編號： 136

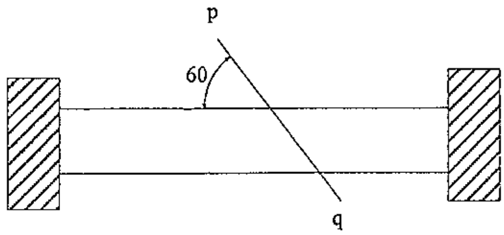
國立成功大學 105 學年度碩士班招生考試試題

系　所：航空太空工程學系

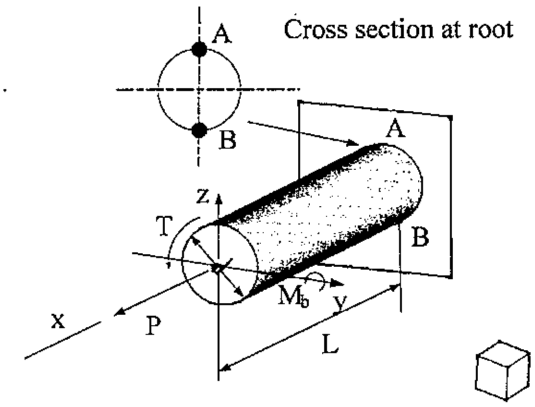
考試科目：材料力學　　　　考試日期：0227，節次：1

※ 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。

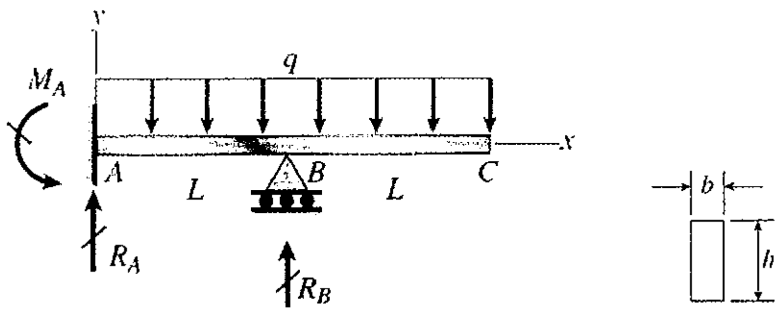
1. **(25%)** A metal bar fits between rigid supports at room temperature (25℃) as shown in the figure. Compute the normal and shear stresses on the inclined section pq if the temperature increases to 200 ℃. Assume coefficient of thermal expansion α=4.0x10^{-6} per℃ and Young's modulus E=30 GPa



2. **(25%)** A cylindrical rod with a diameter d and length L is fixed at one end and subjected to load P at the axial direction, torsion T about the x-axis and moment M_b about the y-axis. Determine the stresses located at points A and B on the root of the rod. On each point, also draw the stress directions on the simple cubic as shown below.



3. **(30%)** A propped cantilever beam of length 2*L* with support at *B* is loaded by a uniformly distributed load with intensity *q* (see figure). The cross section of the section is rectangular with width *b* and height *h*.
   (a) Derive the equation of the deflection curve for beam *ABC* and determine the reactions M_A, R_A, R_B.
   (b) Draw shear-force and bending-moment diagrams, labeling all critical ordinates.
   (c) Find the location where the maximum tensile stress and maximum shear stress occur. Also, determine the maximum tensile stress $\sigma_{\max}$ and maximum shear stress $\tau_{\max}$.
   (d) Determine the strain energy *U* stored in the beam.

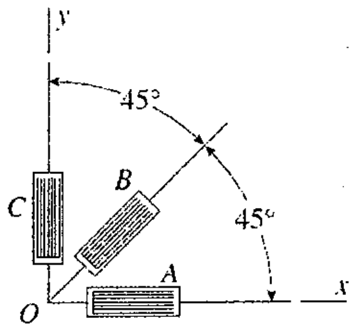


4. **(20%)** During a test of an airplane wing, the strain gage readings from a 45° rosette (see figure) are as follows: gage A, 500×10^{-6}; gage B, 350×10^{-6}; and gage C, -100×10^{-6}. The wing is made of an aluminum alloy having $E=100\text{GPa}$ and $\nu=0.3$.

(a) Determine the principal strains and maximum shear strain.

(b) Determine the principal stresses and maximum shear stress.

(c) Discuss whether the orientation of principal strains and principal stresses are the same.



Appendix:

$$\sigma_{x_1}=\sigma_x\cos^2\theta+\sigma_y\sin^2\theta+2\tau_{xy}\sin\theta\cos\theta,\quad \tau_{x_1y_1}=-(\sigma_x-\sigma_y)\sin\theta\cos\theta+\tau_{xy}(\cos^2\theta-\sin^2\theta)$$

$$\varepsilon_{x_1}=\varepsilon_x\cos^2\theta+\varepsilon_y\sin^2\theta+\gamma_{xy}\sin\theta\cos\theta,\quad \frac{\gamma_{x_1y_1}}{2}=-(\varepsilon_x-\varepsilon_y)\sin\theta\cos\theta+\frac{\gamma_{xy}}{2}(\cos^2\theta-\sin^2\theta)$$

$$\sigma_{1,2}=\frac{\sigma_x+\sigma_y}{2}\pm\sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2+\tau_{xy}^2},\quad \varepsilon_{1,2}=\frac{\varepsilon_x+\varepsilon_y}{2}\pm\sqrt{\left(\frac{\varepsilon_x-\varepsilon_y}{2}\right)^2+\left(\frac{\gamma_{xy}}{2}\right)^2}$$

$$\tau_{max}=\sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2+\tau_{xy}^2},\quad \frac{\gamma_{max}}{2}=\sqrt{\left(\frac{\varepsilon_x-\varepsilon_y}{2}\right)^2+\left(\frac{\gamma_{xy}}{2}\right)^2}$$

$$\varepsilon_x=\frac{1}{E}\left(\sigma_x-\nu\sigma_y\right),\quad \varepsilon_y=\frac{1}{E}\left(\sigma_y-\nu\sigma_x\right),\quad \gamma_{xy}=\frac{\tau_{xy}}{G},\quad G=\frac{E}{2(1+\nu)}$$