.16	246.18
246.47	246.48	246.52	✓246.68	✓246.72	246.73
247.17	247.18	247.22	✓247.30	✓247.30	247.30
		247.32	✓247.32		

80+13.05

+31.8

+50.55

80+693 0000

+88.05

~~6445~~
B.S.T

18.75

37.50

56.25

B.C.

75

E.S.T

-002

-003

+004

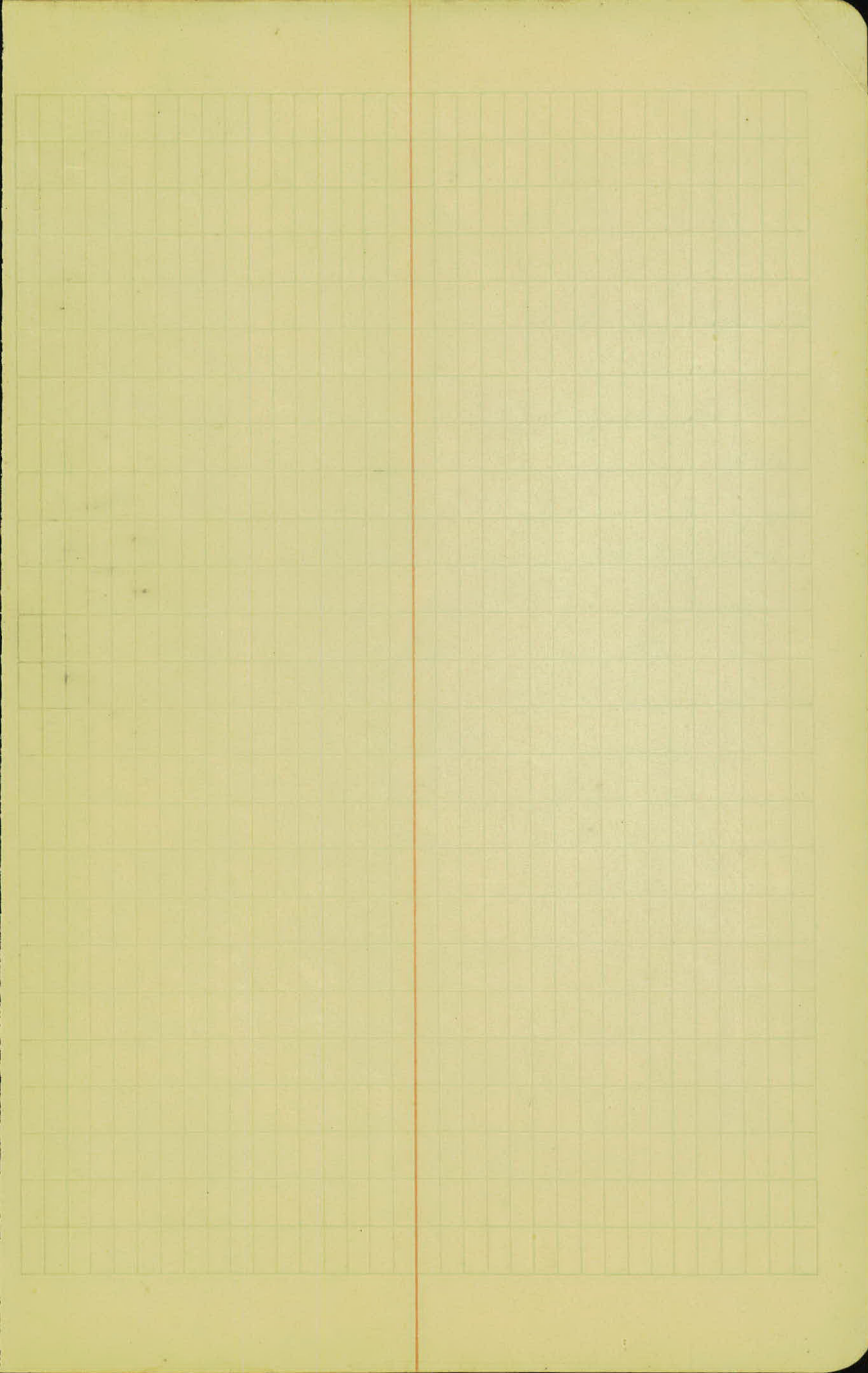
-008

+01

-01

+018

-018



Curve Ht. Station 100+91.9
50 Curve Right.

Station	Def	Point	Profile Grade	Super. Elev. ^{Per. St.}	Extra Width
98+96.1		B.S.T.	230.2	-0.08 -0.08 +0.00 -0.08 +0.05	
99+33.6		37.5	230.17	-0.08 +0.017	
99+71.1		75'	230.13	-0.017 +0.026	
99+78.5		100'	230.10	-0.026 +0.030	
100+08.6	0° 00'	B.C. ^{112.5}	230.09	-0.030 +0.035	
100+21.1		125'	230.08	-0.035 +0.044	
100+46.1	0° 56'	E.S.T.	230.05	-0.044	
+50	1° 02'		230.05	}	
+75	1° 39 1/2'		230.02		
101+00	2° 17'		230.00		
+25			229.97		
+36.8	3° 12'	E.S.T. ^{150'}	229.96	+0.044 -0.044	
+74.2	4° 08 1/2'	E.C. ^{112.5}	229.93	+0.030 -0.030	
102+11.8		75'	229.89	+0.017 -0.017	
+49.3		37.5	229.85	+0.05 -0.08	
+86.8		B.S.T.	229.81	-0.08 +0.08	

Profile Grades

L
±
R

22.0
22.4
27.5

16'	15'	10'	10'	15'	16'
		230.12	230.12		
		230.22	230.09		
230.40	230.38	230.30	229.96	229.88	229.86
230.52	230.49	230.55	229.86	229.71	229.68
230.57	230.54	230.39	229.79	229.64	229.61
230.64	230.60	230.45	229.72	229.56	229.52
230.75	230.71	230.49	229.61	229.39	229.35
230.75	230.71	230.49	229.61	229.39	229.35
230.72	230.68	230.46	229.58	229.36	229.32
230.70	230.66	230.44	229.56	229.34	229.30
230.67	230.63	230.41	229.53	229.31	229.27
230.66	230.62	230.40	229.52	229.30	229.26
		230.23	229.63		
		230.06	229.72		
		229.90	229.77		
		229.73	229.73		

5° Curve. S.T. = 150'

	Dist			Super Elev Per ft	
122+37.4		B.S.T	236.37	-008	
122+74.7		37 1/2	236.75	+005	236.75
123+12.0		75	237.12	-017	
123+49.9		112.5		+030	
= 123+48.4	0000'	B.C.	237.50	-030	
+65.9	0056'	150'		+044	
		F.S.T	237.86	-044	
124+20	1047'		238.15	+044	
+50	2032'			-044	
			238.47	-044	
124+72.2	3006'	150		+044	
		F.S.T.	238.65	-044	
125+09.3	4002'	112.5		+030	
		F.C.	239.00	-030	
125+47.3		75'	239.20	+017	
125+84.7		37.5	239.40	-005	
126+72.2				-008	
		B.S.T.	239.61	+008	

h

E

P.

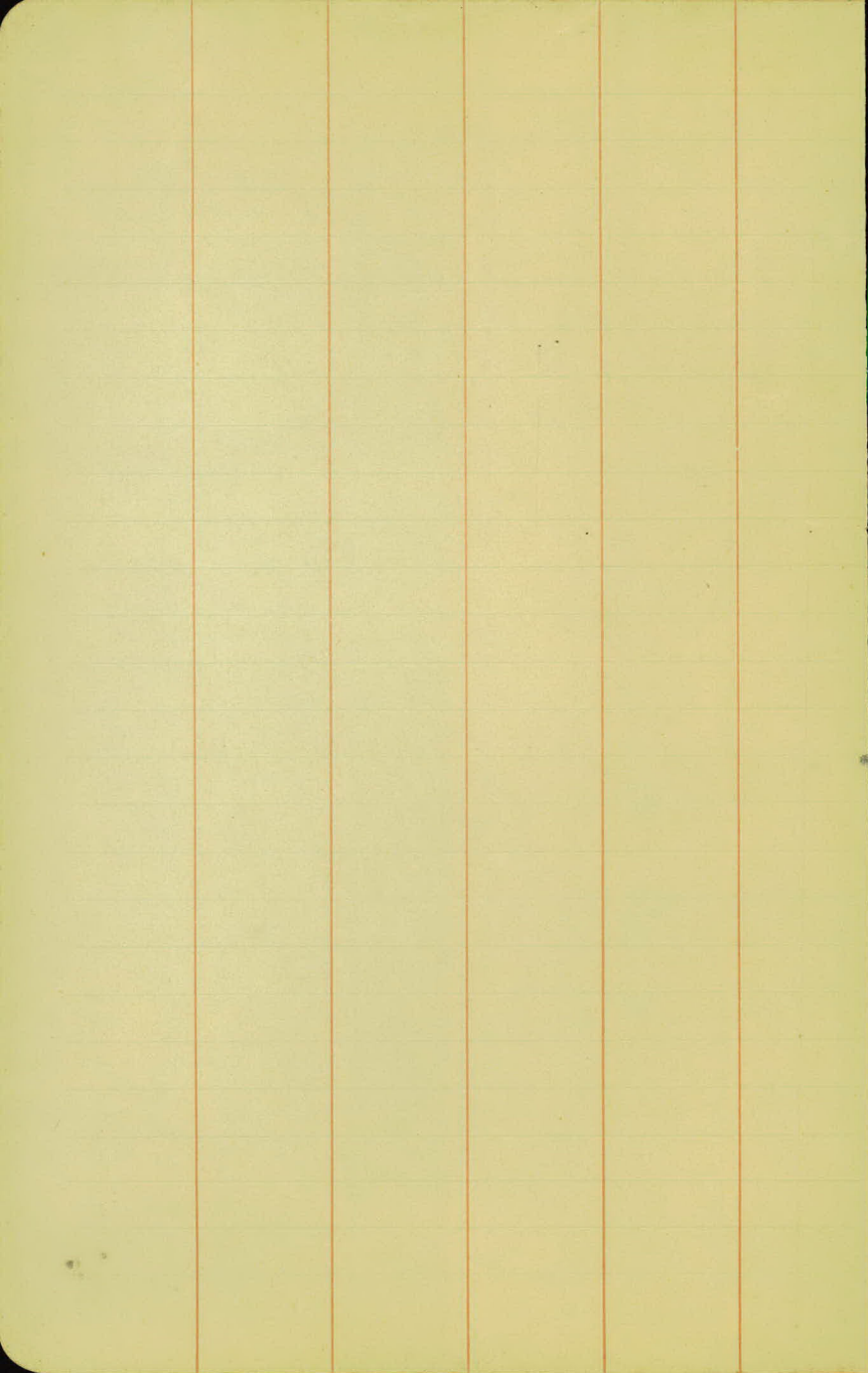
236.29 ✓	236.37	236.29 ✓
236.67 ✓	236.75	236.80 ✓
236.95 ✓	237.12	237.29 ✓
237.20 ✓	237.50	237.80 ✓
237.42 ✓	237.86	238.30 ✓
237.71 ✓	238.15	238.59 ✓
238.03 ✓	238.47	238.91 ✓
238.21 ✓	238.65	239.09 ✓
238.70 ✓	239.00	239.30 ✓
239.03 ✓	239.20	239.37 ✓
239.32 ✓	239.40	239.45 ✓
239.53 ✓	239.61	239.53 ✓

