

NUMERICAL ANALYSIS OF THIN SHELLS

by

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CHAPTER VIII

COMPUTER PROGRAMME FOR TRANSLATIONAL SHELLS

VIII.1. Preparation of data tapes

The sequence of symbols to be specified is presented in the form of a flow diagram in figure 8.1. All symbols enclosed in rectangular cages must be specified in the order they occur in following the flow diagram.

Symbols used in the flow diagram

t = thickness of shell

L_{α} = plan length of shell in α direction

L_{β} = plan length of shell in β direction^x

a = 'rise' of shell at midpoint along edge 1

b = 'rise' of shell at midpoint along edge 3

The measurements a and b are made in the γ direction from the shell surface to the plane containing the four corners of the shell (figure 8.2).

C23 defines the type of loading on the shell (Table 8.1).

^xAlthough the plan lengths are read in as data the computations are made using the arc lengths l_{α} and l_{β} .

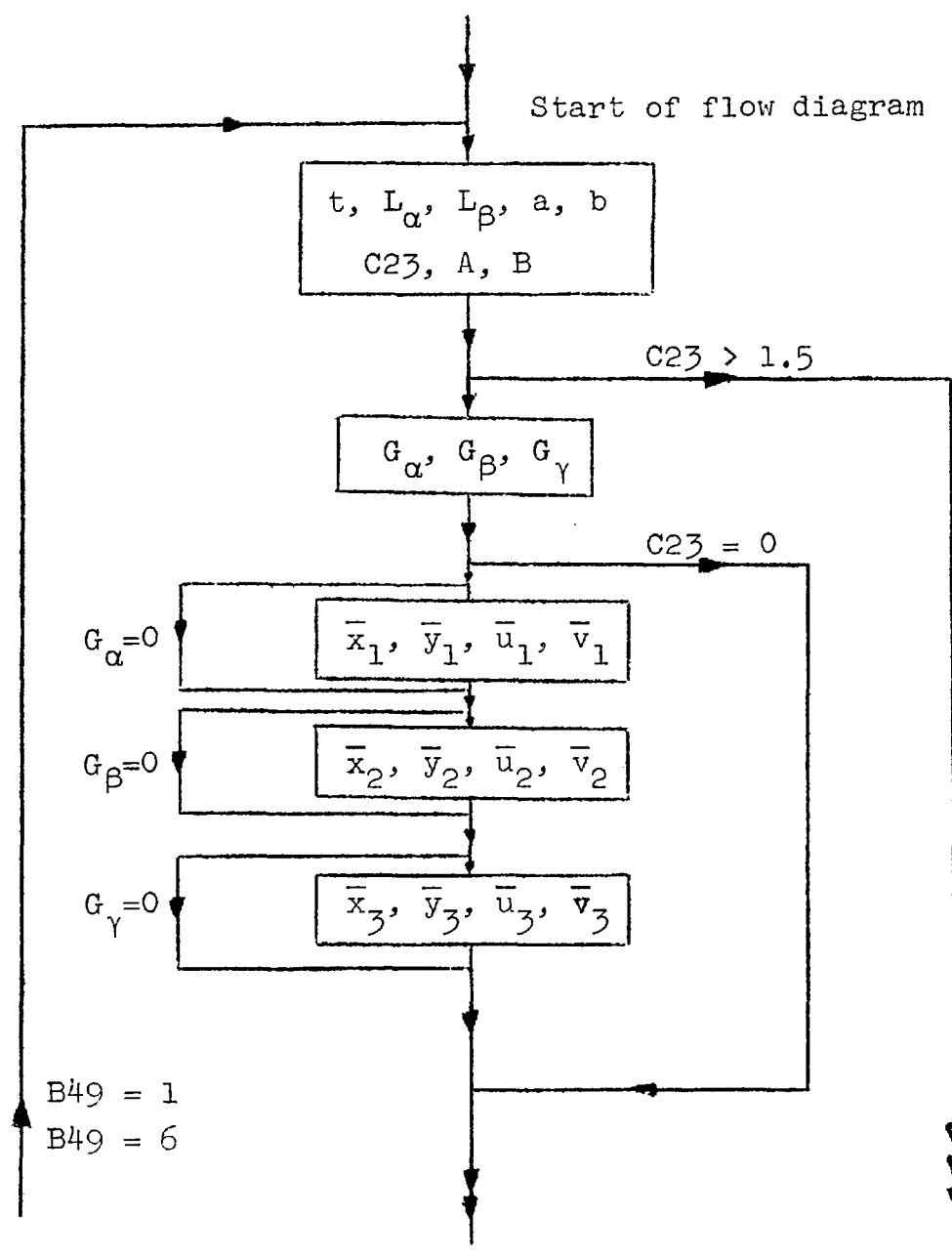


Figure 8.1

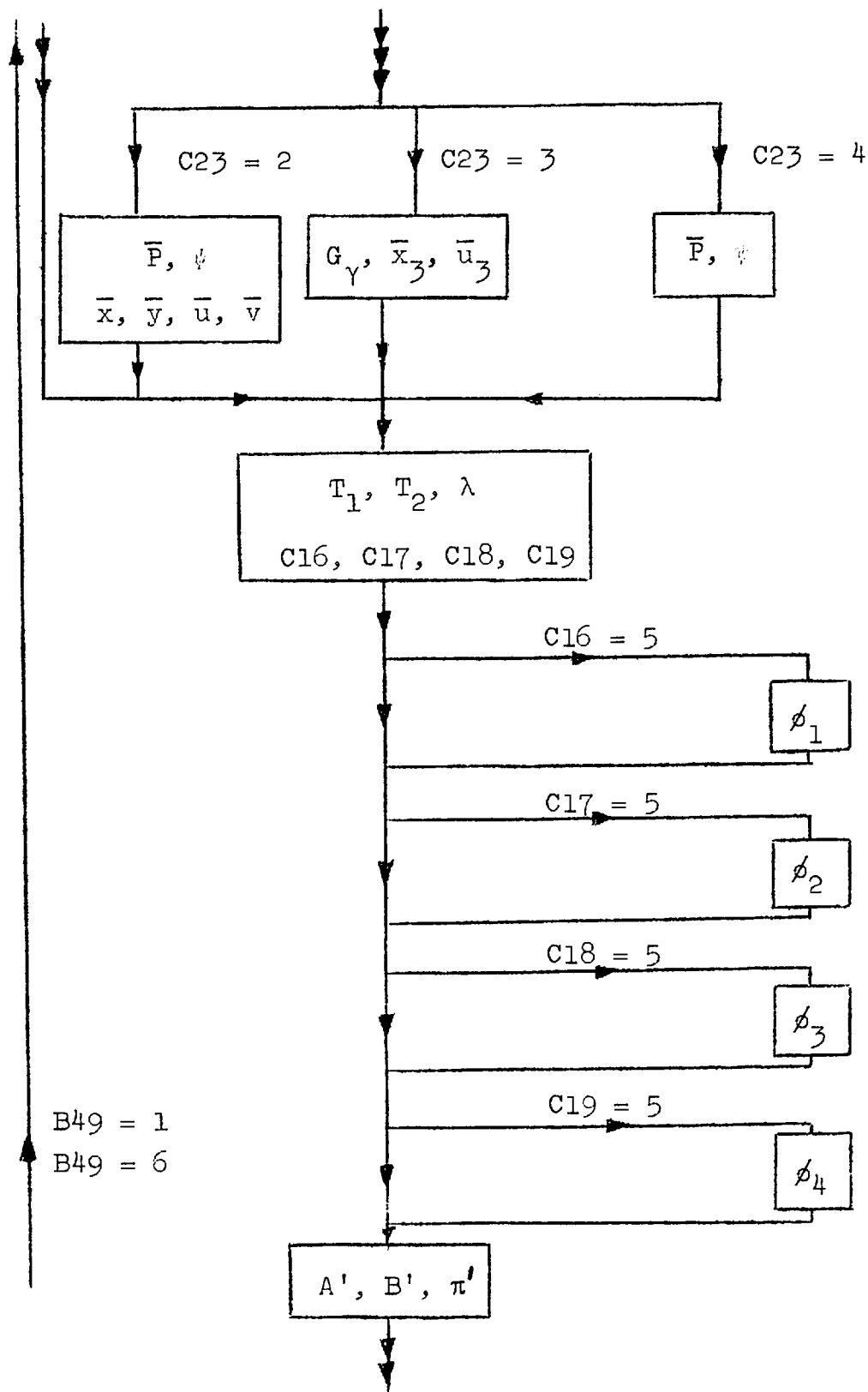


Figure 8.1 (continued)

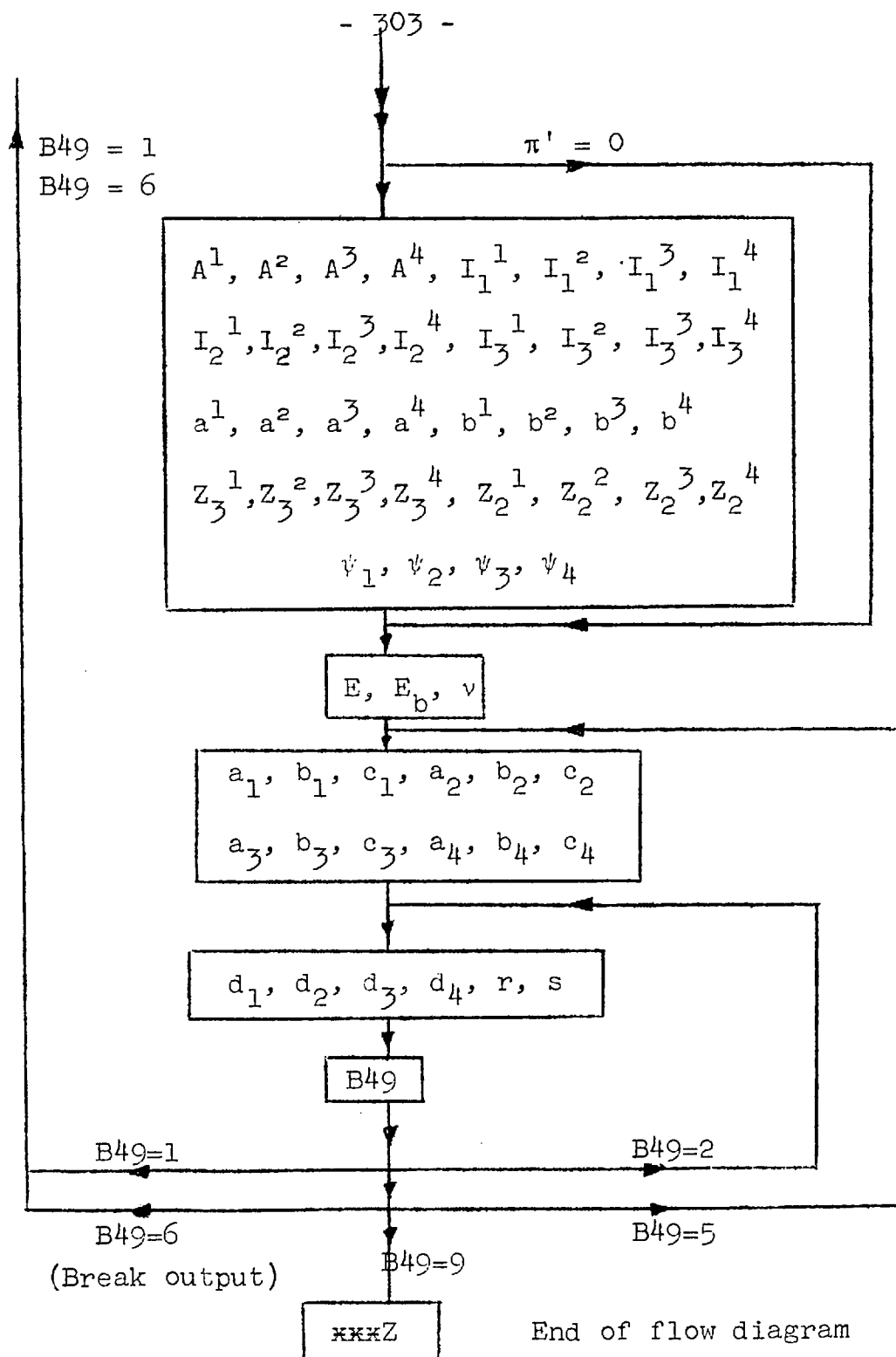
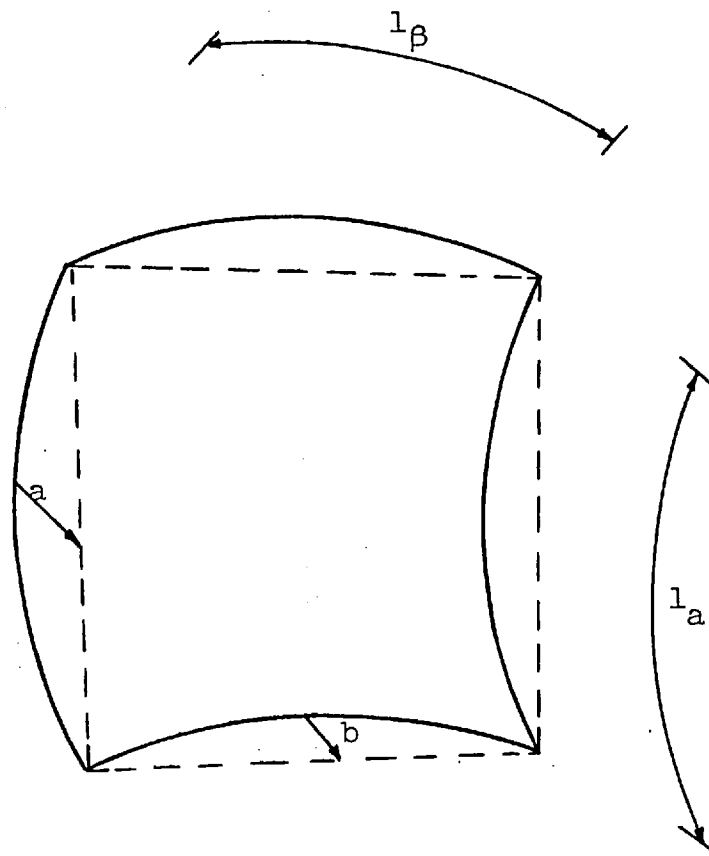


Figure 8.1 (continued)



$$k_\alpha = \frac{2a}{\left(\frac{l_\alpha^2}{4} + a^2\right)}$$

$$k_\beta = \frac{2b}{\left(\frac{l_\beta^2}{4} + b^2\right)}$$

Figure 8.2

TABLE 8.1

C23	Type of loading
0	Uniform loading in the α , β and γ directions acting over the total surface area of the shell. Loading expressed as double Fourier expansions (Appendix 1)
1	Uniform patch loading in the α , β and γ directions. Loading expressed as double Fourier expansions (Appendix 1)
2	Cylindrical shell - uniform patch loading in a fixed direction in the $(\beta-\gamma)$ plane. Loading expressed as double Fourier expansions (Appendix 1)
3	Band load in the γ direction. Loading expressed as a Fourier expansion in the α direction (Appendix 9)
4	Cylindrical shell - uniform loading in a fixed direction in the $(\beta-\gamma)$ plane acting over the total surface area of the shell. Loading expressed as a Fourier expansion in the α direction (Appendix 9)

Loading conditions represented by $C23 = 3$ and $C23 = 4$ can be used only if edges 3 and 4 are simply supported.

A, B define the nature of the loading about axes $\alpha = \frac{l_\alpha}{2}$
and $\beta = \frac{l_\beta}{2}$ respectively.

(+1/-1/0 denotes a symmetric/antimetric/general loading
about axis $\alpha = \frac{l_\alpha}{2}$ or $\beta = \frac{l_\beta}{2}$)

$G_\alpha, G_\beta, G_\gamma$ = intensity of loading on the shell in the α , β
and γ directions respectively.

$(l_\alpha \bar{x}_i, l_\beta \bar{y}_i)$ = coordinates of the centre of the loaded
area (refer appendix 1 where $x_i = l_\alpha \bar{x}_i$, $y_i = l_\beta \bar{y}_i$).

$(l_\alpha \bar{u}_i, l_\beta \bar{v}_i)$ = dimensions of the loaded area (refer
appendix 1 where $u_i = l_\alpha \bar{u}_i$, $v_i = l_\beta \bar{v}_i$).

$i = 1, 2, 3$ correspond to the loading in the α, β and γ
directions respectively

and l_α, l_β are the arc lengths of the shell in the α and β
directions respectively.

$\bar{P}$ = intensity of loading when $C23 = 2$ or $C23 = 4$

ψ = anticlockwise angle measured from the positive direc-
tion of loading ($C23 = 2$ or $C23 = 4$) to the positive
direction of shell axis γ at the origin of coordinates
(α, β, γ) (appendix 9).

T_1 = temperature on shell surface $\gamma = -t/2$

T_2 = temperature on shell surface $\gamma = +t/2$

λ = coefficient of linear thermal expansion of the shell
material.

(When $C23 > 2$, T_1 , T_2 , λ must be specified as zero).

c_{16} , c_{17} , c_{18} , c_{19} define the boundary conditions along edges 1, 2, 3 and 4 respectively. The boundary conditions are defined by the code numbers given in table 2.1.

ϕ_1 , ϕ_4 = anticlockwise angles measured from the plane of the oblique gable to the positive direction of shell axis γ along edges 1 and 4 respectively.

ϕ_2 , ϕ_3 = clockwise angles measured from the plane of the oblique gable to the positive direction of shell axis γ along edges 2 and 4 respectively.

A', B' define the nature of the loading and boundary conditions about the axes $\beta = \frac{l_\beta}{2}$ and $\alpha = \frac{l_\alpha}{2}$ respectively. (+1 defines a system where the loading and boundary conditions are symmetric about the axis $\beta = \frac{l_\beta}{2}$ or $\alpha = \frac{l_\alpha}{2}$. -1 defines a system where the loading is antisymmetric and the boundary conditions are symmetric about the axis $\beta = \frac{l_\beta}{2}$ or $\alpha = \frac{l_\alpha}{2}$. 0 defines a general system of loading and boundary conditions.)

π' = number of edge beams

A^k = area of a transverse section of the beam

I_1^k = second moment of area of a transverse section of the beam about beam axis II

I_2^k = second moment of area of a transverse section of the beam about beam axis III

I_3^k = 'twisting' moment of area of a transverse section
of the beam

a^k, b^k = distances measured from the centroid of the beam
to the junction of the shell and beam in the direc-
tion of beam axes II and III respectively (sign
convention for a^3, a^4 is opposite that for a^1 and a^2)

Z_3^k, Z_2^k = uniform loading on the beam in the direction
of shell axes III and II respectively

ψ_k = angle between beam axis III and shell axis γ defined
in Chapter III sections 3.1 and 3.2

$k = 1, 2, 3, 4$ refer to the beams along shell edges
1, 2, 3 and 4 respectively. For details of edge
beam properties and sign conventions refer sections
III.3.1 and III.3.2

E = Young's modulus of shell material

E_b = Young's modulus of edge beam material

ν = Poisson's ratio of shell material

$$P = a_1 (b_1) c_1^*$$

$$Q = a_2 (b_2) c_2$$

$$P' = a_3 (b_3) c_3$$

$$Q' = a_4 (b_4) c_4$$

*The notation $P = a_1 (b_1) c_1$ represents P taking the
sequence of values $a_1, a_1+b_1, a_1+2b_1, \dots, c_1-b_1, c_1$.

where P , Q are the complementary solution harmonics in the α and β directions respectively and P' , Q' are the particular solution harmonics in the α and β directions respectively.

The values to be specified for a_i and b_i ($i = 1, 2, 3, 4$) are dependent on B' , A' , A , B and are listed in table 8.2.

TABLE 8.2

$B' = +1$	$a_1 = 1 \quad b_1 = 2$	$A = +1$	$a_3 = 1 \quad b_3 = 2$
$B' = -1$	$a_1 = 2 \quad b_1 = 2$	$A = -1$	$a_3 = 0 \quad b_3 = 2$
$B' = 0$	$a_1 = 1 \quad b_1 = 1$	$A = 0$	$a_3 = 0 \quad b_3 = 1$
$A' = +1$	$a_2 = 1 \quad b_2 = 2$	$B = +1$	$a_4 = 1 \quad b_4 = 2$
$A' = -1$	$a_2 = 2 \quad b_2 = 2$	$B = -1$	$a_4 = 0 \quad b_4 = 2$
$A' = 0$	$a_2 = 1 \quad b_2 = 1$	$B = 0$	$a_4 = 0 \quad b_4 = 1$

The solution for the shell is printed over a rectangular grid.

d_1, d_2, d_3, d_4 define the rectangular domain and r, s define the grid over the rectangular domain (figure 8.3).

B49 is a symbol defining the next step of computation. The alternatives available are presented in table 8.3. (Note that more than one problem can be analysed in a single run.)

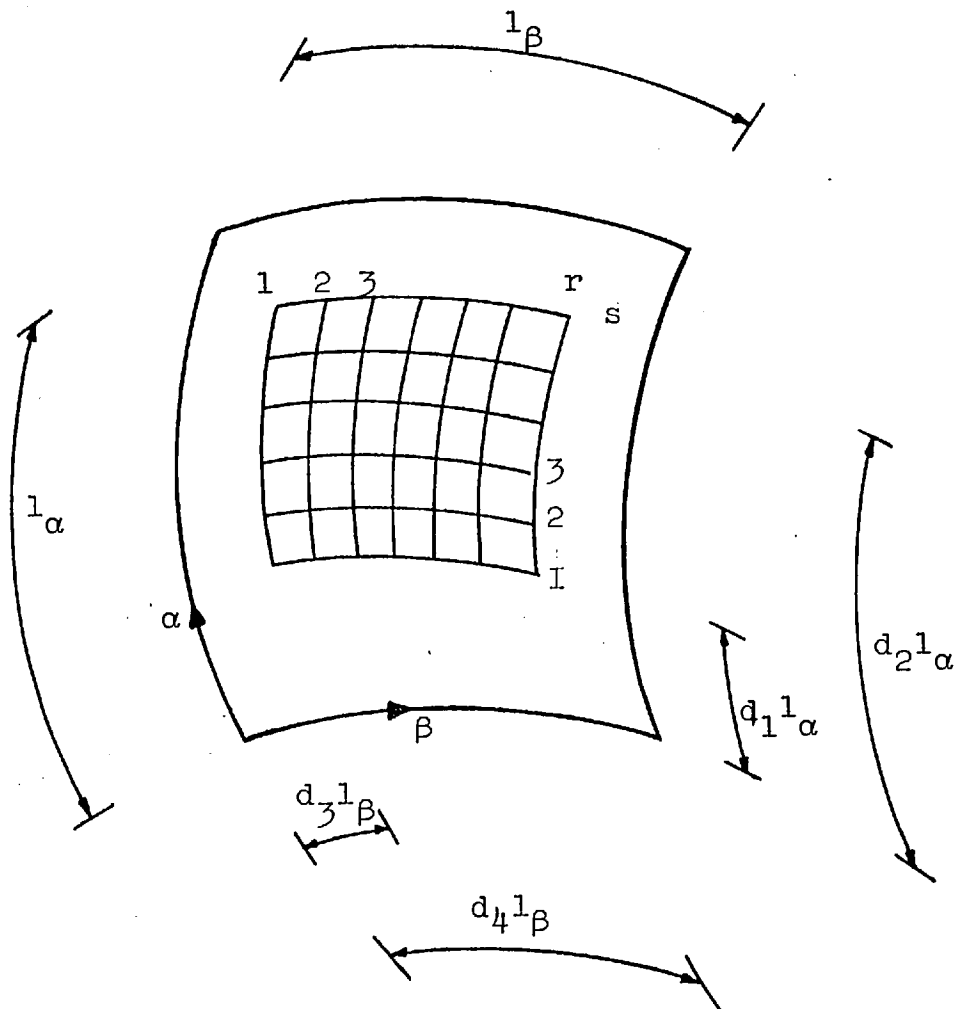


Figure 8.3

TABLE 8.3

B49	Notation
2	Print the shell solution, for the same problem over a different region of the shell
5	Compute the same shell, under the same loading conditions, for a different number of complementary solution and particular solution harmonics
1	Compute another problem
6	Break output ^x and compute another problem
9	End all computations

Note

(i) All symbols in the flow diagram are to be specified even though some symbols may not have any effect on the solution of a particular problem.

^xThis facility is necessary after every 50,000 instructions or every 2000 lines computer output.

- (ii) All irrelevant data to be specified as zero.
- (iii) A^k, I_1^k, I_2^k, I_3^k must be specified as non zero when there is a beam along shell edge k.
- (iv) The edge beam solution ($N_1, S_1, S_2, M_1, M_2, M_3, U_1, U_2, U_3, U_4$) is printed at 0, 1/8, 1/4, 3/8 and 1/2 points along the beam.
- (v) The shell solution consists of the following:-
 $u_\alpha, u_\beta, u_\gamma, \frac{\partial u_\gamma}{\partial \alpha}, \frac{\partial u_\gamma}{\partial \beta}, m_\alpha, m_{\alpha\beta}, m_\beta, n_\alpha, n_{\alpha\beta}, n_\beta, q_\alpha, q_\beta, q'_\alpha, q'_\beta.$
- (vi) Symbols used in the computer output and their equivalent notation in the thesis are given in table 8.4.
- (vii) All angles to be specified in degrees.

