```
0101          IF(ISX.LT.4)THEN
0102            ISX= ISX+1
0103            DXL= DX(ISX)
0104            IF(ITER.EQ.'Y')WRITE(6,26)DXL
0105            GOTO 100
0106          ENDIF
0107          IF(IADD.EQ.0)THEN
0108          IF(SMAX.LT.STRLMT)GOTO 200
0109          IADD= 1
0110          ENDIF
0111          IF(SMAX.LT.STRLMT)THEN
0112            IADD= IADD + 1
0113            FP= FMAX
0114          ELSE
0115            FMAX= FP
0116          ENDIF
0117          IF(ABS(SMAX-STRLMT).LT.1.0)GOTO 200
0118          IF(IADD.LT.8)THEN
0119            FP= FP - FINC(IADD)
0120            GOTO 50
0121          ENDIF
0122      200 LQ= L1/3.
0123            WRITE(6,3)OD
0124            WRITE(6,4)TID
0125            WRITE(6,5)EM
0126            WRITE(6,6)GAMMA
0127            WRITE(6,7)KS
0128            WRITE(6,8)SIGINT
0129            WRITE(6,9)STRLMT
0130            WRITE(6,10)W1
0131          WRITE(6,16)LQ,FP
0132          IF(FILE.EQ.'Y')WRITE(1,16)LQ,FP
0133          WRITE(6,17)
0134          READ(5,13)ANS
0135          IF(ANS.EQ.'y')ANS='Y'
0136          IF(ANS.NE.'Y')STOP
0137          WRITE(6,18)
0138          READ(5,*)DZ
0139          IF(FILE.NE.'Y')THEN
0140            WRITE(1,1)
0141            WRITE(1,3)OD
0142            WRITE(1,4)TID
0143            WRITE(1,5)EM
0144            WRITE(1,6)GAMMA
0145            WRITE(1,7)KS
0146            WRITE(1,8)SIGINT
0147            WRITE(1,9)STRLMT
0148            WRITE(1,10)W1
0149            WRITE(1,16)LQ,FP
0150          ENDIF
```

```
      WRITE(1,19)
      LSEG= LQ/4.0
      IMAX= NINT(LSEG/DZ) + 1
      DO 1000 I=0,IMAX
      Z= DZ*FLOAT(I)
      IF(Z.GT.LSEG)THEN
        ZST= Z-LSEG
        GOTO 1001
      ENDIF
      X= Z*12.0
      AX= AG*X
      BX=BG*X
      SS= SIN(AX)*SINH(BX)
      ZC= COS(AX)*COSH(BX)
      LX=LM*X
      SLL= SINH(LX)
      CLL= COSH(LX)
      X2= X*X
C
      WT=  T1 + T2*CLL - QON/2.*X2
      M= C2*(F0*ZC+E0*SS) + C3*(E0*ZC-F0*SS)
     &   +LM2*T2*CLL - QON
C
      ST= ABS(SIGMA)+ABS(M)*EM*OD/2.
 1000 WRITE(1,20)Z,WT,ST
 1001 WRITE(6,21)ST1
      IZ=0
      DO 2000 I=0,IMAX
      Z= ZST + DZ*FLOAT(I)
      IF(Z.GE.LSEG)THEN
        IF(IZ.EQ.1)GOTO 2001
        IZ 1
        Z= LSEG
      ENDIF
      X= Z*12.0
      AX=AG*X
      BX=BG*X
      SS= SIN(AX)*SINH(BX)
      SC= SIN(AX)*COSH(BX)
      ZS= COS(AX)*SINH(BX)
      ZC= COS(AX)*COSH(BX)
      XL= L1-X
      LX= LM*XL
      SLL= SINH(LX)
      CLL= COSH(LXj
      XL2=XL*XL
C
      WT=  T3 + T4*CLL + QON/2.*XL2
      M= C5*(E0*ZS-F0*SC)+C6*(E0*SS+F0*ZC)+C7*(E0*ZC-F0*SS)
     +   +C8*(F0*ZS+E0*SC)
```

```
0201          &   + LM2*T4*CLL + QON
0202      C
0203           ST= ABS(SIGMA)+ABS(M)*EM*OD/2.
0204           ZT= Z + LSEG
0205       2000 WRITE(1,20)ZT,WT,ST
0206       2001 WRITE(6,22)ST2
0207           WRITE(6,23)ST3
0208           WRITE(6,24)STL
0209           SIGMA= SIGINT + STL
0210           WRITE(6,25)SIGMA
0211           STOP
0212          1 FORMAT(//'0This program calculates a trench profile for lowering'
0213           &,' a pipeline in service.'/' The maximum stress in the pipeline'
0214           &,' is kept below a given stress limit.')
