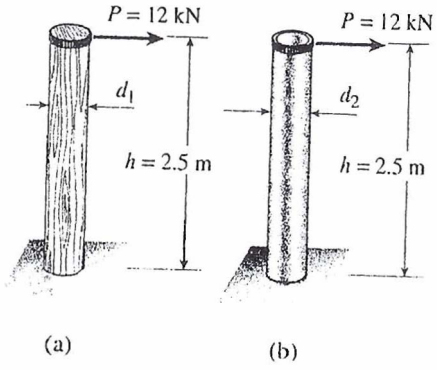
國　立　清　華　大　學　命　題　紙

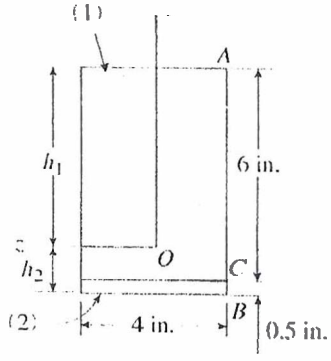
95 學年度＿＿＿＿＿＿動力機械＿＿系（所）＿＿＿＿丙＿＿組碩士班入學考試

科目＿＿＿材 料 力 學＿＿ 科目代碼＿＿1701_共＿3＿頁第＿1＿頁 *請在【答案卷卡】內作答

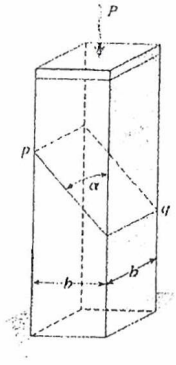
1. A vertical post 2.5-meters high must support a lateral load $P = 12\ kN$ at its upper end. Two plans are proposed – a solid wood post and a hollow aluminum tube. (a) What is the minimum required diameter d_1 of the wood post if the allowable bending stress in the wood is $15\ Mpa$? (b) What is the minimum diameter d_2 of the aluminum tube if its wall thickness is to be one-eight of the outer diameter and the allowable bending stress in the aluminum is $50\ Mpa$? (20 points)



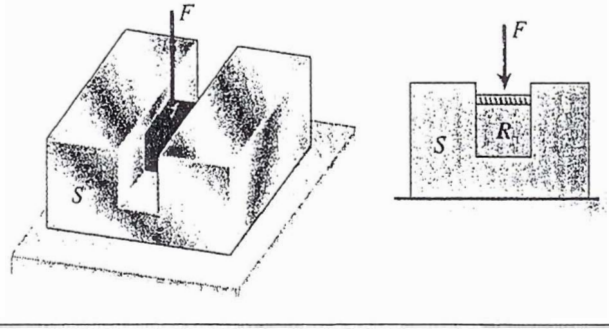
2. The composite beam shown in figure below is formed of a wood beam (4.0 in. X 6.0 in.) and a steel reinforcing plate (4.0 in. wide and 0.5 in. thick). The beam is subjected to a positive bending moment $M = 60\ k\text{-}in$. Calculate the largest tensile and compressive stresses in the wood and the maximum and minimum stresses in the steel if $E_{wood} = 1{,}500\ ksi$ and $E_{steel} = 30{,}000\ ksi$ (20 points)



3. A compression bar having a square cross section of width b must support a load $P = 8{,}000\ lb$. The bar is constructed from two pieces of material that are connected by a glued joint along the plane pq, which is at angle $\alpha = 40^\circ$ to the vertical. The material is a structural plastic for which the allowable stresses in compression and shear are $1{,}100\ psi$ and $600\ psi$, respectively. Also, the allowable stresses in the glued joint are $750\ psi$ in compression and $500\ psi$ in shear. Determine the minimum width b of the bar. (20 points)



4. A block R of rubber with Young's modulus E and Poisson's ratio ν is confined between plane parallel walls of a steel block S (see figure).A uniformly distributed pressure p_0 is applied to the top of the rubber block by a force F. (a) Derive a formula for the lateral pressure p between the rubber and the steel. (disregard friction between the rubber and the steel, and assume that the steel block is rigid) (b) Derive a formula for the dilatation e of the rubber. (c) Derive a formula for the strain energy density u of the rubber. (d) Determine the maximum shear stress in the rubber. (20 points)



5. Beam *ABC* with flexural rigidity *EI* is fixed at *A* and supported by a spring of stiffness *k* at *B* (see figure). A concentrated force *P* acts at the free end *C*. (a) Find the reaction at *B*, (b) draw the shear-force and bending-moment diagrams for beam *ABC*, and (c) determine the deflection at *C*. (20 points)