44

# 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.

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

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

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

BK. #44

Property of
County Engineers Office
Court House
Waterloo Iowa

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

44

INDEX

Tiling Fox Twp Road Assessment
Dist No. 3. Fox Spr Cr Twp Line
N. Thru Jubilee 5 M. then E 2. M. to
Blk Hwk Buchanan Co Line.
Anderson Halverson Contract Mch 7th 1923
Tile grades & check Pages 3-25

Lot 7 - Big Creek Twp. Sec. 19 - T87 - 11 } 26-27
Owned by Black Hawk Co.

Cor. Stone - 1/4 Cor. between Sec 2-3 T88 R12 - 30

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

| | | | | |
|---|---|---|---|---|
| BM | 10.44 | (948.27) | | 937.83 |
| Culv ℄ | | | 15.00 | 933.27 |
| 366+42 | | | | |
| 366+15 S = 366+28 N | | | | |
| 366 | | | | |
| 365 | | | | |
| 364 | | | | |
| 363 | | | | |
| T.P | 13.19 | (959.61) | 1.85 | 946.42 |
| 362 | | | | |
| 361 | | | | |
| ~~360~~ | | | | |
| 360 | | | | |
| 359 | | | | |
| T.P. | 8.99 | (966.14) | 2.46 | 957.15 |
| 358 | | | | |
| 357 | | | | |



| N = Lt | Gr | Cut | S = Rt | Gr | Cut |
|---|---|---|---|---|---|
| | | | 937.40 / 10.87 | 933.50 | 3.90 |
| | | | 937.20 / 11.07 | 934.09 | 3.11 |
| 35.78 / 12.49 | 934.25 | 1.53 | 937.24 / 11.03 (1.78) | 934.25 | 2.99 |
| 37.89 / 10.38 | 936.00 | 1.89 | 939.07 / 9.20 | 936.00 | 3.07 |
| × | × | | × | × | |
| 41.92 / 6.35 | 939.10 | 2.82 | 942.65 / 5.62 | 939.10 | 3.55 |
| 45.49 / 2.78 | 942.20 | 3.29 | 946.42 / 1.85 | 942.20 | 4.22 |
| | | | | .44 Cc | |
| 49.30 / 10.31 | 945.30 | 4.00 | 949.97 / 9.64 (3.10) | 945.30 | 4.67 |
| | .15 Cc | | | .78 Cc | |
| 52.55 / 7.06 | 948.40 | 4.15 | 953.29 / 6.32 | 948.40 | 4.89 |
| | | | | .36 Cc | |
| 54.20 / 5.41 | 951.50 | 2.70 | 955.34 / 4.27 | 951.50 | 3.84 |
| | × × | × | | × × × | |
| 56.20 / 3.41 | 953.17 | 3.03 | 957.15 / 2.46 (6.66) | 953.17 | 3.98 |
| | | | | .19 Cc | |
| 58.06 / 8.08 | 954.84 | 3.22 | 959.20 / 6.94 | 954.84 | 4.36 |
| | | | | .26 Cc | |
| 59.40 / 6.74 | 956.50 | 2.90 | 960.67 / 5.47 | 956.50 | 4.11 |
| | | | | .18 Cc | |

× × ×   × × ×

| | | | | | |
|---|---|---|---|---|---|
| | | 966.14 | | | |
| 356 | | | | | |
| 355 | | | | | |
| T.P | 5.08 | 967.49 | 3.73 | 962.41 | |
| 354 | | | | | |
| 353 | | | | | |
| BM | | | 2.96 | 964.53 | Corr. 964.52 |

Additional Tile

| | | | | | |
|---|---|---|---|---|---|
| 353 | 4.33 | 967.61 | | 963.28 | Hub Rt 353 |
| 352 | | | | | |
| 351 End | | | | | |

| L = N | | | R = S | | |
|---|---|---|---|---|---|
| 960.51 / 5.63 | 957.50 | 3.01 | 961.69 / 4.45 | 957.50 | 4.19 |
| | | | 1.00 % | | .05 Oe |
| 961.38 / 4.76 | 958.50 | 2.88 | 962.41 / 3.73 | 958.50 | 3.91 |
| x x | | | | x x | |
| 962.51 / 4.98 | 959.00 | 3.51 | 962.89 / 4.60 | 959.00 | 3.89 |
| | 963.70 | | 0.50 % | | |
| 962.69 / 4.80 | 959.50 / 4.20 | 3.19 | 963.28 / 4.21 | 959.50 | 3.78 |

Summary
1328' - 6" Tile Custs
1 Rd Xing 28'
.15 Staff Out

Summary
1342' - 6" Tile Custs
1 Culv Conn - 2.00
2.26 Staff Out

| | | | | | |
|---|---|---|---|---|---|
| 962.68 / 4.93 | 959.50 | 3.18 | 963.28 / 4.33 | 959.50 | 3.78 |
| 962.62 / 4.99 | 959.65 | 2.97 | 963.66 / 3.95 | 959.65 | 4.01 |
| 962.16 / 5.45 | 959.80 | 2.36 | 962.73 / 4.88 | 959.80 | 2.93 |

Summary
200' - 6" Tile Custs
No Extras

Summary
200' - 6" Tile Custs
no extras

North

| | | | | | Gr | |
|---|---|---|---|---|---|---|
| BM | 0.86 | 956.73 | | 955.87 | | |
| 300+00 Top of tile | | | 13.08 | 943.65 | 943.25 | |
| 300 | | | 11.06 | 945.67 | 943.25 | 2.42 |
| +50 | | | 8.55 | 948.18 | 944.95 | 3.23 |
| +75 Ditch | | | 8.45 | 948.28 | | |
| +85 | | | 6.53 | 950.20 | 946.15 | 4.05 |
| ℄ Culv Sta 300+86.5 | | | 8.60 | 948.13 | | |
| √301+10 | | | 5.75 | 950.98 | 947.00 | 3.98 |
| 302 | | | 5.13 | 951.60 | 947.35 | 4.25 |
| 303 | | | 3.94 | 952.79 | 947.75 | 5.04 |
| 304 | | | 4.97 | 951.76 | 948.15 | 3.61 |
| +80 ℄ Culv | | | 7.40 | 949.33 | | |
| 305-T.P. | 6.55 | 957.83 | 5.45 | 951.28 | 948.55 | 2.73 |
| 306 | | | 5.37 | 952.46 | 949.55 | 2.91 |
| 307 End | | | 2.16 | 955.67 | 950.55 | .12 |

S.W. Cor. Conc Walk at S.W. Cor of Ho Sta 303+23

N = Lt.

Outlet - Salt 5" Private Tile In Field 5.

3.41%

.14 Oe

0.40%

.90 Oe

.33 Oe

1.00%

Summary

700' 6" Tile Constr.

Road Xing 25'

Drive Xing 40'

.37 Staff Oe

North

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BM | 4.15 | 967.06 | | 962.91 | | | |
| 292+25 | | | 12.29 | 954.77 | 952.50 | 2.27 | |
| 292 | | | 11.54 | 955.52 | 952.95 | 2.57 | |
| 291 | | | 9.34 | 957.72 | 954.75 | 2.97 | |
| 290 Fence | | | 6.65 | 960.41 | 956.55 | 3.86 | |
| Ditch 289+85 = culvert | | | 7.7 | 959.4 | — | | |
| 289+75 | | | 6.01 | 961.05 | 957.10 | 3.95 | |
| 289+50 | | | 5.52 | 961.54 | 957.65 | 3.89 | |
| 289 | | | 5.26 | 961.80 | 958.75 | 3.05 | |
| 288 | | | 4.08 | 962.98 | 958.90 | 4.08 | |
| 287 | | | 2.84 | 964.22 | 959.05 | 5.17 | .63 OC |
| 286 | | | 2.62 | 964.44 | 959.20 | 5.24 | 1.20 OC |
| T.P. 285 | 3.32 | 967.73 | 2.65 | 964.41 | 959.35 | 5.06 | 1.65 OC |
| 284 | | | 4.16 | 963.57 | 959.50 | 4.07 | .06 OC |
| 283 | | | 5.01 | 962.72 | 959.65 | 3.07 | |
| 282 | | | 5.05 | 962.68 | 959.80 | 2.88 | |
| 281 | | | 4.48 | 963.25 | 959.95 | 3.30 | |
| End 280 | | | 4.13 | 963.60 | 960.10 | 3.50 | |

Spk in 1/4 sec Cor Post Lt Sta 289+81

Force outlet in Barrel in Fields.

1.60%

2.20%

0.15%

Summary

1225' 6" Tile Cuts

1 Road X-ing - 25'

3.54' Shaft Oc

Note - Est #1 - May 5 - 1923 Includes 5000 6" Tile Del. on Ground but no Tile Cuts.

