4793

```
      SUBROUTINE CONE (NT,NP,THM,THB,ESM,ESB,ETM,ETB,GM,GB,PRM,PRB,
     1                 R1,R2,S,C,S12,N,Z)
C
C*****************************************************************
C     THIS SUBROUTINE CALCULATES THE GLOBAL ELEMENT STIFFNESS OF A
C     THIN SHELL CONICAL SEGMENT, USING LINEAR IN-PLANE AND CUBIC
C     OUT-OF-PLANE DISPLACEMENT FUNCTIONS.
C
C                          - INPUT -
C
C     THM,ESM,ETM,GM,PRM - MATERIAL CONSTANTS FOR MEMBRANE BEHAVIOR
C     THB,ESB,ETB,GB,PRB - MATERIAL CONSTANTS FOR SHELL BENDING BEHAVIOR
C     R1, R2             - RADII OF CURVATURE OF JOINT 1 AND 2
C     S, C               - SINE AND COSINE OF INCLINATION ANGLE
C     S12                - ELEMENT WIDTH BETWEEN JOINT 1 AND 2
C     N                  - HARMONIC NUMBER
C     TETA0              - SEGMENT ANGLE
C
C                          - OUTPUT -
C
C     T(8,8)             - GLOBAL ELEMENT STIFFNESS
C*****************************************************************
C
000026      COMMON/SETUP/TETA0,NPL,NEL,NJT,NTP,MHARM,NCHECK,INTRES,MCHECK,
     1            IRES(21),MM,N1,N2,PI,NNM,NXBAND,II,IJ,IL
000026      COMMON/STIFF/T(8,8)
000026      DIMENSION THM(NP),THB(NP),ESM(NP),ESB(NP),ETM(NP),ETB(NP),GM(NP),
     1          GB(NP),PRM(NP),PRB(NP)
000026      LOGICAL Z
C
C     SET UP MATRIX OF MATERIAL CONSTANTS
C
000026      FM=PRM(NT)*ETM(NT)/ESM(NT)
000033      FB=PRB(NT)*ETB(NT)/ESB(NT)
000041      DM=1./(1.-FM*PRM(NT))
000046      DB=1./(1.-FB*PRB(NT))
000053      TH3=THB(NT)**3/12.
000056      D11=THM(NT)*ESM(NT)*DM
000062      D22=THM(NT)*ETM(NT)*DM
000066      D12=D22*PRM(NT)
000071      D33=GM(NT)*THM(NT)
000075      D44=TH3*ESB(NT)*DB
000100      D55=TH3*ETB(NT)*DB
000103      D45=D55*PRM(NT)
000106      D66=GB(NT)*TH3
C
C     INITIALIZATION
C
000111      A=0.5*(R2-R1)
000114      B=0.5*(R2+R1)
000116      G=R2/R1
000117      XL=ALOG(G)
000122      A2=A*A
000123      A3=A2*A
000124      B2=B*B
000126      BA2=A2/(B2-A2)
000130      BA4=BA2*BA2
000131      SS=S*S
000132      CC=C*C
000134      XN=N
000136      P=XN*PI/TETA0
000140      PP=P*P
000141      S2=0.5*S12
000143      S122=S12*S12
000144      S123=S12*S122
000146      S124=S122*S122
C
C     INTEGRALS
C
000147      F1=2.
000150      F2=0.
000151      F3=2./3.
000152      F4=0.
000153      F5=.4
000154      F6=0.
000155      F7=2./7.
000156      F8=2.*B
000160      F9=2./3.*A
000162      F10=2./3.*B
000163      IF(R1.EQ.R2) GO TO 5
000171      AI=1./A
000173      AI2=1./A2
000175      AI3=1./A3
000177      G=B/A
000200      G2=G*G
000201      G3=G2*G
000203      G4=G2*G2
000204      G5=G2*G3
