**Problem 1**

At your new job in Silicon Valley,your first task is to perform a safety evaluation of a pressure vessel.The vessel is spherical in shape with a diameter of 2m and will be used to store highly toxic pyrophoric Silane ($SiH_4$) gas.The vessel is stored outside the processing laboratory for safety reasons.If the container fails,most of Santa Clara county will perish.In your evaluation you must answer the following questions:

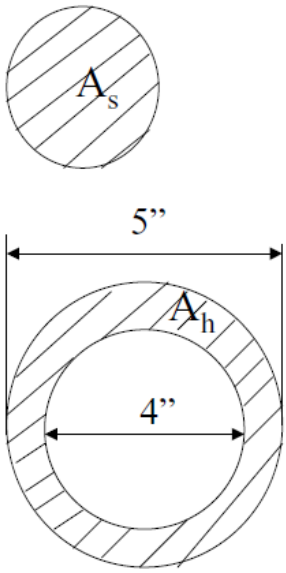
1..what internal pressure will cause first yielding in the 5mm thick walls if the vessel is made from a carbon steel(uniaxial tensile properties: E=210 GPa, $\sigma_y$=450 MPa,$\sigma_u$=560 MPa)?

2.What are the principal stresses and the maximum shear stress at the maximum operating pressure of 1800 kPa?

3.What is the factor of safety for the vessel(compare the maximum operating and yielding pressures)?

**Problem 2**

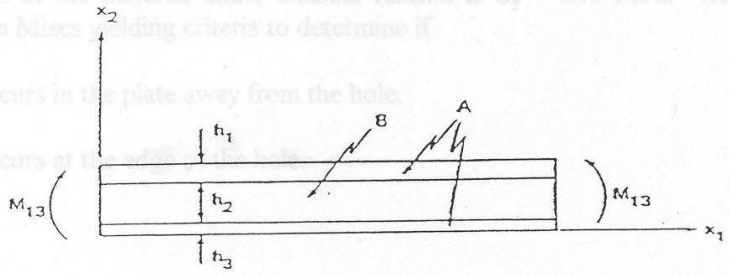
In the figure below, the solid shaft and the hollow shaft have the same cross-sectional area $A_s = A_h$.They are subject to the same torsional load $T_s = T_h$.If both shafts are made of the same material $G_s = G_h$,and have the same length, compare the Torsional Stiffness$(T/\phi)$ of the two shafts,where $\phi_s$ and $\phi_h$ are the angles of twist for the solid and hollow shafts respectively.



**Problem 3**

Problem 1

A composite beam is subjected to an external bending moment $M_{13}$, as shown. The outer layers are made of a material A which always deforms at a constant stress $\sigma_o$ (i.e., a rigid plastic material). The inner core is made of an elastic material B which has a stress-strain relationship given by $\sigma_{11} = E\varepsilon_{11} = (E/\rho)x$, where $\rho$ is the radius of curvature, $E$ is the time-independent modulus, and $x$ is the position in the $x_2$ direction relative to the neutral axis. Determine the location of the neutral axis.




Notes:

- Make sure you understand how to do the HW sets (1 and 2)
- Topics covered in lecture that you should be comfortable with (I got these from the lecture notes):
    - Beam bending (esp slender beams)
    - Strain definition (normal and shear)
    - Bar & tube in tension
    - Pressurization of a thin walled tube
    - Bar & tube in torsion
    - Transformation of stresses (Mohr's circle)
    - Yield criteria (Tresca and von Mises); constraint
    - Stress concentrations (i.e. at a small hole in a semi-infinite plane)