

本試題是否可以使用計算機： 可使用， 不可使用（請命題老師勾選）

1. The cross section of a stainless steel thin-walled tube ( $G=80\text{GPa}$ ) is in the form of an equilateral triangle (see figure 1) The length along the median line of each side is  $b=150\text{mm}$ , and the wall thickness is  $t=8\text{mm}$ . If the allowable shear stress is  $50\text{MPa}$ , what is the maximum permissible torque  $T$  that may act on the tube? At this value of torque, what is the angle of twist  $\theta$  per unit length?(25%)

2. A cross section in the shape of an unbalanced I-beam is shown in the figure 2. Derive the following formula for the distance  $e$  from the centerline of the web to the shear center  $S$ :

$$e = \frac{3I_f(b_2^2 - b_1^2)}{kt_w + 6I_f(b_1 + b_2)}$$

Also, check the formula for the special cases in which  $b_1=0$  and  $b_2=b$  (channel section) and  $b_1=b_2=b/2$  (doubly symmetric I-beam). (25%)

3. A cube of material is placed between lubricated rigid walls in a test fixture, as shown in Fig.3. A pair of forces of magnitude  $P$  which is applied to rigid plates gives rise to a state of uniform compression in the  $x$  direction.

- (a) Calculate the stresses  $\sigma_y$  and  $\sigma_z$  and the strains  $\epsilon_x$ ,  $\epsilon_y$ , and  $\epsilon_z$ . (12%)
- (b) What additional stresses would be generated by a temperature increase in the material of  $\Delta T$ ? Assume that the elastic constants  $E$  and  $\nu$  and the coefficient of thermal expansion  $\alpha$  are given. (13%)

4. Shaft AD has pulleys attached at A and C and is supported in bearings at B and D, as shown in Fig. 4. The pulley tensions  $T_1=150\text{ lb}$ ,  $T_2=100\text{ lb}$ ,  $T_3=460\text{ lb}$ , and  $T_4=500\text{ lb}$ ; the lengths are  $L_1=20\text{ in}$ ,  $L_2=40\text{ in}$ ,  $L_3=40\text{ in}$ , and the diameters are  $d_A=4\text{ in}$  and  $d_C=5\text{ in}$ . Use the maximum-shear-stress criterion to find the minimum allowable diameter of the shaft if the allowable shear stress is  $\tau_s=15\text{ ksi}$ . (25%)

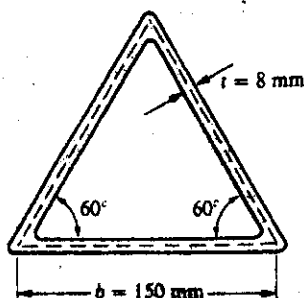


Fig. 1

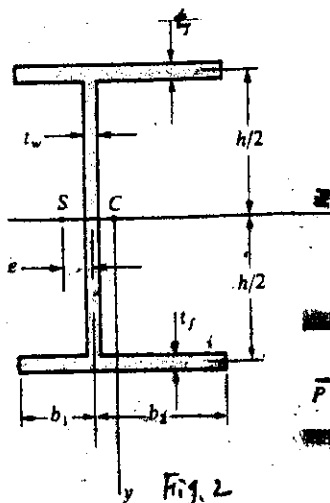


Fig. 2

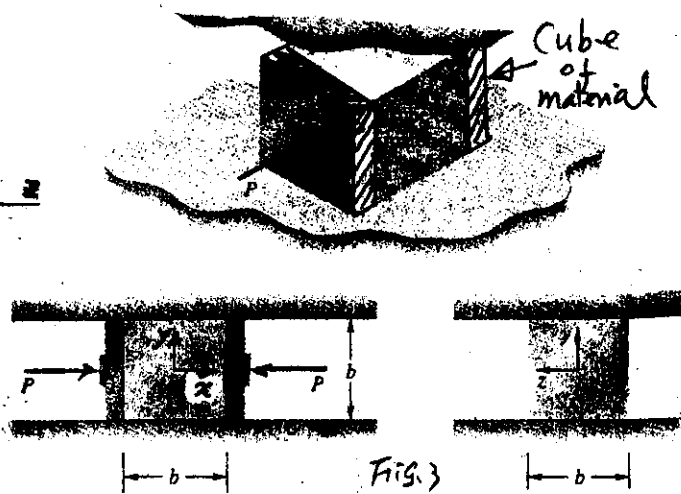


Fig. 3

(背面仍有題目,請繼續作答)

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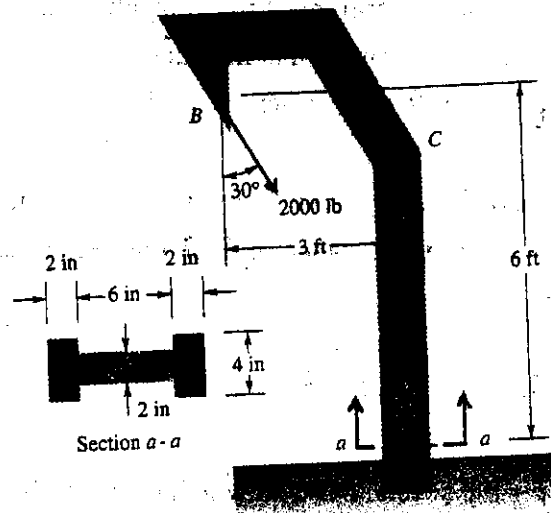


Fig. 4