F.C.D. of Maricopa Co.

Oak Sta. Steam Dining, Ph II

FCD 99-08

PCN No. 027-03-32

① Vertical Control

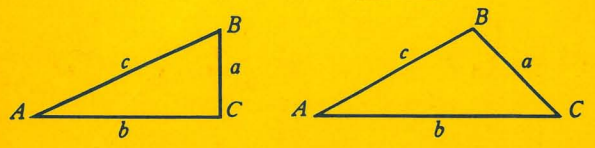
Book 2 of 2

May 1999

ECONOMY FIELD BOOK

603.058

FORMULAE FOR SOLVING RIGHT TRIANGLES



$\text{Sin } A = \frac{a}{c} = \text{Cos } B \qquad \text{Cot } A = \frac{b}{a} = \text{Tan } B$

$\text{Cos } A = \frac{b}{c} = \text{Sin } B \qquad \text{Sec } A = \frac{c}{b} = \text{Cosec } B$

$\text{Tan } A = \frac{a}{b} = \text{Cot } B \qquad \text{Cosec } A = \frac{c}{a} = \text{Sec } B$

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

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

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

Book 2 of 2

Flood Control District of Maricopa Co.

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2801 W. Durango
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Oak Street Storm Drain, Phase II

Contract FCD 99-08
ACN No. 027-03-32

C.S.W. Contractors, Inc.#

Valco Surveying Corp# 0217-000

① Vertical Control

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
18552
Valentine M.
Padilla
Date Signed 5-26-2000
ARIZONA, U.S.A.

Valentine M. Padilla

May 1999

Super - Val Padilla
P.L. - Jim Archibald
π - Kevin Reed
φ -

	+	HI	−	ELEV
				1214.60
	7.31	1221.91		
TP-1			4.84	1217.07
	6.70	1223.77		
TP-2			4.55	1219.22
	6.47	1225.69		
TP-3			3.95	1221.74
	7.84	1229.58		
TP-4			3.80	1225.78
	7.47	1233.25		
TP-5			0.42	1232.83
	5.88	1238.71		
TP-6			4.44	1234.27
	6.53	1240.80		
TP-7			4.24	1236.56
	7.44	1244.00		
TP-8			4.00	1240.00
	7.62	1247.62		
TP-9			2.13	1245.49
	8.58	1254.07		
TP-10			3.77	1250.90
	6.52	1257.42		
TP-11			4.21	1253.21
	8.48	1261.69		
TP-12			3.27	1258.42

TP-1 PK BC SOUTH SIDE OF OAK

TP-2 " "

TP 3 TRAV PT #115 SE COR 74ST & OAK

TP-4 PK BC N. SIDE OAK IN FRONT OF #7258

TP-5 PK BC SE COR SCOTTSDALE & OAK S

TP-6 TRAV #114 BC HH & OAK & SCOTTSDALE

TP-7 PK BC 7102 E. OAK APT #3 N. SIDE OF OAK

TP8 PK BC 7020 E OAK N. SIDE

TP-9 PK BC 6920 E. OAK N. SIDE

TP-10 PK BC 6828 E OAK N. SIDE

TP 11 BC HH 68ST & OAK

TP-12 BC HH 6714 E OAK N. SIDE

	+	HI	−	EL
TP-12				1258 42
	7 92	1266 34		
TP-13			3 00	1263 34

TP-13 PK BC E SIDE OF 6620 EOAK

	+	HI	−	EL
				1273 95
	12 55	1286 50		
TP-14			2 13	1284 37
	12 79	1297 16		
TP-15			0 04	1297 12
	11 42	1308 54		
TP-16			1 24	1307 30
	11 37	1318 67		
TP-17			3 72	1314 95
	3 79	1318 74		
TP-18			9 12	1309 62
	5 86	1315 48		
TP-19			11 86	1303 62
	2 86	1306 48		
TP-20			7 33	1299 13
	4 93	1304 08		
TP-21			9 45	1294 63
	3 67	1298 30		
TP-22			8 44	1289 86
	2 32	1292 18		
TP23			8 46	1283 72
			7 22	1284 96 LIP
			5 57	1286 61

