

WILSON
FIELD BOOK
No. 10404

36

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.

H	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 30.6 = 32.6. For slopes of 1 on $1\frac{1}{2}$ see inside of back cover.

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Finder Return To—
county Engineers Office—
Waterloo, Iowa
Court House

Corner Stones

Sec. 36-89-14 Cedar Falls Twp. Page 60

Sec. 10-88-14 Black Hawk Twp. " 45

Sec. 35-36-89-14 Cedar Falls Twp. " 45

Sec. 31-36-89-14 " " " " 45

Sec. 36-89-14 " " " " 45

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PM 76 4.85

$$\frac{50 \text{ FL}}{9.3} = 5.38$$

$$\frac{30 \text{ F}}{6.2} = 4.84$$

$$\frac{23}{7.7} = 2.99$$

$$\frac{15 \text{ FL}}{7.4} = 2.03$$

$$\frac{15}{7.1} = 2.11$$

$$5.6$$

$$\frac{14}{5.5} = 2.55$$

$$\frac{15 \text{ FL}}{6.7} = 2.24$$

$$\frac{19}{6.1} = 3.12$$

$$\frac{30 \text{ F}}{3.5} = 8.57$$

$$\frac{60 \text{ FL}}{6.5} = 9.23$$

A 1

$$= N^{1/4} \text{ cor Sec 7.}$$

B.M. 75

3.32 902.27

898.95

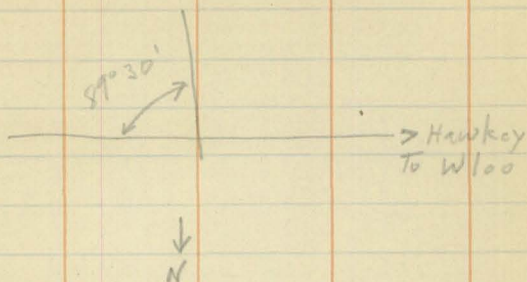
902.27

6.16
5.25

897.02

} High Water { On fence N side br. } Drift.
 { On bank N side br. }

NCF&N King



$$\begin{array}{r} 50 \\ 5.43 \\ \hline 849.94 \end{array}$$

$$\begin{array}{r} 50 \\ 5.42 \\ \hline 849.95 \end{array}$$

$$\begin{array}{r} 5.35 \\ \hline 850.02 \end{array}$$

$$\begin{array}{r} 5.32 \\ \hline 850.05 \end{array}$$

$$\begin{array}{r} 50 \\ 5.49 \\ \hline 849.88 \end{array}$$

$$\begin{array}{r} 50 \\ 5.51 \\ \hline 849.86 \end{array}$$

BM 2 2.88
2.06

855.37

853.31

Top E rail

Top W rail

S. headwall

N headwall

1st Wood

Sta

187+78

E

4.2 9 93
 38 88 87
 82 84 8
 51

No high water mark

7.7	857.8	90	160°33
8.7	856.8	130	180°25
8.4		70	211°53
8.5		50	241°18

field S.
 ditch S
 ditch S
 ditch S fence
 field N.

7.5	858.0	100	322°32
8.6		200	310°12

ditch N

8.5		80	295.32
-----	--	----	--------

ditch at N fence

		50	276°35'
--	--	----	---------

E Br.

Assumed Az: N=0°0'

3.95	865.5		861.6
------	-------	--	-------

Floor

2nd Wood

sta.

199 + 91

4th Wood

Sta

658+44.5

280	9.4	258° 5'
220	11.8	242° 14'
120	8.8	272° 0'

7.9 937.1

	7.4	
310	7.9	48° 2'
190	7.9	44° 50'
150	9.1	36° 5'
100	9.0	49° 11'
40	3.9	0° 0'

3.9 945.0

939.1

95 97

8

} 10' W of W bank
W bank S of rd.

High water Drift S fence

High Water Drift N fence

} E bank N.

E N side br.

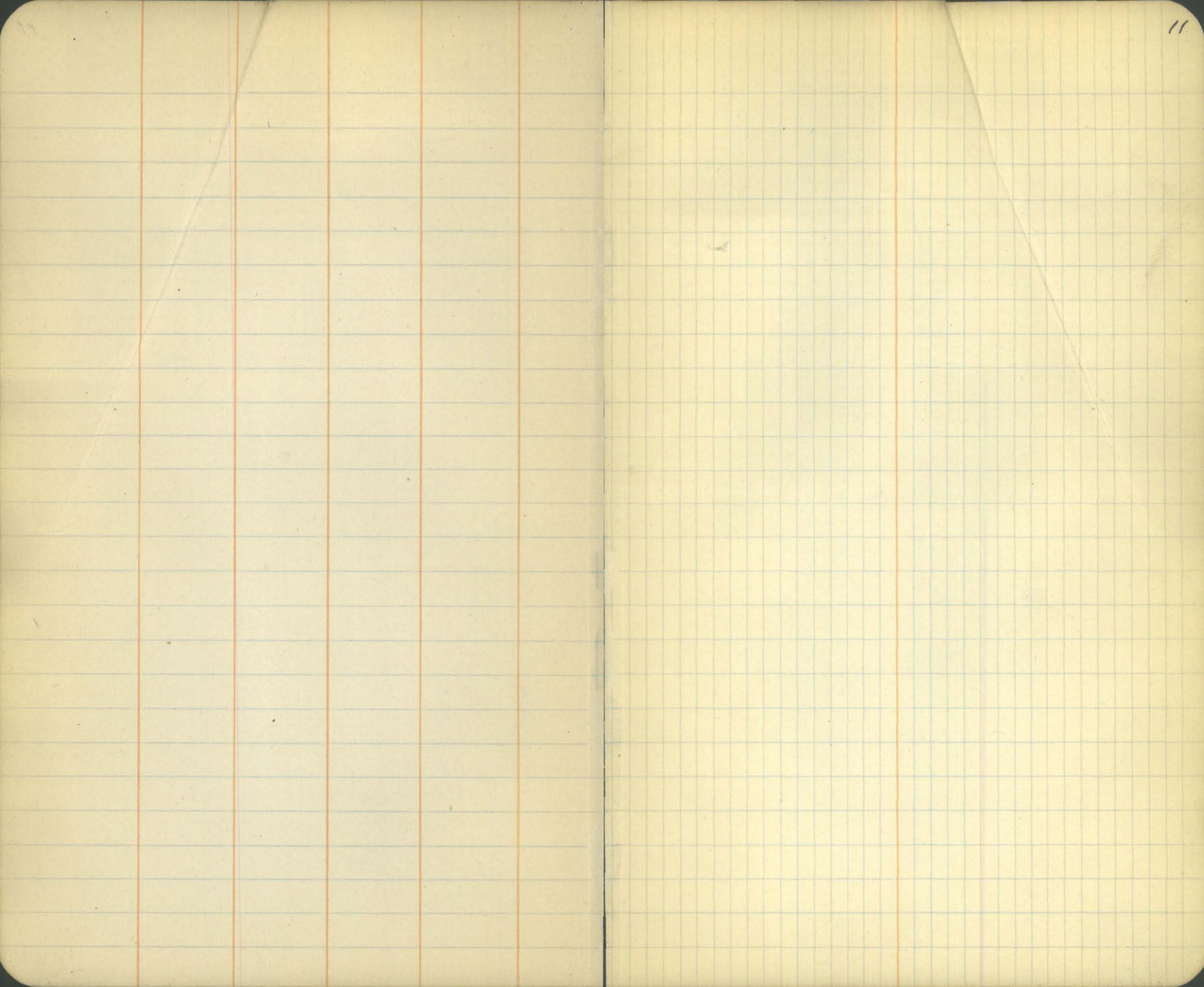
Floor

10	25	N		
	24	S	Conc-Steel	
	23	S	} Wood	9
	22	S		
	21	S		
	20	5	S	12
8	19	20	S	
	18	30	S	
	17	10	S	15
	16		S	
	15	100	N	18
6	14	15	N	19
	13	10	N	
	12	30	N	21
	11			
	10	10	N	23
	9	45	E	24
	8	40	E	25
	7	2	S	
	6	200	S	27
	5	20	S	
	4	60	S	29
	3	50	S	
	2	120	S	
#1	2300	S		

?
?

12	30	260	S		?
	29	1680	S	I	?
	28	1500	S	I	?
	27	160	N		
10	26	40	N		





Contracted

Item	Br. No.			Grade Elev.	Station	N FL	S FL	12
1		23-26	Byner	7x3x26	861.5	187+78	856.7	856.1
2		23-26	"	10x4x26	861.0	199+91	855.3	854.7
3		23-26	"	2-6x4x30	873.0	225+63	867.8	867.2
4		29-30	Barclay	2x2x30	922.0	345+08	E 918.9	W 918.1
5	22	22-27	"	8x4x26	975.3	485+10	969.3	968.7
6	23	25-27	"	2x2x40	985.0	504+80	980.0	980.6
7	26	26-35	"	2x2x40	971.5	558+20	967.5	966.9
8	27	26-35	"	6x4x29	969.0	562+98	962.5	961.9
9	29	26-35	"	3x2x26	976.5	587+97	973.4	972.6
10		25-36	"	30x20 I-Miller-Fifield				
11		6-7	Cedar Falls	2x2x26-Michaelson	949.03	700+30	944.1 8m 947.70	944.7
12		6-7	"	50x20 P.T.-Miller-Fi	901.00	724+29.75	926.3	926.0
13		5-8	"	2x2x26	948.03	750+30	926.3	926.0
14	38	5-8	"	2x2x34	968.0	782+53	961.9	961.3
15		5-8	"	2x2x26	970.0	793+67	964.0	964.0
16	40	4-9	"	3x3x34	971.0	825+94	964.0	964.0
17		4-9	"	2x2x26	961.39	849+32	956.9	957.9
18	42	3-10	"	2x2x26	960.0	854+79	956.0	956.5
19		3-10	"	8x8x36	897.29	885+54	886.5	887.1
20	44	3-10	"	5x5x26	897.03	890+39.5	889.6	890.2
21		3-10	"	4x3x30	923.01	906+57	916.2	916.8
22	46	11	"	2x2x26	962.00	928+30	941.8	942.4
23		11	"	3x2x26	945.65	942+18	941.8	942.4
24		22-27	E. Waterloo	70x18 PT				
25		19-30	Barclay	50x18 P.T.				

Br. No.	Repairs		
	Sec	Twp.	
2	19-30	E. Waterloo	18x18 I
15	19-30	Barclay	2x2x24 Sta. 306+72.5
18	20-29	"	4 1/2 x 3x24 Sta. 380+29
19	"	"	2x2x24 Sta. 397+81
20	21-28	"	2x2x22 Sta. 413+73
21	21-28	"	30x30x22 Sta. 424+64
24	26-27	"	3x3x24 Sta. 519+59
31	25-36	"	3x3x32 Sta. 615+83

Build 12" curtain 4' deep. on NW wing and 12' of face.
 New std. headwall on N. end. Gr. El. = 8
 New headwall on S. end Gr. El. = 955.6
 New headwall on S. end. Gr. El. = 975.4
 New headwall ^{Add 2' 0"} on S. end. Gr. El. = 990.6 ✓
 New headwall & ext. S. end. Gr. El. = 987.1 ✓
 New headwall W. end Gr. El. = ~~986.3~~ 987.0
 New headwall S. end Gr. El. = 964.6 ✓

#11

F.L.

$$\begin{array}{r} 948.03 \\ 3.5 \\ \hline 944.5 \end{array}$$

14

Grade = 948.03

c

E Nails 30' W 15' E

S stk

4.2 947.9 944.5

C 3.4

N. stk.

6.2 945.9 944.0

C 1.9

BM

4.45 952.15

947.70

#13

15

Grade 931.0
 $\begin{array}{r} 3.2 \\ 927.8 \end{array}$

L

Nails 15'W 15'E

S Stk

6.3 929.1 927.5 C 1.6

N. Stk

7.0 928.4 927.0 C 1.4

6.65 935.46

928.81

#14

F.L.

5
5.068
30
64.5
1.51.5 2.16
2
5.2968
629
/ 5.118.3
2
/ 5.1Grade 968.0
5.0

S Ditch

13.5

962.3

N Ditch

12.9

962.9

S sk

12.5
12.9

963.3

62.0

C 1.3

N sk

11.5

964.3

63.0

C 1.3

BM

2.37

975.82

973.45

#15

F.L.

17

Grade 970.0
 $\frac{3.0}{966.5}$

± Nails 15' W 15' E

S Stk. 7.4 967.6 966.0 C 1.6

N Stk 7.0 968.0 966.5 C 1.5

BM 1.6 975.0 973.45

#16

F.L.

$$\begin{array}{r} 74.5 \\ 66.5 \\ \hline \end{array}$$

18

Grade

971.0

49

966.5

26
3

Build 3' N of E of Road
Make N 10' of barrel-level

9.0

966.8

S Ditch

11.4

964.4

N. Ditch

S str

6.9

968.9 966.5

C 2.4

N str

9.6

966.2 964.5

C 1.7

B.M.

