

Book 11

Court House & A.H.

DIEZGEN

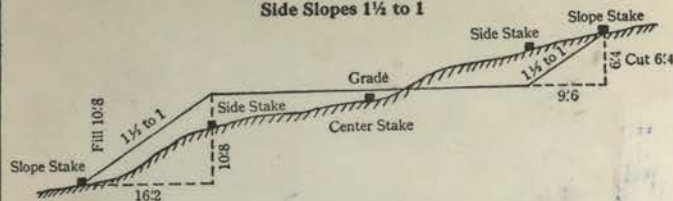
ENGINEERS

ODIN J. RUDSTROM
BOOK NO. 29

ODIN J. RUDSTROM BK. NO. 29

Book 1 (Coordinates)
Book

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING
Roadway of any Width
Side Slopes 1½ to 1



In the figure above: Opposite 6 under "Cut or Fill" and under .4 read 9'6" the distance from the side stake to the slope stake at right. Opposite 10 under "Cut or Fill" and under .8 read 16'2", the distance from the side stake to the slope stake at the left.

Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
Distance out from Side or Shoulder Stake											
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	33.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.4	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

EUGENE DIETZGEN CO.

Book 11

Board of Health Address

Mr Harvey E Rogers
 Chief of Section of
 Water Pollution
 Control.

Department of Health
 University Campus
 Minneapolis 14 Minn

Elev Waterlines

This Field Book is manufactured of a High Grade 100% Rag Paper Having a **WATER RESISTING SURFACE**, and is sewed with **RUST PROOF** wire.

Made in U. S. A.

$$\begin{array}{r}
 3 \quad 918.27 \\
 6 \quad \underline{} \\
 9 \quad 918.30 \\
 \quad \quad \quad \underline{} \\
 \quad \quad \quad 928.36 \\
 \quad \quad \quad \underline{} \\
 \quad \quad \quad 918.45
 \end{array}$$

$$\begin{array}{r}
 57 \\
 30 \\
 \hline
 27
 \end{array}
 \quad
 \begin{array}{r}
 430 \quad 920.39 \\
 \quad \quad \underline{918.45} \\
 \quad \quad 1.94
 \end{array}$$

930.

$$\begin{array}{r}
 920.39 \\
 919.89 \quad 43 \quad \underline{4.5} \\
 \quad \quad \quad \underline{50} \quad \quad \quad \underline{192} \\
 \quad \quad \quad \quad \quad \quad \underline{220} \\
 \quad \quad \quad \quad \quad \quad 215
 \end{array}$$



City of Chisholm

City Hydrant

3rd Ave + 8th NE 69.61

Difference in Elev

Lake Superior

00 Chisholm = 871.95
OIM Div.

At 8th St. and 5th Ave NE
Difference = 872.13

Location of Sewer 45

Block 2 Page 71
Block 1 Page 69

I.P.				
0400	4.66	113.60	108.94	
0400			4.9	108.7
0400			3.77	109.83
0429			4.2	109.4
top 0429			3.1	110.5
0459			4.3	109.3
top 0459			3.2	110.4
0459			3.67	109.93
0489			4.3	109.3
top 0489			3.25	110.35
1119			4.4	109.2
top 1119			3.20	110.40
curb 1119			4.35	109.25
1149			4.7	108.9
top 1149			3.60	110.00
1179			5.3	108.3
1179			4.30	109.30
curb			5.59	108.01
2139			6.0	107.6
top 2139			4.89	108.71
2139			7.0	106.6
top 2139			6.06	107.54
curb			7.12	106.48
2169			8.5	105.1
top 2169			7.43	106.17
				105.63

Fence Line Museum
(City of Chisholm's Elev) May 1955 ①

I.P. NE Cor M.M. property 1

ground

Top curb 34.2' N. of fence line

stake top

Curb 34.4' No

34.20' No

34.30 No

34.0' No

C.64

113.60

2499		9.7	103.9	
top 2499		8.60	105.00	105.03
Curb 2499		8.60	105.00	
3424		9.8	103.8	
top 3424		8.78	104.82	104.43
3459		10.3	103.3	
top 3459		9.22	104.38	103.83
Curb 3459		10.25	103.35	
3489		11.4	102.2	
3489		10.15	103.45	103.23
4419		11.4	102.2	
top 4419		10.22	103.38	102.63
Curb		11.80	101.80	
top 408	105.76	11.72	101.68	
4449		4.2	101.6	
top		3.08	102.70	102.03
Curb 4449		4.5	101.3	
4473 West S. Gate		3.2	102.6	
5103		4.75	101.01	101.48
top stl		3.58	102.20	101.48
Curb 5103		5.0	100.8	
5133		4.7	101.1	
top 5133		3.72	102.06	101.42
5163		5.0	100.8	
top stl		3.95	101.83	101.36
Curb 5163		5.38	100.40	

(2)

2

F.03

34.20' No.

C.39

C.55

C.12

C.75

15' No.

C.67 4439

C.72

C.64

C.47

5193		5.2	100.6	
TOP STK		4.10	101.66	101.30
6423		5.3	100.5	
TOP STK		4.05	101.71	101.24
Curb		5.56	100.20	
5453	643	5.1	100.7	
TOP 5453		3.92	101.84	101.18
5483	6483	5.2	100.6	
TOP STK		3.98	101.78	101.12
Curb 5483		5.66	100.10	
7413	7413	5.3	100.5	
TOP STK		4.06	101.70	101.06
7443		5.2	100.6	
TOP 7443		4.01	101.75	101.00
Curb		5.84	99.92	
7473		5.2	100.6	
TOP STK		4.09	101.67	100.94
8403		5.0	100.8	
TOP		3.85	101.91	100.88
Curb		5.90	99.84	
8433		5.4	100.4	
TOP 8433		4.22	101.54	100.82
8463		5.0	100.8	
TOP STK		3.84	101.92	100.76
Curb		6.16	99.60	

C.36

C.47

C.66

C.62

C.64

C.75

C.73

C.103

C.72

C.116

105.76

8+23		5.5	100.3	
Top Stk.		4.26	101.50	100.70
9+23		5.8	100.0	
Top Stk	9+23	4.62	101.14	100.64
Curb		6.36	99.40	
BM	8.47	109.23	5.00	100.76
9+53		9.1	100.1	
Top Stk	9+53	7.98	101.25	100.58
9+93	E. Sid. Gate	9.2	100.00	100.50
Top Stk		8.18	101.05	100.50
Curb	9+93	10.00	99.23	
10+13	W. Sid. Gate	9.0	100.2	
Top Stk	10+13	8.07	101.16	100.46
10+26	corner	9.6	99.6	
Top		8.56	100.67	100.44
Curb		10.15	99.08	
10+36		6.9	102.3	
Top Stk		5.82	103.41	
10+46		4.1	105.1	
Top Stk		3.12	106.11	
10+66	corner	4.1	105.1	105.6
Top Stk	10+66	2.82	106.41	105.69
10+96		4.1	105.1	
Top Stk	10+96	2.80	106.43	
11+26		4.0	103.2	105.79
Top	11+26	2.76	106.47	105.78

44

C. 80

C. 50

on Light post City Elev 100.76

C. 67

C. 55

C. 70

9+93

10+13

Gate

C. 23

10+46

12+64

↑

So.

10+26

Grad. C. 50

C. 72

C. 72

C. 69

109.23

11456	3.8	105.4	
Top 11456	2.58	106.65	105.87
11486	3.6	105.6	
Top 11486	2.39	106.84	105.96
12116	3.6	105.6	
Top 12116	2.35	106.88	106.05
12146 36	3.8	105.4	
Top 12146 36	2.78	106.45	106.14
12164	3.5	105.7	106.23
Top STK	2.49	106.74	106.23

H

I.P. Fence Line Going So. to Tourist Cabin

0400 198 110.92		108.94	
0430	3.4	107.5	
0430 Top STK.	2.28	108.64	
0464	3.9	107.0	
Top STK	2.79	108.13	
0477 Top Rock	4.10	105.82	
0491	5.74	105.18	
Top STK	5.30	105.62	
0497	5.6	105.3	
1122	4.50	106.40	
Top 1122	6.8	104.1	
1153	5.65	105.27	
Top 1153	8.7	102.2	
1183	2.79	103.15	
Top			

5 (5)

C.78

C.88

C.83

C.31

C.51

next to West Wall

NE Cor. M.M. property

2+14	11.1	99.8
top 2+14	10.02	100.90
TP 1.54 100.11	12.35	98.57
2+44	2.6	97.5
Top Stk	1.54	98.57
2+69	5.4	95.7
Gate ^{Top STK} _{side}	4.42	95.69
2+85 Rd	7.3	92.8
Top STAKE	6.17	93.94
3+05	7.0	93.1
Top STAKE	5.98	94.13
3+35	9.1	91.0
T. S.	8.12	91.99
3+65	10.9	89.2
Top STAKE	9.8	90.3
3+95	11.2	88.9
Top S	10.18	89.93
4+25	12.4	88.7
Top S.	11.47	88.64
4+55 corner	12.8	87.9
Top STAKE	11.66	88.45
4+95	12.9	87.3
Bottom	11.80	88.31

at NE corner of Tourist Court
Cabin

Count House Gold.

Fls of M. H. (same)

on 16th Ave St

on 16th Ave St
166.5' West of 16th Ave (31' 50" of
2nd line)
M.H. 4.60 894.70 890.10 9.95 of L.

M.H.	4.60	894.70	890.10	9.95% of L.
------	------	--------	--------	-------------

B.M.	4.03
------	------

B/M	4.27	890.43
-----	------	--------

M.H.	5.52	95.29	889.77	9.28	1st Log
------	------	-------	--------	------	---------

4.84 89045 BM BN

Drilled a hole in concrete street
on 16th Ave East and North
side of 18th St set a 6" long
Iron Pin By 1" and fill
rest of the hole with lead

380.15 FL

Barke Rudstrom

9-29-56 6 hrs

Brooklyn

on Ring of H.H.
on 16th St. 12 Alley between 16th St & 16th Ave.
E 16th St & 16th Ave.
Hex I. Pin by intersection 16th & 16th Ave.
Nail Power Pole 8' SW

FL 880.01 879.99

on 16th St, between 13th & 14th Ave

Q of Alloy North

13th Ave

Lot Line South Side
Brooklyn Sub.

16th St

Back of Curb

White Pipe Pist

УМН.ТОР 899.77

FL. 879.99

FR. NW Corner BIK 2

Grade East
4.870/s Grade

B.M.	4.84	895.29	890.45
6+41		2.58	
5+98		2.23	
5+50		2.17	
5+00		2.02	
4+50		1.88	
4+00		1.71	
3+50		1.57	
3+00	No curb	1.98	
3+00		1.29	
2+50		1.63	
2+00		2.20	
1+50		2.73	
1+00		3.30	
0+50		3.82	
0+00		4.39	
Intersection		4.78	

4

9-29-56

8 (8)

M. H.

So. side 18th St on curb line

East side of 14th Ave curbs

"

"

"

"

"

"

West side 14th Ave on curb

Curb East side 14th Ave East

"

"

"

"

on No. lot line of Blk 1+2
10th St. & 14th Ave

Count House Addition

Nail
P.P.

34.53
N26°W
23.40
N38°E

1" x 3' Long Drill steel

IP NW Cor Blk 3

House

74.82
Bottom N 8°W
Foundation

NE Cor Blk 3
IP 1" x 3' Long

Nail in PD

N 61°E
55.88

Sunday Sept 30 9
Rudstrom - Barker
Hanson 1 1/2 hrs

Inside of
sidewall
Rubble
Wall 735
92.45
740
To Water
Shut off
1.5 south of wall
Line
1" Drill Steel
4' Long
63.00

1" x 4' Long
IP Round

125.530 125.538

NE Cor Blk 1
IP 1" x 4' Long
84-43-48 Drill Steel

Turned from
East to south
end of Block
and found angle
perfect 84-43-48

14th Ave East

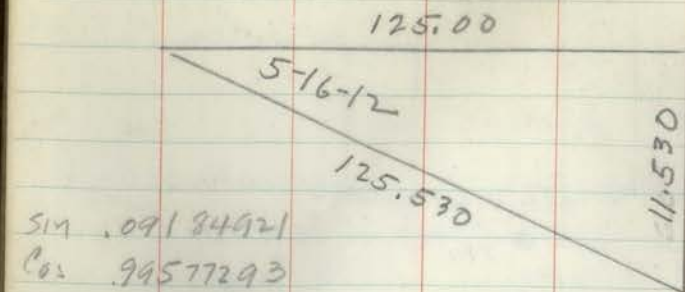
Eastward Line
Blk 2

15th Ave East

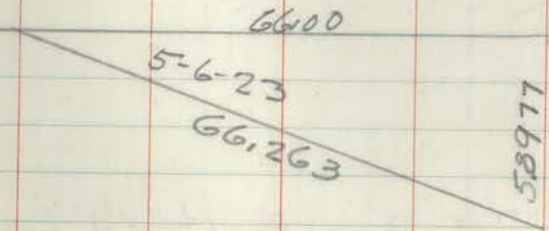
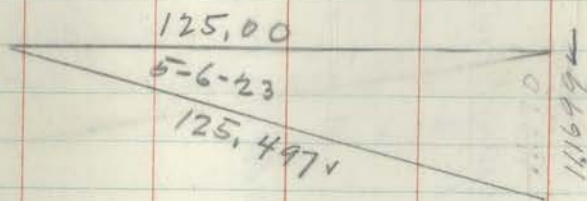
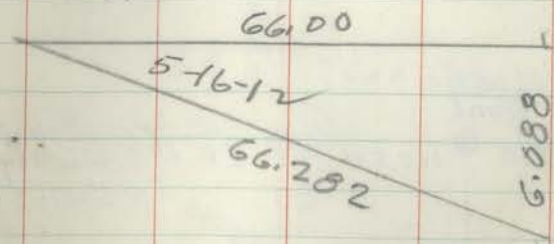
125.497 Round
1 1/2" x 4' Long
Round IP Long IP

1 1/2" x 4' Long
IP 6" below surface

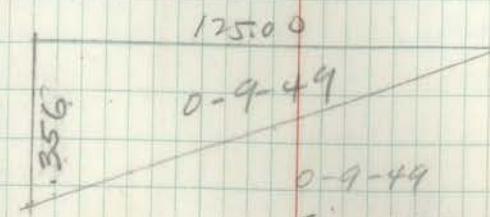
Ericsson Plats Court No.



Sin .09184921
Cos .99577293
Tang .0922291



16th Ave E 10 (10)
From cut in pavement west to
New I.P. on Line 1/16 west
is 36.41' New I.P. is
33.00 West of 16th Ave and
on 1/16 Line Pit is 1 1/2" x 4 Long

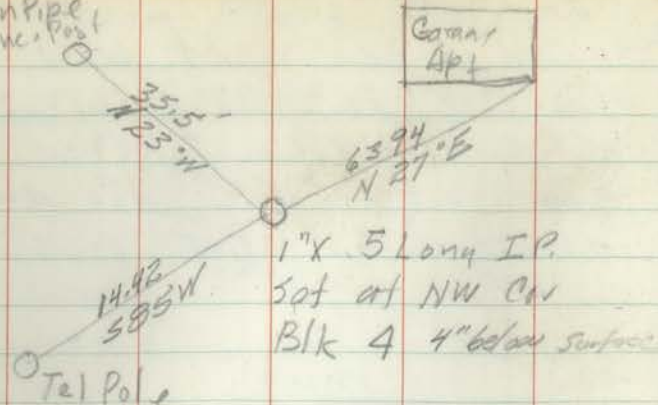


0-9-49
Sin .0028555
Cos .99999592
Tang .0028555

0-9-

5-6-23 Sin .08900536
Cos .99603115
Tang .0893601

Iron Pipe
Fence Post



Gomay
Apt

1" x 5 Long IP.
Set at NW CN
Blk 4 4" below surface

Dunn.

Porch corner.

