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Listing of computer program, Supplement to 479.4, November 1982. (MA-RD-94082081A)

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LISTING OF COMPUTER PROGRAM

Supplement to

Computer Program
For
Ultimate Strength Analysis of Ship Hulls
Subjected to Moment, Torque and Shear
(FEL Report No. 479.4)

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U. S. DEPARTMENT OF TRANSPORTATION, Maritime Administration
Office of Research and Development

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      PROGRAM BOX(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
C          BOX READS AND PRINTS THE INPUT DATA
      COMMON /GEO/ NC,NT,NW,NPC,NDIR,AA,B,TC,DC,TT,AFLSTT,TW
     1,D(20),ASTW(18),NW1,NW2,AFLSTC,DT
      COMMON /CRUT/ CE,CEINC,CEMAX
      COMMON /MP/ SIGYC,SIGYT,SIGYST,EL,POISSO,SIGYWB
      COMMON /CAT/ AMU1,AMU2,AMU3
      COMMON /CFB/ PCOMP(100),EPPLC(100)
      COMMON /IO/ IOUT,IN,IFLAG
      COMMON /WARP/ SWP
      SWP=0.
      IFLAG=0
      IN=5
      IOUT=6
      READ (IN,3) C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13
     1,C14,IFLAG,SWP
      READ (IN,13) NC,NT,NW,NPC,NDIR
      READ (IN,14) AA,B,TC,DC,AFLSTC,TT,DT,AFLSTT
      NW1=NW+1
      NW2=NW-1
      READ (IN,14) TW,(D(I),I=1,NW)
      IF (NW.EQ.1) GO TO 1
      READ (IN,14) (ASTW(I),I=1,NW2)
    1 READ (IN,14) (PCOMP(I),I=1,NPC)
      READ (IN,14) (EPPLC(I),I=1,NPC)
      READ (IN,14) AMU1,AMU2,AMU3
      READ (IN,14) EL,POISSO,SIGYC,SIGYT,SIGYST,SIGYWB
      READ (IN,14) CE,CEINC,CEMAX
      WRITE (IOUT,4) C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,
     1C13,C14,SWP
      WRITE (IOUT,5)
      WRITE (IOUT,6) NC,NT,NW,NPC,NDIR
      WRITE (IOUT,7) AA,B,TC,DC,AFLSTC,TT,DT,AFLSTT
      WRITE (IOUT,8) TW,(D(I),I=1,NW)
      DO 15 I=1,NW
      D(NW+2-I)=D(NW1-I)
   15 CONTINUE
      D(1)=0.
      IF (NW.EQ.1) GO TO 2
      WRITE (IOUT,9) (ASTW(I),I=1,NW2)
    2 WRITE (IOUT,10) (PCOMP(I),EPPLC(I),I=1,NPC)
      WRITE (IOUT,11) EL,POISSO,SIGYC,SIGYT,SIGYST,SIGYWB
      WRITE (IOUT,12) AMU1,AMU2,AMU3,CE,CEINC,CEMAX
      CE=CE*D(NW1)
      CEINC=CEINC*D(NW1)
      CEMAX=CEMAX*D(NW1)
      CALL QIKPLT (EPPLC,PCOMP,-NPC,8H*STRAIN*,7H*FORCE*,
     12H**,-1)
      CALL HVSDEF
      STOP
    3 FORMAT (14A5,I5,F5.0)
    4 FORMAT (//////,5X,14A5,/,5X,5HSWP= ,E12.6,/)
    5 FORMAT (////,5X,13HDATA READBACK,/)
    6 FORMAT (/,5X,4HNC= ,I5,/,5X,4HNT= ,I5,/,5X,4HNW= ,I5,/
     1,5X,5HNPC= ,I5,/,5X,6HNDIR= ,I5,/)
    7 FORMAT (/5X,4HAA= ,E12.6,/5X,3HB= ,E12.6,/,5X,4HTC= ,E
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     112.6,/,5X,4HDC= ,E12.6,/,5X,8HAFLSTC= ,E12.6,/,5X,4
     2HTT= ,E12.6,/,5X,4HDT= ,E12.6,/,5X,8HAFLSTT= ,E12.6,/)
    8 FORMAT (/,5X4HTW= ,E12.6,20(/,5X3HD= ,E12.6),/)
    9 FORMAT (18(/,5X,6HASTW= ,E12.6),/)
   10 FORMAT (100(/,5X7HPCOMP= ,E12.6,5X,7HEPPLC= ,E12.6),/)
   11 FORMAT (/,5X,4HEL= ,E12.6,/,5X,8HPOISSO= ,E12.6,/,5X,7
     1HSIGYC= ,E12.6,/,5X,7HSIGYT= ,E12.6,/,5X,8HSIGYST= ,E1
     22.6,/,5X,8HSIGYWB= ,E12.6,/)
   12 FORMAT (/,5X,6HAMU1= ,E12.6,/,5X,6HAMU2= ,E12.6,/,5X,6
     1HAMU3= ,E12.6,/,5X,4HCE= ,E12.6,/,5X,7HCEINC= ,E12.6,/
     2,5X,7HCEMAX= ,E12.6,//////)
   13 FORMAT (10I5)
   14 FORMAT (8F10.0)
      END


      SUBROUTINE CRISTR
C          SUBROUTINE CRISTR CALCULATES THE CRITICAL SHEAR
C          (FVCR),THE CRITICAL MOMENT (FBCR), AND THE
C          CRITICAL NORMAL FORCE (FCCR) FOR EACH WEB
C          SUBPANEL
      COMMON /SHE/ FVCR(18),FBCR(18),FCCR(18),ALPHA(18),GE1(
     118),GE2(18),DEP(18),ALPMN
      COMMON /GEO/ NC,NT,NW,NPC,NDIR,AA,B,TC,DC,TT,AFLSTT,TW
     1,D(20),ASTW(18),NW1,NW2,AFLSTC,DT
      COMMON /MP/ SIGYC,SIGYT,SIGYST,EL,POISSO,SIGYWB
      COMMON /IO/ IOUT,IN,IFLAG
      DO 1 I=1,NW
      DEP(I)=D(I+1)-D(I)
      GE1(I)=0.
      GE2(I)=0.
      ALPHA(I)=AA/DEP(I)
    1 CONTINUE
      ALPMN=ALPHA(1)
      IF (NW.EQ.1) GO TO 3
      DO 2 I=2,NW
      IF (ALPHA(I).LT.ALPMN) ALPMN=ALPHA(I)
    2 CONTINUE
C          DO ONCE FOR EACH SUBPANEL
    3 DO 17 I=1,NW
C          CALCULATE FVCR
      VLAM=(.8*DEP(I)/TW)*SQRT(SIGYWB/(EL*(5.+5./(ALPHA(I)**
     12))))
      IF (VLAM.GT..58) GO TO 4
      SFVCR=.58*SIGYWB
      GO TO 6
    4 IF (VLAM.GT.1.41) GO TO 5
      SFVCR=(.58-.357*(VLAM-.58)**1.18)*SIGYWB
      GO TO 6
    5 SFVCR=.58*SIGYWB/VLAM**2
    6 FVCR(I)=SFVCR*DEP(I)*TW
      J=I
C          CALCULATE FBCR
      IF (ALPHA(I).GT..666667) GO TO 7
      BK=24.+73.*(.66667-ALPHA(I))**2
      GO TO 8
    7 BK=24.
    8 BLAM=((DEP(I)/TW)/.95)*SQRT(SIGYWB/(EL*BK))
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```
      IF (BLAM.LT.1.5) GO TO 9
      SFBCR=(1./BLAM**2)*SIGYWB
      GO TO 11
    9 IF (BLAM.LT..65) GO TO 10
      SFBCR=((.072*((BLAM-5.62)**2))-.78)*SIGYWB
      GO TO 11
   10 SFBCR=SIGYWB
   11 FBCR(I)=SFBCR*(DEP(I)**2)*TW/6.
C            CALCULATE FCCR
      IF (ALPHA(I).LT.1.) GO TO 12
      CK=4.
      GO TO 13
   12 CK=(ALPHA(I)-1./ALPHA(I))**2
   13 CLAM=((DEP(I)/TW)/.95)*SQRT(SIGYWB/(EL*CK))
      IF (CLAM.LT..65) GO TO 15
      IF (CLAM.LT.1.5) GO TO 14
      SFCCR=(1./(CLAM**2))*SIGYWB
      GO TO 16
   14 SFCCR=(.072*((CLAM-5.62)**2)-.78)*SIGYWB
      GO TO 16
   15 SFCCR=SIGYWB
   16 FCCR(I)=SFCCR*TW*DEP(I)
   17 CONTINUE
      IF (IFLAG.EQ.0) RETURN
      WRITE (IOUT,19)
      WRITE (IOUT,20) (FVCR(I),FBCR(I),FCCR(I),I=1,NW)
      WRITE (IOUT,21)
      RETURN
   19 FORMAT (13X,4HFVCR,13X,4HFBCR,13X,4HFCCR)
   20 FORMAT (3(5X,E12.6))
   21 FORMAT (///)
      END