5.7

975.8

970.15

17

Grade 961.39
 $\begin{array}{r} 35 \\ \overline{957.9} \end{array}$

¢ Nails 15' W 15' E

S. Stk 6.4 959.9 957.9 C 2.0

N. Stk 8.6 957.7 956.9 C 0.8

6.2 966.3 960.10

#18

20

Grade 960.0
 $\begin{array}{r} 3.5 \\ 960.0 \\ \hline 956.5 \end{array}$

S. Stk

5.2

958.3

956.5

C. 1.8

N. Stk

7.0

956.5

956.0

C 0.5

6.0

963.5

957.54

#19

F.L.

21

Grade 897.29
 10.2
 887.0

4 Nails 40' E. 15' W

S Ditch 13.5 887.3

N Ditch 14.2 886.6

S. Stk 10.3 890.5 887.0

N. Stk 13.2 887.6 886.5

2.0 900.8

898.80



21° skew

C 3.5

C 1.1

#20

$$\begin{array}{r} 2.7 \\ 2.7 \\ \hline 5.4 \end{array}$$

$$\begin{array}{r} 7.3 \\ 1.9 \\ \hline 9.2 \end{array}$$

$$\begin{array}{r} 6.7 \\ 2.7 \\ \hline 9.4 \end{array}$$

$$\begin{array}{r} 5 \\ 1.6 \\ \hline 6.6 \end{array}$$

$$\begin{array}{r} 7.1 \\ 7.9 \\ \hline 15.0 \end{array}$$

$$\begin{array}{r} 1.3 \\ 1.2 \\ \hline 2.5 \end{array}$$

22

Grade

$$\begin{array}{r} 897.03 \\ 6.7 \\ \hline 890.3 \end{array}$$

Add 4' on length
Do not build Hand rail

~~About~~ Slight skew

$$\begin{array}{r} 1.1 \\ 1.6 \\ \hline 2.7 \end{array}$$

S ditch

11.0 889.8

N ditch

11.7 889.1

S Spk

$$\begin{array}{r} 7.8 \\ 6.4 \\ \hline 14.2 \end{array}$$

$$\begin{array}{r} 893.0 \\ 894.4 \\ \hline 896.8 \end{array}$$
C ~~4#~~ 2.7 3.3

N Spk

9.7 891.1 889.1 C 2.0

BM

2.0

900.8

898.80

$$\begin{array}{r} 7.9 \\ 6.8 \\ \hline 14.7 \end{array}$$

21

Grade 923.0
 + 4.6
 918.4

S Ditch

9.6 917.9

N Ditch

11.3 916.2

S Stk

5.7 921.8 916.7

C 5.1

N Stk

9.0 918.5 916.2

C 2.3

BM

5.0

927.5

922.49

6.8

4.6

2.2

4 3

4.6

23

3.3

923

916.2

6.8

4.6

2.3

Make skew 25° 0'

34' on skew b-b

22

Set 25' E of old

Grade 962.0
958.5

S Stk

10.8 960.8 958.5

C 2.3

N Stk

12.4 959.2 958.0

C 1.2

BM

0.17 971.64

971.47

2.6
5.9
6.1

Grade 945.65
 $\begin{array}{r} 3.5 \\ \hline 942.1 \end{array}$

S stn

7.6

943.4

942.1

C 1.3

N stn

8.0

943.0

941.6

C 1.4

BM

5.7

951.0

945.30

Ext #1.

Sta. 615+83

Gr Elev = 964.6
58.9
5.7

Remove old headwall

F.L.

10.7 958.9

Ditch

Stk

8.0 961.6

BM 54

4.6

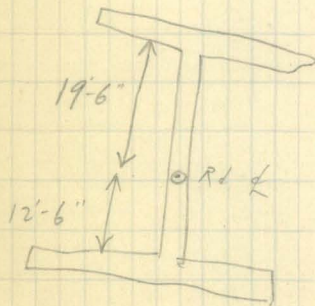
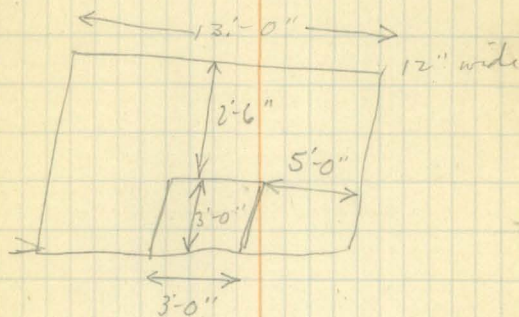
969.68

965.08

26

Build headwall S end

1st Cul E Walkers Park



E end N.

9

Sta 587+77

Grade 976.5

3.5

973.0

Blow out rd 3x2

1st Cul E of Double box

N. Stk

5.4

975.3

973.3

C 2.0

S Stk

6.6

974.1

973.0

C 1.1

BM 51

3.9

980.7

976.84

Gr. 969.0
 5.5
 963.3
 7.5
 5.7
 1.8
 5.1

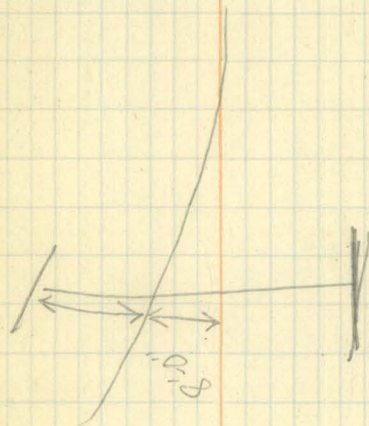
Build with 1.7 drop
 N end 13'0" N of Road E

Roadway b-b - 29'-0"
 Last Lower 10'-0" of barrel level

N. Ditch	10.5	963.0	
S Ditch	12.2	961.3	
N. Stk	7.9	965.6	963.0 961.8 C 2.6
S. Stk	9.8	963.7	961.3 962.8 C 2.4
1	3.6	973.5	969.2

7

Grade 971.5
 $\begin{array}{r} 2.5 \\ 968.0 \end{array}$



N. Stk 4.8 971.2 968.0 3.2

S Stk 7.4 968.6 967.5 1.1

3.8 976.0

972.27
 $\begin{array}{r} 971. \end{array}$

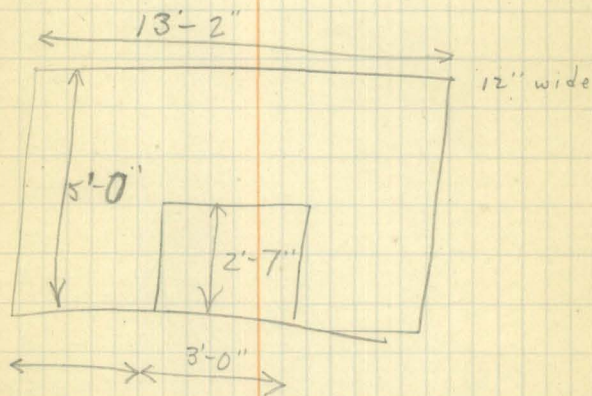
Ext[#] 2.

Gr. 987.0

5~~Add~~

Add 3' to barrel - Remove old headwall

1st cul S of turn S.



F.L.

9.3

982.2

982.2

W. Str

8.3

983.2

982.2

e 1.0

B.M.

3.4

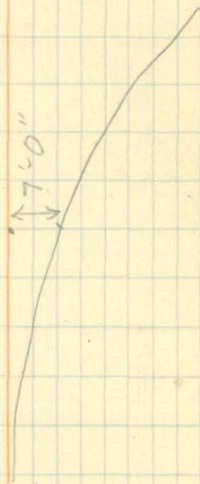
991.5

988.11

#6

Just W of turn S

Grade 985.0
 $\frac{3.0}{981.5}$

Cul. $\frac{1}{2}$ = $\frac{1}{2}$ E 8 W Rd.

N	Stk		6.3	983.0	981.0	C	2.0
---	-----	--	-----	-------	-------	---	-----

S	Stk		5.4	983.9	981.5	C	2.4
---	-----	--	-----	-------	-------	---	-----

6.3	989.3
-----	-------

983.04

5

32

Old wood bridge 1/2 mi W of turn S.

Grade 975.3

Sta. 485+10

$$\begin{array}{r} 5.75 \\ 969.5 \end{array}$$

6.9 971.4

Top of 2x4 on N. fence C 2.4

N. Stk

8.7 969.6 969.0

C 0.6

S. Stk

8.7 969.6 969.3

C 0.3

5.95 972.36

Nail in Trans. pole at br.

B.M.

3.60 978.31

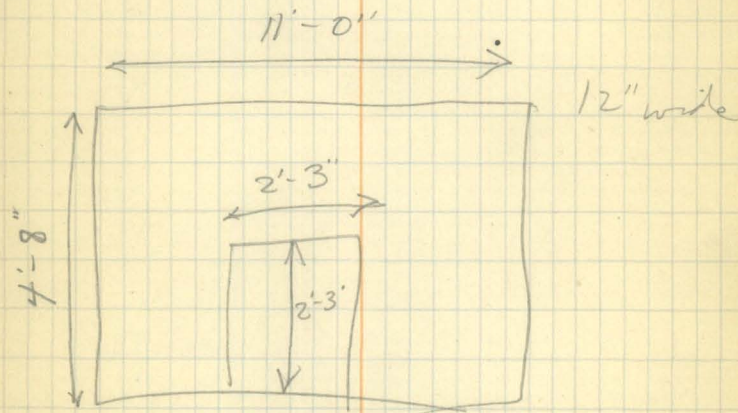
974.71

Ext # 3

33

Center Sec 21-28

Old cut 22' 6-6.
Add 4'-0" to barrel S end



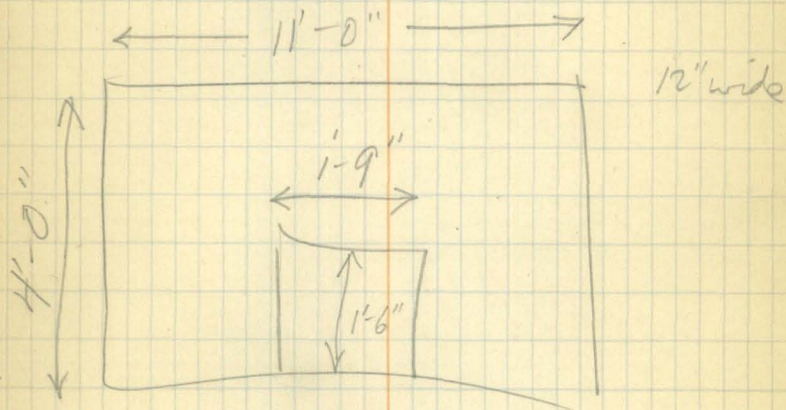
Ext. # 4

W¹/₄ cor 21-28

39

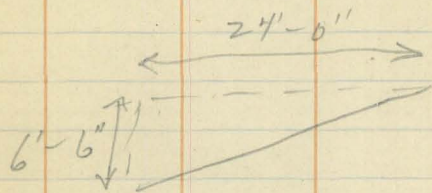
S end

Old cut 22'-0" b-b.
Add 4'-0"



Ext #5

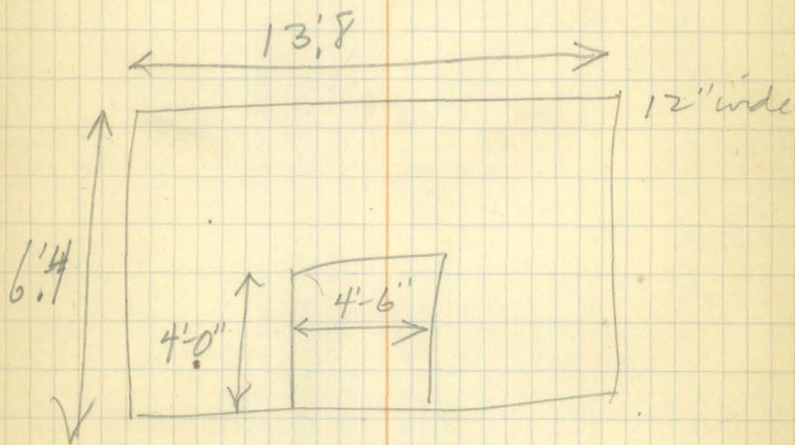
Near & ~~22-29~~ 20-29



955.6

35

Add 2'-0" Sand



#4

Remore rd 2x2

$$\begin{array}{r} 922.0 \\ 3.0 \\ \hline 918.5 \end{array}$$

$$\begin{array}{r} 67 \\ \hline 923.6 \end{array}$$

Old Hambury grade 924.0

W. Stk

8.4

921.9

918.0

C 3.9

E. Stk

4.8

925.5

918.5

C 7.0

4.1

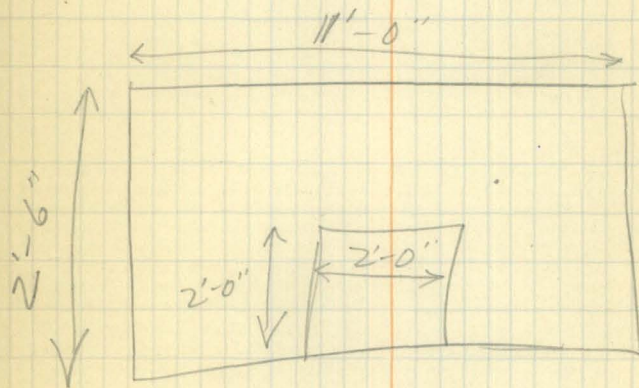
930.3

926.23

EXT # 6

Just E of Percill Farm

37
Add 3'-0" to N end



#3

Gr. 873.0
~~5.70~~
 867.28

7.0 871.6 867.3

C 4.3

S Stk.

