PROGRAM DYNCONE-C

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 CONSIDERING PORE-WATER PRESSURE

C

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

COMMON/LAB1/NPOIN,NELEM,NMATS,NIST,NPREV,ICON,NSIZE,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

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

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

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

COMMON/LA12/ACCEH(1850),ACCEV(1850)

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA14/XMASS(1850,1850),STIFF(2410,2410),STIFS(2410,2410)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(2410),DISPL(2410),DISPT(2410)

COMMON/LA17/VELOI(1850),VELOL(1850),VELOT(1850)

COMMON/LA18/ACCEI(1850),ACCEL(1850)

COMMON/LA19/DAMPI(1850,1850),RESID(2410)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA22/NTENS,KTENS,ITENS(960),JTENS(960)

COMMON/LA23/TMX(960,4,4),TMI(960,4,4)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

C

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

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

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

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

OPEN(10,FILE='PRWATER',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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA26/IEL(960,4),LYW(960)

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

C

NN=2410

NN0=1850

SC1=100000.D0

SC2=SC1\*SC1

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),(IEL(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),(IEL(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,10:K

C INTERFACE 1:G,2:E,3:NYU,4:RHO,5:C,6:FAI,7:DLT,8:ALFA,9:BETA,10:0

C TRUSS 1:E,2:AREA,3:0,4:RHO,5:0,6:0,7:0,8:ALFA,9:BETA,10:0

C BEAM 1;E,2:AREA,3:I,4:RHO,5:0,6:0,7:0,8:ALFA,9:BETA,10:0

WRITE(6,205)

DO 30 MT=1,NMATS

READ(5,105) M,(PRP(MT,I),I=1,10)

WRITE(6,206) M,(PRP(MT,I),I=1,10)

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(16I5)

104 FORMAT(8E10.3)

105 FORMAT(I5,10E8.3)

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:E=',I3

\*/' P-STRA:NL=',I3,' INTER=',I3)

203 FORMAT(/'ELEMENT DATA'/' NO. NODES ELEM NEIBOR TYPE MAT IST

+ L-R')

204 FORMAT(I4,2X,4I4,2X,4I4,2X,5I3)

205 FORMAT(/'MATERIAL PARAMETERS'

\* /'NO. E NYU THICK RHO C\*COS FAI DILT ALFA BETA K'/)

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

DIMENSION LX(3500),NDF(980)

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

C

LOC=NSIZE

DO 30 IE=1,NELEM

IF(K2(IE).EQ.5) GO TO 32

LYW(IE)=NN

GO TO 30

32 LOC=LOC+1

LX(LOC)=IE

LYW(IE)=LOC

30 CONTINUE

NSIZT=LOC

C

WRITE(6,200) NSIZE,NSIZT

200 FORMAT(/'NUMBER OF VARIABLES',2I5)

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

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

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

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

COMMON/LA12/ACCEH(1850),ACCEV(1850)

COMMON/LA16/DISPI(2410),DISPL(2410),DISPT(2410)

COMMON/LA17/VELOI(1850),VELOL(1850),VELOT(1850)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

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,NREQP

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

\* IFUNC,IFIXD,MITER,IPRED,NREQP

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)

READ(5,100) (IREQP(I),I=1,NREQP)

WRITE(6,204) (IREQP(I),I=1,NREQP)

C

DO 10 IV=1,NSIZT

VELOI(IV)=0.D0

DISPI(IV)=0.D0

DISPT(IV)=0.D0

10 DISPL(IV)=0.D0

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

DIMENSION STREI(10,4)

C

DO 10 IE=1,NELEM

DO 12 I=1,6

STRAG(IE,I)=0.D0

STRSG(IE,I)=0.D0

12 CONTINUE

10 CONTINUE

DO 14 IE=1,NELEM

IYIEL(IE)=0

IUNLO(IE)=0

IYHIS(IE)=0

EFFST(IE)=0.D0

EPSTN(IE)=0.D0

PW(IE)=0.D0

14 CONTINUE

C

WRITE(6,200)

DO 20 IS=1,NIST

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

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

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'/' SR SZ TA ST')

