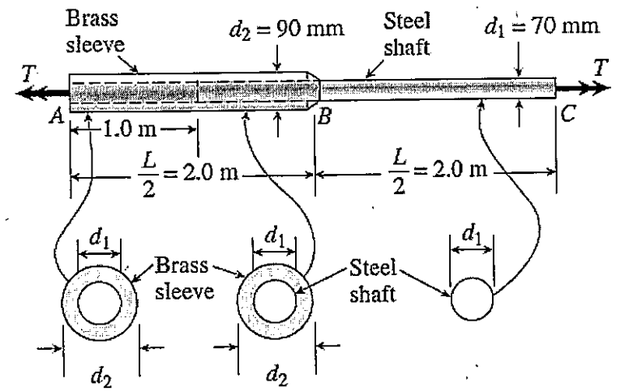
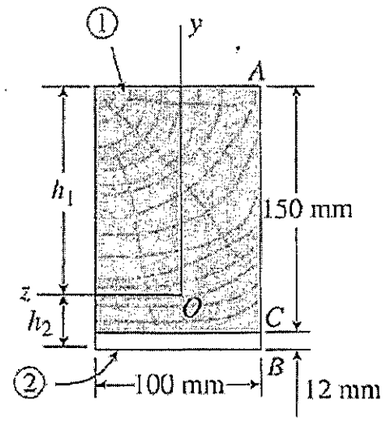
104 學年(下) 博士班 資格考

材料力學

1. (25%) A steel shaft (G_s = 80 GPa) of total length L = 3.0 m is encased for one-third of its length by a brasssleeve (G_b= 40 GPa) that is securely bonded to the steel (see figure). The outer diameters of the shaft and sleeve ared_1= 70 mm and d_2= 90 mm. respectively.
   a. Determine the allowable torque T_1 that may be appliedto the ends of the shaft if the angle of twist between theends is limited to 8.0°.
   b. Determine the allowable torque T_2 if the shear stress inthe brass is limited to τ_b= 70 MPa.
   c. Determine the allowable torque T_3 if the shear stressin the steel is limited to τ_s= 110 MPa.
   d. What is the maximum allowable torque T_{max} if all threeof the preceding conditions must be satisfied?



2. (25%) The composite beam shown in figure is formed of a wood beam (100 mm x 150 mm actual dimensions) and steel reinforcing plate (100 mm wide and 12 mm thick). The beam is subjected to a positive bending moment M = 6 kN·m. Using the transformed-section method, calculate the largest tensile and compressive stresses in the wood (material 1) and the maximum and minimum tensile stresses in the steel (material 2) if E_1 = 10.5 GPa and E_2=210 GPa.



3. (25%) A simple beam ADB supports a concentrated load P acting at the position shown in Fig. 3. Determine the angle of rotation θ_A at support A and the deflection δ_D under the load P. (Note: The beam has length L and constant flexural rigidity EI.)

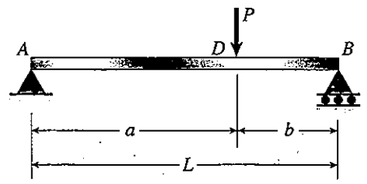


Fig. 3

4. (25%) A two-span continuous beam ABC supports a uniform load of intensity q, as shown in Fig. 4. Each span of the beam has length L. Using the method of superposition, determine all the reactions for this beam.

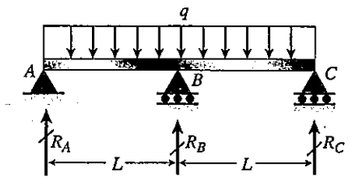


Fig. 4