

系所組別： 機械工程學系乙、丁組

考試科目： 材料力學

考試日期： 0307， 節次： 1

※ 考生請注意：本試題 可 不可 使用計算機

- 1.a. Explain what is the Poisson's ratio.
- b. The value of the Poisson's ratio is between -1 and 1/2.
Explain why it can not be -1 and 1/2 for general engineering materials. 10%

2.a. Prove that the governing differential equation for a bar subjected to a surface torque $t(x)$ and an end load T is

$$(JG\phi')' + t(x) = 0$$

where ϕ is the rotation angle.

b. $t(x)=t$ and $T=T$ are constants. Apply the above differential equation to obtain the torque distribution along the bar where the bar is fixed at $x=0$. 20%

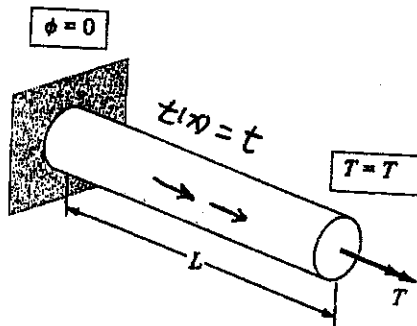


Fig. 1

3. A pin-connected truss is composed of three rods of the same material. The cross-sectional area of rod BD is A_0 and that of AD and CD is A_1 . The truss is subjected to a force P at D, as shown in Fig. 2. Show that if $A_0 = A_1$, the axial forces are given by 20%

$$F_{AD} = F_{CD} = \frac{P \cos^2 \beta}{1 + 2 \cos^3 \beta}, \quad F_{BD} = \frac{P}{1 + 2 \cos^3 \beta} \quad (0 < \beta < 90^\circ).$$

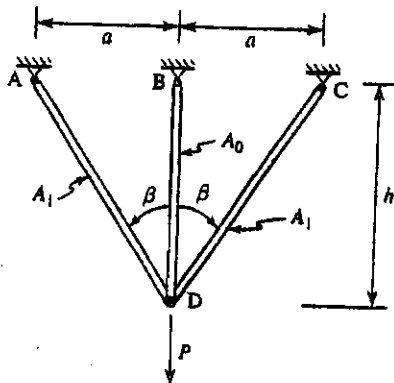


Fig. 2

(背面仍有題目,請繼續作答)

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4. a. Derive the plane-stress transformation equations. Write the $\sigma_{x'}$, $\sigma_{y'}$, $\tau_{x'y'}$, in terms of σ_x , σ_y , τ_{xy} and θ (figure 3)(10%) b. What are the principal axis and principal stress? For given σ_x , σ_y , τ_{xy} , derive the equations for the principal axis and principal stress.(10%)

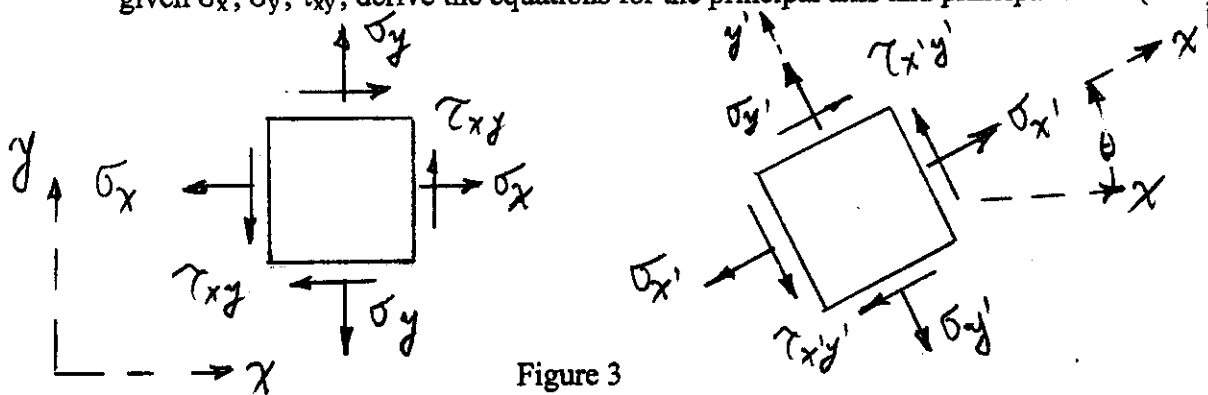


Figure 3

5. A beam has a square cross section and is subjected to a uniform distributed load w (figure 4) EI and G are constant. a. What is the normal stress distribution along the cross section?(5%) b. What is the strain energy of the beam due to the bending? (5%) c. What is shear stress distribution along the cross section?(5%) d. What is the strain energy of the beam due to the shear? (5%)

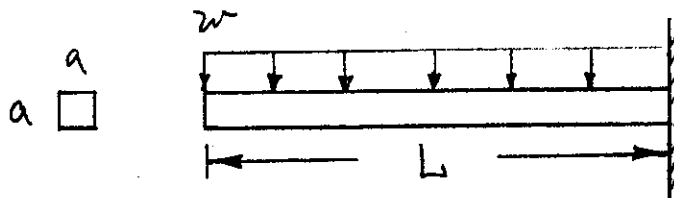


Figure 4

6. If the cross section of the beam is unsymmetric, as shown in the figure 5, show the procedures to calculate the normal stress σ_x in the corner points a and b. The couple moment is M , the Young's modulus is E and the dimension of the shape are shown in the figure.(10%)

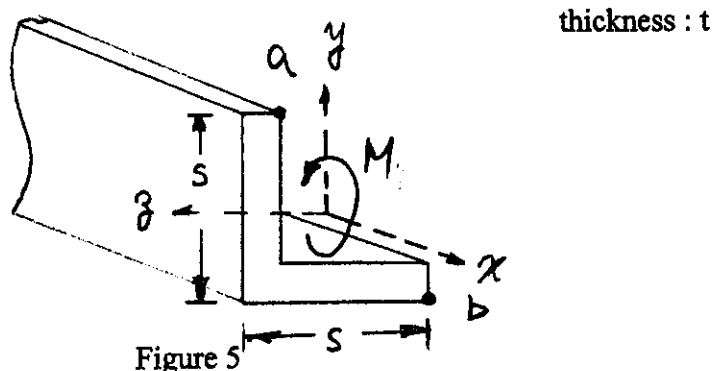


Figure 5