

FIELD BOOK

1880

Gravel Truck Measurements.

63

KEUFFEL & ESSER CO.

DRAWING MATERIALS

AND

SURVEYING INSTRUMENTS.

NEW YORK.

CHICAGO. ST. LOUIS. SAN FRANCISCO. MONTREAL.

TABLES FOR EXCAVATIONS AND EMBANKMENTS.

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 18 FEET WIDE. SIDE SLOPES 1 TO 1.

FOR SINGLE TRACK EXCAVATION.

"Copyright, 1895, by Keuffel & Esser Co."

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

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

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

Finder of this -
Book - Please return
Same to Office of
County Engineer at
Waterloo, Iowa.

**BLACK HAWK COUNTY
ENGINEER'S OFFICE
COURT HOUSE
WATERLOO, IOWA 50703**

Primary Road #359

1560 cu yds. per Mile -

29 x 545 cu yds per 100 ft sta.

797 x 7 cu ft per 100 ft sta.

average truck load = 41 cu. ft.

Secondary Roads

700 cu. Ft to 100' Sta.

Index of Contents.

Pages

Gravel Truck measurements - Moe + Nelson. 1-20

Waterloo-Raymond Rd. Gravel Trucks Cap.

21-23

AJ Flack and Stein Truck measurements. Inter. trucks. 24-25

WATERLOO, IOWA 50703
COURT HOUSE
ENGINEER'S OFFICE
BLACK HAWK COUNTY

Gravel on R.P. = 359

Truck # 4 Driver - Jack Shermann

Date Sept 29 - 1922.

Body measurements

5.89' long

3.25' wide

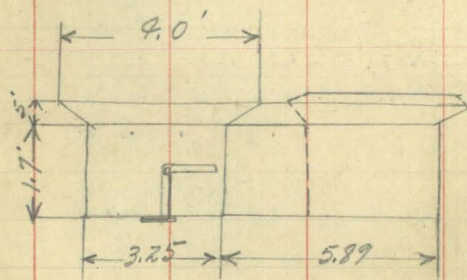
1.7' Deep (to floor)

4.0' Wide top of floor

.5' Deep floor.

23.21 ft

No 4 End dump.



Sept. 29 - 22 = IIII = 8'

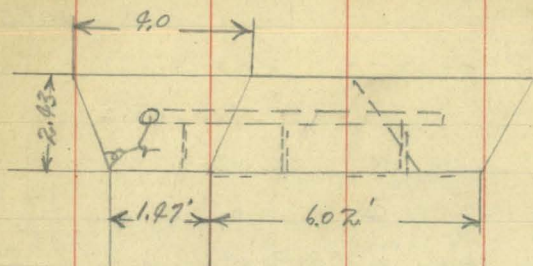
Sept. 30 - 22 = IIII = 12'

Oct 1 - 22 = IIII

Oct 7 - 24 = IIII

Oct 8 - 24 = III

No 161 Bottom dump



Gravel on P.P. # 359

Truck # 16L

Priver Bill Weiss

Date Sept. 29-1922

Body measurements

6.02' Long

9.0' wide top

1.47' " Bottom

2.43 " Deep

} = 20. Cu Ft.

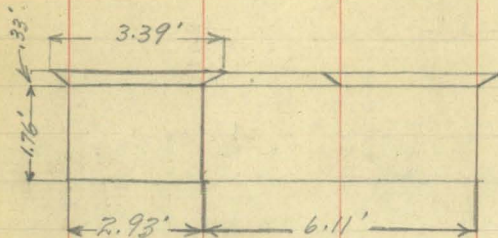
Sept 29-22 = 1111 = 7 ✓

Sept 30-22 = 111111 = 12

Oct 1-22 = 111111

Oct 7-22 = 1111

N^o 24 End dump



4.

Gravel on P.P. # 359

Truck # 24 Driver - H. Weiss.

Date Sept 29-22

Body measurements

6.11' long

2.93' wide

1.76' Deep (to floor) 31.69 To floor

3.39' wide top of floor 37.86

.33' Deep floor Full

Sept 29-22 = 1111 = 7

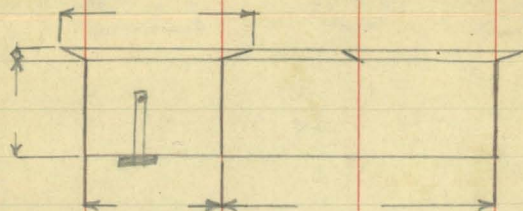
Sept 30-22 = 1111 = 8

Oct 1-22 = 1111

Oct 7-22 = 0

→ Hole

Nº 13 End dump



Gravel on P.P. # 359 ✓

Truck # 13 Driver-Kinney
Sept 29-1922

Body measurements

36" wide

72" long

21.5" ~~deep~~ (to Flare) } = 1.51 yds

47" wide top of Flare

5" Flare

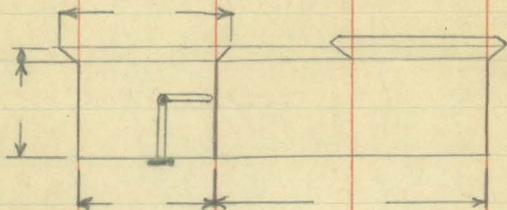
Sept 29-22 = ~~||||~~ || = 7 ✓

Sept 30-22 = ~~||||~~ ||| = 9 ✓

Oct 1-22 = ~~||||~~ || = 7 ✓

Oct 7-24 = ~~||||~~ || = 7 ✓

No 7 End dump.



Truck # 7 Driver
Sept 29-1922

Body measurements

39" wide
19 1/2" Deep to Floor
69.5" long
49" Top of floor
6" Floor

} 41.20 cu. ft.
= ~~41.20~~ yds.

Sept 29-1922 = 1111 = 4

Sept 30-22 =

Oct 1-22 = 11

Oct 7-22 = 1111

Gravel on P.P. #359 ✓

Truck #14 Driver Goodsell
Sept 29-1922

Body measurements

2.0' wide top

1.45' " Bottom

2.12' Deep

6' long

35' cu ft
~~4~~ 6 cu yds

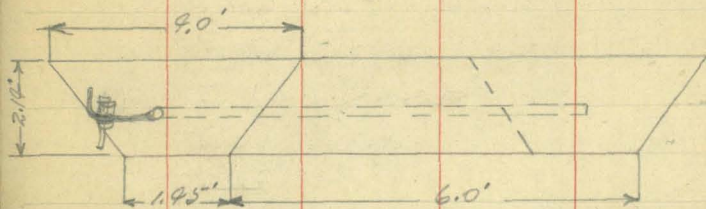
Sept 29-26 = IIII = 6

Sept 30-24 = IIII IIII = 9 → Hole

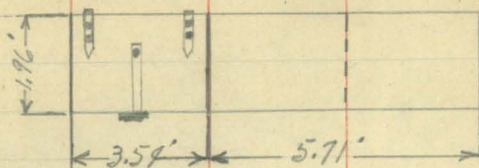
Oct. 1-22 = IIII IIII

Oct 7-24 = 1

No 14 Bottom dump



N^o 9 End dump.



Gravel on P.P. #359

Truck #9 Driver = Boslough
Sept 29-1922

Body measurements.

68.5" Long
42.5" wide
23.5" Deep } = 39.59 Cu Ft.
~~41~~ Cords.

Sept 29-22 = 1111 = 2

Sept. 30-22 = 1111 = 5 hole

Oct 1-22 = 1111

Oct 7-22 = 1111

Gravel on RR # 359

Truck #3 Driver = Boomer

Sept 29-1922

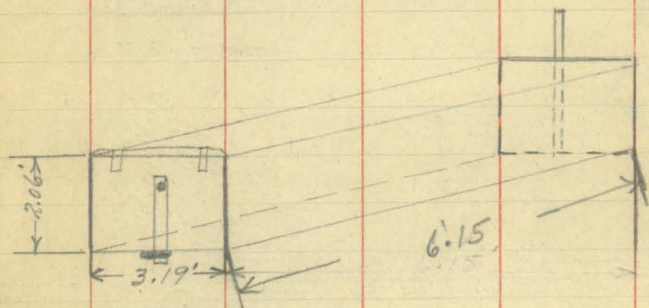
Body measurements.

40.41 cu ft to floor

6.15' long

3.19' wide

2.06' deep

~~22.03 cu ft~~~~155 cu. yds~~

No 3 End dump

Sept. 29-1922 = 111 = 3 - ft

Sept 30-22 = 1111111 = 9 - hole

Oct 1-22 = 1111111

Oct 7-22 = 0

256
319
2304
250

168
81664
81615

4083320
81664
489984

50.223360

Gravel on R.P. # 359

Truck #12 Driver

Sept 30 - 1922

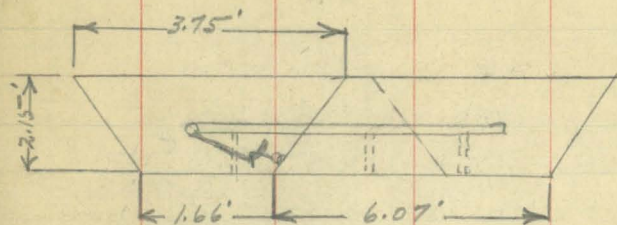
Body measurements

6.07' long

2.15' deep

3.75' wide top

1.66' wide Bottom

35.08 Cuft. = ~~43~~ / 43Sept 30 - 22 = ~~||||~~ = 7Oct 1 - 22 = ~~||||~~ = 7Oct 7 - 24 = ~~||||~~ = 7Truck #12 Now End Dump
 $4.05 \times 18 \times 5.95 = 43.37$ 

$$\begin{array}{r}
 6.07 \\
 1.66 \\
 \hline
 36.42 \\
 36.42 \\
 60.7 \\
 \hline
 100.762
 \end{array}$$

$$\begin{array}{r}
 166 \\
 395 \\
 \hline
 21541 \\
 21541 \\
 \hline
 2705
 \end{array}$$

$$\begin{array}{r}
 2705 \\
 607 \\
 \hline
 18935
 \end{array}$$

$$\begin{array}{r}
 18935 \\
 16230 \\
 \hline
 1641935
 \end{array}$$

$$\begin{array}{r}
 1641935 \\
 209675 \\
 \hline
 1641935 \\
 1641935 \\
 \hline
 3283875 \\
 3283875 \\
 \hline
 6567750
 \end{array}$$

New Box Measurements
72" Long

2.5 High
.95 Base

$$\begin{array}{r} 2.5 \\ .875 \\ \hline 1.25 \\ 1.75 \\ \hline 1.1875 \\ 3 \\ \hline 3.5625 \end{array}$$

2 DEEP
3. Wide
2.5 High

2.5
15.0
3.56
19.50
38.06

2.6 P

$$\begin{array}{r} 2.5 \\ 130 \\ 58 \\ \hline 6.50 \\ 3 \\ \hline 19.50 \end{array}$$

$$\begin{array}{r} 7.2 \\ 1.3 \\ \hline 22.5 \\ 1.25 \\ \hline 9.75 \\ 15. \\ 3.56 \\ \hline 28.31 \end{array}$$

Gravel P.P. = 359

Truck # 18 Driver
Sept. 30 - 1922

Body measurements

32" High

36" Wide

24" center

= 28.31 cu. ft.

Δ 11" Top

Δ 18" Top

Sept 20 - 1111 = 6 hole

Oct 1 - 22 = 111111

Oct 7 - 24 = 0

Truck # 18 Driver

Oct. 9 - 1924

Body measurements.

Box 4.05 x 1.42 x 5.98 = 34.40

Flare 4.25 x .30 x 5.6 = 7.14

Total Feet 41.54

Gravel on P.P. # 359

Truck #22 River-J. Nitengale
Sept 30-1922

Body measurements

72" long	} = 4596"
25" High to Flare	
36.5" wide	
2" Flare	
28" top of Flare	

Sept 30-1922 = 1 = 1

Oct. 1-22 =

Oct 7-22 = 0

6.0 long
3.0 wide
2.0 high
.33 Flare

18	4
2.08	3
<u>144</u>	217
36	3.5
<u>37.44</u>	33
693	105
<u>44.37</u>	105
	6
	<u>6.930</u>

Gravel on P.P. # 359.

