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VOL. III

NUMERICAL NONLINEAR INELASTIC ANALYSIS OF STIFFENED SHELLS OF REVOLUTION

Volume III - Engineer's Program Manual for STARS-2P Digital Computer Program

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16. ABSTRACT

Volume III of this report contains engineering programming information for the STARS-2P (Shell Theory Automated for Rotational Structures-2P (Plasticity)) digital computer program. The report is written for the engineer who will need to make small alterations to the program, such as incorporating a new geometry or altering a table size to fit his specific needs. Each section of this volume covers one major subroutine.

This report is prepared in four volumes. The other volumes are:

Volume I — Theory Manual for STARS-2P Digital Computer Program
Volume II — User's Manual for STARS-2P Digital Computer Program
Volume IV — SATELLITE-1P Program for STARS-2P Digital Computer Program

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INTRODUCTION

This manual presents a general description of the STARS-2P digital computer program. FORTRAN IV is used exclusively in writing the various subroutines. The execution of this program requires the use of thirteen temporary storage units.

The program was initially written and debugged on the IBM 370-165 computer and then converted to the UNIVAC 1108 computer, where it utilizes approximately 60,000 words of core. Only basic FORTRAN Library routines are required by the program these being: sine, cosine, absolute value, and square root.

For ease and speed in usage, the Table of Contents on the following page has also been laid out to present the call sequence of the program.

CONTENTS

SUBROUTINE MAIN

MAIN is the control link for the entire program. Sizing values are read into the program, as well as information for potential load cycling or changes and the material property tables. Calls are made to subroutines RIEMAN and SEGMAT onee for each segment in a region; then subroutine REGMAT is called. This procedure is executed once for every region in the structure. Finally calls to subroutines STRMAT, INITAL and LEBEGE are made.

Subroutine SHPLAS (which is actually called from LEBEGE) updates all the information per load step, and allows the program to loop back to MAIN for the next load increment. If the loading is cycling or progressively changing, the updates for the next load pattern are made before proceeding with the program loops.

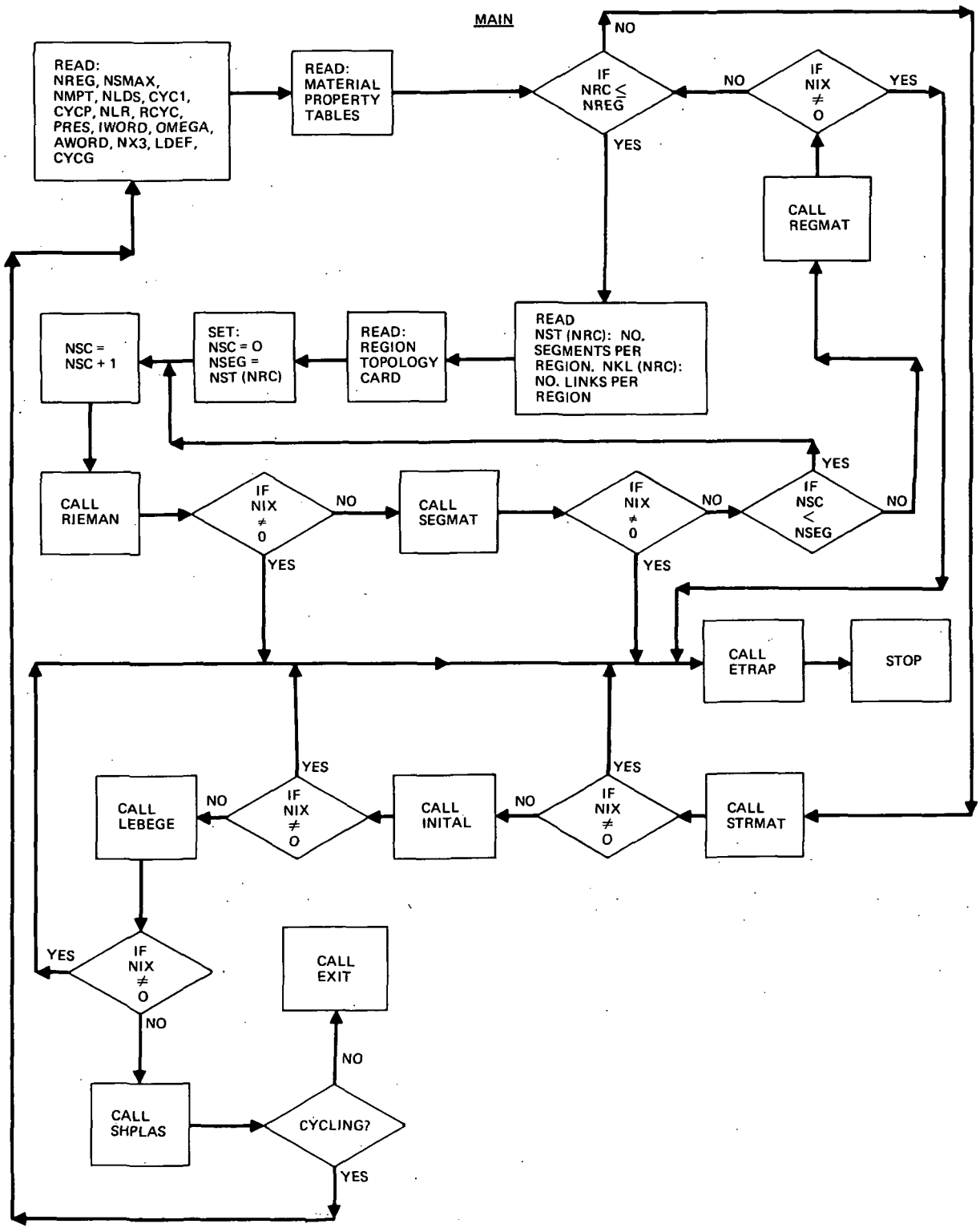
There are also several counters in this control link. These are defined as follows:

NSC - Counts the calls to subroutines RIEMAN and SEGMAT, from 1 to the number of segments within a region.

NRC - Counts the calls to subroutine REGMAT, from 1 to the number of regions in the structure.

P - Counts the load steps in the analysis.

The block data and overlay listings are included in this section.


MAIN
READ: NREG, NSMAX, NMPT, NLDS, CYC1, CYCP, NLR, RCYC, PRES, IWORD, OMEGA, AWORD, NX3, LDEF, CYCG
READ: MATERIAL PROPERTY TABLES
IF NRC ≤ NREG
NO
YES
IF NIX ≠ 0
NO
YES
CALL REGMAT
READ NST (NRC): NO. SEGMENTS PER REGION. NKL (NRC): NO. LINKS PER REGION
READ: REGION TOPOLOGY CARD
SET: NSC = 0 NSEG = NST (NRC)
NSC = NSC + 1
CALL RIEMAN
IF NIX ≠ 0
NO
YES
CALL SEGMAT
IF NIX ≠ 0
NO
YES
IF NSC < NSEG
NO
YES
CALL ETRAP
STOP
CALL LEBEGE
NO
IF NIX ≠ 0
YES
CALL INITAL
NO
IF NIX ≠ 0
YES
CALL STRMAT
YES
IF NIX ≠ 0
NO
CALL SHPLAS
CYCLING?
NO
YES
CALL EXIT

```
RUN,//T STARSS,1HNTSV440063,KEYJOHBIN214,05,500
ASG,T PUR,T,SAVE05
FREE TPF$.
ASG,T TPF$,F/1/POS/10
FOR,IS BLDATA,BLDATA
      BLOCK DATA                                                          100010
      COMMON /NAM1/ FACE(4),STRGO(7),THERM(4),MATER(3),SEGTAB(12)         100020
      COMMON /GINT/ AA(8,4),WW(8,4)                                       100030
      DIMENSION A(32),W(32)                                               100040
      EQUIVALENCE (A(1),AA(1,1)),(W(1),WW(1,1))                           100050
      DATA STRGO /11.0,13.0,21.0,31.0,12.0,14.0,15.0/                     100060
      DATA THERM /4HTHST,4HNOTH,4HTHCN,4HTHIN/                            100070
      DATA MATER /4HISOT,4HORTH,4HSTIF/                                   100080
      DATA SEGTAB/4HST10,4HTHIC,4HRWAF,4HRWA1,4HRWA2,4HRWA3,4HISG1,       100090
     1             4HISG2,4HISG3,4HST11,4HST12,4HST13/                    100100
      DATA FACE /4HSING,4HEQUA,4HUNEQ,4HBLAN/                             100110
      DATA A/0.0,.57735027,.77459667,.86113631,.90617984,.93246951,       100120
     D .94910791,.96028986,0.0,0.0,0.0,.33998104,.53846931,.66120939,     100130
     A .74153118,.79666648,0.0,0.0,0.0,0.0,0.0,.23861919,.40584515,       100140
     T .52553241,0.0,0.0,0.0,0.0,0.0,0.0,.40584515,.18343464/             100150
C                                                                         100160
      DATA W/0.0,1.0,.55555556,.34785484,.23692688,.17132449, .12948497,  100170
     D .10122854,0.0,0.0,.88888889,.65214515,.47862867,.36076157,         100180
     A .27970539,.22238100,0.0,0.0,0.0,0.0,.56888889,.46791393,           100190
     T .3818300,.31370664,0.0,0.0,0.0,0.0,0.0,0.0,.41795918,.36268378/    100200
      END                                                                 100210
```

```
 FOR,IS MAIN,MAIN
C ..... ROUTINE **MAINPROG** ABACUS UPDATED 01/11/74 .....                    200000
      INTEGER SAVJTC,SAVSTP,SEGTAB, Q ,THICK,TYPE                             200010
      INTEGER XN1,XN                                                          200020
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)               200030
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                                  200040
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH                 200050
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)        200060
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB       200070
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE       200080
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS                  200090
      COMMON LODE,ICYCLE,LDISTL                                               200100
      COMMON /NAM1/ FACE(4),STRGO(7),THERM(4),MATER(3),SEGTAB(12)             200110
      COMMON /LYCORR/ YCORR(80)                                               200120
      COMMON /ARING/ NRING(28),AMAT(30,8),RSIG(12),REPS(12),RALPH(12),        200130
     C               RBAPH(12)                                                200140
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                              200150
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI,NEO                                  200160
      COMMON /CDISP/ P,IMAX,DELP,DELP1,YEPS,ZEPS                              200170
      COMMON /GRAFIX/ X(100),Y(100,9),NGRAPH,LDEF(9),NGR,JCYC,NFLAG,JAM,      200180
     C                JNSC                                                    200190
      DIMENSION WORD(3)                                                       200200
      DATA WORD/'PLAS','NLIN','NLPL'/                                         200210
      REWIND 1                                                                200240
      REWIND 2                                                                200250
      REWIND 3                                                                200260
      REWIND 4                                                                200270
      REWIND 8                                                                200280
      REWIND 9                                                                200290
      REWIND 10                                                               200300
      REWIND 11                                                               200310
      REWIND 12                                                               200320
      REWIND 13                                                               200330
      REWIND 14                                                               200340
      REWIND 15                                                               200350
      YEPS = 0.999                                                            200360
      ZEPS = YEPS-1.0                                                         200370
      NCUPLE = 1                                                              200380
      NPROB = 1                                                               200390
      NGP = 1                                                                 200400
      NLCASE = NPROB                                                          200410
      JDSRN = 28                                                              200420
      KDSRN = 23                                                              200430
      NFLAG = 0                                                               200440
  111 WRITE(6,1726)                                                           200450
 1726 FORMAT(1H1)                                                             200460
      READ(5,1000,END=555) STORY                                              200470
 1000 FORMAT(16A4)                                                            200480
      LODE = 1                                                                200490
      ICT = 0                                                                 200500
      NH = 0                                                                  200510
      XN = 0                                                                  200520
      NIX = 0                                                                 200530
      Q=5                                                                     200540
      LDISTL = 5                                                              200550
      DO 100 J=1,3                                                            200560
  100 XNL(J) = 0.0                                                            200570
      READ(5,1001) NREG,NSMAX,NMPT,LINPUT,NLDS,CYC1,CYCP,NLR,RCYC,PRES,       200580
     1             IWORD,OMEGA,AWORD,NX3,LDEF,CYCG                          200590
 1001 FORMAT(I2,I3,3I2,F6.0,F4.0,I2,4X,2F6.0,17X,I2,E14.7/A4,I6,10X,9I1,      200600
```

```
   1 2X,F4.0)                                                          200610
     WRITE(6,602) NSMAX,NREG,NMPT,CYC1
602 FORMAT(////19X,93HUNSYMMETRIC, ORTHOTROPIC, REINFORCED SHELL ANALY  200630
    1SIS WITH COUPLING OF AT MOST 29 SHELL REGIONS,//62X,'STARS-2P',//   200640
    262X,                                                               200650
    3'AS OF JULY 1, 1973'////8X,21HNUMBER OF SEGMENTS = ,I3,21H NUMBER  200660
    4OF REGIONS = ,I2,43H NUMBER OF MATERIAL PROPERTY TABLES USED = ,I2  200670
    5 ,17H NO. OF CYCLES = ,F6.0)
     DO 115 J=1,3                                                       200690
115 IF (WORD(J).EQ.AWORD) GO TO 106                                     200700
     STOP                                                               200710
106 JPLS = J                                                            200720
     GO TO (615,616,617),JPLS                                           200730
615 WRITE(6,618)                                                        200740
618 FORMAT(///55X,'ELASTIC-PLASTIC PROBLEM')                            200750
     GO TO 621                                                          200760
616 WRITE(6,619)                                                        200770
619 FORMAT(///50X,'LARGE DEFLECTION ELASTIC PROBLEM')                   200780
     GO TO 621                                                          200790
617 WRITE(6,620)                                                        200800
620 FORMAT(///50X,'LARGE DEFLECTION PLASTIC PROBLEM')                   200810
621 CONTINUE                                                            200820
     WRITE(6,625)                                                       200830
625 FORMAT(///)                                                         200840
     WRITE(6,605)  (STORY(I),I=1,16)                                    200850
605 FORMAT(11(/),8X,16A4,18(/),80X,35HFOR INFORMATION CALL   V. SVALBO  200860
    1NAS/117X,14H(516) 575-7701/103X,10HP. OGILVIE//103X,9HH. LEVINE)   200870
     NGRAPH = 0                                                         200880
     DO 700 J=1,9                                                       200890
700 IF (LDEF(J).NE.0) NGRAPH = NGRAPH+1                                 200900
     NGR = 0                                                            200910
     NEO = 0                                                            200920
     IF (PRES.NE.0.0) NEO = 1                                           200930
     IF (NEO.EQ.0) GO TO 300                                            200940
     IF (JPLS.GT.1) XNL(1) = 1.0                                        200950
     IF (JPLS.NE.2) XNL(2) = 1.0                                        200960
     IF (NX3.EQ.1) XNL(3) = -1.0                                        200970
300 IO = 13                                                             200980
     JO = JDSRN-IO                                                      200990
     IOR = 11                                                           201000
     P = PRES                                                           201010
     DELP = 1.0/CYC1                                                    201020
     DELP1 = DELP                                                       201030
     OMEGA = OMEGA*OMEGA                                                201040
     NMAT = 1                                                           201050
     IF (CYCP.EQ.0.0) CYCP = 1.0                                        201060
     IF (NLR.LE.1) GO TO 121                                            201070
     LODE = 16                                                          201080
     REWIND LODE                                                        201090
121 CONTINUE                                                            201100
     NROW = 0                                                           201110
     ICT = ICT+1                                                        201120
     ICYCLE = 0                                                         201130
     IF (ICT.EQ.1) ICYCLE = RCYC                                        201140
     ICYC1 = ABS(CYC1)                                                  201150
     IMAX = ICYC1                                                       201160
     IF (NMAT.EQ.0) GO TO 1                                             201170
     KK=-1                                                              201180
     NSAVE=0                                                            201190
     DO 13 I=1,NMPT                                                     201200
     KK=KK+2                                                            201210
```

```
      NXMAT(KK)=NROW+1                                                  201220
      II=NROW+1                                                         201230
      READ(5,1004) STD(I),TYPE                                          201240
 1004 FORMAT (A4,6X,A4,6X)                                              201250
      NROW = 27                                                         201260
      DO 11 L=1,3                                                       201270
   11 IF(TYPE.EQ.MATER(L)) GOTO 12                                      201280
      GO TO 8000                                                        201290
   12 CONTINUE                                                          201300
      IF (L.EQ.1) NROW = 7                                              201310
      IF (L.EQ.2) NROW = 17                                             201320
       LLL=NSAVE+NROW                                                   201330
      READ (5,1005) ((XMAT(M,J),J=1,10),M=II,LLL )                      201340
 1005 FORMAT (5E14.7)                                                   201350
      NROW=NSAVE+NROW                                                   201360
      NXMAT(KK+1)=LLL                                                   201370
   13 NSAVE=NROW                                                        201380
      READ(5,2000)                                                      201390
 2000 FORMAT(1X)                                                        201400
    1 CONTINUE                                                          201410
      P = P+1.0                                                         201420
      ICYCLE = ICYCLE+1                                                 201430
      NGR = 0                                                           201440
      IF (P.NE.CYCG*NGP) GO TO 10                                       201450
      NGR = 1                                                           201460
      NGP = NGP+1                                                       201470
   10 CONTINUE                                                          201480
      C = ICYCLE                                                        201490
      IBEGIN = 0                                                        201500
      N = C/CYCP                                                        201510
      PP = N*CYCP                                                       201520
      IF ((C.EQ.1.0.OR.C.EQ.PP.OR.ICYCLE.EQ.ICYC1.OR.NH.EQ.0).AND.      201530
     1  LINPUT.EQ.1) IBEGIN = 1                                         201540
      JOR = KDSRN-IOR                                                   201550
      DO 99 NRC=1,NREG                                                  201560
      IF (NH.EQ.0.OR.IBEGIN.EQ.1) WRITE(6,1726)                         201570
      IF (Q.EQ.5) READ(5,1003) NST(NRC),NKL(NRC),NRING(NRC),STORY       201580
 1003 FORMAT(3I2,16A4)                                                  201590
      IF (NH.NE.0) GO TO 613                                            201600
      WRITE(6,606)NRC,NST(NRC),NKL(NRC)                                 201610
  606 FORMAT(////////////////////////58X,13HREGION NUMBER,I3//35X,10HTH  201620
     1ERE ARE ,I2,14H SEGMENTS AND ,I2,35H KINEMATIC LINKS WITHIN THIS R 201630
     2EGION)                                                            201640
      GO TO 610                                                         201650
  613 IF (IBEGIN.EQ.0) GO TO 610                                        201660
      WRITE(6,612) NRC,NST(NRC),NKL(NRC)                                201670
  612 FORMAT(///58X,13HREGION NUMBER,I3//35X,10HTHERE ARE ,I2,14H SEGMEN 201680
     1TS AND ,I2,35H KINEMATIC LINKS WITHIN THIS REGION)                201690
  610 CONTINUE                                                          201700
      IF (Q.EQ.5) READ(5,1006) JRTIC(NRC),JRSTOP(NRC),STORY             201710
 1006 FORMAT(5X,2I5,16A4)                                               201720
      NSEG = NST(NRC)                                                   201730
  201 NSC=0                                                             201740
  101 NSC=NSC+1                                                         201750
      IF (NH.EQ.0.OR.IBEGIN.EQ.1) WRITE(6,1726)                         201760
      CALL RIEMAN                                                       201770
      IF (NIX.NE.0) GOTO 8888                                           201780
      CALL SEGMAT                                                       201790
      IF (NIX.NE.0) GOTO 8888                                           201800
      IF(NSC.LT.NSEG) GO TO 101                                         201810
      NSC= 0                                                            201820
```

```
  102 CALL REGMAT                                                          201830
      IF(NIX.LT.0) GO TO 8888                                              201840
      NIX = 0                                                              201850
       REWIND 2                                                            201860
       REWIND 3                                                            201870
   99 CONTINUE                                                             201880
      IF (C.EQ.1.0.OR.C.EQ.PP.OR.ICYCLE.EQ.ICYC1.OR.NH.EQ.0) IBEGIN = 1    201890
  103 CALL STRMAT                                                          201900
      IF (NIX.NE.0) GOTO 8888                                              201910
      REWIND 1                                                             201920
105   CALL INITAL                                                          201930
      REWIND IO                                                            201940
      REWIND JO                                                            201950
      REWIND LODE                                                          201960
      CALL LEBEGE                                                          201970
      REWIND IOR                                                           201980
      REWIND JOR                                                           201990
      IO = JDSRN-IO                                                        202000
      JO = JDSRN-IO                                                        202010
      REWIND IO                                                            202020
      REWIND JO                                                            202030
      IOR = KDSRN-IOR                                                      202040
      Q = 1                                                                202050
      REWIND 1                                                             202060
      REWIND 2                                                             202070
      REWIND 3                                                             202080
      REWIND 4                                                             202090
      REWIND 8                                                             202100
      REWIND 9                                                             202110
      REWIND 10                                                            202120
      REWIND 11                                                            202130
      REWIND 12                                                            202140
      REWIND 13                                                            202150
      REWIND 14                                                            202160
      REWIND 15                                                            202170
      REWIND LODE                                                          202180
      JCYC = P                                                             202190
      WRITE(6,2500) JCYC,ICYCLE                                            202200
 2500 FORMAT(/5X,'CYCLE',I5,',',I5,' IS COMPLETE.')                        202210
      IF (ICYCLE.NE.1.AND.NH.NE.0) GO TO 112                               202220
      NH = 1                                                               202230
      DELP1 = DELP                                                         202240
      LDISTL = 1                                                           202250
  112 CONTINUE                                                             202260
      IF (JPLS.GT.1) XNL(1) = 1.0                                          202270
      IF (JPLS.NE.2) XNL(2) = 1.0                                          202280
      IF (NX3.EQ.1) XNL(3) = -1.0                                          202290
      IF (NIX.NE.0) GO TO 8888                                             202300
      IF (ICYCLE.EQ.ICYC1) GO TO 556                                       202310
      GO TO 1                                                              202320
  556 IF (NLDS.LE.ICT) GO TO 111                                           202330
      READ(5,1010) LINPUT,CYC1,CYCP,LDISTL,NMAT,OMEGA                      202340
 1010 FORMAT(7X,I2,2X,F6.0,F4.0,2X,2I2,31X,E14.7)                          202350
      DELP = 1.0/CYC1                                                      202360
      IF (LDISTL.EQ.0) LDISTL = 1                                          202370
      OMEGA = OMEGA*OMEGA                                                  202380
      GO TO 121                                                            202390
  555 IF (NGRAPH.NE.0) CALL ENDJOB                                         202400
      STOP                                                                 202410
 8000 IERROR=8000                                                          202420
      NERROR= 1                                                            202430
```

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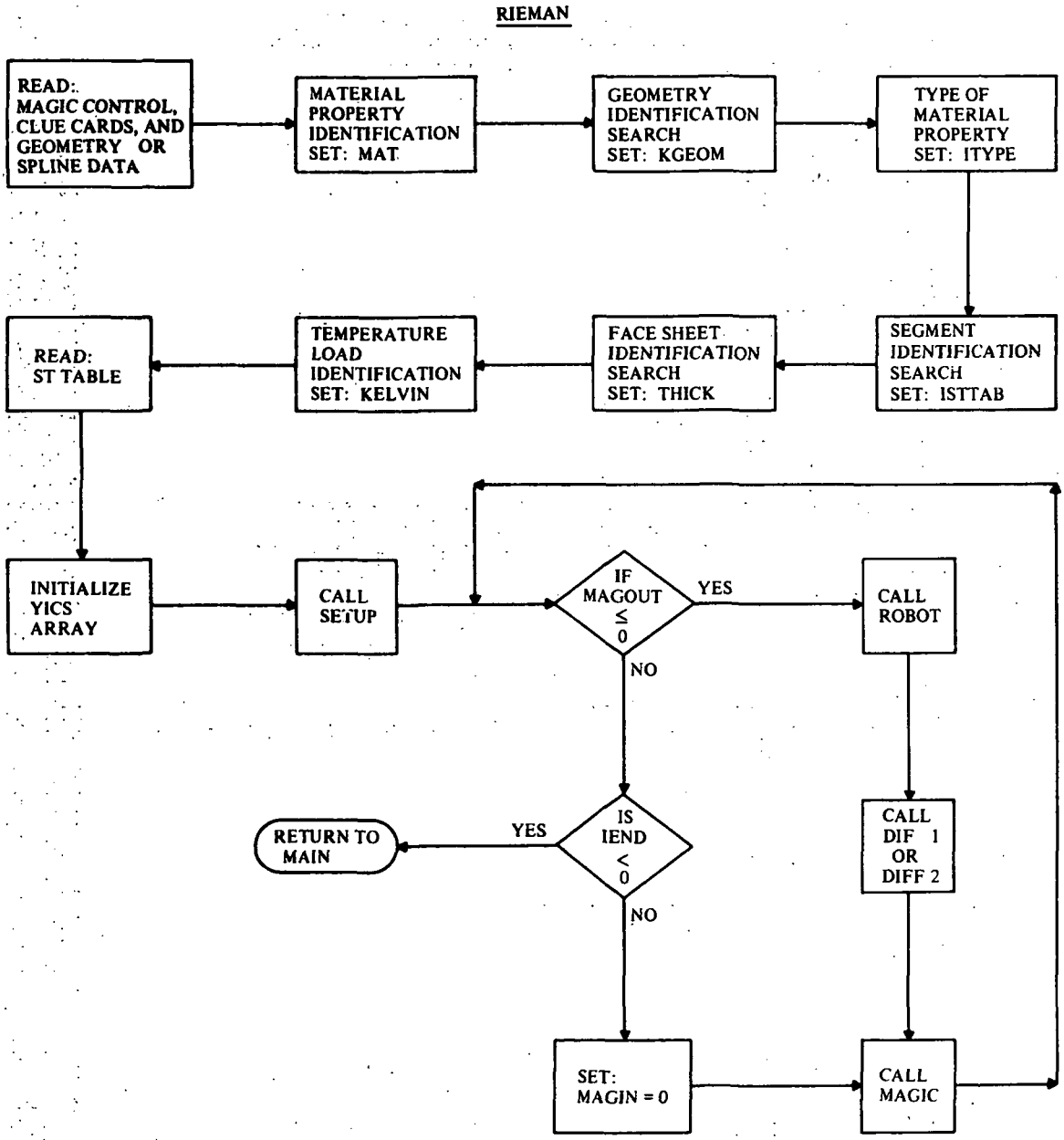
```
 MAP,IS SYM,STARSS
LIB SYS$*MSFC$.
SEG ROOT
IN NBF24$
IN MAIN,BLDATA
SEG RIE*,(ROOT)
IN RIEMAN,SETUP,ROBOT,GEOMET,PLINE,PLICO
SEG DF1*,(RIE)
IN DIF1
SEG DF2*,(RIE)
IN DIFF2
SEG SGMAT*,(ROOT)
IN SEGMAT,SREVN2
SEG RING*,(ROOT)
IN RINGER,RISULT,RITEPS,RGSRSE,SYMSOC,BANDIT,LLTRAN,TRISLV,HOTDOT
SEG REG*,(RING)
IN REGMAT
SEG STR*,(RING)
IN STRMAT
SEG INI*,(ROOT)
IN INITAL
SEG LEB*,(ROOT)
IN LEBEGE,FIXEM,TOBAR,TEMOEG,PLYNE,PLYCO
SEG OD1*,(LEB)
IN ODE1
SEG OD2*,(LEB)
IN ODE2
SEG TRAP*,(ROOT)
IN ETRAP
 COPOUT TPF$.,PUR.
 XQT STARSS
```

SUBROUTINE RIEMAN

This subroutine link assembles the data tables for use in the integration procedure. The subprogram link, RIEMAN, utilizes the subroutines SETUP, ROBOT, DIF1 or DIFF2, to integrate the differential equations of each segment independently, under arbitrary load conditions. The results of the integrations of each segment are stored in the YCORR array in RIEMAN, and represent the stiffness and deflection coefficients of each segment.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
XFTHLD	f_{θ}
XFPHLD	f_{ϕ}
XFZELD	f_{ζ}
XMTHLD	m_{θ}
XMPHLD	m_{ϕ}
ETHET	E_{θ}
EPHI	E_{ϕ}
XGPT	$G_{\phi\theta}$
XNUTP	$\nu_{\theta\phi}$
XNUPT	$\nu_{\phi\theta}$
ALPHTH	α_{θ}
ALPHPH	α_{ϕ}
XNTTH	$N_{T\theta}$
XNTPH	$N_{T\phi}$
XMTTH	$M_{T\theta}$
XMTPH	$M_{T\phi}$
XK11	K_{11}
XK22	K_{22}
XD11	D_{11}
XD22	D_{22}
XK33	K_{33}
XD33	D_{33}


RIEMAN
READ:
MAGIC CONTROL,
CLUE CARDS, AND
GEOMETRY OR
SPLINE DATA
MATERIAL
PROPERTY
IDENTIFICATION
SET: MAT
GEOMETRY
IDENTIFICATION
SEARCH
SET: KGEOM
TYPE OF
MATERIAL
PROPERTY
SET: ITYPE
SEGMENT
IDENTIFICATION
SEARCH
SET: ISTTAB
FACE SHEET
IDENTIFICATION
SEARCH
SET: THICK
TEMPERATURE
LOAD
IDENTIFICATION
SET: KELVIN
READ:
ST TABLE
INITIALIZE
YICS
ARRAY
CALL
SETUP
IF
MAGOUT
≤
0
YES
NO
CALL
ROBOT
IS
IEND
<
0
YES
RETURN TO
MAIN
NO
CALL
DIF 1
OR
DIFF 2
SET:
MAGIN = 0
CALL
MAGIC

```
 FOR,IS RIEMAN,RIEMAN
C ..... ROUTINE ** RIEMAN ** ABACUS UPDATED 01/11/74 .....                    300000
      SUBROUTINE RIEMAN                                                       300010
      INTEGER SAVJTC,SAVSTP,SEGTAB, Q ,THICK,TYPE                             300020
      INTEGER XN                                                              300030
      DOUBLE  PRECISION  YNEW,YPRED                                           300040
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)               300050
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                                  300060
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH                 300070
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)        300080
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB       300090
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE       300100
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS, N1,KBC,NRINGS                  300110
      COMMON LODE,ICYCLE,LDISTL                                               300120
      COMMON /NAM1/ FACE(4),STRGO(7),THERM(4),MATER(3),SEGTAB(12)             300130
      COMMON /LYCORR/ YCORR(72)                                               300140
      COMMON /MAGIK/ KKNT                                                     300150
      COMMON /EQUAZN/ YPRED(72),YDOT(72),YASAVE(72),                          300160
     1                YANTH,YAMTH,YAMPT,YAJPH,                                 300170
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,               300180
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,             300190
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,         300200
     5    ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,                                       300210
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,            300220
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,             300230
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,          300240
     9                XK11,XK12,XK21,XK22,XK33,XD11,                           300250
     A                XNPHI,M,I,BETTA,ZETTA,XC16                               300260
      COMMON /SPLINS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),              300270
     1       DR1DP(100),ZI(14),RI(14),NRZIN                                   300280
      COMMON /ARING/ NRING(28),AMAT(30,8),RSIG(12),REPS(12),RALPH(12),        300290
     C               RBAPH(12)                                                300300
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                              300310
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI,NEO                                  300320
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),          300330
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),          300340
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),           300350
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)                   300360
      COMMON /CMAIN/ ZETA1(21),ZETA2(21),NODE,ALF(4),CE(4),NLRS,HI,HO,T       300370
      DIMENSION LST(13),YDEV(72),YICS(72),YNEW(72)                            300380
      DIMENSION TBDEL(72),FWDEL(72)                                           300390
      DIMENSION ST(30,31),XLAYER(26),HARD(3)                                  300400
      DATA HARD/'ISOT','KINE','PERF'/                                         300410
      DATA APEX1/'APEX'/                                                      300420
 1726 FORMAT(1H1)                                                             300430
      IF(Q.EQ.1)  GO TO 191                                                   300440
      READ(5,1001) RGO,ANG,NLRS,STORY                                         300450
 1001 FORMAT(F2.0,A1,I2,16A4)                                                 300460
C     GEOMETRY IDENTIFICATION SEARCH                                          300470
      DO 504 I=1,7                                                            300480
      IF(RGO-STRGO(I)) 504,505,504                                            300490
  504 CONTINUE                                                                300500
      GOTO 8086                                                               300510
  505 KGEOM=I                                                                 300520
      IGEOM = 0                                                               300530
      IF (KGEOM.EQ.1.OR.KGEOM.EQ.2.OR.KGEOM.EQ.5.OR.KGEOM.EQ.6) IGEOM =1      300540
      IF (KGEOM.EQ.3) IGEOM=2                                                 300550
      IF(KGEOM.EQ.4) IGEOM=3                                                  300560
      IF ( KGEOM.EQ.7 ) IGEOM = 1                                             300570
      WRITE(1) KGEOM,IGEOM,RGO,ANG,NLRS,STORY                                 300580
      READ(5,1002) DTAU,DIFF,STEP,APEX                                        300590
 1002 FORMAT(3E14.1,3X,A4)                                                    300600
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      NAPEX = 0                                                          300610
      IF (APEX.EQ.APEX1) NAPEX = 1                                       300620
      DELTA = 0.0                                                        300630
      WRITE(1) DTAU,DIFF,STEP,DELTA,NAPEX                                300640
      IF (RGO.EQ.14.0) GO TO 180                                         300650
      READ(5,1006) G1,G2,G3                                              300660
 1006 FORMAT(3E14.1)                                                     300670
      WRITE(1)      G1,G2,G3                                             300680
      GO TO 481                                                          300690
  180 READ(5,198) NRZIN,(ZI(J),RI(J),J=1,NRZIN)                          300700
  198 FORMAT(I2,7F10.0/7F10.0)                                           300710
      WRITE(1) NRZIN,(ZI(J),RI(J),J=1,NRZIN)                             300720
  481 CONTINUE                                                           300730
      READ(5,1003) TYPE,HLAYR,SHEET,INTERP,RANKIN,HARDEN,NP              300740
 1003 FORMAT(6(A4,6X),10X,I2)                                            300750
      IF(NP.LT.2.OR.NP.GT.30) GO TO 8787                                 300760
C     MATERIAL PROPERTY IDENTIFICATION                                   300770
      DO 501 I=1,NMPT                                                    300780
      IF (HLAYR-STD(I)) 501,502,501                                      300790
  502 MAT=I                                                              300800
      GOTO 503                                                           300810
  501 CONTINUE                                                           300820
      GOTO 8036                                                          300830
  503 DO 506 I=1,3                                                       300840
      IF(TYPE-MATER(I))506,507,506                                       300850
  506 CONTINUE                                                           300860
      GOTO 8087                                                          300870
  507 ITYPE=I                                                            300880
      DO 510 I=1,12                                                      300890
      IF(INTERP-SEGTAB(I))510,511,510                                    300900
  510 CONTINUE                                                           300910
      GO TO 8088                                                         300920
  511 ISTTAB=I                                                           300930
      DO 508 I=1,4                                                       300940
      IF (SHEET.EQ.FACE(I)) GOTO 509                                     300950
  508 CONTINUE                                                           300960
      GOTO 8089                                                          300970
  509 THICK=I                                                            300980
      KLUE2=1                                                            300990
      GO TO (430,430,420,420,420,420,425,425,425, 430,430,430),ISTTAB    301000
  420 KLUE2=2                                                            301010
      GO TO 430                                                          301020
  425 KLUE2=3                                                            301030
  430 KLUE1=THICK                                                        301040
C     TEMPERATURE LOAD IDENTIFICATION                                    301050
      DO 401 I=1,4                                                       301060
      IF(RANKIN.EQ.THERM(I))GOTO 402                                     301070
  401 CONTINUE                                                           301080
      GOTO 8090                                                          301090
  402 KELVIN=I                                                           301100
C     LINEAR ANALYSIS IDENTIFICATION                                     301110
      IANLYZ = 1                                                         301120
      IWD = 1-IWORD                                                      301130
      NROW = 3-IWD                                                       301140
      IF (THICK.GT.1) NROW = THICK+3-2*IWD                               301150
      IF (ISTTAB.EQ.1) NROW = 14-3*IWD                                   301160
      IF (ISTTAB.EQ.3) NROW = 16-3*IWD                                   301170
      IF (ISTTAB.EQ.4) NROW = 10-2*IWD                                   301180
      IF (ISTTAB.EQ.5) NROW = 12-3*IWD                                   301190
      IF (ISTTAB.EQ.6) NROW = 13-3*IWD                                   301200
      IF (ISTTAB.EQ.7) NROW = 9-2*IWD                                    301210
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      IF (ISTTAB.EQ.8) NROW = 11-3*IWD                                  301220
      IF (ISTTAB.EQ.9) NROW = 12-3*IWD                                  301230
      IF (ISTTAB.EQ.10) NROW = 15-3*IWD                                 301240
      IF (ISTTAB.EQ.11) NROW = 17-4*IWD                                 301250
      IF (ISTTAB.EQ.12) NROW = 18-4*IWD                                 301260
      IF (KELVIN.EQ.2.OR.KELVIN.EQ.4) GO TO 580                         301270
      IF (ISTTAB.GE.10) GO TO 581                                       301280
      IF (ISTTAB.GE.4) NROW = NROW+1                                    301290
      GO TO 580                                                         301300
  581 NROW = NROW+2                                                     301310
  580 CONTINUE                                                          301320
      TEFREE = 0.0                                                      301330
      DO 540 I=1,3                                                      301340
      IF (HARDEN-HARD(I)) 540,541,540                                   301350
  541 KOR = I                                                           301360
      GO TO 542                                                         301370
  540 CONTINUE                                                          301380
      NERROR = 8013                                                     301390
      GO TO 8888                                                        301400
  542 IF (ITYPE.EQ.1) GO TO 550                                         301410
      IF (KOR.GT.1) GO TO 551                                           301420
      NERROR = 8008                                                     301430
      GO TO 8888                                                        301440
  551 KORI = 1                                                          301450
      GO TO 553                                                         301460
  550 KORI = -1                                                         301470
      IF (KOR.EQ.1) KORI = 0                                            301480
  553 CONTINUE                                                          301490
      WRITE(1) ITYPE,MAT,THICK,ISTTAB,KELVIN,KORI,TEFREE,NP,KLUE1,KLUE2,301500
     1          IANLYZ,NROW                                            301510
      GO TO 192                                                         301520
  191 READ(1) KGEOM,IGEOM,RGO,ANG,NLRS,STORY                            301530
      READ(1) DTAU,DIFF,STEP,DELTA,NAPEX                                301540
      IF (RGO.EQ.14.0) GO TO 182                                        301550
      READ (1      ) G1,G2,G3                                           301560
      GO TO 183                                                         301570
  182 READ(1) NRZIN,(ZI(J),RI(J),J=1,NRZIN)                             301580
  183 CONTINUE                                                          301590
      READ(1) ITYPE,MAT,THICK,ISTTAB,KELVIN,KORI,TEFREE,NP,KLUE1,KLUE2, 301600
     1        IANLYZ,NROW                                             301610
  192 EPSIL =1.0E-05                                                    301620
      DIFF  =1.0E-04                                                    301630
      ERR = 1.0 E-07                                                    301640
      IF (NH.NE.0) GO TO 920                                            301650
      I = RGO                                                           301660
      WRITE(6,651) NSC,I,STORY,DTAU,DIFF,STEP,DELTA                     301670
  651 FORMAT(//13X,15HSEGMENT NUMBER ,I2,5X,13HSEGMENT CODE ,I2,5X,     301680
     1   16A4//22X,4HDTAU,15X,4HDIFF                                    301690
     2,15X,4HSTEP,10X,5HDELTA//16X,5(E14.7,5X),2X,F2.0)                 301700
      IF (RGO.EQ.14.0) GO TO 185                                        301710
      WRITE(6,652)  G1,G2,G3                                            301720
  652 FORMAT(//54X,24HGEOMETRY INPUT VARIABLES,//38X,3(E14.7,5X))       301730
      GO TO 645                                                         301740
  185 WRITE(6,186) (ZI(I),RI(I),I=1,NRZIN)                              301750
  186 FORMAT(//57X,24HGEOMETRY INPUT VARIABLES//42X,16HAXIAL COORDINATE, 301760
     1       9X,6HRADIUS/50X,1HZ,20X,1HR/(43X,1P1E15.8,5X,1P1E15.8))    301770
  645 WRITE(6,653) TYPE,HLAYR,SHEET,INTERP,RANKIN,HARDEN,NP             301780
  653 FORMAT(//12X,5(A4,6X),16HHARDENING LAW = ,A4,12X,                 301790
     1       26HNUMBER OF TABLE COLUMNS = ,I2)                          301800
  920 CONTINUE                                                          301810
      L= 2*(MAT-1)+1                                                    301820
      II=NXMAT(L)                                                       301830
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      III=NXMAT(L+1)                                                    301840
      IF (NH.NE.0) GO TO 921                                            301850
      WRITE(6,654)  ((XMAT(I,J),J=1,10),I=II,III)                       301860
  654 FORMAT(//51X,28HMATERIAL PROPERTY TABLE USED,//(10(1H ,E12.5)))   301870
      WRITE(6,655)                                                      301880
  655 FORMAT(//42X, 47HTABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES,) 301890
  921 CONTINUE                                                          301900
       DO 901  I=1,NROW                                                 301910
      IF(Q.EQ.1)  GO TO 193                                             301920
      READ (5,1005) (ST(I,J),J=1,NP)                                    301930
 1005 FORMAT (5E14.7)                                                   301940
      WRITE(1)      (ST(I,J),J=1,NP)                                    301950
      IF (NH.NE.0) GO TO 901                                            301960
  194 WRITE(6,600) (ST(I,J),J=1,NP)                                     301970
  600 FORMAT(1H ,8(E14.7,2X)/(3X,8(E14.7,2X)))                          301980
      GO TO 901                                                         301990
  193 READ (1      ) (ST(I,J),J=1,NP)                                   302000
  901 CONTINUE                                                          302010
      DO 750 JJ=1,12                                                    302020
  750 LST(JJ) = 0                                                       302030
      NLCS = NLCASE                                                     302040
      NLPO = NLRS+1                                                     302050
      KBC = NLPO                                                        302060
      IF (THICK.NE.1) KBC = 2.0*NLPO                                    302070
      TAP1 = NLRS/2                                                     302080
      DO 290 I=1,NLPO                                                   302090
      TAP2 = I-1                                                        302100
      ZETA1(I) = 1.0-TAP2/TAP1                                          302110
  290 ZETA2(I) = 1.0-FLOAT(I-1)/FLOAT(NLRS)                             302120
      K=NROW+1                                                          302130
      JJ=1                                                              302140
      JJJ=6                                                             302150
      MM=1                                                              302160
      DO 17 NLC=1,NLCS                                                  302170
      JT = JJ                                                           302180
      JTT= JJJ                                                          302190
      L=0                                                               302200
      IF (LDISTL.EQ.1) GO TO 195                                        302210
      READ(5,1004) (LST(J),J=JJ,JJJ)                                    302220
 1004 FORMAT(6I1)                                                       302230
      WRITE(LODE) (LST(J),J=JJ,JJJ)                                     302240
      GO TO 196                                                         302250
  195 READ(LODE) (LST(J),J=JJ,JJJ)                                      302260
  196 CONTINUE                                                          302270
      IF(LST(JJ))8031,19,20                                             302280
   20 L = LST(JJ)                                                       302290
   19 JJ=JJ+1                                                           302300
   23 IF(LST(JJ))8031,22,21                                             302310
   21 L=L+1                                                             302320
   22 IF(JJ.EQ.JJJ) GOTO 24                                             302330
      JJ=JJ+1                                                           302340
      GOTO 23                                                           302350
   24 IF(L.EQ.0) GO TO 71                                               302360
      KK = K + L - 1                                                    302370
      DO 72 M=K,KK                                                      302380
      IF (LDISTL.EQ.1) GO TO 197                                        302390
      READ (5,1005) (ST(M,J),J=1,NP)                                    302400
      WRITE(LODE) (ST(M,J),J=1,NP)                                      302410
      GO TO 72                                                          302420
  197 READ(LODE) (ST(M,J),J=1,NP)                                       302430
   72 CONTINUE                                                          302440
```

```
      IF (LST(JT).EQ.0) GO TO 660                                       302450
      LY = K                                                            302460
      KY = K                                                            302470
      KZ = K+LST(1)-1                                                   302480
      K = KZ+1                                                          302490
      IF (ICYCLE.NE.1.AND.NH.NE.0) GO TO 665                            302500
      WRITE(6,656)                                                      302510
  656 FORMAT(//45X,42HTABLE ORDER PHI OR S VS. TEMPERATURE LOADS,)      302520
      DO 657 N=KY,KZ                                                    302530
      WRITE(6,600) (ST(N,J),J=1,NP)                                     302540
  657 CONTINUE                                                          302550
  660 IF((L-LST(JT)).EQ.0) GO TO 665                                    302560
      IF (NH.NE.0) GO TO 665                                            302570
      WRITE(6,661) NLC                                                  302580
  661 FORMAT(//16X,8HPROBLEM ,I2,5X,84HTABLE ORDER  PHI OR S VS. DISTRIB 302590
     1UTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI),)             302600
      WRITE(6,1968) (LST(J),J=JT,JTT)                                   302610
 1968 FORMAT(27H LOAD IDENTIFICATION CLUES ,6I1/)                       302620
      DO 662 N = K, KK                                                  302630
      WRITE(6,600) (ST(N,J),J=1,NP)                                     302640
  662 CONTINUE                                                          302650
  665 CONTINUE                                                          302660
   71 K = K + L - LST(JT)                                               302670
      JJ=JJJ+1                                                          302680
      JJJ=JJ+5                                                          302690
   17 MM=MM+1                                                           302700
  590 CONTINUE                                                          302710
      IF (Q.EQ.1) GO TO 2004                                            302720
      READ (5,591) IS,SAVJTC(IS),SAVSTP(IS),(STORY(I),I=1,16)           302730
  591 FORMAT (3I5,16A4)                                                 302740
      READ(5,2000)                                                      302750
 2000 FORMAT(1X)                                                        302760
      WRITE(1) IS,SAVJTC(IS),SAVSTP(IS),STORY                           302770
      GO TO 2005                                                        302780
 2004 READ(1) IS,SAVJTC(IS),SAVSTP(IS),STORY                            302790
 2005 CONTINUE                                                          302800
      ITIC = SAVJTC(IS)                                                 302810
      ISTOP = SAVSTP(IS)                                                302820
      JTIC = JRTIC(NRC)                                                 302830
      JSTOP = JRSTOP(NRC)                                               302840
      TIC = ST(1,1)                                                     302850
      STOP = ST(1,NP)                                                   302860
      NEQNS=64+8*NPROB                                                  302870
      DO 73 I=1,NEQNS                                                   302880
   73 YICS(I)=0.0                                                       302890
      YICS(5) =1.0                                                      302900
      YICS(14)=1.0                                                      302910
      YICS(23)=1.0                                                      302920
      YICS(32)=1.0                                                      302930
      YICS(33)=1.0                                                      302940
      YICS(42)=1.0                                                      302950
      YICS(51)=1.0                                                      302960
      YICS(60)=1.0                                                      302970
      NCYC=0                                                            302980
      KKNT = 0                                                          302990
      NSAVE=NROW                                                        303000
      IEND=0                                                            303010
      PRINT=TIC                                                         303020
      DTA=DTAU                                                          303030
      DTAU = 0.D0                                                       303040
      IF (NH.NE.0.OR.NEO.NE.0)                                          303050
     1READ(IO) SAVY                                                     303060
```

```
 2001 FORMAT(1X,1P1E16.7,I5,1P6E16.7)                                    303070
   59 CALL SETUP (MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME,  303080
     1DTIME,YICS,YPRED,YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)                  303090
      GOTO  61                                                           303100
   60 CALL MAGIC (MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME,
     1DTIME,YICS,YPRED,YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)
   61 IF(MAGOUT.LE.0) GOTO 25                                            303120
      IF(TIME.GT.STOP) GOTO 62                                           303130
      IF(TIME.LT.STOP) GOTO 63                                           303140
   64 IEND=-1                                                            303150
      GOTO 67                                                            303160
   62 IF(TIME.LE.(STOP+DIFF)) GOTO 64                                    303170
      GOTO 8001                                                          303180
   63 IF((STOP-DIFF).LE.TIME) GOTO 64                                    303190
      IF((TIME+DTIME).GT.STOP) GOTO 65                                   303200
      IF(PRINT.GT.TIME) GOTO 66                                          303210
      PRINT=TIME+DTA                                                     303220
   67 CONTINUE                                                           303230
      IF(IEND.GT.0) GOTO 8002                                            303240
      IF(IEND.LT.0) GOTO  150                                            303250
   66 CONTINUE                                                           303260
      MAGIN = 0                                                          303270
      GOTO 60                                                            303280
   65 DTIME=STOP-TIME                                                    303290
      DELTA = 0.D0                                                       303300
      GOTO 67                                                            303310
   75 NCYC=NCYC+1                                                        303320
      MAGIN=-1                                                           303330
      GOTO 60                                                            303340
   25 LT=0                                                               303350
      IF ((NH.NE.0.OR.NEQ.NE.0).AND.KKNT.EQ.3)                           303360
     1READ(IO) SAVY                                                      303370
      JJ = NLCASE*6                                                      303380
      DO 15  J=1,JJ                                                      303390
   15 LT=LT+LST(J)                                                       303400
  296 NTOTAL = LT+NSAVE                                                  303410
      PHI=TIME                                                           303420
      ARG=PHI                                                            303430
      LL=NP+1                                                            303440
      DO 51 I=1,NP                                                       303450
      IF(ARG-ST(1,I)) 52,55,51                                           303460
   52 IF(I-1) 55,55,54                                                   303470
   51 CONTINUE                                                           303480
      I=NP                                                               303490
      GO TO 55                                                           303500
   54 DO 57 IK=2,NTOTAL                                                  303510
   57 ST(IK,LL)=ST(IK,I-1)+(ST(IK,I)-ST(IK,I-1))*(ARG-ST(1,I-1))/(ST(1,I 303520
     1)-ST(1,I-1))                                                       303530
      GOTO 80                                                            303540
   55 DO 58 IK=2,NTOTAL                                                  303550
   58 ST(IK,LL)=ST(IK,I)                                                 303560
   80 CONTINUE                                                           303570
C     THE UPDATED INTERPOLATED VALUES OF THE MATERIAL PROPERTY COEFFIC   303580
C     IENTS ARE FOUND IN THE XMAT TABLE AND STORED IN THE XLAYER ARRAY   303590
      L = (MAT-1)*2+1                                                    303600
      II=NXMAT(L)                                                        303610
      III = NXMAT(L+1)                                                   303620
      LL=NP+1                                                            303630
      L=NROW + 1                                                         303640
      M=1                                                                303650
      GOTO (91,92,93,93),KELVIN                                          303660
```

```
 91 ARG = (ST(L,LL)+ST(L+1,LL)+ST(L+2,LL)+ST(L+3,LL))/4.0                303670
    GOTO 94                                                             303680
 93 CONTINUE                                                            303690
    ARG = ST(NROW+1,LL)                                                 303700
 94 DO 104 I = 2,10                                                     303710
    IF (ARG-XMAT(II,I)) 121,123,104                                     303720
121 IF (I-2) 8007,8007,124                                              303730
104 CONTINUE                                                            303740
    GOTO 8067                                                           303750
123 L=II+1                                                              303760
    DO 122 J=L,III                                                      303770
    XLAYER(M)=XMAT(J,I)                                                 303780
122 M=M+1                                                               303790
    GOTO 111                                                            303800
124 L=II+1                                                              303810
    DO 125 J=L,III                                                      303820
    XLAYER(M)=XMAT(J,I-1)+(XMAT(J,I)-XMAT(J,I-1))*(ARG-XMAT(II,I-1))/   303830
   1          (XMAT(II,I)-XMAT(II,I-1))                                 303840
125 M=M+1                                                               303850
    GOTO 111                                                            303860
 92 L = II + 1                                                          303870
    DO 922  J=L,III                                                     303880
    XLAYER(M)= XMAT(J,1)                                                303890
922 M=M+1                                                               303900
111 CONTINUE                                                            303910
115 GO TO(101,102,103),ITYPE                                            303920
101 ETHET = XLAYER(1)                                                   303930
    XNUTP = XLAYER(2)                                                   303940
    ALPHTH = XLAYER(3)                                                  303950
    EPHI = ETHET                                                        303960
    XNUPT= XNUTP                                                        303970
    ALPHPH = ALPHTH                                                     303980
    XGPT = ETHET/(2.0*(1.0+XNUPT))                                      303990
    N = 4                                                               304000
    GO TO 105                                                           304010
102 ETHET = XLAYER(1)                                                   304020
    EPHI = XLAYER(2)                                                    304030
    XNUTP = XLAYER(3)                                                   304040
    ALPHTH = XLAYER(4)                                                  304050
    ALPHPH = XLAYER(5)                                                  304060
    XGPT = XLAYER(6)                                                    304070
    XNUPT = ETHET*XNUTP/EPHI                                            304080
    N = 7                                                               304090
    GO TO 105                                                           304100
103 ETHET = XLAYER(1)                                                   304110
    EPHI = XLAYER(2)                                                    304120
    XNUTP= XLAYER(3)                                                    304130
    ALPHTH = XLAYER(4)                                                  304140
    ALPHPH = XLAYER(5)                                                  304150
    XGPT = XLAYER(6)                                                    304160
    ER = XLAYER(17)                                                     304170
    ES = XLAYER(18)                                                     304180
    ALPHR = XLAYER(19)                                                  304190
    ALPHS = XLAYER(20)                                                  304200
    SIGOXR=XLAYER(23)
    SIGOXS=XLAYER(26)
    XNUPT = ETHET*XNUTP/EPHI                                            304210
    N = 7                                                               304220
105 CONTINUE                                                            304230
    SIGOX = XLAYER(N+2)                                                 304240
    CALL ROBOT (ST,KLUE2,NROW,LL,ER,ES,G2,G3,TIME,ITIC,JTIC,NCYC,       304250
   1 SIGOX,ALPHR,ALPHS,SIGOXR,SIGOXS)
```

```
      IF (NIX.NE.0) GO TO 9999                                          304270
C     COMPUTATION OF K AND D FOR K AND D INPUT                          304280
      LL=NP+1                                                           304290
      IF(XK11.EQ.0.0) GOTO 8101                                         304300
      IF(ITYPE.EQ.3.AND.XK12.EQ.0.) GO TO 8102                          304310
      IF(ITYPE.EQ.3.AND.XK21.EQ.0.) GO TO 8103                          304320
      IF(XK22.EQ.0.0) GOTO 8104                                         304330
      IF(XK33.EQ.0.0) GOTO 8105                                         304340
      IF(XD11.EQ.0.0) GOTO 8106                                         304350
      IF(ITYPE.EQ.3.AND.XD12.EQ.0.) GO TO 8107                          304360
      IF(ITYPE.EQ.3.AND.XD21.EQ.0.) GO TO 8108                          304370
      IF(XD22.EQ.0.0) GOTO 8109                                         304380
      IF(XD33.EQ.0.0) GOTO 8110                                         304390
      NL=0                                                              304400
      XSAVE1 = XNTTH                                                    304410
      XSAVE2 = XNTPH                                                    304420
      XSAVE3 = XMTTH                                                    304430
      XSAVE4 = XMTPH                                                    304440
      XSAVE5 = XNL(2)                                                   304450
      XSAVE6 = XNL(3)                                                   304460
      XNTTH = 0.0                                                       304470
      XNTPH = 0.0                                                       304480
      XMTTH = 0.0                                                       304490
      XMTPH = 0.0                                                       304500
      XFTHLD=0.0                                                        304510
      XFPHLD=0.0                                                        304520
      XFZELD=0.0                                                        304530
      XMTHLD=0.0                                                        304540
      XMPHLD=0.0                                                        304550
      XNL(2) = 0.0                                                      304560
      XNL(3) = 0.0                                                      304570
      JF=8+NPROB                                                        304580
      K = NROW                                                          304590
      DO 77 M=1, JF                                                     304600
      I = (M-1)*8 + 1                                                   304610
      IF (M.LT.9) GOTO   49                                             304620
      XNTTH = XSAVE1                                                    304630
      XNTPH = XSAVE2                                                    304640
      XMTTH = XSAVE3                                                    304650
      XMTPH = XSAVE4                                                    304660
      XNL(2) = XSAVE5                                                   304670
      XNL(3) = XSAVE6                                                   304680
      NL=NL+1                                                           304690
      XFTHLD = 0.0                                                      304700
      XFPHLD = 0.0                                                      304710
      XFZELD = 0.0                                                      304720
      XMTHLD = 0.0                                                      304730
      XMPHLD = 0.0                                                      304740
      IR=NL*6-5                                                         304750
      IF(LST(IR).NE.0) K=K+LST(IR)                                      304760
      IF (LST(IR+1).EQ.0) GOTO 44                                       304770
      K=K+1                                                             304780
      XFTHLD=ST(K,LL)                                                   304790
   44 IF(LST(IR+2).EQ.0) GOTO 45                                        304800
      K=K+1                                                             304810
      XFPHLD = ST(K,LL)+XMERD*IWORD                                     304820
   45 IF(LST(IR+3).EQ.0) GOTO 46                                        304830
      K=K+1                                                             304840
      XFZELD = ST(K,LL)+XPRES*IWORD                                     304850
   46 IF(LST(IR+4).EQ.0) GOTO 47                                        304860
      K=K+1                                                             304870
```

```
      XMTHLD = ST(K,LL)+XMONT*IWORD                                    304880
   47 IF(LST(IR+5).EQ.0) GOTO 48                                       304890
      K=K+1                                                            304900
      XMPHLD=ST(K,LL)                                                  304910
   48 CONTINUE                                                         304920
   49 CONTINUE                                                         304930
   50 IF (ISTTAB.GE.3.AND.ISTTAB.LE.9) GO TO 4002                      304940
      CALL DIF1                                                        304950
      GO TO 77                                                         304960
 4002 CALL DIFF2                                                       304970
   77 CONTINUE                                                         304980
      GOTO 75                                                          304990
 8001 IERROR=8001                                                      305000
      NERROR=11                                                        305010
      GOTO 8888                                                        305020
 8002 IERROR=8002                                                      305030
      NERROR=12                                                        305040
      GOTO 8888                                                        305050
 8007 IERROR=8007                                                      305060
      NERROR=15                                                        305070
      GOTO 8888                                                        305080
 8031 IERROR=8031                                                      305090
      NERROR= 9                                                        305100
      GOTO 8888                                                        305110
 8036 IERROR=8036                                                      305120
      NERROR= 2                                                        305130
      GOTO 8888                                                        305140
 8086 IERROR=8086                                                      305150
      NERROR= 3                                                        305160
      GOTO 8888                                                        305170
 8087 IERROR=8087                                                      305180
      NERROR= 4                                                        305190
      GOTO 8888                                                        305200
 8088 IERROR=8088                                                      305210
      NERROR=27                                                        305220
      GOTO 8888                                                        305230
 8089 IERROR=8089                                                      305240
      NERROR= 5                                                        305250
      GOTO 8888                                                        305260
 8090 IERROR=8090                                                      305270
      NERROR= 6                                                        305280
      GOTO 8888                                                        305290
 8067 IERROR= 8067                                                     305300
      NERROR=16                                                        305310
      GOTO 8888                                                        305320
 8101 IERROR = 8101                                                    305330
      NERROR=17                                                        305340
      GOTO 8888                                                        305350
 8102 IERROR = 8102                                                    305360
      NERROR=18                                                        305370
      GOTO 8888                                                        305380
 8103 IERROR = 8103                                                    305390
      NERROR=19                                                        305400
      GOTO 8888                                                        305410
 8104 IERROR = 8104                                                    305420
      NERROR=20                                                        305430
      GOTO 8888                                                        305440
 8105 IERROR = 8105                                                    305450
      NERROR=21                                                        305460
      GOTO 8888                                                        305470
 8106 IERROR = 8106                                                    305480
      NERROR=22                                                        305490
```

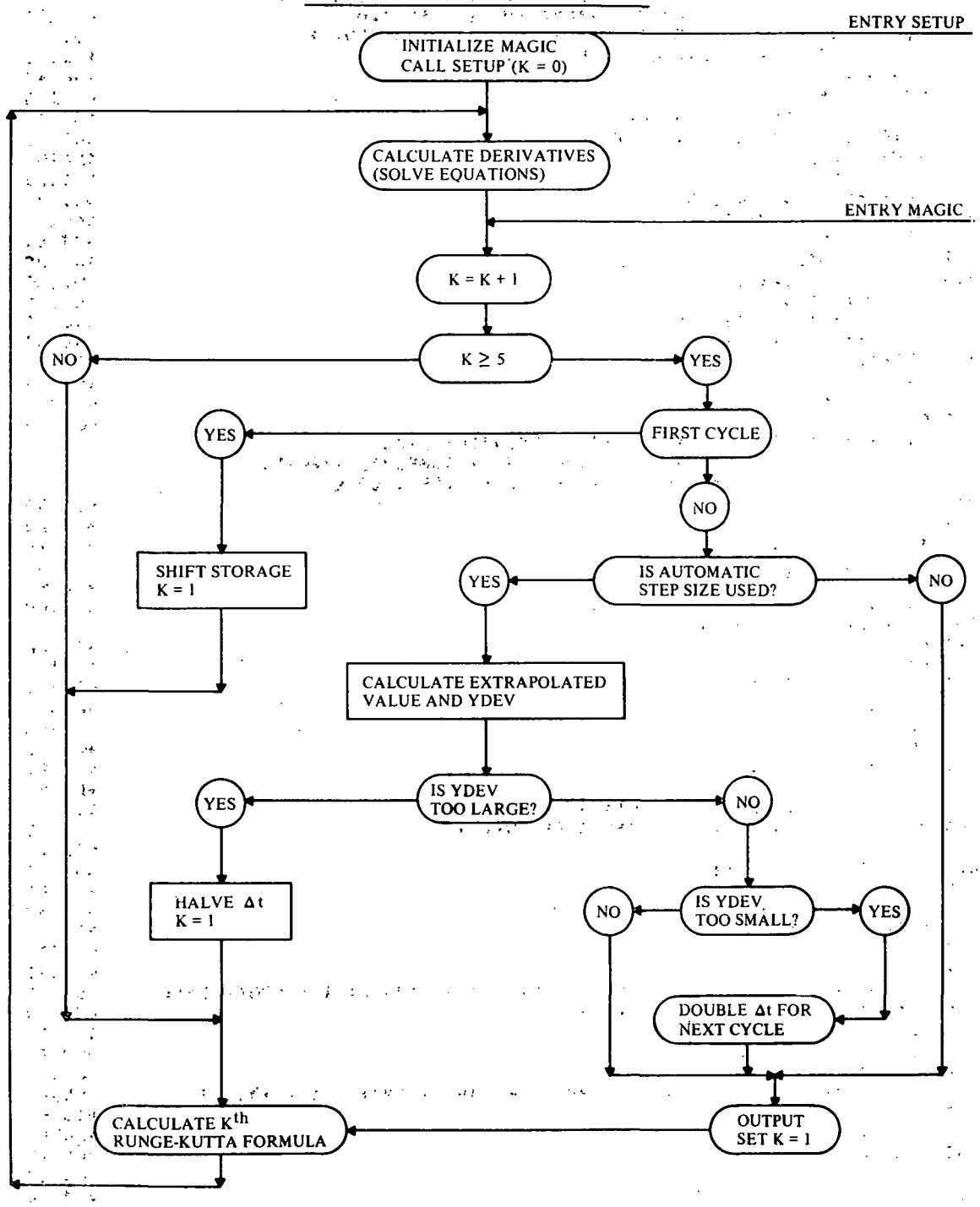
```
      GOTO 8888                                                          305500
 8107 IERROR = 8107                                                      305510
      NERROR=23                                                          305520
      GOTO 8888                                                          305530
 8108 IERROR = 8108                                                      305540
      NERROR=24                                                          305550
      GOTO 8888                                                          305560
 8109 IERROR = 8109                                                      305570
      NERROR=25                                                          305580
      GOTO 8888                                                          305590
 8110 IERROR = 8110                                                      305600
      NERROR=26                                                          305610
      GOTO 8888                                                          305620
 8787 IERROR = 8787                                                      305630
      NERROR=34                                                          305640
 8888 NIX=1                                                              305650
      RETURN                                                             305660
  150 CONTINUE                                                           305670
      IF (NH.NE.0) GO TO 925                                             305680
      WRITE(6,670)                                                       305690
  670 FORMAT(//46X,41HMATRIX X AND Y (TRANSPOSED)  MAGIC OUTPUT)         305700
      WRITE(6,672)  (YCORR(I),I=1,NEQNS)                                 305710
  672 FORMAT(8(2X,E14.7))                                                305720
  925 CONTINUE                                                           305730
      RESTOP=RO                                                          305740
      RADUS(ISTOP) = RO                                                  305750
      TADUS(ISTOP)=RO                                                    305760
      GO TO (221,222,223),IGEOM                                          305770
  221 SN = SIN(PHI)                                                      305780
      CS = COS(PHI)                                                      305790
      GO TO 224                                                          305800
  222 SN = COS(1.570796-G1)                                              305810
      CS = SIN(1.570796-G1)                                              305820
      IF (G1.NE.0.0) GO TO 224                                           305830
      SN = 0.0                                                           305840
      CS = 1.0                                                           305850
      GO TO 224                                                          305860
  223 SN = 1.0                                                           305870
      CS = 0.0                                                           305880
  224 CONTINUE                                                           305890
      AMAT(ISTOP,1) = SAVY(22)                                           305900
      AMAT(ISTOP,2) = SAVY(23)                                           305910
      AMAT(ISTOP,3) = SAVY(5)                                            305920
      AMAT(ISTOP,4) = SAVY(1)*CS-SAVY(3)*SN                              305930
      IF(NSC.LT.NSEG) GO TO 9999                                         305940
      SADUS(JSTOP) = RO                                                  305950
      UADUS(JSTOP)=RO                                                    305960
      AMAT(JSTOP,5) = SAVY(22)                                           305970
      AMAT(JSTOP,6) = SAVY(23)                                           305980
      AMAT(JSTOP,7) = SAVY(5)                                            305990
      AMAT(JSTOP,8) = SAVY(1)*CS-SAVY(3)*SN                              306000
      IF(ITIC.LE.ISTOP) GO TO 9999                                       306010
      SADUS(JSTOP)=RADUS(ITIC)                                           306020
      UADUS(JSTOP)=RADUS(ITIC)                                           306030
 9999 RETURN                                                             306040
       END                                                               306050
```

SUBROUTINE SETUP

SETUP is a double entry subroutine called from RIEMAN. It is a mixed precision, numerical integration routine, with automatic selection of a variable integration step size, which utilizes fifth order Runge-Kutta equations to obtain the solution for first order differential equations.

SUBROUTINE MAGIC

MAGIC is an alternate entry point to subroutine SETUP.


ENTRY SETUP
INITIALIZE MAGIC
CALL SETUP (K = 0)
CALCULATE DERIVATIVES
(SOLVE EQUATIONS)
ENTRY MAGIC
K = K + 1
K ≥ 5
NO
YES
FIRST CYCLE
YES
NO
SHIFT STORAGE
K = 1
IS AUTOMATIC
STEP SIZE USED?
YES
NO
CALCULATE EXTRAPOLATED
VALUE AND YDEV
IS YDEV
TOO LARGE?
YES
NO
HALVE Δt
K = 1
IS YDEV
TOO SMALL?
NO
YES
DOUBLE Δt FOR
NEXT CYCLE
CALCULATE K^th
RUNGE-KUTTA FORMULA
OUTPUT
SET K = 1

```
FOR,IS SETUP,SETUP
      SUBROUTINE SETUP (MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,
     1                  EPSIL,DELTA,ERR,TIME,DTIME,YICS,YPRED,
     2                  YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)                  400030
      DIMENSION YICS(1),YPRED(1),YCORR(1),YDOT(1),YNEW(1),               400040
     1          YDEV(1),FWDEL(1),TBDEL(1)                                400050
      DIMENSION C(3),D(3)                                                400060
      COMMON /MAGIK/ KKNT                                                400070
      DOUBLE PRECISION YNEW,YPRED                                        400080
      DATA C,D / .5,.5,1.0,.5,.0,.5/                                     400090
      TIME = TIC                                                         400100
      TAU  = TIC                                                         400110
      IF (DELTA)200,201,200                                              400120
  200 DTIME = 0.0078125                                                  400130
      GO TO 225                                                          400140
  201 DTIME = STEP                                                       400150
  225 DO 102 I = 1,NEQNS                                                 400160
      YDEV(I)  = 0.0                                                     400170
      YPRED(I) = YICS(I)                                                 400180
      YCORR(I) = YICS(I)                                                 400190
  102 YNEW(I)  = YICS(I)                                                 400200
      MAGOUT   =-2                                                       400210
      GO TO 264                                                          400220
 5555 CONTINUE                                                           400230
      ENTRY MAGIC (MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,
     1                  EPSIL,DELTA,ERR,TIME,DTIME,YICS,YPRED,
     2                  YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)
 5556 CONTINUE                                                           400250
      MSET = 2                                                           400260
      IF (MAGOUT) 305,101,101                                            400270
  101 IF(MAGIN) 21, 27, 14                                               400280
   27 K = 0                                                              400290
      DO 202 I = 1,NEQNS                                                 400300
  202 YNEW(I)  = YPRED(I)                                                400310
   21 K = K +1                                                           400320
      KKNT = K                                                           400330
  210 DO  2  I = 1,NEQNS                                                 400340
      GO TO (9,6,7,4,11),K                                               400350
    9 FWDEL(I) = YDOT(I)                                                 400360
      GO TO 105                                                          400370
    6 TBDEL(I) = YDOT(I)                                                 400380
      GO TO 105                                                          400390
    7 TBDEL(I) = TBDEL(I)   YDOT(I)                                      400400
  105 YPRED(I) = YNEW(I) + C(K)*DTIME*YDOT(I)                            400410
      GO TO (2,2,400),K                                                  400420
  400 YCORR(I) = YPRED(I)                                                400430
    2 CONTINUE                                                           400440
      TIME     = TIME + D(K)*DTIME                                       400450
   99 MAGOUT   = 0.0                                                     400460
  264 RETURN                                                             400470
    4 DO  8  I = 1,NEQNS                                                 400480
      YPRED(I) = YNEW(I) + DTIME*(FWDEL(I) + 2.*TBDEL(I) + YDOT(I))/6.   400490
    8 YDEV(I)  = YCORR(I) - YPRED(I)                                     400500
      GO TO 99                                                           400510
   11 IF (DELTA)80, 5,80                                                 400520
   80 DO  13 I = 1,NEQNS                                                 400530
      IF (EPSIL* ABS(YCORR(I)) + ERR     -  ABS(YDEV(I)))14, 13, 13      400540
   13 CONTINUE                                                           400550
      IF (SIGB)15,15,205                                                 400560
  205 SIGB = 0.0                                                         400570
      GO TO 5                                                            400580
   15 SIGB = 0.0                                                         400590
```

```
      DO 207 I = 1,NEQNS                                                    400600
      IF (ERR   /100.+ DELTA* ABS(YCORR(I)) -  ABS(YDEV(I))) 5,207,207      400610
  207 CONTINUE                                                              400620
      DTIME    = 2.*DTIME                                                   400630
    5 DO 208 I = 1,NEQNS                                                    400640
  208 YCORR(I) = YPRED(I)                                                   400650
  305 IF (DTAU) 19,30,19                                                    400660
   19 IF (TAU - TIME)20,20,27                                               400670
   20 TAU = TAU + DTAU                                                      400680
   30 MAGOUT = 2                                                            400690
      GO TO 264                                                             400700
   14 DTIME = DTIME/2.0                                                     400710
   25 IF (K-3)48,26,26                                                      400720
   26 TIME  = TIME - DTIME - DTIME                                          400730
      GO TO 47                                                              400740
   48 TIME  = TIME - DTIME                                                  400750
   47 SIGB     = +2.                                                        400760
      DO 209 I = 1,NEQNS                                                    400770
  209 YDOT(I) = FWDEL(I)                                                    400780
  212 K       = 0                                                           400790
      GO TO 21                                                              400800
       END                                                                  400810
```

SUBROUTINE ROBOT

This subroutine is used by RIEMAN to calculate geometric and load coefficients for use in the differential equations. With reference to geometry, all the necessary radii are calculated, as well as the stiffness coefficients of the various shell wall constructions. Thermal load moments and direct forces are calculated from direct temperature input. Inertia loads due to shell spin are also calculated.

All the above values are passed back via the label common area EQUAZN.

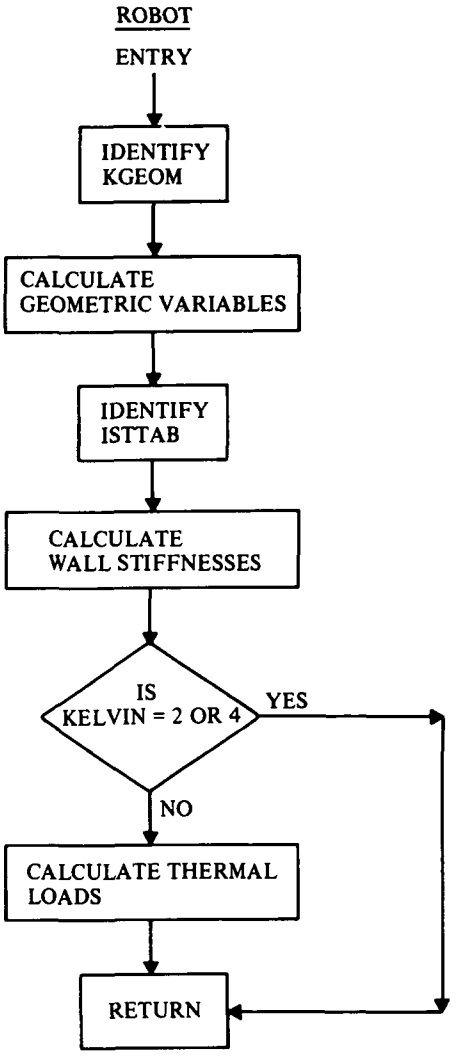
In the case of a special point input geometry the ROBOT routine calls GEOMET.

