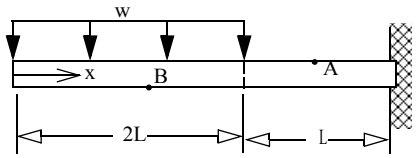
EXAM 2 MEEM 2150 November 12, 2014

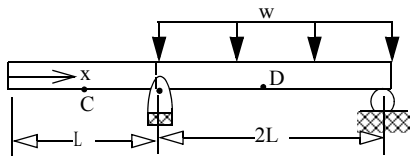
1

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



σ_A= Tension / Compression / Zero

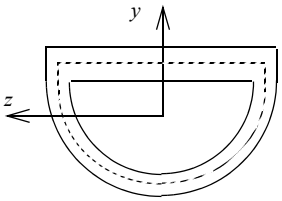
σ_B= Tension / Compression / Zero



σ_C= Tension / Compression / Zero

σ_D= Tension / Compression / Zero

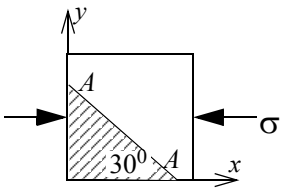
(b) Sketch the direction of the shear flow along the center-line on the thin cross-sections shown, assuming a positive shear force $\boldsymbol{V_y}$

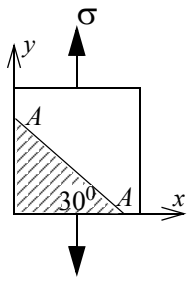


(c) By inspection determine if the normal stress on the incline AA is in tension or compression and the shear stress on the incline AA is positive or negative. Circle the correct answer. Assume coordinate z is perpendicular to this page and towards you.

σ_A is (T) or (C)

τ_A is +ve or -ve





σ_A is (T) or (C)

τ_A is +ve or -ve

In (d-g) **Circle** the correct answer

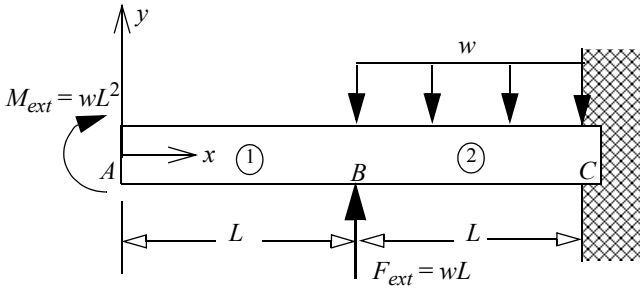
(d) Bending normal *strain* varies linearly across the cross section for a *non-homogeneous* material. True / False

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

(f) The tensile axial force must equal compressive axial force on a cross-section of a beam in pure bending even for non-linear beam material. True / False

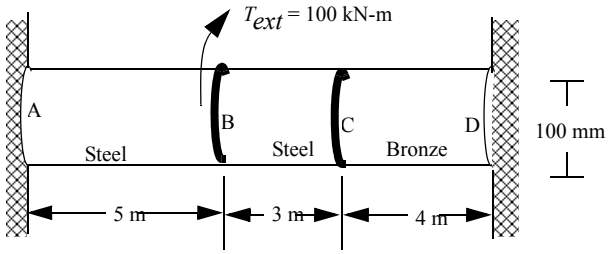
(g) The formula $\sigma_{xx} = -\left(\frac{\boldsymbol{M_z} y}{I_{zz}}\right)$ can be used for finding bending normal stress on a cross-section of a tapered beam. True / False

(h) 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*.

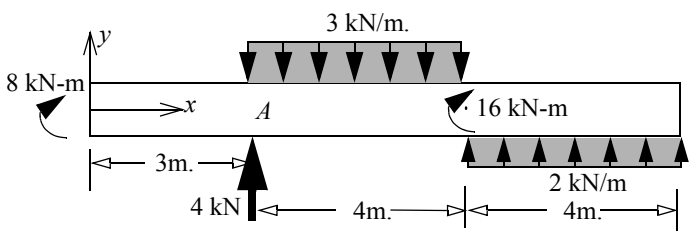


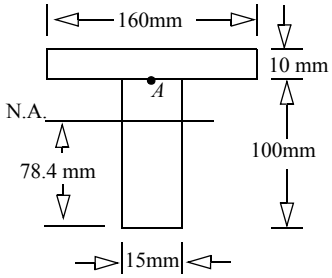
(i) For the beam shown above the internal moment in *AB* was found to be $\boldsymbol{M}_{AB} = wL^2$. Write the boundary value problem (differential equations and all the conditions) for finding deflection at any point. *Do not integrate or solve*.

2 Two solid circular steel shafts and a solid circular bronze are securely connected. The shear modulus of elasticity for steel and bronze are 80 GPa and 40 GPa, respectively. Determine: (a) the angle of rotation of section at B with respect to the wall. (b) the magnitude of maximum torsional shear stress.

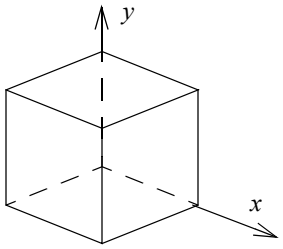


3 (a) Draw the shear force and bending moment diagram for the beam and loading shown. Clearly mark the numerical values and write the nature of the curve (convex, concave, linear). (b) Determine the bending normal stress $(\sigma_{xx})_A$ and shear stress $(\tau_{xy})_A$ at point A. Point A is just below the flange on a cross-section just right of the 4kN force. Show your result on the stress cube given.





Cross Section



Answers 1. (*a*) (T), (C), Zero, (T), (*c*) (C) & positive; (T) and positive. (*d-g*) T,F,T,T (*h*) $V_y = w(x-L) - wL$;

$M_z = wL^2 + wL(x-L) - w(x-L)^2/2$.

2. $\phi_B - \phi_A = 0.437 rads$ CW; $\tau_{max} = 350$ MPa

3. $(\sigma_{xx})_A$ = 47.9 MPa(C) $(\tau_{xy})_A$ = -3.15 MPa