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ORNL/SUB-4269/17

DOCUMENTATION OF THE THERMO/VISCOELASTIC CODE TEVCO

Memorandum Report RSI-0039

Gary D. Callahan

September 30, 1975

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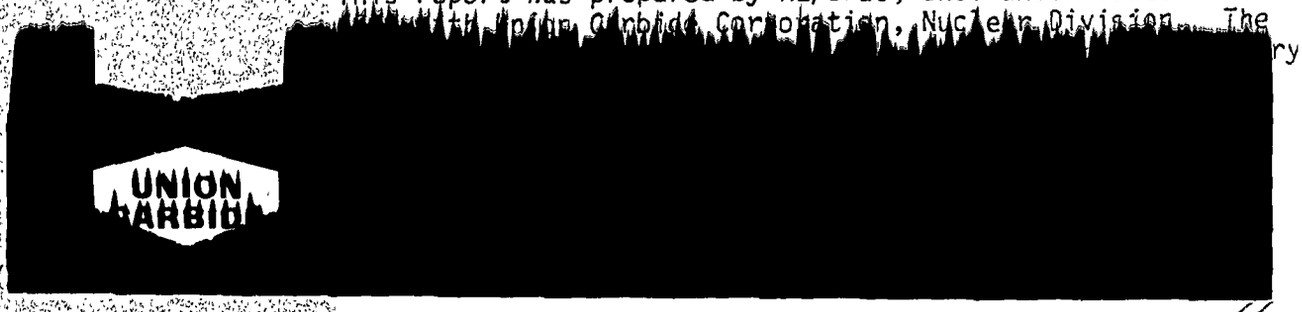

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ORNL-SUB-4269-17

MEMORANDUM REPORT RSI-0039

DOCUMENTATION OF THE THERMO/VISCOELASTIC CODE TEVCO

Submitted To

Holifield National Laboratory
Oak Ridge, Tennessee

operated by

Union Carbide Corporation
Nuclear Division
for the
Energy Research and Development Administration

by

Gary D. Callahan

RE/SPEC INC.
P. O. BOX 725 - RAPID CITY, S. D. 57701 - 605/343-7868

REA

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Rapid City, South Dakota

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FOREWORD

The contents of this report have been reviewed by Mr. Joe L. Ratigan and Dr. Arlo F. Fossum.

RE/SPEC INC.

P. O. Box 725 • Rapid City, S D 57701 • 605/343-7868

September 30, 1975

MEMORANDUM REPORT RSI-0039

TO: Dr. William C. McClain
Holifield National Laboratory
P. O. Box Y
Oak Ridge, TN 37830

FROM: Gary D. Callahan
RE/SPEC Inc.
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SUBJECT: Documentation of the Thermo/Viscoelastic Computer Code TEVCO (Union Carbide Corporation, Nuclear Division, Subcontract No. 4269, RSI/001000/FY76)

1. INTRODUCTORY REMARKS AND OBJECTIVE

The major objective of this report is to provide a brief description and documentation of the thermo/viscoelastic finite element computer code TEVCO. The formulation and theory of the finite element method is beyond the scope of this report, but has been covered in numerous books and periodicals (see for example References 1 and 2). In addition, a general description of the finite element method has been reported previously (3).

2. CODE DESCRIPTION AND CAPABILITIES

Two versions of TEVCO currently exist. One version is adapted to the HNL IBM 360/91 computer system and the other version is adapted to a CDC 3400 computer system. The major differences between the two versions of the code exist in the fact that the CDC version uses peripheral storage devices due to the machine core limitations.

TEVCO may solve any of the following types of problems in either two dimensional X-Y or axially-symmetric R-θ-Z geometry utilizing constant strain triangular elements with stress or displacement boundary conditions specified:

(1) Elastic

(2) Thermoelastic

(3) Viscoelastic

(4) Thermo/viscoelastic

In addition, the above problems may involve geometric nonlinearities (4). Although material nonlinearities are not currently included, they may be provided for with minor program modifications.

The two dimensional X-Y geometry uses the plane strain assumption. Plane stress may be considered by merely replacing Poisson's Ratio (ν) by $\nu/(1 + \nu)$ in the material property matrix.

A basic flow chart of the computer code is shown in Figure 2.1. The flow chart illustrates the direct solution technique utilized for the most complex case (e.g. thermo/viscoelastic with geometric nonlinearities).

Presently, linear strain triangles (LST) and isoparametric quadrilaterals are being incorporated into the code.

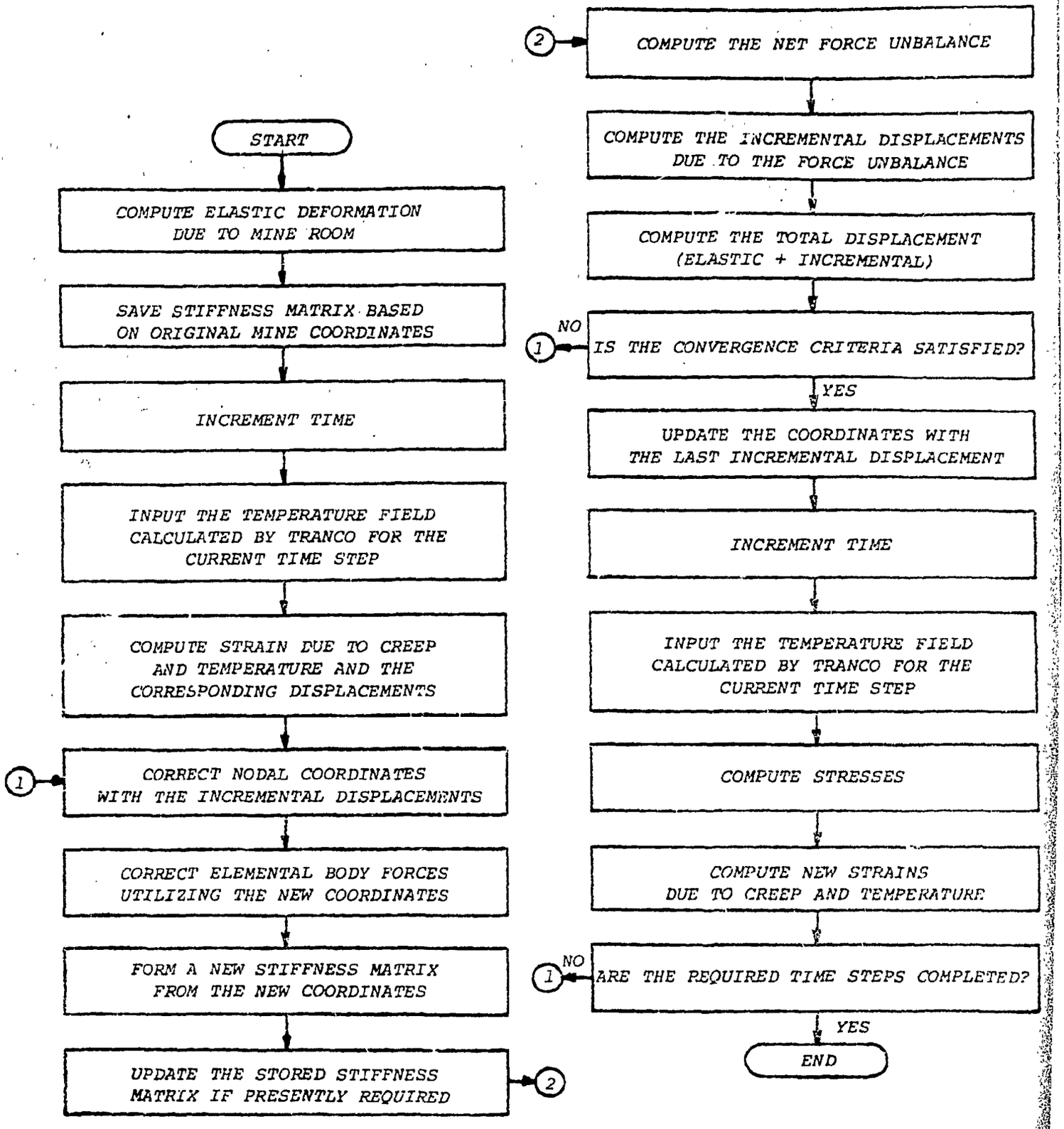

Figure 2.1. Basic Flow Chart of the Thermovisco-Elastic Finite-Element Code.

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1. Zienkiewicz, O. C.: The Finite Element Method in Engineering Science, McGram-Hill, London, (1971).

2. Desai, C. S. and Abel, J. F.: Introduction to the Finite Element Method, Van Nostrand Reinhold Company, New York, (1972).

3. Russell, James E. and Hovland, Helge: Memorandum Report RSI-0006, "General Description of the Finite Element Method of Analysis in Engineering Mechanics", October 5, 1973.

4. Gnirk, P. F., Pariseau, W. G., Russell, J. E., Wawersik, W. R., Callahan, G. D., and Hovland, H.: "Analysis and Evaluation of the Rock Mechanics Aspects of the Proposed Salt Mine Repository", Summary Progress Report (RSI-0005), Prepared for the Oak Ridge National Laboratory (Union Carbide Corp., Nuclear Division Subcontract No. 3706), Sept. 1973.

APPENDIX A

FORTRAN LISTING OF COMPUTER CODE TEVCO

```
      PROGRAM MAIN
C
C
C
C
C
C
C
C
C
C
C
C
C
C
C
C
C
C    RRRRRRRR    EEEEEEEEEE  SSSSSSSSSS  PPPPPPPP    EEEEEEEEEE  CCCCCCCCC
C    RRRRRRRRR   EEEEEEEEEE  SSSSSSSSS   PPPPPPPPP   EEEEEEEEEE  CCCCCCCCC
C    RR       R  EE          SS          PP       P  EE          CC
C    RR       R  EE          SS          PP       P  EE          CC
C    RR       R  EE          SS          PP       P  EE          CC
C    RRRRRRRRRR  EEEEEE      SSSSSSSSSS  PPPPPPPPPP  EEEEEE      CC
C    RRRRRRRR    EEEEEE      SSSSSSSSSS  PPPPPPPP    EEEEEE      CC
C    RR   RR     EE                  SS  PP          EE          CC
C    RR    RR    EE                  SS  PP          EE          CC
C    RR     RR   EE                  SS  PP          EE          CC
C    RR      RR  EEEEEEEEEE  SSSSSSSSSS  PP          EEEEEEEEEE  CCCCCCCCC
C    RR       RR EEEEEEEEEE  SSSSSSSSSS  PP          EEEEEEEEEE  CCCCCCCCC
C
C
C
C
C
C
C
C
C
C
C       RRRRRR   SSSSSS  IIIII      / V     V  EEEEEE      11111
C       R    R   S         I       /  V     V  E               1
C       RRRRRR   SSSSSS    I      /    V   V   EEEE    ---   111
C       R  R          S    I     /      V V    E       ---     1
C       R   R    SSSSSS  IIIII  /        V     EEEEEE      11111
C
C
C
C
C
C
C
C
C
C
C
```

```
C
C
C
C
C
C     VARIABLE              DEFINITION
C
C     ANGLE                 CLOCKWISE ANGLE FROM THE VERTICAL LINE OF ACTION
C                           TO THE MAXIMUM STRESS
C     AREA                  ELEMENTAL AREA
C     BB                    STRAIN MATRIX
C     BBT                   TRANSPOSED BB MATRIX
C     BFORX                 BODY FORCE IN THE X-DIRECTION
C     BFORY                 BODY FORCE IN THE Y-DIRECTION OR DENSITY
C     BFX                   NODAL HORIZONTAL BODY FORCE
C     BFY                   NODAL VERTICAL BODY FORCE
C     CORDS                 X AND Y NODAL COORDINATES
C     D                     STRAIN DISPLACEMENT MATRIX
C     DELT                  TIME-STEP
C     DISP                  DISPLACEMENT VECTOR
C     ELAS                  ELASTICITY MATRIX
C     ELFOR                 ELEMENTAL FORCE VECTORS
C     EPI                   INCREMENTAL STRAIN
C     FER                   INCREMENTAL RESTORING FORCE
C     IBOD                  BODY FORCE CONTROL PARAMETER, BODY FORCES IBOD=1
C     ICLMN,ICLMN1,         DEFINE STIFNESS MATRIX LOCATION
C     ICLMN2,IROW1
C     ICRP                  MATERIAL PROPERTY CONTROL PARAMETER
C     IELMAT                ELEMENTAL MATERIAL TYPE
C     IPRN                  CONTROL DATA PRINTOUT, OUTPUT FOR IPRN=0
C     INSTR                 INITIAL STRAIN INDICATOR, INITIAL STRAIN INSTR=1
C     ITHERM                ITHERM=1, TEMPS ARE READ FROM TAPE LU10
C                           FOR THERMOVISCOELASTIC ANALYSIS
C     ITMAX                 MAXIMUM DESIRED TIME-STEPS
C     IT                    TIME LOOP INDEX
C     LC                    LOAD CASE IDENTIFIER
C    LITHO                  LITHOSTATIC STRESSES READ IN FOR LITHO=1
C     LU1                   LOGICAL TAPE UNIT INCLUDING BB MATRIX
C     LU2                   LOGICAL TAPE UNIT INCLUDING SBSTEI MATRIX
C     LU3                   LOGICAL TAPE UNIT INCLUDING ELAS MATRIX
C     LU7                   LOGICAL TAPE UNIT INCLUDING EQNMTX
C     LU8                   LOGICAL TAPE UNIT INCLUDING EPI
C     MCRP                  MATERIAL NUMBER THAT IS VISCOUS
C     NBAND                 BANDED MATRIX WIDTH
C     NBCTYP                BOUNDARY CONDITION TYPE (XY=11,01,10)
C                           1=FIXED, 0=NOT FIXED
C     NBNFIX                RESTRAINED BOUNDARY NODE NUMBERS
C     NBNODE                NUMBER OF BOUNDARY NODES
C     NAME                  TITLE ARRAY
C     ND2                   NUMBER OF BOUNDARY CONDITIONS TO BE SET
C                           AFTER THE FIRST TIME STEP
C     NELEM                 NUMBER OF ELEMENTS
C     NELCON                ELEMENT NODAL CONNECTION ARRAY
C     NELMAT                NUMBER OF DIFFERENT ELEMENT MATERIAL TYPES
C     NNEL                  MAXIMUM NUMBER OF NODES PER ELEMENT
C     NEQSYS                NUMBER OF EQUATIONS IN SYSTEM
```

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```
C  NFXC      SAVES ORIGINAL NBCTYP VALUES
C  NLCAS     NUMBER OF LOAD CASES
C  NNODES    NUMBER OF NODES
C  NNODE2    TWICE THE NUMBER OF NODES
C  NODL      LOADED NODAL NUMBERS
C  NDF       NUMBER OF DEGEES OF FREEDOM
C  NOIT      0 UTILIZES LARGE DISP. THEORY
C            1 DIRECT SOLUTION  NO LDI
C  NPKONT    INDEX ON THE NUMBER OF PROBLEMS
C  NPROB     MAXIMUM NUMBER OF PROBLEMS
C  NRB,NB    VARIABLES USED TO IDENTIFY BOUNDARY CONDITIONS
C  NSTRE     NODAL STRESS INDICATOR  0= NODAL STRESSES NOT PR
C                                    1= AVERAGE NODAL STRESSE
C                                    2= WEIGHTED NODAL STRESS
C                                    3= BOTH AVERAGE AND WEIG
C                                       NODAL STRESSES PRINTE
C                                    4= NODAL ONLY SKIP ELEME
C                                    5= WEIGHTED ONLY  DITTO
C                                    6= BOTH  ONLY     DITTO
C  NDIS      NDIS=1,NODAL DISPLACEMENT PRESCRIBED,
C            NDIS=0,NO NODAL DISPLACEMENTS PRESCIBED
C  PROP      TYPE MATERIAL ELEMENT PROPERTIES
C  RATIO     YOUNGS MOD. POISSONS RATIO COMBINATION CONSTANT
C  SBS       STRESS BACK-SUBSTITUTION MATRIX
C  SBSTEI    SBS TRANSPOSED TTMES ELAS
C  SELAS     ELASTIC STRESS
C  SEMTX     STRESS-STRAIN MATRIX, ELEMENT STIFNESS MATRIX
C  SM        MEAN STRESS
C  SMAX      MAXIMUM ELEMENTAL STRESS
C  SMIN      MINIMUM ELEMENTAL STRESS
C  ST        TOTAL STRESS
C  TDIS2     TOTAL DISPLACEMENT
C  TM        TOTAL TIME
C  VOLUM     ELEMENTAL VOLUME
C  XE        COORDINATE IDENTIFICATION VARIABLE
C  XCS       CREEP STRAIN
C  XILD      LOAD DISPLACEMENT
C  XLD       TEMPORARY LOAD ARRAY AT NODL
C  XJ,XK,YJ,YK  ELEMENT COORDINATES
C  XNDIS     VALUE EQUAL TO THE INCREMENTAL DISPLACEMENTS
C            USED TO CORRECT THE NODAL COORDINATE VALUES
C
C
C
C---------------------  PROGRAM MAIN ACTS AS THE CONTROL ----------
C--------------------- PROGRAM, MAIN INITIATES SUBROUTINE ----------
C--------------------- CALLS AND INDEXES THE NUMBER OF ----------
C--------------------- PROBLEMS, THE NUMBER OF LOAD CASES ----------
C--------------------- AND THE DESIRED NUMBER OF TIME-STEPS ----------
C--------------------- IN THE PROBLEM SOLUTION ----------
C
      COMMON/LUNITS/LU7,LU8,LU10
      COMMON/GCNTR/ NDIS,NSTRE,NB),NQ(25),NQT(25)
      COMMON/CNTRL/ NRNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NR2,MCRP
      COMMON/DELCON/DELT,TM,JT,NAME(16)
      COMMON/LGDISP/EUB(150),TDELT(2,75),ELDIS(2,75),RCRP(150),
```

```
FTN 1.4          DATE 09/26/75      AT 12343          PAGE NO. 4
      $TEMPC(150),ICONV,IKNT,LUPD,NOIT,TRCRP(150)
      COMMON/TEST/ ITEST,LITHO,NCHK,IPRNT,IRZ
      COMMON/GANDY/ IIK,INDTC,IPR,IIHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON FORMTX(150,25),XILD(150),NBANW,PROP(4,6),NBNFTX(30),
     $NMCTYP(30),SFMTX(12,12),D(4,6),SBS(4,6),BFORY(4),BFORX(10),IBOD
     $,XLD(8)
      COMMON/MTAP/ DB(100,4,6),SHSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BOUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TWES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TWE/ NELEM,NELMAT,NNODES
C
C        THIS PROGRAM IS SET UP FOR 100 ELEMENTS, 75 NODES, A BAND-
C     WIDTH OF 25, AND DIFFERENT MATERIALS
C
      CALL TIMEX(IDATE,ITIME)
      WRITE(6,600) IDATE,ITIME
  600 FORMAT(1H1,*       DATE AND TIME . . . *,A8,5X,A8)
C
      NPROB=0
    1 INDTC=1
      IIK=0
C
C---------- INITIALIZE TAPE UNIT NUMBERS ----------
C
      LUT=7
      LUD=9
      LUIO=10
      REWIND LUIO
C
C---------- INITIALIZE NUMBER OF NODES PER ELEMENT ----------
C
      NNEL=4
      ICONV=1
      LUPD=1
      ITEST=0
      JT=1
      IKNT=0
      DO 11 I=1,150
   11 TRCRP(I)=0.0
C
C---------- SUBROUTINE WRITI PRINTS THE JOB DESCRIPTION ----
C     IPRNT EQUALS 0 FOR TWO DIMENSIONAL AND 1 FOR R-Z
C
      IF(NPROB.GE.1) GO TO 2
      CALL WRITI
    2 READ(60,540) NDIS,NSTRE
  540 FORMAT(2I5)
      WRITE(61,541) NDIS,NSTRE
  541 FORMAT(1H1,*  NDIS=*,I2,*   NSTRE=*,I2)
      READ(60,530) NPROB,JTMAX,INSTR,NBANW,NCHK,IPRNT,NOIT
      READ(60,530) NELT,IPR,IIHERM
      IT=3
      IF(IPR.LE.0) IPR=1
C
C---------- SOLVE THE NUMBER OF PROBLEMS ----------
```

