PROGRAM DYNCONE

C DYNAMIC CONE PENETRATION TEST

C TIME INTEGRATION IMPLICIT ALGORITHM

C CONSTANT STRAIN 3 AND 4 NODED ELEMENTS

C COMPRESSIVE STRESS IS POSITIVE

C AXI-SYMMETRIC TYPE, ORDER OF STRAINS: R,Z,RZ,THETA

C SHEAR-BANDING STRESS-STRAIN RELATIONSHIP

C

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

 COMMON/LA11/IREQD(10),IREQS(10)

 COMMON/LA12/ACCEH(2390),ACCEV(2390)

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA14/XMASS(2390,2390),STIFF(2390,2390),STIFS(2390,2390)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA17/VELOI(2390),VELOL(2390),VELOT(2390)

 COMMON/LA18/ACCEI(2390),ACCEL(2390)

 COMMON/LA19/DAMPI(2390,2390),RESID(2390)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA22/NTENS,KTENS,ITENS(1260),JTENS(1260)

 COMMON/LA23/TMX(1260,4,4),TMI(1260,4,4)

C

 OPEN(5,FILE='DADYNCONE',STATUS='UNKNOWN')

 OPEN(6,FILE='PRDYNCONE',STATUS='UNKNOWN')

 OPEN(8,FILE='PRDISPL',STATUS='UNKNOWN')

 OPEN(9,FILE='STRESHIS',STATUS='UNKNOWN')

 OPEN(10,FILE='PRSTRES',STATUS='UNKNOWN')

 OPEN(11,FILE='M-AVS1.INP',STATUS='UNKNOWN')

 OPEN(12,FILE='M-AVS2.INP',STATUS='UNKNOWN')

 OPEN(13,FILE='M-AVS3.INP',STATUS='UNKNOWN')

C

 CALL INPUTD

 CALL LINKIN

 CALL INTIME

 CALL PREVOS

 CALL LOADPL

 CALL LUMASS

 CALL GSTIFF

C

 DO 10 ISTEP=1,NSTEP

 DO 20 IITER=1,MITER

 CALL IMPEXP(IITER,ISTEP)

 CALL RESEPL(IITER,ISTEP)

 CALL ITRATE(IITER)

 IF(NCHEK.EQ.1) GO TO 15

 20 CONTINUE

 15 CALL OUTDYN(IITER,ISTEP)

 IOUT=NOUTD(ISTEP)

 IF(IOUT.LE.0) GO TO 10

 CALL MAVS1

 CALL MAVS2

 CALL MAVS3

 10 CONTINUE

C

 CLOSE(5)

 CLOSE(6)

 CLOSE(8)

 CLOSE(9)

 CLOSE(10)

 CLOSE(11)

 CLOSE(12)

 CLOSE(13)

 STOP

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE INPUTD

C \*\*\* INPUT ROUTINE

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 DIMENSION TITLE(20),IDA(10),IDAQ(10),NET(10)

C

 NN=2390

 DO 2 I=1,10

 2 IDAQ(I)=0

 DO 4 I=1,6

 4 NET(I)=0

 READ(5,100) (TITLE(I),I=1,15)

 WRITE(6,100) (TITLE(I),I=1,15)

C NPOIN: NUMBER OF NODES, NELEM:NUMBER OF ELEMENTS

C NMATS: NUMBER OF MATERIALS

C NIST : NUMBER OF INITIAL STRESS GROUPS

C NPREV=1: CONSIDER INITIAL STRESSES IN EACH ELEMENT

C 0: NOT CONSIDER

C ICON=1: CONSIDER NON-LINEAR STRESS-STRAIN RELATIONSHIP

C =0: NOT CONSIDER

C ICRI=1: PERFECYLY PLASTIC

C =0: PLASTIC

C IPR=1: PRINT NODE & ELEMENT DATA

C 0: NOT PRINT

 READ(5,101) NPOIN,NELEM,NMATS,NIST,NPREV,ICON,ICRI,IPR

 WRITE(6,200) NPOIN,NELEM,NMATS,NIST,NPREV,ICON,ICRI,IPR

C \*\*\* NODAL COORDINATES

 WRITE(6,201)

 DO 10 IP=1,NPOIN

 READ(5,102) K,XX(IP),YY(IP),IX(IP),IY(IP),IQ(IP)

 IF(IPR.EQ.0) GO TO 10

 WRITE(6,102) K,XX(IP),YY(IP),IX(IP),IY(IP),IQ(IP)

 10 CONTINUE

C \*\*\* ELEMENT DATA

C TRUSS=1,BEAM=2,TEXTILE=3,PLANE-STRAIN=4,5(NL)

C INTERFACE=6(I-J:SHEAR DIREC.,ANTI-CLOCKWISE)

 DO 12 IE=1,NELEM

 READ(5,103) K,(IJK(IE,I),I=1,4),(IDA(I),I=1,4)

 DO 14 I=1,5

 IF(IDA(I).EQ.0) IDA(I)=IDAQ(I)

 IF(IDA(I).LT.0) IDA(I)=0

 14 IDAQ(I)=IDA(I)

 K2(IE)= IDA(1)

 MAT(IE)=IDA(2)

 IST(IE)=IDA(3)

 LRE(IE)=IDA(4)

 N=K2(IE)

 NET(N)=NET(N)+1

 12 CONTINUE

 WRITE(6,202) (NET(I),I=1,6)

 WRITE(6,203)

 DO 20 IE=1,NELEM

 IF(IPR.EQ.0) GO TO 20

 WRITE(6,204) IE,(IJK(IE,I),I=1,4),K2(IE),MAT(IE),IST(IE),LRE(IE)

 20 CONTINUE

C \*\*\* MATERIAL PROPERTIES

C SOLID 1:E,2:NYU,3:THICK,4:RHO,5:C,6:FAI,7:DLT,8:ALFA,9:BETA

C INTERFACE 1:G,2:E,3:NYU,4:RHO,5:C,6:FAI,7:DLT,8:ALFA,9:BETA

C TRUSS 1:E,2:AREA,3:0,4:RHO,5:0,6:0,7:0,8:ALFA,9:BETA

C BEAM 1;E,2:AREA,3:I,4:RHO,5:0,6:0,7:0,8:ALFA,9:BETA

 WRITE(6,205)

 DO 30 MT=1,NMATS

 READ(5,105) M,(PRP(MT,I),I=1,9)

 WRITE(6,206) M,(PRP(MT,I),I=1,9)

 30 CONTINUE

 DO 32 IE=1,NELEM

 MT=MAT(IE)

 EE0(IE)=PRP(MT,1)

 EE(IE)=EE0(IE)

 32 CONTINUE

 READ(5,104) RFAIL

 WRITE(6,207) RFAIL

C

 100 FORMAT(15A4)

 101 FORMAT(15I5)

 102 FORMAT(I5,2F10.3,3I5)

 103 FORMAT(10I5)

 104 FORMAT(8E10.3)

 105 FORMAT(I5,9E8.3)

 200 FORMAT(/'NODES=',I4,' ELEMENTS=',I4,' MATERIALS=',I3,

 \* /' SETS OF INITIAL-STRESSES=',I3

 \* /' PREVIOUS STRESSES=',I2,' NON-LINEAR=',I2

 \* /' PERFECTLY PLASTIC=',I3,' PRINT=',I2)

 201 FORMAT(/'NODAL DATA'/' NO.',9X,'X',9X,'Y',' X-F Y-F R-F')

 202 FORMAT(/'TRUSS=',I3,' BEAM=',I3,' TEXTILE=',I3,' P-STRA=',I4

 \*/' P-STRA(NL)=',I4,' INTERFACE=',I4)

 203 FORMAT(/'ELEMENT DATA'/' NO. NODES TYPE MAT IST L-R')

 204 FORMAT(10I5)

 205 FORMAT(/'MATERIAL PARAMETERS'

 \* /'NO. E NYU THICK RHO C FAI DELT ALFA BETA'/)

 206 FORMAT(I2,10E10.3)

 207 FORMAT(/'FAILURE RATIO=',F7.3)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE LINKIN

C \*\*\* LINKS WITH PROFILE SOLVER

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 DIMENSION LX(6500),NDF(1280)

C

 DO 10 IP=1,NPOIN

 10 NDF(IP)=2

 DO 12 IE=1,NELEM

 IF(K2(IE).NE.2) GO TO 12

 I=IJK(IE,1)

 J=IJK(IE,2)

 NDF(I)=3

 NDF(J)=3

 12 CONTINUE

 DO 20 IP=1,NPOIN

 LY(3\*IP-2)=IX(IP)

 LY(3\*IP-1)=IY(IP)

 IF(NDF(IP).EQ.2) IQ(IP)=1

 20 LY(3\*IP)=IQ(IP)

 NX=3\*NPOIN

 LOC=0

 DO 22 L=1,NX

 IF(LY(L).EQ.0) GO TO 24

 LY(L)=NN

 GO TO 22

 24 LOC=LOC+1

 LX(LOC)=L

 LY(L)=LOC

 22 CONTINUE

 NSIZE=LOC

 WRITE(6,200) NSIZE

 200 FORMAT(/'NUMBER OF VARIABLES',I5)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE INTIME

C \*\*\* INITIAL VALUES AND TIME INTEGRATION DATA

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

 COMMON/LA11/IREQD(10),IREQS(10)

 COMMON/LA12/ACCEH(2390),ACCEV(2390)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA17/VELOI(2390),VELOL(2390),VELOT(2390)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 DIMENSION LOUTD(100)

C

C \*\*\* READ TIME STEPPING AND SELECTIVE OUTPUT PARAMETERS

C STEPS,TAPE-OUT,PRINT,DISP,STRESS,ACCE-STEPS

C 0:ACCE-HIST,2:HORIZONTAL,ITERATIONS,1:STANDARD

 READ(5,100) NSTEP,NOUTP,NREQD,NREQS,NACCE

 READ(5,100) IFUNC,IFIXD,MITER,IPRED

 WRITE(6,200) NSTEP,NOUTP,NREQD,NREQS,NACCE,

 \* IFUNC,IFIXD,MITER,IPRED

C DELT,END-TIME,ACCE-DELT,DELTA,GAMMA

C A0,B0,W,ERR-CHECK

 READ(5,101) DTIME,DTEND,DTREC,DELTA,GAAMA

 READ(5,101) AZERO,BZERO,OMEGA,TOLER

 WRITE(6,201) DTIME,DTEND,DTREC,DELTA,GAAMA,

 \* AZERO,BZERO,OMEGA,TOLER

C \*\*\* SELECTED TIME-STEPS FOR OUTPUT

 READ(5,100) (LOUTD(N),N=1,NOUTP)

 WRITE(6,206) (LOUTD(N),N=1,NOUTP)

 DO 2 N=1,NSTEP

 2 NOUTD(N)=0

 DO 4 L=1,NOUTP

 N=LOUTD(L)

 4 NOUTD(N)=1

C \*\*\* SELECTED NODES AND ELEMENTS FOR OUTPUT

 WRITE(6,202)

 READ(5,100) (IREQD(I),I=1,NREQD)

 WRITE(6,203) (IREQD(I),I=1,NREQD)

 READ(5,100) (IREQS(I),I=1,NREQS)

 WRITE(6,204) (IREQS(I),I=1,NREQS)

C

 DO 10 IP=1,NPOIN

 DO 12 ID=1,3

 IT=(IP-1)\*3+ID

 IT=LY(IT)

 IF(IT.EQ.NN) GO TO 10

 DISPI(IT)=0.D0

 DISPT(IT)=0.D0

 DISPL(IT)=0.D0

 VELOI(IT)=0.D0

 12 CONTINUE

 10 CONTINUE

 IF(IFUNC.NE.0) GO TO 50

C \*\*\* READ ACCELEROGRAM DATA

C IFIXD=0: H&V AC, 1: V, 2: H

C

 AFACT=DTREC/DTIME

 IF(IFIXD-1) 40,42,44

 40 WRITE(6,209) DTREC

 READ(5,103) (ACCEH(N),N=1,NACCE)

