MANTLE

A Finite Element Program for the Thermal-Mechanical Analysis of Mantle Convection

APPENDIX E

Program Listing

Final Report: NASA Grant NGR 06-002-191

by

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May 1979

```
      OVERLAY(FLOW,0,0)
C
C
C*********************************************************************
C                                                                     *
C       THE FOLLOWING VALUES REPRESENT THE MINIMUM DIMENSIONS         *
C       OF THE ARRAYS USED IN MANTLE.  THE SYMBOLS $AA$, $BB$,        *
C       ETC. MUST BE REPLACED BY INTEGER VALUES.  THE SYMBOLS         *
C       IDA, IDB, ETC. ARE FORTRAN VARIABLES THAT ARE USED IN         *
C       THE PROGRAM TO CHECK FOR ARRAY OVERFLOW.                      *
C                                                                     *
C                                                                     *
C       $AA$ = IDA = NUMTP, WHICH MUST BE GREATER THAN NUMVP          *
C       $BB$ = IDB = NUMTP OR NUMVP+NUMPP, WHICHEVER IS GREATER       *
C       $CC$ = IDC = NUMVP                                            *
C       $DD$ = IDD = NUMPP                                            *
C       $EE$ = IDE = 6+NUMPP                                          *
C       $FF$ = IDF = NELMT                                            *
C       $GG$ = IDG = NELMC                                            *
C       $II$ = IDI = MAXIMUM IELEX                                    *
C       $JJ$ = IDJ = MAXIMUM LISTX                                    *
C       $LL$ = IDL = KMAX                                             *
C                                                                     *
C*********************************************************************
C
C
      PROGRAM DRIVE
     1(TAPE5,OUTPUT,TAPE6=OUTPUT,TAPE7,TAPE1,TAPE2,TAPE3,TAPE4,TAPE8,
     2 TAPE9)
C
      COMMON/C1/
     1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
     2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TG($AA$),
     3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
      COMMON/C3/
     1 IELE($II$),NPR($BB$),LIST($JJ$),MOVE($JJ$),INTO($JJ$),
     2 IDIAG(2,$JJ$)
C
      COMMON/C4/
     1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
     2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
      COMMON/C5/
     1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
      DIMENSION
     1 IFLOW(5)
C
      DATA IDA,IDB,IDC,IDD,IEE,IDF/$AA$,$BB$,$CC$,$DD$,$EE$,$FF$/
      DATA IDG,IDI,IDJ,IDL/$GG$,$II$,$JJ$,$LL$/
C
      NTPE=6
      NVPE=6
C
C
C
```

```
C
      WRITE(6,3)
C
      WRITE(6,1)
      READ(5,2) (IFLOW(I),I=1,3)
      WRITE(6,2)(IFLOW(I),I=1,3)
C
      IF(IFLOW(1).EQ.1) CALL OVERLAY(4HFLOW,1,0)
      IF(IFLOW(1).EQ.2) CALL OVERLAY(4HFLOW,2,0)
      IF(IFLOW(2).EQ.1) CALL OVERLAY(4HFLOW,3,0)
      IF(IFLOW(3).EQ.1) CALL OVERLAY(4HFLOW,4,0)
C
      IF(IFLOW(1).NE.7777) GO TO 7777
C
      CALL MAP
      CALL POINT
      CALL VECTOR
      CALL LINE
      CALL FRAME
C
 7777 STOP
C
    1 FORMAT(10H0     IFLOW   )
    2 FORMAT(8I10)
    3 FORMAT(110H0*******************************************************
     1*************************************** DATA FROM DRIVE    )
C
      END
```

```
      OVERLAY(FLOW,1,0)
      PROGRAM MESH1
C
C
      COMMON/C1/
     1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
     2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TQ($AA$),
     3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
      COMMON/C5/
     1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
      DIMENSION
     1 RADIUS(49)
C
      DATA IDO/49/
C
C
C
      WRITE(6,26)
C
C     READ AND INITIALIZATION OF DATA
C
      WRITE(6,20)
      READ(5,21) NPPE
      WRITE(6,21)NPPE
C
      IF(NPPE.NE.0.AND.NPPE.NE.1.AND.NPPE.NE.3) GO TO 7005
C
C
C
C
      NVPE=6
      NTPE=6
      NNPE=6+NPPE
C
C
      WRITE(6,2)
      READ(5,3) RI,RO,RM,RPI
      WRITE(6,3)RI,RO,RM,RPI
C
      XMIN=-RO*1.01
      XMAX=RO*1.01
      YMIN=-RO*1.01
      YMAX=RO*1.01
C
      WRITE(6,18)
      READ(5,19) IPUNCH
      WRITE(6,19)IPUNCH
C
C
      WRITE(6,7)
      READ(5,1) NDIVTH,NDIVR
      WRITE(6,1)NDIVTH,NDIVR
C
C
      WRITE(6,9)
```

```
      READ(5,10) NPBCI,XBCI,YBCI,TBCI
      READ(5,11) CHI,CXI,CYI,TXI,TYI,TQI
      WRITE(6,29)NPBCI,XBCI,YBCI,TBCI,CHI,CXI,CYI,TXI,TYI,TQI
      READ(5,10) NPBCO,XBCO,YBCO,TBCO
      READ(5,11) CHO,CXO,CYO,TXO,TYO,TQO
      WRITE(6,30)NPBCO,XBCO,YBCO,TBCO,CHO,CXO,CYO,TXO,TYO,TQO
C
C
C
C     CALCULATE NUMBER OF NODAL POINTS
C
      NUMEL=NDIVTH*NDIVR*2
      NUMVP=(2*NDIVTH)*(2*NDIVR+1)
      NUMPP=0
      IF(NPPE.EQ.3) NUMPP=NUMVP-(NDIVR)*(NDIVTH+1)
      IF(NPPE.EQ.1) NUMPP=NDIVR*NDIVTH
      NELMC=NUMEL
      NELMT=NUMEL
      IF(RPI.EQ.2.0) GO TO 160
      NUMVP=NUMVP+2*NDIVR+1
      IF(NPPE.EQ.3) NUMPP=NUMPP+NDIVR
  160 CONTINUE
      NUMTP=NUMVP
      NUMNP=NUMVP+NUMPP
C
C
      IF(NUMVP.GT.IDA.OR.NUMVP.GT.IDC) GO TO 7001
      IF(NUMNP.GT.IDB) GO TO 7002
      IF(NUMPP.GT.IDE) GO TO 7003
      IF(NUMEL.GT.IDF.OR.NUMEL.GT.IDG) GO TO 7004
C
C
      IEND=NUMVP
      IF(NUMTP.GT.NUMVP) IEND=NUMTP
      DO 280 I=1,IEND
      NPBC(I)=1
      COSXXP(I)=1.0
      XBC(I)=0.0
      YBC(I)=0.0
      TBC(I)=0.0
      CH(I)=0.0
      CX(I)=0.0
      CY(I)=0.0
      TX(I)=0.0
      TY(I)=0.0
      TQ(I)=0.0
      XORD(I)=-0.0
      YORD(I)=-0.0
  280 CONTINUE
C
C     CALCULATE N.P. COORDINATES AND B.C.
C
      R=NDIVR*2
      DX=1.0/R
      X=0.0
      IEND=NDIVR*2+1
      DO 250 I=1,IEND
      RADIUS(I)=2.0*(X-0.5)*(X-1.0)*RI-4.0*X*(X-1.0)*RM+2.*X*(X-.5)*RO
      X=X+DX
  250 CONTINUE
```

```
C
      PI=3.141592654
      THETA=PI/2.0
      R=2*NDIVTH
      DTHETA=-RPI*PI/R
C
      IEND=2*NDIVTH
      IF(RPI.NE.2.0) IEND=IEND+1
      JEND=2*NDIVR
      ID=NDIVTH*2
      IF(RPI.NE.2.0) ID=NDIVTH*2+1
C
      DO 350 I=1,IEND
      NPI=I
      C=COS(THETA)
      S=SIN(THETA)
      POM=1.0
      IF(S.LT.0.0) POM=-1.0
C
      XBC(NPI)=XBCI*POM
      YBC(NPI)=YBCI*POM
      TBC(NPI)=TBCI
      CH(NPI)=CHI
      CX(NPI)=CXI*POM
      CY(NPI)=CYI*POM
      TX(NPI)=TXI*POM
      TY(NPI)=TYI*POM
      TQ(NPI)=TQI
      COSXXP(NPI)=C*POM
      NPBC(NPI)=NPBCI
      XORD(NPI)=RADIUS(1)*C
      YORD(NPI)=RADIUS(1)*S
C
      DO 340 J=2,JEND
      NPI=NPI+ID
      XORD(NPI)=RADIUS(J)*C
      YORD(NPI)=RADIUS(J)*S
  340 CONTINUE
C
      NPI=NPI+ID
      XBC(NPI)=XBCO*POM
      YBC(NPI)=YBCO*POM
      TBC(NPI)=TBCO
      CH(NPI)=CHO
      CX(NPI)=CXO*POM
      CY(NPI)=CYO*POM
      TX(NPI)=TXO*POM
      TY(NPI)=TYO*POM
      TQ(NPI)=TQO
      COSXXP(NPI)=C*POM
      NPBC(NPI)=NPBCO
      JP1=JEND+1
      XORD(NPI)=RADIUS(JP1)*C
      YORD(NPI)=RADIUS(JP1)*S
      THETA=THETA+DTHETA
  350 CONTINUE
C
C     CALCULATION OF NP ARRAY
C
      MOP=+1
```

```
      IEL=0
C
      IP=(NDIVR*3)+1
      I4=NUMVP+1
      I5=I4+NDIVR
      I6=I4+IP
C
      DO 550 I=1,NDIVTH
      I1=2*I-1
      I2=I1+ID
      I3=I2+ID
      DO 540 J=1,NDIVR
      IEL=IEL+1
      IF(MDP.LT.0) GO TO 520
      NP(IEL,1)=I1
      NP(IEL,2)=I1+1
      NP(IEL,3)=I1+2
      NP(IEL,4)=I2+1
      NP(IEL,5)=I3
      NP(IEL,6)=I2
      IF(NPPE.EQ.0) GO TO 510
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 510
      NP(IEL,7)=I4
      NP(IEL,8)=I5
      NP(IEL,9)=I5+1
  510 CONTINUE
      IEL=IEL+1
      NP(IEL,1)=I1+2
      NP(IEL,2)=I2+2
      NP(IEL,3)=I3+2
      NP(IEL,4)=I3+1
      NP(IEL,5)=I3
      NP(IEL,6)=I2+1
      IF(NPPE.EQ.0) GO TO 530
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 530
      NP(IEL,7)=I5+1
      NP(IEL,8)=I6
      NP(IEL,9)=I5+2
      GO TO 530
  520 CONTINUE
      NP(IEL,1)=I1
      NP(IEL,2)=I1+1
      NP(IEL,3)=I1+2
      NP(IEL,4)=I2+2
      NP(IEL,5)=I3+2
      NP(IEL,6)=I2+1
      IF(NPPE.EQ.0) GO TO 525
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 525
      NP(IEL,7)=I5
      NP(IEL,8)=I6
      NP(IEL,9)=I5+1
  525 CONTINUE
      IEL=IEL+1
      NP(IEL,1)=I1
      NP(IEL,2)=I2+1
      NP(IEL,3)=I3+2
      NP(IEL,4)=I3+1
```

```
      NP(IEL,5)=I3
      NP(IEL,6)=I2
      IF(NPPE.EQ.0) GO TO 530
      NP(IEL,7)=I4
      IF(NPPE.EQ.1) GO TO 530
      NP(IEL,7,=I4
      NP(IEL,8)=I5+1
      NP(IEL,9)=I5+2
  530 CONTINUE
      I1=I3
      I2=I1+ID
      I3=I2+ID
      I4=I4+1
      I5=I5+2
      I6=I6+1
      MOP=-MOP
  540 CONTINUE
      I4=I5+1
      I5=I4+NDIVR
      I6=I4+IP
      IF(NPPE.EQ.1) I4=I*NDIVR+1+NUMVP
  550 CONTINUE
C
C
      IF(RPI.NE.2.0) GO TO 571
      IBGN=NUMEL-NDIVR*2+1
      IEND=NUMEL
      KEND=2*NDIVR+1
      DO 570 I=IBGN,IEND
      DO 570 J=1,6
      DO 569 K=1,KEND
      K1=K*ID+1
      IF(NP(I,J).NE.K1) GO TO 569
      NP(I,J)=NP(I,J)-ID
      GO TO 570
  569 CONTINUE
  570 CONTINUE
  571 CONTINUE
C
C     READ SINGULAR BOUNDARY CONDITIONS
C
      WRITE(6,22)
      READ(5,1) NUMBC
      WRITE(6,1)NUMBC
C
      IF(NUMBC.EQ.0) GO TO 761
      WRITE(6,25)
      DO 760 I=1,NUMBC
      READ(5,24) I1,NPBC(I1),COSXXP(I1),XBC(I1),YBC(I1),TBC(I1)
      READ(5,27) CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TQ(I1)
      WRITE(6,28) I1,NPBC(I1),COSXXP(I1),XBC(I1),YBC(I1),TBC(I1),
     1 CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TQ(I1)
  760 CONTINUE
  761 CONTINUE
C
C
  781 CONTINUE
C
      CALL MSHADJ
C
```

```
C
C     OUTPUT OF DATA
C
      WRITE(6,16)
      WRITE(6,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
      WRITE(6,12)
      DO 820 I=1,NUMTP
      WRITE(6,13) I,XORD(I),YORD(I),NPBC(I),COSXXP(I),XBC(I),YBC(I),
     1 TBC(I),TX(I),TY(I),TQ(I),CH(I),CX(I),CY(I)
  820 CONTINUE
C
      WRITE(6,14)
      DO 840 I=1,NUMEL
      WRITE(6,15) I,(NP(I,J),J=1,NNPE)
  840 CONTINUE
C
      IF(IPUNCH.NE.7) GO TO 855
      WRITE(7,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
C
      DO 845 I=1,NUMTP
      WRITE(7,13) I,XORD(I),YORD(I)
  845 CONTINUE
      DO 850 I=1,NUMEL
      WRITE(7,15) I,(NP(I,J),J=1,NNPE)
  850 CONTINUE
  855 CONTINUE
C
      CALL MAP(XMIN,XMAX,YMIN,YMAX,0.0,1.0,0.0,1.0)
      DO 860 I=1,NUMEL
      I1=NP(I,1)
      I2=NP(I,2)
      I3=NP(I,3)
      I4=NP(I,4)
      I5=NP(I,5)
      I6=NP(I,6)
C
      CALL POINT(XORD(I1),YORD(I1))
      CALL VECTOR(XORD(I2),YORD(I2))
      CALL VECTOR(XORD(I3),YORD(I3))
      CALL VECTOR(XORD(I4),YORD(I4))
      CALL VECTOR(XORD(I5),YORD(I5))
      CALL VECTOR(XORD(I6),YORD(I6))
      CALL VECTOR(XORD(I1),YORD(I1))
C
  860 CONTINUE
      CALL FRAME
C
C
      GO TO 7777
C
C
C     ERROR MESSAGES
C
 7001 WRITE(6,5) NUMVP,IDA,IDC
      STOP
 7002 WRITE(6,6) NUMNP,IDB
      STOP
 7003 WRITE(6,4) NUMPP,IDE
      STOP
 7004 WRITE(6,8) NUMEL,IDG
```

```
      STOP
 7005 WRITE(6,23)
      STOP
C
C
C
C     FORMAT STATEMENTS
C
C
    1 FORMAT(8I10)
    2 FORMAT(40H0       RI         RO         RM        RPI   )
    3 FORMAT(7E10.3)
    4 FORMAT(14H0 NUMPP EQUALS,I5, 22H EXCEEDS DIMENSION IDE, I5)
    5 FORMAT(14H0 NUMVP EQUALS, I5, 26H WHICH EXCEEDS EITHER IDA,,
     1 I5, 8H OR IDC,,I5 )
    6 FORMAT(14H0 NUMNP EQUALS, I5, 20H, WHICH EXCEEDS IDB,,I5)
    7 FORMAT(20H0    NDIVTH      NDIVR  )
    8 FORMAT(14H0 NUMEL EQUALS, I5, 27H, WHICH EXCEEDS EITHER IDF,,
     1 I5, 8H OR IDG, I5)
    9 FORMAT(100H0      NPBC        XBC        YBC        TBC     /   CH
