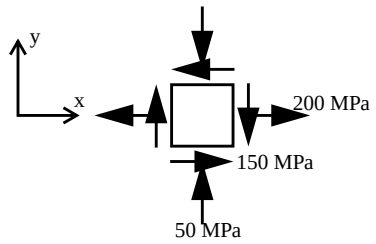
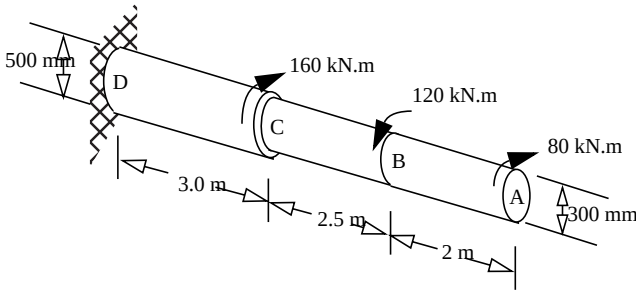
.EM 342 FINAL EXAM May18 1994

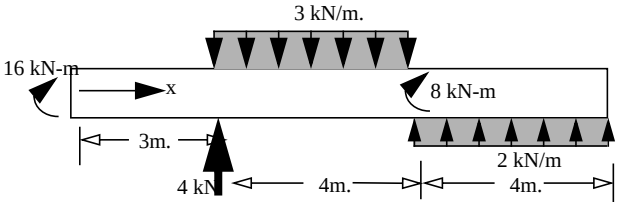
1. On the free surface of a steel member (E = 200 GPa, ν = 0.3) the state of stress shown in the figure exists.
(a) Determine the principal strains and the principal angle. (b) Show your results of part (a) on a properly oriented sketch. (c) Determine the magnitude of maximum shear strain



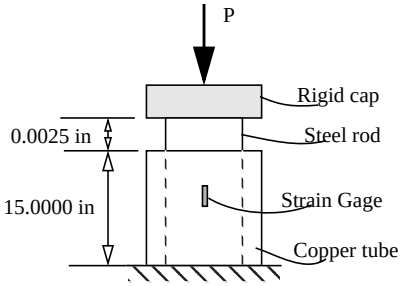
2.A steel shaft (G=80GPa) is subjected to the torques shown below. (a) Determine the maximum torsional shearing stress that occurs in the shaft. (b) Find the rotation (magnitude and direction) of section A with respect to no load position



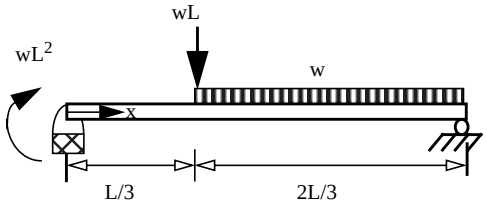
.3. Draw the shear force and bending moment diagram for the beam and loading shown. Clearly mark the numerical values and write the nature of the curve (convex, concave, linear). What is the maximum bending moment and the maximum shear force



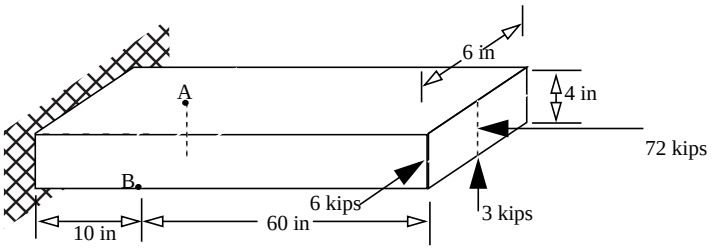
4.A steel rod ($E_s = 30 \times 10^6$ psi) with a cross-sectional area of 2 in^2 and a length of 15.0025 in is loosely inserted into a copper tube, as shown in the figure. The copper tube ($E_c = 17 \times 10^6$ psi) has a cross-sectional area of 3 in^2 and is 15.0000 in long. The strain gage mounted on *steel rod* records a compressive strain of 302×10^{-6} in/in when the axial force P is applied to the rigid cap. Determine the applied force P and the stresses in steel and copper.



5. A beam is loaded as shown. Using the coordinate axis write down all the equations and all the conditions necessary to solve for the elastic curve (displacement at any point on the beam.) in terms of E,I, w and L. DO NOT INTEGRATE OR SOLVE FOR THE INTEGRATION CONSTANTS



6. Determine the normal and shear stresses at points A and B on the section shown.



Answers 1. ε_{p1} = 1531 μ ε_{p2} =-1005.3 μ θ_p = 25.1° γ_{max} = 2537 μ

2. τ_{max} = 15.1 MPa θ_A = 1.677 μ rads cw
3. M_{max} =18.66 kN-m V_{max} = 8 kN-
4. P = 25,020 kips σ_{steel} = 9.06 ksi (C) σ_{copper} = 2.3 ksi (C)
6. σ_A = 14.25 ksi (C) σ_B = 375 psi (T) τ_B = 0