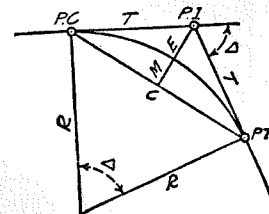


# DIETZGEN'S RAILROAD CURVE AND REDUCTION TABLES

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### CURVE FORMULAS

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

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

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

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

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

### EXPLANATION AND USE OF TABLES

**Stations.**—Given P. I.=Sta. 161+60.35 to find Sta. of P. C. and P. T.  $\Delta=62^\circ 10'$   $D=8^\circ 20'$ . From Table IV for  $1^\circ$  curve  $T=3454.1$  and  $\div 8\frac{1}{3}=414.49$  ft. From Table V correction=.36 or  $T=414.85$  ft. P. C.=Sta. P.I.— $T=157+45.50$ . Also from (4)  $L=746.00$  and P. T.=Sta. P. C. + $L=164+91.50$ .

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

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

**Externals.**—May be found in similar manner to tangents. Thus  $E$  for curve above is 91.37. For from Table IV for  $1^\circ$  curve  $E=960.6$  for  $8^\circ 20'=960.6 \div 8\frac{1}{3}=91.27$  and from Table V correction=.10 or  $E=91.37$  ft. Or suppose  $\Delta=32^\circ$  and  $E$  is measured and found to be 42 ft. What is  $D$ ? From Table IV  $E=230.9$  and  $\div 42=5.5$  or  $D=5^\circ 30'$ .



TABLE I.—MINUTES IN DECIMALS OF A DEGREE.

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

TABLE II.—INCHES IN DECIMALS OF A FOOT.

|       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1-16  | 3-32  | 1/8   | 3-16  | 5-16  | 3/8   | 1/2   | 5/8   | 3/4   | 7/8   |       |
| .0052 | .0078 | .0104 | .0156 | .0208 | .0260 | .0313 | .0417 | .0521 | .0625 | .0729 |
| 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    |
| .0833 | .1667 | .2500 | .3333 | .4167 | .5000 | .5833 | .6667 | .7500 | .8333 | .9167 |

TABLE III.—RADI, ORDINATES AND DEFLECTIONS.

| Deg.   | Radius  | Mid. Ord. | Tan. Offset | Def. for 1 Foot | Deg. | Radius | Mid. Ord. | Tan. Offset | Def. for 1 Foot |
|--------|---------|-----------|-------------|-----------------|------|--------|-----------|-------------|-----------------|
| 0° 10' | 34377.5 | .036      | .145        | 0.05            | 7°   | 819.02 | 1.528     | 6.105       | 2.10            |
| 20     | 17188.8 | .073      | .291        | 0.10            | 20'  | 781.84 | 1.600     | 6.395       | 2.20            |
| 30     | 11459.2 | .109      | .436        | 0.15            | 30   | 764.49 | 1.637     | 6.540       | 2.25            |
| 40     | 8594.42 | .145      | .582        | 0.20            | 40   | 747.89 | 1.673     | 6.685       | 2.30            |
| 50     | 6875.55 | .182      | .727        | 0.25            | 8    | 716.78 | 1.746     | 6.976       | 2.40            |
| 1 10   | 5729.65 | .218      | .873        | 0.30            | 20   | 688.16 | 1.819     | 7.266       | 2.50            |
| 20     | 4911.15 | .255      | 1.018       | 0.35            | 30   | 674.69 | 1.855     | 7.411       | 2.55            |
| 30     | 4297.28 | .291      | 1.164       | 0.40            | 40   | 661.74 | 1.892     | 7.556       | 2.60            |
| 40     | 3819.83 | .327      | 1.309       | 0.45            | 9    | 637.28 | 1.965     | 7.846       | 2.70            |
| 50     | 3437.87 | .364      | 1.454       | 0.50            | 20   | 614.56 | 2.037     | 8.136       | 2.80            |
| 2 10   | 3125.36 | .400      | 1.600       | 0.55            | 30   | 603.80 | 2.074     | 8.281       | 2.85            |
| 20     | 2864.93 | .436      | 1.745       | 0.60            | 40   | 593.42 | 2.110     | 8.426       | 2.90            |
| 30     | 2644.58 | .473      | 1.891       | 0.65            | 10   | 573.69 | 2.183     | 8.716       | 3.00            |
| 40     | 2455.70 | .509      | 2.036       | 0.70            | 20   | 548.44 | 2.292     | 9.150       | 3.15            |
| 50     | 2292.01 | .545      | 2.181       | 0.75            | 30   | 521.67 | 2.402     | 9.585       | 3.30            |
| 3 10   | 2148.79 | .582      | 2.327       | 0.80            | 40   | 499.06 | 2.511     | 10.02       | 3.45            |
| 20     | 2022.41 | .618      | 2.472       | 0.85            | 12   | 478.34 | 2.620     | 10.45       | 3.60            |
| 30     | 1910.08 | .655      | 2.618       | 0.90            | 30   | 459.28 | 2.730     | 10.89       | 3.75            |
| 40     | 1809.57 | .691      | 2.763       | 0.95            | 13   | 441.68 | 2.839     | 11.32       | 3.90            |
| 50     | 1719.12 | .727      | 2.908       | 1.00            | 20   | 425.40 | 2.949     | 11.75       | 4.05            |
| 4 10   | 1637.28 | .764      | 3.054       | 1.05            | 30   | 410.23 | 3.058     | 12.18       | 4.20            |
| 20     | 1562.88 | .800      | 3.199       | 1.10            | 40   | 396.20 | 3.168     | 12.62       | 4.35            |
| 30     | 1494.95 | .836      | 3.345       | 1.15            | 15   | 383.07 | 3.277     | 13.05       | 4.50            |
| 40     | 1432.69 | .873      | 3.490       | 1.20            | 20   | 370.78 | 3.387     | 13.49       | 4.65            |
| 50     | 1375.40 | .909      | 3.635       | 1.25            | 30   | 359.27 | 3.496     | 13.92       | 4.80            |
| 5 10   | 1322.53 | .945      | 3.718       | 1.30            | 40   | 348.45 | 3.606     | 14.35       | 4.95            |
| 20     | 1273.57 | .982      | 3.926       | 1.35            | 17   | 338.27 | 3.716     | 14.78       | 5.10            |
| 30     | 1228.11 | 1.018     | 4.071       | 1.40            | 18   | 319.62 | 3.935     | 15.64       | 5.40            |
| 40     | 1185.78 | 1.055     | 4.217       | 1.45            | 19   | 302.94 | 4.155     | 16.51       | 5.70            |
| 50     | 1146.23 | 1.091     | 4.362       | 1.50            | 20   | 287.94 | 4.374     | 17.37       | 6.00            |
| 6 10   | 1109.33 | 1.127     | 4.507       | 1.55            | 21   | 274.37 | 4.594     | 18.22       | 6.30            |
| 20     | 1074.68 | 1.164     | 4.653       | 1.60            | 22   | 262.04 | 4.814     | 19.08       | 6.60            |
| 30     | 1042.14 | 1.200     | 4.798       | 1.65            | 23   | 250.79 | 5.035     | 19.94       | 6.90            |
| 40     | 1011.51 | 1.237     | 4.943       | 1.70            | 24   | 240.49 | 5.255     | 20.79       | 7.20            |
| 50     | 982.64  | 1.273     | 5.088       | 1.75            | 25   | 231.01 | 5.476     | 21.64       | 7.50            |
| 7 10   | 955.87  | 1.309     | 5.234       | 1.80            | 26   | 222.27 | 5.697     | 22.50       | 7.80            |
| 20     | 929.57  | 1.346     | 5.379       | 1.85            | 27   | 214.18 | 5.918     | 23.35       | 8.10            |
| 30     | 905.13  | 1.382     | 5.524       | 1.90            | 28   | 206.68 | 6.139     | 24.19       | 8.40            |
| 40     | 881.95  | 1.418     | 5.669       | 1.95            | 29   | 199.70 | 6.360     | 25.04       | 8.70            |
| 50     | 859.92  | 1.455     | 5.814       | 2.00            | 30   | 193.18 | 6.583     | 25.88       | 9.00            |

Note. Chord Deflection=2 times tangent deflection.