 WRITE(6,103) (ACCEH(N),N=1,NACCE)

 WRITE(6,210) DTREC

 READ(5,103) (ACCEV(N),N=1,NACCE)

 WRITE(6,103) (ACCEV(N),N=1,NACCE)

 GO TO 50

 42 WRITE(6,210) DTREC

 READ(5,103) (ACCEV(N),N=1,NACCE)

 WRITE(6,103) (ACCEV(N),N=1,NACCE)

 GO TO 50

 44 WRITE(6,209) DTREC

 READ(5,103) (ACCEH(N),N=1,NACCE)

 WRITE(6,103) (ACCEH(N),N=1,NACCE)

 50 CONTINUE

C \*\*\* INITIAL VELOCITIES

 READ (5,100) NVE

 WRITE(6,205) NVE

 IF(NVE.EQ.0) GO TO 80

 DO 60 IL=1,NVE

 READ(5,104) NOD,IXY,VEL

 WRITE(6,104) NOD,IXY,VEL

 IT=(NOD-1)\*3+IXY

 IT=LY(IT)

 IF(IT.EQ.NN) GO TO 60

 VELOI(IT)=VEL

 60 CONTINUE

 80 CONTINUE

C

 100 FORMAT(20I5)

 101 FORMAT(8F10.4)

 102 FORMAT(I5,2F10.5)

 103 FORMAT(10F8.3)

 104 FORMAT(2I5,F10.5)

 200 FORMAT(/'TIME STEPPING PARAMETERS'/

 \* /2X,'NSTEP=',I5,12X,'NOUTP=',I5

 \* /2X,'NREQD=',I5,12X,'NREQS=',I5,12X,'NACCE=',I5

 \* /2X,'IFUNC=',I5,12X,'IFIXD=',I5,12X,'MITER=',I5

 \* /2X,'IPRED=',I5)

 201 FORMAT(/2X,'DTIME=',G12.4,5X,'DTEND=',G12.4,5X,'DTREC=',G12.4

 \* /2X,'DELTA=',G12.4,5X,'GAAMA=',G12.4,5X,'AZERO=',G12.4

 \* /2X,'BZERO=',G12.4,5X,'OMEGA=',G12.4,5X,'TOLER=',G12.4)

 202 FORMAT(/'SELECTIVE OUTPUT' )

 203 FORMAT(/2X,'NODE',10I5)

 204 FORMAT(/2X,'ELEM',10I5)

 205 FORMAT(/'INITIAL VELOCITIES TOTAL=',I5

 \* /2X,'NODE X-Y VELOCITY'/)

 206 FORMAT(/'SELECTIVE TIME-STEPS',30(/10I5))

 209 FORMAT(/'HORIZONTAL ACCELERATION ORDINATES AT',F9.4,2X,'SEC'/)

 210 FORMAT(/'VERTICAL ACCELERATION ORDINATES AT',F9.4,2X,'SEC'/)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE PREVOS

C \*\*\* INITIAL STRESSES

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 DIMENSION STREI(10,4)

C

 DO 10 IE=1,NELEM

 DO 10 I=1,6

 STRAG(IE,I)=0.D0

 STRSG(IE,I)=0.D0

 10 CONTINUE

 DO 12 IE=1,NELEM

 IYIEL(IE)=0

 IUNLO(IE)=0

 IYHIS(IE)=0

 EFFST(IE)=0.D0

 EPSTN(IE)=0.D0

 12 CONTINUE

C

 WRITE(6,200)

 DO 20 IS=1,NIST

 READ(5,100) IS1,(STREI(IS,I),I=1,4)

 WRITE(6,100) IS1,(STREI(IS,I),I=1,4)

 20 CONTINUE

 DO 22 IE=1,NELEM

 IS=IST(IE)

 DO 24 I=1,4

 24 STRIN(IE,I)=STREI(IS,I)

 22 CONTINUE

 IF(NPREV.LE.0) GO TO 80

 OPEN(7,FILE='DASTRE',STATUS='UNKNOWN')

 DO 30 I=1,4

 30 READ(7,101) (STRIN(IE,I),IE=1,NELEM)

 CLOSE(7)

 80 CONTINUE

 DO 32 I=1,4

 32 WRITE(6,101) (STRIN(IE,I),IE=1,NELEM)

 100 FORMAT(I5,4F10.3)

 101 FORMAT(10E11.3)

 200 FORMAT(/'INITIAL STRESSES')

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE LOADPL

C \*\*\* STANDARD LOAD ROUTINE

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

C

 DO 2 IV=1,NSIZE

 2 FORCE(IV)=0.D0

C \*\*\* LOAD DATA

C NFL: NUMBER OF NODAL POINT LOADS

C IGRAV=0: NOT CONSIDER GRAVITY LOADS, 1:CONSIDER

C

 READ (5,100) NFL,IGRAV

 WRITE(6,200) NFL,IGRAV

C \*\*\* READ NODAL POINT LOADS

C NOD: NODE NO.

C IXY: DIRECTION OF LOAD (1=HORIZONTAL, 2=VERTICAL, 3=MOMENT)

C FLO: LOAD

C

 IF(NFL.EQ.0) GO TO 12

 WRITE(6,201)

 DO 10 IL=1,NFL

 READ(5,101) NOD,IXY,FLO

 WRITE(6,101) NOD,IXY,FLO

 IT=(NOD-1)\*3+IXY

 IT=LY(IT)

 IF(IT.EQ.NN) GO TO 10

 RR=XX(NOD)

 FORCE(IT)=FORCE(IT)+FLO\*RR

 10 CONTINUE

 12 CONTINUE

C \*\*\* GIVE GRAVITY LOADS

 IF(IGRAV.EQ.0) GO TO 22

 GRAVZ=-9.81D0

 DO 20 IE=1,NELEM

 KOL2=K2(IE)

 GO TO (31,32,31,34,34,34),KOL2

 31 CALL TRUSS(IE)

 NNODE=2

 NEVAB=6

 GO TO 30

 32 CALL BEAM(IE)

 NNODE=2

 NEVAB=6

 GO TO 30

 34 CALL AXISYM(IE,KOL2)

 NNODE=4

 NEVAB=8

 MM=IJK(IE,4)

 IF(MM.LE.0) NNODE=3

 IF(MM.LE.0) NEVAB=6

 30 CONTINUE

C

 MT=MAT(IE)

 RHO= PRP(MT,4)

 IF(RHO.LE.0.D0) RHO=0.D0

 DMASS=AES(IE)\*RHO\*GRAVZ/DFLOAT(NNODE)

 DO 36 I=1,NNODE

 NOD=IJK(IE,I)

 RR=XX(NOD)

 I2=3\*NOD-1

 IT=LY(I2)

 IF(IT.EQ.NN) GO TO 36

 FORCE(IT)=FORCE(IT)+DMASS\*RR

 36 CONTINUE

 20 CONTINUE

 22 CONTINUE

 WRITE(6,202)

 WRITE(6,203) (FORCE(IV),IV=1,NSIZE)

C

 100 FORMAT(10I5)

 101 FORMAT(2I5,F10.2)

 200 FORMAT(/'NODAL LOADS=',I5,' GRAVITY LOADS=',I5/)

 201 FORMAT(/'NODAL LOAD'/' NODE X-Y LOAD')

 202 FORMAT(/'FORCE'/)

 203 FORMAT(10E11.3)

 80 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE LUMASS

C \*\*\* CALCULATES LUMPED MASS

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LA11/IREQD(10),IREQS(10)

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA14/XMASS(2390,2390),STIFF(2390,2390),STIFS(2390,2390)

 COMMON/LA19/DAMPI(2390,2390),RESID(2390)

 DIMENSION EMASS(8,8)

C

 DO 5 IV=1,NSIZE

 DO 5 JV=1,NSIZE

 XMASS(IV,JV)=0.D0

 5 DAMPI(IV,JV)=0.D0

C

 DO 100 IE=1,NELEM

 KOL2=K2(IE)

 GO TO (31,32,31,34,34,34),KOL2

 31 CALL TRUSS(IE)

 NNODE=2

 NEVAB=4

 GO TO 30

 32 CALL BEAM(IE)

 NNODE=2

 NEVAB=6

 GO TO 30

 34 CALL AXISYM(IE,KOL2)

 NNODE=4

 NEVAB=8

 MM=IJK(IE,4)

 IF(MM.LE.0) NNODE=3

 IF(MM.LE.0) NEVAB=6

 30 CONTINUE

C

 MT=MAT(IE)

 RHO= PRP(MT,4)

 IF(RHO.LE.0.D0) RHO=0.01D0

 ALFA=PRP(MT,8)

 DO 12 I=1,NEVAB

 DO 12 J=1,NEVAB

 12 EMASS(I,J)=0.D0

 DMASS=AES(IE)\*RHO/FLOAT(NNODE)

 DO 14 I=1,NEVAB

 14 EMASS(I,I)=DMASS

C

 DO 20 I=1,NEVAB

 IT=LLL(IE,I)

 IF(IT.EQ.NN) GO TO 20

 DO 22 J=1,NEVAB

 JT=LLL(IE,J)

 IF(JT.EQ.NN) GO TO 22

 XMASS(IT,JT)=XMASS(IT,JT)+EMASS(I,J)

 DAMPI(IT,JT)=DAMPI(IT,JT)+EMASS(I,J)\*ALFA

 22 CONTINUE

 20 CONTINUE

 100 CONTINUE

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE GSTIFF

C \*\*\* EVALUATES STIFFNESS MATRIX

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA14/XMASS(2390,2390),STIFF(2390,2390),STIFS(2390,2390)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA19/DAMPI(2390,2390),RESID(2390)

C

 DO 4 IV=1,NSIZE

 DO 4 JV=1,NSIZE

 4 STIFF(IV,JV)=0.D0

C

 DO 100 IE=1,NELEM

 MT=MAT(IE)

 BETA=PRP(MT,9)

 KOL2=K2(IE)

 GO TO (31,32,31,34,34,34),KOL2

 31 NEVAB=4

 GO TO 30

 32 NEVAB=6

 GO TO 30

 34 NEVAB=8

 IF(IJK(IE,4).EQ.0) NEVAB=6

 30 CONTINUE

 DO 20 I=1,NEVAB

 IT=LLL(IE,I)

 IF(IT.EQ.NN) GO TO 20

 DO 22 J=1,NEVAB

 JT=LLL(IE,J)

 IF(JT.EQ.NN) GO TO 22

 STIFF(IT,JT)=STIFF(IT,JT)+EKK(IE,I,J)

 DAMPI(IT,JT)=DAMPI(IT,JT)+EKK(IE,I,J)\*BETA

 22 CONTINUE

 20 CONTINUE

 100 CONTINUE

C \*\*\* CALCULATES K-STAR MATRICES

 CONSC=1.D0/(DTIME\*DTIME\*DELTA)

 CONSD=GAAMA/(DTIME\*DELTA)

 DO 36 IV=1,NSIZE

 DO 36 JV=1,NSIZE

 36 STIFS(IV,JV)=XMASS(IV,JV)\*CONSC+DAMPI(IV,JV)\*CONSD+STIFF(IV,JV)

C

 CALL MATINV(STIFS,NN,NSIZE,0,DET,IND)

C

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE IMPEXP(IITER,ISTEP)

C \*\*\* GENERATES PARTIAL EFFECTIVE LOAD VECTOR

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

 COMMON/LA12/ACCEH(2390),ACCEV(2390)

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA14/XMASS(2390,2390),STIFF(2390,2390),STIFS(2390,2390)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA17/VELOI(2390),VELOL(2390),VELOT(2390)

