

BOOK 3

1954-55

K&E

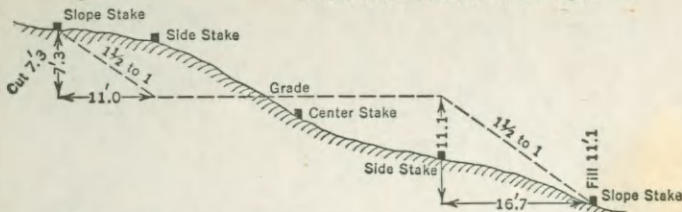
FIELD BOOK

361A



DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING **Roadway of any Width. Side Slopes $1\frac{1}{2}$ to 1.**

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



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

The paper in this book No. F361A
 is made of 50% high grade rag stock
 with a WATER RESISTING surface sizing.

11,377-2. y, x, yk. khss.

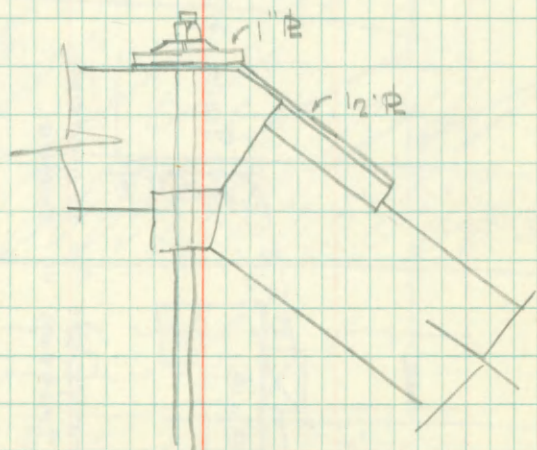
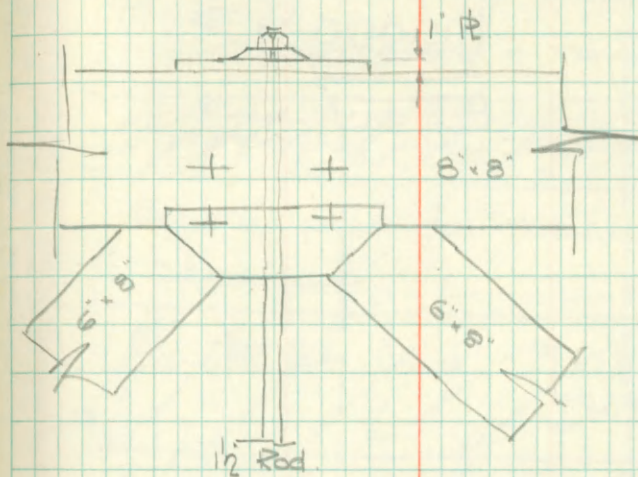
Work Book

Nov 1954 -

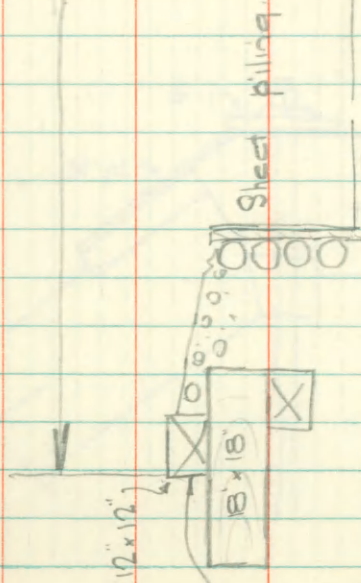
<u>PAGE</u>	<u>DREDGE</u>	
P. 1-4	N.F.	N.F. Bridge.
5	Dr 6.	Saveall Alter.
6	Dr 6	Table spray piping
9	Dr 11	L.H. Winch guard screen
10	Dr 12	Dist. Clean up box
11		6" piping - Jig Supply -
12-13	Dr 6	Table spray piping.
14-15	Dr 9	D. Hopper Wrg #.
17	Dr 12	Dist. Clean up Box + Sluice.
19	Dr 12	Screen p correction
20	Dr 12	Saveall piping.
21	Dr 12	Ladder Roller.
23	Dr 12	Table clean up box piping
24-25	Dr 12	G.S. Table screening.
26	Dr 12	Dist. clean up box piping
27.	Dr 12	Jig conc. laund. piping
28	Dr 12.	L.T. Bearings
29-30	Dr 12	Ladder roller bearings + bushings.

South Fork Ditch Bridge

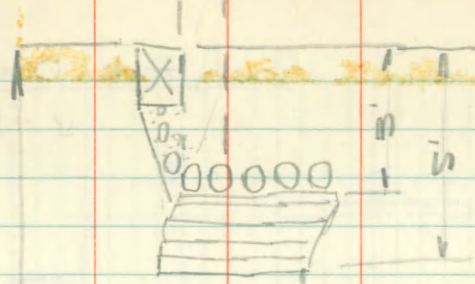
Dec '54



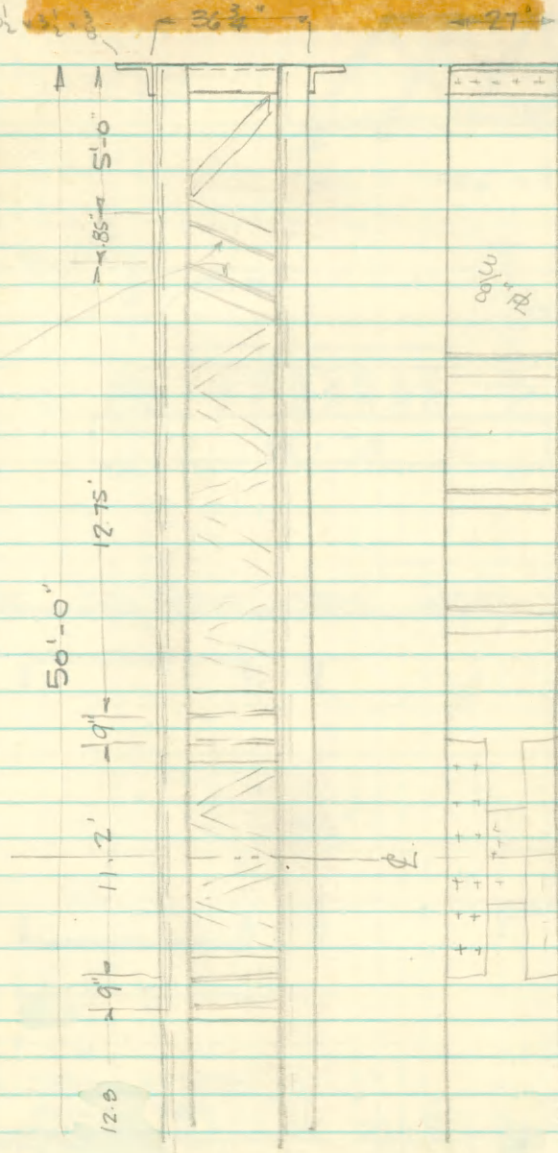
56'-0"



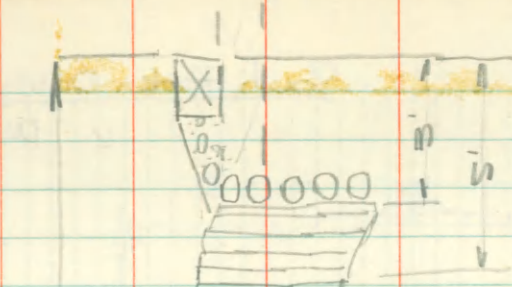
Corresponds to x. member
of trusses in bridge.



50'-0"

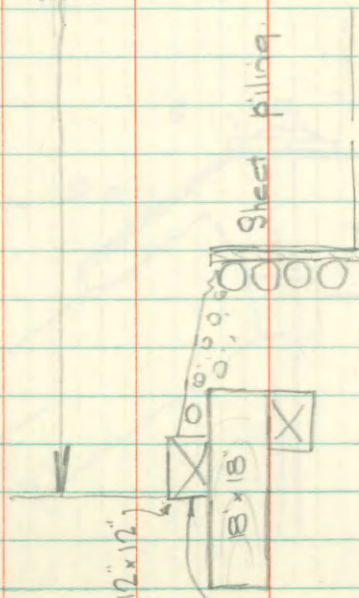


36'-0"

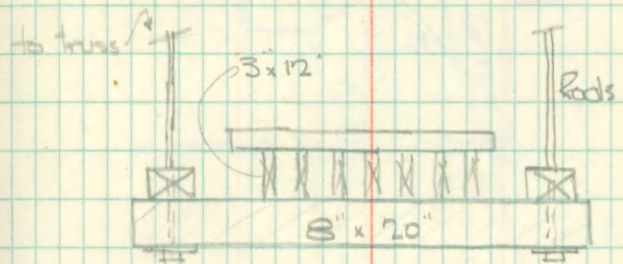
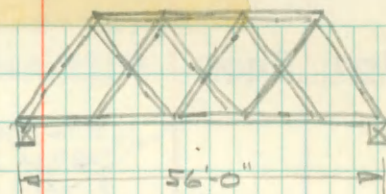
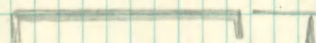


56'-0"

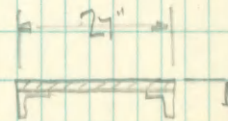
Sheet piling



Corresponds to x member of trusses in bridge.

CROSS SECTIONS NEW STEEL BEAMS25³/₈"

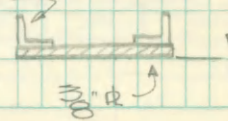
9"



21"

FOR MORE DETAILS
OF BEAMS SEE
PAGE 131-8 OF
FIELD BOOK No. 2

3/2 x 3/2 x 3/8" L



3/8" L

36³/₄"

DREDGE 12.

Ladder Rollers - redesign ?

~~Screener for table~~

Spray pipe for table
cleanup.

Prints for Bud. 9218

7269

~~Ship latches to after
portion on roller
table under portion~~

No ~~on~~ bail
under the ~~roller~~

6-5" Set screw 2" long.

Cleanup water piping
detailed.

Hydraulics. Hampton

Deflectors. 534.1
Sketches.

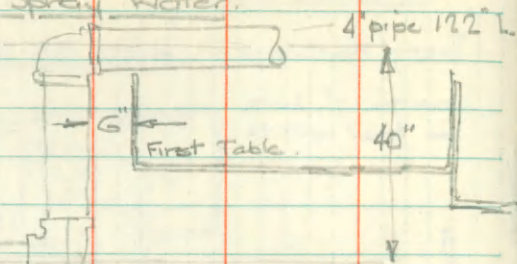
Dr 12 L.T. bearing sketched

Dr 12 - 4 - 16' - 2x4" -
for running -

Dr 12
hips - bolts check

82"

DREDGE 6. Table Spray Water.



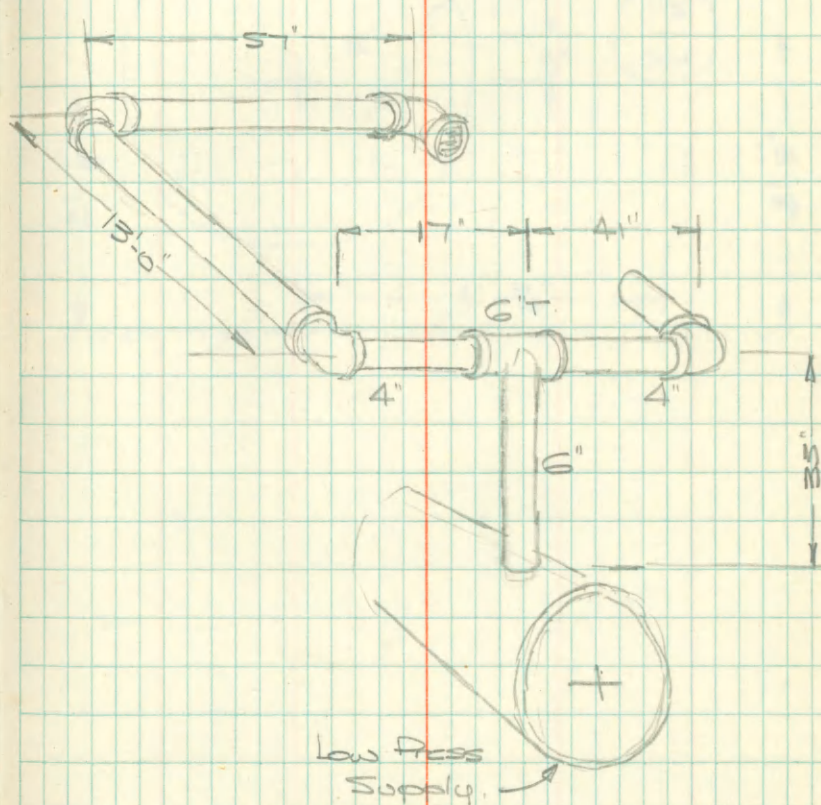
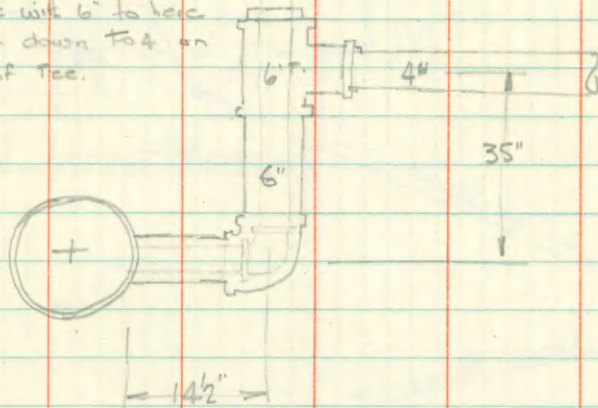
6" φ pipe

