มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

การสอบกลางภาค: ประจำภาคการศึกษาที่ 1	ปีการศึกษา : 2552
วันที่: 30 กรกฎาคม 2552	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	35	
3	25	
4	25	
5	25	
รวม		

ผู้ออกข้อสอบ : บุญ จันทร์ทักษิโณภาส

1. (25 points) At a point in a member, the stress components are found to be

$\sigma_{xx} = 18.8\ MPa,\ \sigma_{yy} = 5.0\ MPa,\ \sigma_{zz} = 25.0\ MPa,\ \sigma_{xy} = -7.0\ MPa,\ \sigma_{xz} = -15.0\ MPa,\ \sigma_{yz} = 0.0\ MPa$

(a) Determine magnitudes of the **principal stresses** and the **maximum shear** stress.

(b) Determine magnitudes of the **normal** and **shear** stress components acting on a plane whose normal lies in the **x-y plane** and making an angle of 60^0 with the **x-axis**.

(c) Determine the direction of the **minimum principal stress** (σ_3).

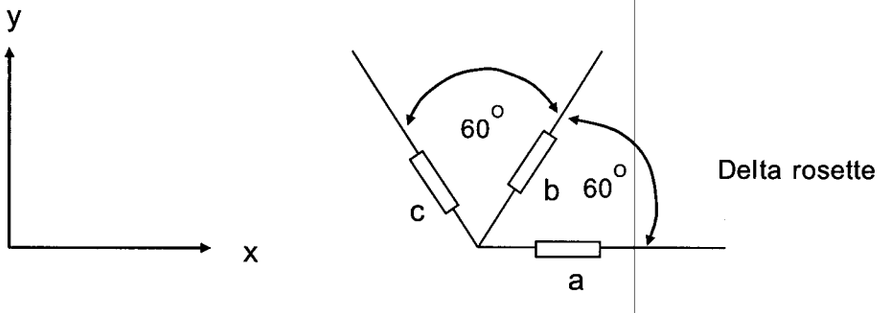
2. (35 points)

A delta rosette shown below is cemented to a point on the free surface of a **plane stress** member (stressed in the x-y plane) . From measurements, $\varepsilon_a = 2.580x10^{-4},\ \varepsilon_b = 1.250x10^{-4},\ \varepsilon_c = -1.800x10^{-4}$.

(a). (10 points) Determine the magnitudes and orientations of the **principal strains** in the x-y plane at that point.

(b) (15 points) Determine the magnitudes of **stress components** at that point If the member **is an isotropic material** with **ν = 0.33**, and **E = 720 GPa**.

(c) (10 points) Determine the magnitudes of stress components at that point if the member **is an orthotropic material** with orthotropic axes x, y, z; and with the following material properties, $E_x = 15.00\ GPa$, $E_y = 12.00\ GPa,\ E_z = 6.00\ GPa,\ G_{xy} = 11.00\ GPa,\ G_{xz} = 10.00\ GPa,\ G_{yz} = 2.500\ GPa,$ $\nu_{xy} = 0.420,\ \nu_{xz} = 0.400,\ \nu_{yz} = 0.650$