1" Drill rod 4' Long
Flush with ground

2" Dunn
Drill rod

Watson
Apt

11 (11)

Court House Held Hitting

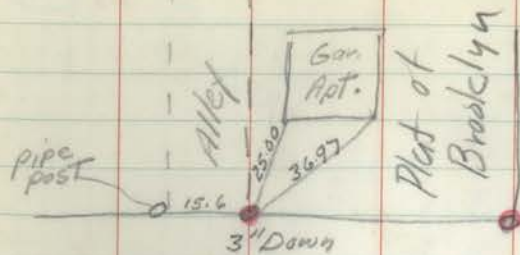
175.
175.98

Temp 28

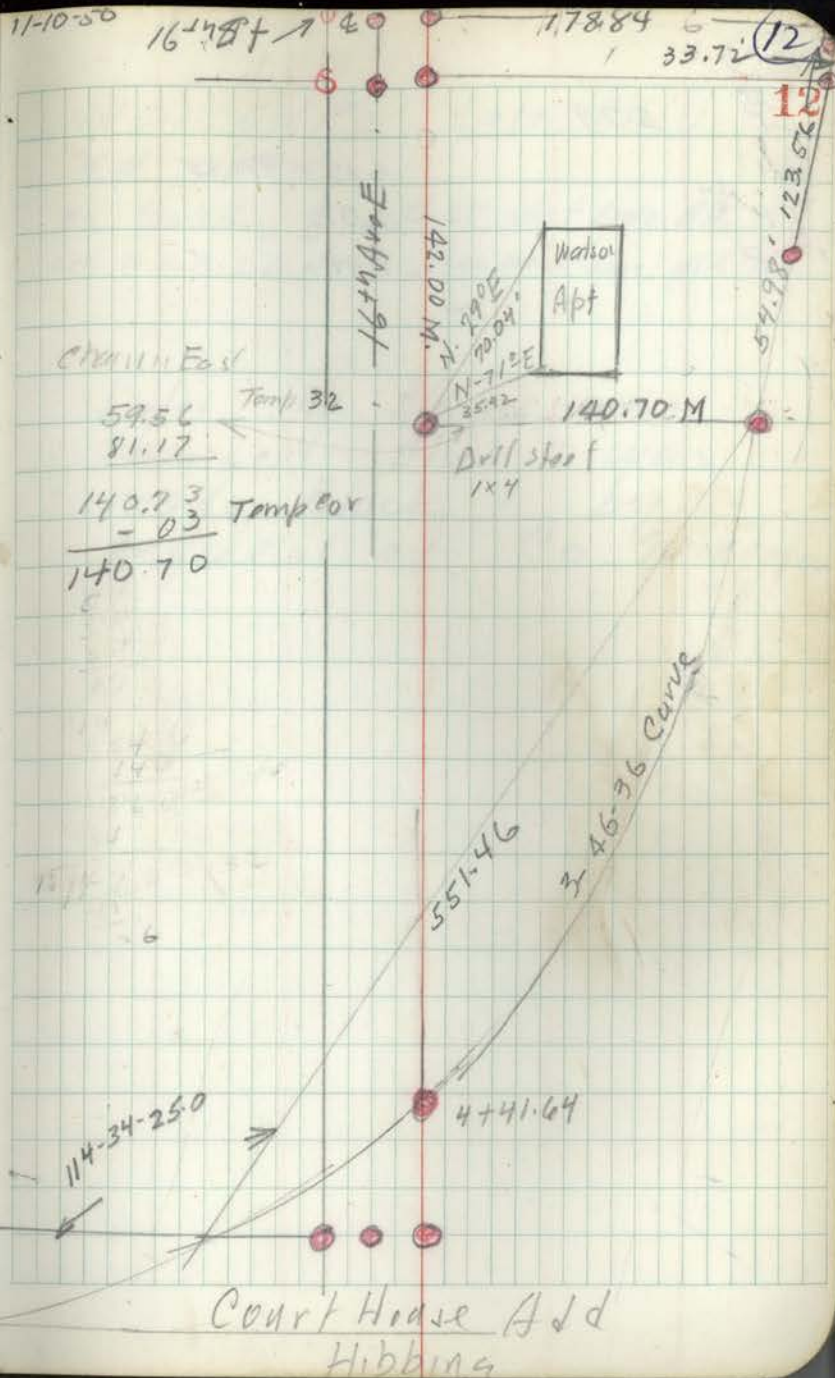
87.98	142.00
<u>73.83</u>	<u>33</u>
161.81	175.00
	<u>161.81</u>
	13.19

175	
<u>11</u>	
87.5	
<u>17.5</u>	
40	26 21 66 .07

161.81	
<u>15</u>	
40	
	161.8
	<u>15</u>
	80.90
	<u>16.18</u>
4	24270 (606)
	<u>24</u>



16th St
In Conc
54



H&K SP.
IP.

5.79

BM

6.17 890.45

IP $1\frac{1}{2}$ "

6.92

1" IP.

6.34

74

MH

(13)

NW Cor. BIK #2

Later. B/L ①

13

M.H. 13th Aug.

on 1/16 Line $\frac{1}{2}$ 16th St. West Line BIK 2 ①

Ext. to North Side of 16th St. on West Line BIK 2 ①

Later the blocks were
changed Block 2 was
made Block 1 by
request of Co Surveyor

SW Cor.			
Foundation	0.17	88807	887.9
M.H.			
NW Cor.			6.25
BLK 3	I.P.		3.76
			884.31

Top: Foundation

Flow Line E2W

4.8' below

1474 A

201/15/10

House

~~89.3~~

FL 867.02

Top 881.82

NW Co.

 $13\frac{1}{2}$

3

14.8' to Fl. Line from East
14.5' " " " west

867.0 2

148

✓✓

2

881.82

148

56702

Hibbing Court House Adl

15
15

Sections at Green Haven
 Add. 0+0 South 13 Φ 2+35th
 St and E. Curb Line of first Ave
 South to Φ 37th St which
 is 8+11 South

HI 926.52 0+0

0:0	546	921.06
54F	6.63	919.89
61S	6.55	919.97
73E	6.41	920.07
125E	6.14	920.38

0+50

6.50	926.47	919.97
0+0	5.54	920.93
75E	8.4	918.1
117E	5.8	920.7

1+0

6.43	926.40	919.97
00	5.53	920.87
80S	8.4	918.0
160S	6.8	919.6

1+50

M.H.	6.37	926.34	919.97
00	5.51	920.83	
74	8.2	918.1	
171	8.1	918.2	
217	7.7	918.6	

Green Haven
 Lots 1 to 11
 Block 4

10-77-56

Barlow-Rudstrom
 Bailor-Hanson
 Fair day +28°

16

16

Curb

Storm sewer catch basin

M.H. Storm 8.5 South 919.97

Φ Pavement

Top Curb S. S. do St.

Top M.H. 919.97

Curb

Yard Grade

Top M.H. 919.97
 curb

on yard fill

919.97

925.52
210
MH 5.55 925.52 ✓ 919.97
00 4.70 920.82 ✓
74 7.2 918.3
160 7.2 918.3
231 3 51 920.4
2.76 925.29 ✓ 2.99 922.53 ✓

2450
00 5.52 919.77 920.77
74 8.4 916.9 917.9
160 8.4 916.9 917.9
217 7.6 917.7 918.7
19E 6.0 919.3 920.3
242E 6.2 919.1 920.1

340
3.68 926.21 ✓ 922.53
00 5.43 920.78 ✓
13E 5.2 921.0
44E 7.6 918.6
74E 8.1 918.1
160 7.8 918.4
199 7.6 918.6
231 6.3 919.9

(17)
17
MHole 919.97

on Lot. to a 2' wt. 2' Lowood
Hydrant 922.53

Curb
Φ 34

Hydrant 922.53

3+50
3.70 926.23 ✓ 922.53

00	5.57	920.66
14 E	5.1	921.1
41 E	8.1	918.1
74 E	8.2	918.1
160	8.0	918.2
219	7.9	918.3
235	5.7	920.5

4+0
3.85 926.38 922.53

0.0	5.82	920.56
13	5.2	921.2
44	8.3	918.1
74	8.5	917.9
160	8.1	918.3
227	7.7	918.7
235	6.2	920.2

4+50
3.55 926.08 922.53

00	5.57	920.51
12	4.9	921.2
40	7.4	918.7
64	5.40	920.68 ✓
74	8.0	918.1
160	7.9	918.2
201	7.4	918.7
239	6.7	919.4

Hydrant 922.53

18
18

Hydrant 922.53

Hydrant 922.53

Top 5 50m. MH 7. South of Line

278 5+00
 278 925.31 ✓ 922.53
 46.21
 00 5.54 919.77 923.32
 13 5.1 920.2 923.8
 46 82 917.1 920.7
 74 8.8 916.5 920.3
 160 8.4 916.9 920.7
 204 8.2 917.1 920.9
 222 922.0

5+50
 390 926.43 922.53
 00 5.48 920.95
 11 4.8 921.6
 44 8.5 917.9
 74 8.9 917.5
 160 9.2 917.2
 195 8.5 917.9
 211 7.1 919.3

6+0
 461 927.14 922.53
 00 5.61 921.53
 10 5.4 921.7
 37 4.0 918.1
 74 9.3 917.8
 160 9.9 917.2
 214 9.5 917.6
 222 7.7 919.4

Hydrant

920.77

on Lot Line W

921.2

918.10 L

917.5

917.9

918.1

Hydrant

922.53

Hydrant

922.53

3.51 927.14 316 923.98

6+50

00	54	922.04
13	54	922.1
34	7.8	919.7
74	10.0	917.5
160	9.9	917.6
214	9.6	917.9
231	7.6	919.9

3.78 7+0 927.76 923.98

00	5.37	922.39
13	4.8	923.0
20	7.4	920.4
44	8.8	919.0
74	9.4	918.4
160	10.1	917.7
221	10.0	917.8
254	9.0	918.8

3.90 7+50 927.88 923.98

00	5.21	922.67
24E	5.1	922.8
74	7.5	920.4
160	9.0	918.9
237	9.8	918.1

BM Hydrant 923.98 37.51 125 E of 1st 2060

BM Hydrant 923.98

Hydrant 923.98

927.88 ✓

811

8+11

20.2W

00

74

100E

160

200

4.71 923.17 ✓

505 922.83 ✓

5.3 922.6

5.6 922.3

6.4 921.5

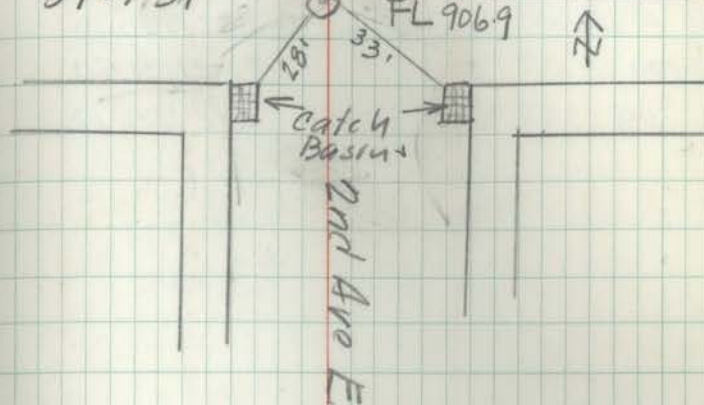
6.7 921.2 ✓

9.47 918.41

37th St

1st Ave + 37th St IP
on Iron Pin

2121

Storm Sewer at 37th St South
and 2nd Ave East37th St M.H. Storm Elevation 918.41
FL 906.9

B.M.	0.14	924.12	923.98
3100		4.58	919.54
3150		✓ 4.74	919.38
4100		✓ 4.90	919.22
4150		✓ 5.06	919.06
5100		✓ 4.92	919.20
5112		- 4.82	919.30
50		✓ 4.42	919.70
6100		✓ 3.82	920.30
50		✓ 3.22	920.90
7100		2.62	921.50
50		2.02	922.10

Hanson 11-3-56 (22)
Grados at Green Haven Barko Rudstrom
Hanson 3-1-56

Hydrom	E. Sidewalk		
Top Curb	+0.46	4.12	920.00 3100
		4.28	919.84 50
		4.44	919.68 4100
Top Curb		4.60	919.52 50
		4.46	919.66 5100
		3.96	920.16 50
		3.36	920.76 6100
		2.76	921.36 50
		2.16	921.96 7100
		1.56	922.56 50

924.12
919.22
4.90

Section avetakey every
25 feet
Sec. 0+00

SEC 1+00

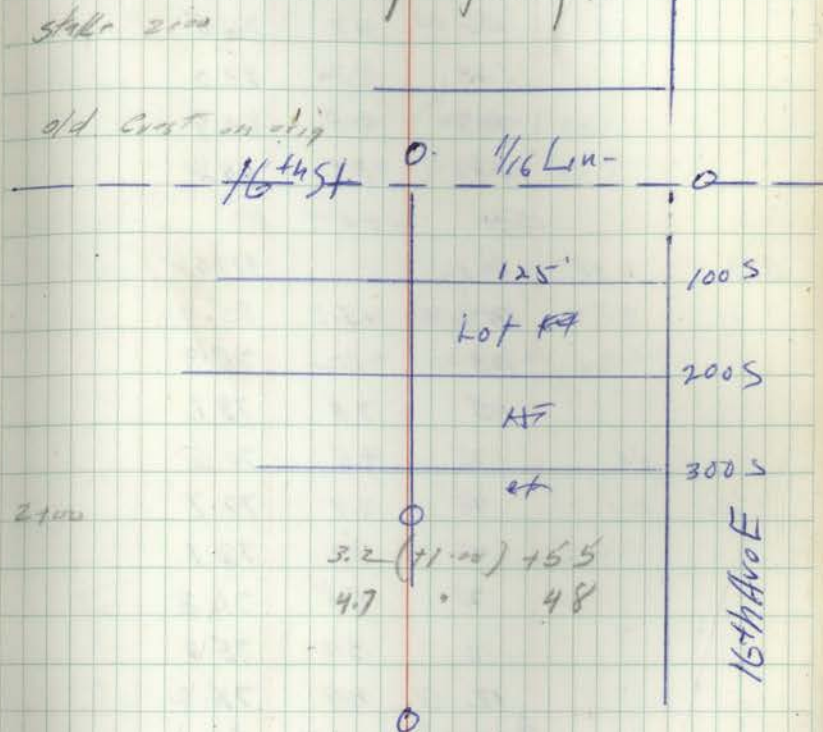
BM.	887	892.76	883.89
	0 W	5.4	87.4
	27 W	5.5	87.3
	58	9.8	83.0
	97	11.0	81.8
	177	11.0	81.8
	250	11.3	81.5
	320	9.9	82.9
	354	4.6	88.2

SEC 2+00

BM.	235	886.24	883.89
	313 W	+2.3	88.5
	277	+0.1	86.3
	245	11.0	75.2
	221	8.3	77.9
	161	7.8	78.4
	95	6.5	79.7
	35	5.3	80.9
	0	5.0	81.2
	46 E	5.8	80.4
	68 E	0.6	85.6

Grades in Court House Mar 1957
Addition
Barber
Rutledge

0.0 is at west end of
lots Facing 16th Ave.
North Line of forty is Sec 0+0



Sec 3400

BM	204	81.17	879.11
	74 E	+5.2	86.4
	60	+3.7	84.9
	43	3.9	77.3
	20 E	4.3	76.9
	0	4.8	76.4
	45 W	7.4	73.8
	106 W	4.7	76.5
	123	8.2	73.0
	157	0.3	80.9
	181	+3.6	84.8

Sec 4700

BM	238	80.04	877.68
	142 W	+5.3	85.4
	123	1.2	78.9
	105	7.0	73.1
	75	9.5	70.6
	48	9.4	70.7
	42	8.0	72.1
	21	5.8	74.3
	0	5.0	75.1
	12 E	4.9	75.2
	32 E	+5.8	85.9
	59	+6.9	87.0

3700

1.9 (+5.30) +7.1
2.0 " 5.7

44 (+1.30) +4.1
43 +2.30 +7.9

4100

2.1 (+3.00) +7.4
4.4 +1.30 +3.2

1.3 (+11.00) +7.1
4.2 " 11.1

Sec 5+00

BM	2.40	80.07	877.67
		85 E 75.1	85.2
		47 +4.2	84.3
		41 3.1	72.0
		20 E 4.3	75.8
		0 5.2	74.9
		21 W 5.9	74.2
		40 6.6	73.5
o/b		53 9.1	71.0
		81 9.5	70.6
		122 +4.2	84.3
		139 +6.5	86.6

Sec 6+00

BM	2.47	80.47 +	878.00
		W 164 W 15.5	86.0
		127 +4.8	85.3
		104 1.8	78.7
		91 6.4	74.1
Ditch Bottom		69 12.3	68.2
C.		57 10.0	70.5
		31 10.4	70.1
		20 5.1	75.4
		0 5.3	75.2
		38 E 4.9	75.6
		58 12.2	82.7
		80 12.8	83.3

5+00

3.7 (+6.00) +8.8
2.5 " + 6.7

4.3 (+4.00) 8.5
3.2 " 9.7

6+00

New Fill 4.5 (+3.30) +10.0
3.1 " 7.9

1.8 (+4.00) 14.0
2.8 " 15.6

Sec. 7400

BM.	2.75	74.97	872.22
		112' E	+8.1 83.1
		46'	+4.2 79.2
		16'	2.8 72.2
		0	5.0 70.0
		37 W	5.7 69.3
		65	4.6 70.4
		86	3.4 71.4
		112	+5.6 80.6
		129	+9.6 84.6

new F-111

Sec. E 1st St.

BM. 6400	2.84	80.84	878.00
		88 E	+0.4 86.2
		74	+0.3 81.1
		58	4.0 76.8
		32	4.8 76.0
		0	5.3 75.5
	C.	5' W	4.9 75.9
	T	18' W	11.1 69.7
	C	50	9.5 71.3
	122	58	13.2 67.6
		71	9.4 71.4
		85	8.6 72.2
		109	2.2 78.6
		127	+3.4 84.2

D, 7/6/6

7400

3.5 (16.00) + 11.6
0.6 " 48

2.2 (+4.00) + 7.8
1.6 (+5.00) 11.2

3.4 + 2.30 + 3.8
2.9 + 3.2

5.1 + 1.30 + 2.9
3.2 + 3.00 + 6.6

7100	8.62	880.84	872.22
6100			284 878.00
		W	
BM	3.63	888.99	885.36
6100			10.99 878.00
5101			11.32 877.67
4101			11.31 877.68
3101			9.88 879.11
2101			5.10 883.89

Elev of New Mesab
 Clinch Entrance to
 Basement East side
 of Bulidina & Footing

3.06 895.39 892.39

10.24 885.15

13.54 881.85

N End Bulv 14th Ave

3-22-57
 Barlow - Rudstrom

Top Manhole @ 18th St +
 14th Ave E

Top of Conc Basement Ent East
 Top Footing below floor

Profile 18th St.

