

379



PHSI 300

No. 300

PHSI 300

379

BLACK HAWK COUNTY
ENGINEER'S OFFICE
COURT HOUSE
WATERLOO, IOWA

379

892.29
7.55
899.84
1.70
895.14

379

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BENCH LEVELS

			1.49	905.03	✓	PP @ Inter.
TP	8.84	906.52	3.89	897.68		
TP	6.04	901.57	4.79	895.53		
TBM	5.20	900.32	4.75	895.12		Nail PP Lt. Sta. 454+0
BM	7.58	899.87				892.20 "X" West Hd W RCB
			7.43	891.27	892.29	"X" WEST Hd W RCB
TBM	4.62	898.70	4.90	894.08	895.11	PP Lt. Sta 454+0
	4.66	898.98	6.01	894.32		
TP	4.30	900.33	8.08	896.03		
TBM	0.14	904.11	7.11	903.97	✓	Nail in PP N. Sta. (Intersection)
TP	1.37	911.08	10.91	909.71		
TP	1.26	920.62	14.38	919.36		
TP	0.77	933.74	14.02	932.97		
TBM			2.26	944.73		Nail in PP Lt. 14+0
	4.83	946.99	9.95	942.16		
TP	0.13	952.11	11.24	951.98		
TP	1.01	963.22	5.73	962.21		
BM	7.90	967.94				
				961.04		
				960.04		PP So. 150' of Sta 0+00
						BM. 055 1' (Low)

2nd RUN BENCH LEVELS

TBM 6.40 889.95

BM 4.06 896.35

892.29

SPK IN 24" PINE 35' Lt. Sta 444+25

X" W. Hdwl. 2x2 RCB Sta. 444+20

(N. of FINCHFORD Co. Rd. "K")

TBM 1.45 905.00 909.03

TP 7.61 906.45 3.21 898.84

TP 6.01 902.05 4.33 896.04

TBM 5.28 900.37 4.55 895.09 895.11

BM 7.35 899.64

892.29 "X" W. Hdwl. RCB

PP @ Intersection

N 1/4 Cor 6-90+4

Sout To

Box Culv.

Sta 444+

450

West East

↑ 94°

53	52	82	75	59	50	55	73	71	50	63
60	33	27	21	16	16	22	26	34	60	

449

94°

54	49	82	72	52	49	54	72	72	75	45	60
60	33	27	21	16		15	19	25	28	34	60

448

94°

62	62	92	84	60	54	62	82	72	45	60
60	33	27	22	15		15	20	26	33	60

447

92°

72	72	104	102	72	72	72	104	102	72	82
60	33	27	21	15		15	21	27	33	60

446

91°

82	72	112	112	92	82	82	112	102	82	96
60	33	26	21	15		15	20	26	33	60

445

91°

102	104	102	112	92	82	92	112	112	92	102
60	33	28	21	14		13	19	27	33	60

B.M. 7.55 899.84

892.29

X in west head wall

456

455

454

TBM. 4.85 899.96

TBM. 4.70 895.14

453

452

451

899.84

WEST

E

EAST

72	67	84	82	52	95 ²	54	72	79	66	79
60	32	27	22	14	48	14	21	27	33	60
	f								f	

72	72	80	79	52	95 ⁴	52	79	81	71	78
60	32	27	24	15	46	14	24	27	33	60
	f								f	

68	66	83	81	51	94 ⁸	51	72	72	62	74
60	32	27	22	14	52	14	21	27	33	60
	f								f	

PP Lt.

62	52	82	82	52	94 ⁴	62	72	72	52	62
60	33	26	21	15	51	15	21	26	34	60

56	51	84	72	52	94 ⁶	62	72	72	42	62
60	33	26	21	15	52	16	22	26	34	60

54	55	82	72	51	94 ⁸	52	72	72	42	62
60	33	27	20	15	50	16	21	25	28	60

462

left					Q	Rt				
70	65	80	85	55	96 ⁴	57	71	75	61	70
60	31	25	21	14	50	13	18	26	32	60
					f					

461

74	68	90	82	60	96 ¹	58	76	78	67	75
60	32	25	21	14	53	13	19	25	32	60
					f					

460

73	73	91	90	62	95 ⁸	62	75	81	72	84
60	31	24	21	14	50	14	19	27	34	60
					f					

TP 5.45 201.38 4.03 895.93

459

67	61	78	75	49	95 ⁶	50	69	72	59	72
60	32	26	21	13	44	14	19	26	33	60
					f					

458

69	64	82	80	52	95 ⁵	52	72	72	62	76
60	32	27	22	14	45	14	20	27	33	60
					f					

457

72	68	84	81	54	95 ³	52	76	76	66	77
60	32	26	21	14	48	14	20	28	33	60
					f					

899.96

468

467

464

465

TR	6.86	904.01	4.23	897.15
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464

463

701.38

WEST

C

EAST

6

[illegible]

5^1 5^0 8^3 7^1 5^4 9^2 5^7 7^0 7^3 4^7 5^6
 60 33 26 18 12 48 12 16 25 32 60
 f f f

6^2 59 80 90 64 98³ 65 79 78 55 65
 60 33 26 22 13 57 13 18 25 32 60
 f f

$\begin{array}{cccccccccccc} 7^3 & 7^1 & 94 & 9^1 & 7^0 & 97^6 & 7^1 & 8^5 & 8^5 & 6^8 & 7^1 \\ 60 & 32 & 26 & 20 & 13 & 6 & 14 & 18 & 29 & 32 & 60 \\ & f & & & & & & & & f & \end{array}$

$$\begin{array}{ccccccccc} 5^3 & 5^3 & 6^6 & 6^3 & 5^0 & 97^2 & & & \\ 60 & 32 & 25 & 19 & 14 & 4 & 2 & 5^1 & 6^4 & 6^1 & 47 & 5^3 \\ & & & & & & & 13 & 19 & 27 & 32 & 60 \end{array}$$

65 61 80 79 53 96⁷ 52 67 55 65
00 32 26 21 13 47 14 18 26 31 60

WEST

Q

EAST

TBM

4.20 905.02 905.00

PP @ Intersection

469

$7\frac{1}{2}$ $8\frac{3}{4}$ $10\frac{1}{2}$ $9\frac{1}{4}$ $7\frac{9}{16}$ $901\frac{1}{2}$ $7\frac{1}{2}$ $7\frac{8}{16}$ $10\frac{1}{4}$ $10\frac{1}{2}$ $8\frac{3}{4}$ $8\frac{1}{2}$
 60 32 27 18 13 7 11 16 25 31 60

TP 8.48 909.22 3.27 900.74

904.01

Co. LINE CROSS Sections

Lt.
NORTH

&

Rt.
South

9

0+33 TOP BANK R.O.W.

0+29 BACK SLOPE

0+18 TOE FORE SLOPE

0+11 SHOULDER

30' 69.1
32' 22'

0+0 & CROSS ROAD

100 20 33 24 38 65 93 104
33 33 100 200 300

BM 8.77 969.75
968.81

960.98
960.04

PP So. Inter. 150' Rt. 33'

6+0

TP

0.53

955.27

954.33

15.01

954.44

953.80

5+0

4+0

3+0

2+00

1+00

969.75

968.81

NORTH

Lt.

E

South

Rt.

10

11
6005
3238
2538
2113
1254.4
0215
1332
2039
2400
32+2.0
60

f

86
6079
3313
2513
2111
1359.2
106114
14132
21133
2486
3189
3980
60

f

29
6035
3491
2492
2076
1263.0
6871
1497
2098
2363
3171
3876
60

f

08
6016
3473
2474
2056
1264.7
5156
1381
2089
2563
3274
3888
60

f

20
6027
3368
2473
1957
1164.9
5460
1481
2187
2676
3188
35101
60

f

30
6043
3371
2674
1758
1164.4
5460
1489
2391
2587
31105
35120
60

f

12+0

Lt. E Rt.
 43.2
 38 47 71 73 60 52 60 103 102 80 105
 60 33 26 19 16 9 52 16 25 27 31 60
 f

11+0

 43.3
 55 60 74 57 52 49 58 98 94 84 106 113
 60 33 20 16 10 49 16 24 27 31 41 60
 f

10+0

 43.8
 57 59 70 50 47 44 51 78 75 96 104
 60 33 20 15 11 44 14 20 36 45 60
 f

TP

4.48

948.22

947.28

11.53

943.74

942.80

9+0

 45.1
 121 121 130 129 107 107 107 146 151 146 172
 60 34 30 26 11 10 14 22 31 38 60
 f

8+0

 47.3
 105 103 106 84 80 86 112 123 124
 60 32 19 11 80 13 21 33 60
 f

7+0

 50.3
 72 74 86 79 55 57 84 85 66 59
 60 35 29 22 12 50 13 21 27 33 60

955.27

954.33

TP 0.71 922.64 921.93
~~921.70~~ 14.11 ~~920.99~~

18+0

17+0

16+0

TP 0.95 936.04 935.09
~~935.10~~ 13.87 ~~934.15~~

15+0

14+0

TBM 3.34 948.96 945.62
~~948.02~~ 2.60 ~~944.68~~ ~~944.73~~

13+0

948.22
~~947.28~~

Lt.

Q

Rt.

13⁷ 13² 15³ 15⁰ 12⁷ 24.0
 60 32 27 21 12 12⁰ 14 14⁸ 14⁹ 12³ 11⁶
 f 21 25 31 60
 f

7⁹ 7³ 9¹ 9¹ 7.4 29.1
 60 33 26 20 13 6⁹ 7⁸ 9⁰ 9² 6³ 5⁶
 f 13 20 25 31 60
 f

10⁰ 10⁹ 3² 3⁰ 2⁰ 34.1
 60 33 28 22 17 12 14 2.0 3⁹ +3.4 +4.1
 15 21 30 60
 f

9² 8⁰ 12⁰ 10² 39.9
 60 33 18 10 9¹ 10⁰ 12⁶ 5⁶ 5⁴
 15 21 32 60

46.9
 2¹ 2⁹ 7⁰ 6⁵ 42.8
 60 26 18 13 6² 6⁹ 10⁹ 5⁰ 6⁹
 f 16 23 32 60

46.6
 1⁶ 2⁸ 5⁸ 6³ 5³ 5¹ 43.3
 70 31 23 20 16 12 4² 5⁵ 10⁰ 6¹ 9¹
 13 20 28 60

24+0

23+0

22+0

TP

0.85

9/3.82

~~9/2.88~~

9.67

9/2.97

9/2.03

21+0

20+0

19+0

922.64
924.70

Lt.

E

Rt.

49 53 75 11 52 9.2 55 83 82 67 70
60 32 27 21 13 7 15 24 26 32 60
f f

42 41 68 41 10.5 41 67 69 58 62
60 32 25 14 3 14 22 26 32 60
f f

28 32 46 47 22 12.2 24 52 53 44 41
60 32 27 21 13 1 15 22 27 31 60
f f

98 106 119 116 90 14.1 93 117 120 114 112
60 31 27 21 13 8 14 26 27 30 60
f f

70 79 95 93 65 16.5 60 89 93 85 80
60 32 28 20 14 6 14 20 27 32 60
f f

42 43 63 59 32 19.8 35 58 62 44 31
60 33 28 21 14 2 13 19 25 31 60
f f

Lt.

C

Rt.

27+90

$\begin{array}{cccccccccccc} 6^2 & 7^4 & 9^3 & 7^8 & 7^9 & 6^0 & 03.9 & 6^9 & 9^1 & 8^6 & 8^1 & 8^0 \\ 32 & 25 & 24 & 23 & 20 & 14 & 5 & 13 & 23 & 26 & 32 & 60 \\ & & & & & & & & & & f & \end{array}$

27+0

$\begin{array}{cccccccccccc} 4^8 & 5^3 & 5^6 & 6^6 & 6^4 & 5^0 & 04.9 & 5^4 & 8^0 & 8^2 & 5^2 & 6^2 \\ 60 & 32 & 28 & 26 & 20 & 13 & 4 & 12 & 20 & 25 & 32 & 60 \\ & & & & & & f & & & & f & \end{array}$

TBM

4.90

909.77

908.81

8.97

904.85

903.91

904.87

PP @ Inter.

26+0

$\begin{array}{cccccccccccc} 7^5 & 7^8 & 9^6 & 9^4 & 7^8 & 6^4 & 6^4 & 8^0 & 10^7 & 11^2 & 9^5 & 9^2 \\ 60 & 31 & 26 & 19 & 12 & 7 & 14 & 21 & 26 & 32 & 60 \\ & & & & & f & & & & & f & \end{array}$

25+0

$\begin{array}{cccccccccccc} 6^6 & 7^1 & 8^9 & 8^1 & 6^5 & 7^8 & 6^1 & 6^7 & 9^5 & 9^8 & 8^6 & 8^9 \\ 60 & 32 & 27 & 20 & 13 & 6 & 14 & 22 & 27 & 32 & 60 \\ & & & & & f & & & & & f & \end{array}$

913.82

~~912.88~~

TBM			0.41	^{915.10} 905.14	905.02	PP Intersection. ✓
TP	7.50	¹ 905.55	3.29	¹ 898.05		
TP	5.79	⁰ 901.34	5.01	¹ 895.55		
TP	6.09	² 900.56	5.07	³ 894.47		
BM	7.25	⁵⁰ 899.54	6.13	892.25	892.29	2'x2' RCB 'X' TOP PAR WEST &
TP	9.39	898.38	2.23	888.99		
BM			<u>3.74</u> ✓	887.48	887.44	'X' NW COR BRIDGE ON CURB
TP	10.18	891.22	6.39	881.04		
TP	2.23	887.43	8.68	885.20		
BM	3.79	893.88		890.09	I.G.S. # 752	SE WING NEW BRIDGE

BENCH LEVELS C Rd "K"

BM 4.89 893.14 886.25 886.25

BM 2.75 ^{892.80}
892.83 3.09 890.05 890.08

BM 884 896.25 5.39 887.41 887.44

BM 4.91 899.04 1.12 892.13 892.29

T.P. 4.70 899.67 4.07 894.97

T.P. 6.44 901.11 5.00 894.67

T.P. 5.67 905.33 1.45 899.66

BM 7.57 ^{912.39}
~~892.85~~ 0.51 904.82 ^{904.80}
905.00

T.P. 10.78 919.50 3.37 909.02

T.P. 13.74 929.78 3.46 916.04

T.P. 14.69 943.39 1.08 928.70

T.P. 13.55 954.62 2.32 941.07

M-CLARKE

PI-

11-18-69

I-McLORD

WINDY & COOL

IGS Cor old Telephone Office

IGS 752 SE wing New Bridge

X Northwest Cor. Bridge CURB (old)

2'X2' Hdw. Culvert.

NAIL IN P.P. North Intersection.

954.22

T.P. 14.31 966.64 2.29 952.33

B.M. 5.05 966.64 5.05 961.59 ^{960.98} 960.04 NAIL P.P. 150' South STA 8+00

T.P. 14.0 953.76 14.26 952.38

T.P. 2.36 943.50 12.64 941.14

T.P. 0.43 931.19 12.74 930.76

T.P. 1.82 918.40 14.61 916.58

B.M. 0.58 905.92 13.66 905.34 ^{904.87} 905.00 NAIL P.P. NORTH Insection. NW Cor

SEC 6-90-A

T.P. 1.85 902.02 5.75 900.17

T.P. 5.14 900.30 6.86 895.16

T.P. 4.46 899.91 4.85 895.45

B.M. 5.74 898.37 7.23 892.63 892.29 2'x2' Culvert Hdws. west.

