

[illegible]

```

C      IER=1
      IF(IER.EQ.0) GO TO 200
      WRITE(6,1)
      GO TO 9999
200    CONTINUE
      CALL START
C      IER=1
      IF(IER.EQ.0) GO TO 300
      WRITE(6,2)
      GO TO 9999
300    CONTINUE
      CALL FORM
C      IER=1
      IF(IER.EQ.0) GO TO 400
      WRITE(6,3)
      GO TO 9999
400    CONTINUE
      IF(ID(1).EQ.1) CALL SOLVE
      IF(ID(1).EQ.2) CALL SOLVE2
      IF(IER.EQ.0) GO TO 500
      WRITE(6,4)
      GO TO 9999
500    CONTINUE
      CALL CHECK
      IF(IER.EQ.0) GO TO 9999
      WRITE(6,5)
      GO TO 9999
1000   CONTINUE
9999   CONTINUE
      CLOSE(3)
      CLOSE(4)
      CLOSE(5)
      CLOSE(6)
      CLOSE(8)
      STOP
      END

C
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C
      SUBROUTINE INPUT
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
1      FORMAT(10X,'Something is wrong in CONTROL!'/)

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2    FORMAT(10X,'Something is wrong in BMESH! '/')
3    FORMAT(10X,'Something is wrong in NODE! '/')
4    FORMAT(10X,'Something is wrong in MATERIAL! '/')
5    FORMAT(10X,'Something is wrong in BCIC! '/')
6    FORMAT(10X,'Something is wrong in DYNA! '/')
7    FORMAT(10X,'Something is wrong in INPLOT! '/')

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100  CONTINUE
      CALL CONTROL
      IF(IER.EQ.0) GO TO 200
      WRITE(6,1)
      GO TO 9999
200  CONTINUE
      CALL BMESH
      IF(IER.EQ.0) GO TO 300
      WRITE(6,2)
      GO TO 9999
300  CONTINUE
      CALL NODE
      IF(IER.EQ.0) GO TO 400
      WRITE(6,3)
      GO TO 9999
400  CONTINUE
      CALL MATERIAL
      IF(IER.EQ.0) GO TO 500
      WRITE(6,4)
      GO TO 9999
500  CONTINUE
      CALL BCIC
      IF(IER.EQ.0) GO TO 600
      WRITE(6,5)
      GO TO 9999
600  CONTINUE
      CALL DYNA
      IF(IER.EQ.0) GO TO 700
      WRITE(6,6)
      GO TO 9999
700  CONTINUE
      CALL INPLOT
      IF(IER.EQ.0) GO TO 1000
      WRITE(6,7)
1000 CONTINUE
9999 CONTINUE
      RETURN
      END

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      SUBROUTINE CONTROL
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)

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COMMON/CBC/MPMESH, MEMESH, MNODE, MSAMP, MAX1, MAX2, MU, MF, MIC
COMMON/DBC/IJK(4, NEMESH)
IER=0
READ(5,5) (ID(I), I=1,7)
C*****C
C
C
C      ID(1) = 1 : Static case
C           2 : Dynamic case (Newmark)
C
C      ID(2) = 1 : local theory
C           2 : nonlocal theory
C
C      ID(3) = 1 (for further development)
C
C      ID(4) = 1 : plane strain
C           2 : plane stress
C
C      ID(5) = 0 : no barrier
C           1 : there is a barrier
C
C      ID(6) = maximum number of time steps for the dynamic analysis
C
C      ID(7) = maximum number of output printing steps (IDEAS)
C
C*****C
5      FORMAT(16I5)
      WRITE(6,5) (ID(I), I=1,7)
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE BMESH
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      COMMON/ABC/ID(10), IER
      COMMON/BBC/XMESH(NPMESH), YMESH(NPMESH), XSAMP(NSAMP), YSAMP(NSAMP)
      COMMON/CBC/MPMESH, MEMESH, MNODE, MSAMP, MAX1, MAX2, MU, MF, MIC
      COMMON/DBC/IJK(4, NEMESH)
1      FORMAT(10X/
15X, 'The followings are information about background mesh'/)
2      FORMAT(10X/5X, '=====')
5      FORMAT(16I5)
3      FORMAT(I5, 3(5X, F15.8))
8      FORMAT(9X, I8, 8X, 4I8)
C7     FORMAT(9X, I8, 7X, 2G9.3)
7      FORMAT(9X, I8, 7X, 2G8.5)
9      FORMAT(9X, 6I8)
      IER=0
      WRITE(6,1)

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      READ(5,9) MPMESH, MEMESH
      WRITE(6,5) MPMESH, MEMESH
      DO 250 K=1, MEMESH
        READ(5,8) I, (IJK(J,I), J=1,4)
C*****
C
C      IJK(J,I) = CONNECTIVITY OF THE BACKGROUND MESH.
C
C*****
      WRITE(6,5) I, (IJK(J,I), J=1,4)
250    CONTINUE
      PF=45.0D0/DATAN(1.0D0)
      DO 200 J=1, MPMESH
C*****C
C
C
C      MEMESH = NUMBER OF ELEMENTS IN BACKGROUND MESH
C
C
C      XMESH(I), YMESH(I) ARE COORDINATES of the background mesh.
C
C*****C
      READ(5,7) I, XMESH(I), YMESH(I)
      WRITE(6,3) I, XMESH(I), YMESH(I)
200    CONTINUE
      WRITE(6,2)
      CALL IDEAS1
1000   CONTINUE
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE NODE
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      COMMON/ABC/ID(10), IER
      COMMON/CBC/MPMESH, MEMESH, MNODE, MSAMP, MAX1, MAX2, MU, MF, MIC
      COMMON/EBC/XNODE(NNODE), YNODE(NNODE), RNODE(NNODE)
1      FORMAT(10X/
15X, 'The followings are information about nodes: '/')
2      FORMAT(10X/5X, '=====')
4      FORMAT(4E15.8)
5      FORMAT(16I5)
3      FORMAT(I5, 3(5X, F15.8), 2X, F11.4)
7      FORMAT(9X, I8)
C8     FORMAT(9X, I8, 7X, 2G9.3)
8      FORMAT(9X, I8, 7X, 3G8.5)
9      FORMAT(25X, 2F8.4)
      IER=0
      PF=45.0D0/DATAN(1.0D0)
      WRITE(6,1)

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        READ(5,8) MNODE
        WRITE(6,5) MNODE
        DO 100 K=1,MNODE
        READ(5,8) J, XT,YT,RT
        XNODE(K)=XT
        YNODE(K)=YT
        RNODE(K)=RT
        WRITE(6,3) K, XNODE(K), YNODE(K), RNODE(K)
100    CONTINUE
1000  CONTINUE
        WRITE(6,2)
        RETURN
        END
C=====
C=====
C=====
        SUBROUTINE MATERIAL
        IMPLICIT REAL*8 (A-H,O-Z)
        PARAMETER (NPMESH=2000)
        PARAMETER (NEMESH=1600)
        PARAMETER (NSAMP=NEMESH)
        PARAMETER (NNODE=500)
        PARAMETER (NAX1=500)
        PARAMETER (NAX2=500)
        COMMON/ABC/ID(10),IER
        COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
4      FORMAT(/5X/)
5      FORMAT(4E15.8)
6      FORMAT(5X,'Density , Radius=',2(5X,F15.8)/)
7      FORMAT(5X,'Young Modulus, Poisson Ratio =',2(2X,E15.8)/)
8      FORMAT(5X,'Ydamp Modulus, Pdamping Ratio =',2(2X,E15.8)/)
        IER=0
        WRITE(6,4)
        READ(5,5) DEN,RADIUS
        WRITE(6,6) DEN,RADIUS
        READ(5,5) YOUNG,POISSON
        WRITE(6,7) YOUNG,POISSON
        READ(5,5) YDAMP,PDAMP
        WRITE(6,8) YDAMP,PDAMP
        A1=YOUNG
        B1=YDAMP
        A2=POISSON
        B2=PDAMP
C=====
C
C      ID(4) = 1 : plane strain
C              2 : plane stress
C
C=====
        GO TO (331,332),ID(4)
331    CONTINUE
        T=A1/(1.0D0+A2)/(1.0D0-2.0D0*A2)
        DK(1,1)=(1.0D0-A2)*T
        DK(1,2)=A2*T
        DK(3,3)=0.5D0*(1.0D0-2.0D0*A2)*T
        DK(2,1)=DK(1,2)
        DK(2,2)=DK(1,1)

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DK(1,3)=0.0D0
DK(2,3)=0.0D0
DK(3,1)=0.0D0
DK(3,2)=0.0D0
T=B1/(1.0D0+B2)/(1.0D0-2.0D0*B2)
DC(1,1)=(1.0D0-B2)*T
DC(1,2)=B2*T
DC(3,3)=0.5D0*(1.0D0-2.0D0*B2)*T
DC(2,1)=DC(1,2)
DC(2,2)=DC(1,1)
DC(1,3)=0.0D0
DC(2,3)=0.0D0
DC(3,1)=0.0D0
DC(3,2)=0.0D0
GO TO 300
332 CONTINUE
T=A1/(1.0D0-A2*A2)
DK(1,1)=T
DK(2,2)=DK(1,1)
DK(1,2)=A2*T
DK(2,1)=DK(1,2)
DK(3,3)=0.5D0*(1.0D0-A2)*T
DK(1,3)=0.0D0
DK(2,3)=0.0D0
DK(3,1)=0.0D0
DK(3,2)=0.0D0
T=B1/(1.0D0-B2*B2)
DC(1,1)=T
DC(2,2)=DC(1,1)
DC(1,2)=B2*T
DC(2,1)=DC(1,2)
DC(3,3)=0.5D0*(1.0D0-B2)*T
DC(1,3)=0.0D0
DC(2,3)=0.0D0
DC(3,1)=0.0D0
DC(3,2)=0.0D0
300 CONTINUE
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
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C
C
C      T(K) =   DK(KL) * E(L) + DC(KL) * E_DOT(L)
C
C
C
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
      WRITE(6,4)
      WRITE(6,1) ((DK(III,JJJ),JJJ=1,3),III=1,3)
      WRITE(6,4)
      WRITE(6,1) ((DC(III,JJJ),JJJ=1,3),III=1,3)
      WRITE(6,4)
1    FORMAT(3(5X,F15.8)/)
      RETURN
      END
C=====

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C=====
C=====
      SUBROUTINE BCIC
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NAX=1000)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      PARAMETER (N2=2*NNODE)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
      COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
      COMMON/KBC/SCALE2(NF),ICF(NF)
