

OFFICE OF  
RAMSEY COUNTY ENGINEER

# CONSTRUCTION NOTES

FORT SNELLING

PROJ. 27-52

BOOK 2

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FIELD BOOK

360 A

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# KEUFFEL & ESSER CO.

## DRAWING MATERIALS AND SURVEYING INSTRUMENTS. NEW YORK.

CHICAGO. ST. LOUIS. SAN FRANCISCO. MONTREAL.

### TABLES FOR EXCAVATIONS AND EMBANKMENTS.

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.  
ROADWAY 18 FEET WIDE. SIDE SLOPES 1 TO 1.  
FOR SINGLE TRACK EXCAVATION.

*"Copyright, 1895, by Keuffel & Esser Co."*

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

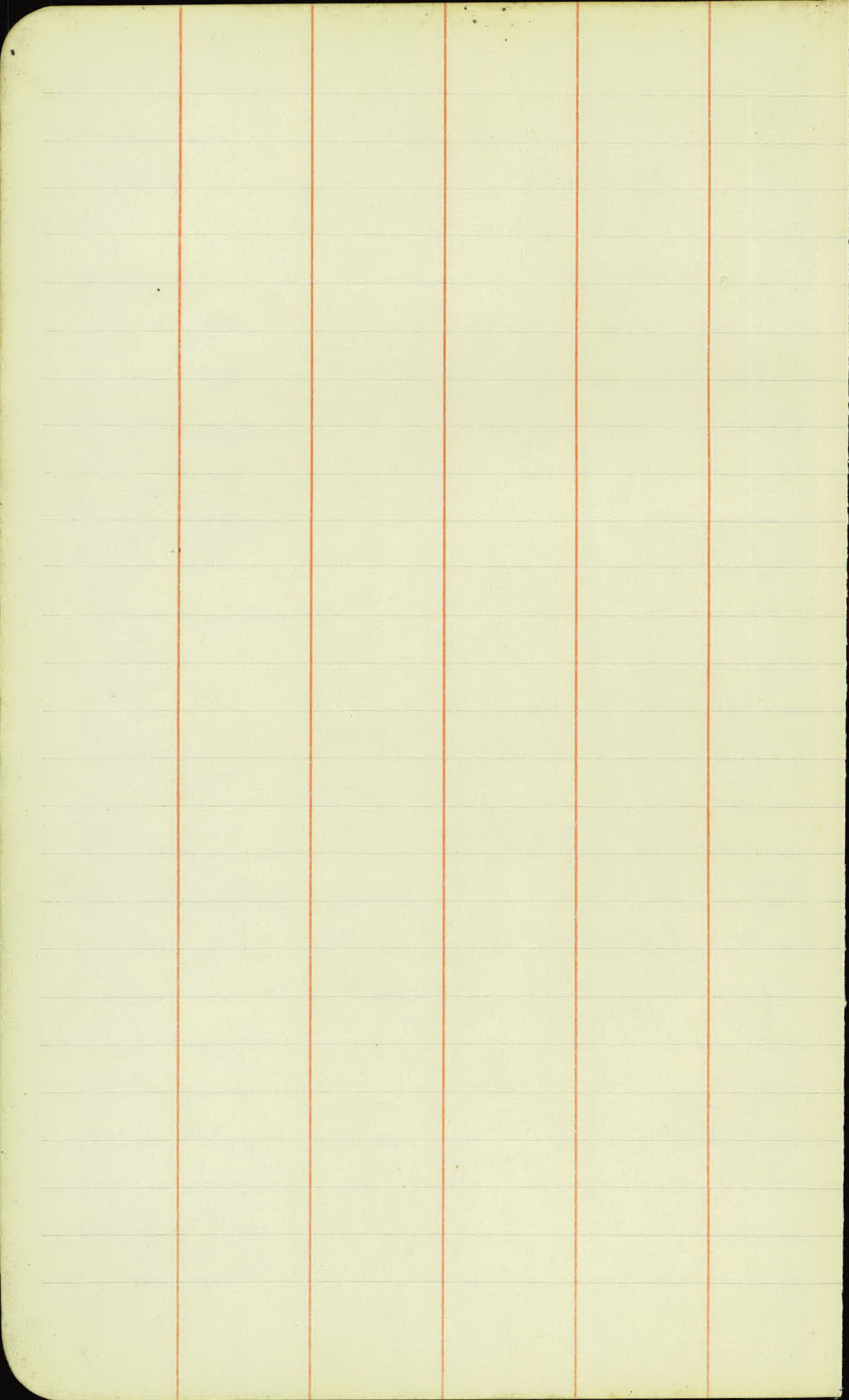
Calculated by Julien A. Hall, M. Am. Soc. C. E.

For Keith's Railroad Curve Labels see end of book.

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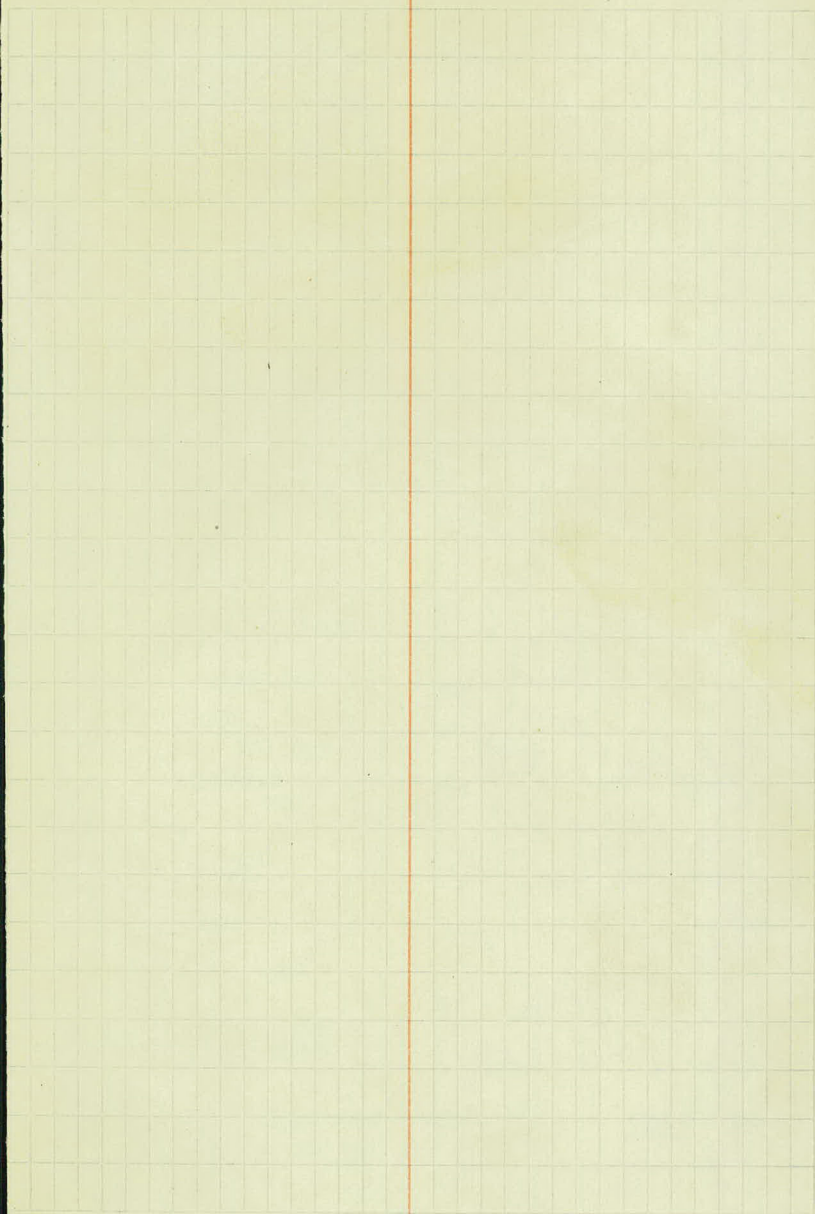
Sta.	to	Sta.	Description	Page	to	Page
992		1014	Fin. X section	31	-	32
1015		1065	" "	45	-	49
992		1065	Final Topography	50	-	58



The image shows a page from a notebook with a grid of 20 columns and 30 rows. A vertical red line runs down the center of the page, dividing the grid into two equal halves of 10 columns each. The grid is composed of thin, light-colored lines. The page is otherwise blank, with no text or markings other than the page number '2' in the top right corner.

# Checking Curb Stakes

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
B.M.	2.96	808.85		805.89	
1089 +10.2					
1089 +00					
+75					
+50					
+25					
1088					
1087 +75					2.99
+50					2.88
T.P.	6.24	812.23	2.86	805.99	
+22.9					6.14
(+52)				06.86	5.37
(+39)					5.36
(+26)					5.36
(+13)					5.36
End. of R.					5.36
1085 +89.2				06.87	5.36
+75				06.98	5.25
+50				07.19	5.04
+25				07.41	4.82
1085 +05.3				07.58	4.65
				07.80	4.43



# Checking Curb Stakes

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
		812.23		08.02	4.21 ✓
				08.24	3.99 ✓
				08.24	3.99 ✓
				08.23	4.00 ✓
				08.22	4.01 ✓
				08.20	4.03 ✓
1084+47.5				08.18	4.25
T.P.	5.13	813.31	4.05	808.18	
+25				08.41	4.90
1084				08.66	4.65
+75				08.91	4.40
+50				09.16	4.15
+25				9.41	3.90
1083				09.66	3.65
+75				09.91	3.40
B.M.	4.12	815.83	1.60	811.71	
+50				10.16	5.67
+25				10.44	5.39
1082				10.77	5.06
+75				11.15	4.68
+50				11.59	4.24
+25				12.08	3.95
1081				12.62	3.21
+75				13.22	2.61
+61.7				13.56	2.27
T.P.	6.47	820.03	2.27	813.56	

Both Sides

811.71 Top Hyd. Rt. 1082+61

# Checking Curb Stakes.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rod.
		820.03		13.60	6.43
				13.64	6.39
				13.68	6.35
				13.72	6.31
1080+50				13.86	6.17
+25				14.51	5.52
+11.6				14.81	5.22
				14.54	5.49
				14.27	5.96
				14.00	6.03
				13.72	6.31
1080				15.07	4.96
B.M.	3.11	820.65	2.49	817.54	
+75				15.58	5.07
+50				16.01	4.64
+48.3				16.04	4.61
				15.94	4.71
				15.84	4.81
				15.74	4.91
1079+38.5				16.19	4.46
				16.44	4.21
				16.69	3.96
				16.94	3.71
1078+98.7				16.68	3.97
				16.45	4.20

817.54 Top Hyd. - Rt. 1079+77

Beg. of Rad. on Rt.

End of Rad. on Rt.

Beg. of Rad. on Lt.

End of Rad. on Lt.

Beg. of Rad. on Rt.

# Checking Curb Stakes

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
		820.65		16.21	4.44
				15.98	4.67
				15.74	4.91
1079				16.67	3.98
+75				16.90	3.75
+50				17.06	3.59
+25				17.18	3.47
1078				17.31	3.34
+75				17.43	3.22
T.P.	4.06	821.54	3.17	817.48	
+53.3				17.54	4.00
				17.56	3.98
				17.57	3.97
				17.58	3.96
1077 + 08.1				17.59	3.95
T.P.	4.06	821.54	3.17	817.48	
1077 + 00				17.56	
76 + 57.4				17.92	3.62 ✓
				17.92	3.62 ✓
				17.92	3.62 ✓
				17.92	3.62 ✓
				17.92	3.62 ✓
1076 + 87				17.63	3.91 ✓
+75					
+58.2				17.81	3.73 ✓
+50				17.75	3.77
+47				17.92	3.62 ✓

4.42

4.15

.32

17.92

17.63

.29

6

End of Rad. on Rt.

End of 50' Curve

Beg. of 50' Curve

Beg. of Rad. on Lt.

End. of Rad. of Lt.

Beg. of Curb Rt.

End of Curb - Rt.

17.75 on Rt.

Beg. of Curb on Lt.

$$\begin{array}{r}
 .0025 \\
 48 \overline{) 0.108} \\
 \underline{\phantom{0.}8} \\
 20
 \end{array}$$

# Checking Curb Stakes

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
+25		821.54		17.60	3.94
+17.9				17.93	3.61 ✓
1076 +00				17.45	4.09
+95				17.30	4.24
+60.3				17.21	4.33
				17.22	4.32
				17.24	4.30
				17.26	4.28
				17.28	4.26
+50				17.30	4.24
1075 +38.5				17.18	4.36 ✓
				17.20	4.34 ✓
				17.23	4.31 ✓
				17.25	4.29 ✓
				17.28	4.26 ✓
South Rail			4.10	17.44	
			4.14	17.40	
			4.18	17.36	
North Rail			4.24	17.30	
B.M.			3.31	818.23	818.21

17.35

17.60 on Rt.

End of Curb on Lt.

17.45 on R. ✓      17.96 on Lt.      (3.78)

17.30-Rt.      17.53 on Lt.      (4.01)

Beg. of 12' R. on Rt.

End of 12' R on Rt. on Old Curb.

17.30 on Lt.

Beg. of 25' R on Lt.

End of 25' R. on L on old curb.

17.43      4.11      4.23      17.31

17.38      4.16      4.30      17.24

17.45      4.09      4.36      17.18

17.42      4.12      4.41      17.13

Spt in 18" Poplar - Rt. 1075+78

16.54      5.00      4.94      16.60

118

118

17.93	
17.04	
.89	
<hr/>	
957.89	

18.10	17.81
17.81	17.10
.29	.71

## Slope Stakes.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rod.
B.M.	4.80	822.73		817.93	
1014+00					
15					
16					
17					
18					
19					
T.P.	4.90	822.13	5.50	817.23	
20				18.05	4.1
21				17.8	4.3
22				17.5	4.6
23				17.2	4.9
24				16.9	5.2
25				16.6	5.5
T.P.	4.47	820.85	5.75	816.38	
26				16.3	4.6
27				15.96	4.9
28				15.55	5.3
29				15.06	5.8
B.M.	1.55	818.60	3.79	817.06	1.4
30				14.5	4.1
31				13.9	4.7
32				13.3	5.3
33				12.7	5.9
T.P.	3.87	816.10	6.37	812.23	

36' - 20'	<u>20.4</u>			<u>23.6</u>	<u>34</u>
	-0.2	+0.1		-1.1	+1.5
	<u>34.8</u>	<u>23</u>		<u>24</u>	<u>34.2</u>
	+1.9	-0.9	+0.2	-1.2	+1.7
	<u>33.4</u>	<u>24</u>		<u>23</u>	<u>34.4</u>
	+1.2	-1.0	+0.2	-0.9	+1.7
	<u>33</u>	<u>24</u>		<u>23.3</u>	<u>34</u>
	+1.1	-1.2	0.0	-1.1	+1.6
	<u>35</u>	<u>23</u>		<u>23.5</u>	<u>33.5</u>
	+1.9	-0.9	-0.1	-1.0	+1.1
	<u>29</u>			<u>26</u>	<u>33.5</u>
2.0	-2.0	-0.1		-1.7	+1.3

7.1	<u>34</u>	<u>23</u>		<u>23.5</u>	<u>34</u>
	+1.6	-0.8	+0.4	-1.0	+1.4
	<u>35</u>	<u>22.5</u>		<u>21.5</u>	<u>36</u>
7.4	+2.0	-0.7	+0.5	-0.5	+2.5
	<u>35</u>	<u>22.5</u>		<u>23.5</u>	<u>30.5</u>
7.8	+1.9	-0.8	+0.5	-1.1	+3.2
	<u>35.5</u>	<u>21.5</u>		<u>23</u>	<u>36</u>
8.3	+2.2	-0.4	+0.4	-0.8	+2.3

817.05 Spk. in 8" Oak - Lt. Sta. 1029+30

6.6	<u>36</u>	<u>21.5</u>		<u>23</u>	<u>36</u>
	+2.5	-0.4	+0.3	-0.9	+2.4
	<u>36.5</u>	<u>22</u>		<u>26</u>	<u>32.5</u>
7.2	+2.7	-0.6	+0.2	-1.8	+0.8
	<u>36</u>			<u>23.5</u>	<u>34</u>
7.8	0.0		+0.2	-1.1	+1.4
	<u>36</u>	<u>21</u>		<u>23.5</u>	<u>35.5</u>
810.4 8.2	+2.4	-0.3	+0.4	-1.1	+2.1

## Slope Stakes.

Sta.	B.S.	I.I.	F.S.	Grade	Gr. Rd.
1034		816.10		812.1	4.0
35				11.6	4.5
36				11.2	4.9
37				11.1	5.0
38				11.0	5.1
39				11.0	5.1
B.M.			1.91	814.19	
B.M.	5.15	818.94		813.79	
992+66.2			4.05	814.89	
993				814.2	4.7
994				14.2	4.7
995				14.2	4.7
996				14.2	4.7
997				14.2	4.7
T.P.	5.13	819.05	5.02	813.92	
998				14.2	4.9
999				14.2	4.9
1000				14.2	4.9
1001				14.3	4.8
1002				14.1	4.7
B.M.	4.97	819.76	4.23	814.82	
1003				14.6	5.2
1004				14.8	5.0
1005				15.0	4.8

Ditch	Rod.					
		<u>32.5</u>	<u>23</u>			<u>23.5</u> <u>33</u>
810.1	6.0	+0.7	-0.8	+0.1		-1.1 <u>33</u>
		<u>31.5</u>	<u>25.5</u>			2.3 <u>33</u>
09.9	6.2	+0.2	-1.7	0.0		-0.9 <u>32</u>
		<u>33</u>	<u>22</u>			22.5 <u>32</u>
09.9	6.2	+1.1	-0.6	+0.1		-0.7 <u>31</u>
		<u>32.5</u>	<u>22.5</u>			23.5 <u>31</u>
10.0	6.1	+0.8	-0.6	+0.3		-1.1 <u>32</u>
		<u>32</u>	<u>21</u>			23 <u>32</u>
10.1	6.0	+0.6	-0.3	+0.5		-0.8 <u>32</u>
		<u>31.5</u>	<u>21.5</u>			23.5 <u>32</u>
10.2	5.9	+0.2	-0.7	+0.3		-1.1 N.O.

