國　立　清　華　大　學　命　題　紙

98 學年度 動力機械工程學 系（所） 丙 組碩士班入學考試

科目 材料力學　科目代碼 1101 共 3 頁第 1 頁 *請在【答案卷卡】內作答

1. As shown in Fig. 1, the ball is truncated at its ends and is used to support the bearing load *P*. If the modulus of elasticity for the material is *E*, determine the decrease in its height when the load is applied. (15%)

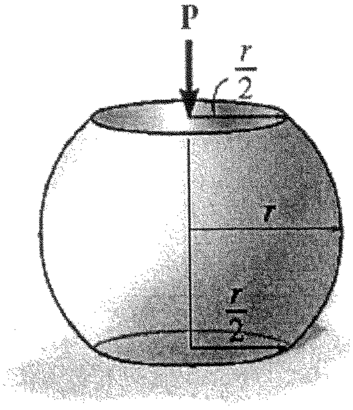

Fig. 1

2. Draw the shear and bending-moment diagrams for the beam and loading shown in Fig. 2 and determine the maximum normal stress due to bending. (15%)

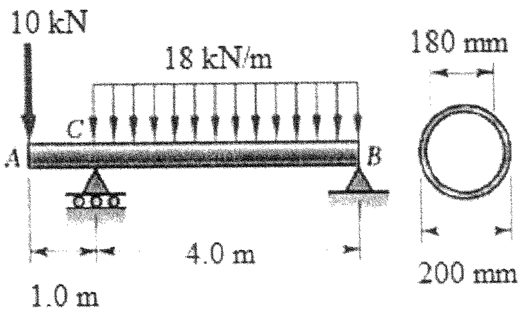

Fig. 2

3. The composite shaft shown in Fig. 3 is manufactured by shrink-fitting a steel sleeve over a brass core so that the two parts act as a single solid bar in torsion. The outer diameters of the two parts are d_1 = 50 mm for the brass core and d_2 = 60 mm for the steel sleeve. The shear moduli of elasticity are G_b = 40 GPa for the brass and G_s = 80 GPa for the steel. Assuming that the allowable shear stresses in the brass and steel are τ_b = 30 MPa and τ_s = 50 MPa, respectively. Determine the maximum permissible torque T_{max} that may be applied to the shaft. (18%)

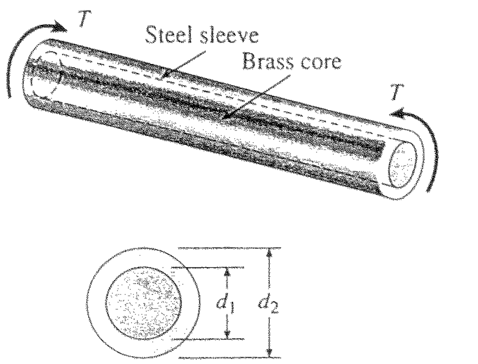

Fig. 3

4. Beam *ACB* of length L = 3.0 m hangs from two springs as shown in Fig. 4. The springs have stiffnesses k_1 = 200 kN/m and k_2 = 100 kN/m, and the beam has flexural rigidity EI = 200 kN-m^2. Determine the displacement and slope of the midpoint C of the beam when the moment M_0 = 3.0 kN-m is applied. (18%)

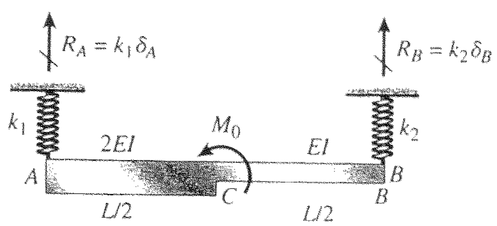

Fig. 4

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5. A beam is loaded and supported as shown in Fig. 5. By using the area-moment method, determine
   (a) the reactions at supports *A, B,* and *C* in terms of *P* and *L*. (9%)
   (b) the slope over the middle support *B* in terms of *P, L, E,* and *I*. (8%)

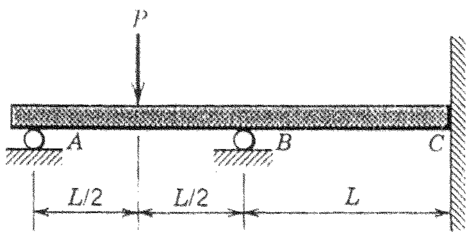


Fig. 5

6. A pinned-end column 12 m long is made by riveting three S204 x 34 structural steel sections (see Table 1 for cross-sectional properties) together as shown in Fig. 6. Determine
   (a) the maximum compressive load that this column can support. Use Young's modulus $E = 200$GPa. (9%)
   (b) the maximum compressive load that this column can support if the rivets are removed and the sections act as separate units. (8%)

Note: In Table 1, *S* is the section modulus and *r* is the radius of gyration.

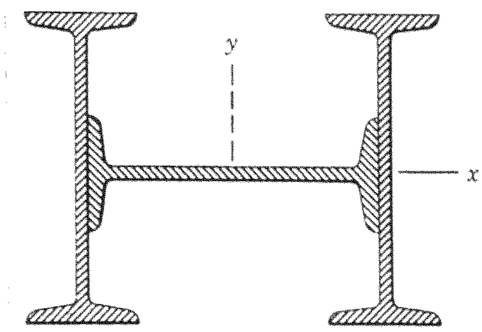
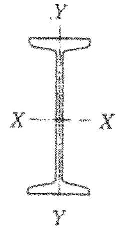


Fig. 6

Table 1



Designation	Area (mm^2)	Depth (mm)	Flange Width (mm)	Flange Thickness (mm)	Web Thickness (mm)	Axis X–X: I (10^6 mm^4)	Axis X–X: S (10^3 mm^3)	Axis X–X: r (mm)	Axis Y–Y: I (10^6 mm^4)	Axis Y–Y: S (10^3 mm^3)	Axis Y–Y: r (mm)
S203 × 34	4370	203.2	105.9	10.8	11.2	27.0	265	78.7	1.79	33.9	20.3