

PRELIMINARY JUNE 1920

DIETZGEN

ENGINEERS'
FIELD BOOK

No. 404

27

EUGENE DIETZGEN CO.

DRAWING MATERIALS, MATHEMATICAL and
SURVEYING INSTRUMENTS

Chicago New York San Francisco New Orleans Pittsburg Toronto

Distances from Center of Roadway for Cross-Sectioning
Roadway 16 feet wide. Side Slopes 1 on 1.
For Single Track Embankment.

II	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	H
0	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	0
1	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	1
2	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	2
3	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	3
4	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	4
5	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	5
6	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	6
7	15.0	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	7
8	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	8
9	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	9
10	18.0	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	10
11	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	11
12	20.0	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	12
13	21.0	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9	13
14	22.0	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	14
15	23.0	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	15
16	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	16
17	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	17
18	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	18
19	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	19
20	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	20
21	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	21
22	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	22
23	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.8	31.9	23
24	32.0	32.1	32.2	32.3	32.4	32.5	32.6	32.7	32.8	32.9	24
25	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8	33.9	25
26	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	26
27	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	27
28	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.7	36.8	36.9	28
29	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7	37.8	37.9	29
30	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8	38.9	30
31	39.0	39.1	39.2	39.3	39.4	39.5	39.6	39.7	39.8	39.9	31
32	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.7	40.8	40.9	32
33	41.0	41.1	41.2	41.3	41.4	41.5	41.6	41.7	41.8	41.9	33
34	42.0	42.1	42.2	42.3	42.4	42.5	42.6	42.7	42.8	42.9	34
35	43.0	43.1	43.2	43.3	43.4	43.5	43.6	43.7	43.8	43.9	35
36	44.0	44.1	44.2	44.3	44.4	44.5	44.6	44.7	44.8	44.9	36
37	45.0	45.1	45.2	45.3	45.4	45.5	45.6	45.7	45.8	45.9	37
38	46.0	46.1	46.2	46.3	46.4	46.5	46.6	46.7	46.8	46.9	38
39	47.0	47.1	47.2	47.3	47.4	47.5	47.6	47.7	47.8	47.9	39
40	48.0	48.1	48.2	48.3	48.4	48.5	48.6	48.7	48.8	48.9	40

Example—If point is 22.6 ft. above grade, how far should it be from center line to be a slope stake point? Ans. from Table 30.6. For same slopes but other widths of roadbed, correct above figures by one-half difference in width of roadbed; thus in example above, for 20 ft. roadbed distance will be $30.6 + (20 - 16) \div 2$ or 2 ft. added to 28.6 = 32.6. For slopes of 1 on 1½ see inside of back cover.

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45.5
Preliminary June 1920

27

Property of
County Engineers Office
Court House
Waterloo Iowa

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607 2-23-00

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Entered 1922 CRST

Old Engel Gravel Pit.

Commencing 445.5 ft ^{and 33' S} E_A of N¹/₄
Cor Sec 18 T 88 R 14

Thence E 8 rods.

Thence S 10 rods

Thence W 8 rods

Thence N 10 rods

Total area $\frac{1}{2}$ A.

Flickinger Gravel Pit.

Commencing 1295 ft. W of N¹/₄ Cor and 33'
S of N¹/₄ Cor Sec 19 - T 88 - R 13 W

Thence W 198'

S 110'

E 198'

N 110'

Total area $\frac{1}{2}$ A.

runs to May 27, 1944
renewal put in place

6/17/26 ^{A.M.}

Staked Boundary Lines as given above.
D. Butterfield - C. Cavanaugh.

✓

6.9

98.2

105

Side ditch

10.1

95.0

Floor

13.0

92.1

855.0

99

61
461.1

100

3.6

101.5

X Fence

101

4.8

100.3

H 1 = 5' 1"

105.1

100.00

N.T.S. County Road Bridge

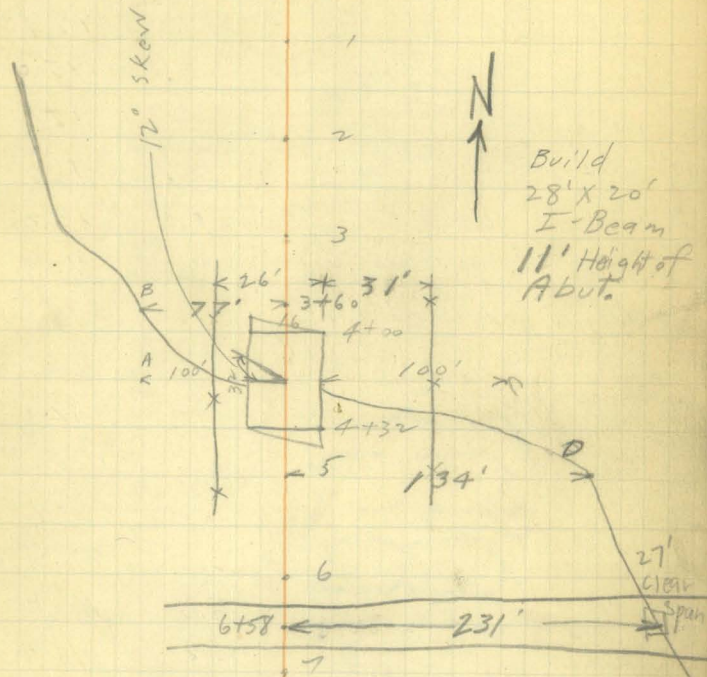
T. 90N R13W Sec 33-34 (Mt. Vernon Twp.)

3+83

Present Water Level	10.2	92.3
High Water	7.5	95.0
D	9.9	92.6
C	8.7	93.8
B	10.3	92.2
A	7.4	95.1
Stream - W. Side Br.	11.1	91.4
Stream - Fence	11.0	91.5
Stream Bed at Br. E Side	10.4	92.1
8	1.6	100.9
7	3.6	98.9
6	2.6	99.9
5	3.3	99.2
4+32 S. End	3.9	98.6
4 N End	4.2	98.3
3	5.3	97.2
2	3.5	99.0
1	5.3	97.2
0	5.9	96.6
B.M.	2.46 102.46	100.00

June 7, 1920
1 Bent with 4 piling
Each Abut. 4 piling

93.3	91.5	97.5	97.7	94.1	94.1
9.2	5.0	5.0	4.8	8.4	8.4
18	9	7	16	38	38



27.4 x 5.5 } Waterway
4 x 3 } 1 mile South

Top of piling on West side of Road 5' S. of S. End of Bridge

6

Top of Fence Post at Fence Intersection
just S-W of Bridge

Channel Change 7
Lincoln Twp
Sacs. 3-4.

2100

94.5

$$\frac{6.7}{\frac{6.25}{7.0}}$$

6.8

$$\frac{7.2}{\frac{6.25}{6.7}}$$

+94

F Credit bed

$$\frac{11}{9.5}$$

9.3

$$\frac{10}{9.3}$$

+83

$$\frac{10}{5.1}$$

5.1

$$\frac{10}{5.3}$$

+60

94.6

$$\frac{8.7}{\frac{8.38}{5.8}}$$

5.6

$$\frac{8.6}{\frac{8.38}{5.8}}$$

+50

94.7

$$\frac{9}{5.5}$$

6.0

$$\frac{20}{5.67}$$

+33

94.7

$$\frac{10}{5.2}$$

5.5

$$\frac{11}{6.5}$$

1+00

94.85

$$\frac{9.6}{\frac{8.44}{4.8}}$$

$$\frac{12}{4.7}$$

4.7

$$\frac{11}{4.9}$$

$$\frac{9.3}{\frac{8.44}{5.0}}$$

+30

95.1

$$\frac{10.2}{\frac{8.45}{4.1}}$$

$$\frac{11}{4.1}$$

$$\frac{5}{4.2}$$

4.7

$$\frac{4}{5.9}$$

$$\frac{9}{6.4}$$

$$\frac{7.1}{\frac{8.27}{6.2}}$$

0+00

95.2

$$\frac{6.3}{\frac{6.25}{6.6}}$$

$$\frac{7}{6.6}$$

$$\frac{3}{4.4}$$

$$\frac{3}{7.7}$$

$$\frac{7}{5.8}$$

$$\frac{7}{5.8}$$

B.M.

3.96

103.96

100.00

Top N end Conc wall w. F.L.

705

3.96 100.00

93.8

OV/Tet

+45

94.0

$\frac{9.5}{C 42}$
5.7

54

$\frac{10.0}{C 42}$
#5.3

3+00

103.96

94.15

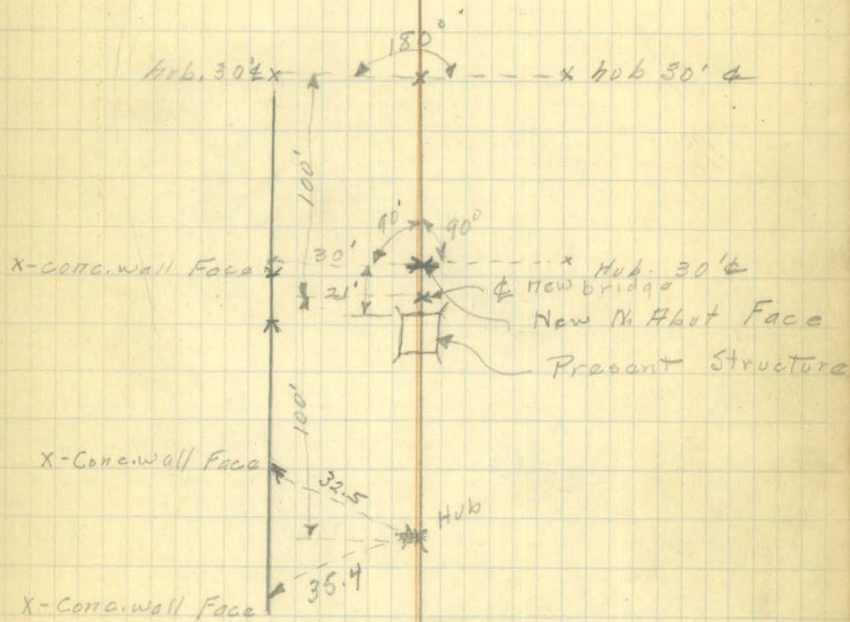
$\frac{11.1}{C 54}$
4.5

42

$\frac{11.4}{C 5.6}$
4.3

Bridge Lincoln Twp
Sec 3-4

N



10
11
Meas. Both Fences on So. Waterloo - C.F. Rd.

width at 1st angle pt - betn fences 58.5

" betn tel. poles - 45.0

width at Gallows Farm betn fences 59.

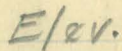
width - at yellow tree at south side of rd - 60.5

" at Hannas tree no side : 54.5

" at corner west of Hannas at cor } 60.2
Bend in fence on north } 57.0

12
4-12-21 P.M.

100.00



Dist. bridge floor to stream bed = 12.7

$$\begin{array}{r} 7.4 \\ 2.2 \\ \hline 9.6 \end{array}$$

$$\begin{array}{r} 7.7 \\ 17.3 \\ \hline 25.0 \end{array}$$

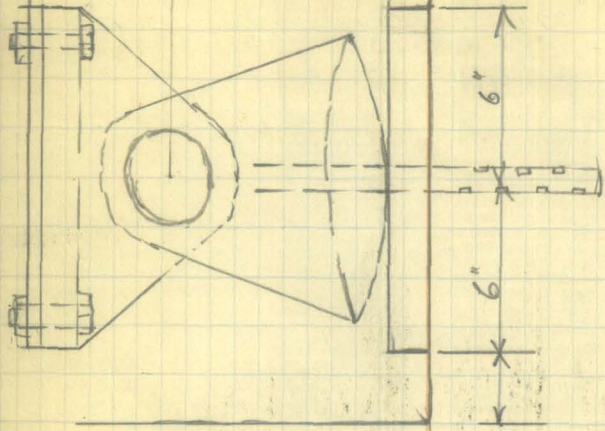
$$\begin{array}{r} 1217 \\ 4.6 \\ \hline 1221.6 \end{array}$$

Plan -

Note: • Indicates Loc. of Soundings

No.	Ground El.	Rock El.
①	90.8	82.8
②	90.8	83.8
③	90.4	82.8
④	90.4	83.9
⑤	90.4	82.7

Note: No provision for expansion on this bridge caused serious cracks and failure of concrete at SE abut. Data hereinafter was secured for design of New abut.



Sketch showing
PROPOSED ROCKER

FOR
Expansion End-on Box 16 PT.
at INDIAN CREEK

Logan Ave. Road

16

33' Gas pipe

Sec 2, stone

Sec 1
89-13

stone x 40.38 x stone

Mound

40.40 x stone

x stone

40.36 Mound

T90 R13

20.16

x stone

Mound

stone x

stone x 40.38 Mound
2.7

stone x

stone x

stone x

John Ball

T90 R13

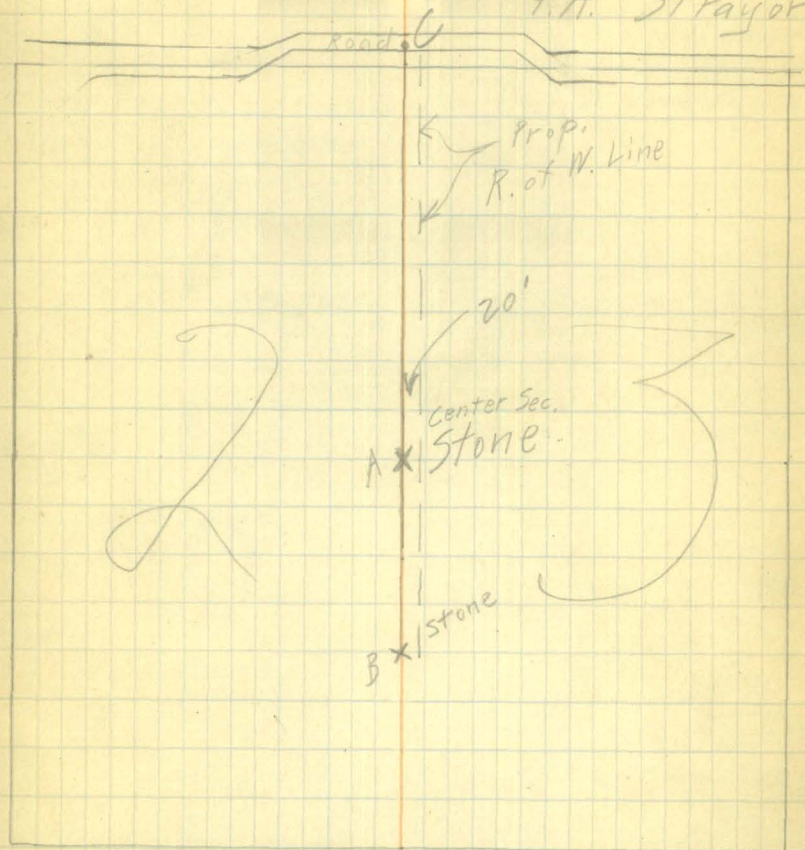
Stone set
in old Mound

Stone set
in old Mound

1868 surveyed
John Ball

June 8, 1921 17

E.B. Spencer
A.A. Lyons
F.A. Strayer



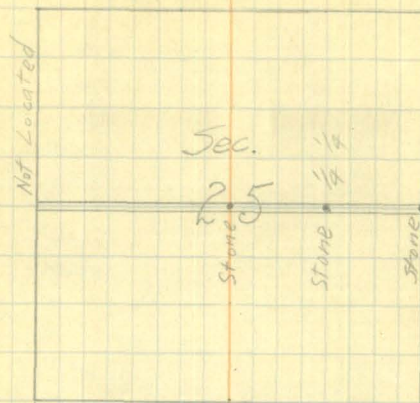
Located stones at A and B

Produced Line A and B North to
point C just North of Sec. Line
of Sec 23 T87R11W.

Set Fence Line stakes on East
side of Road 20ft. from $\frac{1}{4}$ Line from B to C

June 13, 1921

T87 R 11 W



Three stones shown on sketch were located. Line was produced to west sec. line from the stone in center of sec., and the $\frac{1}{4}$ - $\frac{1}{4}$ stone. The above line through the section was used for $\frac{1}{4}$ of highway.

B.M.

4.75

104.25

100.00

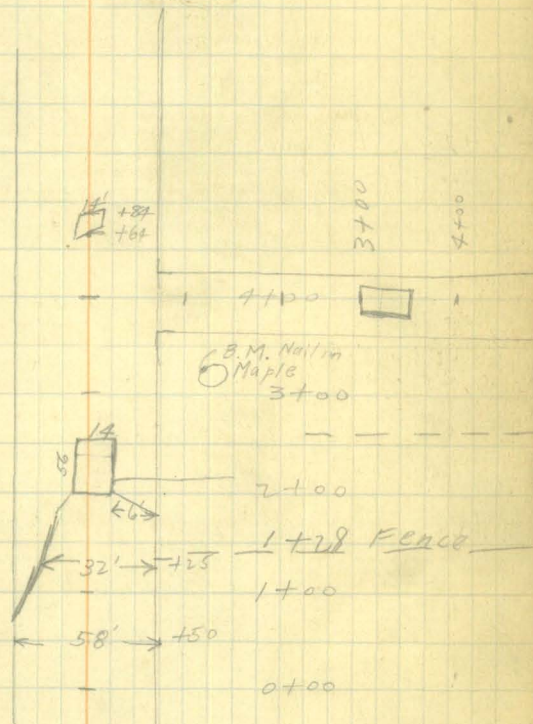
Nail in Big Maple

0

± Road

2+62

Fence Intersects Road East



± Profile

Road

Cedar 5-7

21

6+00

$\frac{99.8}{4.9}$

5+00

$\frac{100.7}{4.0}$

4+74 ± Br.

$\frac{95.6}{7.1}$
8

$\frac{102.3}{2.9}$

$\frac{99.9}{9.8}$
8

4+00

Road East

$\frac{99.2}{5.5}$

$\frac{98.8}{5.4}$
100

$\frac{99.4}{5.3}$
200

$\frac{100.6}{7.1}$
300

$\frac{91.1}{12.6}$
320

$\frac{101.8}{2.9}$
320

$\frac{98.7}{6.9}$
400

3

$\frac{101.0}{3.7}$

2+56 N. End.

