CHAPTER THREE

Solids of Revolution

Example 3.1 Analysis of a rotating disk p. 129

Consider a 1 in thick disk with inner radius 3 in and outer radius 9 in. The disk is rotating at 5000 rpm (revolutions per minute). The material properties are: density = 0.283 lbs / in^3, E = 30 x 10^{6}psi and ν = 0.3.

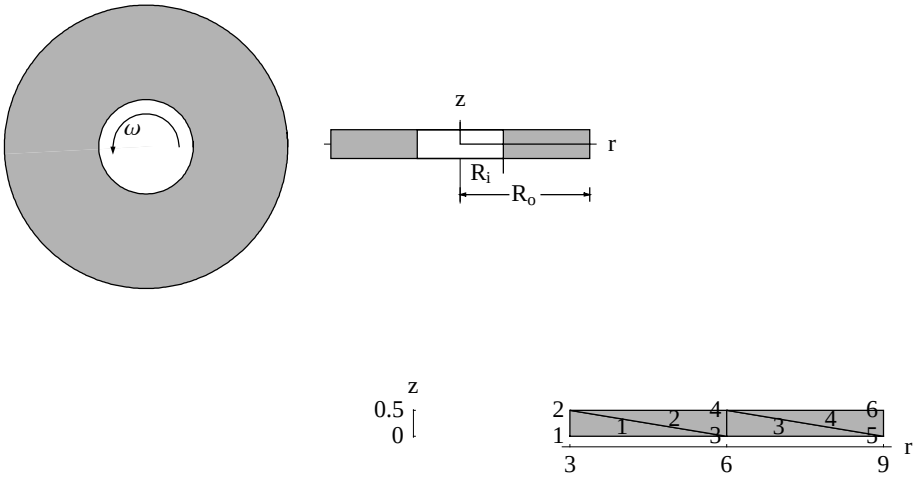


Figure 3.4. Axisymmetric finite element model of half of the disk section

■ Four element solution for comparison with text

AnsysFiles\Chap03\DiskEx31.txt

```
!* Rotating disk Example 3.1 p. 129
!* 4 element solution
 /PREP7
!*
ET,1,PLANE42
KEYOPT,1,1,0
KEYOPT,1,2,1
KEYOPT,1,3,1
KEYOPT,1,5,0
KEYOPT,1,6,0!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,30000
MPDATA,PRXY,1,,0.3
MPDATA,DENS,1,,0.283/386.4/1000
*set,pi,3.14159
*set,ri,3
*set,ro,9
*set,h,1/2
*set,omega,5000*2*pi/60
*set,rm,(ri+ro)/2
N,1,ri,0
N,2,ri,h
N,3,rm,0
N,4,rm,h
N,5,ro,0
N,6,ro,h
e,1,3,2
e,3,4,2
e,5,4,3
e,5,6,4
FINISH
/SOL
OMEGA,0,0,omega,0
ERESX,NO
d,1,UY
d,3,UY
d,5,UY
FINISH
/SOL
/STATUS,SOLU
```

```
/SHRES,SOLU
SOLVE
FINISH
/POST1
!*
PRNSOL,DOF
!*
PRESOL,S,PRIN
!*
```

 PRINT U   NODAL SOLUTION PER NODE

  ***** POST1 NODAL DEGREE OF FREEDOM LISTING *****

  LOAD STEP=   1 SUBSTEP=   1
   TIME=   1.0000   LOAD CASE=   0

  THE FOLLOWING DEGREE OF FREEDOM RESULTS ARE IN GLOBAL COORDINATES

    NODE   UX
       1 0.13230E-02
       2 0.13186E-02
       3 0.12864E-02
       4 0.12881E-02
       5 0.12848E-02
       6 0.12797E-02

 MAXIMUM ABSOLUTE VALUES
 NODE   1
 VALUE   0.13230E-02

 PRINT S   PRIN ELEMENT SOLUTION PER ELEMENT

 ***** POST1 ELEMENT NODAL STRESS LISTING *****

  LOAD STEP=   1 SUBSTEP=   1
   TIME=   1.0000   LOAD CASE=   0

  THE FOLLOWING X,Y,Z VALUES ARE IN GLOBAL COORDINATES

  ELEMENT=   1   PLANE42
    NODE   S1   S2   S3   SINT   SEQV
       1   12.658   3.7024   0.88635   11.772   10.647
       3   7.9545   1.6866   -1.1295   9.0840   8.0541
       2   12.633   3.6916   0.87546   11.757   10.633
       2   12.633   3.6916   0.87546   11.757   10.633

  ELEMENT=   2   PLANE42
    NODE   S1   S2   S3   SINT   SEQV
       3   7.7485   2.1010   0.23505   7.5135   6.7760
       4   7.7548   2.1037   0.23773   7.5171   6.7795
       2   11.469   3.6954   1.8294   9.6393   8.8550
       2   11.469   3.6954   1.8294   9.6393   8.8550

