F.B. # 305

Cross Sections of Downstream Face of Morena Dam.
Pages 3-19.

Stadia Readings on hillside at Lower End of Morena Spillway for Spillway Enlargement.
Pages 21-22.
Pages 29-30
Converse - Inst.
Palmer - Rod.
One Laborer.
Sept. 1928.

Location of Road on South Side Morena Dam.
Page 28.

Surveys Early in 1929

Late 1929 Layout Surveys by Converse, Hill, Parker -

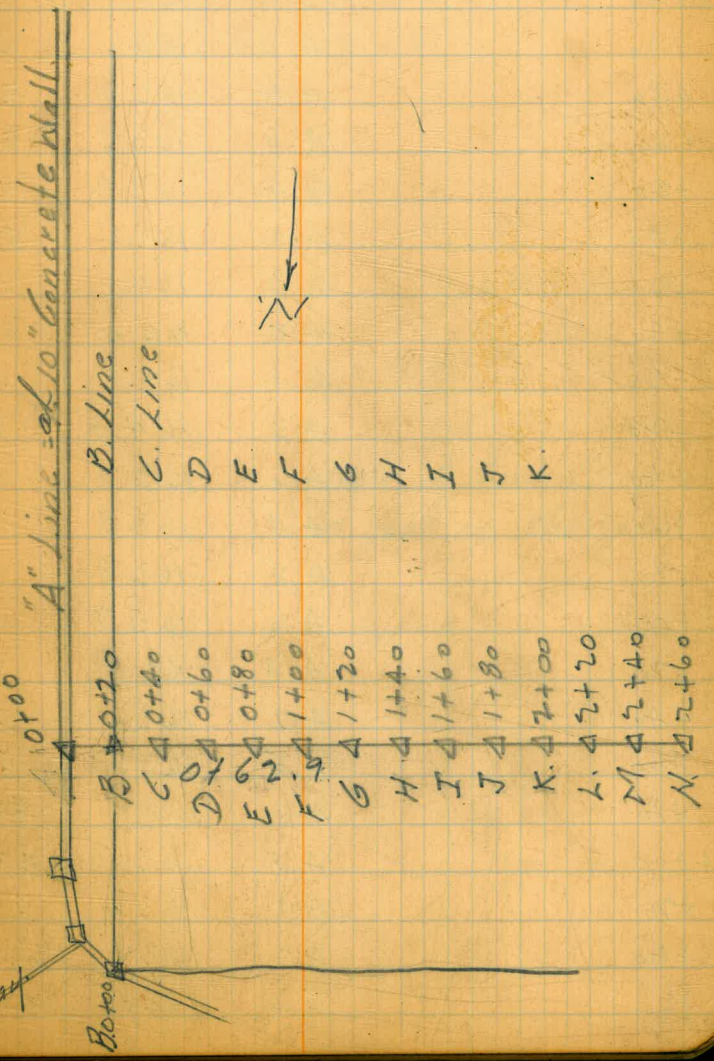
(Continued on next page)

INDEX (cont.)

Cross Sections of Downstream Face of Morena Dam.

	Top. Spillway			155.0
	12.90	167.90		
B.M	Top Post.		1.45	166.45
	Top. 10" Wall		1.93	166.0
				166.45
	1.86	168.31		
T.P. #1			12.72	155.59
	1.61	157.20		
#2			12.85	144.35
	1.27	145.62		
#3			12.48	133.14
	2.65	135.79		
#4	0.31	123.33	12.77	123.02
#5	0.54	110.91	12.96	110.37
#6	0.70	98.97	12.64	98.27
#7	0.86	87.09	12.74	86.23
#8	1.34	75.67	12.76	74.33
#9	0.44	63.40	12.71	62.96
#10	1.75	52.45	12.70	50.70
#11			12.86	39.59

Parapet Wall



			"A" Line		"B."	Line			
B.M.	1.86	168.31							166.45
0+00					5.4	162.9			
0+20			4.7	163.6	5.4	162.9	5.2	163.1	12.0 R. of B.
0+40			4.6	163.7	5.1	163.2	4.6	163.7	12.0 R.
+60			4.3	164.0	5.3	163.0	6.8	161.5	13.0 R.
+80			4.4	163.9	5.3	163.0			
1+00			4.5	163.8	5.1	163.2			
+20			4.4	163.9	5.2	163.1			
+40			4.5	163.8	5.4	162.9			
+60			4.3	164.0	5.3	163.0			0+06 C. Line
+80			4.3	164.0	5.1	163.2			162.6
2+00			4.4	163.9	5.3	163.0			
+20			4.3	164.0	5.0	163.3			
+40			4.6	163.7	5.0	163.3			Note. "A" Line Elevations
+60			4.5	163.8	5.2	163.1			at foot of Parapet.
+80			4.5	163.8	5.3	163.0			
3+00			4.6	163.7	5.3	163.0			
+20			4.5	163.8	5.3	163.0			
+40			4.7	163.6	5.1	163.2			
+60			4.5	163.8	5.2	163.1			
+80			4.6	163.7	5.1	163.2			
4+00			4.8	163.5	5.2	163.1			
+20			4.9	163.4	5.5	162.8			
+40			4.7	163.6	6.0	162.3			
+60			5.0	163.3	5.9	162.4	6.6	161.7	

		A. Line		B. Line	
	168.31				
4+80		5.0	163.3	6.0	162.3
5+00		4.6	163.7		
	Average El.		163.86		163.0

Δ = 0+91°

C. Line:

T.P.#2	10.00	154.35
0+00		144.35
+06		162.6
+20		162.6
+40		
+60		
+80		
1+00	6.2	148.2
+20	8.9	145.5
+40	8.2	146.2
+60	6.8	147.6
+80	6.8	147.6
2+00	8.8	145.6
+20	7.8	146.6
+40	7.0	147.4
+60	10.7	143.7
+80	7.3	147.1
3+00	8.5	145.9
+20	10.1	144.3
+40	7.5	146.9
+60	7.0	147.4
+80	7.3	147.1
4+00	7.6	146.8
+20	8.2	146.2
+40	7.5	146.9

Δ = 0+91.

C. Line

154.35

4+60	7.6	146.8
+80	8.0	146.4
+83	7.4	147.0
	Av. El.	146.53

Δ = 0+62.9

D. Line

T.P. #2	2.45	146.80		144.35
0+80			7.5	139.3
1+00			6.6	140.2
+20			13.2	133.6
T.P. #3	8.20	141.34		133.14
+40			12.1	129.2
+60			11.6	129.7
+80			11.5	129.8
2+00			11.3	130.0
+20			10.5	130.8
+40			12.9	128.4
+60			11.8	128.5
+80			11.0	130.3
3+00			12.0	129.3
+20			9.7	131.6
+40			9.6	131.7
+60			10.9	130.4
+80			11.3	130.0
4+00			10.6	130.7
+20			10.3	131.0
+40			10.3	131.0
+60			9.3	132.0
+80			8.1	133.2
5+00			0.0	141.3
		Av. El.		131.46

144

A = E. 1+24½

E. Line.

H. I. =		123.22
1+16	0.0	123.2
1+24	5.0	118.2
+40	6.4	116.8
+60	8.2	115.0
+80	7.8	115.4
2+00	7.2	116.0
+20	7.0	116.2
+40	8.4	114.8
+60	6.1	117.1
+80	7.0	116.2
3+00	5.7	117.5
+20	5.6	117.6
+40	6.0	117.2
+60	7.6	115.6
+80	7.0	116.2
4+00	6.0	117.2
+20	6.5	116.7
+40	6.6	116.6
+60	4.4	118.8
+70	5.7	117.5
+80	0.0	123.2
+95		132.0

Av. El. 117.96

Δ = 1+40.6

T.P. # 5

0.54 110.91

1+20		
+29		
+40		
+60		
+80		
2+00		
+20		
+40		
+60		
+80		
3+00		
+20		
+40		
+60		
+80		
4+00		
+20		
+40		
+60		
+68		
+80		

F. Line.

110.37

0.0	110.9
4.4	106.5
6.0	104.9
7.6	103.3
8.6	102.3
7.6	103.3
8.7	102.2
7.0	103.9
6.7	104.2
6.4	104.5
5.3	105.6
6.6	104.3
8.5	102.4
7.8	103.1
6.2	104.7
5.4	105.5
6.5	104.4
7.4	103.5
4.0	106.9
0.0	110.9
	118.0

Av. El. 104.57

Δ = 1 + 22.6

T.P.#6

7.68 105.95

1 + 16
+25
+40
+60
+80
2 + 00
+20
+40
+60
+80
3 + 00
+20
+40
+60
+80
4 + 00
+20
+40
+60
+65

6. Line

98.27

0.0	106.0
5.7	100.3
7.8	98.2
10.8	95.2
12.7	93.3
13.0	93.0
13.7	92.3
12.9	93.1
14.5	91.5
12.0	94.0
11.6	94.4
14.3	91.7
15.2	90.8
11.5	94.5
12.8	93.2
11.5	94.5
13.0	93.0
6.7	99.3
3.1	102.9
0.0	106.0

Av. El. 95.4

94.0 Elev H. 1+35

94.0 Elev. I. 1+35

△ = 1+55 ±

T.P. #8

10.56 84.89

H. Line.

74.33

1+35	94.0	
+47	84.9	
1+55.0 △	0.0	
+60	7.2	77.7 Toe of Slope
+80	9.5	75.4
2+00	7.5	77.4
+20	7.0	77.9
+40	8.6	76.3
+60	9.1	75.8
+80	6.7	78.2
3+00	7.2	77.7
+20	10.4	74.5
+40	11.5	73.4
+60	10.4	74.5
+80	10.0	74.9
4+00	7.0	77.9
+20	6.4	78.5 Toe of Slope.
+32	0.0	84.9
+40		91.0

(90)

△ = 1+91.4

I Line.

T.P. #9			62.96
	2.51	65.47	
1+35			94.0
+50			76.2
+65			67.1
+80			64.4 Toe of slope.
2+00		5.5	60.0
+20		5.4	60.1
+40		5.3	60.2
+60		5.8	59.7
+80		5.4	60.0
3+00		5.8	59.7
+20		5.5	60.0
+40		6.7	58.8
+60		7.3	58.2
+80		5.1	60.4
4+00		4.0	61.5 Toe of Slope.
+14		0.0	65.5
+20			70.0
+32			78.5

77

J. Line

Δ = 2+07.5			
T.P. #10			50.70
	1.75	5√.45	
			90.0
1+35			55.3
+75			54.8
+90			
2+00		4.2	48.2
+20		5.8	46.6
+40		7.3	45.1
+60		8.0	44.4
+80		10.0	42.4
3+00		7.6	44.6
+20		8.8	43.6
+40		11.4	41.0
+60		11.7	40.7
+80		7.5	44.9
4+00		2.7	49.7
+16		0.0	52.4
+30			66.0

(63)

90'

R. Line

Δ = 2+29.0

T.P. # 11				39.59
	0.64	40.23		
1+90				55.0
2+00				49.0
+10			3.0	37.2
+30			5.0	35.2
+40			7.2	33.0
+60			10.1	30.1
+80			10.9	29.3
3+00			11.8	28.4
+20			12.2	28.0
+40			14.0	26 I
+60			10.8	29.4
+80			10.7	29.5
4+00			3.3	36.9
+10			2.0	38.2
+12				58.0

1+90 = 55.0

2+00 = 49.0

2+07.5

21.5

2+29.0

			L. Line 270		M.	240 Line.	260 N. Line.			
Δ = 2+29.5 "L"										
T.P. #11				39.59						
	0.77	40.36								
2+08				43.7				43.7 = 2+08		
+29				36.9				36.9 = 2+29		
+40			7.6	32.8						
+1	1.94	29.38						12.92	27.44	
+60			3.9	25.5	11.3	29.1				
3+20										
+80			8.6	20.8	4.6	24.8				
+40	2.41	19.19						12.60	16.78	
3+00			3.5	15.7	3.5	15,7	0.7 . 18.5			
								"O" Line		
+20			4.5	14.7	10.2	9.0	8.0 11.2	8.0	11.2	
+40			5.0	14.2	10.2	9.0	11.5 7.7	8.7	10,5	
+60			2.0	17.2	8.0	11.2	11.2 8.0	14.2	5.0	
T.P.	11.60	30.40	0.39	18.80						
+80			7.4	23.0	13.0	17.4	15.4 15.0	16.0	14.4	
									M. 24.	
4+00			0.8	29.6	3.2	27.2	13.0 17.4		N. 10.	
T.P.	10.34	39.87	0.87	29.53						
+20			1.7	38.2	12.9	N7.0				
+23				60.0	4.9	35.0				B.7

Intermediate Shots - South End of Dam.

B.M.		166.45	
	0.15	166.60	
	6.8	159.8	12' R. 4+60 B. Line.
	17.3	149.3	13' R.
	7.6	159.0	4+80 C Line
	18.0	148.6	4+77 " "
	6.5	160.1	5+00 B. Line
	10.0	156.6	1' R. 5+00 B. Line
	8.9	157.7	5+00 C. Line
	6.1	160.5	4+90 C. Line
	2.8	163.8	5+20 A. "
	2.6	164.0	3' L. 5+20 A " . Foot Dam Face.
	3.3	163.3	7' R. 5+20 A "
	5.8	160.8	14' R.
	9.8	157.8	15' R.
	10.3	156.3	5+20 B. Line
	9.4	157.2	5+20 C. Line
	2.7	163.9	14.0 L. 5+40 A. Line Foot Dam Face
	2.8	163.8	5+40 A Line
	3.2	163.4	5+40 B. "
	2.9	163.7	5+40 C. Line
	3.3	163.3	5+60 A Line
	2.7	163.9	24' L. 5+60 A. Line Con. Wall & Rock Cliff
	3.3	163.3	5+65 A. Line.

10.8
6.5
17.3

63
29
34

Intermediate Shots. North End of Dam.

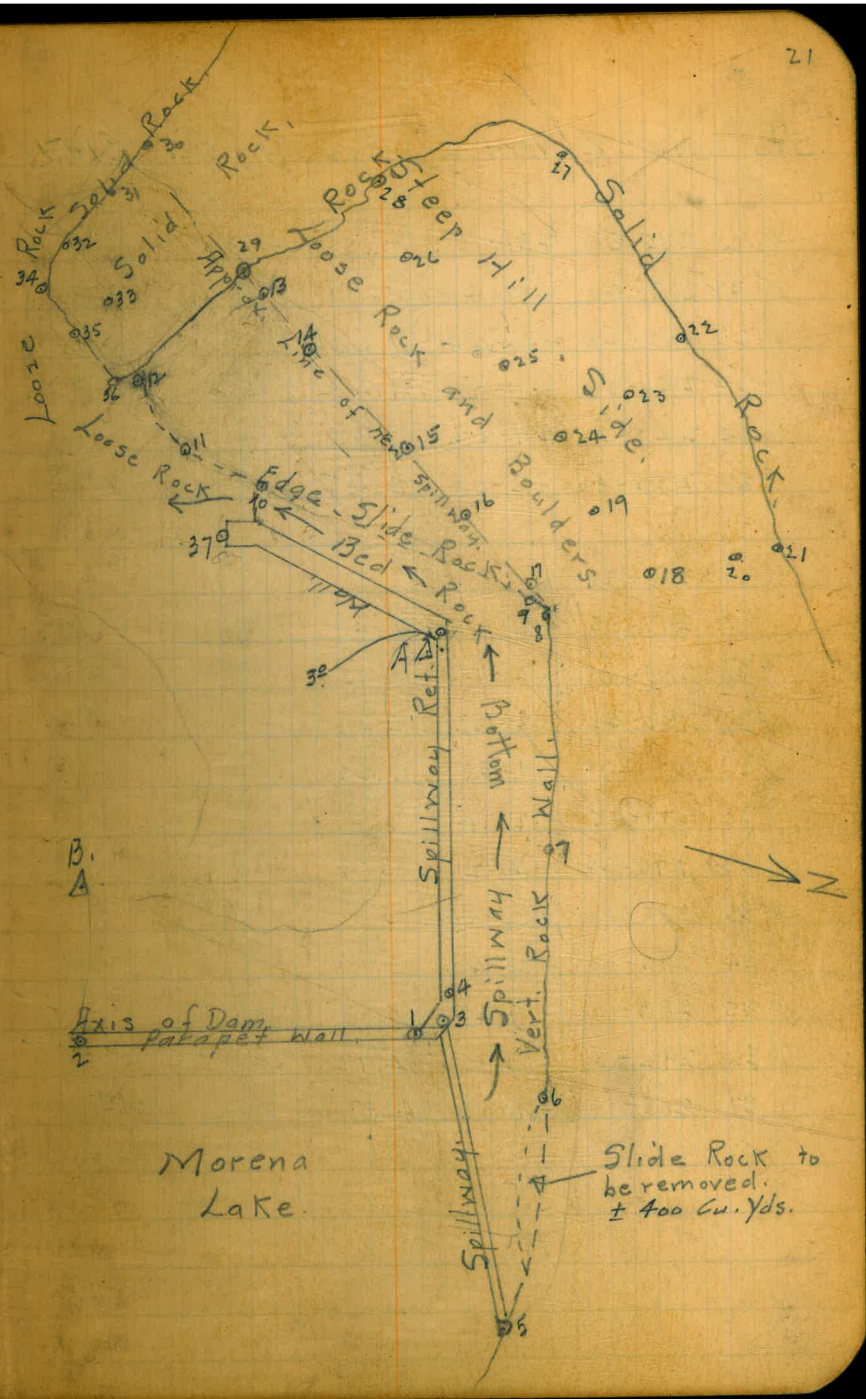
T.P. #2		144.35	
3.61	147.96		
		150.0	0+63 C. Line
	5.8	142.2	0+57 " "
	3.6	144.4	0+34 " "
		153.0	0+80. " "
	6.1	141.9	0+60 D. Line
	4.6	143.4	0+40 D. "
	7.0	141.0	0+60 E. Line
	8.1	139.9	0+84 " "
	7.6	140.4	0+60 F. Line
	8.3	139.7	0+72 F. Line
	8.4	139.6	0+60 G. Line
	8.6	139.4	0+60 H. Line.