9.4 869.2 867.0

C 2.2

5.8 878.6

872.79

#2

39

Grade 861.0
 6.2
 854.8

855.

N. Stk 4.3 859.0 854.8 C 4.2

S. Stk 5.7 857.6 854.5 3.1

2.36 863.37

861.01

#1

1.8

40

0.2

Grade 861.15
~~4.8~~
 856.3

84
~~856.6~~

N. Stk.

6.1

858.9

856.3
~~854.9~~

C 2.6

S Stk

6.6

858.4

856.0
~~854.6~~

C 2.4

4.0
~~2.36~~

865.0

861.01

8x5½ x16.0

Culvert Survey } Mar. 1, 1923, 41
Dewar Corner }

Spencer
Lyon

Poyner - Sec. 23-24.

{ See Book 28 - Page 60.
" " 29 Page 4.

N
↑

4+93 Channel crosses E. Fence

4

3

2
1+98 Channel crosses East Fence.

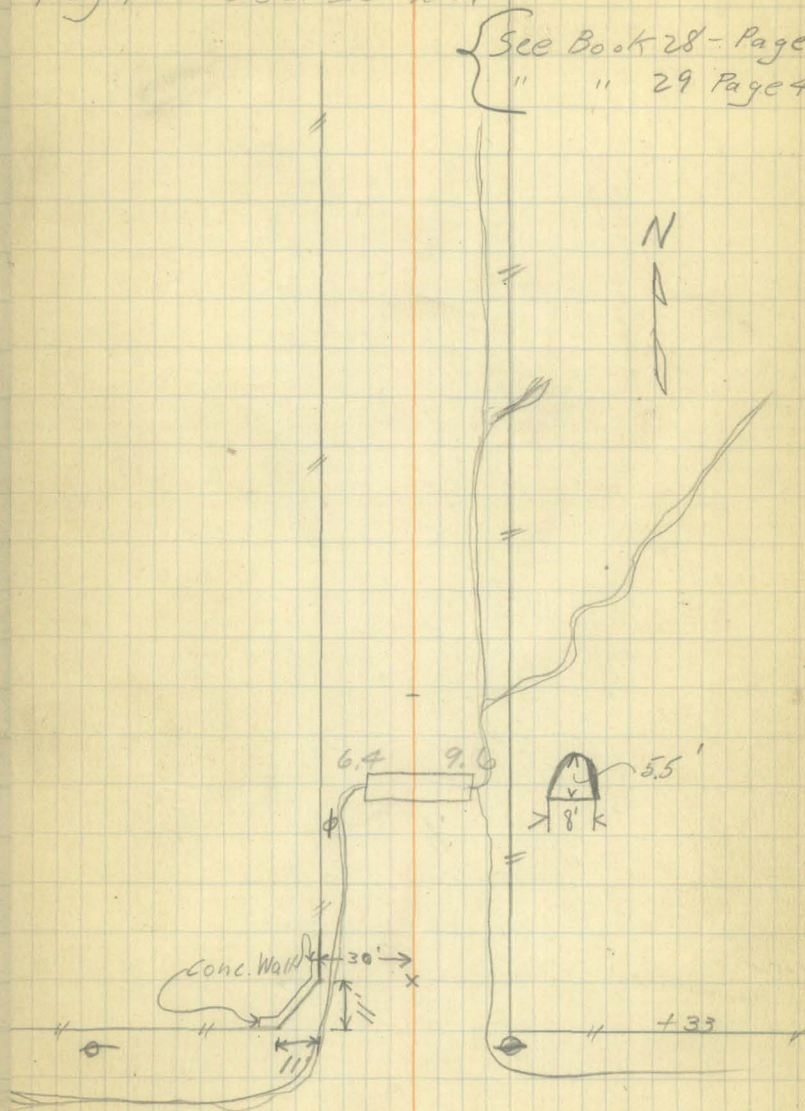
1+30.4 ± Culv. 8x5½ x16' Stone Arch

1

0+44 Opposite Corner of Conc. Wall on Left

0+33 Fence Line E. & W.

0 ± Grant Highway Paving



West

East

X-sec.

Dewar Corner

Poyner Sec. 23-24

B.M.

3.38 884.34

880.96

E. Hub cut 2.14 = 2'-2" 8.80 875.54 973.4

10.3 874.0

W. Hub cut 3.21 = 3'-2 1/2" 8.23 876.11 872.9

3.30 884.24
 E. Hub cut 2.54 = 2'-6 1/2" 8.32 875.94 973.4
 W. Hub cut 2.41 = 2'-5" 8.95 875.31 972.9

877.0' 879.0' 876.0'
 6.5 4.5 7.5
 Ditch 2.0

876.3' 878.5' 875.5'
 7.2 5.0 8.0
 Ditch 8.0

876.0' 878.2' 874.9'
 7.2 5.3 8.0
 Ditch 8.0

876.1' 875.8' 875.2' 874.5' 874.5'
 7.2 7.2 8.3 9.0 9.0
 50 30 20 15 10 5.0 9 12 15 18 20 22
 876.3' 876.3' 876.2' 876.1' 877.5' 878.5' 877.7' 877.2' 875.3' 875.4' 873.2' 873.1'
 7.2 7.2 7.3 7.4 6.0 5.0 5.6 5.2 6.2 8.1 10.3 10.1

1+30

Culv.

876.3'

7.2

50

876.3'

7.2

30

876.3'

7.2

26

874.7'

8.8

22

872.6'

10.9

16

873.3'

5.6

6.4

880.2'

3.3

6.4

880.1'

3.4

3.4

880.4'

3.1

9.6

873.4'

5.6

9.6

872.5'

5.0

10.1

872.2'

6.3

10.1

872.2'

6.3

10.1

876.1'

6.5

2.3

0+44

Paving

B.M.

2.58 883.54

880.96

Top. W. Cor. W. Headwall Culv. S. of Paving.

876.1' 875.5' 875.2' 874.7' 874.4' 873.8' 872.6' 878.5' 878.7' 879.0' 873.0' 878.4' 872.7' 872.6'
 7.4 7.9 7.9 9.1 11.7 12.1 11.9 5.9 5.0 4.5 6.2 5.1 4.8 5.0
 50 40 35 30 23 20 18 16 13 11 8 7.8 7.9 2.45 2.8 3.0 3.4

879.2'
 4.35

Land Survey in N $\frac{1}{2}$ of SW $\frac{1}{4}$

Azi. Rod Dist.

$\Delta 1$ 608.1' East of N-W. Cor. of Tract

	0°00'	1300'	1300'
1	24°15'	6.0 T. 1.6 B.	440
2	28°33'	6.0 T. 3.6 B.	240
3	61°12'	11.5 T. 9.85 M.	330
4	67°05'	10.6 T. 8.0 M.	520
5	95°48'	13.0 T. 9.85 B.	315'
6	132°11'	6.15 T. 3.0 B.	315'
7	169°53'	7.0 T. 4.4 B.	260'

$\Delta 2$

NW Cor. of SW $\frac{1}{4}$ Sec. 27

	0°00'		
8	30°30'	12.00 T. 7.3 B.	470'
9	58°45'	13.00 T. 9.75 B.	425'
10	75°50'	5.0 T. 2.1 M.	580
11	89°39'	10.45 T. 2.84 M.	710'
12	89°35'	1.92 T. 1.0 B.	184'

Located N-W cor. of SW $\frac{1}{4}$ Sec. 27 by measuring 1326.6 ft. South from fence corner at NW Cor. of SW $\frac{1}{4}$ of NW Cor. of SW $\frac{1}{4}$ Sec 27

of Sec. 27

Lester Twp.

to show location of Channel of Chain Creek.

Johnston
Spencer

3/9/23

43

N-E. Corner of SW $\frac{1}{4}$ Sec. 27, T90, R11.

Old Fence Line & N. Bank Old Channel

" " " " " " " "

N. Bank Main Channel

" " " "

" " " "

& Old Bridge

& Old Road

East Line

& Old Br.

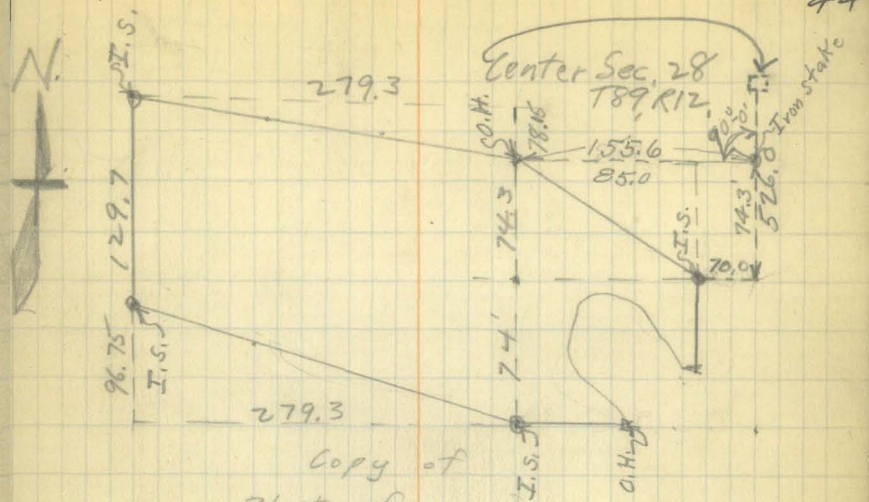
N. Bank Present Channel

N. Bank " "

New S. Br.

New N. Br.

Located N-E Cor. of NW $\frac{1}{4}$ of S-W $\frac{1}{4}$ Sec. 27 by producing line from NW Cor. of SW $\frac{1}{4}$ to Cross fence at center of Sec. 27. Above corner is 1300 ft. from N-W Cor. of S-W $\frac{1}{4}$ Sec. 27.



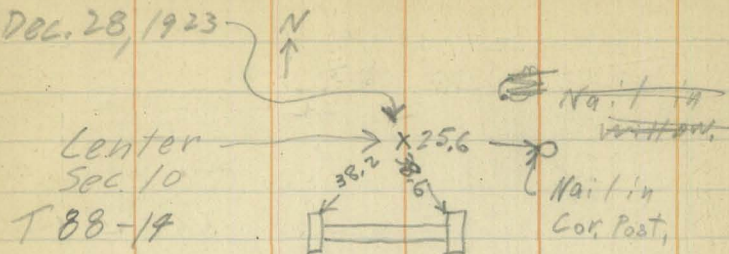
Copy of
Plat of
"Johnston Grave Pit"
full lines show boundaries

Above plat taken from lease
of D. A. Johnston which expires
Dec. 5, 1943.

The above plat filed in Auditor's
Ops on July 15, 1919.

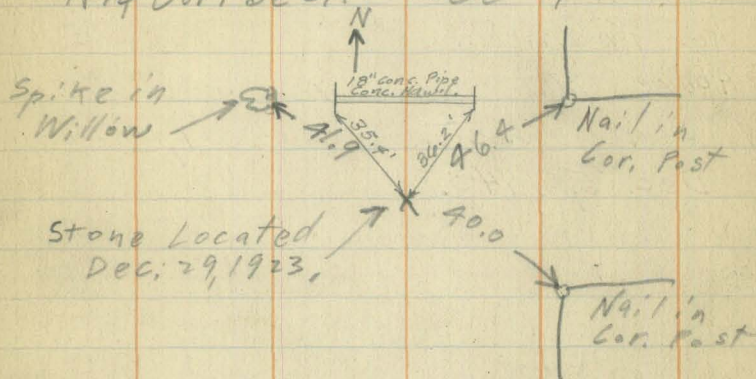
Boundary Lines Retraced July 12th 1930
By. W. D. Johnston - D. S. Butterfield
C. J. Caranough - J. E. Wagner - B. C. Johnston.

✓ Stone & Post
Located
Dec. 28, 1923



25.6 ft. East to Cor. Post
38.6 ft. S-E to inside edge of ditch
38.2 ft. S-W to " " " "

✓ N¹/₄ Cor. Sec. 10 T88-14



See Page 60.

Cedar Falls
Twp.

Hubs
33' Out
from Lime Stone

45

2828.6 ft.

to N¹/₄ Cor.

Sec. 3, Black Hawk

Sec. 3

22

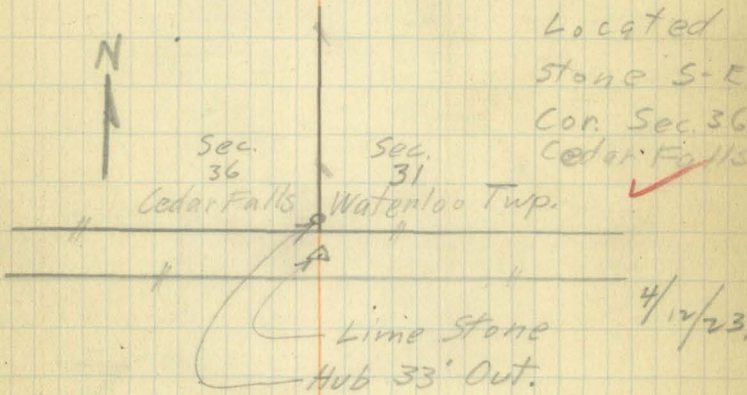
191.4

Black Hawk
Twp.

