MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF OCEAN ENGINEERING AND CIVIL AND ENVIRONMENTAL ENGINEERING
13.10J/1.573J Introduction to Structural Mechanics
Fall 1999
Problem Set 4

Assigned : September 30, 1999
Due : October 7, 1999

1. **Problems from Chapters 6 and 8 of the course textbook.**
   (a) **Problem 6.24**
   (b) **Problem 8.18**

2. **A body is subject to the following distribution of stresses: (Unit of stress : MPa)**

$$\tau_{xx} = xy^2 + z, \tau_{xy} = \tau_{yx} = 3xz + 4y,$$
$$\tau_{yy} = x + 3z, \tau_{yz} = \tau_{zy} = -3z^2/2,$$
$$\tau_{zz} = 0, \tau_{zx} = \tau_{xz} = -z(y^2 + 4).$$

   (a) **In the absence of any body forces, is it in equilibrium?**
   (b) **Assume linear elastic material with young's modulus E = 200 GPa, Poisson's ratio $\nu = 0.3$. What is the strain energy per unit volume at the point $(x, y, z) = (1, 1, 1)$?**

3. **Given the following nonzero stresses at a point.**

$$\begin{aligned} \tau_{xx} &= -3000psi \\ \tau_{yy} &= 4000psi \\ \tau_{xy} &= 2000psi \end{aligned}$$

Answer the following questions for an axis rotated $22.5°$ clockwise from the x axis. Use Mohr's circle as an aid.

(a) $\tau_{x'x'}$, $\tau_{y'y'}$, $\tau_{x'y'}$.

(b) Principal axes.

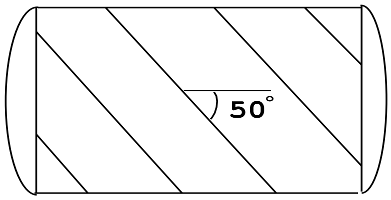
(c) Principal stresses.

(d) Extreme shear

4. The steel pressure tank shown has a 500mm inside diameter and an 8mm wall thickness. Knowing that the butt-welded seams form an angle of 50° with the longitudinal axis and that the gauge pressure in the tank is 1.5 MPa, determine

   (a) the normal stress perpendicular to the weld.

   (b) the shearing stress parallel to the weld.



Problem sets are also available in the course homepage.