Court House Add.

0+00 Sec.

B.M.	3.77	896.16	892.39
Top Curb		3.71	892.45
	D.N.	3.2	893.0
	25' N	3.0	893.2
	35' N	3.0	893.2
Cutter	26 S	3.7	925

0+25 E

0 N	3.4	892.8
13 N	3.5	92.7
33 N	3.0	93.2
26 S.	3.8	92.4

0+50 E

0 N.	3.5	92.7
20 N.	3.8	92.4
33 N.	3.2	93.0
26 S.	4.0	92.2

0+75 E

0 N.	3.6	92.6
13 N.	3.8	92.4
20	4.3	91.9
33 N	3.4	92.8
26 S.	4.0	92.2

(Original Levels)

Windy

4-6-57

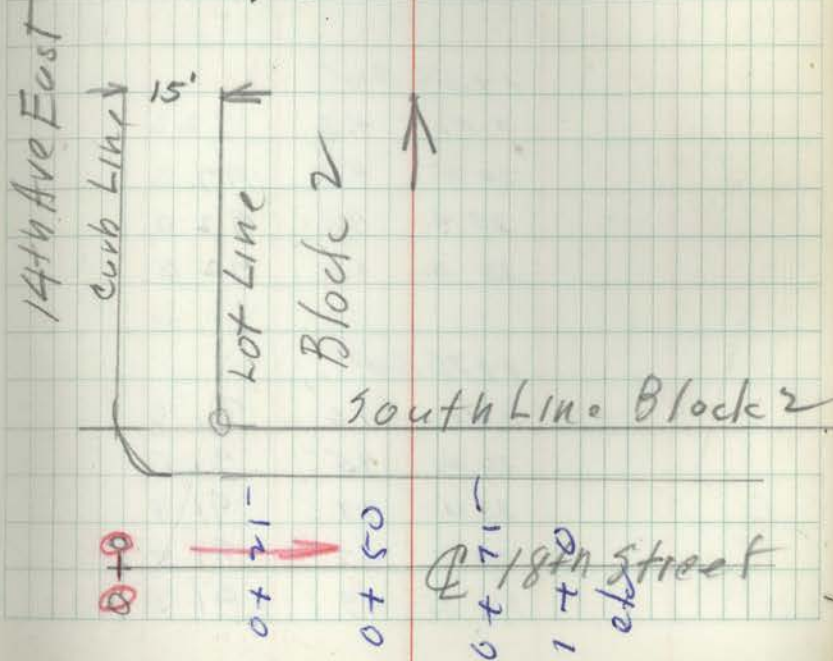
28

Barce Rudstrom

M.H. of 18th St 14th Ave.

catch basin at NE Cor. Court House Bldg.
(Side walk pushed up by frost)
old elev. 892.37

0+0 Sec starts in Line
with Curb on West Side
Block 2 Erickson Add. +
of 18th St. or 15' West of
Lot Line West Side Block
2 - Second Addition



896.1V

1400 E

0 N.	3.7	892.5
10 N.	3.8	924
20	4.3	919
33 N.	3.8	924
26 S.	4.1	921

1425 E.

0 N.	3.8	924
10 N.	4.1	921
20 N.	4.3	919
33 N.	4.1	921
33 S.	4.2	920

1450 East

0 N.	4.0	922
20 N.	4.0	922
33 N.	4.2	920
33 S.	4.2	920

1475 East

0 N.	4.6	916
20 N.	4.5	917
33 N.	4.3	919
20 S.	4.7	915
33 S.	4.9	913

896.2

2100 East

0 N.	4.6	891.6
20 N.	4.6	91.6
33 N.	4.4	91.8
20 S.	5.0	91.2
31 S.	5.2	91.0

2125 East

0 N.	4.7	91.5
20 N.	4.6	91.6
33 N.	4.5	91.7
20 S.	5.1	91.1
33 S.	5.3	90.9

2150 East

0 N.	5.3	90.9
20	5.0	91.2
33 N.	4.9	91.3
20 S.	5.4	90.8
33 S.	5.4	90.8

IP,

5.42 890.74

IP.

6.29 889.87

IP.

9.64 886.52

30

792.39

3.72

796.11

6.29

802.40

SE Cor. BIK #2 (This F.R. Gone)

SW Cor. BIK #1 (This I.P. Gone)

SE Cor. Lot 9 BIK #1

(See Book 12 Page 40)
New Elev

896.2

2175 East

ON.	54	890.8
20	53	90.9
33 N.	53	90.9
20 S.	56	90.6
33	59	90.3

3100 East

ON.	60	90.2
20 N.	58	90.4
33 N.	56	90.6
20 S.	60	90.2
33 S.	63	89.9

3125 East

ON.	61	90.1
20 N.	59	90.3
33 N.	58	90.4
20 S.	63	89.9
33 S.	66	89.6

3150 East

ON.	65	89.7
20 N.	63	89.9
33 N.	63	89.9
20 S.	69	89.3
33 S.	71	89.1

896 ✓
3175 East

ON.	7.2	88.90
20	6.9	87.3
33N	6.7	89.5
20S.	7.4	88.8
33S.	7.5	88.7

4100 East

ON.	8.0	88.2
20	7.9	88.3
33N.	7.8	88.4
20S.	8.4	87.8
33S.	8.6	87.6

4125 E.

ON.	8.9	87.3
20	8.6	87.6
33N.	8.5	87.7
20	9.2	87.0
33S.	9.6	86.6

IP.

	9.40	88.676
--	------	--------

4150 E. - 1

ON.	9.7	86.5
20	9.3	86.9
33 N.	9.1	87.1
20 S.	10.2	86.0
33 S.	10.4	85.8

South Line 18th St set for
Mesaba Clinic 1956

896.2

4175E

ON.	10.4	885.8
20N	10.2	860
33N.	9.9	863
20 S.	10.7	85.5
33 S.	10.9	85.3

5100 East

ON.	10.6	85.6
20	10.5	85.7
33N.	10.6	85.6
20 S.	11.0	85.2
33 S.	11.4	84.8

H

BM. 5.65 892.17 886.52

IP. 6.56 885.61

H

33

SE Cor. Lot 9 B/L #1 (see page 30)
 SE Cor New plat (set today)
 South Side 18th St and 6
 East Side of Lots 1 to 9
 on finished Plat Block 1

Profile 16th St.
sections are taken every 25'

0+00

BM 3.91 894.36 890.45

0 N. 38 890.6

Sidewalk 24 N. 4.1 903

33 N. 3.8 906

Top. Curb 18' S. 3.6 908

Top. Curb 33 S. 3.4 910

0+25 East

0 N. 3.8 906

Top. St. Sewer 25 N. 4.3 901

33 N. 4.0 904

3' S. 4.2 902

5 S. 3.3 911

33 S. 2.5 919

0+50 East

0 N. 4.1 903

15 N. 3.9 905

Top walk. 33 N. 3.9 905

1 S. 4.0 904

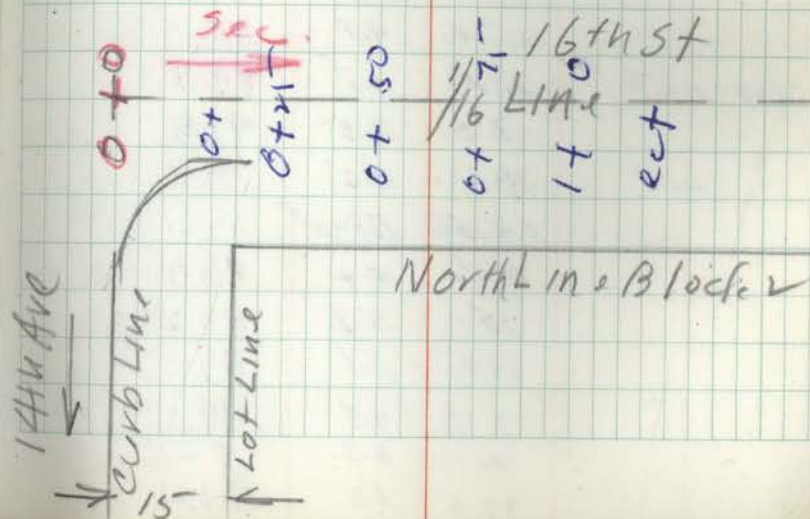
3' S. 2.5 919

33 S. 3.1 913

34

M.H. 1322 - 16th St

0+0 is on E&W cont'd
Line SE 1/4 7-57-20 +
at curb Line West Side
Block 2 Court House
Add. Second. Addition
or 15' west of Lot Line
West Side Block 2.



894.4

0+25 E

0 N. 44 890.0

15 N. 42 90.2

Top walk. 33 N. 42 90.2

8 S. 40 90.4

12 S. 25 91.9

33 S. 29 91.5

1400 E.

0 N. 49 89.5

15 45 89.9

Top walk. 33 N. 45 89.9

8 S. 25 91.9

33 S. 25 91.9

1+25 East

0 N. 5.1 89.3

15 N. 4.7 89.7

Top walk. 33 N. 4.7 89.7

7 S. 2.6 91.8

33 S. 2.6 91.8

1+50 East

0 N. 5.4 89.0

15 5.2 89.2

33 N. 5.1 89.3

7 S. 4.5 89.9

12 2.3 92.1

33 S. 3.2 91.2

1475 East

corner
on walk.

0 N.	5.6	888.8
15	5.6	888
33 N	5.3	89.1
4' S.	4.2	90.2
33 S.	3.6	90.8

2100 East

0 N.	6.3	88.1
15	6.2	88.2
23	6.4	88.0
33 N.	5.7	88.7
2' S.	6.1	88.3
10'	3.1	91.3
33 S.	4.0	90.4

2125 East

0 N.	7.3	87.1
15 N	7.1	87.3
26 N	7.2	87.2
33 N.	6.6	87.8
2' S.	7.3	87.1
8 S.	3.4	91.0
33 S.	4.0	90.4

SW Cor. 14th & N of 16th

E 14th

2150 East

Crest

0 N.	8.2	88.62
15 N	8.1	86.3
26	8.3	86.1
35 N.	7.9	86.5
2 S.	8.2	86.2
8	3.6	90.8
33 S.	4.1	90.3

2175 East

Crest

0 N.	9.2	85.2
15	9.1	85.3
26	9.3	85.1
35 N.	9.6	84.8
3 S.	9.2	85.2
9	5.8	88.6
33 S.	4.7	89.7

3100 East

0 N.	10.3	84.1
15	10.0	84.4
24	10.2	84.2
35 N.	10.5	83.9
3 S.	10.3	84.1
9 S.	8.3	86.1
33	8.0	86.4
40 S.	5.6	88.8

894.4

3125 East

0 N. 11.1 983.3

13 10.6 838

24 10.9 835

Crest

33 N. 11.1 833

9 S. 9.7 847

33 9.6 848

43 S. 9.7 847

3150 East

0 N. 11.6 828

13 11.3 831

24 11.7 827

Crest

34 N. 11.7 827

10' S. 11.3 831

14 10.6 838

33 10.0 844

43 S. 10.0 844

3175 East

0 N. 11.8 826

12 11.8 826

22 12.1 823

28? 12.5 819

46 N. 13.6 808

9 S. 11.9 825

16 10.8 836

33 10.6 838

46 S. 10.7 837

in alley

894.4

4100 East

0 N. 11.9 882.5

12 11.8 82.6

24 11.9 82.5

Gauge 41 N. 12.2 82.2

9 S. 12.2 82.2

19 11.3 83.1

33 11.0 83.4

46 S. 10.7 83.7

4125 East

0 N. 11.7 882.7

12 11.5 82.9

24 11.6 82.8

33 N. 11.7 82.7

37 N. 10.8 83.6

13 S. 12.0 82.4

33 11.4 83.0

43 S. 11.3 83.1

4150 East

0 N. 11.3 83.1

13 11.1 83.3

31 10.6 83.8

35 N. 9.6 84.8

at House 45 N. 9.1 85.3

window sill " 7.9 88.65

11 S. 12.4 82.0

15 11.7 82.7

33 11.3 83.1

46 11.3 83.1

8944
4+75 East

0 N.	10.5	884.1
13	10.3	84.1
24 2	10.3	84.1
26	9.7	84.7
35 N.	8.6	85.8
13 S.	11.5	82.9
33	11.3	83.1
46	11.5	82.9

5+100 East

0 N.	9.4	85.0
12	9.2	85.2
24	9.6	84.8
27 N.	8.3	85.1
Top sidewalk 35 N.	6.6	87.8
11 S.	9.5	84.9
17	11.4	83.0
33	11.2	83.2
46	11.6	82.8

5+25 East

0 N.	7.7	86.7
15 N.	7.3	87.1
28	6.6	87.8
37 N.	5.9	88.5
17 S.	8.3	86.1
24	11.6	82.8
33	11.8	82.6
46 S.	11.8	82.6

894.4
5150 East

ON.	6.2	8882
13N.	5.8	888.6
26	6.0	884
38N.	5.6	888
7 S.	6.3	881
23	6.6	878
33 S.	8.9	855
46 S.	12.2	822

Sidewalk		
IP.	4.31	890.05
IP.	11.52	882.84
IP.	9.90	894.46
IP.	5.11	889.25
IP.	3.32	891.04
IP. old	3.50	890.86

BM	2.74	8709	8435
IP		2.50	8185
Approx Sewer		1545	71.1
BM.		4.25	882.84

Sat 4-6-57 41
Barlow & Rudstrom

East Side 15th St. & 16th Ave

± BIK #1 So Side 10th St.

NW Cor. BIK #1

NE Cor. BIK #2

± BIK #2 - So Side 16th St

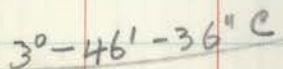
NW Cor. BIK #2

NE Cor. BIK 2

Ext. across 16th St. ± Sewer Line

± BIK IP. So Side 16th St

Court House



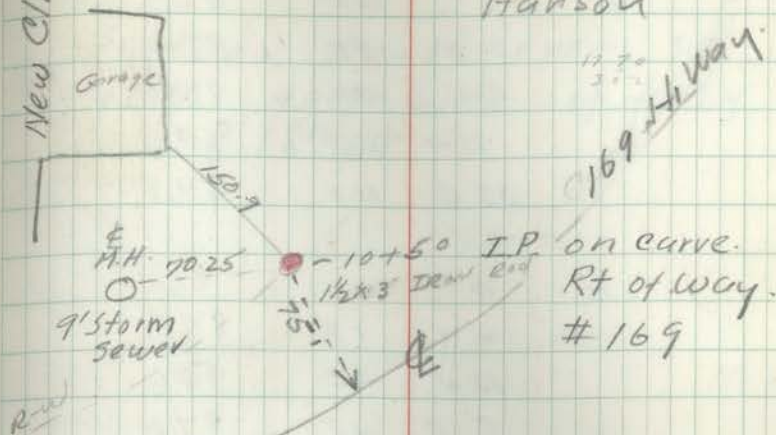
BM	0.35	986.71	985.36
M. H. Ring		14.72	971.99

New Clinic Bld

4-27-57

42

Barker - Redstrom
Hanson



Per run right of way curve
on West side HiWay 169
from Point of Curve at NE
Corner SW-SE 7-57-20 to
East side of Court House
Plot, 0+0 to 14+50.08
3°-46'-36" curve on edge of
RT of way)

from Clinic on 30th January from
Brooklyn

NW Cor. Prior 16th Ave.