```
      C
            IF(IPRNT.EQ.1)IRZ=4
      C
      C---------- READ INPUT DATA ----------
      C
            CALL DATAIN
      C
      C---------- SET THE NUMBER OF SYSTEM EQUATIONS ----------
      C
            NEQSYS=1*NODES*NDF
      C
      C---------- LOOP ON THE NUMBER OF LOAD CASES ----------
      C
      C
            DO 20 LC=1,NLCAS
      C
      C---------- READ LOADS AND CALCULATE BODY FORCES ----------
      C
         67 CALL FORCTN
      C
      C---------- FORM AND LATER SOLVE SIMULTANEOUS EQUATIONS ----
      C
      C---------- LOOP ON NUMBER OF TIME STEPS ----------
      C
         60 CALL FORMTX
            IF(NOIT.EQ.1) GO TO 100
            IF(ICONV .NE. 1) 67,68
         68 IF(JT .GT. 1) GO TO 58
            CALL SOLVE(1,NEQSYS)
            TM=(JT-1)*DELT
            WRITE(6,*35) TM,DELT
      C
            CALL SOLVE(2,NEQSYS)
      C
      C
      C---------- CALCULATE STRESSES AND STRAINS ----------
      C
         58 CALL STRESS
            IF(JT .GT. JTMAX) 70,31
         31 IF(IKNT .EQ. 10) 32,33
         32 IKNT=0
            LORD=0
         40 CONTINUE
         33 CALL INSTAN(ISTR)
            GO TO 67
      C
      C
         20 CONTINUE
         30 CONTINUE
      C
      C        NO ITERATION LOOP
      C
        100 CALL SOLVE(1,NEQSYS)
            TM=DELT
            DO 110 JT=1, ITMAX
            TM=TM+DEL
```

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```
      WRITE(61,530)TM,DELT
      CALL SOLVE(2,'ENSYS)
      CALL STRESS
      CALL INSTAN(INSTR)
  110 CONTINUE
   70 CONTINUE
      IF(NPROB.GT.1) GO TO 1
      CALL TIME(IDATE,ITIME)
      WRITE(6,500) IDATE,ITIME
  510 FORMAT(9I5)
  520 FORMAT(F2*,10.2I5)
  530 FORMAT(1H ,//,30X,*TIME=*,F12.6,2X,*YR      WITH DELT=*,F12.6,/)
      END
```

```
FTN 1.4          DATE 09/26/75      AT 123431          PAGE NO. 1
      SUBROUTINE DATAIN
C
C---------------------- SUBROUTINE DATAIN  CONTROLS THE READ ----------
C---------------------- IN OF THE MATERIAL PROPERTIES, THE -------------
C---------------------- NODAL COORDINATES, THE ELEMENTAL ---------------
C---------------------- NODAL CONNECTION ARRAY, THE BOUNDARY -----------
C---------------------- CONDITIONS, AND PRINTS THESE VALUES ------------
C---------------------- IF DESIRED.  IN ADDITION THE CONTROL ------------
C---------------------- PARAMETERS IN COMMON /CNTRL/ ARE ---------------
C---------------------- INITIALIZED EXCLUDING NEQSYS AND LC. -----------
C
      COMMON/IOUNITS/ LU7,LU8,LU10
      COMMON/GCHAR/  NDIS,NSTRE,NRD,NQ(25),NQT(25)
      COMMON/CNTRL/ NBNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCRP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LGNTSP/FUB(150),TDELT(2,75),FLDIS(2,75),RCRP(150),
     $TEORC(150),ICONV,IKNT,LUPD,JOIT,TPCRP(150)
      COMMON/TEST/ ITEST,LITHO,NCHK,IPRNT,IRZ
      COMMON/GARRY/ IIK,INDIC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON FORMTX/150,25),XILD(150),NRANW,PROP(4,6),NBNETX(30),
     $NNDCTYP(30),SFORTX(12,12),D(4,6),SBS(4,6),BFORY(4),BFORX(10),IROD
     $,XLD(8)
      COMMON/NTAP/ BB(100,4,6),SBSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/ROUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TVES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TVE/ NELEM,NELMAT,NNODES
C
C---------------------- READ AND PRINT LABEL AND CONTROL PARAMETERS ----
C
      READ(60,550) NAME
      WRITE(61,570) NAME
      IF(IPRNT.EQ.1)WRITE(6,931)
  931 FORMAT(1H,//,*          * AXIALLY SYMMETRIC PROBLEM **,/)
C
      READ(60,570) NNODES,NELEM,NBNODE,NLCAS,NDF,NELMAT,IPRN,IROD,LITHO
     1 ,NB2, ICRP
      WRITE(61,430) NNODES,NELEM,NBNODE,NLCAS ,NDF,NELMAT,IPRN,IROD
     1,NRANW,NOIT,ITHERM,NB2,MCRP
C
C---------------------- READ AND WRITE MATERIAL PROPERTIES -------------
C
      READ(60,550) (L,(PROP(N,I),I=1,5),BFORX(N),BFORY(N),N=1,NELMAT)
C
C ---------------------- DIVIDE BODY FORCES BY INCREMENTAL LOADS -------
C
C---------------------- SAVE BODY FORCE TERMS --------------------------
C
      DO 10 I=1,NELMAT
      SGY(I)=BFORY(I)
   10 SGY(I)=BFORY(I)
      WRITE(61,540)
      WRITE(61,545)
      WRITE(61,550) (N,(PROP(N,I),I=1,5),BFORX(N),BFORY(N),N=1,NELMAT)
C
C---------------------- READ NODAL COORDINATES -------------------------
```

```
FTN 4.+        DATE 80/06/75      AT  12343                PAGE NO. 2
C ------------------- OR GENERATE AT EQUAL INTERVALS ----------------
C
      KC=1
   61 READ(60,520) N,(CORDS(N,J),J=1,2)
      DNOD=N+1-KC
      IF(N-KC)81,81,71
   71 MC=KC-1
      DX=(CORDS(N,1)-CORDS(MC,1))/DNOD
      DY=(CORDS(N,2)-CORDS(MC,2))/DNOD
   75 MC=KC-1
      CORDS(KC,1)=CORDS(MC,1)+DX
      CORDS(KC,2)=CORDS(MC,2)+DY
   81 KC=KC+1
      IF(N-KC) 91,91,75
   91 IF(NNODES+1-KC) 101,101,61
  101 CONTINUE
C
      DO 16 I=1,NNODES
      DO 16 J=1,2
   16 CORDS(I,J)=CORDS(I,J)*12.0
C
C
C
C ------------------- READ ELEMENT NODAL CONNECTION ARRAY ----------
C
      LEN=0
      IHH=0
      NEL=0
      DO 175 N=1,NELEM
      ISID=4
      IHH=IHH+1
      IF(NEL-N) 120,170,150
  120 READ(60,520) NEL,(NELCON(N,J),J=1,4),IELMAT(N)
      IF(IHH .LE. NEL) GO TO 119
      WRITE(61,660) IHH
  660 FORMAT(1H ,//,' DATA OUT OF ORDER AT ELEMENT',I5,/)
      IHH=NEL
  119 IF(NEL-1-N) 170,150,130
  130 IF(LEN .EQ. NEL) GO TO 150
      DO 135 I=1,4
  135 NELCON(NEL,I)=NELCON(N,I)
      IELMAT(NEL)=IELMAT(N)
      LEN=NEL
  150 J=N-1
      IF(NELCON(J,4) .GT. 0) GO TO 159
      NELCON(J,4)=0
      ISID=3
  159 DO 160 I=1,ISID
  160 NELCON(N,I)=NELCON(J,I)+1
      IELMAT(N)=IELMAT(J)
      IF(NEL-N-1) 180,180,170
  170 IF(IELMAT(N) .LE. 0) IELMAT(N)=IELMAT(N-1)
  175 CONTINUE
  180 CONTINUE
C
C ------------------- READ BOUNDARY CONDITIONS ---------------------
```

```
C
      READ(60,540) (NBNDFIX(I),NBCTYP(I),I=1,NBNODE)
C
C---------------------- SAVE BOUNDARY CONDITIONS FOR FUTURE USE --------
C
      DO 90 I=1,NBNODE
   90 NFYC(I)=NBCTYP(I)
C
C---------------------- IF DESIRED PRINT INPUT DATA --------------------
C
      IF(IPRN .NE. 0) GO TO 100
C
      WRITE(61,580)
      WRITE(61,530) (I,(CORDS(I,J),J=1,2),I=1,NNODES)
      WRITE(61,590)
      WRITE(61,550) (I,(NELCON(I,J),J=1,4),IELMAT(I),I=1,NELEM)
      WRITE(61,600)
      WRITE(61,540) (NBNDFIX(I),NBCTYP(I),I=1,NBNODE)
C
  510 FORMAT(12A5)
  520 FORMAT(I5,6X,2F10.2)
  530 FORMAT(A1)
  540 FORMAT(2I5)
  550 FORMAT(16A5)
  560 FORMAT(I5,5E12.4/2E12.4)
  570 FORMAT(1H1,16A5)
  580 FORMAT(//,3X,'NODAL POINTS',9X,'COORDINATES'/)
  590 FORMAT(//' ELEMENTS',6X,'NODAL CONNECTIONS',2X,'IELMAT',/)
  600 FORMAT(2)50 BOUNDARY CONDITIONS)
  610 FORMAT(1H0,46X'MATERIAL PROPERTIES'/)
  630 FORMAT(1H0,' NNODES=',I4/,' NELEM=',I5/' NBNODE=',I4/,' NLDCAS=',
     1I4/,' IOPT=',I7/,' NELMAT=',I4/,' IPRN=',I6/,' IROD=',I6/,
     2' NPANM=',I6,/,' NOUT=',I6,/' ITHERM=',I4,/' NR2=',I7,/' MCRP=',
     1 I6,/)
  640 FORMAT(//,1X' MAT',3X,'YOUNGS MOD',3X'POISSONS RATIO',2X'CREEP CON
     1S',                3X'WEIGHT CREEP',2X'RETARD TIME',6X'REFORX',9X
     2,'REFORY'/)
  650 FORMAT(I5,7E14.4)
C
  100 CONTINUE
      RETURN
      END
```

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```
      SUBROUTINE FORCIN
C
C---------------------- SUBROUTINE FORCIN READS INITIAL NODAL ----------
C---------------------- LOADING AND COMPUTES THE ELEMENTAL -------------
C---------------------- BODY FORCES.  THE SUM OF THESE FORCES ----------
C---------------------- CONSTITUTES THE INITIAL LOAD VECTORS -----------
C---------------------- THE PROBLEM IS GIVEN ---------------------------
C
      COMMON/LUNITS/ LU7,LU9,LU10
      COMMON/GCOM/  NDIS,NSTRE,NRD,ND(25),NRT(25)
      COMMON/CNTRL/ NBNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCRP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LOADSP/FUB(150),TDELT(2,75),ELDIS(2,75),RCRP(150),
     $IFORC(150),ICONV,IKNT,LUPD,JDTT,IRCRP(150)
      COMMON/TEST/ ITEST,LITHO,MCHK,IPRRT,IRZ
      COMMON/GAUSS/ JIK,INDIC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON FQ,MTX(150,25),X1LD(150),NBANW,PROP(4,6),NBNETX(30),
     $NRCTYP(30),SFORTX(12,12),D(4,6),SBS(4,6),BFORY(4),BFORX(10),TROD
     $,ALD(8)
      COMMON/MTRP/ BR(100,4,5),SBSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BOUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TYES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TYE/ NELEM,NELMAT,NNODES
C
      DIMENSION XF(3,2),YLD(10,2),NODL(10)
C
C---------------------- CORRECT NODAL COORDINATES ACCORDING TO ---------
C---------------------- THE INCREMENTAL DISPLACEMENTS FROM STRESS -------
C
      IF(ITEST .EQ. 1) GO TO 17
      IF(JT.EQ.1) GO TO 17
   12 DO 15 J=1,NNODES
      CORDS(J,1)=CORDS(J,1) + X1LD(2*J-1)
   15 CORDS(J,2)=CORDS(J,2) + X1LD(2*J)
   17 CONTINUE
C
C---------------------- REINITIALIZE BOUNDARY CONDITION TYPES ----------
C
    9 DO 5 I=1,NBNODE
    5 NRCTYP(I)=NFXC(I)
C
C---------------------- REINITIALIZE BODY FORCE TERMS ------------------
C
      DO 25 I=1,NELMAT
      BFORX(I)=SGX(I)
   25 BFORY(I)=SGY(I)
C
C---------------------- ZERO LOAD DISPLACEMENT ARRAY -------------------
C
      DO 10 J=1,NEQSYS
   10 X1LD(J)=0.0
C
C---------------------- READ AND WRITE LOADED NODE DATA * FOR UNLOADED -
C---------------------- SYSTEM, INCLUDE MAXIMUM NODE WITH ZERO LOADS ---
C
```

```
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      IF(JT.GT.1) GO TO 11
      WRITE(61,530) NAME,LC
   11 WRITE(61,530)
C
      IF(JT .GT. 1) GO TO 33
      ITRAC=1
   20 ITRAC=ITRAC+1
      READ(60,500) NODL(ITRAC),(YLD(ITRAC,I),I=1,NDF),NLODN
      WRITE(61,500) NODL(ITRAC),(YLD(ITRAC,I),I=1,NDF),NLODN
C
C---------- TRANSFER LOADS FROM TEMPORARY ARRAY XLD TO -----
C---------- PERMANENT STORAGE IN XILD ARRAY ----------
C
      DO 30 J=1,NDF
      JJ=(NODL(ITRAC)-1)*NDF+J
   30 XILD(JJ)=YLD(ITRAC,J)+XILD(JJ)
C
C---------- CONTINUE TO READ UNTIL MAXIMUM NODE IS REACHED -
C
      IF(NODL(ITRAC) .LT. NNODES)20,49
   33 DO 31 I=1,NLODN
      DO 31 J=1,NDF
      JJ=(NODL(I)-1)*NDF+J
      XILD(JJ)=YLD(I,J)+XILD(JJ)
   31 WRITE(61,500) NODL(I),(YLD(I,J))
C
C---------- IF BODY FORCES ARE INCLUDED CONTINUE ----------
C---------- OTHERWISE RETURN TO MAIN ----------
C
   49 IF(IBOD .EQ. 0) GO TO 110
C
C---------- CALCULATE BODY FORCES ASSUMING ONE-THIRD -------
C---------- AT EACH VERTEX AND ADD TO LOAD VECTORS ---------
C
      DO 70 II=1,NELEM
      CGX=0.0
      JR=IELMAT(II)
      DO 50 I=1,3
      JJ=NELCON(II,I)
      CGX=CGX+CORDS(JJ,1)
      XE(I,1)=CORDS(JJ,1)
   50 XE(I,2)=CORDS(JJ,2)
      CGX=CGX/3.0
C
C---------- VOLUM IS 1/3 THE ACTUAL VOLUME IN THIS CASE ----
C
      TP=1.0
      IF(IPRINT .EQ. 1) TP=2.*3.14159*CGX
      VOLUM= (XE(2,1)*(XE(3,2)-YE(1,2)) + XE(1,1)*(XE(2,2) - XE(3,2)) +
     5 XE(3,1)*(XE(1,2)-XE(2,2)))/6.0*TP
C
      XFX=VOLUM*RHO*X(JR)
      YFY=VOLUM*RHO*Y(JR)
C
      DO 60 I=1,3
      JJ=NELCON(II,I)
```

```
         XLLD(2*JJ-1)=XLLD(2*JJ-1) + BFX
   60    XLLD(2*JJ)=XLLD(2*JJ) + BFY
C
   70    CONTINUE
C
         NY=NBNODE-NB2
         IF(JT.GT.1) NY=NBNODE
         DO 100 I=1,NY
         I2W=NBNFIX(I)*2
         IF(NBCTYP(I) .EQ. 10) GO TO 90
         IF(NBCTYP(I) .EQ. 01) GO TO 80
C
         XLLD(I2W-1)=0.0
   80    XLLD(I2W)=0.0
         GO TO 100
C
   90    XLLD(I2W-1)=0.0
  100    CONTINUE
  110    CONTINUE
         IF(NDIS.NE.1)GO TO 333
         CALL DISPR
  333    CONTINUE
C
  540    FORMAT(1H ,≠THE LOADS AT NODE≠,I5,2X,2E12.4)
  500    FORMAT(I1 ,2F15.2,I5)
  510    FORMAT(10X,4I5)
  520    FORMAT(1H1,16I5,5X≠LOAD CASE≠,I5)
  530    FORMAT(//7X,≠ NODE≠,8X,≠LOADS≠/)
         RETURN
         END
```

