

```

c-----Usable columns for a Fortran 77 program (1-72)-----
c
c Declare variables
c
c-----
c
c      implicit real*8 (d,t,w,x,y,z)
c      implicit integer (n,e,b)
c      integer i,j,k
c      real*8 NVar2D(1:20000,1:2)
c      real*8 NVar(1:200000,1:3)
c      integer ESS(1:20000,1:4)
c      integer EN(1:200000,1:8)
c
c NVar2D(x,y)
c NVar(x,y,z)
c ESS(n1,n2,n3,n4)
c EN(n1,n2,...,n8)
c
c-----
c
c Define constants
c
c-----
c
c Xfine 1/2 Fine mesh area width in inches
c
c      Xfine=1.75
c
c zDepth = z depth in inches
c
c      zDepth=4.5
c
c NumLayz = the number of layers in the z direction
c
c      NumLayzE=30
c
c Number of elements (divisible by 6) for the inner grid
c
c      NumEx=30
c
c NumSLay = the number of layers of outer elements
c
c      NumSLay=26
c
c-----
c
c Write format statements
c
c-----
c
100  format ()
101  format (I8)
102  format (5(I8))
103  format (I8,I5,3(E20.12),I5)
104  format (I8,I5,8(I8))
105  format (A17)
106  format (A27)
107  format (A7,I8,A4,I8,A21)
108  format (3(E20.12,1X),E20.12)
109  format (7(I8,2X),I8)

```

```

c
c-----
c
c Open the Penetrator info file
c-----
c
c      open(9,file='Target Info.txt')
c      write(9,*)' '
c-----
c
c Begin executing the program
c-----
c
c Convert to mm
c
c      Xfine=Xfine*25.4
c
c      write(9,*)'The inner area spans',2*Xfine,' mm. in x'
c      write(9,*)'The inner area spans',2*(Xfine/25.4),' in. in x'
c      write(9,*)' '
c-----
c
c Number of elements in the y direction
c
c      NumEy=NumEx/2
c-----
c
c Create x and y (same as x here) increments
c
c      NumNx=NumEx+1
c      NumNy=NumEy+1
c      xmax=Xfine
c      xmin=-Xfine
c      ymin=0.0
c      del=(xmax-xmin)/(NumEx)
c-----
c
c Begin the node counter at zero
c
c      n=0
c-----
c
c Create the inner area of nodes
c-----
c
c
c      do i=1,NumNx
c        do j=1,NumNy
c          x=xmin+del*(i-1)
c          y=ymin+del*(j-1)
c          n=n+1
c          NVar2D(n,1)=x
c          NVar2D(n,2)=y
c          if (i.eq.NumNx.and.j.eq.1) then
c            ncl=n
c          end if
c        end do
c      end do
c
c
c

```

```

c ni= the # of the last one in the inner area
c
    ni=n
c
    write(9,*)'There are',ni,' nodes in the inner area.'
    write(9,*)' '
c
c Set the element counter to zero
c
    e=0
c
c-----
c
c Create the elements in the inner area
c
c-----
c
    do i=1,NumEx
        n1=1+NumNy*(i-1)
        n4=n1+1
        n2=1+NumNy*(i)
        n3=n2+1
        e=e+1
        ESS(e,1)=n1
        ESS(e,2)=n2
        ESS(e,3)=n3
        ESS(e,4)=n4
        do j=1,NumEy-1
            n1=n4
            n4=n1+1
            n2=n3
            n3=n2+1
            e=e+1
            ESS(e,1)=n1
            ESS(e,2)=n2
            ESS(e,3)=n3
            ESS(e,4)=n4
        end do
    end do
c
c ei= the # of the last one in the inner area
c
    ei=e
c
    write(9,*)'There are',ei,' elements in the inner area.'
    write(9,*)' '
c
c-----
c
c Create the middle row of transition nodes
c
c-----
c
c Right side row
c
    xmid=Xfine+del*1.5
    ymid=del*1.5
    n=n+1
    NVar2D(n,1)=xmid
    NVar2D(n,2)=ymid-del*0.5
c