0215          2 FORMAT(///'0ENTER THE FOLLLOWING DATA::'
0216          3 FORMAT(/'$ Outside diameter of pipe                    (inches): '
0217           &,:,F13.3)
0218          4 FORMAT('$ Wall thickness of pipe                       (inches): '
0219           &,:,F13.3)
0220          5 FORMAT('$ Elastic modulus of pipe material               (psi): '
0221           &,:,F13.3)
0222          6 FORMAT('$ Specific weight of pipe material          (lb/in**3): '
0223           &,:,F13.3)
0224          7 FORMAT('$ Soil stiffness parameter                      (psi): '
0225           &,:,F13.3)
0226          8 FORMAT('$ Existing axial stress in pipeline             (psi): '
0227           &,:,F13.3)
0228          9 FORMAT('$ Maximum allowable stress in pipeline          (psi): '
0229           &,:,F13.3)
0230         10 FORMAT('$ Lowering depth @ center of pipeline         (inches): '
0231           &,:,F13.3)
0232         11 FORMAT('0 Output will be displayed on the terminal screen.')
0233         12 FORMAT('$ Do you want an additional copy on file FOR001? (Y/N): ')
0234         13 FORMAT(A1)
0235         14 FORMAT('$ Do you want iterative solutions displayed    (Y/N): ')
0236         15 FORMAT('  L=',F9.3,'  Wt Frac=',F7.4,'  Sig(added)=',F7.0,
0237           & '  Sig(max)=',F8.0)
0238         16 FORMAT('0      Trench length                          (feet): ',
0239           &F13.3/'       Weight fraction used for lowering pipeline    : ',
0240           &F13.3/)
0241         17 FORMAT('$ Do you want to generate X-Y data on FOR001?   (Y/N): ')
0242         18 FORMAT('$ Enter length increment for generating X-Y data(feet): ')
0243         19 FORMAT('  X     =  Distance from center of pipeline'/
0244           &       '  WT    =  Depth of trench'/
0245           &       '  STRESS=  Maximum stress @ X'//
0246           &      5X,'X',5X,'WT',5X,'STRESS'/)
0247         20 FORMAT(2X,F5.0,F9.2,F9.0)
0248         21 FORMAT('0      Maximum stress in Region 1               (psi): ',
0249           &  F13.3)
0250         22 FORMAT('       Maximum stress in Region 2               (psi): ',
```

```
0251          &  F13.3)
0252         23 FORMAT('       Maximum stress in Region 3                (psi): ',
0253          &  F13.3)
0254         24 FORMAT('       Axial stress due to length increase       (psi): ',
0255          &  F13.3)
0256         25 FORMAT('       Total axial stress                        (psi): ',
0257          &  F13.3//)
0258         26 FORMAT('0    DXL=',F5.1)
0259            END
```

```
0001          SUBROUTINE DEPTH
0002          IMPLICIT REAL*16 (A-Z)
0003          INTEGER IADD
0004      C
0005          DIMENSION LINC(7)
0006          COMMON/PARA/QK,FP,KS,NM,QON,QOK,W1,H1,L,L0,LM,LM2
0007          DATA LINC/50.,10.,1.,0.1,0.01,0.001,0.0001/
0008      C
0009          L0= L
0010          QOK= QK*FP
0011          QON= QOK*KS/NM
0012          L= 150.0
0013          IADD= 1
0014        100 L1= L*3.