      COMMON/LBC/SCALE3(NIC),ICI(NIC)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      COMMON/QBC/IEAST(25),ISOUTH(25),IWEST(25),INORTH(25)
      COMMON/RBC/MEAST,MWEST,MSOUTH,MNORTH
3      FORMAT(5X,'-----')
4      FORMAT(20X,I3)
5      FORMAT(16I5)
6      FORMAT(5X/5X,'No. of disp. specified boundary conditions =',I5/)
7      FORMAT(5X/5X,'No. of load specified boundary conditions =',I5/)
8      FORMAT(5X/5X,'Number of non-zero initial conditions =',I5/)
9      FORMAT(5X,I5,5X,F15.8)
10     FORMAT(I5,3(5X,F15.8))
11     FORMAT(1X,I3,' IC=',I5,' at x, y =',2E15.8,' factor =',E15.8)
12     FORMAT(5X/20X,'The essential boudary conditions are:')
      IER=0
      MU=0
      MF=0
      MIC=0
      PF=DATAN(1.0D0)/45.0D0
      G=YOUNG/(1.0D0+POISSON)*0.5D0
      IF(ID(4).EQ.1) COEFF=3.0D0-4.0D0*POISSON
      IF(ID(4).EQ.2) COEFF=(3.0D0-POISSON)/(1.0D0+POISSON)
C=====
C=====
C=====
      READ(5,5) MU,MF,MIC
      WRITE(6,6) MU
      IF(MU.GT.NU) IER=1
      IF(MU.EQ.0.AND.ID(1).EQ.1) IER=1
      IF(IER.EQ.1) GO TO 9999
      IF(MU.EQ.0) GO TO 150

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        WRITE(6,12)
        DO 91 I=1,MU
        READ(5,10) ICU(I),XB(I),YB(I),SCALE1(I)
91      WRITE(6,11) I,ICU(I),XB(I),YB(I),SCALE1(I)
150    CONTINUE
        WRITE(6,7) MF
        IF(MF.EQ.0) GO TO 250
        IF(MF.GT.NF) IER=1
        DO 200 I=1,MF
        READ(5,10) ICF(I),SCALE2(I)
200    WRITE(6,9) ICF(I),SCALE2(I)
250    CONTINUE
        WRITE(6,8) MIC
        IF(MIC.EQ.0) GO TO 9999
        IF(MIC.GT.NIC) IER=1
        DO 300 I=1,MIC
        READ(5,10) ICI(I),SCALE3(I)
300    WRITE(6,9) ICI(I),SCALE3(I)
9999   CONTINUE
        RETURN
        END

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        SUBROUTINE DYNA
        IMPLICIT REAL*8 (A-H,O-Z)
        PARAMETER (NU=500)
        PARAMETER (NF=500)
        PARAMETER (NIC=100)
        COMMON/ABC/ID(10),IER
        COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
        COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
        COMMON/KBC/SCALE2(NF),ICF(NF)
        COMMON/LBC/SCALE3(NIC),ICI(NIC)
        COMMON/OBC/DTIME,TREF,ITIME,MTIME
        COMMON/SBC/XBARRIER(2),YBARRIER(2)
1      FORMAT(16I5)
2      FORMAT(4E15.8)
3      FORMAT(2X/5X,'Mtime = ',I5/
        *5X,'Dtime = ',E15.8/
        *5X,'T-ref = ',E15.8/)
4      FORMAT(2X/10X,'the barrier is from ',2(2X,F15.8)/)
5      FORMAT(27X,'to ',2(2X,F15.8)/)
6      FORMAT(5X/5X,'For dynamic problems:')
7      FORMAT(5X/5X,'If there is a barrier,')
8      FORMAT(2X/5X,
        *'Since this is a static problem, the above data is irrelevant.')
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9      FORMAT(2X/
        *5X,'Since this is no barrier, the above data is irrelevant.')
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        IER=0
        MTIME=ID(6)
        WRITE(6,6)
        READ(5,2) DTIME,TREF
        WRITE(6,3) MTIME,DTIME,TREF
        IF(ID(1).EQ.1) WRITE(6,8)
1000   CONTINUE
        WRITE(6,7)

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      READ(5,2) XBARRIER(1),YBARRIER(1)
      READ(5,2) XBARRIER(2),YBARRIER(2)
      WRITE(6,4) XBARRIER(1),YBARRIER(1)
      WRITE(6,5) XBARRIER(2),YBARRIER(2)
      IF(ID(5).EQ.0) WRITE(6,9)
2000  CONTINUE
      RETURN
      END

C=====
C=====
C=====
      SUBROUTINE INPLOT
      IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/ABC/ID(10),IER
      COMMON/UBC/MUPRINT,MSPRINT,IUPRINT(4),ISPRINT(3)
1     FORMAT(16I5)
2     FORMAT(10X,'MUPRINT, MSPRINT = ',2I5/)
3     FORMAT(5X,'IUPRINT = ',4I5/)
4     FORMAT(5X,'ISPRINT = ',3I5/)
      IER=0
      READ(5,1) MUPRINT,MSPRINT
      READ(5,1) (IUPRINT(K),K=1,MUPRINT)
      READ(5,1) (ISPRINT(K),K=1,MSPRINT)
      WRITE(6,2) MUPRINT,MSPRINT
      WRITE(6,3) (IUPRINT(K),K=1,MUPRINT)
      WRITE(6,4) (ISPRINT(K),K=1,MSPRINT)
      RETURN
      END

C=====
C=====
C=====
      SUBROUTINE START
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
      COMMON/SBC/XBARRIER(2),YBARRIER(2)
      DIMENSION NNN(NAX1)
      DIMENSION S(NAX1),SX(NAX1),SY(NAX1)
      DO 100 I=1,MEMESH
      XSAMP(I)=0.25D0*(XMESH(IJK(1,I))+
*                XMESH(IJK(2,I))+
*                XMESH(IJK(3,I))+
*                XMESH(IJK(4,I)))
      YSAMP(I)=0.25D0*(YMESH(IJK(1,I))+

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*           YMESH(IJK(2,I))+
*           YMESH(IJK(3,I))+
*           YMESH(IJK(4,I)))
100  CONTINUE
      MSAMP=MEMESH
      TAREA=0.0D0
      DO 150 I=1, MEMESH
        AX=XMESH(IJK(2,I))-XMESH(IJK(1,I))
        AY=YMESH(IJK(2,I))-YMESH(IJK(1,I))
        BX=XMESH(IJK(3,I))-XMESH(IJK(1,I))
        BY=YMESH(IJK(3,I))-YMESH(IJK(1,I))
        CX=XMESH(IJK(4,I))-XMESH(IJK(1,I))
        CY=YMESH(IJK(4,I))-YMESH(IJK(1,I))
        AREA(I)=0.5D0*(DABS(AX*BY-AY*BX)+DABS(BX*CY-BY*CX))
        TAREA=TAREA+AREA(I)
150  CONTINUE
      WRITE(6,1) TAREA
1    FORMAT(10X,'Total Area =',F15.8/)
      MAX1=0
      TEST=1.0D0
      TESTX=0.0D0
      TESTY=0.0D0
      DO 200 IS=1, MSAMP
        XS=XSAMP(IS)
        YS=YSAMP(IS)
        CALL SHAPE3(XS,YS,NUMBER,NNN,S,SX,SY)
        IF(NUMBER.GT.MAX1) MAX1=NUMBER
12    FORMAT(10X,'H(',I5,')=',F15.8)
14    FORMAT(5X,'J=',I5,4(1X,F15.8))
15    FORMAT(10X,'ISAMP =',I5,' area =',F15.8/)
16    FORMAT(16I5)
18    FORMAT(5(1X,F15.8))
17    FORMAT(10X,'-----')
19    FORMAT(10X/
*5X,'Test results on shape function and its derivatives are:'/
*10X,'Partition of unity =',F15.8/
*10X,'Slope along x-axis =',F15.8/
*10X,'Slope along y-axis =',F15.8/)
20    FORMAT(10X/5X,'It passes the test.'/)
21    FORMAT(10X/
*5X,'Look at these results, user may need to change the model.'/)
      NN1(IS)=NUMBER
      TT=0.0D0
      TX=0.0D0
      TY=0.0D0
      DO 201 I=1, NUMBER
        LMN1(I,IS)=NNN(I)
        PHI(I,IS)=S(I)
        PHIX(I,IS)=SX(I)
        PHIY(I,IS)=SY(I)
        TT=TT+S(I)
        TX=TX+SX(I)
        TY=TY+SY(I)
201  CONTINUE
      IF(DABS(TT-1.0D0).GT.TEST) TTT=TT
      IF(DABS(TT-1.0D0).GT.TEST) TEST=DABS(TT-1.0D0)
      IF(DABS(TX).GT.TESTX) TESTX=DABS(TX)

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        IF(DABS(TY).GT.TESTY) TESTY=DABS(TY)
200    CONTINUE
        JER=0
        WRITE(6,19) TTT,TESTX,TESTY
        IF(TEST.GT.1.0D-8) JER=1
        IF(TESTX.GT.1.0D-6) JER=1
        IF(TESTY.GT.1.0D-6) JER=1
        IF(JER.EQ.0) WRITE(6,20)
        IF(JER.EQ.1) WRITE(6,21)
        IF(IER.EQ.1) GO TO 3000
        MAX2=0
        HMAX=0.0
        DO 300 I=1,MSAMP
            XX=XSAMP(I)
            YY=YSAMP(I)
            H(I)=0.0
            K=0
C        WRITE(6,17)
C        WRITE(6,15) I,AREA(I)
            DO 350 J=1,MSAMP
                X=XSAMP(J)
                Y=YSAMP(J)
                D=DSQRT((X-XX)**2+(Y-YY)**2)/RADIUS
                IF(D.GE.1.0D0) GO TO 350
                CALL BARRIER(XX,YY,X,Y,IPASS)
                IF(IPASS.EQ.0) GO TO 350
                K=K+1
                LMN2(K,I)=J
                FACTOR(K,I)=1.0D0-6.0D0*D*D+8.0D0*D*D*D-3.0D0*D*D*D*D
                H(I)=H(I)+AREA(J)*FACTOR(K,I)
C            WRITE(6,14) J,X,Y,D,FACTOR(K,I)
350    CONTINUE
            NN2(I)=K
            IF(K.GT.MAX2) MAX2=K
            IF(H(I).GT.HMAX) HMAX=H(I)
            WRITE(6,12) I,H(I)
300    CONTINUE
            WRITE(6,123) HMAX
123    FORMAT(5X,'HMAX=',E15.8/)
3000   CONTINUE
        RETURN
        END
C=====
C=====
C=====
        SUBROUTINE SHAPE1(X,Y,NUMBER,NNN,S)
C    SHAPE1 is only for the shape function, PHI, without derivatives.
        IMPLICIT REAL*8 (A-H,O-Z)
        PARAMETER (NPMESH=2000)
        PARAMETER (NEMESH=1600)
        PARAMETER (NSAMP=NEMESH)
        PARAMETER (NNODE=500)
        PARAMETER (NAX1=500)
        PARAMETER (NAX2=500)
        COMMON/ABC/ID(10),IER
        COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
        COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC

```

```

COMMON/DBC/IJK(4,NEMESH)
COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
COMMON/SBC/XBARRIER(2),YBARRIER(2)
DIMENSION P(6),A(6,6),AINV(6,6),B(6,NAX1)
DIMENSION W(NAX1)
DIMENSION NNN(NAX1)
DIMENSION S(NAX1)
1  FORMAT(10X,'NUMBER =',I5,5X,'NAX1 =',I5,'      Wrong!'/)
    K=0
    DO 250 J=1,MNODE
      XX=XNODE(J)
      YY=YNODE(J)
      R=RNODE(J)
      DIST=DSQRT((X-XX)**2+(Y-YY)**2)
      IF(DIST.GE.R) GO TO 250
      CALL BARRIER(XX,YY,X,Y,IPASS)
      IF(IPASS.EQ.0) GO TO 250
      K=K+1
      NNN(K)=J
250  CONTINUE
      NUMBER=K
      IF(NUMBER.GT.NAX1) WRITE(6,1) NUMBER,NAX1
      IF(NUMBER.GT.NAX1) IER=1
      IF(NUMBER.GT.NAX1) GO TO 9999
C=====
C=====
C=====
      KMAX=NUMBER
      DO 10 I=1,6
        DO 10 J=1,6
          A(I,J)=0.0D0
10    CONTINUE
C=====
C=====
C=====
      DO 100 K=1,KMAX
        INODE=NNN(K)
        XI=XNODE(INODE)
        YI=YNODE(INODE)
        RI=RNODE(INODE)
        D=DSQRT((X-XI)**2+(Y-YI)**2)/RI
        W(K)=1.0-6.0*D*D+8.0*D*D*D-3.0*D*D*D*D
        P(1)=1.0D0
        P(2)=XI
        P(3)=YI
        P(4)=XI*XI
        P(5)=YI*YI
        P(6)=XI*YI
        DO 100 II=1,6
          B(II,K)=W(K)*P(II)
        DO 100 JJ=1,6
          A(II,JJ)=A(II,JJ)+P(II)*P(JJ)*W(K)
100  CONTINUE

```

```

CALL INVERSION(6,A,6,AINV,6)
IF(IER.NE.0) WRITE(6,123) NUMBER
123  FORMAT(10X,'from shapel and inversion, NUMBER=',I5)
P(1)=1.0D0
P(2)=X
P(3)=Y
P(4)=X*X
P(5)=Y*Y
P(6)=X*Y
DO 300 I=1,KMAX
S(I)=0.0D0
DO 300 II=1,6
DO 300 JJ=1,6
S(I)=S(I)+P(II)*AINV(II,JJ)*B(JJ,I)
300  CONTINUE
9999  CONTINUE
RETURN
END

C=====
C=====
C=====
SUBROUTINE SHAPE3(X,Y,NUMBER,NNN,S,SX,SY)
IMPLICIT REAL*8 (A-H,O-Z)
PARAMETER (NPMESH=2000)
PARAMETER (NEMESH=1600)
PARAMETER (NSAMP=NEMESH)
PARAMETER (NNODE=500)
PARAMETER (NAX1=500)
PARAMETER (NAX2=500)
COMMON/ABC/ID(10),IER
COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
COMMON/SBC/XBARRIER(2),YBARRIER(2)
DIMENSION P(6),A(6,6),AINV(6,6)
DIMENSION AX(6,6),AY(6,6),PX(6),PY(6)
DIMENSION B(6,NAX1),BX(6,NAX1),BY(6,NAX1)
DIMENSION W(NAX1),WX(NAX1),WY(NAX1)
DIMENSION NNN(*)
DIMENSION S(*),SX(*),SY(*)
1  FORMAT(10X,'NUMBER =',I5,5X,'NAX1 =',I5,' Wrong! '/')
NUMBER=0
DO 250 J=1,MNODE
XJ=XNODE(J)
YJ=YNODE(J)
R=RNODE(J)
DIST=DSQRT((X-XJ)**2+(Y-YJ)**2)
IF(DIST.GE.R) GO TO 250
CALL BARRIER(XJ,YJ,X,Y,IPASS)
IF(IPASS.EQ.0) GO TO 250
NUMBER=NUMBER+1
NNN(NUMBER)=J
250  CONTINUE
IF(NUMBER.GT.NAX1) WRITE(6,1) NUMBER,NAX1
IF(NUMBER.GT.NAX1) IER=1
IF(NUMBER.GT.NAX1) GO TO 9999
C=====
DO 10 I=1,6

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```

DO 10 J=1,6
AX(I,J)=0.0D0
AY(I,J)=0.0D0
10  A(I,J)=0.0D0
C=====
DO 100 I=1,NUMBER
IN=NNN(I)
XI=XNODE(IN)
YI=YNODE(IN)
RI=RNODE(IN)
D=DSQRT((X-XI)**2+(Y-YI)**2)/RI
W(I)=1.0-6.0*D*D+8.0*D*D*D-3.0*D*D*D*D
WS=-12.0*D+24.0*D*D-12.0*D*D*D
ANG=DATAN2(Y-YI,X-XI)
CO=DCOS(ANG)
SI=DSIN(ANG)
WX(I)=WS*CO/RI
WY(I)=WS*SI/RI
P(1)=1.0D0
P(2)=XI
P(3)=YI
P(4)=XI*XI
P(5)=YI*YI
P(6)=XI*YI
DO 100 II=1,6
B(II,I)=W(I)*P(II)
BX(II,I)=WX(I)*P(II)
BY(II,I)=WY(I)*P(II)
DO 100 JJ=1,6
A(II,JJ)=A(II,JJ)+P(II)*P(JJ)*W(I)
AX(II,JJ)=AX(II,JJ)+P(II)*P(JJ)*WX(I)
AY(II,JJ)=AY(II,JJ)+P(II)*P(JJ)*WY(I)
100  CONTINUE
C=====
C=====
C=====
CALL INVERSION(6,A,6,AINV,6)
IF(IER.NE.0) WRITE(6,123) NUMBER
123  FORMAT(10X,'wrong in INVERSION, number =',I5)
P(1)=1.0D0
P(2)=X
P(3)=Y
P(4)=X*X
P(5)=Y*Y
P(6)=X*Y
PX(1)=0
PX(2)=1
PX(3)=0
PX(4)=2*X
PX(5)=0
PX(6)=Y
PY(1)=0
PY(2)=0
PY(3)=1
PY(4)=0
PY(5)=2*Y
PY(6)=X

```

```

      DO 300 I=1,NUMBER
CC S here is Phi.
      S(I)=0.0D0
      SX(I)=0.0D0
      SY(I)=0.0D0
      DO 300 II=1,6
      DO 300 JJ=1,6
      S(I)=S(I)+P(II)*AINV(II,JJ)*B(JJ,I)
      SX(I)=SX(I)+PX(II)*AINV(II,JJ)*B(JJ,I)+
*      P(II)*AINV(II,JJ)*BX(JJ,I)
      SY(I)=SY(I)+PY(II)*AINV(II,JJ)*B(JJ,I)+
*      P(II)*AINV(II,JJ)*BY(JJ,I)
      DO 300 MM=1,6
      DO 300 NN=1,6
      SX(I)=SX(I)-P(II)*AINV(II,JJ)*
*      AX(JJ,MM)*AINV(MM,NN)*B(NN,I)
      SY(I)=SY(I)-P(II)*AINV(II,JJ)*
*      AY(JJ,MM)*AINV(MM,NN)*B(NN,I)
300  CONTINUE
C=====
9999  CONTINUE
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE FORM
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
1  FORMAT(10X,'Something is wrong in MASS!'/)
2  FORMAT(10X,'Something is wrong in STIFF!'/)
3  FORMAT(10X,'Something is wrong in COUPLING!'/)
4  FORMAT(10X,'Something is wrong in FORCING!'/)
100 CONTINUE
      IF(ID(1).NE.1) CALL MASS
      IF(IER.EQ.0) GO TO 200
      WRITE(6,1)
      GO TO 9999
200 CONTINUE
      IF(ID(2).EQ.2) CALL STIFF
      IF(ID(2).EQ.1) CALL STIFF1
      CALL SYM
      WRITE(6,11)

```



```

11    FORMAT(10X,'passing STIFF'/)
      IF(IER.EQ.0) GO TO 300
      WRITE(6,2)
      GO TO 9999
300   CONTINUE
      CALL COUPLING
      WRITE(6,12)
12    FORMAT(10X,'passing COUPLING'/)
      IF(IER.EQ.0) GO TO 400
      WRITE(6,3)
      GO TO 9999
400   CONTINUE
      CALL FORCING
      WRITE(6,13)
13    FORMAT(10X,'passing FORCING'/)
      IF(IER.EQ.0) GO TO 1000
      WRITE(6,4)
1000  CONTINUE
9999  CONTINUE
      RETURN
      END

```

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C=====
C=====
C=====

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      SUBROUTINE MASS
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      M2=2*MNODE
      DO 100 I=1,M2
      DO 100 J=1,M2
      AM(I,J)=0.0D0
100   CONTINUE
      DO 200 IS=1,MSAMP
      DO 200 K=1,NN1(IS)
      IALPHA=LMN1(K,IS)
      I=2*IALPHA-1
      DO 200 L=1,NN1(IS)
      JBETA=LMN1(L,IS)

```

```

      J=2*JBETA-1
      AM(I,J)=AM(I,J)+DEN*PHI(K,IS)*PHI(L,IS)*AREA(IS)
200  CONTINUE
      TMASS=0
      DO 300 I=1,M2,2
      DO 300 J=1,M2,2
      TMASS=TMASS+AM(I,J)
      AM(I+1,J+1)=AM(I,J)
300  CONTINUE
      WRITE(6,1) TMASS
1    FORMAT(10X,'Total mass =',F15.8/)
      RETURN
      END

C=====
C=====
C=====

      SUBROUTINE STIFF1
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
C    COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
C    COMMON/DBC/IJK(4,NEMESH)
C    COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      DIMENSION B(3,NTWO),LL(NTWO)
      M2=2*MNODE
      DO 100 I=1,M2
      DO 100 J=1,M2
      AK(I,J)=0.0D0
      AC(I,J)=0.0D0
100  CONTINUE
      DO 200 IS=1,MSAMP
      MM2=2*NN1(IS)
      DO 250 J=1,NN1(IS)
      JJ=LMN1(J,IS)
      J1=2*J-1
      J2=J1+1
      LL(J1)=2*JJ-1
      LL(J2)=2*JJ
      B(1,J1)=PHIX(J,IS)
      B(1,J2)=0
      B(2,J2)=PHIY(J,IS)

