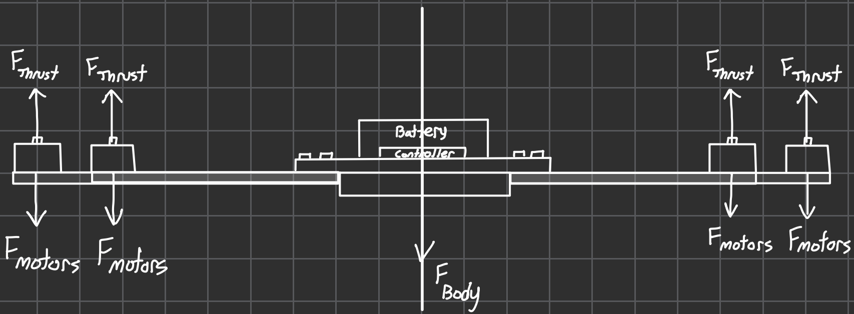
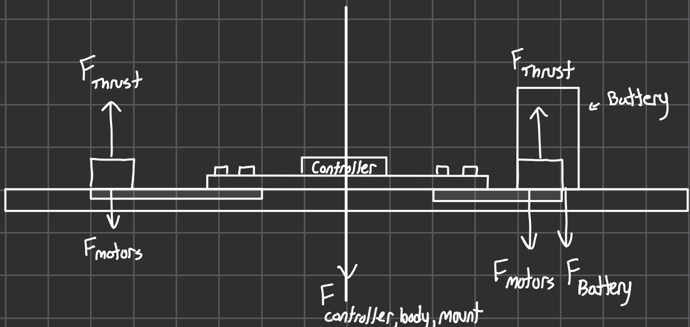




Estimated weight

Arms 1 : 0.045 kg (x2)
Arms 2 : 0.046 kg (x2)
Motors : 0.046 kg (x4)
Propellers : 0.015 kg (x4)
Body : 0.612 kg
Tie downs : 0.035 kg (x2)
Wing Mount : 0.171 kg
Controller : 0.011 kg
Battery : 0.270 kg

Total Weight ≅ 1.56 kg

Weights

$$F_{arms_1} = 0.045\ kg \cdot 9.81\ m/s^2 = 0.441\ N$$

$$F_{arms_2} = 0.046\ kg \cdot 9.81\ m/s^2 = 0.451\ N$$

$$F_{Tie\ downs} = 0.035\ kg \cdot 9.81\ m/s^2 = 0.343\ N$$

$$F_{Body} = (0.612 + 0.171 + 0.011 + 0.270)\ kg \cdot 9.81\ m/s^2 = 10.438\ N$$

$$F_{motors} = (0.046 + 0.015)\ kg \cdot 9.81\ m/s^2 = 0.598\ N$$

$$F_{weight} = 2 \cdot F_{arms_1} + 2 \cdot F_{arms_2} + F_{body} + 4 \cdot F_{motors} \cdot 2 \cdot F_{Tie\ downs} = 13.506\ N$$

Thrust

$$F_{Thrust_{Max}} = 958\ \text{gram-Force} = 9394.77\ mN = 9.395\ N$$

1 gram-Force = 9.80665 mN

$$F_{net_{max}} = (4 \cdot F_{Thrust_{Max}}) - F_{weight} = 24.074\ N$$

(Net force available for motors)

∴ Max Payload ≈ 2.454 kg (@ MAX THRUST) ≈ 5.410 lbs

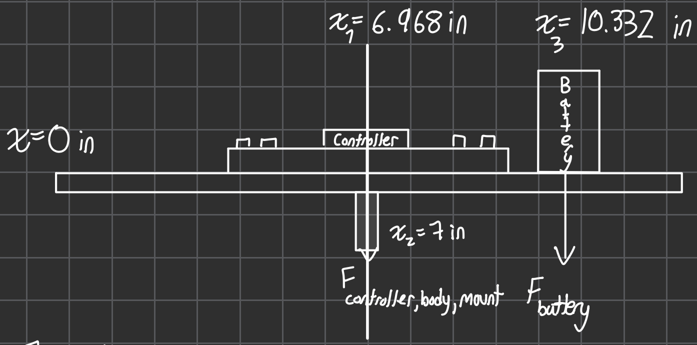
(AT MAX THRUST)

