45

KEUFFEL & ESSER CO.

DRAWING MATERIALS
AND
SURVEYING INSTRUMENTS.

NEW YORK.

CHICAGO. ST. LOUIS. SAN FRANCISCO. MONTREAL.

TABLES FOR EXCAVATIONS AND EMBANKMENTS.

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

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

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

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

45

Finder Please Return to
County Engineers Office
Court House
Waterloo Iowa.

Misc. Br. & Culv. Surveys 1923.

Eagle-Center-LaPorte Road Levels.

45

Br. and Culv. Surveys

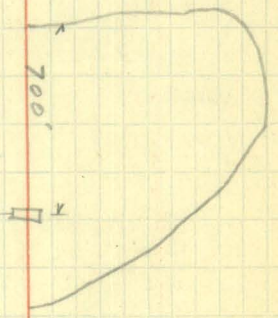
Culvert Survey
Black Hawk 26-35
Corr. pipe in center of mile

May 19, 1923.

B.M. 100.00 Nail in Transmission Pole N. side of Road

See Book 33 Page 59

Constr. 2x2x26 Parallel wings.



May 19, 1923

Eagle 11-12

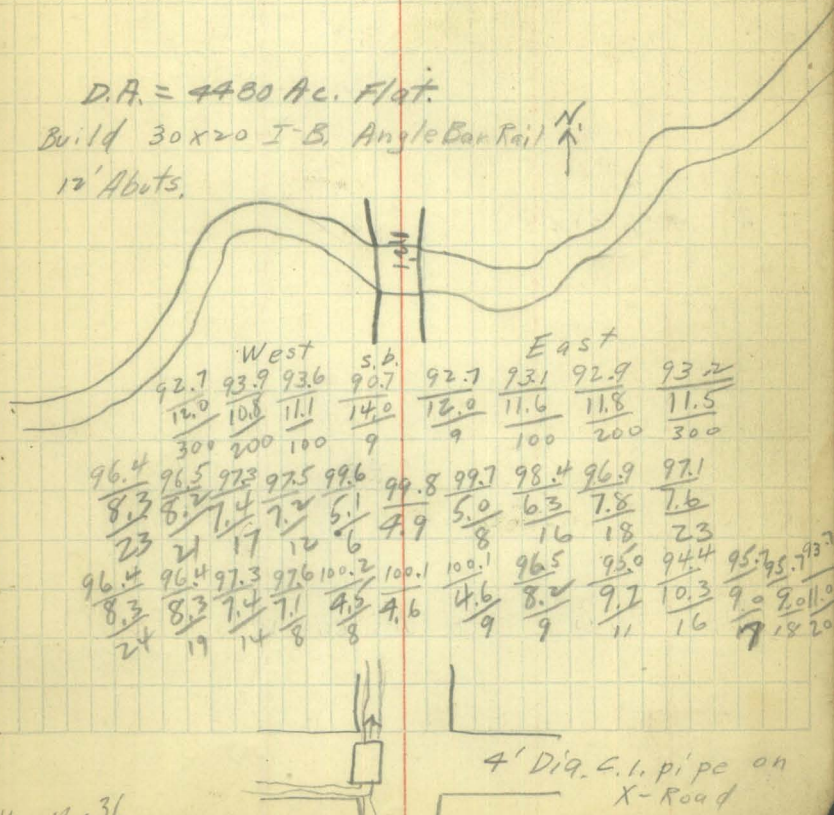
Just N. of South end about 400' d.s.
16'x16' Wood Br. in place
Proposed new ℄ of Br. to be 12'
N. of old Br. centerline.

Staked July 13, 1923

B.M.	4.70	104.70		100.00
300' South			5.5	99.2
200' "			5.2	99.5
100' South			5.4	99.3
℄ Br.			4.6	100.1
100' North			4.7	100.00
200' "			3.8	100.9
300 "			2.6	102.1
High water			6.6	98.1
Top of water			10.8	93.9

Spike on top of piling on End of N-W wing.

D.A. = 4480 Ac. Flat.
Build 30x20 I-B. Angle Bar Rail
12' Abuts.



Stream Profile

X-Sec. of Road 28' N. of Br. center

X-Sec. of Rd 9' S. of Br. center

Opening in Skewbr. = 132 □' Eagle 11-14.
Span at Rt. ∠ = 24'

4' Dia. C.I. pipe on X-Road

Use 13-36

Orange 14-23

E. of West end about 500'

Prop. ℄ of new br. at W. end of old wood Br.

		H.I.		
B.M.	5.67	105.67		100.00
300'			0.1	105.57
200'			3.2	102.5
100' East			4.2	101.5
℄ Br.			4.2	101.5
100' West			4.7	101.0
200' "			3.7	102.0
300' West			1.4	104.3
B.M.	6.28	106.28		100.00
			4.48	101.8

Stream Profile

X-Sec. 17' West of West end wood Br.

May 19, 1923 (3)

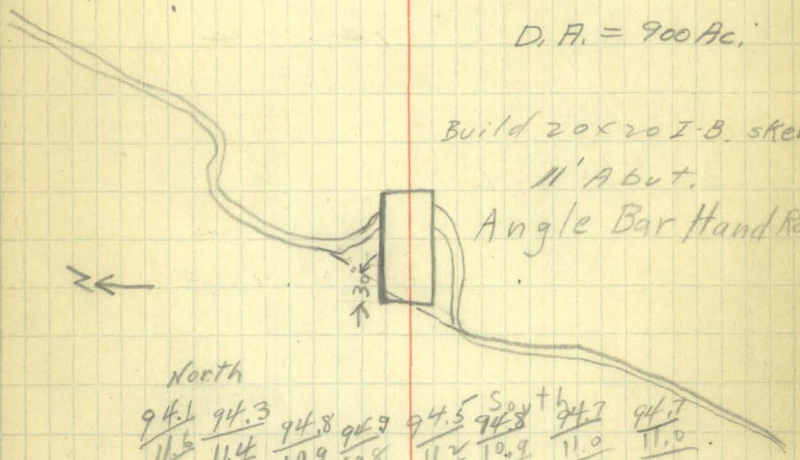
2 Spans

40' Wood Trestle in place

Build 20'x20' skew 30°-60°

Nail in Trans. pole N. of West end of Br.

D. A. = 900 Ac.



94.1	94.3	94.8	94.9	94.5	94.8	94.7	94.7	
11.5	11.4	10.9	10.8	11.2	10.9	11.0	11.0	
300	200	100	8	8	100	200	300	
99.1	98.9	100.9		101.5	98.6	96.5	95.2	
6.6	6.8	4.8		4.2	7.1	9.2	10.5	
20	13	8		4.2	6	12	17	18

Use B-39

Orange 10-11

Broken down Sheet + Iron pipe about 3' dia.

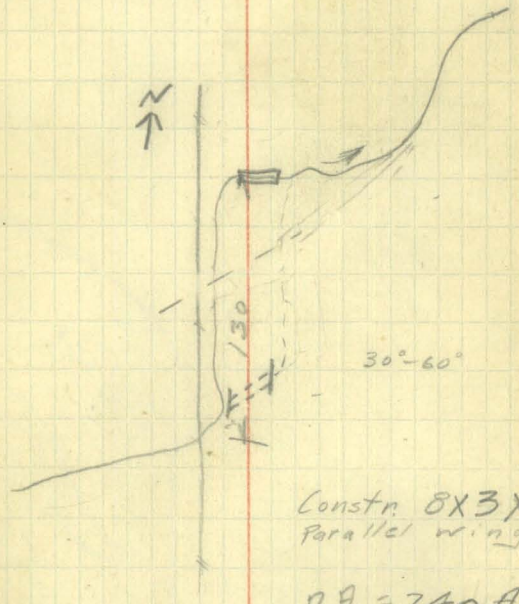
		H.I.			
B.M.	5.12	105.12		100.00	
300			2.9	102.2	
200			4.0	101.1	
100' South			4.6	100.5	
℄ culv.			4.7	100.4	Profile str.
100 North			5.1	100.0	
200 "			4.7	100.4	
300 North			4.2	100.9	

	5.4	105.40		100.00	
E. Hub	Cut 1.88 = 2'-10½"		6.22	99.18	96.3
W. Hub	Cut 2.75 = 2'-9"		6.05	99.35	96.6

about 300' South of N. Line

Nail in willow E. side of Rd. by culv.

97.5	97.4	96.9	96.7	96.3	99.7	100.1	96.3	95.8	94.9	94.6
7.6	7.7	8.2	8.4	8.8	5.4	5.0	8.8	9.3	10.2	10.6
300	200	100	16	11	10	10	12	100	200	300
				S.b.			S.b.			
				96.6			96.3			



Constn. 8X3X22 Skew. Parallel wings.

D.A. = 240 Ac. Rolling

Prop. skew with Parallel wings.

Benm 3-4

Conc. Culv. in N. end of Mile

Constr. 4 X 4 X 24 with

45° wings.

B.M.	5.00	105.00	100.00	
W. Hub	cut 1'-9½"	7.25	97.75	95.95
E. Hub	Cut 2'-0"	7.30	97.70	95.70

Old Culv.

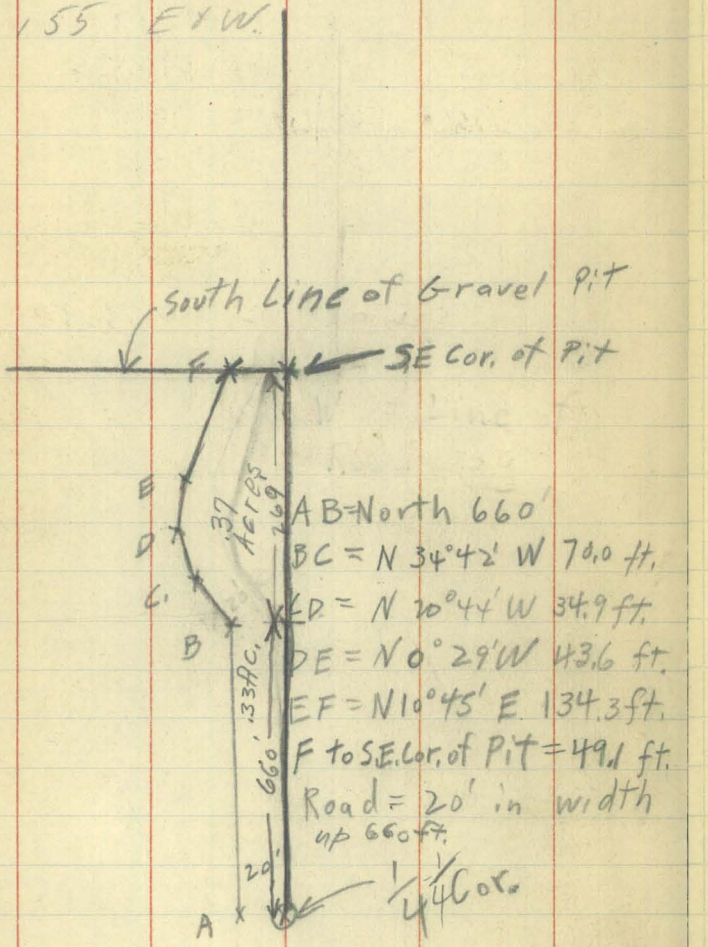
Nail in Cor. Post W. side of Road

West				East
96.4			100.1	
8.6	7.8		4.9	8.3
Fen.	Dit.			Dit.

96.2	95.9	100.7	95.85
8.8	9.10	4.3	9.15
1.6			
Ditch	F.L.		F.L.

F.O. Dunkerton
Gravel Pit
Lester Twp. Sec. 28

281 N & S.
155 E & W.



AB = North 660'
BC = N 34°42' W 70.0 ft.
CD = N 20°44' W 34.9 ft.
DE = N 0° 29' W 43.6 ft.
EF = N 10°45' E 134.3 ft.
F to S.E. Cor. of Pit = 49.1 ft.
Road = 20' in width up 660 ft.

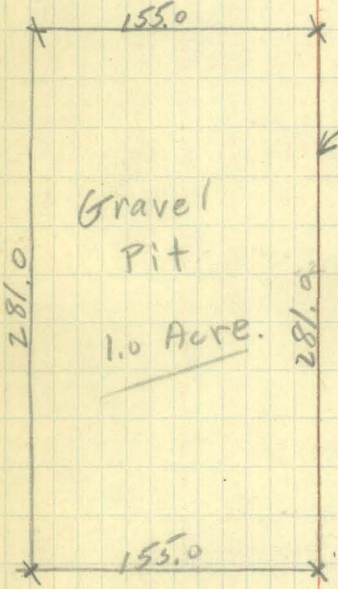
.70 Ac.
in Roadway.

