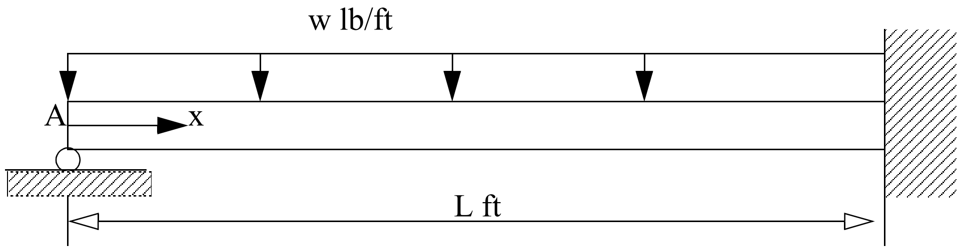
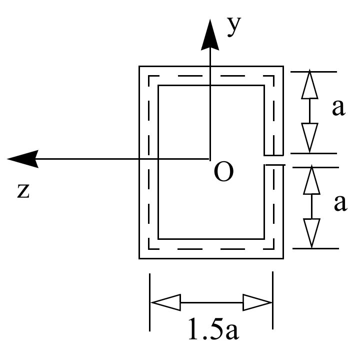
Final MEEM 4150 Dec. 18th, 2000

1. Using <u>energy methods</u> find the reaction force at A and the slope of the beam at A in terms of E, I, w, and L.

R_A = ------------------ $\left(\frac{dv}{dx}\right)_A$ =---------------------



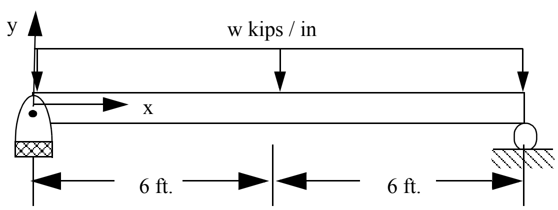
2. A thin walled open cross-section with a uniform thickness ‘t’ is shown. Determine the coordinates of the shear center e_y and e_z with respect to the origin at O.

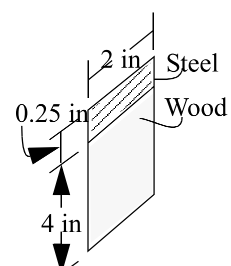


e_y = -------------------

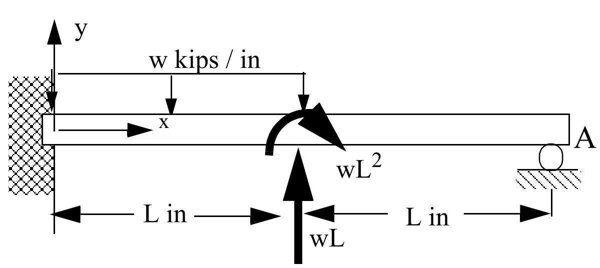
e_z = ------------------

3. A wooden rod (E_W = 2000 ksi) and steel strip (E_s = 30,000 ksi) are fastened securely to rigid plates as shown. Determine the maximum intensity of the load w, if the allowable bending normal stresses in steel and wood are 20 ksi, and 4 ksi.respectively.

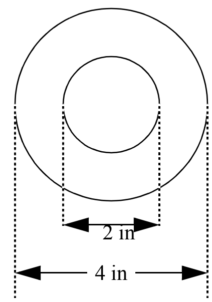




4. (a) Using Discontinuity Functions write the fourth order diffrential equation and the four boundary conditions. DO NOT INTEGRATE or SOLVE.



(b) The torsional shear stress for a hollow shaft made from a non-linear material was found to be $\tau = 10\rho^{0.25}$ ksi . Determine the equivalent internal torque.



T = -----------------

(c,d,e) The principal stresses at a point were found to be σ_1= 40 ksi (T), σ_2= 10 ksi (T), σ_3= 20 ksi (C).

(c) Determine the second stress invariant at the point. I_2= -----------------------

(d) Determine the equivalent von-Mises stress at the point. σ_{von} = ---------------------------

(e) The critical stress intensity factor for the material is $22\text{ksi}\sqrt{\text{in}}$, what would be the critical crack length at that point.

Crack length = -----------

ANSWERS

1. $R_A = \frac{3}{8}wl$ $\left(\frac{dv}{dx}\right)_A = \frac{wL^3}{48EI}$

2. $e_y = 0$ $e_z = 1.73$ a

3. w=11.9 lbs/in

4. (b) T = 164.5 in-kips

(c) I_2= -600 ksi^2.

(d) σ_{von} = 51.96 ksi

(e) Crack length = 0.193 in