 COMMON/LA18/ACCEI(2390),ACCEL(2390)

 COMMON/LA19/DAMPI(2390,2390),RESID(2390)

 DIMENSION TACCE(2390),ACCEJ(2390),ACCEK(2390)

C

 IF(ISTEP.GT.1.OR.IITER.GT.1) GO TO 100

 CONSA=DTIME\*DTIME\*(0.5D0-DELTA)

 CONSB=DTIME\*(1.D0-GAAMA)

 CONSC=1.D0/(DTIME\*DTIME\*DELTA)

 CONSD=GAAMA/(DTIME\*DELTA)

C

 DO 10 IP=1,NPOIN

 DO 12 ID=1,3

 IT=(IP-1)\*3+ID

 IT=LY(IT)

 IF(IT.EQ.NN) GO TO 12

 ACCEI(IT)=1.D0

 ACCEL(IT)=0.D0

 IF(ID.EQ.1.OR.ID.EQ.3) GO TO 12

 ACCEI(IT)=0.D0

 ACCEL(IT)=1.D0

 12 CONTINUE

 10 CONTINUE

C \*\*\* CALCULATES VECTORS FOR HORIZONTAL AND VERTICAL EXCITATION

 DO 30 IV=1,NSIZE

 ACCEK(IV)=0.D0

 ACCEJ(IV)=0.D0

 DISPL(IV)=0.D0

 VELOL(IV)=0.D0

 DO 32 JV=1,NSIZE

 ACCEK(IV)=ACCEK(IV)+XMASS(IV,JV)\*ACCEL(JV)

 ACCEJ(IV)=ACCEJ(IV)+XMASS(IV,JV)\*ACCEI(JV)

 DISPL(IV)=DISPL(IV)+STIFF(IV,JV)\*DISPI(JV)

 VELOL(IV)=VELOL(IV)+DAMPI(IV,JV)\*VELOI(JV)

 32 CONTINUE

 30 CONTINUE

C \*\*\* CALCULATES INITIAL ACCELERATION

 DO 14 IV=1,NSIZE

 14 TACCE(IV)=FORCE(IV)-DISPL(IV)-VELOL(IV)

 DO 16 IV=1,NSIZE

 DO 16 JV=1,NSIZE

 16 STIFF(IV,JV)=XMASS(IV,JV)

C

 CALL MATINV(STIFF,NN,NSIZE,0,DET,IND)

 IF(IND.EQ.1) GO TO 18

 WRITE(6,202) IND

 202 FORMAT(//'INDEX (XMASS)=',I5)

 STOP

C

 18 CONTINUE

 DO 34 IV=1,NSIZE

 ACCEI(IV)=0.D0

 DO 34 JV=1,NSIZE

 34 ACCEI(IV)=ACCEI(IV)+STIFF(IV,JV)\*TACCE(JV)

 WRITE(6,200)

 WRITE(6,201) (ACCEI(IV),IV=1,NSIZE)

C

 100 CONTINUE

 IF(IITER.GT.1) GO TO 110

C \*\*\* CALCULATES PREDICTED DISPLACEMENT AND VELOCITY VECTOR

 DO 20 IV=1,NSIZE

 DISPI(IV)=DISPI(IV)+DTIME\*VELOI(IV)+CONSA\*ACCEI(IV)

 VELOI(IV)=VELOI(IV)+CONSB\*ACCEI(IV)

 DISPT(IV)=DISPI(IV)

 VELOT(IV)=VELOI(IV)

 ACCEI(IV)=CONSC\*(DISPT(IV)-DISPI(IV))

 20 CONTINUE

C \*\*\* CALCULATES LOAD VECTORS

 FACTS=FUNCTS(ISTEP)

 FACTH=FUNCTA(ACCEH,AFACT,ISTEP)

 FACTV=FUNCTA(ACCEV,AFACT,ISTEP)

C

 110 CONTINUE

 IF(ISTEP.EQ.1) GO TO 120

C \*\*\* CALCULATES PARTIAL EFFECTIVE LOAD VECTOR

 DO 36 IV=1,NSIZE

 VELOL(IV)=0.D0

 DO 36 JV=1,NSIZE

 36 VELOL(IV)=VELOL(IV)+DAMPI(IV,JV)\*VELOT(JV)

 120 DO 40 IV=1,NSIZE

 IF(IFUNC.NE.0) GO TO 42

 IF(IFIXD.EQ.2)

 \* DISPL(IV)=-VELOL(IV)-FACTH\*ACCEJ(IV)+FORCE(IV)

 IF(IFIXD.EQ.1)

 \* DISPL(IV)=-VELOL(IV)-FACTV\*ACCEK(IV)+FORCE(IV)

 IF(IFIXD.EQ.0)

 \* DISPL(IV)=-VELOL(IV)-FACTH\*ACCEJ(IV)+FORCE(IV)-FACTV\*ACCEK(IV)

 IF(IFUNC.EQ.0) GO TO 40

 42 DISPL(IV)=-VELOL(IV)+FORCE(IV)\*FACTS

 40 CONTINUE

 200 FORMAT(/'INITIAL ACCELERATION '/)

 201 FORMAT(10E8.2)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE RESEPL(IITER,ISTEP)

C \*\*\* EVALUATES RESIDUAL FORCES

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA19/DAMPI(2390,2390),RESID(2390)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA22/NTENS,KTENS,ITENS(1260),JTENS(1260)

 DIMENSION ELOAD(8),TU(2220),EU(6),DSTRE(4),

 \* STRAN(6),STRES(6),SIGMA(6),SGTOT(6),DESIG(6)

C

 DO 4 IV=1,NSIZE

 4 RESID(IV)=0.D0

 DO 6 IV=1,NSIZE

 6 TU(IV)=DISPT(IV)

 TU(NN)=0.D0

C

 DO 10 IE=1,NELEM

 KOL2=K2(IE)

 MT=MAT(IE)

 YOUNG=PRP(MT,1)

 POISS=PRP(MT,2)

 THICK=PRP(MT,3)

 COHES=PRP(MT,5)

 FRICT=PRP(MT,6)\*0.017453292D0

 DAILT=PRP(MT,7)\*0.017453292D0

 UNIAX=COHES\*DCOS(FRICT)

 PREYS=UNIAX

C

 DO 8 I=1,6

 8 STRES(I)=0.D0

 GO TO (11,12,11,14,14,14),KOL2

 11 NEVAB=4

 NSTRE=1

 GO TO 20

 12 NEVAB=6

 NSTRE=6

 GO TO 20

 14 NEVAB=8

 NSTRE=4

 IF(IJK(IE,4).EQ.0) NEVAB=6

 20 CONTINUE

C

 CALL LINGNL(IE,KOL2,TU,YOUNG,POISS,STRAN,STRES)

 DO 22 I=1,NSTRE

 22 STRAG(IE,I)=STRAG(IE,I)+STRAN(I)

 IF(ISTEP.GT.1.OR.IITER.GT.1) GO TO 23

 DO 24 I=1,NSTRE

 24 STRES(I)=STRES(I)+STRIN(IE,I)

 23 CONTINUE

 DO 26 I=1,NSTRE

 DESIG(I)=STRES(I)

 SIGMA(I)=STRSG(IE,I)+STRES(I)

 26 CONTINUE

 IF(KOL2.LE.4) GO TO 30

C

 IF(IYIEL(IE).GT.0) GO TO 28

 CALL NLINEA(IE,KOL2,IITER,ISTEP)

 28 CONTINUE

C

 CALL YIELDJ(MT,KOL2,SIGMA,YIELD)

 ESPRE=EFFST(IE)-PREYS

C ESPRE.GE.0: THE ELEMENT YIELDED AT PRECEDING STEP

 IF(ESPRE.GE.0.D0) GO TO 32

 ESCUR=YIELD-PREYS

C ESCUR.GT.0: THE ELEMENT HAS YIELDED AT PRESENT STEP

 IF(ESCUR.LE.0.D0) IYIEL(IE)=0

 IF(IYHIS(IE).GT.0.AND.ESCUR.LE.0.D0) IUNLO(IE)=1

 IF(ESCUR.LE.0.D0) GO TO 38

 RFACT=ESCUR/(YIELD-EFFST(IE))

 GO TO 34

 32 CONTINUE

 ESCUR=YIELD-EFFST(IE)

C ESCUR.LE.0: THE ELEMENT DOES NOT YIELD AT PRESENT STEP

 IF(ESCUR.LE.0.D0) IYIEL(IE)=0

 IF(ESCUR.LE.0.D0) GO TO 38

 RFACT=1.D0

 34 CONTINUE

 IYIEL(IE)=1

 IUNLO(IE)=0

 IYHIS(IE)=1

C

 MSTEP=ESCUR\*8.D0/UNIAX+1.D0

 IF(MSTEP.GT.10) MSTEP=10

 ASTEP=MSTEP

 REDUC=1.D0-RFACT

C

 CALL CALSTA(IE,SIGMA,ISTEP)

 DO 36 I=1,NSTRE

 SGTOT(I)=STRSG(IE,I)+REDUC\*STRES(I)

 STRAN(I)=RFACT\*STRAN(I)/ASTEP

 36 CONTINUE

C

 DO 40 JSTEP=1,MSTEP

 CALL DEPMAT(IE,MT,KOL2,SGTOT)

 DO 42 I=1,NSTRE

 DSTRE(I)=0.D0

 DO 42 J=1,NSTRE

 42 DSTRE(I)=DSTRE(I)+DEP(IE,I,J)\*STRAN(J)

 DO 44 I=1,NSTRE

 44 SGTOT(I)=SGTOT(I)+DSTRE(I)

 40 CONTINUE

 CALL YIELDJ(MT,KOL2,SGTOT,YIELD)

 CURYS=UNIAX

 BRING=1.D0

 IF(YIELD.GT.CURYS) BRING=CURYS/YIELD

 DO 46 I=1,NSTRE

 46 STRSG(IE,I)=BRING\*SGTOT(I)

 EFFST(IE)=BRING\*YIELD

 47 CONTINUE

C \*\*\* ALTERNATIVE LOCATION OF STRESS REDUCTION LOOP TERMINATION CARD

 GO TO 50

 38 CONTINUE

 IYIEL(IE)=0

 DO 54 I=1,NSTRE

 54 STRSG(IE,I)=SIGMA(I)

 GO TO 52

C

 30 CONTINUE

 IYIEL(IE)=0

 DO 56 I=1,NSTRE

 56 STRSG(IE,I)=STRSG(IE,I)+DESIG(I)

 52 CONTINUE

 EFFST(IE)=YIELD

 50 CONTINUE

C \*\*\* NO-TENSION

 CALL NOTENS(IE,KOL2)

C \*\*\* CALCULATE THE EQUIVALENT NODAL FORCES

 DVOLU=AES(IE)

 NSTR1=NSTRE

 IF(KOL2.EQ.2) GO TO 60

 DO 62 J=1,NEVAB

 ELOAD(J)=0.D0

 DO 62 I=1,NSTR1

 62 ELOAD(J)=ELOAD(J)+BMX(IE,I,J)\*STRSG(IE,I)\*DVOLU

 GO TO 64

 60 CONTINUE

 DO 66 I=1,NEVAB

 IT=LLL(IE,I)

 66 EU(I)=TU(IT)

 DO 68 I=1,NEVAB

 ELOAD(I)=0.D0

 DO 68 J=1,NEVAB

 68 ELOAD(I)=ELOAD(I)+EKK(IE,I,J)\*EU(J)

 64 CONTINUE

 DO 70 I=1,NEVAB

 IT=LLL(IE,I)

 IF(IT.EQ.NN) GO TO 70

 RESID(IT)=RESID(IT)+ELOAD(I)

 70 CONTINUE

C

 10 CONTINUE

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE ITRATE(IITER)