(3)

BC 56 & OAK

TP 16 PK S. EP 5818 OAK

TP 17 PP S. SIDE OAK #28
W SIDE 5904 OAK
TP 18 BC 60 ST & OAK

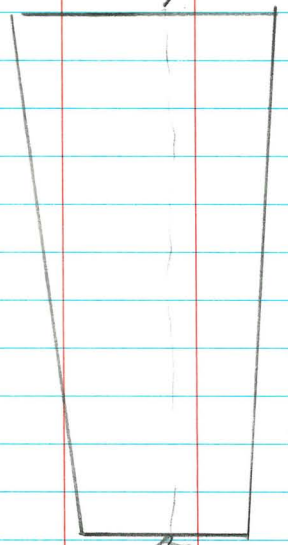
*TP-19 PK TC N SIDE 12' EAST OF PP-32

TP-20 PK TC N SIDE OAK 30' E. PP 34

TP-21 PK TC CURB WEST RET WEST ENTRANCE UNITED BLOOD SERVICE

TP. 22 PP #38 SIDE OAK

TP-23 PK TC NW COR 64 & OAK W. END



161+88

161+72

C-19.22 C19.82
1234.50 1235.10
X X
(15) (20)

C19.12 C19.68
1234.55 1235.11
X (20)
(15) X

1234.49
20 C19.06

STRUCTURE
1
OAK & SCOTTSDALE

STA	+	HI	−	EL
TP-22				1289 86
	3 51	93 37		
108+79 33			8 62	1284 75
108+20 78			7 76	1285 61
107+89 21			7 48	1285 89
107+30 67			6 89	1286 48
106+65 34			6 16	1287 21
106+00			5 82	1287 55
105+50			5 44	1287 93
105+00			4 85	1288 52
104+50			3 79	1289 58
104+00			3 08	1290 29
103+50			2 54	1290 83
103+00			1 83	1291 54
	6 41	1297 95		
102+70			5 95	1292 00
102+40			5 46	1292 49
102+00			5 07	1292 88
101+50			4 53	1293 42
101+00			5 04	1292 91
100+50			5 12	1292 83
100+00			4 34	1293 61
99+50			3 46	1294 49
99+00			2 75	1295 20

STA	+	HI	−	EL
		1297.95		
98+80			2.54	1295.41
98+46			2.03	1295.92
	8.05	1303.97		
98+00			7.43	1296.54
97+50			6.49	1297.48
97+00			5.23	1298.74
96+50			4.68	1299.29
96+00			5.22	1298.75
95+50			6.36	1297.61
95+20			5.90	1298.07
95+00			5.36	1298.61
94+50			4.47	1299.50
94+00			3.43	1300.54
	5.69	1306.23		
94+00			5.69	1300.54
93+50			5.78	1300.45
93+00			6.19	1300.04
92+50			5.66	1300.57
92+00			4.55	1301.68
91+70			4.18	1302.05
91+40			3.78	1302.45

ROD 4 70
HI 4 22

2	231-19-34	88-59-22	62 90	℄ SC
3	259-20-55	89-39-20	208 84	℄
4	254-02-57	89-39-03	212 87	BC TC
5	223-14-43	89-17-48	81 25	BC TC
6	180-00-49	89-23-38	119 81	BC TC
7	179-59-49	89-30-19	229 11	BC TC
8	174-06-59	89-33-50	229 77	℄
9	148-52-16	89-17-38	92 79	BCR
10	158-02-39	89-17-48	88 68	EP
11	131-08-53	89-26-53	90 49	ECR
12	114-13-44	89-23-47	96 70	℄
13	102-29-46	89-38-45	185 92	℄
14	29-04-03	89-48-19	49 25	℄