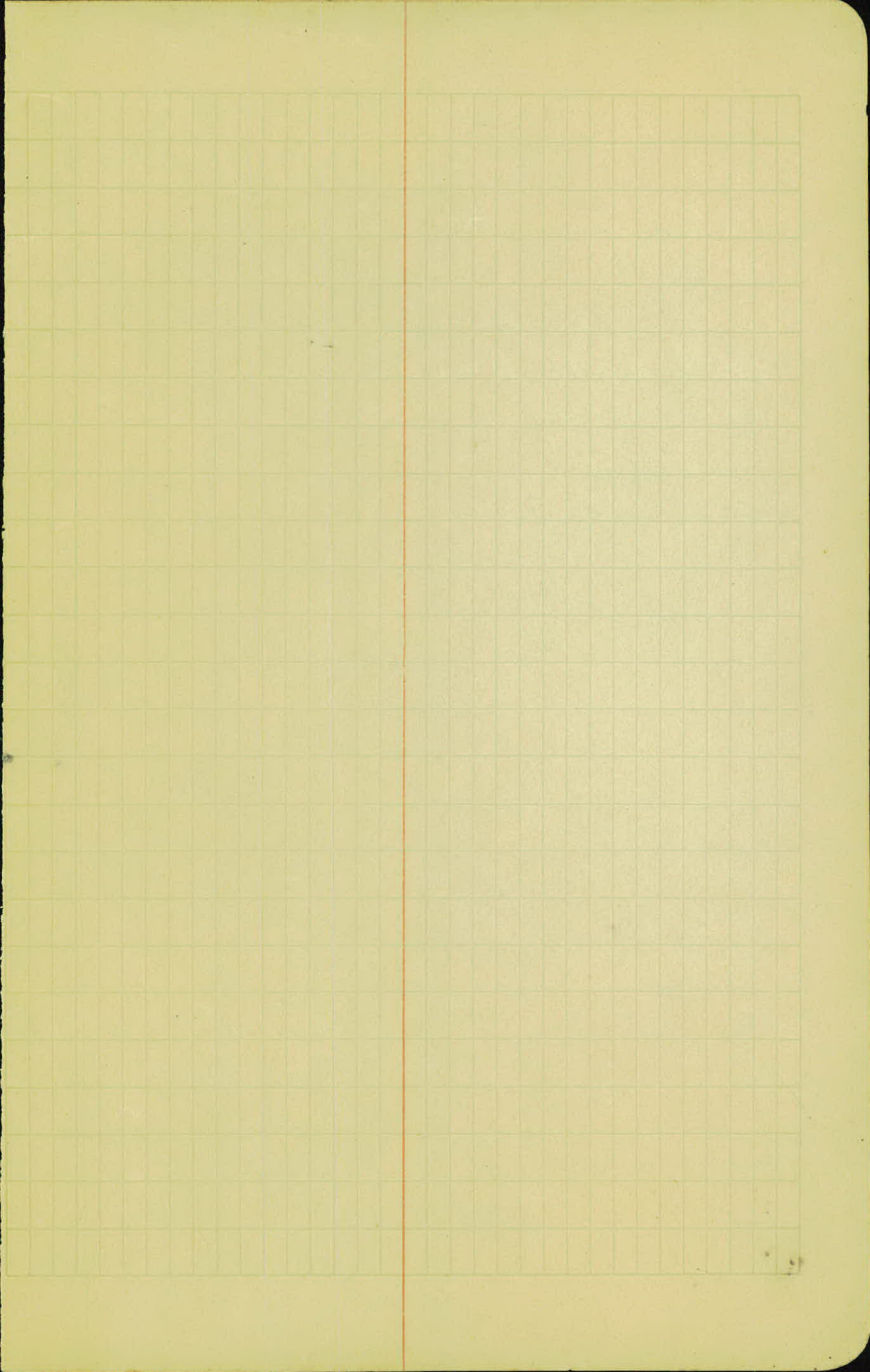
Station	Offset	Point	Super Pen. ft.	Profile Grade
139+33-		B.S.T.	-000	45.46 ✓
139+58-		25	-001	45.61 ✓
139+83-		50	+008	245.78 ✓
= { 140+08 ¹ / ₂ -			-008	
{ 140+06 ¹ / ₂ -	0°00'	B.C. 75	+017	45.95 ✓
140+31 ¹ / ₂	0°22 ¹ / ₂	¹⁰⁰ E.S.T.	-017	46.13 ✓
+65	0°52 ¹ / ₂		+027	46.35 ✓
140+98 ⁹ / ₂	1023'	E.S.T.	+027	46.59 ✓
141+23 ⁹ / ₂	1045 ¹ / ₂ '	F.C. 75	-027	46.77 ✓
+48 ⁹ / ₂		50	+017	46.94 ✓
+73 ⁹ / ₂		25	+008	47.12 ✓
+98 ⁹ / ₂		B.S.T.	-001	
			-008	

12.45
32.45

44.90

pls +





4° Curve Left.

Station	Def Point	Point	Profile Grade	Super Elev Per foot
156+71.85		B.S.T.	-0.008	56.99
157+03.1		51.25	+0.002 -0.008	57.11
157+34.35		62.5	+0.013 -0.013	57.24
157+65.6	0000'	B.C. 73.75	+0.024 -0.024	57.36
+96.85	0031 1/2'	E.S.T.	+0.035 -0.035	57.49
158+00	0041'	✓	}	57.50
+25	10 11'	✓		57.62
+50	10 41'			57.80
+75	20 11'			58.03
159+00	20 41'			58.30
+25	30 11'			58.50
+50	30 41'			58.87
+75	40 11'			58.97
160+00	40 41'			59.1
+25	50 11'			59.16
+34.35	50 22 1/2'	E.S.T.	+0.035 -0.035	59.16
+65.6	6000'	E.C. 73.75	+0.024 -0.024	59.16
+96.85		62.5	+0.013 -0.013	59.16
161+28.1		51.25	+0.002 -0.008	58.89
+59.35		B.S.T.	-0.008 -0.008	58.63

L

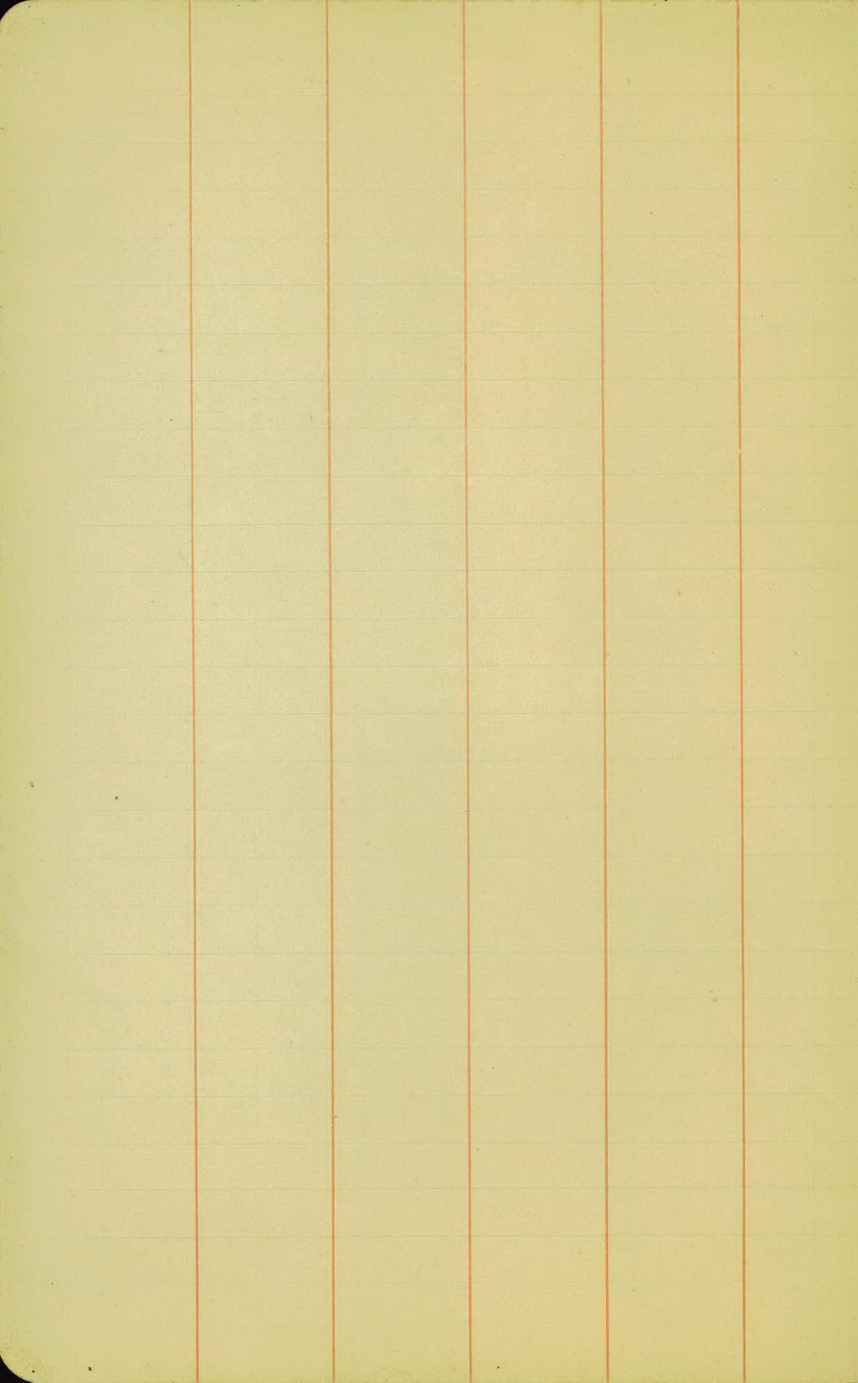
E

R

10' Left.

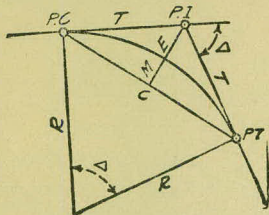
10' Right.