269' N.
660' N.

E.B. Spencer
John Hayes

6

Thence Left 34° 42' 70.0 ft.
" Right 13° 58' 34.9 ft.
" 20° 15' 43.6 ft.
" 11° 14' 134.3 ft
to a point 49.1 ft. west of S-E Cor. of Pit



To 1/4 Cor. 928.0 ft.

5/31/23.

Mt. Vernon Sec. 25-36

B.M.	4.58	104.58		100.00
Profile				

Nail in Fence Post South end of Culv.

100' East $\frac{6.15}{\text{Ditch}}$

South

$\frac{97.53}{7.05}$ Ditch $\frac{98.23}{6.35}$ $\frac{99.78}{9.8}$ $\frac{97.43}{7.15}$

16

North

$\frac{10.2}{100}$ $\frac{13.2}{200}$

100' West $\frac{97.28}{7.3}$ Ditch

Cut 1'-0½" 97.2

96.9 Cut 0.53

Cut 6½"

Constr. 2x2x26

Parallel Wings

Built June 1923.

Lester 5-8

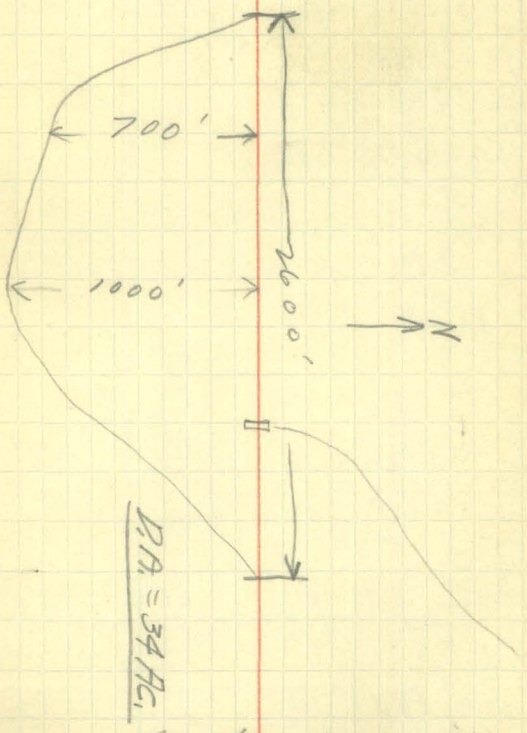
¼ mi. West of East end

B.M.	5.4	105.4		100.00	Nail in Tel. pole N. of Culv.
N. Hub.			7.0	98.4	97.2
S. Hub.			7.7	97.7	97.7

South

$\frac{99.2}{6.2}$ $\frac{99.1}{6.3}$ $\frac{97.3}{8.1}$ 5.1 $\frac{97.4}{8.0}$ North

100 E 100 W. 16 16

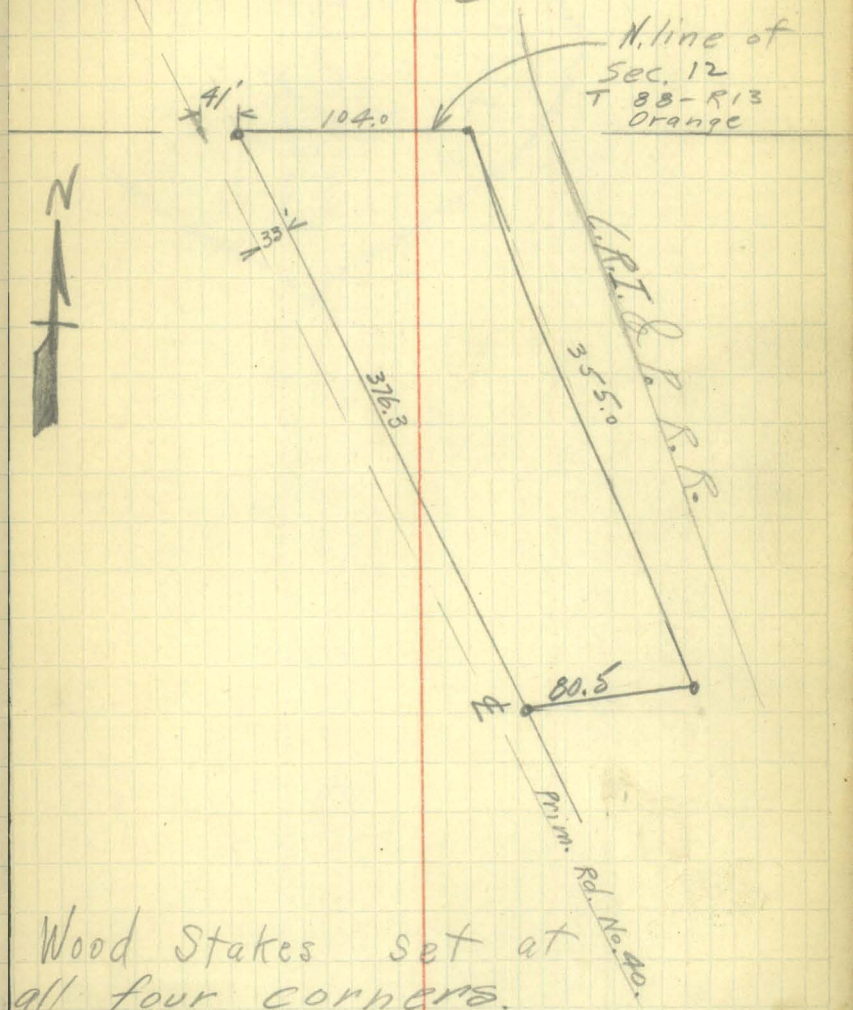


Constr. 3X2X22.

13.8 Cu. Yds.

May 21, 1923.

Borrow Pit to be condemned from Fred Murphy.



Wood Stakes set at all four corners.

Lincoln 25-26
46' Wood Br.
About ¼ mi from S. end

9' - Length of piling above ground
8½ - " " " "

ext. S. end 6'
" N. end 11'

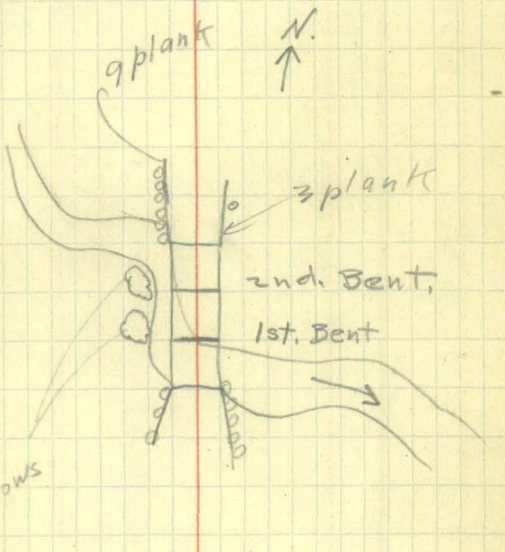
8 backing Plank N. Abut.
9 " " S. Abut.

8 Wing Plank 3 piling = S. W Wing

D. A. = 6000 Ac.

Opening Req.d = 272 □'

Lin. 29-30
1 new cap



120 new plank.

Garton Gravel Pit
N-W¼ Sec. 2 (Mt Vernon) T 90N, R 13W.
1 Acre Adjacent to Road.

Heirs of
T. H. Garton.

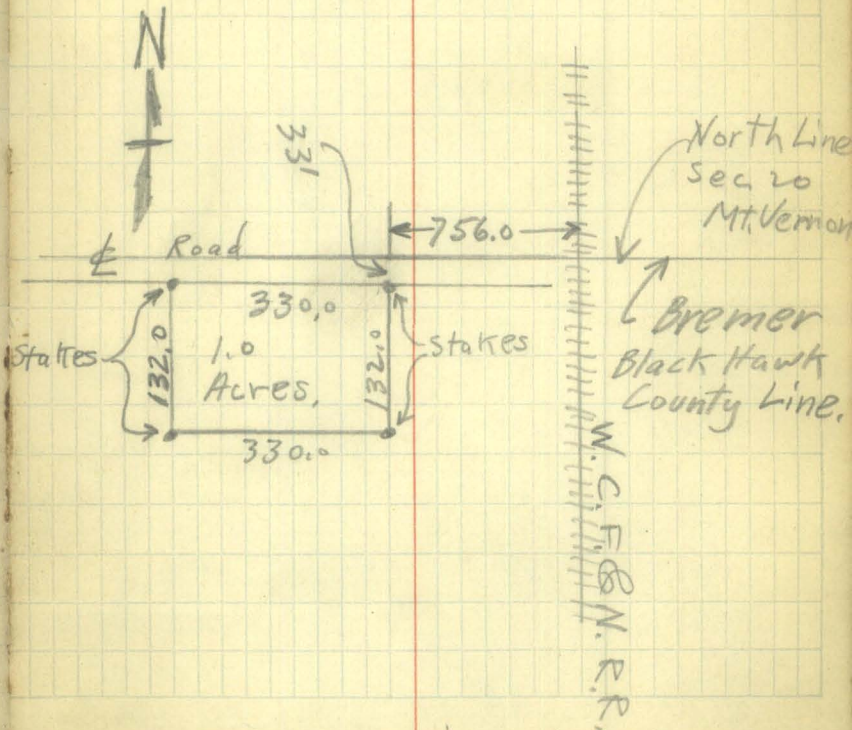
Fred Garton
Dell Freeman
Florence Squires
Nellie Hutton
Myrtle Cain
Agnes Briden
Joe Garton
William Garton

July 2, 1923.
E. B. Spencer
Burkhardt

Consideration
$400.00

20 year Lease

County to fence pit.



Item #9 June 30, 1923 Letting

12 x 6 x 30

℄ 167+07

					Grade →	Spk. in Poplar tree 100' Rt. of Sta. 170+54		
B.M.	3.84	900.75		896.91				
E. Hub			4.92	895.83	889.45	Cut	6.38	6'-4½"
W. Hub			9.58	890.17	889.75	Cut	1.42	1'-5"

4 Gr. 936.00

2 x 2 x 26

Item #10 Sta 204+38.5

B.M.	4.32	939.46		935.14	Sta 202+60 High point on Boulder near F. cor. Rt.
W. Ditch			7.5	931.96	
W. Hub.	Cut 0'-3"		7.22	932.24	932.00
E. Ditch			9.16	930.30	
~~E. Hub~~			~~6.12~~	~~933.34~~	930.3
East Fence			10.00	929.46	

3½ ft. extend East end.

.88 Cu. Yds.

Extra 0.5 Cu. Yds. Conc.

B.M.	4.21	939.35		935.14	
E. Hub	Cut 1.3 = 1'-4½"		7.75	931.60	930.3
			7.11	932.24	

3 X 2 X 2 Sta. 96 + 30.5

Item #8 (June 30, 1923 Contract)

893.38

B.M.	5.29	895.35		890.06	Top E. Hdwall Sta 88+85
W. Hub	Cut 0'-1"		4.96	890.39	890.3
W. Ditch			5.09	890.26	
E. Hub	Cut 1'-4"		4.02	891.33	890.00
E. Ditch			5.35	890.00	89

(Contract June 30, 1923)

Item #7 Extension 4' R. 6' Left Sta. 73+16

B.M.	4.59	897.16		892.57		Pike on top of Northwillow stump 40' west of ℄
W. Hub	Cut 0'-10½"		9.05	888.11	887.21	
W Floor			10.25	886.91		
E. Hub	Cut 0.93	Cut 0'-11"	9.30	887.86	886.9	
E. Floor			10.23	886.93		

(Contract June 30, 1923) 16

	Item #6		2.3 Rt. Ext.		3.7 Left Ext.
B.M.					
	Item #21				
B.M.	5.74	105.74		100.00	Nail in Tel. pole S. side Rd. East of Curve
N. Ditch			5.95		
N. Hub	Cut 0'-3"		6.00	99.74	99.50
S. Dit.			7.0	98.74	
S. Hub	Cut 0'-0"		6.5	99.24	99.25
℄ Rd.			3.8	101.94	

2X2X26

216+77

948.00

Item # 11

B.M.	5.10	950.87		945.77	
W. Hub	Cut 67 = 0'-8"		5.00	945.87	945.2
W Ditch			5.63	945.24	
E. Hub	Cut 44 = 0'-5"		5.65	945.22	944.8
E. Ditch			6.05	944.82	

Spike in root of Cotton tree near Fence Corner Rt. Sta. 210+20.

Item #4
2X2 x 26

Blk Hawk 26-35

July 23, 1923.