VIII.2. Job description

Instructions

The total number of instructions required is the sum of the instructions for compilation and execution of the programme.

Instructions for compilation = 14200

The number of instructions required for the execution of the programme is dependent on the type and number of problems to be analysed in a single run. For a single problem the number of instructions is mainly dependent on the number of equations to be solved. This can be calculated from the information given in table 8.5.

TABLE 8.4

Symbol in computer output	Symbol in thesis
A	α
B	β
C	γ
(A)	suffix α
(B)	suffix β
(C)	suffix γ
θ	ψ
PSI(A)	$\frac{\partial u_{\gamma}}{\partial \alpha}$
PSI(B)	$\frac{\partial u_{\gamma}}{\partial \beta}$
A'	a^k
B'	b^k
PSI	ψ_k
E'	E_b
NU	v

TABLE 8.5

Edge Condition	Number of equations per complementary solution harmonic specified in a direction parallel to the edge
Simply supported	0
Oblique gable	2
Hinged	1
Clamped	2
Free	2
Flexible beam	4

In calculating the total number of equations, edge 2 and edge 4 need not be considered when $A' = \pm 1$ and $B' = \pm 1$ respectively.

Table 8.6 gives an estimate of the number of instructions required per problem corresponding to the number of equations to be solved. Figures in this table are based on the assumption that the shell solution is printed at 30 points and 10 non zero harmonics are considered in both the α and β directions in computing the particular solution.

TABLE 8.6

Number of equations to be solved	Number of instructions
30	1000
40	1500
60	3000
80	6000
100	12000
120	15000

Output

For a typical problem where the shell solution is printed at 30 points the number of lines of print-out is approximately 300. Print-out at additional points count at about 5 lines per point.

Blocks

Compilation = 134

Execution = $60 + \frac{y^2}{512}$

where y = maximum number of equations to be solved in a single run.

Variables

Main = 750

Auxiliary = $2000 + y^2$

where y = maximum number of equations to be solved in a
single run.

VIII.3. Computer programme for translational shells

The programme is written in Extended Mercury Auto-code (EMA)⁽³⁷⁾ for the Atlas computer at the University of London Institute of Computer Science.

```
JOB
DSC42FC1, GUNASEKERA G R16 RUN 15 15.3.67
COMPUTING 135000 INSTRUCTIONS
OUTPUT
O LINE PRINTER 3500 LINES
STORE 113/135 BLOCKS
COMPILER EMA
MAIN >750
AUXILIARY(0,30000)
DUMPS 0
DEPTH 0
```

ROUTINE 6

```
>> LEVY SOLUTION (EDGES 3 AND 4 ON GABLES)
>> LOADING EXPANDED AS A DOUBLE F.SERIES
1) NEWLINE 2
CAPTION
SOLUTION VECTORS
NEWLINE
CAPTION
```

EDGE 1

CAPTION

EDGE 2

NEWLINE

CAPTION

P	N'(ab)	Q'(b)	N(b)	M(b)
	N'(ab)	Q'(b)	N(b)	M(b)

NEWLINE

JUMP 2, C23=3

JUMP 3, C23=4

P=P'(R')R

J'=(P-P')/R'

JUMPDOWN (R4/1)

JUMPDOWN (R1/9)

Ø6(A5)X2,2

Ø6(A7)X4,2

```
Ø7(A5)X0,4
Ø7(A7)X4,4
JUMP 37,A'≠0
JUMPDOWN (R1/9)
Ø6(A6)X2,2
Ø6(A8)X4,2
Ø7(A6)X0,4
Ø7(A8)X4,4
37)JUMPDOWN 11
REPEAT
JUMP 40
```

>> LOADING EXPANDED AS A F.SERIES IN ALPHA DIRECTION

```
2)P=P'(R')R
J'=(P-P')/R'
JUMPDOWN (R3)
X0=C2OY8
X1=C2OY0
X2=C2OY9
X3=C2OY11
X4=Y3
X5=Y13-H6Y6
X6=Y4
X7=Y7
;12=X5
;13=X5
Ø7(A5)X0,4
Ø7(A7)X4,4
JUMP 38,A'≠0
A6=Ø15(A5,4)
A8=Ø15(A7,4)
38)JUMPDOWN 11
REPEAT
JUMP 40
```

>> CYLINDRICAL SHELL SUBJECTED TO A CONSTANT LOAD IN THE (B-C)PLANE

>> FOURIER EXPANSION IN ALPHA DIRECTION

```
3)P=P'(R')R
J'=(P-P')/R'
JUMPDOWN (R3)
;1=ØCOS(H32)
;2=ØSIN(H32)
X0=C2OY8;1
X1=C2OY0;1
X2=C2OY9;2
X3=C2OY11;2
X4=Y3;2
X5=(Y13-H6Y6);2
X6=Y4;1
X7=Y7;1
```

```
;12=X5
Ø7(A5)X0,4
Ø7(A7)X4,4
  JUMP 25,A'≠0
;1=ØCOS(H33)
;2=ØSIN(H33)
X0=C20Y8;1
X1=C20Y0;1
X2=C20Y9;2
X3=C20Y11;2
X4=Y3;2
X5=(Y13-H6Y6);2
X6=Y4;1
X7=Y7;1
;13=X5
Ø7(A6)X0,4
Ø7(A8)X4,4
25)JUMPDOWN 11
REPEAT
JUMP 40
```

```
11);17=124
W'=A'
;16=5
JUMPDOWN (R9/1)
JUMP 12,C16=1
JUMP 13,C16=2
JUMP 14,C16=3
JUMP 15,C16=4
JUMP 23,C16=5
JUMPDOWN (R2/1)
A25=Ø26(A1,A3,4,4,4)
A25=Ø26(A25,A2,4,4,4)
A25=Ø26(A25,A0,4,4,4)
A23=Ø26(A25,A34,4,4,4)
A22=Ø26(A0,A16,4,4,4)
A14=Ø14(A22,C20,A23,16)
A23=Ø26(A25,A35,4,4,4)
A22=Ø26(A0,A17,4,4,4)
A15=Ø14(A22,C20,A23,16)
JUMPDOWN (R4/5)
B36=Ø15(A0,4)
JUMP 16
23);10=ØSIN(;31)
;11=ØCOS(;31)
Ø6(A5)Y0,3
X0=Y0
X1=Y1;11-Y2;10
```

```
Ø6(A7+2)Y0,2
X2=;10;12+Y0;11
X3=Y1
Ø7(B36)X0,4
A14=Ø15(A16,4)
A15=Ø15(A17,4)
A14+12=Ø15(A34+12,4)
A15+12=Ø15(A35+12,4)
Ø6(A34+4)X1,8
K=1(1)4
XK=XK;10+X(K+4);11
REPEAT
Ø7(A14+8)X1,4
Ø6(A16+4)X1,8
K=1(1)4
XK=XK;11-X(K+4);10
REPEAT
Ø7(A14+4)X1,4
Ø6(A35+4)X1,8
K=1(1)4
XK=XK;10+X(K+4);11
REPEAT
Ø7(A15+8)X1,4
Ø6(A17+4)X1,8
K=1(1)4
XK=XK;11-X(K+4);10
REPEAT
Ø7(A15+4)X1,4
JUMP 16
12)B36=Ø15(A5,2)
B36+2=Ø15(A7+2,2)
A14=Ø15(A16,8)
A14+8=Ø15(A34+8,8)
A15=Ø15(A17,8)
A15+8=Ø15(A35+8,8)
JUMP 16
13)B36=Ø15(A5,4)
A14=Ø15(A16,16)
A15=Ø15(A17,16)
JUMP 16
14)B36=Ø15(A7,4)
A14=Ø15(A34,16)
A15=Ø15(A35,16)
JUMP 16
15)B36=Ø15(A5,3)
B36+3=Ø15(A7+3,1)
A14=Ø15(A16,12)
A14+12=Ø15(A34+12,4)
A15=Ø15(A17,12)
```

A15+12=015(A35+12,4)

```
16)JUMP 21,A'≠0
JUMP 17,C17=1
JUMP 18,C17=2
JUMP 19,C17=3
JUMP 20,C17=4
JUMP 24,C17=5
JUMPDOWN (R2/2)
A25=026(A1,A3,4,4,4)
A25=026(A25,A2,4,4,4)
A25=026(A25,A0,4,4,4)
A23=026(A25,A34,4,4,4)
A22=026(A0,A16,4,4,4)
A36=013(A22,C20,A23,16)
A23=026(A25,A35,4,4,4)
A22=026(A0,A17,4,4,4)
A37=013(A22,C20,A23,16)
JUMPDOWN (R4/6)
B36+4=015(A0,4)
JUMP 21
24);10=0SIN(;32)
;11=0COS(;32)
06(A6)Y0,3
X0=Y0
X1=Y1;11+Y2;10
06(A8+2)Y0,2
X2=-;13;10+Y0;11
X3=Y1
07(B36+4)X0,4
A36=015(A16,4)
A37=015(A17,4)
A36+12=015(A34+12,4)
A37+12=015(A35+12,4)
06(A34+4)X1,8
K=1(1)4
XK=-XK;10+X(K+4);11
REPEAT
07(A36+8)X1,4
06(A16+4)X1,8
K=1(1)4
XK=XK;11+X(K+4);10
REPEAT
07(A36+4)X1,4
06(A35+4)X1,8
K=1(1)4
XK=-XK;10+X(K+4);11
REPEAT
07(A37+8)X1,4
```

```
Ø6(A17+4)X1,8
K=1(1)4
XK=XK;11+X(K+4);10
REPEAT
Ø7(A37+4)X1,4
JUMP 21
18)B36+4=Ø15(A6,4)
A36=Ø15(A16,16)
A37=Ø15(A17,16)
JUMP 21
17)B36+4=Ø15(A6,2)
B36+6=Ø15(A8+2,2)
A36=Ø15(A16,8)
A36+8=Ø15(A34+8,8)
A37=Ø15(A17,8)
A37+8=Ø15(A35+8,8)
JUMP 21
19)B36+4=Ø15(A8,4)
A36=Ø15(A34,16)
A37=Ø15(A35,16)
JUMP 21
20)B36+4=Ø15(A6,3)
B36+7=Ø15(A8+3,1)
A36=Ø15(A16,12)
A36+12=Ø15(A34+12,4)
A37=Ø15(A17,12)
A37+12=Ø15(A35+12,4)

21)B33=Ø29(-1,8)
B36=Ø26(B33,B36,8,1,8)
Z0=H2
JUMPDOWN (R10/3)
DJ'=Ø15(B34,4)
EJ'=Ø15(B35,4)
A22=Ø26(A34,DJ',4,1,4)
A23=Ø26(A21,EJ',4,1,4)
A23=Ø26(A35,A23,4,1,4)
A23=Ø11(A22,A23,4)
Ø6(A23)X1,4
A22=Ø26(A35,EJ',4,1,4)
A23=Ø26(A21,DJ',4,1,4)
A23=Ø26(A34,A23,4,1,4)
A23=Ø11(A22,A23,4)
Ø6(A23)X5,4
NEWLINE
PRINT(P)2,0
I=1(1)8
JUMP 99,I≠5
```

```
SPACE 8
99)PRINT(XI)0,4
REPEAT
RETURN
40)JUMPDOWN (R14)
RETURN
```

**

ROUTINE 15

```
>> EDGE BEAM SOLUTIONS PRINT-OUT
>> EDGE BEAM 1
```

```
1);17=124
N'=4
H20=0
H25=H1
H54=P'
H55=R'
H56=R
JUMP 2,C16#0
H12=0
H24=1
NEWLINE 3
CAPTION
EDGE BEAM 1
JUMPDOWN 70
```

```
>> EDGE BEAM 2
```

```
2)JUMP 3,L'#4
H12=1
H24=2
NEWLINE 3
CAPTION
EDGE BEAM 2
JUMPDOWN 70
```

```
>> EDGE BEAM 3
```

```
3)H25=H2
H54=Q'
H55=S'
H56=S
JUMP 4,C18#0
H12=0
H24=3
NEWLINE 3
CAPTION
EDGE BEAM 3
JUMPDOWN 70
```

```
>> EDGE BEAM 4
4)JUMP 5,M'#4
H12=1
H24=4
NEWLINE 3
CAPTION
EDGE BEAM 4
JUMPDOWN 70
JUMP 5
```

```
>> SOLUTION
70)H21=.5H25
H22=(H21-H20)/N'
NEWLINE 2
```

CAPTION				
COORDINATE I	N1	M1	M2	M3
CAPTION				
S1	S2			
NEWLINE				
CAPTION	U1	U3	U2	U4

```
JUMP 72,H24>2.5
JUMPDOWN 18
JUMP 73
72)JUMPDOWN 58
73)JUMPDOWN (R1)
I=0(1)N'
Ø7(G'+10I)X1,10
REPEAT
NEWLINE
```

```
I'=H54
J'=H55
K'=H56
P=I'(J')K'
;16=5
Q=P
JUMP 74,H24=2
JUMP 75,H24=3
JUMP 76,H24=4
JUMPDOWN (R2/1)
JUMP 77
74)JUMPDOWN (R2/2)
JUMP 77
75)JUMPDOWN (R2/3)
JUMP 77
76)JUMPDOWN (R2/4)
77)J=(P-I')/J'
H6=P;/H25
```

```
Y15=ØPARITY(H12)
A25=Ø29(Y15,4)
U+4J=Ø26(A0,U+4J,4,1,4)
U+4J=Ø26(A25,U+4J,4,1,4)
A25=Ø26(A2,U+4J,4,1,4)
A25=Ø11(A25,A4,4)
A26=Ø26(A3,A25,4,1,4)
Ø6(U+4J)Y1,1
Ø6(U+4J+2)Y2,1
Ø6(A25)X1,4
X5=H6X2+Y3Y1
X6=Y2/H6+Y11/H6
Ø6(A26)X7,4
I=Ø(1)N'
H23=H20+IH22
;1=ØSIN(H6H23)
;2=ØCOS(H6H23)
Y1=;1X1
Y2=;1X2
Y3=;1X3
Y4=;2X4
Y5=;2X5
Y6=;2X6
Y7=;2X7
Y8=;1X8
Y9=;1X9
Y10=;1X10
Ø7(A26)Y1,10
G'+10I=Ø11(G'+10I,A26,10)
REPEAT
REPEAT

>> PRINT-OUT
I=Ø(1)N'
H23=H20+IH22
NEWLINE 2
PRINT(H23)4,2
SPACE 10
Ø6(G'+10I)Y1,10
K=1(1)10
JUMP 78,K≠7
NEWLINE
SPACE 20
78)PRINT(YK)0,4
REPEAT
REPEAT
RETURN
```

>> RESULTANT SHELL ACTIONS ALONG EDGE 1 (OR 2)

```
18)P=P'(R')R
JUMP 23,C23=3
JUMP 24,C23=4
JUMPDOWN (R4/1)
X2=0
X3=0
JUMP 14,H12=1
Ø6(A7)X0,2
JUMP 15
14)Ø6(A8)X0,2
JUMP 15
23)JUMPDOWN (R3)
X0=Y3-C27H3Y6
X1=Y13-H6Y6
X2=Y4
X3=Y7
JUMP 15
24)JUMPDOWN (R3)
JUMP 25,H12=1
;1=ØCOS(H32)
;2=ØSIN(H32)
JUMP 26
25);1=ØCOS(H33)
;2=ØSIN(H33)
26)X0=(Y3-C27H3Y6);2
X1=(Y13-H6Y6);2
X2=Y4;1
X3=Y7;1
15)J'=(P-P')/R'
K'=U+4J'
Ø7(K')X0,4
JUMPDOWN (R9/1)
;18=H2
JUMPDOWN (R8/5)
JUMP 16,H12=1
B40=Ø26(A21,EJ',4,1,4)
B40=Ø26(A35,B40,4,1,4)
B39=Ø26(A34,DJ',4,1,4)
JUMP 17
16)B39=Ø26(A21,DJ',4,1,4)
B39=Ø26(A34,B39,4,1,4)
B40=Ø26(A35,EJ',4,1,4)
17)B40=Ø11(B39,B40,4)
K'=Ø11(K',B40,4)
JUMP 22,M+M'=0
U6=P;/H1
X18=ØPARITY(P)
```

```

U5=H1
Q=Q'(S')S
J=(Q-Q')/S'
B34=Ø15(FJ,4)
B35=Ø15(GJ,4)
JUMPDOWN (R7/2)
JUMPDOWN (R9/27)
JUMPDOWN (R11/4)
JUMP 19,H12=0
X18=ØPARITY(Q)
JUMPDOWN (R11/8)
19)K'=Ø11(K',A7,4)
REPEAT
22)REPEAT
RETURN

```

>> RESULTANT SHELL ACTIONS ALONG EDGE 3 (OR 4)

```

58)Q=Q'(S')S
JUMPDOWN (R4/3)
X2=0
X3=0
JUMP 54,H12=1
Ø6(A7)X0,2
JUMP 55
54)Ø6(A8)X0,2
55)J'=(Q-Q')/S'
K'=U+4J'
Ø7(K')X0,4
JUMPDOWN (R9/2)
;18=H1
JUMPDOWN (R8/5)
JUMP 56,H12=1
B40=Ø26(A21,GJ',4,1,4)
B40=Ø26(A35,B40,4,1,4)
B39=Ø26(A34,FJ',4,1,4)
JUMP 57
56)B39=Ø26(A21,FJ',4,1,4)
B39=Ø26(A34,B39,4,1,4)
B40=Ø26(A35,GJ',4,1,4)
57)B40=Ø11(B39,B40,4)
K'=Ø11(K',B40,4)
JUMP 62,L+L'=0
U6=Q;/H2
X18=ØPARITY(Q)
U5=H2
P=P'(R')R
J=(P-P')/R'
B34=Ø15(DJ,4)
B35=Ø15(EJ,4)

```

```
JUMPDOWN (R7/1)
JUMPDOWN (R9/27)
JUMPDOWN (R11/4)
JUMP 59,H12=0
X18=0PARITY(P)
JUMPDOWN (R11/8)
59)K'=011(K',A7,4)
REPEAT
62)REPEAT
5)RETURN
```

**

ROUTINE 9

```
>> C.F. MATRICES
1)JUMPDOWN (R7/1)
JUMP 3
2)JUMPDOWN (R7/2)
```

```
>> MATRICES PA,PB
3);3=-U3U4D
;5=C27U2UOD(1-C)
;6=DU4U2
X0=;6C2-;5C1
X1=;6C1+;5C2
X2=(;6C4-;5C3)C32+C33;6U2
X3=(;6C3+;5C4)C32-C33;5U2
X4=-D(-C1C1C1+1.5C7C2+U3C1(2-C))
X5=-D(-C2C2C2+1.5C7C1-U3C2(2-C))
X6=-DC32(-C3C3C3+1.5C9C4+U3C3(2-C))
X7=-DC32(-C4C4C4+1.5C9C3-U3C4(2-C))-C33DU2U3(1-C)
X8=0
X9=;3
X10=C33;3
X11=;3C32
X12=-D(C8-CU3)
X13=DC7
X14=-DC32(C10-CU3)
X15=DC9C32-C33DU3(1-C)
07(A34)X0,16
0'=0(1)7
X0'=-X0'
REPEAT
07(A35)X0,16
```

```
>> MATRICES QC,QD
;1=C20/U4
;3=-;1/U2
```

```

X0=;3(U4U0+C7)
X1=;3(CU3+C8)
X2=;3(U4U0+C9)C32+C33;3U3(1+C)
X3=;3(CU3+C10)C32+C33;3U4U0
X4=C20
X5=0
X6=C20C32
X7=C20C33
X8=;1(-U4U1C1-U3C2+CC2C11)/C11
X9=;1(-U4U1C2+U3C1+CC1C11)/C11
X10=;1C32(-U4U1C3-U3C4+CC4C12)/C12+C33;1U2(1+C)
X11=;1C32(-U4U1C4+U3C3+CC3C12)/C12-C33;1U0U4/U2
X12=-C1C20
X13=C2C20
X14=-C32C3C20
X15=C4C20C32-C33U2C20
Ø7(A16)X0,16
O'=8(1)15
XO'=-XO'
REPEAT
Ø7(A17)X0,16
JUMP 7,;17=124

```

```

JUMP 21,;19=0
JUMP 28,;19=2
JUMP 32,;19=3
JUMP 33,;19=4
A(14+I')=Ø15(A16,4)
A(14+I')+12=Ø15(A34+12,4)
A(15+I')=Ø15(A17,4)
A(15+I')+12=Ø15(A35+12,4)
Ø6(A34+4)X1,8
K=1(1)4
XK=XKØSIN(;54)+X(K+4)ØCOS(;54)
REPEAT
Ø7(A(14+I')+8)X1,4
Ø6(A16+4)X1,8
K=1(1)4
XK=XKØCOS(;54)-X(K+4)ØSIN(;54)
REPEAT
Ø7(A(14+I')+4)X1,4
Ø6(A35+4)X1,8
K=1(1)4
XK=XKØSIN(;54)+X(K+4)ØCOS(;54)
REPEAT
Ø7(A(15+I')+8)X1,4
Ø6(A17+4)X1,8
K=1(1)4
XK=XKØCOS(;54)-X(K+4)ØSIN(;54)

```

```

REPEAT
Ø7(A(15+I')+4)X1,4
JUMP 22
21)B42=Ø26(A23,A34,4,4,4)
A26=Ø26(A22,A16,4,4,4)
A(14+I')=Ø12(A26,B42,16)
A26=Ø26(A22,A17,4,4,4)
B42=Ø26(A23,A35,4,4,4)
A(15+I')=Ø12(A26,B42,16)
JUMP 22
28)A(14+I')=Ø15(A16,16)
A(15+I')=Ø15(A17,16)
JUMP 22
32)A(14+I')=Ø15(A34,16)
A(15+I')=Ø15(A35,16)
JUMP 22
33)A(14+I')=Ø15(A16,12)
A(14+I')+12=Ø15(A34+12,4)
A(15+I')=Ø15(A17,12)
A(15+I')+12=Ø15(A35+12,4)
22)JUMP 26,W'≠0
JUMP 23,;20=1
JUMP 24,;20=2
JUMP 30,;20=3
JUMP 25,;20=4
JUMP 29,;20=5
B42=Ø26(A25,A34,4,4,4)
A26=Ø26(A0,A16,4,4,4)
A(36-I')=Ø12(A26,B42,16)
B42=Ø26(A25,A35,4,4,4)
A26=Ø26(A0,A17,4,4,4)
A(37-I')=Ø12(A26,B42,16)
JUMP 26
30)A(36-I')=Ø15(A34,16)
A(37-I')=Ø15(A35,16)
JUMP 26
23)A(36-I')=Ø15(A16,8)
A(36-I')+8=Ø15(A34+8,8)
A(37-I')=Ø15(A17,8)
A(37-I')+8=Ø15(A35+8,8)
JUMP 26
29)A(36-I')=Ø15(A16,4)
A(36-I')+12=Ø15(A34+12,4)
A(37-I')=Ø15(A17,4)
A(37-I')+12=Ø15(A35+12,4)
Ø6(A34+4)X1,8
K=1(1)4
XK=XKØEIN(;30)+X(K+4)ØCOS(;30)
REPEAT
Ø7(A(36-I')+8)X1,4

```

```

Ø6(A16+4)X1,8
K=1(1)4
XK=XKØCOS(;30)-X(K+4)ØSIN(;30)
REPEAT
Ø7(A(36-I')+4)X1,4
Ø6(A35+4)X1,8
K=1(1)4
XK=XKØSIN(;30)+X(K+4)ØCOS(;30)
REPEAT
Ø7(A(37-I')+8)X1,4
Ø6(A17+4)X1,8
K=1(1)4
XK=XKØCOS(;30)-X(K+4)ØSIN(;30)
REPEAT
Ø7(A(37-I')+4)X1,4
JUMP 26
24)A(36-I')=Ø15(A16,16)
A(37-I')=Ø15(A17,16)
JUMP 26
25)A(36-I')=Ø15(A16,12)
A(36-I')+12=Ø15(A34+12,4)
A(37-I')=Ø15(A17,12)
A(37-I')+12=Ø15(A35+12,4)
26)JUMP 7,;17=123

```

```

>> MATRICES TJ,TK
27);2=-DU2
;3=-C20/(U2U4)
;5=C27U1DU2(1-C)
;6=DU4U2
X0=;6C2-;5C1
X1=;6C1+;5C2
X2=(;6C4-;5C3)C32+C33;6U2
X3=(;6C3+;5C4)C32-C33;5U2
X4=;2((2-C)C8-U3)
X5=-;2C7(2-C)
X6=;2C32((2-C)C10-U3)
X7=-;2C9C32(2-C)+C33;2U3(1-C)
X8=;3(C7+U4U0)
X9=;3(C8+CU3)
X10=;3C32(C9+U4U0)+C33;3U3(1+C)
X11=;3C32(C10+CU3)+C33;3U4U0
X12=U2C20
X13=0
X14=U2C20C32
X15=U2C20C33
Ø7(A18)X0,16
O'=0(1)3

```

X0'=-X0'

REPEAT

Ø7(A19)X0,16

JUMP 7

>> MATRICES FOR SOLN. (B37,B38)

4)JUMPDOWN (R7/1)

I'=0

JUMP 6

5)JUMPDOWN (R7/2)

I'=4

>> MATRICES B37,B38

6)X0=1

X1=0

X2=C32

X3=C33

X(I'+4)=-D(CC8-U3)

