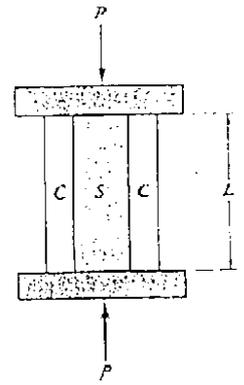
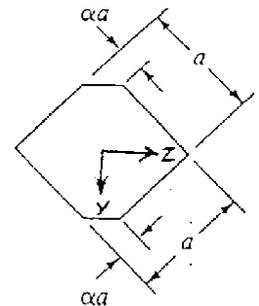


1. A circular steel cylinder S and a hollow copper circular tube C having the same length L are compressed between the rigid plates of a testing machine by force P . Determine the following quantities:
 (a) the compressive force P_S and P_C in the steel cylinder and copper tube, respectively; (b) the corresponding compressive stresses σ_S and σ_C in the materials; and (c) the shortening δ of the assembly. (20%)



參考圖

2. For the cross section as shown in Fig.
 a) Determine the maximum bending stress in response to a bending moment M_x (10%)
 b) Determine the value of α that gives the smallest bending stress. (10%)



3. Solve the following problems

(1) The smallest buckling load for the column with certain constraints at ends is given as

$$P_{cr} = \frac{\pi^2 EI}{L_e^2}, \quad (\text{Euler's column formula})$$

where L_e is called the effective length of a column and is equal to L , the length of a column with pinned ends.

Please *physically explain*

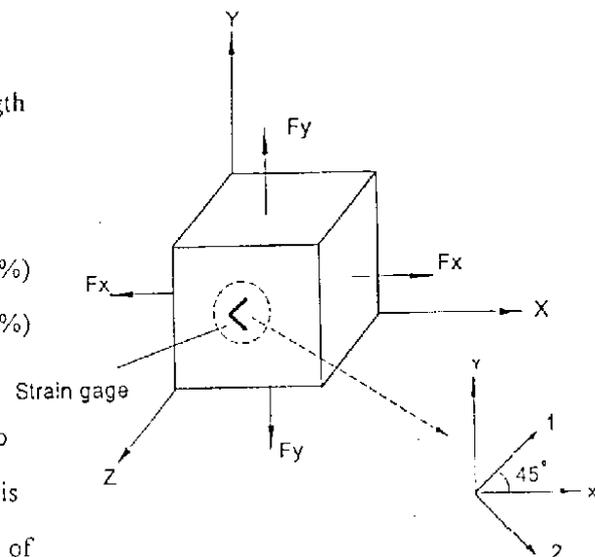
- (a) why $L_e = 2L$ for a column with one end fixed and one end free, and (4%)
 (b) why $L_e = 0.5L$ for a column with both ends fixed. (4%)

(2) A block made of steel having $G = 82,500 \text{ MPa}$ and $\nu = 0.3$ is subjected to the biaxial loads as shown in the figure. A $0/90^\circ$ strain gage rosette, which is firmly attached to one of the face in parallel to the $X-Y$ plane, has readouts of 0.5% and 1.0% from its legs in 1- and 2- directions as indicated, respectively.

Suppose that the block has dimension $10 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm}$ and that the material's response is linearly elastic. Determine F_x , F_y and ϵ_z . (12%)

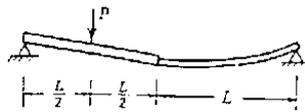
(Hint: $\epsilon_\theta = \epsilon_x \cos^2 \theta + \epsilon_y \sin^2 \theta + \gamma_{xy} \sin \theta \cos \theta$, and

$$\gamma_{1-2} = -(\epsilon_x - \epsilon_y) \sin 2\theta + \gamma_{xy} \cos 2\theta$$



參考用

4. (20%) A simply supported beam is constructed by welding a very stiff beam to a beam which is relatively much less stiff in bending. What is the deflection under a load P applied in the middle of the stiff part if we assume that this part carries a bending moment without any resulting curvature and the flexural rigidity of the other part is EI ?



5. (20%) A simple truss ABC is shown in the figure. Assume that both bars have the same axial rigidity EA and that the length of member AB is L . Denote the horizontal displacement of joint B by D_1 (positive to the right) and denote the vertical displacement by D_2 (positive downward). (a) Express the strain energy U of the structure as a function of the displacements D_1 and D_2 . (b) Determine D_1 and D_2 by using Castigliano's first theorem.

