University of Massachusetts - Amherst
Department of Civil & Environmental Engineering
CEE 630: Advanced Solid Mechanics (Fall 2009)

Homework #5: Due October 22

Problem 1: Consider the stress function $\Phi = C\theta$, which is expressed in a polar coordinate system (r, θ) with C a constant.
(a) Calculate the stresses that result from this stress function.
(b) Discuss the significance of this stress field for an infinite circular plate $(0 \leq r)$, and a ring $(a \leq r \leq b)$. Particularly, consider what moments are generated at the origin and infinity, or at $r = a$ and $r = b$. Are these moments in equilibrium?
(c) Consider a ring with $a \leq r \leq b$. From $\Phi = C\theta$, develop an expression for the displacements u and v in the r and θ directions when the inner surface at $r = a$ is fixed.

Problem 2: Consider the beam of non-uniform cross section shown below.
(a) Determine the value of the constant c in

$$\Phi = c[r^2(\alpha - \theta) + r^2 \sin\theta \cos\theta - r^2 \cos^2\theta \tan\alpha]$$

(b) Compute the stresses σ_x, τ_{xy} from σ_r, σ_θ, $\tau_{r\theta}$
(c) With $\alpha = 20^\circ$ plot σ_x and τ_{xy} on a *vertical* cross section $x = L/2$ through the beam. Plot for comparison the stresses that would be obtained from beam theory.