Top of Hyd. Lt. 1039-

Spt. in 40" C.H. - Rt. 991+50

= Elev. on Pavement.

40'		<u>40</u>	<u>21</u>			<u>21</u>	<u>40</u>	
		D+1.9	-0.6	+0.1		-0.5	D+2.2	
"		<u>40</u>	<u>22</u>			<u>22</u>	<u>40</u>	
		D+1.6	-1.4	-0.1		-1.2	D+2.7	
20'			<u>26.5</u>			<u>22.5</u>	<u>40</u>	
			-3.2	-0.4		-1.7	D+2.2	
			<u>26.5</u>			<u>25.5</u>	<u>32.5</u>	
2.2			-3.1	-0.6		-1.6	D+0.8	
		<u>32</u>	<u>28</u>			<u>24.0</u>	<u>34</u>	
2.2		D+0.4	-2.3	-0.4		-1.1	D+1.5	
		<u>33</u>	<u>29</u>			<u>23</u>	<u>33.5</u>	
2.4		D+0.9	-2.2	-0.1		-1.0	D+1.3	
		<u>35</u>	<u>26.5</u>			<u>24.0</u>	<u>33.5</u>	
2.4		D+1.9	-1.9	-0.1		-1.2	D+1.3	
		<u>34</u>	<u>23.5</u>			<u>20</u>	<u>35</u>	
2.4		D+1.4	-1.1	+0.3		+0.3	D+2.0	
		<u>33.5</u>	<u>25</u>			<u>26.5</u>	<u>32.5</u>	
2.3		D+1.3	-1.6	+0.3		-2.0	D+0.7	
		<u>24</u>	<u>27</u>			<u>27</u>	<u>31.5</u>	
810.3	8.8	-1.9	+0.5			-2.0	D+0.2	811.9 2.2

81A.09 Spt. in 8" Willow. Lt Sta.

10.4		<u>21</u>	<u>25.5</u>			<u>32</u>	
		-0.3	+0.2			-1.6	D+0.6
10.5		<u>22</u>	<u>23.5</u>			<u>34</u>	7.7
		-1.0	+0.3			-1.0	D+1.6
10.6		<u>22.5</u>	<u>24</u>			<u>34</u>	7.5
		-1.2	+0.1			-1.3	D+1.2

## Slope Stakes.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1006		819.76		15.2	4.6
T.P.	5.99	820.99	4.96	815.00	
1007				15.4	5.4
1008				15.9	5.1
1009				16.0	4.8
1010				16.3	4.5
T.P.	4.89	821.91	3.93	816.84	
1011				16.6	5.1
1012				16.9	4.8
1013				17.2	4.5
B.M.			3.99	817.94	

10.7	$\frac{22}{-1.1}$	-0.3	$\frac{25}{-1.5}$	$\frac{33}{D+1.1}$	7.1
10.8	$\frac{24.5}{-0.8}$	+0.5	$\frac{23}{-0.9}$	$\frac{35}{D+1.9}$	7.9
10.9	$\frac{22.5}{-1.3}$	+0.4	$\frac{22.5}{-0.7}$	$\frac{35}{D+1.8}$	7.6
11.0	$\frac{21}{-0.4}$	+0.8	$\frac{21}{-0.2}$	$\frac{36}{D+2.5}$	7.3
11.1	$\frac{21}{-0.6}$	+0.5	$\frac{22}{-0.6}$	$\frac{35}{D+1.9}$	7.0
11.2	$\frac{23}{-1.5}$	+0.2	$\frac{22.5}{-0.7}$	$\frac{35}{D+2.2}$	7.6
11.3	$\frac{25}{-2.5}$	0.0	$\frac{23}{-0.9}$	$\frac{35}{D+1.9}$	7.3
11.4	$\frac{24.5}{-2.3}$	-0.3	$\frac{26}{-1.7}$	$\frac{32.5}{D+0.6}$	7.0

817.93 Spk. in 20" C.H. Lt. Sta. 1016+

## Checking Curve Stakes. (Lft. Side)

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rad.
B.M.	4.61	814.61		810.00	
1065+34.8				810.45	4.16
				810.43	4.18 ✓
				810.40	4.21 ✓
				810.37	4.24 ✓
				810.35	4.26 ✓
1065				810.60	4.01
+75				810.70	3.91
+50				810.80	3.81
+25				810.90	3.71
1064				810.99	3.62
+75				11.05	3.56
+50				11.10	3.51
+25				11.14	3.47
1063				11.17	3.44
+75				11.20	3.41
+50				11.21	3.40
+25				11.22	3.39
T.P.	3.55	814.78	3.38	811.23	
+19.3				11.21	3.57
					3.52
					3.47
B.M.	1.76	814.21	2.32	812.46	
1060+16				810.93	3.28
				810.98	3.23
				811.03	3.18

Spk. in 20" C.W. near Pipe.

Beg. of 12' R. on Lt.

= Elev. of Sidewalk. Lt of End of Rad.

812.45 Top of Hyd. Lt. 1059+60

Beg. of 12' R. on Lt.

End of 12' R on Lt.

Checking Curb States - Lt.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1060+00		814.21		810.89	3.32
+75				10.82	3.39
+52				10.76	3.45
B.M.				70.81	3.40
				10.86	3.35
B.M.	1.74	814.19	1.76	812.45	
1059+08				10.67	3.52
					3.47
					3.42
1059+00				10.65	3.54
+75				10.61	3.58
+54				10.58	3.61
					3.49
					3.36
B.M.	2.52	815.65	1.05	813.14	
1056+50.5				810.61	5.04
					4.92
					4.99
+25				10.62	5.01
1056+00				10.69	4.96
+75				10.70	4.95
+50				10.79	4.86
+48				10.79	4.86
					4.86
					4.86
B.M.			2.52	813.13	

Beg. of 12' R. on Lt.

End. of 12' R. on Lt.

Top of Hyd. Lt. 1059+60

Beg. of 12' R. on Lt.

End of 12' R. on Lt.

Beg. of 12' R. on Lt.

End of 12' R. on Lt.

813.13 Top of Hyd. Lt. 1055+41

Beg. of 12' R. on Lt.

813.13 Top of Hyd. Lt. 1055+41

Checking Curve Stakes - Rt.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
B.M.	4.50	814.50		810.00	
1065 + 75.2				810.25	4.25
					4.12
					3.99
					3.86
					3.73
+50				810.37	4.13
+25				810.48	4.02
1065				810.60	3.90
+75				810.70	3.80
+50				810.80	3.70
+25				810.90	3.60
1064				810.99	3.51
+75				11.05	3.45
+50				11.10	3.40
+25				11.14	3.36
T.P.	4.93	814.55	4.68	809.82	
1063				11.17	3.38
+75				11.20	3.35
+50				11.21	3.34
+25				11.22	3.33
1062				11.21	3.34
+75				11.21	3.34
+50				11.19	3.36
+25				11.16	3.39

Spk. in PP. - Rt. 1063 + 25

Checking Curb Stakes - Rt.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1061+00		814.55		811.12	3.43
B.M.	2.12	814.59	2.10	812.45	
+75				11.08	3.49
+50				11.02	3.55
+25				10.96	3.61
1060				10.89	3.68
+75				10.82	3.75
+50				10.76	3.81
+25				10.70	3.87
1059				10.65	3.92
+75				10.61	3.96
+50				10.58	3.99
+25				10.56	4.01
T.P.	4.38	814.94	4.01	810.56	
1058+05.8				10.54	4.40
					4.28
					4.15
1057+54.8				10.53	4.41
					4.29
					4.16
+50				10.54	4.40
+25				10.54	4.40
B.M.	2.23	815.35	1.79	813.15	
1057				10.55	4.80
+75				10.57	4.78
+50				10.60	4.75

812.45 Top of Hyd. Lt. 1059+60

Beq. of 12' R. on Rt.

End of 12' R. on Rt.

Beq. of 12' R. on Rt.

End. of 12' R. on Rt.

813.12 Top of Hyd. Lt. 1055+41

Checking Curves - Rt. Stakes

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1056+25		815.35		10.64	4.71
1056				10.69	4.66
+75				10.74	4.61
+50				10.79	4.56
+25				10.84	4.51
1055				10.89	4.46
+75.7				10.94	4.41
					4.29
					4.16
B.M.	1.81	814 <sup>93</sup> / <sub>—</sub>	2.23	813.12	
+24.7				11.04	3.89
					3.77
					3.64
1054				11.09	3.84
+75				11.14	3.79
+50				11.19	3.74
+25				11.24	3.69
1053				11.29	3.64
+75				11.34	3.59
+50				11.39	3.54
+25				11.44	3.49
T.P.	3.68	815.12	3.49	811 <sup>44</sup> / <sub>—</sub>	
1052				11.49	3.63
+75				11.53	3.59
+50				11.56	3.56

Top of Hyd. Lt. 1055741

1051+25	815.12	11.58	3.54
1051		11.59	3.53
1050+75.7		11.58	3.54
			3.42
			3.29
T.P.	0.35	814.77	
1050+24.7		11.53	

Top of Hyd. Rt. 1049+

Checking Corn Stakes (Lt.)

Sta.	B.S.	I.I.	F.S.	Grade	Gr. Rd.
B.N.	1.77	814.90		813.13	
1055+04				10.89	4.01
				10.89	4.01
				10.89	4.01
1055				10.89	4.01
+75				10.94	3.96
+50				10.99	3.91
+25				11.04	3.86
1054				11.09	3.81
+75				11.14	3.76
+50				11.19	3.71
+25				11.24	3.66
1053				11.29	3.61
+75				11.34	3.56
+50				11.39	3.51
+25				11.44	3.46
1052				11.49	3.41
T.P.	3.77	815.27	3.40	811.50	
+75				11.53	3.74
+50				11.56	3.71
+25				11.58	3.69
1051				11.59	3.68
+75				11.58	3.69
+50				11.56	3.71
+25				11.53	3.74
T.P.	0.36	815.16	0.47	814.80	

Top of Hyd. Lt. 1055+41

Beg. of 12' R. on Lt.

End of 12' R. on Lt.

214.77 Top of Hyd. Rt. 1019

Checking Curb Stakes - Lt. Side

Sta.	B.S.	I.I.	F.S.	Grade	Gr. Pol.
1050		815.16		811.49	3.67
1049 + 85				11.46	3.70
					3.58
					3.45
B.M.			2.02	813.14	

Re-Checking Curb Stakes - Rt.

B.M.	1.86	814.31		812.45	
1059				10.65	3.66
+95				10.61	3.70
+50				10.58	3.73
+25				10.56	3.75
1058 + 05.8				10.54	3.77

Beq. of 12' R. on Lt.

813.11 S.E. Cor. 3<sup>rd</sup> Step

Top of Hyd. Lt. 1059+60

Checking Curb States - Both Sides.

Sta.	B.S.	H.I.	F.S.	Grade.	Gr. Rod.
T.P.	0.42	815.19		814.77	
B.M.			2.08	813.11	
1050+28.9				11.53	3.66
-					3.54
-					3.41
1050+00				11.49	3.70
1049 + 82.0				11.45	3.70
-					3.58
-					3.49
1049+32.8				11.30	3.89
-					3.77
-					3.64
1049+41				11.34	3.85
-					3.73
-					3.60
1049+25				11.28	3.91
1049+30				11.19	4.00
1048+75				11.09	4.10
-				11.12	4.07
-				11.16	4.03
1048+21				10.87	4.32
-				11.01	4.18
-				11.16	4.03
1048+00				10.79	4.40
+75				10.69	4.50

Top of Hyd. Rt. 1049+

813.11 S.E. Cor. of 358 Stoop. Lt.

Beg. of 12' R. on Lt.

Beg. of 12' R. on Rt.

Beg. of 12' R. on Rt.

Beg. of 12' R. on Lt.

Beg. of 12' R. Rt. & Lt.

End of 12' R. Rt. & Lt.

Beg. of 12' R. Rt. & Lt.

End of 12' R. Rt. & Lt.

Checking Curb Stakes - Both Sides.

Sta	B.S.	I.I.	F.S.	Grade	Gr. Rd.
+50		815.19		10.61	4.58
+25				10.53	4.66
1047+00				10.49	4.72
T.P.	3.96	814.44	4.71	810.48	
+75				10.42	4.02
+50				10.37	4.07
+25				10.34	4.10
1046+00				10.32	4.12
+75				10.31	4.13
1045+59				10.31	4.13
					3.96
					3.98
T.P.	1.37	814.47	1.34	813.10	
1045+13				10.33	4.14
					3.97
					3.99
1045+50				10.31	4.16
+25				10.32	4.15
1045+00				10.34	4.13
+75				10.37	4.10
+50				10.41	4.06
+25				11.46	4.01
1044+00				10.52	3.95
+95				10.54	3.93
					3.86
					3.78

4.13

3.77

.36

Bag of 12' R. on Lt.

Bag of 12' R. on Lt.

Bag of 12' R on Lt.

Checking Curb Stakes - Both Sides

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1043+51		814.47		10.67	3.80
					3.73
					3.65
1043+75				10.59	3.88
+50				10.68	3.79
B.M.	1.80	815.46	0.80	813.67	
+25				10.77	4.69
1043+00				10.87	4.59
+75				10.99	4.47
+50				11.11	4.35
+25				11.24	4.22
1042+00				11.39	4.07
+75				11.53	3.93
+50				11.65	3.81
+25				11.74	3.72
1041+00				11.82	3.64
+75				11.87	3.59
+50				11.91	3.55
+25				11.92	3.54
1040+00				11.91	3.55
+75				11.89	3.57
+78.1				11.89	3.57
					3.52
					3.47

813.66 Top of Hyd. Lt. 1043+48

Beg. of 12' R. on Rt.

Checking Curb Stakes - Both Sides.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1139+65		815.46		11.87	3.59
					3.54
					3.49
B.M.			1.25	814.21	

Beg. of 12' R. on Lt.

814.21 Top of Hyd. Lt. 1039+

## Setting Stakes for Header at Ordnance Bldg.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rod.
B.M.	3.90	822.11		818.21	
1079				16.44	4.77
+75				16.67	4.6
+50				16.83	4.5
+25				16.95	4.38
1078				17.08	4.25
+75				17.20	4.12
+50				17.33	4.78
25 Ft.				17.37	4.94
25 Ft.				17.41	4.70
29 Ft.				17.46	4.65
15 Ft.				17.49	4.62
				17.48	4.63
				17.47	4.64
				17.46	4.65
				17.45	4.66
				17.43	4.68
B.M.	3.83	822.04		818.21	
				17.32	4.72

$$\begin{array}{r} 1.22 \\ 4 \\ \hline 4.82 \end{array}$$

3.44

$$\begin{array}{r} 3.44 \\ 23 \\ \hline 3.67 \end{array}$$

$$\begin{array}{r} 3.44 \\ 3.64 \\ 22 \\ \hline 3.67 \end{array}$$

23

Spk. in 15" Paper - Rt. 1025498

Set to 0.1' above  $\perp$  Grade

Set to straight grade from 77+50 to end of header

Set to 0.40' below elev. of Gorb on Lt.

