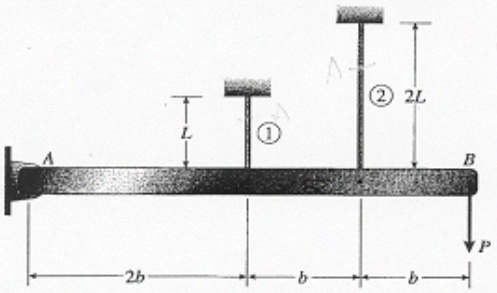
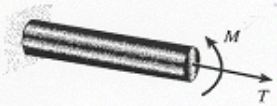
元智大學機械工程研究所 博士班資格考試
計算固力－材料力學

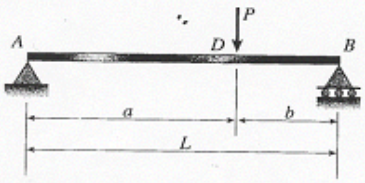
1. The structure consists of a horizontal rigid bar AB supported by two steel wires, one of length L and the other of length 2L. Both wires have cross-sectional area A and are made of elastoplastic material with yield stress σ_y and modulus of elasticity E. A vertical load P acts at end B of the bar.
   (a) Determine the yield load Py and the corresponding displacement δ_y of point B. (8%)
   (b) Determine the plastic load Pp and the corresponding displacement δ_p of point B.(8%)
   (c) Draw a load-displacement diagram with the load P as ordinate and the displacement δ_B of point B as abscissa. (4%)



2 A built in steel bar of solid circular cross section is subjected to an axial tensile force T=26 kN and a bending moment M=2.7kN-m (see figure). Based upon an allowable stress in tension of 125 MPa, determine the required diameter d of the bar. (Disregard the weight of the bar itself.) (20%)



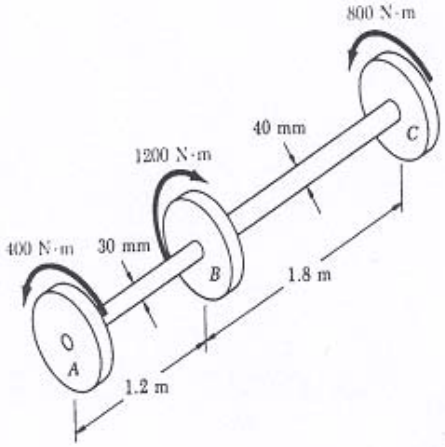
3 A simple supported beam AB has length L and constant flexural rigidity EI, loaded by a concentrated load P acting at the position as shown in the figure. Determine the angle of rotation θ_A at the supports and the deflection δ_D under the load P. (20%)



4 The torques shown are exerted on pulleys A, B, and C. Knowing that both shafts are solid, . Determine:

(a) The maximum shear stresses in shaft AB and in shaft BC. (10%)

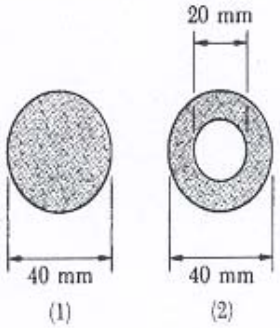
(b) The angles of twist between A and C. (10%)



5 For the buckling of a compression member of 2 m effective length consists of a solid 40 mm diameter brass rod. To reduce the weight of the member by 25%, the solid rod is replaced by a hollow rod of the cross section shown. Determine

(a) The percent reduction in the critical load. (10%)

(b) The value of the critical load for the hollow rod. Use E=105 GPa. (10%)



Vibration :

1. A block slides on a horizontal frictionless surface as shown in Fig. 1. Assume that the cords remain in tension. Determine the natural frequency of the system. (25%)

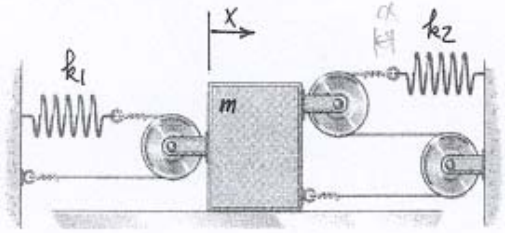


Fig. 1

2. Consider an ergodic random vibration with zero power spectral density at $\omega = 0$. Show that the autocorrelation function $R_f(\tau)$ must satisfy

$\int_{-\infty}^{\infty} R_f(\tau) d\tau = 0$. (25%)