題號： 219　　國立臺灣大學 108 學年度碩士班招生考試試題

科目： 材料力學(B)

節次： 8

1. The two **rigid bars** of Fig. 1 are pin-connected at Point B and vertically supported by three linear springs at Points A, B, and C (see Fig. 1). The lengths of the rigid bars are both L. The stiffness of the three springs at Points A, B, and C are k, $2k$, and k, respectively. The system of Fig. 1 is subjected to an axial compressive load P. Ignore the weight of the rigid bars. Determine the minimum critical load P_{cr} and its corresponding shape for the system. (25%)
2. A 20-kN force and a torsion of 1 kN-m are applied at the top of the 60-mm diameter solid post shown in Fig. 2. Point H is 200-mm below the top of the post (see Fig. 2). Determine the principal stresses and in-plan maximum shear stress at Point H. (25%)

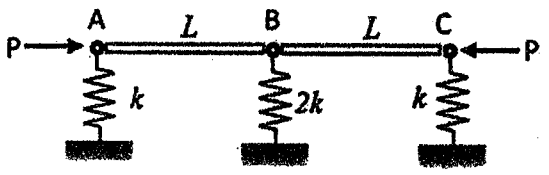

Fig. 1

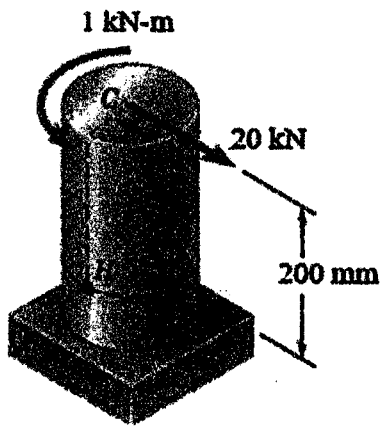

Fig. 2

3. A set of 60° strain gage rosette as shown in Fig. 3-2 is mounted at Point K on the outside of a cylindrical compressed air tank shown in Figure 3-1. The recorded strains are $\varepsilon_a = 80\times10^{-6}$ and $\varepsilon_b = \varepsilon_c = 275\times10^{-6}$. The tank has a diameter-to-thickness ratio (d/t) of 50 and the modulus of elasticity E is 200 GPa. Determine (1) the air pressure in the tank, (2) the principal stresses at Point K, and (3) the **absolute** maximum shear stress at Point K. (25%)

4. A rigid block is suspended by Rods B, C, and D as shown in Fig. 4. The three rods have the same cross section of A and are all made of elastic-perfectly plastic material with a modulus of elasticity E and a yield stress σ_Y. The lengths of Rods B, C, and D are L, $2L$. and L, respectively. The block is slowly subjected to a force P, which produces a downward displacement δ without rotating the block. Rods B, C, and D do not have initial axial force before P applies. Ignore the weight of the block. (25%)
   (1) Which rod will yield first? Also, derive the expression for P and δ as a function of E, A, L, and σ_Y when the first yielding just occurs in any of the three rods.
   (2) Assume the elastic-perfectly plastic material will fracture at a tensile strain of $3\sigma_Y/E$. Plot the relationship of P and δ from P = 0 to the first fracture of the system. Use δ and P as the x and y coordinates, respectively, for the plot.

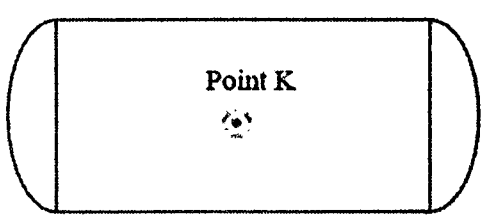

Fig. 3-1

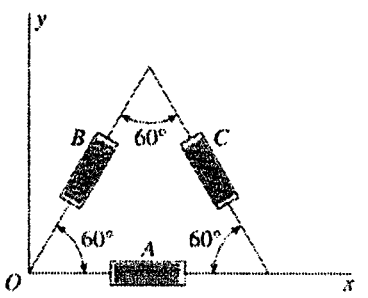

Fig. 3-2

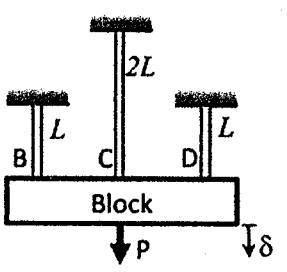

Fig. 4

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