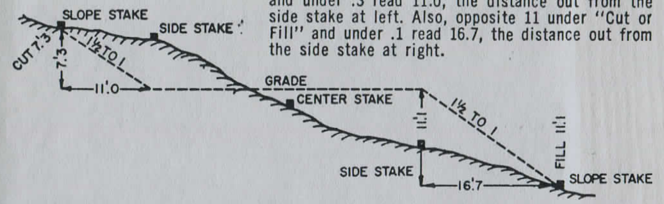
# FIELD BOOK

82 0002

## DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

### Roadway of any Width. Side Slopes 1½ to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill" and under .1 read 16.7, the distance out from the side stake at right.



| Cut or Fill | 0 | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | Cut or Fill |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Distance out from Side or Shoulder Stake | | | | | | | | | | |
| 0 | 0.0 | 0.2 | 0.3 | 0.5 | 0.6 | 0.8 | 0.9 | 1.1 | 1.2 | 1.4 | 0 |
| 1 | 1.5 | 1.7 | 1.8 | 2.0 | 2.1 | 2.3 | 2.4 | 2.6 | 2.7 | 2.9 | 1 |
| 2 | 3.0 | 3.2 | 3.3 | 3.5 | 3.6 | 3.8 | 3.9 | 4.1 | 4.2 | 4.4 | 2 |
| 3 | 4.5 | 4.7 | 4.8 | 5.0 | 5.1 | 5.3 | 5.4 | 5.6 | 5.7 | 5.9 | 3 |
| 4 | 6.0 | 6.2 | 6.3 | 6.5 | 6.6 | 6.8 | 6.9 | 7.1 | 7.2 | 7.4 | 4 |
| 5 | 7.5 | 7.7 | 7.8 | 8.0 | 8.1 | 8.3 | 8.4 | 8.6 | 8.7 | 8.9 | 5 |
| 6 | 9.0 | 9.2 | 9.3 | 9.5 | 9.6 | 9.8 | 9.9 | 10.1 | 10.2 | 10.4 | 6 |
| 7 | 10.5 | 10.7 | 10.8 | 11.0 | 11.1 | 11.3 | 11.4 | 11.6 | 11.7 | 11.9 | 7 |
| 8 | 12.0 | 12.2 | 12.3 | 12.5 | 12.6 | 12.8 | 12.9 | 13.1 | 13.2 | 13.4 | 8 |
| 9 | 13.5 | 13.7 | 13.8 | 14.0 | 14.1 | 14.3 | 14.4 | 14.6 | 14.7 | 14.9 | 9 |
| 10 | 15.0 | 15.2 | 15.3 | 15.5 | 15.6 | 15.8 | 15.9 | 16.1 | 16.2 | 16.4 | 10 |
| 11 | 16.5 | 16.7 | 16.8 | 17.0 | 17.1 | 17.3 | 17.4 | 17.6 | 17.7 | 17.9 | 11 |
| 12 | 18.0 | 18.2 | 18.3 | 18.5 | 18.6 | 18.8 | 18.9 | 19.1 | 19.2 | 19.4 | 12 |
| 13 | 19.5 | 19.7 | 19.8 | 20.0 | 20.1 | 20.3 | 20.4 | 20.6 | 20.7 | 20.9 | 13 |
| 14 | 21.0 | 21.2 | 21.3 | 21.5 | 21.6 | 21.8 | 21.9 | 22.1 | 22.2 | 22.4 | 14 |
| 15 | 22.5 | 22.7 | 22.8 | 23.0 | 23.1 | 23.3 | 23.4 | 23.6 | 23.7 | 23.9 | 15 |
| 16 | 24.0 | 24.2 | 24.3 | 24.5 | 24.6 | 24.8 | 24.9 | 25.1 | 25.2 | 25.4 | 16 |
| 17 | 25.5 | 25.7 | 25.8 | 26.0 | 26.1 | 26.3 | 26.4 | 26.6 | 26.7 | 26.9 | 17 |