North

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BM | 2.99 | 970.17 | | 967.18 | | SpK Lone Mple 100' Left of Sta 275+25 | | |
| 275 | | | 4.65 | 965.52 | 961.26 | 4.26 | .8' Oc | |
| 274 | | | 4.20 | 965.97 | 960.66 | 5.31 | 1.1 Oc | Sta 273+65 to 274 |
| 273 | | | 5.20 | 964.97 | 960.06 | 4.91 | .5 Oc | across drive. |
| 272 | | | 6.59 | 963.58 | 959.46 | 4.12 | | |
| 271 | | | 7.53 | 962.64 | 958.86 | 3.78 | | |
| 270 | | | 9.26 | 960.91 | 958.26 | 2.65 | | |
| 269 | | | 9.95 | 960.22 | 957.66 | 2.56 | | |
| 268 | 3.67 | 963.53 | 10.31 | 959.86 | 957.06 | 2.80 | | |
| 267 | | | 2.72 | 960.81 | 956.46 | 4.35 | .6 Oc | |
| 266 | | | 2.78 | 960.75 | 955.86 | 4.89 | .3 Oc | |
| 265 | | | 5.49 | 958.04 | 954.36 | 3.68 | | |
| 264 | | | 6.66 | 956.87 | 952.86 | 4.01 | | |
| 263+75 | | | 6.71 | 956.82 | 952.76 | 4.06 | | |
| Culv Fl | | | 9.00 | 954.53 | | | | |
| 263+25 | | | 7.20 | 956.33 | 952.56 | 3.77 | | |
| 263 | | | 8.05 | 955.48 | 952.46 | 3.02 | | |
| 262+86 | | | 8.19 | 955.34 | 952.40 | 2.94 | | |
| 262+86 Top 5" Private Tile | | | 10.65 | 952.88 | 952.40 | | | Outlet in Private Tile in Field N. |
| BM | | | 5.82 | Corr. 957.69 | 957.71 | SpK in Cor Post N of X Rd. at Curve | | |

.6%

1.50%

.4%

Note: This line made to enter in 6" private tile at Sta 263+50

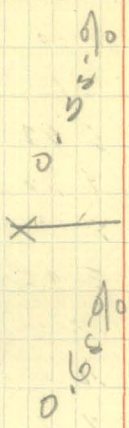
Summary

1214' - 6" Clustr

3.3' Slaff Oent

West

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BM | 3.27 | 976.28 | | 973.01 | | | Spk 1st post Cross F Left Sta 250+23 |
| 253 | | | 3.51 | 972.77 | 968.40 | 4.37 | |
| 252 | | | 5.90 | 970.38 | 967.85 | 2.53 | |
| Culv Rt | | | 7.6 | 968.7 | | | |
| 251 | | | 5.99 | 970.29 | 967.30 | 2.99 | |
| 250 | | | 4.70 | 971.58 | 966.75 | 4.83 | .60c |
| 249 | | | 5.69 | 970.59 | 966.20 | 4.39 | |
| 248 | | | 7.35 | 968.93 | 965.55 | 3.38 | |
| 247 | | | 8.09 | 968.19 | 964.91 | 3.28 | |
| Culv Rt | | | 10.1 | 966.2 | | | |
| 246+52 | | | 8.40 | 967.88 | 964.60 | 3.28 | |
| Top 4" Private Tile | | | 11.32 | 964.96 | | | |




Outlet in private Tile Crossing Road

Summary
648'-6" Culv
.6 Stuff Cent

West

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BM | 10.11 | 962.66 | | 952.55 | Spk □ Gate Post Rt Sta 223+77 | | |
| 228 | | | 1.39 | 961.27 | 957.25 | 4.02 | |
| 227 | | | 4.10 | 958.56 | 955.15 | 3.41 | |
| 226 | | | 6.13 | 956.53 | 953.05 | 3.48 | |
| 225 | | | 7.62 | 955.04 | 950.95 | 4.09 | |
| 224 | | | 9.10 | 953.56 | 950.25 | 3.31 | |
| 223 | 2.84 | 955.55 | 9.95 | 952.71 | 949.55 | 3.16 | |
| 222 | | | 3.13 | 952.42 | 948.85 | 3.57 | .10c |
| 221 | | | 3.28 | 952.27 | 947.70 | 4.57 | .50c |
| 220 | | | 4.55 | 951.00 | 946.55 | 4.45 | .50c |
| 219 | | | 6.53 | 949.02 | 945.40 | 3.62 | |
| 218 | | | 7.87 | 947.68 | 944.25 | 3.43 | |
| 217 | | | 8.98 | 946.57 | 944.05 | 2.52 | |
| 216+77A | | | 8.97 | 946.58 | 944.00 | 2.58 | |
| Culvert | | | 10.9 | 944.7 | | | |
| Top 4" Private Tile | | | 11.20 | 944.35 | | | |

2.10

.7%

1.16

.2%

outlet in private tile Crossing Road

Summary
1126' 6" Custr
1.1 Sloft Ocut

West

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BM | 3.25 | 910.88 | | 907.63 | | | Hub by 1/4 sec Line Lt |
| 185 | | | 2.34 | 908.54 | 904.50 | 4.04 | |
| 184 | | | 3.52 | 907.36 | 903.50 | 3.86 | |
| 183 | | | 4.88 | 906.00 | 902.50 | 3.50 | |
| 182 | | | 5.88 | 905.00 | 901.50 | 3.50 | |
| 181 | | | 6.76 | 904.12 | 900.50 | 3.62 | 1.00 |
| 180 | | | 7.67 | 903.21 | 899.50 | 3.71 | |
| 179-T.P. | 2.99 | 905.67 | 8.19 | 902.68 | 898.50 | 4.18 | |
| 178 | | | 3.66 | 902.01 | 898.00 | 4.01 | |
| 177 | | | 4.23 | 901.44 | 897.50 | 3.94 | |
| 176 | | | 4.71 | 900.96 | 897.00 | 3.96 | 0.50% |
| 175 | | | 5.10 | 900.57 | 896.50 | 4.07 | |
| 174 | | | 5.69 | 899.98 | 896.00 | 3.98 | |
| 173 | | | 6.19 | 899.48 | 895.50 | 3.98 | |
| 172 TP | 2.80 | 901.48 | 6.99 | 898.68 | 894.75 | 3.93 | .75% |
| 171 | | | 3.53 | 897.95 | 894.00 | 3.95 | |
| 170 | | | 4.25 | 897.23 | 893.23 | 4.00 | |
| 169 | | | 5.24 | 896.24 | 892.46 | 3.78 | 0.77% |
| 168 | | | 7.21 | 894.27 | 891.69 | 2.58 | |
| 167+75 | | | 8.82 | 892.66 | 891.50 | 1.16 | |
| 167+75 H2O Level | | | 10.4 | 891.1 | | | |
| 5 ft. Bed W end Old Wood Br | | | 10.7 | 890.8 | | | |
| B.M | | | 4.53 | 896.95 | corr 896.91 | | Spk in C.W. tree Rt Sta 170 + |

Note:- This line stopped at Sta 176+00

Summary
825'-6" Drain
No Extras

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BM | 4.51 | 901.73 | | 897.22 | | G.E. Hwall - 2x21 R23 N of X Rd | |
| Culv. ℄ | | | 7.9 | 893.8 | | | |
| 158+75 | | | 5.49 | 896.24 | 893.98 | 2.26 | |
| 159 | | | 6.42 | 895.31 | 894.00 | 1.31 | |
| 160 | | | 6.16 | 895.57 | 894.10 | 1.47 | |
| 161 | | | 5.16 | 896.57 | 894.20 | 2.37 | |
| 162 | | | 4.96 | 896.77 | 894.30 | 2.47 | |
| 163 | | | 4.98 | 896.75 | 894.40 | 2.35 | |
| 164 | | | 5.39 | 896.34 | 894.50 | 1.94 | |

Sta 233+00 M.

Tile Connecting Fay's 4" Outlet to Demoths 4" Tile S. of Demoths Ho

50.00

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 Tile Top | | | 9.70 | 40.3 | Gr= 39.9 | | |
| H 0 | | | 6.98 | 43.02 | 39.90 | 3.12 | |
| H +25 | | | 6.69 | 43.31 | 40.05 | 3.26 | |
| +35 D | | | 7.5 | 42.5 | ← 14 | | |
| 0+40 H | | | 5.92 | 44.08 | 40.14 | 3.94 | .30c |
| +60 H | | | 5.19 | 44.81 | 40.26 | 4.55 | |
| +75 D | | | 7.3 | 42.7 | | | .30c |
| +80 H | | | 5.63 | 44.37 | 40.38 | 3.99 | |
| +80 Tile Top | | | 7.44 | 42.56 | Gr=42.16 | | |

.60 .80 0

Relay Present 6" Tile 6' to Connect

Summary

86' - 6" Ckstr

1 Staff Out

Lt = West        Rt = East

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BM | 2.42 | 899.64 | | 897.22 | Center E Hwall 2x2 RCB across Rd 158+ | | | | | | | |
| | | ↓ | | | | | | | | | | |
| 158 | | | | | 4.66 | 894.98 | 891.90 | 3.08 | 4.96 | 894.68 | 891.90 | 2.78 |
| 157 | | | | | 4.75 | 894.89 | 891.75 | 3.14 | 5.33 | 894.31 | 891.75 | 2.56 |
| 156 | | | | | 4.79 | 894.85 | 891.60 | 3.25 | 5.36 | 894.26 | 891.60 | 2.68 |
| 155 | | | | | 4.94 | 894.70 | 891.45 | 3.20 | 5.29 | 894.35 | 891.45 | 2.90 |
| 154 | | | | | 4.83 | 894.81 | 891.30 | 3.51 | 5.13 | 894.51 | 891.30 | 3.21 |
| 153 | | | | | 5.34 | 894.30 | 891.15 | 3.15 | 5.30 | 894.34 | 891.15 | 3.19 |
| 152 | | | | | 5.53 | 894.11 | 891.00 | 3.11 | 5.41 | 894.23 | 891.00 | 3.23 |
| 151 | | | | | 5.52 | 894.10 | 890.85 | 3.25 | 5.57 | 894.07 | 890.85 | 3.22 |
| T.D | 5.18 | 899.28 | 5.54 | 894.10 | | | | | | | | |
| 150 | | ↓ | | | 5.21 | 894.07 | 890.70 | 3.37 | 5.15 | 894.13 | 890.70 | 3.43 |
| 149 | | | | | 5.21 | 894.07 | 890.55 | 3.52 | 5.15 | 894.13 | 890.55 | 3.58 |
| 148 | | | | | 5.13 | 894.15 | 890.40 | 3.75 | 5.07 | 894.21 | 890.40 | 3.81 |
| BM | | | 1.58 | 897.70 | [illegible] (Conc) Front Ho | | | | | | | |
| 147 | | | | | 4.87 | 894.41 | 890.25 | 4.16 | 4.96 | 894.32 | 890.25 | 4.07 |