B.M. 5.32 893.22 10.47 887.90 887.44 X - NW. CORB old BRIDGE

898.22

B.M. 3.68 894.21 2.69 890.53 890.08 IGS #752 SE. WING NEW BRIDGE

B.M. 7.52 886.69 886.25 IGS old TELEPHONE OFFICE

BENCH LEVELS

BM 6.70 911.70 905.00 904.87

T.P. 9.11 918.32 2.49 909.21

T.P. 11.38 927.61 2.09 916.23

T.P. 7.73 934.91 0.43 927.18

T.P. 13.29 947.67 0.53 934.38

T.P. 5.80 948.51 4.96 942.71

T.P. 6.92 953.04 2.39 946.12

T.P. 12.28 964.91 0.41 952.63

T.P. 5.32 969.93 0.30 964.61

BM 8.68 969.78 8.83 961.10 960.98

T.P. 2.29 966.41 5.16 964.62

T.P. 1.92 954.55 14.28 952.63

M - CLARKE

19

11-19-69

1 - McCORD

WINDY & COOL

PP NAIL North Intersection N¹/₄ COR
Sec 6 - 90-14

NAIL PP 150' South Intersection Co. LINE.

954.55

T.P. 2.82 948.93 8.44 946.11

T.P. 2.18 944.87 6.24 942.69

T.P. 1.75 936.10 10.52 934.35

T.P. 1.85 929.00 8.95 927.15

T.P. 2.91 919.12 12.79 916.21

T.P. 3.53 912.72 9.93 909.19

B.M. 7.74 904.98 905.00 NAIC P.P. N INTERS. N4 COR SEC 6-90-19

ELK RUN CREEK
1st CHANNEL RELOCATION

25

11+45

TP 5.29 101.75 7.45 96.46

0+00 @ CHANNEL @ STREAM

BM 3.91 103.91

100.00
Assum.
Elev.

Downstream { # 13⁵ Elev. = 88.25
TOP WATER 127 = 89.0

11.45' $\sqrt{3.800}$.31%
3435
1650

Upstream { # 12⁴ Elev. 91.8'
TOP WATER 113 Elev. 92.6

SPK in Fe Post @ Sta.

EIK RUN CREEK

26

2ND CHANNEL RELOCATION

Downstream 5+60

13.2

Upstream 0+00

11.8

$$\begin{array}{r} 1.2 \sqrt{560} \quad 70 \\ 560 \sqrt{1,200} \\ \hline 1120 \\ \hline 800 \end{array}$$

EIK RUN CREEK
MAIN CHANNEL RELOCATION

27



Station 4+50 Downstream

$\theta = 12^\circ$

4+0

Hub = 10⁵ C = 1⁵

3+0

Hub = 7³ C = 4⁴

2+0

Hub = 8⁷ C = 2⁹

1+0

Hub = 8³ C = 3¹

0+50

Hub = 8⁷ C = 2⁵

Station 0+0 Upstream

$\theta = 11^\circ$

ELK RUN CREEK
NORTH (1st) CHANNEL RELOCATION

28

5+0

$$\text{Hub} = 5^1 \quad C = 8^5$$

4+0

$$\text{Hub} = 5^2 \quad C = 8^1$$

3+0

$$\text{Hub} = 5^3 \quad C = 7^2$$

2+0

$$\text{Hub} = 5^6 \quad C = 7^1$$

1+0

$$\text{Hub} = 6^1 \quad C = 6^3$$

0+0

$$\text{Hub} = 7^4 \quad \text{Cut} = 4^2$$

Upstream
#

$$H = 12.0$$

A
 11^{+0}
 10^{+0}
 9^{+0}
 8^{+0}
 7^{+0}

TBM

4.07

100.00

 6^{+0}
 $\text{A} = 15^5$
 $\text{Hub} = 10^0$
 $C = 5^9$
 $\text{Hub} = 10^9$
 $C = 4^3$
 $\text{Hub} = 10^0$
 $C = 4^8$
 $\text{Hub} = 6^8$
 $C = 7^3$
 $\text{Hub} = 8^5$
 $C = 5^3$
 $\text{Hub} = 4^9$
 $C = 9^0$

ROAD WAY GRADE STAKES

ELK RUN CREEK BRIDGE

31

LEFT

2

RIGHT

22+50

DITCH
Rt. ✓

48.3

40.5

88

7.95

856.50

849.34

F 7 16

856.50

847.04

10.25

F 9 46

21+50

48.0

41.5

65

9.24

854.80

848.05

F 6 75

854.80

846.97

10.30

F 7 81

20+50

44.4

42.0

24

12.90

853.80

844.37

F 8 69

853.80

845.01

12.28

F 8 07

19+50

47.9

42.5

54

9.35

851.50

847.94

F 3 56

851.50

847.34

9.95

F 4 16

18+50

49.1

43.0

64

8.20

GRADE 850.00

Elev. 849.07

F 0 9

850.00

Elev. 848.77

8.52

F 1 23

BM 7.49 857.29

849.80 PP Rt. 33' Sta. 18+60 60± SPK.

Rd WY GRADES Cont.

32

LEFT

Q

RIGHT

DITCH

Z8+50

50.3
47.0

7.00 F 2 01

X 3 W

52.30
50.29

52.30
49.89
7.40 F 2 41

Z7+50

50.7
46.0

6.60 F 2 51

4.7

53.20
50.69

53.20
50.19
7.10 F 3 01

Z6+40

1/4 COR.

52.5
45.5

4.80 F 1 51

7.0

52.00
52.49

52.00
52.07
5.22 F 1 93

Z5+50

45.9
44.5

11.42 F 9 43

C 1 4

55.30
45.87

55.30
47.49
9.80 F 7 81

Z4+50

44.0
41.0

GRADE 56.50
Elev. 40.99
16.30 F 15 51

3.0

56.50
Elev. 46.44

10.85 F 10 06

OLD BRIDGE THUR SEC 6-90-19

11-21-69

CLEAR & COOL

	BS	HI	BS	ELEV.
B.M.	3.68	891.12		887.44 887.44

D Bridge seat	8.54	882.58
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C Bridge seat	8.50	882.62
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B Bridge seat		
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A Bridge seat		
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North L	4.30	886.82
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South L	4.42	886.70
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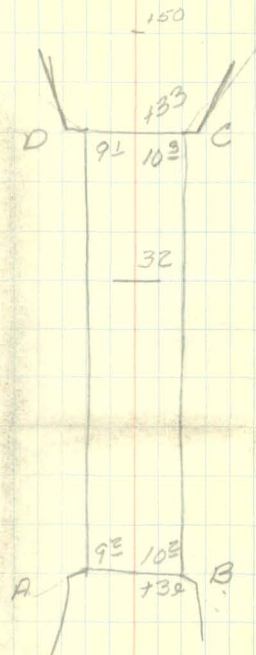
Center L	4.18	886.94
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B.M.	2.68	890.12	3.68	887.44	887.44
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B	7.50	882.62
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A	7.51	882.61
---	------	--------

B.M.	2.68	887.44
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BEC 6-90-19

PROFILE ON OLD BRIDGE

ELEV.

31+99

31+61

32' WATER

872.1

31+75

8.2' WATER

867.1

31+91

7.6' WATER

867.7

32+06

6.6' WATER

868.7

32+30

3.5' WATER

871.8

B.M. 2.68 890.12

887.44 887.44

T.P. 5.24 882.21 13.15 896.97

3++

Edge ICE South 6.85 875.36

Edge ICE North 6.89 875.32

Edge ICE Center 6.87 875.34

T.P. 12.52 891.81 2.92 879.29

B.M. 4.36 887.15 887.44

M = CLARK
H = ZERR
I = MCARD

35

CLEAR & COOL

9+00

8+00

7+00

6+00

5+00

Φ 4.39 883.95 12.92 879.56

4+00

3+00

+60

2+00

1+00

0+00

B.M. #1 2.39 892.48

890.09

Brass plate in S.E. Abut.

79.2

4.8

79.0

5.0

79.2

4.8

78.9

5.1

79.3

4.7

79.6

12.9

83.2

7.3

84.5

8.0

85.5

7.0

86.4

6.1

89.1

3.4

20+00

19+00

18+00

17+00

5.57 887.73 3.39 882.16

16+00 ~~5.57 887.73 3.39 882.16~~

15+00

14+00

13+00

12+00

11+00

Φ 5.62 885.55 4.02 879.93

11+00

+75 end of wall 150' South

10+00

883.95

83.1

4.6

83.2

4.5

83.2

4.5

82.3

5.4

82.2

3.4

83.4

2.2

33

Wall

83.4

12.2

Top of Water
in River so

82.9

2.9

33

Wall

82.9

2.7

33

Wall

82.7

2.9

40

Wall

82.0

3.6

100

Top of
Stone wall

80.0

5.6

Ground

82.0

3.6

81.3

4.3

81.2

4.4

80.5

5.1

~~2.2~~

80.1

3.9

79.6

4.4

			8.3	872.0	
	5.40	880.35	14.32	874.95	
φ	8.51	889.27	812.37	880.76	
B.M. #1			3.05	890.08	890.09
	10.37	893.13	1.01	882.76	
	4.62	883.77	6.92	879.15	
B.M. 2	4.40	886.67	6.06	881.67	

28+00

27+00

26+00

25+00

24+00

23+00

22+00

21+00

887.73

Water Level 70' upstream from Bridge

Brass plate in S.E. end post Base River bridge in Finchford

spk in Powerpole West of stone wall

84.5

3.2

84.5

3.2

84.4

3.3

84.6

3.1

84.9

2.8

84.7

3.0

84.1

3.6

83.3

4.4

Co. line Rd Profile

33+00

32+00

31400

30+00

29+00

 $28 + 75$

B.M.	3.06	907.93	3.06	904.87	904.87
------	------	--------	------	--------	--------

McCord
Zegarac

3

Clear & Cold 39

39



00

63

46

 4^2 4⁴

$\frac{3^2}{175}$ $\frac{3^3}{100}$ $\frac{3^4}{75}$ $\frac{3^5}{50}$ $\frac{3^7}{25}$ 4^3 DRIVE

Power Pole N. of "T" intersection
on Co. line Rd. @ 28+00 $\pm$

$$\begin{array}{c} 4 \\ 2 \\ 2 \end{array}$$

38+00

11⁷

37+00

11⁴

36+00

11¹

35+00

10⁸

34+00

9⁹

6-90-14

Coline Rd X sections

Zegarac
McCond

Overcast & Cold 42

32+00

$$\begin{array}{cccccccccccc} \frac{5^1}{83} & \frac{6^6}{33} & \frac{9^3}{26} & \frac{9^0}{18} & \frac{7^7}{12} & \frac{7^3}{13} & \frac{7^8}{10} & \frac{10^0}{20} & \frac{10^8}{27} & \frac{7^9}{33} & \frac{9^4}{83} \end{array}$$

31+00

$$\begin{array}{cccccccccccc} \frac{4^1}{84} & \frac{4^7}{34} & \frac{6^6}{27} & \frac{8^6}{20} & \frac{5^9}{12} & \frac{5^5}{13} & \frac{6^0}{20} & \frac{8^6}{20} & \frac{7^7}{26} & \frac{7^2}{33} & \frac{8^0}{83} \end{array}$$

30+00

$$\begin{array}{cccccccccccc} \frac{4^5}{83} & \frac{5^0}{35} & \frac{7^4}{27} & \frac{7^0}{18} & \frac{5^7}{12} & \frac{5^2}{13} & \frac{5^7}{19} & \frac{8^5}{26} & \frac{8^5}{26} & \frac{6^8}{32} & \frac{7^5}{82} \end{array}$$

29+00

$$\begin{array}{cccccccccccc} \frac{5^2}{83} & \frac{5^2}{33} & \frac{6^5}{20} & \frac{6^0}{21} & \frac{5^4}{12} & \frac{5^4}{12} & \frac{5^8}{19} & \frac{7^8}{27} & \frac{8^1}{27} & \frac{6^7}{34} & \frac{7^9}{84} \end{array}$$

28+83

Drive Lt.

$$\begin{array}{cccccccccccc} \frac{4^6}{84} & \frac{4^8}{34} & \frac{5^0}{11} & \frac{5^3}{12} & \frac{5^8}{21} & \frac{6^0}{27} & \frac{7^4}{34} & \frac{6^4}{34} & \frac{7^5}{84} \end{array}$$

B.M. 4.04 908.91 4.04 904.87 904.87

Power Pole N. of T intersection
on Coline Rd & "K" @ 28+00 ±

Vallie

Prof. A West Park Sec. 6-90-14
@ over Flow Bridge

3+22

+87

+54

+39 N. Bank of Pond

φ	7.85	886.83	12.80	877.98
		886.83		878.98

2+00

1+79

1+48

1+00

+66

+30

0+00 = 434+00 Running South

0-70

B.M. #

3.34

890.78

891.78

887.44

434+00

10.5

43

72.7
13.171.3
14.572.5
13.375.8
10.075.5
15.375.2
15.677.3
13.578.5
12.378.2
12.676.2
14.678.0
12.888.4
2.4

X in N.W. Cor. of Low Truss on curb

+ 92

+32

0 5.04 887.06 3.81 882.02
888.06 883.02

8+00

7+00

6+00

5+00

+85

+27

4+00

+58

South Bank of Pond

3+49

885.83
~~886.83~~

83.3

3.8

81.7

5.4

82.0

3.8

79.6

6.2

80.5

5.3

78.3

7.5

75.7

10.1

76.1

9.7

78.1

7.7

76.8

9.0

75.2

10.6

B.M.