13.0' Down to Fl. Line 30' Sewer 95.799
95' " " " " 8" line to Clinic West

See book 10 Page 59 for
more information

14th St. Goring So. from
 Nib Line 015W SE 1/4 7+57-70
 441 896.80 HI 12.6 892.39
 884.2

0+00

0+15

£

20' W

95

87.3

26

73

89.5

33 W

66

90.2

33 E

127

84.1

0+25

£

0

104

864

15' W

79

88.9

33 W

72

89.6

8' E

118

87.0

33 E

124

84.4

0+50

£

0

77

89.1

33 W

67

90.1

13 E

85

88.3

21

124

84.4

33 E

123

84.5

Sec. 0+75

£

0

70

89.8

33 W

63

90.5

33 E

80

88.8

1+00

£

0

70

89.8

33 W

62

90.6

33 E

78

89.0

Court House Addition
 Second Addition 427.57

43

Barke-Rudstrom

Sections taken every 25'
 from North Line of forty
 to 18th St

896.80

1725

0

66

8902

33 W

5.7

91.1

33 E

76

892

1750

0

6.0

908

33 W

5.4

91.4

33 E

72

89.6

Sec

1775

0

62

906

33 W

5.1

91.7

33 E

71

89.7

2100

0

5.5

91.3

33 W

5.0

91.8

33 E

68

90.0

2125

0

5.2

91.6

33 W

4.7

92.1

33 E

5.9

90.9

2150

0

5.2

91.6

33 W

4.9

91.9

33 E

5.9

90.9

2175

0

5.4

91.4

33 W

5.1

91.7

33 E

5.9

90.9

89680
3+00

0	5.3	8915
33 W	5.1	91.7
33 E	5.9	90.9

3+25

0	5.6	91.2
33 W	5.0	91.8
33 E	6.4	90.4

3+50

0	5.6	91.2
33 W	4.8	92.0
33 E	6.4	90.4

3+75

0	5.2	91.6
33 W	4.4	92.4
33 E	6.0	90.8

4+00

0	5.1	91.7
33 W	4.8	92.0
33 E	5.6	91.2

4+25

0	5.2	91.6
33 W	4.8	92.0
33 E	5.8	91.0

4+50

0	5.0	91.8
33 W	4.6	92.2
33 E	5.4	91.4

896.40

4775

0	49	919
33 W	48	920
33 E	5.3	915

5700

0	5.3	915
33 W	49	919
33 E	5.6	912

5725

0	54	914
33 W	5.2	916
33 E	5.8	910

5750

0	54	914
33 W	49	919
33 E	5.8	910

5775

0	5.4	914
33 W	5.3	915
33 E	5.8	910

6700

0	6.0	908
33 W	5.8	910
33 E	6.2	906

896.80
 18 1/2

0 67 890.1
 33 W 68 90.0
 33 E 69 89.9

BM 4.41 892.39 Page 28

SAN. Sewer Profile

BM	4.41	896.80	892.39
E 18 1/2		10.5	886.3
6100		10.0	868
75		94	87.4
50		92	87.6
25		94	87.4
5100		88	88.0
75		82	88.6
50		8.2	88.6
25		88	88.0
4100		84	88.4
75		85	88.3
50		91	87.7
25		92	87.6
3100		90	87.8
75		9.1	87.7
50		10.2	86.6
44		11.0	85.8
TP.	2.37	887.48	11.68 885.11

M.H. E 14th & 18th St

East Side Block 1 - ^{second Add.} Court House Add.
 M.H. Court House Addition
 Second Addition

2125	76	879.9
2107	123	75.2
2100	123	75.2
1794	86	78.9
75	76	79.9
30	66	81.1
25	65	81.0
1700	58	81.7
75	51	82.4
50	44	83.1
25	47	82.8
0701	42	83.3
I.P.	458	882.90

NE Cor Block 1

SAN. SEWER PROFILE E WEST BLK 2

BM	5.70	898.09	892.39
6+00		6.1	892.0
75		5.8	923
50		5.6	925
25		5.7	924
5+00		5.3	928
75		4.4	937
50		4.4	937
25		5.1	930
4+00		4.8	933
75		4.9	922
50		5.3	928
25		5.2	929
3+00		5.1	930
75		5.3	928
50		5.4	927
25		5.4	925
2+00		5.9	922
75		6.4	91.7
50		6.1	92.0
25		4.7	91.4
1+00		6.9	91.2
75		6.8	91.3
50		7.1	91.0
25		6.2	91.9
0.8		5.8	92.3
0.0		9.1	89.0
IP.		6.99	891.10

427-57
Barlow - Rudstrom 49

M.H. E 18th ST + 14th Ave

B.M. 538 95.83 890.45
 Top Pipe 19.52 19.52
 C-13.0 to top Pipe Rod - 652

SEWER UNCOVERED

B.M. 2.89 93.34 890.45 Bot Pipe
 Top Pipe 16.96 76.38 875.59

PAH SHOVEL

Shovel tracks 10.3' outside to outside
 " " 6.0' inside to inside

90.45
 52.8
 95.83

OK

875.56 Fl. Line
 876.31 Top pipe

90.45
 28.9

93.34
 16.96
 76.38

1.16%

5-16-57 50

Barlowe R. L. Stroman

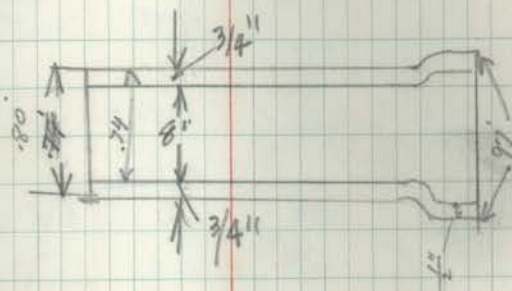
0.75 higher to top pipe

879. Print
 874.88 Cal FL,
 at & Blk. 1
 South

12.14
 98.2
 169.6

8" Tile =

8" inside with
 3/4" shell
 or Total
 9 1/2" = .79' total



B.M.	657	897.02	1.16%	890.45	
		Top M.H.	8.24	888.81	
0+00			21.43	7559	975.59
25			21.14		7588
50			20.85		76.17
75			20.54		76.46
1+00			20.27		76.75
25			19.98		77.04
50			19.69		77.33
75			19.40		77.62
2+00			19.11		77.91
25			18.82		78.20
50			18.53		78.49
75			18.24		78.78
3+00			17.95		879.07
25			17.64		7936
50			17.37		79.65
75			17.08		79.94
4+00			16.79		80.23
25			16.50		80.52
50			16.21		80.81
75	1.82	9780	16.20	9598	81.10
5+00	Hyd.		16.41		81.39
25			16.12		81.68
50			15.83		81.97
M.H. 80			15.48		882.34
		Top M.H.	4.40	9340	

W. of Hyd.	895.98	51
7.21 C-1.0	8.21 Grade	
21.14	21.14	
20.75	20.75	
20.56	20.56	
20.27	20.27	
19.98	19.98	
19.69	19.69	
19.40	19.40	
19.11	19.11	
18.82	18.82	
18.53	18.53	
18.24	18.24	
17.95	17.95	
17.64	17.64	
17.37	17.37	
17.08	17.08	
16.79	16.79	
16.50	16.50	
16.21	16.21	
16.20	16.20	
16.41	16.41	
16.12	16.12	
15.83	15.83	
15.48	15.48	
11.00	11.00	
Top M.H.	893.40	440

1.63% - 2170

- 0.44%
3170 to 6+14

0+33		886.50
1+00		87.59
50		88.40
2+00		89.22
50		90.03
2+70	Gr. Change	90.36
3+00	V.C.	
30		890.90
3+70		890.86
4+00		890.73
50		90.51
5+00		90.29
50		90.07
6+00		89.85
6+14		89.79
BM.		892.39

see next page
for cut stakes

M.H. 18th St. 14th Ave

B.M.	4.51	96.90		892.39	Top Curb
6+14			✓	7.11	89.79
6+00			✓	7.05	89.85
5+50			✓	6.83	90.07
5+00			✓	6.61	90.29
4+50			✓	6.39	90.51
4+00			✓	6.17	90.73
3+70			✓	6.04	90.86
3+30				6.00	90.90
3+00					
2+70				6.54	90.36
1P	232	94.68	454	92.34	
2+50			✓	4.65	90.03
2+00			✓	5.46	89.22
1+50			✓	6.28	88.40
1+00			✓	7.09	87.59
0+50			✓	7.91	86.77
0+33	set on pole	→	8.18		86.50

7.11	100.15				
5.41	2.0	100.15			
7.05	2.0				
5.41	2.0				
6.83	3.0	100.15			
3.83	3.0				
2.01	2.0				
4.01	2.0				
2.01	2.0				
6.17	2.0				
4.17	2.0				
2.01	2.0				
4.01	2.0				
2.01	2.0				
6.00	2.0				
5.00	2.0				
1.00	2.0				
6.54	2.0				
4.54	2.0				
2.01	2.0				
4.45	2.0				
2.45	2.0				
5.46	2.0				
2.46	2.0				
3.01	2.0				
6.28	3.0				
3.28	3.0				
2.01	2.0				
4.01	2.0				
2.01	2.0				
7.91	2.0				
4.91	2.0				
2.91	2.0				
7.91	2.0				
5.91	2.0				
3.91	2.0				
1.91	2.0				
0.91	2.0				
0.13	2.0				

BM				
M.H. STK.	4.13	892.94		888.81
TP.	2.10	882.36	12.68	880.26
TOP			6.65	875.71
Conc. 0.125			6.02	
TOP Pile			5.83	
0.125			5.50	
0.150			5.25	
0.170				

0.400			875.71	
2.13				78.18

2.100				
C-15.0	0.11			15.11
2.13		15.08		14.96

Monday

May 20th

	11.6%	6.02	
		2.7	
	58	57.3	
	29	2.9	11.6
0.1 Low			
0.06 Low		54.4	2.32
0.05 Low		2.3	
		52.1	

Top Pile

5-2 - 57
Rundstrom & Barker

0.12' 51.95

Set Approx Grade for Digging for
Sewer on 10th St

B.M.	267	892.69	890.05
Sewer			890.5 -
		4	
		5.00	
		4.70	14
	29	5.38	
25	29	5.18	
50	58	4.79	
71		3.52	
4.70			
29			
4.41	5.38	3	
29			
4.12	5.10		
29			
3.83	4.79		
29			
3.54			
29			
3.25	4.21	0.02	
29			
2.96	4.01		
29			
2.67	3.71		
29			
2.38	4.41		
29			
2.09	5.15	0.00	
29			
1.80	4.80		

52657

2114

55

Sidewalk	890.05	58
Fl. Line	+ 2.64	
Manhole N End	892.69	22.19
Block 3. West of	890.50	80
15th Ave East	22.19	
	9.17	21.39
	130.00	
	58	
	29	
	87	470
		67
		274

5-31-57

BM
M.H.

4.64

9703

892.39

Lot 11

5.70

91.33

Lot 12

5.42

91.61

Orig Ground Levels

BM
M.H.

4.62

897.01

892.39

SE of
high

SW

10/11

49

892.1

54' W

SE

11/11

52

91.8

30 W

SW

12/11

48

92.2

SE of line

SE

12

49

92.1

NW of line

NW

12/13

48

92.2

NE

12

50

92.0

W of line

12/13/14

42

92.8

East

13/14

45

92.5

W

13/14/15

50

92.0

East

13/14/15

52

91.8

Taken on Lot Lines
at about 54' West of
East Lot Line and at
30' West of East Lot Line

20
33
5292.39
92.39
92.03
91.33
5.70

56

± 18.44

LAWD

Grade

Lot 11

891.33

890.33

Lot 12

91.61

91.61

of E. Lot Line 54' 45"

889.65

" " "

C.H.

889.79

92.43

4+81

54

91.61

890.33

54.2

4+17

897.79

8.2

90.61

3+43

Barker & Rutstrom

2+79

BM			
M.H.	457	96.94	892.39
LAWN			
Lot 11		4.60	92.36
LAWN			
Lot 12		4.05	92.91

Pipeline Grading

2+00		91.38
50		90.63
3+00		89.80
50		88.69
4+00		87.57
50		86.44
5+00		85.34
50		84.23
6+00		83.11
50		82.00
7+00		82.69
50		83.64
8+00		84.59
16th Ave.		84.80

June 1st 1957

LAWN

1-57

92.39	Lot 11 -	892.36	-	891.36
957				
96.94	Lot 12 -	892.91	-	891.91
5239				
4.60	96.94	816.2		
	92.91			
	4.05			

curb
Grades

Approx. top curb stks for 18th St
Pipeline Grading

BM	2.22	89461		89239
2100			323	9138
50			398	9063
3100			481	8980
50		-	592	8869
4400			704	8757
50			815	8646
5100			927	8534
TP	0.89	88384	1166	8295
50			561	7823
6700			073	8311
50			184	8200
7400			115	8269
50			020	8364
8100				8459
TP	778	88869	293	8091
7150			505	8364
8100			410	8459
Conc Abutment			326	8543
IP			549	
top Pave 16th Ave - 18th St			356	885.13
STK			9.1	
Ground			108	
			9.3	

1 - 58

		9239	
		222	
		7461	
223	1' above		
278	1' above		
381	1' above curb OK		
392	2' above		
604	1' above		
715	1' above		
827			
541			
7823	6' below curb		
12.73	12' below curb		
784	6' below		
715	6' below		
454	1' below curb		

BM	458	896.97		892.39	MH
6714			7.17		89.80
6700		✓	7.01	8996	89.96
5750		✓	6.45		90.52
5700		✓	5.88		91.09
4750		✓	5.32		91.65
4730		✓	5.09		91.88
4400		✓	4.68		92.29
3750		✓	4.53		92.44
3700		✓	5.13		91.84
2750		✓	6.13		90.84
2700		✓	7.13		89.84
TP 1150			8.13		89.84
1750	174	9380	5.13	91.84	88.84
1700			5.96		87.84
0750			6.74		86.84
0733			7.30	86.50	

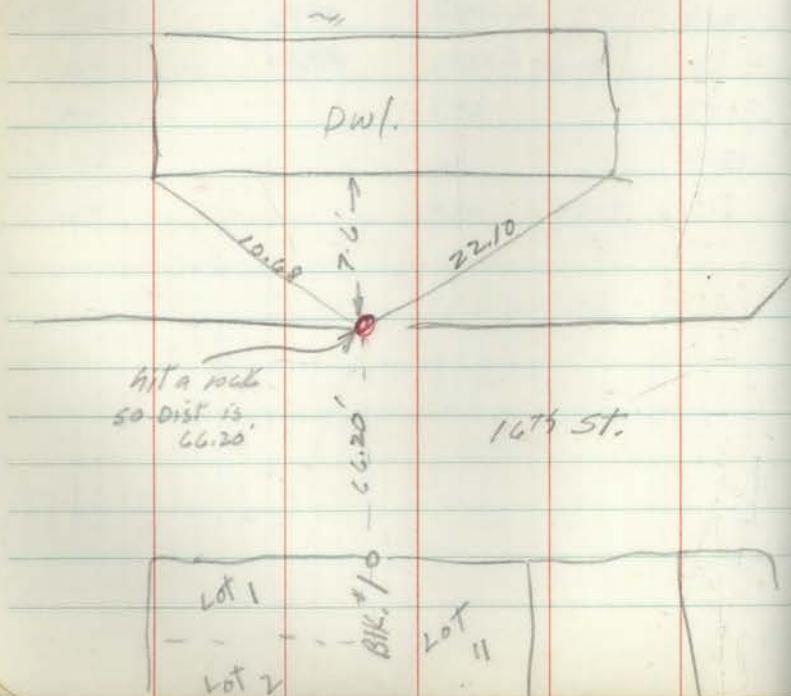
T. Carb - 1415 Ave.

511

	0700		0133-886.50
2' above curb	50		86.84
3' " " OK	1100		87.84
2' above	50		88.84
1' above	2100		89.84
1' above	50	-	90.84
1' above	3100		91.84
1' above	50		92.44
1 curb	4700	-	92.29 4730-91.88
1 curb	50		91.65
2' above curb	5700		91.09
3' above	50		90.52
3'	6700	-	89.96
3'	6714		89.80
4'			

Top of water line Pipe Elev.
W. Side B.R. 2

BM	577	896.22	891.45
Top Lot #1 $\frac{3}{4}$ "	11.4	885.8	
Top Lot 2	11.4	884.8	
Lot 3	11.2	850	
Lot 4	10.5	85.7	
Lot 5	9.9	86.3	
Top pipe at valve	10.5	85.7	
Top valve	9.2	87.0	
Lot 6	10.1	861	
Lot 7	10.4	85.8	
Lot 8	10.7	85.5	



M.H. 16th St 13th Ave

Top 6" Line 4" Lin.

Top 6" Line 4" Lin.

Top 6" Line 4" Lin.

Elev on top of 6" water line
No. side 18th St.

0400 = SW Cor. Bldg. # 2

B.M.	398	89637		89239
5+54	Top North			
1764	1758.5	Top No	121	105
1768			12.1	8843
2160	-21		134	883.0
Top Valve 3' North			12.0	8844
T.P. 2157	645	88957	13.25	88312 *
2155		230'	64	8832
3461		124'	92	880.4
4126		51'	103	879.3
4178			131	8765
T.P. 4178	652	88292	13.17	87640
5134		-234	119	8710
5184		184'	14.9	8680
6162		104'	11.1	8718
7118		5'	75	8754
7168			5.6	8773
7168	Valve		4.05	87887
7168	Hyd		-	
7170	Tee		5.6	8773

B.M. 492 9731 89239
Lot 10 495 89236

2187

61

Dec 2187

M.H. E 18th St 14th Dec 2187

Top 6" water line

W.H. going to North 6" C.T.

228'

Dec 4185

Top Lot North #10

478

290

768

Dec 7168

768

154

184

Taps to Lot 9 + 10

#9 are 45' E of SW Cor Bldg
#10 164' E of SW Cor Bldg

2' So.

4.5' So.

3-457

Top of 6" water line
East Side BIK #2

0+00 - Intersection on 16th St.