X(I'+5)=DCC7

X(I'+6)=-DC32(CC10-U3)

X(I'+7)=DCC9C32+C33DU3(1-C)

X(8-I')=-D(-CU3+C8)

X(9-I')=DC7

X(10-I')=-DC32(-CU3+C10)

X(11-I')=DCC9C32-C33DU3(1-C)

;1=DU4

X(I'+12)=;1C7

X(I'+13)=;1C8

X(I'+14)=;1C9C32+C33;1U3

X(I'+15)=;1C10C32

X(16-I')=0

X(17-I')=-U3;1

X(18-I')=-C33U3;1

X(19-I')=-U3;1C32

X20=DU2C1(1-C)

X21=-DU2C2(1-C)

X22=DU2C3C32(1-C)

X23=-DU2C4C32(1-C)+C33DU3(1-C)

X24=U2C2;1

X25=U2C1;1

X26=U2C4;1C32+C33U3;1

X27=U2C3;1C32

;2=-1/(U2U4)

X(28+2I')=;2(C7+U4U0)

X(29+2I')=;2(C8+CU3)

X(30+2I')=;2C32(C9+U4U0)+C33;2U3(1+C)

X(31+2I')=;2C32(C10+CU3)+C33;2U4U0

X(32+2I')=U2

X(33+2I')=0

```

X(34+2I')=U2C32
X(35+2I')=U2C33
X(36-2I')=(-U4U1C1-U3C2+CC2C11)/(C11U4)
X(37-2I')=(-U4U1C2+U3C1+CC1C11)/(C11U4)
X(38-2I')=(-U4U1C3-U3C4+CC4C12)C32/(C12U4)+C33U2(1+C)/U4
X(39-2I')=(-U4U1C4+U3C3+CC3C12)C32/(C12U4)-C33U1/U2
X(40-2I')=-C1
X(41-2I')=C2
X(42-2I')=-C3C32
X(43-2I')=C4C32-C33U2
;3=-DU2
X(44+I')=;3(C8-U3)
X(45+I')=-;3C7
X(46+I')=;3C32(C10-U3)
X(47+I')=-;3C9C32
X(48-I')=-DC1(-C1C1+3C2C2+U3)
X(49-I')=-DC2(-C2C2+3C1C1-U3)
X(50-I')=-DC3C32(-C3C3+3C4C4+U3)
X(51-I')=-DC4C32(-C4C4+3C3C3-U3)
X(52+I')=;3(C8(2-C)-U3)
X(53+I')=-;3C7(2-C)
X(54+I')=;3C32(C10(2-C)-U3)
X(55+I')=-;3C9C32(2-C)+C33;3U3(1-C)
X(56-I')=-DC1(-C1C1+3C2C2+U3(2-C))
X(57-I')=-DC2(-C2C2+3C1C1-U3(2-C))
X(58-I')=-DC3C32(-C3C3+3C4C4+U3(2-C))
X(59-I')=-DC4C32(-C4C4+3C3C3-U3(2-C))-C33DU2U3(1-C)
Ø7(B37)X0,60
O'=20(1)27
XO'=-XO'
REPEAT
JUMP 8,I'=4
O'=36(1)43
XO'=-XO'
REPEAT
O'=48(1)51
XO'=-XO'
REPEAT
O'=56(1)59
XO'=-XO'
REPEAT
JUMP 9
8)O'=28(1)35
XO'=-XO'
REPEAT
O'=44(1)47
XO'=-XO'
REPEAT
O'=52(1)55

```

```
XO'=-XO'
REPEAT
9)Ø7(B38)X0,60
7)RETURN
```

**

ROUTINE 3

```
>> NAVIER SOLUTION COEFFICIENTS
1)H6=P;/H1
H7=Q;/H2
JUMP 2,C23=2
JUMP 3,C23=3
JUMP 4,C23=4
;10=16/(H1H2)
X=0
JUMP 10,X'=0
JUMP 10,Q=0
JUMP 6,P=0
JUMP 5,A=1
X=ØCOS(H6H41)ØSIN(.5H6H43)/H6
JUMP 7
5)X=(ØSIN(H6H41)-ØSIN(H6H41-.5H6H43))/H6
JUMP 7
6)JUMP 10,A=1
X=H43/4
7)JUMP 8,B=-1
X=;10X'XØSIN(H7H42)ØSIN(.5H7H44)/H7
JUMP 10
8)X=;10X'X(-ØCOS(H7H42)+ØCOS(H7H42-.5H7H44))/H7
10)Y=0
JUMP 16,Y'=0
JUMP 16,P=0
JUMP 11,A=-1
Y=ØSIN(H6H45)ØSIN(.5H6H47)/H6
JUMP 13
11)Y=(-ØCOS(H6H45)+ØCOS(H6H45-.5H6H47))/H6
13)JUMP 15,Q=0
JUMP 14,B≠1
Y=;10Y'Y(ØSIN(H7H46)-ØSIN(H7H46-.5H7H48))/H7
JUMP 16
14)Y=;10Y'YØSIN(H7H46)ØSIN(.5H7H48)/H7
JUMP 16
15)Y=;10Y'YH48/4
JUMP 16,B≠1
Y=0
16)Z=0
JUMP 50,Z'=0
```

```

JUMP 50,P=0
JUMP 50,Q=0
JUMP 17,A=-1
Z=ØSIN(H6H49)ØSIN(.5H6H51)/H6
JUMP 18
17)Z=(-ØCOS(H6H49)+ØCOS(H6H49-.5H6H51))/H6
18)JUMP 19,B=-1
Z=;1ØZ'ZØSIN(H7H50)ØSIN(.5H7H52)/H7
JUMP 50
19)Z=;1ØZ'Z(-ØCOS(H7H50)+ØCOS(H7H50-.5H7H52))/H7
JUMP 50

2)X=0
Y=0
Z=0
JUMP 51,P=0
Z=8Z'ØSIN(H6H49)ØSIN(.5H6H51)/(H6H1H2)
Y=-Z
;1=H50+.5H52
;2=H50-.5H52
JUMP 23,Q=0
JUMP 20,ØMOD(C30-180)<.000001
JUMP 20,ØMOD(C30-360)<.000001
;3=(-ØCOS((H7-H4);1+H32)+ØCOS((H7-H4);2+H32))/(2H7-2H4)
;4=(-ØCOS((H7+H4);1-H32)+ØCOS((H7+H4);2-H32))/(2H7+2H4)
JUMP 22
20)JUMP 21,H4<0
;3=.5(;1-;2)ØSIN(H32)
;4=.25(-ØCOS(2H7;1-H32)+ØCOS(2H7;2-H32))/H7
JUMP 22
21);3=.25(-ØCOS(2H7;1+H32)+ØCOS(2H7;2+H32))/H7
;4=.5(;2-;1)ØSIN(H32)
22)Z=(;3+;4)Z
Y=(;3-;4)Y
JUMP 50
23)Z=0
Y=.5H2Y(ØCOS(H32-H4;1)-ØCOS(H32-H4;2))/H4
JUMP 52

3)X=0
Y=0
Z=0
JUMP 60,P=0
Z=4Z'ØSIN(H6H49)ØSIN(.5H6H51)/(H6H1)
JUMP 61

4)Z=0

JUMP 70,P=0

```

Z=4Z'ØSIN(.5P;)ØSIN(.5P;)/(H6H1)
JUMP 71

50)JUMP 51,P=0
JUMP 52,Q=0
;1=4(1-ØCOS(P;))(1-ØCOS(Q;))/(PQ; ;)
B73=B70;1
B74=B71;1
;1=H6H6+H7H7
;1=;1;1
;2=H4H6H6+H3H7H7
;3=EH;2;2+D;1;1
;4=-;1H3X/H6-;1H4Y/H7+;1Z+;2H7H7X/H6
;4=;2H6H6Y/H7-;2CH6X-;2CH7Y+;4
;4=;4+EB72HH;1(B74-B73)(H6H6+H7H7)/(12-12C)-.5EB72H;2(H6H6+H7H7)(B73+B74)
Y0=;4/;3
;3=EHY0;2-H7H7X/H6+CH6X-H6H6Y/H7+CH7Y
;3=;3+.5EB72H(B73+B74)(H6H6+H7H7)
Y1=;3/;1
Y2=-H7H7Y1-X/H6
Y3=-H6H7Y1
Y4=-H6H6Y1-Y/H7
Y5=DY0(H6H6+CH7H7)-EB72HH(B74-B73)/(12-12C)
Y6=-DH6H7Y0(1-C)
Y7=DY0(H7H7+CH6H6)-EB72HH(B74-B73)/(12-12C)
Y8=(-Y2+CY4-EHH3Y0)/(H6EH)-.5B72(B73+B74)/H6
Y9=(-Y4+CY2-EHH4Y0)/(H7EH)-.5B72(B73+B74)/H7
Y10=H6Y0
Y11=H7Y0
Y12=H6Y5-H7Y6
Y13=H7Y7-H6Y6
JUMP 99

51)Ø'=0(1)13
YØ'=0
REPEAT
JUMP 99,Q=0
Y3=X/H7
Y8=2(1+C)X/(EHH7H7)
JUMP 99

52)Ø'=0(1)13
YØ'=0
REPEAT
Y3=Y/H6
Y9=2(1+C)Y/(EHH6H6)
JUMP 99

```

60)H6=1
61)Y0=(H6Z-X(H3+CH4))/(DH6H6H6H6H6+EH6H4H4)
Y1=(H6EH4Y0+CX)/(H6H6H6)
Y2=-X/H6
Y3=0
Y4=-H6H6Y1
Y5=DH6H6Y0
Y6=0
Y7=CY5
Y8=(-Y2+CY4-EH4Y0)/(H6EH)
Y9=0
Y10=H6Y0
Y11=0
Y12=H6Y5
Y13=0
JUMP 99

```

```

70)H6=1
71);1=(H6H6+H4H4)(H6H6+H4H4)
;3=H6H6
Y0=Z(2;1-;3;3+C;3H4H4)/(D;1;1+EH4H4;3;3)
Y1=(;3EH4Y0+Z(;3/H4-CH4))/;1
Y2=-Y1H4H4
Y3=-Y1H6H4
Y4=-;3Y1+Z/H4
Y5=DY0(;3+CH4H4)
Y6=-DY0(1-C)H6H4
Y7=Y0D(H4H4+C;3)
Y8=(-Y2+CY4)/(H6EH)
Y9=(-Y4+CY2-EH4Y0)/(H4EH)
Y10=H6Y0
Y11=H4Y0
Y12=H6Y5-H4Y6
Y13=H4Y7-H6Y6
99)RETURN

```

**

ROUTINE 1

```

1)O'=O(1)15
XO'=O
REPEAT
JUMP 3

```

```
4)O'=O(1)3
X(O'+K)=YO'
REPEAT
O'=4(1)7
X(O'+K+4)=YO'
REPEAT
O'=3(1)11
X(O'+K+8)=YO'
REPEAT
O'=12(1)15
X(O'+K+12)=YO'
REPEAT
JUMP 3
```

```
9)O'=O(1)7
XO'=O
REPEAT
JUMP 3
```

```
10)O'=O(1)3
XO'=O
REPEAT
3)RETURN
```

**

ROUTINE 2

```
>>EDGE 1
1)Y10=P;/H1
YO=(-2B250COS(P;)+2B25)/(P;)
Y1=B29
Y2=H3
Y3=B21
Y4=B17
Y5=Y10Y10
Y6=B1
Y7=B5
Y8=B9
Y9=B13
Y11=(-2B610COS(P;)+2B61)/(P;)
JUMP 5
```

```
>>EDGE 2
2)Y10=P;/H1
YO=(-2B250COS(P;)+2B25)/(P;)
Y1=-B30
Y2=H3
```

```
Y3=B22
Y4=B18
Y5=Y10Y10
Y6=B2
Y7=B6
Y8=B10
Y9=B14
Y11=(-2B62ØCOS(P;)+2B62)/(P;)
JUMP 5
```

```
>>EDGE 3
3)Y10=Q;/H2
Y0=(-2B27ØCOS(Q;)+2B27)/(Q;)
Y1=B31
Y2=H4
Y3=B23
Y4=B19
Y5=Y10Y10
Y6=B3
Y7=B7
Y8=B11
Y9=B15
Y11=(-2B63ØCOS(Q;)+2B63)/(Q;)
JUMP 5
```

```
*>EDGE 4
4)Y10=Q;/H2
Y0=(-2B28ØCOS(Q;)+2B28)/(Q;)
Y1=-B32
Y2=H4
Y3=B24
Y4=B20
Y5=Y10Y10
Y6=B4
Y7=B8
Y8=B12
Y9=B16
Y11=(-2B64ØCOS(Q;)+2B64)/(Q;)
```

```
>>MATRIX 0
5)JUMPDOWN (R1)
X0=1
X5=ØCOS(Y1)
X6=-ØSIN(Y1)
X9=-X6
X10=X5
X15=1
Ø7(A0)X0,16
JUMP 6,;16=1
```

```
>>MATRIX D
JUMPDOWN (R1)
X0=-Y2Y3+1
X1=-Y3Y10
X2=-Y4Y10
X5=1
X7=Y4
X10=1
X11=-Y3
X15=1
Ø7(A1)X0,16
JUMP 6,;16=2
```

```
>>MATRIX C
JUMPDOWN (R1)
X0=-Y10
X1=Y2
X4=Y3(Y2Y2/Y10-Y10)-Y2/Y10
X5=1
X8=Y10Y4
X9=-Y2Y4
X10=Y2Y3-1
X11=Y2
X12=-Y2Y4
X13=Y10Y4
X14=Y2/Y10-Y10Y3
X15=-Y10
X16=1/(Y5-Y2Y2)
O'=O(1)15
XO'=XO'X16
REPEAT
Ø7(A2)X0,16
JUMP 6,;16=3
```

```
>>EDGE BEAM FLEX. MATRIX
JUMPDOWN (R1)
X0=-Y10Y6
X1=-Y6Y2-Y7Y2(Y2Y2-Y5)
X5=Y5Y7-Y7Y2Y2
X10=-Y5Y8
X11=-Y2Y8
X14=.5Y9Y10Y2
X15=.5Y10Y9
Ø7(A4)X0,16
A3=Ø29(1/E',4)
A3=Ø28(A4,4,4)
JUMP 6,;16=4
```

```
>>EDGE BEAM P.S. MATRIX
JUMPDOWN (R1/10)
X4=1/(Y5-Y2Y2)
X0=Y2Y0X4
X1=Y0X4
X2=-Y11X4
X3=Y2Y11X4/Y10
Ø7(A4)X0,4
6)RETURN
```

**

ROUTINE 4

```
>> SHELL P.SOLUTION
>> EDGES 1 AND 2
1)JUMPDOWN (R1/9)
J=H29
I '=H30
T=H31
Q=J(I ')*T
JUMPDOWN (R3)
X0=C20Y9+X0
X1=C20Y11+X1
X2=Y3-C27H3Y6+X2
X3=Y13-H6Y6+X3
JUMP 2,A '≠0
X8=ØPARITY(Q)
X4=C20Y9X8+X4
X5=C20Y11X8+X5
X6=(Y3-C27H3Y6)X8+X6
X7=(Y13-H6Y6)X8+X7
Ø7(A6)X4,2
Ø7(A8)X6,2
2)Ø7(A5)X0,2
Ø7(A7)X2,2
REPEAT
;12=X3
;13=X7
JUMP 7
```

```
>> EDGES 3 AND 4
3)JUMPDOWN (R1/9)
J=H26
I '=H27
T=H28
```

```

P=J(I')T
JUMPDOWN (R3)
X0=C2OY8+X0
X1=C2OY10+X1
X2=Y3-C27H4Y6+X2
X3=Y12-H7Y6+X3
JUMP 4,B'≠0
X8=ØPARITY(P)
X4=C2OY8X8+X4
X5=C2OY10X8+X5
X6=(Y3-C27H4Y6)X8+X6
X7=(Y12-H7Y6)X8+X7
Ø7(A6)X4,2
Ø7(A8)X6,2
4)Ø7(A5)X0,2
Ø7(A7)X2,2
REPEAT
;12=X3
;13=X7
JUMP 7

>> P.SOLUTION EDGE BEAMS
>> EDGES 1 AND 3
5)A22=Ø26(A0,A5,4,1,4)
A0=Ø26(A2,A0,4,4,4)
A0=Ø26(A0,A7,4,1,4)
A0=Ø11(A4,A0,4)
A0=Ø26(A3,A0,4,1,4)
A0=Ø26(A1,A0,4,1,4)
A0=Ø14(A22,C20,A0,4)
JUMP 7

>> EDGES 2 AND 4
6)A23=Ø26(A0,A6,4,1,4)
A0=Ø26(A2,A0,4,4,4)
A0=Ø26(A0,A8,4,1,4)
A0=Ø12(A4,A0,4)
A0=Ø26(A3,A0,4,1,4)
A0=Ø26(A1,A0,4,1,4)
A0=Ø14(A23,C20,A0,4)
7)RETURN

```

**

ROUTINE 5

```

>> P.SOLUTION GAPS
>> EDGES 1 AND 2
1);16=5

```

```

JUMP 31,L+L'=0
P=P'(R')R
JUMPDOWN (R4/1)
J'=(P-P')/R'
JUMP 5,C16=1
K=U+LJ'
JUMP 2,C16=2
JUMP 3,C16=3
JUMP 4,C16=4
JUMP 51,C16=5
JUMPDOWN (R2/1)
JUMPDOWN (R1/9)
Ø6(A5)X2,2
Ø6(A7)X4,2
Ø7(A5)X0,4
Ø7(A7)X4,4
JUMPDOWN (R4/5)
K=Ø15(A0,4)
JUMP 5
51)Ø6(A5);10,1
;10=-;10ØSIN(;31)
;11=;12ØSIN(;31)
Ø7(K);10,2
JUMP 5
2)K=Ø15(A5,2)
JUMP 5
3)K=Ø15(A7,2)
JUMP 5
4)K=Ø15(A5,1)
5)JUMP 9,A'≠0
JUMP 9,C17=1
K=U+LHØ+L'J'
JUMP 6,C17=2
JUMP 7,C17=3
JUMP 8,C17=4
JUMP 52,C17=5
JUMPDOWN (R2/2)
JUMPDOWN (R1/9)
Ø6(A6)X2,2
Ø6(A8)X4,2
Ø7(A6)X0,4
Ø7(A8)X4,4
JUMPDOWN (R4/6)
K=Ø15(A0,4)
JUMP 9
52)Ø6(A6);10,1
;10=;10ØSIN(;32)
;11=-;13ØSIN(;32)
Ø7(K);10,2

```

```

JUMP 9
6)K=Ø15(A6,2)
JUMP 9
7)K=Ø15(A8,2)
JUMP 9
8)K=Ø15(A6,1)
9)REPEAT

>> EDGES 3 AND 4
31)JUMP 61,M+M'=0
Q=Q'(S')S
JUMPDOWN (R4/3)
J'=(Q-Q')/S'
JUMP 35,C18=1
K=U+(L+L')H8+MJ'
JUMP 32,C18=2
JUMP 33,C18=3
JUMP 34,C18=4
JUMP 53,C18=5
JUMPDOWN (R2/3)
JUMPDOWN (R1/9)
Ø6(A5)X2,2
Ø6(A7)X4,2
Ø7(A5)X0,4
Ø7(A7)X4,4
JUMPDOWN (R4/5)
K=Ø15(A0,4)
JUMP 35
53)Ø6(A5);10,1
;10=-;10ØSIN(;33)
;11=;12ØSIN(;33)
Ø7(K);10,2
JUMP 35
32)K=Ø15(A5,2)
JUMP 35
33)K=Ø15(A7,2)
JUMP 35
34)K=Ø15(A5,1)
35)JUMP 39,B'≠0
JUMP 39,C19=1
K=U+(L+L')H8+MH9+M'J'
JUMP 36,C19=2
JUMP 37,C19=3
JUMP 38,C19=4
JUMP 54,C19=5
JUMPDOWN (R2/4)
JUMPDOWN (R1/9)
Ø6(A6)X2,2
Ø6(A8)X4,2

```

```

Ø7(A6)X0,4
Ø7(A8)X4,4
JUMPDOWN (R4/6)
K=Ø15(A0,4)
JUMP 39
54)Ø6(A6);10,1
;10=;10ØSIN(;34)
;11=-;13ØSIN(;34)
Ø7(K);10,2
JUMP 39
36)K=Ø15(A6,2)
JUMP 39
37)K=Ø15(A8,2)
JUMP 39
38)K=Ø15(A6,1)
39)REPEAT
61)RETURN

```

ROUTINE 7

>> EXPANSION IN ALPHA DIRECTION

```

1)U0=H3
U1=H4
U2=P;/H1
JUMP 3

```

>> EXPANSION IN BETA DIRECTION

```

2)U0=H4
U1=H3
U2=Q;/H2

```

```

3)U3=U2U2
C5=U4U0
C6=U4U1U3
JUMP 4,C31=2
;0=ØSQRT(C5C5C5C5/16+U4U4U3U3(U1-U0)(U1-U0))
;1=ØSQRT(-C5C5/8+;0/2)
;2=U4U3(U1-U0)/(2;1)
;0=ØSQRT((U3+;1)(U3+;1)+(;2-.5C5)(;2-.5C5))
C1=ØSQRT(.5U3+.5;1+.5;0)
C2=(.5;2-.25C5)/C1
;0=ØSQRT((U3-;1)(U3-;1)+(;2+.5C5)(;2+.5C5))
C3=ØSQRT(.5U3-.5;1+.5;0)
C4=(-.5;2-.25C5)/C3
C7=2C1C2
C8=C1C1-C2C2

```

```
C9=2C3C4
C10=C3C3-C4C4
C11=C1C1+C2C2
C12=C3C3+C4C4
JUMP 5
```

```
4);O=ØSQRT(U3U3+C5C5)
C1=ØSQRT(.5U3+.5;O)
C2=-.5C5/C1
C7=2C1C2
C8=C1C1-C2C2
C11=C1C1+C2C2
C3=1
C4=1
C9=1
C10=1
C12=1
5)RETURN
```

**

ROUTINE 8

```
>> POSITION MATRICES L1,L2
3);'=0
4)JUMPDOWN (R1)
;8=ØSIN(C2ZO)
;9=ØCOS(C2ZO)
;10=ØEXP(-C1ZO)
X0=;10;9
X1=;10;8
X4=-X1
X5=X0
JUMP 7,C31=2
;8=ØSIN(C4ZO)
;9=ØCOS(C4ZO)
;10=ØEXP(-C3ZO)
X10=;10;9
X11=;10;8
X14=-X11
X15=X10
JUMP 8
7)X10=ØEXP(-U2ZO)
X15=X10
8)JUMP 6,; '≠0
Ø7(A2O)X0,16
5);'=1
Z0=;18
```

JUMP 4
6) $\emptyset 7(A21)X0,16$
RETURN

**

ROUTINE 10

>>LEVY SOLN. (ARB. CONSTANTS)

1) JUMPDOWN (R9/1)

Z0=H2

JUMP 3

2) JUMPDOWN (R9/2)

Z0=H1

3); ' = 1

JUMPDOWN (R8/4)

A22= $\emptyset 26(A15,A21,4,4,4)$

JUMP 4, W' = 0

A23= $\emptyset 13(A14,W',A22,16)$

B41= $\emptyset 29(4)$

B41= $\emptyset 28(A23,4,4)$

JUMP 5, ; 17 = 0

JUMP 6

4) A23= $\emptyset 26(A36,A21,4,4,4)$

$\emptyset 6(A14)Y0,16$

K=0

JUMPDOWN (R1/4)

$\emptyset 6(A22)Y0,16$

K=4

JUMPDOWN (R1/4)

$\emptyset 6(A23)Y0,16$

K=32

JUMPDOWN (R1/4)

$\emptyset 6(A37)Y0,16$

K=36

JUMPDOWN (R1/4)

$\emptyset 7(B33)X0,64$

B41= $\emptyset 29(8)$

B41= $\emptyset 28(B33,8,8)$

JUMP 5, ; 17 = 0

JUMP 7

8) JUMP 7, W' = 0

6) B34= $\emptyset 26(B41,B36,4,1,4)$

A23= $\emptyset 29(W',4)$

B35= $\emptyset 26(A23,B34,4,1,4)$

JUMP 5

7)B33=026(B41,B36,8,1,8)

B34=015(B33,4)

B35=015(B33+4,4)

5)RETURN

**

ROUTINE 11

9)A6=026(A0,A5,4,1,4)

A0=026(A0,A7,4,1,4)

A0=026(A2,A0,4,1,4)

A0=026(A3,A0,4,1,4)

A0=026(A1,A0,4,1,4)

A0=014(A6,C26,A0,4)

05(A0)X0,4

JUMP 20

3)K=0(1)0'

V'=V+J'+NK

07(V')XK,1

REPEAT

JUMP 20

4)JUMPDOWN (R1)

X19=0SIN(C2U5)

X20=0COS(C2U5)

X21=0EXP(-C1U5)

X22=U5(C11+2C2U6+U6U6)

X23=U5(C11-2C2U6+U6U6)

X0=(X18X21(-C1X19+C2X20-U6X20)+C2+U6)/X22

X0=X0-(X18X21(-C1X19-C2X20+U6X20)+C2-U6)/X23

X1=(X18X21(-C1X20+C2X19-U6X19)+C1)/X23

X1=X1-(X18X21(-C1X20+C2X19+U6X19)+C1)/X22

X4=-X1

X5=X0

JUMP 11,C31#2

X10=2U6(1-X180EXP(-U2U5))/(U5U3+U5U6U6)

