

2. PLOTTING

These notes begin with a description of a plotting routine PLOT3D.for. After compiling this program it is run under the command "PLOT3D PLOT3D.DAT". It produces output like Figure 2.1.

Due to the three dimensional nature of cable nets, plotting takes on a more important role in the case of cable nets than it would in the more conventional cases of structural analysis. For that reason plotting is discussed first here.

PLOT3D contains two subroutines PLOT and SPLOT which reflect the basics of the plotting problem. You can treat a three dimensional plot by always plotting the x-y plane. If you want a different view simply rotate coordinates and again plot the x-y plane. The routine PLOT plots the x-y plane. The routine SPLOT rotates the coordinates using a three dimensional rotation matrix. (The three dimensional rotation matrix used here comes from a program for space frame analysis¹.)

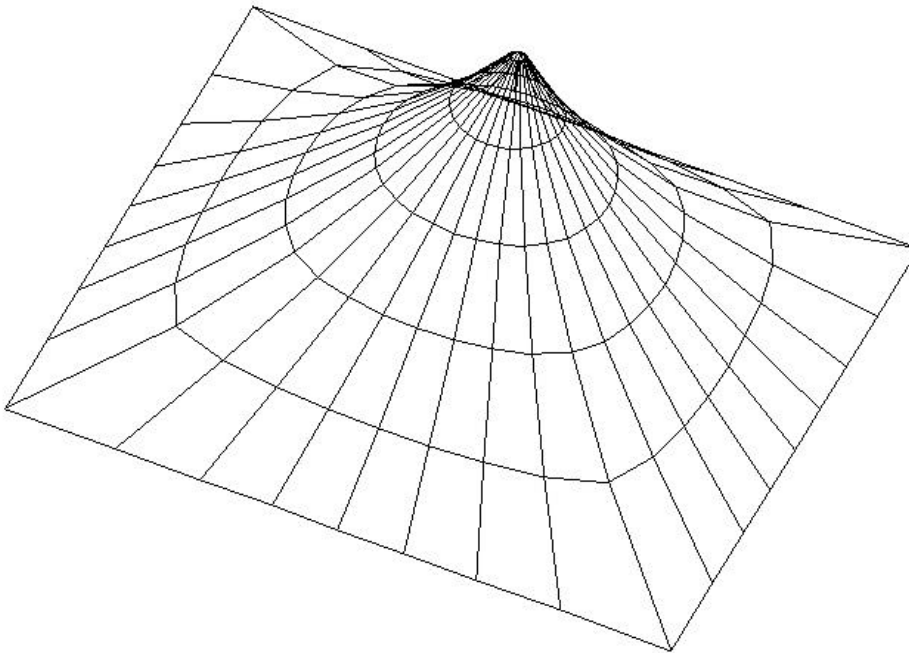


Figure 2.1

¹ *Automated Structural Analysis: An Introduction* by William R. Spillers, Pergamon Press Inc., 1972. (available at <http://www-ec.njit.edu/civil/faculty/spillers.html>)

The routine PLOT has three steps: 1) It computes the size of the object to be plotted, 2) it scales the object to fix the screen, and 3) it draws the object by drawing every line that it contains.

Plot3d.for

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C      PLOT DEMONSTRATION PROGRAM
      INCLUDE 'FGRAPH.FI'
      DIMENSION R(900),NP(900),MI(900),for(900)
      read (50,150)NB,NN,NS
150  FORMAT(3i5)
      N3=3*NN
      read (50,151)(NP(I),MI(I),I=1,NB)
      write(*,151)(NP(I),MI(I),I=1,NB)
151  FORMAT(2i5)
      read (50,156)(R(3*I-2),R(3*I-1),R(3*I)
1    ,I=1,NN)
      write(*,156)(R(3*I-2),R(3*I-1),R(3*I)
1    ,I=1,NN)
156  FORMAT(3f10.3)
      CALL SPLOT(NP,MI,NN,NB,R,for,0)
C      CALL SPLOT(NP,MI,NN,NB,R,for,2)
      STOP
      END