56.91 ✓	56.99	56.91 ✓
57.03 ✓	57.11	57.13 ✓
57.11 ✓	57.24	57.37 ✓
57.12 ✓	57.36	57.60 ✓
57.14 ✓	57.49	57.84 ✓
57.15	57.50 ✓	57.95
57.27 ✓	57.62	57.97 ✓
57.45 ✓	57.80	58.15 ✓
57.68 ✓	58.03	58.38 ✓
57.95 ✓	58.30 ✓	58.65 ✓
58.15 ✓	58.50	58.85 ✓
58.52 ✓	58.87 ✓	59.22 ✓
58.62 ✓	58.97	59.32 ✓
58.75 ✓	✓ 59.10	59.45 ✓
58.81	59.16	59.51
58.81 ✓	59.16	59.51 ✓
58.92 ✓	59.16	59.40 ✓
59.03 ✓	59.16	59.29 ✓
58.81 ✓	58.99	58.91
58.55 ✓	58.63	58.55 ✓



DIETZGEN'S RAILROAD CURVE AND REDUCTION TABLES

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CURVE FORMULAS

$$\text{Radius} = R = \frac{50}{\sin. \frac{D}{2}} \quad (1) \quad \text{Degree of Curve} = D \text{ and } \sin. \frac{D}{2} = \frac{50}{R} \quad (2)$$

$$\text{Tangent} = T = R \tan \frac{\Delta}{2} \quad (3) \quad \text{Length of Curve} = L = 100 \frac{\Delta}{D} \quad (4)$$

$$\text{Middle ordinate} = M = R(1 - \cos. \frac{\Delta}{2}) \quad (5) = R \text{vers} \frac{\Delta}{2} \quad (6)$$

$$\text{External} = E = T \tan \frac{\Delta}{4} \quad (7) = R \div \cos. \frac{\Delta}{2} - R \quad (8) = R \text{exsec} \frac{\Delta}{2} \quad (9)$$

$$\text{Long Chord} = C = 2 R \sin. \frac{\Delta}{2} \quad (10) \quad \Delta = \text{Central Angle}$$

EXPLANATION AND USE OF TABLES

Stations.—Given P. I.—Sta. 161 + 60.35 to find Sta. of P. C. and P. T. $\Delta = 62^\circ 10'$ $D = 8^\circ 20'$. From Table IV for 1° curve $T = 3454.1$ and $\div 8\frac{1}{2} = 414.49$ ft. From Table V correction = .36 or $T = 414.85$ ft. P. C. = Sta. P. I. — $T = 157 + 45.50$. Also from (4) $L = 746.00$ and P. T. = Sta. P. C. + $L = 164 + 91.50$.

Offsets.—Tangent offsets vary (approximately) directly with D and with square of the distance. Thus tangent offset for Sta. 158 on above curve is 2.16 ft. found as follows. From Table III tangent offset for 100 ft. = 7.27 ft. Distance = 158 — Sta. P. C. = 54.50, hence offset = 7.27 $(54.50 \div 100)^2 = 2.16$ ft. Also square of any distance divided by twice the radius equals (approximately) the distance from tangent to curve. Thus $(54.50)^2 \div (2 \times 688.26) = 2.16$ ft.

Deflections.—Deflection angle = $\frac{1}{2} D$ for 100 ft., $\frac{1}{4} D$ for 50 ft., etc. For c ft. = (in minutes) $.3 \times C \times D^\circ$ or = defl. for 1 ft. from Table III $\times C$. For Sta. 158 of above curve = $.3 \times 54.5 \times 8\frac{1}{2} = 136.2'$ or $2^\circ 16.2'$, or = $2.50 \times 54.5 = 136.2'$ from Table III. For Sta. 159 deflection angle = $2^\circ 16.2' + 8^\circ 20' \div 2 = 6^\circ 26.2'$, etc.

Externals.—May be found in similar manner to tangents. Thus E for curve above is 91.37. For from Table IV for 1° curve $E = 960.0$ for $8^\circ 20' = 960.6 \div 8\frac{1}{2} = 91.27$ and from Table V correction = .10 or $E = 91.37$ ft. Or suppose $\Delta = 32^\circ$ and E is measured and found to be 42 ft. What is D ? From Table IV $E = 230.9$ and $\div 42 = 5.5$ or $D = 5^\circ 30'$.

TABLE I.—MINUTES IN DECIMALS OF A DEGREE.

1'	.0167	11'	.1833	21'	.3500	31'	.5167	41'	.6833	51'	.8500
2	.0333	12	.2000	22	.3667	32	.5333	42	.7000	52	.8667
3	.0500	13	.2167	23	.3833	33	.5500	43	.7167	53	.8833
4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

TABLE II.—INCHES IN DECIMALS OF A FOOT.

1-16	3-32	1/8	3-16	1/4	5-16	3/8	1/2	5/8	3/4	7/8
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729
1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

TABLE III.—RADI, ORDINATES AND DEFLECTIONS.

Deg.	Radius	Mid. Ord.	Tan. Offset	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Offset	Def. for 1 Foot
0° 10'	34377.5	.036	.145	0.05	7°	819.02	1.528	6.105	2.10
20	17188.8	.073	.291	0.10	20'	781.84	1.600	6.395	2.20
30	11459.2	.109	.436	0.15	30	764.49	1.637	6.540	2.25
40	8594.42	.145	.582	0.20	40	747.89	1.673	6.685	2.30
50	6875.55	.182	.727	0.25					
1	5729.65	.218	.873	0.30	8	716.78	1.746	6.976	2.40
10	4911.15	.255	1.018	0.35	20	688.16	1.819	7.266	2.50
20	4297.28	.291	1.164	0.40	30	674.69	1.855	7.411	2.55
30	3819.83	.327	1.309	0.45	40	661.74	1.892	7.556	2.60
40	3437.87	.364	1.454	0.50					
50	3125.36	.400	1.600	0.55	9	637.28	1.965	7.846	2.70
					20	614.56	2.037	8.136	2.80
2	2864.93	.436	1.745	0.60	30	603.80	2.074	8.281	2.85
10	2644.58	.473	1.891	0.65	40	593.42	2.110	8.426	2.90
20	2455.70	.509	2.036	0.70					
30	2292.01	.545	2.181	0.75	10	573.69	2.183	8.716	3.00
40	2148.79	.582	2.327	0.80	30	546.44	2.292	9.150	3.15
50	2022.41	.618	2.472	0.85	11	521.67	2.402	9.585	3.30
					30	499.06	2.511	10.02	3.45
3	1910.08	.655	2.618	0.90	12	478.34	2.620	10.45	3.60
10	1809.57	.691	2.763	0.95	30	459.28	2.730	10.89	3.75
20	1719.12	.727	2.908	1.00	13	441.68	2.839	11.32	3.90
30	1637.28	.764	3.054	1.05	30	425.40	2.949	11.75	4.05
40	1562.88	.800	3.199	1.10	14	410.28	3.058	12.18	4.20
50	1494.95	.836	3.345	1.15	30	396.20	3.168	12.62	4.35
4	1432.69	.873	3.490	1.20	15	383.07	3.277	13.05	4.50
10	1375.40	.909	3.635	1.25	30	370.78	3.387	13.49	4.65
20	1322.53	.945	3.718	1.30	16	359.27	3.496	13.92	4.80
30	1273.57	.982	3.926	1.35	30	348.45	3.606	14.35	4.95
40	1228.11	1.018	4.071	1.40	17	338.27	3.716	14.78	5.10
50	1185.78	1.055	4.217	1.45	18	319.62	3.935	15.64	5.40
					19	302.94	4.155	16.51	5.70
5	1146.28	1.091	4.362	1.50	20	287.94	4.374	17.37	6.00
10	1109.33	1.127	4.507	1.55	21	274.37	4.594	18.22	6.30
20	1074.68	1.164	4.653	1.60	22	262.04	4.814	19.08	6.60
30	1042.14	1.200	4.798	1.65	23	250.79	5.035	19.94	6.90
40	1011.51	1.237	4.943	1.70	24	240.49	5.255	20.79	7.20
50	982.64	1.273	5.088	1.75					
					25	231.01	5.476	21.64	7.50
6	955.37	1.309	5.234	1.80	26	222.27	5.697	22.50	7.80
10	929.57	1.346	5.379	1.85	27	214.18	5.918	23.35	8.10
20	905.13	1.382	5.524	1.90	28	206.68	6.139	24.19	8.40
30	881.95	1.418	5.669	1.95	29	199.70	6.360	25.04	8.70
40	859.92	1.455	5.814	2.00	30	193.18	6.583	25.88	9.00

Note. Chord Deflection=2 times tangent deflection.

TABLE IV.—TANGENTS AND EXTERNALS TO A 1° CURVE.

