FEM Project

Topic:To simulate the stress on an Elliptic Disk with the given Loading conditions

Submitted By:

Clint Antony (131501008)

Rajath R (121501032)

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PROBLEM STATEMENT:

19) Find the stress distribution in the elliptic disk compressed by two collinear point loads acting along major axis as shown in Figure 19, for at least 5 different ratios of major to minor axes.

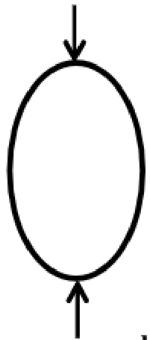


Figure 19: Elliptic disk compressed along major axis

PROCEDURE:

1) ANSYS APDL was used to simulate the following problem.
2) The following are the parameters that have been applied:
   - The material chosen was steel with Modulus of Elasticity of 200 GPa and Poisson's ratio of 0.3.
   - The major axis of the ellipse is 1m. The ratio of the length of the minor axis to major axis was changed during each simulation.
   - Meshing was done using a 6 noded triangular element (PLANE2) and refined at the ends of the major axis.
   - The ellipse was loaded along the major axis by a force of 2kN acting equal and opposite at the two ends of the major axis.
   - The ends of the minor axis were constrained with respect to all degrees of freedom.

RESULTS:

The contour plot of nodal von-Mises stress was plotted for the object and the results were analysed. ('Ratio' given in the figures is the ratio of length of minor axis to length of major axis)

