

PARADISE

HILL.

DIETZEN
D-111

ENGINEERS'

FIELD BOOK

NOV 1918

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 $30.6 + (20 - 16) \div 2$ or 2 ft. added to 30.6 = 32.6. For slopes of 1 on 1½ see inside of back cover.

Copyright, 1914, by Eugene Dietzgen Co.

This Field Book is manufactured of a High Grade 50% Rag Paper having a WATER RESISTING SURFACE, and is sewed with Bing Special Enamel Waterproof thread.

Made in U. S. A.

DARADISE HILL NOTES

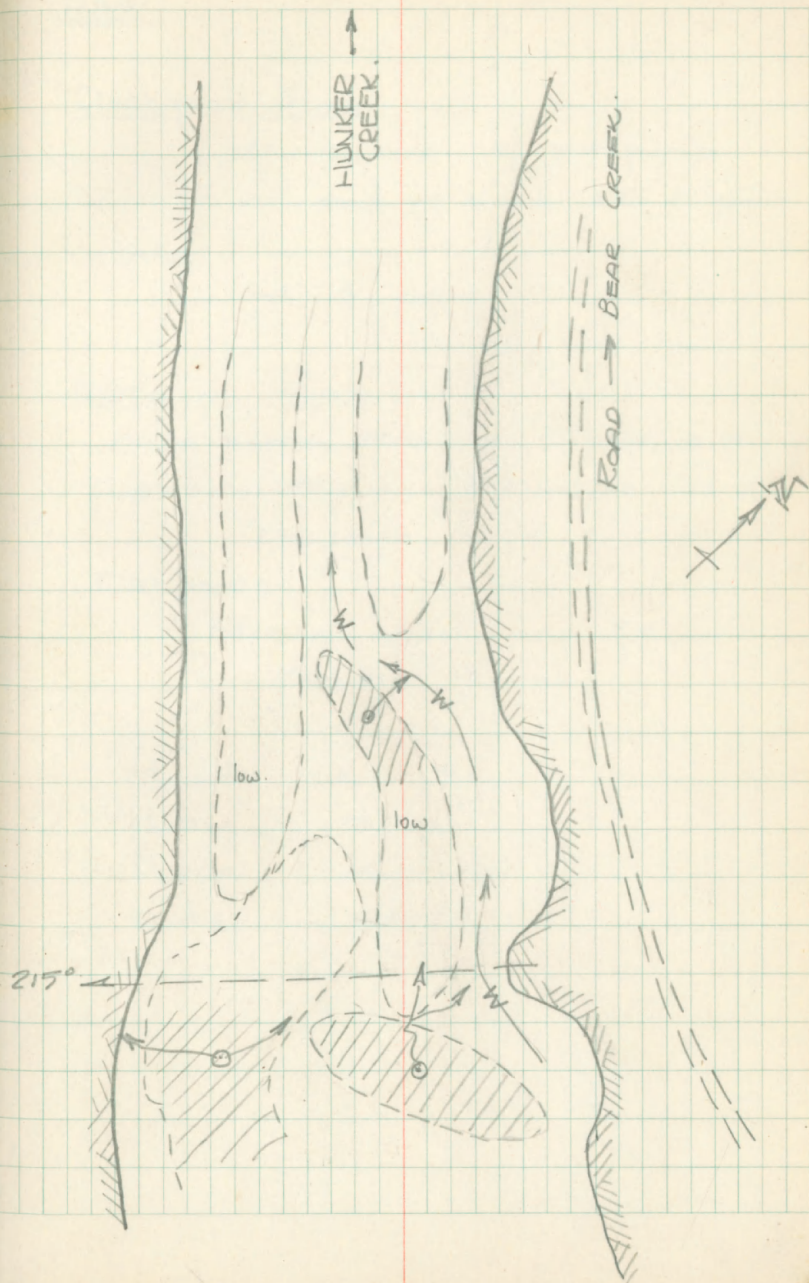
CONTENTS

<u>PAGE</u>	
1	Sketch of site - dist. of tailings
2,3	Dump details - sketches.
4	Layout requirements
5,6	Pipe at Arlington for Last Chance
7	Dump discharge pipe bend.
8	Pump Foundation (at Arlington)
9	Dump Suction pipe
10	Switchboard Dimensions
11	P.H. pump & motor foundation - elevations.
12	Notes -
13	Bottom pipe reqts - Check, gate valve stand pipe from bottom bend -

HUNKER SETTLING DAM -

PARADISE HILL PUMP
STATION

Require fill on
both ends. - More
on north side.



PumpDischarge Pipe -

Starts out 14" at pump

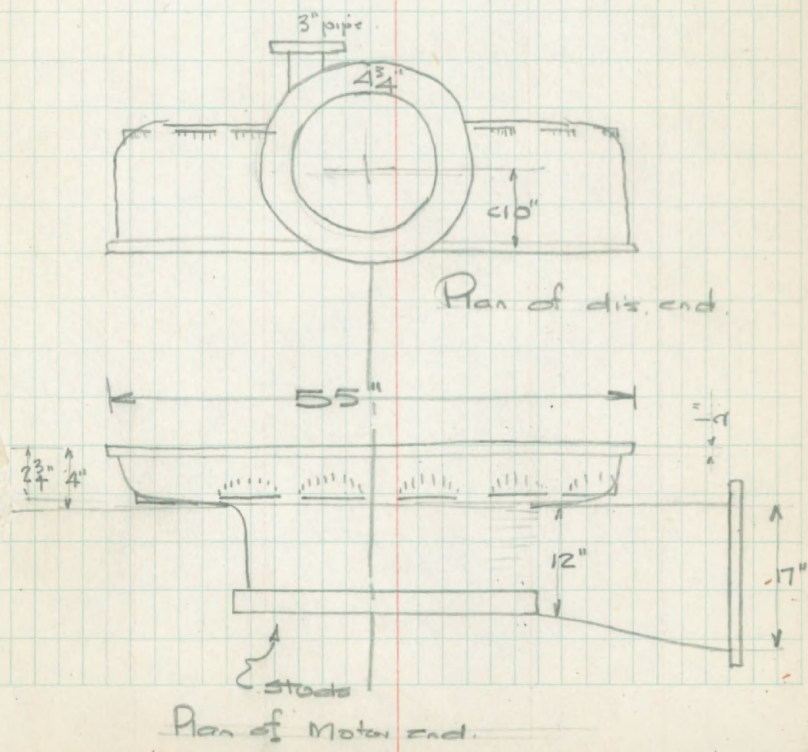
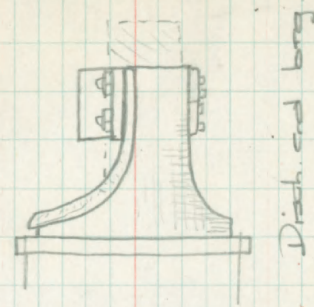
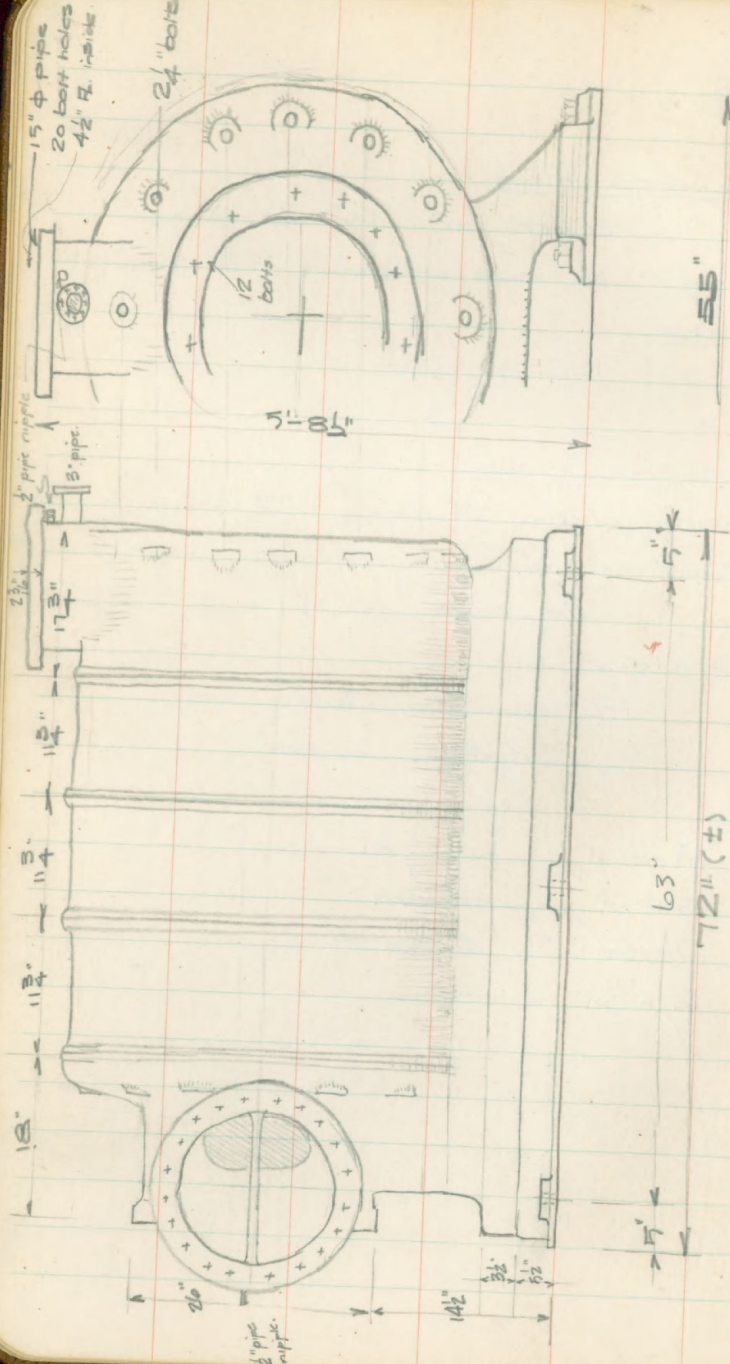
At end of bend 18" ϕ pipeIntake14" ϕ pipe.Data on Pump

Auto Water Balance - Turbine pump
 Kingsford Foundry & Machine Works
 Oswego N. Y.

Dealers -

Parine Machinery Co.,
 Seattle Wash.

Model	M - 21
G.P.M.	6000
Press.	600 f.
R.P.M.	880.



REQUIRE FOR LAYOUT

Pump & Motor Base

Pump house

Pipe line lay out - staked + tractor road X

Topog. of dam site & pipe line X

Section of pipe line ground. X

Check & cut pipe.

Layout of dam site + pump house location

Sluice gate spillway & tail race.

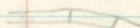
Dam spillway & tail race.

Bridge across spillway.