Found
4/12/23

E. B. Spencer
A. A. Lyons
Paul Turner

Located
Stone S-E
Cor. Sec. 36
Cedar Falls



Cedar Falls
Sec.
36

Cedar Falls
Sec.
36
South ¹/₄ Cor.

2642.9 to S.W. Cor.
Sec. 36

2647.9 to S.E. Cor.
Sec. 36

Sec. 2
Black Hawk
Twp.

Set 10" spike Jan. 15, 1924.
on line between
E. & W. Sec. Corners.

SURVEY OF

46

18X18 I-B.

$\frac{1}{2}$ Mile

East of St Francis Hospital on GRANT

Rdway. on br. 17.6 feet

E. Wat. 19-30

Clear Span = 18.0 feet

B.M. 4.89 861.19

856.30

4.82 856.37

4.95 856.24

10.1 851.1

8.8 852.4

10.8 850.4

9.8 851.4

10.45 850.74

Sta. 25+75 $\pm$ of Br. & Roadway

West end of Br. $\pm$ of Paving.

East " " " " " "

S-E Cor. of Abut.

S-W " " "

N-W " " "

N-E " " "

Top of Water 4/17/23.

851.8	851.8	850.6	850.3	850.2	848.9	847.6	846.6
9.4	9.6	10.6	10.9	11.0	12.3	12.6	12.6
300	200	100	9	9	100	200	300

Stream bed profile

16 $\frac{1}{2}$ " Top of floor to bottom of I-B.

10" I-B & Channels.

7-I-B. 2 Channels.

Foundation Material sandy.

D.A. = 1450 Acres Flat & Long.

20' Span on Twp. Rd. 1 mi.
North of Hawkeye Highway
C.G.W. Br. about $\frac{1}{2}$ mi.
north has a span of 40ft
with wood piles.
Old stone arch had a base
of 12ft, under C.G.W.

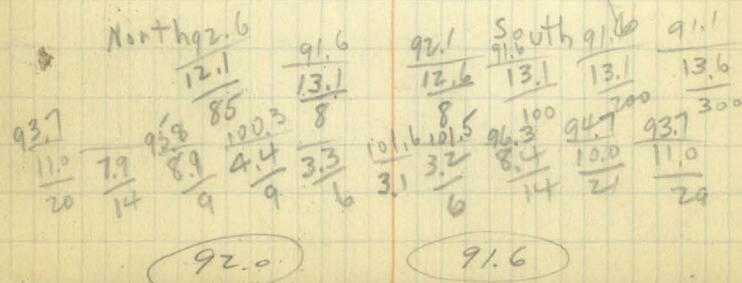
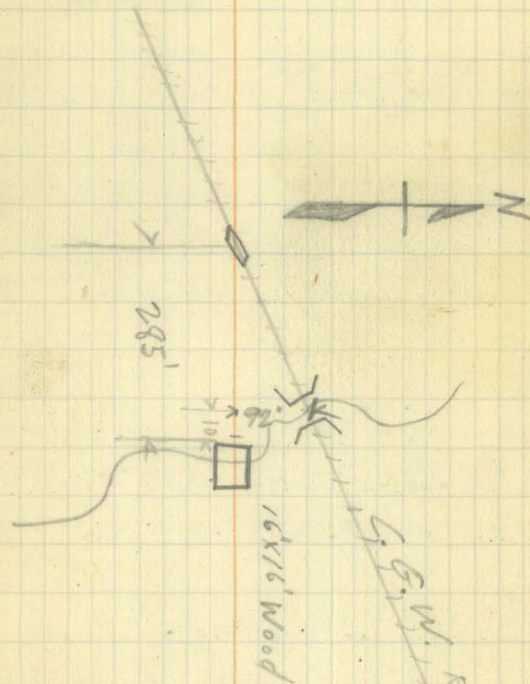
Sec. 15-22 E. Waterloo
285 ft. East of C.G.W. Crossing
Placing $\frac{1}{2}$ of New Br. 12' W. of $\frac{1}{2}$ of Old Br.
ite in Con. Fence Post N-W of Old Wood Br.
p of Wing of Abut. S-W, Con. of R.R. Bridge

7' deep during High Water
Sandy foundation material
C.G.W. used about 18 or 20' piling.

D.A. = 640 Acres Rolling

16' Span
18' Rdway

X-Sec. 12' W. of E. Fr.



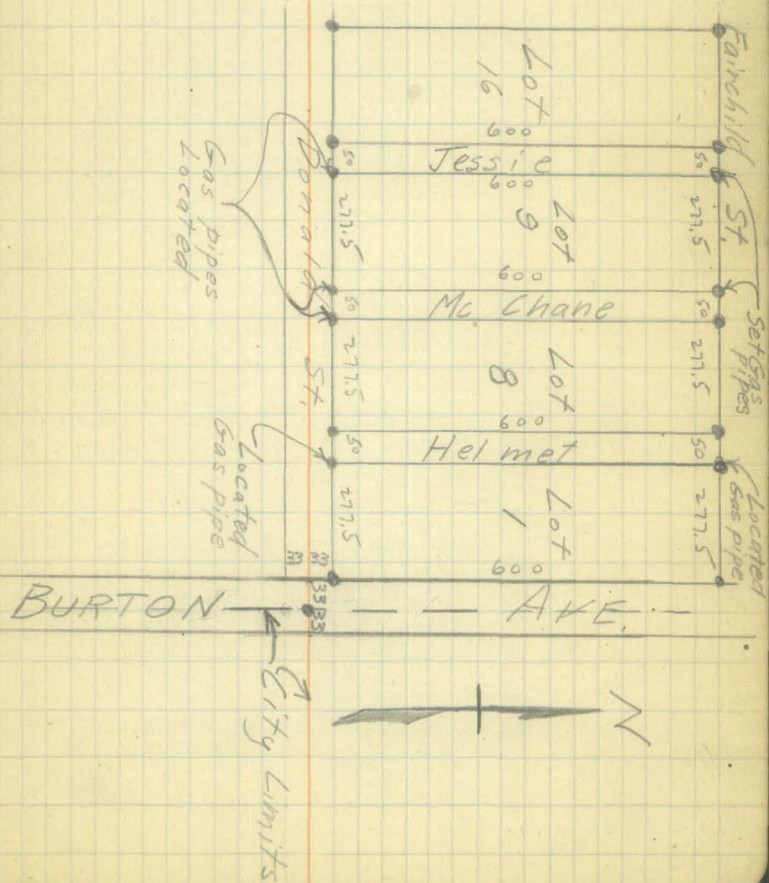
SURVEY OF

LOT No. 9 CLOVERDALE ACRES

W.D. Johnston.
E.B. Spencer.

48

Apr. 18, 1923



Data on Bridge Work. June 1923

Labor \$.40 per hour

Foreman \$.60 " "

Rein. Steel = \$.035 per lb.

Material

1 sack cement = 94[#]

1 cu yd. gravel = 2700[#]

Cost of Gravel at Gilbertsville = \$125 yd.

Cost of cement " " \$280

Weight of Water = 62.5[#] per Cu. ft.

Culvert Survey

Barclay 34 - Fox 4

Cir. Conc. and Sewer pipe in Place, 15" Dia. about 20 rods East of S-W. Cor. of Sec. 34.

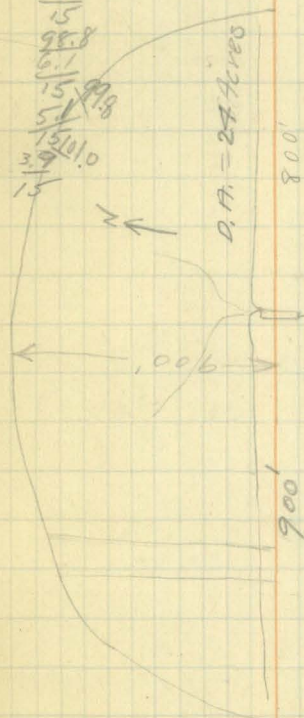
B.M. 4.86 104.86 100.00

Nail in Tel. pole #455 on South side of Road

Cross-Sec. of Road & Stream

100' East on E Road	4.6	100.26
200	3.3	101.56
300	1.6	103.26
100' West	4.8	100.06
200' West	3.4	101.46
300' West	2.2	102.66

North		South	
97.9	98.4	99.5	99.9
7.0	6.5	5.4	5.1
98.8	15	9	5.0
6.1			
100'E =	15.8		
200'E =	5.1		
300'E =	15.9		
100'W =	15.8		
200'W =	5.1		
300'W =	15.10		



98.0

97.5

5.24 105.24

S. Hub	C 1'-0"	6.75	98.49	97.5
N. Hub	C 0'-1 1/2"	7.12	98.12	98.0

Constr. 2x2x22 in same location.
parallel wings. Concrete
Conc. = 10.0 Cu. Yds.

Culvert Survey T89, R12W. 12" Corr. in place
 500' East of School House
 East Waterloo Sec. 17-20

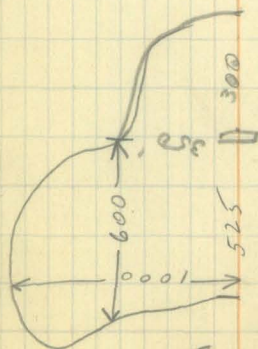
6.34 106.34 100.00

Nail in Tel. pole E. of Culv. on South side

300 East	1.3	
200 "	4.0	
100' East	5.3	
± Culv	4.7	101.6
100' West	4.1	
200 "	2.0	
250 "	0.2	

104.6	103.4	101.1	99.6	100.5	100.9	100.8	100.0	99.5	97.2	94.4	92.3
1.7	2.9	5.2	6.7	5.8	5.7	5.5	6.3	6.8	9.1	11.9	14.0
300	200	100	10	10	4	8	4	9	100	200	300
			F.L.						F.L.		
			99.6					99.1			

↖ ↗



Q.A. = 16 Acres Rolling

Constr. 2x2x22

Parallel wings.

Extra Culv. on Dewar-Readlyn Road.

Benn. 25-26 1400' N. of South End

Sewer Pipe in Place

Constr. 3x3x26

Concrete 16.7 Cu. Yds.

B.M. 5.51 105.51 100.00

Nail in Cor. post S. of Culv. E. of Road

W. F.L. old Culv. 7.95 97.56

F.L. 15 from ϕ 7.65 97.86

W. Hub 7.4 98.11 97.60 Cut 0'-6"

100' Up. Stream 7.0 98.51

E. F.L. 7.9 97.61

E. Hub 8.28 97.23 97.25 Cut 0'-0"

staked 5/19/23.

Culv. N. End of Mile

D.A. = 80 A.C.

B.M. on
Big Cotton Wood at X-Roads.

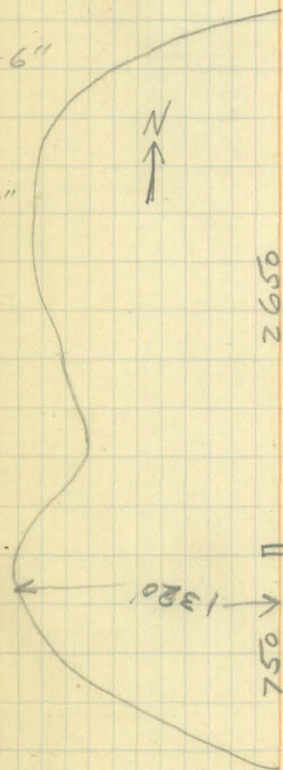
4.65 104.65 100.00

W. Hub 60.6 Cut 0'-2" 7.04 97.61 97.45

F.L. W. old Culv. 7.12 97.53

F.L. E. " " 7.47 97.18

E. Hub Cut 0'-0" 7.80 96.85 96.85



20" V. Sewer Pipe
in place

Use Plan C-32.

E.B. Spencer

70' x 16' Pony Truss

Poyner 15-22 - 1 mi. N. of Grant Highway

Truss over Elk Run Creek

Concrete Floor with I-B-Conc. Abut.

17½ ft. c.t.c. of Trusses.

70' c.t.c. of Bearings

See Page 56 left side for sketch.

80' x 16' Pony Truss

E. Waterloo 27-34 - 1 mi. S. of Grant Hy

over Elk Run Creek

Same type as above

17½ ft. c.t.c. of Truss.

80' c.t.c. of bearings.

Concrete Floor with I-B,
Conc. Abut.

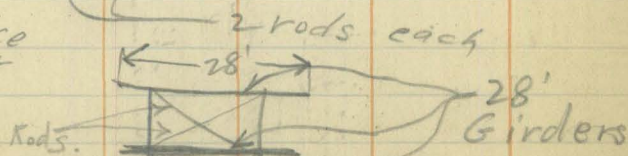
(See Page 56 left side
for sketch.)