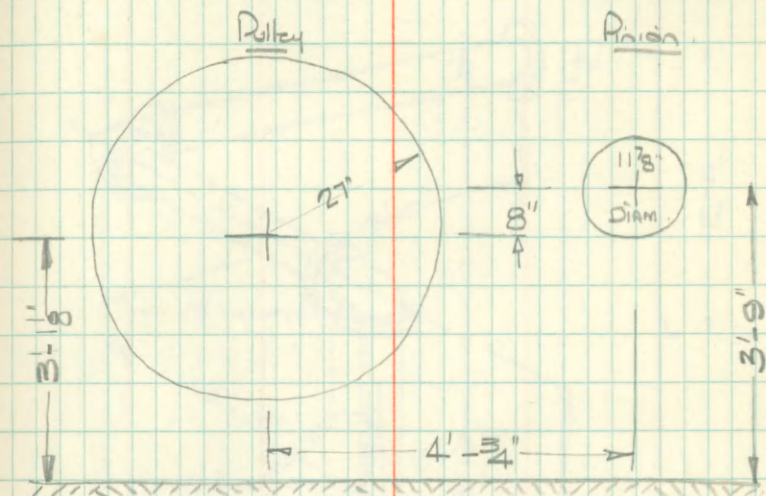
Main L.P. supply 21"

Reet Side

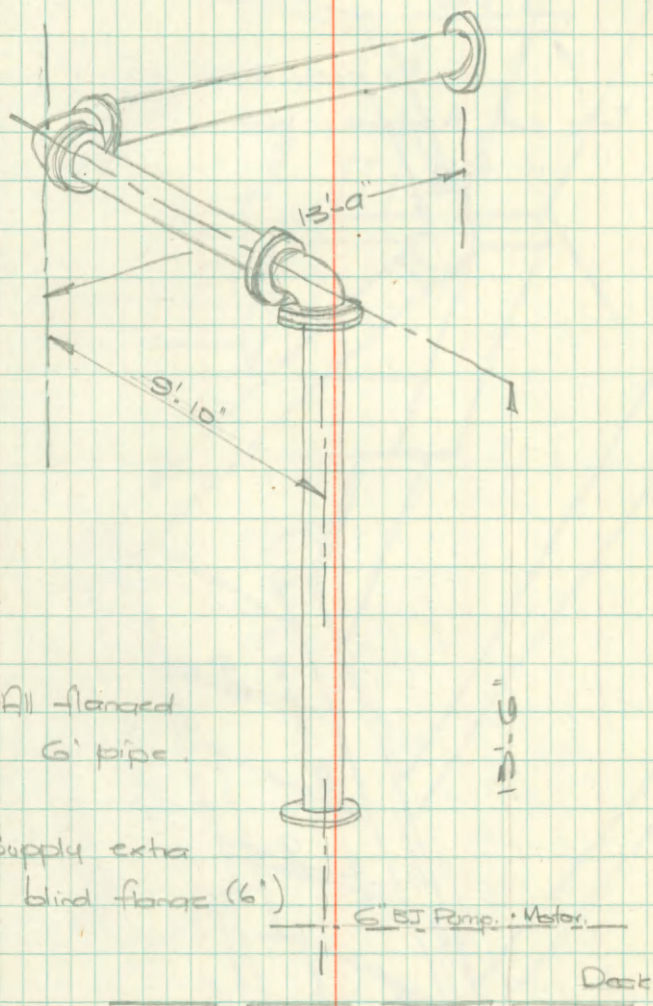
Present pipe

Replace with 6" to here
+ bush down to 4" on
ends of Tee.



GUARD SCREEN FOR L.H. WINCH

Hand-drawn floor plan of a rectangular room. The dimensions are labeled as 12'-0" (width) and 12'-0" (depth). A door is shown on the right wall, with a swing dimension of 4". The plan is drawn on graph paper.



These Measurements for 6" pipe — 1 Deck
to be installed over the 10" pipe.

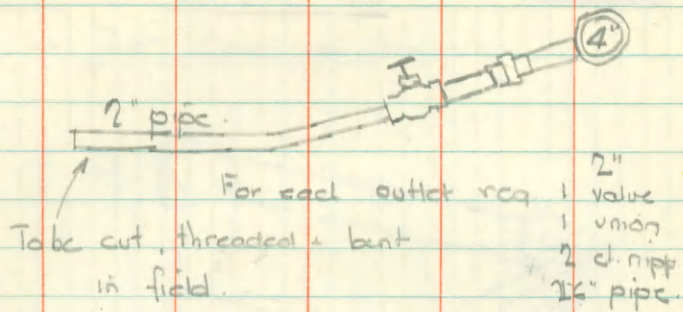
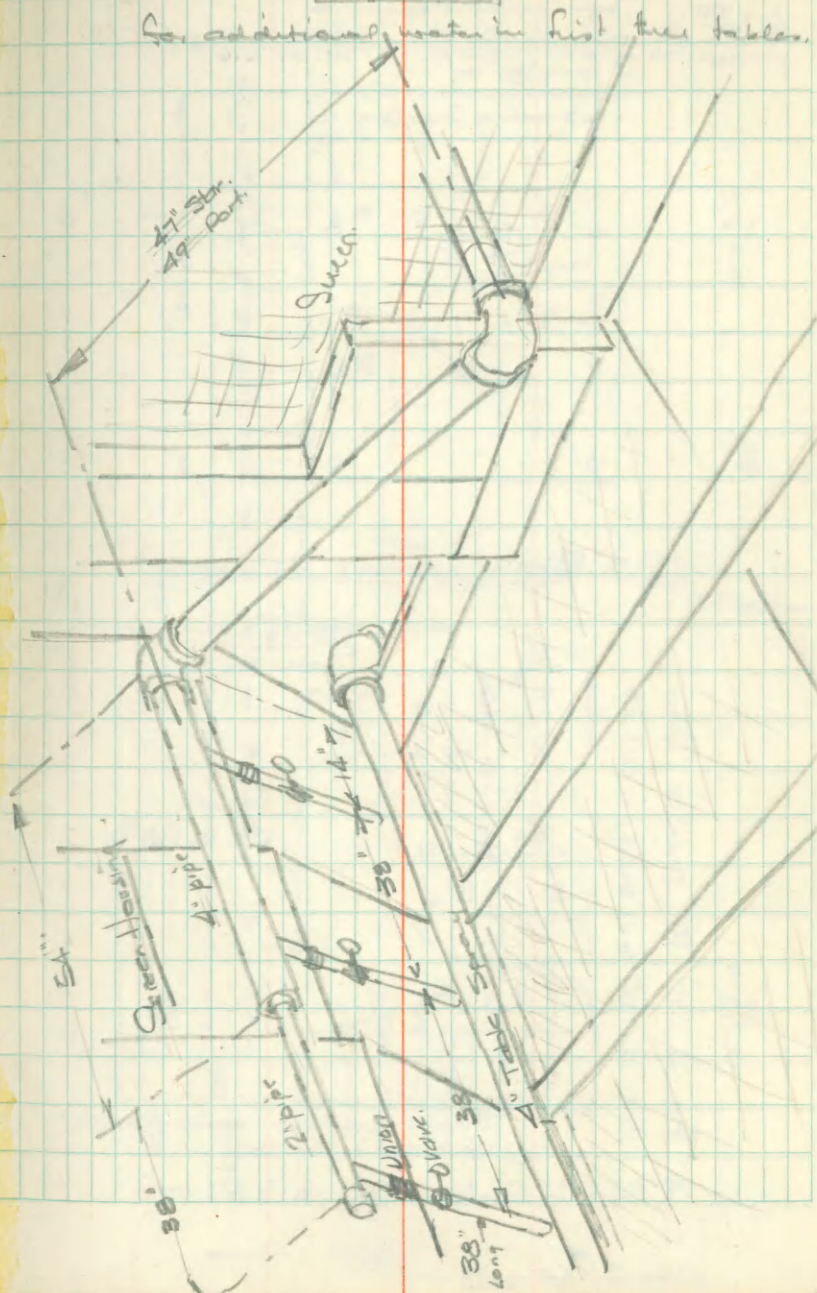
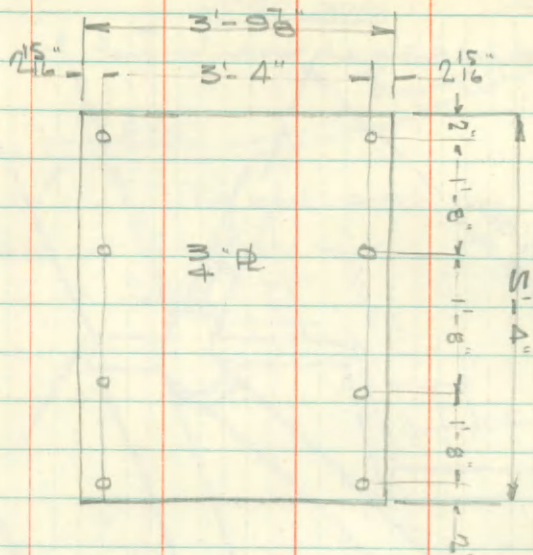


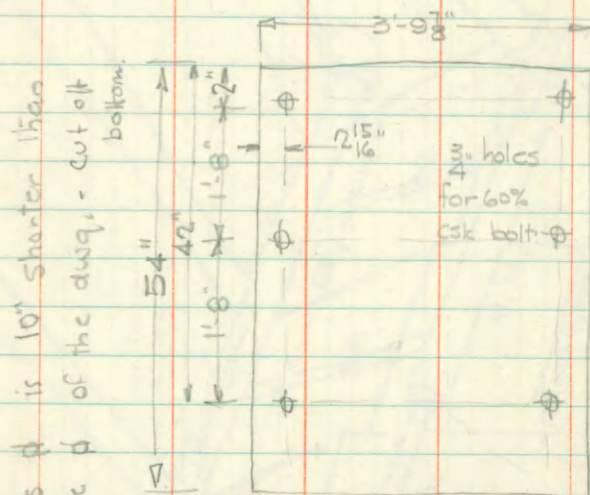
Table Spray

So additional water in list, free tables.





De 9 Hopper Wearing P. back p.



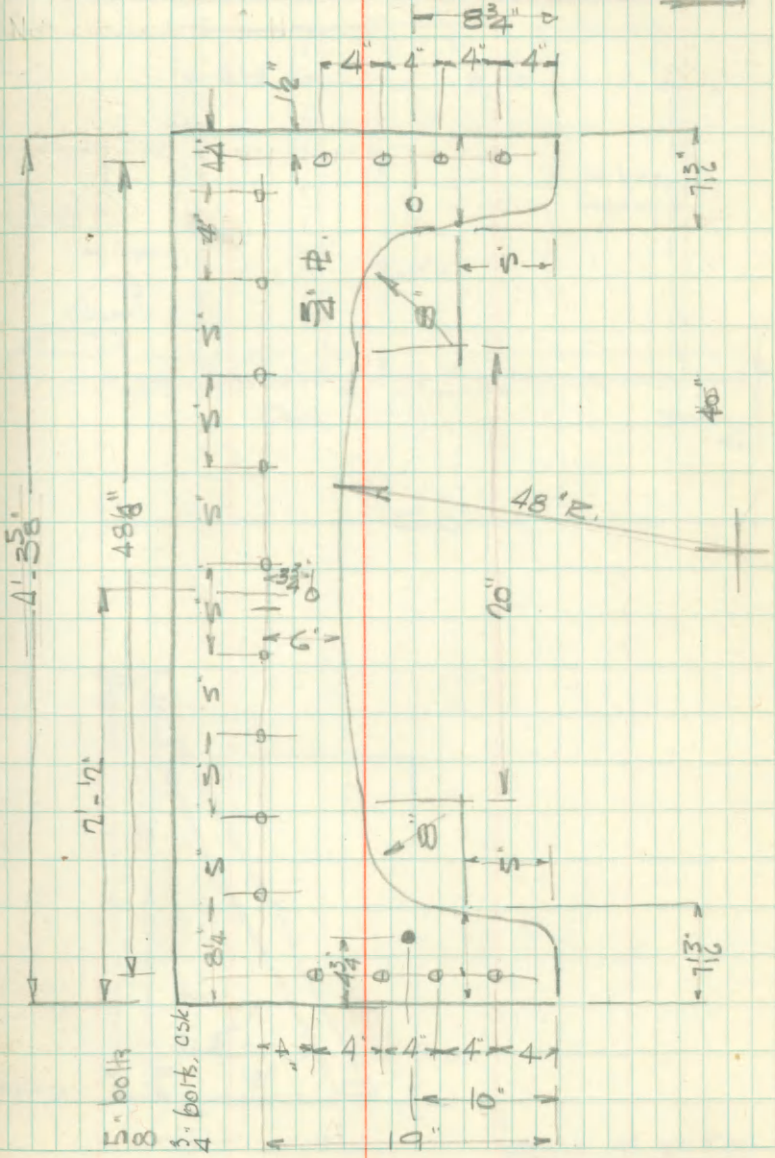
This P is 10" shorter than the P of the dwg. - cut off bottom.

These measurements made in field - correct

No 5467 DWG. Ad. 5.5.55.