      SUBROUTINE PLOT(NB, NN, X, Y, NP, MI,for,iwrite)
      INCLUDE 'FGRAPH.FD'
      DIMENSION NP(1), MI(1), X(1), Y(1),for(1)
      INTEGER*2 DUMMY,xk,yk,xm,ym,lx,ly
      RECORD /XYCOORD/ XY
      character*5 text
      character*8 text1
      CHARACTER*64 FONTPATH
      CHARACTER*20 LIST
      FONTPATH='\NEWFOR\lib\courb.fon'
      LIST="t'courb' //"h6w6b'
      DUMMY = SETVIDEOMODE( $VRES16COLOR)
      DUMMY=REGISTERFONTS(FONTPATH)
      DUMMY=SETFONT(LIST)
      AMAXX=639-20
      AMAYY=479-20
c      find extent of picture window
      XMIN=X(1)
      XMAX=X(1)
      YMIN=Y(1)
      YMAX=Y(1)
      DO 2 I=1,NN
      XI=X(I)
      YI=Y(I)
      IF(XMIN.GT.XI) XMIN=XI
      IF(XMAX.LT.XI) XMAX=XI
      IF(YMIN.GT.YI) YMIN=YI
      2 IF(YMAX.LT.YI) YMAX=YI
c      scale to center of window

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SCALE = AMAX1((XMAX-XMIN)/AMAXX,(YMAX-YMIN)/AMAYY)
XSHIFT = (XMAX+XMIN)/2.0 - 639/2*SCALE
YSHIFT = (YMAX+YMIN)/2.0 - 479/2*SCALE
c move and draw for each line
DO 3 I=1,NB
K=NP(I)
M=MI(I)
XK=(X(K)-XSHIFT)/SCALE
YK=(Y(K)-YSHIFT)/SCALE
XM=(X(M)-XSHIFT)/SCALE
YM=(Y(M)-YSHIFT)/SCALE
c invert picture
YK = 479-YK
YM = 479-YM
LX=((XK+XM)/2)
LY=((YK+YM)/2)
CALL MOVETO ( XK, YK, XY)
DUMMY = LINETO ( XM, YM)
if(iwrite.ne.2) go to 998
call moveto(lx,ly,xy)
write(text, '(i3)') i
call outgtext (text)
998 if(iwrite.eq.0.or.iwrite.eq.2) go to 3
call moveto(lx,ly,xy)
write(text1,'(f7.0)') for(i)
call outgtext (text1)
3 CONTINUE
if(iwrite.ne.2) go to 996
do 997 i=1,nn
lx=(x(i)-xshift)/scale
yk=(y(i)-yshift)/scale
ly=(479-yk)
call moveto(lx,ly,xy)
write(text, '(i3)') i
call outgtext (text)
997 continue
996 continue
RETURN
END

SUBROUTINE SPLOT ( NP,NM,NN,NB,R,for,iwrite)
INCLUDE 'FGRAPH.FD'
c iwrite = 0 no text
c 1 writes member forces
c 2 writes node map
DIMENSION NP(1),NM(1),RXY(1000),ROT(3,3),for(1)
DIMENSION ANGL(3),NT(3),A(3,3),R1(3,3,3)
INTEGER*2 DUMMY
DIMENSION R(1),X(900),Y(900),RZ(1000)
WRITE(*,1)
1 FORMAT(' YOU ARE ABOUT TO ENTER A GRAPHICS '
1 'DISPLAY MODE'/' THE KEYBOARD COMMANDS ARE'//
1 ' +1...POSITIVE ROTATION ABOUT X AXIS'/
1 ' -1...NEGATIVE ROTATION ABOUT X AXIS'/
1 ' +2...POSITIVE ROTATION ABOUT Y AXIS'/
1 ' -2...NEGATIVE ROTATION ABOUT Y AXIS'/
1 ' +3...POSITIVE ROTATION ABOUT Z AXIS'/