3500 feet of pipe from proposed
pump station to the pipe
line corner.

List of pipe available on
Last Chance pipe line -

5'	6'	NOTE	5'	6'	NOTE
	15	In one sect. sep. from other line.		2	
	15	up to exp. joint.	6	16	
	1	Exp. Joint	4	9	
		2'-6" Check Valve	5	9	
		8' Sect. with spring release.	4	4	Top of first bench
	30		5	3	
	30	14 to road.	1	4	
	1		4	1	
			4	2	
1			8		
	1		1		Exp. Jnt
			5		
1			1		increaser 18"-22" 4" th.
			20		
	12		15		-one Fl. sect. 5'-7"
5			11	2	
	4		17	2	
			20	2	← bottom steep hill.
5			5	8	
	4			20	
			1	3	
1			2		-one Fl. sect.
	2		4	2	
			1	4	
1			5	12	
	8		10		8'- $\frac{3}{16}$ " th.
			5	4	
1			20	1	Exp. Joint.

22	4				These are by road near pump house
12				3	
5		Off to side of line.	1		
21			1		bend 
2			2		
2		8"		2	
			1		Exp Joint.

Total length pipe ————— 2845 f.

Total length 18" ϕ pipe ————— 1325 f.

Total length 22" ϕ pipe. ————— 1520 f.

Length pipe to bottom of hill ————— 1526 f.

(excl sect already out)
1162 of 5' & 1632 of 6'

Length pipe up hill cut ————— 5 lengths 5'

Length pipe up hill to be cut ————— 1073 f.

78 lengths - 6' 458

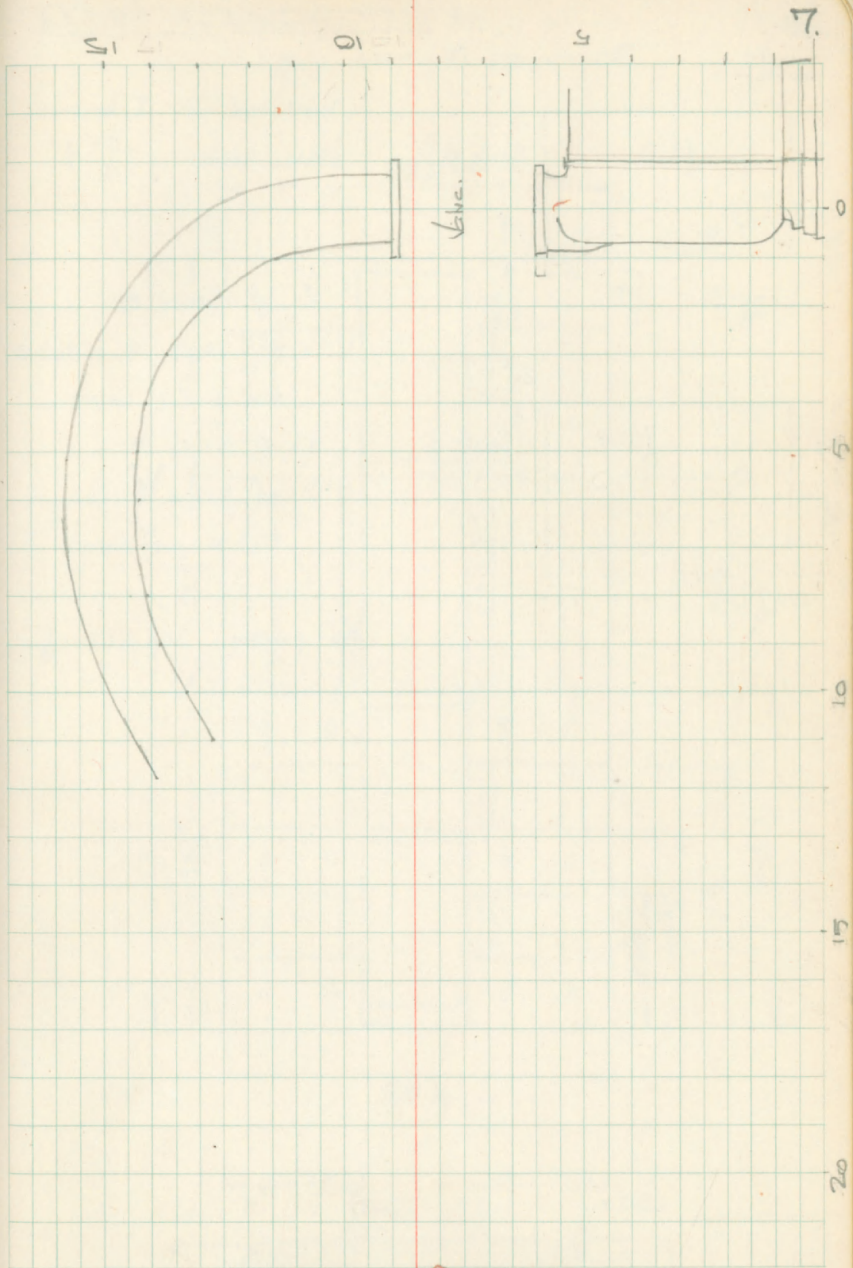
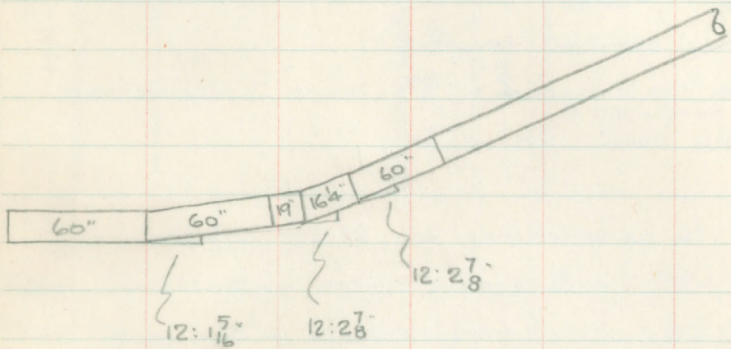
127 " - 5' 615

CUTTING NECESSARY

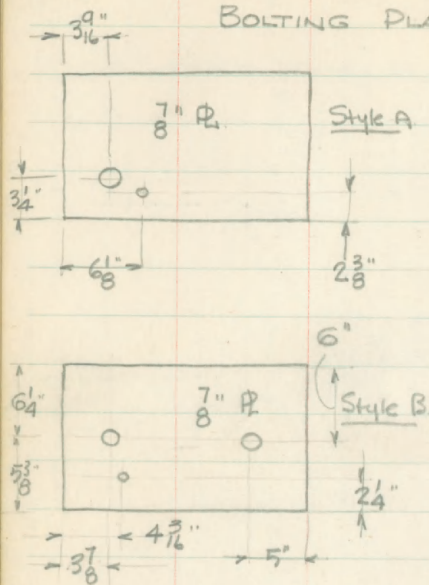
- One cut in 15 sect length at lower end.
 - At 60' lengths - 45 cuts necessary with several additional cuts necessary thru special lengths
 - At 50' lengths - 55 cuts necessary. Will add sp cuts
 - Cuts necessary on steep slope.
- 18 cuts.

1400' from P.H. to
old upper corner.
2600' from P.H. to
lower corner.
2100' from upper corner
to pit.

LOWER BEND FROM P.H.



BOLTING PLATES



Welded to I beams.

Bolt holes - $1\frac{5}{8}$ " ϕ

2 of Style A.

2 of Style A without
the small holes.

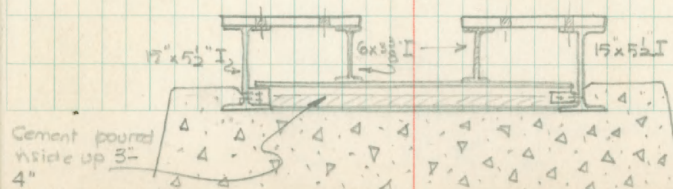
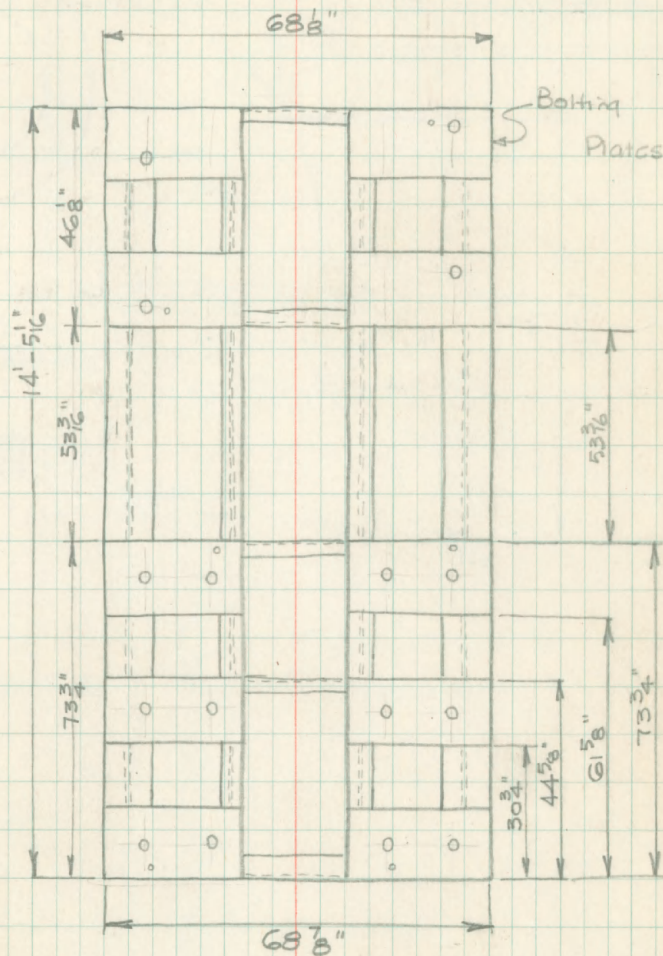
4 of Style B.

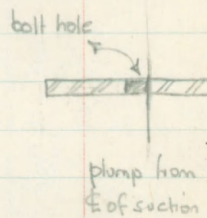
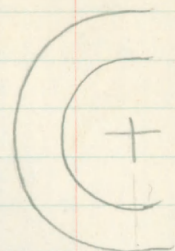
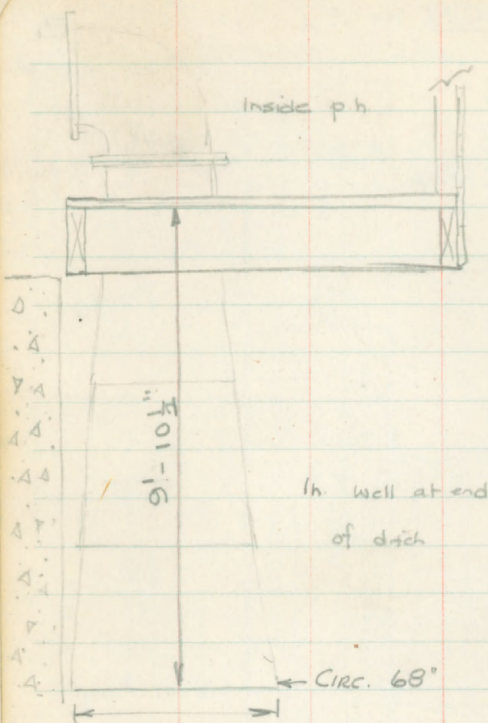
2 of Style B without
the small holes.

