มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

การสอบปลายภาคการศึกษา: ประจำภาคการศึกษาที่ 1	**ปีการศึกษา :** 2550
วันที่: 6 **ตุลาคม** 2550	**เวลา :** 09.00-12.00 **น.**
วิชา: 220-502 Advanced Mechanics of Solids	**ห้อง :** R201

คำอธิบาย

1. **ข้อสอบมีจำนวนทั้งหมด** 5 **ข้อ**
2. **ให้เลือกทำข้อสอบ** 4 **ข้อ**
3. **อนุญาตให้นำเครื่องคิดเลขทุกชนิดเข้าห้องสอบได้ และให้นำตำราเรียน, เอกสารทุกชนิด เข้าห้องสอบได้**
4. **ไม่ต้องส่งกระดาษทดเลขที่แจกให้คืน**

ข้อ	คะแนนเต็ม	ได้คะแนน
1	25	
2	25	
3	25	
4	25	
5	25	
รวม		

ผู้ออกข้อสอบ : บุญ จันทร์ทักษิโณภาส

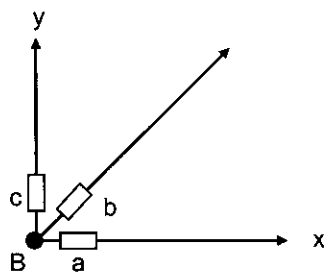
1. (25 marks) A rectangular roset shown below is cemented to a point B on the free surface of a stee member (**isotropic with** ν **=0.29,** **E = 200 GPa).** Under load, the strain readings are $\varepsilon_a = \varepsilon_{xx} = 0.00120$, $\varepsilon_b = 0.00090$, $\varepsilon_c = \varepsilon_{yy} = -0.00100$.

(a) Evaluate the strain tensor, $\begin{pmatrix} \varepsilon_{xx} & \varepsilon_{xy} & \varepsilon_{xz} \\ \varepsilon_{xy} & \varepsilon_{yy} & \varepsilon_{yz} \\ \varepsilon_{xz} & \varepsilon_{yz} & \varepsilon_{zz} \end{pmatrix}$, and the stress tensor, $\begin{pmatrix} \sigma_{xx} & \sigma_{xy} & \sigma_{xz} \\ \sigma_{xy} & \sigma_{yy} & \sigma_{yz} \\ \sigma_{xz} & \sigma_{yz} & \sigma_{zz} \end{pmatrix}$, at B.

(b) Evaluate the principal stresses and the maximum shear stress at B.

(c) Find the line strain, at B, in the direction 30° clockwise from the x-axis (and perpendicular to the z axis).

(Hint : the stress components on the free surface are zero)



2. (25 marks) A hollow thin-wall steel torsion member (G = 77.5 GPa), with cross section shown below n Fig.(a), is subjected to a pure torque T. [Hint : The cross-section is symmetric.]

(a) If the applied torque T = 0.80 kN.m, determine the maximum shear stress developed and calculat e the unit angle of twist.

(b) Given that the cross section is an open cross section instead of a closed cross section, Fig.(b), dete rmine the permissible value for T if the maximum shear stress must not be greater than 180 MPa. Evaluate also the corresponding unit angle of twist.