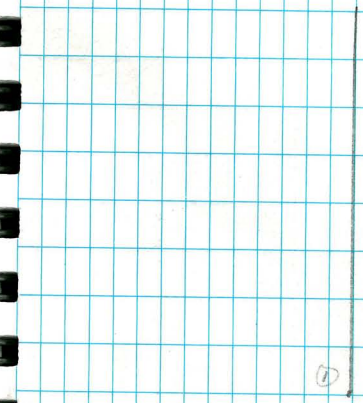
100 00 + 5 22

2	100 63
3	100 77
4	100 82
5	100 51
6	100 79
7	101 50
8	101 27
9	100 66
10	100 61
11	100 39
12	100 54
13	100 67
14	99 69

BCR 4 52
EP 4 57
5 51

20	172-27-50	180 11	100 83
21	169-33-30	130 72	100 72
19	163-53-15	85 60	100 61
22	149-31-30	46 94	5 01
23	86-52-00	23 91	5 42

18	194-10-37	81 83
16	198-40-08	62 64
17	180-01-52	79 43
	185-08-36	65 49



STA	+	HI	−	EL
93+00				1300.04
	4.37	1304.41		
(10) 93+14			4.67	1299.74
95+50			6.81	1297.60
(D) 95+60			7.60	1296.81

93+14	HUB	TG	℄
	1299.74	1298.50	1295.16
		C1 .24	C4 .58

95+60	HUB	TG	℄
	1296.81	1296.92	1294.16
		FO"	C2 .65

	+	HI	−	EL	
TP-17				1314 95	
	2 28	17 23			
(10) 75+74			6 35	1310 88	
	1 75	16 70			
73+60			4 33	12 37	
				1309 62	BC 60 SHOAK
	5 90	1315 52			
80+10 (10)			5 60	1309 92	
	5 17	1314 79			
			4 43	1310 36	
	HUB				
75+74	1310 88		C1 18		1309 70
73+60	1312 37		C4 63		1308 34
80+10	1309 92		C2 42		1307 50
82+70	1310 36		C3 46		1306 80
83+60	1309 48		C4 18		1305 30

AS BUILTS

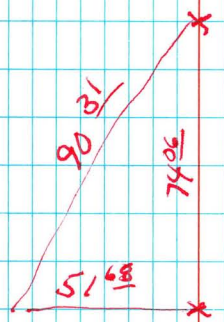
STA	+	HI	−	ELEV	
TP-7				1236 56	
	4 80	1241 36			
			7 31	1234 05	RIM ✓
1ST MH W. OF SCOTT'S			-18 60	1215 45	FL ✓
			4 80	1236 56	TC ✓
CB SE COR 71 ST	157+34		-5 72	1230 84	FL ✓
			3 97	1237 39	RIM ✓
MH 45'± W ℄ 71 ST			15 87	1221 52	FL ✓
TP 9				1245 49	
	3 68	1249 LT			
			7 27	1241 40	TC ✓
CB 80'± E OF 70 ST	150+17		-5 64	1235 76	FL ✓
			7 06	1242 11	RIM ✓
MH 40'± W. OF 70 ST			-13 99	1228 12	FL ✓
			5 42	1243 75	TC ✓
CB 70'± E OF 69 ST	147+39		5 55-	1238 20	FL ✓

STA	+	HI	−	EL	
TP-9				1245 49	
	6 72	1252 21			
CB S SIDE OAK E OF SCHOOL 30'±	143+13		3 71 − 4 08	1248 50 1244 42	TC ✓ FL ✓
CB N. SIDE OAK 90' E OF 68 PL	141+85		2 55 − 6 31	1249 66 1243 35	✓ ✓
TP-10				1250 90	
	7 07	1257 97			
MH 300'± E. OF 68ST			6 77 − 14 55	1251 20 1236 65	RIM ✓ FL ✓
CB S SIDE OAK 100'± E OF 68 ST	137+30		5 02 6 15	1252 95 1246 80	TC ✓ FL ✓
CB 68 ST 70' S. OF OAK	136+59.7		4 75 BLOCKED	1253 22	TC ✓ FL ✓
CB SW COR 68 ST & OAK	135+74		3 62 − 4 34	1254 35 1250 01	TC ✓ FL ✓