3.30 890.07 890.09

Brass Plug in S.E. Curb of River Bridge

→ ϕ 7.81 893.37

885.56

Recheck Last Turn

3.36 891.08 890.09

→ ϕ 888 894.44 895.44 1.50 886.56 890.09

+18 = sta 2+00 Prof. W. of Finchford

10+00

+49

9+00

887.06
888.06

855

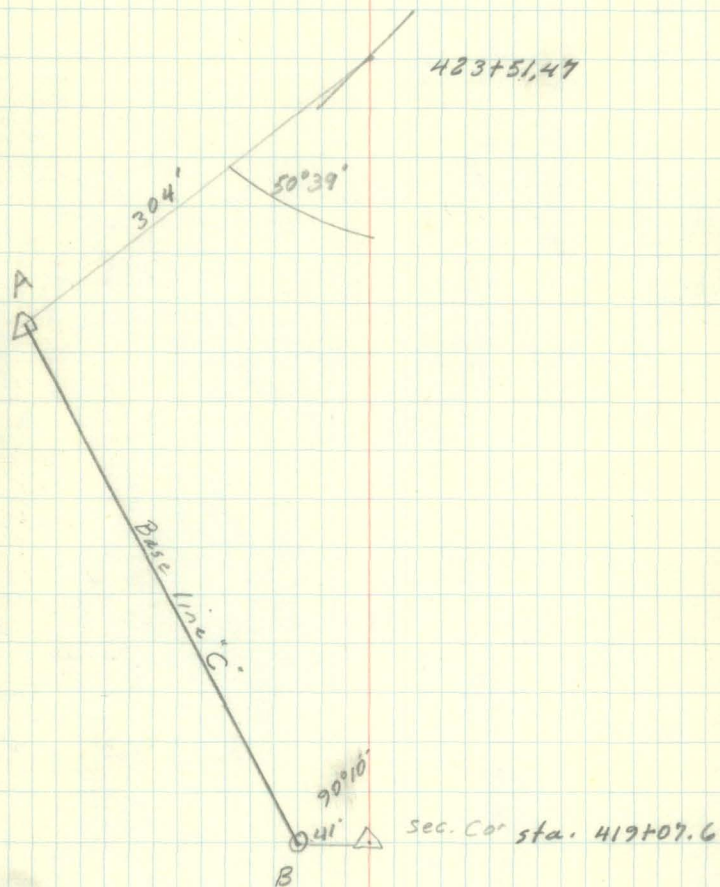
1.6 ±

85.6

1.5

85.6

1.5



Profile line "C" West of Main River Bridge
at Finchford

Cont. on Page 49

1+25

1+24

1+18

0+98

+91

+76

+55

+29

+06

Point A = 0+00

B.M. 2.46 888.71

886.25

I G. S. S. E. Cor. of intersection

72.1
16.6 water level

73.1
15.6

74.7
14.0

74.3
14.4

79.0
9.7

79.8
8.9

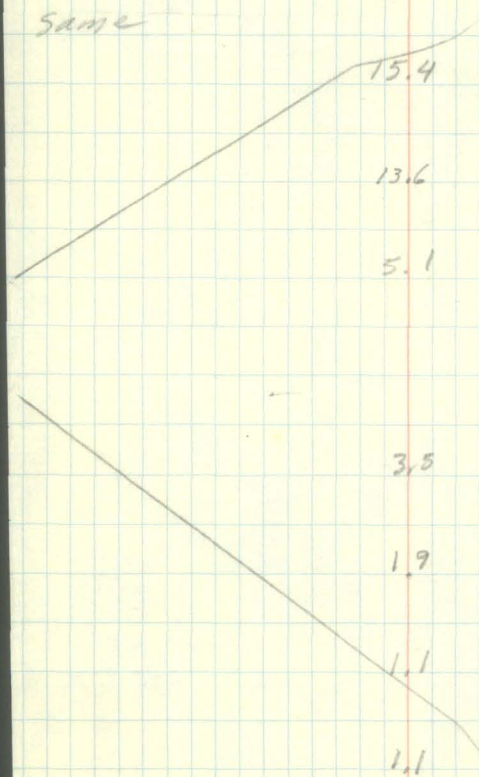
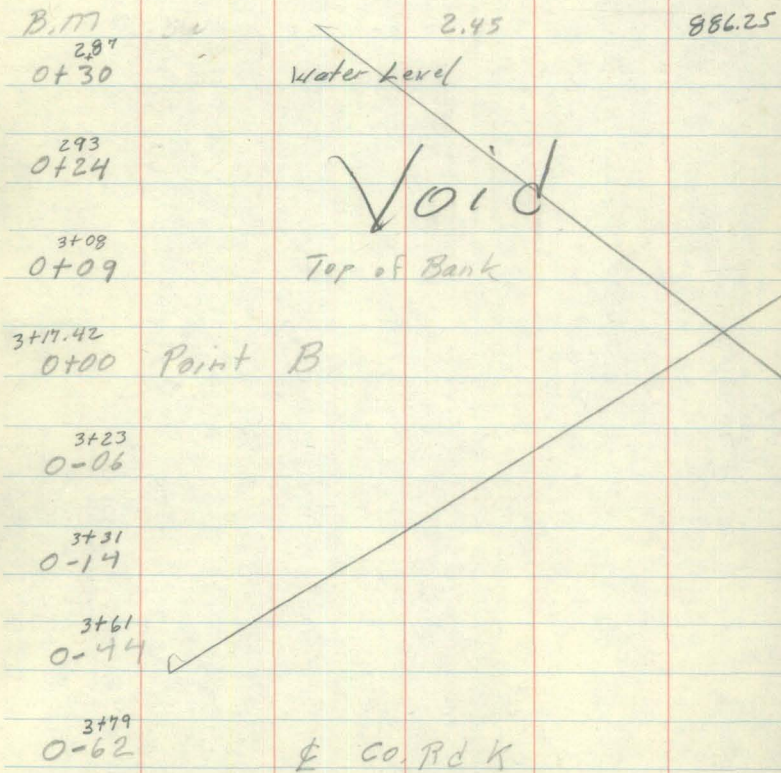
79.2
9.5

80.5
8.2

85.0
3.7

85.4
3.3

See Next Page



B.M. 2.45 886.25

3+79 $\frac{1}{2}$ Co. Rd. "K"

3+61

3+31

3+23

3+17.42 Point "B"

3+08

2+93

2+87

Cont. next page

87.6

1.1

87.6

1.1

86.8

1.9

85.2

3.5

83.6

5.1

75.1

13.6

72.3

16

15.4

Water line

Profile stream bed
up stream Finch Ford Bridge

2+93

2+83

2+50

2+25

2+00

1+80

1+49

1+34

1+28

1+24

872.2

S. Bank

$$\begin{array}{r} 70.6 \\ 1.6 \\ \hline \end{array}$$

$$\begin{array}{r} 70.5 \\ 1.7 \\ \hline \end{array}$$

$$\begin{array}{r} 70.0 \\ 2.2 \\ \hline \end{array}$$

L River

$$\begin{array}{r} 69.5 \\ 2.7 \\ \hline \end{array}$$

$$\begin{array}{r} 70.0 \\ 2.2 \\ \hline \end{array}$$

$$\begin{array}{r} 70.8 \\ 1.4 \\ \hline \end{array}$$

$$\begin{array}{r} 71.8 \\ 0.4 \\ \hline \end{array}$$

$$\begin{array}{r} 70.3 \\ 1.9 \\ \hline \end{array}$$

N. Bank

measurements from top of water to stream
Top of water elevation bed

X-Sections cord "T"
From "L" Rd N. 1500'

2400

1400

0+39

N ditch

0+16

N Edge "L"

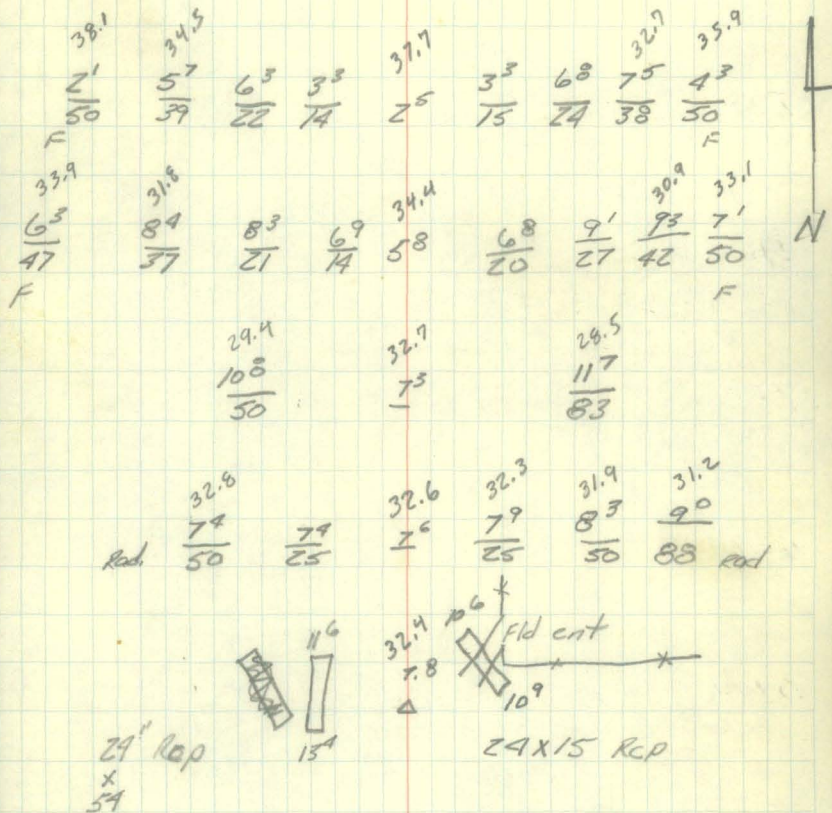
0+00

NE Cor 22-87-11

BM #1 10.92 840.15

829.23

51



Spike in tel pole 33'E & 32'So.
of stg 0+00

9400

T.P. 10.74 858.94 0.06 848.20

8400

7400

6400

5400

4400

3400

2400

T.P. 8.39 848.26 0.28 839.87

840.15

49.5 57.0 51.5 50.3 52

$\frac{104}{98}$	$\frac{119}{90}$	$\frac{115}{26}$	$\frac{84}{17}$	79	$\frac{84}{16}$	$\frac{105}{22}$	$\frac{104}{37}$	$\frac{83}{50}$ F
------------------	------------------	------------------	-----------------	----	-----------------	------------------	------------------	----------------------

43.7 42.8 47.5 44.1

$\frac{46}{50}$	$\frac{55}{38}$	$\frac{54}{28}$	$\frac{15}{17}$	08	$\frac{15}{14}$	$\frac{54}{23}$	$\frac{57}{39}$	$\frac{42}{50}$
-----------------	-----------------	-----------------	-----------------	----	-----------------	-----------------	-----------------	-----------------

39.7 39.6 44.5 38.9 39.4

$\frac{86}{48}$	$\frac{87}{40}$	$\frac{86}{26}$	$\frac{49}{17}$	38	$\frac{45}{14}$	$\frac{91}{23}$	$\frac{94}{40}$	$\frac{89}{50}$ F
-----------------	-----------------	-----------------	-----------------	----	-----------------	-----------------	-----------------	----------------------

39.3 38.2 42.3 36.4 36.4

$\frac{90}{50}$ F	$\frac{101}{41}$	$\frac{99}{27}$	$\frac{71}{17}$	60	$\frac{67}{14}$	$\frac{117}{25}$	$\frac{119}{41}$	$\frac{119}{50}$ F
----------------------	------------------	-----------------	-----------------	----	-----------------	------------------	------------------	-----------------------

39.6 38.9 41.3 36.6 35.8 35.8

$\frac{87}{50}$ F	$\frac{104}{43}$	$\frac{101}{29}$	$\frac{77}{16}$	70	$\frac{80}{14}$	$\frac{127}{26}$	$\frac{127}{41}$	$\frac{125}{50}$ F
----------------------	------------------	------------------	-----------------	----	-----------------	------------------	------------------	-----------------------

39.5 37.3 40.8 36.5 34.9

$\frac{88}{50}$ F	$\frac{106}{41}$	$\frac{110}{25}$	$\frac{83}{16}$	75	$\frac{85}{15}$	$\frac{128}{26}$	$\frac{134}{43}$	$\frac{134}{50}$ F
----------------------	------------------	------------------	-----------------	----	-----------------	------------------	------------------	-----------------------

41.0 36.4 39.9 32.4 35.9

$\frac{75}{49}$ F	$\frac{114}{37}$	$\frac{119}{22}$	$\frac{90}{15}$	84	$\frac{94}{15}$	$\frac{156}{25}$	$\frac{142}{41}$	$\frac{124}{50}$ F
----------------------	------------------	------------------	-----------------	----	-----------------	------------------	------------------	-----------------------

T.P. 1.12 850.30 12.52 849.18

15+00

14+00

T.P. 2.83 861.70 8.65 858.87

13+00

12+00

11+00

T.P. 11.79 867.52 3.21 855.73

10+00

$$\begin{array}{r} 64.4 \\ \frac{2^2}{50} \\ 42 \\ \hline 50 \end{array} \quad \begin{array}{r} 53.4 \\ \frac{8^2}{45} \\ 72 \\ \hline 45 \end{array} \quad \begin{array}{r} 7^2 \\ \frac{29}{26} \\ 29 \\ \hline 26 \end{array} \quad \begin{array}{r} 46 \\ \frac{16}{16} \\ 16 \\ \hline 16 \end{array} \quad \begin{array}{r} 58.0 \\ 37 \\ \hline 16 \end{array} \quad \begin{array}{r} 4^2 \\ \frac{8^2}{26} \\ 8^2 \\ \hline 26 \end{array} \quad \begin{array}{r} 79 \\ \frac{41}{41} \\ 41 \\ \hline 41 \end{array} \quad \begin{array}{r} 36.8 \\ 49 \\ \hline 50 \end{array}$$

$$\begin{array}{r} 53.6 \\ \frac{8^1}{50} \\ 8^1 \\ \hline 50 \end{array} \quad \begin{array}{r} 53.5 \\ \frac{8^2}{43} \\ 8^2 \\ \hline 43 \end{array} \quad \begin{array}{r} 78 \\ \frac{26}{26} \\ 26 \\ \hline 26 \end{array} \quad \begin{array}{r} 35 \\ \frac{16}{16} \\ 16 \\ \hline 16 \end{array} \quad \begin{array}{r} 58.9 \\ 28 \\ \hline 16 \end{array} \quad \begin{array}{r} 3^5 \\ \frac{9^3}{28} \\ 9^3 \\ \hline 28 \end{array} \quad \begin{array}{r} 96 \\ \frac{42}{42} \\ 42 \\ \hline 42 \end{array} \quad \begin{array}{r} 8^5 \\ \frac{50}{50} \\ 50 \\ \hline 50 \end{array}$$

$$\begin{array}{r} 55.2 \\ \frac{12^2}{50} \\ 12^2 \\ \hline 50 \end{array} \quad \begin{array}{r} 54.8 \\ \frac{12^7}{42} \\ 12^7 \\ \hline 42 \end{array} \quad \begin{array}{r} 12^2 \\ \frac{29}{29} \\ 29 \\ \hline 29 \end{array} \quad \begin{array}{r} 9^3 \\ \frac{16}{16} \\ 16 \\ \hline 16 \end{array} \quad \begin{array}{r} 59.1 \\ 84 \\ \hline 17 \end{array} \quad \begin{array}{r} 94 \\ \frac{30}{30} \\ 30 \\ \hline 30 \end{array} \quad \begin{array}{r} 16^8 \\ \frac{44}{44} \\ 44 \\ \hline 44 \end{array} \quad \begin{array}{r} 50.2 \\ 17^3 \\ \hline 50 \end{array}$$

$$\begin{array}{r} 62.2 \\ \frac{5^3}{49} \\ 5^3 \\ \hline 49 \end{array} \quad \begin{array}{r} 10^6 \\ \frac{31}{31} \\ 31 \\ \hline 31 \end{array} \quad \begin{array}{r} 56.5 \\ \frac{11^0}{29} \\ 11^0 \\ \hline 29 \end{array} \quad \begin{array}{r} 9^1 \\ \frac{16}{16} \\ 16 \\ \hline 16 \end{array} \quad \begin{array}{r} 59.0 \\ 8^5 \\ \hline 17 \end{array} \quad \begin{array}{r} 9^5 \\ \frac{25}{25} \\ 25 \\ \hline 25 \end{array} \quad \begin{array}{r} 13^1 \\ \frac{39}{39} \\ 39 \\ \hline 39 \end{array} \quad \begin{array}{r} 54.9 \\ 12^6 \\ \hline 50 \end{array}$$

$$\begin{array}{r} 65.3 \\ \frac{2^2}{49} \\ 2^2 \\ \hline 49 \end{array} \quad \begin{array}{r} 11^5 \\ \frac{28}{28} \\ 28 \\ \hline 28 \end{array} \quad \begin{array}{r} 55.8 \\ \frac{11^7}{22} \\ 11^7 \\ \hline 22 \end{array} \quad \begin{array}{r} 10^1 \\ \frac{16}{16} \\ 16 \\ \hline 16 \end{array} \quad \begin{array}{r} 58.2 \\ 9^3 \\ \hline 17 \end{array} \quad \begin{array}{r} 9^9 \\ \frac{26}{26} \\ 26 \\ \hline 26 \end{array} \quad \begin{array}{r} 10^5 \\ \frac{31}{31} \\ 31 \\ \hline 31 \end{array} \quad \begin{array}{r} 60.4 \\ 7^1 \\ \hline 50 \end{array}$$

$$\begin{array}{r} 56.8 \\ \frac{2^1}{48} \\ 2^1 \\ \hline 48 \end{array} \quad \begin{array}{r} 52.5 \\ \frac{6^4}{31} \\ 6^4 \\ \hline 31 \end{array} \quad \begin{array}{r} 5^9 \\ \frac{24}{24} \\ 24 \\ \hline 24 \end{array} \quad \begin{array}{r} 4^4 \\ \frac{17}{17} \\ 17 \\ \hline 17 \end{array} \quad \begin{array}{r} 55.1 \\ 3^2 \\ \hline 16 \end{array} \quad \begin{array}{r} 3.8 \\ \frac{25}{25} \\ 25 \\ \hline 25 \end{array} \quad \begin{array}{r} 5^2 \\ \frac{30}{30} \\ 30 \\ \hline 30 \end{array} \quad \begin{array}{r} 59.8 \\ 0^9 \\ \hline 50 \end{array}$$

B.M.