```

```

c nc2 = the # of the first node in the middle row of transition nodes
c
  nc2=n
c
  n=n+1
  NVar2D(n,1)=xmid
  NVar2D(n,2)=ymid+del*0.5
c
  do i=1, ((NumNy/3)-1)
    ymid=ymid+del*3
    n=n+1
    NVar2D(n,1)=xmid
    NVar2D(n,2)=ymid-del*0.5
    n=n+1
    NVar2D(n,1)=xmid
    NVar2D(n,2)=ymid+del*0.5
c
  end do
c
c Top row
c
  xmid=Xfine-del*1.5
  ymid=Xfine+del*1.5
  n=n+1
  NVar2D(n,1)=xmid+del*0.5
  NVar2D(n,2)=ymid
  n=n+1
  NVar2D(n,1)=xmid-del*0.5
  NVar2D(n,2)=ymid
c
  do i=1, ((NumNx/3)-1)
    xmid=xmid-del*3
    n=n+1
    NVar2D(n,1)=xmid+del*0.5
    NVar2D(n,2)=ymid
    n=n+1
    NVar2D(n,1)=xmid-del*0.5
    NVar2D(n,2)=ymid
  end do
c
c Left side row
c
  xmid=-Xfine-del*1.5
  ymid=Xfine-del*1.5
  n=n+1
  NVar2D(n,1)=xmid
  NVar2D(n,2)=ymid+del*0.5
  n=n+1
  NVar2D(n,1)=xmid
  NVar2D(n,2)=ymid-del*0.5
c
  do i=1, ((NumNy/3)-1)
    ymid=ymid-del*3
    n=n+1
    NVar2D(n,1)=xmid
    NVar2D(n,2)=ymid+del*0.5
    n=n+1
    NVar2D(n,1)=xmid
    NVar2D(n,2)=ymid-del*0.5
  end do
c

```

```

c-----
c
c Create the outer layer of transition nodes
c
c-----
c
c      del=del*3
c
c Right side row
c
c nc3 = the node # of the first node in the outer row of transition
nodes
c
c      x=Xfine+del
c      do j=1, ((NumNy/3)+2)
c          n=n+1
c          NVar2D(n,1)=x
c          NVar2D(n,2)=del*(j-1)
c          if (j.eq.1) then
c              nc3=n
c          end if
c      end do
c
c Top row
c
c      y=Xfine+del
c      do j=1, ((NumNx/3)+2)
c          n=n+1
c          NVar2D(n,1)=Xfine-(del*(j-1))
c          NVar2D(n,2)=y
c      end do
c
c Left side row
c
c      x=-Xfine-del
c      do j=1, ((NumNy/3)+1)
c          n=n+1
c          NVar2D(n,1)=x
c          NVar2D(n,2)=Xfine-(del*(j-1))
c      end do
c
c-----
c
c Create the transition elements
c
c-----
c
c Right side row
c
c      n1=nc1
c      n2=n1+1
c      n3=n2+1
c      n4=n3+1
c      n5=nc2
c      n6=n5+1
c      n7=nc3
c      n8=n7+1
c      e=e+1
c      ESS(e,1)=n1
c      ESS(e,2)=n7
c      ESS(e,3)=n5