```
FTN 4.7          DATE 09/26/75      AT 12343          PAGE NO. 1
      SUBROUTINE DISPH
C
C     THIS SUBROUTINE  HANDLES DISPLACEMENT BOUNDARY CONDITIONS
C
      COMMON/LIMITS/ LU7,LU9,LU10
      COMMON/SCHH/  NDIS,NSTRE,NBD,NO(25),NDT(25)
      COMMON/CNTRL / NNNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCRP
      COMMON/DELCOM/DELT,TM,JT,NAME(15)
      COMMON/LABTSP/FUB(150),TDELT(2,75),ELDIS(2,75),RCRP(150),
     $IEQRC(150),ICONV,IKNT,LUPD,NDTT,IPCRP(150)
      COMMON/TEST/ TTEST,LITHD,NCHK,IPRAT,IRZ
      COMMON/GARBY/ IIK,INDIC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQNTX(150,25),XLD(150),NBANW,PROP(4,6),NBNETX(30),
     $NBCTYP(30),SFNTX(12,12),D(4,6),SHS(4,6),BFORY(4),BFORX(10),IROD
     $,XLD(8)
      COMMON/NTAB/ BB(100,4,6),SHSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/ROUND/ NEXC(30),SGY(4),SGY(4)
      COMMON/TVES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TVE/ NELEM,NELMAT,NNODES
      DIMENSION R(35)
C
C     READ AND PRINT NUMBER OF NODES WHERE DISPLACEMENT IS SPECIFIED
C
      IF(JT.NE.1)GO TO 16
      READ(60,101)NBD
   16 CONTINUE
      WRITE(61,102)NBD
      IF(NBD.EQ.0) GO TO 88
C
C     READ AND WRITE BOUNDARY NODES WHERE DISPLACEMENTS IS SPECIFIED
C
      WRITE(61,103)
      DO 10 KK=1,NBD
      IK=KK*NDF-1
      IF(JT.NE.1)GO TO 17
      READ(60,105)NO(KK),NDT(KK),R(IK),R(IK+1)
  105 FORMAT(2I5,2E15.4)
   17 CONTINUE
      WRITE(61,104)NO(KK),NDT(KK),R(IK),R(IK+1)
C
C     ASSIGN DISPLACEMENTS TO PROPER STATION IN MATRIX
C
      IC=(NO(KK)-1)*NDF+1
      XLD(IC)=R(IK)*1.0E+29
      XLD(IC+1)=R(IK+1)*1.0E+29
   10 CONTINUE
   88 CONTINUE
C
C
C
  101 FORMAT(I10)
  102 FORMAT(1H0,*NUMBER OF NODES WHERE DISPLACEMENT BOUNDARIES ARE PRES
     1CRIBED=*,I10)
  104 FORMAT(1H ,10X,I3,5X,I3,8X,E14.6,6X,E14.6)
  103 FORMAT(1H0,10X,*NODE*,5X,*R-DISPLACEMENT*,2X,*Z-DISPLACEMENT*)
```

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RETURN
END

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```
      SUBROUTINE EQKMTX
C
C---------------------- SUBROUTINE EQKMTX CREATES THE BANDED ----------
C---------------------- STIFFNESS MATRIX AND INSERTS THE ---------------
C---------------------- BOUNDARY CONDITIONS.  SYMMETRY OF THE ----------
C---------------------- STRUCTURAL STIFFNESS MATRICES IS UTILIZED ------
C---------------------- IN THE DIRECT SOLUTION METHOD. -----------------
C
      COMMON/LUNITS/ LUZ,LUG,LU10
      COMMON/GCOM/ NDIS,NSTRE,NBD,NQ(25),NQT(25)
      COMMON/CUTPT/ NBNODE,NDF,NNEL,NLC45,NEQSYS,LC,NB2,MCRP
      COMMON/DELCON/DELT,TM,JT,NAME(16)
      COMMON/LGDISP/FUB(150),TDELT(2,75),ELDIS(2,75),RCRP(150),
     $IRODC(150),ICONV,IKNT,LUPD,NOIT,IRCRP(150)
      COMMON/TEST/ ITEST,LITHO,MCHK,IPRNT,IRZ
      COMMON/HARRY/ IIK,INDIC,IPR,ITHERM
      COMMON/GBC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQKMTX(150,25),XLD(150),NBAND,PROP(4,6),NBNETX(30),
     $ICTYP(30),SEMTX(12,12),D(4,6),SBS(4,6),BFORY(4),BFORX(10),IBOD
     $,LD(9)
      COMMON/STAB/ BB(100,4,6),SBSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BOUND/ NEXC(30),SGX(4),SGY(4)
      COMMON/TVES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TVE/ NELEM,NELMAT,NNODES
      DIMENSION IRODC(150),NQTT(30)
C
C---------------------- REINITIALIZE BOUNDARY CONDITIONS ---------------
      ITEST=0
      IF(IT.GT.1) GO TO 17
      DO 1 J=1,NEQSYS
    1 IRODC(J)=0.0
C
   17 DO 5 I=1,NBNODE
    5 ICTYP(I)=NEXC(I)
C
C---------------------- ZERO STIFFNESS MATRIX --------------------------
C
      DO 10 I=1,NEQSYS
      DO 10 J=1,NBANDW
   10 EQKMTX(I,J)=0.0
C
C---------------------- DEVELOPE ELEMENTAL MATRIX CONTRIBUTIONS --------
C
      DO 40 N=1,NELEM
C
C---------------------- CONSTRUCT STIFFNESS MATRIX FOR EACH ELEMENT ----
C---------------------- FROM STEMTX AND RETURN SEMTX -------------------
C
      CALL STEMTX(N)
C
C---------------------- STORE SEMTX IN EQKMTX BY ROWS AND COLUMNS ------
C
C---------------------- ROW OPERATION FIRST ----------------------------
C
      DO 40 JJ=1,NNEL
      IROW=(NELCON(N,JJ)-1)*NDF
```

```
      IF(IROW1) 60,20,20
   20 DO 40 JJ=1,NDF
      IROW1=IROW1+1
      I=(JJ-1)*NDF+JJ
C
C---------------------------- COLUMN OPERATION --------------------------------
C
      DO 40 L=1,NNEL
      ICLMN1=(NELCON(N,L)-1)*NDF
      DO 40 LL=1,NDF
      KK=(L-1)*NDF+LL
      ICLMN=ICLMN1+LL+1-IROW1
C
C---------------------------- STORE BANDED MATRIX --------------------------------
C
      IF(ICLMN) 40,40,30
   30 EQNMTX(IROW1,ICLMN)=EQNMTX(IROW1,ICLMN)+SEMTX(I,KK)
C
   40 CONTINUE
   60 CONTINUE
      ICNTC=0
C
C---------------------------- STORE BOUNDARY CONDITIONS IN EQNMTX ------------
C
      NY=NBNODE-NB2
      IF(IT.GT.1) NY=NBNODE
      DO 120 N=1,NY
      NB=10**(NDF-1)
      IB=NBNFIX(N)
      IROW1=(IB-1)*NDF
C
C---------------------------- CHECK EACH NODAL DEGREE OF FREEDOM ------------
C
      DO 120 IRB=1,NDF
      IROW1=IROW1+1
      JBCK=NBCTYP(N)/NB
      IF(JBCK) 110,110,80
   80 EQNMTX(IROW1,1)=1.0
      DO 999 IN=1,NBD
  999 COTT(IN)=COT(IN)
C
      DO 100 J=2,NBANW
      EQNMTX(IROW1,J)=0.0
      NRB=IROW1+1-J
      IF(NRB) 100,100,90
   90 EQNMTX(NRB,J)=0.0
  100 CONTINUE
C
      NBCTYP(N)=NBCTYP(N)-NB*JBCK
  110 NB=NB/10
  120 CONTINUE
C
C       PRESCRIBED BOUNDARY CONDITIONS
C
      IF(N0IS.NE.1)GO TO 122
      DO 121 N=1,NBD
```

```
      A=10**(NDF-1)
      I1=NB(J)
      IROW1=(IR-1)*NDF
      DO 121 IRW=1,NDF
      IROW1=IROW1+1
      JBCK=NOTT(N)/10
      IF(JBCK)111,111,82
   82 EQNMTX(IROW1,1)=1.0*1.0E+28
      NOTT(N)=NOTT(N)-N**JBCK
  111 N=N/10
  121 CONTINUE
  122 CONTINUE
C
      ICLMN=NBANW
      IROW=NEQSYS
      IF(NOTT.EQ.1.AND.JB2.LE.0) GO TO 66
C
C---------- REWIND TAPE AND STORE EQNMTX----------
C
      REWIND LU7
      WRITE(LU7) ((EQNMTX(I,J),I=1,NEQSYS),J=1,NBANW)
      IF(NOTT.EQ.1) GO TO 66
C
C
C ---------- SAVE ORIGINAL STIFFNESS MATRIX PSEUDO-INVERTED OR ---
C ---------- UPDATE THE ORIGINAL MATRIX WHEN DISPLACEMENTS -------
C ---------- BECOME LARGE ENOUGH TO WARRANT UPDATING ------------
C
      IF(IT.LE.2) 92,92
   92 IF(IUPD.EQ.1) GO TO 65
      LUPD=1
      REWIND LU7
      READ (LU7) ((EQNMTX(I,J),I=1,NEQSYS),J=1,NBANW)
   93 CALL SOLVE(1,NEQSYS)
      PRINT 654
  654 FORMAT(/' ** THE A MATRIX IS UPDATED **')
      REWIND LU6
      WRITE (LU6) ((EQNMTX(I,J),I=1,NEQSYS),J=1,NBANW)
      REWIND LU7
      READ (LU7) ((EQNMTX(I,J),I=1,NEQSYS),J=1,NBANW)
   65 IF(ICONV.EQ.1) GO TO 68
C
C ---------- CALCULATE NET FORCE UNBALANCE ----------
C
      CALL SUBS
C
C ---------- CALCULATE DELTA CREEP (INCR. DISP. DELTA-DELTA) -----
C
      REWIND LU
      READ(LU6) ((EQNMTX(I,J),I=1,NEQSYS),J=1,NBANW)
C
C ---------- TRANSFER FORCE UNBALANCE INTO X1LD TO CALCULATE ----
C ---------- A NEW DISPLACEMENT AND RETURN IN THE X1LD ARRAY -----
C
      DO 69 J=1,NEQSYS
   69 X1LD(J)=EUB(J)
```

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```
C
C ---------- CALL SOLVE(2) TO CALCULATE DELTA-DELTA WHICH IS -----
C ---------- TRANSFERED BACK THROUGH X1LD(NEQSYS) ----------
C
      CALL SOLVE(2,NEQSYS)
      DO 800 J=1,NEQSYS
      X1LD(J)=-X1LD(J)
      IF(ABS(X1LD(J)) .LE. 1.0E-15) X1LD(J)=0.0
  800 CONTINUE
C
C---------- FIND TOTAL DISPLACEMENT(TDELT) ELASTIC + CREEP ------
C
      DO 70 J=1,NNODES
      TDELT(1,J)=TDELT(1,J)+X1LD(2*J-1)
   70 TDELT(2,J)=TDELT(2,J)+X1LD(2*J)
      DO 74 I=1,NEQSYS
   74 TCORDC(I)=TCORDC(I)+X1LD(I)
C
C ---------- CHECK CONVERGENCE FOR NODE AT CENTER OF ROOF ------
C
C ---------- PRINT DELTA-DELTA, THE CONVERGENCE CRITERION --------
C
   73 WRITE(6,500) NCHK,X1LD(NCHK)
  500 FORMAT(1H0,' X1LD(',I3,')=',E15.6,/)
C
      IF(ABS(X1LD(NCHK)).LT.10. )67,68
   67 ICONV=1
      DO 27 J=1,NNODES
      COORDS(J,1)=COORDS(J,1)+X1LD(2*J-1)
      COORDS(J,2)=COORDS(J,2)+X1LD(2*J)
   27 CONTINUE
      IFES(I)=1
      T=T1+DELT
      DO 81 J=1,NEQSYS
      X1LD(J)=TCORDC(J)
   81 TCORDC(J)=0.0
      GO TO 66
   68 REWIND LU7
      READ(LU7) ((FORMTA(I,J),I=1,NEQSYS),J=1,NHANW)
   66 RETURN
      END
```

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```
      SUBROUTINE STFMTX(N)
C
C---------------------- STFMTX IS CALLED BY EQKMTX FOR EACH ------------
C---------------------- ELEMENT.  MATRIX MULTIPLICATION IS PERFORMED ---
C---------------------- I.E. (SBSTEL).  THE ELEMENT STIFFNESS ----------
C---------------------- MATRIX IS CREATED AND TRANSFERRED --------------
C---------------------- THROUGH COMMON TO EQKMTX ------------------------
C
      COMMON/LUNITS/ LU7,LU9,LU10
      COMMON/GCNH/ NDIS,NSTRE,NBD,NQ(25),NQT(25)
      COMMON/CNTRL/ NBNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCRP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LOADSP/FUB(150),TDELT(2,75),ELDIS(2,75),RCRP(150),
     $TEMPC(150),ICONV,IKNT,LUPD,NOIT,THCRP(150)
      COMMON/TEST/ ITEST,LITHO,NCHK,IPRRT,IRZ
      COMMON/GAGRY/ IJK,INDIC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQMTX(150,25),XILD(150),NBANW,PROP(4,6),NBNFIX(30),
     $NBCTYP(30),SEMTX(12,12),D(4,6),SBS(4,6),BFORY(4),BFORX(10),TROD
     $,YLD(8)
      COMMON/NTRP/ BB(100,4,6),SBSTEL(100,6,4),ELAS(100,4,4),FPI(100,4)
      COMMON/BOUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TVES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TVE/ NELEM,NELMAT,NNODES
C
      DIMENSION BBT(6,4),A(8,6),ZY(3),ZX(3),BS(4,8),AX(3),AY(3)
C
C---------------------- DETERMINE ELEMENT NODAL CONNECTIONS ------------
C---------------------- AND TYPE OF MATERIAL ----------------------------
C
      IF(INDIC.NE.1) GO TO 4
      DO 901 I=1,4
      DO 901 J=1,6
  901 BB(N,I,J)=0.0
      DO 2 I=1,8
      DO 2 J=1,6
    2 A(I,J)=0.0
      DO 3 I=1,4
      DO 3 J=1,8
    3 BS(I,J)=0.0
    4 NOD1=NELCON(N,1)
      NOD2=NELCON(N,2)
      NOD3=NELCON(N,3)
      MATNO=IELMAT(N)
C
C---------------------- DETERMINE ELEMENT NODAL COORDINATES AND --------
C---------------------- THE ASSOCIATED AREA AND VOLUME -----------------
C
      XJ=CORDS(NOD2,1)-CORDS(NOD1,1)
      XK=CORDS(NOD3,1)-CORDS(NOD1,1)
      YJ=CORDS(NOD2,2)-CORDS(NOD1,2)
      YK=CORDS(NOD3,2)-CORDS(NOD1,2)
C
      AREA=(XJ*YK-XK*YJ)/2.0
C
C---------------------- EXIT IF ERROR IN NODAL CONNECTION ARRAY --------
```

```
C
C     IF(AREA .LE. 0.0) GO TO 100
      IF(IPRNT .EQ. 1) GO TO 105
C
      VOLUM(N)=AREA*1.0
      IF(INDIC.NE.1) GO TO 7
      GO TO 120
  105 CGX=(CORDS(NOD1,1) + CORDS(NOD2,1) + CORDS(NOD3,1))/3.0
      IF(INDIC.NE.1) GO TO 8
      CGY=(CORDS(NOD1,2) + CORDS(NOD2,2) + CORDS(NOD3,2))/3.0
      AX(1)= CORDS(NOD1,1)-CGX
      AX(2)=CORDS(NOD2,1) - CGX
      AX(3)= CORDS(NOD3,1) -CGX
      AY(1)=CORDS(NOD1,2)-CGY
      AY(2)=CORDS(NOD2,2)-CGY
      AY(3)=CORDS(NOD3,2)-CGY
      ZY(1)=AY(2)-AY(3)
      ZY(2)=AY(3)-AY(1)
      ZY(3)=AY(1)-AY(2)
      ZX(1)=AX(3)-AX(2)
      ZX(2)=AX(1)-AX(3)
      ZX(3)=AX(2)-AX(1)
      AX(1)= CORDS(NOD1,1)
      AX(2)=CORDS(NOD2,1)
      AX(3)= CORDS(NOD3,1)
      AY(1)=CORDS(NOD1,2)
      AY(2)=CORDS(NOD2,2)
      AY(3)=CORDS(NOD3,2)
      AJ=AX(2)*AY(3)-AX(3)*AY(2)
      BJ=AX(3)*AY(1)-AX(1)*AY(3)
      AK=AX(1)*AY(2)-AX(2)*AY(1)
      Z=2.*AREA
      IF(AREA .LE. 0.0) WRITE(61,500) N
    8 VOLUM(N)=AREA*2.*3.14159265*CGX
  120 CONTINUE
C
C---------------------- CONSTRUCT STRAIN DISPLACEMENT MATRIX (D) -------
C
      IF(IPRNT .EQ. 1) GO TO 125
    7 D(1,1)=YJ-YK
      D(1,2)=0.0
      D(1,3)=YK
      D(1,4)=0.0
      D(1,5)=-YJ
      D(1,6)=0.0
C
      D(2,1)=0.0
      D(2,2)=XK-XJ
      D(2,3)=0.0
      D(2,4)=-XK
      D(2,5)=0.0
      D(2,6)=XJ
C
      D(3,1)=XK-XJ
      D(3,2)=YJ-YK
      D(3,3)=-XK
```

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```
      D(3,4)=YK
      D(3,5)=XJ
      D(3,6)=-Y
      IF(INDIC.NE.1)GO TO 126
C
C---------- FORM STRAIN DISPLACEMENT MATRIX AND TRANSPOSE --
C
      DO 20 I=1,3
      DO 20 J=1,6
   20 BB(N,I,J)=D(I,J)/(2.*AREA)
C
      GO TO 126
  125 IF(INDIC.NE.1)GO TO 6
      A(1,1)=AI/Z
      A(2,1)=ZY(1)/Z
      A(3,1)=A(1,1)/CGX+A(2,1)*((ZX(1)/Z)*CGY)/CGX
      A(4,1)=ZX(1)/Z
      A(5,2)=AI/Z
      A(6,2)=A(2,1)
      A(7,2)=A(3,1)
      A(8,2)=A(4,1)
      A(1,3)=AJ/Z
      A(2,3)=ZY(2)/Z
      A(3,3)=A(1,3)/CGX+A(2,3)*((ZX(2)/Z)*CGY)/CGX
      A(4,3)=ZX(2)/Z
      A(5,4)=AJ/Z
      A(6,4)=A(2,3)
      A(7,4)=A(3,3)
      A(8,4)=A(4,3)
      A(1,5)=AM/Z
      A(2,5)=ZY(3)/Z
      A(3,5)=A(1,5)/CGX+A(2,5)*((ZX(3)/Z)*CGY)/CGX
      A(4,5)=ZX(3)/Z
      A(5,6)=AM/Z
      A(6,6)=A(2,5)
      A(7,6)=A(3,5)
      A(8,6)=A(4,5)
      BS(1,8)=1.
      BS(2,2)=1.
      BS(3,3)=1.
      BS(4,4)=1.
      BS(4,6)=1.
      DO 222 J=1,6
      DO 222 I=1,4
      DO 222 K=1,8
  222 BB(N,I,J)=BB(N,I,J)+BS(I,K)*A(K,J)
    6 DO 223 J=1,6
      DO 223 I=1,4
  223 D(I,J)=BB(N,I,J)*2.*AREA
  126 DO 30 I=1,6
      DO 30 J=1,4
   30 BBT(I,J)=BB(N,J,I)
C
C---------- FORM STRESS-STRAIN MATRIX (SEMTX) ----------
C
      IF(IPRST.EQ.1) GO TO 127
```

```
      RATIO=PROP(MNUM,1)/((1.0 + PROP(MNUM,2))*(1.0-PROP(MNUM,2)*2.0)
     * *AREA)
C
      SEMTX(1,1)=RATIO*(1.0 - PROP(MNUM,2))
      SEMTX(1,2)=RATIO*PROP(MNUM,2)
      SEMTX(1,3)=0.0
C
      SEMTX(2,1)=SEMTX(1,2)
      SEMTX(2,2)=SEMTX(1,1)
      SEMTX(2,3)=0.0
C
      SEMTX(3,1)=0.0
      SEMTX(3,2)=0.0
      SEMTX(3,3)=PROP(MNUM,1)/(2.0*(1.0+PROP(MNUM,2))*AREA)
      GO TO 128
  127 RATIO=PROP(MNUM,1)*(1.-PROP(MNUM,2))/((1.+PROP(MNUM,2))*(1.-2.*
     1PROP(MNUM,2))*AREA)
      SEMTX(1,1)=1.*RATIO
      SEMTX(1,2)=PROP(MNUM,2)/(1.-PROP(MNUM,2))*RATIO
      SEMTX(1,3)=SEMTX(1,2)
      SEMTX(1,4)=0.
      SEMTX(2,2)=SEMTX(1,1)
      SEMTX(2,3)=SEMTX(1,2)
      SEMTX(2,4)=0.
      SEMTX(3,3)=SEMTX(2,2)
      SEMTX(3,4)=0.
      SEMTX(4,4)=PROP(MNUM,1)/(2.*(1. + PROP(MNUM,2))*AREA)
      SEMTX(2,1)=SEMTX(1,2)
      SEMTX(3,1)=SEMTX(1,3)
      SEMTX(4,1)=SEMTX(1,4)
      SEMTX(3,2)=SEMTX(2,3)
      SEMTX(4,2)=SEMTX(2,4)
      SEMTX(4,3)=SEMTX(3,4)
C
C---------------------- ADD ELAS MATRIX AND SEMTX*AREA ----------------
C
  128 DO 50 I=1,TPZ
      DO 50 J=1,TPZ
   50 ELAS(N,I,J)=SEMTX(I,J)*AREA
C
C---------------------- ZERO SBSTEL MATRIX AND OBTAIN SBS --------------
C---------------------- MATRIX TRANSPOSED TIMES THE ELAS MATRIX --------
C
  129 DO 70 J=1,4
      DO 70 I=1,6
   60 SBSTEL(N,I,J)=0.0
C
      DO 70 K=1,4
   70 SBSTEL(N,I,J)=SBSTEL(N,I,J)+BBT(I,K)*ELAS(N,K,J)
C
C---------------------- SBS IS THE STRESS BACKSUBSTITUTION MATRIX ------
C
      DO 80 I=1,4
      DO 80 J=1,6
      SBS(I,J)=0.0
C
```

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```
      DO 80 K=1,4
   80 SMS(I,J)=SMS(I,J) + SEMTX(I,K)/2.0*D(K,J)
C
C
C---------- CHANGE THE STRESS-STRAIN MATRIX (SEMTX) --------
C---------- TO THE ELEMENT STIFFNESS MATRIX (SEMTX) --------
C
      TPRR=2.*3.141=9*CGX
      IF(TPRT .EQ. 0) TPRR=1.0
      DO 90 I=1,6
      DO 90 J=1,6
      SEMTX(I,J)=0.0
C
      DO 90 K=1,4
      SEMTX(I,J)=SEMTX(I,J) + SMS(K,I)/2.0*D(K,J)*TPRR
   90 CONTINUE
      RETURN
C
  100 WRITE(61,500) N
  500 FORMAT(1H ,*ERROR IN ELEMENT*,I4,1X,*NODAL CONNECTIONS*/)
      END
```

