1. As shown in Fig. 1, beam ACB is subjected to a uniformly distributed load q in segment AC. Point A is supported with a hinge, and there are roller supports at point C and B. The length of segment AC is L_1, and the length of segment CB is L_2 . Beam ACB has a flexural rigidity of EI. Determine the reaction at point B. (Ignore the self-weight of the beam. and express the answer in terms of q, L_1 and L_2.) (25%)

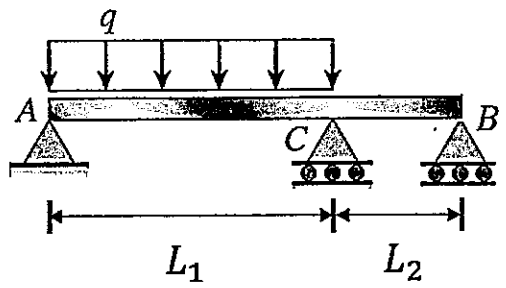

Fig. 1

2. A simply-supported beam with overhang is shown in Fig. 2-1. The support at point A is a hinge, and the support at point C is a roller. There is a uniformly distributed load q spanning all over beam ACB. The cross-section of the beam is shown in Fig. 2-2, and the external load q results in bending with respect to the z-axis (i.e., the axis of centroid). Also, it is known that $L_1 = 3.0$ m, $L_2 = 1.5$ m, $c_1 = 18.48$ mm, $c_2 = 61.52$ mm, and $I_z = 2.469\times10^6$ mm^4 (i.e., the moment of inertia with respect to the axis of centroid). Determine the maximum permissible value of q (in kN/m) if the allowable tensile stress and compressive stress are σ_{aT} = 105 MPa and σ_{aC} = 90 MPa, respectively. (Ignore the self-weight of the beam.) (25%)

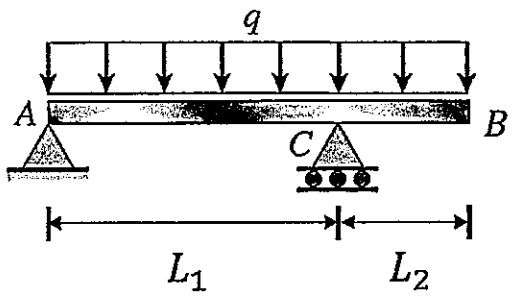

Fig. 2-1

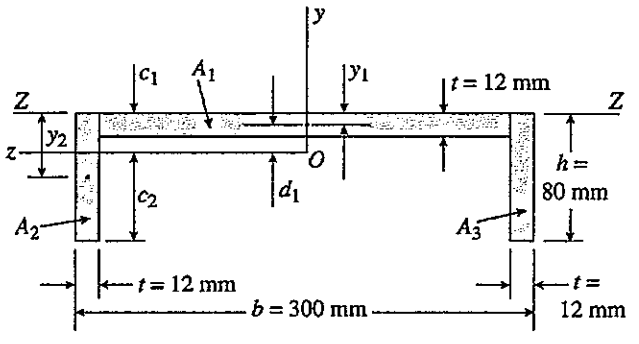

Fig. 2-2

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3. A solid circular bar *ABCD* with fixed supports is subjected to two torques along the axial direction of the bar, namely, T_0 (turning into the paper) and $2T_0$ (turning out of the paper) at points *B* and *C*, respectively, as shown in Fig. 3. The solid bar has a modulus of elasticity *E* for its material and a uniform polar moment of inertia *J* for its cross section. Assume the bar remains linear elastic subjected to the applied torques. Determine:
(1) the reactions at points A and D as a function of T_0.
(2) the maximum angle of twist of the bar and its location in the bar.

(25%)

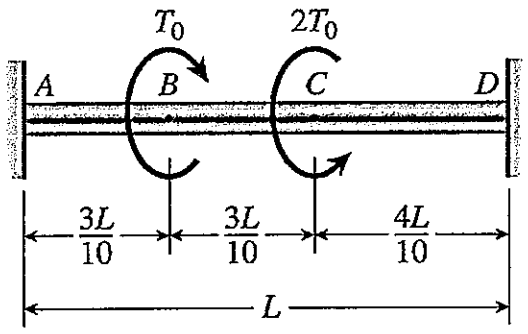

Fig. 3

4. The cantilever beam of Fig. 4.1 is subjected to three external loads as shown in the figure. The directions of the three force P_1, P_2 and 10 kN are in the negative *Z*, negative *Y*, and positive *X* directions, respectively. The material of the beam has a Poisson's ratio ν of 0.3, a modulus of elasticity (*E*) of 200 GPa, and a shear modulus (*G*) of 70 GPa. Three strain gages *E*, *F* and *G* are attached to the beam at Point *a* as shown in Fig. 4-1 in the manner shown in Fig. 4-2 to measure strains. Gages *E* and *F* measure the normal strains ε_E and ε_F in the directions along the X axis and 60°-counterclockwise from the X axis, respectively. The values of ε_E and ε_F are 91.95×10^{-6} and -0.12×10^{-6}, respectively. (25%)
(1) Find the values of P_1 and P_2.
(2) Find the normal strain reading of Gage *G*, ε_G.

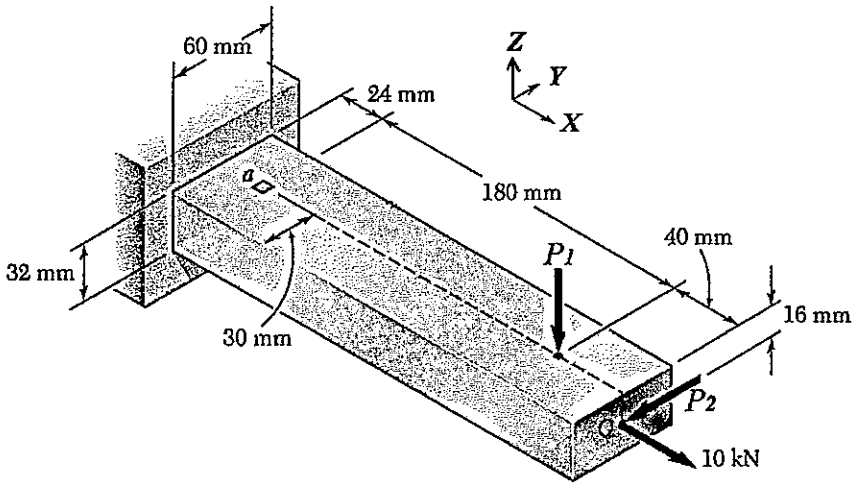

Fig. 4-1

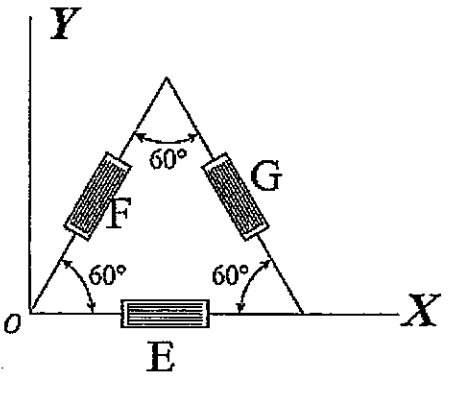

Fig. 4-2

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