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1 '      -3...NEGATIVE ROTATION ABOUT Z AXIS' /
1 '      0...EXIT')
c      delay for reading
      READ(*,*)
      DO 616 I=1,3
      DO 617 J=1,3
      DO 617 K=1,3
617 R1(I,J,K)=0.
616 R1(I,I,I)=1.
      THX=0.
      THY=00.
      THZ=00.
c      rotate using 10 deg increments
      DTH=10.
70  PI=3.14159
      DO 604 I=1,3
      DO 603 J=1,3
603 ROT(J,I)=0.
604 ROT(I,I)=1.
      ANGL(1)=THX
      ANGL(2)=THY
      ANGL(3)=THZ
      NT(1)=1
      NT(2)=2
      NT(3)=3
      I=0
302 I=I+1
      IF(ANGL(I)) 606,605,606
606 L=NT(I)
      GO TO 612
618 DO 607 J=1,3
      DO 607 JA=1,3
      A(J,JA)=0.
      DO 607 JB=1,3
607 A(J,JA)=A(J,JA)+R1(L,J,JB)*ROT(JB,JA)
      DO 608 K=1,3
      DO 608 J=1,3
608 ROT(K,J)=A(K,J)
605 IF(I-3) 302,303,303
303 DO 805 I=1,NN
      RZ(I)=0.
      DO 806 K=1,3
806 RZ(I)=RZ(I)+ROT(3,K)*R(3*I-3+K)
      DO 805 J=1,2
      RXY(2*I-2+J)=0.
      DO 805 K=1,3
805 RXY(2*I-2+J)=RXY(2*I-2+J)+ROT(J,K)*R(3*I-3+K)
      GO TO 59
612 ANG=ANGL(I)*PI/180.
      IF(L-2) 613,614,615
613 R1(1,2,2)=COS(ANG)
      R1(1,2,3)=SIN(ANG)
      R1(1,3,3)=R1(1,2,2)
      R1(1,3,2)=-R1(1,2,3)
      GO TO 618
614 R1(2,1,1)=COS(ANG)
      R1(2,1,3)=-SIN(ANG)

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R1(2,3,1)=-R1(2,1,3)
R1(2,3,3)=R1(2,1,1)
GO TO 618
615 R1(3,1,1)=COS(ANG)
R1(3,1,2)=SIN(ANG)
R1(3,2,1)=-R1(3,1,2)
R1(3,2,2)=R1(3,1,1)
GO TO 618
59 DO 24 I=1,NN
X(I)=RXY(2*I-1)
24 Y(I)=RXY(2*I)
CALL PLOT(NB,NN,X,Y,NP,NM,for,iwrite)
READ(*,*) IVAL
IF(IVAL.EQ.+1) GO TO 2000
IF(IVAL.EQ.-1) GO TO 3000
IF(IVAL.EQ. 2) GO TO 4000
IF(IVAL.EQ.-2) GO TO 5000
IF(IVAL.EQ. 3) GO TO 6000
IF(IVAL.EQ.-3) GO TO 7000
IF(IVAL.EQ. 0) GO TO 8000
2000 THX=THX+DTH
GO TO 70
3000 THX=THX-DTH
GO TO 70
4000 THY=THY+DTH
GO TO 70
5000 THY=THY-DTH
GO TO 70
6000 THZ=THZ+DTH
GO TO 70
7000 THZ=THZ-DTH
GO TO 70
8000 CALL UNREGISTERFONTS()
DUMMY = SETVIDEOMODE( $DEFAULTMODE )
RETURN
END

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Plot3d.dat

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372 216
2 1 .00000000E+00
3 2 .00000000E+00
4 3 .00000000E+00
5 4 .00000000E+00
6 1 .00000000E+00
7 6 .00000000E+00
7 2 .00000000E+00
8 7 .00000000E+00
8 3 .00000000E+00
9 8 .00000000E+00
9 4 .00000000E+00
10 9 .00000000E+00
10 5 .00000000E+00
11 6 .00000000E+00

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12	11	.00000000E+00
12	7	.00000000E+00
13	12	.00000000E+00
13	8	.00000000E+00
14	13	.00000000E+00
14	9	.00000000E+00
15	14	.00000000E+00
15	10	.00000000E+00
16	11	.00000000E+00
17	16	.00000000E+00
17	12	.00000000E+00
18	17	.00000000E+00
18	13	.00000000E+00
19	18	.00000000E+00
19	14	.00000000E+00
20	19	.00000000E+00
20	15	.00000000E+00
21	16	.00000000E+00
22	21	.00000000E+00
22	17	.00000000E+00
23	22	.00000000E+00
23	18	.00000000E+00
24	23	.00000000E+00
24	19	.00000000E+00
25	24	.00000000E+00
25	20	.00000000E+00
26	21	.00000000E+00
27	26	.00000000E+00
27	22	.00000000E+00
28	27	.00000000E+00
28	23	.00000000E+00
29	28	.00000000E+00
29	24	.00000000E+00
30	29	.00000000E+00
30	25	.00000000E+00
32	31	.00000000E+00
33	32	.00000000E+00
34	33	.00000000E+00
35	34	.00000000E+00
36	31	.00000000E+00
37	36	.00000000E+00
37	32	.00000000E+00
38	37	.00000000E+00
38	33	.00000000E+00
39	38	.00000000E+00
39	34	.00000000E+00
40	39	.00000000E+00
40	35	.00000000E+00
41	36	.00000000E+00
42	41	.00000000E+00
42	37	.00000000E+00
43	42	.00000000E+00
43	38	.00000000E+00
44	43	.00000000E+00
44	39	.00000000E+00
45	44	.00000000E+00
45	40	.00000000E+00