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```
      SUBROUTINE SOLVE(IP,NUMEQ)
C
C ********** SOLVE SOLVES THE STIFFNESS MATRIX FOR NODAL DISP. *****
C
      COMMON EQNS(150,25),FUNC(150),IBAND
C
C
C ********** SELECT SOLUTION TYPE DESIRED **************************
C
      IF(IP .EQ. 2) GO TO 50
C
C ********** REDUCE EQNMTX THE EQUATION MATRIX *********************
C
      DO 40 I=1,NUMEQ
      DO 30 J=2,IBAND
C
      HLD=EQNS(I,J)/EQNS(I,1)
      II=I+J-1
      IF(NUMEQ - II) 30,10,10
   10 J1=0
C
      DO 20 K=J,IBAND
      J1=J1+1
   20 EQNS(II,J1)=EQNS(II,J1)-HLD*EQNS(I,K)
   30 EQNS(I,J)=HLD
   40 CONTINUE
      GO TO 120
C
C ********** MODIFY VECTORS FOR EACH EQUATION **********************
C
   50 DO 70 I=1,NUMEQ
      DO 60 J=2,IBAND
      II=I+J-1
      IF(NUMEQ-II) 70,60,60
   60 FUNC(II)=FUNC(II)-EQNS(I,J)*FUNC(I)
   70 FUNC(I)=FUNC(I)/EQNS(I,1)
C
C ********** BACK SUBSTITUTION *************************************
C
      NB=NUMEQ
   80 NB=NB-1
      IF(NB) 90,120,90
   90 DO 110 II=2,IBAND
      JJ=NB+II-1
      IF(NUMEQ-JJ) 110,100,100
  100 FUNC(NB)=FUNC(NB)-EQNS(NB,II)*FUNC(JJ)
  110 CONTINUE
      GO TO 80
C
  120 RETURN
      END
```

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```
      SUBROUTINE STRESS
C---------------------- STRESS CALCULATES AND PRINTS THE ELEMENT -------
C---------------------- STRESSES, INCREMENTAL AND TOTAL, OUTPUTS -------
C---------------------- THE DISPLACEMENTS, CALCULATES THE CREEP --------
C---------------------- STRAIN, AND THE MAXIMUM AND MINIMUM STRESSES ---
C
      COMMON/LUNITS/ LU7,LU9,LU10
      COMMON/GCOM/ NDIS,NSTRE,NBD,NQ(25),NUT(25)
      COMMON/CNTRL/ NRNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCRP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LOADSP/FOR(150),TDELT(2,75),ELDIS(2,75),RCRP(150),
     $TFORC(150),ICONV,IKNT,LUPD,NOIT,TRCRP(150)
      COMMON/TEST/ ITEST,LITHO,NCHK,IPRNT,IRZ
      COMMON/GAUSS/ IIK,INDTC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQUMTX(150,25),XILD(150),NRANK,PROP(4,6),NBNEIX(30),
     $ARCTYP(30),SEMTX(12,12),D(4,6),SSS(4,6),BFORY(4),BFORX(10),IROD
     $,ALD(8)
      COMMON/NTAB/ BB(100,4,6),SBSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/PRINT/ NEXC(30),SGX(4),SGY(4)
      COMMON/TYES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TYE/ NELEM,NELMAT,NNODES
      DIMENSION DISP(2,75),TDISP(2,75),ELFOR(100,4),XCS(4)
C
      EQUIVALENCE (DISP(1),XILD(1))
C
C---------------------- FOR THE ELASTIC CASE (JT=1) ZERO ---------------
C---------------------- TOTAL DISPLACEMENT (TDISP), THE ----------------
C---------------------- ELASTIC STRESS (SELAS) AND THE -----------------
C------------------------ STRAIN CHANGE (EPI) ----------------------------
C
      IF(JT .NE. 1) GO TO 30
      JCNT=1
C
C
      DO 20 N=1,NELEM
      DO 20 I=1,IRZ
      EPI(N,I)=0.0
   20 SELAS(N,I)=0.0
      IF(LITHO .NE. 1) GO TO 27
C
C     IF LITHO = 1 ADD FEET OF OVERBURDEN CARD AT END OF DATA
C
      CALL INSIG
   27 CONTINUE
C
C
C ---------------- SAVE THE ELASTIC DISPLACEMENT(ELDIS) ----------------
C
      DO 36 I=1,NNODES
      ELDIS(1,J)=DISP(1,J)
   36 ELDIS(2,J)=DISP(2,J)
   30 IF(JT .GT. 2) GO TO 41
      DO 10 I=1,NNODES
      DO 10 J=1,NDF
   10 TDISP(J,I)=0.0
```

```
      C
   41 DO 40 I=1,NNODES
      DO 40 J=1,NDF
   40 TDISP(J,I)=TDISP(J,I) + DISP(J,I)
      NST=NSTRF
      JCNT=JCNT+1
      IF(JT.EQ.1) GO TO 422
      IF(JCNT.NE.IPR) GO TO 423
C
C---------------------- SET THE DISPLACEMENT WHICH IS SUBTRACTED -------
C---------------------- FROM THE NODAL COORDINATES EQUAL ---------------
C---------------------- TO THE INCREMENTAL DISPLACEMENT ----------------
C
C---------------------- NOW DISP IS USED FOR DISPLACEMENT IN PLACE -----
C---------------------- OF XILD WHICH IS TRANSFERED FROM SOLMTX --------
C---------------------- AND BY UTILIZING THE EQUIVALENCE ---------------
C
C
C---------------------- PRINT INCREMENTAL AND TOTAL DISPLACEMENTS ------
C
  422 WRITE(61,500) TM
  500 FORMAT(///,4X,' NODE',12X,'INCREMENTAL DISPLACEMENTS',17X,'TOTAL DISP
     $LACEMENT',9X,'AT TIME . . . ',F9.4,2X,'TR',/)
      IF(IPRT .EQ. 1) WRITE(61,501)
  501 FORMAT(23X,' Y',20X,'Z',20X,'R',20X,'Z',/)
C
      DO 510 I=1,NNODES
  510 WRITE(61,515) M,((DISP(J,M),J=1,NDF), (TDISP(J,M),J=1,NDF))
  515 FORMAT(I10,2(5X,E15.8,5X,E15.8))
  423 CONTINUE
C
C---------------------- CALCULATE ELEMENT FORCES -----------------------
C
      DO 190 N=1,NELEM
C
C---------------------- CHOOSE CORRECT NODAL DISPLACEMENT --------------
C---------------------- VECTOR AND CALCULATE CREEP STRAIN --------------
C---------------------- AND THE ELEMENTAL FORCE VECTORS ----------------
C
   70 DO 80 I=1,NNEL
      M=NELCON(N,I)
      IF(M .EQ. 0) GO TO 90
      K=(I-1)*NDF
C
      DO 80 J=1,NDF
      IJ=J+K
   80 XLD(IJ)=DISP(J,M)
   90 CONTINUE
C
      DO 100 I=1,IR7
      XCS(I)=0.0
      DO 100 J=1,6
      XCS(I)=XCS(I)+BB(N,I,J)*XLD(J)
  100 CONTINUE
      DO 110 I=1,IR7
  110 XCS(I)=XCS(I)-EPI(N,I)
```

```
C
      DO 120 I=1,IRZ
      FLFOR(N,I)=0.
      DO 120 J=1,IRZ
  120 FLFOR(N,I)=FLFOR(N,I) + ELAS(N,I,J)*XCS(J)
      INDIC=1
C
C---------- PRINT CREEP STRAIN(XCS) FOR CHOSEN ELEMENTS ----
C
      IF(N.EQ.142.OR.N.EQ.163.OR.N.EQ.168.OR.N.EQ.169) 124, 22
  124 WRITE(61,517) N,(XCS(J),J=1,3),TM
  517 FORMAT(I5,' CREEP STRAIN (XCS) . . .',3(5X,E15.8),3X,'AT TIME . . .
     *',E9.4,2X/YR')
C
C---------- COMPUTE ELASTIC STRESS(SELAS) AND MEAN STRESS --
C---------- (SM) AND STORE ON TAPE UNITS LU6 AND LU5 -------
C
   22 DO 180 I=1,IRZ
  180 SELAS(N,I)=SELAS(N,I) + ELFOR(N,I)
      IELAST=IELMAT(N)
      IF(IPRRT.EQ.1) GO TO 410
      SM(N)=(SELAS(N,1) + SELAS(N,2))/2.0
      GO TO 411
  410 SM(N)=(SELAS(N,1)+SELAS(N,2)+SELAS(N,3))/3.
  411 CONTINUE
C
  190 CONTINUE
C
C---------- END OF LOOP ON NUMBER OF ELEMENTS ---------------
C
C---------- PROCEED TO CALCULATE MAXIMUM AND MINIMUM --------
C---------- STRESSES THE CLOCKWISE ANGLE FROM VERTICAL ------
C---------- AND WRITE TOTAL AND DEVIATORIC STRESSES ---------
C
      IF(IPRRT .EQ. 1) GO TO 261
      IF(JT.EQ.1) GO TO 424
      IF(JCNT.NE.IPR) GO TO 623
      IF(NSTRE.GT.2) GO TO 425
  424 WRITE(61,650)
      WRITE(61,670)
      DO 240 N=1,NELEM
  220 P=(SELAS(N,1) + SELAS(N,2))/2.0
      Q=SQRT(((SELAS(N,2) - SELAS(N,1))/2.0)**2 + SELAS(N,3)**2)
      SMAX=P+Q
      SMIN=P-Q
C
      IF(SELAS(N,3) .EQ. SMIN) GO TO 230
C
      ANGLE=57.2957*ATAN(SELAS(N,3)/(SELAS(N,2)-SMIN))
      GO TO 250
  230 ANGLE=90.
  250 WRITE(61,660) N,(FLFOR(N,I),I=1,3),(SELAS(N,I),I=1,3)
     $,SMAX,SMIN,ANGLE
  240 CONTINUE
      GO TO 425
  261 IF(JT.EQ.1) GO TO 426
```

```
      IF(JCNT.NE.IPR)GO TO 423
      IF(NSTRE.GT.3) GO TO 425
  426 WRITE(61,450)
      WRITE(61,471)
      DO 262 M=1,NELEM
  262 WRITE(61,461) M,(FLFOR(M,I),I=1,4),(SELAS(M,I),I=1,4)
      JCNT=0
  461 FORMAT(I4,8E14.2)
  425 IF(NSTRE.EQ.4) NST=1
      IF(NSTRE.EQ.5) NST=2
      IF(NSTRE.EQ.6) NST=3
      IF(NST  .EQ.0) GO TO 263
      IF(NST  .EQ.1) GO TO 264
      IF(NST  .EQ.2) GO TO 265
      IF(NST  .EQ.3) GO TO 266
  264 CALL USTR(ELFOR)
      GO TO 263
  265 CALL MSTR(ELFOR)
      GO TO 263
  266 CALL NSTR(ELFOR)
      CALL MSTR(ELFOR)
  263 CONTINUE
      JCNT=0
  423 CONTINUE
C
C
C
  450 FORMAT(1H1,4X,4HELEM,10X,12HINCREMENTAL STRESSES,27X,12HTOTAL STRESSES
     $,23X,12HPRINCIPLE STRESSES/)
  470 FORMAT(1H ,6X,1HX-STRESSES,4X,1HY-STRESSES,3X,2HXY-STRESSES,4X,1HX-STR
     $ESSES,4X,1HY-STRESSES,3X,2HXY-STRESSES
     $,7X,8HMAXIMUM,7X,7HMINIMUM,3X,5HANGLE/)
  471 FORMAT(1H ,6X,1HX-STRESSES,4X,1HR-STRESSES,3X,7HTHET-STRESSES,2X,1HZ-
     $STRESSES,4X,1HZ-STRESSES,3X,1HR-STRESSES,4X,7HTHET-STRESSES,2X,1HZ
     $-STRESSES/)
  660 FORMAT(I4,8E14.2)
C
C---------- ZERO DISPLACEMENT(X)LD) BEFORE ----------
C---------- ENTERING SUBROUTINE INSTRN ----------
C
      DO 280 I=1,NEQSYS
  280 XOLD(I)=0.0
      IF(NOIT.EQ.1) GO TO 281
      NI=IT+1
      LCONV=0
  281 CONTINUE
C
      RETURN
      END
```

```
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      SUBROUTINE INSIG
      COMMON/LUNITS/ LU7,LU8,LU10
      COMMON/GCOM/  NDIS,NSTRE,NRD,NQ(25),NQT(25)
      COMMON/CNTRL/ NENODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCPP
      COMMON/DEFCOM/DFLT,TH,JT,NAME(16)
      COMMON/LGS/ISP/EUB(150),TDELT(2,75),ELDIS(2,75),RCPP(150),
     $IEQPC(150),ICONV,IKNT,LUPD,NOIT,TPCRP(150)
      COMMON/TEST/ ITEST,LITHO,MCHK,IPRNT,IRZ
      COMMON/GAUSY/ ITK,INDIC,IPR,ITHERM
      COMMON/GRO/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQ,MTX(150,25),XILD(150),NHANW,PROP(4,6),NBNETX(30),
     $MATYP(30),SETX(12,12),D(4,6),SBS(4,6),BEQRY(4),BEQRX(10),IBOD
     $,ID(8)
      COMMON/NTAP/ BB(100,4,6),SBSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BOUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TYES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TYE/ NELEM,NELMAT,NNODES
C
      READ(60,500) EQB,RHO
      IF(EOF,60)3,4
    3 PRINT 553
      EQB=2000.0
      RHO=.08333333
    4 YMAX=0.0
      DO 5 I=1,NNODES
      YM=CORDS(I,2)
      IF(YMAX.LT.YM) YMAX=YM
    5 CONTINUE
      EQB=EQB*12.
      DO 10 N=1,NELEM
      I=NELCON(N,1)
      J=NELCON(N,2)
      M=NELCON(N,3)
      YB=(CORDS(I,2)+CORDS(J,2)+CORDS(M,2))/3.0
      CGY=YMAX-YB
      MNUM=IELMAT(N)
      SIGY=EQB*RHO+CGY*BEQRY(MNUM)
      PNU=PR12(MNUM,2)
      SIGY=PNU/(1.-PNU)*SIGY
      DIFF=SIGY-SIGX
      IF(IPRNT.EQ.1) GO TO 20
      SELAS(N,1)=DIFF
      GO TO 10
   20 SELAS(N,2)=DIFF
      SELAS(N,3)=SELAS(N,2)
   10 CONTINUE
  500 FORMAT(2F10.2)
  553 FORMAT(' * EQB CARD WAS OMITTED--OVERBURDEN SET TO 2000 FT. AND TH
     1E DENSITY EQUAL TO 1 PSI/FT. * *')
      RETURN
      END
```

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```
      SUBROUTINE NSTR(ELFOR)
C
C     THIS SUBROUTINE CALCULATES THE NODAL STRESSES BASED ON THE ELEMENT
C     STRESSES FOR THE ELEMENTS CONNECTED TO EACH NODE.
C
      COMMON/LUNITS/ LU7,LU9,LU10
      COMMON/SCHM/  NDIS,NSTRE,IBD,NQ(25),NDT(25)
      COMMON/CNTRL/ NPNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCPP
      COMMON/DELCON/DELT,TM,JT,NAME(16)
      COMMON/LOADSP/EUB(150),TDELT(2,75),ELDTS(2,75),RCPP(150),
     $IFORC(150),ICONV,IKNT,LUPD,NOTE,TRCPP(150)
      COMMON/TEST/ ITEST,LITHO,NCHK,IPRNT,IRZ
      COMMON/GAMDY/ TIK,INDTC,IDR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQNITX(150,25),XILD(150),NBANT,PROP(4,6),NBNFTX(30),
     $NFCTYP(30),SFORTX(12,12),D(4,4),SBS(4,6),BFORY(4),BFORX(10),IBOD
     $,KLD(9)
      COMMON/NTOP/ SB(100,4,6),SBSTFL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BCOND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TVES/ CORDS(75,2),IELCON(100,4),IELMAT(100)
      COMMON/TVE/ NELEM,NELMAT,NNODES
      DIMENSION SUM(4),ELFOR(100,4)
C
      WRITE(61,103)
      WRITE(61,102)
      DO 1 I=1,NNODES
      N=0
      DO 2 K=1,4
    2 SUM(K)=0.
      DO 3 KK=1,NELEM
      IF(I.EQ.IELCON(KK,1).OR.I.EQ.IELCON(KK,2).OR.I.EQ.IELCON(KK,3).OR.
     1I.EQ.IELCON(KK,4))30,40
   30 N=N+1
      DO 4 K=1,4
    4 SUM(K)=SUM(K)+ELFOR(KK,K)
   40 CONTINUE
    3 CONTINUE
C
C
C
      DO 6 K=1,4
    6 SUM(K)=SUM(K)/N
      WRITE(61,101)I,(SUM(K),K=1,4)
    1 CONTINUE
C
C
  101 FORMAT(I4,4E14.4)
  102 FORMAT(1H0,4X,4HNODE,10X,14HNODAL STRESSES )
  103 FORMAT(1H ,4X,4HSIGX,3X,4HSIGY,3X,4HTHETA,2X,4H
     1Y,4HSIGS)
C
C
      RETURN
      END
```