All plates - $24\frac{1}{2}$ " $\times$ 12 " $\times$ 7 "

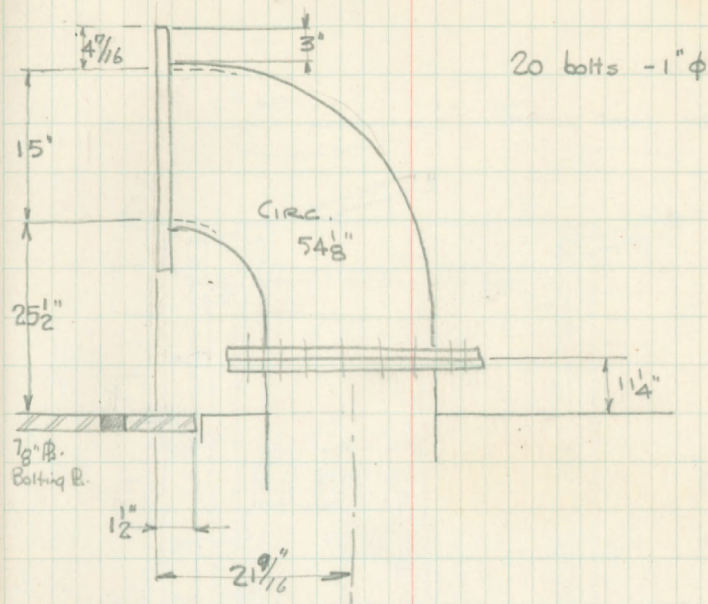
DUMP FOUNDATION

8.

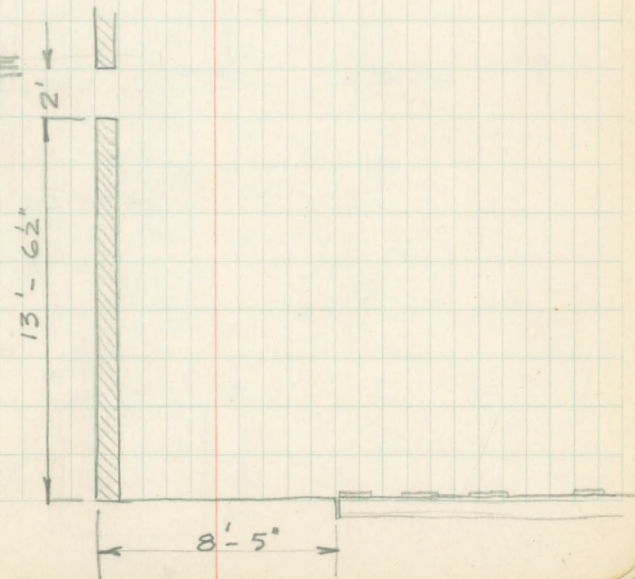


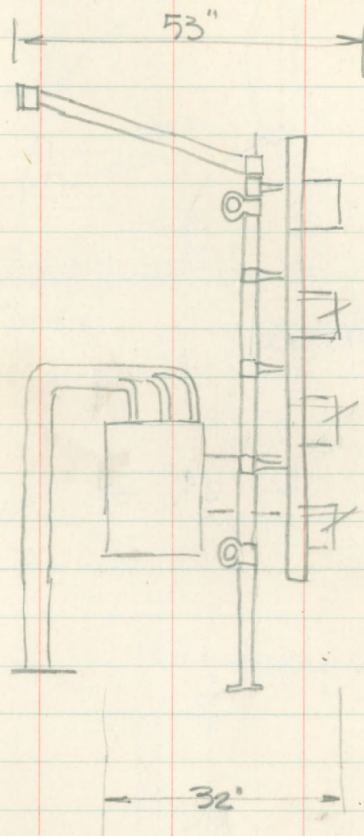


DUMP SECTION.



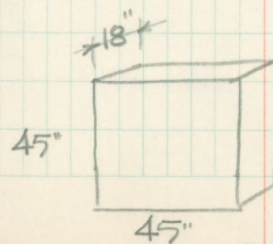
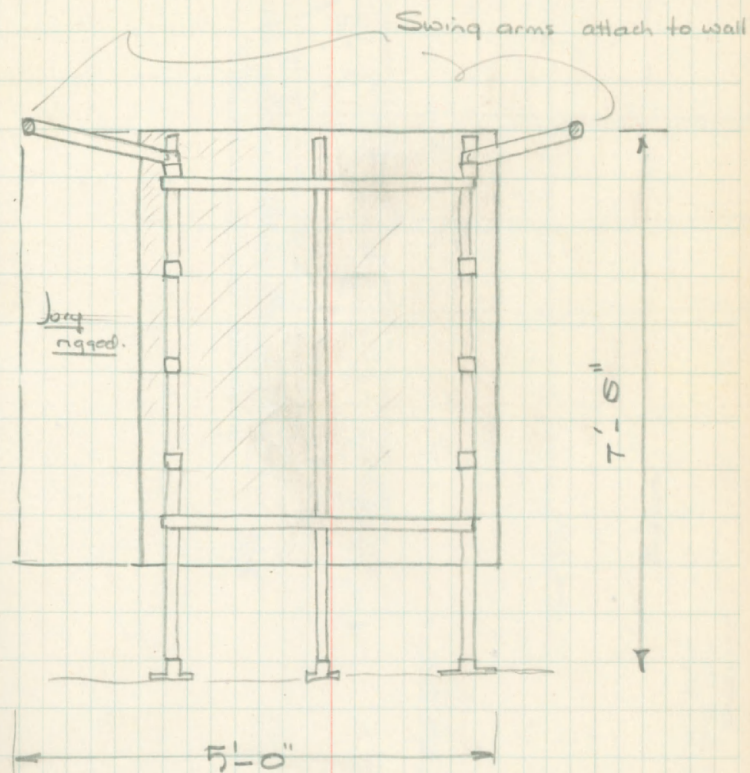
DISCHARGE





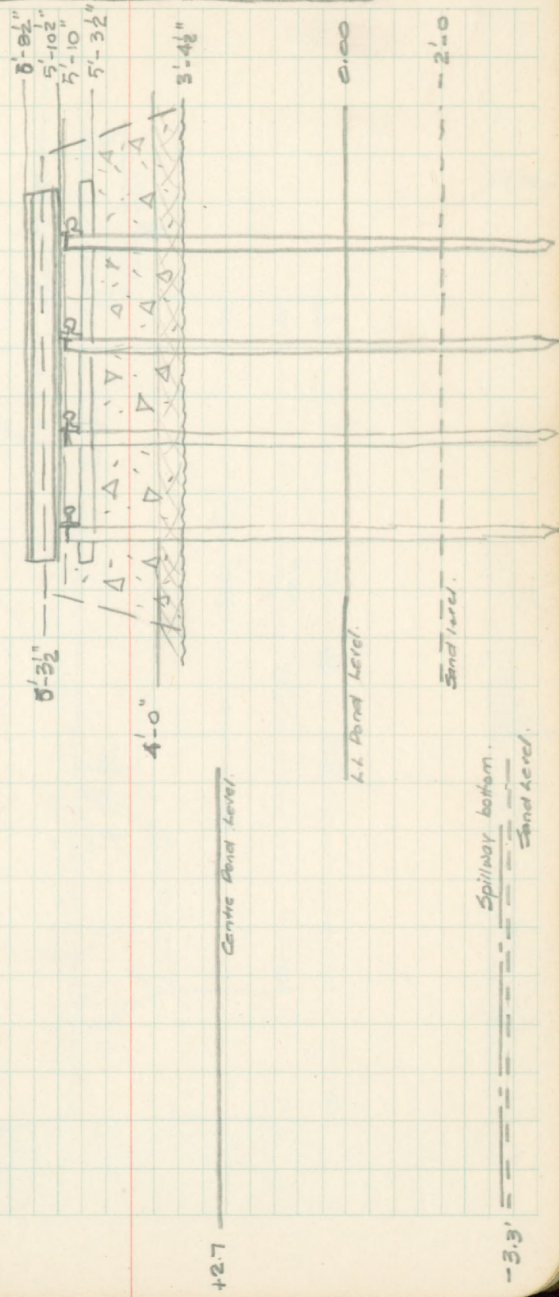
Switchboard Dim's.

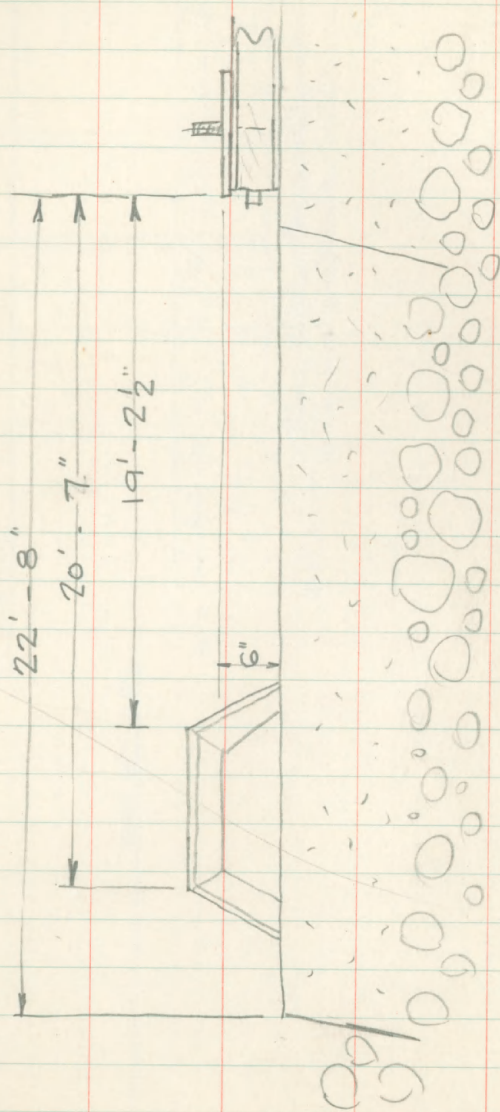
10.