```

```

ESS (e, 4)=n2
e=e+1
ESS (e, 1)=n2
ESS (e, 2)=n5
ESS (e, 3)=n6
ESS (e, 4)=n3
e=e+1
ESS (e, 1)=n3
ESS (e, 2)=n6
ESS (e, 3)=n8
ESS (e, 4)=n4
e=e+1
ESS (e, 1)=n7
ESS (e, 2)=n8
ESS (e, 3)=n6
ESS (e, 4)=n5
c
do j=1, ((NumEy/3)-1)
  n1=n4
  n2=n1+1
  n3=n2+1
  n4=n3+1
  n5=n6+1
  n6=n5+1
  n7=n8
  n8=n7+1
  e=e+1
  ESS (e, 1)=n1
  ESS (e, 2)=n7
  ESS (e, 3)=n5
  ESS (e, 4)=n2
  e=e+1
  ESS (e, 1)=n2
  ESS (e, 2)=n5
  ESS (e, 3)=n6
  ESS (e, 4)=n3
  e=e+1
  ESS (e, 1)=n3
  ESS (e, 2)=n6
  ESS (e, 3)=n8
  ESS (e, 4)=n4
  e=e+1
  ESS (e, 1)=n7
  ESS (e, 2)=n8
  ESS (e, 3)=n6
  ESS (e, 4)=n5
end do
c
c Top right corner
c
  n1=n8
  n2=n1+1
  n3=n2+1
  n4=n4
  e=e+1
  ESS (e, 1)=n1
  ESS (e, 2)=n2
  ESS (e, 3)=n3
  ESS (e, 4)=n4
c
c Top row

```

c

```
n7=n3
n1=n4
n2=n1-NumNy
n3=n2-NumNy
n4=n3-NumNy
n5=n6+1
n6=n5+1
n8=n7+1
e=e+1
ESS(e,1)=n1
ESS(e,2)=n7
ESS(e,3)=n5
ESS(e,4)=n2
e=e+1
ESS(e,1)=n2
ESS(e,2)=n5
ESS(e,3)=n6
ESS(e,4)=n3
e=e+1
ESS(e,1)=n3
ESS(e,2)=n6
ESS(e,3)=n8
ESS(e,4)=n4
e=e+1
ESS(e,1)=n7
ESS(e,2)=n8
ESS(e,3)=n6
ESS(e,4)=n5
```

c

```
do j=1, ((NumEx/3)-1)
  n1=n4
  n2=n1-NumNy
  n3=n2-NumNy
  n4=n3-NumNy
  n5=n6+1
  n6=n5+1
  n7=n8
  n8=n7+1
  e=e+1
  ESS(e,1)=n1
  ESS(e,2)=n7
  ESS(e,3)=n5
  ESS(e,4)=n2
  e=e+1
  ESS(e,1)=n2
  ESS(e,2)=n5
  ESS(e,3)=n6
  ESS(e,4)=n3
  e=e+1
  ESS(e,1)=n3
  ESS(e,2)=n6
  ESS(e,3)=n8
  ESS(e,4)=n4
  e=e+1
  ESS(e,1)=n7
  ESS(e,2)=n8
  ESS(e,3)=n6
  ESS(e,4)=n5
end do
```

c

c Top left corner

c

```
n1=n8
n2=n1+1
n3=n2+1
n4=n4
e=e+1
ESS(e,1)=n1
ESS(e,2)=n2
ESS(e,3)=n3
ESS(e,4)=n4
```

c

c Left side row

c

```
n7=n3
n1=n4
n2=n1-1
n3=n2-1
n4=n3-1
n5=n6+1
n6=n5+1
n8=n7+1
e=e+1
ESS(e,1)=n1
ESS(e,2)=n7
ESS(e,3)=n5
ESS(e,4)=n2
e=e+1
ESS(e,1)=n2
ESS(e,2)=n5
ESS(e,3)=n6
ESS(e,4)=n3
e=e+1
ESS(e,1)=n3
ESS(e,2)=n6
ESS(e,3)=n8
ESS(e,4)=n4
e=e+1
ESS(e,1)=n7
ESS(e,2)=n8
ESS(e,3)=n6
ESS(e,4)=n5
```