STA	+	HI	−	EL	
		1257.97			
MH 70' W. OF OAK			3.57	1254.40	RIM ✓
			15.08	1239.32	FL ✓
CB NW COR OAK & GB ST		1254.40	3.44	1254.53	TC ✓
			4.32	1250.21	FL ✓
TP-12				1258.42	
	6.88	1265.30			
MH 6713 E OAK			6.36	1258.94	RIM ✓
			16.74	1242.20	FL ✓
MH 50' ± E. OF GG PL			1.77	1263.53	RIM ✓
			18.32	1245.21	FL ✓

Sta	+	H I	−	EL	
TP-19				1303 62	
	11 49	1315 11			
MH 87+60±			10 05	1305 06	RIM ✓
			(-8 94)	1296 12	FL ✓
TP TOP SC BOLT FH			3 15	1311 96	
60ST OAK					
SC SIDE OAK					
	4 33	1316 29			
MH 50+ E OF 60 ST			5 38	1310 91	RIM ✓
83+61±			(-13 97)	1296 94	FL ✓
PIPE 50+ E OF 60ST			7 53	1308 76	HEADWALL ✓
			X0 64	1305 65	FL ✓
TP-(1)				1311 96	
	4 50	1316 46			
W. SIDE OF 5926 E OAK			6 47	1309 99	RIM ✓
80+12±			(8 86)	1301 13	FL ✓
TP-(2)			4 69	1311 77	
	4 80	1316 57			
MH 5902 E OAK			5 78	1310 79	RIM ✓
75+93±			(-8 14)	1302 65	FL ✓
MH 5834 E OAK			6 12	1310 45	RIM ✓
73+82±			(-6 52)	1303 93	FL ✓
TP-10			4 29	1307 38	

	+	HI	−	EL	
TP-16				1307.30	
	9.52	1316.82			
MH 5834			6.36	1310.46	✓
MH 5902			6.00	1310.82	✓
TP-(2)			5.05	1311.77	
	4.74	1316.51			
5926 MH			6.53	1309.98	✓
TP-1			4.56	1311.95	
	3.81	1315.76			
MH 50' E 60 ST			4.85	1310.91	✓
MH			10.70	1305.06	
			12.11	1303.65	



STA	+	HI	−	EL	
				1303 62	
	2 37	1305 99			
MH 180' W. OF 61 FL 91+41 ±			4 19	1301 80	RIM
			(8 77)	1293 03	FL
CB PRO 61 PLACE 93+14 ±			7 56	1298 43	GRATE
			(-2 82)	1295 61	FL PIPE
MH 120' W & SPORTS COMPLEX ROAD 95+21			8 08	1297 91	RIM
			(8 04)	1289 87	FL
	5 69	1303 60			
			6 68	1296 92	GRATE
90' W & 95+58 ±			(-2 68)	1294 24	FL PIPE
MH 200' ± E & SPORTS COMPLEX 98+76 ±			8 37	1295 23	RIM
			(-10 06)	1285 17	FL
	2 73	1297 96			
MH ~ 3' W OF & 64 ST 102+40 ±			5 20	1292 76	RIM
			(-9 29)	1283 47	FL
TP-22			8 11	1289 85	
	2 00	1291 85			
MH & W. & 64 ST 105+96			4 02	1287 83	RIM
			9 34	1278 49	FL

