

Finds

47-N.B.2

7th Ave. & 8th St

New Brighton

6th AVE. - Storm Sewer

DR 13-8498

ROLL

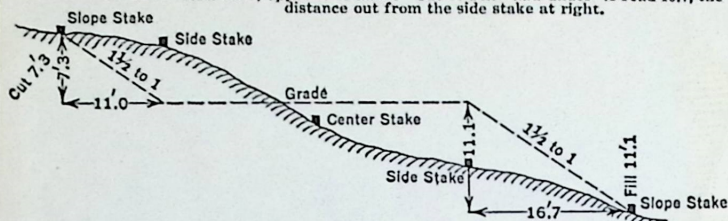
FIELD BOOK

17360-1

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

Roadway of any Width. Side Slopes $1\frac{1}{2}$ to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill" and under .1 read 16.7, the distance out from the side stake at right.



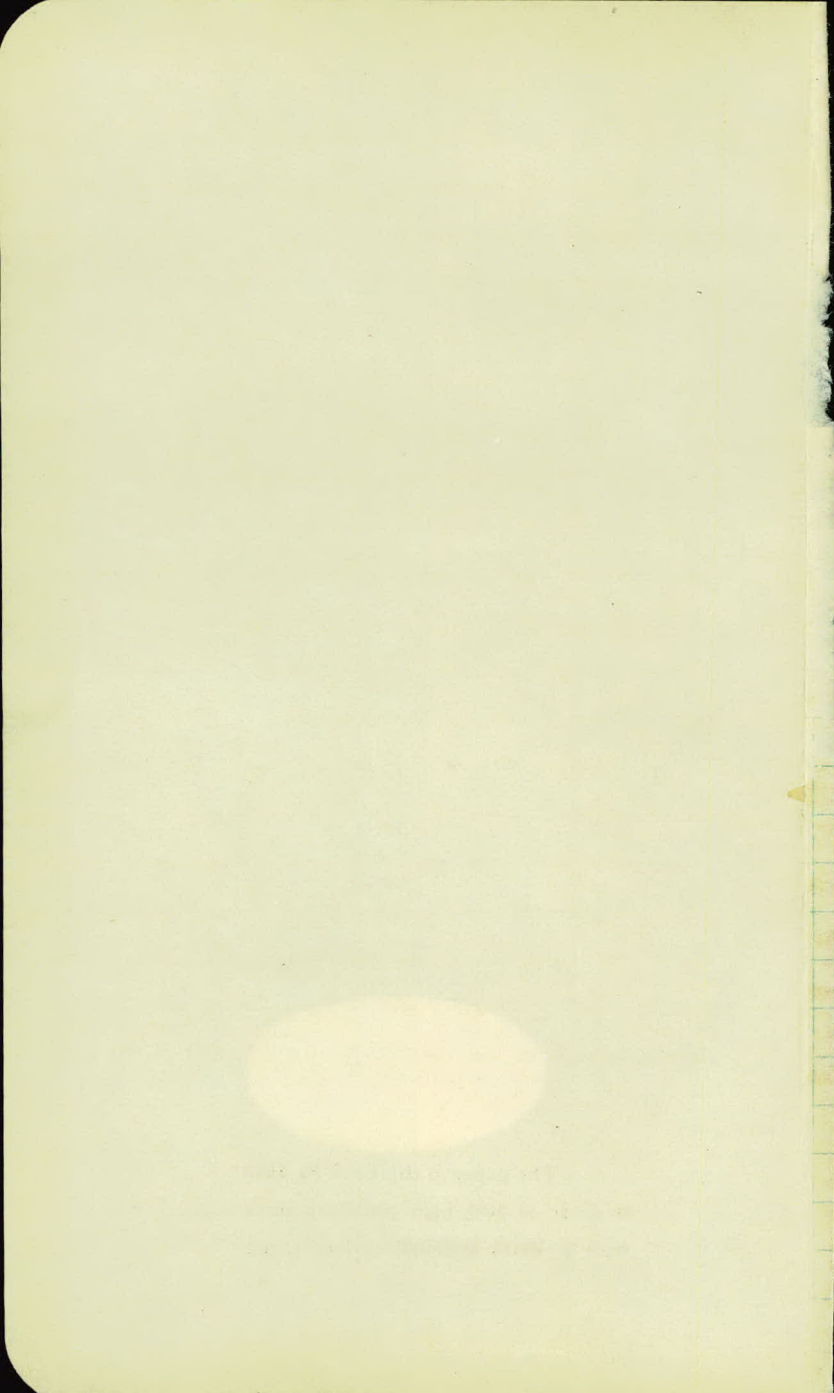
Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
	Distance out from Side or Shoulder Stake										
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	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

KEUFFEL & ESSER CO., N. Y.

For Curve Tables see end of book



The paper in this book No. 360A
is made of 50% high grade rag stock
with a **WATER RESISTING** surface sizing.



1

4

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SIXTH AVE. STORM SEWER	
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8th Street

Final XSections

Sta	+	π	-	Elev.
B.M.	2.31	910.86		(908.55)

0 +00

old π

+12

+21

05.2

06.2

+33

08.4

06.1

+64

06.6

05.0

1

04.0

03.0

+40

00.7

01.7

+72

97.9

00.5

K.A.
P.M.
M.B.
R.C. L

5-7-48

5

2

R

Top Hyd. S.E. Cor 9th & Long Lake Rd.

Reg. Fill 00

5.7

6.4 53 4.8 51 4.7 4.4 3.6 4.7
31 28 16 13 14 31 34

✓

2.5

5.2 4.9 5.3 4.8 4.8 4.3 3.9 0.8
21 15 14 14 15 31 37.4

✓

4.3

5.6 6.0 6.0 6.5 6.1 5.9 5.8 6.1 5.7 5.2 2.0
21 20 15 14 9 11 14 15 30 38

✓

6.9

7.7 8.1 7.9 8.3 7.9 7.9 7.7 7.9 7.6 7.3 4.3
27 24 14.5 14 10 10 14 14.5 29 37

✓

10.2

12.2 9.4 9.2 9.8 9.4 9.2 9.5 9.1 9.0 7.8
37 30 15 14.5 11 13.7 14 27.5 31.7

✓

+64- cut 00

13.0

14.5 10.5 10.2 10.7 10.3 10.4 10.8 10.4 10.1 10.8
39 30 15 14.3 10 13.8 14.2 30 34

✓

Sta.	+	π	-	Elev
		910.86		

2			97.6	99.7
---	--	--	------	------

	+40		98.5	98.7
--	-----	--	------	------

T.P.	4.50	903.09	12.27	898.59
------	------	--------	-------	--------

	+78		99.4	97.9
--	-----	--	------	------

3			99.2	97.2
---	--	--	------	------

	+90		99.1	96.2
--	-----	--	------	------

	+79		98.6	95.5
--	-----	--	------	------

4			98.2	95.1
---	--	--	------	------

	+30		95.8	94.8
--	-----	--	------	------

5-7-98

6

L

Z

R

13.3

131 112 109 6.4 111 112 111 114 110 111 129 ✓
 35 30 155 145 10 8.5 136 14 29.5 34

+117-BCg. Cut 00

12.4

107 122 120 125 122 12.2 12.1 12.3 11.8 12.1 140 ✓
 33 29 153 145 11 9 142 14.6 29.5 34

3.7

21 47 52 5.0 5.5 5.3 5.2 5.3 5.5 5.2 5.3 6.2 ✓
 37 31.6 29.4 14.8 14 10 10 137 14.6 30 31.5

+185-Cut 00

3.9

24 51 56 5.5 6.0 5.8 5.9 5.9 6.1 5.8 6.1 5.7 ✓
 37 32 29 14.7 14 10 9 13.8 14.2 28 29

4.0

43 61 66 6.4 7.0 6.8 6.9 6.9 7.3 6.8 7.0 5.7 ✓
 35 32 30 14 13.0 10 9 13 14 29 33

4.5

55 73 74 7.9 7.5 7.6 7.5 8.0 7.5 7.7 4.7 ✓
 34 29 13.4 12.5 8 8 14 14.5 29.6 36.5

4.9

59 7.6 7.7 8.1 7.9 8.0 8.0 8.5 8.1 8.1 4.7 ✓
 34 30 14.2 13.5 8.5 7.5 14 14.4 30 36.6

7.3

7.9 8.1 8.3 8.8 9.2
 50 30 30 50

Sta	+	π	-	Elev
		903.09		

4	+70		91.6	94.5
---	-----	--	------	------

5			87.1	94.7
B.M.	2.17	900.37	4.99	898.20

	+50		85.5	94.9
--	-----	--	------	------

6			85.1	95.3
---	--	--	------	------

	+30			95.82
--	-----	--	--	-------

B.M.	2.52	900.72	2.17	898.20
------	------	--------	------	--------

	+52		95.5	95.8
--	-----	--	------	------

	+84		84.6	95.8
--	-----	--	------	------

~~+84~~

See staking notes for
a elev

L

Q

R

11.5

~~83~~ 83 84 86 8.8 90
50 36 30 50

✓

16.0

8.0 8.4 8.3 8.9 8.6 8.4 8.5 9.0 8.7 8.7 14.6 5.5 to N.G.
50 24 14.4 13.5 10 7 14 15 33 4.4

Spt. in 15" Pop NW Cor 7 1/2 8 8 1/2

✓

14.9

6.2 6.0 5.3 5.4 5.7 5.5 5.5 5.9 5.5 5.5 12.8 13.8 5.5
50 36 22 15 14.5 7 14 15 32 43.5 4.8

✓

15.3

7.2 7.2 6.4 4.9 5.0 5.6 5.1 5.1 5.4 5.1 5.1 12.8 13.8 5.5
50 37 33 30 14.3 13.5 6 13 13.8 32 44 9.9

10.6 9.2 4.9 4.6 4.6 5.1 4.6 5.4 5.0 4.9 12.9 14.4 5.5
50 36 29.6 23 14 13 12.6 13.4 31 44 5.0

N.G. = 15.5 5.1 4.8 5.4 4.9 5.6 5.4 5.2 12.8 14.6 : N.G.
51 29.5 14 12.5 12.6 13.5 30 43 5.1

16.1

14.1 5.0 4.9 5.2 4.9 5.4 5.2 5.1 13.1 15.1
50 29 13.5 12.5 13 14 30 46 5.2

Sta

+

 π

-

Elev

900.72

6 +90

86.8 95.9

7 +103

94.4 95.9

+107

95.3 95.8

+118

95.3

+125

94.6 95.9

+138

85.9 95.9

+150

84.5 95.9

+178

84.7 95.7

K.A.
A.M.
M.B.
B.C. L

5-2075

8

E

E

13.9

138 50 48 52 48
46 29 14 127

53 51 50 140 ✓
13 14 30 48.5

6.3

65 46 48
34 29 13

48 50 45 53
14 27 32

✓

5.4

57 52 49 51 51
30 27 15 30

✓

+09 = F.00

+16 = F.00

59 48 48 59 44 47 52
36 14 2 36 16 29 32

6.1

63 46 49 50 48 45 42 40 57 57
37 33 16 15 12 15 29 34 39

✓

14.8

147 48 48 51 48 47 45 44 146
53 33 15 135 136 15 30 49

✓

16.2

159 46 48 51
55 33 15 14
53

48 50 47 41 150
14 155 31 52

✓

2. 24°C/147

16.0

156 110 50 51 55 50
53 44 37 135 145

53 49 49 106 1524 FL. 24°C/147
14 15 32 40 48
475 S.S. to NG

Sta	+	π 900.72	-	Elev
8	+00		86.0	95.5
	+26		86.4	95.4
	+31		87.5	95.4
	+57		89.6	95.3
	+83		93.4	95.0
9			94.2	94.8
	+37		94.9	94.6
	+65		95.8	94.1

L

E

R

14.7

152 55 54 57
55 87 15 14

5.2 56 51 47 149
14 15 30 50

✓

14.3

140 91 60 54 58 53
52 43 34 15 187

56 53 52 121 14.2
14 15 30 42 48.2

✓

13.2

68 58 54 58
50 29 15 14

5.3 56 53 53 120 134
14 153 31 42 47

✓

11.1

76 61 57 56 60 54
100 50 32 15 138

57 54 57 12.6
144 154 30 46

✓

7.3

110 101 79 68 59 57 61
56 148 100 63 30 145 127

57 60 57 59 57 9.5
143 153 30 86 100

✓

6.5

109 102 82 62 59 59 62 59
141 151 100 31 30 145 135

61 58 62 56 54 55 7.6
146 137 29 30 51 103 109

✓

5.8

92 101 104 88 69 66 62 68 61
156 151 146 100 31 30 148 136

64 59 62 59 49 47 54
15 16 26 27 100 115 119

✓

4.9

89 108 110 93 83 75 71 66 71
156 151 149 100 55 30 29 148 137

66 65 62 54 49 42
15 16 50 100 146

✓

+70 = cut 100

Sta

+

K

-

Elev

900.72

9 +70

93.9

94.0

+91.16

94.0

93.9

B.M.