Fig 1: Ratio = 2/8

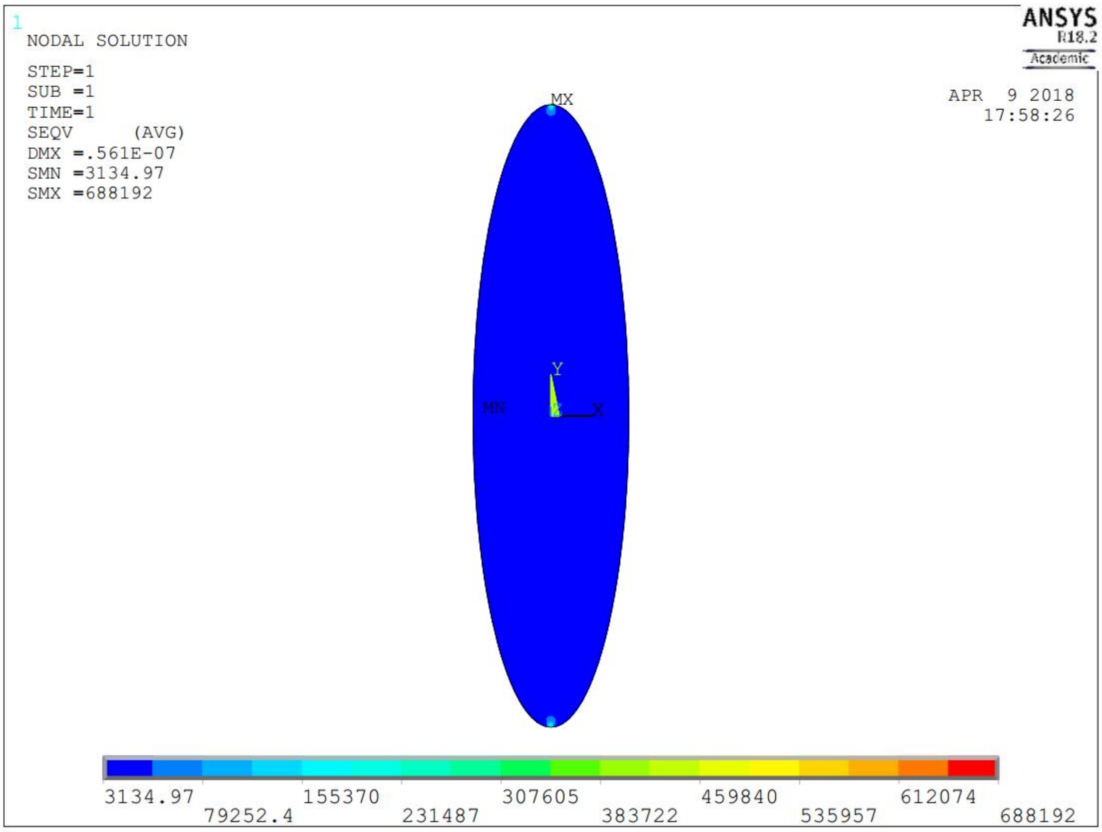


Fig 2: Ratio =3/8

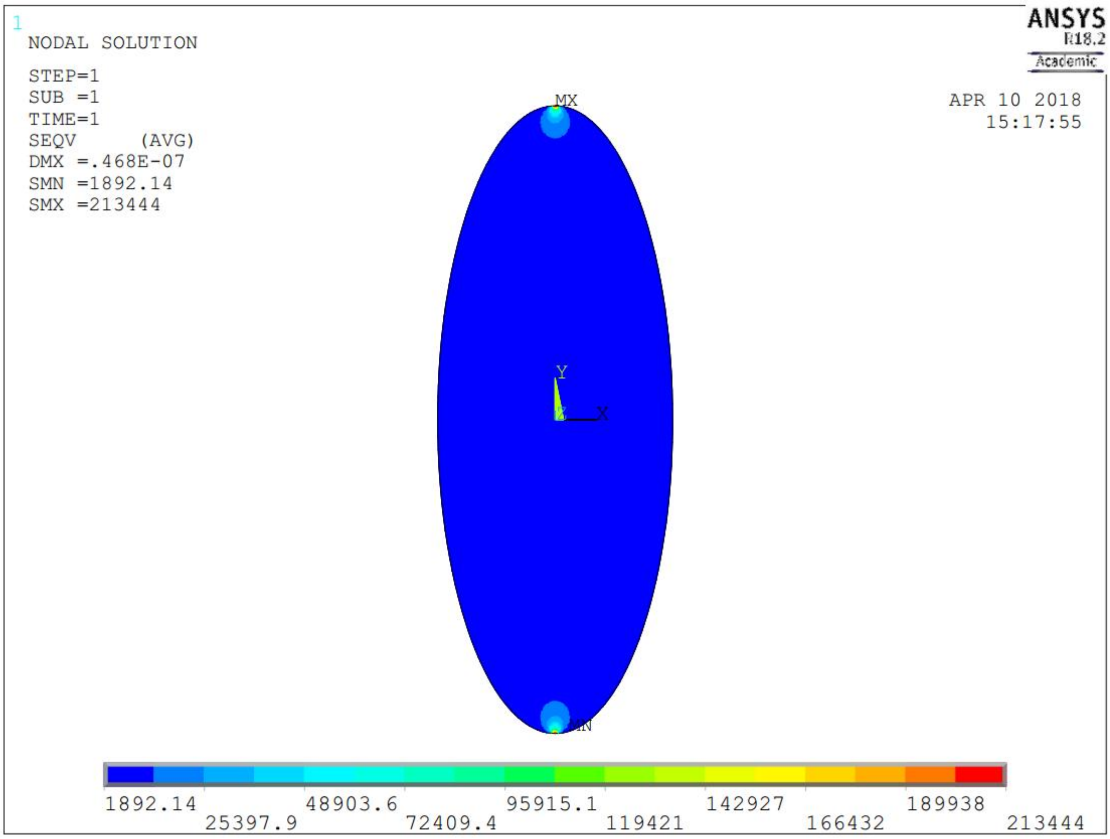


Fig 3: Ratio = 4/8