PUMP FNDTN + SPILLWAY ELEV -

11.





The spillway was put down only 3 feet instead of the 6 feet to sand elevation with the intent that the sump box was ^{to be} placed higher. However, when the ice forced installation at the sump a foot higher still a condition of danger exists. The tailings dam ^{may} not holding the sufficient water back to provide an enough head on the sump to give 6000 g.p.m. at the pump. (about 2 feet over the lip.)

The dam on the h.h. must be widened and possibly augmented with dirt from the hillside in the spring - to be placed ^{on} upstream face to fly and hold the water up on that side.

5'-8 $\frac{1}{2}$ "

13.6"

1.52"

edge of
note base

1.82"

edge of

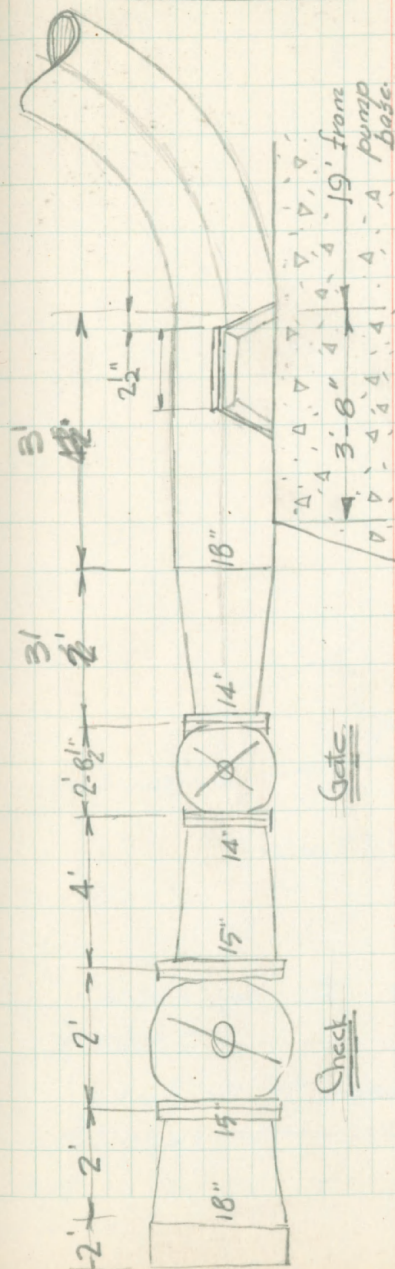
/

I beam

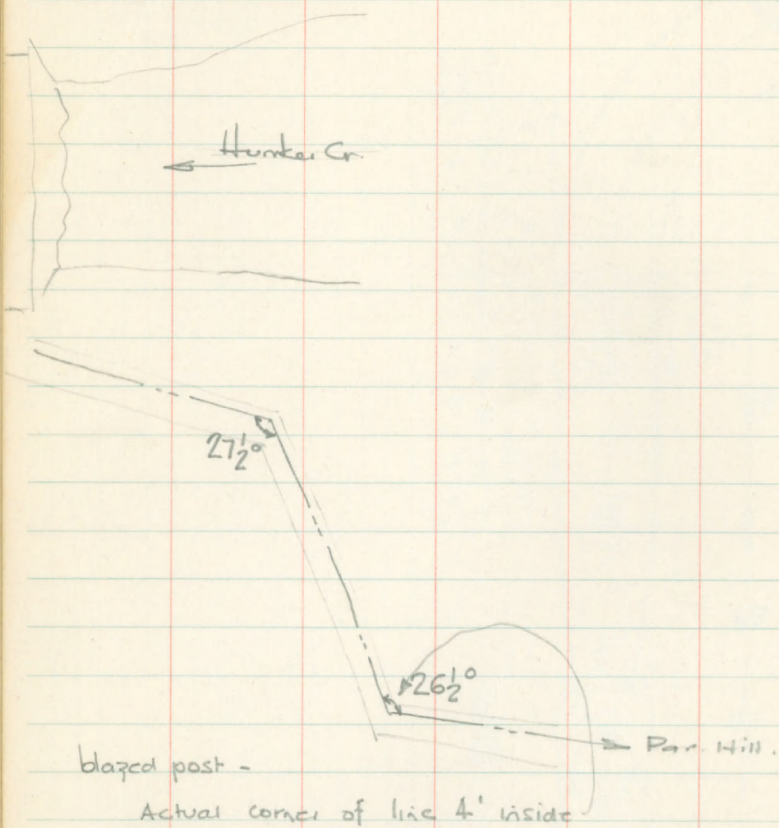
9.24,

7.71

SKETCH OF VALVE & CHECK REQTS



BENDS IN PIPE LINE



From upper bend to top north
corner of the pit ————— 2040 ft.

From upper bend back to the pump
is ————— 1400 ± ft.

SURVEY OF LINE (SLASHED) & PIT & ROAD STN.

15

STA	OBJ	AZIM	Hoe L	VERT L	Hoe Dist	VERT Dist
-----	-----	------	-------	--------	----------	-----------

6	- 5	186° 56'	-	+ 5° 45'	-	-
---	-----	----------	---	----------	---	---

5	- 6	6° 56'	177° 54'	- 5° 38'	395'	(-38.9)
---	-----	--------	----------	----------	------	---------

c		104° 47'	275° 45'	- 2° 34'	186'	- 8.35
---	--	----------	----------	----------	------	--------

5	4	189° 02'	-	7° 51'	-	-
---	---	----------	---	--------	---	---

5	5	9° 02'	181° 46'	- 7° 48'	218	(-298)
---	---	--------	----------	----------	-----	--------

d		87° 16'	260° 00'	- 5° 33'	151	- 14.65
---	--	---------	----------	----------	-----	---------

4	c	8° 45'	181° 29'	- 6° 28'	140	- 15.8
---	---	--------	----------	----------	-----	--------

4	3	187° 16'	-	+ 1° 18'	-	-
---	---	----------	---	----------	---	---

3	4	7° 16'	254° 28'	- 1° 15'	594.0	(-12.95)
---	---	--------	----------	----------	-------	----------

2	3	292° 47'	179° 38'	+ 1° 32'	198.0	(+ 5.3)
---	---	----------	----------	----------	-------	---------

2	7	316° 22'	203° 13'	+ 1° 42'	90.0	+ 2.7
---	---	----------	----------	----------	------	-------

1	2	293° 9'	199° 9'	+ 12° 25'	197.5	(+43.5)
---	---	---------	---------	-----------	-------	---------

1	a	6° 10'	272° 10'	+ 18'	93'	+ .5'
---	---	--------	----------	-------	-----	-------

1	down sluice cut centre.	094 586E				
---	----------------------------------	-------------	--	--	--	--

