編號: 102

國立成功大學109學年度碩士班招生考試試題

系　　所:土木工程學系

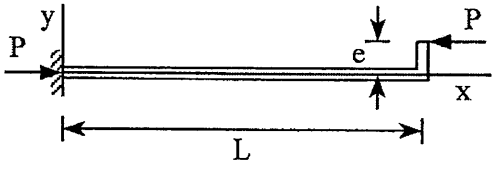
考試科目:材料力學

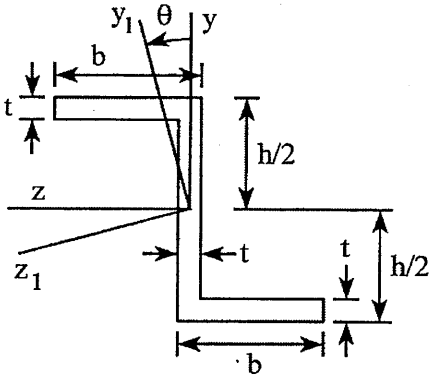
考試日期:0210，節次:1

※考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

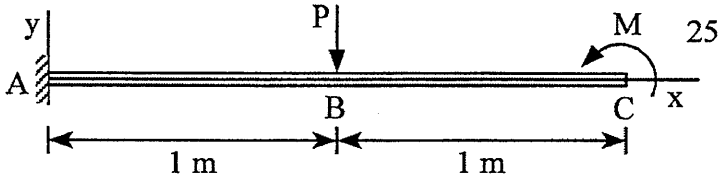
1. A Z-section cantilever beam is subjected to a concentrated load P at the free end with an eccentricity e = 10 mm. Assume L = 4 m, b = 80 mm, h = 120 mm, t = 12 mm, moment of inertia $I_y = 3.257\times10^6\,mm^4$, product of moment inertia $I_{yz}=3.525\times10^6\ mm^4$, Young's modulus E = 200 GPa. (i) Calculate the moment of inertia I_Z、the maximum and the minimum principal moments of inertias I_{max} and I_{min} of the Z-section. (ii) What is the effective length L_e of the beam. (iii) If the beam is free to deflect in any direction on yz plane, calculate the critical buckling load P_{cr} of the beam. (20%)

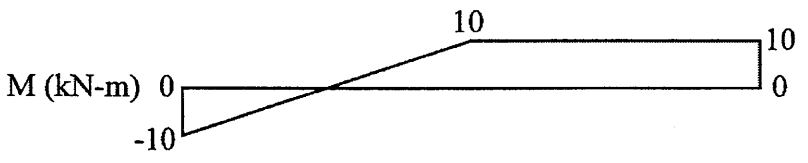
Hint: $I_{y1} = \frac{I_y + I_Z}{2} + \frac{I_y - I_Z}{2}\cos 2\theta - I_{yz}\sin 2\theta$

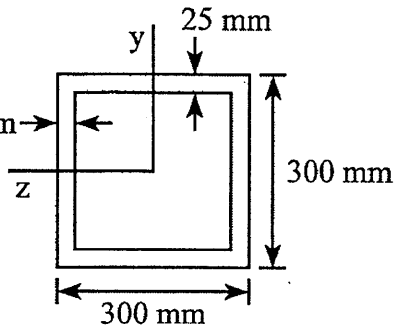




2. A box cantilever beam is subjected to a concentrated force P at point B and a concentrated moment M at point C. The bending moment diagram of the beam is shown below. (i) Calculate the magnitudes of P and M. (ii) Draw the shear force diagram of the beam. (iii) Calculate the maximum shear stress τ_{xy} in the beam. (iv) Calculate the maximum normal stress σ_x in the beam. (20%)







編號: 102

國立成功大學109學年度碩士班招生考試試題

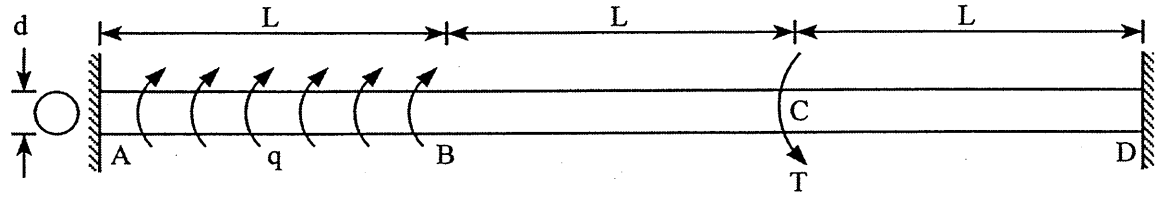
系　　所:土木工程學系

考試科目:材料力學

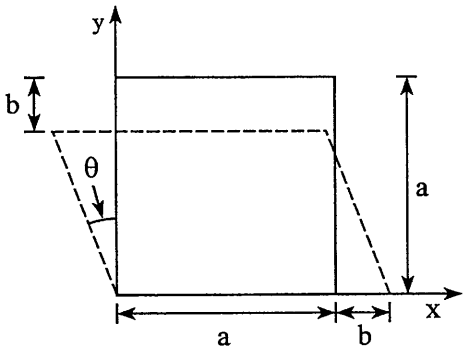
考試日期:0210，節次:1

※考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

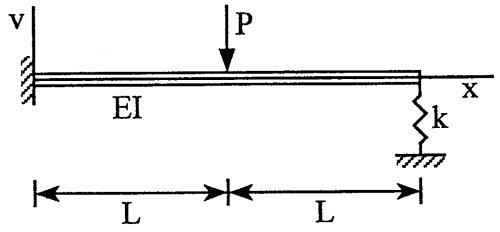
3. A prismatic bar ABCD of solid circular cross section is fixed at ends A and D. The bar is loaded by a distributed torque of constant intensity q per unit length over AB region and subjected to a concentrated torque T = qL at point C. Determine: (i) the reactive torques at supports A and D; (ii) the maximum shear stress in the bar, and (iii) the location on the bar in AB region (except point A) where the angle of twist is zero. (20%)



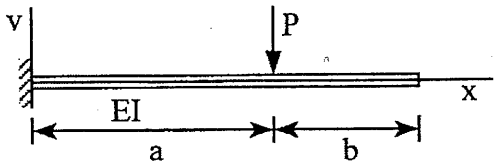
4. A plane stress element ($\sigma_Z = 0$) has $a \times a$ dimension in xy plane as shown by the solid line below. After loading is applied, the stress element is deformed to the configuration shown by the dash line. Assume $a = 1$ cm, $b = 80\times10^{-6}$ cm, $\theta = 160\times10^{-6}$, Young's modulus $E = 200$ GPa, Poisson's ratio $\nu = 0.3$. Calculate the stresses σ_X, σ_Y, τ_{XY} and the strain energy density u of the element. (20%)



5. A cantilever beam is supported by a translational spring with sprint constant $k = EI/L^3$ at the free end. If the bean is subjected to a concentrated load P as shown. Calculate the reaction R is the spring and the deflection of the beam under the concentrated load. (20%)



Hint:



$$v(x) = -\frac{Px^2}{6EI}(3a - x), \quad 0 \le x \le a,$$

$$v(x) = -\frac{Pa^2}{6EI}(3x - a), \quad a \le x \le L.$$