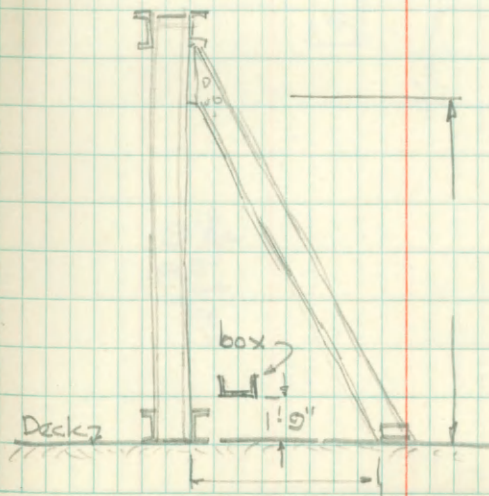
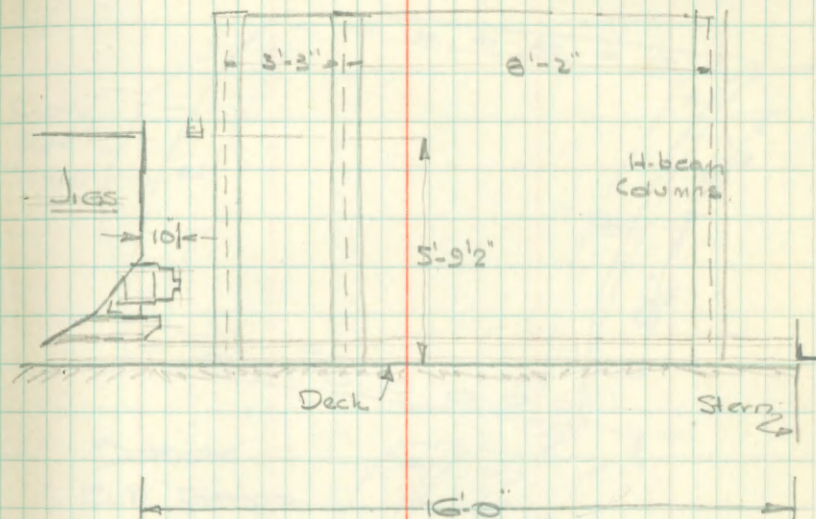
DREDGE No 9.

DUMP HOPPER WEARING P. - 1W" P.

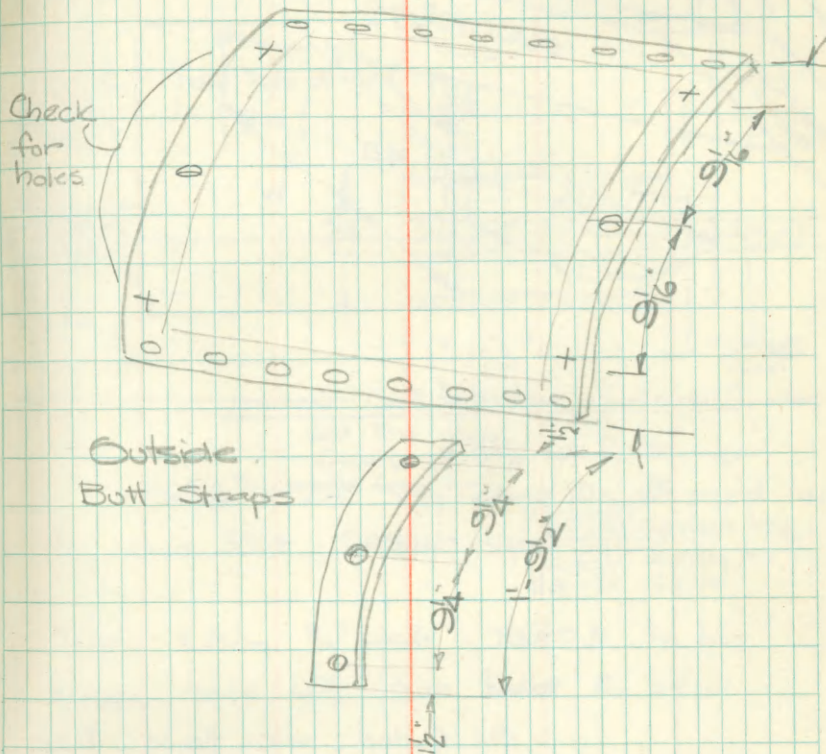


26" Make this tentative.

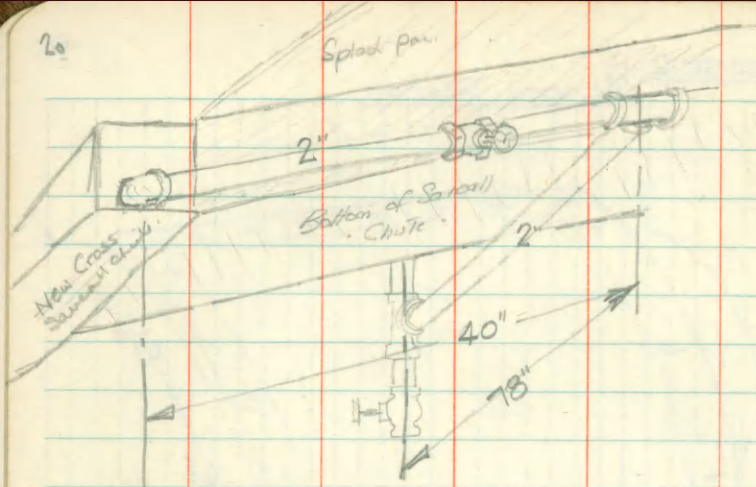
DISTRIBUTOR CLEAN UP BOX + SLUICE.



Looking at Main
Superstructure Bracing
Port Side



16
 0 64
 08 57
 57
 28
 64



DE 12

ADDITIONAL WATER FOR SAVEALL

All 2 inch piping

Req. 2 lengths pipe 78" + 40" -

1 nipple close

1 ell

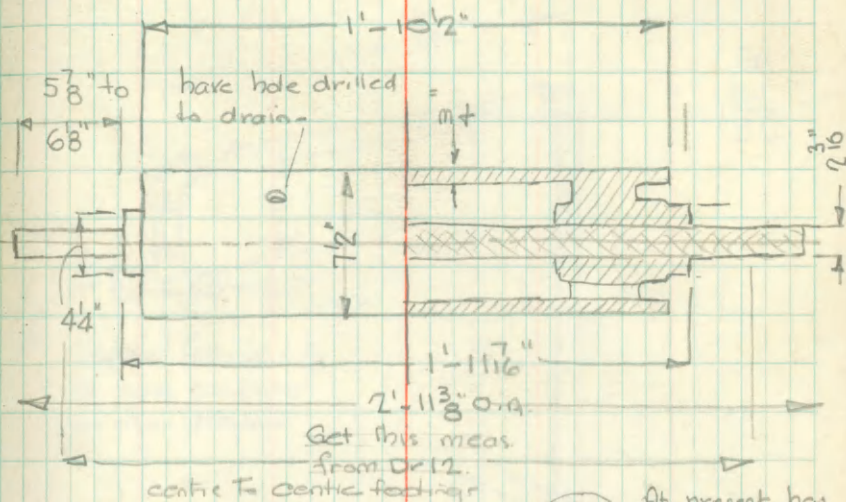
2 tees

2 valves.

Dredge 12

3.5.55

Ladder Roller -

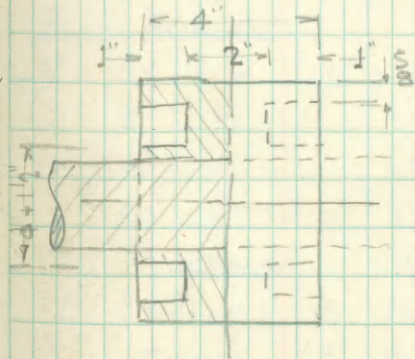


See dwg 5358 - DE 9



At present has
spoked hub -
should be
solid.

Order tubing 3/4" walls - 7 1/2" O.D. to be
made here with two hubs as below
with shaft one hub > other.

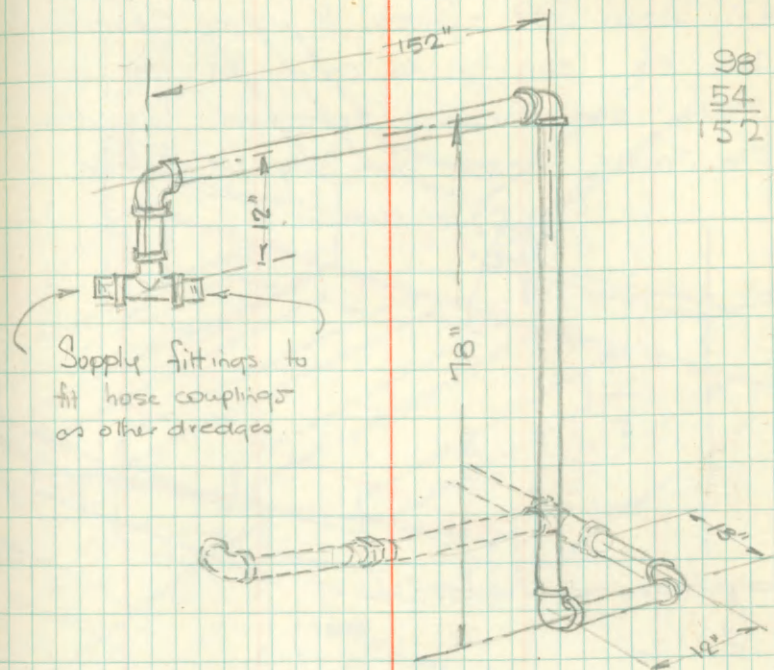


one end 2 1/4

other end 2 1/4 + .030"

DREDGE 12

G. S. 55

Piping to Tide Clean up Box

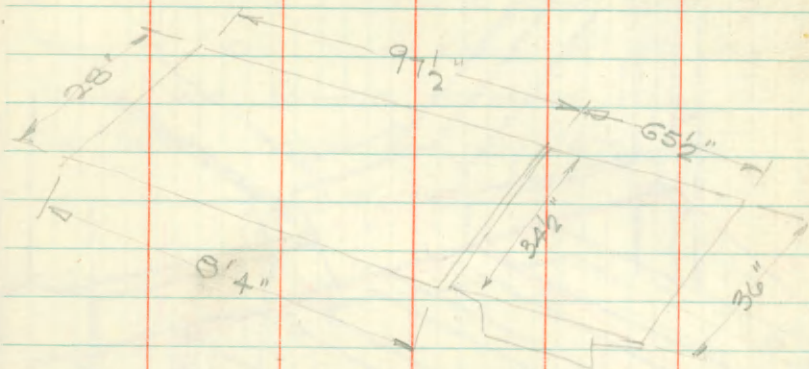
98
 54
 152

Piping Sent out.

2" - 12 1/2" Pipe	1 1/2" - 48" - pipe
9" ✓	24" - ✓
75" ✓	23" - ✓
140" ✓	1 1/2" valve
2" ells - 4	1 1/2" union
2" valve 1	3 1/2" ells.
2" Tee 1	3 1/2" short nip
2 x 4" nipple 2	1 2 1/2" bush.

Send Out.

2" Valve.
 2" Union.
 3 - 2" x 4" nipple
 1 - 7 1/2" nipple
Spray pipe to be measured

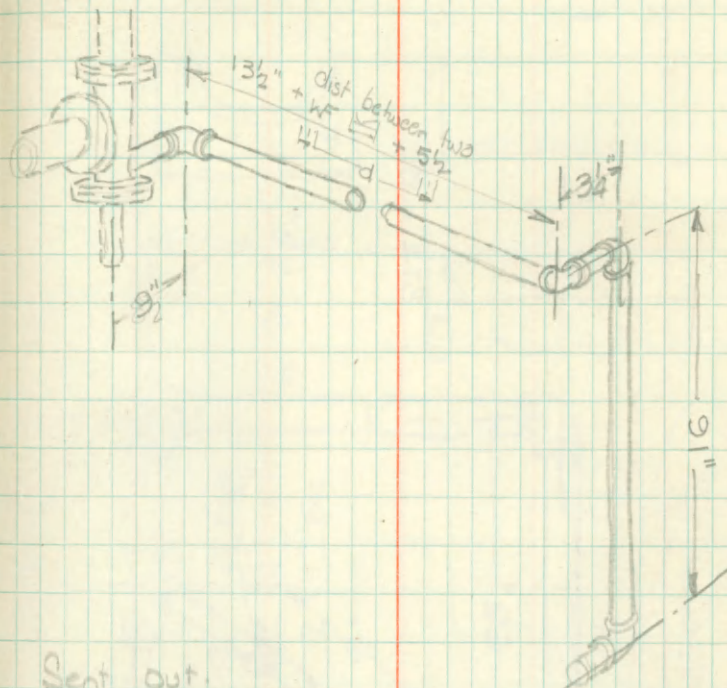


SCREEN

Small Exp Screen Med.



PIPING FROM 2 1/2" LINE TO DIST CLEAN UP.
2" pipe



Sent out.

