Assumed Values:

Quantity	Value	Units
Strength	3.78	ksi
Thrust per motor	10	lbs
Dist. to 1st Motor	12	in
Dist. to 2nd Motor	30	in

Moment of Inertia of a square about its diagonal:

$$I_x = I_y = \frac{a^4}{12}$$

https://byjus.com/jee/moment-of-inertia-of-a-square/

Flexure Formula:

$$\sigma = -\frac{My}{I}$$

http://www.engineeringcorecourses.com/solidmechanics1/C4-bending/C4.2-flexure-formula/theory/

Solution Steps:

$$M = 10[lb] * 12[in] + 10[lb] * 30[in] = 420[in * lb_f]$$

$$y = \sqrt{2} * a$$

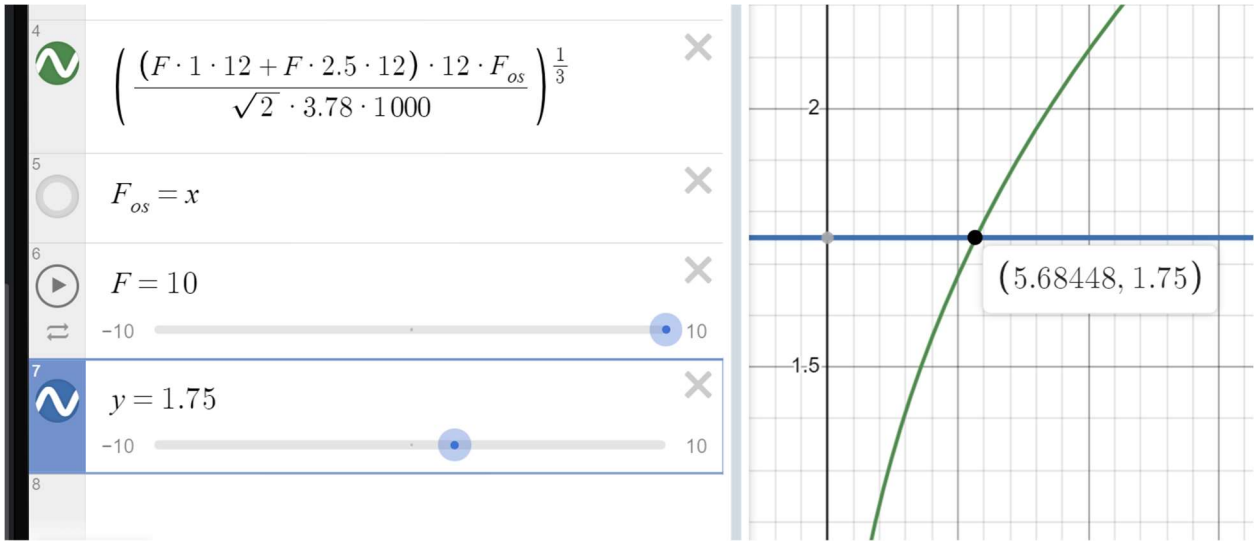
$$a = \sqrt[3]{\frac{12 * M * F_{os}}{\sqrt{2} * \sigma}}\ [in] = 0.9806 * \sqrt[3]{F_{os}}\ [in]$$

$$F_{os} = \left(\frac{a}{0.9806}\right)^3$$

F_os of common square dowel sizes (referenced from Lowes website)

Square edge length [in]	F_os
0.7500	0.4475
1.0000	1.0607
1.2500	2.0716
1.7500	5.6845
2.0000	8.4853

Choice: 1.25in (which is currently out of stock, will likely end up using 1.75)


4
$\left(\frac{(F \cdot 1 \cdot 12 + F \cdot 2.5 \cdot 12) \cdot 12 \cdot F_{os}}{\sqrt{2} \cdot 3.78 \cdot 1000}\right)^{\frac{1}{3}}$
5
$F_{os} = x$
6
$F = 10$
−10
10
7
$y = 1.75$
−10
10
8
2
1.5
(5.68448, 1.75)

4

$$\left(\frac{(F \cdot 1 \cdot 12 + F \cdot 2.5 \cdot 12) \cdot 12}{\sqrt{2} \cdot 3.78 \cdot 1000} \right)^{\frac{1}{3}} \cdot F_{os}^{\frac{1}{3}}$$

$$= 0.980560917811$$

5

$$F_{os} = 1$$

−10 10

6

$$F = 10$$

−10 10

7

$$y = 1.75$$

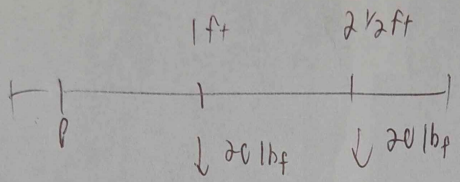
−10 10

8

$$\left(\frac{1.75}{0.980560917811} \right)^{3}$$

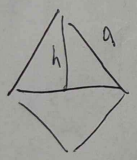
$$= 5.68447560813$$

9



$$M_p = 20 + 50\,lb_f = 70\,ft \cdot lb_f = 840\,in \cdot lb_f$$

$$\sigma = \frac{M_y}{I} = 0.3\,ksi \quad \frac{lb}{in^2}$$



$$I = \frac{M_y}{\sigma} = \frac{840\,[in \cdot lb_f]}{0.3\,[klb/in^2]} \cdot h$$

$$a = h\sqrt{2}$$

$$h = \frac{a}{\sqrt{2}}$$

$$I_x = I_y = \frac{a^4}{12} \quad a \quad \frac{a^4}{12} \cdot \left(\frac{\sqrt{2}}{a}\right) = \frac{840}{0.3 \cdot 1000}\,[in^3]$$

$$a = \sqrt[3]{\frac{840 \cdot 12}{\sqrt{2} \cdot 0.3 \cdot 1000}}\,[in]$$