Subroutines GEOMET, PLICO, PLINE

Starting from a set of z,r points these subroutines calculate the necessary radii of the shell curves using spline fits.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
RO	r_0
R1	r_1
R1DOT	$r_{1,\phi}$
CS	$\cos \phi$
SN	$\sin \phi$
A	a
C	c
XN	n
F2	f_2
F3	f_3
TAN; TN	$\tan \phi$
SEC	$\sec \phi$
TII	T_{ii}
TIK	T_{ic}
TOK	T_{oc}
TOO	T_{oo}
TEFREE	$\overline{T}$
HI	h_i
HO	h_o
T	t
TI	t_i
TO	t_o
SNSQ	$\sin^2 \phi$
CSSQ	$\cos^2 \phi$
CN	$\cos \phi \sin \phi$
X1CS	$1/\cos \phi$
X1SN	$1/\sin \phi$
R2	r_2
BETA	β

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
X1ROSN	$1/r_0 \sin \phi$
X1ROCS	$1/r_0 \cos \phi$
CSX1RO	$\cos \phi/r_0$
CSX1R1	$\cos \phi/r_1$
CSX1R2	$\cos \phi/r_2$
SNX1RO	$\sin \phi/r_0$
SNX1R1	$\sin \phi/r_1$
X1R1	$1/r_1$
X1R2	$1/r_2$
X1R1SQ	$1/r_1^2$
X1ROSQ	$1/r_0^2$


ROBOT
ENTRY
IDENTIFY KGEOM
CALCULATE GEOMETRIC VARIABLES
IDENTIFY ISTTAB
CALCULATE WALL STIFFNESSES
IS KELVIN = 2 OR 4
YES
NO
CALCULATE THERMAL LOADS
RETURN

```
FOR,IS ROBOT,ROBOT
      SUBROUTINE ROBOT (ST,KLUE2,NROW,LL,ER,ES,G2,G3,TIME,ITIC,JTIC,      700010
     1                  NCYC,SIGOX,ALPHR,ALPHS,SIGOXR,SIGOXS)            700020
      INTEGER SAVJTC,SAVSTP,Q,THICK                                      700030
      INTEGER XN1,XN2,XN                                                 700040
      REAL*4 I2                                                          700050
      DOUBLE PRECISION YPRED                                             700060
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)          700070
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                             700080
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH            700090
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)   700100
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB  700110
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE  700120
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS             700130
      COMMON LODE,ICYCLE,LDISTL                                          700140
      COMMON /EQUAZN/ YPRED(72),YDOT(72),YASAVE(72),YANTH,YAMTH,         700150
     1         YAMPT,YAJPH,S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,    700160
     2         X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,X1R1,X1R2,    700170
     3         CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,ROSQ,XNSQ,BETA,R1,   700180
     4         R2,S1,R1DOT,XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,  700190
     5         XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,XNUTP,XNUPT,   700200
     6         XC11,XC22,XC15,XD33,XD22,XD21,XD12,XK11,XK12,XK21,XK22,    700210
     7         XK33,XD11,XNPHI,M,I,BETTA,ZETTA,XC16                       700220
      COMMON /SPLINS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),         700230
     1        DR1DP(100),ZI(14),RI(14),NRZIN                             700240
      COMMON /ARING/ NRING(28),AMAT(30,8),RSIG(12),REPS(12),RALPH(12),   700250
     C               RBAPH(12)                                           700260
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                         700270
      COMMON /MAGIK/ KKNT                                                700280
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI,NEO                             700290
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),     700300
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),     700310
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),      700320
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)              700330
      COMMON /CMAIN/ ZETA1(21),ZETA2(21),NODE,ALF(4),CE(4),NLRS,HI,HO,T  700340
      DIMENSION ST(30,31)                                                700350
      EQUIVALENCE (SINB,SNB),(COSB,CSB)                                  700360
      DATA A/'A   '/                                                     700370
C                                                                        700380
      NCONT = NROW                                                       700390
      GOTO (771,772,773,774,775,776,7077),KGEOM                          700400
C     GEOMETRY FOR ELIPSE(G3=OFFSET DISTANCE )                           700410
  771 A=G1                                                               700420
      BE=G2                                                              700430
      BETA = BE                                                          700440
       BESQ=BE**2                                                        700450
      ASQ=A**2                                                           700460
      SN = SIN(PHI)                                                      700470
      CS = COS(PHI)                                                      700480
      SNSQ = SN**2                                                       700490
      CSSQ = CS**2                                                       700500
      R2 = A*SQRT(1.0/(SNSQ+BESQ*CSSQ))                                  700510
      R2SQ = R2**2                                                       700520
      RO=R2*SN                                                           700530
      R1=R2*R2SQ*BESQ/ASQ                                                700540
      BESQ=BE**2                                                         700550
      R1DOT=0.0                                                          700560
      IF(KGEOM.EQ.1.AND.BETA.NE.1.0.AND.SN.NE.0.0)R1DOT=3.0*(R2*BETA/    700570
     1A) **2*(CS/SNSQ)*(R1*SN-RO)                                        700580
      IF(SN.EQ. 0.0)GO TO 779                                            700590
      R2 = R2-G3/SN                                                      700600
      R2SQ = R2**2                                                       700610
```

```
      RO = RO-G3                                                        700620
      GO TO 7775                                                        700630
  779 IF(G3 .EQ. 0.0)GO TO 7775                                         700640
      R1DOT = 3.0*G3                                                    700650
      RO = -G3                                                          700660
      GO TO 7775                                                        700670
C     GEOMETRY FOR OGIVE                                                700680
  772 R1=G1                                                             700690
      C=G2                                                              700700
      SN = SIN(PHI)                                                     700710
      CS = COS(PHI)                                                     700720
      IF (SN.EQ.0.0) GOTO 777                                           700730
      R2=R1-C/SN                                                        700740
      GOTO 778                                                          700750
  777 R2 = 1.0                                                          700760
  778 RO = R1*SN-C                                                      700770
      R1DOT=0.0                                                         700780
      GOTO 7775                                                         700790
C     GEOMETRY FOR CONE                                                 700800
  773 CS = COS(G1)                                                      700810
      SN=SIN(G1)                                                        700820
      S=PHI                                                             700830
      S1=1.0/S                                                          700840
      R2=CS*SN*PHI                                                      700850
      RO=PHI*CS                                                         700860
      R1DOT=0.0                                                         700870
      GOTO 7775                                                         700880
C     GEOMETRY FOR CYLINDER                                             700890
  774 RO = G1                                                           700900
      R1DOT=0.0                                                         700910
      SN = 1.0                                                          700920
      CS = 1.0                                                          700930
      GOTO 7775                                                         700940
C   MODIFIED  ELLIPSE                                                   700950
  775 XNEXP = G1                                                        700960
      A    =G2                                                          700970
      XN1 = 1.0 + XNEXP                                                 700980
      XN2 = 1.0/XN1                                                     700990
      XN3 = XN1 + 1.0                                                   701000
      XN4 = XN3 + 1.0                                                   701010
      XN5 = XN4/XN1                                                     701020
      SN = SIN(PHI)                                                     701030
      CS = COS(PHI)                                                     701040
      R2   = A*(2.0/(1.0+SN**XN1))**XN2                                 701050
      R1   = (A/2.0)*(R2/A)**XN3                                        701060
      RO=R2*SN                                                          701070
      R1DOT = -XN3*A*(SN**XNEXP*CS/4.0)*(2.0/(1.0+SN**XN1))**XN5        701080
      GOTO 7775                                                         701090
C     GENERAL GEOMETRY                                                  701100
  776 SN = SIN(PHI)                                                     701110
      CS = COS(PHI)                                                     701120
      TAN= SN/CS                                                        701130
      SEC= 1.0/CS                                                       701140
      IF (TIME.EQ.TIC) CALL GEOMET                                      701150
      ARG = PHI                                                         701160
      DO 204 J=1,100                                                    701170
      PHO = PSI(J)                                                      701180
      IF (ANG.EQ.A) IF (ARG-PHO) 221,223,204                            701190
      IF (PHO-ARG) 221,223,204                                          701200
  221 IF (J-1) 8502,8502,224                                            701210
  204 CONTINUE                                                          701220
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```
      GO TO 8503                                                        701230
  223 RO = RAD(J)                                                       701240
      R1 = CUR1(J)                                                      701250
      R2 = CUR2(J)                                                      701260
      R1DOT = DR1DP(J)                                                  701270
      GO TO 7775                                                        701280
 8502 NERROR = 41                                                       701290
      GO TO 8888                                                        701300
 8503 NERROR = 42                                                       701310
 8888 NIX = 1                                                           701320
      GO TO 8889                                                        701330
  224 SUB1 = ARG-PSI(J-1)                                               701340
      SUB2 = PSI(J)-PSI(J-1)                                            701350
      RO = RAD(J-1)+(RAD(J)-RAD(J-1))*SUB1/SUB2                         701360
      R1 = CUR1(J-1)+(CUR1(J)-CUR1(J-1))*SUB1/SUB2                      701370
      R2 = CUR2(J-1)+(CUR2(J)-CUR2(J-1))*SUB1/SUB2                      701380
      R1DOT = DR1DP(J-1)+(DR1DP(J)-DR1DP(J-1))*SUB1/SUB2                701390
      GOTO 7775                                                         701400
C     ISOTENSOID GEOMETRY                                               701410
 7077 CONTINUE                                                          701420
      SN = SIN(PHI)                                                     701430
      CS = COS(PHI)                                                     701440
      A  = G1                                                           701450
      R2 = A/SQRT(SN)                                                   701460
      R1 = 0.5 * R2                                                     701470
      RO = R2 * SN                                                      701480
      R1DOT = - ((A**2)*0.5)*(R1*CS)/RO**2                              701490
 7775 TAN=SN/CS                                                         701500
      IF(TIME.EQ.TIC) RTICK=RO                                          701510
      IF (NCYC.GT.1) GO TO 491                                          701520
      IF (TIME.NE.TIC) GO TO 491                                        701530
      IF(NH.EQ.0.AND.NEO.EQ.0) GO TO 480                                701540
      AMAT(ITIC,1) = SAVY(22)                                           701550
      AMAT(ITIC,2) = SAVY(23)                                           701560
      AMAT(ITIC,3) = SAVY(5)                                            701570
      AMAT(ITIC,4) = SAVY(1)*CS-SAVY(3)*SN                              701580
  480 RADUS(ITIC) = RO                                                  701590
      IF (NSC.NE.1) GO TO 491                                           701600
      SADUS(JTIC) = RO                                                  701610
      IF(NH.EQ.0.AND.NEO.EQ.0) GO TO 491                                701620
      AMAT(JTIC,5) = SAVY(22)                                           701630
      AMAT(JTIC,6) = SAVY(23)                                           701640
      AMAT(JTIC,7) = SAVY(5)                                            701650
      AMAT(JTIC,8) = SAVY(1)*CS-SAVY(3)*SN                              701660
  491 CONTINUE                                                          701670
      ROSQ = RO**2                                                      701680
      XNSQ=XN**2                                                        701690
      CN=CS*SN                                                          701700
      X1CS=1.0/CS                                                       701710
      TN=SN/CS                                                          701720
      X1RO=1.0/RO                                                       701730
      X1ROSQ=1.0/RO**2                                                  701740
      X1CSRO=1.0/(CS*RO)                                                701750
      CN1RO=CN/RO                                                       701760
      SN1RO=SN/RO                                                       701770
      CS1RO=CS/RO                                                       701780
      SNSQ=SN**2                                                        701790
      CSSQ=CS**2                                                        701800
      IF(KGEOM.EQ.4.OR.KGEOM.EQ.3) GOTO 79                              701810
      R1SQ = R1**2                                                      701820
      R2SQ = R2**2                                                      701830
      X1SN=1.0/SN                                                       701840
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```
      X1SNRO=1.0/(SN*RO)                                                701850
      X1R1=1.0/R1                                                       701860
      X1R2=1.0/R2                                                       701870
      CS1R1=CS/R1                                                       701880
      CS1R2=CS/R2                                                       701890
      SN1R1=SN/R1                                                       701900
      X1R1SQ=1.0/R1**2                                                  701910
   79 XNTTH=0.0                                                         701920
      XNTPH=0.0                                                         701930
      XMTTH=0.0                                                         701940
      XMTPH = 0.                                                        701950
C                                                                       701960
C     COMPUTATION OF K AND D FOR MATERIAL PROPETY INPUT                 701970
C                                                                       701980
      HO = 0.0                                                          701990
      T = 0.0                                                           702000
      HI = 0.0                                                          702010
      TS = 0.0                                                          702020
      TR = 0.0                                                          702030
      TR = 0.0                                                          702030
      RHOR = 0.0                                                        702040
      RHOS = 0.0                                                        702050
      RHOI = 0.0                                                        702060
      RHOC = 0.0                                                        702070
      CTH = 0.0                                                         702080
      CPH = 0.0                                                         702090
      YBARI = 0.0                                                       702100
      YBARC = 0.0                                                       702110
      YBARO = 0.0                                                       702120
      GO TO (711,600,711,32,33,34,35,36,37,28,29,30),ISTTAB             702130
C     THICK                                                             702140
  600 GO TO (703,702,701,701),THICK                                     702150
  701 HO= ST(4,LL)                                                      702160
  702 T = ST(3,LL)                                                      702170
      RHOC = ST(NCONT-1,LL)                                             702180
  703 HI= ST(2,LL)                                                      702190
      RHOI = ST(NCONT,LL)                                               702200
      GO TO 40                                                          702210
C     ST11,ST12,ST13                                                    702220
   30 HO= ST(14,LL)                                                     702230
   29 T = ST(13,LL)                                                     702240
      RHOC = ST(NCONT-3,LL)                                             702250
   28 HI= ST(12,LL)                                                     702260
      RHOI = ST(NCONT-2,LL)                                             702270
      RHOS = ST(NCONT-1,LL)                                             702280
      RHOR = ST(NCONT,LL)                                               702290
      GJPH= ST(2,LL)                                                    702300
      GJTH= ST(3,LL)                                                    702310
      APH = ST(4,LL)                                                    702320
      ATH = ST(5,LL)                                                    702330
      CPH = ST(6,LL)                                                    702340
      CTH = ST(7,LL)                                                    702350
      XIPH = ST(8,LL)                                                   702360
      XITH= ST(9,LL)                                                    702370
      SPH = ST(10,LL)                                                   702380
      STH = ST(11,LL)                                                   702390
      IF (KELVIN.EQ.2.OR.KELVIN.EQ.4) GO TO 40                          702400
      ISTAB = ISTTAB-9                                                  702410
      TS = ST(ISTAB+12,LL)                                              702420
      TR = ST(ISTAB+13,LL)                                              702430
      GO TO 40                                                          702440
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C       RWAF1,RWAF2,RWAF3                                                  702450
   34.  HO = ST(10,LL)                                                     702460
   33   T = ST(9,LL)                                                       702470
        RHOC = ST(NCONT-2,LL)                                              702480
   32   HI = ST(8,LL)                                                      702490
        RHOI = ST(NCONT-1,LL)                                              702500
        RHOS = ST(NCONT,LL)                                                702510
        APH = ST(2,LL)                                                     702520
        CPH = ST(3,LL)                                                     702530
        XIPH= ST(4,LL)                                                     702540
        SPH = ST(5,LL)                                                     702550
        BETTA=ST(6,LL)                                                     702560
        ZETTA = ST(7,LL)                                                   702570
        ATH = APH                                                          702580
        CTH = CPH                                                          702590
        XITH= XIPH                                                         702600
        STH = SPH                                                          702610
        RHOR = RHOS*IWORD                                                  702620
        IF (KELVIN.EQ.2.OR.KELVIN.EQ.4) GO TO 40                           702630
        ISTAB = ISTTAB-3                                                   702640
        TS = ST(ISTAB+8,LL)                                                702650
        TR = TS                                                            702660
        GO TO 40                                                           702670
C       ISG1,ISG2,ISG3                                                     702680
   37   HO = ST(9,LL)                                                      702690
   36   T = ST(8,LL)                                                       702700
        RHOC = ST(NCONT-2,LL)                                              702710
   35   HI = ST(7,LL)                                                      702720
        RHOI = ST(NCONT-1,LL)                                              702730
        RHOS = ST(NCONT,LL)                                                702740
        APH = ST(2,LL)                                                     702750
        CPH = ST(3,LL)                                                     702760
        XIPH = ST(4,LL)                                                    702770
        SPH = ST(5,LL)                                                     702780
        BETTA = ST(6,LL)                                                   702790
        ATH = APH                                                          702800
        CTH = CPH                                                          702810
        XITH = XIPH                                                        702820
        STH = SPH                                                          702830
        RHOR = RHOS*IWORD                                                  702840
        IF (KELVIN.EQ.2.OR.KELVIN.EQ.4) GO TO 40                           702850
        ISTAB = ISTTAB-6                                                   702860
        TS = ST(ISTAB+7,LL)                                                702870
        TR = TS                                                            702880
        GO TO 40                                                           702890
C       ST10,RWAF                                                          702900
C       RANKIN=THSTND MEANS INTERPOLATE,COMPUTE NTEMP,MTEMP                702910
C       RANKIN=NOTHRM MEANS DO NOT INTERPOLATE,DO NOT COMPUTE NTEMP,NTEMP  702920
C       RANKIN=THCNST MEANS DO NOT AVERAGE, BUT INTERPOLATE,COMPUTE        702930
C                                                          NTEMP, MTEMP    702940
C       RANKIN=THINHO MEANS INTERPOLATE,BUT DO NOT COMPUTE NTEMP,MTEMP     702950
C                                                                          702960
  711   CONTINUE                                                           702970
        XK11=ST(2,LL)                                                      702980
        XK12=ST(3,LL)                                                      702990
        XK22 = ST(4,LL)                                                    703000
        XK33 = ST(5,LL)                                                    703010
        XD11 = ST(6,LL)                                                    703020
        XD12 = ST(7,LL)                                                    703030
        XD22 = ST(8,LL)                                                    703040
        XD33 = ST(9,LL)                                                    703050
        XC11 = ST(10,LL)                                                   703060
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      XC22 = ST(11,LL)                                                  703070
      XC15 = ST(12,LL)                                                  703080
      XC16 = ST(13,LL)                                                  703090
      XMERD = ST(NCONT-2,LL)                                            703100
      XPRES = ST(NCONT-1,LL)                                            703110
      XMONT = ST(NCONT,LL)                                              703120
      XK21 = XK12                                                       703130
      XD21 = XD12                                                       703140
      GO TO 103                                                         703150
C                                                                       703160
   40 CONTINUE                                                          703170
      IF (IWORD.EQ.1) GO TO 140                                         703180
      RHOR = 0.0                                                        703190
      RHOS = 0.0                                                        703200
      RHOI = 0.0                                                        703210
      RHOC = 0.0                                                        703220
      XMERD = 0.0                                                       703230
      XPRES = 0.0                                                       703240
      XMONT = 0.0                                                       703250
  140 CONTINUE                                                          703260
      TEMP3= (1.0-XNUPT * XNUTP)                                        703270
      GO TO (42,47,49,41),THICK                                         703280
   41 GO TO (103,42,103,42,47,49,42,47,49,42,47,49),ISTTAB              703290
C                                                                       703300
C     SINGLE SHEET                                                      703310
C                                                                       703320
   42 TEMP1 = ETHET*HI                                                  703330
      TEMP2= TEMP1 * HI**2                                              703340
      XK11= TEMP1/TEMP3                                                 703350
      XD11= TEMP2/(12.0* TEMP3)                                         703360
      TEMP1 = EPHI*HI                                                   703370
      TEMP2= TEMP1*HI**2                                                703380
      XK22= TEMP1/TEMP3                                                 703390
      XD22= TEMP2/(12.0* TEMP3)                                         703400
      XK33 = XGPT*HI                                                    703410
      XD33= XK33*HI**2/12.0                                             703420
      YBARI = 0.0                                                       703430
      YBARC = 0.0                                                       703440
      YBARO = 0.0                                                       703450
      GO TO 55                                                          703460
C                                                                       703470
C     EQUAL SHEETS                                                      703480
C                                                                       703490
   47 CONTINUE                                                          703500
      XK11 = 2.0*ETHET*HI/TEMP3                                         703510
      XK22 = 2.0*EPHI*HI/TEMP3                                          703520
      XK33 = 2.0*XGPT                                                   703530
      ZBR = HI+T/2.0                                                    703540
      ZBH = (ZBR-HI/2.0)**2                                             703550
      XD33 = XGPT*HI*((HI**2)/6.0+2.0*ZBH)                              703560
      XD11 = HI*(XK11*HI/12.0+2.0*ETHET*ZBH/TEMP3)                      703570
      XD22 = HI*(XK22*HI/12.0+2.0*EPHI*ZBH/TEMP3)                       703580
      YBARI = ZBR-HI/2.0                                                703590
      YBARC = ZBR-HI-T/2.0                                              703600
      YBARO = HI/2.0-ZBR                                                703610
      GO TO 55                                                          703620
C                                                                       703630
C     UNEQUAL FACE SHEETS                                               703640
C                                                                       703650
   49 CONTINUE                                                          703660
      ZBR = (HI*HI+HO*HO+2.0*(HO*(HI+T)))/(2.0*(HI+HO))                 703670
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```
      ZBHIN = (ZBR-HI/2.0)**2                                          703680
      ZBHOUT = (ZBR-HO/2.0)**2                                         703690
      XK11 = ETHET*(HI+HO)/TEMP3                                       703700
      XK22 = EPHI*(HI+HO)/TEMP3                                        703710
      XK33 = XGPT*(HI+HO)                                              703720
      HIO3 = HI**3+HO**3                                               703730
      XD33 = HIO3*XGPT/12.0+XGPT*(HI*ZBHIN+HO*ZBHOUT)                  703740
      D11 = ETHET*HIO3/12.0                                            703750
      XD11 = (D11+ETHET*(HI*ZBHIN+HO*ZBHOUT))/TEMP3                    703760
      D22 = EPHI*HIO3/12.0                                             703770
      XD22 = (D22+EPHI*(HI*ZBHIN+HO*ZBHOUT))/TEMP3                     703780
      YBARI = ZBR-HI/2.0                                               703790
      YBARC = ZBR-HI-T/2.0                                             703800
      YBARO = HI/2.0-ZBR                                               703810
C                                                                      703820
C     DETERMINE COMPLETE CONSTANTS DEPENDENT ON REINFORCEMENT CLUE      703830
C                                                                      703840
   55 CONTINUE                                                         703850
      ROI = RO-YBARI*SN                                                703860
      ROU = RO-YBARO*SN                                                703870
      ROC = RO-YBARC*SN                                                703880
      IF (THICK.EQ.2) HO = HI                                          703890
      IF (ISTTAB.EQ.5.OR.ISTTAB.EQ.8.OR.ISTTAB.EQ.11) HO = HI          703900
      D3 = RHOI*ROI*HI                                                 703910
      D4 = RHOC*ROC*T                                                  703920
      D5 = RHOI*ROU*HO                                                 703930
      DD = D3+D4+D5                                                    703940
      XMERD = DD*OMEGA*CS                                              703950
      XPRES = -DD*OMEGA*SN                                             703960
      XMONT = -(D3*YBARI+D4*YBARC+D5*YBARO)*OMEGA*CS                   703970
      IF(ISTTAB .EQ.2)GO TO 103                                        703980
      TBARR = ATH/STH                                                  703990
      TBARS = APH/SPH                                                  704000
      ROR = RO-CTH*SN                                                  704010
      ROS = RO-CPH*SN                                                  704020
      EASTH=ER*ATH/STH                                                 704030
      EASPH=ES*APH/SPH                                                 704040
      EISPH= ES* XIPH/SPH                                              704050
      EISTH= ER* XITH/STH                                              704060
      D1 = RHOR*ROR*TBARR                                              704070
      D2 = RHOS*ROS*TBARS                                              704080
      DD = D1+D2+D3+D4+D5                                              704090
      GO TO (58,60,100),KLUE2                                          704100
C                                                                      704110
C     ST CLUE (11,12,13)                                               704120
C                                                                      704130
   58 CONTINUE                                                         704140
      XK12= XK11*XNUTP                                                 704150
      XK11= XK11+ EASTH                                                704160
      XK22= XK22+ EASPH                                                704170
      XC11= EASTH*CTH                                                  704180
      XC22= EASPH*CPH                                                  704190
      XD22= - XD22 - EISPH                                             704200
      XD33= XD33 + GJPH/(4.0*SPH)+ GJTH/(4.0*STH)                      704210
      XD12= -XD11*XNUTP                                                704220
      XD11= -XD11- EISTH                                               704230
      XK21 = XK12                                                      704240
      XD21 = XD12                                                      704250
      XMERD = DD*OMEGA*CS                                              704260
      XPRES = -DD*OMEGA*SN                                             704270
      XMONT = -(D1*CTH+D2*CPH+D3*YBARI+D4*YBARC+D5*YBARO)*OMEGA*CS     704280
      GO TO 103                                                        704290
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C      RWA CLUE (1,2,3)                                                  704300
C                                                                        704310
   60 CONTINUE                                                           704320
      SINB =SIN(BETTA)                                                   704330
      COSB =COS(BETTA)                                                   704340
      SN2TO4 = 2*(SINB**4.)                                              704350
      D= STH*(COSB+SINB)                                                 704360
      ED = ER*ATH/D                                                      704370
      SINB2= SINB**2.                                                    704380
      HL = 2.0*(ABS(ZETTA)-ABS(CTH))                                     704390
      I2=(ATH**3.)/(3* HL**2)                                            704400
   95 XC22 = 2.0*CTH*COSB**3*ED                                          704410
      XC15 = 2.0*CTH*COSB*SINB2*ED                                       704420
      XC16 = XC15                                                        704430
      GRI=  ER* I2/(2.0*(1.0 + XNUTP)*D)                                 704440
      XC11 = CTH*SN2TO4/COSB*ED                                          704450
      EDI = ER*XITH/D                                                    704460
      SN4TO2 = 4.*SINB2                                                  704470
      XD22 = -XD22-2.0*COSB**3*EDI-SN4TO2*COSB*GRI                       704480
      TB= 2.0* BETTA                                                     704490
      XD33 = XD33+((4.0*COS(TB)*                                         704500
     1*2*GRI)/ COSB) + (2.0*COSB*SINB2*EDI)                              704510
      XD12 = -XD11*XNUTP-(2.0*COSB                                       704520
     1*SINB2*EDI)-(SN4TO2*COSB*GRI )                                     704530
      XK12= XK11*XNUTP + (2.0*COSB*SINB2*ED)                             704540
      XK22=XK22+(2*COSB**3*ED)                                           704550
      XK33=XK33+(2*COSB*SINB2*ED)                                        704560
      XK11=XK11+(SN2TO4*ED/COSB)                                         704570
      XD11 = -XD11-SN2TO4*EDI/COSB-(                                     704580
     1 SN4TO2*COSB*GRI)                                                  704590
      XK21 = XK12                                                        704600
      XD21 = XD12                                                        704610
      GO TO 108                                                          704620
C                                                                        704630
C      ISG CLUE (1,2,3)                                                  704640
C                                                                        704650
  100 CONTINUE                                                           704660
      SNB =SIN(BETTA)                                                    704670
      CSB =COS(BETTA)                                                    704680
      TBETTA= 2.0*BETTA                                                  704690
      CS2B= COS(TBETTA)                                                  704700
      ONEC2B=(1.0+ CS2B)/2.                                              704710
      SCB2  =(SNB-CS2B*SNB + 2.)/(2.0*CSB)                               704720
      SN2B  =SIN(TBETTA) /2.                                             704730
      XK12=XK11*XNUTP + (EASTH*SNB*ONEC2B/CSB)                           704740
      XK11=XK11+ EASTH*SCB2                                              704750
      XK22=XK22+ EASTH*(CSB/SNB*ONEC2B)                                  704760
      XK33=XK33+ EASTH* SN2B                                             704770
      XC11=     (EASTH*CTH* SCB2 )                                       704780
      XC15=EASTH*CTH*( SNB* ONEC2B/CSB )                                 704790
      XC16=EASTH*CTH*SN2B                                                704800
      XC22= EASTH*CTH* (CSB/SNB * ONEC2B)                                704810
      XD12=-XD11*XNUTP- EISTH*(SNB*ONEC2B/CSB)                           704820
      XD11=-XD11- EISTH*SCB2                                             704830
      XD22 = -XD22-EISTH*(CSB/SNB*ONEC2B)                                704840
      XD33= XD33+ EISTH*SN2B                                             704850
      XK21 = XK12                                                        704860
      XD21 = XD12                                                        704870
C                                                                        704880
C                                                                        704890
  108 XMERD = (DD-D2)*OMEGA*CS                                           704900
```

```
      XPRES = -(DD-D2)*OMEGA*SN                                          704910
      XMONT = -(D1*CTH+D3*YBARI+D4*YBARC+D5*YBARO)*OMEGA*C S              704920
C                                                                        704930
  103 CONTINUE                                                           704940
      IF (KGEOM.NE.4) GO TO 105                                          704950
      XMERD = 0.0                                                        704960
      XMONT = 0.0                                                        704970
  105 CONTINUE                                                           704980
C                                                                        704990
      GO TO (716,714,715,714),KELVIN                                     705000
  716 TII = ST(NROW+1,LL)                                                705010
      TIK = ST(NROW+2,LL)                                                705020
      TOK = ST(NROW+3,LL)                                                705030
      TOO = ST(NROW+4,LL)                                                705040
      GOTO 717                                                           705050
  715 TII = ST(NROW+1,LL)                                                705060
      TIK = TII                                                          705070
      TOK = TII                                                          705080
      TOO = TII                                                          705090
C                                                                        705100
  717 TEMP1 = ALPHTH+XNUTP*ALPHPH                                        705110
      TEMP2 = ALPHPH+XNUPT*ALPHTH                                        705120
      TEMP3 = 1-XNUPT*XNUTP                                              705130
      TEMP4 = HI/4.0                                                     705140
      ETHK1 = ETHET*TEMP1/TEMP3                                          705150
      TEMP5 = HI**2/24.0                                                 705160
      TEMP61= TII+ TIK-2* TEFREE                                         705170
      TEMP62= TOO+ TOK-2* TEFREE                                         705180
      TEMP71= 2.0* TII +TIK-3*TEFREE                                     705190
      TEMP72= 2.0* TOO +TOK-3*TEFREE                                     705200
      EPHK1 = EPHI*TEMP2/TEMP3                                           705210
      GO TO (811,812,813,814),THICK                                      705220
C                                                                        705230
  814 GO TO (815,811,815,811,812,813,811,812,813,811,812,813),ISTTAB     705240
C                                                                        705250
  811 XNTTH= ETHK1    *           TEMP4 * (TEMP61+ TEMP62)               705260
      XNTPH= EPHK1    *           TEMP4 * (TEMP61 + TEMP62)              705270
      XMTTH= ETHK1    *           TEMP5 * (TEMP71- TEMP72)               705280
      XMTPH= EPHK1    *           TEMP5 * (TEMP71 - TEMP72)              705290
      GO TO 816                                                          705300
  812 TI = T/2.0                                                         705310
      TEMP8= HI/2.0                                                      705320
      XNTTH = ETHK1*TEMP8*(TEMP61+TEMP62)                                705330
      XNTPH = EPHK1*TEMP8*(TEMP61+TEMP62)                                705340
      XMTTH = ETHK1*TEMP8*(HI*(TEMP71-TEMP72)/3.0+TI*(TEMP61-TEMP62))    705350
      XMTPH = EPHK1*TEMP8*(HI*(TEMP71-TEMP72)/3.0+TI*(TEMP61-TEMP62))    705360
      GO TO 816                                                          705370
  813 TI = (HO**2-HI**2+2.0*HO*T)/(2.0*(HI+HO))                          705380
      TO = (HI**2-HO**2+2.0*HI*T)/(2.0*(HI+HO))                          705390
      XNTTH = ETHK1/2.0*(HI*TEMP61+HO*TEMP62)                            705400
      XNTPH = EPHK1/2.0*(HI*TEMP61+HO*TEMP62)                            705410
      XMTTH = ETHK1/2.0*(HI**2*TEMP71/3.0-HO**2*TEMP72/3.0+TI*HI*TEMP61- 705420
     1  TO*HO*TEMP62)                                                   705430
      XMTPH = EPHK1/2.0*(HI**2*TEMP71/3.0-HO**2*TEMP72/3.0+TI*HI*TEMP61- 705440
     1  TO*HO*TEMP62)                                                   705450
  816 CONTINUE                                                           705460
      IF (ISTTAB.EQ.2) GO TO 714                                         705470
      GO TO (817,818,819),KLUE2                                          705480
  817 XNTPH = XNTPH+ES*APH/SPH*ALPHS*TS                                  705490
      XNTTH = XNTTH+ER*ATH/STH*ALPHR*TR                                  705500
      XMTPH = XMTPH+CPH*ES*APH/SPH*ALPHS*TS                              705510
      XMTTH = XMTTH+CTH*ER*ATH/STH*ALPHR*TR                              705520
```

```
      GO TO 714                                                          705530
  818 TEM = ES*APH/SPH*ALPHS*TS                                          705540
      XNTPH = XNTPH+TEM                                                  705550
      XNTTH = XNTTH+TEM                                                  705560
      XMTPH = XMTPH+CPH*TEM                                              705570
      XMTTH = XMTTH+CPH*TEM                                              705580
      GO TO 714                                                          705590
  819 TEM = ES*APH/SPH*ALPHS*TS                                          705600
      XNTPH = XNTPH+TEM*CSB/SNB                                          705610
      XNTTH = XNTTH+TEM*(1.0+SNB)/CSB                                    705620
      XMTPH = XMTPH+CPH*TEM*CSB/SNB                                      705630
      XMTTH = XMTTH+CPH*TEM*(1.0+SNB)/CSB                                705640
      GO TO 714                                                          705650
  815 TEMP10 = ((-XK11*XD11)**.5)/(48.0**.5)                             705660
      TEM11 =((-XK22*XD22)**.5)/(48.0**.5)                               705670
      XNTTH = XK11/4.0*TEMP1*(TEMP61+TEMP62)                             705680
      XNTPH = XK22/4.0*TEMP2*(TEMP61+TEMP62)                             705690
      XMTTH = TEMP10*TEMP1*(TEMP71-TEMP72)                               705700
      XMTPH = TEM11*TEMP2*(TEMP71-TEMP72)                                705710
  714 CONTINUE                                                           705720
      IF (NH.NE.0.OR.(NCYC.NE.0.AND.KKNT.NE.4)) GO TO 8889               705730
      IF (NEO.NE.0) GO TO 8889                                           705740
      DO 1234 K=1,KBC                                                    705750
      DO 1235 J=1,3                                                      705760
      SIGMA(J,K) = 0.0                                                   705770
      SEPS(J,K) = 0.0                                                    705780
      SALPH(J,K) = 0.0                                                   705790
 1235 SBAPH(J,K) = 0.0                                                   705800
      EFF(K) = SIGOX                                                     705810
 1234 NPLA(K) = 0                                                        705820
      DO 1238 J=1,3                                                      705830
      STSRN(J) = 0.0                                                     705840
      NPLAST(J) = 0                                                      705850
      STSIG(J) = 0.0                                                     705860
      STREPS(J) = 0.0                                                    705870
      STALPH(J) = 0.0                                                    705880
      STBAPH(J) = 0.0                                                    705890
      NPLEVS(J) = 0                                                      705900
 1238 EFFST(J) = SIGOXS                                                  705910
      IF (KLUE2.EQ.1) EFFST(2) = SIGOXR                                  705920
      DO 1237 J=1,6                                                      705930
 1237 STR(J) = 0.0                                                       705940
      NPLEV = 0                                                          705950
      IF (KELVIN.EQ.1.OR.KELVIN.EQ.3) GO TO 110                          705960
      DO 111 K=1,KBC                                                     705970
      DO 111 J=1,3                                                       705980
  111 STEPS(J,K) = 0.0                                                   705990
      GO TO 112                                                          706000
  110 IF (THICK.NE.1) GO TO 113                                          706010
      NLH = NLRS/2+1                                                     706020
      DO 115 LR=1,NLH                                                    706030
      T = TOK+2.0*ZETA1(LR)*(TII-TOK)                                    706040
      STEPS(1,LR) = ALPHPH*T                                             706050
      STEPS(2,LR) = ALPHTH*T                                             706060
  115 STEPS(3,LR) = 0.0                                                  706070
      NLH = NLH+1                                                        706080
      DO 116 LR=NLH,NLPO                                                 706090
      T = TOK+2.0*ZETA1(LR)*(TOK-TOO)                                    706100
      STEPS(1,LR) = ALPHPH*T                                             706110
      STEPS(2,LR) = ALPHTH*T                                             706120
  116 STEPS(3,LR) = 0.0                                                  706130
```

```
      GO TO 112                                                          706140
  113 DO 200 K=1,2                                                       706150
      DO 200 LR=1,NLPO                                                   706160
      LRT = LR+(K-1)*NLPO                                                706170
      GO TO (300,400),K                                                  706180
  300 T = TIK+ZETA2(LR)*(TII-TIK)                                        706190
      GO TO 500                                                          706200
  400 T = TOK+ZETA2(LR)*(TOO-TOK)                                        706210
  500 STEPS(1,LRT) = ALPHPH*T                                            706220
      STEPS(2,LRT) = ALPHTH*T                                            706230
  200 STEPS(3,LRT) = 0.0                                                 706240
  112 CONTINUE                                                           706250
      DO 1236 K=1,53                                                     706260
 1236 SAVY(K) = 0.0                                                      706270
      WRITE(IO) SAVY,NPLEV,NPLA,SIGMA,SALPH,SBAPH,STEPS,STR,EFF,STSRN,   706280
     1          NPLAST,STSIG,STREPS,STALPH,STBAPH,NPLEVS,EFFST,SEPS      706290
 8889 RETURN                                                             706300
      END                                                                706310
```

```
 FOR,IS GEOMET,GEOMET
      SUBROUTINE GEOMET                                                  2300010
C     THIS SUBROUTINE CALCULATES THE GEOMETRY FOR A SHELL SEGMENT.       2300020
C     THE INPUT VARIABLES ARE . . .                                      2300030
C             RI(I) - - DISTANCE FROM AXIS OF REV. TO POINTS             2300040
C                       ON SHELL MERIDIAN.                               2300050
C             ZI(I) - - DISTANCE ALONG AXIS OF REV. TO THE               2300060
C                       INTERSECTION OF THE CORRESPONDING RI(I) AND      2300070
C                       THE AXIS OF REV.                                 2300080
C             NRZIN - - NUMBER OF (RI,ZI) PAIRS READ AS INPUT.           2300090
C                                                                        2300100
      COMMON /SPLINS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),         2300110
     1       DR1DP(100),ZI(14),RI(14),NRZIN                              2300120
      DIMENSION CI(4,13),DRDZ(14),SOUT(14),S(101),RADD(100)              2300130
C                                                                        2300140
      FUN(ARG) = SQRT(1.0 + ARG**2)                                      2300150
C                                                                        2300160
      RADS = 3.1415926/180.0                                             2300170
      DATA B/'B    '/                                                    2300180
      AMULT = 1.0                                                        2300190
      IF (ANG.EQ.B) AMULT = -1.0                                         2300200
C                                                                        2300210
C     PASS SPLINE CURVE THROUGH INPUT POINTS ON SHELL MERIDIAN, AND      2300220
C     COMPUTE DR/DZ AT THESE POINTS.                                     2300230
C                                                                        2300240
      CALL PLICO (ZI,RI,NRZIN,CI)                                        2300250
      NDELZ = NRZIN - 1                                                  2300260
      DO 60 I=1,NRZIN                                                    2300270
      CALL PLINE (ZI,RI,NRZIN,CI,ZI(I),FAKE1,DRDZ(I),FAKE2)              2300280
   60 CONTINUE                                                           2300290
C                                                                        2300300
C     COMPUTE MERIDIONAL ARC LENGTH TO INTERPOLATED POINTS BY            2300310
C     NUMERICAL INTEGRATION (SIMPSONS RULE).  SINCE SIMPSONS RULE        2300320
C     REQUIRES AN EVEN NUMBER OF PARTITIONS, INTERPOLATE A POINT         2300330
C     MIDWAY BETWEEN EACH PAIR OF POINTS USING SUBROUTINE SPLINE.        2300340
C                                                                        2300350
      SOUT(1) = 0.                                                       2300360
      DO 70 I=1,NDELZ                                                    2300370
      DZ2=(ZI(I+1)-ZI(I))/2.0                                            2300380
      DZ6=DZ2/3.0                                                        2300390
      CALL PLINE (ZI,RI,NRZIN,CI,ZI(I)+DZ2,FAKE1,DRDZM,FAKE2)            2300400
      SOUT(I+1) = SOUT(I) + DZ6*(FUN(DRDZ(I)) + 4.0*FUN(DRDZM) +         2300410
     1            FUN(DRDZ(I+1)))                                        2300420
   70 CONTINUE                                                           2300430
C                                                                        2300440
C     USE SPLICO TO REPRESENT RI(I) AS A FUNCTION OF SOUT(I).  THEN USE  2300450
C     SPLINE TO INTERPOLATE RADD AND CORRESPONDING DERIVATIVES.  FROM    2300460
C     THESE, COMPUTE THE TWO PRINCIPAL RADII OF CURVATURE,               2300470
C       CUR1 = 1/R1                                                      2300480
C       CUR2 = 1/R2                                                      2300490
C                                                                        2300500
      OLDH1 = SOUT(NRZIN)/99.0                                           2300510
      CALL PLICO (SOUT,RI,NRZIN,CI)                                      2300520
      DO 110 I=1,100                                                     2300530
      S(I) = FLOAT(I-1)*OLDH1                                            2300540
      CALL PLINE (SOUT,RI,NRZIN,CI,S(I),RAD(I),RADD(I),RADD2)            2300550
      IF (ABS(RADD(I)).GT.1.0) RADD(I)=1.0                               2300560
      FACTOR = SQRT(1.0-RADD(I)**2)                                      2300570
      CUR1(I) = -RADD2/FACTOR                                            2300580
      CUR2(I) = FACTOR/RAD(I)                                            2300590
```

```
110 CONTINUE                                                          2300600
    DO 180 J=1,100                                                    2300610
    COSPSI = AMULT*RADD(J)                                            2300620
    PSI(J) = ARCOS(COSPSI)                                            2300630
    SINPSI = -AMULT*RAD(J)*CUR2(J)                                    2300640
    IF (ANG.EQ.8) GO TO 179                                           2300650
    PSI(J) = 2.0*3.1415926-PSI(J)                                     2300660
179 CONTINUE                                                          2300670
    CUR1(J) = -AMULT/CUR1(J)                                          2300680
    CUR2(J) = -AMULT/CUR2(J)                                          2300690
    IF (J.EQ.1) GO TO 180                                             2300700
    I = 1                                                             2300710
    IF (J.EQ.2) GO TO 181                                             2300720
    I = 2                                                             2300730
181 IF (ANG.EQ.8) GO TO 190                                           2300740
    DR1DP(J-1) = (CUR1(J)-CUR1(J-I))/(PSI(J)-PSI(J-I))                2300750
    GO TO 180                                                         2300760
190 DR1DP(J-1) = (CUR1(J-I)-CUR1(J))/(PSI(J-I)-PSI(J))                2300770
180 CONTINUE                                                          2300780
    DR1DP(100) = DR1DP(99)                                            2300790
    DO 42 J=1,100                                                     2300800
    DR1DP(J) = DR1DP(J)*0.1                                           2300810
 42 CONTINUE                                                          2300820
    RETURN                                                            2300830
    END                                                               2300840
```

```
FOR,IS PLICO,PLICO
      SUBROUTINE PLICO (X,Y,M,C)                                        2500010
C     SUBROUTINE TO DETERMINE C(1,K),C(2,K),C(3,K) AND C(4,K).          2500020
      DIMENSION X(14),Y(14),A(14,3),B(14),Z(14)                         2500030
      DIMENSION D(13),P(13),E(13),C(4,13)                               2500040
      MM = M-1                                                          2500050
      DO 10 K=1,MM                                                      2500060
      D(K) = X(K+1) - X(K)                                              2500070
      P(K) = D(K)/6.0                                                   2500080
   10 E(K) = (Y(K+1)-Y(K))/D(K)                                         2500090
      DO 20 K=2,MM                                                      2500100
   20 B(K) = E(K) - E(K-1)                                              2500110
      A(1,2) = -1.0-D(1)/D(2)                                           2500120
      A(1,3) = D(1)/D(2)                                                2500130
      A(2,3) = P(2)-P(1)*A(1,3)                                         2500140
      A(2,2) = 2.0*(P(1)+P(2)) - P(1)*A(1,2)                            2500150
      A(2,3) = A(2,3)/A(2,2)                                            2500160
      B(2) = B(2)/A(2,2)                                                2500170
      DO 30 K=3,MM                                                      2500180
      A(K,2) = 2.0*(P(K-1)+P(K))-P(K-1)*A(K-1,3)                        2500190
      B(K) = B(K)-P(K-1)*B(K-1)                                         2500200
      A(K,3) = P(K)/A(K,2)                                              2500210
   30 B(K) = B(K)/A(K,2)                                                2500220
      Q = D(M-2)/D(M-1)                                                 2500230
      A(M,1) = 1.0+Q+A(M-2,3)                                           2500240
      A(M,2) = -Q-A(M,1)*A(M-1,3)                                       2500250
      B(M) = B(M-2)-A(M,1)*B(M-1)                                       2500260
      Z(M) = B(M)/A(M,2)                                                2500270
      MN = M-2                                                          2500280
      DO 40 I=1,MN                                                      2500290
      K = M-I                                                           2500300
   40 Z(K) = B(K)-A(K,3)*Z(K+1)                                         2500310
      Z(1) = -A(1,2)*Z(2)-A(1,3)*Z(3)                                   2500320
      DO 50 K=1,MM                                                      2500330
      Q = 1.0/(6.0*D(K))                                                2500340
      C(1,K) = Z(K)*Q                                                   2500350
      C(2,K) = Z(K+1)*Q                                                 2500360
      C(3,K) = Y(K)/D(K)-Z(K)*P(K)                                      2500370
   50 C(4,K) = Y(K+1)/D(K)-Z(K+1)*P(K)                                  2500380
      RETURN                                                            2500390
      END                                                               2500400
```

```
 FOR,IS PLINE,PLINE
       SUBROUTINE PLINE (X,Y,M,C,XINT,YINT,DYDX,D2YDX2)                  2400010
C      SUBROUTINE FOR SPLINE FIT INTERPOLATION IN THE TABLE OF VALUES     2400020
C      (X1,Y1) TO (XM,YM), WHERE M MAY BE AS LARGE AS 100, WHERE THE      2400030
C      CONSTANTS C(1,K),C(2,K),C(3,K) AND C(4,K) ARE ALREADY COMPUTED     2400040
C      AND STORED.                                                        2400050
C      SUBROUTINE ALSO COMPUTES DY/DX AND D2Y/DX2 AT XINT.                2400060
       DIMENSION X(14),Y(14),C(4,13)                                      2400070
       IF (XINT-X(1)) 80,10,20                                            2400080
   10  YINT = Y(1)                                                        2400090
       K=1                                                                2400100
       GO TO 70                                                           2400110
   20  K = 1                                                              2400120
   30  IF (XINT-X(K+1)) 60,40,50                                          2400130
   40  YINT = Y(K+1)                                                      2400140
       GO TO 70                                                           2400150
   50  K = K + 1                                                          2400160
       IF (M-K) 80,80,30                                                  2400170
   60  YINT = (X(K+1) - XINT)*(C(1,K)*(X(K+1)-XINT)**2+C(3,K))            2400180
       YINT = YINT + (XINT-X(K))*(C(2,K)*(XINT-X(K))**2+C(4,K))           2400190
   70  DYDX=-3.0*(C(1,K)*(X(K+1)-XINT)**2-C(2,K)*(XINT-X(K))**2)          2400200
      1      -C(3,K)+C(4,K)                                              2400210
       D2YDX2=6.0*(C(1,K)*(X(K+1)-XINT)+C(2,K)*(XINT-X(K)))               2400220
       RETURN                                                             2400230
   80  WRITE (6,90)                                                       2400240
   90  FORMAT (31H OUT OF RANGE FOR INTERPOLATION)                        2400250
       RETURN                                                             2400260
       END                                                                2400270
```

SUBROUTINE DIF1 AND DIFF2

These subroutines are called in RIEMAN as necessary. DIF1 contains the differential equations for the THIC and ST clues, while DIFF2 contains the differential equations for the RWA and ISG clues. Geometry clues, trigonometric values, and predicted values of the differential equation variables are passed via label common area, EQUAZN, to subroutines DIF1 or DIFF2. The coefficients for nonlinear and load terms, X1, X2, X3 and K, are identified depending upon the input clues and pass number.

The specific derivative equations and auxiliary equations are contained in these subroutines. The values of each derivative equation, YDOT, and each auxiliary equation, YA---, are returned to RIEMAN via label common EQUAZN.

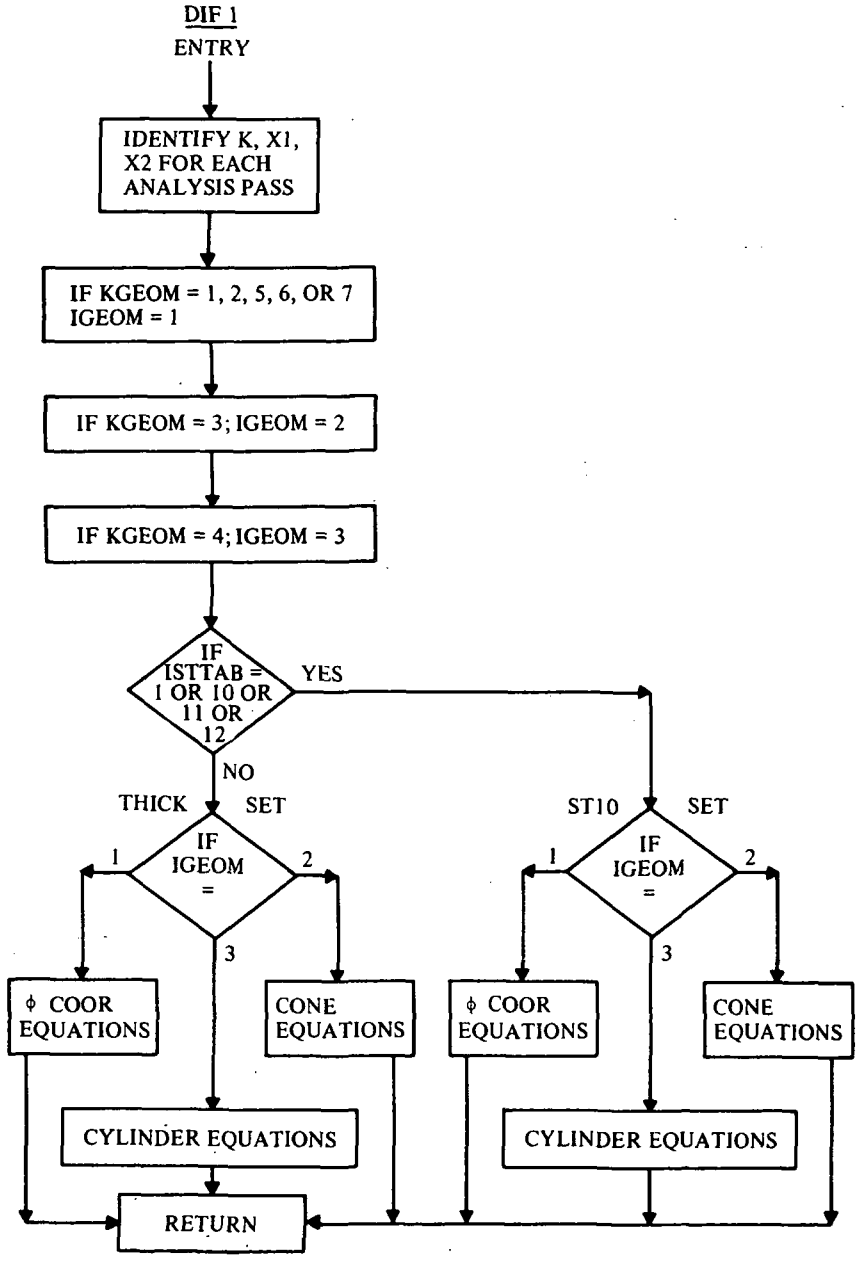
A special equation counter, I, is used in these subroutines, which counts in increments of eight. The first eight values of I, 1 through 57 (in increments of eight), correspond to the eight sets of initial conditions required to compute the segment stiffness matrices in subroutine SEGMAT. The subsequent value of I, 65 (again an increment of eight) corresponds to the computation of a set of eight equations for the loading condition.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)	
XN	n	
YDOT (I)	$T_{\phi\theta,\phi}$	$\frac{dT_{\phi\theta}}{ds}$
YDOT (I + 1)	$N_{\phi,\phi}$	$\frac{dN_{\phi}}{ds}$
YDOT (I + 2)	$J_{\phi,\phi}$	$\frac{dJ_{\phi}}{ds}$
YDOT (I + 3)	$M_{\phi,\phi}$	$\frac{dM_{\phi}}{ds}$
YDOT (I + 4)	$U_{,\phi}$	$\frac{dU}{ds}$
YDOT (I + 5)	$V_{,\phi}$	$\frac{dV}{ds}$
YDOT (I + 6)	$W_{,\phi}$	$\frac{dW}{ds}$
YDOT (I + 7)	$\Omega_{\theta,\phi}$	$\frac{d\Omega_{\theta}}{ds}$
YPRED (I)	$T_{\phi\theta}$	
YPRED (I + 1)	N_{ϕ}	
YPRED (I + 2)	J_{ϕ}	
YPRED (I + 3)	M_{ϕ}	
YPRED (I + 4)	U	
YPRED (I + 5)	V	
YPRED (I + 6)	W	
YPRED (I + 7)	Ω_{θ}	
YAMPT	$M_{\phi\theta}$	
YANTH	N_{θ}	
YAMTH	M_{θ}	

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
R2SQ	r_2^2
ROSQ	r_0^2
X1RO	$1/r_0$
S	s
XK12	K_{12}
XK21	K_{21}
XD12	D_{12}
XD21	D_{21}
XC11	C_{11}
XC22	C_{22}
XNSQ	n^2

Non-Linear Redefinitions (Ref. 2)

YDOT (I+2)	$*J_{\phi,\dot{\phi}}$	$\frac{d*J_{\phi}}{ds}$
YPRED (I+2)	$*J_{\phi}$	
YAJPH	J_{ϕ}	
SAVY ( )	appropriate nonlinear or plastic load terms updated from previous load increment.	


DIF 1
ENTRY
IDENTIFY K, X1, X2 FOR EACH ANALYSIS PASS
IF KGEOM = 1, 2, 5, 6, OR 7 IGEOM = 1
IF KGEOM = 3; IGEOM = 2
IF KGEOM = 4; IGEOM = 3
IF ISTTAB = 1 OR 10 OR 11 OR 12
YES
NO
THICK SET
IF IGEOM =
1
2
3
ϕ COOR EQUATIONS
CONE EQUATIONS
CYLINDER EQUATIONS
ST10 SET
IF IGEOM =
1
2
3
ϕ COOR EQUATIONS
CONE EQUATIONS
CYLINDER EQUATIONS
RETURN

```
 FOR,IS DIF1,DIF1
C ..... ROUTINE **  DIF1  ** ABACUS UPDATED 01/11/74 .....                    500000
      SUBROUTINE DIF1                                                         500010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                           500020
      INTEGER XN1,XN                                                          500030
      REAL K                                                                  500040
      DOUBLE PRECISION YPRED                                                  500050
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)               500060
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                                  500070
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH                 500080
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)        500090
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB       500100
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE       500110
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS                  500120
      COMMON LODE,ICYCLE,LDISTL                                               500130
      COMMON /EQUAZN/ YPRED(72),YDOT(72),YASAVE(72),                          500140
     1                YANTH,YAMTH,YAMPT,YAJPH,                                 500150
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,               500160
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,             500170
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,         500180
     5    ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,                                      500190
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,            500200
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,             500210
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,          500220
     9                XK11,XK12,XK21,XK22,XK33,XD11,                           500230
     A                XNPHI,M,I,BETTA,ZETTA,XC16                               500240
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),          500250
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),          500260
     D              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),           500270
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)                   500280
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                              500290
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                              500300
      EQUIVALENCE (XNL(1),X1),(XNL(2),X2),(XNL(3),X3),(K,DELP)                500310
      IF (ISTTAB.NE.2) GO TO 7786                                             500320
C     THE FOLLOWING EQUATIONS ARE THE 'THICK' SET                             500330
      GO TO (151,152,153),IGEOM                                               500340
C   EQUATIONS FOR SHELLS OF REVOLUTION  ( PHI  COORDINATE )                   500350
  151 CONTINUE                                                                500360
      YAOPH      = XN*YPRED(I+6)*X1RO-YPRED(I+4)*SN1RO                        500370
      YANTH =      XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*((XN*YPRED(I+4)+     500380
     1             YPRED(I+5)*CS-YPRED(I+6)*SN)*X1RO+X1*YAOPH*SAVY(9))+K*     500390
     2             (XNUPT*XNTPH-XNTTH)+X2*(XNUPT*SAVY(11)-SAVY(10))           500400
     3             +X3*SAVY(48)                                               500410
      YAMTH      = XNUPT*YPRED(I+3)-(XD11-XNUPT**2*XD22)*X1RO*(X1RO*(XN*      500420
     1             YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)+K*           500430
     2             (XNUPT*XMTPH-XMTTH)+X2*(XNUPT*SAVY(14)-SAVY(13))           500440
     3             +X3*SAVY(49)                                               500450
      YAMPT      = (-1.0/((RO/XD33)+(SNSQ*X1RO/XK33)))*(-2.0*XN*              500460
     1             YPRED(I+7)+YPRED(I+4)*(CS1R1-CN1RO)+XN*YPRED(I+5)*         500470
     2             (SN1RO+X1R1)+2.0*XN*YPRED(I+6)*CS1RO+YPRED(I)*SN/          500480
     3             XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*RO/XD33)+SN*X1*         500490
     4             (YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))                        500500
     5             +X3*SAVY(50)                                               500510
      YANPT      = YPRED(I)+YAMPT*SN1RO                                       500520
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)      500530
     1             *SAVY(5)-YPRED(I+7)*SAVY(6))                               500540
      YDOT(I+4)  = R1*(YPRED(I+4)*CS1RO+XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+     500550
     1             X2*SAVY(12)/XK33+YAMPT*SN1RO/XK33)+R1*X1*(YAOPH*           500560
     2             SAVY(5)+YPRED(I+7)*SAVY(9))                                500570
     3             +X3*SAVY(51)                                               500580
      YDOT(I+5)  = R1*(YPRED(I+6)*X1R1+(1.0/(XK22-XNUTP**2*XK11))*             500590
     1             (YPRED(I+1)-XNUTP*YANTH+K*(XNTPH-XNUTP*XNTTH)+X2*          500600
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     2              (SAVY(11)-XNUTP*SAVY(10))))-R1*YPRED(I+7)*X1*SAVY(5)     500610
     3              +X3*SAVY(52)                                             500620
      A =           YPRED(I+5)*CS1RO-YPRED(I+6)*SN1RO+SAVY(9)*YAOPH+         500630
     1              YDOT(I+5)/R1-YPRED(I+6)/R1+SAVY(5)*YPRED(I+7)            500640
      B =           SAVY(1)*CS1RO-SAVY(3)*SN1RO+.5*(SAVY(9)*SAVY(9)          500650
     1              +SAVY(5)*SAVY(5))+(SAVY(2)-SAVY(3))/R1                   500660
      YDOT(I)    = R1*(-2.0*YPRED(I)*CS1RO+XN*YANTH*X1RO-XN*YAMTH*SN*       500670
     1              X1ROSQ-YAMPT*CS1RO*(X1R1-SN1RO))-R1*K*(XFTHLD+XMPHLD*    500680
     2              SN1RO)-R1*X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)   500690
     3              /R1+SAVY(4)*K*XFPHLD/R1+SAVY(26)*YAOPH+SAVY(9)*K*        500700
     4              XFZELD+SN/RO*(YANTH*SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*    500710
     5              SAVY(8)-YANPT*SAVY(5)))-X3*SAVY(33)                      500720
      YDOT(I+1) = R1*(CS1RO*(YANTH-YPRED(I+1))-XN*X1RO*(YPRED(I)+            500730
     1              YAMPT*(SN*X1RO+X1R1))+YPRED(I+2)*X1R1)-R1*K*XFPHLD       500740
     2              -R1*X1*(SAVY(25)*A+K*XFPHLD*B                            500750
     3              -SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                   500760
     4              -X3*SAVY(34)                                             500770
      YDOT(I+2) = R1*(-YPRED(I+2)*CS1RO-YANTH*SN1RO-YPRED(I+1)*X1R1          500780
     1              +XNSQ*YAMTH*X1ROSQ-2.0*XN*YAMPT*CS*X1ROSQ)+R1*K*         500790
     2              (XN*XMPHLD*X1RO-XFZELD)-R1*X1*(SAVY(26)*A+K*XFZELD*      500800
     3              B-SAVY(24)*YAOPH-SAVY(9)*K*                              500810
     4              XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)             500820
     5              -X3*SAVY(35)                                             500830
      YDOT(I+3) = R1*(YAMTH*CS1RO-YPRED(I+3)*CS1RO-2.0*XN*YAMPT*X1RO+        500840
     1              YAJPH+K*XMTHLD)                                          500850
     2              +X3*SAVY(36)                                             500860
      YDOT(I+6) = R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                            500870
      YDOT(I+7) = R1*(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*          500880
     1              YAMTH-K*(XMTPH-XNUTP*XMTTH)-X2*(SAVY(14)-XNUTP*          500890
     2              SAVY(13)))                                               500900
     3              +X3*SAVY(53)                                             500910
      GOTO 9005                                                              500920
C     EQUATIONS FOR CONE                                                     500930
  152 CONTINUE                                                               500940
      YAOPH      = XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TAN/S                    500950
      YANTH =      XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*((X1CS/S)*(XN*       500960
     1              YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*        500970
     2              SAVY(9))+K*(XNUPT*XNTPH-XNTTH)+X2*(XNUPT*SAVY(11)-       500980
     3              SAVY(10))                                                500990
     4              +X3*SAVY(48)                                             501000
      YAMTH=XNUPT*YPRED(I+3)-(1.0/S)*X1CS*(XD11-XNUPT**2*XD22)*((1.0/S)*     501010
     1       X1CS*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)-         501020
     2              K*(XMTTH-XNUPT*XMTPH)                                    501030
     3              +X2*(XNUPT*SAVY(14)-SAVY(13))                            501040
     4              +X3*SAVY(49)                                             501050
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-       501060
     1       YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED    501070
     2              (I)*SN/XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*S*CS/XD33)     501080
     3              +SN*X1*(YAOPH*                                           501090
     4              SAVY(5)+SAVY(9)*YPRED(I+7)))                             501100
     5              +X3*SAVY(50)                                             501110
      YANPT      = YPRED(I)+YAMPT*TAN/S                                     501120
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)*     501130
     1              SAVY(5)-YPRED(I+7)*SAVY(6))                              501140
      YDOT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)        501150
     1              +YPRED(I)/XK33+X2*SAVY(12)/XK33+X1*(YAOPH*SAVY(5)        501160
     2              +YPRED(I+7)*SAVY(9))                                     501170
     3              +X3*SAVY(51)                                             501180
      YDOT(I+5) = (1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+        501190
     1              K*(XNTPH-XNUTP*XNTTH)+X2*(SAVY(11)-XNUTP*SAVY(10)))      501200
     2              -YPRED(I+7)*X1*SAVY(5)                                   501210
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     3             +X3*SAVY(52)                                                  501220
      A =          YPRED(I+5)/S-YPRED(I+6)*TN/S+SAVY(9)*YAOPH+YDOT(I+5)          501230
     1             +SAVY(5)*YPRED(I+7)                                           501240
      B =          SAVY(1)/S-SAVY(3)*TN/S+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*          501250
     1             SAVY(5))+SAVY(2)                                              501260
      YDOT(I)   =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2        501270
     1             +YAMPT*TAN/S**2-K*(XFTHLD+XMPHLD*TAN/S)-X1*(SAVY(24)*         501280
     2             A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*K*XFPHLD+             501290
     3             SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+TAN/S*(YANTH*SAVY(9)+         501300
     4             YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*SAVY(5)))-X3*          501310
     5             SAVY(33)                                                      501320
      YDOT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/          501330
     1             (S*S*CS*CS)-K*XFPHLD-X1*(SAVY(25)*A+K*XFPHLD*B-               501340
     2             SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                         501350
     3             -X3*SAVY(34)                                                  501360
      YDOT(I+2) = -YPRED(I+2)/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)              501370
     1             -2.0*XN*YAMPT/(S**2*CS)+K*(XN*XMPHLD*X1CS/S-XFZELD)           501380
     2             -X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-SAVY(9)*K*          501390
     3             XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)                  501400
     4             -X3*SAVY(35)                                                  501410
      YDOT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD          501420
     1             *K                                                            501430
     2             +X3*SAVY(36)                                                  501440
      YDOT(I+6)=YPRED(I+7)                                                       501450
      YDOT(I+7)=(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-             501460
     1             K*(XMTPH-XNUTP*XMTTH)-X2*(SAVY(14)-XNUTP*SAVY(13)))           501470
     2             +X3*SAVY(53)                                                  501480
      GO TO 9005                                                                 501490
C     EQUATIONS FOR CYLINDER                                                     501500
  153 CONTINUE                                                                   501510
      YAOPH      = X1RO*(XN*YPRED(I+6)-YPRED(I+4))                               501520
      YANTH =      XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*((X1RO*(XN*             501530
     1             YPRED(I+4)-YPRED(I+6)))+X1*YAOPH*SAVY(9))+K*(XNUPT*           501540
     2             XNTPH-XNTTH)+X2*(XNUPT*SAVY(11)-SAVY(10))                     501550
     3             +X3*SAVY(48)                                                  501560
      YAMTH=XNUPT*YPRED(I+3)-(X1RO*(XD11-XNUPT**2*XD22))*(X1RO*(XN*YPRED         501570
     1             (I+4)-XNSQ*YPRED(I+6)))+K*(XNUPT*XMTPH-XMTTH)                 501580
     2             +X2*(XNUPT*SAVY(14)-SAVY(13))                                 501590
     3             +X3*SAVY(49)                                                  501600
      YAMPT=(-1.0/((RO/XD33)+(X1RO/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RO*          501610
     1             YPRED(I+5)+YPRED(I)/XK33+X2*(SAVY(12)/XK33-SAVY(15)*          501620
     2             RO/XD33)+X1*(YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))               501630
     3             +X3*SAVY(50)                                                  501640
      YANPT      = YPRED(I)+YAMPT*X1RO                                           501650
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)         501660
     1             *SAVY(5)-YPRED(I+7)*SAVY(6))                                  501670
      YDOT(I+4) = XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+X2*SAVY(12)/XK33+             501680
     1             YAMPT*X1RO/XK33+X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))         501690
     2             +X3*SAVY(51)                                                  501700
      YDOT(I+5) = (1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+            501710
     1             K*(XNTPH-XNUTP*XNTTH)+X2*(SAVY(11)-XNUTP*SAVY(10)))-          501720
     2             YPRED(I+7)*X1*SAVY(5)                                         501730
     3             +X3*SAVY(52)                                                  501740
      A =          -YPRED(I+6)/RO+SAVY(9)*YAOPH+YDOT(I+5)+SAVY(5)*               501750
     1             YPRED(I+7)                                                    501760
      B =          -SAVY(3)/RO+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*SAVY(5))+            501770
     1             SAVY(2)                                                       501780
      YDOT(I)    = XN*YANTH*X1RO-XN*YAMTH*X1ROSQ-K*(XFTHLD+XMPHLD*X1RO)         501790
     1             -X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*        501800
     2             K*XFPHLD+SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+(YANTH*               501810
     3             SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*               501820
     4             SAVY(5))/RO)-X3*SAVY(33)                                      501830
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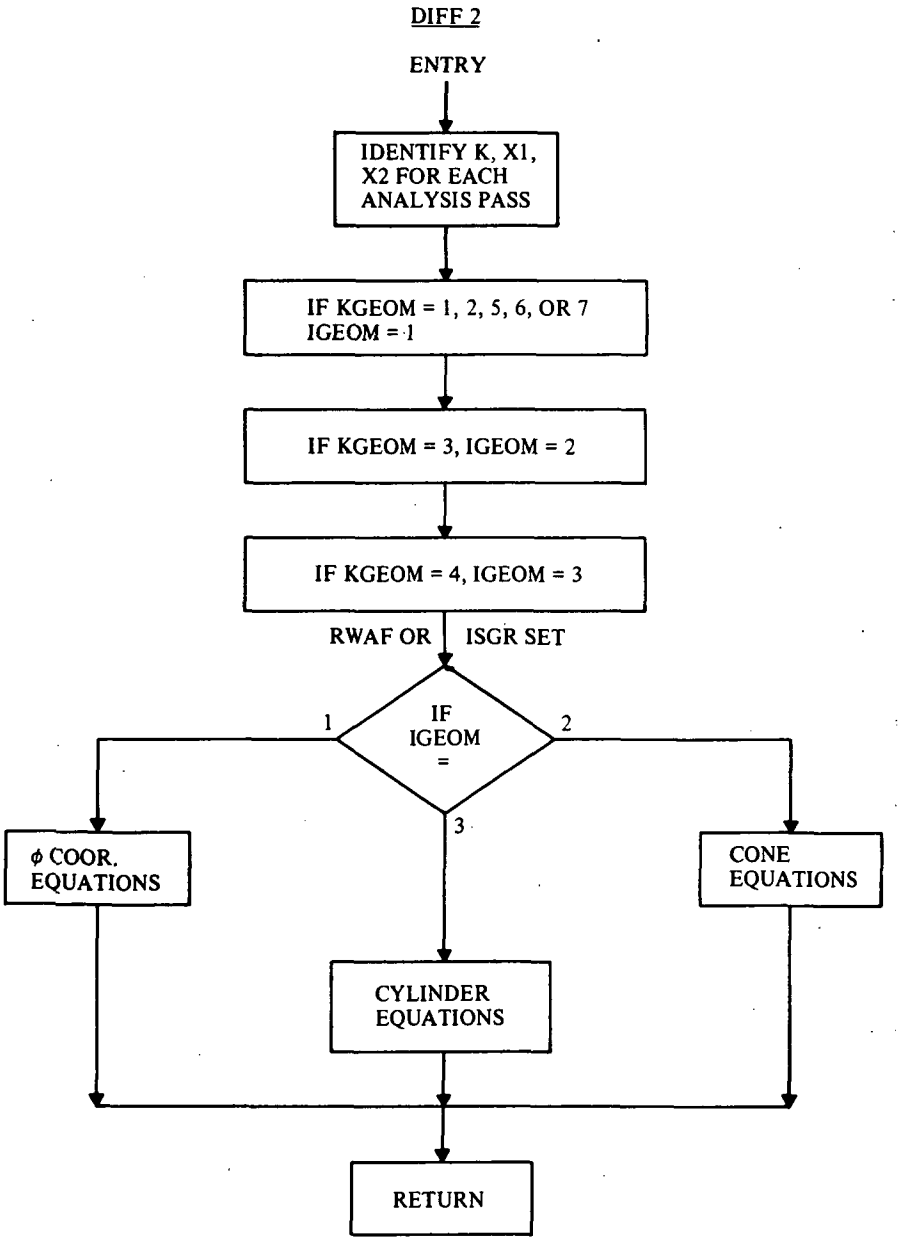
      YDOT(I+1) = -XN*X1RO*YPRED(I)-XN*YAMPT*X1ROSQ-K*XFPHLD-X1*          501840
     1            (SAVY(25)*A+K*XFPHLD*B-SAVY(26)*YPRED(I+7)-SAVY(5)*     501850
     2            K*XFZELD)                                               501860
     3            -X3*SAVY(34)                                            501870
      YDOT(I+2) = -YANTH*X1RO+XNSQ*YAMTH*X1ROSQ+K*(XN*XMPHLD*X1RO-        501880
     1            XFZELD)-X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-       501890
     2            SAVY(9)*K*XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)  501900
     3            -X3*SAVY(35)                                            501910
      YDOT(I+3) = -2.0*XN*YAMPT*X1RO+YAJPH+K*XMTHLD                       501920
     1            +X3*SAVY(36)                                            501930
      YDOT(I+6)=YPRED(I+7)                                                501940
      YDOT(I+7) = (1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH+    501950
     1            K*(XNUTP*XMTTH-XMTPH)-X2*(SAVY(14)-XNUTP*SAVY(13)))     501960
     2            +X3*SAVY(53)                                            501970
      GO TO 9005                                                          501980
 7786 GO TO (4771,4772,4773),IGEOM                                        501990
C     THE FOLLOWING EQUATIONS ARE THE 'ST10' SET                          502000
C   EQUATIONS FOR SHELLS OF REVOLUTION  ( PHI  COORDINATE )               502010
 4771 CONTINUE                                                            502020
      YAOPH     = XN*YPRED(I+6)*X1RO-YPRED(I+4)*SN1RO                     502030
      YANTH     = XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+     502040
     1            X2*SAVY(11)+(XC22/XD22)*(YPRED(I+3)+K*XMTPH+X2*         502050
     1            SAVY(14)))-K*XNTTH-X2*SAVY(10)+(X1RO*XK11-              502060
     1            XK12*XK21*X1RO*(1.0/                                    502070
     2       (XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+  502080
     3            6)*SN+X1RO*YAOPH*SAVY(9))-(XC11+XK12*XC22*XD21/XD22*    502090
     3            (1.0/(XK22+XC22**2/XD22)))*                             502100
     4       (X1RO**2*(XN*YPRED(I+4)*SN-XN**2*YPRED(I+6))+YPRED(I+7)*CS*  502110
     5       X1RO)                                                        502120
     6            +X3*SAVY(48)                                            502130
      YAMTH =     -XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+   502140
     1            X2*SAVY(11))-K*XMTTH-X2*SAVY(13)+XD12*(XK22/(XC22**2+   502150
     2            XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))+(XC11*     502160
     2         X1RO+XD12*XK21*X1RO*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED(  502170
     3            I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN+X1RO*YAOPH*SAVY(9))+   502180
     3            (XD11-XD12*XK22*XD21/(                                  502190
     4         XC22**2+XK22*XD22))*(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED   502200
     5         (I+6))+YPRED(I+7)*CS*X1RO)                                 502210
     6            +X3*SAVY(49)                                            502220
      YAMPT     = (-1.0/((RO/XD33)+(SNSQ*X1RO/XK33)))*(-2.0*XN*           502230
     1            YPRED(I+7)+YPRED(I+4)*(CS1R1-CN1RO)+XN*YPRED(I+5)*      502240
     2            (SN1RO+X1R1)+2.0*XN*YPRED(I+6)*CS1RO+YPRED(I)*SN/       502250
     3            XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*RO/XD33)+SN*X1*      502260
     4            (YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))                     502270
     5            +X3*SAVY(50)                                            502280
      YANPT     = YPRED(I)+YAMPT*SN1RO                                    502290
      YAJPH =     YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)   502300
     1            *SAVY(5)-YPRED(I+7)*SAVY(6))                            502310
      YDOT(I+4) = R1*(YPRED(I+4)*CS1RO+XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+  502320
     1            X2*SAVY(12)/XK33+YAMPT*SN1RO/XK33)+R1*X1*(YAOPH*        502330
     2            SAVY(5)+YPRED(I+7)*SAVY(9))                             502340
     3            +X3*SAVY(51)                                            502350
      YDOT(I+5) = R1*(YPRED(I+6)*X1R1-X1*YPRED(I+7)*SAVY(5)+(1.0/(XK22+   502360
     1            XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+X2*SAVY(11)+(XC22/   502370
     1            XD22)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XK21*X1RO*(XN*   502380
     2            YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)-X1*XK12*YAOPH*  502390
     2            SAVY(9)-(XC22*XD21/XD22                                 502400
     3           )*(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)  502410
     4           *CS*X1RO)))                                              502420
     5            +X3*SAVY(52)                                            502430
      A =         YPRED(I+5)*CS1RO-YPRED(I+6)*SN1RO+SAVY(9)*YAOPH+        502440
```

```
     1              YDOT(I+5)/R1-YPRED(I+6)/R1+SAVY(5)*YPRED(I+7)                    502450
      B =           SAVY(1)*CS1RO-SAVY(3)*SN1RO+.5*(SAVY(9)*SAVY(9)                  502460
     1              +SAVY(5)*SAVY(5))+(SAVY(2)-SAVY(3))/R1                           502470
      YDOT(I)    = R1*(-2.0*YPRED(I)*CS1RO+XN*YANTH*X1RO-XN*YAMTH*SN*               502480
     1              X1ROSQ-YAMPT*CS1RO*(X1R1-SN1RO))-R1*K*(XFTHLD+XMPHLD*          502490
     2              SN1RO)-R1*X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)         502500
     3              /R1+SAVY(4)*K*XFPHLD/R1+SAVY(26)*YAOPH+SAVY(9)*K*              502510
     4              XFZELD+SN/RO*(YANTH*SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*          502520
     5              SAVY(8)-YANPT*SAVY(5)))-X3*SAVY(33)                            502530
      YDOT(I+1) = R1*(CS1RO*(YANTH-YPRED(I+1))-XN*X1RO*(YPRED(I)+                  502540
     1              YAMPT*(SN*X1RO+X1R1))+YPRED(I+2)*X1R1)-R1*K*XFPHLD             502550
     2              -R1*X1*(SAVY(25)*A+K*XFPHLD*B                                  502560
     3              -SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                         502570
     4              -X3*SAVY(34)                                                   502580
      YDOT(I+2) = R1*(-YPRED(I+2)*CS1RO-YANTH*SN1RO-YPRED(I+1)*X1R1                502590
     1              +XNSQ*YAMTH*X1ROSQ-2.0*XN*YAMPT*CS*X1ROSQ)+R1*K*               502600
     2              (XN*XMPHLD*X1RO-XFZELD)-R1*X1*(SAVY(26)*A+K*XFZELD*            502610
     3              B-SAVY(24)*YAOPH-SAVY(9)*K*                                    502620
     4              XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)                   502630
     5              -X3*SAVY(35)                                                   502640
      YDOT(I+3) = R1*(YAMTH*CS1RO-YPRED(I+3)*CS1RO-2.0*XN*YAMPT*X1RO+              502650
     1              YAJPH+K*XMTHLD)                                                502660
     2              +X3*SAVY(36)                                                   502670
      YDOT(I+6) = R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                                  502680
      YDOT(I+7) = R1*((-XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+             502690
     1              X2*SAVY(11)-(XK21/RO)*(XN*YPRED(I+4)+YPRED(I+5)*CS-            502700
     1              YPRED(I+6)*SN)-X1*XK12*YAOPH*SAVY(9))+(XK22/(XC22**2+          502710
     2              XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK22*            502720
     3           XD21/(XC22**2+XK22*XD22))*(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ          502730
     4           *YPRED(I+6))+YPRED(I+7)*CS*X1RO))                                 502740
     5              +X3*SAVY(53)                                                   502750
      GO TO 9005                                                                   502760
C     EQUATIONS FOR CONE                                                         502770
 4772 CONTINUE                                                                     502780
      YAOPH      = XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TAN/S                          502790
      YANTH      = XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+            502800
     1              X2*SAVY(11)+(XC22/XD22)*(YPRED(I+3)+K*XMTPH+X2*                502810
     1              SAVY(14)))-K*XNTTH-X2*SAVY(10)+(1.0/(CS*S))                    502820
     1              *(XK11-XK12*XK21*(                                             502830
     2        1.0/(XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-              502840
     3              YPRED(I+6)*SN+X1*S*CS*YAOPH*SAVY(9))-(XC11+(XK12*XD21*         502850
     3              XC22/XD22)*(1.0/(XK22+XC22*                                    502860
     4        *2/XD22)))*((1.0/(S**2*CS**2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED          502870
     5        (I+6))+YPRED(I+7)/S)                                                 502880
     6              +X3*SAVY(48)                                                   502890
      YAMTH =       -XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+          502900
     1              X2*SAVY(11))-K*XMTTH-X2*SAVY(13)+XD12*(XK22/(XC22**2+          502910
     1              XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))+(XC11/            502920
     2         (S*CS)+XD12*XK21/(S*CS))*(XC22/(XC22**2+XK22*XD22))*(XN*            502930
     3              YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN+X1*S*CS*YAOPH*          502940
     3              SAVY(9))+(XD11-XD12*XK22*                                      502950
     4         XD21/(XC22**2+XK22*XD22))*((1.0/(S*CS)**2)*(XN*YPRED(I+4)*          502960
     5         SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S)                                   502970
     6              +X3*SAVY(49)                                                   502980
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-             502990
     1       YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED          503000
     2              (I)*SN/XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*S*CS/XD33)           503010
     3              +SN*X1*(YAOPH*                                                 503020
     4              SAVY(5)+SAVY(9)*YPRED(I+7)))                                   503030
     5              +X3*SAVY(50)                                                   503040
      YANPT      = YPRED(I)+YAMPT*TAN/S                                           503050
      YAJPH =       YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)*         503060
```

```
     1             SAVY(5)-YPRED(I+7)*SAVY(6))                                    503070
      YDOT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)              503080
     1             +YPRED(I)/XK33+X2*SAVY(12)/XK33+X1*(YAOPH*SAVY(5)              503090
     2             +YPRED(I+7)*SAVY(9))                                           503100
     3             +X3*SAVY(51)                                                   503110
      YDOT(I+5) = -X1*YPRED(I+7)*SAVY(5)+(1.0/(XK22+XC22**2/XD22))*               503120
     1            (YPRED(I+1)+K*XNTPH+X2*SAVY(11)+(XC22/XD22)*                   503130
     2            (YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK21/(S*CS))*(XN*            503140
     2            YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)-X1*XK12*YAOPH*         503150
     3            SAVY(9)-(XC22*XD21/XD22)*((1.0/(S**2*CS**                      503160
     3          2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S))            503170
     4             +X3*SAVY(52)                                                   503180
      A =          YPRED(I+5)/S-YPRED(I+6)*TN/S+SAVY(9)*YAOPH+YDOT(I+5)          503190
     1             +SAVY(5)*YPRED(I+7)                                            503200
      B =          SAVY(1)/S-SAVY(3)*TN/S+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*           503210
     1             SAVY(5))+SAVY(2)                                               503220
      YDOT(I)   =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2        503230
     1             +YAMPT*TAN/S**2-K*(XFTHLD+XMPHLD*TAN/S)-X1*(SAVY(24)*          503240
     2             A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*K*XFPHLD+              503250
     3             SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+TAN/S*(YANTH*SAVY(9)+          503260
     4             YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*SAVY(5)))-X3*           503270
     5             SAVY(33)                                                       503280
      YDOT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/           503290
     1            (S*S*CS*CS)-K*XFPHLD-X1*(SAVY(25)*A+K*XFPHLD*B-                503300
     2             SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                          503310
     3             -X3*SAVY(34)                                                   503320
      YDOT(I+2) = -YPRED(I+2)/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)              503330
     1             -2.0*XN*YAMPT/(S**2*CS)+K*(XN*XMPHLD*X1CS/S-XFZELD)            503340
     2             +X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-SAVY(9)*K*           503350
     3             XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)                   503360
     4             -X3*SAVY(35)                                                   503370
      YDOT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD           503380
     1             *K                                                             503390
     2             +X3*SAVY(36)                                                   503400
      YDOT(I+6)=YPRED(I+7)                                                       503410
      YDOT(I+7) = -(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+X2*            503420
     1             SAVY(11)-XK21*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*         503430
     1             SN)/(S*CS)-X1*XK12*YAOPH*SAVY(9))+(XK22/(XC22**2+XK22*         503440
     2             XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK22*XD21             503450
     3           /(XC22**2+XK22*XD22))*((1.0/(S*CS)**2)*(XN*YPRED(I+4)*SN         503460
     4           -XN**2*YPRED(I+6))+YPRED(I+7)/S)                                 503470
     5             +X3*SAVY(53)                                                   503480
      GO TO 9005                                                                 503490
C     EQUATIONS FOR CYLINDER                                                     503500
 4773 CONTINUE                                                                   503510
      YAOPH      = X1RO*(XN*YPRED(I+6)-YPRED(I+4))                               503520
      YANTH      = XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+           503530
     1             X2*SAVY(11)+                                                   503540
     1             (XC22/XD22)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14)))-K*XNTTH-         503550
     1             X2*SAVY(10)+(X1RO*(XK11-XK12*XK21*(1.0/(XK22+XC22**2/          503560
     2             XD22))))*(XN*YPRED(I+4)-YPRED(I+6)+X1*RO*YAOPH*                503570
     2             SAVY(9))-(XC11+(                                               503580
     3        XK12*XC22*XD21/XD22)*(1.0/(XK22+XC22**2/XD22)))*(X1RO**2*(          503590
     4        XN*YPRED(I+4)-XNSQ*YPRED(I+6)))                                    503600
     5             +X3*SAVY(48)                                                   503610
      YAMTH =    -XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+           503620
     1             X2*SAVY(11))-K*XMTTH-X2*SAVY(13)+XD12*(XK22/(XC22**2+          503630
     2             XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))+(XC11*            503640
     2         X1RO+XD12*XK21*X1RO*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED          503650
     3             (I+4)-YPRED(I+6)+X1*RO*YAOPH*SAVY(9))+(XD11-XD12*XK22*         503660
     3             XD21/(XC22**2+XK22*XD22)                                       503670
```

```
     4          )*(X1ROSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))                    503680
     5              +X3*SAVY(49)                                              503690
      YAMPT=(-1.0/((RO/XD33)+(X1RO/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RO*       503700
     1              YPRED(I+5)+YPRED(I)/XK33+X2*(SAVY(12)/XK33-SAVY(15)*      503710
     2              RO/XD33)+X1*(YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))           503720
     3              +X3*SAVY(50)                                              503730
      YANPT       = YPRED(I)+YAMPT*X1RO                                       503740
      YAJPH =       YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)     503750
     1              *SAVY(5)-YPRED(I+7)*SAVY(6))                              503760
      YDOT(I+4) = XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+X2*SAVY(12)/XK33+          503770
     1              YAMPT*X1RO/XK33+X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))     503780
     2              +X3*SAVY(51)                                              503790
      YDOT(I+5) = -X1*YPRED(I+7)*SAVY(5)+(1.0/(XK22+XC22**2/XD22))*           503800
     1              (YPRED(I+1)+K*XNTPH+X2*SAVY(11)+(XC22/XD22)*              503810
     2              (YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK21*X1RO)*(XN*         503820
     3              YPRED(I+4)-YPRED(I+6))-X1*XK12*YAOPH*SAVY(9)-(XC22*       503830
     4              XD21/XD22)*(X1ROSQ*(XN*(YPRED(I+4)-XN*YPRED(I+6)))))      503840
     5              +X3*SAVY(52)                                              503850
      A =           -YPRED(I+6)/RO+SAVY(9)*YAOPH+YDOT(I+5)+SAVY(5)*           503860
     1              YPRED(I+7)                                                503870
      B =           -SAVY(3)/RO+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*SAVY(5))+        503880
     1              SAVY(2)                                                   503890
      YDOT(I)     = XN*YANTH*X1RO-XN*YAMTH*X1ROSQ-K*(XFTHLD+XMPHLD*X1RO)      503900
     1              -X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*    503910
     2              K*XFPHLD+SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+(YANTH*          503920
     3              SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*           503930
     4              SAVY(5))/RO)-X3*SAVY(33)                                  503940
      YDOT(I+1) = -XN*X1RO*YPRED(I)-XN*YAMPT*X1ROSQ-K*XFPHLD-X1*              503950
     1              (SAVY(25)*A+K*XFPHLD*B-SAVY(26)*YPRED(I+7)-SAVY(5)*       503960
     2              K*XFZELD)                                                 503970
     3              -X3*SAVY(34)                                              503980
      YDOT(I+2) = -YANTH*X1RO+XNSQ*YAMTH*X1ROSQ+K*(XN*XMPHLD*X1RO-            503990
     1              XFZELD)-X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-         504000
     2              SAVY(9)*K*XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)    504010
     3              -X3*SAVY(35)                                              504020
      YDOT(I+3) = -2.0*XN*YAMPT*X1RO+YAJPH+K*XMTHLD                           504030
     1              +X3*SAVY(36)                                              504040
      YDOT(I+6)=YPRED(I+7)                                                    504050
      YDOT(I+7) = -(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+X2*         504060
     1              SAVY(11)-XK21*X1RO*(XN*YPRED(I+4)-YPRED(I+6))-X1*XK12*    504070
     1              YAOPH*SAVY(9))+(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+    504080
     2              K*XMTPH+X2*SAVY(14))-(XK22*XD21/(XC22**2+XK22*XD22))*(    504090
     3            X1ROSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))                     504100
     4              +X3*SAVY(53)                                              504110
 9005 CONTINUE                                                                504120
      RETURN                                                                  504130
       END                                                                    504140
```