000206      G6=G3*G3
000207      G7=G3*G4
000211      F11=XL*AI
000213      F12=(2.-G*XL)*AI
000216      F13=(-2.*G+G2*XL)*AI
000222      F14=(2./3.+2.*G2-G3*XL)*AI
000227      F15=(-2./3.*G-2.*G3+G4*XL)*AI
000235      F16=(.4+2./3.*G2+2.*G4-G5*XL)*AI
000245      F17=(-.4*G-2./3.*G3-2.*G5+G6*XL)*AI
000256      F21=2.*BA2*AI2
000260      F22=(XL-2.*G*BA2)*AI2
000265      F23=(-2.*G*XL+BA2*(-2.+4.*G2))*AI2
000274      F24=(3.*G2*XL+BA2*(4.*G-6.*G3))*AI2
000305      F25=(-4.*G3*XL+BA2*(-2./3.-16./3.*G2+8.*G4))*AI2
000317      F26=(5.*G4*XL+BA2*(4./3.*G+20./3.*G3-10.*G5))*AI2
000332      F27=(-6.*G5*XL+BA2*(-.4-1.6*G2-8.*G4+12.*G6))*AI2
000346      F31=2.*BA4*G*AI3
000352      F32=-2.*BA4*AI3
000354      F33=(XL+BA4*(4.*G-2.*G3))*AI3
000362      F34=(-3.*G*XL+BA4*(2.-10.*G2+6.*G4))*AI3
000373      F35=(6.*G2*XL+BA4*(-6.*G+20.*G3-12.*G5))*AI3
000405      F36=(-10.*G3*XL+BA4*(2./3.+32./3.*G2-100./3.*G4+20.*G6))*AI3
000421      F37=(15.*G4*XL+BA4*(-2.*G-16.*G3+50.*G5-30.*G7))*AI3
000435      GO TO 7
000436    5 R12=R1*R1
000440      R13=R12*R1
000441      F11=F1/R1
000443      F12=F2/R1
000444      F13=F3/R1
000446      F14=F4/R1
000447      F15=F5/R1
000451      F16=F6/R1
000452      F17=F7/R1
000454      F21=F1/R12
000456      F22=F2/R12
000457      F23=F3/R12
000461      F24=F4/R12
000462      F25=F5/R12
000464      F26=F6/R12
000465      F27=F7/R12
000467      F31=F1/R13
000471      F32=F2/R13
000472      F33=F3/R13
000474      F34=F4/R13
000475      F35=F5/R13
000477      F36=F6/R13
000500      F37=F7/R13
C
C     STIFFNESS COEFFICIENTS
C
000502    7 H1=.25*(D22*PP+D33*SS)
000507      H2=.25*(D55*PP+D66*SS)*CC
000514      U1=S/S12
000516      H3=D33*U1
000520      H4=D66*U1*CC
000522      H5=D33/S122
000524      H6=D66*CC/S122
000526      T(1,1)=H1*(F11-2.*F12+F13)+H2*(F31-2.*F32+F33)+H3*F1
     1           -H4*(F22-F21)+H5*F8+H6*F11
000553      T(1,2)=H1*(F11-F13)+H2*(F31-F33)+H4*F22-H5*F8-H6*F11
000570      T(2,2)=H1*(F11+2.*F12+F13)+H2*(F31+2.*F32+F33)-H3*F1
     1           -H4*(F21+F22)+H5*F8+H6*F11
C
000615      H1=.25*P*S*(D22+D33)
000621      H2=P/(2.*S12)
000624      G1=H2*(D33+D12)*F1
000627      G2=H2*(D33-D12)*F1
000632      T(1,3)=-H1*(F11-2.*F12+F13)-G2
000641      T(1,4)=-H1*(F11-F13)-G1
000644      T(2,3)=-H1*(F11-F13)+G1
000650      T(2,4)=-H1*(F11+2.*F12+F13)+G2
C
000656      H1=.25*(D22*SS+D33*PP)
000663      G1=S*D12/S12*F1
000667      G2=D11/S122*F8
000671      T(3,3)=H1*(F11-2.*F12+F13)-G1+G2
000701      T(3,4)=H1*(F11-F13)-G2
000704      T(4,4)=H1*(F11+2.*F12+F13)+G1+G2
C
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