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
1°	50.00	.22	11°	551.70	26.50	21°	1061.9	97.57
10'	58.34	.30	10'	560.11	27.31	10'	1070.6	99.16
20	66.67	.39	20	568.53	28.14	20	1079.2	100.75
30	75.01	.49	30	576.95	28.97	30	1087.8	102.35
40	83.34	.61	40	585.36	29.82	40	1096.4	103.97
50	91.68	.73	50	593.79	30.68	50	1105.1	105.60
2	100.01	.87	12	602.21	31.56	22	1113.7	107.24
10	108.35	1.02	10	610.64	32.45	10	1122.4	108.90
20	116.68	1.19	20	619.07	33.35	20	1131.0	110.57
30	125.02	1.36	30	627.50	34.26	30	1139.7	112.25
40	133.36	1.55	40	635.93	35.18	40	1148.4	113.95
50	141.70	1.75	50	644.37	36.12	50	1157.0	115.66
3	150.04	1.96	13	652.81	37.07	23	1165.7	117.38
10	158.38	2.19	10	661.25	38.03	10	1174.4	119.12
20	166.72	2.43	20	669.70	39.01	20	1183.1	120.87
30	175.06	2.67	30	678.15	39.99	30	1191.8	122.63
40	183.40	2.93	40	686.60	40.99	40	1200.5	124.41
50	191.74	3.21	50	695.06	42.00	50	1209.2	126.20
4	200.08	3.49	14	703.51	43.03	24	1217.9	128.00
10	208.43	3.79	10	711.97	44.07	10	1226.6	129.82
20	216.77	4.10	20	720.44	45.12	20	1235.3	131.65
30	225.12	4.42	30	728.90	46.18	30	1244.0	133.50
40	233.47	4.76	40	737.37	47.25	40	1252.8	135.35
50	241.81	5.10	50	745.85	48.34	50	1261.5	137.23
5	250.16	5.46	15	754.32	49.44	25	1270.2	139.11
10	258.51	5.83	10	762.80	50.55	10	1279.0	141.01
20	266.86	6.21	20	771.29	51.68	20	1287.7	142.93
30	275.21	6.61	30	779.77	52.89	30	1296.5	144.85
40	283.57	7.01	40	788.26	53.97	40	1305.3	146.79
50	291.92	7.43	50	796.75	55.13	50	1314.0	148.75
6	300.28	7.86	16	805.25	56.31	26	1322.8	150.71
10	308.64	8.31	10	813.75	57.50	10	1331.6	152.69
20	316.99	8.76	20	822.25	58.70	20	1340.4	154.69
30	325.35	9.23	30	830.76	59.91	30	1349.2	156.70
40	333.71	9.71	40	839.27	61.14	40	1358.0	158.72
50	342.08	10.20	50	847.78	62.38	50	1366.8	160.76
7	350.44	10.71	17	856.30	63.63	27	1375.6	162.81
10	358.81	11.22	10	864.82	64.90	10	1384.4	164.86
20	367.17	11.75	20	873.35	66.18	20	1393.2	166.95
30	375.54	12.29	30	881.88	67.47	30	1402.0	169.04
40	383.91	12.85	40	890.41	68.77	40	1410.9	171.15
50	392.28	13.41	50	898.95	70.09	50	1419.7	173.27
8	400.66	13.99	18	907.49	71.42	28	1428.6	175.41
10	409.03	14.58	10	916.03	72.76	10	1437.4	177.55
20	417.41	15.18	20	924.58	74.12	20	1446.3	179.72
30	425.79	15.80	30	933.13	75.49	30	1455.1	181.89
40	434.17	16.43	40	941.69	76.86	40	1464.0	184.08
50	442.55	17.07	50	950.25	78.26	50	1472.9	186.29
9	450.93	17.72	19	958.81	79.67	29	1481.8	188.51
10	459.32	18.38	10	967.38	81.09	10	1490.7	190.74
20	467.71	19.06	20	975.96	82.53	20	1499.6	192.99
30	476.10	19.75	30	984.53	83.97	30	1508.5	195.25
40	484.49	20.45	40	993.12	85.43	40	1517.4	197.53
50	492.88	21.16	50	1001.7	86.90	50	1526.3	199.82
10	501.28	21.89	20	1010.3	88.39	30	1535.3	202.12
10	509.68	22.62	10	1018.9	89.89	10	1544.2	204.44
20	518.08	23.38	20	1027.5	91.40	20	1553.1	206.77
30	526.48	24.14	30	1036.1	92.92	30	1562.1	209.12
40	534.89	24.91	40	1044.7	94.46	40	1571.0	211.48
50	543.29	25.70	50	1053.3	96.01	50	1580.0	213.86

TABLE IV.—TANGENTS AND EXTERNALS TO A 1° CURVE.

Central Angle	Tangent	External	Central Angle	Tangent	External	Central 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	483.8	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

TABLE IV.—TANGENTS AND EXTERNALS TO A 1° CURVE.

Central Angle	Tangent	External	Central Angle	Tangent	External	Central 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	20	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

TABLE IV.—TANGENTS AND EXTERNALS TO A 1° CURVE.

Central Angle	Tangent	External	Central Angle	Tangent	External	Central 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	6162.6	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

TABLE V.—CORRECTIONS FOR TANGENTS AND EXTERNALS.

These corrections are to be added to the approximate values, found by dividing the tangent, or external, for a 1° curve (Table IV) by the degree of curve, in order to obtain the true tangents, or externals. Intermediate values may be obtained by interpolation.

FOR TANGENTS ADD

Central Angle	DEGREE OF CURVE													
	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	.79	.89	.99	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	4.40	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
110°	.51	1.03	1.56	2.08	2.61	3.14	3.67	4.21	4.76	5.31	5.86	6.43	7.01	7.60
120°	.62	1.25	1.93	2.52	3.16	3.81	4.45	5.11	5.77	6.44	7.12	7.80	8.50	9.22

FOR EXTERNALS ADD

Central Angle.	DEGREE OF CURVE													
	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	.771	.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
110°	.268	.536	.806	1.08	1.35	1.63	1.91	2.20	2.48	2.76	3.05	3.35	3.66	3.96
120°	.360	.721	1.08	1.45	1.82	2.19	2.57	2.95	3.33	3.72	4.11	4.50	4.91	5.32

TABLE VI.--CORRECTIONS FOR SUB-CHORDS AND LONG CHORDS.

FOR SUB-CHORDS ADD										Excess of arc per 100 ft.	LONG CHORDS				
D	10	20	30	40	50	60	70	80	90		D	200	300	400	500
4°	.00	.00	.01	.01	.01	.01	.01	.01	.00	.02	1	199.99	299.97	399.92	499.85
6	.00	.01	.01	.02	.02	.02	.02	.02	.01	.05	2	199.97	299.88	399.70	499.39
8	.01	.02	.02	.03	.03	.03	.03	.02	.01	.08	3	199.93	299.73	399.32	498.63
10	.01	.02	.03	.04	.05	.05	.05	.04	.02	.13	4	199.88	299.51	398.78	497.57
12	.02	.04	.05	.06	.07	.07	.07	.05	.03	.18	5	199.81	299.24	398.10	496.20
14	.02	.05	.07	.08	.09	.10	.09	.07	.04	.25	6	199.73	298.90	397.26	494.53
16	.03	.06	.09	.11	.12	.12	.12	.09	.05	.33	7	199.63	298.51	396.28	492.57
18	.04	.08	.11	.14	.15	.16	.15	.12	.07	.41	8	199.51	298.05	395.14	490.31
20	.05	.10	.14	.17	.19	.20	.18	.15	.09	.51	9	199.38	297.54	393.86	487.75
22	.06	.12	.17	.21	.23	.24	.22	.18	.10	.62	10	199.24	296.96	392.42	484.90
24	.07	.14	.20	.25	.28	.28	.26	.21	.12	.74	12	198.90	295.63	389.12	478.34
26	.09	.17	.24	.29	.32	.33	.31	.25	.15	.86	14	198.51	294.06	385.22	470.65
28	.10	.19	.27	.34	.37	.38	.36	.29	.17	1.00	16	198.05	292.25	380.76	461.86
30	.11	.22	.31	.39	.43	.44	.41	.33	.19	1.15	18	197.54	290.21	375.74	452.02
32	.13	.25	.36	.44	.49	.50	.47	.38	.22	1.31	20	196.96	287.94	370.17	441.15
34	.15	.28	.40	.50	.55	.57	.53	.43	.25	1.48	22	196.32	285.44	364.06	429.30
36	.17	.32	.45	.56	.62	.64	.59	.48	.28	1.66	24	195.63	282.71	357.43	416.53
38	.18	.36	.51	.62	.70	.71	.66	.53	.31	1.86	26	194.87	279.76	350.30	402.89
40	.21	.40	.56	.69	.77	.79	.73	.59	.35	2.06	28	194.06	276.59	342.69	388.43
42	.23	.44	.62	.76	.85	.87	.81	.65	.38	2.28	30	193.18	273.20	334.61	373.20
44	.25	.48	.68	.84	.94	.96	.89	.72	.42	2.50	32	192.25	269.61	326.08	357.28
46	.27	.52	.75	.92	1.02	1.05	.98	.78	.46	2.74	34	191.26	265.81	317.12	340.73
48	.30	.57	.81	1.00	1.12	1.14	1.06	.86	.50	2.99	36	190.21	261.80	307.77	323.61
50	.32	.62	.89	1.09	1.21	1.24	1.15	.93	.55	3.24	38	189.10	257.60	298.03	305.99
52	.35	.67	.96	1.18	1.31	1.35	1.25	1.01	.59	3.52	40	187.94	253.21	287.94	287.94
54	.38	.73	1.04	1.28	1.42	1.46	1.35	1.09	.64	3.80	42	186.72	248.63	277.51	269.54
56	.41	.78	1.12	1.38	1.53	1.57	1.46	1.17	.69	4.09	44	185.44	243.87	266.78	250.85
58	.44	.84	1.20	1.48	1.65	1.69	1.57	1.26	.74	4.40	46	184.10	239.93	255.78	231.95
60	.47	.91	1.29	1.59	1.76	1.81	1.68	1.35	.80	4.72	48	182.71	233.83	244.51	212.92

NOTE.—When a chord of less than 100 ft. is used the corrections given in the above table should be added to the nominal length of chord to get the length which should be used in order that the 100 ft. points will check with those obtained by using the standard 100 ft. chord. Thus in locating a 14° curve by 25 ft. chords measure 25'.06 for each chord. Long chords are useful in passing obstacles.

TABLE VII.--MIDDLE ORDINATES FOR RAILS IN FEET.

Deg. of Curve	LENGTH OF RAILS							Deg. of Curve	LENGTH OF RAILS.						
	32	30	28	26	24	22	20		32	30	28	26	24	22	20
1°	.022	.020	.016	.013	.011	.009	.008	16°	.356	.313	.273	.236	.200	.170	.139
2	.045	.038	.034	.029	.025	.021	.017	17	.378	.333	.290	.252	.213	.180	.148
3	.037	.058	.051	.044	.037	.031	.026	18	.400	.351	.306	.265	.225	.190	.156
4	.089	.079	.069	.060	.050	.042	.035	19	.423	.371	.324	.280	.238	.201	.165
5	.112	.099	.086	.074	.063	.053	.044	20	.445	.392	.341	.296	.250	.212	.174
6	.134	.117	.102	.088	.076	.064	.052	21	.466	.410	.357	.309	.262	.222	.182
7	.156	.137	.120	.104	.088	.074	.061	22	.487	.430	.375	.325	.275	.233	.191
8	.179	.158	.137	.119	.100	.085	.070	23	.509	.450	.390	.338	.287	.243	.199
9	.201	.175	.153	.133	.112	.095	.078	24	.531	.469	.408	.354	.299	.253	.208
10	.223	.196	.171	.148	.125	.106	.087	25	.552	.486	.424	.367	.311	.263	.216
11	.245	.216	.188	.163	.139	.117	.096	26	.573	.506	.441	.382	.323	.274	.225
12	.268	.236	.206	.179	.151	.128	.105	27	.594	.524	.457	.396	.335	.284	.233
13	.290	.254	.222	.192	.163	.138	.113	28	.618	.545	.475	.411	.348	.294	.242
14	.312	.275	.239	.207	.175	.148	.122	29	.638	.564	.491	.424	.361	.303	.250
15	.334	.295	.257	.223	.188	.159	.131	30	.660	.583	.508	.438	.374	.313	.259

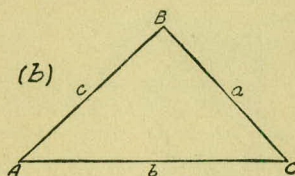
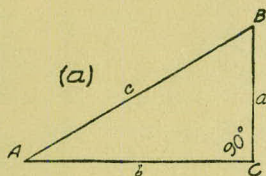
SLOPE REDUCTIONS.