DIFF 2
ENTRY
IDENTIFY K, X1, X2 FOR EACH ANALYSIS PASS
IF KGEOM = 1, 2, 5, 6, OR 7 IGEOM = 1
IF KGEOM = 3, IGEOM = 2
IF KGEOM = 4, IGEOM = 3
RWAF OR ISGR SET
IF IGEOM =
1
2
3
ϕ COOR. EQUATIONS
CYLINDER EQUATIONS
CONE EQUATIONS
RETURN

```
 FOR,IS DIFF2,DIFF2
C ..... ROUTINE ** DIFF2  ** ABACUS UPDATED 01/11/74 .....                    600000
      SUBROUTINE DIFF2                                                        600010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                           600020
      INTEGER XN1,XN                                                          600030
      REAL K                                                                  600040
      DOUBLE PRECISION YPRED                                                  600050
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)               600060
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                                  600070
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH                 600080
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)        600090
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB       600100
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE       600110
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS                  600120
      COMMON LODE,ICYCLE,LDISTL                                               600130
      COMMON /EQUAZN/ YPRED(72),YDOT(72),YASAVE(72),                          600140
     1                YANTH,YAMTH,YAMPT,YAJPH,                                600150
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,              600160
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,            600170
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,        600180
     5    ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,                                      600190
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,           600200
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,            600210
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,         600220
     9                XK11,XK12,XK21,XK22,XK33,XD11,                          600230
     A                XNPHI,M,I,BETTA,ZETTA,XC16                              600240
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                              600250
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),          600260
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),          600270
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),           600280
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)                   600290
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                              600300
      EQUIVALENCE (XNL(1),X1),(XNL(2),X2),(XNL(3),X3),(K,DELP)                600310
 7447 GO TO (7341,7342,7343),IGEOM                                            600320
C     THE FOLLOWING EQUATIONS ARE THE 'RWAF' SET                              600330
C     EQUATIONS FOR SHELLS OF REVOLUTION ( PHI COORDINATE )                   600340
 7341 CONTINUE                                                                600350
      YAOPH      = XN*YPRED(I+6)*X1RO-YPRED(I+4)*SN1RO                        600360
      YANTH =      (YPRED(I+1)+K*XNTPH+X2*SAVY(11))*(XC15*XC22+XD22*XK12)     600370
     1             /(XK22*XD22+XC22**2)-K*XNTTH-X2*SAVY(10)+(XK12*XC22-       600380
     1             XK22*XC15)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))/(XC22*         600390
     2             XC22+XK22*XD22)+(X1RO*(XN*YPRED(I+4)+YPRED(I+5)*CS-        600400
     2             YPRED(I+6)*SN)+X1*YAOPH*SAVY(9))*(XK11+(XC15*(XC15*        600410
     3             XK22-2.0*XK12*XC22)-XK12*XK12*                             600420
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ              600430
     5 *YPRED(I+6))+X1RO*YPRED(I+7)*CS)*(-XC11+(XC15*XC15*XC22+                 600440
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))        600450
     7             +X3*SAVY(48)                                               600460
      YAMTH=       (YPRED(I+3)+K*XMTPH+X2*SAVY(14))*(XC15*XC22+XK22*XD12)     600470
     1             /(XK22*XD22+XC22*XC22)+(YPRED(I+1)+K*XNTPH+X2*SAVY(11)     600480
     2             )*(XD22*XC15-XD12*XC22)/(XD22*XK22+XC22**2)-K*XMTTH-       600490
     3             X2*SAVY(13)+(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))     600500
     4             +X1RO*YPRED(I+7)*CS)*(XD11-(XD12*XD12*XK22+XC15*(2.0*      600510
     5             XC22*XD12-XC15*XD22))/(XC22*XC22+XK22*XD22))+(X1RO*        600520
     6             (XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*      600530
     7             SAVY(9))*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*       600540
     8             XK22+XD22*XK12))/(XC22*XC22+XK22*XD22))                    600550
     9             +X3*SAVY(49)                                               600560
      YAMPT = (1.0/(XC16*SN*X1RO-XK33-SN*X1RO*(XD33*SN/(      RO)-XC16)))     600570
     1       *((XK33*XD33-XC16**2)*X1RO*(-2.0*XN*YPRED(I+7)+YPRED(I+4)*       600580
```

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     2          (CS*X1R1-CN1RO)+XN*YPRED(I+5)*(X1R1+SN1RO)+2.0*XN*YPRED      600590
     3               (I+6)*CS*X1RO)+X1*SN*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9)  600600
     4               )+(YPRED(I)+X2*SAVY(12))*(XD33*SN*X1RO-XC16)+X2*        600610
     5               SAVY(15)*(XK33-XC16*SN/RO))                             600620
     6               +X3*SAVY(50)                                            600630
      YANPT      = YPRED(I)+YAMPT*SN1RO                                      600640
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)     600650
     1             *SAVY(5)-YPRED(I+7)*SAVY(6))                             600660
      YDOT(I+4) = R1*(YPRED(I+4)*CS*X1RO+X1*(YAOPH*SAVY(5)+YPRED(I+7)*       600670
     1             SAVY(9))                                                 600680
     1             +XN*YPRED(I+5)*X1RO+(1.0/(XK33-                          600690
     2             XC16**2/XD33))*(YPRED(I)+YAMPT*(SN*X1RO-XC16/XD33)+X2*   600700
     3             (SAVY(12)-XC16*SAVY(15)/XD33)))                          600710
     4             +X3*SAVY(51)                                             600720
      YDOT(I+5) = YPRED(I+6)-R1*X1*YPRED(I+7)*SAVY(5)+R1*(XD22*(YPRED(I+     600730
     1            1)+K*XNTPH+X2*SAVY(11))+XC22*(YPRED(I+3)+K*XMTPH+X2*      600740
     2            SAVY(14))-(X1RO*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6    600750
     2            )*SN)+X1*YAOPH*SAVY(9))*                                  600760
     3            (XK12*XD22+XC15*XC22)-(X1ROSQ*(XN*YPRED(I+4)-XNSQ*        600770
     4            YPRED(I+6))+X1RO*YPRED(I+7)*CS)*(XC22*XD12-XC15*XD22))    600780
     5            /(XK22*XD22+XC22**2)                                      600790
     6            +X3*SAVY(52)                                              600800
      A =          YPRED(I+5)*CS1RO-YPRED(I+6)*SN1RO+SAVY(9)*YAOPH+          600810
     1             YDOT(I+5)/R1-YPRED(I+6)/R1+SAVY(5)*YPRED(I+7)             600820
      B =          SAVY(1)*CS1RO-SAVY(3)*SN1RO+.5*(SAVY(9)*SAVY(9)           600830
     1             +SAVY(5)*SAVY(5))+(SAVY(2)-SAVY(3))/R1                    600840
      YDOT(I)    = R1*(-2.0*YPRED(I)*CS1RO+XN*YANTH*X1RO-XN*YAMTH*SN*       600850
     1             X1ROSQ-YAMPT*CS1RO*(X1R1-SN1RO))-R1*K*(XFTHLD+XMPHLD*     600860
     2             SN1RO)-R1*X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)    600870
     3             /R1+SAVY(4)*K*XFPHLD/R1+SAVY(26)*YAOPH+SAVY(9)*K*         600880
     4             XFZELD+SN/RO*(YANTH*SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*     600890
     5             SAVY(8)-YANPT*SAVY(5)))-X3*SAVY(33)                       600900
      YDOT(I+1) = R1*(CS1RO*(YANTH-YPRED(I+1))-XN*X1RO*(YPRED(I)+            600910
     1             YAMPT*(SN*X1RO+X1R1))+YPRED(I+2)*X1R1)-R1*K*XFPHLD        600920
     2             -R1*X1*(SAVY(25)*A+K*XFPHLD*B                             600930
     3             -SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                    600940
     4             -X3*SAVY(34)                                              600950
      YDOT(I+2) = R1*(-YPRED(I+2)*CS1RO-YANTH*SN1RO-YPRED(I+1)*X1R1          600960
     1             +XNSQ*YAMTH*X1ROSQ-2.0*XN*YAMPT*CS*X1ROSQ)+R1*K*          600970
     2             (XN*XMPHLD*X1RO-XFZELD)-R1*X1*(SAVY(26)*A+K*XFZELD*       600980
     3             B-SAVY(24)*YAOPH-SAVY(9)*K*                               600990
     4             XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)              601000
     5             -X3*SAVY(35)                                              601010
      YDOT(I+3) = R1*(YAMTH*CS1RO-YPRED(I+3)*CS1RO-2.0*XN*YAMPT*X1RO+        601020
     1             YAJPH+K*XMTHLD)                                           601030
     2             +X3*SAVY(36)                                              601040
      YDOT(I+6) = R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                            601050
      YDOT(I+7) = R1*(XK22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XC22*(YPRED(     601060
     1             I+1)+K*XNTPH+X2*SAVY(11))+(X1RO*(XN*YPRED(I+4)+           601070
     1             YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*SAVY(9))*(XK12*     601080
     2             XC22-XK22*XC15)                                           601090
     2-(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+X1RO*YPRED(I+7)*CS)*       601100
     3(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)                             601110
     3             +X3*SAVY(53)                                              601120
      GO TO 9005                                                             601130
C     EQUATIONS FOR CONE                                                     601140
 7342 CONTINUE                                                               601150
      YAOPH      = XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TAN/S                     601160
      YANTH =      (YPRED(I+1)+K*XNTPH+X2*SAVY(11))*(XC15*XC22+XD22*XK12)    601170
     1             /(XK22*XD22+XC22**2)-K*XNTTH-X2*SAVY(10)+(XK12*XC22-      601180
     1             XK22*XC15)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))/(XC22*        601190
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2              XC22+XK22*XD22)+((XN*YPRED(I+4)+YPRED(I+5)*CS-          601200
3              YPRED(I+6)*SN)/(S*CS)+X1*YAOPH*SAVY(9))*(XK11+(XC15*    601210
3              (XC15*XK22-2.0*XK12*XC22)-XK12*XK12*                    601220
4 XD22)/(XK22*XD22+XC22*XC22))+((XN*YPRED(I+4)*SN-XNSQ*                601230
5 YPRED(I+6))/(S*S*CSSQ)+YPRED(I+7)/S)*(-XC11+(XC15*XC15*XC22+         601240
6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))    601250
7              +X3*SAVY(48)                                            601260
 YAMTH =       (YPRED(I+3)+K*XMTPH+X2*SAVY(14))*(XC15*XC22+XK22*XD12)  601270
1              /(XK22*XD22+XC22**2)+(YPRED(I+1)+K*XNTPH+X2*SAVY(11))*  601280
1              (XD22*XC15-XD12*XC22)/(XD22*XK22+XC22**2)-K*XMTTH-X2*    601290
2              SAVY(13)+(1.0/(S*S*CSSQ)*(-XNSQ*YPRED(I+6)+XN*          601300
2              YPRED(I+4)*                                             601310
3 SN)+YPRED(I+7)/S)*(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*    601320
4              XD22))/(XC22*XC22+XK22*XD22))+(1.0/(S*CS)*(XN*          601330
5              YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*       601340
6              SAVY(9))*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*    601350
7              XK22+XD22*XK12))/(XC22*XC22+XK22*XD22))                 601360
8              +X3*SAVY(49)                                            601370
 YAMPT =((XC16*TAN/S-XK33-(TAN/S)*(XD33*TAN/S-XC16))**(-1))*((XK33*     601380
1       XD33-XC16**2)*(1.0/(S*CS))*(-2.0*XN*YPRED(I+7)-YPRED(I+4)*      601390
2              SN/S+XN*YPRED(I+5)*TAN/S+2.0*XN*YPRED(I+6)/S)+X1*SN*    601400
3              (YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+(YPRED(I)+X2*        601410
4              SAVY(12))*(XD33*TAN/S-XC16)+X2*SAVY(15)*(XK33-XC16*     601420
5              TN/S))                                                  601430
6              +X3*SAVY(50)                                            601440
 YANPT      = YPRED(I)+YAMPT*TAN/S                                     601450
 YAJPH =       YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)*  601460
1              SAVY(5)-YPRED(I+7)*SAVY(6))                             601470
 YDOT(I+4) = YPRED(I+4)/S+X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+XN*     601480
1              YPRED(I+5)/(S*CS)+(1.0/(XK33-XC16**2/                   601490
2              XD33))*(YPRED(I)+YAMPT*(TAN/S-XC16/XD33)+X2*(SAVY(12)-  601500
3              XC16*SAVY(15)/XD33))                                    601510
4              +X3*SAVY(51)                                            601520
 YDOT(I+5) = -X1*YPRED(I+7)*SAVY(5)+(XD22*(YPRED(I+1)+K*XNTPH+X2*       601530
1              SAVY(11))+XC22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK12*  601540
1              XD22+XC15*XC22)*((1.0/(S*CS)*(XN*YPRED(I+4)+YPRED(I+5)  601550
2              *CS-YPRED(I+6)*SN))+X1*YAOPH*SAVY(9))-(XC22*XD12-XC15*  601560
2              XD22)*((-XNSQ*                                          601570
3            YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+YPRED(I+7)/S))    601580
4            /(XK22*XD22+XC22*XC22)                                    601590
5              +X3*SAVY(52)                                            601600
 A =           YPRED(I+5)/S-YPRED(I+6)*TN/S+SAVY(9)*YAOPH+YDOT(I+5)    601610
1              +SAVY(5)*YPRED(I+7)                                     601620
 B =           SAVY(1)/S-SAVY(3)*TN/S+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*    601630
1              SAVY(5))+SAVY(2)                                        601640
 YDOT(I)   =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2    601650
1              +YAMPT*TAN/S**2-K*(XFTHLD+XMPHLD*TAN/S)-X1*(SAVY(24)*    601660
2              A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*K*XFPHLD+        601670
3              SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+TAN/S*(YANTH*SAVY(9)+    601680
4              YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*SAVY(5)))-X3*     601690
5              SAVY(33)                                                601700
 YDOT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/       601710
1              (S*S*CS*CS)-K*XFPHLD-X1*(SAVY(25)*A+K*XFPHLD*B-          601720
2              SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                   601730
3              -X3*SAVY(34)                                            601740
 YDOT(I+2) = -YPRED(I+2)/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)          601750
1              -2.0*XN*YAMPT/(S**2*CS)+K*(XN*XMPHLD*X1CS/S-XFZELD)     601760
2              +X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-SAVY(9)*K*    601770
3              XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)            601780
4              -X3*SAVY(35)                                            601790
 YDOT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD       601800
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```
     1             *K                                                        601810
     2             +X3*SAVY(36)                                              601820
      YDOT(I+6)=YPRED(I+7)                                                   601830
      YDOT(I+7) = (XK22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XC22*               601840
     1            (YPRED(I+1)+K*XNTPH+X2*SAVY(11)))+(XK12*XC22-XK22*XC15)   601850
     2            *((1.0/(S*CS)*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*    601860
     2            SN))+X1*YAOPH*SAVY(9))-(XC15*XC22+XK22*XD12)*             601870
     3          ((-XNSQ*YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+            601880
     4          YPRED(I+7)/S))/(XK22*XD22+XC22*XC22)                        601890
     5            +X3*SAVY(53)                                              601900
      GO TO 9005                                                            601910
C     EQUATIONS FOR CYLINDER                                                601920
 7343 CONTINUE                                                              601930
      YAOPH      = X1RO*(XN*YPRED(I+6)-YPRED(I+4))                         601940
      YANTH =      (YPRED(I+1)+K*XNTPH+X2*SAVY(11))*(XC15*XC22+XD22*XK12)   601950
     1            /(XK22*XD22+XC22**2)-K*XNTTH-X2*SAVY(10)+(XK12*XC22-      601960
     2            XK22*XC15)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))/(XC22*        601970
     2            XC22+XK22*XD22)+(X1RO*(XN*YPRED(I+4)-YPRED(I+6))+X1*      601980
     3            YAOPH*SAVY(9))*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-     601990
     3            XK12*XK12*                                                602000
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1ROSQ*(XN*YPRED(I+4)-XNSQ              602010
     5 *YPRED(I+6)))*(-XC11+(XC15*XC15*XC22+                                602020
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))     602030
     7            +X3*SAVY(48)                                              602040
      YAMTH =      (YPRED(I+3)+K*XMTPH+X2*SAVY(14))*(XC15*XC22+XK22*XD12)   602050
     1            /(XK22*XD22+XC22**2)+(YPRED(I+1)+K*XNTPH+X2*SAVY(11)))*   602060
     2            (XD22*XC15-XD12*XC22)/(XD22*XK22+XC22**2)-K*XMTTH-X2*     602070
     2            SAVY(13)+X1ROSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6))           602080
     3 *(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*                     602090
     4            XD22))/(XC22*XC22+XK22*XD22))+(X1RO*(XN*YPRED(I+4)-       602100
     5            YPRED(I+6))+X1*YAOPH*SAVY(9))*(XC11+(XD12*XC22*XK12-      602110
     5            XC15*(XC15*XC22+XD12*XK22+                                602120
     6 XD22*XK12))/(XC22*XC22+XK22*XD22))                                   602130
     7            +X3*SAVY(49)                                              602140
      YAMPT=(1/(XC16*X1RO-XK33-X1RO*(XD33*X1RO-XC16)))*((XK33*XD33-XC16     602150
     1            **2)*X1RO*(-2.0*XN*YPRED(I+7)+XN*X1RO*YPRED(I+5))+X1*     602160
     2            (YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+(YPRED(I)+X2*          602170
     3            SAVY(12))*(XD33*X1RO-XC16)+*2*SAVY(15)*(XK33-XC16/RO))    602180
     4            +X3*SAVY(50)                                              602190
      YANPT      = YPRED(I)+YAMPT*X1RO                                      602200
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)     602210
     1            *SAVY(5)-YPRED(I+7)*SAVY(6))                              602220
      YDOT(I+4) = X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+XN*YPRED(I+5)/RO    602230
     1            +                                                         602240
     1            (1.0/(XK33-XC16**2/XD33))*(YPRED(I)+                      602250
     2            YAMPT*(X1RO-XC16/XD33)+X2*(SAVY(12)-XC16*SAVY(15)/        602260
     3            XD33))                                                    602270
     4            +X3*SAVY(51)                                              602280
      YDOT(I+5) = -X1*YPRED(I+7)*SAVY(5)+(XD22*(YPRED(I+1)+K*XNTPH+X2*      602290
     1            SAVY(11))+XC22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(X1RO*    602300
     1            (XN*YPRED(I+4)-YPRED(I+6))+X1*YAOPH*SAVY(9))*(XK12*       602310
     2            XD22+XC15*XC22)-X1ROSQ*(XN*YPRED                          602320
     2(I+4)-XNSQ*YPRED(I+6))*(XC22*XD12-XC15*XD22))/(XK22*XD22+XC22**2)      602330
     3            +X3*SAVY(52)                                              602340
      A =          -YPRED(I+6)/RO+SAVY(9)*YAOPH+YDOT(I+5)+SAVY(5)*           602350
     1            YPRED(I+7)                                                602360
      B =          -SAVY(3)/RO+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*SAVY(5))+        602370
     1            SAVY(2)                                                   602380
      YDOT(I)    = XN*YANTH*X1RO-XN*YAMTH*X1ROSQ-K*(XFTHLD+XMPHLD*X1RO)     602390
     1            -X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*    602400
     2            K*XFPHLD+SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+(YANTH*          602410
```

```
     3              SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*          602420
     4              SAVY(5))/RO)-X3*SAVY(33)                                 602430
      YDOT(I+1) =  -XN*X1RO*YPRED(I)-XN*YAMPT*X1ROSQ-K*XFPHLD-X1*           602440
     1              (SAVY(25)*A+K*XFPHLD*B-SAVY(26)*YPRED(I+7)-SAVY(5)*      602450
     2              K*XFZELD)                                                602460
     3              -X3*SAVY(34)                                             602470
      YDOT(I+2) =  -YANTH*X1RO+XNSQ*YAMTH*X1ROSQ+K*(XN*XMPHLD*X1RO-          602480
     1              XFZELD)-X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-        602490
     2              SAVY(9)*K*XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)   602500
     3              -X3*SAVY(35)                                             602510
      YDOT(I+3) =  -2.0*XN*YAMPT*X1RO+YAJPH+K*XMTHLD                         602520
     1              +X3*SAVY(36)                                             602530
      YDOT(I+6)=YPRED(I+7)                                                   602540
      YDOT(I+7) =  (XK22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XC22*              602550
     1              (YPRED(I+1)+K*XNTPH+X2*SAVY(11))+(X1RO*(XN*YPRED(I+4)-   602560
     1              YPRED(I+6))+X1*YAOPH*SAVY(9))*(XK12*XC22-XK22*XC15)-     602570
     2              X1ROSQ*(XN*YPRED                                         602580
     2(I+4)-XNSQ*YPRED(I+6))*(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)       602590
     3              +X3*SAVY(53)                                             602600
9005 CONTINUE                                                               602610
      RETURN                                                                602620
       END                                                                  602630
```

SUBROUTINE SEGMAT

The results of the subroutine link, RIEMAN, are passed through the label common area, LYCORR, to this subroutine. SEGMAT places the elements of the YCORR array into several double-subscripted arrays, forms some coordinate transformation arrays, and calls subroutine SREVN2 for double precision matrix inversion.

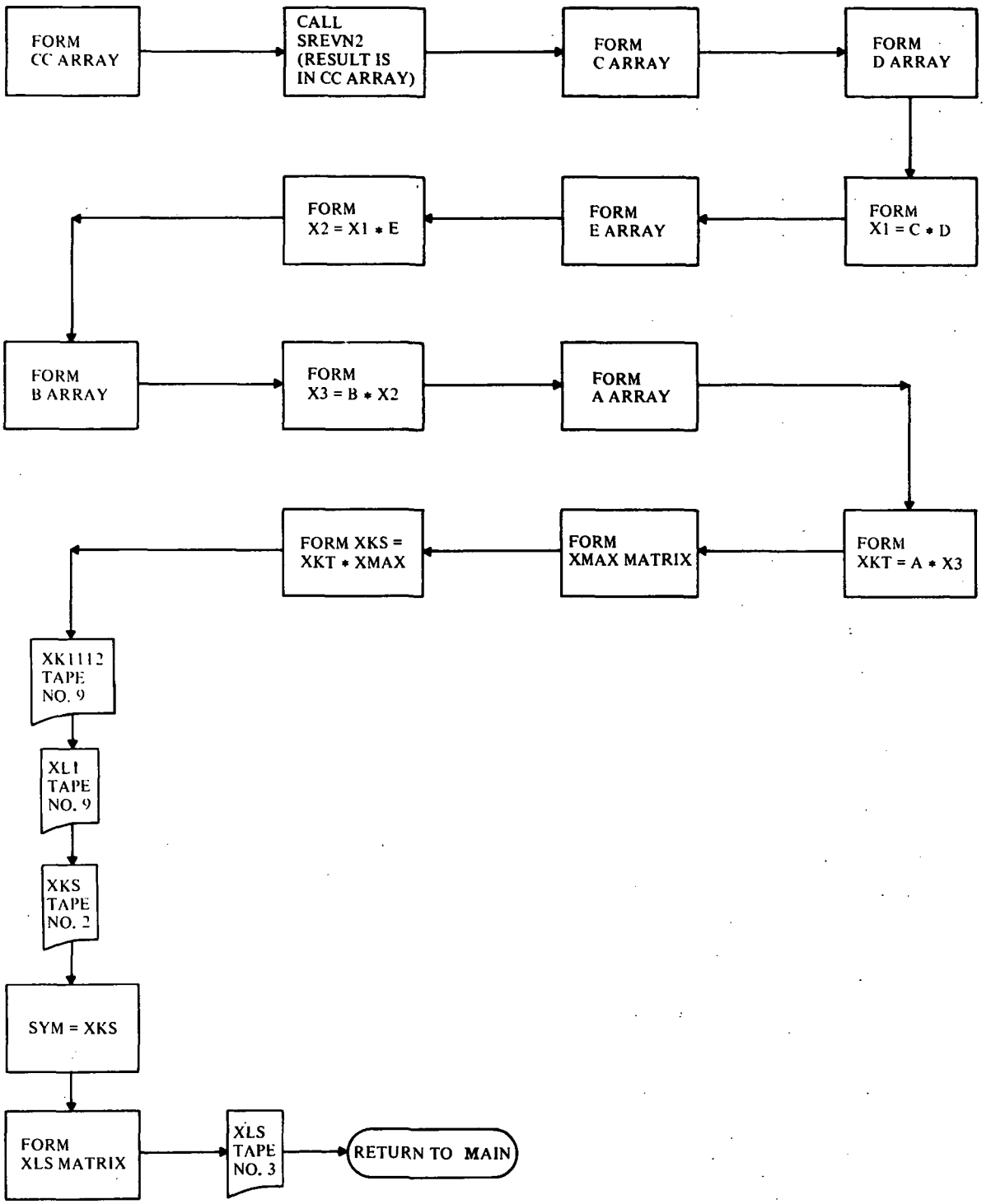
As a result of appropriate matrix operations this subroutine produces a segment stiffness matrix, the XKS array, and a segment load matrix, the XLS array, for each segment. SEGMAT also orients each segment into the global corrdinate system of the structure as a result of the matrix operations.

Subroutine SREVN2

SREVN2 is a subroutine called by SEGMAT to invert a real, double-precision, in-core matrix utilizing Gauss-Jordan elimination with partial pivoting.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
SNI	si
SNJ	sj
CSI	ci
CSJ	cj
A MATRIX	$\begin{bmatrix} IFT & 0 \\ 0 & JFT \end{bmatrix}$
B MATRIX	$\begin{bmatrix} 0 & I_4 & 0 \\ X_1 & X_2 & X_3 \end{bmatrix}$
C MATRIX	$\begin{bmatrix} I_4 & 0 & 0 \\ 0 & Y_2^{-1} & 0 \\ 0 & 0 & I_p \end{bmatrix}$
D MATRIX	$\begin{bmatrix} I_4 & 0 & 0 \\ -Y_1 & JDT^T & -Y_3 \\ 0 & 0 & I_p \end{bmatrix}$
E MATRIX	$\begin{bmatrix} IDT^T & 0 & 0 \\ 0 & I_4 & 0 \\ 0 & 0 & I_p \end{bmatrix}$
XKT MATRIX	$\begin{bmatrix} k & \ell \end{bmatrix}$
XMAX MATRIX	$\begin{bmatrix} 2\pi r_0(i) & \\ & 2\pi r_0(j) \end{bmatrix}$
XKS MATRIX	$s\left[\hat{k}\right](n)$
XLS MATRIX	$s\left[\hat{\ell}\right](n)$

SEGMAT


FORM CC ARRAY
CALL SREVN2 (RESULT IS IN CC ARRAY)
FORM C ARRAY
FORM D ARRAY
FORM X1 = C * D
FORM E ARRAY
FORM X2 = X1 * E
FORM B ARRAY
FORM X3 = B * X2
FORM A ARRAY
FORM XKT = A * X3
FORM XMAX MATRIX
FORM XKS = XKT * XMAX
XK1112 TAPE NO. 9
XL1 TAPE NO. 9
XKS TAPE NO. 2
SYM = XKS
FORM XLS MATRIX
XLS TAPE NO. 3
RETURN TO MAIN

```
FOR,IS SEGMAT,SEGMAT
      SUBROUTINE SEGMAT                                                  800010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                      800020
      INTEGER XN1,XN                                                     800030
      DOUBLE PRECISION CC,ALABEL                                         800040
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)          800050
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                             800060
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH            800070
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)   800080
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB  800090
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE  800100
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS             800110
      COMMON LODE,ICYCLE,LDISTL                                          800120
      COMMON /LYCORR/ YCORR(72)                                          800130
      DIMENSION C(9,9),CC(4,4),D(9,9),E(9,9),B(8,9),A(8,8)               800140
      DIMENSION X1(9,9),X2(9,9),X3(8,9),XKT(8,9),XMAX(8,9)               800150
      DIMENSION XKS(8,9),XLS(8,1),SYM(8,9)                               800160
      DIMENSION  DEAD(4)                                                 800170
      DIMENSION ALABEL(8)                                                800180
      EQUIVALENCE (C(1),E(1),X3(1),XMAX(1),XLS(1))                       800190
      EQUIVALENCE (X2(1),D(1),A(1),XKS(1)),(X1(1),B(1),XKT(1),SYM(1))    800200
      DATA ALABEL/8HFORCE T1,8HFORCE Z1,8HFORCE R1,8HMOMENT 1,           800210
     1            8HFORCE T2,8HFORCE Z2,8HFORCE R2,8HMOMENT 2/           800220
      IF (NH.EQ.0) WRITE(6,1726)                                         800230
1726  FORMAT(1H1)                                                        800240
      A1=G1                                                              800250
      GOTO (601,602,603),IGEOM                                           800260
 601  SNI = SIN(TIC)                                                     800270
      SNJ = SIN(STOP)                                                    800280
      CSI = COS(TIC)                                                     800290
      CSJ = COS(STOP)                                                    800300
      GOTO 1                                                             800310
 602  SNI = COS(1.570796-A1)                                             800320
      CSI = SIN(1.570796-A1)                                             800330
      IF (A1.NE.0.0) GO TO 604                                           800340
      SNI = 0.0                                                          800350
      CSI = 1.0                                                          800360
 604  SNJ = SNI                                                          800370
      CSJ = CSI                                                          800380
      GOTO 1                                                             800390
 603  SNI = 1.0                                                          800400
      SNJ = 1.0                                                          800410
      CSI = 0.0                                                          800420
      CSJ = 0.0                                                          800430
   1  JJ = 8+NPROB                                                       800440
      DO 111 J=1,JJ                                                      800450
      DO 111 I=1,JJ                                                      800460
 111  C(I,J)=0.0                                                         800470
      K=28                                                               800480
      DO 112 J=1,4                                                       800490
      K=K+8                                                              800500
      L=K                                                                800510
      DO 112 I=1,4                                                       800520
      L=L+1                                                              800530
 112  CC(I,J)=YCORR(L)                                                   800540
      CALL SREVN2 (CC,4,DEAD,4,NIX)                                      800550
      IF (NIX.NE.0) GOTO 8120                                            800560
      J1=0                                                               800570
      DO 113 J=5,8                                                       800580
      J1=J1+1                                                            800590
```

```
      II=0                                                          800600
      DO 113 I=5,8                                                  800610
      II=II+1                                                       800620
  113 C(I,J)=CC(II,J1)                                              800630
      DO 114 IJ=1,4                                                 800640
  114 C(IJ,IJ)=1.0                                                  800650
      DO 115 IJ=9,JJ                                                800660
  115 C(IJ,IJ)=1.0                                                  800670
      DO 116 J=1,JJ                                                 800680
      DO 116 I=1,JJ                                                 800690
  116 D(I,J)=0.0                                                    800700
      DO 117 IJ=1,4                                                 800710
  117 D(IJ,IJ)=1.0                                                  800720
      I=5                                                           800730
      D(I,I)=1.0                                                    800740
      D(I+1,I+1)=-SNJ                                               800750
      D(I+2,I+2)=-SNJ                                               800760
      D(I+3,I+3)=1.0                                                800770
      D(I+1,I+2)= CSJ                                               800780
      D(I+2,I+1)=-CSJ                                               800790
      DO 218 IJ=9,JJ                                                800800
  218 D(IJ,IJ)=1.0                                                  800810
      K=-4                                                          800820
      DO 118 J=1,4                                                  800830
      K=K+8                                                         800840
      L=K                                                           800850
      DO 118 I=5,8                                                  800860
      L=L+1                                                         800870
  118 D(I,J)= -YCORR(L)                                             800880
      K=60                                                          800890
      DO 119 J=9,JJ                                                 800900
      K=K+8                                                         800910
      L=K                                                           800920
      DO 119 I=5,8                                                  800930
      L=L+1                                                         800940
  119 D(I,J)=-YCORR(L)                                              800950
      DO 120 J=1,JJ                                                 800960
      DO 120 I=1,JJ                                                 800970
      X1(I,J)=0.0                                                   800980
      DO 120 M=1,JJ                                                 800990
  120 X1(I,J)=X1(I,J)+C(I,M)*D(M,J)                                 801000
      DO 121 J=1,JJ                                                 801010
      DO 121 I=1,JJ                                                 801020
  121 E(I,J)=0.0                                                    801030
      I=1                                                           801040
      E(I,I)=1.0                                                    801050
      E(I+1,I+1)=-SNI                                               801060
      E(I+2,I+2)=-SNI                                               801070
      E(I+3,I+3)=1.0                                                801080
      E(I+1,I+2)=CSI                                                801090
      E(I+2,I+1)=-CSI                                               801100
      DO 122 J=5,JJ                                                 801110
  122 E(J,J)=1.0                                                    801120
      DO 123 J=1,JJ                                                 801130
      DO 123 I=1,JJ                                                 801140
      X2(I,J)=0.0                                                   801150
      DO 123 M=1,JJ                                                 801160
  123 X2(I,J)=X2(I,J)+X1(I,M)*E(M,J)                                801170
      DO 124 J=1,JJ                                                 801180
      DO 124 I=1,8                                                  801190
  124 B(I,J)=0.0                                                    801200
```

```
      J=4                                                          801210
      DO 125  I=1,4                                                801220
      J = J+1
  125 B(I,J) = 1.0
      K = -8
      DO 126 J=1,4
      K = K+8
      L = K
      DO 126 I=5,8                                                 801290
      L=L+1                                                        801300
  126 B(I,J)=YCORR(L)                                              801310
      K = 24                                                       801320
      DO 127 J=5,8                                                 801330
      K=K+8                                                        801340
      L=K                                                          801350
      DO 127 I=5,8                                                 801360
      L=L+1                                                        801370
  127 B(I,J)=YCORR(L)                                              801380
      K=56                                                         801390
      DO 128 J=9,JJ                                                801400
      K=K+8                                                        801410
      L=K                                                          801420
      DO 128 I=5,8                                                 801430
      L=L+1                                                        801440
  128 B(I,J)=YCORR(L)                                              801450
      DO 129 J=1,JJ                                                801460
      DO 129 I=1,8                                                 801470
      X3(I,J)=0.0                                                  801480
      DO 129 M=1,JJ                                                801490
  129 X3(I,J)=X3(I,J)+B(I,M)*X2(M,J)                               801500
      DO 130 J=1,8                                                 801510
      DO 130 I=1,8                                                 801520
  130 A(I,J)=0.0                                                   801530
      I=1                                                          801540
      A(I,I)=-1.0                                                  801550
      A(I+1,I+1)=SNI                                               801560
      A(I+2,I+2)=SNI                                               801570
      A(I+1,I+2)=CSI                                               801580
      A(I+2,I+1)=-CSI                                              801590
      A(I+3,I+3)=1.0                                               801600
      I=5                                                          801610
      A(I,I)=1.0                                                   801620
      A(I+1,I+1)=-SNJ                                              801630
      A(I+2,I+2)=-SNJ                                              801640
      A(I+3,I+3)=-1.0                                              801650
      A(I+1,I+2)=-CSJ                                              801660
      A(I+2,I+1)=CSJ                                               801670
      DO 131 J=1,JJ                                                801680
      DO 131 I=1,8                                                 801690
      XKT(I,J)=0.0                                                 801700
      DO 131 M=1,8                                                 801710
  131 XKT(I,J)=XKT(I,J)+A(I,M)*X3(M,J)                             801720
      PI=3.1415927                                                 801730
      RI=RTICK                                                     801740
      X2PIRI=2.0*PI*RI                                             801750
      RJ=RESTOP                                                    801760
      X2PIRJ=2.0*PI*RJ                                             801770
      DO 132 J=1,8                                                 801780
      DO 132 I=1,8                                                 801790
  132 XMAX(I,J)=0.0                                                801800
      DO 133 I=1,4                                                 801810
```

```
133 XMAX(I,I)=X2PIRI                                                    801820
    DO 134 J=5,8                                                        801830
134 XMAX(J,J)=X2PIRJ                                                    801840
    DO 135  J=1,JJ                                                      801850
    DO 135 I=1,8                                                        801860
    XKS(I,J)=0.0                                                        801870
    DO 135 M=1,8                                                        801880
135 XKS(I,J)=XKS(I,J)+XMAX(I,M)*XKT(M,J)                                801890
    WRITE(9) ((XKT(I,J),J=1,8),I=1,4),IGEOM,G1                          801900
    WRITE(9) ((XKT(I,J),J=9,JJ),I=1,4)                                  801910
    IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 25                               801920
    WRITE(6,781)                                                        801930
781 FORMAT(//55X,22HSTIFFNESS COEFFICIENTS//14X,8HDELTA T1,7X,          801940
   1 8HDELTA Z1,7X,8HDELTA R1,7X,7HTHETA 1,8X,8HDELTA T2,7X,8HDELTA Z2  801950
   2 ,7X,8HDELTA R2,7X,7HTHETA 2)                                       801960
    III=0                                                               801970
    DO 20 M=1,8                                                         801980
    WRITE(6,23) ALABEL(M),(XKS(M,J),J=1,8)                              801990
 23 FORMAT(/1X,A8,1X,8(E14.7,1X))                                       802000
 20 CONTINUE                                                            802010
9968 FORMAT(1H ,8(E14.7,2X)/(5X,8(E14.7,2X)))                           802020
 25 CONTINUE                                                            802030
    J1=8                                                                802040
    ISEG=0                                                              802050
    NRC1=NRC-1                                                          802060
    IF(NRC1.EQ.0)GOTO 143                                               802070
    DO 244 I=1,NRC1                                                     802080
244 ISEG=ISEG+NST(I)                                                    802090
143 ISEG=ISEG+NSC                                                       802100
    SAVTIC(ISEG)=TIC                                                    802110
    WRITE(2) ((XKS(I,J),J=1,8),I=1,8)                                   802120
    DO 137 J=1,8                                                        802130
    DO 137 I=1,8                                                        802140
137 SYM(I,J)=0.0                                                        802150
    INDEC=0                                                             802160
    DO 138 I=1,8                                                        802170
    DO 138 J=1,8                                                        802180
    IF(J.NE.I)GO TO 138                                                 802190
    IF(XKS(I,J).GE.0.0)GO TO 138                                        802200
    INDEC=1                                                             802210
138 SYM(I,J)=XKS(I,J)                                                   802220
    IF(INDEC.EQ.0)GO TO 151                                             802230
    WRITE(6,152)                                                        802240
152 FORMAT(////' **********************************    WARNING - NEGATI  802250
   1VES APPEAR ON MAIN DIAGONAL. REVISE SIZING    **********'//)        802260
151 JJ=2                                                                802270
    N  = 8                                                              802280
    J  = 1                                                              802290
    DO 42  II=1,7                                                       802300
    M  = JJ                                                             802310
    DO 43  I=M,N                                                        802320
    ALPH = ABS(SYM(I,J)) - ABS(SYM(J,I))                                802330
    IF(ALPH) 47,71,48                                                   802340
 47 IF(SYM(I,J).EQ.0.0) GOTO 71                                         802350
    SYM(I,J) = SYM(J,I) / SYM(I,J)                                      802360
    GOTO 43                                                             802370
 48 IF(SYM(J,I).EQ.0.0) GOTO 71                                         802380
    SYM(I,J) = SYM(I,J) / SYM(J,I)                                      802390
    GOTO 43                                                             802400
 71 SYM(I,J) = 1.0                                                      802410
 43 SYM(J,I) = 0.0                                                      802420
```

```
      JJ = JJ +1                                                        802430
      J = J+1                                                           802440
   42 CONTINUE                                                          802450
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 145                            802460
      WRITE(6,785)                                                      802470
  785 FORMAT(//55X,22HSEGMENT SYMMETRY CHECK,)                          802480
      DO 144 I=1,8                                                      802490
  144 WRITE(6,9968)  (SYM(I,J),J=1,8)                                   802500
  145 IF (NPROB.EQ.0) GO TO 9999                                        802510
      DO 136 J=1,NPROB                                                  802520
      J1=J1+1                                                           802530
      DO 136 I=1,8                                                      802540
  136 XLS(I,J)=XKS( I,J1)                                               802550
      WRITE(3)((XLS(I,J),J=1,NPROB),I=1,8)                              802560
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 9999                           802570
      WRITE (6,782)                                                     802580
  782 FORMAT(//55X,22HSEGMENT LOAD MATRICES ,)                          802590
      DO 840 I=1,8                                                      802600
  840 WRITE(6,9968)(XLS(I,J),J=1,NPROB)                                 802610
      GOTO 9999                                                         802620
 8120 IERROR=8120                                                       802630
      NERROR=29                                                         802640
 8888 NIX=1                                                             802650
 9999 CONTINUE                                                          802660
      IF (NH.EQ.0.OR.IBEGIN.EQ.1) WRITE(6,795) RTICK,RESTOP             802670
  795 FORMAT(/' RZERO(I) =',1PE15.6,10X,'RZERO(J) =',1PE15.6)           802680
      RETURN                                                            802690
       END                                                              802700
```

```
FOR,IS SREVN2,SREVN2
      SUBROUTINE SREVN2(A,M,LOC,MID,NIX)                              900010
      DOUBLE PRECISION A(MID,1),PIVOT,TEMP1                           900020
      INTEGER LOC(1)                                                  900030
  100 N = M                                                           900040
      DO 190  K = 1,N                                                 900050
      PIVOT = 0.D0                                                    900060
      DO 120  I = K,N                                                 900070
      IF (PIVOT - DABS(A(I,K))) 110,110,120                           900080
  110 PIVOT = DABS(A(I,K))                                            900090
      L = I                                                           900100
  120 CONTINUE                                                        900110
      IF (PIVOT) 140,130,140                                          900120
  130 NIX = -1                                                        900130
      GO TO 210                                                       900140
  140 LOC(K) = L                                                      900150
      DO 150  J = 1,N                                                 900160
      TEMP1 = A(K,J)                                                  900170
      A(K,J) = A(L,J)                                                 900180
  150 A(L,J) = TEMP1                                                  900190
      TEMP1 = A(K,K)                                                  900200
      A(K,K) = 1.D0                                                   900210
      DO 160  J = 1,N                                                 900220
  160 A(K,J) = A(K,J)/TEMP1                                           900230
      DO 190  I = 1,N                                                 900240
      IF (I - K) 170,190,170                                          900250
  170 TEMP1 = -A(I,K)                                                 900260
      A(I,K) = 0.D0                                                   900270
      DO 180   J = 1,N                                                900280
  180 A(I,J) = A(I,J) + TEMP1*A(K,J)                                  900290
  190 CONTINUE                                                        900300
      DO 200  K = 1,N                                                 900310
      NK = N - K                                                      900320
      L = LOC(NK+1)                                                   900330
      DO 200  I = 1,N                                                 900340
      TEMP1 = A(I,NK+1)                                               900350
      A(I,NK+1) = A(I,L)                                              900360
  200 A(I,L) = TEMP1                                                  900370
      NIX = 0                                                         900380
  210 RETURN                                                          900390
      END                                                             900400
```

SUBROUTINE REGMAT

The segment stiffness matrices, XKS, and the segment load matrices, XLS, are passed from SEGMAT to REGMAT via Tapes #2 and #3, and are placed in the XKRTOT array and the XLRTOT array, respectively. If kinematic links occur between segments in the region, the XKRTOT array and the XLRTOT array are modified to represent the situation. In the case of discrete rings the routine RINGER is called and provides the necessary matrices.

A horizontal and vertical partitioning of the XKRTOT array occurs while the XLRTOT array is subjected to a horizontal partitioning only. Appropriate matrix operations are performed upon the partitions of each array, thus reducing the size of the region stiffness and load matrices and resulting in increased program capacity. The results of these manipulations are the region stiffness matrix, XKR, and the region load matrix, XLR.

Subroutines Called from REGMAT

Subroutine SYMSOC: Is the controlling routine for the solution of sparse, band-like, positive-definite, symmetric coefficient matrices.

Subroutine BANDIT: Is a routine called from SYMSOC which compacts a matrix into the special vector form required.

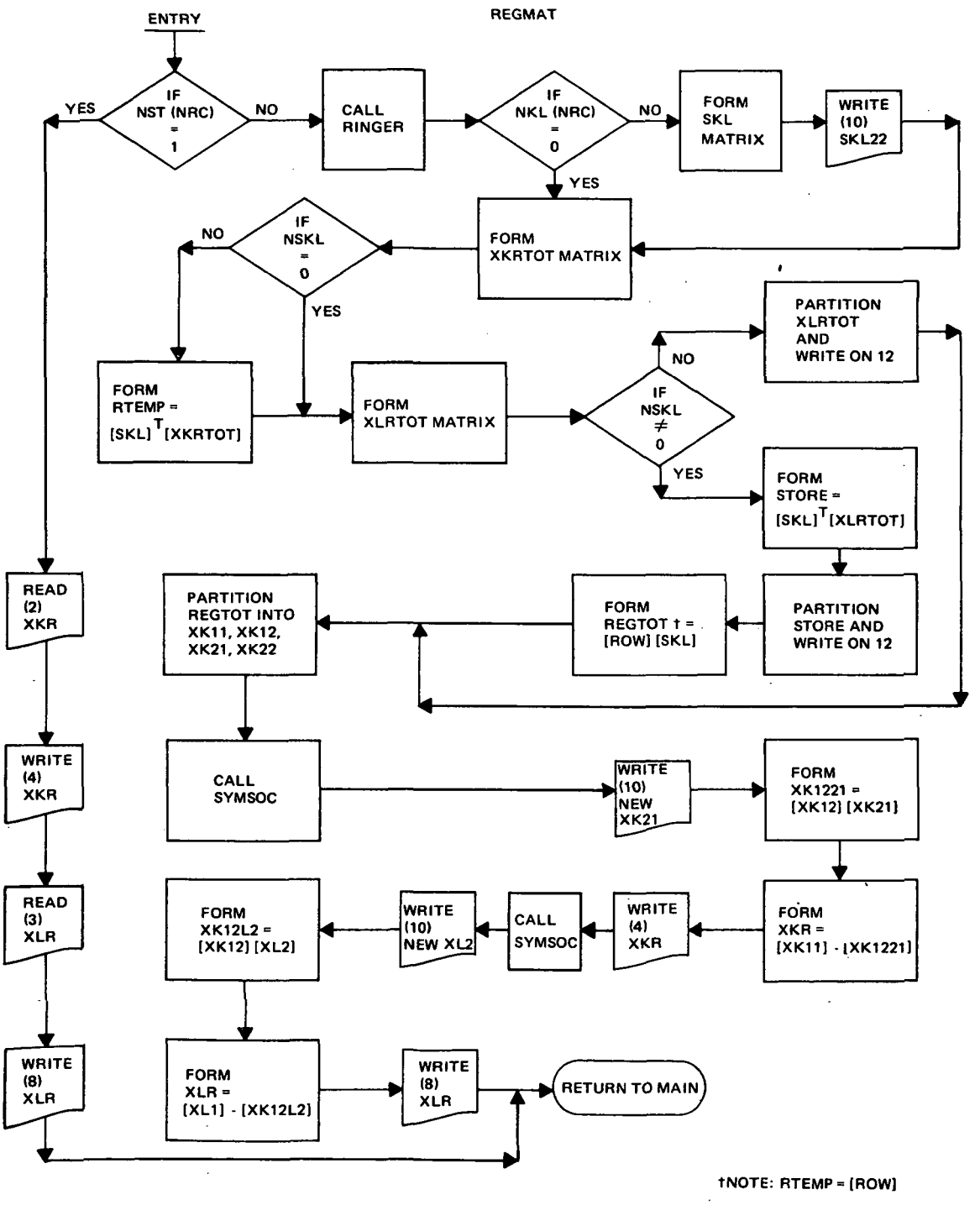
Subroutine LLTRAN: Is a routine called by SYMSOC for Cholesky factorization of sparse, band-like coefficient matrices.

Subroutine HOTDOT: (Alternate entry points PREFCE and FOREWD.) Is a small subroutine used repeatedly for efficiency in computing inner products.

Subroutine TRISLV: (Alternate entry point TRISOL.) Is a routine called by SYMSOC to carry out the solutions of sparse, bank-like, triangular coefficient matrices.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
SKL MATRIX	$[SKL]$
SKLTR MATRIX	$[SKL]^T$
XKRTOT MATRIX	$\begin{bmatrix} K'_{11} & K'_{12} \\ K'_{21} & K'_{22} \end{bmatrix}$
XLRTOT MATRIX	$\begin{bmatrix} L'_{iR1} \\ L'_{jR1} \\ L' \end{bmatrix}$
SKL22 MATRIX	$[SKL_{22}]$
REGTOT MATRIX	$\begin{bmatrix} K_{11} & K_{12} \\ K_{21} & K_{22} \end{bmatrix}$
STORE MATRIX	$\begin{bmatrix} L_{iR1} \\ L_{jR1} \\ L \end{bmatrix}$
XK11 PARTITION	$[\hat{K}_{11}]$
XK12 PARTITION	$[\hat{K}_{12}]$
XK22 PARTITION	$[\hat{K}_{22}]$
XK21 PARTITION	$[\hat{K}_{21}]$

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
XL1 PARTITION	$\left[\hat{L}_{R1}\right]$
XL2 PARTITION	$\left[\hat{L}\right]$
XKR MATRIX	$\left[\hat{K}_{R}\right]$
XLR MATRIX	$\left[\hat{L}_{R}\right]$


REGMAT
ENTRY
IF NST (NRC) = 1
YES
NO
CALL RINGER
IF NKL (NRC) = 0
NO
FORM SKL MATRIX
WRITE (10) SKL22
YES
FORM XKRTOT MATRIX
IF NSKL = 0
NO
YES
FORM RTEMP = [SKL]T [XKRTOT]
FORM XLRTOT MATRIX
IF NSKL ≠ 0
NO
YES
PARTITION XLRTOT AND WRITE ON 12
FORM STORE = [SKL]T [XLRTOT]
PARTITION STORE AND WRITE ON 12
FORM REGTOT † = [ROW] [SKL]
PARTITION REGTOT INTO XK11, XK12, XK21, XK22
READ (2) XKR
WRITE (4) XKR
CALL SYMSOC
WRITE (10) NEW XK21
FORM XK1221 = [XK12] [XK21]
READ (3) XLR
FORM XK12L2 = [XK12] [XL2]
WRITE (10) NEW XL2
CALL SYMSOC
WRITE (4) XKR
FORM XKR = [XK11] - [XK1221]
WRITE (8) XLR
FORM XLR = [XL1] - [XK12L2]
WRITE (8) XLR
RETURN TO MAIN
†NOTE: RTEMP = [ROW]

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FOR,IS REGMAT,REGMAT
      SUBROUTINE REGMAT                                                    1000010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                        1000020
      INTEGER XN1,XN                                                       1000030
      DOUBLE PRECISION ALABEL                                              1000040
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)            1000050
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                               1000060
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH              1000070
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)     1000080
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB    1000090
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE    1000100
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS               1000110
      COMMON LODE,ICYCLE,LDISTL                                            1000120
      COMMON /OPT2/ PRINT                                                  1000130
      COMMON /ARING/ NRING(28),AMAT(30,8),RSIG(12),REPS(12),RALPH(12),     1000140
     C               RBAPH(12)                                             1000150
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI,NEQ                               1000160
      DIMENSION OPEN(4,4)                                                  1000170
      DIMENSION XTEMP(8,8),SKL(120,120),SKLTR(120)                         1000180
      DIMENSION SYM(8,8)                                                   1000190
      DIMENSION XKRTOT(120,120),RTEMP(120),XLRTOT(120,2),XKEEP(8,2)        1000200
      DIMENSION STORE(120,2),ROW(120),REGTOT(120),HOLD(4,120)              1000210
      DIMENSION XK22(112,112),XK11(8,8),XK12(8,112),XK21(112,8)            1000220
      DIMENSION XK1221(8,8),XKR(8,8),LEAD(8)                               1000230
      DIMENSION XL1(8,1),XL2(112,1),XK12L2(8,1),XLR(8,1)                   1000240
      DIMENSION JDEP(112),JIND(15),ANGLE(15)                               1000250
      DIMENSION RNGTOT(4,4),RNGLOD(4,28),JTNO(28)                          1000260
      DIMENSION ALABEL(8)                                                  1000270
      EQUIVALENCE (SYM(1),XK12L2(1),XK1221(1),HOLD(1),JDEP(1))             1000280
      EQUIVALENCE (SKL(1),XKRTOT(1),XK22(1),XLRTOT(1))                     1000290
      EQUIVALENCE (XKR(1),XK11(1),XTEMP(1),XLR(1),XL1(1),XKEEP(1),         1000300
     1            RTEMP(1),ROW(1))                                         1000310
      EQUIVALENCE (SKLTR(1),REGTOT(1),OPEN(1),XK12(1))                     1000320
      EQUIVALENCE (STORE(1),XL2(1),XK21(1))                                1000330
      DATA ALABEL/8HFORCE T1,8HFORCE Z1,8HFORCE R1,8HMOMENT 1,             1000340
     1           8HFORCE T2,8HFORCE Z2,8HFORCE R2,8HMOMENT 2/              1000350
      REWIND  2                                                            1000360
      REWIND 3                                                             1000370
      D = 0.0                                                              1000380
      PRINT = 0.0                                                          1000390
      NOJ = NST(NRC) + NKL(NRC) +1                                         1000400
      NOJ4 = NOJ*4                                                         1000410
      NSKL = NKL(NRC)                                                      1000420
      NH4=4                                                                1000430
      NJTNH4=NH4*NOJ                                                       1000440
      NJINK4 = (NOJ-NSKL)*4                                                1000450
      M8=NJINK4-8                                                          1000460
      NKIV = NJINK4 - 8                                                    1000470
      IF (NST(NRC).EQ.1) GOTO 1                                            1000480
      REWIND JO                                                            1000490
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 690                               1000500
      WRITE(6,1726)                                                        1000510
1726  FORMAT(1H1)                                                          1000520
      WRITE(6,681) NRC,NOJ,NSKL                                            1000530
 681  FORMAT(////51X31HINPUT DATA FOR SEGMENT COUPLING///25X14HREGION NU   1000540
     1MBER ,I2,5X25HNUMBER OF SEGMENT JOINTS ,I3,5X,26HNUMBER OF KINEMAT  1000550
     2IC LINKS ,I3//)                                                      1000560
      WRITE(6,682)                                                         1000570
 682  FORMAT(41X,7HSEGMENT,11X,8HJOINT(I),11X,8HJOINT(J)//)                1000580
      DO 683 I=1,NSEG                                                      1000590
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      KTIC = SAVJTC(I)                                                  1000600
      KSTOP= SAVSTP(I)                                                  1000610
      WRITE(6,684) I,KTIC,KSTOP                                         1000620
  684 FORMAT(43X,2(I3,16X),I3)                                          1000630
  683 CONTINUE                                                          1000640
  690 CONTINUE                                                          1000650
      NNT = NST(NRC)                                                    1000660
      DO 350 I=1,NOJ4                                                   1000670
      DO 350 J=1,NOJ4                                                   1000680
  350 XKRTOT(I,J)=0.0                                                   1000690
  591 FORMAT (3I5,16A4)                                                 1000700
      DO 701 NS=1,NNT                                                   1000710
      READ(2) ((XTEMP(I,J),J=1,8),I=1,8)                                1000720
      J1 = SAVJTC(NS)                                                   1000730
      J2 = SAVSTP(NS)                                                   1000740
      II = 4*(J1-1)                                                     1000750
       L = II                                                           1000760
      IF (J1.GT.J2) GOTO 950                                            1000770
      DO 910  I = 1,8                                                   1000780
       JJ = L                                                           1000790
      II = II + 1                                                       1000800
      DO 910  J = 1,8                                                   1000810
      JJ = JJ + 1                                                       1000820
  910 XKRTOT(II,JJ)=XKRTOT(II,JJ)+XTEMP(I,J)                            1000830
      GOTO 701                                                          1000840
  950 JJ = 4*(J2-1)+1                                                   1000850
      II = II + 1                                                       1000860
      DO 960  JK = 1,4                                                  1000870
      GOTO (951,952,953,954) , JK                                       1000880
  951 IX = II                                                           1000890
      IND = II                                                          1000900
      DO 961 I=1,4                                                      1000910
      DO 961 J=1,4                                                      1000920
  961 OPEN(I,J) = XTEMP(I,J)                                            1000930
      GOTO 955                                                          1000940
  952 IX = II                                                           1000950
      IND = JJ                                                          1000960
      DO 962 I=1,4                                                      1000970
      DO 962 J=1,4                                                      1000980
  962 OPEN(I,J) = XTEMP(I,J+4)                                          1000990
      GOTO 955                                                          1001000
  953 IX = JJ                                                           1001010
      IND = II                                                          1001020
      DO 963 I=1,4                                                      1001030
      DO 963 J=1,4                                                      1001040
  963 OPEN(I,J) = XTEMP(I+4,J)                                          1001050
      GOTO 955                                                          1001060
  954 IX = JJ                                                           1001070
      IND = JJ                                                          1001080
      DO 964 I=1,4                                                      1001090
      DO 964 J=1,4                                                      1001100
  964 OPEN(I,J) = XTEMP(I+4,J+4)                                        1001110
  955 DO 956 I=1,4                                                      1001120
      JX = IND                                                          1001130
      DO 957 J=1,4                                                      1001140
      XKRTOT(IX,JX) = XKRTOT(IX,JX) + OPEN(I,J)                         1001150
  957 JX = JX + 1                                                       1001160
  956 IX = IX + 1                                                       1001170
  960 CONTINUE                                                          1001180
  701 CONTINUE                                                          1001190
      NRNG = NRING(NRC)                                                 1001200
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      IF (NRING(NRC).EQ.0) GO TO 210                                    1001210
      IF (Q.EQ.5) WRITE(6,300)                                          1001220
  300 FORMAT(///)                                                       1001230
      MFLG = 1                                                          1001240
      DO 211 J=1,NRNG                                                   1001250
      CALL RINGER (Q,XN,RNGTOT,RNGLOD,J,RADUS,TADUS,SAVJTC,SAVSTP,JTNO, 1001260
     1             KBC,XNL,MFLG,NSEG,ICYCLE,IBEGIN,LDISTL)              1001270
      JT = 4*(JTNO(J)-1)                                                1001280
      DO 220 I=1,4                                                      1001290
      DO 220 IK=1,4                                                     1001300
  220 XKRTOT(JT+I,JT+IK) = XKRTOT(JT+I,JT+IK)+RNGTOT(I,IK)              1001310
  211 CONTINUE                                                          1001320
      IF (Q.NE.5) GO TO 210                                             1001330
      WRITE(6,300)                                                      1001340
      READ(5,2000)                                                      1001350
  210 CONTINUE                                                          1001360
      REWIND   2                                                        1001370
      IF(NSKL.NE.0) GO TO 931                                           1001380
      DO 5504 I=1,NOJ4                                                  1001390
      WRITE(2) (XKRTOT(I,J),J=1,NOJ4)                                   1001400
 5504 CONTINUE                                                          1001410
      GO TO 101                                                         1001420
  931 CONTINUE                                                          1001430
      WRITE(JO) ((XKRTOT(I,J),J=1,NOJ4),I=1,NOJ4)                       1001440
      REWIND JO                                                         1001450
      DO 501 J=1,NJTNH4                                                 1001460
      DO 501 I=1,NJTNH4                                                 1001470
  501 SKL(I,J)=0.0                                                      1001480
      IF (NH.EQ.0) WRITE(6,685)                                         1001490
  685 FORMAT(//60X13HSEGMENT LINKS//43X8HJOINT(J)5X8HJOINT(I)5X20HANGLE 1001500
     1OF ORIENTATION//)                                                 1001510
      DO 103  NRIG = 1,NSKL                                             1001520
      IF (Q.EQ.1) GO TO 566                                             1001530
      READ(5,503) JDEP(NRIG),JIND(NRIG),ANGLE(NRIG)                     1001540
  503 FORMAT (2I2,E14.7,15A4)                                           1001550
      WRITE(1) JDEP(NRIG),JIND(NRIG),ANGLE(NRIG)                        1001560
      WRITE(6,686) JDEP(NRIG),JIND(NRIG),ANGLE(NRIG)                    1001570
  686 FORMAT(45X,I3,10X,I3,11X,E14.7)                                   1001580
      IF(JIND(NRIG).GE.JDEP(NRIG)) GO TO 8797                           1001590
      GO TO 103                                                         1001600
  566 READ(1) JDEP(NRIG),JIND(NRIG),ANGLE(NRIG)                         1001610
  103 CONTINUE                                                          1001620
      IF (Q.EQ.5) READ(5,2000)                                          1001630
 2000 FORMAT(1X)                                                        1001640
      J = -3                                                            1001650
      N = 1                                                             1001660
      DO 100  IJ = 1,NOJ                                                1001670
      I = 4*IJ-3                                                        1001680
      IF(IJ.EQ.JDEP(N)) GOTO 11                                         1001690
      J = J + 4                                                         1001700
      GOTO 12                                                           1001710
   11 JD = JDEP(N)                                                      1001720
      JI = JIND(N)                                                      1001730
      IF(N.LT.NRIG) N=N+1                                               1001740
      IF (SIN(ANGLE(N)).NE.0.0) GO TO 1829                              1001750
      SKL(I,J) = 1.0                                                    1001760
      SKL(I+1,J+3) = 0.0                                                1001770
      SKL(I+2,J+3) = 0.0                                                1001780
      GO TO 13                                                          1001790
 1829 CONTINUE                                                          1001800
      COTAN = COS(ANGLE(N))/SIN(ANGLE(N))                               1001810
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      SKL(  I,  J) = RADUS(JD)/RADUS(JI)                                1001820
      SKL(I+1,J+3) =-(RADUS(JD)-RADUS(JI))                              1001830
      SKL(I+2,J+3) =-SKL(I+1,J+3)*COTAN                                 1001840
      GOTO 13                                                           1001850
   12 SKL(  I,  J) = 1.0                                                1001860
   13 SKL(I+1,J+1) = 1.0                                                1001870
      SKL(I+2,J+2) = 1.0                                                1001880
      SKL(I+3,J+3) = 1.0                                                1001890
  100 CONTINUE                                                          1001900
 5000 FORMAT(1H ,8(E14.7,2X)/(5X,8(E14.7,2X)))                          1001910
      II = NOJ4 - 4                                                     1001920
      JJ = NJINK4 - 4                                                   1001930
      WRITE(10) ((SKL(I,J),J=5,JJ),I=5,II)                              1001940
      DO 702 J=1,NJINK4                                                 1001950
  702 WRITE(2)  (SKL(I,J),I=1,NOJ4)                                     1001960
      WRITE(2) ((SKL(I,J),J=1,NJINK4),I=1,NOJ4)                         1001970
      REWIND 2                                                          1001980
      READ(JO) ((XKRTOT(I,J),J=1,NOJ4),I=1,NOJ4)                        1001990
      REWIND JO                                                         1002000
 1000 CONTINUE                                                          1002010
      DO 740 I=1,NJINK4                                                 1002020
      READ(2) (SKLTR(J),J=1,NOJ4)                                       1002030
      DO 741 J=1,NOJ4                                                   1002040
      RTEMP  (J)=0.0                                                    1002050
      DO 741 K=1,NOJ4                                                   1002060
  741 RTEMP  (J)=RTEMP  (J)+SKLTR(K)*XKRTOT(K,J)                        1002070
      WRITE(JO) (RTEMP(J),J=1,NOJ4)                                     1002080
  740 CONTINUE                                                          1002090
      REWIND JO                                                         1002100
  101 IF (NPROB.EQ.0) GO TO 1001                                        1002110
      REWIND 2                                                          1002120
      DO 436 I=1,NOJ4                                                   1002130
      DO 436 J=1,NPROB                                                  1002140
  436 XLRTOT(I,J)=0.0                                                   1002150
      DO  971 NS = 1,NNT                                                1002160
      JTIC = SAVJTC(NS)                                                 1002170
      JSTOP= SAVSTP(NS)                                                 1002180
      READ (3) ((XKEEP(I,J),J=1,NPROB),I=1,8)                           1002190
      DO  971 N =1,2                                                    1002200
      GOTO (981,982),N                                                  1002210
  981 II = (JTIC-1)*4 + 1                                               1002220
      III= II + 3                                                       1002230
      GOTO 983                                                          1002240
  982 II = (JSTOP-1)*4 +1                                               1002250
      III= II + 3                                                       1002260
  983 DO  971 J=1,NPROB                                                 1002270
      I =0                                                              1002280
      IF (N.EQ.2) I=4                                                   1002290
      DO  971 IL = II,III                                               1002300
      I = I + 1                                                         1002310
  971 XLRTOT(IL,J)= XLRTOT(IL,J)+ XKEEP(I,J)                            1002320
      IF (NRNG.EQ.0) GO TO 230                                          1002330
      DO 225 J=1,NRNG                                                   1002340
      JT = 4*(JTNO(J)-1)                                                1002350
      DO 227 I=1,4                                                      1002360
      DO 226 IK=1,NPROB                                                 1002370
  226 XLRTOT(JT+I,IK) = XLRTOT(JT+I,IK)+RNGLOD(I,J)                     1002380
  227 CONTINUE                                                          1002390
  225 CONTINUE                                                          1002400
  230 CONTINUE                                                          1002410
      REWIND 3                                                          1002420
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      IF (NSKL.NE.0) GOTO 147                                          1002430
      DO 119 I=1,4                                                     1002440
  119 WRITE(3) (XLRTOT(I,J),J=1,NPROB)                                 1002450
      M3=NJINK4-3                                                      1002460
      DO 118 I=M3,NJINK4                                               1002470
  118 WRITE(3) (XLRTOT(I,J),J=1,NPROB)                                 1002480
      M4=NJINK4-4                                                      1002490
      DO 117 I=5,M4                                                    1002500
  117 WRITE(3) (XLRTOT(I,J),J=1,NPROB)                                 1002510
      REWIND 3                                                         1002520
      GOTO 102                                                         1002530
  147 DO 747  I=1,NJINK4                                               1002540
      READ(2) (SKLTR(J),J=1,NOJ4)                                      1002550
      DO 748  J=1,NPROB                                                1002560
      STORE(I,J)=0.0                                                   1002570
      DO 748   K=1,NOJ4                                                1002580
  748 STORE(I,J)=STORE(I,J)+SKLTR(K)*XLRTOT(K,J)                       1002590
  747 CONTINUE                                                         1002600
      DO 919 I=1,4                                                     1002610
  919 WRITE(3) (STORE(I,J),J=1,NPROB)                                  1002620
      M3=NJINK4-3                                                      1002630
      DO 918 I=M3,NJINK4                                               1002640
  918 WRITE(3) (STORE(I,J),J=1,NPROB)                                  1002650
      M4=NJINK4-4                                                      1002660
      DO 917 I=5,M4                                                    1002670
  917 WRITE(3) (STORE(I,J),J=1,NPROB)                                  1002680
      REWIND 3                                                         1002690
 1001 CONTINUE                                                         1002700
      IF (NSKL.EQ.0) GO TO 102                                         1002710
      READ(2) ((SKL(I,J),J=1,NJINK4),I=1,NOJ4)                         1002720
      REWIND 2                                                         1002730
      DO 750 I=1,NJINK4                                                1002740
      READ(JO) (ROW(J),J=1,NOJ4)                                       1002750
      DO 751 J=1,NJINK4                                                1002760
      REGTOT  (J)=0.0                                                  1002770
      DO 751 K=1,NOJ4                                                  1002780
  751 REGTOT  (J)=REGTOT  (J)  +  ROW(K)*SKL(K,J)                      1002790
  750 WRITE(2) (REGTOT(J),J=1,NJINK4)                                  1002800
C     THE 780 LOOP REARRANGES AND PARTITIONS THE REGION STIFFNESS MATRIX 1002810
  102 NJINK = NJINK4/4                                                 1002820
      REWIND 2                                                         1002830
      DO 625 INK=1,8                                                   1002840
      DO 626 JAK=1,8                                                   1002850
  626 XK11(INK,JAK)=0.0                                                1002860
      DO 625 KIX=1,M8                                                  1002870
      XK12(INK,KIX)=0.0                                                1002880
      XK21(KIX,INK)=0.0                                                1002890
  625 CONTINUE                                                         1002900
      DO 627 KIX=1,M8                                                  1002910
      DO 627 LAX=1,M8                                                  1002920
  627 XK22(KIX,LAX)=0.0                                                1002930
      NREAD=0                                                          1002940
      KOUNT=-8                                                         1002950
      NJINK3=NJINK-1                                                   1002960
      DO 780 N=1,NJINK                                                 1002970
      NREAD=NREAD+1                                                    1002980
      KOUNT=KOUNT+4                                                    1002990
      DO 781 I=1,4                                                     1003000
  781 READ(2)  (HOLD(I,J),J=1,NJINK4)                                  1003010
      IF(NREAD.LE.2.OR.NREAD.GE.NJINK3)GO TO 790                       1003020
      KK=KOUNT+1                                                       1003030
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```
      KKK=KOUNT+12                                                    1003040
      DO 785 L=KK,KKK                                                 1003050
      IROW=4*(NREAD-2)                                                1003060
      J=L-4                                                           1003070
      DO 785 K=1,4                                                    1003080
      IROW=IROW+1                                                     1003090
  785 XK22(IROW,J)=HOLD(K,L)                                          1003100
      GO TO 780                                                       1003110
  790 IF(NREAD.EQ.1)GO TO 791                                         1003120
      IF(NREAD.EQ.2)GO TO 792                                         1003130
      IF(NREAD.EQ.NJINK3)GO TO 793                                    1003140
      IF(NREAD.EQ.NJINK)GO TO 794                                     1003150
  791 DO 796 I=1,4                                                    1003160
      DO 796 J=1,4                                                    1003170
      XK11(I,J)=HOLD(I,J)                                             1003180
      JJ=J+4                                                          1003190
  796 XK12(I,J)=HOLD(I,JJ)                                            1003200
      GO TO 780                                                       1003210
  792 DO 797 I=1,4                                                    1003220
      DO 797 J=1,4                                                    1003230
      XK21(I,J)=HOLD(I,J)                                             1003240
      JJ=J+4                                                          1003250
      XK22(I,J)=HOLD(I,JJ)                                            1003260
      JJJ=J+8                                                         1003270
      IF(NNT.EQ.2)  GO TO 795                                         1003280
      XK22(I,JJ)=HOLD(I,JJJ)                                          1003290
       GO TO 797                                                      1003300
  795 XK21(I,JJ)=HOLD(I,JJJ)                                         1003310
  797 CONTINUE                                                        1003320
      GO TO 780                                                       1003330
  793 M11=NJINK4-11                                                   1003340
      M4=NJINK4-4                                                     1003350
      M8=NJINK4-8                                                     1003360
      KROW=M8-4                                                       1003370
      DO 798 I=1,4                                                    1003380
      KROW=KROW+1                                                     1003390
      KCOL=4                                                          1003400
      K8=M8-8                                                         1003410
      DO 798 J=M11,M8                                                 1003420
      K8=K8+1                                                         1003430
      XK22(KROW,K8)=HOLD(I,J)                                         1003440
      JJ=J+4                                                          1003450
      KK=K8+4                                                         1003460
      XK22(KROW,KK)  =HOLD(I,JJ)                                      1003470
      JJJ=J+8                                                         1003480
      KCOL=KCOL+1                                                     1003490
  798 XK21(KROW,KCOL)=HOLD(I,JJJ)                                     1003500
      GO TO 780                                                       1003510
  794 KEND=NJINK4-8                                                   1003520
      KROW=4                                                          1003530
      M4=NJINK4-4                                                     1003540
      M7=NJINK4-7                                                     1003550
      DO 799 I=1,4                                                    1003560
      KROW=KROW+1                                                     1003570
      K4=KEND-4                                                       1003580
      KCOL=4                                                          1003590
      DO 799 J=M7,M4                                                  1003600
      K4=K4+1                                                         1003610
      XK12(KROW,K4)=HOLD(I,J)                                         1003620
      KCOL=KCOL+1                                                     1003630
      JJ=J+4                                                          1003640
```

```
  799 XK11(KROW,KCOL)=HOLD(I,JJ)                                        1003650
  780 CONTINUE                                                          1003660
7703 NSING=NKIV*(NKIV+1)/2                                              1003670
      N=NKIV                                                            1003680
      IK=1                                                              1003690
      DO 10 K=1,N                                                       1003700
      DO 10 I=K,N                                                       1003710
      XK22(I,K)=(XK22(I,K)+ XK22(K,I))/2.                               1003720
   10 CONTINUE                                                          1003730
      DO 50 K=1,4                                                       1003740
      LEAD(K) = 1                                                       1003750
   50 LEAD(K+4) = NJINK4-11                                             1003760
      CALL SYMSOC (XK22,XK22,N,0,XK21,8,LEAD,112,0.0,NIX)               1003770
      IF (NIX.LT.0) GOTO 8841                                           1003780
      WRITE (10) ((XK21(I,J),J=1,8),I=1,M8    )                         1003790
      WRITE (10)(( SAVJTC(I), SAVSTP(I)),I=1,NNT)                       1003800
      DO 81 J=1,8                                                       1003810
      DO 81 I=1,8                                                       1003820
      XK1221(I,J)=0.0                                                   1003830
      DO 81 K=1,NKIV                                                    1003840
   81 XK1221(I,J)=XK1221(I,J)+XK12(I,K)*XK21(K,J)                       1003850
      DO 82 J=1,8                                                       1003860
      DO 82 I=1,8                                                       1003870
   82 XKR(I,J)=XK11(I,J)-XK1221(I,J)                                    1003880
      DO 650 J=1,7                                                      1003890
      K = J+1                                                           1003900
      DO 650 I=K,8                                                      1003910
      XKR(I,J) = (XKR(I,J)+XKR(J,I))/2.0                                1003920
  650 XKR(J,I) = XKR(I,J)                                               1003930
      WRITE (4) ((XKR(I,J),J=1,8),I=1,8)                                1003940
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 691                            1003950
      WRITE(6,5011)                                                     1003960
 5011 FORMAT(////55X23HREGION STIFFNESS MATRIX//14X8HDELTA T17X8HDELTA Z 1003970
     11,7X,8HDELTA R1,7X,7HTHETA 1,8X,8HDELTA T2,7X,8HDELTA Z2,7X,8HDELT 1003980
     2A R2,7X,7HTHETA 2)                                                1003990
      III=0                                                             1004000
      DO 687 M=1,8                                                      1004010
      WRITE(6,688) ALABEL(M),(XKR(M,J),J=1,8)                           1004020
  688 FORMAT(/1X,A8,1X,8(E14.7,1X))                                     1004030
  687 CONTINUE                                                          1004040
  691 CONTINUE                                                          1004050
      DO 137 J=1,8                                                      1004060
      DO 137 I=1,8                                                      1004070
  137 SYM(I,J)=0.0                                                      1004080
      INDEC=0                                                           1004090
      DO 138 I=1,8                                                      1004100
      DO 138 J=1,8                                                      1004110
      IF(J.NE.I)GO TO 138                                               1004120
      IF(XKR(I,J).GE.0.0)GO TO 138                                      1004130
      INDEC=1                                                           1004140
  138 SYM(I,J)=XKR(I,J)                                                 1004150
      IF(INDEC.EQ.0)GO TO 151                                           1004160
      WRITE(6,152)                                                      1004170
  152 FORMAT(////' ***********************************   WARNING - NEGATI 1004180
     1VES APPEAR ON MAIN DIAGONAL. REVISE SIZING   ****************'//)  1004190
  151 JJ=2                                                              1004200
      N  = 8                                                            1004210
      J  = 1                                                            1004220
      DO 42  II=1,7                                                     1004230
      M  = JJ                                                           1004240
      DO 43  I=M,N                                                      1004250
```

```
      ALPH = ABS(SYM(I,J)) - ABS(SYM(J,I))                              1004260
      IF(ALPH) 47,71,48                                                 1004270
   47 IF(SYM(I,J).EQ.0.0) GOTO 71                                       1004280
      SYM(I,J) = SYM(J,I) / SYM(I,J)                                    1004290
      GOTO 43                                                           1004300
   48 IF(SYM(J,I).EQ.0.0) GOTO 71                                       1004310
      SYM(I,J) = SYM(I,J) / SYM(J,I)                                    1004320
      GOTO 43                                                           1004330
   71 SYM(I,J) = 1.0                                                    1004340
   43 SYM(J,I) = 0.0                                                    1004350
      JJ = JJ +1                                                        1004360
      J = J+1                                                           1004370
   42 CONTINUE                                                          1004380
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 692                            1004390
      WRITE(6,157)                                                      1004400
  157 FORMAT(//56X,21HREGION SYMMETRY CHECK/)                           1004410
      DO 1730 I=1,8                                                     1004420
      WRITE(6,5000) (SYM(I,J),J=1,8)                                    1004430
 1730 CONTINUE                                                          1004440
  692 CONTINUE                                                          1004450
      IF (NPROB.EQ.0) GO TO 150                                         1004460
      DO 819 I=1,4                                                      1004470
  819 READ(3)  (XL1(I,J),J=1,NPROB)                                     1004480
      DO 818 I=5,8                                                      1004490
  818 READ(3)  (XL1(I,J),J=1,NPROB)                                     1004500
      D = 0.0                                                           1004510
      M8 = NJINK4-8                                                     1004520
      DO 817 I=1,M8                                                     1004530
  817 READ(3)  (XL2(I,J),J=1,NPROB)                                     1004540
      LEAD(1) = 1                                                       1004550
      CALL SYMSOC (XK22,XK22,M8,0,XL2,-1,LEAD,112,0.0,NIX)              1004560
      IF (NIX.LT.0) GOTO 8842                                           1004570
      WRITE (10) ((XL2(I,J),J=1,NPROB),I=1,M8    )                      1004580
      NL2=NPROB                                                         1004590
      DO 205  J=1,NPROB                                                 1004600
      DO 205  I=1,8                                                     1004610
      XK12L2(I,J)=0.0                                                   1004620
      DO 205  K=1,NKIV                                                  1004630
  205 XK12L2(I,J)=XK12L2(I,J)+XK12(I,K)*XL2(K,J)                        1004640
      DO 206  J=1,NPROB                                                 1004650
      DO 206  I=1,8                                                     1004660
  206 XLR(I,J)=XL1(I,J)-XK12L2(I,J)                                     1004670
      WRITE(8) ((XLR(I,J),J=1,NPROB),I=1,8)                             1004680
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 150                            1004690
      WRITE(6,5012)                                                     1004700
 5012 FORMAT(//57X,18HREGION LOAD MATRIX/)                              1004710
      DO 5512 I=1,8                                                     1004720
 5512 WRITE(6,5000)  (XLR(I,J),J=1,NPROB)                               1004730
      GOTO 150                                                          1004740
 8841 IERROR=8841                                                       1004750
      NERROR=30                                                         1004760
      GOTO 150                                                          1004770
 8797 IERROR = 8797                                                     1004780
      NERROR=33                                                         1004790
      GO TO 150                                                         1004800
 8842 IERROR=8842                                                       1004810
      NERROR=31                                                         1004820
      GOTO 150                                                          1004830
    1 READ (2) ((XKR(I,J),J=1,8),I=1,8)                                 1004840
      DO 651 J=1,7                                                      1004850
      K = J+1                                                           1004860
```

```
      DO 651 I=K,8                                                      1004870
      XKR(I,J) = (XKR(I,J)+XKR(J,I))/2.0                                1004880
  651 XKR(J,I) = XKR(I,J)                                               1004890
      WRITE(4) ((XKR(I,J),J=1,8),I=1,8)                                 1004900
      IF (NPROB.EQ.0) GO TO 150                                         1004910
      READ(3)  ((XLR(I,J),J=1,NPROB),I=1,8)                             1004920
      WRITE(8) ((XLR(I,J),J=1,NPROB),I=1,8)                             1004930
  150 RETURN                                                            1004940
       END                                                              1004950
```

```
 FOR,IS SYMSOC,SYMSOC
      SUBROUTINE SYMSOC (XMAT,A,M,BAND,Y,N,LEAD,MID,DET,NIX)            1100010
C                                                                       1100020
C SOLUTION OF LINEAR EQUATIONS A*X = Y, WITH POSDEF SYM BANDLIKE A, AND 1100030
C   IN-CORE Y. Y MAY BE A STANDARD DOUBLE ARRAY (ROW DIM MID) OR A COMP- 1100040
C   ACT SINGLE ARRAY (WITH MID=0). IN EITHER CASE, LEAD(K) IS THE FIRST  1100050
C   NON-ZERO ELEMENT OF THE KTH Y-VECTOR. IF MID GT 0, THE SOLUTIONS ARE 1100060
C   STACKED OVER THE RIGHT SIDES. IF MID = 0, THE ROUTINE IS PRINT-ONLY. 1100070
C                                                                       1100080
C                                                                       1100090
C SYMSOC CAN BE RE-ENTERED WITH NEW RIGHT SIDES BY SETTING N LT 0.      1100100
C                                                                       1100110
      DIMENSION A(1),Y(1),X(128),XMAT(MID,1),NUMBER(128)                1100120
      DIMENSION LEAD(1)                                                 1100130
      INTEGER BAND                                                      1100140
      NP = IABS(N)                                                      1100150
      IF (N .LT. 0) GO TO 100                                           1100160
      MM = M*(M+1)/2                                                    1100170
      CALL BANDIT (XMAT,A,M,MID,NUMBER)                                 1100180
      CALL LLTRAN(A,M,BAND,NUMBER,DET,NIX)                              1100190
      IF (MID .EQ. 0) WRITE (6,10) NIX,M,DET                            1100200
   10 FORMAT('8ERROR CODE ='I4,5X,'M ='I4,5X,'DETERMINANT ='1PE16.6)    1100210
  100 IF (NIX .LT. 0) RETURN                                            1100220
      NIX = 0                                                           1100230
      M1 = M + 1                                                        1100240
      IF (MID .EQ. 0) GO TO 110                                         1100250
      INC1 = MID + 1 - M                                                1100260
      IM = M - MID                                                      1100270
      GO TO 120                                                         1100280
  110 WRITE (6,20) N                                                    1100290
   20 FORMAT('8SOLUTIONS'9X,'N ='I5)                                    1100300
      INC1 = 1                                                          1100310
      IM = 0                                                            1100320
  120 CALL TRISLV(A,M,BAND,NUMBER,X,LEAP,1)                             1100330
      DO 170    K = 1,NP                                                1100340
          LEAP = LEAD(K)                                                1100350
          DO 130    J = 1,LEAP                                          1100360
              X(J) = 0.                                                 1100370
  130     CONTINUE                                                      1100380
          IL = IM + INC1                                                1100390
      IF (MID.GT.0) IL = IL+LEAP-1                                      1100400
          IM = MAXO(MID,M1-LEAP) + IM                                   1100410
          J = LEAP                                                      1100420
          DO 140   IJ = IL,IM                                           1100430
              X(J) = Y(IJ)                                              1100440
              J = J + 1                                                 1100450
  140     CONTINUE                                                      1100460
      CALL TRISOL (X,LEAP)
          IF (MID .EQ. 0) GO TO 160                                     1100480
          J = M                                                         1100490
          IJ = IM                                                       1100500
  150         Y(IJ) = X(J)                                              1100510
              IJ = IJ - 1                                               1100520
              J = J - 1                                                 1100530
          IF (J) 170,170,150                                            1100540
  160     WRITE (6,30) K,(X(J), J = 1,M)                                1100550
   30 FORMAT('0'I5,1P8E15.6/(6X,8E15.6))                                1100560
  170 CONTINUE                                                          1100570
      RETURN                                                            1100580
      END                                                               1100590
```

```
FOR,IS BANDIT,BANDIT
      SUBROUTINE BANDIT (XMAT,A,N,MID,NUMBER)                          1200010
      DIMENSION XMAT(MID,1),NUMBER(1),A(1)                             1200020
      K = 0                                                            1200030
      DO 10 J=1,N                                                      1200040
      DO 30 I=1,J                                                      1200050
      IF (XMAT(I,J).EQ.0.0) GO TO 30                                   1200060
      DO 20 L=I,J                                                      1200070
      K = K+1                                                          1200080
   20 A(K) = XMAT(L,J)                                                 1200090
      NUMBER(J) = J-I+1                                                1200100
      GO TO 10                                                         1200110
   30 CONTINUE                                                         1200120
      NUMBER(J) = 0                                                    1200130
   10 CONTINUE                                                         1200140
      RETURN                                                           1200150
      END                                                              1200160
```

```
 FOR,IS LLTRAN,LLTRAN
      SUBROUTINE LLTRAN(A,M,BAND,NUMBER,DET,NIX)                          1300010
CHOLESKY DECOMPOSITION OF A REAL IN-CORE POSITIVE DEFINITE MATRIX A.      1300020
C    ROUTINE ASSUMES A IS STORED IN A TRIANGULAR ARRAY BY ROWS. EACH ROW   1300030
C    STARTS WITH ITS 1ST NON-ZERO ELEMENT AND CONTINUES (WITH STORAGE OF   1300040
C    INTERIOR ZEROS) TO ITS DIAGONAL ELEMENT. FULL LOWER TRIANGLES AND     1300050
C    DIAGONAL MATRICES GIVE NO SPECIAL TROUBLE AND THE ROUTINE IS AIMED    1300060
C    PARTICULARLY AT BAND MATRICES. THE PATTERN OF STORAGE IS SHOWN BY     1300070
C    THE 6X6 MATRIX BELOW.                                                 1300080
C                                                                          1300090
C        X                                      1                          1300100
C        X X                                    2 3                        1300110
C        0 X X          STORED IN THE ORDER     * 4 5                      1300120
C        0 X 0 X                                * 6 7 8                    1300130
C        0 0 0 X X                              * * * 9 A                  1300140
C        0 X 0 X 0 X                            * B C D E F                1300150
C                                                                          1300160
C    WHERE A THROUGH F DENOTE 10 THROUGH 15.                               1300170
C                                                                          1300180
C    TO KEEP TRACK OF ZEROS, THE ROUTINE NEEDS TO BE TOLD THE NUMBER OF    1300190
C    ELEMENTS STORED IN EACH ROW. THIS INFORMATION CAN BE GIVEN EXPLICIT-  1300200
C    LY IN THE ARRAY NUMBER (SETTING BAND = 0) OR IMPLICITLY BY SETTING    1300210
C    BAND TO THE NUMBER OF (COMPLETE) DIAGONALS. WITH THE 2ND CHOICE, THE  1300220
C    ARRAY NUMBER IS NOT USED. IF A IS NOT POSITIVE DEFINITE, SOME LEAD-   1300230
C    ING PRINCIPAL MINOR WILL HAVE A DETERMINANT LE 0, AND NIX WILL BE     1300240
C    SET TO -I WHERE I IS THE FIRST SUCH MINOR. OTHERWISE L REPLACES A     1300250
C    NIX = 1 INDICATES SUCCESSFUL FACTORIZATION WITH DETERMINANT OVERFLOW   1300260
C    NIX = 0 INDICATES SUCCESSFUL FACTORIZATION AND THE DETERMINANT VALUE   1300270
C    IS MEANINGFUL UNLESS IT HAS BEEN WIPED OUT BY UNDERFLOW.              1300280
      DIMENSION A(1),NUMBER(1),S(2)                                        1300290
      EQUIVALENCE (SUM,SUN,S(1)),(SUM1,S(2))                               1300310
      INTEGER BAND                                                         1300320
      LEALEA = 0                                                           1300330
      LEAD1 = 0                                                            1300340
      IK = 0                                                               1300350
      DO 260  I = 1,M                                                      1300360
          IF (BAND) 110,100,110                                            1300370
  100     KOUNT = NUMBER(I)                                                1300380
          GO TO 120                                                        1300390
  110     KOUNT = MINO(I,BAND)                                             1300400
  120     LEAD = I - KOUNT + 1                                             1300410
          IF (LEAD - LEAD1) 130,190,140                                    1300420
  130     LAST = LEAD1                                                     1300430
          LEAD1 = LEAD + 1                                                 1300440
          LEALEA = -LEALEA                                                 1300450
          GO TO 150                                                        1300460
  140     LAST = LEAD                                                      1300470
          LEAD1 = LEAD1 + 1                                                1300480
  150     CONTINUE                                                         1300490
          DO 180  J = LEAD1,LAST                                           1300500
              IF (BAND) 170,160,170                                        1300510
  160         LEALEA = NUMBER(J) + LEALEA                                  1300520
              GO TO 180                                                    1300530
  170         LEALEA = MINO(BAND,J) + LEALEA                               1300540
  180     CONTINUE                                                         1300550
  190     LEALEA = IABS(LEALEA)                                            1300560
          KK = LEALEA                                                      1300570
      LP = 0
      LO = 1
      CALL PREFCE (LP,LO,A(IK+1),A(LEALEA),SUN,LEAST,INC,INDEX,KEY)
          K = LEAD                                                         1300590
  200     IK = IK + 1                                                      1300600
```

```
      SUM = -A(IK)                                                    1300610
      SUM1 = 0.                                                       1300620
      K = K + 1                                                       1300630
      LEAST = MAXO(1,K-INC-LEAD)                                      1300640
      IF (BAND) 220,210,220                                           1300650
210   JAZZ = NUMBER(K)                                                1300660
      GO TO 230                                                       1300670
220   JAZZ = MINO(BAND,K)                                             1300680
230   INC = JAZZ - 1                                                  1300690
   CALL HOTDOT (SUM,LEAST,INC)                                        1300700
      IF (K - I) 240,240,250                                          1300710
240   A(IK) = -SUM / A(KK)                                            1300720
      KK = KK + JAZZ                                                  1300730
      GO TO 200                                                       1300740
250   SUM = -SUM                                                      1300750
      IF (SUM .LE. 0) GO TO 280                                       1300760
      DET = DET * SUM                                                 1300770
      A(IK) = SQRT(SUM)                                               1300780
      LEAD1 = LEAD                                                    1300790
260 CONTINUE                                                          1300800
   NIX = 0                                                            1300810
270 RETURN                                                            1300820
280 NIX = -I                                                          1300830
   GO TO 270                                                          1300840
   END                                                                1300850
```

```
 FOR,IS HOTDOT,HOTDOT
       SUBROUTINE HOTDOT (S,LOW,JUMP)                                  1500010
       GO TO 250                                                       1500020
C                                                                      1500030
C      FORTRAN VERSION NEEDS JUMP POSITIVE FOR SAFETY.                 1500040
C                                                                      1500050
       ENTRY PREFCE (LAST,INC,FIX,VARY,S,LOW,JUMP,INDEX,KEY)
       DIMENSION FIX(1),VARY(1)                                        1500090
C                                                                      1500100
       INDEX = 1                                                       1500110
       KEY = 0                                                         1500120
       GO TO 99                                                        1500130
  250  CONTINUE                                                        1500140
       IF (LOW-LAST) 50,50,120                                         1500150
   50  IJ = INDEX+LOW-1                                                1500160
       IF (KEY) 200,100,99                                             1500170
  100  DO 110 J=LOW,LAST                                               1500180
       S = S+VARY(IJ)*FIX(J)                                           1500190
  110  IJ = IJ+1                                                       1500200
  120  INDEX = INDEX+JUMP                                              1500210
       LAST = LAST+INC                                                 1500220
       GO TO 99                                                        1500230
  200  T = S
       DO 210 J=LOW,LAST
       FIX(J) = FIX(J)+VARY(IJ)*T                                      1500250
  210  IJ = IJ+1                                                       1500260
       GO TO 120                                                       1500270
       ENTRY FOREWD (LAST,INC,FIX,VARY,S,LOW,JUMP,INDEX,KEY)
       INDEX = 1                                                       1500290
       KEY = -1                                                        1500300
   99  RETURN                                                          1500310
       END                                                             1500320
```

```
 FOR,IS TRISLV,TRISLV
       SUBROUTINE TRISLV(A,M,BAND,NUMBER,Y,LEAP,LOP)
C SOLUTION OF LZ = Y, FOLLOWED BY SOLUTION OF LTX = Z.  L IS A LOWER     1400020
C . TRIANGULAR MATRIX STORED BY (PARTIAL) ROWS IN THE ARRAY A. L IS AS-   1400030
C   SUMED BANDLIKE, BUT BAND = 0 MEANS THAT THE NUMBER ARRAY GIVES THE   1400040
C   NUMBER OF ELEMENTS STORED IN EACH ROW. FOR STORAGE ORDER SEE LLTRAN. 1400050
       DIMENSION A(1),Y(1),NUMBER(1),S(2)                                1400060
       EQUIVALENCE (SUM,SUN,S(1)),(SUM1,S(2))                            1400080
       INTEGER BAND                                                      1400090
       M1 = M + 1                                                        1400100
       MM1 = M - 1                                                       1400110
       RETURN                                                            1400120
       ENTRY TRISOL (Y,LEAP)
       LOW = LOP                                                         1400140
       LEAD = LEAP                                                       1400150
       LEAD1 = LEAD + 1                                                  1400160
       II = 0                                                            1400170
       DO 130   I = 1,LEAD                                               1400180
            IF (BAND) 120,110,120                                        1400190
  110       JAZZ = NUMBER(I)                                            1400200
            GO TO 130                                                    1400210
  120       JAZZ = MIN0(I,BAND)                                         1400220
  130  II = II + JAZZ                                                    1400230
       IGO = II - LEAD + 1                                               1400240
       LP = LEAD-1
       CALL PREFCE (LP,1,Y,A(IGO),SUN,LEAST,INC,INDEX,KEY)
       DO 170   I = LEAD1,M1                                             1400260
            LEAST = MAXO(LEAD,I-JAZZ)                                    1400270
            IF(BAND) 150,140,150                                         1400280
  140       JAZZ = NUMBER(I)                                            1400290
            GO TO 160                                                    1400300
  150       JAZZ = MIN0(BAND,I)                                         1400310
  160       INC = JAZZ - 1                                              1400320
            SUM = -Y(I-1)                                               1400330
            SUM1 = 0.                                                   1400340
       CALL HOTDOT (SUN,LEAST,INC)                                       1400350
            Y(I-1) = -SUM/A(II)                                         1400360
            II = II + JAZZ                                              1400370
  170  CONTINUE                                                          1400380
       II = II - JAZZ                                                    1400390
       IGO = II - MM1                                                    1400400
       CALL FOREWD (MM1,-1,Y,A(IGO),SUN,LEAST,INC,INDEX,KEY)
       I = M                                                             1400420
  180       SUM = -Y(I) / A(II)                                         1400430
            Y(I) = -SUM                                                 1400440
            IF(BAND) 200,190,200                                        1400450
  190       JAZZ = NUMBER(I)                                            1400460
            GO TO 210                                                   1400470
  200       JAZZ = MIN0(I,BAND)                                         1400480
  210       INC = 1 - JAZZ                                              1400490
            LEAST = MAXO(LOW,I+INC)                                     1400500
       CALL HOTDOT (SUN,LEAST,INC)                                       1400510
            II = II - JAZZ                                              1400520
            I = I - 1                                                   1400530
       IF (I .GE. LOW) GO TO 180                                         1400540
       RETURN                                                            1400550
       END                                                               1400560
```

