# 國立成功大學 104 學年度碩士班招生考試試題

系所組別：生物醫學工程學系甲組

考試科目：材料力學

考試日期：0211，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。

1. A horizontal rigid bar *AB* is pinned at end *A* and supported by two wires (*CD* and *EF*) at points *D* and *F* (Fig. 1). A vertical load *P* acts at end *B* of the bar. The bar has length $3b$ and wires *CD* and *EF* have lengths $L_1$ and $L_2$, respectively. Also, wire *CD* has diameter $d_1$ and modulus of elasticity $E_1$; wire *EF* has diameter $d_2$ and modulus $E_2$.

   Obtain formulas for the allowable load *P* if the allowable stresses in wires *CD* and *EF*, respectively, are $\sigma_1$ and $\sigma_2$. (Disregard the weight of the bar itself.) (20%)

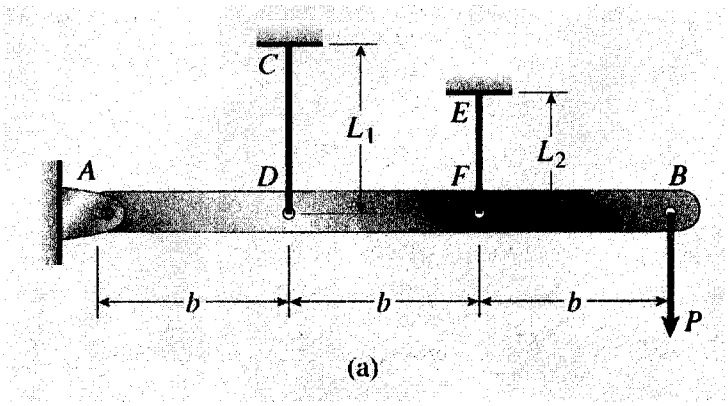


Fig. 1 A horizontal rigid bar *AB* is pinned at end *A* and supported by two wires (*CD* and *EF*) at points *D* and *F*

2. A solid circular bar of steel ($G = 78$ GPa) transmits a torque $T = 360$ N m. The allowable stresses in tension, compression, and shear are 90 MPa, 70 MPa, and 40 MPa, respectively. Also, the allowable tensile strain is $220 \times 10^{-6}$. Determine the minimum required diameter *d* of the bar. (15%)

3. Determine the ratios of the weights of three beams that have the same length, are made of the same material, are subjected to the same maximum bending moment, and have the same maximum bending stress if their cross sections are (1) a rectangle with height equal to twice the width, (2) a square, and (3) a circle. (Fig.2) (15%)

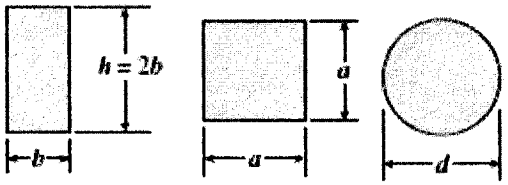


Fig. 2 Three beams of the same length

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4. An element in *biaxial stress* is subjected to stresses $\sigma_x = 28$ MPa and $\sigma_y = -7$ MPa, as shown in the figure (Fig. 3). Using Mohr's circle, determine:

(a) The stresses acting on an element oriented at a counterclockwise angle $\theta = 60^0$ from the x axis.

(b) The maximum shear stresses and associated normal stresses.

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

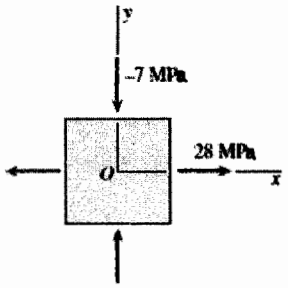


Fig. 3 An element in biaxial stress is subjected to stresses

5. A thin-walled cylindrical pressure vessel of radius *r* is subjected simultaneously to internal gas pressure *p* and a compressive force *F* acting at the ends (Fig. 4).

What should be the magnitude of the force *F* in order to produce pure shear in the wall of the cylinder? (15%)

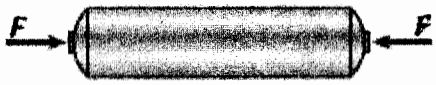


Fig.4 A thin-walled cylindrical pressure vessel of radius *r* is subjected simultaneously to internal gas pressure *p* and a compressive force *F*

6. A cantilever beam *AB* supporting a triangularly distributed load of maximum intensity $q_0$ is shown in the figure. (Fig.5) Derive the equation of the deflection curve and then obtain formulas for the deflection $\delta_B$ and angle of rotation $\theta_B$ at the free end. (*Note*: Use the second-order differential equation of the deflection curve.) (20%)

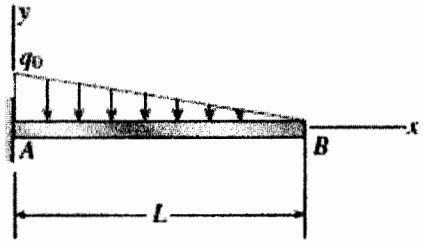


Fig. 5 A cantilever beam *AB* supporting a triangularly distributed load of maximum intensity $q_0$