13.04 837.26 837.21

Top conc mon @ sta 26+33.6

Cutoff 5.5

55

					Pen	
1	9-18-70	39.5	7.8	31.7	0.50	40.9
2	9-18-70	37.3	5.7	31.6	0.50	40.0
3	9-18-70	35.5	2.1	33.4	0.55	36.0
4	9-16-70	30	0.6	29.4	0.60	36.4
5	9-16-70	30	1.0	29.0	0.20	61.6
6	9-18-70	39.5	6.2	33.3	0.35	40.0
7	9-18-70	39	6.0	33.0	0.3	53.6
8	9-18-70	35.7	4.3	31.4	0.45	39.4
9	9-18-70	36.3	3.3	33.0	0.40	36.0
10	9-18-70	39.5	6.8	32.7	0.40	46.3
		362.3	43.8			

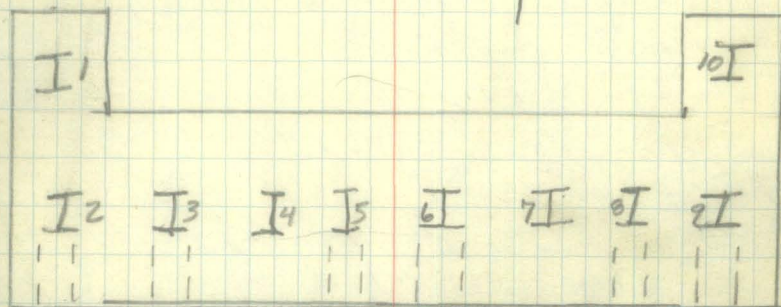
All piling Tested with 8 Foot Drop
340' 318.5

#10 No Bearing 6 to 8" per blow

$$30 \text{ Pile } \frac{36.58}{54.35} = P$$

$$\text{Battered } \frac{33.87}{54.35} = P$$

$$\frac{139,3944}{54.35 \times WPM}$$



Hammer # 2106 = 4870 Lbs Efec. 4020

Cap # 169 = 1540 Lbs.

(Welder) Cecil E. Holmes # 2281

Piling furnished 340 LF

Cut off 21.5 - 10.7 Furnished To ^{No.} pier

Drive 318.5

Extra piling
Welds

40 ft.
8 @ $\frac{30.00}{29.04} =$

North pier placed 54 Cu.Yds of Class X
Concrete in Bottom of Footing. To seal off
Bottom 9-12-1970 WASTED $\frac{1}{2}$ CY

Placed 24 Cu.Yds conc. in Pier Footing
North pier Sept 17, 1970

PLACED 58.2 CY CONC IN PIER STEM
NORTH PIER SEPT. 26, 1970

PLACED 17.5 CY CONC IN N. ABT.

OCT. 1, 1970.

South Pier Footing 28.8 Cu.Yd

" " shaft 91.4 " " Total for Piers

122.2

N. PIER QUANTITIES

CONC. 135.7 CY

REIN. ST. 3812 LBS

CL 21 EXC: $10.5 \times 40.5 \times 7.40 = 3147 \frac{ft^3}{ft^3} = 116.56 CY$
(ELEV. 866.04 - 858.64)

CL 22 EXC. $858.64 - 857.55 = 1.09'$

$7.5 \times 37.5 \times 1.09' = 306.56 \frac{ft^3}{ft^3} = 11.35 CY$

LESS W. $\frac{1}{2}$ KEY NOT REMOVED 5.67 CY

TOTAL CL 22 EXC. = 5.68 CY

N. Pier Concrete

Placed Footing for 29' H

Placed shaft 25' H

S. Pier

Class 21 = $(11.25)(41.0)(10.77) = 194 C.Y.$

South Pier

Oct. 6, 1970 Drove test pile in south Pier County Engineer Ray Stevenson was out. Drove Test pile To EL. 847.49 Drove pile 8 feet into medium hard shale. Decided To change EL. of Bottom of footing To 859.23 and change south pier To a 27 Foot "H" and drive steel H Piling decided To use 40 foot Piling cut into 3 piles of 13'-4".

RA Womble

Contractor furnished 24' of Test pile
Remainder came from cut offs from
N. abutment

Footing

Drop 8'

Pile No	Date	Length in Leads	Cut off	Length in structure	Ave Pen Last 5	Bearing
1	10-23	14.1	2.3	11.8	0.15	75.9
2	10-23	26.7	14.6	12.1	0.1	78.6
3	10-23	13.3	1.4	11.9	0.45	49.6
4	10-23	26.7	14.1	12.6	0.5	41.7
5	10-6-70	34.7	^{23.0} 22.9	12.8	0.4	47.4
6	10-23	26.7	14.1	12.6	0.3	54.6
7	10-23	13.6	0.8	12.8	0.5	47.3
8	10-22	13.6	1.5	12.1	0.46	50.7
9	10-22-70	13.3	1.0	12.3	0.45	47.1
10*	10-23	13.3	2.9	11.4	1.0	29.5
11	10-23	13.3	1.4	11.9	0.5	46.6
12	10-23	13.3	1.1	12.2	0.3	61.2
13	10-23	14.1	1.4	12.7	0.5	47.1
14	10-23	13.8	1.20	12.6	0.4	53.4
15	10-22-70	13.3"	0.5	12.8	0.5	46.8
16	10-23	14.3	2.7	11.6	0.3	58.3
17	10-23	14.6	2.5	12.1	0.25	62.0
18	10-23-70	13.3	1.4	11.9	0.5	46.6
19	10-23	26.7	14.3	12.4	0.3	54.6
20	10-23	13.0	0.5	12.5	0.55	44.8
21	10-23-70	26.7	13.8	12.9	0.25	59.1
22	10-22-70	26.7	13.6	13.1	0.5	44.1
23	26.8"	26.7	13.6	13.4	0.5	41.7
24	10-22-70	13.3	1.2	12.1	0.5	46.9
				295.2		

South Pier

1-3 | 3.9 | 3-9 | 4-9 | 5-0

1	2	3	4	5	6	7	8	9
← 3-1 1/2		3-9	4-3	7-4 1/4				
10	11	12				13	14	15
16	17	18	19	20	21	22	23	24

13-4" B = $\frac{39.8}{54.35}$ 26-8" $\frac{37.5}{54.35}$
 Battered 37.64 35.47

Pile No. 5 Test pile

Poured Footing Oct 27
 Placed 29 1/2 Cu. Yds

No 21 cut off @ 14

No 22 cut off @ 8

No 23 " " @ 7

No 6 " " @ 13

No 20 No 20 from Test Pile # 5

No 4 To 10

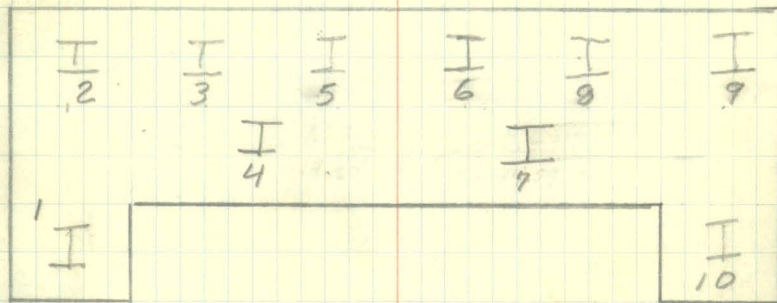
No 19 To 16

2 To 17

Poured shaft Nov. 2, 1970
 Placed 63 1/2 Cu. Yds

Could not get Leads Lower

Pile No.	Date	Length in Leads	Cut off	Length in structure	AVR. Pen. Last 5	Bearing
1	11-5-70	35'	0.3	34.7	1.1	24.6
X2	"	40	2.1	37.9	0.17	63.1
X3	"	40	2.0	38.0	0.05	82.0
4	"	35	0.2	34.8	1.0	26.4
X5	"	40	1.5	38.5	0.55	36.4
X6	"	40	1.3	38.7	0.35	46.9
7	"	35	0.0	35.0	0.7	33.9
X8	"	40	1.5	38.5	0.3	50.5
X9	"	40	0.9	39.1	0.7	31.2
10	"	35	0.0	35.0	1.25	22.3
		380'	9.8	370.2		



$$35' = \frac{356052}{54.35}$$

$$40' = \frac{346752}{54.35} \times .9459 = \frac{32.7993}{54.35}$$

~~Piling Furnished~~
~~Abut 140 LF 340 - 10.7~~
~~S Pier 7 @ 40 - 10 35 & 10 24 339~~
~~779~~
~~Furnished from Cut off N. Abut for S. Pier 10.7~~

Piling Furnished
 N. Abut 340' Less 10.7 To S. Pier 329.3
 S Pier 317.3 Plus 10.7 from N. Abut 328.0

P

Piling Drive
 N. Abutment 318.5
 S. Pier 295.2

Cut

Cut off	Piling Furnished	Piling Drive	Piling Furnish but Not used
N. Abut,	329.3	Less 318.5 =	10.8
S. Pier	328.0	Less 295.2	32.8

657.3

613.7

43.6

South Pier
 Furnish

7 @ 40 = 280
 1 @ 35 = 13.3
 1 @ 24 = 24

317.3 Total Furnish N. Pier

10.7 Furnished from Abut. No pay

328.0

N Abutment

Piling as Paid

N Abut Furnish 318.5

Drive 318.5

Cut off 21.5 @ 75% of Furnish

S. Pier Furnish 295.2

Drive 295.2

Cut off 24.8 @ 75% of Furnish

South Abut

Furnish 370.2

Drive 370.2

Cut off 9.8 @ 75%

WINTER SHUTDOWN 12-15-70

	West Beam	West Center Beam	East Center Beam	East Beam
Plate 1 + 13.25	+0.07 3.17	3.24		3.18 3.25
Splice 1 + 05.00	+0.4 3.25	3.29	3.10	3.27 3.31
+ 96.25	3.32			3.37
+ 87.50	3.36			3.39
+ 78.75	3.40			3.41
Splice + 70.00	3.40	3.44	3.18	3.35 3.39
+ 61.75	+0.7 3.40	3.47		3.37 3.47
Plate + 53.50	+0.7 3.44	3.51		3.43 3.50
Plate Splice + 40.12	+0.7 3.51	3.58	3.34	3.53 3.60
+ 26.75	3.66			3.70
+ 13.37	3.76			3.78
0 + 00	3.87 + 1 1/2	3.66 + 1 1/2	3.65 + 1 3/8	3.83 + 1 1/8