Truck # 10 Driver Bill - Praska

Oct 7 - 1924

Body measurements

$$1.75 \times \underline{4.00} \times \underline{6.00} = 42.00 \text{ cu. Ft. When level full.}$$

Oct 7, 1924 = UH

Truck # 11

Gravel on P.P. #359
Truck #11- Oct 7-1924

Driver Bert. Ploen.

$$2.05 \times 3.30 \times 6.00 = 40.59 \text{ cu. Ft. Level full.}$$

Oct 7-1924=1441

Oct 8, 1924=1

Gravel on P.P. #359

Truck #8 Oct 14-1924

Body measurements

$$1.67 \times 4.9 \times 6.17 \left. \vphantom{1.67 \times 4.9 \times 6.17} \right\} 41.21 = \text{Cu. Ft.}$$

Date	Truck #4	Truck #16	Truck #22	Truck #13	Truck #7	Truck #12	Truck #9	Truck #3	Truck #12	Truck #18	Total
Sep 29	8	7	7	7	4	6	4	3	0	4-22	46
" 30	12	12	2	9	0	9	6	9	7	6-1	75
Oct. 1	6	11	10	10	2	9	10	11	13	11-0	93
Oct. 2	5	11	9	12	5	11	10	11	13	13-13	113
Oct. 7	8	7	0	7	6	1	6	0	8	0-0	43
Oct 8	3	1	0	0	1	1	1	0	0	0-0	7
Oct 9	10	10	5	8	8	6	0	1	9	7-9	73
Oct 10	16	14	10	11	6	11	9	11	13	12-12	125
Oct 11	12	12	7	7	7	11	12	12	11	13-13	117
Oct 13	15	14	12	13	0	10	6	9	12	10-14	115
Oct 14	17	15	3	13	6	10	4	11	14	8-14	115
Oct 15	16	10	14	14	12	9	0	13	10	15-16	129
Oct 16	11	12	12	3	11	1	11	10	13	14-14	112
Oct 17	16	14	7	0	12	0	12	11	15	11-14	112
Oct 18	14	11	7	0	13	5	10	11	14	13-15	113
Oct 20	14	13	13	0	0	12	10	11	13	12-14	112
Oct 21	11	8	9	0	0	10	10	9	10	11-12	90
Oct 22	14	11	0	0	0	12	12	7	7	14-14	91
Oct 23	4	5	0	8	0	11	11	0	9	10-13	71
Oct 24	3	1	0	1	0	2	3	0	2	1-2	15
Oct 28	13	11	0	0	8	9	9	2	9	12-8	81
Oct 29	15	11	0	0	12	9	7	2	12	6-12	60
Oct 30	14	12	0	0	10	7	9	6	12	11-10	91
Nov. 1	13	11	2	0	11	8	10	8	13	10-12	98
Nov. 3	15	15	0	0	13	14	6	11	13	4-3	94

Date	Truck #10	Truck #11	Truck #8	Truck #2	Truck #12	Truck #16	Truck #5	Truck #20	Truck #6	Truck #	Total
Oct. 7	5	6									11
Oct 8	0	1									1
Oct 9	0	7									7
Oct 10	5	11									16
Oct 11	10	10									20
Oct 13	13	10									23
Oct 14	15	14	7								36
Oct 15	17	14	16								47
Oct 16	15	13	14								42
Oct 17	10	9	18								37
Oct 18	10	12	12								34
Oct 20	12	7	13								32
Oct 21	7	8	6								21
Oct 23	9	9	10								28
Oct 24	1	1	1								3
Oct 27	0	1	0								1
Oct 28	0	7	0	10	10	9					36
Oct 29	14	14	13	12	13	12					78
Oct 30	9	11	13	0	14	12					59
Nov. 1	12	8	12	1	11	8					52
Nov. 3	16	10	16	12	16	13					94
Nov. 4	19	9	18	13	16	16	15	15	6		127
Nov 5	21	18	16	0	14	12	16	14	13		149
Nov 6	21	21	22	0	17	17	15	17	2		132
Nov. 7	5	5	7		9		8		6		40

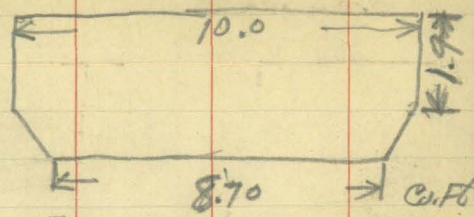
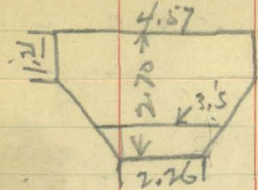
Date	Truck #1	Truck #2	Truck #3	Truck #4	Truck #5	Truck #6	Truck #7	Truck #8	Truck #9	Truck #10	Truck #11	Total
Nov. 4	15	14	12	12	9	13	11		9	11		106
Nov. 5	13	14	7	11	2	14	15		0	6		84
Nov. 6	4	16	13	15	0	14	16		14	15		107
Nov. 7	0	5	5	3	4	0	4		0	0		21
Nov. 8	11	13	0	15	10	16	11	13	13	0		89
Nov. 10	19	16	0	18	12	18	12	13	14	16		138
Nov. 12	16	13	7	0	0	5	0	13	13	6		73
Nov. 15	1	2	1	2	0	1	2	1	0	0		10
Nov. 17	14	13	13	2	1	14	13	13	1	0		84
Nov. 18	15	7	14	0	5	15	0	8	0	0		64
Nov. 19	14	14	9	13	3	15	15	17	0	0		100
Nov. 20	0	3	0	4	0	0	5	4	0	0		16
Nov. 21	13	6	6	13	2	14	4	13	0	0		71
Nov. 22	6	11	9	10	8	11	11	13	0	0		79
Nov. 23	8	0	4	9	3	0	9	8				41
Nov. 24	6	3	3	5		6	5	4				26
Nov. 25	4	0	4	0	0	3	1	3		1		16
Nov. 26	6	10	8	10		9	10			2		55
Nov. 27	0	8	6	8		9	8			9		48

Date	Truck [#] 1	Truck [#] 10	Truck [#] 8	Truck [#] 5	Truck [#] 14 ⁺¹⁰	Truck [#] 6	Truck [#] 20	Truck [#] 13	Truck [#] 14	Truck [#] 16	total
Nov. 8	10	12	15	6	14	6	0				65
Nov. 10	13	8	17	Truck [#] 21	19	11	17				85
Nov. 12	9	8	18	16	0 - 11	0	15	14	16	13	110
Nov. 15	0	0	0	Truck [#] 19	0 - 0	0	0	2	0		2
Nov. 17	0	7	7	0	- 12	0	11	7	11	Truck [#] 17	43
Nov. 18	0	6	18	16	- 17	4	0	1	16	16	94
Nov. 19	0	17	16	3	- 12	0	15	13	7	2	85
Nov. 20	5	2	3	0	- 1	0	4	0		Truck [#] 23	15
Nov. 21	10	9	12	1	- 10		12	4			58
Nov. 22	11	8	14	1	2		10	11			57
Nov. 23	1	7	10	8	9	10	8	4		1	48
Nov. 24	2	2	6	6	4		4	5			29
Nov. 25	3	3	5	4	3		3	3	1		25
Nov. 26	12	13	13	13	6			13		10	80
Nov. 27	7	10	8	10	8		10	4		6	63

Date	Truck [#] 25	Truck [#] 26	Truck [#] 32	Truck [#] 30	Truck [#] 21	Truck [#] 33	total
Nov. 15	2	0					2
Nov. 17	10	15					25
Nov. 18	17	18	13	18	13		79
Nov. 19	3	11	2	2	2		20
Nov. 21		11	Truck [#] 35	Truck [#] 15	1		12
Nov. 22		6	14		1		21
Nov. 23		6	8	10	6	10	40
Nov. 24		6	6		3		15
Nov. 25	Truck [#] 17	4	4		1	3	12
Nov. 26	2	13	11	4	10	9	49
Nov. 27	12		11	11	9	6	58

Gravel Trucks - M.O. Weaver 7/6/76

Truck No. 5. - Driver Hixon



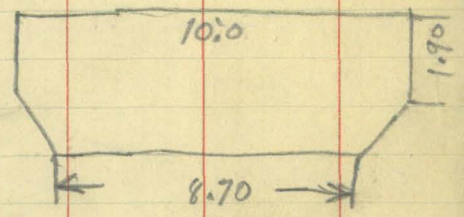
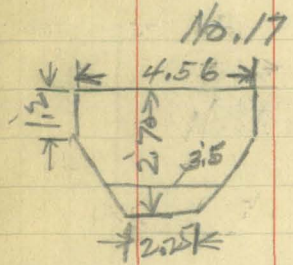
$$\left[(1.21 \times 4.57) + \left(\frac{4.57 + 2.26}{2} \right) 1.49 \right] 10.0 = 106.20$$

(5.53) (3.415) (5.288)

$$\left[\frac{0.8}{2} (1.30) \right] 2.66 = 1.4$$

(0.52)

Cap. No. 5 = $\frac{106.20 - 1.4}{1.05} = 104.8$



$$\left[(1.20 \times 4.56) + \left(\frac{4.56 + 2.25}{2} \right) 1.5 \right] 10.0 = 105.8$$

(5.47) (3.405) (5.11)

$$\frac{0.8}{2} \times 1.3 \times 2.65 = 1.38 \text{ c.f.} = 1.4$$

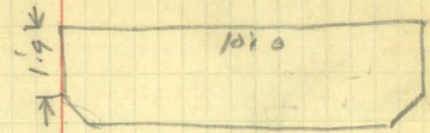
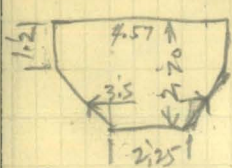
(0.52)

Cap. No 17 = $\frac{105.8 - 1.4}{1.05} = 104.4$

Gravel Trucks M.O. Weaver 7/6/76

Truck No. 7.

Hixon



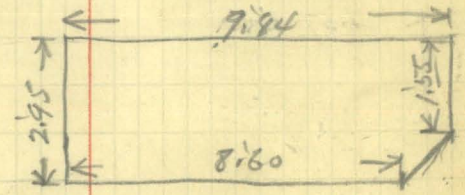
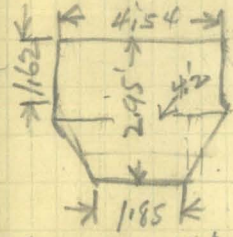
$$\left[(1.20 \times 4.57) + \left(\frac{4.57 + 2.25}{2} \right) 1.5 \right] \times 10.0 = 106.0$$

(5.48) (5.12)

Cap. No. 7. = $\frac{106.0 - 1.4}{1.05} = 104.6$

Truck No 4.

Dr. Downs



$$\left[(1.62 \times 4.54) + \left(\frac{4.54 + 1.85}{2} \right) 4.2 \right] 9.84 = 114.1$$

(7.35) (3.195) (4.25)

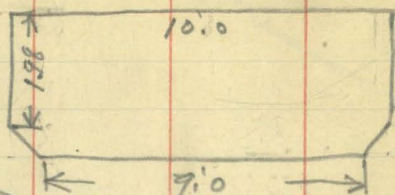
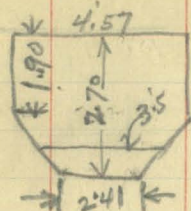
$$\frac{1.4}{2} \times 1.24 \times 2.63 = 2.28 \text{ c.f.} = 2.3$$

(3.76)

Cap. No 4 = $\frac{114.1 - 2.3}{1.05} = 111.8$

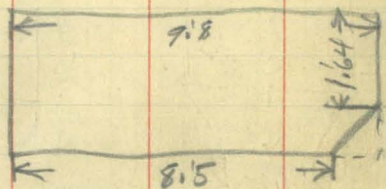
Truck No. 1.

Quigley.



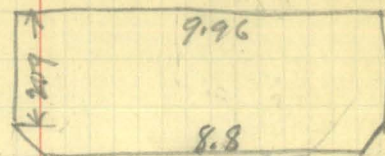
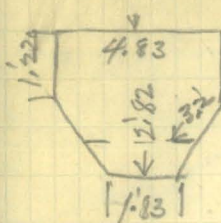
$$\begin{aligned} & \left[(1.90 \times 4.57) + \frac{(4.57 + 2.41) \times 0.8}{2} \right] 10.9 = 114.7 \\ & - \left(\frac{0.72}{2} \times 1.0 \times 2.77 \right) - 1.00 \text{ cu. ft.} = 113.7 \\ & \text{Cap. No. 1} = 113.7 \end{aligned}$$

Truck No. 9.



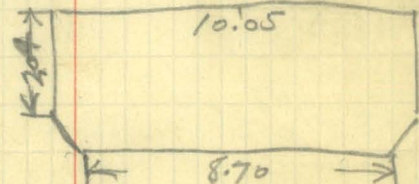
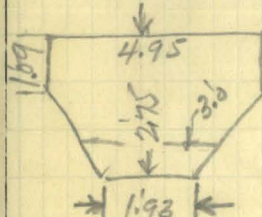
$$\begin{aligned} & \left[(1.43 \times 4.57) + \frac{(4.57 + 1.89) \times 1.52}{2} \right] 9.80 = 112.21 \\ & - \left(\frac{1.31}{2} \times 1.3 \times 2.65 \right) - 2.28 \text{ cu. ft.} = 110.0 \\ & \text{Cap. No. 9} = 110.0 \end{aligned}$$

Truck No. 15.



$$\begin{aligned} & \left[(1.22 \times 4.83) + \frac{(4.83 + 1.83) \times 1.60}{2} \right] 9.96 = 111.75 \\ & - \left(\frac{0.73}{2} \times 1.16 \times 2.79 \right) - 1.00 \text{ cu. ft.} = 110.75 \\ & \text{Cap. No. 15} = 110.75 \end{aligned}$$

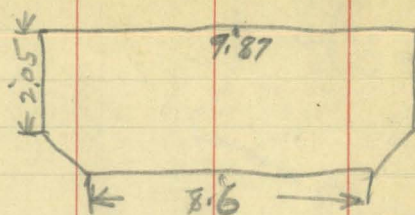
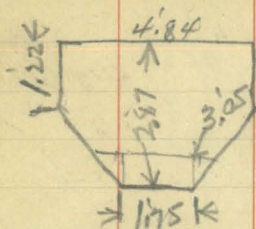
Truck No. 6.



$$\begin{aligned} & \left[(1.09 \times 4.95) + \frac{(4.95 + 1.93) \times 1.66}{2} \right] 10.05 = 111.66 \\ & - \left(\frac{0.71}{2} \times 1.35 \times 2.79 \right) - 1.08 \text{ cu. ft.} = 110.58 \\ & \text{Cap. No. 6} = 110.58 \end{aligned}$$

Gravel Trucks - M.O. Weaver 7/4/16

Truck No 3



$$\left[\frac{5.906}{(4.84 \times 1.22) + \left(\frac{4.84 + 1.75}{2} \right) 1.65} \right] 9.87 = \frac{92.46}{111.80}$$

$$- \frac{1.65 \times 1.17 \times 1.09}{1.93} = - \frac{2.10}{109.70}$$

Net Cap. =

Gravel Trucks

M.O. Weaver

No 12 -

No 18 - Ford.

No 9 -

No 6

No 3

No 5

No 15

No 17

No 7

No 1

No 4

cap 99 cu ft

47 cu ft

110

111

110

108

111

108

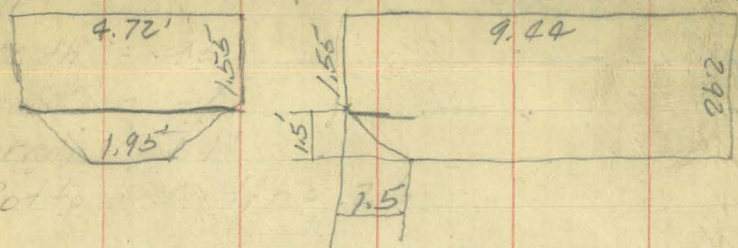
108

113

111

Truck No 10.