c

```
do j=1, ((NumEy/3)-1)
  n1=n4
  n2=n1-1
  n3=n2-1
  n4=n3-1
  n5=n6+1
  n6=n5+1
  n7=n8
  n8=n7+1
  e=e+1
  ESS(e,1)=n1
  ESS(e,2)=n7
  ESS(e,3)=n5
  ESS(e,4)=n2
  e=e+1
  ESS(e,1)=n2
  ESS(e,2)=n5
  ESS(e,3)=n6
```

```

        ESS(e,4)=n3
        e=e+1
        ESS(e,1)=n3
        ESS(e,2)=n6
        ESS(e,3)=n8
        ESS(e,4)=n4
        e=e+1
        ESS(e,1)=n7
        ESS(e,2)=n8
        ESS(e,3)=n6
        ESS(e,4)=n5
    end do
c
c-----
c
c Create the layers of nodes for the mid-size elements
c-----
c
c nc5 = the node # of the first node used (updated in each loop)
c
c     nc5=nc3
c
c     do i=1,NumSLay
c
c nc4 = the node # of the first node in each layer (updated in each
loop)
c
c     nc4=nc5
c
c nc5 = the node # of the first node in each layer of mid-size nodes
c
c     x=Xfine+del*(i+1)
c     do j=1,((NumNy/3)+i+2)
c         n=n+1
c         NVar2D(n,1)=x
c         NVar2D(n,2)=del*(j-1)
c         if (j.eq.1) then
c             nc5=n
c         end if
c     end do
c     y=Xfine+del*(i+1)
c     do j=1,((NumNx/3)+(i*2)+2)
c         n=n+1
c         NVar2D(n,1)=x-del*j
c         NVar2D(n,2)=y
c     end do
c     x=-Xfine-del*(i+1)
c     do j=1,((NumNy/3)+(i+1))
c         n=n+1
c         NVar2D(n,1)=x
c         NVar2D(n,2)=y-del*j
c     end do
c
c-----
c
c Create the mid-size elements
c-----
c
c Right side row

```

```

c
    n1=nc5
    n2=n1+1
    n4=nc4
    n3=n4+1
    e=e+1
    ESS(e,1)=n1
    ESS(e,2)=n2
    ESS(e,3)=n3
    ESS(e,4)=n4
    do j=1, ((NumNy/3)+i-1)
        n1=n2
        n2=n1+1
        n4=n3
        n3=n4+1
        e=e+1
        ESS(e,1)=n1
        ESS(e,2)=n2
        ESS(e,3)=n3
        ESS(e,4)=n4
    end do

```

```

c
c Top right corner
c

```

```

    n1=n2
    n4=n3
    n2=n1+1
    n3=n2+1
    e=e+1
    ESS(e,1)=n1
    ESS(e,2)=n2
    ESS(e,3)=n3
    ESS(e,4)=n4

```

```

c
    do j=1, ((NumNx/3)+i*2)
        n1=n4
        n2=n3
        n3=n2+1
        n4=n1+1
        e=e+1
        ESS(e,1)=n1
        ESS(e,2)=n2
        ESS(e,3)=n3
        ESS(e,4)=n4
    end do

```

```

c
c Top left corner
c

```

```

    n1=n4
    n2=n3
    n3=n2+1
    n4=n3+1
    e=e+1
    ESS(e,1)=n1
    ESS(e,2)=n2
    ESS(e,3)=n3
    ESS(e,4)=n4

