

มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

การสอบกลางภาค: ประจำภาคการศึกษาที่ 1

วันที่: 31 กรกฎาคม 2551

วิชา: 220-502 Advanced Mechanics of Solids

ปีการศึกษา: 2551

เวลา: 09.00-12.00 น.

ห้อง: A400

คำอธิบาย

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

| ข้อ | คะแนนเต็ม | ได้คะแนน |
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| 1 | 25 | |
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| รวม | | |

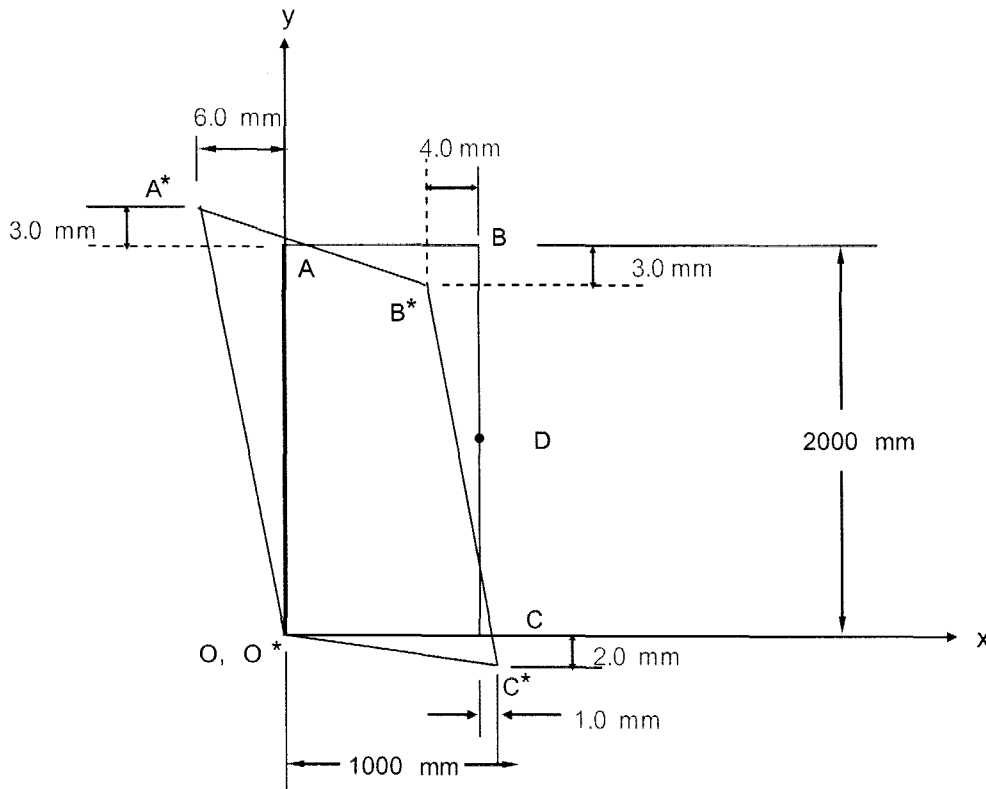
ผู้ออกข้อสอบ : บุญ จันท์ทักษิณภาส

1. (25 marks) A member made of isotropic metal alloy ($E=72.0 \text{ GPa}$ and $\nu = 0.33$) is subjected to a combination of loads. At a point on the free surface which is tangential to the x-y plane, the stress components are found to be $\sigma_{xx} = 120 \text{ MPa}$, $\sigma_{yy} = -40.0 \text{ MPa}$, $\sigma_{xy} = -60.0 \text{ MPa}$.

- Determine the strain components and evaluate the principal strains and their directions.
- Determine the magnitude of the normal component of stress acting on a plane whose normal lies in the x-y plane and making an angle of 45° with the x-axis.

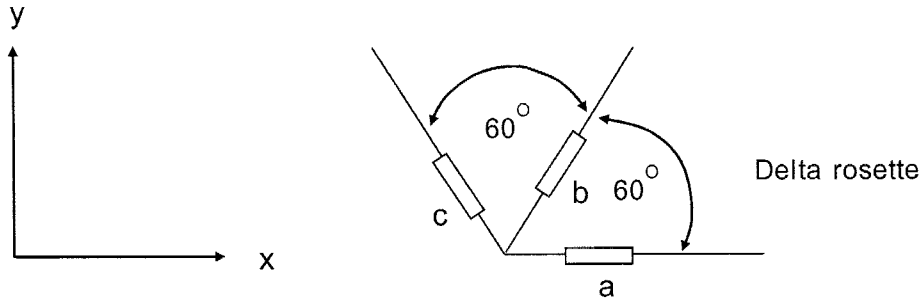
2. (25 marks) A rectangular plate OABC of dimensions 1000 mm x 2000 mm in the x-y plane shown below is loaded so that the plate is in the state of plane strain, ($\epsilon_{zz} = \epsilon_{zx} = \epsilon_{zy} = 0$), and passes to a new position O*A*B*C*.