Stadia shots on side hill at lower end of Spillway on right side.

Sta. Hor. Δ Vert. Δ Rod Dif. Elev. Elev.

Note: Hor. Angles turned to Right from North on Mag. Needle. Needle Variation 15° 30'

A.					145.8
161° 39'	A1	62° 25'	+5° 01'	228.0 1.30	+20.2 166.0
	2	125-12	+2-08	510.0 5.42	+20.3 166.0
	B.	136-30	+1-44	511.0 5.13	+15.3 161.1
	3.	55-57	+5-16	217.0 2.19	-20.0 165.8
	4	53-22	+5-44	194.0 1.96	-19.5 165.3
	5	51-24		5.29	155.0
	6	39-40	-0-50	333.0 3.33	-4.8 141
	7	26-35	-3-08	1.60	-8.7 137.1
	8	326-20	-14-05	66.0 0.70	-16.5 129.3
	9	287-35	-20-21	56.0 0.64	-20.8 125
	10	223-10	-29-48	80.0 1.06	-45.7 100.1
	11	202-20	-26-07	151.0 1.88	-74.1 71.7
	12	206-25	-17-42	232.0 2.56	-74.0 71.8
	13	220-20	-6-04	229.0 2.32	-24.5 121.3
	14	225-15	-7-42	155.0 1.58	-21.0 124.8
	15	235-20	-7-42	121.0 1.23	-16.3 129.5
	16	252-05	-6-27	85.0 0.86	-9.6 136.2
	17	281-50	-3-48	68.0 0.68	-4.5 141.3
	18	293-50	+20-17	98.0 1.11	+36.0 181.8
	19	275-00	+13-14	114.0 1.20	+26.7 172.5
	20	293-50	+29-58	123.0 1.64	+71.0 216.8



Sta.	Hor. ∠	Vert. ∠	Rod	Dif. Elev.	Elev.
A					145.8
✓ 21	295-50	+31-15	162.0 2.20	+98.0	244
✓ 22	263-40	+17-40	197 2.17	+63.	209
✓ 23	262-50	+16-54	154 1.68	+47	193
✓ 24	256-30	+11-27	135 1.40	+27	173
✓ 25	242-40	+9-22	157 1.60	+26	172
26	232-40	+2-08	245 2.45	+9.	155
B					161.1
A	316-30				
✓ 27	297-35	+2-25	639 6.40	+27	188
✓ 28	288-0	-2-23	612 6.13	-26	135
✓ 29	289-30	-5-33	537 5.41	-52	109
✓ 30	277-30	-9-56	605 6.23	-106	55
✓ 31	277-45	-12-14	575 6.01	-124	37
✓ 32	276-55	-16-21	531 5.76	-156	5
✓ 33	284-00	-12-24	544 5.70	-120	+41
✓ 34	275-00	-20-40	480 5.48	-181	-20
✓ 35	283-10	-19-45	453 5.13	-164 ✓	-3
✓ 36	292-0	-13-07	468 4.93	-109 ✓	+52
37	308-	-7-03	480 4.87	-60	+101

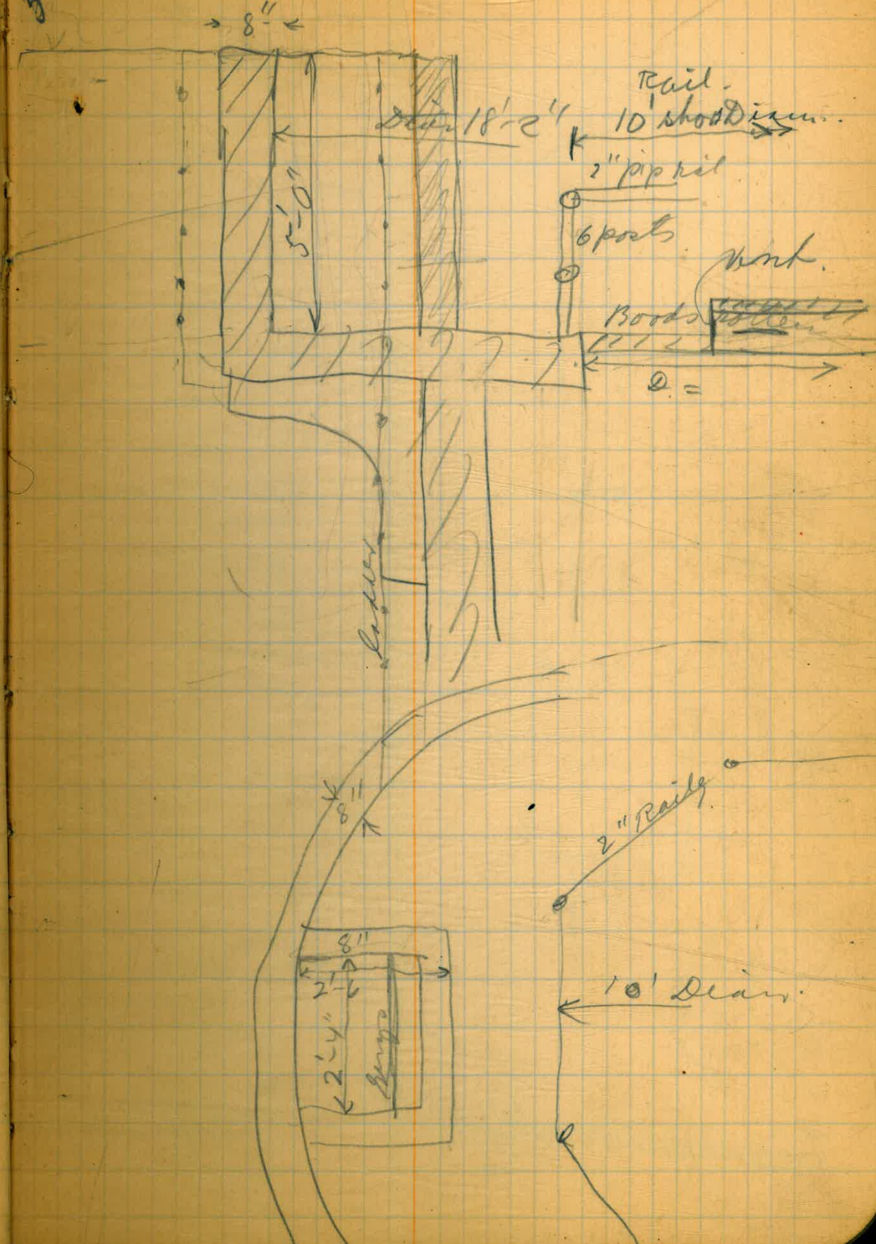
Top Ret. Wall. Foot 13.5 Feet Lower.

El. 166 parapet

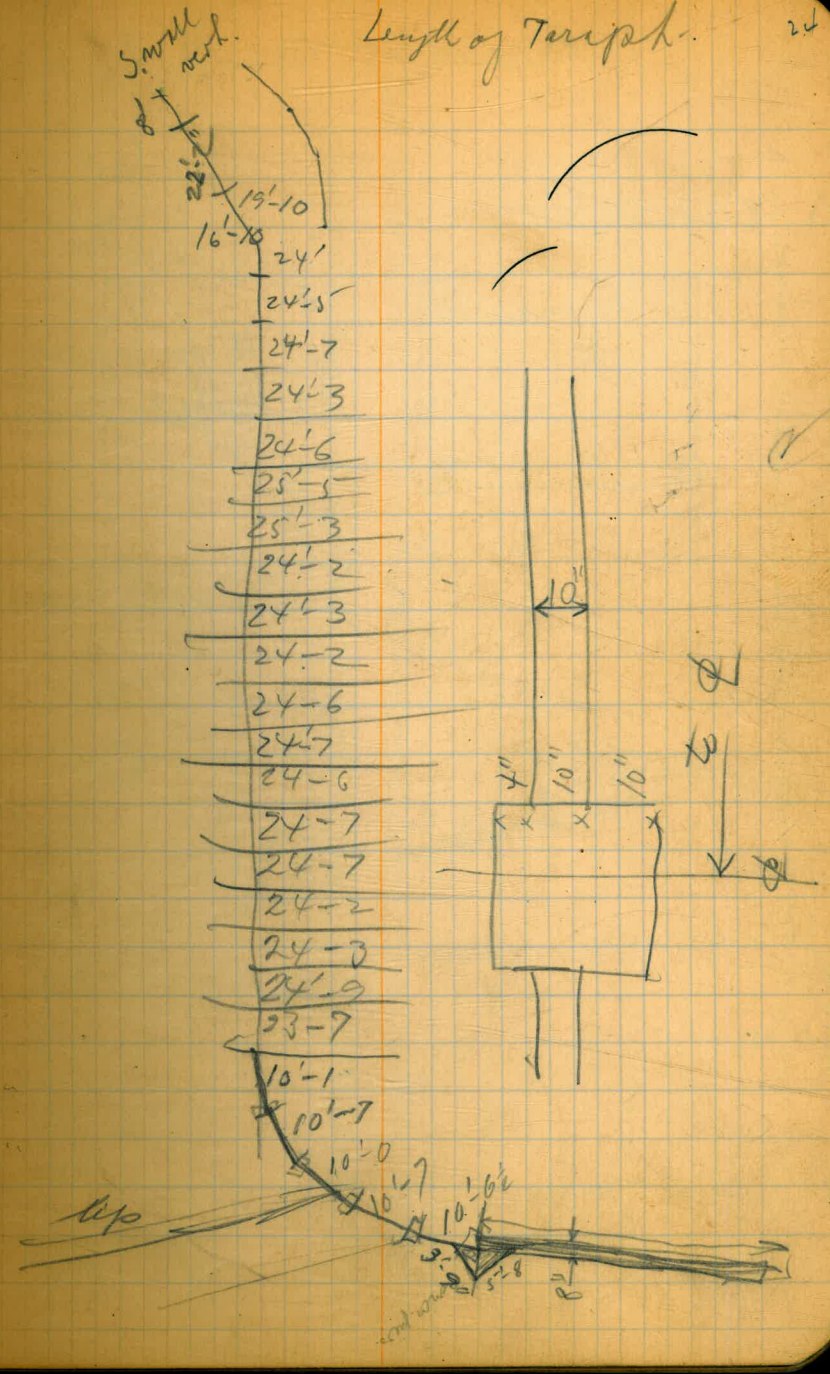
Oct. 25-1928

[illegible]

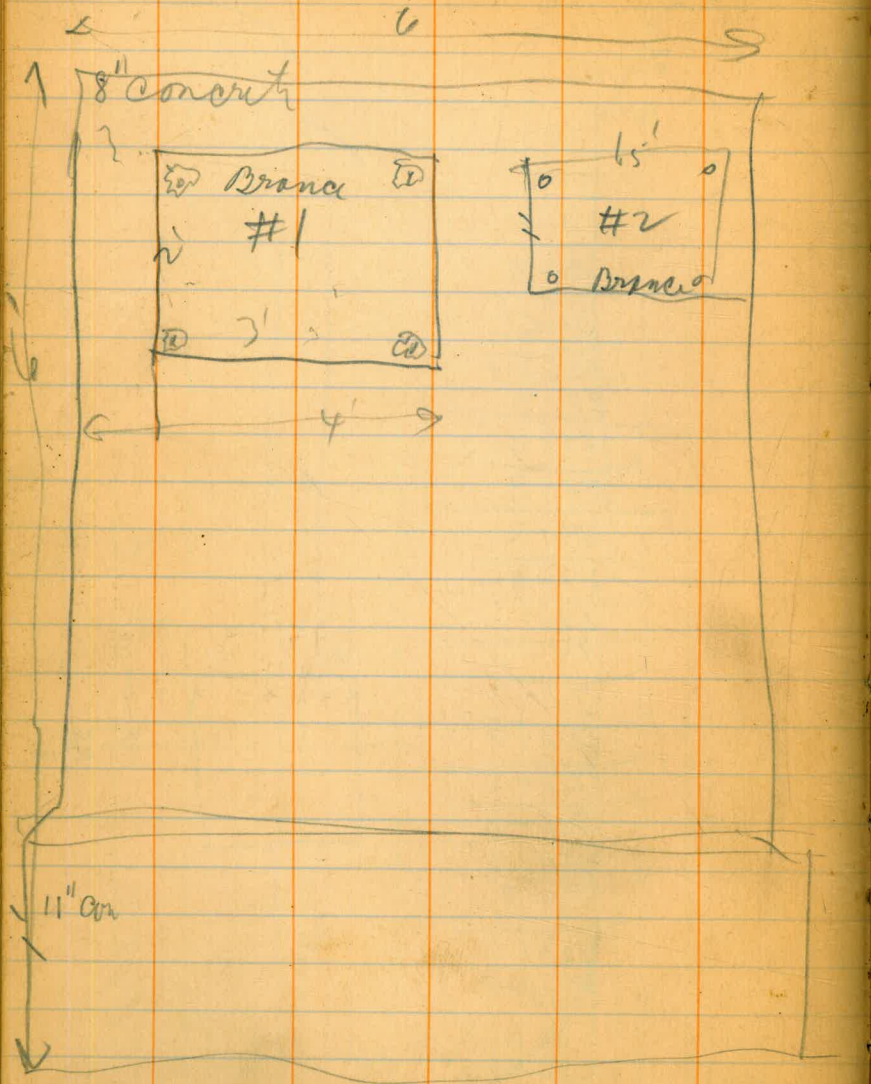
Outlet Tower

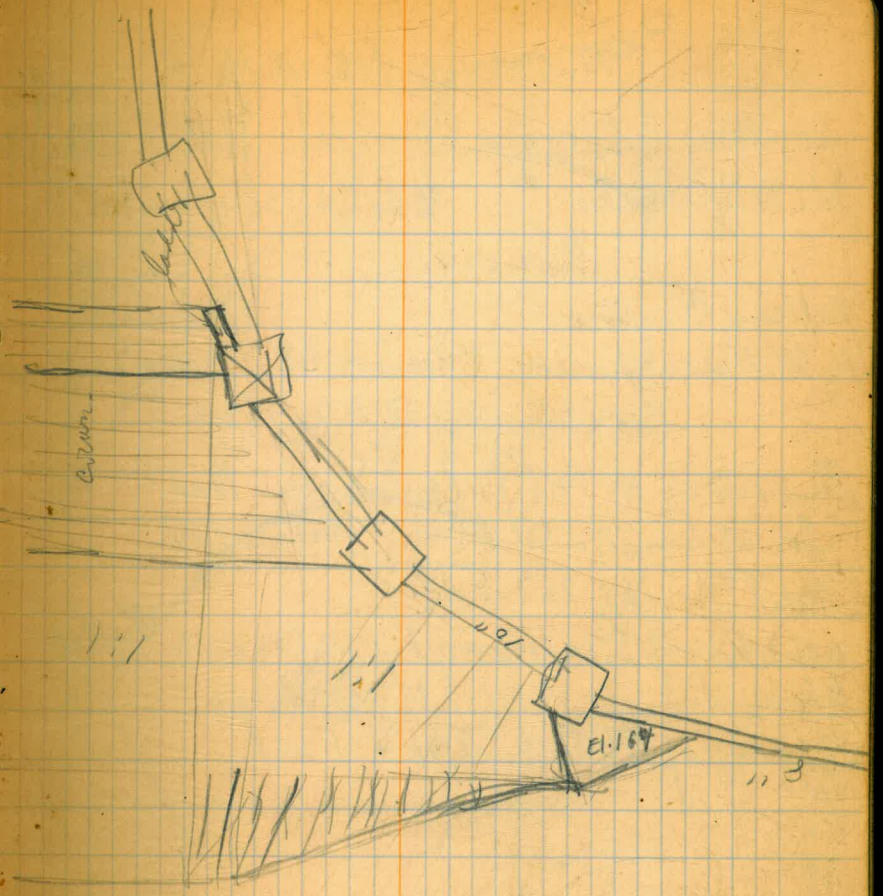


Length of Temple.



Legend of Name Plates





#1

Morena Dam

Southern California Mountain Water Co

John D Spreckels — Adolph B. Spreckels

Owners.