2" pipe 7 1/2'
17'-0"
88"

2" Fittings

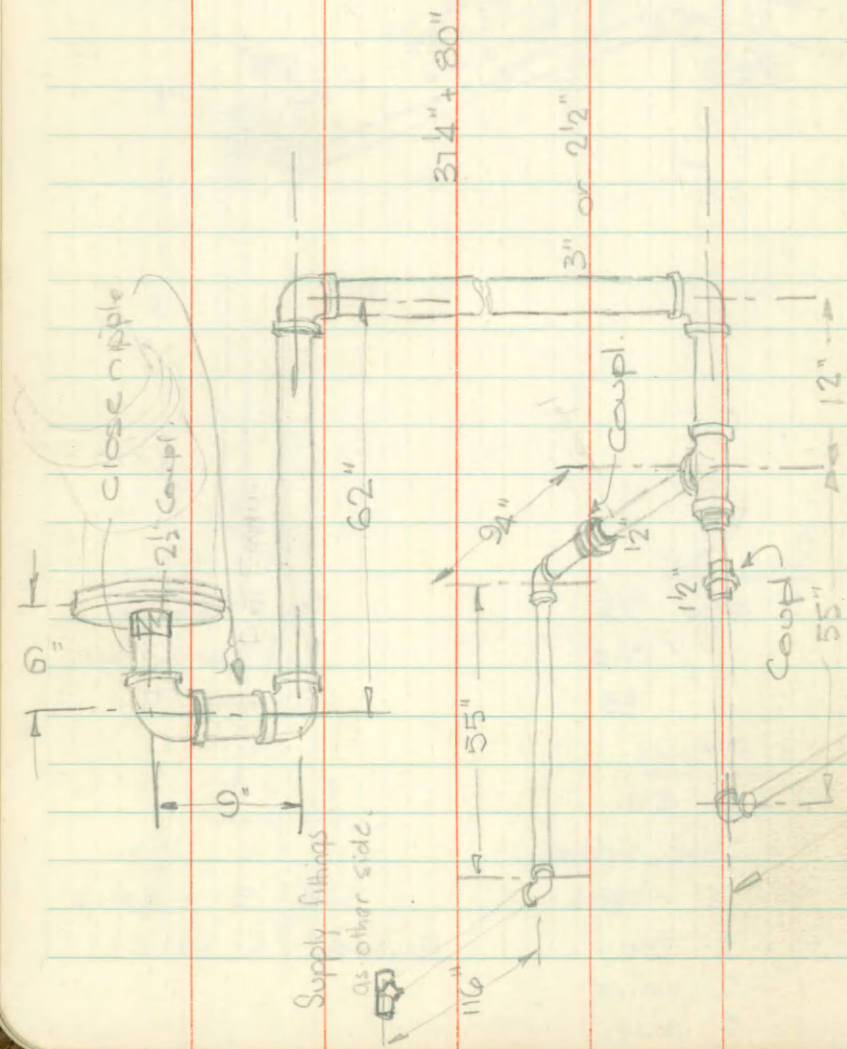
- 4 - 2" Ells.
- 1 - Close nipple.
- 2 - 4' nipples -
- 1 - 2" Tee
- 1 - 2" Valve
- 1 - 2" plug.

Tee + fittings to
Swid cleanup box
2 valves etc.

Sent out.

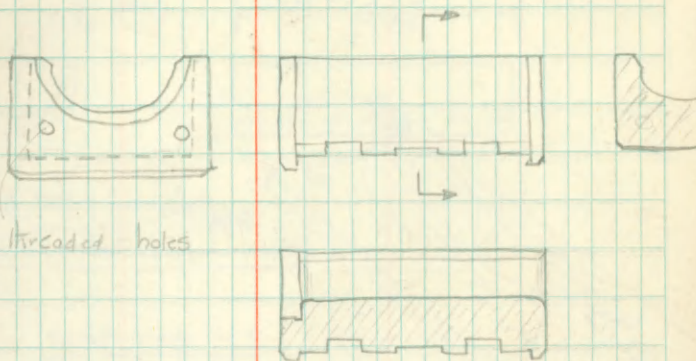
- 1 - 2" Union
- 2 - 3" nipples.
- Maybe 1 - 2" Valve.

JIG PIPING - LAUNDER - CONC

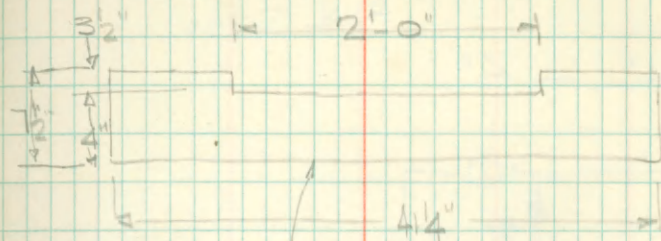


DREOG 12

LOWER TUMBLER BEARINGS

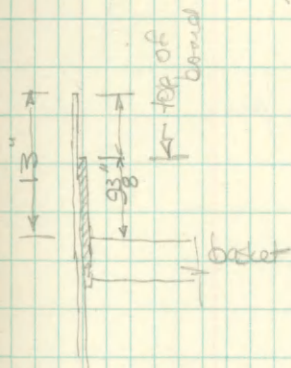


DEWATERING DEVICE



bottom set 2" from bed +
1 1/2' of water went over
slot.

- Experiment carried out on
Star. after jig



When stopped the bed of sand in
after jig - 1 1/2' from top of jig
forward jig - 2" ✓ ✓ ✓

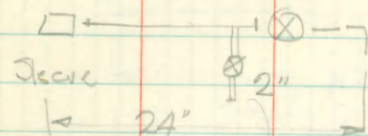
Bracket must be less than 2' wide to fit
against side of jig - to clear hooks etc.

Dist of baffle from after lip of — 79 1/2"
jig - Could be 1 1/2' outside of that
Water runs 6" deep over after jig.
4 1/2" ✓ ✓ Forward ✓

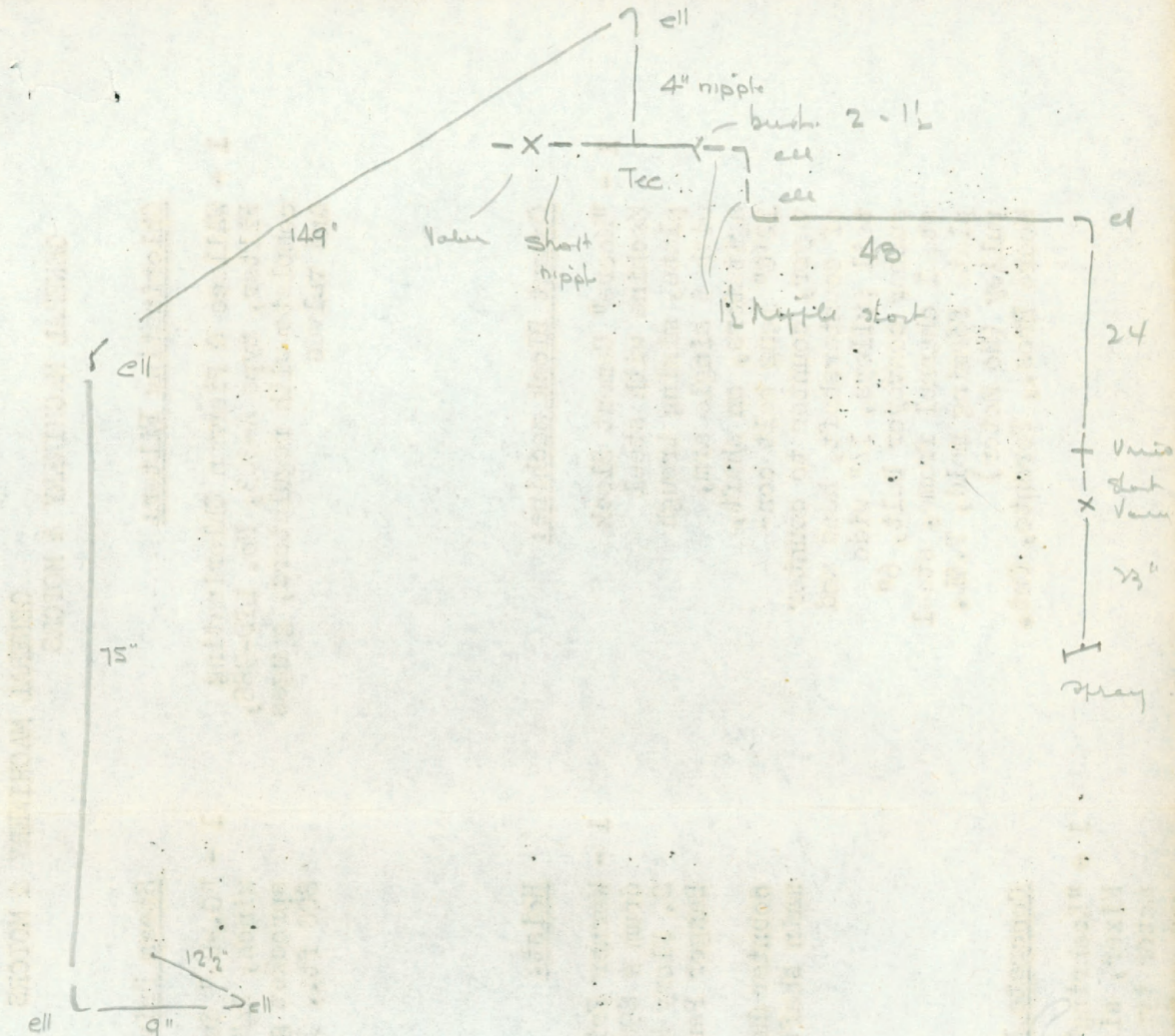
DR 12.

Both Sides

24" - 4"

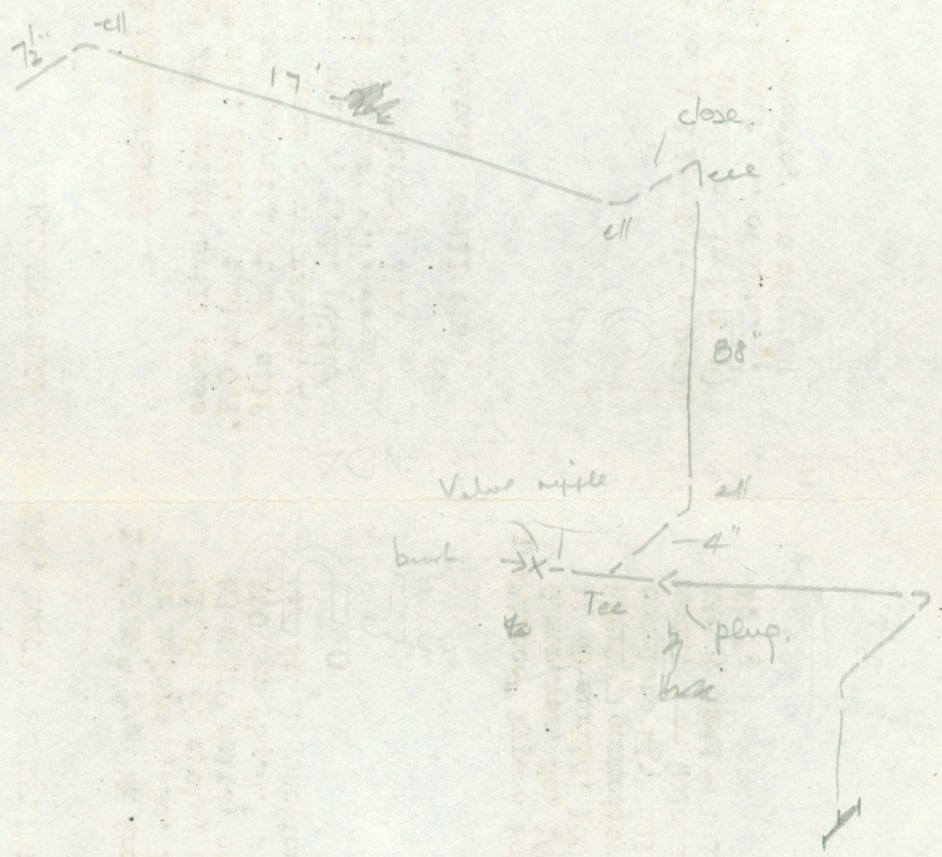


Another Spray pipe



15'-1"
 6'
 13'
 5'

 17'-2"



CURVE TABLES.

Published by KEUFFEL & ESSER CO.

HOW TO USE CURVE TABLES.

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

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

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

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

EXAMPLE.

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

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

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

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

(If corrected Ext. is required find in same way)

Ang. 23° 20' = 23.33° ÷ 10 = 2.3333 = L. C.

2° 19½' = def. for sta.	542	I. P. = sta.	542+72
4° 49½' = " " "	+50	Tan. =	118.47
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.

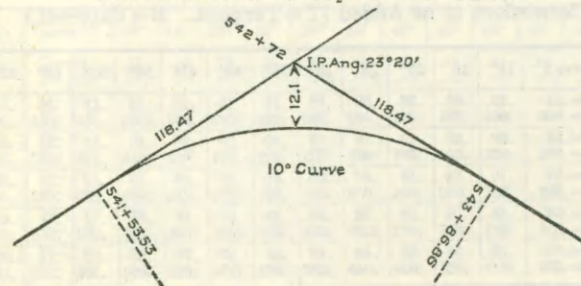


TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
1°	50.00	.22	8°	400.66	13.99	15°	754.32	49.44
10'	58.34	.30	10'	409.03	14.58	10'	762.80	50.55
20'	66.67	.39	20'	417.41	15.18	20'	771.29	51.68
30'	75.01	.49	30'	425.79	15.80	30'	779.77	52.82
40'	83.34	.61	40'	434.17	16.43	40'	788.26	53.97
50'	91.68	.73	50'	442.55	17.07	50'	796.75	55.13
2	100.01	.87	9	450.93	17.72	16	805.25	56.31
10	108.35	1.02	10	459.32	18.38	10	813.75	57.50
20	116.68	1.19	20	467.71	19.06	20	822.25	58.70
30	125.02	1.36	30	476.10	19.75	30	830.76	59.91
40	133.36	1.55	40	484.49	20.45	40	839.27	61.14
50	141.70	1.75	50	492.88	21.16	50	847.78	62.38
3	150.04	1.96	10	501.28	21.89	17	856.30	63.63
10	158.38	2.19	10	509.68	22.62	10	864.82	64.90
20	166.72	2.43	20	518.08	23.35	20	873.35	66.18
30	175.06	2.67	30	526.48	24.14	30	881.88	67.47
40	183.40	2.93	40	534.89	24.91	40	890.41	68.77
50	191.74	3.21	50	543.29	25.70	50	898.95	70.09
4	200.08	3.49	11	551.70	26.50	18	907.49	71.42
10	208.43	3.79	10	560.11	27.31	10	916.03	72.76
20	216.77	4.10	20	568.53	28.14	20	924.58	74.12
30	225.12	4.42	30	576.95	28.97	30	933.13	75.49
40	233.47	4.76	40	585.36	29.82	40	941.69	76.86
50	241.81	5.10	50	593.79	30.68	50	950.25	78.26
5	250.16	5.46	12	602.21	31.56	19	958.81	79.67
10	258.51	5.83	10	610.64	32.45	10	967.38	81.09
20	266.86	6.21	20	619.07	33.35	20	975.96	82.53
30	275.21	6.61	30	627.50	34.26	30	984.53	83.97
40	283.57	7.01	40	635.93	35.18	40	993.12	85.43
50	291.92	7.43	50	644.37	36.12	50	1001.7	86.90
6	300.28	7.86	13	652.81	37.07	20	1010.3	88.39
10	308.64	8.31	10	661.25	38.03	10	1018.9	89.89
20	316.99	8.76	20	669.70	39.01	20	1027.5	91.40
30	325.35	9.23	30	678.15	39.99	30	1036.1	92.92
40	333.71	9.71	40	686.60	40.99	40	1044.7	94.46
50	342.08	10.20	50	695.06	42.00	50	1053.3	96.01
7	350.44	10.71	14	703.51	43.03	21	1061.9	97.57
10	358.81	11.22	10	711.97	44.07	10	1070.6	99.16
20	367.17	11.75	20	720.44	45.12	20	1079.2	100.75
30	375.54	12.29	30	728.90	46.18	30	1087.8	102.35
40	383.91	12.85	40	737.37	47.25	40	1096.4	103.97
50	392.28	13.41	50	745.85	48.34	50	1105.1	105.60