Nail in Transmission pole

B.M.	3.63	103.63		100.00	
N. Hub	Cut .41 = 5"		6.82	96.81	96.4
N. Ditch			7.03	96.60	
					96.15
Center Rd.			5.15	98.48	
S. Hub	Cut 0.5 = 6"		6.96	96.67	96.15
S. Ditch			7.3	96.33	

Item #12 2x2x26 232 + 98.5

B.M.	3.09	97146		968.37	
W. Hub	Cut 0'-5"		9.83	961.63	961.2
W. Ditch			10.38	961.08	
E. Hub	Cut 0'-5"		9.45	962.01	961.6
E. Ditch			9.77	961.69	

Sta. 237+12 Spike in Cor. Maple tree near by
Lt. Cor. Left.

Item	#13		2 x 2 x 26		
B.M.	2.27	975.28		973.01	
E. Hub	Cut	0'-0"	9.34	965.94	965.94
E. Ditch					
W. Hub	Cut 0.28 =	Cut 0'-3½"	8.50	966.78	966.5
W. Ditch			8.65	966.63	

Sta 246+65 — L, 966.0 RT, 965.5 — 20

Sta. 250+23 Spike in 1st. post on ¼-¼ Sec. Fence Left

Item #14 2x2x40

B.M.	5.11	962.80		957.69	
N. Ditch			8.5	954.3	
N. Hub	Cut 1.7 =	1'-8½"	6.35	956.45	954.75
S. Hub	Cut 0.81 =	0'-10"	6.79	956.01	955.2
S. Ditch			7.4	955.4	

Sta. 263+57, 958.6 N, 954.8 S, 955.2

Sta. 263+74 Spike in Compost

Item #18 Ext. N. End 6'

B.M.	5.04	942.87		937.83	X in South headwall Sta 366+43
S. F.L.			9.68	933.19	
N. F.L.			9.20	933.67	
	Cut 1.43 = 1'-5"		7.64	935.23	933.8

Item #17. Sta. 315+60

B.M.	4.62	934.82		930.20	Sta 315+30 High point on Boulder E. side of Twp. road 100' South
N. Hob	Cut 0.2	Cut 0'-2½"	7.37	927.45	927.2
N. Ditch			7.56	927.26	
S. Hob	Cut .51 = 0'-6"		7.46	927.36	926.8
S. Ditch			7.78	927.04	

Item #16. Sta. 300+86.5

B.M.	1.10	956.97		955.87	W. Cor. Walk Sta. 303+23
N. Hob	Cut 0.92 = 11"		7.25	949.72	948.8
N. Ditch			7.8	949.17	
S. Hob	Cut 0.67	0'-8"	7.90	949.07	948.4
S. Ditch			8.70	948.28	
E. Ditch			7.45	949.5	

Sta. 289+74

Item # 15

B.M.	5.06	967.77		962.91	
N. Ditch			7.55	960.42	
N. Hub	Cut 0.57 = 0'-7"		7.00	960.97	960.4
S. Hub	Cut 0.49 = 0'-6"		7.68	960.29	959.8
S. Ditch			8.30	959.67	959.8

2X2X26

962.7

959.7
959.8

Sta. 288+81 Spike in ¼ Sec. Cor. post Left.

Cedar Falls Sec. 21-22

B.M.	6.48	106.48		100.00	
300' East			5.3		
200' East			5.9		
100' East			6.2		
℄ Culv			5.1		
100' West			3.6		
200' "			1.4		
230' West			0.3		
B.M.	6.35	106.35		100.00	
S. Hub.	Cut 2.83 = 2'-10"		8.92	97.43	94.6
N. Hub	Cut 2.28 = 2'-3"		9.17	97.18	94.9

North end

Nail in Willow tree East of Culv. S. side Road.

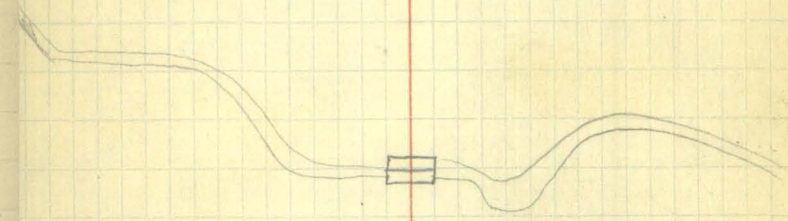
North South

94.7 95.0 101.4 94.9 94.6 94.6

0 10.8 11.1 11.8 11.5 5.7 5.1 6.2 11.6 11.9 11.9 12.5 12.9

0 200 100 25 13 9 9 11 25 100 200 300

F.L. F.L.



D.A. = 880 Ac.

Double Stone Slab Culv.
East Opening 4½ x 3½
West " 4½ x 4

about 46 yds.
Constr. 10 x 6 x 24

Cedar Falls Sec. 33-34

		105.5			
B.M.	5.45	105.45		100.00	
300' North			0.7		
200' North			2.3		
100' North			3.6		
℄ Culv			4.9		
100' South			5.1		
200' South			5.0		
300' South			3.6		
	5.14	105.14		100.00	
E. Hub	Cut 0.76 = 0'-9"		7.28	97.86	97.1
W. Hub	Cut 1.08 = 1'-01"		6.66	98.48	97.4

South end.

Nail in Tel. pole E. side of Rd. S. of Culv.

West					East		
		97.6		100.6		97.1	
6.0/200	6.4/100	7.9/10	5.1/9	4.9	5.9/9	8.4/10	8.9/30

D. ft. = 140 Ac. Flat

Stone Slab Culv. 2½ x 2

4 x 3 x 24

15.4 Cu. Yds.

Cedar Falls Sec. 34 - 4 Black Hawk West end.

B.M.	5.04	105.04		100.00	Nail in Tel. pole E. of Culv. W. Side Road.
300' West			0.3		
200' West			3.0		
100' West			4.9		
& Culv.			5.1		
100' East			5.6		
200' East			5.0		
300' East			3.5		
B.M.	5.1	105.10		100.00	
N. Hub	Cut 1.1	= 1'-1"	7.80	97.30	96.2
S. Hub	Cut 1.0	= 1'-0"	8.20	96.90	95.9

North

$\frac{7.5}{100}$ $\frac{97.0}{8.0}$ $\frac{96.3}{8.7}$ $\frac{99.9}{5.1}$

$\frac{8.0}{27}$ $\frac{8.7}{9}$ $\frac{5.1}{8}$ $\frac{5.5}{8}$

South

$\frac{95.9}{9.1}$ $\frac{96.4}{8.6}$ $\frac{8.7}{100}$ $\frac{9.0}{200}$

$\frac{9.1}{9}$ $\frac{8.6}{25}$

D.A. = 220 Ac. Flat.

Stone Slab = 3x4

Constr. 5X4X24

23.2 Cu. Yds.

Rainbow Drive

Cost of guard rail 1920

Total	784.35
Labor cost	254.30
Approx length	1736 feet.
" cost per foot	45¢

Item #20 10 x 8 x 22 (Contract June 30, 1923)

B.M.	5.2	105.20		100.00		Spike in Cor. Fence Post N-W. of old Br.
S. Hub			10.62	94.58	91.6	Cut 3'-0"
N. Hub			11.58	93.62	92.0	1'-7½"

Profile of Twp. Road between Sec. 10-15 Benn. Twp.

12			5.7	97.0
11			5.6	97.1
10			4.9	97.8
9			4.8	97.9
8			4.8	97.9
7			4.3	98.4
	4.90	102.69	5.67	97.79
6			5.8	97.7
5			5.6	97.9
4+14	38X16 wood		3.6	99.9
4			3.6	99.9
3			5.2	98.3
2+50	16X16 Wood Br.		4.4	99.1
2			5.5	98.0
1			5.3	98.2
0+00			4.4	99.1
B.M.	3.46	103.46		100.00

West end of Sec. 10-15 Benn. Twp.
1-E. Cor. of Cul. just S. of X Roads.

24			5.5	96.9
23			4.5	97.9
	4.05	102.38		
22+85	10x16 Wood		3.81	98.33
22			5.7	96.4
21			5.4	96.7
20			1.1	101.0
19+63	85x16 Wood		1.2	100.9
19			3.1	99.0
18			6.0	96.1
17			6.0	96.1
16			5.6	96.5
15			5.7	96.4
	5.40	102.14	5.95	96.74
14			6.1	96.6
13			5.4	97.3
		102.69		

Craig Creek

			3.29	99.91
	5.46	103.20	5.26	97.74
	6.22	103.00	5.47	96.78
T.P.	5.75	102.25	5.88	96.50
B.M.			2.94	99.44
26			4.5	97.9
25			5.3	97.1
		102.38		

Lincoln 8-9

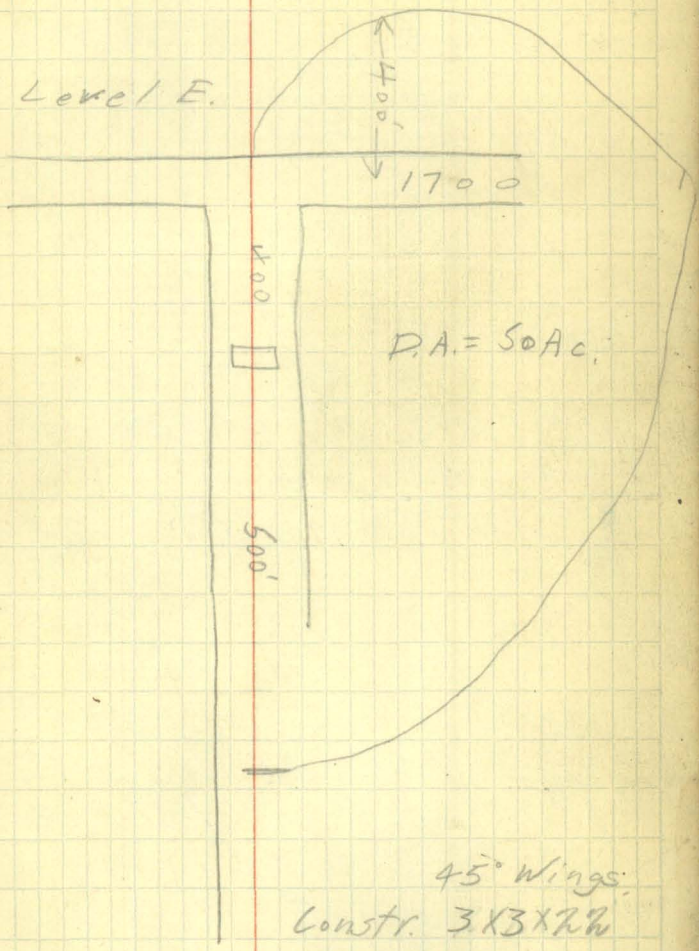
Material for New Wood Br.

12 Piling for Br.
3 Wing "
4 Backing S. end
6 " N. end
3 Caps
30 Plank in Floor
30 ~~13~~ Plank for Joists.

12 — 2x6x16
2 — 4x4x16
1 — 4x4x8

Cedar Falls 19-20
N. End.

B. M.	6.25	106.25		100.00	Nail in Fence Post just N. of Culv. W. side
			11.8		Water Level W.
			12.2		Fence
	Grade		11.2	95.05	95.00 W. Hub
			9.6		Water Level E.
	Cut 1'-0"		9.1	97.15	96.15 Hub E.



Com. at S.E. Cor. Sec. 26-88-12
382' West
157' to E. end Br.
239' " W " "
∠ 31° 42' Rt. = N 58° 18° W = 390'
∠ 58° 37' Rt. = = 933'
∠ 29° 39' Lt. = 225'
∠ 3° 51' Lt.

			10,2	92.2
13			4.6	
12			4.1	
11			5.0	97.4
10			5.1	97.3
9			4.7	97.7
8	6.5	102.4	4.1	95.9
7			2.1	97.9
6			3.1	96.9
5			5.4	
4			7.2	
3			7.9	
2			8.4	
1			8.7	
0			8.8	91.2
		100.00		

Co-Road Paving to Raymond.