$\frac{103.4}{1.3}$

2+28 ± Br.

$\frac{91.9}{12.8}$
8

$\frac{103.4}{1.3}$

$\frac{91.9}{12.8}$
8

2 S. End Br.

$\frac{103.4}{1.3}$

1

$\frac{99.7}{5.0}$

0

$\frac{100.5}{4.2}$

B.M.

4.75

104.75

100.00

Nail in Big Maple in S-E Cor. of Intersection

± Elev.

Proposed Channel

8+33				
8+00				
7+55				
7+00				
6+95				
6+15				
6+00				
5+25				
5+06				
4+50				
T.P.	3.59	104.73	4.25	101.14

4+00				
3+18				
3+00				
2+00				
+90				
+60				
+45				
+15				
1				
0+14				

0+00				
T.P.	4.98	105.39	4.34	100.41
		104.75		

West End

104.7

0+00 = cr. Bnk
W.E.
Bot.

105.4

Grade	Cut	Area	Vol.
8.0	96.7	93.2	3.5
7.4	97.3	93.2	4.1
5.5	99.2	93.3	5.9
5.8	98.9	93.3	5.6
5.4	99.3	93.3	6.0
8.4	96.3	93.4	2.9
7.5	97.2	93.4	3.8
9.8	94.9	93.5	1.4
9.0	95.7	93.5	2.2
6.7	98.0	93.5	4.5
4.8	100.6	93.6	7.0
6.4	99.0	93.7	5.3
5.2	100.2	93.7	6.5
5.0	100.4	93.8	6.6
5.0	100.4	93.8	6.6
10.4	95.0	93.8	1.2
8.1	97.3	93.8	3.5
9.4	96.2	93.9	2.1
7.9	97.5	93.9	3.6
6.7	98.7	94.0	4.7
9.5	95.9	94.0	1.9
12.5	93.0	—	—
—	92.0	—	—

Proposed Channel

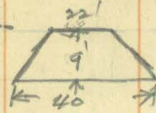
3071.2

8.89

Grade Cut Areas Vol.
C.Y.

Filling Bridge Sites.

cu yds

E. Bridge  $\times 50' 19 - \left[\frac{22+40}{2} \times 9 \times \frac{50}{3} \right] = 520 -$

So. Bridge (10) $\times 56 \left[\frac{22+40}{2} \times 9 \times \frac{56}{3} \right] = 580$

Total road to fill = 1100
Bridges

B.M.

4.76

East End

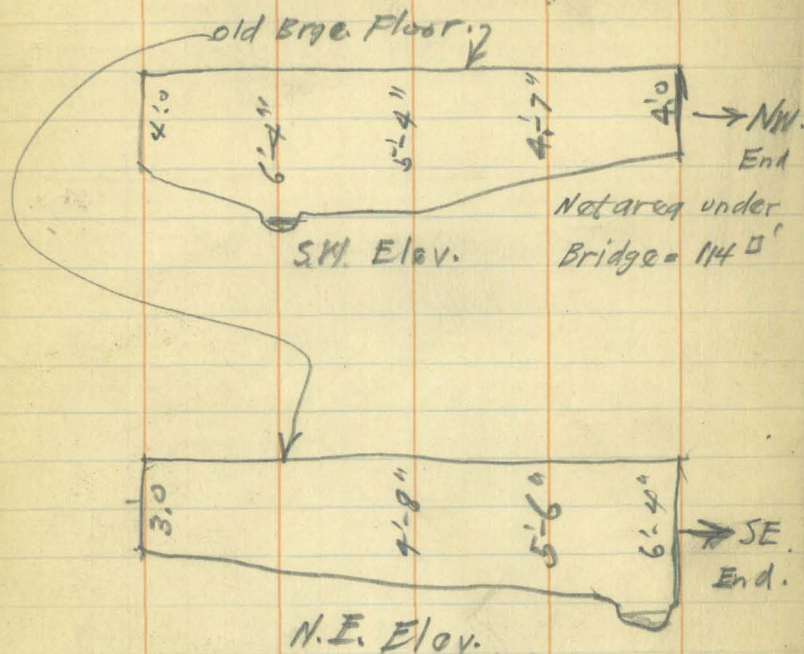
9+59
9+50
9+45
9+00
8+60
8+42
8+33

104.73

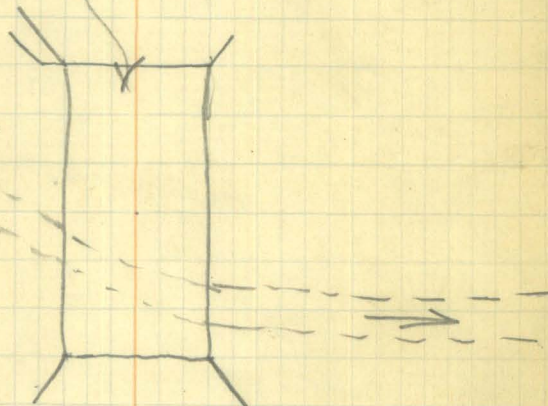
Total/cy. 0+00 to 9+54 = 346.11

(9+52 = Gr. pt. 0.0)	12.8	91.9	93.0	—	00.	1.7
	9.2	95.5	93.0	2.5	46.2	12.4
	7.4	97.3	93.0	4.3	87.2	166.7
	6.3	98.4	93.1	5.3	113.5	154.0
	7.0	97.7	93.1	4.6	94.8	39.7
	10.2	94.5	93.1	1.4	24.3	15.4
					68.3	
				1.81		389.9

109.7

6/24/21
A.M.
W.D.J.To Reopen old rd, Brge - 3/4 Mile NW
of Washburn - on Prim No 40.

2 span 30' wid. Brge.



Note: Use same elev. of low timber for
 under new
 clearance bridge. Clean out channel. and
 regrade approaches.

26

16' Bottom
1:1 slope

Sec. 5, Cedar Twp.
July 13, 1924
Spencer
Strayer

$\frac{101.2}{10}$	$\frac{102.0}{11}$	$\frac{96.9}{8.8}$	$\frac{96.5}{10.2}$	$\frac{96.8}{8.8}$	$\frac{102.0}{10}$	$\frac{100.2}{38}$
--------------------	--------------------	--------------------	---------------------	--------------------	--------------------	--------------------

Spencer
Strayer

$$\begin{array}{r} 101.2 \\ 70 \\ \hline 11 \end{array}$$

$$\begin{array}{r} 102.0 \\ 96.9 \\ \hline 8.8 \end{array}$$

$$\begin{array}{r} 95.5 \\ 10.2 \\ \hline \end{array}$$

$$\begin{array}{r} 96.9 \\ 8.8 \\ \hline \end{array}$$

$$\begin{array}{r} 102.0 \\ 100.2 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 38 \end{array}$$
 Strayer

$\frac{98.9}{6.8}$	$\frac{97.1}{8.6}$	$\frac{95.9}{9.8}$	$\frac{96.9}{8.8}$	$\frac{100.9}{7.8}$	$\frac{101.6}{7.1}$	$\frac{100.2}{3.8}$
--------------------	--------------------	--------------------	--------------------	---------------------	---------------------	---------------------

$\begin{array}{r} C4.4 \\ \underline{13.4} \\ 17.8 \end{array}$

$\begin{array}{r} C \ 5.9 \\ 13.9 \end{array}$	$\begin{array}{r} 99.3 \\ 6.2 \\ \hline 105.5 \end{array}$	$\begin{array}{r} 100.7 \\ 4.8 \\ \hline 105.5 \end{array}$	$\begin{array}{r} 99.3 \\ 6.4 \\ \hline 105.7 \end{array}$	$\begin{array}{r} 99.0 \\ 6.7 \\ \hline 105.7 \end{array}$	$\begin{array}{r} 13.4 \\ 13.4 \end{array}$
--	--	---	--	--	---

$$\frac{100.6}{5.1} \quad \frac{100.4}{5.3} \quad \frac{99.3}{5.4} \quad \frac{99.1}{5.6} \quad \frac{100.1}{5.6}$$
[illegible]
$$\begin{array}{r} 100.6 \\ 3.9 \overline{) 100.6} \\ \underline{39} \\ 616 \\ \underline{615} \\ 10 \end{array}$$

$14.9 \quad 3.8 \quad 3.8 \quad 14.9$
 $\begin{array}{r} 1005 \\ 4.0 \\ \hline 14.9 \end{array}$
 $\begin{array}{r} 1005 \\ 4.0 \\ \hline 14.9 \end{array}$
 $\begin{array}{r} 1005 \\ 4.0 \\ \hline 14.9 \end{array}$
 $\begin{array}{r} 1005 \\ 4.0 \\ \hline 14.9 \end{array}$

	100.0	95.6	93.3	91.1	89.0
	<u>3.9</u>	8.9	9.2	49.2	12
95.8	95.5	95.2	94.8	73	

$$\begin{array}{r} 989 \\ 5.6 \\ \hline 51 \\ 5.6 \\ \hline 5.2 \\ 48 \\ \hline 4.8 \\ 260 \\ \hline 9.3 \\ 7 \end{array}$$

$$\begin{array}{r} 63.4 \\ 97.9 \\ \hline 156 \end{array}$$

$$\begin{array}{r} 7.4 \\ 26.3 \\ \hline 75.8 \end{array}$$

$$\begin{array}{r} 96.0 \\ 85 \end{array}$$

$$\begin{array}{r} 92.6 \\ 11.9 \\ \hline 104.5 \end{array}$$
 W.F.

ail in Big Maple S-E. of Intersection

9+54

9+41

9+30

9+00

8+69

8+50

8+30

8+00

7+55

T.P.

3.05 102.73 4.40 99.68

7+00

6+60

6+24

6+00

5+50

93.1

93.2

93.3

93.4

104.1
104.08

$\frac{96.3}{6.4}$	$\frac{95.6}{7.1}$	$\frac{92.5}{10.2}$	$\frac{91.9}{10.8}$	00
$\frac{13}{13}$	$\frac{10}{10}$	$\frac{6}{6}$		
$\frac{C 4.4}{12.4}$	$\frac{97.6}{5.1}$	$\frac{96.5}{6.2}$	$\frac{97.4}{5.3}$	$\frac{95.2}{1.5}$
	$\frac{25.8}{1.0}$	$\frac{27.5}{5.0}$	$\frac{28.0}{7.7}$	$\frac{92.2}{10.5}$
	$\frac{15}{15}$	$\frac{8}{8}$	$\frac{10.8}{14}$	$\frac{74}{10.1}$
$\frac{C 4.6}{12.6}$	$\frac{97.7}{5.0}$	$\frac{4.3}{13}$	$\frac{98.5}{4.2}$	$\frac{97.2}{5.5}$
	$\frac{97.9}{4.8}$	$\frac{96.5}{5.8}$	$\frac{97.7}{5.0}$	$\frac{97.6}{5.1}$
	$\frac{18.8}{1.3}$	$\frac{19.3}{6.4}$	$\frac{97.2}{5.5}$	$\frac{97.2}{5.5}$
$\frac{C 3.7}{11.7}$	$\frac{96.9}{5.8}$	$\frac{2.6}{5.1}$	$\frac{97.3}{5.4}$	$\frac{97.3}{3.4}$
	$\frac{14}{14}$	$\frac{8}{8}$		$\frac{13}{13}$
	$\frac{97.5}{5.2}$	$\frac{97.2}{3.5}$		$\frac{99.8}{2.9}$
	$\frac{15}{15}$			$\frac{99.7}{4.9}$
$\frac{C 6.0}{14.0}$	$\frac{99.3}{4.8}$	$\frac{98.1}{5.0}$	$\frac{99.4}{4.1}$	$\frac{99.4}{4.1}$
	$\frac{15.4}{8.1}$	$\frac{97.1}{5.0}$	$\frac{99.4}{4.1}$	$\frac{99.4}{4.1}$
	$\frac{15}{15}$			$\frac{99.4}{4.1}$
$\frac{96.9}{7.2}$	$\frac{96.9}{7.2}$	$\frac{96.0}{8.1}$	$\frac{96.4}{7.7}$	$\frac{97.8}{6.3}$
$\frac{C 4.1}{12.1}$	$\frac{97.3}{6.6}$	$\frac{97.3}{6.8}$	$\frac{97.3}{6.8}$	$\frac{97.3}{6.8}$
	$\frac{12}{12}$			$\frac{97.3}{6.8}$
	$\frac{96.4}{7.7}$	$\frac{97.6}{6.5}$	$\frac{97.6}{6.5}$	$\frac{97.6}{6.5}$
	$\frac{13}{13}$			$\frac{97.6}{6.5}$

5+40

93.5

$$\begin{array}{r} \text{C} 2.7 \\ 10.7 \end{array} \quad \begin{array}{r} 96.2 \\ 10.5 \\ 11 \end{array} \quad \begin{array}{r} 97.5 \\ 9.2 \end{array} \quad \begin{array}{r} 97.8 \\ 8.9 \\ 12 \end{array} \quad \begin{array}{r} \text{C} 9.3 \\ 12.3 \end{array}$$

5+24

93.5

$$\begin{array}{r} 100.6 \\ 6.1 \\ 20 \end{array} \quad \begin{array}{r} 96.7 \\ 10.0 \\ 13 \end{array} \quad \begin{array}{r} 95.1 \\ 11.6 \\ 8 \end{array} \quad \begin{array}{r} 96.5 \\ 10.2 \end{array} \quad \begin{array}{r} 97.4 \\ 9.3 \\ 5 \end{array} \quad \begin{array}{r} 99.0 \\ 7.7 \\ 13 \end{array} \quad \begin{array}{r} 99.1 \\ 7.6 \\ 16 \end{array}$$

5+10

$$\begin{array}{r} 101.2 \\ 5.5 \\ 23 \end{array} \quad \begin{array}{r} 102.2 \\ 4.5 \\ 10 \end{array} \quad \begin{array}{r} 102.4 \\ 4.3 \end{array} \quad \begin{array}{r} 102.2 \\ 4.5 \\ 10 \end{array} \quad \begin{array}{r} 100.2 \\ 6.5 \\ 38 \end{array}$$

4+74

93.5

$$\begin{array}{r} \text{C} 6.1 \\ 14.1 \end{array} \quad \begin{array}{r} 99.6 \\ 7.1 \\ 14 \end{array} \quad \begin{array}{r} 97.9 \\ 8.8 \\ 9 \end{array} \quad \begin{array}{r} 97.4 \\ 7.3 \\ 5 \end{array} \quad \begin{array}{r} 97.3 \\ 7.4 \end{array} \quad \begin{array}{r} 96.6 \\ 10.1 \\ 6 \end{array} \quad \begin{array}{r} 96.6 \\ 10.1 \\ 14 \end{array} \quad \begin{array}{r} \text{C} 3.1 \\ 11.1 \end{array}$$

B.M.

6.75

106.75

100.00

South 103.0

North 103.0

$$\begin{array}{r} 100.1 \\ 6.6 \\ 101.1 \\ 5.6 \end{array}$$

4.95

104.95

100.00

364/ Cu. Yds.
Cut Channel
Change

99.6 99.2 96.2 94.4
6.5 6.9 9.9 11.7
58 56 13 11

99.6 99.2 96.2 94.4 93.8 94.5 95.9 98.4
6.5 6.9 9.9 11.7 12.3 11.6 10.2 7.7
58 56 13 11 12.3 6 16 30

99.9 96.1 94.7 94.1 94.3 98.2 99.2
6.2 10.0 11.4 12.0 11.8 7.9 6.9
52 13 8 12.0 7 20 33

99.8 94.6 94.3 98.2 99.2
6.3 11.5 12.0 7.9 6.9
18 7 12.0 7 20 33

B.M. 6.09 106.09

100.0

106.1

Cross Sections Fr. Rd. No 40-

1/4 NW 1/4 Sec 15-89-13- Near

S+g F.S. H.I. R.S. Elev

+50

6+00

5+45.9

P.I.

Gas Pipe

5.62 100.14

5+00

+50

① 4.65 105.76 4.31 101.11

4+00

+50

3+00

+50

Drive Rt

2+00

+50

1+00

0+00

B.M.

5.42 105.42

100.00

Aug. 10 '71

Spencer
Miller
Sears

30

P.N. Cowins.

7.1 7.6 6.2 4.7 4.1 4.8 6.1 5.2 5.3
30 27 19 14 4.1 10 20 23 33

96.7 96.7 99.6 101.1 101.4 101.0 99.7 100.4 100.5

8.8 8.3 5.5 4.8 4.8 5.6 5.9 6.1 6.1

30 25 20 15 14 13 20 33 33

97.0 97.5 100.3 101.0 101.0 100.7 99.9 100.7 100.7

10.6 8.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6

30 28 12 7.6 5.14 32 35 43

95.2 97.2 101.2 101.2 101.2 101.2 99.5 100.4 100.5

10.0 5.9 4.4 5.2 4.5 5.5 6.4 5.5 5.1 5.2

33 25 22 21 17 4.5 15 20 26 29 33

95.8 99.9 101.4 100.6 101.3 101.3 100.3 99.4 100.3 100.7 100.6

2.5 7.1 7.6 6.4 6.1 5.1 4.4 5.1 6.1 6.5 5.3 4.8

3 28 26 22 20 17 15 4.5 11 14 17 23 33

96.7 96.0 94.4 99.7 100.7 101.4 101.3 100.7 99.7 99.3 100.5 101.0

2.9 5.7 7.0 7.4 7.3 4.9 4.4 5.9 6.1 5.2 4.7

33 28 26 22 20 15 4.3 10 14 18 22 33

9.5 99.7 98.4 98.0 98.1 100.5 101.1 101.0 99.5 99.3 100.7 100.7

5.2 6.5 6.9 7.4 6.9 5.4 4.7 4.7 6.3 6.4 5.8 5.2 5.1

2.9 26 24 22 19 15 13 4.3 10 14 18 22 27 33

100.9 96.9 96.5 98.0 96.5 100.0 100.7 101.1 100.7 99.1 99.0 99.6 100.7 100.3

5.1 6.4 7.3 7.0 5.5 5.1 4.5 4.8 6.4 6.8 5.4 5.3

30 26 22 18 15 13 3 4.6 11 15 18 25 33

100.3 99.0 98.1 96.4 99.9 100.3 100.9 100.8 100.6 99.0 98.6 100.0 100.1

5.2 5.1 7.4 7.1 5.5 5.2 4.6 4.9 4.8 4.5 4.5 5.15 6.5 5.1

33 29 22 18 15 12 2 4.7 13 15 17 19 21 25 33

100.2 100.5 96.0 96.3 99.9 100.2 100.8 100.7 100.5 100.6 100.9 100.9 100.3 99.8 99.9

2 5.3 6.2 7.2 6.9 5.5 5.1 4.9 6.3 6.8 6.9 5.7 5.5

30 26 23 18 15 13 4.8 11 14 17 20 26 33

100.1 96.7 96.0 96.5 99.9 100.3 100.6 100.5 99.1 98.6 96.5 99.7 99.9

5.5 6.7 7.5 7.2 5.3 5.3 2.0 7.2 5.9 5.5

33 28 23 18 14 4.9 12 16 18 26 32

99.9 96.7 97.9 98.2 100.1 100.5 100.1 98.4 96.2 99.5 99.9

5.8 7.5 8.0 7.4 5.6 5.7 7.2 7.6 6.9 5.1 4.4

33 27 23 18 14 5.3 13 16 19 22 27 33

99.6 97.9 97.4 98.0 99.6 100.1 99.7 96.2 97.6 98.5 100.3 101.0

6.4 8.1 8.2 6.9 6.1 6.1 2.0 8.2 8.1 6.7 5.8 5.1

33 27 20 17 14 5.7 13 15 18 19 21 24 33

99.0 97.3 97.2 98.5 99.3 99.7 98.4 97.2 97.3 98.7 99.6 100.3

See plat + profile
also

B.M.

