1 A vertical pole of solid circular cross section is twisted by horizontal forces P=4900 N acting at the ends of a horizontal arm AB (see Figure 1). The distance from the outside of the pole to the line of action of each force is c=130 mm.

i. If the allowable shear stress in the pole is 31 MPa, what is the minimum required diameter $d_{min.}$ of the pole due to torsion? (15%)

ii. Solve the preceding problem if the horizontal forces have magnitude P=6.0 kN, the distance c=120 mm, and the allowable shear stress is 25Mpa. (10%)

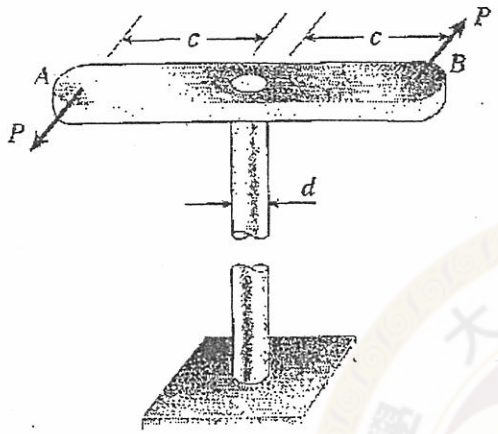

Figure 1

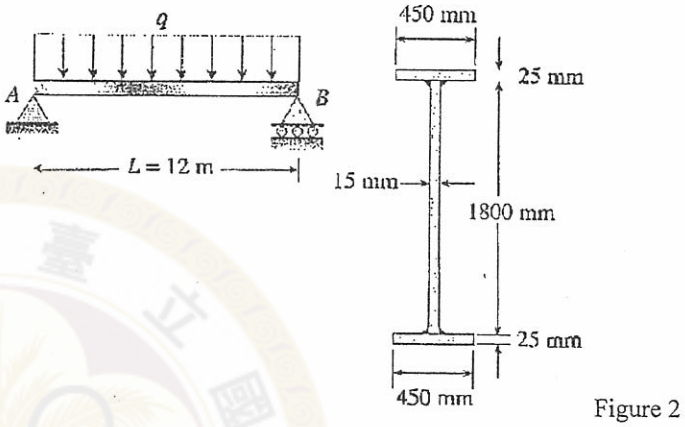

Figure 2

2 A bridge girder AB on a simple span of length L = 12 m supports a uniform load of intensity *q* that includes the weight of the girder (see Figure 2). The girder is constructed of three plates welded to form the cross section shown. Determine the maximum permissible load *q based on*

i. An allowable bending stress σ_{allow}=90 MPa (15%), and

ii. An allowable shear stress τ_{allow}=50 MPa. (10%)

3 The internal pressure of a spherical bubble with a radius of r and a thickness of t is P and the outer pressure is P/2 (see Figure 3).

i. Calculate the membrane stresses. (10%)

ii. Calculate the principal stresses at the outer surface. (10%)

iii. Calculate the principal stresses at the inner surface. (5%)

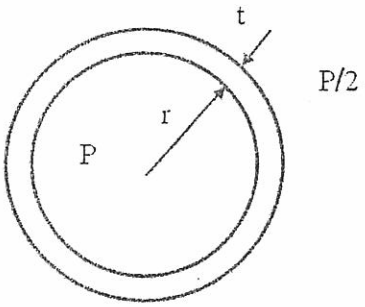

Figure 3

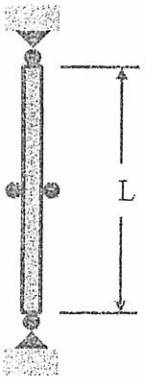

Figure 4

4 A slender column with pinned ends and length L is held between immovable supports (see Figure 4). At mid-height, the column is restrained to move horizontally.

i. Derive the critical load (due to buckling) of this column. (15%)

ii. What increase ΔT in the temperature of this column will produce buckling? (10%)

試題隨卷繳回