     1    CX         CY         TX         TY         TQ  )
   10 FORMAT(I10,3E10.3)
   11 FORMAT(6E10.3)
   12 FORMAT(127H0  NP       XORD       YORD NPBC COSXXP        XBC        Y
     1BC        TBC         TX         TY         TQ         CH         CX
     1     CY      )
   13 FORMAT(I5,2E10.3,I5,F7.4,9E10.3)
   14 FORMAT(40H0  ELEM                                  NP             )
   15 FORMAT(10I7)
   16 FORMAT(60H0     NUMNP      NUMTP      NUMVP      NUMPP      NELMC      N
     1ELMT   )
   17 FORMAT(8I10)
   18 FORMAT(10H0    IPUNCH      )
   19 FORMAT(I10)
   20 FORMAT(10H0      NPPE )
   21 FORMAT(I10)
   22 FORMAT(10H0     NUMBC)
   23 FORMAT(35H0 NPPE MUST EQUAL EITHER 0, 1, OR 3 )
   24 FORMAT(2I10,F10.4,5E10.3)
   25 FORMAT(123H0        NP       NPBC     COSXXP        XBC        YBC
     1  TBC   /         CH         CX         CY         TX         TY
     1TQ        )
   26 FORMAT(110H0**********************************************************
     1********************************** DATA FROM MESH   )
   27 FORMAT(6E10.3)
   28 FORMAT(2I10,F10.4,3E10.3, 3H  / ,6E10.3    )
   29 FORMAT(I10,9E10.3, 10H     INSIDE )
   30 FORMAT(I10,9E10.3, 11H     OUTSIDE )
C
 7777 CONTINUE
      END
```

```
      OVERLAY(FLOW,2,0)
      PROGRAM MESH2
C
C
      COMMON/C1/
     1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
     2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TQ($AA$),
     3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
      COMMON/C5/
     1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
      DIMENSION
     1 NDIV(5,4),JOIN(5,4,2),XCOR(5,8),YCOR(5,8),LNP(5,4,100),
     2 LPBC(5,4),XLBC(5,4),YLBC(5,4),CXLBC(5,4),CYLBC(5,4),TXLBC(5,4),
     3 TYLBC(5,4),TQLBC(5,4),TLBC(5,4),CHBC(5,4),COSLBC(5,4),
     4 LNR(4,100),NPN($BB$),RN(8),NUMLPS(2)
C
C
C
C
      WRITE(6,26)
C
C     READ AND INITIALIZATION OF DATA
C
      WRITE(6,20)
      READ(5,21) NPPE
      WRITE(6,21)NPPE
C
      IF(NPPE.NE.0.AND.NPPE.NE.1.AND.NPPE.NE.3) GO TO 7001
C
C
C
      NVPE=6
      NTPE=6
      NNPE=6+NPPE
C
      WRITE(6,2)
      READ(5,1) NUMLPS(1),NUMLPS(2)
      WRITE(6,1)NUMLPS(1),NUMLPS(2)
C
C
C
      IEND=NUMLPS(2)
      DO 120 I=1,IEND
      DO 120 J=1,4
      LPBC(I,J)=1
      XLBC(I,J)=0.0
      YLBC(I,J)=0.0
      TLBC(I,J)=0.0
      COSLBC(I,J)=1.0
      CHBC(I,J)=0.0
      CXLBC(I,J)=0.0
      CYLBC(I,J)=0.0
      TXLBC(I,J)=0.0
      TYLBC(I,J)=0.0
      TQLBC(I,J)=0.0
```

```
  120 CONTINUE
C
      WRITE(6,4)
      READ(5,3) XMIN,XMAX,YMIN,YMAX
      WRITE(6,3)XMIN,XMAX,YMIN,YMAX
C
      WRITE(6,18)
      READ(5,19) IPUNCH
      WRITE(6,19)IPUNCH
C
      IEND=NUMLPS(2)
      DO 150 I=1,IEND
      WRITE(6-5) I
      WRITE(6,7)
      READ(5,6) NDIV(I,1),NDIV(I,2)
      WRITE(6,6)NDIV(I,1),NDIV(I,2)
C
      WRITE(6,8)
      READ(5,9) ((JOIN(I,J,K),K=1,2),J=1,4)
      WRITE(6,9)((JOIN(I,J,K),K=1,2),J=1,4)
C
      WRITE(6,10)
      READ(5,11) (XCOR(I,J) YCOR(I,J),J=1,8)
      WRITE(6,11)(XCOR(I,J) ,YCOR(I,J),J=1,8)
C
      WRITE(6,22)
      READ(5,1) NUMBC
      WRITE(6,1)NUMBC
C
      IF(NUMBC.EQ.0) GO TO 131
C
      WRITE(6,23)
      DO 130 J=1,NUMBC
      READ(5,24) J1,LPBC(I,J1),COSLBC(I,J1),XLBC(I,J1),YLBC(I,J1),
     1 TLBC(I,J1)
      READ(5,27) CHBC(I,J1),CXLBC(I,J1),CYLBC(I,J1),TXLBC(I,J1),
     1 TYLBC(I,J1),TQLBC(I,J1)
      WRITE(6,28) J1,LPBC(I,J1),COSLBC(I,J1),XLBC(I,J1),YLBC(I,J1),
     1 TLBC(I,J1),CHBC(I,J1),CXLBC(I,J1),CYLBC(I,J1),TXLBC(I,J1),
     1 TYLBC(I,J1),TQLBC(I,J1)
  130 CONTINUE
C
  131 CONTINUE
C
  150 CONTINUE
C
      IEND=NUMLPS(2)
      DO 160 I=1,IEND
      NDIV(I,3)=NDIV(I,1)
      NDIV(I,4)=NDIV(I,2)
  160 CONTINUE
C
C     CALCULATE NUMBER OF NODAL POINTS
C
      NUMTP=0
      NUMVP=0
      NUMPP=0
      IEND=NUMLPS(2)
      DO 260 I=1,IEND
      I7=(2*NDIV(I,1)+1)*(2*NDIV(I,2)+1)
```

```
      IF(I.GT.NUMLPS(1)) GO TO 230
      IF(NPPE.EQ.3) I8=I7-(NDIV(I,1)+1)*(NDIV(I,2)+1)
      IF(NPPE.EQ.1) I8=NDIV(I,1)*NDIV(I,2)
      IF(NPPE.EQ.0) I8=0
C
      NUMVP=NUMVP+I7
      NUMPP=NUMPP+I8
  230 CONTINUE
      NUMTP=NUMTP+I7
C
      J1=4
      DO 250 J=1,4
      IF(JOIN(I,J,1).EQ.0) GO TO 249
      NUMTP=NUMTP-(2*NDIV(I,J)+1)
      IF(JOIN(I,J1,1).NE.0) NUMTP=NUMTP+1
      IF(I.GT.NUMLPS(1)) GO TO 249
      NUMVP=NUMVP-(2*NDIV(I,J)+1)
      IF(NPPE.EQ.3) NUMPP=NUMPP-(NDIV(I,J))
      IF(JOIN(I,J1,1).NE.0) NUMVP=NUMVP+1
  249 CONTINUE
      J1=J
C
  250 CONTINUE
  260 CONTINUE
C
      NUMNP=NUMVP+NUMPP
      IF(NUMTP.GT.NUMNP) NUMNP=NUMTP
C
C
      IF(NUMTP.GT.IDA.OR.NUMVP.GT.IDA) GO TO 7002
      IF(NUMNP.GT.IDB) GO TO 7003
      IF(NUMVP.GT.IDC) GO TO 7004
      IF(NUMPP.GT.IDD) GO TO 7005
      IF(NELMT.GT.IDF) GO TO 7006
      IF(NELMC.GT.IDG) GO TO 7007
C
C
C
      IEND=NUMVP
      IF(NUMTP.GT.NUMVP) IEND=NUMTP
      DO 280 I=1,IEND
      NPBC(I)=1
      COSXXP(I)=1.0
      XBC(I)=0.0
      YBC(I)=0.0
      TBC(I)=0.0
      CH(I)=0.0
      CX(I)=0.0
      CY(I)=0.0
      TX(I)=0.0
      TY(I)=0.0
      TQ(I)=0.0
      XORD(I)=-0.0
      YORD(I)=-0.0
  280 CONTINUE
C
      ITP=0
      IVP=0
      IPP=NUMVP
      IEL=0
```

```
      IELC=0
      DFACT=0.001
C
      IEND=NUMLPS(2)
      DO 720 I=1,IEND
C
      I1=NDIV(I,1)
      I2=2*I1+1
      I3=3*I1+1
C
      I4=NDIV(I,2)
      I5=2*I4+1
      I6=3*I4+1
C
      I7=I2*I5
      IF(NPPE.EQ.3) I8=I7-(I1+1)*(I4+1)
      IF(NPPE.EQ.1) I8=I1*I4
      IF(NPPE.EQ.0) I8=0
      IF(I.GT.NUMLPS(1)) I8=0
      I9=I7+I8
C
C     CALCULATE SIDE ARRAYS
C
      JEND=I2
C
      J2=I7-I2
      J4=I2+1
C
      DO 320 J=1,JEND
      J4=J4-1
      LNR(1,J)=J
      LNR(3,J4)=J2+J
  320 CONTINUE
C
      IF(NPPE.NE.3) GO TO 331
      IF(I.GT.NUMLPS(1)) GO TO 331
C
      JBGN=JEND+1
      JEND=JEND+I1
C
      J1=(I7+1)-JBGN
      J2=(I7+I8-I1+1)-JBGN
      J4=I3+1
C
      DO 330 J=JBGN,JEND
      J4=J4-1
      LNR(1,J)=J1+J
      LNR(3,J4)=J2+J
  330 CONTINUE
  331 CONTINUE
C
C
      JEND=I5
C
      J4=I5+1
C
      DO 340 J=1,JEND
      J4=J4-1
      LNR(2,J)=J*I2
      LNR(4,J4)=(J-1)*I2+1
```

```
  340 CONTINUE
C
      IF(NPPE.NE.3) GO TO 355
      IF(I.GT.NUMLPS(1)) GO TO 355
C
C
C
      JBGN=JEND+1
      JEND=JEND+I4
C
      J1=1
      J4=I6+1
C
      DO 350 J=JBGN,JEND
      J4=J4-1
      LNR(2,J)=I7+J1*(I1+I2)
      LNR(4,J4)=LNR(2,J)-I2+1
      J1=J1+1
  350 CONTINUE
C
  355 CONTINUE
C
C
C     CALCULATE NPN ARRAY
C
      JEND=I9
C
      DO 415 J=1,JEND
      NPN(J)=0
  415 CONTINUE
C
      DO 440 J=1,4
      IF(JOIN(I,J,1).EQ.0) GO TO 440
C
      J1=JOIN(I,J,1)
      J2=JOIN(I,J,2)
C
      KEND=2*NDIV(I,J)+1
      K2=KEND+1
C
      DO 425 K=1,KEND
      K1=LNR(J,K)
      K2=K2-1
      NPN(K1)=LNP(J1,J2,K2)
  425 CONTINUE
C
      IF(NPPE.NE.3) GO TO 440
      IF(I.GT.NUMLPS(1)) GO TO 440
C
C
      KBGN=KEND+1
      KEND=3*NDIV(I,J)+1
      K2=KEND+1
C
      DO 435 K=KBGN,KEND
      K1=LNR(J,K)
      K2=K2-1
      NPN(K1)=LNP(J1,J2,K2)
  435 CONTINUE
C
```

```
  440 CONTINUE
C
      JEND=I7
      DO 460 J=1,JEND
      IF(NPN(J).NE.0) GO TO 460
      ITP=ITP+1
      NPN(J)=ITP
      IF(I.GT.NUMLPS(1)) GO TO 460
      IVP=IVP+1
  460 CONTINUE
C
C
      IF(I.GT.NUMLPS(1)) GO TO 471
      JBGN=JEND+1
      JEND=I9
C
      DO 470 J=JBGN,JEND
      IF(NPN(J).NE.0) GO TO 470
      IPP=IPP+1
      NPN(J)=IPP
  470 CONTINUE
  471 CONTINUE
C
C
C
      IF(NPPE.EQ.3) JEND=I3
      IF(NPPE.NE.3) JEND=I2
      IF(I.GT.NUMLPS(1)) JEND=I2
C
      DO 485 J=1,JEND
      J1=LNR(1,J)
      J3=LNR(3,J)
C
      LNP(I,1,J)=NPN(J1)
      LNP(I,3,J)=NPN(J3)
C
  485 CONTINUE
C
      IF(NPPE.EQ.3) JEND=I6
      IF(NPPE.NE.3) JEND=I5
      IF(I.GT.NUMLPS(1)) JEND=I5
C
      DO 487 J=1,JEND
      J2=LNR(2,J)
      J4=LNR(4,J)
C
      LNP(I,2,J)=NPN(J2)
      LNP(I,4,J)=NPN(J4)
  487 CONTINUE
C
C
C
C     FORMULATE BOUNDARY CONDITIONS
C
      DO 495 J=1,4
      KEND=I2
      IF(J.EQ.2.OR.J.EQ.4) KEND=I5
C
      DO 495 K=1,KEND
      K1=LNP(I,J,K)
```

```
      NPBC(LNP(I,J,K))=LPBC(I,J)
      COSXXP(LNP(I,J,K))=COSLBC(I,J)
      XBC(LNP(I,J,K))=XLBC(I,J)
      YBC(LNP(I,J,K))=YLBC(I,J)
      TBC(LNP(I,J,K))=TLBC(I,J)
      CH(LNP(I,J,K))=CHBC(I,J)
      CX(LNP(I,J,K))=CXLBC(I,J)
      CY(LNP(I,J,K))=CYLBC(I,J)
      TX(LNP(I,J,K))=TXLBC(I,J)
      TY(LNP(I,J,K))=TYLBC(I,J)
      TQ(LNP(I,J,K))=TQLBC(I,J)
  495 CONTINUE
C
C
C
C
C     CALCULATE NODAL POINT COORDINATES
C
      R=2*I1
      DX=1.0/R
      R=2*I4
      DY=1.0/R
C
      JEND=I5
C
      KEND=I2
C
      K1=0
C
      DO 550 J=1,JEND
      R=J-1
      RY=R*DY
C
      DO 540 K=1,KEND
      R=K-1
      RX=R*DX
      RN(1)=+1.0*(1.0-RX)*(1.0-RY)*(1.0-2.0*RX-2.0*RY)
      RN(2)=+4.0*(RX)*(1.0-RX)*(1.0-RY)
      RN(3)=-1.0*(RX)*(1.0-RY)*(1.0-2.0*RX+2.0*RY)
      RN(4)=+4.0*(RX)*(RY)*(1.0-RY)
      RN(5)=-1.0*(RX)*(RY)*(3.0-2.0*RX-2.0*RY)
      RN(6)=+4.0*(RX)*(1.0-RX)*(RY)
      RN(7)=-1.0*(1.0-RX)*(RY)*(1.0+2.0*RX-2.0*RY)
      RN(8)=+4.0*(1.0-RX)*(RY)*(1.0-RY)
      K1=K1+1
      K2=NPN(K1)
      XORD(K2)=0.0
      YORD(K2)=0.0
      DO 530 L=1,8
      XORD(K2)=XORD(K2)+RN(L)*XCOR(I,L)
      YORD(K2)=YORD(K2)+RN(L)*YCOR(I,L)
  530 CONTINUE
C
  540 CONTINUE
  550 CONTINUE
C
C     CALCULATION OF NP ARRAY
C
      JEND=I4
      KEND=I1
```

```
C
      DO 660 J=1,JEND
      DO 650 K=1,KEND
C
      IEL=IEL+2
      IF(I.LE.NUMLPS(1)) IELC=IELC+2
      N1=IEL-1
      N2=IEL
C
      K1=(J-1)*2*I2+(K-1)*2+1
      K2=K1+1
      K3=K1+2
      K4=K1+I2
      K5=K4+1
      K6=K4+2
      K7=K1+2*I2
      K8=K7+1
      K9=K7+2
      IF(NPPE.EQ.3) K10=(J-1)*I3+I7+K
      IF(NPPE.EQ.1) K10=(J-1)*I1+I7+K
      IF(NPPE.EQ.0) K10=0.0
      IF(I.GT.NUMLPS(1)) K10=0
      K11=K10+I1+K-1
      K12=K11+1
      K13=K11+2
      K14=K10+I3
C
      K1=NPN(K1)
      K2=NPN(K2)
      K3=NPN(K3)
      K4=NPN(K4)
      K5=NPN(K5)
      K6=NPN(K6)
      K7=NPN(K7)
      K8=NPN(K8)
      K9=NPN(K9)
      K10=NPN(K10)
      K11=NPN(K11)
      K12=NPN(K12)
      K13=NPN(K13)
      K14=NPN(K14)
C
      D1=(XORD(K9)-XORD(K1))**2+(YORD(K9)-YORD(K1))**2
      D2=(XORD(K7)-XORD(K3))**2+(YORD(K7)-YORD(K3))**2
C
      D1=D1+DFACT*D1
      DFACT=-1.0*DFACT
C
C
      IF(D2.LT.D1) GO TO 630
C
      NP(N1,1)=K1
      NP(N1,2)=K5
      NP(N1,3)=K9
      NP(N1,4)=K8
      NP(N1,5)=K7
      NP(N1,6)=K4
      NP(N1,7)=K12
      NP(N1,8)=K14
      NP(N1,9)=K11
```

```
      IF(NPPE.EQ.1) NP(N1,7)=K10
C
      NP(N2,1)=K1
      NP(N2,2)=K2
      NP(N2,3)=K3
      NP(N2,4)=K6
      NP(N2,5)=K9
      NP(N2,6)=K5
      NP(N2,7)=K10
      NP(N2,8)=K13
      NP(N2,9)=K12
C
      GO TO 650
  630 CONTINUE
C
      NP(N1,1)=K1
      NP(N1,2)=K2
      NP(N1,3)=K3
      NP(N1,4)=K5
      NP(N1,5)=K7
      NP(N1,6)=K4
      NP(N1,7)=K10
      NP(N1,8)=K12
      NP(N1,9)=K11
C
      NP(N2,1)=K3
      NP(N2,2)=K6
      NP(N2,3)=K9
      NP(N2,4)=K8
      NP(N2,5)=K7
      NP(N2,6)=K5
      NP(N2,7)=K13
      NP(N2,8)=K14
      NP(N2,9)=K12
      IF(NPPE.EQ.1) NP(N2,7)=K10
C
  650 CONTINUE
  660 CONTINUE
C
C
  720 CONTINUE
      NELMT=IEL
      NELMC=IELC
      NUMEL=NELMT
C
C     READ SINGULAR BOUNDARY CONDITIONS
C
      WRITE(6,22)
      READ(5,1) NUMBC
      WRITE(6,1)NUMBC
C
      IF(NUMBC.EQ.0) GO TO 761
      WRITE(6,25)
      DO 760 I=1,NUMBC
      READ(5,24) I1,NPBC(I1),COSXXP(I1),XBC(I1),YBC(I1),TBC(I1)