46	41	.00000000E+00
47	46	.00000000E+00
47	42	.00000000E+00
48	47	.00000000E+00
48	43	.00000000E+00
49	48	.00000000E+00
49	44	.00000000E+00
50	49	.00000000E+00
50	45	.00000000E+00
51	46	.00000000E+00
52	51	.00000000E+00
52	47	.00000000E+00
53	52	.00000000E+00
53	48	.00000000E+00
54	53	.00000000E+00
54	49	.00000000E+00
55	54	.00000000E+00
55	50	.00000000E+00
56	51	.00000000E+00
57	56	.00000000E+00
57	52	.00000000E+00
58	57	.00000000E+00
58	53	.00000000E+00
59	58	.00000000E+00
59	54	.00000000E+00
60	59	.00000000E+00
60	55	.00000000E+00
62	61	.00000000E+00
63	61	.00000000E+00
64	1	.00000000E+00
65	62	.00000000E+00
66	63	.00000000E+00
67	64	.00000000E+00
68	65	.00000000E+00
69	66	.00000000E+00
70	67	.00000000E+00
71	68	.00000000E+00
72	69	.00000000E+00
73	70	.00000000E+00
74	61	.00000000E+00
75	74	.00000000E+00
76	74	.00000000E+00
77	6	.00000000E+00
75	62	.00000000E+00
76	63	.00000000E+00
77	64	.00000000E+00
78	75	.00000000E+00
79	76	.00000000E+00
80	77	.00000000E+00
78	65	.00000000E+00
79	66	.00000000E+00
80	67	.00000000E+00
81	78	.00000000E+00
82	79	.00000000E+00
83	80	.00000000E+00
81	68	.00000000E+00
82	69	.00000000E+00

83	70	.00000000E+00
84	81	.00000000E+00
85	82	.00000000E+00
86	83	.00000000E+00
84	71	.00000000E+00
85	72	.00000000E+00
86	73	.00000000E+00
87	74	.00000000E+00
88	87	.00000000E+00
89	87	.00000000E+00
90	11	.00000000E+00
88	75	.00000000E+00
89	76	.00000000E+00
90	77	.00000000E+00
91	88	.00000000E+00
92	89	.00000000E+00
93	90	.00000000E+00
91	78	.00000000E+00
92	79	.00000000E+00
93	80	.00000000E+00
94	91	.00000000E+00
95	92	.00000000E+00
96	93	.00000000E+00
94	81	.00000000E+00
95	82	.00000000E+00
96	83	.00000000E+00
97	94	.00000000E+00
98	95	.00000000E+00
99	96	.00000000E+00
97	84	.00000000E+00
98	85	.00000000E+00
99	86	.00000000E+00
100	87	.00000000E+00
101	100	.00000000E+00
102	100	.00000000E+00
103	16	.00000000E+00
101	88	.00000000E+00
102	89	.00000000E+00
103	90	.00000000E+00
104	101	.00000000E+00
105	102	.00000000E+00
106	103	.00000000E+00
104	91	.00000000E+00
105	92	.00000000E+00
106	93	.00000000E+00
107	104	.00000000E+00
108	105	.00000000E+00
109	106	.00000000E+00
107	94	.00000000E+00
108	95	.00000000E+00
109	96	.00000000E+00
110	107	.00000000E+00
111	108	.00000000E+00
112	109	.00000000E+00
110	97	.00000000E+00
111	98	.00000000E+00
112	99	.00000000E+00