4.94      5.04

4.75      4.99

4.76      4.95

$$\begin{array}{r} 3 \\ .0015 \\ 7 \\ \hline .0105 \end{array}$$

$$\begin{array}{r} .0015 \\ 40 \overline{) 0.06000} \\ \underline{40} \\ 20 \end{array}$$

9.49

$$\begin{array}{r} 16.7 \\ 6 \\ \hline 19.32 \end{array}$$

B.M.	3.79	822.00	818.21		
E. Rail			4.67	17.33	
W. Rail			4.56	17.44	
Pave. Edge			5.49	16.51	
Pave. Edge				16.51	
+20'				16.87	5.15
+37				17.01	4.97
+54				17.15	4.83
+71				17.29	4.7
+88				17.42	4.58
+108'				17.38	4.6
B.M.			3.78	818.22	

17.12  
16.89  
---  
.55

17.38  
16.51  
---  
.87

5.22	5.16 ✓	5.13	5.17 ✓	5.25
5.06 ✓	5.01 ✓	4.99	5.09 ✓	5.28
4.90	4.87 ✓	4.85	4.96 ✓	5.18
4.94	4.92 ✓	4.91	4.80 ✓	4.99
4.56	4.56 ✓	4.56	4.68 ✓	4.92

P18.21

Pavement Grades on 27' Pave.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd
B.M.	1.55	815.96		814.21	
1039				11.45	4.31
+50				11.45	4.31
1038				11.45	4.31
+50				11.50	4.26
1037				11.55	4.21
B.M.	1.00	815.21	1.55	814.21	
1039+18.5				811.45	3.76
				11	3.73
					3.70
1039+24.5				811.45	3.96 ✓
					3.74 ✓
					3.72
+ 3.8'					3.91
T.P.	2.90	815.09	3.02	812.19	
1036+50				11.55	3.54
1036				11.65	3.44
+50				11.80	3.29
1035				12.05	3.04
+50				12.30	2.79
1034				12.55	2.54
T.P.	5.68	818.24	2.53	812.56	
+50				12.85	5.39
1033				13.15	5.09

$$\begin{array}{r}
 15.21 \\
 3.20 \\
 \hline
 12.01 \\
 1.03 \\
 \hline
 .36
 \end{array}$$

Top of Hyd. Lt. 1039+

714.21

Bag of 16.5' R. Lt.

End of 16.5' R. on Lt.

Bag of 16.5' R. on Rt.

End of 16.5' R. on Rt.

End of Header on Rt.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1032+50		818.24		13.45	4.79
1032				13.75	4.49
1031 +50				14.05	4.19
B.M.			1.18	817.06	

817.05 Spk. in 12" Oak - 60' Lt. Sta.

Sta.	B.S.	I.I.	F.S.	Grade	Gr. Rd.
B.M.	4.77	818 .56			
990 + 66			2.85	15.71	
991 + 66			3.49	15.07	
992 + 66			3.79	14.77	
993				814.68	3.88
+50				14.65	3.91
994				14.65	3.91
+50				14.65	3.91
995				14.65	3.91
+50				14.65	3.91
996				14.65	3.91
+50				14.65	3.91
997				14.65	3.91
T.P.	4.44	819 .09	3.91	814.65	
+50				14.65	4.44
998				14.65	4.44
+50				14.65	4.44
T.P.	4.71	819 .37	4.43	814.66	
999				14.65	4.72
+50				14.65	4.72
1000				14.66	4.71
+50				14.68	4.69
1001				14.73	4.64
+50				14.78	4.59
1002				14.86	4.51

813.79 - Spk. in 40° C.Y. - Rt. Sta. 991+50

On Edge of Pavement

" " " "

" " " "

Sta.	B.S.	I.I.	F.S.	Grade	Gr. R.M.
1002+50		819.37		14.95	4.42
1003				15.05	4.32
+50				15.15	4.22
1004				15.25	4.12
B.M.	4.68	819.47	4.55	814.82	814.79
+50				15.35	4.12
1005				15.45	4.02
				15.55	3.92
1006				15.65	3.82
T.P.	4.64	820.29	3.82	815.65	
				15.75	4.54
1007				15.85	4.44
				16.00	4.29
1008				16.15	4.14
T.P.	6.38	821.06	5.61	814.68	
				16.30	4.76
1009				16.45	4.61
				16.60	4.46
1010				16.75	4.31
				16.90	4.16
1011				17.05	4.01
T.P.	5.47	821.28	5.25	815.81	
				17.20	4.08
1012				17.35	3.93
				17.50	3.78
1013				17.65	3.63
+50				17.80	3.48
B.M.	4.03	821.96	3.37	817.91	

Spt. in 8" C.M. 60' Lt. of 1003

Top of Stake 33' Rt. of 1011+00

17.93

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1014		821.96		17.95	4.01
+50				18.10	3.86
B.M.	4.64	822.57	4.03	819.93	
1015				18.25	4.37
+50				18.38	4.19
1016				18.50	4.07
+50				18.58	3.99
T.P.	4.14	822.72	3.99	818.58	
1017				18.65	4.07
+50				18.68	4.04
1018				18.70	4.01
+50				18.68	4.04
1019				18.65	4.07
+50				18.58	4.14
T.P.	3.94	822.53	4.13	818.59	
1020				18.50	4.03
+50				18.38	4.15
1021				18.25	4.28
+50				18.10	4.43
1022				17.95	4.58
T.P.	4.42	821.85	5.10	817.43	
+50				17.39	4.46
1023				17.28	4.57
+50				17.16	4.69
1024				17.05	4.80

Grain Change

Spk. in Tree Rt. of 1022+10

24	+50		821.85		16.94	4.91
25					16.83	5.02
T.P.		3.98	820.82	5.01	816.84	
	+50				16.71	4.11
26					16.60	4.22
	+50				16.48	4.34
27					16.33	4.45
B.M.		2.51	819.56	3.97	817.05	
	+50				16.15	3.41
28					15.96	3.60
	+50				15.75	3.81
29					15.50	4.00
	+50				15.23	4.31
30					14.95	4.60
	+50				14.65	4.91
31					14.35	5.22
	+50				14.05	5.53
B.M.				2.51	817.05	

817.05 Spt. in 12" Oak Lt Sta. 1029+50

817.05 Spt. in 12" Oak Lt. Sta. 1029+50

Sta	+	H.I.	-	Elev.	
B.M.	5.83	819.62		813.79	
992+61 <sup>66.5</sup>				14.9	4.7
993+00				14.3	5.3
994+00				14.1	5.5
995+00				13.9	5.9
996+00				13.5	6.1
997+00				13.9	5.7
T.P.	5.62	819.69	5.55	814.07	
998+00				14.4	5.7
999+00				14.1	5.6
1000+00				14.6	5.1
1001+00				14.6	5.1
1002+00				14.8	4.9
1003+00				15.0	4.9
B.M.	4.88	819.67	4.88	914.81 =	914.79

spike in 40° Oak Ptata 991+50

72	78	47	485	471	482	49	61	69
40	27	19	135		135	24	34	40

67	76	27	48	494	480	494	52	76	80	64
40	37	27	19	135		135	21	29	35	40

70	82	76	50	507	492	505	53	78	80	56
40	34	29	20	135		135	19	38	34	40

119	116	100	87	56	522	509	523	53	77	78	75	61
40	35	33	28	20	135		135	18	26	32	38	40

102	90	89	54	549	534	549	54	78	82	70	72
40	32	28	19	135		135	19	27	32	35	40

76	75	90	88	57	555	542	558	57	79	80	64	60
40	34	32	28	20	135		135	21	27	32	36	40

71	71	89	84	56	558	545	558	55	78	82	68	68
40	35	32	27	19	135		135	20	27	32	35	40

60	62	84	77	54	540	526	542	55	78	81	70	68
40	36	33	25	18	135		135	19	28	32	34	40

67	67	79	75	53	518	507	522	53	77	79	77	66	72
40	34.3	33	27	19	135		135	20	26	31	33	35	40

67	66	82	75	50	50	489	502	52	79	84	74	76
40	34	32	26	20	135		135	20	27	31	32.6	40

70	73	87	84	52	488	474	481	49	80	83	77	70
40	34.5	32	30	20	135		135	19	26	31	32.5	40

61	61	67	85	51	466	455	468	50	75	80	70	70
40	36.6	33	29	23	135		135	20	26	31	32.7	40

spike in 5" willow 60' Lt 379

Sta	+	HZ	-	Elev.
		819.67.		
1004+00				15.1 4.6
T.P.	6.02	821.29.	4.40	815.27.
1005+00				15.2 6.1
1006+00				15.3 6.0
1007+00				16.0 5.3
1008+00				16.2 5.1
1009+00				16.9 4.4
1010+00				17.0 4.3
1011+00				17.0 4.3
1012+00				19.0 4.3
T.P.	5.62	823.06.	3.85	817.44.
1013+00				17.1 6.0
1014+00				17.0 6.1

Cont. on Page 45

$\frac{61}{40}$	$\frac{63}{357}$	$\frac{84}{32}$	$\frac{83}{30}$	$\frac{53}{24}$	$\frac{445}{135}$	480	$\frac{45}{135}$	$\frac{46}{19}$	$\frac{70}{27}$	$\frac{73}{33}$	$\frac{58}{348}$	$\frac{58}{40}$
-----------------	------------------	-----------------	-----------------	-----------------	-------------------	-----	------------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{79}{40}$	$\frac{79}{355}$	$\frac{102}{33}$	$\frac{104}{29}$	$\frac{74}{25}$	$\frac{62}{21}$	$\frac{588}{135}$	572	$\frac{588}{135}$	$\frac{60}{18}$	$\frac{73}{23}$	$\frac{85}{26}$	$\frac{87}{32}$	$\frac{76}{367}$	$\frac{76}{40}$
-----------------	------------------	------------------	------------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{76}{40}$	$\frac{74}{357}$	$\frac{100}{33}$	$\frac{100}{30}$	$\frac{77}{26}$	$\frac{60}{21}$	$\frac{565}{135}$	554	$\frac{569}{135}$	$\frac{57}{19}$	$\frac{70}{22}$	$\frac{88}{27}$	$\frac{89}{30}$	$\frac{88}{33}$	$\frac{75}{342}$	$\frac{76}{40}$
-----------------	------------------	------------------	------------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{70}{40}$	$\frac{68}{347}$	$\frac{96}{33}$	$\frac{95}{30}$	$\frac{68}{26}$	$\frac{56}{21}$	$\frac{544}{135}$	530	$\frac{544}{135}$	$\frac{54}{19}$	$\frac{68}{24}$	$\frac{80}{27}$	$\frac{79}{33}$	$\frac{67}{348}$	$\frac{68}{40}$
-----------------	------------------	-----------------	-----------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{73}{40}$	$\frac{76}{35}$	$\frac{96}{32}$	$\frac{95}{30}$	$\frac{65}{25}$	$\frac{52}{22}$	$\frac{516}{135}$	503	$\frac{518}{135}$	$\frac{51}{18}$	$\frac{65}{22}$	$\frac{82}{27}$	$\frac{79}{33}$	$\frac{68}{35}$	$\frac{63}{40}$
-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

$\frac{58}{40}$	$\frac{58}{37}$	$\frac{86}{33}$	$\frac{86}{29}$	$\frac{50}{22}$	$\frac{488}{135}$	476	$\frac{488}{135}$	$\frac{48}{18}$	$\frac{59}{22}$	$\frac{74}{26}$	$\frac{74}{33}$	$\frac{55}{352}$	$\frac{52}{40}$
-----------------	-----------------	-----------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{57}{40}$	$\frac{57}{325}$	$\frac{84}{32}$	$\frac{82}{30}$	$\frac{48}{23}$	$\frac{456}{135}$	442	$\frac{459}{135}$	$\frac{46}{19}$	$\frac{53}{23}$	$\frac{74}{28}$	$\frac{73}{33}$	$\frac{56}{35}$	$\frac{56}{46}$
-----------------	------------------	-----------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

$\frac{60}{40}$	$\frac{60}{37}$	$\frac{85}{33}$	$\frac{84}{30}$	$\frac{53}{24}$	$\frac{43425}{135}$	411	$\frac{425}{135}$	$\frac{42}{19}$	$\frac{69}{25}$	$\frac{70}{33}$	$\frac{52}{347}$	$\frac{51}{40}$
-----------------	-----------------	-----------------	-----------------	-----------------	---------------------	-----	-------------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{58}{40}$	$\frac{57}{373}$	$\frac{82}{32}$	$\frac{81}{29}$	$\frac{59}{25}$	$\frac{41}{20}$	$\frac{440}{135}$	315	$\frac{40}{135}$	$\frac{41}{20}$	$\frac{69}{27}$	$\frac{67}{33}$	$\frac{51}{355}$	$\frac{49}{40}$
-----------------	------------------	-----------------	-----------------	-----------------	-----------------	-------------------	-----	------------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{79}{40}$	$\frac{79}{367}$	$\frac{99}{33}$	$\frac{96}{30}$	$\frac{72}{25}$	$\frac{57}{20}$	$\frac{543}{135}$	532	$\frac{544}{135}$	$\frac{55}{18}$	$\frac{86}{28}$	$\frac{87}{32}$	$\frac{80}{343}$	$\frac{79}{40}$
-----------------	------------------	-----------------	-----------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	------------------	-----------------

$\frac{97}{40}$	$\frac{75}{35}$	$\frac{108}{34}$	$\frac{104}{29}$	$\frac{68}{23}$	$\frac{55}{19}$	$\frac{523}{135}$	503	$\frac{512}{135}$	$\frac{53}{19}$	$\frac{79}{25}$	$\frac{77}{28}$	$\frac{100}{32}$	$\frac{93}{33}$	$\frac{86}{40}$
-----------------	-----------------	------------------	------------------	-----------------	-----------------	-------------------	-----	-------------------	-----------------	-----------------	-----------------	------------------	-----------------	-----------------

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
B.M.	2.89	808.78		805.89	
1088+99.1				805.62	3.16
					3.43 ✓
					3.71
					3.99
1088+50				05.72	3.06
1088+25				05.74	3.04
1088+00				805.76	3.02 ✓
1087+75				05.76	3.02
1087+50				05.76	3.02 ✓
1087+25				05.91	2.87
T.P.	2.60	810.13	1.25	807.53	
1087+00				806.03	4.11
1086+75				06.12	4.01
+66.5				06.18	3.95 ✓
				06.32	3.81 ✓
				806.46	3.67
+12				6.61	3.52
					3.59 ✓
				806.46	3.67 ✓
1086+00				06.60	3.53
+22.6				806.80	3.33
T.P.	3.99	811.07	3.05	807.08	
150'				806.83	

4.17  
3.  
3.67

3.83  
27

75  
8.5  
66.5

10.13  
9.53  
2.60

Beg. of R. on Rt.

3.16 3.46 3.52 3.58

End of 12' Rad.

3.16 3.36 3.43 3.50

3.34 3.36 3.38

3.32 3.28 3.24

3.36 3.27 3.18

3.32 3.20 3.08

3.17 3.08 2.99

Spk. in T.P. Lt. 1087+

4.41 4.31 4.21

4.31 4.22 4.13

Beg. of 2' R.

4.25 4.17 4.09

Beg. of 20' R. on Rt. 3.82 3.97 3.72

3.83 3.73 3.63

Beg. of 16°08' Curve on Rt.

3.63 3.53 3.43

125'		811.07		809.00	3.00
100'				809.17	3.50
75'				809.34	4.00
50'				809.53	4.50
25'				809.72	5.00
0'				809.90	5.50
T.P.	3.54	811.94	2.67	808.40	
					3.80
					3.85
					3.89 ✓

B.M. 0.21 811.73 ✓

T.P.	3.13	810.66		809.53	
1085+74.6				806.80	3.86
150'				806.83	
125'				09.00	3.66
100'				9.17	3.49
75'				9.34	3.32
50'				9.53	3.13
25'				9.72	2.94
0'				9.90	2.76
T.P.	4.26	812.17	2.75	809.91	

$$\begin{array}{r} 9 \overline{) 1.04} \\ \underline{.26} \end{array}$$

(1.04)

$$\begin{array}{r} 7.80 \\ 6.80 \\ 9 \overline{) 1.56} \\ \underline{.14} \end{array}$$

$$\begin{array}{r} 8.14 \checkmark \\ 7.60 \checkmark \\ \underline{.54} \end{array}$$

34

$$\begin{array}{r} 7.34 \\ 6.80 \\ \underline{.50} \end{array}$$

$$\begin{array}{r} 3 \overline{) 1.56} \\ \underline{.19} \end{array}$$

Beg. of 16°08' Curve,

2.94

Beg. of 13' Rad. on Lt. (El. on Curb built by Fort.)

End. of 13' Rad. on Lt.

3.89

3.89

3.89

811.91 Top of Hyd. Rt. of 1082+61

2.52

812.17

3.91

3.97

4.03

D.M.

0.44

811.73

End of 13' Rad. at Track Header

Beg. of 13' Rad. at end of Curb built by Fort.

811.71 Top of Hyd. Rt. 1082+61

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
B.M.	3.19	809 .08		805.89	
1090 + 69.5					4.34 ✓
					4.51 ✓
					4.69 ✓
					4.86 ✓
					5.04 ✓
1090 + 50					4.25 ✓
+ 29					4.16 ✓
1089 + 92					3.99 ✓
+ 75					3.92 ✓
+ 50					3.81 ✓
1089 + 26				05.37	3.71 ✓
					4.01 ✓
				04.79	4.31 ✓
T.P.			4.30	804 .78	

$$\begin{array}{r} 9 \\ 17 \overline{) 153} \\ \underline{153} \\ 0 \end{array}$$

$$90 + 69.5$$

$$\begin{array}{r} 90 + 69.5 \\ 19 + 26 \\ \hline 143.5 \end{array}$$

$$\begin{array}{r} 4.34 \\ 3.71 \\ \hline .63 \end{array}$$

36

S.E. Cor. 1st Stop - Int. Bldg.

Beg. of 12' Rad on Rt.