30' x 16' Truss-Low

Fox 24-25 over Spr. Creek

17' c.t.c. of Trusses

Plank Floor



Fox 26-35

48' x 16' Truss

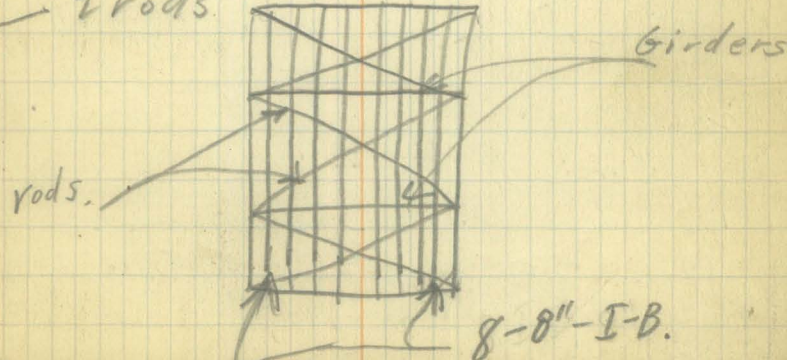
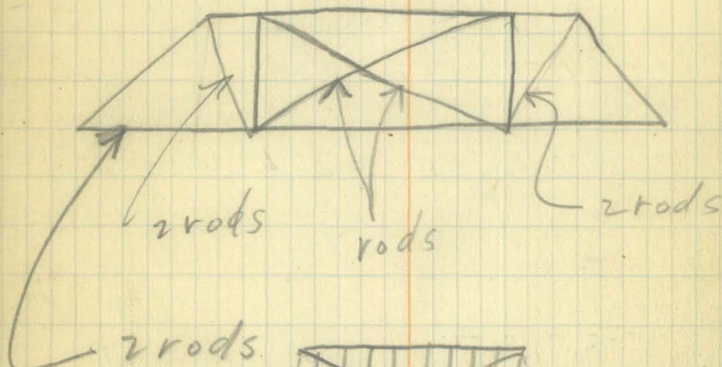
Top of Truss 7½' Above Floor

16½' c.t.c. of Trusses

48' c.t.c. of bearings.

Wood Floor with wood Handrail.

Conc. Abut. with gas pipe handrail.



Data for Painting Proposals

Steel TRUSS BRIDGES.

May 12, 1923 By W. D. Johnston

Bridge across Shellbrook River east of Winslow - 3 spans @ 100 ft. - high truss wood floor -

17 feet c. to c. trusses. Two piers and E. abut. are stone masonry - west end on steel tubes.

Bridge across west Fork Cedar River at Finchford -

1 span @ 154 ft. high truss with 34' I-B approach span at S. Ely end. -

17' c. to c. trusses

Truss by Wrought Iron Bridge Co. Canton, Ohio. Date 1880. Masonry pier & abut. wood joists.

May 14, 1923,

Bridge across Black Hawk Cr. at Hudson La. -

East span 42 ft. Pony Truss,
Central spans 2 @ 80 ft. High Truss
West end 1 @ 16' I-B wood floor
3 Piers - concrete filled steel tubes.
Floor system - wood floor & joists on trusses.

Lester Sec. 4 Pony Truss
over Wapsie River.

80' x 16' Concrete Floor with
I-B,

8' Top of floor to top of truss,
17½ ft. c. to c. of trusses,
Concrete Abutments.

Lester Sec. 23 5/16/23.

80' x 16' H.T. over Wapsie

17' c. to c. of Trusses

Wood floor & joists.

4 steel tubes

5 panels.

12" batter posts and top cords.

Benn. Sec. 3 Co. Line
86' x 16' P.T. over Crane Creek

17½ c. to c. trusses

Conc. Floor & Abuts.

Steel I-B, & Channels.

Report of 16' Wood Br. Barclay 21-22

May 14, 1923 by E. B. Spencer.

Just N. of center of mile.

4 piling on N. end should be replaced with new ones.

All new joists needed.

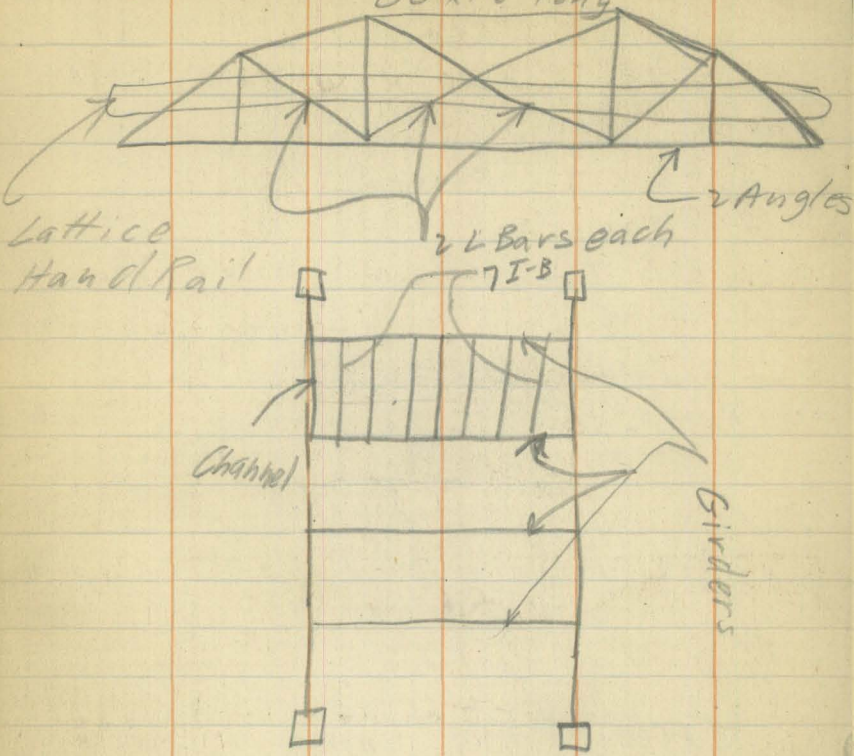
2 new caps needed.

Floor plank in good shape.

Benn. 3-4

4X3X14 Conc. No floor.
about 700' S. of North end Mile.
too short.

E. Wat 27-34
80 x 16 Pony



8' Floor to Top of Truss

Data for Painting Proposals May 13, 1923 56

High Truss in City of
La Porte 120' x 10 High Truss
over Big Creek.

Concrete Floor

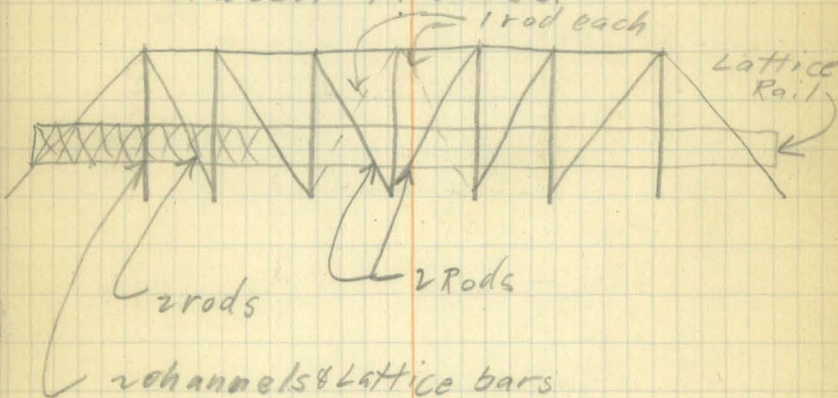
8- Panels

9-I-B & 2 Channels under Main Floor

2 I-B & 2 " under each sidewalk.

2 side walks.

21' 4" between Trusses.



7' between outside Handrail
& C. of Truss

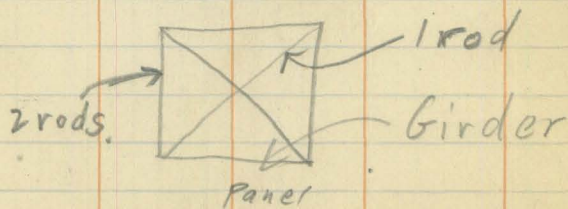
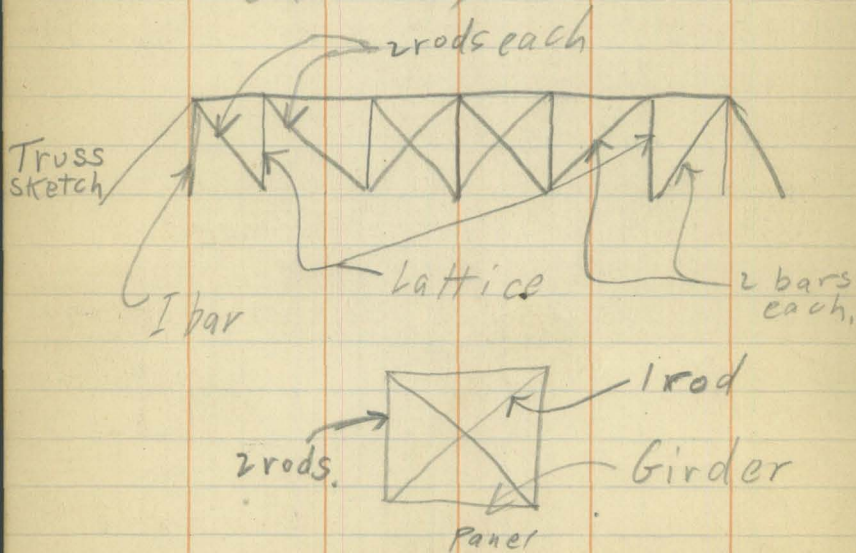
Batter Post 16" wide also top cord

Data for Painting Proposals

May 12, 1923, 51

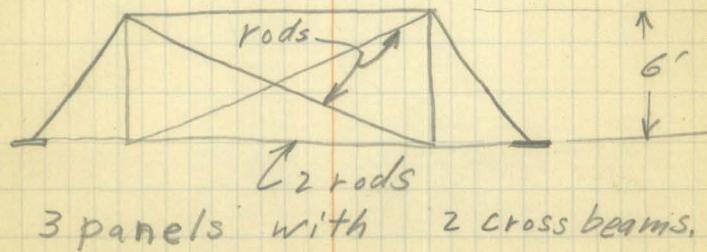
SEC. 19 T87N, R11W.
River Br. E. of LaPorte
3 Span High Truss
150' c.t.c. of bearings
on each span.
17½' c. to c. of Trusses.
14" Trusses
8 Panels each
About 20' High
Wood Floor & Joists.

1884
Wrought Iron Br. Co.
Builders.
Canton, Ohio



40x16' Pony Truss
1st. Br. East of River Br.
in Spr. Creek
Strusses about 4' above floor
Latest Type Pony
17' c.t.c. of Trusses
Concrete Floor
3 panels
7-I-B
2 channels,
Just the outside Trusses
need paint.

Fox 13-14
40x16 Pony Truss over Spring Creek
Wood floor & Joist.
Steel badly rusted
40' c. to c. of bearings.
17' c. to c. of Trusses.



Report of Olsen Contract

4/19/23

I-Beam Bridge Over Wapsie
River Lester Twp, Sec. 10

Hand Rail on Wings not painted
Several piling not bolted
to steel caps.

Poor job of painting
steel caps.

$\frac{1}{2}$ " bolts used on bolting caps
to piling - plans call for $\frac{3}{4}$ " bolts.
No struts used on piling

4/19/23.

58

Guard Rail at
 Elk Run Bridge
 E. Waterloo Twp. Sec. 33

West of Br. South Side 632 ft. 80 post 6"
 " " " North " 632 " 80 post 6"

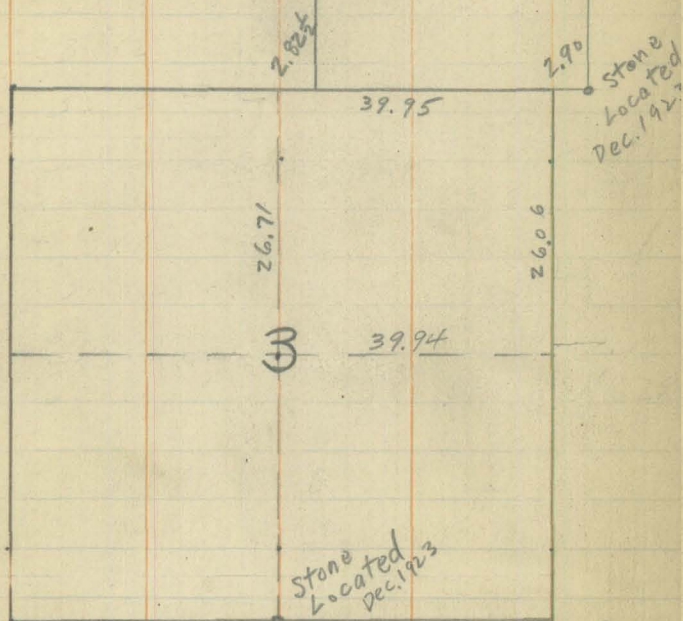
East of Br. South Side 32 ft. 5 post 6"
 " " " North " 48 ft. 7 post 6"

Total length 1344 ft

Total posts 172 post 6"

$$\begin{array}{r} 26.71 \\ 66 \\ \hline 16026 \\ 16026 \\ \hline 176286 \end{array}$$

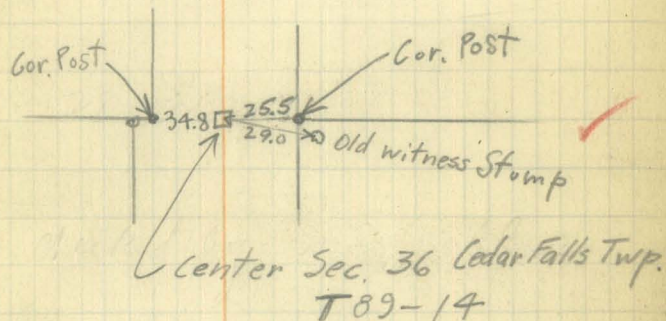
$$\begin{array}{r} 221 + 23.4 \\ 17 + 62.9 \\ \hline 338 + 86.3 \end{array}$$



Sec. 3 T88-R14W.
 Black Hawk Co.