      SUBROUTINE TWOPLA (XW1,XW2,XW3,YW1,YW2,YW3,W1,W2,W3,XZ
C            SUBROUTINE TWOPLA IS GIVEN TWO PLANES, (W AND Z)
C            AND THEN FINDS THE POINT (XO,YO).
     11,XZ2,XZ3,YZ1,YZ2,YZ3,Z1,Z2,Z3,XO,YO,ITWOP,ITWOP1)
      COMMON /IO/ IOUT,IN,IFLAG
      ITWOP1=0
      W0=0.
      Z0=0.
      Z0D=1.E-15
      W0D=1.E-15
      DW1=(XW2*YW3-XW3*YW2)*W1+(XW3*YW1-XW1*YW3)*W2+(XW1*YW2
     1-XW2*YW1)*W3
      DW2=(YW2-YW3)*W1+(YW3-YW1)*W2+(YW1-YW2)*W3
      DW3=(XW3-XW2)*W1+(XW1-XW3)*W2+(XW2-XW1)*W3
      DZ1=(XZ2*YZ3-XZ3*YZ2)*Z1+(XZ3*YZ1-XZ1*YZ3)*Z2+(XZ1*YZ2
     1-XZ2*YZ1)*Z3
      DZ2=(YZ2-YZ3)*Z1+(YZ3-YZ1)*Z2+(YZ1-YZ2)*Z3
      DZ3=(XZ3-XZ2)*Z1+(XZ1-XZ3)*Z2+(XZ2-XZ1)*Z3
      DENOM=DW2*DZ3-DZ2*DW3
      IF (ABS(DENOM).LT.1.E-20) GO TO 1
      XO=(DZ1*DW3-DW1*DZ3)/DENOM
      YO=(DZ2*DW1-DW2*DZ1)/DENOM
      RETURN
C            IF TWOPLA CANNOT FIND A SOLUTION, A WARNING
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```
C          MESSAGE WILL BE PRINTED
    1 ITWOP=1
      ITWOP1=1
      IF (IFLAG.EQ.0) GO TO 2
      WRITE (IOUT,3)
    2 RETURN
    3 FORMAT (///,5X,23HTWOPLA DID NOT CONVERGE,///)
      END


