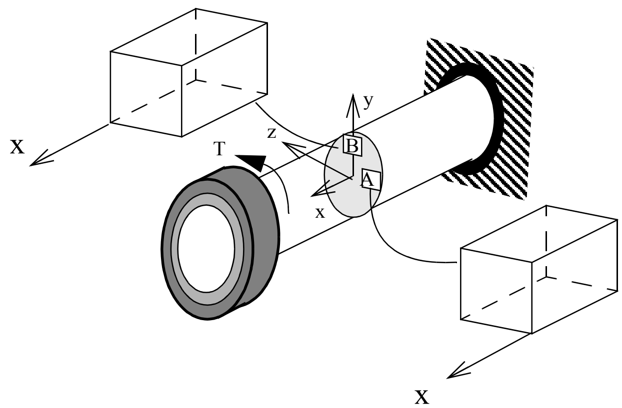
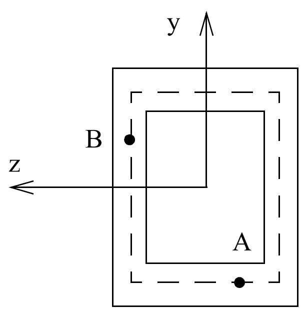
EXAM 2 MEEM 2150 March 31, 2010

1(a) Show the direction of shear stress on the *four relevant* surfaces at points A and B on the given stress cubes.



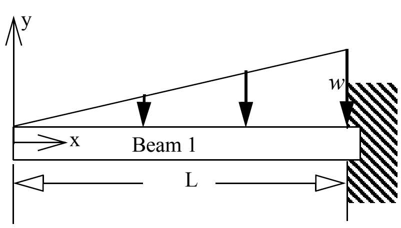
(b) Assuming a *positive* shear force V_y, sketch the direction of the shear flow along the center-line on the thin cross-sections shown. At points A and B, determine whether the stress component is τ_{xy} or τ_{xz} and whether it is positive or negative. Circle the correct answers.

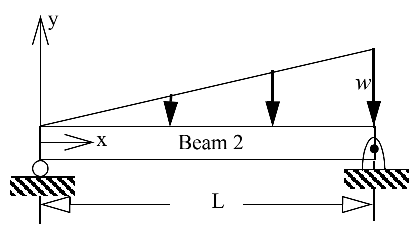


$(\tau_{xy})_A$ or $(\tau_{xz})_A$ +ve or -ve

$(\tau_{xy})_B$ or $(\tau_{xz})_B$ +ve or -ve

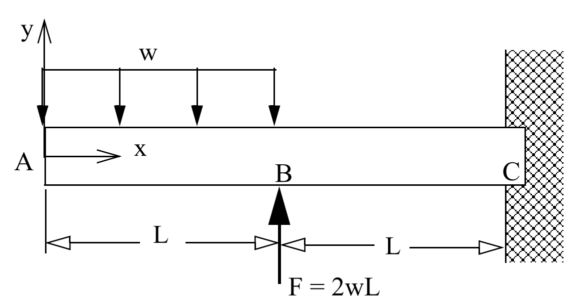
(c) Two beams with loading are shown. Using the given coordinate system, write the boundary conditions necessary to solve for the deflection v(x) of the beam at any point using the 2nd order differential equation.





	Boundary Condition 1	Boundary Condition 2
Beam 1		
Beam 2		

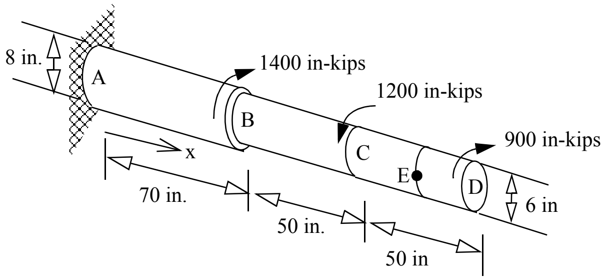
(d) (e) Determine the internal shear force and bending moment as a function of w,L, and x in the interval BC. Use the coordinate system shown.

