มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

การสอบปลายภาคการศึกษา: ประจำภาคการศึกษาที่ 1	ปีการศึกษา : 2549
วันที่: 7 ตุลาคม 2549	เวลา : 09.00-12.00 น.
วิชา: 220-502 Advanced Mechanics of Solids	ห้อง : A201

คำอธิบาย

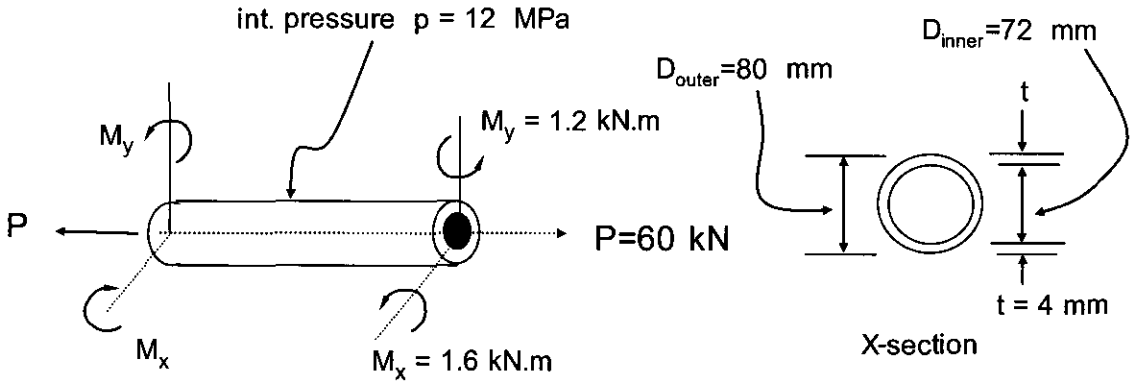
1. ข้อสอบมีจำนวนทั้งหมด 5 ข้อ
2. ให้เลือกทำข้อสอบ 4 ข้อ
3. อนุญาตให้นำเครื่องคิดเลขทุกชนิดเข้าห้องสอบได้ และให้นำตำราเรียน, เอกสารทุกชนิด เข้าห้องสอบได้
4. ไม่ต้องส่งกระดาษทดเลขที่แจกให้คืน

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

ผู้ออกข้อสอบ : บุญ จันทร์ทักษิโณภาส

1. (25 marks) A closed thin-wall steel tube has an outer diameter of 80.0 mm and wall thickness of 4.00 mm. It is subjected to an internal pressure of 12.0 MPa. The axis of the tube lies along the z axis. In addition to internal pressure, the tube is subjected to an axial load P = 60.0 kN, bending moments M_x = 1.6 kN.m and M_y = 1.2 kN.m. If the yield strength of steel Y = 500 MPa, compare the safety factors based on the maximum shear-stress criterion of failure and the maximum octahedral shear stress criterion of failure.

With what value of internal pressure will we have equal value of safety factors from both failure criteria ?



2. (25 marks) A hollow thin-wall steel torsion member has a symmetrical cross section as shown in Fig.(a). The steel has a shear modulus of elasticity G = 77.5 GPa, and the maximum shear stress must be limited to 150 MPa. Determine the maximum permissible torque that may be applied and calculate the corresponding unit angle of twist. If the cross section is an open cross section instead of a closed cross section, determine new values of the permissible torque and the corresponding unit angle of twist.

If the original hollow thin-wall torsion member of Fig.(a) is modified into a symmetrical cross section (with two axes of symmetry) as shown in Fig.(b). What additional information regarding state of shear flow may be deduced based on the concept of Prandtl membrane analogy?

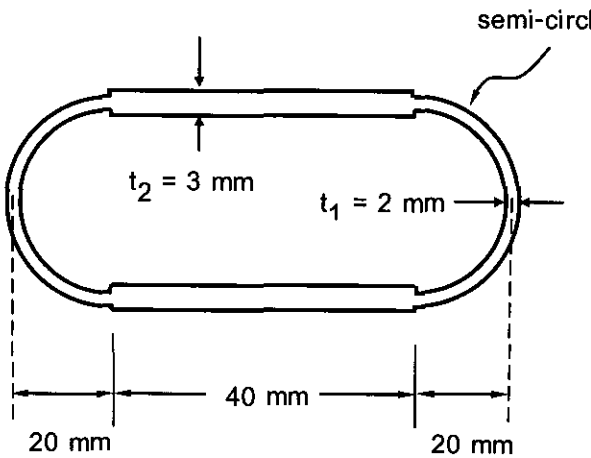


Fig.(a)