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB6/XX(980),YY(980)

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA14/XMASS(1850,1850),STIFF(2410,2410),STIFS(2410,2410)

COMMON/LA19/DAMPI(1850,1850),RESID(2410)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

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)

CALL DRAIN(IE,KOL2)

MM=IJK(IE,4)

NNODE=4

NEVAB=8

IF(MM.EQ.0) NNODE=3

IF(MM.EQ.0) NEVAB=6

30 CONTINUE

C

MT=MAT(IE)

RHO=PRP(MT,4)

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

C UNDER WATER-LEVEL

IF(KOL2.EQ.5) RHO=RHO+1.D0

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA14/XMASS(1850,1850),STIFF(2410,2410),STIFS(2410,2410)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(2410),DISPL(2410),DISPT(2410)

COMMON/LA19/DAMPI(1850,1850),RESID(2410)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

C

DO 4 IV=1,NSIZT

DO 4 JV=1,NSIZT

STIFF(IV,JV)=0.D0

4 STIFS(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 MM=IJK(IE,4)

NEVAB=8

IF(MM.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

DO 110 IE=1,NELEM

IF(K2(IE).NE.5) GO TO 110

MM=IJK(IE,4)

NEVAB=8

IF(MM.EQ.0) NEVAB=6

NW=LYW(IE)

IF(NW.EQ.NN) GO TO 110

DO 40 I=1,NEVAB

IT=LLL(IE,I)

IF(IT.EQ.NN) GO TO 40

STIFF(IT,NW)=CMATX(IE,I)

STIFF(NW,IT)=STIFF(IT,NW)

40 CONTINUE

ALPHA=ALPH(IE)\*DTIME\*SC2

STIFF(NW,NW)=-ALPHA

N1=4

IF(MM.EQ.0) N1=3

DO 50 LW=1,N1

NE=IEL(IE,LW)

IF(NE.LE.0) GO TO 50

NEW=LYW(NE)

ALPHAL=DRAIG(IE,LW)\*DTIME\*SC2

STIFF(NW,NEW)=ALPHAL

STIFF(NEW,NW)=STIFF(NW,NEW)

50 CONTINUE

110 CONTINUE

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

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

CONSD=GAAMA/(DTIME\*DELTA)

NSIZE1=NSIZE+1

DO 36 IV=1,NSIZT

DO 36 JV=1,NSIZT

36 STIFS(IV,JV)=STIFS(IV,JV)+STIFF(IV,JV)

DO 38 IV=1,NSIZE

DO 38 JV=1,NSIZE

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

C

CALL MATINV(STIFS,NN,NSIZT,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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

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

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

COMMON/LA12/ACCEH(1850),ACCEV(1850)

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA14/XMASS(1850,1850),STIFF(2410,2410),STIFS(2410,2410)

COMMON/LA16/DISPI(2410),DISPL(2410),DISPT(2410)

COMMON/LA17/VELOI(1850),VELOL(1850),VELOT(1850)

COMMON/LA18/ACCEI(1850),ACCEL(1850)

COMMON/LA19/DAMPI(1850,1850),RESID(2410)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

DIMENSION TACCE(1850),ACCEJ(1850),ACCEK(1850)

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

C

IF(IITER.GT.1) GO TO 130

DO 50 IE=1,NELEM

IF(K2(IE).NE.5) GO TO 50

MM=IJK(IE,4)

NW=LYW(IE)

DISPL(NW)=0.D0

IF(NW.EQ.NN) GO TO 50

NEVAB=8

IF(MM.LE.0) NEVAB=6

DO 52 I=1,NEVAB

IT=LLL(IE,I)

IF(IT.EQ.NN) GO TO 52

DISPL(NW)=DISPL(NW)+CMATX(IE,I)\*DISPI(IT)

52 CONTINUE

50 CONTINUE

130 CONTINUE

C

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

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

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

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

COMMON/LA12/ACCEH(1850),ACCEV(1850)

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA14/XMASS(1850,1850),STIFF(2410,2410),STIFS(2410,2410)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(2410),DISPL(2410),DISPT(2410)

