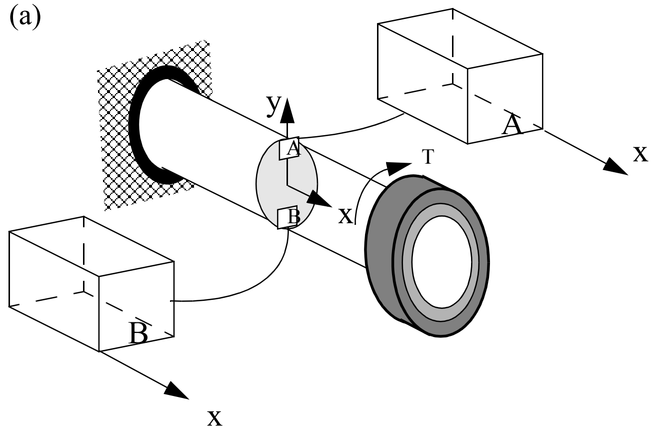
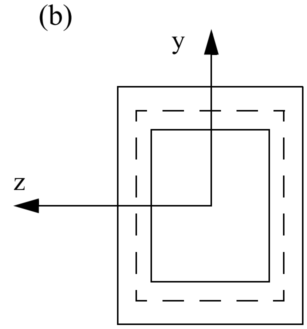
EXAM 2 MEEM 2150 Nov. 12th, 2003

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

(a)

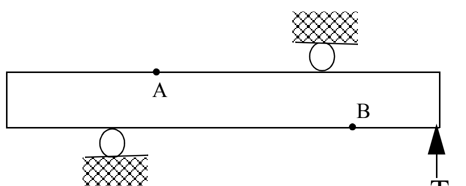


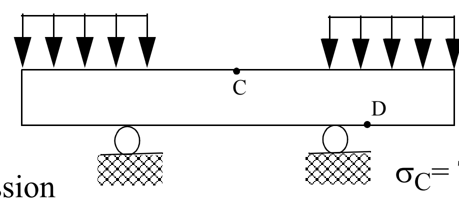
(b)



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

(c) By inspection determine whether the normal stress at the points shown is tension or compression. Circle the correct answers.





σ_A= Tension/Compression

σ_B= Tension/Compression

σ_C= Tension/Compression

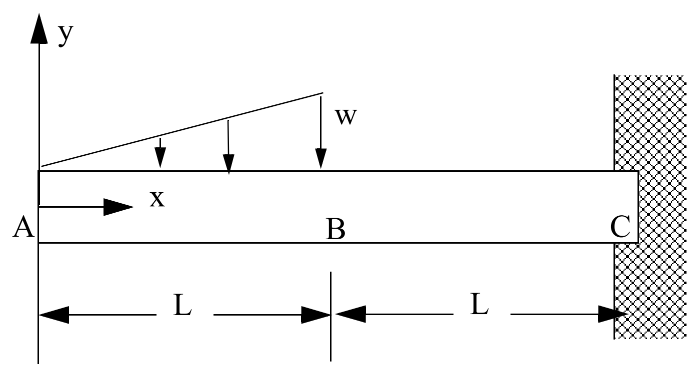
σ_D= Tension/Compression

In (d) and (e) answer circle the correct answer

(d) The equations $\int_A \sigma_{xx} dA = 0$ and $M_z = -\int_A y\sigma_{xx} dA$ *cannot* be used for non-linear materials. True / False

(e) The equation $M_z = -\int_A y\sigma_{xx} dA$ *can* be used for a non-homogenous cross-sections. True / False

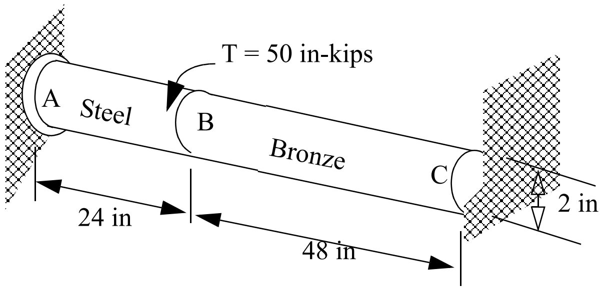
(f) Determine the internal bending moment as a function of w,L, and x in the interval AB. Use the coordinate system shown.



(g) In the beam shown above the internal bending moment in segment BC is: $M_{BC} = \frac{wL}{6}(3x - 2L)$. Assuming EI is a constant, write the boundary value problem for calculating the deflection at any point. Do not integrate or solve for the deflection.

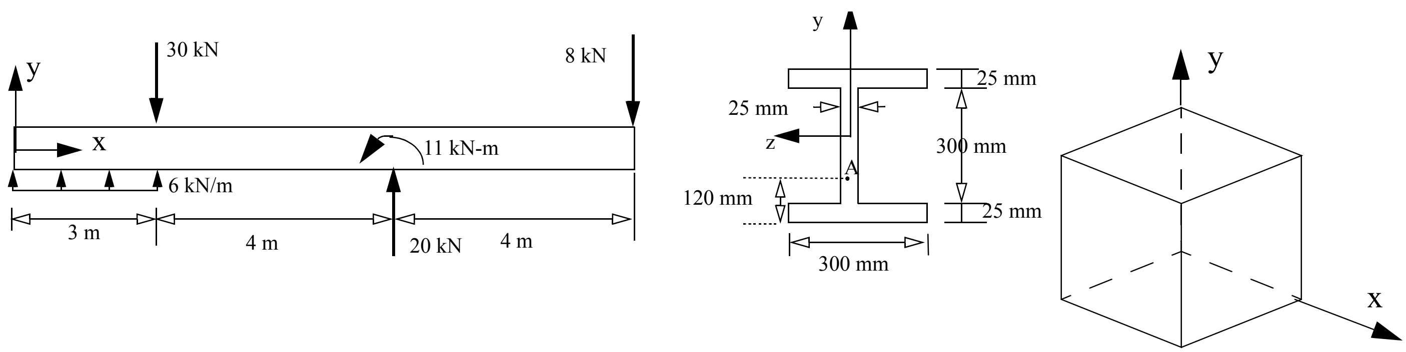
2. A steel (G_s =12,000 ksi) and a bronze (G_{Br} = 5,600 ksi) shaft are securely connected at B as shown. Determine

(a) the maximum torsional shear stress in the shaft (b) rotation of section at B.



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 the cross-section 2 m from the right end. Show your result on a stress cube.



ANSWERS

1c σ_A= Compression σ_B= Tension σ_C= Tension σ_D= Compression

1d=FALSE 1e=TRUE (1f) $M_{AB} = -\left(\frac{wx^3}{6L}\right)$

2. $\tau_{max} = 25.8$ ksi $\phi_B = 0.0516$ rads CCW

3. $(\sigma_{xx})_A$ = 1.94MPa(C) $(\tau_{xy})_A$ = - 1.03MPa