Corrections to be Added (T=Tangent. E=External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
5°	T=.02 E=.000	.03 .000	.05 .001	.06 .001	.08 .002	.10 .002	.11 .002	.13 .003	.15 .003	.16 .004	.18 .004	.20 .004	.21 .005	.23 .005
10°	T=.03 E=.001	.06 .003	.09 .004	.13 .006	.16 .007	.19 .009	.22 .011	.25 .012	.28 .014	.31 .015	.34 .017	.38 .018	.42 .020	.46 .020
15°	T=.04 E=.003	.10 .007	.14 .010	.19 .014	.24 .018	.29 .023	.34 .027	.39 .032	.45 .035	.51 .039	.58 .043	.63 .047	.68 .051	.74 .051
20°	T=.06 E=.006	.13 .011	.19 .017	.26 .022	.32 .028	.39 .034	.45 .038	.51 .043	.58 .045	.65 .051	.72 .057	.79 .063	.86 .070	.90 .076
25°	T=.08 E=.009	.16 .018	.24 .027	.33 .036	.40 .046	.49 .056	.58 .065	.67 .074	.75 .083	.83 .093	.90 .106	.99 .120	1.06 .127	1.14 .135

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
22°	1113.7	107.24	29°	1481.8	188.51	36°	1861.7	294.9
10'	1122.4	108.90	10'	1490.7	190.74	10'	1870.9	297.7
20'	1131.0	110.57	20'	1499.6	192.99	20'	1880.1	300.6
30'	1139.7	112.25	30'	1508.5	195.25	30'	1889.4	303.5
40'	1148.4	113.95	40'	1517.4	197.53	40'	1898.6	306.4
50'	1157.0	115.66	50'	1526.3	199.82	50'	1907.9	309.3
23	1165.7	117.38	30	1535.3	202.12	37	1917.1	312.2
10	1174.4	119.12	10	1544.2	204.44	10	1926.4	315.2
20	1183.1	120.87	20	1553.1	206.77	20	1935.7	318.1
30	1191.8	122.63	30	1562.1	209.12	30	1945.0	321.1
40	1200.5	124.41	40	1571.0	211.48	40	1954.3	324.1
50	1209.2	126.20	50	1580.0	213.86	50	1963.6	327.1
24	1217.9	128.00	31	1589.0	216.3	38	1972.9	330.2
10	1226.6	129.82	10	1598.0	218.7	10	1982.2	333.2
20	1235.3	131.65	20	1606.9	221.1	20	1991.5	336.3
30	1244.0	133.50	30	1615.9	223.5	30	2000.9	339.3
40	1252.8	135.35	40	1624.9	226.0	40	2010.2	342.4
50	1261.5	137.23	50	1633.9	228.4	50	2019.6	345.5
25	1270.2	139.11	32	1643.0	230.9	39	2029.0	348.6
10	1279.0	141.01	10	1652.0	233.4	10	2038.4	351.8
20	1287.7	142.93	20	1661.0	235.9	20	2047.8	354.9
30	1296.5	144.85	30	1670.0	238.4	30	2057.2	358.1
40	1305.3	146.79	40	1679.1	241.0	40	2066.6	361.3
50	1314.0	148.75	50	1688.1	243.5	50	2076.0	364.5
26	1322.8	150.71	33	1697.2	246.1	40	2085.4	367.7
10	1331.6	152.69	10	1706.3	248.7	10	2094.9	371.0
20	1340.4	154.69	20	1715.3	251.3	20	2104.3	374.2
30	1349.2	156.70	30	1724.4	253.9	30	2113.8	377.5
40	1358.0	158.72	40	1733.5	256.5	40	2123.3	380.8
50	1366.8	160.76	50	1742.6	259.1	50	2132.7	384.1
27	1375.6	162.81	34	1751.7	261.8	41	2142.2	387.4
10	1384.4	164.86	10	1760.8	264.5	10	2151.7	390.7
20	1393.2	166.95	20	1770.0	267.2	20	2161.2	394.1
30	1402.0	169.04	30	1779.1	269.9	30	2170.8	397.4
40	1410.9	171.15	40	1788.2	272.6	40	2180.3	400.8
50	1419.7	173.27	50	1797.4	275.3	50	2189.9	404.2
28	1428.6	175.41	35	1806.6	278.1	42	2199.4	407.6
10	1437.4	177.55	10	1815.7	280.8	10	2209.0	411.1
20	1446.3	179.72	20	1824.9	283.6	20	2218.6	414.5
30	1455.1	181.89	30	1834.1	286.4	30	2228.1	418.0
40	1464.0	184.08	40	1843.3	289.2	40	2237.7	421.4
50	1472.9	186.29	50	1852.5	292.0	50	2247.3	425.0

Corrections to be Added (T=Tangent. E=External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
20°	T=.06 E=.006	.13 .011	.19 .017	.26 .022	.32 .028	.39 .034	.45 .038	.51 .045	.58 .051	.65 .057	.72 .063	.79 .070	.84 .076	.90 .083
25°	T=.08 E=.009	.16 .018	.24 .027	.33 .036	.40 .045	.49 .055	.58 .065	.67 .074	.75 .083	.83 .093	.90 .106	.99 .120	1.06 .127	1.14 .135
30°	T=.10 E=.013	.19 .025	.29 .038	.39 .051	.49 .065	.59 .078	.69 .090	.79 .103	.89 .118	.99 .133	1.09 .149	1.20 .170	1.29 .179	1.39 .188
35°	T=.11 E=.018	.22 .035	.34 .054	.47 .072	.58 .086	.69 .109	.80 .131	.93 .153	1.05 .175	1.17 .197	1.29 .213	1.42 .230	1.54 .247	1.66 .264
40°	T=.13 E=.023	.26 .046	.40 .070	.53 .093	.67 .117	.80 .141	.93 .172	1.06 .203	1.20 .234	1.34 .265	1.49 .297	1.64 .329	1.79 .361	1.94 .394
45°	T=.15 E=.030	.30 .060	.44 .093	.60 .119	.76 .153	.91 .184	1.06 .216	1.21 .254	1.37 .289	1.52 .325	1.70 .361	1.87 .398	2.04 .435	2.21 .475

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
43°	2257.0	428.5	50°	2671.8	592.3	57°	3110.9	790.1
10'	2266.6	432.0	10'	2681.9	596.6	10'	3121.7	795.2
20'	2276.2	435.6	20'	2692.1	600.9	20'	3132.6	800.4
30'	2285.9	439.2	30'	2702.3	605.3	30'	3143.4	805.6
40'	2295.6	442.8	40'	2712.5	609.6	40'	3154.2	810.9
50'	2305.2	446.4	50'	2722.7	614.0	50'	3165.1	816.1
44°	2314.9	450.0	51°	2732.9	618.4	58°	3176.0	821.4
10'	2324.6	453.6	10'	2743.1	622.8	10'	3186.9	826.7
20'	2334.3	457.3	20'	2753.4	627.2	20'	3197.8	832.0
30'	2344.1	461.0	30'	2763.7	631.7	30'	3208.8	837.3
40'	2353.8	464.6	40'	2773.9	636.2	40'	3219.7	842.7
50'	2363.5	468.4	50'	2784.2	640.7	50'	3230.7	848.1
45°	2373.3	472.1	52°	2794.5	645.2	59°	3241.7	853.5
10'	2383.1	475.8	10'	2804.9	649.7	10'	3252.7	858.9
20'	2392.8	479.6	20'	2815.2	654.3	20'	3263.7	864.3
30'	2402.6	483.4	30'	2825.6	658.8	30'	3274.8	869.8
40'	2412.4	487.2	40'	2835.9	663.4	40'	3285.8	875.3
50'	2422.3	491.0	50'	2846.3	668.0	50'	3296.9	880.8
46°	2432.1	494.8	53°	2856.7	672.7	60°	3308.0	886.4
10'	2441.9	498.7	10'	2867.1	677.3	10'	3319.1	892.0
20'	2451.8	502.5	20'	2877.5	682.0	20'	3330.3	897.5
30'	2461.7	506.4	30'	2888.0	686.7	30'	3341.4	903.2
40'	2471.5	510.3	40'	2898.4	691.4	40'	3352.6	908.8
50'	2481.4	514.3	50'	2908.9	696.1	50'	3363.8	914.5
47°	2491.3	518.2	54°	2919.4	700.9	61°	3375.0	920.2
10'	2501.2	522.2	10'	2929.9	705.7	10'	3386.3	925.9
20'	2511.2	526.1	20'	2940.4	710.5	20'	3397.5	931.6
30'	2521.1	530.1	30'	2951.0	715.3	30'	3408.8	937.3
40'	2531.1	534.2	40'	2961.5	720.1	40'	3420.1	943.1
50'	2541.0	538.2	50'	2972.1	725.0	50'	3431.4	948.9
48°	2551.0	542.2	55°	2982.7	729.9	62°	3442.7	954.8
10'	2561.0	546.3	10'	2993.3	734.8	10'	3454.1	960.6
20'	2571.0	550.4	20'	3003.9	739.7	20'	3465.4	966.5
30'	2581.0	554.5	30'	3014.5	744.6	30'	3476.8	972.4
40'	2591.0	558.6	40'	3025.2	749.6	40'	3488.3	978.3
50'	2601.1	562.8	50'	3035.8	754.6	50'	3499.7	984.3
49°	2611.2	566.9	56°	3046.5	759.6	63°	3511.1	990.2
10'	2621.2	571.1	10'	3057.2	764.6	10'	3522.6	996.2
20'	2631.3	575.3	20'	3067.9	769.7	20'	3534.1	1002.3
30'	2641.4	579.5	30'	3078.7	774.7	30'	3545.6	1008.3
40'	2651.5	583.8	40'	3089.4	779.8	40'	3557.2	1014.4
50'	2661.6	588.0	50'	3100.2	784.9	50'	3568.7	1020.5

Corrections to be Added (T = Tangent. E = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
40°	T=.13 E=.023	.26 .046	.40 .070	.53 .093	.67 .117	.80 .141	.93 .172	1.06 .203	1.20 .234	1.34 .265	1.49 .297	1.64 .329	1.79 .361	1.94 .393
45°	T=.15 E=.030	.30 .060	.44 .093	.60 .119	.76 .153	.91 .184	1.06 .216	1.21 .254	1.37 .289	1.52 .325	1.70 .351	1.87 .378	2.04 .411	2.21 .445
50°	T=.17 E=.037	.34 .075	.51 .110	.68 .141	.85 .171	1.02 .202	1.19 .233	1.36 .265	1.54 .296	1.72 .328	1.91 .359	2.10 .390	2.29 .421	2.48 .452
55°	T=.19 E=.046	.38 .093	.57 .142	.76 .188	.95 .236	1.14 .283	1.32 .332	1.52 .381	1.72 .429	1.92 .479	2.14 .530	2.35 .582	2.56 .634	2.77 .686
60°	T=.21 E=.056	.42 .112	.63 .168	.84 .225	1.05 .283	1.27 .340	1.47 .398	1.71 .457	1.94 .515	2.17 .575	2.38 .636	2.60 .697	2.83 .758	3.07 .819
65°	T=.23 E=.067	.46 .135	.69 .204	.93 .273	1.16 .343	1.40 .412	1.64 .483	1.88 .554	2.13 .625	2.38 .697	2.63 .768	2.88 .839	3.13 .910	3.39 .981
70°	T=.25 E=.080	.51 .159	.76 .240	1.02 .321	1.28 .403	1.54 .485	1.80 .568	2.06 .652	2.33 .735	2.60 .819	2.88 .906	3.16 .994	3.44 .1.07	3.72 .1.17
75°	T=.27 E=.095	.56 .182	.83 .266	1.12 .353	1.40 .440	1.69 .528	1.98 .617	2.27 .707	2.57 .797	2.87 .887	3.16 .977	3.47 .1.07	3.78 .1.18	4.09 .1.29
80°	T=.30 E=.110	.61 .220	.91 .332	1.22 .445	1.53 .558	1.84 .671	2.15 .787	2.46 .903	2.78 .1.013	3.10 .1.125	3.44 .1.238	3.78 .1.351	4.12 .1.464	4.46 .1.577
85°	T=.33 E=.128	.66 .259	1.00 .391	1.33 .524	1.68 .657	2.02 .790	2.36 .926	2.70 .1.06	3.05 .1.20	3.40 .1.34	3.77 .1.47	4.14 .1.60	4.55 .1.73	4.89 .1.86