William Clayton — Manager

M. M. O'Shaughnessy M.Am.Soc.C.E. Engineer

Constructed A.D. 1896–1912

Foundation 115 Feet Below Stream Bed

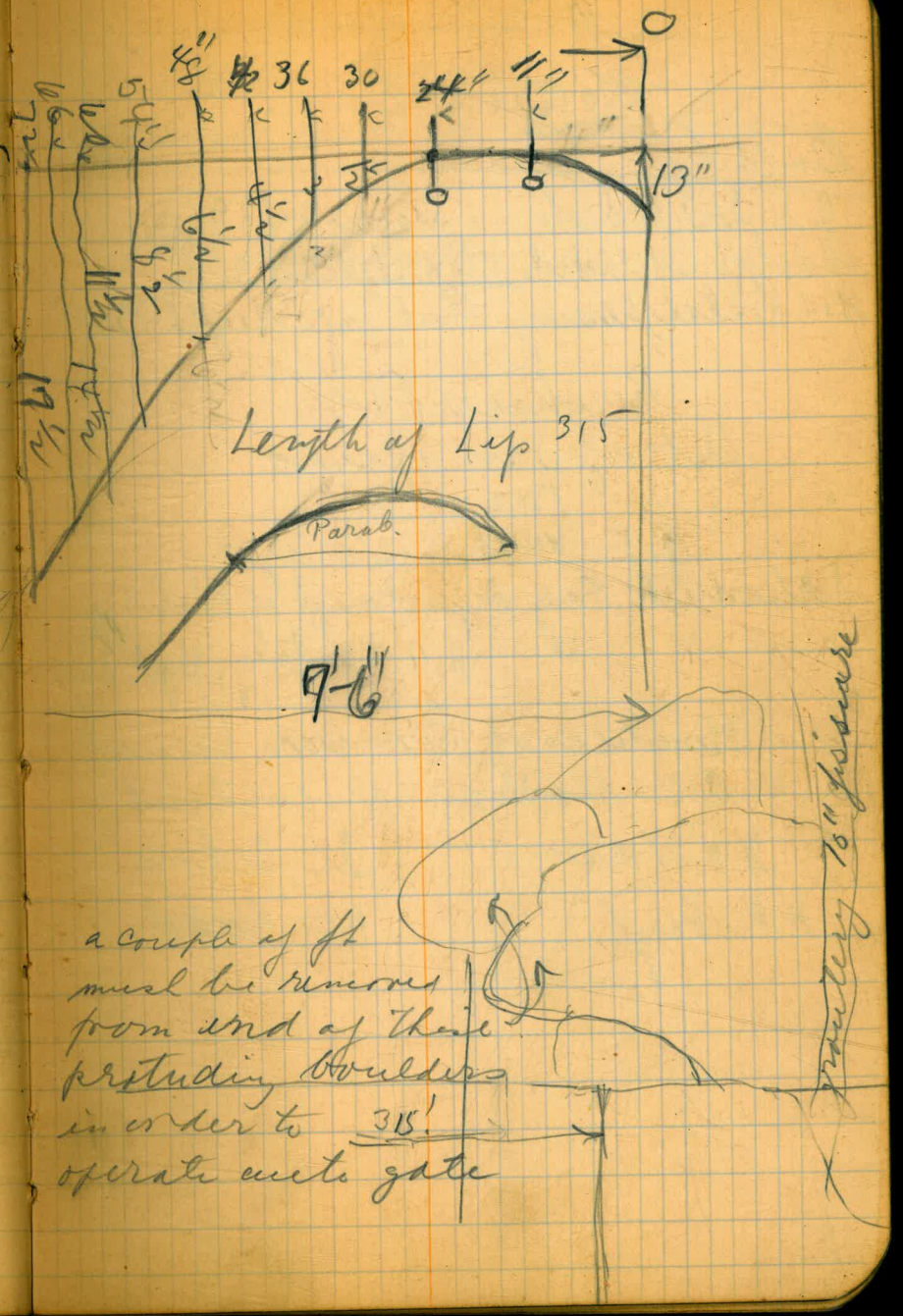
Top of Dam 152 Feet Above Stream Bed

Total Height 267 Feet

Capacity of Reservoir 15,000,000,000 Gallons

Area 1370 acres

Altitude of Outlet 2912 Feet.



#2

Morena Dam

Built by
J. D Spreckels Started - 1896
Adolph Spreckels Completed - 1912
H.M. O'Shaughnessy Chief Eng. Height - 150 ft

Purchased By
City of San Diego
1912 - 13
J.E. Wadham - Mayor
Herbert R. Fay Department of Water
H.A. Whitney - Hyd. Eng

Members of Common Council
A.E. Dodson - President
D.K. Adams J.L. Schoss
H.R. Fay P.E. Woods

Get legend of name plate left at

Mrs. Baldwin

Road above Morena Dam. So. Side

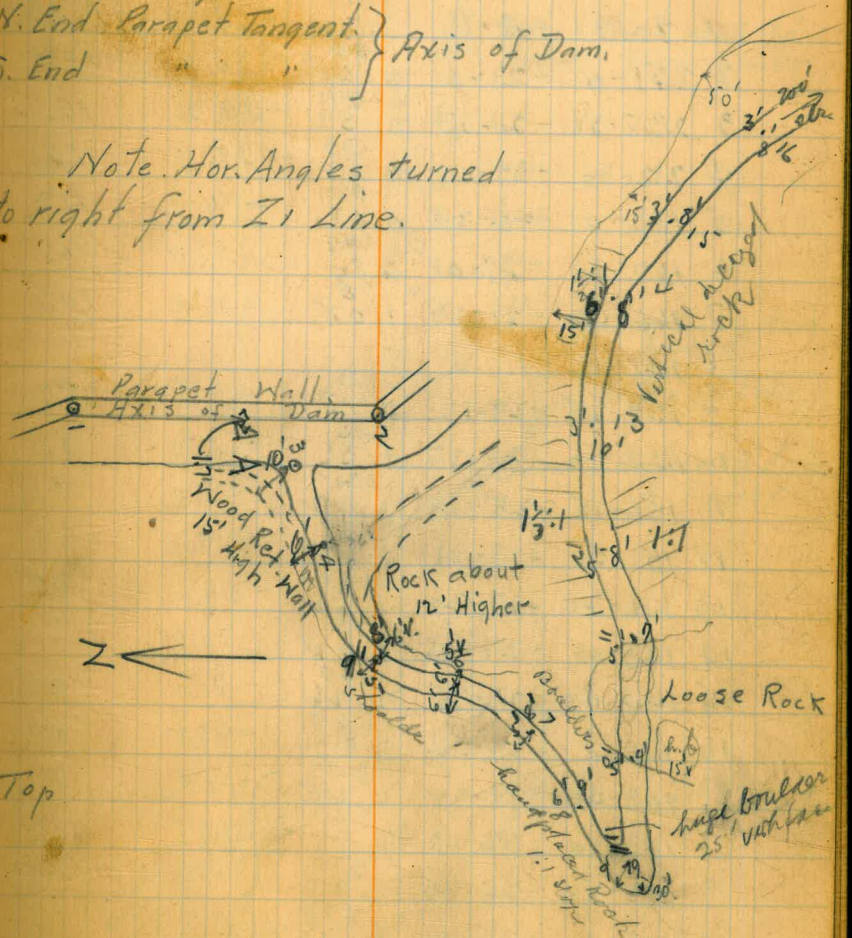
Sta.	Hor. ∠	Vert ∠	Rod	Dif. Elev	Elev.
Z.					166.5
1	0°0′	0°0′	3.27	0	166.45
2	178°42′	0°0′	1.53	0	166.40
3	187°20′	−0-44	1.20	−1.6	165
4	198-52	-1-36	1.55	−4.3	162.2
5	212-06	-0-32	2.03	−1.9	164.6
6	210-50	+0-53	2.58	+4.0	170.5
7	211-35	+2-07	3.22	+11.8	178
8	215-0	+2-55	3.63	+18.5	185
9	217-0	+3-30	4.16	+25.3	192
10	212-03	+4-26	3.85	+29.6	196
11	204-20	+6-15	3.40	+36.8	203
12	199-20	+7-47	3.07	+41.2	208
13	187-40	+10-30	2.66	+47.7	214
14	162-10	+12-0	2.33	+47.4	214
15	146-0	+9-42	2.48	+41.3	208
16	136-55	+7-25	2.93	+37.5	204
		-4-42			

327 166.45
2.3

28

H.I
168.75 H.I. from Shot #1.
N. End Parapet Tangent. } Axis of Dam.
S. End " "

Note. Hor. Angles turned to right from Z1 Line.



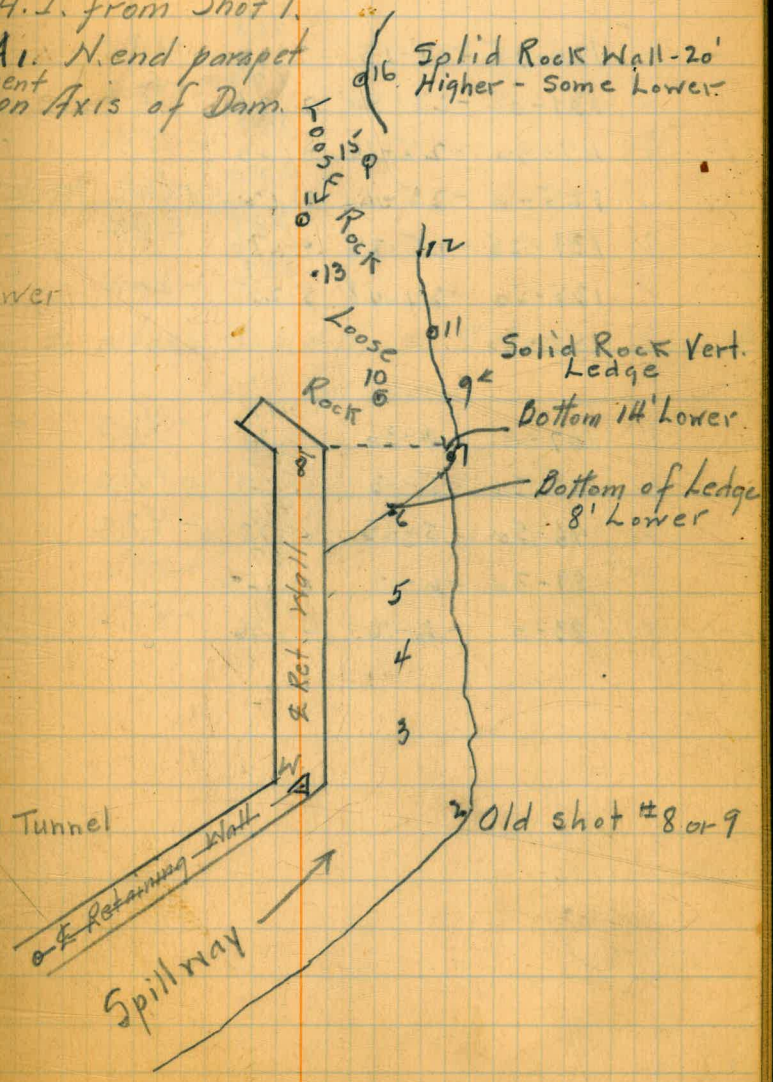
Stadia Readings on Lower End Morena Spillway and below Dam.

Sta	Hor ∠	Vert ∠	Rod	Dif. Elev	Elev.
△ W.					148.0
1	9-17	+4-36	231 2.32 v	+18.5	166.45
2 v	251-0	-21-0	54 0.61	-20.8	127.2
3	235-35	-30-33	40 0.53	-23.2	125
4	212-30	-39-09	38 0.62 v	-31.0	116
5	183-0	-44-20	35 0.68	-34.7	113
6	167-30	-39-0 v	49 0.88	-39.0	109
7	166-45	-31-13	76 1.02 v	-45.2	103
8	141-16				
9	159-25	-29-17	103 1.35	-57.5	90.5'
10	149-20	-30-37	102 1.36	-66.3	82
11	156-15	-25-29	120 1.47	-57.2	91
12 v	151-50	-23-31	137 1.62 v	-59.3	89
13	146-20	-27-20	128 1.62 v	-66.1	82
14	143-05	-27-18	152 1.97 v	-78.3	70
15	144-40	-23-35	190 2.26 v	-83	65
16	146-0	-23-44	227 2.70	-99.5	48
17	103-40	-18-37 v	378 4.20	-127	21
18	103-30	-22-08	333 3.87	-135	13
19	103-50	-24-35	312 3.77	-143	5
20	103-40	-25-49	274 3.38	-132.5	15
21	110-0	-28-06	216 2.77	-115	23
22 v	115-55	-29-27	179 2.33	-99.5	48
23	129-50		℄ Dike		

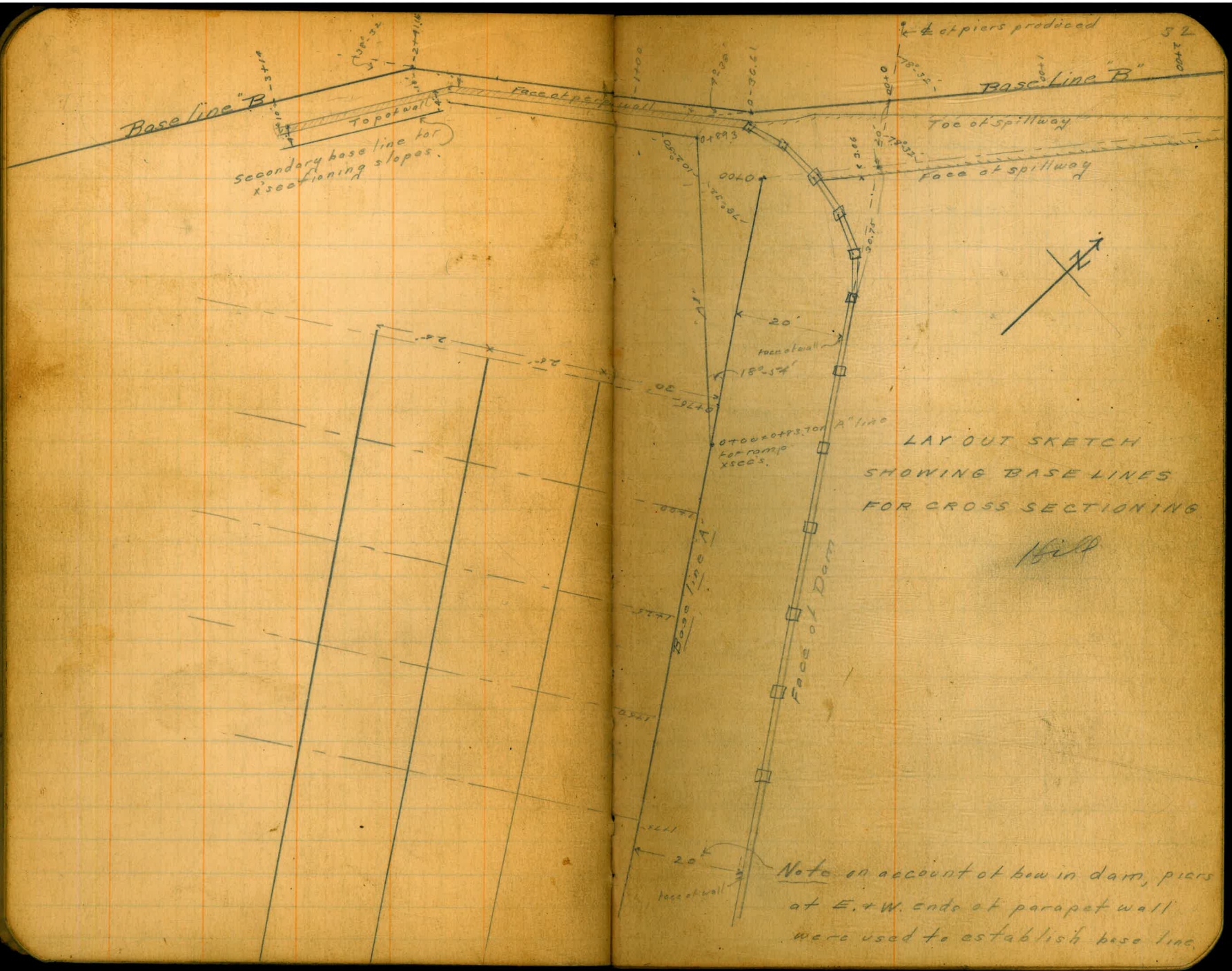
Note - All Hor. Angles turned to right from ℄ of Retaining Wall.

Get H.I. from Shot 1.

Old A1. N. end parapet wall, Tangent on Axis of Dam.