146+67 to 147 33 ft across Private Drive West

| | | | | | |
|---|---|---|---|---|---|
| | | 899.28 | | | |
| 146 | | | | | |
| Connect Collar Dr Lt 145+90 | | | | | |
| 145 | | | | | |
| 144 | | | | | |
| T.P | 4.28 | 897.74 | 5.82 | 893.46 | |
| 143 | | | | | |
| 142 | | | | | |
| 141 | | | | | |
| ∨ 140+35 | | | | | |
| 140+25 E 140+10 W Jnct | | | | | |
| | | | | RR | |
| 140+20 - Ditch Bottom | | | | 7.9 | 889.8 |
| 140+10 E Outlet | | | | ~~4~~ | |
| 140+10 H2O Level | | | | 8.5 | 889.2 |
| RP | | | | 4.59 | (893.15) |

| Elev + RR | Gr | Cut | Elev + RR | Gr | Cut |
|---|---|---|---|---|---|
| 893.69 / 4.59 | 890.10 ~~889~~ | 3.59 | 894.33 / 4.95 | 890.10 | 0.20c 4.23 |
| 893.54 / 5.74 | 889.95 | 3.59 | 893.92 / 5.36 | 889.95 | .10c 3.97 |
| 893.46 / 5.82 | 889.80 | 3.66 | 893.53 / 5.75 | 889.80 | 3.73 |
| 893.15 / 4.59 | 889.65 | 3.50 | 893.56 / 4.18 | 889.65 | 3.91 |
| 892.73 / 5.01 | 889.50 | 3.23 | 892.69 / 5.05 | 889.50 | 3.19 |
| 892.06 / .68 | 889.35 | 2.71 | 892.18 / 5.56 | 889.35 | 2.83 |
| 892.0? / 5.70 | 889.~~28~~ | 2.74 | | | |
| 891.35 / .39 | 889.25 | 2.10 | 891.35 / 6.39 | 889.25 | 2.10 |
| | | | 891 ol / 6.70 | 889.20 | 1.84 |

Center E H wall 7x4x16 RCB

Summary

1790' 6" Cisto
33' - Private X-ing
25' - Road X-ing

Summary

L = W  R = L

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BM | 4.55 | 898.26 | | 893.71 | 2x2 Hub S. of Br. Past left Sta 131+96.5 | | | | | | |
| Hub Level E side Br | | | 8.9 | 889.4 | | | | | | | |
| 136+62 E | | | | | | | | 890.37 / 7.89 | | 889.50 | 0.87 |
| Ditch | | | 7.9 | | | | | 891.45 / 6.41 | | 889.52 | 2.33 |
| 136+50 E | | | | | 2.40 / .86 | 889.57 | 2.83 | 892.40 / 5.86 | | 889.57 | 2.83 |
| 136 E = 136+12 W | | | | | 91.53 / .73 | 889.59 | 1.94 | | | | |
| 135+90 W | | | | | | | | | | | |
| 135 | | | | | 90.72 / 7.54 | 889.67 | 1.05 | 892.50 / 5.76 | 0.10 | 889.67 | 2.83 |
| 134 | | | | | 1.90 / .36 | 889.77 | 2.13 | 892.72 / 5.54 | | 889.77 | 2.95 |
| 133 | | | | | 2.31 / .95 | 889.87 | 2.44 | 893.06 / 5.20 | | 889.87 | 3.19 |
| 132 | | | | | 2.75 / .51 | 889.97 | 2.78 | 893.68 / 4.58 | | 889.97 | 3.71 |
| 131 | | | | | 3.36 / .90 | 890.07 | 3.29 | 894.18 / 4.08 | — | 890.07 | 4.11 |
| 130 | | | | | 5.02 / .24 | 891.87 | 3.15 | 895.57 / 2.75 | | 891.87 | 3.64 |
| T.P | 9.19 | 907.00 | 0.45 | 897.81 | 6.06 / .94 | 893.67 | 4.39 | 897.81 / 9.19 | 1.80 | 893.67 | 4.14 |
| 129 | | | | | | | | | | | |

Note 12" Private Tile Outlets N. side at Sta 131+65

895.47

907.00 ↓

| Sta. | | L | | | | R | |
|---|---|---|---|---|---|---|---|
| | | | .40c | | | | .10c |
| 128 | 7.87 / 13 | 895.47 | 4.40 | 899.61 / 7.39 | 895.47 | | 4.14 |
| | | | .10c | | | | |
| 127 | 1.08 / 95 | 896.22 | 3,83 | 899.87 / 7.13 | 896.22 | | 3.65 |
| 126 | .47 / 53 | 896.97 | 3.50 | 900.16 / 6.82 | 896.97 | | 3.19 |
| 125 | 1.19 / 81 | 897.72 | 3.47 | 900.94 / 6.06 | 897.72 | | 3.22 |
| 124 | 2.34 / 66 | 898.47 | 3.87 | 902.19 / 4.81 | 898.47 | | 3.72 |
| | | | .20c | | | | |
| 123 | 3.72 / 28 | 899.22 | 4.50 | 903.31 / 369 | 899.22 | | 4.09 |
| | | | 40c | | | | |
| 122 End | 5.26 / 74 | 900.97 | 4.29 | 904.79 / 2.21 | 900.97 | | 3.82 |

Summary
1412'-6" Custr
1.1 Sta of Oc
25' Road Xing

Summary
1462'-6" Custr
0.1 Sta of Ocut

All ahead given Est No. 2

| | | | | |
|---|---|---|---|---|
| B M | 4.93 | 894.99 | | 890.06 |
| Culv ft | | | 10.2 | 884.8 |
| 88+89 | | | | |
| 89 | | | | |
| 89 | | | | |
| 89+40 E = 8926 W Jnct 24' across Road | | | | |
| 89+50 | | | | |
| 90 | | | | |
| 91 | | | | |
| 92 | | | | |
| 93 | | | | |
| 94 | | | | |
| 95 | | | | |
| 96 | | | | |
| T.P | 8.09 | 899.53 | 3.55 | 891.44 |
| Culv ft | | | | |
| 97 | | | | |

W = Lt    E = Rt

x Center E Hwall Conc Culv Sta 88+85

| | | Cut | | | Cut |
|---|---|---|---|---|---|
| | | | 889.14 / 5.85 | 885.00 | 4.14 |
| | | | 889.32 / 5.67 | 885.03 | 4.29 |
| 7.93 / .06 | 885.11 | 2.82 | 887.93 / 7.06 | 885.11 | 2.82 |
| 8.62 / .37 | 885.16 | 3.46 | | | |
| 7.70 / .29 | 885.25 | 2.45 | 887.29 / 7.70 | 885.23 | 2.06 |
| 8.20 / .79 | 885.44 | 2.76 | 887.75 / 7.24 | 885.43 | 2.32 |
| 9.05 / .94 | 885.63 | 3.42 | 888.70 / 6.29 | 885.63 | 3.07 |
| 90.24 / 4.75 | 886.43 | 3.81 | 890.01 / 4.98 | 886.43 | 3.58 |
| 2.39 / 2.60 | 887.23 | 5.16 | 892.01 / 2.98 | 887.23 | 4.78 |
| 2.28 / 2.71 | 888.03 | 4.25 | 891.66 / 3.33 | 888.03 | 3.63 |
| 1.73 / .26 | 888.83 | 2.90 | 891.44 / 3.55 | 888.83 | 2.61 |
| 90.0 / 9.5 | | | 890.0 / 9.5 | | |
| 92.16 / 5.37 | 889.33 | 2.83 | 891.91 / 7.62 | 889.33 | 2.58 |

0.20% 0.80% 0.50% 0.50%

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 899.53 | | | 2.90 | 889.83 | 3.07 | 892.16 | 889.83 | 2.33 |
| 98 | | | | | 6.63 | | 5% | 7.37 | | 5% |
| | | | | | 13.60 | 890.33 | 3.27 | 892.98 | 890.33 | 2.65 |
| 99 | | | | | 5.93 | | | 6.55 | | |
| | | | | | 4.93 | 891.43 | 3.50 | 894.64 | 891.43 | 3.21 |
| 100 | | | | | 2.60 | | | 4.89 | | |
| | | | | | 6.15 | 892.53 | 3.62 | 895.32 | 892.53 | 2.79 |
| 101 | | | | | 3.38 | | 0% | 4.21 | | 0% |
| | | | | | 16.96 | 893.63 | 3.35 | 896.03 | 893.63 | 2.40 |
| 102 | | | | | 2.53 | | 1.10 | 3.50 | | 1.10 |
| T.P | 8.42 | 905.40 | 2.55 | 896.98 | | | | | | |
| 103 | | | | | 17.68 | 894.73 | 2.95 | 897.11 | 894.73 | 2.38 |
| | | | | | 7.72 | | | 8.29 | | |
| 104 | | | | | 98.65 | 895.83 | 2.82 | 898.82 | 895.83 | 2.99 |
| | | | | | 2.75 | | | 6.58 | | |
| | | | | | 00.72 | 896.93 | 3.79 | 900.74 | 896.93 | 3.81 |
| 105 | | | | | 2.68 | | | 4.66 | | |
| | | | | | | | 3.00% | | | |
| | | | | | 2.68 | 898.73 | 3.95 | | | |
| 105+60 | | | | | 2.72 | | | | | |
| Bott of Ditch at Tile Outlet | | | 5.10 | 900.30 | | | | | | |
| BM | | | 4.05 | 901.35 | | | | | | |

NEnd Corr culv at W side Intersection

| Summary | Summary |
|---|---|
| East - 51' 8" | West 1634' 6" |
| " 1560'-6" - 0.4 Staff Cent | " 1.2 Staff Cent |
| " 1 culv Corr | " 57' Road Xing |