See Page 45.

N 1/4 Cor.
 Sec. 36
 Cedar Falls Twp.

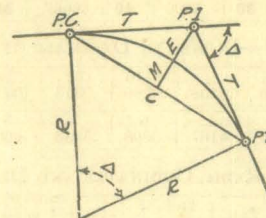


Elec. pole line surveyed and
 stakes set at 31.5 feet
 from E. of Road.

Survey started at south line of Sec. 10
 thence North on Co. Rd. through
 center of Sec. 10, and Sec. 3
 thence east one mile along the
 south side of Sec. 35 & 36
 thence north one mile through
 center of Sec. 36 to the north
 1/4 corner of said Sec. 36.

DIETZGEN'S RAILROAD CURVE AND REDUCTION TABLES

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CURVE FORMULAS

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

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

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

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

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

EXPLANATION AND USE OF TABLES

Stations.—Given P. I.=Sta. 161+60.35 to find Sta. of P. C. and P. T. $\Delta=62^\circ 10'$ $D=8^\circ 20'$. From Table IV for 1° curve $T=3454.1$ and $\div 8\frac{1}{2}=414.49$ 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 $8^\circ 20'=960.6 \div 8\frac{1}{2}=115.27$ 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 $D=5^\circ 30'$.

TABLE I.—MINUTES IN DECIMALS OF A DEGREE.

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

TABLE II.—INCHES IN DECIMALS OF A FOOT.

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	8	716.78	1.746	6.976	2.40
1	5729.65	.218	.873	0.30	20	688.16	1.819	7.266	2.50
10	4911.15	.255	1.018	0.35	30	674.69	1.855	7.411	2.55
20	4297.28	.291	1.164	0.40	40	661.74	1.892	7.556	2.60
30	3819.83	.327	1.309	0.45	9	637.28	1.965	7.846	2.70
40	3437.87	.364	1.454	0.50	20	614.56	2.037	8.136	2.80
50	3125.36	.400	1.600	0.55	30	603.80	2.074	8.281	2.85
2	2864.93	.436	1.745	0.60	40	593.42	2.110	8.426	2.90
10	2644.58	.473	1.891	0.65	10	573.69	2.183	8.716	3.00
20	2455.70	.509	2.036	0.70	30	546.44	2.292	9.150	3.15
30	2292.01	.545	2.181	0.75	40	521.67	2.402	9.585	3.30
40	2148.79	.582	2.327	0.80	11	499.06	2.511	10.02	3.45
50	2022.41	.618	2.472	0.85	12	478.34	2.620	10.45	3.60
3	1910.08	.655	2.618	0.90	30	459.28	2.730	10.89	3.75
10	1809.57	.691	2.763	0.95	13	441.68	2.839	11.32	3.90
20	1719.12	.727	2.908	1.00	30	425.40	2.949	11.75	4.05
30	1637.28	.764	3.054	1.05	14	410.28	3.058	12.18	4.20
40	1562.88	.800	3.199	1.10	30	396.20	3.168	12.62	4.35
50	1494.95	.836	3.345	1.15	15	383.07	3.277	13.05	4.50
4	1432.69	.873	3.490	1.20	30	370.78	3.387	13.49	4.65
10	1375.40	.909	3.635	1.25	16	359.27	3.496	13.92	4.80
20	1322.53	.945	3.718	1.30	30	348.45	3.606	14.35	4.95
30	1273.57	.982	3.926	1.35	17	338.27	3.716	14.78	5.10
40	1228.11	1.018	4.071	1.40	18	319.62	3.935	15.64	5.40
50	1185.78	1.055	4.217	1.45	19	302.94	4.155	16.51	5.70
5	1146.28	1.091	4.362	1.50	20	287.94	4.374	17.37	6.00
10	1109.33	1.127	4.507	1.55	21	274.37	4.594	18.22	6.30
20	1074.68	1.164	4.653	1.60	22	262.04	4.814	19.08	6.60
30	1042.14	1.200	4.798	1.65	23	250.79	5.035	19.94	6.90
40	1011.51	1.237	4.943	1.70	24	240.49	5.255	20.79	7.20
50	982.64	1.273	5.088	1.75	25	231.01	5.476	21.64	7.50
6	955.37	1.309	5.234	1.80	26	222.27	5.697	22.50	7.80
10	929.57	1.346	5.379	1.85	27	214.18	5.918	23.35	8.10
20	905.13	1.382	5.524	1.90	28	206.68	6.139	24.19	8.40
30	881.95	1.418	5.669	1.95	29	199.70	6.360	25.04	8.70
40	859.92	1.455	5.814	2.00	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
20	509.68	22.62	10	1018.9	89.89	10	1544.2	204.44
30	518.08	23.38	20	1027.5	91.40	20	1553.1	206.77
40	526.48	24.14	30	1036.1	92.92	30	1562.1	209.12
50	534.89	24.91	40	1044.7	94.46	40	1571.0	211.48
50	543.29	25.70	50	1053.3	96.01	50	1580.0	213.86

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
31°	1589.0	216.3	41°	2142.2	387.4	51°	2732.9	618.4
10'	1598.0	218.7	10'	2151.7	390.7	10'	2743.1	622.8
20	1606.9	221.1	20	2161.2	394.1	20	2753.4	627.2
30	1615.9	223.5	30	2170.8	397.4	30	2763.7	631.7
40	1624.9	226.0	40	2180.3	400.8	40	2773.9	636.2
50	1633.9	228.4	50	2189.9	404.2	50	2784.2	640.7
32°	1643.0	230.9	42°	2199.4	407.6	52°	2794.5	645.2
10	1652.0	233.4	10	2209.0	411.1	10	2804.9	649.7
20	1661.0	235.9	20	2218.6	414.5	20	2815.2	654.3
30	1670.0	238.4	30	2228.1	418.0	30	2825.6	658.8
40	1679.1	241.0	40	2237.7	421.4	40	2835.9	663.4
50	1688.1	243.5	50	2247.3	425.0	50	2846.3	668.0
33°	1697.2	246.1	43°	2257.0	428.5	53°	2856.7	672.7
10	1706.3	248.7	10	2266.6	432.0	10	2867.1	677.3
20	1715.3	251.3	20	2276.2	435.6	20	2877.5	682.0
30	1724.4	253.9	30	2285.9	439.2	30	2888.0	686.7
40	1733.5	256.5	40	2295.6	442.8	40	2898.4	691.4
50	1742.6	259.1	50	2305.2	446.4	50	2908.9	696.1
34°	1751.7	261.8	44°	2314.9	450.0	54°	2919.4	700.9
10	1760.8	264.5	10	2324.6	453.6	10	2929.9	705.7
20	1770.0	267.2	20	2334.3	457.3	20	2940.4	710.5
30	1779.1	269.9	30	2344.1	461.0	30	2951.0	715.3
40	1788.2	272.6	40	2353.8	464.6	40	2961.5	720.1
50	1797.4	275.3	50	2363.5	468.4	50	2972.1	725.0
35°	1806.6	278.1	45°	2373.3	472.1	55°	2982.7	729.9
10	1815.7	280.8	10	2383.1	475.8	10	2993.3	734.8
20	1824.9	283.6	20	2393.8	479.6	20	3003.9	739.7
30	1834.1	286.4	30	2403.6	483.8	30	3014.5	744.6
40	1843.3	289.2	40	2412.4	487.2	40	3025.2	749.6
50	1852.5	292.0	50	2422.3	491.0	50	3035.8	754.6
36°	1861.7	294.9	46°	2432.1	494.8	56°	3046.5	759.6
10	1870.9	297.7	10	2441.9	498.7	10	3057.2	764.6
20	1880.1	300.6	20	2451.8	502.5	20	3067.9	769.7
30	1889.4	303.5	30	2461.7	506.4	30	3078.7	774.7
40	1898.6	306.4	40	2471.5	510.3	40	3089.4	779.8
50	1907.9	309.3	50	2481.4	514.3	50	3100.2	784.9
37°	1917.1	312.2	47°	2491.3	518.2	57°	3110.9	790.1
10	1926.4	315.2	10	2501.2	522.2	10	3121.7	795.2
20	1935.7	318.1	20	2511.2	526.1	20	3132.6	800.4
30	1945.0	321.1	30	2521.1	530.1	30	3143.4	805.6
40	1954.3	324.1	40	2531.1	534.2	40	3154.2	810.9
50	1963.6	327.1	50	2541.0	538.2	50	3165.1	816.1
38°	1972.9	330.2	48°	2551.0	542.2	58°	3176.0	821.4
10	1982.2	333.2	10	2561.0	546.3	10	3186.9	826.7
20	1991.5	336.3	20	2571.0	550.4	20	3197.8	832.0
30	2000.9	339.3	30	2581.0	554.5	30	3208.8	837.3
40	2010.2	342.4	40	2591.0	558.6	40	3219.7	842.7
50	2019.6	345.5	50	2601.1	562.8	50	3230.7	848.1
39°	2029.0	348.6	49°	2611.2	566.9	59°	3241.7	853.5
10	2038.4	351.8	10	2621.2	571.1	10	3252.7	858.9
20	2047.8	354.9	20	2631.3	575.3	20	3263.7	864.3
30	2057.2	358.1	30	2641.4	579.5	30	3274.8	869.8
40	2066.6	361.3	40	2651.5	583.8	40	3285.8	875.3
50	2076.0	364.5	50	2661.6	588.0	50	3296.9	880.8
40°	2085.4	367.7	50°	2671.8	592.3	60°	3308.0	886.4
10	2094.9	371.0	10	2681.9	596.6	10	3319.1	892.0
20	2104.3	374.2	20	2692.1	600.9	20	3330.3	897.5
30	2113.8	377.5	30	2702.3	605.3	30	3341.4	903.2
40	2123.3	380.8	40	2712.5	609.6	40	3352.6	908.8
50	2132.7	384.1	50	2722.7	614.0	50	3363.8	914.5

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

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

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

Central Angle	Tangent	External	Central Angle	Tangent	External	Central Angle	Tangent	External
91°	5830.5	2444.9	101°	6950.6	3278.1	111°	8336.7	4386.1
10'	5847.5	2457.1	10'	6971.3	3294.1	10'	8362.7	4407.6
20	5864.6	2469.3	20	6992.0	3310.1	20	8388.9	4429.2
30	5881.7	2481.5	30	7012.7	3326.1	30	8415.1	4450.9
40	5898.8	2493.8	40	7033.6	3342.3	40	8441.5	4472.7
50	5916.0	2506.1	50	7054.5	3358.5	50	8468.0	4494.6
92°	5933.2	2518.5	102°	7075.5	3374.9	112°	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
93°	6037.8	2594.0	103°	7203.2	3474.4	113°	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
94°	6144.3	2671.6	104°	7333.6	3576.8	114°	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
95°	6252.8	2751.3	105°	7467.0	3682.3	115°	8993.8	4934.1
10	6271.1	2764.8	10	7489.6	3700.2	10	9022.7	4958.6
20	6289.4	2778.3	20	7512.2	3718.2	20	9051.7	4983.1
30	6307.9	2792.0	30	7534.9	3736.2	30	9080.9	5007.8
40	6326.3	2805.6	40	7557.7	3754.4	40	9110.3	5032.6
50	6344.8	2819.4	50	7580.5	3772.6	50	9139.8	5057.6
96°	6363.4	2833.2	106°	7603.5	3791.0	116°	9169.4	5082.7
10	6382.1	2847.0	10	7626.6	3809.4	10	9199.1	5107.9
20	6400.8	2861.0	20	7649.7	3827.9	20	9229.0	5133.3
30	6419.5	2875.0	30	7672.9	3846.5	30	9259.0	5158.8
40	6438.4	2889.0	40	7696.3	3865.2	40	9289.2	5184.5
50	6457.3	2903.1	50	7719.7	3884.0	50	9319.5	5210.3
97°	6476.2	2917.3	107°	7743.2	3902.9	117°	9349.9	5236.2
10	6495.2	2931.6	10	7766.8	3921.9	10	9380.5	5262.3
20	6514.3	2945.9	20	7790.5	3940.9	20	9411.3	5288.6
30	6533.4	2960.3	30	7814.3	3960.1	30	9442.2	5315.0
40	6552.6	2974.7	40	7838.1	3979.4	40	9473.2	5341.5
50	6571.9	2989.2	50	7862.1	3998.7	50	9504.4	5368.2
98°	6591.2	3003.8	108°	7886.2	4018.2	118°	9535.7	5395.1
10	6610.6	3018.4	10	7910.4	4037.8	10	9567.2	5422.1
20	6630.1	3033.1	20	7934.6	4057.4	20	9598.9	5449.2
30	6649.6	3047.9	30	7959.0	4077.2	30	9630.7	5476.5
40	6669.2	3062.8	40	7983.5	4097.1	40	9662.6	5504.0
50	6688.8	3077.7	50	8008.0	4117.0	50	9694.7	5531.7
99°	6708.6	3092.7	109°	8032.7	4137.1	119°	9727.0	5559.4
10	6728.4	3107.7	10	8057.4	4157.3	10	9759.4	5587.4
20	6748.2	3122.9	20	8082.3	4177.5	20	9792.0	5615.5
30	6768.1	3138.1	30	8107.3	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	5808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
100°	6828.3	3184.1	110°	8182.8	4259.7	120°	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

TABLE V.—CORRECTIONS FOR TANGENTS AND EXTERNALS.