```
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      SUBROUTINE NODSTR(ELFOR)
C
C     THIS SUBROUTINE CALCULATES THE NODAL STRESSES BASED ON THE
C     AVERAGED ELEMENTAL STRESSES FOR THE ELEMENTS CONNECTED TO
C     EACH NODE.
C
      COMMON/LUNITS/ LU7,LU8,LU10
      COMMON/SCOM/ NDIS,NSTRE,NBD,ND(25),NRT(25)
      COMMON/CONTRL/ NRNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NR2,MCPP
      COMMON/DELCOM/DELT,TM,JT,NAME(10)
      COMMON/LCNTRL/EUR(150),TDELT(2,75),FLUTS(2,75),RCPP(150),
     *TEMPC(150),LCONV,IKNT,LUPD,NOIT,TRCRP(150)
      COMMON/TEST/ ITEST,LITHO,MCHK,IPRNT,IKZ
      COMMON/GAMRY/ TIM,INDTC,IDR,ITHERM
      COMMON/BDC/ SFLAS(100,4),SM(100),VOLUM(100)
      COMMON ED,NTX(150,25),X1LO(150),NRANN,PROP(4,6),NBNFIX(30),
     *KBTYP(30),SFNTX(12,12),D(4,5),SMS(4,5),REORY(4),REORX(10),TROD
     *,ZLO(8)
      COMMON/NTEP/ DR(100,4,6),SBSTFL(100,5,4),ELAS(100,4,4),EPI(100,4)
      COMMON/ROUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TYPES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TYPE/ NELEM,NELMAT,NNODES
      DIMENSION SUM(4),ELFOR(100,4),SUM4(4)
      INTEGER A,B,C
C
C
      WRITE(61,103)
      WRITE(6),102)
C
C
C
      DO 1 I=1,NNODES
      K=0
      DO 2 K=1,4
      SUM(K)=0.
    2 SUM(K)=0.0
      SX=0.0
      SY=0.0
      S7=0.0
      S2=0.
      S22=0.0
      S33=0.0
C
C
C
      DO 3 KK=1,NELEM
      IF(I.EQ.NELCON(KK,1).OR.I.EQ.NELCON(KK,2).OR.I.EQ.NELCON(KK,3).OR.
     *I.EQ.NELCON(KK,4))30,40
   30 K=K+1
      A=NELCON(KK,1)
      B=NELCON(KK,2)
      C=NELCON(KK,3)
      IF(I.NE.A)GO TO 41
      A1=ABS(COORDS(I,1)-COORDS(C,1)-2.*COORDS(A,1))
      B1=ABS(COORDS(I,2)-COORDS(C,2)-2.*COORDS(A,2))
      GO TO 42
```

```
41 IF(I.NE.E)GO TO 43
   AA=ABS(CORDS(C,1)+CORDS(A,1)-2.*CORDS(B,1))
   BB=ABS(CORDS(C,2)+CORDS(A,2)-2.*CORDS(B,2))
   GO TO 42
43 IF(I.NE.C)GO TO 42
   AA=ABS(CORDS(A,1)+CORDS(B,1)-2.*CORDS(C,1))
   BB=ABS(CORDS(A,2)+CORDS(B,2)-2.*CORDS(C,2))
42 CONTINUE
C
   SX=SX+(AA/(AA+BB))
   SY=SY+(BB/(AA+BB))
C
C
   PR= PR+((AA/(AA+BB))*ELFOR(KK,2))
   PZ= PZ+((BB/(AA+BB))*ELFOR(KK,1))
   PPR=PPR+((AA/(AA+BB))*SELAS(KK,2))
   PPZ=PPZ+((BB/(AA+BB))*SELAS(KK,1))
C
C
   DO 6 K=3,4
 6 SUM(K)=SUM(K)+ELFOR(KK,K)
C
   DO 9 K=3,4
 9 SUMM(K)=SUMM(K)+SELAS(KK,K)
40 CONTINUE
 3 CONTINUE
C
   DO 7 K=3,4
 7 SUM(K)=SUM(K)/N
   SUM(1)=(1./SY)*PZ
   SUM(2)=(1./SX)*PR
   DO 84 K=3,4
84 SUMM(K)=SUMM(K)/N
   SUMM(1)=(1./SY)*PPZ
   SUMM(2)=(1./SX)*PPR
C
   WRITE(61,101)I,(SUM(K),K=1,4),(SUMM(K),K=1,4)
 1 CONTINUE
C
C
C
101 FORMAT(I4,8E14.4)
102 FORMAT(1H ,≠ NODE ≠,15X,≠NODAL STRESSES≠,10X,≠WEIGHTED AVERAGE≠)
103 FORMAT(1H ,4X,≠Z-STRESSES≠,4X,≠R-STRESSES≠,3X,≠THET-STRESSES≠,2X,≠
   1 ZR-STRESSES≠)
C
C
   RETURN
   END
```

```
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      SUBROUTINE INSTRN(INSTR)
C
C---------------------- INSTRN CALCULATES THE RESTORING FORCES ---------
C---------------------- AND SETS THE BOUNDARY CONDITIONS FOR THE -------
C---------------------- THE VISCOELASTIC PROBLEM, UTILIZING -----------
C---------------------- EPIS TO DETERMIN THE INCREMENTAL STRAINS -------
C
      COMMON/LUNITS/ LU7,LU8,LU10
      COMMON/GCOM/  NDIS,NSTRE,NHD,NQ(25),NQT(25)
      COMMON/CURR/ NGNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCRP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LGRSP/FUR(150),TDELT(2,75),ELDIS(2,75),RCRP(150),
     *TFORC(150),ICONV,INT,LUPD,NDTT,TRCRP(150)
      COMMON/TEST/ ITEST,LITHO,NCHK,IPRBT,IRZ
      COMMON/GARRY/ ITK,INDIC,IPR,ITHERM
      COMMON/GHG/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON FORCTX(150,25),XILD(150),NBANW,PROP(4,6),NBNFTX(30),
     *NBCTYP(30),SFORTX(12,12),D(4,6),SBS(4,6),BFORY(4),BFORX(10),IBOD
     *,KLD(8)
      COMMON/STORE/ BR(100,4,6),SBSTFL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BOUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TWOS/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TWO/ NELEM,NELMAT,NNODES
C
      DIMENSION FFP(6),EPIT(4),ELTEMP(100)
      SAVT=TM
      WRITE(61,520) TM
      IF(ITHERM.NE.1) GO TO 313
      READ(LU10) TM,(ELTEMP(I),I=1,NELEM)
      WRITE(61,520) TM
  520 FORMAT(1H ,*TM=*,F10.6)
  485 TM=SAVT
  313 IF(ITHERM.NE.2) GOTO 314
      READ(61,5555) (ELTEMP(I),I=1,NELEM)
 5555 FORMAT(5(2X,F10.3))
C
C---------------------- CHECK IF INITIAL STRAIN PROBLEM ----------------
C
  314 IF(INSTR .EQ. 0) GO TO 90
C
C---------------------- CALCULATE NEW LOAD VECTORS(XILD) (REMEMBERING --
C---------------------- XILD REPRESENTED DISPLACEMENT IN STRESS WHICH --
C---------------------- WAS ZEROED OUT BEFORE ENTERING INSTRN) FROM -----
C---------------------- THE STRAIN CHANGE CALCULATED IN EPIS -----------
C
      DO 80 N=1,NELEM
      IF(ITHERM .EQ. 0) GO TO 79
C
      TEMP=ELTEMP(N)
      CALL EPIS(EPIT,N,TEMP)
   79 CALL EPIS     (N,EPIT)
C
C---------------------- ZERO INCREMENTAL RESTORING FORCE(FFP) ----------
C
      DO 40 I=1,6
   40 FFP(I)=0.0
```

```
      C
      C---------------------- CALCULATE RESTORING FORCES -------------------
      C
            DO 50 IM=1,6
            DO 50 IMC=1,IR7
         50 FEP(IM)=FEP(IM)+SYSTEL(N,IM,IMC)*EPI(N,IMC)
      C
            DO 60 IM=1,6
         60 FEP(IM)=FEP(IM)*VOLUM(N)
      C
            DO 70 IM=1,3
            JJ=NELCON(N,IM)
            JER=2*JJ-1
            IR=2*IM-1
            XILD(JER)=XILD(JER)+FEP(IR)
         70 XILD(JER+1)=XILD(JER+1)+FEP(IR+1)
         80 CONTINUE
         90 CONTINUE
      C
      C                 SET MINING OUT BOUNDARY CONDITIONS
      C
            IF(NB2.LE.0) GO TO 240
            IF(NOIT.EQ.1.AND.IT.EQ.1) GO TO 205
            IF(NOIT.NE.1.AND.IT.EQ.2) GO TO 205
            GO TO 240
        205 IX=NBNODE-NB2+1
            IY=NBNODE
            DO 207 J=1,NBNODE
        207 NBCTYP(J)=NEXC(J)
            REWIND LUZ
            READ(LUZ) ((EQNMTX(I,J),I=1,NEQSYS),J=1,NBANW)
            DO 220 N=IX,IY
            NB=10**(NDF-1)
            IB=NBNFIX(N)
            IROW1=(IB-1)*NDF
            DO 220 IR1=1,NDF
            IROW1=IROW1+1
            JBCK=NBCTYP(N)/NB
            IF(JBCK) 210,210,230
        230 EQNMTX(IROW1,1)=1.0
            DO 300 J=2,NBANW
            EQNMTX(IROW1,J)=0.0
            NRB=IROW1+1-J
            IF(NRB) 300,300,290
        290 EQNMTX(NRB,J)=0.0
        300 CONTINUE
            NBCTYP(N)=NBCTYP(N)-NB*JBCK
        210 NB=NB/10
        220 CONTINUE
            CALL SOLVE(1,NEQSYS)
        240 CONTINUE
      C
      C---------------------- END OF LOOP ON ELEMENTS ----------------------
      C
      C
      C---------------------- SET BOUNDARY CONDITIONS ----------------------
```

```
C
      DO 180 I=1,NBNODE
      IRW=NBNUFIX(I)*2
C
      IF(NFXC(I) .EQ. 10) GO TO 170
      IF(NFXC(I) .EQ. 01) GO TO 160
C
      XILD(IRW-1)=0.0
  160 XILD(IRW)=0.0
C
      GO TO 180
  170 XILD(IRW-1)=0.0
  180 CONTINUE
      IF(MODIT.EQ.1) GO TO 6000
  690 DO 65 I=1,NEQSYS
   65 RCRP(I)=XILD(I)
      DO 747 J=1,NEQSYS
  747 TRCRP(J)=TRCRP(J)+RCRP(J)
      IF(IT.NE.1) GO TO 9
      DO 11 J=1,NNODES
      COORDS(J,1)=COORDS(J,1)+ELDIS(1,J)
   11 COORDS(J,2)=COORDS(J,2)+ELDIS(2,J)
    9 IKUT=IKUT+1
C
      DO 737 J=1,NEQSYS
  737 XILD(J)=0.0
 5000 RETURN
      END
```

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```
      SUBROUTINE EPTST(EPTT,N,TEMP)
      COMMON/LUNITS/ LU7,LU9,LU10
      COMMON/SCRTCH/ NDIS,NSTRE,NBC,NQ(25),NQT(25)
      COMMON/CNTRL / NRNODE,NDF,NNEL,NLCAS,NCOSYS,LC,NH2,MCPP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LGATSP/FUB(150),TDELT(2,75),FLUIS(2,75),RCPP(150),
     $TEMPC(150),ICONV,IKNT,LUPD,NOTT,TRCRP(150)
      COMMON/TEST/ ITEST,LIMHO,NCHK,IPRNT,IRZ
      COMMON/GAMDY/ TIK,INDTC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQNMTX(150,25),X1LD(150),NRANW,PROP(4,6),NBNETX(30),
     $SUBCTYP(30),SETTX(12,12),D(4,6),SHS(4,6),BFORY(4),BFORX(10),TROO
     $,ILD(9)
      COMMON/MTAB/ DB(100,4,9),SBSTEL(100,6,4),ELAS(100,4,4),EPT(100,4)
      COMMON/BOUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TVAS/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TV#/ NELEM,NELMAT,NNODES
      DIMENSION ALPHA(4),EPTT(4),TOLD(100)
      ALPHA(1)=22.22E-06
      ALPHA(2)=22.22E-06
      ALPHA(3)=4.6E-06
      ALPHA(4)=0.0E+00
      MNUM=IELMAT(N)
      IF(JT .EQ. 2) GO TO 1
    2 DT=TEMP-TOLD(N)
      IF(IPRNT.EQ.1)GO TO 10
      EPTT(1) = (1.5 + PROP(MNUM,2))*ALPHA(MNUM)*DT
      EPTT(2)=EPTT(1)
      EPTT(3)=0.0
      GO TO 12
   10 EPTT(1)=ALPHA(MNUM)*DT
      EPTT(2)=EPTT(3)=EPTT(1)
      EPTT(4)=0.0
   12 CONTINUE
      TOLD(N)=TEMP
      RETURN
    1 TOLD(N)=0.0
      GO TO 2
      END
```

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```
      SUBROUTINE EPIS(N,EPIT)
C
C---------------------- EPIS CALCULATES THE STRAIN INCREMENT ----------
      COMMON/LUNITS/ LUI,LUO,LU10
      COMMON/GCOM/ NDIS,NSTRE,NBD,ND(25),NDT(25)
      COMMON/CNTRL/ MRNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCRP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LCOTSP/EPS(150),IDELT(2,75),ELDIS(2,75),RCRP(150),
     $TEMPC(150),ICONV,IKNT,LJPD,NDIT,TRCRP(150)
      COMMON/TEST/ ITEST,LITHO,NCHK,IPRT,IRZ
      COMMON/GAUSS/ TIK,INDIC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON FOUTX(150,25),XLD(150),NRANF,PROP(4,6),NRNETX(30),
     $MATYP(30),SELTX(12,12),D(4,4),SDS(4,6),BEDRY(4),BEDDX(10),IBOD
     $,ILD(8)
      COMMON/NTAP/ BB(100,4,6),SBSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BODUD/ NFAC(30),SGX(4),SGY(4)
      COMMON/TVES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TVE/ NELEM,NELMAT,NNODES
C
      DIMENSION ST(4),EPIT(4)
C
C---------------------- CALCULATE DEVIATORIC STRESS -------------------
C
      MNUM=IELMAT(N)
      IF(MNUM.NE.MCRP) GO TO 88
      JJ=IRZ-1
      F1 = (SELAS(N,3) - SELAS(N,1)) ** 2
      F2 = (SELAS(N,1) - SELAS(N,2)) ** 2
      F3 = (SELAS(N,2) - SELAS(N,3)) ** 2
      F4 = SELAS (N, 4) **2
      SE = SQRT( .5 * (F1 + F2 + F3 ) + 3.*F4)
      DO 10 K=1,JJ
   10 ST(K)=SELAS(N,K)-SM(N)
      ST(IRZ)=SELAS(N,IRZ)
C
      IF(PROP(MNUM,3) .GT. 1.0E-12) GO TO 50
      TM=TM+DELT
      TMU = 1.7*DELT*8760./SQRT(TM*8760.)
      S = SE / 24300.
      DO 40 K=1,IRZ
   40 EPI(N,K) = TMU*S*S*S*ST(K)/SE
      GO TO 55
   50 DO 51 I=1,IRZ
   51 EPI(N,I)=ST(I)*PROP(MNUM,3)*DELT
C
C---------------------- CONVERT EPI(3) TO GAMMA ----------------
C
   55 EPI(N,IRZ)=EPI(N,IRZ)*2.
      GO TO 56
   88 DO 89 I=1,IRZ
   89 EPI(N,I)=0.0
   56 IF(ITHERM.LE.0) GO TO 226
      DO 787 II=1,IRZ
  787 EPI(N,II)=EPI(N,II) + EPIT(II)
  226 CONTINUE
```

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```
C
C---------------------- PRINT EPI FOR THE APPROPRIATE ELEMENTS --
C
      IF(N.EQ.19.OR.N.EQ.20.OR.N.EQ.21) GO TO 31
      GO TO 90
666   FORMAT(I5,' EPS=',4E15.3,5F12.2)
31    PRINT 666, N,(EPI(N,I),I=1,102),SY(N),(SELAS(N,I),I=1,102)
C
90    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FUPS
      COMMON/LUNITS/ LU7,LU9,LU10
      COMMON/GCOH/  NOTS,NSTRE,NBD,NQ(25),NUT(25)
      COMMON/CNTRL/ NBNODE,NDF,NNEL,NLCAS,NEQSYS,LC,NB2,MCPP
      COMMON/DELCOM/DELT,TM,JT,NAME(16)
      COMMON/LODISP/FUB(150),TDELT(2,75),ELDIS(2,75),RCPP(150),
     $TFORC(150),ICONV,IKNT,LUPD,NUIT,TRCRP(150)
      COMMON/TEST/ ITEST,LITDO,ICHK,IPRNT,IRZ
      COMMON/GARRY/ IIK,INDIC,IPR,ITHERM
      COMMON/GHC/ SELAS(100,4),SM(100),VOLUM(100)
      COMMON EQUMTX(150,25),XILD(150),NBAND,PROP(4,6),NBNFTX(30),
     $NBCTYP(30),SEMTX(12,12),D(4,6),SBS(4,6),BEDRY(4),BEDRX(10),IROD
     $,ALP(8)
      COMMON/MTAP/ BB(100,4,6),SBSTEL(100,6,4),ELAS(100,4,4),EPI(100,4)
      COMMON/BOUND/ NFXC(30),SGX(4),SGY(4)
      COMMON/TVES/ CORDS(75,2),NELCON(100,4),IELMAT(100)
      COMMON/TVE/ NELEM,NELMAT,NNODES
C
      IF(IIK.NE.0) GO TO 7
C
      DO 5 J=1,NNODES
      TDELT(2*J-1)=ELDIS(1,J)
    5 TDELT(2*J) = ELDIS(2,J)
C
    7 DO 9 J=1,NEQSYS
    9 TFORC(J)=XILD(J)+TRCRP(J)
C
      DO 10 I=1,NEQSYS
   10 FUB(I)=0.0
C
      DO 30 I=1,NEQSYS
      DO 20 J=1,NBAND
      FUB(I)=FUB(I)+EQUMTX(I,J)*TDELT(J+I-1)
   20 CONTINUE
C
      J=I-1
      JMC=2
      IF(J .EQ. 0) GO TO 30
      NBA=NBAND-1
C
      DO 40 L=1,NBA
      FUB(I)=FUB(I)+EQUMTX(J,JMC)*TDELT(J)
      JMC=JMC+1
      J=J-1
      IF(J .EQ. 0) GO TO 30
   40 CONTINUE
   30 CONTINUE
      DO 44 I=1,NEQSYS
   44 FUB(I)=FUB(I)-TFORC(I)
      IIK=IIK+1
      RETURN
      END
```

```
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      SUBROUTINE WRITT
C
      DIMENSION RESPEC(16),JOBDES(16)
C
      WRITE(61,105)
C
      WRITE(61,120)
C
      DO 10 I=1,12
      READ(60,210) RESPEC
   10 WRITE(61,110) RESPEC
C
      WRITE(61,120)
C
      DO 20 I=1,5
      READ(61,210) JOBDES
   20 WRITE(61,110) JOBDES
C
  100 FORMAT(1H1)
  110 FORMAT(30X,16A5)
  120 FORMAT(1H ,/////////////)
  210 FORMAT(16A5)
C
      RETURN
      END

TIME LIMIT EXCEEDED. RUN TERMINATED.

END     .JL0001, 123930 80/06/75.        255881 0005.09    1912    10B7
```

APPENDIX B

AN EXAMPLE VISCOELASTIC PROBLEM

B.1. Problem Description

To illustrate the finite element code TEVCO, consider a laboratory core specimen with a radius and height of one inch, as illustrated in Figure B.1.