113	100	.00000000E+00
114	113	.00000000E+00
115	113	.00000000E+00
116	21	.00000000E+00
114	101	.00000000E+00
115	102	.00000000E+00
116	103	.00000000E+00
117	114	.00000000E+00
118	115	.00000000E+00
119	116	.00000000E+00
117	104	.00000000E+00
118	105	.00000000E+00
119	106	.00000000E+00
120	117	.00000000E+00
121	118	.00000000E+00
122	119	.00000000E+00
120	107	.00000000E+00
121	108	.00000000E+00
122	109	.00000000E+00
123	120	.00000000E+00
124	121	.00000000E+00
125	122	.00000000E+00
123	110	.00000000E+00
124	111	.00000000E+00
125	112	.00000000E+00
126	113	.00000000E+00
127	126	.00000000E+00
128	126	.00000000E+00
129	26	.00000000E+00
127	114	.00000000E+00
128	115	.00000000E+00
129	116	.00000000E+00
130	127	.00000000E+00
131	128	.00000000E+00
132	129	.00000000E+00
130	117	.00000000E+00
131	118	.00000000E+00
132	119	.00000000E+00
133	130	.00000000E+00
134	131	.00000000E+00
135	132	.00000000E+00
133	120	.00000000E+00
134	121	.00000000E+00
135	122	.00000000E+00
136	133	.00000000E+00
137	134	.00000000E+00
138	135	.00000000E+00
136	123	.00000000E+00
137	124	.00000000E+00
138	125	.00000000E+00
140	31	.00000000E+00
141	139	.00000000E+00
142	139	.00000000E+00
143	140	.00000000E+00
144	141	.00000000E+00
145	142	.00000000E+00
146	143	.00000000E+00

147	144	.00000000E+00
148	145	.00000000E+00
149	146	.00000000E+00
150	147	.00000000E+00
151	148	.00000000E+00
152	139	.00000000E+00
153	36	.00000000E+00
154	152	.00000000E+00
155	152	.00000000E+00
153	140	.00000000E+00
154	141	.00000000E+00
155	142	.00000000E+00
156	153	.00000000E+00
157	154	.00000000E+00
158	155	.00000000E+00
156	143	.00000000E+00
157	144	.00000000E+00
158	145	.00000000E+00
159	156	.00000000E+00
160	157	.00000000E+00
161	158	.00000000E+00
159	146	.00000000E+00
160	147	.00000000E+00
161	148	.00000000E+00
162	159	.00000000E+00
163	160	.00000000E+00
164	161	.00000000E+00
162	149	.00000000E+00
163	150	.00000000E+00
164	151	.00000000E+00
165	152	.00000000E+00
166	41	.00000000E+00
167	165	.00000000E+00
168	165	.00000000E+00
166	153	.00000000E+00
167	154	.00000000E+00
168	155	.00000000E+00
169	166	.00000000E+00
170	167	.00000000E+00
171	168	.00000000E+00
169	156	.00000000E+00
170	157	.00000000E+00
171	158	.00000000E+00
172	169	.00000000E+00
173	170	.00000000E+00
174	171	.00000000E+00
172	159	.00000000E+00
173	160	.00000000E+00
174	161	.00000000E+00
175	172	.00000000E+00
176	173	.00000000E+00
177	174	.00000000E+00
175	162	.00000000E+00
176	163	.00000000E+00
177	164	.00000000E+00
178	165	.00000000E+00
179	46	.00000000E+00

180	178	.00000000E+00
181	178	.00000000E+00
179	166	.00000000E+00
180	167	.00000000E+00
181	168	.00000000E+00
182	179	.00000000E+00
183	180	.00000000E+00
184	181	.00000000E+00
182	169	.00000000E+00
183	170	.00000000E+00
184	171	.00000000E+00
185	182	.00000000E+00
186	183	.00000000E+00
187	184	.00000000E+00
185	172	.00000000E+00
186	173	.00000000E+00
187	174	.00000000E+00
188	185	.00000000E+00
189	186	.00000000E+00
190	187	.00000000E+00
188	175	.00000000E+00
189	176	.00000000E+00
190	177	.00000000E+00
191	178	.00000000E+00
192	51	.00000000E+00
193	191	.00000000E+00
194	191	.00000000E+00
192	179	.00000000E+00
193	180	.00000000E+00
194	181	.00000000E+00
195	192	.00000000E+00
196	193	.00000000E+00
197	194	.00000000E+00
195	182	.00000000E+00
196	183	.00000000E+00
197	184	.00000000E+00
198	195	.00000000E+00
199	196	.00000000E+00
200	197	.00000000E+00
198	185	.00000000E+00
199	186	.00000000E+00
200	187	.00000000E+00
201	198	.00000000E+00
202	199	.00000000E+00
203	200	.00000000E+00
201	188	.00000000E+00
202	189	.00000000E+00
203	190	.00000000E+00
204	191	.00000000E+00
205	56	.00000000E+00
206	204	.00000000E+00
207	204	.00000000E+00
205	192	.00000000E+00
206	193	.00000000E+00
207	194	.00000000E+00
208	205	.00000000E+00
209	206	.00000000E+00