Est No 3

West = Left

| | | | | | | |
|---|---|---|---|---|---|---|
| B M | 3.93 | 893.99 | | 890.06 | | |
| Culv ℄ | | | ~~9.3~~ 9.3 | 884.7 | | |
| 88+82 | | | 5.01 | 888.98 | 884.80 | 4.18 |
| 88 | | | 6.68 | 887.31 | 884.92 | 2.39 |
| 87 | | | 6.39 | 887.60 | 885.07 | 2.53 |
| 86 | | | 5.86 | 888.13 | 885.22 | 2.91 |
| 85 | | | 5.61 | 888.38 | 885.37 | 3.01 |
| 84 | | | 5.49 | 888.50 | 885.52 | 2.98 |
| Drive 83 | | | 4.37 | 889.62 | 885.67 | 3.95 |
| 82 | | | 4.34 | 889.65 | 886.17 | 3.48 |
| 81=T.P | 11.07 | 900.83 | 4.23 | 889.76 | 886.67 | 3.09 |
| 80 | | | 10.62 | 890.21 | 887.17 | 3.04 |
| 79 | | | 9.40 | 891.43 | 887.67 | 3.76 |

x Center E Hwall Sta 88+85

0.15%

.5%

888.00
885.67
3
4)2.33
.58

891.67
887.67
4.00

887.67
2.40
890.07

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 900.83 | | | | |
| 78 | | | 7.93 | 892.90 | 889.67 | 3.23 |
| 77 = End | | | 3.48 | 895.35 | 891.67 | 3.68 |
| — | | — | | — | | — |
| 76-End | | 900.83 | 4.66 | 896.17 | 892.00 | 4.17 |
| 75-TP | 3.52 | 896.34 | 8.01 | 892.82 | 890.00 | 2.82 |
| 74 | | | 5.34 | 891.00 | 888.00 | 3.00 |
| 73+20 Temp. Outlet | | | 7.65 | 888.69 | 887.70 | 1.00 |
| Culv ℄ | | | 9.4 | 886.9 | | |
| H2O Level | | | 8.6 | 884.7 | | |
| BM | | | 3.74 | 892.60 | | |

2.00%

891.42
886.12
3)5.30
1.77

Summary 1182'-6" - 1 culv Conn no Ex

2.00

0.40

.8' Fill on Culv

Summary
280'-6" - No Extras

West = Left

| | | | | | | |
|---|---|---|---|---|---|---|
| BM | 8.39 | 900.70 | | 892.31 | | |
| Culv FL | | | 11.65 | 889.05 | | |
| 48+52 | | | 8.82 | 891.88 | 889.10 | 2.78 |
| 49 | | | 9.44 | 891.26 | 889.24 | 2.02 |
| 50 | | | 7.88 | 892.82 | 889.55 | 3.27 |
| 51 | | | 5.43 | 895.27 | 892.35 | 2.92 |
| 52 | | | 2.46 | 898.24 | 895.15 | 3.09 |
| TP+50 | 8.83 | 909.27 | 0.26 | 900.44 | 896.55 | 3.89 .35 Oc |
| 53 | | | 6.67 | 902.60 | 897.95 | 4.65 .35 Oc |
| +50 | | | 6.05 | 903.22 | 899.35 | 3.87 |
| 54 | | | 5.62 | 903.65 | 899.85 | 3.80 |
| 55 | | | 5.30 | 903.97 | 900.85 | 3.12 |
| 56 | | | 4.01 | 905.26 | 901.85 | 3.41 |
| T.P 57 | 12.41 | 919.93 | 1.75 | 907.52 | 904.73 | 2.79 |
| 58 | | | 8.94 | 910.99 | 907.61 | 3.38 |
| 59 | | | 5.28 | 914.65 | 910.50 | 4.15 .10c |
| 60 End | | | 3.82 | 916.11 | 912.10 | 4.01 |

X Center E Hwall Sta 48+47

0.3 %

2.80

1.00

2.56

1.60

1.5) 40 (26 .88 .3 1.4 
30
100

912.10
901.85
4) 10.25
2.56

910.50
901.85
3) 8.65
2.88

901.85
2.88
904.73
2.88
907.61
2.88
910.49

Summary
1148' -6"
.8 ft Oc
1 culv conn
50' across Hwy Rd

West

| | | | | | | |
|---|---|---|---|---|---|---|
| BM | 7.17 | 908.31 | | 901.14 | | Connect thru Culv Barrel |
| Culv E | | | 11.5 | 896.8 | — | |
| 41+41 | | | 8.13 | 900.18 | 896.90 .28 | |
| 41 | | | 9.84 | 898.47 | 897.0? .45 | .2 |
| 40 | | | 9.05 | 899.23 | 897.2? .01 | — |
| 39 | | | 7.23 | 901.08 | 897.93 .16 | |
| 38 | | | 7.12 | 901.19 | 898 6? .57 | |
| 37 | | | 4.95 | 903.36 | 899.3? .04 | |
| ~~36~~ | | | ~~1.99~~ | | | |

End at Sta 37 - Found 6" Tile under Sholder in good Condition

Summary
441'-6" Tile
1 Culv Connection

# 8" Outlet Line

× Center E Hwall Sta 9+46

| | | | | | | | Gr | Cut |
|---|---|---|---|---|---|---|---|---|
| B M | 2.90 | (893.88) | | 890.98 | | | | |
| O. Ditch Bottom | | | 13.1 | 880.8 | | | | |
| 0 | | | 11.50 | 882.38 | 881.00 | 1.38 | 881.00 | 1.38 |
| +50 | | | 9.88 | 884.00 | 881.50 | 2.50 | 881.75 | 2.25 |
| +75 | | | 9.34 | 884.54 | 881.75 | 2.79 | 882.12 | 2.42 |
| 1 | | | 8.86 | 885.02 | 882.00 | 3.02 | 882.50 | 2.52 |
| +50 | | | 8.10 | 885.78 | 882.50 | 3.28 | 883.25 | 2.53 |
| Ditch | | | 8.2 | 885.7 | | | | |
| +88 | | | 6.78 | 887.10 | 882.88 | 4.22 | 883.82 | 3.28 Jnct Lead to W. Intake |
| 2+18 = 9+40 | | | 7.20 | 886.68 | 883.18 | 3.50 | 884.27 | 2.41 |
| = 9+46 / 2+24 Jnct 8" + 6" Tile | | | 7.01 | 886.87 | 883.24 | 3.63 | 884.36 | 2.51 Jnct 6" Line 5 / End 8" Tile Intake E side |
| (Hub at Intake W End Culv) | | | 8.25 | 885.63 | — | — | | |
| 10 | | | 6.25 | 887.63 | 883.78 | 3.85 | 884.66 | 2.97 |
| 11 | | | 5.58 | 888.30 | 884.78 | 3.52 | 885.22 | 3.08 |
| 12 | | | 5.06 | 888.82 | 885.78 | 3.04 | 885.78 | 3.04 |
| 13 | 12.90 | (903.08) | 3.70 | 890.18 | 887.78 | 2.40 | | |
| 14 | | | 11.35 | 891.73 | 889.78 | 1.95 | | |
| 15 | | | 8.88 | 894.20 | 891.78 | 2.42 | | |
| 16 | | | 5.47 | 897.61 | 893.78 | 3.83 | | |
| 17 | 7.36 | (908.52) | 1.92 | 901.16 | 898.28 | 2.88 | | |
| 18 | | | 2.21 | 906.31 | 902.78 | 3.53 | | |
| 19 | | | | | | | | |
| 20 | | | | | | | | |

Note: Extended to Sta 20+00 at 4' Depth

Summary:
224' - 8" - 24' across Road
1054' - 6" - 24' drive

East

| | | | | | | |
|---|---|---|---|---|---|---|
| B M | 4.12 | 895.10 | | 890.98 | | |
| 9+40 | | | 8.43 | 886.67 | 883.18 | 3.49 |
| 9 | | | 7.39 | 887.71 | 883.50 | 4.21 |
| 8 | | | 7.39 | 887.71 | 884.05 | 3.66 |
| 7 | | | 7.20 | 887.90 | 884.60 | 3.30 |
| 6 | | | 7.38 | 887.72 | 885.15 | 2.57 |
| 5 | | | 5.92 | 889.18 | 885.70 | 3.48 |
| 4 | | | 4.56 | 890.54 | 886.25 | 4.29 |
| 3 | | | 5.36 | 889.74 | 886.80 | 2.94 |
| 2 | | | 4.96 | 890.14 | 887.35 | 2.79 |

= Snct 8"

S-1000

Summary

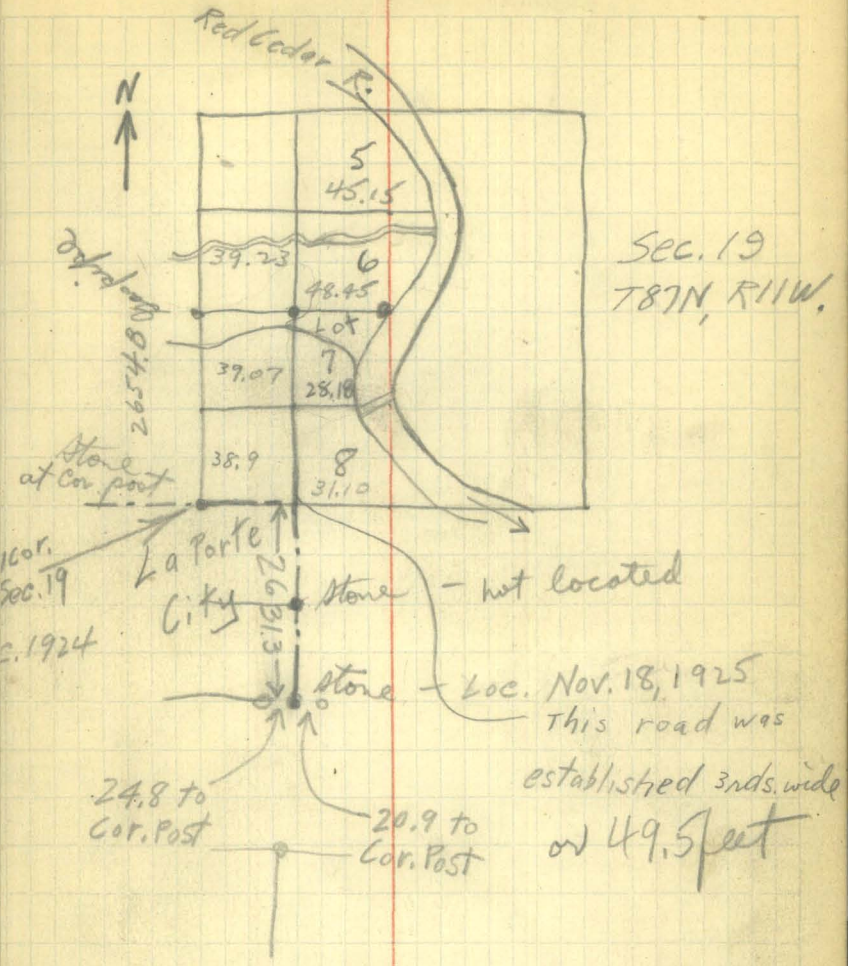
740'-6". no [illegible]