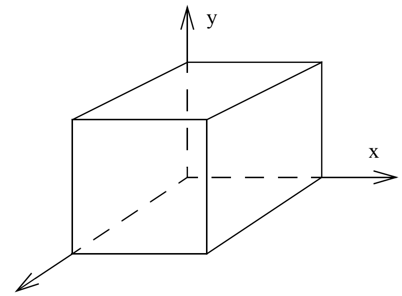


2 A circular steel (G = 12,000 ksi) is subjected to torques shown. Determine:
(a) the rotation of section at D with respect to section at A.

(b) the maximum shear stress in the shaft.

(c) the shear stress at point E and show it on a stress cube. Point E is on the surface of CD.

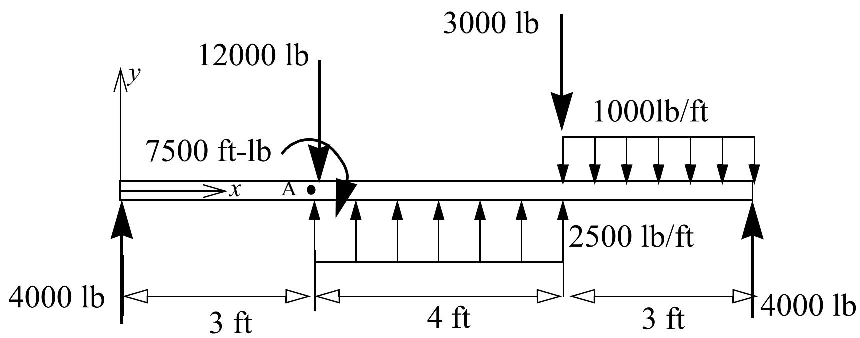


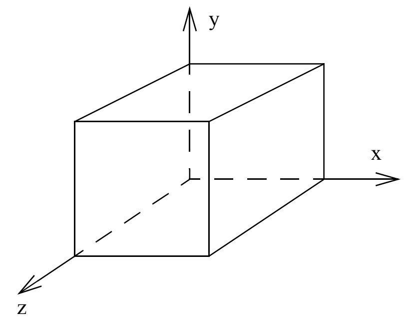


Point E

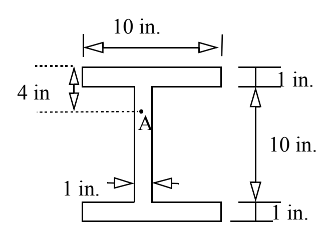
3 (a) Draw the shear force and bending moment diagram for the beam and loading shown. Clearly mark the numerical values and write the nature of the curve (convex, concave, linear).

(b) Determine the bending normal $(\sigma_{xx})_A$ and shear stress $(\tau_{xy})_A$ at point A. Point A is on a cross-section just *left* of the applied force and moment. Show your results on the stress cube.





cross-section



ANSWERS

1. (a) $(\tau_{xy})_A > 0$; $(\tau_{xz})_B > 0$ (b) $(\tau_{xz})_A < 0$; $(\tau_{xy})_B > 0$ (c) Beam 1: $v(L) = 0$; $\frac{dv}{dx}(L) = 0$; Beam 2: $v(0) = 0$; $v(L) = 0$

(d) $\boldsymbol{V}_y = -wL$; (e) $\boldsymbol{M}_z = wLx - \frac{3}{2}wL^2$

2. $\phi_D - \phi_A = 0.0356$ rads ; $\tau_{max} = 21.24$ ksi ; $\tau_E = 21.24$ ksi

3. $(\boldsymbol{V}_y)_{max} = 8000$ lb ; $(\boldsymbol{M}_z)_{max} = 19,500$ ft-lb ; $(\sigma_{xx})_A$ =417.3 psi(C); $(\tau_{xy})_A$ = -379.7 psi