BM.	1313	883.12
6+24	Intersection ESW	13.3
6+21	Valve	11.9
6+00		13.3
5+13		12.9
4+94		12.9
4+92		12.9
4+49		12.3

6" water line E Side BIK #2

0+10 = SE Corner BIK 2

- 05.55 to valve 11.5

BM.	4.74	895.48	890.74
0+46		120	
1+03		12.1	
1+24		12.1	
1+68		11.6	
2+31		11.2	
2+64	Hyd. East	10.6	
2+96		10.4	
3+60		12.1	
4+24		13.1	
TP	0.85	2.69	
4+85		12.6	
5+08		13.2	
5+52		14.0	
5+85	Valve-top	13.2	
BM.		4.36	891.12 NECH-BIK 2

62

TP 2157 Page 41

So Side BIK #2

Tap Lot 11

Tap) Crossover

Tap

Tap Lot 12

3-4-57

Measured curb code
on E. Side 14th Ave E

Tap pipe

SE Cor. BIK 2

for Double
from SW Cor BIK 1

Tap West

Double Tap East

Tap West

" West

Tap West

" "

Tap West

Double E

Tap West

1.5 above pipe

No 1 is { 128' North
 { 256' N
 { 257
 { 384.5
 { 385.5
 { 511.
 { 513

4.23	894.68		890.45
262	887.72	958	885.10
		16.26	871.46

BM.	7.54	90.40	882.84	FL LINE
0+00				870.60
25	✓	19.51	740.1	70.89
50	✓	19.22	71.20	71.18
75	✓	18.93	71.59	71.47
1+00	✓	18.64	71.88	71.76
25	✓	18.35	72.17	72.05
50	✓	18.06	72.46	72.34
75	✓	17.77	72.75	72.63
2+00	✓	17.48	73.04	72.92
25	✓	17.19	73.33	73.21
50	✓	16.90	73.62	73.50
75	✓	16.61	73.91	73.79
3+00	✓	16.32	74.20	74.08
25	✓	16.03	74.49	74.37
50	✓	15.74	74.78	74.66
75	✓	15.45	75.07	74.95
4+00	✓	15.16	75.36	75.24
25		14.87		75.53
TP. 50	4.59	92.66	2.33	880.7
25				

East Side of West Lot
Block 1 of 14th Ave E 63
BM 13th Ave

Top Pipe 8" sewer East side Lot
FL 870.66

		871.46
1.16%		80
751	C-12.0	870.66
722	C-12.0	Flow Line 870.72
793	C-11.0	877.20 FL @
764	C-11.0	
835	C-10.0	Grade 1.160%
906	C-9.0	
977	C-8.0	
1048	C-7.0	
719	C-10.0	
390	C-13.0	
261	C-14.0	
282	C-14.0 - ON GROUND	
203	C-14.0	
174	C-14.0	
145	C-14.0	
116	C-14.0	

Raise all elev. 12 to F.L.

4125	✓	17.13	75.65	75.53
50	✓	16.84	75.94	75.82
75	✓	16.55	76.23	76.11
5900	✓	16.26	76.52	76.40
25	✓	15.97	76.81	76.69
50	✓	15.68	77.10	76.98
75		15.39	77.39	77.27
M.H. ON GROUND		5.3	87.4	
SW Cor		288	89.78	89.87
BIL 1				

MHole Height

No 4	15.74	Less 8" Top	15.07
No 5	13.88	"	13.21
No 6	10.50	"	9.83

500	86.27	890.36	885.36
0.100			872.07
25		13.95	72.32
50 TP.	11.70	890.36	845.7
75		17.79	72.57
1400		17.54	72.82
25		17.29	73.07
50		17.04	73.32
75		16.79	73.57
2400		16.54	73.82
		16.29	74.07

413	C-13.0
284	C-14.0
355	C-13.0
426	C-12.0
397	C-12.0
368	C-12.0
439	C-11.0

Could be 15.10 with out MH^{8"} cover
 " " 13.0
 " " 10.0

FI @ M.H.

895	C-5.0
5.79	C-12.0
1.54	C-16.0
4.29	C-13.0
4.04	C-13.0
4.79	C-12.0
4.54	C-12.0
4.29	C-12.0

84.57
 1.29
 86.27
 72.32
 13.95
 86.27
 72.07
 14.20
 8.15

2125	✓	7.56		
2150	✓	8.17		
2175	✓	8.78		
2186	MH	9.05	72.87	872.07
3100	G+ change	✓ 9.23		71.90
25	✓	9.54	71.58	71.58
3150	✓	9.85		
75	✓	10.17		
4100	✓	10.48		70.64
25	✓	10.80		
50	✓	11.11		
75	✓	11.43		
5100	✓	11.75		
25		12.07		
30		12.13	68.99	69.00

#9 M.H.
5130 is 119' North of M.H. that is
at 18th St.

81.12

19.29
10.29
C-70' old sewer.

861.83

450	C-30
517	C-30
579	C-30
605	C-30
623	C-30
639	C-30
585	C-40
617	C-40
848	C-20
780	C-30
711	C-40
743	C-40
875	C-30

10.13 C-20

0.1%

859.00 Fl. Line
283 up

861.83 top of 30" Cinc Sewer @ 5130

81.12
41.83
19.29

244	11	
244		
244		8.78
244		27
		90.5
81.12		
905		
7207		12.6
17		14
7190		50.4
		126
		170.4
		14
126		
39		1.26 - 100
1134		63 - 50
378		
4714		.31 - 25
	72.07	
	77	
	71.58	81.12
		75.5
		9.54
71.90		
126		81.12
70.64		10.29
		20.24

126
30
378.0 - 38
11.75
38
1213
344

81.12
12.13
68.99

460 976.59

971.99

15.20

961.39

Top 30" Conc Pipe

SAN. Sewer Line

A 2+86-1' H₂

BS.

[5+32] M.H.

0+00

171-13-30

New angle

4+50

7.31

4+75

7.625

5+00

7.935

3.935

C-40

5+25

8.255

3.255

C-50

see bottom page 42

67

Top Mesaba Clinin M.H. on 30" sewer

(961.73 Top 30" Con Pipe)

should be about old

Nite 7-9-57

Barke

Rundstrom

Borelli

0+00 = SE Cor. BIK "1" going North
6" Pipe line

BM	3.31	889.67	986.36
Hyd.		2.40	
		10.81	
Tap West	0+33.5	11.60	
"	0+98	11.08	
"	1+58.5	10.80	
"	2+24	10.90	
"	2+90.5	10.85	878.82
Tap East	257	10.75	
West	3+53	10.60	
TP.	6.75	3.66	
	3+53	13.68	
Tap West	4+18	12.56	
"	4+81.5	11.13	
	5+44	10.05	
Top Pipe @ Valve	5+79	9.15	

+Taps
Water Line on 16th Ave East 68

Nite 7-9-57

Conc. Abut. 16th Ave

top large spout

Top water line at valve 6.5' So. 9'E of

SE Cor.
BIK 7"

Barline

Ruts from

Barrelli

at IP.

Location of Sewer Y^os

Block Lots 1-9 Blk #1

0+00 = M.H. 16th St going South

0+80.5 to west - Lot 1

0+83.5 East Lot 0

1+26.5 to west

1+88.5 to west

2+53.5 " "

2+99 M. Hole

3+14 to west

3+79.5 " "

4+42.0 " "

5+07.5

5+68 to west
5+73 MH

Sewer "Y" West of Lots 14 to 22

00 Sewer MH North End

6'5 East

29.5 West

61 East

126.5 "

192 "

255.5 "

286.5 " + MH

321.5 "

384.5 "

450

Top MH Sec Block 12 Page 46

69

311.5

321.5

Sewer 6" Crossing 16th Ave East
is 317.5 South of NE Corner
Block 1 Water Line at
321 South of NE Corner.

Blk 2

Blk 1

57.5 N of Curb + 122.20 E - Blk 2

Poles 130'E

Blk 1

N 511 - 16' 1" 12 1/2 East

Poles 130.6 East

+ 35 N of Line

Sewer MH is 35' south of N Line
Lot 13 - Blk 1 + 6.4' West of East Lot Line

MH - 35' S of Line 16th

+ 15 + 16 Miles

+ 6.4' West Lot Line

Sewer 6" Crossing 16th Ave East is
317.5 South of NE Cor Block 1.

Water Line Crossing 16th Ave East.
is 321.5 South of NE Cor at

Block 1

Water Taps on West side

Block 2 or on 13th Ave East

Measure south from NW
Corner of Block 2 to

the following Taps

Lot 1 64.3' Copper Service to Lot 1

Lot 2 125.5' 1700 S N. end 4" Line

Lot 3 167.0

Lot 4 228.5

Lot 5 292.9

Lot 6 358.5

Lot 7 424.6

Lot 8 461.2

Lot 9

4" 4" E.L.
363.5
4" 4" End of 4" Line
Service from 18th St.
East from SE Corner of
Block

NW Cor. BIK. #1 - 158' to Standpipe 7' No. of

IP E. Side Bridge Alley 77' JNT-Double C. Cock 8 1/2' No.

42' No. of NE BIK. Cor | 8' E. of

Water

70

18th St.

is 33' East of Block 2 on Lot Line

6" Valve is 35' E of Block 2 13.55' South

Lot Line - 41' No. to 10" Line

12' So. - end of 41' " " "

Lot Line

Location of Sewer "Y"
 & BIK #2

0100 M.H.	on 16th St. South	
0463.5	To West	Lot 1
0471.5	" East	18
1126.7	To West	Lot 2
1142.4	To East	17
1190.4	To West	Lot 3
2107.7	To East	16
2155	West	Lot 4
2172.5	East	15
3120	West	Lot 5
3136	East	14
3182.5	West	Lot 6
3190	East	13
4147	West	Lot 7
4164	East	12
5+151 5+11	West	Lot 8
5+27 ✓	East	Lot 11
5+61 ✓	West	Lot 9
5+68 ✓	East	Lot 10
5+80 ✓	MH	

Erickson Plot Count Ho 71

5-23-57 5-25-57

Barker & Ruckstrom

Sewer Line 34.2N of 16th
 + 4 Eas Lot 4
 Polos 4 W of Lot 4

Given to K. & L.

Total Height of Manhole,

Block 2

MH No 1

" No 2

" No 3

E Side Lots 1 to 9 Block 1

MH No 4 15.74 minus 8" 15.07

MH No 5 13.88 " 8" 13.21

" 6 10.50 " 8" 9.83

W Side Lots 14 to 20

MH No 7 9.45 " 8" 8.77

MH No 8 13.23 minus 8" 12.55

MH No 9 13.68 minus 8" 13.0

Estimate of July 1st 1957

Water Lines

4" CI E Side 13th Ave E	363.5'
6" CI W Side 14th Ave E	595.
6" CI N Side 18th St	620'
17 Short Taps 10' Long	170'
8 Long Taps 57' Long	456'
1 Long Tap 46' Long	46'
2 Hydrants complete	\$834.00
4 6" Gate valves	\$130.
26 Corpor cocks	\$30.00
26 Curb	
26 Valve Boxes	

Sewers

Block 2 -	580
with 18 "Y"	
Manholes	3

East Side Lots 1 to 9

Block 1	568'
with 11 "Y's"	
Manholes	4

Total 8" Sewer 1148

" "Y's 4

(See Book 12 Page 75)
Aug Estimate

763.35
@ 210
@ 260
1578.5 X 5.84 per Lin ft = 9,218.44
562. @ 204 = 463.40
228 Tranche, @ 1.10
Lot 1 N of 4" CI to Lot 1 Blk 2
\$1668
\$520.00

780.00

Item
\$ 9240.20
7696.16
16936.36

80% 13548.80

2 not complete

\$ 7.12 Lin ft =

Item
\$ 7.696.16

\$ 8,173.76

80% = 13,913.76

June Total

\$ 17,392.20

4.17 89656

892.39

73

6414	676	90.52	
6100	⁶⁶⁰ (460)	89.80	
		87.90	C - 2.0
5150	⁶⁵⁴ (504)	90.52	C 1.0
500	⁵⁹⁷ (447)	91.09	C 1.0
450	⁴⁷¹ (391)	91.65	C 1.0
4130	⁴⁰⁸ (368)	91.68	C 1.0
400	³⁶⁷ 3.27	93.29	92.27
350	92.44	92.44	C 0.0
300	4.72	91.84	C 0.0
250	4.72	91.84	90.84
200	372	89.84	C - 1.0
			C - 3.0

B17	434	96.75	892.39	
3100 check E side	491	91.84	91.84	C - 0.0
3100 West side	491			C - 0.0
2170	440	92.44		
2150	⁴⁹¹ 5.91	90.84		C - 1.0
2100	³⁹⁰ 6.91	89.84		C 3.0
1150 +	⁴¹⁰ 7.91	88.84		C 3.0
1100	⁵⁴⁰ 8.91	87.84		C 3.0
0150	⁵⁰⁰ 9.91	86.84		
3150		92.44		C 0.0
4100	9.44			

Fill 40500 cu Yds
New Boundaries to Plat

NW Cor. Fork NW Cor. Plat	84-43-48	584-43-48	360.52
NW Cor. Plat NE Cor. Plat	"	"	456.37
NE Cor. Plat SE Cor. Plat	95-16-12	South	680.55
SE Cor. Plat SW Cor. Plat	84-53-37	N 84-53-37	447.29
SW Cor. Plat NW Cor. Plat	95-06-23	North	681.83

Council wants to fill hole
4-10-57 only 1 1/2 Blad⁷¹

North	South	East	West	South	East
	33.113	358.996		33.113	358.996
	40.677	441.000		73.790	799.996
	680.550			754.340	799.996
39.408			441.003	714.932	358.993
681.83				33.102	358.993

These are final Metast

NW Cor Plat	NW Cor Plat	84-43-48	584-43-48E	360.52	0918.4921 995.77293
NW Cor Plat	SW Cor plat	95-16-12	South	681.83	-
SW Cor Plat	SE Cor Plat	95-6-23	5-84-53-37E	734.87	996.03115 089.00536 636.2325
SW Cor Plat	East Side on RT of Way	124-24-45	N34-31-08E	40.06	771.4149
East Side on RT of Way	SE Cor Blk 4	145-35-15	N5-06-23E	32.95	089.0054 996.0311
East Side on RT of Way	NE Cor Plat	145-35-15	N5-06-23E	643.74	"
NE Cor Plat	NW Cor Plat	90-09-49	N84-43-48W	818.18	0918.4921 995.77293

Bounds Erickson Plat

1-12-57 75

North	South	East	West	South	East
	33.113	358.996		33.113	358.996
	681.83			714.943	358.996
	65.408	731.953		780.351	1090.959
30.903		25.491		749.448	1116.450
32.819		2.933		716.629	1119.383
641.185		57.296		108.263	1173.746
75.149			814.721	33.114	359.025
			cl	33.113	358.996

See page 77 for reverse

Contains 12.22 Acres

	Sin	Cos	Tang	Cotang	
84-53-37	996 0315	08900536	11.190693	0893600	S. Side
84-43-48	995 7729	09184921	10.841377	0922391	N. Side
0-09 49	0028555	9999959	0028555		

125.4981
5-6-23
125

11.170

S. Side - 76 ✓

Total 442.7572

66.2629
5-6-23
66

58978
58974

33.1314
5-6-23
33

68485
29487

125.5318
516-12
125

11.5291

North Side
442.8756

66.2802
516-12
66

18809
60879

33.1401
516-12
33

30439
63405

125.0005
0-9-49
125

43569

66.00
0-9-49
66

1884

33.00
0-9-49
33

0942

Ericksen Court Ho. A'd.

Coordinates to Plat

NW Cor. Furt.	NW Cor. Plat	84-43-48	S-44-43-48E	360.52	09184921 995.77293
NW Cor. Plat	SW Cor. Plat	95-16-12	South	681.83	996.03115
SW Cor. Plat	SE Cor. Plat	95-6-23	S-84-53-37E	734.88	689.00536
SE Cor. Plat	NE Point	113-32-11	N-28-38-34E	605.38	877.62533
RT of Way	on RTW	168-28-29	N-17-07-03E	123.66	479.34724
NE Cor. of RT of Way	E Side 16th Ave				955.70318
E Side 16th Ave	1/16 Line				294.33224
1/16 Line	SW Cor. Plat	78-8-52	N-84-44-09	1063.12	09176714
1/16 Line	Plat		N-84-43-48W		995.78041

Coord. to Blk 2-3

NW Cor. Blk 2	SW Cor. Blk 2	00-00	South	582.4365	582.4365
SW Cor. Blk 2	SE Cor. Blk 2	95-6-23	S-84-53-37E	442.7572	39.40565
SE Cor. Blk 3	NE Cor. Blk 3		North	581.150	581.150
NE Cor. Blk 3	NW Cor. Blk 3		N-84-43-48W	442.8756	40.4778

SE Cor. Plat	NE Cor. Plat	114-34-25	N-24-40-48E	551.06	495.15543
SE Cor. Plat	SW Cor. Plat	65-35-35	N-84-43-22	140.70	868.80417
SW Cor. Plat	SE Cor. Plat	90-09-49	N-5-6-49E	175.00	995.76131
SE Cor. Plat	NE Cor. Plat	90-09-49	N-84-43-22	884.28	09197473

See page 75 for new outline of Plat 1-12-57

ENCKSON Plot

North	South	East	West	South	East
33.113	358.796	33.113	358.796	33.113	358.796
681.83	00	714.943	358.996	714.943	358.996
654.08	731.963	780.351	1090.959	780.351	1090.959
531.297	290.187	249.054	1381.146	249.054	1381.146
118.182	36.397	130.872	1417.543	130.872	1417.543

12.22 Acres

97.559	1058.634	33.213	358.909
Contain. 12.22 acres	ck	33.113	358.996
	S	East	
	582.4365	00	
440.9999	621.8421	440.9999	
	40.6921	440.9999	
441.0035 W	.01435	.0036W	

478.763	276.86	780.351	1090.959
12.941	140.104	301.588	1363.819
174.303	155.97	288.647	1223.716
81.331	880.53	114.344	1239.313
	ck	33.013	358.783
		33.113	358.996

Top Page

Former Plat old. Angl Distances -
Lakeview Cometern
Buhl.