C \*\*\* CALCULATES INCREMENT IN DISPLACEMENT AND APPLIES CONVERGENCE

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

 COMMON/LA14/XMASS(2390,2390),STIFF(2390,2390),STIFS(2390,2390)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA17/VELOI(2390),VELOL(2390),VELOT(2390)

 COMMON/LA18/ACCEI(2390),ACCEL(2390)

 COMMON/LA19/DAMPI(2390,2390),RESID(2390)

 DIMENSION TVECT(2390),DISPD(2390)

C

 NCHEK=0

 DO 2 IV=1,NSIZE

 ACCEL(IV)=0.D0

 DO 2 JV=1,NSIZE

 2 ACCEL(IV)=ACCEL(IV)+XMASS(IV,JV)\*ACCEI(JV)

C \*\*\* CALCULATES TOTAL EFFECTIVE LOAD VECTOR

 DO 10 IV=1,NSIZE

 10 TVECT(IV)=DISPL(IV)-ACCEL(IV)-RESID(IV)

C \*\*\* CALCULATES DELTA DISPLACEMENT

 DO 11 IV=1,NSIZE

 DISPD(IV)=0.D0

 DO 11 JV=1,NSIZE

 11 DISPD(IV)=DISPD(IV)+STIFS(IV,JV)\*TVECT(JV)

C \*\*\* APPLIES CONVERGENCE

 SUMPP=0.D0

 SUMPQ=0.D0

 DO 12 IV=1,NSIZE

 DISPP=DISPD(IV)

 DISPQ=DISPT(IV)+DISPP

 DISPT(IV)=DISPQ

 SUMPP=SUMPP+DISPP\*DISPP

 SUMPQ=SUMPQ+DISPQ\*DISPQ

 12 CONTINUE

 CONSD=DTIME\*(1.D0-GAAMA)

 CONSF=1.D0/(DTIME\*DTIME\*DELTA)

 DO 14 IV=1,NSIZE

 ACCEI(IV)=CONSF\*(DISPT(IV)-DISPI(IV))

 14 VELOT(IV)=VELOI(IV)+CONSD\*ACCEI(IV)

 SUMPP=DSQRT(SUMPP/SUMPQ)

 WRITE(6,200) IITER,SUMPP,SUMPQ

 IF(SUMPP.GT.TOLER) GO TO 30

 NCHEK=1

 GO TO 20

 30 IF(IITER.LT.MITER) GO TO 32

 20 DO 22 IV=1,NSIZE

 VELOI(IV)=VELOT(IV)

 22 DISPI(IV)=DISPT(IV)

 32 CONTINUE

 200 FORMAT(I5,2E10.3)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE LINGNL(IE,KOL2,TU,YOUNG,POISS,STRAN,STRES)

C \*\*\* ELASTIC STRAINS AND STRESSES

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 DIMENSION EU(8),TU(2390),STRAN(6),STRES(6)

C

 DO 5 I=1,6

 STRAN(I)=0.D0

 5 STRES(I)=0.D0

 GO TO (11,12,11,14,14,14),KOL2

C \*\*\* TRUSS & TEXTILE

 11 CONTINUE

 MT=MAT(IE)

 YOUNG=PRP(MT,1)

 DO 20 I=1,4

 IT=LLL(IE,I)

 20 EU(I)=TU(IT)

 STRAN(1)=0.D0

 DO 22 I=1,4

 22 STRAN(1)=STRAN(1)+BMX(IE,1,I)\*EU(I)

 STRAN(1)=STRAN(1)-STRAG(IE,1)

 STRES(1)=STRAN(1)\*YOUNG

 GO TO 10

C \*\*\* BEAM

 12 CONTINUE

 DO 30 I=1,6

 IT=LLL(IE,I)

 30 EU(I)=TU(IT)

 DO 32 I=1,6

 STRES(I)=0.D0

 DO 32 J=1,6

 32 STRES(I)=STRES(I)+DBM(IE,I,J)\*EU(J)

 DO 34 I=1,6

 STRAN(I)=0.D0

 34 STRES(I)=STRES(I)-STRSG(IE,I)

C \*\*\* STRES(I) MEAN PARALLEL & NORMAL NODAL FORCES

C AND BENDING MOMENT AT EACH NODE

 GO TO 10

C \*\*\* SOLID AND INTERFACE

 14 CONTINUE

 NEVAB=8

 IF(IJK(IE,4).LE.0) NEVAB=6

 DO 40 I=1,NEVAB

 IT=LLL(IE,I)

 40 EU(I)=TU(IT)

 DO 42 I=1,4

 STRAN(I)=0.D0

 DO 42 J=1,NEVAB

 42 STRAN(I)=STRAN(I)+BMX(IE,I,J)\*EU(J)

 DO 44 I=1,4

 44 STRAN(I)=STRAN(I)-STRAG(IE,I)

 DO 46 I=1,4

 STRES(I)=0.D0

 DO 46 J=1,4

 46 STRES(I)=STRES(I)+DMX(IE,I,J)\*STRAN(J)

 10 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE NLINEA(IE,KOL2,IITER,ISTEP)

C \*\*\* SECANT MODULUS

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 DIMENSION D(4,4)

C

 MT=MAT(IE)

 CC=PRP(MT,5)

 FAI=PRP(MT,6)\*3.14159D0/180.D0

 DO 2 I=1,4

 DO 2 J=1,4

 2 D(I,J)=0.D0

 GO TO (100,100,100,100,15,16),KOL2

C \*\*\* SOLID

 15 CONTINUE

 EE(IE)=EE0(IE)

 IF(ICON.LE.0) GO TO 25

 IF(IUNLO(IE).GT.0) GO TO 25

 SR=STRSG(IE,1)

 SZ=STRSG(IE,2)

 TA=STRSG(IE,3)

 CALL PRINCE(SR,SZ,TA,S1,S3,THETA)

 IF(S3.LT.0.D0) S3=0.1D0

 IF(S1.LT.0.D0) S1=0.1D0

 SI=(1.D0-DSIN(FAI))\*(S1-S3)

 BO=2.D0\*(CC\*DCOS(FAI)+S3\*DSIN(FAI))/RFAIL

 E=(1.D0-SI/BO)\*\*2\*EE0(IE)

 IF(E.LE.1.D0) E=1.D0

 IF(SI.GE.BO) E=1.D0

 EE(IE)=E

C

 25 CONTINUE

 E=EE(IE)

 P=PRP(MT,2)

 H=PRP(MT,3)

 GP=1.D0+P

 GM=1.D0-P

 GN=1.D0-2.D0\*P

 G=E\*GM/(GP\*GN)

 G1=G\*P/GM

 G2=G\*GN\*0.5D0/GM

 D(1,1)=G

 D(2,2)=G

 D(3,3)=G2

 D(4,4)=G

 D(1,2)=G1

 D(1,4)=G1

 D(2,4)=G1

 D(2,1)=D(1,2)

 D(4,1)=D(1,4)

 D(4,2)=D(2,4)

 GO TO 10

C \*\*\* INTERFACE

 16 CONTINUE

 EE(IE)=EE0(IE)

 IF(ICON.LE.0) GO TO 26

 IF(IUNLO(IE).GT.0) GO TO 26

 DTA=STRSG(IE,3)

 DTA=DABS(DTA)

 DSG=STRSG(IE,2)

 IF(DSG.LE.0.) DSG=0.01

 SI=DTA

 BO=CC+DSG\*DSIN(FAI)/DCOS(FAI)/RFAIL

 E=(1.D0-SI/BO)\*\*2\*EE0(IE)

 IF(E.LE.1.D0) E=1.D0

 IF(SI.GT.BO) E=1.D0

 EE(IE)=E

C

 26 CONTINUE

 E=EE(IE)

 P=PRP(MT,2)

 H=PRP(MT,3)

 GP=1.D0+H

 GM=1.D0-H

 GN=1.D0-2.D0\*H

 G=P/(GP\*GN)

 G1=GM\*G

 G2=H\*G

 D(1,1)=G1

 D(2,2)=G1

 D(3,3)=E

 D(4,4)=G1

 D(1,2)=G2

 D(1,4)=G2

 D(2,4)=G2

 D(2,1)=G2

 D(4,1)=D(1,4)

 D(4,2)=D(2,4)

 10 CONTINUE

 DO 20 I=1,4

 DO 20 J=1,4

 20 DMX(IE,I,J)=D(I,J)

 CALL MATINV(D,4,4,0,DET,IND)

 DO 22 I=1,4

 DO 22 J=1,4

 22 DMI(IE,I,J)=D(I,J)

 100 CONTINUE

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE YIELDJ(MT,KOL2,STEMP,YIELD)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 DIMENSION STEMP(4)

C

 PHIRA=PRP(MT,6)\*0.017453292D0

 SNPHI=DSIN(PHIRA)

 COPHI=DCOS(PHIRA)

 GO TO (10,10,10,10,15,16),KOL2

 15 CONTINUE

C \*\*\* MOHR-COULOMB

 P1=(STEMP(1)+STEMP(2))\*0.5D0

 P2=(STEMP(1)-STEMP(2))\*0.5D0

 P3=P2\*P2+STEMP(3)\*\*2

 P4=0.D0

 IF(P3.GT.0.D0) P4=DSQRT(P3)

 YIELD=P4-P1\*SNPHI

 GO TO 10

 16 CONTINUE

C \*\*\* COULOMB

 TAU=STEMP(3)

 TAU=DABS(TAU)

 SIG=STEMP(2)

 IF(SIG.LT.0.D0) SIG=0.D0

 YIELD=TAU\*COPHI-SIG\*SNPHI

 10 CONTINUE

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE CALSTA(IE,SIGMA,ISTEP)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 DIMENSION SIGMA(6),STD(6),STP(6)

C

 MT=MAT(IE)

 FAI=PRP(MT,6)\*3.14159D0/180.D0

 DO 2 I=1,4

 STP(I)=STRSG(IE,I)

 2 CONTINUE

 DO 4 I=1,4

 4 STD(I)=SIGMA(I)-STP(I)

 KOL2=K2(IE)

 GO TO (10,10,10,10,15,16),KOL2

 15 CONTINUE

 SX=SIGMA(1)

 SY=SIGMA(2)

 TA=SIGMA(3)

 CALL MOHRCO(IE,SX,SY,TA,F1,S,P2,B0)

 SX=STP(1)

 SY=STP(2)

 TA=STP(3)

 CALL MOHRCO(IE,SX,SY,TA,F0,S,P2,B0)

 C1=-F0/(F1-F0)

 SX=STP(1)+STD(1)\*C1

 SY=STP(2)+STD(2)\*C1

 TA=STP(3)+STD(3)\*C1

 CALL MOHRCO(IE,SX,SY,TA,F2,S,P2,B0)

 B2=B0\*\*(-0.5)

 SF=DSIN(FAI)

 A1=B2\*P2-SF

 A2=B2\*P2\*(-1.D0)-SF

 A3=B2\*4.D0\*TA

 R=A1\*STD(1)+A2\*STD(2)+A3\*STD(3)

 IF(R.LE.0.D0) R=0.0001D0

 C=C1-F2/R

 IF(C.GT.1.D0) C=C1

 GO TO 18

 16 CONTINUE

 SG=SIGMA(2)

 TA=SIGMA(3)

 CALL COULOM(IE,SG,TA,F1,S,1)

 SG=STP(2)

 TA=STP(3)

 CALL COULOM(IE,SG,TA,F0,S,1)

 C=-F0/(F1-F0)

 18 CONTINUE

 DO 22 I=1,4

 22 STAX(IE,I)=STP(I)+STD(I)\*C

C

 GO TO (10,10,10,34,34,36),KOL2

 34 CONTINUE

 SX=STAX(LI,1)

 SY=STAX(LI,2)

 TA=STAX(LI,3)

 CALL MOHRCO(LI,SX,SY,TA,F,S,P2,B0)

 CALL PRINCE(SX,SY,TA,S1,S3,AG)