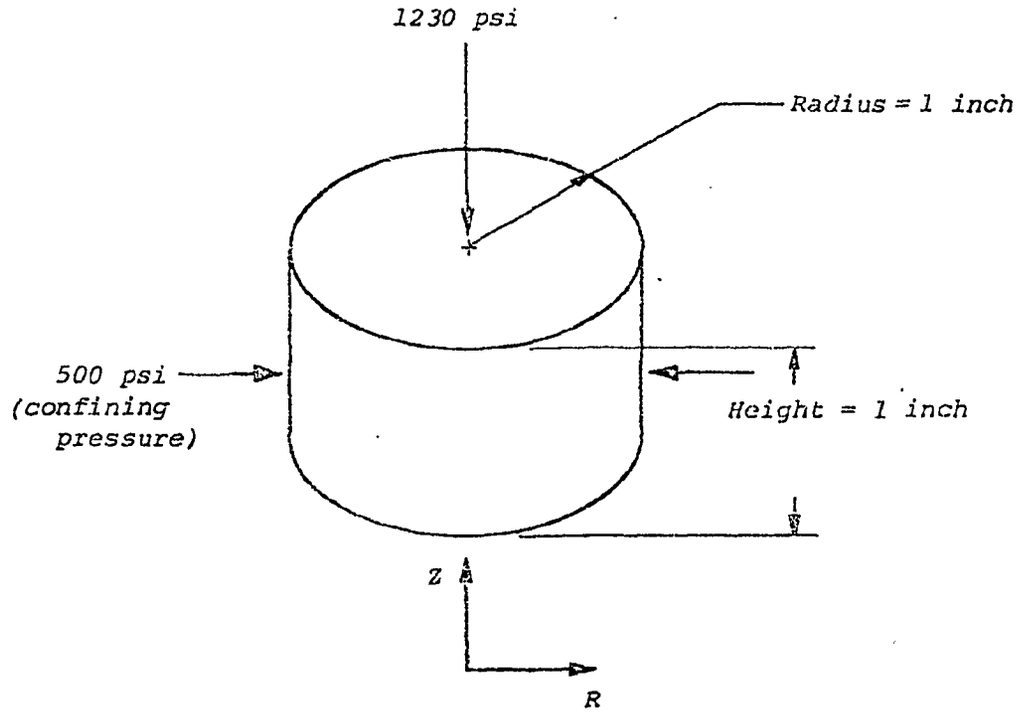

Figure B.1. Viscoelastic Example Problem of a Laboratory Test

The laboratory core is subjected to a confining pressure of 500 psi and loaded to attain a vertical stress of 1,230 psi. The finite element two-dimensional r-z discretization of the core is illustrated in Figure B.2. Note that the center of the core is taken as a line of symmetry.

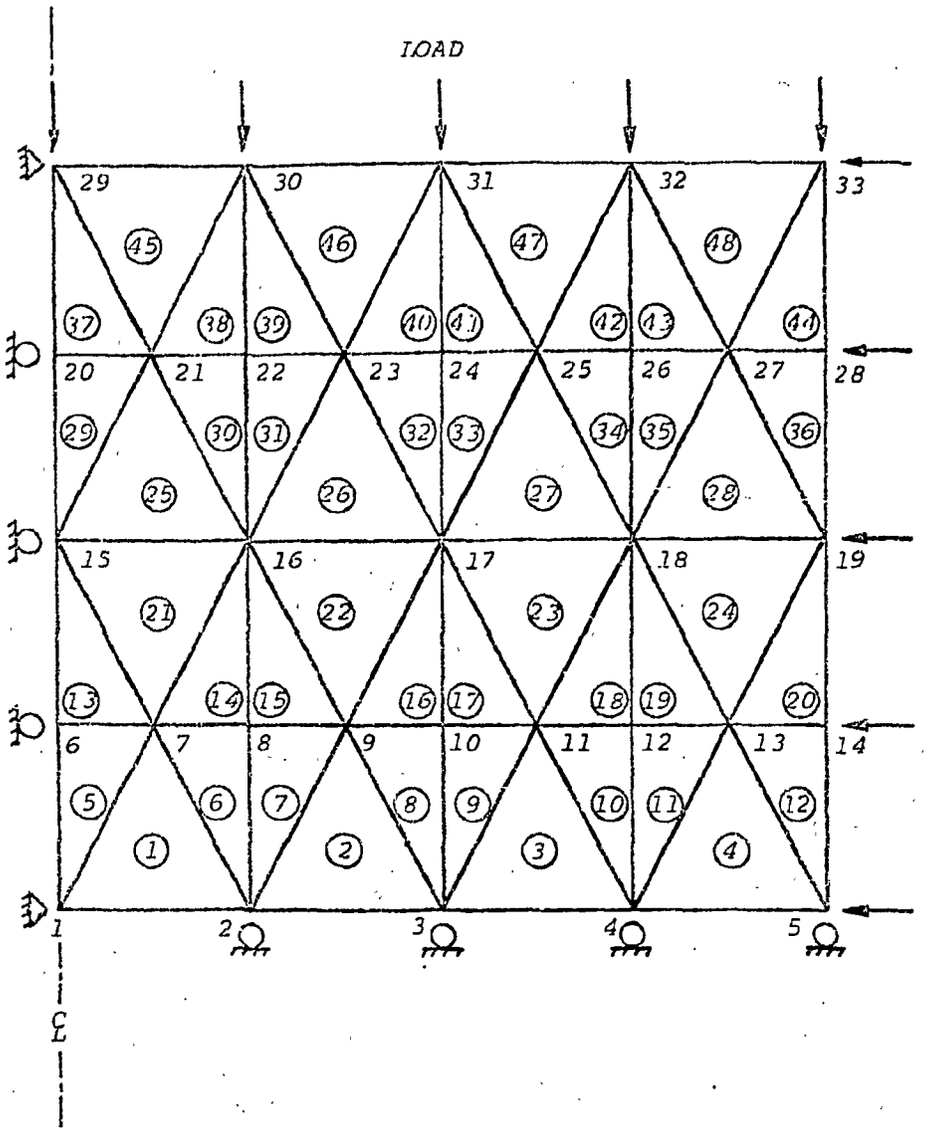

Figure B.2. Finite Element Discretization of the Laboratory Core (Note: Element Numbers are Circled).

B.2. Results of Finite Element Example

A listing of the computed results of the viscoelastic example problem is provided in pages B-4 through B-16. The input data, elemental stresses, nodal displacements, nodal stresses, and incremental creep strain in elements 19, 20, and 21 are displayed in the output. The results at every time step are not provided in this report due to the large amount of computer output for this example run. However, results are illustrated for several early time steps and several late time steps.

A comparison of the finite element computed creep strain and the creep strain computed from the experimentally determined creep law (4) is illustrated in Figure B.3.

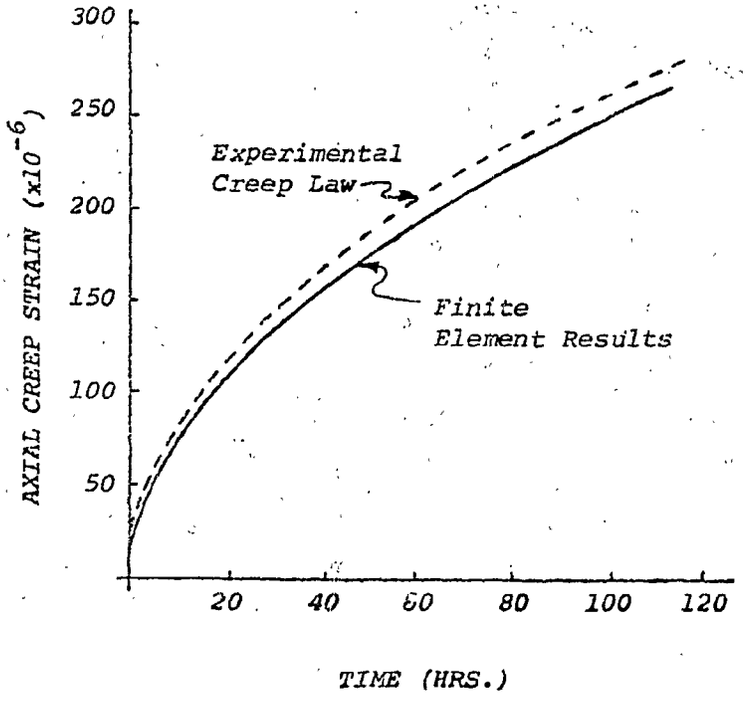

Figure B.3. Comparison of Laboratory Strain and Finite Element Strain as a Function of Time.

SIMPLE MODEL FOR EXPERIMENTAL COMPARISON

* AXIALLY SYMMETRIC PROBLEM *

NNODES= 33
NELEM= 44
NHNODE= 0
NLOCAS= 1
NDF= 2
NELMAT= 1
TRAN= 0
TROT= 0
NHARM= 21
NDIT= 1
TTHERM= 0
NB2= 0
NCRP= 1

MATERIAL PROPERTIES

MAT	YOUNGS MOD	POISSON'S RATIO	CREEP COEF	WEIGHT [illegible]	[illegible]	AFORM	AFORY
1	0.0000+000	0.0000-001	-0.0000+000	-0.0000+000	-0.0000+000	0.0000+000	0.0000+000

NODAL POINTS	COORDINATES	
1	0.50	0.00
2	0.25	0.00
3	0.50	0.00
4	0.75	0.00
5	1.00	0.00
6	0.00	0.25
7	0.12	0.25
8	0.25	0.25
9	0.37	0.25
10	0.50	0.25
11	0.62	0.25
12	0.75	0.25
13	0.87	0.25
14	1.00	0.25
15	0.00	0.50
16	0.25	0.50
17	0.50	0.50
18	0.75	0.50
19	1.00	0.50
20	0.00	0.75
21	0.12	0.75
22	0.25	0.75
23	0.37	0.75
24	0.50	0.75
25	0.62	0.75
26	0.75	0.75
27	0.87	0.75
28	1.00	0.75

30	0.25	1.00
31	0.25	1.00
32	0.25	1.00
33	1.00	1.00

ELEMENTS	NODAL CONNECTIONS				IELMAT
1	1	2	7	6	1
2	2	3	8	7	1
3	3	4	11	10	1
4	4	5	12	11	1
5	1	7	6	5	1
6	2	4	7	5	1
7	2	9	8	5	1
8	3	10	9	5	1
9	5	11	10	5	1
10	6	12	11	5	1
11	6	13	12	5	1
12	5	14	13	5	1
13	6	7	15	5	1
14	7	8	16	5	1
15	8	9	16	5	1
16	9	10	17	5	1
17	10	11	17	5	1
18	11	12	18	5	1
19	12	13	19	5	1
20	13	14	19	5	1
21	7	14	15	5	1
22	9	17	16	5	1
23	11	18	17	5	1
24	13	19	18	5	1
25	15	16	21	5	1
26	16	17	23	5	1
27	17	18	25	5	1
28	18	19	27	5	1
29	19	21	28	5	1
30	18	22	21	5	1
31	19	23	22	5	1
32	17	24	23	5	1
33	17	25	24	5	1
34	18	26	25	5	1
35	18	27	26	5	1
36	19	28	27	5	1
37	20	21	29	5	1
38	21	22	30	5	1
39	22	23	30	5	1
40	23	24	31	5	1
41	24	25	31	5	1
42	25	26	32	5	1
43	25	27	32	5	1
44	27	28	33	5	1
45	21	31	29	5	1
46	23	31	30	5	1
47	25	32	31	5	1
48	27	33	32	5	1

BOUNDARY CONDITIONS

1	11
2	1

SIMPLE MODEL FOR EXPERIMENTAL COMPARISON — LOAD CASE 1

NODE	LOADS		
5	-332.70	-0.00	-0
19	-795.40	-0.00	-0
19	-795.40	-0.00	-0
29	-795.40	-0.00	-0
29	-0.00	-60.38	-0
30	-0.00	-483.02	-0
31	-0.00	-966.04	-0
32	-0.00	-1449.06	-0
33	-332.70	-965.66	-0

TIME= 0.000000 YR WITH DELT= 0.000057

NODE	INCREMENTAL DISPLACEMENTS		TOTAL DISPLACEMENT AT TIME . . . 0.0000 YR	
	R	Z	R	Z
1	0.00000000+000	0.00000000+000	0.00000000+000	0.00000000+000
2	5.73321619-005	0.00000000+000	5.73321619-005	0.00000000+000
3	1.15677871-004	0.00000000+000	1.15677871-004	0.00000000+000
4	1.76130307-004	0.00000000+000	1.76130307-004	0.00000000+000
5	2.37550683-004	0.00000000+000	2.37550683-004	0.00000000+000
6	0.00000000+000	-2.51599299-004	0.00000000+000	-2.51599299-004
7	2.80726186-005	-2.53479208-004	2.80726186-005	-2.53479208-004
8	5.69210634-005	-2.53958734-004	5.69210634-005	-2.53958734-004
9	8.56700634-005	-2.55165316-004	8.56700634-005	-2.55165316-004
10	1.15678730-004	-2.57129814-004	1.15678730-004	-2.57129814-004
11	1.45528770-004	-2.58547542-004	1.45528770-004	-2.58547542-004
12	1.76217805-004	-2.59848304-004	1.76217805-004	-2.59848304-004
13	2.06773314-004	-2.60609808-004	2.06773314-004	-2.60609808-004
14	2.37792490-004	-2.61319580-004	2.37792490-004	-2.61319580-004
15	0.00000000+000	-5.00692833-004	0.00000000+000	-5.00692833-004
16	5.50324724-005	-5.04607168-004	5.50324724-005	-5.04607168-004
17	1.15335789-004	-5.14389097-004	1.15335789-004	-5.14389097-004
18	1.76136732-004	-5.19980510-004	1.76136732-004	-5.19980510-004
19	2.38147428-004	-5.23420618-004	2.38147428-004	-5.23420618-004
20	0.00000000+000	-7.27181495-004	0.00000000+000	-7.27181495-004
21	2.01756680-005	-7.44250993-004	2.01756680-005	-7.44250993-004
22	5.61865820-005	-7.61406499-004	5.61865820-005	-7.61406499-004
23	8.60436750-005	-7.67288867-004	8.60436750-005	-7.67288867-004
24	1.17205872-004	-7.72706931-004	1.17205872-004	-7.72706931-004
25	1.47924068-004	-7.76113170-004	1.47924068-004	-7.76113170-004
26	1.78541190-004	-7.79964806-004	1.78541190-004	-7.79964806-004
27	2.08892781-004	-7.83887144-004	2.08892781-004	-7.83887144-004
28	2.41043095-004	-7.87912602-004	2.41043095-004	-7.87912602-004
29	0.00000000+000	-9.30910716-004	0.00000000+000	-9.30910716-004
30	6.01945744-005	-1.02259529-003	6.01945744-005	-1.02259529-003
31	1.23859591-004	-1.03335948-003	1.23859591-004	-1.03335948-003
32	1.85705912-004	-1.04050006-003	1.85705912-004	-1.04050006-003
33	2.48478240-004	-1.05492702-003	2.48478240-004	-1.05492702-003

ELEM INCREMENTAL STRESSES TOTAL STRESSES PRINCIPLE STRESSES

	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES
1	-1215.77	-505.35	-506.25	-0.68	-1215.77	-505.35	-506.25	-0.68
2	-1220.20	-503.60	-505.57	-0.95	-1220.20	-503.60	-505.57	-0.95
3	-1229.98	-500.83	-505.73	-0.43	-1229.98	-500.83	-505.73	-0.43
4	-1236.13	-500.06	-505.39	-0.08	-1236.13	-500.06	-505.39	-0.08
5	-1211.93	-508.51	-509.51	-4.30	-1211.93	-508.51	-508.51	-4.30
6	-1217.42	-505.07	-506.82	-1.57	-1217.42	-505.07	-506.82	-1.57
7	-1217.46	-505.56	-506.42	-3.23	-1217.46	-505.56	-506.42	-3.23
8	-1225.31	-500.40	-505.83	-4.49	-1225.31	-500.40	-505.83	-4.49
9	-1225.20	-501.02	-504.94	-3.24	-1225.20	-501.02	-504.94	-3.24
10	-1233.47	-499.23	-505.64	-2.87	-1233.47	-499.23	-505.64	-2.87
11	-1233.40	-499.78	-504.94	-1.64	-1233.40	-499.78	-504.94	-1.64
12	-1237.15	-498.05	-504.27	-1.35	-1237.15	-498.05	-504.27	-1.35
13	-1194.74	-497.05	-497.05	-4.30	-1194.74	-497.05	-497.05	-4.30
14	-1212.64	-503.28	-507.13	-3.25	-1212.64	-503.28	-507.13	-3.25
15	-1211.48	-502.57	-504.93	-4.92	-1211.48	-502.57	-504.93	-4.92
16	-1226.48	-501.28	-506.85	-4.88	-1226.48	-501.28	-506.85	-4.88
17	-1226.33	-501.85	-505.89	-3.63	-1226.33	-501.85	-505.89	-3.63
18	-1235.41	-500.53	-506.94	-3.07	-1235.41	-500.53	-506.94	-3.07
19	-1235.34	-501.07	-506.23	-1.83	-1235.34	-501.07	-506.23	-1.83
20	-1242.27	-501.38	-507.49	-1.22	-1242.27	-501.38	-507.49	-1.22
21	-1210.61	-513.00	-512.15	-7.40	-1210.61	-513.00	-512.15	-7.40
22	-1215.08	-493.62	-501.41	-9.45	-1215.08	-493.62	-501.41	-9.45
23	-1229.20	-499.06	-504.85	-6.15	-1229.20	-499.06	-504.85	-6.15
24	-1236.47	-497.95	-504.49	-3.51	-1236.47	-497.95	-504.49	-3.51
25	-1169.05	-493.32	-504.50	-15.15	-1169.05	-493.32	-504.50	-15.15
26	-1224.70	-499.91	-507.50	-7.91	-1224.70	-499.91	-507.50	-7.91
27	-1229.74	-498.93	-503.99	-3.89	-1229.74	-498.93	-503.99	-3.89
28	-1243.06	-502.04	-508.12	-1.93	-1243.06	-502.04	-508.12	-1.93
29	-1184.14	-574.22	-574.22	-39.02	-1184.14	-574.22	-574.22	-39.02
30	-1199.63	-461.75	-498.93	-40.18	-1199.63	-461.75	-498.93	-40.18
31	-1200.89	-472.86	-490.98	-14.41	-1200.89	-472.86	-490.98	-14.41
32	-1222.23	-489.13	-499.18	-10.45	-1222.23	-489.13	-499.18	-10.45
33	-1223.51	-492.43	-499.07	-5.44	-1223.51	-492.43	-499.07	-5.44
34	-1232.51	-498.30	-503.11	-6.06	-1232.51	-498.30	-503.11	-6.06
35	-1234.06	-501.06	-504.21	-6.22	-1234.06	-501.06	-504.21	-6.22
36	-1246.19	-494.66	-504.87	-5.89	-1246.19	-494.66	-504.87	-5.89
37	-1028.07	-470.18	-470.18	-39.02	-1028.07	-470.18	-470.18	-39.02
38	-1234.01	-481.52	-513.98	-32.35	-1234.01	-481.52	-513.98	-32.35
39	-1237.96	-495.33	-510.07	-6.58	-1237.96	-495.33	-510.07	-6.58
40	-1229.92	-491.89	-498.41	-4.99	-1229.92	-491.89	-498.41	-4.99
41	-1232.29	-496.29	-499.93	0.02	-1232.29	-496.29	-499.93	0.02
42	-1231.15	-495.67	-497.91	-0.61	-1231.15	-495.67	-497.91	-0.61
43	-1233.23	-498.97	-499.82	-0.78	-1233.23	-498.97	-499.82	-0.78
44	-1259.38	-502.09	-510.25	-0.70	-1259.38	-502.09	-510.25	-0.70
45	-1074.19	-405.17	-420.28	-93.44	-1074.19	-405.17	-420.28	-93.44
46	-1222.15	-480.77	-489.10	-5.46	-1222.15	-480.77	-489.10	-5.46
47	-1226.87	-489.36	-491.30	-0.32	-1226.87	-489.36	-491.30	-0.32
48	-1242.16	-495.65	-499.14	-7.12	-1242.16	-495.65	-499.14	-7.12

NODE	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES
	NODAL STRESSES			WEIGHTED AVERAGE				
1	-1213.2096	-504.1381	-507.3810	-2.4875	-1213.2096	-506.1381	-507.3810	-2.4875
2	-1217.6234	-504.6836	-506.2651	-1.6065	-1217.6234	-504.6836	-506.2651	-1.6065
3	-1225.1991	-501.8401	-505.5180	-2.2780	-1225.1991	-501.8401	-505.5180	-2.2780
4	-1233.3076	-500.2126	-505.4238	-1.2549	-1233.3076	-500.2126	-505.4238	-1.2549
5	-1236.8102	-499.5575	-504.8290	-0.7114	-1236.8102	-499.5575	-504.8290	-0.7114