- Determine the displacements (u, v), of the plate for the deformation shown in term of x, y coordinates.
- Determine the strain components at the point B of the plate, and evaluate the maximum line strain at B.
- Determine the strain at the point D ($x=1000 \text{ mm}$, $y=1000 \text{ mm}$) in the direction of the line DA.



3. (25 marks) The stress components on a free surface of an isotropic member, with $E = 720 \text{ GPa}$, $\nu = 0.33$, are $\sigma_{xx} = 156.6 \text{ MPa}$, $\sigma_{yy} = -49.13 \text{ MPa}$, $\sigma_{xy} = 65.6 \text{ MPa}$.

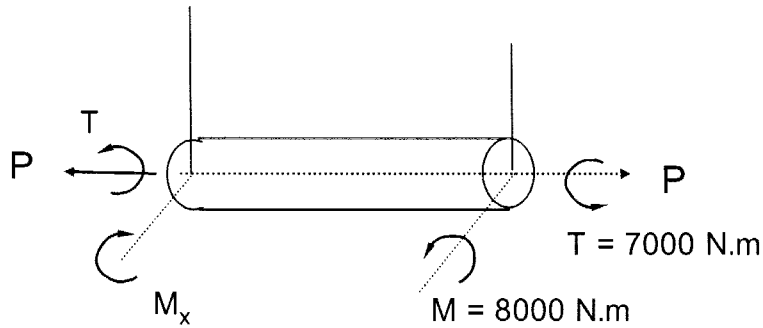
- Determine the strain components at this free surface.
- If a delta rosette is cemented to the free surface of the member as shown below, what would be the readings of gauges a, b and c?



4. (25 marks) A solid metal shaft of diameter $d = 100 \text{ mm}$, is subjected to an axial load P , a bending moment $M = 8000 \text{ N.m}$, and a torque $T = 7000 \text{ N.m}$. It has been designed using a **safety factor** of 2.0 for all loads (ie. for M , T and P).

(a) If yield strength for the metal is $Y = 240 \text{ MPa}$, and assuming that failure occurs at the initiation of yielding, determine the allowable value for P based on the maximum shear-stress criterion of failure.

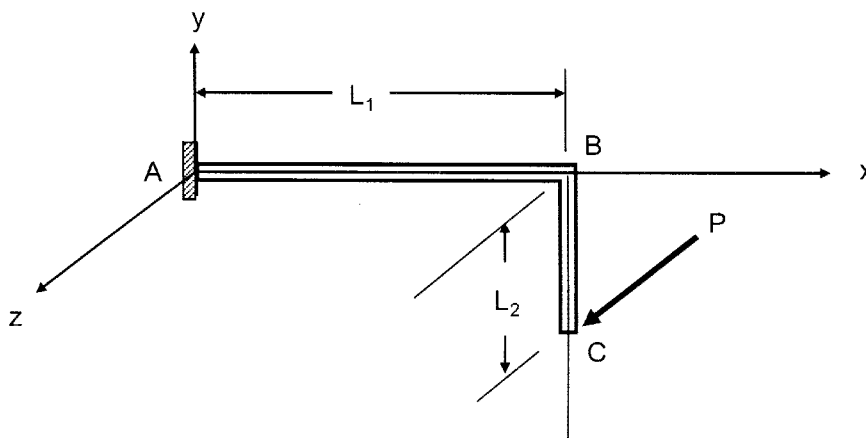
(b) If the metal is a brittle material with ultimate strength, $\sigma_u = 200 \text{ MPa}$, determine the allowable value for P based on the maximum principal stress criterion of failure.



5. (25 marks) A right angle bend ABC, fixed at the end A and free at the end C, is loaded at the free end by a point load $P = 20 \text{ kN}$, acting perpendicular to the plane of the bend as shown below. The bend has a circular cross section with radius $R = 0.07 \text{ m}$, lengths $L_1 = 1.20 \text{ m}$, $L_2 = 0.60 \text{ m}$, $E = 200,000 \text{ MPa}$, $G = 75,000 \text{ MPa}$.

(a) Determine the translational displacement component δ_{Cz} of the free end C.

(b) Determine the angle of twist θ_{Cz} of the free end C.



