INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Endsem

Date: 24.04.17 **Time:** 3 hrs. **Full Marks:** 120 **No. of Students:** 168

Sub. No.: ESO202A/204 **Sub. Name:** Mechanics of Solids **2016-17, II Semester**

Instructions: i) Neatly draw the free body diagram, ii) Assume suitable data if not mentioned, iii) Show the calculations properly, iv) Neglect the friction and self-weight if not mentioned

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1. The smooth pin is supported by two leaves A and B and subjected to a compressive load of 0.4 kN/m caused by bar C (Fig. 1). Determine the intensity of the linearly distributed load w_0 of the leaves on the pin and draw the shear force and bending moment diagram for the pin.

(20)

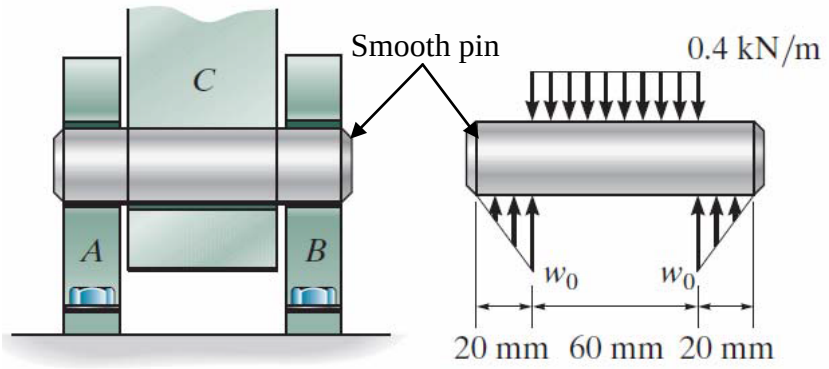

Fig. 1

2. Fig. 2 shows a solid circular steel shaft of diameter 50 mm placed inside a hollow steel tube of outer diameter 75 mm and inner diameter 60 mm. the shaft and the tube are rigidly fixed at one end and are connected to a thick circular plate at the other end. If the length of both the shaft and the hollow tube is 650 mm and the circular plate is subjected to a twisting moment of 2 kN-m, calculate the maximum shear stresses in the shaft and the tube. What is the angle of rotation of the plate and the torsional stiffness of this assembly? Given: G_{steel} = 80 GPa.

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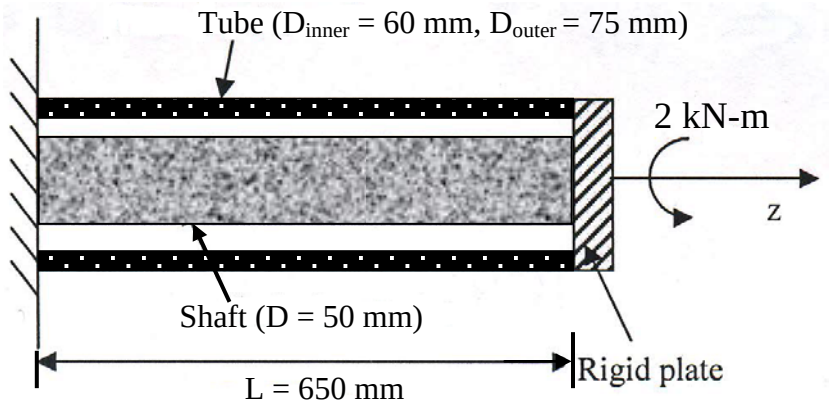

Fig. 2

3. The drill is jammed in the wall i.e., unable to rotate and is subjected to 20 kN-m torque applied by the motor and 150 N force applied by the hand as shown in Fig. 3. Determine the state of stress at point *A* and *B* on the cross section of the drill bit at section *a-a*.

(20)