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

FOR TANGENTS ADD

Central Angle	DEGREE OF CURVE													
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°	.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46
15°	.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.53	.58	.63	.68
20°	.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90
25°	.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14
30°	.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39
35°	.11	.22	.34	.47	.58	.69	.79	.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	.032	.037	.043	.049	.055	.061	.067
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	.891	.987	1.07	1.18	1.29
80°	.110	.220	.332	.445	.558	.671	.787	.903	1.02	1.13	1.25	1.38	1.50	1.62
85°	.128	.259	.391	.524	.657	.790	.926	1.06	1.20	1.34	1.47	1.62	1.76	1.91
90°	.149	.299	.450	.603	.756	.910	1.07	1.22	1.38	1.54	1.70	1.87	2.03	2.20
95°	.174	.350	.522	.706	.885	1.06	1.25	1.43	1.62	1.80	1.99	2.18	2.38	2.58
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	233.83	244.51	212.92

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

TABLE VII.—MIDDLE ORDINATES FOR RAILS IN FEET.

Deg. of Curve	LENGTH OF RAILS							Deg. of Curve	LENGTH OF RAILS.						
	32	30	28	26	24	22	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

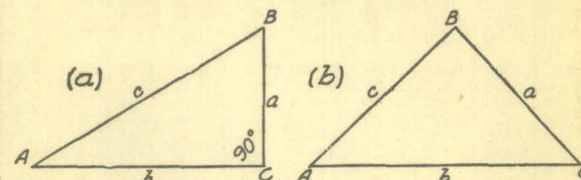
SLOPE REDUCTIONS.

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= $\text{slope distance} \times \cos V. A.$ 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).

TRIGONOMETRIC FORMULAS.

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



FORMULA FOR SOLVING TRIANGLES.

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

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

Angle	Sine.	Tan.	Cotg.	Cosin.	Angle	Sine.	Tan.	Cotg.	Cosin.
0°	0	0	00	1	90°	1	∞	0	0
10	.0029	.0029	343.8	.99998	50	.7660	1.5557	.6457	.6428
20	.0058	.0058	171.9	.99996	40	.6428	1.1071	.90096	.7660
30	.0087	.0087	114.6	.99993	30	.5196	.7660	.7660	.6428
40	.0116	.0116	85.94	.99989	20	.3917	.4228	.90096	.5196
50	.0145	.0145	68.75	.99989	10	.2618	.2618	.90096	.3917
1	.0175	.0175	57.29	.99985	89	.9801	15.707	.0175	.0175
10	.0204	.0204	49.10	.99979	50	.9801	15.707	.0175	.0175
20	.0233	.0233	42.96	.99973	40	.9801	15.707	.0175	.0175
30	.0262	.0262	38.19	.99966	30	.9801	15.707	.0175	.0175
40	.0291	.0291	34.37	.99958	20	.9801	15.707	.0175	.0175
50	.0320	.0320	31.24	.99949	10	.9801	15.707	.0175	.0175
2	.0349	.0349	28.64	.99939	88	.9801	15.707	.0175	.0175
10	.0378	.0378	26.43	.99929	50	.9801	15.707	.0175	.0175
20	.0407	.0407	24.54	.99917	40	.9801	15.707	.0175	.0175
30	.0436	.0437	22.90	.99905	30	.9801	15.707	.0175	.0175
40	.0465	.0466	21.47	.99892	20	.9801	15.707	.0175	.0175
50	.0494	.0495	20.21	.99878	10	.9801	15.707	.0175	.0175
3	.0523	.0524	19.08	.99863	87	.9801	15.707	.0175	.0175
10	.0552	.0553	18.07	.99847	50	.9801	15.707	.0175	.0175
20	.0581	.0582	17.17	.99831	40	.9801	15.707	.0175	.0175
30	.0610	.0612	16.35	.99813	30	.9801	15.707	.0175	.0175
40	.0640	.0641	15.60	.99795	20	.9801	15.707	.0175	.0175
50	.0669	.0670	14.92	.99776	10	.9801	15.707	.0175	.0175
4	.0698	.0699	14.30	.99756	86	.9801	15.707	.0175	.0175
10	.0727	.0729	13.73	.99736	50	.9801	15.707	.0175	.0175
20	.0756	.0758	13.20	.99714	40	.9801	15.707	.0175	.0175
30	.0785	.0787	12.71	.99692	30	.9801	15.707	.0175	.0175
40	.0814	.0816	12.25	.99668	20	.9801	15.707	.0175	.0175
50	.0843	.0846	11.83	.99644	10	.9801	15.707	.0175	.0175
5	.0872	.0875	11.43	.99619	85	.9801	15.707	.0175	.0175
10	.0901	.0904	11.06	.99594	50	.9801	15.707	.0175	.0175
20	.0929	.0934	10.71	.99567	40	.9801	15.707	.0175	.0175
30	.0958	.0963	10.39	.99540	30	.9801	15.707	.0175	.0175
40	.0987	.0992	10.08	.99511	20	.9801	15.707	.0175	.0175
50	.1016	.1022	9.788	.99482	10	.9801	15.707	.0175	.0175
6	.1045	.1051	9.514	.99452	84	.9801	15.707	.0175	.0175
10	.1074	.1080	9.255	.99421	50	.9801	15.707	.0175	.0175
20	.1103	.1110	9.010	.99390	40	.9801	15.707	.0175	.0175
30	.1132	.1139	8.777	.99357	30	.9801	15.707	.0175	.0175
40	.1161	.1169	8.556	.99324	20	.9801	15.707	.0175	.0175
50	.1190	.1198	8.345	.99290	10	.9801	15.707	.0175	.0175
7	.1219	.1228	8.144	.99255	83	.9801	15.707	.0175	.0175
10	.1248	.1257	7.953	.99219	50	.9801	15.707	.0175	.0175
20	.1276	.1287	7.770	.99182	40	.9801	15.707	.0175	.0175
30	.1305	.1317	7.596	.99144	30	.9801	15.707	.0175	.0175
40	.1334	.1346	7.429	.99106	20	.9801	15.707	.0175	.0175
50	.1363	.1376	7.269	.99067	10	.9801	15.707	.0175	.0175
					82				
	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°	.96126	.2867	3.487	.2756
10	.2784	.2899	3.450	.96046	50	.96046	.2899	3.450	.2784
20	.2812	.2931	3.412	.95964	40	.95964	.2931	3.412	.2812
30	.2840	.2962	3.376	.95882	30	.95882	.2962	3.376	.2840
40	.2868	.2994	3.340	.95799	20	.95799	.2994	3.340	.2868
50	.2896	.3026	3.305	.95715	10	.95715	.3026	3.305	.2896
17	.2924	.3057	3.271	.95615	73	.95615	.3057	3.271	.2924
10	.2952	.3089	3.237	.95545	50	.95545	.3089	3.237	.2952
20	.2979	.3121	3.204	.95469	40	.95469	.3121	3.204	.2979
30	.3007	.3153	3.172	.95372	30	.95372	.3153	3.172	.3007
40	.3035	.3185	3.140	.95284	20	.95284	.3185	3.140	.3035
50	.3062	.3217	3.108	.95195	10	.95195	.3217	3.108	.3062
18	.3090	.3249	3.078	.95106	72	.95106	.3249	3.078	.3090
10	.3118	.3281	3.048	.95015	50	.95015	.3281	3.048	.3118
20	.3145	.3314	3.018	.94924	40	.94924	.3314	3.018	.3145
30	.3173	.3346	2.989	.94832	30	.94832	.3346	2.989	.3173
40	.3201	.3378	2.960	.94740	20	.94740	.3378	2.960	.3201
50	.3228	.3411	2.932	.94646	10	.94646	.3411	2.932	.3228
19	.3256	.3443	2.904	.94552	71	.94552	.3443	2.904	.3256
10	.3283	.3476	2.877	.94457	50	.94457	.3476	2.877	.3283
20	.3311	.3508	2.850	.94361	40	.94361	.3508	2.850	.3311
30	.3338	.3541	2.824	.94264	30	.94264	.3541	2.824	.3338
40	.3365	.3574	2.798	.94167	20	.94167	.3574	2.798	.3365
50	.3393	.3607	2.773	.94068	10	.94068	.3607	2.773	.3393
20	.3420	.3640	2.747	.93969	70	.93969	.3640	2.747	.3420
10	.3448	.3673	2.723	.93869	50	.93869	.3673	2.723	.3448
20	.3475	.3706	2.699	.93769	40	.93769	.3706	2.699	.3475
30	.3502	.3739	2.675	.93667	30	.93667	.3739	2.675	.3502
40	.3529	.3772	2.651	.93565	20	.93565	.3772	2.651	.3529
50	.3557	.3805	2.628	.93462	10	.93462	.3805	2.628	.3557
21	.3584	.3839	2.605	.93358	69	.93358	.3839	2.605	.3584
10	.3611	.3872	2.583	.93253	50	.93253	.3872	2.583	.3611
20	.3638	.3906	2.560	.93148	40	.93148	.3906	2.560	.3638
30	.3665	.3939	2.539	.93042	30	.93042	.3939	2.539	.3665
40	.3692	.3973	2.517	.92935	20	.92935	.3973	2.517	.3692
50	.3719	.4006	2.496	.92827	10	.92827	.4006	2.496	.3719
22	.3746	.4040	2.475	.92718	68	.92718	.4040	2.475	.3746
10	.3773	.4074	2.455	.92609	50	.92609	.4074	2.455	.3773
20	.3800	.4108	2.434	.92499	40	.92499	.4108	2.434	.3800
30	.3827	.4142	2.414	.92388	30	.92388	.4142	2.414	.3827
40	.3854	.4176	2.394	.92276	20	.92276	.4176	2.394	.3854
50	.3881	.4210	2.375	.92164	10	.92164	.4210	2.375	.3881
23	.3907	.4245	2.356	.92050	67	.92050	.4245	2.356	.3907
10	.3934	.4279	2.337	.91936	50	.91936	.4279	2.337	.3934
20	.3961	.4314	2.318	.91822	40	.91822	.4314	2.318	.3961
30	.3987	.4348	2.300	.91706	30	.91706	.4348	2.300	.3987
40	.4014	.4383	2.282	.91590	20	.91590	.4383	2.282	.4014
50	.4041	.4417	2.264	.91472	10	.91472	.4417	2.264	.4041
					66				
	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	.78261	30
10	.5324	.6289	1.590	.84650	50	40	.6248	.8002	1.250	.78079	20
20	.5348	.6330	1.580	.84495	40	50	.6271	.8050	1.242	.77897	10
30	.5373	.6371	1.570	.84339	30						
40	.5398	.6412	1.560	.84182	20	39	.6293	.8098	1.235	.77715	51
50	.5422	.6453	1.550	.84025	10	10	.6316	.8146	1.228	.77531	50
						20	.6338	.8195	1.220	.77347	40
33	.5446	.6494	1.540	.83867	57	30	.6361	.8243	1.213	.77162	30
10	.5471	.6536	1.530	.83708	50	40	.6383	.8292	1.206	.76977	20
20	.5495	.6577	1.520	.83549	40	50	.6406	.8342	1.199	.76791	10
30	.5519	.6619	1.511	.83389	30						
40	.5544	.6661	1.501	.83228	20	40	.6428	.8391	1.192	.76604	50
50	.5568	.6703	1.492	.83066	10	10	.6450	.8441	1.185	.76417	50
						20	.6472	.8491	1.178	.76229	40
34	.5592	.6745	1.483	.82904	56	30	.6494	.8541	1.171	.76041	30
10	.5616	.6787	1.473	.82741	50	40	.6517	.8591	1.164	.75851	20
20	.5640	.6830	1.464	.82577	40	50	.6539	.8642	1.157	.75661	10
30	.5664	.6873	1.455	.82413	30						
40	.5688	.6916	1.446	.82248	20	41	.6561	.8693	1.150	.75471	49
50	.5712	.6959	1.437	.82082	10	10	.6583	.8744	1.144	.75280	50
						20	.6604	.8796	1.137	.75088	40
35	.5736	.7002	1.428	.81915	55	30	.6626	.8847	1.130	.74896	30
10	.5760	.7046	1.419	.81748	50	40	.6648	.8899	1.124	.74703	20
20	.5783	.7089	1.411	.81580	40	50	.6670	.8952	1.117	.74509	10
30	.5807	.7133	1.402	.81412	30						
40	.5831	.7177	1.393	.81242	20	42	.6691	.9004	1.111	.74314	48
50	.5854	.7221	1.385	.81072	10	10	.6713	.9057	1.104	.74120	50
						20	.6734	.9110	1.098	.73924	40
36	.5878	.7265	1.376	.80902	54	30	.6756	.9163	1.091	.73728	30
10	.5901	.7310	1.368	.80730	50	40	.6777	.9217	1.085	.73531	20
20	.5925	.7355	1.360	.80558	40	50	.6799	.9271	1.079	.73333	10
30	.5948	.7400	1.351	.80386	30						
40	.5972	.7445	1.343	.80212	20	43	.6820	.9325	1.072	.73135	47
50	.5995	.7490	1.335	.80038	10	10	.6841	.9380	1.066	.72937	50
						20	.6862	.9435	1.060	.72737	40
37	.6018	.7536	1.327	.79864	53	30	.6884	.9490	1.054	.72537	30
10	.6041	.7581	1.319	.79688	50	40	.6905	.9545	1.048	.72337	20
20	.6065	.7627	1.311	.79512	40	50	.6926	.9601	1.042	.72136	10
30	.6088	.7673	1.303	.79335	30						
40	.6111	.7720	1.295	.79158	20	44	.6947	.9657	1.036	.71934	46
50	.6134	.7766	1.288	.78980	10	10	.6967	.9713	1.030	.71732	50
						20	.6988	.9770	1.024	.71529	40
38	.6157	.7813	1.280	.78801	52	30	.7009	.9827	1.018	.71325	30
10	.6180	.7860	1.272	.78622	50	40	.7030	.9884	1.012	.71121	20
20	.6202	.7907	1.265	.78442	40	50	.7050	.9942	1.006	.70916	10
							.7071	1.	1.	.70711	45
											or
	Cosin.	Cotg.	Tan.	Sine.	Angle.		Cosin.	Cotg.	Tan.	Sine.	Angle.