4.64 4.63 4.63 4.67

End of 12' Rad on Rt. S.04 on Old Curb.

End of Curb

End of Curb

Beg of 12' R. on Rt.

4.01 4.06 4.11

End of 12' R. on Rt.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
T.P.	2.65	810.18		809.53	
1085+24.6				806.80	3.38
86+00				6.65	3.53
86+12				6.58	3.60
					3.65
					3.71
+66.5				6.24	3.94
					3.82
					3.71 ✓
86+25				6.19	3.99
87+00				6.03	4.15
T.P.	3.63	809.67	4.14	806.04	
87+25				5.96	3.71
+30				5.89	3.78
+25				5.82	3.85
88+00				5.76	3.91
+25				5.68	3.99
+50				5.60	4.07
T.P.	3.48	809.07	4.08	805.59	
+79				5.51	3.56
				5.26	3.81
				5.01	4.06
				4.77	4.30

Spk. in T.P. - Lt. 1087+

Beg. of  $16^{\circ}08'$  Curve on Rt.

Beg. of 20' R.

End of 20' R.

Beg. of 12' R.

End of 12' R.

7  
Beg. of 20' R.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1088+26		809.07		5.37	
B.M.			3.18	805.89	

Beg. of 12' R.

805.89 S.E. Cor. 1<sup>st</sup> step on Inf. Bldg.

$$\begin{array}{r} 1089+26 \\ 1088+00 \\ \hline 126 \end{array}$$

$$\begin{array}{r} 5.76 \\ 5.37 \\ \hline .39 \end{array}$$

$$126 \overline{) .39}$$

## Stakes for Island

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
B.M.	3.26	809.15		805.89	4.04

4.71 4.71 4.70 4.74

RESETTING SLOPE STAKES

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
B.M.	4.53	818 .32		813.79	
992+66					
993					4.1
+50					
994					4.2
+50					
995					4.4
T.P.	3.12	817 .38	4.06	814.26	
996					3.7 6.2
997					3.8 6.3
998					3.7 6.4
999					3.6 6.5
T.P.	3.81	818 .46	2.93	814.65	
1000					4.4
1001					
T.P.	5.37	820 .09	3.94	814.72	
1002					9.8 / 5.7 / 8.2

2.5 1.00  
1.50

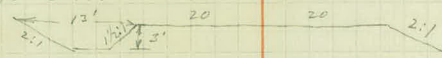
10

2.5 | 8.00  
75  
50

31  
13.5 40  
17.5

Spk. in 40" C.M. - Rt. Sta. 991+50

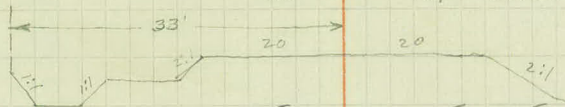
992+66 to 995



<u>21</u>	<u>21</u>	<u>40</u>
-0.6	-0.6	D.C. 2.2

<u>40</u>	<u>22</u>	<u>21.5</u>	<u>40</u>
D.C. 1.6	-1.4	-0.9	D.C. 2.9

<u>25.5</u>	<u>22</u>	<u>40</u>
-2.6	-1.4	D.C. 2.5



<u>25</u>	<u>23.5</u>	<u>33.5</u>
-2.4	-1.0	D.C. 1.3

<u>33</u>	<u>27</u>	<u>22</u>	<u>35.5</u>
D.C. 1.0	-2.1	-0.6	D.C. 2.2

<u>34</u>	<u>26.5</u>	<u>21</u>	<u>34.5</u>
D.C. 1.4	-2.0	-0.2	D.C. 1.7

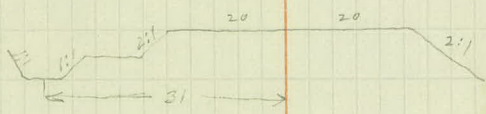
<u>35.5</u>	<u>26</u>	<u>22</u>	<u>34</u>
D.C. 2.2	-1.7	-0.5	D.C. 1.5

<u>34</u>	<u>23.5</u>	<u>20</u>	<u>35</u>
D.C. 1.4	-1.1	+0.3	D.C. 2.0

<u>33.5</u>	<u>25.5</u>	<u>27</u>	<u>32.5</u>
D.C. 1.3	-1.6	-2.1	D.C. 0.7

(6.7)

(6.7)



<u>35</u>	<u>26</u>	<u>24</u>	<u>27</u>	<u>31.5</u>
D.C. 2.2	D.C. 3.4	-1.9	-2.0	D.C. 0.2

10.3

31

Sta.	B.S.	I.L.	F.S.	Grade	Gr. Hd.
1003		820.09			9.7/5.5/8.0
B.M.	5.57	820.36	5.38	814.71	
1004				14.8	9.9/5.6/
1005				15.0	9.8/5.4/
1006				15.2	9.7/5.2/
T.P.	5.31	821.02	4.65	815.71	
1007				15.4	10.2/5.6/
1008				15.7	10.1/5.3/
1009				16.0	10.0/5.0/
T.P.	5.84	822.31	4.55	816.47	
1010				16.3	11.2/6.0/
1011				16.6	11.1/5.7/
1012				16.9	11.0/5.4/
1013				17.2	10.9/5.1/
T.P.	5.46	823.12	4.65	817.66	
1014					11.6/

Ditch  
Grade Lt.  
10.4

$$\begin{array}{r} 5 \\ +3.3 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \\ +3.3 \\ \hline \end{array}$$

$$\begin{array}{r} 21 \\ -0.3 \\ \hline \end{array}$$

$$\begin{array}{r} 26 \\ -1.8 \\ \hline \end{array}$$

$$\begin{array}{r} 32 \\ 00.06 \\ \hline \end{array}$$

814.79 Spk. in 8" C.M. Lt. 1003+

10.5

$$\begin{array}{r} 4.5 \\ +2.8 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.1 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ +2.7 \\ \hline \end{array}$$

$$\begin{array}{r} 22 \\ -11 \\ \hline \end{array}$$

10.6

$$\begin{array}{r} 4 \\ +2.7 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.1 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ +2.6 \\ \hline \end{array}$$

10.7

$$\begin{array}{r} 4.5 \\ +3.1 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +0.8 \\ \hline \end{array}$$

$$\begin{array}{r} 4.5 \\ +2.9 \\ \hline \end{array}$$

10.8

$$\begin{array}{r} 5.5 \\ +3.9 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +0.9 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \\ +3.5 \\ \hline \end{array}$$

$$\begin{array}{r} 23.5 \\ -1.0 \\ \hline \end{array}$$

10.9

$$\begin{array}{r} 4.0 \\ +2.7 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.1 \\ \hline \end{array}$$

$$\begin{array}{r} 4.5 \\ +3.0 \\ \hline \end{array}$$

11.0

$$\begin{array}{r} 6 \\ +4.7 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +2.1 \\ \hline \end{array}$$

$$\begin{array}{r} 4.5 \\ +3.0 \\ \hline \end{array}$$

11.1

$$\begin{array}{r} 6 \\ +4.6 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.8 \\ \hline \end{array}$$

$$\begin{array}{r} 5.5 \\ +3.8 \\ \hline \end{array}$$

11.2

$$\begin{array}{r} 5.5 \\ +4.0 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.9 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \\ +3.6 \\ \hline \end{array}$$

11.3

$$\begin{array}{r} 6 \\ +4.3 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.8 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ +2.9 \\ \hline \end{array}$$

11.4

$$\begin{array}{r} 5.5 \\ +3.8 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.9 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ +2.5 \\ \hline \end{array}$$

11.5

$$\begin{array}{r} 4.0 \\ +2.4 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ +1.9 \\ \hline \end{array}$$

$$\begin{array}{r} 4.5 \\ +3.1 \\ \hline \end{array}$$

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
1015		823.12			10.2/5.5
1016					8.8/5.6
B.M.	5.22	823.15	5.19	817.93	
1017					5.6/7.5
1018					5.6/8.1
1019					5.6/8.1
T.P.	4.24	822.91	4.48	818.67	
1020					5.3/7.8
1021					5.5/8.0
1022					5.7/8.2
1023					5.9/8.4
1024					6.2/8.7
T.P.	3.46	821.66	4.71	818.20	
1025					5.2/7.7
1026					5.5/8.0

$$\begin{array}{r}
 12.9 \\
 \hline
 3 \\
 +1.7 \\
 \hline
 0 \\
 +1.8 \\
 \hline
 3.5 \\
 +1.9 \\
 \hline
 25.5 \\
 -2.8 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 26 \\
 -1.8 \\
 \hline
 31.5 \\
 D.C. 0.3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 14.3 \\
 \hline
 3.5 \\
 +1.8 \\
 \hline
 0 \\
 +1.6 \\
 \hline
 3 \\
 +1.4 \\
 \hline
 24 \\
 -2.0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 21 \\
 -0.3 \\
 \hline
 35.5 \\
 D.C. 2.3 \\
 \hline
 \end{array}$$

817.93

$$\begin{array}{r}
 15.7 \\
 \hline
 32 \\
 D+0.4 \\
 \hline
 20 \\
 5+0.6 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 20 \\
 0.0 \\
 \hline
 35 \\
 D+2.0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 34 \\
 D+1.5 \\
 \hline
 34 \\
 -1.0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 34.5 \\
 -0.8 \\
 \hline
 34.5 \\
 D+1.7 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 36 \\
 +0.1 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 36 \\
 -0.1 \\
 \hline
 36 \\
 D+2.4 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 38 \\
 +0.9 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 34.5 \\
 -0.6 \\
 \hline
 34.5 \\
 D+1.9 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 35.5 \\
 D+2.2 \\
 \hline
 35.5 \\
 -0.3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 35 \\
 -0.5 \\
 \hline
 35 \\
 D+2.0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 34 \\
 D+1.4 \\
 \hline
 23 \\
 -1.0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 35 \\
 -0.6 \\
 \hline
 35 \\
 D+1.9 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 33.5 \\
 D+1.3 \\
 \hline
 33.5 \\
 -1.2 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 34.5 \\
 -0.7 \\
 \hline
 34.5 \\
 D+1.8 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 35.5 \\
 D+2.2 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 33.5 \\
 -1.2 \\
 \hline
 32.5 \\
 D+1.3 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 32 \\
 D+0.5 \\
 \hline
 32 \\
 -2.0 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 24.5 \\
 -1.5 \\
 \hline
 34 \\
 D+1.5 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 34 \\
 D+1.6 \\
 \hline
 34 \\
 -0.9 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 23 \\
 -0.9 \\
 \hline
 34 \\
 D+1.4 \\
 \hline
 \end{array}$$

1027.

821.66

5.8 / 8.3

1028

15.6 6.1 / 8.6

B.M.

4.57

817.09

$$\begin{array}{r} 63 \\ 45 \\ \hline 1.18 \end{array}$$

$$\begin{array}{r} 64 \\ 18 \\ \hline 46 \end{array}$$

43

$$\begin{array}{r} 35 \\ \hline D+2.0 \end{array}$$

$$\begin{array}{r} 21 \\ \hline -0.4 \end{array}$$

$$\begin{array}{r} 21 \\ \hline -0.3 \end{array}$$

$$\begin{array}{r} 36 \\ \hline D+2.6 \end{array}$$

$$\begin{array}{r} 23.5 \\ \hline -1.1 \end{array}$$

817.05 B.M. Spt. in 8" Oak Lt. 1029+30

SIDEWALK STAKES SO. OF ORD. BLDG.

Sta.	B.S.	H.I.	F.S.	Grade	Gr. Rd.
B.M.	4.52	822.06		817.54	
0+00 ✓				4.38	4.38
+25				4.52	4.52
+50				4.67	4.67
+75				4.81	4.81
1+00				4.96	4.96
+25 ✓				5.10	5.10
+50				5.35	5.35
+75				5.61	5.61
2				5.86	5.86
+25 ✓				6.12	6.12
+50				6.43	6.43
2+73 ✓				6.72	6.72
			7.09	7.09	
B.M.			4.52	817.54	

1.97

5.10  
4.38  
5 .72  
1.4

4 1.02  
.25

Top of Hyd. Rt. 1079+77

Elev. of Curb.

4.38 -0.4

-0.9

-0.10

-0.5

-0.7

-0.9

5.10 0.0

-0.1

-0.25

+0.2

-0.2

6.12 -0.1

7.8  
6.1  
1.7

-0.31

-0.5

-1.7

Elev. of end of Walk Built by Fort.

817.54

Sta	+	HI	-	Elev	
		823.06			
1015+00				17.6	5.5
B.M.	499	922.92	5.14	917.92	812.93
1016+00				18.2	4.7
1017+00				18.3	4.6
1018+00				18.1	4.8
1019+00				18.3	4.6
1020+00				18.3	4.6
1021+00				18.1	4.8
T.P.	385	921.80	4.97	917.95	
1022+00				17.8	4.0
1023+00				17.3	4.5
1024+00				16.8	5.0
1025+00				16.5	5.3

85	96	97	95	74	5.5	5.06	492	507	51	88	86	77	76
40	343	31	27	24	18	13.5		13.5	19	30	33	34.9	40

72	63	85	83	50	4.96	479	4.91	50	64	74	78	55	56
40	343	31	26	18	13.5		13.5	18	22	25	31	34.4	40

63	62	80	81	50	4.99	482	4.92	51	73	76	54	59
40	343	32	26	19	13.5		13.5	19	26	31	35	40

66	61	79	76	49	4.92	478	4.88	48	73	75	57	61
40	34	30	26	18	13.5		13.5	19	28	31	33.2	40

54	54	76	74	50	4.88	473	4.89	49	70	73	56	56
40	337	30	26	19	13.5		13.5	19	27	31	33.5	40

+ 85 End Ditch ht

Drive way	42	46	489	475	485	48	72	73	56	55
	40	25	13.5		13.5	19	26	31	34.5	40

+ 35 Beg Ditch ht.

60	59	78	78	50	5.06	492	5.02	51	76	76	59	61
40	344	32	27	19	13.5		13.5	19	26	32	35	40

56	53	70	68	42	4.08	392	4.07	41	66	69	52	53
40	337	31	25	19	13.5		13.5	19	26	33	36	40

59	57	72	72	40	4.36	422	4.35	44	70	72	55	54
40	338	31	26	19	13.5		13.5	20	26	32	33.4	40

55	54	71	68	46	4.60	448	4.62	46	70	74	61	61
40	33	30	25	19	13.5		13.5	19	28	32	33.7	40

73	71	76	78	49	4.87	474	4.86	51	73	76	63	64
40	32	31	26	19	13.5		13.5	20	28	33	44.4	40

Sta	+	H I	-	Elev	
		921.80			
1026				16.6	5.2
1027				16.6	5.2
1028				16.1	5.9
+40				16.0	5.8
T.P.	393	919.08	6.65	915.15	
1029				15.7	3.4
B.M.	199	919.06	1.99	917.09	917.09
1030				15.0	4.1
T.P.	317	917.30	4.93	914.13	
1031				14.1	3.2
1032				13.6	3.9
1033				13.2	4.1
1034				12.3	5.0
1035				11.8	5.5



Sta	+	St. I.	-	Eleu	
		917.30			
1036				11.6	5.9
1037				11.6	5.9
1038				11.9	5.6
T.P.	5.01	916.50	5.81	911.49	
1039				11.5	5.0
+ 58.9 = + 52.0				11.8	4.7
1040+00				11.9	4.6
1041+00				12.2	4.3
1042+00				12.4	4.1
1043+00				11.6	4.9
1044+00				10.9	5.6
T.P.	4.88	915.31	6.07	910.43	
1045+00				10.8	4.5



sta	+	HI	-	Elev.
		915.31		
1046				10.9 4.4
1047				11.0 4.3
1048				11.1 4.2
+48				11.9 3.4
T.P	4.81	916.13	3.99	911.32
1049				11.8 4.3
1050				12.3 3.8
1051				12.4 3.9
1052				12.2 3.9
1053				11.9 4.2
1054				12.1 4.0
1055				11.7 4.4
B.M.	2.22	915.30	3.05	913.08 = 913.12



Sta	+	H Z	-	Elev	
		915.30			
1056				11.4	3.9
1057				11.0	4.3
1058				10.5	4.8
1059				10.3	5.0
BM	3.56	816.01	2.91	912.39	812.45
1060				10.3	5.9
1061				10.9	5.3
1062				11.0	5.0
1063				10.3	5.9
1064				10.2	5.8
T.P.	4.61	815.62	5.00	811.01	
1065				10.1	5.5
+840				10.1	5.55
BM			5.59	810.03	810.00

$$\begin{array}{r} x \\ 45 \quad 48 \quad 465 \quad 465 \quad 506 \quad 484 \quad 506 \quad 469 \quad 468 \quad 48 \quad 48 \quad 50 \\ \hline 40 \quad 26 \quad 184 \quad 18 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 25 \quad 36 \quad 40 \end{array}$$

$$\begin{array}{r} x \\ 504 \quad 527 \quad 497 \quad 524 \quad 483 \quad 482 \quad 52 \quad 50 \\ \hline 30 \quad 19 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 29 \quad 40 \end{array}$$

$$\begin{array}{r} x \\ 504 \quad 520 \quad 499 \quad 523 \quad 476 \quad 476 \quad 48 \quad 54 \quad 55 \\ \hline 30 \quad 19 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 29 \quad 35 \quad 40 \end{array}$$

$$\begin{array}{r} x \\ 46 \quad 469 \quad 469 \quad 516 \quad 487 \quad 512 \quad 472 \quad 471 \quad 48 \quad 55 \quad 52 \\ \hline 30 \quad 18.4 \quad 18 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 24 \quad 38 \quad 40 \end{array}$$

