

Ae/AM/CE/ME 102c

Mechanics of Structures and Solids – Spring 2007-08

Assignment 6, Due May 29, 9:00AM, in class

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Problem 1: Consider a square bar occupying the region $(0,L) \times (0,t) \times (0,t)$ in the reference configuration and made of a Mooney-Rivlin material subjected to a uniaxial tension with total force f on the faces $\{x_1 = 0\}$ and $\{x_1 = L\}$.

- (a) Find the relation between the applied force f and the stretch in the x_1 direction.
- (b) Find the Piola-Kirchhoff stress.

Problem 2: Consider a square plate occupying the region $(0,L) \times (0,L) \times (0,t)$ in the reference configuration and made of a Mooney-Rivlin material undergoing a simple shear deformation:

$$y_1 = x_1 + \kappa x_2 \quad y_2 = x_2 \quad y_3 = x_3$$

Find the Cauchy stress and show that the following hold:

- (a) the universal relation $T_{11} - T_{22} = \kappa T_{12}$
- (b) the Poynting effect $T_{11} - T_{22} \neq 0$

Find the shear stress - shear strain relationship.

Find the Piola-Kirchhoff stress tensor.

Now assume that the faces of the plate are stress-free so that $T_{13} = T_{23} = T_{33} = 0$. Find the total forces acting on the edges $\{x_1 = L\}$ and $\{x_2 = L\}$.

Problem 3: Consider the interaction force between two parallel screw dislocations, A and B. Let dislocation A be located at the origin along the z-axis $(0,0,0)$ and dislocation B is located at the coordinate $(x,y,0)$. Both dislocations have the same Burger's vector, $\underline{b} = b\mathbf{k}$. What force does dislocation A exert on dislocation B?