SUBROUTINE RINGER

This subroutine reads the discrete ring geometric data, and temperatures, and forms the ring stiffness and thermal load matrices. These matrices are passed back to either of subroutines REGMAT or STRMAT (see next) as necessary, for incorporation into the region or structure matrices, respectively. The ring plasticity effects are calculated and the stresses and strains updated for each load increment.

The calculations in RINGER account for the eccentricity of the ring centroid from the base shell wall, and the offset of the ring centroid from the shear center.

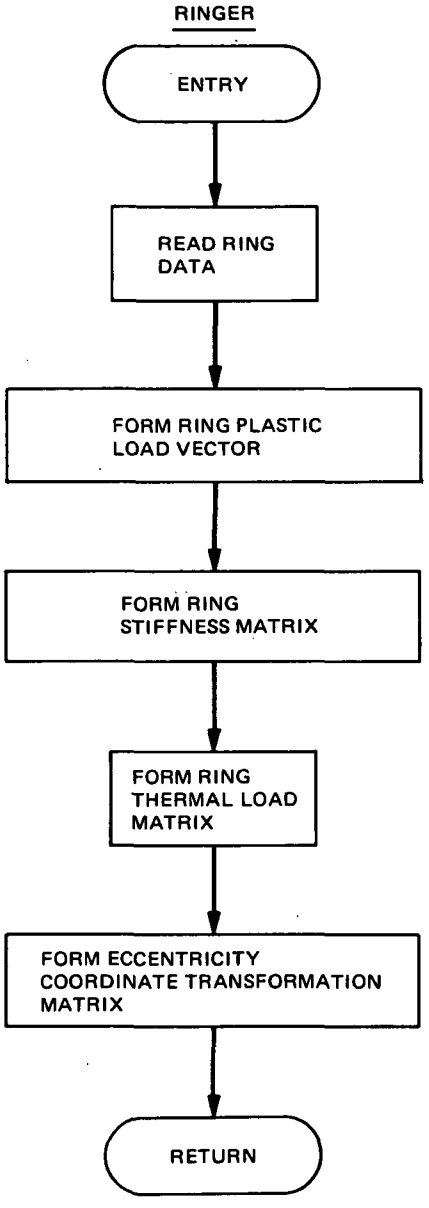
Subroutines Called from RINGER

Subroutine RITEPS: Is a routine called by RINGER to calculate the thermal strains throughout the ring.

Subroutine RISULT: Is a routine called by RINGER to calculate ring stress resultants and moments.

Subroutine RGSRSE: Is a routine called by RINGER to calculate ring elastic stresses.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
RNGTOT MATRIX	$\left[k_R\right]$
TDEL MATRIX	$\left[T_\Delta\right]$
RNGLOD MATRIX	$\left[\ell_R\right]$
RC	r_c
RS	r_s
XC	x_c
YC	y_c


RINGER
ENTRY
READ RING DATA
FORM RING PLASTIC LOAD VECTOR
FORM RING STIFFNESS MATRIX
FORM RING THERMAL LOAD MATRIX
FORM ECCENTRICITY COORDINATE TRANSFORMATION MATRIX
RETURN

```
FOR,IS RINGER,RINGER
      SUBROUTINE RINGER (Q,XN,RNGTOT,RNGLOD,J,ADUS,BADUS,JTIC,JSTOP,      2900010
     1                   JTNO,KBC,XNL,MFLG,NSEG,ICYCLE,IBEGIN,LDISTL)     2900020
      INTEGER Q,XN                                                        2900030
      COMMON /ARING/ NRING(28),AMAT(30,8),RSIG(12),REPS(12),RALPH(12),    2900040
     C               RBAPH(12)                                            2900050
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                          2900060
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI,NEO                              2900070
      COMMON /CDISP/ P,IMAX,DELP,DELP1,YEPS,ZEPS                          2900080
      DIMENSION RNGTOT(4,4),RNGLOD(4,28),TDEL(4,4),XKTOT(4,4),XL(4)       2900090
      DIMENSION ADUS(30),BADUS(30),JTIC(30),JSTOP(30),JTNO(28),XNL(3)     2900100
      DIMENSION RNGSRN(2),RGSRS(3),NPLA(12),DSIG(12),DEPS(12)             2900110
      DIMENSION RTEPS(12),TEPS(12),TEPSIN(3),ENTH(3),RGEOM(6),REPSIN(3)   2900120
      DIMENSION AWORD(9),JIPR(9),REFF(12),HARD(3),SAVR(6)                 2900130
      EQUIVALENCE (TEPSIN(1),AMN),(TEPSIN(2),BN)                          2900140
      DATA AWORD /'SREC','ZSEC','ISEC','HREC','HTRI','CRRC','CHSC',      2900150
     1            'TSEC','RASC'/                                          2900160
      DATA HARD/'ISOT','KINE','PERF'/                                     2900170
      DATA JIPR/9,9,9,12,9,12,9,6,6/                                      2900180
      X1 = XNL(1)                                                         2900190
      X3 = XNL(3)                                                         2900200
      IF (Q.EQ.1) GO TO 212                                               2900210
      READ(5,213) JTNO(J),EA,EIY,EIXY,EIX,E,WORD,PHI,SIGOX,RMOSS,RMOSN,   2900220
     1            ALPR,RC,XC,YC,XBAR,YBAR,TI,TO,ROJ,RHO,HARDEN,RGEOM      2900230
  213 FORMAT(I2,5E14.7/A4,2X,4E14.7/6E12.5/4E14.7,4X,A4/6E12.5)            2900240
      DO 11 K=1,9                                                         2900250
      IF (AWORD(K).EQ.WORD) GO TO 12                                      2900260
   11 CONTINUE                                                            2900270
   12 NTYP = K                                                            2900280
      NIPR = JIPR(NTYP)                                                   2900290
      NPLEV = 0                                                           2900300
      DO 25 K=1,3                                                         2900310
      IF (HARD(K).EQ.HARDEN) GO TO 26                                     2900320
   25 CONTINUE                                                            2900330
      NERROR = 8013                                                       2900340
      GO TO 8888                                                          2900350
   26 KOR = K                                                             2900360
      KORIR = 0                                                           2900370
      IF (KOR.GT.1) KORIR = -1                                            2900380
      IF (NEO.NE.0) GO TO 600                                             2900390
      DO 20 K=1,12                                                        2900400
      NPLA(K) = 0                                                         2900410
      RSIG(K) = 0.0                                                       2900420
      REPS(K) = 0.0                                                       2900430
      REFF(K) = SIGOX                                                     2900440
      RALPH(K) = 0.0                                                      2900450
   20 RBAPH(K) = 0.0                                                      2900460
      DO 21 K=1,2                                                         2900470
      RNGSRN(K) = 0.0                                                     2900480
      REPSIN(K) = 0.0                                                     2900490
   21 RGSRS(K) = 0.0                                                      2900500
      RGSRS(3) = 0.0                                                      2900510
      REPSIN(3) = 0.0                                                     2900520
      C = 0.0                                                             2900530
      IPRINT = 0                                                          2900540
      D = 0.0                                                             2900550
      DELR = 0.0                                                          2900560
      DO 610 K=1,6                                                        2900570
  610 SAVR(K) = 0.0                                                       2900580
      DO 240 K=1,3                                                        2900590
```

```
240 ENTH(K) = 0.0                                                       2900600
    CALL RITEPS (RTEPS,TI,TO,ALPR,NTYP,RGEOM)                           2900610
    IND = 0                                                             2900620
    CALL RISULT (TEPSIN,RTEPS,ENTH(3),NTYP,IND,RGEOM,PHI)               2900630
600 CONTINUE                                                            2900640
    WRITE(1) JTNO(J),EA,EIY,EIXY,EIX,E,NTYP,NIPR,PHI,RC,XC,YC,          2900650
   1         XBAR,YBAR,ROJ,RHO,RGEOM,ALPR                               2900660
    WRITE(6,300) JTNO(J),EA,EIY,EIXY,EIX,ALPR,E,RC,XC,YC,XBAR,YBAR,     2900670
   1             ROJ,TI,TO,RHO                                          2900680
300 FORMAT(/55X,'RING AT JOINT NO. ',I2//' EA =',1PE12.5,6X,'EIY =',    2900690
   1 1PE12.5,5X,'EIXY =',1PE12.5,4X,'EIX =',1PE12.5,5X,'ALPR =',        2900700
   2 1PE12.5,4X,'E =',1PE12.5/' RC =',1PE12.5,6X,'XC =',1PE12.5,6X,     2900710
   3 'YC =',1PE12.5,6X,'XBAR =',1PE12.5,4X,'YBAR =',1PE12.5,4X,'RO =',  2900720
   4 1PE12.5/' TI =',1PE12.5,6X,'TO =',1PE12.5,6X,'RHO =',1PE12.5)      2900730
    GO TO 211                                                           2900740
212 READ(1)  JTNO(J),EA,EIY,EIXY,EIX,E,NTYP,NIPR,PHI,RC,XC,YC,          2900750
   1         XBAR,YBAR,ROJ,RHO,RGEOM,ALPR                               2900760
211 CONTINUE                                                            2900770
    A = EA/E                                                            2900780
    ROM = RHO*OMEGA*DELP                                                2900790
    RS = RC+XC                                                          2900800
    RCS = RC*RS                                                         2900810
    RC2 = RC*RC                                                         2900820
    YC2 = YC*YC                                                         2900830
    TWOPI = 2.0*3.1415927                                               2900840
    RNGTOT(1,1) = 1.0/RCS*(EA+EIY/RC2)                                  2900850
    RNGTOT(2,1) = 0.0                                                   2900860
    RNGTOT(3,1) = 0.0                                                   2900870
    RNGTOT(4,1) = 1.0/RCS*(-EA*YC-EIY*YC/RC2-EIXY/RC)                   2900880
    RNGTOT(1,2) = 0.0                                                   2900890
    RNGTOT(2,2) = 0.0                                                   2900900
    RNGTOT(3,2) = 0.0                                                   2900910
    RNGTOT(4,2) = 0.0                                                   2900920
    RNGTOT(1,3) = 0.0                                                   2900930
    RNGTOT(2,3) = 0.0                                                   2900940
    RNGTOT(3,3) = 0.0                                                   2900950
    RNGTOT(4,3) = 0.0                                                   2900960
    RNGTOT(1,4) = RNGTOT(4,1)                                           2900970
    RNGTOT(2,4) = 0.0                                                   2900980
    RNGTOT(3,4) = 0.0                                                   2900990
    RNGTOT(4,4) = 1.0/RCS*(YC2*EA+EIY*YC+EIX+2.0*EIXY*YC/RC)            2901000
    IF (NEQ.NE.0) GO TO 50                                              2901010
    IF (Q.NE.1) GO TO 400                                               2901020
 50 READ(JOR) NPLEV,RNGSRN,RGSRS,NPLA,RSIG,REPS,RALPH,RBAPH,RTEPS,      2901030
   1          SIGOX,RMOSS,RMOSN,REFF,KORIR,AMN,BN,OENTH3,ODELR,SAVR,    2901040
   2          IPRINT                                                    2901050
    K = JTNO(J)                                                         2901060
    IF (MFLG.EQ.2) GO TO 102                                            2901070
    ENTH(1) = (AMAT(K,1)*ROJ-YBAR*(AMAT(K,3)-OENTH3))/RS                2901080
    ENTH(2)=(AMAT(K,3)-OENTH3)/RS
    ENTH(3) = AMAT(K,3)                                                 2901100
    DELR = AMAT(K,4)                                                    2901110
    GO TO 101                                                           2901120
102 ENTH(1) = (AMAT(K,5)*ROJ-YBAR*(AMAT(K,7)-OENTH3))/RS                2901130
    ENTH(2)=(AMAT(K,7)-OENTH3)/RS
    ENTH(3) = AMAT(K,7)                                                 2901150
    DELR = AMAT(K,8)                                                    2901160
101 CONTINUE                                                            2901170
    IF (ICYCLE.NE.1) GO TO 180                                          2901180
    IF (LDISTL.EQ.1) GO TO 185                                          2901190
    READ(5,215) SIGOX,RMOSS,RMOSN,TI,TO                                 2901200
```

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215 FORMAT(5E14.7)                                                      2901210
    CALL RITEPS (RTEPS,TI,TO,ALPR,NTYP,RGEOM)                           2901220
    IND = 0                                                             2901230
    CALL RISULT (TEPSIN,RTEPS,ENTH(3),NTYP,IND,RGEOM,PHI)               2901240
185 IF (DELP/ABS(DELP).EQ.DELP1/ABS(DELP1)) GO TO 180                   2901250
    DO 181 I=1,12                                                       2901260
    NPLA(I) = 0                                                         2901270
181 RBAPH(I) = RSIG(I)                                                  2901280
180 CONTINUE                                                            2901290
    DDELR = DELR-ODELR                                                  2901300
    DOMEG = ENTH(3)-OENTH3                                              2901310
    D1 = DELR-YBAR*ENTH(3)                                              2901320
    DD1 = DDELR-YBAR*DOMEG                                              2901330
    DF1 = RNGTOT(1,1)*DD1+RNGTOT(4,1)*DOMEG+SAVR(1)                     2901340
    DF2 = RNGTOT(1,4)*DD1+RNGTOT(4,4)*DOMEG+SAVR(2)                     2901350
    SAVR(5) = SAVR(5)+DF1                                               2901360
    SAVR(6) = SAVR(6)+DF2                                               2901370
    C = RNGTOT(1,1)*D1+RNGTOT(4,1)*ENTH(3)-SAVR(5)+SAVR(3)              2901380
    D = RNGTOT(1,4)*D1+RNGTOT(4,4)*ENTH(3)-SAVR(6)+SAVR(4)              2901390
    DO 483 L=1,2                                                        2901400
483 RNGSRN(L) = RNGSRN(L)+ENTH(L)                                       2901410
    DO 484 II=1,NIPR                                                    2901420
484 TEPS(II) = DELP * RTEPS(II)                                         2901430
    CALL RGSRSE (DSIG,ENTH,TEPS,E,NTYP,RGEOM,PHI)                       2901440
    IF(NPLEV .EQ.0) GO TO 540                                           2901450
    DO 500 II=1,NIPR                                                    2901460
    IF(NPLA(II) .LE.0) GO TO 496                                        2901470
    IF((RSIG(II)-RALPH(II))*DSIG(II) .LT. ZEPS) GO TO 495               2901480
    IF (RMOSN.NE.0.0) GO TO 485                                         2901490
    DEPS(II) = DSIG(II)/E                                               2901500
    REPS(II) = REPS(II) + DEPS(II)                                      2901510
    DSIG(II) = 0.0                                                      2901520
    GO TO 500                                                           2901530
485 IF (RMOSS.EQ.0.0) GO TO 490                                         2901540
    TOMP = 0.42857143*RMOSN*(ABS(RSIG(II)-RBAPH(II))/RMOSS)**(RMOSN-    2901550
   1       1.0)                                                         2901560
    DSIG(II)=DSIG(II)/(1.+TOMP)                                         2901570
    RDSIG = DSIG(II)                                                    2901580
    DEPS(II) = TOMP/E*DSIG(II)                                          2901590
    RSIG(II) = RSIG(II) + DSIG(II)                                      2901600
    REPS(II) = REPS(II) + DEPS(II)                                      2901610
    IF (KORIR.EQ.0) RDSIG = 0.0                                         2901620
    RALPH(II) = RALPH(II)+RDSIG                                         2901630
    IF (KORIR.EQ.0) REFF(II) = RSIG(II)                                 2901640
    GO TO 500                                                           2901650
490 DSIG(II) = RMOSN*DSIG(II)                                           2901660
    RDSIG = DSIG(II)                                                    2901670
    RSIG(II) = RSIG(II) + DSIG(II)                                      2901680
    DEPS(II) = DSIG(II)/E*((1.0-RMOSN)/RMOSN)                           2901690
    REPS(II) = REPS(II) + DEPS(II)                                      2901700
    IF (KORIR.EQ.0) RDSIG = 0.0                                         2901710
    RALPH(II) = RALPH(II)+RDSIG                                         2901720
    IF (KORIR.EQ.0) REFF(II) = RSIG(II)                                 2901730
    GO TO 500                                                           2901740
495 NPLA(II) = -II                                                      2901750
496 RSIG(II) = RSIG(II) + DSIG(II)                                      2901760
    DEPS(II) = 0.0                                                      2901770
    YCOND = YEPS                                                        2901780
    IF (KORIR.EQ.0) YCOND = YCOND*REFF(II)/SIGOX                        2901790
    IF (ABS((RSIG(II)-RALPH(II))/SIGOX).GE.YCOND) NPLA(II) = II         2901800
500 CONTINUE                                                            2901810
```

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507 IND = 0                                                              2901820
    CALL RISULT (REPSIN,DEPS,ENTH(3),NTYP,IND,RGEOM,PHI)                 2901830
    GO TO 550                                                            2901840
540 DO 545 II=1,NIPR                                                     2901850
    RSIG(II) = RSIG(II) + DSIG(II)                                       2901860
    IF (ABS(RSIG(II)/SIGOX).LT.YEPS) GO TO 545                           2901870
    NPLEV = 1                                                            2901880
    NPLA(II) = II                                                        2901890
545 CONTINUE                                                             2901900
    REPSIN(1) = 0.0                                                      2901910
    REPSIN(2) = 0.0                                                      2901920
550 IND = 1                                                              2901930
    CALL RISULT (RGSRS,RSIG,ENTH(3),NTYP,IND,RGEOM,PHI)                  2901940
    IF (P.EQ.2.) GO TO 620                                               2901950
    IF (IPRINT.EQ.0) GO TO 322                                           2901960
620 PP = P-1.0                                                           2901970
    IF (MFLG.EQ.2) GO TO 320                                             2901980
    WRITE(6,301) JTNO(J),PP                                              2901990
301 FORMAT(/34X,'RING AT REGION JOINT NO. ',I2,24X,'CYCLE = ',F5.0)      2902000
    GO TO 321                                                            2902010
320 WRITE(6,302) JTNO(J),PP                                              2902020
302 FORMAT(/32X,'RING AT STRUCTURE JOINT NO. ',I2,24X,'CYCLE = ',F5.0)   2902030
321 WRITE(6,303) RNGSRN,RGSRS                                            2902040
303 FORMAT(3X,'EPS THETA=',1PE12.5,4X,'K THETA=',1PE12.5,6X,'N THETA='   2902050
   1 ,1PE12.5,6X,'MR =',1PE12.5,10X,'MZ =',1PE12.5)                      2902060
    IF (NPLEV.EQ.0) GO TO 322                                            2902070
    WRITE(6,304) (RSIG(I),I=1,NIPR)                                      2902080
304 FORMAT(//' SIGMA =',7X,1P9E13.5/15X,1P3E13.5)                        2902090
    WRITE(6,305) (REPS(I),I=1,NIPR)                                      2902100
305 FORMAT(/' EPSILON PLAS =',1P9E13.5/15X,1P3E13.5)                     2902110
322 CONTINUE                                                             2902120
400 CONTINUE                                                             2902130
    TEM1 = E/RS*AMN                                                      2902140
    RNGLOD(1,J) = DELP*TEM1+E/RS*REPSIN(1)-X3*C                          2902150
    RNGLOD(2,J) = 0.0                                                    2902160
    RNGLOD(3,J) = 0.0                                                    2902170
    RNGLOD(4,J) =DELP*(-TEM1*YC-E/RS*BN)-E/RS*(YC*REPSIN(1)+REPSIN(2))   2902180
   1             -X3*D                                                   2902190
    SAVR(1) = RNGLOD(1,J)                                                2902200
    SAVR(2) = RNGLOD(4,J)                                                2902210
    SAVR(3) = SAVR(3)+SAVR(1)                                            2902220
    SAVR(4) = SAVR(4)+SAVR(2)                                            2902230
    IPRINT = 0                                                           2902240
    IF (IBEGIN.EQ.1.OR.(IMAX-1).EQ.ICYCLE) IPRINT = 1                    2902250
    WRITE(IOR) NPLEV,RNGSRN,RGSRS,NPLA,RSIG,REPS,RALPH,RBAPH,RTEPS,      2902260
   1           SIGOX,RMOSS,RMOSN,REFF,KORIR,AMN,BN,ENTH(3),DELR,SAVR,    2902270
   2           IPRINT                                                    2902280
    XBRS = 1.0-XBAR/RS                                                   2902290
    TDEL(1,1) = 0.0                                                      2902300
    TDEL(2,1) = 0.0                                                      2902310
    TDEL(3,1) = -1.0/XBRS                                                2902320
    TDEL(4,1) = 0.0                                                      2902330
    TDEL(1,2) = 0.0                                                      2902340
    TDEL(2,2) = -1.0                                                     2902350
    TDEL(3,2) = 0.0                                                      2902360
    TDEL(4,2) = 0.0                                                      2902370
    TDEL(1,3) = -1.0                                                     2902380
    TDEL(2,3) = 0.0                                                      2902390
    TDEL(3,3) = 0.0                                                      2902400
    TDEL(4,3) = 0.0                                                      2902410
    TDEL(1,4) = -YBAR                                                    2902420
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      TDEL(2,4) = +XBAR                                                 2902430
      TDEL(3,4) = 0.0                                                   2902440
      TDEL(4,4) = -1.0                                                  2902450
      DO 813 L=1,4                                                      2902460
      DO 813 M=1,4                                                      2902470
      XKTOT(L,M) = 0.0                                                  2902480
      DO 813 N=1,4                                                      2902490
  813 XKTOT(L,M) = XKTOT(L,M)+RNGTOT(L,N)*TDEL(N,M)                     2902500
      DO 814 L=1,4                                                      2902510
      DO 814 M=1,4                                                      2902520
      RNGTOT(L,M) = 0.0                                                 2902530
      DO 814 N=1,4                                                      2902540
  814 RNGTOT(L,M) = RNGTOT(L,M)+TDEL(N,L)*XKTOT(N,M)                    2902550
      DO 815 L=1,4                                                      2902560
      XL(L) = 0.0                                                       2902570
      DO 815 N=1,4                                                      2902580
  815 XL(L) = XL(L)+TDEL(N,L)*RNGLOD(N,J)                               2902590
      DO 816 L=1,2                                                      2902600
  816 RNGLOD(L,J) = XL(L)                                               2902610
      B = -ROM*RC*A                                                     2902620
      RNGLOD(3,J) = XL(3)+B                                             2902630
      RNGLOD(4,J) = XL(4)+YBAR*B                                        2902640
      DO 1100 L=1,NSEG                                                  2902650
      IF (JTNO(J).EQ.JTIC(L)) GO TO 1105                                2902660
 1100 CONTINUE                                                          2902670
      GO TO 1107                                                        2902680
 1105 M = JTIC(L)                                                       2902690
      RMULT = ADUS(M)*TWOPI                                             2902700
      GO TO 1111                                                        2902710
 1107 DO 1101 L=1,NSEG                                                  2902720
      IF (JTNO(J).EQ.JSTOP(L)) GO TO 1106                               2902730
 1101 CONTINUE                                                          2902740
 1106 M = JSTOP(L)                                                      2902750
      RMULT = BADUS(M)*TWOPI                                            2902760
 1111 CONTINUE                                                          2902770
      DO 820 L=1,4                                                      2902780
      DO 820 M=1,4                                                      2902790
  820 RNGTOT(L,M) = RNGTOT(L,M)*RMULT                                   2902800
      DO 821 L=1,4                                                      2902810
  821 RNGLOD(L,J) = RNGLOD(L,J)*RMULT                                   2902820
  402 RETURN                                                            2902830
 8888 NIX = 1                                                           2902840
      GO TO 402                                                         2902850
      END                                                               2902860
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 FOR,IS RITEPS,RITEPS
       SUBROUTINE RITEPS (RTEPS,TI,TO,ALPR,NTYP,RGEOM)                    3000010
       COMMON /GINT/ AA(8,4),WW(8,4)                                      3000020
       DIMENSION RTEPS(1),TEMP(4),RGEOM(1)                                3000030
       PI = 3.14159265                                                    3000040
       TEMP(1) = (TI-TO)/2.0                                              3000050
       TEMP(2) = (TI+TO)/2.0                                              3000060
       GO TO (100,200,200,300,400,500,200,600,600),NTYP                   3000070
C                                                                         3000080
C      SOLID RECTANGULAR SECTION                                          3000090
C                                                                         3000100
   100 RTEPS(1) = ALPR*(TEMP(1)*AA(3,1)+TEMP(2))                          3000110
       RTEPS(2) = RTEPS(1)                                                3000120
       RTEPS(3) = RTEPS(1)                                                3000130
       RTEPS(4) = ALPR*(-TEMP(1)*AA(3,1)+TEMP(2))                         3000140
       RTEPS(5) = RTEPS(4)                                                3000150
       RTEPS(6) = RTEPS(4)                                                3000160
       RTEPS(7) = ALPR*TEMP(2)                                            3000170
       RTEPS(8) = RTEPS(7)                                                3000180
       RTEPS(9) = RTEPS(7)                                                3000190
       GO TO 990                                                          3000200
C                                                                         3000210
C      Z-SECTION, I-SECTION OR CHANNEL SECTION                            3000220
C                                                                         3000230
   200 DENO=RGEOM(1)*RGEOM(4)+RGEOM(2)*RGEOM(5)+RGEOM(3)*RGEOM(6)
       X1=RGEOM(2)/2.*(RGEOM(3)*RGEOM(6)-RGEOM(1)*RGEOM(4))/DENO
       TEMP(3)=2.*TEMP(1)/RGEOM(2)
       TEMP(4)=RGEOM(2)/2.-X1
       RTEPS(7)=ALPR*TI
       RTEPS(8)=RTEPS(7)
       RTEPS(9)=RTEPS(7)
       XT=RGEOM(2)/2.*AA(3,1)-X1
       TT=TEMP(3)*(XT-TEMP(4))+TI
       RTEPS(4)=ALPR*TT
       XT=-RGEOM(2)/2.*AA(3,1)-X1
       TT=TEMP(3)*(XT-TEMP(4))+TI
       RTEPS(5)=ALPR*TT
       XT=-X1
       TT=TEMP(3)*(XT-TEMP(4))+TI
       RTEPS(6)=ALPR*TT
       RTEPS(1)=ALPR*TO
       RTEPS(2)=RTEPS(1)
       RTEPS(3)=RTEPS(1)
       GO TO 990                                                          3000330
C                                                                         3000340
C      HOLLOW RECTANGULAR SECTION                                         3000350
C                                                                         3000360
   300 X1=RGEOM(1)*RGEOM(2)/2.*(RGEOM(5)-RGEOM(3))/(RGEOM(1)*(RGEOM(3)
      1 +RGEOM(5))+2.*RGEOM(2)*RGEOM(4))
       TEMP(3)=2.*TEMP(1)/RGEOM(2)
       TEMP(4)=RGEOM(2)/2.-X1
       RTEPS(7)=ALPR*TI
       RTEPS(8)=RTEPS(7)
       RTEPS(9)=RTEPS(7)
       XT=RGEOM(2)/2.*AA(3,1)-X1
       TT=TEMP(3)*(XT-TEMP(4))+TI
       RTEPS(4)=ALPR*TT
       XT=-RGEOM(2)/2.*AA(3,1)-X1
       TT=TEMP(3)*(XT-TEMP(4))+TI
       RTEPS(5)=ALPR*TT
       XT=-X1
       TT=TEMP(3)*(XT-TEMP(4))+TI
```

```
      RTEPS(6)=ALPR*TT
      RTEPS(1)=ALPR*TO
      RTEPS(2)=RTEPS(1)
      RTEPS(3)=RTEPS(1)
      RTEPS(10) = RTEPS(4)                                              3000460
      RTEPS(11) = RTEPS(5)                                              3000470
      RTEPS(12) = RTEPS(6)                                              3000480
      GO TO 990                                                         3000490
C                                                                       3000500
C     TRIANGULAR SECTION (ISOSCELES)                                    3000510
C                                                                       3000520
  400 RTEPS(4) = TI*ALPR                                                3000530
      RTEPS(5) = RTEPS(4)                                               3000540
      RTEPS(6) = RTEPS(4)                                               3000550
      X1 = RGEOM(1)*RGEOM(1)*RGEOM(3)                                   3000560
      ST = RGEOM(2)/(2.0*RGEOM(1))                                      3000570
      CT = SQRT(1.0-ST*ST)                                              3000580
      X2 = 2.0*RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4)                      3000590
      X1 = X1*CT/X2                                                     3000600
      X2 = -RGEOM(1)*CT*(RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4))/X2        3000610
      TEMP(3) = (X1+X2)/2.0                                             3000620
      TEMP(4) = (X1-X2)/2.0                                             3000630
      X = TEMP(3)*AA(3,1)+TEMP(4)                                       3000640
      Q = TEMP(1)/TEMP(4)                                               3000650
      RTEPS(1) = (Q*(X-X1)+TI)*ALPR                                     3000660
      RTEPS(7) = RTEPS(1)                                               3000670
      X = -TEMP(3)*AA(3,1)+TEMP(4)                                      3000680
      RTEPS(2) = (Q*(X-X1)+TI)*ALPR                                     3000690
      RTEPS(8) = RTEPS(2)                                               3000700
      X = TEMP(4)                                                       3000710
      RTEPS(3) = (Q*(X-X1)+TI)*ALPR                                     3000720
      RTEPS(9) = RTEPS(3)                                               3000730
      GO TO 990                                                         3000740
C                                                                       3000750
C     CRRC SECTION                                                      3000760
C                                                                       3000770
  500 RTEPS(1) = ALPR*TI                                                3000780
      RTEPS(2) = RTEPS(1)                                               3000790
      RTEPS(3) = RTEPS(1)                                               3000800
      X1 = (2.0*RGEOM(1)*RGEOM(1)+PI*RGEOM(2)*(RGEOM(1)+RGEOM(2)/PI))*  3000810
     1     RGEOM(3)/((4.0*RGEOM(1)+PI*RGEOM(2))*RGEOM(3)+2.0*RGEOM(2)*  3000820
     2     RGEOM(4))                                                    3000830
      X = X1+RGEOM(2)/2.0*(AA(3,1)-1.0)                                 3000840
      X2 = X1-(RGEOM(1)+RGEOM(2)/2.0)                                   3000850
      TEMP(3) = (X1+X2)/2.0                                             3000860
      TEMP(4) = (X1-X2)/2.0                                             3000870
      Q = TEMP(1)/TEMP(4)                                               3000880
      RTEPS(4) = (Q*(X-X1)+TI)*ALPR                                     3000890
      RTEPS(7) = RTEPS(4)                                               3000900
      X = X1-RGEOM(2)/2.0*(AA(3,1)+1.0)                                 3000910
      RTEPS(5) = (Q*(X-X1)+TI)*ALPR                                     3000920
      RTEPS(8) = RTEPS(5)                                               3000930
      RTEPS(6) = (-Q*RGEOM(2)/2.0+TI)*ALPR                              3000940
      RTEPS(9) = RTEPS(6)                                               3000950
      THETA = PI/2.0*(1.0+AA(3,1))                                      3000960
      X = X1-RGEOM(1)-RGEOM(2)/2.0*SIN(THETA)                           3000970
      RTEPS(10) = (Q*(X-X1)+TI)*ALPR                                    3000980
      THETA = PI/2.0*(1.0-AA(3,1))                                      3000990
      X = X1-RGEOM(1)-RGEOM(2)/2.0*SIN(THETA)                           3001000
      RTEPS(11) = (Q*(X-X1)+TI)*ALPR                                    3001010
      X = X1-RGEOM(1)-RGEOM(2)/2.0                                      3001020
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      RTEPS(12) = (Q*(X-X1)+TI)*ALPR                                    3001030
      GO TO 990                                                         3001040
C                                                                       3001050
C     T-SECTION OR RIGHT ANGULAR SECTION                                3001060
C                                                                       3001070
  600 X1=RGEOM(2)/2.*(RGEOM(2)*RGEOM(4)+2.*RGEOM(1)*RGEOM(3))/(RGEOM(2)
     1 *RGEOM(4)+RGEOM(1)*RGEOM(3))
      TEMP(3)=2.*TEMP(1)/RGEOM(2)
      RTEPS(1)=ALPR*TO
      RTEPS(2) = RTEPS(1)                                               3001090
      RTEPS(3) = RTEPS(1)                                               3001100
      XT=RGEOM(2)/2.*(AA(3,1)-1.)+X1
      TT=TEMP(3)*(XT-X1)+TI
      RTEPS(4)=ALPR*TT
      XT=-RGEOM(2)/2.*(AA(3,1)+1.)+X1
      TT=TEMP(3)*(XT-X1)+TI
      RTEPS(5)=ALPR*TT
      XT=-RGEOM(2)/2.+X1
      TT=TEMP(3)*(XT-X1)+TI
      RTEPS(6)=ALPR*TT
  990 RETURN                                                            3001140
      END                                                               3001150
```

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FOR,IS RISULT,RISULT
      SUBROUTINE RISULT (RGSRS,SIG,ENTH,NTYP,IND,RGEOM,PHI)                3100010
      COMMON /GINT/ AA(8,4),WW(8,4)                                        3100020
      DIMENSION RGSRS(1),SIG(1),TEMP(2),RGEOM(1)                           3100030
      II = 1                                                               3100040
      PI = 3.14159265                                                      3100050
      ANG = PHI+ENTH                                                       3100060
      TEMP(1) = COS(ANG)                                                   3100070
      TEMP(2) = SIN(ANG)                                                   3100080
      RGSRS(1) = 0.0                                                       3100090
      RGSRS(2) = 0.0                                                       3100100
      IF (IND .NE.0) RGSRS(3) = 0.0                                        3100110
      GO TO (100,300,400,600,200,500,700,800,900),NTYP                     3100120
C                                                                          3100130
C       SOLID RECTANGULAR SECTION                                          3100140
C                                                                          3100150
  100 DO 140 L=1,2                                                         3100160
      XT = RGEOM(1)/2.0*AA(3,L)                                            3100170
  110 DO 130 LL=1,2                                                        3100180
      YT = RGEOM(2)/2.0*AA(3,LL)                                           3100190
  120 RGSRS(1) = RGSRS(1) + WW(3,L) * WW(3,LL) * SIG(II)                   3100200
      RGSRS(2) = RGSRS(2) - WW(3,L) * WW(3,LL) * SIG(II) *(-XT*TEMP(1) + 3100210
     1 YT * TEMP(2))                                                       3100220
      IF (IND.NE.0) RGSRS(3) = RGSRS(3) - WW(3,L) * WW(3,LL)*SIG(II) *     3100230
     1 (XT * TEMP(2) + YT * TEMP(1))                                       3100240
      II = II+1                                                            3100250
      IF(YT .LE.0.0) GO TO 130                                             3100260
      YT = -YT                                                             3100270
      GO TO 120                                                            3100280
  130 CONTINUE                                                             3100290
      IF(XT .LE. 0.0) GO TO 140                                            3100300
      XT = -XT                                                             3100310
      GO TO 110                                                            3100320
  140 CONTINUE                                                             3100330
      FACT = RGEOM(1)*RGEOM(2)/4.0                                         3100340
      RGSRS(1) = RGSRS(1) * FACT                                           3100350
      RGSRS(2) = RGSRS(2) * FACT                                           3100360
      IF(IND .NE.0) RGSRS(3) = RGSRS(3) * FACT                             3100370
      GO TO 990                                                            3100380
C                                                                          3100390
C     TRIANGULAR SECTION (ISOSCELES)                                       3100400
C                                                                          3100410
  200 CONTINUE                                                             3100420
      X1 = RGEOM(1)*RGEOM(1)*RGEOM(3)                                      3100430
      ST = RGEOM(2)/2.0/RGEOM(1)                                           3100440
      CT = SQRT(1.0-ST*ST)                                                 3100450
      X2 = 2.0*RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4)                         3100460
      X1 = X1*CT/2.0                                                       3100470
      X2 = RGEOM(1)*CT*(RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4))/X2            3100480
      DO 230 L=1,2                                                         3100490
      SI = AA(3,L)                                                         3100500
  210 RGSRS(1) = RGSRS(1)+WW(3,L)*((SIG(II)+SIG(II+6))*RGEOM(1)*RGEOM(3)   3100510
     1           +SIG(II+3)*RGEOM(2)*RGEOM(4))/2.0                         3100520
      YT = -RGEOM(2)/2.0*SI                                                3100530
      RGSRS(2) = RGSRS(2)-WW(3,L)*RGEOM(2)*RGEOM(4)*SIG(II+3)/2.0*         3100540
     1           (-X1*TEMP(1)+YT*TEMP(2))                                  3100550
      XT = (X1-X2)/2.0-(X2+X1)/2.0*SI                                      3100560
      YT = RGEOM(2)/2.0*(1.0-SI)                                           3100570
      RGSRS(2) = RGSRS(2)-WW(3,L)*RGEOM(1)*RGEOM(3)*SIG(II)/2.0*           3100580
     1           (-XT*TEMP(1)+YT*TEMP(2))                                  3100590
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```
      YT = -YT                                                          3100600
      RGSRS(2) = RGSRS(2)-WW(3,L)*RGEOM(1)*RGEOM(3)*SIG(II+6)/2.0*      3100610
     1           (-XT*TEMP(1)+YT*TEMP(2))                               3100620
      IF (IND.EQ.0) GO TO 220                                           3100630
      YT = -RGEOM(2)/2.0*SI                                             3100640
      RGSRS(3) = RGSRS(3)-WW(3,L)*RGEOM(2)*RGEOM(4)*SIG(II+3)/2.0*      3100650
     1           (X1*TEMP(2)+YT*TEMP(1))                                3100660
      XT = (X1-X2)/2.0-(X2+X1)/2.0*SI                                   3100670
      YT = RGEOM(2)/2.0*(1.0-SI)                                        3100680
      RGSRS(3) = RGSRS(3)-WW(3,L)*RGEOM(1)*RGEOM(3)*SIG(II)/2.0*        3100690
     1           (XT*TEMP(2)+YT*TEMP(1))                                3100700
      YT = -YT                                                          3100710
      RGSRS(3) = RGSRS(3)-WW(3,L)*RGEOM(1)*RGEOM(3)*SIG(II+6)/2.0*      3100720
     1           (XT*TEMP(2)+YT*TEMP(1))                                3100730
  220 II = II+1                                                         3100740
      IF (SI.LE.0.0) GO TO 230                                          3100750
      SI = -SI                                                          3100760
      GO TO 210                                                         3100770
  230 CONTINUE                                                          3100780
      GO TO 990                                                         3100790
C                                                                       3100800
C      Z-SECTION                                                        3100810
C                                                                       3100820
  300 DENO=RGEOM(1)*RGEOM(4)+RGEOM(2)*RGEOM(5)+RGEOM(3)*RGEOM(6)
      X1=RGEOM(2)/2.*(RGEOM(3)*RGEOM(6)-RGEOM(1)*RGEOM(4))/DENO
      Y1=(RGEOM(1)**2*RGEOM(4)-RGEOM(3)**2*RGEOM(6))/2./DENO
      X2=-RGEOM(2)/2.-X1
      X3=RGEOM(2)/2.-X1
      DO 330 L=1,2
      SI = AA(3,L)                                                      3100840
  310 RGSRS(1) = RGSRS(1) + WW(3,L) * (SIG(II) * RGEOM(1) * RGEOM(4)    3100850
     1           + SIG(II+3) * RGEOM(2) * RGEOM(5)                      3100860
     2           + SIG(II+6) * RGEOM(3) * RGEOM(6))/2.0                 3100870
      YT=RGEOM(1)/2.*(1.+SI)-Y1
      RGSRS(2) = RGSRS(2)-WW(3,L) * SIG(II) / 2.0*RGEOM(1) *            3100890
     1 RGEOM(4)*(-X1*TEMP(1)+YT*TEMP(2))
      YT=RGEOM(2)/2.*SI-X1
      RGSRS(2) = RGSRS(2) + WW(3,L) * SIG(II+3) / 2.0 * RGEOM(2) *      3100920
     1 RGEOM(5)*(-YT*TEMP(1)-Y1*TEMP(2))
      YT=-RGEOM(3)/2.*(1.-SI)-Y1
      RGSRS(2) = RGSRS(2) - WW(3,L) * SIG(II+6) / 2.0 * RGEOM(3) *      3100950
     1 RGEOM(6)*(-X3*TEMP(1)+YT*TEMP(2))
      IF (IND .EQ.0) GO TO 320                                          3100970
      YT=RGEOM(1)/2.*(1.+SI)-Y1
      RGSRS(3) = RGSRS(3) - WW(3,L) * SIG(II) / 2.0 * RGEOM(1) *        3100990
     1 RGEOM(4)*(X1*TEMP(2)+YT*TEMP(1))
      YT=RGEOM(2)/2.*SI-X1
      RGSRS(3) = RGSRS(3) - WW(3,L) * SIG(II+3) / 2.0 * RGEOM(2) *      3101020
     1 RGEOM(5)*(YT*TEMP(2)-Y1*TEMP(1))
      YT=-RGEOM(3)/2.*(1.-SI)-Y1
      RGSRS(3) = RGSRS(3) - WW(3,L) * SIG(II+6) / 2.0 * RGEOM(3) *      3101050
     1 RGEOM(6)*(X3*TEMP(2)+YT*TEMP(1))
  320 II = II + 1                                                       3101070
      IF (SI .LE.0.0) GO TO 330                                         3101080
      SI = -SI                                                          3101090
      GO TO 310                                                         3101100
  330 CONTINUE                                                          3101110
      GO TO 990                                                         3101120
C                                                                       3101130
C      I- SECTION                                                       3101140
C                                                                       3101150
```

```
400 X1=RGEOM(2)/2.*(RGEOM(3)*RGEOM(6)-RGEOM(1)*RGEOM(4))/(RGEOM(1)*
   1 RGEOM(4)+RGEOM(2)*RGEOM(5)+RGEOM(3)*RGEOM(6))
    X2=RGEOM(2)/2.-X1
    X3=-RGEOM(2)/2.-X1
    DO 430 L=1,2
    SI = AA(3,L)                                                        3101170
410 RGSRS(1) = RGSRS(1) + WW(3,L) * (SIG(II) * RGEOM(1) * RGEOM(4)      3101180
   1             + SIG(II+3) * RGEOM(2) * RGEOM(5)                     3101190
   2             + SIG(II+6) * RGEOM(3) * RGEOM(6)) / 2.0              3101200
    YT = RGEOM(1) * SI / 2.0                                            3101210
    RGSRS(2) = RGSRS(2) - WW(3,L) * SIG(II) / 2.0 * RGEOM(1) *          3101220
   1 RGEOM(4)*(-X3*TEMP(1)+YT*TEMP(2))
    YT=RGEOM(2)*SI/2.-X1
    RGSRS(2) = RGSRS(2) + WW(3,L) * SIG(II+3) / 2.0 * RGEOM(2) *        3101250
   1             RGEOM(5) * YT * TEMP(1)                               3101260
    YT = RGEOM(3) * SI / 2.0                                            3101270
    RGSRS(2) = RGSRS(2) - WW(3,L) * SIG(II+6) / 2.0 * RGEOM(3) *        3101280
   1RGEOM(6)*(-X2*TEMP(1)+YT*TEMP(2))
    IF (IND .EQ. 0) GO TO 420                                           3101300
    YT = RGEOM(1) * SI / 2.0                                            3101310
    RGSRS(3) = RGSRS(3) - WW(3,L) * SIG(II) / 2.0 * RGEOM(1) *          3101320
   1 RGEOM(4)*(X3*TEMP(2)+YT*TEMP(1))
    YT=RGEOM(2)*SI/2.-X1
    RGSRS(3) = RGSRS(3) - WW(3,L) * SIG(II+3) / 2.0 * RGEOM(2) *        3101350
   1             RGEOM(5) * YT * TEMP(2)                               3101360
    YT = RGEOM(3) * SI / 2.0                                            3101370
    RGSRS(3) = RGSRS(3) - WW(3,L) * SIG(II+6) / 2.0 * RGEOM(3) *        3101380
   1 RGEOM(6)*(X2*TEMP(2)+YT*TEMP(1))
420 II = II+1                                                           3101400
    IF (SI .LE.0.0) GO TO 430                                           3101410
    SI = -SI                                                            3101420
    GO TO 410                                                           3101430
430 CONTINUE                                                            3101440
    GO TO 990                                                           3101450
                                                                        3101460
    CRRC SECTION                                                        3101470
                                                                        3101480
500 CONTINUE                                                            3101490
    X1 = (2.0*RGEOM(1)*RGEOM(1)+PI*RGEOM(2)*(RGEOM(1)+RGEOM(2)/PI))*    3101500
   1     RGEOM(3)/((4.0*RGEOM(1)+PI*RGEOM(2))*RGEOM(3)+2.0*RGEOM(2)*    3101510
   2     RGEOM(4))                                                     3101520
    DO 530 L=1,2                                                        3101530
    SI = AA(3,L)                                                        3101540
510 RGSRS(1) = RGSRS(1)+WW(3,L)/2.0*(SIG(II)*RGEOM(2)*RGEOM(4)+         3101550
   1             (SIG(II+3)+SIG(II+6))*RGEOM(1)*RGEOM(3)+SIG(II+9)*    3101560
   2             RGEOM(2)*RGEOM(3)*PI/2.0)                             3101570
    XT = X1                                                             3101580
    YT = -RGEOM(2)/2.0*SI                                               3101590
    RGSRS(2) = RGSRS(2)-WW(3,L)*SIG(II)/2.0*RGEOM(2)*RGEOM(4)*          3101600
   1             (-XT*TEMP(1)+YT*TEMP(2))                              3101610
    XT = RGEOM(1)/2.0*(SI-1.0)+X1                                       3101620
    YT = RGEOM(2)/2.0                                                   3101630
    RGSRS(2) = RGSRS(2)-WW(3,L)*SIG(II+3)/2.0*RGEOM(1)*RGEOM(3)*        3101640
   1             (-XT*TEMP(1)+YT*TEMP(2))                              3101650
    YT = -YT                                                            3101660
    RGSRS(2) = RGSRS(2)-WW(3,L)*SIG(II+6)/2.0*RGEOM(1)*RGEOM(3)*        3101670
   1             (-XT*TEMP(1)+YT*TEMP(2))                              3101680
    THT = PI/2.0*(1.0+SI)                                               3101690
    XT = X1-RGEOM(1)-RGEOM(2)/2.0*SIN(THT)                              3101700
    YT = RGEOM(2)/2.0*COS(THT)                                          3101710
    RGSRS(2) = RGSRS(2)-WW(3,L)*SIG(II+9)/4.0*RGEOM(2)*RGEOM(3)*PI*     3101720
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     1            (-XT*TEMP(1)+YT*TEMP(2))                                  3101730
      IF (IND.EQ.0) GO TO 520                                               3101740
      XT = X1                                                               3101750
      YT = -RGEOM(2)/2.0*SI                                                 3101760
      RGSRS(3) = RGSRS(3)-WW(3,L)*SIG(II)/2.0*RGEOM(2)*RGEOM(4)*            3101770
     1            (XT*TEMP(2)+YT*TEMP(1))                                   3101780
      XT = RGEOM(1)/2.0*(SI-1.0)+RGEOM(1)                                   3101790
      YT = RGEOM(2)/2.0                                                     3101800
      RGSRS(3) = RGSRS(3)-WW(3,L)*SIG(II+3)/2.0*RGEOM(1)*RGEOM(3)*          3101810
     1            (XT*TEMP(2)+YT*TEMP(1))                                   3101820
      YT = -YT                                                              3101830
      RGSRS(3) = RGSRS(3)-WW(3,L)*SIG(II+6)/2.0*RGEOM(1)*RGEOM(3)*          3101840
     1            (XT*TEMP(2)+YT*TEMP(1))                                   3101850
      XT = X1-RGEOM(1)-RGEOM(2)/2.0*SIN(THT)                                3101860
      YT = RGEOM(2)/2.0*COS(THT)                                            3101870
      RGSRS(3) = RGSRS(3)-WW(3,L)*SIG(II+9)/4.0*RGEOM(2)*RGEOM(3)*          3101880
     1            PI*(XT*TEMP(2)+YT*TEMP(1))                                3101890
  520 II = II+1                                                             3101900
      IF (SI.LE.0.0) GO TO 530                                              3101910
      SI = -SI                                                              3101920
      GO TO 510                                                             3101930
  530 CONTINUE                                                              3101940
      GO TO 990                                                             3101950
C                                                                           3101960
C     HOLLOW RECTANGULAR SECTION                                            3101970
C                                                                           3101980
  600 X1=RGEOM(1)*RGEOM(2)/2.*(RGEOM(5)-RGEOM(3))/(RGEOM(1)*(RGEOM(3)
     1 +RGEOM(5))+2.*RGEOM(2)*RGEOM(4))
      X2=RGEOM(2)/2.-X1
      X3=-RGEOM(2)/2.-X1
      DO 630 L=1,2
      SI = AA(3,L)                                                          3102000
  610 RGSRS(1)=RGSRS(1)+WW(3,L)*(RGEOM(1)*RGEOM(3)*SIG(II)
     1 +RGEOM(1)*RGEOM(5)*SIG(II+6)+RGEOM(2)*RGEOM(4)*(SIG(II+3)
     2 +SIG(II+9)))/2.0
      YT = RGEOM(1) * SI / 2.0                                              3102040
      RGSRS(2)=RGSRS(2)-WW(3,L)*(SIG(II)*(-X3*TEMP(1)+YT*TEMP(2))*RGEOM
     1 (3)+SIG(II+6)*(-X2*TEMP(1)+YT*TEMP(2))*RGEOM(5))*RGEOM(1)/2.
      YT=RGEOM(2)*SI/2.-X1
      RGSRS(2) = RGSRS(2) - WW(3,L) * (SIG(II+3) * (RGEOM(1) * TEMP(2) / 3102090
     1            2.0 - YT * TEMP(1)) + SIG(II+9) * (-RGEOM(1) * TEMP(2) 3102100
     2            / 2.0 - YT * TEMP(1))) * RGEOM(2) * RGEOM(4) / 2.0      3102110
      IF (IND.EQ.0) GO TO 620                                               3102120
      YT = RGEOM(1) * SI / 2.0                                              3102130
      RGSRS(3)=RGSRS(3)-WW(3,L)*(SIG(II)*(X3*TEMP(2)+YT*TEMP(1))*
     1 RGEOM(3)+SIG(II+6)*(X2*TEMP(2)+YT*TEMP(1))*RGEOM(5))*RGEOM(1)/2.
      YT=RGEOM(2)*SI/2.-X1
      RGSRS(3) = RGSRS(3) - WW(3,L) * (SIG(II+3) * (YT * TEMP(2) +          3102180
     1 RGEOM(1)/2.*TEMP(1))+SIG(II+9)*(YT*TEMP(2)-
     2 RGEOM(1)/2.*TEMP(1)))*RGEOM(2)*RGEOM(4)/2.
  620 II = II+1                                                             3102210
      IF (SI.LE.0.0) GO TO 630                                              3102220
      SI = -SI                                                              3102230
      GO TO 610                                                             3102240
  630 CONTINUE                                                              3102250
      GO TO 990                                                             3102260
C                                                                           3102270
C     CHANNEL SECTION                                                       3102280
C                                                                           3102290
  700 CONTINUE                                                              3102300
      DENO=RGEOM(1)*RGEOM(4)+RGEOM(2)*RGEOM(5)+RGEOM(3)*RGEOM(6)
```

```
      Y1=(RGEOM(1)**2*RGEOM(4)+RGEOM(3)**2*RGEOM(6))/2./DENO
      X1=RGEOM(2)/2.*(RGEOM(3)*RGEOM(6)-RGEOM(1)*RGEOM(4))/DENO
      DO 730 L=1,2                                                        3102330
      SI = AA(3,L)                                                        3102340
  710 RGSRS(1)=RGSRS(1)+WW(3,L)/2.*(SIG(II)*RGEOM(1)*RGEOM(4)+SIG(II+3)
     1 *RGEOM(2)*RGEOM(5)+SIG(II+6)*RGEOM(3)*RGEOM(6))
      XT=-RGEOM(2)/2.-X1
      YT = RGEOM(1)/2.0*(SI-1.0)+Y1                                       3102380
      RGSRS(2)=RGSRS(2)-WW(3,L)*SIG(II)/2.0*RGEOM(1)*RGEOM(4)*
     1          (-XT*TEMP(1)+YT*TEMP(2))                                  3102400
      XT=RGEOM(2)/2.-X1
      YT=RGEOM(3)/2.*(SI-1.)+Y1
      RGSRS(2)=RGSRS(2)-WW(3,L)*SIG(II+6)/2.*RGEOM(3)*RGEOM(6)*
     1          (-XT*TEMP(1)+YT*TEMP(2))                                  3102430
      XT=RGEOM(2)/2.*SI-Y1
      RGSRS(2)=RGSRS(2)-WW(3,L)*SIG(II+3)/2.*RGEOM(2)*RGEOM(5)*
     1          (-XT*TEMP(1)+Y1*TEMP(2))                                  3102460
      IF (IND.EQ.0) GO TO 720                                             3102470
      XT=-RGEOM(2)/2.-X1
      YT=RGEOM(1)/2.*(SI-1.)+Y1
      RGSRS(3)=RGSRS(3)-WW(3,L)*SIG(II)/2.*RGEOM(1)*RGEOM(4)*
     1          (XT*TEMP(2)+YT*TEMP(1))                                   3102500
      XT=RGEOM(2)/2.-X1
      YT=RGEOM(3)/2.*(SI-1.)+Y1
      RGSRS(3)=RGSRS(3)-WW(3,L)*SIG(II+6)/2.*RGEOM(3)*RGEOM(6)*
     1          (XT*TEMP(2)+YT*TEMP(1))                                   3102530
      XT=RGEOM(2)/2.*SI-Y1
      RGSRS(3)=RGSRS(3)-WW(3,L)*SIG(II+3)/2.*RGEOM(2)*RGEOM(5)*
     1     (XT*TEMP(2)+Y1*TEMP(1))
  720 II = II+1                                                           3102570
      IF (SI.LE.0.0) GO TO 730                                            3102580
      SI = -SI                                                            3102590
      GO TO 710                                                           3102600
  730 CONTINUE                                                            3102610
C                                                                         3102620
C     T-SECTION                                                           3102630
C                                                                         3102640
  800 CONTINUE                                                            3102650
      X1 = RGEOM(2)/2.0*(RGEOM(2)*RGEOM(4)+2.0*RGEOM(1)*RGEOM(3))/        3102660
     1     (RGEOM(2)*RGEOM(4)+RGEOM(1)*RGEOM(3))                          3102670
      DO 830 L=1,2                                                        3102680
      SI = AA(3,L)                                                        3102690
  810 RGSRS(1) = RGSRS(1)+WW(3,L)*(SIG(II)*RGEOM(1)*RGEOM(3)+SIG(II+3)*   3102700
     1          RGEOM(2)*RGEOM(4))/2.0                                    3102710
      YT = RGEOM(1)/2.0*SI                                                3102720
      XT = X1-RGEOM(2)                                                    3102730
      RGSRS(2) = RGSRS(2)-WW(3,L)*SIG(II)/2.0*RGEOM(1)*RGEOM(3)*          3102740
     1          (-XT*TEMP(1)+YT*TEMP(2))                                  3102750
      XT=RGEOM(2)/2.*(SI-1.0)+X1
      RGSRS(2) = RGSRS(2)+WW(3,L)*SIG(II+3)/2.0*RGEOM(2)*RGEOM(4)*XT*     3102770
     1          TEMP(1)                                                   3102780
      IF (IND.EQ.0) GO TO 820                                             3102790
      XT = X1-RGEOM(2)                                                    3102800
      RGSRS(3) = RGSRS(3)-WW(3,L)*SIG(II)/2.0*RGEOM(1)*RGEOM(3)*          3102810
     1          (XT*TEMP(2)+YT*TEMP(1))                                   3102820
      XT = RGEOM(2)/2.0*(SI-1.0)+X1                                       3102830
      RGSRS(3) = RGSRS(3)-WW(3,L)+SIG(II+3)/2.0*RGEOM(2)*RGEOM(4)*XT*     3102840
     1          TEMP(2)                                                   3102850
  820 II = II+1                                                           3102860
      IF (SI.LE.0.0) GO TO 830                                            3102870
      SI = -SI                                                            3102880
```

