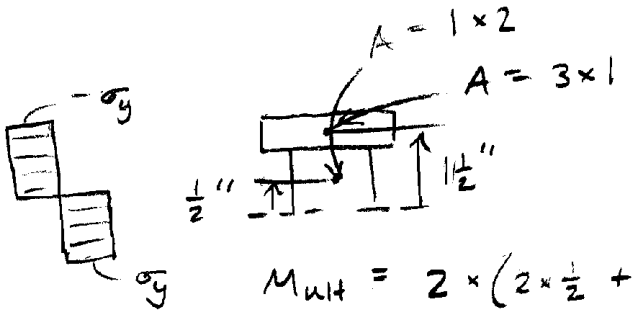
4.42 : see last week, problem 4.39

4.89 : (4.90) see 4.76

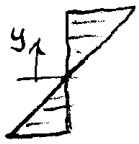
ULTIMATE LOAD :



$$M_{ult} = 2 \times \left(2 \times \tfrac{1}{2} + 3 \times 1\tfrac{1}{2}\right) \sigma_Y$$

$$= 462 \text{ k-in}$$

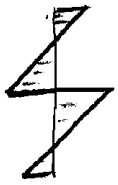
UNLOADING :



$$\Delta\sigma = \frac{-M \cdot y}{I} = \frac{M_{ULT} \cdot y}{I}$$

$$I = \frac{4^3 \cdot 3 - 2^3 \cdot 1}{12} = 15.33$$

RESIDUAL :

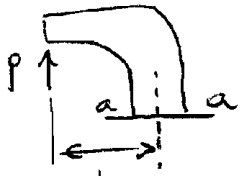


@ $y = 1"$ $\sigma_{res} = -\sigma_y + \Delta\sigma$

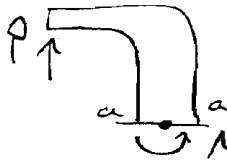
$$= -42 + \frac{462 \cdot 1"}{I} = -11.9 \text{ ksi}$$

@ $y = 2"$ $\sigma_{res} = +18.3$ ksi

4.102 : (4.103)



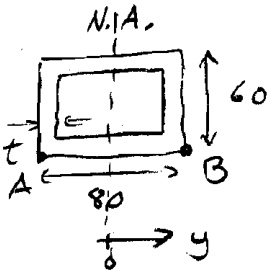
$200 + \frac{80}{2} = 240$ mm



$M = P \times 240$ mm

$\downarrow P = 20$ kN

BENDING



$$B: \sigma_b = \frac{-M \cdot (40\text{mm})}{I} = -104.3 \text{ MPa}$$

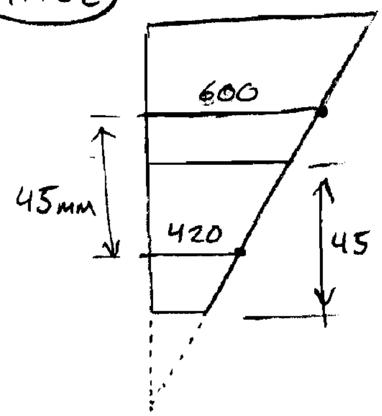
$$A: \sigma_b = \frac{-M(-40\text{mm})}{I} = 104.3 \text{ MPa}$$

$$I = \frac{60 \cdot 80^3 - 40 \cdot 60^3}{12}$$

Axial: B & A: $\sigma_a = \frac{P}{A} = \frac{20\text{kN}}{60 \times 80 - 40 \times 60} = 8.33$ MPa

(a) $\sigma_A = 112.7$ MPa (b) $\sigma_B = -96$ MPa.

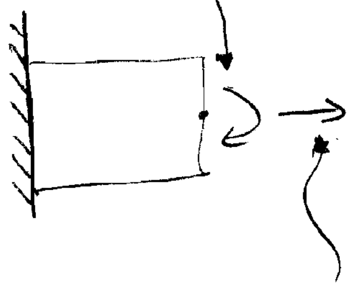
4.121 : (4.122)



$K = \frac{-\varepsilon}{y}$ $\quad K = -\frac{\Delta \varepsilon}{\Delta y} = \frac{-(600-420)}{45\,mm} = -4\,\frac{\mu}{mm}$

$M = EI \cdot K = (200\,GPa)\left(\frac{25 \cdot 40^3}{12}\right) \cdot \left(-4\,\frac{\mu}{mm}\right) =$

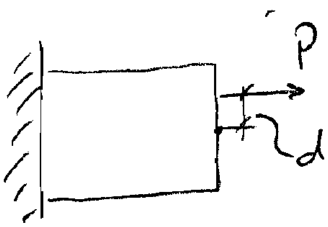
$M = (200{,}000)(I)(-4 \times 10^{-6}) = -1{,}215{,}000\ N \cdot mm$



$\varepsilon_{centroid} = \frac{2}{3}(600-420) + 420 = 540\,\mu$

$P = E \cdot \varepsilon_{centroid} \cdot Area$

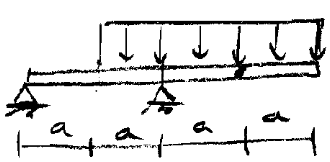
$P = (200{,}000)(540 \times 10^{-6})(25 \times 90) = 243{,}000\ N$