When distances are measured on a slope they may be reduced to the equivalent horizontal distance by the following approximate rule:— subtract from the slope distance the square of the rise divided by twice the slope distance. Thus for a slope distance of 250.3 ft. and a rise of 15 ft. correction = $15^2 \div 2 \times 250.3 = .45$ (by slide rule) or horizontal distance = $250.3 - .45 = 249.85$. When vertical angle = V. A. is measured horizontal distance = slope distance — slope distance (1 — Cos. V. A.). Thus for slope distance of 248.7 ft. and V. A. of $4^\circ 20'$ from Table VIII Cos. = .99714 and correction = $1 - .99714 = .00286$ per foot or total of $.286 \times 2\frac{1}{2}$ (near enough) = .57 and horizontal distance = $248.7 - .57 = 248.13$ ft.

See fig. (a).

TRIGONOMETRICAL FORMULAS.

$$\begin{aligned} \sin. & A = \frac{a}{c} \\ \cos. & A = \frac{b}{c} \\ \tan. & A = \frac{a}{b} \\ \cot. & A = \frac{b}{a} \\ \sec. & A = \frac{c}{b} \\ \text{cosec.} & A = \frac{c}{a} \end{aligned}$$



FORMULA FOR SOLVING TRIANGLES.

Given	Sought.	Right triangles. See fig. (a).
a, c	A, B, b	$\sin. A = \frac{a}{c}, \cos. B = \frac{a}{c}, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan. A = \frac{a}{b}, \cot. B = \frac{a}{b}, c = \sqrt{a^2 + b^2}$
A, a	B, b, c	$B = 90^\circ - A, b = a \cot. A, c = \frac{a}{\sin. A}$
A, b	B, a, c	$B = 90^\circ - A, a = b \tan. A, c = \frac{b}{\cos. A}$
A, c	B, a, b	$B = 90^\circ - A, a = c \sin. A, b = c \cos. A$
Given	Sought.	Oblique triangles. See fig. (b).
A, B, a	b	$b = \frac{a \sin. B}{\sin. A}$
A, a, b	B	$\sin. B = \frac{b \sin. A}{a}$
a, b, C	$A - B$	$\tan. \frac{1}{2} (A - B) = \frac{(a - b) \tan. \frac{1}{2} (A + B)}{a + b}$
a, b, c	A	$\left\{ \begin{aligned} &\text{If } s = \frac{1}{2} (a + b + c), \sin. \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}} \\ &\cos. \frac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}, \tan. \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}} \\ &\sin. A = \frac{2 \sqrt{(s-a)(s-b)(s-c)}}{bc} \end{aligned} \right.$
A, B, C, a	area	$\text{area} = \frac{a^2 \sin. B \sin. C}{2 \sin. A}$
A, b, c	area	$\text{area} = \frac{1}{2} bc \sin. A$
a, b, c	area	$s = \frac{1}{2} (a + b + c), \text{area} = \sqrt{s(s-a)(s-b)(s-c)}$

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.		Angle	Sine.	Tan.	Cotg.	Cosin.	
<i>or</i> 0	0	0	∞	1	90	<i>or</i> 8	.1392	.1405	7.115	.99027	82
10	.0029	.0029	343.8	1	50	10	.1421	.1435	6.968	.98986	50
20	.0058	.0058	171.9	.99998	40	20	.1449	.1465	6.827	.98944	40
30	.0087	.0087	114.6	.99996	30	30	.1478	.1495	6.691	.98902	30
40	.0116	.0116	85.94	.99993	20	40	.1507	.1524	6.561	.98858	20
50	.0145	.0145	68.75	.99989	10	50	.1536	.1554	6.435	.98814	10
1	.0175	.0175	57.29	.99985	89	9	.1564	.1584	6.314	.98769	81
10	.0204	.0204	49.10	.99979	50	10	.1593	.1614	6.197	.98723	50
20	.0233	.0233	42.96	.99973	40	20	.1622	.1644	6.084	.98676	40
30	.0262	.0262	38.19	.99966	30	30	.1650	.1673	5.976	.98629	30
40	.0291	.0291	34.37	.99958	20	40	.1679	.1703	5.871	.98580	20
50	.0320	.0320	31.24	.99949	10	50	.1708	.1733	5.769	.98531	10
2	.0349	.0349	28.64	.99939	88	10	.1736	.1763	5.671	.98481	80
10	.0378	.0378	26.43	.99929	50	10	.1765	.1793	5.576	.98430	50
20	.0407	.0407	24.54	.99917	40	20	.1794	.1823	5.485	.98378	40
30	.0436	.0437	22.90	.99905	30	30	.1822	.1853	5.396	.98325	30
40	.0465	.0466	21.47	.99892	20	40	.1851	.1883	5.309	.98272	20
50	.0494	.0495	20.21	.99878	10	50	.1880	.1914	5.226	.98218	10
3	.0523	.0524	19.08	.99863	87	11	.1908	.1944	5.145	.98163	79
10	.0552	.0553	18.07	.99847	50	10	.1937	.1974	5.066	.98107	50
20	.0581	.0582	17.17	.99831	40	20	.1965	.2004	4.989	.98050	40
30	.0610	.0612	16.35	.99813	30	30	.1994	.2035	4.915	.97992	30
40	.0640	.0641	15.60	.99795	20	40	.2022	.2065	4.843	.97934	20
50	.0669	.0670	14.92	.99776	10	50	.2051	.2095	4.773	.97875	10
4	.0698	.0699	14.30	.99756	86	12	.2079	.2126	4.705	.97815	78
10	.0727	.0729	13.73	.99736	50	10	.2108	.2156	4.638	.97754	50
20	.0756	.0758	13.20	.99714	40	20	.2136	.2186	4.574	.97692	40
30	.0785	.0787	12.71	.99692	30	30	.2164	.2217	4.511	.97630	30
40	.0814	.0816	12.25	.99668	20	40	.2193	.2247	4.449	.97566	20
50	.0843	.0846	11.83	.99644	10	50	.2221	.2278	4.390	.97502	10
5	.0872	.0875	11.43	.99619	85	13	.2250	.2309	4.331	.97437	77
10	.0901	.0904	11.06	.99594	50	10	.2278	.2339	4.275	.97371	50
20	.0929	.0934	10.71	.99567	40	20	.2306	.2370	4.219	.97304	40
30	.0958	.0963	10.39	.99540	30	30	.2334	.2401	4.165	.97237	30
40	.0987	.0992	10.08	.99511	20	40	.2363	.2432	4.113	.97169	20
50	.1016	.1022	9.788	.99482	10	50	.2391	.2462	4.061	.97100	10
6	.1045	.1051	9.514	.99452	84	14	.2419	.2493	4.011	.97030	76
10	.1074	.1080	9.255	.99421	50	10	.2447	.2524	3.962	.96959	50
20	.1103	.1110	9.010	.99390	40	20	.2476	.2555	3.914	.96887	40
30	.1132	.1139	8.777	.99357	30	30	.2504	.2586	3.867	.96815	30
40	.1161	.1169	8.556	.99324	20	40	.2532	.2617	3.821	.96742	20
50	.1190	.1198	8.345	.99290	10	50	.2560	.2648	3.776	.96667	10
7	.1219	.1228	8.144	.99255	83	15	.2588	.2679	3.732	.96593	75
10	.1248	.1257	7.953	.99219	50	10	.2616	.2711	3.689	.96517	50
20	.1276	.1287	7.770	.99182	40	20	.2644	.2742	3.647	.96440	40
30	.1305	.1317	7.596	.99144	30	30	.2672	.2773	3.606	.96363	30
40	.1334	.1346	7.429	.99106	20	40	.2700	.2805	3.566	.96285	20
50	.1363	.1376	7.269	.99067	10	50	.2728	.2836	3.526	.96206	10
					82						74
	Cosin.	Cotg.	Tan.	Sine.	Angle.		Cosin.	Cotg.	Tan.	Sine.	Angle.

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.		Angle	Sine.	Tan.	Cotg.	Cosin.	
<i>or</i> 16	.2756	.2867	3.487	.96126	74	24	.4067	.4452	2.246	.91355	66
10	.2784	.2899	3.450	.96046	50	10	.4094	.4487	2.229	.91236	50
20	.2812	.2931	3.412	.95964	40	20	.4120	.4522	2.211	.91116	40
30	.2840	.2962	3.376	.95882	30	30	.4147	.4557	2.194	.90996	30
40	.2868	.2994	3.340	.95799	20	40	.4173	.4592	2.177	.90875	20
50	.2896	.3026	3.305	.95715	10	50	.4200	.4628	2.161	.90753	10
17	.2924	.3057	3.271	.95615	73	25	.4226	.4663	2.145	.90631	65
10	.2952	.3089	3.237	.95545	50	10	.4253	.4699	2.128	.90507	50
20	.2979	.3121	3.204	.95459	40	20	.4279	.4734	2.112	.90383	40
30	.3007	.3153	3.172	.95372	30	30	.4305	.4770	2.097	.90259	30
40	.3035	.3185	3.140	.95284	20	40	.4331	.4806	2.081	.90133	20
50	.3062	.3217	3.108	.95195	10	50	.4358	.4841	2.066	.90007	10
18	.3090	.3249	3.078	.95106	72	26	.4384	.4877	2.050	.89879	64
10	.3118	.3281	3.048	.95015	50	10	.4410	.4913	2.035	.89752	50
20	.3145	.3314	3.018	.94924	40	20	.4436	.4950	2.020	.89623	40
30	.3173	.3346	2.989	.94832	30	30	.4462	.4986	2.006	.89493	30
40	.3201	.3378	2.960	.94740	20	40	.4488	.5022	1.991	.89363	20
50	.3228	.3411	2.932	.94646	10	50	.4514	.5059	1.977	.89232	10
19	.3256	.3443	2.904	.94552	71	27	.4540	.5095	1.963	.89101	63
10	.3283	.3476	2.877	.94457	50	10	.4566	.5132	1.949	.88968	50
20	.3311	.3508	2.850	.94361	40	20	.4592	.5169	1.935	.88835	40
30	.3338	.3541	2.824	.94264	30	30	.4617	.5206	1.921	.88701	30
40	.3365	.3574	2.798	.94167	20	40	.4643	.5243	1.907	.88566	20
50	.3393	.3607	2.773	.94068	10	50	.4669	.5280	1.894	.88431	10
20	.3420	.3640	2.747	.93969	70	28	.4695	.5317	1.881	.88295	62
10	.3448	.3673	2.723	.93869	50	10	.4720	.5354	1.868	.88158	50
20	.3475	.3706	2.699	.93769	40	20	.4746	.5392	1.855	.88020	40
30	.3502	.3739	2.675	.93667	30	30	.4772	.5430	1.842	.87882	30
40	.3529	.3772	2.651	.93565	20	40	.4797	.5467	1.829	.87743	20
50	.3557	.3805	2.628	.93462	10	50	.4823	.5505	1.816	.87603	10
21	.3584	.3839	2.605	.93358	69	29	.4848	.5543	1.804	.87462	61
10	.3611	.3872	2.583	.93253	50	10	.4874	.5581	1.792	.87321	50
20	.3638	.3906	2.560	.93148	40	20	.4899	.5619	1.780	.87178	40
30	.3665	.3939	2.539	.93042	30	30	.4924	.5658	1.767	.87036	30
40	.3692	.3973	2.517	.92935	20	40	.4950	.5696	1.756	.86892	20
50	.3719	.4006	2.496	.92827	10	50	.4975	.5735	1.744	.86748	10
22	.3746	.4040	2.475	.92718	68	30	.5000	.5774	1.732	.86603	60
10	.3773	.4074	2.455	.92609	50	10	.5025	.5812	1.720	.86457	50
20	.3800	.4108	2.434	.92499	40	20	.5050	.5851	1.709	.86310	40
30	.3827	.4142	2.414	.92388	30	30	.5075	.5890	1.698	.86163	30
40	.3854	.4176	2.394	.92276	20	40	.5100	.5930	1.686	.86015	20
50	.3881	.4210	2.375	.92164	10	50	.5125	.5969	1.675	.85866	10
23	.3907	.4245	2.356	.92050	67	31	.5150	.6009	1.664	.85717	59
10	.3934	.4279	2.337	.91936	50	10	.5175	.6048	1.653	.85567	50
20	.3961	.4314	2.318	.91822	40	20	.5200	.6088	1.643	.85416	40
30	.3987	.4348	2.300	.91706	30	30	.5225	.6128	1.632	.85264	30
40	.4014	.4383	2.282	.91590	20	40	.5250	.6168	1.621	.85112	20
50	.4041	.4417	2.264	.91472	10	50	.5275	.6208	1.611	.84959	10
					66						58
	Cosin.	Cotg.	Tan.	Sine.	Angle.		Cosin.	Cotg.	Tan.	Sine.	Angle.