Capacity = 108 cu ft.



$$1.55 \times 4.72 = 7.32$$

$$1.37 \times 3.385 = 4.64$$

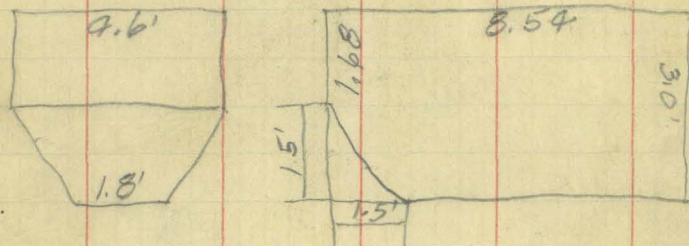
$$11.96 \times 9.44 = 112.9 \text{ cu ft.}$$

$$- 1.5 \times \frac{1.5}{2} \times 2.91$$

$$\frac{3.27}{108.63}$$

Truck No 102

capacity = 100 cu ft.



$$1.68 \times 4.6 = 7.73$$

$$1.32 \times 3.2 = 4.22$$

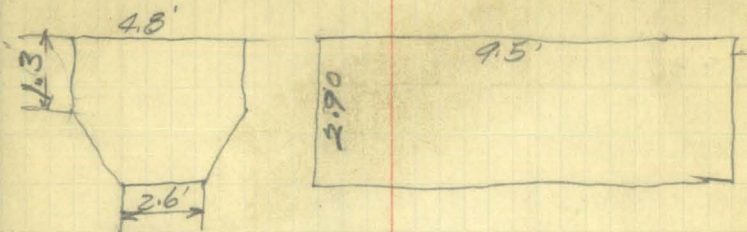
$$11.95 \times 8.54 = 102.05$$

$$- 1.5 \times \frac{1.5}{2} \times 2.73$$

$$\frac{3.07}{98.98}$$

Truck No 22

115 cu ft.



$$1.3 \times 4.8 \times 9.5 =$$

$$59.28 \text{ cu ft.}$$

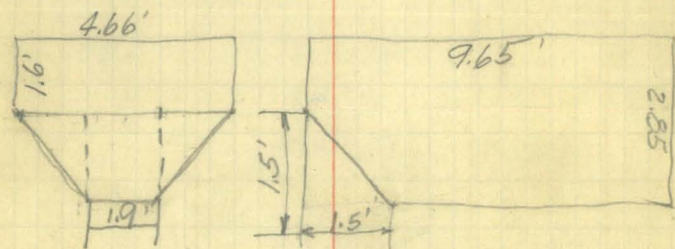
$$\frac{3.7}{4.8 + 2.6} \times 1.6 \times 9.5 =$$

$$\frac{56.20}{115.52 \text{ cu ft.}}$$

$$115.52 \text{ cu ft.}$$

Truck No 14

capacity = 108 cu ft.



$$1.6 \times 4.66 = 7.46$$

$$1.25 \times 3.28 = 4.10$$

$$11.56 \times 9.65 = 111.55 \text{ cu ft.}$$

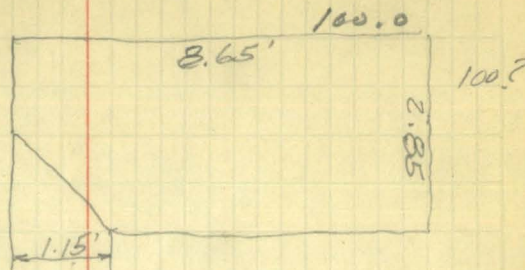
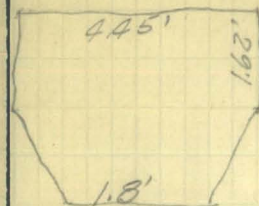
$$- \left(1.5 \times \frac{1.5}{2} \times 2.82 \right)$$

$$\frac{3.17}{108.38 \text{ cu ft.}}$$

Gravel Trucks A.J. Flockenstein. 8/15/2725

Truck No. 16

capacity = 94.0 cu.ft.



$$1.62 \times 4.45 = 7.21$$

$$1.23 \times 3.125 = 3.84$$

$$11.05 \times 8.65 = 95.58 \text{ cu.ft.}$$

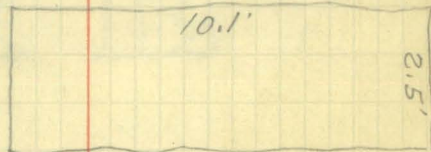
$$- \frac{1.15 \times 1.15 \times 2.68}{2}$$

Added 2" strip on top

$$\begin{array}{r} 1.77 \\ 93.81 \text{ cu.ft.} \\ - 6.5 \text{ cu.ft.} \\ \hline 100.3 \end{array}$$

Truck No 12

capacity = 95 cu.ft.



$$1.23 \times 4.52 \times 10.1 =$$

$$\frac{(4.52 + 1.6) \times 1.27 \times 10.1}{2} =$$

$$56.15 \text{ cu.ft.}$$

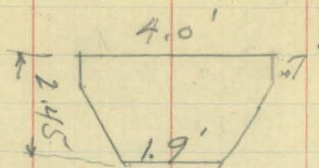
$$39.25$$

$$95.4 \text{ cu.ft.}$$

6-15-29

Measured of Gravel Tracks
Moe + Nelson.

#10 Chev. 12-451

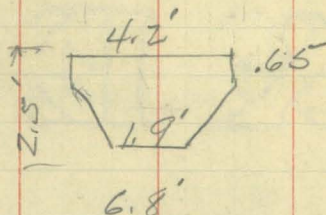


$$\begin{array}{r} 2.45 \\ .70 \\ \hline 1.75 \end{array}$$

6.7' Long.

$$53.33 = 2.00 \text{ yd.}$$

#2 Chev. 37-154



$$\begin{array}{r} 2.50 \\ .65 \\ \hline 1.85 \end{array}$$

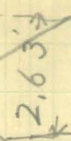
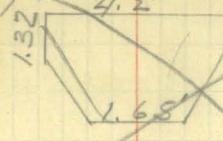
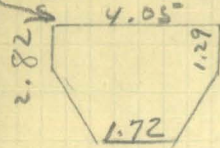
6.8'

$$56.91 \text{ cu. Ft.} = 2.18 \text{ cu. yd.}$$

26

Graveling
Reo.-

#3 Dodge - 26-218 Traded Dodge on Reo.



$$\begin{array}{r} 2.63 \\ 1.32 \\ \hline 1.31 \end{array}$$

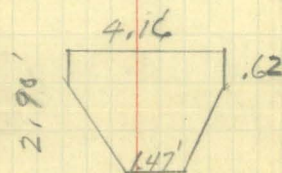
9.0 Long.

7.85' Long.

$$73.55 \text{ cu. Ft.} = 2.72 \text{ yd.}$$

$$87.25 = 3.23 \text{ yd.}$$

#15 Chev. 6. M-927

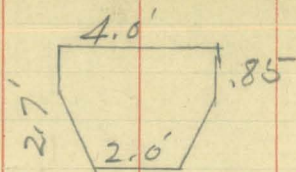


$$\begin{array}{r} 2.90 \\ .62 \\ \hline 2.28 \end{array}$$

$$\begin{array}{r} 53.94 \\ \hline 52.32 \end{array}$$

$$6.0' \text{ Long} = 2.00 \text{ yd.}$$

#9 chev. L-923



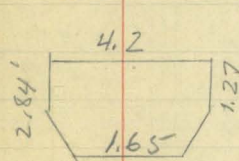
$$\begin{array}{r} 2.70 \\ .85 \\ \hline 1.85 \end{array}$$

60.86 6.8' Long 2.25 yd.

Reo: traded -6-24-29.

#6 Chev 26-122

Reo.



$$\begin{array}{r} 2.66 \\ 1.62 \\ \hline 1.06 \end{array}$$

9.08 Long.

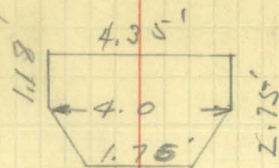
6.45' Long.

~~52.30 Cu.Ft. = 1.93 yd.~~

Reo.

90.07 Cu.Ft. = 3.33 yd.

#1 Reo. 74-912

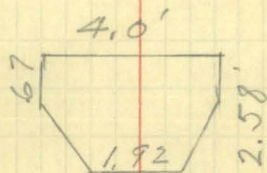


$$\begin{array}{r} 2.75 \\ 1.18 \\ \hline 1.57 \end{array}$$

92.15 9.55' 1.41
~~91.68~~ Cu.Ft. = 3.39 yd.

Ford 11-439

#8

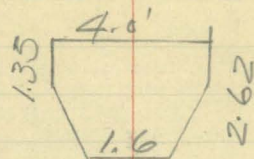


$$\begin{array}{r} 2.58 \\ .67 \\ \hline 1.91 \end{array}$$

6.95'

57.89 = 2.14

#5 Chev. 74-901



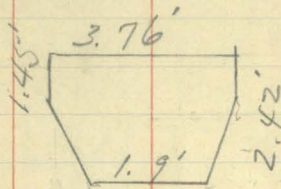
$$\begin{array}{r} 2.62 \\ 1.35 \\ \hline 1.27 \end{array}$$

7.05'

$$63.09 \text{ cu. ft.} = 2.33 \text{ yd.}$$

Chev. 86-507

7

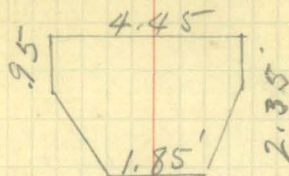


$$\begin{array}{r} 2.42 \\ 1.45 \\ \hline .97 \end{array}$$

7.05' Long

$$57.73 = 2.13 \text{ yd.}$$

#11. Chev. 74-867

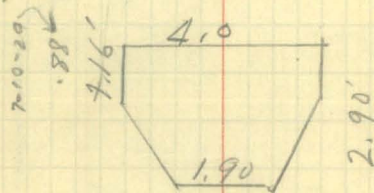


$$\begin{array}{r} 2.35 \\ 1.85 \\ \hline 1.40 \end{array}$$

7.55' Long.

$$65.15 = 2.41$$

#12 Dodge - 30-352



$$\begin{array}{r} 2.90 \\ 1.16 \\ \hline 1.74 \end{array}$$

7.62' Long.

74.44

65.91

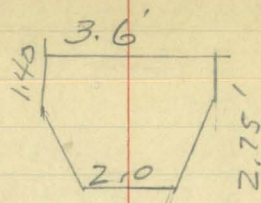
=

2.75

2.44

changed 7-9-29

#13. Chev. 26-345

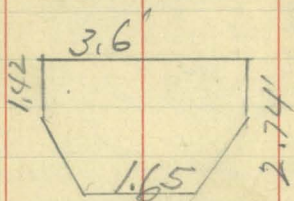


$$\begin{array}{r} 2.75 \\ 1.40 \\ \hline 1.35 \end{array}$$

6.75' Long.

$$59.53 = 2.20 \text{ yd.}$$

#14. Chev. M-942

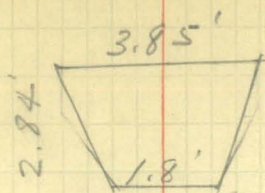


$$\begin{array}{r} 2.74 \\ 1.42 \\ \hline 1.32 \end{array}$$

6.55' Long.

$$56.13 = 2.07 \text{ yd.}$$

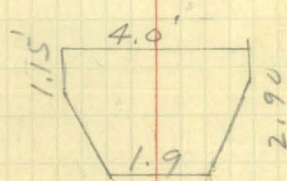
#4 Ford 30-160



7.55' Long.

$$60.57 = 2.24 \text{ yd.}$$

#16 chev. 35-607



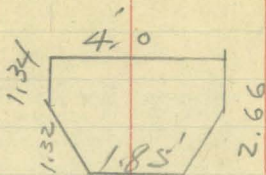
$$\begin{array}{r} 2.90 \\ 1.15 \\ \hline 1.75 \end{array}$$

6.22'

$$60.70 = 2.24 \text{ yds}$$

17 chev. M-941

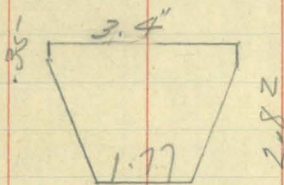
2-2" strips on top.



$$\begin{array}{r} 2.66 \\ 1.34 \\ \hline 1.32 \end{array}$$

$$64.54 = 7.0 \text{ Long} = 2.39 \text{ yd.}$$

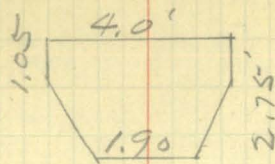
18 chev. M-779



$$\begin{array}{r} 2.82 \\ 3.5 \\ \hline 2.47 \end{array}$$

$$53.00 = 7.0 \text{ Long} = 1.96 \text{ yds.}$$

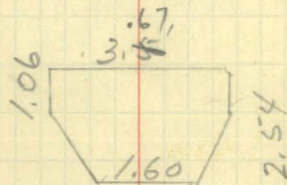
19 Dodge-29-147



$$\begin{array}{r} 2.75 \\ 1.05 \\ \hline 1.70 \end{array}$$

$$61.70 = 6.7 \text{ Long} = 2.28 \text{ yds.}$$

20 Dodge-64-242

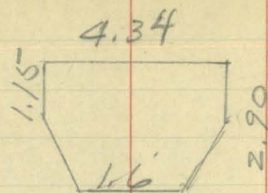


$$\begin{array}{r} 2.54 \\ 1.66 \\ \hline 1.48 \end{array}$$

$$\begin{array}{r} 62.43 \\ 60.96 \text{ Cu.Ft.} \\ \hline 2.31 \\ 2.25 \end{array}$$

1" on top = 2.25 Cu.Ft. or .083 yd.

