

RING ELEMENT DYNAMIC STRESSES

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ABSTRACT

The stresses in the CTRAPRG and CTIRARG ring elements are not calculated for any of the dynamic solutions in the current COSMIC version of NASTRAN. This paper presents a DMAP alter sequence for Solution 8 and post-processing program, NASTPOST, to calculate these stresses. Test cases are presented which describe the method. The stiffness and the consistent versus concentrated mass problems which have been ascribed to this element are reviewed.

The DMAP alter sequence introduces Solution 8 displacements to a Solution 1 module to calculate Real and Imaginary stress components during the execution of Solution 8. The post-processor, NASTPOST, calculates the magnitude/phase stress results.

The DMAP sequence has been written specifically for Level 52 MSC/NASTRAN, but can certainly be used for any COSMIC version with slight modification.

INTRODUCTION

None of the currently documented versions of NASTRAN calculate the dynamic stresses in the CTRAPRG and CTIRARG solid of revolution elements. The stresses for these elements are calculated in NASTRAN for static solutions (e.g., Solution 1) but not in the dynamic solutions (e.g., Solution 8). Comments have been made by others which express the reasons for not including the stress calculations are related to the formulation of the mass matrix for the element.

Sample problems are given to show that the difference between the consistent and concentrated mass approach is greater than one might expect from arguments solely between the merits of consistent or concentrated mass.

This paper describes a DMAP alter sequence for Solution 8 and a post-processing program, NASTPOST, to calculate these dynamic stresses. The DMAP alter sequence introduces the displacements computed in Solution 8 to a Solution 1 module to calculate the complex stresses in the form of real and imaginary components. The post-processor, NASTPOST, calculates the stresses in the form of magnitude/phase.

DISCUSSION

It is not spelled out in the NASTRAN Users Manual that stresses for the solid of revolution elements are not calculated for dynamic solutions. Therefore, if one asks for stresses in a Solution 8 case control, the run is not aborted, but no stresses are obtained.

In order to perform noise path studies of an axisymmetric structure it became necessary to obtain these stresses. At first, the displacements for the entire structure, obtained from a Solution 8 forced vibration analysis were written into an output file; then these displacements, less one, were written into SPC format as enforced displacements for a Solution static analysis (this was done for the real and imaginary components separately). This technique was later modified, utilizing the DMAP alter sequence AOS8\$CS and a post-processor, NASTPOST.

The DMAP alter sequence is given in Figure 1. The major points are:

- The user can specify output requests as usual for SPCFORCES and DISPLACEMENTS.
- The user should specify STRESS (PUNCH) = ALL or a particular set ID if he wishes to subsequently use NASTPOST to calculate the magnitude/phase. This punched file will be sent to the users system space. (FOR 013.DAT for the MSC/NASTRAN VAX 11/780 VERSION).
- AOS8\$CS should be placed on the user's RFALTER library and executed then by calling RFAI = AOS8\$CS.

The program NASTPOST is given in the appendix and is used to calculate magnitude/phase stress components from real/imaginary stress components. The major points are:

- The components from FOR013.DAT above, are used as input to calculate the magnitude/phase stress components.
- This program can be run immediately after the execution of MSC/NASTRAN or at some later time.

The test problem for AOS8\$CS and NASTPOST is a circular plate fixed at the edges and driven by a single force, 100 dynes, at the center, normal to the plane of the plate. The finite element control model is the CQUAD2 and CTRIAG2 bending element model shown in Figure 2. The CTRAPRG model, shown in Figure 3, is formulated as a concentrated or consistent mass for each of the runs. The NASTRAN default value is the consistent mass matrix. The concentrated mass matrix is entered as CONM2 data. The three cases are compared in Table 1 for static, 2000 Hz and 8000 Hz at a position near the concentrated load and at the fixed edge.

The concentrated mass formulation gives good results, as compared to the control model. The consistent mass, or default formulation, gives results which do not agree with the control model at either the low, 2 kHz, or high, 8 kHz, forcing frequencies.

The static solution agrees very well with the control model which indicates that the stiffness of the model is represented correctly by solid of revolution elements. The error therefore is associated with the mass matrix formulation. The degree of error is obviously greater than one would expect from the normal arguments of consistent versus concentrated mass differences.¹

It can be argued that the use of cyclic symmetry with 3D elements rather than solid of revolution elements would have been a possible solution. This is certainly an avenue that deserves added investigation for comparison of cost and accuracy of solution compared to the solid of revolution elements with concentrated mass matrix.