4.23

896.49

(896.42)

5-20-98

10

L

E

R

6.8

8.0 69 71 67
50 15 13

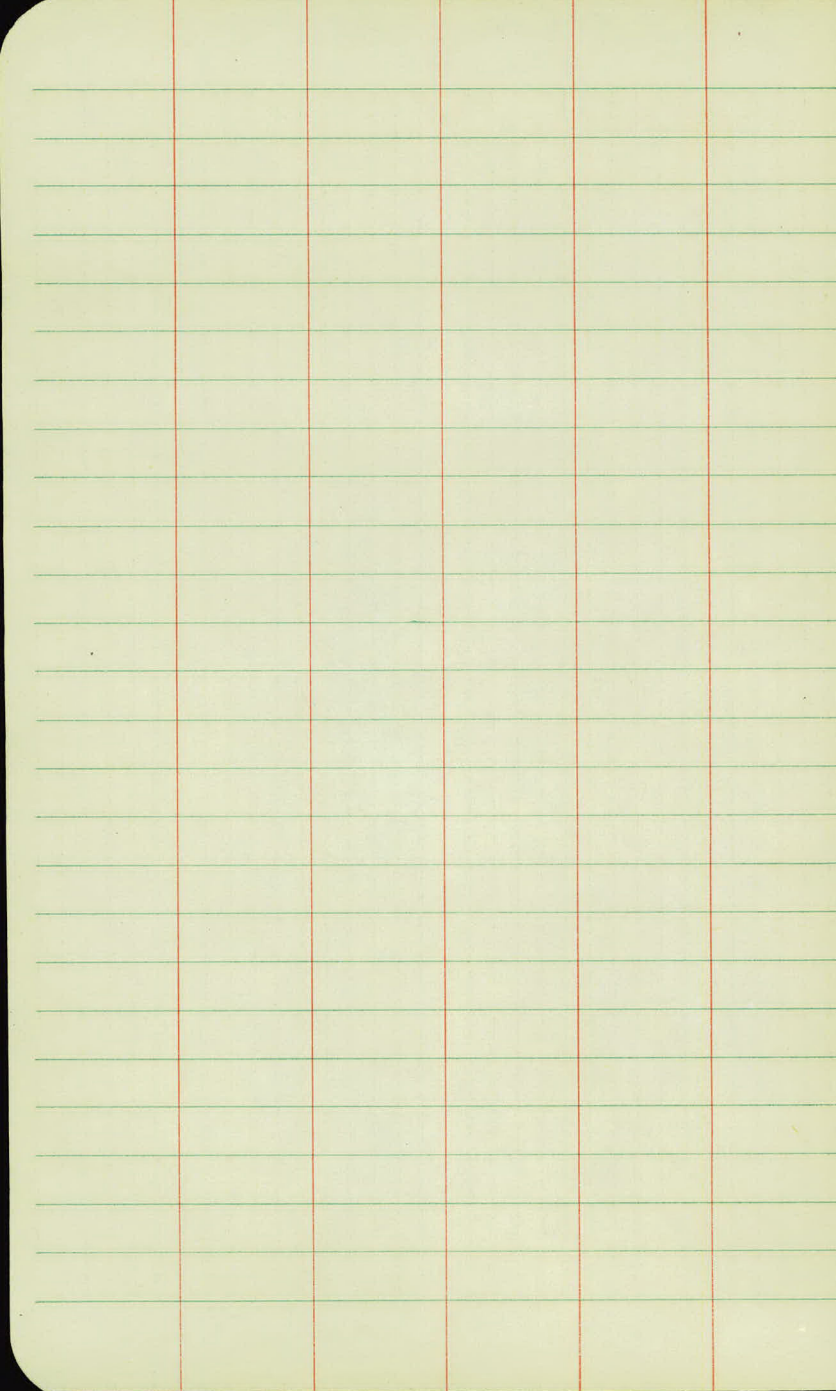
63 56
15 50

+78 = F00

6.7

6.8

Spt. in P.P.S.W. Cor 5 1/2 Ave & 8th St



Final Xsections

7th Ave.

Service Drive Xsections

Service Drive

Sta	+	π	-	Elev
B.M.	1.23	909.34		(908.11)
			<u>old E</u>	
0 +20			04.3	02.9
+60			04.5	02.6
+70			04.6	02.8
1			04.5	03.2
+34			04.7	03.7
+50			04.8	03.9
+59			04.9	03.9
+67			04.9	04.1

5-20-48

19

L

E

R

Top of Septic Tank

5.0
24 64 71 70
14 7 10

✓

4.8
19 63 67 67
18 5 10

✓

4.7
17 61 65 67 77
18 6 10 28

✓

4.8
15 44 55 61 67 80
17 11 6 22 28

✓

4.6
15 40 52 56 61 6.0 to N.G.
19 12 6 15

✓

4.5
17 35 49 54 59 68
18 15 7 14 17

✓

4.4
N.G. = 29 39 48 54 57 77
17 16 7 13 16

✓

4.4
42 47 45 52 56 75
19 16 11 12 17

✓

Sta + π - Elev.

909.34

1 +88

05.0 04.3

H.I. Cont. to 7th Ave

L

E

E

4.3
44 44 50 53 87
27 12 11 20

✓

7th Ave

Sta	+	π	-	Elev
		909.34		
0 - 88			$\frac{0.4 \pm}{07.8}$	02.4
- 80			07.2	02.4
- 69			00.5	02.2
B.M.	5.19 3.79	903.45	11.08	898.26 (898.26)
- 65				02.3
- 37			97.8	00.6
0 + 00			94.5	97.8
+ 37			93.4	95.8
+ 75			93.7	94.8

5-20-48

21

1.5
 65 69 65 5.8 2.9 ✓
 50 14 20 30

2.1
 66 69 6.9 6.2 ✓
 50 28 50

8.8
 7.4 7.3 7.1 7.0 6.6 ✓
 50 35 23 50

Spl. in 15' Pop N.W. Cor 7' 1/2 & 8' 1/2

1.7 1.3 1.2 1.2 0.9
 45 25 25 50

5.7
 47 35 33 3.6 29 30 3.6 3.1 2.8 2.7 ✓
 40 35 16 15 7 14 14.5 31 50

9.0
 73 59 61 65 59 5.7 5.7 6.2 5.8 5.9 6.2 ✓
 37 34 15 14 9 8 14.5 15 29 50

10.1
 94 78 78 84 7.9 7.7 7.8 8.3 7.9 7.8 8.1 11.6 ✓
 37 33 14.7 14 8 10 14 15 26 39 44

9.8
 91 88 92 96 91 8.7 9.1 9.5 9.1 8.9 9.2 9.3 13.1 ✓
 34 31 15 14 9 9 14.5 15 27 37 41 47

Sta	+	π	-	Elev
		90345		

1			93.4	94.2
---	--	--	------	------

+50			93.6	93.3
-----	--	--	------	------

2			93.6	93.7
---	--	--	------	------

+45			93.8	93.9
-----	--	--	------	------

B.M.	3.03	901.29	519	898.26
------	------	--------	-----	--------

+87.6			94.3	94.5
-------	--	--	------	------

3 +17.6				94.8
---------	--	--	--	------

+97.6			94.8	95.2
-------	--	--	------	------

4			95.4	95.6
---	--	--	------	------

5-21-98

22

L

E

R

10.1

86 94 95 101 96
32 31 156 146 75

93 95 99 95 95 98 104 145 ✓
8 14 15 30 36 42 50

9.9

16.7

75 100 101 109 104 102 104 106 101 98 106 ~~107~~ ✓
35 30 15 14 8 10 145 155 32 40 54

9.9

✓

69 97 99 103 98 98
36 30 163 155 8

99 104 98 96 104 172
6 14 15 30 40 53

9.7

63 93 97 101 97
37 30 165 155 10

96 98 101 97 94 101 173 ✓
11 14 155 30 43 57

7.0

32 66 68 73 68 68 69 73 69 70 68
36 30 16 145 11 10 14 15 34 50 ✓

60 63 65 65 67
50 25 25 50

6.5

42 59 60 62 60
32 30 15 14 10

61 61 65 63 65 66
10 145 15 29 50 ✓

5.9

45 56 67 62 59 57 58 63 60 63 56 58 71 77
33 31 15 145 11 11 15 155 30 32 61 100 149 ✓

$$NG = \frac{167}{205} \frac{111}{186}$$

Sta.	+	π	-	Elev.
		901.29		

4	+45		95.9	96.0
---	-----	--	------	------

	+86		97.4	96.7
--	-----	--	------	------

5			00.1	96.9
---	--	--	------	------

	+26		99.9	97.2
--	-----	--	------	------

L

E

R

5.4

3.2 4.9 5.3 5.9 5.5 5.3
33 31 143 14 10

5.5 6.0 5.6 5.6 5.0 6.0
10 15 155 30 32 65

NG = 162 112 85 77 70
228 217 176 137 100

3.9

1.9 4.3 4.7 5.2 4.8
35 31 146 14 9

4.6 5.0 5.2 4.9 5.0 4.0 4.6 5.0 5.8
11 144 15 30 32 38 68 100

NG = 140 96 87 72 63
224 216 207 168 137

1.2

2.3 4.1 4.5 4.9 4.6 4.4
35 31 15 145 10

4.8 6.2 4.9 4.7 3.6 4.0 4.6
11 137 146 30 32 46 65

NG = 130 88 8.0 6.8 6.1 5.5
226 215 200 175 142 100

1.4

0.0 3.9 4.2 4.6 4.2
38 31 159 146 10

4.1 4.4 5.0 4.6 4.5 3.0 3.2 4.9 5.6
10 14 145 30 32 50 100 139

9.0 7.7 7.5 6.2
232 227 200 172

Sta

+

 π

-

Elev

901.29

5 +69

99.7

97.6

6

99.1

97.9

+30

99.2

97.8

+36

99.3

97.8

T.P

352

900.99

382

897.47

L

E

R

✓

^{1.6}
 45 0.2 37 37 41 36 37 39 45 40 40 25 26 33
 45 37 32 152 145 8 9 136 14 30 32 37 30

85 62 7.0 58 50 42
 260 228 200 167 136 93

✓

^{2.2}
 21 07 37 36 40 35 34 36 42 39 39 26 23 29 29 35
 58 40 32 15 144 8 8 14 147 30 32 52 63 79 87

~~39 38 37 41~~ 9.2 5.7 7.1 6.3 5.2 5.1 4.4
~~10 2 9 14~~ 262 239 218 192 171 152 129

✓

^{2.1}
 139 00 30 38 36 37 40 35 35 37 41 38 39 27 23 29 26 34 37
 56 41 36 32 26 15 145 10 8 9 14 154 31 33 50 59 76 100 120

+5.0 = N.G.
 67

93 87 74 61 58 49 48
 260 249 230 200 188 174 154

✓

^{2.0}
 00 30 38 36 37 40 35 35 37 41 38 39 27 23 29 26 34 37
 41 36 32 26 15 145 10 8 9 14 154 30 33 50 59 76 100 120

143 455 = N.G.
 52 66

93 87 74 61 58 49 48
 260 243 230 200 188 174 154

Sta	+	π	-	Elev
		900.99		

6 + 79			99.8	97.6
--------	--	--	------	------

7			00.0	97.3
---	--	--	------	------

+50			98.4	96.6
-----	--	--	------	------

8			96.8	95.7
---	--	--	------	------

T.P.	1.56	898.65	3.90	897.09
------	------	--------	------	--------

+52 = Top Bank Lt.
+60 = Bottom of Bank Lt.

