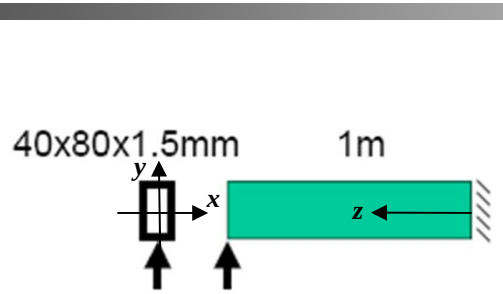
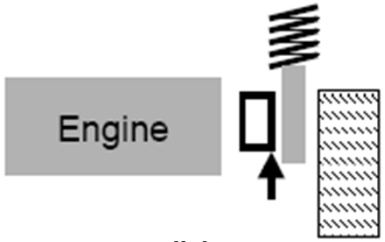
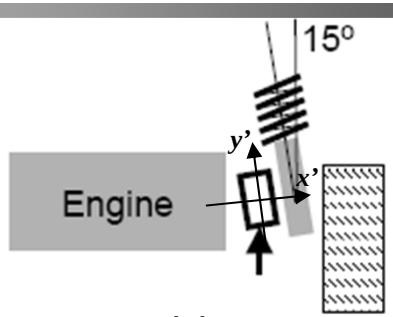
3.2 Motor Compartment Rail (1)



(a)

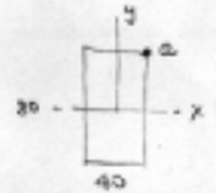


(b)



(c)

a) $I = t h^2 \left(\frac{3b+h}{6}\right)$ approximation from 0.2b



$I_{xx} = (1.5)\,80^2\left[\frac{3\cdot 40+80}{6}\right] = 32\times10^4\ mm^4$

$\delta = \frac{Fl^3}{3EI} = \frac{(2000N)(1000)^3}{3\cdot 207000\cdot 32\cdot 10^4} = 10.06\ mm\ up$

$\sigma_a = \frac{Mc}{I}$ $M = 2000N\,(1000mm)$ $c = \frac{80}{2}\ mm$

$\sigma_a = \frac{(2000)\,1000(40)}{32\cdot 10^4} = 250\ \frac{N}{mm^2}$ compression

in addition to bending as in a) beam also twists

Torque $T = 2000N\cdot\frac{40}{2}mm = 4\times10^4\ N\,mm$

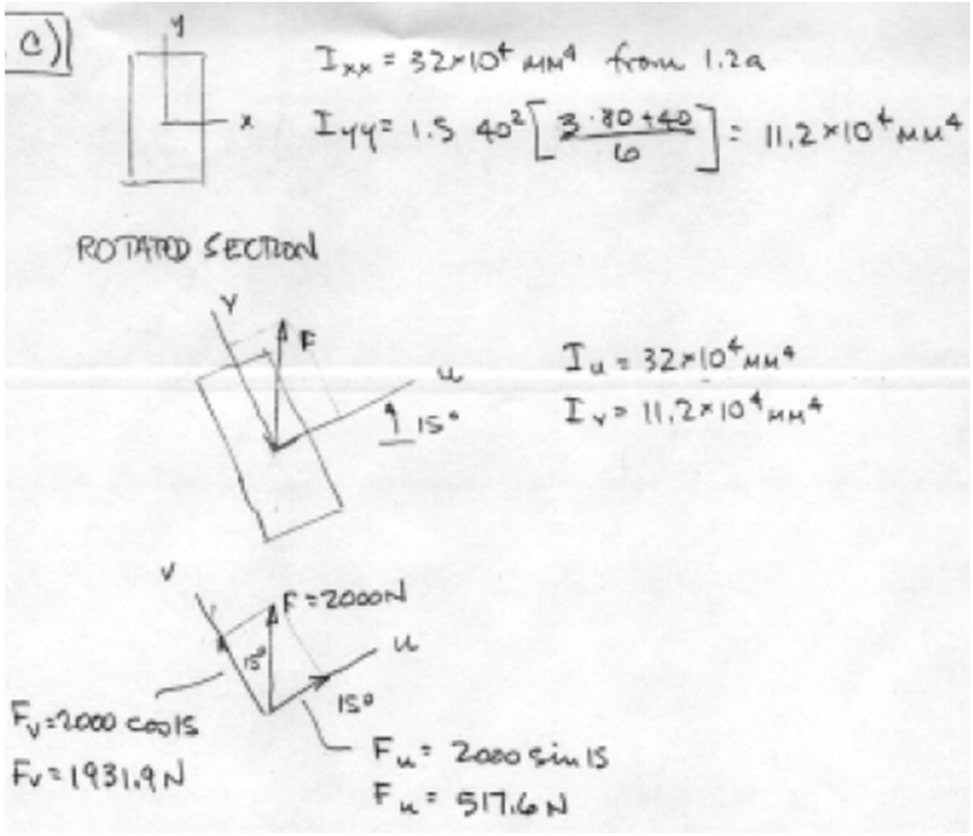
twist $\theta = \frac{TL}{4GA^2}\left(\frac{P}{t}\right)$ where P is perimeter of section