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

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central Angle | Tangent | External |
|---------------|---------|----------|---------------|---------|----------|---------------|---------|----------|
| 1°            | 50.00   | .22      | 11°           | 551.70  | 26.50    | 21°           | 1061.9  | 97.57    |
| 10'           | 58.34   | .30      | 10'           | 560.11  | 27.31    | 10'           | 1070.6  | 99.16    |
| 20'           | 66.67   | .39      | 20'           | 568.53  | 28.14    | 20'           | 1079.2  | 100.75   |
| 30'           | 75.01   | .49      | 30'           | 576.95  | 28.97    | 30'           | 1087.8  | 102.35   |
| 40'           | 83.34   | .61      | 40'           | 585.36  | 29.82    | 40'           | 1096.4  | 103.97   |
| 50'           | 91.68   | .73      | 50'           | 593.79  | 30.68    | 50'           | 1105.1  | 105.60   |
| 2             | 100.01  | .87      | 12            | 602.21  | 31.56    | 22            | 1113.7  | 107.24   |
| 10            | 108.35  | 1.02     | 10            | 610.64  | 32.45    | 10            | 1122.4  | 108.90   |
| 20            | 116.68  | 1.19     | 20            | 619.07  | 33.35    | 20            | 1131.0  | 110.57   |
| 30            | 125.02  | 1.36     | 30            | 627.50  | 34.26    | 30            | 1139.7  | 112.25   |
| 40            | 133.36  | 1.55     | 40            | 635.93  | 35.18    | 40            | 1148.4  | 113.95   |
| 50            | 141.70  | 1.75     | 50            | 644.37  | 36.12    | 50            | 1157.0  | 115.66   |
| 3             | 150.04  | 1.96     | 13            | 652.81  | 37.07    | 23            | 1165.7  | 117.38   |
| 10            | 158.38  | 2.19     | 10            | 661.25  | 38.03    | 10            | 1174.4  | 119.12   |
| 20            | 166.72  | 2.43     | 20            | 669.70  | 39.01    | 20            | 1183.1  | 120.87   |
| 30            | 175.06  | 2.67     | 30            | 678.15  | 39.99    | 30            | 1191.8  | 122.63   |
| 40            | 183.40  | 2.93     | 40            | 686.60  | 40.99    | 40            | 1200.5  | 124.41   |
| 50            | 191.74  | 3.21     | 50            | 695.06  | 42.00    | 50            | 1209.2  | 126.20   |
| 4             | 200.08  | 3.49     | 14            | 703.51  | 43.03    | 24            | 1217.9  | 128.00   |
| 10            | 208.43  | 3.79     | 10            | 711.97  | 44.07    | 10            | 1226.6  | 129.82   |
| 20            | 216.77  | 4.10     | 20            | 720.44  | 45.12    | 20            | 1235.3  | 131.65   |
| 30            | 225.12  | 4.42     | 30            | 728.90  | 46.18    | 30            | 1244.0  | 133.50   |
| 40            | 233.47  | 4.76     | 40            | 737.37  | 47.25    | 40            | 1252.8  | 135.35   |
| 50            | 241.81  | 5.10     | 50            | 745.85  | 48.34    | 50            | 1261.5  | 137.23   |
| 5             | 250.16  | 5.46     | 15            | 754.32  | 49.44    | 25            | 1270.2  | 139.11   |
| 10            | 258.51  | 5.83     | 10            | 762.80  | 50.55    | 10            | 1279.0  | 141.01   |
| 20            | 266.86  | 6.21     | 20            | 771.29  | 51.68    | 20            | 1287.7  | 142.93   |
| 30            | 275.21  | 6.61     | 30            | 779.77  | 52.89    | 30            | 1296.5  | 144.85   |
| 40            | 283.57  | 7.01     | 40            | 788.26  | 53.97    | 40            | 1305.3  | 146.79   |
| 50            | 291.92  | 7.43     | 50            | 796.75  | 55.13    | 50            | 1314.0  | 148.75   |
| 6             | 300.28  | 7.86     | 16            | 805.25  | 56.31    | 26            | 1322.8  | 150.71   |
| 10            | 308.64  | 8.31     | 10            | 813.75  | 57.50    | 10            | 1331.6  | 152.69   |
| 20            | 316.99  | 8.76     | 20            | 822.25  | 58.70    | 20            | 1340.4  | 154.69   |
| 30            | 325.35  | 9.23     | 30            | 830.76  | 59.91    | 30            | 1349.2  | 156.70   |
| 40            | 333.71  | 9.71     | 40            | 839.27  | 61.14    | 40            | 1358.0  | 158.72   |
| 50            | 342.08  | 10.20    | 50            | 847.78  | 62.38    | 50            | 1366.8  | 160.76   |
| 7             | 350.44  | 10.71    | 17            | 856.30  | 63.63    | 27            | 1375.6  | 162.81   |
| 10            | 358.81  | 11.22    | 10            | 864.82  | 64.90    | 10            | 1384.4  | 164.86   |
| 20            | 367.17  | 11.75    | 20            | 873.35  | 66.18    | 20            | 1393.2  | 166.95   |
| 30            | 375.54  | 12.29    | 30            | 881.88  | 67.47    | 30            | 1402.0  | 169.04   |
| 40            | 383.91  | 12.85    | 40            | 890.41  | 68.77    | 40            | 1410.9  | 171.15   |
| 50            | 392.28  | 13.41    | 50            | 898.95  | 70.09    | 50            | 1419.7  | 173.27   |
| 8             | 400.66  | 13.99    | 18            | 907.49  | 71.42    | 28            | 1428.6  | 175.41   |
| 10            | 409.03  | 14.58    | 10            | 916.03  | 72.76    | 10            | 1437.4  | 177.55   |
| 20            | 417.41  | 15.18    | 20            | 924.58  | 74.12    | 20            | 1446.3  | 179.72   |
| 30            | 425.79  | 15.80    | 30            | 933.13  | 75.49    | 30            | 1455.1  | 181.89   |
| 40            | 434.17  | 16.43    | 40            | 941.69  | 76.86    | 40            | 1464.0  | 184.08   |
| 50            | 442.55  | 17.07    | 50            | 950.25  | 78.26    | 50            | 1472.9  | 186.29   |
| 9             | 450.93  | 17.72    | 19            | 958.81  | 79.67    | 29            | 1481.8  | 188.51   |
| 10            | 459.32  | 18.38    | 10            | 967.38  | 81.09    | 10            | 1490.7  | 190.74   |
| 20            | 467.71  | 19.06    | 20            | 975.96  | 82.53    | 20            | 1499.6  | 192.99   |
| 30            | 476.10  | 19.75    | 30            | 984.53  | 83.97    | 30            | 1508.5  | 195.25   |
| 40            | 484.49  | 20.45    | 40            | 993.12  | 85.43    | 40            | 1517.4  | 197.53   |
| 50            | 492.88  | 21.16    | 50            | 1001.7  | 86.90    | 50            | 1526.3  | 199.82   |
| 10            | 501.28  | 21.89    | 20            | 1010.3  | 88.39    | 30            | 1535.3  | 202.12   |
| 10            | 509.68  | 22.62    | 10            | 1018.9  | 89.89    | 10            | 1544.2  | 204.44   |
| 20            | 518.08  | 23.35    | 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.

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central Angle | Tangent | External |
|---------------|---------|----------|---------------|---------|----------|---------------|---------|----------|
| 31°           | 1580.0  | 216.3    | 41°           | 2142.2  | 387.4    | 51°           | 2732.9  | 618.4    |
| 10'           | 1598.0  | 218.7    | 10'           | 2151.7  | 390.7    | 10'           | 2743.1  | 622.8    |
| 20            | 1606.9  | 221.1    | 20            | 2161.2  | 394.1    | 20            | 2753.4  | 627.2    |
| 30            | 1615.9  | 223.5    | 30            | 2170.8  | 397.4    | 30            | 2763.7  | 631.7    |
| 40            | 1624.9  | 226.0    | 40            | 2180.3  | 400.8    | 40            | 2773.9  | 636.2    |
| 50            | 1633.9  | 228.4    | 50            | 2189.9  | 404.2    | 50            | 2784.2  | 640.7    |
| 32°           | 1643.0  | 230.9    | 42°           | 2199.4  | 407.6    | 52°           | 2794.5  | 645.2    |
| 10            | 1652.0  | 233.4    | 10            | 2209.0  | 411.1    | 10            | 2804.9  | 649.7    |
| 20            | 1661.0  | 235.9    | 20            | 2218.6  | 414.5    | 20            | 2815.2  | 654.3    |
| 30            | 1670.0  | 238.4    | 30            | 2228.1  | 418.0    | 30            | 2825.6  | 658.8    |
| 40            | 1679.1  | 241.0    | 40            | 2237.7  | 421.4    | 40            | 2835.9  | 663.4    |
| 50            | 1688.1  | 243.5    | 50            | 2247.3  | 425.0    | 50            | 2846.3  | 668.0    |
| 33°           | 1697.2  | 246.1    | 43°           | 2257.0  | 428.5    | 53°           | 2856.7  | 672.7    |
| 10            | 1706.3  | 248.7    | 10            | 2266.6  | 432.0    | 10            | 2867.1  | 677.3    |
| 20            | 1715.3  | 251.3    | 20            | 2276.2  | 435.6    | 20            | 2877.5  | 682.0    |
| 30            | 1724.4  | 253.9    | 30            | 2285.9  | 439.2    | 30            | 2888.0  | 686.7    |
| 40            | 1733.5  | 256.5    | 40            | 2295.6  | 442.8    | 40            | 2898.4  | 691.4    |
| 50            | 1742.6  | 259.1    | 50            | 2305.2  | 446.4    | 50            | 2908.9  | 696.1    |
| 34°           | 1751.7  | 261.8    | 44°           | 2314.9  | 450.0    | 54°           | 2919.4  | 700.9    |
| 10            | 1760.8  | 264.5    | 10            | 2324.6  | 453.6    | 10            | 2929.9  | 705.7    |
| 20            | 1770.0  | 267.2    | 20            | 2334.3  | 457.3    | 20            | 2940.4  | 710.5    |
| 30            | 1779.1  | 269.9    | 30            | 2344.1  | 461.0    | 30            | 2951.0  | 715.3    |
| 40            | 1788.2  | 272.6    | 40            | 2353.8  | 464.6    | 40            | 2961.5  | 720.1    |
| 50            | 1797.4  | 275.3    | 50            | 2363.5  | 468.4    | 50            | 2972.1  | 725.0    |
| 35°           | 1806.6  | 278.1    | 45°           | 2373.3  | 472.1    | 55°           | 2982.7  | 729.9    |
| 10            | 1815.7  | 280.8    | 10            | 2383.1  | 475.8    | 10            | 2993.3  | 734.8    |
| 20            | 1824.9  | 283.6    | 20            | 2392.8  | 479.6    | 20            | 3003.9  | 739.7    |
| 30            | 1834.1  | 286.4    | 30            | 2402.6  | 483.3    | 30            | 3014.5  | 744.6    |
| 40            | 1843.3  | 289.2    | 40            | 2412.4  | 487.2    | 40            | 3025.2  | 749.6    |
| 50            | 1852.5  | 292.0    | 50            | 2422.3  | 491.0    | 50            | 3035.8  | 754.6    |
| 36°           | 1861.7  | 294.9    | 46°           | 2432.1  | 494.8    | 56°           | 3046.5  | 759.6    |
| 10            | 1870.9  | 297.7    | 10            | 2441.9  | 498.7    | 10            | 3057.2  | 764.6    |
| 20            | 1880.1  | 300.6    | 20            | 2451.8  | 502.5    | 20            | 3067.9  | 769.7    |
| 30            | 1889.4  | 303.5    | 30            | 2461.7  | 506.4    | 30            | 3078.7  | 774.7    |
| 40            | 1898.6  | 306.4    | 40            | 2471.5  | 510.3    | 40            | 3089.4  | 779.8    |
| 50            | 1907.9  | 309.3    | 50            | 2481.4  | 514.3    | 50            | 3100.2  | 784.9    |
| 37°           | 1917.1  | 312.2    | 47°           | 2491.3  | 518.2    | 57°           | 3110.9  | 790.1    |
| 10            | 1926.4  | 315.2    | 10            | 2501.2  | 522.2    | 10            | 3121.7  | 795.2    |
| 20            | 1935.7  | 318.1    | 20            | 2511.2  | 526.1    | 20            | 3132.6  | 800.4    |
| 30            | 1945.0  | 321.1    | 30            | 2521.1  | 530.1    | 30            | 3143.4  | 805.6    |
| 40            | 1954.3  | 324.1    | 40            | 2531.1  | 534.2    | 40            | 3154.2  | 810.9    |
| 50            | 1963.6  | 327.1    | 50            | 2541.0  | 538.2    | 50            | 3165.1  | 816.1    |
| 38°           | 1972.9  | 330.2    | 48°           | 2551.0  | 542.2    | 58°           | 3176.0  | 821.4    |
| 10            | 1982.2  | 333.2    | 10            | 2561.0  | 546.3    | 10            | 3186.9  | 826.7    |
| 20            | 1991.5  | 336.3    | 20            | 2571.0  | 550.4    | 20            | 3197.8  | 832.0    |
| 30            | 2000.9  | 339.3    | 30            | 2581.0  | 554.5    | 30            | 3208.8  | 837.3    |
| 40            | 2010.2  | 342.4    | 40            | 2591.0  | 558.6    | 40            | 3219.7  | 842.7    |
| 50            | 2019.6  | 345.5    | 50            | 2601.1  | 562.8    | 50            | 3230.7  | 848.1    |
| 39°           | 2029.0  | 348.6    | 49°           | 2611.2  | 566.9    | 59°           | 3241.7  | 853.5    |
| 10            | 2038.4  | 351.8    | 10            | 2621.2  | 571.1    | 10            | 3252.7  | 858.9    |
| 20            | 2047.8  | 354.9    | 20            | 2631.3  | 575.3    | 20            | 3263.7  | 864.3    |
| 30            | 2057.2  | 358.1    | 30            | 2641.4  | 579.5    | 30            | 3274.8  | 869.8    |
| 40            | 2066.6  | 361.3    | 40            | 2651.5  | 583.8    | 40            | 3285.8  | 875.3    |
| 50            | 2076.0  | 364.5    | 50            | 2661.6  | 588.0    | 50            | 3296.9  | 880.8    |
| 40°           | 2085.4  | 367.7    | 50°           | 2671.8  | 592.3    | 60°           | 3308.0  | 886.4    |
| 10            | 2094.9  | 371.0    | 10            | 2681.9  | 596.6    | 10            | 3319.1  | 892.0    |
| 20            | 2104.3  | 374.2    | 20            | 2692.1  | 600.9    | 20            | 3330.3  | 897.5    |
| 30            | 2113.8  | 377.5    | 30            | 2702.3  | 605.3    | 30            | 3341.4  | 903.2    |
| 40            | 2123.3  | 380.8    | 40            | 2712.5  | 609.6    | 40            | 3352.6  | 908.8    |
| 50            | 2132.7  | 384.1    | 50            | 2722.7  | 614.0    | 50            | 3363.8  | 914.5    |