Sta.	Hor ∠	Vert ∠	Rod	Dif. Elev.	Elev.	
N					148	
24	124-35	-27-23	168 2.13	-87.5	60	
25	131-05	-27-32	178 2.26	-92.6	55	
26	117-30	-25-16	327 4.00	-154.4	-6	Bottom Channel
27	125-0	-25-40	350 4.30	-168	-20	
28	131-25	-25.25	389 4.76	-184	-36	
29	135-50	-24-48	433 5.25	-200.	-52	
30	158-0					Line to steep Solid Rock. Extreme Limit of Spillway.
31	107-0	-4-30	577 5.80	-45.3	+103	Old roadway. Top of Old Dam or extension of Berm of present Dam.
32	103-30	-5-13	523 5.27	-47.6	100	
33	96-50	-5-45	474 4.78	-47.7	100	
34	89-30	-6-17	437 4.42	-48.1	100	
35	83-0	-6-16	431 4.36	-47.4	100	



LAY OUT SKETCH
SHOWING BASE LINES
FOR CROSS SECTIONING

Bill

Xsects in bot. of spillway 10/23/29
North from Dam line
From base line "B"

Parker
Converse
Hill - notes
Elliot
Simpson
Walton

Station	B.S.	H.I.	F.S.	Elev.
B.M.	0.48	155.48		155.00
T.P.			12.90	142.58
	4.12	146.70		
0+00				
0+50				
0+75				
1+15				
1+50				
2+00				
T.P.			0.90	145.80
	10.64	156.44		
2+25				
2+50				

See sketch Page 32

Left — Base Line "B" — Right

Top of Spillway at Dam - gauge 15.5'

Station								
0+00	S.R. 144.0 / 2.7 / 70	S.R. 138.3 / 8.4 / 64	S.R. 135.9 / 10.8 / 50	V.R. 138.1 / 8.6 / 29	S.R. 135.9 / 10.8 / 29	S.R. 137.4 / 9.3 / 15	S.R. 137.8 / 8.9	S.R. 137.8 / 8.9 / 0.6 toe of spillway
0+50	S.R. 136.7 / 10.0 / 63	V.R. 138.1 / 8.6 / 63	S.R. 136.4 / 10.3 / 52	S.R. 137.2 / 9.5 / 42	S.R. 139.0 / 7.7 / 29	S.R. 139.5 / 7.2	S.R. 139.6 / 7.1 / 2.0 toe	
0+75	V.R. 140.3 / 6.4 / 62	S.R. 138.0 / 8.7 / 62	S.R. 138.9 / 7.8 / 41	S.R. 140.2 / 6.5 / 36	S.R. 140.5 / 6.2 / 8	S.R. 140.6 / 6.1	S.R. 140.7 / 6.0 / 3.0 toe	
1+15	V.R. 150.5 / +3.8 / 57	V.R. 148.4 / +1.7 / 43	V.R. 142.7 / 4.0 / 26	S.R. 141.2 / 5.5 / 26	S.R. 141.8 / 4.9	V.R. 141.8 / 4.9 / 7.5 toe		
1+50	V.R. 152.7 / +6.0 / 19	S.R. 142.2 / 4.5 / 16	V.R. 143.7 / 3.0 / 16	S.R. 142.2 / 4.5 / 9	V.R. 144.9 / 1.8 / 9	S.R. 142.8 / 3.9	S.R. 142.9 / 3.8 / 5.7 toe	
2+00	V.R. 158.7 / +12.0 / 38	V.R. 154.0 / +7.3 / 28	V.R. 147.3 / +0.6 / 13	S.R. 144.9 / 1.8	S.R. 145.1 / 1.6 / 7.5 toe			
2+25	V.R. 149.9 / 6.5 / 21	V.R. 149.0 / 7.4 / 9	S.R. 145.5 / 10.9	S.R. 145.7 / 10.7 / 8.3 toe				
2+50	earth 181.2 / +25.0 / 49	V.R. 176.9 / +20.5 / 35	V.R. 164.8 / +8.4 / 26	V.R. 158.7 / +2.3 / 17	V.R. 153.5 / 2.9 / 4	S.R. 147.2 / 9.2	S.R. 147.6 / 8.8 / 10.3 toe	

12/2/29.
H.T.N.

	Left			Base Line		Right				
2+75	136.44	V.R. 182.5 +26.1 51	V.R. 181.4 +25.0 35							
2+87	V.R. 175.4 +19.0 17.5	V.R. 170.0 +13.6 9.0	S.R. 160.3 +.39 3.5	S.R. 152.6 3.8 3.0	S.R. 151.2 5.2	S.R. 149.0 7.4 8	S.R. 149.2 toe 7.1 11.8	Beg Ellipse 152.9 3.5 15.5	155.0 1.4 21.0	Spill Left face Spill 154.9 2.2 22.7
2+95		V.R. 183.1 +26.7 26	V.R. 173.7 +17.3 11	S.R. 168.4 +12.0	S.R. 164.4 +8.0 5	S.R. 161.3 +4.9 14	S.R. 157.1 1.7 14.5	Beg Spill 155.0 1.4 20		
3+01	V.R. 183.2 +26.8 32	Road V.R. 183.1 +26.7 23	V.R. 178.6 +22.2 15	V.R. 171.8 +18.4 7	S.R. 171.4 +15.0	S.R. 166.1 +9.7 5	S.R. 164.6 +8.2 14	S.R. 164.8 +8.4 26	S.R. 159.8 6.6 26	149.8
3+02	V.R. 183.2 +26.8 32	Road V.R. 183.1 +26.7 21	V.R. 177.6 +21.2 14	V.R. 175.4 +19.0 8	S.R. 172.5 +16.1 3	S.R. 176.6 +20.2	S.R. 176.4 +20.0 9	S.R. 173.6 +17.2 19.0	S.R. 169.1 +8.0 27	S.R. 169.0 +7.6 29	S.R. 149.8 6.6 29
3+15	V.R. 183.0 +26.6 23	Road V.R. 183.2 +26.8 12	V.R. 179.5 +23.1 6	S.R. 177.1 +21.0	S.R. 175.2 +18.8 21	S.R. 170.2 +13.8 25	S.R. 149.8 6.6 25			

Xsections in spillway, south from dam line. From Base line "B"

See sketch page "32

T.P.				142.58	from page "32
	1.56	144.14 ✓			
0-17					
0-28					
0-41					
0-50					
0-66					
-1+00					
-1+25					
			12.56	131.58	
	1.20	132.78			

Left — Base Line "B" — Right

S.R. = Solid Rock
L.R. = Loose Rock

Toe of Spill.

0-17: S.R. 137.4 6.7/1.5 ✓; S.R. 137.4 6.7 ✓; S.R. 136.6 7.5/22 ✓; S.R. 137.9 9.2/32 ✓; L.R. 135.3 8.8/32 ✓; S.R. 133.7 10.4/51 ✓; L.R. 135.3 8.8/51 ✓; S.R. 136.9 7.2/64 ✓; S.R. 142.3 1.8/70 ✓

0-28: S.R. 137.1 7.0/1.5 ✓; L.R. 136.1 8.0/1.5 ✓; S.R. 137.1 7.0/0.0 ✓; L.R. 138.5 5.6/0.0 ✓; L.R. 139.7 4.4/8.0 ✓; S.R. 136.6 7.5/8.0 ✓; L.R. 138.0 6.1/17.0 ✓; S.R. 136.6 7.5/17 ✓; L.R. 137.6 6.5/32 ✓; S.R. 134.9 9.2/32 ✓; L.R. 135.0 9.1/52 ✓; S.R. 134.1 10.0/52 ✓; S.R. 139.7 4.4/70 ✓

0-41: S.R. 136.6 7.5/4.0 ✓; L.R. 137.5 6.6/4.0 ✓; S.R. 136.6 7.5/0.0 ✓; L.R. 137.6 6.6/0.0 ✓; L.R. 137.4 6.7/8 ✓; S.R. 136.2 7.9/8 ✓; L.R. 135.8 8.3/33 ✓; S.R. 134.9 9.2/33 ✓; L.R. 135.8 8.3/55 ✓; S.R. 135.1 9.0/55 ✓; S.R. 138.4 5.7/69 ✓

0-50: S.R. 136.2 7.9/4 ✓; L.R. 137.3 6.8/4 ✓; L.R. 137.3 6.8/0.0 ✓; S.R. 136.2 7.9/0.0 ✓; L.R. 138.8 5.3/5. ✓; S.R. 136.1 8.0/5 ✓; L.R. 136.8 7.3/18 ✓; S.R. 134.4 9.7/18 ✓; L.R. 136.3 7.8/55 ✓; S.R. 135.5 8.6/55 ✓; S.R. 137.5 6.6/65 ✓

0-66: L.R. 136.2 7.9/4 ✓; S.R. 135.6 8.5/4 ✓; L.R. 136.1 8.0/0 ✓; S.R. 135.6 8.5/0 ✓; S.R. 133.9 10.2/20 ✓; L.R. 134.4 9.7/20 ✓; L.R. 135.9 8.3/30 ✓; S.R. 134.0 10.1/30 ✓; L.R. 135.3 8.8/48 ✓; S.R. 133.9 10.2/48 ✓; L.R. 134.4 7.7/64 ✓; S.R. 135.4 8.7/64 ✓

-1+00: S.R. 134.5 9.6/4 ✓; L.R. 134.6 9.5/4 ✓; L.R. 134.6 9.5/0.0 ✓; S.R. 134.1 10.0/0.0 ✓; S.R. 133.0 11.1/8.0 ✓; L.R. 134.8 10.0/8.0 ✓; L.R. 135.0 9.1/41 ✓; S.R. 133.5 10.6/41 ✓; L.R. 137.1 7.0/62 ✓; S.R. 134.1 10.0/62 ✓

-1+25: L.R. 134.1 10.0/4 ✓; S.R. 133.6 10.5/4 ✓; L.R. 133.9 10.2/0.0 ✓; S.R. 133.4 10.7/0.0 ✓; L.R. 132.9 11.2/17 ✓; S.R. 129.9 14.2/17 ✓; L.R. 134.1 10.0/29 ✓; S.R. 131.1 13.0/29; L.R. 134.5 9.6/62; S.R. 132.7 11.4/62

10/24/29
clear

Parker
Conners
Hiff - notes
Elliot
Simpson
Walton

132.78

-1+50

-1+75

-2+00

-2+25

-2+35

-2+41.15 perp. to back tang.

T.P. 13.04 119.74

0.77 120.51

-2+41.15 angle bisected

-2+41.15 perp. to forward tang.

Left Base Line "B" Right 36.

S.R. 132.1
0.1
4

L.R. 132.8
0.0
0.0

S.R. 132.3
0.5
0.0

S.R. 131.8
1.0
6.0

L.R. 132.3
0.5
6.0

L.R. 132.2
0.6
11

S.R. 130.8
2.0
11

S.R. 131.5
1.3
21

L.R. 132.0
0.8
21

S.R. 131.0
1.8
38

L.R. 131.5
1.3
38

S.R. 131.5
1.3
45

L.R. 132.5
0.3
45

S.R. 131.0
1.8
50

L.R. 132.9
0.0
50

S.R. 133.2
+0.4
61

L.R. 135.9
+1.0
61

S.R. 132.1
0.7
4

S.R. 131.9
0.9
00

S.R. 130.4
2.3
13

L.R. 131.0
1.8
13

S.R. 129.2
3.6
33

L.R. 129.8
3.0
30

S.R. 130.7
2.1
40

L.R. 131.3
1.5
40

S.R. 130.5
2.3
61

L.R. 131.3
1.5
61

S.R. 131.1
1.7
4

S.R. 129.8
2.0
00

S.R. 130.2
2.6
5

S.R. 129.6
4.0
12

L.R. 129.3
3.5
12

S.R. 129.6
3.2
34

L.R. 130.3
2.5
34

S.R. 129.8
4.0
46

L.R. 129.4
3.4
46

S.R. 130.3
2.5
57

L.R. 130.9
2.0
57

S.R. 129.5
3.3
4.0

S.R. 129.3
3.5
00

S.R. 128.6
4.2
5

S.R. 126.9
5.9
8

S.R. 128.5
4.3
14

S.R. 127.2
5.2
22

S.R. 128.5
4.3
41

L.R. 128.8
4.0
41

S.R. 129.9
2.9
52

L.R. 130.4
2.4
52

S.R. 128.6
4.2
4.0

S.R. 128.0
4.8
00

S.R. 127.3
8.5
1.5

S.R. 127.5
5.3
16

S.R. 123.5
7.3
18

S.R. 122.5
10.3
23

S.R. 125.7
7.1
29

S.R. 128.0
4.8
42

S.R. 128.1
4.7
51

118.0
14.8
2.4

117.6
15.2
00

119.1
13.4
7

125.4
7.4
15

122.6
10.3
16

124.7
8.1
33

125.5
5.3
42

126.9
4.9
51

All Solid Rock.

wall 118.2
2.3
2.4

117.6
2.9

120.6
0.0

124.2
-3.7

126.4
-5.9

126.5
-6.0

S.R.

wall 118.3
2.2
2

117.6
2.9

118.6
1.9
7

117.6
2.9
15

117.1
3.4
23

119.9
0.6
24

122.9
+1.8
29

Left	Base Line "B"	Right

120.3-1

-2+16

-2+50

+69

T.P. 12.67 107.84

1.5-1 109.35

-2+73

-2+82

-2+89

-3+04

-3+14 end of corer wall

T.P. 12.33 97.02

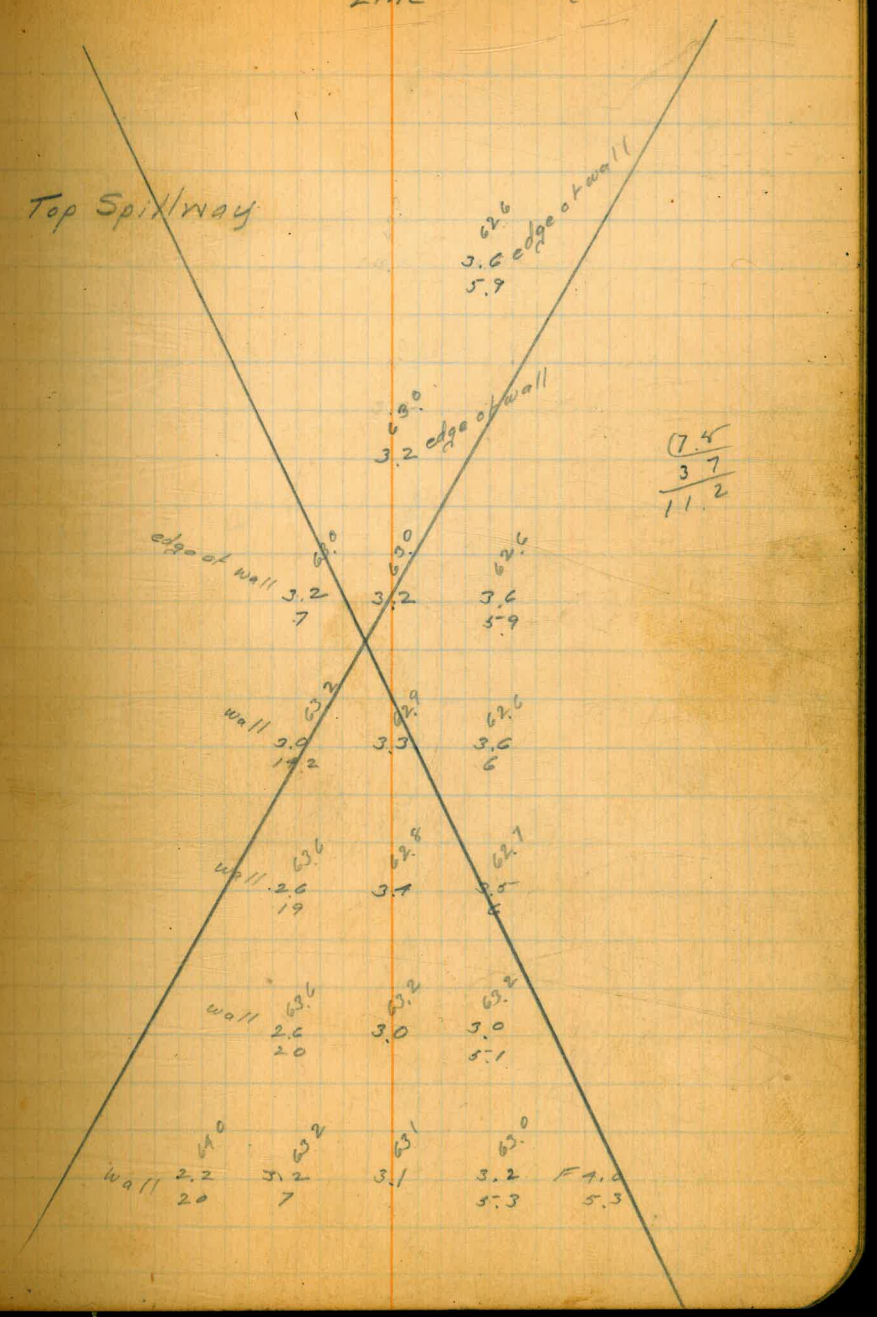
(cont. on page 62)

wall	116.3	116.1	117.1	117.2	117.9					
	4.2	4.1	2.8	3.3	2.6 SR.					
	2		4	22	28					
wall	114.8	114.6	116.9	115.6	117.0	118.0				
	5.7	5.9	3.6	4.9	3.5	2.5 SR.				
	2.6		6	12	25	30				
wall	110.0	110.2	109.8	110.5	110.1	113.5	114.2			
	10.5	10.3	10.7	10.0	10.4	7.0	6.3 SR			
	1.7		9	21	26	26	27			
wall	105.7	105.1	104.8	crevice 101.3	101.3	109.2	101.9	109.1	108.1	
	3.7	4.3	4.6	8.1	2.1	0.2	1.5	0.0	0.7 SR	
	1.2		1.5	2.8	4	6	16	21	27	
wall	101.5	103.1	102.1	101.1	107.1	108.1	108.1			
	7.9	6.3	6.7	9.3	2.3	1.3	1.3 SR.			
	7.7		3.5	6	9	17	27			
wall	93.9	93.1	93.6	100.5	crevice 93.8	101.7	104.1	105.1	105.2	
	15.5	16.0	15.8	8.9	15.6	7.7	5.0	3.7	4.2 SR	
	1.2		1.5	5.5	8.5	10.5	13	18	25	
wall	86.1	86.2	88.7	89.0	101.1	102.9				
	22.7	23.2	20.7	20.1	8.0	6.5 SR.				
	1.5	2.5		13	16	19				
wall	84.4	84.0	84.0	86.0	86.3	100.3				
	25.0	25.4	25.4	23.4	23.1	8.1				
	5.2		16	24	24	25				

Sections along Base L. "A" — Parker, Converse, Hill, Elliot, Simpson — 10/25/29

See sketch Page 32

Sta.	+S	H.I.	-S	Elev	Grade
				155.00	
	11.23	166.23			
0-06					167.0
0-01.3					
0+00					
0+06					
0+14.5					
0+25					
0+50					



(cont.)