 PI3(LI)=AG

 GO TO 38

 36 CONTINUE

 SG=STAX(LI,2)

 TA=STAX(LI,3)

 CALL COULOM(LI,SG,TA,F,S,0)

 PI3(LI)=0.D0

 38 CONTINUE

 PI1(LI)=S

 10 CONTINUE

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE DEPMAT(IE,MT,KOL2,SIGMA)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA23/TMX(1260,4,4),TMI(1260,4,4)

 DIMENSION T(4,4),TD(4,4),DPF(4,4),SIGMA(6)

C

 DO 2 I=1,3

 2 STAX(IE,I)=SIGMA(I)

 GO TO (10,10,10,10,15,16),KOL2

 15 CONTINUE

 SX=SIGMA(1)

 SY=SIGMA(2)

 TA=SIGMA(3)

 CALL MOHRCO(IE,SX,SY,TA,F,S,P2,B0)

 CALL PRINCE(SX,SY,TA,S1,S3,AG)

 PI3(IE)=AG

C

 E=PRP(MT,1)

 E=EE(IE)

 P=PRP(MT,2)

 G=E/(2.D0\*(1.D0+P))

 FAI=PRP(MT,6)\*3.14159D0/180.D0

 DLT=PRP(MT,7)\*3.14159D0/180.D0

 TFI=DSIN(FAI)/DCOS(FAI)

 TDL=DSIN(DLT)/DCOS(DLT)

C

 SI=1.D0

 IF(LRE(IE).GE.2) SI=-1.D0

 SIT=PI3(IE)

 ALF=3.14159D0\*0.25D0+DATAN(TFI)\*0.5D0

 BET=(ALF+SIT)\*(-1.D0)

 IF(LRE(IE).GE.2) BET=ALF-SIT

 PI4(IE)=BET

 IF(ICRI.LE.0) GO TO 20

C \*\*\* PERFECTLY PLASTIC

 TFI=0.D0

 TDL=0.D0

 20 CONTINUE

C

 CB=DCOS(BET)

 SB=DSIN(BET)

 T(1,1)=CB\*CB

 T(1,2)=SB\*SB

 T(1,3)=-2.D0\*SB\*CB

 T(1,4)=0.D0

 T(2,1)=SB\*SB

 T(2,2)=CB\*CB

 T(2,3)=2.D0\*SB\*CB

 T(2,4)=0.D0

 T(3,1)=SB\*CB

 T(3,2)=-SB\*CB

 T(3,3)=CB\*CB-SB\*SB

 T(3,4)=0.D0

 T(4,1)=0.D0

 T(4,2)=0.D0

 T(4,3)=0.D0

 T(4,4)=1.D0

 DO 22 I=1,4

 DO 22 J=1,4

 22 TMX(LI,I,J)=T(I,J)

 CALL DINV(T,4,4,0,DET,IND)

 DO 24 I=1,4

 DO 24 J=1,4

 24 TMI(LI,I,J)=T(I,J)

 DO 26 I=1,4

 DO 26 J=1,4

 26 T(I,J)=TMX(LI,I,J)

C

 C1=E\*(1.D0-P)/((1.D0+P)\*(1.D0-2.D0\*P))

 C2=E\*P/((1.D0+P)\*(1.D0-2.D0\*P))

 B1=1.D0/(C1\*TFI\*TDL+G)

 DPF(1,1)=C1

 DPF(1,2)=C2

 DPF(1,3)=0.D0

 DPF(1,4)=C2

 DPF(2,1)=C2

 DPF(2,2)=C1

 DPF(2,3)=0.D0

 DPF(2,4)=C2

 DPF(3,1)=-SI\*C2\*TFI

 DPF(3,2)=-SI\*C1\*TFI

 DPF(3,3)=0.D0

 DPF(3,4)=-SI\*C2\*TFI

 DPF(4,1)=C2

 DPF(4,2)=C2

 DPF(4,3)=0.D0

 DPF(4,4)=C1

 CALL MULT(T,DPF,TD,4,4,4)

 CALL XULT(TD,T,DPF,4,4,4)

 GO TO 18

C

 16 CONTINUE

 G=PRP(MT,1)

 E=PRP(MT,2)

 P=PRP(MT,3)

 FAI=PRP(MT,6)\*3.14159D0/180.D0

 DLT=PRP(MT,7)\*3.14159D0/180.D0

 TFI=DSIN(FAI)/DCOS(FAI)

 TDL=DSIN(DLT)/DCOS(DLT)

 SI=-1.D0

 IF(SIGMA(3).LT.0.) SI=1.D0

 IF(ICRI.LE.0) GO TO 28

C \*\*\* PERFECTLY PLASTIC

 TFI=0.D0

 TDL=0.D0

 28 CONTINUE

 C1=E\*(1.D0-P)/((1.D0+P)\*(1.D0-2.D0\*P))

 C2=E\*P/((1.D0+P)\*(1.D0-2.D0\*P))

 B1=1.D0/(C1\*TFI\*TDL+G)

 DPF(1,1)=C1

 DPF(1,2)=C2

 DPF(1,3)=0.D0

 DPF(1,4)=C2

 DPF(2,1)=C2

 DPF(2,2)=C1

 DPF(2,3)=0.D0

 DPF(2,4)=C2

 DPF(3,1)=-SI\*C2\*TFI

 DPF(3,2)=-SI\*C1\*TFI

 DPF(3,3)=0.D0

 DPF(3,4)=-SI\*C2\*TFI

 DPF(4,1)=C2

 DPF(4,2)=C2

 DPF(4,3)=0.D0

 DPF(4,4)=C1

C

 18 CONTINUE

 DO 30 I=1,4

 DO 30 J=1,4

 30 DEP(LI,I,J)=DPF(I,J)

 10 CONTINUE

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE MOHRCO(L,SR,SZ,TA,F,S,P2,B0)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 M=MAT(L)

 CC=PRP(M,5)

 FAI=PRP(M,6)

 FAI=FAI\*3.14159D0/180.D0

 SFI=DSIN(FAI)

 CFI=DCOS(FAI)

 P1=SR+SZ

 P2=SR-SZ

 A1=P1\*SFI+2.D0\*CC\*CFI

 B0=P2\*P2+4.D0\*TA\*TA

 IF(B0.LT.0.0001D0) B0=0.0001D0

 B1=DSQRT(B0)

 F=B1-A1

 S=A1/B1

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE COULOM(L,SG,TA,F,S,IC)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 M=MAT(L)

 CC=PRP(M,5)

 FAI=PRP(M,6)

 FAI=FAI\*3.14159D0/180.D0

 SFI=DSIN(FAI)

 CFI=DCOS(FAI)

 ST=CC+SG\*SFI/CFI

 IF(IC.LE.0) ST=VFUNC(ST)

 TA=DABS(TA)

 F=TA-ST

 S=0.D0

 IF(TA.GT.0.001D0) S=ST/TA

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE NOTENS(IE,KOL2)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA22/NTENS,KTENS,ITENS(1260),JTENS(1260)

 DIMENSION SIG(6)

C

 DO 2 I=1,4

 2 SIG(I)=STRSG(IE,I)

 JTENS(IE)=0

 GO TO (10,10,11,10,14,16),KOL2

 11 SG=SIG(1)

 IF(SG.LE.0.) GO TO 18

 SIG(1)=0.D0

 KTENS=KTENS+1

 ITENS(KTENS)=IE

 JTENS(IE)=KTENS

 GO TO 18

 14 SR=SIG(1)

 SZ=SIG(2)

 TA=SIG(3)

 ST=SIG(4)

 IF(ST.LT.0.D0) SIG(4)=0.D0

 CALL PRINCE(SR,SZ,TA,S1,S3,TH)

 IF(S3.GE.0.001D0) GO TO 18

 KTENS=KTENS+1

 ITENS(KTENS)=IE

 JTENS(IE)=KTENS

 C=1.

 IF(TA.LT.0.) C=-1.D0

 IF(S1-0.001D0) 20,20,22

 20 SIG(1)=0.001D0

 SIG(2)=0.001D0

 SIG(3)=0.D0

 GO TO 18

 22 S=SZ-SR

 IF(S) 30,30,32

 30 IF(SR) 50,50,40

 40 SZ=S1-SR

 SIG(2)=SZ

 GO TO 35

 32 IF(SZ) 52,52,42

 42 SR=S1-SZ

 SIG(1)=SR

 35 A=(S1\*\*2-(SR-SZ)\*\*2)\*0.25D0

 IF(A.LT.0.000001D0) A=0.000001D0

 SIG(3)=C\*DSQRT(A)

 GO TO 18

 50 C1=1.D0

 GO TO 55

 52 C1=-1.D0

 55 R=(S1-S3)\*0.5D0

 B2=R\*R-TA\*TA

 IF(B2) 56,56,57

 56 T=0.5D0\*3.14159D0

 GO TO 58

 57 B=DSQRT(B2)

 AT=TA/B

 T=DATAN(AT)

 58 S=S1\*0.5\*DCOS(T)

 SIG(1)=S1\*0.5D0+C1\*S

 SIG(2)=S1\*0.5D0-C1\*S

 SIG(3)=S1\*0.5D0\*DSIN(T)\*C

 GO TO 18

 16 SG=SIG(2)

 IF(SG.GE.0.D0) GO TO 18

 KTENS=KTENS+1

 ITENS(KTENS)=IE

 JTENS(IE)=KTENS

 SIG(2)=0.001D0

 TA=SIG(3)

 C=1.D0

 IF(TA.LT.0.D0) C=-1.D0

 MT=MAT(IE)

 SIG(3)=C\*PRP(MT,5)

 18 CONTINUE

 10 CONTINUE

 DO 60 I=1,4

 60 STRSG(IE,I)=SIG(I)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE TRUSS(L)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 DIMENSION LL(4),BM(4),EK(4,4),T(4,4),TEK(4,4),TET(4,4)

C

 II=IJK(L,1)

 JJ=IJK(L,2)

C

 MT=MAT(L)

 E=PRP(MT,1)

 A=PRP(MT,2)

 XI=XX(II)

 YI=YY(II)

 XJ=XX(JJ)

 YJ=YY(JJ)

 DX=XJ-XI

 DY=YJ-YI

 EL=DSQRT(DX\*DX+DY\*DY)

 C=DX/EL

 S=DY/EL

 BM(1)=1.D0/EL

 BM(2)=0.D0

 BM(3)=-1.D0/EL

 BM(4)=0.D0

 DO 10 I=1,4

 DO 10 J=1,4

 10 EK(I,J)=BM(I)\*BM(J)\*E\*EL\*A

C

 DO 20 I=1,4

 DO 20 J=1,4

 20 T(I,J)=0.D0

 T(1,1)=C

 T(1,2)=S

 T(2,1)=-S

 T(2,2)=C

 T(3,3)=C

 T(3,4)=S

 T(4,3)=-S

 T(4,4)=C

 CALL WULT(T,EK,TEK,4,4,4)

 CALL MULT(TEK,T,TET,4,4,4)

 DO 22 I=1,4

 DO 22 J=1,4

 22 EKK(L,I,J)=TET(I,J)

 AES(L)=A\*EL

 DO 24 J=1,4

 BMX(L,1,J)=0.D0

 DO 24 K=1,4

 24 BMX(L,1,J)=BMX(L,1,J)+BM(K)\*T(K,J)

 LL(4)=3\*JJ-1

 LL(3)=LL(4)-1

 LL(2)=3\*II-1

 LL(1)=LL(2)-1

 DO 30 I=1,4

 IT=LL(I)

 30 LLL(L,I)=LY(IT)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE BEAM(L)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 DIMENSION LL(10),EK(6,6),T(6,6),TEK(6,6),TET(6,6),EKT(6,6)

C

 II=IJK(L,1)

 JJ=IJK(L,2)

C

 MT=MAT(L)