T.le Chk

| | | | | |
|---|---|---|---|---|
| BM | 5.08 | 895.14 | | 890.06 |
| | | .60 | | |
| | | 894.54 | | |
| 90 | | | | |
| 91 | | | | |
| 92 | | | | |
| 93 | | | | |
| 94 | | | | |
| 95 | | | | |
| 96 T.D | 6.63 | 898.32 | 3.45 | 891.69 |
| | | 60 | | |
| | | 897.72 | | |
| 97 | | | | |
| 98 | | | | |
| 99 | | | | |
| 100 | | | | |
| 101 | | | | |
| 102 | | | | |

| W = L | | E = R+ | |
|---|---|---|---|
| | G | | G |
| 9.30 | 885.24 | 9.32 | 885.22 |
| 9.11 | 885.43 | 9.14 | 885.40 |
| 8.91 | 885.63 | 8.93 | 885.61 |
| 8.18 | 886.36 | 8.12 | 886.42 |
| 7.26 | 887.28 | 7.25 | 887.29 |
| 6.49 | 888.05 | 6.49 | 888.05 |
| 8.93 | 888.79 | 8.98 | 888.74 |
| 8.52 | 889.20 | ~~8.52~~ | 8.50 |
| 7.94 | 889.78 | 7.97 | 889.75 |
| 7.48 | 890.24 | 7.48 | 890.24 |
| 6.33 | 891.39 | 6.30 | 891.42 |
| 5.17 | 892.55 | 5.18 | 892.54 |
| 4.14 | 893.58 | 4.14 | 893.58 |

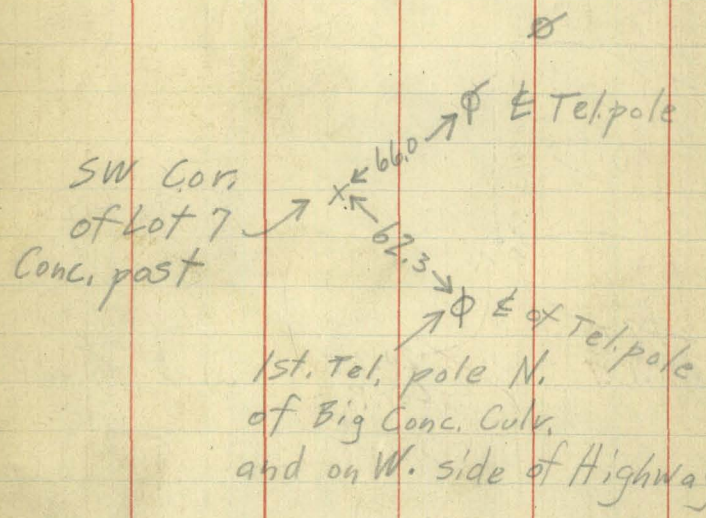
Lot 7 Sec. 19-87-11
Prop. of Black Hawk Co.



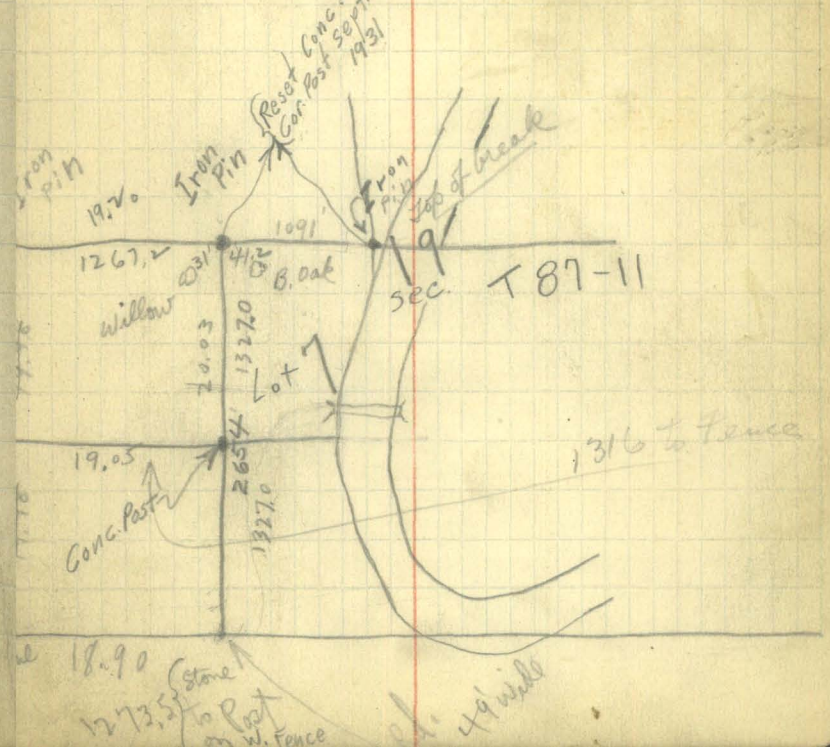
Nov. 18, 1925.

Set Concrete monument at SW Cor. of Lot 7 - measured 1327.0 from NW Cor. of Lot 7 to est. corner

E. B. Spencer
Paul Turner



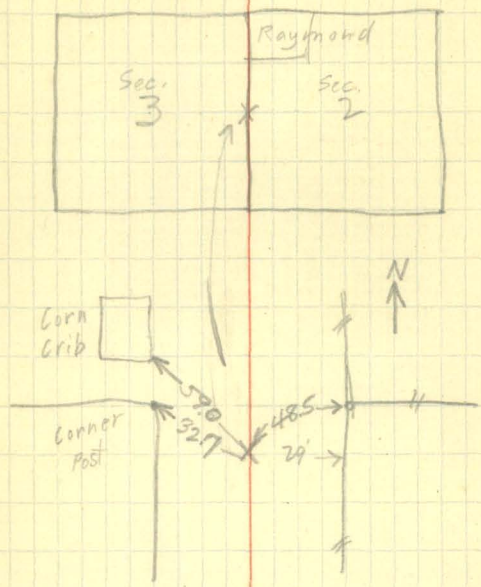

3 Iron Pins and Stone Located Dec. 1924.



| Sta. | B.S. | H.I. | F.S. | Elev. |
|---|---|---|---|---|
| B.M. | 0.31 | 100.31 | | [illegible] |
| C.P. | 6.93 | 95.03 | 12.21 | 88.10 |
| 0+00 / +20 (Offset for corner) | | | | |
| +32 | | | | |
| +45 | | | | |
| +52 | | | | |
| +65 | | | | |
| 1+00 | | | | |
| +05 | | | | |
| +13 | | | | |
| +32 | | | | |
| +44 | | | | |
| +57 | | | | |

| Sta | B.S. | H.I. | F.S. | Elev. |
|---|---|---|---|---|
| | | | | |
| +6.9 | | | | |
| +9.4 = End | | | | |
| 2+50 | | | | |

Ties for 1/4 Corner
between Sec. 2 and 3 - T88-R12
Mar. 26, 1925



# KEITH'S RAILROAD CURVE TABLES.

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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° 20′ to the R. at Station 542+72.

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

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

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

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

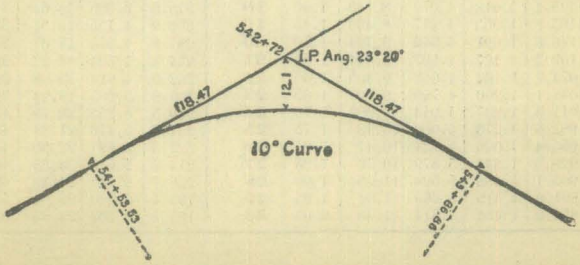
| | | | |
|---|---|---|---|
| 2° 19½′=def. for sta. | 542 | I. P.=sta. | 542+72 |
| 4° 49½′= " " " | +50 | Tan.= | 1.18.47 |
| 7° 19½′= " " " | 543 | B. C.=sta. | 541+53.53 |
| 9° 49½′= " " " | +50 | L. C.= | 2.33.33 |
| 11° 40′= " " " | 543+ | E. C.=sta. | 543+86.86 |
| | 86.86 | | |

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

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

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

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



## Table I. — Minutes in Decimals of a Degree.

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

## Table II. — Inches in Decimals of a Foot.

| 1-16 | 3-32 | 1/8 | 3-16 | 1/4 | 5-16 | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 |
|---|---|---|---|---|---|---|---|---|---|---|
| .0052 | .0078 | .0104 | .0156 | .0208 | .0260 | .0313 | .0417 | .0521 | .0625 | .0729 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| .0833 | .1667 | .2500 | .3333 | .4167 | .5000 | .5833 | .6667 | .7500 | .8333 | .9167 |