  ELEMENT=   3   PLANE42
    NODE   S1   S2   S3   SINT   SEQV
       5   4.9172   1.1967   -0.87601   5.7933   5.0843
       4   6.4254   1.8430   -0.22968   6.6550   5.8984
       3   6.4201   1.8407   -0.23194   6.6520   5.8956

```
       3   6.4201      1.8407    -0.23194      6.6520      5.8956

 ELEMENT=       4        PLANE42
   NODE     S1          S2          S3          SINT        SEQV
      5   4.8950      1.3465    -0.14150      5.0365      4.4818
      6   4.8830      1.3414    -0.14663      5.0297      4.4752
      4   6.2125      1.9111     0.42312      5.7893      5.2073
      4   6.2125      1.9111     0.42312      5.7893      5.2073
```

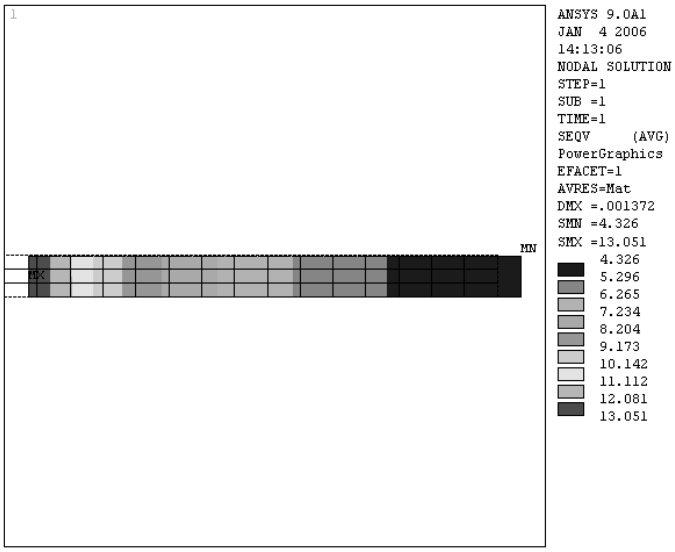
■ Solution with default Ansys mesh

AnsysFiles\Chap03\DiskEx31Mesh.txt

```
!* Rotating disk Example 3.1 p. 129
!* Using default Ansys Mesh
 /PREP7
!*
ET,1,PLANE42
KEYOPT,1,1,0
KEYOPT,1,2,1
KEYOPT,1,3,1
KEYOPT,1,5,0
KEYOPT,1,6,0!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,30000
MPDATA,PRXY,1,,0.3
MPDATA,DENS,1,,0.283/386.4/1000
*set,pi,3.14159
*set,ri,3
*set,ro,9
*set,h,1/2
*set,omega,5000*2*pi/60
*set,rm,(ri+ro)/2
k,1,ri,0
k,2,ri,h
k,3,ro,0
k,4,ro,h
a,1,3,4,2
MSHKEY,0
CM,_Y,AREA
ASEL, , , ,       1
CM,_Y1,AREA
CHKMSH,'AREA'
CMSEL,S,_Y
!*
AMESH,_Y1
```

```
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*
FINISH
/SOL
OMEGA,0,0,omega,0
ERESX,NO
DL,1, ,UY,FINISH
/SOL
/STATUS,SOLU
SOLVE
FINISH
/POST1
!*
PRNSOL,DOF
!*
PRESOL,S,PRIN
!*
```

Plot of vonMises stresses



Example 3.2 Thermal stresses p. 135

A 70 mm diameter steel ring is fitted on to a 20 mm diameter aluminum tube at a temperature of 100°C as shown in Figure 3.5. Find stresses in the ring and the tube when the assembly cools to a room temperature of 25°C. Assume perfect bond between the ring and the tube. Use the following data.

Ring: $E = 200\,\text{GPa}$ $\nu = 0.3$ $\alpha = 12 \times 10^{-6}$

Tube: $E = 70\,\text{GPa}$ $\nu = 0.33$ $\alpha = 23 \times 10^{-6}$ Tube wall thickness = 10 mm

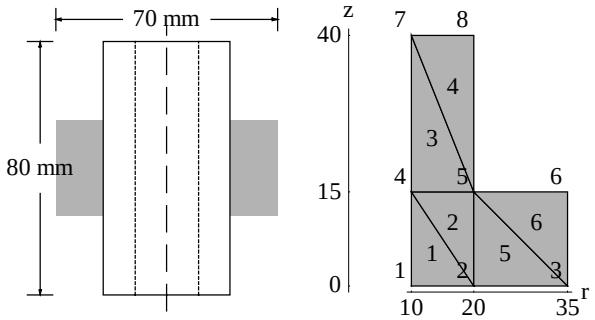


Figure 3.5. Steel and aluminum assembly and axisymmetric model of half of the assembly