 E= PRP(MT,1)

 A= PRP(MT,2)

 AI=PRP(MT,3)

 XI=XX(II)

 YI=YY(II)

 XJ=XX(JJ)

 YJ=YY(JJ)

 DX=XJ-XI

 DY=YJ-YI

 EL=DSQRT(DX\*DX+DY\*DY)

 C=DX/EL

 S=DY/EL

 G=E\*A/EL

 G5=2.D0\*E\*AI/EL

 G4=2.D0\*G5

 G3=3.D0\*G5/EL

 G2=2.D0\*G3/EL

C

 DO 20 I=1,6

 DO 20 J=1,6

 T(I,J)=0.D0

 EK(I,J)=0.D0

 20 CONTINUE

 EK(1,1)=G

 EK(2,2)=G2

 EK(3,3)=G4

 EK(4,4)=G

 EK(5,5)=G2

 EK(6,6)=G4

 EK(1,4)=-G

 EK(2,3)=G3

 EK(2,5)=-G2

 EK(2,6)=G3

 EK(3,5)=-G3

 EK(3,6)=G5

 EK(5,6)=-G3

 DO 22 I=1,5

 IP1=I+1

 DO 24 J=IP1,6

 24 EK(J,I)=EK(I,J)

 22 CONTINUE

 DO 26 K=1,4,3

 T(K,K)=C

 T(K,K+1)=S

 T(K+1,K)=-S

 T(K+1,K+1)=C

 T(K+2,K+2)=1.D0

 26 CONTINUE

 CALL WULT(T,EK,TEK,6,6,6)

 CALL MULT(TEK,T,TET,6,6,6)

 CALL MULT(EK,T,EKT,6,6,6)

 DO 28 I=1,6

 DO 28 J=1,6

 DBM(L,I,J)=EKT(I,J)

 EKK(L,I,J)=TET(I,J)

 28 CONTINUE

 AES(L)=A\*EL

 LL(6)=3\*JJ

 LL(5)=LL(6)-1

 LL(4)=LL(5)-1

 LL(3)=3\*II

 LL(2)=LL(3)-1

 LL(1)=LL(2)-1

 DO 30 I=1,6

 IT=LL(I)

 30 LLL(L,I)=LY(IT)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE AXISYM(L,KOL2)

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA23/TMX(1260,4,4),TMI(1260,4,4)

 DIMENSION LL(10),D(4,4),ES(8,8),IOE(6),B(4,6),DB(4,6),

 \* EK(6,6),BM(4,8),BMT(4,8),T(8,8),TEK(8,8),XXL(4),YYL(4),

 \* COR(8),COD(8)

C

 II=IJK(L,1)

 JJ=IJK(L,2)

 KK=IJK(L,3)

 MM=IJK(L,4)

 MT=MAT(L)

C

 DO 2 I=1,4

 DO 2 J=1,4

 2 D(I,J)=0.D0

C

 E=PRP(MT,1)

 P=PRP(MT,2)

 H=PRP(MT,3)

 GO TO (80,80,80,14,14,16),KOL2

 14 GP=1.D0+P

 GM=1.D0-P

 GN=1.D0-2.D0\*P

 G=E\*GM/(GP\*GN)

 G1=G\*P/GM

 G2=G\*GN\*0.5D0/GM

 D(1,1)=G

 D(2,2)=G

 D(3,3)=G2

 D(4,4)=G

 D(1,2)=G1

 D(1,4)=G1

 D(2,4)=G1

 D(2,1)=D(1,2)

 D(4,1)=D(1,4)

 D(4,2)=D(2,4)

 GO TO 18

 16 GP=1.D0+H

 GM=1.D0-H

 GN=1.D0-2.D0\*H

 G=P/(GP\*GN)

 G1=GM\*G

 G2=H\*G

 D(1,1)=G1

 D(2,2)=G1

 D(3,3)=E

 D(4,4)=G1

 D(1,2)=G2

 D(1,4)=G2

 D(2,4)=G2

 D(2,1)=G2

 D(4,1)=D(1,4)

 D(4,2)=D(2,4)

C

 DO 4 I=1,4

 DO 4 J=1,4

 4 TMX(L,I,J)=0.D0

 DO 6 I=1,4

 6 TMX(L,I,I)=1.D0

 DO 8 I=1,4

 DO 8 J=1,8

 8 TMI(L,I,J)=TMX(L,I,J)

C

 DX=XX(JJ)-XX(II)

 DY=YY(JJ)-YY(II)

 EL=DSQRT(DX\*DX+DY\*DY)

 C=DX/EL

 S=DY/EL

 TA=S/C

 PI4(L)=DATAN(TA)

 DO 20 I=1,8

 DO 20 J=1,8

 20 T(I,J)=0.D0

 DO 22 I=1,7,2

 T(I,I)=C

 T(I,I+1)=S

 T(I+1,I)=-S

 T(I+1,I+1)=C

 22 CONTINUE

 COR(1)=XX(II)

 COR(2)=YY(II)

 COR(3)=XX(JJ)

 COR(4)=YY(JJ)

 COR(5)=XX(KK)

 COR(6)=YY(KK)

 COR(7)=XX(MM)

 COR(8)=YY(MM)

 DO 24 I=1,8

 COD(I)=0.D0

 DO 24 J=1,8

 24 COD(I)=COD(I)+T(I,J)\*COR(J)

 DO 26 I=1,4

 IE=2\*I

 IO=IE-1

 XXL(I)=COD(IO)

 YYL(I)=COD(IE)

 26 CONTINUE

C

 18 DO 30 I=1,4

 DO 30 J=1,6

 30 B(I,J)=0.D0

 DO 32 I=1,8

 DO 32 J=1,8

 32 ES(I,J)=0.D0

 DO 34 I=1,4

 DO 34 J=1,8

 34 BMT(I,J)=0.D0

 AE=0.D0

 I1=0

 I2=1

 I3=2

 N4=4

 NV=8

 IF(MM.EQ.0) N4=1

 IF(MM.EQ.0) NV=6

 DO 40 LI=1,N4

 I1=I1+1

 I2=I2+1

 IF(I2.EQ.5) I2=1

 I3=I3+1

 IF(I3.EQ.5) I3=1

 I1E=2\*I1

 I1O=I1E-1

 I2E=2\*I2

 I2O=I2E-1

 I3E=2\*I3

 I3O=I3E-1

 IOE(1)=I1O

 IOE(2)=I1E

 IOE(3)=I2O

 IOE(4)=I2E

 IOE(5)=I3O

 IOE(6)=I3E

 GO TO (80,80,80,44,44,46),KOL2

 44 IIT=IJK(L,I1)

 JJT=IJK(L,I2)

 KKT=IJK(L,I3)

 XI=XX(IIT)

 YI=YY(IIT)

 XJ=XX(JJT)

 YJ=YY(JJT)

 XK=XX(KKT)

 YK=YY(KKT)

 GO TO 48

 46 XI=XXL(I1)

 YI=YYL(I1)

 XJ=XXL(I2)

 YJ=YYL(I2)

 XK=XXL(I3)

 YK=YYL(I3)

 48 RR=(XI+XJ+XK)\*0.333333333

 ZZ=(YI+YJ+YK)\*0.333333333

 AI=XJ\*YK-XK\*YJ

 AJ=XK\*YI-XI\*YK

 AK=XI\*YJ-XJ\*YI

 BI=YJ-YK

 BJ=YK-YI

 BK=YI-YJ

 CI=XK-XJ

 CJ=XI-XK

 CK=XJ-XI

 DA=(AI+AJ+AK)\*0.5D0

 AE4=DABS(DA)\*RR

 AE=AE+AE4\*0.5D0

 D2=0.125D0/DA

 IF(MM.EQ.0) D2=0.5D0/DA

 BMT(3,I1E)=BMT(3,I1E)-BI\*D2

 BMT(3,I1O)=BMT(3,I1O)-CI\*D2

 BMT(3,I2E)=BMT(3,I2E)-BJ\*D2

 BMT(3,I2O)=BMT(3,I2O)-CJ\*D2

 BMT(3,I3E)=BMT(3,I3E)-BK\*D2

 BMT(3,I3O)=BMT(3,I3O)-CK\*D2

 BMT(4,I1O)=BMT(4,I1O)-(AI/RR+BI+CI\*ZZ/RR)\*D2

 BMT(4,I2O)=BMT(4,I2O)-(AJ/RR+BJ+CJ\*ZZ/RR)\*D2

 BMT(4,I3O)=BMT(4,I3O)-(AK/RR+BK+CK\*ZZ/RR)\*D2

C

 DEL2=1.D0/(AI+AJ+AK)

 B(3,1)=-CI\*DEL2

 B(3,2)=-BI\*DEL2

 B(3,3)=-CJ\*DEL2

 B(3,4)=-BJ\*DEL2

 B(3,5)=-CK\*DEL2

 B(3,6)=-BK\*DEL2

 B(4,1)=-(AI/RR+BI+CI\*ZZ/RR)\*DEL2

 B(4,3)=-(AJ/RR+BJ+CJ\*ZZ/RR)\*DEL2

 B(4,5)=-(AK/RR+BK+CK\*ZZ/RR)\*DEL2

 DO 12 I=1,3

 IE=2\*I

 IO=IE-1

 B(1,IO)=B(3,IE)

 B(2,IE)=B(3,IO)

 12 CONTINUE

 CALL MULT(D,B,DB,4,4,6)

 CALL WULT(B,DB,EK,6,4,6)

 DO 52 I=1,6

 IE=IOE(I)

 DO 54 J=1,6

 JE=IOE(J)

 ES(IE,JE)=ES(IE,JE)+EK(I,J)

 54 CONTINUE

 52 CONTINUE

 40 CONTINUE

C

 IF(MM.EQ.0) AE=DABS(AE4)

 AES(L)=AE

 GO TO (80,80,80,64,64,66),KOL2

 64 C1=0.25D0

 IF(MM.EQ.0) C1=1.D0

 DO 70 I=1,NV

 DO 70 J=1,NV

 70 EKK(L,I,J)=ES(I,J)\*AE\*C1

 DO 72 I=1,2

 DO 72 J=1,NV

 72 BMX(L,I,J)=0.D0

 DO 74 J=1,NV

 BMX(L,3,J)=BMT(3,J)

 74 BMX(L,4,J)=BMT(4,J)

 N1=NV/2

 DO 76 J=1,N1

 JE=2\*J

 JO=JE-1

 BMX(L,1,JO)=BMX(L,3,JE)

 76 BMX(L,2,JE)=BMX(L,3,JO)

 GO TO 68

 66 CALL WULT(T,ES,TEK,8,8,8)

 CALL MULT(TEK,T,ES,8,8,8)

 DO 78 I=1,8

 DO 78 J=1,8

 78 EKK(L,I,J)=ES(I,J)\*AES(L)\*0.25D0

 DO 90 I=1,4

 DO 90 J=1,8

 90 BM(I,J)=0.D0

 DO 92 J=1,8

 BM(3,J)=BMT(3,J)

 92 BM(4,J)=BMT(4,J)

 DO 94 J=1,4

 JE=2\*J

 JO=JE-1

 BM(1,JO)=BM(3,JE)

 BM(2,JE)=BM(3,JO)

 94 CONTINUE

 DO 96 I=1,4

 DO 96 J=1,8

 BMX(L,I,J)=0.D0

 DO 96 K=1,8

 96 BMX(L,I,J)=BMX(L,I,J)+BM(I,K)\*T(K,J)

 68 LL(8)=3\*MM-1

 LL(7)=LL(8)-1

 LL(6)=3\*KK-1

 LL(5)=LL(6)-1

 LL(4)=3\*JJ-1

 LL(3)=LL(4)-1

 LL(2)=3\*II-1

 LL(1)=LL(2)-1

 DO 98 I=1,NV

 IT=LL(I)