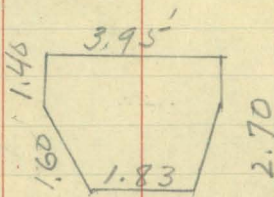
21 - Gra-Badge 29-199



$$\begin{array}{r} 2.90 \\ 1.15 \\ \hline 1.75 \end{array}$$

$$\begin{array}{r} 91.91 \\ 93.61 \\ \hline \end{array} \quad \begin{array}{l} 9.1 \text{ Long} \\ = \\ 3.47 \end{array} \text{ yd.}$$

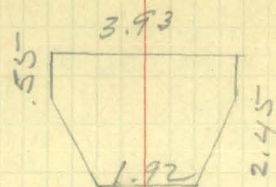
22 Chev. 74-840



$$\begin{array}{r} 2.70 \\ 1.40 \\ \hline 1.30 \end{array}$$

$$\begin{array}{r} 7.05 \text{ Long} \\ = \\ 65.47 \end{array} \quad \begin{array}{l} = \\ 2.42 \end{array}$$

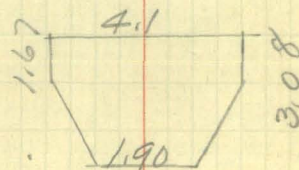
23 - Chev 29-357



$$\begin{array}{r} 2.45 \\ 1.55 \\ \hline 1.90 \end{array}$$

$$\begin{array}{r} 54.35 \\ = \\ 7.05 \text{ Long} \end{array} \quad \begin{array}{l} = \\ 2.00 \end{array}$$

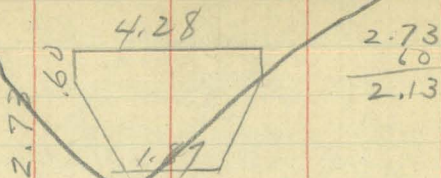
24 - Inter 9-299



$$\begin{array}{r} 3.08 \\ 1.67 \\ \hline 1.41 \end{array}$$

$$\begin{array}{r} 8.1 \text{ Long} \\ = \\ 89.66 \end{array} \quad \begin{array}{l} = \\ 3.32 \end{array}$$

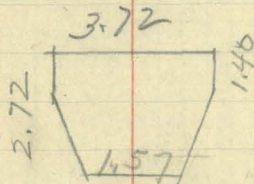
25- Chev. 11-438



6.0 Long.
54.60 Cu.Ft. = 2.02 C.Y.

Chev.

#26 M-944



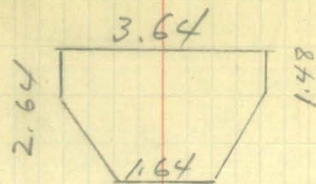
2.72
1.40
1.32

6.25' Long.

54.38 = 2.01 C.Y.

Chev.

#27- 74-899



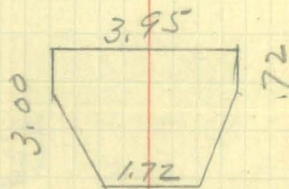
2.64
1.48
1.16

6.87' Long

58.05 = 2.15

Chev.

#28-56-298

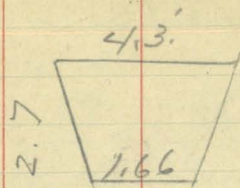


3.00
1.72
2.28

6.05' Long.

56.27 = 2.08

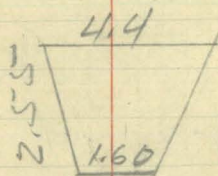
29 - Chev. 74-448



6.68'

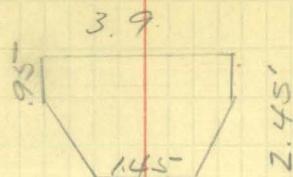
$$53.77 = 2.00 \text{ C.Y.}$$

30 - Chev. H-1288



6.08' Long.

$$46.51 = 1.72 \text{ C.Y.}$$

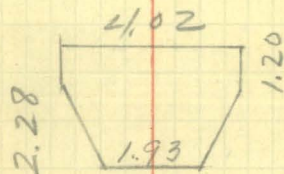
T-Ford
31 29-146

$$\begin{array}{r} 2.45 \\ 95 \\ \hline 1.50 \end{array}$$

7-0 Long.

$$53.97 = 2.00 \text{ yd.}$$

32. Chev. 74-578

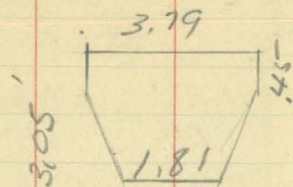


$$\begin{array}{r} 2.28 \\ 1.20 \\ \hline 1.08 \end{array}$$

7.02 Long.

$$56.37 \text{ Cu. Ft.} = 2.09 \text{ C.Y.}$$

#33. Dodge-11-269

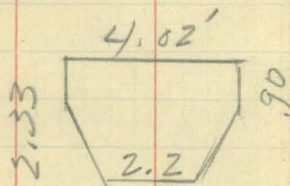


$$\begin{array}{r} 3.05 \\ 4.5 \\ \hline 2.60 \end{array}$$

6.0 Long

53.94 = 2.00 C.Y.

#34 - Chev. 12-454

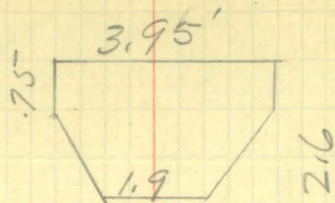


$$\begin{array}{r} 2.33 \\ 1.90 \\ \hline 1.43 \end{array}$$

6.69 Long

53.92 = 2.00 C.Y.

#35 - 29-443



$$\begin{array}{r} 2.60 \\ 1.75 \\ \hline 1.85 \end{array}$$

6.9 Long

57.75 Cu.Ft. = 2.13 yds.

#36 - Ford. 11-454

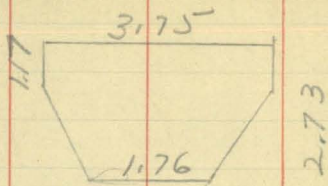


$$\begin{array}{r} 2.70 \\ 1.63 \\ \hline 1.07 \end{array}$$

6.43 Long

55.23 = 2.04 C.Y.

37- M-770



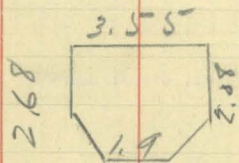
$$\begin{array}{r} 2.73 \\ 1.17 \\ \hline 1.56 \end{array}$$

6.85 Long.

59.53 cu. Ft.

2.20 C.Y.

#25-



$$\begin{array}{r} 2.68 \\ 2.38 \\ \hline .60 \end{array}$$

6.08 Long.

54.83

2.03 yds

#55. Chev. 35-655

$$\begin{array}{r} 2.92 \\ 1.22 \\ \hline 1.70 \end{array}$$



7.06 Long

$$61.92 = 2.3 \text{ C.Y.}$$

#60. Dodge - 41-336



$$\begin{array}{r} 3.45 \\ .88 \\ \hline 2.57 \end{array}$$

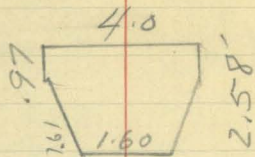
6.71 Long.

$$73.87 = 2.73$$

#58 Inter. 29-395

9935-01 =

3.49 c/p



8.02

$$\begin{array}{r} 2.58 \\ 97 \\ \hline 1.61 \end{array}$$

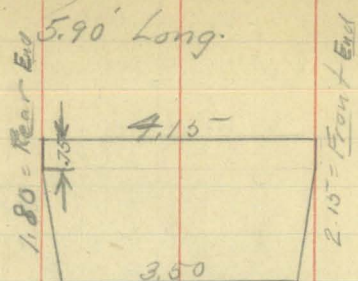
67.29

=

2.49

Chev. Lic. #9-358

Truck #12



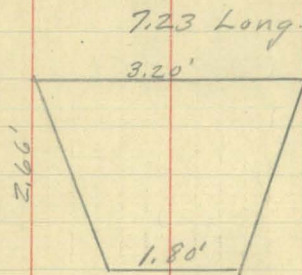
$$3.825 \times 1.225 \times 5.90 = 27.64 \text{ Cu. ft.}$$

$$4.15 \times 0.75 \times 5.90 = 18.36 \text{ Cu. ft.}$$

$$= 46.00 \text{ Cu. ft.} =$$

Chev. Lic. #25-272

Truck #21



Product

$$0.79 \times 1.99 \times 0.65 = 1.02 \text{ Cu. ft.}$$

$$2.50 \times 2.66 \times 7.23 = 48.08 \text{ Cu. ft.}$$

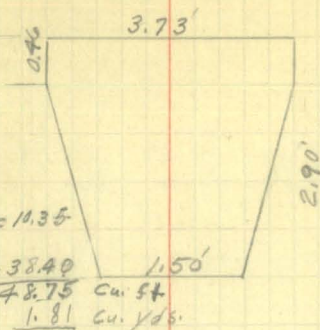
$$48.08 - 1.02 = 47.06 \text{ Cu. ft.}$$

$$47.06 \text{ Cu. ft.} = 1.74 \text{ Cu. yds.}$$

International Lic. #9-29

Truck #1.

6.03' Long.



$$3.73' \times 0.46' \times 6.03' = 14.35$$

$$1.70 \text{ Cu. yd.} \times 2.44' \times 6.03' = 38.40$$

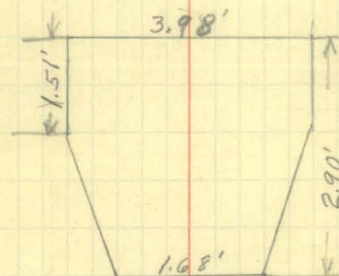
$$\frac{48.75 \text{ Cu. ft.}}{1.81 \text{ Cu. yds.}}$$

$$55.23 \text{ Cu. ft.} = 2.04 \text{ Cu. yds.}$$

New Dodge Lic. #11-535

Truck #3.

6.58' = Long.



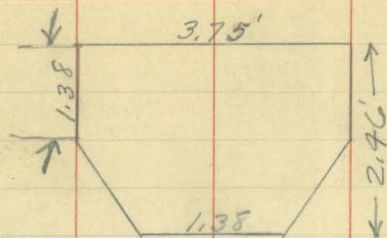
$$3.98' \times 1.51' \times 6.58' = 39.54$$

$$2.83' \times 1.39' \times 6.58' = 25.88$$

$$\frac{65.42 \text{ Cu. ft.}}{2.42 \text{ Cu. yds.}}$$

International Lic. #9-426

Truck #2.



7.95' Long.

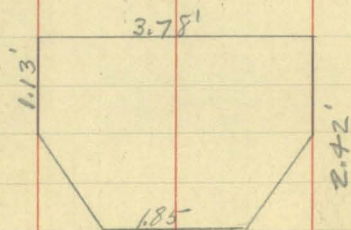
$$3.75' \times 1.38' \times 7.95' = 40.62$$

$$2.56' \times 1.08' \times 7.95' = 21.98$$

$$\frac{62.60 \text{ cu ft.}}{2.32 \text{ cu yds}}$$

Chev. Lic. #H-788

Truck #6



6.05' Long.

$$3.78' \times 1.13' \times 6.05' = 25.84$$

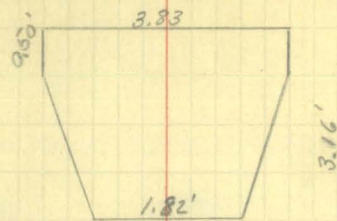
$$2.86' \times 1.29' \times 6.05' = 22.32$$

$$\frac{48.16 \text{ cu ft.}}{1.78 \text{ cu yds.}}$$

$$54.00 \text{ cu ft.} = 2.00 \text{ yds}$$

International Lic. #9-376

Truck #412



6.04' Long

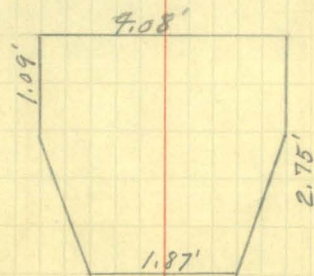
$$83' \times 0.50' \times 6.04' = 11.57$$