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

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central Angle | Tangent | External |
|---------------|---------|----------|---------------|---------|----------|---------------|---------|----------|
| 61°           | 3375.0  | 920.2    | 71°           | 4086.9  | 1308.2   | 81°           | 4893.6  | 1805.3   |
| 10'           | 3386.3  | 925.9    | 10'           | 4099.5  | 1315.6   | 10'           | 4908.0  | 1814.7   |
| 20            | 3397.5  | 931.6    | 20            | 4112.1  | 1322.9   | 20            | 4922.5  | 1824.1   |
| 30            | 3408.8  | 937.3    | 30            | 4124.8  | 1330.3   | 30            | 4937.0  | 1833.6   |
| 40            | 3420.1  | 943.1    | 40            | 4137.4  | 1337.7   | 40            | 4951.5  | 1843.1   |
| 50            | 3431.4  | 948.9    | 50            | 4150.1  | 1345.1   | 50            | 4966.1  | 1852.6   |
| 62°           | 3442.7  | 954.8    | 72°           | 4162.8  | 1352.6   | 82°           | 4980.7  | 1862.2   |
| 10            | 3454.1  | 960.6    | 10            | 4175.6  | 1360.1   | 10            | 4995.4  | 1871.8   |
| 20            | 3465.4  | 966.5    | 20            | 4188.5  | 1367.6   | 20            | 5010.0  | 1881.5   |
| 30            | 3476.8  | 972.4    | 30            | 4201.2  | 1375.2   | 30            | 5024.8  | 1891.2   |
| 40            | 3488.3  | 978.3    | 40            | 4214.0  | 1382.8   | 40            | 5039.5  | 1900.9   |
| 50            | 3499.7  | 984.3    | 50            | 4226.8  | 1390.4   | 50            | 5054.3  | 1910.7   |
| 63°           | 3511.1  | 990.2    | 73°           | 4239.7  | 1398.0   | 83°           | 5069.2  | 1920.5   |
| 10            | 3522.6  | 996.2    | 10            | 4252.6  | 1405.7   | 10            | 5084.0  | 1930.4   |
| 20            | 3534.1  | 1002.3   | 20            | 4265.6  | 1413.5   | 20            | 5099.0  | 1940.3   |
| 30            | 3545.6  | 1008.3   | 30            | 4278.5  | 1421.2   | 30            | 5113.9  | 1950.3   |
| 40            | 3557.2  | 1014.4   | 40            | 4291.5  | 1429.0   | 40            | 5128.9  | 1960.2   |
| 50            | 3568.7  | 1020.5   | 50            | 4304.6  | 1436.8   | 50            | 5143.9  | 1970.3   |
| 64°           | 3580.3  | 1026.6   | 74°           | 4317.6  | 1444.6   | 84°           | 5159.0  | 1980.4   |
| 10            | 3591.9  | 1032.8   | 10            | 4330.7  | 1452.5   | 10            | 5174.1  | 1990.5   |
| 20            | 3603.5  | 1039.0   | 20            | 4343.8  | 1460.4   | 20            | 5189.3  | 2000.6   |
| 30            | 3615.1  | 1045.2   | 30            | 4356.9  | 1468.4   | 30            | 5204.4  | 2010.8   |
| 40            | 3626.8  | 1051.4   | 40            | 4370.1  | 1476.4   | 40            | 5219.7  | 2021.1   |
| 50            | 3638.5  | 1057.7   | 50            | 4383.3  | 1484.4   | 50            | 5234.9  | 2031.4   |
| 65°           | 3650.2  | 1063.9   | 75°           | 4396.5  | 1492.4   | 85°           | 5250.3  | 2041.7   |
| 10            | 3661.9  | 1070.2   | 10            | 4409.8  | 1500.5   | 10            | 5265.6  | 2052.1   |
| 20            | 3673.7  | 1076.6   | 20            | 4423.1  | 1508.6   | 20            | 5281.0  | 2062.5   |
| 30            | 3685.4  | 1082.9   | 30            | 4436.4  | 1516.7   | 30            | 5296.4  | 2073.0   |
| 40            | 3697.2  | 1089.3   | 40            | 4449.7  | 1524.9   | 40            | 5311.9  | 2083.5   |
| 50            | 3709.0  | 1095.7   | 50            | 4463.1  | 1533.1   | 50            | 5327.4  | 2094.1   |
| 66°           | 3720.9  | 1102.2   | 76°           | 4476.5  | 1541.4   | 86°           | 5343.0  | 2104.7   |
| 10            | 3732.7  | 1108.6   | 10            | 4489.9  | 1549.7   | 10            | 5358.6  | 2115.3   |
| 20            | 3744.6  | 1115.1   | 20            | 4503.4  | 1558.0   | 20            | 5374.2  | 2126.0   |
| 30            | 3756.5  | 1121.7   | 30            | 4516.9  | 1566.3   | 30            | 5389.9  | 2136.7   |
| 40            | 3768.5  | 1128.2   | 40            | 4530.4  | 1574.7   | 40            | 5405.6  | 2147.5   |
| 50            | 3780.4  | 1134.8   | 50            | 4544.0  | 1583.1   | 50            | 5421.4  | 2158.4   |
| 67°           | 3792.4  | 1141.4   | 77°           | 4557.6  | 1591.6   | 87°           | 5437.2  | 2169.2   |
| 10            | 3804.4  | 1148.0   | 10            | 4571.2  | 1600.1   | 10            | 5453.1  | 2180.2   |
| 20            | 3816.4  | 1154.7   | 20            | 4584.8  | 1608.6   | 20            | 5469.0  | 2191.1   |
| 30            | 3828.4  | 1161.3   | 30            | 4598.5  | 1617.1   | 30            | 5484.9  | 2202.2   |
| 40            | 3840.5  | 1168.1   | 40            | 4612.2  | 1625.7   | 40            | 5500.9  | 2213.2   |
| 50            | 3852.6  | 1174.8   | 50            | 4626.0  | 1634.4   | 50            | 5517.0  | 2224.3   |
| 68°           | 3864.7  | 1181.6   | 78°           | 4639.8  | 1643.0   | 88°           | 5533.1  | 2235.5   |
| 10            | 3876.8  | 1188.4   | 10            | 4653.0  | 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            | 4681.8  | 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</ |               |         |          |               |         |          |

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

| Central Angle | Tangent | External | Central Angle | Tangent | External | Central Angle | Tangent | External |
|---------------|---------|----------|---------------|---------|----------|---------------|---------|----------|
| 91°           | 5830.5  | 2444.9   | 101°          | 6950.6  | 3278.1   | 111°          | 8336.7  | 4386.1   |
| 10'           | 5847.5  | 2457.1   | 10'           | 6971.3  | 3294.1   | 10'           | 8362.7  | 4407.6   |
| 20            | 5864.6  | 2469.3   | 20            | 6992.0  | 3310.1   | 20            | 8388.9  | 4429.2   |
| 30            | 5881.7  | 2481.5   | 30            | 7012.7  | 3326.1   | 30            | 8415.1  | 4450.9   |
| 40            | 5898.8  | 2493.8   | 40            | 7033.6  | 3342.3   | 40            | 8441.5  | 4472.7   |
| 50            | 5916.0  | 2506.1   | 50            | 7054.5  | 3358.5   | 50            | 8468.0  | 4494.6   |
| 92°           | 5933.2  | 2518.5   | 102°          | 7075.5  | 3374.9   | 112°          | 8494.6  | 4516.6   |
| 10            | 5950.5  | 2531.0   | 10            | 7096.6  | 3391.2   | 10            | 8521.3  | 4538.8   |
| 20            | 5967.9  | 2543.5   | 20            | 7117.8  | 3407.7   | 20            | 8548.1  | 4561.1   |
| 30            | 5985.3  | 2556.0   | 30            | 7139.0  | 3424.3   | 30            | 8575.0  | 4583.4   |
| 40            | 6002.7  | 2568.6   | 40            | 7160.3  | 3440.9   | 40            | 8602.1  | 4606.0   |
| 50            | 6020.2  | 2581.3   | 50            | 7181.7  | 3457.6   | 50            | 8629.3  | 4628.6   |
| 93°           | 6037.8  | 2594.0   | 103°          | 7203.2  | 3474.4   | 113°          | 8656.6  | 4651.3   |
| 10            | 6055.4  | 2606.8   | 10            | 7224.7  | 3491.3   | 10            | 8684.0  | 4674.2   |
| 20            | 6073.1  | 2619.7   | 20            | 7246.3  | 3508.2   | 20            | 8711.5  | 4697.2   |
| 30            | 6090.8  | 2632.6   | 30            | 7268.0  | 3525.2   | 30            | 8739.2  | 4720.3   |
| 40            | 6108.6  | 2645.5   | 40            | 7289.8  | 3542.4   | 40            | 8767.0  | 4743.6   |
| 50            | 6126.4  | 2658.5   | 50            | 7311.7  | 3559.6   | 50            | 8794.9  | 4766.9   |
| 94°           | 6144.3  | 2671.6   | 104°          | 7333.6  | 3576.8   | 114°          | 8822.9  | 4790.4   |
| 10            | 6162.6  | 2684.7   | 10            | 7355.6  | 3594.2   | 10            | 8851.0  | 4814.1   |
| 20            | 6180.2  | 2697.9   | 20            | 7377.8  | 3611.7   | 20            | 8879.3  | 4837.8   |
| 30            | 6198.3  | 2711.2   | 30            | 7399.9  | 3629.2   | 30            | 8907.7  | 4861.7   |
| 40            | 6216.4  | 2724.5   | 40            | 7422.2  | 3646.8   | 40            | 8936.3  | 4885.7   |
| 50            | 6234.6  | 2737.9   | 50            | 7444.6  | 3664.5   | 50            | 8965.0  | 4909.9   |
| 95°           | 6252.8  | 2751.3   | 105°          | 7467.0  | 3682.3   | 115°          | 8993.8  | 4934.1   |
| 10            | 6271.1  | 2764.8   | 10            | 7489.6  | 3700.2   | 10            | 9022.7  | 4958.6   |
| 20            | 6289.4  | 2778.3   | 20            | 7512.2  | 3718.2   | 20            | 9051.7  | 4983.1   |
| 30            | 6307.9  | 2792.0   | 30            | 7534.9  | 3736.2   | 30            | 9080.9  | 5007.3   |
| 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 TANGENTS AND EXTERNALS.