      READ(5,27) CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TQ(I1)
      WRITE(6,28) I1,NPBC(I1),COSXXP(I1),XBC(I1),YBC(I1),TBC(I1),
     1 CH(I1),CX(I1),CY(I1),TX(I1),TY(I1),TQ(I1)
  760 CONTINUE
  761 CONTINUE
```

```
C
C
      IF(NPPE.EQ.0) GO TO 781
      IF(NELMT.LE.NELMC) GO TO 781
      IBGN=NELMC+1
      JBGN=NVPE+1
      JEND=NVPE+NPPE
      DO 780 I=IBGN,NELMT
      DO 780 J=JBGN,JEND
      NP(I,J)=0
  780 CONTINUE
  781 CONTINUE
C
      CALL MSHADJ
C
C
C     OUTPUT OF DATA
C
      WRITE(6,16)
      WRITE(6,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
      WRITE(6,12)
      DO 820 I=1,NUMTP
      WRITE(6,13) I,XORD(I),YORD(I),NPBC(I),COSXXP(I),XBC(I),YBC(I),
     1 TBC(I),TX(I),TY(I),TQ(I),CH(I),CX(I),CY(I)
  820 CONTINUE
C
      WRITE(6,14)
      DO 840 I=1,NUMEL
      WRITE(6,15) I,(NP(I,J),J=1,NNPE)
  840 CONTINUE
C
      IF(IPUNCH.NE.7) GO TO 855
      WRITE(7,17) NUMNP,NUMTP,NUMVP,NUMPP,NELMC,NELMT
C
      DO 845 I=1,NUMTP
      WRITE(7,13) I,XORD(I),YORD(I)
  845 CONTINUE
      DO 850 I=1,NUMEL
      WRITE(7,15) I,(NP(I,J),J=1,NNPE)
  850 CONTINUE
  855 CONTINUE
C
      CALL MAP(XMIN,XMAX,YMIN,YMAX,0.0,1.0,0.0,1.0)
      DO 860 I=1,NUMEL
      I1=NP(I,1)
      I2=NP(I,2)
      I3=NP(I,3)
      I4=NP(I,4)
      I5=NP(I,5)
      I6=NP(I,6)
C
      CALL POINT(XORD(I1),YORD(I1))
      CALL VECTOR(XORD(I2),YORD(I2))
      CALL VECTOR(XORD(I3),YORD(I3))
      CALL VECTOR(XORD(I4),YORD(I4))
      CALL VECTOR(XORD(I5),YORD(I5))
      CALL VECTOR(XORD(I6),YORD(I6))
      CALL VECTOR(XORD(I1),YORD(I1))
  860 CONTINUE
C
```

```
      CALL FRAME
C
C
C
      GO TO 7777
C
C
C     ERROR MESSAGES
C
 7001 WRITE(6,29)
      STOP
 7002 WRITE(6,30) NUMTP,NUMVP,IDA
      STOP
 7003 WRITE(6,31) NUMNP,IDB
      STOP
 7004 WRITE(6,32) NUMVP,IDC
      STOP
 7005 WRITE(6,33) NUMPP,IDD
      STOP
 7006 WRITE(6,34) NELMT,IDF
      STOP
 7007 WRITE(6,35) NELMC,IDG
      STOP
C
C
C     FORMAT STATEMENTS
C
C
    1 FORMAT(8I10)
    2 FORMAT(20H0NUMLPS(1) NUMLPS(2)    )
    3 FORMAT(7E10.3)
    4 FORMAT(40H0     XMIN       XMAX       YMIN       YMAX      )
    5 FORMAT(//,12H LOOP NUMBER  ,   I5)
    6 FORMAT(2I10)
    7 FORMAT(20H0NDIV(I,1) NDIV(I,2)  )
    8 FORMAT(20H0  JOIN(I,J,K) ARRAY    )
    9 FORMAT(4(I7,I3))
   10 FORMAT(20H0     XCOR       YCOR    )
   11 FORMAT(2E10.3)
   12 FORMAT(127H0  NP       XORD       YORD NPBC COSXXP        XBC        Y
     1BC        TBC         TX         TY         TQ         CH         CX
     1     CY      )
   13 FORMAT(I5,2E10.3,I5,F7.4,9E10.3)
   14 FORMAT(40H0  ELEM                                NP             )
   15 FORMAT(10I7)
   16 FORMAT(60H0    NUMNP      NUMTP      NUMVP      NUMPP      NELMC      N
     1ELMT   )
   17 FORMAT(8I10)
   18 FORMAT(10H0   IPUNCH      )
   19 FORMAT(I10)
   20 FORMAT(10H0     NPPE )
   21 FORMAT(I10)
   22 FORMAT(10H0    NUMBC)
   23 FORMAT(123H0      SIDE         BC     COSXXP        XBC        YBC
     1  TBC   /         CH         CX         CY         TX         TY
     1TQ         )
   24 FORMAT(2I10,F10.4,5E10.3)
   25 FORMAT(123H0        NP       NPBC     COSXXP        XBC        YBC
     1  TBC   /         CH         CX         CY         TX         TY
     1TQ         )
```

```
   26 FORMAT(110H0**********************************************************
     1********************************** DATA FROM MESH  )
   27 FORMAT(6E10.3)
   28 FORMAT(2I10,F10.4,3E10.3, 3H  / ,6E10.3   )
   29 FORMAT(35H0 NPPE MUST EQUAL EITHER 0, 1, OR 3 )
   30 FORMAT(8H0 NUMVP=,I4,10H,OR NUMTP=,I4,21H IS GREATER THAN IDA,
     1 ,I4)
   31 FORMAT(14H0 NUMNP EQUALS,I5,28H, WHICH IS GREATER THAN IDB=,I5)
   32 FORMAT(14H0 NUMVP EQUALS,I5,28H, WHICH IS GREATER THAN IDC=,I5)
   33 FORMAT(14H0 NUMPP EQUALS,I5,28H, WHICH IS GREATER THAN IDD=,I5)
   34 FORMAT(14H0 NELMT EQUALS,I5,28H, WHICH IS GREATER THAN IDF=,I5)
   35 FORMAT(14H0 NELMC EQUALS,I5,28H, WHICH IS GREATER THAN IDG=,I5)
C
 7777 CONTINUE
      END
```

```
      OVERLAY(FLOW,3,0)
      PROGRAM WAVE
C
      COMMON/C1/
     1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
     2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TH($AA$),
     3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
      COMMON/C3/
     1 IELE($II$),NPR($BB$),LIST($JJ$),MOVE($JJ$),INTO($JJ$),
     2 IDIAG(2,$JJ$)
C
      COMMON/C4/
     1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
     2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
      COMMON/C5/
     1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
      DIMENSION
     1 IORDER(2,$FF$),LSTOP($JJ$),LSTIC($JJ$),LSTOLD($JJ$),
     2 NPIX($BB$),MSHCD(2)
C
      NTPE=6
      NVPE=6
C
C
C
      WRITE(6,20)
C
      REWIND 1
      REWIND 3
C
      WRITE(6,19)
      READ(5,4) MSHCD(1),MSHCD(2)
      WRITE(6,4)MSHCD(1),MSHCD(2)
C
      DO 1000 I0=1,2
C
      IF(MSHCD(I0).EQ.0) GO TO 1000
C
      WRITE(6,27) I0
      NNPE=NVPE+NPPE
      NUMNP=NUMVP+NUMPP
      NUMEL=NELMC
      IF(I0.EQ.1) GO TO 120
      NUMNP=NUMTP
      NUMEL=NELMT
      NNPE=NTPE
  120 CONTINUE
C
C     FORMULATE NPIX ARRAY AND INITIALIZE NPR ARRAY
C
      DO 130 I=1,NUMNP
      NPIX(I)=0
      NPR(I)=0
  130 CONTINUE
```

```
C
      DO 135 I=1,NUMEL
      DO 135 J=1,NNPE
      J1=NP(I,J)
      NPIX(J1)=NPIX(J1)+1
  135 CONTINUE
C
      IF(NUMNP.EQ.NUMVP) GO TO 138
      IF(IO.EQ.2) GO TO 138
C
      IBGN=NUMVP+1
      DO 137 I=IBGN,NUMNP
      NPIX(I)=NVPE*NPIX(I)
  137 CONTINUE
  138 CONTINUE
C
      WRITE(6,15)
      READ(5,4) MAXVOL,IBMIN
      WRITE(6,4)MAXVOL,IBMIN
C
      DO 140 I=1,NUMEL
      IORDER(IO,I)=I
  140 CONTINUE
C
C
      WRITE(6,10)
      READ(5,4) IREAD
      WRITE(6,4)IREAD
C
      IF(IREAD.NE.5) GO TO 150
C
      READ(5,11) (IORDER(IO,I),I=1,NUMEL)
  150 CONTINUE
      WRITE(6,12)
      WRITE(6,11)(IORDER(IO,I),I=1,NUMEL)
C
C
C
C     CHECK TO SEE IF ALL ELEMENTS ARE ACCOUNTED FOR
C       (TEMPORARY USE OF NPR ARRAY )
C
C
      DO 160 I=1,NUMEL
      NPR(I)=1
  160 CONTINUE
C
      DO 165 I=1,NUMEL
      I1=IORDER(IO,I)
      NPR(I1)=NPR(I1)-1
  165 CONTINUE
C
      DO 170 I=1,NUMEL
      IF(NPR(I1).NE.0) GO TO 7004
  170 CONTINUE
C
C
C     FORMULATE TAPE SEGMENTS
C
C
C     INITIALIZE
```

```
C
      DO 230 I=1,IDJ
      LIST(I)=0
      LSTCP(I)=0
      LSTIC(I)=0
  230 CONTINUE
C
      DO 231 I=1,IDI
      IELE(I)=0
  231 CONTINUE
C
C
      NUMSEG(IO)=0
      IBMIO=IBMIN
      NQMIO=0
      LSTICX=0
      LSTCPX=0
      IBOLD=0
      IELEX=0
      IEMPT=0
C
C
C
C
C
C
      WRITE(6,9)
C
      DO 900 I=1,NUMEL
C
      I1=IORDER(IO,I)
      IELEX=IELEX+1
      IELE(IELEX)=I1
C
C     PLACE NEW NODAL POINTS IN LSTIN
C
      DO 330 J=1,NNPE
      J1=NP(I1,J)
      IF(J1.GT.NUMVP.AND.IO.EQ.1) GO TO 320
      NPIX(J1)=NPIX(J1)-1
  320 CONTINUE
      KEND=LSTICX
      IF(KEND.EQ.0) GO TO 326
C
      DO 325 K=1,KEND
      IF(J1.EQ.LSTIC(K)) GO TO 330
  325 CONTINUE
  326 CONTINUE
      LSTICX=LSTICX+1
      LSTIC(LSTICX)=J1
  330 CONTINUE
C
C
C     TRANSFER COMPLETED N.P. TO LSTCP
C
C
  335 CONTINUE
      IPCHK=0
C
      JEND=LSTICX
```

```
      DO 360 J=1,JEND
  340 CONTINUE
      J1=LSTIC(J)
      IF(J1.EQ.0) GO TO 360
      IF(NPIX(J1).GT.0) GO TO 360
C
      IF(IO.EQ.2) GO TO 348
      IF(NUMVP.EQ.NUMNP) GO TO 348
      IF(J1.GT.NUMVP) GO TO 348
C
      DO 345 K=1,I
      K1=IORDER(I,K)
      DO 345 L=1,NVPE
      L1=NP(K1,L)
      IF(L1.NE.J1) GO TO 345
      MBGN=NVPE+1
      DO 343 M=MBGN,NNPE
      M1=NP(K1,M)
      NPIX(M1)=NPIX(M1)-1
  343 CONTINUE
  345 CONTINUE
C
C
      IPCHK=1
C
  348 CONTINUE
C
      LSTCPX=LSTCPX+1
      LSTCP(LSTCPX)=J1
C
      DO 350 K=J,LSTICX
      LSTIC(K)=LSTIC(K+1)
  350 CONTINUE
      LSTICX=LSTICX-1
      GO TO 340
  360 CONTINUE
C
      IF(IPCHK.EQ.1) GO TO 335
C
C
C
C     CALCULATE NPR ARRAY
C
      DO 375 J=1,NUMNP
      IF(NPR(J).EQ.-1) GO TO 375
      NPR(J)=0
  375 CONTINUE
C
      DO 385 J=1,LSTCPX
      J1=LSTCP(J)
      NPR(J1)=J
  385 CONTINUE
C
      IF(LSTICX.EQ.0) GO TO 388
      DO 387 J=1,LSTICX
      J1=LSTIC(J)
      NPR(J1)=J+LSTCPX
  387 CONTINUE
  388 CONTINUE
C
```

```
C     CALCULATE CURRENT IB
C
      IB=0
C
      DO 430 J=1,NUMEL
      DO 420 K=1,NNPE
      K1=NP(J,K)
      K2=NPR(K1)
      IF(K2.LE.0) GO TO 420
C
      DO 410 L=1,NNPE
      L1=NP(J,L)
      L2=NPR(L1)
      IF(L2.EQ.0) GO TO 410
      L2=IABS(L2)
      IBCHK=IABS(K2-L2)+1
      IF(IBCHK.GT.IB) IB=IBCHK
  410 CONTINUE
  420 CONTINUE
  430 CONTINUE
C
C
      IF(IB.GT.IBMIO) IBMIO=IB
      LISTX=LSTCPX+LSTICX
      IF(LISTX.GT.NQMIO) NQMIO=LISTX
C
C     ESTIMATE STORAGE REQIREMENTS FOR AN ADDITIONAL ELEMENT
C
      IF(I.EQ.NUMEL) GO TO 499
C
      IBCHK=IB+(NNPE-3)
      NQCHK=LISTX+(NNPE-3)
C
      IF(IBCHK.LT.IBMIO.AND.NQCHK.LT.NQMIO) GO TO 900
C
      IF(NQCHK.LT.NQMIO) NQCHK=NQMIO
      IF(IBCHK.LT.IBMIO) IBCHK=IBMIO
C
      KCHK=(NQCHK-IBCHK)*IBCHK+((IBCHK**2-IBCHK)/2)+IBCHK
      IF(KCHK.LT.MAXVOL) GO TO 900
C
C
  499 CONTINUE
C
C     PLACE ON TAPE AND PREPARE FOR NEW SEGMENT
C
C     CALCULATE KVOL FOR CURRENT SEGMENT
C
      KVOL=(LISTX-IB)*IB+((IB**2-IB)/2) +IB
      KMIO=(NQMIO-IBMIO)*IBMIO+((IBMIO**2-IBMIO)/2)+IBMIO
C
      NUMSEG(IO)=NUMSEG(IO)+1
C
C
C     FORMULATE LIST
C
      DO 510 J=1,LSTCPX
      LIST(J)=LSTCP(J)
```

```
  510 CONTINUE
C
      DO 515 J=1,LSTICX
      J1=LSTCPX+J
      LIST(J1)=LSTIC(J)
  515 CONTINUE
C
      ICOMP=LSTCPX
C
C
C     FORMULATE MOVE AND INTO ARRAYS
C
      DO 530 J=1,IDJ
      MOVE(J)=0
      INTO(J)=0
  530 CONTINUE
C
      MOVEX=0
C
C
      IF(NUMSEG(IO).LE.1) GO TO 680
C
      JEND=LSTOLX
      IF(JEND.LT.LISTX) JEND=LISTX
C
      DO 650 J=1,JEND
      J1=J
C
  620 CONTINUE
      J2=LSTOLD(J1)
      J3=LIST(J1)
      IF(J2.NE.0) GO TO 640
      IF(J3.EQ.0) GO TO 650
C
      DO 630 K=1,JEND
      K1=K
      K2=LSTOLD(K1)
      IF(K2.NE.J3) GO TO 630
      MOVEX=MOVEX+1
      MOVE(MOVEX)=K1
      INTO(MOVEX)=J1
      LSTOLD(J1)=J3
      LSTOLD(K1)=0
      IF(K1.GT.J) GO TO 650
      J1=K1
      GO TO 620
  630 CONTINUE
C
      IF(J1.LE.J) LSTOLD(J1)=LIST(J1)
      GO TO 650
  640 CONTINUE
      IF(J2.NE.J3) GO TO 650
      MOVEX=MOVEX+1
      MOVE(MOVEX)=J1
      INTO(MOVEX)=J1
  650 CONTINUE
C
C
C     HAS MOVE BEEN SUCCESFUL
C
```

```
C
      ICHK=0
      DO 670 J=1,JEND
      IF(LSTOLD(J).NE.LIST(J)) ICHK=+1
  670 CONTINUE
C
      IF(ICHK.NE.0) GO TO 7003
C
C
C
      KMIO=(NQMIO-IBMIO)*IBMIO+((IBMIO**2-IBMIO)/2)+IBMIO
C
C
C
  880 CONTINUE
C
C
      NSEG=NUMSEG(IO)
C
C
      IF(ICOMP.LT.1) GO TO 7001
C
      WRITE(6,8) NSEG,KVOL
      WRITE(6,2) NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
      WRITE(6,2) (IELE(J),J=1,IELEX)
      WRITE(6,2) (LIST(J),J=1,LISTX)
C     WRITE(6,2) (NPR(J),J=1,NUMNP)       ********  SUPRESSED ***********
      WRITE(6,2) (MOVE(J),J=1,MOVEX)
      WRITE(6,2) (INTO(J),J=1,MOVEX)
      IF(IO.EQ.1) WRITE(1)
     1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      IF(IO.EQ.2) WRITE(3)
     1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      IF(LISTX.GT.IDJ) GO TO 7005
      IF(IELEX.GT.IDI) GO TO 7005
C
C
C     INITIALIZE FOR NEXT TAPE SEGMENT
C
      IF(I.EQ.NUMEL) GO TO 900
C
C
      DO 885 J=1,ICOMP
      J1=LIST(J)