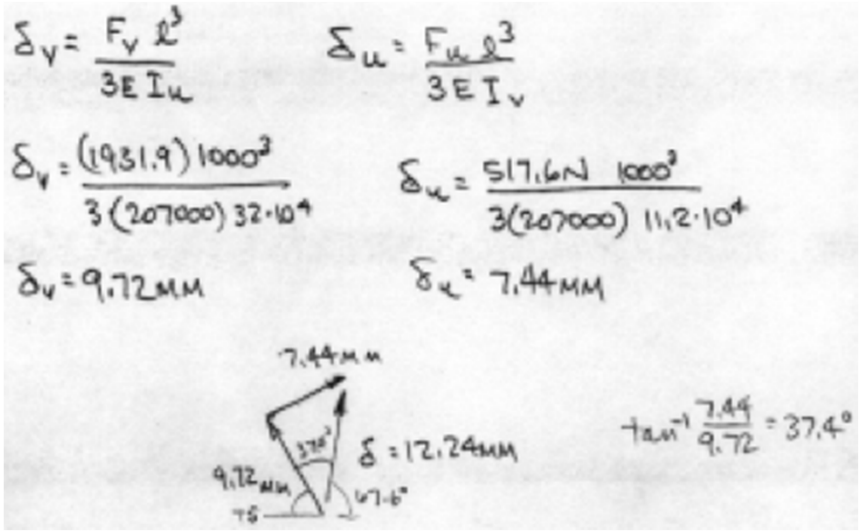
$\theta = \frac{(4\cdot10^4\ N\,mm)(1000\ mm)}{4\left(79600\frac{N}{mm^2}\right)(40\cdot80\ mm^2)^2}\ \frac{(40+40+80+80)_{mm}}{1.5mm}$

$\theta = .002\ RAD \sim .1145°$

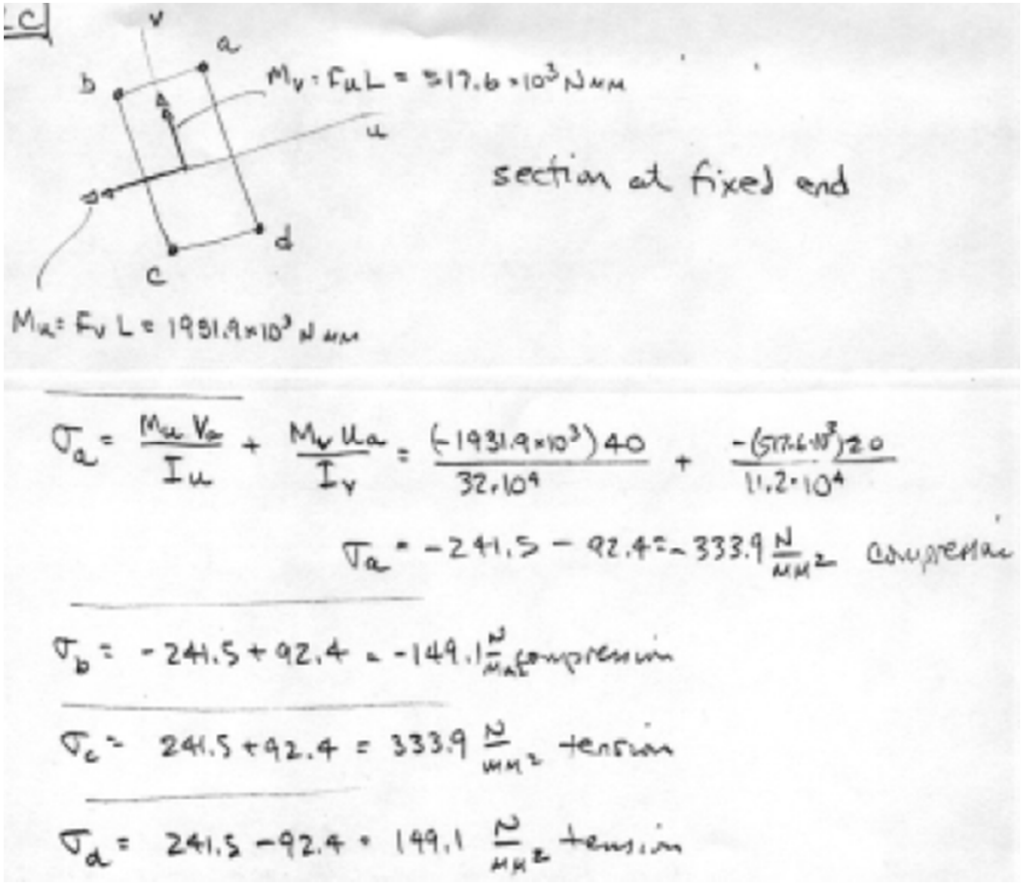
in addition to upward motion from part a), end of beam will also rotate .002 RAD counter clockwise (direct stress is same)

3.2 Motor Compartment Rail (2)





3.2 Motor Compartment Rail (3)



$M_v = F_u L = 517.6 \times 10^3$ N mm

$M_u = F_v L = 1931.9 \times 10^3$ N mm

$$\sigma_a = \frac{M_u V_a}{I_u} + \frac{M_v u_a}{I_v} = \frac{(-1931.9 \times 10^3)\,40}{32 \cdot 10^4} + \frac{-(517.6 \cdot 10^3)\,20}{11.2 \cdot 10^4}$$

$\sigma_a = -241.5 - 92.4 = -333.9 \frac{N}{mm^2}$ compression

$\sigma_b = -241.5 + 92.4 = -149.1 \frac{N}{mm^2}$ compression

$\sigma_c = 241.5 + 92.4 = 333.9 \frac{N}{mm^2}$ tension

$\sigma_d = 241.5 - 92.4 = 149.1 \frac{N}{mm^2}$ tension