5.12 99.87

4.48 104.99 5.15 100.57

①

3.77 105.66 4.34 101.89

12+00

11+00

10+00

9+00

①

4.53 106.23 4.06 101.70

8+00

+50

Drive Rt

7+00

105.76

5.5

100.7

5.2

101.0

5.0

101.2

4.9

101.3

4.4	4.6	6.7	4.7	4.1	4.2	6.0	5.9	5.3
38	25	79	12	10.7	10.4	20	25	33
101.4	101.2	99.1	101.1	101.7	101.4	99.8	99.9	100.5
4.6	4.4	6.5	6.3	4.2	3.8	3.8	4.5	4.5
30	26	21	17	12	12	33	33	33
101.2	101.4	99.3	99.5	101.6	101.0	102.0	101.3	101.3
5.7	6.7	6.2	7.6	3.8	4.3	5.5	5.8	5.2
30	25	18	12	10	10	14	24	33
101.1	99.1	99.6	101.2	102.0	101.5	100.3	100.0	100.6

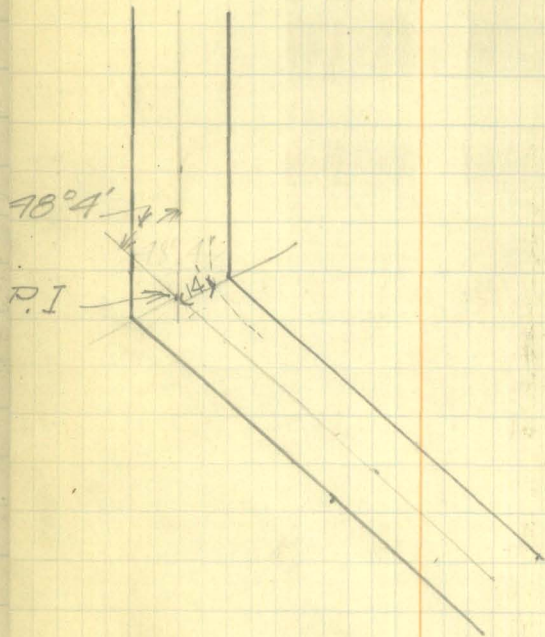
P.I. Sta. 5 + 45.9

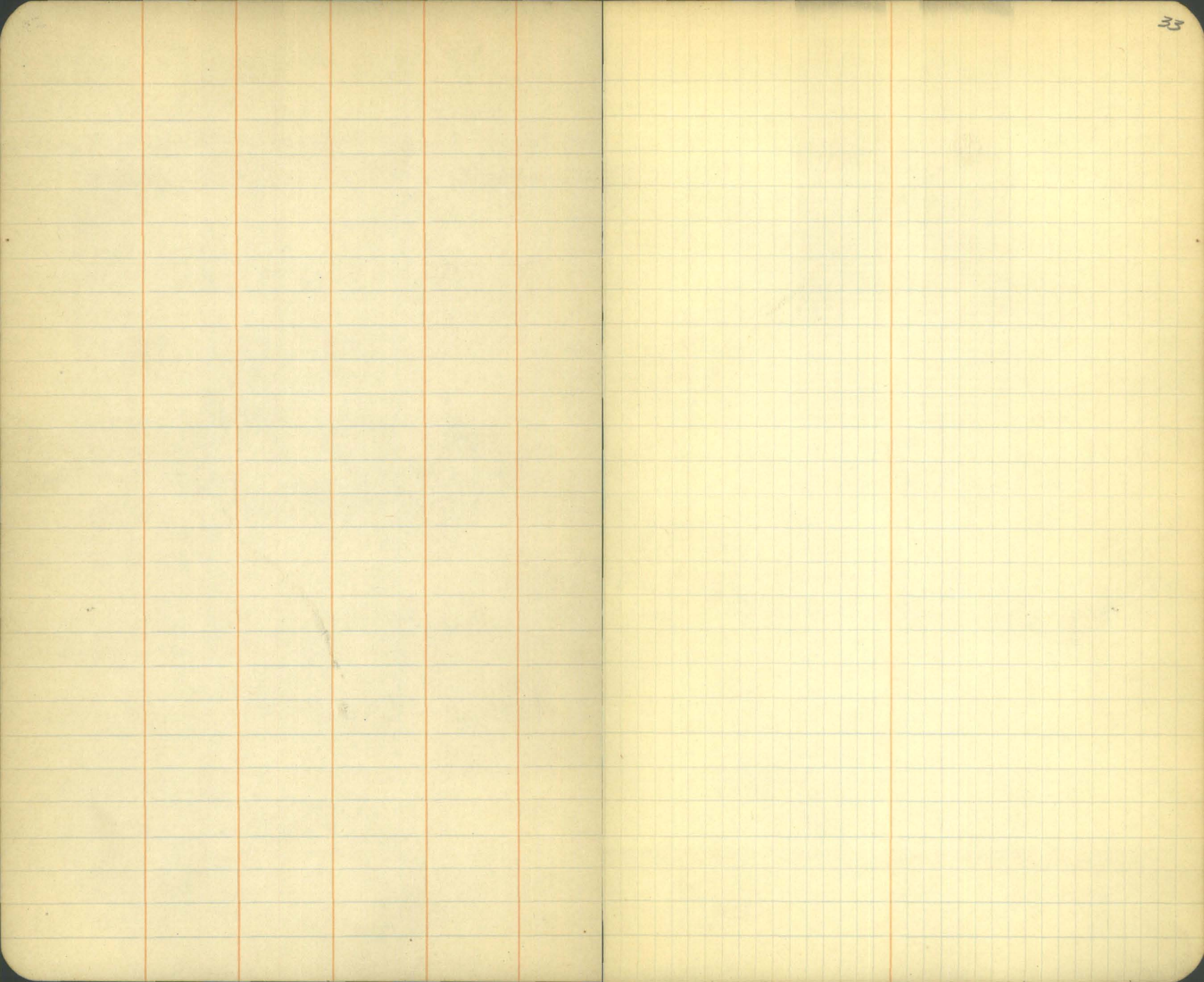
Angle of $\pm 48^{\circ} 4''$

B.M. 5.42 105.42

100.00

Spike in large trans. pole, N.E. Corner
Walker St. and Cedar Bend Rd.





7+50		11.4	93.27	93.2
7+00		11.1	93.6	93.2
		11.6		
6+00		11.5	93.17	93.3
5+50		10.25	94.4	93.4
T.P.	1.50	104.67	1.78	103.17
5+26		11.5	93.45	93.5
5+06		10.55	94.4	93.5
4+00		8.3	96.65	93.6
3+00		10.55	94.4	93.7
2+00		10.0	94.95	93.8
1+00		11.00	93.95	93.9
0+00				94.0
	104.95			

9		11.0	93.67	93.0
8	104.67	9.6	95.07	93.1

X-Sec. Fill at East Br. ~~Cedar~~ 5-8 Cedar.
 B.S. H.I. F.S. Elev.

36

0+45

0+34

0+24

0+13

T.P.

0

2.92 104.80 3.17 101.88 =

B.M.

5.05 105.1
 103.05

100.00

					Area
94.4	99.6	100.2	100.2	98.9	88
10.4	5.2	4.6	4.6	5.9	
15	9		7	12	
92.3	99.5	99.9	99.5	92.8	163
12.5	5.3	4.9	5.3	12.0	
16	6.5		7	16	
91.2	99.3	99.8	99.4	91.6	192
13.6	5.5	5.0	5.4	13.2	
91.6	99.3	99.8	99.2	92.2	120
12.9	5.5	5.0	5.6	12.6	
18	7		7	18	
99.0	99.6	99.9	99.6	93.6	120
5.8	5.5	5.2	5.5	11.5	
20	10		8	18	

Add 1590 = 304.75 cu yds. (265 Cu. Yds)

B.S. H.I. F.S. Elev.

0+57

0+40

0+23

0+10

0

B.M.

6.10

106.10

100.00

Area

94.9 ✓ 6.2 <u>13</u> 94.1✓ <u>12.0</u> 18	100.9✓ 5.2 <u>8</u> 100.9✓ 5.2 <u>8</u>	101.1✓ 5.0 <u>8</u> 101.1✓ 5.0 <u>8</u>	101.0✓ 5.1 <u>10</u> 100.9✓ 5.2 <u>8</u>	94.8 ✓ 11.3 <u>16</u> 93.0✓ <u>13.1</u> 21	72
92.7✓ 13.4 <u>20</u> 92.1✓ <u>14.0</u> 20	101.2✓ 4.9 <u>8</u> 101.2✓ 4.7 <u>8</u>	101.6✓ 4.5 <u>8</u> 101.8✓ 4.3 <u>8</u>	101.1✓ 5.0 <u>8.5</u> 101.6✓ 4.5 <u>8</u>	92.1✓ 14 <u>21</u> 92.5✓ 13.6 <u>20</u>	210
93.3✓ 12.8 <u>22</u>	101.3✓ 4.8 <u>14</u>	102.0✓ 4.1 <u>9</u>	101.5✓ 4.6 <u>9</u>	94.2✓ 11.6 <u>20</u>	255
					265
					225

Fill + 15% = 567.64 cu yds.

Cedar Sec. 5 Sept. 1, 1921

0+70

0+45

0+35

0+25

0+10

0+00

$\frac{96.9}{8}$ 98.1 $\frac{96.7}{8}$

37

$\frac{93.8}{14}$ $\frac{98.0}{2.5}$ 98.2 $\frac{97.3}{4}$ $\frac{93.5}{11}$

21.5

$\frac{96.0}{11.5}$ $\frac{98.0}{4}$ 98.5 $\frac{97.9}{3.5}$ $\frac{93.5}{10}$

24

$\frac{93.2}{14}$ $\frac{96.2}{8}$ $\frac{98.5}{2}$ 98.8 $\frac{98.1}{3}$ $\frac{93.3}{11}$

40.3

$\frac{93.2}{11}$ $\frac{98.7}{3}$ 98.5 $\frac{97.6}{7}$ $\frac{95.1}{12}$

18.8

$\frac{93.5}{11}$ $\frac{99.6}{2}$ 99.9 $\frac{99.5}{3}$ $\frac{95.4}{9}$

Total +15%

1646. Yds.

IN NE 1/4 Sec. 7 Cedar

Oct 5 - AM. 21 39

X-section - Dike across old channel Miller's Cr. Channel Chg. Job (W.D.J. Fraustroyer
T.D. Foster -

B.M.	6.41	<u>106.41</u>		100.00
F.P.	1.78	<u>103.59</u>	4.60	101.81.

Nail in Big Maple at SE cor. road intn.

Lt. or S.E.

±

Rt. or N.W.

0+00	Area.	Quan.
------	-------	-------

+05

11

+05

38

+15

47

+30

60

+50

32

+60

37

+75

19

0+85

2

0+90

246 cu.

2.6
<u>2.0</u>

$\frac{9.9}{15}$	$\frac{8.3}{11}$	$\frac{4.2}{5.5}$	$\frac{3.1}{2.0}$	$\frac{4.1}{4}$	$\frac{6.3}{7.5}$	$\frac{9.5}{12}$	✓
------------------	------------------	-------------------	-------------------	-----------------	-------------------	------------------	---

$\frac{9.5}{12.5}$	$\frac{8.3}{11.8}$	$\frac{4.7}{6}$	$\frac{3.5}{2.0}$	$\frac{4.1}{4}$	$\frac{7.6}{9}$	$\frac{9.5}{12.5}$	✓
--------------------	--------------------	-----------------	-------------------	-----------------	-----------------	--------------------	---

$\frac{6.9}{11.0}$	$\frac{5.2}{6.0}$	$\frac{3.4}{2.0}$	$\frac{4.7}{4}$	$\frac{7.3}{8}$	$\frac{9.4}{10.5}$	✓
--------------------	-------------------	-------------------	-----------------	-----------------	--------------------	---

$\frac{8.7}{13}$	$\frac{4.4}{5}$	$\frac{3.5}{2.0}$	$\frac{4.3}{4}$	$\frac{9.5}{12.5}$	✓
------------------	-----------------	-------------------	-----------------	--------------------	---

$\frac{9.0}{13}$	$\frac{4.3}{4.5}$	$\frac{3.3}{2.0}$	$\frac{4.1}{5}$	$\frac{7.2}{11}$	✓
------------------	-------------------	-------------------	-----------------	------------------	---

$\frac{7.7}{9.0}$	$\frac{3.0}{1.5}$	$\frac{3.1}{2.0}$	$\frac{4.4}{5}$	$\frac{6.0}{12}$	✓
-------------------	-------------------	-------------------	-----------------	------------------	---

$\frac{4.2}{6.0}$	$\frac{2.3}{2.0}$	$\frac{4.4}{6.0}$	—
-------------------	-------------------	-------------------	---

X-Section for Fill. at Frosts Bridge. Sec. 1-5 Cedar.

B.M. 0.10 100.10 100.00

0.55 99.55

Low-raise 1 ft.

5.7 94.4

Areas cu. Yds.

2.3

97.8

New Brg on E.

Grade pte on old piling on E West

N. of New Brg. Gate

78

27.

95.4

Grade.

82/13

90/9.0

7.7/0.0

7.7

164

4

95.7

06

10.5

10.5/0.0

10.5

304.

33

10.1

10.1/0.0

10.1

232

47

10.1

10.1/0.0

10.1

97.8

Grade.

47

2.3 97.8

Grade

El. Brg. Floor N. end

232

97.8

n

100

10.0

2.3 10.0/0.0

I-B Bridge

Level. " S. end

364

415

10.2

10.0/0.0

10.2

124

95.8

n.

55

10.0/Level.

Set Grade stke on E. at 0+55.

Gr. 4.3 92/0.0

7.4/13

5.2/22

107

90

8.6/23

9.5/10

8.1

4.8/16

Level

45

31

8.1/26

9.2/20

5.4

4.5/9

Level.

13

0.0

125

0.0 Fill

860

+10% 926 cu. Yds.

Note: Figure Fill 20' top width

X- Sect - Widening Gr. NW. side Con. Rd. Dike Rd. NE of LaPorte -

B.M. 101 101.01 100.00

0+00 3.5 96.5

+50

1+00

+50

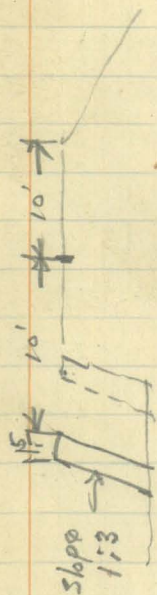
2+00

+50

3+00

+50

4+00



slope
1:1.3



+55.

Opp. End of Brg abt. wings.

4+62
42

S.W. end Brge-

5+04

N.E. " "

con. on 42.

Sec 19 - Spr. Cr. Twp.

Top cone, Flor. SW. end. pony Tr. Brge.

$\frac{5.5}{11.4}$ $\frac{4.8}{12.4}$ $\frac{E}{10}$ $\frac{3.5}{0.0}$ ✓

$\frac{4.7}{12}$ $\frac{4.4}{9.5}$ $\frac{E}{7}$ $\frac{3.5}{0.0}$ ✓

$\frac{4.9}{12}$ $\frac{4.6}{9.5}$ $\frac{E}{7}$ $\frac{3.5}{0.0}$ ✓

$\frac{5.9}{12.3}$ $\frac{5.4}{7.1}$ $\frac{E}{6}$ $\frac{3.5}{0.0}$ ✓

$\frac{5.9}{12.3}$ $\frac{5.4}{6.5}$ $\frac{E}{4.5}$ $\frac{3.2}{0.0}$ ✓

$\frac{6.5}{12.5}$ $\frac{6.3}{6.1}$ $\frac{E}{3.5}$ $\frac{3.2}{0.0}$ ✓

$\frac{6.3}{12.8}$ $\frac{5.3}{6.1}$ $\frac{E}{3}$ $\frac{2.5}{0.0}$ ✓

$\frac{6.0}{12.4}$ $\frac{4.7}{7.1}$ $\frac{E}{4.0}$ $\frac{2.5}{0.0}$ ✓

$\frac{6.3}{12.8}$ $\frac{5.7}{10}$ $\frac{E}{60}$ $\frac{2.5}{0.0}$

$\frac{6.3}{11.5}$ $\frac{E}{9.0}$ $\frac{1.8}{0.0}$

E. indicates edge of
old railway fill.

11.5
2 $\frac{1}{3}$ 14.2

$\frac{2}{3} = \frac{24}{36}$
333
7 $\frac{1}{3}$
10.4

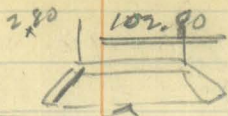
5.7 $\frac{1}{2}$
3.6 $\frac{1}{4}$
8 $\frac{5.1}{3.5}$
11.5 $\frac{1.6}{1.5}$
12.3 $\frac{1.5}{11.5}$

6.3
2.5
3.8
1.3
18.5
12.8

3.5
16.2
12.4

6.2
3.7
1.2
4.8

B.M.