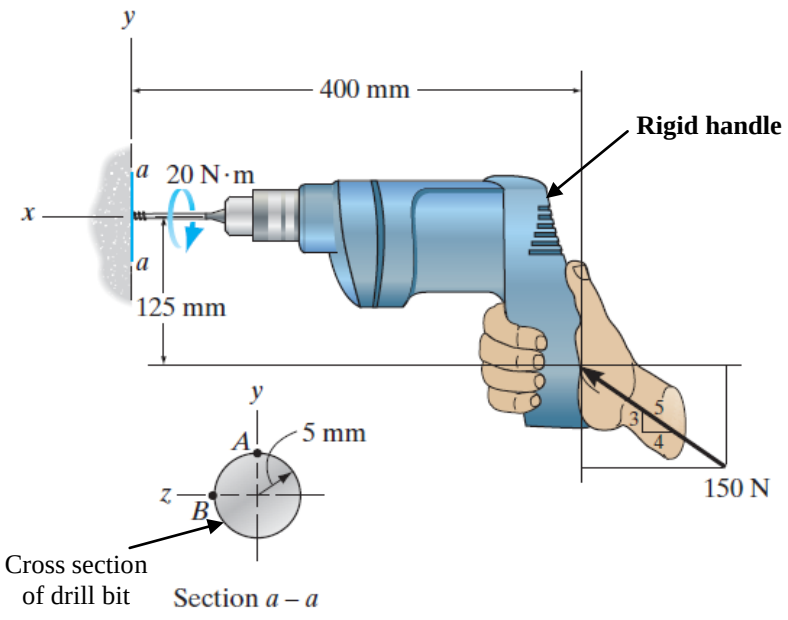

Fig. 3

4. A solid circular bar bent 90^0 at two points (B and C) is built-in at one end (A) as shown in Fig. 4. A vertical (y direction) force P acts at the free end D. Obtain the expression for the vertical deflection at D using energy method. Neglect the effect of shear deformations. Given: diameter of bar – d, elastic modulus – E and shear modulus – G.

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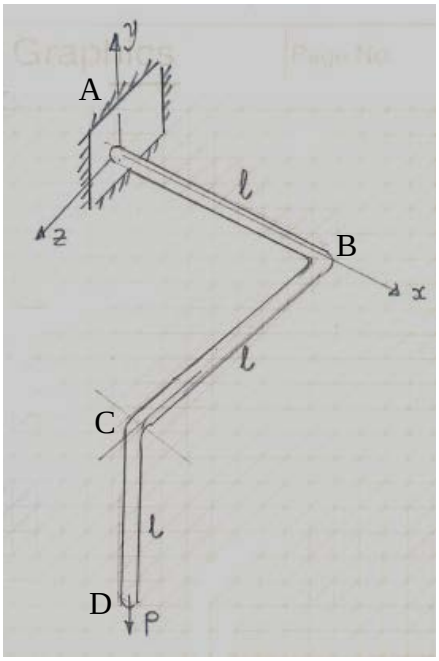

Fig. 4

5. A propped cantilever beam of constant EI is loaded as shown in Fig. 5. Determine the reactions at the supports A and B using method of superposition.

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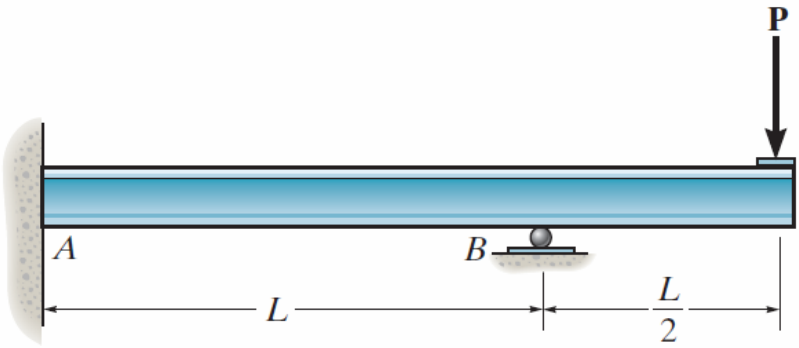

Fig. 5

6. A slender column of length l is built-in at its lower end A and laterally supported at its upper end B as shown in Fig. 6. Find the first (smallest) critical value of the compressive load P. The flexural rigidity of the column is EI.

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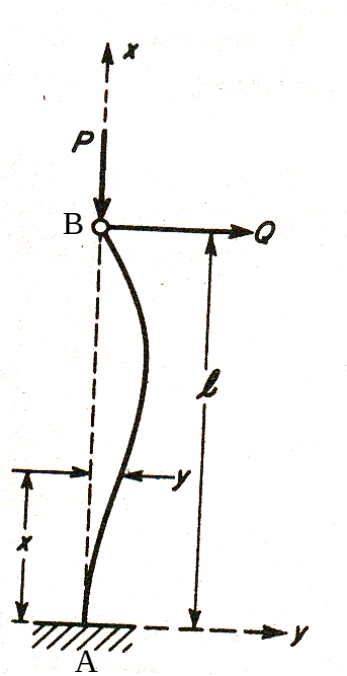

Fig. 6