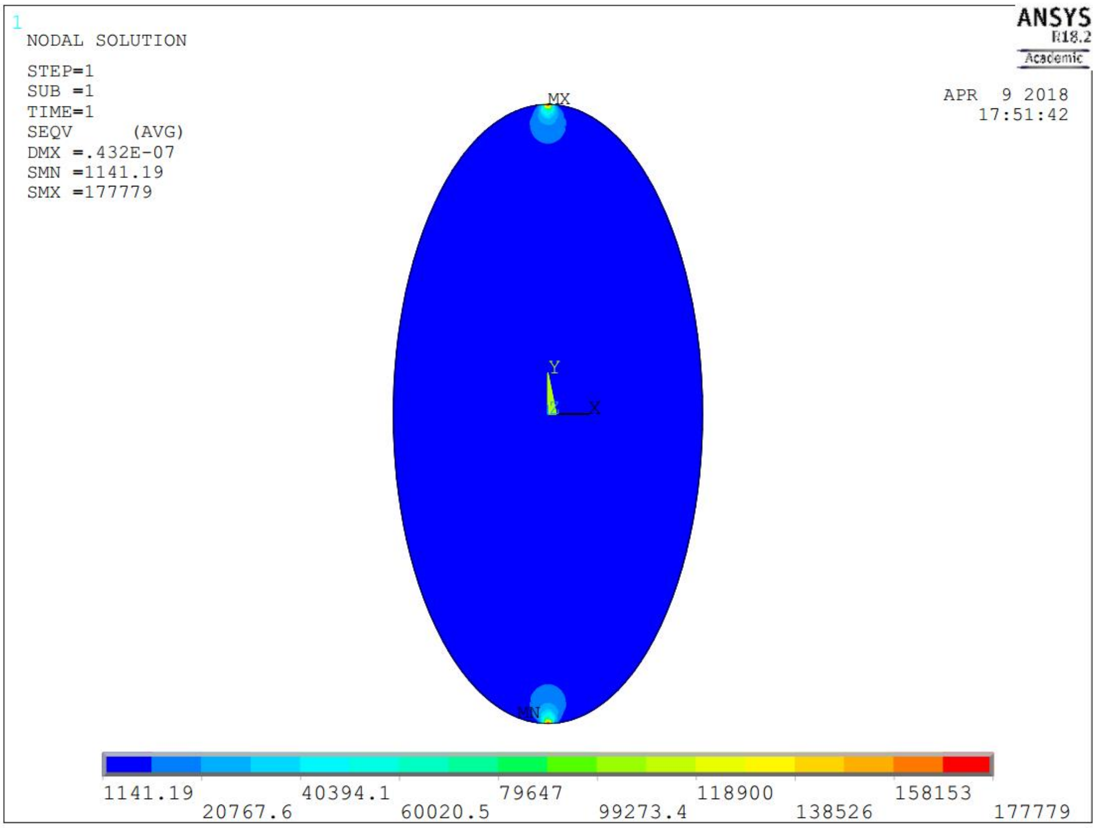


Fig 4: Ratio = 5/8

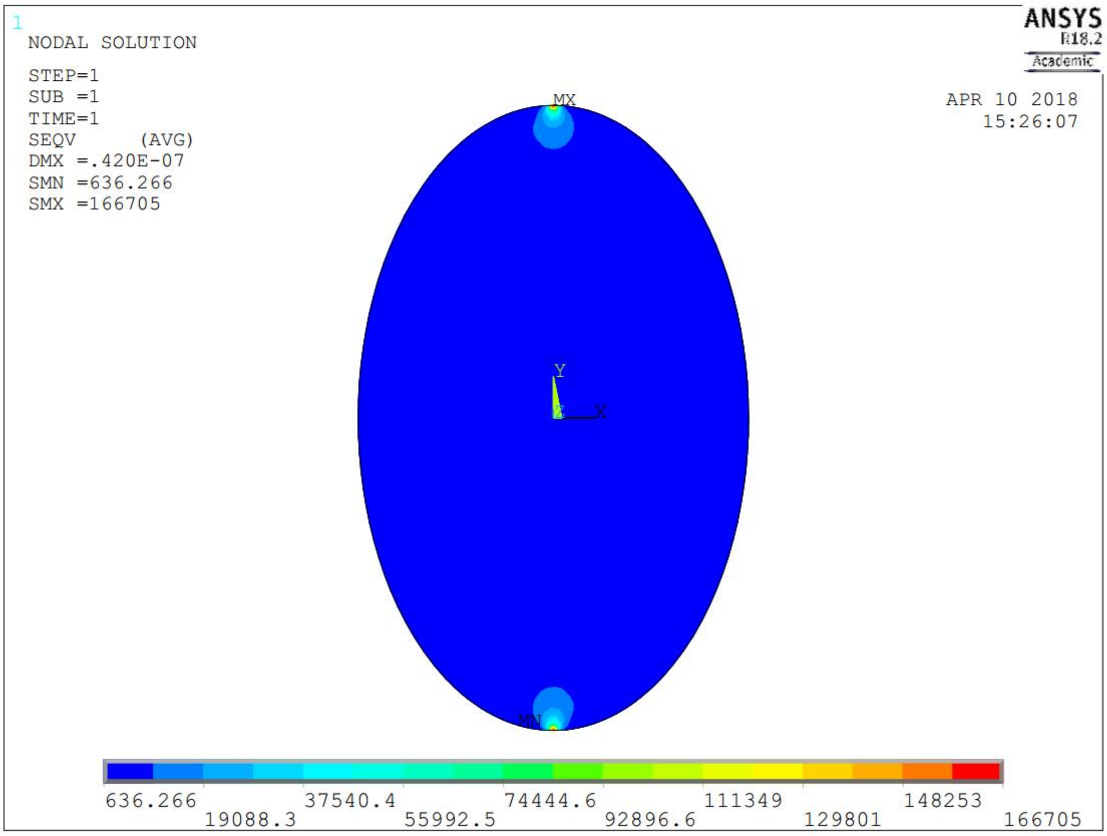
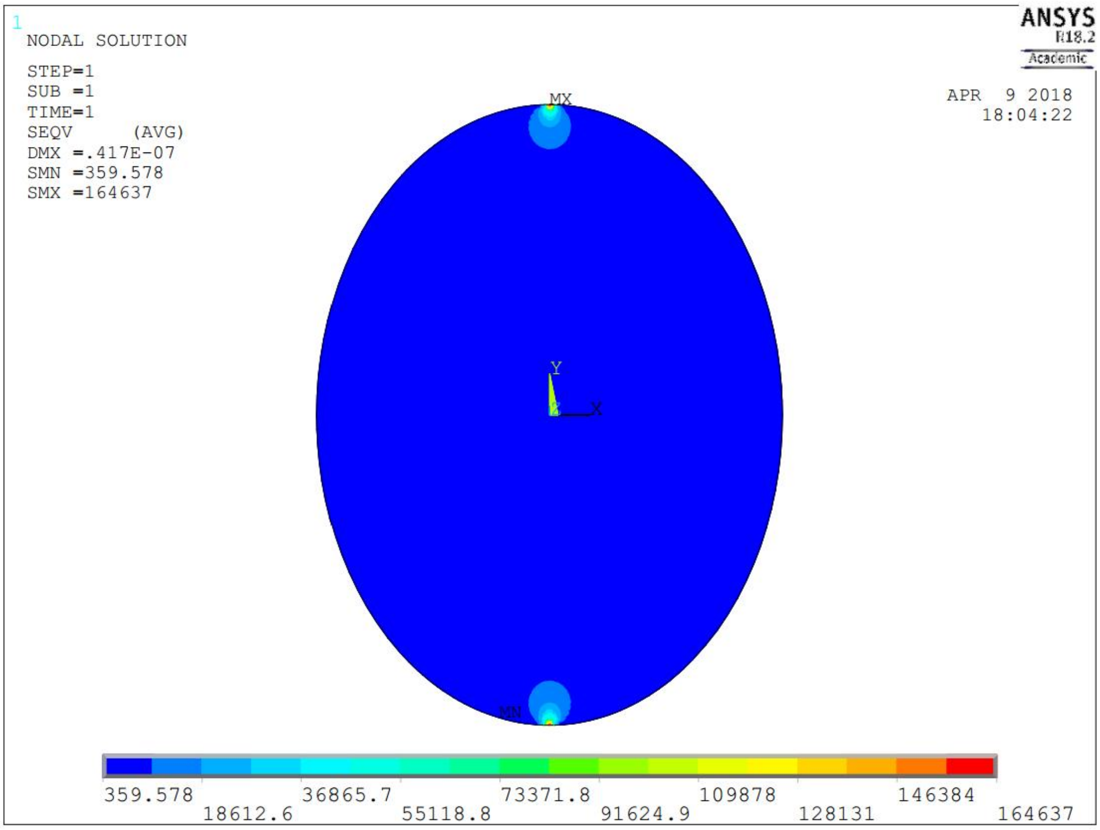
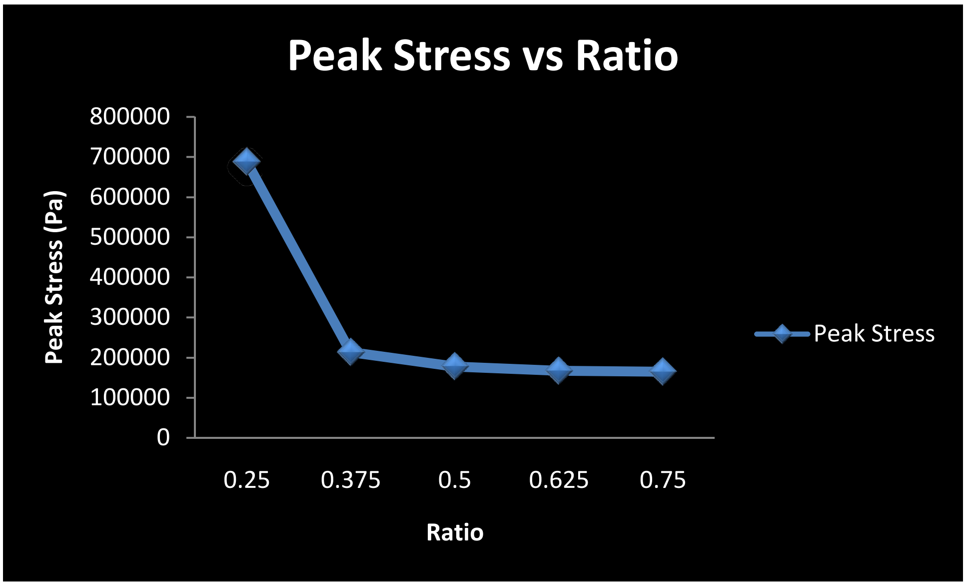