166.23 grade

0+63 167.0

0+75

1+00

1+25

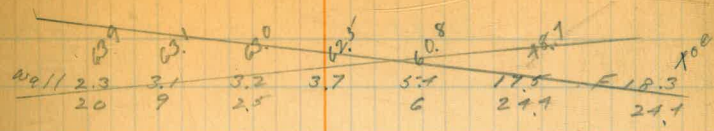
1+50

1+75

2+00

2+25

Left Base Line Right



63.8 63.2 63.1 62.1 60.9
2.7 3.0 3.1 4.1 5.3
20 10 3 3.5

63.9 63.9 63.3 63.1 62.7
2.3 2.3 2.9 3.1 3.5
20 14 10 2.5

61.0 63.4 63.1 62.7 61.9
2.2 2.8 3.1 3.5 4.3
20 9 2 2

63.9 63.3 63.0 62.9
2.3 2.9 3.2 3.7
20 9 2

64.2 63.3 62.8
2.0 2.9 3.1
20 3

64.2 63.5 63.3 62.8
2.0 2.7 2.9 3.4
20 9 3.5

64.1 64.1 63.6 63.1
2.1 2.1 2.6 3.1
20 15 6

(cont.)

	16623	grade
2+38		167.0
2+50		
2+63		
2+75		
3+00		
3+25		
3+50		
3+75		
4+00		

Left Base Line Right #1

Wall	63.1	63.4	61.1
	2.5	2.8	5.1
	20	2	
	63.1	63.3	62.5
	2.5	2.9	3.7
	20	1.5	
	64.0	63.4	62.2
	2.2	2.8	4.0
	20	2	
	63.8	63.7	62.2
	2.1	3.0	4.0
	20	4	
	64.0	63.2	62.7
	2.2	3.0	3.5
	20	1.5	
	63.7	63.1	62.5
	2.5	3.1	3.7
	20	3	
	63.8	63.2	62.2
	2.1	3.0	4.0
	20	2.5	
	63.9	63.2	61.7
	2.3	3.0	4.5
	20	3.5	
	63.7	63.1	61.8
	2.5	3.1	4.4
	20	3	

(cont.)

Left | Base Line | Right

166.23

Station									
4+25	wall	63.1 2.5 20	63.0 3.2 10	62.8 3.4 2	61.2 5.0				
4+50		63.8 2.7 20	62.6 3.6 3.5	60.9 5.3					
4+60		63.5 2.7 20	62.5 3.7 3.5	61.1 5.1					
4+66		63.4 2.8 20	62.7 3.5 9	62.4 3.8					
4+75		63.5 2.7 20	62.2 4.0	61.6 4.6 7.2	F 57.4 17.2 (struck)	7.8 20	17.8 20	14.8 45	
4+84		63.8 2.4 20	62.4 3.8 8	61.9 4.3	61.2 5.0 7.5	5.5 20	7.0 27	13.0 28	11.8 43
+97		63.8 2.4 20	62.8 3.4 8	60.2 6.0	57.8 8.4 1.5	58.0 8.2 9	58.0 8.2 12		
5+00		63.9 2.3 20	62.8 3.4 9	60.3 5.9 1.5	57.0 9.2	57.8 8.4 12.3	F 9.2 2.3 (struck)	6.9 36	7.8 50
5+11 ∆ pt.	63.8 2.4 20	63.1 3.1 11	60.3 5.9 4.5	55.8 10.4 3	55.4 10.8	56.3 9.9 14.3	F 10.7 14.3 (struck)	9.2 34	6.0 44

(cont.)

166.23 grade

5+25 167.0

5+35

5+36

5+39.5 ↓pt.

5+50

5+65

12.77 153.79

0.12 153.91

10.61 143.30

4.58 147.88

	Left			Base Line	Right				
63.9	64.2	61.5	57.5	56.9	51.0				
2.3	2.8	4.7	8.7	9.3	9.2	E 10.6	8.8	6.8	
20	10	7	3.5		13.3	18.3	30	31	
63.9	63.6	62.0	59.1	57.8	57.4				
2.3	2.6	4.2	7.1	8.1	8.8	5.1	6.6	+6.8	level
20	8	3	2.5		12.8	25	30	30	
	63.9	63.5	63.1		63.3	163.9	175.1		
	2.3	2.7	3.1		2.9	2.3	+8.9		
	20	7			1.9	28	32		
	63.9	63.1	63.1		63.3	163.9	174.2		
	2.3	2.5	3.1		2.9	2.3	+8.9		
	20	7			1.9	28	32		
	63.9	64.1	63.2		63.3		164.0	170.0	
	2.3	2.1	3.0		2.9	E 3.7	4.2	+3.8	
	20	7			1.9	5.0	20	34	
		63.9	63.3		63.3	168.0	171.0		
		2.3	2.9		2.9	1.2	+1.8		
		20			1.9	28.5	35		

Line parallel to Base Line "A"
+ 30' South

Left & Right

	147.88	Grade 144.50
0+75	3.9	144.0
1+00	10.2	37.7
+25	10.4	37.5
+50	10.6	37.3
+75	10.4	37.5
2+00	9.1	38.8
+25	10.8	37.1
+38	11.0	36.9
+50	8.8	39.1
+63	8.9	39.0
+75	8.6	39.3
3+00	9.7	38.2
+25	8.1	39.8
+50	9.7	38.2
+75	9.2	38.7
4+00	9.3	38.6
+25	9.2	38.7
+50	8.8	39.1
+60	8.7	39.5
+66	8.4	39.5
4+76	3.4	44.5 toe

141.1
6.8 toe
3.5

Line parallel to Base Line "A"
55' South

					Grade	
B.M.	11.21	166.21		155.0	125.75	Top of Spillway
T.P.			13.00	153.21		
	1.83	155.04				
T.P.			12.69	142.35		
	0.13	142.48				
T.P.			10.78	131.70		
	1.19	132.89				
0+92.1			7.1	125.8		Toe of slope
1+00			11.0	121.9		
+25			14.7	118.2		
+50			14.8	118.1		
+75			13.8	119.1		
2+00			13.7	119.2		
+25			13.7	119.2		
+38			13.3	119.6		
+50			13.3	119.6		
+63			13.8	119.1		
+75			13.7	119.2		
3+00			12.1	120.8		
+25			13.2	119.7		
+50			12.9	120.0		
+75			12.9	120.0		
4+00			13.1	119.8		
+25			12.5	120.4		
+50			11.3	121.6		
+60			8.8	124.1		
+63.8			7.1	125.8		Toe of slope

+5

Left & Right

121.6 115.6 toe
+50 11.3 17.2
13

Line parallel to Base Line "A"
80' South

					Grade	Left	℄	Right
		132.89						
T.P.			13.00	119.89				
	1.12	121.01						
			12.30	108.71				
	3.31	112.02						
1+00			2.9		107.0	112.4 toe of slope + 0.4 7.0	109.1 2.9	
1+05							107.0 5.0 toe of slope	
1+25						101.0 95 11.0 0.0	105.5 6.5 rk 0.0	105.3 6.7 toe (on rock) 2.3
1+50						102.9 95 9.2 0.0	103.3 8.7 rk 0.0	95.2 16.8 toe (on rock) 15.7
1+75							102.3 9.7 95	93.1 18.9 toe (on rock) 18.5
2+00						98.5 13.5 0.0	102.6 9.4 0.0	92.0 20.0 toe (ground) 2.0
2+25						102.0 95 10.0 0.0	102.5 rk 9.5 0.0	95.4 16.3 toe (on ground) 15.1

Line parallel to Base Line "A" 80' South (cont.)

112.02

	Grade
2+38	107.0
2+50	
2+75	
3+00	
3+25	
3+50	
3+75	
4+00	
4+25	

Left ℄ Right

10/20/29 clear

Parker
Converse
Hill
Elliot
Simpson
Walton

107.0
5.0 toe

99.8 105.1 100.1 toe (rock) 95.5
gr. 12.2 6.9 rk. 11.3 16.5 toe ground
0.0 0.0 8.7 15.1

99.6 104.5 102.3 toe on rock 95.9 toe ground
gr. 12.4 7.5 rk. 9.7 16.1
0.0 0.0 6.3 17.8

100.7 103.6 101.4 toe rk.
gr. 11.3 8.4 rk 10.6 (8-3.0 times)
0.0 0.0 7.5 toe (or rock 2.0 above ground)

98.7 101.7 94.8 toe
13.3 10.3 rk 17.2
gr. 0.0 0.0 rk 16

101.2 103.8 101.3
gr. 10.8 8.2 rk. 10.7 toe gr. 10 1.3
0.0 0.0 7.6 10.7
11.

100.6 103.5 102.0
gr. 11.4 8.5 rk. 10.0 toe ground 10.5 101.5
0.0 0.0 6.7 10

102.2 103.9 99.2 toe ground
gr. 9.8 8.2 rk 12.8
0.0 0.0 9.7

102.6 101.8 toe ground 100.0
9.4 gr. 10.2 12.0
6.9 17

(cont.)

112.02

4+38

107.0
5.0 +00

10/27/29

Line parallel to Base Line "A"
105' South.

					Grade
T.P.	1.73	110.14		108.71	88.25
			12.34	97.80	
	0.17	97.97			
1+25			8.5	89.3	
1+27.5			9.7	88.3	toe
1+37			13.4	82.6	
1+50			14.2	83.8	
1+75			11.5	86.5	
2+00			8.6	89.4	
2+25			10.8	87.2	
2+38			10.6	87.4	

(cont.)

		97.97			Grade
2+50			8.6	89.4	88.25
2+63			10.0	88.0	
2+75			10.5	87.5	
3+00			10.8	87.2	
3+25			11.0	87.0	
3+50			10.7	87.3	
3+75			10.9	87.1	
3+93.5			9.7	88.3	+00
T.P.			12.60	85.37	
	2.21	87.58			

Line parallel to Base line "A"
130' South

		87.58		Grade
T.P.			12.82	74.76	69.60
	0.54	75.30		
1+43.5			5.8	69.5
1+50			11.5	63.8
1+75			10.5	64.8
2+00			9.6	65.7
2+25			8.2	67.1
2+38			10.5	64.8
2+50			11.0	64.3
2+63			7.2	68.1
2+75			7.2	68.1
3+00			9.6	65.7
3+25			8.9	66.4
3+50			8.1	67.2
3+75			7.5	67.8
3+85.5			5.8	69.5
T.P.			11.91	63.30
	2.68	65.98		
			13.09	52.89
	0.63	53.52		

Left & Right

5-0

63.8
11.5

60.3 toe
15.0
12.0

Line parallel to Base line "A"
15-5' South

			5-3.5-2	Grade 5-0.75-
1+70			2.8	5-0.7
1+75			3.9	49.6
2+00			6.4	47.1
2+25			8.0	45.5-
2+38			10.1	43.4
2+50			8.9	44.6
2+63			9.5-	44.0
2+75			8.8	44.7
3+00			6.2	47.3
3+25			10.8	42.7
3+50			6.5-	47.0
3+75			6.4	47.1
3+83			2.8	5-0.7
T.P.			12.36	41.16
	0.5-9	41.75-		
			12.53	29.22
	6.16	35.38		

Left & Right

51

A 9.6 3.9 — 13.0 10.5- 10 toe

A 7.1 6.4 — 41.4- 12.0 12

Line parallel to base line "A"
180' South

35.38

		Grade
		32.0
2+00		
2+14.5	3.1	32.0
2+38	8.8	26.6
2+50	8.9	26.5
2+60	9.0	26.4
2+75	10.6	24.8
3+00	8.3	27.1
3+25	11.7	23.7
3+50	7.5	27.9
3+65	3.4	32.0

Left & Right

52

+0e
38.2
+2.8
2+00

Line parallel to Base line "A" - 205' South

					Grade
T.P.	1.56	30.78		29.22	13.25
			12.15	18.63	
	3.53	22.16			
2+75			8.9	13.3 toe	
3+00			12.3		
3+25					
3+43					
3+50					

Left	℄	Right
	13.3 toe 8.9	
	09.9 12.3	06.4 toe 15.8 9.2
	12.3 9.9	09.9 toe 12.3 4.5
	13.3 8.9	
toe 21.4 0.8 10.7	21.4 0.8	

Stadia shots from base line "B"

10/28/29

Parker
Converse

Sta.		Hor. ∆	Stadia slope Dist.	Vert. ∆	Dif. Elev.	Ground	Remarks
H.I. = 5.3 2+25		90°				145.5	
	1		0.25 21.3	+22°29'	8.8		
	2		0.70 38.4	+42-10	34.6		So. Edge old road. No. Edge Rd. 6' farther - 15 Higher
	3						
H.I. 5.3 2+00	1		1.55 95.8	+38°-08'	75.2	144.9	LR. & earth
	2		1.24 77.0	+38°-00'	60.1		" "
	3		0.65 42.5	+36°-00'	30.9		S.R.
H.I. 5.3 1+50	1		1.03 78.4	+29°-14'	43.8	142.8	rock & earth slide - mostly rock backed by SR
	2		1.65 103.8	+37°-30'	79.6		SR
	3		2.20 127.8	+40°23'	108.6		" broken
	4		2.70 158.5	+40°-00'	133.1		SR. & LR.
H.I. 5.3 1+15	1		2.65 153.7	+40°-25'	131.0	141.8	SR. broken
	2		2.01 115.0	+40°-50	99.4		SR. broken
	3		1.30 77.5	+39°-55'	64.6		SR. broken
H.I. 5.3 0+75	1		0.74 67.5	+17°14'	20.9	140.6	SR.
	2		1.65 130.2	+27°19'	67.1		SR. broken
	3		2.38 173.3	+31°25'	100.6		" "
	4		2.98 200.4	+34°54'	139.7		" "
H.I. 5.3 0+50	1		3.30 223.1	+34°41'	155.1	139.5	about solid rock line
	2		1.82 140.1	+28°-35'	76.3		SR broken & large boulders
	3		1.12 96.4	+21°-53'	38.7		" " "
	4		0.74 70.9	+11°-50'	14.7		" " "
H.I. 5.3 0+00	1		2.47 185.3	+29°-51'	100.9	137.8	toe of solid rock
	2		1.91 152.2	+26°-46'	76.7		
	3		1.08 96.7	+18-55	41.7		
	4		0.80 72.0	+17-14	22.3		SR

(cont.)

Sta.		Hor Δ	Slope Dist	Vert. Δ	Dif. Elev.	Gro. Elev.	
	H.I. 5.3						
0-41.0		90° to 0+00				136.6	
			0.74				
	1		69.3	+14-35	18.0		S.R.
			0.90				
	2		82.0	+17-17	28.0		L.R.
			1.08				
	3		97.0	+18-35	32.7		"
			1.45				
	4		122.5	+23-07	52.3		"
			2.09				
	5		169.5	+26-44	85.4		Toe Solid Rock.
	H.I. 5.3						
			2.10				
0-66	1		169.2	+26-10	83.1	135.6	Toe " "
			1.79				
	2		148.3	+24-50	68.7		
			1.48				
	3		127.0	+22-05	51.7		
			1.06				
	4		94.0	+20-30	35.2		
			0.82				
	5		70.5	+22-01	28.5		S.R.
	H.I. 5.3						
			0.80				
-1+00	1		65.8	+24-54	30.4	134.1	S.R.
			1.12				
	2		93.5	+23-55	41.4		
			1.50				
	3		124.3	+24-27	58.8		
			2.12				
	4		171.7	+25-53	83.3		Toe Solid Rock
	H.I. 5.3						
			1.77				
-1+50	1		136.3	+28-40	81.7	132.3	Toe " "
			1.35				
	2		108.4	+26-18	53.5		
			1.20				
	3		99.6	+24-22	45.1		
			0.83				
	4		64.7	+27-58	31.4		S.R.
	H.I. 5.3						
			2.40				
-2+00	1		161.3	+34-56	112.6	130.8	Toe Solid Rock
			2.10				
	2		139.8	+35-20	99.1		
			1.77				
	3		124.8	+32-55	80.7		
			0.95				
	4		70.8	+30-21	41.7		
			0.70				
	5		62.7	+18-54	21.4		SR

(cont.)