      SUBROUTINE WVSDEF
C          SUBROUTINE WVSDEF IS THE MAIN CONTROL SUBROUTINE
      COMMON /W/ WLO(50)
      DIMENSION STRA1(50), STRA2(50), STRA3(50), STRA4(50),
     1YS1(3), YS2(3), WIN1B(18), WIN2B(18), WIN1A(18), WIN2A
     2(18), WINSAV(36), IST01B(18), IST02B(18), IST01A(18),
     3IST02A(18)
      COMMON /GB/ GBUCK1(18),GBUCK2(18)
      COMMON /WEB/ IBUCK1(18),IBUCK2(18),SUB1F(18),SUB2F(18)
     1,SUB1B(18),SUB2B(18)
      COMMON /IO/ IOUT,IN,IFLAG
      COMMON /CFB/ PCOMP(100),EPPLC(100)
      COMMON /SHE/ FVCR(18),FBCR(18),FCCR(18),ALPHA(18),GE1(
     118),GE2(18),DEP(18),ALPMN
      COMMON /WESUB/ V1ULT(18),V2ULT(18),SUB1SB(18),SUB2SB(1
     18),GAMUL1(18),GAMUL2(18)
      COMMON /CRUT/ CE,CEINC,CEMAX
      COMMON /MP/ SIGYC,SIGYT,SIGYST,EL,POISSO,SIGYWB
      COMMON /CAT/ AMU1,AMU2,AMU3
      COMMON /GEO/ NC,NT,NW,NPC,NDIR,AA,B,TC,DC,TT,AFLSTT,TW
     1,D(20),ASTW(18),NW1,NW2,AFLSTC,DT
      COMMON /PRO/ CORN,ACFE,RNTPO,DCS,DCST,RNCPO,G,ICIB,TOL
     1AXF,TOLYBM,FACMAG,YBMOY,AXFY
      COMMON /MAIN/ S1(3),S2(3),S3(3),S4(3),AXF(3),YBMO(3)
      COMMON /WINTZ/ WINTR1(18),WINTR2(18),SUB2V(18),SUB1V(1
     18),WLOD,GAMMA1,GAMMA2
      COMMON /WARP/ SWP
      COMMON /TENS/ BSUBV1,BSUBV2,SHEAR1(50),SHEAR2(50),CURV
     1(50)
      COMMON /LWEB/ SAV1B(18),SAV2B(18),SAVSH1(18),SAVSH2(18
     1)
C          SEVERAL VARIABLES AND ARRAYS ARE INITIALIZED
      ITWOP=0
      WTOL=.05
      IDONE=0
      IND=0
      IMAXI=0
      ICON=0
      DO 1 I=1,NW
      WIN1B(I)=0.
      WIN2B(I)=0.
      IST01B(I)=0
      IST02B(I)=0
      IBUCK1(I)=0
    1 IBUCK2(I)=0
      CALL PROPRT
      CALL CRISTR
      EPY=SIGYC/EL
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C           THIS LOOP DIMENSIONALIZES THE INPUT LOAD RESPONSE
C           CURVE OF THE COMPRESSION FLANGE. (FORCE VS
C           STRAIN)
      DO 2 I=1,NPC
      PCOMP(I)=PCOMP(I)*SIGYC*ACFE
    2 EPPLC(I)=EPPLC(I)*EPY
      ICIB=1
      E=(AMU3/B)*2.
C           FOR FIRST VALUE OF CURVATURE S1 AND S2 ARE
C           ASSUMED
      S1(1)=-CE/2.
      S2(1)=S1(1)
C           COUNTER LIMITING THE NUMBER OF ITERATIONS
C           PERFORMED UNTIL CONVERGENCE IS MET IS INITIALIZED
    3 ICIT=0
C           POINT 1 IS ESTABLISHED
      S3(1)=S2(1)+CE*(2.-1./(SWP+1.))
      S4(1)=S1(1)+CE/(SWP+1.)
      CALL AFAYM (S1(1),S2(1),S3(1),S4(1),AXF(1),YBMO(1))
C           CHECK IF CONVERGENCE CRITERIA HAVE BEEN MET FOR
C           POINT 1
      IF (ABS(AXF(1)).GT.TOLAXF) GO TO 4
      IF (ABS(YBMO(1)).GT.TOLYBM) GO TO 4
      ST1=S1(1)
      ST2=S2(1)
      ST3=S3(1)
      ST4=S4(1)
      ATXF=AXF(1)
      YTBMO=YBMO(1)
      GO TO 29
C           POINT 2 IS ESTABLISHED
    4 IAXCHK=0
      IF (AXF(1).GT.0.) IAXCHK=-1
      IYBMCH=0
      IF (YBMO(1).GT.0.) IYBMCH=1
      IPNCHK=IYBMCH+IAXCHK+2
      RSINC=YBMO(1)/YBMOY
      IF (ABS(AXF(1)).GT.ABS(YBMO(1))) RSINC=AXF(1)/AXFY
      GO TO (6,5,7), IPNCHK
C           THE RESULTANT AXIAL FORCE (AXF) AND THE BENDING
C           MOMENT ABOUT THE VERTICAL CENTROIDAL AXIS (YBMO)
C           HAVE THE SAME SIGN
    5 S1(2)=S1(1)-RSINC*ABS(S1(1))
      S2(2)=S2(1)
      GO TO 8
C           THE AXF IS POSITIVE AND THE YBMO IS NEGATIVE
    6 S2(2)=S2(1)-ABS(RSINC*S2(1))
      S1(2)=S1(1)
      GO TO 8
C           THE AXF IS NEGATIVE AND THE YBMO IS POSITIVE
    7 S2(2)=S2(1)+ABS(RSINC*S2(1))
      S1(2)=S1(1)
    8 S3(2)=S2(2)+CE*(2.-1./(SWP+1.))
      S4(2)=S1(2)+CE/(SWP+1.)
      CALL AFAYM (S1(2),S2(2),S3(2),S4(2),AXF(2),YBMO(2))
C           CHECK IF CONVERGENCE CRITERIA HAVE BEEN MET FOR
C           POINT 2
      IF (ABS(AXF(2)).GT.TOLAXF) GO TO 9
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      IF (ABS(YBMO(2)).GT.TOLYBM) GO TO 9
      ST1=S1(2)
      ST2=S2(2)
      ST3=S3(2)
      ST4=S4(2)
      ATXF=AXF(2)
      YTBMO=YBMO(2)
      GO TO 29
C           POINT 3 IS ESTABLISHED
    9 IAXCHK=0
      IF (AXF(2).GT.0.) IAXCHK=-1
      IYBMCH=0
      IF (YBMO(2).GT.0.) IYBMCH=1
      IPNCHE=IYBMCH+IAXCHK+2
      IF (IPNCHE.EQ.IPNCHK) GO TO 13
      IF (IABS(IPNCHE-IPNCHK).EQ.2) GO TO 13
      RSINC=YBMO(2)/YBMOY
      IF (ABS(AXF(2)).GT.ABS(YBMO(2))) RSINC=AXF(2)/AXFY
      GO TO (11,10,12), IPNCHE
C           THE AXF AND THE YBMO HAVE THE SAME SIGN
   10 S1(3)=S1(2)-RSINC*ABS(S1(2))
      S2(3)=S2(2)
      GO TO 17
C           THE AXF IS POSITIVE AND THE YBMO IS NEGATIVE
   11 S2(3)=S2(2)-ABS(RSINC*S2(2))
      S1(3)=S1(2)
      GO TO 17
C           THE AXF IS NEGATIVE AND THE YBMO IS POSITIVE
   12 S2(3)=S2(2)+ABS(RSINC*S2(2))
      S1(3)=S1(2)
      GO TO 17
   13 IWAY=0
      RSINC=AXF(2)/AXFY
      IF (ABS(YBMO(1)+YBMO(2)).LT.ABS(AXF(1)+AXF(2))) GO TO
     114
      RSINC=YBMO(2)/YBMOY
      IWAY=1
   14 IF (IPNCHK.EQ.2) GO TO 15
      S1(3)=S1(2)+S1(2)*RSINC
      S2(3)=S2(2)
      GO TO 17
   15 IF (IWAY.EQ.0) GO TO 16
      S2(3)=S2(2)-S2(2)*RSINC
      S1(3)=S1(2)
      GO TO 17
   16 S2(3)=S2(2)+S2(2)*RSINC
      S1(3)=S1(2)
   17 S3(3)=S2(3)+CE*(2.-1./(SWP+1.))
      S4(3)=S1(3)+CE/(SWP+1.)
      CALL AFAYM (S1(3),S2(3),S3(3),S4(3),AXF(3),YBMO(3))
C           CHECK IF CONVERGENCE CRITERIA HAVE BEEN MET FOR
C           POINT 3
      IF (ABS(AXF(3)).GT.TOLAXF) GO TO 18
      IF (ABS(YBMO(3)).GT.TOLYBM) GO TO 18
      ST1=S1(3)
      ST2=S2(3)
      ST3=S3(3)
      ST4=S4(3)
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      ATXF=AXF(3)
      YTBMO=YBMO(3)
      GO TO 29
C             A DUPLICATE SET OF POINTS IS ESTABLISHED FOR USE
C             IN SUBROUTINE TWOPLA
   18 DO 19 I=1,3
      YS1(I)=S1(I)
      YS2(I)=S2(I)
   19 CONTINUE
   20 IF (IFLAG.EQ.0) GO TO 21
      WRITE (IOUT,1000)
      WRITE (IOUT,74) (S1(I),S2(I),AXF(I),YS1(I),YS2(I),YBMO
     1(I),I=1,3)
   21 CALL TWOPLA (S1(1),S1(2),S1(3),S2(1),S2(2),S2(3),AXF(1
     1),AXF(2),AXF(3),YS1(1),YS1(2),YS1(3),YS2(1),YS2(2),YS2
     2(3),YBMO(1),YBMO(2),YBMO(3),ST1,ST2,ITWOP,ITWOP1)
      ST3  =ST2   +CE*(2.-1./(SWP+1.))
      ST4  =ST1   +CE/(SWP+1.)
C             THE AXF AND THE YBMO ARE FOUND FOR THE
C             EXTRAPOLATED STRAINS S1 AND S2
      CALL AFAYM (ST1,ST2,ST3,ST4,ATXF,YTBMO)
      IF (IFLAG.EQ.0) GO TO 22
      WRITE (IOUT,1001)
      WRITE (IOUT,75) ST1,ST2,ST3,ST4,ATXF,YTBMO
   22 IF (ITWOP1.EQ.1) GO TO 29
      IF (ABS(ATXF).GT.TOLAXF) GO TO 23
      IF (ABS(YTBMO).LT.TOLYBM) GO TO 29
   23 IF (ICIT.LT.10) GO TO 81
      ITWOP=1
      IF (IFLAG.EQ.0) GO TO 29
      WRITE (IOUT,82)
      GO TO 29
   81 ICIT=ICIT+1
C             REPLACE THE POINTS HAVING THE WORST VALUES OF AXF
C             AND YBMO.  IF THE NEW POINT IS NOT BETTER THAN
C             ANY OF THE OTHERS, REPLACE THE POINT WITH THE
C             WORST VALUE OF AXF.
      IWA=1
      WAXF=ABS(AXF(1))
      IWY=1
      WYBMO=ABS(YBMO(1))
      DO 25 I=2,3
      IF (ABS(AXF(I)).LT.WAXF) GO TO 24
      IWA=I
      WAXF=ABS(AXF(I))
   24 IF (ABS(YBMO(I)).LT.WYBMO) GO TO 25
      IWY=I
      WYBMO=ABS(YBMO(I))
   25 CONTINUE
      IREP=0
      IF (WAXF.LT.ABS(ATXF)) GO TO 26
      IREP=1
      AXF(IWA)=ATXF
      S1(IWA)=ST1
      S2(IWA)=ST2
   26 IF (WYBMO.LT.ABS(YTBMO)) GO TO 27
      YBMO(IWY)=YTBMO
      YS1(IWY)=ST1
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      YS2(IWY)=ST2
      GO TO 28
   27 IF (IREP.EQ.1) GO TO 28
      AXF(IWA)=ATXF
      S1(IWA)=ST1
      S2(IWA)=ST2
   28 GO TO 20
C             WHEN CONVERGENCE CRITERIA ARE MET, THE BENDING
C             MOMENT ABOUT A HORIZONTAL AXIS IN THE SECTION IS
C             CALCULATED.
   29 CALL MOMENT (BMO)
      IF (IFLAG.EQ.0) GO TO 30
      RCE=CE/D(NW1)
      WRITE (IOUT,1002)
      WRITE (IOUT,76) ST1,ST2,ST3,ST4,BMO,RCE
C             IF THE BENDING MOMENT IS DECREASING, INDICATING
C             THAT THE SECTION IS IN THE POST ULTIMATE REGION
C             ITERATIONS ARE PERFORMED TO FIND THE TRUE MAXIMUM
C             STRENGTH (LINES 30-44)
   30 WLOD=BMO/AMU2
      IF (IDONE.EQ.1) GO TO 45
      IF (IMAXI.GT.0) GO TO 34
      IF (ICIB.LT.3) GO TO 45
      IF (WLOD.GT.WLO(ICIB-1)) GO TO 45
      IND=1
      IMAXI=1
      CESAV=CURV(ICIB-1)
      WLOSAV=WLO(ICIB-1)
      ST1SAV=STRA1(ICIB-1)
      ST2SAV=STRA2(ICIB-1)
      ST3SAV=STRA3(ICIB-1)
      ST4SAV=STRA4(ICIB-1)
      BMOSAV=WLOSAV*AMU2
      W1=WLO(ICIB-2)
      W2=WLO(ICIB-1)
      W3=WLOD
      C1=CURV(ICIB-2)
      C2=CURV(ICIB-1)
      C3=CE
      CALL PARMAX (W1,W2,W3,C1,C2,C3,CE)
      IF (ABS((CE-C2)/C2).LT..005) GO TO 33
      IF (CE.GT.C2) GO TO 68
      DO 32 I=1,NW
      IF (ISTO1A(I).EQ.1) GO TO 31
      IBUCK1(I)=0
   31 IF (ISTO2A(I).EQ.1) GO TO 32
      IBUCK2(I)=0
   32 CONTINUE
      GO TO 68
   33 IND=0
      IDONE=1
      CE=C3
      GO TO 45
   34 IWHER=0
      IF (WLOD.LE.WLOSAV) IWHER=1
      IF (IMAXI.GT.10) GO TO 43
      IMAXI=IMAXI+1
      CESAV=CE
```