$F_{net} = 4t - 13.506$ (Net force wrt Thrust)

$\text{Max payload} = \frac{F_{net}}{9.81} = 0.408t - 1.377$ (Max payload wrt thrust)

Finding the center of mass (body) (NOT RIGHT)

* ASSUMING F_{weight} OF CONTROLLER, BATTERY & MOUNT ARE POINT FORCES *



$$x_{cm} = \frac{\sum m_i \vec{r}_i}{M}$$

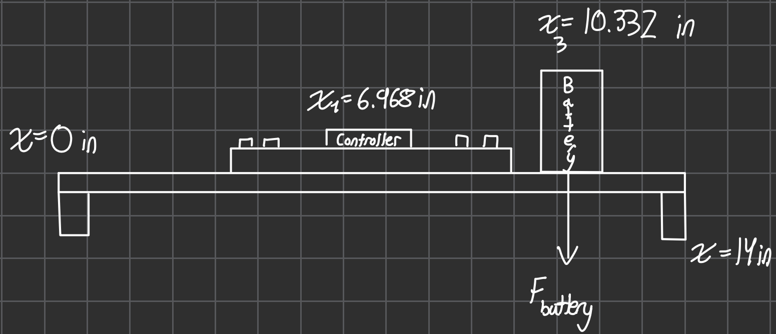
$$7.664 = \frac{(0.612 \cdot 7) + (0.035 \cdot 7) + 0.035x + (0.011 \cdot 6.968) + (0.270 \cdot 10.332) + (0.171 \cdot 6.820)}{1.134}$$

$$8.691 = 8.562 + 0.035x$$

$x = 3.686$ [in] (Location of 2nd tie down to make center of mass to allign w/ center of moments)

THIS IS W/O PAYLOAD

Aligning Center of Mass to Center of Moments



Center of Moments: 7.664 in (Needs to = Center of Mass)

$$x_{cm} = \frac{\sum m_i \vec{r}_i}{M}$$

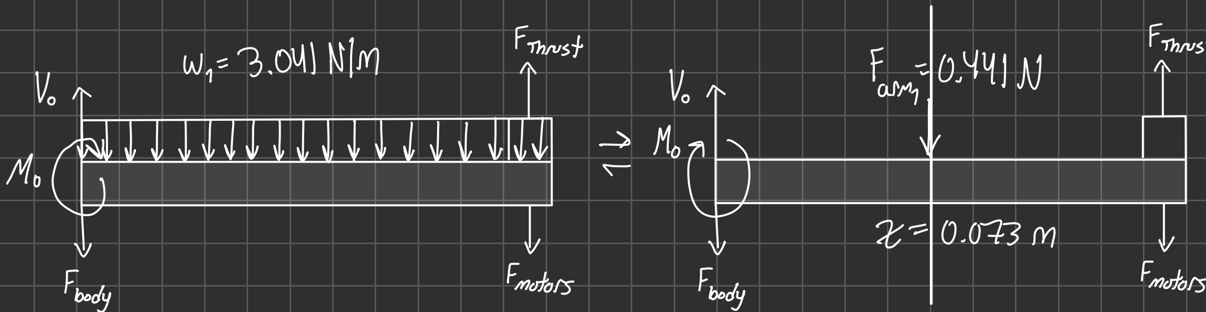
$$7.664 = \frac{\underset{\text{Body}}{(0.612 \cdot 7)} + \underset{\text{Tie Mount}}{(0.035 \cdot 14)} + \underset{\text{Controller}}{(0.011 \cdot 6.968)} + \underset{\text{Battery}}{(0.27 \cdot 10.332)} + \underset{\text{Wing Mount}}{(0.171 \cdot 6.82)} + \underset{\text{Payload}}{(2.454x)}}{3.588}$$

$$27.498 = 8.807 + 2.454x$$

$x = 7.617$ in (Location of payload to have center of mass = center of moments)