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.		Angle	Sine.	Tan.	Cotg.	Cosin.	
°						°					
32	.5299	.6249	1.600	.84805	58	30	.6225	.7954	1.257	.78261	
10	.5324	.6289	1.590	.84650	50	40	.6248	.8002	1.250	.78079	
20	.5348	.6330	1.580	.84495	40	50	.6271	.8050	1.242	.77897	
30	.5373	.6371	1.570	.84339	30						
40	.5398	.6412	1.560	.84182	20	39	.6293	.8098	1.235	.77715	
50	.5422	.6453	1.550	.84025	10	10	.6316	.8146	1.228	.77531	
						20	.6338	.8195	1.220	.77347	
33	.5446	.6494	1.540	.83867	57	30	.6361	.8243	1.213	.77162	
10	.5471	.6536	1.530	.83708	50	40	.6383	.8292	1.206	.76977	
20	.5495	.6577	1.520	.83549	40	50	.6406	.8342	1.199	.76791	
30	.5519	.6619	1.511	.83389	30						
40	.5544	.6661	1.501	.83228	20	40	.6428	.8391	1.192	.76604	
50	.5568	.6703	1.492	.83066	10	10	.6450	.8441	1.185	.76417	
						20	.6472	.8491	1.178	.76229	
34	.5592	.6745	1.483	.82904	56	30	.6494	.8541	1.171	.76041	
10	.5616	.6787	1.473	.82741	50	40	.6517	.8591	1.164	.75851	
20	.5640	.6830	1.464	.82577	40	50	.6539	.8642	1.157	.75661	
30	.5664	.6873	1.455	.82413	30						
40	.5688	.6916	1.446	.82248	20	41	.6561	.8693	1.150	.75471	
50	.5712	.6959	1.437	.82082	10	10	.6583	.8744	1.144	.75280	
						20	.6604	.8796	1.137	.75088	
35	.5736	.7002	1.428	.81915	55	30	.6626	.8847	1.130	.74896	
10	.5760	.7046	1.419	.81748	50	40	.6648	.8899	1.124	.74703	
20	.5783	.7089	1.411	.81580	40	50	.6670	.8952	1.117	.74509	
30	.5807	.7133	1.402	.81412	30						
40	.5831	.7177	1.393	.81242	20	42	.6691	.9004	1.111	.74314	
50	.5854	.7221	1.385	.81072	10	10	.6713	.9057	1.104	.74120	
						20	.6734	.9110	1.098	.73924	
36	.5878	.7265	1.376	.80902	54	30	.6756	.9163	1.091	.73728	
10	.5901	.7310	1.368	.80730	50	40	.6777	.9217	1.085	.73531	
20	.5925	.7355	1.360	.80558	40	50	.6799	.9271	1.079	.73333	
30	.5948	.7400	1.351	.80386	30						
40	.5972	.7445	1.343	.80212	20	43	.6820	.9325	1.072	.73135	
50	.5995	.7490	1.335	.80038	10	10	.6841	.9380	1.066	.72937	
						20	.6862	.9435	1.060	.72737	
37	.6018	.7536	1.327	.79864	53	30	.6884	.9490	1.054	.72537	
10	.6041	.7581	1.319	.79688	50	40	.6905	.9545	1.048	.72337	
20	.6065	.7627	1.311	.79512	40	50	.6926	.9601	1.042	.72136	
30	.6088	.7673	1.303	.79335	30						
40	.6111	.7720	1.295	.79158	20	44	.6947	.9657	1.036	.71934	
50	.6134	.7766	1.288	.78980	10	10	.6967	.9713	1.030	.71732	
						20	.6988	.9770	1.024	.71529	
38	.6157	.7813	1.280	.78801	52	30	.7009	.9827	1.018	.71325	
10	.6180	.7860	1.272	.78622	50	40	.7030	.9884	1.012	.71121	
20	.6202	.7907	1.265	.78442	40	50	.7050	.9942	1.006	.70916	
							.7071	1.	1.	.70711	
										°	
	Cosin.	Cotg.	Tan.	Sine.	Angle.		Cosin.	Cotg.	Tan.	Sine.	Angle.

TABLE IX.—CALCULATION OF EARTHWORK.

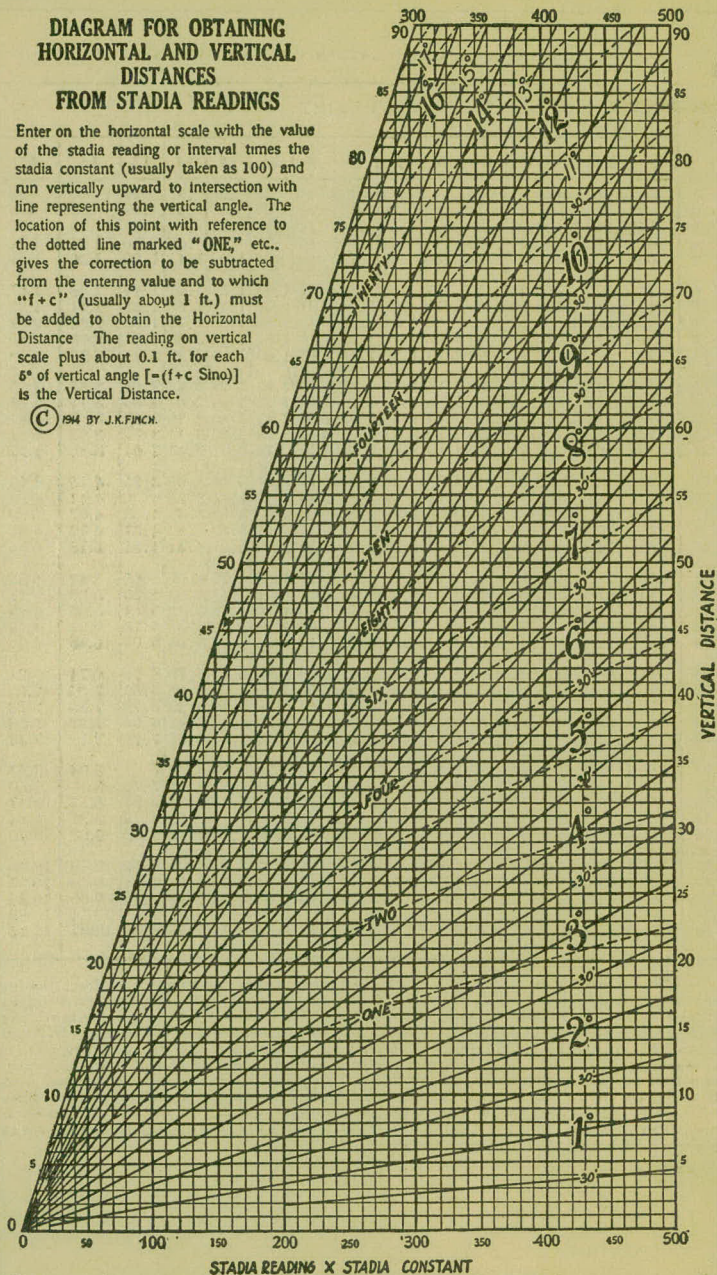
Width	HEIGHT														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.02	.04	.06	.07	.09	.11	.13	.15	.17	.18	.20	.22	.24	.26	.28
2	.04	.07	.11	.15	.18	.22	.26	.30	.33	.37	.41	.44	.48	.52	.56
3	.06	.11	.17	.22	.28	.33	.39	.44	.50	.56	.61	.67	.72	.78	.83
4	.07	.15	.22	.30	.37	.44	.52	.59	.67	.74	.81	.89	.96	1.04	1.11
5	.09	.19	.28	.37	.46	.56	.65	.74	.83	.93	1.02	1.11	1.20	1.30	1.39
6	.11	.22	.33	.44	.56	.67	.78	.89	1.00	1.11	1.22	1.33	1.44	1.55	1.67
7	.13	.26	.39	.52	.65	.78	.91	1.04	1.16	1.30	1.42	1.55	1.68	1.81	1.94
8	.15	.30	.44	.59	.74	.89	1.04	1.19	1.33	1.48	1.63	1.78	1.92	2.08	2.22
9	.17	.33	.50	.67	.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50
10	.18	.37	.56	.74	.93	1.11	1.30	1.48	1.67	1.85	2.04	2.22	2.41	2.59	2.78
11	.20	.41	.61	.82	1.02	1.22	1.43	1.63	1.83	2.04	2.24	2.44	2.65	2.85	3.06
12	.22	.44	.67	.89	1.11	1.33	1.56	1.78	2.00	2.22	2.44	2.67	2.89	3.11	3.33
13	.24	.48	.72	.96	1.20	1.44	1.68	1.92	2.16	2.41	2.65	2.89	3.13	3.37	3.61
14	.26	.52	.78	1.04	1.30	1.55	1.81	2.08	2.33	2.59	2.85	3.11	3.37	3.63	3.89
15	.28	.56	.83	1.11	1.39	1.67	1.94	2.22	2.50	2.78	3.06	3.33	3.61	3.89	4.17
16	.30	.59	.89	1.18	1.48	1.78	2.07	2.37	2.67	2.96	3.26	3.56	3.85	4.15	4.44
17	.31	.63	.94	1.26	1.57	1.89	2.20	2.52	2.83	3.15	3.46	3.78	4.09	4.41	4.72
18	.33	.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00
19	.35	.70	1.06	1.41	1.76	2.11	2.46	2.82	3.17	3.52	3.87	4.22	4.57	4.92	5.28
20	.37	.74	1.11	1.48	1.85	2.22	2.59	2.96	3.33	3.70	4.07	4.44	4.81	5.18	5.56
21	.39	.78	1.17	1.55	1.94	2.33	2.72	3.11	3.50	3.89	4.28	4.67	5.06	5.44	5.83
22	.41	.81	1.22	1.63	2.04	2.44	2.85	3.26	3.67	4.07	4.48	4.89	5.30	5.70	6.11
23	.43	.85	1.28	1.70	2.13	2.56	2.98	3.41	3.83	4.26	4.68	5.11	5.54	5.96	6.39
24	.44	.89	1.33	1.78	2.22	2.67	3.11	3.56	4.00	4.44	4.89	5.33	5.78	6.22	6.67
25	.46	.92	1.39	1.85	2.31	2.78	3.24	3.70	4.17	4.63	5.09	5.56	6.02	6.48	6.94
26	.48	.96	1.44	1.92	2.41	2.89	3.37	3.85	4.33	4.82	5.30	5.78	6.26	6.74	7.24
27	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50
28	.52	1.04	1.55	2.07	2.59	3.11	3.63	4.15	4.67	5.18	5.70	6.22	6.74	7.26	7.78
29	.54	1.07	1.61	2.15	2.68	3.22	3.76	4.30	4.83	5.37	5.91	6.44	6.98	7.52	8.06
30	.56	1.11	1.67	2.22	2.78	3.33	3.89	4.44	5.00	5.55	6.11	6.67	7.22	7.78	8.33
31	.57	1.15	1.72	2.30	2.87	3.44	4.02	4.59	5.17	5.74	6.32	6.89	7.46	8.04	8.61
32	.59	1.18	1.78	2.37	2.96	3.56	4.15	4.74	5.33	5.92	6.52	7.11	7.70	8.30	8.89
33	.61	1.22	1.83	2.44	3.05	3.67	4.28	4.89	5.50	6.11	6.72	7.33	7.94	8.55	9.17
34	.63	1.26	1.89	2.52	3.15	3.78	4.40	5.04	5.67	6.29	6.93	7.56	8.18	8.81	9.44
35	.65	1.30	1.94	2.59	3.24	3.89	4.53	5.18	5.83	6.48	7.13	7.78	8.42	9.08	9.72
36	.67	1.33	2.00	2.67	3.33	4.00	4.66	5.33	6.00	6.67	7.33	8.00	8.67	9.33	10.00
37	.68	1.37	2.06	2.74	3.42	4.11	4.79	5.48	6.17	6.85	7.54	8.22	8.91	9.59	10.28
38	.70	1.41	2.11	2.82	3.52	4.22	4.92	5.63	6.33	7.03	7.74	8.44	9.15	9.85	10.56
39	.72	1.44	2.17	2.89	3.61	4.33	5.05	5.78	6.50	7.22	7.95	8.67	9.39	10.11	10.83
40	.74	1.48	2.22	2.96	3.70	4.44	5.18	5.92	6.67	7.41	8.15	8.89	9.63	10.37	11.11