$$82' \times 2.66' \times 6.04' = 45.30$$

$$\frac{56.87 \text{ cu ft.}}{2.11 \text{ cu yds}}$$

International Lic. #9-375

Truck #8



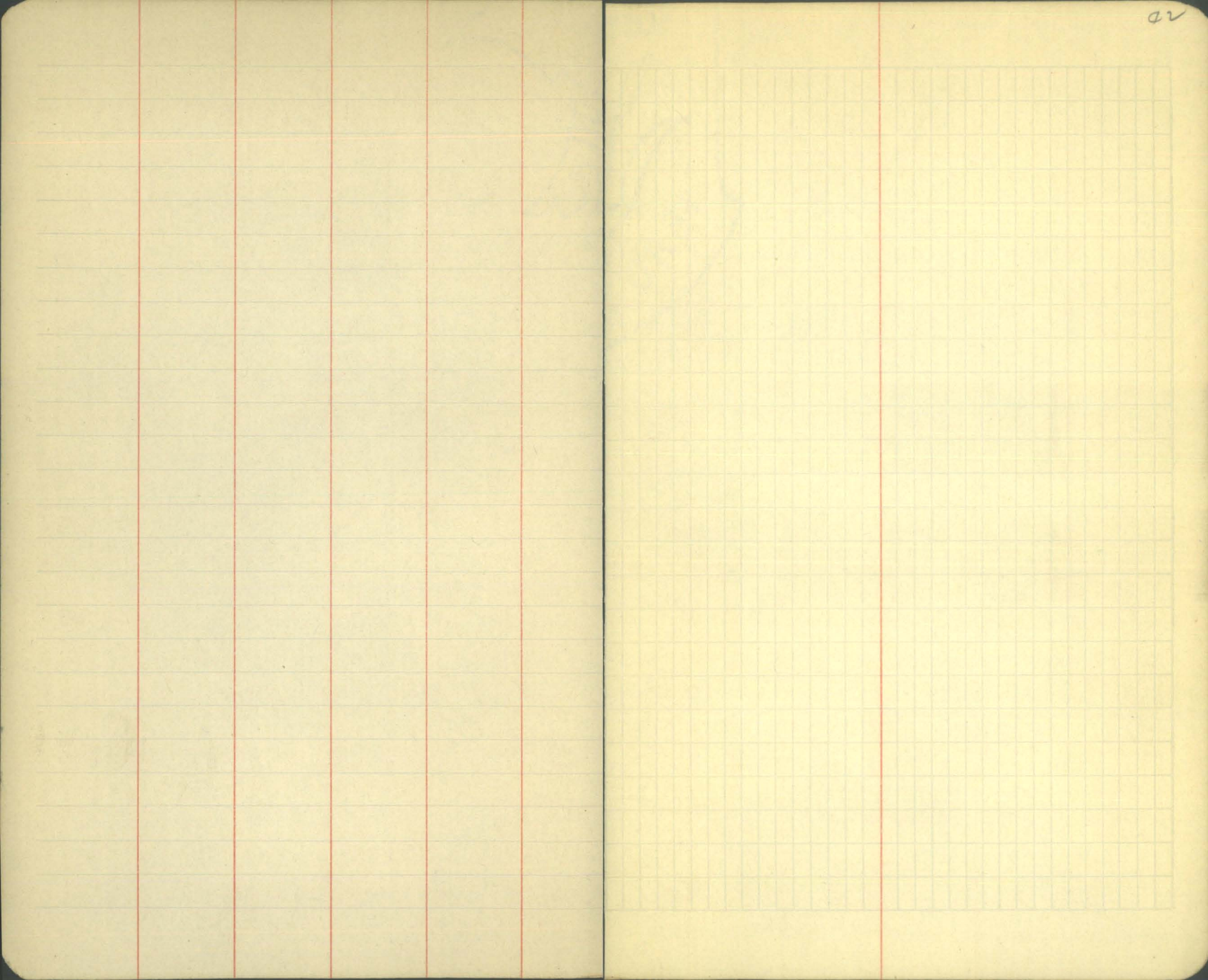
8.40' Long

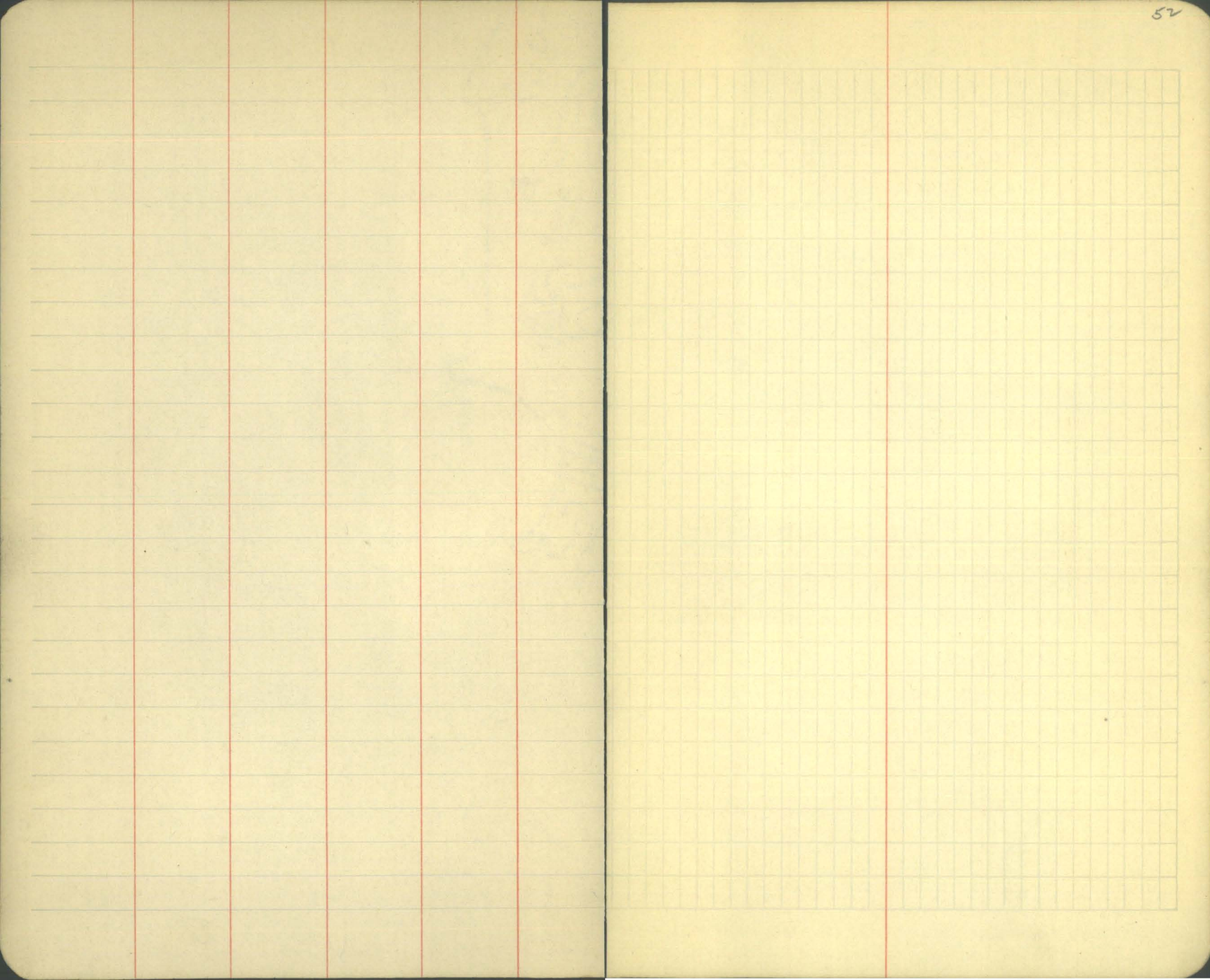
$$7.08' \times 1.09' \times 8.40' = 37.36$$

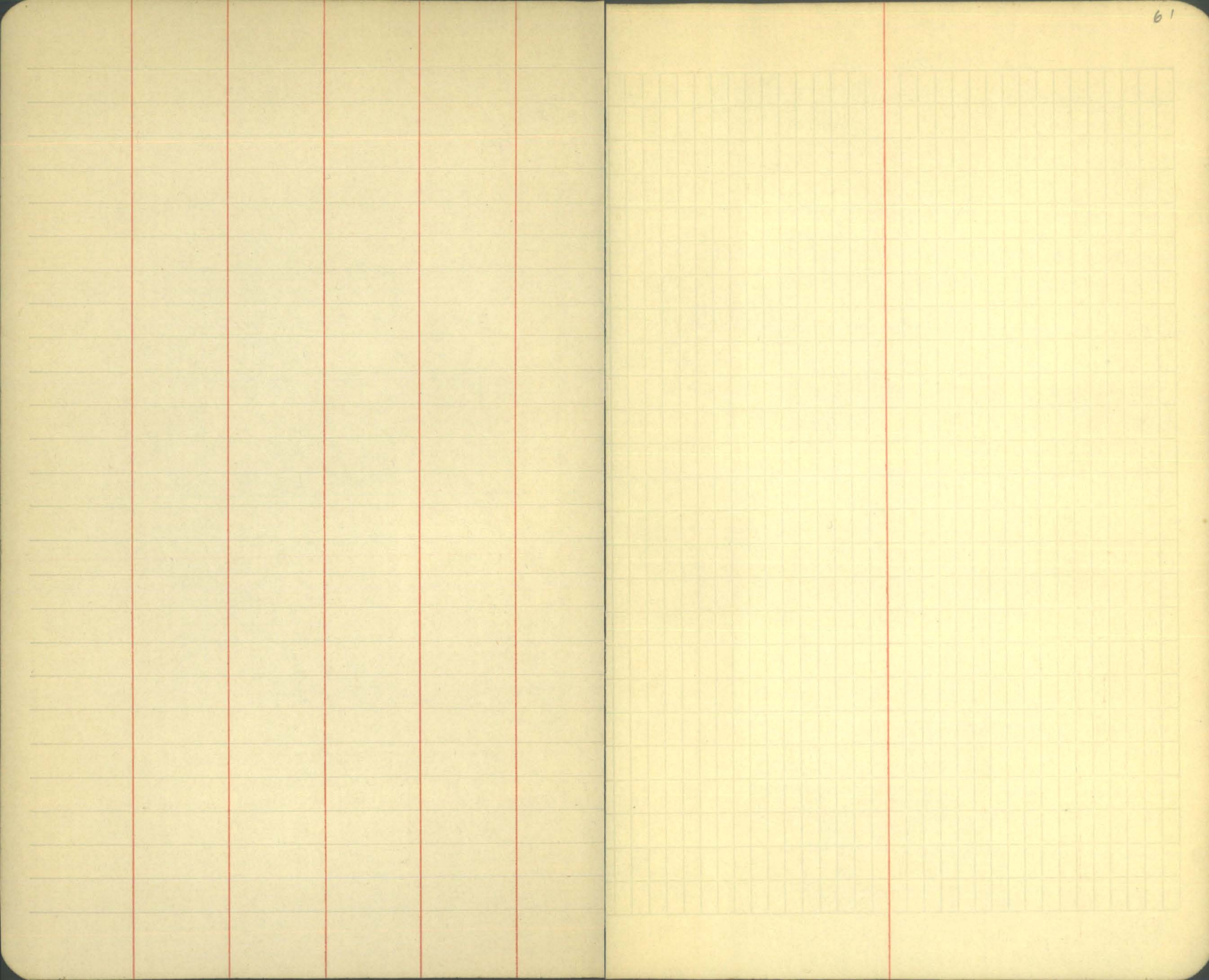
$$7.97' \times 1.66' \times 8.40' = 49.30$$

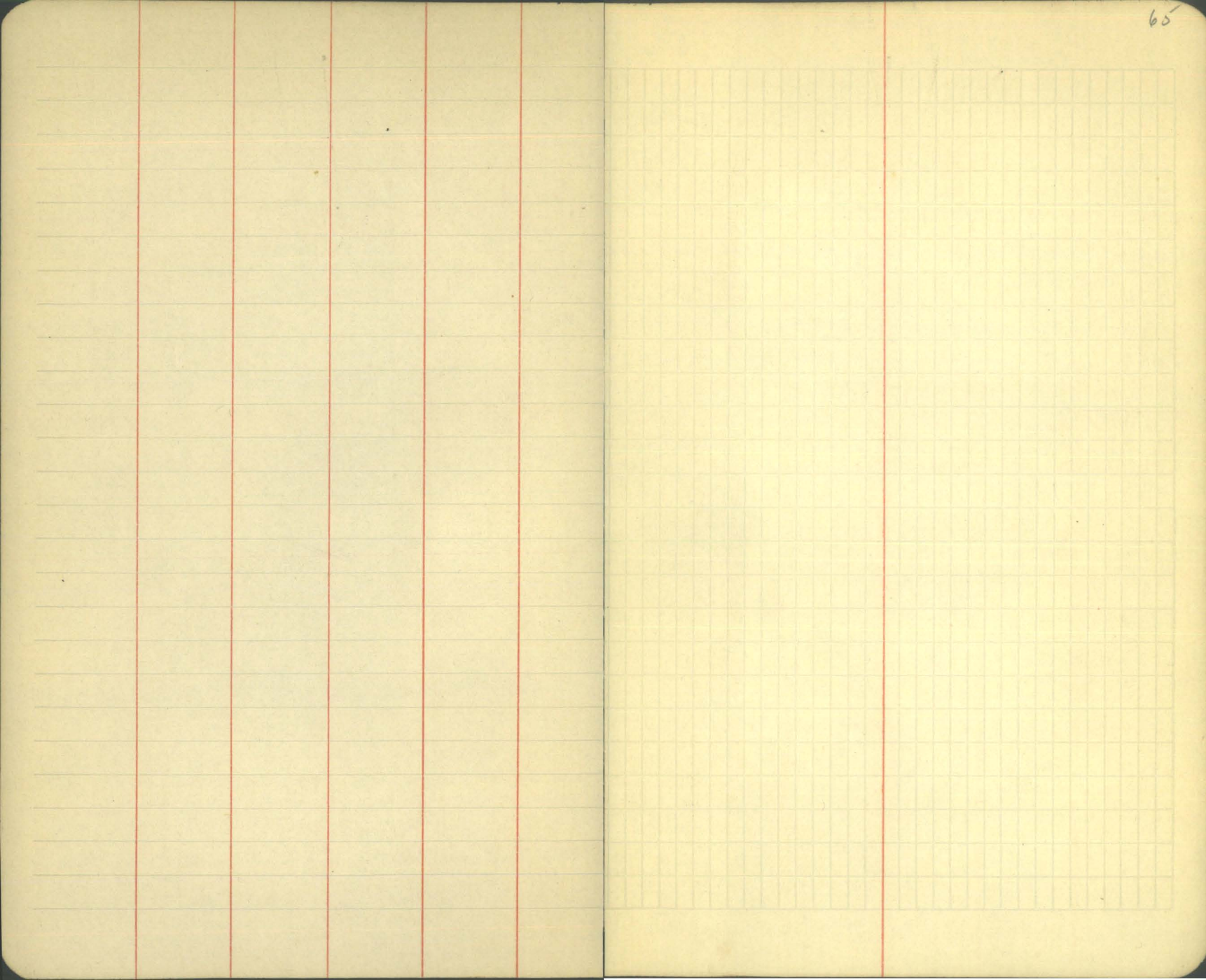
$$\frac{86.66 \text{ cu ft.}}{3.21 \text{ cu yds}}$$

Cher. Lic. # 443 - Tr. No. 35 - 2.13 cu. yds.
measured on Cedar Falls - Dunkerton Co. Rd