7	-1211.1862	-503.4771	-506.3196	-3.5812	-1211.1862	-503.4771	-506.3196	-3.5812	
8	-1214.7501	-504.1190	-506.3271	-3.2410	-1214.7501	-504.1190	-506.3271	-3.2410	
9	-1218.9095	-502.4517	-505.1691	-4.6531	-1218.9095	-502.4517	-505.1691	-4.6531	
10	-1225.8290	-501.1357	-505.8800	-4.0608	-1225.8290	-501.1357	-505.8800	-4.0608	
11	-1229.8451	-500.6571	-505.6661	-3.2321	-1229.8451	-500.6571	-505.6661	-3.2321	
12	-1234.4056	-500.1545	-505.9370	-2.3531	-1234.4056	-500.1545	-505.9370	-2.3531	
13	-1236.6704	-500.0707	-505.4676	-1.6039	-1236.6704	-500.0707	-505.4676	-1.6039	
14	-1239.7108	-499.7138	-505.8805	-1.2813	-1239.7108	-499.7138	-505.8805	-1.2813	
15	-1189.5689	-511.2777	-521.9813	-16.4641	-1189.5689	-511.2777	-521.9813	-16.4641	
16	-1205.7258	-496.2511	-503.4427	-12.8332	-1205.7258	-496.2511	-503.4427	-12.8332	
17	-1224.6497	-497.4529	-503.5940	-6.4766	-1224.6497	-497.4529	-503.5940	-6.4766	
18	-1234.4261	-499.6796	-505.2422	-4.0820	-1234.4261	-499.6796	-505.2422	-4.0820	
19	-1242.7410	-499.4998	-506.2429	-3.1373	-1242.7410	-499.4998	-506.2429	-3.1373	
20	-1106.1061	-522.1969	-522.1969	-39.0160	-1106.1061	-522.1969	-522.1969	-39.0160	
21	-1141.5407	-496.9179	-497.0150	-43.1916	-1141.5407	-496.9179	-497.0150	-43.1916	
22	-1218.1234	-477.8673	-503.4889	-23.3792	-1218.1234	-477.8673	-503.4889	-23.3792	
23	-1223.0883	-487.3029	-499.2076	-8.3008	-1223.0883	-487.3029	-499.2076	-8.3008	
24	-1226.9859	-492.4361	-499.1474	-5.2142	-1226.9859	-492.4361	-499.1474	-5.2142	
25	-1229.0850	-495.6742	-499.2178	-2.7167	-1229.0850	-495.6742	-499.2178	-2.7167	
26	-1232.7366	-498.5001	-501.2635	-3.4159	-1232.7366	-498.5001	-501.2635	-3.4159	
27	-1242.9118	-499.1950	-504.4018	-3.7727	-1242.9118	-499.1950	-504.4018	-3.7727	
28	-1252.7847	-498.3759	-507.5602	-3.2977	-1252.7847	-498.3759	-507.5602	-3.2977	
29	-1043.4449	-421.4182	-445.2300	-66.2297	-1043.4449	-421.4182	-445.2300	-66.2297	
30	-1206.7135	-454.3340	-483.3592	-34.4581	-1206.7135	-454.3340	-483.3592	-34.4581	
31	-1228.9075	-487.3221	-494.6835	-2.6867	-1228.9075	-487.3221	-494.6835	-2.6867	
32	-1232.9647	-493.7090	-497.0421	-2.2072	-1232.9647	-493.7090	-497.0421	-2.2072	
33	-1253.6405	-497.2613	-504.6929	-3.9103	-1253.6405	-497.2613	-504.6929	-3.9103	

TM= 0.00000

19 EPS	-4.453-006	4.877-006	4.775-006	-7.255-008	-7.48+002	-1.24+003	-5.01+002	-5.06+002	-1.83+000
20 EPS	-4.899-006	5.010-006	4.888-006	-4.896-008	-7.50+002	-1.24+003	-5.01+002	-5.07+002	-1.22+000
21 EPS	-4.393-006	4.184-006	4.199-006	-2.664-007	-7.45+002	-1.21+003	-5.13+002	-5.12+002	-7.40+000

TIME= 0.000057 YR WITH DELT= 0.000057

TM= 0.00006

19 EPS	-4.824-006	3.449-006	3.375-006	-5.126-008	-7.48+002	-1.24+003	-5.01+002	-5.06+002	-1.83+000
20 EPS	-4.995-006	3.542-006	3.454-006	-3.482-008	-7.50+002	-1.24+003	-5.01+002	-5.08+002	-1.22+000
21 EPS	-5.038-006	2.963-006	2.975-006	-1.859-007	-7.46+002	-1.21+003	-5.13+002	-5.12+002	-7.29+000

TIME= 0.000114 YR WITH DELT= 0.000057

TM= 0.00011

19 EPS	-5.571-006	2.816-006	2.755-006	-4.183-008	-7.48+002	-1.24+003	-5.01+002	-5.06+002	-1.83+000
20 EPS	-5.709-006	2.891-006	2.818-006	-2.855-008	-7.50+002	-1.24+003	-5.01+002	-5.08+002	-1.23+000
21 EPS	-4.854-006	2.422-006	2.432-006	-1.503-007	-7.46+002	-1.21+003	-5.13+002	-5.12+002	-7.21+000

TIME= 0.000171 YR WITH DELT= 0.000057

TM= 0.00017

19 EPS	-4.926-006	2.438-006	2.346-006	-3.620-008	-7.48+002	-1.24+003	-5.01+002	-5.06+002	-1.83+000
20 EPS	-4.943-006	2.503-006	2.440-006	-2.480-008	-7.50+002	-1.24+003	-5.01+002	-5.08+002	-1.23+000
21 EPS	-4.308-006	2.100-006	2.108-006	-1.292-007	-7.46+002	-1.21+003	-5.13+002	-5.12+002	-7.15+000

TIME= 0.000228 YR WITH DELT= 0.000057

TM= 0.00023

19 EPS	-4.314-006	2.181-006	2.133-006	-3.236-008	-7.48+002	-1.24+003	-5.01+002	-5.06+002	-1.83+000

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20 EPS	-4.620-004	2.239-006	2.191-006	-2.225-008	-7.50+002	-1.24+003	-5.01+002	-5.08+002	-1.24+000
21 EPS	-3.766-004	1.879-006	1.987-006	-1.147-007	-7.46+002	-1.21+003	-5.13+002	-5.13+002	-7.10+000

TIME= 0.000285 YR WITH DELT= 0.000057

TM= 0.00029

19 EPS	-3.938-004	1.991-006	1.947-006	-2.952-008	-7.48+002	-1.24+003	-5.01+002	-5.07+002	-1.83+000
20 EPS	-4.634-004	2.043-006	1.991-006	-2.036-008	-7.50+002	-1.24+003	-5.01+002	-5.08+002	-1.24+000
21 EPS	-3.441-004	1.717-006	1.724-006	-1.041-007	-7.46+002	-1.21+003	-5.14+002	-5.13+002	-7.05+000

TIME= 0.000342 YR WITH DELT= 0.000057

TM= 0.00034

19 EPS	-3.646-004	1.843-006	1.803-006	-2.732-008	-7.48+002	-1.24+003	-5.01+002	-5.07+002	-1.83+000
20 EPS	-3.934-004	1.891-006	1.843-006	-1.890-008	-7.51+002	-1.24+003	-5.01+002	-5.08+002	-1.24+000
21 EPS	-3.137-004	1.590-006	1.597-006	-9.587-008	-7.46+002	-1.21+003	-5.14+002	-5.13+002	-7.01+000

TIME= 0.000400 YR WITH DELT= 0.000057

TM= 0.00040

19 EPS	-3.410-004	1.724-006	1.686-006	-2.554-008	-7.48+002	-1.24+003	-5.01+002	-5.07+002	-1.83+000
20 EPS	-3.692-004	1.769-006	1.723-006	-1.771-008	-7.51+002	-1.24+003	-5.02+002	-5.08+002	-1.25+000
21 EPS	-2.983-004	1.489-006	1.495-006	-8.922-008	-7.46+002	-1.21+003	-5.14+002	-5.13+002	-6.97+000

TIME= 0.000457 YR WITH DELT= 0.000057

TM= 0.00046

19 EPS	-3.315-004	1.625-006	1.589-006	-2.407-008	-7.48+002	-1.24+003	-5.01+002	-5.07+002	-1.83+000
20 EPS	-3.592-004	1.668-006	1.624-006	-1.673-008	-7.51+002	-1.24+003	-5.02+002	-5.08+002	-1.25+000
21 EPS	-2.814-004	1.404-006	1.410-006	-8.372-008	-7.46+002	-1.21+003	-5.14+002	-5.13+002	-6.94+000

TIME= 0.000514 YR WITH DELT= 0.000057

TM= 0.00051

19 EPS	-3.050-004	1.542-006	1.508-006	-2.282-008	-7.48+002	-1.24+003	-5.01+002	-5.07+002	-1.82+000
20 EPS	-3.323-004	1.582-006	1.541-006	-1.590-008	-7.51+002	-1.24+003	-5.02+002	-5.08+002	-1.25+000
21 EPS	-2.671-004	1.333-006	1.338-006	-7.906-008	-7.47+002	-1.21+003	-5.14+002	-5.13+002	-6.90+000

TIME= 0.000571 YR WITH DELT= 0.000057

NODE	INCREMENTAL DISPLACEMENTS		TOTAL DISPLACEMENT AT TIME . . . 0.0006 YR	
	R	Z	R	Z
1	0.00000000+000	0.00000000+000	0.00000000+000	0.00000000+000
2	7.52434799-007	0.00000000+000	5.74968615-006	0.00000000+000
3	7.21916469-007	0.00000000+000	1.14567124-005	0.00000000+000
4	1.1015[illegible]	0.00000000+000	1.7487502[illegible]-005	0.00000000+000
5	1.44[illegible]	0.00000000+000	2.30554387-005	0.00000000+000
6	0.00000000+000	-7.2491339[illegible]-007	0.00000000+000	-1.1501918[illegible]-005
7	1.[illegible]	-7.3[illegible]1520-007	2.8442887[illegible]-006	-1.1595[illegible]48-005
8	2.[illegible]	-7.2[illegible]4247-007	5.6585125[illegible]-006	-1.1436[illegible]861-005

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9	5.342841[illegible]-007	-7.21870519-007	9.47499367-006	-1.1654-300-005
10	7.[illegible]	-7.35632293-007	1.14588850-005	-1.14789241-005
11	9.[illegible]	-7.44678569-007	1.44228357-005	-1.18248784-005
12	1.[illegible]	-7.54945057-007	1.75183675-005	-1.19887150-005
13	1.[illegible]	-7.58573225-007	2.05948372-005	-1.20479138-005
14	1.494[illegible]	-7.65675357-007	2.37334844-005	-1.21503326-005
15	0.000[illegible]	-1.44496233-006	0.00000000+000	-2.29260428-005
16	3.42[illegible]	-1.42795853-006	5.42429309-006	-2.26616657-005
17	7.20[illegible]	-1.47254013-006	1.14331140-005	-2.33771717-005
18	1.10[illegible]	-1.51374403-006	1.75530349-005	-2.40391665-005
19	1.5[illegible]	-1.53620300-006	2.38623437-005	-2.43971026-005
20	0.00[illegible]	-2.02949273-006	0.00000000+000	-3.22052129-005
21	1.28[illegible]	-2.04546392-006	2.03714157-006	-3.30902200-005
22	3.41[illegible]	-2.14617014-006	5.42022030-006	-3.43725555-005
23	5.41[illegible]	-2.18701565-006	8.59786010-006	-3.47129734-005
24	7.30[illegible]	-2.22649773-006	1.17359091-005	-3.53480046-005
25	9.34[illegible]	-2.24735981-006	1.48369436-005	-3.55827065-005
26	1.13[illegible]	-2.27744151-006	1.79462184-005	-3.61648311-005
27	1.32[illegible]	-2.30194479-006	2.10358663-005	-3.65445968-005
28	1.53[illegible]	-2.33258910-006	2.43924630-005	-3.70477866-005
29	0.00[illegible]	-2.56165511-006	0.00000000+000	-4.06144806-005
30	3.44[illegible]	-2.93521974-006	5.79613489-006	-4.65840275-005
31	7.41[illegible]	-3.00048119-006	1.24081165-005	-4.76349868-005
32	1.17[illegible]	-3.05331539-006	1.87332330-005	-4.84847893-005
33	1.58[illegible]	-3.14671136-006	2.52470239-005	-4.99858135-005

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EM	INCREMENTAL STRESSES				TOTAL STRESSES			PRINCIPLE STRESSES	
	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES	
1	-0.10	-0.01	-0.01	0.00	-1217.44	-505.45	-506.35	-0.68	
2	-0.03	-0.01	-0.00	-0.01	-1220.67	-503.78	-505.64	-1.04	
3	0.06	0.00	-0.02	-0.00	-1229.94	-500.81	-505.99	-0.46	
4	0.02	0.00	-0.02	0.00	-1235.80	-500.05	-505.72	-0.05	
5	-0.13	0.00	0.00	0.00	-1214.07	-508.43	-508.43	-4.29	
6	-0.07	-0.03	-0.01	0.02	-1218.55	-505.49	-506.99	-1.23	
7	-0.09	-0.03	-0.02	0.00	-1218.64	-505.99	-506.71	-3.21	
8	-0.01	0.01	-0.01	-0.01	-1225.40	-500.28	-505.98	-4.73	
9	-0.01	0.01	-0.01	-0.01	-1225.29	-500.93	-505.05	-3.39	
0	-0.03	0.01	-0.01	-0.01	-1233.18	-498.99	-505.89	-3.05	
1	-0.02	0.01	-0.01	-0.00	-1233.12	-499.59	-505.13	-1.65	
2	-0.03	0.01	-0.01	-0.01	-1236.65	-497.83	-504.52	-1.43	
3	-0.13	0.04	0.04	0.00	-1196.92	-496.34	-496.34	-4.29	
4	-0.04	0.01	0.01	0.02	-1213.34	-503.17	-506.95	-2.99	
5	-0.03	0.02	0.02	-0.00	-1212.03	-502.30	-504.65	-4.97	
6	-0.01	-0.00	-0.02	-0.02	-1226.70	-501.28	-507.13	-5.14	
7	-0.01	-0.01	-0.01	-0.01	-1226.54	-501.88	-506.13	-3.79	
8	-0.06	-0.03	-0.03	-0.01	-1235.44	-500.57	-507.45	-3.22	
9	-0.02	-0.01	-0.03	0.00	-1235.38	-501.18	-506.70	-1.82	
0	-0.01	-0.01	-0.04	-0.00	-1242.02	-501.54	-508.08	-1.25	
1	-0.14	-0.05	-0.04	0.03	-1213.26	-513.84	-512.84	-6.87	
2	0.01	0.05	0.02	-0.02	-1214.98	-492.83	-501.04	-9.80	
3	0.01	0.02	-0.00	-0.02	-1229.05	-498.72	-504.94	-6.48	
4	-0.03	0.02	-0.01	-0.00	-1236.00	-497.56	-504.64	-3.59	
5	-0.03	0.11	0.09	0.02	-1170.67	-491.65	-503.12	-14.90	
6	-0.03	0.01	-0.02	-0.01	-1225.03	-499.78	-507.75	-6.09	
7	-0.01	0.01	-0.01	-0.01	-1229.85	-498.86	-504.20	-4.03	
8	-0.01	-0.02	-0.04	0.00	-1243.16	-502.31	-508.85	-1.86	
9	-0.60	-0.25	-0.25	-0.03	-1194.07	-578.30	-578.30	-39.46	

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30	[illegible]	0.12	0.03	-0.04	-1198.81	-459.71	-498.47	-40.87
31	0.[illegible]	0.11	0.06	0.00	-1200.39	-471.11	-490.94	-14.40
32	[illegible]	0.[illegible]	0.01	-0.03	-1221.61	-488.36	-498.98	-10.96
33	[illegible]	[illegible]	0.02	-0.01	-1223.24	-491.73	-498.79	-5.55
34	[illegible]	0.02	-0.01	-0.02	-1232.45	-498.02	-503.22	-6.36
35	[illegible]	0.01	-0.01	-0.00	-1234.08	-500.84	-504.33	-6.28
36	[illegible]	0.04	-0.02	-0.01	-1245.42	-494.06	-505.17	-6.09
37	-0.47	0.10	0.10	-0.04	-1035.75	-468.43	-468.43	-39.70
38	-0.02	-0.02	-0.11	-0.04	-1234.20	-481.86	-515.75	-32.96
39	-0.[illegible]	-0.[illegible]	-0.10	0.00	-1238.68	-496.17	-511.64	-6.55
40	-0.[illegible]	-0.01	-0.03	-0.02	-1230.22	-492.03	-498.90	-5.37
41	-0.[illegible]	-0.02	-0.04	0.00	-1232.76	-496.61	-500.51	0.03
42	-0.[illegible]	-0.[illegible]	-0.02	-0.01	-1231.48	-495.71	-498.18	-0.78
43	-0.[illegible]	-0.01	-0.02	0.00	-1233.74	-499.15	-500.18	-0.70
44	0.01	-0.03	-0.07	-0.01	-1259.25	-502.58	-511.48	-0.82
45	0.[illegible]	0.25	0.23	-0.07	-1074.01	-400.91	-416.58	-94.63
46	0.[illegible]	0.[illegible]	0.03	-0.02	-1221.36	-479.30	-488.62	-5.77
47	0.[illegible]	0.04	0.02	-0.01	-1226.55	-488.73	-490.99	-0.43
48	0.[illegible]	0.02	-0.02	-0.01	-1241.90	-495.40	-499.41	-7.32