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
64°	3580.3	1026.6	71°	4086.9	1308.2	78°	4639.8	1643.0
10'	3591.9	1032.8	10'	4099.5	1315.6	10'	4652.6	1651.7
20'	3603.5	1039.0	20'	4112.1	1322.9	20'	4667.4	1660.5
30'	3615.1	1045.2	30'	4124.8	1330.3	30'	4681.3	1669.2
40'	3626.8	1051.4	40'	4137.4	1337.7	40'	4695.2	1678.1
50'	3638.5	1057.7	50'	4150.1	1345.1	50'	4709.2	1686.9
65°	3650.2	1063.9	72°	4162.8	1352.6	79°	4723.2	1695.8
10'	3661.9	1070.2	10'	4175.6	1360.1	10'	4737.2	1704.7
20'	3673.7	1076.6	20'	4188.5	1367.6	20'	4751.2	1713.7
30'	3685.4	1082.9	30'	4201.2	1375.2	30'	4765.3	1722.7
40'	3697.2	1089.3	40'	4214.0	1382.8	40'	4779.4	1731.7
50'	3709.0	1095.7	50'	4226.8	1390.4	50'	4793.6	1740.8
66°	3720.9	1102.2	73°	4239.7	1398.0	80°	4807.7	1749.9
10'	3732.7	1108.6	10'	4252.6	1405.7	10'	4822.0	1759.0
20'	3744.6	1115.1	20'	4265.6	1413.5	20'	4836.2	1768.2
30'	3756.5	1121.7	30'	4278.5	1421.2	30'	4850.5	1777.4
40'	3768.5	1128.2	40'	4291.5	1429.0	40'	4864.8	1786.7
50'	3780.4	1134.8	50'	4304.6	1436.8	50'	4879.2	1796.0
67°	3792.4	1141.4	74°	4317.6	1444.6	81°	4893.6	1805.3
10'	3804.4	1148.0	10'	4330.7	1452.5	10'	4908.0	1814.7
20'	3816.4	1154.7	20'	4343.8	1460.4	20'	4922.5	1824.1
30'	3828.4	1161.3	30'	4356.9	1468.4	30'	4937.0	1833.6
40'	3840.5	1168.1	40'	4370.1	1476.4	40'	4951.5	1843.1
50'	3852.6	1174.8	50'	4383.3	1484.4	50'	4966.1	1852.6
68°	3864.7	1181.6	75°	4396.5	1492.4	82°	4980.7	1862.2
10'	3876.8	1188.4	10'	4409.8	1500.5	10'	4995.4	1871.8
20'	3889.0	1195.2	20'	4423.1	1508.6	20'	5010.0	1881.5
30'	3901.2	1202.0	30'	4436.4	1516.7	30'	5024.8	1891.2
40'	3913.4	1208.9	40'	4449.7	1524.9	40'	5039.5	1900.9
50'	3925.6	1215.8	50'	4463.1	1533.1	50'	5054.3	1910.7
69°	3937.9	1222.7	76°	4476.5	1541.4	83°	5069.2	1920.5
10'	3950.2	1229.7	10'	4489.9	1549.7	10'	5084.0	1930.4
20'	3962.5	1236.7	20'	4503.4	1558.0	20'	5099.0	1940.3
30'	3974.8	1243.7	30'	4516.9	1566.3	30'	5113.9	1950.3
40'	3987.2	1250.8	40'	4530.4	1574.7	40'	5128.9	1960.2
50'	3999.5	1257.9	50'	4544.0	1583.1	50'	5143.9	1970.3
70°	4011.9	1265.0	77°	4557.6	1591.6	84°	5159.0	1980.4
10'	4024.4	1272.1	10'	4571.2	1600.1	10'	5174.1	1990.5
20'	4036.8	1279.3	20'	4584.8	1608.6	20'	5189.3	2000.6
30'	4049.3	1286.5	30'	4598.5	1617.1	30'	5204.4	2010.8
40'	4061.8	1293.6	40'	4612.2	1625.7	40'	5219.7	2021.1
50'	4074.4	1300.9	50'	4626.0	1634.4	50'	5234.9	2031.4

Corrections to be Added (T = Tangent. E = External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
60°	T=.21 E=.050	.42 .112	.63 .168	.84 .225	1.05 .283	1.27 .340	1.49 .398	1.71 .457	1.94 .516	2.17 .575	2.38 .636	2.60 .697	2.83 .758	3.07 .819
65°	T=.23 E=.067	.46 .135	.69 .204	.93 .273	1.16 .343	1.40 .412	1.64 .483	1.88 .554	2.13 .625	2.38 .697	2.63 .768	2.88 .839	3.13 .910	3.39 .981
70°	T=.25 E=.080	.51 .159	.76 .240	1.02 .321	1.28 .403	1.54 .485	1.80 .568	2.06 .652	2.33 .735	2.60 .819	2.88 .906	3.16 .994	3.44 .1.07	3.72 .1.17
75°	T=.27 E=.095	.56 .182	.83 .266	1.12 .353	1.40 .440	1.69 .528	1.98 .617	2.27 .707	2.57 .797	2.87 .887	3.16 .977	3.47 .1.07	3.78 .1.18	4.09 .1.29
80°	T=.30 E=.110	.61 .220	.91 .332	1.22 .445	1.53 .558	1.84 .671	2.15 .787	2.46 .903	2.78 .1.013	3.10 .1.125	3.44 .1.238	3.78 .1.351	4.12 .1.464	4.46 .1.577
85°	T=.33 E=.128	.66 .259	1.00 .391	1.33 .524	1.68 .657	2.02 .790	2.36 .926	2.70 .1.06	3.05 .1.20	3.40 .1.34	3.77 .1.47	4.14 .1.60	4.55 .1.73	4.89 .1.86

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
85°	5250.3	2041.7	92°	5933.2	2518.5	99°	6708.6	3092.7
10'	5265.6	2052.1	10'	5950.5	2531.0	10'	6728.4	3107.7
20	5281.0	2062.5	20	5967.9	2543.5	20	6748.2	3122.9
30	5296.4	2073.0	30	5985.3	2556.0	30	6768.1	3138.3
40	5311.9	2083.5	40	6002.7	2568.6	40	6788.1	3153.3
50	5327.4	2094.1	50	6020.2	2581.3	50	6808.2	3168.7
86°	5343.0	2104.7	93°	6037.8	2594.0	100°	6828.3	3184.1
10	5358.6	2115.3	10	6055.4	2606.8	10	6848.5	3199.6
20	5374.2	2126.0	20	6073.1	2619.7	20	6868.8	3215.1
30	5389.9	2136.7	30	6090.8	2632.6	30	6889.2	3230.8
40	5405.6	2147.5	40	6108.6	2645.5	40	6909.6	3246.5
50	5421.4	2158.4	50	6126.4	2658.5	50	6930.1	3262.3
87°	5437.2	2169.2	94°	6144.3	2671.6	101°	6950.6	3278.1
10	5453.1	2180.2	10	6162.6	2684.7	10	6971.3	3294.1
20	5469.0	2191.1	20	6180.2	2697.0	20	6992.0	3310.1
30	5484.9	2202.2	30	6198.3	2711.2	30	7012.7	3326.1
40	5500.9	2213.2	40	6216.4	2724.5	40	7033.6	3342.3
50	5517.0	2224.3	50	6234.6	2737.9	50	7054.5	3358.5
88°	5533.1	2235.5	95°	6252.8	2751.3	102°	7075.5	3374.9
10	5549.2	2246.7	10	6271.1	2764.8	10	7096.6	3391.2
20	5565.4	2258.0	20	6289.4	2778.3	20	7117.8	3407.7
30	5581.6	2269.3	30	6307.9	2792.0	30	7139.0	3424.3
40	5597.8	2280.6	40	6326.3	2805.6	40	7160.3	3440.9
50	5614.2	2292.0	50	6344.8	2819.4	50	7181.7	3457.6
89°	5630.5	2303.5	96°	6363.4	2833.2	103°	7203.2	3474.4
10	5646.9	2315.0	10	6382.1	2847.0	10	7224.7	3491.3
20	5663.4	2326.6	20	6400.8	2861.0	20	7246.3	3508.2
30	5679.9	2338.2	30	6419.5	2875.0	30	7268.0	3525.2
40	5696.4	2349.8	40	6438.4	2889.0	40	7289.8	3542.4
50	5713.0	2361.5	50	6457.3	2903.1	50	7311.7	3559.6
90°	5729.7	2373.3	97°	6476.2	2917.3	104°	7333.6	3576.8
10	5746.3	2385.1	10	6495.2	2931.6	10	7355.6	3594.2
20	5763.1	2397.0	20	6514.3	2945.9	20	7377.8	3611.7
30	5779.9	2408.9	30	6533.4	2960.3	30	7399.9	3629.2
40	5796.7	2420.9	40	6552.6	2974.7	40	7422.2	3646.8
50	5813.6	2432.9	50	6571.9	2989.2	50	7444.6	3664.5
91°	5830.5	2444.9	98°	6591.2	3003.8	105°	7467.0	3682.3
10	5847.5	2457.1	10	6610.6	3018.4	10	7489.6	3700.2
20	5864.6	2469.3	20	6630.1	3033.1	20	7512.2	3718.2
30	5881.7	2481.5	30	6649.6	3047.9	30	7534.9	3736.2
40	5898.8	2493.8	40	6669.2	3062.8	40	7557.7	3754.4
50	5916.0	2506.1	50	6688.8	3077.7	50	7580.5	3772.6

Corrections to be Added (T=Tangent. E.=External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
85°	T=.33 E=.128	.86 .259	1.00 .391	1.33 .524	1.68 .857	2.02 1.06	2.36 1.20	2.70 1.34	3.05 1.47	3.40 1.81	3.77 2.15	4.14 2.49	4.55 2.83	4.89 3.17
90°	T=.36 E=.149	.72 .299	1.09 .450	1.45 .603	1.83 .756	2.20 1.10	2.57 1.22	2.94 1.38	3.32 1.54	3.70 1.70	4.10 1.87	4.50 2.03	4.91 2.20	5.32 2.37
95°	T=.39 E=.174	.79 .350	1.19 .522	1.55 .706	2.00 .885	2.40 1.06	2.80 1.25	3.20 1.43	3.60 1.62	4.00 1.80	4.40 1.99	4.80 2.18	5.23 2.38	5.83 2.53
100°	T=.43 E=.200	.88 .401	1.30 .604	1.74 .809	2.18 1.01	2.62 1.22	3.06 1.43	3.50 1.64	3.95 1.85	4.40 2.06	4.88 2.28	5.37 2.50	5.85 2.73	6.34 2.90
105°	T=.46 E=.230	.94 .470	1.42 .593	1.90 .808	2.38 1.08	2.87 1.36	3.34 1.63	3.84 1.91	4.35 2.19	4.84 2.49	5.35 2.61	5.87 2.90	6.40 3.16	6.93 3.41
110°	T=.50 E=.260	1.03 .535	1.55 .808	2.08 1.08	2.60 1.36	3.10 1.63	3.66 1.91	4.20 2.19	4.76 2.49	5.31 2.61	5.86 3.05	6.43 3.35	7.01 3.65	7.59 3.95
115°	T=.54 E=.307	1.13 .624	1.70 .939	2.29 1.26	2.86 1.57	3.45 1.89	4.03 2.21	4.63 2.54	5.23 2.87	5.83 3.20	6.44 3.53	7.07 3.88	7.70 4.23	8.35 4.53
120°	T=.61 E=.339	1.25 .720	1.89 1.08	2.52 1.45	3.16 1.82	3.81 2.20	4.44 2.56	5.11 2.95	5.78 3.33	6.44 3.72	7.11 4.10	7.80 4.50	8.51 4.91	9.21 5.32

TABLE I. — Tangents and External to a 1° Curve.
Chord = 100 ft.

Int. Angle	Tangent	External	Int. Angle	Tangent	External	Int. Angle	Tangent	External
106°	7003.5	3791.0	111°	8336.7	4386.1	116°	9169.4	5082.7
10'	7026.6	3809.4	10'	8362.7	4407.6	10'	9199.1	5107.9
20	7049.7	3827.9	20	8388.9	4429.2	20	9229.0	5133.3
30	7072.9	3846.5	30	8415.1	4450.9	30	9259.0	5158.8
40	7096.3	3865.2	40	8441.5	4472.7	40	9289.2	5184.5
50	7119.7	3884.0	50	8468.0	4494.6	50	9319.5	5210.3
107°	7743.2	3902.9	112°	8494.6	4516.6	117°	9349.9	5236.2
10	7766.8	3921.9	10	8521.3	4538.8	10	9380.5	5262.3
20	7790.5	3940.9	20	8548.1	4561.1	20	9411.3	5288.6
30	7814.3	3960.1	30	8575.0	4583.4	30	9442.2	5315.0
40	7838.1	3979.4	40	8602.1	4606.0	40	9473.2	5341.5
50	7862.1	3998.7	50	8629.3	4628.6	50	9504.4	5368.2
108°	7886.2	4018.2	113°	8656.6	4651.3	118°	9535.7	5395.1
10	7910.4	4037.8	10	8684.0	4674.2	10	9567.2	5422.1
20	7934.6	4057.4	20	8711.5	4697.2	20	9598.9	5449.2
30	7959.0	4077.2	30	8739.2	4720.3	30	9630.7	5476.5
40	7983.5	4097.1	40	8767.0	4743.6	40	9662.6	5504.0
50	8008.0	4117.0	50	8794.9	4766.9	50	9694.7	5531.7
109°	8032.7	4137.1	114°	8822.9	4790.4	119°	9727.0	5559.4
10	8057.4	4157.3	10	8851.0	4814.1	10	9759.4	5587.4
20	8082.3	4177.5	20	8879.3	4837.8	20	9792.0	5615.5
30	8107.3	4197.9	30	8907.7	4861.7	30	9824.8	5643.8
40	8132.3	4218.4	40	8936.3	4885.7	40	9857.7	5672.3
50	8157.5	4239.0	50	8965.0	4909.9	50	9890.8	5700.9
110°	8182.8	4259.7	115°	8993.8	4934.1	120°	9924.0	5729.7
10	8208.2	4280.5	10	9022.7	4958.6	10	9957.5	5758.6
20	8233.7	4301.4	20	9051.7	4983.1	20	9991.0	5787.7
30	8259.3	4322.4	30	9080.9	5007.8	30	10025.0	5817.0
40	8285.0	4343.6	40	9110.3	5032.6	40	10059.0	5846.5
50	8310.8	4364.8	50	9139.8	5057.6	50	10093.0	5876.1

Corrections to be Added (T=Tangent. E.=External.)