210	207	.00000000E+00					
208	195	.00000000E+00					
209	196	.00000000E+00					
210	197	.00000000E+00					
211	208	.00000000E+00					
212	209	.00000000E+00					
213	210	.00000000E+00					
211	198	.00000000E+00					
212	199	.00000000E+00					
213	200	.00000000E+00					
214	211	.00000000E+00					
215	212	.00000000E+00					
216	213	.00000000E+00					
214	201	.00000000E+00					
215	202	.00000000E+00					
216	203	.00000000E+00					
.000	-50.000	.000	0 2	0	0	0	0
9.946	-50.000	.000	0 0	0	0	0	0
20.711	-50.000	.000	0 0	0	0	0	0
33.409	-50.000	.000	0 0	0	0	0	0
50.000	-50.000	.000	0 0	0	0	0	0
.000	-38.233	10.000	0 2	0	0	0	0
7.568	-38.047	10.000	0 0	0	0	0	0
15.496	-37.411	10.000	0 0	0	0	0	0
24.015	-35.942	10.000	0 0	0	0	0	0
32.464	-32.465	10.000	0 0	0	0	0	0
.000	-27.000	20.000	0 2	0	0	0	0
5.314	-26.715	20.000	0 0	0	0	0	0
10.689	-25.807	20.000	0 0	0	0	0	0
16.035	-23.998	20.000	0 0	0	0	0	0
20.823	-20.823	20.000	0 0	0	0	0	0
.000	-16.873	30.000	0 2	0	0	0	0
3.302	-16.602	30.000	0 0	0	0	0	0
6.549	-15.810	30.000	0 0	0	0	0	0
9.625	-14.405	30.000	0 0	0	0	0	0
12.311	-12.311	30.000	0 0	0	0	0	0
.000	-8.221	40.000	0 2	0	0	0	0
1.600	-8.044	40.000	0 0	0	0	0	0
3.140	-7.581	40.000	0 0	0	0	0	0
4.562	-6.827	40.000	0 0	0	0	0	0
5.792	-5.792	40.000	0 0	0	0	0	0
.000	-1.000	50.000	0 2	0	0	0	0
.195	-.981	50.000	0 0	0	0	0	0
.383	-.924	50.000	0 0	0	0	0	0
.556	-.831	50.000	0 0	0	0	0	0
.707	-.707	50.000	0 0	0	0	0	0
50.000	.000	.000	0 1	0	0	0	0
50.000	-9.946	.000	0 0	0	0	0	0
50.000	-20.711	.000	0 0	0	0	0	0
50.000	-33.409	.000	0 0	0	0	0	0
50.000	-50.000	.000	0 0	0	0	0	0
38.233	.000	10.000	0 1	0	0	0	0
38.047	-7.568	10.000	0 0	0	0	0	0
37.411	-15.496	10.000	0 0	0	0	0	0
35.942	-24.015	10.000	0 0	0	0	0	0
32.465	-32.464	10.000	0 0	0	0	0	0
27.000	.000	20.000	0 1	0	0	0	0