 98 LLL(L,I)=LY(IT)

 DO 100 I=1,4

 DO 100 J=1,NV

 DBM(L,I,J)=0.D0

 DO 100 K=1,4

 100 DBM(L,I,J)=DBM(L,I,J)+D(I,K)\*BMX(L,K,J)

 DO 102 I=1,4

 DO 102 J=1,4

 102 DMX(L,I,J)=D(I,J)

 CALL MATINV(D,4,4,0,DET,IND)

 DO 104 I=1,4

 DO 104 J=1,4

 104 DMI(L,I,J)=D(I,J)

 80 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 FUNCTION FUNCTS(JSTEP)

C \*\*\* HEAVISIDE AND HARMONIC TIME FUNCTION

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 COMMON/LA10/AZERO,BZERO,OMEGA,TOLER,AFACT,RFAIL

C

 FUNCTS=0.D0

 IF(IFUNC.EQ.0.OR.IFUNC.GE.3) GO TO 80

 IF(JSTEP.EQ.0.OR.FLOAT(JSTEP)\*DTIME.GT.DTEND) GO TO 80

 IF(IFUNC.EQ.1) FUNCTS=1.D0

 IF(IFUNC.EQ.2) ARGUM=OMEGA\*JSTEP\*DTIME

 IF(IFUNC.EQ.2) FUNCTS=AZERO+BZERO\*DSIN(ARGUM)

 80 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 FUNCTION FUNCTA(ACC,AFACT,IST)

C \*\*\* ACCELEROGRAM INTERPOLATION

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 DIMENSION ACC(2000)

C

 FUNCTA=0.D0

 IF(IFUNC.NE.0) RETURN

 TE=FLOAT(IST)\*DTIME

 IF(IST.EQ.0.OR.TE.GT.DTEND) RETURN

 X=(FLOAT(IST)-1.D0)/AFACT+1.D0

 M=X

 N=M+1

 X=X-FLOAT(M)

 FUNCTA=ACC(M)\*(1.D0-X)+X\*ACC(N)

 RETURN

 END

C \* \* \* \* \*

 SUBROUTINE DINV(AA,N0,N1,N2,DET,IND)

 IMPLICIT REAL\*8(A-H,O-Z)

 DIMENSION AA(N0,N0),IPERM(2600),X(2600)

 N=N1

 M=N+N2

 NMX=N0+1

 IF(0.GE.N.OR.N2.LT.0.OR.N.GE.NMX.OR.M.GE.NMX) GO TO 80

 IND=1

 DO 1 I=1,N

 1 IPERM(I)=I

 EPS=0.D0

 DO 2 K=1,N

 RMAX=0.D0

 DO 3 J=K,N

 V=DABS(AA(K,J))

 IF(RMAX-V) 4,3,3

 4 RMAX=V

 L=J

 3 CONTINUE

 IF(EPS-RMAX) 5,6,6

 6 IF(EPS\*0.01D0-RMAX) 7,8,8

 8 DET=0.D0

 IND=3

 DO 9 I=1,N

 DO 9 J=1,N

 9 AA(I,J)=1.0038D0

 WRITE(6,200)

 GO TO 11

 7 IND=2

 5 PIVOT=AA(K,L)

 PIVI=1.D0/PIVOT

 IF(L-K) 12,13,12

 12 IW=IPERM(K)

 IPERM(K)=IPERM(L)

 IPERM(L)=IW

 DO 14 I=1,N

 W=AA(I,K)

 AA(I,K)=AA(I,L)

 AA(I,L)=W

 14 CONTINUE

 13 CONTINUE

 DO 15 J=1,M

 X(J)=AA(K,J)\*PIVI

 AA(K,J)=X(J)

 15 CONTINUE

 DO 16 I=1,N

 IF(I-K) 17,16,17

 17 W=AA(I,K)

 IF(W) 18,16,18

 18 DO 19 J=1,M

 IF(J-K) 20,19,20

 20 AA(I,J)=-W\*X(J)+AA(I,J)

 19 CONTINUE

 AA(I,K)=-W\*PIVI

 16 CONTINUE

 AA(K,K)=PIVI

 EPS=DMAX1(RMAX\*1.D-33,EPS)

 2 CONTINUE

 DO 21 I=1,N

 22 K=IPERM(I)

 IF(K-I) 23,21,23

 23 IW=IPERM(K)

 IPERM(K)=IPERM(I)

 IPERM(I)=IW

 DO 24 J=1,M

 W=AA(I,J)

 AA(I,J)=AA(K,J)

 AA(K,J)=W

 24 CONTINUE

 GO TO 22

 21 CONTINUE

 11 RETURN

 80 CONTINUE

 WRITE(6,201) N,N2

 IND=4

 GO TO 11

 201 FORMAT(/'N1=',I5,' N2=',I5,' MEMORY-OVER')

 200 FORMAT(/'THE GIVEN MATRIX IS SINGULAR')

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE MATINV(AA,N0,N1,N2,DET,IND)

 IMPLICIT REAL\*8(A-H,O-Z)

 DIMENSION AA(N0,N0),IPERM(2390),X(2390)

 N=N1

 M=N+N2

 NMX=N0+1

 IF(0.GE.N.OR.N2.LT.0.OR.N.GE.NMX.OR.M.GE.NMX) GO TO 80

 IND=1

 DO 1 I=1,N

 1 IPERM(I)=I

 EPS=0.D0

 DO 2 K=1,N

 RMAX=0.D0

 DO 3 J=K,N

 V=DABS(AA(K,J))

 IF(RMAX-V) 4,3,3

 4 RMAX=V

 L=J

 3 CONTINUE

 IF(EPS-RMAX) 5,6,6

 6 IF(EPS\*0.01D0-RMAX) 7,8,8

 8 DET=0.D0

 IND=3

 DO 9 I=1,N

 DO 9 J=1,N

 9 AA(I,J)=1.0038D0

 WRITE(6,200)

 GO TO 11

 7 IND=2

 5 PIVOT=AA(K,L)

 PIVI=1.D0/PIVOT

 IF(L-K) 12,13,12

 12 IW=IPERM(K)

 IPERM(K)=IPERM(L)

 IPERM(L)=IW

 DO 14 I=1,N

 W=AA(I,K)

 AA(I,K)=AA(I,L)

 AA(I,L)=W

 14 CONTINUE

 13 CONTINUE

 DO 15 J=1,M

 X(J)=AA(K,J)\*PIVI

 AA(K,J)=X(J)

 15 CONTINUE

 DO 16 I=1,N

 IF(I-K) 17,16,17

 17 W=AA(I,K)

 IF(W) 18,16,18

 18 DO 19 J=1,M

 IF(J-K) 20,19,20

 20 AA(I,J)=-W\*X(J)+AA(I,J)

 19 CONTINUE

 AA(I,K)=-W\*PIVI

 16 CONTINUE

 AA(K,K)=PIVI

 EPS=DMAX1(RMAX\*1.E-33,EPS)

 2 CONTINUE

 DO 21 I=1,N

 22 K=IPERM(I)

 IF(K-I) 23,21,23

 23 IW=IPERM(K)

 IPERM(K)=IPERM(I)

 IPERM(I)=IW

 DO 24 J=1,M

 W=AA(I,J)

 AA(I,J)=AA(K,J)

 AA(K,J)=W

 24 CONTINUE

 GO TO 22

 21 CONTINUE

 11 RETURN

 80 CONTINUE

 WRITE(6,201) N,N2

 IND=4

 GO TO 11

 201 FORMAT(/'N1=',I5,' N2=',I5,' MEMORY-OVER')

 200 FORMAT(/'THE GIVEN MATRIX IS SINGULAR')

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 FUNCTION VFUNC(C)

 IMPLICIT REAL\*8(A-H,O-Z)

 VFUNC=0.D0

 IF(C.GT.0.D0) VFUNC=C

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE PRINCE(SR,SZ,TA,S1,S3,T)

 IMPLICIT REAL\*8(A-H,O-Z)

 C=0.5D0\*(SR+SZ)

 A1=(SZ-SR)\*0.5D0

 A2=A1\*A1+TA\*TA

 A=0.D0

 IF(A2.GT.0.D0) A=DSQRT(A2)

 S1=C+A

 S3=C-A

 IF(SZ.EQ.S3) GO TO 1

 T1=TA/(SZ-S3)

 T=DATAN(T1)

 GO TO 2

 1 T=3.14159D0\*0.5D0

 2 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE MULT(A,B,C,L,M,N)

 IMPLICIT REAL\*8(A-H,O-Z)

 DIMENSION A(L,M),B(M,N),C(L,N)

 DO 1 I=1,L

 DO 1 J=1,N

 C(I,J)=0.D0

 DO 1 K=1,M

 1 C(I,J)=C(I,J)+A(I,K)\*B(K,J)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE WULT(A,B,C,L,M,N)

 IMPLICIT REAL\*8(A-H,O-Z)

 DIMENSION A(M,L),B(M,N),C(L,N)

 DO 1 I=1,L

 DO 1 J=1,N

 C(I,J)=0.D0

 DO 1 K=1,M

 1 C(I,J)=C(I,J)+A(K,I)\*B(K,J)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE XULT(A,B,C,L,M,N)

 IMPLICIT REAL\*8(A-H,O-Z)

 DIMENSION A(L,M),B(N,M),C(L,N)

 DO 1 I=1,L

 DO 1 J=1,N

 C(I,J)=0.D0

 DO 1 K=1,M

 1 C(I,J)=C(I,J)+A(I,K)\*B(J,K)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE VULT(A,U,V,M,N)

 IMPLICIT REAL\*8(A-H,O-Z)

 DIMENSION A(M,N),U(N),V(M)

 DO 1 I=1,M

 V(I)=0.D0

 DO 1 J=1,N

 1 V(I)=V(I)+A(I,J)\*U(J)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE OUTDYN(IITER,ISTEP)

C \*\*\* OUTPUT ROUTINE

 IMPLICIT REAL\*8(A-H,O-Z)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB5/DMX(1260,4,4),DMI(1260,4,4),BMX(1260,4,8),DBM(1260,6,8)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LAB8/IFIXD,MITER,IPRED,NCHEK,ICRI

 COMMON/LAB9/DTIME,DTEND,DTREC,DELTA,GAAMA

 COMMON/LA11/IREQD(10),IREQS(10)

 COMMON/LA13/FORCE(2390),EPSTN(1260),EFFST(1260),EE(1260),EE0(1260)

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA17/VELOI(2390),VELOL(2390),VELOT(2390)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA23/TMX(1260,4,4),TMI(1260,4,4)

 DIMENSION STRPR(1260,12),UR(1280),UZ(1280),SBD(20,4),SSD(20,2)

C

 KSTEP=ISTEP

 IOUT=NOUTD(KSTEP)

C

 XTIME=FLOAT(KSTEP)\*DTIME

 WRITE(6,200) KSTEP,XTIME

C \*\*\* REARRANGE DISPLACEMENT VECTOR

 DO 10 IP=1,NPOIN

 I1=(IP-1)\*3+1

 IT=LY(I1)

 UR(IP)=DISPI(IT)

 I2=(IP-1)\*3+2

 IT=LY(I2)

 UZ(IP)=DISPI(IT)

 10 CONTINUE

C

 IF(IOUT.LE.0) GO TO 50

 WRITE(6,201)

 DO 12 IP=1,NPOIN

 12 WRITE(6,202) IP,UR(IP),UZ(IP)

 GO TO 54

 50 DO 52 ID=1,NREQD

 IP=IREQD(ID)

 52 WRITE(6,202) IP,UR(IP),UZ(IP)

 54 CONTINUE

 IP1=IREQD(1)

 WRITE(8,205) XTIME,UZ(IP1)

C \*\*\* WRITES STRESSES ON OUTPUT FILE

 DO 14 IE=1,NELEM

 KOL2=K2(IE)