25 25 32 39 36 41 37 34 35 41 37 38 30 25 25 23
73 40 33 31 15.2 145 11 10 14.4 151 30 32 37 58 85

29 31 37 = N.G.
100 146 174

95 92 68 54 46 41 31
261 251 234 200 169 133 111

27 26 31 41 41 45 39
64 38 32 31 15.4 14.4 9

37 3.8 42 39 4.2 3.2 25 27 23
9 13.8 14.4 30 31 36 59 84

29 33 37
100 140 167

99 93 68 59 5.0 4.4 4.1 2.7
261 250 234 220 181 158 132 100

34 34 46 48 50 47 4.4 4.5 4.8 4.5 4.4 4.6 37 29 30
40 32 30 15 14 10 11 14 14.5 21 30 32 36 44

38 39 4.2 = N.G.
76 100 142

103 100 48 50 46 45 38 33 23 27
262 257 232 200 169 150 125 111 85 67

39 55 54 58 55 53
34 30 15 14.0 10

55 59 55 52 4.5 3.7
10 13.8 14.3 21 29 36

108 57 48 51 4.8 3.9 3.7 3.7
262 258 230 200 177 154 126 100 71

Sta	+	π	-	Elev
		898.65		

8	+50		96.4	95.0
---	-----	--	------	------

9			95.4	93.8
---	--	--	------	------

	+10		94.6	93.7
--	-----	--	------	------

	+50		93.4	92.7
--	-----	--	------	------

10			92.4	91.4
----	--	--	------	------

	+25		91.9	90.7
--	-----	--	------	------

	+50		91.6	90.1
--	-----	--	------	------

L

Q

R

27 42 39 48 38 2.3 3.7 38 44 4.0 41 16 21 21 26
 32 30 15 145 10 8 13.5 145 30 37 44 74 100

906

81 72 45 44 36 29 32 29
 258 247 232 220 200 173 159 131

38 40 52 52 55 48 49 3.3 49 56 53 53 30
 32 30 148 14 9 8 145 16 30 37

44 56 54 57 51 52 4.1 5.0 52 58 55 55 40 33
 32 30 15 13 13 9 7 135 145 30 33 36

50 6.4 63 67 6.1 6.0 5.3 6.1 20 65 64 51
 33 30 152 142 9 8 137 155 30 33

6.1 75 75 79 75 6.3 73 75 8.0 77 78 62
 33 30 15 14 9 9 137 145 30 33

6.2 81 81 84 81 6.8 8.1 86 87 84 6.0
 33 29 152 145 10 9 14 146 30 34

7.7 87 87 9.0 8.6 8.6 8.7 9.1 8.7 8.6 7.6
 32 29 155 145 10 11 14 145 30 32

Sta	+	π	-	Elev.
		898.65		
11			90.3	89.2
+26			89.4	88.7
+40			88.7	88.5
T.P.	3.55	892.84	9.36	889.29
+74			88.5	87.6
+87			87.5	87.3
12			87.2	87.2
+07			87.3	87.0
+15			86.9	86.9
B.M.			5.90	886.94 (886.90)

K.A.
A.M.
M.B.
K.C.

5-21-98

27

8.4
91 96 96 99 97 9.5 96 10.2 9.8 99 9.2 ✓
32 29 15 14 10 9 14.5 15 28.5 30

9.3
94 101 100 104 99 100 10.3 10.7 10.3 10.5 9.6 ✓
32 30 16 14.5 8 9 14 14.4 28 30

10.0
9.8 10.2 10.4 10.7 10.3 10.2 10.7 11.2 10.7 10.5 10.8 9.9 ✓
31 30 15.5 15 7 9 13 14.4 20 27 29

4.3
45 53 51 58 54 52 54 59 56 5.5 4.2 ✓
38 37 29 15 9 10 13.6 14.3 26 29

5.3
7.0 5.7 5.8 5.6 5.7 5.5 5.7 6.1 5.9 5.7 4.2 ✓
43.5 40 34 29 14 10 12 13 27 29

5.9 5.6 5.8 5.7 4.4 ✓
26 15 27 29

5.5
5.9 5.8 5.7 5.7 4.5 ✓
14 16 26 28

5.9 5.7 7.4 ✓
25 31
+21 = F.00

Top Hyd BE 600 7' 1" & Front St.

Sta.

+

π

-

Elev

L

E

R

Stoking Notes

SIXTH AVE. SEWER

South of Front St.

Sta.	P.G.	P.G.R	-	Elev.
B.M.	2.52	889.37		(886.85)

3	+71.42	79.89	9.48 ✓
---	--------	-------	--------

4		79.8	9.57 ✓
---	--	------	--------

	+50	97.65	9.72 ✓
--	-----	-------	--------

5		79.5	9.87 ✓
---	--	------	--------

	+50	79.35	10.02 ✓
--	-----	-------	---------

6		79.20	10.17 ✓
---	--	-------	---------

+16

	+49	79.05	10.32 ✓
--	-----	-------	---------

$$\begin{array}{r} 89.97 \\ \text{L Pav} = 85.58 = \text{R Pav.} \\ \text{Lt } 3.79 \end{array}$$

29

Rt

Top Hyd. SE

10'0.5.

11-9-45

C.25

K.A.

698

A.M.

B.G.

C.45 & 40

507 5.67

C.50

472

C.50

487

C.55

452

C.55

467

+18.8" Cor. Bldg.

C.B. Rk.

C.55

482

10'0.5.

Sta.	P.G.	P.G.	-	Elev.
------	------	------	---	-------

889.37

6 +78

+83

7	78.9	10.47		
---	------	-------	--	--

+50 7875 10.62

8	78.6	10.77		
---	------	-------	--	--

+50 7845 10.92

9	78.30	11.07		
---	-------	-------	--	--

+47 7816 11.21

10'0.5.

G. B.L.P. side G.H. $\frac{4.97}{5.0} = EL = 84.4$

M.H. - G.B.P.H.

C.6.0
4.47

C.7.5
3.12

C.7.0
3.77

C.7.5
3.42

C.7.5
3.57

M.H. C.8.0
3.21

10'0.5.

Sto	P.C.	P.G.R.	-	E/cr.
		989.37		

9 +50	75.86	13.51		
-------	-------	-------	--	--

10 +16	75.66	13.71		
--------	-------	-------	--	--

+42	75.58	13.79		
-----	-------	-------	--	--

// +83	75.46	13.91		
--------	-------	-------	--	--

10-9-48

31

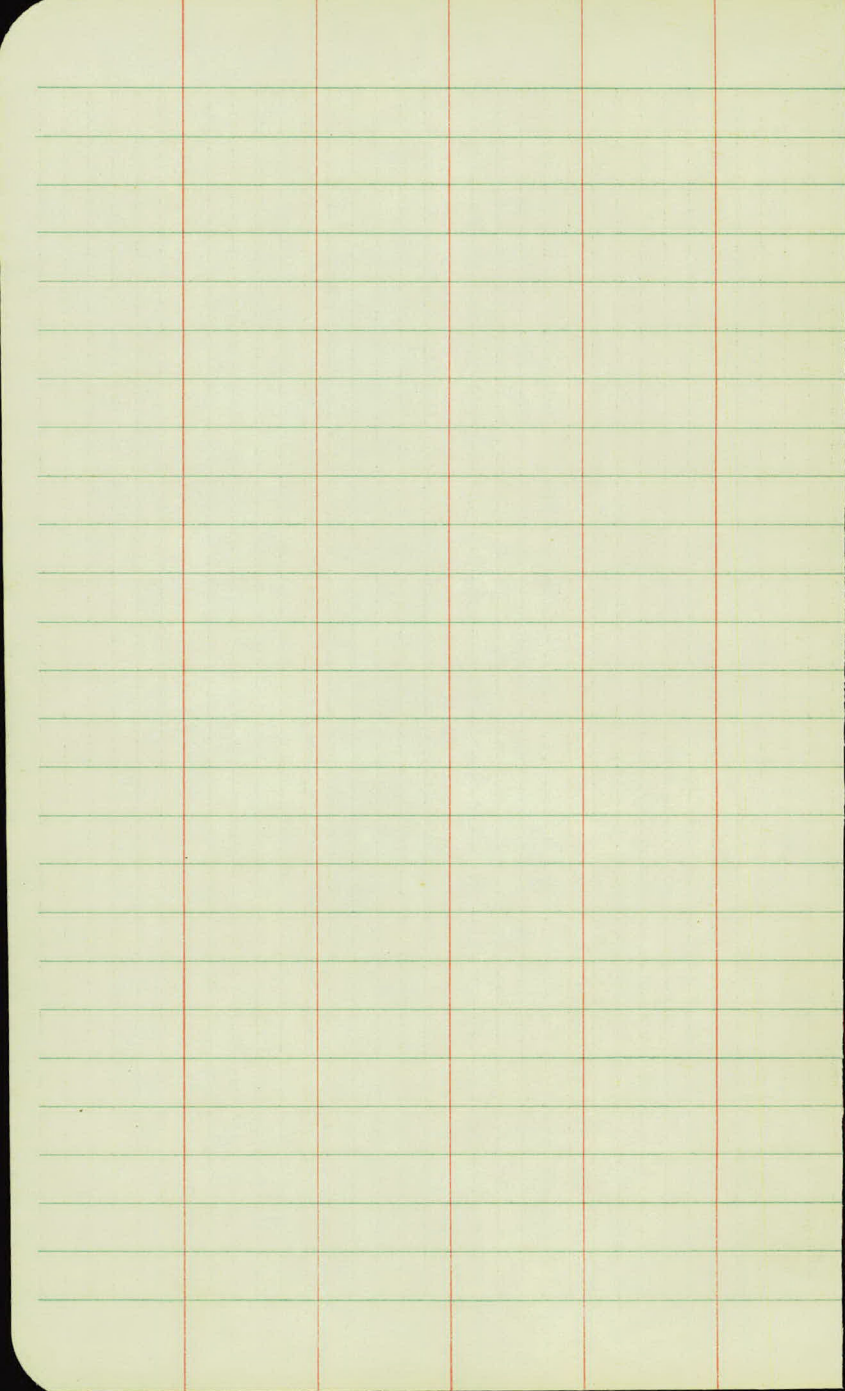
10'0.5.

C.10.0
3.51

C.10.5
3.21

C.4.5
9.29

C.0.5
13.41
10'0.5.



CURVE TABLES.

Published by KEUFFEL & ESSER CO.

HOW TO USE CURVE TABLES.