ELEV	STA DIST	AI
------	----------	----

400'	42'	
------	-----	--

1343.75	398'	
---------	------	--

186'		
------	--	--

223'	60"	
------	-----	--

1382.65	222'	
---------	------	--

152'		
------	--	--

141'		
------	--	--

593'	60"	
------	-----	--

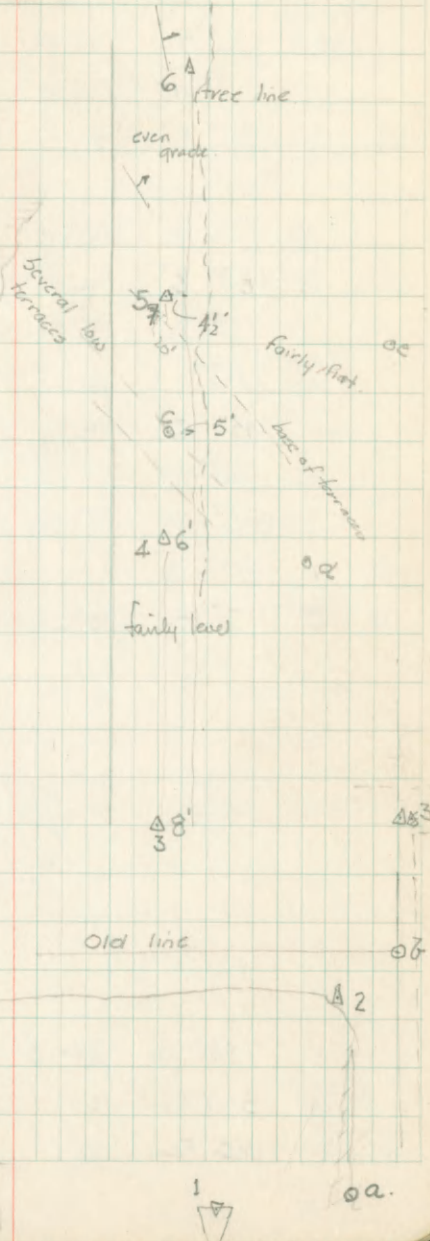
1412.45	594'	62"
---------	------	-----

1425.40	198'	52 1/2"
---------	------	---------

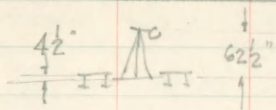
90'	51"	
-----	-----	--

1420.1	207'	
--------	------	--

93'		
-----	--	--



Sta Des Azim Hbr L Vert L Hbr Dist Vert Dist

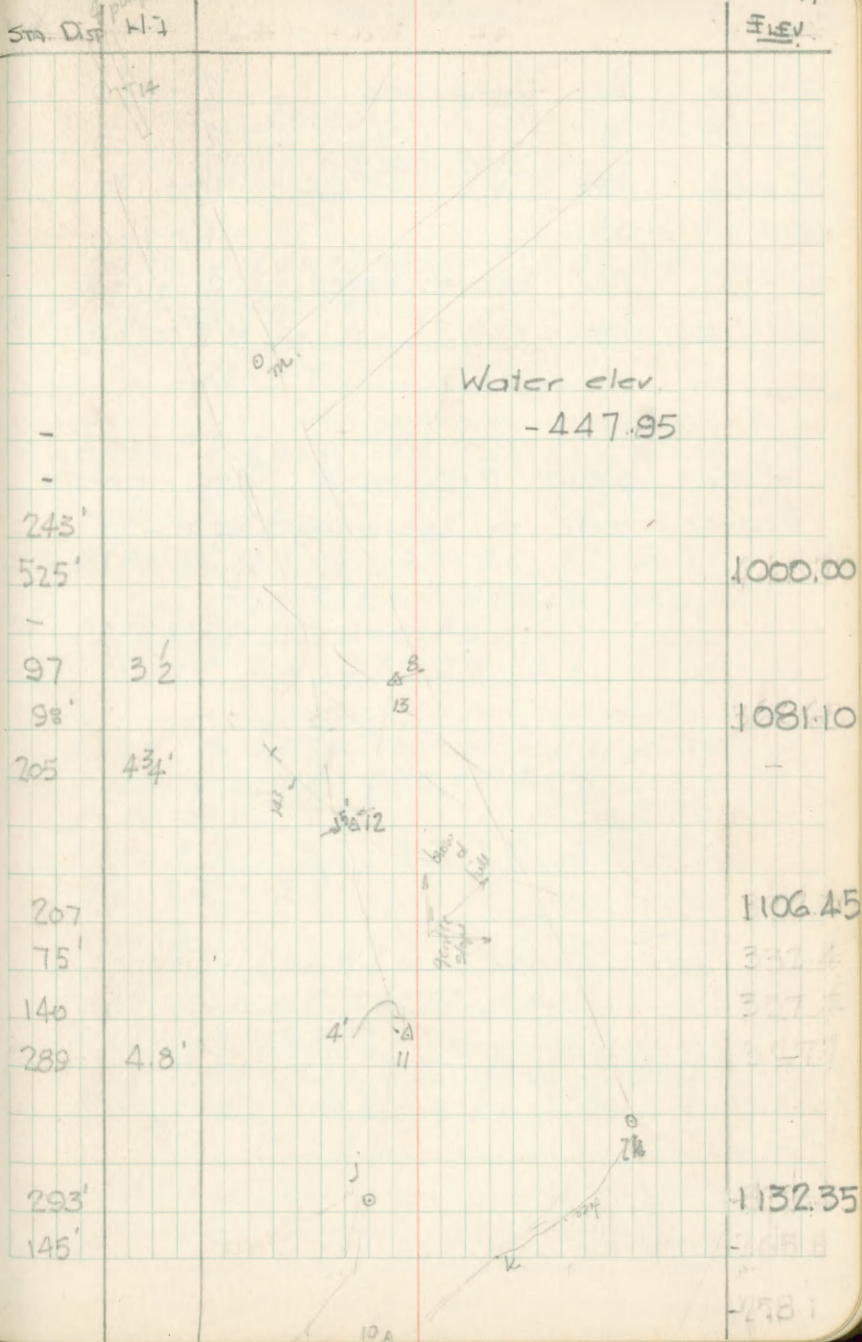


93'

Sta Dist H-7

17
Elev

14 - Pump +	2°12'	179°58'	-	-	-
Motor					
14 - 13	182°14'	-	-	-	-
m.	- 43'	160°19'	11°35'	233'	
14	2°14'	161°50'	9°00'	512'	(81.1)
pole	29°11'	188°42'	-	-	-
13 12	200°24'	-	+15°32'	-	-
13	20°24'	185°26'	-15°35'	90	(25.35)
12 13	194°58'	-	?	-	-
12	14°58'	178°04'	-7°14'	204	(25.9)
7	98°44'	261°50'	-17°2'	68.5	21.0
k	182°54'	346°0'	+6°44'	138	16.3
11 10	196°54'	-	+10°40'	-	-
11	16°54'	189°51'	-10°40'	282	(53.3)
10 - j	10°29'	183°26'	+10°35'	140	-10.7



0 - 20	20	Dump box	2" - 1'-0"
20 - 28	8	} Steel boxes. 72' total	2" - 1'-0"
28 - 44	16		1 1/2" - 1'-0"
44 - 92	48		1" - 1'-0"
92 - 192	100	Wooden boxes	3/4" - 1'-0"
192 - end	300+	✓	1/2" - 1'-0"

Screen plate throughout Steel boxes.
Undercurrent in convenient spot -

LOAD #1 LOCATION AT PUMP SITE
PIPE SIZE 18"

PIPE # 1. 2. 3. 4. 5. 6. 7. 8.

LOAD #2 LOCATION ON TOP OF DAM.
PIPE SIZE 18"

PIPE # 9. 10. 11. 12. 13. 14. 15.
16. 17.

LOAD #3 LOCATION IN GULLY ABOVE
DAM

PIPE SIZE 18"

PIPE # 18. 19. 20. 21. 22. 23.

24. 25. CHANGES TO 22" PIPE

PIPE SIZE 22" LOAD #3

PIPE # 26. 27. 28. 29.

LOAD #4 LOCATION MIDWAY ABOVE
GULLY & UPPER END OF PIPE LINE.
PIPE SIZE 22" #30

PIPE # 31. 32. 33. 34. 35. 36.
37. 38. 39.

LOAD #5 LOCATION 600 FT FROM
UPPER END OF CLEARING
PIPE SIZE 22"

PIPE # 40. 41. 42. 43. 44. 45.
46. 47. 48. 49. 50.

THE YUKON CONSOLIDATED GOLD CORPORATION, LIMITED

Nº 2986 A

WAREHOUSE REQUISITION

Furnished for Shop

DATE Jan 11/51

Charge to Dep't 6

Quantity	ITEM	Issued	Price	Cost
1	16" x 16" x 16" box			
12	White Box Co. 7 1/2 x 2"			

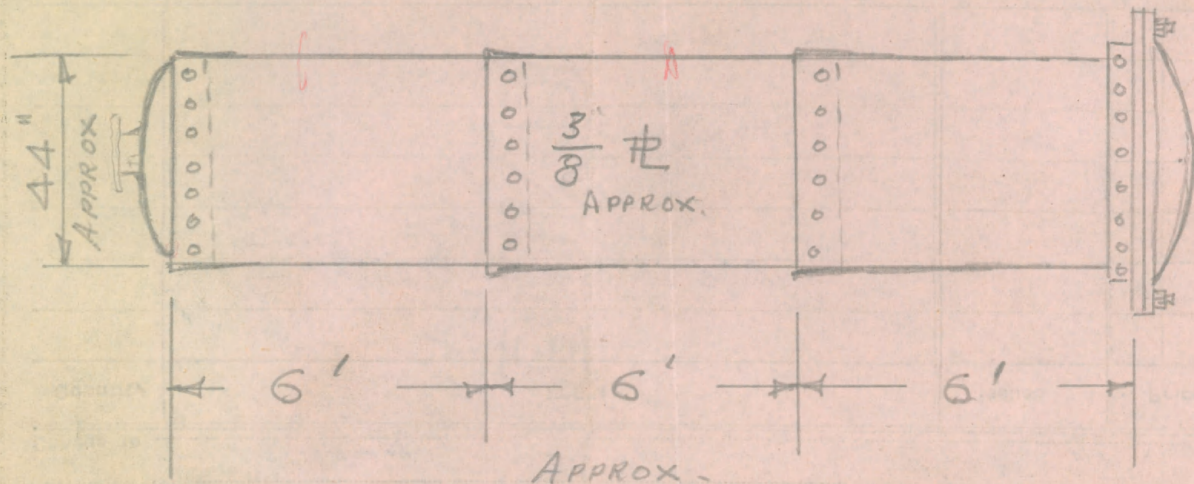
Signed Trappier VIA.

W/B

T.

P.

IN BONE YARD RT. SIDE



AMERICAN BONE YARD

THE AMERICAN BONE YARD CO. CONSERVATION FILMS

NO 5080

V

Top of pipe to be 2' above ground

STA	DBL	Az	VERT L	SL DIST	Hoe DIST	VERT DIST
1	2	P.L.	14° 30'		11' 49	bottom
	3				12.00	+2.35 above
	4		+8° 45'	57.7	57.43	+8.78
	5		+10° 42'	104.2	102.39	+19.35
	1a		+12° 38'	76'	74.16	+16.62
5 -	6		+5° 39'	129.3	128.67	+12.74
	5a		+6° 02'	100'	99.45	+10.51
	6					
6 -	6a		+16° 04'	86'	82.64	+23.80
	7		21° 45'	172.43	160.15	+63.90
7	6		20° 3'			
	a		-14° 45'	23	22.24	-5.86
7	8		9° 33'	172.75	170.35	+28.66
8	a		-8° 44'	128	126.52	-19.43
	+45		7' w cut 7' below line.	196.43		
8 -	9		+6° 08'	125.00	319.60	+34.33

H.I.	H.P.	ELEV	2.70
bottom inside pipe	top of pipe	0	$\frac{235}{25.5} = \frac{x}{1.5}$
3.05 from top of pipe	+2.70' 2.0 from ground	+2.35	$x = \frac{(1.5)(235)}{(25.5)}$ = .138
	.75' bottom of pipe	11.83	or 1 5/8" out of top of pipe
	+3.8	22.40	11.81
		19.67	52.15 57.7
1.5'	1'-0"	36.64	Cut 1 1/8"
	5.3	34.41	11.81 .85 11.00
3' 75 above 4' 75 above ground	4.75'	64.19	Slope A - level Slope B - Slope C = 11.00 = .249 44.8 = 3"
+2.05 +5.15	3.1	104.29	104 129.3 172.5 405.8
	-5.15	100.48	30.71
	3.9	135.00	18.23
1.2+ 5.1		117.77	35.33
	2.6	170.33	

9
9 9a 45 45 +6 2.6
4.85

b +13° 27' 183

10 +15° 174.1
152.75 315.70 +84.59

c +14° 38' 243

10 - 11 +6° 32' 94.8 94.18 10.79 32
5.0

170.33

87.19

4.85

13.99

4.85

3.2 257.52

4.85

1.5 Z Hor L 177° 41'
271.51

"

"

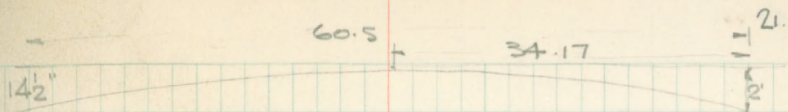
"

"

"

PIPE LENGTHS

2-3	44.18
3-4	53.15
4-5	34.41
5-6	58.35
6-7	49.70
7-8	50.32
8-9	64.03
9-10	69.98
10-11	59.00
11-12	57.87
12-13	53.80
13-14	58.17
14-15	56.42 SL CURVE
15-16	60.51 CURVE
16-17	55.57 SL CURVE
17-18	62.80 17 maybe B



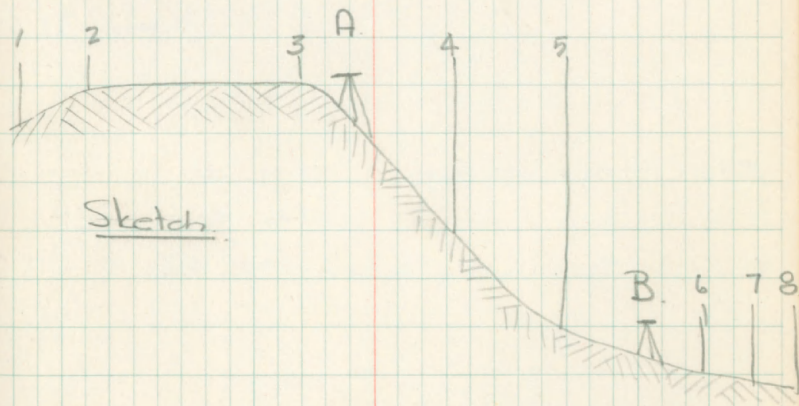
SPILLWAY - MAIN DAM - PROFILE.