100.00 pp. 41

E = edge of Grade -

5+10

+50

6+00

+50

7+00

+50

8+00

+50

9+155

End.

~~9+155~~

$$\frac{10.3}{13}$$

$$\frac{E}{10}$$

$$\frac{3.1}{0} \checkmark$$

$$\frac{7.3}{13.2}$$

$$\frac{8.3}{10}$$

$$\frac{E}{6.5}$$

$$\frac{4.1}{0} \checkmark$$

$$\frac{8.3}{12.8}$$

$$\frac{7.8}{8}$$

$$\frac{E}{5.5}$$

$$\frac{4.3}{0} \checkmark$$

$$\frac{7.9}{12.7}$$

$$\frac{7.4}{8}$$

$$\frac{E}{5.5}$$

$$\frac{4.4}{0} \checkmark$$

$$\frac{9.1}{13.0}$$

$$\frac{8.0}{9}$$

$$\frac{E}{6.5}$$

$$\frac{4.6}{0} \checkmark$$

$$\frac{9.1}{13.0}$$

$$\frac{8.3}{8.7}$$

$$\frac{E}{6.5}$$

$$\frac{4.7}{0} \checkmark$$

$$\frac{8.2}{12.6}$$

$$\frac{7.2}{7}$$

$$\frac{E}{6.0}$$

$$\frac{4.9}{0} \checkmark$$

$$\frac{7.2}{12.2}$$

$$\frac{6.2}{7.5}$$

$$\frac{E}{6.0}$$

$$\frac{5.0}{0} \checkmark$$

$$\frac{7.3}{12.2}$$

$$\frac{6.8}{9.5}$$

$$\frac{E}{4.5}$$

$$\frac{5.3}{0}$$

11.5

7.2

2.0

11.5

13.9

9.3

4.7

35.5

8.3

4.3

1.7

11.5

4.0

1.3

11.5

7.8

6.0

3.6

1.2

11.5

9.2

4.6

1.5

8.1

4.0

3.3

1.1

11.5

12.6

7.2

5.2

7.7

11.5

12.2

7.0

5.3

3.1

1.7

11.5

12.2

Levels in N. Ditch C.Rd. - Thru Sect 4 Loster (from E. Brge across
Wapsie River to 4'x4' cul. East.)
Top N. Rd wall. - cone cul. (from 4'x4')

B.M.	3.0	<u>103.00</u>		<u>100.00</u>	
				103.00	Cot.
0+00			-5.8	94.2	94.2° F.L. 4'x4' Box cul.
1+00	water in N. Ditch 12 ft deep		9.4	93.6	94.100.0
2			9.0	94.0	94.040.0
3			8.0	95.0	93.961.0
4			7.6	95.4	93.881.5
5			7.6	95.4	93.801.6
6			7.9	95.1	93.721.4
7			7.8	95.2	93.641.6
8	6.89	<u>102.98</u>	6.91	96.09	
9			7.4	95.6	93.562.0
10			7.8	95.2	93.481.9
11			7.7	95.3	93.401.9
12			7.3	95.7	93.322.4
13			6.8	96.2	93.243.0
14			6.6	96.4	93.163.2
15			7.0	95.0	93.081.9
16	4.45	<u>103.08</u>	4.35	98.63	+
17			7.3	95.8	93.002.8
18			7.6	95.5	92.922.6
19			8.2	94.9	92.842.1
20			8.6	94.3	92.761.7
			9.0	94.1	92.681.4
			9.1	94.0	92.601.4

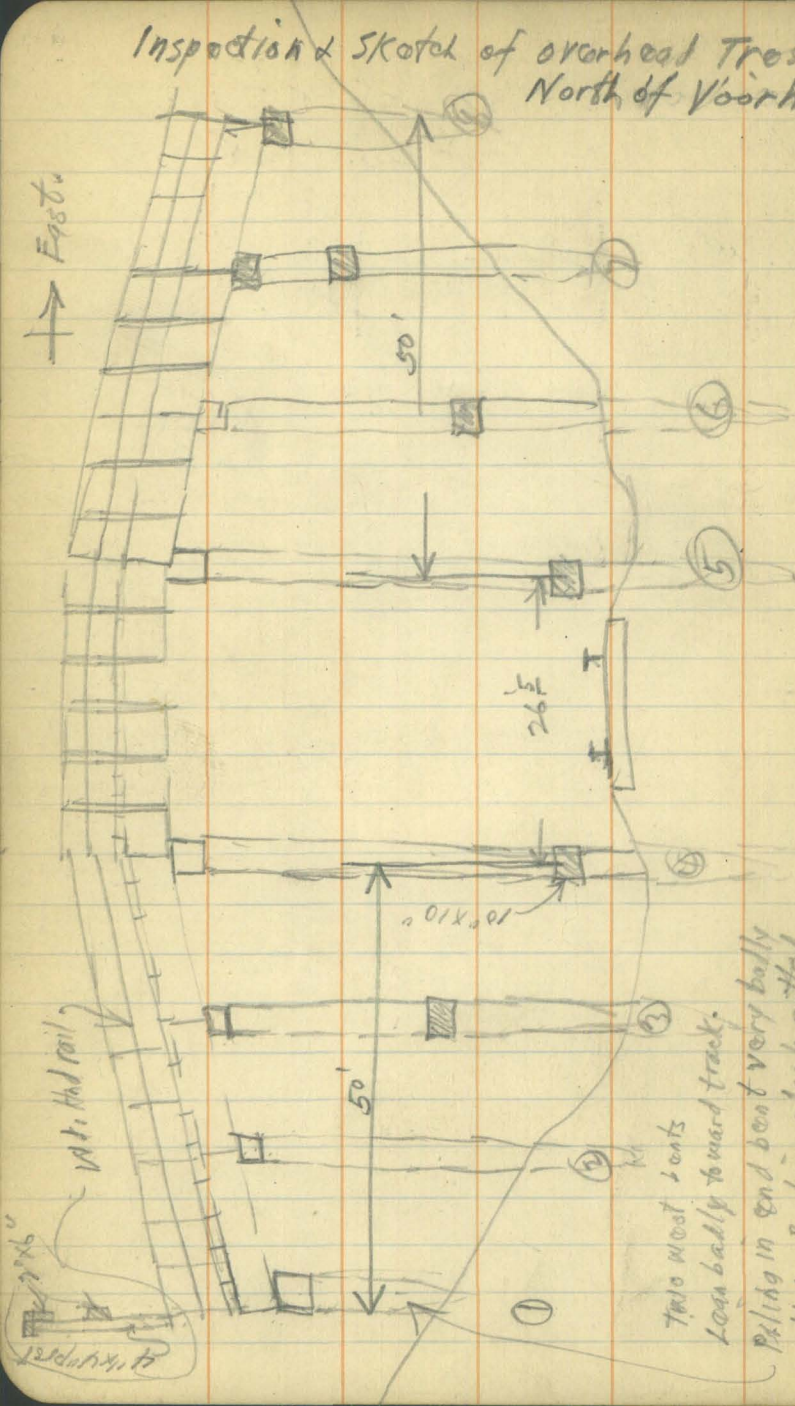
$$\begin{array}{r} .089 \\ \times 1000 \\ \hline 1.60 \\ 94.2 \\ \hline 92.6 \\ i.c. \end{array}$$

Jim Adams Driveway on N. side of Rd.

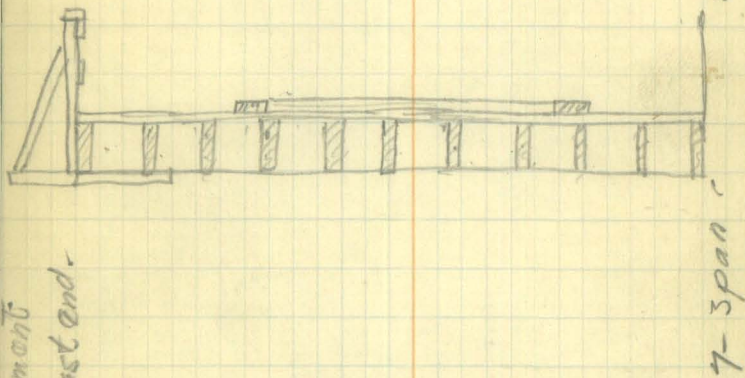
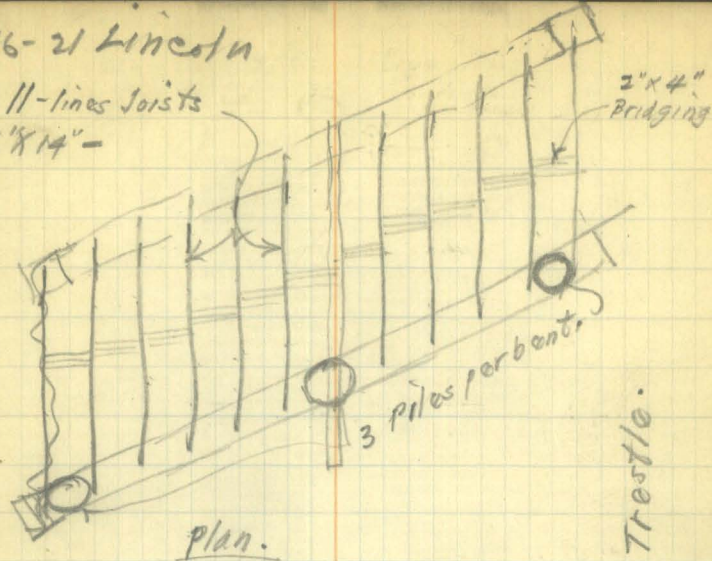
$$\begin{array}{r} 317000 \\ 2700 \times 30 = 2850 \text{ cu.} \\ \hline 27 \\ 73 \end{array}$$

1.77 = Ave. cut.

Inspection & Sketch of overhead Trestle 100-16-21 Lincoln
North of Voorhies



11-lines Joists
6' x 14' -



Bent No 2 shows Settlement
Break in floor near East end.

Re-X-sect. for fill at Frosts Bridge Fill Sec. 4-5 Cedar.

Nov. 2 1921. 45 P.M.

BM.	0.25	<u>100.25</u>	100.00	East
93.7 West	95.1	95.8	95.3	90.7
<u>6.5</u>	<u>5.2</u>	<u>4.5</u>	<u>5.0</u>	<u>9.6</u>
17.0	14.0	8.0	12.0	19.5
94.3	96.1	97.0	96.8	91.8
<u>10.0</u>	<u>4.2</u>	<u>3.3</u>	<u>3.5</u>	<u>8.5</u>
18.5	14.5	8.0	10.5	16
90.8	97.1	97.8	97.5	92.1
<u>9.5</u>	<u>3.2</u>	<u>2.8</u>	<u>2.8</u>	<u>8.2</u>
19.0	11	8.0	10.5	16
91.7	96.3	97.5	96.8	91.8
<u>8.0</u>	<u>4.0</u>	<u>2.8</u>	<u>3.5</u>	<u>8.5</u>
15.5	11.0	8.0	11.0	18
91.3	95.5	95.9	95.7	92.6
<u>9.0</u>	<u>4.8</u>	<u>4.4</u>	<u>4.6</u>	<u>7.7</u>
16.4	9.0	8.0	11.5	16.5
91.0	95.0	95.4	95.1	—
<u>9.2</u>	<u>5.2</u>	<u>4.9</u>	<u>5.2</u>	—
17	10	8.0	13	—
93.0	94.9	95.3	95.6	—
<u>7.2</u>	<u>5.4</u>	<u>5.0</u>	<u>4.7</u>	—
14.5	10.5	8.0	11.5	—

to cement curb. N.W. side was 8' 10" front Gate.

See pp 40.

0+00 = Arrow 47' N. of N. end of Bridge

Extra on North

$$\frac{45 \times 8 \times 1.5}{27} = 20 \text{ cu yd}$$

0+33

0+47 = N. end Bridge

Extra on South

0+00 = S. end of bridge.

$$\frac{45 \times 11 \times 1.0}{27} = 18.3 \text{ cu yd}$$

0+14

0+50

38. cy.

0+82

Final Est 945 @ 35¢

1+02

Levels on Pony Tr. Sec 26

Payner Indian Cr. about. Job -

B.M. 3.42 103.42 100.00 + on top of SEly old about.

5.65

S.W. corner and -

5.63

S.E. cor. " " .

5.53

5.50 ⁰³

N.W. cor. " "

5.49

5.46 ⁰³

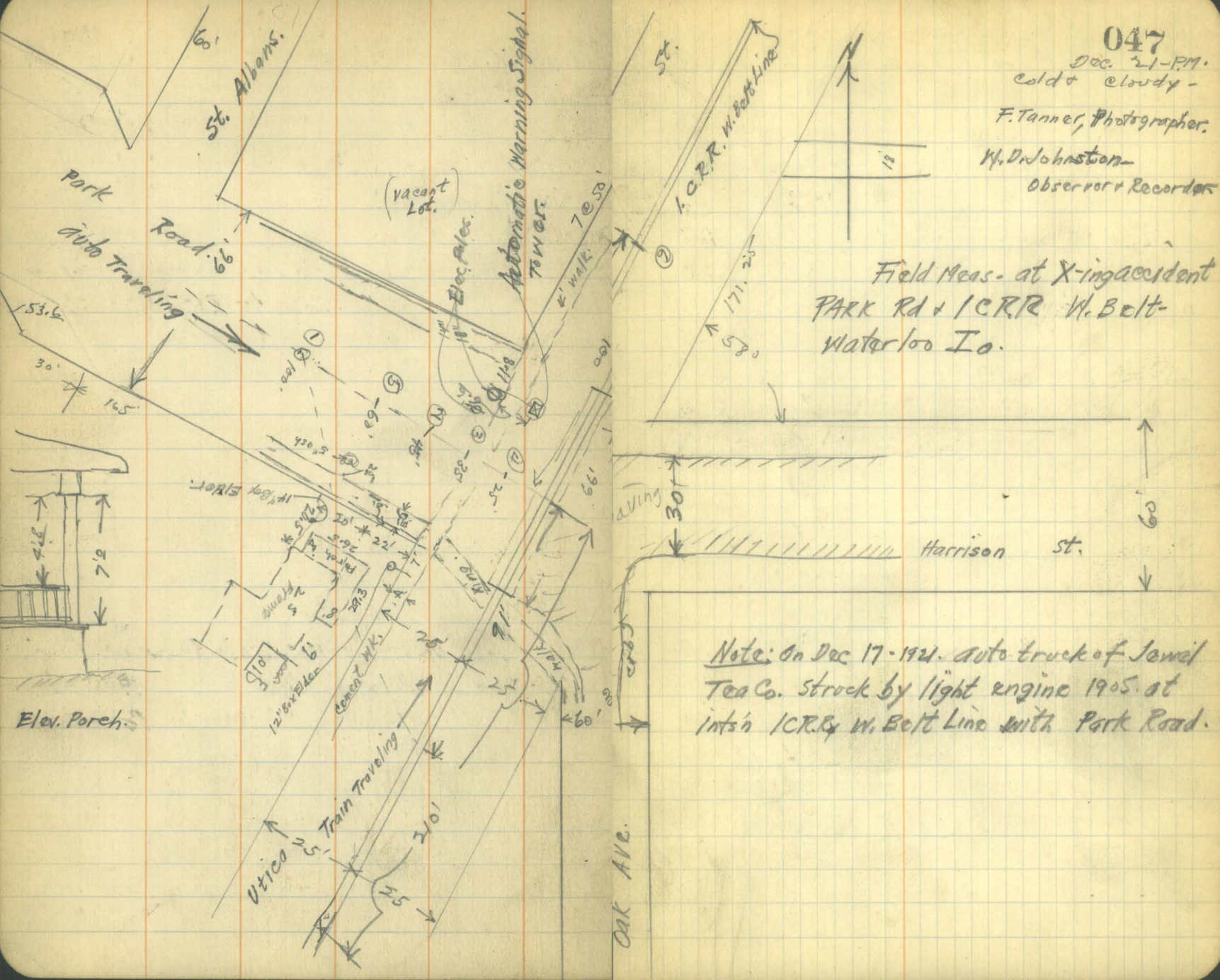
N.E. cor. " "

Dec. 21-P.M.
cold & cloudy -

W. D. Johnston
Observer & Recorder

Field Meas. at X-ing accident
PARK Rd & I CRR W. Belt-
waterloo Io.

Note: On Dec 17-1921. auto truck of Samuel Tea Co. struck by light engine 1905. at int'n ICR & W. Belt Line south Park Road.



X-Section under 2-span I-beam bridge

on trap rd - betw 7-88-13 and 18-88-13.

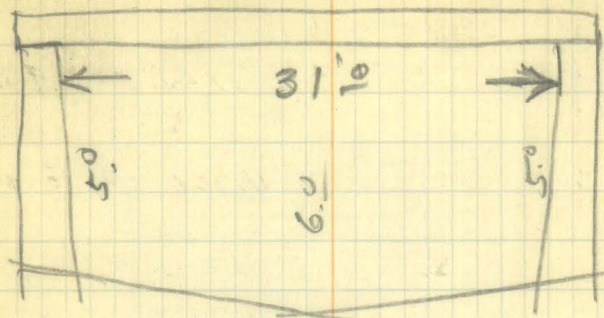


$$\begin{aligned} 21.7 \times 4.5 &= 97.7 \\ 21.7 \times 3 &= 65.1 \\ \hline \text{Area} &= 162.8 \text{ sq ft} \end{aligned}$$

Elev. south side

$$\begin{array}{r} 707.30.7 \\ 31.70.7 \\ \hline 707.21.41 \\ 21.21.70.49 \\ \hline 728.43.11.49 \end{array}$$

old bridge across Goose Cr 048
Sec 7-8 8-13



$$\begin{aligned} \text{Elev.} \\ \text{Area} &= 170.5 - \end{aligned}$$

High water elev would be at $\pm$ elevation of Highway approx. 60' north of angle pt. at Klingman corner.