CONCLUDING REMARKS

A DMAP alter sequence for Solution 8 and a post-processing program NASTPOST has been presented to calculate the dynamic stresses in CTRAPRG and CTIRARG solid of revolution ring finite elements. Users of this technique are cautioned to use the concentrated or lumped mass matrix rather than the consistent mass (default value) matrix.

The DMAP sequence has been written specifically for Level 52 MSC/NASTRAN, but can certainly be used for any COSMIC version with slight modification.

REFERENCES

1. Cook, R. D., "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Inc.

TABLE 1

COMPARISON OF STRESSES, 3/8 cm from CONCENTRATED LOAD

| FREQUENCY | 0 ¹ | 2 kHz | 8 kHz |
|----------------|----------------|-------|-------|
| QUAD2 | 134.4 | 75.5 | 66.4 |
| TRAPRG (CONS.) | 132.3 | 17.2 | 63.1 |
| TRARG (CONC.) | 132.3 | 96. | 60.5 |

TABLE 2

COMPARISON OF STRESSES, 3/8 cm from FIXED EDGE

| FREQUENCY | 0 ¹ | 2 kHz | 8 kHz |
|----------------|----------------|-------|-------|
| QUAD2 | 44.4 | 34.2 | 38.2 |
| TRAPRG (CONS.) | 45.6 | 27.0 | 10.0 |
| TRAPRG (CONC.) | 45.6 | 33.0 | 36.0 |

¹ OBTAINED FROM SOLUTION 1

FIGURE 1 - ALTER AOS8\$CS

```
$ BEGINNING OF ALTER AOS8$CS
$
$ THIS ALTER PACKAGE IS USED TO CALCULATE
$
$   *DISPLACEMENTS (REAL/IMAGINARY) OR
$                   (MAGNITUDE/PHASE)
$
$   *SPCFORCES     (REAL/IMAGINARY) OR
$                   (MAGNITUDE/PHASE)
$
$   *STRESSES      (REAL/IMAGINARY)
$
$ FOR THE CTRAPRG AND CTRIARG RING ELEMENTS
$
$
$ CASE CONTROL INPUT
```

FIGURE 1 - (Cont'd)

\$
\$ THE USER SHOULD SELECT THE DESIRED
\$ OUTPUT AS USUAL FOR DISPLACEMENTS
\$ AND SPCFORCES.
\$
\$ THE USER SHOULD SELECT THE PUNCH
\$ OPTION FOR STRESS IF IT IS DESIRED TO
\$ SUBSEQUENTLY CALCULATE (MAGNITUDE/
\$ PHASE) USING A POST-PROCESSING PROGRAM
\$
\$
ALTER 166
OFF OPPC1, OQPC1, OUPVC1, , , //U, N, CARDNO \$
ALTER 185, 186
PARAM //STSR/13/-64 \$
GP3 GEOM3, EQEXIN, GEOM2/, ETT/0/U, N, NOGRAU/0 \$

FIGURE 1 - (Cont'd)

PARAML UPVC//C,N,TRAILER/2/U,N,ROWS \$
MATGEN ,/UNIT/1/ROWS \$
MODTRL UPVC///3 \$
MPYAD UNIT,UPVC,/ASQR/ \$
DIAGONAL ASQR/ATRM// \$
ADD UPVC,/BSQR/(0.0,-1.0) \$
DIAGONAL BSQR/BTRM// \$
SDR2 CASECC,CSTM,MPT,DIT,EQEXIN,SIL,ETT,EDT,BGPDT,,,ATRM,EST,
XYCDB/,,,OESCR,,/STATICS/S,N,NOSORT2 \$
SDR2 CASECC,CSTM,MPT,DIT,EQEXIN,SIL,ETT,EDT,BGPDT,,,BTRM,EST,
XYCDB/,,,OESCI,,/STATICS/S,N,NOSORT2 \$
OFF ,,,,OESCR,,//S,N,CARDNO \$
OFF ,,,,OESCI,,//S,N,CARDNO \$
PARAM //STSR/7/-64 \$
ENDALTER \$
\$