      NPR(J1)=-1
  885 CONTINUE
      DO 890 J=1,IDJ
      LSTOLD(J)=LIST(J)
      LIST(J)=0
      LSTCP(J)=0
  890 CONTINUE
C
      DO 891 J=1,IDI
      IELE(J)=0
  891 CONTINUE
C
      DO 892 J=1,ICOMP
      LSTOLD(J)=0
  892 CONTINUE
C
```

```
C
      IEMPT=ICOMP
      IELEX=0
      LSTOLX=LISTX
      LISTX=0
      LSTCPX=0
      IBOLD=IBMIO
C
C
  900 CONTINUE
C
C
C
C     CALCULATION OF IDIAG
C
C
      IF(IO.EQ.2) GO TO 930
      IDIAG(1,1)=1
      DO 920 I=2,NQMIO
      I1=NQMIO-I+2
      IF(I1.GT.IBMIO) I1=IBMIO
      IDIAG(1,I)=IDIAG(1,I-1)+I1
  920 CONTINUE
      GO TO 951
C
  930 CONTINUE
      IBT=2*(IBMIO-1)+1
      IDIAG(2,1)=1
C
      DO 950 I=2,NQMIO
      I1=IBT
      IF(I.LT.IBMIO) I1=I1-(IBMIO-I)
      IF(I.GT.NQMIO-IBMIO+2) I1=I1-(IBMIO-(NQMIO-I)-2)
      IDIAG(2,I)=IDIAG(2,I-1)+I1
  950 CONTINUE
  951 CONTINUE
C
C
      WRITE(6,3)
      WRITE(6,4) KMIO,IBMIO,NQMIO,NUMSEG(IO)
      IF(KMIO.GT.MAXVOL) WRITE(6,16) KMIO,MAXVOL
C
      KMAX(IO)=KMIO
      IBMAX(IO)=IBMIO
      NQMAX(IO)=NQMIO
C
 1000 CONTINUE
      REWIND 1
      REWIND 3
      WRITE(9)XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,
     1 NPBC,NP,XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,
     2 NPPE,KMAX,IBMAX,NQMAX,NUMSEG,IDIAG,
     3 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
      GO TO 7777
C
C     ERROR MESSAGES
C
C
C
C
```

```
 7001 WRITE(6,5) NUMSEG
      WRITE(6,6) (IELE(I),I=1,IELEX)
      WRITE(6,6) (LIST(I),I=1,LISTX)
      STOP
C
C
 7003 WRITE(6,1)
      WRITE(6,2)(LIST(I),I=1,LISTX)
      WRITE(6,2)(LSTOLD(I),I=1,LISTX)
      STOP
C
 7004 WRITE(6,13)
      WRITE(6,14)(IORDER(IO,I),I=1,NUMEL)
      STOP
C
 7005 WRITE(6,7) IDI,IDJ
      STOP
C
C
C
C     FORMAT STATEMENTS
C
    1 FORMAT(50H0 MOVE-INTO ROUTINE NOT VALID, LIST AND LSTOLD ARE    )
    2 FORMAT(20I5)
    3 FORMAT(40H0     KMAX     IBMAX     NQMAX    NUMSEG )
    4 FORMAT(4I10)
    5 FORMAT(45H0  ERROR -- FIRST NODAL POINT IN TAPE SEGMENT   ,I5,
     1 36HIS NOT COMPLETED,  IELE AND LIST ARE     )
    6 FORMAT(20I5)
    7 FORMAT(67H0 IELEX OR LISTX IS GREATER THAN DIMENSION IDI OR IDJ WH
     1ICH EQUAL,  ,I5, 4H AND, I5)
    8 FORMAT(14H0 TAPE SEGMENT  ,I4, 17H    KVOL EQUALS  ,I6)
    9 FORMAT(39H0 NSEG IB LISTX ICOMP IELEX MOVEX IEMPT ,/,
     1 40H  IELE(I) LIST(I) NPR(I) MOVE(I) INTO(I)     )
   10 FORMAT(10H0    IREAD  )
   11 FORMAT(10I5)
   12 FORMAT(12H0  IORDER(I)  )
   13 FORMAT(34H0 ERROR IN IORDER ARRAY, IORDER IS   )
   14 FORMAT(20I5)
   15 FORMAT(20H0   MAXVOL     IBMIN )
   16 FORMAT(19H0 NOTE, KMAX EQUALS, I6, 28H WHICH EXCEEDS THE MAXVOL OF
     1, I6)
   19 FORMAT(20H0 MSHCD(1)  MSHCD(2)  )
   20 FORMAT(110H0**********************************************************
     1********************************** DATA FROM WAVE   )
   27 FORMAT(81H0**********************************************************
     1********** DATA FOR MESH,  I3)
 7777 CONTINUE
      END
```

```
      OVERLAY(FLOW,4,0)
      PROGRAM COUPLE
C
C
C
      COMMON/C1/
     1 XORD($AA$),YORD($AA$),XBC($CC$),YBC($CC$),TBC($AA$),
     2 CX($CC$),CY($CC$),CH($AA$),TX($CC$),TY($CC$),TQ($AA$),
     3 COSXXP($CC$),NPBC($AA$),NP($FF$,$EE$)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
      COMMON/C3/
     1 IELE($II$),NPR($BB$),LIST($JJ$),MOVE($JJ$),INTO($JJ$),
     2 IDIAG(2,$JJ$)
C
      COMMON/C4/
     1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
     2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
      COMMON/C5/
     1 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
      COMMON/C6/
     1 SF(7,6,7),WT(2,7),NUMQPT(2),ISTRES(3)
C
      COMMON/C7/
     1 SKXX($LL$),SKXY($LL$),SKYX($LL$),SKYY($LL$)
C
      COMMON/C8/
     1 TIME,DTIME,DTMAX,DUMAX,
     1 DELU,DELF,DELT,DELQ,
     1 ITERC,ITERT,
     1 DFCONV,DUCONV,DTCONV,DQCONV,
     1 VECTL,CTEMP,
     1 THETA,ALPHAT,TRANS,
     1 INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
     1 INCLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
     1 LCU,LTU,
     1 MNI,ITMAXC,ITMAXT,
     1 INCR,ITV,MOP,INTEMP,LAGEUL,IRZ
C
      COMMON/C9/
     1  UX($CC$), UY($CC$), UT($CC$),
     2 PX($DD$),PY($DD$),IPQ($DD$,2),
     3 FTX($CC$),FTY($CC$),FTQ($AA$),
     4 SIGII($GG$),SIGXX($GG$,3),SIGYY($GG$,3),SIGXY($GG$,3),
     5 SIGTH($GG$,3),MAT($FF$)
C
      DIMENSION
     1 RHS1($BB$),RHS2($BB$)
C
C
C
C
      REWIND 9
      READ(9) XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,
     1 NPBC,NP,XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,
     2 NPPE,KMAX,IBMAX,NQMAX,NUMSEG,IDIAG,
```

```
    3 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP
C
      NTPE=6
      NVPE=6
C
      WRITE(6,5)
C
C     INPUT DATA AND INITIALIZATION
C
C
C
C     READ MATERIAL DATA
      NUMNP=NUMVP+NUMPP
      IF(NUMTP.GT.NUMNP) NUMNP=NUMTP
      NUMEL=NELMT
C
C
      WRITE(6,11)
      READ(5,12) NUMAT
      WRITE(6,12)NUMAT
      DO 150 I=1,NUMEL
      MAT(I)=1
  150 CONTINUE
C
      IF(NUMAT.EQ.1) GO TO 160
      WRITE(6,27)
      READ(5,22) (MAT(I),I=1,NUMEL)
      WRITE(6,22)(MAT(I),I=1,NUMEL)
  160 CONTINUE
C
C
C
C     READ RUN DATA
C
      WRITE(6,15)
      READ(5,16) INCPR,INCPU,INCPL
      WRITE(6,16)INCPR,INCPU,INCPL
C
      WRITE(6,17)
      READ(5,18) INTPR,INTPU,INTPL
      WRITE(6,18)INTPR,INTPU,INTPL
C
      WRITE(6,23)
      READ(5,24) ITV,MOP,TRANS,THETA,INTEMP,LAGEUL,IRZ
      WRITE(6,24)ITV,MOP,TRANS,THETA,INTEMP,LAGEUL,IRZ
C
      WRITE(6,25)
      READ(5,26) TIMEM,MNI,DUMAX,DTMAX
      WRITE(6,26)TIMEM,MNI,DUMAX,DTMAX
C
      WRITE(6,7)
       READ(5,4) ITMAXC,ITMAXT
      WRITE(6,4) ITMAXC,ITMAXT
C
      WRITE(6,2)
      READ(5,1) VECTL,CTEMP
      WRITE(6,1)VECTL,CTEMP
C
      WRITE(6,28)
      READ(5,29) INTLCU(1),INTLCU(2),INTLTU(1),INTLTU(2),LCU,LTU
```

```
      WRITE(6,29)INTLCU(1),INTLCU(2),INTLTU(1),INTLTU(2),LCU,LTU
C
C
      WRITE(6,30)
      READ(5,31) DFCONV,DQCONV,DUCONV,DTCONV
      WRITE(6,31)DFCONV,DQCONV,DUCONV,DTCONV
C
C
C
C
      REWIND 1
      REWIND 2
      REWIND 3
      REWIND 4
C
C
C     PROGRAM INITIALIZATION
C
C
      CALL SHAFAC
     1 (NPPE)
C
      IF(NUMPP.EQ.0) GO TO 171
C
      DO 170 I=1,NUMPP
      PX(I)=0.0
      PY(I)=0.0
  170 CONTINUE
  171 CONTINUE
C
      DELU=0.0
      DELF=0.0
      DELT=0.0
      DELQ=0.0
      INCLTU(1)=INTLTU(1)
      INCLCU(1)=INTLCU(1)
C
      DO 175 I=1,NELMC
      DO 175 J=1,3
      SIGXX(I,J)=0.0
      SIGYY(I,J)=0.0
      SIGXY(I,J)=0.0
      SIGTH(I,J)=0.0
  175 CONTINUE
C
C
      DO 180 I=1,NUMNP
      UX(I)=0.0
      UY(I)=0.0
      UT(I)=0.0
  180 CONTINUE
C
C
      WRITE(6,3)
      READ(5,4) NPTS,NSEC
      WRITE(6,4)NPTS,NSEC
C
      IF(NPTS.EQ.0) GO TO 183
      WRITE(6,36)
      DO 182 I=1,NPTS
```

```
      READ(5,35) I1,XORD(I1),YORD(I1),UX(I1),UY(I1),UT(I1)
      WRITE(6,35)I1,XORD(I1),YORD(I1),UX(I1),UY(I1),UT(I1)
  182 CONTINUE
  183 CONTINUE
C
      IF(NSEC.EQ.0) GO TO 186
      WRITE(6,8)
      DO 185 I=1,NSEC
      READ(5,9) JBGN,JEND,INCR,TEMPO,UXO,UYO
      WRITE(6,9)JBGN,JEND,INCR,TEMPO,UXO,UYO
C
      DO 185 J=JBGN,JEND,INCR
      UT(J)=TEMPO
      UX(J)=UXO
      UY(J)=UYO
  185 CONTINUE
C
  186 CONTINUE
C
      CALL BNDRY
C
  190 CONTINUE
C
C
      WRITE(6,6)
C
      TIME=0.0
      INCR=0
      DTIME=DTMAX
C
C
  200 CONTINUE
C
C
C     BEGIN NEW INCREMENT
C
C
C
C
      IF(ITV.GT.0) CALL CREEP
     1 (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
     2 IELE,NPR,LIST,MOVE,INTO,IDIAG,
     3 SKXX,SKXY,SKYX,SKYY,
     4 UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
     5 RHS1,RHS2,MAT,
     6 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
      IF(ITV.GT.0) ITV=ITV*MOP
C
      IF(ITV.LT.0) CALL TEMP
     1 (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
     2 IELE,NPR,LIST,MOVE,INTO,IDIAG,
     3 SKXX,SKXY,SKYX,SKYY,
     4 UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
     5 RHS1,RHS2,MAT,
     6 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
      IF(ITV.LT.0) ITV=ITV*MOP
C
      IF(INTEMP.NE.1) GO TO 350
      INTEMP=0
      WRITE(6,33)
```

```
      WRITE(6,1) (UT(I),I=1,NUMTP)
      GO TO 200
  350 CONTINUE
C
      INCR=INCR+1
      LCU=0
      LTU=0
      IF(INCLCU(1).GT.INCR) GO TO 370
      LCU=1
      INCLCU(1)=INCLCU(1)+INTLCU(1)
  370 CONTINUE
C
      IF(INCLTU(1).GT.INCR) GO TO 375
      LTU=1
      INCLTU(1)=INCLTU(1)+INTLTU(1)
  375 CONTINUE
      IF(TRANS.EQ.1) GO TO 420
      IF(DELT.LE.DTCONV) MNI=INCR
      GO TO 450
  420 CONTINUE
      TIME=TIME+DTIME
      IF(TIME.GE.TIMEM) MNI=INCR
      IF(LAGEL.EQ.0) GO TO 450
      DO 440 I=1,NUMNP
      YORD(I)=YORD(I)+UY(I)*DTIME
      IF(IRZ.EQ.1.AND.XORD(I).EQ.0.0) GO TO 440
      XORD(I)=XORD(I)+UX(I)*DTIME
  440 CONTINUE
  450 CONTINUE
C
      IF(INCR.LT.MNI) GO TO 460
C
      INCPU=INCR
      INCPL=INCR
      INCPR=INCR
  460 CONTINUE
C
      CALL PPP
     1 (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
     2 UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,MAT,
     3 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
      IF(INCR.GE.MNI) STOP
C
      IF(TRANS.EQ.0) GO TO 200
C
C
C     CALCULATE NEXT DTIME
C
      DTIME=DTMAX
      GO TO 200
C
C
C
C
C     FORMAT STATEMENTS
C
    1 FORMAT(10E10.3)
    2 FORMAT(20H0    VECTL      CTEMP  )
    3 FORMAT(20H0     NPTS       NSEC   )
```

```
    4 FORMAT(8I10)
    5 FORMAT(110H0**********************************************************
     1********************************** DATA FROM COUPLE     )
    6 FORMAT(110H0**********************************************************
     1********************************** OUTPUT DATA    )
    7 FORMAT(20H0    ITMAXC     ITMAXT  )
    8 FORMAT(60H0      JBGN       JEND       INCR      TEMPO        UX0
     1 UY0     )
    9 FORMAT(3I10,3E10.3)
   11 FORMAT(10H0     NUMAT)
   12 FORMAT(I10)
   14 FORMAT(4E10.3)
   15 FORMAT(30H0     INCPR      INCPU      INCPL )
   16 FORMAT(3I10)
   17 FORMAT(30H0     INTPR      INTPU      INTPL)
   18 FORMAT(3I10)
   22 FORMAT(20I4)
   23 FORMAT(70H0       ITV        MOP      TRANS      THETA     INTEMP     LA
     1GUEL        IRZ    )
   24 FORMAT(2I10,2F10.3,3I10)
   25 FORMAT(40H0     TIMEM        MNI      DUMAX      DTMAX )
   26 FORMAT(E10.3,I10,2E10.3)
   27 FORMAT(12H0 MAT ARRAY    )
   28 FORMAT(60H0INTLCU(1) INTLCU(2) INTLTU(1) INTLTU(2)        LCU
     1 LTU   )
   29 FORMAT(7I10)
   30 FORMAT(40H0    DFCONV     DQCONV     DUCONV     DTCONV   )
   31 FORMAT(7E10.3)
   33 FORMAT(26H0 INITIALIZED TEMPERATURES    )
   35 FORMAT(I5,2E10.3,3E18.10)
   36 FORMAT(20H0 INITIALIZED VALUES ,/, 79H    NP       XORD       YORD
     1              UX                 UY                 UT     )
C
C
      END
```

```
      SUBROUTINE CREEP
     1 (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
     2 IELE,NPR,LIST,MOVE,INTO,IDIAG,
     3 SKXX,SKXY,SKYX,SKYY,
     4 UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
     5 FX,FY,MAT,
     6 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
C
C
C
      DIMENSION
     1 XORD(IDA),YORD(IDA),XBC(IDC),YBC(IDC),TBC(IDA),
     2 CX(IDC),CY(IDC),CH(IDA),TX(IDC),TY(IDC),TQ(IDA),
     3 COSXXP(IDC),NPBC(IDA),NP(IDF,IDE)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPE
C
      DIMENSION