```
      WLOSAV=WLOD
      ST1SAV=ST1
      ST2SAV=ST2
      ST3SAV=ST3
      ST4SAV=ST4
      BMOSAV=BMO
      IF (IWHER.EQ.1) GO TO 35
      IF (CE.GT.C2) GO TO 37
      C3=C2
      C2=CE
      W3=W2
      W2=WLOD
      GO TO 38
   35 IF (CE.GT.C2) GO TO 36
      C1=CE
      W1=WLOD
      GO TO 38
   36 C3=CE
      W3=WLOD
      GO TO 38
   37 C1=C2
      C2=CE
      W1=W2
      W2=WLOD
   38 CALL PARMAX (W1,W2,W3,C1,C2,C3,CE)
      IF (CE.GT.CURV(ICIB-1)) GO TO 40
      DO 39 I=1,NW
      IBUCK1(I)=0
      IF (ISTO1A(I).EQ.1) IBUCK1(I)=1
      IBUCK2(I)=0
      IF (ISTO2A(I).EQ.1) IBUCK2(I)=1
   39 CONTINUE
      GO TO 42
   40 DO 41 I=1,NW
      IBUCK1(I)=ISTO1B(I)
      IBUCK2(I)=ISTO2B(I)
   41 CONTINUE
   42 IF (ABS((CE-C2)/C2).GT..005) GO TO 68
      CE=CESAV
      GO TO 43
   43 IF (CE.LE.CURV(ICIB-1)) ICIB=ICIB-1
      IMAXI=0
      IDONE=1
      DO 44 I=1,NW
      ISTO1B(I)=IBUCK1(I)
      ISTO2B(I)=IBUCK2(I)
   44 CONTINUE
C             THE INTERACTION VALUES FOR SUBPANEL BUCKLING ARE
C             CALCULATED
   45 CALL WEBSH (BMO,IWEBFA)
C             THE LARGEST INTERACTION VALUE IS FOUND
      IF (IWEBFA.EQ.1) GO TO 66
C             CHECK YIELDING OF EACH SUBPANEL
      DO 101 I=1,NW
      IF (IBUCK1(I).EQ.1) GOTO 102
      IF (SUB1F(I).LT.0.) GOTO 102
      THR1F=ABS(2.*SUB1B(I)/DEP(I))+SUB1F(I)
      VM=SQRT(THR1F**2+3.*SUB1V(I)**2)
```

```
      VM=VM/(TW*DEP(I))
      IF (SIGYWB.GT.VM) GOTO 102
      IBUCK1(I)=1
      GBUCK1(I)=GAMMA1
      SUB1SB(I)=SUB1V(I)
      GAMUL1(I)=1.001*GAMMA1
      GE1(I)=G
      V1ULT(I)=1.001*SUB1V(I)
 102  CONTINUE
      IF (IBUCK2(I).EQ.1) GOTO 101
      IF (SUB2F(I).LT.0.) GOTO 101
      THR2F=ABS(2.*SUB2B(I)/DEP(I))+SUB2F(I)
      VM=SQRT(THR2F**2+3.*SUB2V(I)**2)
      VM=VM/(TW*DEP(I))
      IF (SIGYWB.GT.VM) GOTO 101
      IBUCK2(I)=1
      GBUCK2(I)=GAMMA2
      SUB2SB(I)=SUB2V(I)
      GAMUL2(I)=1.001*GAMMA2
      GE2(I)=G
      V2ULT(I)=1.001*SUB2V(I)
 101  CONTINUE
      DO 46 I=1,NW
      WINSAV(I)=WINTR1(I)
      IF (IBUCK1(I).EQ.1) WINSAV(I)=0.
      WINSAV(I+NW)=WINTR2(I)
      IF (IBUCK2(I).EQ.1) WINSAV(I+NW)=0.
   46 CONTINUE
C          IF ON CONVERGING CYCLE, IN THE PROCESS OF
C          ITERATING FOR THE BUCKLING POINT OF A SUBPANEL,
C          GOTO 52
      IF (ICON.EQ.1) GO TO 52
      N2NW=2*NW
      WINMAX=0.
      JHIGH=1
      DO 47 I=1,N2NW
      IF (WINSAV(I).LT.WINMAX) GO TO 47
      WINMAX=WINSAV(I)
      JHIGH=I
   47 CONTINUE
C          IF NEW BUCKLING HAS NOT OCCURED GO TO 71
      IF (WINMAX.LE.(1.-WTOL)) GO TO 71
C          IF AN INTERACTION VALUE IS WITHIN TOLERANCE BY
C          CHANCE, GO TO 72
      IF (WINMAX.LE.(1.+WTOL)) GO TO 72
      IF (ICIB.GT.1) GO TO 48
      CE=CE/WINMAX
      GO TO 68
C          MUST ITERATE FOR AN INTERACTION VALUE WHICH IS
C          WITHIN TOLERANCE
C          ICON=1 INDICATES THAT THE PROGRAM IS IN THE
C          CONVERGING MOD
   48 ICON=1
      CURVE2=CURV(ICIB-1)
      CURVE3=CE
      IF (JHIGH.GT.NW) GO TO 49
      AINT2=WIN1B(JHIGH)
      GO TO 50
```

```
   49 AINT2=WIN2B(JHIGH-NW)
   50 AINT3=WINSAV(JHIGH)
C            A BETTER VALUE OF CURVATURE IS FOUND BY USING
C            LINEAR INTERPOLATION
   51 CE=((CURVE3-CURVE2)/(AINT3-AINT2))*(1.-AINT3)+CURVE3
      GO TO 68
   52 IF (JHIGH.GT.NW) GO TO 53
      CHINT=WINTR1(JHIGH)
      GO TO 54
   53 CHINT=WINTR2(JHIGH-NW)
C            IF THE INTERACTION VALUE OF NEW CURVATURE IS
C            ACCEPTABLE, GOTO 56
   54 IF (CHINT.GE.(1.-WTOL).AND.CHINT.LE.(1.+WTOL)) GO TO 5
     16
C            IF INTERACTION VALUE OF THE NEW CURVATURE IS NOT
C            ACCEPTABLE, MAKE ANOTHER INTERPOLATION FOR
C            INTERACTION = 1
      IF (CHINT.LT.1.) GO TO 55
      AINT3=CHINT
      CURVE3=CE
      GO TO 51
   55 AINT2=CHINT
      CURVE2=CE
      GO TO 51
C            CHECK TO MAKE SURE THAT NO NEW BUCKLING HAS
C            OCCURED
   56 TMAX=0.
      DO 57 I=1,N2NW
      IF (WINSAV(I).LE.TMAX) GO TO 57
      TMAX=WINSAV(I)
   57 CONTINUE
C            IF NO NEW BUCKLING HAS OCCURED, GO TO 73
      IF (TMAX.LT.(1.+WTOL)) GO TO 73
      ICON=0
      GO TO 68
   58 ICON=0
C            WHEN A SUBPANEL≠S BUCKLING POINT HAS BEEN FOUND,
C            THE ULTIMATE STRENGTH AND EFFECTIVE SHEAR MODULAS
C            ARE CALCULATED HERE
C            FOR SUBPANELS IN WEB 1
   59 IF (JHIGH.GT.NW) GO TO 60
      IBUCK1(JHIGH)=1
      GBUCK1(JHIGH)=GAMMA1
      SUB1SB(JHIGH)=SUB1V(JHIGH)
      GAMUL1(JHIGH)=(SIGYST/EL)*(ALPHA(JHIGH)+(1./ALPHA(JHIG
     1H)))
      BSTR=6.*SUB1B(JHIGH)/((DEP(JHIGH)**2)*TW)
      ASTR=SUB1F(JHIGH)/(TW*DEP(JHIGH))
      CSTR=SUB1V(JHIGH)/(TW*DEP(JHIGH))
      ASTR=¬ASTR
      SIGTI=SIGYST-SQRT(.25*((ASTR+BSTR)**2)+3.*CSTR)
      TTFI=SIGTI/(2.*SQRT(1.+ALPMN/2.+ALPMN**2))
      GE1(JHIGH)=TTFI/(GAMUL1(JHIGH)-GAMMA1)
      V1ULT(JHIGH)=(CSTR+TTFI)*TW*DEP(JHIGH)
      IF (IFLAG.EQ.0) GO TO 61
      WRITE (IOUT,77) JHIGH,GE1(JHIGH),V1ULT(JHIGH)
      GO TO 61
C            FOR SUBPANELS IN WEB 2
```