FIGURE 2 - CQUAD2, CTRIAG FINITE ELEMENT MODEL OF 10.00 CM DIA., 1 CM THK PLATE

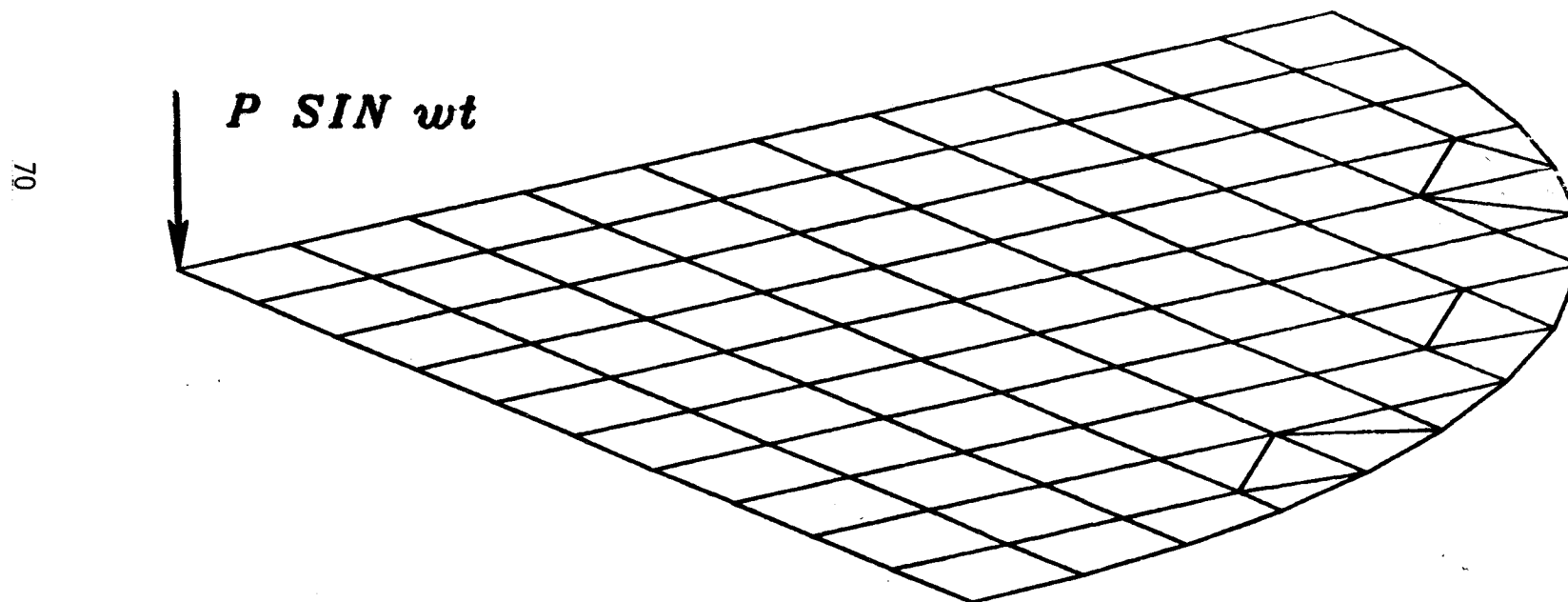
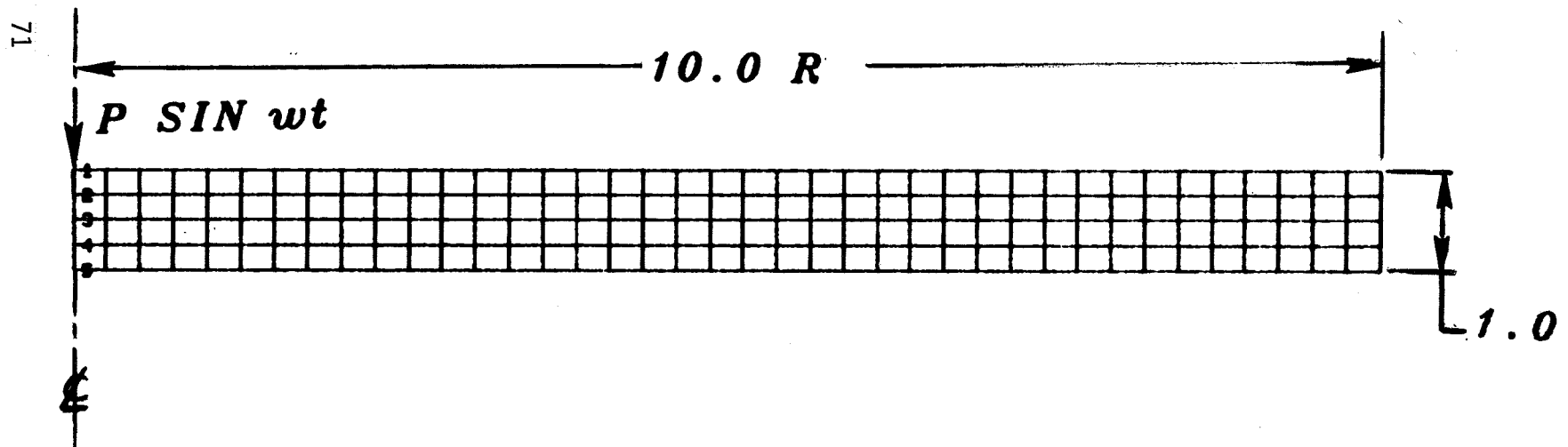