```
      GO TO 810                                                          3102890
  830 CONTINUE                                                           3102900
      GO TO 990                                                          3102910
C                                                                        3102920
C     RIGHT ANGULAR SECTION                                              3102930
C                                                                        3102940
  900 CONTINUE                                                           3102950
      X1=RGEOM(2)/2.*(RGEOM(2)*RGEOM(4)+2.*RGEOM(1)*RGEOM(3))/(RGEOM(2)
     1 *RGEOM(4)+RGEOM(1)*RGEOM(3))
      Y1=RGEOM(1)**2*RGEOM(3)/2./(RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4))
      DO 930 L=1,2                                                       3102990
      SI = AA(3,L)                                                       3103000
  910 RGSRS(1) = RGSRS(1)+WW(3,L)/2.0*(SIG(II)*RGEOM(1)*RGEOM(3)+        3103010
     1           SIG(II+3)*RGEOM(2)*RGEOM(4))                            3103020
      XT = X1-RGEOM(2)                                                   3103030
      YT = Y1+RGEOM(1)/2.0*(SI-1.0)                                      3103040
      RGSRS(2) = RGSRS(2)-WW(3,L)*SIG(II)*RGEOM(1)*RGEOM(3)/2.0*         3103050
     1           (-XT*TEMP(1)+YT*TEMP(2))                                3103060
      XT = X1+RGEOM(2)/2.0*(SI-1.0)                                      3103070
      YT = Y1                                                            3103080
      RGSRS(2) = RGSRS(2)-WW(3,L)*SIG(II+3)*RGEOM(2)*RGEOM(4)/2.0*       3103090
     1           (-XT*TEMP(1)+YT*TEMP(2))                                3103100
      IF (IND.EQ.0) GO TO 920                                            3103110
      XT = X1-RGEOM(2)                                                   3103120
      YT = Y1+RGEOM(1)/2.0*(SI-1.0)                                      3103130
      RGSRS(3) = RGSRS(3)-WW(3,L)*SIG(II)*RGEOM(1)*RGEOM(3)/2.0*         3103140
     1           (XT*TEMP(2)+YT*TEMP(1))                                 3103150
      XT = X1+RGEOM(2)/2.0*(SI-1.0)                                      3103160
      YT = Y1                                                            3103170
      RGSRS(3) = RGSRS(3)-WW(3,L)*SIG(II+3)*RGEOM(2)*RGEOM(4)/2.0*       3103180
     1           (XT*TEMP(2)+YT*TEMP(1))                                 3103190
  920 II = II+1                                                          3103200
      IF (SI.LE.0.0) GO TO 930                                           3103210
      SI = -SI                                                           3103220
      GO TO 910                                                          3103230
  930 CONTINUE                                                           3103240
  990 RETURN                                                             3103250
      END                                                                3103260
C ..... ROUTINE ** RGSRSE ** ABACUS UPDATED 10/01/73 .....              3200000
```

```
FOR,IS RGSRSE,RGSRSE
      SUBROUTINE RGSRSE (SIG,ENTH,REPS,E,NTYP,RGEOM,PHI)                3200010
      COMMON /GINT/ AA(8,4),WW(8,4)                                     3200020
      DIMENSION SIG(1),TEMP(2),ENTH(1),REPS(1),RGEOM(1)                 3200030
      II = 1                                                            3200040
      PI = 3.14159265                                                   3200050
      ANG = PHI+ENTH(3)                                                 3200060
      TEMP(1) = COS(ANG)                                                3200070
      TEMP(2) = SIN(ANG)                                                3200080
      GO TO (100,300,400,600,200,500,700,800,900),NTYP                  3200090
C                                                                       3200100
C      SOLID RECTANGULAR SECTION                                        3200110
C                                                                       3200120
  100 DO 150 L=1,2                                                      3200130
      XT = RGEOM(1) / 2.0 * AA(3,L)                                     3200140
  110 DO 140 LL=1,2                                                     3200150
      YT = RGEOM(2) / 2.0 * AA(3,LL)                                    3200160
  120 SIG(II) = E * (ENTH(1) - (-XT * TEMP(1) + YT * TEMP(2)) *         3200170
     1          ENTH(2) - REPS(II))                                    3200180
      II = II+1                                                         3200190
      IF(YT .LE.0.0) GO TO 140                                          3200200
      YT = -YT                                                          3200210
      GO TO 120                                                         3200220
  140 CONTINUE                                                          3200230
      IF(XT .LE.0.0) GO TO 150                                          3200240
      XT = -XT                                                          3200250
      GO TO 110                                                         3200260
  150 CONTINUE                                                          3200270
      GO TO 990                                                         3200280
C                                                                       3200290
C     TRIANGULAR SECTION (ISOSCELES)                                    3200300
C                                                                       3200310
  200 CONTINUE                                                          3200320
      X1 = RGEOM(1)*RGEOM(1)*RGEOM(3)                                   3200330
      ST = RGEOM(2)/(2.0*RGEOM(1))                                      3200340
      CT = SQRT(1.0-ST*ST)                                              3200350
      X2 = 2.0*RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4)                      3200360
      X1 = X1*CT/X2                                                     3200370
      X2 = -RGEOM(1)*CT*(RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4))/X2        3200380
      DO 220 L=1,2                                                      3200390
      SI = AA(3,L)                                                      3200400
  210 CONTINUE                                                          3200410
      YT = -RGEOM(2)/2.0*SI                                             3200420
      SIG(II+3)=E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II+3))
      XT = (X1-X2)/2.0-(X2+X1)/2.0*SI                                   3200440
      YT = RGEOM(2)/2.0*(1.0-SI)                                        3200450
      SIG(II) = E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II))   3200460
      YT = -YT                                                          3200470
      SIG(II+6)=E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II+6))
      II = II+1                                                         3200490
      IF (SI.LE.0.0) GO TO 220                                          3200500
      SI = -SI                                                          3200510
      GO TO 210                                                         3200520
  220 CONTINUE                                                          3200530
      GO TO 990                                                         3200540
C                                                                       3200550
C      Z-SECTION                                                        3200560
C                                                                       3200570
  300 DENO=RGEOM(1)*RGEOM(4)+RGEOM(2)*RGEOM(5)+RGEOM(3)*RGEOM(6)
      X1=RGEOM(2)/2.*(RGEOM(3)*RGEOM(6)-RGEOM(1)*RGEOM(4))/DENO
```

```
      Y1=(RGEOM(1)**2*RGEOM(4)-RGEOM(3)**2*RGEOM(6))/2./DENO
      X2=-RGEOM(2)/2.-X1
      X3=RGEOM(2)/2.-X1
      DO 320 L=1,2
      SI = AA(3,L)                                                    3200590
  310 YT=RGEOM(1)/2.*(1.0+SI)-Y1
      SIG(II)=E*(ENTH(1)-(-X2*TEMP(1)+
     1          YT * TEMP(2)) * ENTH(2) - REPS(II))                   3200620
      YT=RGEOM(2)*SI/2.-X1
      SIG(II+3)=E*(ENTH(1)-(-YT*TEMP(1)-Y1*TEMP(2))*ENTH(2)-REPS(II+3))
      YT=-RGEOM(3)/2.*(1.0-SI)-Y1
      SIG(II+6)=E*(ENTH(1)-(-X3*TEMP(1)
     1            + YT * TEMP(2)) * ENTH(2) - REPS(II+6))             3200670
      II = II+1                                                       3200680
      IF(SI .LE.0.0) GO TO 320                                        3200690
      SI = -SI                                                        3200700
      GO TO 310                                                       3200710
  320 CONTINUE                                                        3200720
      GO TO 990                                                       3200730
C                                                                     3200740
C       I-SECTION                                                     3200750
C                                                                     3200760
  400 X1=RGEOM(2)/2.*(RGEOM(3)*RGEOM(6)-RGEOM(1)*RGEOM(4))/(RGEOM(1)*
     1 RGEOM(4)+RGEOM(2)*RGEOM(5)+RGEOM(3)*RGEOM(6))
      X2=RGEOM(2)/2.-X1
      X3=-RGEOM(2)/2.-X1
      DO 430 L=1,2
      SI = AA(3,L)                                                    3200780
  410 YT = RGEOM(1) * SI / 2.0                                        3200790
      SIG(II)=E*(ENTH(1)-(-X3*TEMP(1)
     1          + YT * TEMP(2)) * ENTH(2) - REPS(II))                 3200810
      YT=RGEOM(2)*SI/2.-X1
      SIG(II+3) = E * (ENTH(1) + YT * TEMP(1) * ENTH(2) - REPS(II+3)) 3200830
      YT = RGEOM(3) * SI / 2.0                                        3200840
      SIG(II+6)=E*(ENTH(1)-(-X2*TEMP(1)
     1            + YT * TEMP(2)) * ENTH(2) - REPS(II+6))             3200860
      II = II+1                                                       3200870
      IF(SI .LE.0.0) GO TO 430                                        3200880
      SI = -SI                                                        3200890
      GO TO 410                                                       3200900
  430 CONTINUE                                                        3200910
      GO TO 990                                                       3200920
C                                                                     3200930
C     CRRC SECTION                                                    3200940
C                                                                     3200950
  500 CONTINUE                                                        3200960
      X1 = (2.0*RGEOM(1)*RGEOM(1)+PI*RGEOM(2)*(RGEOM(1)+RGEOM(2)/PI))* 3200970
     1     RGEOM(3)/((4.0*RGEOM(1)+PI*RGEOM(2))*RGEOM(3)+2.0*RGEOM(2)* 3200980
     2     RGEOM(4))                                                  3200990
      DO 520 L=1,2                                                    3201000
      SI = AA(3,L)                                                    3201010
  510 XT = X1                                                         3201020
      YT = -RGEOM(2)/2.0*SI                                           3201030
      SIG(II) = E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II)) 3201040
      XT = RGEOM(1)/2.0*(SI-1.0)+X1                                   3201050
      YT = RGEOM(2)/2.0                                               3201060
      SIG(II+3)=E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II+3))
      YT = -YT                                                        3201080
      SIG(II+6)=E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II+6))
      THT = PI/2.0*(1.0+SI)                                           3201100
      XT = X1-RGEOM(1)-RGEOM(2)/2.0*SIN(THT)                          3201110
```

```
      YT = RGEOM(2)/2.0*COS(THT)                                          3201120
      SIG(II+9)=E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II+9))
      II = II+1                                                           3201140
      IF (SI.LE.0.0) GO TO 520                                            3201150
      SI = -SI                                                            3201160
      GO TO 510                                                           3201170
  520 CONTINUE                                                            3201180
      GO TO 990                                                           3201190
C                                                                         3201200
C     HOLLOW RECTANGULAR SECTION                                          3201210
C                                                                         3201220
  600 X1=RGEOM(1)*RGEOM(2)/2.*(RGEOM(5)-RGEOM(3))/(RGEOM(1)*(RGEOM(3)
     1 +RGEOM(5))+2.*RGEOM(2)*RGEOM(4))
      X2=RGEOM(2)/2.-X1
      X3=-RGEOM(2)/2.-X1
      DO 620 L=1,2
      SI = AA(3,L)                                                        3201240
  610 YT = RGEOM(1) * SI / 2.0                                            3201250
      SIG(II)=E*(ENTH(1)-(-X3*TEMP(1)
     1           + YT * TEMP(2)) * ENTH(2) - REPS(II))                    3201270
      SIG(II+6)=E*(ENTH(1)-(-X2*TEMP(1)
     1      +YT*TEMP(2))*ENTH(2)-REPS(II+6))
      YT=RGEOM(2)*SI/2.-X1
      SIG(II+3) = E * (ENTH(1) - (RGEOM(1) * TEMP(2) / 2.0                3201310
     1   -YT*TEMP(1))*ENTH(2)-REPS(II+3))
      SIG(II+9) = E * (ENTH(1) - (-RGEOM(1) * TEMP(2) / 2.0               3201330
     1   -YT*TEMP(1))*ENTH(2)-REPS(II+9))
      II = II+1                                                           3201350
      IF (SI.LE.0.0) GO TO 620                                            3201360
      SI = -SI                                                            3201370
      GO TO 610                                                           3201380
  620 CONTINUE                                                            3201390
      GO TO 990                                                           3201400
C                                                                         3201410
C     CHANNEL SECTION                                                     3201420
C                                                                         3201430
  700 CONTINUE                                                            3201440
      DENO=RGEOM(1)*RGEOM(4)+RGEOM(2)*RGEOM(5)+RGEOM(3)*RGEOM(6)
      Y1=(RGEOM(1)**2*RGEOM(4)+RGEOM(3)**2*RGEOM(6))/2./DENO
      X1=RGEOM(2)/2.*(RGEOM(3)*RGEOM(6)-RGEOM(1)*RGEOM(4))/DENO
      DO 720 L=1,2                                                        3201470
      SI = AA(3,L)                                                        3201480
  710 YT = RGEOM(1)/2.0*(SI-1.0)+Y1                                       3201490
      XT=-RGEOM(2)/2.-X1
      SIG(II) = E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II))     3201510
      XT=RGEOM(2)/2.-X1
      YT=RGEOM(3)/2.*(SI-1.)+Y1
      SIG(II+6)=E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II+6))
      XT=RGEOM(2)/2.*SI-Y1
      SIG(II+3)=E*(ENTH(1)-(-XT*TEMP(1)+Y1*TEMP(2))*ENTH(2)-REPS(II+3))
      II = II+1                                                           3201560
      IF (SI.LE.0.0) GO TO 720                                            3201570
      SI = -SI                                                            3201580
      GO TO 710                                                           3201590
  720 CONTINUE                                                            3201600
      GO TO 990                                                           3201610
C                                                                         3201620
C     T-SECTION                                                           3201630
C                                                                         3201640
  800 CONTINUE                                                            3201650
      X1 = RGEOM(2)/2.0*(RGEOM(2)*RGEOM(4)+2.0*RGEOM(1)*RGEOM(3))/        3201660
```

```
     1      (RGEOM(2)*RGEOM(4)+RGEOM(1)*RGEOM(3))                          3201670
            DO 820 L=1,2                                                   3201680
            SI = AA(3,L)                                                   3201690
  810       XT = X1-RGEOM(2)                                               3201700
            YT = RGEOM(1)/2.0*SI                                           3201710
            SIG(II) = E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II))3201720
            XT = RGEOM(2)/2.0*(SI-1.0)+X1                                  3201730
            SIG(II+3)=E*(ENTH(1)+XT*TEMP(1)*ENTH(2)-REPS(II+3))
            II = II+1                                                      3201750
            IF (SI.LE.0.0) GO TO 820                                       3201760
            SI = -SI                                                       3201770
            GO TO 810                                                      3201780
  820       CONTINUE                                                       3201790
            GO TO 990                                                      3201800
C                                                                          3201810
C           RIGHT ANGULAR SECTION                                          3201820
C                                                                          3201830
  900       CONTINUE                                                       3201840
            X1=RGEOM(2)/2.*(RGEOM(2)*RGEOM(4)+2.*RGEOM(1)*RGEOM(3))/(RGEOM(2)
           1 *RGEOM(4)+RGEOM(1)*RGEOM(3))
            Y1=RGEOM(1)**2*RGEOM(3)/2./(RGEOM(1)*RGEOM(3)+RGEOM(2)*RGEOM(4))
            DO 920 L=1,2                                                   3201880
            SI = AA(3,L)                                                   3201890
  910       XT = X1-RGEOM(2)                                               3201900
            YT = RGEOM(2)/2.0*(SI-1.0)+Y1                                  3201910
            SIG(II) = E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II))3201920
            XT = RGEOM(2)/2.0*(SI-1.0)+X1                                  3201930
            YT = Y1                                                        3201940
            SIG(II+3)=E*(ENTH(1)-(-XT*TEMP(1)+YT*TEMP(2))*ENTH(2)-REPS(II+3))
            II = II+1                                                      3201960
            IF (SI.LE.0.0) GO TO 920                                       3201970
            SI = -SI                                                       3201980
            GO TO 910                                                      3201990
  920       CONTINUE                                                       3202000
            GO TO 990                                                      3202010
  990       RETURN                                                         3202020
            END                                                            3202030
```

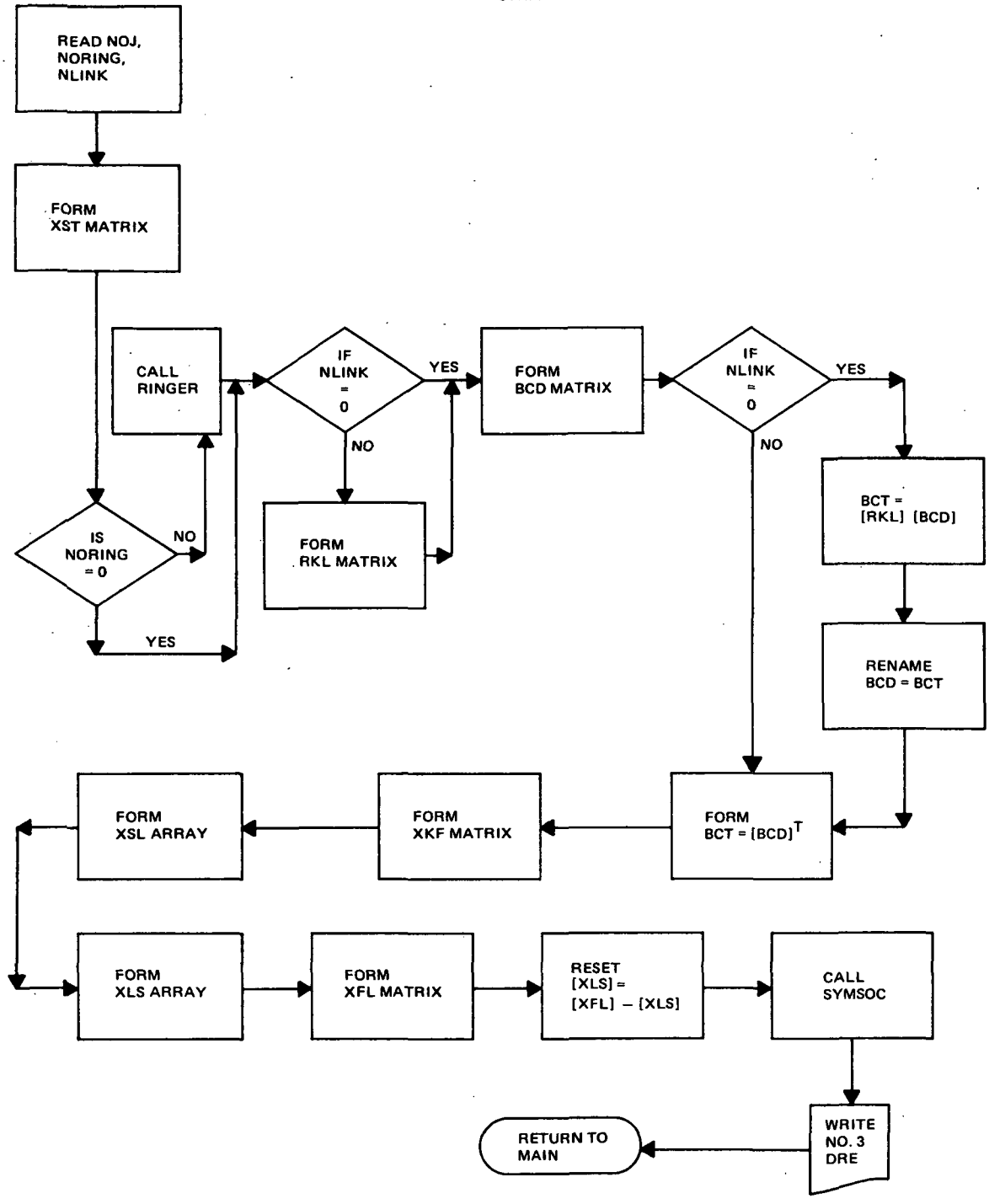
SUBROUTINE STRMAT

The region stiffness matrices, XKR, and the region load matrices, XLR, are passed from REGMAT to STRMAT via Tape #4 and Tape #8, and are placed in the XKSTOT array and the XLSTOT array, respectively. A matrix, BCD, is formed to represent the boundary conditions, and, if kinematic links occur between regions, the RKL matrix is developed to represent this situation. The subroutine RINGER is again called for discrete ring matrices.

As a result of appropriate matrix operations, a reduced structure stiffness matrix is formed. The solution of the problem is obtained by again calling the routine SYMSOC. This produces the region end deflection array, DRE.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
BCD MATRIX	$[BC]$
BCT MATRIX	$[BC]^T$
XST MATRIX	$[\hat{K}]_T$
XKF MATRIX	$[\hat{K}]_F$
A MATRIX	$[\hat{A}]_F$
XSL MATRIX	$[\hat{L}]_T$
XLS ARRAY	$\{\hat{L}\}_F$
XFL ARRAY	$\{\hat{F}\}_F$
DRE ARRAY	$\{\Delta\}_T$

STRMAT


READ NOJ, NORING, NLINK
FORM XST MATRIX
CALL RINGER
IF NLINK = 0
YES
NO
FORM RKL MATRIX
FORM BCD MATRIX
IF NLINK = 0
YES
NO
BCT = [RKL] [BCD]
RENAME BCD = BCT
IS NORING = 0
NO
YES
FORM BCT = [BCD]T
FORM XKF MATRIX
FORM XSL ARRAY
FORM XLS ARRAY
FORM XFL MATRIX
RESET [XLS] = [XFL] – [XLS]
CALL SYMSOC
WRITE NO. 3 DRE
RETURN TO MAIN

```
FOR,IS STRMAT,STRMAT
      SUBROUTINE STRMAT                                                 1600010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                     1600020
      INTEGER XN1,XN                                                    1600030
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)         1600040
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                            1600050
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH           1600060
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  1600070
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB 1600080
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE 1600090
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS            1600100
      COMMON LODE,ICYCLE,LDISTL                                         1600110
      COMMON /ARING/ NRING(28),AMAT(30,8),RSIG(12),REPS(12),RALPH(12),  1600120
     C               RBAPH(12)                                          1600130
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                        1600140
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                        1600150
      DIMENSION SCLA(128),LOC(128)                                      1600160
      DIMENSION ICOL(10)                                                1600170
      DIMENSION RKL(120,120),OPEN(4,4)                                  1600180
      DIMENSION DLP(4),BCD(124,124),TEMP(124),BCT(124),XKF(128),BC(128) 1600190
      DIMENSION A(124,124),XSL(124,1),XFL(124,1),DRE(128,1),BCA(128)    1600200
      DIMENSION XKR(8,8),XSTR(128),XLS(124,1),XLR(8,1)                  1600210
      DIMENSION XST(124,124),XSTBC(124,124),TEMP1(124)                  1600220
      DIMENSION RNGTOT(4,4),RNGLOD(4,28),JTNO(28)                       1600230
      DIMENSION COLTTL(2)                                               1600240
      DIMENSION LEAD(1)                                                 1600250
      EQUIVALENCE (XST(1),BCD(1),A(1),XSTBC(1),RKL(1))                  1600260
      EQUIVALENCE (XSTR(1),XKF(1),XFL(1),XSL(1),DRE(1),SCLA(1),         1600270
     1             TEMP(1),OPEN(1))                                     1600280
      EQUIVALENCE (XKR(1),XLR(1),BC(1),BCT(1),BCA(1),TEMP1(1),LOC(1))   1600290
      DATA COLTTL/4H  CO,4HLUMN/                                        1600300
      REWIND  2                                                         1600310
      REWIND  3                                                         1600320
      REWIND  4                                                         1600330
      REWIND  8                                                         1600340
      REWIND  9                                                         1600350
      REWIND 14                                                         1600360
    1 FORMAT(1H ,8(E14.7,2X)/(3X,8(E14.7,2X)))                          1600370
  101 FORMAT (3I5,16A4)                                                 1600380
      IF (NH.EQ.0.OR.IBEGIN.EQ.1) WRITE(6,1726)                         1600390
 1726 FORMAT(1H1)                                                       1600400
      IF (NH.NE.0) GO TO 1700                                           1600410
      READ(5,101) NOJ,NORING,NLINK                                      1600420
      NOJS = NOJ                                                        1600430
      NLINKS = NLINK                                                    1600440
      NRINGS = NORING                                                   1600450
      GO TO 1701                                                        1600460
 1700 NOJ = NOJS                                                        1600470
      NLINK = NLINKS                                                    1600480
      NORING = NRINGS                                                   1600490
 1701 CONTINUE                                                          1600500
      NH4=4                                                             1600510
      NH8=8                                                             1600520
      NJTNH4=NOJ*NH4                                                    1600530
      DO 102  J=1,NJTNH4                                                1600540
      DO 102  I=1,NJTNH4                                                1600550
  102 XST(I,J)=0.0                                                      1600560
      DO 100 NR=1,NREG                                                  1600570
      READ(4) ((XKR(I,J),J=1,8),I=1,8)                                  1600580
      J1=JRTIC(NR)                                                      1600590
      J2=JRSTOP(NR)                                                     1600600
      II=4*(J1-1)                                                       1600610
```

```
  450 JJ=4*(J2-1)+1                                                      1600620
      II=II+1                                                            1600630
      DO 460 JK=1,4                                                      1600640
      GO TO (451,452,453,454),JK                                         1600650
  451 IX=II                                                              1600660
      IND=II                                                             1600670
      DO 461 I=1,4                                                       1600680
      DO 461 J=1,4                                                       1600690
  461 OPEN(I,J)=XKR(I,J)                                                 1600700
      GO TO 455                                                          1600710
  452 IX=II                                                              1600720
      IND=JJ                                                             1600730
      DO 462 I=1,4                                                       1600740
      DO 462 J=1,4                                                       1600750
  462 OPEN(I,J)=XKR(I,J+4)                                               1600760
      GO TO 455                                                          1600770
  453 IX=JJ                                                              1600780
      IND=II                                                             1600790
      DO 463 I=1,4                                                       1600800
      DO 463 J=1,4                                                       1600810
  463 OPEN(I,J)=XKR(I+4,J)                                               1600820
      GO TO 455                                                          1600830
  454 IX=JJ                                                              1600840
      IND=JJ                                                             1600850
      DO 464 I=1,4                                                       1600860
      DO 464 J=1,4                                                       1600870
  464 OPEN(I,J)=XKR(I+4,J+4)                                             1600880
  455 DO 456 I=1,4                                                       1600890
      JX=IND                                                             1600900
      DO 457 J=1,4                                                       1600910
      XST(IX,JX)=XST(IX,JX)+OPEN(I,J)                                    1600920
  457 JX=JX+1                                                            1600930
  456 IX=IX+1                                                            1600940
  460 CONTINUE                                                           1600950
  100 CONTINUE                                                           1600960
      IF (NORING.EQ.0) GO TO 1170                                        1600970
      MFLG = 2                                                           1600980
      DO 1211 J=1,NORING                                                 1600990
      CALL RINGER (Q,XN,RNGTOT,RNGLOD,J,SADUS,UADUS,JRTIC,JRSTOP,JTNO,   1601000
     1             KBC,XNL,MFLG,NREG,ICYCLE,IBEGIN,LDISTL)               1601010
      JT = 4*(JTNO(J)-1)                                                 1601020
      DO 1220 I=1,4                                                      1601030
      DO 1220 IK=1,4                                                     1601040
 1220 XST(JT+I,JT+IK) = XST(JT+I,JT+IK)+RNGTOT(I,IK)                     1601050
 1211 CONTINUE                                                           1601060
      IF (Q.NE.5) GO TO 1170                                             1601070
      WRITE(6,300)                                                       1601080
  300 FORMAT(///)                                                        1601090
      READ(5,2000)                                                       1601100
 2000 FORMAT(1X)                                                         1601110
 1170 CONTINUE                                                           1601120
      DO 107 I=1,NJTNH4                                                  1601130
  107 WRITE (2)  (XST(I,J),J=1,NJTNH4)                                   1601140
      REWIND 2                                                           1601150
      REWIND 4                                                           1601160
      IF (NH.NE.0) GO TO 3200                                            1601170
C  GENERATION OF BC BOUNDARY CONDITION SCRAMBLING MATRIX                 1601180
      WRITE(6,347) NOJ,NLINK                                             1601190
  347 FORMAT(////51X30HINPUT DATA FOR REGION COUPLING///31X24HNUMBER OF  1601200
     1REGION JOINTS ,I3,14X26HNUMBER OF KINEMATIC LINKS ,I3///44X6HREGID 1601210
     2N11X8HJOINT(I)11X8HJOINT(J)///)                                    1601220
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      DO 348 I=1,NREG                                                   1601230
      KTIC=JRTIC(I)                                                     1601240
      KSTOP=JRSTOP(I)                                                   1601250
      WRITE(6,349) I,KTIC,KSTOP                                         1601260
  349 FORMAT(46X,I2,2(16X,I3))                                          1601270
  348 CONTINUE                                                          1601280
      IF(NLINK.EQ.0) GO TO 3108                                         1601290
       DO 756 I=1,NJTNH4                                                1601300
       DO 756 J=1,NJTNH4                                                1601310
  756 RKL(I,J)=0.0                                                      1601320
      DO 757 I = 1,NJTNH4                                               1601330
  757 RKL(I,I) = 1.0                                                    1601340
      DO 789 I=1,4                                                      1601350
       DO 789 J=1,4                                                     1601360
  789 OPEN(I,J)=0.0                                                     1601370
      OPEN(2,2) = 1.0                                                   1601380
      OPEN(3,3) = 1.0                                                   1601390
      OPEN(4,4) = 1.0                                                   1601400
      WRITE(6,1824)                                                     1601410
 1824 FORMAT(//60X,12HREGION LINKS//43X,8HJOINT(J),5X,8HJOINT(I),       1601420
     15X,20HANGLE OF ORIENTATION)                                       1601430
      DO 502 NRIG=1,NLINK                                               1601440
      READ(5,503) JD,JI,COTAN                                           1601450
  503 FORMAT(2I2,E14.7)                                                 1601460
      WRITE(6,1828) JD,JI,COTAN                                         1601470
 1828 FORMAT(46X,I2,11X,I2,11X,E14.7)                                   1601480
      IF (SIN(COTAN).NE.0.0) GO TO 1829                                 1601490
      OPEN(1,1) = 1.0                                                   1601500
      OPEN(2,4) = 0.0                                                   1601510
      OPEN(3,4) = 0.0                                                   1601520
      GO TO 1830                                                        1601530
 1829 CONTINUE                                                          1601540
      COTAN = COS(COTAN)/SIN(COTAN)                                     1601550
      OPEN(1,1) = SADUS(JD) / SADUS(JI)                                 1601560
      OPEN(2,4) = - (SADUS(JD)-SADUS(JI))                               1601570
      OPEN(3,4) = - OPEN(2,4)* COTAN                                    1601580
 1830 CONTINUE                                                          1601590
      IXX= JD*4-3                                                       1601600
      DO 504 I=1,4                                                      1601610
      JXX= JI*4-3                                                       1601620
      DO 505 J=1,4                                                      1601630
      RKL(IXX,JXX)=OPEN(I,J)                                            1601640
  505 JXX=JXX+1                                                         1601650
  504 IXX=IXX+1                                                         1601660
  502 CONTINUE                                                          1601670
      READ(5,2000)                                                      1601680
      DO 781 I=1,NJTNH4                                                 1601690
  781 WRITE(3) (RKL(I,J),J=1,NJTNH4)                                    1601700
      REWIND 3                                                          1601710
 3108 CONTINUE                                                          1601720
      DO 108 J=1,NJTNH4                                                 1601730
      DO 108 I=1,NJTNH4                                                 1601740
  108 BCD(I,J)=0.0                                                      1601750
      ICR =1                                                            1601760
      WRITE(6,2372)                                                     1601770
 2372 FORMAT(//////57X19HBOUNDARY CONDITIONS//30X5HJOINT5X7HDELTA T,5X,7 1601780
     1HDELTA Z,5X,7HDELTA R,5X,7H THETA ,7X,11HANGLE ALPHA)             1601790
      DO 109 J=1,NOJ                                                    1601800
      READ (5,110) JN,DLP(1),DLP(2),DLP(3),DLP(4),ANGLE                 1601810
  110 FORMAT  (I2,4F2.0,E14.1)                                          1601820
      I1 = DLP(1)                                                       1601830
      I2 = DLP(2)                                                       1601840
```

```
      I3 = DLP(3)                                                        1601850
      I4 = DLP(4)                                                        1601860
      WRITE(6,2373) JN,I1,I2,I3,I4,ANGLE                                 1601870
 2373 FORMAT(/31X,I3,9X,I2,10X,I2,10X,I2,10X,I2, 7X,E14.7)               1601880
      II  = (4*JN)-3                                                     1601890
      DO 121 I=1,4                                                       1601900
      IF(DLP(I)-1.0) 113,114,115                                         1601910
  115 IF(DLP(I)-2.0) 116,116,117                                         1601920
  114 BCD(II,ICR)=1.0                                                    1601930
      GOTO 118                                                           1601940
  116 BCD(II,ICR)=SIN(ANGLE)                                             1601950
      BCD(II+1,ICR)= -COS(ANGLE)                                         1601960
      GOTO 118                                                           1601970
  117 BCD(II-1,ICR)=COS(ANGLE)                                           1601980
      BCD(II,ICR)=SIN(ANGLE)                                             1601990
  118 ICR=ICR+1                                                          1602000
  113 II=II+1                                                            1602010
  121 CONTINUE                                                           1602020
  109 CONTINUE                                                           1602030
      READ(5,2000)                                                       1602040
      ICR=ICR-1                                                          1602050
      NZ=ICR                                                             1602060
      IF(NLINK.EQ.0) GO TO 3124                                          1602070
      DO 783 N=1,NJTNH4                                                  1602080
      READ(3) (TEMP(M),M=1,NJTNH4)                                       1602090
      DO 782 J=1,NZ                                                      1602100
      BCT(J)=0.0                                                         1602110
      DO 782 I=1,NJTNH4                                                  1602120
  782 BCT(J)=BCT(J)+TEMP(I)*BCD(I,J)                                     1602130
  783 WRITE (4)  (BCT(L),L=1, NZ)                                        1602140
      REWIND 3                                                           1602150
      REWIND 4                                                           1602160
      DO 126 M=1,NJTNH4                                                  1602170
  126 READ(4) (BCD(M,N),N=1,NZ)                                          1602180
C     AT THIS POINT THE BCD ARRAY IS THE PRODUCT OF RKL AND BCD ARRAYS   1602190
 3124 CONTINUE                                                           1602200
      DO 124 J=1,NZ                                                      1602210
  124 WRITE(14) (BCD(I,J),I=1,NJTNH4)                                    1602220
      DO 125 I=1,NJTNH4                                                  1602230
  125 WRITE(14) (BCD(I,J),J=1,NZ)                                        1602240
      REWIND 14                                                          1602250
      REWIND 4                                                           1602260
      GO TO 3201                                                         1602270
 3200 DO 3300 J=1,NZ                                                     1602280
 3300 READ(14) (BCD(I,J),I=1,NJTNH4)                                     1602290
      REWIND 14                                                          1602300
 3201 CONTINUE                                                           1602310
      DO 180  L=1,NJTNH4                                                 1602320
      READ (2) (XSTR(J),J=1,NJTNH4)                                      1602330
      DO 184  M=1,NZ                                                     1602340
      TEMP1(M) = 0.0                                                     1602350
      DO 181  N=1,NJTNH4                                                 1602360
  181 TEMP1(M) = TEMP1(M)+XSTR(N)*BCD(N,M)                               1602370
  184 CONTINUE                                                           1602380
      WRITE(4) (TEMP1(I),I=1,NZ)                                         1602390
  180 CONTINUE                                                           1602400
      REWIND 4                                                           1602410
      DO 183  II=1,NJTNH4                                                1602420
  183 READ (4) (XSTBC(II,JJ),JJ=1,NZ)                                    1602430
      REWIND 4                                                           1602440
      DO 182  N=1,NZ                                                     1602450
```

```
      READ(14) (BCT(J),J=1,NJTNH4)                                    1602460
      DO 185  M=1,NZ                                                  1602470
      XKF(M)=0.0                                                      1602480
      DO 186  K=1,NJTNH4                                              1602490
  186 XKF(M)=XKF(M)+BCT(K)*XSTBC(K,M)                                 1602500
  185 CONTINUE                                                        1602510
      WRITE (4) (XKF(I),I=1,NZ)                                       1602520
  182 CONTINUE                                                        1602530
      REWIND 2                                                        1602540
      REWIND 4                                                        1602550
      DO 187 I=1,NZ                                                   1602560
  187 READ(4) (A(I,J),J=1,NZ)                                         1602570
      IF (IBEGIN.EQ.0.OR.LINPUT.EQ.0) GO TO 1750                      1602580
      WRITE(6,1726)                                                   1602590
      WRITE(6,2365)                                                   1602600
 2365 FORMAT(50X,29H THE REDUCED STIFFNESS MATRIX/)                   1602610
      NUMBER = 2                                                      1602620
      JJ = 0                                                          1602630
      JJJ = 0                                                         1602640
 1725 JJ = JJJ + 1                                                    1602650
      JJJ = JJJ + 8                                                   1602660
      MM = 8                                                          1602670
      IF (JJJ.GT.NZ) MM=8-(JJJ-NZ)                                    1602680
      MMM = JJ                                                        1602690
      IF(JJJ.GT.NZ) JJJ=NZ                                            1602700
      DO 1721 M=1,MM                                                  1602710
      ICOL(M)=MMM                                                     1602720
 1721 MMM = MMM + 1                                                   1602730
      NUMBER = NUMBER + 3                                             1602740
      WRITE(6,1729) ((COLTTL,ICOL(M)),M=1,MM)                         1602750
 1729 FORMAT(/10H   ROW    ,8(2A4,1X,I3,3X)/)                        1602760
      DO 1722 I=1,NZ                                                  1602770
      NUMBER = NUMBER + 1                                             1602780
      WRITE(6,1728)I,(A(I,J),J=JJ,JJJ)                                1602790
 1728 FORMAT(3X,I3,4X,8(E14.7,1X))                                    1602800
      IF(NUMBER.LT.55) GO TO 1722                                     1602810
      NUMBER = 3                                                      1602820
      WRITE(6,1726)                                                   1602830
      WRITE(6,1729) ((COLTTL,ICOL(M)),M=1,MM)                         1602840
 1722 CONTINUE                                                        1602850
      IF(JJJ.NE.NZ) GO TO 1725                                        1602860
 1750 CONTINUE                                                        1602870
      REWIND 14                                                       1602880
      DO 991 J=1,NPROB                                                1602890
      DO 991 I=1,NJTNH4                                               1602900
  991 XSL(I,J) = 0.0                                                  1602910
 1001 DO 777 NR=1,NREG                                                1602920
      J1 = JRTIC(NR)                                                  1602930
      J2 = JRSTOP(NR)                                                 1602940
      READ(8) ((XLR(I,J),J=1,NPROB),I=1,NH8)                          1602950
      DO 777 N2 = 1,2                                                 1602960
      GOTO (11,12),N2                                                 1602970
   11 II = (J1-1)*NH4+1                                               1602980
      III= II+NH4-1                                                   1602990
      GOTO 3                                                          1603000
   12 II = (J2-1)*4+1                                                 1603010
      III= II+NH4-1                                                   1603020
    3 DO 777 J=1,NPROB                                                1603030
      I=0                                                             1603040
      IF(N2.EQ.2) I=NH4                                               1603050
      DO 777 IL=II,III                                                1603060
      I=I+1                                                           1603070
```

```
  777 XSL(IL,J) = XSL(IL,J)+XLR(I,J)                                    1603080
      IF (NORING.EQ.0) GO TO 1150                                       1603090
      DO 1225 J=1,NORING                                                1603100
      JT = 4*(JTNO(J)-1)                                                1603110
      DO 1227 I=1,4                                                     1603120
      DO 1226 IK=1,NPROB                                                1603130
 1226 XSL(JT+I,IK) = XSL(JT+I,IK)+RNGLOD(I,J)                           1603140
 1227 CONTINUE                                                          1603150
 1225 CONTINUE                                                          1603160
 1150 CONTINUE                                                          1603170
      DO 876 N=1,NZ                                                     1603180
      READ(14) (BCT(J),J=1,NJTNH4)                                      1603190
      DO 717 M=1,NPROB                                                  1603200
      XLS(N,M) = 0.0                                                    1603210
      DO 806 K=1,NJTNH4                                                 1603220
  806 XLS(N,M) = XLS(N,M) + BCT(K)*XSL(K,M)                             1603230
  717 CONTINUE                                                          1603240
  876 CONTINUE                                                          1603250
      DO 301 J=1,NPROB                                                  1603260
      DO 301 I=1,NZ                                                     1603270
  301 XFL(I,J) = 0.0                                                    1603280
      IF (LDISTL.EQ.1) GO TO 360                                        1603290
      READ(5,302)  LINLOD,(STORY(I),I=1,16)                             1603300
  302 FORMAT(I4,16A4)                                                   1603310
      WRITE(LODE) LINLOD                                                1603320
      GO TO 361                                                         1603330
  360 READ(LODE) LINLOD                                                 1603340
  361 CONTINUE                                                          1603350
      IF(LINLOD.EQ.0)  GO TO 303                                        1603360
      IF (ICYCLE.EQ.1.OR.NH.EQ.0) WRITE(6,341)                          1603370
  341 FORMAT(1H1///57X,19HEXTERNAL LINE LOADS///36X,14HPROBLEM NUMBER,7X 1603380
     120HPOINT OF APPLICATION,7X,12HAPPLIED LOAD//)                     1603390
      IF (LDISTL.EQ.1) GO TO 362                                        1603400
      JEXT2 = 1                                                         1603410
      DO 304 N=1,LINLOD                                                 1603420
      READ(5,305) JEXT1,XFL(JEXT1,JEXT2)                                1603430
  305 FORMAT(5X,I5,E14.7)                                               1603440
      IF (ICYCLE.EQ.1.OR.IBEGIN.EQ.1)                                   1603450
     1WRITE(6,342) JEXT2,JEXT1,XFL(JEXT1,JEXT2)                         1603460
  342 FORMAT(41X,I3,22X,I3,15X,E14.7)                                   1603470
  304 CONTINUE                                                          1603480
      WRITE(LODE) ((XFL(I,J),I=1,NZ),J=1,NPROB)                         1603490
      GO TO 303                                                         1603500
  362 READ(LODE) ((XFL(I,J),I=1,NZ),J=1,NPROB)                          1603510
  303 CONTINUE                                                          1603520
      IF (LDISTL.NE.1) READ(5,2000)                                     1603530
  306 CONTINUE                                                          1603540
      DO 811 J=1,NPROB                                                  1603550
      DO 811 I=1,NZ                                                     1603560
  811 XLS(I,J) = XFL(I,J)*DELP-XLS(I,J)                                 1603570
      DO 520 J=1,NPROB                                                  1603580
      DO 530 I=1,NZ                                                     1603590
      IF (XLS(I,J).NE.0.0) GO TO 540                                    1603600
  530 CONTINUE                                                          1603610
      LEAD(J) = NZ                                                      1603620
      GO TO 520                                                         1603630
  540 LEAD(J) = I                                                       1603640
  520 CONTINUE                                                          1603650
      CALL SYMSOC (A,A,NZ,0,XLS,NPROB,LEAD,124,0.0,NIX)                 1603660
      IF (NIX.NE.0) GO TO 8777                                          1603670
      DO 812 J=1,NJTNH4                                                 1603680
```

```
      READ(14) (BC(K),K=1,NZ)                                          1603690
      DO 813 M=1,NPROB                                                 1603700
      DRE(J,M)=0.0                                                     1603710
      DO 813 N=1,NZ                                                    1603720
  813 DRE(J,M) = DRE(J,M)+BC(N)*XLS(N,M)                               1603730
  812 CONTINUE                                                         1603740
      IF (NH.NE.0.AND.(LINPUT.NE.1.OR.IBEGIN.NE.1)) GO TO 1776         1603750
      WRITE(6,1726)                                                    1603760
      WRITE(6,2368)                                                    1603770
 2368 FORMAT(31X,70HTHE EXPANDED REGION JOINT DISPLACEMENT MATRIX (REGIO 1603780
     1N END DEFLECTIONS))                                              1603790
      WRITE(6,1770)                                                    1603800
 1770 FORMAT(//14X,5HJOINT,14X,7HPROBLEM,13X,7HDELTA T,13X,7HDELTA Z,13X 1603810
     1,7HDELTA R,11X,11HOMEGA-THETA)                                   1603820
      NUMBER = 4                                                       1603830
      KK=-3                                                            1603840
      DO 1735 J=1,NOJ                                                  1603850
      NUMBER = NUMBER + NPROB + 1                                      1603860
      IF(NUMBER.LT.56) GO TO 1745                                      1603870
      WRITE(6,1726)                                                    1603880
      WRITE(6,1770)                                                    1603890
      NUMBER=2+NPROB+3                                                 1603900
 1745 KK=KK+4                                                          1603910
      KKK=KK+3                                                         1603920
      WRITE(6,1739)                                                    1603930
 1739 FORMAT(1H )                                                      1603940
      DO 1764 L=1,NPROB                                                1603950
      WRITE(6,1765) J,L,(DRE(K,L),K=KK,KKK)                            1603960
 1765 FORMAT(15X,I2,18X,I2,9X,4(3X,E14.7,3X))                          1603970
 1764 CONTINUE                                                         1603980
 1735 CONTINUE                                                         1603990
 1776 CONTINUE                                                         1604000
      DO 71  NR=1,NREG                                                 1604010
      DO 71  K=1,2                                                     1604020
      II =(JRTIC(NR) - 1) *4 +1                                        1604030
      IF(K.EQ.2) II= JRSTOP(NR)*4-3                                    1604040
      III= II + 3                                                      1604050
      DO 71 I = II,III                                                 1604060
   71 WRITE(3) (DRE(I,J),J=1,NPROB)                                    1604070
      REWIND 2                                                         1604080
      REWIND 3                                                         1604090
      REWIND 4                                                         1604100
      GOTO 7                                                           1604110
 8777 IERROR =8777                                                     1604120
      NERROR=32                                                        1604130
      NIX=1                                                            1604140
    7 RETURN                                                           1604150
       END                                                             1604160
```

SUBROUTINE INITAL

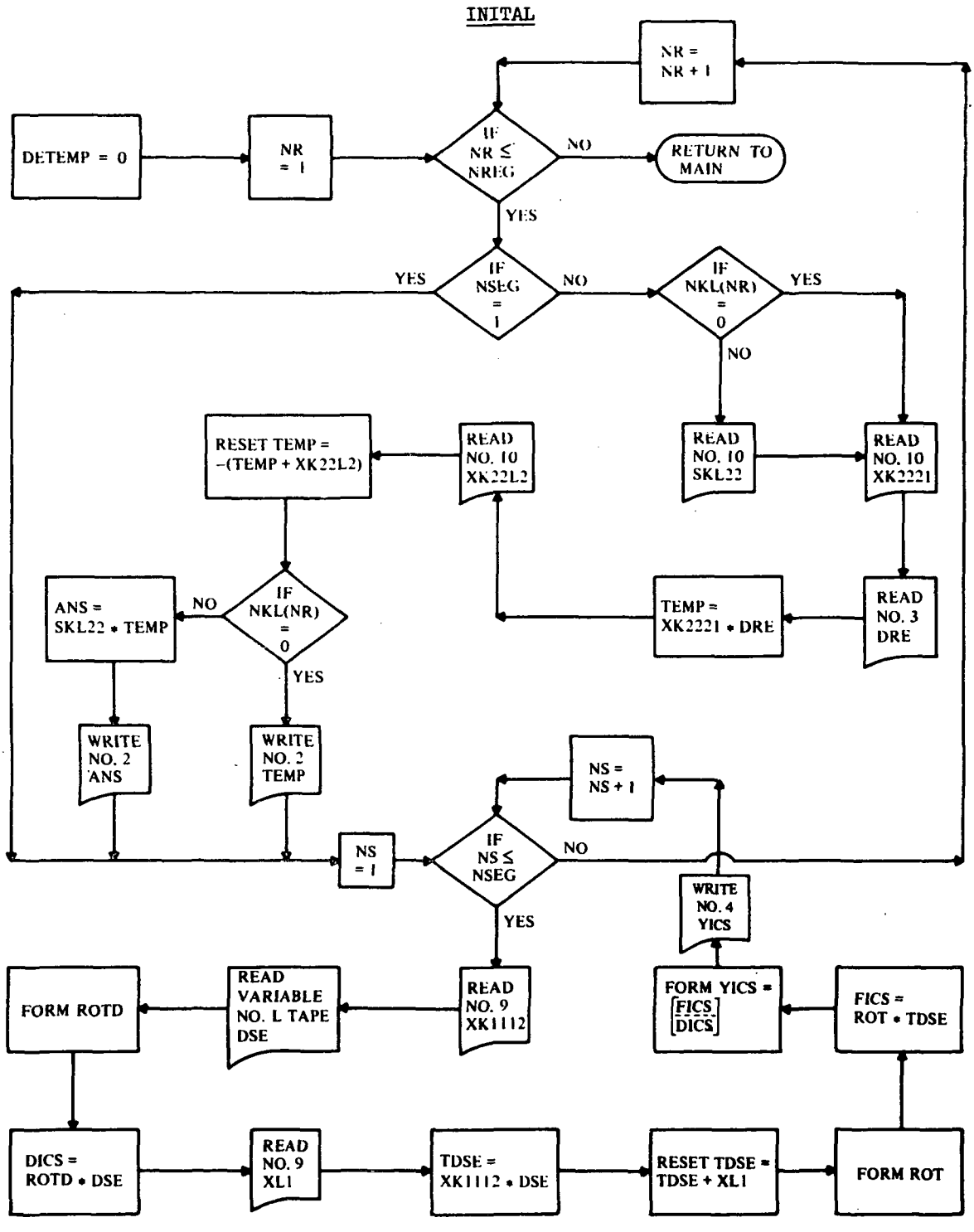
As a result of the matrix operations performed in REGMAT, the SKI22, the XK2221, and the XK22L2 arrays for each region are passed to INITAL. The XK1112 and XL1 arrays for each segment, resulting from the matrix procedures in SEGMAT, are also passed to INITAL. The region end deflection matrices, DRE, which were formed in STRMAT are transmitted to INITAL.

Following appropriate matrix operations upon these arrays, the force initial conditions, the FICS array, and the deflections initial conditions, the DICS array, are produced. These arrays combine to form the YICS matrix, which contains the true initial conditions for the structure to be analyzed.

The pertinent counters in the subroutine are:

NS = segment counter
NR = region counter

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
XK2221 MATRIX	$\left[\hat{K}_{22}\right]^{-1} \left[\hat{K}_{21}\right]$
XK22L2 MATRIX	$\left[\hat{K}_{22}\right]^{-1} \left[\hat{L}\right]$
DSE ARRAY	$\{\Delta\}$
XK1112 MATRIX	$\left[k_{ii} \mid k_{ij}\right]$
ROTD MATRIX	$\left[IDT\right]^{T}$
DICS ARRAY	$\{\delta(i)\}$
XL1 ARRAY	$\{\ell(i)\}$
ROT MATRIX	$\left[IFT\right]^{T}$
FICS ARRAY	$\{f(i)\}$


INITAL
NR = NR + 1
DETEMP = 0
NR = 1
IF NR ≤ NREG
NO
RETURN TO MAIN
YES
IF NSEG = 1
YES
NO
IF NKL(NR) = 0
YES
NO
RESET TEMP = -(TEMP + XK22L2)
READ NO. 10 XK22L2
READ NO. 10 SKL22
READ NO. 10 XK2221
ANS = SKL22 * TEMP
NO
IF NKL(NR) = 0
YES
TEMP = XK2221 * DRE
READ NO. 3 DRE
WRITE NO. 2 ANS
WRITE NO. 2 TEMP
NS = NS + 1
NS = 1
IF NS ≤ NSEG
NO
YES
WRITE NO. 4 YICS
FORM ROTD
READ VARIABLE NO. L TAPE DSE
READ NO. 9 XK1112
FORM YICS = FICS / DICS
FICS = ROT * TDSE
DICS = ROTD * DSE
READ NO. 9 XL1
TDSE = XK1112 * DSE
RESET TDSE = TDSE + XL1
FORM ROT

```
FOR,IS INITAL,INITAL
      SUBROUTINE INITAL                                                    1700010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                        1700020
      INTEGER XN1,XN                                                       1700030
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)            1700040
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                               1700050
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,GI,XNL(3),NH              1700060
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)     1700070
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB    1700080
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE    1700090
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS               1700100
      COMMON LODE,ICYCLE,LDISTL                                            1700110
      DIMENSION XK2221(112,8),DRE(8,1),TEMP(112,1),XK22L2(112,1)           1700120
      DIMENSION XK1112(4,8),DSE(8,1),ROTD(4,4),DICS(4,1)                   1700130
      DIMENSION TDSE(8,1),YICS(8,1)                                        1700140
      DIMENSION XL1(4,1),ROT(4,4),FICS(4,1),SKL22(112,112),ANS(112,1)      1700150
      EQUIVALENCE (ROT(1),ROTD(1)),(TIC,TICK)                              1700160
      EQUIVALENCE (DSE(1),DRE(1)),(XK2221(1),XK22L2(1))                    1700170
      EQUIVALENCE (SKL22(1),XK1112(1)),(YICS(1),TDSE(1))                   1700180
      NH4 = 4                                                              1700190
      NH41=NH4+1                                                           1700200
      NH8 = 8                                                              1700210
      NH81=NH8+1                                                           1700220
      REWIND  2                                                            1700230
      REWIND  3                                                            1700240
      REWIND  4                                                            1700250
       REWIND  8                                                           1700260
      REWIND  9                                                            1700270
      REWIND 10                                                            1700280
      DO 100 NR=1,NREG                                                     1700290
      NOJ = NST(NR) + NKL(NR) + 1                                          1700300
      ISKL22 = 4*(NOJ-2)                                                   1700310
      JSKL22 = 4*(NOJ-2-NKL(NR))                                           1700320
      NJTNH4=NOJ*NH4                                                       1700330
      M8=4*(NOJ-NKL(NR))-8                                                 1700340
      NSEG=NST(NR)                                                         1700350
      IF (NSEG.EQ.1) GOTO 703                                              1700360
      IF(NKL(NR).EQ.0) GO TO 415                                           1700370
      READ(10) ((SKL22(I,J),J=1,JSKL22),I=1,ISKL22)                        1700380
  415 READ(10)  ((XK2221(I,J),J=1,NH8),I=1,M8)                             1700390
      READ(10) (SAVJTC(I),SAVSTP(I),I=1,NSEG)                              1700400
  703 DO 91 K = 1,2                                                        1700410
      II = 1                                                               1700420
      IF(K.EQ.2) II=5                                                      1700430
      III = II+3                                                           1700440
      DO 91 I=II,III                                                       1700450
   91 READ(3) (DRE(I,J),J=1,NPROB)                                         1700460
      IF (NSEG.EQ.1) GOTO 999                                              1700470
      DO 101 J=1,NPROB                                                     1700480
      DO 101 I=1,M8                                                        1700490
      TEMP(I,J)=0.0                                                        1700500
      DO 101 K=1,NH8                                                       1700510
      TEMP(I,J)=TEMP(I,J)+XK2221(I,K)*DRE(K,J)                             1700520
  101 CONTINUE                                                             1700530
      READ(10)((XK22L2(I,J),J=1,NPROB),I=1,M8)                             1700540
      DO 102 J=1,NPROB                                                     1700550
      DO 102 I=1,M8                                                        1700560
  102 TEMP(I,J)= -(TEMP(I,J)+XK22L2(I,J))                                  1700570
      IF(NKL(NR).EQ.0) GO TO 435                                           1700580
      DO 445 I = 1,ISKL22                                                  1700590
```

```
      DO 445 J=1,NPROB                                                    1700600
      ANS(I,J)=0.0                                                        1700610
      DO 445 K = 1,JSKL22                                                 1700620
  445 ANS(I,J)=ANS(I,J)+SKL22(I,K)*TEMP(K,J)                              1700630
  435 DO 391 N=1,NSEG                                                     1700640
      IF((N.EQ.1.OR.N.EQ.NSEG).AND.SAVJTC(N).GT.SAVSTP(N)) GO TO 370      1700650
      DO 398 K=1,2                                                        1700660
      IF (N.NE.1.OR.K.NE.1) GOTO 393                                      1700670
      DO 394 I= 1,4                                                       1700680
  394 WRITE (2) (DRE(I,J),J=1,NPROB)                                      1700690
      GO TO 398                                                           1700700
  393 IF(N.EQ.NSEG.AND.K.EQ.2) GOTO 395                                   1700710
      IF (K.EQ.1) II = SAVJTC(N)*4-7                                      1700720
      IF (K.EQ.2) II = SAVSTP(N)*4-7                                      1700730
      III = II + 3                                                        1700740
      DO 397 I=II,III                                                     1700750
      IF (NKL(NR).EQ.0) GOTO 392                                          1700760
      WRITE (2) (ANS(I,J),J=1,NPROB)                                      1700770
      GOTO 397                                                            1700780
  392 WRITE (2) (TEMP(I,J),J=1,NPROB)                                     1700790
  397 CONTINUE                                                            1700800
      GO TO 398                                                           1700810
  395 DO 396 I=5,8                                                        1700820
  396 WRITE (2)  (DRE(I,J),J=1,NPROB)                                     1700830
  398 CONTINUE                                                            1700840
      GO TO 391                                                           1700850
  370 IF(N.EQ.NSEG) GO TO 380                                             1700860
      IF(NKL(NR).EQ.0) GO TO 375                                          1700870
      DO 371 I=1,4                                                        1700880
  371 WRITE(2) (ANS(I,J),J=1,NPROB)                                       1700890
      GO TO 376                                                           1700900
  375 DO 372 I=1,4                                                        1700910
  372 WRITE(2) (TEMP(I,J),J=1,NPROB)                                      1700920
  376 DO 373 I=1,4                                                        1700930
  373 WRITE(2) (DRE(I,J),J=1,NPROB)                                       1700940
       GO TO 391                                                          1700950
  380 CONTINUE                                                            1700960
       DO 381 I=5,8                                                       1700970
  381 WRITE(2) (DRE(I,J),J=1,NPROB)                                       1700980
       IF(NKL(NR).EQ.0) GO TO 385                                         1700990
      II = ISKL22-3                                                       1701000
      III = ISKL22                                                        1701010
       DO 382 I=II,III                                                    1701020
  382 WRITE(2) (ANS(I,J),J=1,NPROB)                                       1701030
       GO TO 391                                                          1701040
  385 II = M8-3                                                           1701050
      III = M8                                                            1701060
      DO 383 I=II,III                                                     1701070
  383 WRITE(2) (TEMP(I,J),J=1,NPROB)                                      1701080
  391 CONTINUE                                                            1701090
      REWIND 2                                                            1701100
  999 DO 201 NS=1,NSEG                                                    1701110
      READ  (9) ((XK1112(I,J),J=1,NH8),I=1,NH4),IGEOM,G1                  1701120
      ISEG=0                                                              1701130
      NR1=NR-1                                                            1701140
      IF(NR1.EQ.0)GOTO8                                                   1701150
      DO 7 I=1,NR1                                                        1701160
    7 ISEG=ISEG+NST(I)                                                    1701170
    8 ISEG=ISEG+NS                                                        1701180
      TIC= SAVTIC(ISEG)                                                   1701190
      GO TO (21,22,23),IGEOM                                              1701200
```

```
 21 SN = SIN(TIC)                                                    1701210
    CS = COS(TIC)                                                    1701220
    GO TO 25                                                         1701230
 22 SN = COS(1.570796-G1)                                            1701240
    CS = SIN(1.570796-G1)                                            1701250
    IF (G1.NE.0.0) GO TO 25                                          1701260
    SN = 0.0                                                         1701270
    CS = 1.0                                                         1701280
    GO TO 25                                                         1701290
 23 SN = 1.0                                                         1701300
    CS = 0.0                                                         1701310
 25 CONTINUE                                                         1701320
    IF (NSEG.EQ.1) GO TO 80                                          1701330
    DO 78 I = 1,8                                                    1701340
 78 READ (2) (DSE(I,J),J=1,NPROB)                                    1701350
 80 CONTINUE                                                         1701360
    DO 302 J=1,NH4                                                   1701370
    DO 302 I=1,NH4                                                   1701380
302 ROTD(I,J)=0.0                                                    1701390
    DO 305 J=1,NH4,4                                                 1701400
    ROTD(J,J)=1.0                                                    1701410
    ROTD(J+1,J+2)=CS                                                 1701420
    ROTD(J+2,J+1)=-CS                                                1701430
    ROTD(J+1,J+1)=-SN                                                1701440
    ROTD(J+2,J+2)=-SN                                                1701450
305 ROTD(J+3,J+3)=1.0                                                1701460
    DO 306 J=1,NPROB                                                 1701470
    DO 306 I=1,NH4                                                   1701480
    DICS(I,J)=0.0                                                    1701490
    DO 306 K=1,NH4                                                   1701500
306 DICS(I,J)=DICS(I,J)+ROTD(I,K)*DSE(K,J)                           1701510
    READ(9) ((XL1(I,J),J=1,NPROB),I=1,NH4)                           1701520
    DO 202 J=1,NPROB                                                 1701530
    DO 202 I=1,NH4                                                   1701540
    TDSE(I,J)=0.0                                                    1701550
    DO 202 K=1,NH8                                                   1701560
202 TDSE(I,J)=TDSE(I,J)+XK1112(I,K)*DSE(K,J)                         1701570
    DO 203 J=1,NPROB                                                 1701580
    DO 203 I=1,NH4                                                   1701590
203 TDSE(I,J)=TDSE(I,J)+XL1(I,J)                                     1701600
    DO 301 J=1,NH4                                                   1701610
    DO 301 I=1,NH4                                                   1701620
301 ROTD(I,J)=0.0                                                    1701630
    DO 204 J=1,NH4,4                                                 1701640
    ROT(J,J)=-1.0                                                    1701650
    ROT(J+1,J+2)=-CS                                                 1701660
    ROT(J+2,J+1)= CS                                                 1701670
    ROT(J+1,J+1)=SN                                                  1701680
    ROT(J+2,J+2)=SN                                                  1701690
204 ROT(J+3,J+3)=1.0                                                 1701700
    DO 205 J=1,NPROB                                                 1701710
    DO 205 I=1,NH4                                                   1701720
    FICS(I,J)=0.0                                                    1701730
    DO 205 K=1,NH4                                                   1701740
205 FICS(I,J)=ROT(I,K)*TDSE(K,J)+FICS(I,J)                           1701750
    DO 402 J=1,NPROB                                                 1701760
    DO 402 I=1,NH4                                                   1701770
    II=I+NH4                                                         1701780
    YICS(I,J)=FICS(I,J)                                              1701790
402 YICS(II,J)=DICS(I,J)                                             1701800
    WRITE(4)   ((YICS(I,J),I=1,8),J=1,NPROB)                         1701810
```

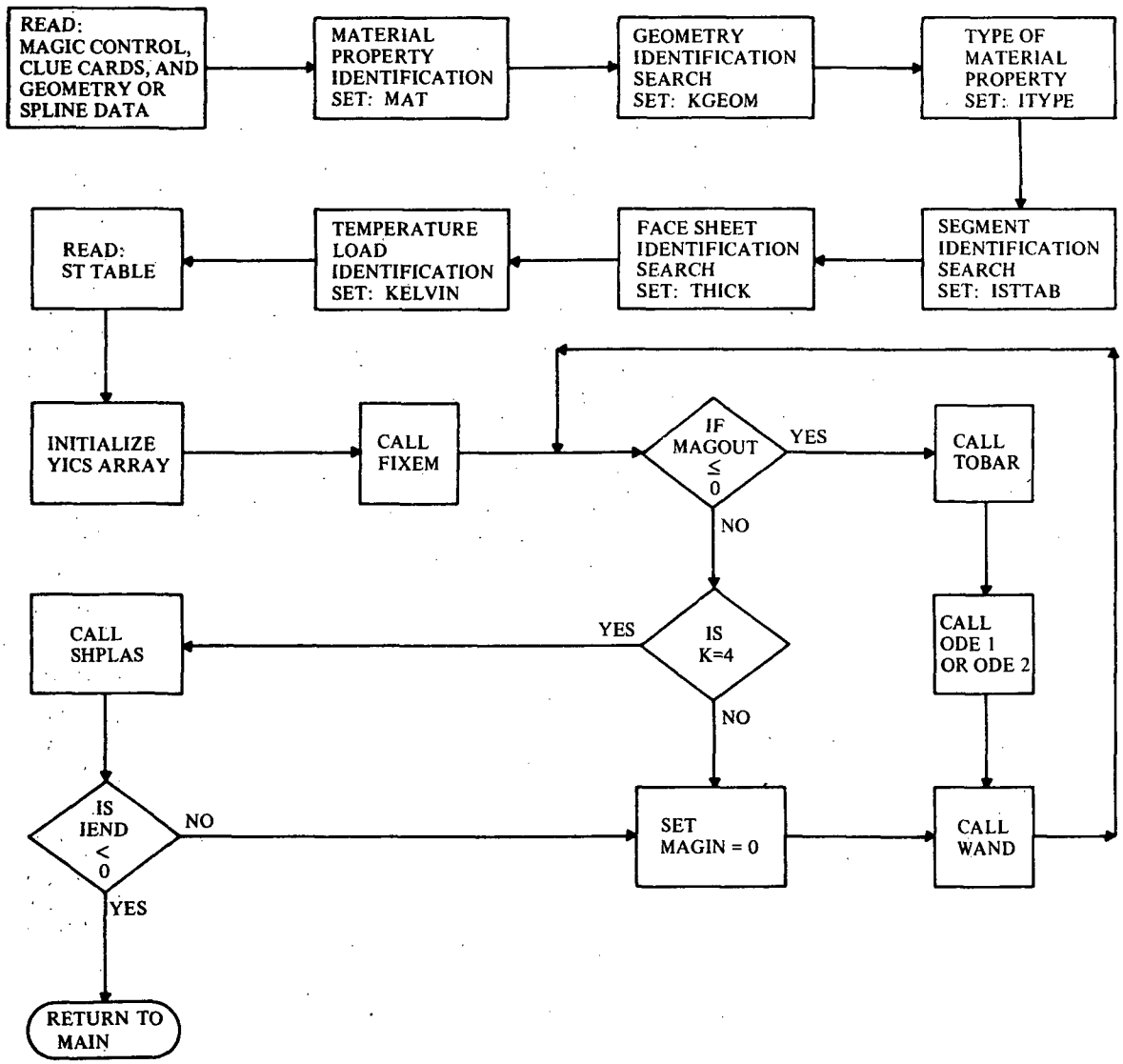
```
201 CONTINUE                                                    1701820
    REWIND 2                                                    1701830
100 CONTINUE                                                    1701840
    REWIND  1                                                   1701850
    REWIND  4                                                   1701860
     REWIND  8                                                  1701870
    RETURN                                                      1701880
     END                                                        1701890
```

SUBROUTINE LEBEGE

The subroutine link LEBEGE receives the YICS array for each segment from INITAL via Tape #4. The subroutine FIXEM is called to integrate the differential equations of each segment, under true load conditions. FIXEM is identical to subroutine SETUP, while WAND corresponds to subroutine MAGIC and only consideration of the OVERLAY structure dictates the change in names. The subroutines TOBAR, TEMOEG, PLYCO, and PLYNE are similarly equivalent to ROBOT, GEOMET, PLICO, and PLINE discussed previously.

The results of the final integration sequence are the forces and deflections at the beginning, intermediate, and end points of each segment. These are always the incremental values. The updating for current load step is accomplished in subroutine SHPLAS.

Subroutine GRAPH: This subroutine controls the system graphical routines. GRAPH prints the titles and passes the graphical display points to the necessary system routines, which utilize a Stromberg-Carlson 4020 plotter.


READ:
MAGIC CONTROL,
CLUE CARDS, AND
GEOMETRY OR
SPLINE DATA
MATERIAL
PROPERTY
IDENTIFICATION
SET: MAT
GEOMETRY
IDENTIFICATION
SEARCH
SET: KGEOM
TYPE OF
MATERIAL
PROPERTY
SET: ITYPE
SEGMENT
IDENTIFICATION
SEARCH
SET: ISTTAB
FACE SHEET
IDENTIFICATION
SEARCH
SET: THICK
TEMPERATURE
LOAD
IDENTIFICATION
SET: KELVIN
READ:
ST TABLE
INITIALIZE
YICS ARRAY
CALL
FIXEM
IF
MAGOUT
≤
0
YES
CALL
TOBAR
NO
IS
K=4
YES
CALL
SHPLAS
CALL
ODE 1
OR ODE 2
NO
IS
IEND
<
0
NO
SET
MAGIN = 0
CALL
WAND
YES
RETURN TO
MAIN

```
FOR,IS LEBEGE,LEBEGE
      SUBROUTINE LEBEGE                                                 1800010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                     1800020
      INTEGER XN                                                        1800030
      DOUBLE PRECISION YNEW,YPRED                                       1800040
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)         1800050
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                            1800060
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH           1800070
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  1800080
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB 1800090
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE  1800100
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS            1800110
      COMMON LODE,ICYCLE,LDISTL                                         1800120
      COMMON /ARING/ NRING(28),AMAT(30,8),RSIG(12),REPS(12),RALPH(12),  1800130
     C               RBAPH(12)                                          1800140
      COMMON /SNILPS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),        1800150
     1       DR1DP(100),ZI(14),RI(14),NRZIN                             1800160
      COMMON /MAGIQ/ KKNT,TII,TIK,TOK,TOO                               1800170
      COMMON /LASTEQ/ YPRED(8),YDOT(8),YASAVE(8),                       1800180
     1                YANTH,YAMTH,YAMPT,YANPT,YAOPH,YAQPH,YAQTH,YAJPH,  1800190
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,        1800200
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,      1800210
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,  1800220
     5     ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,R1SQ,                          1800230
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,     1800240
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,      1800250
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,   1800260
     9                XK11,XK12,XK21,XK22,XK33,XD11,                    1800270
     A                   M,I,SITIN,SITOUT,SIPIN,SIPOUT,TPTIN,TPTOUT,    1800280
     B               ZBRIN,ZBROUT,SCRIPA,SCRIPI,SIFIN,SIFOUT,TZEPH,TZETH 1800290
     8                  ,XNPHI,BETTA,ZETTA,XC16                        1800300
     C                  ,RMOSS,RMOSN,YLDST,ROC,HP,FPLUH,GPLUH,TWON     1800310
     D                  ,RMOSSY,RMOSNY,RMOSXY,RMONXY                   1800320
     D                  ,RMOSNS,RMOSSS,SIGOXS,RMOSNR,RMOSSR,SIGOXR     1800330
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI,NEO                            1800340
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                        1800350
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),    1800360
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),    1800370
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),     1800380
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)             1800390
      COMMON /CMAIN/ ZETA1(21),ZETA2(21),NODE,ALF(4),CE(4),NLRS,HI,HO,T 1800400
      COMMON /CDISP/ P                                                  1800410
      COMMON /RWO/ ER,ES,CPH,CTH,APH,ATH,SPH,STH,ALPHS,ALPHR,TS,TR,SNB, 1800420
     C             CSB                                                 1800430
      COMMON /GRAFIX/ X(100),Y(100,9),NGRAPH,LDEF(9),NGR,JCYC,NFLAG,JAM, 1800440
     C                JNSC                                             1800450
      DIMENSION LST(13),YDEV(8),YICS(8),YNEW(8)                         1800460
      DIMENSION XKF(128),TBDEL(8),FWDEL(8),YCORR(8)                     1800470
      DIMENSION ST(30,31),XLAYER(26)                                    1800480
      EQUIVALENCE (YNEW(1),XKF(1))                                      1800490
      REWIND  1                                                         1800500
  600 FORMAT(1H ,8(E14.7,2X)/(3X,8(E14.7,2X)))                          1800510
      KSC = 0                                                           1800520
      JAM =1                                                            1800530
      JNSC =0                                                           1800540
      DO 451 I=1,NREG                                                   1800550
  451 KSC = KSC + NST(I)                                                1800560
      LSC = 0                                                           1800570
  902 LSC = LSC + 1                                                     1800580
      JCYC = 0                                                          1800590
```

```
      XNTTH = 0.0                                                       1800600
      XNTPH = 0.0                                                       1800610
      XMTTH = 0.0                                                       1800620
      XMTPH = 0.0                                                       1800630
      NSC=LSC                                                           1800640
      JNSC=JNSC+1                                                       1800650
      IF(JNSC.LE.NST(JAM)) GO TO 1727                                   1800660
      NRNG = NRING(JAM)                                                 1800670
      IF (NRNG.EQ.0) GO TO 1900                                         1800680
      DO 1901 I=1,NRNG                                                  1800690
 1901 READ(1) DUMLNK                                                    1800700
 1900 CONTINUE                                                          1800710
      NNSKL = NKL(JAM)                                                  1800720
      IF (NNSKL.EQ.0) GO TO 1724                                        1800730
      DO 1725 I=1,NNSKL                                                 1800740
 1725 READ(1) DUMLNK                                                    1800750
 1724 CONTINUE                                                          1800760
      JAM=JAM+1                                                         1800770
      JNSC=1                                                            1800780
 1727 CONTINUE                                                          1800790
      READ(1) KGEOM,IGEOM,RGO,ANG,NLRS,STORY                            1800800
      READ(1) DTAU,DIFF,STEP,DELTA,NAPEX                                1800810
      IF (RGO.EQ.14.0) GO TO 182                                        1800820
      READ(1)        G1,G2,G3                                           1800830
      GO TO 183                                                         1800840
  182 READ(1) NRZIN,(ZI(J),RI(J),J=1,NRZIN)                             1800850
  183 CONTINUE                                                          1800860
      READ(1) ITYPE,MAT,THICK,ISTTAB,KELVIN,KORI,TEFREE,NP,KLUE1,KLUE2, 1800870
     1        IANLYZ,NROW                                               1800880
      DIFF  =1.0E-04                                                    1800890
      EPSIL =1.0E-05                                                    1800900
      ERR = 1.0 E-07                                                    1800910
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 1776                           1800920
      WRITE(6,1726)                                                     1800930
 1726 FORMAT(1H1)                                                       1800940
      IF(JNSC.EQ.1) WRITE(6,606) JAM,NST(JAM),NKL(JAM)                  1800950
  606 FORMAT(//58X,13HREGION NUMBER,I3//35X,10HTHERE ARE ,I2,14H SEGMENT 1800960
     1S AND ,I2,35H KINEMATIC LINKS WITHIN THIS REGION)                 1800970
      I = RGO                                                           1800980
      WRITE(6,651) JNSC,I,NLRS                                          1800990
  651 FORMAT(//13X,15HSEGMENT NUMBER ,I2,5X,13HSEGMENT CODE ,I2,5X,     1801000
     1 14HNO. OF LAYERS ,I2)                                            1801010
 1776 CONTINUE                                                          1801020
      NCONT = NROW                                                      1801030
      IF (NH.EQ.0.OR.IBEGIN.EQ.1) WRITE(6,655)                          1801040
  655 FORMAT(//42X,47HTABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES)   1801050
       DO 901  I=1,NROW                                                 1801060
      READ(1)        (ST(I,J),J=1,NP)                                   1801070
      IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 901                            1801080
      WRITE(6,600) (ST(I,J),J=1,NP)                                     1801090
  901 CONTINUE                                                          1801100
      DO 750 JJ=1,12                                                    1801110
  750 LST(JJ) = 0                                                       1801120
      NLCS = NLCASE                                                     1801130
      NLPO = NLRS+1                                                     1801140
      KBC = NLPO                                                        1801150
      IF (THICK.NE.1) KBC = 2.0*NLPO                                    1801160
      TAP1 = NLRS/2                                                     1801170
      DO 290 I=1,NLPO                                                   1801180
      TAP2 = I-1                                                        1801190
      ZETA1(I) = 1.0-TAP2/TAP1                                          1801200
```

```
290 ZETA2(I) = 1.0-FLOAT(I-1)/FLOAT(NLRS)                                    1801210
    K=NROW+1                                                                 1801220
    JJ=1                                                                     1801230
    JJJ=6                                                                    1801240
    MM=1                                                                     1801250
    DO 17 NLC=1,NLCS                                                         1801260
    JT = JJ                                                                  1801270
    JTT= JJJ                                                                 1801280
    L=0                                                                      1801290
    READ(LODE) (LST(J),J=JJ,JJJ)                                             1801300
    IF(LST(JJ))8031,19,20                                                    1801310
 20 L = LST(JJ)                                                              1801320
 19 JJ=JJ+1                                                                  1801330
 23 IF(LST(JJ))8031,22,21                                                    1801340
 21 L=L+1                                                                    1801350
 22 IF(JJ.EQ.JJJ) GOTO 24                                                    1801360
    JJ=JJ+1                                                                  1801370
    GOTO 23                                                                  1801380
 24 IF (L.EQ.0) GO TO 668                                                    1801390
    KK = K + L - 1                                                           1801400
    DO 72 M=K,KK                                                             1801410
    READ(LODE) (ST(M,J),J=1,NP)                                              1801420
 72 CONTINUE                                                                 1801430
    IF (LST(JT).EQ.0) GO TO 660                                              1801440
    KZ = K + LST(1) -1                                                       1801450
    K = KZ + 1                                                               1801460
660 CONTINUE                                                                 1801470
    IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 665                                   1801480
    WRITE(6,661)                                                             1801490
 661 FORMAT(//31X,84HTABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THE      1801500
   1TA, F PHI, F ZETA, M THETA, M PHI),)                                     1801510
    WRITE(6,1968) (LST(J),J=JT,JTT)                                          1801520
1968 FORMAT(27H LOAD IDENTIFICATION CLUES ,6I1/)                             1801530
    DO 662 N=K,KK                                                            1801540
 662 WRITE(6,600) (ST(N,J),J=1,NP)                                           1801550
 668 IF (NH.NE.0.AND.IBEGIN.NE.1) GO TO 665                                  1801560
    WRITE(6,7000)                                                            1801570
7000 FORMAT(////3X,21HPHI (RAD. OR IN.)    ,21HDEGRES                       1801580
   1              21HR ZERO               ,21HBASE THICKNESS               1801590
   2              21HSTEP                 ,21HEPSILON THETA IN     /       1801600
   3           3X,21HEPSILON THETA        ,21HEPSILON PHI                  1801610
   4              21HGAMMA PHI THETA      ,21HK PHI                        1801620
   5              21HK THETA              ,21HEPSILON THETA OUT    /       1801630
   6           3X,21HU                    ,21HK PHI THETA                  1801640
   7              21HN THETA              ,21HN PHI                        1801650
   8              21HN PHI THETA          ,21HEPSILON PHI IN       /       1801660
   9           3X,21HV                    ,21HJ PHI STAR                   1801670
   A              21HM THETA              ,21HM PHI                        1801680
   B              21HM PHI THETA          ,21HEPSILON PHI OUT      /       1801690
   C           3X,21HW                    ,21HT PHI THETA                  1801700
   D              21HSIGMA THETA IN       ,21HSIGMA PHI IN                 1801710
   E              21HTAU PHI THETA IN     ,21HGAMMA PHI THETA IN   /       1801720
   F           3X,21HOMEGA THETA          ,21HOMEGA PHI                    1801730
   G              21HSIGMA THETA OUT      ,21HSIGMA PHI OUT                1801740
   H              21HTAU PHI THETA OUT    ,21HGAMMA PHI THETA OUT  )       1801750
    WRITE(6,7001) P                                                          1801760
7001 FORMAT(////50X,'CYCLE',F8.0)                                            1801770
 665 CONTINUE                                                                1801780
 71 K = K + L - LST(JT)                                                      1801790
    JJ=JJJ+1                                                                 1801800
    JJJ=JJ+5                                                                 1801810
```