Sta.		Hor. ∠.	Slope Dist.	Vert. ∠.	Dif. Elev.	Gro. Elev	
H.I. 5.3			2.66		101.6		
-2+25	1		164.7	+38-05	129.1	129.3	Toe Solid Rock
			1.97				
	2		128.0	+36-15	93.8		
			1.25				
	3		90.5	+31-42	55.9		
			0.75				
	4		60.3	+26-13	29.7		S.R.
H.I. 5.3							
-2+41.15		90°	from Back Tangent.			117.6	
			2× 1.40				
	1		158.2	+41-12	138.4		Toe solid Rock.
			2.28				
	2		133.4	+40-04	112.2		
			1.93				
	3		122.2	+37°-16'	93.0	210.6	
			0.78				
	4		55.5	+34-06	36.2	153.8	
H.I. 5.3							
-2+41.15		109°16'	from Back Tangent			117.6	
			2× 1.35				
	1		148.8	+42-03	136.9		Toe solid Rock.
			2.10				
	2		108.6	+44-02	105.3		
			0.99				
	3		67.0	+34-45	46.7		
			0.76				
	4		50.3	+35°-33'	36.0	(lay now 147.4 ?) ?	
H.I. 5.3							
-2+41.15		90° from Forward Tangent + Inst. Point ~~#2~~					-2+41.15. ½ L. ~~E~~ W Edge Conc. Spillway Ret. Wall.
			0.74				Top Present Conc. Wall. E. Side Spillway
	1		74.8	-0°20'	-0.4	147.0	W. Line Proposed Spillway enlargement
			1.49				
	2		117.2	+27-30	60.9	208.3	
			1.12				
	3		97.2	+21-16	37.8	185.2	
			1.81				
	4		138.5	+29-0	76.7		
			2× 1.15				
H.I. 5.0	5		180.6	+27-37	94.4		Toe Solid Rock.
			2.12				
-2+69	1		163.9	+28-24	88.7	130.3	12' farther to Toe Solid Rock.
			1.83				
	2		139.1	+28-55	76.8		
			1.41				
	3		118.9	+23-21	51.4	181.7	
			0.78				
	4		76.8	+7-07	9.6	140	

Parker
Converse
Hill
Elliott
Simpson
Walton

7.48

Base line 14'E. of Base line "B"

Sta.		Hor. ∠.	Slope Dist	Vert ∠.	Dif. Elev.	Gro. Elev.	
-2+69	5		0.43 41.0	-12-19	-8.9	130.3	
	6						Top Conc. Wall.
-2+89		90°	from	back	tangent	117.8	
	1		0.46 45.7	+4-16	3.4	121.2	
	2		0.78 73.3	+14-17	18.6	136.4	W. Line of proposed spillway enlargement
	3		1.37 108.4	+27-10	55.6	173.4	
	4		1.81 135.0	+30-14	78.7		50' farther 15' higher to toe solid rock
-3+04		90°	from	back	tangent	108.5	
	1		0.46 45.8	+3-18	3.0	111.5	
	2		0.50 47.3	+13-29	11.0	119.5	
	3		0.79 75.0	+15-55	21.4	129.9	W. Line of proposed spillway enlargement
	4		1.23 94.0	+29°03	52.2	160.7	
	5		1.75 130.0	+30-24	76.3		
	6		2.40 181.9	+29-25	102.6		Toe solid rock
-3+14		90°	from	back	tangent	103.4	
	1		0.46 45.2	+7-42	6.1	109.5	
	2		0.79 73.0	+16-00	21.0	124.4	W. Line of proposed spillway enlargement
	3		1.22 98.6	+26-01	48.1	151.5	
	4		1.69 126.2	+30-12	73.4	176.8	
	5		2.49 187.5	+29-58	108.4		Toe solid rock

Stadia shots from base line "B"

Sta	Hor. L	Slope Dist.	Vert. L	Diff. Elev.	Gro. Elev.	
H.I. 5.3						
-3+30	90°	from back tangent			87.5	
		0.38				
1		34.1	+18-35	11.5		
		0.83				
2		56.6	+34-20	38.6		W. Line of proposed spillway enlargement
		1.06				
3		72.5	+34-10	49.2		
		1.37				
4		88.9	+36-19	65.4		
		1.91				
5		110.8	+40-23	94.2		
6						28' farther 6' higher than #5
7						50 farther 19' higher than #5 = Toe solid rock
H.I. 5.0						
-3+50	90°	from back tangent			83.3	
		0.47				
1		39.9	+22-51	16.9		
		0.70				
2		57.8	+29-37	30.0		W. Line of proposed spillway enlargement
		1.16				
3		80.0	+33-52	53.7		
		1.78				
4		97.2	+42-18	88.5		
						34' farther 8' higher than #4
						68' " 24' " " " = Toe Solid Rock
H.I. 5.0						
-3+75	90°	from back tangent			78.7	
		0.21				
1		16.9	+26-11	8.4		
		0.81				
2		55.5	+34-07	37.6		
		1.43				
3		83.1	+40-18	70.5		
		1.95				
4		115.0	+39-46	95.7		<7.7 Lower
		2.01				
5		123.6	+38-19	97.6		
6						13' higher 47' farther than #5

(cont.)

Sta	Hor. L	Slope Dist	Vert L	Diff. Elev	Gro. Elev	
-3+96 H.I. 5.0	90° from back tangent, transit 40' Lt.					and 8° lower than ℄.
1		1.07 79.8	+27°-50'	42.1	~~66.9~~ 58.9	
2		1.28 102.8	+26°-19'	5-0.9		
3						
4		1.63 131.2	+26-09	5-7.8		
5		2.17 164.7	+30-20	94.0		
6		2.60 188.2	+31-40	116.1		13.4 higher, 34.0 farther - Toe of solid rock
-4+13	90° from	back	tangent	69.3		
1		0.43 31.1	+31-38	19.2		
2		0.73 56.6	+28-20	30.5		
3		1.06 78.9	+30-24	46.2		
4		1.78 115.5	+35-45	61.4		
5		2.15 142.6	+35-31	101.8		
-4+35 H.I. 4.5	90°	from	back	tangent	62.8	-11' higher 35' farther - Toe solid rock
1		0.71 57.6	+28°-35'	28.1		
2		1.14 79.6	+33°-18'	5-2.3		
3		1.42 84.6	+39°-24	69.5		
4		2.20 138.0	+37°-35'	106.3		(14.0 lower, 5' back) +8.0 higher 34.0 farther toe solid rock
-4+60	90°	from	back	tangent	5-5.1	
1		0.30 21.6	+32-08	13.5		Solid rock
2		0.66 51.9	+27-32	27.0		
3		0.75 59.5	+27-07	32.0		Toe of solid rock
4		1.34 92.6	+33-45	61.9		
5		1.89 124.8	+35-39	89.5		Same distance out 16' lower - Solid rock 85 higher 395 farther than #5 - Toe solid rock

(cont.)

Sta	Hor. L	Rod. Int.	Vert L	Diff. El.	Gro. Elev	
-4+80					~~30.3~~ 34.9	Note transit 40' Left of ℄
		0.68				
1		56.7	+24-02	23.3		Solid Rock
		1.04				
2		92.5	+21-20	35.4		Solid Rock
3						2' higher & 13' farther than #2 - Solid Rock
		1.99				
4		114.6	+28-39	62.8		Solid Rock
		1.71				
5		129.0	+29-40	73.5		Solid Rock
6						10± higher & 56' farther than #5 Solid Rock
7						22± higher & 60' farther than #5 Solid Rock

Xsects from base line "B" (cont. from page 37)

Porter
Converse
Hill
Elliot
Simpson
Walton

Left Base Line Right

10/29/29 & 10/30/29

T.P.	0.29	97.31		97.02	
-3+30					
-3+50					
T.R.			12.53	84.78	at sta. 3+49
	0.62	85.40			
-3+75					
T.P.			12.95	72.45	15' left 3+30
	0.55	73.00			
-3+96					
-4+13					
	0.58	73.03		72.45	
-4+35					
T.P.			12.84	60.19	at 4+40
	0.37	60.56			
B.M.			12.64	47.92	
-4+60					
T.P.			12.16	48.40	
	0.64	49.04			

Top of solid rock pt. 30' R. at 5+00

(cont.)

Left Base Line Right

49.04

T.P. 12.88 36.16 20' left 4+80

0.58 36.74

4+80

T.P. 12.55 24.19

1.18 25.37

T.P. 4.10 17.76 11.71 13.66 6'L. 5+15

5+10

T.P. 12.61 05.15 10'R 5+25

3.96 09.11

5+25

5+44

5+62

5+89

6+00

Levels over spillway at axis point of gates.

11/5/29

Top of Spillway at Dam.

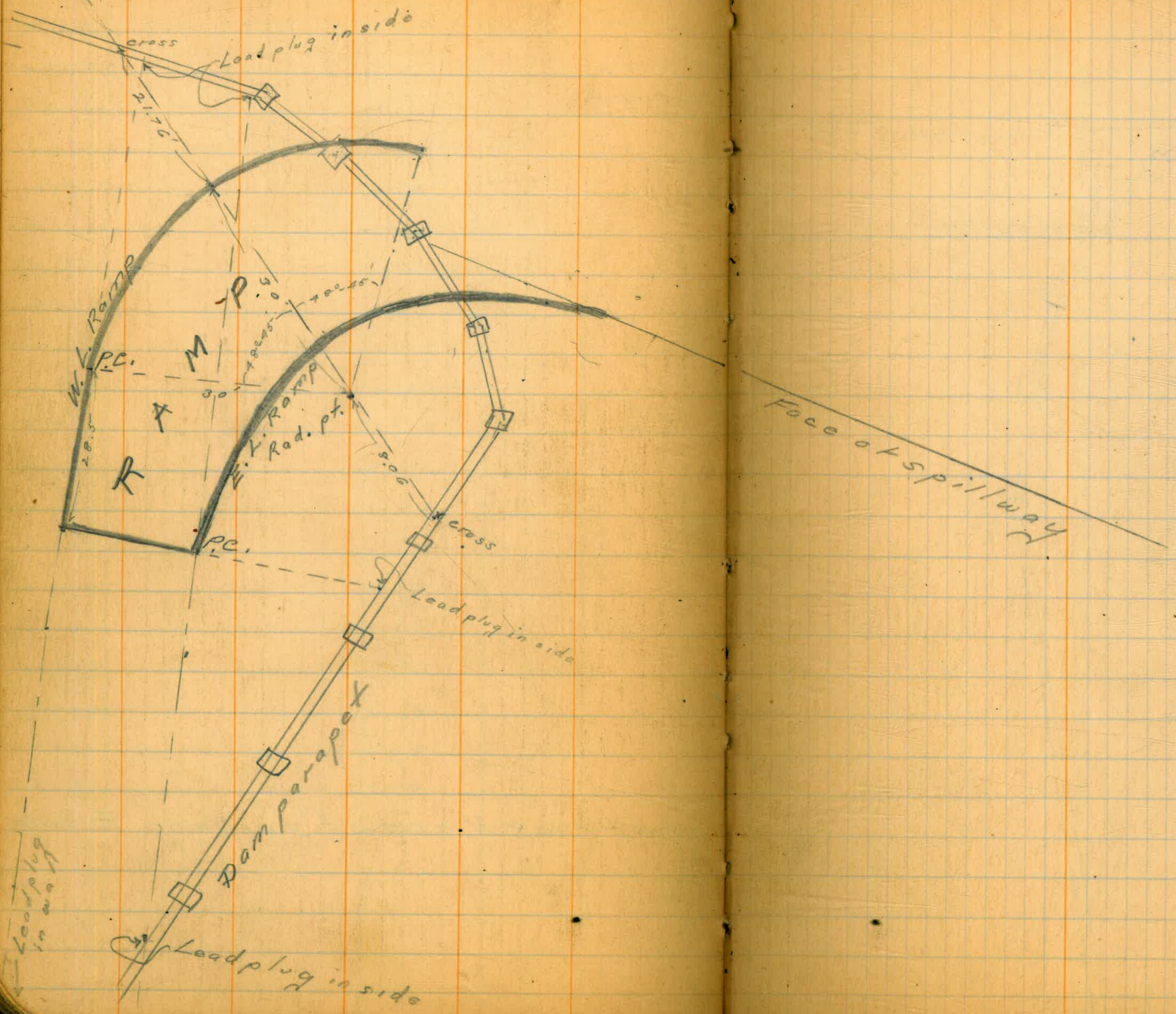
B.M.	4.69	159.59	154.90
0+00		5.22	
0+12.92		5.18	
0+14.25		5.17	
+27.17		5.20	
+28.50		5.21	
+41.42		5.24	
+42.75		5.23	
+56.67		5.19	
+57.0		5.19	
+69.92		5.17	
+71.25		5.16	
+84.17		5.10	
+85.50		5.10	
+98.42		5.13	
+99.75		5.12	
1+12.67		5.11	
+14.0		5.11	
+26.92		5.12	
+28.25		5.11	
+41.17		5.17	
+42.50		5.18	
+55.42		5.17	
+56.75		5.17	
+69.67		5.07	

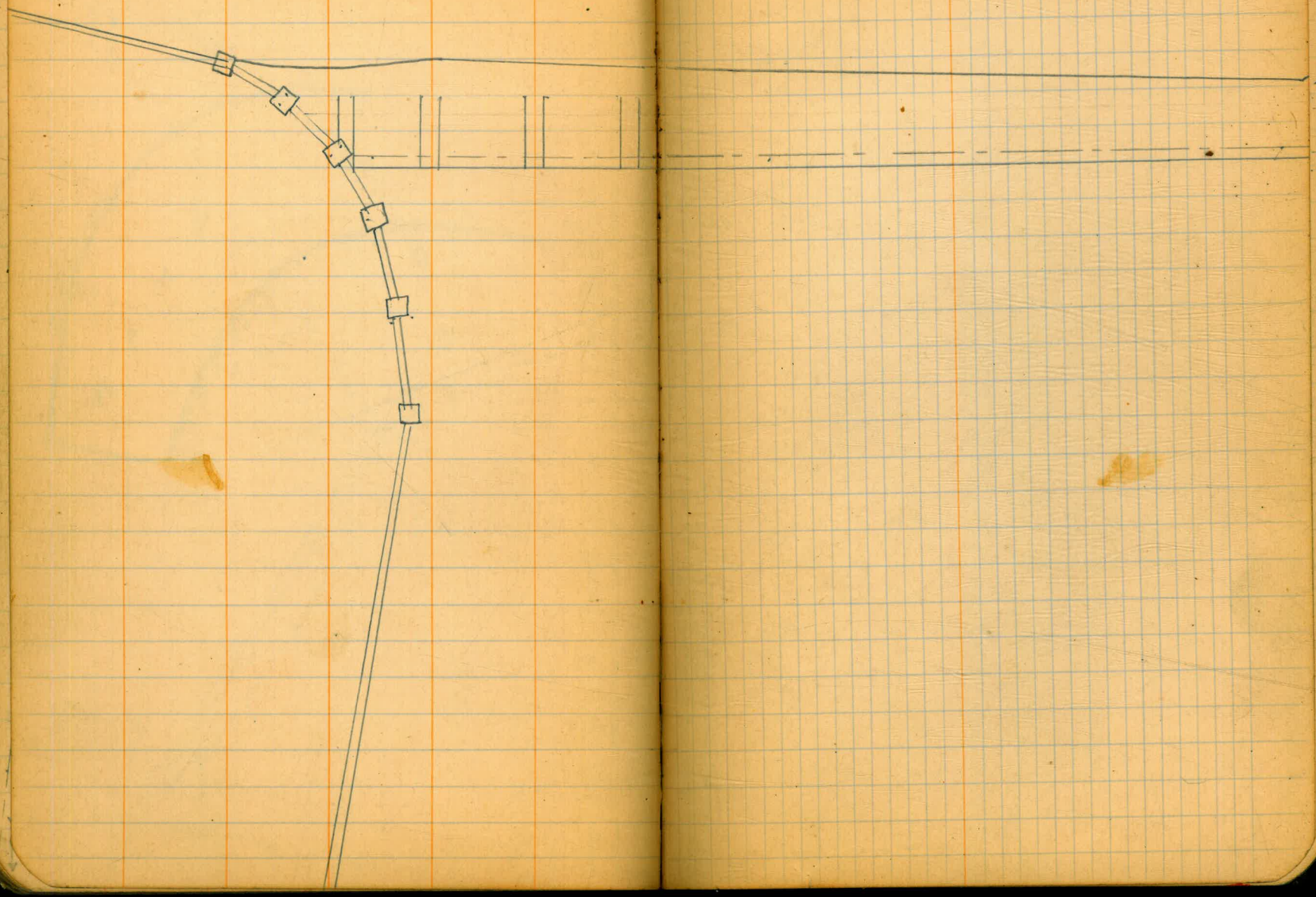
(cont.)

	159.89		
1+71.0		5.16	
1+83.92		5.11	
+85.25		5.11	
+98.17		5.15	
+99.50		5.16	
2+12.42		5.17	
2+13.75		5.16	
+26.67		5.13	
+28.0		5.13	
+40.92		5.12	
+42.25		5.14	
+55.17		5.14	
+56.50		5.14	
+69.42		5.15	
+70.75		5.13	
+83.67		5.16	
+85.0		5.16	
+97.92		5.19	
+99.25		5.18	
3+12.16		4.72	
B.M.		6.75	152.84

pt. of rock N. end of spillway E. side

References for curve points of ramp.