FIGURE 3 - CTRAPRG SOLID OF REVOLUTION FINITE ELEMENT MODEL



APPENDIX A

THE NASTPOST PROGRAM

| | | |
|-----|---|-------|
| C | DATA SET NASTPOST AT LEVEL 017 AS OF 11/05/79 | 00001 |
| | COMMON /HDRCOM/TITLE(16),SUBT(16),LABEL(16) | 00002 |
| | DATA DTIT/'\$TIT',CASE/'CASE',DSUB/'\$SUB', | 00003 |
| | * DELE/'\$ELE',BSTR/'STR',DLAB/'\$LAB' | 00004 |
| | DATA I036,I037/2x0/ | 00005 |
| | 1 CONTINUE | 00006 |
| | REWIND 7 | 00007 |
| C - | GET TITLE CARD | 00008 |
| | 5 CONTINUE | 00009 |
| | READ(7,900,END=999) TEMP,TITLE | 00010 |
| | IF(TEMP.EQ.DTIT) GO TO 6 | 00011 |
| | GO TO 5 | 00012 |
| C - | GET SUBTITLE CARD | 00013 |
| | 6 CONTINUE | 00014 |
| | READ(7,900,END=999) TEMP,SUBT | 00015 |
| | IF(TEMP.EQ.DSUB) GO TO 7 | 00016 |
| | GO TO 6 | 00017 |
| C - | GET LABEL CARD | 00018 |
| | 7 CONTINUE | 00019 |
| | READ(7,900,END=999) TEMP,LABEL | 00020 |
| | IF(TEMP.EQ.DLAB) GO TO 10 | 00021 |
| | GO TO 7 | 00022 |
| C - | GET STRESS CARD | 00023 |
| | 10 CONTINUE | 00024 |
| | READ(7,910,END=999) TEMP | 00025 |
| | IF(TEMP.EQ.BSTR) GO TO 20 | 00026 |
| | GO TO 10 | 00027 |
| C - | GET SUBCASE IDENTIFICATION | 00028 |
| | 20 CONTINUE | 00029 |
| | READ(7,920,END=999) TEMP,ISID | 00030 |
| | IF(TEMP.EQ.CASE) GO TO 30 | 00031 |
| | GO TO 20 | 00032 |
| C - | GET ELEMENT TYPE | 00033 |
| | 30 CONTINUE | 00034 |
| | READ(7,930,END=999) TEMP,IELTYP | 00035 |
| | IF(TEMP.NE.DELE) GO TO 5 | 00036 |
| C - | CHECK ELEMENT TYPES | 00037 |
| | IF(IELTYP.EQ.36) GO TO 300 | 00038 |
| | IF(IELTYP.EQ.37) GO TO 370 | 00039 |
| | GO TO 5 | 00040 |
| C - | ELEMENT TYPE = 36 | 00041 |
| | 300 CONTINUE | 00042 |
| | IF(I036.EQ.0) CALL RU36(ISID,IELTYP,IEOF) | 00043 |
| | IF(I036.EQ.1) CALL RC36(ISID,IELTYP,IEOF) | 00044 |
| | IF(I036.EQ.1.AND. IEOF.EQ.1) GO TO 999 | 00045 |
| | I036 = MOD(I036+1,2) | 00046 |
| | GO TO 8 | 00047 |
| C - | ELEMENT TYPE = 37 | 00048 |
| | 370 CONTINUE | 00049 |
| | IF(I037.EQ.0) CALL RU37(ISID,IELTYP,IEOF) | 00050 |
| | IF(I037.EQ.1) CALL RC37(ISID,IELTYP,IEOF) | 00051 |
| | IF(I037.EQ.1.AND. IEOF.EQ.1) GO TO 999 | 00052 |
| | I037 = MOD(I037+1,2) | 00053 |
| | GO TO 8 | 00054 |
| | 999 STOP | 00055 |
| | 900 FORMAT(A4,6X,15A4,A2) | 00056 |
| | 910 FORMAT(6X,A4) | 00057 |
| | 920 FORMAT(4X,A4,6X,19) | |
| | 930 | |

