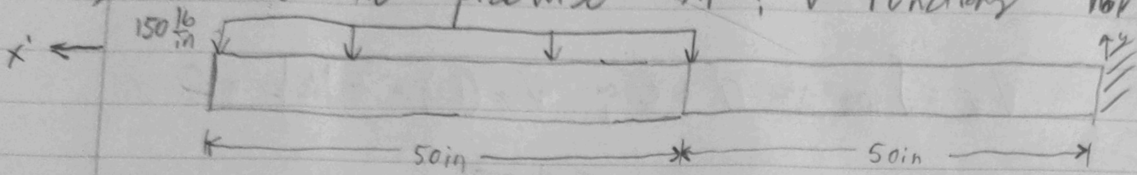
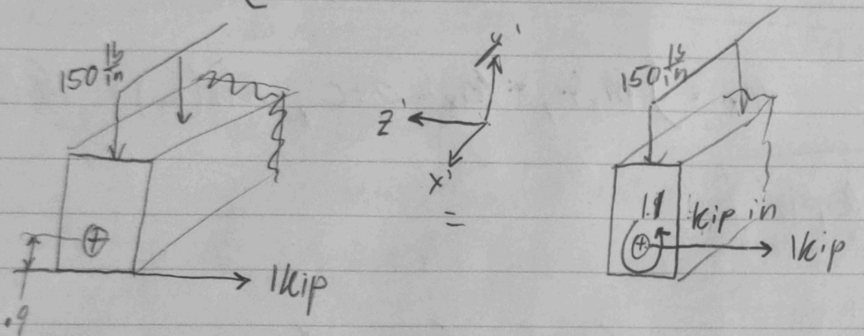
HW5

a & b) are in Matlab, I wrote a function which computes these values.

c) Solve the piecewise M & V functions for



$$p_y = \begin{cases} -150 \frac{lb}{in}, & x \geq 50 \\ 0, & x < 50 \end{cases}, \quad p_z = 0, \quad p_x = 0$$



$m_y = 0$, $m_x = 0$, $m_z = 0$

d) $P_x(L) = 0$, $V_y(L) = 0$, $V_z(L) = -1kip$, $M_x(L) = 1.1 kip in$, $M_y(L) = 0$, $M_z(L) = 0$

$P_x' = -p_x$; $P_x = 0 + C$, $P_x(L) = 0 = C$, $\boxed{P_x = 0}$

$$V_y' = -p_y, \quad V_y = \int \begin{cases} 150 \frac{lb}{in}, & x \geq 50 \\ 0, & x < 50 \end{cases} = \begin{cases} C_1 + 150 \frac{lb}{in} x, & x \geq 50 \\ C_2, & x < 50 \end{cases}$$

$V_y(L) = 0 = C_1 + 150 L = C_1 = -150L$, $V_y(\frac{L}{2}) = 150 \frac{lb}{in}(x - L) = -150 \frac{lb}{in} \frac{L}{2}$

$V_y(\frac{L}{2}) = -150 \frac{lb}{in} \frac{L}{2} = C_2$, $C_2 = -150 \frac{lb}{in} \frac{L}{2}$

HW5

$$\boxed{V_y(x) = \begin{cases} 150(x-L), & x \geq 50 \\ -75L, & x < 50 \end{cases}}$$

$V_z' = p_z$, $V_z = \int p_z = 0 + C$, $V_z(L) = -1kip = C$

$$\boxed{V_z(x) = -1kip}$$

$M_x' = m_x = 0$, $M_x = \int m_x$, $M_x = 0 + C$, $M_x(L) = .9 \, kipin = C$

$$\boxed{M_x(x) = 1.9 \, kipin}$$

$M_y' = -m_y + V_z$, $M_y = -\int m_y + \int V_z = -\int 1kip = -x \, kip + C$

$M_y(L) = 0 = -L \, kip + C$, $C = +L \, kip$

$$\boxed{M_y = (L-x) \, kip}$$

$M_z' = -m_z - V_y = \begin{cases} 150(L-x), & x \geq 50 \\ 75L, & x < 50 \end{cases}$

$$M_z = \int \begin{cases} 150(L-x), & x \geq 50 \\ 75L, & x < 50 \end{cases} = \boxed{\begin{cases} 150Lx - 75x^2 + C_1, & x \geq 50 \\ 75Lx + C_2, & x < 50 \end{cases}}$$

$M_z(L) = 0 = 150L^2 - 75L^2 + C_1 = 75L^2 + C_1$, $C_1 = -75L^2$

HW5

$$M_z\left(\frac{L}{2}\right) = \cancel{75L^2} - 75\frac{L^2}{4} - \cancel{75L^2} = \frac{75}{2}L^2 + C_2$$

$$-75\left(\frac{L^2}{4}+\frac{L^2}{2}\right) = C_2 = -\frac{3}{4}75L^2 = -\frac{225}{4}L^2$$

$$\boxed{M_z = \begin{cases} 150Lx - 75x^2 - 75L^2, & x \geq 50 \\ 75Lx - \frac{225}{4}L^2, & x < 50 \end{cases}}$$

e) $$\varepsilon_{xx} = \frac{P+P^T}{E_1 A^*} - \frac{M_z - M_z^T}{E_1 I_{zz}^*}y + \frac{M_y + M_y^T}{E_1 I_{yy}^*}z$$

$$\sigma_{xx} = E\varepsilon_{xx} - E\alpha\Delta T$$

$$E(y) = \begin{cases} 30e6\,psi, & y < -2in \\ 10e6\,psi, & y \geq -2in \end{cases}, \quad \alpha(y) = \begin{cases} 6.5e{-6}, & y < -2in \\ 13e{-6}, & y \geq -2in \end{cases}$$

$$P^T = \int_A E\alpha\Delta T\,dA, \quad M_y^T = \int_A E\alpha\Delta T z\,dA, \quad M_z^T = \int_A E\alpha\Delta T y\,dA$$

$$P^T = E_1\alpha_1\int_{A_1}\Delta T\,dA_1 + E_2\alpha_2\int_{A_2}\Delta T\,dA_2, \qquad \int_{A_1}\Delta T\,dA_1 = 1.5\int_{-1}^{1.9}\Delta T\,dy$$

$$M_y^T = E_1\alpha_1\int_{A_1}\Delta T z\,dA_1 + E_2\alpha_2\int_{A_2}\Delta T z\,dA_2, \qquad \int_{A_2}\Delta T\,dA_1 = 1.5\int_{-11}^{-1}\Delta T\,dy$$

$$M_z^T = E_1\alpha_1\int_{A_1}\Delta T y\,dA_1 + E_2\alpha_2\int_{A_2}\Delta T y\,dA_2,$$

if $\Delta T = 0$ $\quad P^T = M_y^T = M_z^T = 0$

if $\Delta T = 10y^2 + y^3$ °F

P^T, M_y^T, M_z^T come out as constants, which I have calculated in Matlab

$$u_0' = \frac{P + P^T}{E_1 A^*}, \quad v_0'' = \frac{(M_z - M_z^T) I_{yy}^* + (M_y + M_y^T) I_{yz}^*}{E_1 \left(I_{yy}^* I_{zz}^* - I_{yz}^{*2} \right)}$$

$$w_0'' = \frac{(M_y + M_y^T) I_{zz}^* + (M_z - M_z^T) I_{yz}^*}{E_1 \left(I_{yy}^* I_{zz}^* - I_{yz}^{*2} \right)}$$