Fig 5: Ratio = 6/8



ANALYSIS:

Since the peak stress is the most important critical parameter in structural mechanics, the variation of the peak stress with ratio has been plotted.



- From the plot we can see that the peak stress (von-Mises) increases as the ratio decreases or as the length of minor axis decreases. It increases quite drastically as lower ratios are attained which can be explained by sharpness attained by the tip at lower ratio acting as places for stress concentration.
- The body tends to fail at the ends of major axis if the loading and boundary conditions used in the problem are applied.

ADDITIONAL ANALYSIS:

Here the plots have been analysed using the axis-symmetry of the problem.

- Boundary Conditions applied:
  - Loading: 1000 N applied at the end of major axis.
  - Displacement: Along the major axis, u_x was constrained and along minor axis u_y was constrained. The tip of the minor axis was also constrained of all DOF.

- For a particular ratio, the first two figures correspond to the auto calculated contour and uniform contour (user specified) plot of von-Mises stress respectively. In the plot we can see that the peak stress is different from the peak stress without the axis-symmetry (given above) contour plot. This can be because of the meshing differences and hence the value at the end of major axis, being a point of singularity, is prone to have errors or change in values. However the minimum stress in both cases remains approximately the same.

- For a particular ratio, the second two figures correspond to the variation of σx, σy, τxy along the Minor and Major axis respectively.

Fig: Contour plots after applying symmetry [**Ratio =1/2**]