X15=X10

JUMP 12

11)X19=0SIN(C4U5)

X20=0COS(C4U5)

X21=0EXP(-C3U5)

X22=U5(C12+2C4U6+U6U6)

X23=U5(C12-2C4U6+U6U6)

X10=(X18X21(-C3X19-C4X20-U6X20)+C4+U6)/X22

```

X10=X10-(X18X21(-C3X19-C4X20+U6X20)+C4-U6)/X23
X11=(X18X21(-C3X20+C4X19-U6X19)+C3)/X23
X11=X11-(X18X21(-C3X20+C4X19+U6X19)+C3)/X22
X14=-X11
X15=X10
12)Ø7(A22)X0,16
K=0(1)15
XK=-X18XK
REPEAT
Ø7(A23)X0,16
A25=Ø26(A22,B34,4,1,4)
A26=Ø26(A23,B35,4,1,4)
A22=Ø26(A18+4,A25,3,1,4)
A23=Ø26(A19+4,A26,3,1,4)
A24+1=Ø11(A22,A23,3)
X19=ØSIN(C2U5)
X20=ØCOS(C2U5)
X21=ØEXP(-C1U5)
X22=U5(C11+2C2U6+U6U6)
X23=U5(C11-2C2U6+U6U6)
X0=(X18X21(-C1X20+C2X19+U6X19)+C1)/X22
X0=X0+(X18X21(-C1X20+C2X19-U6X19)+C1)/X23
X1=(X18X21(-C1X19-C2X20-U6X20)+C2+U6)/X22
X1=X1-(X18X21(C1X19+C2X20-U6X20)-C2+U6)/X23
X4=-X1
X5=X0
JUMP 13,C31#2
X10=2U2(1-X18ØEXP(-U2U5))/(U5U3+U5U6U6)
X15=X10
JUMP 14
13)X19=ØSIN(C4U5)
X20=ØCOS(C4U5)
X21=ØEXP(-C3U5)
X22=U5(C12+2C4U6+U6U6)
X23=U5(C12-2C4U6+U6U6)
X10=(X18X21(-C3X20+C4X19+U6X19)+C3)/X22
X10=X10+(X18X21(-C3X20+C4X19-U6X19)+C3)/X23
X11=(X18X21(-C3X19-C4X20-U6X20)+C4+U6)/X22
X11=X11-(X18X21(C3X19+C4X20-U6X20)-C4+U6)/X23
X14=-X11
X15=X10
14)Ø7(A22)X0,16
K=0(1)15
XK=X18XK
REPEAT
Ø7(A23)X0,16
A25=Ø26(A22,B34,4,1,4)
A26=Ø26(A23,B35,4,1,4)
A25=Ø26(A18,A25,1,1,4)

```

```
A26=Ø26(A19,A26,1,1,4)
A24=Ø11(A25,A26,1)
JUMPDOWN (R1/9)
Ø6(A24)Y0,4
X0=Y0
X1=Y1
X6=Y2
X7=Y3
Ø7(A5)X4,4
Ø7(A7)X0,4
JUMP 20
```

```
8)Ø6(A5)X0,4
Ø6(A7)X4,4
K=0(1)7
XK=X18XK
REPEAT
Ø7(A5)X0,4
Ø7(A7)X4,4
20)RETURN
```

**

ROUTINE 12

```
1)JUMP 51,M+M'=0
;16=4
U5=H2
Q=Q'(S')S
O=(Q-Q')/S'
U6=Q;/U5
X18=ØPARITY(Q)
JUMPDOWN (R11/4)
JUMP 6,C18=1
O'=M-1
J'=T+MNO
JUMP 2,C18=2
JUMP 3,C18=3
JUMP 4,C18=4
JUMP 52,C18=5
JUMPDOWN (R2/3)
C26=C20
JUMPDOWN (R11/9)
O'=3
JUMP 5
2)Ø6(A5+2)X0,2
JUMP 5
3)Ø6(A7)X0,2
JUMP 5
52)Ø6(A5+2)X0,1
```

```

Ø6(A7+1)C24,1
X0=-X0ØSIN(;33)
X1=C24ØSIN(;33)
JUMP 5
4)Ø6(A5+2)X0,1
5)JUMPDOWN (R11/3)
6)JUMP 11,B'≠0
JUMP 11,C19=1
X18=ØPARITY(P)
JUMPDOWN (R11/8)
O'=M'-1
J'=T+MNH9+M'NO
JUMP 7,C19=2
JUMP 8,C19=3
JUMP 9,C19=4
JUMP 53,C19=5
JUMPDOWN (R2/4)
C26=-C20
JUMPDOWN (R11/9)
O'=3
JUMP 10
7)Ø6(A5+2)X0,2
JUMP 10
53)Ø6(A5+2)X0,1
Ø6(A7+1)C24,1
X0=X0ØSIN(;34)
X1=-C24ØSIN(;34)
JUMP 10
8)Ø6(A7)X0,2
JUMP 10
9)Ø6(A5+2)X0,1
10)JUMPDOWN (R11/3)
11)REPEAT
JUMP 51

```

```

31)JUMP 51,L+L'=0
;16=4
U5=H1
P=P'(R')R
O=(P-P')/R'
U6=P;/U5
X18=ØPARITY(P)
JUMPDOWN (R11/4)
JUMP 36,C16=1
O'=L-1
J'=T+LNO
JUMP 32,C16=2
JUMP 33,C16=3
JUMP 34,C16=4

```

```

JUMP 54,C16=5
JUMPDOWN (R2/1)
C26=C20
JUMPDOWN (R11/9)
O'=3
JUMP 35
32)Ø6(A5+2)X0,2
JUMP 35
54)Ø6(A5+2)X0,1
Ø6(A7+1)C24,1
X0=-X0ØSIN(;31)
X1=C24ØSIN(;31)
JUMP 35
33)Ø6(A7)X0,2
JUMP 35
34)Ø6(A5+2)X0,1
35)JUMPDOWN (R11/3)
36)JUMP 41,A'≠0
JUMP 41,C17=1
X18=ØPARITY(Ø)
JUMPDOWN (R11/8)
O'=L'-1
J'=T+LNH8+L'NO
JUMP 37,C17=2
JUMP 38,C17=3
JUMP 39,C17=4
JUMP 55,C17=5
JUMPDOWN (R2/2)
C26=-C20
JUMPDOWN (R11/9)
O'=3
JUMP 40
37)Ø6(A5+2)X0,2
JUMP 40
55)Ø6(A5+2)X0,1
Ø6(A7+1)C24,1
X0=X0ØSIN(;32)
X1=-C24ØSIN(;32)
JUMP 40
38)Ø6(A7)X0,2
JUMP 40
39)Ø6(A5+2)X0,1
40)JUMPDOWN (R11/3)
41)REPEAT
51)RETURN

```

**

***T

ROUTINE 13

>> ACTIONS ALONG EDGE 1

1) $N = (L + L')H8 + (M + M')H9$

$V = \emptyset 29(1, N)$

;17=0

W'=A'

JUMP 11, C16=1

;19=C16

;20=C17

;54=;31

;30=-;32

I'=0

JUMPDOWN (R1/10)

$\emptyset 7(B36+4)X0,4$

$P = P'(R')R$

$J = (P - P')/R'$

;16=4

JUMP 113, C16 $\neq$ 0

JUMPDOWN (R2/1)

$A23 = \emptyset 26(A1, A3, 4, 4, 4)$

$A23 = \emptyset 26(A23, A2, 4, 4, 4)$

$A23 = \emptyset 26(A23, A0, 4, 4, 4)$

$A26 = \emptyset 29(C20, 4)$

$A23 = \emptyset 26(A26, A23, 4, 4, 4)$

$A22 = \emptyset 15(A0, 16)$

113) JUMP 105, L' $\neq$ 4

JUMPDOWN (R2/2)

$A25 = \emptyset 26(A1, A3, 4, 4, 4)$

$A25 = \emptyset 26(A25, A2, 4, 4, 4)$

$A25 = \emptyset 26(A25, A0, 4, 4, 4)$

$A26 = \emptyset 29(-C20, 4)$

$A25 = \emptyset 26(A26, A25, 4, 4, 4)$

105) JUMPDOWN (R10/1)

JUMP 2, C16=2

JUMP 3, C16=3

JUMP 6, C16=4

JUMP 7, C16=5

I=0(1)3

JUMPDOWN (R1/10)

XI=1

$\emptyset 7(B36)X0,4$

JUMPDOWN (R10/8)

$T = N(L + L')H8 + LJ + I$

JUMPDOWN (R12/1)

REPEAT

JUMP 4

7) I=0(1)1

JUMPDOWN (R1/10)

```
X(I+1)=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ+I
JUMPDOWN (R12/1)
REPEAT
JUMP 4
6)JUMPDOWN (R1/10)
X2=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ
JUMPDOWN (R12/1)
JUMP 4
2)I=0(1)1
JUMPDOWN (R1/10)
X(I+2)=1
Ø7(B36)X0,4
```

```
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ+I
JUMPDOWN (R12/1)
REPEAT
JUMP 4
3)I=0(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ+I
JUMPDOWN (R12/1)
REPEAT
4)REPEAT
NEWLINE 2
CAPTION
EDGE 1 COMPLETE
```

>> ACTIONS ALONG EDGE 2

```
11)JUMP 21,C17=1
JUMP 21,A'≠0
;19=C17
;20=C16
;30=;31
;54=-;32
I'=22
JUMPDOWN (R1/10)
Ø7(B36)X0,4
P=P'(R')R
```

```

J=(P-P')/R'
;16=4
JUMP 114,C17#0
JUMPDOWN (R2/2)
A23=Ø26(A1,A3,4,4,4)
A23=Ø26(A23,A2,4,4,4)
A23=Ø26(A23,A0,4,4,4)
A26=Ø29(-C20,4)
A23=Ø26(A26,A23,4,4,4)
A22=Ø15(A0,16)
114)JUMP 106,C16#0
JUMPDOWN (R2/1)
A25=Ø26(A1,A3,4,4,4)
A25=Ø26(A25,A2,4,4,4)
A25=Ø26(A25,A0,4,4,4)
A26=Ø29(C20,4)
A25=Ø26(A26,A25,4,4,4)
106)JUMPDOWN (R10/1)
JUMP 12,C17=2
JUMP 13,C17=3
JUMP 16,C17=4
JUMP 17,C17=5
I=0(1)3
JUMPDOWN (R1/10)
XI=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J+I
JUMPDOWN (R12/1)
REPEAT
JUMP 14
17)I=0(1)1
JUMPDOWN (R1/10)
X(I+1)=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J+I
JUMPDOWN (R12/1)
REPEAT
JUMP 14
16)JUMPDOWN (R1/10)
X2=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J
JUMPDOWN (R12/1)
JUMP 14
12)I=0(1)1
JUMPDOWN (R1/10)

```

```
X(I+2)=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J+I
JUMPDOWN (R12/1)
REPEAT
JUMP 14
13)I=0(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J+I
JUMPDOWN (R12/1)
REPEAT
14)REPEAT
NEWLINE
CAPTION
EDGE 2 COMPLETE
```

>> ACTIONS ALONG EDGE 3

```
21)W'=B'
JUMP 31,C18=1
;19=C18
;20=C19
;54=;33
;30=-;34
I'=0
JUMPDOWN (R1/10)
Ø7(B36+4)X0,4
Q=Q'(S')S
J=(Q-Q')/S'
;16=4
JUMP 115,C18≠0
JUMPDOWN (R2/3)
A23=Ø26(A1,A3,4,4,4)
A23=Ø26(A23,A2,4,4,4)
A23=Ø26(A23,A0,4,4,4)
A26=Ø29(C20,4)
A23=Ø26(A26,A23,4,4,4)
A22=Ø15(A0,16)
115)JUMP 107,M'≠4
JUMPDOWN (R2/4)
A25=Ø26(A1,A3,4,4,4)
A25=Ø26(A25,A2,4,4,4)
A25=Ø26(A25,A0,4,4,4)
A26=Ø29(-C20,4)
A25=Ø26(A26,A25,4,4,4)
```

```
107)JUMPDOWN (R10/2)
JUMP 22,C18=2
JUMP 23,C18=3
JUMP 26,C18=4
JUMP 27,C18=5
I=0(1)3
JUMPDOWN (R1/10)
XI=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MJ+I
JUMPDOWN (R12/31)
REPEAT
JUMP 24
27)I=0(1)1
JUMPDOWN (R1/10)
X(I+1)=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MJ+I
JUMPDOWN (R12/31)
REPEAT
JUMP 24
26)JUMPDOWN (R1/10)
X2=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MJ
JUMPDOWN (R12/31)
JUMP 24
22)I=0(1)1
JUMPDOWN (R1/10)
X(I+2)=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MJ+I
JUMPDOWN (R12/31)
REPEAT
JUMP 24
23)I=0(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MJ+I
JUMPDOWN (R12/31)
REPEAT
24)REPEAT
NEWLINE
CAPTION
EDGE 3 COMPLETE
```

>> ACTIONS ALONG EDGE 4

```

31) JUMP 41, C19=1
JUMP 41, B'≠0
;19=C19
;20=C18
;30=;33
;54=-;34
I'=22
JUMPDOWN (R1/10)
Ø7(B36)X0,4
Q=Q'(S')S
J=(Q-Q')/S'
;16=4
JUMP 116, C19≠0
JUMPDOWN (R2/4)
A23=Ø26(A1,A3,4,4,4)
A23=Ø26(A23,A2,4,4,4)
A23=Ø26(A23,A0,4,4,4)
A26=Ø29(-C20,4)
A23=Ø26(A26,A23,4,4,4)
A22=Ø15(A0,16)
116) JUMP 108, C18≠0
JUMPDOWN (R2/3)
A25=Ø26(A1,A3,4,4,4)
A25=Ø26(A25,A2,4,4,4)
A25=Ø26(A25,A0,4,4,4)
A26=Ø29(C20,4)
A25=Ø26(A26,A25,4,4,4)
108) JUMPDOWN (R10/2)
JUMP 32, C19=2
JUMP 33, C19=3
JUMP 36, C19=4
JUMP 37, C19=5
I=0(1)3
JUMPDOWN (R1/10)
XI=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J+I
JUMPDOWN (R12/31)
REPEAT
JUMP 34
37) I=0(1)1
JUMPDOWN (R1/10)
X(I+1)=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J+I

```

```
JUMPDOWN (R12/31)
REPEAT
JUMP 34
36)JUMPDOWN (R1/10)
X2=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J
JUMPDOWN (R12/31)
JUMP 34
32)I=0(1)1
JUMPDOWN (R1/10)
X(I+2)=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J+I
JUMPDOWN (R12/31)
REPEAT
JUMP 34
33)I=0(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J+I
JUMPDOWN (R12/31)
REPEAT
34)REPEAT
```

```
41)JUMP 62,N=0
NEWLINE
CAPTION
MATRIX V FORMED
NEWLINE 2
JUMPDOWN (R5)
CAPTION
P.SOLN. GAPS (DISPLACEMENTS MULTIPLIED BY C20)
JUMP 42,L=0
NEWLINE
CAPTION
EDGE 1
K=LH8-L
I=0(L)K
Ø6(U+I)X1,L
NEWLINE
O'=1(1)L
PRINT(XO')0,4
```

```
REPEAT
REPEAT
42)JUMP 43,L'=0
NEWLINE
CAPTION
EDGE 2
K=LH8
J=K+L'H8-L'
I=K(L')J
Ø6(U+I)X1,L'
NEWLINE
O'=1(1)L'
PRINT(XO')0,4
REPEAT
REPEAT
43)JUMP 44,M=0
NEWLINE
CAPTION
EDGE 3
K=(L+L')H8
J=K+MH9-M
I=K(M)J
Ø6(U+I)X1,M
NEWLINE
O'=1(1)M
PRINT(XO')0,4
REPEAT
REPEAT
44)JUMP 45,M'=0
NEWLINE
CAPTION
EDGE 4
K=(L+L')H8+MH9
J=K+M'H9-M'
I=K(M')J
Ø6(U+I)X1,M'
NEWLINE
O'=1(1)M'
PRINT(XO')0,4
REPEAT
REPEAT

45)JUMP 62,N=0
U=Ø28(v,N,1)
NEWLINE 2
CAPTION
MATRIX V INVERTED
NEWLINE 3
CAPTION
SOLUTION VECTORS
```

NEWLINE 2

>> ARBITRARY CONSTANTS

46)JUMPDOWN (R1/10)

$\emptyset 7(A6)X0,4$

$P=P'(R')R$

$J'=(P-P')/R'$

$DJ'=\emptyset 15(A6,4)$

$EJ'=\emptyset 15(A6,4)$

REPEAT

$Q=Q'(S')S$

$J'=(Q-Q')/S'$

$FJ'=\emptyset 15(A6,4)$

$GJ'=\emptyset 15(A6,4)$

REPEAT

>> ACTIONS ALONG EDGE 1

;17=123

$W'=A'$

JUMP 50,C16=1

CAPTION

EDGE 1

NEWLINE

CAPTION

P

;19=C16

;20=C17

;54=;31

;30=-;32

$I'=0$

$P=P'(R')R$

;16=4

JUMP 117,C16 $\neq$ 0

JUMPDOWN (R2/1)

$A23=\emptyset 26(A1,A3,4,4,4)$

$A23=\emptyset 26(A23,A2,4,4,4)$

$A23=\emptyset 26(A23,A0,4,4,4)$

$A26=\emptyset 29(C20,4)$

$A23=\emptyset 26(A26,A23,4,4,4)$

$A22=\emptyset 15(A0,16)$

117)JUMP 109,L' $\neq$ 4

JUMPDOWN (R2/2)

$A25=\emptyset 26(A1,A3,4,4,4)$

$A25=\emptyset 26(A25,A2,4,4,4)$

$A25=\emptyset 26(A25,A0,4,4,4)$

$A26=\emptyset 29(-C20,4)$

$A25=\emptyset 26(A26,A25,4,4,4)$

109)J'=(P-P')/R'

```

K=U+LJ'
JUMPDOWN (R1/9)
JUMP 47,C16=2
JUMP 48,C16=3
JUMP 63,C16=4
JUMP 70,C16=5
Ø6(K)X0,4
JUMP 49
70)Ø6(K)X1,2
JUMP 49
63)Ø6(K)X2,1
JUMP 49
47)Ø6(K)X2,2
JUMP 49
48)Ø6(K)X0,2
49)NEWLINE
PRINT(P)2,0
I=0(1)3
XI=-XI
PRINT(XI)0,4
REPEAT
Ø7(B36)X0,8
JUMPDOWN (R10/1)
DJ'=Ø15(B34,4)
EJ'=Ø15(B35,4)
REPEAT
JUMP 54,W'≠0

```

>> ACTIONS ALONG EDGE 2

```

50)JUMP 54,C17=1
;19=C17
;20=C16
;54=-;32
;30=;31
I'=22
NEWLINE 2
CAPTION
EDGE 2
NEWLINE
CAPTION
P
P=P'(R')R
;16=4
JUMP 118,C17≠0
JUMPDOWN (R2/2)
A23=Ø26(A1,A3,4,4,4)
A23=Ø26(A23,A2,4,4,4)
A23=Ø26(A23,A0,4,4,4)
A26=Ø29(-C20,4)

```

```

A23=Ø26(A26,A23,4,4,4)
A22=Ø15(A0,16)
118)JUMP 110,C16≠0
JUMPDOWN (R2/1)
A25=Ø26(A1,A3,4,4,4)
A25=Ø26(A25,A2,4,4,4)
A25=Ø26(A25,A0,4,4,4)
A26=Ø29(C20,4)
A25=Ø26(A26,A25,4,4,4)
110)J'=(P-P')/R'
K=U+LH8+L'J'
JUMPDOWN (R1/9)
JUMP 51,C17=2
JUMP 52,C17=3
JUMP 64,C17=4
JUMP 71,C17=5
Ø6(K)X4,4
JUMP 53
71)Ø6(K)X5,2
JUMP 53
64)Ø6(K)X6,1
JUMP 53
51)Ø6(K)X6,2
JUMP 53
52)Ø6(K)X4,2
53)NEWLINE
PRINT(P)2,0
I=4(1)7
XI=-XI
PRINT(XI)0,4
REPEAT
Ø7(B36)X0,8
JUMPDOWN (R10/1)
DJ'=Ø11(DJ',B34,4)
EJ'=Ø11(EJ',B35,4)
REPEAT

```

>> ACTIONS ALONG EDGE 3

```

54)W'=B'
JUMP 58,C18=1
;19=C18
;20=C19
;54=;33
;30=-;34
I'=0
NEWLINE 2
CAPTION
EDGE 3
NEWLINE

```

CAPTION

```

Q
Q=Q'(S')S
;16=4
JUMP 119,C18≠0
JUMPDOWN (R2/3)
A23=Ø26(A1,A3,4,4,4)
A23=Ø26(A23,A2,4,4,4)
A23=Ø26(A23,A0,4,4,4)
A26=Ø29(C20,4)
A23=Ø26(A26,A23,4,4,4)
A22=Ø15(A0,16)
119)JUMP 111,M'≠4
JUMPDOWN (R2/4)
A25=Ø26(A1,A3,4,4,4)
A25=Ø26(A25,A2,4,4,4)
A25=Ø26(A25,A0,4,4,4)
A26=Ø29(-C20,4)
A25=Ø26(A26,A25,4,4,4)
111)J'=(Q-Q')/S'
K=U+(L+L')H8+MJ'
JUMPDOWN (R1/9)
JUMP 55,C18=2
JUMP 56,C18=3
JUMP 65,C18=4
JUMP 72,C18=5
Ø6(K)X0,4
JUMP 57
72)Ø6(K)X1,2
JUMP 57
65)Ø6(K)X2,1
JUMP 57
55)Ø6(K)X2,2
JUMP 57
56)Ø6(K)X0,2
57)NEWLINE
PRINT(Q)2,0
I=0(1)3
XI=-XI
PRINT(XI)0,4
REPEAT
Ø7(B36)X0,8
JUMPDOWN (R10/2)
FJ'=Ø15(B34,4)
GJ'=Ø15(B35,4)
REPEAT
JUMP 62,W'≠0

```

>> ACTIONS ALONG EDGE 4

58)JUMP 62,C19=1

;19=C19

;20=C18

;54=-;34

;30=;33

I'=22

NEWLINE 2

CAPTION

EDGE 4

NEWLINE

CAPTION

Q

Q=Q'(S')S

;16=4

JUMP 104,C19#0

JUMPDOWN (R2/4)

A23=026(A1,A3,4,4,4)

A23=026(A23,A2,4,4,4)

A23=026(A23,A0,4,4,4)

A26=029(-C20,4)

A23=026(A26,A23,4,4,4)

A22=015(A0,16)

104)JUMP 112,C18#0

JUMPDOWN (R2/3)

A25=026(A1,A3,4,4,4)

A25=026(A25,A2,4,4,4)

A25=026(A25,A0,4,4,4)

A26=029(C20,4)

A25=026(A26,A25,4,4,4)

112)J'=(Q-Q')/S'

K=U+(L+L')H8+MH9+M'J'

JUMPDOWN (R1/9)

JUMP 59,C19=2

JUMP 60,C19=3

JUMP 66,C19=4

JUMP 73,C19=5

06(K)X4,4

JUMP 61

73)06(K)X5,2

JUMP 61

66)06(K)X6,1

JUMP 61

59)06(K)X6,2

JUMP 61

60)06(K)X4,2

61)NEWLINE

PRINT(Q)2,0

I=4(1)7

```

XI=-XI
PRINT(XI)0,4
REPEAT
Ø7(B36)X0,8
JUMPDOWN (R10/2)
FJ' =Ø11(FJ',B34,4)
GJ' =Ø11(GJ',B35,4)
REPEAT
62)JUMPDOWN (R14)
RETURN

```

**

ROUTINE 14

>> TOTAL SOLUTION PRINT INSTRUCTIONS

>>OUTPUT DOMAIN

1)READ(H20)

READ(H21)

READ(H22)

READ(H23)

H20=H20H1

H21=H21H1

H22=H22H2

H23=H23H2

READ(N)

READ(N')

I=1(1)15

XI=0

REPEAT

K=NN'-1

I=0(1)K

Ø7(G'+15I)X1,15

REPEAT

N=N-1

N'=N'-1

JUMP 4,N=0

H24=(H21-H20)/N

4)JUMP 5,N'=0

H25=(H23-H22)/N'

5)NEWLINE 4

CAPTION

POINT(A,B)

U(C)

M(A)

M(B)

CAPTION

N(A)

N(B)

M(AB)

N(AB)

NEWLINE

CAPTION

U(A)

PSI(A)

U(B)

CAPTION
 PSI(B) Q(A) Q(B) Q'(A)
 NEWLINE
 CAPTION

Q'(B)