Electric

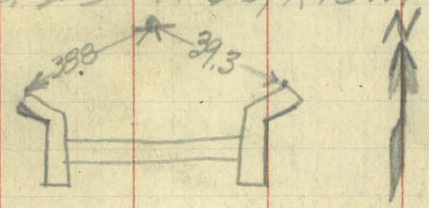
Gilbert Road #298.
10 rod jog in Sec. 25-89-12
Follow Sec. line
Road 4 rds. wide

4 rod Road #186
between Sec. 35-36-89-12

Ties for Cor. Stone at S-W Cor.
of Sec. 25 T 88, R12.
Elm 20" N45°E. 74.5'
Elm 18" N45°W 71.5'
N.E. Cor. School 145.3'

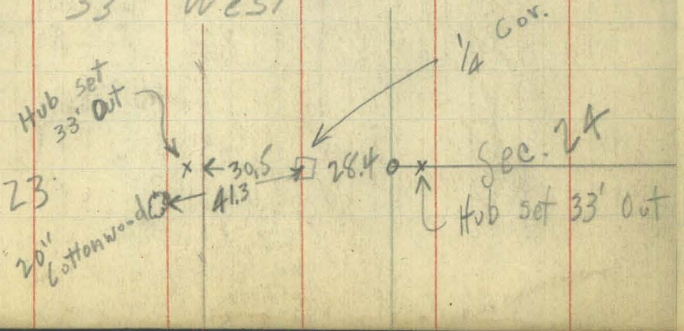
Ties for Cor. Stone SE Cor.
of Sec. 23 T. 89, R12W.

℄ paving



Sec. 26 Sec. 25

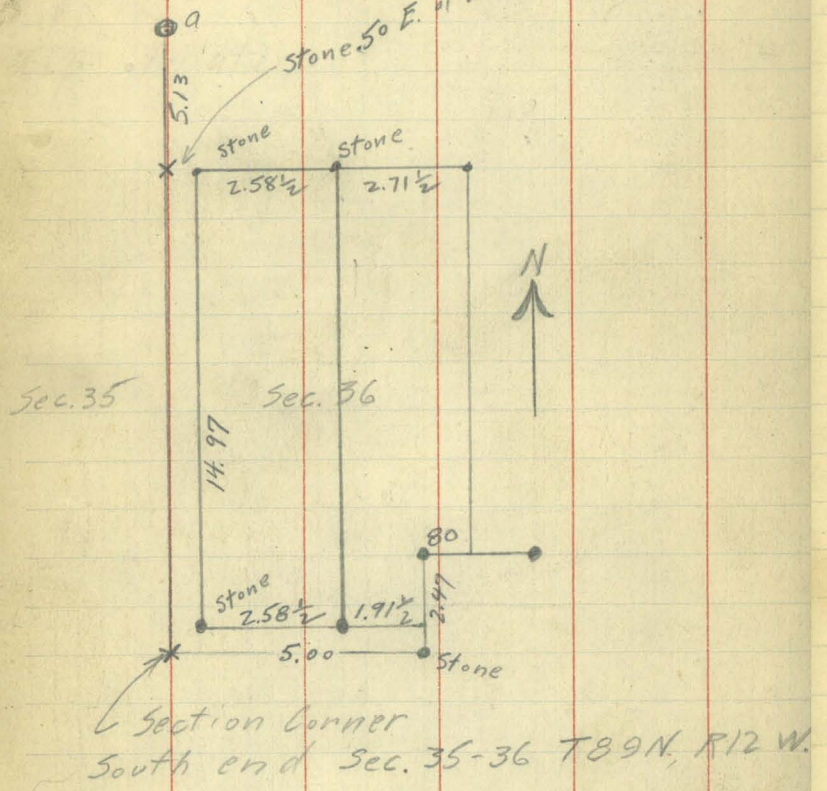
Ties for Center Sec. 23-24-89-1
S 80°W 41.3' to 20" Cotton Wo
West Fence Out 30.5'
East Cor. Post 28.4'
Hub 33' East
" 33' West

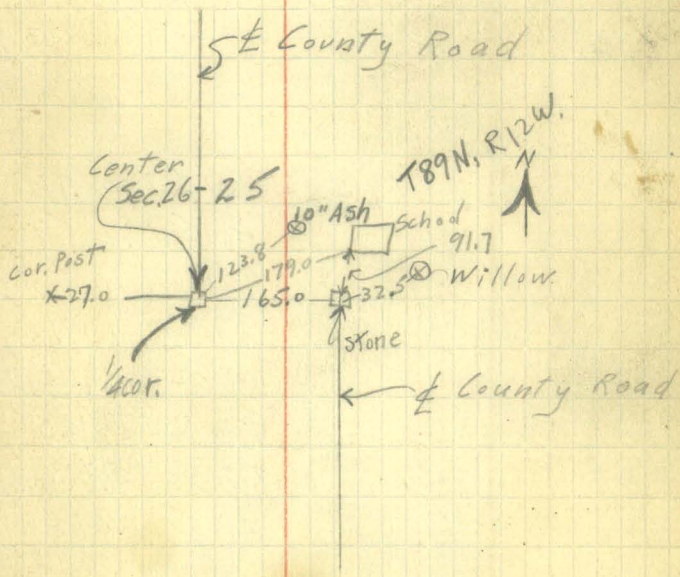


See W. W. Hewitt
Raymond.

Located 12/3/23
42' SW to Cor. Fence Post
46' SE to Cor. Fence Post

Center 35-36 T89N. R12W.


a
stone .50 E. of Line
5.13
stone
stone
2.58½
2.71½
N
Sec. 35
Sec. 36
14.97
80
stone
2.58½
1.91½
2.47
5.00
stone
℄ Section Corner
South end Sec. 35-36 T89N, R12W.

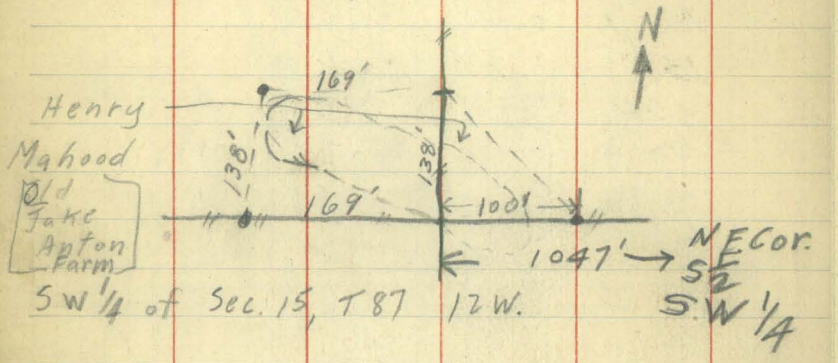

℄ County Road
Center
Sec. 26-25
T89N, R12W.
10" Ash
School
91.7
Cor. Post
27.0
123.8
179.0
165.0
32.5
Willow
Stone
¼ Cor.
℄ County Road

8" Tile Lester Twp. Ro... Lester Sec. 2-11 E.B. Spencer V. Budke

			Hub	Hub Elev.	D. to				
B.M.			3.41	99.98		Nail in Corner Fence Post			
18			2.27	101.12	3.4	9.0	97.44		3.68
17			3.65	99.74	4.2	8.2	96.64		3.10
16			4.81	98.58	5.7	7.7	95.84		2.74
15			5.83	97.56	7.0	7.4	95.04	0.8%	2.52
14			7.02	96.37	8.2	7.2	94.24		2.13
13	6.88	103.39	2.82	96.51	4.3	5.0	93.44		3.07
12			3.24	96.09	5.4	3.9	92.64		3.45
11			4.57	94.76	6.5	2.8	91.64	1.0%	3.12
10			5.43	93.90			90.64		3.26
9			6.30	93.03			89.64		3.39
8			6.48	92.85			88.64		4.21
Culv. F.L.					10.00	9.33			
7+30	6.59	99.33	3.95	92.74			88.41		4.33
6+90			4.15	92.54			88.28		4.26
6			6.16	90.53	7.8	8.9	87.98		2.55
5			5.73	90.96	7.7	9.0	87.65	0.3%	3.31
4			6.82	89.87	8.0	8.7	87.32		2.56
3			7.68	89.01	8.8	7.9	86.99		2.02
2			8.33	88.36	10.0	6.7	86.66		1.70
1			8.85	87.84	10.5	6.2	86.33		1.51
0			8.23	88.46			86.0		2.46 Outlet in Culvert
Top Water			11.10	85.59		5.6			
B.M.	7.89	96.69		88.80		Center West Head wall R.C.B.			

Henry Mahood Pit NE¼, SW¼ Sec. 15-87-12 Mullen-Newton Pit

West side 138'
South " 169'



SW¼ of Sec. 15, T87 12W.

Estimate 2400 Cu. Yds. Gravel.

Area = 0.695 Acres

About 15 rods south of NE Cor. of Sec. 13 Eagle Twp. along West side of road.

2' stripping
8' gravel
150' along road
50' wide

Eagle Center - La Porte Co. Road

T.P.	1.30	892.52	12.53	891.22
171			9.4	894.4
170		903.8	3.8	900.0
T.P.	2.19	903.75	11.98	901.56
169			9.3	904.2
168		913.5	4.1	909.4
T.P.	1.92	913.54	4.14	911.62
167			1.5	914.3
166+65			0.6	915.2
166			1.5	914.3
165			4.9	910.9
164			7.5	908.3
163		915.8	9.4	906.4
T.P.	11.71	915.76	0.54	904.05
162			0.5	904.1
161		899.3 899.2	2.9	901.7
160+34 Culv.		5.3 5.4 Lt. Rt	3.5	901.1
160+00		904.6	4.9	899.7
B.M. 18	2.57	904.59	2.57	902.02
	12.19	904.59	0.33	892.40
	12.29	892.73	0.43	880.44
	11.77	880.87	2.27	869.10
B.M. #19			4.67	866.10
	5.94	871.37	3.40	865.43
B.M. #20	4.83	868.83		864.00

on Top S-W Wing Pony Truss: Millers Creek

B.M. #23			4.22	896.51
T.P.	13.00	900.73	0.49	887.73
B.M. #22	7.16	888.22	7.16	881.06
T.P.	7.22	888.22	7.66	881.00
	2.58	888.66	12.49	886.08
	0.21	898.57	8.65	898.36
	10.42	907.01	0.20	896.59
B.M. #21	12.75	996.79	0.12	884.04
	12.00	984.16	1.35	872.16
T.P.	7.21	973.51	3.98	866.30
B.M. #20	6.28	970.28		864.00

B.M. #16			0.85	909.77
179			7.8	902.8
T.P.	10.85	910.62	2.20	899.77
178			2.2	899.8
177			4.9	897.1
176		902.0	8.5	893.5
T.P.	9.98	901.97	0.53	891.99
175			3.2	889.3
174			53	887.2
B.M. #17	881.0	881.8	6.28	886.24
173 +64 Culv.	11.5 Lt.	0.7 Rt.	5.7	886.8
173			5.2	887.3
172			2.8	889.1
		892.52		

X on S. Headwall Culv. Sta. 105+00

Nail in Elec. Pole N. side of Br. About Sta. 109

Nail in Fence Post at Fence Intersection Lt. About Sta. 128

T.P.	0.03	916.95	11.65	916.92	Nail in Tel. pole
T.P.	1.42	928.57	3.95	927.15	
T.P.	6.77	931.10	2.75	924.33	
T.P.	4.23	927.08	1.10	922.85	
B.M. #27	10.06	923.95	10.06	913.89	on S. Headwall C/L. Sta. 72+16
B.M. #26	2.12	923.95	4.84	921.83	Nail in Elec. Pole Rt. of Sta. 75
T.P.	6.82	926.67	0.60	919.85	
B.M. #25	3.73	920.45	3.73	916.72	on S. Headwall About Sta. 85
T.P.	3.41	920.45	12.43	917.04	
T.P.	1.35	929.47	7.95	928.12	
T.P.	10.97	936.07	0.60	925.10	
B.M. #24	12.72	925.70		912.98	
B.M. #20			6.27	864.07	
	3.89	870.34	7.04	866.45	
T.P.	1.65	873.49	12.66	871.84	
B.M. #21	0.37	884.50	13.11	884.18	
	0.57	897.24	8.27	896.67	
	11.69	904.94	0.51	893.25	
T.P.	8.97	893.76	1.69	884.79	
B.M. #22	5.39	886.48	11.01	881.09	
T.P.	0.49	892.10	11.31	891.61	
B.M. 23			6.39	896.53	
	0.07	902.92	10.59	902.85	
B.M. 24	0.46	913.44	0.46	912.98	Nail in Elec. Pole Rt. of Sta. 100+00
	12.89	913.44	0.22	900.55	
		900.77			

6+50			2.8	941.9
6			2.9	941.8
5+27	939.7 / 5.5 / Lt.	939.6 / 5.1 / Rt.	3.2	941.5
T.P.	3.05	944.72	9.90	941.67
5			10.0	941.6
4			8.8	942.8
3			6.2	945.4
2+50			4.6	947.0
2			5.0	946.6
1+23	Culv.	944.4 / 7.2 / Lt. 944.5 / 7.1 / Rt.	4.5	947.1
1			4.4	947.2
0+00		951.6	4.1	947.5
B.M.#31	3.27	951.57	3.27	948.30
T.P.	6.24	951.57	0.49	946.33
T.P.	7.10	946.82	5.19	939.72
T.P.	2.76	944.91	3.26	942.15
T.P.	11.75	945.41	0.42	933.66
T.P.	11.76	934.08	0.50	922.32
B.M.#30	7.97	922.82	5.61	914.85
T.P.	1.31	920.46	6.85	919.15
T.P.	7.80	926.00	0.90	918.20
T.P.	10.36	919.10	4.45	908.74
B.M.#29			4.33	908.86
	0.16	913.19	12.46	913.03
T.P.	6.06	925.49	0.25	919.43
T.P.	8.36	919.68	5.63	911.32
B.M.#28			2.93	914.02
		916.95		

2" X 30' Corr. pipe

[illegible] on S. Headwall Culv. Sta. 1+23.