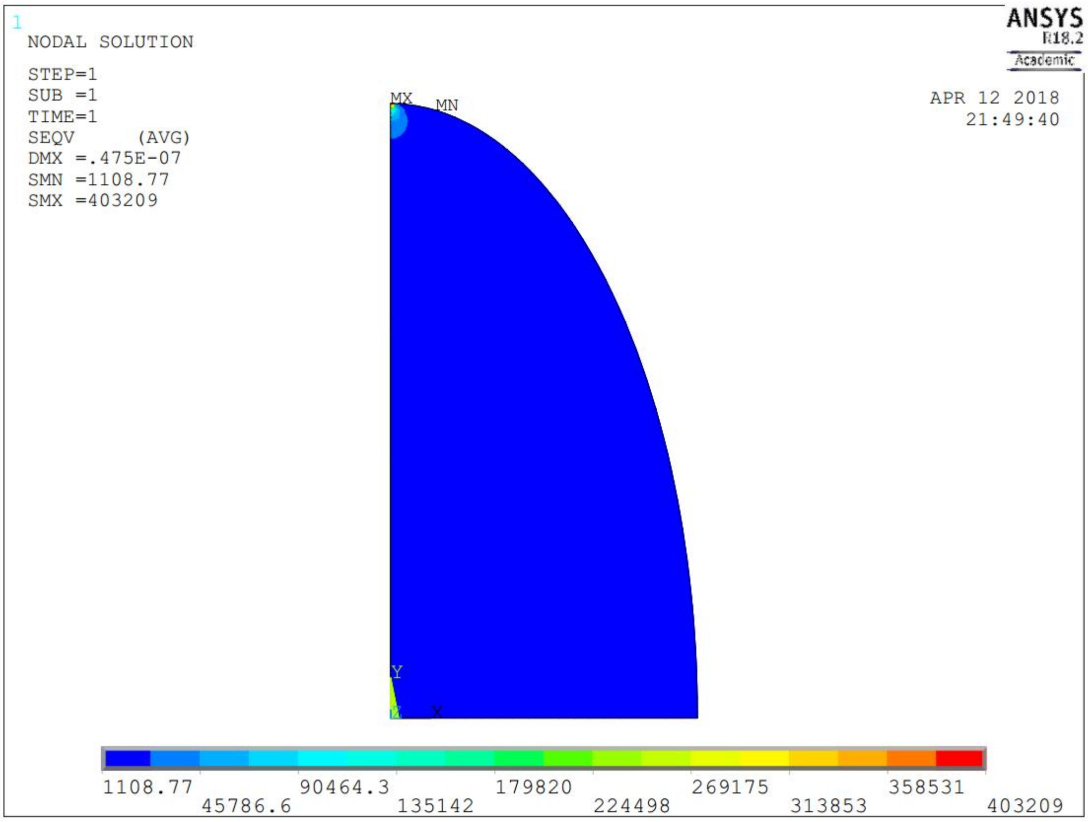


Fig: Contour plots after applying symmetry (User specified uniform contour) [**Ratio =1/2**]

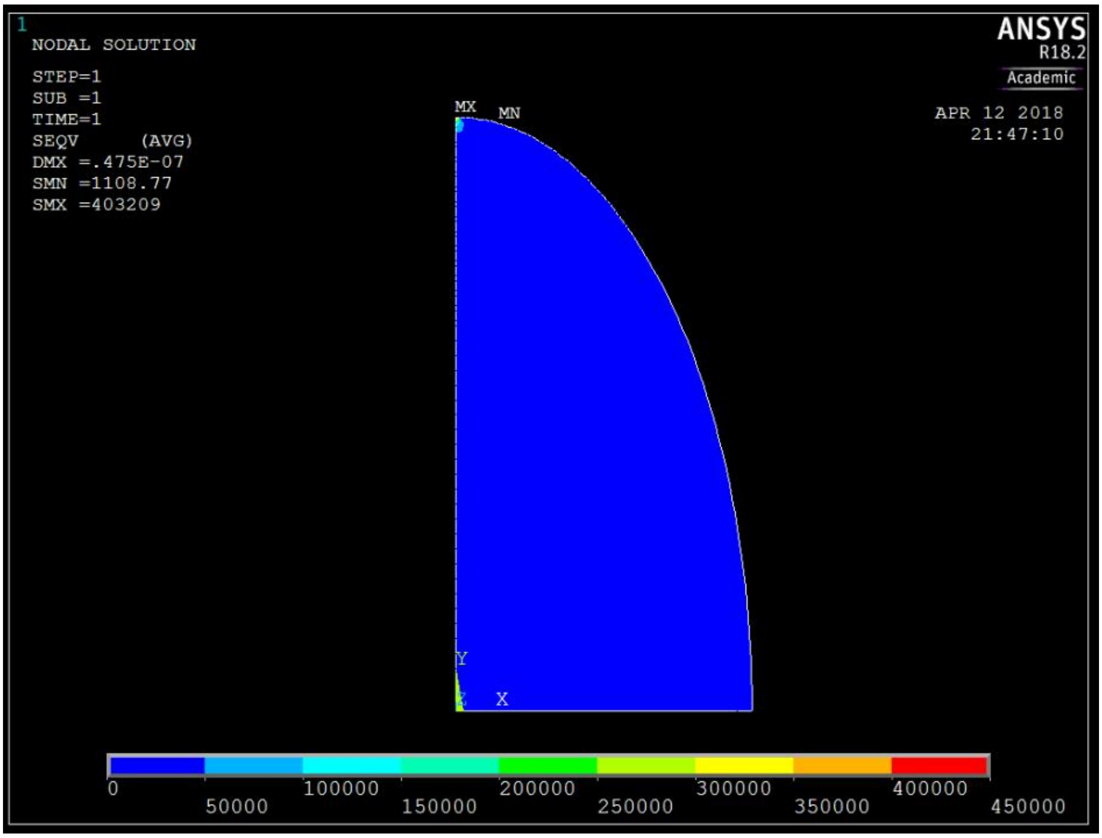


Fig: σx, σy, τxy along the Minor axis [**Ratio =1/2**]