 GO TO (21,21,21,21,24,21),KOL2

 21 DO 28 I=1,6

 28 STRPR(IE,I)=STRSG(IE,I)

 DO 22 I=7,11

 22 STRPR(IE,I)=0.D0

 GO TO 14

 24 SR=STRSG(IE,1)

 SZ=STRSG(IE,2)

 TA=STRSG(IE,3)

 ST=STRSG(IE,4)

 CALL PRINCE(SR,SZ,TA,S1,S3,AG)

 RA=180.D0/3.14159D0

 STRPR(IE,1)=SR

 STRPR(IE,2)=SZ

 STRPR(IE,3)=TA

 STRPR(IE,4)=ST

 STRPR(IE,5)=S1

 STRPR(IE,6)=S3

 STRPR(IE,7)=PI4(IE)\*RA

 STRPR(IE,8)=PI2(IE)

 14 CONTINUE

C

 IF(IOUT.LE.0) GO TO 30

 WRITE(6,203)

 DO 16 IE=1,NELEM

 16 WRITE(6,204) IE,IYIEL(IE),IUNLO(IE),IYHIS(IE),

 \* (STRPR(IE,I),I=1,8),EE(IE)

 DO 18 I=1,4

 18 WRITE(10,207) (STRPR(IE,I),IE=1,NELEM)

 30 CONTINUE

 DO 32 IS=1,NREQS

 IE=IREQS(IS)

 WRITE(6,204) IE,IYIEL(IE),IUNLO(IE),IYHIS(IE),

 \* (STRPR(IE,I),I=1,8),EE(IE)

 32 CONTINUE

C

 DO 34 IS=1,NREQS

 IE=IREQS(IS)

 DO 36 I=1,4

 36 SBD(IS,I)=STRPR(IE,I)

C

 S1=STRPR(IE,5)

 S3=STRPR(IE,6)

 SSD(IS,1)=(S1+S3)\*0.5

 SSD(IS,2)=(S1-S3)\*0.5

 34 CONTINUE

 WRITE(9,206) XTIME,((SBD(IS,I),I=1,2),IS=1,NREQS)

C

 200 FORMAT(/'TIME STEP',I5,3X,'TIME ',E12.4)

 201 FORMAT(/'NODE',6X,'R-DISP',6X,'Z-DISP')

 202 FORMAT(I5,2E12.3)

 203 FORMAT(/'STRESSES'/' EL YIELD UNLOAD',1X,'R-ST',5X,'Z-ST',

 \* 4X,'XY-ST',5X,'T-ST',6X,'MAX',6X,'MIN',1X,'S1-ANG',1X,'SITA',

 \* 2X,'BETA',2X,'SF-RZ',3X,'SF-T')

 204 FORMAT(I4,3I2,9E9.2)

 205 FORMAT(5F12.8)

 206 FORMAT(F6.4,8F8.2)

 207 FORMAT(10E11.3)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE MAVS1

C \*\*\* MICRO-AVS10 OUTPUT (PART 1: DIRECTION OF SHEAR BAND)

 IMPLICIT REAL\*8(A-H,O-Z)

 CHARACTER\*5 AC(900)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA22/NTENS,KTENS,ITENS(1260),JTENS(1260)

 DIMENSION SR(1690),SZ(1690),XXX(1580),YYY(1580)

 DIMENSION J(1690)

C

 DO 2 L=1,NELEM

 KOL2=K2(L)

 J(L)=1

 SR(L)=0.D0

 SZ(L)=0.D0

 GO TO (2,2,2,2,5,6),KOL2

 5 CONTINUE

 IF(IYIEL(L).LE.0.AND.JTENS(L).LE.0) GO TO 2

 IF(JTENS(L).GE.1) SI=3.14159D0\*0.5D0

 IF(IYIEL(L).GE.1) SI=PI4(L)

 GO TO 4

 6 CONTINUE

 IF(IYIEL(L).LE.0.AND.JTENS(L).LE.0) GO TO 2

 IF(JTENS(L).GE.1) SI=PI4(L)

 IF(IYIEL(L).GE.1) SI=PI4(L)

 4 CONTINUE

 SR(L)=DCOS(SI)

 SZ(L)=DSIN(SI)

 2 CONTINUE

C

 NELEM1=0

 DO 20 L=1,NELEM

 IF(K2(L).LE.3) GO TO 20

 NELEM1=NELEM1+1

 20 CONTINUE

C

 WRITE(11,301) NPOIN,NELEM1

 DO 8 I=1,NPOIN

 XXX(I)=XX(I)\*100.D0

 YYY(I)=YY(I)\*100.D0

 WRITE(11,302) I,XXX(I),YYY(I),0

 8 CONTINUE

C

 DO 10 L=1,NELEM

 AC(L)='quad'

 IF(IJK(L,4).EQ.0) AC(L)='tri'

 IF(IJK(L,3).EQ.0) GO TO 10

 WRITE(11,303) L,J(L),AC(L),(IJK(L,I),I=1,4)

 10 CONTINUE

 WRITE(11,304)

 WRITE(11,305)

 WRITE(11,306)

 DO 12 L=1,NELEM

 12 WRITE(11,307) L,SR(L),SZ(L)

C

 301 FORMAT(2I5,4X,'0',4X,'2',4X,'0')

 302 FORMAT(I5,2F12.3,F9.3)

 303 FORMAT(2I5,A8,I4,20I5)

 304 FORMAT(3X,'2',3X,'1',4X,'1')

 305 FORMAT('strX , (kN/m2)')

 306 FORMAT('strY , (kN/m2)')

 307 FORMAT(I5,3E13.4)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE MAVS2

C \*\*\* MICRO-AVS10 OUTPUT (PART 2: DISPLACEMENTS & YIELD ELEMENTS)

 IMPLICIT REAL\*8(A-H,O-Z)

 CHARACTER\*5 AC(900)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB2/LY(4500),LLL(1260,8),IX(1280),IY(1280),IQ(1280)

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA22/NTENS,KTENS,ITENS(1260),JTENS(1260)

 DIMENSION UX(1580),UY(1580),UM(1580),WST(1690,6),PI9(1690)

C

 DO 2 IP=1,NPOIN

 I1=(IP-1)\*3+1

 IT=LY(I1)

 UX(IP)=DISPI(IT)

 I2=(IP-1)\*3+2

 IT=LY(I2)

 UY(IP)=DISPI(IT)

 2 CONTINUE

 WRITE(12,310) 1

 WRITE(12,311)

 WRITE(12,300) 1

C

 WRITE(12,301) NPOIN,NELEM

 DO 10 I=1,NPOIN

 10 WRITE(12,302) I,XX(I),YY(I),0

 DO 12 L=1,NELEM

 AC(L)='quad'

 IF(IJK(L,4).EQ.0) AC(L)='tri'

 IF(IJK(L,3).EQ.0) AC(L)='line'

 WRITE(12,303) L,K2(L),AC(L),(IJK(L,I),I=1,4)

 12 CONTINUE

 WRITE(12,304)

 WRITE(12,305)

 WRITE(12,306)

 WRITE(12,307)

 WRITE(12,308)

 DO 14 I=1,NPOIN

 14 WRITE(12,309) I,UX(I),UY(I),0

 WRITE(12,313)

 WRITE(12,314)

 DO 20 L=1,NELEM

 20 PI9(L)=0.1D0

 DO 22 L=1,NELEM

 IF(IYIEL(L).GE.1) PI9(L)=2.D0

 22 CONTINUE

 DO 24 L=1,NELEM

 24 WRITE(12,315) L,PI9(L)

C

 300 FORMAT('step',I1)

 301 FORMAT(2I5)

 302 FORMAT(I5,3F10.4)

 303 FORMAT(2I5,A6,20I5)

 304 FORMAT(4X,'3',4X,'1')

 305 FORMAT(4X,'3',4X,'1',4X,'1',4X,'1')

 306 FORMAT(1X,'disp\_x, m')

 307 FORMAT(1X,'disp\_y, m')

 308 FORMAT(1X,'disp\_z, m')

 309 FORMAT(I5,3E14.4)

 310 FORMAT(I5)

 311 FORMAT('data\_geom')

 313 FORMAT(4X,'1',4X,'1')

 314 FORMAT(1X,'no')

 315 FORMAT(I5,E12.3)

 RETURN

 END

C \* \* \* \* \* \* \* \* \* \* \* \*

 SUBROUTINE MAVS3

C \*\*\* MICRO-AVS10 OUTPUT (PART 3: PRINCIPAL STRESSES)

 IMPLICIT REAL\*8(A-H,O-Z)

 CHARACTER\*5 AC(900)

 COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NN

 COMMON/LAB3/IJK(1260,4),K2(1260),MAT(1260),IST(1260),LRE(1260)

 COMMON/LAB4/PRP(20,12),AES(1260),EKK(1260,8,8),STAX(1260,6)

 COMMON/LAB6/XX(1280),YY(1280)

 COMMON/LAB7/NSTEP,NOUTP,NOUTD(1000),NREQD,NREQS,NACCE,IFUNC

 COMMON/LA15/STRAG(1260,6),STRSG(1260,6),STRIN(1260,6)

 COMMON/LA16/DISPI(2390),DISPL(2390),DISPT(2390)

 COMMON/LA20/IYIEL(1260),IUNLO(1260),IYHIS(1260)

 COMMON/LA21/PI1(1260),PI2(1260),PI3(1260),PI4(1260),DEP(1260,4,4)

 COMMON/LA22/NTENS,KTENS,ITENS(1260),JTENS(1260)

 DIMENSION WST(6),AX(1690),AY(1690),XXX(1580),YYY(1580)

 DIMENSION J(1690)

C

 DO 2 L=1,NELEM

 J(L)=0

 AX(L)=0.D0

 AY(L)=0.D0

 2 CONTINUE

C

 DO 10 L=1,NELEM

 KOL2=K2(L)

 IF(KOL2.LE.3) GO TO 10

 IF(IYIEL(L).GE.1) GO TO 12

 DO 20 I=1,3

 20 WST(I)=STRSG(L,I)

 GO TO 14

 12 CONTINUE

 DO 22 I=1,3

 22 WST(I)=STAX(L,I)

 14 CONTINUE

 SR=WST(1)

 SZ=WST(2)

 TA=WST(3)

 CALL PRINCE(SR,SZ,TA,S1,S3,TH)

 AX(L)=S1\*DSIN(TH)

 AY(L)=S1\*DCOS(TH)

 10 CONTINUE

C

 NNE1=0

 DO 6 L=1,NELEM

 IF(IJK(L,3).EQ.0) GO TO 6

 NNE1=NNE1+1

 6 CONTINUE

 WRITE(13,301) NPOIN,NNE1

C

 DO 30 I=1,NPOIN

 XXX(I)=XX(I)\*100.D0

 YYY(I)=YY(I)\*100.D0

 WRITE(13,302) I,XXX(I),YYY(I),0

 30 CONTINUE

 DO 32 L=1,NELEM

 AC(L)='quad'

 IF(IJK(L,4).EQ.0) AC(L)='tri'

 IF(IJK(L,3).EQ.0) GO TO 32

 WRITE(13,303) L,J(L),AC(L),(IJK(L,I),I=1,4)

 32 CONTINUE

 WRITE(13,304)

 WRITE(13,305)

 WRITE(13,306)

 DO 34 L=1,NELEM

 34 WRITE(13,307) L,AX(L),AY(L)

C

 301 FORMAT(2I5,4X,'0',4X,'2',4X,'0')

 302 FORMAT(I5,2F12.3,F9.3)

 303 FORMAT(2I5,A8,I4,20I5)

 304 FORMAT(3X,'2',3X,'1',4X,'1')

 305 FORMAT('strX , (kN/m2)')

 306 FORMAT('strY , (kN/m2)')

 307 FORMAT(I5,3E13.4)

 RETURN

 END