Hiways-

Blade Grading - 1921.

Gang

Roads Graded.

Burd Auto Co.

Prim. Rd. 40. W'loo To LaPorte-

(40-80 Tractor & operator -)

Co. Rd. 1 3/4 M. W. & W'loo - Eagle Cr.

Gang
Rate

Miles
Graded

Cost.

Cost
per Mile.

049

4.85
0.65
\$ 5.50

11.25
1.75

13.2

\$ 4028.64

\$ 309.90

S. L. Sturm

Co. Rd. - Old W'loo & Cedar Falls Rd.

Co. Rd. - Hudson to Cedar Falls

Pr. Rd No 5 Thru Payner & Barclay

\$ 5.50
3.60
7.70
11.30

11.30

9.50

\$ 2648.25

234.35

1356.

14m73

And. Hayes with
Trp. outfit.

Co. Rd. - Along N. line Sec 5 & 6 Lesta

" " Thru " 3 & 4 "

Co. Rd. - Betwn (4-5) (8-9) (20-21) a

\$ 4.00

7.0

7.0

\$ 1168.-

\$ 166.85

* Dart Sales Co. (No. 1) Co. Rd. - Hudson - Hicks Sec 4-5 Line

\$ 4.35

3.0

1335.14

\$ 445.-

* Dart Sales Co. (No. 2) Pr. Rd # 59 - (34-35) Blk H.R. & 23 Lincoln

4.35

2.0

412x 00

Not completed.

x Both outfits released because of insufficient power.

Were using - 18-25 Hart Parr Tractors.

S. C. Bowen

Co. Rd. - (16-21) Lincoln East 1/2 M.

0.5

* Co. owned Hart-Parr
N. L. Mayland & Geo
Saraga.

Pr. Rd No 57 and Pr. No 5. Cedar F.

Co. Rd. (3-4) C.F. (26-35) (27-34) (33-34) N. Vernon

Co. Rd. (3-4) E. Waterloo

15.

Light Grading.

* Part time spent on "smoothing up" various
other Roads.

* Wise Bros outfit
& Crotcher

Co. Rd. - (26-35) (25-26) (30-31) E. of Hudson

3.50
0.65
4.15

4.15

3.0

64.3

List B/K Hawk Co. Gravel Pits

1921

001

Pit No	Name	Location		Notes
		Section	Twp.	
		34	Lester	
1	Broster Hill Pit	34	Lester	20 yr Lease
2	Barclay Twp	23	Barclay	Owned
3	Sewick	21	"	20 yr Lease
4	-	16	Spr Creek	Owned
5	Burger	21	Cedar	Owned
6	Shick	33	Orange	2 yr Lease
7	Brandhorst	28	B/K Hawk	20 yr Lease
8	Engle	14	" "	Owned
9	Krog	27	Cedar Falls	20 yr Lease
10	Beltz	7	" "	20 yr Lease
11	Bishop	36	Washington	Owned
12	Becker	4	Union	25 yr Lease
13	Johnston	28	E. Waterloo	20 yr Lease
14	Gowan	19	Lester	
15	Allen	21	Bennington	
16	Renner	2	E. Waterloo	
17	Andorf	20	B/K Hawk	5 yr Lease
18	Even	18	Fox	

Bridge insp trip to H.W. millers Dist.
 16' x 16' wood Brge -
 Wood Bridge - alt 300' N. of S. cor -
 11-12 Eagle -
 South Pile bent in bad shape -

millers
 Decker
 Johnston
 Ahlstrom

Wd. Bridge on trip Rd.
 SE 1/4 Sec 20-87-11. 4-21-22

052

H.W. Johnston
 T.D. Teeter

1 @ 12' Wd. joists
 1 @ 16' Wd. "
 1 @ 30' I-B (6 I-B 30' lg.)
 1 @ 10' Wd. Joists
 68' = Total Length

meas. depth; floor to channel bot. on north side
 $12' + 7.5 = 19.5$
 $18' + 7.5 = 25.5$
 $11' + 7.5 = 18.5$

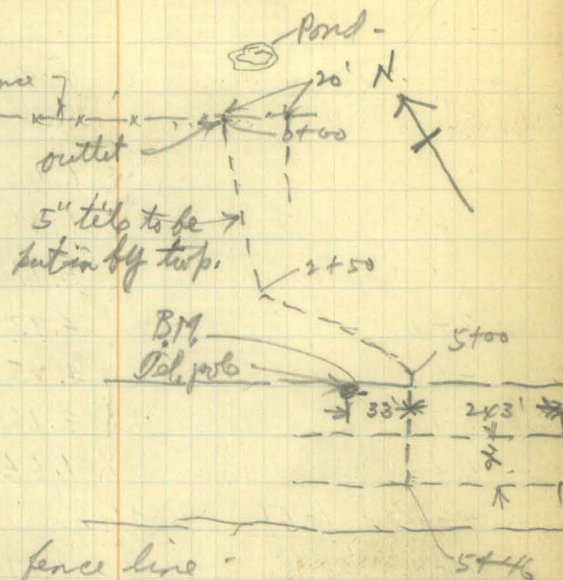
Big floor to channel bot.

would eliminate 3 wd. bridges on E. & W. Rd.
 could remove 100' curved chord steel truss
 on N. & S. Rd.

Survey for outlet tile tarp road - S.E. LaBerty at low spot just outside town limits - 053
 50c 31-87-11
 4/21/22 P.M.

B.M.	B.S. ✓ 3.58	H.I. 103.58	F.S.	Elev.
0+00			7.62	95.96
+50			4.28	99.30
1+00			1.27	102.31
+50			1.82	101.76
2+00			3.80	99.78
Δ +50	angle pt. to left thru low spot Gr = 0.40%		4.78	98.80
3+00			4.83	98.75
+50			5.27	98.31
4+00			4.91	98.67
+50			4.94	98.64
Δ 5+00	angle pt.		4.69	98.89
5+02				
5+20	4.69 103.19		4.32	99.26
5+46	3.41		4.21	99.37

Spike in S.E. side tel. pole on N. side road



Tile line along each side of highway

B.M.	3.13	<u>103.13</u>	N.E. side	100.00	S.W. side	Depths	
0+00			3.91	99.22	95.3	3.92	3'-11"
+50			4.10	99.03	95.5	3.53	3'-6 ⁵ / ₈ "
1+00			3.99	99.14	95.70	3.44	3'-6 ¹ / ₈ "
+50			4.00	99.13	95.9	3.23	3'-1 ¹ / ₂ "
2+00			3.75	99.38	96.1	3.21	3'-0 ¹ / ₈ "
2+15	Sta off tel pole on S. side Rd.			17			
2+43	End.		3.75	99.38	96.27	3.11	3'-8"

S.W. side

Depths

Gr = 0.40%

Survey tile line twp road. on E. side.
SE 1/4 Sec 36 Big Creek

Sec 36 - 87-12

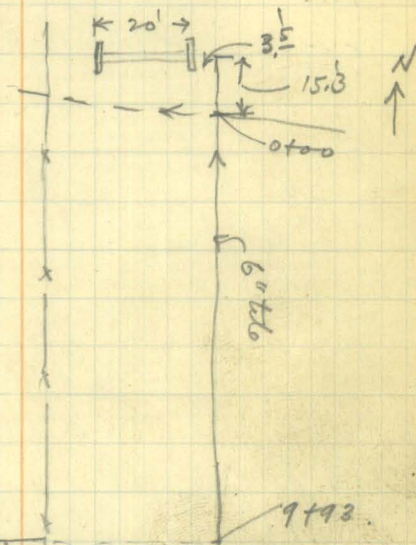
054

4/21/22
W. J. Johnston
98 Reeter,
S. H. Hummer
Rd. supt -

B.M.	S.V.S	105.25	100.00						
- 0+15.3									
0+00		7.04	98.21	93.40	4.81	4'-9 3/4"			
+50		6.93	98.32	93.99	4.33	4'-4"			
1+00		6.60	98.65	94.57	4.08	4'-1"			
+50		6.26	98.99	95.15	3.84	3'-10 1/8"			
2+00		5.81	99.44	95.74	3.70	3'-8 3/8"			
3+00		4.93	100.32	96.91	3.41	3'-5"			
4+00		4.25	101.00	98.08	.92	2'-11"			
5+00		3.16	102.09	99.25	.84	2'-10 1/8"			
6+00	(Break in Grade)	1.65	103.60	100.43	.17	3'-2"			
T.P. 9+00		10.61	114.21						
7+00		8.27	105.94	102.86	.08	3'-1"			
8+00		5.96	108.25	105.29	2.96	2'-11 1/2"			
9+00		3.35	110.86	107.74	1.12	3'-1 1/2"			
9+93	End-	0.12	114.09	110.00	.09	4'-1"			

center of top of E. Hd. walk-

Center line of 4' x 2' conc. box culvert -
junction with private tile line (4' x 2' down to top of 8" (8) outlet tile)



Pl. H. E. A. fence line to west of road -
of County line. (110.0 proposed Grade)

mail data to Salis Hummer
LaPorte City -

G. R. Decker - Teeter - Shirley 4/22/22

1-line 6" on west side of road - from
mail box of Erick Sorensen - 500 ft. north
to outlet at E. end of 2'x2' culvert at cor-
ner of pig in road to west.

Guard Rail on South end of Beaver
Bridge - Steel Trusses -

H. W. Miller - Becker - Akko & W.D.J.
 April 29 - 934.

Recommended - R.C.B. in place of 12" corr p.
 City, twp Rd - approx 1/4 mile west of SE Cor
 Sec. 9-16 Orange twp.

S.G. 1600 a. 4' x 3' - 24'

with 45° wings -

Pit in Gravel Pit - Extension to Schick
orange trap

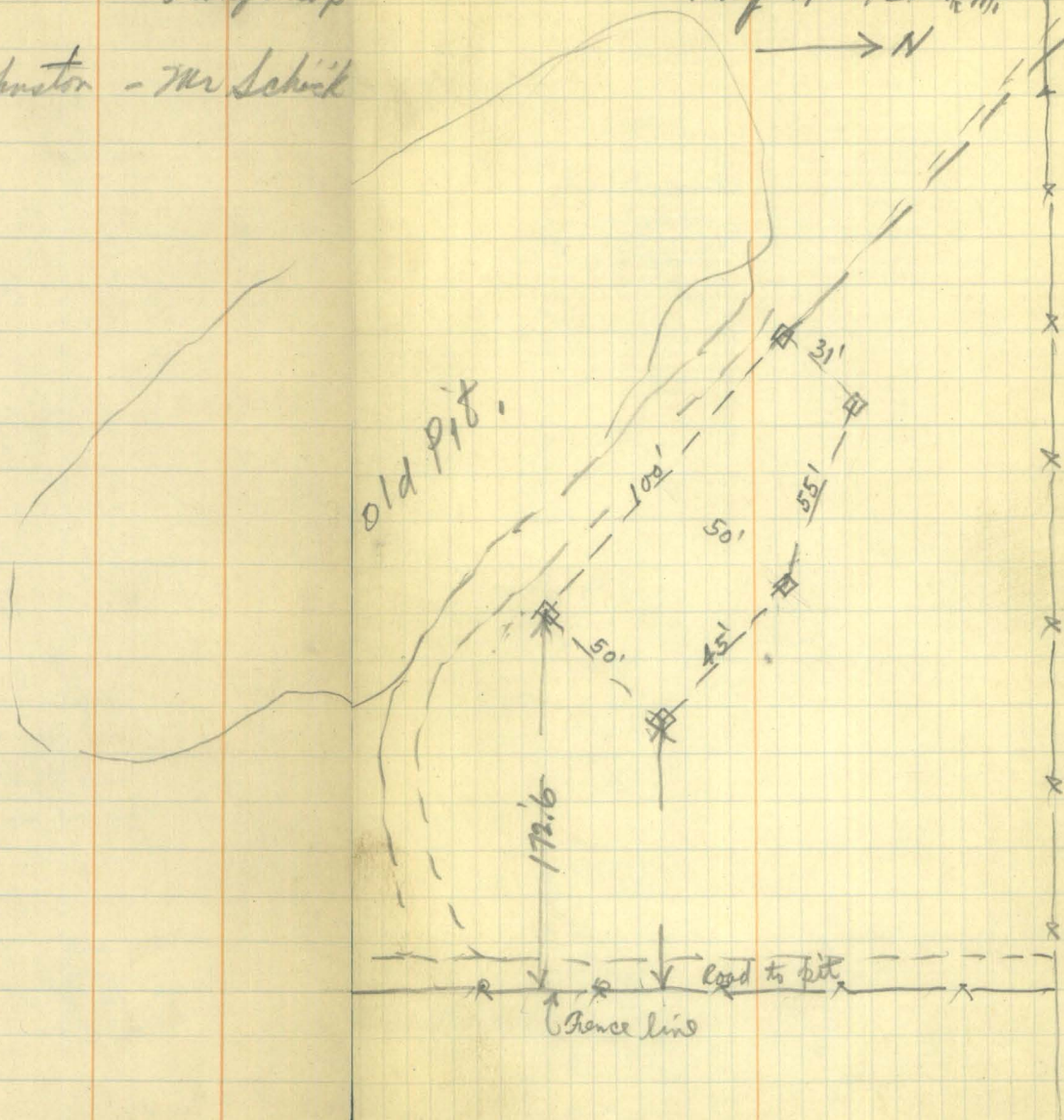
H. Co. Miller - vs Johnston - Mr. Schick

May-17-1922 A.M.

→ N

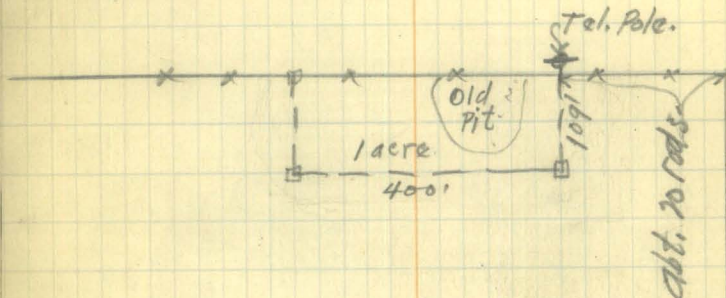
old 918.

4th The pole west of Pine way
to gravel pit.



Gravel Pit. Located in
NE $\frac{1}{4}$ Sec. - 23-89-11.

058



Staked out Clayton Gravel Pit.
June 8- P.M. 1922
Ahles
Miller
Bailey
Johnston.

Note: - See Book #78 Page #10
for New Extension Sketch. 3/22/28

61
914.0

060

B.M.

1.67

921.97

920.30

5.77 916.20 914.0

2.2 C 2'-2 $\frac{1}{2}$ "

West

7.16 914.81 912.0

2.81 C 2'-9 $\frac{3}{4}$ "

5.88 916.09 912.5

3.59 C 3'-7"

4.41 947.48

943.07

8.02 939.46 938.00

9.22 938.26 937.35

10.1 937.38

9.52 937.96

1.46 1'-5 $\frac{1}{2}$ "
East ~~1.46~~ 1'-5 $\frac{1}{2}$ "

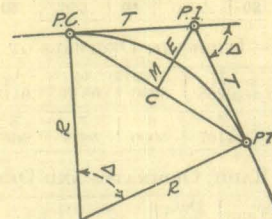
West 0.76 - 0'-9"

~~1.61~~ 1'-7 $\frac{1}{2}$ "

.91 - 0'-11"

543560
8710 074

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


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

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

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

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

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

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

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

Stations.—Given P. I.=Sta. 161+60.35 to find Sta. of P. C. and P. T. $\Delta=62^{\circ} 10'$ $D=8^{\circ} 20'$. From Table IV for 1° curve $T=3454.1$ and $+8\frac{1}{2}=414.49$ ft. From Table V correction=.36 or $T=414.85$ ft. P. C.=Sta. P. I.— $T=157+45.50$. Also from (4) $L=746.00$ and P. T.=Sta. P. C. + $L=164+91.50$.

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

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

Externals.—May be found in similar manner to tangents. Thus E for curve above is 115.37 For from Table IV for 1° curve E=960.6 for 8° $E=960.6 \div 8\frac{1}{2}=115.27$ and from Table V correction=.10 or E=115.37 Or suppose $\Delta=32^\circ$ and E is measured and found to be 42 ft. What is D? From Table IV E=230.9 and $\div 42=5.5$ or D=5° 30'.

TABLE I.—MINUTES IN DECIMALS OF A DEGREE.

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

TABLE II.—INCHES IN DECIMALS OF A FOOT.

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.—RADI, ORDINATES AND DEFLECTIONS.