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

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

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

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

EXAMPLE.

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

Ext. in Tab. I opposite $23^\circ 20' = 120.87$
 $120.87 \div 12 = 10.07$. Say a 10° Curve.

Tan. in Tab. I opp. $23^\circ 20' = 1183.1$
 $1183.1 \div 10 = 118.31$.

Correction for A. $23^\circ 20'$ for a 10° Cur. = 0.16
 $118.31 + 0.16 = 118.47 =$ corrected Tangent.

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

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

$2^\circ 19\frac{1}{2}' =$ def. for sta.	542	I. P. = sta.	542+72
$4^\circ 49\frac{1}{2}' =$ " " "	+50	Tan. =	1 18.47
$7^\circ 19\frac{1}{2}' =$ " " "	543	B. C. = sta.	541+53.53
$9^\circ 49\frac{1}{2}' =$ " " "	+50	L. C. =	2 33.33
$11^\circ 40' =$ " " "	543+	E. C. = Sta.	543+86.86
	86.86		

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

$2^\circ 19\frac{1}{2}' =$ def. for sta. 542.

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

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

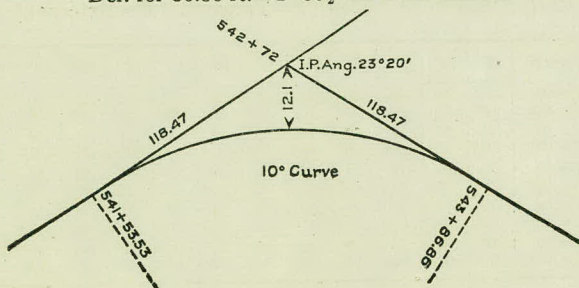


TABLE I. — Tangents and External to a 1° Curve.

Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
1°	50.00	.22	8°	400.66	13.99	15°	754.32	49.44
10'	58.34	.30	10'	409.03	14.58	10'	762.80	50.55
20	66.67	.39	20	417.41	15.18	20	771.29	51.68
30	75.01	.49	30	425.79	15.80	30	779.77	52.82
40	83.34	.61	40	434.17	16.43	40	788.26	53.97
50	91.68	.73	50	442.55	17.07	50	796.75	55.13
2	100.01	.87	9	450.93	17.72	16	805.25	56.31
10	108.35	1.02	10	459.32	18.38	10	813.75	57.50
20	116.68	1.19	20	467.71	19.06	20	822.25	58.70
30	125.02	1.36	30	476.10	19.75	30	830.76	59.91
40	133.36	1.55	40	484.49	20.45	40	839.27	61.14
50	141.70	1.75	50	492.88	21.16	50	847.78	62.38
3	150.04	1.96	10	501.28	21.89	17	856.30	63.63
10	158.38	2.19	10	509.68	22.62	10	864.82	64.90
20	166.72	2.43	20	518.08	23.38	20	873.35	66.18
30	175.06	2.67	30	526.48	24.14	30	881.88	67.47
40	183.40	2.93	40	534.89	24.91	40	890.41	68.77
50	191.74	3.21	50	543.29	25.70	50	898.95	70.09
4	200.08	3.49	11	551.70	26.50	18	907.49	71.42
10	208.43	3.79	10	560.11	27.31	10	916.03	72.76
20	216.77	4.10	20	568.53	28.14	20	924.58	74.12
30	225.12	4.42	30	576.95	28.97	30	933.13	75.49
40	233.47	4.76	40	585.36	29.82	40	941.69	76.86
50	241.81	5.10	50	593.79	30.68	50	950.25	78.26
5	250.16	5.46	12	602.21	31.56	19	958.81	79.67
10	258.51	5.83	10	610.64	32.45	10	967.38	81.09
20	266.86	6.21	20	619.07	33.35	20	975.96	82.53
30	275.21	6.61	30	627.50	34.26	30	984.53	83.97
40	283.57	7.01	40	635.93	35.18	40	993.12	85.43
50	291.92	7.43	50	644.37	36.12	50	1001.7	86.90
6	300.28	7.83	13	652.81	37.07	20	1010.3	88.39
10	308.64	8.31	10	661.25	38.03	10	1018.9	89.89
20	316.99	8.76	20	669.70	39.01	20	1027.5	91.40
30	325.35	9.23	30	678.15	39.99	30	1036.1	92.92
40	333.71	9.71	40	686.60	40.99	40	1044.7	94.46
50	342.08	10.20	50	695.06	42.00	50	1053.3	96.01
7	350.44	10.71	14	703.51	43.03	21	1061.9	97.57
10	358.81	11.22	10	711.97	44.07	10	1070.6	99.16
20	367.17	11.75	20	720.44	45.12	20	1079.2	100.75
30	375.54	12.29	30	728.90	46.18	30	1087.8	102.35
40	383.91	12.85	40	737.37	47.25	40	1096.4	103.97
50	392.28	13.41	50	745.85	48.34	50	1105.1	105.60

Corrections to be Added (T = Tangent. E = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
5°	T=.02 E=.000	.03 .000	.05 .001	.06 .001	.08 .002	.10 .002	.11 .002	.13 .003	.15 .003	.16 .004	.18 .004	.20 .004	.21 .005	.23 .005
10°	T=.03 E=.001	.06 .003	.09 .004	.13 .006	.16 .007	.19 .008	.22 .009	.25 .011	.28 .012	.31 .014	.34 .015	.38 .017	.42 .018	.46 .020
15°	T=.04 E=.003	.10 .007	.14 .010	.19 .014	.24 .018	.29 .023	.34 .027	.39 .029	.45 .032	.51 .035	.53 .039	.58 .043	.63 .047	.68 .051
20°	T=.06 E=.006	.13 .011	.19 .017	.26 .022	.32 .028	.39 .034	.45 .038	.51 .045	.58 .051	.65 .057	.72 .063	.79 .070	.84 .076	.90 .083
25°	T=.08 E=.009	.16 .018	.24 .027	.33 .036	.40 .046	.49 .056	.58 .065	.67 .074	.75 .083	.83 .093	.90 .106	.99 .120	1.06 .127	1.14 .135

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
22°	1113.7	107.24	29°	1481.8	188.51	36°	1861.7	294.9
10'	1122.4	108.90	10'	1490.7	190.74	10'	1870.9	297.7
20	1131.0	110.57	20	1499.6	192.99	20	1880.1	300.6
30	1139.7	112.25	30	1508.5	195.25	30	1889.4	303.5
40	1148.4	113.95	40	1517.4	197.53	40	1898.6	306.4
50	1157.0	115.66	50	1526.3	199.82	50	1907.9	309.3
23	1165.7	117.38	30	1535.3	202.12	37	1917.1	312.2
10	1174.4	119.12	10	1544.2	204.44	10	1926.4	315.2
20	1183.1	120.87	20	1553.1	206.77	20	1935.7	318.1
30	1191.8	122.63	30	1562.1	209.12	30	1945.0	321.1
40	1200.5	124.41	40	1571.0	211.48	40	1954.3	324.1
50	1209.2	126.20	50	1580.0	213.86	50	1963.6	327.1
24	1217.9	128.00	31	1589.0	216.3	38	1972.9	330.2
10	1226.6	129.82	10	1598.0	218.7	10	1982.2	333.2
20	1235.3	131.65	20	1606.9	221.1	20	1991.5	336.3
30	1244.0	133.50	30	1615.9	223.5	30	2000.9	339.3
40	1252.8	135.35	40	1624.9	226.0	40	2010.2	342.4
50	1261.5	137.23	50	1633.9	228.4	50	2019.6	345.5
25	1270.2	139.11	32	1643.0	230.9	39	2029.0	348.6
10	1279.0	141.01	10	1652.0	233.4	10	2038.4	351.8
20	1287.7	142.93	20	1661.0	235.9	20	2047.8	354.9
30	1296.5	144.85	30	1670.0	238.4	30	2057.2	358.1
40	1305.3	146.79	40	1679.1	241.0	40	2066.6	361.3
50	1314.0	148.75	50	1688.1	243.5	50	2076.0	364.5
26	1322.8	150.71	33	1697.2	246.1	40	2085.4	367.7
10	1331.6	152.69	10	1706.3	248.7	10	2094.9	371.0
20	1340.4	154.69	20	1715.3	251.3	20	2104.3	374.2
30	1349.2	156.70	30	1724.4	253.9	30	2113.8	377.5
40	1358.0	158.72	40	1733.5	256.5	40	2123.3	380.8
50	1366.8	160.76	50	1742.6	259.1	50	2132.7	384.1
27	1375.6	162.81	34	1751.7	261.8	41	2142.2	387.4
10	1384.4	164.86	10	1760.8	264.5	10	2151.7	390.7
20	1393.2	166.95	20	1770.0	267.2	20	2161.2	394.1
30	1402.0	169.04	30	1779.1	269.9	30	2170.8	397.4
40	1410.9	171.15	40	1788.2	272.6	40	2180.3	400.8
50	1419.7	173.27	50	1797.4	275.3	50	2189.9	404.2
28	1428.6	175.41	35	1806.6	278.1	42	2199.4	407.6
10	1437.4	177.55	10	1815.7	280.8	10	2209.0	411.1
20	1446.3	179.72	20	1824.9	283.6	20	2218.6	414.5
30	1455.1	181.89	30	1834.1	286.4	30	2228.1	418.0
40	1464.0	184.08	40	1843.3	289.2	40	2237.7	421.4
50	1472.9	186.29	50	1852.5	292.0	50	2247.3	425.0

Corrections to be Added (T = Tangent. E = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
20°	T=.06 E=.006	.13 .011	.19 .017	.26 .022	.32 .028	.39 .034	.45 .038	.51 .045	.58 .051	.65 .057	.72 .063	.79 .070	.84 .076	.90 .083
25°	T=.08 E=.009	.16 .018	.24 .027	.33 .036	.40 .046	.49 .056	.58 .065	.67 .074	.75 .083	.83 .093	.90 .106	.99 .120	1.06 .127	1.14 .135
30°	T=.10 E=.013	.19 .025	.29 .038	.39 .051	.49 .065	.59 .078	.69 .090	.79 .103	.89 .116	.99 .129	1.09 .149	1.20 .170	1.29 .179	1.39 .188
35°	T=.11 E=.018	.22 .035	.34 .054	.47 .072	.58 .086	.69 .109	.80 .131	.93 .153	1.05 .175	1.17 .197	1.29 .213	1.42 .230	1.54 .247	1.66 .264
40°	T=.13 E=.023	.26 .046	.40 .070	.53 .093	.67 .117	.80 .141	.93 .172	1.06 .203	1.20 .234	1.34 .265	1.49 .277	1.64 .290	1.79 .315	1.94 .341
45°	T=.15 E=.030	.30 .060	.44 .093	.60 .119	.76 .153	.91 .184	1.06 .216	1.21 .254	1.37 .289	1.52 .325	1.70 .351	1.87 .378	2.04 .411	2.21 .445