COMMON/LA17/VELOI(1850),VELOL(1850),VELOT(1850)

COMMON/LA18/ACCEI(1850),ACCEL(1850)

COMMON/LA19/DAMPI(1850,1850),RESID(2410)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA22/NTENS,KTENS,ITENS(960),JTENS(960)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

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

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

C

DO 4 IV=1,NSIZT

RESID(IV)=0.D0

4 TU(IV)=DISPT(IV)

TU(NN)=0.D0

C

DO 100 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

C

HARDS=0.D0

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

100 CONTINUE

C

DO 110 IE=1,NELEM

IF(K2(IE).NE.5) GO TO 110

MM=IJK(IE,4)

NW=LYW(IE)

IF(NW.EQ.NN) GO TO 110

NEVAB=8

IF(MM.EQ.0) NEVAB=6

DO 80 I=1,NEVAB

IT=LLL(IE,I)

IF(IT.EQ.NN) GO TO 80

ELOAD(I)=CMATX(IE,I)\*TU(NW)

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

80 CONTINUE

C

ALPHA=ALPH(IE)\*DTIME\*SC2

TLU=0.D0

DO 82 I=1,NEVAB

IT=LLL(IE,I)

IF(IT.EQ.NN) GO TO 82

TLU=TLU+CMATX(IE,I)\*TU(IT)

82 CONTINUE

N1=4

IF(MM.EQ.0) N1=3

TAP=0.D0

DO 84 LW=1,N1

NE=IEL(IE,LW)

C IF(NE.LE.0) GO TO 56

NEW=LYW(NE)

ALPHAL=DRAIG(IE,LW)\*DTIME\*SC2

TAP=TAP+ALPHAL\*TU(NEW)

84 CONTINUE

RESID(NW)=TLU-ALPHA\*TU(NW)+TAP

110 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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

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

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

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

COMMON/LA12/ACCEH(1850),ACCEV(1850)

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA14/XMASS(1850,1850),STIFF(2410,2410),STIFS(2410,2410)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(2410),DISPL(2410),DISPT(2410)

COMMON/LA17/VELOI(1850),VELOL(1850),VELOT(1850)

COMMON/LA18/ACCEI(1850),ACCEL(1850)

COMMON/LA19/DAMPI(1850,1850),RESID(2410)

DIMENSION TVECT(2410),DISPD(2410)

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)

NSIZE1=NSIZE+1

DO 12 IV=NSIZE1,NSIZT

12 TVECT(IV)=DISPL(IV)-RESID(IV)

C \*\*\* CALCULATES DELTA DISPLACEMENT

DO 14 IV=1,NSIZT

DISPD(IV)=0.D0

DO 14 JV=1,NSIZT

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

C \*\*\* APPLIES CONVERGENCE

SUMPP=0.D0

SUMPQ=0.D0

DO 16 IV=1,NSIZT

DISPP=DISPD(IV)

DISPQ=DISPT(IV)+DISPP

DISPT(IV)=DISPQ

SUMPP=SUMPP+DISPP\*DISPP

SUMPQ=SUMPQ+DISPQ\*DISPQ

16 CONTINUE

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

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

DO 18 IV=1,NSIZE

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

18 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)

DO 24 IV=NSIZE1,NSIZT

24 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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

DIMENSION EU(8),TU(1850),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 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 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)

GO TO 10

C \*\*\* SOLID AND INTERFACE

14 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(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

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

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

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(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

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(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

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(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

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

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA23/TMX(960,4,4),TMI(960,4,4)

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 MATINV(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,SX,SY,TA,F,S,P2,B0)

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

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

M=MAT(L)

CC=PRP(M,5)

FAI=PRP(M,6)

FAI=FAI\*3.14159D0/180.D0

SFI=DSIN(FAI)

CFI=DCOS(FAI)

P1=SX+SY

P2=SX-SY

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(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

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(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA22/NTENS,KTENS,ITENS(960),JTENS(960)

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

DIMENSION SIG(6)

C

DO 2 I=1,3

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 CONTINUE

SX=SIG(1)

SZ=SIG(2)