~~on S. Headwall Culv. Sta. 1+23.~~

[illegible] on S. Headwall Culv. Sta. 22+47.

5.8 on S. Headwall Culv. Sta. 39+11

[illegible] on S. Headwall Culv. Sta. 53+24

25			6.0	915.2
24			7.5	913.7
23		921.2	7.6	913.6
B.M. #30	6.38	921.23	9.14	914.85
22+47 Cor.	909.3 / 14.7 / 2+	906.5 / 15.5 / Rt.	10.2	913.8
22			9.8	914.2
21			8.8	915.2
20			7.2	916.8
19		924.0	4.8	919.2
T.P.	1.04	923.99	12.82	922.95
18			13.2	922.5
17			8.7	927.0
16			4.2	931.6
T.P.	1.60	935.77	12.70	934.17
15			10.8	936.1
14			6.6	940.3
13			3.8	943.1
12+52			2.9	944.0
12		946.9	3.1	943.8
T.P.	5.60	946.87	3.45	941.27
11			3.4	941.3
10			5.4	939.3
9			5.8	938.9
8+90	7.9 Lt.	7.5 Rt.	5.9	938.8
8			5.7	939.0
7			3.8	940.9
		944.72		

9.3 / 5.1 / 14.7 — 9.4 / 6.4 / 15.5

" X 30 Corr. Pipe

See Page 46

T.P.	1.59	922.95	2.24	921.36
44+42			0.0	923.6 ✓
44			1.0	922.6 ✓
43			6.7	916.9 ✓
T.P.	10.70	923.60	0.48	912.90
42			2.1	911.3 ✓
41			5.1	908.3 ✓
40			6.1	907.3 ✓
B.M.#29	9046 / 9.8	9047 ✓ / 9.2	4.50	908.88 ✓
39+11 Culv.	4	RT.	6.0	907.4 ✓
39		9134	5.9	907.5 ✓
T.P.	5.04	913.38	10.51	908.34
38			11.0	907.8 ✓
37			9.8	909.0 ✓
36			8.0	910.8 ✓
35			5.3	913.5 ✓
34			3.0	915.8 ✓
33			2.0	916.8 ✓
T.P.	0.45	918.85	7.79	918.40
32			7.8	918.4 ✓
31			6.3	919.9 ✓
30			5.5	920.7 ✓
29			5.4	920.8 ✓
28			4.2	922.0 ✓
27		926.✓	2.6	923.6 ✓
T.P.	5.70	926.19	0.74	920.49
26			2.3	918.9 ✓
		921.73		

Jan. 7, 1924

Main Yard Nov. 13, 1923

74 - 16' & 18' piling
25 - 24' "
58 - 20' - 24' - 26' Big Pile of p

Est. Value = $568.00

Inventory at E. Waterloo Yards.

Est. Value	
432.35	221 - 3" x 12" x 16' plank
63.35	14 - 8" x 10" x 16' caps
48.60	3 - 12" x 20' Corr.
23.60	1 - 15" x 20' "

64			3.7	923.4
T.P.	3.03	927.12	7.70	924.09
63			7.1	924.7
62			5.9	925.9
61			5.6	926.2
60			5.1	926.7
5.9			3.9	927.9
58			3.6	928.2
T.P.	7.13	931.79	0.20	924.66
57			1.3	923.6
56			6.8	918.1
55			10.2	914.6
54			12.2	912.6
B.M.#28	10.80	924.86	2.25	914.06
53+24 Culv.	91.09 − 6.1 Ft.	91.09 − 5.9 Ft.	4.1	912.2
53	909.1	909.1	4.4	911.9
52+19 Culv	902 Ft.	7.2 Ft.	5.1	911.2
52			5.2	911.1
51			5.2	911.1
50			5.1	911.2
T.P.	4.57	916.31	11.21	911.74
49			11.4	911.5
48			10.6	912.3
47			8.8	914.1
46			5.6	917.3
45			1.9	921.0
		922.95		

916.82

B.M.#24			10.51	912.12
	1.96	922.63	11.21	720.67
	0.55	931.88	2.40	931.33
T.P.	8.81	933.73	0.35	924.92
B.M.#25	9.43	925.27	7.83	915.84
T.P.	3.90	923.67	7.46	919.77
79+43.5			7.46	919.8
79			6.8	920.4
78			4.9	922.3
77			1.9	925.3
76+75			1.7	925.5
76			4.2	923.0
75			8.8	918.4
T.P.	12.56	927.23	7.49	914.67
74			7.5	914.7
73			9.3	912.9
B.M.#27	9.19	922.16	9.19	912.97
72+16	Calv.	910.8 / 11.8 Lt. — 909.9 / 12.3 Rt.	9.0	913.2
72			9.0	913.2
71			7.3	914.9
70		922.2	3.3	918.9
T.P.	1.84	922.16	6.80	920.32
69			3.6	923.5
68			4.5	922.6
67			5.2	921.9
66+24	921.3 / 5.8 Lt.	920.7 / 0.4 Rt.	5.3	921.8
66			5.3	921.8
65		927.1	4.7	922.4
		927.12		

12" x 26' Corr. pipe

E-C Road to La Ponte City

B.M. #27			11.34	913.97
	1.77	925.31	3.16	923.54
	1.98	926.70	6.15	924.72
	3.60	930.87	4.91	927.37
	11.19	932.28	0.33	921.09
B.M. #28	7.36	921.42		914.06

Diff. = 0.09

on So Headwall Culv. Sta. 53+24

Henry Hoppe Tile

Carl Hebell
Route #5
La Porte City.

A 4+75			1.73	112.68	110.05	2.68	2'-8 1/4"
A 4			2.80	111.61	108.69	3.01	3'-0"
A 3			4.12	110.29	107.21	3.09	3'-1"
A 2+50	Jct.		4.78	109.63	106.54	3.13	3'-1 1/2"
A 2			5.23	109.18	106.25	2.93	2'-11"
A 1+75	Jct.		5.30	109.11	106.19	2.99	3'-0"
A 1	Jct.		5.28	109.13	105.75	3.38	3'-4 1/2"
A 0		114.41			105.25	3.01	3'-0"
10+75			1.76	112.65	109.45	3.20	3'-2 1/2"
10			3.51	110.90	107.95	2.95	2'-11 1/2"
9			4.65	109.76	106.95	2.81	2'-10"
8			5.65	108.76	105.95	2.81	2'-10"
7			5.72	108.69	105.60	3.09	3'-1"
6	Jct.		6.15	108.26	105.25	3.01	3'-0"
5		6.25	4.08	108.16	104.90	3.26	3'-3"
4			3.82	108.42	104.55	3.87	3'-10 1/2"
3			3.55	108.69	104.24	4.49	4'-6"
2			4.28	107.96	103.85	4.11	4'-1 1/2"
1			6.68	105.56	101.75	3.81	3'-9 3/4"
0+00			9.97	102.27	99.62	2.62	2'-7 1/2"
B.M.	12.24	12.24		100.00			p. of 4" Tile

1.0% | 2.0% | 0.35% | 2.10%

33
05
38

1075
475
200
200
175

16.5 | 2125 | 129
165

475
95

B.M.			12.98	99.99			
	4.81	112.97	6.25	108.16			
D1+75			1.21	113.20	110.0	3.20	3'-2½"
D1			3.09	111.32	108.5 0%	2.82	2'-10"
D0					106.5		
C2			1.42	112.99	109.6	3.35	3'-4¼"
C1			3.88	110.53	107.8 76%	2.65	2'-7¾"
C0					106.1		
B2			1.65	112.76	109.6	3.11	3'-1¼"
B1			3.82	110.59	107.75%	2.89	2'-10¾"
B0		114.41			105.7		

.1. 3
6
.78

Garling Private Tile

Spring Creek Sec. 4. Sept. 7, 1923.

Chas L. Garling

7+60			0.65	107.88	104.68	3.20	= 3'-2½"	
7+00			1.41	107.12	103.9	3.22	= 3'-2¾"	
6+00			3.09	105.44	102.6	2.84	= 2'-10"	
B.M.	8.53	108.53		100.00				
5+00			0.50	104.62	101.3	3.32	= 3'-4"	ϕ
4+00			2.80	102.32	99.3	3.02	3'-0¼"	
3+00			5.36	99.76	97.3	2.46	2'-5½"	
2+00			6.76	98.36	95.3	3.06	3'-0¾"	ϕ
1+50			5.86	99.26	95.05	4.21	4'-2½"	
1+00			8.00	97.12	94.8	2.32	2'-4"	
0+00			9.78	95.34	94.3	1.04	1'-0½"	
			6.8					
			1.5				Rock	
			7.7				√ end of Culv.	
B.M.	5.12	105.12		100.00			Nail in Tel pole	

			8.53	99.95				
	1.93	108.48	12.05	106.55				
A 9+00			2.31	116.29	112.8		3.49 = 3'-6"	
A 8+00			5.20	113.40	110.8	1.0%	2.6 = 2'-7¼"	
	6.85	118.60						
A 7+00			2.27	111.75	108.8		2.95	2'-11½"	
A 6+00			4.17	109.85	106.8		3.05	3'-0½"	℄
A 5+00			5.83	108.19	105.3	1.0	2.89	2'-10¾"	
A 4+00			7.44	106.58	103.8		2.78	2'-9¼"	
A 3+00			8.75	105.27	102.3	1	2.97	2'-11½"	℄
T.P.	11.40	114.02	2.50	102.62		3.0%			
A 2+00			2.50	102.62	99.3		3.32	3'-4"	
A 1+00			5.46	99.66	96.3		3.36	3'-4¼"	℄
A 0+50			6.50	98.62	95.8	1.0%	2.82	2'-10"	
A 0+00				98.36	95.3				℄
	5.12	105.12		100.00					

KEITH'S RAILROAD CURVE TABLES.

Published by KEUFFEL & ESSER CO., New York.

HOW TO USE KEITH'S TABLES.

EXAMPLE.

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P.=23° 20′ to the R. at Station 542+72.

Ext. in Tab. IV opposite 23° 20′=120.87
120.87÷12=10.07. Say a 10° Curve.

Tan. in Tab. IV opp. 23° 20′=1183.1
1183.1÷10=118.31.

Tab. V. correction for A. 23° 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° 20′=23.33°÷10=2.3333=L. C.

2° 19½′=def. for sta.	542	I. P. =sta.	542+72
4° 49½′= " " "	+50	Tan.=	1.18.47
7° 19½′= " " "	543	B. C.=sta.	541+53.53
9° 49½′= " " "	+50	L. C.=	2.33.33
11° 40′= " " "	543+	E. C.=sta.	543+86.86
	86.86		

100—53.53=46.47×3′(def. for 1 ft. of 10° Cur.)=139.41′=
2° 19½′ =def. for sta. 542.

Def. for 50 ft.=2° 30′ for a 10° Curve.

Def. for 36.86 ft.=1° 50½′ for a 10° Curve

(These tables are published in Field Books of KEUFFEL & ESSER Co., New York, N. Y.)

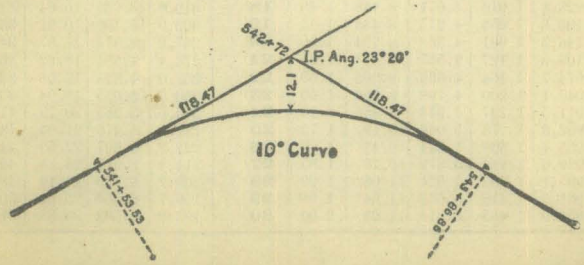


Table I. — Minutes in Decimals of a Degree.

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

Table II. — Inches in Decimals of a Foot.