56.

STN NO.	B.S.	F.S.	IS.	Δ elev.	ELEV.
A.			4.22		100.0
1			4.32		99.9
2			1.13		103.1
3			2.44		101.8
4			7.4		96.8
5		12.4	12.4		91.8

B.		75			88.25
6			9.24		83.31
7			11.99		80.56
8			14.34		78.21

DIST.	H.I.	Elev. X
	4.2	104.2
50'		
25'		
8'		
14'		
30'		
11'	4.3	92.55
18'		
46'		
66'		



LEVELLING FOR SPILLWAY

H.I. = 100.00'

57.

Top of concrete - 5.34 f. 94.66

Shot #1 - 12.2 87.80

Δ elev. 6.86

H.I. 100'

Top concrete - 4.76 95.24

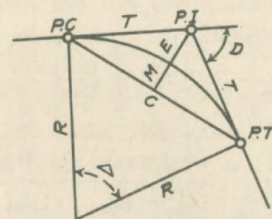
Shot #1. - 11.52 88.68

Δ elev. 6.56

BM	B.S.	H.I.	F.S.	I.S.	elev.
	4.75	104.75			
			1	11.10	93.65
				Δ elev. 6.35	
				10.89	93.86
				elev. of	
				bottom	91.65
				Elev. top dump	99.6
				Elev. lip	94.9
				Elev. Spillway base	93.86

DIETZGEN'S RAILROAD CURVE AND REDUCTION TABLES

Copyright, 1914, by Eugene Dietzgen Co., New York City



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 $\div 8\frac{1}{3}=414.49$ 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 $\times 54.5 \times 8\frac{1}{3}=136.2'$ 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 115.37. For from Table IV for 1° curve $E=960.6$ for $8^\circ 20'=960.6 \div 8\frac{1}{3}=115.27$ and from Table V correction=.10 or $E=115.37$ 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.

$\frac{1}{16}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
.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.—RADII, 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
2	2864.93	.436	1.745	0.60	20	614.56	2.037	8.136	2.80
10	2644.58	.473	1.891	0.65	30	603.80	2.074	8.281	2.85
20	2455.70	.509	2.036	0.70	40	593.42	2.110	8.426	2.90
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	20	546.44	2.292	9.150	3.15
50	2022.41	.618	2.472	0.85	30	521.67	2.402	9.585	3.30
3	1910.08	.655	2.618	0.90	40	499.06	2.511	10.02	3.45
10	1809.57	.691	2.763	0.95	12	478.34	2.620	10.45	3.60
20	1719.12	.727	2.908	1.00	30	459.28	2.730	10.89	3.75
30	1637.28	.764	3.054	1.05	13	441.68	2.839	11.32	3.90
40	1562.88	.800	3.199	1.10	30	425.40	2.949	11.75	4.05
50	1494.95	.836	3.345	1.15	14	410.28	3.058	12.18	4.20
					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					
6	955.37	1.309	5.234	1.80	25	231.01	5.476	21.64	7.50
10	929.57	1.346	5.379	1.85	26	222.27	5.697	22.50	7.80
20	905.13	1.382	5.524	1.90	27	214.18	5.918	23.35	8.10
30	881.95	1.418	5.669	1.95	28	206.68	6.139	24.19	8.40
40	859.92	1.455	5.814	2.00	29	199.70	6.360	25.04	8.70
					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	483.3	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	30'	5113.9	1950.3
40'	3557.2	1014.4	40'	4291.5	1429.0	40'	5128.9	1960.2
50'	3568.7	1020.5	50'	4304.6	1436.8	50'	5143.9	1970.3
64°	3580.3	1026.6	74°	4317.6	1444.6	84°	5159.0	1980.4
10'	3591.9	1032.8	10'	4330.7	1452.5	10'	5174.1	1990.5
20'	3603.5	1039.0	20'	4343.8	1460.4	20'	5189.3	2000.6
30'	3615.1	1045.2	30'	4356.9	1468.4	30'	5204.4	2010.8
40'	3626.8	1051.4	40'	4370.1	1476.4	40'	5219.7	2021.1
50'	3638.5	1057.7	50'	4383.3	1484.4	50'	5234.9	2031.4
65°	3650.2	1063.9	75°	4396.5	1492.4	85°	5250.3	2041.7
10'	3661.9	1070.2	10'	4409.8	1500.5	10'	5265.6	2052.1
20'	3673.7	1076.6	20'	4423.1	1508.6	20'	5281.0	2062.5
30'	3685.4	1082.9	30'	4436.4	1516.7	30'	5296.4	2073.0
40'	3697.2	1089.3	40'	4449.7	1524.9	40'	5311.9	2083.5
50'	3709.0	1095.7	50'	4463.1	1533.1	50'	5327.4	2094.1
66°	3720.9	1102.2	76°	4476.5	1541.4	86°	5343.0	2104.7
10'	3732.7	1108.6	10'	4489.9	1549.7	10'	5358.6	2115.3
20'	3744.6	1115.1	20'	4503.4	1558.0	20'	5374.2	2126.0
30'	3756.5	1121.7	30'	4516.9	1566.3	30'	5389.9	2136.7
40'	3768.5	1128.2	40'	4530.4	1574.7	40'	5405.6	2147.5
50'	3780.4	1134.8	50'	4544.0	1583.1	50'	5421.4	2158.4
67°	3792.4	1141.4	77°	4557.6	1591.6	87°	5437.2	2169.2
10'	3804.4	1148.0	10'	4571.2	1600.1	10'	5453.1	2180.2
20'	3816.4	1154.7	20'	4584.8	1608.6	20'	5469.0	2191.1
30'	3828.4	1161.3	30'	4598.5	1617.1	30'	5484.9	2202.2
40'	3840.5	1168.1	40'	4612.2	1625.7	40'	5500.9	2213.2
50'	3852.6	1174.8	50'	4626.0	1634.4	50'	5517.0	2224.3
68°	3864.7	1181.6	78°	4639.8	1643.0	88°	5533.1	2235.5
10'	3876.8	1188.4	10'	4653.6	1651.7	10'	5549.2	2246.7
20'	3889.0	1195.2	20'	4667.4	1660.5	20'	5565.4	2258.0
30'	3901.2	1202.0	30'	4681.3	1669.2	30'	5581.6	2269.3
40'	3913.4	1208.9	40'	4695.2	1678.1	40'	5597.8	2280.6
50'	3925.6	1215.8	50'	4709.2	1686.9	50'	5614.2	2292.0
69°	3937.9	1222.7	79°	4723.2	1695.8	89°	5630.5	2303.5
10'	3950.2	1229.7	10'	4737.2	1704.7	10'	5646.9	2315.0
20'	3962.5	1236.7	20'	4751.2	1713.7	20'	5663.4	2326.6
30'	3974.8	1243.7	30'	4765.3	1722.7	30'	5679.9	2338.2
40'	3987.2	1250.8	40'	4779.4	1731.7	40'	5696.4	2349.8
50'	3999.5	1257.9	50'	4793.6	1740.8	50'	5713.0	2361.5
70°	4011.9	1265.0	80°	4807.7	1749.9	90°	5729.7	2373.3
10'	4024.4	1272.1	10'	4822.0	1759.0	10'	5746.3	2385.1
20'	4036.8	1279.3	20'	4836.2	1768.2	20'	5763.1	2397.0
30'	4049.3	1286.5	30'	4850.5	1777.4	30'	5779.9	2408.9
40'	4061.8	1293.6	40'	4864.8	1786.7	40'	5796.7	2420.9
50'	4074.4	1300.9	50'	4879.2	1796.0	50'	5813.6	2432.9