TA=SIG(3)

CALL PRINCE(SX,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-SX

IF(S) 30,30,32

30 IF(SX) 50,50,40

40 SZ=S1-SX

SIG(2)=SZ

GO TO 35

32 IF(SZ) 52,52,42

42 SX=S1-SZ

SIG(1)=SX

35 A=(S1\*\*2-(SX-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

DO 4 I=1,3

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

10 CONTINUE

RETURN

END

C \* \* \* \* \*

SUBROUTINE TRUSS(L)

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

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA23/TMX(960,4,4),TMI(960,4,4)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

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)

NEVAB=8

IF(MM.EQ.0) NEVAB=6

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

GGX=0.

GGY=0.

I1=0

I2=1

I3=2

N4=4

IF(MM.EQ.0) N4=1

C

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)\*0.333333333D0

ZZ=(YI+YJ+YK)\*0.333333333D0

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

DLT=AI+AJ+AK

VOL=DABS(DLT)\*RR\*0.5D0

GGX=GGX+RR\*VOL

GGY=GGY+ZZ\*0.25D0

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(DA)

AES(L)=AE

GXX(L)=GGX/AE\*0.5D0

GYY(L)=GGY

IF(MM.NE.0) GO TO 62

GXX(L)=RR

GYY(L)=ZZ

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

64 C1=0.25D0

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

DO 70 I=1,NEVAB

DO 70 J=1,NEVAB

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

DO 72 I=1,2

DO 72 J=1,NEVAB

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

DO 74 J=1,NEVAB

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

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

C

N1=4

IF(MM.EQ.0) N1=3

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)

DO 77 I=1,N1

JE=I\*2

JO=JE-1

CMATX(L,JO)=(BMX(L,1,JO)+BMX(L,4,JO))\*AES(L)\*SC1

CMATX(L,JE)=BMX(L,2,JE)\*AES(L)\*SC1

77 CONTINUE

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,NEVAB

IT=LL(I)

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

DO 100 I=1,4

DO 100 J=1,NEVAB

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 \* \* \* \* \* \* \* \* \* \* \* \*

SUBROUTINE DRAIN(IE,KOL2)

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

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB6/XX(980),YY(980)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

C

IF(KOL2.NE.5) RETURN

MM=IJK(IE,4)

MT=MAT(IE)

ALP=0.D0

N1=4

IF(MM.EQ.0) N1=3

DO 10 I=1,N1

NAI=IEL(IE,I)

DRAIG(IE,I)=0.D0

IF(NAI.EQ.0) GO TO 10

NOI=IJK(IE,I)

J=I+1

IF(J.EQ.5) J=1

IF(MM.EQ.0.AND.J.EQ.4) J=1

NOJ=IJK(IE,J)

DLW=(XX(NOI)-XX(NOJ))\*\*2+(YY(NOI)-YY(NOJ))\*\*2

IF(NAI.LT.0) GO TO 12

DLL=(GXX(NAI)-GXX(IE))\*\*2+(GYY(NAI)-GYY(IE))\*\*2

MTI=MAT(NAI)

IF(I.EQ.2.OR.I.EQ.4) GO TO 14

DN=(GXX(NAI)-XX(NOI))\*\*2

DM=(GXX(IE)-XX(NOI))\*\*2

GO TO 16

14 DN=(GYY(NAI)-YY(NOI))\*\*2

DM=(GYY(IE)-YY(NOI))\*\*2

16 DKK=PRP(MTI,10)\*DSQRT(DN/DLL)+PRP(MT,10)\*DSQRT(DM/DLL)

DRAIG(IE,I)=DSQRT(DLW/DLL)\*PRP(MT,10)

GO TO 18

12 II=I+2

IF(MM.NE.0.AND.II.GT.4) II=II-4

IF(MM.EQ.0.AND.II.GT.3) II=II-3

NOII=IJK(IE,II)

DLL=(XX(NOII)-XX(NOJ))\*\*2+(YY(NOII)-YY(NOJ))\*\*2

DRAIG(IE,I)=DSQRT(DLW/DLL)\*2.D0\*PRP(MT,10)