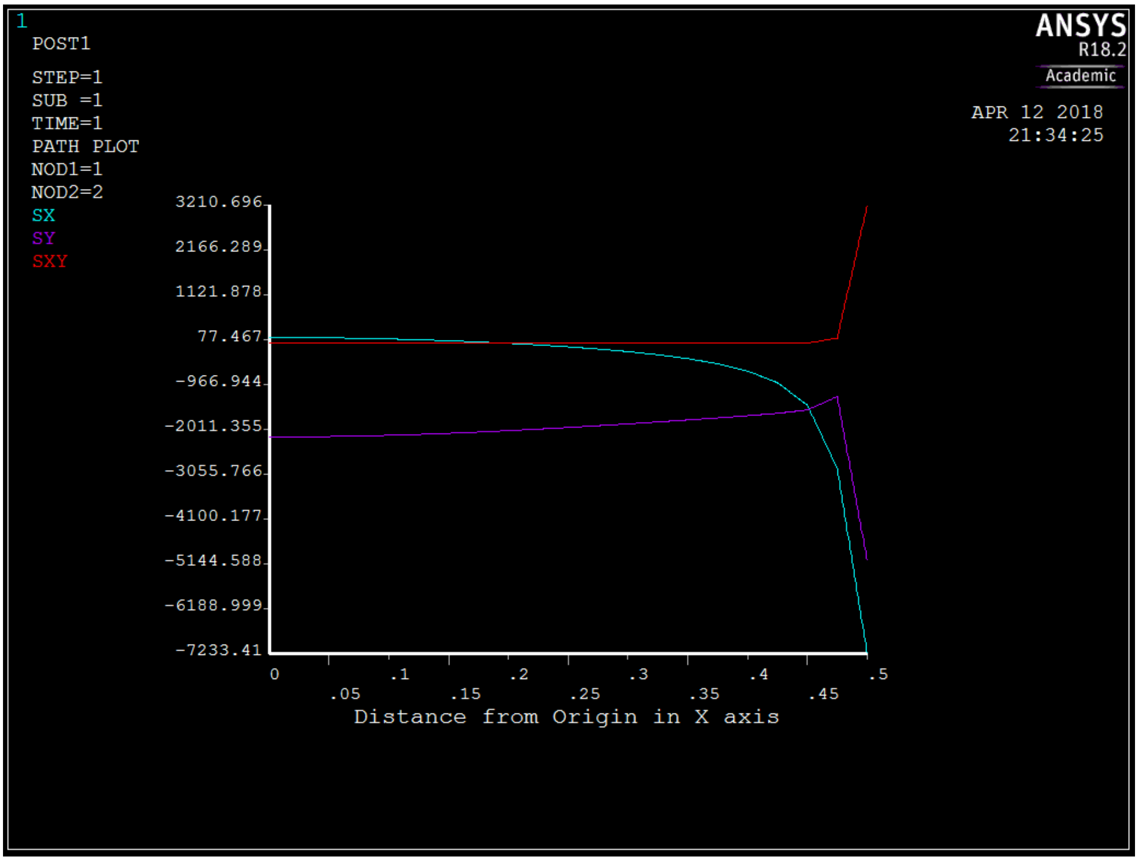


Fig: σx, σy, τxy along the Major axis [**Ratio =1/2**]

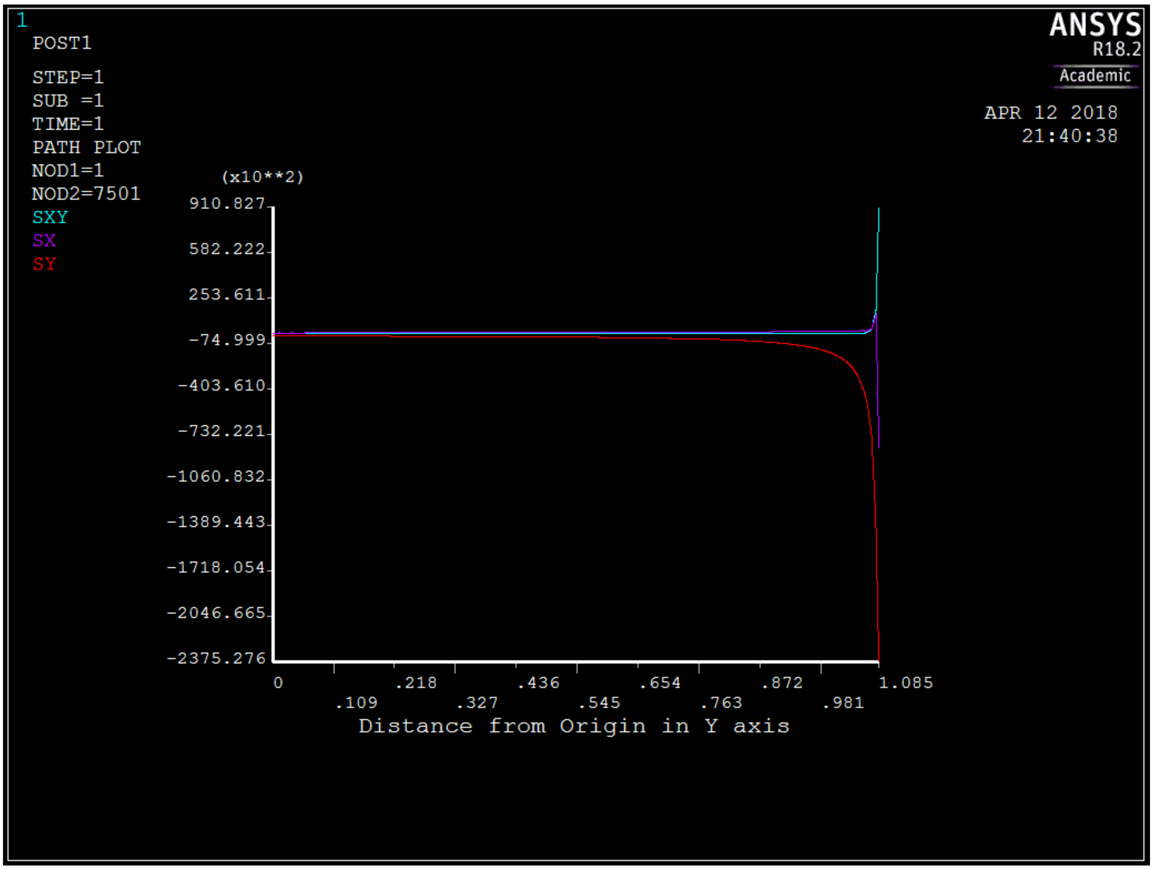


Fig: Contour plots after applying symmetry [**Ratio =3/4**]

