

- (15%) 1. A solid circular bar of brittle material (such as chalk) was under a twisting moment (i.e. torsion). What is the type of its failure? Explain it.
- (15%) 2. What are the three-point bending and the four-point bending? If you want to perform a pure moment test, how do you design the experiment?
- (15%) 3. How do you design an experiment to determine one of two material properties, Poisson's ratio?
- (15%) 4. Sketch simple examples to explain (a) Reciprocal theorem, and (b) Castigliano's second theorem in the energy methods.
- (20%) 5. A 60° strain rosette consists of three electrical-resistance strain gauges arranged as shown in Figure 5. Gauges A, B and C measure the normal strains ϵ_a, ϵ_b and ϵ_c in the direction of the x-axis and two inclined directions shown, respectively. Obtain the equations for the strains ϵ_x, ϵ_y and r_{xy} associated with the x y axes.
- (20%) 6. Figure 6 shows a column with pinned ends: (a) ideal column, and (b) buckled shape. Determine the critical load and the deflected shape of the buckled column by using the second-order equation in terms of bending moment, M , i.e. $EIv'' = -M$, in which $v'' = d^2 v/dx^2$, v is the lateral deflection in the y direction and EI is the flexural rigidity for bending in the xy plane (the plane of buckling).

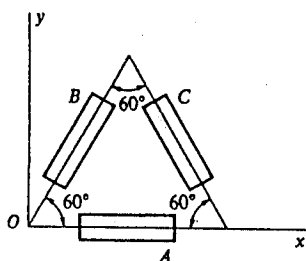


Figure 5.

Hint:

$$\epsilon_{x_1} = \frac{\epsilon_x + \epsilon_y}{2} + \frac{\epsilon_x - \epsilon_y}{2} \cos 2\theta + \frac{\gamma_{xy}}{2} \sin 2\theta$$

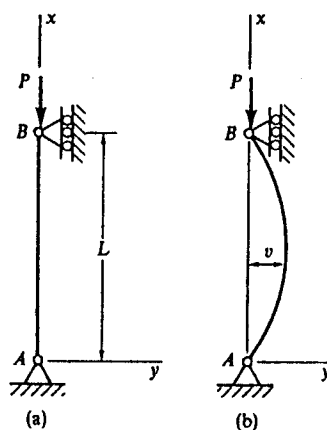


Figure 6.