MAE 212: Spring 2001

HW 2

Due Thursday, February 8

1. Two members of uniform cross section 2×3 in. are glued together along plane a-a, which forms an angle of 25^o with the horizontal. Knowing that the allowable stresses for the glued joint are $\sigma = 100$ psi and $\tau = 80$ psi, determine the largest axial load P which may be applied.

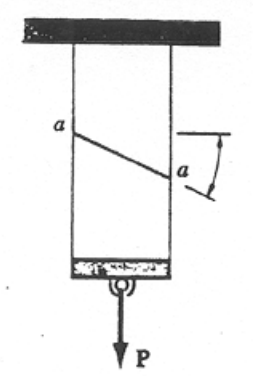

Figure 1: Problem 1.

2. Strain rosette readings are made at critical point on the free surface in a structural steel component. The 60^o rosette contains three wires positioned at 0^o, 60^o and 120^o. The readings are: $\epsilon_a = 200 \times 10^{-6}$, $\epsilon_b = 150 \times 10^{-6}$ and $\epsilon_c = -250 \times 10^{-6}$. Find the principal strains and stresses and their directions in the plane of the rosette. The material properties are $E = 250$ GPa and $\nu = 0.4$.

3. Show that in a closed-end, thin-walled cylinder subjected to internal pressure p, the maximum shear-stress component in the θz plane is one-quarter the maximum normal stress component in that plane.

4. A long, thin-walled cylindrical tank has a radius r and a wall thickness t. Its ends are closed, and when a pressure p is put in the tank a strain gage mounted on the outside surface in a direction parallel to the axis of the tank measures a strain of e_o. What is the pressure in the tank?

5. Show that is a state of plane stress is to be described in terms of polar coordinates, the requirement that $\sum F = 0$ leads to the following two equations:

$$\frac{\partial \sigma_r}{\partial r} + \frac{1}{r}\frac{\partial \tau_{r\theta}}{\partial \theta} + \frac{\sigma_r - \sigma_\theta}{r} = 0, \qquad \frac{\partial \tau_{r\theta}}{\partial r} + \frac{1}{r}\frac{\partial \sigma_\theta}{\partial \theta} + 2\frac{\tau_{r\theta}}{r} = 0$$

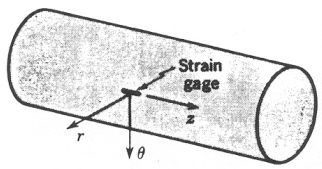

Figure 2: Problem 4.

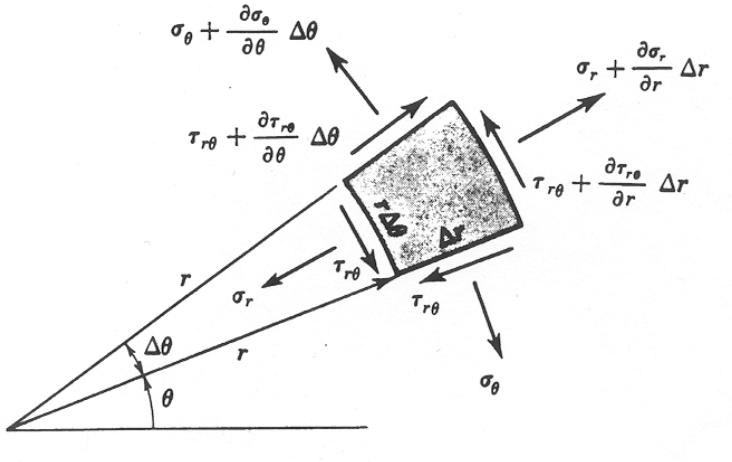

Figure 3: Problem 5.

Note that the length of the curved boundary on the outer edge of the element is $(r + \Delta r)\Delta\theta$.

6. A 0.8-m by 0.6-m rectangle ABCD is drawn on a thin plate prior to loading. Subsequent to loading, the deformed geometry is shown by the dashed lines in Fig. 4. Determine the components of plane strain at point A.

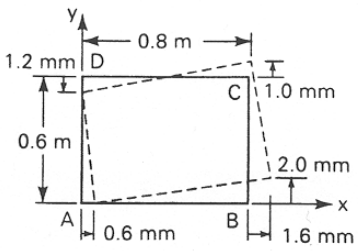

Figure 4: Problem 6.