Top x Hydron.

$$\begin{array}{r} 63 \quad 65 \quad 51 \quad 513 \quad 512 \quad 557 \quad 533 \quad 557 \quad 512 \quad 53 \quad 51 \quad 61 \quad 61 \\ \hline 40 \quad 31 \quad 25 \quad 18.4 \quad 18 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 24 \quad 32 \quad 40 \end{array}$$

$$\begin{array}{r} 61 \quad 52 \quad 524 \quad 534 \quad 516 \quad 535 \quad 487 \quad 486 \quad 50 \quad 62 \quad 63 \\ \hline 43 \quad 38 \quad 30 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 24 \quad 32 \quad 40 \end{array}$$

$$\begin{array}{r} 61 \quad 56 \quad 513 \quad 521 \quad 491 \quad 519 \quad 476 \quad 475 \quad 46 \quad 57 \quad 62 \quad 63 \\ \hline 41 \quad 36 \quad 30 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 25 \quad 32 \quad 37 \quad 40 \end{array}$$

$$\begin{array}{r} 65 \quad 58 \quad 49 \quad 487 \quad 488 \quad 530 \quad 503 \quad 528 \quad 496 \quad 485 \quad 49 \quad 59 \quad 58 \quad 58 \\ \hline 42 \quad 27 \quad 24 \quad 18.4 \quad 18 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 25 \quad 29 \quad 35 \quad 40 \end{array}$$

$$\begin{array}{r} 63 \quad 43 \\ \hline 58 \quad 50 \\ 59 \quad 63 \quad 59 \quad 52 \quad 501 \quad 502 \quad 544 \quad 518 \quad 541 \quad 50 \quad 499 \quad 49 \quad 55 \quad 56 \quad 53 \\ \hline 43 \quad 39 \quad 28 \quad 25 \quad 18.4 \quad 18 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 25 \quad 29 \quad 36 \quad 40 \end{array}$$

$$\begin{array}{r} 53 \quad 53 \\ \hline 70 \quad 66 \\ 59 \quad 61 \quad 58 \quad 51 \quad 501 \quad 502 \quad 541 \quad 513 \quad 541 \quad 501 \quad 500 \quad 49 \quad 63 \quad 67 \\ \hline 62 \quad 50 \quad 28 \quad 26 \quad 18.4 \quad 18 \quad 18 \quad \quad \quad 18 \quad 18 \quad 18.4 \quad 26 \quad 34 \quad 40 \end{array}$$

$$\begin{array}{r} C. \quad P. \\ 525 \quad 595 \quad 555 \quad 551 \quad 555 \quad 565 \quad 525 \quad 524 \quad 50 \quad 56 \quad 57 \\ \hline 74 \quad 74 \quad 45 \quad 31 \quad 555 \quad 185 \quad 185 \quad 189 \quad 28 \quad 315 \quad 40 \end{array}$$

spike in 40° C. W. RT ota 1065 x 840

1003

1002.

+57 X Drain. 24 X 60 R<sub>3</sub>

1001

1000

999

998

997

996

995

994

+40 Drive Rt No Culv. A sta. 993+00

993+00

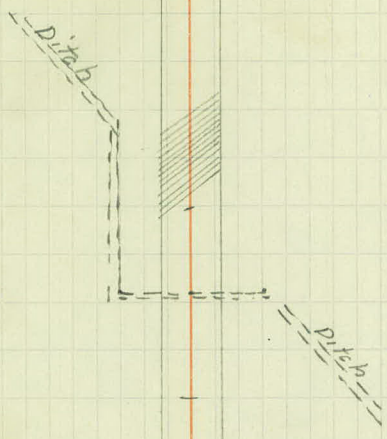
+75 Drive Rt 15" X 24 CM New

+66<sup>1</sup> Bcg Pav.

992+00

Cul 29 = Lt.

Cul. Rt 30.8

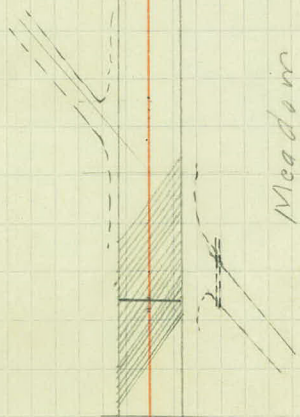


Meadow

Meadow

140 Rd. 5g 25'

+ 63 Bcg Cul <sup>30'</sup> Δ 993



10191

1018

1017

1016

1015

108 X Drain

24' X 60' P<sub>3</sub>

30' R

30' L

1014

1013

1012

1011

101 Bo Drive

RT

15" X 24' CM Now

1010

1009

1008

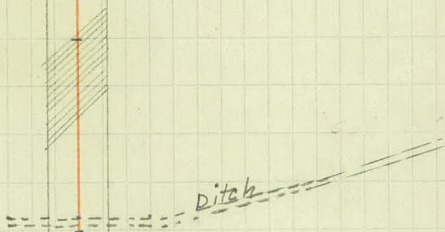
1007

1006

1005

1004

Timber



Ditch

Timber

189 Beg Cul 30'

Meadow



Meadow

1034

1033

1032

+81  $\&$  Track 37' A +35

+73  $\&$  Tracks 49' A +18

+58  $\&$  Drive Rt 15" x 40 CM New.

1031+00

1030

1029+00

+20  $\&$  Rd Rt 15" x 40 CM New. A 54

1028

1027

1026

1025

1024

1023

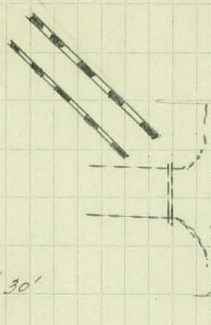
1022

1021

+09  $\&$  Rd Lt A +44

1020

27'



+38 Bay Col 30'

Mud dam



Timber

Timber

27'

+100 Bay 66h. 50'

~~1041~~

1040

+44<sup>s</sup> to Drive Lt

20' Fir Header

+48 to Leavenworth St. Rt 21' Fir Header

1039

1038

1037

1036

750 X Drain

Rt 27'  
15" X 24" C.M. New Lt 27'

1035

+00 T. 27'

+92 PP 24'

+79 T. 27'

+41 T. 27'

+28 3/4 SW 23'

+15 T. 26'

+97 T. 26'

+72 PP 24'

+77 T. 26'

+61 T. 26'

+60 GP 21'

+65<sup>s</sup> End 12' Rad 18'

+53<sup>s</sup> Beg 12' Rad 30'

+33 Hydrant 26'

+34<sup>s</sup> End Rad 30'

+18 Beg 16<sup>s</sup> Rad. 135'

+21 1/4 sidewalk 14-34'

+19 Cor 3 W 34'

+41 Rd 9 23

+40 GP 24

+25% sidewalk 14

+78 End 12' Rad 18'

+66 Beg 12' Rad 30'

+44<sup>s</sup> End 16<sup>s</sup> Rad 30'

+31 Beg 16<sup>s</sup> Rad. 135'

Rad. curb  
19'

MM

104600

1348 2 Drive wt. No Header

104500

104400

1957 2 Drive wt. 21' Fir Header.

1043

1042

1041

+65 T 26'  
 +65 1/2 C.B. 18' 17x17'  
 +56 1/2 End 12' Rad 18' } 18'  
 +48 1/2 Beg 12' Rad 30' } Rad Curb

+54 C.B. 185. ✓

+20 T 24'  
 +24 1/2 End 12' Rad 30' } 18'  
 +12 1/2 Beg 12' Rad 18' } Rad Curb  
 +105 C.B. 18' 17x17'

+35 PP 26'

+74 T 25'

+32 PP 25'

+31 T 25'

+95 T 26'  
 +96 End Rad 18' } 18' Rad.  
 +84 Beg 12' Rad 25' } Curb

+63 1/2 End 12' Rad 28' } 17' Rad  
 +51 1/2 Beg 12' Rad 18' } Curb

+26 PP 25'

+49 H 4d 33'  
 +43 1/2 C.B. 18' 17x17'

+43 M.H. 21'

+02 T 26'

+76 T 26'

+50 T 26'

+26 T 26'

+20 PP 25'

+00 S.VV 21'

+49 T 26'

+25 T 26'

1051400

+50' ♀ Drive Rt. 28' Fir Header

1050

+53' ♀ Drive Rt 29' Fir Header

+62' ♂ Drive Lt 21' Fir Header

1049

368

+48 ♀ Minn Ave Lt 31' Fir Header

+48 ♂ Minn Ave Rt 31' Fir Header

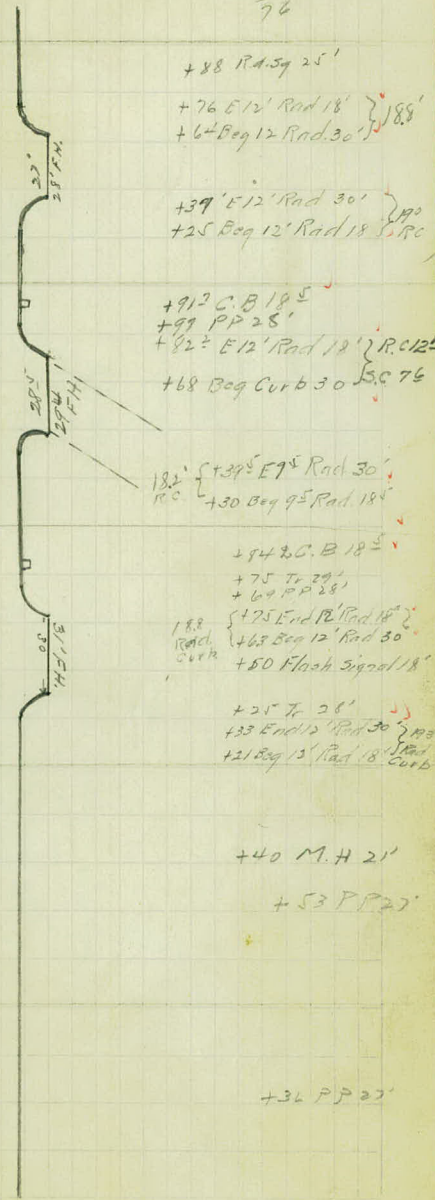
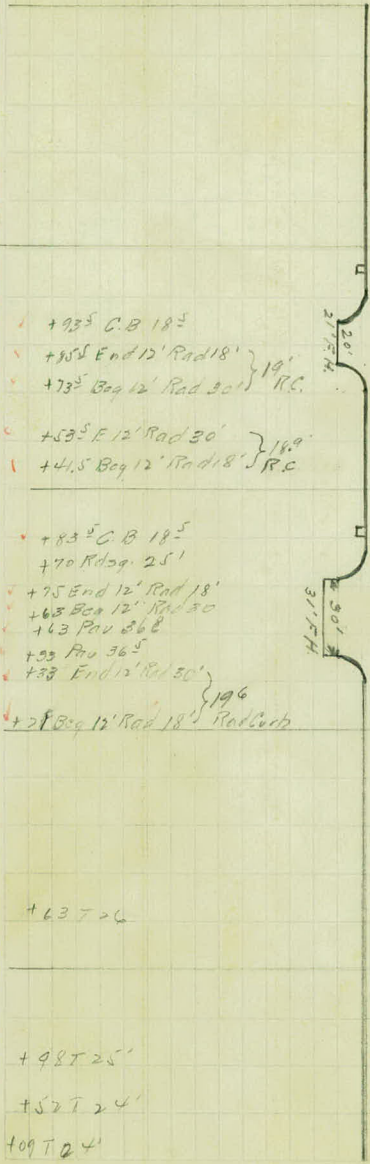
1048

1047

1046

285  
2

37  
27  
64  
12  
76



+98 T 25'  
+52 T 24'  
+09 T 24'

+36 PP 27'

134  
37  
104

1056

+26<sup>5</sup> to Drive Lt 21' Fir Header.

1055

+504 to Drive Rt 27.7 Fir Header

1054

1053

1052

1051

94 P.P. 29'

+42 Hyd. 36'  
 +48 E 12' Rad 18' } 193 ✓  
 +36 S Bog 12' Rad 30' } R.C.  
 +16 E 12' Rad 30' } 189 ✓  
 +04 S Bog 12' Rad 18' } R.C.

80'  
B.P.

+93 C.B. 18<sup>s</sup>

+79 Hoss Carr. 21'  
 +77 P.P. 29' ✓  
 +75 E 12' Rad 30' } 189 ✓  
 +63 S Bog 12' " 18' } R.C.  
 +37 E 12' Rad 30' } 182 ✓  
 +25 Bog 12' Rad 18' } R.C.

+59 P.P. 29'

+21 Tr. 31'

+16 Tr. S.W. 18<sup>s</sup> 6<sup>s</sup>

+41 P.P. 29'

+74 Tr. 30'

+43 M.H. 21'

+26 P.P. 28'

1061

1060

+30<sup>3</sup> R Drive Lt      27' Fir Header

1059

1058

+80<sup>4</sup> R Drive Rt

26.8

27.8 F Header

1057

1056

+28<sup>5</sup> End 12' Rad 30' } 189  
+16<sup>5</sup> Beg 12' Rad 18' } R.C.

+17 PP 31'

+60 C.B. 18<sup>5</sup>  
+59 Hyd. 37'

+52<sup>5</sup> E 12' Rad 18' } 192  
+40<sup>5</sup> Beg 12' Rad 30' } R.C.

+79 M.H. 31'

+20<sup>5</sup> End 12' Rad 30' } 189  
+08<sup>5</sup> Beg 12' Rad 18' } R.C.

+15 PP 30'

+54<sup>3</sup> E 12' Rad 18' }  
+42<sup>3</sup> Beg 12' Rad 30' }

+14 PP 30

Pav. 30'

189 { +05<sup>5</sup> E 12' Rad 18' }  
R.C. { +93<sup>5</sup> Beg 12' Rad 30' }

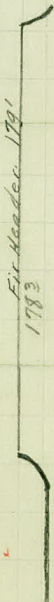
+50 D. Inlet 18' }

189 { +67 E 12' Rad 30  
R.C. { +55 Beg 12' Rad 18' }

Pav 30'

+51<sup>5</sup> C.B. 18<sup>5</sup>  
+12 PP 30'

+64 E 12' Rad 30' } 189  
+52 Beg 12' Rad 18' } R.C.



1066'

1065'

1064'

1063'

1062'

+88' Drive Pt

13' Fir Header.

1795' Fir Header

1061'

1791

+82 Flash signal 2'

+66 E 25' Rad 50

+42 Bog 25' Rad 18' } 46 P  
R.C.

+66 Pav 50'

+56 R/d 29'

+32 C.B 18'

+29 R/d 20'

+913

+98 Pav 50'

56  
17 1/2  
28 1/2  
R.C.

+77 Bog 25' Rad 18'

+58 C.B 18'

+53 PP 33'

+66 29 31'

+61 PP 31'

+57 R/d 20'

+51 PP 31'

+62 M.H 21'

+19 E 12' Rad 18' } 189  
R.C.

+07 Bog 12' Rad 30' }  
R.C.