## Table III. — Radii, Ordinates and Deflections.

| Deg. | Radius | Mid. Ord. | Tan. Def. | Chd. Def. | Def. for 1 Foot | Deg. | Radius | Mid. Ord. | Tan. Def. | Chd. Def. | Def. for 1 Foot |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0° 10′** | 34377. | .036 | .145 | .291 | 0.05′ | **7°** | 819.0 | 1.528 | 6.105 | 12.21 | 2.10′ |
| 20 | 17189. | .073 | .291 | .582 | 0.10 | 20′ | 781.8 | 1.600 | 6.395 | 12.79 | 2.20 |
| 30 | 11459. | .109 | .436 | .873 | 0.15 | 30 | 764.5 | 1.637 | 6.540 | 13.08 | 2.25 |
| 40 | 8594.4 | .145 | .582 | 1.164 | 0.20 | 40 | 747.9 | 1.673 | 6.685 | 13.37 | 2.30 |
| 50 | 6875.5 | .182 | .727 | 1.454 | 0.25 | **8** | 716.8 | 1.746 | 6.976 | 13.95 | 2.40 |
| **1** | 5729.6 | .218 | .873 | 1.745 | 0.30 | 20 | 688.2 | 1.819 | 7.266 | 14.53 | 2.50 |
| 10 | 4911.2 | .255 | 1.018 | 2.036 | 0.35 | 30 | 674.7 | 1.855 | 7.411 | 14.82 | 2.55 |
| 20 | 4297.3 | .291 | 1.164 | 2.327 | 0.40 | 40 | 661.7 | 1.892 | 7.556 | 15.11 | 2.60 |
| 30 | 3819.8 | .327 | 1.309 | 2.618 | 0.45 | **9** | 637.3 | 1.965 | 7.846 | 15.69 | 2.70 |
| 40 | 3437.9 | .364 | 1.454 | 2.909 | 0.50 | 20 | 614.6 | 2.037 | 8.136 | 16.27 | 2.80 |
| 50 | 3125.4 | .400 | 1.600 | 3.200 | 0.55 | 30 | 603.8 | 2.074 | 8.281 | 16.56 | 2.85 |
| **2** | 2864.9 | .436 | 1.745 | 3.490 | 0.60 | 40 | 593.4 | 2.110 | 8.426 | 16.85 | 2.90 |
| 10 | 2644.6 | .473 | 1.891 | 3.781 | 0.65 | **10** | 573.7 | 2.183 | 8.716 | 17.43 | 3.00 |
| 20 | 2455.7 | .509 | 2.036 | 4.072 | 0.70 | 30 | 546.4 | 2.292 | 9.150 | 18.30 | 3.15 |
| 30 | 2292.0 | .545 | 2.181 | 4.363 | 0.75 | **11** | 521.7 | 2.402 | 9.585 | 19.16 | 3.30 |
| 40 | 2148.8 | .582 | 2.327 | 4.654 | 0.80 | 30 | 499.1 | 2.511 | 10.02 | 20.04 | 3.45 |
| 50 | 2022.4 | .618 | 2.472 | 4.945 | 0.85 | **12** | 478.3 | 2.620 | 10.45 | 20.91 | 3.60 |
| **3** | 1910.1 | .655 | 2.618 | 5.235 | 0.90 | 30 | 459.3 | 2.730 | 10.89 | 21.77 | 3.75 |
| 10 | 1809.6 | .691 | 2.763 | 5.526 | 0.95 | **13** | 441.7 | 2.839 | 11.32 | 22.64 | 3.90 |
| 20 | 1719.1 | .727 | 2.908 | 5.817 | 1.00 | | 425.4 | 2.949 | 11.75 | 23.51 | 4.05 |
| 30 | 1637.3 | .764 | 3.054 | 6.108 | 1.05 | **14** | 410.3 | 3.058 | 12.18 | 24.37 | 4.20 |
| 40 | 1562.9 | .800 | 3.199 | 6.398 | 1.10 | 30 | 396.2 | 3.168 | 12.62 | 25.24 | 4.35 |
| 50 | 1495.0 | .836 | 3.345 | 6.689 | 1.15 | **15** | 383.1 | 3.277 | 13.05 | 26.11 | 4.50 |
| **4** | 1432.7 | .873 | 3.490 | 6.980 | 1.20 | 30 | 370.8 | 3.387 | 13.49 | 26.97 | 4.65 |
| 10 | 1375.4 | .909 | 3.635 | 7.271 | 1.25 | **16** | 359.3 | 3.496 | 13.92 | 27.84 | 4.80 |
| 20 | 1322.5 | .945 | 3.718 | 7.561 | 1.30 | 30 | 348.5 | 3.606 | 14.35 | 28.70 | 4.95 |
| 30 | 1273.6 | .982 | 3.926 | 7.852 | 1.35 | **17** | 338.3 | 3.716 | 14.78 | 29.56 | 5.10 |
| 40 | 1228.1 | 1.018 | 4.071 | 8.143 | 1.40 | **18** | 319.6 | 3.935 | 15.64 | 31.29 | 5.40 |
| 50 | 1185.8 | 1.055 | 4.217 | 8.433 | 1.45 | **19** | 302.9 | 4.155 | 16.51 | 33.01 | 5.70 |
| **5** | 1146.3 | 1.091 | 4.362 | 8.724 | 1.50 | **20** | 287.9 | 4.374 | 17.37 | 34.73 | 6.00 |
| 10 | 1109.3 | 1.127 | 4.507 | 9.014 | 1.55 | **21** | 274.4 | 4.594 | 18.22 | 36.44 | 6.30 |
| 20 | 1074.7 | 1.164 | 4.653 | 9.305 | 1.60 | **22** | 262.0 | 4.814 | 19.08 | 38.16 | 6.60 |
| 30 | 1042.1 | 1.200 | 4.798 | 9.596 | 1.65 | **23** | 250.8 | 5.035 | 19.94 | 39.87 | 6.90 |
| 40 | 1011.5 | 1.237 | 4.943 | 9.886 | 1.70 | **24** | 240.5 | 5.255 | 20.79 | 41.58 | 7.20 |
| 50 | 982.6 | 1.273 | 5.088 | 10.18 | 1.75 | **25** | 231.0 | 5.476 | 21.64 | 43.28 | 7.50 |
| **6** | 955.4 | 1.309 | 5.234 | 10.47 | 1.80 | **26** | 222.3 | 5.697 | 22.50 | 44.99 | 7.80 |
| 10 | 929.6 | 1.346 | 5.379 | 10.76 | 1.85 | **27** | 214.2 | 5.918 | 23.35 | 46.69 | 8.10 |
| 20 | 905.1 | 1.382 | 5.524 | 11.05 | 1.90 | **28** | 206.7 | 6.139 | 24.19 | 48.38 | 8.40 |
| 30 | 881.9 | 1.418 | 5.669 | 11.34 | 1.95 | **29** | 199.7 | 6.360 | 25.04 | 50.07 | 8.70 |
| 40 | 859.9 | 1.455 | 5.814 | 11.63 | 2.00 | **30** | 193.2 | 6.583 | 25.88 | 51.76 | 9.00 |



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

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

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

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



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

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

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

| Angle | Tangent | External | Angle | Tangent | External | Angle | Tangent | External |
|---|---|---|---|---|---|---|---|---|
| **91°** | 5830.5 | 2444.9 | **101°** | 6950.6 | 3278.1 | **111°** | 8336.7 | 4386.1 |
| 10′ | 5847.5 | 2457.1 | 10′ | 6971.3 | 3294.1 | 10′ | 8362.7 | 4407.6 |
| 20 | 5864.6 | 2469.3 | 20 | 6992.0 | 3310.1 | 20 | 8388.9 | 4429.2 |
| 30 | 5881.7 | 2481.5 | 30 | 7012.7 | 3326.1 | 30 | 8415.1 | 4450.9 |
| 40 | 5898.8 | 2493.8 | 40 | 7033.6 | 3342.3 | 40 | 8441.5 | 4472.7 |
| 50 | 5916.0 | 2506.1 | 50 | 7054.5 | 3358.5 | 50 | 8468.0 | 4494.6 |
| **92** | 5933.2 | 2518.5 | **102** | 7075.5 | 3374.9 | **112** | 8494.6 | 4516.6 |
| 10 | 5950.5 | 2531.0 | 10 | 7096.6 | 3391.2 | 10 | 8521.3 | 4538.8 |
| 20 | 5967.9 | 2543.5 | 20 | 7117.8 | 3407.7 | 20 | 8548.1 | 4561.1 |
| 30 | 5985.3 | 2556.0 | 30 | 7139.0 | 3424.3 | 30 | 8575.0 | 4583.4 |
| 40 | 6002.7 | 2568.6 | 40 | 7160.3 | 3440.9 | 40 | 8602.1 | 4606.0 |
| 50 | 6020.2 | 2581.3 | 50 | 7181.7 | 3457.6 | 50 | 8629.3 | 4628.6 |
| **93** | 6037.8 | 2594.0 | **103** | 7203.2 | 3474.4 | **113** | 8656.6 | 4651.3 |
| 10 | 6055.4 | 2606.8 | 10 | 7224.7 | 3491.3 | 10 | 8684.0 | 4674.2 |
| 20 | 6073.1 | 2619.7 | 20 | 7246.3 | 3508.2 | 20 | 8711.5 | 4697.2 |
| 30 | 6090.8 | 2632.6 | 30 | 7268.0 | 3525.2 | 30 | 8739.2 | 4720.3 |
| 40 | 6108.6 | 2645.5 | 40 | 7289.8 | 3542.4 | 40 | 8767.0 | 4743.6 |
| 50 | 6126.4 | 2658.5 | 50 | 7311.7 | 3559.6 | 50 | 8794.9 | 4766.9 |
| **94** | 6144.3 | 2671.6 | **104** | 7333.6 | 3576.8 | **114** | 8822.9 | 4790.4 |
| 10 | 6162.6 | 2684.7 | 10 | 7355.6 | 3594.2 | 10 | 8851.0 | 4814.1 |
| 20 | 6180.2 | 2697.9 | 20 | 7377.8 | 3611.7 | 20 | 8879.3 | 4837.8 |
| 30 | 6198.3 | 2711.2 | 30 | 7399.9 | 3629.2 | 30 | 8907.7 | 4861.7 |
| 40 | 6216.4 | 2724.5 | 40 | 7422.2 | 3646.8 | 40 | 8936.3 | 4885.7 |
| 50 | 6234.6 | 2737.9 | 50 | 7444.6 | 3664.5 | 50 | 8965.0 | 4909.9 |
| **95** | 6252.8 | 2751.3 | **105** | 7467.0 | 3682.3 | **115** | 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 | 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