Deg.	Radius	Mid. Ord.	Tan. Offset	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Offset	Def. for 1 Foot
0° 10'	34377.5	.036	.145	0.05'	7°	819.02	1.528	6.105	2.10'
20	17188.8	.073	.291	0.10	20'	781.84	1.600	6.395	2.20
30	11459.2	.109	.436	0.15	30	764.49	1.637	6.540	2.25
40	8594.42	.145	.582	0.20	40	747.89	1.673	6.685	2.30
50	6875.55	.182	.727	0.25					
1	5729.65	.218	.873	0.30	8	716.78	1.746	6.976	2.40
10	4911.15	.255	1.018	0.35	20	688.16	1.819	7.266	2.50
20	4297.28	.291	1.164	0.40	30	674.69	1.855	7.411	2.55
30	3819.83	.327	1.309	0.45	40	661.74	1.892	7.556	2.60
40	3437.87	.364	1.454	0.50	9	637.28	1.965	7.846	2.70
50	3125.36	.400	1.600	0.55	20	614.56	2.037	8.136	2.80
2	2864.93	.436	1.745	0.60	30	603.80	2.074	8.281	2.85
10	2644.58	.473	1.891	0.65	40	593.42	2.110	8.426	2.90
20	2455.70	.509	2.036	0.70	10	573.69	2.183	8.716	3.00
30	2292.01	.545	2.181	0.75	30	546.44	2.292	9.150	3.15
40	2148.79	.582	2.327	0.80	11	521.67	2.402	9.585	3.30
50	2022.41	.618	2.472	0.85	30	499.06	2.511	10.02	3.45
3	1910.08	.655	2.618	0.90	12	478.34	2.620	10.45	3.60
10	1809.57	.691	2.763	0.95	30	459.28	2.730	10.89	3.75
20	1719.12	.727	2.908	1.00	13	441.68	2.839	11.32	3.90
30	1637.28	.764	3.054	1.05	30	425.40	2.949	11.75	4.05
40	1562.88	.800	3.199	1.10	14	410.28	3.058	12.18	4.20
50	1494.95	.836	3.345	1.15	30	396.20	3.168	12.62	4.35
4	1432.69	.873	3.490	1.20	15	383.07	3.277	13.05	4.50
10	1375.40	.909	3.635	1.25	30	370.78	3.387	13.49	4.65
20	1322.53	.945	3.718	1.30	16	359.27	3.496	13.92	4.80
30	1273.57	.982	3.926	1.35	30	348.45	3.606	14.35	4.95
40	1228.11	1.018	4.071	1.40	17	338.27	3.716	14.78	5.10
50	1185.78	1.055	4.217	1.45	18	319.62	3.935	15.64	5.40
5	1146.28	1.091	4.362	1.50	19	302.94	4.155	16.51	5.70
10	1109.33	1.127	4.507	1.55	20	287.94	4.374	17.37	6.00
20	1074.68	1.164	4.653	1.60	21	274.37	4.594	18.22	6.30
30	1042.14	1.200	4.798	1.65	22	262.04	4.814	19.08	6.60
40	1011.51	1.237	4.943	1.70	23	250.79	5.035	19.94	6.90
50	982.64	1.273	5.088	1.75	24	240.49	5.255	20.79	7.20
6	955.37	1.309	5.234	1.80	25	231.01	5.476	21.64	7.50
10	929.57	1.346	5.379	1.85	26	222.27	5.697	22.50	7.80
20	905.13	1.382	5.524	1.90	27	214.18	5.918	23.35	8.10
30	881.95	1.418	5.669	1.95	28	206.68	6.139	24.19	8.40
40	859.92	1.455	5.814	2.00	29	199.70	6.360	25.04	8.70
					30	193.18	6.583	25.88	9.00

Note. Chord Deflection=2 times tangent deflection.

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
1°	50.00	.22	11°	551.70	26.50	21°	1061.9	97.57
10'	58.34	.30	10'	560.11	27.31	10'	1070.6	99.16
20	66.67	.39	20	568.53	28.14	20	1079.2	100.75
30	75.01	.49	30	576.95	28.97	30	1087.8	102.35
40	83.34	.61	40	585.36	29.82	40	1096.4	103.97
50	91.68	.73	50	593.79	30.68	50	1105.1	105.60
2	100.01	.87	12	602.21	31.56	22	1113.7	107.24
10	108.35	1.02	10	610.64	32.45	10	1122.4	108.90
20	116.68	1.19	20	619.07	33.35	20	1131.0	110.57
30	125.02	1.36	30	627.50	34.26	30	1139.7	112.25
40	133.36	1.55	40	635.93	35.18	40	1148.4	113.95
50	141.70	1.75	50	644.37	36.12	50	1157.0	115.66
3	150.04	1.96	13	652.81	37.07	23	1165.7	117.38
10	158.38	2.19	10	661.25	38.03	10	1174.4	119.12
20	166.72	2.43	20	669.70	39.01	20	1183.1	120.87
30	175.06	2.67	30	678.15	39.99	30	1191.8	122.63
40	183.40	2.93	40	686.60	40.99	40	1200.5	124.41
50	191.74	3.21	50	695.06	42.00	50	1209.2	126.20
4	200.08	3.49	14	703.51	43.03	24	1217.9	128.00
10	208.43	3.79	10	711.97	44.07	10	1226.6	129.82
20	216.77	4.10	20	720.44	45.12	20	1235.3	131.65
30	225.12	4.42	30	728.90	46.18	30	1244.0	133.50
40	233.47	4.76	40	737.37	47.25	40	1252.8	135.35
50	241.81	5.10	50	745.85	48.34	50	1261.5	137.23
5	250.16	5.46	15	754.32	49.44	25	1270.2	139.11
10	258.51	5.83	10	762.80	50.55	10	1279.0	141.01
20	266.86	6.21	20	771.29	51.68	20	1287.7	142.93
30	275.21	6.61	30	779.77	52.89	30	1296.5	144.85
40	283.57	7.01	40	788.26	53.97	40	1305.3	146.79
50	291.92	7.43	50	796.75	55.13	50	1314.0	148.75
6	300.28	7.86	16	805.25	56.31	26	1322.8	150.71
10	308.64	8.31	10	813.75	57.50	10	1331.6	152.69
20	316.99	8.76	20	822.25	58.70	20	1340.4	154.69
30	325.35	9.23	30	830.76	59.91	30	1349.2	156.70
40	333.71	9.71	40	839.27	61.14	40	1358.0	158.72
50	342.08	10.20	50	847.78	62.38	50	1366.8	160.76
7	350.44	10.71	17	856.30	63.63	27	1375.6	162.81
10	358.81	11.22	10	864.82	64.90	10	1384.4	164.86
20	367.17	11.75	20	873.35	66.18	20	1393.2	166.95
30	375.54	12.29	30	881.88	67.47	30	1402.0	169.04
40	383.91	12.85	40	890.41	68.77	40	1410.9	171.15
50	392.28	13.41	50	898.95	70.09	50	1419.7	173.27
8	400.66	13.99	18	907.49	71.42	28	1428.6	175.41
10	409.03	14.58	10	916.03	72.76	10	1437.4	177.55
20	417.41	15.18	20	924.58	74.12	20	1446.3	179.72
30	425.79	15.80	30	933.13	75.49	30	1455.1	181.89
40	434.17	16.43	40	941.69	76.86	40	1464.0	184.08
50	442.55	17.07	50	950.25	78.26	50	1472.9	186.29
9	450.93	17.72	19	958.81	79.67	29	1481.8	188.51
10	459.32	18.38	10	967.38	81.09	10	1490.7	190.74
20	467.71	19.06	20	975.96	82.53	20	1499.6	192.99
30	476.10	19.75	30	984.53	83.97	30	1508.5	195.25
40	484.49	20.45	40	993.12	85.43	40	1517.4	197.53
50	492.88	21.16	50	1001.7	86.90	50	1526.3	199.82
10	501.28	21.89	20	1010.3	88.39	30	1535.3	202.12
10	509.68	22.62	10	1018.9	89.89	10	1544.2	204.44
20	518.08	23.38	20	1027.5	91.40	20	1553.1	206.77
30	526.48	24.14	30	1036.1	92.92	30	1562.1	209.12
40	534.89	24.91	40	1044.7	94.46	40	1571.0	211.48
50	543.29	25.70	50	1053.3	96.01	50	1580.0	213.80

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
31°	1589.0	216.3	41°	2142.2	387.4	51°	2732.9	618.4
10'	1598.0	218.7	10'	2151.7	390.7	10'	2743.1	622.8
20	1606.9	221.1	20	2161.2	394.1	20	2753.4	627.2
30	1615.9	223.5	30	2170.8	397.4	30	2763.7	631.7
40	1624.9	226.0	40	2180.3	400.8	40	2773.9	636.2
50	1633.9	228.4	50	2189.9	404.2	50	2784.2	640.7
32°	1643.0	230.9	42°	2199.4	407.6	52°	2794.5	645.2
10	1652.0	233.4	10	2209.0	411.1	10	2804.9	649.7
20	1661.0	235.9	20	2218.6	414.5	20	2815.2	654.3
30	1670.0	238.4	30	2228.1	418.0	30	2825.6	658.8
40	1679.1	241.0	40	2237.7	421.4	40	2835.9	663.4
50	1688.1	243.5	50	2247.3	425.0	50	2846.3	668.0
33°	1697.2	246.1	43°	2257.0	428.5	53°	2856.7	672.7
10	1706.3	248.7	10	2266.6	432.0	10	2867.1	677.3
20	1715.3	251.3	20	2276.2	435.6	20	2877.5	682.0
30	1724.4	253.9	30	2285.9	439.2	30	2888.0	686.7
40	1733.5	256.5	40	2295.6	442.8	40	2898.4	691.4
50	1742.6	259.1	50	2305.2	446.4	50	2908.9	696.1
34°	1751.7	261.8	44°	2314.9	450.0	54°	2919.4	700.9
10	1760.8	264.5	10	2324.6	453.6	10	2929.9	705.7
20	1770.0	267.2	20	2334.3	457.3	20	2940.4	710.5
30	1779.1	269.9	30	2344.1	461.0	30	2951.0	715.3
40	1788.2	272.6	40	2353.8	464.6	40	2961.5	720.1
50	1797.4	275.3	50	2363.5	468.4	50	2972.1	725.0
35°	1806.6	278.1	45°	2373.3	472.1	55°	2982.7	729.9
10	1815.7	280.8	10	2383.1	475.8	10	2993.3	734.8
20	1824.9	283.6	20	2392.8	479.6	20	3003.9	739.7
30	1834.1	286.4	30	2402.6	483.3	30	3014.5	744.6
40	1843.3	289.2	40	2412.4	487.2	40	3025.2	749.6
50	1852.5	292.0	50	2422.3	491.0	50	3035.8	754.6
36°	1861.7	294.9	46°	2432.1	494.8	56°	3046.5	759.6
10	1870.9	297.7	10	2441.9	498.7	10	3057.2	764.6
20	1880.1	300.6	20	2451.8	502.5	20	3067.9	769.7
30	1889.4	303.5	30	2461.7	506.4	30	3078.7	774.7
40	1898.6	306.4	40	2471.5	510.3	40	3089.4	779.8
50	1907.9	309.3	50	2481.4	514.3	50	3100.2	784.9
37°	1917.1	312.2	47°	2491.3	518.2	57°	3110.9	790.1
10	1926.4	315.2	10	2501.2	522.2	10	3121.7	795.2
20	1935.7	318.1	20	2511.2	526.1	20	3132.6	800.4
30	1945.0	321.1	30	2521.1	530.1	30	3143.4	805.6
40	1954.3	324.1	40	2531.1	534.2	40	3154.2	810.9
50	1963.6	327.1	50	2541.0	538.2	50	3165.1	816.1
38°	1972.9	330.2	48°	2551.0	542.2	58°	3176.0	821.4
10	1982.2	333.2	10	2561.0	546.3	10	3186.9	826.7
20	1991.5	336.3	20	2571.0	550.4	20	3197.8	832.0
30	2000.9	339.3	30	2581.0	554.5	30	3208.8	837.3
40	2010.2	342.4	40	2591.0	558.6	40	3219.7	842.7
50	2019.6	345.5	50	2601.1	562.8	50	3230.7	848.1
39°	2029.0	348.6	49°	2611.2	566.9	59°	3241.7	853.5
10	2038.4	351.8	10	2621.2	571.1	10	3252.7	858.9
20	2047.8	354.9	20	2631.3	575.3	20	3263.7	864.3
30	2057.2	358.1	30	2641.4	579.5	30	3274.8	869.8
40	2066.6	361.3	40	2651.5	583.8	40	3285.8	875.3
50	2076.0	364.5	50	2661.6	588.0	50	3296.9	880.8
40°	2085.4	367.7	50°	2671.8	592.3	60°	3308.0	886.4
10	2094.9	371.0	10	2681.9	596.6	10	3319.1	892.0
20	2104.3	374.2	20	2692.1	600.9	20	3330.3	897.5
30	2113.8	377.5	30	2702.3	605.3	30	3341.4	903.2
40	2123.3	380.8	40	2712.5	609.6	40	3352.6	908.8
50	2132.7	384.1	50	2722.7	614.0	50	3363.8	914.5

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

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

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
91°	5830.5	2444.9	101°	6950.6	3278.1	111°	8336.7	4386.1
10'	5847.5	2457.1	10'	6971.3	3294.1	10'	8362.7	4407.6
20	5864.6	2469.3	20	6992.0	3310.1	20	8388.9	4429.2
30	5881.7	2481.5	30	7012.7	3326.1	30	8415.1	4450.9
40	5898.8	2493.8	40	7033.6	3342.3	40	8441.5	4472.7
50	5916.0	2506.1	50	7054.5	3358.5	50	8468.0	4494.6
92°	5933.2	2518.5	102°	7075.5	3374.9	112°	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
93°	6037.8	2594.0	103°	7203.2	3474.4	113°	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
94°	6144.3	2671.6	104°	7333.6	3576.8	114°	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
95°	6252.8	2751.3	105°	7467.0	3682.3	115°	8993.8	4934.1
10	6271.1	2764.8	10	7489.6	3700.2	10	9022.7	4958.6
20	6289.4	2778.3	20	7512.2	3718.2	20	9051.7	4983.1
30	6307.9	2792.0	30	7534.9	3736.2	30	9080.9	5007.8
40	6326.3	2805.6	40	7557.7	3754.4	40	9110.3	5032.6
50	6344.8	2819.4	50	7580.5	3772.6	50	9139.8	5057.6
96°	6363.4	2833.2	106°	7603.5	3791.0	116°	9169.4	5082.7
10	6382.1	2847.0	10	7626.6	3809.4	10	9199.1	5107.9
20	6400.8	2861.0	20	7649.7	3827.9	20	9229.0	5133.3
30	6419.5	2875.0	30	7672.9	3846.5	30	9259.0	5158.8
40	6438.4	2889.0	40	7696.3	3865.2	40	9289.2	5184.5
50	6457.3	2903.1	50	7719.7	3884.0	50	9319.5	5210.3
97°	6476.2	2917.3	107°	7743.2	3902.9	117°	9349.9	5236.2
10	6495.2	2931.6	10	7766.8	3921.9	10	9380.5	5262.3
20	6514.3	2945.9	20	7790.5	3940.9	20	9411.3	5288.6
30	6533.4	2960.3	30	7814.3	3960.1	30	9442.2	5315.0
40	6552.6	2974.7	40	7838.1	3979.4	40	9473.2	5341.5
50	6571.9	2989.2	50	7862.1	3998.7	50	9504.4	5368.2
98°	6591.2	3003.8	108°	7886.2	4018.2	118°	9535.7	5395.1
10	6610.6	3018.4	10	7910.4	4037.8	10	9567.2	5422.1
20	6630.1	3033.1	20	7934.5	4057.4	20	9598.9	5449.2
30	6649.6	3047.9	30	7959.0	4077.2	30	9630.7	5476.5
40	6669.2	3062.8	40	7983.5	4097.1	40	9662.6	5504.0
50	6688.8	3077.7	50	8008.0	4117.0	50	9694.7	5531.7
99°	6708.6	3092.7	109°	8032.7	4137.1	119°	9727.0	5559.4
10	6728.4	3107.7	10	8057.4	4157.3	10	9759.4	5587.4
20	6748.2	3122.9	20	8082.3	4177.5	20	9792.0	5615.5
30	6768.1	3138.1	30	8107.3	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	6808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
100°	6828.3	3184.1	110°	8182.8	4259.7	120°	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

TABLE V.—CORRECTIONS FOR TANGENTS AND EXTERNALS.

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

FOR TANGENTS ADD

Central Angle	DEGREE OF CURVE															
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°		
10°	.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46		
15°	.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.58	.63	.68	.72		
20°	.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90		
25°	.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14		
30°	.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39		
35°	.11	.22	.34	.47	.58	.69	.79	.81	.92	1.04	1.29	1.42	1.54	1.66		
40°	.13	.26	.40	.53	.67	.80	.93	1.06	1.20	1.34	1.49	1.64	1.79	1.94		
45°	.15	.30	.44	.60	.76	.91	1.06	1.21	1.37	1.52	1.70	1.87	2.04	2.21		
50°	.17	.34	.51	.68	.85	1.02	1.19	1.36	1.54	1.72	1.91	2.10	2.29	2.48		
55°	.19	.38	.57	.76	.95	1.14	1.32	1.52	1.72	1.92	2.14	2.35	2.56	2.77		
60°	.21	.42	.63	.84	1.05	1.27	1.49	1.71	1.94	2.17	2.38	2.60	2.83	3.07		
65°	.23	.46	.69	.93	1.16	1.40	1.64	1.88	2.13	2.38	2.63	2.88	3.13	3.39		
70°	.25	.51	.76	1.02	1.28	1.54	1.80	2.06	2.33	2.60	2.88	3.16	3.44	3.72		
75°	.27	.56	.83	1.12	1.40	1.69	1.98	2.27	2.57	2.87	3.16	3.47	3.78	4.09		
80°	.30	.61	.91	1.22	1.53	1.84	2.15	2.46	2.78	3.10	3.44	3.78	4.12	4.46		
85°	.33	.66	1.00	1.33	1.68	2.02	2.36	2.70	3.05	3.40	3.77	4.14	4.55	4.89		
90°	.36	.72	1.09	1.45	1.83	2.20	2.57	2.94	3.32	3.70	4.10	4.50	4.91	5.32		
95°	.39	.79	1.19	1.55	2.00	2.40	2.80	3.20	3.61	4.02	4.40	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		
110°	.51	1.03	1.56	2.08	2.61	3.14	3.67	4.21	4.76	5.31	5.86	6.43	7.01	7.60		
120°	.62	1.25	1.93	2.52	3.16	3.81	4.45	5.11	5.77	6.44	7.12	7.80	8.50	9.22		

FOR EXTERNALS ADD

Central Angle.	DEGREE OF CURVE														
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	
10°	.001	.003	.004	.006	.007	.008	.009	.011	.012	.014	.015	.017	.018	.020	
15°	.003	.007	.010	.014	.018	.023	.027	.029	.032	.035	.039	.043	.047	.051	
20°	.006	.011	.017	.022	.028	.034	.038	.045	.051	.057	.063	.070	.076	.083	
25°	.009	.018	.027	.036	.046	.056	.065	.074	.083	.093	.106	.120	.127	.135	
30°	.013	.025	.038	.051	.065	.078	.090	.103	.116	.129	.149	.170	.179	.188	
35°	.018	.035	.054	.072	.086	.109	.131	.153	.175	.197	.213	.230	.247	.264	
40°	.023	.046	.070	.093	.117	.141	.172	.203	.234	.265	.277	.290	.315	.341	
45°	.030	.060	.093	.119	.153	.184	.216	.254	.289	.325	.351	.378	.411	.445	
50°	.037	.075	.116	.151	.189	.227	.266	.305	.345	.384	.425	.467	.508	.550	
55°	.046	.093	.142	.188	.236	.283	.332	.381	.420	.479	.530	.582	.641	.700	
60°	.056	.112	.168	.225	.283	.340	.398	.457	.516	.575	.636	.697	.774	.851	
65°	.067	.135	.204	.273	.343	.412	.483	.554	.625	.697	.771	.845	.922	1.01	
70°	.080	.159	.240	.321	.403	.485	.568	.652	.735	.819	.906	.994	1.08	1.17	
75°	.095	.182	.266	.353	.440	.528	.618	.707	.797	.887	.977	1.07	1.18	1.29	
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	.895	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	
110°	.268	.536	.806	1.08	1.35	1.63	1.91	2.20	2.48	2.76	3.05	3.35	3.66	3.96	
120°	.360	.721	1.08	1.45	1.82	2.19	2.57	2.95	3.33	3.72	4.11	4.50	4.91	5.32	