>> C.FUNCTION SOLN. ACTIONS ALONG EDGES 1 AND 2

JUMP 101,C23>2.5
 JUMP 6,L+L'=0
 101)P=P'(R')R
 K'=(P-P')/R'
 JUMPDOWN (R9/4)
 J'=0(1)N'
 H12=H22+J'H25
 Z0=H12
 ;18=H2-Z0
 JUMPDOWN (R8/3)
 A20=Ø26(A20,DK',4,1,4)
 A21=Ø26(A21,EK',4,1,4)
 B39=Ø26(B37,A20,15,1,4)
 B40=Ø26(B38,A21,15,1,4)
 B40=Ø11(B39,B40,15)
 Ø6(B40)Y1,15
 I'=0(1)N
 H11=H20+I'H24
 ;0=U2H11
 ;1=ØSIN(;0)
 ;2=ØCOS(;0)
 I=1(1)5
 XI=;1YI
 REPEAT
 I=6(1)9
 XI=;2YI
 REPEAT
 X10=;1Y10
 X11=;1Y11
 X12=;2Y12
 X13=;1Y13
 X14=;2Y14
 X15=;1Y15
 Ø7(B40)X1,15
 K=15N'I'+15I'+15J'+G'
 K=Ø11(K,B40,15)
 REPEAT
 REPEAT
 REPEAT

```

>> C.FUNCTION SOLN. ACTIONS ALONG EDGES 3 AND 4
6)JUMP 7,M+M'=0
Q=Q'(S')S
K'=(Q-Q')/S'
JUMPDOWN (R9/5)
I'=O(1)N
H11=H20+I'H24
Z0=H11
;18=H1-Z0
JUMPDOWN (R8/3)
A20=Ø26(A20,FK',4,1,4)
A21=Ø26(A21,GK',4,1,4)
B39=Ø26(B37,A20,15,1,4)
B40=Ø26(B38,A21,15,1,4)
B40=Ø11(B39,B40,15)
Ø6(B40)Y1,15
J'=O(1)N'
H12=H22+J'H25
;0=U2H12
;1=ØSIN(;0)
;2=ØCOS(;0)
I=1(1)5
XI=;1YI
REPEAT
X6=;2Y6
X7=;2Y7
X8=;1Y8
X9=;1Y9
X10=;2Y10
X11=;2Y11
X12=;1Y12
X13=;2Y13
X14=;1Y14
X15=;2Y15
Ø7(B40)X1,15
K=15N'I'+15I'+15J'+G'
K=Ø11(K,B40,15)
REPEAT
REPEAT
REPEAT

```

```

>> P.SOLN. (NAVIER SOLN.)
7)K'=H40
I'=H26
K=H27
T'=H28

```

```

J'=H29
J=H30
T=H31
P=I'(K)T'
I=(P-I')H39/K
Q=J'(J)T
JUMPDOWN (R3)
O=I+(Q-J')/J
Ø7(F'+O)Y0,1
Ø7(F'+O+K')Y5,1
Ø7(F'+O+2K')Y7,1
Ø7(F'+O+3K')Y2,1
Ø7(F'+O+4K')Y4,1
Ø7(F'+O+5K')Y6,1
Ø7(F'+O+6K')Y3,1
Ø7(F'+O+7K')Y8,1
Ø7(F'+O+8K')Y10,1
Ø7(F'+O+9K')Y9,1
Ø7(F'+O+10K')Y11,1
Ø7(F'+O+11K')Y12,1
Ø7(F'+O+12K')Y13,1
X1=Y12-H7Y6
Ø7(F'+O+13K')X1,1
X1=Y13-H6Y6
Ø7(F'+O+14K')X1,1
REPEAT
REPEAT

```

```

I'=O(1)N
NEWLINE
H11=H20+I'H24
J'=O(1)N'
H12=H22+J'H25
NEWLINE 2
PRINT(H11)4,2
CAPTION
,
PRINT(H12)4,2
SPACE 2
X0=1
Ø7(A11)X0,1
Ø7(A12)X0,1

```

```

>> POSITION MATRICES
T=H26
O=H27
O'=H28

```

```

P=T(O)O'
H6=P;H11/H1
I=(P-T)/O
XI=ØSIN(H6)
YI=ØCOS(H6)
REPEAT
Ø7(A9)X0,H38
Ø7(A10)Y0,H38
JUMP 8,C23=4
JUMP 9,C23=3
T=H29
O=H30
O'=H31
Q=T(O)O'
H7=Q;H12/H2
I=(Q-T)/O
XI=ØSIN(H7)
YI=ØCOS(H7)
REPEAT
Ø7(A11)X0,H39
Ø7(A12)Y0,H39
JUMP 9
8)X0=ØCOS(H32-H4H12)
Y0=ØSIN(H32-H4H12)
Ø7(A11)X0,1
Ø7(A12)Y0,1

```

```

>>PRINT OUT
9)K=15N'I'+15I'+15J'+G'
I=0(1)4
J=IH40
A13=Ø26(A9,F'+J,1,H39,H38)
A13=Ø26(A13,A11,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=5(1)6
J=IH40
A13=Ø26(A10,F'+J,1,H39,H38)
A13=Ø26(A13,A12,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=7(1)8
J=IH40
A13=Ø26(A10,F'+J,1,H39,H38)
A13=Ø26(A13,A11,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=9(1)10

```

```
J=IH40
A13=Ø26(A9,F'+J,1,H39,H38)
A13=Ø26(A13,A12,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=11(2)13
J=IH40
A13=Ø26(A10,F'+J,1,H39,H38)
A13=Ø26(A13,A11,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=12(2)14
J=IH40
A13=Ø26(A9,F'+J,1,H39,H38)
A13=Ø26(A13,A12,1,1,H39)
Ø6(A13)XI,1
REPEAT
Ø6(K)X20,15
I=0(1)14
;1=XI+X(I+20)
JUMP 98,I=14
JUMP 99,I≠7
98)SPACE 22
99)PRINT(;1)0,4
REPEAT
REPEAT
REPEAT
RETURN
```

**

CHAPTER 0

```
A►50
B►80
C►40
D►50
E►50
F►50
G►50
H►60
U►10
V►1
W►1
X►100
Y►60
Z►1
;►55
```

C27=1

C28=1

>> SHELL DIMENSIONS

1)NEWLINE 2

CAPTION

SHALLOW TRANSLATIONAL SHELL ($K(ab)=0$) ON RECTANGULAR PLAN AREA.

NEWLINE 2

CAPTION

T	LA(plan)	LB(plan)	RISE A	RISE B
---	----------	----------	--------	--------

NEWLINE

READ(H)

PRINT(H)0,4

I=1(1)4

READ(HI)

SPACE 2

PRINT(HI)0,4

REPEAT

;1=H3

;2=H4

JUMP 60,H3=0

$H3=1/ (.125H1H1/H3+.5H3)$

60)JUMP 61,H4=0

$H4=1/ (.125H2H2/H4+.5H4)$

61)NEWLINE 2

CAPTION

K(a)

K(b)

NEWLINE

PRINT(H3)0,6

SPACE 2

PRINT(H4)0,6

$C29=360\text{ARCSIN}(\text{MOD}(.5H1H3))/;$

$C30=360\text{ARCSIN}(\text{MOD}(.5H2H4))/;$

NEWLINE 2

CAPTION

$\theta(a)$

$\theta(b)$

LA(arc)

LB(arc)

NEWLINE

JUMP 62,H3=0

JUMP 62, $\text{MOD} (;1)-\text{MOD}(1/H3)<0$

$C29=360-C29$

62)JUMP 63,H4=0

JUMP 63, $\text{MOD} (;2)-\text{MOD}(1/H4)<0$

$C30=360-C30$

63)PRINT(C29)3,3

SPACE 2

PRINT(C30)3,3

JUMP 64,H3=0

$H1=\text{MOD} (;C29/(180H3))$

64)JUMP 65,H4=0

```
H2=0MOD( ;C30/(180H4))
65)SPACE 2
PRINT(H1)0,4
SPACE 2
PRINT(H2)0,4
```

```
C31=0
C32=1
C33=0
JUMP 66,0MOD(H3)+0MOD(H4)≠0
NEWLINE 2
```

```
CAPTION
FLAT PLATE -  $K(a) = 0$ , MODIFIED  $K(b) =$ 
 $H4=0EXP(-20)/(H1+H2)$ 
PRINT(H4)0,4
JUMP 2
66)JUMP 2,H4=0
JUMP 2,0MOD((H3-H4)/H4)>.020MOD(C28)
H4=H3
NEWLINE 2
CAPTION
MODIFIED  $K(A) = K(B) =$ 
PRINT(H3)0,6
C31=2
C32=0
C33=1
```

```
>> LOADING ON SHELL
2)READ(C23)
READ(A)
READ(B)
NEWLINE 2
JUMP 70,A=0
JUMP 71,A=-1
CAPTION
LOADING SYMMETRIC ABOUT AXIS  $A=L(a)/2$ .
JUMP 70
71)CAPTION
LOADING ANTIMETRIC ABOUT AXIS  $A=L(a)/2$ .
70)NEWLINE
JUMP 72,B=0
JUMP 73,B=-1
CAPTION
LOADING SYMMETRIC ABOUT AXIS  $B=L(b)/2$ .
JUMP 72
73)CAPTION
LOADING ANTIMETRIC ABOUT AXIS  $B=L(b)/2$ .
```

72)NEWLINE 2
JUMP 74,C23=1
JUMP 76,C23=3
JUMP 77,C23=4
JUMP 75,C23=2

CAPTION

UNIFORM LOADING ON TOTAL SURFACE AREA OF SHELL.
EXPANSION)

(DOUBLE FOURIER

NEWLINE

CAPTION

INTENSITY OF LOADING

G(a)

G(b)

CAPTION

G(c)

NEWLINE

READ(X')

READ(Y')

READ(Z')

SPACE 26

PRINT(X')0,6

SPACE 12

PRINT(Y')0,6

SPACE 8

PRINT(Z')0,6

H41=.5H1

H42=.5H2

H43=H1

H44=H2

H45=.5H1

H46=.5H2

H47=H1

H48=H2

H49=.5H1

H50=.5H2

H51=H1

H52=H2

JUMP 80

74)CAPTION

UNIFORM PATCH LOADING.

(DOUBLE FOURIER EXPANSION).

NEWLINE

CAPTION

INTENSITY OF LOADING

CO-ORDINATES OF CENTRE OF PATCH

CAPTION

DIMENSIONS OF PATCH

READ(X')

READ(Y')

READ(Z')

JUMP 78,X'=0

I=41(1)44

```
READ(HI)
REPEAT
NEWLINE
CAPTION
G(a)=
PRINT('X')0,6
SPACE 18
H41=H41H1
H42=H42H2
H43=H43H1
H44=H44H2
PRINT(H41)0,4
PRINT(H42)0,4
SPACE 18
PRINT(H43)0,4
PRINT(H44)0,4
78)JUMP 79,Y'=0
I=45(1)48
READ(HI)
REPEAT
NEWLINE
CAPTION
G(b)=
PRINT('Y')0,6
SPACE 18
H45=H45H1
H46=H46H2
H47=H47H1
H48=H48H2
PRINT(H45)0,4
PRINT(H46)0,4
SPACE 18
PRINT(H47)0,4
PRINT(H48)0,4
79)JUMP 80,Z'=0
I=49(1)52
READ(HI)
REPEAT
NEWLINE
CAPTION
G(c)=
PRINT('Z')0,6
SPACE 18
H49=H49H1
H50=H50H2
H51=H51H1
H52=H52H2
PRINT(H49)0,4
PRINT(H50)0,4
```

SPACE 18
PRINT(H51)0,4
PRINT(H52)0,4
JUMP 80

75)CAPTION
CYLINDRICAL SHELL - LOADING APPLIED IN A FIXED DIRECTION IN (B-C) PLANE.
CAPTION

DOUBLE FOURIER EXPANSION.

NEWLINE

CAPTION

$\theta =$

READ(Z')

READ(H32)

I=49(1)52

READ(H1)

REPEAT

PRINT(H32)3,3

H32=;H32/180

NEWLINE

CAPTION

INTENSITY OF LOADING

COORDINATES OF CENTRE OF PATCH

CAPTION

DIMENSIONS OF PATCH

NEWLINE

PRINT(Z')0,6

SPACE 22

H49=H49H1

H50=H50H2

H51=H51H1

H52=H52H2

PRINT(H49)0,4

PRINT(H50)0,4

SPACE 20

PRINT(H51)0,4

PRINT(H52)0,4

JUMP 80

76)CAPTION

UNIFORM PATCH LOADING IN C DIRECTION.

(SINGLE FOURIER EXPANSION)

NEWLINE

CAPTION

INTENSITY OF LOADING

CO-ORDINATES OF CENTRE OF PATCH

CAPTION

DIMENSIONS OF PATCH

NEWLINE

READ(Z')

READ(H49)

```

READ(H51)
H49=H49H1
H51=H51H1
H50=.5H2
H52=H2
PRINT(Z')0,6
SPACE 18
PRINT(H49)0,4
PRINT(H50)0,4
SPACE 18
PRINT(H51)0,4
PRINT(H52)0,4
JUMP 80

```

```

77)CAPTION
CYLINDRICAL SHELL - SELF WEIGHT.          (SINGLE FOURIER EXPANSION)
NEWLINE
CAPTION
INTENSITY OF LOADING =
READ(Z')
READ(H32)
PRINT(Z')0,6
NEWLINE
CAPTION
 $\theta =$ 
PRINT(H32)3,3
H32=;H32/180
H33=H32-H4H2

```

```

>> TEMPERATURE LOADING
30)READ(B70)
READ(B71)
READ(B72)
NEWLINE 2
CAPTION
TEMPERATURE T1 =
PRINT(B70)0,4
NEWLINE
CAPTION
TEMPERATURE T2 =
PRINT(B71)0,4
NEWLINE
CAPTION
COEFFICIENT OF LINEAR THERMAL EXPANSION =
PRINT(B72)0,4

```

>> BOUNDARY CONDITIONS

I=16(1)19

READ(CI)

REPEAT

C20=100000

NEWLINE 2

CAPTION

C20=1.0000, 5

NEWLINE 2

CAPTION

EDGE 1 -

K)=15)

L=4

JUMP 10,C16=0

L=0

JUMP 11,C16=1

L=2

JUMP 12,C16=2

JUMP 13,C16=3

O'=1

JUMP 43,C16=5

L=1

JUMP 14,C16=4

15)NEWLINE

CAPTION

EDGE 2 -

K)=16)

L'=4

JUMP 10,C17=0

L'=0

JUMP 11,C17=1

L'=2

JUMP 12,C17=2

JUMP 13,C17=3

O'=2

JUMP 43,C17=5

L'=1

JUMP 14,C17=4

16)NEWLINE

CAPTION

EDGE 3 -

K)=17)

M=4

JUMP 10,C18=0

M=0

JUMP 11,C18=1

M=2

JUMP 12,C18=2

```

JUMP 13,C18=3
O'=3
JUMP 43,C18=5
M=1
JUMP 14,C18=4
17)NEWLINE
CAPTION
EDGE 4 -
K)=18)
M'=4
JUMP 10,C19=0
M'=0
JUMP 11,C19=1
M'=2
JUMP 12,C19=2
JUMP 13,C19=3
O'=4
JUMP 43,C19=5
M'=1
JUMP 14,C19=4

```

```

10)CAPTION
FLEXIBLE EDGE BEAM.
JUMP (K)
11)CAPTION
DEEP THIN INEXTENSIBLE NORMAL GABLE (SIMPLY SUPPORTED).
JUMP (K)
12)CAPTION
CLAMPED.
JUMP (K)
13)CAPTION
FREE.
JUMP (K)
14)CAPTION
HINGED.
JUMP (K)
43)READ(;(O'+30))

```

```

CAPTION
DEEP THIN INEXTENSIBLE OBLIQUE GABLE    Ø=
PRINT(;(O'+30))3,3
;(O'+30)=;(O'+30);/130
JUMP (K)

```

```

18)READ(A')
JUMP 19,A'=0
L'=0
NEWLINE 2
JUMP 41,A'=-1

```

```

CAPTION
BOUNDARY CONDITIONS AND LOADING SYMMETRIC ABOUT AXIS B=L(B)/2
JUMP 19
41)CAPTION
BOUNDARY CONDITIONS SYMMETRIC AND LOADING ANTIMETRIC ABOUT AXIS B=L(B)/2
19)READ(B')
JUMP 23,B'=0
M'=0
NEWLINE
JUMP 42,B'=-1
CAPTION
BOUNDARY CONDITIONS AND LOADING SYMMETRIC ABOUT AXIS A=L(A)/2
JUMP 23
42)CAPTION
BOUNDARY CONDITIONS SYMMETRIC AND LOADING ANTIMETRIC ABOUT AXIS A=L(A)/2.

>>EDGE BEAMS (A,I1,I2,I3,a,b,Z3,Z2,psi)
23)READ(;1)
JUMP 4,;1=0
I=1(1)28
READ(BI)
REPEAT
I=61(1)64
READ(BI)
REPEAT
I=29(1)32
READ(BI)
REPEAT
NEWLINE 2
CAPTION
EDGE BEAMS          1          2          3
                   4
NEWLINE
CAPTION
A      =
I=1(1)4
PRINT(BI)0,6
REPEAT
NEWLINE
CAPTION
I1     =
I=5(1)8
PRINT(BI)0,6
REPEAT
NEWLINE
CAPTION
I2     =
I=9(1)12
PRINT(BI)0,6
REPEAT
NEWLINE
CAPTION
I3     =
I=13(1)16
PRINT(BI)0,6
REPEAT

```

```

NEWLINE
CAPTION
A'      =
I=17(1)20
PRINT(BI)0,6
REPEAT
NEWLINE
CAPTION
B'      =
I=21(1)24
PRINT(BI)0,6
REPEAT
NEWLINE
CAPTION
U.D.L.Z3=
I=25(1)28
PRINT(BI)0,6
REPEAT
NEWLINE
CAPTION
U.D.L.Z2=
I=61(1)64
PRINT(BI)0,6
REPEAT
NEWLINE
CAPTION
PSI      =
I=29(1)32
PRINT(BI)0,6
BI=;BI/180
REPEAT

```

>>ELASTIC CONSTANTS

```

4)READ(E)
READ(E')
READ(C)
D=EHHH/(12-12CC)
NEWLINE 2
CAPTION
      E              E'              NU              D
NEWLINE
PRINT(E)0,4
PRINT(E')0,4
PRINT(C)0,3
PRINT(D)0,4
U4=20SQRT(3-3CC)/H
JUMP 5,E'≠0
E'=1

```

```
>> F.SERIES SPECIFICATIONS
5)READ(P')
READ(R')
READ(R)
READ(Q')
READ(S')
READ(S)
NEWLINE 2
CAPTION
C.SOIN. HARMONICS IN (A) DIRECTION P =
PRINT(P')1,0
SPACE 2
PRINT(R')1,0
SPACE 2
PRINT(R)2,0
NEWLINE
CAPTION
C.SOIN. HARMONICS IN (B) DIRECTION Q =
PRINT(Q')1,0
SPACE 2
PRINT(S')1,0
SPACE 2
PRINT(S)2,0
JUMP 44,R'≠0
R'=1
44)I=(R-P')/R'+1
H8=I
JUMP 45,S'≠0
S'=1
45)I=(S-Q')/S'+1
H9=I
H10=H8H9
I=26(1)31
READ(HI)
REPEAT
NEWLINE
CAPTION
P.SOIN. HARMONICS IN (A) DIRECTION P'=
PRINT(H26)1,0
SPACE 2
PRINT(H27)1,0
SPACE 2
PRINT(H28)2,0
NEWLINE
CAPTION
P.SOIN. HARMONICS IN (B) DIRECTION Q'=
PRINT(H29)1,0
SPACE 2
PRINT(H30)1,0
SPACE 2
```

```
PRINT(H31)2,0
JUMP 46,H27≠0
H27=1
46) I=(H28-H26)/H27+1
H38=I
JUMP 47,H30≠0
H30=1
47) I=(H31-H29)/H30+1
H39=I
H40=H38H39
```

>> MATRIX STARTING LOCATIONS

```
21) I=0(1)4
AI=16I
REPEAT
I=0(1)3
A(I+5)=80+4I
REPEAT
I=0(1)9
A(I+14)=96+16I
REPEAT
A24=256
B33=260
B41=324
B35=388
B36=396
B37=404
B38=464
B39=524
B40=539
A25=554
A26=570
B34=586
B42=590
B43=622
B44=654
A34=686
A35=702
A36=718
A37=734
A9=750
A10=750+H38
A11=A10+H38
A12=A11+H39
A13=A12+H39
U=A13+H40
V=U+(L+L')H8+(M+M')H9
J=H8-1
```

```

I=0(1)J
DI=V+8I
EI=DI+4
REPEAT
K=H9-1
I=0(1)K
FI=EJ+8I+4
GI=FI+4
REPEAT
F'=V+8H3+8H9
G'=F'+15H40

JUMP 54,L+L'+M+M'=0
JUMP 56,M+M'=0
JUMPDOWN (R13)
JUMPDOWN (R15)
JUMP 55
54)JUMPDOWN (R14)
JUMP 55
56)JUMPDOWN (R6)
JUMPDOWN (R15)
55)READ(B49)
JUMP 1,B49=1
JUMP 5,B49=5
JUMP 52,B49=6
JUMP 53,B49=9
JUMPDOWN (R14)
JUMP 55
52)NEWLINE
1071,0,0,0
JUMP 1
53)END
CLOSE

```

***T

```

.25 70 40 4.5 4
0 1 1 0 0 50
0 0 0
0 0 2 2 1 1
2
4.5 4.5 0 0
7.58 7.58 0 0
.375 .375 0 0
1.287 1.287 0 0
.5 -.5 0 0
.25 .25 0 0

```

675 675 0 0
 0 0 0 0
 22.62 22.62 0 0
 4.5,8 4.5,8 .15
 1 2 29 1 2 29
 1 2 19 1 2 19
 0 .5 0 .5
 5 5
 5

1 2 39 1 2 39
 1 2 19 1 2 19
 0 .5 0 .5
 5 5
 5

1 2 49 1 2 49
 1 2 19 1 2 19
 0 .5 0 .5
 5 5
 1

.25 50 50 3.1755 3.1755
 0 1 1 0 0 50
 0 0 0
 0 0 0 0 1 1
 4
 4.5 4.5 4.5 4.5
 7.58 7.58 7.58 7.58
 .375 .375 .375 .375
 1.287 1.287 1.287 1.287
 .5 -.5 .5 -.5
 .25 .25 .25 .25
 675 675 675 675
 0 0 0 0
 14.48 14.48 14.48 14.48
 4.5,8 4.5,8 .15
 1 2 19 1 2 19
 1 2 19 1 2 19
 0 .5 0 .5
 5 5
 5

1 2 29 1 2 29
 1 2 19 1 2 19
 0 .5 0 .5
 5 5
 5

1 2 39 1 2 39

1 2 19 1 2 19
 0 .5 0 .5
 5 5
 1

.208333 70 30 0 4
 2 1 0 50 54 .5 .5 1 1
 0 0 0
 0 5 2 2 36 0 1
 1

4.5 0 0 0
 7.58 0 0 0
 .375 0 0 0
 1.287 0 0 0
 .5 0 0 0
 2 0 0 0
 675 0 0 0
 0 0 0 0

54 0 0 0
 4.5,8 4.5,8 .15
 1 2 19 1 1 19
 1 2 19 0 1 19
 0 .5 0 1
 5 5
 9

***Z

CHAPTER IX

COMPUTER PROGRAMME FOR RULED SURFACES

IX.1. Preparation of data tapes

The sequence of symbols to be specified is presented in the form of a flow diagram in figure 9.1. All symbols enclosed in rectangular cages must be specified in the order they occur in following the flow diagram.

Symbols used in the flow diagram

$k_{\alpha\beta}$ = 'twist' of the surface, defined in figure 9.2

n_1, n_2, n_3, n_4 = constant edge forces $n_{\alpha\beta}$ applied along edges 1, 2, 3 and 4 respectively (when boundary condition is represented by code number 6).

All other symbols are as defined for translational shells in section VIII.1.

Note

(i) Computations are made using the plan lengths L_α and L_β (translational shells are computed using the arc lengths l_α and l_β).

(ii) Only loading conditions represented by $C23 = 0$ and $C23 = 1$ are applicable.

(iii) The code numbers defining the boundary conditions ($c_{16}, c_{17}, c_{18}, c_{19}$) are listed in table 2.2.

