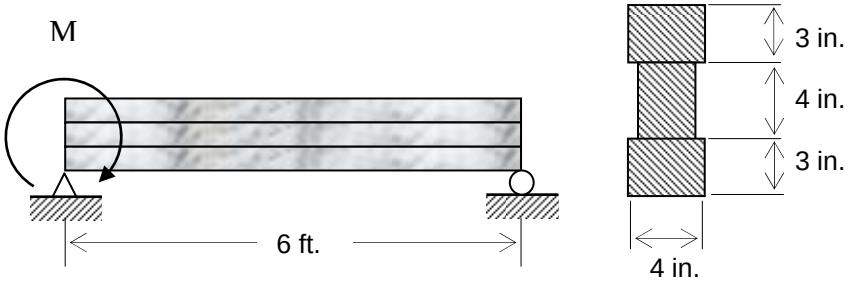
CME 203 **EXAM II - SPRING 2009** **033009**

NAME:_____UIN:_____

I pledge my honor that I have not sought unfair advantage over other students, including, but not limited to giving or receiving unauthorized aid during this exam. _____
signature

(1) Three wood beams, each of cross section (3 in. x 4 in.) are glued together to form a solid beam of dumbbell cross section, as shown. The beam is simply supported with a span of 6 ft. What is the maximum moment M_{max} that may act at the left end of the beam if (a) the allowable shear stress in the glued joints is 200 psi, (b) the allowable shear stress in the wood is 225 psi, and (c) the allowable bending stress in the wood is 1800 psi? Disregard the weight of the beam, and (d) draw the shear force and bending moment diagrams. (60 points)



(2) An element in plane stress is subjected to stresses $\sigma_x = -2,000\text{psi}$, $\sigma_y = -12,000$ psi and $\tau_{xy} = -5,000\sqrt{3}$ psi. (a) Determine the principal directions and stresses and show them on a sketch of a properly oriented element. (b) Determine the maximum shear stresses and the associated normal stresses and show them on a sketch of a properly oriented element. (40 points)

Formulas and Equations

$$\frac{dV}{dx} = -q, \quad \frac{dM}{dx} = V, \quad \sigma = -\frac{My}{I}, \quad \tau = \frac{VQ}{Ib}, \quad f = \frac{VQ}{I}, \quad I_{rectangle} = \frac{1}{12}bh^3$$

$$\sigma(\theta) = \frac{1}{2}(\sigma_x + \sigma_y) + \frac{1}{2}(\sigma_x - \sigma_y)\cos 2\theta + \tau_{xy}\sin 2\theta$$

$$\tau(\theta) = -\frac{1}{2}(\sigma_x - \sigma_y)\sin 2\theta + \tau_{xy}\cos 2\theta$$

$$\tan 2\theta_p = \frac{2\tau_{xy}}{(\sigma_x - \sigma_y)} \qquad \tan 2\theta_s = -\frac{(\sigma_x - \sigma_y)}{2\tau_{xy}}$$