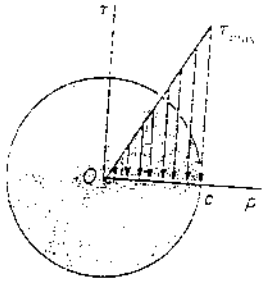
1. What is the definition of "stiffness"? Use axial loading and bending cases to explain it, respectively. (20%)

2. In the generalization of Hooke's law for stress and strain, there are 36 elastic constants (i.e. material properties). Under which conditions, the constants will he reduced to 2 constants? (20%)

3. Consider the case when the torque T is such that all shearing stresses in the shaft remain below the proportional limit and below the elastic limit as well. Derive the elastic torsion formula, $\tau = \frac{T\rho}{J}$, from the Hooke's law, $\tau = G\gamma$, for a solid circular shaft of radius c. (τ is shearing stress, J is polar moment of inertia, G is shear modulus of elasticity and γ is the shear strain expressed in radians.) (20%)

Fig. 3



4. We always consider two material properties in the strength of materials, i.e. modulus of elasticity (E) and Poisson's ratio (υ).
For a prismatic long member, describe at least two experimental testing to determine these two material properties. (20%)

5. The unpressurized cylindrical storage tank shown has a $\frac{3}{16}$-in. wall thickness and is made of a steel with a 60-ksi ultimate strength in tension. Determine the maximum height h to which it may be filled with water if a factor of safety of 4.00 is desired.
(Specific weight of water = 62.4 lb/ft^3.) (20%)

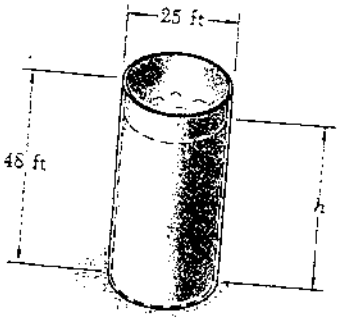


Fig. 5