     1 IELE(IDI),NPR(IDJ),LIST(IDJ),MOVE(IDJ),INTO(IDJ),IDIAG(2,IDJ)
C
      COMMON/C4/
     1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
     2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
      COMMON/C6/
     1 SF(7,6,7),WT(2,7),NUMQPT(2),ISTRES(3)
C
      DIMENSION
     1 SKXX(IDL),SKXY(IDL),SKYX(IDL),SKYY(IDL)
C
      COMMON/C8/
     1 TIME,DTIME,DTMAX,DUMAX,
     1 DELU,DELF,DELT,DELQ,
     1 ITERC,ITERT,
     1 DFCONV,DUCONV,DTCONV,DQCONV,
     1 VECTL,CTEMP,
     1 THETA,ALPHAT,TRANS,
     1 INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
     1 INCLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
     1 LCU,LTU,
     1 MNI,ITMAXC,ITMAXT,
     1 INCR,ITV,MOP,INTEMP,LAGEUL,IRZ
C
      DIMENSION
     1 UX(IDC),UY(IDC),UT(IDA),
     2 PX(IDD),PY(IDD),IPQ(IDD,2),
     3 FTX(IDC),FTY(IDC),FTQ(IDA),
     4 SIGII(IDG),SIGXX(IDG,3),SIGYY(IDG,3),SIGXY(IDG,3),SIGTH(IDG,3),
     5 MAT(IDF)
C
C
      DIMENSION
     1 FX(IDB),FY(IDB)
C
      COMMON
     1 TXX(9,9),TXY(9,9),TYX(9,9),TYY(9,9),
     1 SXX(9,9),SXY(9,9),SYX(9,9),SYY(9,9),
     1 SPX(6,3),SPY(6,3),
```

```
     1 SIGXXJ(3),SIGYYJ(3),SIGXYJ(3),SIGTHJ(3),
     1 DNDX(3),DNDY(3),
     1 RJAC(2,2),RJACI(2,2),DNDX(6),DNDY(6)
C
C
      NVPE=6
      NTPE=6
      NUMNP=NUMVP+NUMPP
      NNPE=NVPE+NPPE
      INCLCU(2)=INTLCU(2)
      ITERC=0
C
C
      LSTP1=NDMAX(1)+1
      IDIAG(1,LSTP1)=KMAX(1)+1
  100 CONTINUE
C
      IF(LCU.EQ.1) SKBC=1.0E+20
C
C
      DO 140 I=1,NUMVP
      FX(I)=0.0
      FY(I)=0.0
      FTX(I)=0.0
      FTY(I)=0.0
  140 CONTINUE
C
      IF(NUMPP.EQ.0) GO TO 146
C
      DO 145 I=1,NUMPP
      I1=NUMVP+I
      FX(I1)=0.0
      FY(I1)=0.0
      IPD(I,1)=0
      IPD(I,2)=0
      FTX(I1)=0.0
      FTY(I1)=0.0
  145 CONTINUE
C
  146 CONTINUE
C
C
C
C
C
      IF(LCU.EQ.0) GO TO 161
      IEND=KMAX(1)
      DO 160 I=1,IEND
      SKXX(I)=0.0
      SKXY(I)=0.0
      SKYX(I)=0.0
      SKYY(I)=0.0
  160 CONTINUE
  161 CONTINUE
C
C
      REWIND 1
      REWIND 2
C
C
```

```
C     FORMATION AND DIAGONALIZATION OF K MATRIX
C
C
C
      IEND=NUMSEG(1)
      DO 499 I=1,IEND
C
C
      READ(1)
     1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      IF(LCU.EQ.0) READ(2) SKXX,SKXY,SKYX,SKYY,SKBC
C
      IF(I.NE.NSEG) GO TO 7007
C
      IF(I.GT.1.AND.LCU.EQ.1) CALL SLIDE
     1 (IELE,NPR,LIST,MOVE,INTO,IDIAG,SKXX,SKXY,SKYX,SKYY,
     2 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
C
C
      DO 370 J=1,IELEX
C
      IELEJ=IELE(J)
      MJ=MAT(IELEJ)
C
C
      DO 210 K=1,NNPE
      DO 210 L=1,NNPE
      SXX(K,L)=0.0
      SXY(K,L)=0.0
      SYX(K,L)=0.0
      SYY(K,L)=0.0
C
      TXX(K,L)=0.0
      TXY(K,L)=0.0
      TYX(K,L)=0.0
      TYY(K,L)=0.0
  210 CONTINUE
      DO 212 K=1,6
      DO 212 L=1,3
      SPX(K,L)=0.0
      SPY(K,L)=0.0
  212 CONTINUE
C
      VOL=0.0
C
C     BEGIN QUADRATURE
C
      KEND=NUMQPT(1)
      DO 260 K=1,KEND
C
      KPEN=K
      DO 215 L=1,3
  215 IF(ISTRES(L).EQ.K) KPEN=K
C
C
      XK=0.0
      YK=0.0
      TEMPK=0.0
      UXK=0.0
```

```
      UYK=0.0
      RJAC(1,1)=0.0
      RJAC(1,2)=0.0
      RJAC(2,1)=0.0
      RJAC(2,2)=0.0
C
      DO 220 L=1,6
C
      L1=NP(IELEJ,L)
      XK=XK+SF(1,L,K)*XORD(NP(IELEJ,L))
      YK=YK+SF(1,L,K)*YORD(NP(IELEJ,L))
      TEMPK=TEMPK+SF(1,L,K)*UT(L1)
      UXK=UXK+SF(1,L,K)*UX(NP(IELEJ,L))
      UYK=UYK+SF(1,L,K)*UY(NP(IELEJ,L))
C
      RJAC(1,1)=RJAC(1,1)+SF(2,L,K)*XORD(NP(IELEJ,L))
      RJAC(1,2)=RJAC(1,2)+SF(3,L,K)*XORD(NP(IELEJ,L))
      RJAC(2,1)=RJAC(2,1)+SF(2,L,K)*YORD(NP(IELEJ,L))
      RJAC(2,2)=RJAC(2,2)+SF(3,L,K)*YORD(NP(IELEJ,L))
C
  220 CONTINUE
C
      DETJ=RJAC(1,1)*RJAC(2,2)-RJAC(2,1)*RJAC(1,2)
C
      IF(DETJ.LT.0) GO TO 7002
C
      RJACI(1,1)=+RJAC(2,2)/DETJ
      RJACI(1,2)=-RJAC(1,2)/DETJ
      RJACI(2,1)=-RJAC(2,1)/DETJ
      RJACI(2,2)=+RJAC(1,1)/DETJ
C
C


      DV=DETJ
      IF(IRZ.EQ.1) DV=XK*DETJ
C
C
C
C
      DO 235 L=1,6
      DNDX(L)=RJACI(1,1)*SF(2,L,K)+RJACI(2,1)*SF(3,L,K)
      DNDY(L)=RJACI(1,2)*SF(2,L,K)+RJACI(2,2)*SF(3,L,K)
  235 CONTINUE
C
      DO 236 L=1,3
      L1=L
      L2=L+3
      DNQDX(L)=RJACI(1,1)*SF(7,L1,1)+RJACI(2,1)*SF(7,L2,1)
      DNQDY(L)=RJACI(1,2)*SF(7,L1,1)+RJACI(2,2)*SF(7,L2,1)
  236 CONTINUE
C
C
C     CALCULATION OF PLASTIC STRAINS, STRESSES AND ELASTIC FORCES
C
C
C
C
C
C     CALCULATE TOTAL STRAIN RATE AND VORTICITY
C
```

```
      EPSXX=0.0
      EPSYY=0.0
      EPSTH=0.0
      EPSXY=0.0
      OMGYX=0.0
C
      DO 240 L=1,NVPE
      L1=NP(IELEJ,L)
      EPSXX=EPSXX+DNDX(L)*UX(L1)
      EPSYY=EPSYY+DNDY(L)*UY(L1)
      EPSXY=EPSXY+(DNDX(L)*UY(L1)+DNDY(L)*UX(L1))/2.0
      OMGYX=OMGYX+(DNDY(L)*UX(L1)-DNDX(L)*UY(L1))/2.0
  240 CONTINUE
      IF(IRZ.EQ.1.AND.XK.EQ.0.0)  EPSTH=EPSXX
      IF(IRZ.EQ.1.AND.XK.NE.0.0) EPSTH=UXK/XK
      OMGXY=-OMGYX
C
      GK=G(TEMPK,MI)
      IF(GK.LT.0.0) GO TO 242
C
C     CALCULATE STRESS RATES
C
      DXXDT=0.0
      DYYDT=0.0
      DXYDT=0.0
      DTHDT=0.0
C
      DO 241 L=1,3
      DXXDT=DXXDT+DNQDX(L)*SIGXX(IELEJ,L)*UXK
     1                  +DNQDY(L)*SIGXX(IELEJ,L)*UYK
     1                     -2.0*SIGXY(IELEJ,L)*OMGYX
      DYYDT=DYYDT+DNQDX(L)*SIGYY(IELEJ,L)*UXK
     1                  +DNQDY(L)*SIGYY(IELEJ,L)*UYK
     1                     -2.0*SIGXY(IELEJ,L)*OMGXY
      DXYDT=DXYDT+DNQDX(L)*SIGXY(IELEJ,L)*UXK
     1                  +DNQDY(L)*SIGXY(IELEJ,L)*UYK
     1                     -SIGXX(IELEJ,L)*OMGXY-SIGYY(IELEJ,L)*OMGYX
      IF(IRZ.EQ.0) GO TO 241
      DTHDT=DTHDT+DNQDX(L)*SIGTH(IELEJ,L)*UXK
     1                  +DNQDY(L)*SIGTH(IELEJ,L)*UYK
  241 CONTINUE
C
C
C     CALCULATE PLASTIC STRAIN RATES
C
C
      EPSXX=EPSXX-DXXDT/(2.0*GK)
      EPSYY=EPSYY-DYYDT/(2.0*GK)
      EPSXY=EPSXY-DXYDT/(2.0*GK)
      EPSTH=EPSTH-DTHDT/(2.0*GK)
C
  242 CONTINUE
C
C     CALCULATE EPSII
C
      EPSII=(2.0/3.0)*(EPSXX**2+EPSYY**2+EPSTH**2+2.0*EPSXY**2)
      EPSII=SQRT(EPSII)
C
      CALL VISC(VS,VT,PENLTY,NPPE,EPSII,TEMPK,XK,YK,MJ)
C
```

```
C
      IF(K.EQ.1) SIGII(IELEJ)=3.0*VS*EPSII
C
C
C     CALCULATE STRESS DEVIATOR
C
C
      DO 243 L=1,3
      IF(ISTRES(L).NE.K) GO TO 243
      SIGXXJ(L)=2.0*VS*EPSXX
      SIGYYJ(L)=2.0*VS*EPSYY
      SIGXYJ(L)=2.0*VS*EPSXY
      IF(IRZ.EQ.0) GO TO 243
      SIGTHJ(L)=2.0*VS*EPSTH
  243 CONTINUE
C
      IF(DV.EQ.0.0) GO TO 260
C
C
C     CALCULATE BODY FORCES AND ELASTIC FORCES
C
      GAMXK=GAMX(TEMPK,XK,YK,MJ)
      GAMYK=GAMY(TEMPK,XK,YK,MJ)
      IF(GK.GT.0.0) RELAX=VS/GK
C
      WTDV=WT(1,K)*DV
      DO 248 L=1,NVPE
C
      L1=NP(IELEJ,L)
C
      FXL1=SF(1,L,K)*GAMXK*WTDV
      FYL1=SF(1,L,K)*GAMYK*WTDV
C
      IF(GK.LT.0.0) GO TO 246
      FXL1=FXL1+RELAX*(DNDX(L)*DXXDT+DNDY(L)*DXYDT)*WTDV
      FYL1=FYL1+RELAX*(DNDY(L)*DYYDT+DNDX(L)*DXYDT)*WTDV
      IF(IRZ.EQ.0) GO TO 246
      FXL1=FXL1+RELAX*SF(1,L,K)*DTHDT*(1.0/XK)*WTDV
  246 CONTINUE
C
      IF(COSXXP(L1).EQ.1.0) GO TO 247
      C=COSXXP(L1)
      S=SQRT(1.0-C**2)
      FXP=+C*FXL1+S*FYL1
      FYP=-S*FXL1+C*FYL1
      FXL1=FXP
      FYL1=FYP
  247 CONTINUE
      FX(L1)=FX(L1)+FXL1
      FY(L1)=FY(L1)+FYL1
      FTX(L1)=FTX(L1)-FXL1
      FTY(L1)=FTY(L1)-FYL1
  248 CONTINUE
C
C
C
C
      IST=1
      V=VS
      V2=2.0*VS
```

```
      IF(K.EQ.KPEN) V2=2.0*VS+PENLTY
      P=PENLTY
C
  250 CONTINUE
C
      DO 257 L=1,NVPE
      DO 255 M=1,NVPE
C
      XX=(DNDX(L)*V2*DNDX(M)+DNDY(L)*V*DNDY(M))*WTDV
      YY=(DNDY(L)*V2*DNDY(M)+DNDX(L)*V*DNDX(M))*WTDV
      XY=(DNDY(L)*V*DNDX(M))*WTDV
C
      IF(IRZ.EQ.1)
     1 XX=XX+SF(1,L,K)*(V2/(XK**2))*SF(1,M,K)*WTDV
C
      IF(IST.EQ.2) GO TO 252
      SXX(L,M)=SXX(L,M)+XX
      SYY(L,M)=SYY(L,M)+YY
      SXY(L,M)=SXY(L,M)+XY
      IF(LCU.EQ.0.OR.VT.NE.VS) GO TO 253
  252 CONTINUE
      TXX(L,M)=TXX(L,M)+XX
      TYY(L,M)=TYY(L,M)+YY
      TXY(L,M)=TXY(L,M)+XY
  253 CONTINUE
C
      IF(IST.EQ.2) GO TO 257
      IF(NPPE.NE.0.OR.K.NE.KPEN) GO TO 255
      XY=DNDX(L)*P*DNDY(M)*WTDV
      IF(IRZ.EQ.0) GO TO 254
C
      XX=(DNDX(L)*(P/XK)*SF(1,M,K)+SF(1,L,K)*(P/XK)*DNDX(M))*WTDV
      XY=XY+SF(1,L,K)*(P/XK)*DNDY(M)*WTDV
      SXX(L,M)=SXX(L,M)+XX
  254 CONTINUE
      SXY(L,M)=SXY(L,M)+XY
      IF(LCU.EQ.0) GO TO 255
      TXY(L,M)=TXY(L,M)+XY
      IF(IRZ.EQ.0) GO TO 255
      TXX(L,M)=TXX(L,M)+XX
C
  255 CONTINUE
C
      IF(NPPE.EQ.0) GO TO 257
      DO 256 M=1,NPPE
      SPX(L,M)=SPX(L,M)+SF(4,M,K)*DNDX(L)*WTDV
      SPY(L,M)=SPY(L,M)+SF(4,M,K)*DNDY(L)*WTDV
      IF(IRZ.EQ.1)
     1 SPX(L,M)=SPX(L,M)+(SF(4,M,K)*SF(1,L,K)/XK)*WTDV
  256 CONTINUE
C
  257 CONTINUE
C
      IF(IST.EQ.2) GO TO 258
      IF(VT.EQ.VS) GO TO 258
      IST=2
      V=VT
      V2=2.0*VT
      IF(K.EQ.KPEN) V2=2.0*VT+PENLTY
      GO TO 250
```

```
C
  258 CONTINUE
C
C
C
C
      VOL=VOL+WTDV
C
C
  260 CONTINUE
C
      DO 265 K=1,3
      SIGXX(IELEJ,K)=SIGXXJ(K)
      SIGYY(IELEJ,K)=SIGYYJ(K)
      SIGXY(IELEJ,K)=SIGXYJ(K)
      IF(IRZ.EQ.1)
     1SIGTH(IELEJ,K)=SIGTHJ(K)
  265 CONTINUE
C
C
C
C     END OF VOLUME QUADRATURE
C
C     BEGIN SURFACE QUADRATURE
C
      DO 290 K=1,3
      K1=2*K
      MIDSID=NP(IELEJ,K1)
      SUM=TX(MIDSID)+TY(MIDSID)+CX(MIDSID)+CY(MIDSID)
      IF(SUM.EQ.0.0) GO TO 290
      NBC=IABS(NPBC(MIDSID))
C
  267 IF(NBC.LT.10) GO TO 268
      NBC=NBC-10
      GO TO 267
  268 CONTINUE
C
C
C
      LEND=NUMQPT(2)
      DO 280 L=1,LEND
C
      XL=0.0
      DXDXI=0.0
      DYDXI=0.0
C
      TXL=0.0
      TYL=0.0
      VXL=0.0
      VYL=0.0
C
      CXXL=0.0
      CXYL=0.0
      CYYL=0.0
C
C
      M1=K1-2
      DO 270 M=1,3
      M1=M1+1
      IF(M1.EQ.7) M1=1
```

```
      NPM=NP(IELEJ,M1)
C
      SF6ML=SF(6,M,L)
      SF5ML=SF(5,M,L)
C
      DXDXI=DXDXI+SF6ML*XORD(NPM)
      DYDXI=DYDXI+SF6ML*YORD(NPM)
C
      XL=XL+SF5ML*XORD(NPM)
C
      C=COSXXP(NPM)
      S=SQRT(1.0-C**2)
C
      TXL=TXL+SF5ML*(C*TX(NPM)-S*TY(NPM))
      TYL=TYL+SF5ML*(S*TX(NPM)+C*TY(NPM))
      VXL=VXL+SF5ML*(C*CX(NPM)*XBC(NPM)-S*CY(NPM)*YBC(NPM))
      VYL=VYL+SF5ML*(S*CX(NPM)*XBC(NPM)+C*CY(NPM)*YBC(NPM))
      CXXL=CXXL+SF5ML*(C*CX(NPM)*C+S*CY(NPM)*S)
      CXYL=CXYL+SF5ML*(C  CX(NPM)*S-S*CY(NPM)*C)
      CYYL=CYYL+SF5ML*(S  CX(NPM)*S+C*CY(NPM)*C)
C
  270 CONTINUE
      TXL=TXL+VXL
      TYL=TYL+VYL
C
C
      DS=SQRT(DXDXI**2+DYDXI**2)
      IF(IRZ.EQ.1) DS=XL*DS
C
      M1=K1-2
      DO 280 M=1,3
      M1=M1+1
      IF(M1.EQ.7) M1=1
      NPM1=NP(IELEJ,M1)
C
      WTSFM=WT(2,L)*SF(5,M,L)
C
      C=COSXXP(NPM1)
      S=SQRT(1.0-C**2)
      FX(NPM1)=FX(NPM1)+WTSFM*(+C*TXL+S*TYL)*DS
      FY(NPM1)=FY(NPM1)+WTSFM*(-S*TXL+C*TYL)*DS
C
      TXM1=CXXL*UX(NPM1)+CXYL*UY(NPM1)
      TYM1=CXYL*UX(NPM1)+CYYL*UY(NPM1)
      FTX(NPM1)=FTX(NPM1)-WTSFM*(+C*TXM1+S*TYM1)*DS
      FTY(NPM1)=FTY(NPM1)-WTSFM*(-S*TXM1+C*TYM1)*DS
C
C
      N1=K1-2
      DO 280 N=1,3
C
      N1=N1+1
      IF(N1.EQ.7) N1=1
C
      SFNDS=SF(5,N,L)*DS
C
      SXX(M1,N1)=SXX(M1,N1)+WTSFM*CXXL*SFNDS
      SXY(M1,N1)=SXY(M1,N1)+WTSFM*CXYL*SFNDS
      SYY(M1,N1)=SYY(M1,N1)+WTSFM*CYYL*SFNDS
      IF(LCU.EQ.0) GO TO 280
```

```
      TXX(M1,N1)=TXX(M1,N1)+WTSFM*CXXL*SFNDS
      TXY(M1,N1)=TXY(M1,N1)+WTSFM*CXYL*SFNDS
      TYY(M1,N1)=TYY(M1,N1)+WTSFM*CYYL*SFNDS
C
  280 CONTINUE
  290 CONTINUE
C
C     END OF SURFACE QUADRATURE
C
C     END  OF QUADRATURE
C
C
C
C
      IF(VOL.LT.0.0) GO TO 7001
C
C
C
C
      DO 316 K=1,6
      DO 316 L=1,6