■ Six element solution for comparison with text

AnsysFiles\Chap03\ThermalEx31.txt

```
!* Thermal stress Example 3.2 p. 135
!* 6 element solution
 /PREP7
!*
ET,1,PLANE42
KEYOPT,1,1,0
KEYOPT,1,2,1
KEYOPT,1,3,1
KEYOPT,1,5,0
KEYOPT,1,6,0!*
MPTEMP,,,,,,,,
MPTEMP,1,0
UIMP,1,REFT,,,
MPDATA,CTEX,1,,12*10**(-6)
MPDATA,EX,1,,200000
MPDATA,PRXY,1,,0.3
MPTEMP,,,,,,,,
MPTEMP,1,0
UIMP,2,REFT,,,
MPDATA,CTEX,2,,23*10**(-6)
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,2,,70000
MPDATA,PRXY,2,,0.33
*set,ri,10
```

```
*set,ro,35
*set,h,40
*set,t,10
N,1,ri,0
N,2,ri+t,0
N,3,ro,0
N,4,ri,15
N,5,ri+t,15
N,6,ro,15
N,7,ri,h
N,8,ri+t,h
mat,2
e,1,2,4
e,2,5,4
e,4,5,7
e,5,8,7
mat,1
e,2,3,5
e,3,6,5
FINISH
/SOL
TUNIF,-75,
ERESX,NO
d,1,UY
d,2,UY
d,3,UY
FINISH
/SOL
/STATUS,SOLU
SOLVE
FINISH
/POST1
!*
PRNSOL,DOF
!*
PRESOL,S,PRIN
!*

 PRINT U    NODAL SOLUTION PER NODE

  ***** POST1 NODAL DEGREE OF FREEDOM LISTING *****

  LOAD STEP=     1  SUBSTEP=     1
   TIME=    1.0000      LOAD CASE=   0

  THE FOLLOWING DEGREE OF FREEDOM RESULTS ARE IN GLOBAL COORDINATES

    NODE      UX
       1 -0.65415E-02
       2 -0.25971E-01
       3 -0.35443E-01
       4 -0.88025E-02
```

```
      5 -0.27621E-01
      6 -0.39481E-01
      7 -0.21122E-01
      8 -0.37935E-01

MAXIMUM ABSOLUTE VALUES
NODE          6
VALUE  -0.39481E-01

PRINT S    PRIN ELEMENT SOLUTION PER ELEMENT

***** POST1 ELEMENT NODAL STRESS LISTING *****

 LOAD STEP=     1  SUBSTEP=     1
  TIME=    1.0000      LOAD CASE=   0

 THE FOLLOWING X,Y,Z VALUES ARE IN GLOBAL COORDINATES


 ELEMENT=       1        PLANE42
   NODE    S1          S2          S3          SINT        SEQV
      1   87.424      53.396      30.281      57.143      49.787
      2   54.057      36.961      13.846      40.211      34.953
      4   77.374      48.446      25.331      52.043      45.164
      4   77.374      48.446      25.331      52.043      45.164

 ELEMENT=       2        PLANE42
   NODE    S1          S2          S3          SINT        SEQV
      2   85.123      70.947      34.524      50.600      45.210
      5   82.824      66.279      32.224      50.600      44.687
      4   93.577      88.111      42.978      50.600      48.100
      4   93.577      88.111      42.978      50.600      48.100

 ELEMENT=       3        PLANE42
   NODE    S1          S2          S3          SINT        SEQV
      4   46.454      20.606      8.6564      37.797      33.463
      5   25.216      10.146     -1.8038      27.020      23.452
      7  -6.3639     -8.3042     -18.314      11.950      11.108
      7  -6.3639     -8.3042     -18.314      11.950      11.108

 ELEMENT=       4        PLANE42
   NODE    S1          S2          S3          SINT        SEQV
      5   17.837      11.132      3.9496      13.887      12.029
      8  -3.2366     -10.419     -11.336      8.0996      7.6822
      7  -5.9424     -13.125     -16.830      10.887      9.5877
      7  -5.9424     -13.125     -16.830      10.887      9.5877

 ELEMENT=       5        PLANE42
   NODE    S1          S2          S3          SINT        SEQV
      2   12.318     -60.508     -81.787      94.105      85.475
      3   29.775     -41.053     -43.050      72.826      71.848
      5   8.0858     -64.740     -91.661      99.747      89.381
      5   8.0858     -64.740     -91.661      99.747      89.381

***** POST1 ELEMENT NODAL STRESS LISTING *****

 LOAD STEP=     1  SUBSTEP=     1
  TIME=    1.0000      LOAD CASE=   0

 THE FOLLOWING X,Y,Z VALUES ARE IN GLOBAL COORDINATES
```

```
 ELEMENT=       6        PLANE42
   NODE    S1          S2          S3          SINT        SEQV
      3   16.892      8.9526     -26.476      43.368      39.994
      6   9.7226      1.7834     -43.204      52.927      49.437
      5  -2.1370     -10.076     -70.876      68.739      65.134
      5  -2.1370     -10.076     -70.876      68.739      65.134
```