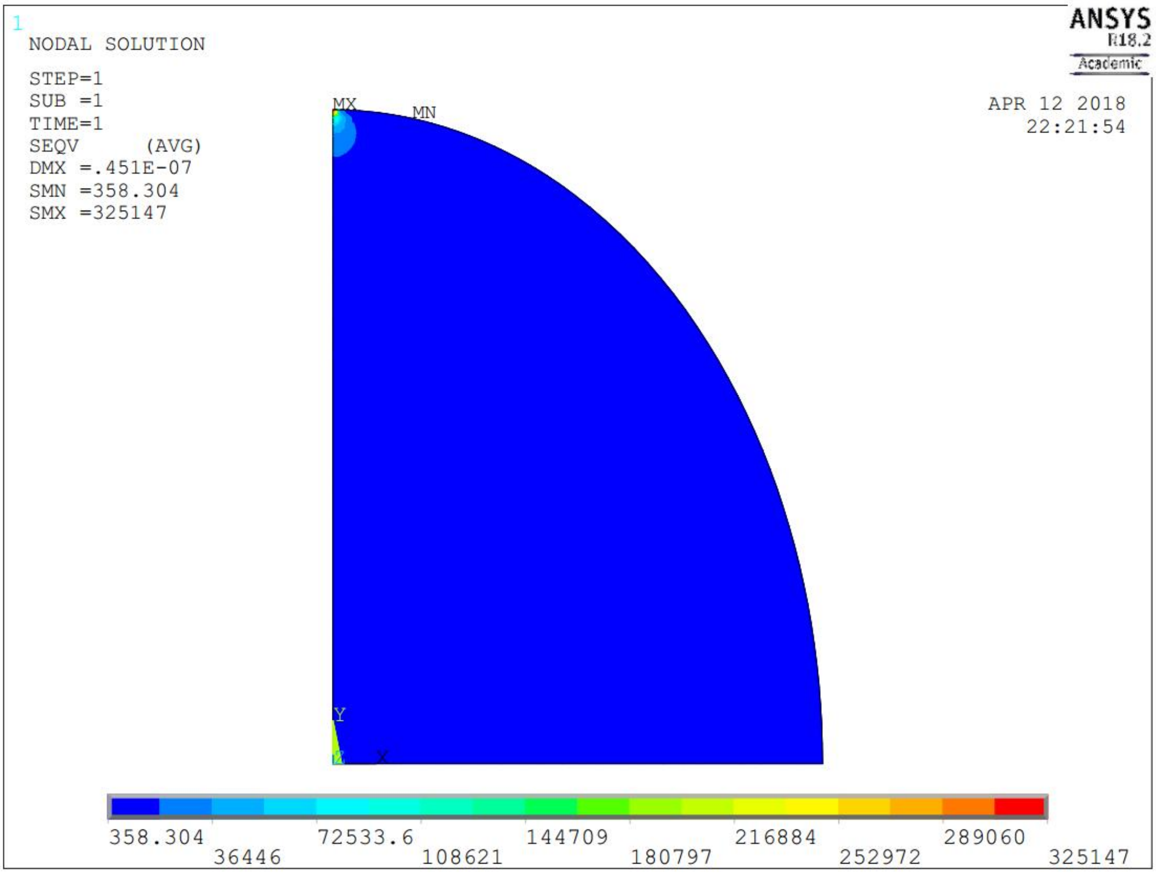


Fig: Contour plots after applying symmetry (User specified uniform contour) [**Ratio =3/4**]