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
43°	2257.0	428.5	50°	2671.8	592.3	57°	3110.9	790.1
10'	2266.6	432.0	10'	2681.9	596.6	10'	3121.7	795.2
20	2276.2	435.6	20	2692.1	600.9	20	3132.6	800.4
30	2285.9	439.2	30	2702.3	605.3	30	3143.4	805.6
40	2295.6	442.8	40	2712.5	609.6	40	3154.2	810.9
50	2305.2	446.4	50	2722.7	614.0	50	3165.1	816.1
44	2314.9	450.0	51	2732.9	618.4	58	3176.0	821.4
10	2324.6	453.6	10	2743.1	622.8	10	3186.9	826.7
20	2334.3	457.3	20	2753.4	627.2	20	3197.8	832.0
30	2344.1	461.0	30	2763.7	631.7	30	3208.8	837.3
40	2353.8	464.6	40	2773.9	636.2	40	3219.7	842.7
50	2363.5	468.4	50	2784.2	640.7	50	3230.7	848.1
45	2373.3	472.1	52	2794.5	645.2	59	3241.7	853.5
10	2383.1	475.8	10	2804.9	649.7	10	3252.7	858.9
20	2392.8	479.6	20	2815.2	654.3	20	3263.7	864.3
30	2402.6	483.4	30	2825.6	658.8	30	3274.8	869.8
40	2412.4	487.2	40	2835.9	663.4	40	3285.8	875.3
50	2422.3	491.0	50	2846.3	668.0	50	3296.9	880.8
46	2432.1	494.8	53	2856.7	672.7	60	3308.0	886.4
10	2441.9	498.7	10	2867.1	677.3	10	3319.1	892.0
20	2451.8	502.5	20	2877.5	682.0	20	3330.3	897.5
30	2461.7	506.4	30	2888.0	686.7	30	3341.4	903.2
40	2471.5	510.3	40	2898.4	691.4	40	3352.6	908.8
50	2481.4	514.3	50	2908.9	696.1	50	3363.8	914.5
47	2491.3	518.2	54	2919.4	700.9	61	3375.0	920.2
10	2501.2	522.2	10	2929.9	705.7	10	3386.3	925.9
20	2511.2	526.1	20	2940.4	710.5	20	3397.5	931.6
30	2521.1	530.1	30	2951.0	715.3	30	3408.8	937.3
40	2531.1	534.2	40	2961.5	720.1	40	3420.1	943.1
50	2541.0	538.2	50	2972.1	725.0	50	3431.4	948.9
48	2551.0	542.2	55	2982.7	729.9	62	3442.7	954.8
10	2561.0	546.3	10	2993.3	734.8	10	3454.1	960.6
20	2571.0	550.4	20	3003.9	739.7	20	3465.4	966.5
30	2581.0	554.5	30	3014.5	744.6	30	3476.8	972.4
40	2591.0	558.6	40	3025.2	749.6	40	3488.3	978.3
50	2601.1	562.8	50	3035.8	754.6	50	3499.7	984.3
49	2611.2	566.9	56	3046.5	759.6	63	3511.1	990.2
10	2621.2	571.1	10	3057.2	764.6	10	3522.6	996.2
20	2631.3	575.3	20	3067.9	769.7	20	3534.1	1002.3
30	2641.4	579.5	30	3078.7	774.7	30	3545.6	1008.3
40	2651.5	583.8	40	3089.4	779.8	40	3557.2	1014.4
50	2661.6	588.0	50	3100.2	784.9	50	3568.7	1020.5

Corrections to be Added (T = Tangent. E = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
40°	T=.13 E=.023	.26 .046	.40 .070	.53 .093	.67 .117	.80 .141	.93 .172	1.06 .203	1.20 .234	1.34 .265	1.49 .277	1.64 .290	1.79 .315	1.94 .341
45°	T=.15 E=.030	.30 .060	.44 .093	.60 .119	.76 .153	.91 .184	1.06 .216	1.21 .254	1.37 .289	1.52 .325	1.70 .351	1.87 .378	2.04 .411	2.21 .445
50°	T=.17 E=.037	.34 .075	.51 .116	.68 .151	.85 .189	1.02 .227	1.19 .266	1.36 .305	1.54 .345	1.72 .384	1.91 .425	2.10 .467	2.29 .508	2.48 .550
55°	T=.19 E=.046	.38 .093	.57 .142	.76 .188	.95 .236	1.14 .283	1.32 .332	1.52 .381	1.72 .420	1.92 .479	2.14 .530	2.35 .582	2.56 .641	2.77 .700
60°	T=.21 E=.056	.42 .112	.63 .168	.84 .225	1.05 .283	1.27 .340	1.49 .398	1.71 .457	1.94 .516	2.17 .575	2.38 .636	2.60 .697	2.83 .774	3.07 .851
65°	T=.23 E=.067	.46 .135	.69 .204	.93 .273	1.16 .343	1.40 .412	1.64 .483	1.88 .554	2.13 .625	2.38 .697	2.63 .771	2.88 .845	3.13 .922	3.39 1.01

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

V

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
64°	3580.3	1026.6	71°	4086.9	1308.2	78°	4639.8	1643.0
10'	3591.9	1032.8	10'	4099.5	1315.6	10'	4653.6	1651.7
20	3603.5	1039.0	20	4112.1	1322.9	20	4667.4	1660.5
30	3615.1	1045.2	30	4124.8	1330.3	30	4681.3	1669.2
40	3626.8	1051.4	40	4137.4	1337.7	40	4695.2	1678.1
50	3638.5	1057.7	50	4150.1	1345.1	50	4709.2	1686.9
65	3650.2	1063.9	72	4162.8	1352.6	79	4723.2	1695.8
10	3661.9	1070.2	10	4175.6	1360.1	10	4737.2	1704.7
20	3673.7	1076.6	20	4188.5	1367.6	20	4751.2	1713.7
30	3685.4	1082.9	30	4201.2	1375.2	30	4765.3	1722.7
40	3697.2	1089.3	40	4214.0	1382.8	40	4779.4	1731.7
50	3709.0	1095.7	50	4226.8	1390.4	50	4793.6	1740.8
66	3720.9	1102.2	73	4239.7	1398.0	80	4807.7	1749.9
10	3732.7	1108.6	10	4252.6	1405.7	10	4822.0	1759.0
20	3744.6	1115.1	20	4265.6	1413.5	20	4836.2	1768.2
30	3756.5	1121.7	30	4278.5	1421.2	30	4850.5	1777.4
40	3768.5	1128.2	40	4291.5	1429.0	40	4864.8	1786.7
50	3780.4	1134.8	50	4304.6	1436.8	50	4879.2	1796.0
67	3792.4	1141.4	74	4317.6	1444.6	81	4893.6	1805.3
10	3804.4	1148.0	10	4330.7	1452.5	10	4908.0	1814.7
20	3816.4	1154.7	20	4343.8	1460.4	20	4922.5	1824.1
30	3828.4	1161.3	30	4356.9	1468.4	30	4937.0	1833.6
40	3840.5	1168.1	40	4370.1	1476.4	40	4951.5	1843.1
50	3852.6	1174.8	50	4383.3	1484.4	50	4966.1	1852.6
68	3864.7	1181.6	75	4396.5	1492.4	82	4980.7	1862.2
10	3876.8	1188.4	10	4409.8	1500.5	10	4995.4	1871.8
20	3889.0	1195.2	20	4423.1	1508.6	20	5010.0	1881.5
30	3901.2	1202.0	30	4436.4	1516.7	30	5024.8	1891.2
40	3913.4	1208.9	40	4449.7	1524.9	40	5039.5	1900.9
50	3925.6	1215.8	50	4463.1	1533.1	50	5054.3	1910.7
69	3937.9	1222.7	76	4476.5	1541.4	83	5069.2	1920.5
10	3950.2	1229.7	10	4489.9	1549.7	10	5084.0	1930.4
20	3962.5	1236.7	20	4503.4	1558.0	20	5099.0	1940.3
30	3974.8	1243.7	30	4516.9	1566.3	30	5113.9	1950.3
40	3987.2	1250.8	40	4530.4	1574.7	40	5128.9	1960.2
50	3999.5	1257.9	50	4544.0	1583.1	50	5143.9	1970.3
70	4011.9	1265.0	77	4557.6	1591.6	84	5159.0	1980.4
10	4024.4	1272.1	10	4571.2	1600.1	10	5174.1	1990.5
20	4036.8	1279.3	20	4584.8	1608.6	20	5189.3	2000.6
30	4049.3	1286.5	30	4598.5	1617.1	30	5204.4	2010.8
40	4061.8	1293.6	40	4612.2	1625.7	40	5219.7	2021.1
50	4074.4	1300.9	50	4626.0	1634.4	50	5234.9	2031.4

Corrections to be Added (T = Tangent. E = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
60°	T=.21 E=.056	.42 .112	.63 .168	.84 .225	1.05 .283	1.27 .340	1.49 .398	1.71 .457	1.94 .516	2.17 .575	2.38 .636	2.60 .697	2.83 .774	3.07 .851
65°	T=.23 E=.067	.46 .135	.69 .204	.93 .273	1.16 .343	1.40 .412	1.64 .483	1.88 .554	2.13 .625	2.38 .697	2.63 .771	2.88 .845	3.13 .922	3.39 1.01
70°	T=.25 E=.080	.51 .159	.76 .240	1.02 .321	1.28 .403	1.54 .485	1.80 .568	2.06 .652	2.33 .735	2.60 .819	2.88 .906	3.16 .994	3.44 1.08	3.72 1.17
75°	T=.27 E=.095	.56 .182	.83 .286	1.12 .383	1.40 .480	1.69 .578	1.98 .678	2.27 .777	2.57 .877	2.87 .977	3.16 1.07	3.47 1.18	3.78 1.29	4.09 1.39
80°	T=.30 E=.110	.61 .220	.91 .332	1.22 .445	1.53 .558	1.84 .671	2.15 .787	2.46 .903	2.78 1.02	3.10 1.13	3.44 1.25	3.78 1.38	4.12 1.50	4.46 1.62
85°	T=.33 E=.128	.66 .259	1.00 .391	1.33 .524	1.68 .657	2.02 .790	2.36 .926	2.70 1.06	3.05 1.20	3.40 1.34	3.77 1.47	4.14 1.62	4.55 1.76	4.89 1.91

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
85°			92°			99°		
10'	5250.3	2041.7	10'	5933.2	2518.5	10'	6708.6	3092.7
20	5265.6	2052.1	20	5950.5	2531.0	20	6728.4	3107.7
30	5281.0	2062.5	30	5967.9	2543.5	30	6748.2	3122.9
40	5296.4	2073.0	40	5985.3	2556.0	40	6768.1	3138.1
50	5311.9	2083.5	50	6002.7	2568.6	50	6788.1	3153.3
	5327.4	2094.1		6020.2	2581.3		6808.2	3168.7
86			93			100		
10	5343.0	2104.7	10	6037.8	2594.0	10	6828.3	3184.1
20	5358.6	2115.3	20	6055.4	2606.8	20	6848.5	3199.6
30	5374.2	2126.0	30	6073.1	2619.7	30	6868.8	3215.1
40	5389.9	2136.7	40	6090.8	2632.6	40	6889.2	3230.8
50	5405.6	2147.5	50	6108.6	2645.5	50	6909.6	3246.5
	5421.4	2158.4		6126.4	2658.5		6930.1	3262.3
87			94			101		
10	5437.2	2169.2	10	6144.3	2671.6	10	6950.6	3278.1
20	5453.1	2180.2	20	6162.6	2684.7	20	6971.3	3294.1
30	5469.0	2191.1	30	6180.2	2697.9	30	6992.0	3310.1
40	5484.9	2202.2	40	6198.3	2711.2	40	7012.7	3326.1
50	5500.9	2213.2	50	6216.4	2724.5	50	7033.6	3342.3
	5517.0	2224.3		6234.6	2737.9		7054.5	3358.5
88			95			102		
10	5533.1	2235.5	10	6252.8	2751.3	10	7075.5	3374.9
20	5549.2	2246.7	20	6271.1	2764.8	20	7096.6	3391.2
30	5565.4	2258.0	30	6289.4	2778.3	30	7117.8	3407.7
40	5581.6	2269.3	40	6307.9	2792.0	40	7139.0	3424.3
50	5597.8	2280.6	50	6326.3	2805.6	50	7160.3	3440.9
	5614.2	2292.0		6344.8	2819.4		7181.7	3457.6
89			96			103		
10	5630.5	2303.5	10	6363.4	2833.2	10	7203.2	3474.4
20	5646.9	2315.0	20	6382.1	2847.0	20	7224.7	3491.3
30	5663.4	2326.6	30	6400.8	2861.0	30	7246.3	3508.2
40	5679.9	2338.2	40	6419.5	2875.0	40	7268.0	3525.2
50	5696.4	2349.8	50	6438.4	2889.0	50	7289.8	3542.4
	5713.0	2361.5		6457.3	2903.1		7311.7	3559.6
90			97			104		
10	5729.7	2373.3	10	6476.2	2917.3	10	7333.6	3576.8
20	5746.3	2385.1	20	6495.2	2931.6	20	7355.6	3594.2
30	5763.1	2397.0	30	6514.3	2945.9	30	7377.8	3611.7
40	5779.9	2408.9	40	6533.4	2960.3	40	7399.9	3629.2
50	5796.7	2420.9	50	6552.6	2974.7	50	7422.2	3646.8
	5813.6	2432.9		6571.9	2989.2		7444.6	3664.5
91			98			105		
10	5830.5	2444.9	10	6591.2	3003.8	10	7467.0	3682.3
20	5847.5	2457.1	20	6610.6	3018.4	20	7489.6	3700.2
30	5864.6	2469.3	30	6630.1	3033.1	30	7512.2	3718.2
40	5881.7	2481.5	40	6649.6	3047.9	40	7534.9	3736.2
50	5898.8	2493.8	50	6669.2	3062.8	50	7557.7	3754.4
	5916.0	2506.1		6688.8	3077.7		7580.5	3772.6