26.715	-5.314	20.000	0	0	0	0	0
25.807	-10.689	20.000	0	0	0	0	0
23.998	-16.035	20.000	0	0	0	0	0
20.823	-20.823	20.000	0	0	0	0	0
16.873	.000	30.000	0	1	0	0	0
16.602	-3.302	30.000	0	0	0	0	0
15.810	-6.549	30.000	0	0	0	0	0
14.405	-9.625	30.000	0	0	0	0	0
12.311	-12.311	30.000	0	0	0	0	0
8.221	.000	40.000	0	1	0	0	0
8.044	-1.600	40.000	0	0	0	0	0
7.581	-3.140	40.000	0	0	0	0	0
6.827	-4.562	40.000	0	0	0	0	0
5.792	-5.792	40.000	0	0	0	0	0
1.000	.000	50.000	0	1	0	0	0
.981	-.195	50.000	0	0	0	0	0
.924	-.383	50.000	0	0	0	0	0
.831	-.556	50.000	0	0	0	0	0
.707	-.707	50.000	0	0	0	0	0
.000	50.000	.000	0	0	0	0	0
9.946	50.000	.000	0	0	0	0	0
-9.946	50.000	.000	0	0	0	0	0
-9.946	-50.000	.000	0	0	0	0	0
20.711	50.000	.000	0	0	0	0	0
-20.711	50.000	.000	0	0	0	0	0
-20.711	-50.000	.000	0	0	0	0	0
33.409	50.000	.000	0	0	0	0	0
-33.409	50.000	.000	0	0	0	0	0
-33.409	-50.000	.000	0	0	0	0	0
50.000	50.000	.000	0	0	0	0	0
-50.000	50.000	.000	0	0	0	0	0
-50.000	-50.000	.000	0	0	0	0	0
.000	38.233	10.000	0	0	0	0	0
7.568	38.047	10.000	0	0	0	0	0
-7.568	38.047	10.000	0	0	0	0	0
-7.568	-38.047	10.000	0	0	0	0	0
15.496	37.411	10.000	0	0	0	0	0
-15.496	37.411	10.000	0	0	0	0	0
-15.496	-37.411	10.000	0	0	0	0	0
24.015	35.942	10.000	0	0	0	0	0
-24.015	35.942	10.000	0	0	0	0	0
-24.015	-35.942	10.000	0	0	0	0	0
32.464	32.465	10.000	0	0	0	0	0
-32.464	32.465	10.000	0	0	0	0	0
-32.464	-32.465	10.000	0	0	0	0	0
.000	27.000	20.000	0	0	0	0	0
5.314	26.715	20.000	0	0	0	0	0
-5.314	26.715	20.000	0	0	0	0	0
-5.314	-26.715	20.000	0	0	0	0	0
10.689	25.807	20.000	0	0	0	0	0
-10.689	25.807	20.000	0	0	0	0	0
-10.689	-25.807	20.000	0	0	0	0	0
16.035	23.998	20.000	0	0	0	0	0
-16.035	23.998	20.000	0	0	0	0	0
-16.035	-23.998	20.000	0	0	0	0	0
20.823	20.823	20.000	0	0	0	0	0
-20.823	20.823	20.000	0	0	0	0	0

-20.823	-20.823	20.000	0	0	0	0	0
.000	16.873	30.000	0	0	0	0	0
3.302	16.602	30.000	0	0	0	0	0
-3.302	16.602	30.000	0	0	0	0	0
-3.302	-16.602	30.000	0	0	0	0	0
6.549	15.810	30.000	0	0	0	0	0
-6.549	15.810	30.000	0	0	0	0	0
-6.549	-15.810	30.000	0	0	0	0	0
9.625	14.405	30.000	0	0	0	0	0
-9.625	14.405	30.000	0	0	0	0	0
-9.625	-14.405	30.000	0	0	0	0	0
12.311	12.311	30.000	0	0	0	0	0
-12.311	12.311	30.000	0	0	0	0	0
-12.311	-12.311	30.000	0	0	0	0	0
.000	8.221	40.000	0	0	0	0	0
1.600	8.044	40.000	0	0	0	0	0
-1.600	8.044	40.000	0	0	0	0	0
-1.600	-8.044	40.000	0	0	0	0	0
3.140	7.581	40.000	0	0	0	0	0
-3.140	7.581	40.000	0	0	0	0	0
-3.140	-7.581	40.000	0	0	0	0	0
4.562	6.827	40.000	0	0	0	0	0
-4.562	6.827	40.000	0	0	0	0	0
-4.562	-6.827	40.000	0	0	0	0	0
5.792	5.792	40.000	0	0	0	0	0
-5.792	5.792	40.000	0	0	0	0	0
-5.792	-5.792	40.000	0	0	0	0	0
.000	1.000	50.000	0	0	0	0	0
.195	.981	50.000	0	0	0	0	0
-.195	.981	50.000	0	0	0	0	0
-.195	-.981	50.000	0	0	0	0	0
.383	.924	50.000	0	0	0	0	0
-.383	.924	50.000	0	0	0	0	0
-.383	-.924	50.000	0	0	0	0	0
.556	.831	50.000	0	0	0	0	0
-.556	.831	50.000	0	0	0	0	0
-.556	-.831	50.000	0	0	0	0	0
.707	.707	50.000	0	0	0	0	0
-.707	.707	50.000	0	0	0	0	0
-.707	-.707	50.000	0	0	0	0	0
-50.000	.000	.000	0	0	0	0	0
50.000	9.946	.000	0	0	0	0	0
-50.000	9.946	.000	0	0	0	0	0
-50.000	-9.946	.000	0	0	0	0	0
50.000	20.711	.000	0	0	0	0	0
-50.000	20.711	.000	0	0	0	0	0
-50.000	-20.711	.000	0	0	0	0	0
50.000	33.409	.000	0	0	0	0	0
-50.000	33.409	.000	0	0	0	0	0
-50.000	-33.409	.000	0	0	0	0	0
50.000	50.000	.000	0	0	0	0	0
-50.000	50.000	.000	0	0	0	0	0
-50.000	-50.000	.000	0	0	0	0	0
-38.233	.000	10.000	0	0	0	0	0
38.047	7.568	10.000	0	0	0	0	0
-38.047	7.568	10.000	0	0	0	0	0
-38.047	-7.568	10.000	0	0	0	0	0