| 18 | 27.0 | 27.2 | 27.3 | 27.5 | 27.6 | 27.8 | 27.9 | 28.1 | 28.2 | 28.4 | 18 |
| 19 | 28.5 | 28.7 | 28.8 | 29.0 | 29.1 | 29.3 | 29.4 | 29.6 | 29.7 | 29.9 | 19 |
| 20 | 30.0 | 30.2 | 30.3 | 30.5 | 30.6 | 30.8 | 30.9 | 31.1 | 31.2 | 31.4 | 20 |
| 21 | 31.5 | 31.7 | 31.8 | 32.0 | 32.1 | 32.3 | 32.4 | 32.6 | 32.7 | 32.9 | 21 |
| 22 | 33.0 | 33.2 | 33.3 | 33.5 | 33.6 | 33.8 | 33.9 | 34.1 | 34.2 | 34.4 | 22 |
| 23 | 34.5 | 34.7 | 34.8 | 35.0 | 35.1 | 35.3 | 35.4 | 35.6 | 35.7 | 35.9 | 23 |
| 24 | 36.0 | 36.2 | 36.3 | 36.5 | 36.6 | 36.8 | 36.9 | 37.1 | 37.2 | 37.4 | 24 |
| 25 | 37.5 | 37.7 | 37.8 | 38.0 | 38.1 | 38.3 | 38.4 | 38.6 | 38.7 | 38.9 | 25 |
| 26 | 39.0 | 39.2 | 39.3 | 39.5 | 39.6 | 39.8 | 39.9 | 40.1 | 40.2 | 40.4 | 26 |
| 27 | 40.5 | 40.7 | 40.8 | 41.0 | 41.1 | 41.3 | 41.4 | 41.6 | 41.7 | 41.9 | 27 |
| 28 | 42.0 | 42.2 | 42.3 | 42.5 | 42.6 | 42.8 | 42.9 | 43.1 | 43.2 | 43.4 | 28 |
| 29 | 43.5 | 43.7 | 43.8 | 44.0 | 44.1 | 44.3 | 44.4 | 44.6 | 44.7 | 44.9 | 29 |
| 30 | 45.0 | 45.2 | 45.3 | 45.5 | 45.6 | 45.8 | 45.9 | 46.1 | 46.2 | 46.4 | 30 |
| 31 | 46.5 | 46.7 | 46.8 | 47.0 | 47.1 | 47.3 | 47.4 | 47.6 | 47.7 | 47.9 | 31 |
| 32 | 48.0 | 48.2 | 48.3 | 48.5 | 48.6 | 48.8 | 48.9 | 49.1 | 49.2 | 49.4 | 32 |
| 33 | 49.5 | 49.7 | 49.8 | 50.0 | 50.1 | 50.3 | 50.4 | 50.6 | 50.7 | 50.9 | 33 |
| 34 | 51.0 | 51.2 | 51.3 | 51.5 | 51.6 | 51.8 | 51.9 | 52.1 | 52.2 | 52.4 | 34 |
| 35 | 52.5 | 52.7 | 52.8 | 53.0 | 53.1 | 53.3 | 53.4 | 53.6 | 53.7 | 53.9 | 35 |
| 36 | 54.0 | 54.2 | 54.3 | 54.5 | 54.6 | 54.8 | 54.9 | 55.1 | 55.2 | 55.4 | 36 |
| 37 | 55.5 | 55.7 | 55.8 | 56.0 | 56.1 | 56.3 | 56.4 | 56.6 | 56.7 | 56.9 | 37 |
| 38 | 57.0 | 57.2 | 57.3 | 57.5 | 57.6 | 57.8 | 57.9 | 58.1 | 58.2 | 58.4 | 38 |
| 39 | 58.5 | 58.7 | 58.8 | 59.0 | 59.1 | 59.3 | 59.4 | 59.6 | 59.7 | 59.9 | 39 |
| 40 | 60.0 | 60.2 | 60.3 | 60.5 | 60.6 | 60.8 | 60.9 | 61.1 | 61.2 | 61.4 | 40 |