```
 17 MM=MM+1                                                              1801820
590 CONTINUE                                                             1801830
    READ(1) IS,SAVJTC(IS),SAVSTP(IS),STORY                               1801840
    NSAVE = NROW                                                         1801850
    JJ=NPROB*6                                                           1801860
    LT=0                                                                 1801870
    DO 15  J=1,JJ                                                        1801880
 15 LT=LT+LST(J)                                                         1801890
    NTOTAL=LT+NSAVE                                                      1801900
    NEQNS=8*NPROB                                                        1801910
    TIC = ST(1,1)                                                        1801920
    STOP = ST(1,NP)                                                      1801930
    READ(4)     (YICS(I),I=1,NEQNS)                                      1801940
    NCYC=0                                                               1801950
    KKNT = 0                                                             1801960
    NSAVE=NROW                                                           1801970
    IEND=0                                                               1801980
    NPR = 1                                                              1801990
    PRINT=TIC                                                            1802000
    DTA=DTAU                                                             1802010
    DTAU=0.0                                                             1802020
    READ(10) SAVY,NPLEV,NPLA,SIGMA,SALPH,SBAPH,STEPS,STR,EFF,STSRN,      1802030
   1          NPLAST,STSIG,STREPS,STALPH,STBAPH,NPLEVS,EFFST,SEPS       1802040
 59 CALL FIXEM (MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME,   1802050
   1            DTIME,YICS,YPRED,YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)       1802060
    GOTO  61                                                             1802070
 60 CALL WAND(MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,EPSIL,DELTA,ERR,TIME,     1802080
   1          DTIME,YICS,YPRED,YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)         1802090
 61 IF(MAGOUT.LE.0) GOTO 25                                              1802100
    IF(TIME.GT.STOP) GOTO 62                                             1802110
    IF(TIME.LT.STOP) GOTO 63                                             1802120
 64 IEND=-1                                                              1802130
    GOTO 67                                                              1802140
 62 IF(TIME.LE.(STOP+DIFF)) GOTO 64                                      1802150
    GOTO 8001                                                            1802160
 63 IF((STOP-DIFF).LE.TIME) GOTO 64                                      1802170
    IF((TIME+DTIME).GT.STOP) GOTO 65                                     1802180
    IF(PRINT.GT.TIME) GOTO 66                                            1802190
    PRINT=TIME+DTA                                                       1802200
 67 CONTINUE                                                             1802210
    NPR = 1                                                              1802220
    IF (TIME.EQ.TIC) NPR = 0                                             1802230
6450 IF(IEND.GT.0) GO TO 8002                                            1802240
    IF(IEND.LT.0) GOTO  150                                              1802250
    MAGIN = 0                                                            1802260
    GO TO 60                                                             1802270
 66 MAGIN=0                                                              1802280
    NPR = 0                                                              1802290
    GOTO 60                                                              1802300
 65 DTIME=STOP-TIME                                                      1802310
    DELTA=0.0                                                            1802320
    GOTO 67                                                              1802330
 75 NCYC=NCYC+1                                                          1802340
    IF (NCYC.NE.1.AND.KKNT.NE.4) GO TO 175                               1802350
    IF ((TIME+STEP).GT.(STOP-DIFF)) NPR = 1                              1802360
    CALL SHPLAS (NCYC,NAPEX,NPR,STEP)                                    1802370
    NPR = 0                                                              1802380
175 MAGIN = -1                                                           1802390
    GOTO 60                                                              1802400
 25 PHI=TIME                                                             1802410
    ARG=PHI                                                              1802420
```

```
      IF (KKNT.EQ.3)                                                    1802430
     1READ(IO) SAVY,NPLEV,NPLA,SIGMA,SALPH,SBAPH,STEPS,STR,EFF,STSRN,   1802440
     1          NPLAST,STSIG,STREPS,STALPH,STBAPH,NPLEVS,EFFST,SEPS     1802450
      LL=NP+1                                                           1802460
      DO 51 I=1,NP                                                      1802470
      IF(ARG-ST(1,I)) 52,55,51                                          1802480
   52 IF(I-1) 55,55,54                                                  1802490
   51 CONTINUE                                                          1802500
      I=NP                                                              1802510
      GO TO 55                                                          1802520
   54 DO 57 IK=2,NTOTAL                                                 1802530
   57 ST(IK,LL)=ST(IK,I-1)+(ST(IK,I)-ST(IK,I-1))*(ARG-ST(1,I-1))/(ST(1,I 1802540
     1)-ST(1,I-1))                                                      1802550
      GOTO 80                                                           1802560
   55 DO 58 IK=2,NTOTAL                                                 1802570
   58 ST(IK,LL)=ST(IK,I)                                                1802580
   80 CONTINUE                                                          1802590
C     THE UPDATED INTERPOLATED VALUES OF THE MATERIAL PROPERTY COEFFIC   1802600
C     IENTS ARE FOUND IN THE XMAT TABLE AND STORED IN THE XLAYER ARRAY   1802610
      L=(MAT-1)*2+1                                                     1802620
      II=NXMAT(L)                                                       1802630
       III=NXMAT(L+1)                                                   1802640
      LL=NP+1                                                           1802650
      L=NROW + 1                                                        1802660
      M=1                                                               1802670
      GOTO (91,92,93,93),KELVIN                                         1802680
   91 ARG = (ST(L,LL)+ST(L+1,LL)+ST(L+2,LL)+ST(L+3,LL))/4.0             1802690
      GOTO 94                                                           1802700
   93 CONTINUE                                                          1802710
      ARG = ST(NROW+1,LL)                                               1802720
   94 DO 104 I = 2,10                                                   1802730
      IF (ARG-XMAT(II,I)) 121,123,104                                   1802740
  121 IF (I-2) 8007,8007,124                                            1802750
  104 CONTINUE                                                          1802760
      GOTO 8067                                                         1802770
  123 L=II+1                                                            1802780
      DO 122 J=L,III                                                    1802790
      XLAYER(M)=XMAT(J,I)                                               1802800
  122 M=M+1                                                             1802810
      GOTO 111                                                          1802820
  124 L=II+1                                                            1802830
      DO 125 J=L,III                                                    1802840
      XLAYER(M)=XMAT(J,I-1)+(XMAT(J,I)-XMAT(J,I-1))*(ARG-XMAT(II,I-1))/ 1802850
     1          (XMAT(II,I)-XMAT(II,I-1))                               1802860
  125 M=M+1                                                             1802870
      GOTO 111                                                          1802880
   92 L = II + 1                                                        1802890
      DO 922  J=L,III                                                   1802900
      XLAYER(M)= XMAT(J,1)                                              1802910
  922 M=M+1                                                             1802920
  111 CONTINUE                                                          1802930
  115 GO TO(101,102,103),ITYPE                                          1802940
  101 ETHET = XLAYER(1)                                                 1802950
      XNUTP     =XLAYER(2)                                              1802960
      ALPHTH = XLAYER(3)                                                1802970
      EPHI = ETHET                                                      1802980
      XNUPT= XNUTP                                                      1802990
      ALPHPH = ALPHTH                                                   1803000
      XGPT = ETHET/(2.0*(1.0+XNUPT))                                    1803010
      N = 4                                                             1803020
      GO TO 105                                                         1803030
```

```
102 ETHET = XLAYER(1)                                                  1803040
    EPHI = XLAYER(2)                                                   1803050
    XNUTP = XLAYER(3)                                                  1803060
    ALPHTH = XLAYER(4)                                                 1803070
    ALPHPH = XLAYER(5)                                                 1803080
    XGPT = XLAYER(6)                                                   1803090
    XNUPT = ETHET*XNUTP/EPHI                                           1803100
    N = 7                                                              1803110
    GO TO 105                                                          1803120
103 ETHET = XLAYER(1)                                                  1803130
    EPHI = XLAYER(2)                                                   1803140
    XNUTP= XLAYER(3)                                                   1803150
    ALPHTH = XLAYER(4)                                                 1803160
    ALPHPH = XLAYER(5)                                                 1803170
    XGPT = XLAYER(6)                                                   1803180
    ER = XLAYER(17)                                                    1803190
    ES = XLAYER(18)                                                    1803200
    ALPHR = XLAYER(19)                                                 1803210
    ALPHS = XLAYER(20)                                                 1803220
    RMOSSR = XLAYER(21)                                                1803230
    RMOSNR = XLAYER(22)                                                1803240
    SIGOXR = XLAYER(23)                                                1803250
    RMOSSS = XLAYER(24)                                                1803260
    RMOSNS = XLAYER(25)                                                1803270
    SIGOXS = XLAYER(26)                                                1803280
    XNUPT = ETHET*XNUTP/EPHI                                           1803290
    N = 7                                                              1803300
105 CONTINUE                                                           1803310
    RMOSS = XLAYER(N)                                                  1803320
    RMOSN = XLAYER(N+1)                                                1803330
    SIGOX = XLAYER(N+2)                                                1803340
    IF (ITYPE.NE.1) GO TO 108                                          1803350
    SIGOY = SIGOX                                                      1803360
    SIGOZ = SIGOX                                                      1803370
    SIGXY = SIGOX/SQRT(3.0)                                            1803380
    GO TO 109                                                          1803390
108 CONTINUE                                                           1803400
    SIGOY = XLAYER(N+3)                                                1803410
    SIGOZ = XLAYER(N+4)                                                1803420
    SIGXY = XLAYER(N+5)                                                1803430
    RMOSSY = XLAYER(N+6)                                               1803440
    RMOSNY = XLAYER(N+7)                                               1803450
    RMOSXY = XLAYER(N+8)                                               1803460
    RMONXY = XLAYER(N+9)                                               1803470
    IF (KORI.GT.0) GO TO 227                                           1803480
109 CONTINUE                                                           1803490
    IF (RMOSN.EQ.0.0) GO TO 225                                        1803500
    YLDST = SIGOX*SIGOX                                                1803510
    IF (RMOSS.NE.0.0) GO TO 224                                        1803520
    ROC = YLDST*EPHI*RMOSN/(1.0-RMOSN)                                 1803530
    GO TO 227                                                          1803540
224 ROC = 2.333333*EPHI*YLDST/RMOSN                                    1803550
225 RMOSN = RMOSN-1.0                                                  1803560
227 TEM1 = SIGOX*SIGOX                                                 1803570
    TEM2 = SIGOY*SIGOY                                                 1803580
    TEM3 = SIGOZ*SIGOZ                                                 1803590
    TEM4 = 0.5/TEM1                                                    1803600
    TEM5 = 0.5/TEM2                                                    1803610
    TEM6 = 0.5/TEM3                                                    1803620
    HP = TEM4+TEM5-TEM6                                                1803630
    TWON = 1.0/(SIGXY*SIGXY)                                           1803640
```

```
      FPLUH = 1.0/TEM2                                                  1803650
      GPLUH = 1.0/TEM1                                                  1803660
      CALL TOBAR (ST,KLUE2,NROW,LL,E1,E2,HI,HO,T,TII,TOO,TIK,TOK,       1803670
     1            DEGRES,G2,G3,TIME,NCONT)                              1803680
      IF (NIX.NE.0) GO TO 9999                                          1803690
      LL=NP+1                                                           1803700
      IF(XK11.EQ.0.0) GOTO 8101                                         1803710
      IF(ITYPE.EQ.3.AND.XK12.EQ.0.) GO TO 8102                          1803720
      IF(ITYPE.EQ.3.AND.XK21.EQ.0.) GO TO 8103                          1803730
      IF(XK22.EQ.0.0) GOTO 8104                                         1803740
      IF(XK33.EQ.0.0) GOTO 8105                                         1803750
      IF(XD11.EQ.0.0) GOTO 8106                                         1803760
      IF(ITYPE.EQ.3.AND.XD12.EQ.0.) GO TO 8107                          1803770
      IF(ITYPE.EQ.3.AND.XD21.EQ.0.) GO TO 8108                          1803780
      IF(XD22.EQ.0.0) GOTO 8109                                         1803790
      IF(XD33.EQ.0.0) GOTO 8110                                         1803800
      NL=0                                                              1803810
      JF = NPROB                                                        1803820
      K = NROW                                                          1803830
      DO 7 M=1,JF                                                       1803840
      I = (M-1)*8 + 1                                                   1803850
      NL=NL+1                                                           1803860
      XFTHLD=0.0                                                        1803870
      XFPHLD=0.0                                                        1803880
      XFZELD=0.0                                                        1803890
      XMTHLD=0.0                                                        1803900
      XMPHLD=0.0                                                        1803910
      IR=NL*6-5                                                         1803920
      IF(LST(IR).NE.0) K=K+LST(IR)                                      1803930
      IF (LST(IR+1).EQ.0) GOTO 44                                       1803940
      K=K+1                                                             1803950
      XFTHLD=ST(K,LL)                                                   1803960
   44 IF(LST(IR+2).EQ.0) GOTO 45                                        1803970
      K=K+1                                                             1803980
      XFPHLD = ST(K,LL)+XMERD*IWORD                                     1803990
   45 IF(LST(IR+3).EQ.0) GOTO 46                                        1804000
      K=K+1                                                             1804010
      XFZELD = ST(K,LL)+XPRES*IWORD                                     1804020
   46 IF(LST(IR+4).EQ.0) GOTO 47                                        1804030
      K=K+1                                                             1804040
      XMTHLD = ST(K,LL)+XMONT*IWORD                                     1804050
   47 IF(LST(IR+5).EQ.0) GOTO 48                                        1804060
      K=K+1                                                             1804070
      XMPHLD=ST(K,LL)                                                   1804080
   48 CONTINUE                                                          1804090
   50 IF (ISTTAB.GE.3.AND.ISTTAB.LE.9) GO TO 4002                       1804100
      CALL ODE1                                                         1804110
      GO TO 77                                                          1804120
 4002 CALL ODE2                                                         1804130
   77 CONTINUE                                                          1804140
    7 CONTINUE                                                          1804150
      GOTO 75                                                           1804160
 8001 IERROR=8001                                                       1804170
      NERROR = 11                                                       1804180
      GOTO 8888                                                         1804190
 8002 IERROR=8002                                                       1804200
      NERROR = 12                                                       1804210
      GOTO 8888                                                         1804220
 8007 IERROR=8007                                                       1804230
      NERROR = 15                                                       1804240
      GOTO 8888                                                         1804250
```

```
8031 IERROR=8031                                                    1804260
     NERROR = 9                                                     1804270
8067 IERROR= 8067                                                   1804280
     NERROR = 16                                                    1804290
     GOTO 8888                                                      1804300
8101 IERROR = 8101                                                  1804310
     NERROR = 17                                                    1804320
     GOTO 8888                                                      1804330
8102 IERROR = 8102                                                  1804340
     NERROR = 18                                                    1804350
     GOTO 8888                                                      1804360
8103 IERROR = 8103                                                  1804370
     NERROR = 19                                                    1804380
     GOTO 8888                                                      1804390
8104 IERROR = 8104                                                  1804400
     NERROR = 20                                                    1804410
     GOTO 8888                                                      1804420
8105 IERROR = 8105                                                  1804430
     NERROR = 21                                                    1804440
     GOTO 8888                                                      1804450
8106 IERROR = 8106                                                  1804460
     NERROR = 22                                                    1804470
     GOTO 8888                                                      1804480
8107 IERROR = 8107                                                  1804490
     NERROR = 23                                                    1804500
     GOTO 8888                                                      1804510
8108 IERROR = 8108                                                  1804520
     NERROR = 24                                                    1804530
     GOTO 8888                                                      1804540
8109 IERROR = 8109                                                  1804550
     NERROR = 25                                                    1804560
     GOTO 8888                                                      1804570
8110 IERROR = 8110                                                  1804580
     NERROR = 26                                                    1804590
8888 NIX=1                                                          1804600
     GO TO 9999                                                     1804610
 150 IF (NGR.EQ.1) CALL GRAPH (KGEOM)                               1804620
     IF (LSC.LT.KSC) GO TO 902                                      1804630
9999 RETURN                                                         1804640
      END                                                           1804650
```

```
FOR,IS FIXEM,FIXEM
      SUBROUTINE FIXEM (MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,
     1                  EPSIL,DELTA,ERR,TIME,DTIME,YICS,YPRED,
     2                   YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)                  1900030
C     RUNGE KUTTA MAGIC (REVISED)  SINGLE PRECISION          FORTRAN IV   1900040
      DIMENSION YICS( 1),YPRED( 1),YCORR( 1), YDOT( 1), YNEW( 1),         1900050
     1          YDEV(1),FWDEL(1),TBDEL(1)                                 1900060
      DIMENSION C(3),D(3)                                                 1900070
      COMMON /MAGIQ/ KKNT                                                 1900080
      DOUBLE PRECISION YNEW,YPRED                                         1900090
      DATA C,D / .5,.5,1.0,.5,.0,.5/                                      1900100
      MSET=1                                                              1900110
      TIME = TIC                                                          1900120
      TAU  = TIC                                                          1900130
      IF (DELTA)200,201,200                                               1900140
  200 DTIME = 0.0078125                                                   1900150
      GO TO 225                                                           1900160
  201 DTIME = STEP                                                        1900170
  225 DO 102 I = 1,NEQNS                                                  1900180
      YDEV(I)  = 0.0                                                      1900190
      YPRED(I) = YICS(I)                                                  1900200
      YCORR(I) = YICS(I)                                                  1900210
  102 YNEW(I)  = YICS(I)                                                  1900220
      MAGOUT   =-2                                                        1900230
      GO TO 264                                                           1900240
 5555 CONTINUE                                                            1900250
      ENTRY WAND (MAGIN,MAGOUT,TIC,STEP,NEQNS,DTAU,
     1                  EPSIL,DELTA,ERR,TIME,DTIME,YICS,YPRED,
     2                  YCORR,YDOT,YNEW,YDEV,FWDEL,TBDEL)
 5556 CONTINUE                                                            1900270
      MSET=2                                                              1900280
      IF (MAGOUT) 305,101,101                                             1900290
  101 IF(MAGIN) 21, 27, 14                                                1900300
   27 K = 0                                                               1900310
      DO 202 I = 1,NEQNS                                                  1900320
  202 YNEW(I)  = YPRED(I)                                                 1900330
   21 K = K +1                                                            1900340
      KKNT = K                                                            1900350
  210 DO  2  I = 1,NEQNS                                                  1900360
      GO TO (9,6,7,4,11),K                                                1900370
    9 FWDEL(I) = YDOT(I)                                                  1900380
      GO TO 105                                                           1900390
    6 TBDEL(I) = YDOT(I)                                                  1900400
      GO TO 105                                                           1900410
    7 TBDEL(I) = TBDEL(I) + YDOT(I)                                       1900420
  105 YPRED(I) = YNEW(I) + C(K)*DTIME*YDOT(I)                             1900430
      GO TO (2,2,400),K                                                   1900440
  400 YCORR(I) = YPRED(I)                                                 1900450
    2 CONTINUE                                                            1900460
      TIME     = TIME + D(K)*DTIME                                        1900470
   99 MAGOUT   = 0.0                                                      1900480
  264 RETURN                                                              1900490
    4 DO  8  I = 1,NEQNS                                                  1900500
      YPRED(I) = YNEW(I) + DTIME*(FWDEL(I) + 2.*TBDEL(I) + YDOT(I))/6.    1900510
    8 YDEV(I)  = YCORR(I) - YPRED(I)                                      1900520
      GO TO 99                                                            1900530
   11 IF (DELTA)80, 5,80                                                  1900540
   80 DO  13 I = 1,NEQNS                                                  1900550
      IF (EPSIL*ABS(YCORR(I)) + ERR - ABS(YDEV(I))) 14,13,13              1900560
   13 CONTINUE                                                            1900570
```

```
      IF (SIGB)15,15,205                                                    1900580
  205 SIGB = 0.0                                                            1900590
      GO TO 5                                                               1900600
   15 SIGB = 0.0                                                            1900610
      DO 207 I = 1,NEQNS                                                    1900620
      IF (ERR  /100.+ DELTA*ABS(YCORR(I)) - ABS(YDEV(I))) 5,207,207         1900630
  207 CONTINUE                                                              1900640
      DTIME    = 2.*DTIME                                                   1900650
    5 DO 208 I = 1,NEQNS                                                    1900660
  208 YCORR(I) = YPRED(I)                                                   1900670
  305 IF (DTAU) 19,30,19                                                    1900680
   19 IF (TAU - TIME)20,20,27                                               1900690
   20 TAU = TAU + DTAU                                                      1900700
   30 MAGOUT = 2                                                            1900710
      GO TO 264                                                             1900720
   14 DTIME = DTIME/2.0                                                     1900730
   25 IF (K-3)48,26,26                                                      1900740
   26 TIME  = TIME - DTIME - DTIME                                          1900750
      GO TO 47                                                              1900760
   48 TIME  = TIME - DTIME                                                  1900770
   47 SIGB     = +2.                                                        1900780
      DO 209 I = 1,NEQNS                                                    1900790
  209 YDOT(I) = FWDEL(I)                                                    1900800
  212 K       = 0                                                           1900810
      GO TO 21                                                              1900820
       END                                                                  1900830
```

```
FOR,IS TOBAR,TOBAR
      SUBROUTINE TOBAR (ST,KLUE2,NROW,LL,E1,E2,HI,HO,T,TII,TOO,          2200010
     1                  TIK,TOK,DEGRES,G2,G3,TIME,NCONT)                 2200020
      INTEGER SAVJTC,SAVSTP,Q,THICK                                      2200030
      INTEGER XN1,XN2,XN                                                 2200040
      REAL*4 I2                                                          2200050
      DOUBLE PRECISION YPRED                                             2200060
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)          2200070
      COMMON TADUS(30),UACUS(30),SAVTIC(900)                             2200080
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH            2200090
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)   2200100
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB  2200110
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE  2200120
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS             2200130
      COMMON LODE,ICYCLE,LDISTL                                          2200140
      COMMON /LASTEQ/ YPRED(8),YDOT(8),YASAVE(8),                        2200150
     1                YANTH,YAMTH,YAMPT,YANPT,YAOPH,YAQPH,YAQTH,YAJPH,   2200160
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,         2200170
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,       2200180
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,   2200190
     5    ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,R1SQ,                           2200200
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,      2200210
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,       2200220
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,    2200230
     9                XK11,XK12,XK21,XK22,XK33,XD11,                     2200240
     A                   M,I,SITIN,SITOUT,SIPIN,SIPOUT,TPTIN,TPTOUT,     2200250
     B               ZBRIN,ZBROUT,SCRIPA,SCRIPI,SIFIN,SIFOUT,TZEPH,TZETH 2200260
     B                  ,XNPHI,BETTA,ZETTA,XC16                         2200270
     C                  ,RMOSS,RMOSN,YLOST,ROCP,HP,FPLUH,GPLUH,TWON     2200280
     D                  ,RMOSSY,RMOSNY,RMOSXY,RMONXY
     D                  ,RMOSNS,RMOSSS,SIGOXS,RMOSNR,RMOSSR,SIGOXR      2200290
      COMMON /SNILPS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),         2200300
     1       DR1DP(100),ZI(14),RI(14),NRZIN                              2200310
      COMMON /RWO/ ER,ES,CPH,CTH,APH,ATH,SPH,STH,ALPHS,ALPHR,TS,TR,SNB,  2200320
     C             CSB                                                  2200330
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                         2200340
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),     2200350
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),     2200360
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),      2200370
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)              2200380
      DIMENSION ST(30,31)                                                2200390
      EQUIVALENCE (SINB,SNB),(COSB,CSB)                                  2200400
      DATA A/'A   '/                                                     2200410
      GOTO (771,772,773,774,775,776,7077),KGEOM                          2200420
C     GEOMETRY FOR ELIPSE(G3=OFFSET DISTANCE )                           2200430
  771 A=G1                                                               2200440
      BE=G2                                                              2200450
      BETA = BE                                                          2200460
       BESQ=BE**2                                                        2200470
      ASQ=A**2                                                           2200480
      SN = SIN(PHI)                                                      2200490
      CS = COS(PHI)                                                      2200500
      SNSQ = SN**2                                                       2200510
      CSSQ = CS**2                                                       2200520
      R2 = A*SQRT(1.0/(SNSQ+BESQ*CSSQ))                                  2200530
      R2SQ = R2**2                                                       2200540
      RO=R2*SN                                                           2200550
      R1=R2*R2SQ*BESQ/ASQ                                                2200560
      BESQ=BE**2                                                         2200570
      R1DOT=0.0                                                          2200580
```

```
      IF(KGEOM.EQ.1.AND.BETA.NE.1.0.AND.SN.NE.0.0)R1DOT=3.0*(R2*BETA/    2200590
     1A) **2*(CS/SNSQ)*(R1*SN-RO)                                        2200600
      IF(SN.EQ. 0.0)GO TO 779                                            2200610
      R2 = R2-G3/SN                                                      2200620
      R2SQ = R2**2                                                       2200630
      RO = RO-G3                                                         2200640
      GO TO 7775                                                         2200650
  779 IF(G3 .EQ. 0.0)GO TO 7775                                          2200660
      R1DOT = 3.0*G3                                                     2200670
      RO = -G3                                                           2200680
      GO TO 7775                                                         2200690
C     GEOMETRY FOR OGIVE                                                 2200700
  772 R1=G1                                                              2200710
      C=G2                                                               2200720
      SN = SIN(PHI)                                                      2200730
      CS = COS(PHI)                                                      2200740
      IF (SN.EQ.0.0) GOTO 777                                            2200750
      R2=R1-C/SN                                                         2200760
      GOTO 778                                                           2200770
  777 R2 = 1.0                                                           2200780
  778 RO = R1*SN-C                                                       2200790
      R1DOT=0.0                                                          2200800
      GOTO 7775                                                          2200810
C     GEOMETRY FOR CONE                                                  2200820
  773 CS = COS(G1)                                                       2200830
      SN=SIN(G1)                                                         2200840
      S=PHI                                                              2200850
      S1=1.0/S                                                           2200860
      R2=CS*SN*PHI                                                       2200870
      RO=PHI*CS                                                          2200880
      R1DOT=0.0                                                          2200890
      GOTO 7775                                                          2200900
C     GEOMETRY FOR CYLINDER                                              2200910
  774 RO = G1                                                            2200920
      SN=1.0                                                             2200930
      CS=1.0                                                             2200940
      R1DOT=0.0                                                          2200950
      GOTO 7775                                                          2200960
C   MODIFIED  ELLIPSE                                                    2200970
  775 XNEXP=G1                                                           2200980
      A   =G2                                                            2200990
      XN1=1.0+XNEXP                                                      2201000
      XN2=1.0/XN1                                                        2201010
      XN3=XN1+1.0                                                        2201020
      XN4=XN3+1.0                                                        2201030
      XN5=XN4/XN1                                                        2201040
      SN = SIN(PHI)                                                      2201050
      CS = COS(PHI)                                                      2201060
      R2= A*(2.0/(1.0+SN**XN1))**XN2                                     2201070
      R1=(A/2.0)*(R2/A)**XN3                                             2201080
      RO=R2*SN                                                           2201090
      R1DOT=-XN3*A*(SN**XNEXP*CS/4.0)*(2.0/(1.0+SN**XN1))**XN5           2201100
      GOTO 7775                                                          2201110
C     GENERAL GEOMETRY                                                   2201120
  776 SN = SIN(PHI)                                                      2201130
      CS = COS(PHI)                                                      2201140
      TAN = SN / CS                                                      2201150
      SEC = 1.0 / CS                                                     2201160
      IF (TIME.EQ.TIC) CALL TEMOEG                                       2201170
      ARG = PHI                                                          2201180
      DO 204 J=1,100                                                     2201190
```

```
      PHO = PSI(J)                                                      2201200
      IF (ANG.EQ.A) IF (ARG-PHO) 221,223,204                            2201210
      IF (PHO-ARG) 221,223,204                                          2201220
  221 IF (J-1) 8502,8502,224                                            2201230
  204 CONTINUE                                                          2201240
      GO TO 8503                                                        2201250
  223 RO = RAD(J)                                                       2201260
      R1 = CUR1(J)                                                      2201270
      R2 = CUR2(J)                                                      2201280
      R1DOT = DR1DP(J)                                                  2201290
      GO TO 7775                                                        2201300
 8502 NERROR = 41                                                       2201310
      GO TO 8888                                                        2201320
 8503 NERROR = 42                                                       2201330
 8888 NIX = 1                                                           2201340
      GO TO 8889                                                        2201350
  224 SUB1 = ARG-PSI(J-1)                                               2201360
      SUB2 = PSI(J)-PSI(J-1)                                            2201370
      RO = RAD(J-1)+(RAD(J)-RAD(J-1))*SUB1/SUB2                         2201380
      R1 = CUR1(J-1)+(CUR1(J)-CUR1(J-1))*SUB1/SUB2                      2201390
      R2 = CUR2(J-1)+(CUR2(J)-CUR2(J-1))*SUB1/SUB2                      2201400
      R1DOT = DR1DP(J-1)+(DR1DP(J)-DR1DP(J-1))*SUB1/SUB2                2201410
      GOTO 7775                                                         2201420
C     ISOTENSOID GEOMETRY                                               2201430
 7077 CONTINUE                                                          2201440
      SN = SIN(PHI)                                                     2201450
      CS = COS(PHI)                                                     2201460
      A  = G1                                                           2201470
      R2 = A / SQRT(SN)                                                 2201480
      R1 = 0.5 * R2                                                     2201490
      RO = R2 * SN                                                      2201500
      R1DOT = - ((A**2)*0.5)*(R1*CS)/RO**2                              2201510
 7775 TAN=SN/CS                                                         2201520
      DEGRES  = 0.0                                                     2201530
      IF(IGEOM.EQ.1) DEGRES = PHI * 57.29578                            2201540
      ROSQ = RO**2                                                      2201550
      XNSQ=XN**2                                                        2201560
      CN=CS*SN                                                          2201570
      X1CS=1.0/CS                                                       2201580
      TN=SN/CS                                                          2201590
      X1RO=1.0/RO                                                       2201600
      X1ROSQ=1.0/RO**2                                                  2201610
      X1CSRO=1.0/(CS*RO)                                                2201620
      CN1RO=CN/RO                                                       2201630
      SN1RO=SN/RO                                                       2201640
      CS1RO=CS/RO                                                       2201650
      SNSQ=SN**2                                                        2201660
      CSSQ=CS**2                                                        2201670
      IF(KGEOM.EQ.4.OR.KGEOM.EQ.3) GOTO 79                              2201680
      R1SQ = R1**2                                                      2201690
      R2SQ = R2**2                                                      2201700
      X1SN=1.0/SN                                                       2201710
      X1SNRO=1.0/(SN*RO)                                                2201720
      X1R1=1.0/R1                                                       2201730
      X1R2=1.0/R2                                                       2201740
      CS1R1=CS/R1                                                       2201750
      CS1R2=CS/R2                                                       2201760
      SN1R1=SN/R1                                                       2201770
      X1R1SQ=1.0/R1**2                                                  2201780
   79 XNTTH=0.0                                                         2201790
      XNTPH=0.0                                                         2201800
```

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      XMTTH=0.0                                                          2201810
      XMTPH=0.0                                                          2201820
C                                                                        2201830
C     COMPUTATION OF K AND D FOR MATERIAL PROPETY INPUT                  2201840
C                                                                        2201850
      HO = 0.0                                                           2201860
      T = 0.0                                                            2201870
      HI = 0.0                                                           2201880
      TS = 0.0                                                           2201890
      TR = 0.0                                                           2201900
      RHOR = 0.0                                                         2201910
      RHOS = 0.0                                                         2201920
      RHOI = 0.0                                                         2201930
      RHOC = 0.0                                                         2201940
      CTH = 0.0                                                          2201950
      CPH = 0.0                                                          2201960
      YBARI = 0.0                                                        2201970
      YBARC = 0.0                                                        2201980
      YBARO = 0.0                                                        2201990
      GO TO (711,600,711,32,33,34,35,36,37,28,29,30),ISTTAB              2202000
C     THICK                                                              2202010
  600 GO TO (703,702,701,701),THICK                                      2202020
  701 HO= ST(4,LL)                                                       2202030
  702 T = ST(3,LL)                                                       2202040
      RHOC = ST(NCONT-1,LL)                                              2202050
  703 HI= ST(2,LL)                                                       2202060
      RHOI = ST(NCONT,LL)                                                2202070
      GO TO 40                                                           2202080
C     ST11,ST12,ST13                                                     2202090
   30 HO= ST(14,LL)                                                      2202100
   29 T = ST(13,LL)                                                      2202110
      RHOC = ST(NCONT-3,LL)                                              2202120
   28 HI= ST(12,LL)                                                      2202130
      RHOI = ST(NCONT-2,LL)                                              2202140
      RHOS = ST(NCONT-1,LL)                                              2202150
      RHOR = ST(NCONT,LL)                                                2202160
      GJPH= ST(2,LL)                                                     2202170
      GJTH= ST(3,LL)                                                     2202180
      APH = ST(4,LL)                                                     2202190
      ATH = ST(5,LL)                                                     2202200
      CPH = ST(6,LL)                                                     2202210
      CTH = ST(7,LL)                                                     2202220
      XIPH = ST(8,LL)                                                    2202230
      XITH= ST(9,LL)                                                     2202240
      SPH = ST(10,LL)                                                    2202250
      STH = ST(11,LL)                                                    2202260
      IF (KELVIN.EQ.2.OR.KELVIN.EQ.4) GO TO 40                           2202270
      ISTAB = ISTTAB-9                                                   2202280
      TS = ST(ISTAB+12,LL)                                               2202290
      TR = ST(ISTAB+13,LL)                                               2202300
      GO TO 40                                                           2202310
C     RWAF1,RWAF2,RWAF3                                                  2202320
   34 HO = ST(10,LL)                                                     2202330
   33 T = ST(9,LL)                                                       2202340
      RHOC = ST(NCONT-2,LL)                                              2202350
   32 HI = ST(8,LL)                                                      2202360
      RHOI = ST(NCONT-1,LL)                                              2202370
      RHOS = ST(NCONT,LL)                                                2202380
      APH = ST(2,LL)                                                     2202390
      CPH = ST(3,LL)                                                     2202400
      XIPH= ST(4,LL)                                                     2202410
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```
      SPH = ST(5,LL)                                                    2202420
      BETTA=ST(6,LL)                                                    2202430
      ZETTA = ST(7,LL)                                                  2202440
      ATH = APH                                                         2202450
      CTH = CPH                                                         2202460
      XITH= XIPH                                                        2202470
      STH = SPH                                                         2202480
      RHOR = RHOS*IWORD                                                 2202490
      IF (KELVIN.EQ.2.OR.KELVIN.EQ.4) GO TO 40                          2202500
      ISTAB = ISTTAB-3                                                  2202510
      TS = ST(ISTAB+8,LL)                                               2202520
      TR = TS                                                           2202530
      GO TO 40                                                          2202540
C     ISG1,ISG2,ISG3                                                    2202550
   37 HO = ST(9,LL)                                                     2202560
   36 T = ST(8,LL)                                                      2202570
      RHOC = ST(NCONT-2,LL)                                             2202580
   35 HI = ST(7,LL)                                                     2202590
      RHOI = ST(NCONT-1,LL)                                             2202600
      RHOS = ST(NCONT,LL)                                               2202610
      APH = ST(2,LL)                                                    2202620
      CPH = ST(3,LL)                                                    2202630
      XIPH = ST(4,LL)                                                   2202640
      SPH = ST(5,LL)                                                    2202650
      BETTA = ST(6,LL)                                                  2202660
      ATH = APH                                                         2202670
      CTH = CPH                                                         2202680
      XITH = XIPH                                                       2202690
      STH = SPH                                                         2202700
      RHOR = RHOS*IWORD                                                 2202710
      IF (KELVIN.EQ.2.OR.KELVIN.EQ.4) GO TO 40                          2202720
      ISTAB = ISTTAB-6                                                  2202730
      TS = ST(ISTAB+7,LL)                                               2202740
      TR = TS                                                           2202750
      GO TO 40                                                          2202760
C     ST10,RWAF                                                         2202770
C     RANKIN=THSTND MEANS INTERPOLATE,COMPUTE NTEMP,MTEMP               2202780
C     RANKIN=NOTHRM MEANS DO NOT INTERPOLATE,DO NOT COMPUTE NTEMP,NTEMP 2202790
C     RANKIN=THCNST MEANS DO NOT AVERAGE, BUT INTERPOLATE,COMPUTE       2202800
C                                                        NTEMP, MTEMP   2202810
C     RANKIN=THINHO MEANS INTERPOLATE,BUT DO NOT COMPUTE NTEMP,MTEMP    2202820
C                                                                       2202830
  711 CONTINUE                                                          2202840
      XK11=ST(2,LL)                                                     2202850
      XK12=ST(3,LL)                                                     2202860
      XK22 = ST(4,LL)                                                   2202870
      XK33 = ST(5,LL)                                                   2202880
      XD11 = ST(6,LL)                                                   2202890
      XD12 = ST(7,LL)                                                   2202900
      XD22 = ST(8,LL)                                                   2202910
      XD33 = ST(9,LL)                                                   2202920
      XC11 = ST(10,LL)                                                  2202930
      XC22 = ST(11,LL)                                                  2202940
      XC15 = ST(12,LL)                                                  2202950
      XC16 = ST(13,LL)                                                  2202960
      XMERD = ST(NCONT-2,LL)                                            2202970
      XPRES = ST(NCONT-1,LL)                                            2202980
      XMONT = ST(NCONT,LL)                                              2202990
      XK21 = XK12                                                       2203000
      XD21 = XD12                                                       2203010
      GO TO 103                                                         2203020
```

```
C                                                                       2203030
   40 CONTINUE                                                          2203040
      IF (IWORD.EQ.1) GO TO 140                                         2203050
      RHOR = 0.0                                                        2203060
      RHOS = 0.0                                                        2203070
      RHOI = 0.0                                                        2203080
      RHOC = 0.0                                                        2203090
      XMERD = 0.0                                                       2203100
      XPRES = 0.0                                                       2203110
      XMONT = 0.0                                                       2203120
  140 CONTINUE                                                          2203130
      TEMP3= (1.0-XNUPT * XNUTP)                                        2203140
      GO TO (42,47,49,41),THICK                                         2203150
   41 GO TO (103,42,103,42,47,49,42,47,49,42,47,49),ISTTAB              2203160
C                                                                       2203170
C     SINGLE SHEET                                                      2203180
C                                                                       2203190
   42 TEMP1 = ETHET*HI                                                  2203200
      TEMP2= TEMP1 * HI**2                                              2203210
      XK11= TEMP1/TEMP3                                                 2203220
      XD11= TEMP2/(12.0* TEMP3)                                         2203230
      TEMP1 = EPHI*HI                                                   2203240
      TEMP2= TEMP1*HI**2                                                2203250
      XK22= TEMP1/TEMP3                                                 2203260
      XD22= TEMP2/(12.0* TEMP3)                                         2203270
      XK33 = XGPT*HI                                                    2203280
      XD33= XK33*HI**2/12.0                                             2203290
      YBARI = 0.0                                                       2203300
      YBARC = 0.0                                                       2203310
      YBARO = 0.0                                                       2203320
      GO TO 55                                                          2203330
C                                                                       2203340
C     EQUAL SHEETS                                                      2203350
C                                                                       2203360
   47 CONTINUE                                                          2203370
      XK11 = 2.0*ETHET*HI/TEMP3                                         2203380
      XK22 = 2.0*EPHI*HI/TEMP3                                          2203390
      XK33 = 2.0*XGPT                                                   2203400
      ZBR = HI+T/2.0                                                    2203410
      ZBH = (ZBR-HI/2.0)**2                                             2203420
      XD33 = XGPT*HI*((HI**2)/6.0+2.0*ZBH)                              2203430
      XD11 = HI*(XK11*HI/12.0+2.0*ETHET*ZBH/TEMP3)                      2203440
      XD22 = HI*(XK22*HI/12.0+2.0*EPHI*ZBH/TEMP3)                       2203450
      YBARI = ZBR-HI/2.0                                                2203460
      YBARC = ZBR-HI-T/2.0                                              2203470
      YBARO = HI/2.0-ZBR                                                2203480
      GO TO 55                                                          2203490
C                                                                       2203500
C     UNEQUAL FACE SHEETS                                               2203510
C                                                                       2203520
   49 CONTINUE                                                          2203530
      ZBR = (HI*HI+HO*HO+2.0*(HO*(HI+T)))/(2.0*(HI+HO))                 2203540
      ZBHIN = (ZBR-HI/2.0)**2                                           2203550
      ZBHOUT = (ZBR-HO/2.0)**2                                          2203560
      XK11 = ETHET*(HI+HO)/TEMP3                                        2203570
      XK22 = EPHI*(HI+HO)/TEMP3                                         2203580
      XK33 = XGPT*(HI+HO)                                               2203590
      HI03 = HI**3+HO**3                                                2203600
      XD33 = HI03*XGPT/12.0+XGPT*(HI*ZBHIN+HO*ZBHOUT)                   2203610
      D11 = ETHET*HI03/12.0                                             2203620
      XD11 = (D11+ETHET*(HI*ZBHIN+HO*ZBHOUT))/TEMP3                     2203630
```

```
      D22 = EPHI*HIO3/12.0                                                    2203640
      XD22 = (D22+EPHI*(HI*ZBHIN+HO*ZBHOUT))/TEMP3                            2203650
      YBARI = ZBR-HI/2.0                                                      2203660
      YBARC = ZBR-HI-T/2.0                                                    2203670
      YBARO = HI/2.0-ZBR                                                      2203680
C                                                                             2203690
C     DETERMINE COMPLETE CONSTANTS DEPENDENT ON REINFORCEMENT CLUE            2203700
C                                                                             2203710
   55 CONTINUE                                                                2203720
      ROI = RO-YBARI*SN                                                       2203730
      ROU = RO-YBARO*SN                                                       2203740
      ROC = RO-YBARC*SN                                                       2203750
      IF (THICK.EQ.2) HO = HI                                                 2203760
      IF (ISTTAB.EQ.5.OR.ISTTAB.EQ.8.OR.ISTTAB.EQ.11) HO = HI                 2203770
      D3 = RHOI*ROI*HI                                                        2203780
      D4 = RHOC*ROC*T                                                         2203790
      D5 = RHOI*ROU*HO                                                        2203800
      DD = D3+D4+D5                                                           2203810
      XMERD = DD*OMEGA*CS                                                     2203820
      XPRES = -DD*OMEGA*SN                                                    2203830
      XMONT = -(D3*YBARI+D4*YBARC+D5*YBARO)*OMEGA*CS                          2203840
      IF(ISTTAB .EQ.2)GO TO 103                                               2203850
      TBARR = ATH/STH                                                         2203860
      TBARS = APH/SPH                                                         2203870
      ROR = RO-CTH*SN                                                         2203880
      ROS = RO-CPH*SN                                                         2203890
      EASTH=ER*ATH/STH                                                        2203900
      EASPH=ES*APH/SPH                                                        2203910
      EISPH= ES* XIPH/SPH                                                     2203920
      EISTH= ER* XITH/STH                                                     2203930
      D1 = RHOR*ROR*TBARR                                                     2203940
      D2 = RHOS*ROS*TBARS                                                     2203950
      DD = D1+D2+D3+D4+D5                                                     2203960
      GO TO (58,60,100),KLUE2                                                 2203970
C                                                                             2203980
C     ST CLUE (11,12,13)                                                      2203990
C                                                                             2204000
   58 CONTINUE                                                                2204010
      XK12= XK11*XNUTP                                                        2204020
      XK11= XK11+ EASTH                                                       2204030
      XK22= XK22+ EASPH                                                       2204040
      XC11= EASTH*CTH                                                         2204050
      XC22= EASPH*CPH                                                         2204060
      XD22 = -XD22-EISPH                                                      2204070
      XD33= XD33 + GJPH/(4.0*SPH)+ GJTH/(4.0*STH)                             2204080
      XD12= -XD11*XNUTP                                                       2204090
      XD11= -XD11- EISTH                                                      2204100
      XK21 = XK12                                                             2204110
      XD21 = XD12                                                             2204120
      XMERD = DD*OMEGA*CS                                                     2204130
      XPRES = -DD*OMEGA*SN                                                    2204140
      XMONT = -(D1*CTH+D2*CPH+D3*YBARI+D4*YBARC+D5*YBARO)*OMEGA*CS            2204150
      GO TO 103                                                               2204160
C     RWA CLUE (1,2,3)                                                        2204170
C                                                                             2204180
   60 CONTINUE                                                                2204190
      SINB =SIN(BETTA)                                                        2204200
      COSB =COS(BETTA)                                                        2204210
      SN2TO4 = 2*(SINB**4.)                                                   2204220
      D= STH*(COSB+SINB)                                                      2204230
      ED = ER*ATH/D                                                           2204240
```

```
      SINB2= SINB**2.                                                    2204250
      HL = 2.0*(ABS(ZETTA)-ABS(CTH))                                     2204260
      I2=(ATH**3.)/(3* HL**2)                                            2204270
   95 XC22 = 2.0*CTH*COSB**3*ED                                          2204280
      XC15 = 2.0*CTH*COSB*SINB2*ED                                       2204290
      XC16 = XC15                                                        2204300
      GRI=  ER* I2/(2.0*(1.0 + XNUTP)*D)                                 2204310
      XC11 = CTH*SN2TO4/COSB*ED                                          2204320
      EDI = ER*XITH/D                                                    2204330
      SN4TO2 = 4.*SINB2                                                  2204340
      XD22 = -XD22-2.0*COSB**3*EDI-SN4TO2*COSB*GRI                       2204350
      TB= 2.0* BETTA                                                     2204360
      XD33 = XD33+((4.0*COS(TB)*                                         2204370
     1*2*GRI)/ COSB) + (2.0*COSB*SINB2*EDI)                              2204380
      XD12 = -XD11*XNUTP-(2.0*COSB                                       2204390
     1*SINB2*EDI)-(SN4TO2*COSB*GRI )                                     2204400
      XK12= XK11*XNUTP + (2.0*COSB*SINB2*ED)                             2204410
      XK22=XK22+(2*COSB**3*ED)                                           2204420
      XK33=XK33+(2*COSB*SINB2*ED)                                        2204430
      XK11=XK11+(SN2TO4*ED/COSB)                                         2204440
      XD11 = -XD11-SN2TO4*EDI/COSB-(                                     2204450
     1 SN4TO2*COSB*GRI)                                                  2204460
      XK21 = XK12                                                        2204470
      XD21 = XD12                                                        2204480
      GO TO 108                                                          2204490
C                                                                        2204500
C     ISG CLUE (1,2,3)                                                   2204510
C                                                                        2204520
  100 CONTINUE                                                           2204530
      SNB =SIN(BETTA)                                                    2204540
      CSB =COS(BETTA)                                                    2204550
      TBETTA= 2.0*BETTA                                                  2204560
      CS2B= COS(TBETTA)                                                  2204570
      ONEC2B=(1.0+ CS2B)/2.                                              2204580
      SCB2  =(SNB-CS2B*SNB + 2.)/(2.0*CSB)                               2204590
      SN2B  =SIN(TBETTA) /2.                                             2204600
      XK12=XK11*XNUTP + (EASTH*SNB*ONEC2B/CSB)                           2204610
      XK11=XK11+ EASTH*SCB2                                              2204620
      XK22=XK22+ EASTH*(CSB/SNB*ONEC2B)                                  2204630
      XK33=XK33+ EASTH* SN2B                                             2204640
      XC11=      (EASTH*CTH* SCB2 )                                      2204650
      XC15=EASTH*CTH*( SNB* ONEC2B/CSB )                                 2204660
      XC16=EASTH*CTH*SN2B                                                2204670
      XC22= EASTH*CTH* (CSB/SNB * ONEC2B)                                2204680
      XD12=-XD11*XNUTP- EISTH*(SNB*ONEC2B/CSB)                           2204690
      XD11=-XD11- EISTH*SCB2                                             2204700
      XD22 = -XD22-EISTH*(CSB/SNB*ONEC2B)                                2204710
      XD33= XD33+ EISTH*SN2B                                             2204720
      XK21 = XK12                                                        2204730
      XD21 = XD12                                                        2204740
C                                                                        2204750
C                                                                        2204760
  108 XMERD = (DD-D2)*OMEGA*CS                                           2204770
      XPRES = -(DD-D2)*OMEGA*SN                                          2204780
      XMONT = -(D1*CTH+D3*YBARI+D4*YBARC+D5*YBARO)*OMEGA*CS              2204790
C                                                                        2204800
  103 CONTINUE                                                           2204810
      IF (KGEOM.NE.4) GO TO 105                                          2204820
      XMERD = 0.0                                                        2204830
      XMONT = 0.0                                                        2204840
  105 CONTINUE                                                           2204850
```

```
C                                                                       2204860
      GOTO (716,714,715,714),KELVIN                                     2204870
  716 TII = ST(NROW+1,LL)                                               2204880
      TIK = ST(NROW+2,LL)                                               2204890
      TOK = ST(NROW+3,LL)                                               2204900
      TOO = ST(NROW+4,LL)                                               2204910
      GOTO 717                                                          2204920
  715 TII = ST(NROW+1,LL)                                               2204930
      TIK = TII                                                         2204940
      TOK = TII                                                         2204950
      TOO = TII                                                         2204960
C                                                                       2204970
  717 TEMP1 = ALPHTH+XNUTP*ALPHPH                                       2204980
      TEMP2 = ALPHPH+XNUPT*ALPHTH                                       2204990
      TEMP3 = 1-XNUPT*XNUTP                                             2205000
      TEMP4 = HI/4.0                                                    2205010
      ETHK1 = ETHET*TEMP1/TEMP3                                         2205020
      TEMP5 = HI**2/24.0                                                2205030
      TEMP61= TII+ TIK-2* TEFREE                                        2205040
      TEMP62= TOO+ TOK-2* TEFREE                                        2205050
      TEMP71= 2.0* TII +TIK-3*TEFREE                                    2205060
      TEMP72= 2.0* TOO +TOK-3*TEFREE                                    2205070
      EPHK1 = EPHI*TEMP2/TEMP3                                          2205080
      GO TO (811,812,813,814),THICK                                     2205090
C                                                                       2205100
  814 GO TO (815,811,815,811,812,813,811,812,813,811,812,813),ISTTAB    2205110
C                                                                       2205120
  811 XNTTH= ETHK1    *           TEMP4 * (TEMP61+ TEMP62)              2205130
      XNTPH= EPHK1    *           TEMP4 * (TEMP61 + TEMP62)             2205140
      XMTTH= ETHK1    *           TEMP5 * (TEMP71- TEMP72)              2205150
      XMTPH= EPHK1    *           TEMP5 * (TEMP71 - TEMP72)             2205160
      GO TO 816                                                         2205170
  812 TI = T/2.0                                                        2205180
      TEMP8= HI/2.0                                                     2205190
      XNTTH = ETHK1*TEMP8*(TEMP61+TEMP62)                               2205200
      XNTPH = EPHK1*TEMP8*(TEMP61+TEMP62)                               2205210
      XMTTH = ETHK1*TEMP8*(HI*(TEMP71-TEMP72)/3.0+TI*(TEMP61-TEMP62))   2205220
      XMTPH = EPHK1*TEMP8*(HI*(TEMP71-TEMP72)/3.0+TI*(TEMP61-TEMP62))   2205230
      GO TO 816                                                         2205240
  813 TI = (HO**2-HI**2+2.0*HO*T)/(2.0*(HI+HO))                         2205250
      TO = (HI**2-HO**2+2.0*HI*T)/(2.0*(HI+HO))                         2205260
      XNTTH = ETHK1/2.0*(HI*TEMP61+HO*TEMP62)                           2205270
      XNTPH = EPHK1/2.0*(HI*TEMP61+HO*TEMP62)                           2205280
      XMTTH = ETHK1/2.0*(HI**2*TEMP71/3.0-HO**2*TEMP72/3.0+TI*HI*TEMP61- 2205290
     1  TO*HO*TEMP62)                                                  2205300
      XMTPH = EPHK1/2.0*(HI**2*TEMP71/3.0-HO**2*TEMP72/3.0+TI*HI*TEMP61- 2205310
     1  TO*HO*TEMP62)                                                  2205320
  816 CONTINUE                                                          2205330
      IF (ISTTAB.EQ.2) GO TO 714                                        2205340
      GO TO (817,818,819),KLUE2                                         2205350
  817 XNTPH = XNTPH+ES*APH/SPH*ALPHS*TS                                 2205360
      XNTTH = XNTTH+ER*ATH/STH*ALPHR*TR                                 2205370
      XMTPH = XMTPH+CPH*ES*APH/SPH*ALPHS*TS                             2205380
      XMTTH = XMTTH+CTH*ER*ATH/STH*ALPHR*TR                             2205390
      GO TO 714                                                         2205400
  818 TEM = ES*APH/SPH*ALPHS*TS                                         2205410
      XNTPH = XNTPH+TEM                                                 2205420
      XNTTH = XNTTH+TEM                                                 2205430
      XMTPH = XMTPH+CPH*TEM                                             2205440
      XMTTH = XMTTH+CPH*TEM                                             2205450
      GO TO 714                                                         2205460
```

```
  819 TEM = ES*APH/SPH*ALPHS*TS                                    2205470
      XNTPH = XNTPH+TEM*CSB/SNB                                    2205480
      XNTTH = XNTTH+TEM*(1.0+SNB)/CSB                              2205490
      XMTPH = XMTPH+CPH*TEM*CSB/SNB                                2205500
      XMTTH = XMTTH+CPH*TEM*(1.0+SNB)/CSB                          2205510
      GO TO 714                                                    2205520
  815 TEMP10 = ((-XK11*XD11)**.5)/(48.0**.5)                       2205530
      TEM11 =((-XK22*XD22)**.5)/(48.0**.5)                         2205540
      XNTTH = XK11/4.0*TEMP1*(TEMP61+TEMP62)                       2205550
      XNTPH = XK22/4.0*TEMP2*(TEMP61+TEMP62)                       2205560
      XMTTH = TEMP10*TEMP1*(TEMP71-TEMP72)                         2205570
      XMTPH = TEM11*TEMP2*(TEMP71-TEMP72)                          2205580
  714 CONTINUE                                                     2205590
 8889 RETURN                                                       2205600
      END                                                          2205610
```

```
 FOR,IS TEMOEG,TEMOEG
      SUBROUTINE TEMOEG                                                  2600010
C     THIS SUBROUTINE CALCULATES THE GEOMETRY FOR A SHELL SEGMENT.       2600020
C     THE INPUT VARIABLES ARE . . .                                      2600030
C               RI(I) - - DISTANCE FROM AXIS OF REV. TO POINTS           2600040
C                         ON SHELL MERIDIAN.                             2600050
C               ZI(I) - - DISTANCE ALONG AXIS OF REV. TO THE             2600060
C                         INTERSECTION OF THE CORRESPONDING RI(I) AND    2600070
C                         THE AXIS OF REV.                               2600080
C               NRZIN - - NUMBER OF (RI,ZI) PAIRS READ AS INPUT.         2600090
C                                                                        2600100
      COMMON /SNILPS/ ANG,PSI(100),RAD(100),CUR1(100),CUR2(100),         2600110
     1        DR1DP(100),ZI(14),RI(14),NRZIN                             2600120
      DIMENSION CI(4,13),DRDZ(14),SOUT(14),S(101),RADD(100)              2600130
C                                                                        2600140
      FUN(ARG) = SQRT(1.0 + ARG**2)                                      2600150
C                                                                        2600160
      RADS = 3.1415926/180.0                                             2600170
      DATA B/'B   '/                                                     2600180
      AMULT = 1.0                                                        2600190
      IF (ANG.EQ.B) AMULT = -1.0                                         2600200
C                                                                        2600210
C     PASS SPLINE CURVE THROUGH INPUT POINTS ON SHELL MERIDIAN, AND      2600220
C     COMPUTE DR/DZ AT THESE POINTS.                                     2600230
C                                                                        2600240
      CALL PLYCO (ZI,RI,NRZIN,CI)                                        2600250
      NDELZ = NRZIN - 1                                                  2600260
      DO 60 I=1,NRZIN                                                    2600270
      CALL PLYNE (ZI,RI,NRZIN,CI,ZI(I),FAKE1,DRDZ(I),FAKE2)              2600280
   60 CONTINUE                                                           2600290
C                                                                        2600300
C     COMPUTE MERIDIONAL ARC LENGTH TO INTERPOLATED POINTS BY            2600310
C     NUMERICAL INTEGRATION (SIMPSONS RULE).  SINCE SIMPSONS RULE        2600320
C     REQUIRES AN EVEN NUMBER OF PARTITIONS, INTERPOLATE A POINT         2600330
C     MIDWAY BETWEEN EACH PAIR OF POINTS USING SUBROUTINE  PLINE.        2600340
C                                                                        2600350
      SOUT(1) = 0.                                                       2600360
      DO 70 I=1,NDELZ                                                    2600370
      DZ2=(ZI(I+1)-ZI(I))/2.0                                            2600380
      DZ6=DZ2/3.0                                                        2600390
      CALL PLYNE (ZI,RI,NRZIN,CI,ZI(I)+DZ2,FAKE1,DRDZM,FAKE2)            2600400
      SOUT(I+1) = SOUT(I) + DZ6*(FUN(DRDZ(I)) + 4.0*FUN(DRDZM) +         2600410
     1              FUN(DRDZ(I+1)))                                      2600420
   70 CONTINUE                                                           2600430
C                                                                        2600440
C     USE SPLICO TO REPRESENT RI(I) AS A FUNCTION OF SOUT(I).  THEN USE  2600450
C     SPLINE TO INTERPOLATE RADD AND CORRESPONDING DERIVATIVES.  FROM    2600460
C     THESE, COMPUTE THE TWO PRINCIPAL RADII OF CURVATURE,               2600470
C       CUR1 = 1/R1                                                      2600480
C       CUR2 = 1/R2                                                      2600490
C                                                                        2600500
      OLDH1 = SOUT(NRZIN)/99.0                                           2600510
      CALL PLYCO (SOUT,RI,NRZIN,CI)                                      2600520
      DO 110 I=1,100                                                     2600530
      S(I) = FLOAT(I-1)*OLDH1                                            2600540
      CALL PLYNE (SOUT,RI,NRZIN,CI,S(I),RAD(I),RADD(I),RADD2)            2600550
      IF (ABS(RADD(I)).GT.1.0) RADD(I)=1.0                               2600560
      FACTOR = SQRT(1.0-RADD(I)**2)                                      2600570
      CUR1(I) = -RADD2/FACTOR                                            2600580
      CUR2(I) = FACTOR/RAD(I)                                            2600590
```

```
110 CONTINUE                                                          2600600
    DO 180 J=1,100                                                    2600610
    COSPSI = AMULT*RADD(J)                                            2600620
    PSI(J) = ARCOS(COSPSI)                                            2600630
    SINPSI = -AMULT*RAD(J)*CUR2(J)                                    2600640
    IF (ANG.EQ.8) GO TO 179                                           2600650
    PSI(J) = 2.0*3.1415926-PSI(J)                                     2600660
179 CONTINUE                                                          2600670
    CUR1(J) = -AMULT/CUR1(J)                                          2600680
    CUR2(J) = -AMULT/CUR2(J)                                          2600690
    IF (J.EQ.1) GO TO 180                                             2600700
    I = 1                                                             2600710
    IF (J.EQ.2) GO TO 181                                             2600720
    I = 2                                                             2600730
181 IF (ANG.EQ.8) GO TO 190                                           2600740
    DR1DP(J-1) = (CUR1(J)-CUR1(J-I))/(PSI(J)-PSI(J-I))                2600750
    GO TO 180                                                         2600760
190 DR1DP(J-1) = (CUR1(J-I)-CUR1(J))/(PSI(J-I)-PSI(J))                2600770
180 CONTINUE                                                          2600780
    DR1DP(100) = DR1DP(99)                                            2600790
    DO 42 J=1,100                                                     2600800
    DR1DP(J) = DR1DP(J)*0.1                                           2600810
 42 CONTINUE                                                          2600820
    RETURN                                                            2600830
    END                                                               2600840
```

```
 FOR,IS PLYCO,PLYCO
      SUBROUTINE PLYCO (X,Y,M,C)                                        2800010
C     SUBROUTINE TO DETERMINE C(1,K),C(2,K),C(3,K) AND C(4 K).          2800020
      DIMENSION X(14),Y(14),A(14,3),B(14),Z(14)                         2800030
      DIMENSION D(13),P(13),E(13),C(4,13)                               2800040
      MM = M-1                                                          2800050
      DO 10 K=1,MM                                                      2800060
      D(K) = X(K+1) - X(K)                                              2800070
      P(K) = D(K)/6.0                                                   2800080
   10 E(K) = (Y(K+1)-Y(K))/D(K)                                         2800090
      DO 20 K=2,MM                                                      2800100
   20 B(K) = E(K) - E(K-1)                                              2800110
      A(1,2) = -1.0-D(1)/D(2)                                           2800120
      A(1,3) = D(1)/D(2)                                                2800130
      A(2,3) = P(2)-P(1)*A(1,3)                                         2800140
      A(2,2) = 2.0*(P(1)+P(2)) - P(1)*A(1,2)                            2800150
      A(2,3) = A(2,3)/A(2,2)                                            2800160
      B(2) = B(2)/A(2,2)                                                2800170
      DO 30 K=3,MM                                                      2800180
      A(K,2) = 2.0*(P(K-1)+P(K))-P(K-1)*A(K-1,3)                        2800190
      B(K) = B(K)-P(K-1)*B(K-1)                                         2800200
      A(K,3) = P(K)/A(K,2)                                              2800210
   30 B(K) = B(K)/A(K,2)                                                2800220
      Q = D(M-2)/D(M-1)                                                 2800230
      A(M,1) = 1.0+Q+A(M-2,3)                                           2800240
      A(M,2) = -Q-A(M,1)*A(M-1,3)                                       2800250
      B(M) = B(M-2)-A(M,1)*B(M-1)                                       2800260
      Z(M) = B(M)/A(M,2)                                                2800270
      MN = M-2                                                          2800280
      DO 40 I=1,MN                                                      2800290
      K = M-I                                                           2800300
   40 Z(K) = B(K)-A(K,3)*Z(K+1)                                         2800310
      Z(1) = -A(1,2)*Z(2)-A(1,3)*Z(3)                                   2800320
      DO 50 K=1,MM                                                      2800330
      Q = 1.0/(6.0*D(K))                                                2800340
      C(1,K) = Z(K)*Q                                                   2800350
      C(2,K) = Z(K+1)*Q                                                 2800360
      C(3,K) = Y(K)/D(K)-Z(K)*P(K)                                      2800370
   50 C(4,K) = Y(K+1)/D(K)-Z(K+1)*P(K)                                  2800380
      RETURN                                                            2800390
      END                                                               2800400
```

```
 FOR,IS PLYNE,PLYNE
       SUBROUTINE PLYNE (X,Y,M,C,XINT,YINT,DYDX,D2YDX2)                    2700010
C      SUBROUTINE FOR SPLINE FIT INTERPOLATION IN THE TABLE OF VALUES      2700020
C      (X1,Y1) TO (XM,YM), WHERE M MAY BE AS LARGE AS 100,  HERE THE       2700030
C      CONSTANTS C(1,K),C(2,K),C(3,K) AND C(4,K) ARE ALREAD  COMPUTED      2700040
C      AND STORED.                                                         2700050
C      SUBROUTINE ALSO COMPUTES DY/DX AND D2Y/DX2 AT XINT.                 2700060
       DIMENSION X(14),Y(14),C(4,13)                                       2700070
       IF (XINT-X(1)) 80,10,20                                             2700080
   10  YINT = Y(1)                                                         2700090
       K=1                                                                 2700100
       GO TO 70                                                            2700110
   20  K = 1                                                               2700120
   30  IF (XINT-X(K+1)) 60,40,50                                           2700130
   40  YINT = Y(K+1)                                                       2700140
       GO TO 70                                                            2700150
   50  K = K + 1                                                           2700160
       IF (M-K) 80,80,30                                                   2700170
   60  YINT = (X(K+1) - XINT)*(C(1,K)*(X(K+1)-XINT)**2+C(3,K))             2700180
       YINT = YINT + (XINT-X(K))*(C(2,K)*(XINT-X(K))**2+C(4,K))            2700190
   70  DYDX=-3.0*(C(1,K)*(X(K+1)-XINT)**2-C(2,K)*(XINT-X(K))**2)           2700200
      1      -C(3,K)+C(4,K)                                               2700210
       D2YDX2=6.0*(C(1,K)*(X(K+1)-XINT)+C(2,K)*(XINT-X(K)))                2700220
       RETURN                                                              2700230
   80  WRITE (6,90)                                                        2700240
   90  FORMAT (31H OUT OF RANGE FOR INTERPOLATION)                         2700250
       RETURN                                                              2700260
       END                                                                 2700270
```

```
FOR,IS GRAPH,GRAPH
      SUBROUTINE GRAPH (KGEOM)
      COMMON /GRAFIX/ X(100),Y(100,9),NGRAPH,LDEF(9),NGR,JCYC,NFLAG,JAM,
     C                JNSC
      COMMON /CDISP/ P
      DIMENSION IDARY(22),YTITLE(12),YTIT(4,9),XTITLE(12)
      DIMENSION TITLE(12),ALPHA(2)
      DATA YTITLE/12*'      '/
      DATA TITLE/'REGION',' NO.= ',2*6H      ,'SEGMEN','T NO.=',
     1           2*6H      ,'CYCLE ','NO.=  ',2*6H      /
      DATA YTIT/'U     ',3*'      ',
     1          'V     ',3*'      ',
     2          'W     ',3*'      ',
     3          'SIGMA ','THETA ','IN    ','      ',
     4          'SIGMA ','PHI IN','      ','      ',
     5          'TAU PH','I THET','A IN  ','      ',
     6          'SIGMA ','THETA ','OUT   ','      ',
     7          'SIGMA ','PHI OU','T     ','      ',
     8          'TAU PH','I THET','A OUT ','      '/
      DATA XTITLE/'DISTAN','CE ALO','NG SEG','MENT ('/
      DATA A/'PHI)'/,B/'S)  '/
      EXTERNAL TABL1V
      IF (NFLAG.NE.0) GO TO 1
      CALL IDENT (9,IDARY)
      NFLAG = 1
    1 CONTINUE
      CALL CHSIZV (2,2)
      CALL RITSTV (13,19,TABL1V)
      XMN = X(1)
      XMX = X(1)
      DO 20 J=1,JCYC
      IF (X(J).LT.XMN) XMN = X(J)
      IF (X(J).GT.XMX) XMX = X(J)
   20 CONTINUE
      CALL SCRND (XMX,XMN,XMAX,XMIN)
      INDEX = 0
      DO 100 K=1,9
      IF (LDEF(K).EQ.0) GO TO 100
      INDEX = INDEX+1
      YMN = Y(1,INDEX)
      YMX = Y(1,INDEX)
      DO 30 L=1,JCYC
      IF (Y(L,INDEX).LT.YMN) YMN = Y(L,INDEX)
      IF (Y(L,INDEX).GT.YMX) YMX = Y(L,INDEX)
   30 CONTINUE
      CALL SCRND (YMX,YMN,YMAX,YMIN)
      IF (KGEOM.EQ.3.OR.KGEOM.EQ.4) GO TO 1234
      XTITLE(5) = A
      GO TO 1235
 1234 XTITLE(5) = B
 1235 CONTINUE
      DO 45 M=1,4
   45 YTITLE(M) = YTIT(M,K)
      CALL QUIK3L (-1,XMIN,XMAX,YMIN,YMAX,1H*,XTITLE,YTITLE,-JCYC,X,
     1             Y(1,INDEX))
      ENCODE (801,ALPHA) JAM,JNSC
  801 FORMAT(2I6)
      TITLE(3) = ALPHA(1)
      TITLE(7) = ALPHA(2)
      KCYC = P
```

```
      ENCODE (802,ALPHA) KCYC
  802 FORMAT(I6)
      TITLE(11) = ALPHA(1)
      CALL RITE2V (46,1005,1023,90,1,72,1,TITLE,IERR)
      IF (IERR.NE.0) WRITE(6,800) IERR
  800 FORMAT(' IERR =',I3,' CHARACTER COUNT WHERE WRITING WAS STOPPED')
  100 CONTINUE
      RETURN
      END
```

SUBROUTINES ODE1 AND ODE2

Subroutine LEBEGE calls either ODE1 or ODE2, as necessary, and various geometric and trigonometric clues, as well as the predicted values of the variables for the differential equations, are passed to this subprogram via label common area LASTEQ.

The equations in ODE1 and ODE2 are identical to those in subroutines DIF1 and DIFF2 respectively. Subroutines ODE1 and ODE2 perform the final integration for each segment in the structure utilizing the initial conditions previously obtained, and return these values to LEBEGE via label common area LASTEQ.