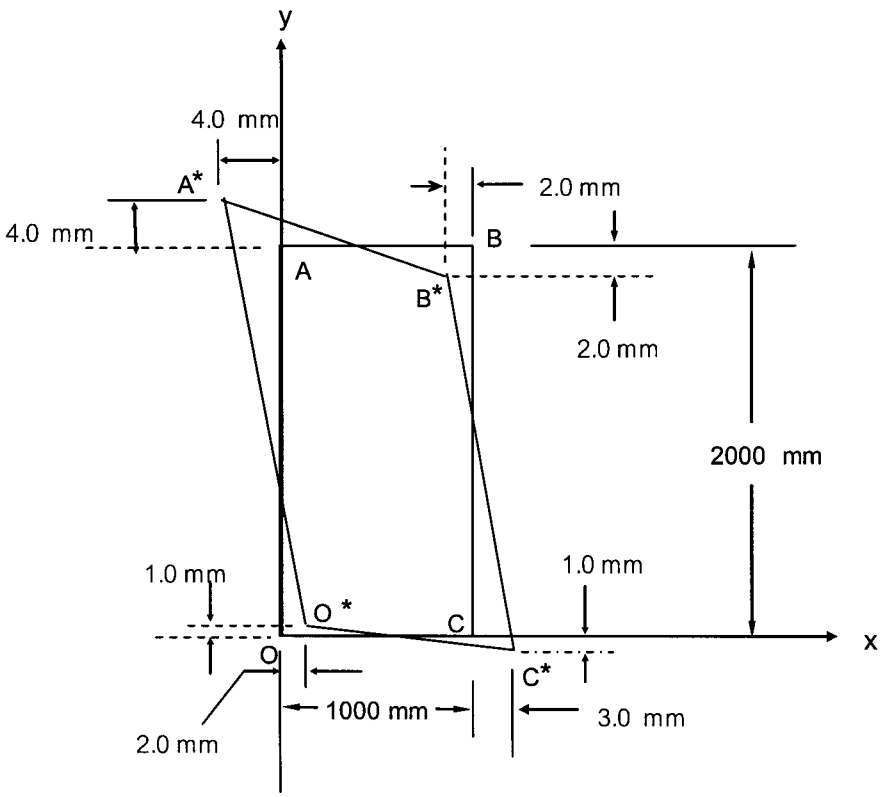


3. (25 points) A rectangular plate **OABC** of dimensions 1000 mm x 2000 mm in the x-y plane shown below is loaded so that the plate is in the state of **plane strain,** ($\varepsilon_{zz} = \varepsilon_{zx} = \varepsilon_{zy} = 0$), and passes to a new position **O*A*B*C***

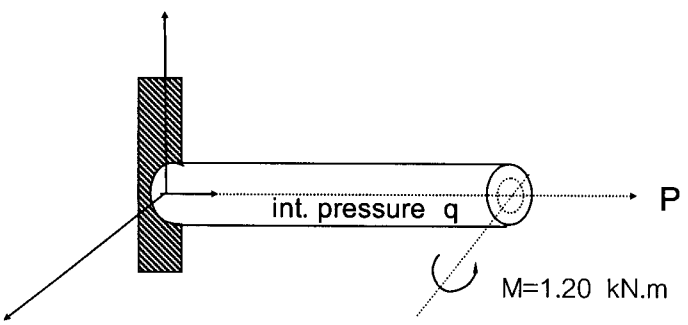
(a). Determine the **displacements (u, v),** of the plate for the deformation shown in term of x, y coordinates.

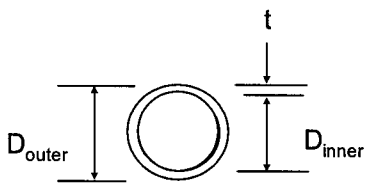
(b). Determine the **strain components at the point B** of the plate, and evaluate the maximum strain at B.

(c). Determine the strain at the point B in the direction of the **line BO**.



4. (25 points) A closed-end thin wall steel tube with the yield strength Y = 320 MPa, has outside diameter 122 mm and inside diameter 118 mm (ie. mean diameter of 120 mm and wall thickness of 4 mm). It is subjected to an internal pressure q = 6 MPa, a bending moment M =1.20 kN.m, and an axial external applied load P, as shown below. Using a safety factor SF = 2.00, determine the maximum allowable value of the axial load P based on maximum shear stress criterion of failure.





X-section

5. (25 points) A solid metal shaft of diameter **d = 120 mm**, is subjected to an axial load **P = 220.0 kN**, a bending moment **M = 10.00 kN.m**, and a torque **T = 15.0 kN.m**.

(a) If yield strength for the metal is **Y = 300 MPa**, and assuming that failure occurs at the initiation of yielding, determine the factor of safety based on the **octahedral shear stress criterion** of failure.

(b) If the metal is a brittle material with ultimate strength, $\sigma_u = 200\ MPa,\ E = 200\ GPa,\ \nu = 0.29$, determine the factor of safety based on the **maximum principal strain criterion** of failure.