Assignment #5

1. Show that for the case of small strains the relative change in the volume of a body subjected to hydrostatic pressure p is given by:

$$\frac{\Delta V}{V} = \frac{3(1-2\nu)}{E} P$$

2. A piece of steel ($\nu = 0.3,\ E = 2.1x10^6\ Kg/cm^2$) is subjected to hydrostatic pressure of $6x10^5\ Kg/cm^2$. The volume of this piece in vacuum is $2000cm^3$.

   (a) Determine the volume of the piece under the given hydrostatic pressure.
   (b) Find the maximum shear stress in the piece.
   (c) Calculate the principal stresses in the piece.
   (d) Evaluate the bulk modulus of steel.

3. At a particular point in a body the strain field is given by:

$$\sigma_{ij} = \begin{pmatrix} 1000 & 0 & 500 \\ 0 & 500 & 0 \\ 500 & 0 & 0 \end{pmatrix} \quad Kg/cm^2$$

   and the following measurements were taken $\varepsilon_{xx} = 2.75x10^{-4}, \varepsilon_{xz} = 2.25x10^{-4}$.

   (a) Determine all the elastic moduli: μ, E, κ, λ, ν.
   (b) Determine the strain tensor.

4. The following stress field is suggested as a solution for a triangular wedge subjected to a uniform load q along its boundary $x_2 = 0$:

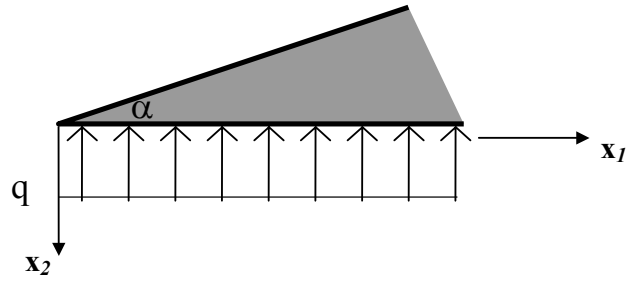
$$\tau_{11} = A\left(\arctan\left(\frac{x_2}{x_1}\right) - \frac{x_1 x_2}{x_1^2 + x_2^2} + C \right) \qquad \tau_{12} = -A\frac{x_2^2}{x_1^2 + x_2^2}$$

$$\tau_{22} = A\left(\arctan\left(\frac{x_2}{x_1}\right) + \frac{x_1 x_2}{x_1^2 + x_2^2} + B \right) \qquad \tau_{i3} = 0$$

(a) Is this stress field acceptable?

(b) Write the boundary conditions for boundaries $x_2 = 0$ and $x_2 = -x_1 \tan\alpha$.

(c) Determine the constants *A, B* and *C*.



5. Recreate the solution given by S.P. Timoshenko and J.N. Goodier [1] for a beam under pure ‘bending’. Explain the assumptions and the stages of the solution.

[1] S.P., Timoshenko and J.N., Goodier, “Theory of Elasticity” 3-rd Edition, pp. 284-288.