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```

      B(2,J1)=0
      B(3,J1)=PHIY(J,IS)
      B(3,J2)=PHIX(J,IS)
250  CONTINUE
      DO 230 IA=1,MM2
      IALPHA=LL(IA)
      DO 230 JB=1,MM2
      JBETA=LL(JB)
      TAK=0
      DO 220 I=1,3
      DO 220 J=1,3
      TAK=DK(I,J)*B(I,IA)*B(J,JB)*AREA(IS)
      AK(IALPHA,JBETA)=AK(IALPHA,JBETA)+TAK
      TAC=DC(I,J)*B(I,IA)*B(J,JB)*AREA(IS)
      AC(IALPHA,JBETA)=AC(IALPHA,JBETA)+TAC
220  CONTINUE
230  CONTINUE
200  CONTINUE
      RETURN
      END

C=====
C=====
C=====

      SUBROUTINE STIFF
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
C      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
C      COMMON/DBC/IJK(4,NEMESH)
C      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
C      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
C      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      M2=2*MNODE
      DO 100 I=1,M2
      DO 100 J=1,M2
      AK(I,J)=0.0D0
      AC(I,J)=0.0D0
100  CONTINUE
      HH=1.0D0/HMAX
      DO 200 IS=1,MSAMP
      A1=AREA(IS)
      DO 200 K=1,NN2(IS)
      JS=LMN2(K,IS)

```

```

      A2=AREA(JS)
      FACT=FACTOR(K,IS)
      CALL SUM(IS,JS,HH,FACT,A1,A2)
200  CONTINUE
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE SUM(IS,JS,H,F,A1,A2)
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
C      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
C      COMMON/DBC/IJK(4,NEMESH)
C      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      DIMENSION B1(3,NTWO),B2(3,NTWO)
      DIMENSION L1(NTWO),L2(NTWO)
      MTWO=2*MAX1
      IMAX=NN1(IS)
      JMAX=NN1(JS)
      IF(IMAX.GT.MAX1) GO TO 500
      IF(JMAX.GT.MAX1) GO TO 500
      IMAX2=2*IMAX
      JMAX2=2*JMAX
      DO 100 I=1,3
      DO 100 J=1,MTWO
      B1(I,J)=0.0D0
      B2(I,J)=0.0D0
100  CONTINUE
      DO 200 I=1,IMAX
      II=LMN1(I,IS)
      I1=2*I-1
      I2=2*I
      L1(I1)=2*II-1
      L1(I2)=2*II
      B1(1,I1)=PHIX(I,IS)
      B1(2,I2)=PHIY(I,IS)
      B1(3,I1)=PHIY(I,IS)
      B1(3,I2)=PHIX(I,IS)
200  CONTINUE
      DO 300 I=1,JMAX

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```

      II=LMN1(I,JS)
      I1=2*I-1
      I2=2*I
      L2(I1)=2*II-1
      L2(I2)=2*II
      B2(1,I1)=PHIX(I,JS)
      B2(2,I2)=PHIY(I,JS)
      B2(3,I1)=PHIY(I,JS)
      B2(3,I2)=PHIX(I,JS)
300    CONTINUE
      DO 400 IA=1,IMAX2
      IALPHA=L1(IA)
      DO 400 JB=1,JMAX2
      JBETA=L2(JB)
      DO 400 I=1,3
      DO 400 J=1,3
      AK(IALPHA,JBETA)=AK(IALPHA,JBETA)+DK(I,J)*B1(I,IA)*
*          B2(J,JB)*H*F*A1*A2
      AC(IALPHA,JBETA)=AC(IALPHA,JBETA)+DC(I,J)*B1(I,IA)*
*          B2(J,JB)*H*F*A1*A2
400    CONTINUE
      GO TO 1000
500    IER=1
      WRITE(6,1) MAX1,IMAX,JMAX
1      FORMAT(10X,'MAX1, IMAX, JMAX =',3I5/)
1000   CONTINUE
      RETURN
      END

C=====
C=====
C=====
      SUBROUTINE COUPLING
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
C      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
C      COMMON/DBC/IJK(4,NEMESH)
C      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
C      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
C      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
C      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      DIMENSION S(NAX1)
      DIMENSION NNN(NAX1)
      M2=2*MNODE

```

```

DO 50 I=1,MU
DO 50 J=1,M2
50 AG(I,J)=0.0D0
DO 1000 III=1,MU
FL(III)=SCALE1(III)
IC=ICU(III)
X=XB(III)
Y=YB(III)
1 FORMAT(10X,2I5,' x, y =',2F18.5,I5/)
CALL SHAPE1(X,Y,NUMBER,NNN,S)
C WRITE(6,1) III,IC,X,Y,NUMBER
DO 1000 I=1,NUMBER
II=NNN(I)*2+IC-2
AG(III,II)=S(I)
C WRITE(6,2) I,NNN(I),II,S(I)
2 FORMAT(15X,I5,' nnn, II =',2I5,' S=',E15.8)
1000 CONTINUE
RETURN
END

C=====
C=====
C=====

SUBROUTINE FORCING
IMPLICIT REAL*8 (A-H,O-Z)
PARAMETER (NPMESH=2000)
PARAMETER (NEMESH=1600)
PARAMETER (NSAMP=NEMESH)
PARAMETER (NNODE=500)
PARAMETER (NAX=1000)
PARAMETER (NAX1=500)
PARAMETER (NAX2=500)
PARAMETER (NTWO=2*NAX1)
PARAMETER (N2=2*NNODE)
PARAMETER (NU=500)
PARAMETER (NF=500)
PARAMETER (NIC=100)
COMMON/ABC/ID(10),IER
C COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
C COMMON/DBC/IJK(4,NEMESH)
C COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
C COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
C COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
C COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
C COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
COMMON/KBC/SCALE2(NF),ICF(NF)
C COMMON/LBC/SCALE3(NIC),ICI(NIC)
COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
M2=2*MNODE
MAX=M2+MU
DO 100 I=1,NAX
100 FU(I)=0.0D0
IF(MF.EQ.0) GO TO 300
DO 200 I=1,MF
200 FU(ICF(I))=SCALE2(I)
300 CONTINUE

```

```

C      DO 1000 I=1,MAX
C1000  WRITE(6,25) I,FU(I)
C25    FORMAT(5X,'???' ,I5,'   F=' ,E15.8)
      RETURN
      END

C=====
C=====
C=====
      SUBROUTINE SOLVE
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NAX=1000)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
      COMMON/OBC/DTIME,TREF,ITIME,MTIME
      COMMON/TBC/F1(N2),F2(N2)

C=====
C=====
      M2=2*MNODE
      MAX=2*MNODE+MU

C=====
C=====
      DO 100 I=1,MAX
      DO 100 J=1,MAX
100    AAA(I,J)=0.0D0
      DO 110 I=1,M2
      F(I)=FU(I)
      DO 110 J=1,M2
110    AAA(I,J)=AK(I,J)
      DO 120 I=1,MU
      II=I+M2
      F(II)=FL(I)
      DO 120 J=1,M2
      AAA(II,J)=AG(I,J)*1.0D+0
      AAA(J,II)=AG(I,J)*1.0D+0
120    CONTINUE

C=====
C=====
      CALL GAUSS(MAX,AAA,F,U,NAX,IER)

```

```

C=====
C=====
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE SOLVE2
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NAX=1000)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
      COMMON/OBC/DTIME,TREF,ITIME,MTIME
      COMMON/TBC/F1(N2),F2(N2)
      DIMENSION TM(N2,N2),TC(N2,N2)
      M2=2*MNODE
      MAX=2*MNODE+MU
      DO 100 I=1,MAX
      DO 100 J=1,MAX
100   AAA(I,J)=0.0D0
      DO 110 I=1,M2
      F(I)=FU(I)
      DO 110 J=1,M2
110   AAA(I,J)=AK(J,I)
      DO 120 I=1,MU
      II=I+M2
      F(II)=FL(I)
      DO 120 J=1,M2
      AAA(II,J)=AG(I,J)*1.0D+0
      AAA(J,II)=AG(I,J)*1.0D+0
120   CONTINUE
C=====
C
C
C      AK | AG'
C      AAA = ---|----
C      AG | 0
C

```



```

C
C-----
      CALL TREAT
      IF( IER.NE.0) GO TO 9000
C-----
C
      From now on, AAA is the inverse of the original AAA, i.e.,
C
C      AAA =  $\begin{array}{c|c} a & b \\ \hline b' & c \end{array}$ 
C
C
C
C      A =  $\begin{array}{c|c} K & G' \\ \hline G & 0 \end{array}$ 
C
C
C      AAA * A = I
C
C=====
      DO 310 I=1,M2
      U(I)=0
      UDOT(I)=0
      F1(I)=0
      F2(I)=0
      DO 320 J=1,M2
      AK(I,J)=0
      IF(I.EQ.J) AK(I,J)=1
320    F1(I)=F1(I)+AAA(I,J)*FU(J)
      DO 330 J=1,MU
330    F2(I)=F2(I)+AAA(I,J+M2)*FL(J)
310    CONTINUE
      DO 340 I=1,M2
      DO 340 J=1,M2
      TM(I,J)=0
      TC(I,J)=0
      DO 340 K=1,M2
      TA=AAA(I,K)
      TM(I,J)=TM(I,J)+TA*AM(K,J)
      TC(I,J)=TC(I,J)+TA*AC(K,J)
340    CONTINUE
      DO 350 I=1,M2
      DO 350 J=1,M2
      AM(I,J)=TM(I,J)
      AC(I,J)=TC(I,J)
350    CONTINUE
C=====
C
      From now on , the equation reads as
C
C      M*Udd + C*Ud + U = F1xf1(t) + F2xf2(t)
C
C
C=====
      CALL NEWMARK(AM,AC,AK,F1,ITIME,DTIME,MTIME,ID(7),M2,N2)
9000  RETURN

```

```

      END
C=====
C=====
C=====
      SUBROUTINE TREAT
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NP2=2*NPMESH)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NAX=1000)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/DBC/IJK(4,NEMESH)
      COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
      COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
      COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
      COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
      COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
      COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
      COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
      COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
      COMMON/OBC/DTIME,TREF,ITIME,MTIME
      COMMON/PBC/DISP(NP2),STRAIN(3,NSAMP),STRESS(3,NSAMP)
C=====
C=====
      M2=2*MNODE
      MAX=2*MNODE+MU
C=====
C=====
      CALL PINV(MAX,M2,AAA,NAX)
      DO 400 I=1,M2-1
      DO 400 J=I+1,M2
      TIJ=AAA(I,J)
      TJI=AAA(J,I)
      AAA(I,J)=TJI
      AAA(J,I)=TIJ
400  CONTINUE
      DO 450 I=1,M2
      DO 450 J=1,MU
450  AAA(I,J+M2)=AAA(J+M2,I)
C=====
C=====
      IER=0
      DO 500 I=1,M2
      DO 500 J=1,M2
      T=0
      IF(I.EQ.J) T=-1

```