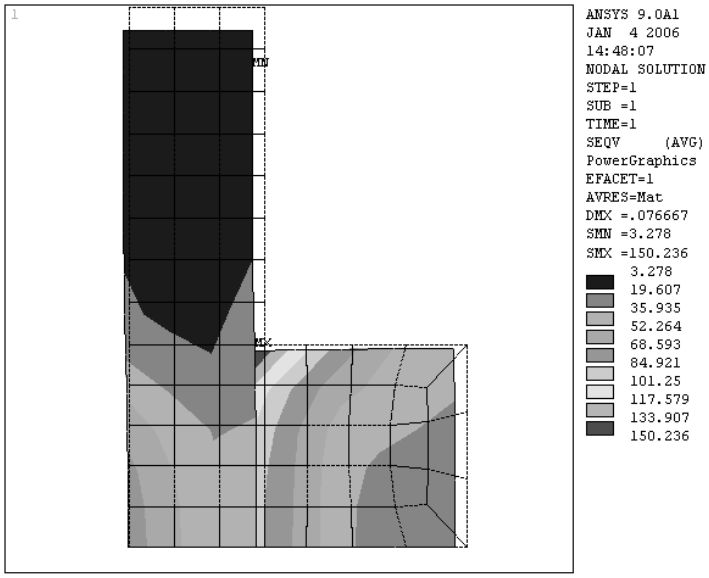
■ Solution with default Ansys mesh

AnsysFiles\Chap03\ThermalEx31Mesh.txt

```
!* Thermal stress Example 3.2 p. 135
!* Using default Ansys mesh
 /PREP7
!*
ET,1,PLANE42
KEYOPT,1,1,0
KEYOPT,1,2,1
KEYOPT,1,3,1
KEYOPT,1,5,0
KEYOPT,1,6,0!*
MPTEMP,,,,,,,,
MPTEMP,1,0
UIMP,1,REFT,,,
MPDATA,CTEX,1,,12*10**(-6)
MPDATA,EX,1,,200000
MPDATA,PRXY,1,,0.3
MPTEMP,,,,,,,,
MPTEMP,1,0
UIMP,2,REFT,,,
MPDATA,CTEX,2,,23*10**(-6)
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,2,,70000
MPDATA,PRXY,2,,0.33
*set,ri,10
*set,ro,35
*set,h,40
*set,t,10
k,1,ri,0
k,2,ri+t,0
k,3,ro,0
k,4,ri,15
k,5,ri+t,15
k,6,ro,15
k,7,ri,h
```

```
k,8,ri+t,h
a,1,2,5,4
a,4,5,8,7
a,2,3,6,5
FLST,5,2,5,ORDE,2
FITEM,5,1
FITEM,5,-2
CM,_Y,AREA
ASEL, , , ,P51X
CM,_Y1,AREA
CMSEL,S,_Y
!*
CMSEL,S,_Y1
AATT,       2, ,   1,       0,
CMSEL,S,_Y
CMDELE,_Y
CMDELE,_Y1
!*
CM,_Y,AREA
ASEL, , , ,       3
CM,_Y1,AREA
CMSEL,S,_Y
!*
CMSEL,S,_Y1
AATT,       1, ,   1,       0,
CMSEL,S,_Y
CMDELE,_Y
CMDELE,_Y1
!*
MSHKEY,0
AMESH,ALL
FINISH
/SOL
TUNIF,-75,
ERESX,NO
dl,1,,UY
dl,8,,UY
FINISH
/SOL
/STATUS,SOLU
SOLVE
FINISH
/POST1
!*
PRNSOL,DOF
!*
PRESOL,S,PRIN
!*
```

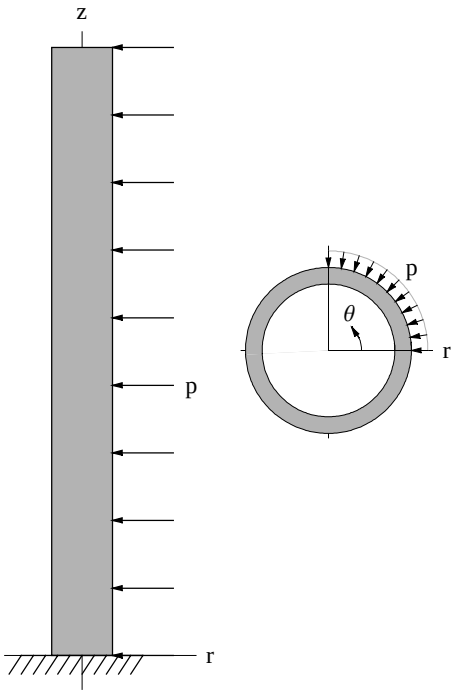
Plot of vonMises stresses



General loading on Axisymmetric structures

This example is not included in the printed book.