```
   60 IBUCK2(JHIGH-NW)=1
      GBUCK2(JHIGH-NW)=GAMMA2
      SUB2SB(JHIGH-NW)=SUB2V(JHIGH-NW)
      GAMUL2(JHIGH-NW)=(SIGYST/EL)*(ALPHA(JHIGH-NW)+(1./ALPH
     1A(JHIGH-NW)))
      BSTR=6.*SUB2B(JHIGH-NW)/((DEP(JHIGH-NW)**2)*TW)
      ASTR=SUB2F(JHIGH-NW)/(TW*DEP(JHIGH-NW))
      CSTR=SUB2V(JHIGH-NW)/(TW*DEP(JHIGH-NW))
      ASTR=-ASTR
      SIGTI=SIGYST-SQRT(.25*((ASTR+BSTR)**2)+3.*CSTR)
      TTFI=SIGTI/(2.*SQRT(1.+ALPMN/2.+ALPMN**2))
      GE2(JHIGH-NW)=TTFI/(GAMUL2(JHIGH-NW)-GAMMA2)
      V2ULT(JHIGH-NW)=(CSTR+TTFI)*TW*DEP(JHIGH-NW)
      IF (IFLAG.EQ.0) GO TO 61
      WRITE (IOUT,77) JHIGH,GE2(JHIGH-NW),V2ULT(JHIGH-NW)
C             CHECK FOR OTHER SUBPANELS WHICH MAY BE WITHIN
C             TOLERANCE BY CHANCE
   61 DO 62 I=1,NW
      IF (IBUCK1(I).EQ.1) GO TO 62
      IF (WINSAV(I).LT.(1.-WTOL)) GO TO 62
      JHIGH=I
      GO TO 59
   62 CONTINUE
      DO 63 I=1,NW
      IF (IBUCK2(I).EQ.1) GO TO 63
      IF (WINSAV(I+NW).LT.(1.-WTOL)) GO TO 63
      JHIGH=I+NW
      GO TO 59
   63 CONTINUE
C             PUT INTERACTION VALUES INTO TEMPORARY STORAGE
   64 DO 65 I=1,NW
      WIN1A(I)=WIN1B(I)
      WIN2A(I)=WIN2B(I)
      WIN1B(I)=WINTR1(I)
      WIN2B(I)=WINTR2(I)
      IST01A(I)=IST01B(I)
      IST02A(I)=IST02B(I)
      IST01B(I)=IBUCK1(I)
      IST02B(I)=IBUCK2(I)
C             STORE DATA FOR FINAL PRINTING
   65 CONTINUE
   66 STRA1(ICIB)=ST1
      STRA2(ICIB)=ST2
      STRA3(ICIB)=ST3
      STRA4(ICIB)=ST4
      WLO(ICIB)=WLOD
      CURV(ICIB)=CE
      SHEAR1(ICIB)=BSUBV1/((D(NW1)-D(NW))*TT)
      SHEAR2(ICIB)=BSUBV2/((D(NW1)-D(NW))*TT)
      DO 83 I=1,NW
      SAVSH1(I)=SUB1V(I)/(TW*(D(I+1)-D(I)))
      SAVSH2(I)=SUB2V(I)/(TW*(D(I+1)-D(I)))
      SAV1B(I)=SUB1B(I)
      SAV2B(I)=SUB2B(I)
   83 CONTINUE
      IF (IFLAG.EQ.0) GO TO 67
      WRITE (IOUT,1003)
      WRITE (IOUT,78) (IBUCK1(I),IBUCK2(I),I=1,NW)
```

```
   67 IF (CE.GT.CEMAX) GO TO 69
      IF (IWEBFA.EQ.1) GO TO 69
      ICIB=ICIB+1
      CE=CE+CEINC
   68 S1(I)=ST1
      S2(I)=ST2
      GO TO 3
   69 IF (ITWOP.EQ.0) GO TO 70
      WRITE (IOUT,79)
   70 WRITE (IOUT,80)
      DO 100 I=1,ICIB
      CURV(I)=CURV(I)/D(NW1)
  100 CONTINUE
      WRITE (IOUT,75) (CURV(I),WLO(I),STRA1(I),STRA2(I),STRA
     13(I),STRA4(I),I=1,ICIB)
      CALL QIKPLT (CURV,WLO,-ICIB,6H*CURV*,6H*LOAD*,2H**,-1)
      STOP
C           THESE STATEMENTS DIRECT CALCULATIONS IN THE EVENT
C           THAT THERE IS SUBPANEL BUCKLING OCCURING
C           IMMEDIATELY AFTER THE ULTIMATE STRENGTH IS
C           REACHED
   71 IF (IND.EQ.0) GO TO 64
      IND=0
      GO TO 64
   72 IF (IND.EQ.0) GO TO 59
      IND=0
      GO TO 59
   73 IF (IND.EQ.0) GO TO 58
      IDONE=0
      IND=0
      GO TO 58
   74 FORMAT (2(3X,3(2X,E12.6)))
   75 FORMAT (5X,E12.6,2X,E12.6,2X,E12.6,2X,E12.6,2X,E12.6,
     12X,E12.6)
   76 FORMAT (3X,6(2X,E12.6),//)
   77 FORMAT (/,5X,7HJHIGH= ,I5,/,5X,4HGE= ,E12.6,/,5X,11
     1HULT SHEAR= ,E12.6,/)
   78 FORMAT (5X,I5,5X,I5)
   79 FORMAT (/////,5X,33HCAUTION-TWOPLA DID NOT ALWAYS CON,
     15HVERGE,////)
   80 FORMAT (///,8X,5HCURVE,9X,6HW LOAD,10X,2HS1,12X,2HS2,
     112X,2HS3,12X,2HS4,/)
   82 FORMAT (///,5X,36HDID NOT CONVERGE AFTER 10 ITERATIONS
     1,///)
 1000 FORMAT (/,10X,2HS1,12X,2HS2,11X,3HAXF,14X,3HYS1,11X,
     13HYS2,8X,11HYBMO/FACMAG)
 1001 FORMAT (/,9X,3HST1,11X,3HST2,11X,3HST3,11X,3HST4,11X,
     13HAXF,8X,11HYBMO/FACMAG)
 1002 FORMAT (//,9X,3HST1,11X,3HST2,11X,3HST3,11X,3HST4,11X,
     13HBMO,11X,4HCURV)
 1003 FORMAT (/,7X,5HWEB 1,5X,5HWEB 2)
      END


      SUBROUTINE WEBSH (BMO,IWEBFA)
C           SUBROUTINE WEBSH CALCULATES THE BUCKLING
C           INTERACTION VALUE FOR EACH SUBPANEL
      DIMENSION IULT1(18), IULT2(18), V1(18), V2(18)
```