Sta Occ	Sta Site	Angle	Bearing	Dist	North
NE Cor	IP. 1	0°-00	South	80.00	
IP. 1	IP. 2	180-00	South	514.24	
IP. 2	IP. 3	180-00	South	253.89	
IP. 3	IP. 4	88-15-40	N 88-15-40 W	399.68	12.13
IP. 4	IP. 5	180-00	N 88-15-40 W	76.23	14.456
IP. 5	IP. 6	37-47-20	N 53-57 E	374.96	220.660
IP. 6	IP. 7	195-57	N 38°-00 E	157-15	123.836
IP. 7	IP. 8	186-11-30	N 31-48-30 E	270.24	229.65
IP. 8	IP. 2	148-31-30	N 63-17 E	372.95	167.67
IP. 2	IP. 3	63-17	South		

SE NW Sec 28-58-20 NE 1/4 to
N 1/2 5 Ltr East Side Cometern
Assumed to be N 1/2.

South	East	West	South	West
80.00			80.00	00
514.24			594.24	00
253.89			848.13	00
		399.496	836.00	399.496
		476.110	821.544	875.606
	303.155		600.884	572.451
	96.75		477.048	475.701
	142.435		247.388	333.266
	333.133		79.718	.133
			80.00	0.00

see book 9 Page 48 for
New Traips.

Location of Potter's Field Grains

KIP. H. 135. IP 80' S. of Cor.
 Hub 0.00 63.50

K Hub 135. IP 80' S. of Cor.
 301-20 92' South Last Cross
 191' North Last Cross

CENTURY MATHEW'S SEWER
 M & H Plumbing Hitting

102'	6.25	106.25	100.00
40'	.	5.74	
207'	1.03	96.37	10.91
80		7.00	89.37

102
 207
 80
 80
 469. total

64. 4.92

Top Cap tank

Dry well

100.00
 89.37
 10.63
 2.4

Drop. 13.0

84.4
 2.4
 87.0

106.25
 10.91
 95.34
 1.03
 96.37
 7.00
 89.37

100.0
 87.0
 13.0

May 16th 1957

1 96.63

2 98.99

3 96.18

4 97.51 +856 to Hub on Lin.

389.31 ✓

5 63.55 Hub

6 55.49

IP 7 41.51

549.86 ✓

- .03 temp.

549.83

587.97 Temp 58°

549.83

38.14' Sta. to IP.

594.00

587.97

6.03

Chain in IP Line

AD- 1 49.70 ✓

2 46.62 ✓

IP, 3 37.85 ✓

4 71.44 ✓

5 87.84 ✓

6 92.19 ✓

7 74.56 ✓

8 81.75 ✓

9 84.67 ✓

10 39.42 ✓

11 47.89 ✓

12 78.96 ✓

IP 13 69.55 ✓

Total 862.42

13-15-92.10

16 75.36

17 55.35

18 43.14

19 66.01

20 58.60

IP 21 71.44

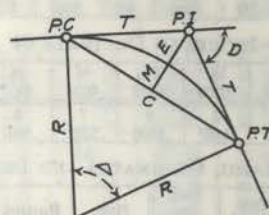
462.00

old stake

1323.42

DIETZGEN'S RAILROAD CURVE AND REDUCTION TABLES

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


130
66
266
462

CURVE FORMULAS

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

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

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

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

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

EXPLANATION AND USE OF TABLES

Stations.—Given P. I. = Sta. 161 + 60.35 to find Sta. of P. C. and P. T. $\Delta = 62^\circ 10'$ $D = 8^\circ 20'$. From Table IV for 1° curve $T = 3454.1$ and $\div 8 \frac{1}{3} = 414.49$ ft. From Table V correction = .36 or $T = 414.85$ ft. P. C. = Sta. P. I. - $T = 157 + 45.50$. Also from (4) $L = 746.00$ and P. T. = Sta. P. C. + $L = 164 + 91.50$.

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

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

Externals.—May be found in similar manner to tangents. Thus E for curve above is 115.37. For from Table IV for 1° curve $E = 960.6$ for $8^\circ 20' = 960.6 \div 8 \frac{1}{3} = 115.27$ and from Table V correction = .10 or $E = 115.37$ ft. Or suppose $\Delta = 32^\circ$ and E is measured and found to be 42 ft. What is D ? From Table IV $E = 230.9$ and $\div 42 = 5.5$ or $D = 5^\circ 30'$.

TABLE I.—MINUTES IN DECIMALS OF A DEGREE.

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

TABLE II.—INCHES IN DECIMALS OF A FOOT.

$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729	.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.—RADIUS, ORDINATES AND DEFLECTIONS.

Deg.	Radius	Mid. Ord.	Tan Offset	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan Offset	Def. for 1 Foot
0° 10'	34377.5	.036	.145	0.05'	7°	819.02	1.528	6.105	2.10'
20	17188.8	.073	.291	0.10	20	781.84	1.600	6.395	2.20
30	11459.2	.109	.436	0.15	30	764.49	1.637	6.540	2.25
40	8594.4	.145	.582	0.20	40	747.89	1.673	6.685	2.30
50	6875.55	.182	.727	0.25					
1° 10'	5729.65	.218	.873	0.30	8°	716.78	1.746	6.976	2.40
20	4911.15	.255	1.018	0.35	20	688.16	1.819	7.266	2.50
30	4297.28	.291	1.164	0.40	30	674.69	1.855	7.411	2.55
40	3819.83	.327	1.309	0.45	40	661.74	1.892	7.556	2.60
50	3437.87	.364	1.454	0.50	9°	637.28	1.965	7.846	2.70
	3125.36	.400	1.600	0.55	20	614.56	2.037	8.136	2.80
2° 10'	2864.93	.436	1.745	0.60	30	603.80	2.074	8.281	2.85
20	2644.58	.473	1.891	0.65	40	593.42	2.110	8.426	2.90
30	2455.70	.509	2.036	0.70	10°	573.69	2.183	8.716	3.00
40	2292.01	.545	2.181	0.75	30	546.44	2.292	9.150	3.15
50	2148.79	.582	2.327	0.80	40	521.67	2.402	9.585	3.30
	2022.41	.618	2.472	0.85	11°	499.06	2.511	10.02	3.45
3° 10'	1910.08	.655	2.618	0.90	20	478.34	2.620	10.45	3.60
20	1809.57	.691	2.763	0.95	30	459.28	2.730	10.89	3.75
30	1719.12	.727	2.908	1.00	40	441.68	2.839	11.32	3.90
40	1637.28	.764	3.054	1.05	13°	425.40	2.949	11.75	4.05
50	1562.88	.800	3.199	1.10	30	410.28	3.058	12.18	4.20
	1494.95	.836	3.345	1.15	40	396.20	3.168	12.62	4.35
4° 10'	1432.69	.873	3.490	1.20	15°	383.07	3.277	13.05	4.50
20	1375.40	.909	3.635	1.25	30	370.78	3.387	13.49	4.65
30	1322.53	.945	3.718	1.30	40	359.27	3.496	13.92	4.80
40	1273.57	.982	3.926	1.35	17°	348.45	3.606	14.35	4.95
50	1228.11	1.018	4.071	1.40	30	338.27	3.716	14.78	5.10
	1185.78	1.055	4.217	1.45	40	319.62	3.935	15.64	5.40
5° 10'	1146.28	1.091	4.362	1.50	19°	302.94	4.155	16.51	5.70
20	1109.33	1.127	4.507	1.55	20°	287.94	4.374	17.37	6.00
30	1074.68	1.164	4.653	1.60	21°	274.37	4.594	18.22	6.30
40	1042.14	1.200	4.798	1.65	22°	262.04	4.814	19.08	6.60
50	1011.51	1.237	4.943	1.70	23°	250.79	5.035	19.94	6.90
	982.64	1.273	5.088	1.75	24°	240.49	5.255	20.79	7.20
6° 10'	955.37	1.309	5.234	1.80	25°	231.01	5.476	21.64	7.50
20	929.57	1.346	5.379	1.85	26°	222.27	5.697	22.50	7.80
30	905.13	1.382	5.524	1.90	27°	214.18	5.918	23.35	8.10
40	881.95	1.418	5.669	1.95	28°	206.68	6.139	24.19	8.40
50	859.92	1.455	5.814	2.00	29°	199.70	6.360	25.04	8.70
					30°	193.18	6.583	25.88	9.00

NOTE. Chord Deflection=2 times tangent deflection.

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

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

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
31°	1589.0	216.3	41°	2142.2	387.4	51°	2732.9	618.4
10'	1598.0	218.7	10'	2151.7	390.7	10'	2743.1	622.8
20'	1606.9	221.1	20'	2161.2	394.1	20'	2753.4	627.2
30'	1615.9	223.5	30'	2170.8	397.4	30'	2763.7	631.7
40'	1624.9	226.0	40'	2180.3	400.8	40'	2773.9	636.2
50'	1633.9	228.4	50'	2189.9	404.2	50'	2784.2	640.7
32°	1643.0	230.9	42°	2199.4	407.6	52°	2794.5	645.2
10'	1652.0	233.4	10'	2209.0	411.1	10'	2804.9	649.7
20'	1661.0	235.9	20'	2218.6	414.5	20'	2815.2	654.3
30'	1670.0	238.4	30'	2228.1	418.0	30'	2825.6	658.8
40'	1679.1	241.0	40'	2237.7	421.4	40'	2835.9	663.4
50'	1688.1	243.5	50'	2247.3	425.0	50'	2846.3	668.0
33°	1697.2	246.1	43°	2257.0	428.5	53°	2856.7	672.7
10'	1706.3	248.7	10'	2266.6	432.0	10'	2867.1	677.3
20'	1715.3	251.3	20'	2276.2	435.6	20'	2877.5	682.0
30'	1724.4	253.9	30'	2285.9	439.2	30'	2888.0	686.7
40'	1733.5	256.5	40'	2295.6	442.8	40'	2898.4	691.4
50'	1742.6	259.1	50'	2305.2	446.4	50'	2908.9	696.1
34°	1751.7	261.8	44°	2314.9	450.0	54°	2919.4	700.9
10'	1760.8	264.5	10'	2324.6	453.6	10'	2929.9	705.7
20'	1770.0	267.2	20'	2334.3	457.3	20'	2940.4	710.5
30'	1779.1	269.9	30'	2344.1	461.0	30'	2951.0	715.3
40'	1788.2	272.6	40'	2353.8	464.6	40'	2961.5	720.1
50'	1797.4	275.3	50'	2363.5	468.4	50'	2972.1	725.0
35°	1806.6	278.1	45°	2373.3	472.1	55°	2982.7	729.9
10'	1815.7	280.8	10'	2383.1	475.8	10'	2993.3	734.8
20'	1824.9	283.6	20'	2392.8	479.6	20'	3003.9	739.7
30'	1834.1	286.4	30'	2402.6	483.8	30'	3014.5	744.6
40'	1843.3	289.2	40'	2412.4	487.2	40'	3025.2	749.6
50'	1852.5	292.0	50'	2422.3	491.0	50'	3035.8	754.6
36°	1861.7	294.9	46°	2432.1	494.8	56°	3046.5	759.6
10'	1870.9	297.7	10'	2441.9	498.7	10'	3057.2	764.6
20'	1880.1	300.6	20'	2451.8	502.5	20'	3067.9	769.7
30'	1889.4	303.5	30'	2461.7	506.4	30'	3078.7	774.7
40'	1898.6	306.4	40'	2471.5	510.3	40'	3089.4	779.8
50'	1907.9	309.3	50'	2481.4	514.3	50'	3100.2	784.9
37°	1917.1	312.2	47°	2491.3	518.2	57°	3110.9	790.1
10'	1926.4	315.2	10'	2501.2	522.2	10'	3121.7	795.2
20'	1935.7	318.1	20'	2511.2	526.1	20'	3132.6	800.4
30'	1945.0	321.1	30'	2521.1	530.1	30'	3143.4	805.6
40'	1954.3	324.1	40'	2531.1	534.2	40'	3154.2	810.9
50'	1963.6	327.1	50'	2541.0	538.2	50'	3165.1	816.1
38°	1972.9	330.2	48°	2551.0	542.2	58°	3176.0	821.4
10'	1982.2	333.2	10'	2561.0	546.3	10'	3186.9	826.7
20'	1991.5	336.3	20'	2571.0	550.4	20'	3197.8	832.0
30'	2000.9	339.3	30'	2581.0	554.5	30'	3208.8	837.3
40'	2010.2	342.4	40'	2591.0	558.6	40'	3219.7	842.7
50'	2019.6	345.5	50'	2601.1	562.8	50'	3230.7	848.1
39°	2029.0	348.6	49°	2611.2	566.9	59°	3241.7	853.5
10'	2038.4	351.8	10'	2621.2	571.1	10'	3252.7	858.9
20'	2047.8	354.9	20'	2631.3	575.3	20'	3263.7	864.3
30'	2057.2	358.1	30'	2641.4	579.5	30'	3274.8	869.8
40'	2066.6	361.3	40'	2651.5	583.8	40'	3285.8	875.3
50'	2076.0	364.5	50'	2661.6	588.0	50'	3296.9	880.8
40°	2085.4	367.7	50°	2671.8	592.3	60°	3308.0	886.4
10'	2094.9	371.0	10'	2681.9	596.6	10'	3319.1	892.0
20'	2104.3	374.2	20'	2692.1	600.9	20'	3330.3	897.5
30'	2113.8	377.5	30'	2702.3	605.3	30'	3341.4	903.2
40'	2123.3	380.8	40'	2712.5	609.6	40'	3352.6	908.8
50'	2132.7	384.1	50'	2722.7	614.0	50'	3363.8	914.5

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

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

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
91°	5830.5	2444.9	101°	6950.6	3278.1	111°	8336.7	4386.1
10'	5847.5	2457.1	10'	6971.3	3294.1	10'	8362.7	4407.6
20	5864.6	2469.3	20	6992.0	3310.1	20	8388.9	4429.2
30	5881.7	2481.5	30	7012.7	3326.1	30	8415.1	4450.9
40	5898.8	2493.8	40	7033.6	3342.3	40	8441.5	4472.7
50	5916.0	2506.1	50	7054.5	3358.5	50	8468.0	4494.6
92°	5933.2	2518.5	102°	7075.5	3374.9	112°	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
93°	6037.8	2594.0	103°	7203.2	3474.4	113°	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
94°	6144.3	2671.6	104°	7333.6	3576.8	114°	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
95°	6252.8	2751.3	105°	7467.0	3682.3	115°	8993.8	4934.1
10	6271.1	2764.8	10	7489.6	3700.2	10	9022.7	4958.6
20	6289.4	2778.3	20	7512.2	3718.2	20	9051.7	4983.1
30	6307.9	2792.0	30	7534.9	3736.2	30	9080.9	5007.8
40	6326.3	2805.6	40	7557.7	3754.4	40	9110.3	5032.6
50	6344.8	2819.4	50	7580.5	3772.6	50	9139.8	5057.6
96°	6363.4	2833.2	106°	7603.5	3791.0	116°	9169.4	5082.7
10	6382.1	2847.0	10	7626.6	3809.4	10	9199.1	5107.9
20	6400.8	2861.0	20	7649.7	3827.9	20	9229.0	5133.3
30	6419.5	2875.0	30	7672.9	3846.5	30	9259.0	5158.8
40	6438.4	2889.0	40	7696.3	3865.2	40	9289.2	5184.5
50	6457.3	2903.1	50	7719.7	3884.0	50	9319.5	5210.3
97°	6476.2	2917.3	107°	7743.2	3902.9	117°	9349.9	5236.2
10	6495.2	2931.6	10	7766.8	3921.9	10	9380.5	5262.3
20	6514.3	2945.9	20	7790.5	3940.9	20	9411.3	5288.6
30	6533.4	2960.3	30	7814.3	3960.1	30	9442.2	5315.0
40	6552.6	2974.7	40	7838.1	3979.4	40	9473.2	5341.5
50	6571.9	2989.2	50	7862.1	3998.7	50	9504.4	5368.2
98°	6591.2	3003.8	108°	7886.2	4018.2	118°	9535.7	5395.1
10	6610.6	3018.4	10	7910.4	4037.8	10	9567.2	5422.1
20	6630.1	3033.1	20	7934.6	4057.4	20	9598.9	5449.2
30	6649.6	3047.9	30	7959.0	4077.2	30	9630.7	5476.5
40	6669.2	3062.8	40	7983.5	4097.1	40	9662.6	5504.0
50	6688.8	3077.7	50	8008.0	4117.0	50	9694.7	5531.7
99°	6708.6	3092.7	109°	8032.7	4137.1	119°	9727.0	5559.4
10	6728.4	3107.7	10	8057.4	4157.3	10	9759.4	5587.4
20	6748.2	3122.9	20	8082.3	4177.5	20	9792.0	5615.5
30	6768.1	3138.1	30	8107.3	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	6808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
100°	6828.3	3184.1	110°	8182.8	4259.7	120°	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

TABLE V.—CORRECTIONS FOR TANGENTS AND EXTERNALS.