18 ALP=ALP+DRAIG(IE,I)

10 CONTINUE

ALPH(IE)=ALP

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

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

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

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) N1

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',I5)

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(SX,SY,TA,S1,S3,T)

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

C=0.5D0\*(SX+SY)

A1=(SY-SX)\*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(SY.EQ.S3) GO TO 1

T1=TA/(SY-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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB5/DMX(960,4,4),DMI(960,4,4),BMX(960,4,8),DBM(960,6,8)

COMMON/LAB6/XX(980),YY(980)

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

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

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

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

COMMON/LA13/FORCE(1850),EPSTN(960),EFFST(960),EE(960),EE0(960)

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(2410),DISPL(2410),DISPT(2410)

COMMON/LA17/VELOI(1850),VELOL(1850),VELOT(1850)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA23/TMX(960,4,4),TMI(960,4,4)

COMMON/LA24/GXX(960),GYY(960),CMATX(960,8),SC1,SC2

COMMON/LA25/DRAIG(960,4),ALPH(960),PW(960)

COMMON/LA26/IEL(960,4),LYW(960)

DIMENSION STRPR(960,12),UR(980),UZ(980),SBD(20,4),SSD(20,2),

\* PPW(20),PSTR(20)

C

KSTEP=ISTEP

IOUT=NOUTD(KSTEP)

C

XTIME=FLOAT(KSTEP)\*DTIME

WRITE(6,200) KSTEP,XTIME

C \*\*\* REARRANGE DISPLACEMENT VECTOR

DO 2 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)

2 CONTINUE

NSIZE1=NSIZE+1

DO 4 IE=1,NELEM

IT=LYW(IE)

PW(IE)=DISPI(IT)\*SC1

4 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 CONTINUE

DO 52 ID=1,NREQD

IP=IREQD(ID)

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

54 CONTINUE

IP=IREQD(1)

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

DO 56 I=1,NREQP

IE=IREQP(I)

PPW(I)=PW(IE)

PSTR(I)=STRSG(IE,2)

56 CONTINUE

WRITE(10,208) XTIME,(PPW(I),I=1,NREQP),

\* (PSTR(I),I=1,NREQP)

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),PW(IE)

C DO 18 I=1,4

C 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),PW(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',2X,'R-ST',2X,'Z-ST',

\* 2X,'XY-ST',2X,'T-ST',2X,'MAX',2X,'MIN',2X,'S1-ANG',2X,'SITA',

\* 2X,'E',2X,'PW')

204 FORMAT(I4,3I2,10E9.2)

205 FORMAT(8F12.8)

206 FORMAT(F6.3,8F8.2)

207 FORMAT(10E11.3)

208 FORMAT(F12.8,7F12.2)

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,NSIZT,NN0,NN

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB6/XX(980),YY(980)

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

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(1850),DISPL(1850),DISPT(1850)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA22/NTENS,KTENS,ITENS(960),JTENS(960)

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

IF(K2(L).LE.3) GO TO 12

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

12 CONTINUE

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,NSIZT,NN0,NN

COMMON/LAB2/LY(3500),LLL(960,8),IX(980),IY(980),IQ(980)

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB6/XX(980),YY(980)

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

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(1850),DISPL(1850),DISPT(1850)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA22/NTENS,KTENS,ITENS(960),JTENS(960)

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,NSIZT,NN0,NN

COMMON/LAB3/IJK(960,4),K2(960),MAT(960),IST(960),LRE(960)

COMMON/LAB4/PRP(20,12),AES(960),EKK(960,8,8),STAX(960,6)

COMMON/LAB6/XX(980),YY(980)

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

COMMON/LA15/STRAG(960,6),STRSG(960,6),STRIN(960,6)

COMMON/LA16/DISPI(1850),DISPL(1850),DISPT(1850)

COMMON/LA20/IYIEL(960),IUNLO(960),IYHIS(960)

COMMON/LA21/PI1(960),PI2(960),PI3(960),PI4(960),DEP(960,4,4)

COMMON/LA22/NTENS,KTENS,ITENS(960),JTENS(960)

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