

## Strain Transformation and Rosette Gage Problems

The following problems should reinforce the concepts presented in class and in the lab notes. Use Mohr's Circle to visualize the process and use a calculator, a spreadsheet or a Matlab program to actually compute the required transformed quantities.

### **Mohr's Circle Strain Transformation Problems**

1. Using Mohr's Circle to visualize the states of strain, compute the principal strains and their orientation with respect to the  $x$  axis system for each case:

(a)  $\epsilon_x=0$   
 $\epsilon_y=-2000$   
 $\gamma_{xy}=0$

(b)  $\epsilon_x=0$   
 $\epsilon_y=-0$   
 $\gamma_{xy}=3000$

(c)  $\epsilon_x=-6000$   
 $\epsilon_y=-6000$   
 $\gamma_{xy}=0$

2. Using Mohr's Circle, compute, (a) the state of strain that exists  $88^\circ$  counterclockwise from the  $x$  axis, and (b) the principal strains and their orientation with respect to the  $x$  axis. Assume all strains are in microstrain units.

(a)  $\epsilon_x=8000$   
 $\epsilon_y=-4000$   
 $\gamma_{xy}=3000$

(b)  $\epsilon_x=-8000$   
 $\epsilon_y=2000$   
 $\gamma_{xy}=4000$

3. Using Mohr's Circle to visualize the problem, compute the strain state that exists in the  $x$ - $y$  reference axis system if

(a)  $\epsilon_1=10000$   
 $\epsilon_2=2000$   
 $\gamma_{xy}=-6000$

4. Using Mohr's Circle, determine the state of stress, the principal stresses and their direction that exist in the  $x'y'$  reference axis system oriented  $15^\circ$  clockwise from the  $x$  axis for the following cases:

(a)  $\epsilon_x=4000$   
 $\sigma_y=-24$  ksi  
 $\tau_{xy}=12$  ksi

(b)  $\epsilon_x=3000$   
 $\epsilon_y=-8000$   
 $\gamma_{xy}=-6000$

Note:  
Use  $E=10e6$  psi  
 $G=3/8 E$   
 $\nu=1/3$

### **Strain Rosette Problems**

1. The strain readings from a rectangular rosette whose  $0^\circ$ ,  $45^\circ$  and  $90^\circ$  elements are numbered A,B,C are listed below. Find the principal strains, the maximum shear strain, and the orientation of the axes on which they act.
  - (a)  $\epsilon_A = 1000$   
 $\epsilon_B = 200$   
 $\epsilon_C = -600$
  - (b)  $\epsilon_A = -8000$   
 $\epsilon_B = 1000$   
 $\epsilon_C = 800$
  
2. The strain readings from a delta rosette are:
  - (a)  $\epsilon_A = 6000$   
 $\epsilon_B = 8000$   
 $\epsilon_C = -2000$
  - (b)  $\epsilon_A = -4000$   
 $\epsilon_B = -12000$   
 $\epsilon_C = 4000$

Find the principal strains, the orientation of the principal axes, and the maximum shear strain. Find the strains for an x-y axis system rotated  $20^\circ$  clockwise from the gage A axis.