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

FOR TANGENTS ADD

| Central Angle | DEGREE OF CURVE |      |      |      |      |      |      |      |      |      |      |      |      |      |
|---------------|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|               | 5°              | 10°  | 15°  | 20°  | 25°  | 30°  | 35°  | 40°  | 45°  | 50°  | 55°  | 60°  | 65°  | 70°  |
| 10°           | .03             | .06  | .09  | .13  | .16  | .19  | .22  | .25  | .28  | .31  | .34  | .38  | .42  | .46  |
| 15°           | .04             | .10  | .14  | .19  | .24  | .29  | .34  | .39  | .45  | .51  | .53  | .58  | .63  | .68  |
| 20°           | .06             | .13  | .19  | .26  | .32  | .39  | .45  | .51  | .58  | .65  | .72  | .79  | .84  | .90  |
| 25°           | .08             | .16  | .24  | .33  | .40  | .49  | .58  | .67  | .75  | .83  | .90  | .99  | 1.06 | 1.14 |
| 30°           | .10             | .19  | .29  | .39  | .49  | .59  | .69  | .79  | .89  | .99  | 1.09 | 1.20 | 1.29 | 1.39 |
| 35°           | .11             | .22  | .34  | .47  | .58  | .69  | .79  | .81  | .92  | 1.04 | 1.20 | 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 | 2.87 | 3.16 | 3.44 | 3.72 |
| 75°           | .27             | .56  | .83  | 1.12 | 1.40 | 1.69 | 1.98 | 2.27 | 2.57 | 2.87 | 3.16 | 3.47 | 3.78 | 4.09 |
| 80°           | .30             | .61  | .91  | 1.22 | 1.53 | 1.84 | 2.15 | 2.46 | 2.78 | 3.10 | 3.44 | 3.78 | 4.12 | 4.46 |
| 85°           | .33             | .66  | 1.00 | 1.33 | 1.68 | 2.02 | 2.36 | 2.70 | 3.05 | 3.40 | 3.77 | 4.14 | 4.55 | 4.89 |
| 90°           | .36             | .72  | 1.09 | 1.45 | 1.83 | 2.20 | 2.57 | 2.94 | 3.32 | 3.70 | 4.10 | 4.50 | 4.91 | 5.32 |
| 95°           | .39             | .79  | 1.19 | 1.55 | 2.00 | 2.40 | 2.80 | 3.20 | 3.61 | 4.02 | 4.40 | 4.98 | 5.38 | 5.83 |
| 100°          | .43             | .86  | 1.30 | 1.74 | 2.18 | 2.62 | 3.06 | 3.50 | 3.95 | 4.40 | 4.88 | 5.37 | 5.85 | 6.34 |
| 110°          | .51             | 1.03 | 1.56 | 2.08 | 2.61 | 3.14 | 3.67 | 4.21 | 4.76 | 5.31 | 5.86 | 6.43 | 7.01 | 7.60 |
| 120°          | .62             | 1.25 | 1.93 | 2.52 | 3.16 | 3.81 | 4.45 | 5.11 | 5.77 | 6.44 | 7.12 | 7.80 | 8.50 | 9.22 |

FOR EXTERNALS ADD

| Central Angle | DEGREE OF CURVE |      |      |      |      |      |      |      |      |      |      |      |      |      |
|---------------|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|               | 5°              | 10°  | 15°  | 20°  | 25°  | 30°  | 35°  | 40°  | 45°  | 50°  | 55°  | 60°  | 65°  | 70°  |
| 10°           | .001            | .003 | .004 | .006 | .007 | .008 | .009 | .011 | .012 | .014 | .015 | .017 | .018 | .020 |
| 15°           | .003            | .007 | .010 | .014 | .018 | .023 | .027 | .029 | .032 | .035 | .039 | .043 | .047 | .051 |
| 20°           | .006            | .011 | .017 | .022 | .028 | .034 | .038 | .045 | .051 | .057 | .063 | .070 | .076 | .083 |
| 25°           | .009            | .018 | .027 | .036 | .046 | .056 | .065 | .074 | .083 | .093 | .103 | .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 | .212 | .230 | .247 | .264 |
| 40°           | .023            | .046 | .070 | .093 | .117 | .141 | .172 | .203 | .234 | .265 | .277 | .290 | .315 | .341 |
| 45°           | .030            | .060 | .093 | .119 | .153 | .184 | .216 | .254 | .289 | .325 | .351 | .373 | .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°           | .055            | .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 | .897 | 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 |      |      |      |      |      |      |      |      |      |      |

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

| FOR SUB-CHORDS ADD |     |     |      |      |      |      |      |      |     | Excess of arc per 100 ft. | LONG CHORDS |        |        |        |        |
|--------------------|-----|-----|------|------|------|------|------|------|-----|---------------------------|-------------|--------|--------|--------|--------|
| D                  | 10  | 20  | 30   | 40   | 50   | 60   | 70   | 80   | 90  |                           | D           | 200    | 300    | 400    | 500    |
| 4°                 | .00 | .00 | .01  | .01  | .01  | .01  | .01  | .01  | .00 | .02                       | 1           | 199.99 | 299.97 | 399.92 | 499.85 |
| 6                  | .00 | .01 | .01  | .02  | .02  | .02  | .02  | .01  | .01 | .05                       | 2           | 199.97 | 299.88 | 399.70 | 499.39 |
| 8                  | .01 | .02 | .02  | .03  | .03  | .03  | .03  | .02  | .01 | .08                       | 3           | 199.93 | 299.73 | 399.32 | 498.63 |
| 10                 | .01 | .02 | .03  | .04  | .05  | .05  | .05  | .04  | .02 | .13                       | 4           | 199.88 | 299.51 | 398.78 | 497.57 |
| 12                 | .02 | .04 | .05  | .06  | .07  | .07  | .07  | .05  | .03 | .18                       | 5           | 199.81 | 299.24 | 398.10 | 496.20 |
| 14                 | .02 | .05 | .07  | .08  | .09  | .10  | .09  | .07  | .04 | .25                       | 6           | 199.73 | 298.90 | 397.26 | 494.53 |
| 16                 | .03 | .06 | .09  | .11  | .12  | .12  | .12  | .09  | .05 | .33                       | 7           | 199.63 | 298.51 | 396.28 | 492.57 |
| 18                 | .04 | .08 | .11  | .14  | .15  | .16  | .15  | .12  | .07 | .41                       | 8           | 199.51 | 298.05 | 395.14 | 490.31 |
| 20                 | .05 | .10 | .14  | .17  | .19  | .20  | .18  | .15  | .09 | .51                       | 9           | 199.38 | 297.54 | 393.86 | 487.75 |
| 22                 | .06 | .12 | .17  | .21  | .23  | .24  | .22  | .18  | .10 | .62                       | 10          | 199.24 | 296.96 | 392.42 | 484.90 |
| 24                 | .07 | .14 | .20  | .25  | .28  | .28  | .26  | .21  | .12 | .74                       | 12          | 198.90 | 295.63 | 389.12 | 478.34 |
| 26                 | .09 | .17 | .24  | .29  | .32  | .33  | .31  | .25  | .15 | .86                       | 14          | 198.51 | 294.06 | 385.22 | 470.65 |
| 28                 | .10 | .19 | .27  | .34  | .37  | .38  | .36  | .29  | .17 | 1.00                      | 16          | 198.05 | 292.25 | 380.76 | 461.86 |
| 30                 | .11 | .22 | .31  | .39  | .43  | .44  | .41  | .33  | .19 | 1.15                      | 18          | 197.54 | 290.21 | 375.74 | 452.02 |
| 32                 | .13 | .25 | .36  | .44  | .49  | .50  | .47  | .38  | .22 | 1.31                      | 20          | 196.96 | 287.94 | 370.17 | 441.15 |
| 34                 | .15 | .28 | .40  | .50  | .55  | .57  | .53  | .43  | .25 | 1.48                      | 22          | 196.32 | 285.44 | 364.06 | 429.30 |
| 36                 | .17 | .32 | .45  | .56  | .62  | .64  | .59  | .48  | .28 | 1.66                      | 24          | 195.63 | 282.71 | 357.43 | 416.53 |
| 38                 | .18 | .36 | .51  | .62  | .70  | .71  | .66  | .53  | .31 | 1.85                      | 26          | 194.87 | 279.76 | 350.30 | 402.89 |
| 40                 | .21 | .40 | .56  | .69  | .77  | .79  | .73  | .59  | .35 | 2.06                      | 28          | 194.06 | 276.59 | 342.69 | 388.43 |
| 42                 | .23 | .44 | .62  | .76  | .85  | .87  | .81  | .65  | .38 | 2.28                      | 30          | 193.18 | 273.20 | 334.61 | 373.20 |
| 44                 | .25 | .48 | .68  | .84  | .94  | .96  | .89  | .72  | .42 | 2.50                      | 32          | 192.25 | 269.61 | 326.08 | 357.28 |
| 46                 | .27 | .52 | .75  | .92  | 1.02 | 1.05 | .98  | .78  | .46 | 2.74                      | 34          | 191.26 | 265.81 | 317.12 | 340.73 |
| 48                 | .30 | .57 | .81  | 1.00 | 1.12 | 1.14 | 1.06 | .86  | .50 | 2.99                      | 36          | 190.21 | 261.80 | 307.77 | 323.61 |
| 50                 | .32 | .62 | .89  | 1.09 | 1.21 | 1.24 | 1.15 | .93  | .55 | 3.24                      | 38          | 189.10 | 257.60 | 298.03 | 305.99 |
| 52                 | .35 | .67 | .96  | 1.18 | 1.31 | 1.35 | 1.25 | 1.01 | .59 | 3.52                      | 40          | 187.94 | 253.21 | 287.94 | 287.94 |
| 54                 | .38 | .73 | 1.04 | 1.28 | 1.42 | 1.46 | 1.35 | 1.09 | .64 | 3.80                      | 42          | 186.72 | 248.63 | 277.51 | 269.54 |
| 56                 | .41 | .78 | 1.12 | 1.38 | 1.53 | 1.57 | 1.46 | 1.17 | .69 | 4.09                      | 44          | 185.44 | 243.87 | 266.78 | 250.85 |
| 58                 | .44 | .84 | 1.20 | 1.48 | 1.65 | 1.69 | 1.57 | 1.26 | .74 | 4.40                      | 46          | 184.10 | 239.93 | 255.78 | 231.95 |
| 60                 | .47 | .91 | 1.29 | 1.59 | 1.76 | 1.81 | 1.68 | 1.35 | .80 | 4.72                      | 48          | 182.71 | 235.83 | 244.51 | 212.92 |

NOTE.—When a chord of less than 100 ft. is used the corrections given in the above table should be added to the nominal length of chord to get the length which should be used in order that the 100 ft. points will check with those obtained by using the standard 100 ft. chord. Thus in locating a 14° curve by 25 ft. chords measure 25'00 for each chord. Long chords are useful in passing obstacles.