KEUFFEL & ESSER CO.

For Curve Tables see end of book.

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The paper in this book is made of 100% high grade rag stock with a WATER RESISTING surface sizing.

KEUFFEL & ESSER CO.

| Cut or Fill |
|---|
| 0 |
| 1 |
| 2 |
| 3 |
| 4 |
| 5 |
| 6 |
| 7 |
| 8 |
| 9 |
| 10 |
| 11 |
| 12 |
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| 34 |
| 35 |
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| 37 |
| 38 |
| 39 |
| 40 |

KEUF

Top Bolt. Fire Hyd. El. 1301.78
Court & Alley

Tom Kaiser Formen

Chardon Alley
12/16/74

| | | | | | |
|---|---|---|---|---|---|
| BM. | 1.62 | 1303.32 | | 1301.70 | |
| T.B.M. | | | 5.72 | 1297.60 | Top of Conc wall N. side stairway under Elect. Board |
| T.B.M. | | | 10.20 | 1293.12 | Top of Curb N. End of Alley ± 25' from Sidewalk |
| | | | 1.62 | 1301.70 | |

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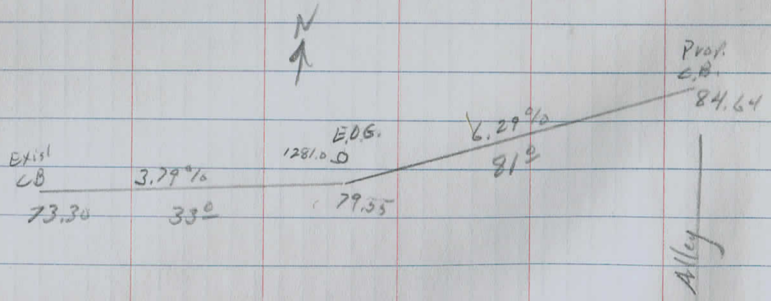
Alley
12/17/74

| | | | | | |
|---|---|---|---|---|---|
| TBM | 2.75 | 95.87 | | 1293.12 | Top Curb N. End Alley ± 25' from Sidewalk |
| | | | 17.57 | 78.30 | CB - FL 6" Line |
| TBM. | | | 2.75 | 1293.12 | % |

3.70

13.12
.75
3.70
17.57



12/16/74

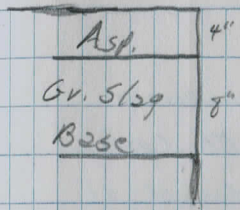
| | | | |
|---|---|---|---|
| F/L Prop C.B. | = | 1285.00 | 1287.67 |
| F/L | C B | 1278.30 | 1278.30 |
| | | 6.70 | 9.37 |

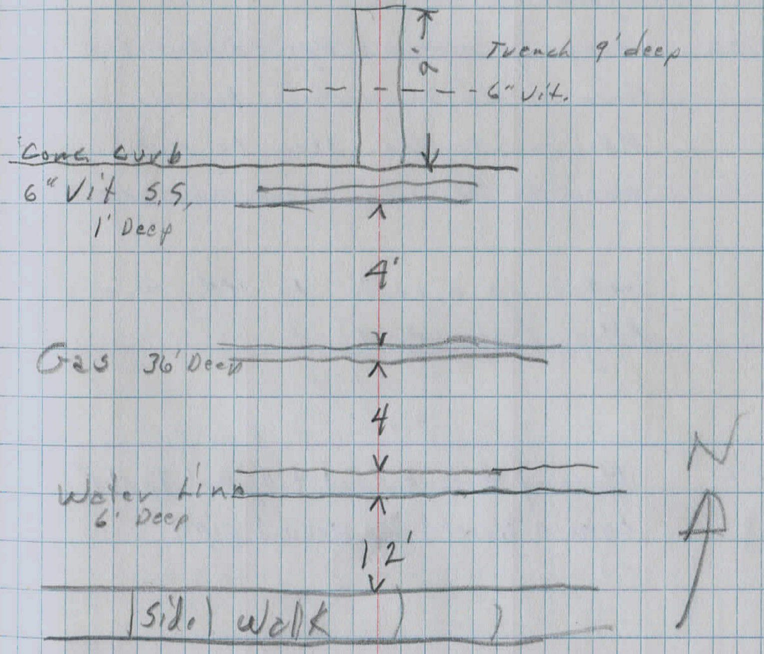
4.3 - 6.0

33'

8:30 Began exc. at 0+7 to side walk Located water main at +07 ± 6' deep checked with state plan - shows 16" line to be ± 10 N. of S curb called Joe Kalicka Chardon Vill Mait. dept - said go ahead + dig for it - Exc. 9' into pavement area & undercut 1.5' didn't find pipe we are on bed rock at 9' deep going to put water m manhole in A.M. make sure M.H.s are connected as plan shows

4:30





12/17/74

Snow, 33°

8:00 1 Forman 2 operators - 2 Laborers

9:00 running auger into MH, & using
sensing unit works for 1st 50'
sent for hose to connect to
Hydrant

10:30 running water & Dye - evident that
there is no connection Between
M.H.s on S. side seem to cut
over to N. side above our area ?

worked up a grade to MH. W. of
Alley (see Pg 1)

1:00 Placeing tile & sand fill, Dirt Top ± 1'
conc & bricked up around pipe

4:30 Placed ± 50' of pipe & backfilled

12/18/74 Wed

Snowing Cold 24°

8:00

1 Foreman

2 operators Backhoe & Loader

2 Laborers

Completed line from Exist.
C.B. to Prop. C.B. #1

11:00 Exc. for C.B.

