國立成功大學 105 學年度碩士班招生考試試題

系　　所：生物醫學工程學系

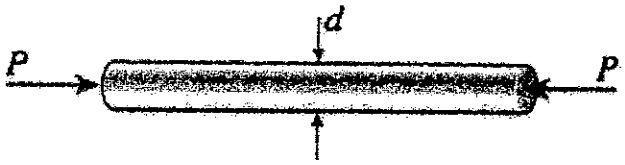
考試科目：材料力學

考試日期：0227，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。
(若計算複雜題目，請將完整算式寫出)

1. A high-strength steel bar used in a large crane has diameter $d = 50$ mm. (see figure). The steel has modulus of elasticity $E = 200$ GPa and Poisson's ratio $\nu = 0.3$. Because of clearance requirements, the diameter of the bar is limited to 50.025 mm when it is compressed by axial forces.

- What is the largest compressive load P_{max} that is permitted? (15%)

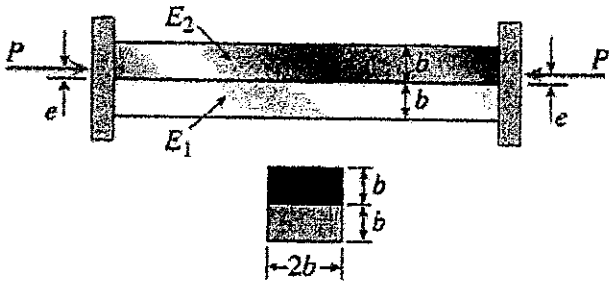


2. A *bimetallic* bar (or composite bar) of square cross section with dimensions $2b$ X $2b$ is constructed of two different metals having moduli of elasticity E_1 and E_2 (see figure). The two parts of the bar have the same cross-sectional dimensions. The bar is compressed by forces P acting through rigid end plates. The line of action of the loads has an eccentricity e *(see figure)* of such magnitude that each part of the bar is stressed uniformly in compression.

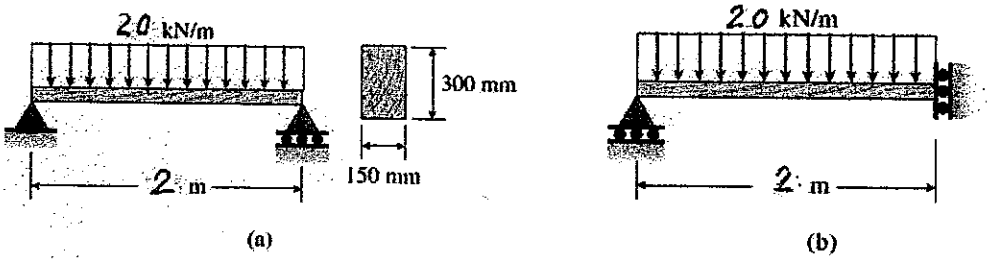
(a) Determine the axial forces P_1 and P_2 in the two parts of the bar.

(b) Determine the eccentricity e of the loads.

(c) Determine the ratio σ_1/σ_2 of the stresses in the two parts of the bar. (20%)



3. Calculate the maximum shear stress τ_{max} and the maximum bending stress σ_{max} in a wood beam (see figure) carrying a uniform load of 20 kN/m (which includes the weight of the beam) if the length is 2 m and the cross section is rectangular with width 150 mm and height 300 mm, and the beam is (a) simply supported as in the figure part (a) and (b) has a sliding support at right as in the figure part (b). (20%)



國立成功大學 105 學年度碩士班招生考試試題

系　　所：生物醫學工程學系

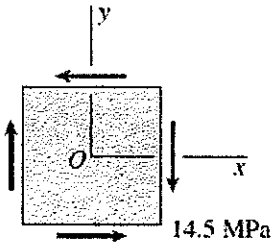
考試科目：材料力學　　考試日期：0227，節次：2

4. An element in *pure shear* is subjected to stresses τ_{xy}=14.5 MPa, as shown in the figure. Using Mohr's circle, determine:

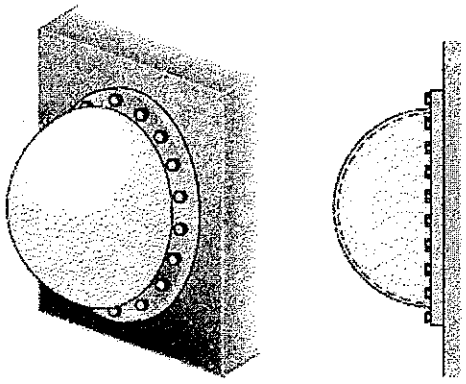
(a) The stresses acting on an element oriented at a counterclockwise angle $\theta = 22.5^0$ from the x axis

(b) The principal stresses.

Show all results on sketches of properly oriented elements. (15%)



5. A hemispherical window (or *viewport*) in a decompression chamber (see figure) is subjected to an internal air pressure of 600 kPa. The port is attached to the wall of the chamber by 18 bolts. Find the tensile force F in each bolt and the tensile stress σ in the viewport if the radius of the hemisphere is 400 mm and its thickness is 25 mm. (15%)



6. Derive the equation of the deflection curve for a cantilever beam AB supporting a load P at the free end (see figure). Also, determine the deflection δ_B and angle of rotation θ_B at the free end. (*Note*: Use the second-order differential equation of the deflection curve.) (15%) $EIv'' = M$