| Δ ANGLE \ CURVE | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | 60° | 65° | 70° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10° | .03 | .06 | .09 | .13 | .16 | .19 | .22 | .25 | .28 | .31 | .34 | .38 | .42 | .46 |
| 15° | .04 | .10 | .14 | .19 | .24 | .29 | .34 | .39 | .45 | .51 | .53 | .58 | .63 | .68 |
| 20° | .06 | .13 | .19 | .26 | .32 | .39 | .45 | .51 | .58 | .65 | .72 | .79 | .84 | .90 |
| 25° | .08 | .16 | .24 | .33 | .40 | .49 | .58 | .67 | .75 | .83 | .90 | .99 | 1.06 | 1.14 |
| 30° | .10 | .19 | .29 | .39 | .49 | .59 | .69 | .79 | .89 | .99 | 1.09 | 1.20 | 1.29 | 1.39 |
| 35° | .11 | .22 | .34 | .47 | .58 | .69 | .70 | .81 | .92 | 1.04 | 1.29 | 1.42 | 1.54 | 1.66 |
| 40° | .13 | .26 | .40 | .53 | .67 | .80 | .93 | 1.06 | 1.20 | 1.34 | 1.49 | 1.64 | 1.79 | 1.94 |
| 45° | .15 | .30 | .44 | .60 | .76 | .91 | 1.06 | 1.21 | 1.37 | 1.52 | 1.70 | 1.87 | 2.04 | 2.21 |
| 50° | .17 | .34 | .51 | .68 | .85 | 1.02 | 1.19 | 1.36 | 1.54 | 1.72 | 1.91 | 2.10 | 2.29 | 2.48 |
| 55° | .19 | .38 | .57 | .76 | .95 | 1.14 | 1.32 | 1.52 | 1.72 | 1.92 | 2.14 | 2.35 | 2.56 | 2.77 |
| 60° | .21 | .42 | .63 | .84 | 1.05 | 1.27 | 1.49 | 1.71 | 1.94 | 2.17 | 2.38 | 2.60 | 2.83 | 3.07 |
| 65° | .23 | .46 | .69 | .93 | 1.16 | 1.40 | 1.64 | 1.88 | 2.13 | 2.38 | 2.63 | 2.88 | 3.13 | 3.39 |
| 70° | .25 | .51 | .76 | 1.02 | 1.28 | 1.54 | 1.80 | 2.06 | 2.33 | 2.60 | 2.88 | 3.16 | 3.44 | 3.72 |
| 75° | .27 | .56 | .83 | 1.12 | 1.40 | 1.69 | 1.98 | 2.27 | 2.57 | 2.87 | 3.16 | 3.47 | 3.78 | 4.09 |
| 80° | .30 | .61 | .91 | 1.22 | 1.53 | 1.84 | 2.15 | 2.46 | 2.78 | 3.10 | 3.44 | 3.78 | 4.12 | 4.46 |
| 85° | .33 | .66 | 1.00 | 1.33 | 1.68 | 2.02 | 2.36 | 2.70 | 3.05 | 3.40 | 3.77 | 4.14 | 4.55 | 4.89 |
| 90° | .36 | .72 | 1.09 | 1.45 | 1.83 | 2.20 | 2.57 | 2.94 | 3.32 | 3.70 | 4.10 | 4.50 | 4.91 | 5.32 |
| 95° | .39 | .79 | 1.19 | 1.55 | 2.00 | 2.40 | 2.80 | 3.20 | 3.61 | 4.02 | 4.40 | 4.98 | 5.38 | 5.83 |
| 100° | .43 | .86 | 1.30 | 1.74 | 2.18 | 2.62 | 3.06 | 3.50 | 3.95 | 4.40 | 4.88 | 5.37 | 5.85 | 6.34 |

### For Externals Add

| ANGLE \ CURVE | 5° | 10° | 15° | 20° | 25° | 30° | 35° | 40° | 45° | 50° | 55° | 60° | 65° | 70° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10° | .001 | .003 | .004 | .006 | .007 | .008 | .009 | .011 | .012 | .014 | .015 | .017 | .018 | .020 |
| 15° | .003 | .007 | .010 | .014 | .018 | .023 | .027 | .029 | .032 | .035 | .039 | .043 | .047 | .051 |
| 20° | .006 | .011 | .017 | .022 | .028 | .034 | .038 | .045 | .051 | .057 | .063 | .070 | .076 | .083 |
| 25° | .009 | .018 | .027 | .036 | .046 | .056 | .065 | .074 | .083 | .093 | .106 | .120 | .127 | .135 |
| 30° | .013 | .025 | .038 | .051 | .065 | .078 | .090 | .103 | .116 | .129 | .149 | .170 | .179 | .188 |
| 35° | .018 | .035 | .054 | .072 | .086 | .109 | .131 | .153 | .175 | .197 | .213 | .230 | .247 | .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 | .711 | .845 | .922 | 1.01 |
| 70° | .080 | .159 | .240 | .321 | .403 | .485 | .568 | .652 | .735 | .819 | .906 | .994 | 1.08 | 1.17 |
| 75° | .095 | .182 | .286 | .383 | .480 | .578 | .678 | .777 | .877 | .977 | 1.07 | 1.18 | 1.29 | 1.39 |
| 80° | .110 | .220 | .332 | .445 | .558 | .671 | .787 | .903 | 1.02 | 1.13 | 1.25 | 1.38 | 1.50 | 1.62 |
| 85° | .128 | .259 | .391 | .524 | .657 | .790 | .926 | 1.06 | 1.20 | 1.34 | 1.47 | 1.62 | 1.76 | 1.91 |
| 90° | .149 | .299 | .450 | .603 | .756 | .910 | 1.07 | 1.22 | 1.38 | 1.54 | 1.70 | 1.87 | 2.03 | 2.20 |
| 95° | .174 | .350 | .522 | .706 | .985 | 1.06 | 1.25 | 1.43 | 1.62 | 1.80 | 1.99 | 2.18 | 2.38 | 2.58 |
| 100° | .200 | .401 | .604 | .809 | 1.01 | 1.22 | 1.43 | 1.64 | 1.85 | 2.06 | 2.28 | 2.50 | 2.73 | 2.96 |

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

| Degree of Curve | Radius $\frac{50}{\text{sin. def. ang.}}$ | $\frac{\frac{1}{2}\text{ sub chord}}{R}$ = sin of def. angle | | | | 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.

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

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

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

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

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

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

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

$E = T \tan \frac{1}{4} I$

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

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

$\text{Tan. def.} = \frac{1}{2} \text{ chord def.}$

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 Externals 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 7.