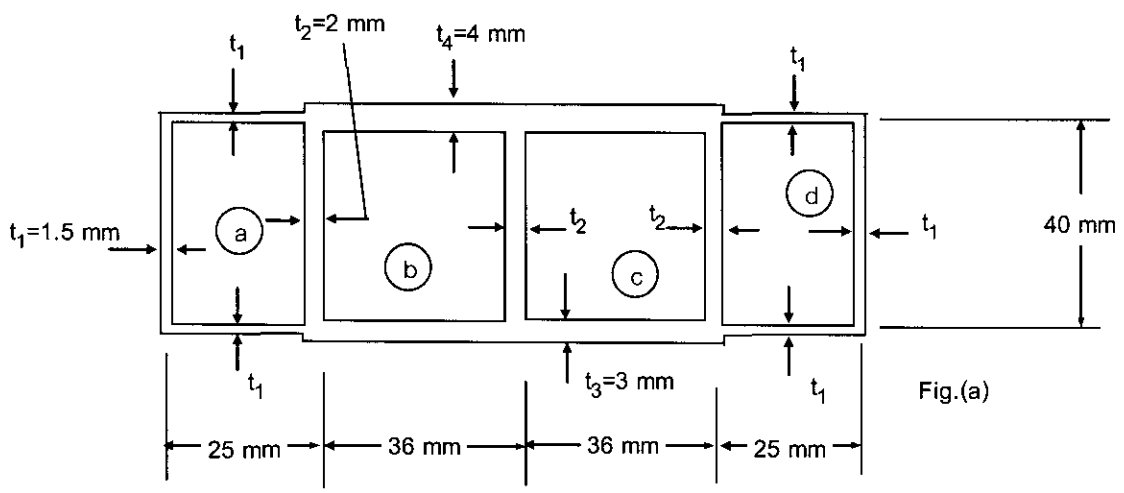


Fig.(a)

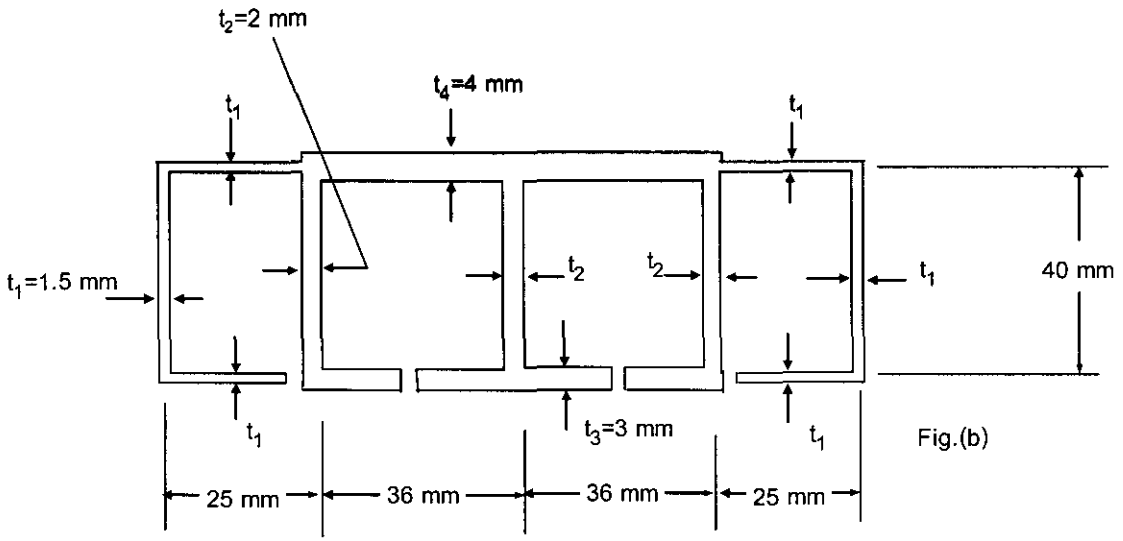
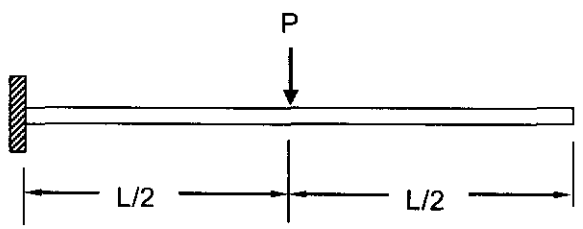


