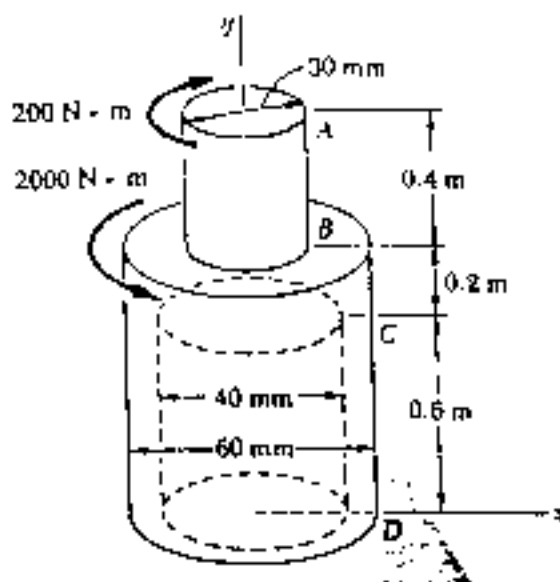


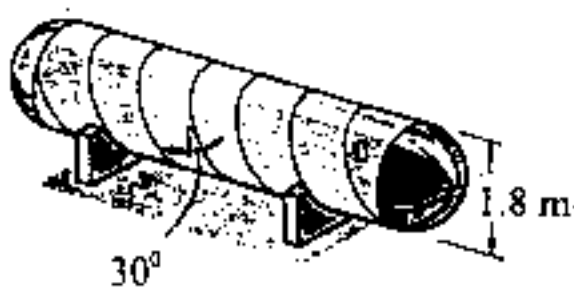
Explain the following items:(25%)

- (1) Strain hardening
- (2) Saint-Venant's principle
- (3) Fatigue
- (4) Creep
- (5) Neutral surface of a beam

2. The vertical shaft AD is attached to a fixed base at D and is subjected to the torques shown. A 40-mm-diameter hole has been drilled into portion CD of the shaft. Knowing that the entire shaft is made of steel for which $G = 100 \text{ GPa}$, determine the angle of twist at end A.(25%)



3. A cylindrical pressure tank is supported by two cradles as shown; one of the cradles is designed so that it does not exert any longitudinal force on the tank. The tank has a 1.8 m outside diameter and is fabricated from a 20 mm steel plate by butt welding along a helix which forms an angle of 30° with a transverse plane. The end caps are spherical and has a uniform wall thickness of 15 mm. For the internal gage pressure of 800 kPa, determine (a) the normal stress and the maximum shearing stress in the spherical caps, (b) the stresses in directions perpendicular and parallel to the helical weld, (c) under what condition, the shear stresses at the inner surface and at the outer surface of the tank can be regarded as the same? (25%)



國 立 清 華 大 學 命 題 紙

八十七學年度 材料科學工程研究所(系) 工 組碩士班研究生入學考試

科目 工程力學(III) 科號 2102 共 2 頁第 2 頁 *請在試卷【答案卷】內作答

A simple beam AB with span length $L = 1.5$ m supports a concentrated load $P = 5$ kN acting at distance $c = 0.6$ m from the right-hand support as shown. The beam is made of steel and has a rectangular cross section of width $b = 5$ cm and height $h = 20$ cm. The cross section mn is located at $x = 0.2$ m from end A of the beam and G is the point located 5 cm below the upper surface on cross section mn , determine (a) normal stress on cross section mn as a function of y , (b) shear stresses on cross section mn as a function of y , (c) principal stresses at G, (d) maximum shear stresses at G, (e) the largest tensile stress in the beam. (Consider only in-plane stresses) (25%)