      SYX(L,K)=SXY(K,L)
      TYX(L,K)=TXY(K,L)
  316 CONTINUE
C
      IF(NPPE.EQ.0) GO TO 340
C
C
      DO 330 K=1,NPPE
      IP=NP(IELEJ,K+6)
      IP=IP-NUMVP
C
      IF(IPQ(IP,1).EQ.0) GO TO 324
      IPQ(IP,2)=IELEJ
C
      DO 322 L=1,6
      SXX(K+6,L)=0.0
      SXY(K+6,L)=0.0
      SYX(K+6,L)=SPX(L,K)
      SYY(K+6,L)=SPY(L,K)
  322 CONTINUE
C
      SXX(K+6,K+6)=0.0
      SYY(K+6,K+6)=-1.0
C
      GO TO 328
C
  324 CONTINUE
C
      IPQ(IP,1)=IELEJ
C
      DO 326 L=1,6
      SXX(K+6,L)=SPX(L,K)
      SXY(K+6,L)=SPY(L,K)
      SYY(K+6,L)=0.0
      SYX(K+6,L)=0.0
  326 CONTINUE
C
C
      SXX(K+6,K+6)=0.0
```

```
      SYY(K+6,K+6)=1.0
  328 CONTINUE
C
C
      DO 329 L=1,6
      SYY(L,K+6)=SYY(K+6,L)
      SYX(L,K+6)=SXY(K+6,L)
      SXX(L,K+6)=SXX(K+6,L)
      SXY(L,K+6)=SYX(K+6,L)
  329 CONTINUE
  330 CONTINUE
C
      DO 335 K=1,NNPE
      DO 335 L=1,NNPE
      IF(K.LT.7.AND.L.LT.7) GO TO 335
      TXX(K,L)=SXX(K,L)
      TXY(K,L)=SXY(K,L)
      TYX(K,L)=SYX(K,L)
      TYY(K,L)=SYY(K,L)
  335 CONTINUE
  340 CONTINUE
C
C
C     ROTATION OF BOUNDARY POINTS
C
      DO 348 K=1,NVPE
      C=COSXXP(NP(IELEJ,K))
      IF(C.EQ.1.0) GO TO 348
      S=SQRT(1.0-C**2)
C
C
      DO 346 L=1,NNPE
C
      XX=+C*SXX(K,L)+S*SYX(K,L)
      XY=+C*SXY(K,L)+S*SYY(K,L)
      YX=-S*SXX(K,L)+C*SYX(K,L)
      YY=-S*SXY(K,L)+C*SYY(K,L)
C
      SXX(K,L)=XX
      SXY(K,L)=XY
      SYX(K,L)=YX
      SYY(K,L)=YY
C
      XX=+SXX(L,K)*C+SXY(L,K)*S
      XY=-SXX(L,K)*S+SXY(L,K)*C
      YX=+SYX(L,K)*C+SYY(L,K)*S
      YY=-SYX(L,K)*S+SYY(L,K)*C
C
      SXX(L,K)=XX
      SXY(L,K)=XY
      SYX(L,K)=YX
      SYY(L,K)=YY
C
      IF(LCU.EQ.0) GO TO 346
C
      XX=+C*TXX(K,L)+S*TYX(K,L)
      XY=+C*TXY(K,L)+S*TYY(K,L)
      YX=-S*TXX(K,L)+C*TYX(K,L)
      YY=-S*TXY(K,L)+C*TYY(K,L)
C
```

```
      TXX(K,L)=XX
      TXY(K,L)=XY
      TYX(K,L)=YX
      TYY(K,L)=YY
C
      XX=+TXX(L,K)*C+TXY(L,K)*S
      XY=-TXX(L,K)*S+TXY(L,K)*C
      YX=+TYX(L,K)*C+TYY(L,K)*S
      YY=-TYX(L,K)*S+TYY(L,K)*C
C
      TXX(L,K)=XX
      TXY(L,K)=XY
      TYX(L,K)=YX
      TYY(L,K)=YY
C
  346 CONTINUE
C
  348 CONTINUE
  349 CONTINUE
C
C
      CALL STIFF(IELEJ,ITV)
C
C
C     SUBTRACT SK*U FROM RHS
C
      DO 359 K=1,NNPE
      NPK=NP(IELEJ,K)
      IF(K.GT.NVPE) GO TO 354
      UXK=UX(NPK)
      UYK=UY(NPK)
      C=COSXXP(NPK)
      IF(C.EQ.1.0) GO TO 350
      S=SQRT(1.0-C**2)
      UXK=+C*UX(NPK)+S*UY(NPK)
      UYK=-S*UX(NPK)+C*UY(NPK)
  350 CONTINUE
C
      NBC=IABS(NPBC(NPK))
C
  351 IF(NBC.LT.10) GO TO 352
      NBC=NBC-10
      GO TO 351
  352 CONTINUE
C
      IF(NBC.EQ.4.OR.NBC.EQ.2) UXK=XBC(NPK)
      IF(NBC.EQ.4.OR.NBC.EQ.3) UYK=YBC(NPK)
      GO TO 356
  354 CONTINUE
      NPK=NPK-NUMVP
      UXK=PX(NPK)
      UYK=PY(NPK)
  356 CONTINUE
C
      DO 358 L=1,NNPE
      IF(K.GT.NVPE.AND.L.GT.NVPE) GO TO 359
      NPL=NP(IELEJ,L)
      FXNPL=SXX(L,K)*UXK+SXY(L,K)*UYK
      FYNPL=SYX(L,K)*UXK+SYY(L,K)*UYK
      FX(NPL)=FX(NPL)-FXNPL
```

```
      FY(NPL)=FY(NPL)-FYNPL
      FTX(NPL)=FTX(NPL)+FXNPL
      FTY(NPL)=FTY(NPL)+FYNPL
  358 CONTINUE
  359 CONTINUE
C
C
C
      IF(LCU.EQ.0) GO TO 370
C
C     PLACE IN LARGE SK MATRIX
C
C
C
      DO 366 L=1,NNPE
      L1=NPR(NP(IELEJ,L))
C
      DO 364 M=1,NNPE
      M1=NPR(NP(IELEJ,M))
      IF(M1.LT.L1) GO TO 364
      M2=IDIAG(1,L1)+(M1-L1)
      IF(M2.GE.IDIAG(1,L1+1)) GO TO 7009
C
      SKXX(M2)=SKXX(M2)+TXX(L,M)
      SKXY(M2)=SKXY(M2)+TXY(L,M)
      SKYX(M2)=SKYX(M2)+TYX(L,M)
      SKYY(M2)=SKYY(M2)+TYY(L,M)
  364 CONTINUE
  366 CONTINUE
C
C
C
  370 CONTINUE
C
C     ALL ELEMENTS ACCOUNTED FOR IN CURRENT TAPE SEGMENT
C
C
C
C
C
C
C
C     FORMULATION OF BOUNDARY CONDITIONS
C
C
C
      DO 395 J=1,ICOMP
      J1=LIST(J)
      IF(J1.GT.NUMVP) GO TO 395
      J2=IDIAG(1,J)
C
      IF(CX(J1).EQ.0.0) FX(J1)=FX(J1)+XBC(J1)
      IF(CY(J1).EQ.0.0) FY(J1)=FY(J1)+YBC(J1)
      NBC=IABS(NPBC(J1))
C
  380 IF(NBC.LT.10) GO TO 381
      NBC=NBC-10
      GO TO 380
  381 CONTINUE
C
```

```
      IF(NBC.EQ.1) GO TO 395
      IF(SKBC.GT.1.0) SKBC=1.0/(SKXX(J2)*SKBC)
      IF(NBC.EQ.3) GO TO 393
      IF(LCU.EQ.0) GO TO 392
      SKXX(J2)=1.0/SKBC
  392 FX(J1)=0.0
      IF(NBC.EQ.2) GO TO 395
  393 CONTINUE
      IF(LCU.EQ.0) GO TO 394
      SKYY(J2)=1.0/SKBC
  394 FY(J1)=0.0
C
  395 CONTINUE
C
C     TRIANGULARIZATION
C
C
      DO 450 J=1,ICOMP
C
      J2=LIST(J)
      J1=IDIAG(1,J)
      IF(LCU.EQ.0) GO TO 420
      XX=SKXX(J1)
      XY=SKXY(J1)
      YY=SKYY(J1)
C
      SKA=XX*YY-XY*XY
C
      IF(SKA.EQ.0.0) GO TO 7004
C
      SKAI=1.0/SKA
      SRXX=+YY*SKAI
      SRXY=-XY*SKAI
      SRYX=+SRXY
      SRYY=+XX*SKAI
C
      SKXX(J1)=SRXX
      SKXY(J1)=SRXY
      SKYX(J1)=SRYX
      SKYY(J1)=SRYY
C
  420 CONTINUE
C
      IF(J.EQ.LISTX) GO TO 442
      KEND=LISTX-J
      IF(KEND.GT.(IB-1)) KEND=IB-1
      DO 440 K=1,KEND
      JPK=J+K
      K1=IDIAG(1,J)+K
      K2=LIST(JPK)
C
      IF(LCU.EQ.0) GO TO 435
C
      SFXX=SKXX(K1)*SRXX+SKYX(K1)*SRYX
      SFXY=SKXX(K1)*SRXY+SKYX(K1)*SRYY
      SFYX=SKXY(K1)*SRXX+SKYY(K1)*SRYX
      SFYY=SKXY(K1)*SRXY+SKYY(K1)*SRYY
C
      L1=IDIAG(1,J)+K-1
      L2=IDIAG(1,JPK)-1
```

```
C
      DO 430 L=K,KEND
C
      L1=L1+1
      L2=L2+1
C
      SKXX(L2)=SKXX(L2)-SFXX*SKXX(L1)-SFXY*SKYX(L1)
      SKXY(L2)=SKXY(L2)-SFXX*SKXY(L1)-SFXY*SKYY(L1)
      SKYX(L2)=SKYX(L2)-SFYX*SKXX(L1)-SFYY*SKYX(L1)
      SKYY(L2)=SKYY(L2)-SFYX*SKXY(L1)-SFYY*SKYY(L1)
  430 CONTINUE
C
C
      SKXX(K1)=SFXX
      SKXY(K1)=SFYX
      SKYX(K1)=SFXY
      SKYY(K1)=SFYY
C
C
C
  435 CONTINUE
C
      FX(K2)=FX(K2)-SKXX(K1)*FX(J2)-SKYX(K1)*FY(J2)
      FY(K2)=FY(K2)-SKXY(K1)*FX(J2)-SKYY(K1)*FY(J2)
C
  440 CONTINUE
  442 CONTINUE
C
C
  450 CONTINUE
      IF(LCU.EQ.0) GO TO 499
C
      WRITE(2) SKXX,SKXY,SKYX,SKYY,SKBC
C
  499 CONTINUE
C
C
C
C
C     DETERMINE DELF
C
      DELF=-1.0
      DO 610 I=1,NUMNP
      IF(IABS(NPBC(I)).NE.1) GO TO 610
      IF(ABS(FX(I)).GT.DELF) DELF=ABS(FX(I))
      IF(ABS(FY(I)).GT.DELF) DELF=ABS(FY(I))
  610 CONTINUE
C
C     BACK SUBSTITUTION
C
C
C
      IEND=NUMSEG(1)
      DO 680 I=1,IEND
C
      BACKSPACE 2
      BACKSPACE 1
      READ(1)
     1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      READ(2) SKXX,SKXY,SKYX,SKYY,SKBC
```

```
C
      DO 670 J=1,ICOMP
      J1=ICOMP+1-J
      J2=LIST(J1)
      J3=IDIAG(1,J1)
C
      FXJ2  =SKXX(J3)*FX(J2)+SKXY(J3)*FY(J2)
      FYJ2  =SKYX(J3)*FX(J2)+SKYY(J3)*FY(J2)
      FX(J2)=FXJ2
      FY(J2)=FYJ2
C
      IF(J1.EQ.LISTX) GO TO 670
C
C
      KBGN=IDIAG(1,J1)+1
      J3=LISTX-J1-1
      IF(J3.GT.IB-2) J3=IB-2
      KEND=KBGN+J3
C
      K1=J1
      DO 650 K=KBGN,KEND
      K1=K1+1
      K2=LIST(K1)
      FXJ2=FX(J2)-SKXX(K)*FX(K2)-SKXY(K)*FY(K2)
      FYJ2=FY(J2)-SKYX(K)*FX(K2)-SKYY(K)*FY(K2)
      FX(J2)=FXJ2
      FY(J2)=FYJ2
  650 CONTINUE
  670 CONTINUE
C
      BACKSPACE 2
      BACKSPACE 1
C
  680 CONTINUE
C
C     ROTATE FX AND FY VECTORS TO X-Y AXES
C
C
      DELU=0.0
      DO 715 I=1,NUMVP
      IF(COSXXP(I).EQ.1.0) GO TO 705
      C=COSXXP(I)
      S=SQRT(1.0-C**2)
      UXI=+C*UX(I)+S*UY(I)
      UYI=-S*UX(I)+C*UY(I)
      UX(I)=UXI
      UY(I)=UYI
  705 CONTINUE
      NBC=IABS(NFBC(I))
C
  712 IF(NBC.LT.10) GO TO 713
      NBC=NBC-10
      GO TO 712
  713 CONTINUE
C
      IF(NBC.EQ.4.OR.NBC.EQ.2) UX(I)=XBC(I)
      IF(NBC.EQ.4.OR.NBC.EQ.3) UY(I)=YBC(I)
      IF(ABS(FX(I)).GT.DELU) DELU=ABS(FX(I))
      IF(ABS(FY(I)).GT.DELU) DELU=ABS(FY(I))
C
```

```
      UX(I)=UX(I)+FX(I)
      UY(I)=UY(I)+FY(I)
      IF(COSXXP(I).EQ.1.0) GO TO 715
      UXI=+C*UX(I)-S*UY(I)
      UYI=+S*UX(I)+C*UY(I)
      UX(I)=UXI
      UY(I)=UYI
  715 CONTINUE
C
C
      IF(NPPE.EQ.0) GO TO 721
      DO 720 I=1,NUMPP
      I1=NUMVP+I
      PX(I)=PX(I)+FX(I1)
      PY(I)=PY(I)+FY(I1)
  720 CONTINUE
  721 CONTINUE
C
C
      CALL BNDRYC
C
C
      LCU=0
C
C     ITERATION CHECK
C
      CALL SECOND(RTM)
      ITERC=ITERC+1
      IF(ITERC.EQ.1) WRITE(6,6)
      WRITE(6,5) INCR,ITERC,DELU,DELF,RTM
      IF(ITERC.GE.ITMAXC) GO TO 7777
      IF(INCR.EQ.0.AND.ITERC.LE.2) GO TO 730
      IF(DELF.LE.DFCONV) GO TO 7777
  730 CONTINUE
C
C
      IF(ITERC.LT.INCLCU(2)) GO TO 100
      INCLCU(2)=INCLCU(2)+INTLCU(2)
      LCU=1
      GO TO 100
C
C
C
C
C
 7001 WRITE(6,1) VOL,IELEJ,I
      STOP
C
 7002 WRITE(6,2)I
      STOP
C
 7004 WRITE(6,14) I,J,J2,J1,XX,XY,YY
      STOP
 7007 WRITE(6,4) I,NSEG
      STOP
 7009 WRITE(6,3) I,J,K,L,M,IELEJ
      STOP
C
C     FORMAT STATEMENTS
C
```

```
  1 FORMAT(14H VOLUME EQUALS, E10.3,11H IN ELEMENT, I4, 13H TAPE SEGME
   1NT, I4)
  2 FORMAT(*   NEGATIVE  DETJ, TAPE SEGMENT*,I5)
  3 FORMAT(40H MISTAKE IN PLACEMENT IN LARGE SK MATRIX  ,6I5)
  4 FORMAT(14HO TAPE SEGMENT  ,I5, 14H LISTS NSEG AS   , I5)
  5 FORMAT(2I10,3E10.3)
  6 FORMAT(50HO     INCR     ITERC      DELU      DELF   CP TIME  )
 14 FORMAT(25HO SINGULARITY DURNIG LDU   , 4I6,3E15.5)
7777 CONTINUE
     RETURN
     END
```

```
      SUBROUTINE TEMP
     1 (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
     2 IELE,NPR,LIST,MOVE,INTO,IDIAG,
     3 SKTT,SKXY,SKYX,SKYY,
     4 UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,
     5 UTI,FQ,MAT,
     6 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
      DIMENSION
     1 XORD(IDA),YORD(IDA),XBC(IDC),YBC(IDC),TBC(IDA),
     2 CX(IDC),CY(IDC),CH(IDA),TX(IDC),TY(IDC),TQ(IDA),
     3 COSXXP(IDC),NPBC(IDA),NP(IDF,IDE)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,MPPE
C
      DIMENSION
     1 IELE(IDI),NPR(IDB),LIST(IDJ),MOVE(IDJ),INTO(IDJ),IDIAG(2,IDJ)
C
      COMMON/C4/
     1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
     2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
C
      COMMON/C6/
     1 SF(7,6,7),WT(2,7),NUMQPT(2),ISTRES(3)
C
      DIMENSION
     1 SKTT(IDL),SKXY(IDL),SKYX(IDL),SKYY(IDL)
C
      COMMON/C8/
     1 TIME,DTIME,DTMAX,DUMAX,
     1 DELU,DELF,DELT,DELQ,
     1 ITERC,ITERT,
     1 DFCONV,DUCONV,DTCONV,DQCONV,
     1 VECTL,CTEMP,
     1 THETA,ALPHAT,TRANS,
     1 INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
     1 INCLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
     1 LCU,LTU,
     1 MNI,ITMAXC,ITMAXT,
     1 INCR,ITV,MOP,INTEMP,LAGEUL,IRZ
C
      DIMENSION
     1 UX(IDC),UY(IDC),UT(IDA),
     2 PX(IDD),PY(IDD),IPQ(IDD,2),
     3 FTX(IDC),FTY(IDC),FTQ(IDA),
     4 SIGII(IDG),SIGXX(IDG,3),SIGYY(IDG,3),SIGXY(IDG,3),SIGTH(IDG,3),
     5 MAT(IDF)
C
      COMMON
     1 CPH(9,9),CMH(9,9),
     1 DNQDX(3),DNQDY(3),
     1 RJAC(2,2),RJACI(2,2),DNDX(6),DNDY(6)
C
C
      DIMENSION
     1 UTI(IDB),FQ(IDB)
C
C
```

```
C
C
      NVPE=6
      NTPE=6
C
C
      DO 110 I=1,NUMTP
      UTI(I)=UT(I)
  110 CONTINUE
C
      INCLTU(2)=INTLTU(2)
      IVERT=0
C
C
C     BEGIN NEW ITERATION
C
  130 CONTINUE
      DO 140 I=1,NUMTP
      FTQ(I)=0.0
      FQ(I)=0.0
  140 CONTINUE
C
      CALL BNDRYT
C
C
      IF(LTU.EQ.1) SKBC=1.0E30
C
      ST=TRANS
      IF(INTEMP.EQ.1) ST=0.0
      IF(ST.EQ.0.0) DTIME=1.0
      TH=THETA
      IF(ST.EQ.0.0)  TH=1.0
C
      IF(LTU.EQ.0) GO TO 161
C
      IEND=2*KMAX(2)-NQMAX(2)
      DO 160 I=1,IEND
      SKTT(I)=0.0
  160 CONTINUE
  161 CONTINUE
C
      REWIND 3
      REWIND 4
C
C
C
      IEND=NUMSEG(2)
C
      DO 650 I=1,IEND
C
C
      READ(3)
     1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      IF(LTU.EQ.0) READ(4) SKTT,SKXY,SKYX,SKYY,SKBC