TABLE VII.—MIDDLE ORDINATES FOR RAILS IN FEET.

| Deg. of Curve | LENGTH OF RAILS |      |      |      |      |      | Deg. of Curve | LENGTH OF RAILS. |      |      |      |      |      |      |      |
|---------------|-----------------|------|------|------|------|------|---------------|------------------|------|------|------|------|------|------|------|
|               | 32              | 30   | 28   | 26   | 24   | 22   |               | 20               | 32   | 30   | 28   | 26   | 24   | 22   | 20   |
| 1°            | .022            | .020 | .016 | .013 | .011 | .009 | .008          | 16°              | .356 | .313 | .273 | .236 | .200 | .170 | .139 |
| 2             | .045            | .038 | .034 | .029 | .025 | .021 | .017          | 17               | .378 | .333 | .290 | .252 | .213 | .180 | .148 |
| 3             | .067            | .058 | .051 | .044 | .037 | .031 | .026          | 18               | .400 | .351 | .306 | .265 | .225 | .190 | .156 |
| 4             | .089            | .079 | .069 | .060 | .050 | .042 | .035          | 19               | .423 | .371 | .324 | .280 | .238 | .201 | .165 |
| 5             | .112            | .099 | .086 | .074 | .063 | .053 | .044          | 20               | .445 | .392 | .341 | .296 | .250 | .212 | .174 |
| 6             | .134            | .117 | .102 | .088 | .076 | .064 | .052          | 21               | .466 | .410 | .357 | .309 | .262 | .222 | .182 |
| 7             | .156            | .137 | .120 | .104 | .088 | .074 | .061          | 22               | .487 | .430 | .375 | .325 | .275 | .233 | .191 |
| 8             | .179            | .158 | .137 | .119 | .100 | .085 | .070          | 23               | .509 | .450 | .390 | .338 | .287 | .243 | .199 |
| 9             | .201            | .175 | .153 | .133 | .112 | .095 | .078          | 24               | .531 | .469 | .408 | .354 | .299 | .253 | .208 |
| 10            | .223            | .196 | .171 | .148 | .125 | .106 | .087          | 25               | .552 | .486 | .424 | .367 | .311 | .263 | .216 |
| 11            | .245            | .216 | .188 | .163 | .139 | .117 | .096          | 26               | .573 | .506 | .441 | .382 | .323 | .274 | .225 |
| 12            | .268            | .236 | .206 | .179 | .151 | .128 | .105          | 27               | .594 | .524 | .457 | .396 | .335 | .284 | .233 |
| 13            | .290            | .254 | .222 | .192 | .163 | .138 | .113          | 28               | .618 | .545 | .475 | .411 | .348 | .294 | .242 |
| 14            | .312            | .275 | .239 | .207 | .175 | .148 | .122          | 29               | .638 | .564 | .491 | .424 | .361 | .303 | .250 |
| 15            | .334            | .295 | .257 | .223 | .188 | .159 | .131          | 30               | .660 | .583 | .508 | .438 | .374 | .313 | .259 |

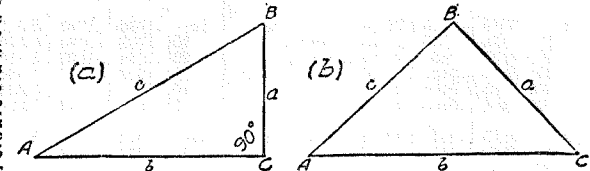
SLOPE REDUCTIONS.

When distances are measured on a slope they may be reduced to the equivalent horizontal distance by the following approximate rule:—subtract from the slope distance the square of the rise divided by twice the slope distance. Thus for a slope distance of 250.3 ft. and a rise of 15 ft. correction=15<sup>2</sup>÷2×250.3=.45 (by slide rule) or horizontal distance=250.3—.45=249.85. When vertical angle=V. A. is measured horizontal distance=slope distance(1—Cos. V. A.). Thus for slope distance of 248.7 ft. and V. A. of 4° 20' from Table VIII Cos=.99714 and correction=1—.99714=.00286 per foot or total of .286×2½ (near enough)=.57 and horizontal distance=248.7—.57=248.13 ft.

See fig. (a).

TRIGONOMETRICAL FORMULAS.

- sin.  $A = \frac{a}{c}$
- cos.  $A = \frac{b}{c}$
- tan.  $A = \frac{a}{b}$
- cot.  $A = \frac{b}{a}$
- sec.  $A = \frac{c}{b}$
- cosec.  $A = \frac{c}{a}$



FORMULA FOR SOLVING TRIANGLES.

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

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

| Angle | Sine. | Tan.  | Cotg. | Cosin. | Angle | Sine. | Tan.  | Cotg.  | Cosin. |
|-------|-------|-------|-------|--------|-------|-------|-------|--------|--------|
| 0     | 0     | 0     | ∞     | 1      | 90    | 1     | ∞     | 0      | 0      |
| 10    | .0029 | .0029 | 343.8 | .99998 | 50    | .7660 | .7660 | 1.284  | .6428  |
| 20    | .0058 | .0058 | 171.9 | .99996 | 40    | .6428 | .6428 | 1.556  | .3572  |
| 30    | .0087 | .0087 | 114.6 | .99993 | 30    | .5196 | .5196 | 1.961  | .1961  |
| 40    | .0116 | .0116 | 85.94 | .99989 | 20    | .3957 | .3957 | 2.552  | .0773  |
| 50    | .0145 | .0145 | 68.75 | .99989 | 10    | .2709 | .2709 | 3.663  | .0087  |
| 1     | .0175 | .0175 | 57.29 | .99985 | 89    | .9823 | .9823 | 15.838 | -.1175 |
| 10    | .0204 | .0204 | 49.10 | .99979 | 50    | .7660 | .7660 | 1.284  | -.6428 |
| 20    | .0233 | .0233 | 42.96 | .99973 | 40    | .6428 | .6428 | 1.556  | -.3572 |
| 30    | .0262 | .0262 | 38.19 | .99966 | 30    | .5196 | .5196 | 1.961  | -.1961 |
| 40    | .0291 | .0291 | 34.37 | .99958 | 20    | .3957 | .3957 | 2.552  | -.0773 |
| 50    | .0320 | .0320 | 31.24 | .99949 | 10    | .2709 | .2709 | 3.663  | -.0087 |
| 2     | .0349 | .0349 | 28.64 | .99939 | 88    | .9823 | .9823 | 15.838 | -.1175 |
| 10    | .0378 | .0378 | 26.43 | .99929 | 50    | .7660 | .7660 | 1.284  | -.6428 |
| 20    | .0407 | .0407 | 24.54 | .99917 | 40    | .6428 | .6428 | 1.556  | -.3572 |
| 30    | .0436 | .0437 | 22.90 | .99905 | 30    | .5196 | .5196 | 1.961  | -.1961 |
| 40    | .0465 | .0466 | 21.47 | .99892 | 20    | .3957 | .3957 | 2.552  | -.0773 |
| 50    | .0494 | .0495 | 20.21 | .99878 | 10    | .2709 | .2709 | 3.663  | -.0087 |
| 3     | .0523 | .0524 | 19.08 | .99863 | 87    | .9823 | .9823 | 15.838 | -.1175 |
| 10    | .0552 | .0553 | 18.07 | .99847 | 50    | .7660 | .7660 | 1.284  | -.6428 |
| 20    | .0581 | .0582 | 17.17 | .99831 | 40    | .6428 | .6428 | 1.556  | -.3572 |
| 30    | .0610 | .0612 | 16.35 | .99813 | 30    | .5196 | .5196 | 1.961  | -.1961 |
| 40    | .0640 | .0641 | 15.60 | .99795 | 20    | .3957 | .3957 | 2.552  | -.0773 |
| 50    | .0669 | .0670 | 14.92 | .99776 | 10    | .2709 | .2709 | 3.663  | -.0087 |
| 4     | .0698 | .0699 | 14.30 | .99756 | 86    | .9823 | .9823 | 15.838 | -.1175 |
| 10    | .0727 | .0729 | 13.73 | .99736 | 50    | .7660 | .7660 | 1.284  | -.6428 |
| 20    | .0756 | .0758 | 13.20 | .99714 | 40    | .6428 | .6428 | 1.556  | -.3572 |
| 30    | .0785 | .0787 | 12.71 | .99692 | 30    | .5196 | .5196 | 1.961  | -.1961 |
| 40    | .0814 | .0816 | 12.25 | .99668 | 20    | .3957 | .3957 | 2.552  | -.0773 |
| 50    | .0843 | .0846 | 11.83 | .99644 | 10    | .2709 | .2709 | 3.663  | -.0087 |
| 5     | .0872 | .0875 | 11.43 | .99619 | 85    | .9823 | .9823 | 15.838 | -.1175 |
| 10    | .0901 | .0904 | 11.06 | .99594 | 50    | .7660 | .7660 | 1.284  | -.6428 |
| 20    | .0929 | .0934 | 10.71 | .99567 | 40    | .6428 | .6428 | 1.556  | -.3572 |
| 30    | .0958 | .0963 | 10.39 | .99540 | 30    | .5196 | .5196 | 1.961  | -.1961 |
| 40    | .0987 | .0992 | 10.08 | .99511 | 20    | .3957 | .3957 | 2.552  | -.0773 |
| 50    | .1016 | .1022 | 9.788 | .99482 | 10    | .2709 | .2709 | 3.663  | -.0087 |
| 6     | .1045 | .1051 | 9.514 | .99452 | 84    | .9823 | .9823 | 15.838 | -.1175 |
| 10    | .1074 | .1080 | 9.255 | .99421 | 50    | .7660 | .7660 | 1.284  | -.6428 |
| 20    | .1103 | .1110 | 9.010 | .99390 | 40    | .6428 | .6428 | 1.556  | -.3572 |
| 30    | .1132 | .1139 | 8.777 | .99357 | 30    | .5196 | .5196 | 1.961  | -.1961 |
| 40    | .1161 | .1169 | 8.556 | .99324 | 20    | .3957 | .3957 | 2.552  | -.0773 |
| 50    | .1190 | .1198 | 8.345 | .99290 | 10    | .2709 | .2709 | 3.663  | -.0087 |
| 7     | .1219 | .1228 | 8.144 | .99255 | 83    | .9823 | .9823 | 15.838 | -.1175 |
| 10    | .1248 | .1257 | 7.953 | .99219 | 50    | .7660 | .7660 | 1.284  | -.6428 |
| 20    | .1276 | .1287 | 7.770 | .99182 | 40    | .6428 | .6428 | 1.556  | -.3572 |
| 30    | .1305 | .1317 | 7.596 | .99144 | 30    | .5196 | .5196 | 1.961  | -.1961 |
| 40    | .1334 | .1346 | 7.429 | .99106 | 20    | .3957 | .3957 | 2.552  | -.0773 |
| 50    | .1363 | .1376 | 7.269 | .99067 | 10    | .2709 | .2709 | 3.663  | -.0087 |