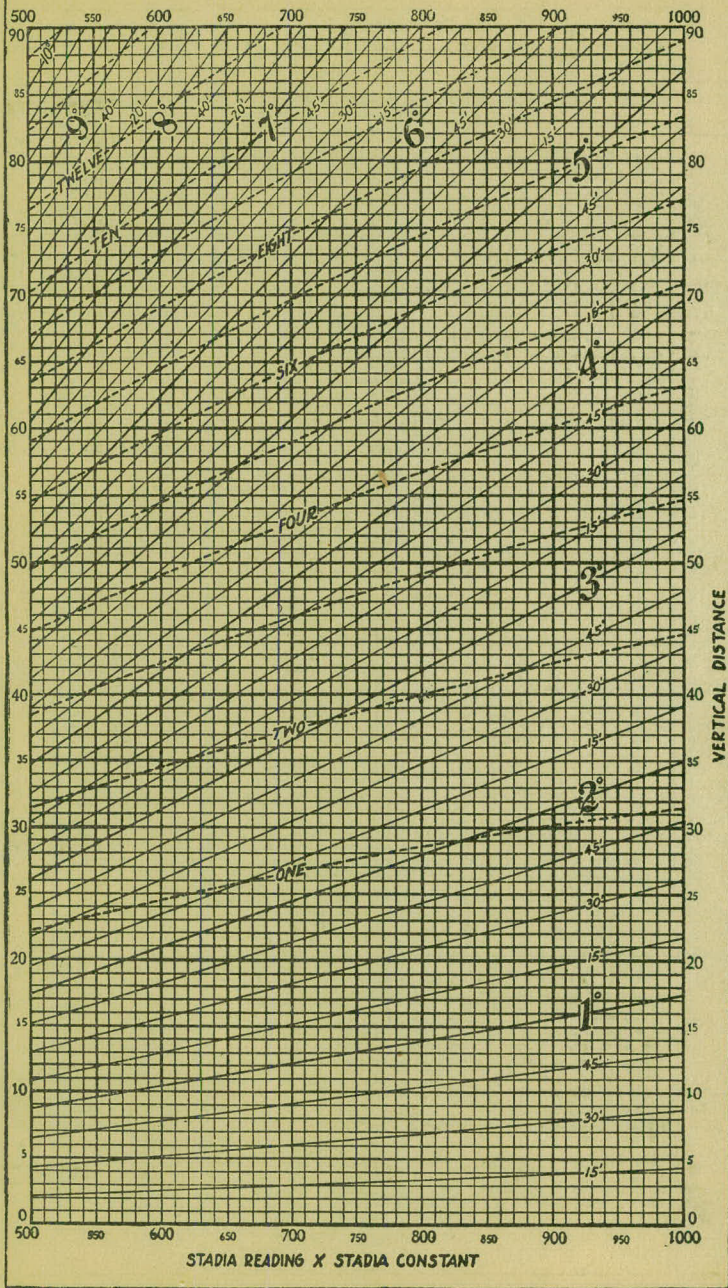
Table gives cu. yds. in 1 ft. of a triangle of given width and height. Corrections for tenths of width are one tenth the values found under each height considering the widths from 1 to 9 as tenths and similarly the corrections for tenths of height are one tenth the figures opposite width considering the heights from 1 to 9 as tenths. Thus if $w = 16.2$ and $h = 5.3$, cu. yds. $= 1.43 + .028 + .089 = 1.597$ cu. yds. or practically 160 cu. yds. per 100 ft. If w exceeds 40 ft., use one half and multiply result by 2, if both w and h are large use one half of each and multiply result by 4. Any cross-section may be divided into triangles by the following rule. To the triangle of the sum of the outside cuts (or fills) $= h$, and $\frac{1}{2}$ the roadbed $= w$, add the triangles formed by taking the distance out to each break in turn ($= w$'s) by the difference between the cuts (or fills) on each side of it ($= h$'s) always subtracting the outer from the inner.