```

DO 510 K=1,M2
510  T=T+AAA(I,K)*AK(K,J)
DO 520 K=1,MU
520  T=T+AAA(I,K+M2)*AG(K,J)
IF(DABS(T).GT.1.0D-8) IER=1
IF(DABS(T).GT.1.0D-8) WRITE(6,1) I,J,T
500  CONTINUE
WRITE(6,2) IER
C=====
C=====
IER=0
DO 600 I=1,M2
DO 600 J=1,MU
T=0
DO 610 K=1,M2
610  T=T+AAA(I,K)*AG(J,K)
IF(DABS(T).GT.1.0D-8) IER=1
IF(DABS(T).GT.1.0D-8) WRITE(6,1) I,J,T
600  CONTINUE
WRITE(6,3) IER
C=====
C=====
1  FORMAT(5X,'in TREAT:',2I5,F15.8)
2  FORMAT(10X,'in TREAT: first test : IER=',I5/)
3  FORMAT(10X,'in TREAT: second test : IER=',I5/)
RETURN
END
C=====
C=====
C=====
SUBROUTINE PINV(M,M2,T,NA)
IMPLICIT REAL*8 (A-H,O-Z)
COMMON/ABC/ID(10),IER
DIMENSION T(NA,NA)
DIMENSION B(M,M2)
C  DIMENSION A(M,M)
C=====
C=====
DO 10 I=1,M
DO 10 J=1,M2
C  A(I,J)=T(I,J)
B(I,J)=0
IF(I.EQ.J) B(I,J)=1
10  CONTINUE
C=====
C=====
DO 100 K=1,M-1
KMAX=K
TMAX=DABS(T(K,K))
DO 110 KK=K+1,M
IF(TMAX.GE.DABS(T(KK,K))) GO TO 110
KMAX=KK
TMAX=DABS(T(KK,K))
110 CONTINUE
IF(KMAX.EQ.K) GO TO 111
DO 120 KK=K,M
RT=T(K,KK)

```

```

        T(K, KK) = T(KMAX, KK)
120      T(KMAX, KK) = RT
        DO 121 KK=1, M2
            RT = B(K, KK)
            B(K, KK) = B(KMAX, KK)
121      B(KMAX, KK) = RT
111      CONTINUE
        DO 100 I=K+1, M
            FACT = -T(I, K) / T(K, K)
            DO 102 J=1, M2
                B(I, J) = B(I, J) + FACT * B(K, J)
102      CONTINUE
            DO 101 J=K+1, M
                T(I, J) = T(I, J) + FACT * T(K, J)
101      CONTINUE
100      CONTINUE
C=====
C=====
C=====
        DO 300 J=1, M2
300      B(M, J) = B(M, J) / T(M, M)
C=====
C=====
C=====
        DO 400 K=1, M-1
            I = M-K
            DO 500 J=I+1, M
                DO 500 L=1, M2
                    B(I, L) = B(I, L) - T(I, J) * B(J, L)
500      CONTINUE
            DO 550 L=1, M2
                B(I, L) = B(I, L) / T(I, I)
550      CONTINUE
400      CONTINUE
        DO 900 I=1, M
            DO 900 J=1, M2
900      T(I, J) = B(I, J)
C=====
C=====
C=====
C      DO 1000 I=1, M
C      DO 1000 J=1, M
C      TEST=0
C      IF(I.EQ.J) TEST=-1
C      DO 1001 K=1, M
C      TEST=TEST+A(I, K) * B(K, J)
C1001  CONTINUE
C1000  IF(DABS(TEST).GT.1.0D-8) WRITE(6, 1) I, J, TEST
        WRITE(6, 2)
1      FORMAT(5X, 'in PINV:', 2I8, E17.8/)
2      FORMAT(10X, 'passing PINV'/)
        RETURN
        END
C=====
C=====
C=====
        SUBROUTINE CHECK

```

```

IMPLICIT REAL*8 (A-H,O-Z)
PARAMETER (NPMESH=2000)
PARAMETER (NP2=2*NPMESH)
PARAMETER (NEMESH=1600)
PARAMETER (NSAMP=NEMESH)
PARAMETER (NNODE=500)
PARAMETER (NAX1=500)
PARAMETER (NAX2=500)
PARAMETER (NAX=1000)
PARAMETER (NTWO=2*NAX1)
PARAMETER (N2=2*NNODE)
PARAMETER (NU=500)
PARAMETER (NF=500)
PARAMETER (NIC=100)
COMMON/ABC/ID(10),IER
COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
COMMON/DBC/IJK(4,NEMESH)
COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
COMMON/OBC/DTIME,TREF,ITIME,MTIME
COMMON/PBC/DISP(NP2),STRAIN(3,NSAMP),STRESS(3,NSAMP)
DIMENSION NNN(NAX1)
DIMENSION S(NAX1),SX(NAX1),SY(NAX1)
DIMENSION ERATE(3,NSAMP)
IF(ID(1).EQ.2) GO TO 2000
3  FORMAT(10X/5X,'*****')
   WRITE(6,3)
   WRITE(6,3)
C=====
   MAX=2*MNODE+MU
   FMAX=0.0D0
   DO 50 I=1,MAX
50  IF(DABS(F(I)).GT.FMAX) FMAX=DABS(F(I))
   FMAX=FMAX*1.0D-6
   JER=0
   DO 60 I=1,MAX
   T=0.0D0
   DO 70 J=1,MAX
70  T=T+AAA(I,J)*U(J)
   DF=F(I)-T
   IF(DABS(DF).LT.FMAX) GO TO 60
   WRITE(6,5) I,T,F(I),DF
   JER=JER+1
60  CONTINUE
5   FORMAT(5X,I5,' T,F,DF =',3(1X,F15.8))
   IF(JER.EQ.0) WRITE(6,8)
8   FORMAT(10X,'The solver did a good job.'/)
C=====
   WRITE(6,7)
7   FORMAT(10X,'The followings are disp. at mesh points:')

```

```

DO 100 IP=1,MPMESH
X=XMESH(IP)
Y=YMESH(IP)
C=====
C=====
C=====
IX=2*IP-1
IY=IX+1
DISP(IX)=0.0D0
DISP(IY)=0.0D0
CALL SHAPE1(X,Y,NUMBER,NNN,S)
DO 200 K=1,NUMBER
JP=NNN(K)
JX=2*JP-1
JY=JX+1
DISP(IX)=DISP(IX)+S(K)*U(JX)
DISP(IY)=DISP(IY)+S(K)*U(JY)
200 CONTINUE
WRITE(6,1) IP,DISP(IX),DISP(IY)
1 FORMAT(2X,'IP=',I5,2X,'UX=',F15.8,2X,'UY=',F15.8)
100 CONTINUE
WRITE(6,3)
WRITE(6,23)
23 FORMAT(10X/
*10X,'The followings are strains at sampling points:')
DO 300 IE=1,MSAMP
X=XSAMP(IE)
Y=YSAMP(IE)
CALL SHAPE3(X,Y,NUMBER,NNN,S,SX,SY)
STRAIN(1,IE)=0.0D0
STRAIN(2,IE)=0.0D0
STRAIN(3,IE)=0.0D0
ERATE(1,IE)=0.0D0
ERATE(2,IE)=0.0D0
ERATE(3,IE)=0.0D0
DO 350 K=1,NUMBER
JP=NNN(K)
JX=2*JP-1
JY=JX+1
STRAIN(1,IE)=STRAIN(1,IE)+SX(K)*U(JX)
STRAIN(2,IE)=STRAIN(2,IE)+SY(K)*U(JY)
STRAIN(3,IE)=STRAIN(3,IE)+SX(K)*U(JY)+SY(K)*U(JX)
ERATE(1,IE)=ERATE(1,IE)+SX(K)*UDOT(JX)
ERATE(2,IE)=ERATE(2,IE)+SY(K)*UDOT(JY)
ERATE(3,IE)=ERATE(3,IE)+SX(K)*UDOT(JY)+SY(K)*UDOT(JX)
350 CONTINUE
WRITE(6,22) IE,(STRAIN(L,IE),L=1,3)
22 FORMAT(2X,'IE=',I5,' Ex, Ey, Exy =',3(1X,E15.8))
300 CONTINUE
WRITE(6,3)
WRITE(6,25)
25 FORMAT(10X/
*10X,'The followings are stresses at sampling points:')
*10X/
*9X,'X',9X,'Y',12X,'Sxx',13X,'Syy',13X,'Sxy')
DO 400 IS=1,MSAMP
X=XSAMP(IS)

```

```

        Y=YSAMP( IS)
        STRESS(1, IS)=0.0D0
        STRESS(2, IS)=0.0D0
        STRESS(3, IS)=0.0D0
        IF(ID(2).EQ.2) GO TO 450
        DO 501 I=1,3
        DO 501 J=1,3
        STRESS(I, IS)=STRESS(I, IS)+DK(I, J)*STRAIN(J, IS)+
*          DC(I, J)*ERATE(J, IS)
501    CONTINUE
        GO TO 550
450    CONTINUE
        HH=1.0D0/H( IS)
        DO 500 K=1, NN2( IS)
        JS=LMN2(K, IS)
        AA=AREA(JS)
        FACT=FACTOR(K, IS)
        DO 500 I=1,3
        DO 500 J=1,3
        STRESS(I, IS)=STRESS(I, IS)+HH*AA*FACT*(DK(I, J)*STRAIN(J, JS)+
*          DC(I, J)*ERATE(J, JS))
500    CONTINUE
550    WRITE(6,2) IS,X,Y,(STRESS(L, IS),L=1,3)
2      FORMAT(2X,I3,2(1X,F9.5),3(1X,E15.8))
400    CONTINUE
        WRITE(6,3)
        WRITE(6,9)
9      FORMAT(5X/5X,'The followings are checks for essential BC :'/)
        DO 600 I=1,MU
        X=XB(I)
        Y=YB(I)
        IC=ICU(I)
        USPEC=SCALE1(I)
        UC=0.0D0
        CALL SHAPE1(X,Y,NUMBER,NNN,S)
        DO 700 K=1,NUMBER
        JP=NNN(K)
        JC=2*JP-2+IC
        UC=UC+S(K)*U(JC)
700    CONTINUE
        WRITE(6,4) I,ICU(I),X,Y,USPEC,UC
600    CONTINUE
4      FORMAT(2X,2I5,' x, y =',2F10.5,' U-spe, U-cal =',2F10.5)
        WRITE(6,3)
        CALL IDEAS2
2000   CONTINUE
        RETURN
        END