C
      IF(I.GT.1.AND.LTU.EQ.1) CALL SLIDE
     1 (IELE,NPR,LIST,MOVE,INTO,IDIAG,SKTT,SKXY,SKYX,SKYY,
     2 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
      DO 370 J=1,IELEX
```

```
C
      IELEJ=IELE(J)
      MJ=MAT(IELEJ)
      RHOJ=RHO(MJ,IELEJ)
      CPJ=CP(MJ,IELEJ)
      RCPJ=RHOJ*CPJ
      RKXJ=RKX(MJ,IELEJ)
      RKYJ=RKY(MJ,IELEJ)
C
      DO 210 K=1,NTPE
      DO 210 L=1,NTPE
      CPH(K,L)=0.0
      CMH(K,L)=0.0
  210 CONTINUE
C
C
      VOL=0.0
C
C
C     BEGIN QUADRATURE
C
C
      KEND=NUMQPT(1)
      DO 260 K=1,KEND
C
      XK=0.0
      YK=0.0
      TEMPK=0.0
      RJAC(1,1)=0.0
      RJAC(1,2)=0.0
      RJAC(2,1)=0.0
      RJAC(2,2)=0.0
C
      DO 220 L=1,NTPE
      NPL=NP(IELEJ,L)
      XK=XK+SF(1,L,K)*XORD(NPL)
      YK=YK+SF(1,L,K)*YORD(NPL)
      TEMPK=TEMPK+SF(1,L,K)*(UT(NPL)+UTI(NPL))/2.0
      RJAC(1,1)=RJAC(1,1)+SF(2,L,K)*XORD(NPL)
      RJAC(1,2)=RJAC(1,2)+SF(3,L,K)*XORD(NPL)
      RJAC(2,1)=RJAC(2,1)+SF(2,L,K)*YORD(NPL)
      RJAC(2,2)=RJAC(2,2)+SF(3,L,K)*YORD(NPL)
  220 CONTINUE
C
      DETJ=RJAC(1,1)*RJAC(2,2)-RJAC(2,1)*RJAC(1,2)
C
      RJACI(1,1)=+RJAC(2,2)/DETJ
      RJACI(1,2)=-RJAC(1,2)/DETJ
      RJACI(2,1)=-RJAC(2,1)/DETJ
      RJACI(2,2)=+RJAC(1,1)/DETJ
C
      DV=DETJ
      IF(IRZ.EQ.1) DV=XK*DETJ
      VOL=VOL+WT(1,K)*DV
C
C
      DO 235 L=1,NTPE
      DNDX(L)=RJACI(1,1)*SF(2,L,K)+RJACI(2,1)*SF(3,L,K)
      DNDY(L)=RJACI(1,2)*SF(2,L,K)+RJACI(2,2)*SF(3,L,K)
  235 CONTINUE
```

```
C
      DO 236 L=1,3
      L1=L
      L2=L+3
      DNQDX(L)=RJACI(1,1)*SF(7,L1,1)+RJACI(2,1)*SF(7,L2,1)
      DNQDY(L)=RJACI(1,2)*SF(7,L1,1)+RJACI(2,2)*SF(7,L2,1)
  236 CONTINUE
C
C
      UXK=0.0
      UYK=0.0
      IF(INTEMP.EQ.1) GO TO 249
      IF(LAGEUL.EQ.1) GO TO 241
C
      DO 240 L=1,NTPE
      NPL=NP(IELEJ,L)
      UXK=UXK+SF(1,L,K)*UX(NPL)
      UYK=UYK+SF(1,L,K)*UY(NPL)
  240 CONTINUE
  241 CONTINUE
C
C
C     CALCULATE VISCOUS HEATING
C
      IF(MOP.EQ.1) GO TO 249
      IF(IELEJ.GT.NELMC) GO TO 249
C
      EPSXX=0.0
      EPSYY=0.0
      EPSTH=0.0
      EPSXY=0.0
      OMGYX=0.0
C
      DO 245 L=1,NVPE
      L1=NP(IELEJ,L)
      EPSXX=EPSXX+DNDX(L)*UX(L1)
      EPSYY=EPSYY+DNDY(L)*UY(L1)
      EPSXY=EPSXY+(DNDX(L)*UY(L1)+DNDY(L)*UX(L1))/2.0
      OMGYX=OMGYX+(DNDY(L)*UX(L1)-DNDX(L)*UY(L1))/2.0
  245 CONTINUE
      OMGXY=-OMGYX
C
      IF(IRZ.EQ.1.AND.XK.EQ.0.0)  EPSTH=EPSXX
      IF(IRZ.EQ.1.AND.XK.NE.0.0) EPSTH=UXK/XK
C
      GK=G(TEMPK,MI)
      IF(GK.LT.0.0) GO TO 247
C
C     CALCULATE STRESS RATES
C
      DXXDT=0.0
      DYYDT=0.0
      DXYDT=0.0
      DTHDT=0.0
C
      DO 246 L=1,3
      DXXDT=DXXDT+DNQDX(L)*SIGXX(IELEJ,L)*UXK
     1                 +DNQDY(L)*SIGXX(IELEJ,L)*UYK
     1                    -2.0*SIGXY(IELEJ,L)*OMGYX
      DYYDT=DYYDT+DNQDX(L)*SIGYY(IELEJ,L)*UXK
```

```
     1                  +DNQDY(L)*SIGYY(IELEJ,L)*UYK
     1                      -2.0*SIGXY(IELEJ,L)*OMGXY
      DXYDT=DXYDT+DNQDX(L)*SIGXY(IELEJ,L)*UXK
     1                  +DNQDY(L)*SIGXY(IELEJ,L)*UYK
     1                      -SIGXX(IELEJ,L)*OMGXY-SIGYY(IELEJ,L)*OMGYX
      IF(IRZ.EQ.0) GO TO 246
      DTHDT=DTHDT+DNQDX(L)*SIGTH(IELEJ,L)*UXK
     1                  +DNQDY(L)*SIGTH(IELEJ,L)*UYK
  246 CONTINUE
C
C     CALCULATE PLASTIC STRAIN RATES
C
C
      EPSXX=EPSXX-DXXDT/(2.0*GK)
      EPSYY=EPSYY-DYYDT/(2.0*GK)
      EPSXY=EPSXY-DXYDT/(2.0*GK)
      EPSTH=EPSTH-DTHDT/(2.0*GK)
C
  247 CONTINUE
C
C     CALCULATE EPSII
C
      EPSII=(2.0/3.0)*(EPSXX**2+EPSYY**2+EPSTH**2+2.0*EPSXY**2)
      EPSII=SQRT(EPSII)
      CALL VISC(VS,VT,PENLTY,NPPE,EPSII,TEMPK,XK,YK,MJ)
      Q=2.0*VS*(3.0/2.0)*(EPSII**2)
C
C
C
      DO 248 L=1,NVPE
      L1=NP(IELEJ,L)
      FQ(L1)=FQ(L1)+WT(1,K)*SF(1,L,K)*Q*DV*DTIME
  248 CONTINUE
C
  249 CONTINUE
C
C
      C=0.0
      DO 250 L=1,NTPE
      DO 250 M=1,NTPE
      H=WT(1,K)*(DNDX(L)*RKXJ*DNDX(M)+DNDY(L)*RKYJ*DNDY(M))*DV
      H=H+WT(1,K)*(RCPJ*(DNDX(M)*UXK+DNDY(M)*UYK))*SF(1,L,K)*DV
      IF(ST.EQ.1.0) C=WT(1,K)*(SF(1,L,K)*RCPJ*SF(1,M,K))*DV
C
C
      CPH(L,M)=CPH(L,M)+C+H*TH*DTIME
      IF(ST.EQ.0.0) GO TO 250
      CMH(L,M)=CMH(L,M) +C -H*(1.0-TH)*DTIME
C
  250 CONTINUE
C
  260 CONTINUE
C
C     END OF VOLUME QUADRATURE
C
      IF(VOL.LE.0.0) GO TO 7003
C
C     SURFACE QUADRATURE
C
      DO 290 K=1,3
```

```
      K1=2*K
      MIDSID=NP(IELEJ,K1)
      IF(CH(MIDSID).EQ.0.0.AND.TQ(MIDSID).EQ.0.0) GO TO 290
C
      LEND=NUMQPT(2)
      DO 280 L=1,LEND
      XL=0.0
      DXDXI=0.0
      DYDXI=0.0
      TQL=0.0
      CHL=CH(MIDSID)
C
      M1=K1-2
      DO 270 M=1,3
      M1=M1+1
      IF(M1.EQ.7) M1=1
      NPM=NP(IELEJ,M1)
C
      DXDXI=DXDXI+SF(6,M,L)*XORD(NPM)
      DYDXI=DYDXI+SF(6,M,L)*YORD(NPM)
      XL=XL+SF(5,M,L)*XORD(NPM)
      IF(TQ(MIDSID).NE.0.0) TQL=TQL+SF(5,M,L)*TQ(NPM)
C
  270 CONTINUE
      DS=SQRT(DXDXI**2+DYDXI**2)
      IF(IRZ.EQ.1) DS=XL*DS
C
      M1=K1-2
      DO 280 M=1,3
      M1=M1+1
      IF(M1.EQ.7) M1=1
      NPM1=NP(IELEJ,M1)
C
      FQ(NPM1)=FQ(NPM1)+WT(2,L)*SF(5,M,L)*TQL*DS*DTIME
C
      N1=K1-2
      DO 280 N=1,3
      N1=N1+1
      IF(N1.EQ.7) N1=1
      NPN1=NP(IELEJ,N1)
C
      QL=WT(2,L)*SF(5,M,L)*CHL*SF(5,N,L)*DS
      CPH(M1,N1)=CPH(M1,N1)+QL*TH*DTIME
      FQ(NPM1)=FQ(NPM1)+QL*DTIME*TBC(NPN1)
      IF(ST.EQ.0.0) GO TO 280
      CMH(M1,N1)=CMH(M1,N1)-QL*(1.0-TH)*DTIME
C
  280 CONTINUE
  290 CONTINUE
C
      IF(ST.EQ.0) GO TO 331
C
C     FORMULATION OF FQ=CMH*UT
C
C
      DO 330 K=1,NTPE
      NPK=NP(IELEJ,K)
      DO 330 L=1,NTPE
      NPL=NP(IELEJ,L)
      FQ(NPK)=FQ(NPK)+CMH(K,L)*UT(NPL)
```

```
  330 CONTINUE
  331 CONTINUE
C
      CALL STIFF(IELEJ,ITV)
C
      IF(LTU.EQ.0) GO TO 370
C
C
      CALL STIFF(IELEJ,ITV)
C
C
C     PLACE IN LARGE K-MATRIX
C
      DO 366 K=1,NTPE
      K1=NPR(NP(IELEJ,K))
      DO 366 L=1,NTPE
      L1=NPR(NP(IELEJ,L))
      L2=IDIAG(2,K1)+(L1-K1)
      SKTT(L2)=SKTT(L2)+CPH(K,L)
  366 CONTINUE
C
  370 CONTINUE
C
C
C     ALL ELEMENTS ACCOUNTED FOR IN CURRENT TAPE SEGMENT
C
C
C     FORMULATION SOURCES, SINKS AND BOUNDARY CONDITIONS
C
      DO 385 J=1,ICOMP
      J1=LIST(J)
      J2=IDIAG(2,J)
C
      IF(CH(J1).EQ.0.0)   FQ(J1)=FQ(J1)+TBC(J1)*DTIME
      IF(NPBC(J1).GT.0) GO TO 385
C
      IF(LTU.EQ.0) GO TO 384
      IF(SKBC.GT.1.0) SKBC=1.0/(SKTT(J2)*SKBC)
      SKTT(J2)=1.0/SKBC
  384 CONTINUE
      FQ(J1)=TBC(J1)/SKBC
  385 CONTINUE
C
C     L-D-U DECOMPOSITION
C
      IF(LTU.EQ.0) GO TO 499
C
      DO 450 J=1,ICOMP
      J1=LIST(J)
      J2=IDIAG(2,J)
      IF(SKTT(J2).EQ.0.0) GO TO 7001
      SRTT=1.0/SKTT(J2)
      SKTT(J2)=SRTT
C
      IF(J.EQ.LISTX) GO TO 450
C
      KEND=LISTX-J
      IF(KEND.GT.(IB-1)) KEND=IB-1
C
      DO 449 K=1,KEND
```

```
      JPK=J+K
      K1=IDIAG(2,JPK)-K
      FAC=SRTT*SKTT(K1)
      SKTT(K1)=FAC
      IF(FAC.EQ.0) GO TO 449
      L1=IDIAG(2,J)
      L2=IDIAG(2,JPK)-K
C
      DO 448 L=1,KEND
      L1=L1+1
      L2=L2+1
      SKTT(L2)=SKTT(L2)-SKTT(L1)*FAC
  448 CONTINUE
  449 CONTINUE
  450 CONTINUE
      WRITE(4) SKTT,SKXY,SKYX,SKYY,SKBC
C
  499 CONTINUE
C
C
C     FORWARD ELIMINATION
C
C
C
      DO 630 J=1,ICOMP
      J1=LIST(J)
      J2=IDIAG(2,J)
      KEND=LISTX-J
      IF(KEND.EQ.0) GO TO 630
      IF(KEND.GT.IB-1) KEND=IB-1
C
      DO 620 K=1,KEND
      JPK=J+K
      IF(JPK.GT.LISTX) GO TO 620
      K1=LIST(JPK)
      K2=IDIAG(2,JPK)-K
      FQ(K1)=FQ(K1)-SKTT(K2)*FQ(J1)
  620 CONTINUE
C
  630 CONTINUE
C
  650 CONTINUE
C
      LTU=0
C
C
C
C
C     BACK SUBSTITUTION
C
      IEND=NUMSEG(2)
      IF(IEND.EQ.0) IEND=1
      DO 690 I=1,IEND
C
      BACKSPACE 3
      BACKSPACE 4
      READ(3)
     1 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT,IELE,NPR,LIST,MOVE,INTO
      READ(4) SKTT,SKXY,SKYX,SKYY,SKBC
C
```

```
      DO 680 J=1,ICOMP
      J1=ICOMP+1-J
      J2=LIST(J1)
      FQJ2=FQ(J2)
      IF(J1.EQ.LISTX) GO TO 679
C
      KBGN=IDIAG(2,J1)+1
      J3=LISTX-J1
      IF(J3.GT.IB-1) J3=IB-1
      KEND=IDIAG(2,J1)+J3
C
      K1=J1
      DO 675 K=KBGN,KEND
      K1=K1+1
      K2=LIST(K1)
      FQJ2=FQJ2-SKTT(K)*FQ(K2)
  675 CONTINUE
C
  679 CONTINUE
      IDIAGJ=IDIAG(2,J1)
      FQ(J2)=FQJ2*SKTT(IDIAGJ)
  680 CONTINUE
C
C
C
      BACKSPACE 3
      BACKSPACE 4
  690 CONTINUE
C
C
C     CHANGE UTI ARRAY AND DETERMINE MAX DELT FOR CURRENT ITERATION
C
      DELT=0.0
      DO 708 I=1,NUMTP
      D=ABS(UTI(I)-FQ(I))
      IF(D.GT.DELT) DELT=D
      UTI(I)=FQ(I)
  708 CONTINUE
C
C
C     ITERATION CHECK
C
      CALL SECOND(RTM)
      ITERT=ITERT+1
      IF(ITERT.EQ.1) WRITE(6,6)
      WRITE(6,5) INCR,ITERT,DELT,RTM
      IF(DELT.LE.DTCONV) GO TO 850
      IF(ITERT.GE.ITMAXT) GO TO 850
      IF(ITERT.LT.INCLTU(2)) GO TO 130
      INCLTU(2)=INCLTU(2)+INTLTU(2)
      LTU=1
      GO TO 130
C
C
  850 CONTINUE
C
C
C     CHANGE UT ARRAY AND CALCULATE MAX DELT FOR CURRENT INCREMENT
C
      DELT=0.0
```

```
      DO 870 I=1,NUMTP
      D=ABS(UTI(I)-UT(I))
      IF(D.GT.DELT) DELT=D
      UT(I)=UTI(I)
  870 CONTINUE
C
C
      RETURN
C
C     ERROR MESSAGES
C
 7001 WRITE(6,1) I,J,J1,J2,SKTT(J2)
    1 FORMAT(12H1 ERROR 7001 ,4I5,E15.5)
      STOP
 7003 WRITE(6,2) J,IELEJ,VOL,(NP(IELEJ,I1),I1=1,NTPE)
      WRITE(6,3) (I1,XORD(I1),YORD(I1),I1=1,NUMTP)
    2 FORMAT(12H1 ERROR 7003,  2I5,E10.3,6I5)
    3 FORMAT(I7,2E10.3)
    5 FORMAT(2I10,2E10.3)
    6 FORMAT(40H0     INCR      ITERT       DELT    CP TIME  )
      STOP
C
C
      END
```

```
      SUBROUTINE SLIDE
     1 (IELE,NPR,LIST,MOVE,INTO,IDIAG,SKXX,SKXY,SKYX,SKYY,
     2 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
      DIMENSION
     1 IELE(IDI),NPR(IDB),LIST(IDJ),MOVE(IDJ),INTO(IDJ),IDIAG(2,IDJ)
C
      COMMON/C4/
     1 KMAX(2),IBMAX(2),NQMAX(2),NUMSEG(2),
     2 NSEG,IB,LISTX,ICOMP,IELEX,MOVEX,IEMPT
C
      DIMENSION
     1 SKXX(IDL),SKXY(IDL),SKYX(IDL),SKYY(IDL)
C
      COMMON/C8/
     1 TIME,DTIME,DTMAX,DUMAX,
     1 DELU,DELF,DELT,DELQ,
     1 ITERC,ITERT,
     1 DFCONV,DUCONV,DTCONV,DQCONV,
     1 VECTL,CTEMP,
     1 THETA,ALPHAT,TRANS,
     1 INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
     1 INCLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
     1 LCU,LTU,
     1 MNI,ITMAXC,ITMAXT,
     1 INCR,ITV,MOP,INTEMP,LAGEUL,IRZ
C
C
      IF(ITV.EQ.-1) GO TO 500
C
C
      IEND=IDIAG(1,IEMPT+1)-1
      DO 230 I=1,IEND
      SKXX(I)=0.0
      SKXY(I)=0.0
      SKYX(I)=0.0
      SKYY(I)=0.0
  230 CONTINUE
C
C
      DO 399 I=1,MOVEX
      II=INTO(I)
      IF(II.EQ.0) GO TO 400
      IM=MOVE(I)
C
      DO 350 J=I,MOVEX
      JI=INTO(J)
      IF(JI.EQ.0) GO TO 399
      JM=MOVE(J)
C
      IF(IABS(JM-IM).GT.(IB-1)) GO TO 350
C
      ITEST=+1
      IF(II.GT.JI) GO TO 250
      KI=IDIAG(1,II)+(JI-II)
      GO TO 260
  250 CONTINUE
      ITEST=-1
      KI=IDIAG(1,JI)+(II-JI)
  260 CONTINUE
```

```
C
      IF(IM.GT.JM) GO TO 270
      KM=IDIAG(1,IM)+(JM-IM)
      GO TO 280
  270 CONTINUE
      ITEST=ITEST*(-1)
      KM=IDIAG(1,JM)+(IM-JM)
  280 CONTINUE
      IF(KM.EQ.KI) GO TO 350
C
C
      SKXX(KI)=SKXX(KM)
      SKYY(KI)=SKYY(KM)
C
      IF(ITEST.LT.0) GO TO 300
      SKXY(KI)=SKXY(KM)
      SKYX(KI)=SKYX(KM)
      GO TO 340
C
  300 CONTINUE
      SKXY(KI)=SKYX(KM)
      SKYX(KI)=SKXY(KM)
  340 CONTINUE
C
      SKXX(KM)=0.0
      SKXY(KM)=0.0
      SKYY(KM)=0.0
      SKYX(KM)=0.0
  350 CONTINUE