367
296
—
.91

363
29.7
—
.86

63

4.28

4.28

.92

.88

5.20

5.16

Plate 2.36

2.36

1+75.00 2.96

6¹⁵/₁₆

2.97

6¹⁵/₁₆

1+61.62 3.07

7¹³/₁₆

3.02

7¹/₈

1+48.25 3.13

7¹⁵/₁₆

3.08

7¹/₄

Plate
1+34.87 +0.7
3.10

3.17

6¹/₂

3.07

3 1/4 6¹/₈

Pier Plate
1+21.50 +0.7
3.13

3.20

6¹/₁₆

3.13

3.20 6¹/₁₆

Plate
1+13.25

splice
1+05.00

96.25

87.50

78.75

splice
70.00

Plate
61.75

Plate Pier
53.50

Plate
40.12

26.75

13.37

0+00

2.78 ^{.85}
~~2.78~~ 2.77 6¹/₄ 2.79 ^{.86}
~~2.78~~ 2.72 6⁷/₈

2.86 ^{.90}
~~2.86~~ 2.82 6⁷/₈ 2.90 ^{.94}
~~2.86~~ 2.82 7⁷/₈

2.94
~~2.94~~ 7¹/₂ 2.99 8³/₁₆

2.99
~~2.99~~ 7¹/₁₆ 3.01 8¹/₁₆

3.03 7¹/₁₆ 3.02 7⁵/₈

3.02 -0.04 ^{3.06}
~~2.98~~ 6¹⁵/₁₆ 2.96 ^{3.00}
~~2.92~~ 6⁵/₈

3.02 ^{3.09}
~~2.93~~ 6⁵/₁₆ 2.99 ^{3.06}
~~2.92~~ 6¹/₈

3.05 ^{3.12}
~~2.98~~ 6¹/₄ 3.03 ^{3.10}
~~2.96~~ 6¹/₁₆

3.09 ^{3.16}
~~0.07~~ 3.02 6¹/₄ 3.14 ^{3.21}
~~3.02~~ 6⁷/₈

3.22 7¹/₄ 3.28 7³/₄

3.28 7¹/₄ 3.32 7⁷/₈

3.34 6¹⁵/₁₆ 3.33 6¹³/₁₆

3.14

3.16

Plate

1475.00

7461.62

148.25

Plate
1434.87Plate Pier
1421.50

2.57

6¹/₁₆

2.57

6¹/₁₆

2.67

7¹/₁₆

2.61

7¹/₁₆

2.73

7¹/₁₆

2.68

7¹/₁₆

2.70

2.77

6¹/₂

2.67

2.74

6¹/₈

2.74

2.81

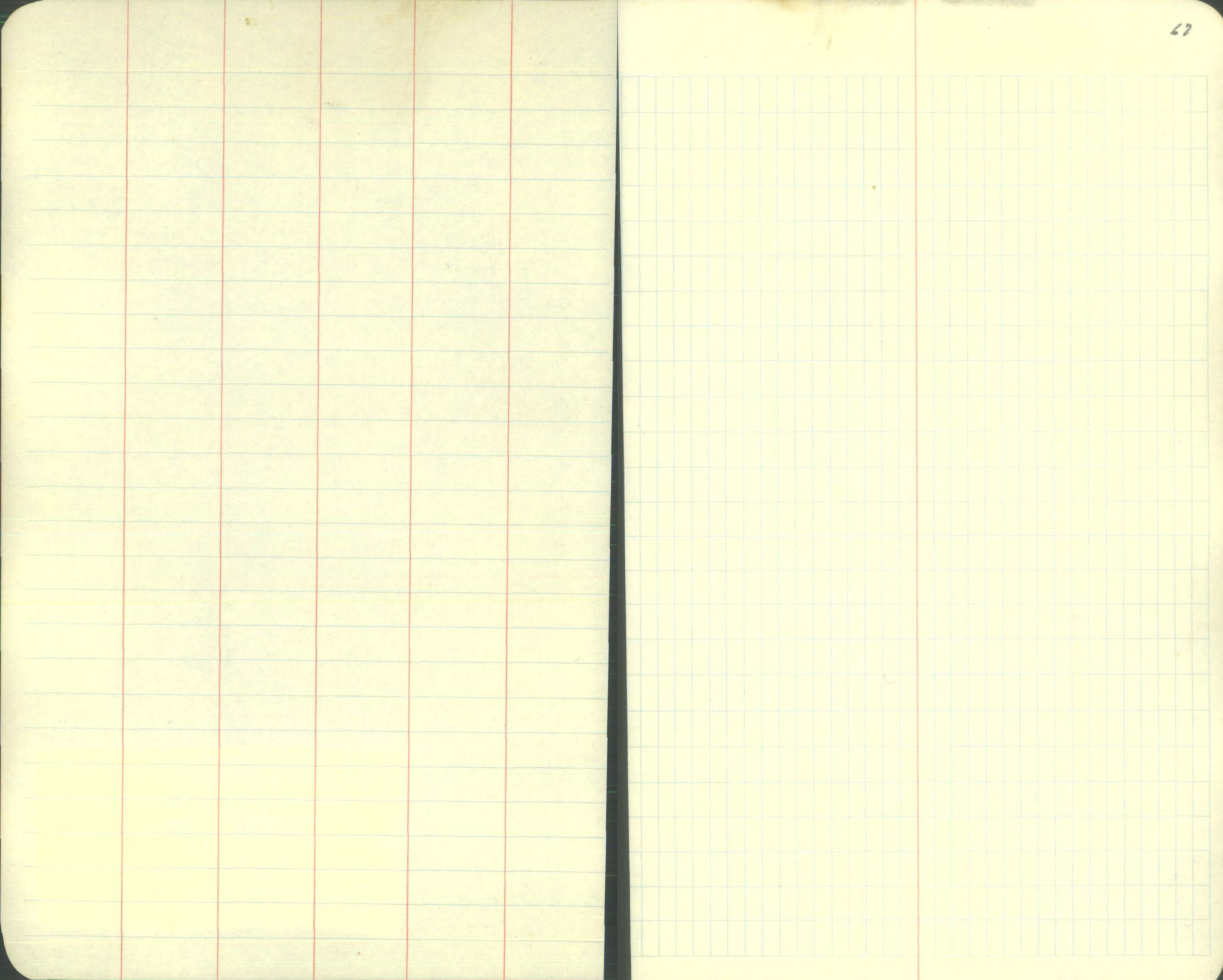
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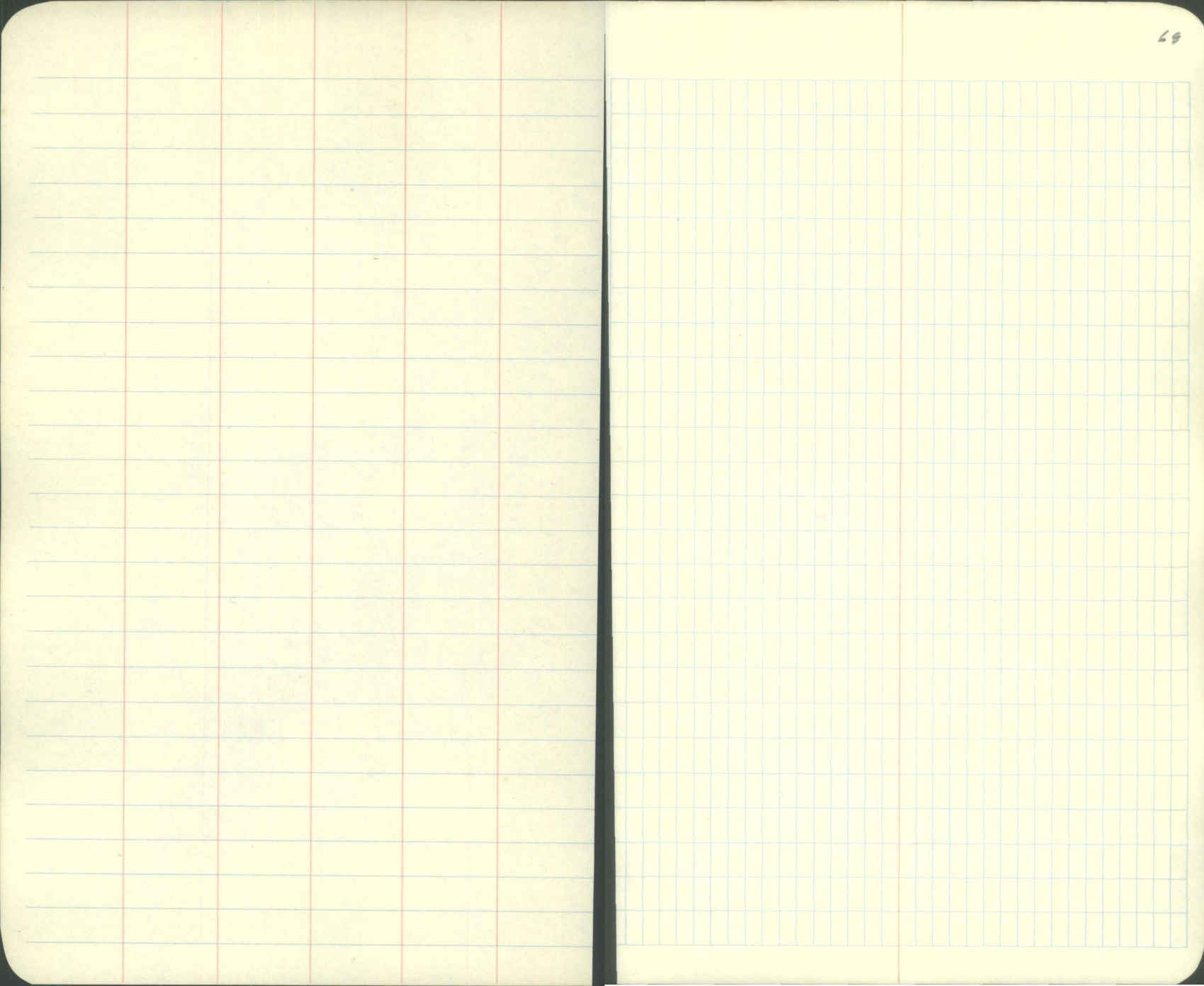
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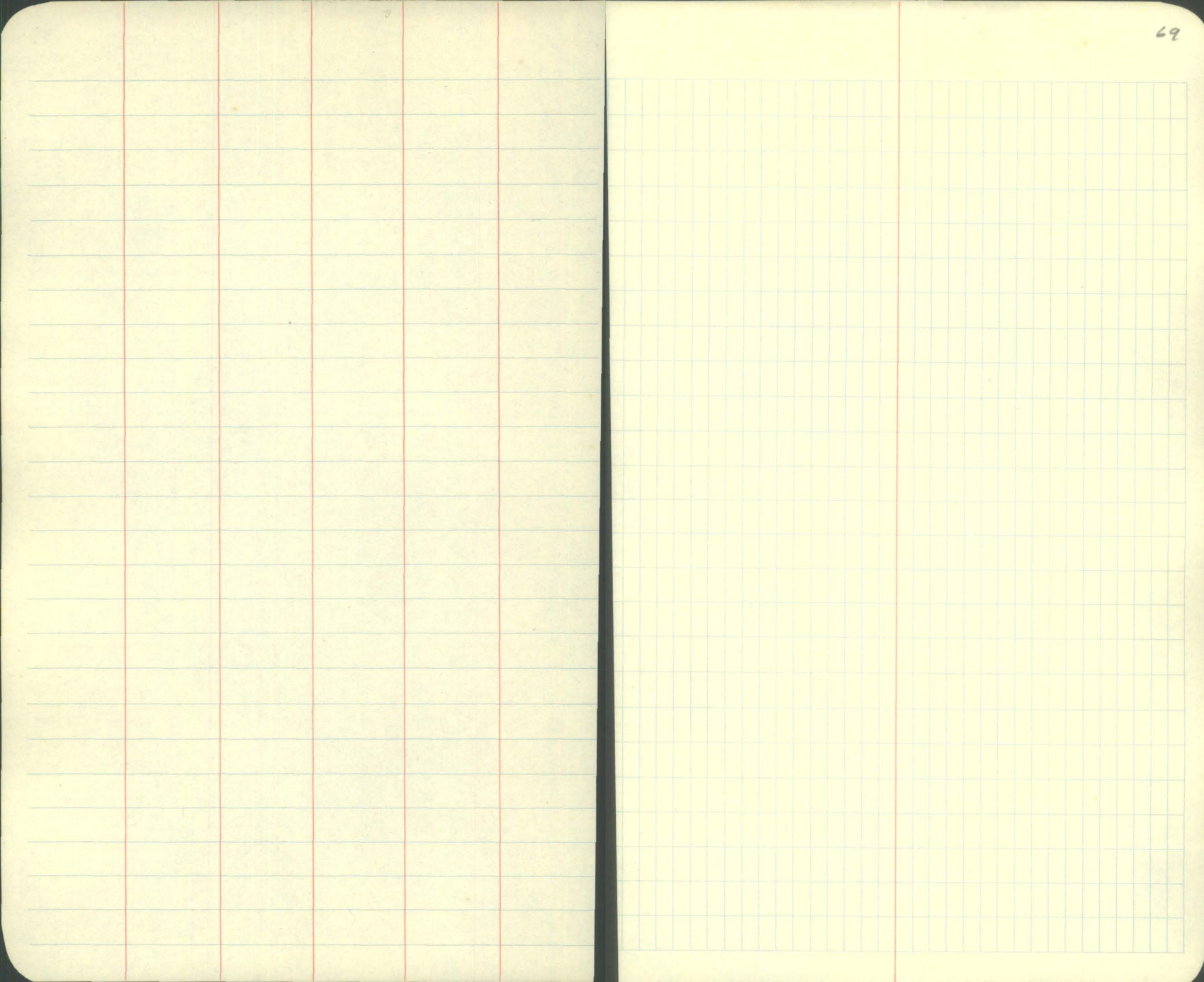
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6¹/₈

66-End







IMPROVED TABLES AND INFORMATION

HORIZONTAL STADIA CORRECTIONS

2°—00' — 0.1	21°—00' — 12.8	33°—00' — 29.7
3°—00' — 0.3	21°—30' — 13.4	33°—15' — 30.1
4°—00' — 0.5	22°—00' — 14.0	33°—30' — 30.5
5°—00' — 0.8	22°—30' — 14.7	33°—45' — 30.9
6°—00' — 1.1	23°—00' — 15.3	34°—00' — 31.3
7°—00' — 1.5	23°—30' — 15.9	34°—15' — 31.7
8°—00' — 1.9	24°—00' — 16.5	34°—30' — 32.1
9°—00' — 2.5	24°—30' — 17.2	34°—45' — 32.5
10°—00' — 3.0	25°—00' — 17.9	35°—00' — 32.9
10°—30' — 3.3	25°—30' — 18.6	35°—15' — 33.3
11°—00' — 3.6	26°—00' — 19.2	35°—30' — 33.7
11°—30' — 4.0	26°—30' — 19.9	35°—45' — 34.1
12°—00' — 4.3	27°—00' — 20.6	36°—00' — 34.6
12°—30' — 4.7	27°—30' — 21.3	36°—15' — 35.0
13°—00' — 5.1	28°—00' — 22.0	36°—30' — 35.4
13°—30' — 5.5	28°—30' — 22.8	36°—45' — 35.8
14°—00' — 5.9	29°—00' — 23.5	37°—00' — 36.2
14°—30' — 6.3	29°—30' — 24.3	37°—15' — 36.6
15°—00' — 6.7	30°—00' — 25.0	37°—30' — 37.1
15°—30' — 7.2	30°—15' — 25.4	37°—45' — 37.5
16°—00' — 7.6	30°—30' — 25.8	38°—00' — 37.9
16°—30' — 8.1	30°—45' — 26.2	38°—15' — 38.3
17°—00' — 8.5	31°—00' — 26.5	38°—30' — 38.7
17°—30' — 9.0	31°—15' — 26.9	38°—45' — 39.1
18°—00' — 9.5	31°—30' — 27.3	39°—00' — 39.6
18°—30' — 10.1	31°—45' — 27.7	39°—15' — 40.0
19°—00' — 10.6	32°—00' — 28.1	39°—30' — 40.5
19°—30' — 11.2	32°—15' — 28.5	
20°—00' — 11.7	32°—30' — 28.9	
20°—30' — 12.3	32°—45' — 29.3	

Chains to Feet

1	66
2	132
3	198
4	264
5	330
6	396
7	462
8	528
9	594
10	660

Feet to Chains

100	1.515
200	3.030
300	4.545
400	6.060
500	7.575
600	9.090
700	10.606
800	12.121
900	13.636
1,000	15.151

DIRECTIONS FOR USE OF TABLES

TABLE No. 1.

Distance of slope stake from side or shoulder stake for any width roadway, slope $1\frac{1}{2}$ to 1. If ground is nearly level, the cut or fill at side stake is located by the double entry method in left column and top row. The number in body of table in same row and column gives distance from side stake to slope stake. If ground is not level estimate the difference in elevation between the side stake and slope stake, lower target by this amount if cut, elevate if fill. Add this amount to cut or fill and find distance in table. Set up rod at this point, and line of sight should cut target. If it does not make the slight adjustment necessary.

TABLE No. 9.

To find Tangent and External for curve of any other degree, divide by degree of curve and add correction found in column of corrections.

Degree of curve with a given I may be found by dividing tangent, (or external), opposite I by given tangent, (or external).

The distance from a point on the tangent to the curve is very nearly the square of the tangent length divided by twice the radius.

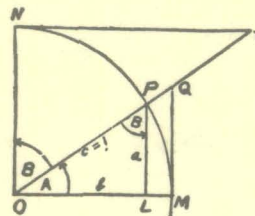


TABLE II
TRIGONOMETRIC FORMULÆ

$$\angle A = \angle MOP \quad \angle B = \angle PON = \angle OPL$$

$$R = OP = c = 1$$

$$\sin A = \frac{a}{c} = \frac{a}{1} = a = \cos B = LP$$

$$\cos A = \frac{b}{c} = \frac{b}{1} = b = \sin B = OL$$

$$\tan A = \frac{a}{b} = \frac{MQ}{OM} = \frac{MQ}{1} = MQ = \cot B = MQ$$

$$\cot A = \frac{NT}{ON} = \frac{NT}{1} = NT = \tan B = NT$$

$$\sec A = \frac{OQ}{OM} = \frac{OQ}{1} = OQ = \csc B = OQ$$

$$\sec A = \frac{OT}{ON} = \frac{OT}{1} = OT = \sec B = OT$$

$$\text{vers } A = \frac{LM}{OP} = LM = \text{covers } B \#$$

$$\text{covers A} = \frac{OP - LP}{OP} = OP - LP = \text{vers B}$$

$$\operatorname{exsec} A = PQ = \operatorname{coexsec} B$$

$$\text{coexsec } A = PT = \text{exsec } B$$

$$\sin \frac{1}{2} A = \sqrt{\frac{1 - \cos A}{2}} \qquad \cos \frac{1}{2} A = \sqrt{\frac{1 + \cos A}{2}}$$

$$\sin 2A = 2 \sin A \cos A \quad \cos 2A = \cos^2 A - \sin^2 A$$

Law of Sines $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Law of Cosines $c^2 = a^2 + b^2 - 2ab \cos C$

$$\text{Law of Tangents } \frac{a+b}{a-b} = \frac{\tan \frac{1}{2} (A+B)}{\tan \frac{1}{2} (A-B)}$$

TABLE II—Continued
TRIGONOMETRIC FORMULAE (continued)

In any triangle:

Given a, b, C; to find c, B, A.

Use Law of Sines.

Given A, B, c; to find a, b, C.

Use Law of Sines.

Given a, b, c; to find A, B, C.