## Natural Sines

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

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

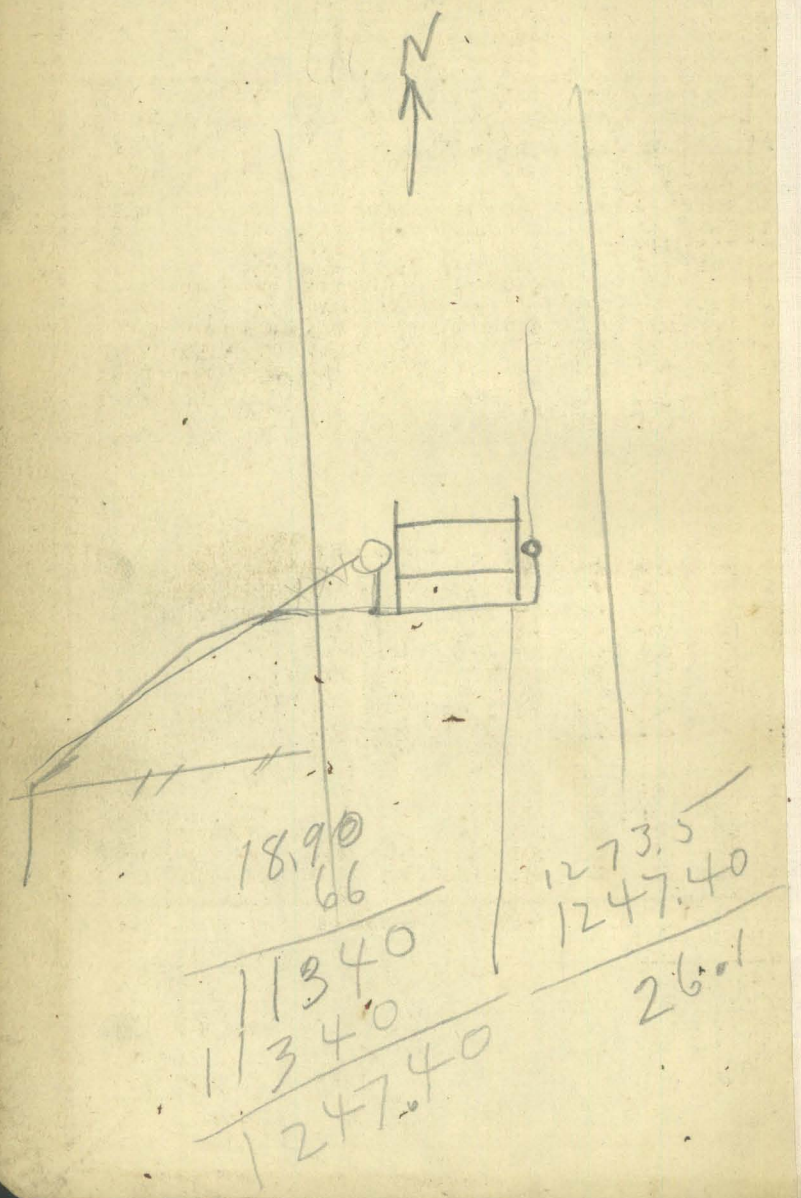
## Natural Cosines

## Natural Tangents

| Deg. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | Deg. | Deg. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | Deg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0000 | 0029 | 0058 | 0087 | 0116 | 0145 | 89 | 40 | 8391 | 8441 | 8491 | 8541 | 8591 | 8642 | 49 |
| 1 | 0175 | 0204 | 0233 | 0262 | 0291 | 0320 | 88 | 41 | 8693 | 8744 | 8796 | 8847 | 8899 | 8952 | 48 |
| 2 | 0349 | 0378 | 0407 | 0437 | 0466 | 0495 | 87 | 42 | 9004 | 9057 | 9110 | 9163 | 9217 | 9271 | 47 |
| 3 | 0524 | 0553 | 0582 | 0612 | 0641 | 0670 | 86 | 43 | 9325 | 9380 | 9435 | 9490 | 9545 | 9601 | 46 |
| 4 | 0699 | 0729 | 0758 | 0787 | 0816 | 0846 | 85 | 44 | 9657 | 9713 | 9770 | 9827 | 9884 | 9942 | 45 |
| 5 | 0875 | 0904 | 0934 | 0963 | 0992 | 1022 | 84 | 45 | 1.0000 | 1.0058 | 1.0117 | 1.0176 | 1.0235 | 1.0295 | 44 |
| 6 | 1051 | 1080 | 1110 | 1139 | 1169 | 1198 | 83 | 46 | 1.0355 | 1.0416 | 1.0477 | 1.0533 | 1.0599 | 1.0661 | 43 |
| 7 | 1228 | 1257 | 1287 | 1317 | 1346 | 1376 | 82 | 47 | 1.0724 | 1.0786 | 1.0850 | 1.0913 | 1.0977 | 1.1041 | 42 |
| 8 | 1405 | 1435 | 1465 | 1495 | 1524 | 1554 | 81 | 48 | 1.1106 | 1.1171 | 1.1237 | 1.1303 | 1.1369 | 1.1436 | 41 |
| 9 | 1584 | 1614 | 1644 | 1673 | 1703 | 1733 | 80 | 49 | 1.1504 | 1.1571 | 1.1640 | 1.1708 | 1.1778 | 1.1847 | 40 |
| 10 | 1763 | 1793 | 1823 | 1853 | 1883 | 1914 | 79 | 50 | 1.1918 | 1.1988 | 1.2059 | 1.2131 | 1.2203 | 1.2276 | 39 |
| 11 | 1944 | 1974 | 2004 | 2035 | 2065 | 2095 | 78 | 51 | 1.2349 | 1.2423 | 1.2497 | 1.2572 | 1.2647 | 1.2723 | 38 |
| 12 | 2126 | 2156 | 2186 | 2217 | 2247 | 2278 | 77 | 52 | 1.2799 | 1.2876 | 1.2954 | 1.3032 | 1.3111 | 1.3190 | 37 |
| 13 | 2309 | 2339 | 2370 | 2401 | 2432 | 2462 | 76 | 53 | 1.3270 | 1.3351 | 1.3452 | 1.3514 | 1.3597 | 1.3680 | 36 |
| 14 | 2493 | 2524 | 2555 | 2586 | 2617 | 2648 | 75 | 54 | 1.3764 | 1.3848 | 1.3934 | 1.4019 | 1.4106 | 1.4193 | 35 |
| 15 | 2679 | 2711 | 2742 | 2773 | 2805 | 2836 | 74 | 55 | 1.4281 | 1.4370 | 1.4460 | 1.4550 | 1.4641 | 1.4733 | 34 |
| 16 | 2867 | 2899 | 2931 | 2962 | 2994 | 3026 | 73 | 56 | 1.4826 | 1.4919 | 1.5013 | 1.5108 | 1.5204 | 1.5301 | 33 |
| 17 | 3057 | 3089 | 3121 | 3153 | 3185 | 3217 | 72 | 57 | 1.5399 | 1.5497 | 1.5597 | 1.5697 | 1.5798 | 1.5900 | 32 |
| 18 | 3249 | 3281 | 3314 | 3346 | 3378 | 3411 | 71 | 58 | 1.6003 | 1.6107 | 1.6212 | 1.6319 | 1.6426 | 1.6534 | 31 |
| 19 | 3443 | 3476 | 3508 | 3541 | 3574 | 3607 | 70 | 59 | 1.6643 | 1.6753 | 1.6864 | 1.6977 | 1.7090 | 1.7205 | 30 |
| 20 | 3640 | 3673 | 3706 | 3739 | 3772 | 3805 | 69 | 60 | 1.7321 | 1.7437 | 1.7556 | 1.7675 | 1.7797 | 1.7917 | 29 |
| 21 | 3839 | 3872 | 3906 | 3939 | 3973 | 4006 | 68 | 61 | 1.8040 | 1.8165 | 1.8291 | 1.8418 | 1.8546 | 1.8676 | 28 |
| 22 | 4040 | 4074 | 4108 | 4142 | 4176 | 4210 | 67 | 62 | 1.8807 | 1.8940 | 1.9074 | 1.9210 | 1.9347 | 1.9486 | 27 |
| 23 | 4245 | 4279 | 4314 | 4348 | 4383 | 4417 | 66 | 63 | 1.9626 | 1.9768 | 1.9912 | 2.0057 | 2.0204 | 2.0353 | 26 |
| 24 | 4452 | 4487 | 4522 | 4557 | 4592 | 4628 | 65 | 64 | 2.0503 | 2.0655 | 2.0809 | 2.0965 | 2.1123 | 2.1283 | 25 |
| 25 | 4663 | 4699 | 4734 | 4770 | 4806 | 4841 | 64 | 65 | 2.1445 | 2.1609 | 2.1775 | 2.1943 | 2.2113 | 2.2286 | 24 |
| 26 | 4877 | 4913 | 4950 | 4986 | 5022 | 5059 | 63 | 66 | 2.2460 | 2.2637 | 2.2817 | 2.2998 | 2.3183 | 2.3369 | 23 |
| 27 | 5095 | 5132 | 5169 | 5206 | 5243 | 5280 | 62 | 67 | 2.3559 | 2.3750 | 2.3945 | 2.4142 | 2.4342 | 2.4545 | 22 |
| 28 | 5317 | 5354 | 5392 | 5430 | 5467 | 5505 | 61 | 68 | 2.4751 | 2.4960 | 2.5172 | 2.5386 | 2.5605 | 2.5826 | 21 |
| 29 | 5543 | 5581 | 5619 | 5658 | 5696 | 5735 | 60 | 69 | 2.6051 | 2.6279 | 2.6511 | 2.6746 | 2.6985 | 2.7228 | 20 |
| 30 | 5774 | 5812 | 5851 | 5890 | 5930 | 5969 | 59 | 70 | 2.7475 | 2.7725 | 2.7980 | 2.8239 | 2.8502 | 2.8770 | 19 |
| 31 | 6009 | 6048 | 6088 | 6128 | 6168 | 6208 | 58 | 71 | 2.9042 | 2.9319 | 2.9600 | 2.9887 | 3.0178 | 3.0475 | 18 |
| 32 | 6249 | 6289 | 6330 | 6371 | 6412 | 6453 | 57 | 72 | 3.0777 | 3.1084 | 3.1397 | 3.1716 | 3.2041 | 3.2371 | 17 |
| 33 | 6494 | 6536 | 6577 | 6619 | 6661 | 6703 | 56 | 73 | 3.2709 | 3.3052 | 3.3402 | 3.3759 | 3.4124 | 3.4495 | 16 |
| 34 | 6745 | 6787 | 6830 | 6873 | 6916 | 6959 | 55 | 74 | 3.4874 | 3.5261 | 3.5656 | 3.6059 | 3.6470 | 3.6891 | 15 |
| 35 | 7002 | 7046 | 7089 | 7133 | 7177 | 7221 | 54 | 75 | 3.7321 | 3.7760 | 3.8208 | 3.8657 | 3.9136 | 3.9617 | 14 |
| 36 | 7265 | 7310 | 7355 | 7400 | 7445 | 7490 | 53 | 76 | 4.0108 | 4.0611 | 4.1126 | 4.1653 | 4.2193 | 4.2747 | 13 |
| 37 | 7536 | 7581 | 7627 | 7673 | 7720 | 7766 | 52 | 77 | 4.3315 | 4.3897 | 4.4494 | 4.5107 | 4.5736 | 4.6382 | 12 |
| 38 | 7813 | 7860 | 7907 | 7954 | 8002 | 8050 | 51 | 78 | 4.7046 | 4.7729 | 4.8430 | 4.9152 | 4.9894 | 5.0658 | 11 |
| 39 | 8098 | 8146 | 8195 | 8243 | 8292 | 8342 | 50 | 79 | 5.1446 | 5.2257 | 5.3093 | 5.3955 | 5.4845 | 5.5764 | 10 |
| Deg. | 60′ | 50′ | 40′ | 30 | 20′ | 10′ | Deg. | Deg. | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | Deg. |

| Deg. | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | Deg. |
|---|---|---|---|---|---|---|---|
| 80 | 5.6713 | 5.7694 | 5.8708 | 5.9758 | 6.0844 | 6.1970 | 9 |
| 81 | 6.3138 | 6.4348 | 6.5606 | 6.6912 | 6.8269 | 6.9682 | 8 |
| 82 | 7.1154 | 7.2687 | 7.4287 | 7.5958 | 7.7704 | 7.9530 | 7 |
| 83 | 8.1443 | 8.3450 | 8.5555 | 8.7769 | 9.0098 | 9.2553 | 6 |
| 84 | 9.5144 | 9.7882 | 10.078 | 10.385 | 10.711 | 11.059 | 5 |
| 85 | 11.430 | 11.826 | 12.250 | 12.706 | 13.197 | 13.727 | 4 |
| 86 | 14.300 | 14.924 | 15.605 | 16.350 | 17.169 | 18.075 | 3 |
| 87 | 19.081 | 20.206 | 21.470 | 22.903 | 24.542 | 26.432 | 2 |
| 88 | 28.636 | 31.242 | 34.368 | 38.189 | 42.964 | 49.104 | 1 |
| 89 | 57.290 | 68.750 | 85.940 | 114.588 | 171.885 | 343.77 | 0 |
| Deg. | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | Deg. |

## Natural Cotangents




## 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.