1-16	3-32	1/8	3-16	1/4	5-16	3/8	1/2	5/8	3/4	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

Table III. — Radii, Ordinates and Deflections.

Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foo
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	\	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

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
1°	50.00	.22	11°	551.70	26.50	21°	1061.9	97.57
10′	58.34	.30	10′	560 11	27.31	10′	1070.6	99.16
20	66.67	.39	20	568.53	28.14	20	1079.2	100.75
30	75.01	.49	30	576.95	28.97	30	1087.8	102.35
40	83.34	.61	40	585.36	29.82	40	1096.4	103.97
50	91.68	.73	50	593.79	30.68	50	1105.1	105.60
2	100.01	.87	12	602.21	31.56	22	1113.7	107.24
10	108.35	1.02	10	610.64	32.45	10	1122.4	108.90
20	116.68	1.19	20	619.07	33.35	20	1131.0	110.57
30	125.02	1.36	30	627.50	34.26	30	1139.7	112.25
40	133.36	1.55	40	635.93	35.18	40	1148.4	113.95
50	141.70	1.75	50	644.37	36.12	50	1157.0	115.66
3	150.04	1.96	13	652.81	37.07	23	1165.7	117.38
10	158.38	2.19	10	661.25	38.03	10	1174.4	119.12
20	166.72	2.43	20	669.70	39.01	20	1183.1	120.87
30	175.06	2.67	30	678.15	39.99	30	1191.8	122.63
40	183.40	2.93	40	686.60	40.99	40	1200.5	124.41
50	191.74	3.21	50	695.06	42.00	50	1209.2	126.20
4	200.08	3.49	14	703.51	43.03	24	1217.9	128.00
10	208.43	3.79	10	711.97	44.07	10	1226.6	129.82
20	216.77	4.10	20	720.44	45.12	20	1235.3	131.65
30	225.12	4.42	30	728.90	46.18	30	1244.0	133.50
40	233.47	4.76	40	737.37	47.25	40	1252.8	135.35
50	241.81	5.10	50	745.85	48.34	50	1261.5	137.23
5	250.16	5.46	15	754.32	49.44	25	1270.2	139.11
10	258.51	5.83	10	762.80	50.55	10	1279.0	141.01
20	266.86	6.21	20	771.29	51.68	20	1287.7	142.93
30	275.21	6.61	30	779.77	52.89	30	1296.5	144.85
40	283.57	7.01	40	788.26	53.97	40	1305.3	146.79
50	291.92	7.43	50	796.75	55.13	50	1314.0	148.75
6	300.28	7.86	16	805.25	56.31	26	1322.8	150.71
10	308.64	8.31	10	813.75	57.50	10	1331.6	152.69
20	316.99	8.76	20	822.25	58.70	20	1340.4	154.69
30	325.35	9.23	30	830.76	59.91	30	1349.2	156.70
40	333.71	9.71	40	839.27	61.14	40	1358.0	158.72
50	342.08	10.20	50	847.78	62.38	50	1366.8	160.76
7	350.44	10.71	17	856.30	63.63	27	1375.6	162.81
10	358.81	11.22	10	864.82	64.90	10	1384.4	164.86
20	367.17	11.75	20	873.35	66.18	20	1393.2	166.95
30	375.54	12.29	30	881.88	67.47	30	1402.0	169.04
40	383.91	12.85	40	890.41	68.77	40	1410.9	171.15
50	392.28	13.41	50	898.95	70.09	50	1419.7	173.27
8	400.66	13.99	18	907.49	71.42	28	1428.6	175.41
10	409.03	14.58	10	916.03	72.76	10	1437.4	177.55
20	417.41	15.18	20	924.58	74.12	20	1446.3	179.72
30	425.79	15.80	30	933.13	75.49	30	1455.1	181.89
40	434.17	16.43	40	941.69	76.86	40	1464.0	184.08
50	442.55	17.07	50	950.25	78.26	50	1472.9	186.29
9	450.93	17.72	19	958.81	79.67	29	1481.8	188.51
10	459.32	18.38	10	967.38	81.09	10	1490.7	190.74
20	467.71	19.06	20	975.96	82.53	20	1499.6	192.99
30	476.10	19.75	30	984.53	83.97	30	1508.5	195.25
40	484.49	20.45	40	993.12	85.43	40	1517.4	197.53
50	492.88	21.16	50	1001.7	86.90	50	1526.3	199.82
10	501.28	21.89	20	1010.3	88.39	30	1535.3	202.12
10	509.68	22.62	10	1018.9	89.89	10	1544.2	204.44
20	518.08	23.38	20	1027.5	91.40	20	1553.1	206.77
30	526.48	24.14	30	1036.1	92.92	30	1562.1	209.12
40	534.89	24.91	40	1044.7	94.46	40	1571.0	211.48
50	543.29	25.70	50	1053.3	96.01	50	1580.0	213.86

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
31°	1589.0	216.3	**41°**	2142.2	387.4	**51°**	2732.9	618.4
10′	1598.0	218.7	10′	2151.7	390.7	10′	2743.1	622.8
20	1606.9	221.1	20	2161.2	394.1	20	2753.4	627.2
30	1615.9	223.5	30	2170.8	397.4	30	2763.7	631.7
40	1624.9	226.0	40	2180.3	400.8	40	2773.9	636.2
50	1633.9	228.4	50	2189.9	404.2	50	2784.2	640.7
32	1643.0	230.9	**42**	2199.4	407.6	**52**	2794.5	645.2
10	1652.0	233.4	10	2209.0	411.1	10	2804.9	649.7
20	1661.0	235.9	20	2218.6	414.5	20	2815.2	654.3
30	1670.0	238.4	30	2228.1	418.0	30	2825.6	658.8
40	1679.1	241.0	40	2237.7	421.4	40	2835.9	663.4
50	1688.1	243.5	50	2247.3	425.0	50	2846.3	668.0
33	1697.2	246.1	**43**	2257.0	428.5	**53**	2856.7	672.7
10	1706.3	248.7	10	2266.6	432.0	10	2867.1	677.3
20	1715.3	251.3	20	2276 2	435.6	20	2877.5	682.0
30	1724.4	253.9	30	2285.9	439.2	30	2888.0	686.7
40	1733.5	256.5	40	2295.6	442.8	40	2898.4	691.4
50	1742.6	259.1	50	2305.2	446.4	50	2908.9	696.1
34	1751.7	261.8	**44**	2314.9	450.0	**54**	2919.4	700.9
10	1760.8	264.5	10	2324.6	453.6	10	2929.9	705.7
20	1770.0	267.2	20	2334.3	457.3	20	2940.4	710.5
30	1779.1	269.9	30	2344.1	461.0	30	2951.0	715.3
40	1788.2	272.6	40	2353.8	464.6	40	2961.5	720.1
50	1797.4	275.3	50	2363.5	468.4	50	2972.1	725.0
35	1806.6	278.1	**45**	2373.3	472.1	**55**	2982.7	729.9
10	1815.7	280.8	10	2383.1	475.8	10	2993.3	734.8
20	1824.9	283.6	20	2392.8	479.6	20	3003.9	739.7
30	1834.1	286.4	30	2402.6	483.8	30	3014.5	744.6
40	1843.3	289.2	40	2412.4	487.2	40	3025.2	749.6
50	1852.5	292.0	50	2422.3	491.0	50	3035.8	754.6
36	1861.7	294.9	**46**	2432.1	494.8	**56**	3046.5	759.6
10	1870.9	297.7	10	2441.9	498.7	10	3057.2	764.6
20	1880.1	300.6	20	2451.8	502.5	20	3067.9	769.7
30	1889.4	303.5	30	2461.7	506.4	30	3078.7	774.7
40	1898.6	306.4	40	2471.5	510.3	40	3089.4	779.8
50	1907.9	309.3	50	2481.4	514.3	50	3100.2	784.9
37	1917.1	312.2	**47**	2491.3	518.2	**57**	3110.9	790.1
10	1926.4	315.2	10	2501.2	522.2	10	3121.7	795.2
20	1935.7	318.1	20	2511.2	526.1	20	3132.6	800.4
30	1945.0	321.1	30	2521.1	530.1	30	3143.4	805.6
40	1954.3	324.1	40	2531.1	534.2	40	3154.2	810.9
50	1963.6	327.1	50	2541.0	538.2	50	3165.1	816.1
38	1972.9	330.2	**48**	2551.0	542.2	**58**	3176.0	821.4
10	1982.2	333.2	10	2561.0	546.3	10	3186.9	826.7
20	1991.5	336.3	20	2571.0	550.4	20	3197.8	832.0
30	2000.9	339.3	30	2581.0	554.5	30	3208.8	837.3
40	2010.2	342.4	40	2591.0	558.6	40	3219.7	842.7
50	2019.6	345.5	50	2601.1	562.8	50	3230.7	848.1
39	2029.0	348.6	**49**	2611.2	566.9	**59**	3241.7	853.5
10	2038.4	351.8	10	2621.2	571.1	10	3252.7	858.9
20	2047.8	354.9	20	2631.3	575.3	20	3263.7	864.3
30	2057.2	358.1	30	2641.4	579.5	30	3274.8	869.8
40	2066.6	361.3	40	2651.5	583.8	40	3285.8	875.3
50	2076.0	364.5	50	2661.6	588.0	50	3296.9	880.8
40	2085.4	367.7	**50**	2671.8	592.3	**60**	3308.0	886.4
10	2094.9	371.0	10	2681.9	596.6	10	3319.1	892.0
20	2104.3	374.2	20	2692.1	600.9	20	3330.3	897.5
30	2113.8	377.5	30	2702.3	605.3	30	3341.4	903.2
40	2123.3	380.8	40	2712.5	609.6	40	3352.6	908.8
50	2132 7	384.1	50	2722.7	614.0	50	3363.8	914.5

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
61°	3375.0	920.2	**71°**	4086.9	1308.2	**81°**	4893.6	1805.3
10′	3386.3	925.9	10′	4099.5	1315.6	10′	4908.0	1814.7
20	3397.5	931.6	20	4112.1	1322.9	20	4922.5	1824.1
30	3408.8	937.3	30	4124.8	1330.3	30	4937.0	1833.6
40	3420.1	943.1	40	4137.4	1337.7	40	4951.5	1843.1
50	3431.4	948.9	50	4150.1	1345.1	50	4966.1	1852.6
62	3442.7	954.8	**72**	4162.8	1352.6	**82**	4980.7	1862.2
10	3454.1	960.6	10	4175.6	1360.1	10	4995.4	1871.8
20	3465.4	966.5	20	4188.5	1367.6	20	5010.0	1881.5
30	3476.8	972.4	30	4201.2	1375.2	30	5024.8	1891.2
40	3488.3	978.3	40	4214.0	1382.8	40	5039.5	1900.9
50	3499.7	984.3	50	4226.8	1390.4	50	5054.3	1910.7
63	3511.1	990.2	**73**	4239.7	1398.0	**83**	5069.2	1920.5
10	3522.6	996.2	10	4252.6	1405.7	10	5084.0	1930.4
20	3534.1	1002.3	20	4265.6	1413.5	20	5099.0	1940.3
30	3545.6	1008.3	30	4278.5	1421.2	30	5113.9	1950.3
40	3557.2	1014.4	40	4291.5	1429.0	40	5128.9	1960.2
50	3568.7	1020.5	50	4304.6	1436.8	50	5143.9	1970.3
64	3580.3	1026.6	**74**	4317.6	1444.6	**84**	5159.0	1980.4
10	3591.9	1032.8	10	4330.7	1452.5	10	5174.1	1990.5
20	3603.5	1039.0	20	4343.8	1460.4	20	5189.3	2000.6
30	3615.1	1045.2	30	4356.9	1468.4	30	5204.4	2010.8
40	3626.8	1051.4	40	4370.1	1476.4	40	5219.7	2021.1
50	3638.5	1057.7	50	4383.3	1484.4	50	5234.9	2031.4
65	3650.2	1063.9	**75**	4396.5	1492.4	**85**	5250.3	2041.7
10	3661.9	1070.2	10	4409.8	1500.5	10	5265.6	2052.1
20	3673.7	1076.6	20	4423.1	1508.6	20	5281.0	2062.5
30	3685.4	1082.9	30	4436.4	1516.7	30	5296 4	2073.0
40	3697.2	1089.3	40	4449.7	1524.9	40	5311.9	2083.5
50	3709.0	1095.7	50	4463.1	1533.1	50	5327.4	2094.1
66	3720.9	1102.2	**76**	4476.5	1541.4	**86**	5343.0	2104.7
10	3732.7	1108.6	10	4489.9	1549.7	10	5358.6	2115.3
20	3744.6	1115.1	20	4503.4	1558.0	20	5374.2	2126.0
30	3756.5	1121.7	30	4516.9	1566.3	30	5389.9	2136.7
40	3768.5	1128.2	40	4530.4	1574.7	40	5405.6	2147.5
50	3780.4	1134.8	50	4544.0	1583.1	50	5421.4	2158.4
67	3792.4	1141.4	**77**	4557.6	1591.6	**87**	5437.2	2169.2
10	3804.4	1148.0	10	4571.2	1600.1	10	5453.1	2180.2
20	3816.4	1154.7	20	4584.8	1608.6	20	5469.0	2191.1
30	3828.4	1161.3	30	4598.5	1617.1	30	5484.9	2202.2
40	3840.5	1168.1	40	4612.2	1625.7	40	5500.9	2213.2
50	3852.6	1174.8	50	4626.0	1634.4	50	5517.0	2224.3
68	3864.7	1181.6	**78**	4639.8	1643.0	**88**	5533.1	2235.5
10	3876.8	1188.4	10	4653.6	1651.7	10	5549.2	2246.7
20	3889.0	1195.2	20	4667.4	1660.5	20	5565.4	2258.0
30	3901.2	1202.0	30	4681.3	1669.2	30	5581.6	2269.3
40	3913.4	1208.9	40	4695.2	1678.1	40	5597.8	2280.6
50	3925.6	1215.8	50	4709.2	1686.9	50	5614.2	2292.0
69	3937.9	1222.7	**79**	4723.2	1695.8	**89**	5630.5	2303.5
10	3950.2	1229.7	10	4737.2	1704.7	10	5646.9	2315.0
20	3962.5	1236.7	20	4751.2	1713.7	20	5663.4	2326.6
30	3974.8	1243.7	30	4765.3	1722.7	30	5679.9	2338.2
40	3987.2	1250.8	40	4779.4	1731.7	40	5696.4	2349.8
50	3999.5	1257.9	50	4793.6	1740.8	50	5713.0	2361.5
70	4011.9	1265.0	**80**	4807.7	1749.9	**90**	5729.7	2373.3
10	4024.4	1272.1	10	4822.0	1759.0	10	5746.3	2385.1
20	4036.8	1279.3	20	4836.2	1768.2	20	5763.1	2397.0
30	4049.3	1286.5	30	4850.5	1777.4	30	5779.9	2408.9
40	4061.8	1293.6	40	4864.8	1786.7	40	5796.7	2420.9
50	4074.4	1300.9	50	4879.2	1796.0	50	5813.6	2432.9