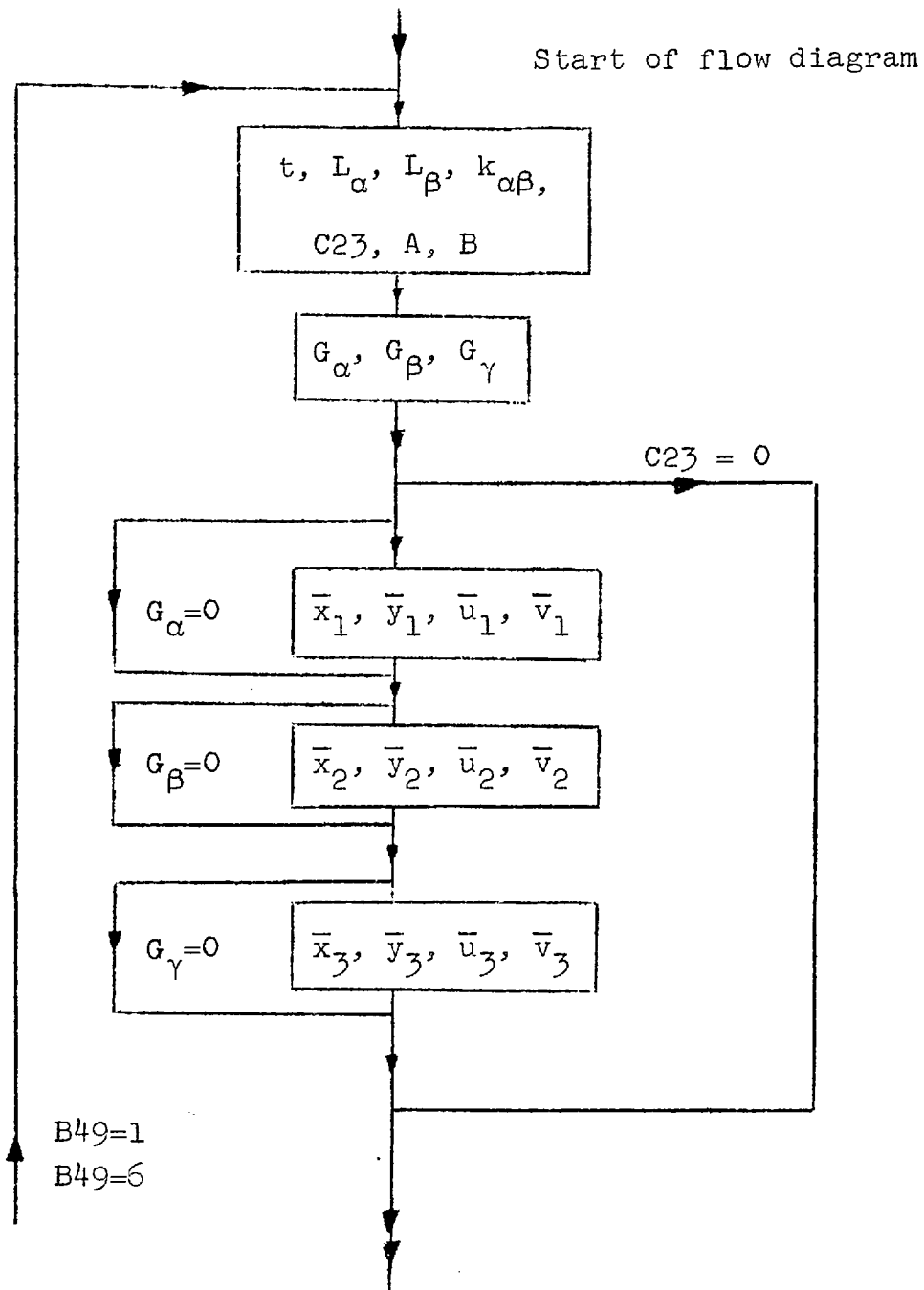


Figure 9.1

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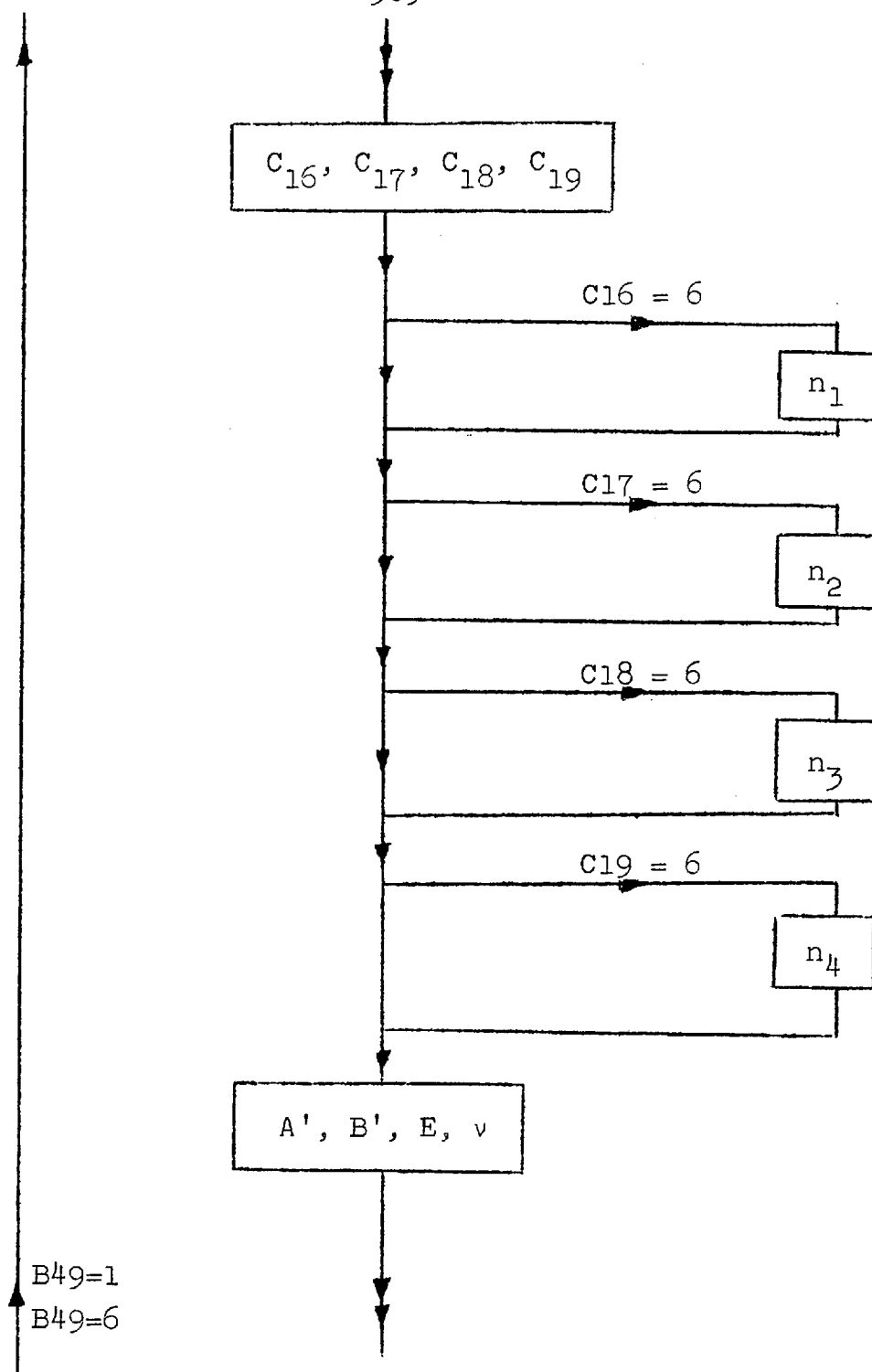


Figure 9.1 (continued)

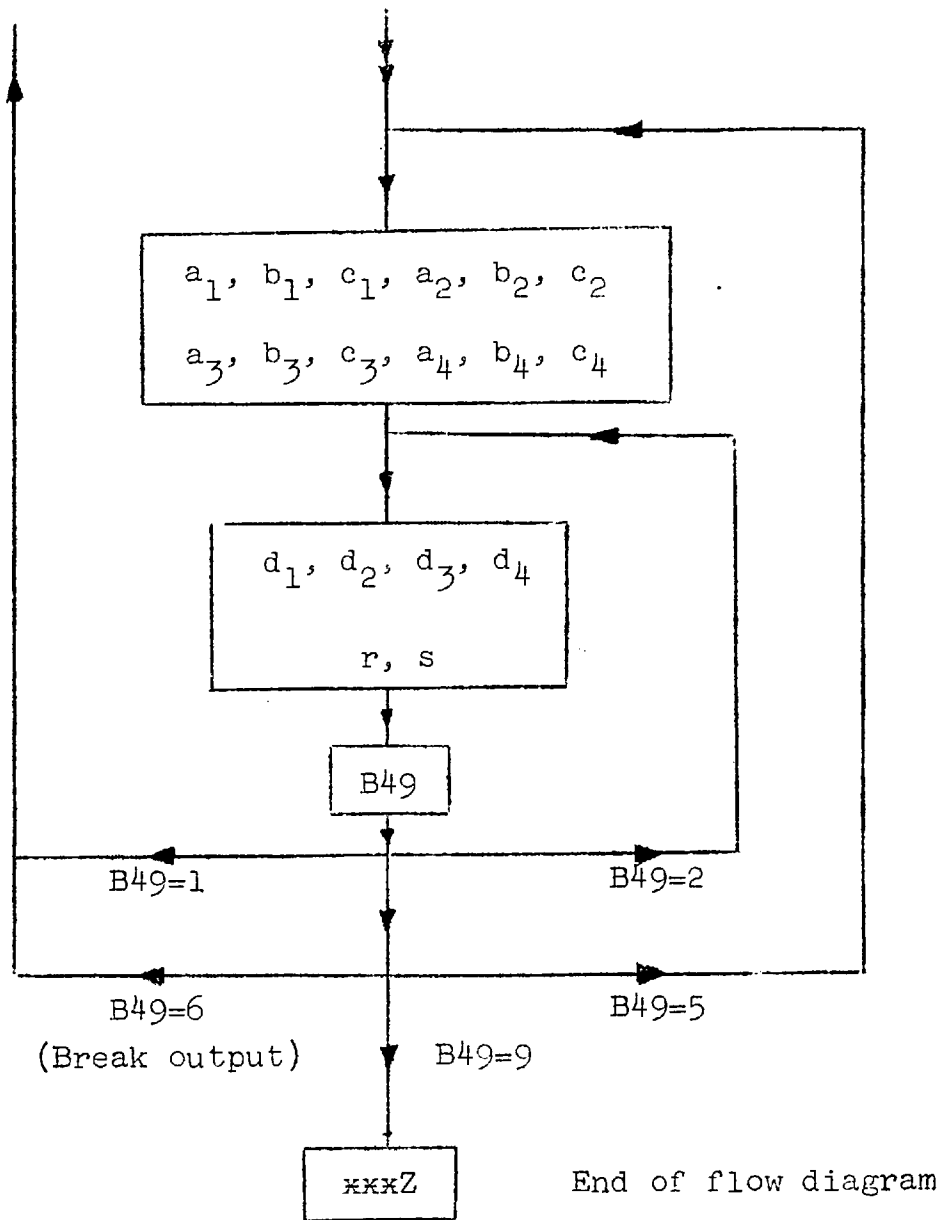
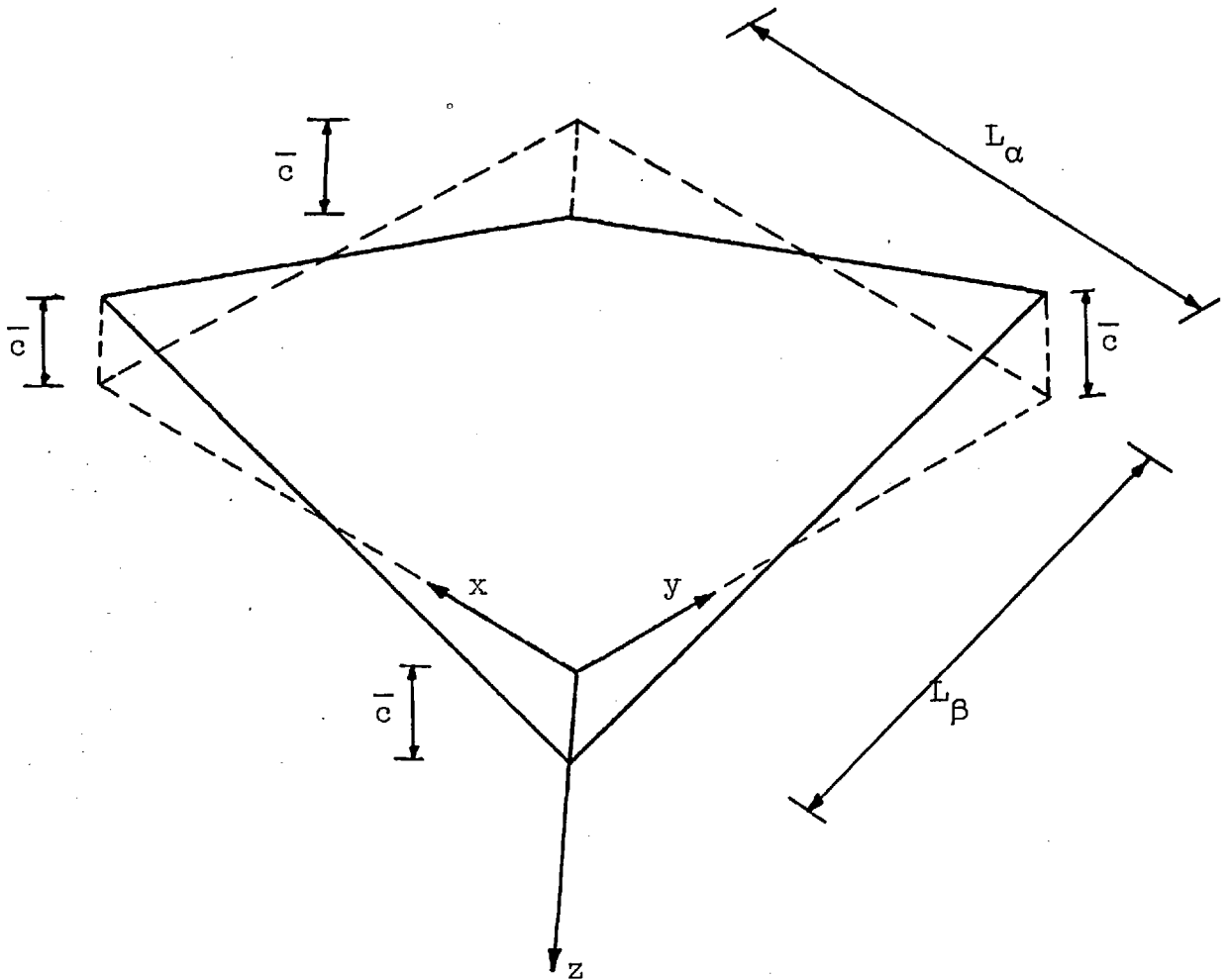


Figure 9.1 (continued)



The middle surface of the shell is represented by the equation (section II.1):-

$$z = ax^2 + by^2 + cxy + dx + ey + f$$

$$\text{Then } k_{\alpha\beta} = c$$

$$\text{In the above diagram } c = \frac{4\bar{c}}{L_\alpha L_\beta}$$

Figure 9.2

IX.2. Job description⁽³⁷⁾

Instructions

The comments made in section VII.2 for translational shells are applicable where tables 8.5 and 8.6 are replaced by tables 9.1 and 9.2 respectively and,

Instruction for compilation = 7800

TABLE 9.1

Edge Condition	Number of equations per complementary solution harmonic specified in a direction parallel to the edge
Free-guided	0
Hinged	1
Clamped	2
Free	2
Simply supported	2
Code number 6	2

Output

For a typical problem where the shell solution is printed at 30 points the number of lines of print-out is approximately 250 lines. Print-out at additional points counts at about 5 lines per point.

TABLE 9.2

Number of equations to be solved	Number of instructions
30	1000
40	1500
60	3000
80	5000
100	9000
120	12000

Blocks

$$\text{Compilation} = 100$$

$$\text{Execution} = 40 + \frac{y^2}{512}$$

where y = maximum number of equations to be solved in
a single run.

Variables

$$\text{Main} = 750$$

$$\text{Auxiliary} = 2000 + y^2$$

where y = maximum number of equations to be solved in
a single run.

IX.3. Computer programme for ruled surfaces

The programme is written in Extended Mercury Auto-code (EMA)⁽³⁷⁾ for the Atlas computer at the University of London Institute of Computer Science.

```
JOB
DSC42FC1, GUNASEKERA G R6 RUN 30 1.3.67
COMPUTING 60000 INSTRUCTIONS
OUTPUT
0 LINE PRINTER 2500 LINES
STORE 80/104 BLOCKS
COMPILER EMA
MAIN ▶750
AUXILIARY(0,20000)
DUMPS 0
DEPTH 0
```

ROUTINE 3

```
>> NAVIER SOLUTION COEFFICIENTS
1)H6=P;/H1
H7=Q;/H2
JUMP 3,C23=3
;10=16/(H1H2)
X=0
JUMP 10,X'=0
JUMP 10,P=0
JUMP 5,A=-1
X=0SIN(H6H41)0SIN(.5H6H43)/H6
JUMP 6
5)X=(-0COS(H6H41)+0COS(H6H41-.5H6H43))/H6
6)JUMP 7,B=1
JUMP 8,Q=0
X=;10X'X0COS(H7H42)0SIN(.5H7H44)/H7
JUMP 10
8)X=;10X'XH44/4
JUMP 10
7)JUMP 9,Q=0
X=;10X'X(0SIN(H7H42)-0SIN(H7H42-.5H7H44))/H7
JUMP 10
9)X=0
```

```

10)Y=0
JUMP 16,Y'=0
JUMP 16,Q=0
JUMP 11,A=1
JUMP 12,P=0
Y=ØCOS(H6H45)ØSIN(.5H6H47)/H6
JUMP 13
12)Y=H47/4
JUMP 13
11)JUMP 16,P=0
Y=(ØSIN(H6H45)-ØSIN(H6H45-.5H6H47))/H6
13)JUMP 14,B=-1
Y=;1ØY'YØSIN(H7H46)ØSIN(.5H7H48)/H7
JUMP 16
14)Y=;1ØY'Y(-ØCOS(H7H46)+ØCOS(H7H46-.5H7H48))/H7
16)Z=0
JUMP 50,Z'=0
JUMP 50,P=0
JUMP 50,Q=0
JUMP 17,A=-1
Z=ØSIN(H6H49)ØSIN(.5H6H51)/H6
JUMP 18
17)Z=(-ØCOS(H6H49)+ØCOS(H6H49-.5H6H51))/H6
18)JUMP 19,B=-1
Z=;1ØZ'ZØSIN(H7H50)ØSIN(.5H7H52)/H7
JUMP 50
19)Z=;1ØZ'Z(-ØCOS(H7H50)+ØCOS(H7H50-.5H7H52))/H7
JUMP 50

```

```

3)X=0
Y=0
Z=0
JUMP 60,P=0
Z=4Z'ØSIN(H6H49)ØSIN(.5H6H51)/(H6H1)
JUMP 61

```

```

50)JUMP 51,P=0
JUMP 52,Q=0
;1=H6H6
;2=H7H7
;3=;1+;2
;4=;3;3
;5=D;4;4+4EHH5H5;1;2
Y0=(;4Z-2H5H6H7((;2/H6-CH6)X+(;1/H7-CH7)Y))/;5
Y1=(2EHH5H6H7Y0+(;2/H6-CH6)X+(;1/H7-CH7)Y)/;4
Y2=DY0(;1+C;2)
Y3=-DH6H7Y0(1-C)
Y4=DY0(;2+C;1)

```

```
Y5=-;2Y1+X/H6
Y6=-H6H7Y1
Y7=-;1Y1+Y/H7
Y8=(Y5-CY7)/(H6EH)
Y9=(Y7-CY5)/(H7EH)
Y10=H6Y0
Y11=H7Y0
Y12=H6Y2-H7Y3
Y13=H7Y4-H6Y3
JUMP 99
```

```
51)O'=O(1)13
YO'=O
REPEAT
JUMP 99,Q=O
Y7=Y/H7
Y5=CY7
Y9=(1-CC)Y7/(H7EH)
JUMP 99
```

```
52)O'=O(1)13
YO'=O
REPEAT
Y5=X/H6
Y7=CY5
Y8=(1-CC)Y5/(H6EH)
JUMP 99
```

```
60)H6=1
61)O'=O(1)13
YO'=O
REPEAT
Y0=Z/(DH6H6H6H6)
Y2=Z/(H6H6)
Y4=CY2
Y9=-2H5Y0/H6
Y10=H6Y0
Y12=H6Y2
99)RETURN
```

**

ROUTINE 6

```
>> LEVY SOLUTION (EDGES 3 AND 4 FREE-GUIDED.)
1)NEWLINE 2
CAPTION
SOLUTION VECTORS
NEWLINE
```

CAPTION

EDGE 1

EDGE 2

NEWLINE

CAPTION

N(b)	Q'(b)	N(ab)	M(b)	N(b)
CAPTION	Q'(b)	N(ab)	M(b)	

NEWLINE

JUMP 2,C23=3

>> LOADING EXPANDED AS A DOUBLE FOURIER SERIES.

P=P'(R')R

JUMPDOWN (R4/1)

J'=(P-P')/R'

JUMPDOWN (R1/9)

Ø6(A5)X2,2

Ø6(A7)X4,2

Ø7(A5)X0,4

Ø7(A7)X4,4

JUMP 3,A'≠0

JUMPDOWN (R1/9)

Ø6(A6)X2,2

Ø6(A8)X4,2

Ø7(A6)X0,4

Ø7(A8)X4,4

3)JUMPDOWN 5

REPEAT

JUMP 40

>> LOADING EXPANDED AS A FOURIER SERIES IN ALPHA DIRECTION.

2)P=P'(R')R

JUMPDOWN (R3)

J'=(P-P')/R'

JUMPDOWN (R1/9)

X0=C20Y9

X7=Y4

X1=C20Y0

Ø7(A5)X0,4

Ø7(A7)X4,4

JUMP 4,A'≠0

Ø7(A6)X0,4

Ø7(A8)X4,4

4)JUMPDOWN 5

REPEAT

JUMP 40

5);17=124

W'=A'

JUMPDOWN (R9/1)

JUMP 6,C16=10
JUMP 7,C16=2
JUMP 8,C16=3
JUMP 9,C16=4
B36=Ø15(A7,1)
B36+1=Ø15(A5+1,2)
B36+3=Ø15(A7+3,1)
A14=Ø15(A34,4)
A14+4=Ø15(A16+4,8)
A14+12=Ø15(A34+12,4)
A15=Ø15(A35,4)
A15+4=Ø15(A17+4,8)
A15+12=Ø15(A35+12,4)
JUMP 10
6)B36=Ø15(A5,2)
B36+2=Ø15(A7+2,2)
A14=Ø15(A16,8)
A14+8=Ø15(A34+8,8)
A15=Ø15(A17,8)
A15+8=Ø15(A35+8,8)
JUMP 10
7)B36=Ø15(A5,4)
A14=Ø15(A16,16)
A15=Ø15(A17,16)
JUMP 10
8)B36=Ø15(A7,4)
A14=Ø15(A34,16)
A15=Ø15(A35,16)
JUMP 10
9)B36=Ø15(A5,3)
B36+3=Ø15(A7+3,1)
A14=Ø15(A16,12)
A14+12=Ø15(A34+12,4)
A15=Ø15(A17,12)
A15+12=Ø15(A35+12,4)

10)JUMP 15,A'≠0
JUMP 11,C17=10
JUMP 12,C17=2
JUMP 13,C17=3
JUMP 14,C17=4
B36+4=Ø15(A8,1)
B36+5=Ø15(A6+1,2)
B36+7=Ø15(A8+3,1)
A36=Ø15(A34,4)
A36+4=Ø15(A16+4,8)
A36+12=Ø15(A34+12,4)
A37=Ø15(A35,4)
A37+4=Ø15(A17+4,8)

```
A37+12=Ø15(A35+12,4)
JUMP 15
11)B36+4=Ø15(A6,2)
B36+6=Ø15(A8+2,2)
A36=Ø15(A16,8)
A36+8=Ø15(A34+8,8)
A37=Ø15(A17,8)
A37+8=Ø15(A35+8,8)
JUMP 15
12)B36+4=Ø15(A6,4)
A36=Ø15(A16,16)
A37=Ø15(A17,16)
JUMP 15
13)B36+4=Ø15(A8,4)
A36=Ø15(A34,16)
A37=Ø15(A35,16)
JUMP 15
14)B36+4=Ø15(A6,3)
B36+7=Ø15(A8+3,1)
A36=Ø15(A16,12)
A36+12=Ø15(A34+12,4)
A37=Ø15(A17,12)
A37+12=Ø15(A35+12,4)

15)B33=Ø29(-1,8)
B36=Ø26(B33,B36,8,1,8)
Z0=H2
JUMPDOWN (R10/3)
DJ'=Ø15(B34,4)
EJ'=Ø15(B35,4)
A22=Ø26(A34,DJ',4,1,4)
A23=Ø26(A21,EJ',4,1,4)
A23=Ø26(A35,A23,4,1,4)
A23=Ø11(A22,A23,4)
Ø6(A23)X1,4
A22=Ø26(A35,EJ',4,1,4)
A23=Ø26(A21,DJ',4,1,4)
A23=Ø26(A34,A23,4,1,4)
A23=Ø11(A22,A23,4)
Ø6(A23)X5,4
NEWLINE
I=1(1)8
JUMP 16,I#5
SPACE 8
16)PRINT(XI)0,4
REPEAT
RETURN
40)JUMPDOWN (R14)
```

RETURN

**

ROUTINE 1

1)O'=0(1)15

XO'=0

REPEAT

JUMP 3

2)NEWLINE 2

O'=0(1)7

PRINT(XO')0,4

REPEAT

NEWLINE 2

O'=8(1)15

PRINT(XO')0,4

REPEAT

NEWLINE 2

JUMP 3

4)O'=0(1)3

X(O'+K)=YO'

REPEAT

O'=4(1)7

X(O'+K+4)=YO'

REPEAT

O'=8(1)11

X(O'+K+8)=YO'

REPEAT

O'=12(1)15

X(O'+K+12)=YO'

REPEAT

JUMP 3

9)O'=0(1)7

XO'=0

REPEAT

JUMP 3

10)O'=0(1)3

XO'=0

REPEAT

3)RETURN

**

ROUTINE 4

>> SHELL P.SOLUTION

>> EDGES 1 AND 2

1)JUMPDOWN (R1/9)

J=H29

I'=H30

T=H31

Q=J(I')T

JUMPDOWN (R3)