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

$$\cos \frac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}$$

$$\tan \frac{1}{2} A = \frac{r}{s-a}$$

$$\tan \frac{1}{2} B = \frac{r}{s-b}$$

$$\tan \frac{1}{2} C = \frac{r}{s-c}$$

Area of a triangle:

$$\text{Area} = \frac{1}{2} ab \sin C$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

PRISMOIDAL FORMULA.

$$\text{Vol.} = \frac{h}{6} (B+b+4M)$$

h = altitude; b, B = bases; M = midsection

TABLE III
INCHES AND FRACTIONS OF AN INCH IN DECIMALS OF A FOOT

	0	1	2	3	4	5	6	7	8	9	10	11	
$\frac{1}{16}$	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219	$\frac{1}{16}$
$\frac{1}{8}$	.0104	.0938	.1771	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271	$\frac{1}{8}$
$\frac{3}{16}$	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323	$\frac{3}{16}$
$\frac{1}{4}$	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375	$\frac{1}{4}$
$\frac{5}{16}$	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427	$\frac{5}{16}$
$\frac{3}{8}$	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479	$\frac{3}{8}$
$\frac{7}{16}$	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531	$\frac{7}{16}$
$\frac{1}{2}$	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583	$\frac{1}{2}$
$\frac{9}{16}$	.0469	.1302	.2135	.2969	.3803	.4635	.5469	.6302	.7135	.7969	.8802	.9635	$\frac{9}{16}$
$\frac{5}{8}$	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688	$\frac{5}{8}$
$\frac{11}{16}$	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740	$\frac{11}{16}$
$\frac{3}{4}$	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792	$\frac{3}{4}$
$\frac{7}{8}$	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844	$\frac{7}{8}$
$\frac{15}{16}$	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896	$\frac{15}{16}$
1	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948	1
	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	1.000	
	0	1	2	3	4	5	6	7	8	9	10	11	

TABLE IV
USEFUL RELATIONS.

Lineal feet	$\times .00019$	= miles
Lineal yards	$\times .0006$	= miles
Square inches	$\times .007$	= square feet
Square feet	$\times .111$	= square yards
Square yards	$\times .0002067$	= acres
Acres	$\times 4840$	= square yards
Cubic inches	$\times .00058$	= cubic feet
Cubic feet	$\times .03704$	= cubic yards
Links	$\times .22$	= yards
Links	$\times .66$	= feet
Feet	$\times 1.5$	= links

$$360^\circ = 21600' = 1296000''$$

$$\text{Radius} = \text{arc of } 57.2957790^\circ$$

$$\text{Arc of } 1^\circ (\text{radius} = 1) = .017453292$$

$$\text{Arc of } 1' (\text{radius} = 1) = .000290888$$

$$\text{Arc of } 1'' (\text{radius} = 1) = .000004848$$

$$\pi = 3.141592654$$

$$\sqrt{\frac{1}{\pi}} = 0.564190$$

$$\frac{\pi}{4} = 0.785398163$$

$$\sqrt[3]{\frac{6}{\pi}} = 1.240700982$$

$$\frac{\pi}{6} = 0.523598776$$

$$\pi^2 = 9.869604401$$

$$\sqrt{\frac{4}{\pi}} = 1.128379167$$

$$\frac{1}{\pi^2} = 0.101321184$$

$$\frac{\pi}{6} = 0.523598776$$

$$\sqrt{\pi} = 1.772453851$$

$$\frac{4\pi}{3} = 4.188790205$$

$$\frac{1}{\pi} = 0.3183099$$

Curvature of Earth's surface = about 0.7 feet in 1 mile

Curvature in feet = $0.667 (\text{Dist. in miles})^2$

Difference between arc and chord length, 0.05 feet in $11\frac{1}{2}$ miles

$$\text{Probable error of a single observation} = 0.6754 \sqrt{\frac{M v^2}{n-1}}$$

Error in chaining of 0.01 feet in 100 feet:

Due to—

1. Length of tape error of 0.01 feet
2. Alignment. One end 1.4 feet out of line
3. Sag of tape at centre of 0.61 feet.
4. Temperature difference of 15°
5. Difference of pull of 15 lbs.

STADIA REDUCTION FORMULAE

$$\text{Horizontal Distance} = R - R \sin^2 a + C \cos a$$

$$\text{Vertical Distance} = R \frac{1}{2} \sin 2a + C \sin a$$

$$R = \text{Reading} \times \frac{\text{distance from Object glass to cross hairs}}{\text{distance between cross hairs}}$$

C = distance from Object glass to cross hairs + distance from Object glass to center of instrument.

a = angle of elevation for mid Reading

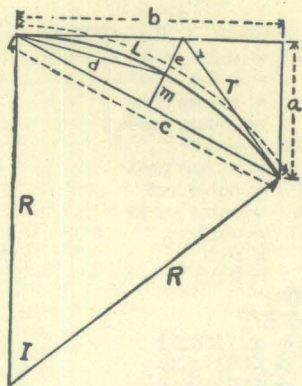


TABLE V
CURVE FORMULAE FOR SIMPLE CURVES
COMPILED BY J. CALVIN LOCKE, C.E.

- (1) $c = \sqrt{2Ra}$ (2) $c = \sqrt{a^2 + b^2}$
 (3) $c = \sqrt{2R(R - \sqrt{(R+b)(R-b)})} = \sqrt{2R(R - \sqrt{R^2 - b^2})}$
 (4) $c = 2\sqrt{m(2R - m)}$
 (5) $c = 2R \sin \frac{1}{2} I$ (6) $c = 2T \cos \frac{1}{2} I$
 (7) $e = R \operatorname{exsec} \frac{1}{2} I$
 (8) $e = R \tan \frac{1}{2} I \tan \frac{1}{4} I$ (9) $e = T \tan \frac{1}{4} I$
 (10) $b = \sqrt{a(2R - a)}$
 (11) $b = \sqrt{\left(c + \frac{c^2}{2R}\right)\left(c - \frac{c^2}{2R}\right)} = \sqrt{c^2 - \frac{c^4}{4R^2}}$
 (12) $b = R \sin I$ (13) $b = a \cot \frac{1}{2} I$
 (14) $R = \frac{a^2 + b^2}{2a} = \frac{c^2}{2a}$ (15) $R = \frac{d^2}{2m} = \frac{c^2 + 4m^2}{8m}$
 (16) $d = \sqrt{R(2R - \sqrt{(2R+c)(2R-c)})} = \sqrt{R(2R - \sqrt{4R^2 - c^2})}$
 (17) $d = \sqrt{2Rm}$ (18) $d = 2R \sin \frac{1}{4} I$ (19) $m = \frac{d^2}{2R}$
 (20) $m = R \mp \sqrt{\left(R + \frac{c}{2}\right)\left(R - \frac{c}{2}\right)} = R \mp \sqrt{R^2 - \frac{c^2}{4}}$
 (21) $m = R \operatorname{vers} \frac{1}{2} I$ (22) $m = R \sin \frac{1}{2} I \tan \frac{1}{4} I$ (23) $m = \frac{1}{2} c \tan \frac{1}{4} I$
 (24) $a = \frac{c^2}{2R}$ (25) $a = R - \sqrt{(R+b)(R-b)} = R - \sqrt{R^2 - b^2}$
 (26) $a = 2R(\sin^2 \frac{1}{2} I)$ (27) $a = R \operatorname{vers} I$ (28) $a = R \sin I \tan \frac{1}{2} I$
 (29) $a = b \tan \frac{1}{2} I$ (30) $a = T \sin I$ (31) $T = R \tan \frac{1}{2} I$
 (32) $I = \frac{L}{R} \times 57.295780$ (33) $R = \frac{L}{I} \times 57.295780$
 (34) $L = IR \times 0.01745329$ (35) $L = \frac{8d - c}{3}$
 (36) $\text{Area Seg.} = \frac{IR - R^2 \sin I}{2} = \frac{LR - Rb}{2}$

TABLE VI
SINES, COSINES, TANGENTS, COTANGENTS

deg	sin 0'	tan 0'	sin 10'	tan 10'	sin 20'	tan 20'	sin 30'	tan 30'	sin 40'	tan 40'	sin 50'	tan 50'	sin 60'	tan 60'
0	0000	0000	0029	0029	0058	0058	0087	0087	0116	0116	0145	0145	0175	0175
1	175	0175	0204	0204	0233	0233	0262	0262	291	291	320	320	349	349
2	349	349	378	378	407	407	436	436	465	465	494	494	523	523
3	523	524	552	553	581	582	610	612	640	641	669	670	698	698
4	698	699	727	729	756	758	785	787	814	816	843	846	872	872
5	872	875	901	904	929	934	958	963	987	992	1016	1022	1045	1045
6	1045	1051	1074	1080	1103	1110	1132	1139	1161	1169	1190	1198	1222	1222
7	1219	1228	1248	1257	1279	1287	1305	1317	1334	1346	1363	1376	1398	1398
8	1392	1405	1421	1435	1449	1465	1478	1495	1507	1524	1536	1554	1571	1571
9	1564	1584	1593	1614	1622	1644	1650	1673	1679	1703	1708	1733	1738	1759
10	1736	1763	1765	1793	1794	1823	1822	1853	1851	1883	1880	1914	1919	1945
11	1908	1944	1937	1974	1965	2004	1994	2035	2022	2065	2051	2095	2085	2125
12	2079	2126	2108	2156	2136	186	2164	217	193	247	221	278	251	305
13	250	309	278	339	306	370	334	401	363	432	391	462	421	487
14	419	493	447	524	476	555	504	586	532	617	560	648	581	665
15	588	679	616	711	644	742	672	773	700	805	728	836	751	854
16	756	867	784	899	812	931	840	962	868	994	896	1026	919	1045
17	924	1057	952	1089	939	1121	1007	1153	1035	1185	1062	1222	1091	1255
18	1090	1249	1118	1281	1145	1314	1173	1346	1201	1378	1228	1411	1261	1445
19	1256	1443	1283	1476	1311	1508	1338	1541	1365	1574	1393	1607	1420	1650
20	1420	1640	1448	1673	1475	1706	1502	1739	1529	1772	1557	1805	1585	1838
21	1584	1839	1611	1872	1638	1906	1665	1939	1692	1973	1719	2006	1746	2068
22	1746	2040	1773	2074	1800	2108	1827	2142	1854	2176	1881	2210	1916	2261
23	1907	2245	1934	2279	1961	2314	1987	2348	2014	2383	2041	2417	2066	2466
24	2067	2452	2094	2487	2120	2522	2147	2557	2173	2592	2200	2628	2225	2673
25	2226	2663	2253	2699	2279	2734	2305	2770	2331	2806	2358	2841	2384	2886
26	2384	2877	2410	2913	2436	2950	2462	2986	2488	3022	2514	3059	2540	3096
27	2540	3095	2566	3132	2592	3169	2617	3206	2643	3243	2669	3280	2695	3317
28	2695	3177	2720	3254	2746	3292	2772	3329	2797	3366	2823	3403	2849	3440
29	2848	3343	2874	3381	2899	3419	2924	3458	2950	3496	2975	3533	3000	3570
30	3000	3574	3025	3612	3050	3651	3075	3690	3100	3729	3125	3769	3150	3808
31	3150	3809	3175	3848	3200	3888	3225	3928	3250	3968	3275	4008	3300	4048
32	3299	4049	3324	4089	3348	4129	3373	4169	3398	4210	3423	4250	3448	4291
33	3446	4294	3471	4336	3495	4377	3519	4418	3544	4459	3569	4500	3594	4541
34	3592	4545	3616	4587	3640	4629	3664	4670	3688	4712	3712	4754	3736	4796
35	3736	4797	3760	4840	3783	4882	3807	4924	3831	4967	3855	5009	3879	5052
36	3878	5053	3901	5100	3925	5142	3948	5184	3972	5226	3995	5269	4019	5312
37	4018	5360	4041	5408	4065	5450	4088	5493	4111	5536	4134	5579	4157	5622
38	4157	5623	4180	5666	4202	5709	4225	5752	4248	5795	4271	5838	4294	5881
39	4293	5898	4316	5941	4338	5985	4361	6028	4383	6071	4406	6114	4429	6157
40	4428	6159	4450	6204	4472	6249	4494	6294	4517	6339	4539	6384	4561	6429
41	4561	6473	4583	6519	4604	6565	4626	6610	4648	6656	4670	6701	4692	6747
42	4691	6794	4713	6841	4734	6887	4756	6933	4777	6979	4799	7025	4821	7071
43	4820	7116	4841	7164	4862	7211	4884	7258	4905	7305	4926	7352	4947	7399
44	4947	7447	4967	7495	4988	7543	5009	7590	5029	7638	5049	7686	5069	7734
45	5071	7781	5092	7830	5112	7879	5133	7928	5153	7977	5173	8026	5193	8075
46	5193	8126	5213	8176	5233	8226	5253	8276	5273	8326	5293	8376	5313	8426
47	5313	8476	5333	8527	5353	8578	5373	8629	5393	8679	5413	8730	5433	8780
48	5433	8830	5453	8881	5473	8932	5493	8983	5513	9034	5533	9085	5553	9136
49	5553	9186	5573	9237	5593	9288	5613	9339	5633	9390	5653	9441	5673	9492
50	5673	9542	5693	9593	5713	9644	5733	9695	5753	9746	5773	9797	5793	9848
51	5793	9899	5813	9950	5833	10001	5853	10052	5873	10103	5893	10154	5913	10205
52	5913	10256	5933	10307	5953	10358	5973	10409	5993	10460	6013	10511	6033	10562
53	6033	10613	6053	10664	6073	10715	6093	10766	6113	10817	6133	10868	6153	10919
54	6153	10970	6173	11021	6193	11072	6213	11123	6233	11174	6253	11225	6273	11276
55	6273	11327	6293	11378	6313	11429	6333	11480	6353	11531	6373	11582	6393	11633
56	6393	11684	6413	11735	6433	11786	6453	11837	6473	11888	6493	11939	6513	11990
57	6513	12041	6533	12092	6553	12143	6573	12194	6593	12245	6613	12296	6633	12347
58	6633	12398	6653	12449	6673	12500	6693	12551	6713	12602	6733	12653	6753	12704
59	6753	12756	6773	12807	6793	12858	6813	12909	6833	12960	6853	13011	6873	13062
60	6873	13113	6893	13164	6913	13215	6933	13266	6953	13317	6973	13368	6993	13419