Xsec. of Ramp

B.M.	12.28	167.18 ✓	154.90
0+00		4.3	
0+20			
0+22			
0+35			
0+51			
0+63			
0+76			
0+82			
0+93			

10/7/29

Parker
Converse
Hill
Elliot
Simpson
Walton

Left	Base Line	Right
	162.9 ✓	
	4.3	
139.0 ✓ 28.2 71	141.2 ✓ 26.0 31	162.9 ✓ 4.3 17
159.7 ✓ 7.5	162.8 ✓ 4.4 8	163.2 ✓ 4.0 20 wall
138.3 ✓ 28.9 46	137.1 ✓ 30.1 35	143.2 ✓ 24.0 26
149.9 ✓ 17.3 13	154.4 ✓ 7.8 1	161.9 ✓ 5.3
162.8 ✓ 4.4 3	162.8 ✓ 4.4 15	164.1 ✓ 3.1 wall 31
135.8 ✓ 31.4 36	139.7 ✓ 27.5 27	143.8 ✓ 23.4 19
160.9 ✓ 16.3 9	154.1 ✓ 10.1	156.0 ✓ 11.2 3
163.0 ✓ 4.2 7	163.3 ✓ 3.9 19	163.5 ✓ 3.7 wall 35
140.2 ✓ 27.0 62	142.6 ✓ 24.6 17	142.6 ✓ 24.6 5
143.6 ✓ 23.6	162.1 ✓ 5.1 7	163.5 ✓ 3.7 10
163.2 ✓ 4.0 27	163.6 ✓ 3.6 wall 38	
140.6 ✓ 26.6 50	141.7 ✓ 25.5 20	140.7 ✓ 26.5 6
141.4 ✓ 25.8	152.5 ✓ 14.7 3	163.5 ✓ 3.7 9
162.8 ✓ 4.4 20	163.5 ✓ 3.7 wall 40	
140.8 ✓ 26.4 55	142.2 ✓ 25.0 39	143.1 ✓ 24.1 19
144.2 ✓ 23.0	152.2 ✓ 15.0 2	162.5 ✓ 4.7 9
162.5 ✓ 4.7 19	162.9 ✓ 4.3 wall 35	
149.1 ✓ 22.3 62	147.8 ✓ 17.4 19	152.1 ✓ 15.1 33
159.0 ✓ 8.2 14	161.9 ✓ 5.3	162.6 ✓ 4.6 9
162.7 ✓ 4.5 wall 20		
157.2 ✓ 10.0 30	162.0 ✓ 5.2	162.4 ✓ 4.8 9.0

Xsecs along top of spillway on E. side

11/8/29

	Left	Base Line	Right
BM. 11.65 166.65		15-4.90	
0+89.3			162.0 4.6
1+30.	40.1 33.6 26.0 26.0 22.3 18.6 99 73 56 43 23 20	14.6 11	14.2 9.4 8
1+65 T.P.	62.0 46.8 37.4 26.8 26.1 20.0 99 72 52 33 24 17	20.1 9	12.6 9.4 1
2+00 T.P.		12.69 15-3.86	-32°-30' 17.1 15.9 12.7 15.1 125± 12 1 1
		0.5.8 15-4.14	
2+35			-34°-00' 11.4 6.8 3.8 6.2 200± 15 1 1
2+71			-32-30 16.4 10.5 9.7 11.1 7.0 9.0 200± 22 7 1 1

top of wall 160.4

bottom of wall 157.2

107.16

4+25

102.2 104.7
5.0 2.5 use slope at on gr.
0.0 0.0

Levels over line parallel & 80' S. of base line - Dam xsec's

5.33 114.04 108.71

1+25

1+50

1+75

2+00

T.P. 12.10 101.94

5.21 107.15

2+25

2+50

2+75

3+00

3+25

3+50

3

3+75

4+00

101.0 101.1
12.0 gr. 12.9 rk. even slope to 105
15

102.8 95.1
11.2 18.9 " "
15 rk. rock slide to bot

102.3
11.7 use sl. st. = 2.5 above gr.

98.5
15.5 use sl. st.

102.0
6.2 " "

105.1 99.8
2.1 7.4 " "
00 00

99.6 102.1 101.0
7.6 4.5 6.2 rk
00 00 6

103.4 100.9 101.2
3.8 6.5 6.0 rk.
00 00 10

101.5 98.7 99.1 96.8
5.5 8.5 7.4 rk 10.4 gr.
0.0 0.0 7 7

101.6 101.2
2.6 6.0 use sl. st.
00 00

101.5 100.6 103.9 100.6
2.7 6.6 3.3 6.6 gr.
0.0 0.0 7 7

101.3 102.2 101.3
2.8 5.0 gr. 5.9 rk 1.0 below gr.
00 00 10

Elevs on secondary base line
from 2+41.15 to 3+14

	11.87	108.89		97.02
3+14			6.5	103.7
3+04			0.4	108.5
T.P.			0.22	108.67
	12.80	121.47		
2+89			3.7	117.8
T.P.			0.94	120.53
	12.80	133.33		
2+69			3.0	130.3
T.P.			0.48	132.85
	12.43	145.29		
T.P.			1.36	143.88
	12.53	156.41		
2+41.15			11.8	144.6
T.P.			0.41	156.00
	10.33	166.33		
			11.43	154.90

109.0
+0.1
9

118.5
3.0
1

130.6
2.7
1

141.4
9.0
1

Line 160 S.

1219 41.71 29.22

2+00

6.1 6.1
4.1

Stadia shot to road from Dam

2.55 168.55 1.660 top SE corner wall

+16.3 214.8

Rod 1.56 329
Vert ∠ +20°35' 1.56
1974
1645
329
51.321 46.

Toe of Dam slope at 1¼-1
from ~~base~~ line 80' S. of base line

	H.I.	Grade
	1120.2	103.0
1+00		
1+25		
1+50		
1+75		
2+00		
2+25		
2+50		
2+75		

9.0 toe (ground)

9.2 toe (ground)

9.1 toe

11.3 15.7 toe (ground)
8

10.0 rock 17.3 toe (ground)
6.6

6.9 rock 17.3 toe (ground)
6.6

8.0 rock 12.3 toe (ground)
4.1

	H.I. 112.02	℄	
3+00		12.0 ground	13.8 toe (ground) 6
3+25		13.2 root	15.8 toe (ground) 7.8
3+50		10.3 ground	10.5 toe (ground) 1.9
3+75		11.5 ground	11.5 toe (ground) 3.2
4+00		11.7 ground	11.7 toe ground 3
4+25		9.0 toe ground	
T.P.		2.28	102.74

to 4+25

380

$$\begin{array}{r} 32.5 \\ 400 \\ \hline 27)\,13000.0 \\ 108 \\ \hline 220 \\ 216 \\ \hline 40 \\ 27 \\ \hline 130 \end{array} \quad 481.4$$

112 − 98.0
19 − 22.0
93 − 134

104 − 126
24 − 223
80 − 97
93
173 − 231
86 − 115

$$\begin{array}{r} 1.33 \\ 86)\,115 \\ 86 \\ \hline 290 \\ 258 \\ \hline 320 \end{array}$$

133.14

8.34 141.48

				Hor. Dist	Dif. Elev.
Δ. E. ⊕ +91					
1.	58.0	R. 15°45'	-31°05'	42.5	-25.5
	81.0	R. 36°30'	-32°15'	58.0	-36.5
	372.0	R. 3°0'	-4°30'	370.0	-29.1
	360.0	R. 7°30'	-6°0'	354.0	-37.4
	357.0	R. 27°15'	-20°40'	312.5	-117.9
	310.0	R. 34°40'	-26°0'	250.4	-122.14
	59.6				

141.48
122.4
19.0

164.0 163.
19.0 19
145 144
1.5 1.5
725 216.0
145
2175

00 = 163
20 = 146
17 1.1
17/20
17
30
17
13

2:1
20 = 10

1½:1

28° = 41.45
29° = 42.40
30° = 43.30
31° = 44.15
32° = 45.00

116.0
105.0
112.4
104.1
23.6
19.3

91
33.1
424.1

.58
44
232
232
25.52

26.6
.58
2128
1330
15428

7.82
3.72
1564
5474
2346
29.094

39.4
3.1
394
1182
122.14

372.
.62
744
2232
230.64

28.5
.81
285
2280
23.085

33.02
3.57
23114
16510
9906
117.814

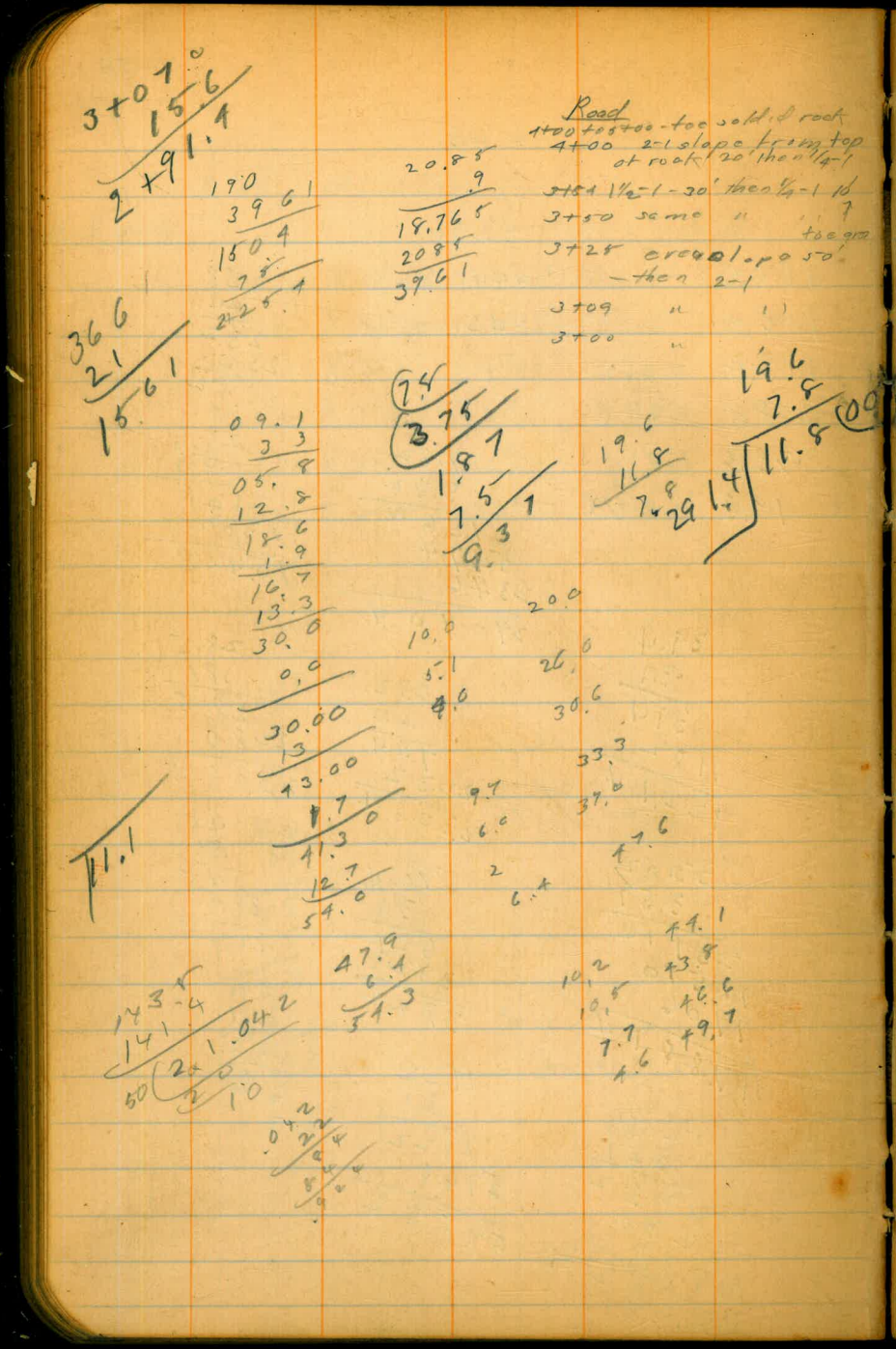
10.4
3.6
624
312
37.44

45
.81
45
360
36.45

12.46
3.57
8722
6230
6238
44.482

19.22
3.1
1922
5766
59.582

1.1
3.6
66
33



IMPROVED TABLES

AND

INFORMATION

TABLE VI (continued)
SINES, COSINES, TANGENTS, COTANGENTS (continued)

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

TABLE VII
RODS IN FEET AND INCHES

Rods	Feet Inches	Rods	Feet Inches	Rods	Feet Inches	Rods	Feet Inches	Rods	Feet Inches
1	16—6	21	346—6	41	676—6	61	1006—6	81	1336—6
2	33—0	22	363—0	42	693—0	62	1023—0	82	1353—0
3	49—6	23	379—6	43	709—6	63	1039—6	83	1369—6
4	66—0	24	396—0	44	726—0	64	1056—0	84	1386—0
5	82—6	25	412—6	45	742—6	65	1072—6	85	1402—6
6	99—0	26	429—0	46	759—0	66	1089—0	86	1419—0
7	115—6	27	445—6	47	775—6	67	1105—6	87	1435—6
8	132—0	28	462—0	48	792—0	68	1122—0	88	1452—0
9	148—6	29	478—6	49	808—6	69	1138—6	89	1468—6
10	165—0	30	495—0	50	825—0	70	1155—0	90	1485—0
11	181—6	31	511—6	51	841—6	71	1171—6	91	1501—6
12	198—0	32	528—0	52	858—0	72	1188—0	92	1518—0
13	214—6	33	544—6	53	874—6	73	1204—6	93	1534—6
14	231—0	34	561—0	54	891—0	74	1221—0	94	1551—0
15	247—6	35	577—6	55	907—6	75	1237—6	95	1567—6
16	264—0	36	594—0	56	924—0	76	1254—0	96	1584—0
17	280—6	37	610—6	57	940—6	77	1270—6	97	1600—6
18	297—0	38	627—0	58	957—0	78	1287—0	98	1617—0
19	313—6	39	643—6	59	973—6	79	1303—6	99	1633—6
20	330—0	40	660—0	60	990—0	80	1320—0	100	1650—0

TABLE VIII
LINKS IN FEET AND INCHES

Links	Feet Inches	Links	Feet Inches	Links	Feet Inches	Links	Feet Inches	Links	Feet Inches	Links	Feet Inches
1	0- 7.92	18	11-10.56	35	23- 1.20	52	34- 3.84	69	45- 6.48	86	56- 9.12
2	1- 3.84	19	12- 6.48	36	23- 9.12	53	34-11.76	70	46- 2.40	87	57- 5.04
3	1-11.76	20	13- 2.40	37	24- 5.04	54	35- 7.68	71	46-10.32	88	58- 0.96
4	2- 7.68	21	13-10.32	38	25- 0.96	55	36- 3.60	72	47- 6.24	89	58- 8.88
5	3- 3.60	22	14- 6.24	39	25- 8.88	56	36-11.52	73	48- 2.16	90	59- 4.80
6	3-11.52	23	15- 2.16	40	26- 4.80	57	37- 7.44	74	48-10.08	91	60- 0.72
7	4- 7.44	24	15-10.08	41	27- 0.72	58	38- 3.36	75	49- 6.00	92	60- 8.64
8	5- 3.36	25	16- 6.00	42	27- 8.64	59	38-11.28	76	50- 1.92	93	61- 4.56
9	5-11.28	26	17- 1.92	43	28- 4.56	60	39- 7.20	77	50- 9.84	94	62- 0.48
10	6- 7.20	27	17- 9.84	44	29- 0.48	61	40- 3.12	78	51- 5.76	95	62- 8.40
11	7- 3.12	28	18- 5.76	45	29- 8.40	62	40-11.04	79	52- 1.68	96	63- 4.32
12	7-11.04	29	19- 1.68	46	30- 4.32	63	41- 6.96	80	52- 9.60	97	64- 0.24
13	8- 6.96	30	19- 9.60	47	31- 0.24	64	42- 2.88	81	53- 5.52	98	64- 8.16
14	9- 2.88	31	20- 5.52	48	31- 8.16	65	42-10.80	82	54- 1.44	99	65- 4.08
15	9-10.80	32	21- 1.44	49	32- 4.08	66	43- 6.72	83	54- 9.36	100	66- .000
16	10- 6.72	33	21- 9.36	50	33- 0.00	67	44- 2.64	84	55- 5.28	101	66 -7 92
17	11- 2.64	34	22- 5.28	51	33- 7.92	68	44-10.56	85	56- 1.20	102	67- 3.84

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=70°	I	T	E	I=80°	I	T	E	I=90°
61°	3375.0	920.2	+	71°	4086.9	1308.2	+	81°	4893.6	1805.3	+
10′	3386.3	925.9	5° C.	10′	4099.5	1315.6	5° C.	10′	4908.0	1814.7	5° C.
20′	3397.5	931.6	T	20′	4112.1	1322.9	T	20′	4922.5	1824.1	T
30′	3408.8	937.3	.25	30′	4124.8	1330.3	.30	30′	4937.0	1833.6	.36
40′	3420.1	943.1	E	40′	4137.4	1337.7	E	40′	4951.5	1843.1	E
50′	3431.4	948.9		50′	4150.1	1345.1		50′	4966.1	1852.6	
62°	3442.7	954.8	.080	72°	4162.8	1352.6	.110	82°	4980.7	1862.2	.149
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	10° C.	73°	4239.7	1398.0	10° C.	83°	5069.2	1920.5	10° C.
10′	3522.6	996.2	T	10′	4252.6	1405.7	T	10′	5084.0	1930.4	T
20′	3534.1	1002.3	.51	20′	4265.6	1413.5	.61	20′	5099.0	1940.3	.72
30′	3545.6	1008.3	E	30′	4278.5	1421.2	E	30′	5113.9	1950.3	E
40′	3557.2	1014.4	.159	40′	4291.5	1429.0	.220	40′	5128.9	1960.2	.299
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	15° C.	50′	4383.3	1484.4	15° C.	50′	5234.9	2031.4	15° C.
65°	3650.2	1063.9	T	75°	4396.5	1492.4	T	85°	5250.3	2041.7	T
10′	3661.9	1070.2	.76	10′	4409.8	1500.5	.91	10′	5265.6	2052.1	1.09
20′	3673.7	1076.6	E	20′	4423.1	1508.6	E	20′	5281.0	2062.5	E
30′	3685.4	1082.9	.240	30′	4436.4	1516.7	.332	30′	5296.4	2073.0	.450
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	20° C.	40′	4530.4	1574.7	20° C.	40′	5405.6	2147.5	20° C.
50′	3780.4	1134.8	T	50′	4544.0	1583.1	T	50′	5421.4	2158.4	T
			1.02				1.22				1.45
67°	3792.4	1141.4	E	77°	4557.6	1591.6	E	87°	5437.2	2169.2	E
10′	3804.4	1148.0	.321	10′	4571.2	1600.1	.445	10′	5453.1	2180.2	.603
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	25° C.	20′	4667.4	1660.5	25° C.	20′	5565.4	2258.0	25° C.
30	3901.2	1202.0	T	30′	4681.3	1669.2	T	30′	5581.6	2269.3	T
40′	3913.4	1208.9	1.28	40′	4695.2	1678.1	1.53	40′	5597.8	2280.6	1.83
50′	3925.6	1215.8	E	50′	4709.2	1686.9	E	50′	5614.2	2292.0	E
69°	3937.9	1222.7	.403	79°	4723.2	1695.8	.558	89°	5630.5	2303.5	.756
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	30° C.	80°	4807.7	1749.9	30° C.	90°	5729.7	2373.3	30° C.
10′	4024.4	1272.1	T	10′	4822.0	1759.0	T	10′	5746.3	2385.1	T
20′	4036.8	1279.3	1.54	20′	4836.2	1768.2	1.84	20′	5763.1	2397.0	2.20
30′	4049.3	1286.5	E	30′	4850.5	1777.4	E	30′	5779.9	2408.9	E
40′	4061.8	1293.6	.485	40′	4864.8	1786.7	.671	40′	5796.7	2420.9	.910
50′	4074.4	1300.9		50′	4879.2	1796.0		50′	5813.6	2432.9	