Pav 30'

+50 4 I.W. 28' A+36'

+43 PP 31'

RC { +00 E Rad 18' ✓

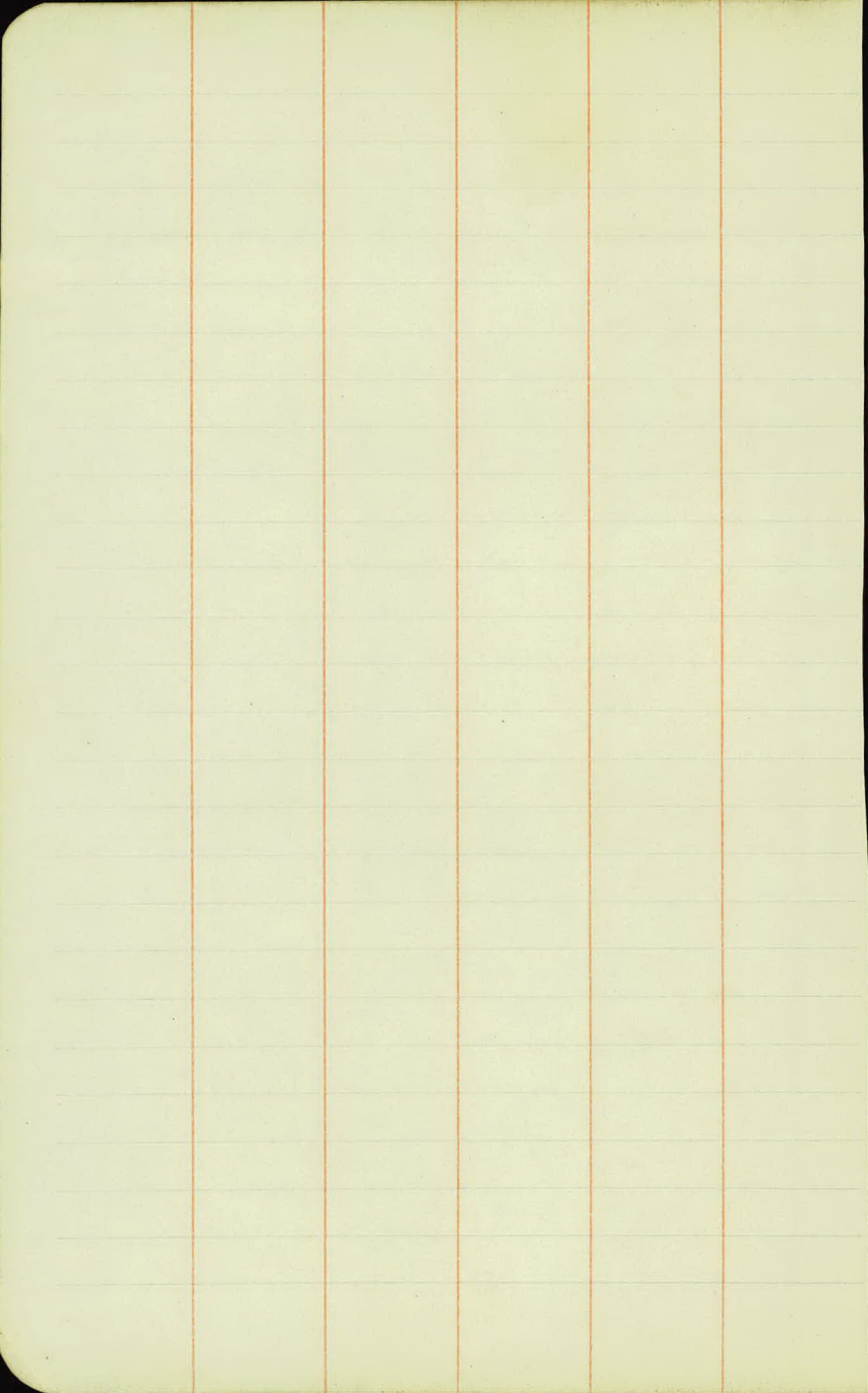
96 { +74 Bog Rad 24' ✓

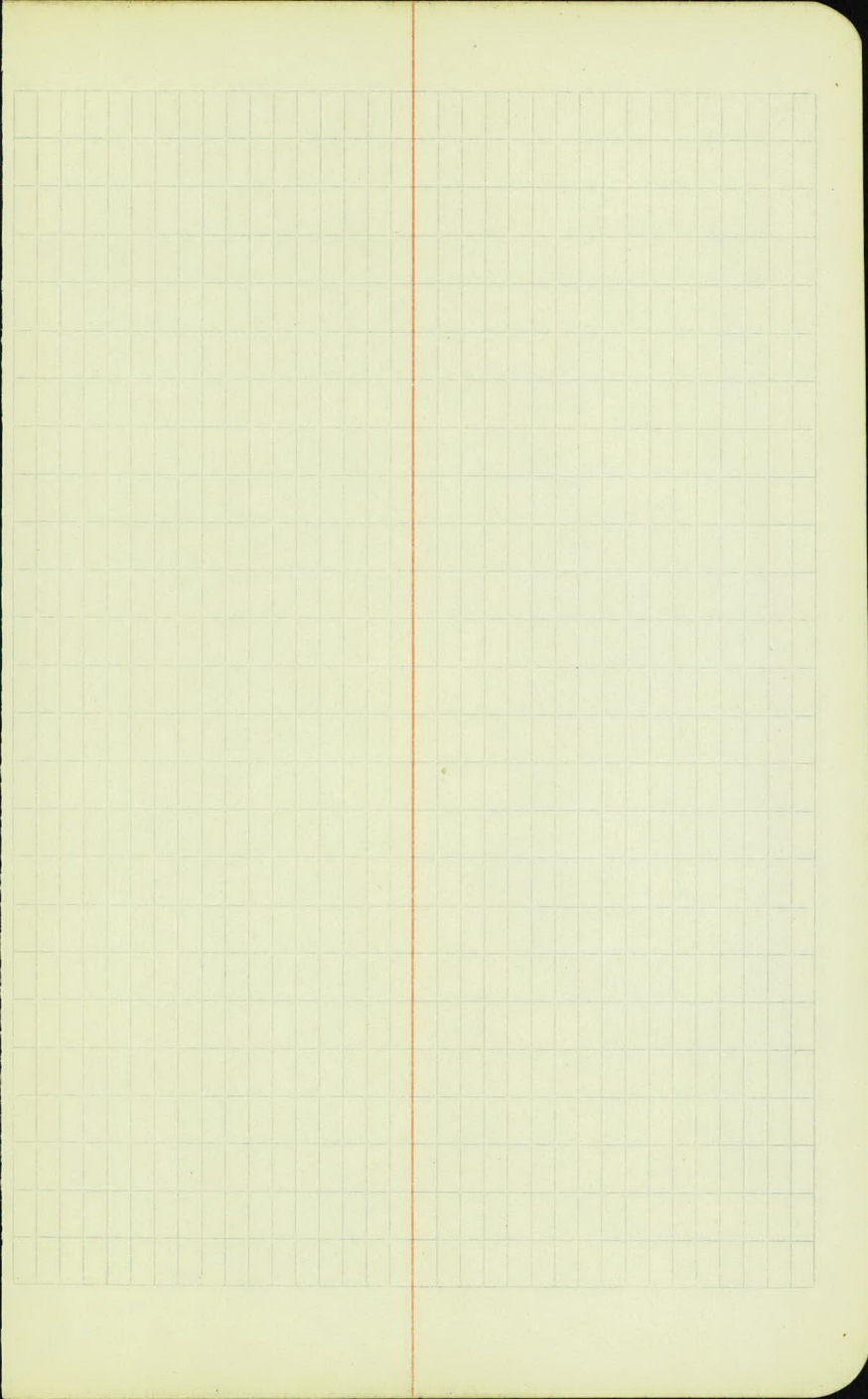
95 { +82 E 6' Rad 24' ✓

RC { +76 Bog 6' Rad 18'

+29 PP 31'

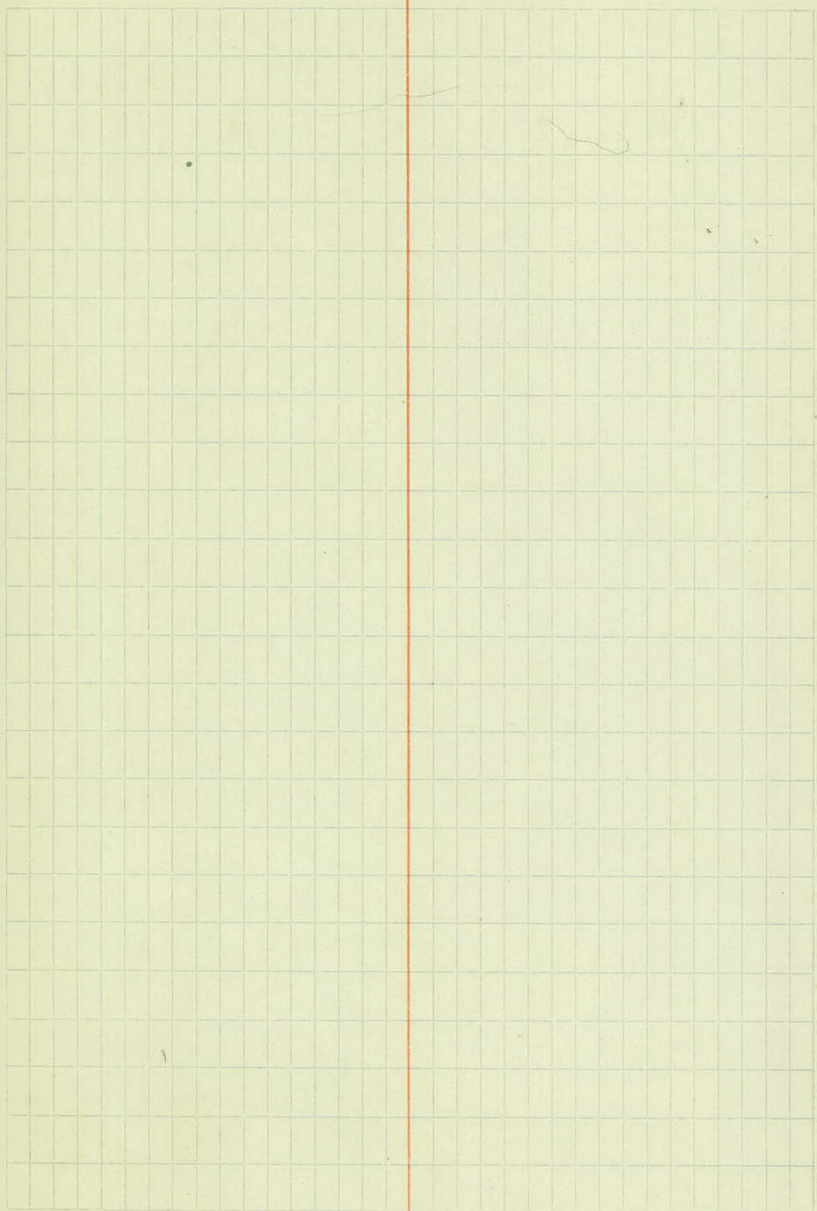
Pav 30

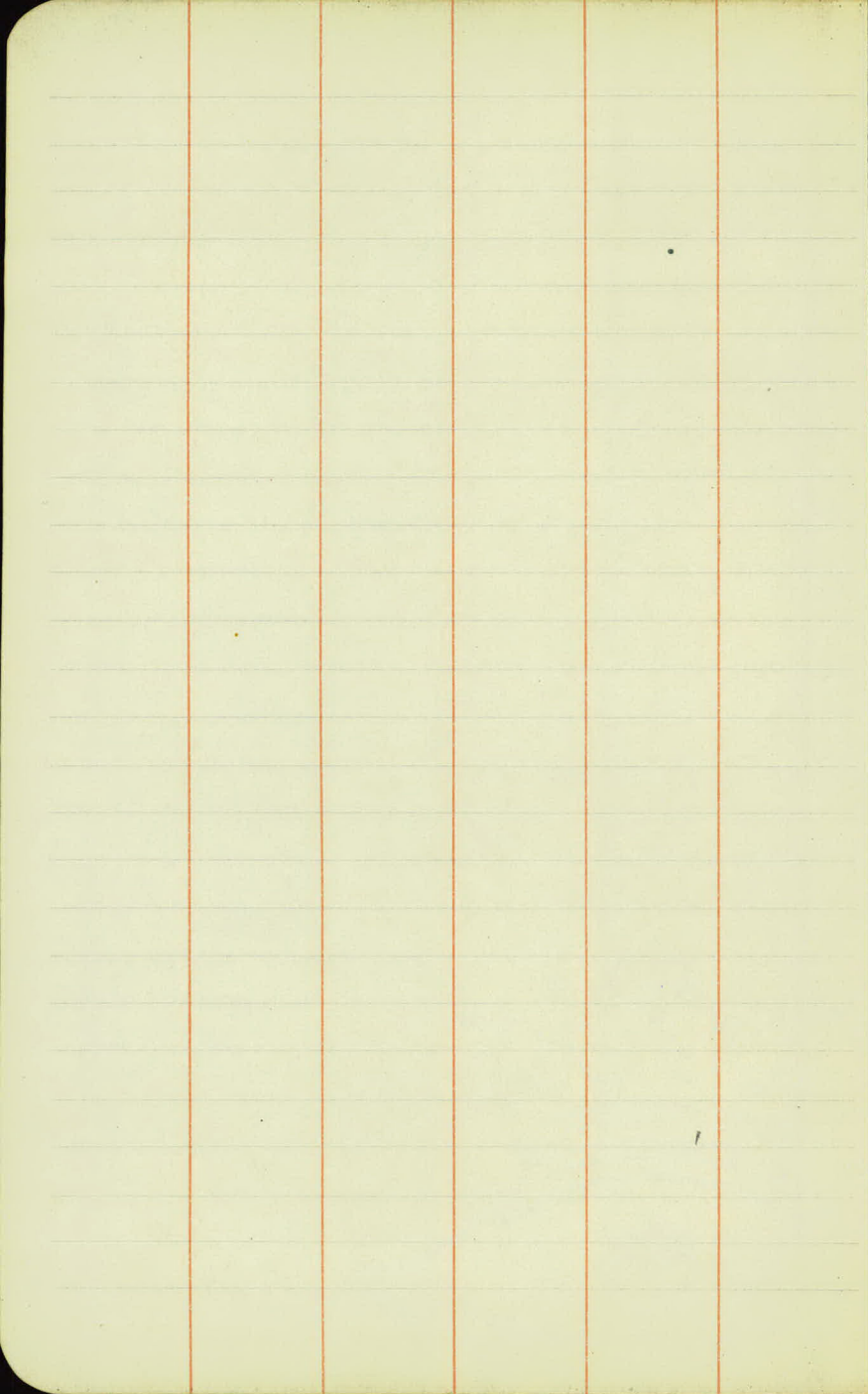


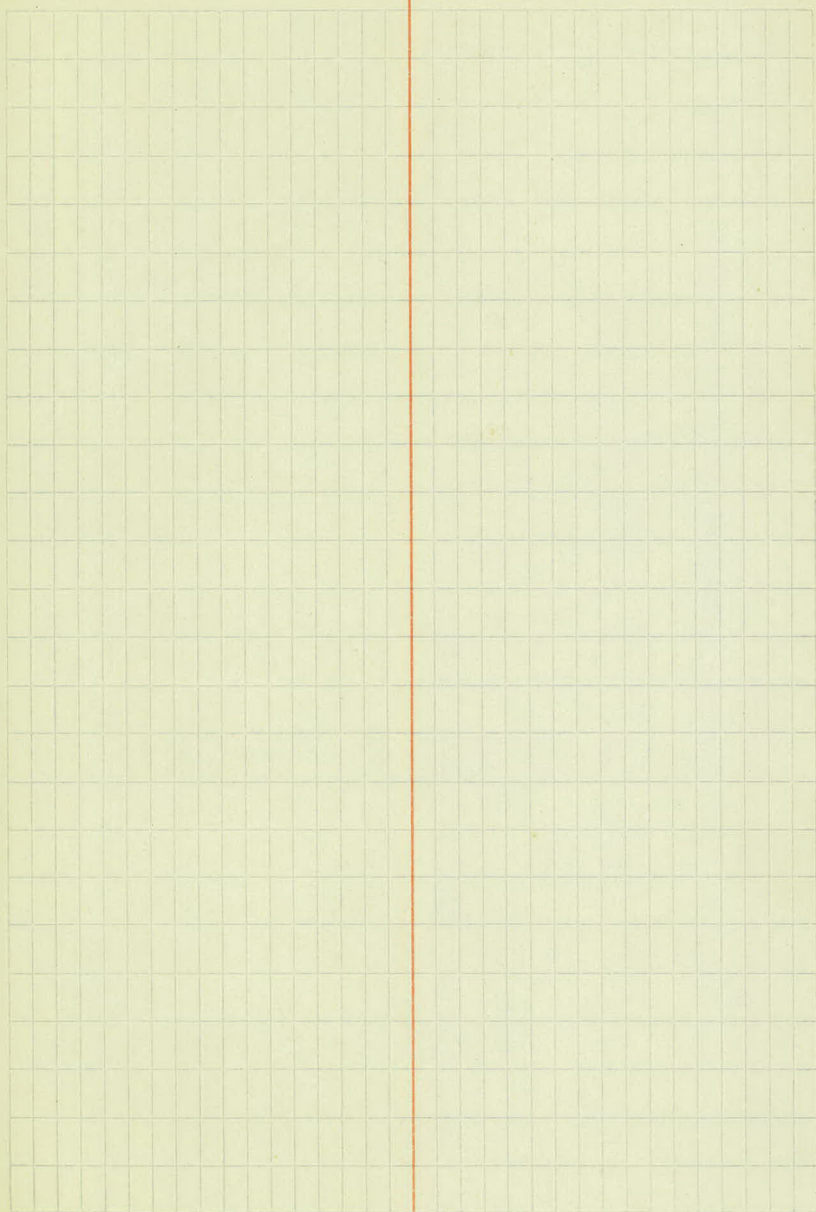


993+50	814.18	1013+50	17.34
994	14.15	14	17.45
+50	14.07	+50	17.52
95	13.97	15	17.57
+50	13.85	+50	17.59
96	13.74	16	17.59
+50	13.64	+50	17.58
97	13.60	17	17.57
+50	13.64	+50	17.55
98	13.70	18	17.54
+50	13.80	+50	17.52
99	13.90	19	17.50
+50	14.00	+50	17.45
1000	14.11	20	17.40
+50		+50	17.33
1001		21	17.26
+50		+50	17.15
1002		22	17.05
+50			

1013+50 - 17, 34







Thompson 500

Hausler 500

Jouk up. 500

Barthelme.