STA	+	HI	—	EL	
				1214 60	
	6 84	1221 44			
MH 100'± W. OF MILLER			5 28	1216 16	RIM ✓
187+57±			8 42	1207 74	FL ✓
MH 183+13±			3 36	1218 08	RIM ✓ BOLTED SHUT ✓
	6 33	1224 41			
RIM CB			5 20	1219 21	RIM ✓
180+52±			3 20	1216 01	FL ✓
RAV 1.5			2 68	1221 23	
	6 14	1227 87			
CB SE COR 74 & OAK ON OAK			5 97	1221 90	RIM
			N/A		FL
CB NE COR 74 & OAK ON OAK		176+31	5 92	1221 95	RIM ✓
			2 85	1219 10	FL ✓
MH NE COR 74 & OAK			5 77	1222 10	RIM ✓
			13 04	1209 06	FL ✓
CB E SIDE 74 N OF OAK		175+96	5 61	1222 26	RIM ✓
			3 98	1218 28	FL ✓
CB NW COR 74 & OAK		175+54	5 42	1222 45	RIM ✓
			4 10	1218 35	FL ✓
MH NW COR OAK & 74			5 21	1222 66	RIM ✓
			13 60	1209 06	FL ✓
CB SW COR OAK & 74		175+54	5 44	1222 43	RIM ✓
			4 14	1218 29	FL ✓

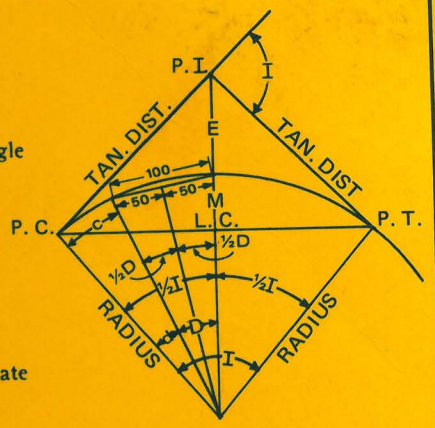
STA	+	HI	−	EL	
		1227.87			
CB E SIDE 74 - S. OF OAK		175+91	5.58	1222.29	RIM
			BOLTED SHUT		FL
CB 150' ± W OF 74 ST		173+95	4.41	1223.46	✓ RIM
173+96 ±			−8.12	1215.34	✓ FL
TP			3.21	1224.76	
	6.24	1231.00			
CB 171+52 ±			6.03	1224.97	✓ RIM
			−8.60	1216.37	✓ FL
MH 170+00			5.41	1225.59	✓ RIM
					FL
CB S. SIDE OAK 100' ± E 72 PL		168+46	4.13	1226.87	✓ RIM
			5.60	1221.27	✓ FL
CB N. SIDE OAK 50' ± E 74 PL			4.02	1226.98	RIM
					N/A
TP			3.14	1227.86	
	6.21	1234.07			
CB 100± W. 74 PL N. SIDE			6.12	1227.95	✓ RIM
		166+22	−4.68	1223.27	✓ FL
CB 100± W MH S. SIDE			5.91	1228.16	✓ RIM
			−5.71	1222.45	✓ FL
MH 163+33 ±			1.47	1232.60	✓ RIM
					FL

MILLER
SCOTTS DALE
68 57

1214 60
1234 22
1253 12

CURVE FORMULAE

D=Degree of Curve
1°=1-Degree of Curve
2°=2-Degree of Curve
P.C.=Point of Curve
P.T.=Point of Tangent
P.I.=Point of Intersection
I=Intersection of Angle, Angle Between Two Tangents
L=Length of Curve, from P.C. to P.T.
T=Tangent Distance
E=External Distance
R=Radius
L.C.=Length of Chord
M=Length of Middle Ordinate
c=Length of Sub-Chord
d=Angle of Sub-Chord



$$R = \frac{L.C.}{2 \sin ½I}, \quad T = R \tan ½I = \frac{L.C.}{2 \cos ½I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, \quad D\,1° = R = 5730, \quad D\,2° = \frac{5730}{2}, \quad D = \frac{5730}{R}$$

$$M = R\,(1 - \cos ½I), = R - R \cos \frac{I}{2}$$

$$\frac{E + R}{R} = \sec \frac{I}{2}, \quad \frac{R - M}{R} = \cos \frac{I}{2}$$

$$c = 2\,R \sin ½d, \quad d = \frac{c}{2\,R}$$

$$L.C. = 2\,R \sin ½I, \quad E = R\,(\sec ½I - 1), = R \sec \frac{I}{2} - R$$

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

Inches in Decimals of a Foot

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