1:00 Exc. trench for line up Alley
Set up lazer for grade
Due to restricted work area have
to exc & placed 3 sec. & Backfill w/
sand & Compact

330 Conc. arrived for C.B. Base
Sides caved in so have to Clean
out mud ect.
had more conc. then needed, Placed

4:00 ± 6" of Conc in road area that was
exc. Mon Left ± 2" low for Asphalt
Placing Snow fence & Lights

4:30 around work area for protection
to Public
Quit

12/19/74 Thur

Lt Snow Cold 28°

8:00 1 Forman 1 operator, 1 Laborer

||||

12/20/74

$8^{00}$ Cldy - cold 24°

1 - Foreman, 1 operator B/H, 1 laborer

$8^{30}$/A Broke Water connection sta 1+78

W. Side Main off $10^{55}$/A

Returned to service ±$12^{30}$/P.

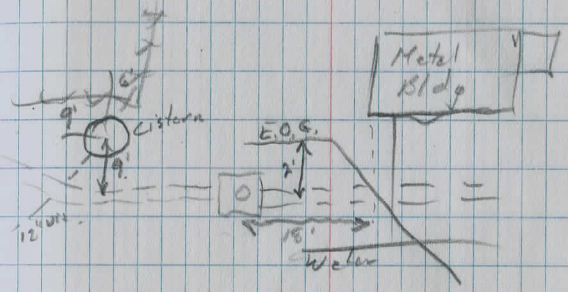
12/23/74

8:00 Cloudy 45°

1 Formon - 2 operators, 2 laborers
1, Mason, 1 Truck & Driver

8:30 Exposed Gas main Line 1+82
Replaced water line to Metal Bldg
w/ copper line

Due to Gas line moved Loc
of C.B. 13' further South



# CURVE TABLES

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## HOW TO USE CURVE TABLES

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

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

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

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

### *EXAMPLE*

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

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

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

Correction for A. 23° 20′ for a 10° Cur. = 0.16
118.31 + 0.16 = 118.47 = corrected Tangent.

(If corrected Ext. is required find in same way)
Ang. 23° 20′ = 23.33° ÷ 10 = 2.3333 = L. C.

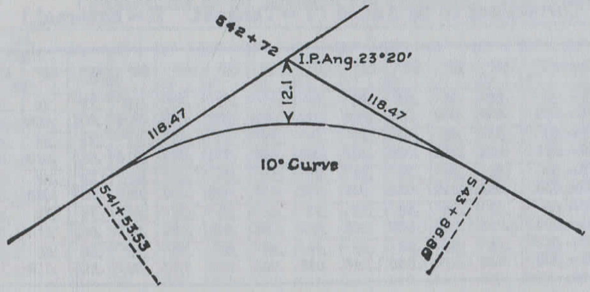
| | | | | |
|---|---|---|---|---|
| $2° 19\frac{1}{2}'$ = def. for sta. | | | | 542 |
| $4° 49\frac{1}{2}'$ = | " | " | " | +50 |
| $7° 19\frac{1}{2}'$ = | " | " | " | 543 |
| $9° 49\frac{1}{2}'$ = | " | " | " | +50 |
| 11° 40′ = | " | " | " | 543+<br>86.86 |

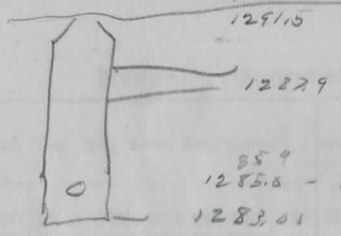
| | |
|---|---|
| I. P. = sta. | 542+72 |
| Tan. = | 1 .18.47 |
| B. C. = sta. | 541+53.53 |
| L. C. = | 2 .33.33 |
| E. C. = Sta. | 543+86.86 |

100 − 53.53 = 46.47 × 3′(def. for 1 ft. of 10° Cur.) = 139.41′ = $2° 19\frac{1}{2}'$ = def. for sta. 542.