Corrections to be Added (T = Tangent. E. = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
85°	T=.33 E=.128	.66 .259	1.00 .391	1.33 .524	1.68 .657	2.02 .790	2.36 .926	2.70 1.06	3.05 1.20	3.40 1.34	3.77 1.47	4.14 1.62	4.55 1.76	4.89 1.91
90°	T=.36 E=.149	.72 .299	1.09 .450	1.45 .603	1.83 .756	2.20 .910	2.57 1.07	2.94 1.22	3.32 1.38	3.70 1.54	4.10 1.70	4.50 1.87	4.91 2.03	5.32 2.20
95°	T=.39 E=.174	.79 .350	1.19 .522	1.55 .706	2.00 .985	2.40 1.06	2.80 1.25	3.20 1.43	3.61 1.62	4.02 1.80	4.49 1.99	4.98 2.18	5.38 2.38	5.83 2.58
100°	T=.43 E=.200	.86 .401	1.30 .604	1.74 .809	2.18 1.01	2.62 1.22	3.06 1.43	3.50 1.64	3.95 1.85	4.40 2.06	4.88 2.28	5.37 2.50	5.85 2.73	6.34 2.96
105°	T=.46 E=.230	.94 .470	1.42 .700	1.90 .933	2.38 1.17	2.87 1.42	3.34 1.65	3.84 1.90	4.35 2.14	4.84 2.39	5.35 2.64	5.87 2.90	6.40 3.16	6.93 3.41

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
106°	7603.5	3791.0	111°	8336.7	4386.1	116°	9169.4	5082.7
10'	7626.6	3809.4	10'	8362.7	4407.6	10'	9199.1	5107.9
20	7649.7	3827.9	20	8388.9	4429.2	20	9229.0	5133.3
30	7672.9	3846.5	30	8415.1	4450.9	30	9259.0	5158.8
40	7696.3	3865.2	40	8441.5	4472.7	40	9289.2	5184.5
50	7719.7	3884.0	50	8468.0	4494.6	50	9319.5	5210.3
107	7743.2	3902.9	112	8494.6	4516.6	117	9349.9	5236.2
10	7766.8	3921.9	10	8521.3	4538.8	10	9380.5	5262.3
20	7790.5	3940.9	20	8548.1	4561.1	20	9411.3	5288.6
30	7814.3	3960.1	30	8575.0	4583.4	30	9442.2	5315.0
40	7838.1	3979.4	40	8602.1	4606.0	40	9473.2	5341.5
50	7862.1	3998.7	50	8629.3	4628.6	50	9504.4	5368.2
108	7886.2	4018.2	113	8656.6	4651.3	118	9535.7	5395.1
10	7910.4	4037.8	10	8684.0	4674.2	10	9567.2	5422.1
20	7934.6	4057.4	20	8711.5	4697.2	20	9598.9	5449.2
30	7959.0	4077.2	30	8739.2	4720.3	30	9630.7	5476.5
40	7983.5	4097.1	40	8767.0	4743.6	40	9662.6	5504.0
50	8008.0	4117.0	50	8794.9	4766.9	50	9694.7	5531.7
109	8032.7	4137.1	114	8822.9	4790.4	119	9727.0	5559.4
10	8057.4	4157.3	10	8851.0	4814.1	10	9759.4	5587.4
20	8082.3	4177.5	20	8879.3	4837.8	20	9792.0	5615.5
30	8107.3	4197.9	30	8907.7	4861.7	30	9824.8	5643.8
40	8132.3	4218.4	40	8936.3	4885.7	40	9857.7	5672.3
50	8157.5	4239.0	50	8965.0	4909.9	50	9890.8	5700.9
110	8182.8	4259.7	115	8993.8	4934.1	120	9924.0	5729.7
10	8208.2	4280.5	10	9022.7	4958.6	10	9957.5	5758.6
20	8233.7	4301.4	20	9051.7	4983.1	20	9991.0	5787.7
30	8259.3	4322.4	30	9080.9	5007.8	30	10025.0	5817.0
40	8285.0	4343.6	40	9110.3	5032.6	40	10059.0	5846.5
50	8310.8	4364.8	50	9139.8	5057.6	50	10093.0	5876.1

Corrections to be Added (T = Tangent. E = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
100°	T=.43 E=.200	.86 .401	1.30 .604	1.74 .809	2.18 1.01	2.62 1.22	3.06 1.43	3.50 1.64	3.95 1.85	4.40 2.06	4.88 2.28	5.37 2.50	5.85 2.73	6.34 2.96
105°	T=.46 E=.230	.94 .470	1.42 .700	1.90 .938	2.38 1.17	2.87 1.42	3.34 1.65	3.84 1.90	4.35 2.14	4.84 2.39	5.35 2.64	5.87 2.90	6.40 3.16	6.93 3.41
110°	T=.50 E=.260	1.03 .535	1.55 .808	2.08 1.08	2.60 1.36	3.14 1.63	3.66 1.91	4.21 2.19	4.76 2.49	5.31 2.61	5.86 3.05	6.43 3.35	7.01 3.65	7.59 3.95
115°	T=.54 E=.307	1.13 .624	1.70 .939	2.29 1.26	2.86 1.57	3.45 1.89	4.03 2.21	4.63 2.54	5.23 2.87	5.83 3.20	6.44 3.53	7.07 3.88	7.70 4.23	8.35 4.58
120°	T=.61 E=.339	1.25 .720	1.89 1.08	2.52 1.45	3.16 1.82	3.81 2.20	4.44 2.56	5.11 2.95	5.78 3.33	6.44 3.72	7.11 4.10	7.80 4.50	8.51 4.91	9.21 5.32

TABLE II. — Radii, Ordinates and Deflections. Chord = 100 ft.

Deg.	Radius	Mid. Ord.	Tan. Dist.	Def. Dist.	Def. for 1 Ft.	Deg.	Radius	Mid. Ord.	Tan. Dist.	Def. Dist.	Def. for 1 Ft.
	ft.	ft.	ft.	ft.	/		ft.	ft.	ft.	ft.	/
0° 10'	34377.	.036	.145	.291	0.05	7°	819.0	1.528	6.105	12.21	2.10
20	17189.	.073	.291	.582	0.10	20'	781.8	1.600	6.395	12.79	2.20
30	11459.	.109	.436	.873	0.15	30	764.5	1.637	6.540	13.08	2.25
40	8594.4	.145	.582	1.164	0.20	40	747.9	1.673	6.685	13.37	2.30
50	6875.5	.182	.727	1.454	0.25	8	716.8	1.746	6.976	13.95	2.40
1	5729.6	.218	.873	1.745	0.30	20	688.2	1.819	7.266	14.53	2.50
10	4911.2	.255	1.018	2.036	0.35	30	674.7	1.855	7.411	14.82	2.55
20	4297.3	.291	1.164	2.327	0.40	40	661.7	1.892	7.556	15.11	2.60
30	3819.8	.327	1.309	2.618	0.45	9	637.3	1.965	7.846	15.69	2.70
40	3437.9	.364	1.454	2.909	0.50	20	614.6	2.037	8.136	16.27	2.80
50	3125.4	.400	1.600	3.200	0.55	30	603.8	2.074	8.281	16.56	2.85
2	2864.9	.436	1.745	3.490	0.60	40	593.4	2.110	8.426	16.85	2.90
10	2644.6	.473	1.891	3.781	0.65	10	573.7	2.183	8.716	17.43	3.00
20	2455.7	.509	2.036	4.072	0.70	30	546.4	2.292	9.150	18.30	3.15
30	2292.0	.545	2.181	4.363	0.75	11	521.7	2.402	9.585	19.16	3.30
40	2148.8	.582	2.327	4.654	0.80	30	499.1	2.511	10.02	20.04	3.45
50	2022.4	.618	2.472	4.945	0.85	12	478.3	2.620	10.45	20.91	3.60
3	1910.1	.655	2.618	5.235	0.90	30	459.3	2.730	10.89	21.77	3.75
10	1809.6	.691	2.763	5.526	0.95	13	441.7	2.839	11.32	22.64	3.90
20	1719.1	.727	2.908	5.817	1.00	30	425.4	2.949	11.75	23.51	4.05
30	1637.3	.764	3.054	6.108	1.05	14	410.3	3.058	12.18	24.37	4.20
40	1562.9	.800	3.199	6.398	1.10	30	396.2	3.168	12.62	25.24	4.35
50	1495.0	.836	3.345	6.689	1.15	15	383.1	3.277	13.05	26.11	4.50
4	1432.7	.873	3.490	6.980	1.20	30	370.8	3.387	13.49	26.97	4.65
10	1375.4	.909	3.635	7.271	1.25	16	359.3	3.496	13.92	27.84	4.80
20	1322.5	.945	3.718	7.561	1.30	30	348.5	3.606	14.35	28.70	4.95
30	1273.6	.982	3.926	7.852	1.35	17	338.3	3.716	14.78	29.56	5.10
40	1228.1	1.018	4.071	8.143	1.40	18	319.6	3.935	15.64	31.29	5.40
50	1185.8	1.055	4.217	8.433	1.45	19	302.9	4.155	16.51	33.01	5.70
5	1146.3	1.091	4.362	8.724	1.50	20	287.9	4.374	17.37	34.73	6.00
10	1109.3	1.127	4.507	9.014	1.55	21	274.4	4.594	18.22	36.44	6.30
20	1074.7	1.164	4.653	9.305	1.60	22	262.0	4.814	19.08	38.16	6.60
30	1042.1	1.200	4.798	9.596	1.65	23	250.8	5.035	19.94	39.87	6.90
40	1011.5	1.237	4.943	9.886	1.70	24	240.5	5.255	20.79	41.58	7.20
50	982.6	1.273	5.088	10.18	1.75	25	231.0	5.476	21.64	43.28	7.50
6	955.4	1.309	5.234	10.47	1.80	26	222.3	5.697	22.50	44.99	7.80
10	929.6	1.346	5.379	10.76	1.85	27	214.2	5.918	23.35	46.69	8.10
20	905.1	1.382	5.524	11.05	1.90	28	206.7	6.139	24.19	48.38	8.40
30	881.9	1.418	5.669	11.34	1.95	29	199.7	6.360	25.04	50.07	8.70
40	859.9	1.455	5.814	11.63	2.00	30	193.2	6.583	25.88	51.76	9.00

The middle ordinate in inches for any cord of length (C) is equal to .0012 C² multiplied by the middle ordinate taken from the above table. Thus, if it desired to bend a 30 ft. rail to fit a 10 degree curve, its middle ordinate should be .0012×900×2.183 or 2.36 inches.