A circular pipe section is subjected to pressure p over a quarter of its circumference, as shown in the figure. The pipe is fixed at the base. Determine tip deflection and maximum von-Mises stress.



Outer radius = 100 mm; Inner radius = 50 mm; Height = 1 *m*

$E = 200\,\text{GPa}$; $\nu = 0.25$; $p = 5\,\text{MPa}$

■ Fourier coefficients

If the applied loading is a function of θ, then using Fourier series it can be expressed as follows.

$$T(\theta) = a_0 + \sum_{n=1}^{\infty} a_n \cos(n\theta) + \sum_{n=1}^{\infty} b_n \sin(n\theta)$$

For a given loading the coefficients a_0, a_n, b_n, $n = 1, 2, \ldots$ are obtained as follows.

$$a_0 = \frac{1}{2\pi} \int_{-\pi}^{\pi} T(\theta)\, d\theta$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} T(\theta) \cos(n\theta)\, d\theta$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} T(\theta) \sin(n\theta)\, d\theta$$

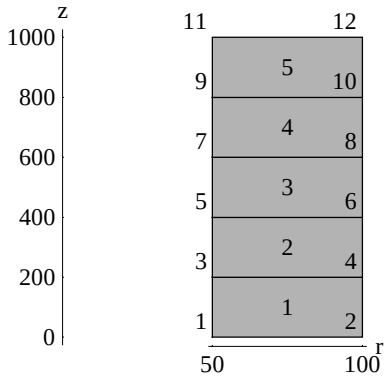
Fourier coefficients for the given 1/4 circle load

$$a_0 = p/4$$

Symmetric terms: $\{\frac{p}{\pi}, 0, -\frac{p}{3\pi}\}$

Antisymmetric terms: $\{\frac{p}{\pi}, \frac{p}{\pi}, \frac{p}{3\pi}\}$

Finite element model



■ Ansys solution: 5 Plane25 element solution

AnsysFiles\Chap03\PipeColumnAxi.txt

```
/PREP7
!*
*set,pi,3.14159
ET,1,PLANE25
KEYOPT,1,1,0
KEYOPT,1,2,1
!*
!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,200000
MPDATA,PRXY,1,,0.25
*set,ri,50
*set,ro,100
```

```
*set,h,1000
*set,p,5
N,1,ri,0
N,2,ro,0
N,3,ri,h/5
N,4,ro,h/5
N,5,ri,2*h/5
N,6,ro,2*h/5
N,7,ri,3*h/5
N,8,ro,3*h/5
N,9,ri,4*h/5
N,10,ro,4*h/5
N,11,ri,5*h/5
N,12,ro,5*h/5
e,1, 2, 4, 3
e,3, 4, 6, 5
e,5, 6, 8, 7
e,7, 8, 10, 9
e,9, 10, 12, 11
FINISH
/SOL
ERESX,NO
d,1,All
d,2,all
*do, i, 1,5,1
SFE,i,2,PRES, ,p/4, , ,
*enddo
MODE,0,
LSWRITE,1,
!*
*do, i, 1,5,1
SFEDELE,i,2,PRES
SFE,i,2,PRES, ,p/pi, , ,
*enddo
MODE,1,1
ERESX,NO
LSWRITE,2,
!*
*do, i, 1,5,1
SFEDELE,i,2,PRES
SFE,i,2,PRES, ,p/pi, , ,
*enddo
MODE,1,-1
ERESX,NO
LSWRITE,3,
!*
!*
*do, i, 1,5,1
SFEDELE,i,2,PRES
```

```
SFEDELE,i,2,PRES
SFE,i,2,PRES, ,p/pi, , ,
*enddo
MODE,2,-1
ERESX,NO
LSWRITE,4,
!*
*do, i, 1,5,1
SFEDELE,i,2,PRES
SFE,i,2,PRES, ,p/(3*pi), , ,
*enddo
MODE,3,1
ERESX,NO
LSWRITE,5,
!*
!*
*do, i, 1,5,1
SFEDELE,i,2,PRES
SFE,i,2,PRES, ,p/(3*pi), , ,
*enddo
MODE,3,-1
ERESX,NO
LSWRITE,6,
!*
/STATUS,SOLU
/SOL
LSSOLVE,1,6,1,
FINISH
/POST1
*do, i, 1,6,1
LCDEF,i,i,,
*enddo
LCFILE,7,'ld7',' ',' '
*do, i, 1,6,1
LCASE,i,
*enddo
*do, i, 1,6,1
LCOPER,ADD,i, , ,
*enddo
!*
PRNSOL,U,X
```