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
91°	5830.5	2444.9	**101°**	6950.6	3278.1	**111°**	8336.7	4386.1
10′	5847.5	2457.1	10′	6971.3	3294.1	10′	8362.7	4407.6
20	5864.6	2469.3	20	6992.0	3310.1	20	8388.9	4429.2
30	5881.7	2481.5	30	7012.7	3326.1	30	8415.1	4450.9
40	5898.8	2493.8	40	7033.6	3342.3	40	8441.5	4472.7
50	5916.0	2506.1	50	7054.5	3358.5	50	8468.0	4494.6
92	5933.2	2518.5	**102**	7075.5	3374.9	**112**	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
93	6037.8	2594.0	**103**	7203.2	3474.4	**113**	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
94	6144.3	2671.6	**104**	7333.6	3576.8	**114**	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
95	6252.8	2751.3	**105**	7467.0	3682.3	**115**	8992.8	4934.1
10	6271.1	2764.8	10	7489.6	3700.2	10	9022.7	4958.6
20	6289.4	2778.3	20	7512.2	3718.2	20	9051.7	4983.1
30	6307.9	2792.0	30	7534.9	3736.2	30	9080.9	5007.8
40	6326.3	2805.6	40	7557.7	3754.4	40	9110.3	5032.6
50	6344.8	2819.4	50	7580.5	3772.6	50	9139.8	5057.6
96	6363.4	2833.2	**106**	7603.5	3791.0	**116**	9169.4	5082.7
10	6382.1	2847.0	10	7626.6	3809.4	10	9199.1	5107.9
20	6400.8	2861.0	20	7649.7	3827.9	20	9229.0	5133.3
30	6419.5	2875.0	30	7672.9	3846.5	30	9259.0	5158.8
40	6438.4	2889.0	40	7696.3	3865.2	40	9289.2	5184.5
50	6457.3	2903.1	50	7719.7	3884.0	50	9319.5	5210.3
97	6476.2	2917.3	**107**	7743.2	3902.9	**117**	9349.9	5236.2
10	6495.2	2931.6	10	7766.8	3921.9	10	9380.5	5262.3
20	6514.3	2945.9	20	7790.5	3940.9	20	9411.3	5288.6
30	6533.4	2960.3	30	7814.3	3960.1	30	9442.2	5315.0
40	6552.6	2974.7	40	7838.1	3979.4	40	9473.2	5341.5
50	6571.9	2989.2	50	7862.1	3998.7	50	9504.4	5368.2
98	6591.2	3003.8	**108**	7886.2	4018.2	**118**	9535.7	5395.1
10	6610.6	3018.4	10	7910.4	4037.8	10	9567.2	5422.1
20	6630.1	3033.1	20	7934.6	4057.4	20	9598.9	5449.2
30	6649.6	3047.9	30	7959.0	4077.2	30	9630.7	5476.5
40	6669.2	3062.8	40	7983.5	4097.1	40	9662.6	5504.0
50	6688.8	3077.7	50	8008.0	4117.0	50	9694.7	5531.7
99	6708.6	3092.7	**109**	8032.7	4137.1	**119**	9727.0	5559.4
10	6728.4	3107.7	10	8057.4	4157.3	10	9759.4	5587.4
20	6748.2	3122.9	20	8082.3	4177.5	20	9792.0	5615.5
30	6768.1	3138.1	30	8107.3	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	6808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
100	6828.3	3184.1	**110**	8182.8	4259.7	**120**	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

Table V. Corrections for use with table IV,

For Tangents Add

Δ ANGLE / CURVE	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46
15°	.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.53	.58	.63	.68
20°	.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90
25°	.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14
30°	.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39
35°	.11	.22	.34	.47	.58	.69	.70	.81	.92	1.04	1.29	1.42	1.54	1.66
40°	.13	.26	.40	.53	.67	.80	.93	1.06	1.20	1.34	1.49	1.64	1.79	1.94
45°	.15	.30	.44	.60	.76	.91	1.06	1.21	1.37	1.52	1.70	1 87	2.04	2.21
50°	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.54	1.72	1.91	2.10	2.29	2.48
55°	.19	.38	.57	.76	.95	1.14	1.32	1.52	1.72	1 92	2.14	2.35	2.56	2.77
60°	.21	.42	.63	.84	1.05	1.27	1.49	1.71	1.94	2.17	2.38	2.60	2.83	3.07
65°	.23	.46	.69	.93	1.16	1.40	1.64	1.88	2.13	2.38	2 63	2.88	3.13	3.39
70°	.25	.51	.76	1.02	1.28	1.54	1.80	2.06	2.33	2.60	2.88	3.16	3.44	3.72
75°	.27	.56	.83	1.12	1.40	1.69	1.98	2.27	2.57	2.87	3.16	3.47	3.78	4.09
80°	.30	.61	.91	1.22	1.53	1.84	2.15	2.46	2.78	3.10	3.44	3.78	4.12	4.46
85°	.33	.66	1.00	1.33	1.68	2.02	2.36	2.70	3.05	3.40	3.77	4.14	4.55	4.89
90°	.36	.72	1.09	1.45	1.83	2.20	2.57	2.94	3.32	3.70	4.10	4.50	4.91	5.32
95°	.39	.79	1.19	1.55	2.00	2.40	2.80	3.20	3.61	4.02	4.40	4.98	5.38	5.83
100°	.43	.86	1.30	1.74	2.18	2.62	3.06	3 50	3.95	4.40	4.88	5.37	5.85	6 34

For Externals Add

ANGLE / CURVE	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.001	.003	.004	.006	.007	.008	.009	.011	.012	.014	.015	.017	.018	.020
15°	.003	.007	.010	.014	.018	.023	.027	.029	.032	.035	.039	.043	.047	.051
20°	.006	.011	.017	.022	.028	.034	038	.045	.051	.057	.063	.070	.076	.083
25°	.009	.018	.027	.036	.046	.056	.065	.074	.083	.093	106	.120	.127	.135
30°	.013	.025	.038	.051	.065	.078	.090	.103	.116	.129	.149	.170	.179	.188
35°	.018	.035	.054	.072	.086	.109	.131	.153	.175	.197	.213	.230	.247	.266
40°	.023	.045	.070	.093	.117	.141	.172	.203	.234	.265	.277	.290	.315	.341
45°	.030	.060	.093	.119	153	.184	.216	.254	.289	.325	.351	.378	.411	.445
50°	.037	.075	.116	.151	.189	.227	.266	.305	.345	.384	.425	.467	.508	.550
55°	.046	.093	.142	.188	.236	.283	.332	.381	.420	.479	.530	.582	.641	.700
60°	.056	.112	.168	.225	.283	.340	.398	.457	.516	.575	.636	697	.774	.851
65°	.067	.135	.204	.273	.343	.412	.483	.554	.625	.697	.711	.845	922	1.01
70°	.080	.159	.240	.321	.403	.485	.568	.652	.735	.819	.906	.994	1.08	1.17
75°	.095	.182	.286	.383	.480	.578	.678	.777	.877	977	1.07	1.18	1.29	1.39
80°	110	.220	.332	.445	.558	.671	.787	.903	1.02	1.13	1 25	1.38	1 50	1.62
85°	.128	.259	.391	.524	.657	.790	.926	1.06	1.20	1.34	1.47	1 62	1.76	1.91
90°	.149	.299	.450	.603	.756	.910	1.07	1.22	1.38	1.54	1.70	1.87	2.03	2.20
95°	.174	.350	.522	.706	.985	1.06	1.25	1.43	1.62	1.80	1 99	2.18	2.38	2.58
100°	.200	.401	.604	.809	1.01	1.22	1.43	1.64	1.85	2.06	2.28	2.50	2.73	2.96

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

Degree of Curve	Radius 50 / sin. def. ang.	½ sub chord / R = sin of def. angle 12.5 Ft.	15 Ft.	20 Ft	25 Ft.	Length of arc for 100 ft.
30°	193.18	1° 51′	2° 17′	2° 58′	3° 43′	101.15
32°	181.39	1° 59′	2° 25′	3° 10′	3° 58′	101.33
34°	171.01	2° 06′	2° 33′	3° 21′	4° 12′	101.48
36°	161.80	2° 13′	2° 41′	3° 33′	4° 26′	101.66
38°	153.58	2° 20′	2° 49′	3° 44′	4° 40′	101.85
40°	146.19	2° 27′	2° 57′	3° 55′	4° 54′	102.06
42°	139.52	2° 34′	3° 05′	4° 07′	5° 08′	102.29
44°	133 47	2° 41′	3° 13′	4° 18′	5° 22′	102.53
46°	127.97	2° 48′	3° 21′	4° 29′	5° 36′	102.76
48°	122.92	2° 55′	3° 29′	4° 40′	5° 50′	103.00
50°	118 31	3° 02′	3° 38′	4° 51′	6° 04′	103 24
52°	114 06	3° 09′	3° 46′	5° 02′	6° 17′	103 54
54°	110.11	3° 16′	3° 54′	5° 13′	6° 31′	103 84
56°	106.50	3° 22′	4° 02′	5° 23′	6° 44′	104.14
58°	103.14	3° 29′	4° 10′	5° 34′	6° 57′	104.43
60°	100.00	3° 35′	4° 18′	5° 44′	7° 11′	104.72

CURVE FORMULAS.

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

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

$\text{Sin. D} = \frac{50}{R}$

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

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

$R = \frac{50}{\text{Sin. D}}$

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

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

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

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

Tan. def. = ½ chord def

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

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

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

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

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

To find angle for a given distance and deflection.

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

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

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

Right Angle Triangles. Square the altitude, divide by twice the base Add quotient to base for hypotenuse.

