國立臺灣大學105學年度碩士班招生考試試題

1. (10%) Consider a state of plane stress described by σ_{11}, σ_{22} and σ_{12}. It is in a state of pure shear if $\sigma_{11}+\sigma_{22}=0$. Suppose $\sigma_{11}=100\text{MPa}$, $\sigma_{22}=-100\text{MPa}$, $\sigma_{12}=-100\text{MPa}$. Find a plane oriented at an angle θ such that the normal stress on that plane is zero. In addition, what is the shear stress on that plane?

2. (20%) A thin-walled cylindrical pressure vessel of radius r and thickness t is subjected simultaneously to internal gas pressure p and a compressive force F acting at the ends (see Figure 1). Assume $r \gg t$.
   (a) (10%) What should be the magnitude of compressive force F in order to produce pure shear in the wall of the cylinder?
   (b) (10%) If force $F=60\pi$ kN, internal pressure p =12 MPa, inner radius r = 100 mm, and allowable normal and shear stresses are 100 MPa and 48 MPa, respectively, what is the required thickness of the vessel?

Fig 1. (Problem 2)

3. (20%) A rigid triangular frame is pivoted at C and held by two identical horizontal wires at points A and B (see Fig. 2). Each wire has axial rigidity $EA=10^5$ N and coefficient of thermal expansion $\alpha=10\times10^{-6}/°C$. If a vertical load P =100 N acts at point D and both wires have their temperatures raised by 100°C, what are the tensile forces T_A and T_B in the wires at A and B, respectively?

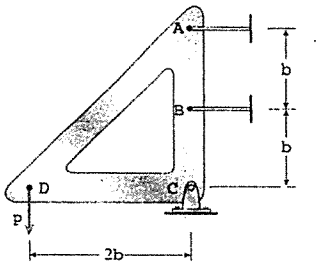

Fig. 2 (Problem 3)

4. (30%) A prismatic bar AB of solid circular cross section (diameter d and length L) is fixed at the left-hand end and free at the right-hand end (see Fig. 3). The bar is loaded by a distributed torque of constant intensity T per unit length.
   (a) (10%) What is the strain energy of the bar?
   (b) (5%) What is the angle of twist at end B?
   (c) (10%) What is the angle of twist at the middle of the bar if both ends are fixed?
   (d) (5%) What is the strain energy of the bar if both ends are fixed?

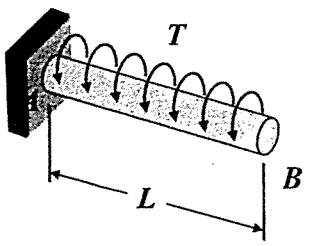

Fig. 3 (Problem 4)

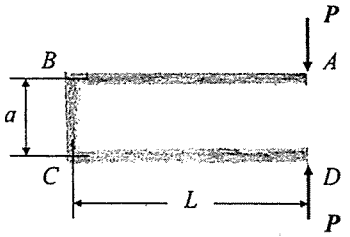

Fig. 4 (Problem 5)

5. (20%) The frame ABCD shown in Figure 4 is squeezed by two collinear forces P acting at points A and D. The flexural rigidity EI is constant throughout the frame. Disregard the effects of axial deformations and consider only the effects of bending due to the loads P.
   (a) (10%) What is the angle of rotation at point B when the loads are applied?
   (b) (10%) What is the decrease δ in the distance between points A and D when the loads P are applied?

試題隨卷繳回