NODE	UX	UY	UZ
1	0	0	0
2	0	0	0
3	-0.24467	8.10E-02	-0.24314
4	-0.25539	0.18643	-0.23076
5	-0.78601	0.14969	-0.78581
6	-0.78971	0.30792	-0.77749
7	-1.4928	0.18256	-1.4944
8	-1.4952	0.37113	-1.4887
9	-2.2749	0.1978	-2.2768
10	-2.2756	0.3964	-2.2725
11	-3.0741	0.20272	-3.0765
12	-3.0744	0.40283	-3.0724

ELEMENT= 1 PLANE25

NODE	S1	S2	S3	SINT	SEQV
1	175.95	28.908	-28.963	204.91	182.98
2	233.74	51.657	5.0279	228.72	209.33
4	177.61	13.216	-3.7913	181.40	173.52
3	111.94	-0.77039	-18.854	130.79	122.75

ELEMENT= 2 PLANE25

NODE	S1	S2	S3	SINT	SEQV
3	105.90	-21.376	-53.077	158.98	145.74
4	123.40	-13.619	-46.972	170.37	156.39
6	116.65	7.1954	-3.1359	119.79	114.97
5	83.612	-0.78159	-6.4622	90.074	87.372

ELEMENT= 3 PLANE25

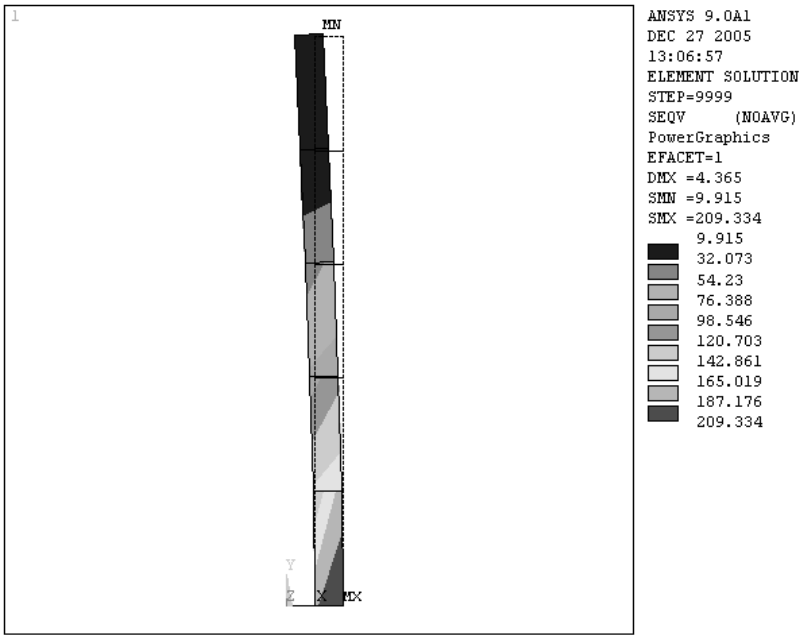
NODE	S1	S2	S3	SINT	SEQV
5	56.315	-5.9226	-32.637	88.952	79.056
6	69.116	-1.3147	-26.018	95.134	85.502
8	59.142	4.1794	-2.4654	61.608	58.569
7	40.594	-1.2669	-4.7230	45.317	43.692

ELEMENT= 4 PLANE25

NODE	S1	S2	S3	SINT	SEQV
7	25.135	-4.3072	-19.638	44.773	39.411
8	27.048	-3.5608	-17.569	44.618	39.521
10	23.325	1.6016	-4.3189	27.644	25.211
9	17.962	0.21677	-5.3599	23.322	21.094

ELEMENT= 5 PLANE25

NODE	S1	S2	S3	SINT	SEQV
9	6.0362	-1.6270	-10.337	16.373	14.189
10	5.2902	-2.1170	-9.7773	15.067	13.049
12	4.6963	-0.51225	-6.7373	11.434	9.9148
11	4.6681	-0.42324E-01	-7.2001	11.868	10.351



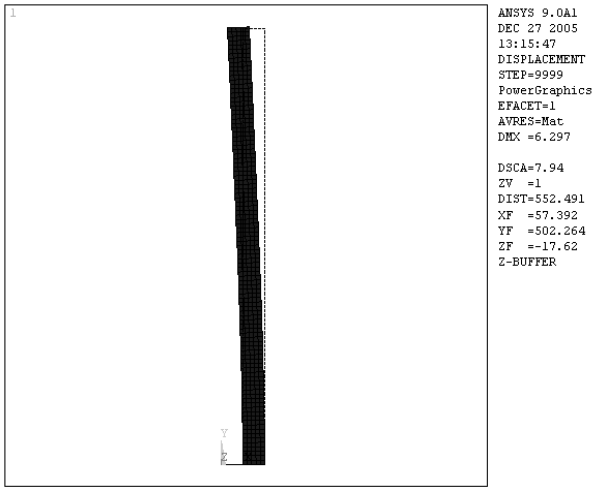
■ Ansys solution using Plane25 element with finer mesh