TABLE IX.—CALCULATION OF EARTHWORK.

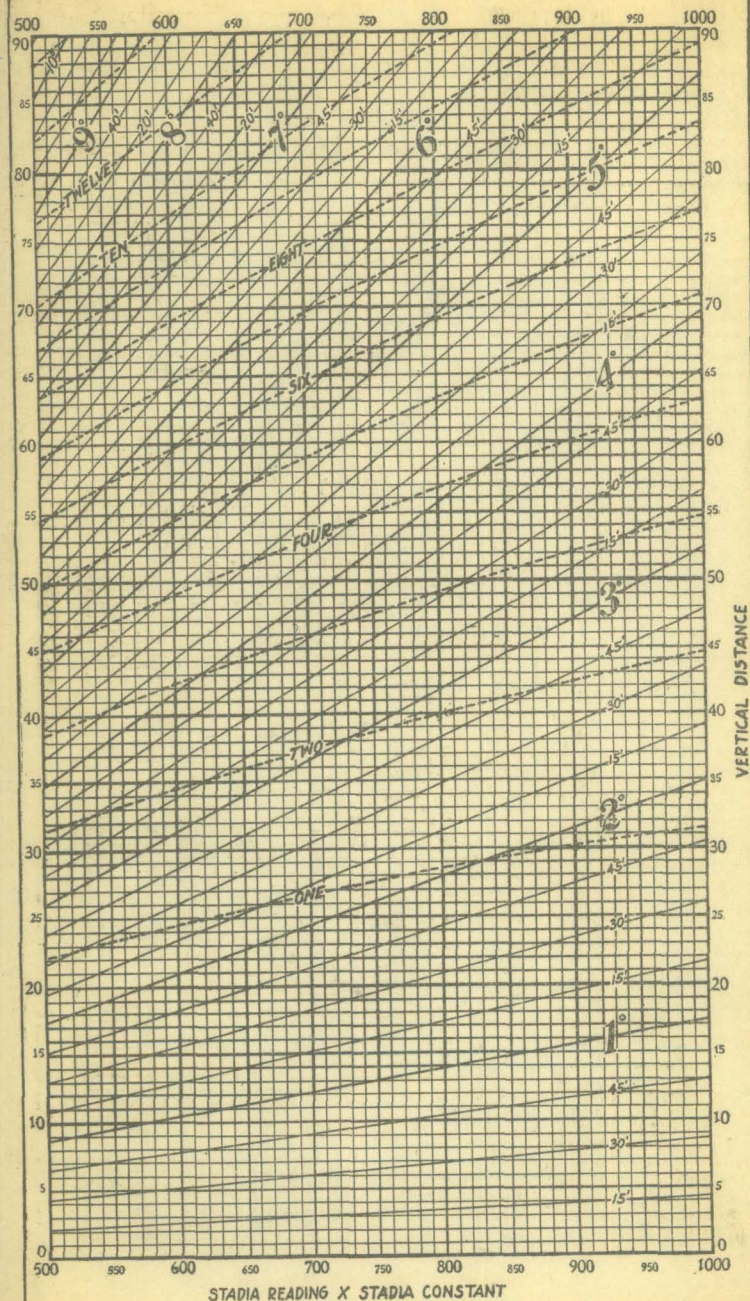
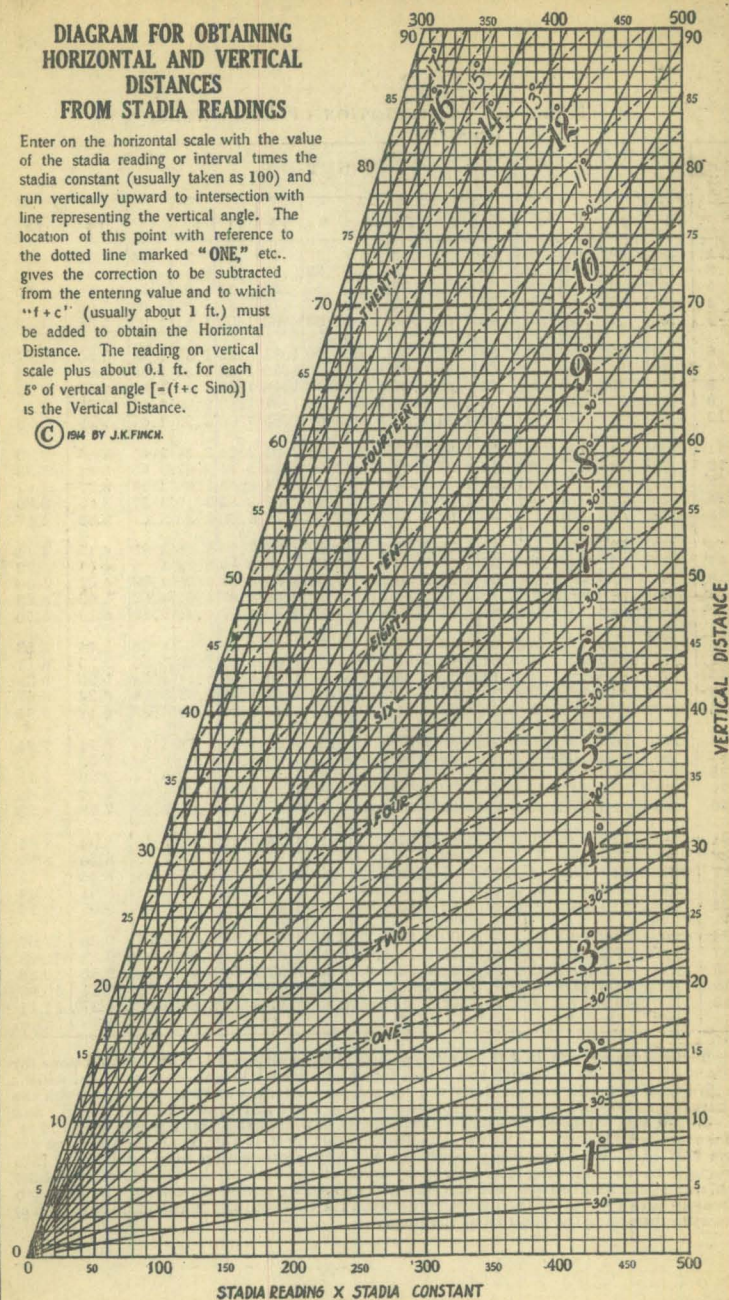
Width	HEIGHT														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.02	.04	.06	.07	.09	.11	.13	.15	.17	.18	.20	.22	.24	.26	.28
2	.04	.07	.11	.15	.18	.22	.26	.30	.33	.37	.41	.44	.48	.52	.56
3	.06	.11	.17	.22	.28	.33	.39	.44	.50	.56	.61	.67	.72	.78	.83
4	.07	.15	.22	.30	.37	.44	.52	.59	.67	.74	.81	.89	.96	1.04	1.11
5	.09	.19	.28	.37	.46	.56	.65	.74	.83	.93	1.02	1.11	1.20	1.30	1.39
6	.11	.22	.33	.44	.56	.67	.78	.89	1.00	1.11	1.22	1.33	1.44	1.55	1.67
7	.13	.26	.39	.52	.65	.78	.91	1.04	1.16	1.30	1.42	1.55	1.68	1.81	1.94
8	.15	.30	.44	.59	.74	.89	1.04	1.19	1.33	1.48	1.63	1.78	1.92	2.08	2.22
9	.17	.33	.50	.67	.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50
10	.18	.37	.56	.74	.93	1.11	1.30	1.48	1.67	1.85	2.04	2.22	2.41	2.59	2.78
11	.20	.41	.61	.82	1.02	1.22	1.43	1.63	1.83	2.04	2.24	2.44	2.65	2.85	3.06
12	.22	.44	.67	.89	1.11	1.33	1.56	1.78	2.00	2.22	2.44	2.67	2.89	3.11	3.33
13	.24	.48	.72	.96	1.20	1.44	1.68	1.92	2.16	2.41	2.65	2.89	3.13	3.37	3.61
14	.26	.52	.78	1.04	1.30	1.55	1.81	2.08	2.33	2.59	2.85	3.11	3.37	3.63	3.89
15	.28	.56	.83	1.11	1.39	1.67	1.94	2.22	2.50	2.78	3.06	3.33	3.61	3.89	4.17
16	.30	.59	.89	1.18	1.48	1.78	2.07	2.37	2.67	2.96	3.26	3.56	3.85	4.15	4.44
17	.31	.63	.94	1.26	1.57	1.89	2.20	2.52	2.83	3.15	3.46	3.78	4.09	4.41	4.72
18	.33	.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00
19	.35	.70	1.06	1.41	1.76	2.11	2.46	2.82	3.17	3.52	3.87	4.22	4.57	4.92	5.28
20	.37	.74	1.11	1.48	1.85	2.22	2.59	2.96	3.33	3.70	4.07	4.44	4.81	5.18	5.56
21	.39	.78	1.17	1.55	1.94	2.33	2.72	3.11	3.50	3.89	4.28	4.67	5.06	5.44	5.83
22	.41	.81	1.22	1.63	2.04	2.42	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	4.95	5.56	6.11	6.67	7.22	7.78	8.33
31	.57	1.15	1.72	2.20	2.83	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	3.38	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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$$\begin{array}{r}
 29 \\
 \hline
 140 \\
 224 \\
 13 \\
 238 \\
 323 \\
 210 \\
 \hline
 1148 \checkmark
 \end{array}$$

$$\begin{array}{r}
 225 \\
 323 \\
 238 \\
 13 \\
 221 \\
 8 \\
 128 \\
 17 \\
 \hline
 1173 \checkmark
 \end{array}$$

$$\begin{array}{r}
 12 \\
 18 \\
 \hline
 96 \\
 12 \\
 \hline
 216 \\
 8 \\
 \hline
 224
 \end{array}$$

$$\begin{array}{r}
 14 \\
 15 \\
 \hline
 70 \\
 14 \\
 \hline
 210
 \end{array}$$

$$\begin{array}{r}
 1201 \\
 1183 \\
 \hline
 18
 \end{array}$$

$$\begin{array}{r}
 1344 \overline{) 321.68} \\
 \underline{2688} \\
 5288 \\
 \underline{5376} \\
 24
 \end{array}$$

$$\begin{array}{r}
 14 \\
 15 \\
 14 \\
 15 \\
 15 \\
 15 \\
 15 \\
 10 \\
 16 \\
 16 \\
 16 \\
 16 \\
 17 \\
 16 \\
 15 \\
 \hline
 295
 \end{array}$$

$$\begin{array}{r}
 12 \\
 12 \\
 13 \\
 13 \\
 14 \\
 14 \\
 13 \\
 14 \\
 \hline
 105
 \end{array}$$

$$\begin{array}{r}
 8- \\
 13 \\
 17 \\
 \hline
 91 \\
 13 \\
 \hline
 221
 \end{array}$$

$$\begin{array}{r}
 16 \\
 8 \\
 \hline
 128
 \end{array}$$

$$\begin{array}{r}
 396 \\
 805 \\
 \hline
 1201 \\
 1173 \\
 \hline
 28
 \end{array}$$

Limestone - 32'-7" N of Cor post S side road

Cor 4-5-8-9 Union Twp

Niggerhead N 1/4 Sec 8 Union Twp

33'-0" N of S cor post S side road

341

330

728
2400

3280

314
64

56
128
96
200

79
8
632

17
14

68

17

23

13

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

Roadway 16 feet wide. Side Slopes 1 on 1 1/2.
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) ÷ 2 or 2 ft. added to 41.9 = 43.9. For slopes of 1 on 1 see inside of front cover.