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
91° 10' 20 30 40 50	5830.5 5847.5 5864.6 5881.7 5898.8 5916.0	2444.9 2457.1 2469.3 2481.5 2493.8 2506.1	101° 10' 20 30 40 50	6950.6 6971.3 6992.0 7012.7 7033.6 7054.5	3278.1 3294.1 3310.1 3326.1 3342.3 3358.5	111° 10' 20 30 40 50	8336.7 8362.7 8388.9 8415.1 8441.5 8468.0	4386.1 4407.6 4429.2 4450.9 4472.7 4494.6
92° 10 20 30 40 50	5933.2 5950.5 5967.9 5985.3 6002.7 6020.2	2518.5 2531.0 2543.5 2556.0 2568.6 2581.3	102° 10 20 30 40 50	7075.5 7096.6 7117.8 7139.0 7160.3 7181.7	3374.9 3391.2 3407.7 3424.3 3440.9 3457.6	112° 10 20 30 40 50	8494.6 8521.3 8548.1 8575.0 8602.1 8629.3	4516.6 4538.8 4561.1 4583.4 4606.0 4628.6
93° 10 20 30 40 50	6037.8 6055.4 6073.1 6090.8 6108.6 6126.4	2594.0 2606.8 2619.7 2632.6 2645.5 2658.5	103° 10 20 30 40 50	7203.2 7224.7 7246.3 7268.0 7289.8 7311.7	3474.4 3491.3 3508.2 3525.2 3542.4 3559.6	113° 10 20 30 40 50	8656.6 8684.0 8711.5 8739.2 8767.0 8794.9	4651.3 4674.2 4697.2 4720.3 4743.6 4766.9
94° 10 20 30 40 50	6144.3 6162.6 6180.2 6198.3 6216.4 6234.6	2671.6 2684.7 2697.9 2711.2 2724.5 2737.9	104° 10 20 30 40 50	7333.6 7355.6 7377.8 7399.9 7422.2 7444.6	3576.8 3594.2 3611.7 3629.2 3646.8 3664.5	114° 10 20 30 40 50	8822.9 8851.0 8879.3 8907.7 8936.3 8965.0	4790.4 4814.1 4837.8 4861.7 4885.7 4909.9
95° 10 20 30 40 50	6252.8 6271.1 6289.4 6307.9 6326.3 6344.8	2751.3 2764.8 2778.3 2792.0 2805.6 2819.4	105° 10 20 30 40 50	7467.0 7489.6 7512.2 7534.9 7557.7 7580.5	3682.3 3700.2 3718.2 3736.2 3754.4 3772.6	115° 10 20 30 40 50	8993.8 9022.7 9051.7 9080.9 9110.3 9139.8	4934.1 4958.6 4983.1 5007.8 5032.6 5057.6
96° 10 20 30 40 50	6363.4 6382.1 6400.8 6419.5 6438.4 6457.3	2833.2 2847.0 2861.0 2875.0 2889.0 2903.1	106° 10 20 30 40 50	7603.5 7626.6 7649.7 7672.9 7696.3 7719.7	3791.0 3809.4 3827.9 3846.5 3865.2 3884.0	116° 10 20 30 40 50	9169.4 9199.1 9229.0 9259.0 9289.2 9319.5	5082.7 5107.9 5133.3 5158.8 5184.5 5210.3
97° 10 20 30 40 50	6476.2 6495.2 6514.3 6533.4 6552.6 6571.9	2917.3 2931.6 2945.9 2960.3 2974.7 2989.2	107° 10 20 30 40 50	7743.2 7766.8 7790.5 7814.3 7838.1 7862.1	3902.9 3921.9 3940.9 3960.1 3979.4 3998.7	117° 10 20 30 40 50	9349.9 9380.5 9411.3 9442.2 9473.2 9504.4	5236.2 5262.3 5288.6 5315.0 5341.5 5368.2
98° 10 20 30 40 50	6591.2 6610.6 6630.1 6649.6 6669.2 6688.8	3003.8 3018.4 3033.1 3047.9 3062.8 3077.7	108° 10 20 30 40 50	7886.2 7910.4 7934.6 7959.0 7983.5 8008.0	4018.2 4037.8 4057.4 4077.2 4097.1 4117.0	118° 10 20 30 40 50	9535.7 9567.2 9598.9 9630.7 9662.6 9694.7	5395.1 5422.1 5449.2 5476.5 5504.0 5531.7
99° 10 20 30 40 50	6708.6 6728.4 6748.2 6768.1 6788.1 6808.2	3092.7 3107.7 3122.9 3138.1 3153.3 3168.7	109° 10 20 30 40 50	8032.7 8057.4 8082.3 8107.3 8132.3 8157.5	4137.1 4157.3 4177.5 4197.9 4218.4 4239.0	119° 10 20 30 40 50	9727.0 9759.4 9792.0 9824.8 9857.7 9890.8	5559.4 5587.4 5615.5 5643.8 5672.3 5700.9
100° 10 20 30 40 50	6828.3 6848.5 6868.8 6889.2 6909.6 6930.1	3184.1 3199.6 3215.1 3230.8 3246.5 3262.3	110° 10 20 30 40 50	8182.8 8208.2 8233.7 8259.3 8285.0 8310.8	4259.7 4280.5 4301.4 4322.4 4343.6 4364.8	120° 10 20 30 40 50	9924.0 9957.5 9991.0 10025.0 10059.0 10093.0	5729.7 5758.6 5787.7 5817.0 5846.5 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	.81	.92	1.04	1.29	1.42	1.54	1.66		
40°	.13	.26	.40	.53	.67	.80	.93	1.06	1.20	1.34	1.49	1.64	1.79	1.94		
45°	.15	.30	.44	.60	.76	.91	1.06	1.21	1.37	1.52	1.70	1.87	2.04	2.21		
50°	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.54	1.72	1.91	2.10	2.29	2.48		
55°	.19	.38	.57	.76	.95	1.14	1.32	1.52	1.72	1.92	2.14	2.35	2.56	2.77		
60°	.21	.42	.63	.84	1.05	1.27	1.49	1.71	1.94	2.17	2.38	2.60	2.83	3.07		
65°	.23	.46	.69	.93	1.16	1.40	1.64	1.88	2.13	2.38	2.63	2.88	3.13	3.39		
70°	.25	.51	.76	1.02	1.28	1.54	1.80	2.06	2.33	2.60	2.88	3.16	3.44	3.72		
75°	.27	.56	.83	1.12	1.40	1.69	1.98	2.27	2.57	2.87	3.16	3.47	3.78	4.09		
80°	.30	.61	.91	1.22	1.53	1.84	2.15	2.46	2.78	3.10	3.44	3.78	4.12	4.46		
85°	.33	.66	1.00	1.33	1.68	2.02	2.36	2.70	3.05	3.40	3.77	4.14	4.55	4.89		
90°	.36	.72	1.09	1.45	1.83	2.20	2.57	2.94	3.32	3.70	4.10	4.50	4.91	5.32		
95°	.39	.79	1.19	1.55	2.00	2.40	2.80	3.20	3.61	4.02	4.40	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	.032	.037	.043	.049	.054	.061	.067		
20°	.006	.011	.017	.022	.028	.034	.039	.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	.266	.353	.440	.528	.617	.707	.797	.877	.971	1.07	1.18	1.29		
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	.885	1.06	1.25	1.43	1.62	1.80	1.99	2.18	2.38	2.53		
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	.01	.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	.21	.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	196.90	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	388.42
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	1.20	.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.

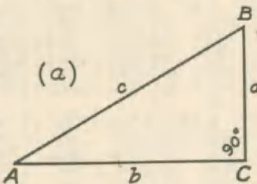
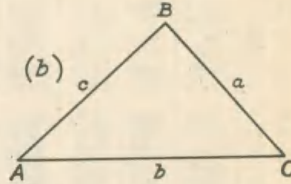
Deg. of Curve	LENGTH OF RAILS							Deg. of Curve	LENGTH OF RAILS						
	32	30	28	26	24	22	20		32	30	28	26	24	22	20
1°	.022	.020	.016	.013	.011	.009	.008	16°	.356	.313	.273	.236	.200	.170	.139
2	.045	.038	.034	.029	.025	.021	.017	17	.378	.333	.290	.252	.213	.180	.148
3	.067	.058	.051	.044	.037	.031	.026	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 that 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° 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.

sin.	$A = \frac{a}{c}$		
cos.	$A = \frac{b}{c}$		
tan.	$A = \frac{a}{b}$		
cot.	$A = \frac{b}{a}$		
sec.	$A = \frac{c}{b}$		
cosec.	$A = \frac{c}{a}$		

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. $\frac{1}{2}(A - B) = \frac{a - b \tan. \frac{1}{2}(A + B)}{a + b}$
c, b, c	A	$\left\{ \begin{array}{l} \text{If } s = \frac{1}{2}(a + b + c), \sin. \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}} \\ \cos. \frac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}, \tan. \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}} \\ \sin. A = \frac{2 \sqrt{(s-a)(s-b)(s-c)}}{bc} \end{array} \right.$
A, B, C, a	area	area = $\frac{a^2 \sin. B \sin. C}{2 \sin. A}$
A, b, c	area	area = $\frac{1}{2} b c \sin. A$
a, b, c	area	$s = \frac{1}{2}(a + b + c)$, area = $\sqrt{s(s-a)(s-b)(s-c)}$

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.		Angle	Sine.	Tan.	Cotg.	Cosin.	
0°	0	0	∞	1	90	0°	.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
	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.	
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
	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
10	.5324	.6289	1.590	.84650	50	.40	.6248	.8002	1.250
20	.5348	.6330	1.580	.84495	40	.50	.6271	.8050	1.242
30	.5373	.6371	1.570	.84339	30				
40	.5398	.6412	1.560	.84182	20	39	.6293	.8098	1.235
50	.5422	.6453	1.550	.84025	10	10	.6316	.8146	1.228
					20	20	.6338	.8195	1.220
33	.5446	.6494	1.540	.83867	57	30	.6361	.8243	1.213
10	.5471	.6536	1.530	.83708	50	40	.6383	.8292	1.206
20	.5495	.6577	1.520	.83549	40	50	.6406	.8342	1.199
30	.5519	.6619	1.511	.83389	30				
40	.5544	.6661	1.501	.83228	20	40	.6428	.8391	1.192
50	.5568	.6703	1.492	.83066	10	10	.6450	.8441	1.185
					20	20	.6472	.8491	1.178
34	.5592	.6745	1.483	.82904	56	30	.6494	.8541	1.171
10	.5616	.6787	1.473	.82741	50	40	.6517	.8591	1.164
20	.5640	.6830	1.464	.82577	40	50	.6539	.8642	1.157
30	.5664	.6873	1.455	.82413	30				
40	.5688	.6916	1.446	.82248	20	41	.6561	.8693	1.150
50	.5712	.6959	1.437	.82082	10	10	.6583	.8744	1.144
					20	20	.6604	.8796	1.137
35	.5736	.7002	1.428	.81915	55	30	.6626	.8847	1.130
10	.5760	.7046	1.419	.81748	50	40	.6648	.8899	1.124
20	.5783	.7089	1.411	.81580	40	50	.6670	.8952	1.117
30	.5807	.7133	1.402	.81412	30				
40	.5831	.7177	1.393	.81242	20	42	.6691	.9004	1.111
50	.5854	.7221	1.385	.81072	10	10	.6713	.9057	1.104
					20	20	.6734	.9110	1.098
36	.5878	.7265	1.376	.80902	54	30	.6756	.9163	1.091
10	.5901	.7310	1.368	.80730	50	40	.6777	.9217	1.085
20	.5925	.7355	1.360	.80558	40	50	.6799	.9271	1.079
30	.5948	.7400	1.351	.80386	30				
40	.5972	.7445	1.343	.80212	20	43	.6820	.9325	1.072
50	.5995	.7490	1.335	.80038	10	10	.6841	.9380	1.066
					20	20	.6862	.9435	1.060
37	.6018	.7536	1.327	.79864	53	30	.6884	.9490	1.054
10	.6041	.7581	1.319	.79688	50	40	.6905	.9545	1.048
20	.6065	.7622	1.311	.79512	40	50	.6926	.9601	1.042
30	.6088	.7673	1.303	.79335	30				
40	.6111	.7720	1.295	.79158	20	44	.6947	.9657	1.036
50	.6134	.7766	1.288	.78980	10	10	.6967	.9713	1.030
					20	20	.6988	.9770	1.024
38	.6157	.7813	1.280	.78801	52	30	.7009	.9827	1.018
10	.6180	.7860	1.272	.78622	50	40	.7030	.9884	1.012
20	.6202	.7907	1.265	.78442	40	50	.7050	.9942	1.006
							.7071	.1	1.000
									.70711
									45
									or
	Cosin.	Cotg.	Tan.	Sine.	Angle		Cosin.	Cotg.	Tan.
									Sine.
									Angle