AnsysFiles\Chap03\PipeColumnFineAxi.txt

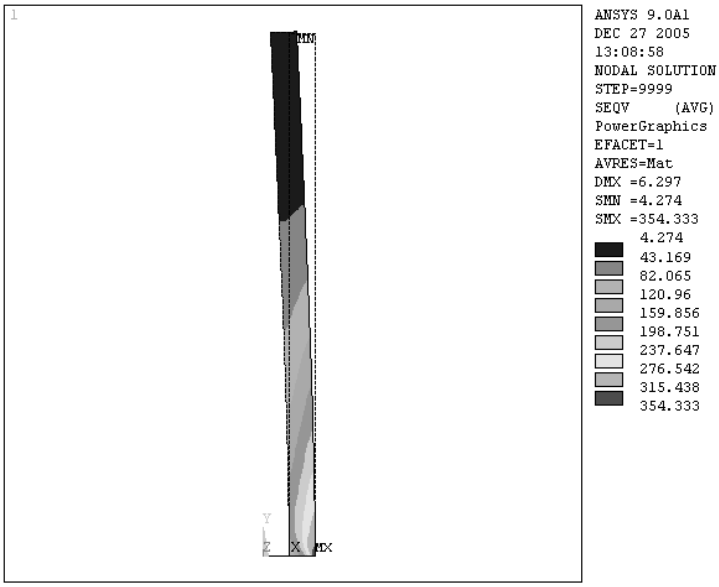
```
/PREP7
!*
*set,pi,3.14159
ET,1,PLANE25
KEYOPT,1,1,0
KEYOPT,1,2,1
!*
!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,200000
MPDATA,PRXY,1,,0.25
*set,ri,50
*set,ro,100
*set,rm,75
*set,h,1000
*set,p,5
k,1,ri,0
k,2,ro,0
k,3,ri,h
```

```
k,4,ro,h
a,1,2,4,3
ESIZE,10,0,
CM,_Y,AREA
ASEL, , , ,       1
CM,_Y1,AREA
CHKMSH,'AREA'
CMSEL,S,_Y
!*
MSHKEY,1
AMESH,_Y1
MSHKEY,0
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*
DL,1, ,ALL,
FINISH
/SOL
ERESX,NO
SFL,2,PRES,p/4,
MODE,0,
LSWRITE,1,
!*
SFLDELE,       2,PRES
SFL,2,PRES,p/pi,
MODE,1,1
ERESX,NO
LSWRITE,2,
!*
SFLDELE,       2,PRES
SFL,2,PRES,p/pi,
MODE,1,-1
ERESX,NO
LSWRITE,3,
!*
!*
SFLDELE,       2,PRES
SFL,2,PRES,p/pi,
MODE,2,-1
ERESX,NO
LSWRITE,4,
!*
SFLDELE,       2,PRES
SFL,2,PRES,-p/(3*pi),
MODE,3,1
ERESX,NO
LSWRITE,5,
```

```
LSWRITE,5,
!*
!*
SFLDELE,       2,PRES
SFL,2,PRES,p/(3*pi),
MODE,3,-1
ERESX,NO
LSWRITE,6,
!*
/STATUS,SOLU
/SOL
LSSOLVE,1,6,1,
FINISH
/POST1
LCDEF,1,1,,
LCDEF,2,2,,
LCDEF,3,3,,
LCDEF,4,4,,
LCDEF,5,5,,
LCDEF,6,6,,
LCFILE,7,'ld7',' ',' '
LCASE,1,
LCASE,2,
LCASE,3,
LCASE,4,
LCASE,5,
LCASE,6,
LCOPER,ADD,1, , ,
LCOPER,ADD,2, , ,
LCOPER,ADD,3, , ,
LCOPER,ADD,4, , ,
LCOPER,ADD,5, , ,
LCOPER,ADD,6, , ,
!*
PRNSOL,U,X
```