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

| Angle | Sine. | Tan.  | Cotg. | Cosin. | Angle | Sine. | Tan.  | Cotg. | Cosin. |
|-------|-------|-------|-------|--------|-------|-------|-------|-------|--------|
| 16    | .2756 | .2867 | 3.487 | .96126 | 74    | .4697 | .4452 | 2.246 | .91355 |
| 10    | .2784 | .2899 | 3.450 | .96046 | 50    | .4094 | .4487 | 2.229 | .91236 |
| 20    | .2812 | .2931 | 3.412 | .95964 | 40    | .4120 | .4522 | 2.211 | .91116 |
| 30    | .2840 | .2962 | 3.376 | .95882 | 30    | .4147 | .4557 | 2.194 | .90996 |
| 40    | .2868 | .2994 | 3.340 | .95799 | 20    | .4173 | .4592 | 2.177 | .90875 |
| 50    | .2896 | .3026 | 3.305 | .95715 | 10    | .4200 | .4628 | 2.161 | .90753 |
| 17    | .2924 | .3057 | 3.271 | .95615 | 73    | .4226 | .4663 | 2.145 | .90631 |
| 10    | .2952 | .3089 | 3.237 | .95545 | 50    | .4253 | .4699 | 2.128 | .90507 |
| 20    | .2979 | .3121 | 3.204 | .95459 | 40    | .4279 | .4734 | 2.112 | .90383 |
| 30    | .3007 | .3153 | 3.172 | .95372 | 30    | .4305 | .4770 | 2.097 | .90259 |
| 40    | .3035 | .3185 | 3.140 | .95284 | 20    | .4331 | .4806 | 2.081 | .90133 |
| 50    | .3062 | .3217 | 3.108 | .95195 | 10    | .4358 | .4841 | 2.066 | .90007 |
| 18    | .3090 | .3249 | 3.078 | .95106 | 72    | .4384 | .4877 | 2.050 | .89879 |
| 10    | .3118 | .3281 | 3.048 | .95015 | 50    | .4410 | .4913 | 2.035 | .89752 |
| 20    | .3145 | .3314 | 3.018 | .94924 | 40    | .4436 | .4950 | 2.020 | .89623 |
| 30    | .3173 | .3346 | 2.989 | .94832 | 30    | .4462 | .4986 | 2.006 | .89493 |
| 40    | .3201 | .3378 | 2.960 | .94740 | 20    | .4488 | .5022 | 1.991 | .89363 |
| 50    | .3228 | .3411 | 2.932 | .94646 | 10    | .4514 | .5059 | 1.977 | .89232 |
| 19    | .3256 | .3443 | 2.904 | .94552 | 71    | .4540 | .5095 | 1.963 | .89101 |
| 10    | .3283 | .3476 | 2.877 | .94457 | 50    | .4566 | .5132 | 1.949 | .88968 |
| 20    | .3311 | .3508 | 2.850 | .94361 | 40    | .4592 | .5169 | 1.935 | .88835 |
| 30    | .3338 | .3541 | 2.824 | .94264 | 30    | .4617 | .5206 | 1.921 | .88701 |
| 40    | .3365 | .3574 | 2.798 | .94167 | 20    | .4643 | .5243 | 1.907 | .88566 |
| 50    | .3393 | .3607 | 2.773 | .94068 | 10    | .4669 | .5280 | 1.894 | .88431 |
| 20    | .3420 | .3640 | 2.747 | .93969 | 70    | .4695 | .5317 | 1.881 | .88295 |
| 10    | .3448 | .3673 | 2.723 | .93869 | 50    | .4720 | .5354 | 1.868 | .88158 |
| 20    | .3475 | .3706 | 2.699 | .93769 | 40    | .4746 | .5392 | 1.855 | .88020 |
| 30    | .3502 | .3739 | 2.675 | .93667 | 30    | .4772 | .5430 | 1.842 | .87882 |
| 40    | .3529 | .3772 | 2.651 | .93565 | 20    | .4797 | .5467 | 1.829 | .87743 |
| 50    | .3557 | .3805 | 2.628 | .93462 | 10    | .4823 | .5505 | 1.816 | .87603 |
| 21    | .3584 | .3839 | 2.605 | .93358 | 69    | .4848 | .5543 | 1.804 | .87462 |
| 10    | .3611 | .3872 | 2.583 | .93253 | 50    | .4874 | .5581 | 1.792 | .87321 |
| 20    | .3638 | .3906 | 2.560 | .93148 | 40    | .4899 | .5619 | 1.780 | .87178 |
| 30    | .3665 | .3939 | 2.539 | .93042 | 30    | .4924 | .5658 | 1.767 | .87036 |
| 40    | .3692 | .3973 | 2.519 | .92935 | 20    | .4950 | .5696 | 1.756 | .86892 |
| 50    | .3719 | .4006 | 2.496 | .92827 | 10    | .4975 | .5735 | 1.744 | .86748 |
| 22    | .3746 | .4040 | 2.475 | .92718 | 68    | .4900 | .5774 | 1.732 | .86603 |
| 10    | .3773 | .4074 | 2.455 | .92609 | 50    | .5025 | .5812 | 1.720 | .86457 |
| 20    | .3800 | .4108 | 2.434 | .92499 | 40    | .5050 | .5851 | 1.709 | .86310 |
| 30    | .3827 | .4142 | 2.414 | .92388 | 30    | .5075 | .5890 | 1.698 | .86163 |
| 40    | .3854 | .4176 | 2.394 | .92276 | 20    | .5100 | .5930 | 1.686 | .86015 |
| 50    | .3881 | .4210 | 2.375 | .92164 | 10    | .5125 | .5969 | 1.675 | .85866 |
| 23    | .3907 | .4245 | 2.356 | .92050 | 67    | .5150 | .6009 | 1.664 | .85719 |
| 10    | .3934 | .4279 | 2.337 | .91936 | 50    | .5175 | .6048 | 1.653 | .85577 |
| 20    | .3961 | .4314 | 2.318 | .91822 | 40    | .5200 | .6088 | 1.643 | .85416 |
| 30    | .3987 | .4348 | 2.300 | .91706 | 30    | .5225 | .6128 | 1.632 | .85264 |
| 40    | .4014 | .4383 | 2.282 | .91590 | 20    | .5250 | .6168 | 1.621 | .85112 |
| 50    | .4041 | .4417 | 2.264 | .91472 | 10    | .5275 | .6208 | 1.611 | .84959 |

TABLE VIII.—NATURAL TRIGONOMETRICAL FUNCTIONS.

| Angle | Sine.  | Tan.  | Cotg. | Cosin. |        | Angle | Sine.  | Tan.  | Cotg. | Cosin. |        |
|-------|--------|-------|-------|--------|--------|-------|--------|-------|-------|--------|--------|
| °     |        |       |       |        |        | °     |        |       |       |        |        |
| 32    | .5299  | .6249 | 1.600 | .84805 | 58     | 30    | .6225  | .7954 | 1.257 | .78261 |        |
| 10    | .5324  | .6289 | 1.590 | .84650 | 50     | 40    | .6248  | .8002 | 1.250 | .78079 |        |
| 20    | .5348  | .6330 | 1.580 | .84495 | 40     | 50    | .6271  | .8050 | 1.242 | .77897 |        |
| 30    | .5373  | .6371 | 1.570 | .84339 | 30     | 39    | .6293  | .8098 | 1.235 | .77715 |        |
| 40    | .5398  | .6412 | 1.560 | .84182 | 20     | 10    | .6316  | .8146 | 1.228 | .77531 |        |
| 50    | .5422  | .6453 | 1.550 | .84025 | 10     | 20    | .6338  | .8195 | 1.220 | .77347 |        |
| 33    | .5446  | .6494 | 1.540 | .83867 | 57     | 30    | .6361  | .8243 | 1.213 | .77162 |        |
| 10    | .5471  | .6536 | 1.530 | .83708 | 50     | 40    | .6383  | .8292 | 1.206 | .76977 |        |
| 20    | .5495  | .6577 | 1.520 | .83549 | 40     | 50    | .6406  | .8342 | 1.199 | .76791 |        |
| 30    | .5519  | .6619 | 1.511 | .83389 | 30     | 40    | .6428  | .8391 | 1.192 | .76604 |        |
| 40    | .5544  | .6661 | 1.501 | .83228 | 20     | 10    | .6450  | .8441 | 1.185 | .76417 |        |
| 50    | .5568  | .6703 | 1.492 | .83066 | 10     | 20    | .6472  | .8491 | 1.178 | .76229 |        |
| 34    | .5592  | .6745 | 1.483 | .82904 | 56     | 30    | .6494  | .8541 | 1.171 | .76041 |        |
| 10    | .5616  | .6787 | 1.473 | .82741 | 50     | 40    | .6517  | .8591 | 1.164 | .75851 |        |
| 20    | .5640  | .6830 | 1.464 | .82577 | 40     | 50    | .6539  | .8642 | 1.157 | .75661 |        |
| 30    | .5664  | .6873 | 1.455 | .82413 | 30     | 41    | .6561  | .8693 | 1.150 | .75471 |        |
| 40    | .5688  | .6916 | 1.446 | .82248 | 20     | 10    | .6583  | .8744 | 1.144 | .75280 |        |
| 50    | .5712  | .6959 | 1.437 | .82082 | 10     | 20    | .6604  | .8796 | 1.137 | .75088 |        |
| 35    | .5736  | .7002 | 1.428 | .81915 | 55     | 30    | .6626  | .8847 | 1.130 | .74896 |        |
| 10    | .5760  | .7046 | 1.419 | .81748 | 50     | 40    | .6648  | .8899 | 1.124 | .74703 |        |
| 20    | .5783  | .7089 | 1.411 | .81580 | 40     | 50    | .6670  | .8952 | 1.117 | .74509 |        |
| 30    | .5807  | .7133 | 1.402 | .81412 | 30     | 42    | .6691  | .9004 | 1.111 | .74314 |        |
| 40    | .5831  | .7177 | 1.393 | .81242 | 20     | 10    | .6713  | .9057 | 1.104 | .74120 |        |
| 50    | .5854  | .7221 | 1.385 | .81072 | 10     | 20    | .6734  | .9110 | 1.098 | .73924 |        |
| 36    | .5878  | .7265 | 1.376 | .80902 | 54     | 30    | .6756  | .9163 | 1.091 | .73728 |        |
| 10    | .5901  | .7310 | 1.368 | .80730 | 50     | 40    | .6777  | .9217 | 1.085 | .73531 |        |
| 20    | .5925  | .7355 | 1.360 | .80558 | 40     | 50    | .6799  | .9271 | 1.079 | .73333 |        |
| 30    | .5948  | .7400 | 1.351 | .80386 | 30     | 43    | .6820  | .9325 | 1.072 | .73135 |        |
| 40    | .5972  | .7445 | 1.343 | .80212 | 20     | 10    | .6841  | .9380 | 1.066 | .72937 |        |
| 50    | .5995  | .7490 | 1.335 | .80038 | 10     | 20    | .6862  | .9435 | 1.060 | .72737 |        |
| 37    | .6018  | .7536 | 1.327 | .79864 | 53     | 30    | .6884  | .9490 | 1.054 | .72537 |        |
| 10    | .6041  | .7581 | 1.319 | .79688 | 50     | 40    | .6905  | .9545 | 1.048 | .72337 |        |
| 20    | .6065  | .7627 | 1.311 | .79512 | 40     | 50    | .6926  | .9601 | 1.042 | .72136 |        |
| 30    | .6088  | .7673 | 1.303 | .79335 | 30     | 44    | .6947  | .9657 | 1.036 | .71934 |        |
| 40    | .6111  | .7720 | 1.295 | .79158 | 20     | 10    | .6967  | .9713 | 1.030 | .71732 |        |
| 50    | .6134  | .7766 | 1.288 | .78980 | 10     | 20    | .6988  | .9770 | 1.024 | .71529 |        |
| 38    | .6157  | .7813 | 1.280 | .78801 | 52     | 30    | .7009  | .9827 | 1.018 | .71325 |        |
| 10    | .6180  | .7860 | 1.272 | .78622 | 50     | 40    | .7030  | .9884 | 1.012 | .71121 |        |
| 20    | .6202  | .7907 | 1.265 | .78442 | 40     | 50    | .7050  | .9942 | 1.006 | .70916 |        |
|       |        |       |       |        |        |       | .7071  | 1.    | 1.    | .70711 |        |
|       | Cosin. | Cotg. | Tan.  | Sine.  | Angle. |       | Cosin. | Cotg. | Tan.  | Sine.  | Angle. |