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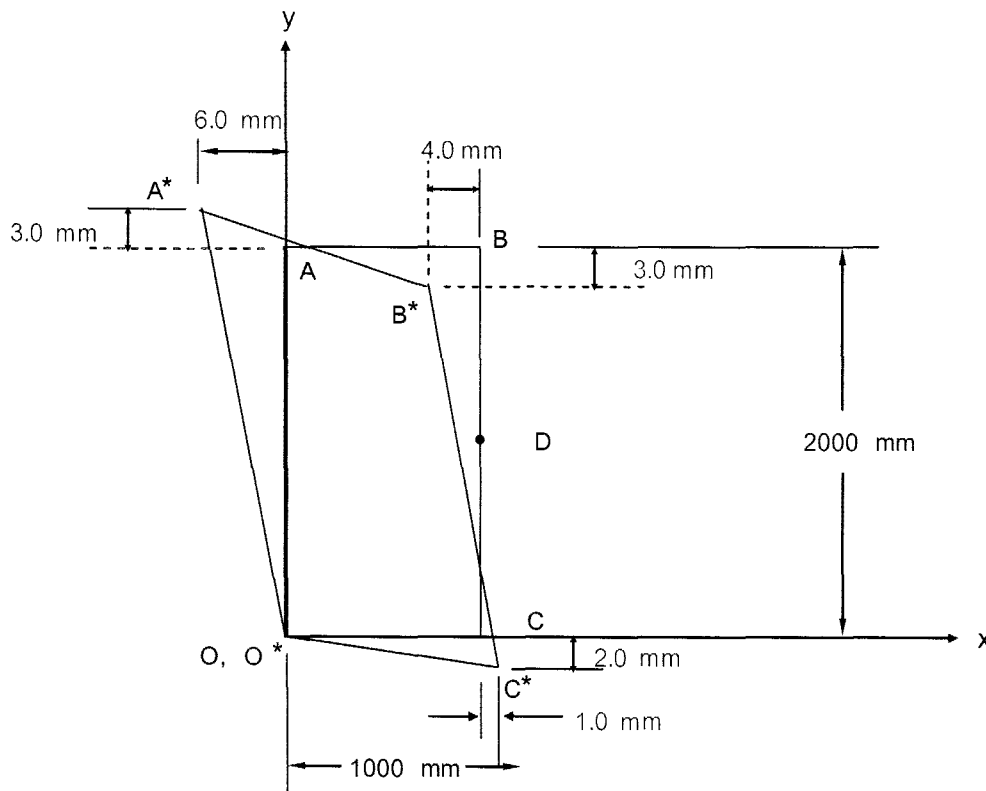
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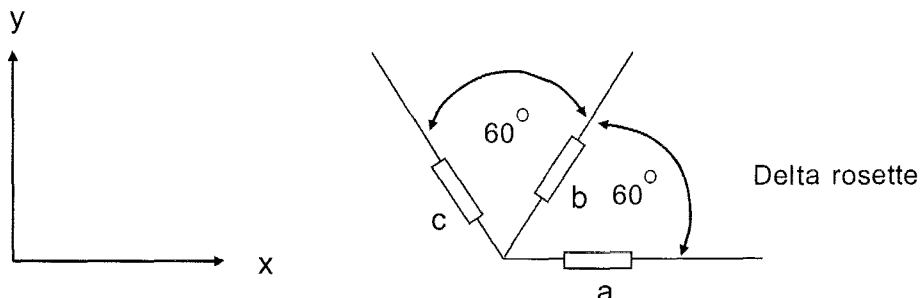
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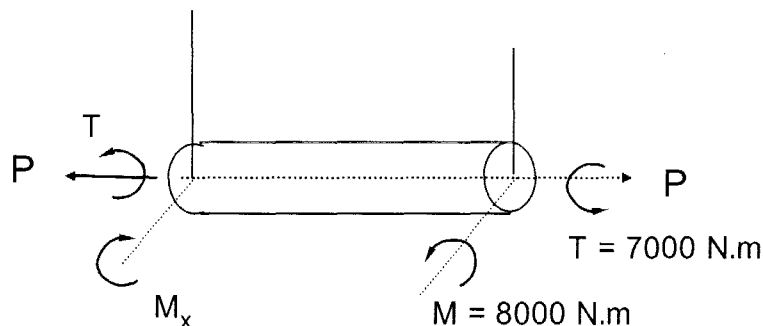
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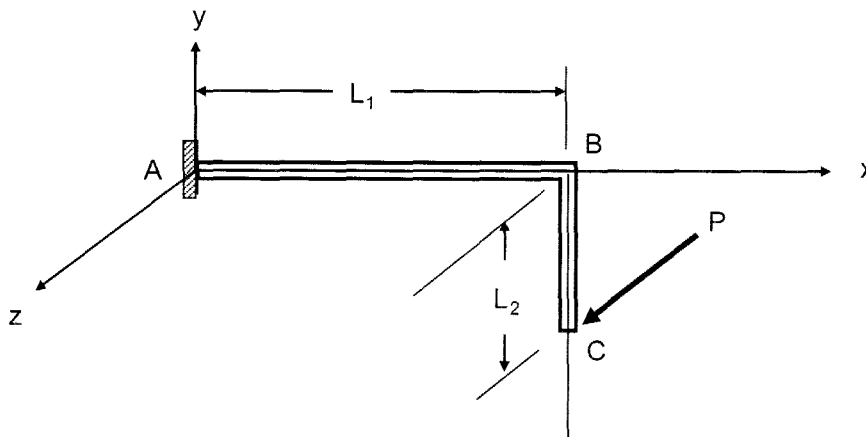