```
      COMMON /GB/ GBUCK1(18),GBUCK2(18)
      COMMON /WEB/ IBUCK1(18),IBUCK2(18),SUB1F(18),SUB2F(18)
     1,SUB1B(18),SUB2B(18)
      COMMON /SUM/ SUMMA1,SUMMA2,GAM1,GAM2,VMAX1(18),VMAX2(1
     18)
      COMMON /WINTZ/ WINTR1(18),WINTR2(18),SUB2V(18),SUB1V(1
     18),WLOD,GAMMA1,GAMMA2
      COMMON /CAT/ AMU1,AMU2,AMU3
      COMMON /GEO/ NC,NT,NW,NPC,NDIR,AA,B,TC,DC,TT,AFLSTT,TW
     1,D(20),ASTW(18),NW1,NW2,AFLSTC,DT
      COMMON /W/ WLO(50)
      COMMON /PRO/ CORN,ACFE,RNTPO,DCS,DCST,RNCPO,G,ICIB,TOL
     1AXF,TOLYBM,FACMAG,YBMOY,AXFY
      COMMON /IO/ IOUT,IN,IFLAG
      COMMON /WESUB/ V1ULT(18),V2ULT(18),SUB1SB(18),SUB2SB(1
     18),GAMUL1(18),GAMUL2(18)
      COMMON /SHE/ FVCR(18),FBCR(18),FCCR(18),ALPHA(18),GE1(
     118),GE2(18),DEP(18),ALPMN
      COMMON /TENS/ BSUBV1,BSUBV2,SHEAR1(50),SHEAR2(50),CURV
     1(50)
      IWEBFA=0
C             CALCULATE THE TOTAL SHEAR IN EACH WEB (VT1,VT2)
      WLOD=BMO/AMU2
      TORQ=WLOD*AMU3
      VV=WLOD*AMU1/2.
      Q=TORQ/(2.*B)
      VT1=ABS(VV+Q)
      VT2=ABS(VV-Q)
      IF (ICIB.EQ.1) GO TO 1
C             IF THE SECTION IS IN THE UNLOADING STATE GO TO 26
      IF (WLOD.LT.WLO(ICIB-1)) GO TO 26
C             LOADING STATE
C             WEB NUMBER 1
    1 DO 2 I=1,NW
    2 IULT1(I)=0
      DO 4 I=1,NW
      IF (IBUCK1(I).EQ.1) GO TO 3
      V1(I)=DEP(I)*TW*G
      V2(I)=0.
      GO TO 4
    3 V1(I)=GE1(I)*DEP(I)*TW
      V2(I)=SUB1SB(I)-GBUCK1(I)*GE1(I)*DEP(I)*TW
    4 CONTINUE
    5 VVV=0.
      V=0.
      DO 6 I=1,NW
      V=V-V2(I)
      VVV=VVV+V1(I)
    6 CONTINUE
      V=VT1+V
C             CHECK FOR A SHEAR FAILURE OF WEB NUMBER 1
      IF (ABS(VVV).LT..1E-15) GO TO 7
      GAMMA1=V/VVV
      GO TO 8
    7 WRITE (IOUT,31) WLOD,VT1,GAMMA1
      IWEBFA=1
      RETURN
C             CHECK FOR SUBPANELS REACHING THEIR ULTIMATE SHEAR
```

```
C          CAPACITY
    8 DO 9 I=1,NW
      IF (IULT1(I).EQ.1) GO TO 9
      IF (IBUCK1(I).EQ.0) GO TO 9
      IF (GAMMA1.LT.GAMUL1(I)) GO TO 9
      V2(I)=V1ULT(I)
      V1(I)=0.
      IULT1(I)=1
      GO TO 5
    9 CONTINUE
C          CALCULATE THE SHEAR FORCE IN EACH SUBPANEL OF WEB
C          NUMBER 1
      SUMMA1=0.
      DO 13 I=1,NW
      IF (IULT1(I).EQ.0) GO TO 10
      SUB1V(I)=V1ULT(I)
      GO TO 12
   10 IF (IBUCK1(I).EQ.0) GO TO 11
      SUB1V(I)=GE1(I)*(GAMMA1-GBUCK1(I))*DEP(I)*TW+SUB1SB(I)
      GO TO 12
   11 SUB1V(I)=G*GAMMA1*DEP(I)*TW
   12 VMAX1(I)=SUB1V(I)
      SUMMA1=SUMMA1+SUB1V(I)
   13 CONTINUE
C          LOADING STATE
C          WEB NUMBER 2
      DO 14 I=1,NW
   14 IULT2(I)=0
      DO 16 I=1,NW
      IF (IBUCK2(I).EQ.1) GO TO 15
      V1(I)=DEP(I)*TW*G
      V2(I)=0.
      GO TO 16
   15 V1(I)=GE2(I)*DEP(I)*TW
      V2(I)=SUB2SB(I)-GBUCK2(I)*GE2(I)*DEP(I)*TW
   16 CONTINUE
   17 VVV=0.
      V=0.
      DO 18 I=1,NW
      V=V-V2(I)
      VVV=VVV+V1(I)
   18 CONTINUE
      V=VT2+V
C          CHECK FOR SHEAR FAILURE OF WEB NUMBER 2
      IF (ABS(VVV).LT..1E-15) GO TO 19
      GAMMA2=V/VVV
      GO TO 20
   19 WRITE (IOUT,32) WLOD,VT2,GAMMA2
      IWEBFA=1
      RETURN
C          CHECK FOR SUBPANELS REACHING THEIR ULTIMATE SHEAR
C          CAPACITY
   20 DO 21 I=1,NW
      IF (IULT2(I).EQ.1) GO TO 21
      IF (IBUCK2(I).EQ.0) GO TO 21
      IF (GAMMA2.LT.GAMUL2(I)) GO TO 21
      V2(I)=V2ULT(I)
      V1(I)=0.
```

```
      IULT2(I)=1
      GO TO 17
   21 CONTINUE
C           CALCULATE THE SHEAR FORCE IN EACH SUBPANEL OF WEB
C           NUMBER 2
      SUMMA2=0.
      DO 25 I=1,NW
      IF (IULT2(I).EQ.0) GO TO 22
      SUB2V(I)=V2ULT(I)
      GO TO 24
   22 IF (IBUCK2(I).EQ.0) GO TO 23
      SUB2V(I)=GE2(I)*(GAMMA2-GBUCK2(I))*DEP(I)*TW+SUB2SB(I)
      GO TO 24
   23 SUB2V(I)=G*GAMMA2*DEP(I)*TW
   24 VMAX2(I)=SUB2V(I)
      SUMMA2=SUMMA2+SUB2V(I)
   25 CONTINUE
      GO TO 29
C           UNLOADING STATE
C           WEB NUMBER 1
   26 GAM1=GAMMA1+((VT1-SUMMA1)/(G*D(NW1)*TW))
C           CALCULATE THE SHEAR FORCE IN EACH SUBPANEL OF WEB
C           NUMBER 1
      DO 27 I=1,NW
      SUB1V(I)=VMAX1(I)-(GAMMA1-GAM1)*G*DEP(I)*TW
   27 CONTINUE
C           UNLOADING STATE
C           WEB NUMBER 2
      GAM2=GAMMA2+((VT2-SUMMA2)/(G*D(NW1)*TW))
C           CALCULATE THE SHEAR FORCE IN EACH SUBPANEL OF WEB
C           NUMBER 2
      DO 28 I=1,NW
      SUB2V(I)=VMAX2(I)-(GAMMA2-GAM2)*G*DEP(I)*TW
   28 CONTINUE
C           CALCULATE THE INTERACTION VALUE OF EACH WEB
C           SUBPANEL
   29 DO 30 I=1,NW
      WINTR1(I)=(SUB1V(I)/FVCR(I))**2+(SUB1B(I)/FBCR(I))**2-
     1(SUB1F(I)/FCCR(I))
      WINTR2(I)=(SUB2V(I)/FVCR(I))**2+(SUB2B(I)/FBCR(I))**2-
     1(SUB2F(I)/FCCR(I))
   30 CONTINUE
      IF (IFLAG.EQ.0) GO TO 300
      WRITE (IOUT,35) GAMMA1,GAMMA2
      WRITE (IOUT,34)
      WRITE (IOUT,33) (SUB1F(I),SUB1B(I),SUB2F(I),SUB2B(I),I
     1=1,NW)
      WRITE (IOUT,36) VT1,VT2,(WINTR1(I),SUB1V(I),WINTR2(I),
     1SUB2V(I),I=1,NW)
  300 BSUBV1=SUB1V(NW)
      BSUBV2=SUB2V(NW)
      IF (Q.LT.VV) BSUBV2=-SUB2V(NW)
      RETURN
   31 FORMAT (///,5X,22HSHEAR FAILURE OF WEB 1,/,5X,3HW= ,E1
     12.6,5X,5HVT1= ,E12.6,5X,8HGAMMA1= ,E12.6,///)
   32 FORMAT (///,5X,22HSHEAR FAILURE OF WEB 2,/,5X,3HW= ,E1
     12.6,5X,5HVT2= ,E12.6,5X,8HGAMMA2= ,E12.6,///)
   33 FORMAT (4(5X,E12.6))
```

