

ANSYS - 3D Curved Beam step 8

Problem Specification

1. Start-up and preliminary set-up
2. Specify element type and constants
3. Specify material properties
4. Specify geometry
5. Mesh geometry
6. Specify boundary conditions
7. Solve!
- 8. Postprocess the results**
9. Validate the results

Step 8: Postprocess the results

Enter the postprocessing module to analyze the solution.

Main Menu > General Postproc

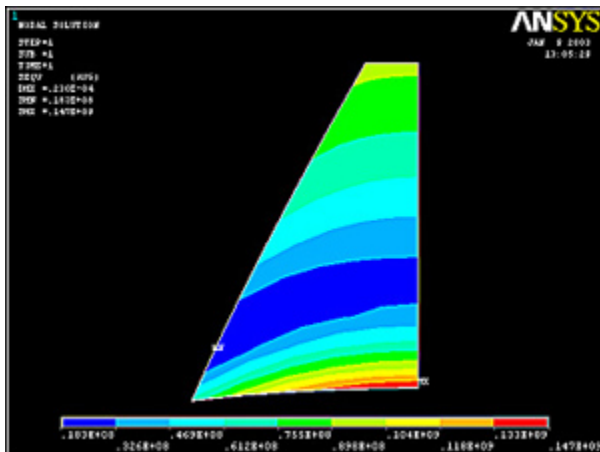
Plot von Mises Stress

To display the von Mises stress distribution as *continuous* contours, select

Main Menu > General Postproc > Plot results > Contour Plot > Nodal Solu

Select **Stress** from the left list, **von Mises SEQV** from the right list and click OK.

Utility Menu > PlotCtrls > Pan,Zoom,Rotate > Right



(Click Picture for Larger Image)

The maximum von Mises stress is 147 MPa and occurs at the bottom on the symmetry line.

Plot Circumferential Stress

is the SY stress component in cylindrical coordinates in ANSYS. Activate the cylindrical coordinate system for results display (you need to do this even if you were working in the cylindrical system in the preprocessor):

Main Menu > General Postproc > Options for Outp

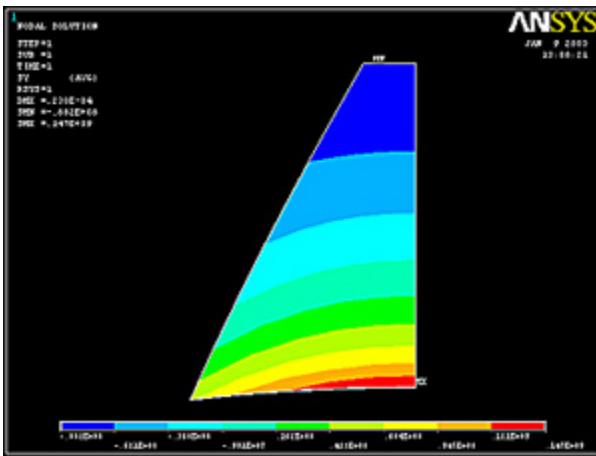
Select **Global Cylindric** for **Results Coord System**.

To display the stress distribution over face 1 as *continuous* contours, select

Utility Menu > PlotCtrls > Pan,Zoom,Rotate > Right

Main Menu > General Postproc > Contour Plot > Plot results > Nodal Solu

Select **Stress** from the left list, **Y-direction SY** from the right list and click **OK**.



(Click Picture for Larger Image)

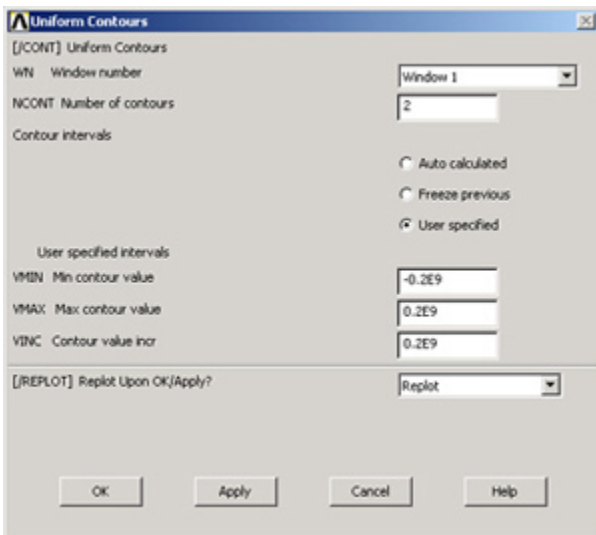
Check where the maximum (MX) and minimum (MN) values occur in the plot. The circumferential stress is tensile (positive) and compressive (negative) on the inner and outer portions of the cross-section, respectively. Is this what you'd have expected? The contours are more closely spaced at smaller r values. This agrees with the prediction of curved beam theory that the stress gradients will be highest on the edge nearest the center of curvature.

Plot Neutral Axis

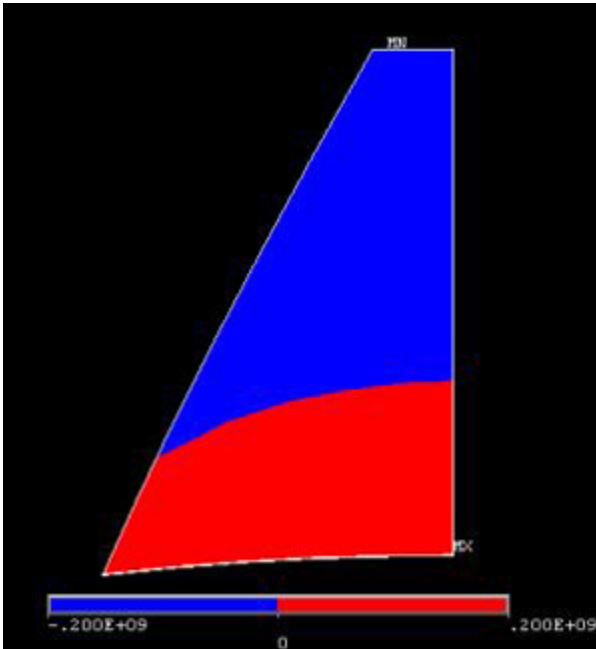
The neutral axis is the locus of points where is zero. To visualize the neutral axis, we'll change the contour levels that are plotted.