C=====
C=====
C=====
        SUBROUTINE SYM
        IMPLICIT REAL*8 (A-H,O-Z)
        PARAMETER (NPMESH=2000)
        PARAMETER (NP2=2*NPMESH)
        PARAMETER (NEMESH=1600)
        PARAMETER (NSAMP=NEMESH)

```

```

PARAMETER (NNODE=500)
PARAMETER (NAX1=500)
PARAMETER (NAX2=500)
PARAMETER (NAX=1000)
PARAMETER (NTWO=2*NAX1)
PARAMETER (N2=2*NNODE)
PARAMETER (NU=500)
PARAMETER (NF=500)
PARAMETER (NIC=100)
COMMON/ABC/ID(10),IER
COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
COMMON/DBC/IJK(4,NEMESH)
COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
COMMON/OBC/DTIME,TREF,ITIME,MTIME
COMMON/PBC/DISP(NP2),STRAIN(3,NSAMP),STRESS(3,NSAMP)
C=====
      M2=2*MNODE
      MAX=2*MNODE+MU
      ISYM=1
1      FORMAT(10X,'SYMMETRY is checked and ISYM =',I5/)
      DO 100 I=1,M2-1
      DO 100 J=I+1,M2
      TEST=AK(I,J)-AK(J,I)
      IF(DABS(TEST).GT.1.0D-10) ISYM=0
100    CONTINUE
      WRITE(6,1) ISYM
2000   CONTINUE
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE EXCEL
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NP2=2*NPMESH)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)
      PARAMETER (NAX2=500)
      PARAMETER (NAX=1000)
      PARAMETER (NTWO=2*NAX1)
      PARAMETER (N2=2*NNODE)
      PARAMETER (NU=500)
      PARAMETER (NF=500)
      PARAMETER (NIC=100)
      COMMON/ABC/ID(10),IER
      COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)

```



```

COMMON/CBC/MPMESH, MEMESH, MNODE, MSAMP, MAX1, MAX2, MU, MF, MIC
COMMON/DBC/IJK(4, NEMESH)
COMMON/EBC/XNODE(NNODE), YNODE(NNODE), RNODE(NNODE)
COMMON/FBC/DEN, RADIUS, YOUNG, POISSON, YDAMP, PDAMP, DK(3,3), DC(3,3)
COMMON/GBC/LMN1(NAX1, NSAMP), NN1(NSAMP), LMN2(NAX2, NSAMP), NN2(NSAMP)
COMMON/HBC/PHI(NAX1, NSAMP), PHIX(NAX1, NSAMP), PHIY(NAX1, NSAMP)
COMMON/IBC/AREA(NSAMP), H(NSAMP), HMAX, FACTOR(NAX2, NSAMP)
COMMON/JBC/XB(NU), YB(NU), SCALE1(NU), ICU(NU)
COMMON/MBC/AM(N2, N2), AC(N2, N2), AK(N2, N2), AG(NU, N2), FU(N2), FL(NU)
COMMON/NBC/AAA(NAX, NAX), U(NAX), UDOT(NAX), UDD(NAX), F(NAX)
COMMON/OBC/DTIME, TREF, ITIME, MTIME
COMMON/PBC/DISP(NP2), STRAIN(3, NSAMP), STRESS(3, NSAMP)
COMMON/UBC/MUPRINT, MSPRINT, IUPRINT(4), ISPRINT(3)
DIMENSION NNN(NAX1)
DIMENSION S(NAX1), SX(NAX1), SY(NAX1)
DIMENSION UPRINT(8), SPRINT(9)
DIMENSION ERATE(3, NSAMP)
123  FORMAT(F8.3, 9F8.4)
      TIME=ITIME*DTIME
C=====
      MAX=2*MNODE+MU
      MUP=2*MUPRINT
      MSP=3*MSPRINT
C=====
C      DO 100 IP=1,MPMESH
      KK=0
      DO 100 L=1,MUPRINT
      IP=IUPRINT(L)
      X=XMESH(IP)
      Y=YMESH(IP)
      IX=2*IP-1
      IY=IX+1
      KK=KK+1
      UPRINT(KK)=0
      KK=KK+1
      UPRINT(KK)=0
      CALL SHAPE1(X, Y, NUMBER, NNN, S)
      DO 200 K=1,NUMBER
      JP=NNN(K)
      JX=2*JP-1
      JY=JX+1
      UPRINT(KK-1)=UPRINT(KK-1)+S(K)*U(JX)
      UPRINT(KK)=UPRINT(KK)+S(K)*U(JY)
200  CONTINUE
100  CONTINUE
      WRITE(3,123) TIME, (UPRINT(JJ), JJ=1, MUP)
      DO 300 IE=1,MSAMP
      X=XSAMP(IE)
      Y=YSAMP(IE)
      CALL SHAPE3(X, Y, NUMBER, NNN, S, SX, SY)
      STRAIN(1, IE)=0.0D0
      STRAIN(2, IE)=0.0D0
      STRAIN(3, IE)=0.0D0
      ERATE(1, IE)=0.0D0
      ERATE(2, IE)=0.0D0
      ERATE(3, IE)=0.0D0
      DO 350 K=1,NUMBER

```

```

      JP=NNN(K)
      JX=2*JP-1
      JY=JX+1
      STRAIN(1,IE)=STRAIN(1,IE)+SX(K)*U(JX)
      STRAIN(2,IE)=STRAIN(2,IE)+SY(K)*U(JY)
      STRAIN(3,IE)=STRAIN(3,IE)+SX(K)*U(JY)+SY(K)*U(JX)
      ERATE(1,IE)=ERATE(1,IE)+SX(K)*UDOT(JX)
      ERATE(2,IE)=ERATE(2,IE)+SY(K)*UDOT(JY)
      ERATE(3,IE)=ERATE(3,IE)+SX(K)*UDOT(JY)+SY(K)*UDOT(JX)
350    CONTINUE
300    CONTINUE
      KK=0
      DO 400 L=1,MSPRINT
      IS=ISPRINT(L)
C      DO 400 IS=1,MSAMP
      KK=KK+1
      SPRINT(KK)=0.0D0
      KK=KK+1
      SPRINT(KK)=0.0D0
      KK=KK+1
      SPRINT(KK)=0.0D0
      IF(ID(2).EQ.2) GO TO 650
      DO 501 I=1,3
      II=KK-3+I
      DO 501 J=1,3
      SPRINT(II)=SPRINT(II)+DK(I,J)*STRAIN(J,IS)+
*          DC(I,J)*ERATE(J,IS)
501    CONTINUE
      GO TO 550
650    CONTINUE
      HH=1.0D0/H(IS)
      DO 500 K=1,NN2(IS)
      JS=LMN2(K,IS)
      AA=AREA(JS)
      FACT=FACTOR(K,IS)
      DO 500 I=1,3
      II=KK-3+I
      DO 500 J=1,3
      SPRINT(II)=SPRINT(II)+HH*AA*FACT*(DK(I,J)*STRAIN(J,JS)+
*          DC(I,J)*ERATE(J,JS))
500    CONTINUE
550    CONTINUE
400    CONTINUE
      WRITE(4,123) TIME,(SPRINT(JJ),JJ=1,MSP)
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE PRESENT
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NP2=2*NPMESH)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      PARAMETER (NNODE=500)
      PARAMETER (NAX1=500)

```

```

PARAMETER (NAX2=500)
PARAMETER (NAX=1000)
PARAMETER (NTWO=2*NAX1)
PARAMETER (N2=2*NNODE)
PARAMETER (NU=500)
PARAMETER (NF=500)
PARAMETER (NIC=100)
COMMON/ABC/ID(10),IER
COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
COMMON/DBC/IJK(4,NEMESH)
COMMON/EBC/XNODE(NNODE),YNODE(NNODE),RNODE(NNODE)
COMMON/FBC/DEN,RADIUS,YOUNG,POISSON,YDAMP,PDAMP,DK(3,3),DC(3,3)
COMMON/GBC/LMN1(NAX1,NSAMP),NN1(NSAMP),LMN2(NAX2,NSAMP),NN2(NSAMP)
COMMON/HBC/PHI(NAX1,NSAMP),PHIX(NAX1,NSAMP),PHIY(NAX1,NSAMP)
COMMON/IBC/AREA(NSAMP),H(NSAMP),HMAX,FACTOR(NAX2,NSAMP)
COMMON/JBC/XB(NU),YB(NU),SCALE1(NU),ICU(NU)
COMMON/MBC/AM(N2,N2),AC(N2,N2),AK(N2,N2),AG(NU,N2),FU(N2),FL(NU)
COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
COMMON/OBC/DTIME,TREF,ITIME,MTIME
COMMON/PBC/DISP(NP2),STRAIN(3,NSAMP),STRESS(3,NSAMP)
DIMENSION NNN(NAX1)
DIMENSION S(NAX1),SX(NAX1),SY(NAX1)
DIMENSION ERATE(3,NSAMP)
3  FORMAT(10X/5X,'*****')
WRITE(6,3)
WRITE(6,3)
TIME=ITIME*DTIME
WRITE(6,33) ITIME,DTIME
33  FORMAT(5X,'in PRESENT: ITIME, DTIME =',I5,E15.8/)
C=====
MAX=2*MNODE+MU
C=====
WRITE(6,11)
DO 100 IP=1,MPMESH
X=XMESH(IP)
Y=YMESH(IP)
IX=2*IP-1
IY=IX+1
DISP(IX)=0.0D0
DISP(IY)=0.0D0
CALL SHAPE1(X,Y,NUMBER,NNN,S)
DO 200 K=1,NUMBER
JP=NNN(K)
JX=2*JP-1
JY=JP+1
DISP(IX)=DISP(IX)+S(K)*U(JX)
DISP(IY)=DISP(IY)+S(K)*U(JY)
200 CONTINUE
11  FORMAT(/10X,'The followings are disp. on mesh points :'/)
WRITE(6,1) IP,DISP(IX),DISP(IY)
1  FORMAT(2X,'IP=',I3,2X,'UX=',F15.8,2X,'UY=',F15.8)
100 CONTINUE
WRITE(6,3)
WRITE(6,23)
23  FORMAT(10X/
*10X,'The followings are strains at sampling points: '/')

```