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

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





859
1285.0 - 84.6

27
48
75

2'3"

12.5

93.37
12.50
82.87 Pipe
85.00 M.H.
2.13 Diff

1293.12
2.25
1295.37 H I
\- 4.25 (Gd. level C.B.
1291.12
85.00 F/L Pipe
6.12

1291.5 Gd. Lev 8.90
87.9 F/L S
3.6

2' 4

93.12
1
94.12
87.9
6.22
6.70

1293.12
2.35
1295.47
9.50
1285.97

9-1½
6-7
-10

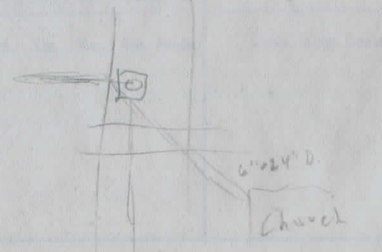
6-9½
6-8
Top Sw.
B. + Storm.

7-11
8-3
8-2½

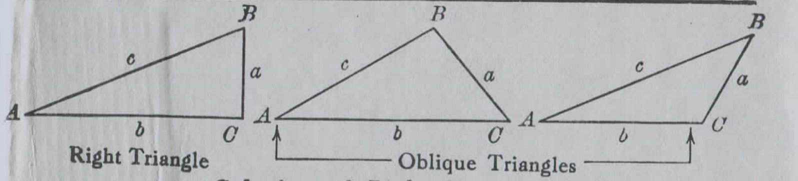
6-7 6-9

7-11
8-3

-1785
-3700
3.02%
1.83



# TRIGONOMETRIC FORMULÆ



## Solution of Right Triangles

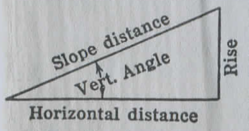
For Angle $A$. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\operatorname{cosec} = \frac{c}{a}$

| Given | Required | |
|---|---|---|
| $a, b$ | $A, B, c$ | $\tan A = \frac{a}{b} = \cot B$, $c = \sqrt{a^2+b^2} = a\sqrt{1+\frac{b^2}{a^2}}$ |
| $a, c$ | $A, B, b$ | $\sin A = \frac{a}{c} = \cos B$, $b = \sqrt{(c+a)(c-a)} = c\sqrt{1-\frac{a^2}{c^2}}$ |
| $A, a$ | $B, b, c$ | $B = 90° - A$, $b = a \cot A$, $c = \frac{a}{\sin A.}$ |
| $A, b$ | $B, a, c$ | $B = 90° - A$, $a = b \tan A$, $c = \frac{b}{\cos A.}$ |
| $A, c$ | $B, a, b$ | $B = 90° - A$, $a = c \sin A$, $b = c \cos A$, |

## Solution of Oblique Triangles

| Given | Required | |
|---|---|---|
| $A, B, a$ | $b, c, C$ | $b = \frac{a \sin B}{\sin A}$, $C = 180° - (A+B)$, $c = \frac{a \sin C}{\sin A}$ |
| $A, a, b$ | $B, c, C$ | $\sin B = \frac{b \sin A}{a}$, $C = 180° - (A+B)$, $c = \frac{a \sin C}{\sin A}$ |
| $a, b, C$ | $A, B, c$ | $A+B = 180° - C$, $\tan \frac{1}{2}(A-B) = \frac{(a-b)\tan\frac{1}{2}(A+B)}{a+b}$,<br>$c = \frac{a \sin C}{\sin A}$ |
| $a, b, c$ | $A, B, C$ | $s = \frac{a+b+c}{2}$, $\sin\frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{bc}}$,<br>$\sin\frac{1}{2}B = \sqrt{\frac{(s-a)(s-c)}{ac}}$, $C = 180° - (A+B)$ |
| $a, b, c$ | Area | $s = \frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$ |
| $A, b, c$ | Area | area $= \frac{bc \sin A}{2}$ |
| $A, B, C, a$ | Area | area $= \frac{a^2 \sin B \sin C}{2 \sin A}$ |

## REDUCTION TO HORIZONTAL



Horizontal distance = Slope distance multiplied by the cosine of the vertical angle. Thus: slope distance = 319.4 ft. Vert. angle = 5° 10′. From Table, Page IX. cos 5° 10′ = .9959. Horizontal distance = 319.4 × .9959 = 318.09 ft. Horizontal distance also = Slope distance minus slope distance times (1 − cosine of vertical angle). With the same figures as in the preceding example, the following result is obtained. Cosine 5° 10′ = .9959. 1 − .9959 = .0041. 319.4 × .0041 = 1.31. 319.4 − 1.31 = 318.09 ft.

When the rise is known, the horizontal distance is approximately:—the slope distance less the square of the rise divided by twice the slope distance. Thus: rise = 14 ft., slope distance = 302.6 ft. Horizontal distance $= 302.6 - \frac{14 \times 14}{2 \times 302.6} = 302.6 - 0.32 = 302.28$ ft.

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