```
   34 FORMAT (12X,5HSUB1F,12X,5HSUB1B,12X,5HSUB2F,12X,
     15HSUB2B)
   35 FORMAT (5X,8HGAMMA1= ,E12.6,5X,8HGAMMA2= ,E12.6,/)
   36 FORMAT (/,5X,5HVT1= ,E12.6,5X,5HVT2= ,E12.6,//,5X,5
     1HWEB 1,5X,11HINTERACTION,5X,11HSHEAR FORCE,10X,
     25HWEB 2,5X,11HINTERACTION,5X,11HSHEAR FORCE,18(/,10X,
     3E12.6,10X,E12.6,15X,E12.6,10X,E12.6),//)
      END


      SUBROUTINE AFAYM (S1,S2,S3,S4,AXF,YBMO)
C           SUBROUTINE FARCE CALCULATES THE RESULTANT AXIAL
C           FORCE (AXF) AND THE RESULTANT BENDING MOMENT
C           (YBMO) ABOUT THE VERTICAL CENTROIDAL AXIS OF THE
C           SECTION
      DIMENSION STRNW1(20), STRNW2(20)
      COMMON /WEB/ IBUCK1(18),IBUCK2(18),SUB1F(18),SUB2F(18)
     1,SUB1B(18),SUB2B(18)
      COMMON /GEO/ NC,NT,NW,NPC,NDIR,AA,B,TC,DC,TT,AFLSTT,TW
     1,D(20),ASTW(18),NW1,NW2,AFLSTC,DT
      COMMON /MP/ SIGYC,SIGYT,SIGYST,EL,POISSO,SIGYWB
      COMMON /CFB/ PCOMP(100),EPPLC(100)
      COMMON /MOM/ FORCE(20),FORTE(20),W1FOR(18),W2FOR(18),F
     1CORN1,FCORN2
      COMMON /PRO/ CORN,ACFE,RNTPO,DCS,DCST,RNCPO,G,ICIB,TOL
     1AXF,TOLYBM,FACMAG,YBMOY,AXFY
      COMMON /CRUT/ CE,CEINC,CEMAX
      COMMON /TENS/ BSUBV1,BSUBV2,SHEAR1(50),SHEAR2(50),CURV
     1(50)
      COMMON /LWEB/ SAV1B(18),SAV2B(18),SAVSH1(18),SAVSH2(18
     1)
      COMMON /TRMSTO/ INDIC(20), FORTEF(20)
      C1=-((S4-S1)/D(NW1))*DCS-S1
      C2=-((S3-S2)/D(NW1))*DCS-S2
C           CALCULATE THE FORCE AT EACH STIFFENER OF THE
C           COMPRESSION FLANGE (NOTE POSITIVE FORCES)
      DO 5 I=1,NC
      RI=FLOAT(I)
      STRAIN=C1-(RI*(C1-C2)/RNCPO)
      IF (STRAIN.LT.EPPLC(2)) GO TO 3
      IF (STRAIN.GE.EPPLC(NPC)) GO TO 4
      DO 1 J=3,NPC
      JJ=J
      IF (STRAIN.LT.EPPLC(J)) GO TO 2
    1 CONTINUE
    2 CALL PARINT (EPPLC(JJ-2),EPPLC(JJ-1),EPPLC(JJ),PCOMP(J
     1J-2),PCOMP(JJ-1),PCOMP(JJ),STRAIN,FORCE(I))
      GO TO 5
    3 CALL PARINT (EPPLC(1),EPPLC(2),EPPLC(3),PCOMP(1),PCOMP
     1(2),PCOMP(3),STRAIN,FORCE(I))
      GO TO 5
C           IF THE STRAIN OF A COMPRESSION FLANGE SEGMENT
C           IS BEYOND THE LIMITS OF THE INPUT RESPONSE CURVE,
C           A LINEAR EXTENSION OF THE CURVE IS USED TO FIND
C           THE CORRESPONDING FORCE.
    4 FORCE(I)=((PCOMP(NPC)-PCOMP(NPC-1))/(EPPLC(NPC)-EPPLC(
     1NPC-1)))*(STRAIN-EPPLC(NPC))+PCOMP(NPC)
      IF (FORCE(I).LT.0.) FORCE(I)=0.
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    5 CONTINUE
C           CALCULATE THE FORCE IN EACH CORNER OF THE
C           COMPRESSION FLANGE (NOTE POSITIVE FORCES)
      FCORN1=FORCE(1)*CORN*TC/ACFE
      FCORN2=FORCE(NC)*CORN*TC/ACFE
C           CALCULATE THE FORCE IN EACH TENSION FLANGE
C           STIFFENER
      FORMAX=AFLSTT*SIGYST
      C1=S4+(S1-S4)*DT/D(NW1)
      C2=S3+(S2-S3)*DT/D(NW1)
      DO 6 I=1,NT
      STRAIN=C1-((C1-C2)*FLOAT(I)/RNTPO)
      FORTE(I)=STRAIN*EL*AFLSTT
      IF (FORTE(I).GT.FORMAX) FORTE(I)=FORMAX
    6 CONTINUE
C           CALCULATE THE FORCE IN EACH TENSION FLANGE
C           ELEMENT
      IF (ICIB.LT.3) GO TO 21
      S1HEAR=(CE-CURV(ICIB-2))*(SHEAR1(ICIB-2)-SHEAR1(ICIB-1
     1))/(CURV(ICIB-2)-CURV(ICIB-1))+SHEAR1(ICIB-2)
      S2HEAR=(CE-CURV(ICIB-2))*(SHEAR2(ICIB-2)-SHEAR2(ICIB-1
     1))/(CURV(ICIB-2)-CURV(ICIB-1))+SHEAR2(ICIB-2)
      GO TO 22
   21 S1HEAR=0.
      S2HEAR=0.
      DO 26 I=1,NT
 26   INDIC(I)=0
   22 ATFE=B*TT/RNTPO
      DO 23 I=1,NT
      IF(INDIC(I).EQ.1) GOTO 23
      RI=I
      STRAIN =S4-(S4-S3)*RI/RNTPO
      SHEARI=S1HEAR-(S1HEAR-S2HEAR)*RI/RNTPO
      FORMAX=SIGYT**2-3.*SHEARI**2
      IF (FORMAX.LT.0.) FORMAX=0.
      FORMAX=SQRT(FORMAX)
      FORTEF(I)=STRAIN*EL
      IF (FORTEF(I).GT.FORMAX) GOTO 24
      GOTO 25
 24   INDIC(I)=1
      FORTEF(I)=FORMAX
 25   FORTEF(I)=FORTEF(I)*ATFE
   23 CONTINUE
      TCOR1=FORTEF(1)/2.
      TCOR2=FORTEF(NT)/2.
C           CALCULATE THE FORCE IN EACH WEB STIFFENER (BOTH
C           SIDES)
      STRNW1(1)=S1
      STRNW2(1)=S2
      IF (NW.EQ.1) GO TO 8
      DO 7 I=2,NW
      STRNW1(I)=S1+(S4-S1)*D(I)/D(NW1)
      STRNW2(I)=S2+(S3-S2)*D(I)/D(NW1)
      WFMAX=ASTW(I-1)*SIGYST
      W1FOR(I-1)=STRNW1(I)*EL*ASTW(I-1)
      IF (ABS(W1FOR(I-1)).GT.WFMAX) W1FOR(I-1)=SIGN(WFMAX,W1
     1FOR(I-1))
      W2FOR(I-1)=STRNW2(I)*EL*ASTW(I-1)
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      IF (ABS(W2FOR(I-1)).GT.WFMAX) W2FOR(I-1)=SIGN(WFMAX,W2
     1FOR(I-1))
    7 CONTINUE
    8 STRNW1(NW1)=S4
      STRNW2(NW1)=S3
C          CALCULATE THE FORCE AND MOMENT IN EACH WEB
C          SUBPANEL (BOTH SIDES)
C          IF IBUCK FOR A PARTICULAR SUBPANEL EQUALS 1, THE
C          FORCE AND MOMENT IN THAT SUBPANEL ARE NOT CHANGED
C          FROM WHAT WAS PREVIOUSLY CALCULATED
      DO 10 I=1,NW
      DEPTH=D(I+1)-D(I)
      IF (IBUCK1(I).EQ.1) GO TO 9
      AVG=(STRNW1(I)+STRNW1(I+1))/2.
      SUB1F(I)=AVG*EL*TW*DEPTH
      SUB1B(I)=(TW*(STRNW1(I)-AVG)*EL*DEPTH**2)/6.
    9 IF (IBUCK2(I).EQ.1) GO TO 10
      AVG=(STRNW2(I)+STRNW2(I+1))/2.
      SUB2F(I)=AVG*EL*TW*DEPTH
      SUB2B(I)=(TW*(STRNW2(I)-AVG)*EL*DEPTH**2)/6.
   10 CONTINUE
C          CALCULATE THE RESULTANT AXIAL FORCE
      SUM=0.
      DO 11 I=1,NC
   11 SUM=SUM-FORCE(I)
      SUM=SUM-FCORN1-FCORN2
      DO 12 I=1,NT
      SUM=SUM+FORTEF(I)
   12 SUM=SUM+FORTE(I)
      SUM=SUM+TCOR1+TCOR2
      IF (NW.EQ.1) GO TO 14
      DO 13 I=1,NW2
   13 SUM=SUM+W1FOR(I)+W2FOR(I)
   14 DO 15 I=1,NW
   15 SUM=SUM+SUB1F(I)+SUB2F(I)
      AXF=SUM
C          CALCULATE THE BENDING MOMENT ABOUT WEB 2
C          COMPRESSION FLANGE CONTRIBUTION
      SUM=0.
      DO 16 I=1,NC
      RI=FLOAT(I)
   16 SUM=SUM-(B-RI*2.*CORN)*FORCE(I)
      SUM=SUM-(B-CORN/2.)*FCORN1-(CORN/2.)*FCORN2
C          TENSION FLANGE CONTRIBUTION
      DO 17 I=1,NT
      RI=FLOAT(I)
   17 SUM=SUM+(FORTE(I)+FORTEF(I))*(B-(RI*B/RNTPO))
      SUM=SUM+TCOR1*(B-B/(RNTPO*2.))+TCOR2*(B/(RNTPO*2.))
C          WEB STIFFENER CONTRIBUTION
      IF (NW.EQ.1) GO TO 19
      DO 18 I=1,NW2
   18 SUM=SUM+B*W1FOR(I)
C          WEB SUBPANEL CONTRIBUTION
   19 DO 20 I=1,NW
   20 SUM=SUM+B*SUB1F(I)
C          THE BENDING MOMENT ABOUT WEB 2 IS NOW MODIFIED
C          SO THAT IT APPROXIMATES THE BENDING MOMENT ABOUT
C          THE VERTICAL CENTROIDAL AXIS
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C          THE BENDING MOMENT IS ALSO DIVIDED BY FACMAG, A
C          PRECALCULATED CONSTANT WHICH REDUCES THE
C          CALCULATED BENDING MOMENT TO THE SAME ORDER OF
C          MAGNITUDE AS THE RESULTANT AXIAL FORCE
      YBMO=(SUM-(B/2.)*AXF)/FACMAG
      RETURN
      END