Calculating Moments & Shears of Arms

Arm 1:



$L = 0.145$ m $\quad F_{arm_1} = 0.441$ N $\quad w_1 = 3.041$ N/m

$R = 0.441$ N @ 0.073 m

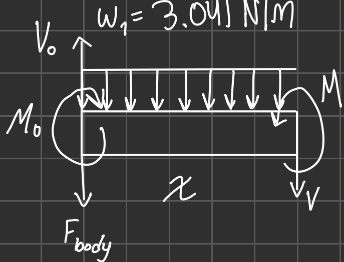
$$\Sigma F_y = V_0 - F_{body} - F_{arm_1} - F_{motors} + F_{Thrust} = 0$$

$$V_0 - 35.198 - 0.441 - 0.598 + 9.395 = 0$$

$$V_0 - 26.842 \quad \therefore V_0 = 26.842 \text{ [N]}$$

$$\Sigma M_{x=0} = -M_0 - 0.441(0.073) - 0.598(0.127) + 9.395(0.127) = 0$$

$$-M_0 + 1.085 = 0 \quad \therefore M_0 = 1.085 \text{ [N·m]}$$



$$\Sigma F_y = V_0 - w_1 x - F_{body} - V = 0$$

$$26.842 - 3.041x - 35.198 - V = 0$$

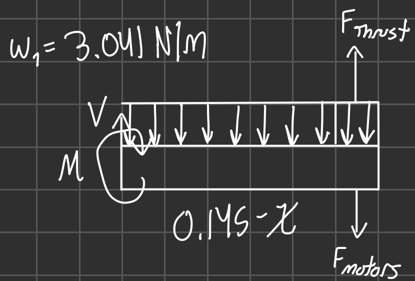
$$V = -3.041x - 8.356 \text{ [N] } (0 < x < 0.073)$$

$$\Sigma M_{x=0} = -M_0 - 3.041x\left(\frac{x}{2}\right) - Vx + M = 0$$

$$-1.085 - 1.521x^2 + 3.041x^2 + 8.356x + M = 0$$

$$1.52x^2 + 8.356x - 1.085 + M = 0$$

$$M = -1.52x^2 - 8.356x + 1.085 \text{ [N} \cdot \text{m] } (0 < x < 0.073)$$



$$\Sigma F_y = V - 3.041(0.145 - x) - F_{motors} + F_{Thrust} = 0$$

$$V - 0.441 + 3.041x - 0.598 + 9.395 = 0$$

$$V + 3.041x + 8.356 = 0 \quad \therefore V = -3.041x - 8.356 \text{ [N] } (0.073 < x < 0.145)$$

$$\Sigma M_{x=0.073} = -M - \left((0.441 - 3.041x)(0.073 - 0.5x)\right) - 0.598(0.127 - x) + 9.395(0.127 - x) = 0$$

$$-M-(0.032-0.221x-0.222x+1.571x^2)-0.076+0.598x$$
$$+1.193-9.395x=0$$

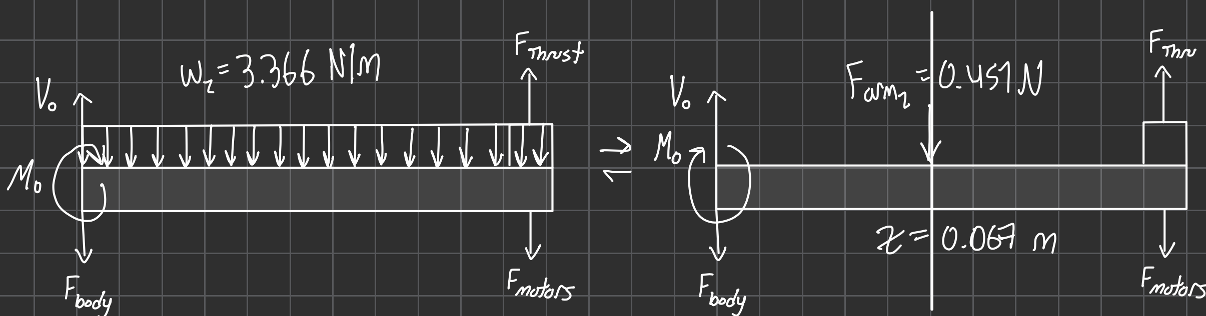
$$-M-(1.571x^2-0.443x+0.032)+1.117-8.797x=0$$

