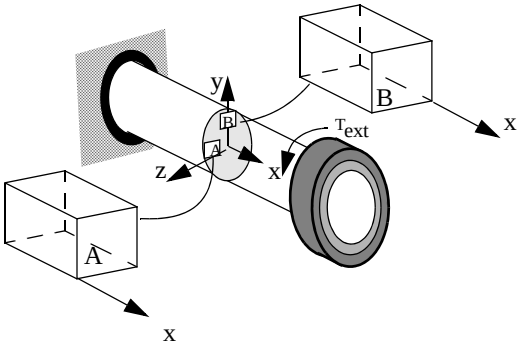
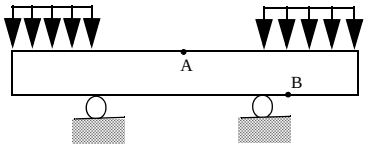
EXAM 2 MEEM 2150 Nov. 13th, 2007

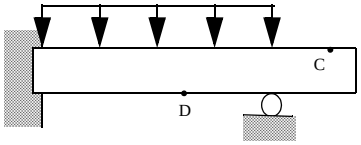
To get **FULL CREDIT** you must draw free body diagram any time you use equilibrium equations to determine forces or moments.

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



(b) By inspection determine whether the bending normal stress at the points shown is in tension, compression or zero. Circle the correct answers.





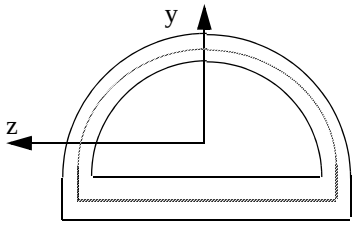
σ_A= Tension / Compression / Zero

σ_B= Tension / Compression / Zero

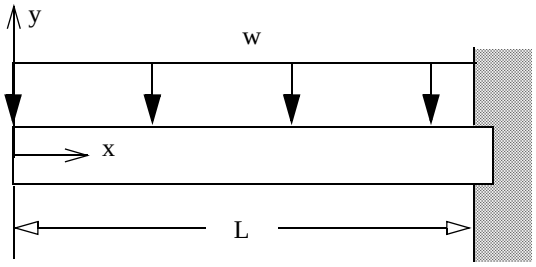
σ_C= Tension / Compression / Zero

σ_D= Tension / Compression / Zero

(c) Sketch the direction of the shear flow along the center-line on the thin cross-sections shown, assuming a positive shear force $\boldsymbol{V_y}$



(d) For the beam and loading shown write the boundary value problem for finding deflection at any point. *Do not integrate or solve*.



(e-j) Circle the correct Answer

(e) Torsional shear *strain* varies linearly across the cross section for a *non-homogenous* material. True / False

(f) Torsional shear *stress* varies linearly across the cross section for a *non-homogenous* material. True / False

(g) Bending normal *strain* varies linearly across the cross section for a *non-homogenous* material. True / False

(h) Bending normal *stress* varies linearly across the cross section for a *non-homogenous* material. True / False

(i) The formula $\tau_{x\theta} = \frac{T\rho}{J}$ can be used for finding shear stress on a cross-section of a tapered shaft. True / False

(j) The formula $\phi_2 - \phi_1 = \frac{T(x_2 - x_1)}{GJ}$ can be used for finding relative rotation of a segment of a tapered shaft.

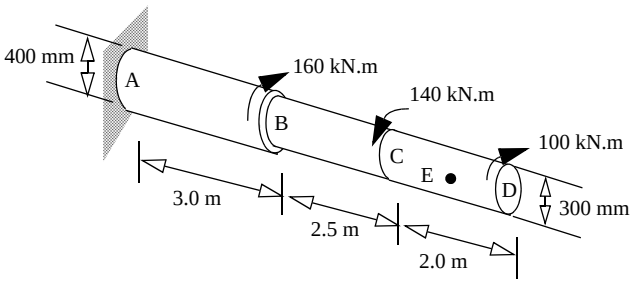
True / False

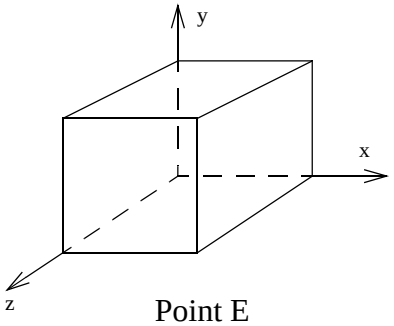
2 (A circular steel (G = 80 GPa) is subjected to torques shown. Determine:

(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.

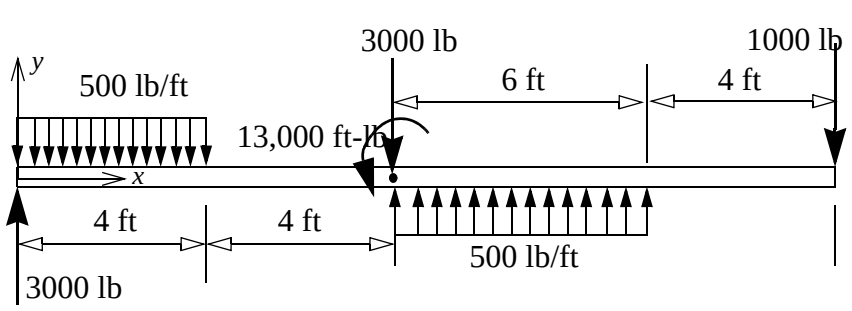


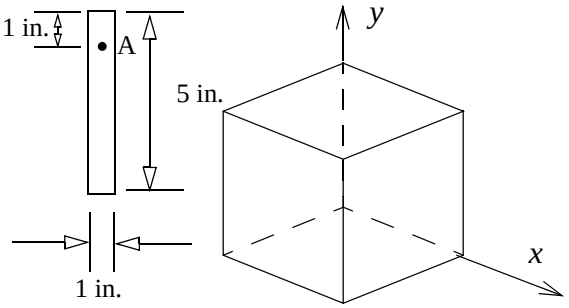


Point E

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) the bending normal $(\sigma_{xx})_A$ and shear stress $(\tau_{xy})_A$ at point A. Point A is on a cross-section 2 feet from the right end. Show your results on the stress cube.





Cross-section

ANSWERS

1. (b) σ_A= Tension; σ_B= Compression; σ_C= Zero; σ_D= Tension

(e) True (f) False (g) True(h) False(i) True(j) False

2. $\phi_D - \phi_A$ = 0.00336 rads CW τ_{max} = 18.86 MPa τ_E = 18.86 MPa

3. $(\sigma_{xx})_A$ = 3456 psi(T) $(\tau_{xy})_A$ = -192 psi