Utility Menu > PlotCtrls > Style > Contours > Uniform Contours

Enter 2 for **Number of contours**, and choose **User specified** for **Contour Intervals**. Enter **Min contour value**=-0.2E9, **Max contour value**=0.2E9, and **Contour value incr**=0.2E9. Click **OK**.



This plots the regions with positive and negative values in different colors. In the red region, $0 < \sigma < 200 \text{ MPa}$ and in the blue region, $-200 \text{ MPa} < \sigma < 0$. So the boundary between the two colors is the neutral axis.



The FEA results indicate that the neutral axis is curved, contrary to the assumption in mechanics of materials theory.

Plot Radial Stress

In cylindrical coordinates, the radial stress is the *SX* stress component.

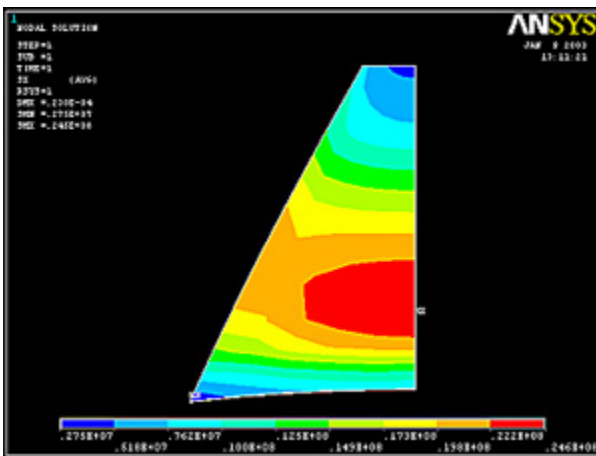
Main Menu > General Postproc > Plot results > Nodal Solu...

Select **Stress** from the left list, **X-direction SX** from the right list and click **OK**.

Change contour plot options back to original:

Utility Menu > PlotCtrls > Style > Contours > Uniform Contours

Enter 9 for **Number of Contours**, and choose Auto calculated for **Contour Intervals**. Click **OK**.



(Click Picture for Larger Image)

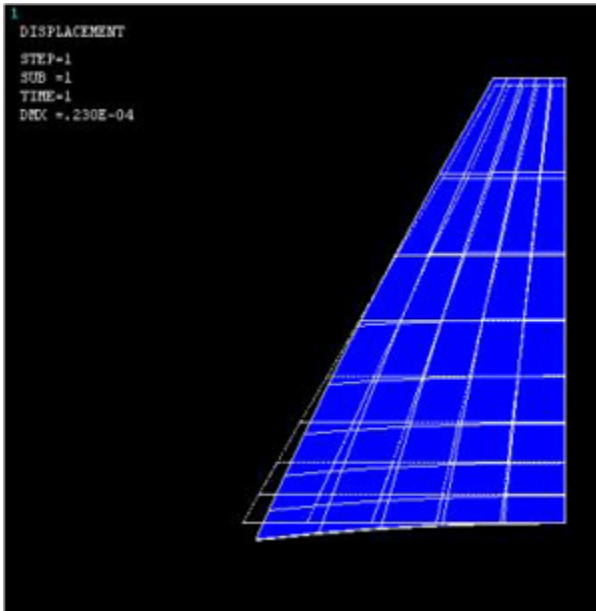
The radial stress is tensile over the entire cross-section.

Plot Deformed Shape

Main Menu > General Postproc > Plot Results > Deformed Shape

Select **Def + undeformed** and click **OK**.

This plots the deformed and undeformed shapes in the *Graphics* window. The maximum displacement $DMX=0.230e-4$ m.



Animate the deformation:

Utility Menu > PlotCtrls > Animate > Deformed Shape

Select **Def + undeformed** and click **OK. Select Forward Only** in the *Animation Controller*.

From the animation of the deformation of the cross-section, check that the following BCs are satisfied: $u=0$ at node A, $w=0$ along AB and CD. (Note that the z-direction is from right to left in the above view).

The radial stress is tensile, so the radial dimension becomes larger as expected. We saw that the circumferential stress is, respectively, tensile and compressive on the inner and outer portions of the cross-section. You can check that the stress S_z parallel to the axis of revolution is small. Therefore, the Poisson effect should cause the inner and outer portions, respectively, to contract and expand in the z-direction as is observed. Circumferential tension on the inner portion pulls material toward the center of curvature. Outer corners are more flexible than the central portion. So it makes sense that the outer, bottom corner moves inward with respect to central point A (Cook et al). Thus, the deformation we get looks reasonable.

Animate the front view:

Utility Menu > PlotCtrls > Pan,Zoom,Rotate > Front

Utility Menu > PlotCtrls > Animate > Deformed Shape

Select **Def + undeformed** and click **OK. Select Forward Only** in the *Animation Controller*.

From this animation, check that the BCs for v on both faces are satisfied.

Save your work: **Toolbar > SAVE_DB**

[Go to Step 9: Validate the results](#)

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