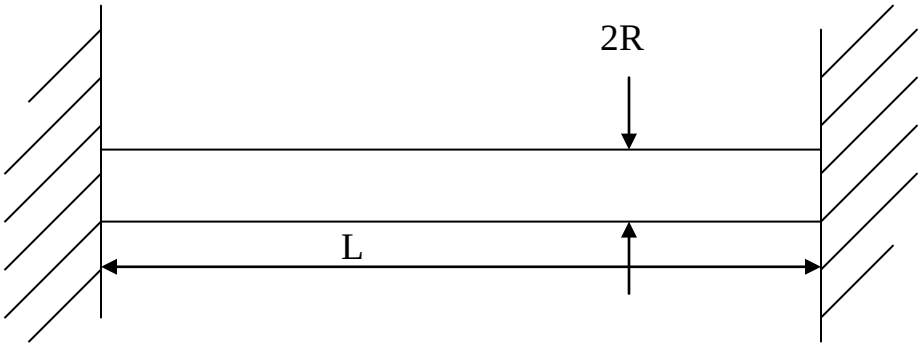
**Ph.D. Qualifying Exam in Mechanics of Materials (Spring 2003)**
**Mechanical Engineering Department, UNM**

Problem1: Consider the following circular bar that fits snug between two rigid walls. The temperature of this bar has been uniformly raised by $\Delta T$, determine:
a) The stress along the bar (in the *x*-direction)
b) The lateral strains (in the *y* and *z*-directions)
Assuming no friction between the bar ends and the walls, and knowing that the thermal strain, $\varepsilon_t$, generated from a temperature change in the bar is given by: $\varepsilon_t = \alpha\,(\Delta T)$, where $\alpha$ is the coefficient of thermal expansion of the homogeneous and isotropic bar material. Finally, the Poisson's ratio of this material is $\nu$.
Note: the bar length is L and its radius is R.

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Problem2: Consider a material point or element, in plane stress, centered at *O* (see sketch). If

$\sigma_x = 15{,}000\,psi$

$\sigma_y = 5{,}000\,psi$

$\tau_{xy} = 4{,}000\,psi$

**<u>Using a Mohr's circle construction (not an engineering drawing)</u>**,
a) Determine the principle stresses
b) The maximum shear stress