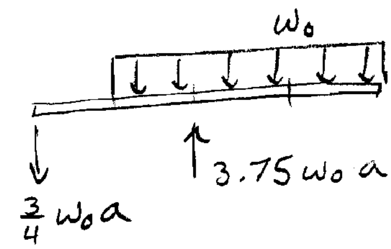
$P \cdot d = M$

$d = M/P = 5\,mm$

5.101 : (5.100)
5.98 :



$\Rightarrow$



$w(x) = -w_0 \cdot \langle x-a \rangle^0$

$V(x) - V(0) = \int_0^x -w_0 \langle x-a \rangle^0\, dx + 3.75\, w_0 \cdot a \langle x-2a \rangle^0$

$\quad \hookrightarrow -\frac{3}{4} w_0 \cdot a \qquad \hookrightarrow -w_0 \langle x-a \rangle^1$

$V(x) = -w_0 \langle x-a \rangle + 3.75\, w_0 \cdot a \langle x-2a \rangle^0 - \frac{3}{4} w_0 \cdot a$

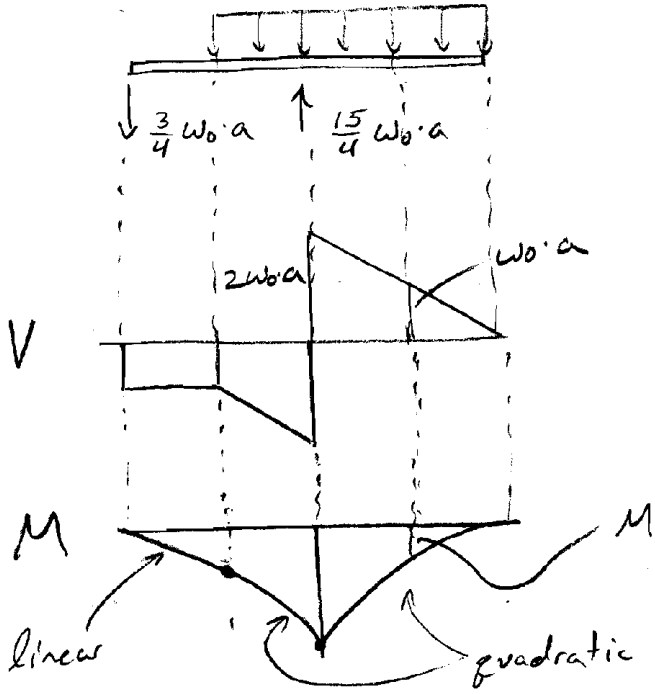
$M(x) - \cancel{M(0)}^{\,0} = \int_0^x -w_0 \langle x-a \rangle + 3.75\, w_0 \cdot a \langle x-2a \rangle^0 - \frac{3}{4} w_0 \cdot a \ \ dx$

$M(x) = -w_0 \langle x-a \rangle^2 \cdot \frac{1}{2} + 3.75\, w_0 \cdot a \langle x-2a \rangle - \frac{3}{4} w_0 \cdot a \cdot x$

$M @ E = M(3a) = -w_0 \langle 2a \rangle^2 \cdot \frac{1}{2} + 3.75\, w_0 \cdot a \langle a \rangle - \frac{3}{4} \cdot w_0 \cdot a(3a)$

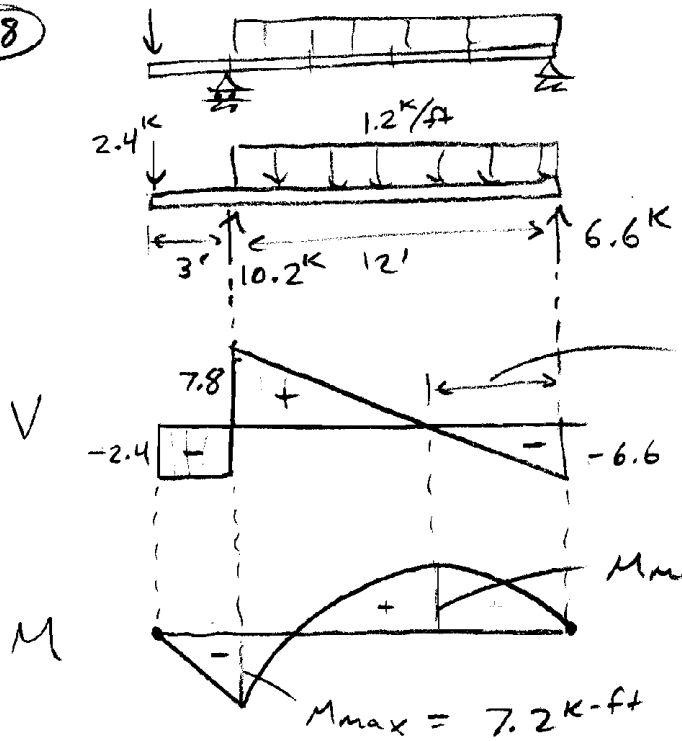
$= -2 w_0 a^2 + 3.75 w_0 a^2 - \frac{9}{4} w_0 a^2 = \mp \frac{1}{2} w_0 a^2$

5.100 check by graphical method



$$M = \frac{1}{2} \cdot w_0 \cdot a \cdot a = \frac{w_0 a^2}{2}$$

5.57 (5.58)



$-6.6 + 1.2 \cdot d = 0, \quad d = 5.5'$

$M_{max} = \frac{1}{2}(6.6^K)(5.5') = 18.15^{K\text{-}ft}$

$M_{max} = 7.2^{K\text{-}ft}$

⊖ ⇒ Find S

$$\sigma_{max} = \frac{M}{S}$$