Carnegie Mellon

Mechanical Engineering

Self-paced learning on the Web

FEM/ANSYS

Test S2: Steel Bracket

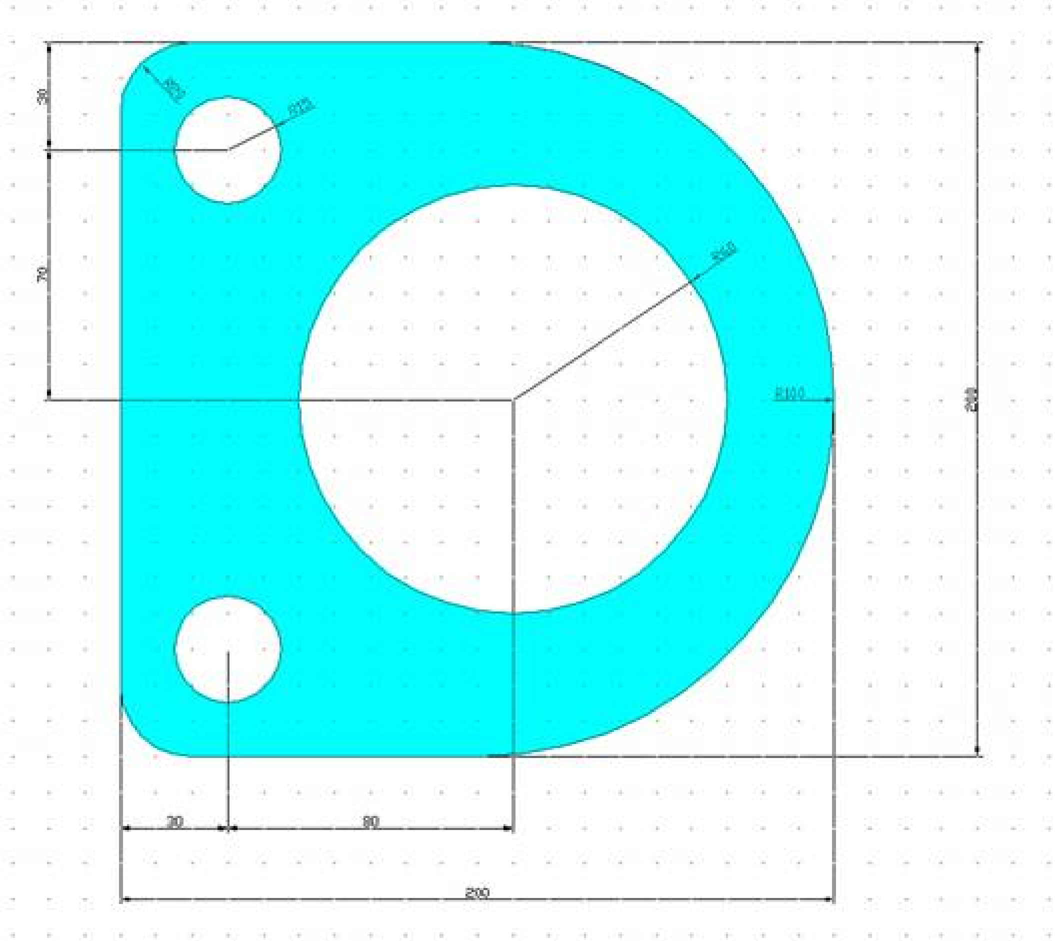
Structural Test #2: Analysis of a Steel Bracket

Introduction: In this example you will learn to use the Solid 8 Node element in ANSYS.

Physical Problem: Structural analysis of the Steel Support shown in the figure. This is a typical bracket used to support towel rods.