37.411	15.496	10.000	0	0	0	0	0
-37.411	15.496	10.000	0	0	0	0	0
-37.411	-15.496	10.000	0	0	0	0	0
35.942	24.015	10.000	0	0	0	0	0
-35.942	24.015	10.000	0	0	0	0	0
-35.942	-24.015	10.000	0	0	0	0	0
32.465	32.464	10.000	0	0	0	0	0
-32.465	32.464	10.000	0	0	0	0	0
-32.465	-32.464	10.000	0	0	0	0	0
-27.000	.000	20.000	0	0	0	0	0
26.715	5.314	20.000	0	0	0	0	0
-26.715	5.314	20.000	0	0	0	0	0
-26.715	-5.314	20.000	0	0	0	0	0
25.807	10.689	20.000	0	0	0	0	0
-25.807	10.689	20.000	0	0	0	0	0
-25.807	-10.689	20.000	0	0	0	0	0
23.998	16.035	20.000	0	0	0	0	0
-23.998	16.035	20.000	0	0	0	0	0
-23.998	-16.035	20.000	0	0	0	0	0
20.823	20.823	20.000	0	0	0	0	0
-20.823	20.823	20.000	0	0	0	0	0
-20.823	-20.823	20.000	0	0	0	0	0
-16.873	.000	30.000	0	0	0	0	0
16.602	3.302	30.000	0	0	0	0	0
-16.602	3.302	30.000	0	0	0	0	0
-16.602	-3.302	30.000	0	0	0	0	0
15.810	6.549	30.000	0	0	0	0	0
-15.810	6.549	30.000	0	0	0	0	0
-15.810	-6.549	30.000	0	0	0	0	0
14.405	9.625	30.000	0	0	0	0	0
-14.405	9.625	30.000	0	0	0	0	0
-14.405	-9.625	30.000	0	0	0	0	0
12.311	12.311	30.000	0	0	0	0	0
-12.311	12.311	30.000	0	0	0	0	0
-12.311	-12.311	30.000	0	0	0	0	0
-8.221	.000	40.000	0	0	0	0	0
8.044	1.600	40.000	0	0	0	0	0
-8.044	1.600	40.000	0	0	0	0	0
-8.044	-1.600	40.000	0	0	0	0	0
7.581	3.140	40.000	0	0	0	0	0
-7.581	3.140	40.000	0	0	0	0	0
-7.581	-3.140	40.000	0	0	0	0	0
6.827	4.562	40.000	0	0	0	0	0
-6.827	4.562	40.000	0	0	0	0	0
-6.827	-4.562	40.000	0	0	0	0	0
5.792	5.792	40.000	0	0	0	0	0
-5.792	5.792	40.000	0	0	0	0	0
-5.792	-5.792	40.000	0	0	0	0	0
-1.000	.000	50.000	0	0	0	0	0
.981	.195	50.000	0	0	0	0	0
-.981	.195	50.000	0	0	0	0	0
-.981	-.195	50.000	0	0	0	0	0
.924	.383	50.000	0	0	0	0	0
-.924	.383	50.000	0	0	0	0	0
-.924	-.383	50.000	0	0	0	0	0
.831	.556	50.000	0	0	0	0	0
-.831	.556	50.000	0	0	0	0	0

-.831	-.556	50.000	0	0	0	0	0	0
.707	.707	50.000	0	0	0	0	0	0
-.707	.707	50.000	0	0	0	0	0	0
-.707	-.707	50.000	0	0	0	0	0	0