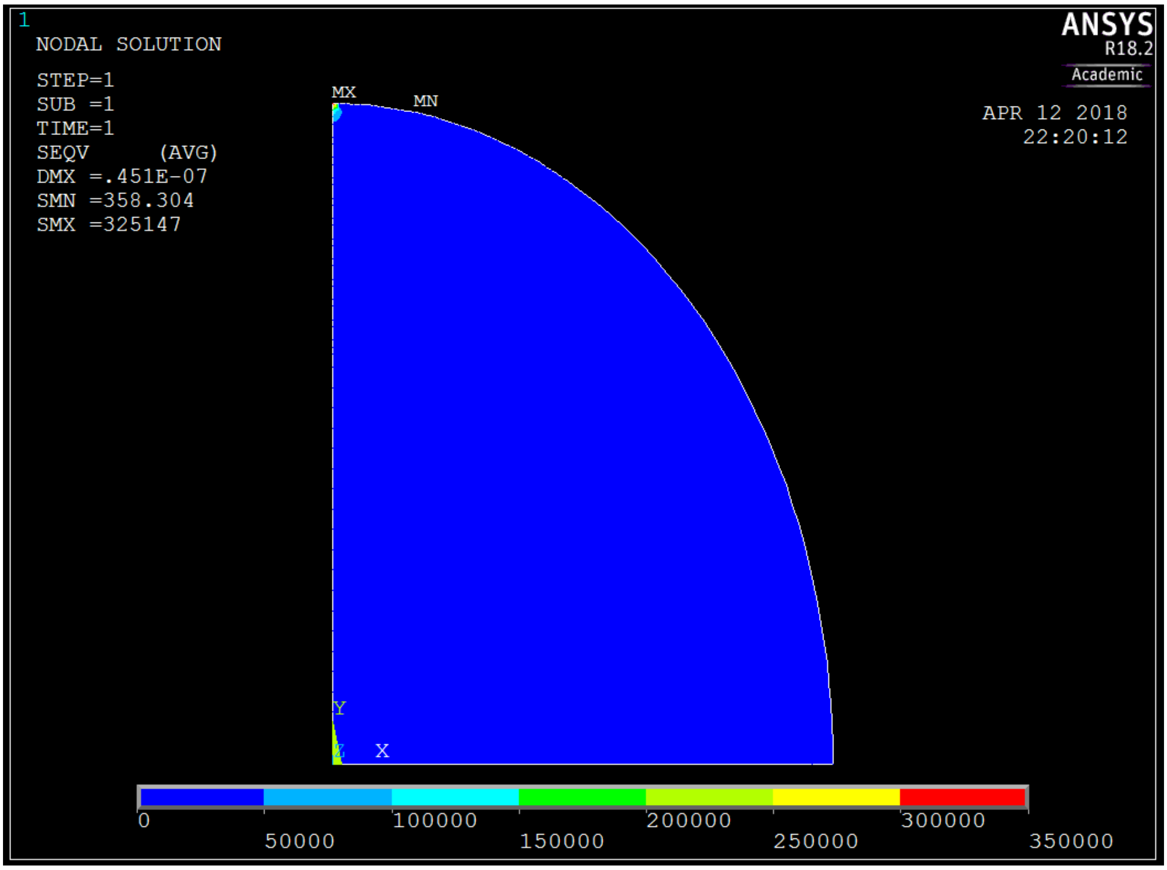


Fig: σx, σy, τxy along the Minor axis [**Ratio =3/4**]

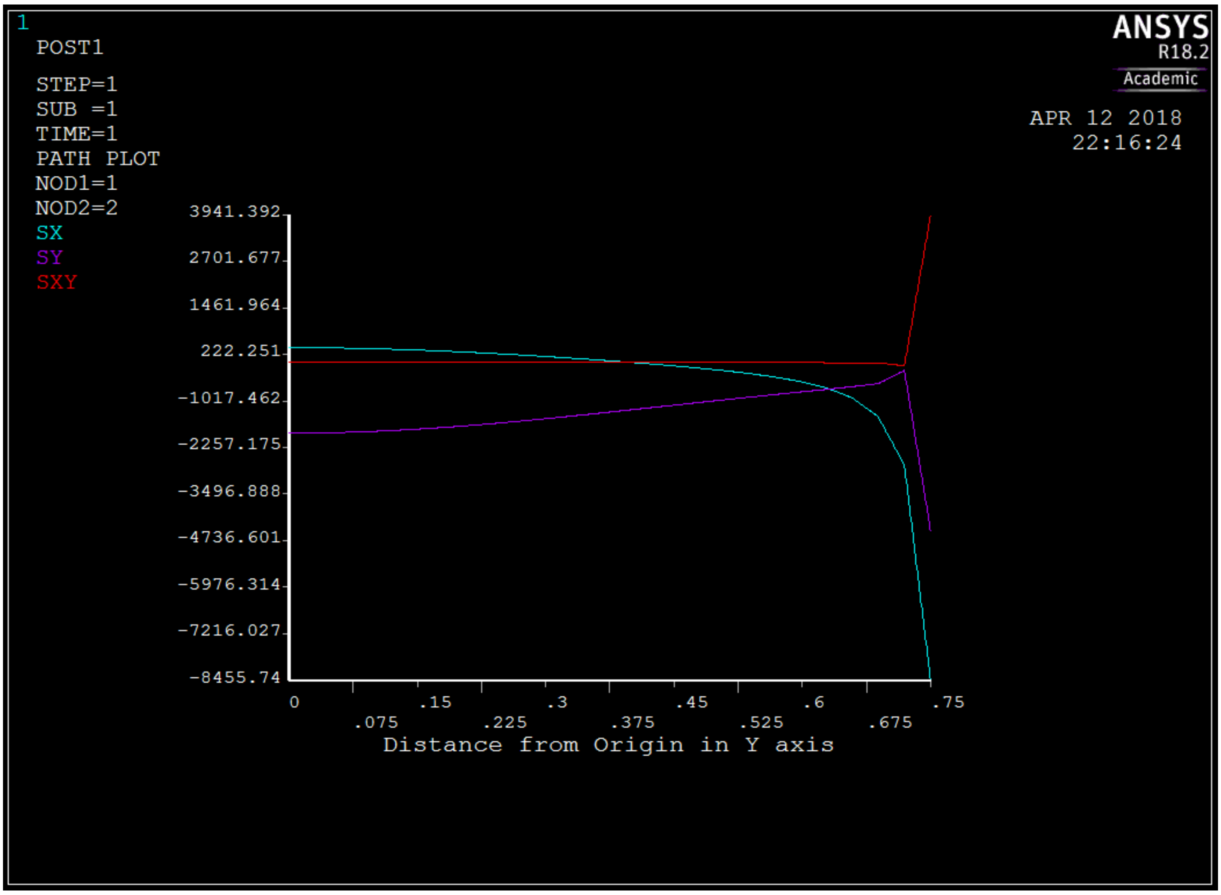


Fig: σx, σy, τxy along the Major axis [**Ratio =3/4**]