Problem Description:

- We will model the bracket as a solid 8 node plane stress element. By a plane stress element we are assuming that there are no stresses in the thickness direction of the bracket.
- **Geometry**: The thickness of the bracket is 3.125 mm
- **Material**: Assume the structure is made of steel with modulus of elasticity E=200 GPa.
- **Boundary conditions**: The bracket is fixed at the screw holes.
- **Loading**: The bracket is loaded at one point in the center of the large hole. The load is 2000 N.
- **Objective**:
  - Plot deformed shape
  - Determine the principal stress and the von Mises stress. (Use the stress plots to determine these)
  - Remodel the bracket without the fillet at the corner, and see how principal stress and von Mises stress change.
- You are required to hand in print outs for the above.
- Figure:



IMPORTANT: Convert all dimensions and forces into SI units

- Turn on the keypoint numbering function in the ANSYS Utility Menu.
- Create the keypoints to form the area that will become the bracket.
- Then connect the keypoints with lines and define an area to form the bracket master area.
- Fillet the lines to form the curve on the right side. Use a fillet radius of 0.1.
- Create two areas defined by the fillet curve and the respective corner of the bracket master area.
- Create the Circular areas in the center and left side of the bracket.
- Subtract the areas defined by the fillet, the center circle, and the two smaller circles to form the shape of the bracket intended to be analyzed.
- Add the two lines forming the bottom of the circle together to form one arc that encompasses the lower semicircle of the center circle.
- Define the Material Properties of the **Steel** Element (Elastic Modulus and Poison’s Ration are the important qualities)
- Define the Element Properties as a Quad 8 node Structural Solid.
- In the Element Type Window, set the option of setting the Plane Stresses to the thickness. (Hint: in the window it’s the value for K3)
- Set the Real Constant Set No. to 1 and the Real Constant for the Plane Stress with Thickness to 0.03.
- Mesh the bracket. (Do so by picking the lines around the outer boundary of the bracket and setting the element edge length to 0.0125. Next set the element edge length around the small circles to 0.00125. Then Mesh the area.)
- Apply the boundary conditions. (Structrual Displacement on the edges of the “screw holes” equal to zero, and a structural force / moment on the bottom of the large circle equal to –900N in the Y direction.)

- Solve
- List the nodal results of the solution with respect to all degrees of freedom.
- Plot the nodal solution with respect to all degrees of freedom. Show both the deformed and undeformed shape of the bracket.

(The nodal displacements will be listed as follows:)