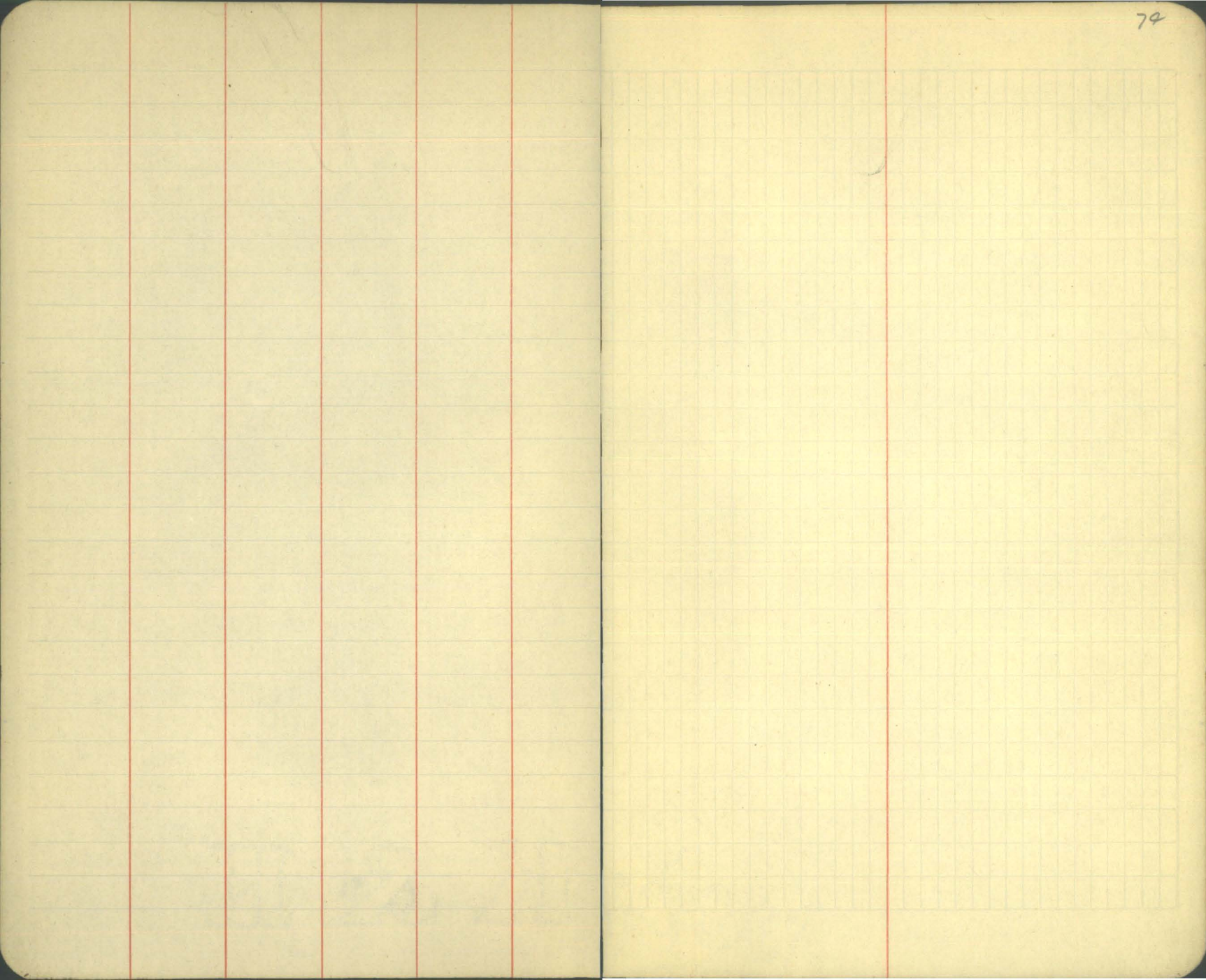


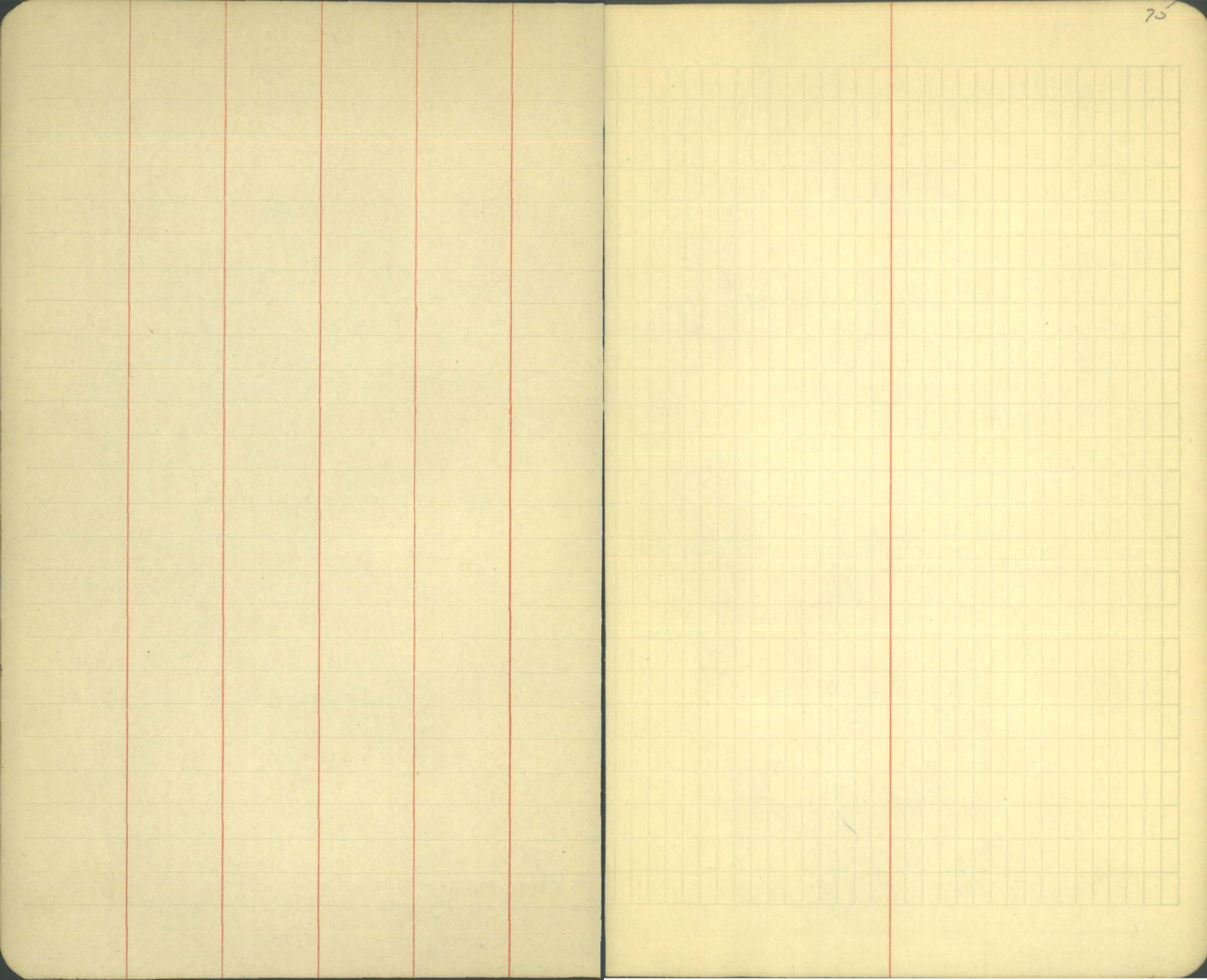




Moore + Young. Maintaining Road
Date Hours Miles On P.P. # 359
Oct 11 3 1/2 2

Date	Truck#/loads	Cu. Ft	St.	Total
Oct 9	#4 2	43+43	490	86
Oct 9	#11 1	40	490	40
Oct 10	#4 2	42+43	506	85
Oct 10	#4 2	43+43	511	86
Oct 13	#24 1	39	527	39
Oct 13	#14 1	36	527	36
Oct 16	#18 1	43	551	43
Oct 16	#3 1	41	551	41
Oct 17	#9 1	41	552	41
Oct 17	#12 1	39	552	39
Oct 28	#12 1	42	475	42
Oct 28	#16 1	48	475	48
Nov-1	#9 1	40	452	40
Nov. 1	#9 1	45	452	45
Nov. 3	#16 2	49-49	445+443	98
Nov. 8	#11+18 2	43-43	398	86
Nov-10	#6+20 2	42-43	387	85
Nov-10	#6+15 2	43-41	385	84
Nov-17	#161-16 2	40-48	365	88
Nov-22	#14-161 2	37-39	2	76





Truck # 21

End Dump

42 Cu ft
level/full

Truck # 5

Bottom Dump

54 Cu ft
level Full

Truck # 35

Bottom Dump

57 Cu ft.
level Full

Truck # 17 Dodge

Bottom Dump

52½ Cu ft
level Full

Truck # 20 Bottom Dump

$$(1.46 + 4.00) \div 2 \times 6.04 \times 2.3 = 37.92$$

Truck # 29

End Dump measures 36 Cu ft level full

Truck # 26

End dump measures 44 Cu ft level Full

Truck # 21

End Dump measures 43 Cu ft level Full

Truck # 5

Bottom Dump measures 38 Cu ft level Full

Truck # 25

Bottom Dump - 47½ Cu ft level Full

Truck # 30

Bottom Dump - 52 Cu ft level Full

Truck # 23

Bottom Dump - 52 Cu ft level Full

Truck # 19

End Dump - 42 Cu ft level Full

Truck #2 Bottom Dump

$$(1.49 + 3.93) \div 2 \times 5.93 \times 2.125 = 24.779$$

Gravel on Hudson & Hicks Road.

78

Date	Truck #9	Truck #10	Truck #13	Truck #14	Truck #17	Truck #18	Truck #22	Truck #3	Truck #8	Truck #10	Total
Oct 24	12	9	1	9	9	8	10	5	12	13	88
Oct 25	7	7	0	7	8	7	9	8	9	0	62
									Truck #11	Truck #12	
Oct 24									12	12	24
Oct 25									7	8	15

Gravel for City of Hudson.

Date	Truck #4	Truck #10	Truck #12	Truck #9	Truck #18	Truck #22	Truck #3	Truck #8	Truck #11	Truck #12	Total
Oct 25	7	5	6	5	6	6	5	4	5	6	55

TRUCK #15 Bottom Dump

$$(.15 \times 4.1) \div 2 \times 6.0 \times 2.3 = 38.6$$

Truck #16 Bottom Dump

$$(1.53 + 4) \div 2 \times 2.175 \times 6.04 = 36.34$$

$$\text{Flare } 4.25 \times 61 \times 41 = \frac{10.63}{46.97}$$

KEITH'S RAILROAD CURVE TABLES.

Published by KEUFFEL & ESSER CO., New York.

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HOW TO USE KEITH'S TABLES.

EXAMPLE.

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

Ext. in Tab. IV opposite $23^{\circ} 20' = 120.87$
 $120.87 + 12 = 10.07$. Say a 10° Curve.

Tan. in Tab. IV opp. $23^{\circ} 20' = 118.1$
 $118.1 + 10 = 118.31$.

Tab. V. correction for A. $23^{\circ} 20'$ for a 10° Cur.=0.16
 $118.31 + 0.16 = 118.47 = \text{corrected Tangent}$.

(If corrected Ext. is required find in same way)
Ang. $23^{\circ} 20' = 23.33^{\circ} + 10 = 2.3333 = \text{L. C.}$

$2^{\circ} 19\frac{1}{2}' = \text{def. for sta. 542}$	I. P.=sta. 542+72
$4^{\circ} 49\frac{1}{2}' = \text{" " " +50}$	Tan.= 1.18.47
$7^{\circ} 19\frac{1}{2}' = \text{" " " 543}$	B. C.=sta. 541+53.53
$9^{\circ} 49\frac{1}{2}' = \text{" " " +50}$	L. C.= 2.33.33
$11^{\circ} 40' = \text{" " " 543+}$	E. C.=sta. 543+86.86
86.86	

$100 - 53.53 = 46.47 \times 3' (\text{def. for 1 ft. of } 10^{\circ} \text{ Cur.}) = 139.41' =$
 $2^{\circ} 19\frac{1}{2}' = \text{def. for sta. 542.}$

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

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

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

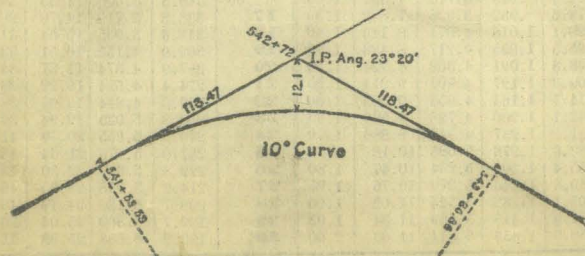


TABLE I. — Minutes in Decimals of a Degree.

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

TABLE II. — Inches in Decimals of a Foot.

1-16	3-32	$\frac{1}{8}$	3-16	$\frac{1}{4}$	5-16	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729
1	2	3	4	5	6	7	8	9	10	11
.0933	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

TABLE III. — Radii, Ordinates and Deflections.

Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot	Deg.	Radius	Mid. Ord.	Tan. Def.	Chd. Def.	Def. for 1 Foot
0° 10'	84377.	.086	.145	.291	0.05	7°	819.0	1.528	6.105	12.21	2.10
20	17189.	.073	.291	.582	0.10	20'	781.8	1.600	6.395	12.79	2.29
30	11459.	.109	.436	.873	0.15	30	764.5	1.637	6.540	13.08	2.25
40	8594.4	.145	.582	1.164	0.20	40	747.9	1.673	6.685	13.37	2.30
50	6875.5	.182	.727	1.454	0.25	50	716.8	1.746	6.976	13.95	2.40
1 10	5729.6	.218	.873	1.745	0.30	20	688.2	1.819	7.266	14.53	2.50
20	4911.2	.255	1.018	2.036	0.35	30	674.7	1.855	7.411	14.82	2.55
30	4297.3	.291	1.164	2.327	0.40	40	661.7	1.892	7.556	15.11	2.60
40	3819.8	.327	1.309	2.618	0.45	50	637.3	1.965	7.846	15.69	2.70
50	3437.9	.364	1.454	2.909	0.50	20	614.6	2.037	8.136	16.27	2.80
1 10	3125.4	.400	1.600	3.200	0.55	30	603.8	2.074	8.281	16.56	2.85
20	2864.9	.436	1.745	3.490	0.60	40	593.4	2.110	8.426	16.85	2.90
30	2644.6	.473	1.891	3.781	0.65	50	573.7	2.193	8.716	17.43	3.00
40	2455.7	.509	2.036	4.072	0.70	20	546.4	2.292	9.150	18.30	3.15
50	2292.0	.545	2.181	4.363	0.75	30	521.7	2.402	9.585	19.16	3.30
1 10	2148.8	.582	2.327	4.654	0.80	40	499.1	2.511	10.02	20.04	3.45
20	2022.4	.618	2.472	4.945	0.85	50	478.3	2.620	10.45	20.91	3.60
30	1910.1	.655	2.618	5.235	0.90	20	459.3	2.730	10.89	21.77	3.75
40	1809.6	.691	2.763	5.526	0.95	30	441.7	2.839	11.32	22.64	3.90
50	1719.1	.727	2.908	5.817	1.00	40	425.4	2.949	11.75	23.51	4.05
1 10	1637.3	.764	3.054	6.108	1.05	50	410.3	3.058	12.18	24.37	4.20
20	1562.9	.800	3.199	6.398	1.10	20	396.2	3.168	12.62	25.24	4.35
30	1495.0	.836	3.345	6.689	1.15	30	383.1	3.277	13.05	26.11	4.50
40	1432.7	.873	3.490	6.980	1.20	40	370.8	3.387	13.49	26.97	4.65
50	1375.4	.909	3.635	7.271	1.25	50	359.3	3.496	13.92	27.84	4.80
1 10	1322.5	.945	3.718	7.561	1.30	20	348.5	3.606	14.35	28.70	4.95
20	1273.6	.982	3.826	7.852	1.35	30	338.3	3.716	14.78	29.56	5.10
30	1228.1	1.018	4.071	8.143	1.40	40	319.6	3.835	15.64	31.29	5.40
40	1185.8	1.055	4.217	8.433	1.45	50	302.9	4.155	16.51	33.01	5.70
50	1146.3	1.091	4.362	8.724	1.50	20	287.9	4.374	17.37	34.73	6.00
1 10	1109.3	1.127	4.507	9.014	1.55	30	274.4	4.594	18.22	36.44	6.30
20	1074.7	1.164	4.653	9.305	1.60	40	262.0	4.814	19.08	38.16	6.60
30	1042.1	1.200	4.798	9.596	1.65	50	250.8	5.035	19.94	39.87	6.90
40	1011.5	1.237	4.943	9.886	1.70	20	240.5	5.255	20.79	41.58	7.20
50	982.6	1.273	5.088	10.18	1.75	30	231.0	5.476	21.64	43.28	7.50
1 10	955.4	1.309	5.234	10.47	1.80	40	222.3	5.697	22.50	44.99	7.80
20	929.6	1.346	5.379	10.76	1.85	50	214.2	5.918	23.35	46.69	8.10
30	905.1	1.382	5.524	11.05	1.90	20	206.7	6.139	24.19	48.38	8.40
40	881.9	1.418	5.669	11.34	1.95	30	199.7	6.360	25.04	50.07	8.70
50	859.9	1.455	5.814	11.63	2.00	40	193.2	6.583	25.88	51.76	9.00