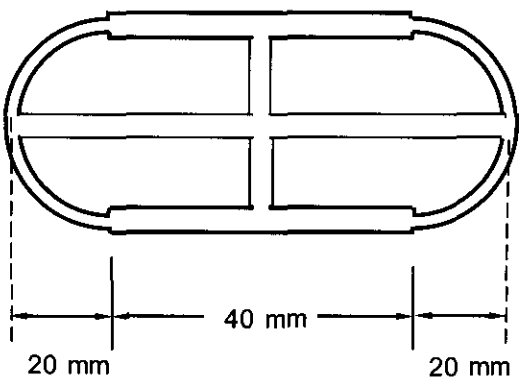
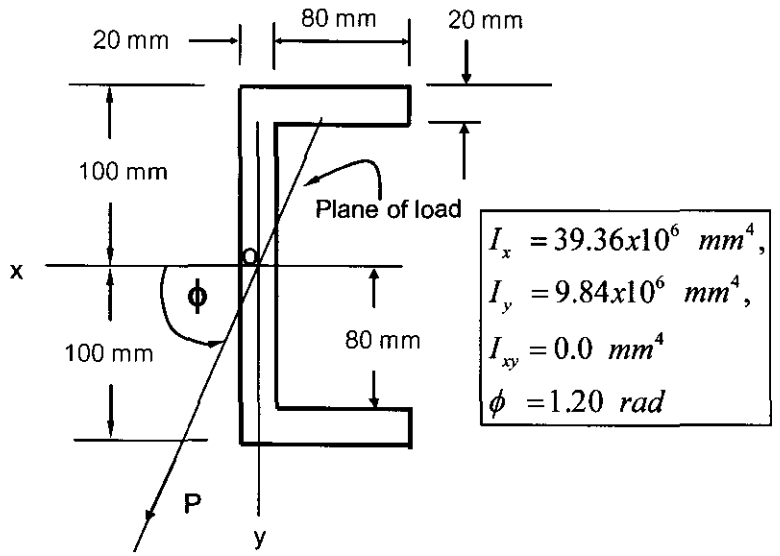


Fig.(b)

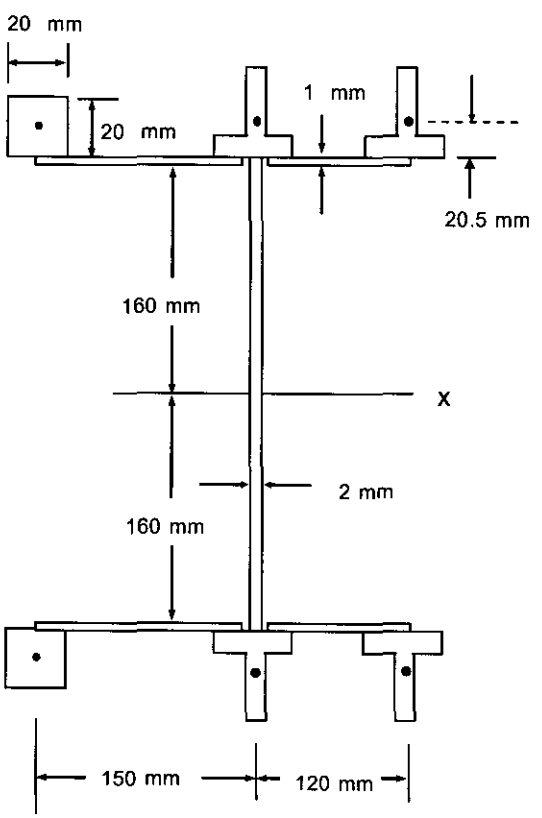
3. (25 marks) A C-section steel member (E =200 GPa) with the cross section shown below is used as a simply supported beam of 4.0 m span. The beam is subjected to a point load P = 22 kN at mid span with the direction as shown. Determine the maximum tensile and compressive stresses in the beam and the deflection at mid-span.



4. (25 marks) A composite beam has a symmetrical cross section. It consists of a vertical web with a thickness of 2.0 mm and four horizontal webs with a thickness of 1.00 mm welded to four T-stringers and two square stringers (20x20 mm) as shown. Each T-stringer has area of 1000 mm^2 and its centroid is located 20.5 mm above its base.

(a) What assumptions are usually employed in analyzing the moment of resistance and shear resistance of composite beam consisting of stringers and very thin webs ?

(b) Find approximate location of the shear centre of the cross section.



5. (25 marks) A symmetrical steel beam (E = 200 GPa) rests on a hard rubber foundation as shown below. The length in contact with the foundation is L = 8000 mm, and the beam has a square cross section (60x60 mm). The value of the spring constant for the hard rubber foundation is $k_0 = 0.200$ N/mm^3.

(a) If Q = 20000 N, and P = 0.0 , acting at the locations shown, determine the maximum deflection and maximum fibre stresses within the length of the beam which is in contact with the rubber foundation.

(b) If Q = 0 , and P =20000 N, determine the maximum deflection and maximum bending moment in the beam.