

系所組別： 工程科學系在職專班乙組

考試科目： 材料力學（專班）

考試日期： 0307，節次： 3

※ 考生請注意：本試題  可  不可 使用計算機

每題 25 分，共四題，共計 100 分。

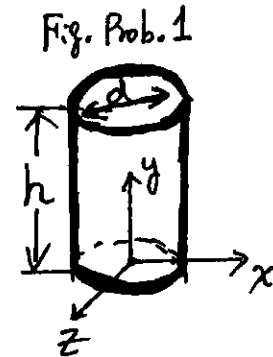
Prob.1. A cylindrical block of an isotropically elastic solid ( $E, \nu, G$ ) is under a hydrostatic pressure  $P$  and hence results in a dilatation (volume change/unit volume)  $\Delta$ . Now consider: (a) A pressure  $P_a$  is applied to top and bottom faces of block only and results in the same dilatation  $\Delta$ , then determine  $P_a$ , and find the changes in the height ( $\Delta h$ ) and the diameter ( $\Delta d$ ). (b) A pressure  $P_b$  is applied to the cylindrical surface of block only and results in the same dilatation  $\Delta$ , then determine  $P_b, \Delta h$ , and  $\Delta d$ . Express your solutions in terms of ( $E, \nu, G$ ) and  $P$ .

- Hints: 1. Hydrostatic pressure is in the opposite direction of all normal stresses,  
 2.  $\Delta$  is the summation of all normal strains,  
 3. the isotropic Hooke's law:

$$\epsilon_{xx} = \frac{1+\nu}{E} \tau_{xx} - \frac{\nu}{E} (\tau_{xx} + \tau_{yy} + \tau_{zz})$$

$$\epsilon_{yy} = \frac{1+\nu}{E} \tau_{yy} - \frac{\nu}{E} (\tau_{xx} + \tau_{yy} + \tau_{zz})$$

$$\epsilon_{zz} = \frac{1+\nu}{E} \tau_{zz} - \frac{\nu}{E} (\tau_{xx} + \tau_{yy} + \tau_{zz})$$



Prob.2 A hollow shaft AB (outer dia = 2m, inner dia = 1m) and a solid shaft BC (dia = 1.5m) are connected to a coupling disk B and to fixed supports at A and C. Both shafts are made of the same elastic material. Consider a moment of 12 KN·m is applied to the disk, as shown in Fig. Prob.2, then determine the reaction at each support (b) the maximum shearing stress in shaft AB and BC.

Hints :

1.  $\phi = \frac{TL}{JG}$  and  $\tau = \frac{T\rho}{J}$

2. A and C are fixed,  $\phi_{C/A} = 0$

3.  $J = \frac{1}{2} \pi r^4$

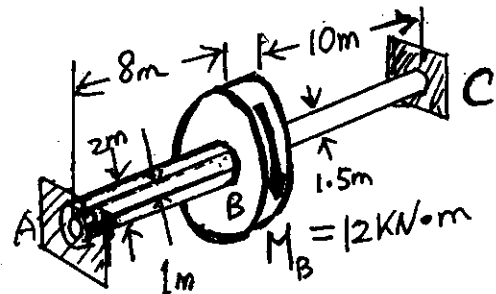


Fig. Prob. 2

(背面仍有題目,請繼續作答)

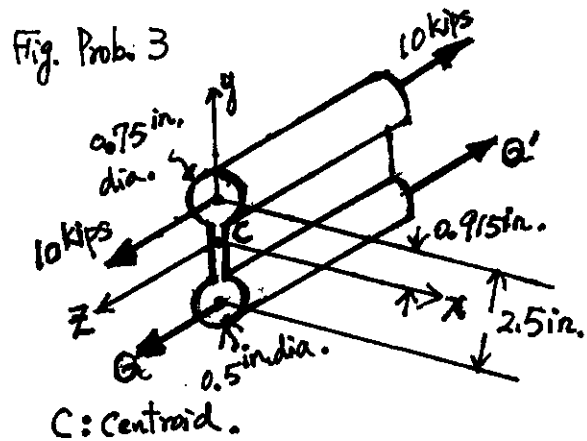
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Prob.3 Two steel rods are welded to a 1/8-in.-thick steel plate to form the machine element shown. Determine the range of values of the load Q for which the tensile stress in the element does not exceed 20 ksi (Given:  $I_x = 0.9875 \text{ in}^4$ ;  $E = 29 \times 10^6 \text{ psi}$ )



Prob.4 Two forces are applied as shown to rod AB, which is welded to the 50-mm-diameter cylinder DE. Assuming that all stresses remain below the proportional limit, determine (a) the values, and (b) the direction with respect to the coordinate system (x, y, z), of the principal stresses and the maximum shearing stress at point K.

Hint : (1) you may use the formula or the Mohr's circle to solve the problem.

(2) For semi-circle,  $Q$  (1st moment of Area) =  $\frac{2}{3}$  (radius)<sup>3</sup>.  $\tau = \frac{VQ}{It}$