```

DO 300 IE=1,MSAMP
X=XSAMP(IE)
Y=YSAMP(IE)
CALL SHAPE3(X,Y,NUMBER,NNN,S,SX,SY)
STRAIN(1,IE)=0.0D0
STRAIN(2,IE)=0.0D0
STRAIN(3,IE)=0.0D0
ERATE(1,IE)=0.0D0
ERATE(2,IE)=0.0D0
ERATE(3,IE)=0.0D0
DO 350 K=1,NUMBER
JP=NNN(K)
JX=2*JP-1
JY=JX+1
STRAIN(1,IE)=STRAIN(1,IE)+SX(K)*U(JX)
STRAIN(2,IE)=STRAIN(2,IE)+SY(K)*U(JY)
STRAIN(3,IE)=STRAIN(3,IE)+SX(K)*U(JY)+SY(K)*U(JX)
ERATE(1,IE)=ERATE(1,IE)+SX(K)*UDOT(JX)
ERATE(2,IE)=ERATE(2,IE)+SY(K)*UDOT(JY)
ERATE(3,IE)=ERATE(3,IE)+SX(K)*UDOT(JY)+SY(K)*UDOT(JX)
350 CONTINUE
WRITE(6,22) IE,(STRAIN(L,IE),L=1,3)
22 FORMAT(2X,'IE=',I3,' Ex, Ey, Exy =',3(1X,E15.8))
300 CONTINUE
WRITE(6,3)
WRITE(6,25)
25 FORMAT(10X/
*10X,'The followings are stresses at sampling points: '/
*10X/
*9X,'X',9X,'Y',12X,'Sxx',13X,'Syy',13X,'Sxy' /)
DO 400 IS=1,MSAMP
STRESS(1,IS)=0.0D0
STRESS(2,IS)=0.0D0
STRESS(3,IS)=0.0D0
IF(ID(2).EQ.2) GO TO 650
DO 501 I=1,3
DO 501 J=1,3
STRESS(I,IS)=STRESS(I,IS)+DK(I,J)*STRAIN(J,IS)+
1 DC(I,J)*ERATE(J,IS)
501 CONTINUE
GO TO 550
650 CONTINUE
HH=1.0D0/H(IS)
DO 500 K=1,NN2(IS)
JS=LMN2(K,IS)
AA=AREA(JS)
FACT=FACTOR(K,IS)
DO 500 I=1,3
DO 500 J=1,3
STRESS(I,IS)=STRESS(I,IS)+HH*AA*FACT*(DK(I,J)*STRAIN(J,JS)+
* DC(I,J)*ERATE(J,JS))
500 CONTINUE
550 WRITE(6,2) IS,(STRESS(L,IS),L=1,3)
2 FORMAT(2X,'IE=',I3,' Sx, Sy, Sxy =',3(1X,E15.8))
400 CONTINUE
WRITE(6,3)
WRITE(6,9)

```

```

9      FORMAT(5X/5X,'The followings are checks for essential BC :'/)
C      CALL AMP(TIME,FACTF,FACTU)
C      CALL FTIME(TIME,FACT)
C      DO 600 I=1,MU
C          X=XB(I)
C          Y=YB(I)
C          IC=ICU(I)
C          US=SCALE1(I)*FACT
C          UC=0.0D0
C          DO 700 J=1,M2
700      UC=UC+AAA(I+M2,J)*U(J)
C          WRITE(6,4) I,ICU(I),X,Y,US,UC
600      CONTINUE
4      FORMAT(2X,2I3,' x, y =',2F10.5,' U-spe, U-cal =',2F10.5)
C          WRITE(6,3)
C          RETURN
C          END
C=====
C=====
C=====
C          SUBROUTINE IDEAS1
C-----C
C      This is a 2-D case.                                C
C                                                                C
C      Subroutine to print nodal coordinate and element connectivity in C
C      IDEAS format for postprocessing.                    C
C-----C
C          IMPLICIT REAL*8 (A-H,O-Z)
C          PARAMETER (NPMESH=2000)
C          PARAMETER (NEMESH=1600)
C          PARAMETER (NSAMP=NEMESH)
C          COMMON/BBC/XMESH(NPMESH),YMESH(NPMESH),XSAMP(NSAMP),YSAMP(NSAMP)
C          COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
C          COMMON/DBC/IJK(4,NEMESH)
10      FORMAT ('      -1')
11      FORMAT ('      781')
12      FORMAT(4I10)
13      FORMAT(1P3D25.16)
14      FORMAT ('      780')
15      FORMAT(8I10)
C-----C
C      write nodal coordinates                                C
C-----C
C          WRITE(8,10)
C          WRITE(8,11)
C          Z=0
C          DO 100 I=1, MPMESH
C          WRITE(8,12) I,0,0,11
C          WRITE(8,13) XMESH(I),YMESH(I),Z
100      CONTINUE
C          WRITE(8,10)
C-----C
C      write the element no. and connectivity                C
C-----C
C          WRITE(8,10)
C          WRITE(8,14)
C          DO 200 I=1,MEMESH

```

```

C      WRITE(8,15) I,115,1,2,1,1,7,8
C      WRITE(8,15) I,94,1,3,1,1,11,4
C      WRITE(8,15) (IJK(J,I),J=5,8),(IJK(K,I),K=1,4)
C      WRITE(8,15) (IJK(K,I),K=1,4)
200    CONTINUE
C      WRITE(8,10)
C      RETURN
C      END

C=====
C=====
C=====
      SUBROUTINE IDEAS2
C-----C
C      This is a 2-D case.                                C
C                                                         C
C      Subroutine to print out stresses and displacements
C                                                         C
C-----C
      IMPLICIT REAL*8 (A-H,O-Z)
      PARAMETER (NPMESH=2000)
      PARAMETER (NP2=2*NPMESH)
      PARAMETER (NEMESH=1600)
      PARAMETER (NSAMP=NEMESH)
      COMMON/CBC/MPMESH,MEMESH,MNODE,MSAMP,MAX1,MAX2,MU,MF,MIC
      COMMON/OBC/DTIME,TREF,ITIME,MTIME
      COMMON/PBC/DISP(NP2),STRAIN(3,NSAMP),STRESS(3,NSAMP)
C=====
C=====
C=====
31     FORMAT ('      -1')
32     FORMAT ('      56')
33     FORMAT ('RATIO=',E14.8,' at ITIME=',I3)
35     FORMAT ('Model Solution From POLAR')
36     FORMAT (5X,'ITIME =',I5)
37     FORMAT (5X,'Time =',F15.8)
38     FORMAT ('      ')
39     FORMAT (6I10)
40     FORMAT (A6)
41     FORMAT (1P6E13.5)
42     FORMAT (14X,I5)
43     FORMAT ('      55')
51     FORMAT ('The Stress Data at :')
52     FORMAT ('The Displacement Data at :')
57     FORMAT (5X)
C-----C
C      writes stresses of each element                    C
C-----C
      TIME=ITIME*DTIME
      WRITE(6,1) ITIME,DTIME,TIME
1     FORMAT(5X/10X,'In ideas2 :'/
*15X,'ITIME =',I5/
*15X,'DTIME =',E15.8/
*15X,'TIME =',E15.8/)
      WRITE(8,31)
      WRITE(8,32)
      WRITE(8,51)
      WRITE(8,36) ITIME

```

```

        WRITE(8,57)
        WRITE(8,37) TIME
        WRITE(8,38)
        WRITE(8,39) 1,1,4,2,2,6
        WRITE(8,39) 1,1,ITIME
        WRITE(8,41) 0.0E0
        DO 100 IE=1,MSAMP
        WRITE(8,39) IE
100      WRITE(8,41) STRESS(1,IE),STRESS(3,IE),STRESS(2,IE)
        WRITE(8,31)
C-----C
C      write displacements of each node      C
C-----C
        WRITE(8,31)
        WRITE(8,43)
        WRITE(8,52)
        WRITE(8,36) ITIME
        WRITE(8,57)
        WRITE(8,37) TIME
        WRITE(8,38)
        WRITE(8,39) 1,1,3,8,2,6
        WRITE(8,39) 1,1,ITIME
        WRITE(8,41) 0.0E0
        DO 400 I=1,MPMESH
        J1=(I-1)*2+1
        J2=J1+1
        WRITE(8,39) I
        WRITE(8,41) (DISP(K),K=J1,J2)
400      CONTINUE
        WRITE(8,31)
        RETURN
        END
C=====
C=====
C=====
        SUBROUTINE INVERSION(M,A,NA,B,NB)
        IMPLICIT REAL*8 (A-H,O-Z)
        COMMON/ABC/ID(10),IER
        DIMENSION A(NA,NA),B(NB,NB),T(M,M)
C*****
        AMAX=0
        IER=0
        DO 10 I=1,M
        DO 10 J=1,M
        B(I,J)=0.0D0
        IF(I.EQ.J) B(I,J)=1.0D0
        IF(DABS(A(I,J)).GT.AMAX) AMAX=DABS(A(I,J))
10      T(I,J)=A(I,J)
        AERROR=AMAX*1.0D-8
C*****
        DO 100 K=1,M-1
        DO 100 I=K+1,M
        FACT = -T(I,K)/T(K,K)
        DO 101 J=K+1,M
        T(I,J) = T(I,J)+FACT*T(K,J)
101      CONTINUE
        DO 102 J=1,M

```

```

      B(I,J)=B(I,J)+FACT*B(K,J)
102  CONTINUE
100  CONTINUE
C*****
      IF(DABS(T(M,M)).LT.AERROR) IER=1
      IF(DABS(T(M,M)).LT.AERROR) WRITE(6,2) M,T(M,M)
      DO 200 J=1,M
      B(M,J)=B(M,J)/T(M,M)
200  CONTINUE
C*****
      DO 400 K=1,M-1
      I = M-K
      IF(DABS(T(I,I)).LT.AERROR) IER=1
      IF(DABS(T(I,I)).LT.AERROR) WRITE(6,2) I,T(I,I)
      DO 500 J=I+1,M
      DO 500 L=1,M
      B(I,L)=B(I,L)-T(I,J)*B(J,L)
500  CONTINUE
      DO 550 L=1,M
      B(I,L)=B(I,L)/T(I,I)
550  CONTINUE
400  CONTINUE
C*****
      DO 1000 I=1,M
      DO 1000 J=1,M
      T(I,J)=0.0D0
      IF(I.EQ.J) T(I,J)=-1.0D0
      DO 900 K=1,M
900  T(I,J)=T(I,J)+A(I,K)*B(K,J)
      IF(DABS(T(I,J)).GT.1.0D-6) IER=1
      IF(DABS(T(I,J)).GT.1.0D-6) WRITE(6,1) I,J,T(I,J)
1000 CONTINUE
1  FORMAT(2I5,' in INVERSION ',E15.8)
2  FORMAT(5X,' in inversion ',I5,2X,'T=',E15.8/)
C*****
      RETURN
      END

```