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

sin 0'	tan 0'	sin 10'	tan 10'	sin 20'	tan 20'	sin 30'	tan 30'	sin 40'	tan 40'	sin 50'	tan 50'	sin 60'	tan 60'
46 7193	1.0355	7214	1.0416	7234	1.0477	7254	1.0533	7274	1.0599	7294	1.0661	43	
47 314	.0724	333	.0786	353	.0850	373	.0913	392	.0977	412	.1041	42	
48 431	.1106	451	.1171	470	.1237	490	.1303	509	.1369	528	.1436	41	
49 547	.1504	566	.1571	585	.1640	604	.1708	623	.1778	642	.1847	40	
50 660	1.1918	7679	1.1988	7698	1.2059	7716	1.2131	7735	1.2203	7753	1.2276	39	
51 771	.2349	790	.2423	808	.2497	826	.2572	844	.2647	862	.2723	38	
52 880	.2799	898	.2876	916	.2954	934	.3032	951	.3111	969	.3190	37	
53 986	.3270	8004	.3351	8021	.3452	8039	.3514	8056	.3597	8073	.3680	36	
54 8090	.3764	107	.3848	124	.3934	141	.4019	158	.4106	175	.4193	35	
55 192	.4281	208	.4370	225	.4460	241	.4550	258	.4641	274	.4733	34	
56 290	.4826	307	.4919	323	.5013	339	.5108	355	.5204	371	.5301	33	
57 387	.5399	403	.5497	418	.5597	434	.5697	450	.5798	465	.5900	32	
58 480	.6003	496	.6107	511	.6212	526	.6319	542	.6426	557	.6534	31	
59 572	.6643	587	.6753	601	.6864	616	.6977	631	.7090	646	.7205	30	
60 660	1.7321	8675	1.7437	8689	1.7556	8704	1.7675	8718	1.7797	8732	1.7917	29	
61 746	.8040	760	.8165	774	.8291	788	.8418	802	.8546	816	.8676	28	
62 829	.8807	843	.8940	857	.9074	870	.9210	884	.9347	897	.9486	27	
63 910	.9626	923	.9768	936	.9912	949	2.0057	962	2.0204	975	2.0352	26	
64 988	2.0503	9001	2.0655	9013	2.0809	9026	.0965	9038	.1123	9051	.1283	25	
65 9063	.1445	075	.1609	088	.1775	100	.1943	112	.2113	124	.2286	24	
66 135	.2460	147	.2637	159	.2817	171	.2998	182	.3183	194	.3369	23	
67 205	.3559	216	.3750	228	.3945	239	.4142	250	.4342	261	.4545	22	
68 272	.4751	283	.4960	293	.5172	304	.5386	315	.5605	325	.5826	21	
69 336	.6051	346	.6279	356	.6511	367	.6746	377	.6985	387	.7228	20	
70 397	2.7475	9407	2.7725	9417	2.7980	9426	2.8239	9436	2.8502	9446	2.8770	19	
71 455	.9042	465	.9319	474	.9600	483	.9887	492	3.0178	502	3.0475	18	
72 511	3.0777	520	3.1084	528	3.1397	537	3.1716	546	3.2041	555	3.2371	17	
73 563	.2709	572	.3052	580	.3402	588	.3759	596	.4124	605	.4495	16	
74 613	.4874	621	.5261	628	.5656	636	.6059	644	.6470	652	.6891	15	
75 659	.7321	667	.7760	674	.8208	681	.8657	689	.9136	696	.9617	14	
76 703	4.0108	710	4.0611	717	4.1126	724	4.1653	730	4.2193	737	4.2747	13	
77 744	.3315	750	.3897	757	.4494	763	.5107	769	.5736	775	.6382	12	
78 781	.7046	787	.7729	793	.8430	799	.9152	805	.9894	811	5.0658	11	
79 816	.1446	822	5.2257	827	5.3093	833	5.3955	838	5.4845	843	.5764	10	
80 9848	5.6713	9853	5.7694	9858	5.8708	9863	5.9758	9868	6.0844	9872	6.1970	9	
81 877	6.3138	881	6.4348	886	6.5606	890	6.6912	894	.8269	899	.9682	8	
82 903	7.1154	907	7.2687	911	7.4287	914	7.5958	918	7.7704	922	7.9530	7	
83 925	8.1443	929	8.3450	932	8.5555	936	8.7769	939	9.0098	942	9.2553	6	
84 945	9.5144	948	9.7882	951	10.078	954	10.385	957	10.711	959	11.059	5	
85 962	11.430	964	11.826	967	12.250	969	12.706	971	13.197	974	13.727	4	
86 976	14.300	978	14.924	980	15.605	981	16.350	983	17.169	985	18.075	3	
87 986	19.081	988	20.206	989	21.470	990	22.903	992	24.542	993	26.432	2	
88 994	28.636	995	31.242	996	34.368	997	38.189	997	42.964	998	49.104	1	
89 9998	57.290	9999	68.750	9999	85.940	9999	114.58	1.000	171.88	1.000	343.77	0	
90 60'	60'	50'	50'	40'	40'	30'	30'	20'	20'	10'	10'	deg	
deg	cos	cot	cos	cot	cos	cot	cos	cot	cos	cot	cos	cot	deg

TABLE VII
RODS IN FEET, 10THS AND 100THS OF FEET

Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet
1	16.50	21	346.50	41	676.50	61	1006.50	81	1336.50
2	33.00	22	363.00	42	693.00	62	1023.00	82	1353.00
3	49.50	23	379.50	43	709.50	63	1039.50	83	1369.50
4	66.00	24	396.00	44	726.00	64	1056.00	84	1386.00
5	82.50	25	412.50	45	742.50	65	1072.50	85	1402.50
6	99.00	26	429.00	46	759.00	66	1089.00	86	1419.00
7	115.50	27	445.50	47	775.50	67	1105.50	87	1435.50
8	132.00	28	462.00	48	792.00	68	1122.00	88	1452.00
9	148.50	29	478.50	49	808.50	69	1138.50	89	1468.50
10	165.00	30	495.00	50	825.00	70	1155.00	90	1485.00
11	181.50	31	511.50	51	841.50	71	1171.50	91	1501.50
12	198.00	32	528.00	52	858.00	72	1188.00	92	1518.00
13	214.50	33	544.50	53	874.50	73	1204.50	93	1534.50
14	231.00	34	561.00	54	891.00	74	1221.00	94	1551.00
15	247.50	35	577.50	55	907.50	75	1237.50	95	1567.50
16	264.00	36	594.00	56	924.00	76	1254.00	96	1584.00
17	280.50	37	610.50	57	940.50	77	1270.50	97	1600.50
18	297.00	38	627.00	58	957.00	78	1287.00	98	1617.00
19	313.50	39	643.50	59	973.50	79	1303.50	99	1633.50
20	330.00	40	660.00	60	990.00	80	1320.00	100	1650.00

TABLE VIII
LINKS IN FEET, 10THS AND 100THS OF FEET

Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet
1	0.66	18	11.88	35	23.10	52	34.32	69	45.54	86	56.76
2	1.32	19	12.54	36	23.76	53	34.98	70	46.20	87	57.42
3	1.98	20	13.20	37	24.42	54	35.64	71	46.86	88	58.08
4	2.64	21	13.86	38	25.08	55	36.30	72	47.52	89	58.74
5	3.30	22	14.52	39	25.74	56	36.96	73	48.18	90	59.40
6	3.96	23	15.18	40	26.40	57	37.62	74	48.84	91	60.06
7	4.62	24	15.84	41	27.06	58	38.28	75	49.50	92	60.72
8	5.28	25	16.50	42	27.72	59	38.94	76	50.16	93	61.38
9	5.94	26	17.16	43	28.38	60	39.60	77	50.82	94	62.04
10	6.60	27	17.82	44	29.04	61	40.26	78	51.48	95	62.70
11	7.26	28	18.48	45	29.70	62	40.92	79	52.14	96	63.36
12	7.92	29	19.14	46	30.36	63	41.58	80	52.80	97	64.02
13	8.58	30	19.80	47	31.02	64	42.24	81	53.46	98	64.68
14	9.24	31	20.46	48	31.68	65	42.90	82	54.12	99	65.34
15	9.90	32	21.12	49	32.34	66	43.56	83	54.78	100	66.00
16	10.56	33	21.78	50	33.00	67	44.22	84	55.44	101	66.66
17	11.22	34	22.44	51	33.66	68	44.88	85	56.10	102	67.32

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=10°	I	T	E	I=20°	I	T	E	I=30°
1°	50.00	.218	+	11°	551.70	26.500	+	21°	1061.9	97.577	+
10'	58.34	.297	5° C.	10'	560.11	27.313	5° C	10'	1070.6	99.155	5° C
20'	66.67	.388	T	20'	568.53	28.137	T	20'	1079.2	100.75	T
30'	75.01	.491	T	30'	576.95	28.974	T	30'	1087.8	102.35	T
40'	83.34	.606	.03	40'	585.36	29.824	.06	40'	1096.4	103.97	.10
50'	91.68	.733	E	50'	593.79	30.686	E	50'	1105.1	105.60	E
2°	100.01	.873	.001	12°	602.21	31.561	.006	22°	1113.7	107.24	.013
10'	108.35	1.024		10'	610.64	32.447		10'	1122.4	108.90	
20'	116.68	1.188		20'	619.07	33.347		20'	1131.0	110.57	
30'	125.02	1.364		30'	627.50	34.259		30'	1139.7	112.25	
40'	133.36	1.552		40'	635.93	35.183		40'	1148.4	113.95	
50'	141.70	1.752		50'	644.37	36.120		50'	1157.0	115.66	
3°	150.04	1.964	10° C.	13°	652.81	37.070	10° C.	23°	1165.7	117.38	10° C.
10'	158.38	2.188	T	10'	661.25	38.031	T	10'	1174.4	119.12	T
20'	166.72	2.425	.06	20'	669.70	39.006	.13	20'	1183.1	120.87	.19
30'	175.06	2.674	E	30'	678.15	39.993	E	30'	1191.8	122.63	E
40'	183.40	2.934	.003	40'	686.60	40.992	.011	40'	1200.5	124.41	.025
50'	191.74	3.207		50'	695.06	42.004		50'	1209.2	126.20	
4°	200.08	3.492	15° C.	14°	703.51	43.029	15° C.	24°	1217.9	128.00	15° C.
10'	208.43	3.790	T	10'	711.97	44.066	T	10'	1226.6	129.82	T
20'	216.77	4.099	.09	20'	720.44	45.116	.19	20'	1235.3	131.65	.29
30'	225.12	4.421	.004	30'	728.90	46.178	.017	30'	1244.0	133.50	.39
40'	233.47	4.755		40'	737.37	47.253		40'	1252.8	135.35	.49
50'	241.81	5.100		50'	745.85	48.341		50'	1261.5	137.23	
5°	250.16	5.459	20° C.	15°	754.32	49.441	20° C.	25°	1270.2	139.11	20° C.
10'	258.51	5.829	T	10'	762.80	50.554	T	10'	1279.0	141.01	T
20'	266.86	6.211	.09	20'	771.29	51.679	.19	20'	1287.7	142.93	.29
30'	275.21	6.606	.004	30'	779.77	52.818	.017	30'	1296.5	144.85	.39
40'	283.57	7.013		40'	788.26	53.969		40'	1305.3	146.79	.49
50'	291.92	7.432		50'	796.75	55.132		50'	1314.0	148.75	
6°	300.28	7.863	25° C.	16°	805.25	56.309	25° C.	26°	1322.8	150.71	25° C.
10'	308.64	8.307	T	10'	813.75	57.498	T	10'	1331.6	152.69	T
20'	316.99	8.762	.13	20'	822.25	58.699	.26	20'	1340.4	154.69	.39
30'	325.35	9.230	.006	30'	830.76	59.914	.022	30'	1349.2	156.70	.49
40'	333.71	9.710		40'	839.27	61.141		40'	1358.0	158.72	
50'	342.08	10.202		50'	847.78	62.381		50'	1366.8	160.76	
7°	350.44	10.707	30° C.	17°	856.30	63.634	30° C.	27°	1375.6	162.81	30° C.
10'	358.81	11.224	T	10'	864.82	64.900	T	10'	1384.4	164.86	T
20'	367.17	11.753	.16	20'	873.35	66.178	.26	20'	1393.2	166.95	.39
30'	375.54	12.294	.006	30'	881.88	67.470	.022	30'	1402.0	169.04	.49
40'	383.91	12.847		40'	890.41	68.774		40'	1410.9	171.15	
50'	392.28	13.413		50'	898.95	70.091		50'	1419.7	173.27	
8°	400.66	13.991	35° C.	18°	907.49	71.421	35° C.	28°	1428.6	175.41	35° C.
10'	409.03	14.582	T	10'	916.03	72.764	T	10'	1437.4	177.55	T
20'	417.41	15.184	.16	20'	924.58	74.119	.26	20'	1446.3	179.72	.39
30'	425.79	15.799	.006	30'	933.13	75.488	.022	30'	1455.1	181.89	.49
40'	434.17	16.428		40'	941.69	76.869		40'	1464.0	184.08	
50'	442.55	17.065		50'	950.25	78.264		50'	1472.9	186.29	
9°	450.93	17.717	40° C.	19°	958.81	79.671	40° C.	29°	1481.8	188.51	40° C.
10'	459.32	18.381	T	10'	967.38	81.092	T	10'	1490.7	190.74	T
20'	467.71	19.058	.16	20'	975.96	82.525	.26	20'	1499.6	192.99	.39
30'	476.10	19.746	.006	30'	984.53	83.972	.022	30'	1508.5	195.25	.49
40'	484.49	20.447		40'	993.12	85.431		40'	1517.4	197.53	
50'	492.88	21.161		50'	1001.7	86.904		50'	1526.3	199.82	
10°	501.28	21.887	45° C.	20°	1010.3	88.389	45° C.	30°	1535.3	202.12	45° C.
10'	509.68	22.624	T	10'	1018.9	89.888	T	10'	1544.2	204.44	T
20'	518.08	23.375	.16	20'	1027.5	91.399	.26	20'	1553.1	206.77	.39
30'	526.48	24.138	.006	30'	1036.1	92.924	.022	30'	1562.1	209.12	.49
40'	534.89	24.913		40'	1044.7	94.462		40'	1571.0	211.48	
50'	543.29	25.700		50'	1053.3	96.013		50'	1580.0	213.86	

T = R tan ½ I

E = R exsec ½ I

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=40°	I	T	E	I=50°	I	T	E	I=60°
31°	1589.0	216.3	+	41°	2142.2	387.4	+	51°	2732.9	618.4	+
10'	1598.0	218.7	5° C.	10'	2151.7	390.7	5° C.	10'	2743.1	622.8	5° C.
20'	1606.9	221.1	T	20'	2161.2	394.1	T	20'	2753.4	627.2	T
30'	1615.9	223.5	T	30'	2170.8	397.4	T	30'	2763.7	631.7	T
40'	1624.9	226.0	.13	40'	2180.3	400.8	.17	40'	2773.9	636.2	.21
50'	1633.9	228.4	E	50'	2189.9	404.2	E	50'	2784.2	640.7	E
32°	1643.0	230.9	.023	42°	2199.4	407.6	.037	52°	2794.5	645.2	.056
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	10° C.	43°	2257.0	428.5	10° C.	53°	2856.7	672.7	10° C.
10'	1706.3	248.7	T	10'	2266.6	432.0	T	10'	2867.1	677.3	T
20'	1715.3	251.3	.26	20'	2276.2	435.6	.34	20'	2877.5	682.0	.42
30'	1724.4	253.9	E	30'	2285.9	439.2	E	30'	2888.0	686.7	E
40'	1733.5	256.5	.046	40'	2295.6	442.8	.075	40'	2898.4	691.4	.112
50'	1742.6	259.1		50'	2305.2	446.4		50'	2908.9	696.1	
34°	1751.7	261.8	15° C.	44°	2314.9	450.0	15° C.	54°	2919.4	700.9	15° C.
10'	1760.8	264.5	T	10'	2324.6	453.6	T	10'	2929.9	705.7	T
20'	1770.0	267.2	.51	20'	2334.3	457.3	.51	20'	2940.4	710.5	.51
30'	1779.1	269.9	.040	30'	2344.1	461.0	.116	30'	2951.0	715.3	.168
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	20° C.	45°	2373.3	472.1	20° C.	55°	2982.7	729.9	20° C.
10'	1815.7	280.8	T	10'	2383.1	475.8	T	10'	2993.3	734.8	T
20'	1824.9	283.6	.40	20'	2392.8	479.6	.51	20'	3003.9	739.7	.51
30'	1834.1	286.4	.070	30'	2402.6	483.4	.116	30'	3014.5	744.6	.168
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	25° C.	46°	2432.1	494.8	25° C.	56°	3046.5	759.6	25° C.
10'	1870.9	297.7	T	10'	2441.9	498.7	T	10'	3057.2	764.6	T
20'	1880.1	300.6	.53	20'	2451.8	502.5	.51	20'	3067.9	769.7	.51
30'	1889.4	303.5	.093	30'	2461.7	506.4	.151	30'	3078.7	774.7	.225
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	30° C.	47°	2491.3	518.2	30° C.	57°	3110.9	790.1	30° C.
10'	1926.4	315.2	T	10'	2501.2	522.2	T	10'	3121.7	795.2	T
20'	1935.7	318.1	.68	20'	2511.2	526.1	.68	20'	3132.6	800.4	.68
30'	1945.0	321.1	.093	30'	2521.1	530.1	.151	30'	3143.4	805.6	.225
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	35° C.	48°	2551.0	542.2	35° C.	58°	3176.0	821.4	35° C.
10'	1982.2	333.2	T	10'	2561.0	546.3	T	10'	3186.9	826.7	T
20'	1991.5	336.3	.68	20'	2571.0	550.4	.68	20'	3197.8	832.0	.68
30'	2000.9	339.3	.093	30'	2581.0	554.5	.151	30'	3208.8	837.3	.225
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	40° C.	49°	2611.2	566.9	40° C.	59°	3241.7	853.5	40° C.
10'	2038.4	351.8	T	10'	2621.2	571.1	T	10'	3252.7	858.9	T
20'	2047.8	354.9	.51	20'	2631.3	575.3	.51	20'	3263.7	864.3	.51
30'	2057.2	358.1	.040	30'	2641.4	579.5	.116	30'	3274.8	869.8	.168
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	30° C.	50°	2671.8	592.3	30° C.	60°	3308.0	886.4	30° C.
10'	2094.9	371.0	T	10'	2681.9	596.6	T	10'	3319.1	892.0	T
20'	2104.3	374.2	.80	20'	2692.1	600.9	1.02	20'	3330.3	897.5	1.27
30'	2113.8	377.5	E	30'	2702.3	605.3	E	30'	3341.4	903.2	E
40'	2123.3	380.8	.141	40'	2712.5	609.6	.227	40'	3352.6	908.8	.340
50'	2132.7	384.1		50'	2722.7	614.0		50'	3363.8	914.5	