      SUBROUTINE PROPRT
C          SUBROUTINE PROPRT CALCULATES CONSTANTS WHICH
C          ARE USED IN OTHER PARTS OF THIS PROGRAM
      COMMON /MP/ SIGYC,SIGYT,SIGYST,EL,POISSO
      COMMON /PRO/ CORN,ACFE,RNTPO,DCS,DCST,RNCPO,G,ICIB,TOL
     1AXF,TOLYBM,FACMAG,YBMOY,AXFY
      COMMON /GEO/ NC,NT,NW,NPC,NDIR,AA,B,TC,DC,TT,AFLSTT,TW
     1,D(20),ASTW(18),NW1,NW2,AFLSTC,DT
      TOLAXF=.0005
      TOLYBM=.0005
      G=EL/(2.*(1.+POISSO))
      IF (NDIR.NE.-1) GO TO 1
      DC=-DC
      DT=-DT
    1 CORN=(B/(FLOAT(NC)+1.))*.5
      ACFE=CORN*TC*2.+AFLSTC
      RNTPO=FLOAT(NT)+1.
      DCS=AFLSTC*DC/ACFE
      DCST=D(NW1)-DCS
      RNC=FLOAT(NC)
      RNCPO=RNC+1.
      SY=(B/6.)*(B*(TC+TT)+6.*TW*D(NW1))
      AREA=B*(TC+TT)+TW*2.*D(NW1)
      FACMAG=SY/AREA
      YBMOY=SIGYST*SY/FACMAG
      AXFY=AREA*SIGYST
      TOLAXF=TOLAXF*AXFY
      TOLYBM=TOLYBM*YBMOY
      RETURN
      END


      SUBROUTINE MOMENT (BMO)
C          SUBROUTINE MOMENT DETERMINES THE BENDING MOMENT
C          ABOUT THE MID PLANE OF THE TENSION FLANGE AFTER
C          THE BENDING MOMENT ABOUT THE VERTICAL CENTROIDAL
C          AXIS AND THE RESULTANT AXIAL FORCE CONVERGE TO
C          ZERO
      COMMON /MOM/ FORCE(20),FORTE(20),W1FOR(18),W2FOR(18),F
     1CORN1,FCORN2
      COMMON /PRO/ CORN,ACFE,RNTPO,DCS,DCST,RNCPO,G,ICIB
      COMMON /WEB/ IBUCK1(18),IBUCK2(18),SUB1F(18),SUB2F(18)
     1,SUB1B(18),SUB2B(18)
      COMMON /GEO/ NC,NT,NW,NPC,NDIR,AA,B,TC,DC,TT,AFLSTT,TW
     1,D(20),ASTW(18),NW1,NW2,AFLSTC,DT
C          CONTRIBUTION OF COMPRESSION FLANGE
      SUM=0.
      DO 1 I=1,NC
    1 SUM=SUM+FORCE(I)
```

```
      SUM=SUM*DCST
      SUM=SUM+D(NW1)*(FCORN1+FCORN2)
C          CONTRIBUTION OF WEB STIFFENERS
      IF (NW.EQ.1) GO TO 3
      DO 2 I=1,NW2
    2 SUM=SUM+(D(I+1)-D(NW1))*(W1FOR(I)+W2FOR(I))
C          CONTRIBUTION OF WEB SUBPANELS
    3 DO 4 I=1,NW
      DIST=(D(I)+D(I+1))/2.-D(NW1)
    4 SUM=SUM+DIST*(SUB1F(I)+SUB2F(I))-SUB1B(I)-SUB2B(I)
C          CONTRIBUTION OF TENSION FLANGE STIFFENERS
      DO 5 I=1,NT
    5 SUM=SUM-DC*FORTE(I)
      BMO=SUM
      RETURN
      END


      SUBROUTINE PARINT (X1,X2,X3,Y1,Y2,Y3,X,Y)
C          SUBROUTINE PARINT IS GIVEN POINTS (X1,Y1),
C          (X2,Y2), AND (X3,Y3).
C          FOR A GIVEN VALUE OF X, IT WILL FIND THE
C          CORRESPONDING VALUE OF Y BY UTILIZING PARABOLIC
C          INTERPOLATION.
      A=(1./(X2-X1))*((Y3-Y2)/(X3-X2)-(Y3-Y1)/(X3-X1))
      B=(Y3-Y1)/(X3-X1)-(X3+X1)*A
      C=Y3-A*X3*X3-B*X3
      Y=A*X*X+B*X+C
      RETURN
      END


      SUBROUTINE PARMAX (Y1,Y2,Y3,X1,X2,X3,X)
C          SUBROUTINE PARMAX IS GIVEN THREE POINTS (X1,Y1),
C          (X2,Y2), AND (X3,Y3).
C          THE X COORDINATE OF THE MAXIMUM WILL BE FOUND BY
C          USING PARABOLIC CURVE FITTING AND DIFFERENTIATION
      A=(1./(X2-X1))*((Y3-Y2)/(X3-X2)-(Y3-Y1)/(X3-X1))
      B=(Y3-Y1)/(X3-X1)-(X3+X1)*A
      X=-B/(2.*A)
      RETURN
      END
```