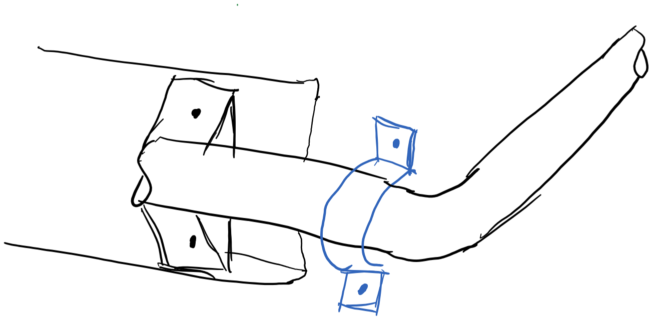
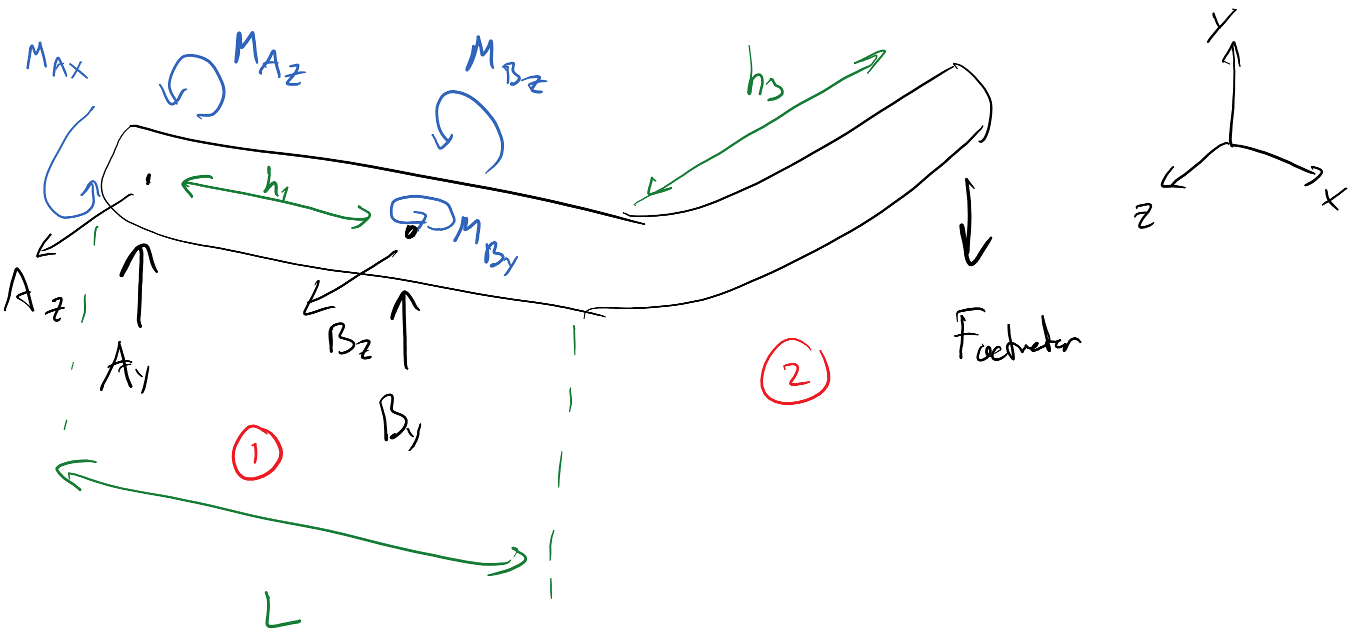
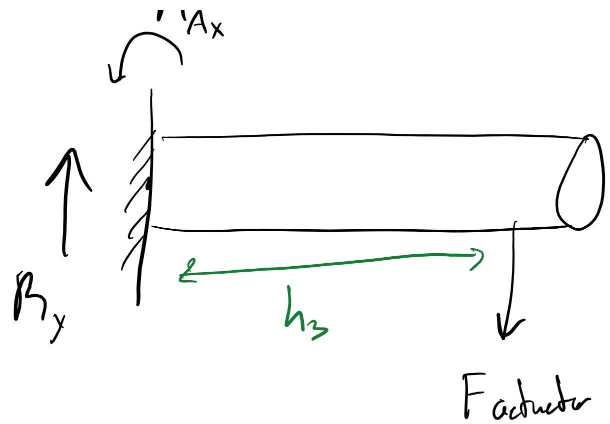
C-Frame Tube thickness

Wednesday, October 23, 2019 9:23 AM



Static load case: weight of actuator





let $B_y = B_y + A_y$

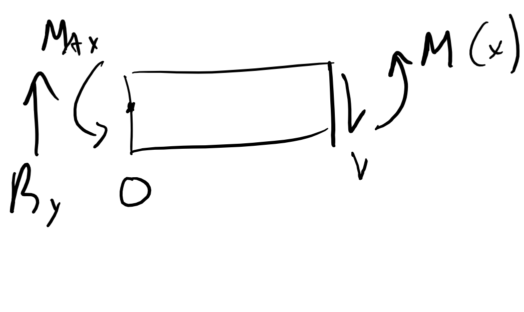
$$\sum F_y = 0 = B_y - F_{act}$$

$$B_y = F_{act}$$

$$\sum M = 0 = M_{A_x} - h_3 F_{act}$$

$$M_{A_x} = h_3 F_{act}$$

$$0 < x < h_3$$



$$\uparrow \sum F_y = B_y - V = 0 \rightarrow V = B_y$$

$$\circlearrowleft^{+} \quad \sum M_O = M_{Ax} + M(x) - Vx = 0$$

$$M(x) = Vx - M_{Ax}$$

$$M(x) = F_{act}(x - h_3)$$

$$= -h_3 F_{act} + F_{act}\, x$$

Moment of Inertia for tube along longitudinal axis

$$I = \frac{\pi}{4}\left(R_2^{\,4} - R_1^{\,4}\right), \qquad R_2 > R_1$$

Flexure formula, assuming linearly elastic material

$$\sigma_{max} = \frac{M_{max}}{S_{allow}}$$

$$S = \frac{I}{c} = \frac{I}{R_2}$$

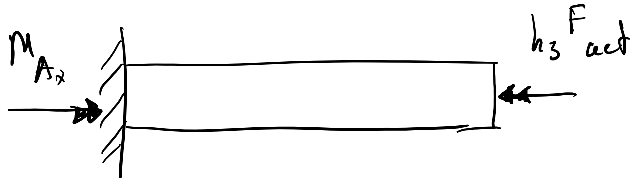
$$\sigma_{max} = \frac{R_2 M_{max}}{I}$$

$$\sigma_{max} = \frac{4 R_2 M_{max}}{\pi \left(R_2^4 - R_1^4 \right)}$$

Maximum shear stress in beam with hollow circular cross-section, assuming shear stress at neutral axis are parallel to y-axis & uniformly distributed across section.

$$\tau_{max} = \frac{VQ}{Ib} = \frac{4V}{3A}\left(\frac{r_2^2 + r_2 r_1 + r_1^2}{r_2^2 + r_1^2}\right) \qquad (5\text{-}44)$$

Section I



pure torsion

Torsion formula, assuming linear elastic material in pure torsion

$$\tau_{max} = \frac{T_{max}\, r}{I_p}$$

$$\tau_{max} = \frac{M_{Ax}\, r_2}{\frac{\pi}{2}\left(R_2^4 - R_1^4\right)}$$