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FORMAT(A4,12X,I11)
END
C DATA SET NASTRU36 AT LEVEL 004 AS OF 11/02/79
SUBROUTINE RU36(ISID,IELTYP,IEOF)
DIMENSION TEMP(2),DATA(4)
DATA TITLE//ST '//,CONT//'-CON//,BLANK// '//
DATA INN,IOUT/7,9/
REWIND IOUT
PRINT 10
10 FORMAT('SUBROUTINE RU36')
READ(INN,900,END=999) IELNO,DATA(1),DATA(2),DATA(3)
001 CONTINUE
READ(INN,910,END=990) CARDN,DATA(4)
IF(CARDN .NE. CONT) GO TO 990
WRITE(IOUT) ISID,IELTYP,IELNO,DATA
C READ(INN,920,END=999) TEMP
C BACKSPACE INN
CALL BACKSP(TEMP,INN,1999)
IF(TEMP(1).EQ.BLANK)
S READ(10,900,END=999)IELNO,DATA(1),DATA(2),DATA(3)
IF(TEMP(1) .EQ. BLANK) GO TO 001
IF(TEMP(1) .NE. TITLE) GO TO 990
800 CONTINUE
ENDFILE IOUT
REWIND IOUT
RETURN
990 CONTINUE
STOP 3600
999 IEOF = 1
GO TO 800
900 FORMAT(I10,8X,3E18.6)
910 FORMAT(A4,14X,3E18.6)
920 FORMAT(2A2)
END
C DATA SET NASTRU37 AT LEVEL 004 AS OF 11/02/79
SUBROUTINE RU37(ISID,IELTYP,IEOF)
10 FORMAT('SUBROUTINE RU37')
DIMENSION TEMP(2),DATA(20),KKREAD(33)
DATA TITLE//ST '//,CONT//'-CON//,BLANK// '//
DATA INN,IOUT/7,8/
REWIND IOUT
PRINT 10
READ(INN,900,END=999) IELNO,DATA(1),DATA(2),DATA(3)
001 CONTINUE
READ(INN,910,END=990) CARDN,DATA(4),DATA(5),DATA(6)
IF(CARDN .NE. CONT) GO TO 990
READ(INN,910,END=990) CARDN,DATA(7),DATA(8),DATA(9)
IF(CARDN .NE. CONT) GO TO 990
READ(INN,910,END=990) CARDN,DATA(10),DATA(11),DATA(12)
IF(CARDN .NE. CONT) GO TO 990
READ(INN,910,END=990) CARDN,DATA(13),DATA(14),DATA(15)
IF(CARDN .NE. CONT) GO TO 990
READ(INN,910,END=990) CARDN,DATA(16),DATA(17),DATA(18)
IF(CARDN .NE. CONT) GO TO 990
READ(INN,910,END=990) CARDN,DATA(19),DATA(20)
IF(CARDN .NE. CONT) GO TO 990
WRITE(IOUT) ISID,IELTYP,IELNO,DATA
C READ(INN,920,END=999) TEMP
C BACKSPACE INN
READ(INN,930,END=999)KKREAD
REWIND 10
WRITE(10,930)KKREAD
REWIND