X0=C20Y8+X0

X1=C20Y11+X1

X2=Y7+X2

X3=Y13-H6Y3+X3

JUMP 2,A'≠0

X8=ØPARITY(Q)

X4=C20Y8X8+X4

X5=C20Y11X8+X5

X6=Y7X8+X6

X7=(Y13-H6Y3)X8+X7

Ø7(A6)X4,2

Ø7(A8)X6,2

2)Ø7(A5)X0,2

Ø7(A7)X2,2

REPEAT

JUMP 5

>> EDGES 3 AND 4

3)JUMPDOWN (R1/9)

J=H26

I'=H27

T=H28

P=J(I')T

JUMPDOWN (R3)

X0=C20Y9+X0

X1=C20Y10+X1

X2=Y5+X2

X3=Y12-H7Y3+X3

JUMP 4,B'≠0

X8=ØPARITY(P)

X4=C20Y9X8+X4

X5=C20Y10X8+X5

X6=Y5X8+X6

X7=(Y12-H7Y3)X8+X7

Ø7(A6)X4,2

Ø7(A8)X6,2

4)Ø7(A5)X0,2

Ø7(A7)X2,2

REPEAT

5)RETURN

**

ROUTINE 5

>> P.SOLUTION GAPS

>> EDGES 1 AND 2

1) JUMP 31, $L+L'=0$

$P=P'(R')R$

JUMPDOWN ($R_4/1$)

$J'=(P-P')/R'$

JUMP 4, $C16=10$

$K=U+LJ'$

JUMP 2, $C16=2$

JUMP 3, $C16=3$

JUMP 8, $C16=4$

JUMP 9, $C16=1$

$K=\phi_{15}(A_7, 1)$

; $10=-4; 21/(P;)$

$\phi_7(K+1); 10, 1$

JUMP 4

9) $K=\phi_{15}(A_7, 1)$

$K+1=\phi_{15}(A_5, 1)$

JUMP 4

8) $K=\phi_{15}(A_5, 1)$

JUMP 4

2) $K=\phi_{15}(A_5, 2)$

JUMP 4

3) $K=\phi_{15}(A_7, 2)$

4) JUMP 7, $A' \neq 0$

JUMP 7, $C17=10$

$K=U+LH_8+L'J'$

JUMP 5, $C17=2$

JUMP 6, $C17=3$

JUMP 10, $C17=4$

JUMP 11, $C17=1$

$K=\phi_{15}(A_8, 1)$

; $10=-4; 22/(P;)$

$\phi_7(K+1); 10, 1$

JUMP 7

11) $K=\phi_{15}(A_8, 1)$

$K+1=\phi_{15}(A_6, 1)$

JUMP 7

10) $K=\phi_{15}(A_6, 1)$

JUMP 7

5) $K=\phi_{15}(A_6, 2)$

JUMP 7

6) $K=\phi_{15}(A_8, 2)$

7) REPEAT

```

>> EDGES 3 AND 4
31) JUMP 61, M+M'=0
Q=Q'(S')S
JUMPDOWN (R4/3)
J'=(Q-Q')/S'
JUMP 34, C18=10
K=U+(L+L')H8+MJ'
JUMP 32, C18=2
JUMP 33, C18=3
JUMP 38, C18=4
JUMP 39, C18=1
K=Ø15(A7,1)
;10=-4;23/(Q;)
Ø7(K+1);10,1
JUMP 34
39)K=Ø15(A7,1)
K+1=Ø15(A5,1)
JUMP 34
38)K=Ø15(A5,1)
JUMP 34
32)K=Ø15(A5,2)
JUMP 34
33)K=Ø15(A7,2)
34)JUMP 37, B'≠0
JUMP 37, C19=10
K=U+(L+L')H8+MH9+M'J'
JUMP 35, C19=2
JUMP 36, C19=3
JUMP 40, C19=4
JUMP 41, C19=1
K=Ø15(A8,1)
;10=-4;24/(Q;)
Ø7(K+1);10,1
JUMP 37
41)K=Ø15(A8,1)
K+1=Ø15(A6,1)
JUMP 37
40)K=Ø15(A6,1)
JUMP 37
35)K=Ø15(A6,2)
JUMP 37
36)K=Ø15(A8,2)
37)REPEAT
61)RETURN

```

**

ROUTINE 7

>> ROOTS OF AUXILIARY EQN.

1)U1=P;/H1

JUMP 3

2)U1=Q;/H2

3)U2=U1U1

U3=C5U2+128U2U2U2/27

;O=ØSQRT(C5U2U2(.25C5+64U2U2/27))

C3=.5ØSQRT(4U2/3+ØEXP(ØLOG(.5U3+;O)/3)+ØEXP(ØLOG(.5U3-;O)/3))

;1=ØSQRT(U2+.25U1C6/C3-C3C3)

C4=ØSQRT(-U2+.25U1C6/C3+C3C3)

C1=C3+;1

C2=ØMOD(C3-;1)

C7=2C3C4

C8=C3C3-C4C4

C9=C3C3+C4C4

RETURN

**

ROUTINE 8

>> POSN. MATRICES L1,L2

1)JUMPDOWN (R7/1)

;18=H2-ZO

JUMP 3

2)JUMPDOWN (R7/2)

;18=H1-ZO

>> L1

3);'=0

4)JUMPDOWN (R1)

;8=ØEXP(-C3ZO)

XO=ØEXP(-C1ZO)

X5=ØEXP(-C2ZO)

X10=;8ØCOS(C4ZO)

X11=;8ØSIN(C4ZO)

X14=-X11

X15=X10

JUMP 6,;'\neq 0

Ø7(A20)XO,16

>> L2

5);'=1

ZO=;18

JUMP 4

6)Ø7(A21)XO,16

RETURN

**

ROUTINE 9

>>C.F. MATRICES

1)JUMPDOWN (R7/1)

JUMP 3

2)JUMPDOWN (R7/2)

>> MATRICES PA,PB

3);1=U4U2

;3=-U4U1

X0=;1

X1=;1

X2=-;1

X3=0

X4=-DC1(-C1C1+(2-C)U2)

X5=-DC2(-C2C2+(2-C)U2)

X6=-DC3(-C3C3+3C4C4+(2-C)U2)

X7=-DC4(-C4C4+3C3C3-(2-C)U2)

X8=-;3C1

X9=-;3C2

X10=;3C3

X11=-;3C4

X12=-D(C1C1-CU2)

X13=-D(C2C2-CU2)

X14=-D(C8-CU2)

X15=DC7

Ø7(A34)X0,16

O'=O(1)7

XO'=-XO'

REPEAT

Ø7(A35)X0,16

>> MATRICES QC,QD

;1=-C2OU4/(EH)

;3=;1/U1

X0=;1(-U2/C1-CC1)

X1=;1(-U2/C2-CC2)

X2=;1C3(C+U2/C9)

X3=;1C4(-C+U2/C9)

X4=C20

X5=C20

X6=C20

X7=0

X8=;3(C1C1-CU2)

```

X9=;3(C2C2-CU2)
X10=;3(CU2-C8)
X11=;3C7
X12=-C1C20
X13=-C2C20
X14=-C3C20
X15=C4C20
Ø7(A16)X0,16
O'=8(1)15
XO'=-XO'
REPEAT
Ø7(A17)X0,16
JUMP 7,;17=124

```

```

JUMP 21,;19=1
JUMP 28,;19=2
JUMP 32,;19=3
A(14+I')=Ø15(A16,12)
A(14+I')+12=Ø15(A34+12,4)
A(15+I')=Ø15(A17,12)
A(15+I')+12=Ø15(A35+12,4)
JUMP 22
21)A(14+I')=Ø15(A34,4)
A(14+I')+4=Ø15(A16+4,4)
A(14+I')+12=Ø15(A34+12,4)
A(15+I')=Ø15(A35,4)
A(15+I')+4=Ø15(A17+4,4)
A(15+I')+12=Ø15(A35+12,4)
JUMP 33,;19=6
A(14+I')+8=Ø15(A16+8,4)
A(15+I')+8=Ø15(A17+8,4)
JUMP 22
33)A(14+I')+8=Ø15(A34+8,4)
A(15+I')+8=Ø15(A35+8,4)
JUMP 22
28)A(14+I')=Ø15(A16,16)
A(15+I')=Ø15(A17,16)
JUMP 22
32)A(14+I')=Ø15(A34,16)
A(15+I')=Ø15(A35,16)
22)JUMP 26,W'≠0
JUMP 23,;20=10
JUMP 24,;20=2
JUMP 25,;20=3
JUMP 29,;20=1
JUMP 29,;20=6
A(36-I')=Ø15(A16,12)
A(36-I')+12=Ø15(A34+12,4)

```

```

A(37-I')=Ø15(A17,12)
A(37-I')+12=Ø15(A35+12,4)
JUMP 26
23)A(36-I')=Ø15(A16,8)
A(36-I')+8=Ø15(A34+8,8)
A(37-I')=Ø15(A17,8)
A(37-I')+8=Ø15(A35+8,8)
JUMP 26
24)A(36-I')=Ø15(A16,16)
A(37-I')=Ø15(A17,16)
JUMP 26
25)A(36-I')=Ø15(A34,16)
A(37-I')=Ø15(A35,16)
JUMP 26
29)A(36-I')=Ø15(A34,4)
A(36-I')+4=Ø15(A16+4,4)
A(36-I')+12=Ø15(A34+12,4)
A(37-I')=Ø15(A35,4)
A(37-I')+4=Ø15(A17+4,4)
A(37-I')+12=Ø15(A35+12,4)
JUMP 30,;20=6
A(36-I')+8=Ø15(A16+8,4)
A(37-I')+8=Ø15(A17+8,4)
JUMP 26
30)A(36-I')+8=Ø15(A34+8,4)
A(37-I')+8=Ø15(A35+8,4)
26)JUMP 7,;17=123

```

>> MATRICES TJ,TK

```

27);2=-DU1
;3=C2OU4/(EH)
X0=-U4C1C1
X1=-U4C2C2
X2=U4C8
X3=-U4C7
X4=;2(-U2+(2-C)C1C1)
X5=;2(-U2+(2-C)C2C2)
X6=;2(-U2+(2-C)C8)
X7=-;2C7(2-C)
X8=;3(U2/C1+CC1)
X9=;3(U2/C2+CC2)
X10=-;3C3(C+U2/C9)
X11=-;3C4(-C+U2/C9)
X12=U1C20
X13=X12
X14=X12
X15=0
Ø7(A18)X0,16
Ø'=0(1)3

```

```
XO'=-XO'  
REPEAT  
Ø7(A19)XO,16  
JUMP 7
```

```
>> MATRICES B37,B38  
4)JUMPDOWN (R7/1)  
I'=0  
JUMP 6  
5)JUMPDOWN (R7/2)  
I'=4
```

```
6)XO=1  
X1=1  
X2=1  
X3=0  
X(I'+4)=-D(-U2+CC1C1)  
X(I'+5)=-D(-U2+CC2C2)  
X(I'+6)=-D(-U2+CC8)  
X(I'+7)=DCC7  
X(8-I')=-D(C1C1-CU2)  
X(9-I')=-D(C2C2-CU2)  
X(10-I')=-D(C8-CU2)  
X(11-I')=DC7  
X(I'+12)=-U4C1C1  
X(I'+13)=-U4C2C2  
X(I'+14)=U4C8  
X(I'+15)=-U4C7  
X(16-I')=U4U2  
X(17-I')=U4U2  
X(18-I')=-U4U2  
X(19-I')=0  
;2=-DU1(1-C)  
X20=-;2C1  
X21=-;2C2  
X22=-;2C3  
X23=;2C4  
X24=U4U1C1  
X25=U4U1C2  
X26=-U4U1C3  
X27=U4U1C4  
;3=-U4/(EHU1)  
X(28+2I')=;3(C1C1-CU2)  
X(29+2I')=;3(C2C2-CU2)  
X(30+2I')=;3(CU2-C8)  
X(31+2I')=;3C7  
X(32+2I')=-C1  
X(33+2I')=-C2
```

```
X(34+2I')=-C3
X(35+2I')=C4
;4=-U4/(EH)
X(36-2I')=;4(-U2-CC1C1)/C1
X(37-2I')=;4(-U2-CC2C2)/C2
X(38-2I')=;4(CC3C9+U2C3)/C9
X(39-2I')=;4(-CC4C9+U2C4)/C9
X(40-2I')=U1
X(41-2I')=U1
X(42-2I')=U1
X(43-2I')=0
;5=-DU1
X(44+I')=;5(-U2+C1C1)
X(45+I')=;5(-U2+C2C2)
X(46+I')=;5(-U2+C8)
X(47+I')=-;5C7
X(48-I')=-DC1(-C1C1+U2)
X(49-I')=-DC2(-C2C2+U2)
X(50-I')=-DC3(-C3C3+3C4C4+U2)
X(51-I')=-DC4(-C4C4+3C3C3-U2)
X(56-I')=-DC1(-C1C1+U2(2-C))
X(57-I')=-DC2(-C2C2+U2(2-C))
X(58-I')=-DC3(-C3C3+3C4C4+U2(2-C))
X(59-I')=-DC4(-C4C4+3C3C3-U2(2-C))
X(52+I')=;5(-U2+C1C1(2-C))
X(53+I')=;5(-U2+C2C2(2-C))
X(54+I')=;5(-U2+C8(2-C))
X(55+I')=-;5C7(2-C)
Ø7(B37)X0,60
O'=12(1)23
XO'=-XO'
REPEAT
JUMP 8,I'=4
O'=28(1)35
XO'=-XO'
REPEAT
O'=48(1)51
XO'=-XO'
REPEAT
O'=56(1)59
XO'=-XO'
REPEAT
JUMP 9
8)O'=36(1)47
XO'=-XO'
REPEAT
O'=52(1)55
XO'=-XO'
REPEAT
9)Ø7(B38)X0,60
```

7)RETURN

**

ROUTINE 10

>> LEVY SOLUTION - ARBITRARY CONSTANTS

1)JUMPDOWN (R9/1)

Z0=H2

JUMP 3

2)JUMPDOWN (R9/2)

Z0=H1

3);'=1

JUMPDOWN (R8/4)

A22=Ø26(A15,A21,4,4,4)

JUMP 4,W'=0

A23=Ø13(A14,W',A22,16)

B41=Ø29(4)

B41=Ø28(A23,4,4)

JUMP 5,;17=0

JUMP 6

4)A23=Ø26(A36,A21,4,4,4)

Ø6(A14)Y0,16

K=0

JUMPDOWN (R1/4)

Ø6(A22)Y0,16

K=4

JUMPDOWN (R1/4)

Ø6(A23)Y0,16

K=32

JUMPDOWN (R1/4)

Ø6(A37)Y0,16

K=36

JUMPDOWN (R1/4)

Ø7(B33)X0,64

B41=Ø29(8)

B41=Ø28(B33,8,8)

JUMP 5,;17=0

JUMP 7

8)JUMP 7,W'=0

6)B34=Ø26(B41,B36,4,1,4)

A23=Ø29(W',4)

B35=Ø26(A23,B34,4,1,4)

JUMP 5

7)B33=Ø26(B41,B36,8,1,8)

```
B34=Ø15(B33,4)
B35=Ø15(B33+4,4)
5)RETURN
```

**

ROUTINE 11

```
3)K=0(1)0'
V'=V+J'+NK
Ø7(V')XK,1
REPEAT
JUMP 20
```

```
4)JUMPDOWN (R1)
X19=ØSIN(C4U5)
X20=ØCOS(C4U5)
X21=ØEXP(-C3U5)
X22=U5(C9+2C4U6+U6U6)
X23=U5(C9-2C4U6+U6U6)
X0=2U6(1-X18ØEXP(-C1U5))/(U5C1C1+U5U6U6)
X5=2U6(1-X18ØEXP(-C2U5))/(U5C2C2+U5U6U6)
X10=(X18X21(-C3X19-C4X20-U6X20)+C4+U6)/X22
X10=X10-(X18X21(-C3X19-C4X20+U6X20)+C4-U6)/X23
X11=(X18X21(-C3X20+C4X19-U6X19)+C3)/X23
X11=X11-(X18X21(-C3X20+C4X19+U6X19)+C3)/X22
X14=-X11
X15=X10
Ø7(A22)X0,16
X0=-X18X0
X5=-X18X5
X10=-X18X10
X11=-X18X11
X14=-X11
X15=X10
Ø7(A23)X0,16
A25=Ø26(A22,B34,4,1,4)
A26=Ø26(A23,B35,4,1,4)
A25=Ø26(A18+4,A25,3,1,4)
A26=Ø26(A19+4,A26,3,1,4)
A24+1=Ø11(A25,A26,3)
X0=2C1(1-X18ØEXP(-C1U5))/(U5C1C1+U5U6U6)
X5=2C2(1-X18ØEXP(-C2U5))/(U5C2C2+U5U6U6)
X10=(X18X21(-C3X20+C4X19+U6X19)+C3)/X22
X10=X10+(X18X21(-C3X20+C4X19-U6X19)+C3)/X23
X11=(X18X21(-C3X19-C4X20-U6X20)+C4+U6)/X22
X11=X11-(X18X21(C3X19+C4X20-U6X20)-C4+U6)/X23
```

```
X14=-X11
X15=X10
Ø7(A22)X0,16
X0=X18X0
X5=X18X5
X10=X18X10
X11=X18X11
X14=-X11
X15=X10
Ø7(A23)X0,16
A25=Ø26(A22,B34,4,1,4)
A26=Ø26(A23,B35,4,1,4)
A25=Ø26(A18,A25,1,1,4)
A26=Ø26(A19,A26,1,1,4)
A24=Ø11(A25,A26,1)
JUMP 20
```

```
8)Ø6(A24)X0,4
K=0(1)3
XK=X18XK
REPEAT
Ø7(A24)X0,4
20)RETURN
```

**

ROUTINE 12

```
1)JUMP 51,M+M'=0
U5=H2
Q=Q'(S')S
Q=(Q-Q')/S'
U6=Q;/U5
X18=ØPARITY(Q)
JUMPDOWN (R11/4)
JUMP 9,C18=10
Q'=M-1
J'=T+MNO
JUMP 3,C18=2
JUMP 4,C18=3
JUMP 11,C18=4
JUMP 12,C18=1
Ø6(A24)X0,1
X1=0
JUMP 5
12)Ø6(A24)X0,1
Ø6(A24+2)X1,1
JUMP 5
```

11) $\emptyset 6(A24+2)X0,1$
JUMP 5
3) $\emptyset 6(A24+2)X0,2$
JUMP 5
4) $\emptyset 6(A24)X0,2$
5) JUMPDOWN (R11/3)
9) JUMP 8, B' $\neq$ 0
JUMP 8, C19=10
X18= $\emptyset$ PARITY(P)
JUMPDOWN (R11/8)
O'=M'-1
J'=T+MNH9+M'NO
JUMP 6, C19=2
JUMP 7, C19=3
JUMP 13, C19=4
JUMP 14, C19=1
 $\emptyset 6(A24)X0,1$
X1=0
JUMP 10
14) $\emptyset 6(A24)X0,1$
 $\emptyset 6(A24+2)X1,1$
JUMP 10
13) $\emptyset 6(A24+2)X0,1$
JUMP 10
6) $\emptyset 6(A24+2)X0,2$
JUMP 10
7) $\emptyset 6(A24)X0,2$
10) JUMPDOWN (R11/3)
8) REPEAT
JUMP 51

31) JUMP 51, L+L'=0
U5=H1
P=P'(R')R
O=(P-P')/R'
U6=P;/U5
X18= $\emptyset$ PARITY(P)
JUMPDOWN (R11/4)
JUMP 39, C16=10
O'=L-1
J'=T+LNO
JUMP 33, C16=2
JUMP 34, C16=3
JUMP 41, C16=4
JUMP 42, C16=1
 $\emptyset 6(A24)X0,1$
X1=0
JUMP 35
42) $\emptyset 6(A24)X0,1$

```

Ø6(A24+2)X1,1
JUMP 35
41)Ø6(A24+2)X0,1
JUMP 35
33)Ø6(A24+2)X0,2
JUMP 35
34)Ø6(A24)X0,2
35)JUMPDOWN (R11/3)
39)JUMP 38,A'≠0
JUMP 38,C17=10
X18=ØPARITY(Q)
JUMPDOWN (R11/8)
O'=L'-1
J'=T+LNH8+L'NO
JUMP 36,C17=2
JUMP 37,C17=3
JUMP 43,C17=4
JUMP 44,C17=1
Ø6(A24)X0,1
X1=0
JUMP 40
44)Ø6(A24)X0,1
Ø6(A24+2)X1,1
JUMP 40
43)Ø6(A24+2)X0,1
JUMP 40
36)Ø6(A24+2)X0,2
JUMP 40
37)Ø6(A24)X0,2
40)JUMPDOWN (R11/3)
38)REPEAT
51)RETURN

```

**

ROUTINE 13

>> ACTIONS ALONG EDGE 1
1)N=(L+L')H8+(M+M')H9

```

V=Ø29(1,N)
;17=0
W'=A'
JUMP 11,C16=10
;19=C16
;20=C17
I'=0
JUMPDOWN (R1/10)
Ø7(B36+4)X0,4

```

```

P=P'(R')R
J=(P-P')/R'
JUMPDOWN (R10/1)
JUMP 2,C16=2
JUMP 3,C16=3
JUMP 9,C16=4
I=0(1)1
JUMPDOWN (R1/10)
JUMP 5,I=0
X2=1
JUMP 6
5)X0=1
6)Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ+I
JUMPDOWN (R12/1)
REPEAT
JUMP 4
9)JUMPDOWN (R1/10)
X2=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ
JUMPDOWN (R12/1)
JUMP 4
2)I=0(1)1
JUMPDOWN (R1/10)
X(I+2)=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ+I
JUMPDOWN (R12/1)
REPEAT
JUMP 4
3)I=0(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LJ+I
JUMPDOWN (R12/1)
REPEAT
4)REPEAT
NEWLINE 2
CAPTION
EDGE 1 COMPLETE

```

>> ACTIONS ALONG EDGE 2

```
11) JUMP 21, C17=10
JUMP 21, A'≠0
;19=C17
;20=C16
I'=22
JUMPDOWN (R1/10)
Ø7(B36)X0,4
P=P'(R')R
J=(P-P')/R'
JUMPDOWN (R10/1)
JUMP 12, C17=2
JUMP 13, C17=3
JUMP 19, C17=4
I=O(1)1
JUMPDOWN (R1/10)
JUMP 15, I=0
X2=1
JUMP 16
15)X0=1
16)Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J+I
JUMPDOWN (R12/1)
REPEAT
JUMP 14
19)JUMPDOWN (R1/10)
X2=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J
JUMPDOWN (R12/1)
JUMP 14
12)I=O(1)1
JUMPDOWN (R1/10)
X(I+2)=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J+I
JUMPDOWN (R12/1)
REPEAT
JUMP 14
13)I=O(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=N(L+L')H8+LH8+L'J+I
JUMPDOWN (R12/1)
```

REPEAT
14) REPEAT
NEWLINE
CAPTION
EDGE 2 COMPLETE

>> ACTIONS ALONG EDGE 3

21) $W' = B'$
JUMP 31, $C18 = 10$
; $19 = C18$
; $20 = C19$
 $I' = 0$
JUMPDOWN (R1/10)
 $\emptyset 7(B36+4)X0,4$
 $Q = Q'(S')S$
 $J = (Q - Q')/S'$
JUMPDOWN (R10/2)
JUMP 22, $C18 = 2$
JUMP 23, $C18 = 3$
JUMP 29, $C18 = 4$
 $I = 0(1)1$
JUMPDOWN (R1/10)
JUMP 25, $I = 0$
 $X2 = 1$
JUMP 26
25) $X0 = 1$
26) $\emptyset 7(B36)X0,4$
JUMPDOWN (R10/8)
 $T = (L+L')H8+MJ+I$
JUMPDOWN (R12/31)
REPEAT
JUMP 24
29) JUMPDOWN (R1/10)
 $X2 = 1$
 $\emptyset 7(B36)X0,4$
JUMPDOWN (R10/8)
 $T = (L+L')H8+MJ$
JUMPDOWN (R12/31)
JUMP 24
22) $I = 0(1)1$
JUMPDOWN (R1/10)
 $X(I+2) = 1$
 $\emptyset 7(B36)X0,4$
JUMPDOWN (R10/8)
 $T = (L+L')H8+MJ+I$
JUMPDOWN (R12/31)
REPEAT
JUMP 24

```
23) I=0(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MJ+I
JUMPDOWN (R12/31)
REPEAT
24) REPEAT
NEWLINE
CAPTION
EDGE 3 COMPLETE
```

```
>> ACTIONS ALONG EDGE 4
31) JUMP 41, C19=10
JUMP 41, B'≠0
;19=C19
;20=C18
I'=22
JUMPDOWN (R1/10)
Ø7(B36)X0,4
Q=Q'(S')S
J=(Q-Q')/S'
JUMPDOWN (R10/2)
JUMP 32, C19=2
JUMP 33, C19=3
JUMP 39, C19=4
I=0(1)1
JUMPDOWN (R1/10)
JUMP 35, I=0
X2=1
JUMP 36
35) X0=1
36) Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J+I
JUMPDOWN (R12/31)
REPEAT
JUMP 34
39) JUMPDOWN (R1/10)
X2=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J
JUMPDOWN (R12/31)
JUMP 34
32) I=0(1)1
JUMPDOWN (R1/10)
X(I+2)=1
```

```

Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J+I
JUMPDOWN (R12/31)
REPEAT
JUMP 34
33)I=0(1)1
JUMPDOWN (R1/10)
XI=1
Ø7(B36+4)X0,4
JUMPDOWN (R10/8)
T=(L+L')H8+MH9+M'J+I
JUMPDOWN (R12/31)
REPEAT
34)REPEAT