TABLE IX.—CALCULATION OF EARTHWORK.

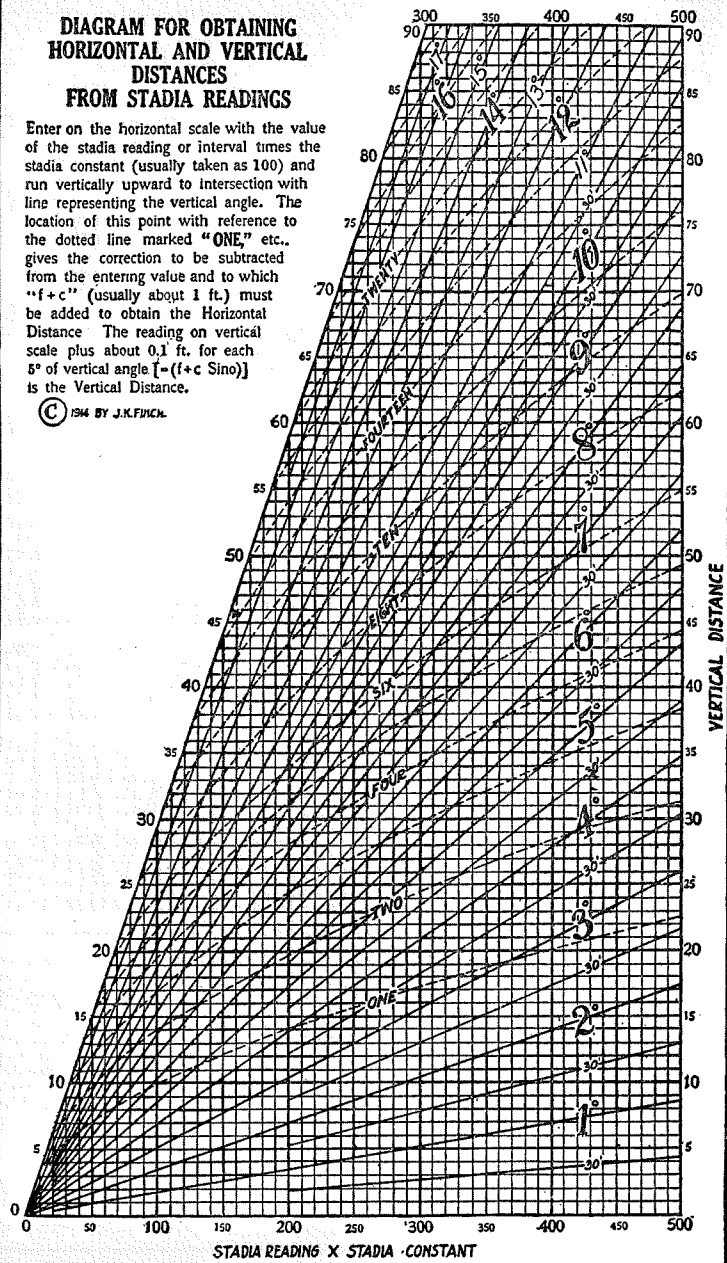
| Width | HEIGHT |      |      |      |      |      |      |      |      |      |      |      |      |       |       |
|-------|--------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|
|       | 1      | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14    | 15    |
| 4     | .02    | .04  | .06  | .07  | .09  | .11  | .13  | .15  | .17  | .18  | .20  | .22  | .24  | .26   | .28   |
| 5     | .04    | .07  | .11  | .15  | .18  | .22  | .26  | .30  | .33  | .37  | .41  | .44  | .48  | .52   | .56   |
| 6     | .06    | .11  | .17  | .22  | .28  | .33  | .39  | .44  | .50  | .56  | .61  | .67  | .72  | .78   | .83   |
| 7     | .07    | .15  | .22  | .30  | .37  | .44  | .52  | .59  | .67  | .74  | .81  | .89  | .96  | 1.04  | 1.11  |
| 8     | .09    | .19  | .28  | .37  | .46  | .56  | .65  | .74  | .83  | .93  | 1.02 | 1.11 | 1.20 | 1.30  | 1.39  |
| 9     | .11    | .22  | .33  | .44  | .56  | .67  | .78  | .89  | 1.00 | 1.11 | 1.22 | 1.33 | 1.44 | 1.55  | 1.67  |
| 10    | .13    | .26  | .39  | .52  | .65  | .78  | .91  | 1.04 | 1.16 | 1.30 | 1.42 | 1.55 | 1.68 | 1.81  | 1.94  |
| 11    | .15    | .30  | .44  | .59  | .74  | .89  | 1.04 | 1.19 | 1.33 | 1.48 | 1.63 | 1.78 | 1.92 | 2.08  | 2.22  |
| 12    | .17    | .33  | .50  | .67  | .83  | 1.00 | 1.17 | 1.33 | 1.50 | 1.67 | 1.83 | 2.00 | 2.17 | 2.33  | 2.50  |
| 13    | .18    | .37  | .56  | .74  | .93  | 1.11 | 1.30 | 1.48 | 1.67 | 1.85 | 2.04 | 2.22 | 2.41 | 2.59  | 2.78  |
| 14    | .20    | .41  | .61  | .82  | 1.02 | 1.22 | 1.43 | 1.63 | 1.83 | 2.04 | 2.24 | 2.44 | 2.65 | 2.85  | 3.06  |
| 15    | .22    | .44  | .67  | .91  | 1.11 | 1.33 | 1.56 | 1.78 | 2.00 | 2.22 | 2.44 | 2.67 | 2.89 | 3.11  | 3.33  |
| 16    | .24    | .48  | .72  | .96  | 1.20 | 1.44 | 1.68 | 1.92 | 2.16 | 2.41 | 2.65 | 2.89 | 3.13 | 3.37  | 3.61  |
| 17    | .26    | .52  | .78  | 1.04 | 1.30 | 1.55 | 1.81 | 2.08 | 2.33 | 2.59 | 2.85 | 3.11 | 3.37 | 3.63  | 3.89  |
| 18    | .28    | .56  | .83  | 1.11 | 1.39 | 1.67 | 1.94 | 2.22 | 2.50 | 2.78 | 3.06 | 3.33 | 3.61 | 3.89  | 4.17  |
| 19    | .30    | .59  | .89  | 1.18 | 1.48 | 1.78 | 2.07 | 2.37 | 2.67 | 2.96 | 3.26 | 3.56 | 3.85 | 4.15  | 4.44  |
| 20    | .31    | .63  | .94  | 1.26 | 1.57 | 1.89 | 2.20 | 2.52 | 2.83 | 3.15 | 3.46 | 3.78 | 4.09 | 4.41  | 4.72  |
| 21    | .33    | .67  | 1.00 | 1.33 | 1.67 | 2.00 | 2.33 | 2.67 | 3.00 | 3.33 | 3.67 | 4.00 | 4.33 | 4.67  | 5.00  |
| 22    | .35    | .70  | 1.06 | 1.41 | 1.76 | 2.11 | 2.46 | 2.82 | 3.17 | 3.52 | 3.87 | 4.22 | 4.57 | 4.92  | 5.28  |
| 23    | .37    | .74  | 1.11 | 1.48 | 1.85 | 2.22 | 2.59 | 2.96 | 3.33 | 3.70 | 4.07 | 4.44 | 4.81 | 5.18  | 5.56  |
| 24    | .39    | .78  | 1.17 | 1.55 | 1.94 | 2.33 | 2.72 | 3.11 | 3.50 | 3.89 | 4.28 | 4.67 | 5.06 | 5.44  | 5.83  |
| 25    | .41    | .81  | 1.22 | 1.63 | 2.04 | 2.44 | 2.85 | 3.26 | 3.67 | 4.07 | 4.48 | 4.89 | 5.30 | 5.70  | 6.11  |
| 26    | .43    | .85  | 1.28 | 1.70 | 2.13 | 2.56 | 2.98 | 3.41 | 3.83 | 4.26 | 4.68 | 5.11 | 5.54 | 5.96  | 6.39  |
| 27    | .44    | .89  | 1.33 | 1.78 | 2.22 | 2.67 | 3.11 | 3.56 | 4.00 | 4.44 | 4.89 | 5.33 | 5.78 | 6.22  | 6.67  |
| 28    | .46    | .92  | 1.39 | 1.85 | 2.31 | 2.78 | 3.24 | 3.70 | 4.17 | 4.63 | 5.09 | 5.56 | 6.02 | 6.48  | 6.94  |
| 29    | .48    | .96  | 1.44 | 1.92 | 2.41 | 2.89 | 3.37 | 3.85 | 4.33 | 4.82 | 5.30 | 5.78 | 6.26 | 6.74  | 7.24  |
| 30    | .50    | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 | 6.00 | 6.50 | 7.00  | 7.50  |
| 31    | .52    | 1.04 | 1.55 | 2.07 | 2.59 | 3.11 | 3.63 | 4.15 | 4.67 | 5.18 | 5.70 | 6.22 | 6.74 | 7.26  | 7.78  |
| 32    | .54    | 1.07 | 1.61 | 2.15 | 2.68 | 3.22 | 3.76 | 4.30 | 4.83 | 5.37 | 5.91 | 6.44 | 6.98 | 7.52  | 8.06  |
| 33    | .56    | 1.11 | 1.67 | 2.22 | 2.78 | 3.33 | 3.89 | 4.44 | 5.00 | 5.55 | 6.11 | 6.67 | 7.22 | 7.78  | 8.33  |
| 34    | .57    | 1.15 | 1.72 | 2.30 | 2.87 | 3.44 | 4.02 | 4.59 | 5.17 | 5.74 | 6.32 | 6.89 | 7.46 | 8.04  | 8.61  |
| 35    | .59    | 1.18 | 1.78 | 2.37 | 2.96 | 3.56 | 4.15 | 4.74 | 5.33 | 5.92 | 6.52 | 7.11 | 7.70 | 8.30  | 8.89  |
| 36    | .61    | 1.22 | 1.83 | 2.44 | 3.05 | 3.67 | 4.28 | 4.89 | 5.50 | 6.11 | 6.72 | 7.33 | 7.94 | 8.55  | 9.17  |
| 37    | .63    | 1.26 | 1.89 | 2.52 | 3.15 | 3.78 | 4.40 | 5.04 | 5.67 | 6.29 | 6.93 | 7.56 | 8.18 | 8.81  | 9.44  |
| 38    | .65    | 1.30 | 1.94 | 2.59 | 3.24 | 3.89 | 4.53 | 5.18 | 5.83 | 6.48 | 7.13 | 7.78 | 8.42 | 9.08  | 9.72  |
| 39    | .67    | 1.33 | 2.00 | 2.67 | 3.33 | 4.00 | 4.66 | 5.33 | 6.00 | 6.67 | 7.33 | 8.00 | 8.67 | 9.33  | 10.00 |
| 40    | .68    | 1.37 | 2.06 | 2.74 | 3.42 | 4.11 | 4.79 | 5.48 | 6.17 | 6.85 | 7.54 | 8.22 | 8.91 | 9.59  | 10.28 |
| 41    | .70    | 1.41 | 2.11 | 2.82 | 3.52 | 4.22 | 4.92 | 5.63 | 6.33 | 7.03 | 7.74 | 8.44 | 9.15 | 9.85  | 10.56 |
| 42    | .72    | 1.44 | 2.17 | 2.89 | 3.61 | 4.33 | 5.05 | 5.78 | 6.50 | 7.22 | 7.95 | 8.67 | 9.39 | 10.11 | 10.83 |
| 43    | .74    | 1.48 | 2.22 | 2.96 | 3.70 | 4.44 | 5.18 | 5.92 | 6.67 | 7.41 | 8.15 | 8.89 | 9.63 | 10.37 | 11.11 |