von Mises stresses



■ Ansys solution using solid 3D elements

AnsysFiles\Chap03\PipeColumn.txt

```
/PREP7
!*
ET,1,SOLID45
!*
```

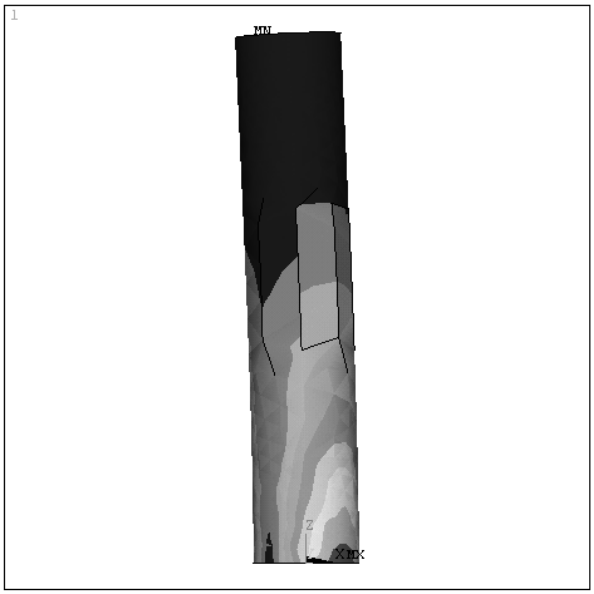
```
!*
MPTEMP,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,200000
MPDATA,PRXY,1,,0.25
CYL4,0,0,50, ,100
ADELE,       1
LSTR,       4,       5
LSTR,       1,       6
LSTR,       8,       2
LSTR,       7,       3
FLST,2,4,4
FITEM,2,4
FITEM,2,10
FITEM,2,5
FITEM,2,9
AL,P51X
FLST,2,4,4
FITEM,2,1
FITEM,2,11
FITEM,2,8
FITEM,2,10
AL,P51X
VOFFST,1,1000, ,
!*
VOFFST,2,1000, ,
FLST,3,1,6,ORDE,1
FITEM,3,1
VSYMM,X,P51X, , , ,0,0
VPLOT
FLST,3,1,6,ORDE,1
FITEM,3,2
VSYMM,X,P51X, , , ,0,0
VPLOT
FLST,2,4,6,ORDE,2
FITEM,2,1
FITEM,2,-4
VGLUE,P51X
DA,1,All
DA,2,All
DA,28,All
DA,32,All
SFA,4,1,PRES,5
!*
MSHKEY,0
MSHAPE,1,3d
FLST,5,4,6,ORDE,3
FITEM,5,1
FITEM,5,5
```

```
VSEL,S,,,5,6,1
FITEM,5,-7
CM,_Y,VOLU
VSEL, , , ,P51X
CM,_Y1,VOLU
CHKMSH,'VOLU'
CMSEL,S,_Y
!*
VMESH,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
FINISH
/SOL
/STATUS,SOLU
SOLVE
FINISH
/POST1
PLDISP,2
/VIEW, 1 ,,-1
/ANG, 1
/REP,FAST
!*
!*
/EFACET,1
PLNSOL, S,EQV, 0,1.0
/VIEW, 1 ,,1
/ANG, 1
/REP,FAST
/VIEW, 1 ,,,1
/ANG, 1
/REP,FAST
/VIEW, 1 ,,,-1
/ANG, 1
/REP,FAST
!*
/EFACET,1
PLNSOL, S,X, 0,1.0
```

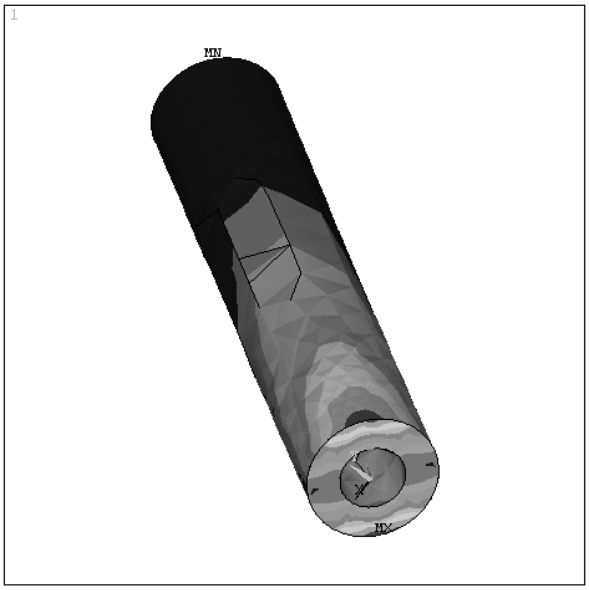
ANSYS 9.0A1
DEC 27 2005
13:18:33
DISPLACEMENT
STEP=1
SUB =1
TIME=1
PowerGraphics
EFACET=1
AVRES=Mat
DMX =6.034

DSCA=8.286
YV =-1
DIST=553.515
XF =-17.516
YF =17.515
ZF =503.195
Z-BUFFER

von Mises stresses



ANSYS 9.0A1
DEC 27 2005
13:19:26
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
SEQV (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =6.034
SMN =.412738
SMX =462.598
.412738
51.767
103.121
154.475
205.829
257.183
308.537
359.891
411.245
462.598



ANSYS 9.0A1
DEC 27 2005
13:24:15
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
SEQV (AVG)
PowerGraphics
EFACET=1
AVRES=Mat
DMX =6.034
SMN =.412738
SMX =462.598

.412738
51.767
103.121
154.475
205.829
257.183
308.537
359.891
411.245
462.598