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

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

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

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

Natural Sines

Deg.	0′	10′	20′	30′	40′	50′	Deg.	Deg.	0′	10′	20′	30′	40′	50′	Deg.
0	0000	0029	0058	0087	0116	0145	89	40	6428	6450	6472	6494	6517	6539	49
1	0175	0204	0233	0262	0291	0320	88	41	6561	6583	6604	6626	6648	6670	48
2	0349	0378	0407	0436	0465	0494	87	42	6691	6713	6734	6756	6777	6799	47
3	0523	0552	0581	0610	0640	0669	86	43	6820	6841	6862	6884	6905	6926	46
4	0698	0727	0756	0785	0814	0843	85	44	6947	6967	6988	7009	7030	7050	45
5	0872	0901	0929	0958	0987	1016	84	45	7071	7092	7112	7133	7153	7173	44
6	1045	1074	1103	1132	1161	1190	83	46	7193	7214	7234	7254	7274	7294	43
7	1219	1248	1279	1305	1334	1363	82	47	7314	7333	7353	7373	7392	7412	42
8	1392	1421	1449	1478	1507	1536	81	48	7431	7451	7470	7490	7509	7528	41
9	1564	1593	1622	1650	1679	1708	80	49	7547	7566	7585	7604	7623	7642	40
10	1736	1765	1794	1822	1851	1880	79	50	7660	7679	7698	7716	7735	7753	39
11	1908	1937	1965	1994	2022	2051	78	51	7771	7790	7808	7826	7844	7862	38
12	2079	2108	2136	2164	2193	2221	77	52	7880	7898	7916	7934	7951	7969	37
13	2250	2278	2306	2334	2363	2391	76	53	7986	8004	8021	8039	8056	8073	36
14	2419	2447	2476	2504	2532	2560	75	54	8090	8107	8124	8141	8158	8175	35
15	2588	2616	2644	2672	2700	2728	74	55	8192	8208	8225	8241	8258	8274	34
16	2756	2784	2812	2840	2868	2896	73	56	8290	8307	8323	8339	8355	8371	33
17	2924	2952	2979	3007	3035	3062	72	57	8387	8403	8418	8434	8450	8465	32
18	3090	3118	3145	3173	3201	3228	71	58	8480	8496	8511	8526	8542	8557	31
19	3256	3283	3311	3338	3365	3393	70	59	8572	8587	8601	8616	8631	8646	30
20	3420	3448	3475	3502	3529	3557	69	60	8660	8675	8689	8704	8718	8732	29
21	3584	3611	3638	3665	3692	3719	68	61	8746	8760	8774	8788	8802	8816	28
22	3746	3773	3800	3827	3854	3881	67	62	8829	8843	8857	8870	8884	8897	27
23	3907	3934	3961	3987	4014	4041	66	63	8910	8923	8936	8949	8962	8975	26
24	4067	4094	4120	4147	4173	4200	65	64	8988	9001	9013	9026	9038	9051	25
25	4226	4253	4279	4305	4331	4358	64	65	9063	9075	9088	9100	9112	9124	24
26	4384	4410	4436	4462	4488	4514	63	66	9135	9147	9159	9171	9182	9194	23
27	4540	4566	4592	4617	4643	4669	62	67	9205	9216	9228	9239	9250	9261	22
28	4695	4720	4746	4772	4797	4823	61	68	9272	9283	9293	9304	9315	9325	21
29	4848	4874	4899	4924	4950	4975	60	69	9336	9346	9356	9367	9377	9387	20
30	5000	5025	5050	5075	5100	5125	59	70	9397	9407	9417	9426	9436	9446	19
31	5150	5175	5200	5225	5250	5275	58	71	9455	9465	9474	9483	9492	9502	18
32	5299	5324	5348	5373	5398	5422	57	72	9511	9520	9528	9537	9546	9555	17
33	5446	5471	5495	5519	5544	5568	56	73	9563	9572	9580	9588	9596	9605	16
34	5592	5616	5640	5664	5688	5712	55	74	9613	9621	9628	9636	9644	9652	15
35	5736	5760	5783	5807	5831	5854	54	75	9659	9667	9674	9681	9689	9696	14
36	5878	5901	5925	5948	5972	5995	53	76	9703	9710	9717	9724	9730	9737	13
37	6018	6041	6065	6088	6111	6134	52	77	9744	9750	9757	9763	9769	9775	12
38	6157	6180	6202	6225	6248	6271	51	78	9781	9787	9793	9799	9805	9811	11
39	6293	6316	6338	6361	6383	6406	50	79	9816	9822	9827	9833	9838	9843	10
Deg.	60′	50′	40′	30′	20′	10′	Deg.	Deg.	60′	50′	40′	30′	20′	10′	Deg.

Deg.	0′	10′	20′	30′	40′	50′	Deg.
80	9848	9853	9858	9863	9868	9872	9
81	9877	9881	9886	9890	9894	9899	8
82	9903	9907	9911	9914	9918	9922	7
83	9925	9929	9932	9936	9939	9942	6
84	9945	9948	9951	9954	9957	9959	5
85	9962	9964	9967	9969	9971	9974	4
86	9976	9978	9980	9981	9983	9985	3
87	9986	9988	9989	9990	9992	9993	2
88	9994	9995	9996	9997	9997	9998	1
89	9998	9999	9999	9999	1.0000	1.0000	0
Deg.	60′	50′	40′	30′	20′	10′	Deg.

Natural Cosines

Natural Tangents

deg.	0′	10′	20′	30′	40′	50′	deg.	deg.	0′	10′	20′	30′	40′	50′	deg.
0	0000	0029	0058	0087	0116	0145	89	40	8391	8441	8491	8541	8591	8642	49
1	0175	0204	0233	0262	0291	0320	88	41	8693	8744	8796	8847	8899	8952	48
2	0349	0378	0407	0437	0466	0495	87	42	9004	9057	9110	9163	9217	9271	47
3	0524	0553	0582	0612	0641	0670	86	43	9325	9380	9435	9490	9545	9601	46
4	0699	0729	0758	0787	0816	0846	85	44	9657	9713	9770	9827	9884	9942	45
5	0875	0904	0934	0963	0992	1022	84	45	1.0000	1.0058	1.0117	1.0176	1.0235	1.0295	44
6	1051	1080	1110	1139	1169	1198	83	46	1.0355	1.0416	1.0477	1.0533	1.0599	1.0661	43
7	1228	1257	1287	1317	1346	1376	82	47	1.0724	1.0786	1.0850	1.0913	1.0977	1 1041	42
8	1405	1435	1465	1495	1524	1554	81	48	1.1106	1.1171	1.1237	1.1303	1.1369	1.1436	41
9	1584	1614	1644	1673	1703	1733	80	49	1.1504	1.1571	1.1640	1.1708	1.1778	1.1847	40
10	1763	1793	1823	1853	1883	1914	79	50	1.1918	1 1988	1.2059	1.2131	1.2203	1.2276	39
11	1944	1974	2004	2035	2065	2095	78	51	1.2349	1.2423	1.2497	1.2572	1.2647	1.2723	38
12	2126	2156	2186	2217	2247	2278	77	52	1.2799	1.2876	1.2954	1.3032	1.3111	1.3190	37
13	2309	2339	2370	2401	2432	2462	76	53	1.3270	1.3351	1.3452	1.3514	1.3597	1 3680	36
14	2493	2524	2555	2586	2617	2648	75	54	1.3764	1.3848	1.3934	1.4019	1.4106	1.4193	35
15	2679	2711	2742	2773	2805	2836	74	55	1.4281	1.4370	1.4460	1.4550	1.4641	1.4733	34
16	2867	2899	2931	2962	2994	3026	73	56	1.4826	1.4919	1.5013	1.5108	1.5204	1.5301	33
17	3057	3089	3121	3153	3185	3217	72	57	1 5399	1.5497	1.5597	1 5697	1 5798	1.5900	32
18	3249	3281	3314	3346	3378	3411	71	58	1.6003	1.6107	1.6212	1.6319	1.6426	1.6534	31
19	3443	3476	3508	3541	3574	3607	70	59	1.6643	1 6753	1.6864	1.6977	1.7090	1 7205	30
20	3640	3673	3706	3739	3772	3805	69	60	1.7321	1.7437	1.7556	1.7675	1.7797	1.7917	29
21	3839	3872	3906	3939	3973	4006	68	61	1.8040	1.8165	1.8291	1.8418	1.8546	1.8676	28
22	4040	4074	4108	4142	4176	4210	67	62	1.8807	1.8940	1.9074	1.9210	1.9347	1.9486	27
23	4245	4279	4314	4348	4383	4417	66	63	1.9626	1.9768	1.9912	2.0057	2.0204	2.0353	26
24	4452	4487	4522	4557	4592	4628	65	64	2.0503	2.0655	2.0809	2.0965	2.1123	2.1283	25
25	4663	4699	4734	4770	4806	4841	64	65	2 1445	2.1609	2.1775	2 1943	2.2113	2.2286	24
26	4877	4913	4950	4986	5022	5059	63	66	2.2460	2.2637	2.2817	2.2998	2.3183	2.3369	23
27	5095	5132	5169	5206	5243	5280	62	67	2.3559	2.3750	2.3945	2.4142	2.4342	2.4545	22
28	5317	5354	5392	5430	5467	5505	61	68	2.4751	2.4960	2.5172	2.5386	2.5605	2.5826	21
29	5543	5581	5619	5658	5696	5735	60	69	2.6051	2 6279	2.6511	2.6746	2.6985	2.7228	20
30	5774	5812	5851	5890	5930	5969	59	70	2.7475	2.7725	2 7980	2.8239	2.8502	2.8770	19
31	6009	6048	6088	6128	6168	6208	58	71	2.9042	2.9319	2 9600	2.9887	3.0178	3.0475	18
32	6249	6289	6330	6371	6412	6453	57	72	3.0777	3 1084	3.1397	3.1716	3.2041	3.2371	17
33	6494	6536	6577	6619	6661	6703	56	73	3.2709	3 3052	3.3402	3.3759	3.4124	3.4495	16
34	6745	6787	6830	6873	6916	6959	55	74	3.4874	3.5261	3 5656	3.6059	3.6470	3.6891	15
35	7002	7046	7089	7133	7177	7221	54	75	3.7321	3.7760	3.8208	3.8657	3.9136	3.9617	14
36	7265	7310	7355	7400	7445	7490	53	76	4.0108	4.0611	4.1126	4.1653	4.2193	4.2747	13
37	7536	7581	7627	7673	7720	7766	52	77	4 3315	4.3897	4.4494	4.5107	4.5736	4.6382	12
38	7813	7860	7907	7954	8002	8050	51	78	4 7046	4.7729	4.8430	4.9152	4.9894	5.0658	11
39	8098	8146	8195	8243	8292	8342	50	79	5 1446	5.2257	5,3093	5.3955	5.4845	5.5764	10
deg.	60′	50′	40′	30	20′	10′	deg.	deg.	60′	50′	40′	30′	20′	10′	deg.

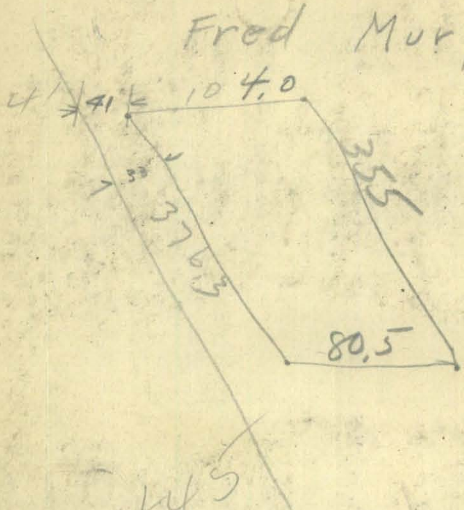
deg.	0′	10′	20′	30′	40′	50′	deg.
80	5.6713	5 7694	5.8708	5 9758	6.0844	6.1970	9
81	6 3138	6.4348	6 5606	6.6912	6.8269	6.9682	8
82	7.1154	7 2687	7.4287	7.5958	7.7704	7.9530	7
83	8.1443	8 3450	8.5555	8.7769	9.0098	9.2553	6
84	9.5144	9 7882	10.078	10.385	10.711	11.059	5
85	11.430	11.826	12.250	12.706	13.197	13.727	4
86	14.300	14.924	15.605	16.350	17.169	18.075	3
87	19.081	20.206	21.470	22.903	24.542	26.432	2
88	28.636	31.242	34.368	38.189	42.964	49.104	1
89	57.290	68 750	85.940	114.588	171.885	343.77	0
deg.	60′	50′	40′	30′	20′	10′	deg.

Natural Cotangents

41 East

376.3

Fred Murphy



281
155
1405
1405
281
43555

97.73
95.93
1.80

1'-9½"

1. 10°-74
24
933.67 10°45
19
931.00
40.0
24 48
.02

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

Roadway 14 feet wide. Side Slopes 1½ to 1.

For Single Track Embankment.

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

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

4.80

33 10½
13 58
20° 44
15
29'

MADE IN GERMANY.