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

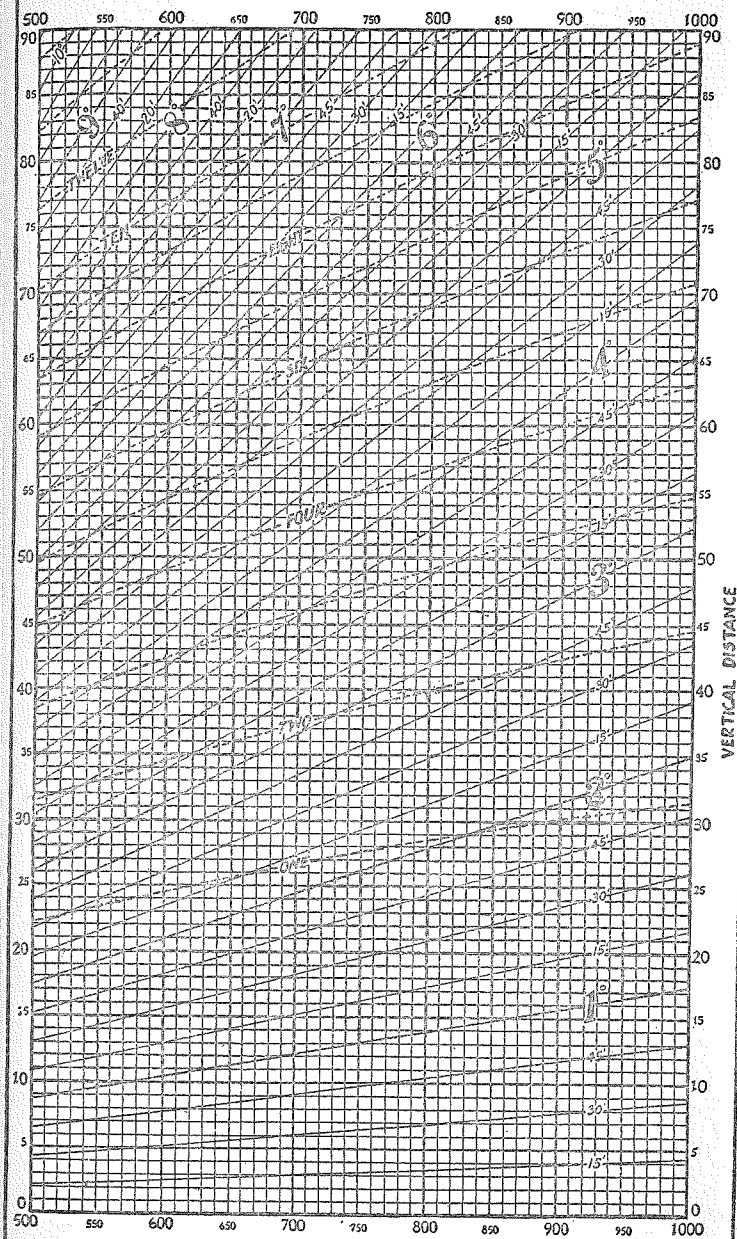
**DIAGRAM FOR OBTAINING  
HORIZONTAL AND VERTICAL  
DISTANCES  
FROM STADIA READINGS**

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

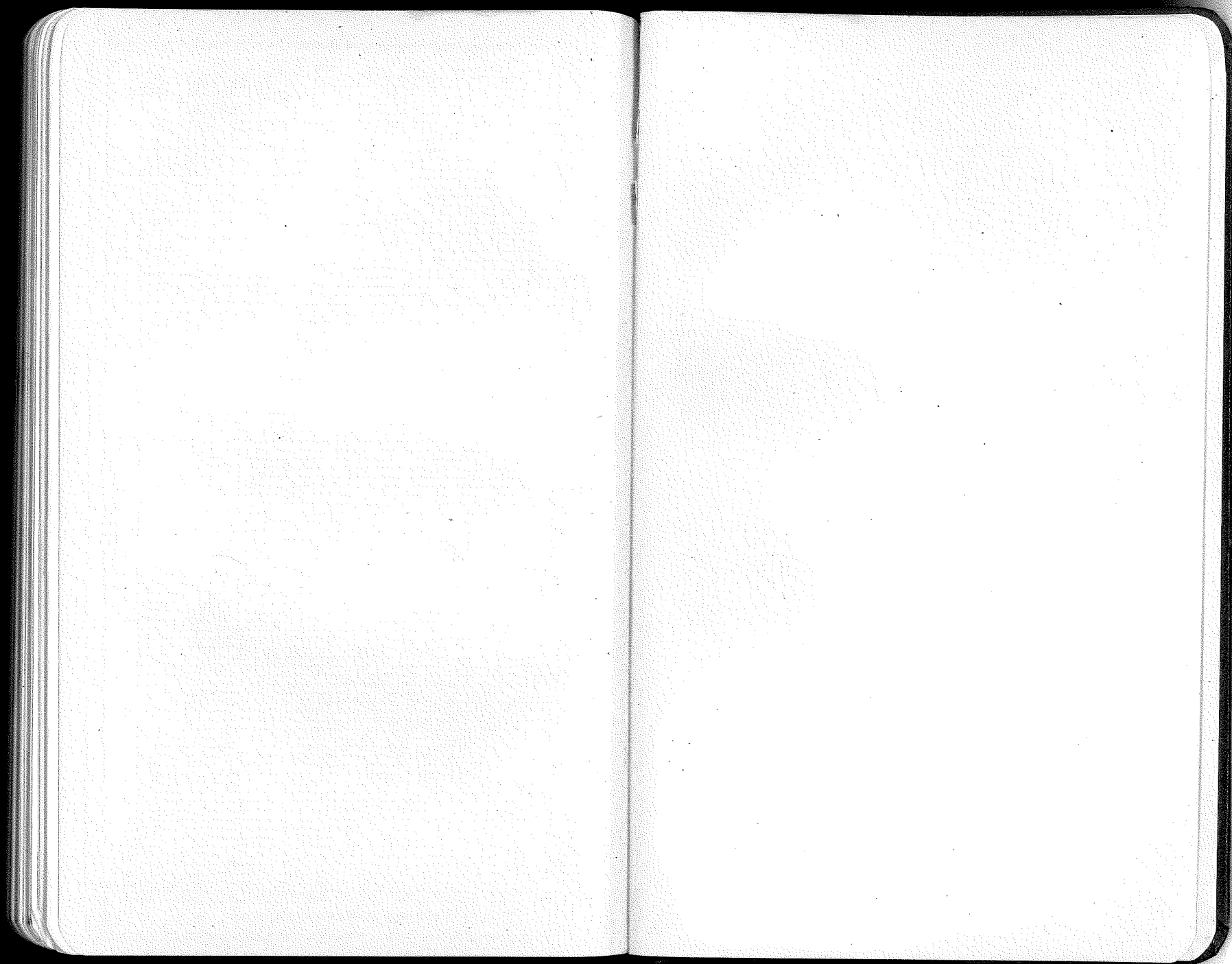
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STADIA READING X STADIA CONSTANT



STADIA READING X STADIA CONSTANT





DISTANCES FROM CENTER OF ROADWAY FOR  
CROSS-SECTIONING.

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

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

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

Sectional Subdivision  
S 35 T. 134-28

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