```

```

c
    do j=1, ((NumNy/3)+i)
        n2=n1
        n1=n1+1
    end do

```

```

        n3=n4
        n4=n4+1
        e=e+1
        ESS(e,1)=n1
        ESS(e,2)=n2
        ESS(e,3)=n3
        ESS(e,4)=n4
    end do
c
    end do
c
c Num2DN = final number of 2 D nodes
c
    Num2DN=n
c
c xWidth = the final width of the target in the x - direction
c
    xWidth=abs(NVar2D(Num2DN,1))
c
    write(9,*)'The target spans',2*xWidth,' mm in x.'
    write(9,*)'The target spans',2*(xWidth/25.4),' in in x.'
    write(*,*)' '
    write(*,*)'The target spans',2*(xWidth/25.4),' in in x.'
    write(9,*)' '
c
    write(9,*)'There are',Num2DN,' 2-D nodes in the target.'
    write(9,*)' '
c
c NumE2D = final number of 2 D elements
c
    Num2DE=e
c
    write(9,*)'There are',Num2DE,' 2-D elements in the target.'
    write(9,*)' '
c
c-----
c
c Create the Dyna3D master surface cards
c
c-----
c
    open(1,file='D T MS Cards.txt')
c
    do i=1,Num2DE
        n1=ESS(i,1)
        n2=ESS(i,2)
        n3=ESS(i,3)
        n4=ESS(i,4)
        write(1,102)i,n1,n2,n3,n4
    end do
c
    close(1)
c
    write(*,*)' '
    write(*,*)'"D T MS Cards.txt" has been written.'
c
c-----
c
c Create the 2-D ANSTS test file
c
c-----

```

```

c
  open(1,file='ANSYS 2D Target.txt')
  write(1,*) '/FILNAM, 2-D Test Plot'
  write(1,*) '/prep7'
  write(1,*) '/TITLE, 2-D Test Plot'
  write(1,*) 'ANTYPE,static'
  write(1,*) '!*'
  write(1,*) 'et,1,plane42'
  write(1,*) '!*'
  do i=1,Num2DN
    write(1,*) 'n,,',NVar2D(i,1),',',',',NVar2D(i,2)
  end do
  write(1,*) '!*'
  do i=1,Num2DE
    write(1,*) 'e,',',',ESS(i,1),',',',',ESS(i,2),',',',',ESS(i,3),',',',',ESS(i,4)
  end do
  close(1)

c
c   write(*,*) ' '
c   write(*,*) '"ANSYS 2D Target.txt" has been written.'
c
-----
c
c Extrude in the z direction
c
-----
c
c Convert to mm
c
  zDepth=zDepth*25.4
c
c Create z increments
c
  zmax=0.0
  zmin=-zDepth
  del=(zmax-zmin)/(NumLayzE)
  NumLayzN=NumLayzE+1
c
-----
c
c Extrude the layers of nodes
c
-----
c
c Reset the node counter to zero
c
  n=0
c
c Set initial z to zero
c
  z=0.0
  do i=1,NumLayzN
    z=-del*(i-1)
    do j=1,Num2DN
      n=n+1
      NVar(n,1)=NVar2D(j,1)
      NVar(n,2)=NVar2D(j,2)
      NVar(n,3)=z
    end do
  end do

```

```

c
c   NumN=n
c
c   NumN=n
c
c   write(9,*)'There are',NumN,' 3-D nodes in the target.'
c   write(9,*)' '
c   write(*,*)' '
c   write(*,*)'There are',NumN,' 3-D nodes in the target.'
c   write(*,*)' '
c
c zFinal = the final dpeth of the target (in the z - direction)
c
c   zFinal=abs(NVar(NumN,3))
c
c   write(9,*)'The target spans',zFinal,' mm in z'
c   write(9,*)'The target spans',zFinal/25.4,' in in z'
c   write(9,*)' '
c
c-----
c
c Extrude the layers of elements
c
c-----
c
c Reset the element counter to zero
c
c   e=0
c
c   do i=1,NumLayzE
c     do j=1,Num2DE
c       e=e+1
c       EN(e,1)=ESS(j,1)+Num2DN*(i-1)
c       EN(e,2)=ESS(j,2)+Num2DN*(i-1)
c       EN(e,3)=ESS(j,3)+Num2DN*(i-1)
c       EN(e,4)=ESS(j,4)+Num2DN*(i-1)
c       EN(e,5)=EN(e,1)+Num2DN
c       EN(e,6)=EN(e,2)+Num2DN
c       EN(e,7)=EN(e,3)+Num2DN
c       EN(e,8)=EN(e,4)+Num2DN
c     end do
c   end do
c
c   NumE=e
c
c   write(9,*)'There are',NumE,' 3-D elements in the target.'
c   write(9,*)' '
c
c   write(*,*)' '
c   write(*,*)'"Target Info.txt" has been written.'
c
c-----
c
c Write the Dyna3D node cards
c
c-----
c
c   open(1,file='D T N Cards.txt')
c
c Write the 10 info lines
c