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
1°	50.00	.22	11°	551.70	26.50	21°	1061.9	97.57
10'	58.34	.30	10'	560.11	27.31	10'	1070.6	99.16
20	66.67	.39	20	568.53	28.14	20	1079.2	100.75
30	75.01	.49	30	576.95	28.97	30	1087.8	102.35
40	83.34	.61	40	585.36	29.82	40	1096.4	103.97
50	91.68	.73	50	593.79	30.68	50	1105.1	105.60
2	100.01	.87	12	602.21	31.56	22	1113.7	107.24
10	108.35	1.02	10	610.64	32.45	10	1122.4	108.90
20	116.68	1.19	20	619.07	33.35	20	1131.0	110.57
30	125.02	1.36	30	627.50	34.26	30	1139.7	112.25
40	133.36	1.55	40	635.93	35.18	40	1148.4	113.95
50	141.70	1.75	50	644.37	36.12	50	1157.0	115.66
3	150.04	1.96	13	652.81	37.07	23	1165.7	117.38
10	158.38	2.19	10	661.25	38.03	10	1174.4	119.12
20	166.72	2.43	20	669.70	39.01	20	1183.1	120.87
30	175.06	2.67	30	678.15	39.99	30	1191.8	122.63
40	183.40	2.93	40	686.60	40.99	40	1200.5	124.41
50	191.74	3.21	50	695.06	42.00	50	1209.2	126.20
4	200.08	3.49	14	703.51	43.03	24	1217.9	128.00
10	208.43	3.79	10	711.97	44.07	10	1226.6	129.82
20	216.77	4.10	20	720.44	45.12	20	1235.3	131.65
30	225.12	4.42	30	728.90	46.18	30	1244.0	133.50
40	233.47	4.76	40	737.37	47.25	40	1252.8	135.35
50	241.81	5.10	50	745.85	48.34	50	1261.5	137.23
5	250.16	5.46	15	754.32	49.44	25	1270.2	139.11
10	258.51	5.83	10	762.80	50.55	10	1279.0	141.01
20	266.86	6.21	20	771.29	51.68	20	1287.7	142.93
30	275.21	6.61	30	779.77	52.89	30	1296.5	144.85
40	283.57	7.01	40	788.26	53.97	40	1305.3	146.79
50	291.92	7.43	50	796.75	55.13	50	1314.0	148.75
6	300.28	7.86	16	805.25	56.31	26	1322.8	150.71
10	308.64	8.31	10	813.75	57.50	10	1331.6	152.69
20	316.99	8.76	20	822.25	58.70	20	1340.4	154.69
30	325.35	9.23	30	830.76	59.91	30	1349.2	156.70
40	333.71	9.71	40	839.27	61.14	40	1358.0	158.72
50	342.08	10.20	50	847.78	62.38	50	1366.8	160.76
7	350.44	10.71	17	856.30	63.63	27	1375.6	162.81
10	358.81	11.22	10	864.82	64.90	10	1384.4	164.86
20	367.17	11.75	20	873.35	66.18	20	1393.2	166.95
30	375.54	12.29	30	881.88	67.47	30	1402.0	169.04
40	383.91	12.85	40	890.41	68.77	40	1410.9	171.15
50	392.28	13.41	50	898.95	70.09	50	1419.7	173.27
8	400.66	13.99	18	907.49	71.42	28	1428.6	175.41
10	409.03	14.58	10	916.03	72.76	10	1437.4	177.55
20	417.41	15.18	20	924.58	74.12	20	1446.3	179.72
30	425.79	15.80	30	933.13	75.49	30	1455.1	181.89
40	434.17	16.43	40	941.69	76.86	40	1464.0	184.08
50	442.55	17.07	50	950.25	78.26	50	1472.9	186.29
9	450.93	17.72	19	958.81	79.67	29	1481.8	188.51
10	459.32	18.38	10	967.38	81.09	10	1490.7	190.74
20	467.71	19.06	20	975.96	82.53	20	1499.6	192.99
30	476.10	19.75	30	984.53	83.97	30	1508.5	195.25
40	484.49	20.45	40	993.12	85.43	40	1517.4	197.53
50	492.88	21.16	50	1001.7	86.90	50	1526.3	199.82
10	501.28	21.89	20	1010.3	88.39	30	1535.3	202.12
10	509.68	22.62	10	1018.9	89.89	10	1544.2	204.44
20	518.08	23.38	20	1027.5	91.40	20	1553.1	206.77
30	526.48	24.14	30	1036.1	92.92	30	1562.1	209.12
40	534.89	24.91	40	1044.7	94.46	40	1571.0	211.48
50	543.29	25.70	50	1053.3	96.01	50	1580.0	213.86

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
31°	1589.0	216.3	41°	2142.2	387.4	51°	2732.9	618.4
10'	1598.0	218.7	10'	2151.7	390.7	10'	2748.1	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.

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
61°	3375.0	920.2	71°	4086.9	1308.2	81°	4893.6	1805.3
10'	3388.3	925.9	10'	4099.5	1315.6	10'	4908.0	1814.7
20	3397.5	931.6	20	4112.1	1322.9	20	4922.5	1824.1
30	3408.8	937.3	30	4124.8	1330.3	30	4937.0	1833.6
40	3420.1	943.1	40	4137.4	1337.7	40	4951.5	1843.1
50	3431.4	948.9	50	4150.1	1345.1	50	4966.1	1852.6
62°	3442.7	954.8	72°	4162.8	1352.6	82°	4980.7	1862.2
10	3454.1	960.6	10	4175.6	1360.1	10	4995.4	1871.8
20	3465.4	966.5	20	4188.5	1367.6	20	5010.0	1881.5
30	3476.8	972.4	30	4201.2	1375.2	30	5024.8	1891.2
40	3488.3	978.3	40	4214.0	1382.8	40	5039.5	1900.9
50	3499.7	984.3	50	4226.8	1390.4	50	5054.3	1910.7
63°	3511.1	990.2	73°	4239.7	1398.0	83°	5069.2	1920.5
10	3522.6	996.2	10	4252.6	1405.7	10	5084.0	1930.4
20	3534.1	1002.3	20	4265.6	1413.5	20	5099.0	1940.3
30	3545.6	1008.3	30	4278.5	1421.2	30	5113.9	1950.3
40	3557.2	1014.4	40	4291.5	1429.0	40	5128.9	1960.2
50	3568.7	1020.5	50	4304.6	1436.8	50	5143.9	1970.3
64°	3580.3	1026.6	74°	4317.6	1444.6	84°	5159.0	1980.4
10	3591.9	1032.8	10	4330.7	1452.5	10	5174.1	1990.5
20	3603.5	1039.0	20	4343.8	1460.4	20	5189.3	2000.6
30	3615.1	1045.2	30	4356.9	1468.4	30	5204.4	2010.8
40	3626.8	1051.4	40	4370.1	1476.4	40	5219.7	2021.1
50	3638.5	1057.7	50	4383.3	1484.4	50	5234.9	2031.4
65°	3650.2	1063.9	75°	4396.5	1492.4	85°	5250.3	2041.7
10	3661.9	1070.2	10	4409.8	1500.5	10	5265.6	2052.1
20	3673.7	1076.6	20	4423.1	1508.6	20	5281.0	2062.5
30	3685.4	1082.9	30	4436.4	1516.7	30	5296.4	2073.0
40	3697.2	1089.3	40	4449.7	1524.9	40	5311.9	2083.5
50	3709.0	1095.7	50	4463.1	1533.1	50	5327.4	2094.1
66°	3720.9	1102.2	76°	4476.5	1541.4	86°	5343.0	2104.7
10	3732.7	1108.6	10	4489.9	1549.7	10	5358.6	2115.3
20	3744.6	1115.1	20	4503.4	1558.0	20	5374.2	2126.0
30	3756.5	1121.7	30	4516.9	1566.3	30	5389.9	2136.7
40	3768.5	1128.2	40	4530.4	1574.7	40	5405.6	2147.5
50	3780.4	1134.8	50	4544.0	1583.1	50	5421.4	2158.4
67°	3792.4	1141.4	77°	4557.6	1591.6	87°	5437.2	2169.2
10	3804.4	1148.0	10	4571.2	1600.1	10	5453.1	2180.2
20	3816.4	1154.7	20	4584.8	1608.6	20	5469.0	2191.1
30	3828.4	1161.3	30	4598.5	1617.1	30	5484.9	2202.2
40	3840.5	1168.1	40	4612.2	1625.7	40	5500.9	2213.2
50	3852.6	1174.8	50	4626.0	1634.4	50	5517.0	2224.3
68°	3864.7	1181.6	78°	4639.8	1643.0	88°	5533.1	2235.5
10	3876.8	1188.4	10	4653.6	1651.7	10	5549.2	2246.7
20	3889.0	1195.2	20	4667.4	1660.5	20	5565.4	2258.0
30	3901.2	1202.0	30	4681.3	1669.2	30	5581.6	2269.3
40	3913.4	1208.9	40	4695.2	1678.1	40	5597.8	2280.6
50	3925.6	1215.8	50	4709.2	1686.9	50	5614.2	2292.0
69°	3937.9	1222.7	79°	4723.2	1695.8	89°	5630.5	2303.5
10	3950.2	1229.7	10	4737.2	1704.7	10	5646.9	2315.0
20	3962.5	1236.7	20	4751.2	1713.7	20	5663.4	2326.6
30	3974.8	1243.7	30	4765.3	1722.7	30	5679.9	2338.2
40	3987.2	1250.8	40	4779.4	1731.7	40	5696.4	2349.8
50	3999.5	1257.9	50	4793.6	1740.8	50	5713.0	2361.5
70°	4011.9	1265.0	80°	4807.7	1749.9	90°	5729.7	2373.3
10	4024.4	1272.1	10	4822.0	1759.0	10	5746.3	2385.1
20	4036.8	1279.3	20	4836.2	1768.2	20	5763.1	2397.0
30	4049.3	1286.5	30	4850.5	1777.4	30	5779.9	2408.9
40	4061.8	1293.6	40	4864.8	1786.7	40	5796.7	2420.9
50	4074.4	1300.9	50	4879.2	1796.0	50	5813.6	2432.9

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

Angle	Tangent	External	Angle	Tangent	External	Angle	Tangent	External
91°	5830.5	2444.9	101°	6950.6	3278.1	111°	8336.7	4386.1
10°	5847.5	2457.1	10°	6971.3	3294.1	10°	8362.7	4407.6
20	5864.6	2469.3	20	6992.0	3310.1	20	8388.9	4429.2
30	5881.7	2481.5	30	7012.7	3326.1	30	8415.1	4450.9
40	5898.8	2493.8	40	7033.6	3342.3	40	8441.5	4472.7
50	5916.0	2506.1	50	7054.5	3358.5	50	8468.0	4494.6
92°	5933.2	2518.5	102°	7075.5	3374.9	112°	8494.6	4516.6
10	5950.5	2531.0	10	7096.6	3391.2	10	8521.3	4538.8
20	5967.9	2543.5	20	7117.8	3407.7	20	8548.1	4561.1
30	5985.3	2556.0	30	7139.0	3424.3	30	8575.0	4583.4
40	6002.7	2568.6	40	7160.3	3440.9	40	8602.1	4606.0
50	6020.2	2581.3	50	7181.7	3457.6	50	8629.3	4628.6
93°	6037.8	2594.0	103°	7203.2	3474.4	113°	8656.6	4651.3
10	6055.4	2606.8	10	7224.7	3491.3	10	8684.0	4674.2
20	6073.1	2619.7	20	7246.3	3508.2	20	8711.5	4697.2
30	6090.8	2632.6	30	7268.0	3525.2	30	8739.2	4720.3
40	6108.6	2645.5	40	7289.8	3542.4	40	8767.0	4743.6
50	6126.4	2658.5	50	7311.7	3559.6	50	8794.9	4766.9
94°	6144.3	2671.6	104°	7333.6	3576.8	114°	8822.9	4790.4
10	6162.6	2684.7	10	7355.6	3594.2	10	8851.0	4814.1
20	6180.2	2697.9	20	7377.8	3611.7	20	8879.3	4837.8
30	6198.3	2711.2	30	7399.9	3629.2	30	8907.7	4861.7
40	6216.4	2724.5	40	7422.2	3646.8	40	8936.3	4885.7
50	6234.6	2737.9	50	7444.6	3664.5	50	8965.0	4909.9
95°	6252.8	2751.3	105°	7467.0	3682.3	115°	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	8107.8	4197.9	30	9824.8	5643.8
40	6788.1	3153.3	40	8132.3	4218.4	40	9857.7	5672.3
50	6808.2	3168.7	50	8157.5	4239.0	50	9890.8	5700.9
100°	6828.3	3184.1	110°	8182.8	4259.7	120°	9924.0	5729.7
10	6848.5	3199.6	10	8208.2	4280.5	10	9957.5	5758.6
20	6868.8	3215.1	20	8233.7	4301.4	20	9991.0	5787.7
30	6889.2	3230.8	30	8259.3	4322.4	30	10025.0	5817.0
40	6909.6	3246.5	40	8285.0	4343.6	40	10059.0	5846.5
50	6930.1	3262.3	50	8310.8	4364.8	50	10093.0	5876.1