The ODE1, ODE2 flow charts are identical to the DIF1, DIFF2 flow charts respectively.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
YANPT	$N_{\phi\theta}$
YAQPH	Q_{ϕ}
YAQTH	Q_{θ}
YAOPH	Ω_{ϕ}

```
FOR,IS ODE1,ODE1
      SUBROUTINE ODE1                                                    2000010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                      2000020
      INTEGER XN1,XN                                                     2000030
      REAL K                                                             2000040
      DOUBLE PRECISION YPRED                                             2000050
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)          2000060
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                             2000070
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH            2000080
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)   2000090
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB  2000100
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE  2000110
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS             2000120
      COMMON LODE,ICYCLE,LDISTL                                          2000130
      COMMON /LASTEQ/ YPRED(8),YDOT(8),YASAVE(8),                        2000140
     1                YANTH,YAMTH,YAMPT,YANPT,YAOPH,YAQPH,YAQTH,YAJPH,   2000150
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,         2000160
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,       2000170
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,   2000180
     5    ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,R1SQ,                           2000190
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,      2000200
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,       2000210
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,    2000220
     9                XK11,XK12,XK21,XK22,XK33,XD11,                     2000230
     A                   M,I,SITIN,SITOUT,SIPIN,SIPOUT,TPTIN,TPTOUT,     2000240
     B              ZBRIN,ZBROUT,SCRIPA,SCRIPI,SIFIN,SIFOUT,TZEPH,TZETH 2000250
     B                 ,XNPHI,BETTA,ZETTA,XC16                          2000260
     C                 ,RMOSS,RMOSN,YLDST,ROC,HP,FPLUH,GPLUH,TWON       2000270
     D                 ,RMOSSY,RMOSNY,RMOSXY,RMONXY                     2000280
     D                 ,RMOSNS,RMOSSS,SIGOXS,RMOSNR,RMOSSR,SIGOXR       2000290
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                         2000300
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),     2000310
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),     2000320
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),      2000330
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)              2000340
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                         2000350
      EQUIVALENCE (XNL(1),X1),(XNL(2),X2),(XNL(3),X3),(K,DELP)           2000360
      IF (ISTTAB.NE.2) GO TO 7786                                        2000370
C     THE FOLLOWING EQUATIONS ARE THE 'THICK' SET                        2000380
      GO TO (151,152,153),IGEOM                                          2000390
C   EQUATIONS FOR SHELLS OF REVOLUTION  ( PHI  COORDINATE )              2000400
  151 CONTINUE                                                           2000410
      YAOPH      = XN*YPRED(I+6)*X1RO-YPRED(I+4)*SN1RO                   2000420
      YANTH =      XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*((XN*YPRED(I+4)+ 2000430
     1             YPRED(I+5)*CS-YPRED(I+6)*SN)*X1RO+X1*YAOPH*SAVY(9))+K* 2000440
     2             (XNUPT*XNTPH-XNTTH)+X2*(XNUPT*SAVY(11)-SAVY(10))       2000450
     3             +X3*SAVY(48)                                           2000460
      YAMTH      = XNUPT*YPRED(I+3)-(XD11-XNUPT**2*XD22)*X1RO*(X1RO*(XN* 2000470
     1             YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)+K*       2000480
     2             (XNUPT*XMTPH-XMTTH)+X2*(XNUPT*SAVY(14)-SAVY(13))       2000490
     3             +X3*SAVY(49)                                           2000500
      YAMPT      = (-1.0/((RO/XD33)+(SNSQ*X1RO/XK33)))*(-2.0*XN*         2000510
     1             YPRED(I+7)+YPRED(I+4)*(CS1R1-CN1RO)+XN*YPRED(I+5)*     2000520
     2             (SN1RO+X1R1)+2.0*XN*YPRED(I+6)*CS1RO+YPRED(I)*SN/      2000530
     3             XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*RO/XD33)+SN*X1*     2000540
     4             (YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))                    2000550
     5             +X3*SAVY(50)                                           2000560
      YANPT      = YPRED(I)+YAMPT*SN1RO                                  2000570
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)  2000580
     1             *SAVY(5)-YPRED(I+7)*SAVY(6))                           2000590
      YDOT(I+4) = R1*(YPRED(I+4)*CS1RO+XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+  2000600
```

```
     1              X2*SAVY(12)/XK33+YAMPT*SN1RO/XK33)+R1*X1*(YAOPH*          2000610
     2              SAVY(5)+YPRED(I+7)*SAVY(9))                               2000620
     3              +X3*SAVY(51)                                              2000630
      YDOT(I+5) =  R1*(YPRED(I+6)*X1R1+(1.0/(XK22-XNUTP**2*XK11))*           2000640
     1              (YPRED(I+1)-XNUTP*YANTH+K*(XNTPH-XNUTP*XNTTH)+X2*         2000650
     2              (SAVY(11)-XNUTP*SAVY(10))))-R1*YPRED(I+7)*X1*SAVY(5)      2000660
     3              +X3*SAVY(52)                                              2000670
      A =           YPRED(I+5)*CS1RO-YPRED(I+6)*SN1RO+SAVY(9)*YAOPH+          2000680
     1              YDOT(I+5)/R1-YPRED(I+6)/R1+SAVY(5)*YPRED(I+7)             2000690
      B =           SAVY(1)*CS1RO-SAVY(3)*SN1RO+.5*(SAVY(9)*SAVY(9)           2000700
     1              +SAVY(5)*SAVY(5))+(SAVY(2)-SAVY(3))/R1                    2000710
      YDOT(I)    =  R1*(-2.0*YPRED(I)*CS1RO+XN*YANTH*X1RO-XN*YAMTH*SN*       2000720
     1              X1ROSQ-YAMPT*CS1RO*(X1R1-SN1RO))-R1*K*(XFTHLD+XMPHLD*     2000730
     2              SN1RO)-R1*X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)    2000740
     3              /R1+SAVY(4)*K*XFPHLD/R1+SAVY(26)*YAOPH+SAVY(9)*K*         2000750
     4              XFZELD+SN/RO*(YANTH*SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*     2000760
     5              SAVY(8)-YANPT*SAVY(5)))-X3*SAVY(33)                       2000770
      YDOT(I+1) =  R1*(CS1RO*(YANTH-YPRED(I+1))-XN*X1RO*(YPRED(I)+           2000780
     1              YAMPT*(SN*X1RO+X1R1))+YPRED(I+2)*X1R1)-R1*K*XFPHLD        2000790
     2              -R1*X1*(SAVY(25)*A+K*XFPHLD*B                             2000800
     3              -SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                    2000810
     4              -X3*SAVY(34)                                              2000820
      YDOT(I+2) =  R1*(-YPRED(I+2)*CS1RO-YANTH*SN1RO-YPRED(I+1)*X1R1         2000830
     1              +XNSQ*YAMTH*X1ROSQ-2.0*XN*YAMPT*CS*X1ROSQ)+R1*K*          2000840
     2              (XN*XMPHLD*X1RO-XFZELD)-R1*X1*(SAVY(26)*A+K*XFZELD*       2000850
     3              B-SAVY(24)*YAOPH-SAVY(9)*K*                               2000860
     4              XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)              2000870
     5              -X3*SAVY(35)                                              2000880
      YDOT(I+3) =  R1*(YAMTH*CS1RO-YPRED(I+3)*CS1RO-2.0*XN*YAMPT*X1RO+       2000890
     1              YAJPH+K*XMTHLD)                                           2000900
     2              +X3*SAVY(36)                                              2000910
      YDOT(I+6) =  R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                           2000920
      YDOT(I+7) =  R1*(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*         2000930
     1              YAMTH-K*(XMTPH-XNUTP*XMTTH)-X2*(SAVY(14)-XNUTP*           2000940
     2              SAVY(13)))                                                2000950
     3              +X3*SAVY(53)                                              2000960
      GOTO 9005                                                              2000970
C     EQUATIONS FOR CONE                                                     2000980
  152 CONTINUE                                                               2000990
      YAOPH      =  XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TAN/S                   2001000
      YANTH =       XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*((X1CS/S)*(XN*     2001010
     1              YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*         2001020
     2              SAVY(9))+K*(XNUPT*XNTPH-XNTTH)+X2*(XNUPT*SAVY(11)-        2001030
     3              SAVY(10))                                                 2001040
     4              +X3*SAVY(48)                                              2001050
      YAMTH=XNUPT*YPRED(I+3)-(1.0/S)*X1CS*(XD11-XNUPT**2*XD22)*((1.0/S)*     2001060
     1       X1CS*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)*CS)-          2001070
     2              K*(XMTTH-XNUPT*XMTPH)                                     2001080
     3              +X2*(XNUPT*SAVY(14)-SAVY(13))                             2001090
     4              +X3*SAVY(49)                                              2001100
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-       2001110
     1       YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED     2001120
     2              (I)*SN/XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*S*CS/XD33)      2001130
     3              +SN*X1*(YAOPH*                                            2001140
     4              SAVY(5)+SAVY(9)*YPRED(I+7)))                              2001150
     5              +X3*SAVY(50)                                              2001160
      YANPT      =  YPRED(I)+YAMPT*TAN/S                                      2001170
      YAJPH =       YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)*   2001180
     1              SAVY(5)-YPRED(I+7)*SAVY(6))                               2001190
      YDOT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)        2001200
     1              +YPRED(I)/XK33+X2*SAVY(12)/XK33+X1*(YAOPH*SAVY(5)         2001210
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     2              +YPRED(I+7)*SAVY(9))                                          2001220
     3              +X3*SAVY(51)                                                  2001230
      YDOT(I+5) = (1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+            2001240
     1              K*(XNTPH-XNUTP*XNTTH)+X2*(SAVY(11)-XNUTP*SAVY(10)))         2001250
     2              -YPRED(I+7)*X1*SAVY(5)                                        2001260
     3              +X3*SAVY(52)                                                  2001270
      A =           YPRED(I+5)/S-YPRED(I+6)*TN/S+SAVY(9)*YAOPH+YDOT(I+5)          2001280
     1              +SAVY(5)*YPRED(I+7)                                           2001290
      B =           SAVY(1)/S-SAVY(3)*TN/S+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*          2001300
     1              SAVY(5))+SAVY(2)                                              2001310
      YDOT(I)   =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2        2001320
     1              +YAMPT*TAN/S**2-K*(XFTHLD+XMPHLD*TAN/S)-X1*(SAVY(24)*        2001330
     2              A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*K*XFPHLD+            2001340
     3              SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+TAN/S*(YANTH*SAVY(9)+        2001350
     4              YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*SAVY(5)))-X3*         2001360
     5              SAVY(33)                                                      2001370
      YDOT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/           2001380
     1              (S*S*CS*CS)-K*XFPHLD-X1*(SAVY(25)*A+K*XFPHLD*B-              2001390
     2              SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                         2001400
     3              -X3*SAVY(34)                                                  2001410
      YDOT(I+2) = -YPRED(I+2)/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)              2001420
     1              -2.0*XN*YAMPT/(S**2*CS)+K*(XN*XMPHLD*X1CS/S-XFZELD)           2001430
     2              -X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-SAVY(9)*K*         2001440
     3              XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)                  2001450
     4              -X3*SAVY(35)                                                  2001460
      YDOT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD           2001470
     1              *K                                                            2001480
     2              +X3*SAVY(36)                                                  2001490
      YDOT(I+6)=YPRED(I+7)                                                       2001500
      YDOT(I+7)=(1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH-             2001510
     1              K*(XMTPH-XNUTP*XMTTH)-X2*(SAVY(14)-XNUTP*SAVY(13)))           2001520
     2              +X3*SAVY(53)                                                  2001530
      GO TO 9005                                                                 2001540
C     EQUATIONS FOR CYLINDER                                                     2001550
  153 CONTINUE                                                                   2001560
      YAOPH      = X1RO*(XN*YPRED(I+6)-YPRED(I+4))                               2001570
      YANTH =      XNUPT*YPRED(I+1)+(XK11-XNUPT**2*XK22)*((X1RO*(XN*             2001580
     1              YPRED(I+4)-YPRED(I+6)))+X1*YAOPH*SAVY(9))+K*(XNUPT*          2001590
     2              XNTPH-XNTTH)+X2*(XNUPT*SAVY(11)-SAVY(10))                     2001600
     3              +X3*SAVY(48)                                                  2001610
      YAMTH=XNUPT*YPRED(I+3)-(X1RO*(XD11-XNUPT**2*XD22))*(X1RO*(XN*YPRED         2001620
     1              (I+4)-XNSQ*YPRED(I+6)))+K*(XNUPT*XMTPH-XMTTH)                 2001630
     2              +X2*(XNUPT*SAVY(14)-SAVY(13))                                 2001640
     3              +X3*SAVY(49)                                                  2001650
      YAMPT=(-1.0/((RO/XD33)+(X1RO/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RO*          2001660
     1              YPRED(I+5)+YPRED(I)/XK33+X2*(SAVY(12)/XK33-SAVY(15)*         2001670
     2              RO/XD33)+X1*(YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))               2001680
     3              +X3*SAVY(50)                                                  2001690
      YANPT      = YPRED(I)+YAMPT*X1RO                                           2001700
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)         2001710
     1              *SAVY(5)-YPRED(I+7)*SAVY(6))                                  2001720
      YDOT(I+4) = XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+X2*SAVY(12)/XK33+             2001730
     1              YAMPT*X1RO/XK33+X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))         2001740
     2              +X3*SAVY(51)                                                  2001750
      YDOT(I+5) = (1.0/(XK22-XNUTP**2*XK11))*(YPRED(I+1)-XNUTP*YANTH+            2001760
     1              K*(XNTPH-XNUTP*XNTTH)+X2*(SAVY(11)-XNUTP*SAVY(10)))-         2001770
     2              YPRED(I+7)*X1*SAVY(5)                                         2001780
     3              +X3*SAVY(52)                                                  2001790
      A =           -YPRED(I+6)/RO+SAVY(9)*YAOPH+YDOT(I+5)+SAVY(5)*               2001800
     1              YPRED(I+7)                                                    2001810
      B =           -SAVY(3)/RO+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*SAVY(5))+           2001820
```

```
     1             SAVY(2)                                                  2001830
      YDOT(I)    = XN*YANTH*X1RO-XN*YAMTH*X1ROSQ-K*(XFTHLD+XMPHLD*X1RO)    2001840
     1             -X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*   2001850
     2             K*XFPHLD+SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+(YANTH*         2001860
     3             SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*          2001870
     4             SAVY(5))/RO)-X3*SAVY(33)                                 2001880
      YDOT(I+1) = -XN*X1RO*YPRED(I)-XN*YAMPT*X1ROSQ-K*XFPHLD-X1*            2001890
     1             (SAVY(25)*A+K*XFPHLD*B-SAVY(26)*YPRED(I+7)-SAVY(5)*      2001900
     2             K*XFZELD)                                                2001910
     3             -X3*SAVY(34)                                             2001920
      YDOT(I+2) = -YANTH*X1RO+XNSQ*YAMTH*X1ROSQ+K*(XN*XMPHLD*X1RO-          2001930
     1             XFZELD)-X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-        2001940
     2             SAVY(9)*K*XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)   2001950
     3             -X3*SAVY(35)                                             2001960
      YDOT(I+3) = -2.0*XN*YAMPT*X1RO+YAJPH+K*XMTHLD                         2001970
     1             +X3*SAVY(36)                                             2001980
      YDOT(I+6)=YPRED(I+7)                                                  2001990
      YDOT(I+7) = (1.0/(XD22-XNUTP**2*XD11))*(-YPRED(I+3)+XNUTP*YAMTH+      2002000
     1             K*(XNUTP*XMTTH-XMTPH)-X2*(SAVY(14)-XNUTP*SAVY(13)))      2002010
     2             +X3*SAVY(53)                                             2002020
      GO TO 9005                                                            2002030
 7786 GO TO (4771,4772,4773),IGEOM                                          2002040
C     THE FOLLOWING EQUATIONS ARE THE 'ST10' SET                            2002050
C   EQUATIONS FOR SHELLS OF REVOLUTION  ( PHI  COORDINATE )                 2002060
 4771 CONTINUE                                                              2002070
      YAOPH      = XN*YPRED(I+6)*X1RO-YPRED(I+4)*SN1RO                      2002080
      YANTH      = XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+      2002090
     1             X2*SAVY(11)+(XC22/XD22)*(YPRED(I+3)+K*XMTPH+X2*          2002100
     1             SAVY(14)))-K*XNTTH-X2*SAVY(10)+(X1RO*XK11-               2002110
     1             XK12*XK21*X1RO*(1.0/                                     2002120
     2        (XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+   2002130
     3             6)*SN+X1*RO*YAOPH*SAVY(9))-(XC11+XK12*XC22*XD21/XD22*    2002140
     3             (1.0/(XK22+XC22**2/XD22)))*                              2002150
     4        (X1RO**2*(XN*YPRED(I+4)*SN-XN**2*YPRED(I+6))+YPRED(I+7)*CS*   2002160
     5        X1RO)                                                         2002170
     6             +X3*SAVY(48)                                             2002180
      YAMTH =       -XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+    2002190
     1             X2*SAVY(11))-K*XMTTH-X2*SAVY(13)+XD12*(XK22/(XC22**2+    2002200
     2             XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))+(XC11*      2002210
     2         X1RO+XD12*XK21*X1RO*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED(   2002220
     3             I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN+X1*RO*YAOPH*SAVY(9))+   2002230
     3             (XD11-XD12*XK22*XD21/(                                   2002240
     4         XC22**2+XK22*XD22))*(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED     2002250
     5         (I+6))+YPRED(I+7)*CS*X1RO)                                   2002260
     6             +X3*SAVY(49)                                             2002270
      YAMPT      = (-1.0/((RO/XD33)+(SNSQ*X1RO/XK33)))*(-2.0*XN*           2002280
     1             YPRED(I+7)+YPRED(I+4)*(CS1R1-CN1RO)+XN*YPRED(I+5)*       2002290
     2             (SN1RO+X1R1)+2.0*XN*YPRED(I+6)*CS1RO+YPRED(I)*SN/        2002300
     3             XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*RO/XD33)+SN*X1*       2002310
     4             (YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))                      2002320
     5             +X3*SAVY(50)                                             2002330
      YANPT      = YPRED(I)+YAMPT*SN1RO                                     2002340
      YAJPH =       YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)    2002350
     1             *SAVY(5)-YPRED(I+7)*SAVY(6))                             2002360
      YDOT(I+4) = R1*(YPRED(I+4)*CS1RO+XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+     2002370
     1             X2*SAVY(12)/XK33+YAMPT*SN1RO/XK33)+R1*X1*(YAOPH*         2002380
     2             SAVY(5)+YPRED(I+7)*SAVY(9))                              2002390
     3             +X3*SAVY(51)                                             2002400
      YDOT(I+5) = R1*(YPRED(I+6)*X1R1-X1*YPRED(I+7)*SAVY(5)+(1.0/(XK22+      2002410
     1             XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+X2*SAVY(11)+(XC22/    2002420
     1             XD22)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XK21*X1RO*(XN*    2002430
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     2              YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)-X1*XK12*YAOPH* 2002440
     2              SAVY(9)-(XC22*XD21/XD22                                 2002450
     3             )*(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7) 2002460
     4             *CS*X1RO)))                                             2002470
     5              +X3*SAVY(52)                                           2002480
      A =           YPRED(I+5)*CS1RO-YPRED(I+6)*SN1RO+SAVY(9)*YAOPH+       2002490
     1              YDOT(I+5)/R1-YPRED(I+6)/R1+SAVY(5)*YPRED(I+7)          2002500
      B =           SAVY(1)*CS1RO-SAVY(3)*SN1RO+.5*(SAVY(9)*SAVY(9)        2002510
     1              +SAVY(5)*SAVY(5))+(SAVY(2)-SAVY(3))/R1                 2002520
      YDOT(I)    = R1*(-2.0*YPRED(I)*CS1RO+XN*YANTH*X1RO-XN*YAMTH*SN*      2002530
     1              X1ROSQ-YAMPT*CS1RO*(X1R1-SN1RO))-R1*K*(XFTHLD+XMPHLD*  2002540
     2              SN1RO)-R1*X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4) 2002550
     3              /R1+SAVY(4)*K*XFPHLD/R1+SAVY(26)*YAOPH+SAVY(9)*K*      2002560
     4              XFZELD+SN/RO*(YANTH*SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*  2002570
     5              SAVY(8)-YANPT*SAVY(5)))-X3*SAVY(33)                    2002580
      YDOT(I+1) = R1*(CS1RO*(YANTH-YPRED(I+1))-XN*X1RO*(YPRED(I)+          2002590
     1              YAMPT*(SN*X1RO+X1R1))+YPRED(I+2)*X1R1)-R1*K*XFPHLD     2002600
     2              -R1*X1*(SAVY(25)*A+K*XFPHLD*B                          2002610
     3              -SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                 2002620
     4              -X3*SAVY(34)                                           2002630
      YDOT(I+2) = R1*(-YPRED(I+2)*CS1RO-YANTH*SN1RO-YPRED(I+1)*X1R1        2002640
     1              +XNSQ*YAMTH*X1ROSQ-2.0*XN*YAMPT*CS*X1ROSQ)+R1*K*       2002650
     2              (XN*XMPHLD*X1RO-XFZELD)-R1*X1*(SAVY(26)*A+K*XFZELD*    2002660
     3              B-SAVY(24)*YAOPH-SAVY(9)*K*                            2002670
     4              XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)           2002680
     5              -X3*SAVY(35)                                           2002690
      YDOT(I+3) = R1*(YAMTH*CS1RO-YPRED(I+3)*CS1RO-2.0*XN*YAMPT*X1RO+      2002700
     1              YAJPH+K*XMTHLD)                                        2002710
     2              +X3*SAVY(36)                                           2002720
      YDOT(I+6) = R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                          2002730
      YDOT(I+7) = R1*((-XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+     2002740
     1              X2*SAVY(11)-(XK21/RO)*(XN*YPRED(I+4)+YPRED(I+5)*CS-    2002750
     1              YPRED(I+6)*SN)-X1*XK12*YAOPH*SAVY(9))+(XK22/(XC22**2+  2002760
     2              XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK22*    2002770
     3             XD21/(XC22**2+XK22*XD22))*(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ 2002780
     4             *YPRED(I+6))+YPRED(I+7)*CS*X1RO))                       2002790
     5              +X3*SAVY(53)                                           2002800
      GO TO 9005                                                           2002810
C     EQUATIONS FOR CONE                                                   2002820
 4772 CONTINUE                                                             2002830
      YAOPH      = XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TAN/S                   2002840
      YANTH      = XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+     2002850
     1              X2*SAVY(11)+(XC22/XD22)*(YPRED(I+3)+K*XMTPH+X2*        2002860
     1              SAVY(14)))-K*XNTTH-X2*SAVY(10)+(1.0/(CS*S))            2002870
     1              *(XK11-XK12*XK21*(                                     2002880
     2        1.0/(XK22+XC22**2/XD22)))*(XN*YPRED(I+4)+YPRED(I+5)*CS-      2002890
     3              YPRED(I+6)*SN+X1*S*CS*YAOPH*SAVY(9))-(XC11+(XK12*XD21* 2002900
     3              XC22/XD22)*(1.0/(XK22+XC22*                            2002910
     4        *2/XD22)))*((1.0/(S**2*CS**2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED 2002920
     5        (I+6))+YPRED(I+7)/S)                                         2002930
     6              +X3*SAVY(48)                                           2002940
      YAMTH =       -XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+  2002950
     1              X2*SAVY(11))-K*XMTTH-X2*SAVY(13)+XD12*(XK22/(XC22**2+  2002960
     1              XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))+(XC11/    2002970
     2         (S*CS)+XD12*XK21/(S*CS))*(XC22/(XC22**2+XK22*XD22))*(XN*    2002980
     3              YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN+X1*S*CS*YAOPH*  2002990
     3              SAVY(9))+(XD11-XD12*XK22*                              2003000
     4         XD21/(XC22**2+XK22*XD22))*((1.0/(S*CS)**2)*(XN*YPRED(I+4)*  2003010
     5         SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S)                           2003020
     6              +X3*SAVY(49)                                           2003030
      YAMPT=(-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-2.0*XN*YPRED(I+7)-     2003040
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     1       YPRED(I+4)*SN/S+XN*YPRED(I+5)*TN/S+2.0*XN*YPRED(I+6)/S+YPRED 2003050
     2            (I)*SN/XK33+X2*(SAVY(12)*SN/XK33-SAVY(15)*S*CS/XD33)    2003060
     3            +SN*X1*(YAOPH*                                          2003070
     4            SAVY(5)+SAVY(9)*YPRED(I+7)))                            2003080
     5            +X3*SAVY(50)                                            2003090
      YANPT      = YPRED(I)+YAMPT*TAN/S                                   2003100
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)* 2003110
     1            SAVY(5)-YPRED(I+7)*SAVY(6))                             2003120
      YDOT(I+4)=(1.0/S)*(YPRED(I+4)+XN*YPRED(I+5)*X1CS+YAMPT*TN/XK33)      2003130
     1            +YPRED(I)/XK33+X2*SAVY(12)/XK33+X1*(YAOPH*SAVY(5)       2003140
     2            +YPRED(I+7)*SAVY(9))                                    2003150
     3            +X3*SAVY(51)                                            2003160
      YDOT(I+5) = -X1*YPRED(I+7)*SAVY(5)+(1.0/(XK22+XC22**2/XD22))*       2003170
     1            (YPRED(I+1)+K*XNTPH+X2*SAVY(11)+(XC22/XD22)*            2003180
     2            (YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK21/(S*CS))*(XN*     2003190
     2            YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)-X1*XK12*YAOPH*  2003200
     3            SAVY(9)-(XC22*XD21/XD22)*((1.0/(S**2*CS**               2003210
     3          2))*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+YPRED(I+7)/S))     2003220
     4            +X3*SAVY(52)                                            2003230
      A =         YPRED(I+5)/S-YPRED(I+6)*TN/S+SAVY(9)*YAOPH+YDOT(I+5)    2003240
     1            +SAVY(5)*YPRED(I+7)                                     2003250
      B =         SAVY(1)/S-SAVY(3)*TN/S+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*    2003260
     1            SAVY(5))+SAVY(2)                                        2003270
      YDOT(I)  =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2  2003280
     1            +YAMPT*TAN/S**2-K*(XFTHLD+XMPHLD*TAN/S)-X1*(SAVY(24)*   2003290
     2            A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*K*XFPHLD+       2003300
     3            SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+TAN/S*(YANTH*SAVY(9)+   2003310
     4            YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*SAVY(5)))-X3*    2003320
     5            SAVY(33)                                                2003330
      YDOT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/    2003340
     1            (S*S*CS*CS)-K*XFPHLD-X1*(SAVY(25)*A+K*XFPHLD*B-         2003350
     2            SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                   2003360
     3            -X3*SAVY(34)                                            2003370
      YDOT(I+2) = -YPRED(I+2)/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)       2003380
     1            -2.0*XN*YAMPT/(S**2*CS)+K*(XN*XMPHLD*X1CS/S-XFZELD)     2003390
     2            +X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-SAVY(9)*K*    2003400
     3            XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)            2003410
     4            -X3*SAVY(35)                                            2003420
      YDOT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD    2003430
     1            *K                                                      2003440
     2            +X3*SAVY(36)                                            2003450
      YDOT(I+6)=YPRED(I+7)                                                2003460
      YDOT(I+7) = -(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+X2*     2003470
     1            SAVY(11)-XK21*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*  2003480
     1            SN)/(S*CS)-X1*XK12*YAOPH*SAVY(9))+(XK22/(XC22**2+XK22*  2003490
     2            XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK22*XD21      2003500
     3          /(XC22**2+XK22*XD22))*((1.0/(S*CS)**2)*(XN*YPRED(I+4)*SN  2003510
     4          -XN**2*YPRED(I+6))+YPRED(I+7)/S)                          2003520
     5            +X3*SAVY(53)                                            2003530
      GO TO 9005                                                          2003540
C     EQUATIONS FOR CYLINDER                                              2003550
 4773 CONTINUE                                                            2003560
      YAOPH      = X1RO*(XN*YPRED(I+6)-YPRED(I+4))                        2003570
      YANTH      = XK12*(1.0/(XK22+XC22**2/XD22))*(YPRED(I+1)+K*XNTPH+    2003580
     1            X2*SAVY(11)+                                            2003590
     1            (XC22/XD22)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14)))-K*XNTTH-  2003600
     1            X2*SAVY(10)+(X1RO*(XK11-XK12*XK21*(1.0/(XK22+XC22**2/   2003610
     2            XD22))))*(XN*YPRED(I+4)-YPRED(I+6)+X1*RO*YAOPH*         2003620
     2            SAVY(9))-(XC11+(                                        2003630
     3        XK12*XC22*XD21/XD22)*(1.0/(XK22+XC22**2/XD22)))*(X1RO**2*(  2003640
     4        XN*YPRED(I+4)-XNSQ*YPRED(I+6)))                             2003650
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     5              +X3*SAVY(48)                                                    2003660
      YAMTH =       -XD12*(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+           2003670
     1              X2*SAVY(11))-K*XMTTH-X2*SAVY(13)+XD12*(XK22/(XC22**2+           2003680
     2              XK22*XD22))*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))+(XC11*             2003690
     2          X1RO+XD12*XK21*X1RO*(XC22/(XC22**2+XK22*XD22)))*(XN*YPRED           2003700
     3              (I+4)-YPRED(I+6)+X1*RO*YAOPH*SAVY(9))+(XD11-XD12*XK22*          2003710
     3              XD21/(XC22**2+XK22*XD22)                                        2003720
     4           )*(X1ROSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))                         2003730
     5              +X3*SAVY(49)                                                    2003740
      YAMPT=(-1.0/((RO/XD33)+(X1RO/XK33)))*(-2.0*XN*YPRED(I+7)+XN*X1RO*            2003750
     1              YPRED(I+5)+YPRED(I)/XK33+X2*(SAVY(12)/XK33-SAVY(15)*            2003760
     2              RO/XD33)+X1*(YAOPH*SAVY(5)+SAVY(9)*YPRED(I+7)))                 2003770
     3              +X3*SAVY(50)                                                    2003780
      YANPT       = YPRED(I)+YAMPT*X1RO                                            2003790
      YAJPH =       YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)           2003800
     1              *SAVY(5)-YPRED(I+7)*SAVY(6))                                    2003810
      YDOT(I+4) =  XN*YPRED(I+5)*X1RO+YPRED(I)/XK33+X2*SAVY(12)/XK33+               2003820
     1              YAMPT*X1RO/XK33+X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))           2003830
     2              +X3*SAVY(51)                                                    2003840
      YDOT(I+5) =  -X1*YPRED(I+7)*SAVY(5)+(1.0/(XK22+XC22**2/XD22))*               2003850
     1              (YPRED(I+1)+K*XNTPH+X2*SAVY(11)+(XC22/XD22)*                    2003860
     2              (YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK21*X1RO)*(XN*               2003870
     3              YPRED(I+4)-YPRED(I+6))-X1*XK12*YAOPH*SAVY(9)-(XC22*             2003880
     4              XD21/XD22)*(X1ROSQ*(XN*(YPRED(I+4)-XN*YPRED(I+6)))))           2003890
     5              +X3*SAVY(52)                                                    2003900
      A =           -YPRED(I+6)/RO+SAVY(9)*YAOPH+YDOT(I+5)+SAVY(5)*                 2003910
     1              YPRED(I+7)                                                      2003920
      B =           -SAVY(3)/RO+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*SAVY(5))+              2003930
     1              SAVY(2)                                                         2003940
      YDOT(I)     = XN*YANTH*X1RO-XN*YAMTH*X1ROSQ-K*(XFTHLD+XMPHLD*X1RO)           2003950
     1              -X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*          2003960
     2              K*XFPHLD+SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+(YANTH*                2003970
     3              SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*                 2003980
     4              SAVY(5))/RO)-X3*SAVY(33)                                        2003990
      YDOT(I+1) =  -XN*X1RO*YPRED(I)-XN*YAMPT*X1ROSQ-K*XFPHLD-X1*                  2004000
     1              (SAVY(25)*A+K*XFPHLD*B-SAVY(26)*YPRED(I+7)-SAVY(5)*             2004010
     2              K*XFZELD)                                                       2004020
     3              -X3*SAVY(34)                                                    2004030
      YDOT(I+2) =  -YANTH*X1RO+XNSQ*YAMTH*X1ROSQ+K*(XN*XMPHLD*X1RO-                2004040
     1              XFZELD)-X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-               2004050
     2              SAVY(9)*K*XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)          2004060
     3              -X3*SAVY(35)                                                    2004070
      YDOT(I+3) =  -2.0*XN*YAMPT*X1RO+YAJPH+K*XMTHLD                               2004080
     1              +X3*SAVY(36)                                                    2004090
      YDOT(I+6)=YPRED(I+7)                                                         2004100
      YDOT(I+7) =  -(XC22/(XC22**2+XK22*XD22))*(YPRED(I+1)+K*XNTPH+X2*             2004110
     1              SAVY(11)-XK21*X1RO*(XN*YPRED(I+4)-YPRED(I+6))-X1*XK12*          2004120
     1              YAOPH*SAVY(9))+(XK22/(XC22**2+XK22*XD22))*(YPRED(I+3)+          2004130
     2              K*XMTPH+X2*SAVY(14))-(XK22*XD21/(XC22**2+XK22*XD22))*(          2004140
     3           X1ROSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6)))                           2004150
     4              +X3*SAVY(53)                                                    2004160
9005 CONTINUE                                                                      2004170
     RETURN                                                                        2004180
      END                                                                          2004190
```

```
FOR,IS ODE2,ODE2
      SUBROUTINE ODE2,                                                    2100010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                       2100020
      INTEGER XN1,XN                                                      2100030
      REAL K                                                              2100040
      DOUBLE PRECISION YPRED                                              2100050
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)           2100060
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                              2100070
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH             2100080
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)    2100090
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB   2100100
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE   2100110
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS              2100120
      COMMON LODE,ICYCLE,LDISTL                                           2100130
      COMMON /LASTEQ/ YPRED(8),YDOT(8),YASAVE(8),                         2100140
     1                YANTH,YAMTH,YAMPT,YANPT,YAOPH,YAQPH,YAQTH,YAJPH,    2100150
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,          2100160
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,        2100170
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,    2100180
     5    ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,R1SQ,                            2100190
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,       2100200
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,        2100210
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,     2100220
     9                XK11,XK12,XK21,XK22,XK33,XD11,                      2100230
     A                   M,I,SITIN,SITOUT,SIPIN,SIPOUT,TPTIN,TPTOUT,     2100240
     B              ZBRIN,ZBROUT,SCRIPA,SCRIPI,SIFIN,SIFOUT,TZEPH,TZETH  2100250
     8                ,XNPHI,BETTA,ZETTA,XC16                            2100260
     C                ,RMOSS,RMOSN,YLDST,ROC,HP,FPLUH,GPLUH,TWON         2100270
     D                ,RMOSSY,RMOSNY,RMOSXY,RMONXY                       2100280
     D                ,RMOSNS,RMOSSS,SIGOXS,RMOSNR,RMOSSR,SIGOXR         2100290
      COMMON /PLS/ OMEGA,IWORD,XMERD,XPRES,XMONT                         2100300
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),     2100310
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),     2100320
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),      2100330
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)              2100340
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                         2100350
      EQUIVALENCE (XNL(1),X1),(XNL(2),X2),(XNL(3),X3),(K,DELP)           2100360
      GO TO (7341,7342,7343),IGEOM                                       2100370
C     THE FOLLOWING EQUATIONS ARE THE 'RWAF' SET                         2100380
C     EQUATIONS FOR SHELLS OF REVOLUTION ( PHI COORDINATE )              2100390
 7341 CONTINUE                                                           2100400
      YAOPH      = XN*YPRED(I+6)*X1RO-YPRED(I+4)*SN1RO                   2100410
      YANTH =     (YPRED(I+1)+K*XNTPH+X2*SAVY(11))*(XC15*XC22+XD22*XK12) 2100420
     1            /(XK22*XD22+XC22**2)-K*XNTTH-X2*SAVY(10)+(XK12*XC22-   2100430
     1            XK22*XC15)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))/(XC22*     2100440
     2            XC22+XK22*XD22)+(X1RO*(XN*YPRED(I+4)+YPRED(I+5)*CS-    2100450
     2            YPRED(I+6)*SN)+X1*YAOPH*SAVY(9))*(XK11+(XC15*(XC15*    2100460
     3            XK22-2.0*XK12*XC22)-XK12*XK12*                         2100470
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ          2100480
     5 *YPRED(I+6))+X1RO*YPRED(I+7)*CS)*(-XC11+(XC15*XC15*XC22+             2100490
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))    2100500
     7            +X3*SAVY(48)                                           2100510
      YAMTH=      (YPRED(I+3)+K*XMTPH+X2*SAVY(14))*(XC15*XC22+XK22*XD12) 2100520
     1            /(XK22*XD22+XC22*XC22)+(YPRED(I+1)+K*XNTPH+X2*SAVY(11) 2100530
     2            )*(XD22*XC15-XD12*XC22)/(XD22*XK22+XC22**2)-K*XMTTH-   2100540
     3            X2*SAVY(13)+(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6)) 2100550
     4            +X1RO*YPRED(I+7)*CS)*(XD11-(XD12*XD12*XK22+XC15*(2.0*  2100560
     5            XC22*XD12-XC15*XD22))/(XC22*XC22+XK22*XD22))+(X1RO*     2100570
     6            (XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*  2100580
     7            SAVY(9))*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*   2100590
     8            XK22+XD22*XK12))/(XC22*XC22+XK22*XD22))                2100600
     9            +X3*SAVY(49)                                           2100610
```

```
      YAMPT = (1.0/(XC16*SN*X1RO-XK33-SN*X1RO*(XD33*SN/(      RO)-XC16)))  2100620
     1        *((XK33*XD33-XC16**2)*X1RO*(-2.0*XN*YPRED(I+7)+YPRED(I+4)*  2100630
     2        (CS*X1R1-CN1RO)+XN*YPRED(I+5)*(X1R1+SN1RO)+2.0*XN*YPRED     2100640
     3             (I+6)*CS*X1RO)+X1*SN*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9)  2100650
     4             )+(YPRED(I)+X2*SAVY(12))*(XD33*SN*X1RO-XC16)+X2*        2100660
     5             SAVY(15)*(XK33-XC16*SN/RO))                             2100670
     6             +X3*SAVY(50)                                            2100680
      YANPT      = YPRED(I)+YAMPT*SN1RO                                    2100690
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)   2100700
     1             *SAVY(5)-YPRED(I+7)*SAVY(6))                            2100710
      YDOT(I+4) = R1*(YPRED(I+4)*CS*X1RO+X1*(YAOPH*SAVY(5)+YPRED(I+7)*     2100720
     1             SAVY(9))                                                2100730
     1             +XN*YPRED(I+5)*X1RO+(1.0/(XK33-                         2100740
     2             XC16**2/XD33))*(YPRED(I)+YAMPT*(SN*X1RO-XC16/XD33)+X2*  2100750
     3             (SAVY(12)-XC16*SAVY(15)/XD33)))                         2100760
     4             +X3*SAVY(51)                                            2100770
      YDOT(I+5) = YPRED(I+6)-R1*X1*YPRED(I+7)*SAVY(5)+R1*(XD22*(YPRED(I+   2100780
     1             1)+K*XNTPH+X2*SAVY(11))+XC22*(YPRED(I+3)+K*XMTPH+X2*    2100790
     2             SAVY(14))-(X1RO*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6  2100800
     2             )*SN)+X1*YAOPH*SAVY(9))*                                2100810
     3             (XK12*XD22+XC15*XC22)-(X1ROSQ*(XN*YPRED(I+4)-XNSQ*      2100820
     4             YPRED(I+6))+X1RO*YPRED(I+7)*CS)*(XC22*XD12-XC15*XD22))  2100830
     5             /(XK22*XD22+XC22**2)                                    2100840
     6             +X3*SAVY(52)                                            2100850
      A =          YPRED(I+5)*CS1RO-YPRED(I+6)*SN1RO+SAVY(9)*YAOPH+        2100860
     1             YDOT(I+5)/R1-YPRED(I+6)/R1+SAVY(5)*YPRED(I+7)           2100870
      B =          SAVY(1)*CS1RO-SAVY(3)*SN1RO+.5*(SAVY(9)*SAVY(9)         2100880
     1             +SAVY(5)*SAVY(5))+(SAVY(2)-SAVY(3))/R1                  2100890
      YDOT(I)    = R1*(-2.0*YPRED(I)*CS1RO+XN*YANTH*X1RO-XN*YAMTH*SN*      2100900
     1             X1ROSQ-YAMPT*CS1RO*(X1R1-SN1RO))-R1*K*(XFTHLD+XMPHLD*   2100910
     2             SN1RO)-R1*X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)  2100920
     3             /R1+SAVY(4)*K*XFPHLD/R1+SAVY(26)*YAOPH+SAVY(9)*K*       2100930
     4             XFZELD+SN/RO*(YANTH*SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*   2100940
     5             SAVY(8)-YANPT*SAVY(5)))-X3*SAVY(33)                     2100950
      YDOT(I+1) = R1*(CS1RO*(YANTH-YPRED(I+1))-XN*X1RO*(YPRED(I)+          2100960
     1             YAMPT*(SN*X1RO+X1R1))+YPRED(I+2)*X1R1)-R1*K*XFPHLD      2100970
     2             -R1*X1*(SAVY(25)*A+K*XFPHLD*B                           2100980
     3             -SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                  2100990
     4             -X3*SAVY(34)                                            2101000
      YDOT(I+2) = R1*(-YPRED(I+2)*CS1RO-YANTH*SN1RO-YPRED(I+1)*X1R1        2101010
     1             +XNSQ*YAMTH*X1ROSQ-2.0*XN*YAMPT*CS*X1ROSQ)+R1*K*        2101020
     2             (XN*XMPHLD*X1RO-XFZELD)-R1*X1*(SAVY(26)*A+K*XFZELD*     2101030
     3             B-SAVY(24)*YAOPH-SAVY(9)*K*                             2101040
     4             XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)            2101050
     5             -X3*SAVY(35)                                            2101060
      YDOT(I+3) = R1*(YAMTH*CS1RO-YPRED(I+3)*CS1RO-2.0*XN*YAMPT*X1RO+      2101070
     1             YAJPH+K*XMTHLD)                                         2101080
     2             +X3*SAVY(36)                                            2101090
      YDOT(I+6) = R1*(YPRED(I+7)-YPRED(I+5)*X1R1)                          2101100
      YDOT(I+7) = R1*(XK22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XC22*(YPRED(   2101110
     1             I+1)+K*XNTPH+X2*SAVY(11))+(X1RO*(XN*YPRED(I+4)+         2101120
     1             YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*SAVY(9))*(XK12*   2101130
     2             XC22-XK22*XC15)                                         2101140
     2-(X1ROSQ*(XN*YPRED(I+4)*SN-XNSQ*YPRED(I+6))+X1RO*YPRED(I+7)*CS)*     2101150
     3(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)                           2101160
     3             +X3*SAVY(53)                                            2101170
      GO TO 9005                                                           2101180
C     EQUATIONS FOR CONE                                                   2101190
 7342 CONTINUE                                                             2101200
      YAOPH      = XN*YPRED(I+6)*X1CS/S-YPRED(I+4)*TAN/S                   2101210
      YANTH =      (YPRED(I+1)+K*XNTPH+X2*SAVY(11))*(XC15*XC22+XD22*XK12)  2101220
```

```
1              /(XK22*XD22+XC22**2)-K*XNTTH-X2*SAVY(10)+(XK12*XC22-    2101230
1              XK22*XC15)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))/(XC22*      2101240
2              XC22+XK22*XD22)+((XN*YPRED(I+4)+YPRED(I+5)*CS-          2101250
3              YPRED(I+6)*SN)/(S*CS)+X1*YAOPH*SAVY(9))*(XK11+(XC15*    2101260
3              (XC15*XK22-2.0*XK12*XC22)-XK12*XK12*                    2101270
4 XD22)/(XK22*XD22+XC22*XC22))+((XN*YPRED(I+4)*SN-XNSQ*                2101280
5 YPRED(I+6))/(S*S*CSSQ)+YPRED(I+7)/S)*(-XC11+(XC15*XC15*XC22+         2101290
6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22))    2101300
7              +X3*SAVY(48)                                            2101310
 YAMTH =       (YPRED(I+3)+K*XMTPH+X2*SAVY(14))*(XC15*XC22+XK22*XD12)  2101320
1              /(XK22*XD22+XC22**2)+(YPRED(I+1)+K*XNTPH+X2*SAVY(11))*  2101330
1              (XD22*XC15-XD12*XC22)/(XD22*XK22+XC22**2)-K*XMTTH-X2*    2101340
2              SAVY(13)+(1.0/(S*S*CSSQ)*(-XNSQ*YPRED(I+6)+XN*          2101350
2              YPRED(I+4)*                                             2101360
3 SN)+YPRED(I+7)/S)*(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*    2101370
4              XD22))/(XC22*XC22+XK22*XD22))+(1.0/(S*CS)*(XN*           2101380
5              YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)*SN)+X1*YAOPH*       2101390
6              SAVY(9))*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*    2101400
7              XK22+XD22*XK12))/(XC22*XC22+XK22*XD22))                 2101410
8              +X3*SAVY(49)                                            2101420
 YAMPT =((XC16*TAN/S-XK33-(TAN/S)*(XD33*TAN/S-XC16))**(-1))*((XK33*     2101430
1        XD33-XC16**2)*(1.0/(S*CS))*(-2.0*XN*YPRED(I+7)-YPRED(I+4)*     2101440
2              SN/S+XN*YPRED(I+5)*TAN/S+2.0*XN*YPRED(I+6)/S)+X1*SN*    2101450
3              (YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+(YPRED(I)+X2*        2101460
4              SAVY(12))*(XD33*TAN/S-XC16)+X2*SAVY(15)*(XK33-XC16*     2101470
5              TN/S))                                                  2101480
6              +X3*SAVY(50)                                            2101490
 YANPT       = YPRED(I)+YAMPT*TAN/S                                    2101500
 YAJPH =       YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)*  2101510
1              SAVY(5)-YPRED(I+7)*SAVY(6))                             2101520
 YDOT(I+4) =  YPRED(I+4)/S+X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+XN*    2101530
1              YPRED(I+5)/(S*CS)+(1.0/(XK33-XC16**2/                   2101540
2              XD33))*(YPRED(I)+YAMPT*(TAN/S-XC16/XD33)+X2*(SAVY(12)-  2101550
3              XC16*SAVY(15)/XD33))                                    2101560
4              +X3*SAVY(51)                                            2101570
 YDOT(I+5) =  -X1*YPRED(I+7)*SAVY(5)+(XD22*(YPRED(I+1)+K*XNTPH+X2*      2101580
1              SAVY(11))+XC22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(XK12*  2101590
1              XD22+XC15*XC22)*((1.0/(S*CS)*(XN*YPRED(I+4)+YPRED(I+5)  2101600
2              *CS-YPRED(I+6)*SN))+X1*YAOPH*SAVY(9))-(XC22*XD12-XC15*  2101610
2              XD22)*((-XNSQ*                                          2101620
3            YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+YPRED(I+7)/S))    2101630
4            /(XK22*XD22+XC22*XC22)                                    2101640
5              +X3*SAVY(52)                                            2101650
 A =           YPRED(I+5)/S-YPRED(I+6)*TN/S+SAVY(9)*YAOPH+YDOT(I+5)    2101660
1              +SAVY(5)*YPRED(I+7)                                     2101670
 B =           SAVY(1)/S-SAVY(3)*TN/S+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*    2101680
1              SAVY(5))+SAVY(2)                                        2101690
 YDOT(I)   =-2.0*YPRED(I)/S+XN*YANTH*X1CS/S-XN*YAMTH*SN*X1CS**2/S**2    2101700
1              +YAMPT*TAN/S**2-K*(XFTHLD+XMPHLD*TAN/S)-X1*(SAVY(24)*    2101710
2              A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)*K*XFPHLD+        2101720
3              SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+TAN/S*(YANTH*SAVY(9)+    2101730
4              YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*SAVY(5)))-X3*     2101740
5              SAVY(33)                                                2101750
 YDOT(I+1)= -YPRED(I+1)/S+YANTH/S-XN*YPRED(I)/(S*CS)-XN*YAMPT*SN/       2101760
1              (S*S*CS*CS)-K*XFPHLD-X1*(SAVY(25)*A+K*XFPHLD*B-          2101770
2              SAVY(26)*YPRED(I+7)-SAVY(5)*K*XFZELD)                   2101780
3              -X3*SAVY(34)                                            2101790
 YDOT(I+2) =  -YPRED(I+2)/S-YANTH*TAN/S+XNSQ*YAMTH/(S**2*CS**2)         2101800
1              -2.0*XN*YAMPT/(S**2*CS)+K*(XN*XMPHLD*X1CS/S-XFZELD)     2101810
2              +X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-SAVY(9)*K*    2101820
3              XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)            2101830
4              -X3*SAVY(35)                                            2101840
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      YDOT(I+3)= YAMTH/S-YPRED(I+3)/S-2.0*XN*YAMPT/(S*CS)+YAJPH+XMTHLD   2101850
     1             *K                                                    2101860
     2             +X3*SAVY(36)                                          2101870
      YDOT(I+6)=YPRED(I+7)                                               2101880
      YDOT(I+7) = (XK22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XC22*           2101890
     1             (YPRED(I+1)+K*XNTPH+X2*SAVY(11))+(XK12*XC22-XK22*XC15) 2101900
     2             *((1.0/(S*CS)*(XN*YPRED(I+4)+YPRED(I+5)*CS-YPRED(I+6)* 2101910
     2             SN))+X1*YAOPH*SAVY(9))-(XC15*XC22+XK22*XD12)*          2101920
     3           ((-XNSQ*YPRED(I+6)+XN*YPRED(I+4)*SN)/(S*S*CSSQ)+         2101930
     4           YPRED(I+7)/S))/(XK22*XD22+XC22*XC22)                     2101940
     5             +X3*SAVY(53)                                          2101950
      GO TO 9005                                                         2101960
C     EQUATIONS FOR CYLINDER                                             2101970
 7343 CONTINUE                                                           2101980
      YAOPH      = X1RO*(XN*YPRED(I+6)-YPRED(I+4))                       2101990
      YANTH =      (YPRED(I+1)+K*XNTPH+X2*SAVY(11))*(XC15*XC22+XD22*XK12) 2102000
     1             /(XK22*XD22+XC22**2)-K*XNTTH-X2*SAVY(10)+(XK12*XC22-   2102010
     2             XK22*XC15)*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))/(XC22*     2102020
     2             XC22+XK22*XD22)+(X1RO*(XN*YPRED(I+4)-YPRED(I+6))+X1*   2102030
     3             YAOPH*SAVY(9))*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-  2102040
     3             XK12*XK12*                                            2102050
     4 XD22)/(XK22*XD22+XC22*XC22))+(X1ROSQ*(XN*YPRED(I+4)-XNSQ           2102060
     5 *YPRED(I+6)))*(-XC11+(XC15*XC15*XC22+                             2102070
     6 XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*XC22)/(XK22*XD22+XC22*XC22)) 2102080
     7             +X3*SAVY(48)                                          2102090
      YAMTH =      (YPRED(I+3)+K*XMTPH+X2*SAVY(14))*(XC15*XC22+XK22*XD12) 2102100
     1             /(XK22*XD22+XC22**2)+(YPRED(I+1)+K*XNTPH+X2*SAVY(11))* 2102110
     2             (XD22*XC15-XD12*XC22)/(XD22*XK22+XC22**2)-K*XMTTH-X2*  2102120
     2             SAVY(13)+X1ROSQ*(XN*YPRED(I+4)-XNSQ*YPRED(I+6))        2102130
     3 *(XD11-(XD12*XD12*XK22+XC15*(2.0*XC22*XD12-XC15*                  2102140
     4             XD22))/(XC22*XC22+XK22*XD22))+(X1RO*(XN*YPRED(I+4)-    2102150
     5             YPRED(I+6))+X1*YAOPH*SAVY(9))*(XC11+(XD12*XC22*XK12-   2102160
     5             XC15*(XC15*XC22+XD12*XK22+                            2102170
     6 XD22*XK12))/(XC22*XC22+XK22*XD22))                                2102180
     7             +X3*SAVY(49)                                          2102190
      YAMPT=(1/(XC16*X1RO-XK33-X1RO*(XD33*X1RO-XC16)))*((XK33*XD33-XC16  2102200
     1             **2)*X1RO*(-2.0*XN*YPRED(I+7)+XN*X1RO*YPRED(I+5))+X1*  2102210
     2             (YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+(YPRED(I)+X2*       2102220
     3             SAVY(12))*(XD33*X1RO-XC16)+X2*SAVY(15)*(XK33-XC16/RO)) 2102230
     4             +X3*SAVY(50)                                          2102240
      YANPT      = YPRED(I)+YAMPT*X1RO                                   2102250
      YAJPH =      YPRED(I+2)+X1*(SAVY(8)*YAOPH+YANPT*SAVY(9)-YPRED(I+1)  2102260
     1             *SAVY(5)-YPRED(I+7)*SAVY(6))                          2102270
      YDOT(I+4) = X1*(YAOPH*SAVY(5)+YPRED(I+7)*SAVY(9))+XN*YPRED(I+5)/RO 2102280
     1             +                                                     2102290
     1             (1.0/(XK33-XC16**2/XD33))*(YPRED(I)+                  2102300
     2             YAMPT*(X1RO-XC16/XD33)+X2*(SAVY(12)-XC16*SAVY(15)/     2102310
     3             XD33))                                                2102320
     4             +X3*SAVY(51)                                          2102330
      YDOT(I+5) = -X1*YPRED(I+7)*SAVY(5)+(XD22*(YPRED(I+1)+K*XNTPH+X2*    2102340
     1             SAVY(11))+XC22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-(X1RO* 2102350
     1             (XN*YPRED(I+4)-YPRED(I+6))+X1*YAOPH*SAVY(9))*(XK12*    2102360
     2             XD22+XC15*XC22)-X1ROSQ*(XN*YPRED                      2102370
     2(I+4)-XNSQ*YPRED(I+6))*(XC22*XD12-XC15*XD22))/(XK22*XD22+XC22**2)  2102380
     3             +X3*SAVY(52)                                          2102390
      A =          -YPRED(I+6)/RO+SAVY(9)*YAOPH+YDOT(I+5)+SAVY(5)*       2102400
     1             YPRED(I+7)                                            2102410
      B =          -SAVY(3)/RO+0.5*(SAVY(9)*SAVY(9)+SAVY(5)*SAVY(5))+    2102420
     1             SAVY(2)                                               2102430
      YDOT(I)    = XN*YANTH*X1RO-XN*YAMTH*X1ROSQ-K*(XFTHLD+XMPHLD*X1RO)  2102440
     1             -X1*(SAVY(24)*A+K*XFTHLD*B+SAVY(25)*YDOT(I+4)+SAVY(4)* 2102450
```

```
     2             K*XFPHLD+SAVY(26)*YAOPH+SAVY(9)*K*XFZELD+(YANTH*          2102460
     3             SAVY(9)+YAOPH*SAVY(7)-YPRED(I+7)*SAVY(8)-YANPT*           2102470
     4             SAVY(5))/RO)-X3*SAVY(33)                                  2102480
      YDOT(I+1) = -XN*X1RO*YPRED(I)-XN*YAMPT*X1ROSQ-K*XFPHLD-X1*             2102490
     1             (SAVY(25)*A+K*XFPHLD*B-SAVY(26)*YPRED(I+7)-SAVY(5)*       2102500
     2             K*XFZELD)                                                 2102510
     3             -X3*SAVY(34)                                              2102520
      YDOT(I+2) = -YANTH*X1RO+XNSQ*YAMTH*X1ROSQ+K*(XN*XMPHLD*X1RO-           2102530
     1             XFZELD)-X1*(SAVY(26)*A+K*XFZELD*B-SAVY(24)*YAOPH-         2102540
     2             SAVY(9)*K*XFTHLD+SAVY(25)*YPRED(I+7)+SAVY(5)*K*XFPHLD)    2102550
     3             -X3*SAVY(35)                                              2102560
      YDOT(I+3) = -2.0*XN*YAMPT*X1RO+YAJPH+K*XMTHLD                          2102570
     1             +X3*SAVY(36)                                              2102580
      YDOT(I+6)=YPRED(I+7)                                                   2102590
      YDOT(I+7) = (XK22*(YPRED(I+3)+K*XMTPH+X2*SAVY(14))-XC22*               2102600
     1             (YPRED(I+1)+K*XNTPH+X2*SAVY(11))+(X1RO*(XN*YPRED(I+4)-    2102610
     1             YPRED(I+6))+X1*YAOPH*SAVY(9))*(XK12*XC22-XK22*XC15)-      2102620
     2             X1ROSQ*(XN*YPRED                                          2102630
     2(I+4)-XNSQ*YPRED(I+6))*(XC15*XC22+XK22*XD12))/(XC22**2+XK22*XD22)      2102640
     3             +X3*SAVY(53)                                              2102650
 9005 CONTINUE                                                               2102660
      RETURN                                                                 2102670
       END                                                                   2102680
C ..... ROUTINE ** TOBAR  ** ABACUS UPDATED 01/11/74 .....                  2200000
```

SUBROUTINE SHPLAS

Subroutine SHPLAS is called from LEBEGE and incremental stress resultants, deformations and geometric data are passed to the subroutine in the label common area LASTEQ. The routine SHPLAS updates all values to the current load increment and calls a series of routines to obtain the plasticity history of the shell.

Subroutines Called from SHPLAS

Subroutine SHSRSE: Is a routine to calculate elastic stresses throughout the shell wall cross-section.

Subroutine SEPSIS: Is a routine to calculate the plastic strain increments and the shift in the yield surface. The total stresses and plastic strains are also obtained. For this routine the material must be isotropic and the hardening laws either kinematic or istropic.

Subroutine LINEQU: Is a small simultaneous equation solver.

Subroutine ORTHKN: Performs the same function as SEPSIS, above, for orthotropic (kinematic hardening) plasticity.

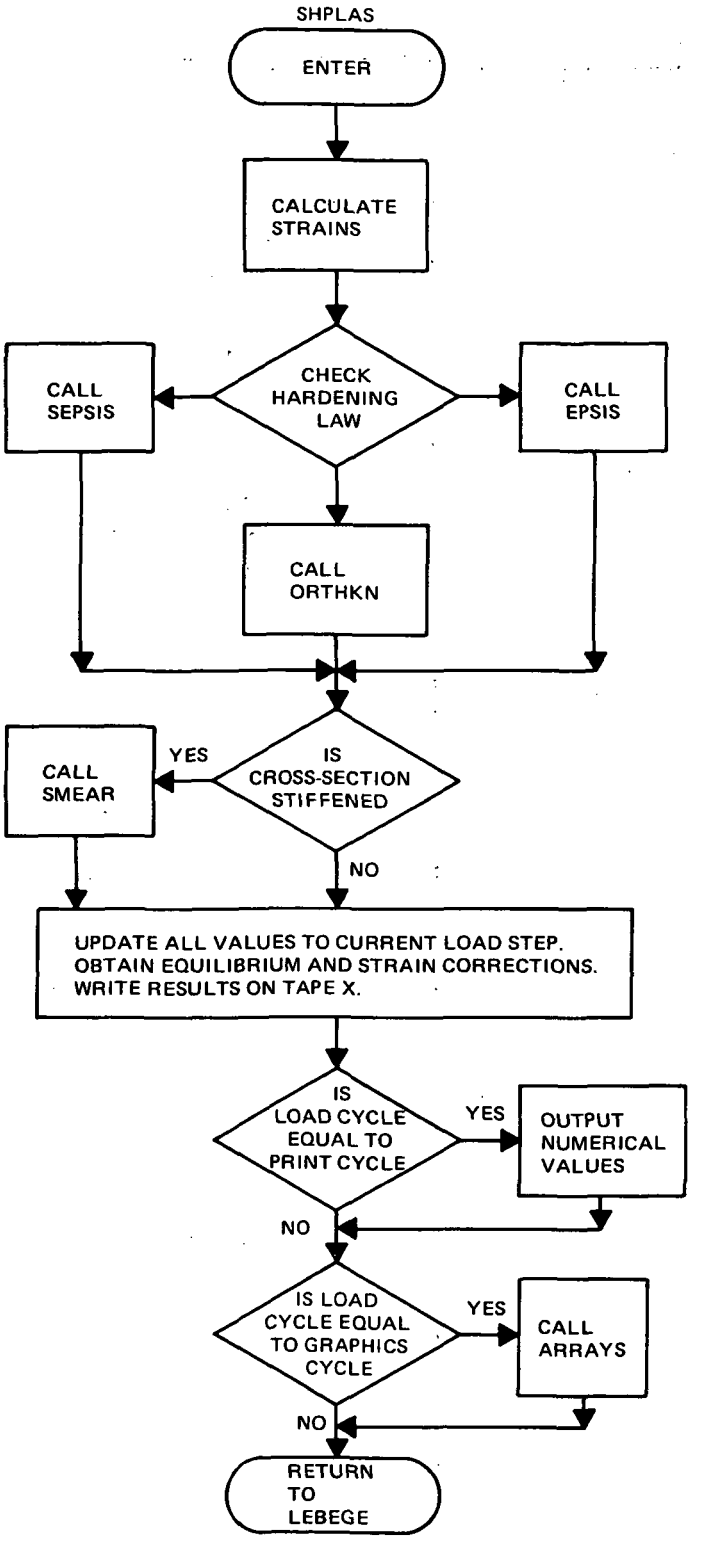
Subroutine EPSIS: Performs the same function as SEPSIS, above, for perfectly plastic behavior.

Subroutine SMEAR: Is a routine to calculate the plasticity effects of smeared reinforcement.

Subroutine SAVXES: Is a routine which obtains an equilibrium and strain correction for each point in the shell, for a series of load steps.

Subroutine ARRAYS: If the clues are set for graphical display of results, the necessary information is passed to this subroutine, which in turn arranges the information to be plotted into proper arrays.

FORTRAN CODE	ENGINEERING SYMBOLS (REF. 1)
EPSITH	ε_{θ_o}
EPSIPH	ε_{ϕ_o}
GAPHTH	$\gamma_{\phi\theta_o}$
XKTH	k_θ
XKPH	k_ϕ
XKPT	$k_{\phi\theta}$


SHPLAS
ENTER
CALCULATE STRAINS
CHECK HARDENING LAW
CALL SEPSIS
CALL EPSIS
CALL ORTHKN
IS CROSS-SECTION STIFFENED
YES
CALL SMEAR
NO
UPDATE ALL VALUES TO CURRENT LOAD STEP.
OBTAIN EQUILIBRIUM AND STRAIN CORRECTIONS.
WRITE RESULTS ON TAPE X.
IS LOAD CYCLE EQUAL TO PRINT CYCLE
YES
OUTPUT NUMERICAL VALUES
NO
IS LOAD CYCLE EQUAL TO GRAPHICS CYCLE
YES
CALL ARRAYS
NO
RETURN TO LEBEGE

```
FOR,IS SHPLAS,SHPLAS
      SUBROUTINE SHPLAS (NCYC,NAPEX,NPR,STEP)                                3300010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                          3300020
      INTEGER XN                                                             3300030
      DOUBLE PRECISION YPRED                                                 3300040
      DOUBLE PRECISION YCORR                                                 3300050
C                                                                            3300060
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)              3300070
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                                 3300080
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH                3300090
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)       3300100
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB      3300110
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE      3300120
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS                 3300130
      COMMON LODE,ICYCLE,LDISTL                                              3300140
      COMMON /LASTEQ/ YPRED(8),YDOT(8),YASAVE(8),                            3300150
     1                YANTH,YAMTH,YAMPT,YANPT,YAOPH,YAQPH,YAQTH,YAJPH,      3300160
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,            3300170
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,          3300180
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,      3300190
     5    ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,R1SQ,                               3300200
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,         3300210
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,          3300220
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,       3300230
     9                XK11,XK12,XK21,XK22,XK33,XD11,                        3300240
     A                   M,I,SITIN,SITOUT,SIPIN,SIPOUT,TPTIN,TPTOUT,        3300250
     B             ZBRIN,ZBROUT,SCRIPA,SCRIPI,SIFIN,SIFOUT,TZEPH,TZETH      3300260
     B                ,XNPHI,BETTA,ZETTA,XC16                               3300270
     C                ,RMOSS,RMOSN,YLDST,ROC,HP,FPLUH,GPLUH,TWON            3300280
     D                ,RMOSSY,RMOSNY,RMOSXY,RMONXY                          3300290
     D                ,RMOSNS,RMOSSS,SIGOXS,RMOSNR,RMOSSR,SIGOXR            3300300
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),         3300310
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),         3300320
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),          3300330
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)                  3300340
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                             3300350
      COMMON /CMAIN/ ZETA1(21),ZETA2(21),NODE,ALF(4),CE(4),NLRS,HI,HO,T      3300360
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI,NEO                                 3300370
      COMMON /MAGIQ/ KKNT,TII,TIK,TOK,TOO                                    3300380
      COMMON /RWO/ ER,ES,CPH,CTH,APH,ATH,SPH,STH,ALPHS,ALPHR,TS,TR,SNB,      3300390
     C             CSB                                                       3300400
      COMMON /GRAFIX/ X(100),Y(100,9),NGRAPH,LDEF(9),NGR,JCYC,NFLAG,JAM,     3300410
     C                JNSC                                                  3300420
      DIMENSION SAVX(53),EPSTNT(3,2)                                         3300430
      DIMENSION DSTR(6),EPSINT(3,2),TEMP(7),DSIG(3),DEPS(3),TEPS(3)          3300440
      DIMENSION YCORR(16)                                                    3300450
      DIMENSION SIGMI(3),SIGMO(3),EPSI(3),EPSO(3)                            3300460
      DIMENSION DTOT(3),EE(2),DEN(3),DEM(3)                                  3300470
      EQUIVALENCE (DSTR(1),EPSIPH),(DSTR(2),EPSITH),(DSTR(3),GAPHTH)         3300480
      EQUIVALENCE (DSTR(4),XKPH),(DSTR(5),XKTH),(DSTR(6),XKPT)               3300490
      EQUIVALENCE (YPRED(1),YCORR(1))                                        3300500
      EQUIVALENCE (NERR,NIX)                                                 3300510
      EQUIVALENCE (XNL(1),X1),(XNL(2),X2),(XNL(3),X3)                        3300520
      EQUIVALENCE (RMOSSX,RMOSS),(RMOSNX,RMOSN)                              3300530
   13 FORMAT(1HO,40X,35HSTRAINS AND STRESSES SHELL ELEMENTS)                 3300540
   30 FORMAT(1HO,45X,4HNODE,I5,10H OF MEMBER,I5,12H NOT ON DISK)             3300550
   50 FORMAT(1HO,50X,35HERROR IN LINEQU IN EPSIS   CYCLE = ,F6.0)            3300560
   55 FORMAT(1HO,50X,35HERROR IN LINEQU IN SEPSIS  CYCLE = ,F6.0)            3300570
   60 FORMAT(1HO,50X,35HERROR IN LINEQU IN ORTHKN  CYCLE = ,F6.0)            3300580
      JDISK = 6                                                              3300590
```

```
      SIMP=.3333333/(NLPO-1)                                            3300600
      IL = 1                                                            3300610
      IA = 1                                                            3300620
      IF (NH.EQ.0) GO TO 180                                            3300630
      IF (LDISTL.EQ.1) GO TO 112                                        3300640
      IF (KELVIN.EQ.1.OR.KELVIN.EQ.3) GO TO 110                         3300650
      DO 111 K=1,KBC                                                    3300660
      DO 111 J=1,3                                                      3300670
  111 STEPS(J,K) = 0.0                                                  3300680
      GO TO 112                                                         3300690
  110 IF (THICK.NE.1) GO TO 113                                         3300700
      NLH = NLRS/2+1                                                    3300710
      DO 115 LR=1,NLH                                                   3300720
      TT = TOK+2.0*ZETA1(LR)*(TII-TOK)                                  3300730
      STEPS(1,LR) = ALPHPH*TT                                           3300740
      STEPS(2,LR) = ALPHTH*TT                                           3300750
  115 STEPS(3,LR) = 0.0                                                 3300760
      NLH = NLH+1                                                       3300770
      DO 116 LR=NLH,NLPO                                                3300780
      TT = TOK+2.0*ZETA1(LR)*(TOK-TOO)                                  3300790
      STEPS(1,LR) = ALPHPH*TT                                           3300800
      STEPS(2,LR) = ALPHTH*TT                                           3300810
  116 STEPS(3,LR) = 0.0                                                 3300820
      GO TO 112                                                         3300830
  113 DO 200 K=1,2                                                      3300840
      DO 200 LR=1,NLPO                                                  3300850
      LRT = LR+(K-1)*NLPO                                               3300860
      GO TO (300,400),K                                                 3300870
  300 TT = TIK+ZETA2(LR)*(TII-TIK)                                      3300880
      GO TO 500                                                         3300890
  400 TT = TOK+ZETA2(LR)*(TOO-TOK)                                      3300900
  500 STEPS(1,LRT) = ALPHPH*TT                                          3300910
      STEPS(2,LRT) = ALPHTH*TT                                          3300920
  200 STEPS(3,LRT) = 0.0                                                3300930
  112 CONTINUE                                                          3300940
      IF (DELP/ABS(DELP).EQ.DELP1/ABS(DELP1)) GO TO 180                 3300950
      DO 181 K=1,KBC                                                    3300960
      NPLA(K) = 0                                                       3300970
      DO 181 J=1,3                                                      3300980
  181 SBAPH(J,K) = SIGMA(J,K)                                           3300990
      DO 182 J=1,3                                                      3301000
      NPLAST(J) = 0                                                     3301010
  182 STBAPH(J) = STSIG(J)                                              3301020
  180 CONTINUE                                                          3301030
      IF (NAPEX.EQ.0.OR.(NH.NE.0.AND.IBEGIN.NE.1)) GO TO 49             3301040
      IF (NPR.EQ.0) GO TO 49                                            3301050
      IF (PHI.NE.TIC) GO TO 49                                          3301060
      WRITE(6,42)                                                       3301070
   42 FORMAT(//20X,'THIS IS AN APEX SEGMENT')                           3301080
   49 CONTINUE                                                          3301090
  356 GO TO (1781,1782,1783),IGEOM                                      3301100
C     PHI COORDINATE                                                    3301110
 1781 EPSITH=X1RO*(YCORR(IL+5)*CS-YCORR(IL+6)*SN)                       3301120
     1        +X1*YAOPH*SAVY(9)                                         3301130
      EPSIPH=X1R1*(YDOT(IL+5) - YCORR(IL+6))                            3301140
     1        +X1*YCORR(IL+7)*SAVY(5)                                   3301150
      GAPHTH = YDOT(IL+4)*X1R1 - (         YCORR(IL+4)*CS)*X1RO         3301160
     1        -X1*(YAOPH*SAVY(5)+YCORR(IL+7)*SAVY(9))                   3301170
      XKPH = YDOT(IL+7)*X1R1                                            3301180
      XKTH = X1RO* YCORR(IL+7)*CS                                       3301190
      XKPT = X1RO*0.5*(2.0*YAOPH*CS+X1R1*(                              3301200
```

```
     1 YDOT(IL+4) * SN + YCORR(IL+4) * CS          ))                    3301210
       GO TO 1785                                                       3301220
C      CONE                                                            3301230
 1782 EPSITH = (1.0/(S*CS)) * (      +YCORR(IL+5)*CS-SN*YCORR(IL+6))     3301240
     1        +X1*YAOPH*SAVY(9)                                         3301250
       EPSIPH= YDOT(IL+5)                                               3301260
     1        +X1*YCORR(IL+7)*SAVY(5)                                   3301270
       GAPHTH = YDOT(IL+4) - 1.0/(S*CS) * (      +CS * YCORR(IL+4))     3301280
     1        -X1*(YAOPH*SAVY(5)+YCORR(IL+7)*SAVY(9))                   3301290
       XKPH  = YDOT(IL+7)                                               3301300
       XKTH = 1.0/(S*CS) *  YCORR(IL+7) * CS                            3301310
       XKPT = 1.0/(2.0*S*CS)*(2.0*YAOPH*CS+                             3301320
     1  YDOT(IL+4) * SN)                                               3301330
       GO TO 1785                                                       3301340
C      CYLINDER                                                        3301350
 1783 EPSITH= X1RO* (       - YCORR(IL+6))                             3301360
     1        +X1*YAOPH*SAVY(9)                                         3301370
       EPSIPH= YDOT(IL+5)                                               3301380
     1        +X1*YCORR(IL+7)*SAVY(5)                                   3301390
       GAPHTH= YDOT(IL+4)                                               3301400
     1        -X1*(YAOPH*SAVY(5)+YCORR(IL+7)*SAVY(9))                   3301410
       XKPH  = YDOT(IL+7)                                               3301420
       XKPT = 0.5*X1RO*YDOT(IL+4)                                       3301430
       XKTH = 0.0                                                       3301440
 1785 CONTINUE                                                          3301450
  280 CONTINUE                                                          3301460
       CE(1) = EPHI/(1.0-XNUTP*XNUPT)                                   3301470
       CE(2) = ETHET/(1.0-XNUTP*XNUPT)                                  3301480
       CE(3) = XGPT                                                     3301490
       CE(4) = XNUPT*EPHI/(1.0-XNUTP*XNUPT)                             3301500
       ALF(1) = 1.0/EPHI                                                3301510
       ALF(2) = 1.0/ETHET                                               3301520
       ALF(3) = 1.0/XGPT                                                3301530
       ALF(4) = -XNUPT/ETHET                                            3301540
C       INITIALIZE EPSINT ARRAY                                         3301550
  285 DO 290 JJ = 1,3                                                   3301560
       DO 290 JT = 1,2                                                  3301570
  290 EPSINT(JJ,JT) = 0.0                                               3301580
C                                                                       3301590
       LIM = 2                                                          3301600
       IF (THICK.EQ.1) LIM = 1                                          3301610
       DO 3800 IS=1,LIM                                                 3301620
       DO 2911 JJ=1,3                                                   3301630
       DO 2911 JT=1,2                                                   3301640
 2911 EPSTNT(JJ,JT) = 0.0                                               3301650
       DO 380 LR = 1,NLPO                                               3301660
       LRT = NLPO*(IS-1)+LR                                             3301670
       GO TO (2901,2902),LIM                                            3301680
 2901 TEMP(4) = ZETA1(LR)*HI/2.0                                        3301690
       GO TO 292                                                        3301700
 2902 GO TO (2903,2904),IS                                              3301710
 2903 TEMP(4) = ZETA2(LR)*HI+(2.0*T*HO+HO*HO-HI*HI)/2.0/(HI+HO)         3301720
       GO TO 292                                                        3301730
 2904 TEMP(4) = ZETA2(LR)*HO-(2.0*HI*(HO+T)+HI*HI+HO*HO)/2.0/(HI+HO)    3301740
  292 DO 293 II=1,3                                                     3301750
  293 TEPS(II) = DELP*STEPS(II,LRT)                                     3301760
C                                                                       3301770
       CALL SHSRSE (DSIG,TEMP,DSTR,1,TEPS)                              3301780
       IF(NPLEV .EQ.0) GO TO 395                                        3301790
C                                                                       3301800
  315 TEMP(5) = SIGMA(1,LRT)-SALPH(1,LRT)                               3301810
```

```
      TEMP(6) = SIGMA(2,LRT)-SALPH(2,LRT)                                3301820
      TEMP(7) = SIGMA(3,LRT)-SALPH(3,LRT)                                3301830
      IF (NPLA(LRT).LE.0) GO TO 375                                      3301840
C                                                                        3301850
      IF (GPLUH*TEMP(5)*DSIG(1)+FPLUH*TEMP(6)*DSIG(2)-HP*(TEMP(5)*       3301860
     1  DSIG(2)+TEMP(6)*DSIG(1))+TWON*TEMP(7)*DSIG(3).LT.ZEPS) GO TO 370 3301870
      DO 318 JJ=1,3                                                      3301880
  318 TEMP(JJ) = TEMP(JJ)-TEPS(JJ)                                       3301890
      IF (KORI.GT.0) GO TO 319                                           3301900
      IF (RMOSN.EQ.-1.0) GO TO 320                                       3301910
      CALL SEPSIS (TEMP,DEPS,SIGMA,DSIG,SEPS,SALPH,SBAPH,LRT,NERR,       3301920
     1             RMOSN,RMOSS,ROC,YLDST,EFF,KORI)                       3301930
      IF(NERR .EQ.0) GO TO 335                                           3301940
      WRITE(JDISK,55) P                                                  3301950
      GO TO 980                                                          3301960
  319 IF (RMOSNX.EQ.0.0) GO TO 320                                       3301970
      CALL ORTHKN (TEMP,DEPS,DSIG,LRT,ALF,NERR)                          3301980
      IF (NERR.EQ.0) GO TO 335                                           3301990
      WRITE(JDISK,60) P                                                  3302000
      GO TO 980                                                          3302010
C                                                                        3302020
  320 CALL EPSIS (TEMP,DEPS,SIGMA,DSIG,SEPS,LRT,NERR,GPLUH,FPLUH,HP,     3302030
     1            TWON)                                                 3302040
      IF(NERR .EQ.0) GO TO 335                                           3302050
      WRITE(JDISK,50) P                                                  3302060
      GO TO 980                                                          3302070
  335 IF(LR .EQ.2*(LR/2)) GO TO 360                                      3302080
      IF(LR .EQ. 1 .OR. LR .EQ. NLPO) GO TO 350                          3302090
      DO 340 JJ = 1,3                                                    3302100
      EPSTNT(JJ,1) = EPSTNT(JJ,1)+2.0*DEPS(JJ)                           3302110
  340 EPSTNT(JJ,2) = EPSTNT(JJ,2)+2.0*TEMP(4)*DEPS(JJ)                   3302120
      GO TO 380                                                          3302130
  350 DO 355 JJ = 1,3                                                    3302140
      EPSTNT(JJ,1) = EPSTNT(JJ,1)+DEPS(JJ)                               3302150
  355 EPSTNT(JJ,2) = EPSTNT(JJ,2)+TEMP(4)*DEPS(JJ)                       3302160
      GO TO 380                                                          3302170
  360 DO 365 JJ = 1,3                                                    3302180
      EPSTNT(JJ,1) = EPSTNT(JJ,1)+4.0*DEPS(JJ)                           3302190
  365 EPSTNT(JJ,2) = EPSTNT(JJ,2)+4.0*TEMP(4)*DEPS(JJ)                   3302200
      GO TO 380                                                          3302210
  370 NPLA(LRT) = -LRT                                                   3302220
  375 DO 378 JJ = 1,3                                                    3302230
      SIGMA(JJ,LRT) = SIGMA(JJ,LRT)+DSIG(JJ)                             3302240
  378 TEMP(JJ+4) = TEMP(JJ+4) + DSIG(JJ)                                 3302250
      YCOND = YEPS                                                       3302260
      IF (KORI.EQ.0) YCOND = YCOND*EFF(LRT)*EFF(LRT)/YLDST               3302270
      IF (GPLUH*TEMP(5)*TEMP(5)+FPLUH*TEMP(6)*TEMP(6)-2.0*HP*TEMP(5)*    3302280
     1    TEMP(6)+TWON*TEMP(7)*TEMP(7).GE.YCOND) NPLA(LRT) = LRT         3302290
      GO TO 380                                                          3302300
  395 CONTINUE                                                           3302310
      DO 398 JJ=1,3                                                      3302320
  398 SIGMA(JJ,LRT) = SIGMA(JJ,LRT)+DSIG(JJ)                             3302330
      TEMP(1) = GPLUH*SIGMA(1,LRT)*SIGMA(1,LRT)+FPLUH*SIGMA(2,LRT)*      3302340
     1  SIGMA(2,LRT)-2.0*HP*SIGMA(1,LRT)*SIGMA(2,LRT)+TWON*SIGMA(3,LRT)* 3302350
     2  SIGMA(3,LRT)                                                     3302360
      IF (TEMP(1).LT.YEPS) GO TO 380                                     3302370
      NPLA(LRT) = LRT                                                    3302380
      NPLEV = 1                                                          3302390
  380 CONTINUE                                                           3302400
      GO TO (3801,3802),IS                                               3302410
 3801 DO 385 JJ=1,3                                                      3302420
```

```
      DO 385 JT=1,2                                                     3302430
  385 EPSINT(JJ,JT) = EPSINT(JJ,JT)+EPSTNT(JJ,JT)*SIMP*HI               3302440
      GO TO 3800                                                        3302450
 3802 DO 386 JJ=1,3                                                     3302460
      DO 386 JT=1,2                                                     3302470
  386 EPSINT(JJ,JT) = EPSINT(JJ,JT)+EPSTNT(JJ,JT)*SIMP*HO               3302480
 3800 CONTINUE                                                          3302490
      DO 435 JJ=1,6                                                     3302500
  435 STR(JJ) = STR(JJ) + DSTR(JJ)                                      3302510
      DENPT = 0.0                                                       3302520
      DENPH = 0.0                                                       3302530
      DENTH = 0.0                                                       3302540
      DEMPH = 0.0                                                       3302550
      DEMTH = 0.0                                                       3302560
      DEMPT = 0.0                                                       3302570
      GO TO (5000,5000,5000,5250,5250,5250,5500,5500,5500,5750,5750,    3302580
     1       5750),ISTTAB                                               3302590
C     SMEARED RINGS AND STRINGER PLASTICITY                             3302600
 5750 IF (APH.EQ.0.0) GO TO 5850                                        3302610
      DTOT(1) = EPSITH-CPH*XKPH                                         3302620
      STSRN(1) = STSRN(1)+DTOT(1)                                       3302630
      DTOT(1) = DTOT(1)-DELP*ALPHS*TS                                   3302640
      CALL SMEAR (ES,NPLEVS(1),NPLAST(1),STSIG(1),STALPH(1),RMOSNS,     3302650
     1            STREPS(1),RMOSSS,SIGOXS,STBAPH(1),EFFST(1),DENPH,     3302660
     2            DEMPH,SPH,CPH,DTOT(1),APH)                            3302670
 5850 IF (ATH.EQ.0.0) GO TO 5000                                        3302680
      DTOT(2) = EPSITH-CTH*XKTH                                         3302690
      STSRN(2) = STSRN(2)+DTOT(2)                                       3302700
      DTOT(2) = DTOT(2)-DELP*ALPHR*TR                                   3302710
      CALL SMEAR (ER,NPLEVS(2),NPLAST(2),STSIG(2),STALPH(2),RMOSNR,     3302720
     1            STREPS(2),RMOSSR,SIGOXR,STBAPH(2),EFFST(2),DENTH,     3302730
     2            DEMTH,STH,CTH,DTOT(2),ATH)                            3302740
      GO TO 5000                                                        3302750
C     WAFFLE PLASTICITY                                                 3302760
 5250 IF (ATH.EQ.0.0) GO TO 5000                                        3302770
      DTOT(1) = EPSIPH-CPH*XKPH                                         3302780
      DTOT(2) = EPSITH-CPH*XKTH                                         3302790
      DTOT(3) = GAPHTH-2.0*CPH*XKPT                                     3302800
      EE(1) = DTOT(1)-CSB*CSB+DTOT(2)*SNB*SNB+DTOT(3)*SNB*CSB           3302810
      STSRN(1) = STSRN(1)+EE(1)                                         3302820
      EE(1) = EE(1)-DELP*ALPHS*TS                                       3302830
      EE(2) = DTOT(1)*SNB*SNB+DTOT(2)*CSB*CSB-DTOT(3)*SNB*CSB           3302840
      STSRN(2) = STSRN(2)+EE(2)                                         3302850
      EE(2) = EE(2)-DELP*ALPHS*TS                                       3302860
      DO 5300 II=1,2                                                    3302870
      CALL SMEAR (ES,NPLEVS(II),NPLAST(II),STSIG(II),STALPH(II),RMOSNS, 3302880
     1            STREPS(II),RMOSSS,SIGOXS,STBAPH(II),EFFST(II),DEN(II), 3302890
     2            DEM(II),SPH,CPH,EE(II),APH)                           3302900
 5300 CONTINUE                                                          3302910
      DENPH = (DEN(1)*CSB+DEN(2)*SNB)/(CSB+SNB)                         3302920
      DENTH = (DEN(1)*SNB+DEN(2)*CSB)/(CSB+SNB)                         3302930
      DEMPH = DENPH*CPH                                                 3302940
      DEMTH = DENTH*CPH                                                 3302950
      DENPT = (DEN(1)-DEN(2))/2.0                                       3302960
      DEMPT = DENPT*CPH                                                 3302970
      GO TO 5000                                                        3302980
C     ISOGRID PLASTICITY                                                3302990
 5500 IF (APH.EQ.0.0) GO TO 5000                                        3303000
      DTOT(1) = EPSIPH-CPH*XKPH                                         3303010
      DTOT(2) = EPSITH-CPH*XKTH                                         3303020
      DTOT(3) = GAPHTH-2.0*CPH*XKPT                                     3303030
```