```

C=====
C=====
C=====

```

```

      SUBROUTINE BARRIER(X1,Y1,X2,Y2,IPASS)
      IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/ABC/ID(10),IER
      COMMON/SBC/XBARRIER(2),YBARRIER(2)
      IPASS=1
      IF(ID(5).NE.1) GO TO 1000
C  XB1=XBARRIER(1)
C  YB1=YBARRIER(1)
      XB2=XBARRIER(2)
C  YB2=YBARRIER(2)
      IF(X1.GE.XB2.AND.X2.GE.XB2) GO TO 1000
      YTEST=Y1*Y2
      IF(YTEST.GE.0.0D0) GO TO 1000
      DX=DABS(X2-X1)
      DY=DABS(Y2-Y1)
      IF(DY.LT.1.0D-9) GO TO 1000
      IF(DX.LT.1.0D-9) IPASS=0

```



```

        IF(DX.LT.1.0D-9) GO TO 1000
        S=(Y2-Y1)/(X2-X1)
        B=Y1-S*X1
        XX=-B/S
        IF(XX.GE.XB2) GO TO 1000
        IPASS=0
1000  CONTINUE
C      IF(IPASS.EQ.0) WRITE(6,1) X1,Y1,X2,Y2,IPASS
C      WRITE(6,1) X1,Y1,X2,Y2,IPASS
1      FORMAT(2X,'BARRIER: X1, Y1=',2F15.8/
*11X,'X2, Y2=',2F15.8,' ipass =',I5)
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE NEWMARK(AM,AC,AK,FU,ITIME,DTIME,MTIME,IPRINT,M,N)
      IMPLICIT REAL*8 (A-H,O-U)
      PARAMETER (NAX=1000)
      COMMON/NBC/AAA(NAX,NAX),U(NAX),UDOT(NAX),UDD(NAX),F(NAX)
      DIMENSION AM(N,N),AC(N,N),AK(N,N)
      DIMENSION FU(*)
      DIMENSION FF(M)
      DELTA=0.5D0
      ALPHA=0.25D0
      AN0=1.0D0/DTIME/DTIME/ALPHA
      AN1=DELTA/DTIME/ALPHA
      AN2=1.0D0/DTIME/ALPHA
      AN3=0.5D0/ALPHA-1.0D0
      AN4=DELTA/ALPHA-1.0D0
      AN5=0.5D0*DTIME*(DELTA/ALPHA-2.0D0)
      AN6=DTIME*(1.0D0-DELTA)
      AN7=DELTA*DTIME
      WRITE(6,1) DTIME,MTIME,IPRINT
1      FORMAT(5X,'DTIME, MTIME, IPRINT =',E15.8,2I5/)
      ITIME=0
      TIME=ITIME*DTIME
      CALL FTIME(TIME,FACTOR)
      WRITE(6,6) ITIME,TIME,FACTOR
6      FORMAT(5X,I5,' TIME=',E15.8,' factor=',E15.8/)
C=====
C=====
      DO 100 I=1,M
      FF(I)=FU(I)*FACTOR
      DO 100 J=1,M
100  FF(I)=FF(I)-AC(I,J)*UDOT(J)-AK(I,J)*U(J)
C=====
C=====
      CALL GAUSS(M,AM,FF,UDD,N,IER)
      IF(IER.NE.0) GO TO 2000
C=====
C=====
      DO 200 I=1,M
      DO 200 J=1,M
      AK(I,J)=AK(I,J)+AN0*AM(I,J)+AN1*AC(I,J)
200  CONTINUE
C=====

```

```

C=====
      CALL SIMPIN(M,AK,N,IER)
      IF( IER.NE.0) GO TO 2000
C=====
C=====
1000  CONTINUE
      ITIME=ITIME+1
      TIME=ITIME*DTIME
      CALL FTIME(TIME,FACTOR)
      WRITE(6,6) ITIME,TIME,FACTOR
      DO 300 I=1,M
        FF(I)=FU(I)*FACTOR
        DO 300 J=1,M
          TM=AN0*U(J)+AN2*UDOT(J)+AN3*UDD(J)
          TC=AN1*U(J)+AN4*UDOT(J)+AN5*UDD(J)
300    FF(I)=FF(I)+AM(I,J)*TM+AC(I,J)*TC
          DO 400 I=1,M
            UPLUS=0
            DO 450 J=1,M
450      UPLUS=UPLUS+AK(I,J)*FF(J)
            ZDD=AN0*(UPLUS-U(I))-AN2*UDOT(I)-AN3*UDD(I)
            UDOT(I)=UDOT(I)+AN6*UDD(I)+AN7*ZDD
            U(I)=UPLUS
            UDD(I)=ZDD
400    CONTINUE
          CALL EXCEL
          ITEST=ITIME/IPRINT
          ITEST=ITIME-ITEST*IPRINT
          IF(ITEST.EQ.0) CALL PRESENT
          IF(ITEST.EQ.0) CALL IDEAS2
          IF(ITIME.LT.MTIME) GO TO 1000
2000  CONTINUE
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE SIMPIN(M,T,NA,IER)
      IMPLICIT REAL*8 (A-H,O-Z)
      DIMENSION T(NA,NA),B(M,M),A(M,M)
C*****
      AMAX=0
      DO 10 I=1,M
        DO 10 J=1,M
          B(I,J)=0.0D0
          A(I,J)=T(I,J)
          IF(DABS(T(I,J)).GT.AMAX) AMAX=DABS(T(I,J))
          IF(I.EQ.J) B(I,J)=1.0D0
10    CONTINUE
      IER = 0
      AERROR=AMAX*1.0D-10
      DO 100 K=1,M-1
        KMAX=K
        TMAX=DABS(T(K,K))
        DO 110 KK=K+1,M
          IF(TMAX.GE.DABS(T(KK,K))) GO TO 110
          KMAX=KK

```

```

      TMAX=DABS(T(KK,K))
110  CONTINUE
      IF(KMAX.EQ.K) GO TO 111
C     RF=F(K)
C     F(K)=F(KMAX)
C     F(KMAX)=RF
      DO 119 J=1,M
      RT=B(K,J)
      B(K,J)=B(KMAX,J)
119  B(KMAX,J)=RT
      DO 120 KK=K,M
      RT=T(K,KK)
      T(K,KK)=T(KMAX,KK)
120  T(KMAX,KK)=RT
111  CONTINUE
      DO 100 I=K+1,M
      FACT = -T(I,K)/T(K,K)
      DO 101 J=K+1,M
      T(I,J) = T(I,J)+FACT*T(K,J)
101  CONTINUE
      DO 102 J=1,M
      B(I,J)=B(I,J)+FACT*B(K,J)
102  CONTINUE
100  CONTINUE
C*****
      IF(DABS(T(M,M)).LT.AERROR) IER=1
      DO 200 J=1,M
      B(M,J)=B(M,J)/T(M,M)
200  CONTINUE
C*****
      DO 400 K=1,M-1
      I = M-K
      IF(DABS(T(I,I)).LT.AERROR) IER=1
      DO 500 J=I+1,M
      DO 500 L=1,M
      B(I,L)=B(I,L)-T(I,J)*B(J,L)
500  CONTINUE
      DO 550 L=1,M
      B(I,L)=B(I,L)/T(I,I)
550  CONTINUE
400  CONTINUE
C*****
      DO 900 I=1,M
      DO 900 J=1,M
      TEST=0
      IF(I.EQ.J) TEST=-1
      DO 950 K=1,M
950  TEST=TEST+A(I,K)*B(K,J)
      IF(DABS(TEST).LT.1.0D-7) GO TO 900
      IER=1
      WRITE(6,1) I,J,TEST
900  CONTINUE
      IF(IER.EQ.1) GO TO 2000
      WRITE(6,2)
1    FORMAT(5X,2I5,' test=',5X,E15.8/)
2    FORMAT(5X,'SIMPIN did a good job!'/)
      DO 1000 I=1,M

```

```

        DO 1000 J=1,M
        T(I,J)=B(I,J)
1000    CONTINUE
2000    CONTINUE
        RETURN
        END
C=====
C=====
C=====
        SUBROUTINE GAUSS(M,A,APF,Y,NA,IER)
        IMPLICIT REAL*8 (A-H,O-Z)
        DIMENSION A(NA,NA)
        DIMENSION T(M,M),F(M)
        DIMENSION Y(*),APF(*)
C=====
C=====
        IER = 0
        FMAX=0.0
        DO 10 I=1,M
        F(I)=APF(I)
        IF(DABS(F(I)).GT.FMAX) FMAX=DABS(F(I))
        DO 10 J=1,M
        IF(DABS(A(I,J)).GT.AMAX) AMAX=DABS(A(I,J))
10      T(I,J)=A(I,J)
C=====
C=====
        DO 100 K=1,M-1
        KMAX=K
        TMAX=DABS(T(K,K))
        DO 110 KK=K+1,M
        IF(TMAX.GE.DABS(T(KK,K))) GO TO 110
        KMAX=KK
        TMAX=DABS(T(KK,K))
110    CONTINUE
        IF(KMAX.EQ.K) GO TO 111
        RF=F(K)
        F(K)=F(KMAX)
        F(KMAX)=RF
        DO 120 KK=K,M
        RT=T(K,KK)
        T(K,KK)=T(KMAX,KK)
120    T(KMAX,KK)=RT
111    CONTINUE
        DO 100 I=K+1,M
        FACT = -T(I,K)/T(K,K)
        F(I) = F(I)+FACT*F(K)
        DO 100 J=K+1,M
        T(I,J) = T(I,J)+FACT*T(K,J)
100    CONTINUE
C=====
C=====
C=====
        Y(M) = F(M)/T(M,M)
C=====
C=====
C=====
        DO 400 K=1,M-1

```

```

      I = M-K
      DO 500 J=I+1,M
      F(I) = F(I)-T(I,J)*Y(J)
500   CONTINUE
      Y(I) = F(I)/T(I,I)
400   CONTINUE
C=====
C=====
C=====
      DO 600 I=1,M
      TEST=APF(I)
      DO 601 J=1,M
601   TEST=TEST-A(I,J)*Y(J)
      TEST=DABS(TEST)/FMAX
      IF(DABS(TEST).GT.1.0D-7) IER=1
      IF(DABS(TEST).GT.1.0D-9) WRITE(6,1) I,FMAX,APF(I),TEST
600   CONTINUE
      IF(IER.EQ.0) WRITE(6,2)
1     FORMAT(2X,'in GAUSS:',I5,' FMAX, f and test =',E10.3,E12.5,F14.9)
2     FORMAT(10X,'GAUSS did a good job.'/)
      RETURN
      END
C=====
C=====
C=====
      SUBROUTINE FTIME(T,FACTOR)
      IMPLICIT REAL*8 (A-H,O-Z)
      COMMON/OBC/DTIME,TREF,ITIME,MTIME

C
C
C      This is a user-specified subroutine.
C
C      The following example says:
C
C      The factor in time equals 1 for t less than the reference t,
C      for t greater than t-reference, the factor is equal to zero.
C
C
      FACTOR=0
      IF(T.LE.TREF) FACTOR=1
      RETURN
      END

```



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