Table V. Corrections for use with table IV,

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For Tangents Add															
ANGLE	CURVE	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°		.03	.06	.09	.13	.16	.19	.22	.25	.28	.31	.34	.38	.42	.46
15°		.04	.10	.14	.19	.24	.29	.34	.39	.45	.51	.53	.58	.63	.68
20°		.06	.13	.19	.26	.32	.39	.45	.51	.58	.65	.72	.79	.84	.90
25°		.08	.16	.24	.33	.40	.49	.58	.67	.75	.83	.90	.99	1.06	1.14
30°		.10	.19	.29	.39	.49	.59	.69	.79	.89	.99	1.09	1.20	1.29	1.39
35°		.11	.22	.34	.47	.58	.69	.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

For Externals Add															
ANGLE	CURVE	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
10°		.001	.003	.004	.006	.007	.008	.009	.011	.012	.014	.015	.017	.018	.020
15°		.003	.007	.010	.014	.018	.023	.027	.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	.045	.070	.093	.117	.141	.172	.203	.234	.265	.277	.290	.315	.341
45°		.030	.060	.093	.119	.153	.184	.216	.254	.289	.325	.351	.378	.411	.445
50°		.037	.075	.116	.151	.189	.227	.266	.305	.345	.384	.425	.467	.508	.550
55°		.046	.093	.142	.188	.236	.283	.332	.381	.420	.479	.530	.582	.641	.700
60°		.056	.112	.168	.225	.283	.340	.398	.457	.516	.575	.636	.697	.774	.851
65°		.067	.135	.204	.273	.343	.412	.483	.554	.625	.697	.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	.617	.707	.797	.877	.971	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

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

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

CURVE FORMULAS.

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

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

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

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

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

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

To find angle for a given distance and deflection.

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

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

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

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

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

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

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

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 2.

Natural Sines

deg.	0'	10'	20'	30'	40'	50'	deg.	0'	10'	20'	30'	40'	50'	deg.
0	0000	0029	0058	0087	0116	0145	89	40	6428	6450	6472	6494	6517	6539
1	0175	0204	0233	0262	0291	0320	88	41	6561	6583	6604	6626	6648	6670
2	0349	0378	0407	0436	0465	0494	87	42	6691	6713	6734	6756	6777	6799
3	0523	0552	0581	0610	0640	0669	86	43	6820	6841	6862	6884	6905	6926
4	0698	0727	0756	0785	0814	0843	85	44	6947	6968	6988	7009	7030	7050
5	0872	0901	0929	0958	0987	1016	84	45	7071	7092	7112	7133	7153	7173
6	1045	1074	1103	1132	1161	1190	83	46	7193	7214	7234	7254	7274	7294
7	1219	1248	1279	1305	1334	1363	82	47	7314	7335	7355	7375	7395	7415
8	1392	1421	1449	1478	1507	1536	81	48	7431	7451	7470	7490	7509	7528
9	1564	1593	1622	1650	1679	1708	80	49	7547	7566	7585	7604	7623	7642
10	1736	1765	1794	1822	1851	1880	79	50	7660	7679	7698	7716	7735	7753
11	1908	1937	1965	1994	2022	2051	78	51	7771	7790	7808	7826	7844	7862
12	2079	2108	2136	2164	2193	2221	77	52	7880	7898	7916	7934	7951	7969
13	2250	2278	2306	2334	2363	2391	76	53	7986	8004	8021	8039	8056	8073
14	2419	2447	2476	2504	2532	2560	75	54	8090	8107	8124	8141	8158	8175
15	2588	2616	2644	2672	2700	2728	74	55	8192	8208	8225	8241	8258	8274
16	2756	2784	2812	2840	2868	2896	73	56	8290	8307	8323	8339	8355	8371
17	2924	2952	2979	3007	3035	3062	72	57	8387	8403	8418	8434	8450	8465
18	3090	3118	3145	3173	3201	3228	71	58	8480	8496	8511	8526	8542	8557
19	3256	3283	3311	3338	3365	3393	70	59	8572	8587	8601	8616	8631	8646
20	3420	3448	3475	3502	3529	3557	69	60	8660	8675	8689	8704	8718	8732
21	3584	3611	3638	3665	3692	3719	68	61	8746	8760	8774	8788	8802	8816
22	3746	3773	3800	3827	3854	3881	67	62	8829	8843	8857	8870	8884	8897
23	3907	3934	3961	3987	4014	4041	66	63	8910	8923	8936	8949	8962	8975
24	4067	4094	4120	4147	4173	4200	65	64	8988	9001	9013	9026	9038	9051
25	4226	4253	4279	4305	4331	4358	64	65	9063	9075	9088	9100	9112	9124
26	4384	4410	4436	4462	4488	4514	63	66	9135	9147	9159	9171	9182	9194
27	4540	4566	4592	4617	4643	4669	62	67	9205	9216	9228	9239	9250	9261
28	4695	4720	4746	4772	4797	4823	61	68	9272	9283	9293	9304	9315	9325
29	4848	4874	4899	4924	4950	4975	60	69	9336	9346	9356	9367	9377	9387
30	5000	5025	5050	5075	5100	5125	59	70	9397	9407	9417	9426	9436	9446
31	5150	5175	5200	5225	5250	5275	58	71	9455	9465	9474	9483	9492	9502
32	5299	5324	5348	5373	5398	5422	57	72	9511	9520	9528	9537	9546	9555
33	5446	5471	5495	5519	5544	5568	56	73	9563	9572	9580	9588	9596	9605
34	5592	5616	5640	5664	5688	5712	55	74	9613	9621	9628	9636	9644	9652
35	5736	5760	5783	5807	5831	5854	54	75	9659	9667	9674	9681	9689	9696
36	5878	5901	5925	5948	5972	5995	53	76	9703	9710	9717	9724	9730	9737
37	6018	6041	6065	6088	6111	6134	52	77	9744	9750	9757	9763	9769	9775
38	6157	6180	6202	6225	6248	6271	51	78	9781	9787	9793	9799	9805	9811
39	6293	6316	6338	6361	6383	6406	50	79	9816	9822	9827	9833	9838	9843

deg.	0'	10'	20'	30'	40'	50'	deg.
80	9848	9853	9858	9863	9868	9872	9
81	9877	9881	9886	9890	9894	9898	8
82	9903	9907	9911	9914	9918	9922	7
83	9925	9929	9932	9936	9939	9942	6
84	9945	9948	9951	9954	9957	9959	5
85	9962	9964	9967	9969	9971	9974	4
86	9976	9978	9980	9981	9983	9985	3
87	9986	9988	9989	9990	9992	9993	2
88	9994	9995	9996	9997	9997	9998	1
89	9998	9999	9999	9999	1.0000	1.0000	0

deg. 60' 50' 40' 30' 20' 10' deg.

Natural Cosines

Natural Tangents

deg.	0'	10'	20'	30'	40'	50'	deg.	0'	10'	20'	30'	40'	50'	deg.
0	0000	0029	0058	0087	0116	0145	89	40	8391	8441	8491	8541	8591	8642
1	0175	0204	0233	0262	0291	0320	88	41	8693	8744	8796	8847	8899	8952
2	0349	0378	0407	0437	0466	0495	87	42	9004	9057	9110	9163	9217	9271
3	0524	0553	0582	0612	0641	0670	86	43	9325	9380	9435	9490	9545	9601
4	0699	0729	0758	0787	0816	0846	85	44	9657	9713	9770	9827	9884	9942
5	0875	0904	0934	0963	0992	1022	84	45	1.0000	1.0058	1.0117	1.0176	1.0235	1.0295
6	1051	1080	1110	1139	1169	1198	83	46	1.0355	1.0416	1.0477	1.0533	1.0599	1.0661
7	1228	1257	1287	1317	1346	1376	82	47	1.0724	1.0786	1.0850	1.0913	1.0977	1.1041
8	1405	1435	1465	1495	1524	1554	81	48	1.1106	1.1171	1.1237	1.1303	1.1369	1.1436
9	1584	1614	1644	1673	1703	1733	80	49	1.1504	1.1571	1.1640	1.1708	1.1778	1.1847
10	1763	1793	1823	1853	1883	1914	79	50	1.1918	1.1988	1.2059	1.2131	1.2203	1.2276
11	1944	1974	2004	2035	2065	2095	78	51	1.2349	1.2423	1.2497	1.2572	1.2647	1.2723
12	2126	2156	2186	2217	2247	2278	77	52	1.2799	1.2876	1.2954	1.3032	1.3111	1.3190
13	2309	2339	2370	2401	2432	2462	76	53	1.3270	1.3351	1.3432	1.3514	1.3597	1.3680
14	2493	2524	2555	2586	2617	2648	75	54	1.3764	1.3848	1.3934	1.4019	1.4106	1.4193
15	2679	2711	2742	2773	2805	2836	74	55	1.4281	1.4370	1.4460	1.4550	1.4641	1.4733
16	2867	2899	2931	2962	2994	3026	73	56	1.4826	1.4919	1.5013	1.5108	1.5204	1.5301
17	3057	3089	3121	3153	3185	3217	72	57	1.5399	1.5497	1.5597	1.5697	1.5798	1.5900
18	3249	3281	3314	3346	3378	3411	71	58	1.6003	1.6107	1.6212	1.6319	1.6426	1.6534
19	3443	3476	3508	3541	3574	3607	70	59	1.6643	1.6753	1.6864	1.6977	1.7090	1.7205
20	3640	3673	3706	3739	3772	3805	69	60	1.7321	1.7437	1.7556	1.7675	1.7797	1.7917
21	3839	3872	3906	3939	3973	4006	68	61	1.8040	1.8165	1.8291	1.8418	1.8546	1.8676
22	4040	4074	4108	4142	4176	4210	67	62	1.8807	1.8940	1.9074	1.9210	1.9347	1.9486
23	4245	4279	4314	4348	4383	4417	66	63	1.9626	1.9768	1.9912	2.0057	2.0204	2.0353
24	4452	4487	4522	4557	4592	4628	65	64	2.0503	2.0655	2.0809	2.0965	2.1123	2.1283
25	4663	4699	4734	4770	4806	4841	64	65	2.1445	2.1603	2.1775	2.1943	2.2113	2.2286
26	4877	4913	4950	4986	5022	5059	63	66	2.2460	2.2637	2.2817	2.2998	2.3183	2.3369
27	5095	5132	5169	5206	5243	5280	62	67	2.3559	2.3750	2.3945	2.4142	2.4342	2.4545
28	5317	5354	5392	5430	5467	5505	61	68	2.4751	2.4960	2.5172	2.5386	2.5605	2.5826
29	5543	5581	5619	5658	5696	5735	60	69	2.6051	2.6279	2.6511	2.6746	2.6985	2.7228
30	5774	5812	5851	5890	5930	5969	59	70	2.7475	2.7725	2.7980	2.8239	2.8502	2.8770
31	6009	6048	6088	6128	6169	6208	58	71	2.9042	2.9319	2.9600	2.9887	3.0178	3.0475
32	6249	6289	6330	6371	6412	6453	57	72	3.0777	3.1084	3.1397	3.1716	3.2041	3.2371
33	6494	6536	6577	6619	6661	6703	56	73	3.2709	3.3052	3.3402	3.3759	3.4124	3.4495
34	6745	6787	6830	6873	6916	6959	55	74	3.4874	3.5261	3.5656	3.6059	3.6470	3.6891
35	7002	7046	7089	7133	7177	7221	54	75	3.7321	3.7760	3.8208	3.8657	3.9136	3.9617
36	7265	7310	7355	7400	7445	7490	53	76	4.0108	4.0611	4.1126	4.1653	4.2193	4.2747
37	7536	7581	7627	7673	7720	7766	52	77	4.3315	4.3897	4.4494	4.5107	4.5736	4.6382
38	7813	7860	7907	7954	8002	8050	51	78	4.7046	4.7729	4.8430	4.9152	4.9894	5.0658
39	8095	8146	8195	8243	8292	8342	50	79	5.1446	5.2257	5.3093	5.3955	5.4845	5.5764
deg.	60'	50'	40'	30'	20'	10'	deg.	60'	50'	40'	30'	20'	10'	deg.

deg.	0'	10'	20'	30'	40'	50'	deg.
80	5.6713	5.7694	5.8708	5.9758	6.0844	6.1970	9
81	6.3138	6.4348	6.5606	6.6912	6.8269	6.9682	8
82	7.1154	7.2687	7.4287	7.5958	7.7704	7.9530	7
83	8.1443	8.3450	8.5555	8.7769	9.0098	9.2553	6
84	9.5144	9.7882	10.078	10.385	10.711	11.059	5
85	11.430	11.826	12.250	12.706	13.197	13.727	4
86	14.300	14.924	15.605	16.350	17.169	18.075	3
87	19.081	20.206	21.470	22.903	24.532	26.432	2
88	28.636	31.242	34.368	38.189	42.964	49.104	1
89	57.290	68.750	85.940	114.588	171.885	343.770	0
deg.	60'	50'	40'	30'	20'	10'	deg.

Natural Cotangents

691400
 479165
 111.35
 2.705
 .5
 135.25
 6.07
 94695
 81150
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 32.2
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 27) 69377 (254
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 352
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 4500
 300

1yd to 3.52 ft.
 9 trucks average 37.1

110
 110
 100
 113
 111
 105
 657

DISTANCES FROM CENTER OF ROADWAY FOR CROSS-SECTIONING.

ROADWAY 14 FEET WIDE. SIDE SLOPES 1 1/2 TO 1.

FOR SINGLE TRACK EMBANKMENT.

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

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

MADE IN GERMANY.