T = R tan ½ I E = R exsec ½ I

2-44-15
32.61
204.54

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=100°	I	T	E	I=110°	I	T	E	I=120
91°	5830.5	2444.9	+	101°	6950.6	3278.1	+	111°	8336.7	4386.1	+
10′	5847.5	2457.1	5° C.	10′	6971.3	3294.1	5° C.	10′	8362.7	4407.6	5° C.
20′	5864.6	2469.3	T	20′	6992.0	3310.1	T	20′	8388.9	4429.2	T
30′	5881.7	2481.5	.43	30′	7012.7	3326.1	.51	30′	8415.1	4450.9	.62
40′	5898.8	2493.8	E	40′	7033.6	3342.3	E	40′	8441.5	4472.7	E
50′	5916.0	2506.1		50′	7054.5	3358.5		50′	8468.0	4494.6	
92°	5933.2	2518.5	.200	102°	7075.5	3374.9	.268	112°	8494.6	4516.6	.360
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	10° C.	103°	7203.2	3474.4	10° C.	113°	8656.6	4651.3	10° C.
10′	6055.4	2606.8	T	10′	7224.7	3491.3	T	10′	8684.0	4674.2	T
20′	6073.1	2619.7	.86	20′	7246.3	3508.2	.103	20′	8711.5	4697.2	1.25
30′	6090.8	2632.6	E	30′	7268.0	3525.2	E	30′	8739.2	4720.3	E
40′	6108.6	2645.5	.401	40′	7289.8	3542.4	40′	8767.0	4743.6	.721	
50′	6126.4	2658.5		50′	7311.7	3559.6	.536	50′	8794.9	4766.9	
94°	6144.3	2671.6		104°	7333.6	3576.8		114°	8822.9	4790.4	
10′	6162.2	2684.7		10′	7355.6	3594.2		10′	8851.0	4814.1	
20′	6180.2	2697.9		20′	7377.8	3611.7		20′	8879.3	4837.8	
30′	6198.3	2711.2		30′	7399.9	3629.2		30′	8907.7	4861.7	
40′	6216.4	2724.5		40′	7422.2	3646.8		40′	8936.3	4885.7	
50′	6234.6	2737.9	15° C.	50′	7444.6	3664.5	15° C.	50′	8965.0	4909.9	15° C.
95°	6252.8	2751.3	T	105°	7467.0	3682.3	T	115°	8993.8	4934.1	T
10′	6271.1	2764.8	1.30	10′	7489.6	3700.2	1.56	10′	9022.7	4958.6	1.93
20′	6289.4	2778.3	E	20′	7512.2	3718.2	E	20′	9051.7	4983.1	E
30′	6307.9	2792.0	.604	30′	7534.9	3736.2	30′	9080.9	5007.8	1.09	
40′	6326.3	2805.6	40′	7557.7	3754.4	.806	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	20° C.	40′	7696.3	3865.2	20° C.	40′	9289.2	5184.5	20° C.
50′	6457.3	2903.1	T	50′	7719.7	3884.0	T	50′	9319.5	5210.3	T
			1.74				2.08				2.52
97°	6476.2	2917.3	E	107°	7743.2	3902.9	E	117°	9349.9	5236.2	E
10′	6495.2	2931.6	.809	10′	7766.8	3921.9	1.08	10′	9380.5	5262.3	1.46
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	25° C.	20′	7934.6	4057.4	25° C.	20′	9598.9	5449.2	25° C.
30′	6649.6	3047.9	T	30′	7959.0	4077.2	T	30′	9630.7	5476.5	T
40′	6669.2	3062.8	2.18	40′	7983.5	4097.1	2.61	40′	9662.6	5504.0	3.16
50′	6688.8	3077.7	E	50′	8008.0	4117.0	E	50′	9694.7	5531.7	E
99°	6708.6	3092.7	1.02	109°	8032.7	4137.1	1.36	119°	9727.0	5559.4	1.83
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	30° C.	110°	8182.8	4259.7	30° C.	120°	9924.0	5729.7	30° C.
10′	6848.5	3199.6	T	10′	8208.2	4280.5	T	10′	9957.5	5758.6	T
20′	6868.8	3215.1	2.62	20′	8233.7	4301.4	3.14	20′	9991.0	5787.7	3.81
30′	6889.2	3230.8	E	30′	8259.3	4322.4	E	30′	10025.0	5817.0	E
40′	6909.6	3246.5	40′	8285.0	4343.6	40′	10059.0	5846.5			
50′	6930.1	3262.3	1.22	50′	8310.8	4364.8	1.63	50′	10093.0	5876.1	2.20

T = R tan ½ I E = R exsec ½ I

TABLE X.

MIDDLE ORDINATES OF RAILS

Length of Rail (feet)

C ° ′	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch	C °	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch
0–20	17189	.08	.07	.06	.05	.04	.03	8	716.8	1.88	1.64	1.42	1.20	1.01	.84
0–40	8594	.16	.14	.12	.10	.08	.07	9	637.3	2.12	1.84	1.60	1.35	1.14	.94
1–0	5730	.24	.20	.18	.15	.13	.10	10	573.7	2.36	2.05	1.78	1.50	1.27	1.04
1–20	4297	.31	.27	.23	.20	.17	.13	11	521.7	2.59	2.26	1.95	1.65	1.39	1.15
1–40	3438	.39	.34	.29	.25	.21	.17	12	478.3	3.83	2.47	2.15	1.81	1.54	1.26
2–0	2865	.47	.41	.35	.30	.25	.20	13	441.7	3.05	2.66	2.30	1.96	1.66	1.36
2–20	2456	.55	.48	.41	.35	.29	.23	14	410.3	3.30	2.87	2.48	2.10	1.78	1.46
2–40	2149	.63	.55	.47	.40	.33	.27	15	383.1	3.54	3.08	2.68	2.26	1.91	1.57
3–0	1910	.71	.62	.53	.45	.38	.31	16	359.3	3.76	3.28	2.83	2.40	2.04	1.67
3–20	1719	.78	.68	.59	.50	.42	.35	17	338.3	4.00	3.48	3.02	2.57	2.16	1.78
3–40	1563	.86	.75	.65	.55	.46	.38	18	319.6	4.21	3.67	3.18	2.70	2.28	1.87
4–0	1433	.94	.82	.71	.60	.50	.42	19	302.9	4.45	3.89	3.36	2.86	2.41	1.98
4–20	1323	1.02	.89	.77	.65	.55	.45	20	287.9	4.70	4.09	3.55	3.00	2.54	2.09
4–40	1228	1.10	.96	.83	.70	.59	.48	22	262.0	5.16	4.44	3.84	3.30	2.80	2.29
5	1146	1.18	1.03	.89	.75	.63	.52	24	240.5	5.64	4.92	4.20	3.59	3.04	2.50
6	955.3	1.41	1.23	1.06	.90	.76	.62	26	222.3	6.07	5.29	4.58	3.88	3.29	2.70
7	819.0	1.65	1.44	1.24	1.05	.89	.73								

TABLE XI.

SHORT RADIUS CURVES

Radius Feet	Chord Feet	Central Angle	Deflection Angle	Deflection for 1 Foot
35	10	16-26	8-13	49.3
45	10	12-46	6-23	38.3
50	15	17-16	8-38	34.5
60	15	14-22	7-11	28.8
75	15	11-30	5-45	23.0
100	20	11-30	5-45	17.3
120	20	9-34	4-47	14.3
150	20	7-39	3-49	11.5
190	25	7-32	3-46	9.15
200	25	7-10	3-35	8.6
225	25	6-25	3-12	7.7
240	25	5-58	2-59	7.2
250	25	5-44	2-52	6.9
275	25	5-12	2-36	6.2
288	50	9-58	4-59	6.0
300	50	9-32	4-46	5.7
350	50	8-12	4-06	4.9
376	50	7-40	3-50	4.6
400	50	7-10	3-35	4.3
410	50	7-00	3-30	4.2

To find length of curve divide angle from P. C. to P. T. by central angle of chord and multiply by length of chord.

TABLE XII.

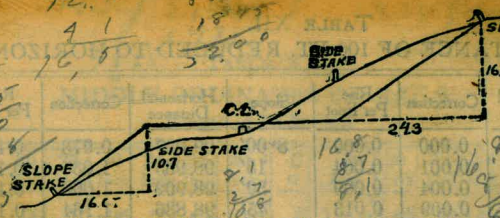
INCLINED DISTANCE OF 100 FT. REDUCED TO HORIZONTAL

Slope	Horizontal Distance	Correction	Rise Per Foot	Slope	Horizontal Distance	Correction	Rise Per Foot
0°00′	100.000	0.000	0.000	8°00′	99.027	0.973	0.139
15′	99.999	0.001	0.004	15′	98.965	1.035	0.143
30′	99.996	0.004	0.009	30′	98.902	1.098	0.148
45′	99.991	0.009	0.013	45′	98.836	1.164	0.152
1 00	99.985	0.015	0.017	9 00	98.769	1.231	0.156
15	99.976	0.024	0.022	15	98.700	1.300	0.161
30	99.966	0.034	0.026	30	98.629	1.371	0.165
45	99.953	0.047	0.031	45	98.556	1.444	0.169
2 00	99.939	0.061	0.035	10 00	98.481	1.519	0.174
15	99.923	0.077	0.039	15	98.404	1.596	0.178
30	99.905	0.095	0.044	30	98.325	1.675	0.182
45	99.885	0.115	0.048	45	98.245	1.755	0.187
3 00	99.863	0.137	0.052	11 00	98.163	1.837	0.191
15	99.839	0.161	0.057	15	98.079	1.921	0.195
30	99.813	0.187	0.061	30	97.992	2.008	0.199
45	99.786	0.214	0.065	45	97.905	2.095	0.204
4 00	99.756	0.244	0.070	12 00	97.815	2.185	0.208
15	99.725	0.275	0.074	15	97.723	2.277	0.212
30	99.692	0.308	0.078	30	97.630	2.370	0.216
45	99.657	0.343	0.083	45	97.534	2.466	0.221
5 00	99.619	0.381	0.087	13 00	97.437	2.563	0.225
15	99.580	0.420	0.092	15	97.338	2.662	0.229
30	99.540	0.460	0.096	30	97.237	2.763	0.233
45	99.497	0.503	0.100	45	97.134	2.866	0.238
6 00	99.452	0.548	0.105	14 00	97.030	2.970	0.242
15	99.406	0.594	0.109	15	96.923	3.077	0.246
30	99.357	0.643	0.113	30	96.815	3.185	0.250
45	99.307	0.693	0.118	45	96.705	3.295	0.255
7 00	99.255	0.745	0.122	15 00	96.593	3.407	0.259
15	99.200	0.800	0.126	15	96.479	3.521	0.263
30	99.144	0.856	0.131	30	96.363	3.637	0.267
45	99.087	0.913	0.135	45	96.246	3.754	0.271

TABLE XIII.

MINUTES IN DECIMALS OF A DEGREE.

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



DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING.

SLOPE 1½ TO 1. ROADWAY OF ANY WIDTH.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	0 00	0 15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	0
1	1.50	1 65	1 80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	1
2	3.00	3.15	3.30	3 45	3.60	3 75	3.90	4.05	4.20	4 35	2
3	4.50	4 65	4.80	4.95	5 10	5 25	5 40	5.55	5.70	5.85	3
4	6.00	6 15	6.30	6.45	6.60	6.75	6.90	7.05	7.20	7.35	4
5	7 50	7.65	7.80	7.95	8.10	8.25	8.40	8.55	8.70	8.85	5
6	9 00	9 15	9.30	9.45	9.60	9.75	9.90	10.05	10.20	10.35	6
7	10.50	10 65	10.80	10.95	11.10	11.25	11.40	11.55	11 70	11.85	7
8	12.00	12 15	12.30	12.45	12.60	12.75	12.90	13.05	13.20	13.35	8
9	13 50	13 65	13 80	13 95	14.10	14.25	14.40	14 55	14.70	14.85	9
10	15.00	15 15	15 30	15 45	15.60	15.75	15.90	16.05	16.20	16 35	10
11	16 50	16 65	16 80	16.95	17 10	17.25	17.40	17.55	17.70	17.85	11
12	18 00	18.15	18.30	18 45	18.60	18 75	18.90	19.05	19.20	19 35	12
13	19 50	19 65	19.80	19.95	20.10	20.25	20 40	20.55	20.70	20.85	13
14	21.00	21 15	21.30	21.45	21 60	21.75	21.90	22 05	22 20	22 35	14
15	22 50	22 65	22 80	22 95	23.10	23.25	23.40	23.55	23.70	23.85	15
16	24.00	24 15	24 30	24 45	24.60	24.75	24 90	25 05	25.20	25.35	16
17	25.50	25 65	25.80	25 95	26.10	26 25	26 40	26.55	26.70	26.85	17
18	27.00	27 15	27.30	27 45	27.60	27.75	27.90	28.05	28 20	28.35	18
19	28 50	28 65	28 80	28.95	29.10	29.25	29 40	29.55	29.70	29.85	19
20	30 00	30 15	30.30	30.45	30.60	30.75	30.90	31.05	31.20	31.35	20
21	31 50	31 65	31.80	31.95	32 10	32 25	32.40	32.55	32 70	32 85	21
22	33 00	33 15	33 30	33 45	33.60	33 75	33.90	34.05	34.20	34.35	22
23	34 50	34 65	34.80	34.95	35.10	35 25	35 40	35.55	35.70	35 85	23
24	36.00	36 15	36.30	36 45	36.60	36.75	36.90	37.05	37 20	37.35	24
25	37.50	37.65	37 80	37.95	38.10	38.25	38.40	38.55	38.70	38.85	25
26	39 00	39 15	39.30	39 45	39 60	39.75	39.90	40.05	40.20	40.35	26
27	40 50	40 65	40 80	40.95	41.10	41.25	41 40	41.55	41.70	41.85	27
28	42 00	42 15	42.30	42.45	42.60	42 75	42.90	43.05	43.20	43.35	28
29	43 50	43 65	43.80	43 95	44.10	44 25	44 40	44.55	44.70	44 85	29
30	45 00	45 15	45.30	45 45	45.60	45.75	45 90	46.05	46 20	46.35	30
31	46.50	46.65	46.80	46 95	47.10	47.25	47.40	47.55	47.70	47.85	31
32	48 00	48.15	48.30	48 45	48.60	48 75	48.90	49.05	49 20	49.35	32
33	49.50	49 65	49.80	49.95	50.10	50.25	50.40	50.55	50 70	50.85	33
34	51 00	51.15	51.30	51.45	51.60	51.75	51 90	52.05	52.20	52.35	34
35	52 50	52.65	52.80	52.95	53.10	53.25	53.40	53.55	53.70	53.85	35
36	54 00	54 15	54.30	54 45	54.60	54.75	54.90	55.05	55.20	55.35	36
37	55 50	55 65	55.80	55 95	56.10	56.25	56.40	56.55	56.70	56.85	37
38	57 00	57.15	57 30	57 45	57.60	57 75	57.90	58.05	58.20	58 35	38
39	58 50	58.65	58 80	58 95	59.10	59 25	59.40	59 55	59.70	59.85	39
40	60 00	60 15	60 30	60 45	60 60	60.75	60 90	61.05	61 20	61.35	40
41	61.50	61 65	61 80	61 95	62 10	62 25	62.40	62 55	62 70	62.85	41
42	63 00	63.15	63 30	63 45	63 60	63 75	63 90	64 05	64 20	64.35	42
43	64.50	64 65	64 80	64.95	65.10	65 25	65 40	65.55	65.70	65.85	43
44	66 00	66 15	66 30	66.45	66.60	66 75	66.90	67.05	67.20	67.35	44
45	67 50	67 65	67 80	67 95	68.10	68.25	68.40	68.55	68.70	68.85	45
46	69 00	69 15	69 30	69.45	69.60	69 75	69.90	70.05	70.20	70.35	46
47	70 50	70 65	70 80	70 95	71.10	71.25	71 40	71.55	71.70	71.85	47
48	72.00	72 15	72.30	72.45	72.60	72.75	72.90	73 05	73.20	73 35	48
49	73 50	73 65	73.80	73.95	74.10	74.25	74.40	74.55	74.70	74.85	49
50	75.00	75.15	75.30	75.45	75.60	75.75	75.90	76.05	76.20	76.35	50

Computed by L. Leland Locke.