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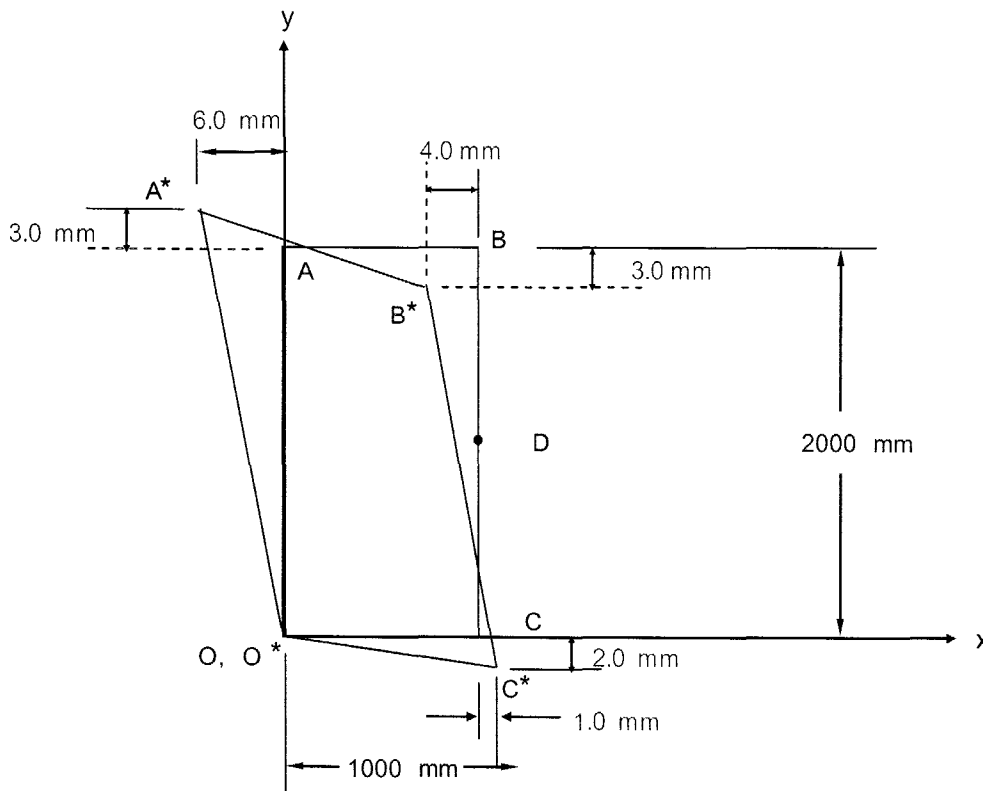
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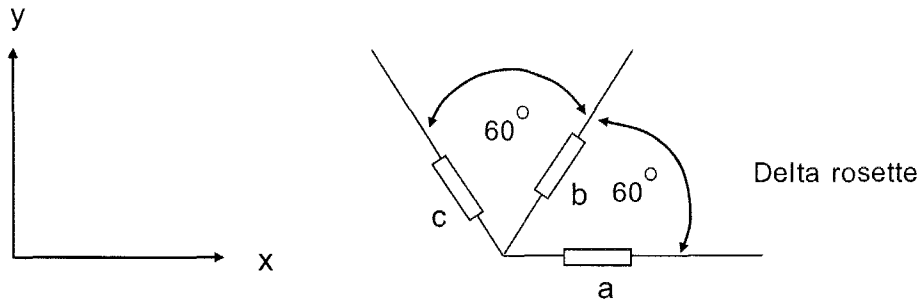
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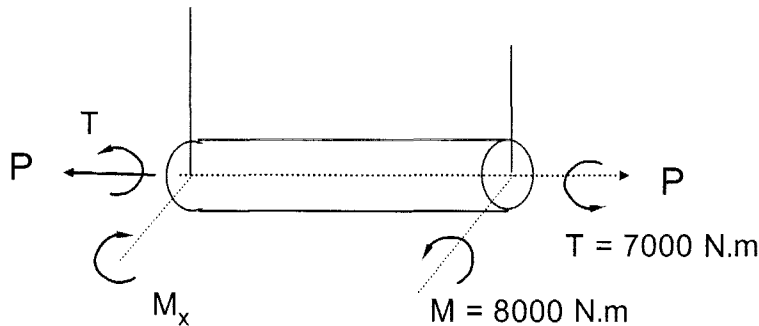
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