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|-----|--|-------|
| 10 | READ(10,920)TEMP | |
| | REWIND 10 | |
| | IF(TEMP(1) .EQ. BLANK) | |
| | \$ READ(10,900,END=999)IELNO,DATA(1),DATA(2),DATA(3) | |
| | IF(TEMP(1).EQ.BLANK) GOTO 001 | |
| | IF(TEMP(1) .NE. TITLE) GO TO 990 | 00024 |
| 800 | CONTINUE | 00025 |
| | ENDFILE IOUO | 00026 |
| | REWIND IOUO | 00027 |
| | RETURN | 00028 |
| 990 | CONTINUE | 00029 |
| | STOP 3700 | 00030 |
| 999 | IEOF = 1 | 00031 |
| | GO TO 800 | 00032 |
| 900 | FORMAT(I10,8X,3E18.6) | 00033 |
| 910 | FORMAT(A4,14X,3E18.6) | 00034 |
| 920 | FORMAT(2A2) | 00035 |
| 930 | FORMAT(33A4) | |
| | END | 00036 |
| C | DATA SET NASTRC36 AT LEVEL 025 AS OF 11/05/79 | 00001 |
| | SUBROUTINE RC36(ISID,IELTYP,IEOF) | |
| 10 | FORMAT('SUBROUTINE RC36') | 00002 |
| | DIMENSION TEMP(2),DATAI(4),DATAR(4),RMAG(4),PHASE(4) | 00003 |
| | DATA TITLE/'ST ','/','CONT/'-CON'/','BLANK'/'' | 00004 |
| | DATA IPRT,INN,IOUO/6,7,9/ | |
| | PRINT 10 | 00005 |
| | IELCNT = 99 | 00006 |
| | RADDEG = 57.29578 | 00008 |
| | READ(INN,900,END=999) IELNO,DATAI(1),DATAI(2),DATAI(3) | |
| 001 | CONTINUE | 00009 |
| | READ(INN,910,END=990) CARDN,DATAI(4) | 00010 |
| | IF(CARDN .NE. CONT) GO TO 990 | 00011 |
| | READ(IOUO) ISIDR,IELTPR,IELNOR,DATAR | 00012 |
| | IF(ISIDR .NE. ISID) GO TO 990 | 00013 |
| | IF(IELTPR .NE. IELTYP) GO TO 990 | 00014 |
| | IF(IELNOR .NE. IELNO) GO TO 990 | 00015 |
| | DO 699 I = 1,4 | 00016 |
| | RMAG(I) = SQRT(DATAR(I)*DATAR(I) + DATAI(I)*DATAI(I)) | 00017 |
| | IF(DATAR(I) .NE. 0.0) GO TO 690 | 00018 |
| | IF(DATAI(I) .EQ. 0.0) PHASE(I) = 0.0 | 00019 |
| | IF(DATAI(I) .GT. 0.0) PHASE(I) = 90.0 | 00020 |
| | IF(DATAI(I) .LT. 0.0) PHASE(I) = 270.0 | 00021 |
| | GO TO 699 | 00022 |
| 690 | CONTINUE | 00023 |
| | RATIO = ABS(DATAI(I)/DATAR(I)) | 00024 |
| | PHASE(I) = ATAN(RATIO)*RADDEG | 00025 |
| | IF(DATAR(I).GE.0.0 .AND. DATAR(I).LT.0.0) | 00026 |
| X | PHASE(I) = PHASE(I) + 90.0 | 00027 |
| | IF(DATAR(I).LT.0.0 .AND. DATAR(I).LT.0.0) | 00028 |
| X | PHASE(I) = PHASE(I) + 180.0 | 00029 |
| | IF(DATAR(I).LT.0.0 .AND. DATAR(I).GT.0.0) | 00030 |
| X | PHASE(I) = PHASE(I) + 270.0 | 00031 |
| 699 | CONTINUE | 00032 |
| C | WRITE(IPRT,930) ISID,IELTYP,IELNO,DATAR,DATAI | 00033 |
| | IF(IELCNT .LT. 50) GO TO 700 | 00034 |
| | CALL HB36(ISID) | 00035 |
| | IELCNT = 0 | 00036 |
| 700 | CONTINUE | |
| | IELCNT = IELCNT + 1 | |