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=70°	I	T	E	I=80°	I	T	E	I=90°
61°	3375.0	920.2	+ 5° C. .25 E	71°	4086.9	1308.2	+ 5° C. .30 E	81°	4893.6	1805.3	+ 5° C. .36 E
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	.080	72°	4162.8	1352.6	.110	82°	4980.7	1862.2	.149
10'	3454.1	960.6		10'	4175.6	1360.1		10'	4995.4	1871.8	
20'	3465.4	966.5		20'	4188.5	1367.6		20'	5010.0	1881.5	
30'	3476.8	972.4		30'	4201.2	1375.2		30'	5024.8	1891.2	
40'	3488.3	978.3		40'	4214.0	1382.8		40'	5039.5	1900.9	
50'	3499.7	984.3		50'	4226.8	1390.4		50'	5054.3	1910.7	
63°	3511.1	990.2	10° C.	73°	4239.7	1398.0	10° C.	83°	5069.2	1920.5	10° C.
10'	3522.6	996.2		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	15° C.	74°	4317.6	1444.6	15° C.	84°	5159.0	1980.4	15° C.
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	T .76 E .240	75°	4396.5	1492.4	T .91 E .332	85°	5250.3	2041.7	T 1.09 E .450
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	20° C.	76°	4476.5	1541.4	20° C.	86°	5343.0	2104.7	20° C.
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	T E .321	77°	4557.6	1591.6	T E .445	87°	5437.2	2169.2	T E .603
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	25° C.	78°	4639.8	1643.0	25° C.	88°	5533.1	2235.5	25° C.
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	.403	79°	4723.2	1695.8	.558	89°	5630.5	2303.5	.756
10'	3950.2	1229.7		10'	4737.2	1704.7		10'	5646.9	2315.0	
20'	3962.5	1236.7		20'	4751.2	1713.7		20'	5663.4	2326.6	
30'	3974.8	1243.7		30'	4765.3	1722.7		30'	5679.9	2338.2	
40'	3987.2	1250.8		40'	4779.4	1731.7		40'	5696.4	2349.8	
50'	3999.5	1257.9		50'	4793.6	1740.8		50'	5713.0	2361.5	
70°	4011.9	1265.0	30° C.	80°	4807.7	1749.9	30° C.	90°	5729.7	2373.3	30° C.
10'	4024.4	1272.1		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	

T = R tan ½ I

E = R exsec ½ I

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=100°	I	T	E	I=110°	I	T	E	I=120°
91°	5830.5	2444.9	+ 5° C. T .43 E	101°	6950.6	3278.1	+ 5° C. T .51 E	111°	8336.7	4386.1	+ 5° C. T .62 E
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	.200	102°	7075.5	3374.9	.268	112°	8494.6	4516.6	.360
10'	5950.5	2531.0		10'	7096.6	3391.2		10'	8521.3	4538.8	
20'	5967.9	2543.5		20'	7117.8	3407.7		20'	8548.1	4561.1	
30'	5985.3	2556.0		30'	7139.0	3424.3		30'	8575.0	4583.4	
40'	6002.7	2568.6		40'	7160.3	3440.9		40'	8602.1	4606.0	
50'	6020.2	2581.3		50'	7181.7	3457.6		50'	8629.3	4628.6	
93°	6037.8	2594.0	10° C. T .86 E .4015	103°	7203.2	3474.4	10° C. T .103 E .536	113°	8656.6	4651.3	10° C. T 1.25 E .721
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	4768.9	
94°	6144.3	2671.6	15° C. T 1.30 E .604	104°	7333.6	3576.8	15° C. T 1.56 E .806	114°	8822.9	4790.4	15° C. T 1.93 E 1.09
10'	6162.2	2684.7		10'	7355.6	3594.2		10'	8851.0	4814.1	
20'	6180.2	2697.9		20'	7377.8	3611.7		20'	8879.3	4837.8	
30'	6198.3	2711.2		30'	7399.9	3629.2		30'	8907.7	4861.7	
40'	6216.4	2724.5		40'	7422.2	3646.8		40'	8936.3	4885.7	
50'	6234.6	2737.9		50'	7444.6	3664.5		50'	8965.0	4909.9	
95°	6252.8	2751.3	20° C. T 1.74 E .809	105°	7467.0	3682.3	20° C. T 2.08 E 1.08	115°	8993.8	4934.1	20° C. T 2.52 E 1.46
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	25° C. T 2.18 E 1.02	106°	7603.5	3791.0	25° C. T 2.61 E 1.36	116°	9169.4	5082.7	25° C. T 3.16 E 1.83
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	30° C. T 2.62 E 1.22	107°	7743.2	3902.9	30° C. T 3.14 E 1.63	117°	9349.9	5236.2	30° C. T 3.81 E 2.20
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	35° C. T 2.92 E 1.52	108°	7886.2	4018.2	35° C. T 3.62 E 2.12	118°	9535.7	5395.1	35° C. T 4.31 E 2.81
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	40° C. T 3.22 E 1.82	109°	8032.7	4137.1	40° C. T 3.92 E 2.42	119°	9727.0	5559.4	40° C. T 4.61 E 3.31
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	45° C. T 3.52 E 2.02	110°	8182.8	4259.7	45° C. T 4.22 E 2.72	120°	9924.0	5729.7	45° C. T 4.91 E 3.41
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 X.
MIDDLE ORDINATES OF RAILS
Length of Rail (feet)

C o /	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch	C o	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch
0-20	17189	.08	.07	.06	.05	.04	.03	8	716.8	1.88	1.64	1.42	1.20	1.01	.84
0-40	8594	.16	.14	.12	.10	.08	.07	9	637.3	2.12	1.84	1.60	1.35	1.14	.94
1-0	5730	.24	.20	.18	.15	.13	.10	10	573.7	2.36	2.05	1.78	1.50	1.27	1.04
1-20	4297	.31	.27	.23	.20	.17	.13	11	521.7	2.59	2.26	1.95	1.65	1.39	1.15
1-40	3438	.39	.34	.29	.25	.21	.17	12	478.3	3.83	2.47	2.15	1.81	1.54	1.28
2-0	2865	.47	.41	.35	.30	.25	.20	13	441.7	3.05	2.66	2.30	1.96	1.66	1.36
2-20	2456	.55	.48	.41	.35	.29	.23	14	410.3	3.30	2.87	2.48	2.10	1.78	1.46
2-40	2149	.63	.55	.47	.40	.33	.27	15	383.1	3.54	3.08	2.68	2.26	1.91	1.57
3-0	1910	.71	.62	.53	.45	.38	.31	16	359.3	3.76	3.28	2.83	2.40	2.04	1.67
3-20	1719	.78	.68	.59	.50	.42	.35	17	338.3	4.00	3.48	3.02	2.57	2.16	1.78
3-40	1563	.86	.75	.65	.55	.46	.38	18	319.6	4.21	3.67	3.18	2.70	2.28	1.87
4-0	1433	.94	.82	.71	.60	.50	.42	19	302.9	4.45	3.89	3.36	2.86	2.41	1.98
4-20	1323	1.02	.89	.77	.65	.55	.45	20	287.9	4.70	4.09	3.55	3.00	2.54	2.09
4-40	1228	1.10	.96	.83	.70	.59	.48	22	262.0	5.16	4.44	3.84	3.30	2.80	2.29
5	1146	1.18	1.03	.89	.75	.63	.52	24	240.5	5.64	4.92	4.20	3.59	3.04	2.50
6	955.3	1.41	1.23	1.06	.90	.76	.62	26	222.3	6.07	5.29	4.58	3.88	3.29	2.70
7	819.0	1.65	1.44	1.24	1.05	.89	.73								

TABLE XI.
SHORT RADIUS CURVES

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

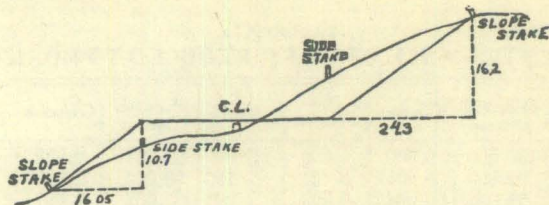
To find length of curve divide angle from P. C. to P. T. by central angle of chord, and multiply by length of chord.

TABLE XII.
INCLINED DISTANCE OF 100 FT. REDUCED TO HORIZONTAL

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

TABLE XIII.
MINUTES IN DECIMALS OF A DEGREE.

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



DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING.

SLOPE $1\frac{1}{2}$ TO 1. ROADWAY OF ANY WIDTH.

	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	0.00	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	0
1	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	1
2	3.00	3.15	3.30	3.45	3.60	3.75	3.90	4.05	4.20	4.35	2
3	4.50	4.65	4.80	4.95	5.10	5.25	5.40	5.55	5.70	5.85	3
4	6.00	6.15	6.30	6.45	6.60	6.75	6.90	7.05	7.20	7.35	4
5	7.50	7.65	7.80	7.95	8.10	8.25	8.40	8.55	8.70	8.85	5
6	9.00	9.15	9.30	9.45	9.60	9.75	9.90	10.05	10.20	10.35	6
7	10.50	10.65	10.80	10.95	11.10	11.25	11.40	11.55	11.70	11.85	7
8	12.00	12.15	12.30	12.45	12.60	12.75	12.90	13.05	13.20	13.35	8
9	13.50	13.65	13.80	13.95	14.10	14.25	14.40	14.55	14.70	14.85	9
10	15.00	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	10
11	16.50	16.65	16.80	16.95	17.10	17.25	17.40	17.55	17.70	17.85	11
12	18.00	18.15	18.30	18.45	18.60	18.75	18.90	19.05	19.20	19.35	12
13	19.50	19.65	19.80	19.95	20.10	20.25	20.40	20.55	20.70	20.85	13
14	21.00	21.15	21.30	21.45	21.60	21.75	21.90	22.05	22.20	22.35	14
15	22.50	22.65	22.80	22.95	23.10	23.25	23.40	23.55	23.70	23.85	15
16	24.00	24.15	24.30	24.45	24.60	24.75	24.90	25.05	25.20	25.35	16
17	25.50	25.65	25.80	25.95	26.10	26.25	26.40	26.55	26.70	26.85	17
18	27.00	27.15	27.30	27.45	27.60	27.75	27.90	28.05	28.20	28.35	18
19	28.50	28.65	28.80	28.95	29.10	29.25	29.40	29.55	29.70	29.85	19
20	30.00	30.15	30.30	30.45	30.60	30.75	30.90	31.05	31.20	31.35	20
21	31.50	31.65	31.80	31.95	32.10	32.25	32.40	32.55	32.70	32.85	21
22	33.00	33.15	33.30	33.45	33.60	33.75	33.90	34.05	34.20	34.35	22
23	34.50	34.65	34.80	34.95	35.10	35.25	35.40	35.55	35.70	35.85	23
24	36.00	36.15	36.30	36.45	36.60	36.75	36.90	37.05	37.20	37.35	24
25	37.50	37.65	37.80	37.95	38.10	38.25	38.40	38.55	38.70	38.85	25
26	39.00	39.15	39.30	39.45	39.60	39.75	39.90	40.05	40.20	40.35	26
27	40.50	40.65	40.80	40.95	41.10	41.25	41.40	41.55	41.70	41.85	27
28	42.00	42.15	42.30	42.45	42.60	42.75	42.90	43.05	43.20	43.35	28
29	43.50	43.65	43.80	43.95	44.10	44.25	44.40	44.55	44.70	44.85	29
30	45.00	45.15	45.30	45.45	45.60	45.75	45.90	46.05	46.20	46.35	30
31	46.50	46.65	46.80	46.95	47.10	47.25	47.40	47.55	47.70	47.85	31
32	48.00	48.15	48.30	48.45	48.60	48.75	48.90	49.05	49.20	49.35	32
33	49.50	49.65	49.80	49.95	50.10	50.25	50.40	50.55	50.70	50.85	33
34	51.00	51.15	51.30	51.45	51.60	51.75	51.90	52.05	52.20	52.35	34
35	52.50	52.65	52.80	52.95	53.10	53.25	53.40	53.55	53.70	53.85	35
36	54.00	54.15	54.30	54.45	54.60	54.75	54.90	55.05	55.20	55.35	36
37	55.50	55.65	55.80	55.95	56.10	56.25	56.40	56.55	56.70	56.85	37
38	57.00	57.15	57.30	57.45	57.60	57.75	57.90	58.05	58.20	58.35	38
39	58.50	58.65	58.80	58.95	59.10	59.25	59.40	59.55	59.70	59.85	39
40	60.00	60.15	60.30	60.45	60.60	60.75	60.90	61.05	61.20	61.35	40
41	61.50	61.65	61.80	61.95	62.10	62.25	62.40	62.55	62.70	62.85	41
42	63.00	63.15	63.30	63.45	63.60	63.75	63.90	64.05	64.20	64.35	42
43	64.50	64.65	64.80	64.95	65.10	65.25	65.40	65.55	65.70	65.85	43
44	66.00	66.15	66.30	66.45	66.60	66.75	66.90	67.05	67.20	67.35	44
45	67.50	67.65	67.80	67.95	68.10	68.25	68.40	68.55	68.70	68.85	45
46	69.00	69.15	69.30	69.45	69.60	69.75	69.90	70.05	70.20	70.35	46
47	70.50	70.65	70.80	70.95	71.10	71.25	71.40	71.55	71.70	71.85	47
48	72.00	72.15	72.30	72.45	72.60	72.75	72.90	73.05	73.20	73.35	48
49	73.50	73.65	73.80	73.95	74.10	74.25	74.40	74.55	74.70	74.85	49
50	75.00	75.15	75.30	75.45	75.60	75.75	75.90	76.05	76.20	76.35	50

Computed by L. Leland Locke.

876.20
11.69

887.89
0.88

887.01

90.34
87.02

3.32

887.01

7116
87.84

3.32

Dist b/w Hnd

1 1/4 11 June. N & T

2.0

4.0

Length

& cap to some 93 up.

85 10 0.6

100' = 80

200' 30

250' = 03

22

59

60

37

23

112

91.81
87.44
4.37

99
51.95
43

1.9

93

475

25
5/125

829.23
10.92
840.15

BLACK HAWK COUNTY
ENGINEER'S OFFICE
COURT HOUSE
WATERLOO, IOWA

4/13 1.33
3/4

3.9
904.01
3.27
900.74

121.70
9.01
12.03

103.91
7.45
96.46
5.29
101.75

1125
5/575
2.

901.75
13.50

88.25

901.75
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89.05

80
840.15
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839.87
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91.8
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103.9
11.858.94

12.6 3.21

855.73

11.79

867.52

8.65

858.87

2.83

861.70

12.52

849.18

1.12

850.30

13.04

837.26