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

FOR SUB-CHORDS ADD										Excess of arc per 100 ft.	LONG CHORDS				
D	10	20	30	40	50	60	70	80	90		D	200	300	400	500
4°	.00	.00	.01	.01	.01	.01	.01	.01	.00	.02	1	199.99	299.97	399.92	499.85
6°	.00	.01	.01	.02	.02	.02	.02	.01	.01	.05	2	199.97	299.88	399.70	499.39
8°	.01	.02	.02	.03	.03	.03	.03	.02	.01	.08	3	199.93	299.73	399.32	498.63
10°	.01	.02	.03	.04	.05	.05	.05	.04	.02	.13	4	199.88	299.51	398.78	497.57
12°	.02	.04	.05	.06	.07	.07	.07	.05	.03	.18	5	199.81	299.24	398.10	496.20
14°	.02	.05	.07	.08	.09	.10	.09	.07	.04	.25	6	199.73	298.90	397.26	494.53
16°	.03	.06	.09	.11	.12	.12	.12	.09	.05	.33	7	199.63	298.51	396.28	492.57
18°	.04	.08	.11	.14	.15	.16	.15	.12	.07	.41	8	199.51	298.05	395.14	490.31
20°	.05	.10	.14	.17	.19	.20	.18	.15	.09	.51	9	199.38	297.54	393.86	487.75
22°	.06	.12	.17	.21	.23	.24	.22	.18	.10	.62	10	199.24	296.96	392.42	484.90
24°	.07	.14	.20	.25	.28	.28	.26	.21	.12	.74	12	198.90	295.63	389.12	478.34
26°	.09	.17	.24	.29	.32	.33	.31	.25	.15	.86	14	198.51	294.06	385.22	470.65
28°	.10	.19	.27	.34	.37	.38	.36	.29	.17	1.00	16	198.05	292.25	380.76	461.86
30°	.11	.22	.31	.39	.43	.44	.41	.33	.19	1.15	18	197.54	290.21	375.74	452.02
32°	.13	.25	.36	.44	.49	.50	.47	.38	.22	1.31	20	196.96	287.94	370.17	441.15
34°	.15	.28	.40	.50	.55	.57	.53	.43	.25	1.48	22	196.32	285.44	364.06	429.30
36°	.17	.32	.45	.56	.62	.64	.59	.48	.28	1.66	24	195.63	282.71	357.43	416.53
38°	.18	.36	.51	.62	.70	.71	.66	.53	.31	1.86	26	194.87	279.76	350.30	402.89
40°	.21	.40	.56	.69	.77	.79	.73	.59	.35	2.06	28	194.06	276.59	342.69	388.43
42°	.23	.44	.62	.76	.85	.87	.81	.65	.38	2.28	30	193.18	273.20	334.61	373.20
44°	.25	.48	.68	.84	.94	.96	.89	.72	.42	2.50	32	192.25	269.61	326.08	357.28
46°	.27	.52	.75	.92	1.02	1.05	.98	.78	.46	2.74	34	191.26	265.81	317.12	340.73
48°	.30	.57	.81	1.00	1.12	1.14	1.06	.86	.50	2.99	36	190.21	261.80	307.77	323.61
50°	.32	.62	.89	1.09	1.21	1.24	1.15	.93	.55	3.24	38	189.10	257.60	298.03	305.99
52°	.35	.67	.96	1.18	1.31	1.35	1.25	1.01	.59	3.52	40	187.94	253.21	287.94	287.94
54°	.38	.73	1.04	1.28	1.42	1.46	1.35	1.09	.64	3.80	42	186.72	248.63	277.51	269.54
56°	.41	.78	1.12	1.38	1.53	1.57	1.46	1.17	.69	4.09	44	185.44	243.87	266.78	250.85
58°	.44	.84	1.20	1.48	1.65	1.69	1.57	1.26	.74	4.40	46	184.10	239.93	255.78	231.95
60°	.47	.91	1.29	1.59	1.76	1.81	1.68	1.35	.80	4.72	48	182.71	235.83	244.51	212.92

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

TABLE VII.—MIDDLE ORDINATES FOR RAILS IN FEET.

Deg. of Curve	LENGTH OF RAILS							Deg. of Curve	LENGTH OF RAILS.						
	32	30	28	26	24	22	20		32	30	28	26	24	22	20
1°	.022	.020	.016	.013	.011	.009	.008	16°	.356	.313	.273	.236	.200	.170	.139
2°	.045	.038	.034	.029	.025	.021	.017	17°	.378	.333	.290	.252	.213	.180	.148
3°	.037	.058	.051	.044	.037	.031	.026	18°	.400	.351	.306	.265	.225	.190	.156
4°	.089	.079	.069	.060	.050	.042	.035	19°	.423	.371	.324	.280	.238	.201	.165
5°	.112	.099	.086	.074	.063	.053	.044	20°	.445	.392	.341	.296	.250	.212	.174
6°	.134	.117	.102	.088	.076	.064	.052	21°	.466	.410	.357	.309	.262	.222	.182
7°	.156	.137	.120	.104	.088	.074	.061	22°	.487	.430	.375	.325	.275	.233	.191
8°	.179	.158	.137	.119	.100	.085	.070	23°	.509	.450	.390	.338	.287	.243	.199
9°	.201	.175	.153	.133	.112	.095	.078	24°	.531	.469	.408	.354	.299	.253	.208
10°	.223	.196	.171	.148	.125	.106	.087	25°	.552	.486	.424	.367	.311	.263	.216
11°	.245	.216	.188	.163	.139	.117	.096	26°	.573	.506	.441	.382	.323	.274	.225
12°	.268	.236	.206	.179	.151	.128	.105	27°	.594	.524	.457	.396	.335	.284	.233
13°	.290	.254	.222	.192	.163	.138	.113	28°	.618	.545	.475	.411	.348	.294	.242
14°	.312	.275	.239	.207	.175	.148	.122	29°	.638	.564	.491	.424	.361	.303	.250
15°	.334	.295	.257	.223	.188	.159	.131	30°	.660	.583	.508	.438	.374	.313	.259

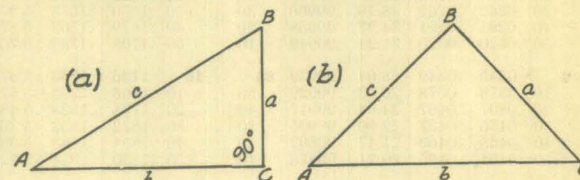
SLOPE REDUCTIONS.

When distances are measured on a slope they may be reduced to the equivalent horizontal distance by the following approximate rule:—subtract from the slope distance the square of the rise divided by twice the slope distance. Thus for a slope distance of 250.3 ft. and a rise of 15 ft. correction= $15^2 \div 2 \times 250.3 = .45$ (by slide rule) or horizontal distance= $250.3 - .45 = 249.85$. When vertical angle= $V. A.$ is measured horizontal distance=slope distance—slope distance $(1 - \cos. V. A.)$. Thus for slope distance of 248.7 ft. and $V. A.$ of $4^\circ 20'$ from Table VIII $\cos = .99714$ and correction= $1 - .99714 = .00286$ per foot or total of $.286 \times 2\frac{1}{2}$ (near enough) = .57 and horizontal distance= $248.7 - .57 = 248.13$ ft.

See fig. (a).

TRIGONOMETRICAL FORMULAS.

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



FORMULA FOR SOLVING TRIANGLES.

Given		Sought.		Right triangles. See fig. (a).	
a, c	A, B, b	$\sin. A = \frac{a}{c}, \cos. B = \frac{b}{c}, b = \sqrt{(c+a)(c-a)}$			
a, b	A, B, c	$\tan. A = \frac{a}{b}, \cot. B = \frac{a}{b}, c = \sqrt{a^2 + b^2}$			
A, a	B, b, c	$B = 90^\circ - A, b = a \cot. A, c = \frac{a}{\sin. A}$			
A, b	B, a, c	$B = 90^\circ - A, a = b \tan. A, c = \frac{b}{\cos. A}$			
A, c	B, a, b	$B = 90^\circ - A, a = c \sin. A, c = c \cos. A$			
Given		Sought.		Oblique triangles. See fig. (b).	
A, B, a	b	$b = \frac{a \sin. B}{\sin. A}$			
A, a, b	B	$\sin. B = \frac{b \sin. A}{a}$			
a, b, C	A — B	$\tan. \frac{1}{2} (A - B) = \frac{(a - b) \tan. \frac{1}{2} (A + B)}{a + b}$			
a, b, c	A	$\left\{ \begin{array}{l} \text{If } s = \frac{1}{2} (a + b + c), \sin. \frac{1}{2} A = \sqrt{\frac{(s - b)(s - c)}{bc}} \\ \cos. \frac{1}{2} A = \sqrt{\frac{s(s - a)}{bc}}, \tan. \frac{1}{2} A = \sqrt{\frac{(s - b)(s - c)}{s(s - a)}} \\ \sin. A = 2 \sqrt{\frac{s(s - a)(s - b)(s - c)}{bc}} \end{array} \right.$			
A, B, C, a	area	$\text{area} = \frac{a^2 \sin. B \sin. C}{2 \sin. A}$			
A, b, c	area	$\text{area} = \frac{1}{2} bc \sin. A$			
a, b, c	area	$s = \frac{1}{2} (a + b + c), \text{area} = \sqrt{s(s - a)(s - b)(s - c)}$			

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.	Angle	Sine.	Tan.	Cotg.	Cosin.		
0	0	0	∞	1	90	1	∞	0	0		
10	.0029	.0029	343.8	.99999	50	.7660	1.0713	.93256	.64279		
20	.0058	.0058	171.9	.99998	40	.6428	.6745	.78129	.76604		
30	.0087	.0087	114.6	.99996	30	.5196	.5299	.66262	.86603		
40	.0116	.0116	85.94	.99993	20	.3907	.3917	.50953	.93969		
50	.0145	.0145	68.75	.99989	10	.2618	.2618	.39176	.96594		
1	.0175	.0175	57.29	.99985	89	.9802	5.2729	.01753	.19509		
10	.0204	.0204	49.10	.99979	50	.7660	1.0713	.93256	.64279		
20	.0233	.0233	42.96	.99973	40	.6428	.6745	.78129	.76604		
30	.0262	.0262	38.19	.99966	30	.5196	.5299	.66262	.86603		
40	.0291	.0291	34.37	.99958	20	.3907	.3917	.50953	.93969		
50	.0320	.0320	31.24	.99949	10	.2618	.2618	.39176	.96594		
2	.0349	.0349	28.64	.99939	88	.9799	5.2729	.01753	.19509		
10	.0378	.0378	26.43	.99929	50	.7660	1.0713	.93256	.64279		
20	.0407	.0407	24.54	.99917	40	.6428	.6745	.78129	.76604		
30	.0436	.0437	22.90	.99905	30	.5196	.5299	.66262	.86603		
40	.0465	.0466	21.47	.99892	20	.3907	.3917	.50953	.93969		
50	.0494	.0495	20.21	.99878	10	.2618	.2618	.39176	.96594		
3	.0523	.0524	19.08	.99863	87	.9781	5.2729	.01753	.19509		
10	.0552	.0553	18.07	.99847	50	.7660	1.0713	.93256	.64279		
20	.0581	.0582	17.17	.99831	40	.6428	.6745	.78129	.76604		
30	.0610	.0612	16.35	.99813	30	.5196	.5299	.66262	.86603		
40	.0640	.0641	15.60	.99795	20	.3907	.3917	.50953	.93969		
50	.0669	.0670	14.92	.99776	10	.2618	.2618	.39176	.96594		
4	.0698	.0699	14.30	.99756	86	.9763	5.2729	.01753	.19509		
10	.0727	.0729	13.73	.99736	50	.7660	1.0713	.93256	.64279		
20	.0756	.0758	13.20	.99714	40	.6428	.6745	.78129	.76604		
30	.0785	.0787	12.71	.99692	30	.5196	.5299	.66262	.86603		
40	.0814	.0816	12.25	.99668	20	.3907	.3917	.50953	.93969		
50	.0843	.0846	11.83	.99644	10	.2618	.2618	.39176	.96594		
5	.0872	.0875	11.43	.99619	85	.9745	5.2729	.01753	.19509		
10	.0901	.0904	11.06	.99594	50	.7660	1.0713	.93256	.64279		
20	.0929	.0934	10.71	.99567	40	.6428	.6745	.78129	.76604		
30	.0958	.0963	10.39	.99540	30	.5196	.5299	.66262	.86603		
40	.0987	.0992	10.08	.99511	20	.3907	.3917	.50953	.93969		
50	.1016	.1022	9.788	.99482	10	.2618	.2618	.39176	.96594		
6	.1045	.1051	9.514	.99452	84	.9727	5.2729	.01753	.19509		
10	.1074	.1080	9.255	.99421	50	.7660	1.0713	.93256	.64279		
20	.1103	.1110	9.010	.99390	40	.6428	.6745	.78129	.76604		
30	.1132	.1139	8.777	.99357	30	.5196	.5299	.66262	.86603		
40	.1161	.1169	8.556	.99324	20	.3907	.3917	.50953	.93969		
50	.1190	.1198	8.345	.99290	10	.2618	.2618	.39176	.96594		
7	.1219	.1228	8.144	.99255	83	.9709	5.2729	.01753	.19509		
10	.1248	.1257	7.953	.99219	50	.7660	1.0713	.93256	.64279		
20	.1276	.1287	7.770	.99182	40	.6428	.6745	.78129	.76604		
30	.1305	.1317	7.596	.99144	30	.5196	.5299	.66262	.86603		
40	.1334	.1346	7.429	.99106	20	.3907	.3917	.50953	.93969		
50	.1363	.1376	7.269	.99067	10	.2618	.2618	.39176	.96594		
	Cosin.	Cotg.	Tan.	Sine.	Angle.		Cosin.	Cotg.	Tan.	Sine.	Angle.

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.		Angle	Sine.	Tan.	Cotg.	Cosin.	
16	.2756	.2867	3.487	.96126	74	24	.4067	.4452	2.246	.91355	66
10	.2784	.2899	3.450	.96046	50	10	.4094	.4487	2.229	.91236	50
20	.2812	.2931	3.412	.95964	40	20	.4120	.4522	2.211	.91116	40
30	.2840	.2962	3.376	.95882	30	30	.4147	.4557	2.194	.90996	30
40	.2868	.2994	3.340	.95799	20	40	.4173	.4592	2.177	.90875	20
50	.2896	.3026	3.305	.95715	10	50	.4200	.4628	2.161	.90753	10
17	.2924	.3057	3.271	.95615	73	25	.4226	.4663	2.145	.90631	65
10	.2952	.3089	3.237	.95545	50	10	.4253	.4699	2.128	.90507	50
20	.2979	.3121	3.204	.95459	40	20	.4279	.4734	2.112	.90383	40
30	.3007	.3153	3.172	.95372	30	30	.4305	.4770	2.097	.90259	30
40	.3035	.3185	3.140	.95284	20	40	.4331	.4806	2.081	.90133	20
50	.3062	.3217	3.108	.95195	10	50	.4358	.4841	2.066	.90007	10
18	.3090	.3249	3.078	.95106	72	26	.4384	.4877	2.050	.89879	64
10	.3118	.3281	3.048	.95015	50	10	.4410	.4913	2.035	.89752	50
20	.3145	.3314	3.018	.94924	40	20	.4436	.4950	2.020	.89623	40
30	.3173	.3346	2.989	.94832	30	30	.4462	.4986	2.006	.89493	30
40	.3201	.3378	2.960	.94740	20	40	.4488	.5022	1.991	.89363	20
50	.3228	.3411	2.932	.94646	10	50	.4514	.5059	1.977	.89232	10
19	.3256	.3443	2.904	.94552	71	27	.4540	.5095	1.963	.89101	63
10	.3283	.3476	2.877	.94457	50	10	.4566	.5132	1.949	.88968	50
20	.3311	.3508	2.850	.94361	40	20	.4592	.5169	1.935	.88835	40
30	.3338	.3541	2.824	.94264	30	30	.4617	.5206	1.921	.88701	30
40	.3365	.3574	2.798	.94167	20	40	.4643	.5243	1.907	.88566	20
50	.3393	.3607	2.773	.94068	10	50	.4669	.5280	1.894	.88431	10
20	.3420	.3640	2.747	.93969	70	28	.4695	.5317	1.881	.88295	62
10	.3448	.3673	2.723	.93869	50	10	.4720	.5354	1.868	.88158	50
20	.3475	.3706	2.699	.93769	40	20	.4746	.5392	1.855	.88020	40
30	.3502	.3739	2.675	.93667	30	30	.4772	.5430	1.842	.87882	30
40	.3529	.3772	2.651	.93565	20	40	.4797	.5467	1.829	.87743	20
50	.3557	.3805	2.628	.93462	10	50	.4823	.5505	1.816	.87603	10
21	.3584	.3839	2.605	.93358	69	29	.4848	.5543	1.804	.87462	61
10	.3611	.3872	2.583	.93253	50	10	.4874	.5581	1.792	.87321	50
20	.3638	.3906	2.560	.93148	40	20	.4899	.5619	1.780	.87178	40
30	.3665	.3939	2.539	.93042	30	30	.4924	.5658	1.767	.87036	30
40	.3692	.3973	2.517	.92935	20	40	.4950	.5696	1.756	.86892	20
50	.3719	.4006	2.496	.92827	10	50	.4975	.5735	1.744	.86748	10
22	.3746	.4040	2.475	.92718	68	30	.5000	.5774	1.732	.86603	60
10	.3773	.4074	2.455	.92609	50	10	.5025	.5812	1.720	.86457	50
20	.3800	.4108	2.434	.92499	40	20	.5050	.5851	1.709	.86310	40
30	.3827	.4142	2.414	.92388	30	30	.5075	.5890	1.698	.86163	30
40	.3854	.4176	2.394	.92276	20	40	.5100	.5930	1.686	.86015	20
50	.3881	.4210	2.375	.92164	10	50	.5125	.5969	1.675	.85866	10
23	.3907	.4245	2.356	.92050	67	31	.5150	.6009	1.664	.85717	59
10	.3934	.4279	2.337	.91936	50	10	.5175	.6048	1.653	.85567	50
20	.3961	.4314	2.318	.91822	40	20	.5200	.6088	1.643	.85416	40
30	.3987	.4348	2.300	.91706	30	30	.5225	.6128	1.632	.85264	30
40	.4014	.4383	2.282	.91590	20	40	.5250	.6168	1.621	.85112	20
50	.4041	.4417	2.264	.91472	10	50	.5275	.6208	1.611	.84959	10
					66						58
	Cosin.	Cotg.	Tan.	Sine.	Angle.		Cosin.	Cotg.	Tan.	Sine.	Angle.