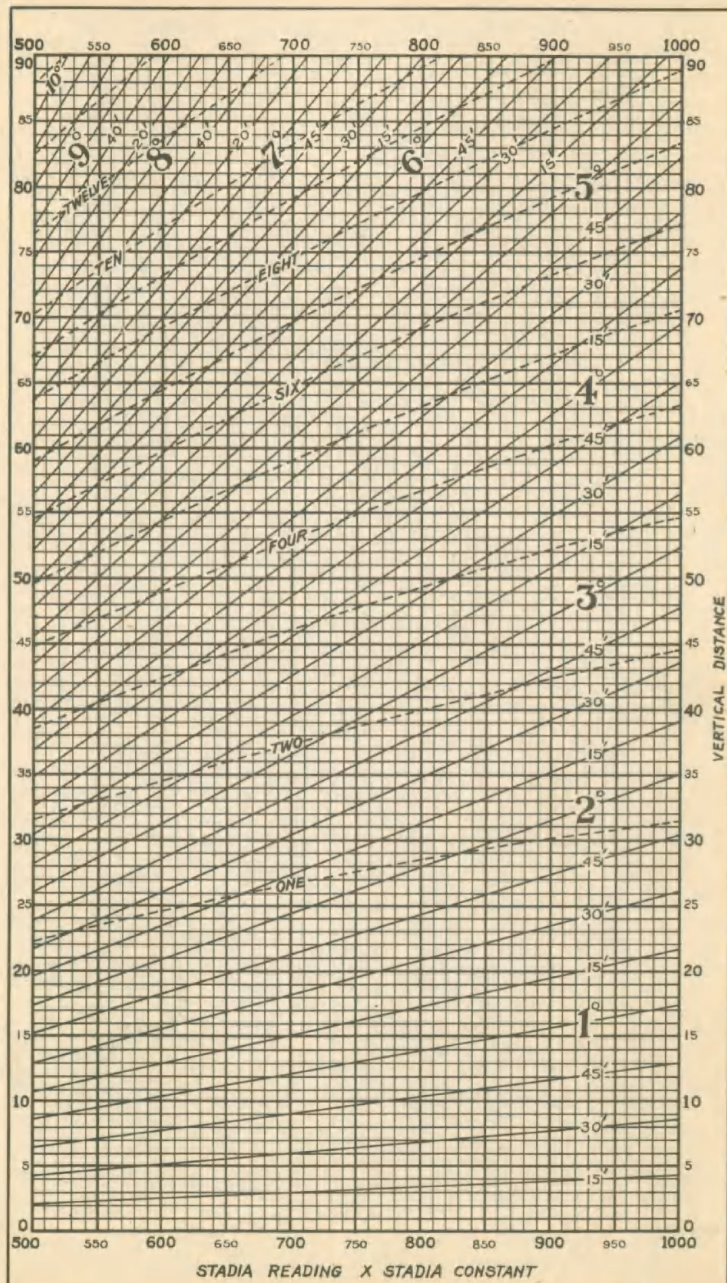
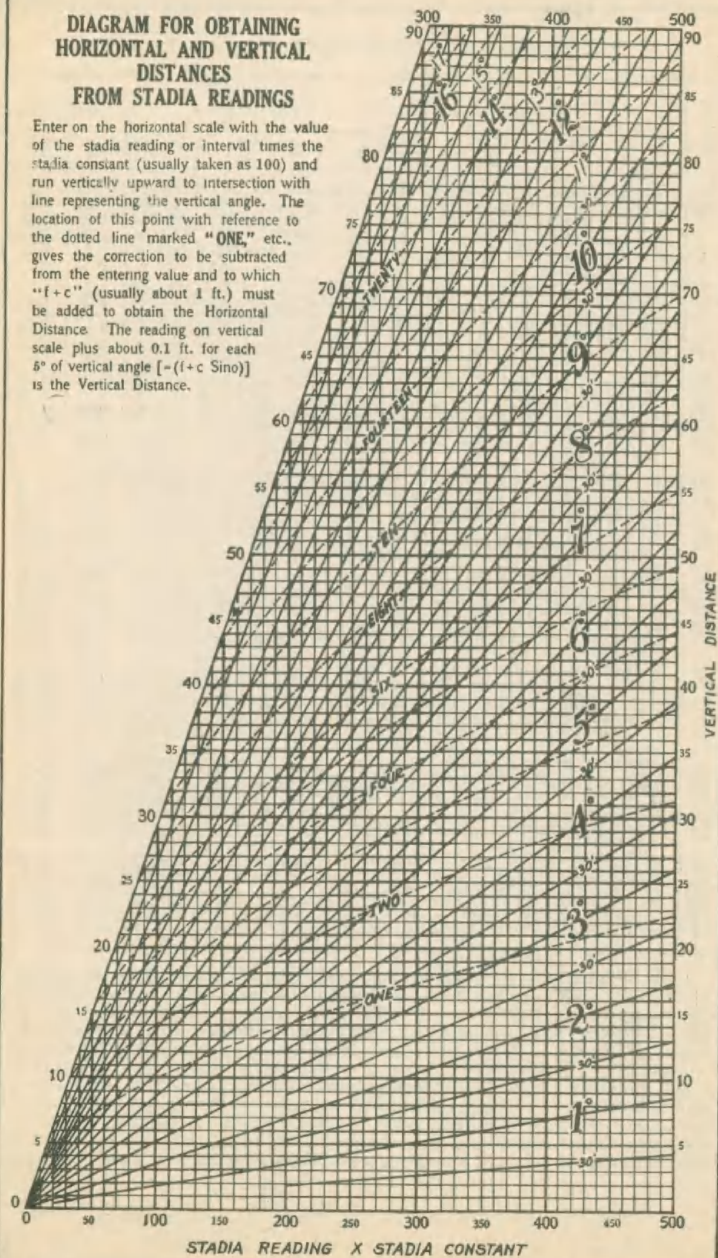
TABLE IX.—CALCULATION OF EARTHWORK.

Width	HEIGHT														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.02	.04	.06	.07	.08	.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. = $1.48 + .018 + .089 = 1.587$ cu. yds. or practically 159 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 [$-(f+c \sin \alpha)$] is the Vertical Distance.

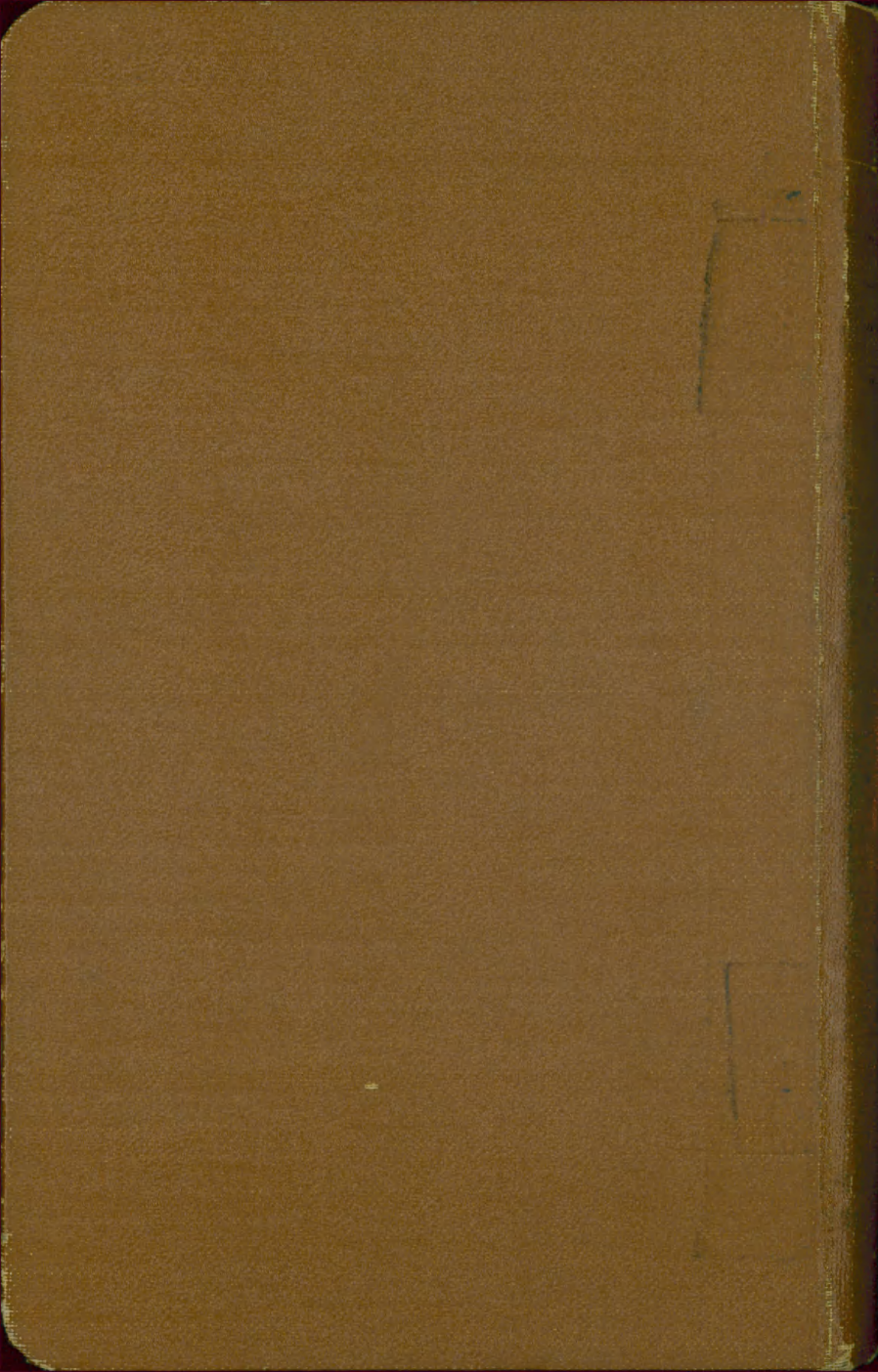


DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

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	26.2	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.





Library and Archives
Canada

395 Wellington Street
Ottawa, ON K1A 0N4

Bibliothèque et Archives
Canada

395, rue Wellington
Ottawa, ON K1A 0N4

For material still subject to legislative, contractual or institutional obligations, users warrant that they will respect those obligations and not use LAC collections in a manner that would infringe the rights of others. Liability that may arise in the use of a copy is assumed in full by the user. LAC accepts no responsibility for unauthorized use of collection material by users.

To ensure proper citation and to facilitate relocation of an item, the source of the material and its reference number should always accompany the copy.

Pour les documents faisant encore l'objet d'obligations législatives, contractuelles ou institutionnelles, les usagers s'engagent à respecter ces obligations et à ne pas utiliser les documents des collections de BAC de façon à nuire aux droits d'autrui. Ils doivent assumer entièrement toute responsabilité qui pourrait découler de l'utilisation d'une reproduction de document. BAC décline toute responsabilité quant à l'utilisation non autorisée de documents provenant de ses collections.

Afin de citer un document avec exactitude et d'en faciliter le repérage, sa source et son numéro de référence doivent toujours accompagner la reproduction.

TITLE/TITRE _____
RG _____ MG ²⁸ _____ R- _____ SERIES/SÉRIE ^{III 43} _____
ACCESSION _____ VOL ⁸⁸ _____ PAGE(S) ⁴² _____
BOX/BOÎTE _____ REEL/BOBINE _____
FILE/DOSSIER PARADISE HILL _____
DATE MARCH 2015 _____