TABLE III. Deflections for Sub Chords for Short Radius Curves.

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

CURVE FORMULAS

$T = R \tan \frac{1}{2} I$	$R = T \cot. \frac{1}{2} I$	Chord def. = $\frac{\text{chord}^2}{R}$
$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin. } \frac{1}{2} D}$	$R = \frac{50}{\text{Sin. } \frac{1}{2} D}$	No. chords = $\frac{I}{D}$
$\text{Sin. } \frac{1}{2} D = \frac{50}{R}$	$E = R \text{ ex. sec } \frac{1}{2} I$	Tan. def. = $\frac{1}{2} \text{ chord def.}$
$\text{Sin. } \frac{1}{2} D = \frac{50 \tan \frac{1}{2} I}{T}$	$E = T \tan \frac{1}{4} I$	

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

To find angle for a given distance and deflection.

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

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

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

GENERAL DATA

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

Given Base 100, Alt. $10.10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. $25.25^2 \div 200 = 3.125$. $100 - 3.125 = 96.875 = \text{Base}$.

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

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

LEVELING. The correction for curvature and refraction, in feet and decimals of feet is equal to $0.574d^2$, where d is the distance in miles. The correction for curvature alone is closely, $\frac{1}{3}d^2$. The combined correction is negative.

PROBABLE ERROR. If d_1, d_2, d_3 , etc. are the discrepancies of various results from the mean, and if Σd^2 = the sum of the squares of these differences and n = the number of observations, then the probable error of the mean =

$$\pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$$

SOLAR EPHEMERIS. Attention is called to the Solar Ephemeris for the current year, published by Keuffel & Esser Co., and furnished free of charge upon request, which is $3\frac{1}{2} \times 5\frac{1}{2}$ in., with about 90 pages of data very useful to the Surveyor; such as the adjustments of transits, levels and solar attachments; directions and tables for determining the meridian and the latitude from observations on the sun and Polaris; stadia measurements; magnetic declination; arithmetic constants; English and Metric conversions; trigonometric formulas; Natural and Logarithmic Functions; and Logarithms of Numbers.

TABLE IV. — 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 V. — Inches in Decimals of a Foot.

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

Natural Trigonometrical Functions

Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.							Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.								
°							°								
0	0	0	1.	∞	∞	1.	90	8	.1392	.1405	1.0098	7.185	7.115	.99027	82
10	.0029	.0029		343.8	343.8	1.	50	10	.1421	.1435	1.0102	7.040	6.968	.98986	50
20	.0058	.0058		171.9	171.9	.99998	40	20	.1449	.1465	1.0107	6.900	6.827	.98944	40
30	.0087	.0087		114.6	114.6	.99996	30	30	.1478	.1495	1.0111	6.766	6.691	.98902	30
40	.0116	.0116	1.0001	85.94	85.94	.99993	20	40	.1507	.1524	1.0115	6.636	6.561	.98858	20
50	.0145	.0145	1.0001	63.76	63.75	.99989	10	50	.1536	.1554	1.0120	6.512	6.435	.98814	10
1	.0175	.0175	1.0002	57.30	57.29	.99985	89	9	.1564	.1584	1.0125	6.394	6.314	.98769	81
10	.0204	.0204	1.0002	49.11	49.10	.99979	50	10	.1593	.1614	1.0129	6.277	6.197	.98723	50
20	.0233	.0233	1.0003	42.98	42.96	.99973	40	20	.1622	.1644	1.0134	6.166	6.084	.98676	40
30	.0262	.0262	1.0003	38.20	38.19	.99966	30	30	.1650	.1673	1.0139	6.059	5.976	.98629	30
40	.0291	.0291	1.0004	34.38	34.37	.99958	20	40	.1679	.1703	1.0144	5.955	5.871	.98580	20
50	.0320	.0320	1.0005	31.26	31.24	.99949	10	50	.1708	.1733	1.0149	5.855	5.769	.98531	10
2	.0349	.0349	1.0006	28.65	28.64	.99939	88	10	.1736	.1763	1.0154	5.759	5.671	.98481	80
10	.0378	.0378	1.0007	26.45	26.43	.99929	50	10	.1765	.1793	1.0160	5.665	5.576	.98430	50
20	.0407	.0407	1.0008	24.56	24.54	.99917	40	20	.1794	.1823	1.0165	5.575	5.485	.98378	40
30	.0436	.0437	1.0010	22.93	22.90	.99905	30	30	.1822	.1853	1.0170	5.488	5.396	.98325	30
40	.0465	.0466	1.0011	21.49	21.47	.99892	20	40	.1851	.1883	1.0176	5.403	5.309	.98272	20
50	.0494	.0495	1.0012	20.23	20.21	.99878	10	50	.1880	.1914	1.0181	5.320	5.226	.98218	10
3	.0523	.0524	1.0014	19.11	19.08	.99863	87	11	.1908	.1944	1.0187	5.241	5.145	.98163	79
10	.0552	.0553	1.0015	18.10	18.07	.99847	50	10	.1937	.1974	1.0193	5.164	5.066	.98107	50
20	.0581	.0582	1.0017	17.20	17.17	.99831	40	20	.1965	.2004	1.0199	5.089	4.989	.98050	40
30	.0610	.0612	1.0019	16.38	16.35	.99813	30	30	.1994	.2035	1.0205	5.016	4.915	.97992	30
40	.0640	.0641	1.0020	15.64	15.60	.99795	20	40	.2022	.2065	1.0211	4.945	4.843	.97934	20
50	.0669	.0670	1.0022	14.96	14.92	.99776	10	50	.2051	.2095	1.0217	4.877	4.773	.97875	10
4	.0698	.0699	1.0024	14.34	14.30	.99756	86	12	.2079	.2126	1.0223	4.810	4.705	.97815	78
10	.0727	.0729	1.0027	13.76	13.73	.99736	50	10	.2108	.2156	1.0230	4.745	4.638	.97754	50
20	.0756	.0758	1.0029	13.23	13.20	.99714	40	20	.2136	.2186	1.0236	4.682	4.574	.97692	40
30	.0785	.0787	1.0031	12.75	12.71	.99692	30	30	.2164	.2217	1.0243	4.620	4.511	.97630	30
40	.0814	.0816	1.0033	12.29	12.25	.99668	20	40	.2193	.2247	1.0249	4.560	4.449	.97566	20
50	.0843	.0846	1.0036	11.87	11.83	.99644	10	50	.2221	.2278	1.0256	4.502	4.390	.97502	10
5	.0872	.0875	1.0038	11.47	11.43	.99619	85	13	.2250	.2309	1.0263	4.445	4.331	.97437	77
10	.0901	.0904	1.0041	11.10	11.06	.99594	50	10	.2278	.2339	1.0270	4.390	4.275	.97371	50
20	.0929	.0934	1.0043	10.76	10.71	.99567	40	20	.2306	.2370	1.0277	4.336	4.219	.97304	40
30	.0958	.0963	1.0046	10.43	10.39	.99540	30	30	.2334	.2401	1.0284	4.284	4.165	.97237	30
40	.0987	.0992	1.0049	10.13	10.08	.99511	20	40	.2363	.2432	1.0291	4.232	4.113	.97169	20
50	.1016	.1022	1.0052	9.839	9.788	.99482	10	50	.2391	.2462	1.0299	4.182	4.061	.97100	10
6	.1045	.1051	1.0055	9.567	9.514	.99452	84	14	.2419	.2493	1.0306	4.133	4.011	.97030	76
10	.1074	.1080	1.0058	9.309	9.255	.99421	50	10	.2447	.2524	1.0314	4.086	3.962	.96959	50
20	.1103	.1110	1.0061	9.065	9.010	.99390	40	20	.2476	.2555	1.0321	4.039	3.914	.96887	40
30	.1132	.1139	1.0065	8.834	8.777	.99357	30	30	.2504	.2586	1.0329	3.994	3.867	.96815	30
40	.1161	.1169	1.0068	8.614	8.556	.99324	20	40	.2532	.2617	1.0337	3.949	3.821	.96742	20
50	.1190	.1198	1.0072	8.405	8.345	.99290	10	50	.2560	.2648	1.0345	3.906	3.776	.96667	10
7	.1219	.1228	1.0075	8.206	8.144	.99255	83	15	.2588	.2679	1.0353	3.864	3.732	.96593	75
10	.1248	.1257	1.0079	8.016	7.953	.99219	50	10	.2616	.2711	1.0361	3.822	3.689	.96517	50
20	.1276	.1287	1.0082	7.834	7.770	.99182	40	20	.2644	.2742	1.0369	3.782	3.647	.96440	40
30	.1305	.1317	1.0086	7.661	7.596	.99144	30	30	.2672	.2773	1.0377	3.742	3.606	.96363	30
40	.1334	.1346	1.0090	7.496	7.429	.99106	20	40	.2700	.2805	1.0386	3.703	3.566	.96285	20
50	.1363	.1376	1.0094	7.337	7.269	.99067	10	50	.2728	.2836	1.0394	3.665	3.526	.96206	10
							82								74

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Natural Trigonometrical Functions

Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.							Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.						
°	'						°	'					
16	.2756	.2867	1.0403	3.628	3.487	.96126	74						
10	.2784	.2899	1.0412	3.592	3.450	.96046	50	24	.4067	.4452	1.0946	2.459	2.246
20	.2812	.2931	1.0423	3.556	3.412	.95904	40	10	.4094	.4487	1.0961	2.443	2.229
30	.2840	.2962	1.0429	3.521	3.376	.95882	30	20	.4120	.4522	1.0975	2.427	2.211
40	.2868	.2994	1.0438	3.487	3.340	.95799	20	30	.4147	.4557	1.0989	2.411	2.194
50	.2896	.3026	1.0448	3.453	3.305	.95715	10	40	.4173	.4592	1.1004	2.396	2.177
17	.2924	.3057	1.0457	3.420	3.271	.95630	73	50	.4200	.4628	1.1019	2.381	2.161
10	.2952	.3089	1.0466	3.388	3.237	.95545	50	25	.4226	.4663	1.1034	2.366	2.145
20	.2979	.3121	1.0476	3.357	3.204	.95459	40	10	.4253	.4699	1.1049	2.351	2.128
30	.3007	.3153	1.0485	3.326	3.172	.95372	30	20	.4279	.4734	1.1064	2.337	2.112
40	.3035	.3185	1.0495	3.295	3.140	.95284	20	30	.4305	.4770	1.1079	2.323	2.097
50	.3062	.3217	1.0505	3.265	3.108	.95195	10	40	.4331	.4806	1.1095	2.309	2.081
18	.3090	.3249	1.0515	3.236	3.078	.95106	72	50	.4358	.4841	1.1110	2.295	2.066
10	.3118	.3281	1.0525	3.207	3.048	.95015	50	26	.4384	.4877	1.1126	2.281	2.050
20	.3145	.3314	1.0535	3.179	3.018	.94924	40	10	.4410	.4913	1.1142	2.268	2.035
30	.3173	.3346	1.0545	3.152	2.989	.94832	30	20	.4436	.4950	1.1158	2.254	2.020
40	.3201	.3378	1.0555	3.124	2.960	.94740	20	30	.4462	.4986	1.1174	2.241	2.006
50	.3228	.3411	1.0566	3.098	2.932	.94646	10	40	.4488	.5022	1.1190	2.228	1.991
19	.3256	.3443	1.0576	3.072	2.904	.94552	71	50	.4514	.5059	1.1207	2.215	1.977
10	.3283	.3476	1.0587	3.046	2.877	.94457	50	27	.4540	.5095	1.1223	2.203	1.963
20	.3311	.3508	1.0598	3.020	2.850	.94361	40	10	.4566	.5132	1.1240	2.190	1.949
30	.3338	.3541	1.0608	2.996	2.824	.94264	30	20	.4592	.5169	1.1257	2.178	1.935
40	.3365	.3574	1.0619	2.971	2.798	.94167	20	30	.4617	.5206	1.1274	2.166	1.921
50	.3393	.3607	1.0631	2.947	2.773	.94068	10	40	.4643	.5243	1.1291	2.154	1.907
20	.3420	.3640	1.0642	2.924	2.747	.93969	70	50	.4669	.5280	1.1308	2.142	1.894
10	.3448	.3673	1.0653	2.900	2.723	.93869	50	28	.4695	.5317	1.1326	2.130	1.881
20	.3475	.3706	1.0665	2.878	2.699	.93769	40	10	.4720	.5354	1.1343	2.119	1.868
30	.3502	.3739	1.0676	2.856	2.675	.93667	30	20	.4746	.5392	1.1361	2.107	1.855
40	.3529	.3772	1.0688	2.833	2.651	.93565	20	30	.4772	.5430	1.1379	2.096	1.842
50	.3557	.3805	1.0700	2.811	2.628	.93462	10	40	.4797	.5467	1.1397	2.085	1.829
21	.3584	.3839	1.0711	2.790	2.605	.93358	69	50	.4823	.5505	1.1415	2.073	1.816
10	.3611	.3872	1.0723	2.769	2.583	.93253	50	29	.4848	.5543	1.1434	2.063	1.804
20	.3638	.3906	1.0736	2.749	2.560	.93148	40	10	.4874	.5581	1.1452	2.052	1.792
30	.3665	.3939	1.0748	2.729	2.539	.93042	30	20	.4899	.5619	1.1471	2.041	1.780
40	.3692	.3973	1.0760	2.709	2.517	.92935	20	30	.4924	.5658	1.1490	2.031	1.767
50	.3719	.4006	1.0773	2.689	2.496	.92827	10	40	.4950	.5696	1.1509	2.020	1.756
22	.3746	.4040	1.0785	2.670	2.475	.92718	68	50	.4975	.5735	1.1528	2.010	1.744
10	.3773	.4074	1.0798	2.650	2.455	.92609	50	30	.5000	.5774	1.1547	2.000	1.732
20	.3800	.4108	1.0811	2.632	2.434	.92499	40	10	.5025	.5812	1.1566	1.990	1.720
30	.3827	.4142	1.0824	2.613	2.414	.92388	30	20	.5050	.5851	1.1586	1.980	1.709
40	.3854	.4176	1.0837	2.595	2.394	.92276	20	30	.5075	.5890	1.1606	1.970	1.698
50	.3881	.4210	1.0850	2.577	2.375	.92164	10	40	.5100	.5930	1.1626	1.961	1.686
23	.3907	.4245	1.0864	2.559	2.356	.92050	67	50	.5125	.5969	1.1646	1.951	1.675
10	.3934	.4279	1.0877	2.542	2.337	.91936	50	31	.5150	.6009	1.1666	1.942	1.664
20	.3961	.4314	1.0891	2.525	2.318	.91822	40	10	.5175	.6048	1.1687	1.932	1.653
30	.3987	.4348	1.0904	2.508	2.300	.91706	30	20	.5200	.6088	1.1707	1.923	1.643
40	.4014	.4383	1.0918	2.491	2.282	.91590	20	30	.5225	.6128	1.1728	1.914	1.632
50	.4041	.4417	1.0932	2.475	2.264	.91472	10	40	.5250	.6168	1.1749	1.905	1.621
								50	.5275	.6208	1.1770	1.896	1.611

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Natural Trigonometrical Functions

Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.

Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.
32	.5299	.6249	1.1792	1.887	1.600	.84805
10	.5324	.6289	1.1813	1.878	1.590	.84650
20	.5348	.6330	1.1835	1.870	1.580	.84495
30	.5373	.6371	1.1857	1.861	1.570	.84339
40	.5398	.6412	1.1879	1.853	1.560	.84182
50	.5422	.6453	1.1901	1.844	1.550	.84025
33	.5446	.6494	1.1924	1.836	1.540	.83867
10	.5471	.6536	1.1946	1.828	1.530	.83708
20	.5495	.6577	1.1969	1.820	1.520	.83549
30	.5519	.6619	1.1992	1.812	1.511	.83389
40	.5544	.6661	1.2015	1.804	1.501	.83228
50	.5568	.6703	1.2039	1.796	1.492	.83066
34	.5592	.6745	1.2062	1.788	1.483	.82904
10	.5616	.6787	1.2086	1.781	1.473	.82741
20	.5640	.6830	1.2110	1.773	1.464	.82577
30	.5664	.6873	1.2134	1.766	1.455	.82413
40	.5688	.6916	1.2158	1.758	1.446	.82248
50	.5712	.6959	1.2183	1.751	1.437	.82082
35	.5736	.7002	1.2208	1.743	1.428	.81915
10	.5760	.7046	1.2233	1.736	1.419	.81748
20	.5783	.7089	1.2258	1.729	1.411	.81580
30	.5807	.7133	1.2283	1.722	1.402	.81412
40	.5831	.7177	1.2309	1.715	1.393	.81242
50	.5854	.7221	1.2335	1.708	1.385	.81072
36	.5878	.7265	1.2361	1.701	1.376	.80902
10	.5901	.7310	1.2387	1.695	1.368	.80730
20	.5925	.7355	1.2413	1.688	1.360	.80558
30	.5948	.7400	1.2440	1.681	1.351	.80386
40	.5972	.7445	1.2466	1.675	1.343	.80212
50	.5995	.7490	1.2494	1.668	1.335	.80038
37	.6018	.7536	1.2521	1.662	1.327	.79864
10	.6041	.7581	1.2549	1.655	1.319	.79688
20	.6065	.7627	1.2577	1.649	1.311	.79512
30	.6088	.7673	1.2605	1.643	1.303	.79335
40	.6111	.7720	1.2633	1.636	1.295	.79158
50	.6134	.7766	1.2661	1.630	1.288	.78980
38	.6157	.7813	1.2690	1.624	1.280	.78801
10	.6180	.7860	1.2719	1.618	1.272	.78622
20	.6202	.7907	1.2748	1.612	1.265	.78442
30	.6225	.7954	1.2778	1.606	1.257	.78261
40	.6248	.8002	1.2808	1.601	1.250	.78079
50	.6271	.8050	1.2838	1.595	1.242	.77897

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.

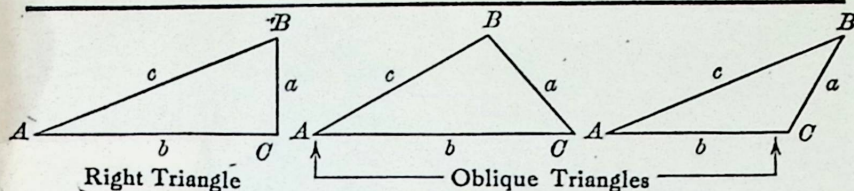
Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.
39	.6293	.8098	1.2868	1.589	1.235	.77715
10	.6316	.8146	1.2898	1.583	1.228	.77531
20	.6338	.8195	1.2929	1.578	1.220	.77347
30	.6361	.8243	1.2959	1.572	1.213	.77162
40	.6383	.8292	1.2991	1.567	1.206	.76977
50	.6406	.8342	1.3022	1.561	1.199	.76791
40	.6428	.8391	1.3054	1.556	1.192	.76604
10	.6450	.8441	1.3086	1.550	1.185	.76417
20	.6472	.8491	1.3118	1.545	1.178	.76229
30	.6494	.8541	1.3151	1.540	1.171	.76041
40	.6517	.8591	1.3184	1.535	1.164	.75851
50	.6539	.8642	1.3217	1.529	1.157	.75661
41	.6561	.8693	1.3251	1.524	1.150	.75471
10	.6583	.8744	1.3284	1.519	1.144	.75280
20	.6604	.8796	1.3318	1.514	1.137	.75088
30	.6626	.8847	1.3352	1.509	1.130	.74896
40	.6648	.8899	1.3386	1.504	1.124	.74703
50	.6670	.8952	1.3421	1.499	1.117	.74509
42	.6691	.9004	1.3456	1.494	1.111	.74314
10	.6713	.9057	1.3492	1.490	1.104	.74120
20	.6734	.9110	1.3527	1.485	1.098	.73924
30	.6756	.9163	1.3563	1.480	1.091	.73728
40	.6777	.9217	1.3600	1.476	1.085	.73531
50	.6799	.9271	1.3636	1.471	1.079	.73333
43	.6820	.9325	1.3673	1.466	1.072	.73135
10	.6841	.9380	1.3711	1.462	1.066	.72937
20	.6862	.9435	1.3748	1.457	1.060	.72737
30	.6884	.9490	1.3786	1.453	1.054	.72537
40	.6905	.9545	1.3824	1.448	1.048	.72337
50	.6926	.9601	1.3863	1.444	1.042	.72136
44	.6947	.9657	1.3902	1.440	1.036	.71934
10	.6967	.9713	1.3941	1.435	1.030	.71732
20	.6988	.9770	1.3980	1.431	1.024	.71529
30	.7009	.9827	1.4020	1.427	1.018	.71325
40	.7030	.9884	1.4061	1.422	1.012	.71121
50	.7050	.9942	1.4101	1.418	1.006	.70916
	.7071	1.	1.414	1.414	1.	.70711

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

250

700
20
14 000

TRIGONOMETRIC FORMULÆ



Solution of Right Triangles

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

Given a, b Required 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 Required 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 Required B, b, c

$$B = 90^\circ - A, b = a \cot A, c = \frac{a}{\sin A}$$

A, b Required B, a, c

$$B = 90^\circ - A, a = b \tan A, c = \frac{b}{\cos A}$$

A, c Required B, a, b

$$B = 90^\circ - A, a = c \sin A, b = c \cos A$$

Solution of Oblique Triangles

Given A, B, a Required 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 Required 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 Required 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 Required 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

$$s = \frac{a + b + c}{2}, \text{area} = \sqrt{s(s - a)(s - b)(s - c)}$$

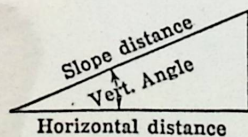
A, b, c Area

$$\text{area} = \frac{b c \sin A}{2}$$

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: slope distance = 319.4 ft. Vert. angle = $5^\circ 10'$. From Table, Page IX. $\cos 5^\circ 10' = .9959$. Horizontal distance = $319.4 \times .9959 = 318.09$ ft.

Horizontal distance also = Slope distance minus slope distance times (1 - cosine of vertical angle). With the same figures as in the preceding example, the following result is obtained. $\cos 5^\circ 10' = .9959$. $1 - .9959 = .0041$. $319.4 \times .0041 = 1.31$. $319.4 - 1.31 = 318.09$ ft.

When the rise is known, the horizontal distance is approximately:—the slope distance less the square of the rise divided by twice the slope distance. Thus: rise = 14 ft., slope distance = 302.6 ft. Horizontal distance = $302.6 - \frac{14 \times 14}{2 \times 302.6} = 302.6 - 0.32 = 302.28$ ft.