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

FOR TANGENTS ADD

Central Angle	DEGREE OF CURVE													
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46
15°	.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.53	.58	.63	.68
20°	.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90
25°	.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14
30°	.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39
35°	.11	.22	.34	.47	.58	.69	.79	.89	.99	1.09	1.20	1.31	1.42	1.54
40°	.13	.26	.40	.53	.67	.80	.93	1.06	1.20	1.34	1.49	1.64	1.79	1.94
45°	.15	.30	.44	.60	.76	.91	1.06	1.21	1.37	1.52	1.70	1.87	2.04	2.21
50°	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.54	1.72	1.91	2.10	2.29	2.48
55°	.19	.38	.57	.76	.95	1.14	1.32	1.52	1.72	1.92	2.14	2.35	2.56	2.77
60°	.21	.42	.63	.84	1.05	1.27	1.49	1.71	1.94	2.17	2.38	2.60	2.83	3.07
65°	.23	.46	.69	.93	1.16	1.40	1.64	1.88	2.13	2.38	2.63	2.88	3.13	3.39
70°	.25	.51	.76	1.02	1.28	1.54	1.80	2.06	2.33	2.60	2.88	3.16	3.44	3.72
75°	.27	.56	.83	1.12	1.40	1.69	1.98	2.27	2.57	2.87	3.16	3.47	3.78	4.09
80°	.30	.61	.91	1.22	1.53	1.84	2.15	2.46	2.78	3.10	3.44	3.78	4.12	4.46
85°	.33	.66	1.00	1.33	1.68	2.02	2.36	2.70	3.05	3.40	3.77	4.14	4.55	4.89
90°	.36	.72	1.09	1.45	1.83	2.20	2.57	2.94	3.32	3.70	4.10	4.50	4.91	5.32
95°	.39	.79	1.19	1.55	2.00	2.40	2.80	3.20	3.61	4.02	4.40	4.88	5.38	5.83
100°	.43	.86	1.30	1.74	2.18	2.62	3.06	3.50	3.95	4.40	4.86	5.37	5.85	6.34
110°	.51	1.03	1.56	2.08	2.61	3.14	3.67	4.21	4.76	5.31	5.86	6.43	7.01	7.60
120°	.62	1.25	1.93	2.52	3.16	3.81	4.45	5.11	5.77	6.44	7.12	7.80	8.50	9.22

FOR EXTERNALS ADD

Central Angle	DEGREE OF CURVE													
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.001	.003	.004	.006	.007	.008	.009	.011	.012	.014	.015	.017	.018	.020
15°	.003	.007	.010	.014	.018	.023	.027	.032	.037	.043	.049	.055	.061	.067
20°	.006	.011	.017	.022	.028	.034	.039	.045	.051	.057	.063	.070	.076	.083
25°	.009	.018	.027	.036	.046	.056	.065	.074	.083	.093	.106	.120	.127	.135
30°	.013	.025	.038	.051	.065	.078	.090	.103	.116	.129	.149	.170	.179	.188
35°	.018	.035	.054	.072	.086	.109	.131	.153	.175	.197	.213	.230	.247	.264
40°	.023	.046	.070	.093	.117	.141	.172	.203	.234	.265	.277	.290	.315	.341
45°	.030	.060	.093	.119	.153	.184	.216	.254	.289	.325	.351	.378	.411	.445
50°	.037	.075	.116	.151	.189	.227	.266	.305	.345	.384	.425	.467	.508	.550
55°	.046	.093	.142	.188	.236	.283	.332	.381	.420	.479	.530	.582	.641	.700
60°	.056	.112	.168	.225	.283	.340	.398	.457	.516	.575	.636	.697	.774	.851
65°	.067	.135	.204	.273	.343	.412	.483	.554	.625	.697	.771	.845	.922	1.01
70°	.080	.159	.240	.321	.403	.485	.568	.652	.735	.819	.906	.994	1.08	1.17
75°	.095	.182	.266	.353	.440	.528	.617	.707	.797	.887	.977	1.07	1.18	1.29
80°	.110	.220	.332	.445	.558	.671	.787	.903	1.02	1.13	1.25	1.38	1.50	1.62
85°	.128	.259	.391	.524	.657	.790	.926	1.06	1.20	1.34	1.47	1.62	1.76	1.91
90°	.149	.299	.450	.603	.756	.910	1.07	1.22	1.38	1.54	1.70	1.87	2.03	2.20
95°	.174	.350	.522	.706	.885	1.06	1.25	1.43	1.62	1.80	1.99	2.18	2.38	2.53
100°	.200	.401	.604	.809	1.01	1.22	1.43	1.64	1.85	2.06	2.28	2.50	2.73	2.96
110°	.268	.536	.806	1.08	1.35	1.63	1.91	2.20	2.48	2.76	3.05	3.35	3.66	3.96
120°	.360	.721	1.08	1.45	1.82	2.19	2.57	2.95	3.33	3.72	4.11	4.50	4.91	5.32

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

FOR SUB-CHORDS ADD										Excess of arc per 100 ft.	LONG CHORDS				
D	10	20	30	40	50	60	70	80	90		D	200	300	400	500
4°	.00	.00	.01	.01	.01	.01	.01	.01	.00	.02	1	199.99	299.97	399.92	499.85
6	.00	.01	.01	.02	.02	.02	.02	.01	.01	.05	2	199.97	299.88	399.70	499.39
8	.01	.02	.02	.03	.03	.03	.03	.02	.01	.08	3	199.93	299.73	399.32	498.63
10	.01	.02	.03	.04	.05	.05	.05	.04	.02	.13	4	199.88	299.51	398.78	497.57
12	.02	.04	.05	.06	.07	.07	.07	.05	.03	.18	5	199.81	299.24	398.10	496.20
14	.02	.05	.07	.08	.09	.10	.09	.07	.04	.25	6	199.73	298.90	397.26	494.53
16	.03	.06	.09	.11	.12	.12	.12	.09	.05	.33	7	199.63	298.51	396.28	492.57
18	.04	.08	.11	.14	.15	.16	.15	.12	.07	.41	8	199.51	298.05	395.14	490.31
20	.05	.10	.14	.17	.19	.20	.18	.15	.09	.51	9	199.38	297.54	393.86	487.75
22	.06	.12	.17	.21	.23	.24	.22	.18	.10	.62	10	199.24	296.96	392.42	484.90
24	.07	.14	.20	.25	.28	.28	.26	.21	.12	.74	12	198.90	295.63	389.12	478.34
26	.09	.17	.24	.29	.32	.33	.31	.25	.15	.86	14	198.51	294.06	385.22	470.65
28	.10	.19	.27	.34	.37	.38	.36	.29	.17	1.00	16	198.05	292.25	380.76	461.86
30	.11	.22	.31	.39	.43	.44	.41	.33	.19	1.15	18	197.54	290.21	375.74	452.02
32	.13	.25	.36	.44	.49	.50	.47	.38	.22	1.31	20	196.90	287.94	370.17	441.15
34	.15	.28	.40	.50	.55	.57	.53	.43	.25	1.48	22	196.32	285.44	364.06	429.30
36	.17	.32	.45	.56	.62	.64	.59	.48	.28	1.66	24	195.63	282.71	357.43	416.53
38	.18	.36	.51	.62	.70	.71	.66	.53	.31	1.86	26	194.87	279.76	350.30	402.89
40	.21	.40	.56	.69	.77	.79	.73	.59	.35	2.06	28	194.06	276.59	342.69	388.42
42	.23	.44	.62	.76	.85	.87	.81	.65	.38	2.28	30	193.18	273.20	334.61	373.20
44	.25	.48	.68	.84	.94	.96	.89	.72	.42	2.50	32	192.25	269.61	326.08	357.28
46	.27	.52	.75	.92	1.02	1.05	.98	.78	.46	2.74	34	191.26	265.81	317.12	340.73
48	.30	.57	.81	1.00	1.12	1.14	1.06	.86	.50	2.99	36	190.21	261.80	307.77	323.61
50	.32	.62	.89	1.09	1.21	1.24	1.15	.93	.55	3.24	38	189.10	257.60	298.03	305.99
52	.35	.67	.96	1.18	1.31	1.35	1.25	1.01	.59	3.52	40	187.94	253.21	287.94	287.94
54	.38	.73	1.04	1.28	1.42	1.46	1.35	1.09	.64	3.80	42	186.72	248.63	277.51	269.54
56	.41	.78	1.12	1.38	1.53	1.57	1.46	1.17	.69	4.09	44	185.44	243.87	266.78	250.85
58	.44	.84	1.20	1.48	1.65	1.69	1.57	1.20	.74	4.40	46	184.10	239.93	255.78	231.95
60	.47	.91	1.29	1.59	1.76	1.81	1.68	1.35	.80	4.72	48	182.71	233.83	244.51	212.92

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

TABLE VII.—MIDDLE ORDINATES FOR RAILS IN FEET.

Deg. of Curve	LENGTH OF RAILS						Deg. of Curve	LENGTH OF RAILS					
	32	30	28	26	24	22		32	30	28	26	24	22
1°	.022	.020	.016	.013	.011	.009	16°	.356	.313	.273	.236	.200	.170
2	.045	.038	.034	.029	.025	.021	17	.378	.333	.290	.252	.213	.180
3	.067	.058	.051	.044	.037	.031	18	.400	.351	.306	.265	.225	.190
4	.089	.079	.069	.060	.050	.042	19	.423	.371	.324	.280	.238	.201
5	.112	.099	.086	.074	.063	.053	20	.445	.392	.341	.296	.250	.212
6	.134	.117	.102	.088	.076	.064	21	.466	.410	.357	.309	.262	.222
7	.156	.137	.120	.104	.088	.074	22	.487	.430	.375	.325	.275	.233
8	.179	.158	.137	.119	.100	.085	23	.509	.450	.390	.338	.287	.243
9	.201	.175	.153	.133	.112	.095	24	.531	.469	.408	.354	.299	.253
10	.223	.196	.171	.148	.125	.106	25	.552	.486	.424	.367	.311	.263
11	.245	.216	.188	.163	.139	.117	26	.573	.506	.441	.382	.323	.274
12	.268	.236	.206	.179	.151	.128	27	.594	.524	.457	.396	.335	.284
13	.290	.254	.222	.192	.163	.138	28	.618	.545	.475	.411	.348	.294
14	.312	.275	.239	.207	.175	.148	29	.638	.564	.491	.424	.361	.303
15	.334	.295	.257	.223	.188	.159	30	.660	.583	.508	.438	.374	.313

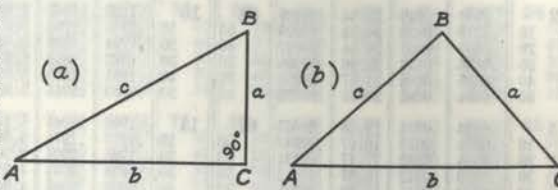
SLOPE REDUCTIONS.

When distances are measured on a slope that may be reduced to the equivalent horizontal distance by the following approximate rule:—subtract from the slope distance the square of the rise divided by twice the slope distance. Thus for a slope distance of 250.3 ft. and a rise of 15 ft. correction=15²÷2×250.3=.45 (by slide rule) or horizontal distance=250.3-.45=249.85. When vertical angle=V. A. is measured horizontal distance=slope distance—slope distance (1—Cos. V. A.). Thus for slope distance of 248.7 ft. and V. A. of 4° 20' from Table VIII Cos=.99714 and correction=1-.99714=.00286 per foot or total of .286×2½ (near enough)=.57 and horizontal distance=248.7-.57=248.13 ft.

See fig. (a).

TRIGONOMETRICAL FORMULAS.

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



FORMULA FOR SOLVING TRIANGLES.

Given	Sought.	Right triangles. See fig. (a).
a, c	A, B, b	$\sin. A = \frac{a}{c}, \cos. B = \frac{b}{c}, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan. A = \frac{a}{b}, \cot. B = \frac{b}{a}, c = \sqrt{a^2 + b^2}$
A, a	B, b, c	$B = 90^\circ - A, b = a \cot. A, c = \frac{a}{\sin. A}$
A, b	B, a, c	$B = 90^\circ - A, a = b \tan. A, c = \frac{b}{\cos. A}$
A, c	B, a, b	$B = 90^\circ - A, a = c \sin. A, b = c \cos. A$

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

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.		Angle	Sine.	Tan.	Cotg.	Cosin.	
0	0	0	∞	1	90	0	1	∞	0	0	90
10	.0029	.0029	343.8	.99998	50	80	.1392	.1405	7.115	.99027	82
20	.0058	.0058	171.9	.99996	40	70	.1421	.1435	6.968	.98986	50
30	.0087	.0087	114.6	.99996	30	60	.1449	.1465	6.827	.98944	40
40	.0116	.0116	85.94	.99993	20	50	.1478	.1495	6.691	.98902	30
50	.0145	.0145	68.75	.99989	10	40	.1507	.1524	6.561	.98858	20
						30	.1536	.1554	6.435	.98814	10
1	.0175	.0175	57.29	.99985	89	9	.1564	.1584	6.314	.98769	81
10	.0204	.0204	49.10	.99979	50	10	.1593	.1614	6.197	.98723	50
20	.0233	.0233	42.96	.99973	40	20	.1622	.1644	6.084	.98676	40
30	.0262	.0262	38.19	.99966	30	30	.1650	.1673	5.976	.98629	30
40	.0291	.0291	34.37	.99958	20	40	.1679	.1703	5.871	.98580	20
50	.0320	.0320	31.24	.99949	10	50	.1708	.1733	5.769	.98531	10
2	.0349	.0349	28.64	.99939	88	10	.1736	.1763	5.671	.98481	80
10	.0378	.0378	26.43	.99929	50	10	.1765	.1793	5.576	.98430	50
20	.0407	.0407	24.54	.99917	40	20	.1794	.1823	5.485	.98378	40
30	.0436	.0437	22.90	.99905	30	30	.1822	.1853	5.396	.98325	30
40	.0465	.0466	21.47	.99892	20	40	.1851	.1883	5.309	.98272	20
50	.0494	.0495	20.21	.99878	10	50	.1880	.1914	5.226	.98218	10
3	.0523	.0524	19.08	.99863	87	11	.1908	.1944	5.145	.98163	79
10	.0552	.0553	18.07	.99847	50	10	.1937	.1974	5.066	.98107	50
20	.0581	.0582	17.17	.99831	40	20	.1965	.2004	4.989	.98050	40
30	.0610	.0612	16.35	.99813	30	30	.1994	.2035	4.915	.97992	30
40	.0640	.0641	15.60	.99795	20	40	.2022	.2065	4.843	.97934	20
50	.0669	.0670	14.92	.99776	10	50	.2051	.2095	4.773	.97875	10
4	.0698	.0699	14.30	.99756	86	12	.2079	.2126	4.705	.97815	78
10	.0727	.0729	13.73	.99736	50	10	.2108	.2156	4.638	.97754	50
20	.0756	.0758	13.20	.99714	40	20	.2136	.2186	4.574	.97692	40
30	.0785	.0787	12.71	.99692	30	30	.2164	.2217	4.511	.97630	30
40	.0814	.0816	12.25	.99668	20	40	.2193	.2247	4.449	.97566	20
50	.0843	.0846	11.83	.99644	10	50	.2221	.2278	4.390	.97502	10
5	.0872	.0875	11.43	.99619	85	13	.2250	.2309	4.331	.97437	77
10	.0901	.0904	11.06	.99594	50	10	.2278	.2339	4.275	.97371	50
20	.0929	.0934	10.71	.99567	40	20	.2306	.2370	4.219	.97304	40
30	.0958	.0963	10.39	.99540	30	30	.2334	.2401	4.165	.97237	30
40	.0987	.0992	10.08	.99511	20	40	.2363	.2432	4.113	.97169	20
50	.1016	.1022	9.788	.99482	10	50	.2391	.2462	4.061	.97100	10
6	.1045	.1051	9.514	.99452	84	14	.2419	.2493	4.011	.97030	76
10	.1074	.1080	9.255	.99421	50	10	.2447	.2524	3.962	.96959	50
20	.1103	.1110	9.010	.99390	40	20	.2476	.2555	3.914	.96887	40
30	.1132	.1139	8.777	.99357	30	30	.2504	.2586	3.867	.96815	30
40	.1161	.1169	8.556	.99324	20	40	.2532	.2617	3.821	.96742	20
50	.1190	.1198	8.345	.99290	10	50	.2560	.2648	3.776	.96667	10
7	.1219	.1228	8.144	.99255	83	15	.2588	.2679	3.732	.96593	75
10	.1248	.1257	7.953	.99219	50	10	.2616	.2711	3.689	.96517	50
20	.1276	.1287	7.770	.99182	40	20	.2644	.2742	3.647	.96440	40
30	.1305	.1317	7.596	.99144	30	30	.2672	.2773	3.606	.96363	30
40	.1334	.1346	7.429	.99106	20	40	.2700	.2805	3.566	.96285	20
50	.1363	.1376	7.269	.99067	10	50	.2728	.2836	3.526	.96206	10
	Cosin.	Cotg.	Tan.	Sine.	Angle		Cosin.	Cotg.	Tan.	Sine.	Angle