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                                00037
C      WRITE(IPRT,940) IELNO,((RMAG(I),PHASE(I)),I=1,4)
C      READ(INN,920,END=999) TEMP
C      BACKSPACE INN
      CALL BACKSP(TEMP,INN,&999)
      IF(TEMP(1).EQ.BLANK)
S     READ(10,900,END=999) IELNO,DATAI(1),DATAI(2),DATAI(3)
      IF(TEMP(1) .EQ. BLANK) GO TO 801
      IF(TEMP(1) .NE. TITLE) GO TO 990
      RETURN
990  CONTINUE
      STOP 3601
999  IEOF = 1
      RETURN
900  FORMAT(I10,8X,3E18.6)
910  FORMAT(A4,14X,3E18.6)
920  FORMAT(2A2)
930  FORMAT(1X,3I10,2(/,4(5X,1PE12.5)))
940  FORMAT(1X,15,8X,4(1PE12.5,' '//,0PF10.5,5X))
      END
C      DATA SET NASTRC37  AT LEVEL 022 AS OF 11/05/79
10   SUBROUTINE RC37(ISID,IELTYP,IEOF)
      DIMENSION TEMP(2),DATAR(20),RMAG(20),PHASE(20)
      DATA TITLE/'ST '//,CONT/'-CON',BLANK/' '//
      DATA IPRT,INN,IOUT/6,7,8/
      PRINT 10
      IELCNT = 10
      RADDEG = 57.29578
      READ(INN,900,END=999) IELNO,DATAI(1),DATAI(2),DATAI(3)
001  CONTINUE
      READ(INN,910,END=990) CARDN,DATAI(4),DATAI(5),DATAI(6)
      IF(CARDN .NE. CONT) GO TO 990
      READ(INN,910,END=990) CARDN,DATAI(7),DATAI(8),DATAI(9)
      IF(CARDN .NE. CONT) GO TO 990
      READ(INN,910,END=990) CARDN,DATAI(10),DATAI(11),DATAI(12)
      IF(CARDN .NE. CONT) GO TO 990
      READ(INN,910,END=990) CARDN,DATAI(13),DATAI(14),DATAI(15)
      IF(CARDN .NE. CONT) GO TO 990
      READ(INN,910,END=990) CARDN,DATAI(16),DATAI(17),DATAI(18)
      IF(CARDN .NE. CONT) GO TO 990
      READ(INN,910,END=990) CARDN,DATAI(19),DATAI(20)
      IF(CARDN .NE. CONT) GO TO 990
      READ(IOUT) ISIDR,IELTPR,IELNOR,DATAR
      IF(ISID .NE. ISIDR) GO TO 990
      IF(IELTYP .NE. IELTPR) GO TO 990
      IF(IELNOR .NE. IELNO) GO TO 990
      DO 699 I = 1,20
      RMAG(I) = SQRT(DATAR(I)*DATAR(I) + DATAI(I)*DATAI(I))
      IF(DATAR(I) .NE. 0.0) GO TO 690
      IF(DATAI(I) .EQ. 0.0) PHASE(I) = 0.0
      IF(DATAI(I) .GT. 0.0) PHASE(I) = 90.0
      IF(DATAI(I) .LT. 0.0) PHASE(I) = 270.0
      GO TO 690
690  CONTINUE
      RATIO = ABS(DATAI(I)/DATAR(I))
      PHASE(I) = ATAN(RATIO)*RADDEG
      IF(DATAR(I).GE.0.0 .AND. DATAR(I).LT.0.0)
X     PHASE(I) = PHASE(I) + 90.0
      IF(DATAR(I).LT.0.0 .AND. DATAR(I).LT.0.0)