PRNSOL Command

File

PRINT U NODAL SOLUTION PER NODE

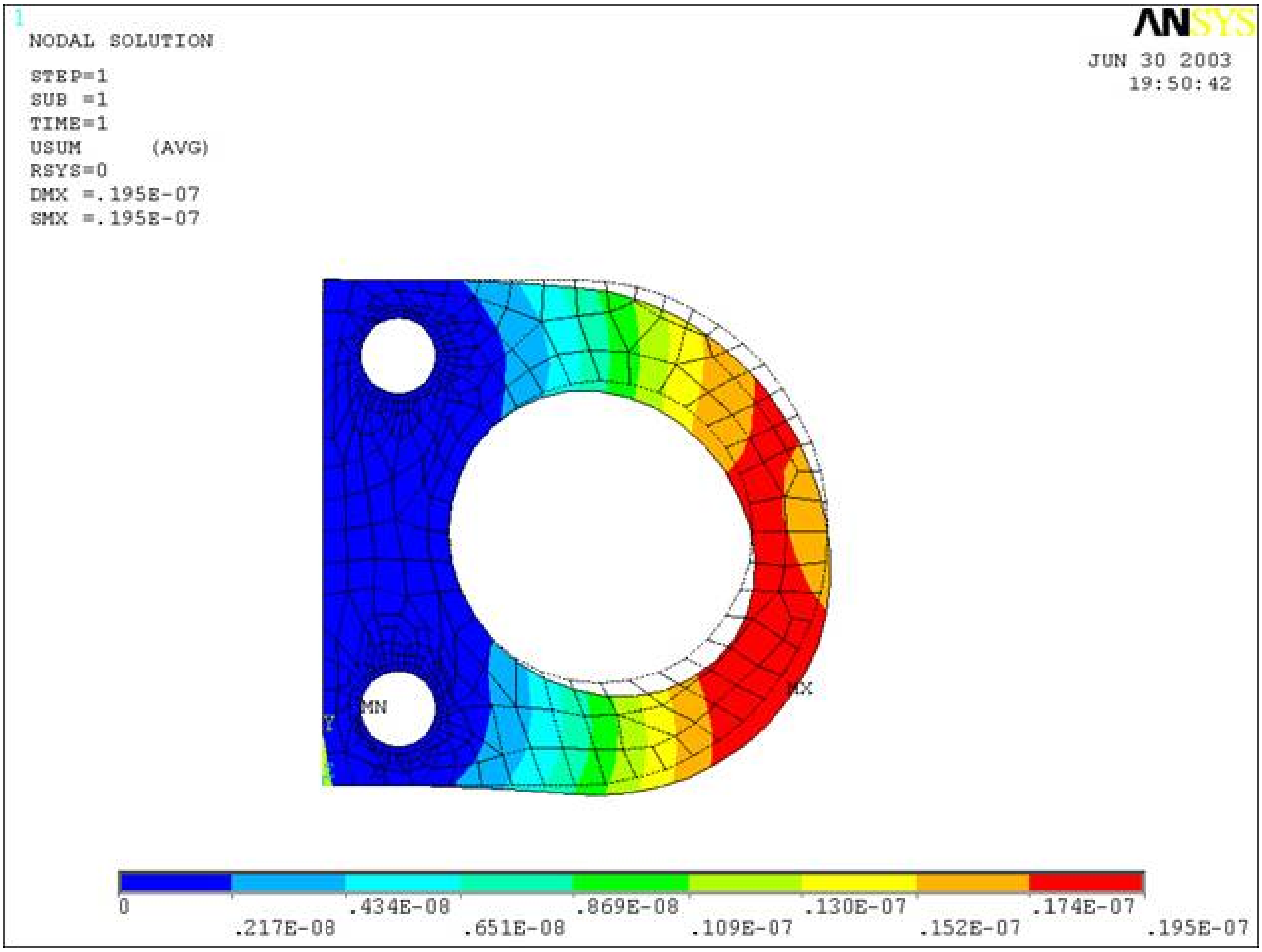
***** POST1 NODAL DEGREE OF FREEDOM LISTING *****

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

THE FOLLOWING DEGREE OF FREEDOM RESULTS ARE IN GLOBAL COORDINATES

NODE	UX	UY	UZ	USUM
1	-0.41991E-09	0.25366E-09	0.0000	0.49057E-09
2	0.44078E-09	0.29874E-09	0.0000	0.53248E-09
3	-0.33441E-09	0.25128E-09	0.0000	0.41830E-09
4	-0.23213E-09	0.23912E-09	0.0000	0.33326E-09
5	-0.13097E-09	0.19271E-09	0.0000	0.23300E-09
6	-0.59378E-10	0.12252E-09	0.0000	0.13615E-09
7	-0.29170E-10	0.54533E-10	0.0000	0.61844E-10
8	-0.20787E-10	-0.55329E-11	0.0000	0.21511E-10
9	-0.19200E-10	-0.54776E-10	0.0000	0.58044E-10
10	-0.15056E-10	-0.10292E-09	0.0000	0.10402E-09
11	-0.10352E-10	-0.15809E-09	0.0000	0.15843E-09
12	-0.11727E-10	-0.21836E-09	0.0000	0.21868E-09
13	-0.31392E-10	-0.28263E-09	0.0000	0.28437E-09
14	-0.69755E-10	-0.33699E-09	0.0000	0.34413E-09
15	-0.12367E-09	-0.37727E-09	0.0000	0.39702E-09
16	-0.18847E-09	-0.39956E-09	0.0000	0.44178E-09
17	-0.25627E-09	-0.39932E-09	0.0000	0.47447E-09
18	-0.32005E-09	-0.37837E-09	0.0000	0.49558E-09
19	-0.37280E-09	-0.33746E-09	0.0000	0.50285E-09
20	-0.40872E-09	-0.28035E-09	0.0000	0.49563E-09
21	-0.42298E-09	-0.20996E-09	0.0000	0.47222E-09
22	-0.41153E-09	-0.13249E-09	0.0000	0.43233E-09
23	[illegible]	[illegible]	[illegible]	[illegible]

(The nodal displacement should look like this:)



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