Int. Angle	Curve 5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
106°	T=.43 E=.200	.86 .401	1.30 .604	1.74 .809	2.18 1.01	2.62 1.22	3.06 1.43	3.50 1.64	3.95 1.85	4.40 2.06	4.88 2.28	5.37 2.50	5.85 2.73	6.34 2.90
105°	T=.46 E=.230	.94 .470	1.42 .593	1.90 .808	2.38 1.08	2.87 1.36	3.34 1.63	3.84 1.91	4.35 2.19	4.84 2.49	5.35 2.61	5.87 2.90	6.40 3.16	6.93 3.41
110°	T=.50 E=.260	1.03 .535	1.55 .808	2.08 1.08	2.60 1.36	3.10 1.63	3.66 1.91	4.20 2.19	4.76 2.49	5.31 2.61	5.86 3.05	6.43 3.35	7.01 3.65	7.59 3.95
115°	T=.54 E=.307	1.13 .624	1.70 .939	2.29 1.26	2.86 1.57	3.45 1.89	4.03 2.21	4.63 2.54	5.23 2.87	5.83 3.20	6.44 3.53	7.07 3.88	7.70 4.23	8.35 4.53
120°	T=.61 E=.339	1.25 .720	1.89 1.08	2.52 1.45	3.16 1.82	3.81 2.20	4.44 2.56	5.11 2.95	5.78 3.33	6.44 3.72	7.11 4.10	7.80 4.50	8.51 4.91	9.21 5.32

TABLE II. — Radii, Ordinates and Deflections. Chord = 100 ft.

Deg.	Radius	Mid. Ord.	Tan. Dist.	Def. Dist.	Def. for 1 Ft.	Deg.	Radius	Mid. Ord.	Tan. Dist.	Def. Dist.	Def. for 1 Ft.
	ft.	ft.	ft.	ft.	ft.		ft.	ft.	ft.	ft.	ft.
0° 10'	34377.7	.036	.145	.291	0.05	7°	819.0	1.523	6.105	12.21	2.10
20	17189.0	.073	.291	.582	0.10	20'	781.8	1.690	6.395	12.79	2.20
30	11459.0	.106	.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	6.635	13.37	2.30
50	6875.5	.182	.727	1.454	0.25	50	716.8	1.746	6.976	13.95	2.40
1	5729.6	.218	.873	1.745	0.30	20	638.2	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	50	637.3	1.955	7.816	15.69	2.70
40	3437.0	.361	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	50	573.7	2.183	8.716	17.43	3.00
20	2425.0	.509	2.036	4.072	0.70	30	546.4	2.292	9.150	18.30	3.15
30	2252.7	.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	30	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	3.826	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

The middle ordinate in inches for any cord of length (C) is equal to .0012 C³ multiplied by the middle ordinate taken from the above table. Thus, if it desired to bend a 30 ft. rail to fit a 10 degree curve, its middle ordinate should be .0012×900×2.183 or 2.36 inches.

TABLE III. Deflections for Sub Chords for Short Radius Curves.

Degree of Curve	Radius 50	$\frac{1}{2}$ sub chord = sin of $\frac{1}{2}$ def. angle				Length of arc for 100 ft.
	sin. $\frac{1}{2}$ def. ang.	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

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

$$T = \frac{50 \tan \frac{1}{2} I}{\sin \frac{1}{2} D}$$

$$\sin \frac{1}{2} D = \frac{50}{R}$$

$$\sin \frac{1}{2} D = \frac{50 \tan \frac{1}{2} I}{T}$$

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

$$R = \frac{\sin \frac{1}{2} D}{50}$$

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

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

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

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

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

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

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft. see Table II.), 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.

GENERAL DATA

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. $25.25^2 \div 200 = 3.125$, $100 - 3.125 = 96.875 = \text{Base}$.

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.

LEVELING. The correction for curvature and refraction, in feet and decimals of feet is equal to $0.574d^2$, where d is the distance in miles. The correction for curvature alone is closely, $\frac{1}{3}d^2$. The combined correction is negative.

PROBABLE ERROR. If d_1, d_2, d_3 , etc. are the discrepancies of various results from the mean, and if $\Sigma d^2 = \text{the sum of the squares of these differences}$ and n = the number of observations, then the probable error of the mean =

$$\pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$$

SOLAR EPHEMERIS. Attention is called to the Solar Ephemeris for the current year, published by Keuffel & Esser Co., and furnished free of charge upon request, which is $3\frac{1}{2} \times 5\frac{1}{2}$ in., with about 90 pages of data very useful to the Surveyor; such as the adjustments of transits, levels and solar attachments; directions and tables for determining the meridian and the latitude from observations on the sun and Polaris; stadia measurements; magnetic declination; arithmetic constants; English and Metric conversions; trigonometric formulas; Natural and Logarithmic Functions; and Logarithms of Numbers.

TABLE IV. — 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 V. — Inches in Decimals of a Foot.

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

Angle.	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.	Angle.	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.
0	0	0	1	∞	∞	1	0	0	0	1	∞	∞	1
10	.0029	.0029	343.8	343.8	1.	90	8	.1392	.1405	1.0098	7.185	7.115	.99027
20	.0058	.0058	171.9	171.9	.99998	80	10	.1421	.1435	1.0102	7.040	6.968	.98966
30	.0087	.0087	114.6	114.6	.99996	70	20	.1449	.1465	1.0107	6.900	6.827	.98944
40	.0116	.0116	85.94	85.94	.99993	60	30	.1478	.1495	1.0111	6.760	6.691	.98902
50	.0145	.0145	68.76	68.75	.99980	50	40	.1507	.1524	1.0115	6.636	6.561	.98852
1	.0175	.0175	57.30	57.29	.99965	89	50	.1536	.1554	1.0120	6.512	6.435	.98814
10	.0204	.0204	49.11	49.10	.99979	80	60	.1564	.1584	1.0125	6.394	6.314	.98769
20	.0233	.0233	42.98	42.96	.99973	70	70	.1593	.1614	1.0129	6.277	6.197	.98723
30	.0262	.0262	38.20	38.19	.99966	60	80	.1622	.1644	1.0134	6.166	6.084	.98676
40	.0291	.0291	34.38	34.37	.99958	50	90	.1650	.1673	1.0139	6.059	5.976	.98629
50	.0320	.0320	31.26	31.24	.99949	40	100	.1679	.1703	1.0144	5.955	5.871	.98580
2	.0349	.0349	28.65	28.64	.99938	88	10	.1708	.1733	1.0149	5.855	5.769	.98531
10	.0378	.0378	26.45	26.43	.99929	80	20	.1738	.1763	1.0154	5.759	5.671	.98481
20	.0407	.0407	24.56	24.54	.99917	70	30	.1765	.1793	1.0160	5.665	5.576	.98430
30	.0436	.0437	22.93	22.90	.99905	60	40	.1794	.1823	1.0165	5.575	5.485	.98378
40	.0465	.0466	21.40	21.47	.99892	50	50	.1822	.1853	1.0170	5.483	5.396	.98325
50	.0494	.0495	20.23	20.21	.99878	40	60	.1851	.1883	1.0176	5.403	5.309	.98272
3	.0523	.0524	19.11	19.08	.99863	87	70	.1880	.1914	1.0181	5.320	5.226	.98218
10	.0552	.0553	18.10	18.07	.99847	80	80	.1908	.1944	1.0187	5.241	5.145	.98163
20	.0581	.0582	17.20	17.17	.99831	70	90	.1937	.1974	1.0193	5.164	5.069	.98107
30	.0610	.0612	16.33	16.35	.99813	60	10	.1965	.2004	1.0199	5.089	4.996	.98050
40	.0640	.0641	15.64	15.60	.99795	50	20	.1994	.2035	1.0205	5.016	4.915	.97992
50	.0669	.0670	14.96	14.92	.99776	40	30	.2022	.2065	1.0211	4.945	4.843	.97934
4	.0698	.0699	14.34	14.30	.99756	86	40	.2051	.2095	1.0217	4.877	4.773	.97875
10	.0727	.0729	13.76	13.73	.99736	80	50	.2079	.2126	1.0223	4.810	4.705	.97815
20	.0756	.0758	13.23	13.20	.99714	70	60	.2108	.2156	1.0230	4.745	4.638	.97754
30	.0785	.0787	12.75	12.71	.99692	60	70	.2136	.2186	1.0236	4.682	4.574	.97692
40	.0814	.0816	12.29	12.25	.99668	50	80	.2164	.2217	1.0243	4.620	4.511	.97630
50	.0843	.0846	11.87	11.83	.99644	40	90	.2193	.2247	1.0249	4.560	4.449	.97566
5	.0872	.0875	11.47	11.43	.99619	85	10	.2221	.2278	1.0256	4.502	4.390	.97502
10	.0901	.0904	11.10	11.06	.99594	80	20	.2250	.2309	1.0263	4.445	4.331	.97437
20	.0929	.0934	10.76	10.71	.99567	70	30	.2278	.2339	1.0270	4.390	4.275	.97371
30	.0958	.0963	10.43	10.39	.99540	60	40	.2306	.2370	1.0277	4.336	4.219	.97304
40	.0987	.0992	10.13	10.08	.99511	50	50	.2334	.2401	1.0284	4.284	4.165	.97237
50	.1016	.1022	9.829	9.788	.99482	40	60	.2363	.2432	1.0291	4.232	4.113	.97169
6	.1045	.1051	9.567	9.514	.99452	84	70	.2391	.2462	1.0299	4.182	4.061	.97100
10	.1074	.1080	9.269	9.255	.99421	80	80	.2419	.2493	1.0306	4.133	4.011	.97030
20	.1103	.1109	9.010	9.010	.99390	70	90	.2447	.2524	1.0314	4.086	3.962	.96960
30	.1132	.1139	8.777	8.777	.99357	60	10	.2476	.2555	1.0321	4.039	3.914	.96887
40	.1161	.1169	8.556	8.556	.99324	50	20	.2504	.2586	1.0329	3.994	3.867	.96815
50	.1190	.1198	8.345	8.345	.99290	40	30	.2532	.2617	1.0337	3.949	3.821	.96742
7	.1219	.1228	8.144	8.144	.99255	83	40	.2560	.2648	1.0345	3.906	3.778	.96667
10	.1248	.1257	7.953	7.953	.99219	80	50	.2588	.2679	1.0353	3.864	3.732	.96593
20	.1276	.1287	7.770	7.770	.99182	70	60	.2616	.2711	1.0361	3.822	3.689	.96517
30	.1305	.1317	7.596	7.596	.99144	60	70	.2644	.2742	1.0369	3.782	3.647	.96440
40	.1334	.1346	7.429	7.429	.99106	50	80	.2672	.2773	1.0377	3.742	3.605	.96363
50	.1363	.1376	7.269	7.269	.99067	40	90	.2700	.2805	1.0386	3.703	3.566	.96285
						82	10	.2728	.2836	1.0394	3.665	3.526	.96206