Zkoglum.

Peterson

Wheeler

Crane

Wilshoven.

Weber

Beaton.

# KEITH'S RAILROAD CURVE TABLES.

Published by KEUFFEL & ESSER CO., New York.

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## HOW TO USE KEITH'S TABLES.

### EXAMPLE.

Wanted a Curve with an Ext. of about 12 ft. Angle  
of Intersection or I. P.= $23^{\circ} 20'$  to the R. at Station  
542+72.

Ext. in Tab. IV opposite  $23^{\circ} 20'$ =120.87

$120.87 \div 12 = 10.07$ . Say a  $10^{\circ}$  Curve.

Tan. in Tab. IV opp.  $23^{\circ} 20'$ =1183.1

$1183.1 \div 10 = 118.31$ .

Tab. V. correction for A.  $23^{\circ} 20'$  for a  $10^{\circ}$  Cur.=0.16

$118.31 + 0.16 = 118.47$ =corrected Tangent.

(If corrected Ext. is required find in same way)

Ang.  $23^{\circ} 20' = 23.33^{\circ} \div 10 = 2.3333$ =L. C.

$2^{\circ} 19\frac{1}{2}'$ =def. for sta.	542	I. P.=sta.	542+72
$4^{\circ} 49\frac{1}{2}'$ = " " "	+50	Tan.=	1.18 47
$7^{\circ} 19\frac{1}{2}'$ = " " "	543	B. C.=sta.	541+53.53
$9^{\circ} 49\frac{1}{2}'$ = " " "	+50	L. C.=	2.33.33
$11^{\circ} 40'$ = " " "	543+	E. C.=sta.	543+86.86
	86.86		

$100 - 53.53 = 46.47 \times 3'$  (def. for 1 ft. of  $10^{\circ}$  Cur.)=139.41'=  
 $2^{\circ} 19\frac{1}{2}'$ =def. for sta. 542.

Def. for 50 ft.= $2^{\circ} 30'$  for a  $10^{\circ}$  Curve.

Def. for 36.86 ft.= $1^{\circ} 50\frac{1}{2}'$  for a  $10^{\circ}$  Curve

(These tables are published in Field Books of  
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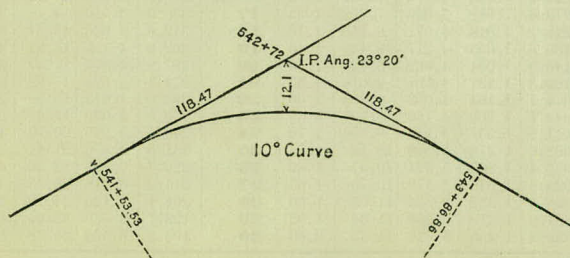


TABLE I. — Minutes in Decimals of a Degree.

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

TABLE II. — Inches in Decimals of a Foot.

1-16	3-32	<sup>1</sup> / <sub>8</sub>	3-16	<sup>1</sup> / <sub>4</sub>	5-16	<sup>3</sup> / <sub>8</sub>	<sup>1</sup> / <sub>2</sub>	<sup>5</sup> / <sub>8</sub>	<sup>3</sup> / <sub>4</sub>	<sup>7</sup> / <sub>8</sub>
.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. Def.	Chd. Def.	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot
<b>0° 10'</b>	34377.	.036	.145	.291	0.05'	<b>7°</b>	819.0	1.528	6.105	12.21	2.10'
<b>20</b>	17189.	.073	.291	.582	0.10	<b>20'</b>	781.8	1.600	6.395	12.79	2.20
<b>30</b>	11459.	.109	.436	.873	0.15	<b>30</b>	764.5	1.637	6.540	13.08	2.25
<b>40</b>	8594.4	.145	.582	1.164	0.20	<b>40</b>	747.9	1.673	6.685	13.37	2.30
<b>50</b>	6875.5	.182	.727	1.454	0.25	<b>8</b>	716.8	1.746	6.976	13.95	2.40
<b>1</b>	5729.6	.218	.873	1.745	0.30	<b>20</b>	688.2	1.819	7.266	14.53	2.50
<b>10</b>	4911.2	.255	1.018	2.036	0.35	<b>30</b>	674.7	1.855	7.411	14.82	2.55
<b>20</b>	4297.3	.291	1.164	2.327	0.40	<b>40</b>	661.7	1.892	7.556	15.11	2.60
<b>30</b>	3819.8	.327	1.309	2.618	0.45	<b>9</b>	637.3	1.965	7.846	15.69	2.70
<b>40</b>	3437.9	.364	1.454	2.909	0.50	<b>20</b>	614.6	2.037	8.136	16.27	2.80
<b>50</b>	3125.4	.400	1.600	3.200	0.55	<b>30</b>	603.8	2.074	8.281	16.56	2.85
<b>2</b>	2864.9	.436	1.745	3.490	0.60	<b>40</b>	593.4	2.110	8.426	16.85	2.90
<b>10</b>	2644.6	.473	1.891	3.781	0.65	<b>10</b>	573.7	2.183	8.716	17.43	3.00
<b>20</b>	2455.7	.509	2.036	4.072	0.70	<b>30</b>	546.4	2.292	9.150	18.30	3.15
<b>30</b>	2292.0	.545	2.181	4.363	0.75	<b>11</b>	521.7	2.402	9.585	19.16	3.30
<b>40</b>	2148.8	.582	2.327	4.654	0.80	<b>30</b>	499.1	2.511	10.02	20.04	3.45
<b>50</b>	2022.4	.618	2.472	4.945	0.85	<b>12</b>	478.3	2.620	10.45	20.91	3.60
<b>3</b>	1910.1	.655	2.618	5.235	0.90	<b>30</b>	459.3	2.730	10.89	21.77	3.75
<b>10</b>	1809.6	.691	2.763	5.526	0.95	<b>13</b>	441.7	2.839	11.32	22.64	3.90
<b>20</b>	1719.1	.727	2.908	5.817	1.00	<b>30</b>	425.4	2.949	11.75	23.51	4.05
<b>30</b>	1637.3	.764	3.054	6.108	1.05	<b>14</b>	410.3	3.058	12.18	24.37	4.20
<b>40</b>	1562.9	.800	3.199	6.398	1.10	<b>30</b>	396.2	3.168	12.62	25.24	4.35
<b>50</b>	1495.0	.836	3.345	6.689	1.15	<b>15</b>	383.1	3.277	13.05	26.11	4.50
<b>4</b>	1432.7	.873	3.490	6.980	1.20	<b>30</b>	370.8	3.387	13.49	26.97	4.65
<b>10</b>	1375.4	.909	3.635	7.271	1.25	<b>16</b>	359.3	3.496	13.92	27.84	4.80
<b>20</b>	1322.5	.945	3.781	7.561	1.30	<b>30</b>	348.5	3.606	14.35	28.70	4.95
<b>30</b>	1273.6	.982	3.926	7.852	1.35	<b>17</b>	338.3	3.716	14.78	29.56	5.10
<b>40</b>	1228.1	1.018	4.071	8.143	1.40	<b>18</b>	319.6	3.935	15.64	31.29	5.40
<b>50</b>	1185.8	1.055	4.217	8.433	1.45	<b>19</b>	302.9	4.155	16.51	33.01	5.70
<b>5</b>	1146.3	1.091	4.362	8.724	1.50	<b>20</b>	287.9	4.374	17.37	34.73	6.00
<b>10</b>	1109.3	1.127	4.507	9.014	1.55	<b>21</b>	274.4	4.594	18.22	36.44	6.30
<b>20</b>	1074.7	1.164	4.653	9.305	1.60	<b>22</b>	262.0	4.814	19.08	38.16	6.60
<b>30</b>	1042.1	1.200	4.798	9.596	1.65	<b>23</b>	250.8	5.035	19.94	39.87	6.90
<b>40</b>	1011.5	1.237	4.943	9.886	1.70	<b>24</b>	240.5	5.255	20.79	41.58	7.20
<b>50</b>	982.6	1.273	5.088	10.18	1.75	<b>25</b>	231.0	5.476	21.64	43.28	7.50
<b>6</b>	955.4	1.309	5.234	10.47	1.80	<b>26</b>	222.3	5.697	22.50	44.99	7.80
<b>10</b>	929.6	1.346	5.379	10.76	1.85	<b>27</b>	214.2	5.918	23.35	46.69	8.10
<b>20</b>	905.1	1.382	5.524	11.05	1.90	<b>28</b>	206.7	6.139	24.19	48.38	8.40
<b>30</b>	881.9	1.418	5.669	11.34	1.95	<b>29</b>	199.7	6.360	25.04	50.07	8.70
<b>40</b>	859.9	1.455	5.814	11.63	2.00	<b>30</b>	193.2	6.583	25.88	51.76	9.00

TABLE IV. — Tangents and Externals to a 1° Curve.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
<b>1°</b>	50.00	.22	<b>11°</b>	551.70	26.50	<b>21°</b>	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
<b>2</b>	100.01	.87	<b>12</b>	602.21	31.56	<b>22</b>	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
<b>3</b>	150.04	1.96	<b>13</b>	652.81	37.07	<b>23</b>	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
<b>4</b>	200.08	3.49	<b>14</b>	703.51	43.03	<b>24</b>	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
<b>5</b>	250.16	5.46	<b>15</b>	754.32	49.44	<b>25</b>	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
<b>6</b>	300.28	7.86	<b>16</b>	805.25	56.31	<b>26</b>	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
<b>7</b>	350.44	10.71	<b>17</b>	856.30	63.63	<b>27</b>	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
<b>8</b>	400.66	13.99	<b>18</b>	907.49	71.42	<b>28</b>	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
<b>9</b>	450.93	17.72	<b>19</b>	958.81	79.67	<b>29</b>	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
<b>10</b>	501.28	21.89	<b>20</b>	1010.3	88.39	<b>30</b>	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.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
<b>31°</b>	1589.0	216.3	<b>41°</b>	2142.2	387.4	<b>51°</b>	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
<b>32</b>	1643.0	230.9	<b>42</b>	2199.4	407.6	<b>52</b>	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
<b>33</b>	1697.2	246.1	<b>43</b>	2257.0	428.5	<b>53</b>	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
<b>34</b>	1751.7	261.8	<b>44</b>	2314.9	450.0	<b>54</b>	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
<b>35</b>	1806.6	278.1	<b>45</b>	2373.3	472.1	<b>55</b>	2982.7	729.9
10	1815.7	280.8	10	2383.1	475.8	10	2993.3	734.8
20	1824.9	283.6	20	2392.8	479.6	20	3003.9	739.7
30	1834.1	286.4	30	2402.6	483.4	30	3014.5	744.6
40	1843.3	289.2	40	2412.4	487.2	40	3025.2	749.6
50	1852.5	292.0	50	2422.3	491.0	50	3035.8	754.6
<b>36</b>	1861.7	294.9	<b>46</b>	2432.1	494.8	<b>56</b>	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
<b>37</b>	1917.1	312.2	<b>47</b>	2491.3	518.2	<b>57</b>	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
<b>38</b>	1972.9	330.2	<b>48</b>	2551.0	542.2	<b>58</b>	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
<b>39</b>	2029.0	348.6	<b>49</b>	2611.2	566.9	<b>59</b>	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
<b>40</b>	2085.4	367.7	<b>50</b>	2671.8	592.3	<b>60</b>	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.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
<b>61°</b>	3375.0	920.2	<b>71°</b>	4086.9	1308.2	<b>81°</b>	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
<b>62</b>	3442.7	954.8	<b>72</b>	4162.8	1352.6	<b>82</b>	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
<b>63</b>	3511.1	990.2	<b>73</b>	4239.7	1398.0	<b>83</b>	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
<b>64</b>	3580.3	1026.6	<b>74</b>	4317.6	1444.6	<b>84</b>	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
<b>65</b>	3650.2	1063.9	<b>75</b>	4396.5	1492.4	<b>85</b>	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
<b>66</b>	3720.9	1102.2	<b>76</b>	4476.5	1541.4	<b>86</b>	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
<b>67</b>	3792.4	1141.4	<b>77</b>	4557.6	1591.6	<b>87</b>	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
<b>68</b>	3864.7	1181.6	<b>78</b>	4639.8	1643.0	<b>88</b>	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
<b>69</b>	3937.9	1222.7	<b>79</b>	4723.2	1695.8	<b>89</b>	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
<b>70</b>	4011.9	1265.0	<b>80</b>	4807.7	1749.9	<b>90</b>	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.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
<b>91°</b>	5830.5	2444.9	<b>101°</b>	6950.6	3278.1	<b>111°</b>	8336.7	4386.1
10'	5847.5	2457.1	10'	6971.3	3294.1	10'	8362.7	4407.6
20'	5864.6	2469.3	20'	6992.0	3310.1	20'	8388.9	4429.2
30'	5881.7	2481.5	30'	7012.7	3326.1	30'	8415.1	4450.9
40'	5898.8	2493.8	40'	7033.6	3342.3	40'	8441.5	4472.7
50'	5916.0	2506.1	50'	7054.5	3358.5	50'	8468.0	4494.6
<b>92</b>	5933.2	2518.5	<b>102</b>	7075.5	3374.9	<b>112</b>	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
<b>93</b>	6037.8	2594.0	<b>103</b>	7203.2	3474.4	<b>113</b>	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
<b>94</b>	6144.3	2671.6	<b>104</b>	7333.6	3576.8	<b>114</b>	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
<b>95</b>	6252.8	2751.3	<b>105</b>	7467.0	3682.3	<b>115</b>	8993.8	4934.1
10	6271.1	2764.8	10	7489.6	3700.2	10	9022.7	4958.6
20	6289.4	2778.3	20	7512.2	3718.2	20	9051.7	4983.1
30	6307.9	2792.0	30	7534.9	3736.2	30	9080.9	5007.8
40	6326.3	2805.6	40	7557.7	3754.4	40	9110.3	5032.6
50	6344.8	2819.4	50	7580.5	3772.6	50	9139.8	5057.6
<b>96</b>	6363.4	2833.2	<b>106</b>	7603.5	3791.0	<b>116</b>	9169.4	5082.7
10	6382.2	2847.0	10	7626.6	3809.4	10	9199.1	5107.9
20	6400.8	2861.0	20	7649.7	3827.9	20	9229.0	5133.3
30	6419.5	2875.0	30	7672.9	3846.5	30	9259.0	5158.8
40	6438.4	2889.0	40	7696.3	3865.2	40	9289.2	5184.5
50	6457.3	2903.1	50	7719.7	3884.0	50	9319.5	5210.3
<b>97</b>	6476.2	2917.3	<b>107</b>	7743.2	3902.9	<b>117</b>	9349.9	5236.2
10	6495.2	2931.6	10	7766.8	3921.9	10	9380.5	5262.3
20	6514.3	2945.9	20	7790.5	3940.9	20	9411.3	5288.6
30	6533.4	2960.3	30	7814.3	3960.1	30	9442.2	5315.0
40	6552.6	2974.7	40	7838.1	3979.4	40	9473.2	5341.5
50	6571.9	2989.2	50	7862.1	3998.7	50	9504.4	5368.2
<b>98</b>	6591.2	3003.8	<b>108</b>	7886.2	4018.2	<b>118</b>	9535.7	5395.1
10	6610.6	3018.4	10	7910.4	4037.8	10	9567.2	5422.1
20	6630.1	3033.1	20	7934.6	4057.4	20	9598.9	5449.2
30	6649.6	3047.9	30	7959.0	4077.2	30	9630.7	5476.5
40	6669.2	3062.8	40	7983.5	4097.1	40	9662.6	5504.0
50	6688.8	3077.7	50	8008.0	4117.0	50	9694.7	5531.7
<b>99</b>	6708.6	3092.7	<b>109</b>	8032.7	4137.1	<b>119</b>	9727.0	5559.4
10	6728.4	3107.7	10	8057.4	4157.3	10	9759.4	5587.4
20	6748.2	3122.9	20	8082.3	4177.5	20	9792.0	5615.5
30	6768.1	3138.1	30	8107.3	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	6808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
<b>100</b>	6828.3	3184.1	<b>110</b>	8182.8	4259.7	<b>120</b>	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

Table V. Corrections for use with table IV,

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For Tangents Add															
ANGLE	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	.54	.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	4.49	4.98	5.38	5.83	
100°	.43	.86	1.30	1.74	2.18	2.62	3.06	3.50	3.95	4.40	4.88	5.37	5.85	6.34	

## For Externals Add

ANGLE	CURVE	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.001	.003	.004	.006	.007	.008	.009	.011	.012	.014	.015	.017	.018	.020	
15°	.003	.007	.010	.014	.018	.023	.027	.029	.032	.035	.039	.043	.047	.051	
20°	.006	.011	.017	.022	.028	.034	.038	.045	.051	.057	.063	.070	.076	.083	
25°	.009	.018	.027	.036	.046	.056	.065	.074	.083	.093	.106	.120	.127	.135	
30°	.013	.025	.038	.051	.065	.078	.090	.103	.116	.129	.149	.170	.179	.188	
35°	.018	.035	.054	.072	.086	.109	.131	.153	.175	.197	.213	.230	.247	.264	
40°	.023	.046	.070	.093	.117	.141	.172	.203	.234	.265	.277	.290	.315	.341	
45°	.030	.060	.093	.119	.153	.184	.216	.254	.289	.325	.351	.378	.411	.445	
50°	.037	.075	.116	.151	.189	.227	.266	.305	.345	.384	.425	.467	.508	.550	
55°	.046	.093	.142	.188	.236	.283	.332	.381	.420	.479	.530	.582	.641	.700	
60°	.056	.112	.168	.225	.283	.340	.398	.457	.516	.575	.636	.697	.774	.851	
65°	.067	.135	.204	.273	.343	.412	.483	.554	.625	.697	.771	.845	.922	1.01	
70°	.080	.159	.240	.321	.403	.485	.568	.652	.735	.819	.906	.994	1.08	1.17	
75°	.095	.182	.266	.353	.440	.528	.618	.707	.797	.887	.977	1.07	1.18	1.29	1.39
80°	.110	.220	.332	.445	.558	.671	.787	.903	1.02	1.13	1.25	1.38	1.50	1.62	
85°	.128	.259	.391	.524	.657	.790	.926	1.06	1.20	1.34	1.47	1.62	1.76	1.91	
90°	.149	.299	.450	.603	.756	.910	1.07	1.22	1.38	1.54	1.70	1.87	2.03	2.20	
95°	.174	.350	.522	.706	.885	1.06	1.25	1.43	1.62	1.80	1.99	2.18	2.38	2.58	
100°	.200	.401	.604	.809	1.01	1.22	1.43	1.64	1.85	2.06	2.28	2.50	2.73	2.96	

Table VI. Deflections for Sub Chords for Short Radius Curves.