$$-M-1.571x^2+0.443x-0.032+1.117-8.797x=0$$

$$-M+1.085-8.354x-1.571x^2=0$$

$$M=-1.571x^2-8.354x+1.085\ (N\cdot m) \qquad (0.073<x<0.145)$$

Arm 2:



$L=0.134\ m \quad F_{arm_2}=0.451\ N \quad W_1=3.366\ N/m$

$R=0.451\ N$ @ $0.067\ m$

$$\Sigma F_y = V_0 - F_{body} - F_{arm_2} - F_{motors} + F_{thrust} = 0$$

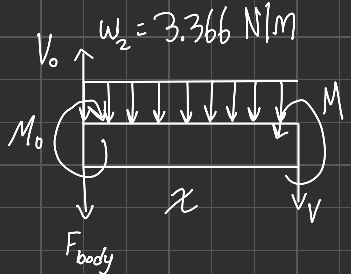
$$V_0 - 35.198 - 0.451 - 0.598 + 9.395 = 0$$

$$V_0 - 26.852 = 0 \quad \therefore V_0 = 26.852\ [N]$$

$$\sum M_{x=0} = -M_0 - 0.451(0.067) - 0.598(0.117) + 9.395(0.117) = 0$$

$$-M_0 - 0.03 - 0.07 + 1.099 = 0$$

$$-M_0 + 0.999 = 0 \quad \therefore M_0 = 0.999\ [N \cdot m]$$



$$\sum F_y = 26.852 - 35.198 - 3.366x - V = 0$$

$$-8.346 - 3.366x - V = 0 \quad \therefore V = -3.366x - 8.346\ [N]$$

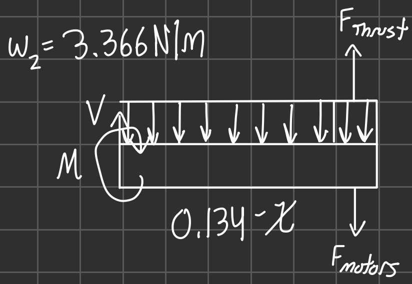
$$(0 < x < 0.067)$$

$$\sum M_{x=0} = -0.999 - 3.366x\left(\frac{x}{2}\right) - Vx + M = 0$$

$$-0.999 - 1.683x^2 + 3.366x^2 + 8.346x + M = 0$$

$$1.683x^2 + 8.346x - 0.999 + M = 0$$

$$\therefore M = -1.683x^2 - 8.346x + 0.999\ [N \cdot m] \quad (0 < x < 0.067)$$



$$\Sigma F_y = V - 3.366(0.134 - x) - 0.598 + 9.395 = 0$$

$$V - 0.451 + 3.366x - 0.598 + 9.395 = 0$$

$$V + 3.366x + 8.346 = 0$$

$$V = -3.366x - 8.346 \text{ [N]} \quad (0.067 < x < 0.134)$$

$$\Sigma M_{x=0.067} = -M - ((0.451 - 3.366x)(0.067 - 0.5x)) - 0.598(0.117 - x) + 9.395(0.117 - x) = 0$$

$$-M - (0.03 - 0.226x - 0.226x + 1.683x^2) - 0.07 + 0.598x + 1.099 - 9.395x = 0$$

$$-M - (1.683x^2 - 0.452x + 0.03) + 1.029 - 8.797x = 0$$

$$-M - 1.683x^2 + 0.452x - 0.03 + 1.029 - 8.797x = 0$$

$$\therefore M = -1.683x^2 - 8.345x + 0.999 \text{ [N·m]} \quad (0.067 < x < 0.134)$$