```

```

41)JUMP 62,N=0
NEWLINE
CAPTION
MATRIX V FORMED
NEWLINE 2
JUMPDOWN (R5)
CAPTION
P.SGIN. GAPS (DISPLACEMENTS MULTIPLIED BY C20)
JUMP 42,L=0
NEWLINE
CAPTION
EDGE 1
K=LH8-L
I=0(L)K
Ø6(U+I)X1,L
NEWLINE
Q'=1(1)L
PRINT(XQ')0,4
REPEAT
REPEAT
42)JUMP 43,L'=0
NEWLINE
CAPTION
EDGE 2
K=LH8
J=K+L'H8-L'
I=K(L')J
Ø6(U+I)X1,L'
NEWLINE
Q'=1(1)L'
PRINT(XQ')0,4
REPEAT

```

```
REPEAT
43) JUMP 44, M=0
NEWLINE
CAPTION
EDGE 3
 $K = (L + L') H_8$ 
 $J = K + M H_9 - M$ 
 $I = K(M) J$ 
 $\phi_6(U + I) X_1, M$ 
NEWLINE
 $O' = 1(1) M$ 
PRINT(XO') 0,4
REPEAT
REPEAT
44) JUMP 45, M'=0
NEWLINE
CAPTION
EDGE 4
 $K = (L + L') H_8 + M H_9$ 
 $J = K + M' H_9 - M'$ 
 $I = K(M') J$ 
 $\phi_6(U + I) X_1, M'$ 
NEWLINE
 $O' = 1(1) M'$ 
PRINT(XO') 0,4
REPEAT
REPEAT

45)  $U = \phi_{28}(V, N, 1)$ 
NEWLINE 2
CAPTION
MATRIX V INVERTED
NEWLINE 3
CAPTION
SOLUTION VECTORS
NEWLINE 2
```

```
>> ARBITRARY CONSTANTS
46) JUMPDOWN (R1/10)
 $\phi_7(A_6) X_0, 4$ 
 $P = P'(R') R$ 
 $J' = (P - P') / R'$ 
 $DJ' = \phi_{15}(A_6, 4)$ 
 $EJ' = \phi_{15}(A_6, 4)$ 
REPEAT
 $Q = Q'(S') S$ 
 $J' = (Q - Q') / S'$ 
 $FJ' = \phi_{15}(A_6, 4)$ 
 $GJ' = \phi_{15}(A_6, 4)$ 
REPEAT
```

>> ACTIONS ALONG EDGE 1

```
;17=123
W'=A'
JUMP 50,C16=10
CAPTION
EDGE 1
NEWLINE
CAPTION
P
;19=C16
;20=C17
I'=0
P=P'(R')R
J'=(P-P')/R'
K=U+LJ'
JUMPDOWN (R1/9)
JUMP 47,C16=2
JUMP 48,C16=3
JUMP 63,C16=4
Ø6(K)X0,1
Ø6(K+1)X2,1
JUMP 49
63)Ø6(K)X2,1
JUMP 49
47)Ø6(K)X2,2
JUMP 49
48)Ø6(K)X0,2
49)NEWLINE
PRINT(P)2,0
I=0(1)3
XI=-XI
PRINT(XI)0,4
REPEAT
Ø7(B36)X0,8
JUMPDOWN (R10/1)
DJ'=Ø15(B34,4)
EJ'=Ø15(B35,4)
REPEAT
JUMP 54,W'≠0
```

>> ACTIONS ALONG EDGE 2

```
50)JUMP 54,C17=10
;19=C17
;20=C16
I'=22
NEWLINE 2
CAPTION
EDGE 2
```

```
NEWLINE
CAPTION
P
P=P'(R')R
J'=(P-P')/R'
K=U+LH8+L'J'
JUMPDOWN (R1/9)
JUMP 51,C17=2
JUMP 52,C17=3
JUMP 64,C17=4
Ø6(K)X4,1
Ø6(K+1)X6,1
JUMP 53
64)Ø6(K)X6,1
JUMP 53
51)Ø6(K)X6,2
JUMP 53
52)Ø6(K)X4,2
53)NEWLINE
PRINT(P)2,0
I=4(1)7
XI=-XI
PRINT(XI)0,4
REPEAT
Ø7(B36)X0,8
JUMPDOWN (R10/1)
DJ'=Ø11(DJ',B34,4)
EJ'=Ø11(EJ',B35,4)
REPEAT
```

>> ACTIONS ALONG EDGE 3

```
54)W'=B'
JUMP 58,C18=10
;19=C18
;20=C19
I'=0
NEWLINE 2
CAPTION
EDGE 3
NEWLINE
CAPTION
Q
Q=Q'(S')S
J'=(Q-Q')/S'
K=U+(L+L')H8+MJ'
JUMPDOWN (R1/9)
JUMP 55,C18=2
JUMP 56,C18=3
JUMP 65,C18=4
```

```

ø6(K)X0,1
ø6(K+1)X2,1
JUMP 57
65)ø6(K)X2,1
JUMP 57
55)ø6(K)X2,2
JUMP 57
56)ø6(K)X0,2
57)NEWLINE
PRINT(Q)2,0
I=O(1)3
XI=-XI
PRINT(XI)0,4
REPEAT
ø7(B36)X0,8
JUMPDOWN (R10/2)
FJ'=ø15(B34,4)
GJ'=ø15(B35,4)
REPEAT
JUMP 62,W'≠0

```

>> ACTIONS ALONG EDGE 4

```

58)JUMP 62,C19=10
;19=C19
;20=C18
I'=22
NEWLINE 2
CAPTION
EDGE 4
NEWLINE
CAPTION
Q
Q=Q'(S')S
J'=(Q-Q')/S'
K=U+(L+L')H8+MH9+M'J'
JUMPDOWN (R1/9)
JUMP 59,C19=2
JUMP 60,C19=3
JUMP 66,C19=4
ø6(K)X4,1
ø6(K+1)X6,1
JUMP 61
66)ø6(K)X6,1
JUMP 61
59)ø6(K)X6,2
JUMP 61
60)ø6(K)X4,2
61)NEWLINE
PRINT(Q)2,0

```

```

I=4(1)7
XI=-XI
PRINT(XI)0,4
REPEAT
Ø7(B36)X0,8
JUMPDOWN (R10/2)
FJ'=Ø11(FJ',B34,4)
GJ'=Ø11(GJ',B35,4)
REPEAT
62)JUMPDOWN (R14)
RETURN

```

**

ROUTINE 14

>> TOTAL SOLUTION PRINT INSTRUCTIONS

>>OUTPUT DOMAIN

1)READ(H20)

READ(H21)

READ(H22)

READ(H23)

H20=H20H1

H21=H21H1

H22=H22H2

H23=H23H2

READ(N)

READ(N')

I=1(1)15

XI=0

REPEAT

K=NN'-1

I=0(1)K

Ø7(G'+15I)X1,15

REPEAT

N=N-1

N'=N'-1

JUMP 4,N=0

H24=(H21-H20)/N

4)JUMP 5,N'=0

H25=(H23-H22)/N'

5)NEWLINE 4

CAPTION

POINT(A,B)

U(C)

M(A)

M(B)

CAPTION

N(A)

N(B)

M(AB)

N(AB)

NEWLINE

CAPTION

	U(A)	PSI(B)	U(B)
CAPTION			
	PSI(A)	Q(A)	Q'(A)
NEWLINE			
CAPTION		Q'(B)	

>> C.FUNCTION SOLN. ACTIONS ALONG EDGES 1 AND 2

JUMP 101,C23>2.5

JUMP 6,L+L'=0

101)P=P'(R')R

K'=(P-P')/R'

JUMPDOWN (R9/4)

J'=O(1)N'

H12=H22+J'H25

ZO=H12

;18=H2-ZO

JUMPDOWN (R8/3)

A20=026(A20,DK',4,1,4)

A21=026(A21,EK',4,1,4)

B39=026(B37,A20,15,1,4)

B40=026(B38,A21,15,1,4)

B40=011(B39,B40,15)

06(B40)Y1,15

I'=O(1)N

H11=H20+I'H24

;0=U1H11

;1=0SIN(;0)

;2=0COS(;0)

I=1(1)3

XI=;1YI

REPEAT

I=4(1)6

XI=;2YI

REPEAT

I=7(1)9

XI=;1YI

REPEAT

X10=;2Y10

X11=;2Y11

X12=;2Y12

X13=;1Y13

X14=;2Y14

X15=;1Y15

07(B40)X1,15

K=15N'I'+15I'+15J'+G'

K=011(K,B40,15)

REPEAT

REPEAT

REPEAT

```

>> C.FUNCTION SOLN. ACTIONS ALONG EDGES 3 AND 4
6)JUMP 7,M+M'=0
Q=Q'(S')S
K'=(Q-Q')/S'
JUMPDOWN (R9/5)
I'=O(1)N
H11=H20+I'H24
Z0=H11
;18=H1-Z0
JUMPDOWN (R8/3)
A20=Ø26(A20,FK',4,1,4)
A21=Ø26(A21,GK',4,1,4)
B39=Ø26(B37,A20,15,1,4)
B40=Ø26(B38,A21,15,1,4)
B40=Ø11(B39,B40,15)
Ø6(B40)Y1,15
J'=O(1)N'
H12=H22+J'H25
;0=U1H12
;1=ØSIN(;0)
;2=ØCOS(;0)
I=1(1)3
XI=;1YI
REPEAT
I=4(1)6
XI=;2YI
REPEAT
X7=;1Y7
X8=;2Y8
X9=;2Y9
X10=;1Y10
X11=;1Y11
X12=;1Y12
X13=;2Y13
X14=;1Y14
X15=;2Y15
Ø7(B40)X1,15
K=15N'I'+15I'+15J'+G'
K=Ø11(K,B40,15)
REPEAT
REPEAT
REPEAT

```

>> P.SOLUTION (NAVIER SOLN1)

7)K'=H40

I'=H26

K=H27

T'=H28

J'=H29

J=H30

T=H31

P=I'(K)T'

I=(P-I')H39/K

Q=J'(J)T

JUMPDOWN (R3)

C=I+(Q-J')/J

Ø7(F'+C)Y0,1

Ø7(F'+C+K')Y2,1

Ø7(F'+C+2K')Y4,1

Ø7(F'+C+3K')Y5,1

Ø7(F'+C+4K')Y7,1

Ø7(F'+C+5K')Y3,1

Ø7(F'+C+6K')Y6,1

Ø7(F'+C+7K')Y8,1

Ø7(F'+C+8K')Y11,1

Ø7(F'+C+9K')Y9,1

Ø7(F'+C+10K')Y10,1

Ø7(F'+C+11K')Y12,1

Ø7(F'+C+12K')Y13,1

X1=Y12-H7Y3

Ø7(F'+C+13K')X1,1

X1=Y13-H6Y3

Ø7(F'+C+14K')X1,1

REPEAT

REPEAT

X0=1

Ø7(A11)X0,1

Ø7(A12)X0,1

I'=O(1)N

NEWLINE

H11=H20+I'H24

J'=O(1)N'

H12=H22+J'H25

NEWLINE 2

PRINT(H11)4,2

CAPTION

,

PRINT(H12)4,2

SPACE 2

>> POSITION MATRICES

```

T=H26
O=H27
O'=H28
P=T(O)O'
H6=P;H11/H1
I=(P-T)/O
XI=ØSIN(H6)
YI=ØCOS(H6)
REPEAT
Ø7(A9)X0,H38
Ø7(A10)Y0,H38
JUMP 9,C23=3
T=H29
O=H30
O'=H31
Q=T(O)O'
H7=Q;H12/H2
I=(Q-T)/O
XI=ØSIN(H7)
YI=ØCOS(H7)
REPEAT
Ø7(A11)X0,H39
Ø7(A12)Y0,H39

```

>>PRINT OUT

```

9)K=15N'I'+15I'+15J'+G'
I=0(1)2
J=IH40
A13=Ø26(A9,F'+J,1,H39,H38)
A13=Ø26(A13,A11,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=3(1)5
J=IH40
A13=Ø26(A10,F'+J,1,H39,H38)
A13=Ø26(A13,A12,1,1,H39)
Ø6(A13)XI,1
REPEAT
J=6H40
A13=Ø26(A9,F'+J,1,H39,H38)
A13=Ø26(A13,A11,1,1,H39)
Ø6(A13)X6,1
I=7(1)8
J=IH40

```

```
A13=Ø26(A9,F'+J,1,H39,H38)
A13=Ø26(A13,A12,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=9(1)11
J=IH40
A13=Ø26(A10,F'+J,1,H39,H38)
A13=Ø26(A13,A11,1,1,H39)
Ø6(A13)XI,1
REPEAT
I=12(2)14
J=IH40
A13=Ø26(A9,F'+J,1,H39,H38)
A13=Ø26(A13,A12,1,1,H39)
Ø6(A13)XI,1
REPEAT
J=13H40
A13=Ø26(A10,F'+J,1,H39,H38)
A13=Ø26(A13,A11,1,1,H39)
Ø6(A13)X13,1
Ø6(K)X20,15
I=0(1)14
JUMP 99,I=14
JUMP 98,I≠7
99)SPACE 22
98);1=XI+X(I+20)
PRINT(;1)0,4
REPEAT
REPEAT
REPEAT
RETURN
```

**

CHAPTER 0

```
A►50
B►50
C►30
D►50
E►50
F►50
G►50
H►60
U►10
V►1
W►1
X►100
```

Y>60

Z>1

; >55

>>SHELL

>>t,La,Lb,Ra,Rb

1)NEWLINE 2

CAPTION

HYPERBOLIC PARABOLOIDAL SHELL ($K(a)=0, K(b)=0$)

NEWLINE 2

CAPTION

T	La(plan)	Lb(plan)	K(ab)
---	----------	----------	-------

NEWLINE

READ(H)

READ(H1)

READ(H2)

READ(H5)

PRINT(H)0,4

PRINT(H1)0,4

PRINT(H2)0,4

PRINT(H5)0,4

>> LOADING ON SHELL

2)READ(C23)

READ(A)

READ(B)

NEWLINE 2

JUMP 70,A=0

JUMP 71,A=-1

CAPTION

LOADING SYMMETRIC ABOUT AXIS $A=L(a)/2$.

JUMP 70

71)CAPTION

LOADING ANTIMETRIC ABOUT AXIS $A=L(a)/2$.

70)NEWLINE

JUMP 72,B=0

JUMP 73,B=-1

CAPTION

LOADING SYMMETRIC ABOUT AXIS $B=L(b)/2$.

JUMP 72

73)CAPTION

LOADING ANTIMETRIC ABOUT AXIS $B=L(b)/2$.

72)NEWLINE 2

JUMP 74,C23=1

JUMP 76,C23=3

CAPTION

UNIFORM LOADING ON TOTAL SURFACE AREA OF SHELL. (DOUBLE FOURIER EXPANSION)

```

NEWLINE
CAPTION
INTENSITY OF LOADING          G(a)          G(b)
      G(c)
NEWLINE
READ(X')
READ(Y')
READ(Z')
SPACE 26
PRINT(X')0,6
SPACE 12
PRINT(Y')0,6
SPACE 8
PRINT(Z')0,6
H41=.5H1
H42=.5H2
H43=H1
H44=H2
H45=.5H1
H46=.5H2
H47=H1
H48=H2
H49=.5H1
H50=.5H2
H51=H1
H52=H2
JUMP 80

```

```

74)CAPTION
UNIFORM PATCH LOADING (DOUBLE FOURIER EXPANSION).
NEWLINE
CAPTION
INTENSITY OF LOADING          CO-ORDINATES OF CENTRE OF PATCH
CAPTION
                                DIMENSIONS OF PATCH

READ(X')
READ(Y')
READ(Z')
JUMP 78,X'=0
I=41(1)44
READ(HI)
REPEAT
NEWLINE
CAPTION
G(a)=
PRINT(X')0,6
SPACE 18
H41=H41H1
H42=H42H2
H43=H43H1

```

```

H44=H44H2
PRINT(H41)0,4
PRINT(H42)0,4
SPACE 18
PRINT(H43)0,4
PRINT(H44)0,4
78)JUMP 79,Y'=0
I=45(1)48
READ(HI)
REPEAT
NEWLINE
CAPTION
G(b)=
PRINT(Y')0,6
SPACE 18
H45=H45H1
H46=H46H2
H47=H47H1
H48=H48H2
PRINT(H45)0,4
PRINT(H46)0,4
SPACE 18
PRINT(H47)0,4
PRINT(H48)0,4
79)JUMP 80,Z'=0
I=49(1)52
READ(HI)
REPEAT
NEWLINE
CAPTION
G(c)=
PRINT(Z')0,6
SPACE 18
H49=H49H1
H50=H50H2
H51=H51H1
H52=H52H2
PRINT(H49)0,4
PRINT(H50)0,4
SPACE 18
PRINT(H51)0,4
PRINT(H52)0,4
JUMP 80

```

76)CAPTION

UNIFORM PATCH LOADING IN C DIRECTION (SINGLE FOURIER EXPANSION)

NEWLINE

CAPTION

INTENSITY OF LOADING

CO-ORDINATES OF CENTRE OF PATCH

CAPTION

DIMENSIONS OF PATCH

```
NEWLINE
READ(Z')
READ(H49)
READ(H51)
H49=H49H1
H51=H51H1
H50=.5H2
H52=H2
PRINT(Z')0,6
SPACE 18
PRINT(H49)0,4
PRINT(H50)0,4
SPACE 18
PRINT(H51)0,4
PRINT(H52)0,4

>> BOUNDARY CONDITIONS
80)I=16(1)19
READ(CI)
REPEAT
C20=100000
NEWLINE 2
CAPTION
C20=1.0000, 5
NEWLINE 2
CAPTION
EDGE 1 -
K)=15)
L=0
JUMP 11,C16=10
L=2
JUMP 12,C16=2
JUMP 13,C16=3
JUMP 28,C16=1
JUMP 29,C16=6
L=1
JUMP 14,C16=4
15)NEWLINE
CAPTION
EDGE 2 -
K)=16)
L'=0
JUMP 11,C17=10
L'=2
JUMP 12,C17=2
JUMP 13,C17=3
JUMP 28,C17=1
JUMP 30,C17=6
```

```
L'=1
JUMP 14,C17=4
16)NEWLINE
CAPTION
EDGE 3 -
K)=17)
M=0
JUMP 11,C18=10
M=2
JUMP 12,C18=2
JUMP 13,C18=3
JUMP 28,C18=1
JUMP 31,C18=6
M=1
JUMP 14,C18=4
17)NEWLINE
CAPTION
EDGE 4 -
K)=3)
M'=0
JUMP 11,C19=10
M'=2
JUMP 12,C19=2
JUMP 13,C19=3
JUMP 28,C19=1
JUMP 32,C19=6
M'=1
JUMP 14,C19=4
```

```
11)CAPTION
FREE GUIDED-EDGE
JUMP (K)
12)CAPTION
CLAMPED
JUMP (K)
13)CAPTION
FREE
JUMP (K)
14)CAPTION
HINGED
JUMP (K)
28)CAPTION
DEEP THIN INEXTENSIBLE NORMAL GABLE (SIMPLY SUPPORTED)
JUMP (K)
29)READ(;21)
CAPTION
N(b)=0,U(c)=0,M(b)=0,N(ab)=
PRINT(;21)0,4
JUMP (K)
30)READ(;22)
```

```

CAPTION
N(b)=0,U(c)=0,M(b)=0,N(ab)=
PRINT(;22)0,4
JUMP (K)
31)READ(;23)
CAPTION
N(a)=0,U(c)=0,M(a)=0,N(ab)=
PRINT(;23)0,4
JUMP (K)
32)READ(;24)
CAPTION
N(a)=0,U(c)=0,M(a)=0,N(ab)=
PRINT(;24)0,4
JUMP (K)

3)READ(A')
NEWLINE 2
JUMP 18,A'=0
L'=0
JUMP 33,A'=-1
CAPTION
BOUNDARY CONDITIONS AND LOADING SYMMETRIC ABOUT AXIS B=L(b)/2.
JUMP 18
33)CAPTION
BOUNDARY CONDITIONS SYMMETRIC AND LOADING ANTIMETRIC ABOUT AXIS B=L(b)/2.
18)READ(B')
JUMP 4,B'=0
M'=0
NEWLINE
JUMP 34,B'=-1
CAPTION
BOUNDARY CONDITIONS AND LOADING SYMMETRIC ABOUT AXIS A=L(a)/2.
JUMP 4
34)CAPTION
BOUNDARY CONDITIONS SYMMETRIC AND LOADING ANTIMETRIC ABOUT AXIS A=L(a)/2.

>> ELASTIC CONSTANTS
4)NEWLINE 2
READ(E)
READ(C)
D=EHHH/(12-12CC)
CAPTION
      E              NU              D
NEWLINE
PRINT(E)0,4
PRINT(C)0,3
PRINT(D)0,4

```

>> F.SERIES SPECIFICATIONS

```
5)READ(P')
READ(R')
READ(R)
READ(Q')
READ(S')
READ(S)
I=26(1)31
READ(HI)
REPEAT
NEWLINE 2
CAPTION
C.SOLN. HARMONICS IN (A) DIRECTION =
PRINT(P')1,0
SPACE 2
PRINT(R')1,0
SPACE 2
PRINT(R)2,0
```

```
NEWLINE
CAPTION
C.SOLN. HARMONICS IN (B) DIRECTION =
PRINT(Q')1,0
SPACE 2
PRINT(S')1,0
SPACE 2
PRINT(S)2,0
JUMP 44,R'≠0
R'=1
44)I=(R-P')/R'+1
H8=I
JUMP 45,S'≠0
S'=1
45)I=(S-Q')/S'+1
H9=I
H10=H8H9
C5=4EHH5H5/D
C6=2ØMOD(H5)(ØSQRT(EH/D))
U4=ØSIGN(H5)(ØSQRT(EHD))
NEWLINE
CAPTION
P.SOLN. HARMONICS IN (A) DIRECTION =
PRINT(H26)1,0
SPACE 2
PRINT(H27)1,0
SPACE 2
PRINT(H28)2,0
NEWLINE
CAPTION
```

P.SOLN. HARMONICS IN (B) DIRECTION =

```
PRINT(H29)1,0
SPACE 2
PRINT(H30)1,0
SPACE 2
PRINT(H31)2,0
JUMP 46,H27#0
H27=1
46)I=(H28-H26)/H27+1
H38=I
JUMP 47,H30#0
H30=1
47)I=(H31-H29)/H30+1
H39=I
H40=H38H39
```

>> MATRIX STARTING LOCATIONS

```
21)I=0(1)4
AI=16I
REPEAT
I=0(1)3
A(I+5)=80+4I
REPEAT
I=0(1)9
A(I+14)=96+16I
REPEAT
A24=256
B33=260
B41=324
B35=388
B36=396
B37=404
B38=464
B39=524
B40=539
A25=554
A26=570
B34=586
B42=590
B43=622
B44=654
A34=686
A35=702
A36=718
A37=734
A9=750
A10=750+H38
A11=A10+H38
A12=A11+H39
```

```

A13=A12+H39
U=A13+H40
V=U+(L+L')H8+(M+M')H9
K=H8-1
I=0(1)K
DI=V+8I
EI=DI+4
REPEAT
J=H9-1
I=0(1)J
FI=EK+8I+4
GI=FI+4
REPEAT
F'=V+8H8+8H9
G'=F'+15H40

```

```

JUMP 54, L+L'+M+M'=0
JUMP 56, M+M'=0
JUMPDOWN (R13)
JUMP 55
54)JUMPDOWN (R14)
JUMP 55
56)JUMPDOWN (R6)
55)READ(B49)
JUMP 1, B49=1
JUMP 5, B49=5
JUMP 52, B49=6
JUMP 53, B49=9
JUMPDOWN (R14)
JUMP 55
52)NEWLINE
1071,0,0,0
JUMP 1
53)END
CLOSE

```

***T

```

.25 50 50 -.008
0 1 1 0 0 50
10 10 10 10 1 1
4.5,8 .15
1 1 1 1 1 1
1 2 19 1 2 19
0 .5 0 .5
5 5
1

```

```
.25 50 50 -.008
0 1 1 0 0 50
4 4 4 4 1 1
4.5,8 .15
1 2 19 1 2 19
1 2 19 1 2 19
0 .5 0 .5
5 5
1
```

```
.25 50 50 -.008
0 1 1 0 0 50
2 2 2 2 1 1
4.5,8 .15
1 2 19 1 2 19
1 2 19 1 2 19
0 .5 0 .5
5 5
1
```

```
.25 50 60 -.008
0 0 0 -10 -10 50
4 2 4 2 0 0
4.5,8 .15
1 1 19 1 1 19
0 1 19 0 1 19
0 1 0 1
5 5
1
```

```
.25 50 60 -.008
0 0 0 -10 -10 50
1 2 1 2 0 0
4.5,8 .15
1 1 7 1 1 7
0 1 7 0 1 7
0 1 0 1
5 5
5
```

```
1 1 11 1 1 11
0 1 7 0 1 7
0 1 0 1
5 5
9
```

***Z