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Angle.	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.	Angle.	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.
10	.1756	.1867	1.0403	3.628	3.487	.96126	74	24	.4067	.4452	1.0940	2.459	2.246
20	.2784	.2899	1.0412	3.592	3.450	.96046	60	10	.4094	.4487	1.0961	2.443	2.229
30	.2812	.2931	1.0423	3.556	3.412	.95964	50	20	.4120	.4522	1.0975	2.427	2.211
40	.2840	.2962	1.0429	3.521	3.376	.95882	40	30	.4147	.4557	1.0989	2.411	2.194
50	.2868	.2994	1.0438	3.487	3.340	.95799	30	40	.4173	.4592	1.1004	2.396	2.177
60	.2896	.3026	1.0448	3.452	3.305	.95715	20	50	.4200	.4628	1.1019	2.381	2.161
70	.2924	.3057	1.0457	3.420	3.271	.95630	10	60	.4226	.4663	1.1034	2.366	2.145
80	.2952	.3089	1.0468	3.388	3.237	.95545	0	70	.4253	.4699	1.1049	2.351	2.128
90	.2979	.3121	1.0476	3.357	3.204	.95460	80	80	.4279	.4734	1.1064	2.337	2.112
100	.3007	.3153	1.0485	3.326	3.172	.95372	70	90	.4305	.4770	1.1079	2.323	2.097
110	.3035	.3185	1.0495	3.295	3.140	.95284	60	10	.4331	.4806	1.1095	2.309	2.081
120	.3062	.3217	1.0505	3.265	3.108	.95195	50	20	.4358	.4841	1.1110	2.295	2.066
130	.3090	.3249	1.0515	3.236	3.078	.95106	40	30	.4384	.4877	1.1126	2.281	2.050
140	.3118	.3281	1.0525	3.207	3.048	.95015	30	40	.4410	.4913	1.1142	2.268	2.035
150	.3145	.3314	1.0535	3.179	3.018	.94924	20	50	.4436	.4950	1.1158	2.254	2.020
160	.3173	.3346	1.0545	3.152	2.989	.94832	10	60	.4462	.4986	1.1174	2.241	2.006
170	.3201	.3378	1.0555	3.124	2.960	.94740	0	70	.4488	.5022	1.1190	2.228	1.991
180	.3228	.3411	1.0566	3.098	2.932	.94646	80	80	.4514	.5059	1.1207	2.215	1.977
190	.3256	.3443	1.0576	3.072	2.904	.94552	70	90	.4540	.5095	1.1223	2.203	1.963
200	.3283	.3476	1.0587	3.046	2.877	.94457	60	10	.4566	.5132	1.1240	2.190	1.949
210	.3311	.3508	1.0598	3.020	2.850	.94361	50	20	.4592	.5169	1.1257	2.178	1.935
220	.3338	.3541	1.0608	2.992	2.824	.94264	40	30	.4617	.5206	1.1274	2.166	1.921
230	.3365	.3574	1.0619	2.971	2.798	.94167	30	40	.4643	.5243	1.1291	2.154	1.907
240	.3393	.3607	1.0631	2.947	2.773	.94068	20	50	.4669	.5280	1.1308	2.142	1.894
250	.3420	.3640	1.0642	2.924	2.747	.93969	10	60	.4695	.5317	1.1326	2.130	1.881
260	.3448	.3673	1.0653	2.900	2.723	.93869	0	70	.4720	.5354	1.1343	2.119	1.868
270	.3475	.3706	1.0665	2.878	2.699	.93769	80	80	.4746	.5392	1.1361	2.107	1.855
280	.3502	.3739	1.0676	2.856	2.675	.93667	70	90	.4772	.5430	1.1379	2.096	1.843
290	.3529	.3772	1.0688	2.833	2.651	.93565	60	10	.4797	.5467	1.1397	2.085	1.829
300	.3557	.3805	1.0700	2.811	2.628	.93462	50	20	.4823	.5505	1.1415	2.073	1.816
310	.3584	.3839	1.0711	2.790	2.605	.93358	40	30	.4848	.5543	1.1434	2.063	1.804
320	.3611	.3872	1.0723	2.769	2.583	.93253	30	40	.4874	.5581	1.1452	2.052	1.792
330	.3638	.3906	1.0736	2.749	2.560	.93148	20	50	.4899	.5619	1.1471	2.041	1.780
340	.3665	.3939	1.0748	2.729	2.539	.93042	10	60	.4924	.5658	1.1490	2.031	1.767
350	.3692	.3973	1.0760	2.709	2.517	.92935	0	70	.4950	.5696	1.1509	2.020	1.756
360	.3719	.4006	1.0773	2.689	2.496	.92827	80	80	.4975	.5735	1.1528	2.010	1.744
370	.3746	.4040	1.0785	2.670	2.475	.92718	70	90	.5000	.5774	1.1547	2.000	1.732
380	.3773	.4074	1.0798	2.650	2.455	.92609	60	10	.5025	.5812	1.1566	1.990	1.720
390	.3800	.4108	1.0811	2.632	2.434	.92499	50	20	.5050	.5851	1.1586	1.980	1.709
400	.3827	.4142	1.0824	2.613	2.414	.92388	40	30	.5075	.5890	1.1605	1.970	1.

Natural Trigonometrical Functions

Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.

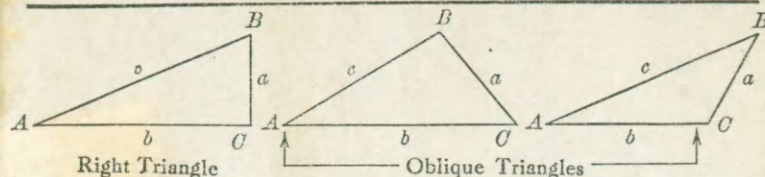
° /						° /
32	.5209	.6249	1.1792	1.887	1.600	.84805
10	.5324	.6289	1.1813	1.878	1.590	.84650
20	.5348	.6330	1.1835	1.870	1.580	.84495
30	.5373	.6371	1.1857	1.861	1.570	.84339
40	.5398	.6412	1.1879	1.853	1.560	.84182
50	.5422	.6453	1.1901	1.844	1.550	.84025
33	.5446	.6494	1.1924	1.836	1.540	.83867
10	.5471	.6536	1.1946	1.828	1.530	.83708
20	.5495	.6577	1.1969	1.820	1.520	.83549
30	.5519	.6619	1.1992	1.812	1.511	.83389
40	.5544	.6661	1.2015	1.804	1.501	.83228
50	.5568	.6703	1.2039	1.796	1.492	.83068
34	.5592	.6745	1.2062	1.788	1.483	.82904
10	.5616	.6787	1.2086	1.781	1.473	.82741
20	.5640	.6830	1.2110	1.773	1.464	.82577
30	.5664	.6873	1.2134	1.766	1.455	.82413
40	.5688	.6916	1.2158	1.758	1.446	.82248
50	.5712	.6959	1.2183	1.751	1.437	.82082
35	.5736	.7002	1.2208	1.743	1.428	.81915
10	.5760	.7046	1.2233	1.736	1.419	.81748
20	.5783	.7089	1.2258	1.729	1.411	.81580
30	.5807	.7133	1.2283	1.722	1.402	.81412
40	.5831	.7177	1.2309	1.715	1.393	.81242
50	.5854	.7221	1.2335	1.708	1.385	.81072
36	.5878	.7265	1.2361	1.701	1.376	.80902
10	.5901	.7310	1.2387	1.695	1.368	.80730
20	.5925	.7355	1.2413	1.688	1.360	.80558
30	.5948	.7400	1.2440	1.681	1.351	.80386
40	.5972	.7445	1.2466	1.675	1.343	.80212
50	.5995	.7490	1.2494	1.668	1.335	.80038
37	.6018	.7536	1.2521	1.662	1.327	.79864
10	.6041	.7581	1.2549	1.655	1.319	.79688
20	.6065	.7627	1.2577	1.649	1.311	.79512
30	.6088	.7673	1.2605	1.643	1.303	.79335
40	.6111	.7720	1.2633	1.636	1.295	.79158
50	.6134	.7768	1.2661	1.630	1.288	.78980
38	.6157	.7813	1.2690	1.624	1.280	.78801
10	.6180	.7860	1.2719	1.618	1.272	.78622
20	.6202	.7907	1.2748	1.612	1.265	.78442
30	.6225	.7954	1.2778	1.606	1.257	.78261
40	.6248	.8002	1.2808	1.601	1.250	.78079
50	.6271	.8050	1.2838	1.595	1.242	.77897

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle

Angle. Sin. Tan. Sec. Cosec. Cotg. Cosin.

° /						° /
58	.6293	.8098	1.2868	1.589	1.235	.77715
10	.6316	.8146	1.2898	1.583	1.228	.77531
20	.6338	.8195	1.2929	1.578	1.220	.77347
30	.6361	.8243	1.2959	1.572	1.213	.77162
40	.6383	.8292	1.2991	1.567	1.206	.76977
50	.6406	.8342	1.3022	1.561	1.199	.76791
39	.6428	.8391	1.3054	1.556	1.192	.76604
10	.6450	.8441	1.3086	1.550	1.185	.76417
20	.6472	.8491	1.3118	1.545	1.178	.76229
30	.6494	.8541	1.3151	1.540	1.171	.76041
40	.6517	.8591	1.3184	1.535	1.164	.75851
50	.6539	.8642	1.3217	1.529	1.157	.75661
41	.6561	.8693	1.3251	1.524	1.150	.75471
10	.6583	.8744	1.3284	1.519	1.144	.75280
20	.6604	.8796	1.3318	1.514	1.137	.75088
30	.6626	.8847	1.3352	1.509	1.130	.74896
40	.6648	.8899	1.3386	1.504	1.124	.74703
50	.6670	.8952	1.3421	1.499	1.117	.74509
42	.6691	.9004	1.3456	1.494	1.111	.74314
10	.6713	.9057	1.3492	1.490	1.104	.74120
20	.6734	.9110	1.3527	1.485	1.098	.73924
30	.6756	.9163	1.3563	1.480	1.091	.73728
40	.6777	.9217	1.3600	1.476	1.085	.73531
50	.6799	.9271	1.3636	1.471	1.079	.73333
43	.6820	.9325	1.3673	1.466	1.072	.73135
10	.6841	.9380	1.3711	1.462	1.066	.72937
20	.6862	.9435	1.3748	1.457	1.060	.72737
30	.6884	.9490	1.3786	1.453	1.054	.72537
40	.6905	.9545	1.3824	1.448	1.048	.72337
50	.6926	.9601	1.3863	1.444	1.042	.72136
44	.6947	.9657	1.3902	1.440	1.036	.71934
10	.6967	.9713	1.3941	1.435	1.030	.71732
20	.6988	.9770	1.3980	1.431	1.024	.71529
30	.7009	.9827	1.4020	1.427	1.018	.71325
40	.7030	.9884	1.4061	1.422	1.012	.71121
50	.7050	.9942	1.4101	1.418	1.006	.70916
	.7071	1.	1.414	1.414	1.	.70711

Cosin. Cotg. Cosec. Sec. Tan. Sin. Angle



Right Triangle

Oblique Triangles

Solution of Right Triangles

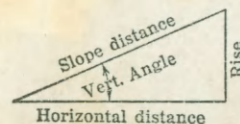
For Angle A . $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{a}$, $\csc = \frac{c}{b}$

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

Solution of Oblique Triangles

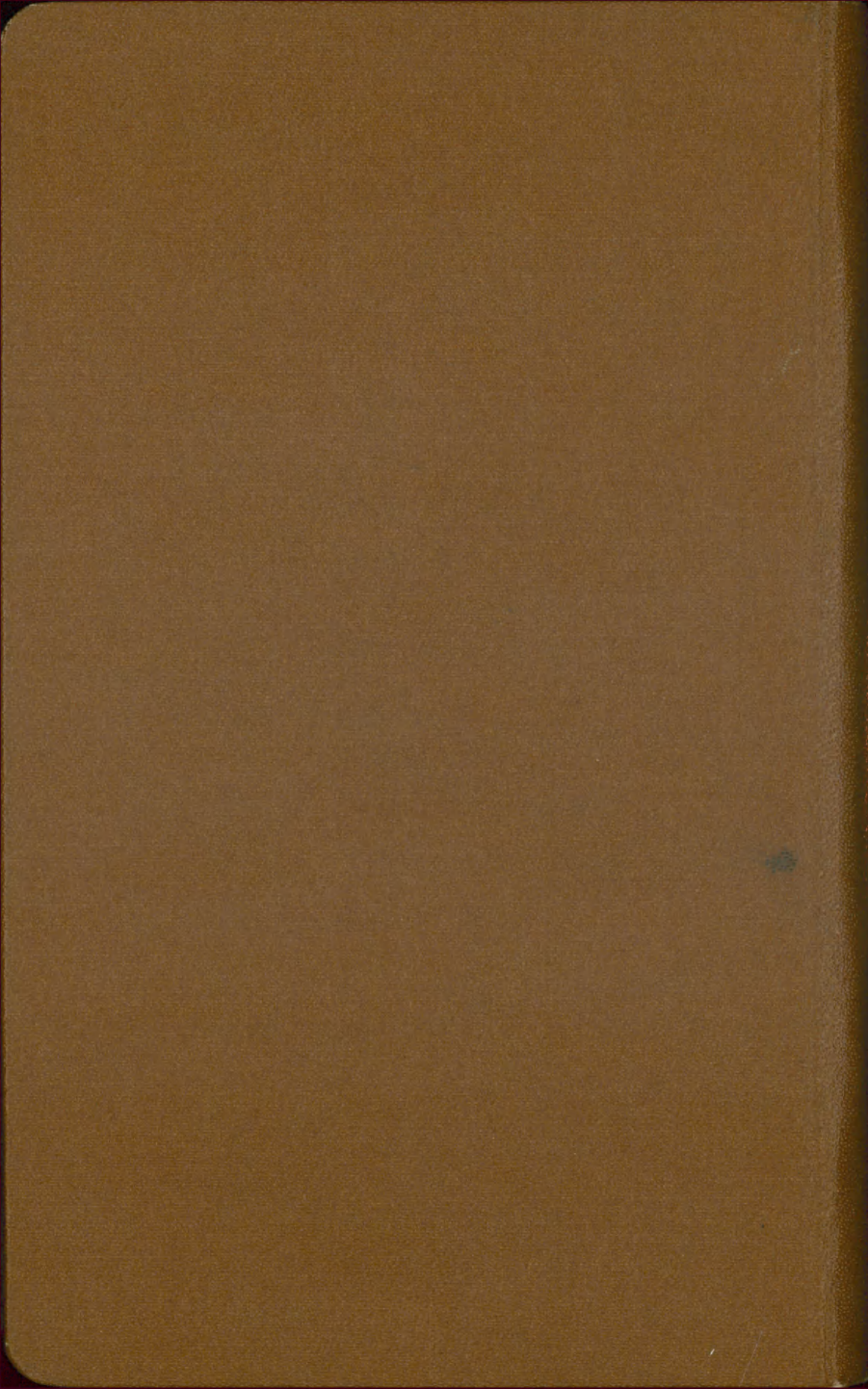
Given A, B, a	Required b, c, C	$b = \frac{a \sin B}{\sin A}$, $C = 180^\circ - (A + B)$, $c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a}$, $C = 180^\circ - (A + B)$, $c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A + B = 180^\circ - C$, $\tan \frac{1}{2}(A - B) = \frac{(a -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

REDUCTION TO HORIZONTAL



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

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





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