```

```

        write(1,101)Num2DN
        write(1,101)Num2DE
        write(1,101)NumN
        write(1,101)NumE
        write(1,*)'line 5'
        write(1,*)'line 6'
        write(1,*)'line 7'
        write(1,*)'line 8'
        write(1,*)'line 9'
        write(1,*)'line 10'
c
c Define the mins and max
c
        xmax=xWidth
        ymax=xmax
        xmin=-xmax
        ymin=0.0
        zmax=0.0
        zmax=-zFinal
c
c Write each card while checking and instituting the proper BC
c
c BCr=2 - no y translation (symmetry)
c BCr=7 - no x,y,z translation
c BCr=0 - no rotational BC
c
        BCr=0
c
c Set a tolerance for locations
c
        Tol=0.00001
c
        do i=1,NumN
            x=NVar(i,1)
            y=NVar(i,2)
            z=NVar(i,3)
            if (y.gt.(ymax-Tol).and.y.lt.(ymax+Tol)) then
                BCr=7
            else if (x.lt.(xmin+Tol).and.x.gt.(xmin-Tol)) then
                BCr=7
            else if (x.gt.(xmax-Tol).and.x.lt.(xmax+Tol)) then
                BCr=7
            else if (y.lt.(ymin+Tol).and.y.gt.(ymin-Tol)) then
                BCr=2
            else
                BCr=0
            end if
            write(1,103)i,BCr,x,y,z,BCr
        end do
c
        close(1)
c
c        write(*,*)' '
c        write(*,*)'"D T N Cards.txt" has been written.'
c
c-----
c
c Write the dyna3d element cards
c
c-----
c

```

```

c Set the material to 1
c
c   Mat=1
c
c NOTE: node numbering is reversed for the target element cards
c
c   open(1,file='D T E Cards.txt')
c
c   do i=1,NumE
c     n1=EN(i,1)
c     n2=EN(i,4)
c     n3=EN(i,3)
c     n4=EN(i,2)
c     n5=EN(i,5)
c     n6=EN(i,8)
c     n7=EN(i,7)
c     n8=EN(i,6)
c     write(1,104) i,Mat,n1,n2,n3,n4,n5,n6,n7,n8
c   end do
c
c   close(1)
c
c   write(*,*) ' '
c   write(*,*) '"D T E Cards.txt" has been written.'
c
c-----
c
c Create a Tecplot test file
c
c-----
c
c   open(1,file='Tecplot Target.dat')
c
c   write(1,105) 'TITLE="Test Plot"'
c   write(1,106) 'VARIABLES="X","Y","Z","Mat"'
c   write(1,107) 'ZONE N=',NumN,',', E=',',NumE,',', F=FEPOINT, ET=BRICK'
c
c   do i=1,NumN
c     x=NVar(i,1)
c     y=NVar(i,2)
c     z=NVar(i,3)
c     write(1,108) x,y,z,Mat*1.0
c   end do
c
c   write(1,*) ' '
c
c   do i=1,NumE
c     n1=EN(i,1)
c     n2=EN(i,2)
c     n3=EN(i,3)
c     n4=EN(i,4)
c     n5=EN(i,5)
c     n6=EN(i,6)
c     n7=EN(i,7)
c     n8=EN(i,8)
c     write(1,109) n1,n2,n3,n4,n5,n6,n7,n8
c   end do
c
c   write(*,*) ' '
c   write(*,*) '"Tecplot Target.dat" has been written.'
c   write(*,*) ' '

```

```
c
c-----
c
c End of the program
c
c-----

      end
c
```