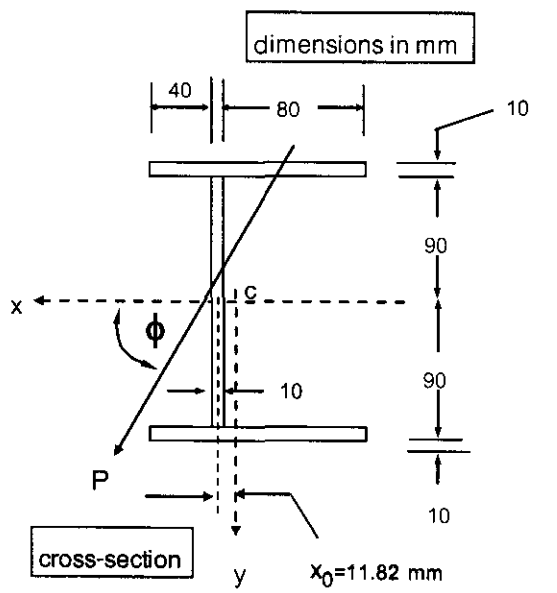
Fig.(b)

3. (25 marks) A steel member (E =200 GPa) with the cross section shown below is used as a cantilve beam of length L =2.0 m. The beam is subjected to a point load P = 12 kN at mid length passing through the shear centre of the cross-section, and with the direction as shown ($\phi = 70^\circ$). Determine the maximum tensile and co mpressive stresses in the beam and the deflection at the free end of the beam (C is the centroid of the cross-section .

Note : 1. The view shown below is from the free end toward the fixed end of the beam.

2. The deflection at the end of a cantilver beam of length L symmetrically loaded by a point load, Q_y, at its mid length is given by, $\delta_y = \dfrac{5Q_yL^3}{48EI_x}$.





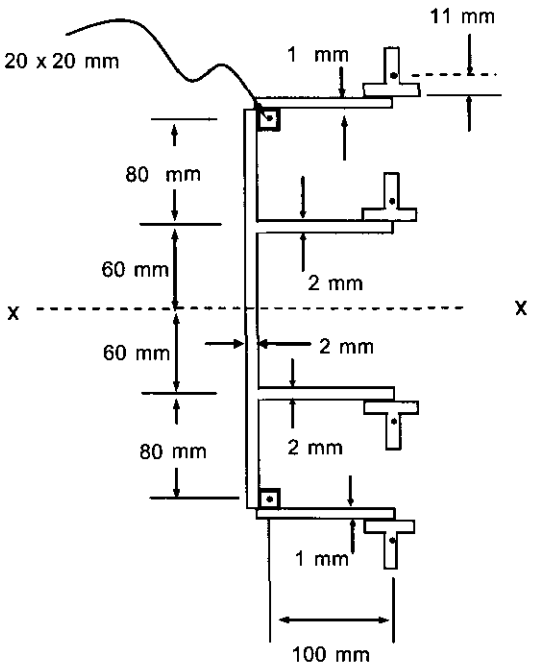
$I_x = 2.835 \times 10^7$ mm^4

$I_y = 3.954 \times 10^6$ mm^4

$I_{xy} = 0$

$\phi = 70^0$

4. (25 marks) An extrude aluminium beam whose cross-section consists of a vertical web and two horizo ıtal webs of 2 mm thickness is made into a composite beam by welding two horizontal web of 1.00 mm thick, four T-stringers and two square stringers (of 20x20 mm) to the original cross-section. Each T-stringer has area of 800 mr ^{2} and its centroid is located 11.0 mm above its base. The cross-section of the composite beam is shown below. I)etermine the approximate location of the shear centre of the cross-section. (Note: the cross-section is symmetric).



5. (25 marks) A steel I-beam of symmetrical cross section (E = 200 GPa, depth = 100 mm, I_x = 1.25› 10^6 mm^4) and 16 m long, is supported by a series of spring (K = 460 N/mm) spaced at a distance ℓ = 400 mm centre to centre along the beam length. A combination of point load P = 3.0 kN and a distributed load of loa‹ ed length 4.00 m and intensity w = 2 N/mm is applied to the beam as shown below.

(a) Determine the maximum deflection of the beam.

(b) Determine the maximum flexural stress in the beam.

(c) If the point load is a moving load which can move to any point within the middle half region (Regior H) of the beam, determine the possible maximum bending stress in the beam.