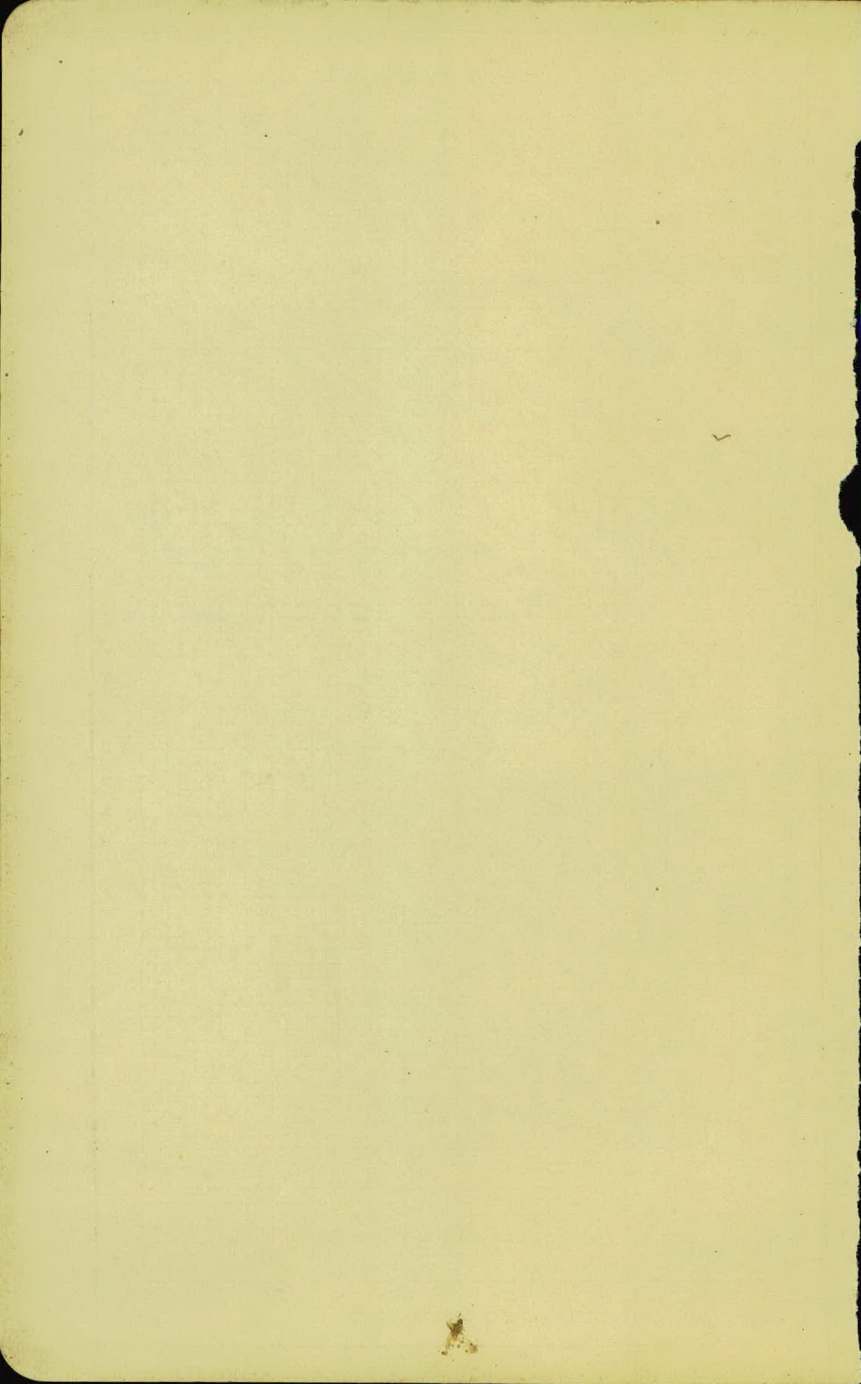
DIAGRAM FOR OBTAINING HORIZONTAL AND VERTICAL DISTANCES FROM STADIA READINGS

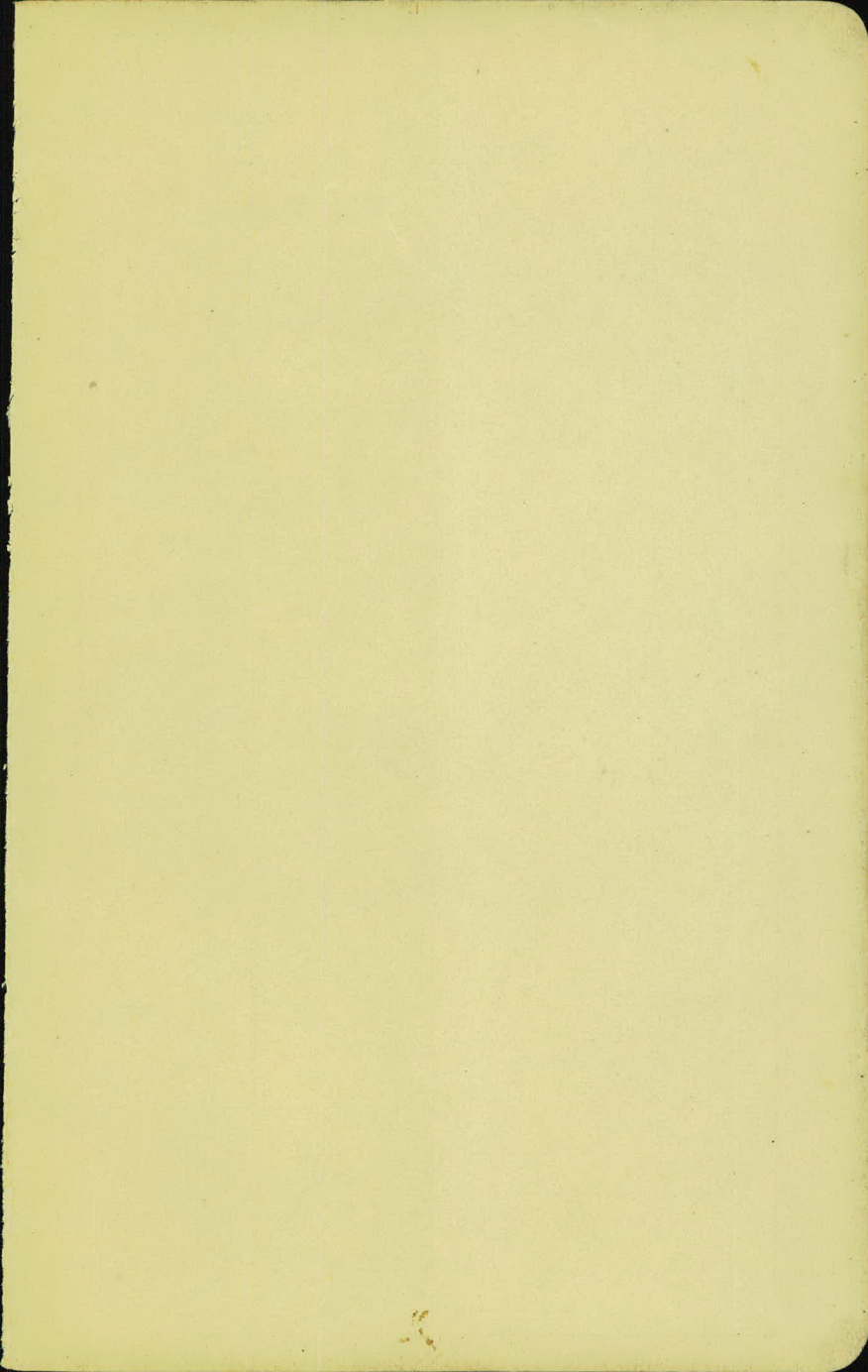
Enter on the horizontal scale with the value of the stadia reading or interval times the stadia constant (usually taken as 100) and run vertically upward to intersection with line representing the vertical angle. The location of this point with reference to the dotted line marked "ONE," etc., gives the correction to be subtracted from the entering value and to which "f+c" (usually about 1 ft.) must be added to obtain the Horizontal Distance. The reading on vertical scale plus about 0.1 ft. for each 5° of vertical angle [- (f+c) Sino] is the Vertical Distance.

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215.34
12.35
227.69

257.00
8.02
265.02
60.12
490

206.93
8.02
264.95
4.82
260.13

492

265.02
4.17
260.85
8.25

264.95
4.17
260.78
8.25

201.01

269.10
9.42
258.68

269.02
9.42
258.61

257.6

502

~~10~~

58

32

65/4

U 2449

N.W. 1/4 26'

$$\Delta = 19^{\circ}33'$$

$$\frac{1}{2}\Delta = 9^{\circ}46\frac{1}{2}'$$

700
 60.4
 80
 60
 59.9

 960.3

47.5

 219
 266.5

301.1412014

 2814930
 1688958
 2533437
 2251944

 110698
 281493
 60081822

1733
 1703

 30
 65

 1950
 1703

 17225

2814.83^{45 2}
 .17225

 1407415
 562966
 562966
 1970381
 281483

 4848544675
 96990

253.64
 47.5
 301.14

11791
 10000
 1791
 10000
 11791

¹⁰⁰
⁰⁰
2814.93

2814.83

.17225

.17225

1407465

1407415

56298.6

562966

56298.6

562966

1970.451

1970381

281493

81483

484.8576

484.8544675

2 19.33
10

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

Roadway 16 feet wide. Side Slopes 1 on 1½.
For Single Track Embankment.

H	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	H
0	8.0	8.2	8.3	8.5	8.6	8.8	8.9	9.1	9.2	9.4	0
1	9.5	9.7	9.8	10.0	10.1	10.3	10.4	10.6	10.7	10.9	1
2	11.0	11.2	11.3	11.5	11.6	11.8	11.9	12.1	12.2	12.4	2
3	12.5	12.7	12.8	13.0	13.1	13.3	13.4	13.6	13.7	13.9	3
4	14.0	14.2	14.3	14.5	14.6	14.8	14.9	15.1	15.2	15.4	4
5	15.5	15.7	15.8	16.0	16.1	16.3	16.4	16.6	16.7	16.9	5
6	17.0	17.2	17.3	17.5	17.6	17.8	17.9	18.1	18.2	18.4	6
7	18.5	18.7	18.8	19.0	19.1	19.3	19.4	19.6	19.7	19.9	7
8	20.0	20.2	20.3	20.5	20.6	20.8	20.9	21.1	21.2	21.4	8
9	21.5	21.7	21.8	22.0	22.1	22.3	22.4	22.6	22.7	22.9	9
10	23.0	23.2	23.3	23.5	23.6	23.8	23.9	24.1	24.2	24.4	10
11	24.5	24.7	24.8	25.0	25.1	25.3	25.4	25.6	25.7	25.9	11
12	26.0	25.2	26.3	26.5	26.6	26.8	26.9	27.1	27.2	27.4	12
13	27.5	27.7	27.8	28.0	28.1	28.3	28.4	28.6	28.7	28.9	13
14	29.0	29.2	29.3	29.5	29.6	29.8	29.9	30.1	30.2	30.4	14
15	30.5	30.7	30.8	31.0	31.1	31.3	31.4	31.6	31.7	31.9	15
16	32.0	32.2	32.3	32.5	32.6	32.8	32.9	33.1	33.2	33.4	16
17	33.5	33.7	33.8	34.0	34.1	34.3	34.4	34.6	34.7	34.9	17
18	35.0	35.2	35.3	35.5	35.6	35.8	35.9	36.1	36.2	36.4	18
19	36.5	36.7	36.8	37.0	37.1	37.3	37.4	37.6	37.7	37.9	19
20	38.0	38.2	38.3	38.5	38.6	38.8	38.9	39.1	39.2	39.4	20
21	39.5	39.7	39.8	40.0	40.1	40.3	40.4	40.6	40.7	40.9	21
22	41.0	41.2	41.3	41.5	41.6	41.8	41.9	42.1	42.2	42.4	22
23	42.5	42.7	42.8	43.0	43.1	43.3	43.4	43.6	43.7	43.9	23
24	44.0	44.2	44.3	44.5	44.6	44.8	44.9	45.1	45.2	45.4	24
25	45.5	45.7	45.8	46.0	46.1	46.3	46.4	46.6	46.7	46.9	25
26	47.0	47.2	47.3	47.5	47.6	47.8	47.9	48.1	48.2	48.4	26
27	48.5	48.7	48.8	49.0	49.1	49.3	49.4	49.6	49.7	49.9	27
28	50.0	50.2	50.3	50.5	50.6	50.8	50.9	51.1	51.2	51.4	28
29	51.5	51.7	51.8	52.0	52.1	52.3	52.4	52.6	52.7	52.9	29
30	53.0	53.2	53.3	53.5	53.6	53.8	53.9	54.1	54.2	54.4	30
31	54.5	54.7	54.8	55.0	55.1	55.3	55.4	55.6	55.7	55.9	31
32	56.0	56.2	56.3	56.5	56.6	56.8	56.9	57.1	57.2	57.4	32
33	57.5	57.7	57.8	58.0	58.1	58.3	58.4	58.6	58.7	58.9	33
34	59.0	59.2	59.3	59.5	59.6	59.8	59.9	60.1	60.2	60.4	34
35	60.5	60.7	60.8	61.0	61.1	61.3	61.4	61.6	61.7	61.9	35
36	62.0	62.2	62.3	62.5	62.6	62.8	62.9	63.1	63.2	63.4	36
37	63.5	63.7	63.8	64.0	64.1	64.3	64.4	64.6	64.7	64.9	37
38	65.0	65.2	65.3	65.5	65.6	65.8	65.9	66.1	66.2	66.4	38
39	66.5	66.7	66.8	67.0	67.1	67.3	67.4	67.6	67.7	67.9	39
40	68.0	68.2	68.3	68.5	68.6	68.8	68.9	69.1	69.2	69.4	40

Example—If point is 22.6 ft. above grade, how far should it be from center line to be a slope stake point? Ans. from Table 41.9. For same slopes but other widths of roadbed correct above figures by one-half difference in width of roadbed; thus in example above for 20 ft. roadbed distance will be $41.9 + (20 - 16) \div 2$ or 2 ft. added to 41.9 = 43.9. For slopes of 1 on 1 see inside of front cover.

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