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Z-STRESSES P-STRESSES THET-STRESSES RZ-STRESSES

NODE	NODAL STRESSES		WEIGHTED AVERAGE				
1	-0.1147	-0.0036	-0.0008	0.0002	-1215.1932	-506.1964	-507.3935	-2.4814
2	-0.0479	-0.0130	-0.0096	0.0041	-1218.7499	-504.8951	-506.4213	-1.5409
3	-0.[illegible]	-0.[illegible]	-0.0085	-0.0077	-1225.3314	-501.8692	-505.6658	-2.4064
4	0.[illegible]	0.[illegible]	-0.0152	-0.0026	-1233.0577	-500.1444	-505.6824	-1.2996
5	0.[illegible]	0.[illegible]	-0.0173	-0.0017	-1236.3660	-499.4944	-505.1202	-0.7398
6	-0.1256	0.[illegible]	0.0240	0.0002	-1205.4964	-502.3866	-502.3866	-4.2876
7	-0.[illegible]	0.0072	0.0000	0.0115	-1213.0341	-503.3574	-506.3174	-3.3914
8	-0.[illegible]	-0.0072	0.0004	0.0087	-1215.6408	-504.2356	-506.3226	-3.1020
9	-0.[illegible]	-0.[illegible]	-0.0010	-0.0097	-1219.2588	-502.4592	-505.1911	-4.8159
10	-0.[illegible]	0.0027	-0.0114	-0.0120	-1225.9807	-501.0000	-506.0726	-4.2617
11	0.[illegible]	0.0037	-0.0142	-0.0098	-1229.8032	-500.5962	-505.9064	-3.3970
12	0.[illegible]	0.[illegible]	-0.0212	-0.0048	-1234.2803	-500.0843	-506.2925	-2.4345
13	0.[illegible]	0.0022	-0.0197	-0.0016	-1236.3459	-500.0340	-505.7985	-1.6318
14	0.[illegible]	0.[illegible]	-0.0250	-0.0039	-1239.3334	-499.6832	-506.2986	-1.3435
15	-0.[illegible]	-0.[illegible]	-0.0418	0.0051	-1194.3167	-511.3151	-522.6495	-16.3797
16	-0.[illegible]	0.[illegible]	0.0206	-0.0014	-1206.0891	-495.6236	-503.1088	-12.8621
17	0.[illegible]	0.0213	-0.0013	-0.0150	-1224.6395	-497.1007	-503.6186	-6.7294
18	0.[illegible]	0.[illegible]	-0.0179	-0.0071	-1234.3950	-499.5493	-505.5414	-4.2042
19	0.[illegible]	0.[illegible]	-0.0265	-0.0036	-1242.3392	-499.4020	-506.6860	-3.1976
20	-0.[illegible]	-0.[illegible]	-0.0742	-0.0343	-1114.9063	-523.3620	-523.3620	-39.5806
21	-0.[illegible]	-0.[illegible]	0.0137	-0.0337	-1144.0215	-497.0735	-496.7728	-43.7531
22	0.[illegible]	0.[illegible]	-0.0299	-0.0189	-1218.0189	-477.2136	-503.9736	-23.6950
23	0.[illegible]	0.[illegible]	-0.0073	-0.0131	-1222.9970	-486.9177	-499.3210	-8.5241
24	-0.[illegible]	0.[illegible]	-0.0092	-0.0149	-1227.0407	-492.1811	-499.2928	-5.4667
25	-0.[illegible]	0.[illegible]	-0.0061	-0.0081	-1229.0957	-495.5176	-499.3148	-2.8542
26	-0.[illegible]	0.[illegible]	-0.0133	-0.0067	-1232.9374	-498.4303	-501.4787	-3.5295
27	0.[illegible]	0.0021	-0.0304	-0.0043	-1242.8253	-499.1578	-504.9052	-3.8452
28	0.[illegible]	0.0032	-0.0460	-0.0099	-1252.3367	-498.3211	-508.3278	-3.4573
29	-0.[illegible]	0.[illegible]	0.1649	-0.0555	-1048.4994	-417.7852	-442.5005	-67.1672
30	-0.[illegible]	0.[illegible]	0.0123	-0.0308	-1206.8533	-452.3322	-483.1468	-34.9774
31	-0.[illegible]	0.[illegible]	-0.0049	-0.0121	-1228.9903	-486.5922	-494.7554	-2.8866
32	-0.[illegible]	0.[illegible]	-0.0094	-0.0060	-1233.1499	-493.4076	-497.1909	-2.3076
33	0.[illegible]	0.[illegible]	-0.0454	-0.0097	-1253.4677	-497.1979	-505.4450	-4.0691

TM= [illegible]

19 EPS	-2.[illegible]	1.[illegible]-006	1.[illegible]-006	-2.175-008	-7.48+002	-1.24+003	-5.01+002	-5.07+002	-1.82+000
20 EPS	-2.[illegible]	1.[illegible]-006	1.[illegible]-006	-1.519-008	-7.51+002	-1.24+003	-5.02+002	-5.08+002	-1.25+000
21 EPS	-2.[illegible]	1.271-006	1.277-006	-7.506-008	-7.47+002	-1.21+003	-5.14+002	-5.13+002	-6.87+000

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TM= 0.01173									
19 FDS	-4.093-007	3.544-007	3.448-007	-4.932-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.72+000
20 FDS	-7.127-007	3.621-007	3.506-007	-4.082-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.40+000
21 FDS	-6.296-007	3.138-007	3.158-007	-1.373-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.13+000

TIME= 0.010788 YR WITH DELT= 0.000057

TM= 0.01179									
19 FDS	-4.073-007	3.534-007	3.439-007	-4.917-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.72+000
20 FDS	-7.109-007	3.612-007	3.497-007	-4.073-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.40+000
21 FDS	-6.280-007	3.130-007	3.150-007	-1.368-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.12+000

TIME= 0.010845 YR WITH DELT= 0.000057

NODE INCREMENTAL DISPLACEMENTS TOTAL DISPLACEMENT AT TIME . . . 0.0108 YR

	R	Z	R	Z
1	0.00000000+000	0.00000000+000	0.00000000+000	0.00000000+000
2	8.36-05135-008	0.00000000+000	3.00328470-005	0.00000000+000
3	1.66143774-007	0.00000000+000	5.97667942-005	0.00000000+000
4	2.53081397-007	0.00000000+000	9.11261502-005	0.00000000+000
5	3.41434466-007	0.00000000+000	1.23170954-004	0.00000000+000
6	0.00000000+000	-1.66175533-007	0.00000000+000	-5.98900843-005
7	4.13461-17-008	-1.67859763-007	1.48550685-005	-6.04347454-005
8	8.22279150-008	-1.65628643-007	2.95469539-005	-5.96180106-005
9	1.23166296-007	-1.65837420-007	4.42596737-005	-5.97100691-005
10	1.66225743-007	-1.68923056-007	5.97808874-005	-6.08401714-005
11	2.09852456-007	-1.70775499-007	7.52131250-005	-6.15549554-005
12	2.53600064-007	-1.73059507-007	9.12994428-005	-6.23930987-005
13	2.97899485-007	-1.73777474-007	1.07290981-004	-6.26765102-005
14	3.43056755-007	-1.75486933-007	1.23599112-004	-6.32755687-005
15	0.00000000+000	-3.31375433-007	0.00000000+000	-1.19404653-004
16	7.91321 45-008	-3.24695997-007	2.83758817-005	-1.18217447-004
17	1.65932093-007	-3.39231891-007	5.96694410-005	-1.21799507-004
18	2.54249074-007	-3.46932711-007	9.15060724-005	-1.25095060-004
19	3.45019208-007	-3.51940545-007	1.24288802-004	-1.26931110-004
20	0.00000000+000	-4.67248528-007	0.00000000+000	-1.68041863-004
21	3.07539285-008	-4.80696389-007	1.08331994-005	-1.72764750-004
22	7.91435211-008	-4.90123414-007	2.83634350-005	-1.76406130-004
23	1.24912961-007	-5.02997406-007	4.48843560-005	-1.80996490-004
24	1.70084288-007	-5.11604719-007	6.11955113-005	-1.84201362-004
25	2.14290689-007	-5.15685630-007	7.73309096-005	-1.85812912-004
26	2.59673651-007	-5.22154303-007	9.35089727-005	-1.88235993-004
27	3.04316575-007	-5.27048363-007	1.09597576-004	-1.90114120-004
28	3.52216311-007	-5.34061802-007	1.26944000-004	-1.92686723-004
29	0.00000000+000	-5.93701598-007	0.00000000+000	-2.12861622-004
30	8.35178143-008	-6.75483374-007	3.01815663-005	-2.42975004-004
31	1.79021473-007	-6.88977705-007	6.44943671-005	-2.48153847-004
32	2.69855697-007	-7.00020174-007	9.74028734-005	-2.52363514-004
33	3.63535148-007	-7.10648783-007	1.31245317-004	-2.59823697-004

ELEM	INCREMENTAL STRESSES				TOTAL STRESSES				PRINCIPLE STRESSES
	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES	Z-STRESSES	R-STRESSES	THET-STRESSES	RZ-STRESSES	

1	-0.01	-0.00	-0.00	-0.00	-1222.43	-505.83	-506.73	-0.67
2	-0.00	-0.00	-0.00	-0.00	-1222.18	-504.41	-505.77	-1.35
3	0.00	0.00	-0.00	-0.00	-1229.82	-500.70	-506.76	-0.55
4	0.00	0.00	-0.00	0.00	-1234.84	-500.03	-506.78	0.09
5	-0.01	0.00	0.00	-0.00	-1220.18	-508.15	-508.15	-4.35
6	-0.01	-0.00	-0.00	0.00	-1222.17	-506.98	-507.52	-0.04
7	-0.01	-0.00	-0.00	0.00	-1222.51	-507.58	-507.74	-3.10
8	-0.00	0.00	-0.00	-0.00	-1225.65	-499.79	-506.35	-5.59
9	-0.00	0.00	-0.00	-0.00	-1225.53	-500.56	-505.28	-3.83
10	0.00	0.00	-0.00	-0.00	-1232.22	-498.12	-506.57	-3.63
11	0.00	0.00	-0.00	0.00	-1232.17	-498.89	-505.67	-1.61
12	0.00	0.00	-0.00	-0.00	-1235.10	-497.04	-505.27	-1.75
13	-0.01	0.01	0.01	-0.00	-1202.75	-493.80	-493.80	-4.36
14	-0.01	0.01	0.00	0.00	-1215.64	-502.81	-506.27	-2.00
15	-0.00	0.01	0.00	-0.00	-1213.75	-501.32	-503.57	-5.07
16	-0.00	-0.00	-0.00	-0.00	-1227.57	-501.38	-508.08	-6.01
17	-0.00	-0.00	-0.00	-0.00	-1227.39	-502.09	-506.94	-4.25
18	-0.00	-0.00	-0.01	-0.00	-1235.65	-500.83	-509.19	-3.73
19	-0.00	-0.00	-0.00	0.00	-1235.62	-501.62	-508.32	-1.72
20	0.00	-0.00	-0.01	-0.00	-1241.43	-502.12	-510.06	-1.40
21	-0.02	-0.01	-0.01	0.00	-1221.94	-517.11	-515.58	-5.12
22	0.00	0.01	0.01	-0.00	-1214.35	-489.90	-499.51	-10.89
23	0.00	0.00	0.00	-0.00	-1228.47	-497.49	-505.08	-7.48
24	0.00	0.00	-0.00	-0.00	-1234.38	-496.12	-504.95	-3.82
25	-0.01	0.02	0.02	0.00	-1175.09	-484.69	-497.87	-13.94
26	-0.00	0.00	-0.00	-0.00	-1226.37	-499.50	-508.68	-8.63
27	-0.00	0.00	-0.00	-0.00	-1230.27	-498.45	-504.93	-4.43
28	-0.00	-0.00	-0.01	0.00	-1243.67	-503.38	-511.42	-1.56
29	-0.05	-0.05	-0.00	-0.00	-1229.22	-594.11	-594.11	-41.05
30	0.01	0.02	0.01	-0.01	-1196.07	-453.04	-496.75	-43.29
31	0.01	0.02	0.01	0.00	-1198.53	-465.21	-486.14	-13.96
32	0.00	0.01	0.00	-0.00	-1220.80	-485.81	-498.22	-12.63
33	0.00	0.01	0.00	0.00	-1222.26	-489.26	-497.73	-5.73
34	0.00	0.01	-0.00	-0.00	-1232.14	-496.99	-503.52	-7.31
35	0.00	0.00	-0.00	0.00	-1233.99	-499.96	-504.61	-6.35
36	0.01	0.01	-0.00	-0.00	-1242.77	-491.95	-505.98	-6.79
37	-0.08	0.01	0.01	-0.01	-1062.93	-463.05	-463.05	-42.09
38	-0.01	-0.01	-0.02	-0.01	-1235.88	-483.78	-522.25	-35.37
39	-0.01	-0.01	-0.02	0.00	-1242.01	-499.66	-517.92	-6.26
40	-0.00	-0.00	-0.01	-0.00	-1231.51	-492.88	-500.89	-6.78
41	-0.01	-0.01	-0.01	0.00	-1234.78	-498.07	-502.82	0.10
42	-0.00	-0.00	-0.00	-0.00	-1232.70	-496.10	-499.34	-1.40
43	-0.01	-0.00	-0.00	0.00	-1235.50	-499.95	-501.66	-0.44
44	0.00	-0.01	-0.01	-0.00	-1259.05	-504.39	-515.68	-1.35
45	0.01	0.04	0.04	-0.01	-1071.63	-386.29	-403.57	-97.97
46	0.01	0.02	0.01	-0.00	-1218.38	-474.14	-486.91	-6.75
47	0.00	0.01	0.00	-0.00	-1225.27	-486.53	-489.97	-0.82
48	0.00	0.00	-0.00	-0.00	-1240.91	-494.52	-500.30	-7.93

X-STRESSES Y-STRESSES TWIST-STRESSES RZ-STRESSES

NODE	NORMAL STRESSES		WEIGHTED AVERAGE				
1	-0.0143	-0.0007	-0.0001	-0.0002	-1220.9282	-506.4122	-507.4386	-2.5115
2	-0.0007	-0.0021	-0.0015	0.0008	-1222.3299	-505.6625	-506.9429	-1.2921
3	-0.0016	-0.0002	-0.0008	-0.0012	-1225.7282	-501.9617	-506.0624	-2.6311
4	0.0027	0.0007	-0.0019	-0.0003	-1232.2383	-499.9007	-506.4468	-1.4248
5	0.0035	0.0005	-0.0024	-0.0003	-1235.0134	-499.2802	-506.0260	-0.8380
6	-0.0138	0.0043	0.0043	-0.0005	-1211.4628	-500.9729	-508.9729	-4.3562
7	-0.0148	0.0013	-0.0002	0.0018	-1218.6847	-502.9351	-506.3424	-2.7574
8	-0.0079	-0.0014	0.0002	0.0018	-1218.5172	-504.6735	-506.2774	-2.5528
9	-0.0037	-0.0002	0.0003	-0.0014	-1220.3189	-502.5149	-505.1713	-5.3372
10	-0.0017	0.0031	-0.0016	-0.0018	-1226.5339	-500.9513	-506.6649	-4.9199
[illegible]	[illegible]	[illegible]	[illegible]	-0.0014	-1229.6694	-500.3974	-506.6362	-3.9110

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12	0.0000	0.0006	-0.0031	-0.0006	-1233.9154	-499.8658	-507.4366	-2.6714	
13	0.0006	0.0004	-0.0028	-0.0001	-1235.3441	-499.9194	-506.8418	-1.7042	
14	0.0126	0.0003	-0.0038	-0.0008	-1238.2664	-499.5795	-507.6636	-1.5830	
15	-0.1420	-0.0019	-0.0089	0.0004	-1210.1465	-511.6659	-525.3415	-16.1185	
16	-0.0376	0.0061	0.0038	0.0002	-1207.1362	-493.5022	-501.8729	-12.8620	
17	-0.0006	0.0034	0.0001	-0.0020	-1224.6254	-495.9097	-503.6450	-7.5072	
18	0.0009	0.0013	-0.0026	-0.0008	-1234.2991	-499.1065	-506.5009	-4.5517	
19	0.0026	0.0010	-0.0038	-0.0005	-1241.0754	-499.0714	-508.1017	-3.3932	
20	-0.2928	-0.0188	-0.0188	-0.0060	-1146.0730	-528.5789	-528.5789	-41.5734	
21	-0.1297	-0.0067	0.0005	-0.0053	-1152.1695	-498.4944	-496.2679	-45.6186	
22	-0.0015	0.0039	-0.0059	-0.0028	-1218.1207	-475.4240	-505.8190	-24.7184	
23	0.0003	0.0021	-0.0018	-0.0016	-1222.7936	-485.8914	-499.8280	-9.1689	
24	-0.0012	0.0014	-0.0021	-0.0022	-1227.3375	-491.5051	-499.9151	-6.2613	
25	-0.0004	0.0008	-0.0013	-0.0011	-1229.1184	-495.1072	-499.7176	-3.2671	
26	-0.0010	0.0003	-0.0025	-0.0009	-1233.5811	-498.2512	-502.2863	-3.8761	
27	0.0107	0.0002	-0.0049	-0.0006	-1242.5573	-499.0626	-506.6070	-4.0702	
28	0.0030	0.0003	-0.0009	-0.0019	-1250.9089	-498.1721	-510.8307	-4.0686	
29	-0.6591	0.0354	0.0261	-0.0074	-1065.8276	-405.4778	-433.3055	-70.0333	
30	-0.0031	0.0193	0.0013	-0.0043	-1207.6295	-445.5913	-482.5644	-36.5877	
31	-0.0014	0.0071	-0.0015	-0.0020	-1229.3717	-484.1214	-495.1483	-3.5646	
32	-0.0017	0.0029	-0.0021	-0.0010	-1233.7611	-492.4021	-497.8160	-2.6477	
33	0.0011	0.0006	-0.0073	-0.0017	-1252.9991	-496.9901	-507.9878	-4.6397	

TM= 0.01084

19 EPS	-6.055-007	3.525-007	3.430-007	-4.903-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.72+000
20 EPS	-7.090-007	3.502-007	3.487-007	-4.064-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.40+000
21 EPS	-5.564-007	3.122-007	3.142-007	-1.363-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.12+000

TIME= 0.010902 YR WITH DELT= 0.000057

TM= 0.01090

19 EPS	-6.037-007	3.516-007	3.421-007	-4.889-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.72+000
20 EPS	-7.071-007	3.493-007	3.478-007	-4.054-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 EPS	-5.548-007	3.114-007	3.134-007	-1.359-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.11+000

TIME= 0.010959 YR WITH DELT= 0.000057

TM= 0.01096

19 EPS	-6.019-007	3.507-007	3.412-007	-4.875-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.72+000
20 EPS	-7.053-007	3.484-007	3.469-007	-4.045-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 EPS	-5.532-007	3.106-007	3.126-007	-1.354-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.11+000

TIME= 0.011016 YR WITH DELT= 0.000057

TM= 0.01102

19 EPS	-6.001-007	3.498-007	3.403-007	-4.860-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.72+000
20 EPS	-7.034-007	3.474-007	3.460-007	-4.036-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 EPS	-5.517-007	3.098-007	3.118-007	-1.349-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.10+000

TIME= 0.011073 YR WITH DELT= 0.000057

TM= 0.01107

19 EPS	-5.983-007	3.489-007	3.394-007	-4.847-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.71+000
20 EPS	-7.016-007	3.465-007	3.451-007	-4.027-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 EPS	-5.501-007	3.090-007	3.111-007	-1.344-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.10+000

TIME= 0.011130 YR WITH DELT= 0.000057

TM= 0.01113

19 FDS	-6.865-007	3.480-007	3.385-007	-4.833-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.71+000
20 FDS	-6.939-007	3.556-007	3.442-007	-4.018-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 FDS	-6.196-007	3.083-007	3.103-007	-1.340-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.09+000

TIME= 0.011187 YR WITH DELT= 0.000057

TM= 0.01119

19 FDS	-6.868-007	3.471-007	3.377-007	-4.819-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.71+000
20 FDS	-6.940-007	3.547-007	3.433-007	-4.010-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 FDS	-6.179-007	3.075-007	3.095-007	-1.335-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.09+000

TIME= 0.011244 YR WITH DELT= 0.000057

TM= 0.01124

19 FDS	-6.830-007	3.462-007	3.368-007	-4.805-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.71+000
20 FDS	-6.062-007	3.538-007	3.425-007	-4.001-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 FDS	-6.155-007	3.067-007	3.088-007	-1.330-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.08+000

TIME= 0.011302 YR WITH DELT= 0.000057

TM= 0.01130

19 FDS	-6.813-007	3.454-007	3.360-007	-4.792-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.71+000
20 FDS	-6.945-007	3.529-007	3.416-007	-3.992-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 FDS	-6.140-007	3.060-007	3.080-007	-1.326-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.08+000

TIME= 0.011359 YR WITH DELT= 0.000057

TM= 0.01136

19 FDS	-6.796-007	3.445-007	3.351-007	-4.778-009	-7.49+002	-1.24+003	-5.02+002	-5.08+002	-1.71+000
20 FDS	-6.927-007	3.520-007	3.407-007	-3.983-009	-7.51+002	-1.24+003	-5.02+002	-5.10+002	-1.41+000
21 FDS	-6.125-007	3.052-007	3.072-007	-1.321-008	-7.52+002	-1.22+003	-5.17+002	-5.16+002	-5.08+000

(RST-0035)