1. A bar in the shape of a circular cone having length L and diameter d at the support hangs vertically under its own weight (see Fig. 1). Let γ = weight density and E = modulus of elasticity of the material.
   (a) Find the strain energy density at a height of x above the tip of the bar. (15%)
   (c) Find the strain energy of the bar. (10%)

2. A pinned-end column of aluminum (E = 72 GPa) with length L = 1.8 m is constructed of circular tube with outside diameter d = 50 mm (see Fig. 2). The column must resist an axial load P = 18 kN with a factor of safety n = 2.0 with respect to the critical load.
   (a) Write down the relationship between the critical load and the flexural rigidity of the column. (10%)
   (b) Determine the required thickness t of the tube. (15%)

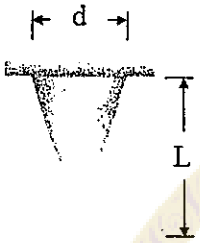

Fig. 1

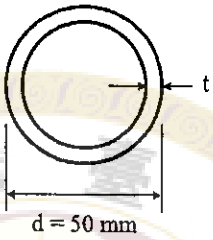

Fig. 2

3. A torsional assembly is shown in Fig. 3. The shaft *AB* consists of a *hollow* aluminum alloy ($G_A$ = 32 GPa) of diameter 150 mm and thickness 25 mm and a bronze *core* ($G_B$ = 40 GPa) of diameter 100 mm. The aluminum and bronze parts are securely connected at the ends to carry torques simultaneously. The bronze core is extended uniformly to the end *C*. Both ends *A* and *C* are fixed. When the torque *T* = 36 kN·m is applied,
   (a) Draw free body diagrams for shaft segments *AB* and *BC* with pertinent dimensions and symbols. (5%)
   (b) Determine the maximum shear stress in *each* of the shaft materials. (20%)

4. A simple beam with an overhang is loaded and supported as shown in Fig. 4. The beam has a length 2*L* and uniform cross section with constant *EI*, where *E* is the modulus of elasticity and *I* is the second moment of area of the transverse section about its neutral axis. The intensity of the distributed load *w* is applied from the hinged support *A* to the mid point *B*. The roller support *C* is located at *x* in between *B* and *D*. The concentrated load *wL*/3 is applied at end *D*.
   (a) Find the distance *x* of support *C* such that the reactions at *A* and *C* are equal. (10%)
   (b) For the equal reactions at *A* and *C*, find the maximum permissible value for the distributed load intensity *w* if the allowable flexural stress of the beam is $\sigma_a$. (15%)

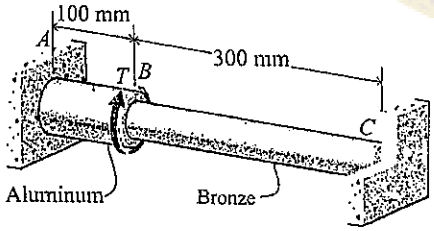

Fig. 3

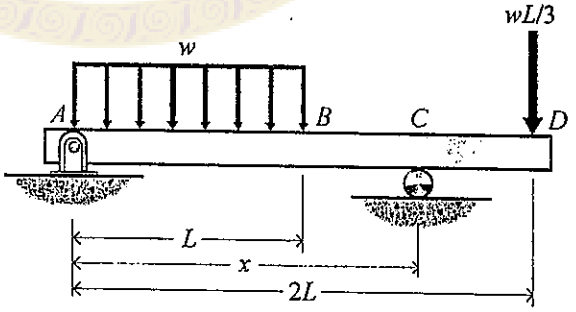

Fig. 4

試題隨卷繳回