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

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

TABLE IX.—CALCULATION OF EARTHWORK.

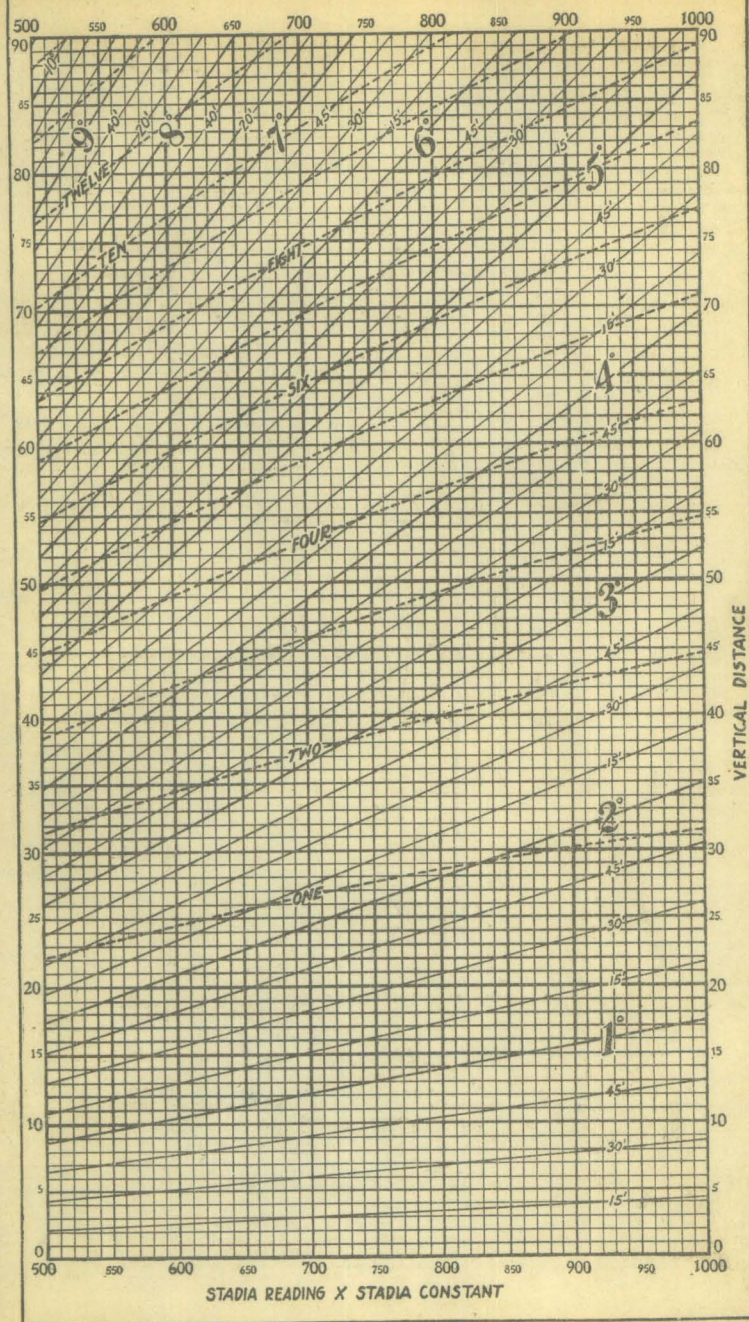
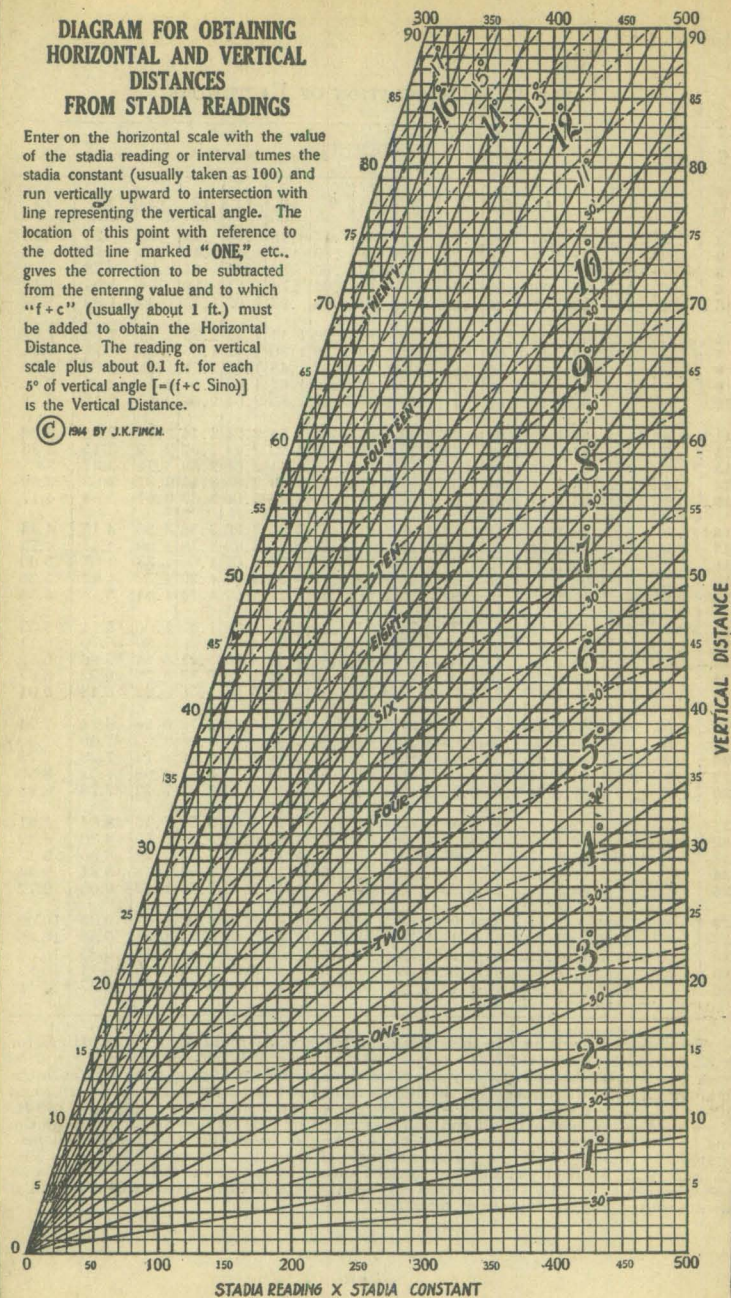
Width	HEIGHT														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.02	.04	.06	.07	.09	.11	.13	.15	.17	.18	.20	.22	.24	.26	.28
2	.04	.07	.11	.15	.18	.22	.26	.30	.33	.37	.41	.44	.48	.52	.56
3	.06	.11	.17	.22	.28	.33	.39	.44	.50	.56	.61	.67	.72	.78	.83
4	.07	.15	.22	.30	.37	.44	.52	.59	.67	.74	.81	.89	.96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

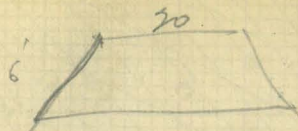
Table gives cu. yds. in 1 ft. of a triangle of given width and height. Corrections for tenths of width are one tenth the values found under each height considering the widths from 1 to 9 as tenths and similarly the corrections for tenths of height are one tenth the figures opposite width considering the heights from 1 to 9 as tenths. Thus if $w = 16.2$ and $h = 5.3$, cu. yds. $= 1.48 + .028 + .089 = 1.597$ cu. yds. or practically 160 cu. yds. per 100 ft. If w exceeds 40 ft., use one half and multiply result by 2, if both w and h are large use one half of each and multiply result by 4. Any cross-section may be divided into triangles by the following rule. To the triangle of the sum of the outside cuts (or fills) $= h$, and $\frac{1}{2}$ the roadbed $= w$, add the triangles formed by taking the distance out to each break in turn ($= w$'s) by the difference between the cuts (or fills) on each side of it ($= h$'s) always subtracting the outer from the inner.

DIAGRAM FOR OBTAINING HORIZONTAL AND VERTICAL DISTANCES FROM STADIA READINGS

Enter on the horizontal scale with the value of the stadia reading or interval times the stadia constant (usually taken as 100) and run vertically upward to intersection with line representing the vertical angle. The location of this point with reference to the dotted line marked "ONE," etc., gives the correction to be subtracted from the entering value and to which " $f+c$ " (usually about 1 ft.) must be added to obtain the Horizontal Distance. The reading on vertical scale plus about 0.1 ft. for each 5° of vertical angle [$=(f+c \sin \alpha)$] is the Vertical Distance.

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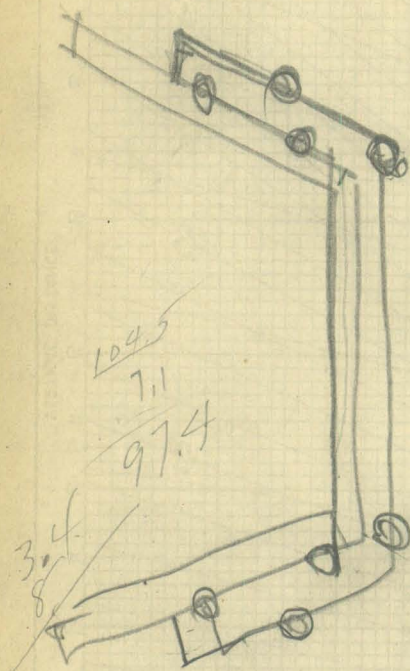




~~15~~

18
20
36
20
58

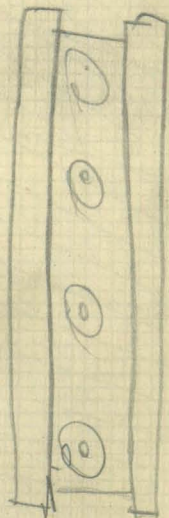
$$150 \times 77 \times 6 = 900.-$$



104.5
7.1
97.4

3.4
8

11.4



74	104	59
40.67	3.6	98.1
37.6	98.4	90.6
1.0	94.6	35
97.0	3.8	17
94.5	1.9	5.2
2.5	5.7	
1.2		
3.7		

5.5
31
55

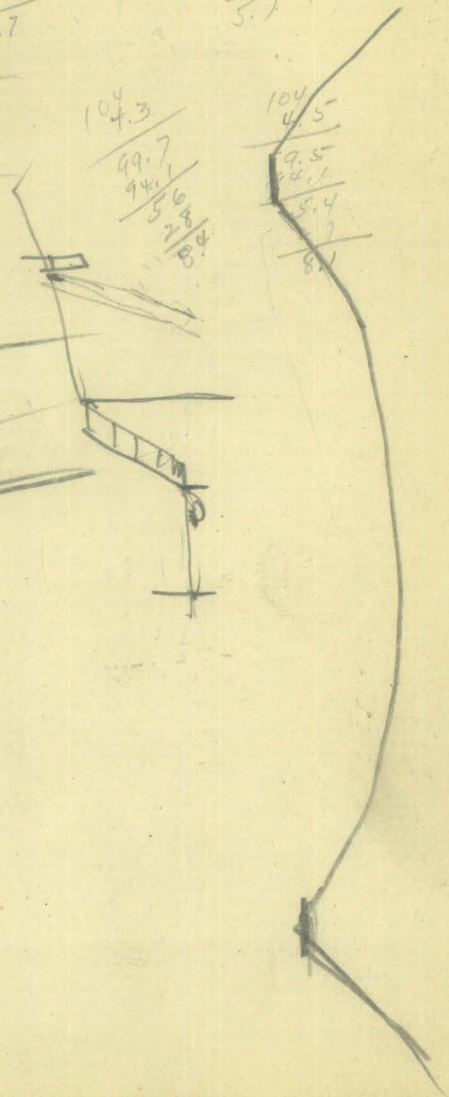
16.5

170.5
21.7
4.5

108.5
868
976.5

104.3
99.7
94.1
5.6
2.8
8.4

104.5
9.5
94.1
5.4
8.1



DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

Roadway 16 feet wide. Side Slopes 1 on 1½.
For Single Track Embankment.

H	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	H
0	8.0	8.2	8.3	8.5	8.6	8.8	8.9	9.1	9.2	9.4	0
1	9.5	9.7	9.8	10.0	10.1	10.3	10.4	10.6	10.7	10.9	1
2	11.0	11.2	11.3	11.5	11.6	11.8	11.9	12.1	12.2	12.4	2
3	12.5	12.7	12.8	13.0	13.1	13.3	13.4	13.6	13.7	13.9	3
4	14.0	14.2	14.3	14.5	14.6	14.8	14.9	15.1	15.2	15.4	4
5	15.5	15.7	15.8	16.0	16.1	16.3	16.4	16.6	16.7	16.9	5
6	17.0	17.2	17.3	17.5	17.6	17.8	17.9	18.1	18.2	18.4	6
7	18.5	18.7	18.8	19.0	19.1	19.3	19.4	19.6	19.7	19.9	7
8	20.0	20.2	20.3	20.5	20.6	20.8	20.9	21.1	21.2	21.4	8
9	21.5	21.7	21.8	22.0	22.1	22.3	22.4	22.6	22.7	22.9	9
10	23.0	23.2	23.3	23.5	23.6	23.8	23.9	24.1	24.2	24.4	10
11	24.5	24.7	24.8	25.0	25.1	25.3	25.4	25.6	25.7	25.9	11
12	26.0	26.2	26.3	26.5	26.6	26.8	26.9	27.1	27.2	27.4	12
13	27.5	27.7	27.8	28.0	28.1	28.3	28.4	28.6	28.7	28.9	13
14	29.0	29.2	29.3	29.5	29.6	29.8	29.9	30.1	30.2	30.4	14
15	30.5	30.7	30.8	31.0	31.1	31.3	31.4	31.6	31.7	31.9	15
16	32.0	32.2	32.3	32.5	32.6	32.8	32.9	33.1	33.2	33.4	16
17	33.5	33.7	33.8	34.0	34.1	34.3	34.4	34.6	34.7	34.9	17
18	35.0	35.2	35.3	35.5	35.6	35.8	35.9	36.1	36.2	36.4	18
19	36.5	36.7	36.8	37.0	37.1	37.3	37.4	37.6	37.7	37.9	19
20	38.0	38.2	38.3	38.5	38.6	38.8	38.9	39.1	39.2	39.4	20
21	39.5	39.7	39.8	40.0	40.1	40.3	40.4	40.6	40.7	40.9	21
22	41.0	41.2	41.3	41.5	41.6	41.8	41.9	42.1	42.2	42.4	22
23	42.5	42.7	42.8	43.0	43.1	43.3	43.4	43.6	43.7	43.9	23
24	44.0	44.2	44.3	44.5	44.6	44.8	44.9	45.1	45.2	45.4	24
25	45.5	45.7	45.8	46.0	46.1	46.3	46.4	46.6	46.7	46.9	25
26	47.0	47.2	47.3	47.5	47.6	47.8	47.9	48.1	48.2	48.4	26
27	48.5	48.7	48.8	49.0	49.1	49.3	49.4	49.6	49.7	49.9	27
28	50.0	50.2	50.3	50.5	50.6	50.8	50.9	51.1	51.2	51.4	28
29	51.5	51.7	51.8	52.0	52.1	52.3	52.4	52.6	52.7	52.9	29
30	53.0	53.2	53.3	53.5	53.6	53.8	53.9	54.1	54.2	54.4	30
31	54.5	54.7	54.8	55.0	55.1	55.3	55.4	55.6	55.7	55.9	31
32	56.0	56.2	56.3	56.5	56.6	56.8	56.9	57.1	57.2	57.4	32
33	57.5	57.7	57.8	58.0	58.1	58.3	58.4	58.6	58.7	58.9	33
34	59.0	59.2	59.3	59.5	59.6	59.8	59.9	60.1	60.2	60.4	34
35	60.5	60.7	60.8	61.0	61.1	61.3	61.4	61.6	61.7	61.9	35
36	62.0	62.2	62.3	62.5	62.6	62.8	62.9	63.1	63.2	63.4	36
37	63.5	63.7	63.8	64.0	64.1	64.3	64.4	64.6	64.7	64.9	37
38	65.0	65.2	65.3	65.5	65.6	65.8	65.9	66.1	66.2	66.4	38
39	66.5	66.7	66.8	67.0	67.1	67.3	67.4	67.6	67.7	67.9	39
40	68.0	68.2	68.3	68.5	68.6	68.8	68.9	69.1	69.2	69.4	40

Example—If point is 22.6 ft. above grade, how far should it be from center line to be a slope stake point? Ans. from Table 41.9. For same slopes but other widths of roadbed correct above figures by one-half difference in width of roadbed; thus in example above for 20 ft. roadbed distance will be $41.9 + (20 - 16) \div 2$ or 2 ft. added to 41.9 = 43.9. For slopes of 1 on 1 see inside of front cover.