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      TEMP(1) = (DTOT(1)+DTOT(2))/2.0                                   3303040
      TEMP(2) = (DTOT(2)-DTOT(1))/2.0                                   3303050
      TEMP(3) = DTOT(2)                                                 3303060
      DTOT(1) = TEMP(1)-TEMP(2)*COS(2.0*BETTA)+DTOT(3)/2.0*SIN(2.0*     3303070
     1          BETTA)                                                  3303080
      STSRN(1) = STSRN(1)+DTOT(1)                                       3303090
      DTOT(1) = DTOT(1)-DELP*ALPHS*TS                                   3303100
      DTOT(2) = TEMP(1)-TEMP(2)*COS(2.0*BETTA)-DTOT(3)/2.0*SIN(2.0*     3303110
     1          BETTA)                                                  3303120
      STSRN(2) = STSRN(2)+DTOT(2)                                       3303130
      DTOT(2) = DTOT(2)-DELP*ALPHS*TS                                   3303140
      DTOT(3) = TEMP(3)                                                 3303150
      STSRN(3) = STSRN(3)+DTOT(3)                                       3303160
      DTOT(3) = DTOT(3)-DELP*ALPHS*TS                                   3303170
      DO 5525 II=1,3                                                    3303180
      CALL SMEAR (ES,NPLEVS,NPLAST(II),STSIG(II),STALPH(II),RMOSNS,     3303190
     1            STREPS(II),RMOSSS,SIGOXS,STBAPH(II),EFFST(II),DEN(II),3303200
     2            DEM(II),SPH,CPH,DTOT(II),APH)                         3303210
5525  CONTINUE                                                          3303220
      DENPH = (DEN(1)*CSB+DEN(2)*CSB)/2.0/SNB                           3303230
      DENTH = (DEN(1)*SNB+DEN(2)*SNB+2.0*DEN(3))/2.0/CSB                3303240
      DENPT = (DEN(1)-DEN(2))/2.0                                       3303250
      DEMPH = DENPH*CPH                                                 3303260
      DEMTH = DENTH*CPH                                                 3303270
      DEMPT = DENPT*CPH                                                 3303280
      GO TO 5000                                                        3303290
5000  CONTINUE                                                          3303300
      SAVX(1) = SAVY(1)+YPRED(I+5)                                      3303310
      SAVX(2) = SAVY(2)+YDOT(I+5)                                       3303320
      SAVX(3) = SAVY(3)+YPRED(I+6)                                      3303330
      SAVX(4) = SAVY(4)+YDOT(I+4)                                       3303340
      SAVX(5) = SAVY(5)+YPRED(I+7)                                      3303350
      SAVX(6) = SAVY(6)+YPRED(I+1)                                      3303360
      SAVX(7) = SAVY(7)+YANTH                                           3303370
      SAVX(8) = SAVY(8)+YANPT                                           3303380
      SAVX(9) = SAVY(9)+YAOPH                                           3303390
      SAVX(10) = CE(2)*(EPSINT(2,1)+XNUTP*EPSINT(1,1))                  3303400
     1           +DENTH                                                 3303410
      SAVX(11) = CE(1)*(EPSINT(1,1)+XNUPT*EPSINT(2,1))                  3303420
     1           +DENPH                                                 3303430
      SAVX(12) = XGPT*EPSINT(3,1)                                       3303440
     1           +DENPT                                                 3303450
      SAVX(13) = CE(2)*(EPSINT(2,2)+XNUTP*EPSINT(1,2))                  3303460
     1           +DEMTH                                                 3303470
      SAVX(14) = CE(1)*(EPSINT(1,2)+XNUPT*EPSINT(2,2))                  3303480
     1           +DEMPH                                                 3303490
      SAVX(15) = XGPT*EPSINT(3,2)                                       3303500
     1           +DEMPT                                                 3303510
      SAVX(16) = SAVY(16)+YPRED(I)                                      3303520
      SAVX(17) = SAVY(17)+YPRED(I+2)                                    3303530
      SAVX(18) = SAVY(18)+YPRED(I+3)                                    3303540
      SAVX(19) = SAVY(19)+YPRED(I+4)                                    3303550
      SAVX(20) = SAVY(20)+YAMTH                                         3303560
      SAVX(21) = SAVY(21)+YAMPT                                         3303570
      SAVX(22) = EPSITH                                                 3303580
      SAVX(23) = XKTH                                                   3303590
      SAVX(24) = SAVY(24)+DELP*XFTHLD                                   3303600
      SAVX(25) = SAVY(25)+DELP*XFPHLD                                   3303610
      SAVX(26) = SAVY(26)+DELP*XFZELD                                   3303620
      SAVX(27) = SAVY(27)+DELP*XMTHLD                                   3303630
      SAVX(28) = SAVY(28)+DELP*XMPHLD                                   3303640
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      SAVX(29) = SAVY(29)+YDOT(I)                                       3303650
      SAVX(30) = SAVY(30)+YDOT(I+1)                                     3303660
      SAVX(31) = SAVY(31)+YDOT(I+2)                                     3303670
      SAVX(32) = SAVY(32)+YDOT(I+3)                                     3303680
      DO 120 J=6,8                                                      3303690
  120 IF (ABS(SAVX(J)).LT.1.E-5) SAVX(J) = 0.0                          3303700
      DO 121 J=10,18                                                    3303710
  121 IF (ABS(SAVX(J)).LT.1.E-5) SAVX(J) = 0.0                          3303720
      DO 122 J=20,21                                                    3303730
  122 IF (ABS(SAVX(J)).LT.1.E-5) SAVX(J) = 0.0                          3303740
      CALL SAVXES (SAVX)                                                3303750
      WRITE(JO) SAVX,NPLEV,NPLA,SIGMA,SALPH,SBAPH,STEPS,STR,EFF,STSRN,  3303760
     1          NPLAST,STSIG,STREPS,STALPH,STBAPH,NPLEVS,EFFST,SEPS     3303770
      IF(NH.NE.0.AND.IBEGIN.NE.1.AND.NGR.EQ.0) GO TO 980
      IF (NPR.EQ.0.AND.NGR.EQ.0) GO TO 980                              3303790
      THK = 0.0                                                         3303800
      DO 540 J=1,3                                                      3303810
      SIGMI(J) = 0.0                                                    3303820
      SIGMO(J) = 0.0                                                    3303830
      EPSI(J) = 0.0                                                     3303840
  540 EPSO(J) = 0.0                                                     3303850
      GO TO (158,131,158,152,153,154,152,153,154,152,153,154),ISTTAB    3303860
  131 GO TO (152,153,154,158),THICK                                     3303870
  152 THK = HI                                                          3303880
      DO 542 J=1,3                                                      3303890
      SIGMO(J) = SIGMA(J,NLPO)                                          3303900
      EPSI(J) = STR(J)+HI/2.0*STR(J+3)                                  3303910
  542 EPSO(J) = STR(J)-HI/2.0*STR(J+3)                                  3303920
      EPSI(3) = EPSI(3)+HI/2.0*STR(6)                                   3303930
      EPSO(3) = EPSO(3)-HI/2.0*STR(6)                                   3303940
      GO TO 157                                                         3303950
  153 THK = T+2.0*HI                                                    3303960
      GO TO 155                                                         3303970
  154 THK = T+HI+HO                                                     3303980
  155 CONTINUE                                                          3303990
      ZETAI = (HI*HI+HO*HO+2.0*HI*HO+2.0*HO*T)/(2.0*(HI+HO))            3304000
      ZETAO = (HI*HI+HO*HO+2.0*HI*HO+2.0*HI*T)/(2.0*(HI+HO))            3304010
      DO 543 J=1,3                                                      3304020
      SIGMO(J) = SIGMA(J,NLPO*2)                                        3304030
      EPSI(J) = STR(J)+ZETAI*STR(J+3)                                   3304040
  543 EPSO(J) = STR(J)-ZETAO*STR(J+3)                                   3304050
      EPSI(3) = EPSI(3)+ZETAI*STR(6)                                    3304060
      EPSO(3) = EPSO(3)-ZETAO*STR(6)                                    3304070
  157 DO 541 J=1,3                                                      3304080
  541 SIGMI(J) = SIGMA(J,1)                                             3304090
  158 CONTINUE                                                          3304100
      IF (NGR.EQ.1) CALL ARRAYS (SAVX(19),SAVX(1),SAVX(3),SIGMI(2),     3304110
     1                SIGMI(1),SIGMI(3),SIGMO(2),SIGMO(1),SIGMO(3),PHI) 3304120
      IF(NPR.EQ.0.OR.IBEGIN.NE.1) GO TO 980
      DEGRES = 0.0                                                      3304140
      IF (IGEOM.EQ.1) DEGRES = PHI*57.29578                             3304150
      WRITE(6,7001) PHI,DEGRES,RO,THK,STEP,EPSI(2),                     3304160
     1              STR(2),STR(1),(STR(I),I=3,5),EPSO(2),               3304170
     2              SAVX(19),STR(6),SAVX(7),SAVX(6),SAVX(8),EPSI(1),    3304180
     3              SAVX(1),SAVX(17),SAVX(20),SAVX(18),SAVX(21),EPSO(1),3304190
     4              SAVX(3),SAVX(16),SIGMI(2),SIGMI(1),SIGMI(3),EPSI(3),3304200
     5              SAVX(5),SAVX(9),SIGMO(2),SIGMO(1),SIGMO(3),EPSO(3)  3304210
 7001 FORMAT(////(3X,6(1PE14.7,7X)))                                    3304220
      IF (NPLEV.EQ.0) GO TO 515                                         3304230
      WRITE(6,519) (NPLA(NL),NL=1,KBC)                                  3304240
  519 FORMAT(//' NPLA =',8X,21I5)                                       3304250
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```
      WRITE(6,517) ((SIGMA(L3,NL),L3=1,3),NL=1,KBC)                    3304260
  517 FORMAT(/' SIGMA =',7X,1P9E13.5/(15X,1P9E13.5))                   3304270
      WRITE(6,518) ((SEPS(L3,NL),L3=1,3),NL=1,KBC)                     3304280
  518 FORMAT(/' EPSILON PLAS =',1P9E13.5/(15X,1P9E13.5))               3304290
  515 CONTINUE                                                         3304300
  980 RETURN                                                           3304310
      END                                                              3304320
```

```
 FOR,IS SHSRSE,SHSRSE
      SUBROUTINE SHSRSE (DSIG,TEMP,STR,LL,EPS)                          3500010
      COMMON /CMAIN/ ZETA1(21),ZETA2(21),NODE,ALF(4),CE(4),NLRS,HI,HO,T 3500020
      DIMENSION DSIG(3),TEMP(4),STR(1),EPS(1),ESR(3)                    3500030
C     IF (ISTTAB.NE.2) GO TO 640                                        3500040
C 621 GO TO (610,650,650,640),THICK                                     3500050
  610 CONTINUE                                                          3500060
  650 CONTINUE                                                          3500070
  640 CONTINUE                                                          3500080
      TEMP(1) = STR(LL)-TEMP(4)*STR(LL+3)                               3500090
      TEMP(2) = STR(LL+1)-TEMP(4)*STR(LL+4)                             3500100
      TEMP(3) = STR(LL+2)-2.0*TEMP(4)*STR(LL+5)                         3500110
      ESR(1)=TEMP(1)-EPS(1)                                             3500120
      ESR(2)=TEMP(2)-EPS(2)                                             3500130
      ESR(3)=TEMP(3)-EPS(3)                                             3500140
      DSIG(1) = CE(1)*ESR(1)+CE(4)*ESR(2)                               3500150
      DSIG(2) = CE(4)*ESR(1)+CE(2)*ESR(2)                               3500160
      DSIG(3) = CE(3)*ESR(3)                                            3500170
      RETURN                                                            3500180
      END                                                               3500190
```

```
 FOR,IS SEPSIS,SEPSIS
      SUBROUTINE SEPSIS (DTOT,DEPS,SIGMA,DSIG,SEPS,SALPH,SBAPH,LR,NERR,  3600010
     1                   RMOSN,RMOSS,ROC,YLDST,EFF,KORI)                 3600020
C                                                                        3600030
C      STRAIN HARDENING- SHELL ELEMENTS.                                 3600040
C                                                                        3600050
      COMMON /CMAIN/ ZETA1(21),ZETA2(21),NODE,ALF(4),CE(4),NLRS,HI,HO,T  3600060
      DIMENSION DTOT(3),DEPS(3),SIGMA(3,1),DSIG(3),SEPS(3,1),            3600070
     D SALPH(3,1),SBAPH(3,1),TEMP(3),SAG(3),R(3,3),CAPM(3)               3600080
      DIMENSION EFF(1)                                                   3600090
      DO 100 I=1,3                                                       3600100
      SAG(I)=SIGMA(I,LR)-SALPH(I,LR)                                     3600110
  100 TEMP(I)=SIGMA(I,LR)-SBAPH(I,LR)                                    3600120
C     CHECK FOR ISOTROPIC HARDENING                                      3600130
      IF (KORI.EQ.0) GO TO 301                                           3600140
C      CHECK FOR LINEAR STRAIN HARDENING                                 3600150
      IF (RMOSS.NE.0.0) GO TO 252                                        3600160
      DEN = ROC                                                          3600170
      GO TO 254                                                          3600180
C      NON LINEAR                                                        3600190
  252 DEN = ROC*(RMOSS/SQRT(TEMP(1)*(TEMP(1)-TEMP(2))+TEMP(2)*TEMP(2)+   3600200
     1  3.0*TEMP(3)*TEMP(3)))**RMOSN                                     3600210
      GO TO 254                                                          3600220
  301 IF (RMOSS.NE.0.0) GO TO 352                                        3600230
      DEN = -(RMOSN+1.0)/RMOSN/ALF(1)                                    3600240
      GO TO 354                                                          3600250
  352 DEN = 2.333333/ALF(1)/(RMOSN+1.0)*(RMOSS/EFF(LR))**RMOSN           3600260
  354 DEN = DEN*EFF(LR)*EFF(LR)                                          3600280
  254 CAPM(1)=SAG(1)-0.5*SAG(2)                                          3600290
      CAPM(2)=SAG(2)-0.5*SAG(1)                                          3600300
      CAPM(3)=3.0*SAG(3)                                                 3600310
C     FORM R MATRIX RELATING TOTAL STRAIN AND STRESS INCREMENT           3600320
      TEMP(1)=CAPM(1)/DEN                                                3600330
      R(1,1) = ALF(1)+TEMP(1)*CAPM(1)                                    3600340
      R(2,1) = ALF(4)+TEMP(1)*CAPM(2)                                    3600350
      R(1,2)=R(2,1)                                                      3600360
      R(3,1)=TEMP(1)*CAPM(3)                                             3600370
      R(1,3)=R(3,1)                                                      3600380
      TEMP(1)=CAPM(2)/DEN                                                3600390
      R(2,2) = ALF(2)+TEMP(1)*CAPM(2)                                    3600400
      R(3,2)=TEMP(1)*CAPM(3)                                             3600410
      R(2,3)=R(3,2)                                                      3600420
      R(3,3) = ALF(3)+CAPM(3)*CAPM(3)/DEN                                3600430
C     SOLVE SYSTEM FOR STRESS INCREMENT                                  3600440
      CALL LINEQU(R,DTOT,3,1,3,NERR)                                     3600450
      IF(NERR.EQ.0) GO TO 260                                            3600460
      GO TO 990                                                          3600470
  260 DSIG(1)=DTOT(1)                                                    3600480
      DSIG(2)=DTOT(2)                                                    3600490
      DSIG(3)=DTOT(3)                                                    3600500
C     PLASTIC STRAIN INCREMENTS                                          3600510
      TEMP(1)=CAPM(1)*DTOT(1)+CAPM(2)*DTOT(2)+CAPM(3)*DTOT(3)            3600520
      TEMP(2) = TEMP(1)/YLDST                                            3600530
      IF (KORI.EQ.0) TEMP(2) = 0.0                                       3600540
      TEMP(1)=TEMP(1)/DEN                                                3600550
      DO 270 I=1,3                                                       3600560
      DEPS(I)=CAPM(I)*TEMP(1)                                            3600570
      SALPH(I,LR)=SALPH(I,LR)+SAG(I)*TEMP(2)                             3600580
      SIGMA(I,LR)=SIGMA(I,LR)+DSIG(I)                                    3600590
      IF (KORI.EQ.0) EFF(LR) = SQRT(SIGMA(1,LR)**2+SIGMA(2,LR)**2-       3600600
     1                SIGMA(1,LR)*SIGMA(2,LR)+3.0*SIGMA(3,LR)**2)        3600610
  270 SEPS(I,LR)=SEPS(I,LR)+DEPS(I)                                      3600620
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8888 CONTINUE                                                    202440
     CALL ETRAP                                                  202450
     STOP                                                        202460
      END                                                        202470
```

```
 FOR,IS LINEQU,LINEQU
      SUBROUTINE LINEQU(A,Y,M,N,MID,NIX)                              3900010
C                                                                     3900020
      DIMENSION A(MID,MID),Y(MID,1)                                   3900030
      M1 = M - 1                                                      3900040
      DO 150 K = 1,M1                                                 3900050
      KP = K + 1                                                      3900060
      X = 0.                                                          3900070
      DO 110 I = K,M                                                  3900080
      IF(X - ABS(A(I,K))) 100,110,110                                 3900090
  100 X = ABS(A(I,K))                                                 3900100
      L = I                                                           3900110
  110 CONTINUE                                                        3900120
      IF(X) 120,120,130                                               3900130
  130 DO 140 J = 1,M                                                  3900160
      X = A(K,J)                                                      3900170
      A(K,J) = A(L,J)                                                 3900180
  140 A(L,J) = X                                                      3900190
      DO 143 J = 1,N                                                  3900200
      X = Y(K,J)                                                      3900210
      Y(K,J) = Y(L,J)                                                 3900220
  143 Y(L,J) = X                                                      3900230
      DO 150 I = KP,M                                                 3900240
      X = A(I,K) / A(K,K)                                             3900250
      DO 146 J = 1,N                                                  3900260
  146 Y(I,J) = Y(I,J) - Y(K,J)*X                                      3900270
      DO 150 J = KP,M                                                 3900280
  150 A(I,J) = A(I,J) - A(K,J) * X                                    3900290
      T = ABS(A(M,M))                                                 3900300
      IF(T) 160,120,160                                               3900310
  160 DO 165 J = 1,N                                                  3900320
  165 Y(M,J) = Y(M,J) / A(M,M)                                        3900330
      K = M                                                           3900340
      DO 180 I = 1,M1                                                 3900350
      X = 0.                                                          3900360
      KP = K                                                          3900370
      K = K-1                                                         3900380
      DO 180 L=1,N                                                    3900390
      DO 170 J = KP,M                                                 3900400
  170 X = X + A(K,J) * Y(J,L)                                         3900410
  180 Y(K,L) = (Y(K,L) - X ) / A(K,K)                                 3900420
      NIX = 0                                                         3900430
      GO TO 190
  120 NIX = -(KP-1)
  190 RETURN                                                          3900440
      END                                                             3900450
```

```
FOR,IS ORTHKN,ORTHKN
      SUBROUTINE ORTHKN (DTOT,DEPS,DSIG,LR,ALF,NERR)                    3800010
      COMMON /LASTEQ/ DUM(124),RMOSSX,RMOSNX,YLDST,ROC,HP,FPLUH,GPLUH,  3800020
     C                TWON,RMOSSY,RMOSNY,RMOSXY,RMONXY                  3800030
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),    3800040
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),    3800050
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),     3800060
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)             3800070
      DIMENSION CAPM(4),TEMP(3),DEPS(1),DSIG(1),R(3,3),ALF(1),SAG(3)    3800080
      DIMENSION DTOT(1)                                                 3800090
      DO 100 I=1,3                                                      3800100
      SAG(I) = SIGMA(I,LR)-SALPH(I,LR)                                  3800110
  100 TEMP(I) = SIGMA(I,LR)-SBAPH(I,LR)                                 3800120
      SIGB = FPLUH*TEMP(2)**2+GPLUH*TEMP(1)**2-2.0*HP*TEMP(1)*TEMP(2)+  3800130
     1       TWON*TEMP(3)**2                                            3800140
      IF (RMOSSX.NE.0.0) GO TO 205                                      3800150
      CX=ALF(1)*(1.0-RMOSNX)/RMOSNX*(GPLUH**2+HP**2+(GPLUH-HP)**2)/     3800160
     1 GPLUH**2                                                         3800170
      GO TO 210                                                         3800180
  205 CX=RMOSNX*ALF(1)/2.333333*(SQRT(SIGB/GPLUH)/RMOSSX)**(RMOSNX-1.0) 3800190
     1  *(GPLUH**2+HP**2+(GPLUH-HP)**2)/GPLUH**2                        3800200
  210 IF (RMOSSY.NE.0.0) GO TO 215                                      3800210
      CY=ALF(2)*(1.0-RMOSNY)/RMOSNY*(FPLUH**2+HP**2+(FPLUH-HP)**2)/     3800220
     1 FPLUH**2                                                         3800230
      GO TO 220                                                         3800240
  215 CY=RMOSNY*ALF(2)/2.333333*(SQRT(SIGB/FPLUH)/RMOSSY)**(RMOSNY-1.0) 3800250
     1  *(FPLUH**2+HP**2+(FPLUH-HP)**2)/FPLUH**2                        3800260
  220 IF (RMOSXY.NE.0.0) GO TO 225                                      3800270
      CXY=0.5*ALF(3)*(1.0-RMONXY)/RMONXY                                3800280
      GO TO 230                                                         3800290
  225 CXY=RMONXY*ALF(3)/4.6666667*(SQRT(SIGB/TWON)/RMOSXY)**(RMONXY     3800300
     1 -1.0)                                                            3800310
  230 ONDC=(GPLUH*SAG(1)**2-HP*SAG(1)*SAG(2))*CX+(FPLUH*SAG(2)**2       3800320
     1 -HP*SAG(1)*SAG(2))*CY+TWON*SAG(3)**2*CXY                         3800330
  240 CAPM(1) = 2.0*(GPLUH*SAG(1)-HP*SAG(2))                            3800340
      CAPM(2) = 2.0*(FPLUH*SAG(2)-HP*SAG(1))                            3800350
      CAPM(3) = 2.0*TWON*SAG(3)                                         3800360
      CAPM(4) = -2.0*((FPLUH-HP)*SAG(2)+(GPLUH-HP)*SAG(1))              3800370
      DEN=(CAPM(1)**2+CAPM(2)**2+CAPM(3)**2/2.+CAPM(4)**2)/ONDC
      TEMP(1) = CAPM(1)/DEN                                             3800390
      R(1,1) = ALF(1)+TEMP(1)*CAPM(1)                                   3800400
      R(2,1) = ALF(4)+TEMP(1)*CAPM(2)                                   3800410
      R(1,2) = R(2,1)                                                   3800420
      R(3,1) = TEMP(1)*CAPM(3)                                          3800430
      R(1,3) = R(3,1)                                                   3800440
      TEMP(1) = CAPM(2)/DEN                                             3800450
      R(2,2) = ALF(2)+TEMP(1)*CAPM(2)                                   3800460
      R(3,2) = TEMP(1)*CAPM(3)                                          3800470
      R(2,3) = R(3,2)                                                   3800480
      R(3,3) = ALF(3)+CAPM(3)*CAPM(3)/DEN                               3800490
C     SOLVE SYSTEM FOR STRESS INCREMENT                                 3800500
      CALL LINEQU (R,DTOT,3,1,3,NERR)                                   3800510
      IF (NERR.EQ.0) GO TO 260                                          3800520
      GO TO 990                                                         3800530
  260 DSIG(1) = DTOT(1)                                                 3800540
      DSIG(2) = DTOT(2)                                                 3800550
      DSIG(3) = DTOT(3)                                                 3800560
C     PLASTIC STRAIN INCREMENTS                                         3800570
      TEMP(1) = CAPM(1)*DTOT(1)+CAPM(2)*DTOT(2)+CAPM(3)*DTOT(3)         3800580
      TEMP(2) = TEMP(1)/DEN                                             3800590
      DO 270 I=1,3                                                      3800600
      DEPS(I) = CAPM(I)*TEMP(2)                                         3800610
```

```
      SALPH(I,LR) = SALPH(I,LR)+SAG(I)*TEMP(1)/2.0                    3800620
      SIGMA(I,LR) = SIGMA(I,LR)+DSIG(I)                               3800630
  270 SEPS(I,LR) = SEPS(I,LR)+DEPS(I)                                 3800640
  990 RETURN                                                          3800650
      END                                                             3800660
```

```
 FOR,IS EPSIS,EPSIS
      SUBROUTINE EPSIS (DTOT,DEPS,SIGMA,DSIG,SEPS,LR,NERR,                3700010
     1                  GPLUH,FPLUH,HP,TWON)                              3700020
C                                                                         3700030
C       PERFECT PLASTICITY- SHELL ELEMENTS                                3700040
C                                                                         3700050
      COMMON /CMAIN/ ZETA1(21),ZETA2(21),NODE,ALF(4),CE(4),NLRS,HI,HO,T   3700060
      DIMENSION DTOT(1),DEPS(1),SIGMA(3,1),DSIG(1),SEPS(3,1),EUP(3,3),    3700070
     D SMAM(3),ESTAR(3,3),CAPM(3)                                         3700080
      CAPM(1) = GPLUH*SIGMA(1,LR)-HP*SIGMA(2,LR)                          3700090
      CAPM(2) = FPLUH*SIGMA(2,LR)-HP*SIGMA(1,LR)                          3700100
      CAPM(3) = TWON*SIGMA(3,LR)                                          3700110
      TMAX = ABS(CAPM(1))                                                 3700120
      MMAX=1                                                              3700130
      IF(ABS(CAPM(2)).LT.TMAX) GO TO 110                                  3700140
      MMAX = 2                                                            3700150
      TMAX=ABS(CAPM(2))                                                   3700160
  110 IF(ABS(CAPM(3)) .LT. TMAX) GO TO 140                                3700170
      MMAX = 3                                                            3700180
  140 TEMP = CAPM(MMAX)                                                   3700190
C                                                                         3700200
C       INITIALIZE EUP,E UPPER BAR                                        3700210
  152 DO 170 I =1,3                                                       3700220
      DO 160 J=1,3                                                        3700230
  160 EUP(I,J) = 0.0                                                      3700240
  170 EUP(I,I) = 1.0                                                      3700250
C                                                                         3700260
C       SET SMAM AND COMPLETE EUP                                         3700270
      DO 180 I = 1,3                                                      3700280
      SMAM(I) = CAPM(I) / TEMP                                            3700290
      EUP(MMAX,I) = EUP(MMAX,I) - SMAM(I)                                 3700300
  180 CONTINUE                                                            3700310
      EUP(MMAX,MMAX) = 0.0                                                3700320
C                                                                         3700330
C       ESTAR=ALF * EUP                                                   3700340
      DO 190 I =1,3                                                       3700350
      ESTAR(1,I) = ALF(1)*EUP(1,I)+ALF(4)*EUP(2,I)                        3700360
      ESTAR(2,I) = ALF(4)*EUP(1,I)+ALF(2)*EUP(2,I)                        3700370
  190 ESTAR(3,I) = ALF(3)*EUP(3,I)                                        3700380
C                                                                         3700390
C       ESTAR=ESTAR,+ E LOWER BAR                                         3700400
      DO 200 I =1,3                                                       3700410
  200 ESTAR(I,MMAX) = ESTAR(I,MMAX) + SMAM(I)                             3700420
C                                                                         3700430
C       SOLVE LINEAR SYSTEM FOR DSIG(I.NE.MMAX) AND DEPS(MMAX)            3700440
      CALL LINEQU(ESTAR,DTOT,3,1,3,NERR)                                  3700450
      IF(NERR .EQ.0) GO TO 210                                            3700460
      GO TO 990                                                           3700470
  210 DO 220 I =1,3                                                       3700480
  220 DSIG(I) = DTOT(I)                                                   3700490
C                                                                         3700500
C       SET DSIG(MMAX) AND DEPS(I.NE.MMAX)                                3700510
      DEPS(MMAX) = DSIG(MMAX)                                             3700520
      DSIG(MMAX) = 0.0                                                    3700530
      DO 230 I =1,3                                                       3700540
      IF(I .EQ.MMAX) GO TO 230                                            3700550
      DSIG(MMAX) = DSIG(MMAX) - SMAM(I) * DSIG(I)                         3700560
      DEPS(I) = SMAM(I) * DEPS(MMAX)                                      3700570
  230 CONTINUE                                                            3700580
      DO 290 I =1,3                                                       3700590
      SIGMA(I,LR) = SIGMA(I,LR) + DSIG(I)                                 3700600
  290 SEPS(I,LR) = SEPS(I,LR) + DEPS(I)                                   3700610
```

```
  990 RETURN                                                        3700620
C                                                                   3700630
      END                                                           3700640
```

```
FOR,IS SMEAR,SMEAR
      SUBROUTINE SMEAR (ES,NPLEVS,NPLAST,STSIG,STALPH,RMOSNS,STREPS,     4100010
     1                  RMOSSS,SIGOXS,STBAPH,EFFST,DENPHI,DEMPHI,SPH,    4100020
     2                  CPH,DTOT,AST)                                    4100030
      COMMON /PLSTIC/ IO,JO,IOR,JOR,KORI                                  4100040
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                          4100050
      DSIG = ES*DTOT                                                      4100060
      IF (NPLEVS.EQ.0) GO TO 100                                          4100070
      IF (NPLAST.LE.0) GO TO 200                                          4100080
      IF ((STSIG-STALPH)*DSIG.LT.ZEPS) GO TO 300                          4100090
      IF (RMOSNS.NE.0.0) GO TO 400                                        4100100
      DEPS = DSIG/ES                                                      4100110
      STREPS = STREPS+DEPS                                                4100120
      DSIG = 0.0                                                          4100130
      GO TO 600                                                           4100140
  400 IF (RMOSSS.EQ.0.0) GO TO 500                                        4100150
      TOMP = .42857143*RMOSNS*(ABS(STSIG-STBAPH)/RMOSSS)**(RMOSNS-1.0)    4100160
      DSIG = DSIG-(1.0+TOMP)                                              4100170
      RDSIG = DSIG                                                        4100180
      DEPS = TOMP/ES*DSIG                                                 4100190
      STSIG = STSIG+DSIG                                                  4100200
      STREPS = STREPS+DEPS                                                4100210
      IF (KORI.EQ.0) RDSIG = 0.0                                          4100220
      STALPH = STALPH+RDSIG                                               4100230
      IF (KORI.EQ.0) EFFST = STSIG                                        4100240
      GO TO 600                                                           4100250
  500 DSIGT = RMOSNS*DSIG                                                 4100260
      RDSIG = DSIG                                                        4100270
      STSIG = STSIG+DSIG                                                  4100280
      DEPS = DSIG/ES*((1.0-RMOSNS)/RMOSNS)                                4100290
      STREPS = STREPS+DEPS                                                4100300
      IF (KORI.EQ.0) RDSIG = 0.0                                          4100310
      STALPH = STALPH+RDSIG                                               4100320
      IF (KORI.EQ.0) EFFST = STSIG                                        4100330
      GO TO 600                                                           4100340
  300 NPLAST = -1                                                         4100350
  200 STSIG = STSIG+DSIG                                                  4100360
      DEPS = 0.0                                                          4100370
      YCOND = YEPS                                                        4100380
      IF (KORI.EQ.0) YCOND = YCOND*EFFST/SIGOXS                           4100390
      IF (ABS((STSIG-STALPH)/SIGOXS).GE.YCOND) NPLAST = 1                 4100400
  600 CONTINUE                                                            4100410
      DENPHI = ES*AST*DEPS/SPH                                            4100420
      DEMPHI = DENPHI*CPH                                                 4100430
      GO TO 800                                                           4100440
  100 STSIG = STSIG+DSIG                                                  4100450
      IF (ABS(STSIG/SIGOXS).LT.YEPS) GO TO 700                            4100460
      NPLEVS = 1                                                          4100470
      NPLAST = 1                                                          4100480
  700 DENPHI = 0.0                                                        4100490
      DEMPHI = 0.0                                                        4100500
  800 RETURN                                                              4100510
      END                                                                 4100520
```

```
FOR,IS SAVXES,SAVXES
      SUBROUTINE SAVXES (SAVX)                                          3400010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                     3400020
      INTEGER XN                                                        3400030
      DOUBLE PRECISION YPRED                                            3400040
C                                                                       3400050
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)         3400060
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                            3400070
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH           3400080
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  3400090
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB 3400100
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE 3400110
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS            3400120
      COMMON LODE,ICYCLE,LDISTL                                         3400130
      COMMON /LASTEQ/ YPRED(8),YDOT(8),YASAVE(8),                       3400140
     1                YANTH,YAMTH,YAMPT,YANPT,YAOPH,YAQPH,YAQTH,YAJPH,  3400150
     2                S,SN,CS,SNSQ,CSSQ,TAN,SEC,CN,X1CS,X1SN,TN,        3400160
     3                X1RO,X1ROSQ,X1SNRO,X1CSRO,CN1RO,SN1RO,CS1RO,      3400170
     4                X1R1,X1R2,CS1R1,CS1R2,SN1R1,X1R1SQ,R2SQ,RO,BESQ,  3400180
     5     ROSQ,XNSQ,BETA,R1,R2,S1,R1DOT,R1SQ,                          3400190
     6                XNTTH,XNTPH,XMTTH,XMTPH,XFTHLD,XFPHLD,XFZELD,     3400200
     7                XMTHLD,XMPHLD,ETHET,EPHI,XGPT,ALPHTH,ALPHPH,      3400210
     8                XNUTP,XNUPT,XC11,XC22,XC15,XD33,XD22,XD21,XD12,   3400220
     9                XK11,XK12,XK21,XK22,XK33,XD11,                    3400230
     A                   M,I,SITIN,SITOUT,SIPIN,SIPOUT,TPTIN,TPTOUT,    3400240
     B               ZBRIN,ZBROUT,SCRIPA,SCRIPI,SIFIN,SIFOUT,TZEPH,TZETH 3400250
     B                  ,XNPHI,BETTA,ZETTA,XC16                        3400260
     C                  ,RMOSS,RMOSN,YLOST,ROC,HP,FPLUH,GPLUH,TWON     3400270
     D                  ,RMOSSY,RMOSNY,RMOSXY,RMONXY                   3400280
     D                  ,RMOSNS,RMOSSS,SIGOXS,RMOSNR,RMOSSR,SIGOXR     3400290
      COMMON /WOOD/ SAVY(53),NPLEV,NLPO,NPLA(21),STR(6),SIGMA(3,21),    3400300
     C              SEPS(3,21),SALPH(3,21),SBAPH(3,21),STEPS(3,21),    3400310
     O              EFF(21),STSRN(3),NPLAST(3),STSIG(3),STREPS(3),     3400320
     M              STALPH(3),STBAPH(3),EFFST(3),NPLEVS(3)             3400330
      COMMON /CDISP/ P,PMAX,DELP,DELP1,YEPS,ZEPS                        3400340
      EQUIVALENCE (XNL(1),X1),(XNL(2),X2),(XNL(3),X3)                   3400350
      DIMENSION SAVX(1)                                                 3400360
      GO TO (101,102,103),IGEOM                                         3400370
  101 CONTINUE                                                          3400380
      A = (SAVX(1)*CS-SAVX(3)*SN)/RO+0.5*SAVX(9)*SAVX(9)+(SAVX(2)-      3400390
     1    SAVX(3))/R1+0.5*SAVX(5)*SAVX(5)                               3400400
      SAVX(33) = -(SAVX(29)-R1*(CS/RO*(-2.0*SAVX(16)-SAVX(21)*(1.0/R1-  3400410
     1           SN/RO))-X1*(SAVX(24)*A+SAVX(25)*SAVX(4)/R1+SAVX(26)*   3400420
     2           SAVX(9))-SN/RO*(SAVX(28)+X1*(SAVX(7)*SAVX(9)-SAVX(8)*  3400430
     3           SAVX(5)))-SAVX(24)))                                   3400440
      SAVX(34) = -(SAVX(30)-R1*(CS/RO*(-SAVX(6)+SAVX(7))+SAVX(17)/R1-   3400450
     1           X1*(SAVX(25)*A-SAVX(26)*SAVX(5))-SAVX(25)))           3400460
      SAVX(35) = -(SAVX(31)+R1*((SAVX(17)*CS+SAVX(7)*SN)/RO+SAVX(6)/R1+ 3400470
     1           X1*(SAVX(26)*A-SAVX(24)*SAVX(9)+SAVX(25)*SAVX(5))+     3400480
     2           SAVX(26)))                                             3400490
      SAVX(36) = SAVX(32)-R1*((CS/RO*(SAVX(20)-SAVX(18)))+SAVX(17)+     3400500
     1           X1*(SAVX(8)*SAVX(9)-SAVX(6)*SAVX(5))+SAVX(27))        3400510
      GO TO 105                                                         3400520
  102 CONTINUE                                                          3400530
      A = (SAVX(1)-SAVX(3)*TN)/S+0.5*(SAVX(9)*SAVX(9)+SAVX(5)*          3400540
     1    SAVX(5))+SAVX(2)                                              3400550
      SAVX(33) = -2.0*SAVX(16)/S+SAVX(21)*TN/(S*S)-X1*(SAVX(24)*A+      3400560
     1           SAVX(25)*SAVX(4)+SAVX(26)*SAVX(9))-SAVX(28)*TN/S-      3400570
     1           TN/S*X1*(SAVX(7)*                                      3400580
     2           SAVX(9)-SAVX(8)*SAVX(5))-SAVX(29)-SAVX(24)             3400590
```

```
      SAVX(34) = -(SAVX(6)-SAVX(7))/S-X1*(SAVX(25)*A-SAVX(26)*SAVX(5))-   3400600
     1           SAVX(30)-SAVX(25)                                        3400610
      SAVX(35) = -(SAVX(17)+SAVX(7)*TN)/S-X1*(SAVX(26)*A-SAVX(24)*        3400620
     1           SAVX(9)+SAVX(25)*SAVX(5))-SAVX(31)-SAVX(26)              3400630
      SAVX(36) = -((SAVX(20)-SAVX(18))/S+SAVX(17)+X1*(SAVX(8)*SAVX(9)-    3400640
     1           SAVX(6)*SAVX(5))+SAVX(27)-SAVX(32))                      3400650
      GO TO 105                                                           3400660
  103 CONTINUE                                                            3400670
      A = -SAVX(3)/RO+0.5*(SAVX(9)*SAVX(9)+SAVX(5)*SAVX(5))+SAVX(2)       3400680
      SAVX(33) = -X1*(SAVX(24)*A+SAVX(25)*SAVX(4)+SAVX(26)*SAVX(9))-      3400690
     1           SAVX(28)/RO-X1*(SAVX(7)*SAVX(9)-SAVX(8)*SAVX(5))/RO-     3400700
     2           SAVX(29)-SAVX(24)                                        3400710
      SAVX(34) = -X1*(SAVX(25)*A-SAVX(26)*SAVX(5))-SAVX(30)-SAVX(25)      3400720
      SAVX(35) = -SAVX(7)/RO-X1*(SAVX(26)*A-SAVX(24)*SAVX(9)+SAVX(25)*    3400730
     1           SAVX(5))-SAVX(31)-SAVX(26)                               3400740
      SAVX(36) = -(SAVX(17)+X1*(SAVX(8)*SAVX(9)-SAVX(6)*SAVX(5))+         3400750
     1           SAVX(27))+SAVX(32)                                       3400760
  105 CONTINUE                                                            3400770
      SAVX(37) = SAVY(37)+SAVX(10)                                        3400780
      SAVX(38) = SAVY(38)+SAVX(11)                                        3400790
      SAVX(39) = SAVY(39)+SAVX(12)                                        3400800
      SAVX(40) = SAVY(40)+SAVX(13)                                        3400810
      SAVX(41) = SAVY(41)+SAVX(14)                                        3400820
      SAVX(42) = SAVY(42)+SAVX(15)                                        3400830
      SAVX(43) = SAVY(43)+DELP*XNTPH                                      3400840
      SAVX(44) = SAVY(44)+DELP*XNTTH                                      3400850
      SAVX(45) = SAVY(45)+DELP*XMTPH                                      3400860
      SAVX(46) = SAVY(46)+DELP*XMTTH                                      3400870
      SAVX(47) = SAVY(47)+YDOT(I+7)                                       3400880
      IF (ISTTAB.NE.2) GO TO 7776                                         3400890
      GO TO (151,152,153),IGEOM                                           3400900
  151 CONTINUE                                                            3400910
      SAVX(48) = SAVX(7)-(XNUPT*SAVX(6)+(XK11-XNUPT**2*XK22)*((SAVX(1)*   3400920
     1           CS-SAVX(3)*SN)*X1RO+X1*SAVX(9)**2*0.5)+XNUPT*SAVX(43)-   3400930
     2           SAVX(44)+X2*(XNUPT*SAVX(38)-SAVX(37)))                   3400940
      SAVX(49) = SAVX(20)-(XNUPT*SAVX(18)-(XD11-XNUPT**2*XD22)*X1RO*      3400950
     1           SAVX(5)*CS+(XNUPT*SAVX(45)-SAVX(46))+X2*(XNUPT*SAVX(41)  3400960
     2           -SAVX(40)))                                              3400970
      SAVX(50) = SAVX(21)-((-1.0/((RO/XD33)+(SNSQ*X1RO/XK33)))*(SAVX(19)  3400980
     1           *(CS1R1-CN1RO)+SAVX(16)*SN/XK33+X2*(SAVX(39)*SN/XK33-    3400990
     2           SAVX(42)*RO/XD33)+SN*X1*SAVX(9)*SAVX(5)))                3401000
      SAVX(51) = SAVX(4)-(R1*(SAVX(19)*CS1RO+SAVX(16)/XK33+X2*SAVX(39)/   3401010
     1           XK33+SAVX(21)*SN1RO/XK33)+R1*X1*SAVX(9)*SAVX(5))         3401020
      SAVX(52) = SAVX(2)-(R1*(SAVX(3)*X1R1+(1.0/(XK22-XNUTP**2*XK11))*    3401030
     1           (SAVX(6)-XNUTP*SAVX(7)+SAVX(43)-XNUTP*SAVX(44)+X2*       3401040
     2           (SAVX(38)-XNUTP*SAVX(37))))-R1*SAVX(5)**2*X1*0.5)        3401050
      SAVX(53) = SAVX(47)-(R1*(1.0/(XD22-XNUTP**2*XD11))*(-SAVX(18)+      3401060
     1           XNUTP*SAVX(20)-SAVX(45)+XNUTP*SAVX(46)-X2*(SAVX(41)-     3401070
     2           XNUTP*SAVX(40))))                                        3401080
      GO TO 175                                                           3401090
  152 CONTINUE                                                            3401100
      SAVX(48) = SAVX(7)-(XNUPT*SAVX(6)+(XK11-XNUPT**2*XK22)*((X1CS/S)*   3401110
     1           (SAVX(1)*CS-SAVX(3)*SN)+X1*SAVX(9)**2*0.5)+XNUPT*        3401120
     2           SAVX(43)-SAVX(44)+X2*(XNUPT*SAVX(38)-SAVX(37)))          3401130
      SAVX(49) = SAVX(20)-(XNUPT*SAVX(18)-(1.0/S)*X1CS*(XD11-XNUPT**2*    3401140
     1           XD22)*SAVX(5)*CS-SAVX(46)+XNUPT*SAVX(45)+X2*(XNUPT*      3401150
     2           SAVX(41)-SAVX(40)))                                      3401160
      SAVX(50) = SAVX(21)-((-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-       3401170
     1           SAVX(19)*SN/S+SAVX(16)*SN/XK33+X2*(SAVX(39)*SN/XK33-     3401180
     2           SAVX(42)*S*CS/XD33)+SN*X1*SAVX(9)*SAVX(5)))              3401190
      SAVX(51) = SAVX(4)-((1.0/S)*(SAVX(19)+SAVX(21)*TN/XK33)+SAVX(16)/   3401200
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     1            XK33+X2*SAVX(39)/XK33+X1*SAVX(9)*SAVX(5))                      3401210
      SAVX(52) = SAVX(2)-((1.0/(XK22-XNUTP**2*XK11))*(SAVX(6)-XNUTP*            3401220
     1            SAVX(7)+SAVX(43)-XNUTP*SAVX(44)+X2*(SAVX(38)-XNUTP*           3401230
     2            SAVX(37)))-X1*SAVX(5)*SAVX(5)*0.5)                             3401240
      SAVX(53) = SAVX(47)-((1.0/(XD22-XNUTP**2*XD11))*(-SAVX(18)+XNUTP*         3401250
     1            SAVX(20)-SAVX(45)+XNUTP*SAVX(46)-X2*(SAVX(41)-XNUTP*          3401260
     2            SAVX(40))))                                                    3401270
      GO TO 175                                                                 3401280
  153 CONTINUE                                                                  3401290
      SAVX(48) = SAVX(7)-(XNUPT*SAVX(6)+(XK11-XNUPT**2*XK22)*(-X1RO*            3401300
     1            SAVX(3)+X1*SAVX(9)**2*0.5)+XNUPT*SAVX(43)-SAVX(44)+           3401310
     2            X2*(XNUPT*SAVX(38)-SAVX(37)))                                  3401320
      SAVX(49) = SAVX(20)-(XNUPT*SAVX(18)+(XNUPT*SAVX(45)-SAVX(46))+            3401330
     1            X2*(XNUPT*SAVX(41)-SAVX(40)))                                  3401340
      SAVX(50) = SAVX(21)-((-1.0/((RO/XD33)+(X1RO/XK33)))*(SAVX(16)/XK33        3401350
     1            +X2*(SAVX(39)/XK33-SAVX(42)*RO/XD33)+X1*SAVX(9)*SAVX(5)       3401360
     2            ))                                                             3401370
      SAVX(51) = SAVX(4)-(SAVX(16)/XK33+X2*SAVX(39)/XK33+SAVX(21)*X1RO/         3401380
     1            XK33+X1*SAVX(9)*SAVX(5))                                       3401390
      SAVX(52) = SAVX(2)-((1.0/(XK22-XNUTP**2*XK11))*(SAVX(6)-XNUTP*            3401400
     1            SAVX(7)+(SAVX(43)-XNUTP*SAVX(44))+X2*(SAVX(38)-XNUTP*         3401410
     2            SAVX(37)))-X1*SAVX(5)*SAVX(5)*0.5)                             3401420
      SAVX(53) = SAVX(47)-((1.0/(XD22-XNUTP**2*XD11))*(-SAVX(18)+XNUTP*         3401430
     1            SAVX(20)+(XNUTP*SAVX(46)-SAVX(45))-X2*(SAVX(41)-XNUTP*        3401440
     2            SAVX(40))))                                                    3401450
      GO TO 175                                                                 3401460
 7776 IF (ISTTAB.GE.3.AND.ISTTAB.LE.9) GO TO 7777                               3401470
      GO TO (161,162,163),IGEOM                                                 3401480
  161 CONTINUE                                                                  3401490
      SAVX(48) = SAVX(7)-(XK12*(1.0/(XK22+XC22**2/XD22))*(SAVX(6)+              3401500
     1            SAVX(43)+X2*SAVX(38)+XC22/XD22*(SAVX(18)+SAVX(45)+X2*         3401510
     2            SAVX(41)))-SAVX(44)-X2*SAVX(37)+(X1RO*XK11-XK12*XK21*         3401520
     3            X1RO*(1.0/(XK22+XC22**2/XD22)))*(SAVX(5)*CS-SAVX(3)*SN+       3401530
     4            X1*RO*SAVX(9)**2*0.5)-(XC11+XK12*XC22*XD21/XD22*(1.0/         3401540
     5            (XK22+XC22**2/XD22)))*SAVX(5)*CS*X1RO)                         3401550
      SAVX(49) = SAVX(20)-(-XD12*(XC22/(XC22**2+XK22*XD22))*(SAVX(6)+           3401560
     1            SAVX(43)+X2*SAVX(38))-SAVX(46)-X2*SAVX(40)+XD12*(XK22/        3401570
     2            (XC22**2+XK22*XD22))*(SAVX(18)+SAVX(45)+X2*SAVX(41))+         3401580
     3            (XC11*X1RO+XD12*XK21*X1RO*(XC22/(XC22**2+XK22*XD22)))*        3401590
     4            (SAVX(1)*CS-SAVX(3)*SN+X1*RO*SAVX(9)**2*0.5)+(XD11-           3401600
     5            XD12*XK22*XD21/(XC22**2+XK22*XD22))*SAVX(5)*CS*X1RO)           3401610
      SAVX(50) = SAVX(21)-((-1.0/((RO/XD33)+(SNSQ*X1RO/XK33)))*(SAVX(19)        3401620
     1            *(CS1R1-CN1RO)+SAVX(16)*SN/XK33+X2*(SAVX(39)*SN/XK33-         3401630
     2            SAVX(42)*RO/XD33)+SN*X1*SAVX(9)*SAVX(5)))                      3401640
      SAVX(51) = SAVX(4)-(R1*(SAVX(19)*CS1RO+SAVX(16)/XK33+X2*SAVX(39)/         3401650
     1            XK33+SAVX(21)*SN1RO/XK33)+R1*X1*SAVX(9)*SAVX(5))               3401660
      SAVX(52) = SAVX(2)-(R1*(SAVX(3)*X1R1-X1*SAVX(5)**2*0.5+(1.0/(XK22         3401670
     1            +XC22**2/XD22))*(SAVX(6)+SAVX(43)+X2*SAVX(38)+(XC22/          3401680
     2            XD22)*(SAVX(18)+SAVX(45)+X2*SAVX(41))-XK21*X1RO*              3401690
     3            (SAVX(1)*CS-SAVX(3)*SN)-X1*XK12*SAVX(9)**2*0.5-(XC22*         3401700
     4            XD21/XD22)*SAVX(5)*CS*X1RO)))                                  3401710
      SAVX(53) = SAVX(47)-(R1*((-XC22/(XC22**2+XK22*XD22))*(SAVX(6)+            3401720
     1            SAVX(43)+X2*SAVX(38)-(XK21/RO)*(SAVX(1)*CS-SAVX(3)*SN)-       3401730
     2            X1*XK12*SAVX(9)**2*0.5)+(XK22/(XC22**2+XK22*XD22))*           3401740
     3            (SAVX(18)+SAVX(45)+X2*SAVX(41))-(XK22*XD21/(XC22**2+          3401750
     4            XK22*XD22))*SAVX(5)*CS*X1RO))                                  3401760
      GO TO 175                                                                 3401770
  162 CONTINUE                                                                  3401780
      SAVX(48) = SAVX(7)-(XK12*(1.0/(XK22+XC22**2/XD22))*(SAVX(6)+              3401790
     1            SAVX(43)+X2*SAVX(38)+(XC22/XD22)*(SAVX(18)+SAVX(45)+          3401800
     2            X2*SAVX(41)))-SAVX(44)-X2*SAVX(37)+(1.0/(CS*S))*(XK11-        3401810
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     3            XK12*XK21*(1.0/(XK22+XC22**2/XD22)))*(SAVX(1)*CS-          3401820
     4            SAVX(3)*SN+X1*S*CS*SAVX(9)**2*0.5)-(XC11+(XK12*XD21*       3401830
     5            XC22/XD22)*(1.0/(XK22+XC22**2/XD22)))*SAVX(5)/S)           3401840
      SAVX(49) =  SAVX(20)-(-XD12*(XC22/(XC22**2+XK22*XD22))*(SAVX(6)+       3401850
     1            SAVX(43)+X2*SAVX(38))-SAVX(46)-X2*SAVX(40)+XD12*(XK22/     3401860
     2            (XC22**2+XK22*XD22))*(SAVX(18)+SAVX(45)+X2*SAVX(41))+      3401870
     3            (XC11/(S*CS)+XD12*XK21/(S*CS))*(XC22/(XC22**2+XK22*        3401880
     4            XD22))*(SAVX(1)*CS-SAVX(3)*SN+X1*S*CS*SAVX(9)**2*0.5)      3401890
     5            +(XD11-XD12*XK22*XD21/(XC22**2+XK22*XD22))*SAVX(5)/S)      3401900
      SAVX(50) =  SAVX(21)-((-1.0/((S*CS/XD33)+(SN*TN/(XK33*S))))*(-         3401910
     1            SAVX(19)*SN/S+SAVX(16)*SN/XK33+X2*(SAVX(39)*SN/XK33-       3401920
     2            SAVX(42)*S*CS/XD33)+SN*X1*SAVX(9)*SAVX(5)))                3401930
      SAVX(51) =  SAVX(4)-((1.0/S)*(SAVX(19)+SAVX(21)*TN/XK33)+SAVX(16)/     3401940
     1            XK33+X2*SAVX(39)/XK33+X1*SAVX(9)*SAVX(5))                  3401950
      SAVX(52) =  SAVX(2)-(-X1*SAVX(5)**2*0.5+(1.0/(XK22+XC22**2/XD22))*     3401960
     1            (SAVX(6)+SAVX(43)+X2*SAVX(38)+(XC22/XD22)*(SAVX(18)+       3401970
     2            SAVX(45)+X2*SAVX(41))-(XK21/(S*CS))*(SAVX(1)*CS-SAVX(3)    3401980
     3            *SN)-X1*XK12*SAVX(9)**2*0.5-(XC22*XD21/XD22)*SAVX(5)/      3401990
     4            S))                                                        3402000
      SAVX(53) =  SAVX(47)-(-(XC22/(XC22**2+XK22*XD22))*(SAVX(6)+SAVX(43)    3402010
     1            +X2*SAVX(38)-XK21*(SAVX(1)*CS-SAVX(3)*SN)/(S*CS)-X1*       3402020
     2            XK12*SAVX(9)**2*0.5)+(XK22/(XC22**2+XK22*XD22))*           3402030
     3            (SAVX(18)+SAVX(45)+X2*SAVX(41))-(XK22*XD21/(XC22**2+       3402040
     4            XK22*XD22))*SAVX(5)/S)                                     3402050
      GO TO 175                                                             3402060
  163 CONTINUE                                                              3402070
      SAVX(48) =  SAVX(7)-(XK12*(1.0/(XK22+XC22**2/XD22))*(SAVX(6)+         3402080
     1            SAVX(43)+X2*SAVX(38)+(XC22/XD22)*(SAVX(18)+SAVX(45)+X2*    3402090
     2            SAVX(41)))-SAVX(44)-X2*SAVX(37)+(X1RO*(XK11-XK12*XK21*     3402100
     3            (1.0/(XK22+XC22**2/XD22))))*(-SAVX(3)+X1*RO*SAVX(9)*       3402110
     4            SAVX(9)*0.5))                                              3402120
      SAVX(49) =  SAVX(20)-(-XD12*(XC22/(XC22**2+XK22*XD22))*(SAVX(6)+       3402130
     1            SAVX(43)+X2*SAVX(38))-SAVX(46)-X2*SAVX(40)+XD12*(XK22/     3402140
     2            (XC22**2+XK22*XD22))*(SAVX(18)+SAVX(45)+X2*SAVX(41))+      3402150
     3            (XC11*X1RO+XD12*XK21*X1RO*(XC22/(XC22**2+XK22*XD22)))*     3402160
     4            (-SAVX(3)+X1*RO*SAVX(9)*SAVX(9)*0.5))                      3402170
      SAVX(50) =  SAVX(21)-((-1.0/((RO/XD33)+(X1RO/XK33)))*(SAVX(16)/XK33    3402180
     1            +X2*(SAVX(39)/XK33-SAVX(42)*RO/XD33)+X1*SAVX(9)*SAVX(5)    3402190
     2            ))                                                         3402200
      SAVX(51) =  SAVX(4)-(SAVX(16)/XK33+X2*SAVX(39)/XK33+SAVX(21)*X1RO/     3402210
     1            XK33+X1*SAVX(9)*SAVX(5))                                   3402220
      SAVX(52) =  SAVX(2)-(-X1*SAVX(5)**2*0.5+(1.0/(XK22+XC22**2/XD22))*     3402230
     1            (SAVX(6)+SAVX(43)+X2*SAVX(38)+(XC22/XD22)*(SAVX(18)+       3402240
     2            SAVX(45)+X2*SAVX(41))-(XK21*X1RO)*(-SAVX(3))-X1*XK12*      3402250
     3            SAVX(9)*SAVX(9)*0.5))                                      3402260
      SAVX(53) =  SAVX(47)-(-(XC22/(XC22**2+XK22*XD22))*(SAVX(6)+SAVX(43)    3402270
     1            +X2*SAVX(38)-XK21*X1RO*(-SAVX(3))-X1*XK12*SAVX(9)*         3402280
     2            SAVX(9)*0.5)+(XK22/(XC22**2+XK22*XD22))*(SAVX(18)+         3402290
     3            SAVX(45)+X2*SAVX(41)))                                     3402300
      GO TO 175                                                             3402310
 7777 GO TO (171,172,173),IGEOM                                             3402320
  171 CONTINUE                                                              3402330
      SAVX(48) =  SAVX(7)-((SAVX(6)+SAVX(43)+X2*SAVX(38))*(XC15*XC22+XD22    3402340
     1            *XK12)/(XK22*XD22+XC22**2)-SAVX(44)-X2*SAVX(37)+(XK12*     3402350
     2            XC22-XK22*XC15)*(SAVX(18)+SAVX(45)+X2*SAVX(41))/(XC22      3402360
     3            *XC22+XK22*XD22)+(X1RO*(SAVX(1)*CS-SAVX(3)*SN)+X1*         3402370
     4            SAVX(9)**2*0.5)*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-     3402380
     5            XK12*XK12*XD22)/(XK22*XD22+XC22*XC22))+X1RO*SAVX(5)*CS*     3402390
     6            (-XC11+(XC15*XC15*XC22+XC15*(XK12*XD22+XK22*XD12)-XK12     3402400
     7            *XD12*XC22)/(XK22*XD22+XC22*XC22)))                        3402410
      SAVX(49) =  SAVX(20)-((SAVX(18)+SAVX(45)+X2*SAVX(41))*(XC15*XC22+      3402420
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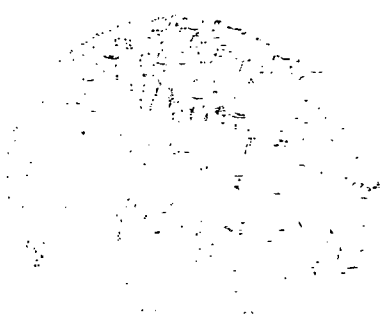
     1            XK22*XD12)/(XK22*XD22+XC22*XC22)+(SAVX(6)+SAVX(43)+X2*   3402430
     2            SAVX(38))*(XD22*XC15-XD12*XC22)/(XD22*XK22+XC22*XC22)-   3402440
     3            SAVX(46)-X2*SAVX(40)+X1RO*SAVX(5)*CS*(XD11-(XD12*XD12*   3402450
     4            XK22+XC15*(2.0*XC22*XD12-XC15*XD22))/(XC22*XC22+XK22*    3402460
     5            XD22))+(X1RO*(SAVX(1)*CS-SAVX(3)*SN)+X1*SAVX(9)*         3402470
     6            SAVX(9)*0.5)*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+      3402480
     7            XD12*XK22+XD22*XK12))/(XC22*XC22+XK22*XD22)))            3402490
      SAVX(50) = SAVX(21)-((1.0/(XC16*SN*X1RO-XK33-SN*X1RO*(XD33*SN/RO-   3402500
     1            XC16)))*((XK33*XD33-XC16*XC16)*X1RO*SAVX(19)*(CS*X1R1-   3402510
     2            CN1RO)+X1*SN*SAVX(9)*SAVX(5)+(SAVX(16)+X2*SAVX(39))*     3402520
     3            (XD33*SN*X1RO-XC16)+X2*SAVX(42)*(XK33-XC16*SN/RO)))      3402530
      SAVX(51) = SAVX(4)-(R1*(SAVX(19)*CS*X1RO+X1*SAVX(9)*SAVX(5)+(1.0/   3402540
     1            (XK33-XC16*XC16/XD33))*(SAVX(16)+SAVX(21)*(SN*X1RO-XC16  3402550
     2            /XD33)+X2*(SAVX(39)-XC16*SAVX(42)/XD33))))               3402560
      SAVX(52) = SAVX(2)-(SAVX(3)-R1*X1*SAVX(5)*SAVX(5)*0.5+R1*(XD22*      3402570
     1            (SAVX(6)+SAVX(43)+X2*SAVX(38))+XC22*(SAVX(18)+SAVX(45)+  3402580
     2            X2*SAVX(41))-(X1RO*(SAVX(1)*CS-SAVX(3)*SN)+X1*SAVX(9)*   3402590
     3            SAVX(9)*0.5)*(XK12*XD22+XC15*XC22)-X1RO*SAVX(5)*CS*      3402600
     4            (XC22*XD12-XC15*XD22))/(XK22*XD22+XC22*XC22))            3402610
      SAVX(53) = SAVX(47)-(R1*(XK22*(SAVX(18)+SAVX(45)+X2*SAVX(41))-XC22   3402620
     1            *(SAVX(6)+SAVX(43)+X2*SAVX(38))+(X1RO*(SAVX(1)*CS-       3402630
     2            SAVX(3)*SN)+X1*SAVX(9)**2*0.5)*(XK12*XC22-XK22*XC15)-    3402640
     3            X1RO*SAVX(5)*CS*(XC15*XC22+XK22*XD12))/(XC22**2+XK22*    3402650
     4            XD22))                                                   3402660
      GO TO 175                                                            3402670
  172 CONTINUE                                                             3402680
      SAVX(48) = SAVX(7)-((SAVX(6)+SAVX(43)+X2*SAVX(38))*(XC15*XC22+XD22   3402690
     1            *XK12)/(XK22*XD22+XC22**2)-SAVX(44)-X2*SAVX(37)+(XK12*   3402700
     2            XC22-XK22*XC15)*(SAVX(18)+SAVX(45)+X2*SAVX(41))/(XC22*   3402710
     3            XC22+XK22*XD22)+((SAVX(1)*CS-SAVX(3)*SN)/(S*CS)+X1*      3402720
     4            SAVX(9)**2*0.5)*(XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-   3402730
     5            XK12*XK12*XD22)/(XK22*XD22+XC22*XC22))+SAVX(5)/S*(-XC11   3402740
     6            +(XC15*XC15*XC22+XC15*(XK12*XD22+XK22*XD12)-XK12*XD12*   3402750
     7            XC22)/(XK22*XD22+XC22*XC22)))                            3402760
      SAVX(49) = SAVX(20)-((SAVX(18)+SAVX(45)+X2*SAVX(41))*(XC15*XC22+     3402770
     1            XK22*XD12)/(XK22*XD22+XC22*XC22)+(SAVX(6)+SAVX(43)+X2*   3402780
     2            SAVX(38))*(XD22*XC15-XD12*XC22)/(XD22*XK22+XC22*XC22)-   3402790
     3            SAVX(46)-X2*SAVX(40)+SAVX(5)/S*(XD11-(XD12*XD12*XK22+    3402800
     4            XC15*(2.0*XC22*XD12-XC15*XD22))/(XC22*XC22+XK22*XD22))+  3402810
     5            (1.0/(S*CS)*(SAVX(1)*CS-SAVX(3)*SN)+X1*SAVX(9)**2*0.5)   3402820
     6            *(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+XD12*XK22+XD22*   3402830
     7            XK12))/(XC22*XC22+XK22*XD22)))                           3402840
      SAVX(50) = SAVX(21)-(1.0/(XC16*TN/S-XK33-(TN/S)*(XD33*TN/S-XC16))*   3402850
     1            ((XK33*XD33-XC16*XC16)*(1.0/(S*CS))*(-SAVX(19)*SN/S)+    3402860
     2            X1*SN*SAVX(9)*SAVX(5)+(SAVX(16)+X2*SAVX(39))*(XD33*TN/S  3402870
     3            -XC16)+X2*SAVX(42)*(XK33-XC16*TN/S)))                    3402880
      SAVX(51) = SAVX(4)-(SAVX(19)/S+X1*SAVX(9)*SAVX(5)+(1.0/(XK33-XC16*   3402890
     1            XC16/XD33))*(SAVX(16)+SAVX(21)*(TN/S-XC16/XD33)+X2*      3402900
     2            (SAVX(39)-XC16*SAVX(42)/XD33)))                          3402910
      SAVX(52) = SAVX(2)-(-X1*SAVX(5)**2*0.5+(XD22*(SAVX(6)+SAVX(43)+      3402920
     1            X2*SAVX(38))+XC22*(SAVX(18)+SAVX(45)+X2*SAVX(41))-(XK12  3402930
     2            *XD22+XC15*XC22)*((1.0/(S*CS)*(SAVX(1)*CS-SAVX(3)*SN))+  3402940
     3            X1*SAVX(9)**2*0.5)-(XC22*XD12-XC15*XD22)*SAVX(5)/S)/     3402950
     4            (XK22*XD22+XC22*XC22))                                   3402960
      SAVX(53) = SAVX(47)-((XK22*(SAVX(18)+SAVX(45)+X2*SAVX(41))-XC22*     3402970
     1            (SAVX(6)+SAVX(43)+X2*SAVX(38))+(XK12*XC22-XK22*XC15)*    3402980
     2            ((1.0/(S*CS)*(SAVX(1)*CS-SAVX(3)*SN))+X1*SAVX(9)*        3402990
     3            SAVX(9)*0.5)-(XC15*XC22+XK22*XD12)*SAVX(5)/S)/(XK22*     3403000
     4            XD22+XC22*XC22))                                         3403010
      GO TO 175                                                            3403020
  173 CONTINUE                                                             3403030
```

```
      SAVX(48) = SAVX(7)-((SAVX(6)+SAVX(43)+X2*SAVX(38))*(XC15*XC22+XD22 3403040
     1           *XK12)/(XK22*XD22+XC22*XC22)-SAVX(44)-X2*SAVX(37)+(XK12 3403050
     2           *XC22-XK22*XC15)*(SAVX(18)+SAVX(45)+X2*SAVX(41))/(XC22* 3403060
     3           XC22+XK22*XD22)+(X1RO*(-SAVX(3))+X1*SAVX(9)**2*0.5)*    3403070
     4           (XK11+(XC15*(XC15*XK22-2.0*XK12*XC22)-XK12*XK12*XD22)/  3403080
     5           (XK22*XD22+XC22*XC22)))                                 3403090
      SAVX(49) = SAVX(20)-((SAVX(18)+SAVX(45)+X2*SAVX(41))*(XC15*XC22+   3403100
     1           XK22*XD12)/(XK22*XD22+XC22*XC22)+(SAVX(6)+SAVX(43)+X2*  3403110
     2           SAVX(38))*(XD22*XC15-XD12*XC22)/(XD22*XK22+XC22*XC22)-  3403120
     3           SAVX(46)-X2*SAVX(40)+(X1RO*(-SAVX(3))+X1*SAVX(9)*       3403130
     4           SAVX(9)*0.5)*(XC11+(XD12*XC22*XK12-XC15*(XC15*XC22+     3403140
     5           XD12*XK22+XD22*XK12))/(XC22*XC22+XK22*XD22)))           3403150
      SAVX(50) = SAVX(21)-((1.0/(XC16*X1RO-XK33-X1RO*(XD33*X1RO-XC16)))* 3403160
     1           (X1*SAVX(9)*SAVX(5)+(SAVX(16)+X2*SAVX(39))*(XD33*X1RO-  3403170
     2           XC16)+X2*SAVX(15)*(XK33-XC16/RO)))                      3403180
      SAVX(51) = SAVX(4)-(X1*SAVX(9)*SAVX(5)+(1.0/(XK33-XC16*XC16/XD33)) 3403190
     1           *(SAVX(16)+SAVX(21)*(X1RO-XC16/XD33)+X2*(SAVX(39)-XC16* 3403200
     2           SAVX(42)/XD33)))                                        3403210
      SAVX(52) = SAVX(2)-(-X1*SAVX(5)**2*0.5+(XD22*(SAVX(6)+SAVX(43)+X2  3403220
     1           *SAVX(38))+XC22*(SAVX(18)+SAVX(45)+X2*SAVX(41))-(X1RO*  3403230
     2           (-SAVX(3))+X1*SAVX(9)**2*0.5)*(XK12*XD22+XC15*XC22))/   3403240
     3           (XK22*XD22+XC22*XC22))                                  3403250
      SAVX(53) = SAVX(47)-((XK22*(SAVX(18)+SAVX(45)+X2*SAVX(41))-XC22*   3403260
     1           (SAVX(6)+SAVX(43)+X2*SAVX(38))+(X1RO*(-SAVX(3))+X1*     3403270
     2           SAVX(9)**2*0.5)*(XK12*XC22-XK22*XC15))/(XC22*XC22+XK22  3403280
     3           *XD22))                                                 3403290
  175 CONTINUE                                                           3403300
      RETURN                                                             3403310
      END                                                                3403320
```

```
FOR,IS ARRAYS,ARRAYS
      SUBROUTINE ARRAYS (A,B,C,D,E,F,G,H,O,PHI)                          4200010
      COMMON /GRAFIX/ X(100),Y(100,9),NGRAPH,LDEF(9),NGR,JCYC,NFLAG,JAM, 4200020
     C                JNSC                                               4200030
      DIMENSION Z(9)                                                     4200040
      Z(1) = A                                                           4200050
      Z(2) = B                                                           4200060
      Z(3) = C                                                           4200070
      Z(4) = D                                                           4200080
      Z(5) = E                                                           4200090
      Z(6) = F                                                           4200100
      Z(7) = G                                                           4200110
      Z(8) = H                                                           4200120
      Z(9) = O                                                           4200130
      INDEX = 0                                                          4200140
      JCYC = JCYC+1                                                      4200150
      DO 100 J=1,9                                                       4200160
      IF (LDEF(J).EQ.0) GO TO 100                                        4200170
      INDEX = INDEX+1                                                    4200180
      Y(JCYC,INDEX) = Z(J)                                               4200190
  100 CONTINUE                                                           4200200
      X(JCYC) = PHI                                                      4200210
      RETURN                                                             4200220
      END                                                                4200230
```

SUBROUTINE ETRAP

This is an error trap subroutine which can be called by the MAIN routine at various stages of program execution. If the indicator NIX is not equal to zero, MAIN will call ETRAP and indicate the proper error message to be printed.



```
FOR,IS ETRAP,ETRAP
      SUBROUTINE ETRAP                                                  4000010
      INTEGER SAVJTC,SAVSTP,Q,THICK                                     4000020
      INTEGER XN                                                        4000030
      COMMON STORY(16),XMAT(270,10),STD(10),SADUS(30),RADUS(30)         4000040
      COMMON TADUS(30),UADUS(30),SAVTIC(900)                            4000050
      COMMON XN,TEFREE,TIC,PHI,STOP,RESTOP,RTICK,G1,XNL(3),NH           4000060
      COMMON NST(30),NKL(30),NXMAT(20),SAVJTC(30),SAVSTP(30),JRTIC(30)  4000070
      COMMON JRSTOP(30),NREG,NMPT,NRC,NSC,NIX,IERROR,KGEOM,IGEOM,ISTTAB 4000080
      COMMON KELVIN,IBEGIN,NPROB,NSEG,NERROR,Q,THICK,NOJS,NLINKS,NLCASE 4000090
      COMMON NTSKL,NZ,NBCT,LINPUT,NTRKL,NPASS,XN1,KBC,NRINGS            4000100
      COMMON LODE,ICYCLE,LDISTL                                         4000110
      WRITE(6,1726)                                                     4000120
 1726 FORMAT(1H1)                                                       4000130
      GO TO (8000,8036,8086,8087,8089,8090,8013,8009,8031,8008,8001,    4000140
     1       8002,8003,8006,8007,8067,8101,8102,8103,8104,8105,8106,    4000150
     2       8107,8108,8109,8110,8088,110,8120,8841,8842,8777,8797,     4000160
     3       8787),NERROR                                               4000170
 8000 WRITE(6,1)                                                        4000180
    1 FORMAT(/  4X,'ONE OF THE MATERIAL PROPERTY TABLES CANNOT BE IDENTI 4000190
     1FIED AS ISOT, ORTH, OR STIF.'/)                                   4000200
      GO TO 505                                                         4000210
 8036 WRITE(6,2)                                                        4000220
    2 FORMAT(/  4X,'A MATERIAL PROPERTY TABLE NAME FOR A SEGMENT CANNOT 4000230
     1BE FOUND IN THE TABLE LIST.'/)                                    4000240
      GO TO 505                                                         4000250
 8086 WRITE(6,3)                                                        4000260
    3 FORMAT(/  4X,'THE TYPE OF GEOMETRY OF A SEGMENT CANNOT BE IDENTIFI 4000270
     1ED AS ONE HANDLED BY THE PROGRAM.'/)                              4000280
      GO TO 505                                                         4000290
 8087 WRITE(6,4)                                                        4000300
    4 FORMAT(/  4X,'THE TYPE OF MATERIAL PROPERTY TABLE FOR A SEGMENT CA 4000310
     1NNOT BE IDENTIFIED AS ISOT, ORTH, OR STIF.'/)                     4000320
      GO TO 505                                                         4000330
 8089 WRITE(6,5)                                                        4000340
    5 FORMAT(/  4X,'THE WALL CONSTRUCTION OF A SEGMENT CANNOT BE IDENTIF 4000350
     1IED AS SING, EQUA, UNEQ, OR BLAN.'/)                              4000360
      GO TO 505                                                         4000370
 8090 WRITE(6,6)                                                        4000380
    6 FORMAT(/  4X,'THE TYPE OF TEMPERATURE INPUT FOR A SEGMENT CANNOT B 4000390
     1E IDENTIFIED AS THST, NOTH, THCN, OR THIN.'/)                     4000400
 8013 WRITE(6,7)                                                        4000410
    7 FORMAT(/  4X,'THE PROGRAM CANNOT RECOGNIZE THE HARDENING CLUE AS B 4000420
     1EING EITHER ISOT, KINE OR PERF.'/)                                4000430
 8009 GO TO 505                                                         4000440
 8031 WRITE(6,9)                                                        4000450
    9 FORMAT(/  4X,'THE LOAD INDICATOR CLUES CAN ONLY BE ZERO, BLANK, ON 4000460
     1E, OR FOUR.'/)                                                    4000470
      GO TO 505                                                         4000480
 8008 WRITE(6,10)                                                       4000490
   10 FORMAT(/  4X,'THE COMBINATION OF AN ORTHOTROPIC MATERIAL AND THE I 4000500
     1SOTROPIC HARDENING RULE IS NOT PRESENTLY ALLOWED.'/)              4000510
      GO TO 505                                                         4000520
 8001 WRITE(6,11)                                                       4000530
   11 FORMAT(/  4X,'THE MAGIC CYCLE HAS GONE PAST STOP BY MORE THAN THE 4000540
     1PERMITTED VALUE. CHECK TO SEE IF FIXED STEP SIZE IS TOO LARGE.'/) 4000550
      GO TO 505                                                         4000560
 8002 WRITE(6,12)                                                       4000570
   12 FORMAT(/  4X,'THE RIEMAN VARIABLE, IEND, WHICH SIGNALS THE END OF 4000580
     1A SEGMENT SHOULD ONLY BE ZERO OR NEGATIVE ONE.'/)                 4000590
```

```
8003 GO TO 505                                                          4000600
8006 GO TO 505                                                          4000610
8007 WRITE(6,15)                                                        4000620
  15 FORMAT(/  4X,'THE INTERPOLATED VALUE OF TEMPERATURE FOR THE MATERI 4000630
     1AL PROPERTY TABLE IS LESS THAN THE SECOND TEMPERATURE VALUE.'/)    4000640
     GO TO 505                                                          4000650
8067 WRITE(6,16)                                                        4000660
  16 FORMAT(/  4X,'THE INTERPOLATED VALUE OF TEMPERATURE FOR THE MATERI 4000670
     1AL PROPERTY TABLE IS GREATER THAN THE LAST VALUE OF TEMPERATURE.'  4000680
     2/)                                                                4000690
     GO TO 505                                                          4000700
8101 WRITE(6,17)                                                        4000710
  17 FORMAT(/  4X,'THE K11 STIFFNESS PARAMETER IS ZERO.'/)              4000720
     GO TO 505                                                          4000730
8102 WRITE(6,18)                                                        4000740
  18 FORMAT(/  4X,'THE K12 STIFFNESS PARAMETER IS ZERO.'/)              4000750
     GO TO 505                                                          4000760
8103 WRITE(6,19)                                                        4000770
  19 FORMAT(/  4X,'THE K21 STIFFNESS PARAMETER IS ZERO.'/)              4000780
     GO TO 505                                                          4000790
8104 WRITE(6,20)                                                        4000800
  20 FORMAT(/  4X,'THE K22 STIFFNESS PARAMETER IS ZERO.'/)              4000810
     GO TO 505                                                          4000820
8105 WRITE(6,21)                                                        4000830
  21 FORMAT(/  4X,'THE K33 STIFFNESS PARAMETER IS ZERO.'/)              4000840
     GO TO 505                                                          4000850
8106 WRITE(6,22)                                                        4000860
  22 FORMAT(/  4X,'THE D11 STIFFNESS PARAMETER IS ZERO.'/)              4000870
     GO TO 505                                                          4000880
8107 WRITE(6,23)                                                        4000890
  23 FORMAT(/  4X,'THE D12 STIFFNESS PARAMETER IS ZERO.'/)              4000900
     GO TO 505                                                          4000910
8108 WRITE(6,24)                                                        4000920
  24 FORMAT(/  4X,'THE D21 STIFFNESS PARAMETER IS ZERO.'/)              4000930
     GO TO 505                                                          4000940
8109 WRITE(6,25)                                                        4000950
  25 FORMAT(/  4X,'THE D22 STIFFNESS PARAMETER IS ZERO.'/)              4000960
     GO TO 505                                                          4000970
8110 WRITE(6,26)                                                        4000980
  26 FORMAT(/  4X,'THE D33 STIFFNESS PARAMETER IS ZERO.'/)              4000990
     GO TO 505                                                          4001000
8088 WRITE(6,27)                                                        4001010
  27 FORMAT(/  4X,'THE PROGRAM CANNOT DETERMINE WHETHER THE PROBLEM INP 4001020
     1UT IS THIC, RWAF, RWA1, RWA2, RWA3, ST10, ST11, ST12, ST13, ISG1,  4001030
     2ISG2, OR ISG3.'/)                                                 4001040
 110 GO TO 505                                                          4001050
8120 WRITE(6,29)                                                        4001060
  29 FORMAT(/  4X,'THE Y2 BLOCK IN THE SEGMENT MAGIC OUTPUT IS SINGULAR 4001070
     1.'/)                                                              4001080
     GO TO 505                                                          4001090
8841 WRITE(6,30)                                                        4001100
  30 FORMAT(/  4X,'IN THE COMPUTATION OF THE REGION STIFFNESSES, THE K2 4001110
     12 MATRIX WAS NOT POSITIVE DEFINITE.'/)                            4001120
     GO TO 505                                                          4001130
8842 WRITE(6,31)                                                        4001140
  31 FORMAT(/  4X,'IN THE COMPUTATION OF THE REGION LOADS, THE K22 MATR 4001150
     1IX WAS NOT POSITIVE DEFINITE.'/)                                  4001160
     GO TO 505                                                          4001170
8777 WRITE(6,32)                                                        4001180
  32 FORMAT(/  4X,'IN THE COMPUTATION OF THE REDUCED FLEXIBILITY MATRIX 4001190
     1, THE REDUCED STIFFNESS MATRIX IS SINGULAR.'/)                    4001200
```

```
      GO TO 505                                                          4001210
 8797 WRITE(6,33)                                                        4001220
   33 FORMAT(/  4X,'FOR KINEMATIC LINKS BETWEEN SEGMENTS, THE DEPENDENT  4001230
     1JOINT NUMBER MUST BE GREATER THAN THE INDEPENDENT JOINT NUMBER.'/) 4001240
      GO TO 505                                                          4001250
 8787 WRITE(6,34)                                                        4001260
   34 FORMAT(/  4X,'THE NUMBER OF POINTS IN THE ST TABLE MUST BE BETWEEN 4001270
     1 2 AND 30.'/)                                                     4001280
  505 RETURN                                                            4001290
      END                                                               4001300
```

REFERENCES

1. Svalbonas, V., "Numerical Analysis of Stiffened Shells of Revolution-Vol. I: Theory", NASA CR-2273, September 1973.

2. Svalbonas, V., and Levine, H., "Numerical Nonlinear Inelastic Analysis of Stiffened Shells of Revolution-Vol. I: Theory", NASA CR-2559

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