0015          H1= 2.*QON/LM2*(1./COSH(LM*L1)-1.)+QON*L1*L1+QK-QOK
0016          H= ABS(H1)
0017          IF(H.LT.W1)THEN
0018            LMIN= L
0019          ELSE
0020            IADD= IADD + 1
0021            L= LMIN
0022          ENDIF
0023      C 200 IF(ABS(W1-H).LT.0.01)RETURN
0024        200 IF(IADD.LT.8)THEN
0025              L= L + LINC(IADD)
0026              GOTO 100
0027          ENDIF
0028          RETURN
0029          END
```

```
0001            SUBROUTINE COEFF
0002            IMPLICIT REAL*16 (A-Z)
0003            COMMON/PARA/QK,FP,KS,NM,QON,QOK,W1,H1,LX,LO,LM,LM2
0004            COMMON/CONST/C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,T1,T2,T3,T4
0005            COMMON/GREEK/AG,BG,AG2,BG2,E0,F0,G0,H0
0006      C
0007      C
0008            L1= LX*3.
0009            AL= AG*L1
0010            BL= BG*L1
0011            SS= SIN(AL)*SINH(BL)
0012            SC= SIN(AL)*COSH(BL)
0013            ZS= COS(AL)*SINH(BL)
0014            ZC= COS(AL)*COSH(BL)
0015      C
0016            A= -ZC/SS
0017            B= 1/SS
0018            C= 2.*QOK/SS
0019            A2= AG*ZS+BG*SC
0020            B2= BG*ZS-AG*SC
0021            X3= B2+A*A2
0022            D= BG/X3
0023            E= -B*A2/X3
0024            F= AG/X3
0025            G= -C*A2/X3
0026            A2= A*D
0027            B2= A*E+B
0028            D2= A*F
0029            E2= A*G+C
0030            A3= E0*SS + F0*ZC
0031            B3= -F0*SS + E0*ZC
0032            X5= A2*A3+B3*D
0033            H= F0/X5
0034            I= (E0-A3*B2-E*B3)/X5
0035            J= -(A3*D2+B3*F)/X5
0036            K= -(A3*E2+B3*G)/X5
0037            A3= D*H
0038            B3= D*I+E
0039            D3= D*J+F
0040            E3= D*K+G
0041            AZ= A2*H
0042            BZ= A2*I+B2
0043            DZ= A2*J+D2
0044            EZ= A2*K+E2
0045            A2= AZ
0046            B2= BZ
0047            D2= DZ
0048            E2= EZ
0049            A4= G0*ZS+H0*SC
0050            B4= H0*ZS-G0*SC
```

```
0051          X6= A4*A2+B4*A3-H0*H
0052          L= (H0*I-A4*B2-B4*B3)/X6
0053          M= (G0+H0*J-A4*D2-B4*D3)/X6
0054          N= (H0*K-A4*E2-B4*E3)/X6
0055          A5= H*L+I
0056          B5= H*M+J
0057          D5= H*N+K
0058          X7= ZC+ZS*A5+SS*L
0059          O= -(SC+ZS*B5+SS*M)/X7
0060          P= 1./X7
0061          Q= -(Q0K+ZS*D5+SS*N)/X7
0062          A6= M+L*O
0063          B6= L*P
0064          D6= N+L*Q
0065          AX5= A5*O+B5
0066          BX5= A5*P
0067          DX5= A5*Q+D5
0068          A5=AX5
0069          B5=BX5
0070          D5=DX5
0071          A7= -AG*SS+BG*ZC
0072          B7= AG*ZS+BG*SC
0073          D7= BG*ZS-AG*SC
0074          E7= BG*SS+AG*ZC
0075          X8= E7+A7*A5+B7*A6+D7*O
0076          R= -(BG+A7*B5+B7*B6+D7*P)/X8
0077          S= AG/X8
0078          T= -(A7*D5+B7*D6+D7*Q)/X8
0079          A7= P+O*R
0080          B7= O*S
0081          D7= Q+O*T
0082          AX6= B6+A6*R
0083          BX6= A6*S
0084          DX6= D6+A6*T
0085          A6= AX6
0086          B6= BX6
0087          D6= DX6
0088          AX5= B5+A5*R
0089          BX5= A5*S
0090          DX5= D5+A5*T
0091          A5= AX5
0092          B5= BX5
0093          D5= DX5
0094          A8= E0*ZS-F0*SC
0095          B8= E0*SS+F0*ZC
0096          D8= -F0*SS+E0*ZC
0097          E8= F0*ZS+E0*SC
0098          X9= E0-(A8*A5+B8*A6+D8*A7+E8*R)
0099          U= (F0+A8*B5+B8*B6+D8*B7+E8*S)/X9
0100          M2= LM2*T4+Q0N
```