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1 Answer the following questions:

(1). Translate the following sentences to Chinese:

a. Principle of superposition states that the resultant stress or displacement at the point can be determined by first finding the stress or displacement caused by each component load acting separately on the member. (5%)

b. The maximum shear stress theory states that yielding of the material begins when the absolute maximum shear stress in the material reaches the shear stress that causes the same material to yield when it is subjected only to axial tension. (5%)

(2). In beam theory the bending stress $\sigma = -My/I$ is derived based on the assumption that, under pure bending condition, the cross-sectional plane of the beam remains a plane. The assumption is invalid if shear stress exists. Sketch the deformed shape of the cross-sectional plane for a beam with rectangular cross-section under bending and shear. Under what condition the bending stress equation $\sigma = -My/I$ remains valid? (5%)

(3). How can we increase the torsional rigidity of a circular shaft while keeping the size of the cross-sectional area constant? (5%)

2 Solve the problem as shown in Fig. 1 by using Castigliano's theorem (alternative solution approach is not allowed). Bending rigidity of the beam is EI

(1). Determine the support reaction at B (10%)

(2). Determine the beam deflection at $x = L/2$ (10%)

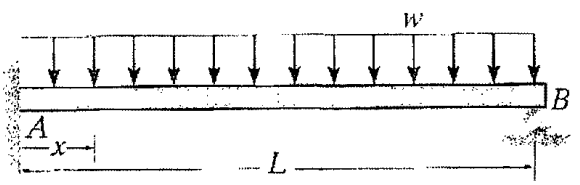

Fig. 1

3 A column, as shown in Fig. 2, is pin-connected at the support location with a torsional spring of constant k. The spring is undeformed initially when the column is in vertical configuration. Assuming the column is rigid,

(1). determine the critical load P when buckling occurs, (5%)

(2). sketch the P vs. θ plot for all possible equilibrium conditions, θ denotes the angle of rotation for the column. Describe the stability of equilibrium configurations. (15%)

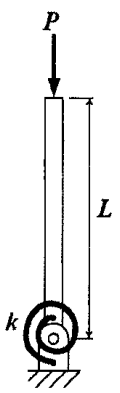

Fig. 2

(背面仍有題目,請繼續作答)

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4. As shown in Fig. 3, a rod (Young's modulus E_1, Poisson's ratio ν_1, coefficient of thermal expansion α_1, cross-section area A_1) and sleeve (Young's modulus E_2, Poisson's ratio ν_2, coefficient of thermal expansion α_2, cross-section area A_2) are held between a rigid wall and a rigid plate. A stiff spring of constant k is held on the other side of the plate and another rigid wall Initially, the system is stress-free and the temperature is zero. The temperature of the left wall is then raised such that the temperature distribution $T = \Delta T\left(1 - x/L\right)^2$ Assuming the only nonzero stress component in the rod and sleeve is the axial stress,
   (1). determine the stress distributions in the rod and sleeve, (10%)
   (2). determine the strain distributions in the rod and sleeve. (10%)

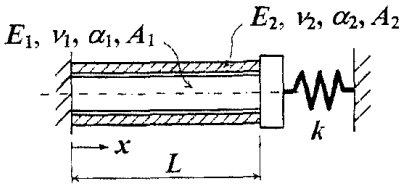

Fig. 3

5 A thin-walled beam of uniform thickness t is subjected a vertical shear load as shown in Fig. 4
   (1) Determine the location of shear center for the beam. (15%)
   (2) Shear stress on the beam cross-section can be determined by considering the end load as combined loads. Briefly describe the types of loading (and their magnitudes) that contribute to the resultant shear stress. (5%)

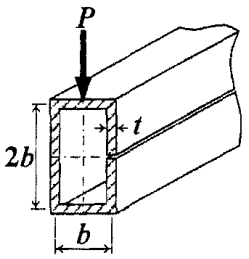

Fig. 4