CHAPTER FIVE

Multifield Formulations for Analysis of Elastic Solids

Example 5.2 p. 238 — Standard formulation Plane42 element

Consider plane strain analysis of a solid loaded over 10 m length on the top and supported as shown in Figure 5.2. Assume $E = 10^6 \, \text{kN}/m^2$ and $q = 10^5 \, \text{kN}/m^2$. Compare stresses and displacements for a range of Poisson's ratios from $v = 0.3$ to 0.499.
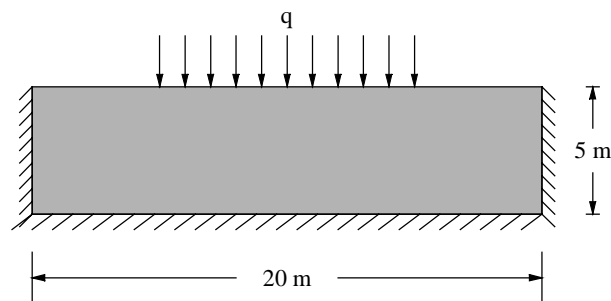

Figure 5.2. Elastic solid symmetrically loaded by applied pressure

Taking advantage of symmetry the right half of the solid is discretized into 16 elements as shown. The right side and the bottom are fixed. The left side of the model is constrained in the x direction because of symmetry. The pressure is applied on the top side of elements 4 and 8.
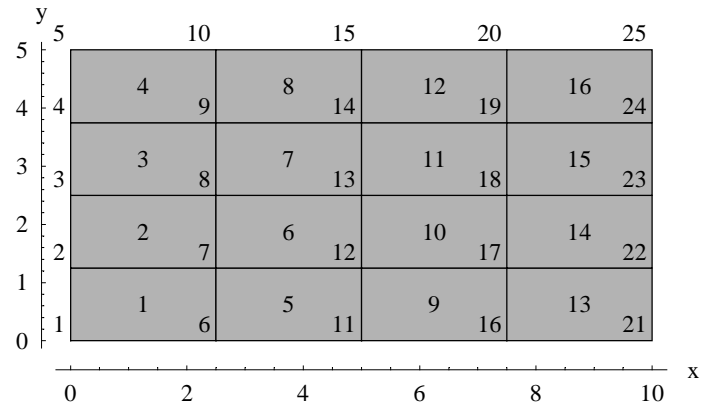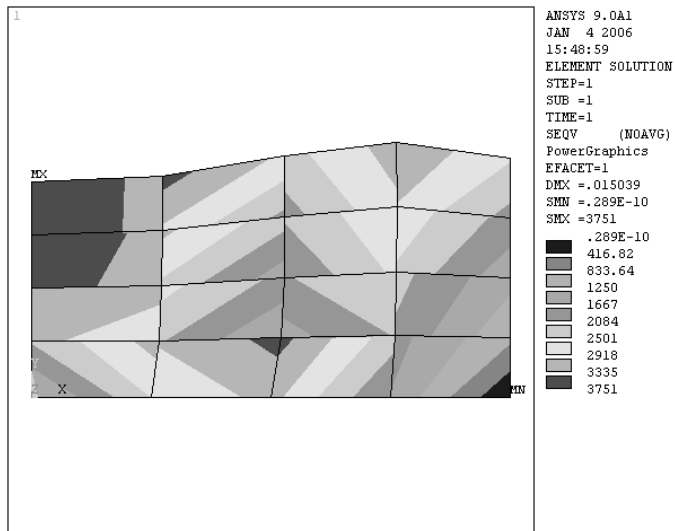

Figure 5.3. Sixteen element model

AnsysFiles\Chap05\Ex52StandardQuad.txt

```
!Example used to demonstrate Poissons\
  ratio locking
! Poissons ratio is changed from 0.3\
  to 0.499
!* Example 5.2 p. 238
!*
/PREP7
!*
ET,1,PLANE42
!*
KEYOPT,1,1,0
KEYOPT,1,2,1
KEYOPT,1,3,2
KEYOPT,1,5,0
KEYOPT,1,6,0
!*
!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,1000000
MPDATA,PRXY,1,,.499
K,1,,,,
K,2,5,,,
K,3,10,,,
K,4,10,5,,
K,5,5,5,,
K,6,0,5,,
A,1,2,5,6
A,2,3,4,5
esize,2.5
LESIZE,6, , ,4, , , , ,1
MSHKEY,1
AMESH,ALL
DL,1, ,ALL,
DL,5, ,ALL,
DL,6, ,ALL,
DL,      4, ,SYMM
SFL,3,PRES, 100000, , ,
FINISH
/SOL
/STATUS,SOLU
SOLVE
FINISH
/POST1
PRNSOL,U,Y
```

VonMises stress contours (element solution - not averaged)


```
ANSYS 9.0A1
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15:48:59
ELEMENT SOLUTION
STEP=1
SUB =1
TIME=1
SEQV      (NOAVG)
PowerGraphics
EFACET=1
DMX =.015039
SMN =.289E-10
SMX =3751
      .289E-10
      416.82
      833.64
      1250
      1667
      2084
      2501
      2918
      3335
      3751
```

Example 5.6 p. 257 — UP formulation Element Plane182

AnsysFiles\Chap05\Ex56UPForm.txt

```
!UP Formulation. No Poissons ratio\
  locking
! Poissons ratio is changed from 0.3\
  to 0.499
!* Example 5.6 p. 238
/PREP7
!*
ET,1,PLANE182
!*
KEYOPT,1,3,2
!*
!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,1000000
MPDATA,PRXY,1,,.499
K,1,,,,
K,2,5,,,
K,3,10,,,
K,4,10,5,,
K,5,5,5,,
K,6,0,5,,
A,1,2,5,6
A,2,3,4,5
esize,2.5
LESIZE,6, , ,4, , , , ,1
MSHKEY,1
AMESH,ALL
DL,1, ,ALL,
DL,5, ,ALL,
DL,6, ,ALL,
DL,      4, ,SYMM
SFL,3,PRES, 100000, , ,
FINISH
/SOL
/STATUS,SOLU
SOLVE
FINISH
/POST1
PRNSOL,U,Y
```

VonMises stress contours (element solution - not averaged)