  399 CONTINUE
  400 CONTINUE
C
      GO TO 600
C
  500 CONTINUE
C
C
C
C     NOTE, IN THIS SECTION SKXX IS EQUIVALENT TO SKTT
C
C
      IEND=IDIAG(2,IEMPT+1) -1
      DO 530 I=1,IEND
      SKXX(I)=0.0
  530 CONTINUE
C
      IBGN=IEMPT+2
      IEND=NQMAX(2)
      DO 545 I=IBGN,IEND
      JBGN=IDIAG(2,I)-I+1
      JEND=JBGN+IEMPT-1
      IF(I.GT.IBMAX(2)) JBGN=IDIAG(2,I)-IBMAX(2)+1
      IF(JBGN.GT.JEND) GO TO 546
C
      DO 540 J=JBGN,JEND
      SKXX(J)=0.0
  540 CONTINUE
  545 CONTINUE
  546 CONTINUE
C
```

```
C
C
      DO 599 I=1,MOVEX
      II=INTO(I)
      IF(II.EQ.0) GO TO 600
      IM=MOVE(I)
C
      DO 550 J=1,MOVEX
      JI=INTO(J)
      IF(JI.EQ.0) GO TO 599
      JM=MOVE(J)
      IF(IABS(JM-IM).GT.(IB-1)) GO TO 550
C
      KI=IDIAG(2,II)+(JI-II)
      KM=IDIAG(2,IM)+(JM-IM)
      IF(KM.EQ.KI) GO TO 550
      SKXX(KI)=SKXX(KM)
      SKXX(KM)=0.0
  550 CONTINUE
  599 CONTINUE
  600 CONTINUE
C
C
C
      RETURN
C
      END
```

```
      SUBROUTINE PPP
     1 (XORD,YORD,XBC,YBC,TBC,CX,CY,CH,TX,TY,TQ,COSXXP,NPBC,NP,
     2 UX,UY,UT,PX,PY,IPQ,FTX,FTY,FTQ,SIGII,SIGXX,SIGYY,SIGXY,SIGTH,MAT,
     3 IDA,IDB,IDC,IDD,IDE,IDF,IDG,IDH,IDI,IDJ,IDK,IDL,IDM,IDN,IDO,IDP)
C
C
      DIMENSION
     1 XORD(IDA),YORD(IDA),XBC(IDC),YBC(IDC),TBC(IDA),
     2 CX(IDC),CY(IDC),CH(IDA),TX(IDC),TY(IDC),TQ(IDA),
     3 COSXXP(IDC),NPBC(IDA),NP(IDF,IDE)
C
      COMMON/C2/
     1 XMIN,XMAX,YMIN,YMAX,NUMVP,NUMPP,NUMTP,NELMC,NELMT,NPPS
C
      DIMENSION
     1 UX(IDC),UY(IDC),UT(IDA),
     2 PX(IDD),PY(IDD),IPQ(IDD,2),
     3 FTX(IDC),FTY(IDC),FTQ(IDA),
     4 SIGII(IDG),SIGXX(IDG,3),SIGYY(IDG,3),SIGXY(IDG,3),SIGTH(IDG,3),
     5 MAT(IDF)
C
      COMMON/C8/
     1 TIME,DTIME,DTMAX,DUMAX,
     1 DELU,DELF,DELT,DELQ,
     1 ITERC,ITERT,
     1 DFCONV,DUCONV,DTCONV,DQCONV,
     1 VECTL,CTEMP,
     1 THETA,ALPHAT,TRANS,
     1 INCPR,INCPU,INCPL,INTPR,INTPU,INTPL,
     1 INCLCU(2),INCLTU(2),INTLCU(2),INTLTU(2),
     1 LCU,LTU,
     1 MNI,ITMAXC,ITMAXT,
     1 INCR,ITV,MOP,INTEMP,LAGEUL,IRZ
C
      DIMENSION
     1 NP3(4,4),X(2),Y(2)
C
      DATA NP3/1 ,4,2,2.3,5,4,6,4,6,6,1,2,4,2/
C
C
      IF(INCR.NE.INCPR) GO TO 200
C
C     PRINTED OUTPUT
C
      INCPR=INCPR+INTPR
C
      WRITE(6,30) TIME,INCR
C
C
      WRITE(6,2)
      WRITE(6,3)DELU,DELF,DELT,DELQ,ITERC,ITERT
C
      WRITE(6,37)TIME
      WRITE(6,1) DUMAX
C
      WRITE(6,15)
      WRITE(6,14) (I,XORD(I),YORD(I),UX(I),UY(I),UT(I),FTX(I),FTY(I),
     1 I=1,NUMTP)
      IF(ITV.EQ.-1.AND.MOP.EQ.+1) GO TO 200
      IF(NUMPP.EQ.0) GO TO 161
```

```
C
      WRITE(6,7)
      DO 160 I=1,NUMPP
      I1=NUMVP+I
      WRITE(6,8) I1,PX(I),PY(I),IPQ(I,1),IPQ(I,2)
  160 CONTINUE
  161 CONTINUE
C
      WRITE(6,4)
      WRITE(6,5) (I,SIGII(I),(SIGXX(I,J),SIGYY(I,J),SIGXY(I,J),J=1,3),
     1  I=1,NELMC)
C
  200 CONTINUE
C
C     PUNCHED OUTPUT
C
C
C
      IF(INCR.NE.INCPU.OR.INTPU.LT.0) GO TO 205
C
      INCPU=INCPU+INTPU
C
      WRITE(7,9) INCR,TIME
      NUMNP=NUMVP
      IF(NUMTP.GT.NUMVP) NUMNP=NUMTP
      WRITE(7,10)(I,XORD(I),YORD(I),UX(I),UY(I),UT(I),I=1,NUMNP)
C
  205 CONTINUE
C
C     PLOTTED OUTPUT
C
C
C
      IF(INCR.NE.INCPL.OR.INTPL.LT.0) RETURN
      CALL MAP(XMIN,XMAX,YMIN,YMAX,0.0,1.0,0.0,1.0)
C
      INCPL=INCPL+INTPL
C
C
C
C
      NUMEL=NELMC
      IF(NELMT.GT.NELMC) NUMEL=NELMT
      DO 210 I=1,NUMEL
      I1=NP(I,1)
      I2=NP(I,2)
      I3=NP(I,3)
      I4=NP(I,4)
      I5=NP(I,5)
      I6=NP(I,6)
C
      CALL POINT(XORD(I1),YORD(I1))
      CALL VECTOR(XORD(I2),YORD(I2))
      CALL VECTOR(XORD(I3),YORD(I3))
      CALL VECTOR(XORD(I4),YORD(I4))
      CALL VECTOR(XORD(I5),YORD(I5))
      CALL VECTOR(XORD(I6),YORD(I6))
      CALL VECTOR(XORD(I1),YORD(I1))
  210 CONTINUE
      CALL FRAME
  212 CONTINUE
```

```
C
C
      IF(MOP.EQ.-1) GO TO 220
      IF(ITV.EQ.-1) GO TO 480
  220 CONTINUE
C
C
C     PLOT VELOCITY FIELD
C
      VMAX=0.0
C
      DO 250 I=1,NUMVP
      IF(ABS(UX(I)).GT.VMAX) VMAX=ABS(UX(I))
      IF(ABS(UY(I)).GT.VMAX) VMAX=ABS(UY(I))
  250 CONTINUE
C
      IF(VMAX.NE.0.0) GO TO 340
      WRITE(6,6)
      GO TO 479
  340 CONTINUE
C
      DT=REJECTL/VMAX
C
C
      DO 350 I=1,NUMVP
      CALL LINE(XORD(I),YORD(I),XORD(I)+UX(I)*DT,YORD(I)+UY(I)*DT)
  350 CONTINUE
C
      CALL FRAME
C
C
  479 IF(MOP.EQ.+1) GO TO 550
  480 CONTINUE
C
C
C     PLOT ISOTHERMS
C
      DO 500 I=1,NELMT
      CMIN=UT(NP(I,1))
      CMAX=CMIN
C
      DO 420 J=2,6
C
      IF(UT(NP(I,J)).LT.CMIN) CMIN=UT(NP(I,J))
      IF(UT(NP(I,J)).GT.CMAX) CMAX=UT(NP(I,J))
  420 CONTINUE
C
C
      CHK=(CMAX-CMIN)/CTEMP
      IF(CHK.GT.200.0) GO TO 7001
C
      INT=CMIN/CTEMP
      C=INT*CTEMP
C
  430 CONTINUE
C
      DO 460 J=1,4
C
      J3=0
C
```

```
      DO 450 K=1,3
      J1=NP3(J,K)
      J2=NP3(J,K+1)
      J1=NP(I,J1)
      J2=NP(I,J2)
      SLOPE=UT(J2)-UT(J1)
      IF(SLOPE.EQ.0) GO TO 440
      PT=(C-UT(J1))/SLOPE
      IF(PT.LT.0.OR.PT.GT.1.0) GO TO 450
      GO TO 445
  440 CONTINUE
      IF(UT(J1).NE.C) GO TO 450
      PT=J3
  445 CONTINUE
      J3=J3+1
      X(J3)=XORD(J1)+PT*(XORD(J2)-XORD(J1))
      Y(J3)=YORD(J1)+PT*(YORD(J2)-YORD(J1))
      IF(J3.EQ.2) GO TO 451
  450 CONTINUE
  451 CONTINUE
C
C
      IF(J3.NE.2) GO TO 460
      CALL LINE(X(1),Y(1),X(2),Y(2))
  460 CONTINUE
C
      C=C+CTEMP
      IF(C.LE.CMAX) GO TO 430
  500 CONTINUE
C
      CALL FRAME
C
  550 CONTINUE
C
      RETURN
C
 7001 WRITE(6,11) CMAX,CMIN,CTEMP
      STOP
C
C
C
C     FORMAT STATEMENTS
C
    1 FORMAT(28H MAXIMUM DISPLACEMENT EQUALS     ,E11.4  )
    2 FORMAT(60H0      DELU       DELF       DELT       DELQ      ITERC      I
     1TERT    )
    3 FORMAT(4E10.3,2I10)
    4 FORMAT(109H0  ELEM        SIGII     SIGXX1     SIGYY1     SIGXY1     SI
     1GXX2     SIGYY2     SIGXY2     SIGXX3     SIGYY3     SIGXY3    )
    5 FORMAT(I7,E12.5,9E10.3)
    6 FORMAT(54H0 VMAX=0.0 IN PLOT ROUTINE, VELOCITY FIELD NOT PLOTTED )
    7 FORMAT(//,53H  NODAL POINT        PRS              QRS              IPQ
     1    ,/)
    8 FORMAT(I12,2E15.6,I7,I4)
    9 FORMAT(8H *******,I10,E15.5, 33H**********************************)
   10 FORMAT(I5,2E10.3,3E18.10)
   11 FORMAT(49H0 AUTO STOP,  PLOT BLOW UP, CMAX,CMIN,CTEMP EQUAL  ,
     1 3E10.3)
   14 FORMAT(I7,2E10.3,5E15.5)
   15 FORMAT(102H0  N.P.       XORD       YORD              UX
```

```
     1UY              UT              FTX              FTY  )
    30 FORMAT(1H ,////,13H TIME EQUALS   ,E15.7,/,29H NUMBER OF INCREMENT
      1S EQUALS         ,I6  )
    37 FORMAT(14HO DTIME EQUALS   ,E10.3)
C
C
      END
```

```
      SUBROUTINE SHAFAC
     1 (NPPE)
C
      COMMON/C6/
     1 SF(7,6,7),WT(2,7),NUMQPT(2),ISTRES(3)
C
      COMMON
     1 RJAC(2,2),RJACI(2,2),QPT(25,3)
C
C
C
C
C
      ISTRES(1)=5
      ISTRES(2)=6
      ISTRES(3)=7
      NUMQPT(1)=7
      NUMQPT(2)=3
C
      A1=0.059715871789770
      B1=0.470142064105115
      A2=0.797426985353087
      B2=0.101286507323456
C
      QPT(1,1)=1.0/3.0
      QPT(1,2)=1.0/3.0
      QPT(2,1)=A1
      QPT(2,2)=B1
      QPT(3,1)=B1
      QPT(3,2)=A1
      QPT(4,1)=B1
      QPT(4,2)=B1
      QPT(5,1)=B2
      QPT(5,2)=A2
      QPT(6,1)=B2
      QPT(6,2)=B2
      QPT(7,1)=A2
      QPT(7,2)=B2
C
      WT(1,1)=0.1125
      WT(1,2)=0.066197076394253
      WT(1,3)=WT(1,2)
      WT(1,4)=WT(1,2)
      WT(1,5)=0.062969590272413
      WT(1,6)=WT(1,5)
      WT(1,7)=WT(1,5)
C
C
C
      IEND=NUMQPT(1)
      DO 230 I=1,IEND
      QPT(I,3)=1.0-QPT(I,1)-QPT(I,2)
  230 CONTINUE
C
C
C
      JEND=NUMQPT(1)
      DO 350 J=1,JEND
      DO   340   I=1,6
      SF(1,I,J)=SFN(QPT(J,1),QPT(J,2),QPT(J,3),I)
```

```
      SF(2,I,J)=SFNXI(QPT(J,1),QPT(J,2),QPT(J,3),I)
      SF(3,I,J)=SFNETA(QPT(J,1),QPT(J,2),QPT(J,3),I)
  340 CONTINUE
      SF(4,1,J)=1.0
      IF(NPPE.EQ.1) GO TO 350
      DO 349 I=1,3
      SF(4,I,J)=SFNP(QPT(J,1),QPT(J,2),QPT(J,3),I)
  349 CONTINUE
  350 CONTINUE
C
C     CALCULATION SHAPE FACTOR DERIVATIVES FOR STRESS RATES
C
C
C
      I1=ISTRES(1)
      I2=ISTRES(2)
      I3=ISTRES(3)
C
      RJAC(1,1)=-QPT(I1,1)+QPT(I2,1)
      RJAC(1,2)=-QPT(I1,1)+QPT(I3,1)
      RJAC(2,1)=-QPT(I1,2)+QPT(I2,2)
      RJAC(2,2)=-QPT(I1,2)+QPT(I3,2)
C
C
      DETJ=RJAC(1,1)*RJAC(2,2)-RJAC(2,1)*RJAC(1,2)
C
      RJACI(1,1)=+RJAC(2,2)/DETJ
      RJACI(1,2)=-RJAC(1,2)/DETJ
      RJACI(2,1)=-RJAC(2,1)/DETJ
      RJACI(2,2)=+RJAC(1,1)/DETJ
C
      SF(7,1,1)=-RJACI(1,1)-RJACI(2,1)
      SF(7,2,1)=+RJACI(1,1)
      SF(7,3,1)=           +RJACI(2,1)
C
      SF(7,4,1)=-RJACI(1,2)-RJACI(2,2)
      SF(7,5,1)=+RJACI(1,2)
      SF(7,6,1)=           +RJACI(2,2)
C
C
C
C     FOR SURFACE INTEGRATION
C
      QPT(1,1)=(-SQRT(0.6)+1.0)/2.0
      QPT(1,3)=1.0-QPT(1,1)
      QPT(2,1)=0.5
      QPT(2,3)=0.5
      QPT(3,1)=(+SQRT(0.6)+1.0)/2.0
      QPT(3,3)=1.0-QPT(3,1)
C
      WT(2,1)=5.0/18.0
      WT(2,2)=8.0/18.0
      WT(2,3)=5.0/18.0
C
      JEND=NUMQPT(2)
      DO 410 J=1,JEND
      DO 410 I=1,3
      I1=I+4
       IF(I1.EQ.7) I1=1
C
```

```
      SF(5,I,J)=SFN(QPT(J,1),0.0,QPT(J,3),I1)
      SF(6,I,J)=SFNXI(QPT(J,1),0.0,QPT(J,3),I1)
C
  410 CONTINUE
C
C
C
      RETURN
C
      END
```

```
      FUNCTION SFN(XI,ETA,ZETA,N)
C
C
      GO TO (201,202,203,204,205,206),N
C
  201 SFN=(2.0*XI-1.0)*XI
       RETURN
  202 SFN=4.0*ETA*XI
      RETURN
  203 SFN=(2.0*ETA-1.0)*ETA
      RETURN
  204 SFN=4.0*ETA*ZETA
      RETURN
  205 SFN=(2.0*ZETA-1.0)*ZETA
      RETURN
  206 SFN=4.0*XI*ZETA
      RETURN
C
C
C
      END
      FUNCTION SFNXI(XI,ETA,ZETA,N)
C
C
      GO TO (201,202,203,204,205,206),N
C
  201 SFNXI=4.0*XI-1.0
      RETURN
  202 SFNXI=4.0*ETA
      RETURN
  203 SFNXI=0.0
      RETURN
  204 SFNXI=-4.0*ETA
      RETURN
  205 SFNXI=-4.0*ZETA+1.0
      RETURN
  206 SFNXI=4.0*ZETA-4.0*XI
      RETURN
C
C
      END
      FUNCTION SFNETA(XI,ETA,ZETA,N)
C
C
      GO TO (201,202,203,204,205,206),N
C
  201 SFNETA=0.0
      RETURN
  202 SFNETA=4.0*XI
      RETURN
  203 SFNETA=4.0*ETA-1.0
      RETURN
  204 SFNETA=4.0*ZETA-4.0*ETA
      RETURN
  205 SFNETA=-4.0*ZETA+1.0
      RETURN
  206 SFNETA=-4.0*XI
      RETURN
C
      END
```

```
      FUNCTION SFNP(XI,ETA,ZETA,N)
      GO TO (201,202,203),N
  201 SFNP=1.0-2.0*ZETA
      RETURN
  202 SFNP=1.0-2.0*XI
      RETURN
  203 SFNP=1.0-2.0*ETA
      RETURN
```

```
      FUNCTION GAMX(TEMPK,XK,YK,MJ)
      GAMX=0.0
      F=-0.74*TEMPK
      R=SQRT(XK**2+YK**2)
      GAMX=-F*XK/R
      RETURN
      END
C
      FUNCTION GAMY(TEMPK,XK,YK,MJ)
      GAMY=0.0
      F=-0.74*TEMPK
      R=SQRT(XK**2+YK**2)
      GAMY=-F*YK/R
      RETURN
      END
C
      FUNCTION G(TEMPK,MI)
       G=-1.0
      RETURN
      END
C
      SUBROUTINE VISC(VS,VT,PENLTY,NPPE,EPSII,TEMPK,XK,YK,MJ)
      VS=3.0
      VT=3.0
      PENLTY=0.0
      IF(NPPE.EQ.0) PENLTY=1000.0*VS
      RETURN
      END
C
      SUBROUTINE MSHADJ
      RETURN
      END
      SUBROUTINE BNDRY
      RETURN
      END
C
      SUBROUTINE BNDRYC
      RETURN
      END
C
      SUBROUTINE BNDRYT
      RETURN
      END
C
      FUNCTION RHO(MJ,IELEJ)
      RHO=.370E+04
      RETURN
      END
C
      FUNCTION CP(MJ,IELEJ)
      CP=1.2E+03
      RETURN
      END
C
      FUNCTION RKX(MJ,IELEJ)
      RKX=6.66
      RETURN
      END
C
```

```
      FUNCTION RKY(MJ,IELEJ)
      RKY=6.66
      RETURN
      END
C
      SUBROUTINE STIFF(IELEJ,ITV)
      RETURN
      END
```