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

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

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.		Angle	Sine.	Tan.	Cotg.	Cosin.	
0°						0°					
32	.5299	.6249	1.600	.84805	58	30	.6225	.7954	1.257	.78261	30
10	.5324	.6289	1.590	.84650	50	40	.6248	.8002	1.250	.78079	20
20	.5348	.6330	1.580	.84495	40	50	.6271	.8050	1.242	.77897	10
30	.5373	.6371	1.570	.84339	30						
40	.5398	.6412	1.560	.84182	20	39	.6293	.8098	1.235	.77715	51
50	.5422	.6453	1.550	.84025	10	10	.6316	.8146	1.228	.77531	50
						20	.6338	.8195	1.220	.77347	40
33	.5446	.6494	1.540	.83867	57	30	.6361	.8243	1.213	.77162	30
10	.5471	.6536	1.530	.83708	50	40	.6383	.8292	1.206	.76977	20
20	.5495	.6577	1.520	.83549	40	50	.6406	.8342	1.199	.76791	10
30	.5519	.6619	1.511	.83389	30						
40	.5544	.6661	1.501	.83228	20	40	.6428	.8391	1.192	.76604	50
50	.5568	.6703	1.492	.83066	10	10	.6450	.8441	1.185	.76417	50
						20	.6472	.8491	1.178	.76229	40
34	.5592	.6745	1.483	.82904	56	30	.6494	.8541	1.171	.76041	30
10	.5616	.6787	1.473	.82741	50	40	.6517	.8591	1.164	.75851	20
20	.5640	.6830	1.464	.82577	40	50	.6539	.8642	1.157	.75661	10
30	.5664	.6873	1.455	.82413	30						
40	.5688	.6916	1.446	.82248	20	41	.6561	.8693	1.150	.75471	49
50	.5712	.6959	1.437	.82082	10	10	.6583	.8744	1.144	.75280	50
						20	.6604	.8796	1.137	.75088	40
35	.5736	.7002	1.428	.81915	55	30	.6626	.8847	1.130	.74896	30
10	.5760	.7046	1.419	.81748	50	40	.6648	.8899	1.124	.74703	20
20	.5783	.7089	1.411	.81580	40	50	.6670	.8952	1.117	.74509	10
30	.5807	.7133	1.402	.81412	30						
40	.5831	.7177	1.393	.81242	20	42	.6691	.9004	1.111	.74314	48
50	.5854	.7221	1.385	.81072	10	10	.6713	.9057	1.104	.74120	50
						20	.6734	.9110	1.098	.73924	40
36	.5878	.7265	1.376	.80902	54	30	.6756	.9163	1.091	.73728	30
10	.5901	.7310	1.368	.80730	50	40	.6777	.9217	1.085	.73531	20
20	.5925	.7355	1.360	.80558	40	50	.6799	.9271	1.079	.73333	10
30	.5948	.7400	1.351	.80386	30						
40	.5972	.7445	1.343	.80212	20	43	.6820	.9325	1.072	.73135	47
50	.5995	.7490	1.335	.80038	10	10	.6841	.9380	1.066	.72937	50
						20	.6862	.9435	1.060	.72737	40
37	.6018	.7536	1.327	.79864	53	30	.6884	.9490	1.054	.72537	30
10	.6041	.7581	1.319	.79688	50	40	.6905	.9545	1.048	.72337	20
20	.6065	.7627	1.311	.79512	40	50	.6926	.9601	1.042	.72136	10
30	.6088	.7673	1.303	.79335	30						
40	.6111	.7720	1.295	.79158	20	44	.6947	.9657	1.036	.71934	46
50	.6134	.7766	1.288	.78980	10	10	.6967	.9713	1.030	.71732	50
						20	.6988	.9770	1.024	.71529	40
38	.6157	.7813	1.280	.78801	52	30	.7009	.9827	1.018	.71325	30
10	.6180	.7860	1.272	.78622	50	40	.7030	.9884	1.012	.71121	20
20	.6202	.7907	1.265	.78442	40	50	.7050	.9942	1.006	.70916	10
							.7071	.1	1.	.70711	45
											or
	Cosin.	Cotg.	Tan.	Sine.	Angle		Cosin.	Cotg.	Tan.	Sine.	Angle

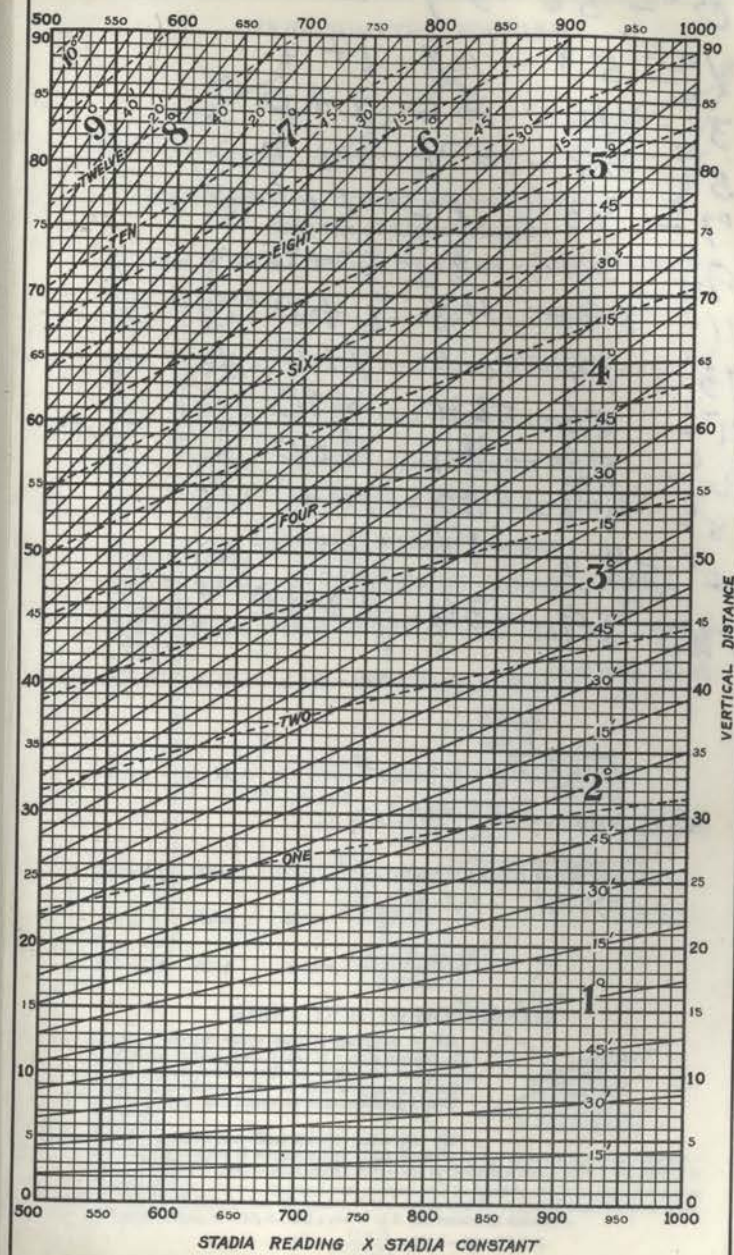
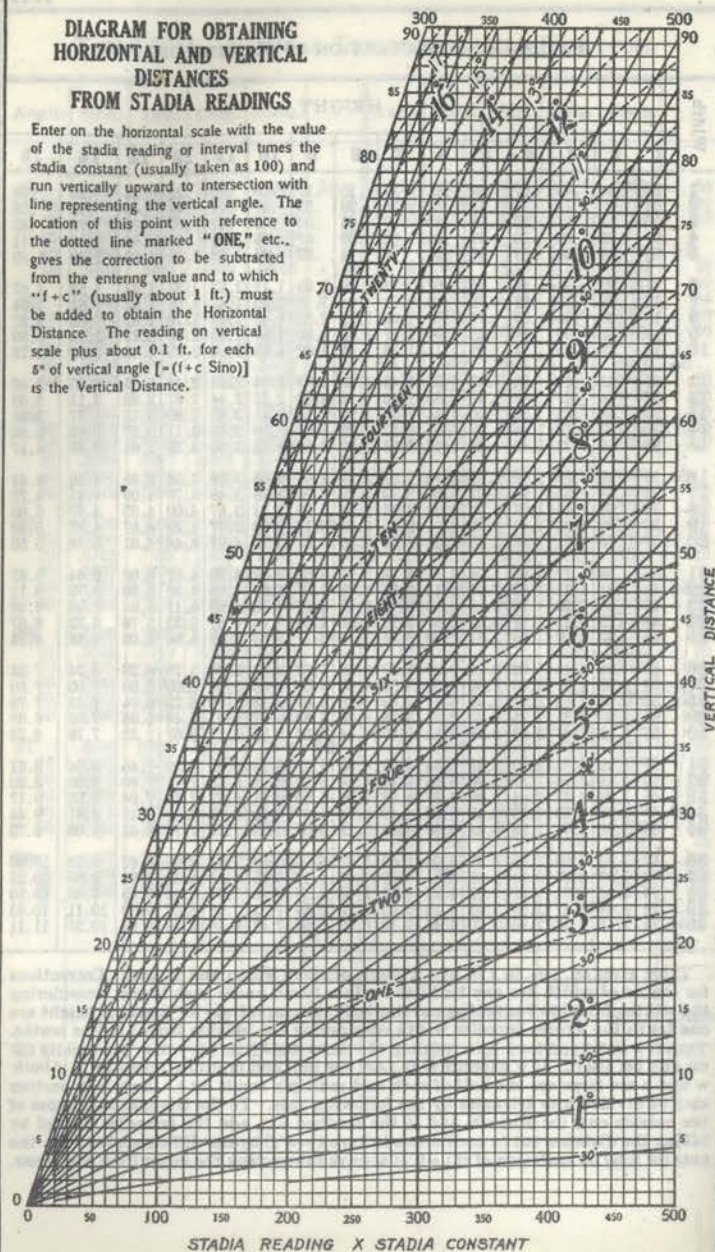
TABLE IX.—CALCULATION OF EARTHWORK.

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

Table gives cu. yds. in 1 ft. of a triangle of given width and height. Corrections for tenths of width are one tenth the values found under each height considering the widths from 1 to 9 as tenths and similarly the corrections for tenths of height are one tenth the figures opposite width considering the heights from 1 to 9 as tenths. Thus if $w=16.2$ and $h=5.3$, cu. yds. = $1.48 + .018 + .089 = 1.587$ cu. yds. or practically 159 cu. yds. per 100 ft. If w exceeds 40 ft., use one half and multiply result by 2, if both w and h are large use one half of each and multiply result by 4. Any cross-section may be divided into triangles by the following rule. To the triangle of the sum of the outside cuts (or fills) = h , and $\frac{1}{2}$ the roadbed = w , add the triangles formed by taking the distance out to each break in turn (= w 's) by the difference between the cuts (or fills) on each side of it (= h 's) always subtracting the outer from the inner.

DIAGRAM FOR OBTAINING HORIZONTAL AND VERTICAL DISTANCES FROM STADIA READINGS

Enter on the horizontal scale with the value of the stadia reading or interval times the stadia constant (usually taken as 100) and run vertically upward to intersection with line representing the vertical angle. The location of this point with reference to the dotted line marked "ONE," etc., gives the correction to be subtracted from the entering value and to which "+f+c" (usually about 1 ft.) must be added to obtain the Horizontal Distance. The reading on vertical scale plus about 0.1 ft. for each 8" of vertical angle $[= (1+c \sin \alpha)]$ is the Vertical Distance.



0°	56	39	
1°	53	18	1+0
3°	46	36	2+0
5°	39	54	3+0
7°	33	12	4+0
9°	26	30	5+0
11°	19	48	6+0
13°	13	06	7+0
15°	06	24	8+0
16°	59	42	9+0
18°	53	00	10+0
20°	46	18	11+0
22°	39	36	12+0

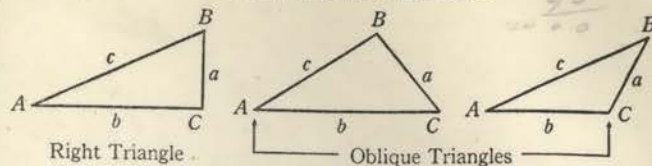
Court House Curve

13.0' Down to Fl. L. of 30° S. on
9.5' " 8° point from Clinic

13+77.12 27.12' = 2

644
360
284
33
251

TRIGONOMETRIC FORMULÆ



Solution of Right Triangles

For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\csc = \frac{c}{a}$

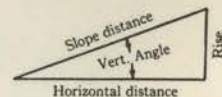
Given	Required	
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B$, $c = \sqrt{a^2 + b^2} = a\sqrt{1 + \frac{b^2}{a^2}}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B$, $b = \sqrt{(c+a)(c-a)} = c\sqrt{1 - \frac{a^2}{c^2}}$
A, a	B, b, c	$B = 90^\circ - A$, $b = a \cot A$, $c = \frac{a}{\sin A}$
A, b	B, a, c	$B = 90^\circ - A$, $a = b \tan A$, $c = \frac{b}{\cos A}$
A, c	B, a, b	$B = 90^\circ - A$, $a = c \sin A$, $b = c \cos A$

Solution of Oblique Triangles

Given	Required	
A, B, a	b, c, C	$b = \frac{a \sin B}{\sin A}$, $C = 180^\circ - (A+B)$, $c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a}$, $C = 180^\circ - (A+B)$, $c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A+B = 180^\circ - C$, $\tan \frac{1}{2}(A-B) = \frac{(a-b) \tan \frac{1}{2}(A+B)}{a+b}$ $c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a+b+c}{2}$, $\sin \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}}$ $\sin \frac{1}{2} B = \sqrt{\frac{(s-a)(s-c)}{ac}}$, $C = 180^\circ - (A+B)$
a, b, c	Area	$s = \frac{a+b+c}{2}$, $\text{area} = \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	$\text{area} = \frac{bc \sin A}{2}$
A, B, C, a	Area	$\text{area} = \frac{a^2 \sin B \sin C}{2 \sin A}$

REDUCTION TO HORIZONTAL

Horizontal distance = slope distance multiplied by the cosine of the vertical angle. Thus, for a slope distance of 403.6 ft. and a vertical angle of $4^\circ 40'$ —the cosine of $4^\circ 40'$, taken from a table of natural trigonometrical functions, = .9967, and horizontal distance = $403.6 \times .9967 = 402.27$ ft.



Horizontal distance also = Slope distance minus slope distance times (1 - cosine of vertical angle). Using the same figures as in the preceding example— $\cos 4^\circ 40' = .9967$, $1 - .9967 = .0033$, $403.6 \times .0033 = 1.33$ ft. Horizontal dist. = $403.6 - 1.33 = 402.27$ ft.

When the rise is known, the horizontal distance may be found by the following approximate rule:—the slope distance less the square of the rise divided by twice the slope distance. Thus, for a slope distance of 372.5 ft., and a rise of 15 ft., the horizontal distance =

$$372.5 - \frac{15 \times 15}{2 \times 372.5} = 372.5 - .30 = 372.2 \text{ ft.}$$

$$\begin{array}{r} -122.135 \\ 97.815 \\ \hline 24.320 \end{array}$$

$$\begin{array}{r} 126.32 \\ 035 \\ \hline 126.285 \\ 125.53 \\ \hline .755 \end{array}$$

$$\begin{array}{r} 227.2020 \\ 300 \\ \hline 119.8725 \\ 1087.25 \\ \hline 206 \\ 26 \\ \hline 21 \end{array}$$

$$\begin{array}{r} 170.00 \\ 39.41 \\ \hline 209.41 \end{array}$$

$$\begin{array}{r} 877.20 \\ 873.75 \\ \hline 128 \overline{) 3456} \\ \underline{256} \\ 864 \\ \underline{764} \\ 920 \\ \underline{924} \\ 268 \end{array}$$

$$\begin{array}{r} 126 \\ 3 \\ \hline .378 \end{array}$$

$$\begin{array}{r} 99.65 \\ 27.00 \\ \hline 126.65 \\ 3 \\ \hline 126.62 \end{array}$$

$$84-43.48$$

$$95-06.22$$

$$90-09.49$$

$$145-35.15$$

$$124-75.40$$

$$538-118.175$$

$$269-60.51$$

$$\begin{array}{r} 2348 \\ 2412 \\ \hline 8760 \end{array}$$

$$\begin{array}{r} 1.53-18 \\ 30 \end{array}$$

$$\begin{array}{r} 1.83 \\ 2.23 \end{array}$$

$$\begin{array}{r} 70.47 \\ 8.67 \\ \hline 79.14 \end{array}$$

$$\begin{array}{r} 5.29 \\ 5.22 \end{array}$$

$$958120$$

$$818.41$$

$$21141.3754$$

$$84-43$$

$$4.8$$

$$3.3$$

$$\begin{array}{r} 831.93 \\ 422 \\ \hline 832.35 \end{array}$$

$$\begin{array}{r} 87.75 \\ 87.20 \end{array}$$

$$\begin{array}{r} 92.10 \\ 82.15 \end{array}$$

$$\begin{array}{r} 886.36 \\ 331 \end{array}$$

$$\begin{array}{r} 889.67 \\ 10.85 \end{array}$$

$$878.82$$

$$974.6516$$

$$\begin{array}{r} 985.36 \\ 31 \end{array}$$

$$\begin{array}{r} 985.71 \\ 12.72 \end{array}$$

$$170.99$$

$$1.2$$

$$1.6851$$

$$\begin{array}{r} 1.8823 \\ 28 \end{array}$$

$$\begin{array}{r} 1.8851 \\ 27 \end{array}$$

$$1320.27$$

$$\begin{array}{r} 377.77 \\ 33.1 \end{array}$$

$$509.297$$