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

CURVE FORMULAS.

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

$$T = \frac{50 \tan \frac{1}{2} I}{\sin. D}$$

$$\sin. D = \frac{50}{R}$$

$$\sin. D = \frac{50 \tan \frac{1}{2} I}{T}$$

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

$$R = 50$$

$$\sin. D$$

$$E = R \text{ ex. sec. } \frac{1}{2} I$$

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

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

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

$$\text{Tan. def.} = \frac{1}{2} \text{ chord def.}$$

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

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

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

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

To find Nat. Tan. and Nat. Ex. Sec. for any angle by Table IV.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat. Tan. or Nat. Ex. Sec.

To find angle for a given distance and deflection.

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

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

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

RIGHT ANGLE TRIANGLES.— Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

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

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

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

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

## Natural Sines

DEG.	0'	10'	20'	30'	40'	50'	DEG.	DEG.	0'	10'	20'	30'	40'	50'	DEG.
0	0000	0029	0058	0087	0116	0145	89	40	6428	6450	6472	6494	6517	6539	49
1	0175	0204	0233	0262	0291	0320	88	41	6561	6583	6604	6626	6648	6670	48
2	0349	0378	0407	0436	0465	0494	87	42	6691	6713	6734	6756	6777	6799	47
3	0523	0552	0581	0610	0640	0669	86	43	6820	6841	6862	6884	6905	6926	46
4	0698	0727	0756	0785	0814	0843	85	44	6947	6967	6988	7009	7030	7050	45
5	0872	0901	0929	0958	0987	1016	84	45	7071	7092	7112	7133	7153	7173	44
6	1045	1074	1103	1132	1161	1190	83	46	7193	7214	7234	7254	7274	7294	43
7	1219	1248	1276	1305	1334	1363	82	47	7314	7333	7353	7373	7392	7412	42
8	1392	1421	1449	1478	1507	1536	81	48	7431	7451	7470	7490	7509	7528	41
9	1564	1593	1622	1650	1679	1708	80	49	7547	7566	7585	7604	7623	7642	40
10	1736	1765	1794	1822	1851	1880	79	50	7660	7679	7698	7716	7735	7753	39
11	1908	1937	1965	1994	2022	2051	78	51	7771	7790	7808	7826	7844	7862	38
12	2079	2108	2136	2164	2193	2221	77	52	7880	7898	7916	7934	7951	7969	37
13	2250	2278	2306	2334	2363	2391	76	53	7986	8004	8021	8039	8056	8073	36
14	2419	2447	2476	2504	2532	2560	75	54	8090	8107	8124	8141	8158	8175	35
15	2588	2616	2644	2672	2700	2728	74	55	8192	8208	8225	8241	8258	8274	34
16	2756	2784	2812	2840	2868	2896	73	56	8290	8307	8323	8339	8355	8371	33
17	2924	2952	2979	3007	3035	3062	72	57	8387	8403	8418	8434	8450	8465	32
18	3090	3118	3145	3173	3201	3228	71	58	8480	8496	8511	8526	8542	8557	31
19	3256	3283	3311	3338	3365	3393	70	59	8572	8587	8601	8616	8631	8646	30
20	3420	3448	3475	3502	3529	3557	69	60	8660	8675	8689	8704	8718	8732	29
21	3584	3611	3638	3665	3692	3719	68	61	8746	8760	8774	8788	8802	8816	28
22	3746	3773	3800	3827	3854	3881	67	62	8829	8843	8857	8870	8884	8897	27
23	3907	3934	3961	3987	4014	4041	66	63	8910	8923	8936	8949	8962	8975	26
24	4067	4094	4120	4147	4173	4200	65	64	8988	9001	9013	9026	9038	9051	25
25	4226	4253	4279	4305	4331	4358	64	65	9063	9075	9088	9100	9112	9124	24
26	4384	4410	4436	4462	4488	4514	63	66	9135	9147	9159	9171	9182	9194	23
27	4540	4566	4592	4617	4643	4669	62	67	9205	9216	9228	9239	9250	9261	22
28	4695	4720	4746	4772	4797	4823	61	68	9272	9283	9293	9304	9315	9325	21
29	4848	4874	4899	4924	4950	4975	60	69	9336	9346	9356	9367	9377	9387	20
30	5000	5025	5050	5075	5100	5125	59	70	9397	9407	9417	9426	9436	9446	19
31	5150	5175	5200	5225	5250	5275	58	71	9455	9465	9474	9483	9492	9502	18
32	5299	5324	5348	5373	5398	5422	57	72	9511	9520	9528	9537	9546	9555	17
33	5446	5471	5495	5519	5544	5568	56	73	9563	9572	9580	9588	9596	9605	16
34	5592	5616	5640	5664	5688	5712	55	74	9613	9621	9628	9636	9644	9652	15
35	5736	5760	5783	5807	5831	5854	54	75	9659	9667	9674	9681	9689	9696	14
36	5878	5901	5925	5948	5972	5995	53	76	9703	9710	9717	9724	9730	9737	13
37	6018	6041	6065	6088	6111	6134	52	77	9744	9750	9757	9763	9769	9775	12
38	6157	6180	6202	6225	6248	6271	51	78	9781	9787	9793	9799	9805	9811	11
39	6293	6316	6338	6361	6383	6406	50	79	9816	9822	9827	9833	9838	9843	10
DEG.	60'	50'	40'	30'	20'	10'	DEG.	DEG.	60'	50'	40'	30'	20'	10'	DEG.
80	9848	9853	9858	9863	9868	9872	9								
81	9877	9881	9886	9890	9894	9899	8								
82	9903	9907	9911	9914	9918	9922	7								
83	9925	9929	9932	9936	9939	9942	6								
84	9945	9948	9951	9954	9957	9959	5								
85	9962	9964	9967	9969	9971	9974	4								
86	9976	9978	9980	9981	9983	9985	3								
87	9986	9988	9989	9990	9992	9993	2								
88	9994	9995	9996	9997	9997	9998	1								
89	9998	9999	9999	9999	I.0000	I.0000	0								
DEG.	60'	50'	40'	30'	20'	10'	DEG.								DEG.

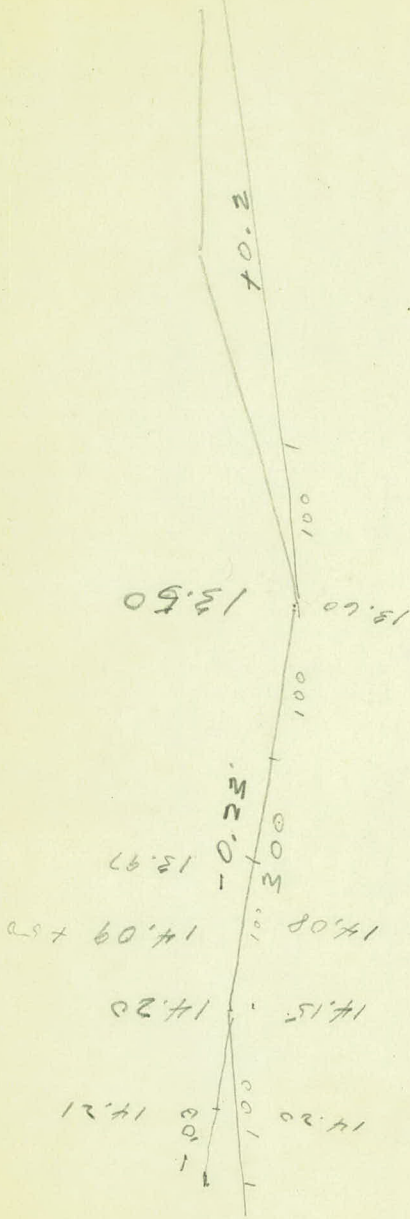
## Natural Cosines

Natural Tangents

DEG.	0'	10'	20'	30'	40'	50'	DEG.	0'	10'	20'	30'	40'	50'	DEG.	
0	0000	0029	0058	0087	0116	0145	89	40	8391	8441	8491	8541	8591	8642	49
1	0175	0204	0233	0262	0291	0320	88	41	8693	8744	8796	8847	8899	8952	48
2	0349	0378	0407	0437	0466	0495	87	42	9004	9057	9110	9163	9217	9271	47
3	0524	0553	0582	0612	0641	0670	86	43	9325	9380	9435	9490	9545	9601	46
4	0699	0729	0758	0787	0816	0846	85	44	9657	9713	9770	9827	9884	9942	45
5	0875	0904	0934	0963	0992	1022	84	45	1.0000	1.0058	1.0117	1.0176	1.0235	1.0295	44
6	1051	1080	1110	1139	1169	1198	83	46	1.0355	1.0416	1.0477	1.0533	1.0599	1.0661	43
7	1228	1257	1287	1317	1346	1376	82	47	1.0724	1.0786	1.0850	1.0913	1.0977	1.1041	42
8	1405	1435	1465	1495	1524	1554	81	48	1.1106	1.1171	1.1237	1.1303	1.1369	1.1436	41
9	1584	1614	1644	1673	1703	1733	80	49	1.1504	1.1571	1.1640	1.1708	1.1778	1.1847	40
10	1763	1793	1823	1853	1883	1914	79	50	1.1918	1.1988	1.2059	1.2131	1.2203	1.2276	39
11	1944	1974	2004	2035	2065	2095	78	51	1.2349	1.2423	1.2497	1.2572	1.2647	1.2723	38
12	2126	2156	2186	2217	2247	2278	77	52	1.2799	1.2876	1.2954	1.3032	1.3111	1.3190	37
13	2309	2339	2370	2401	2432	2462	76	53	1.3270	1.3351	1.3432	1.3514	1.3597	1.3680	36
14	2493	2524	2555	2586	2617	2648	75	54	1.3764	1.3848	1.3934	1.4019	1.4106	1.4193	35
15	2679	2711	2742	2773	2805	2836	74	55	1.4281	1.4370	1.4460	1.4550	1.4641	1.4733	34
16	2867	2899	2931	2962	2994	3026	73	56	1.4826	1.4919	1.5013	1.5108	1.5204	1.5301	33
17	3057	3089	3121	3153	3185	3217	72	57	1.5399	1.5497	1.5597	1.5697	1.5798	1.5900	32
18	3249	3281	3314	3346	3378	3411	71	58	1.6003	1.6107	1.6212	1.6319	1.6426	1.6534	31
19	3443	3476	3508	3541	3574	3607	70	59	1.6643	1.6753	1.6864	1.6977	1.7090	1.7205	30
20	3640	3673	3706	3739	3772	3805	69	60	1.7321	1.7437	1.7556	1.7675	1.7797	1.7917	29
21	3839	3872	3906	3939	3973	4006	68	61	1.8040	1.8165	1.8291	1.8418	1.8546	1.8676	28
22	4040	4074	4108	4142	4176	4210	67	62	1.8807	1.8940	1.9074	1.9210	1.9347	1.9486	27
23	4245	4279	4314	4348	4383	4417	66	63	1.9626	1.9768	1.9912	2.0057	2.0204	2.0353	26
24	4452	4487	4522	4557	4592	4628	65	64	2.0503	2.0655	2.0809	2.0965	2.1123	2.1283	25
25	4663	4699	4734	4770	4806	4841	64	65	2.1445	2.1609	2.1775	2.1943	2.2113	2.2286	24
26	4877	4913	4950	4986	5022	5059	63	66	2.2450	2.2637	2.2817	2.2998	2.3183	2.3369	23
27	5095	5132	5169	5206	5243	5280	62	67	2.3559	2.3750	2.3945	2.4142	2.4342	2.4545	22
28	5317	5354	5392	5430	5467	5505	61	68	2.4751	2.4960	2.5172	2.5386	2.5605	2.5826	21
29	5543	5581	5619	5658	5696	5735	60	69	2.6051	2.6279	2.6511	2.6746	2.6985	2.7228	20
30	5774	5812	5851	5890	5930	5969	59	70	2.7475	2.7725	2.7980	2.8239	2.8502	2.8770	19
31	6009	6048	6088	6128	6168	6208	58	71	2.9042	2.9319	2.9600	2.9887	3.0178	3.0475	18
32	6249	6289	6330	6371	6412	6453	57	72	3.0777	3.1084	3.1397	3.1716	3.2041	3.2371	17
33	6494	6536	6577	6619	6661	6703	56	73	3.2709	3.3052	3.3402	3.3759	3.4124	3.4495	16
34	6745	6787	6830	6873	6916	6959	55	74	3.4874	3.5261	3.5656	3.6059	3.6470	3.6891	15
35	7002	7046	7089	7133	7177	7221	54	75	3.7321	3.7760	3.8208	3.8667	3.9136	3.9617	14
36	7265	7310	7355	7400	7445	7490	53	76	4.0108	4.0611	4.1126	4.1653	4.2193	4.2747	13
37	7536	7581	7627	7673	7720	7766	52	77	4.3315	4.3897	4.4494	4.5107	4.5736	4.6382	12
38	7813	7860	7907	7954	8002	8050	51	78	4.7046	4.7729	4.8430	4.9152	4.9894	5.0658	11
39	8098	8146	8195	8243	8292	8342	50	79	5.1446	5.2257	5.3093	5.3955	5.4845	5.5764	10

DEG.	0'	10'	20'	30'	40'	50'	DEG.
80	5.6713	5.7694	5.8708	5.9758	6.0844	6.1970	9
81	6.3138	6.4348	6.5606	6.6912	6.8269	6.9682	8
82	7.1154	7.2687	7.4287	7.5958	7.7704	7.9530	7
83	8.1443	8.3450	8.5555	8.7769	9.0098	9.2553	6
84	9.5144	9.7882	10.078	10.385	10.711	11.059	5
85	11.430	11.826	12.250	12.706	13.197	13.727	4
86	14.300	14.924	15.605	16.350	17.169	18.075	3
87	19.081	20.206	21.470	22.903	24.542	26.432	2
88	28.636	31.242	34.368	38.189	42.964	49.104	1
89	57.290	68.750	85.940	114.588	171.885	343.770	0

Natural Cotangents



$$\frac{3}{70} \approx \frac{4}{23}$$

14.20

100/100

$$\begin{array}{r} 4.33 \\ 2.9 \\ \hline 7.23 \end{array}$$

$$\begin{array}{r} 4.05 \\ 2.9 \\ \hline 6.95 \end{array}$$

$$\begin{array}{r} 2 \\ 9 \overline{) 65} \\ \underline{16} \end{array}$$

2.41

3.1416

2.57

$$\begin{array}{r} 8000 \\ \hline 251328000 \end{array}$$

2.73 ✓

2.89 ✓

3.06 ✓

3.1416

$$\begin{array}{r} 125133.8000 \end{array}$$

12

$$\begin{array}{r} 3.1416 \\ 12 \\ \hline 37.6992 \end{array}$$

$$\begin{array}{r} 3.1416 \\ 12 \\ \hline 128496 \\ 31316 \\ \hline 50.2656 \\ 37.6992 \\ \hline 14.5664 \end{array}$$

806.80

806.03

.77

.01243

78  $\overline{) 77000}$

98

190

156

340

312

280

234

$$125 \overline{) .77}$$

06.03

05.76

.27

.01243

25

6215

2486

31075

.01243

23

3729

2486

28589

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 14 FEET WIDE. SIDE SLOPES 1 1/2 TO 1.

FOR SINGLE TRACK EMBANKMENT.

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

Calculated by Julien A. Hall, M. Am. Soc. C. E.

MADE IN GERMANY.

U 2500