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X   PHASE(I) = PHASE(I) + 180.0
IF(DATAI(I).LT.0.0 .AND. DATAR(I).GT.0.0)
X   PHASE(I) = PHASE(I) + 270.0
699 CONTINUE
C   WRITE(IPRT,930) ISID,IELTYP,IELNO,DATAR,DATAI
IF(IELCNT .LE. 7) GO TO 700
CALL HD37(ISID)
IELCNT = 0
700 CONTINUE
IELCNT = IELCNT + 1
DO 710 I = 1,5
J = 4*(I-1) + 1
K = J + 3
IF(I .EQ. 1) WRITE(IPRT,940) IELNO,I,
X   ((RMAG(IX1),PHASE(IX1)),IX1-J,K)
IF(I .NE. 1) WRITE(IPRT,950) I,
X   ((RMAG(IX1),PHASE(IX1)),IX1-J,K)
710 CONTINUE
WRITE(IPRT,960)
C   READ(INN,920,END=999) TEMP
C   BACKSPACE INN
CALL BACKSP(TEMP,INN,&999)
IF(TEMP(1).EQ.BLANK)
S   READ(10,900,END=999)IELNO,DATAI(1),DATAI(2),DATAI(3)
IF(TEMP(1) .EQ. BLANK) GO TO 001
IF(TEMP(1) .NE. TITLE) GO TO 990
RETURN
990 CONTINUE
STOP 3701
999 IEOF = 1
RETURN
900 FORMAT(I10,8X,3E18.6)
910 FORMAT(A4,14X,3E18.6)
920 FORMAT(2A2)
930 FORMAT(1X,3I10,10(/,4(5X,1PE13.6)))
940 FORMAT(1X,15,1X,I3,4X,4(1PE12.5,' ',0PF10.5,5X))
950 FORMAT(7X,I3,4X,4(1PE12.5,' ',0PF10.5,5X))
960 FORMAT(' ')
END
C   DATA SET NASTHD36 AT LEVEL 007 AS OF 10/24/79
SUBROUTINE HD36(ISID)
10  FORMAT('SUBROUTINE HD36')
COMMON /HDRCOM/TITLE(16),SUBT(16),LABEL(16)
PRINT 10
IPRT = 6
WRITE(IPRT,100) TITLE
WRITE(IPRT,110) SUBT
WRITE(IPRT,120) LABEL,ISID
WRITE(IPRT,140)
WRITE(IPRT,150)
WRITE(IPRT,160)
WRITE(IPRT,170)
RETURN
100 FORMAT('1',3X,15A4,A2)
110 FORMAT(' ',3X,15A4,A2)
120 FORMAT('0',3X,15A4,A2,50X,'SUBCASE',I3)
130 FORMAT(' ')
140 FORMAT(27X,'STRESSES FOR THE TRIAN',

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X          'GULAR RINGS (CTRIARG)')
150 FORMAT(61X, '(MAGNITUDE/PHASE)')
160 FORMAT(4X, 'EL', 17X, 'RADIAL', 19X, 'CIRCUMFERENTIAL',
X 19X, 'AXIAL', 24X, 'SHEAR')
170 FORMAT(4X, 'ID', 19X, '(X)', 24X, '(THETA)', 24X, '(Z)',
X 26X, '(ZX)')
END
C          DATA SET NASTHD37 AT LEVEL 006 AS OF 10/24/79
SUBROUTINE HD37(ISID)
10  FORMAT('SUBROUTINE HD37')
COMMON /HDCOM/TITLE(16),SUBT(16),LABEL(16)
PRINT 10
IPRT = 6
WRITE(IPRT,100) TITLE
WRITE(IPRT,110) SUBT
WRITE(IPRT,120) LABEL,ISID
WRITE(IPRT,140)
WRITE(IPRT,150)
WRITE(IPRT,160)
WRITE(IPRT,170)
RETURN
100 FORMAT('1',3X,15A4,A2)
110 FORMAT(' ',3X,15A4,A2)
120 FORMAT('0',3X,15A4,A2,50X,'SUBCASE',I3)
130 FORMAT(' ')
140 FORMAT(27X,'STRESSES FOR THE TRAPE',
X 'ZOIDAL RINGS (CTRAPRG)')
150 FORMAT(61X, '(MAGNITUDE/PHASE)')
160 FORMAT(4X, 'EL', 2X, 'ST', 13X, 'RADIAL', 19X, 'CIRCUMFERENTIAL',
X 19X, 'AXIAL', 24X, 'SHEAR')
170 FORMAT(4X, 'ID', 2X, 'PT', 15X, '(X)', 24X, '(THETA)', 24X, '(Z)',
X 26X, '(ZX)')
END
SUBROUTINE BACKSP(TEMP,INN,I)
DIMENSION KKREAD(33),TEMP(2)
READ(INN,930,END=990)KKREAD
REWIND 10
WRITE(10,930)KKREAD
REWIND 10
READ(10,920)TEMP
REWIND 10
930 FORMAT(33A4)
980 FORMAT(2A2)
RETURN
990 RETURN 1
END
S

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