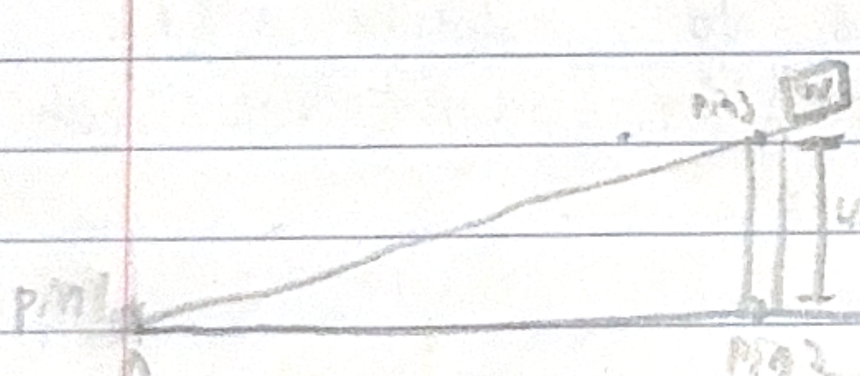
Portfolio 2

a. The objective is to lift the maximum amount of weight to the highest possible height given only one bar, three pins (two of which must be mounted to the ground), and a linear actuator from the supplies online catalog. This must be done within a 150 cm X 50 cm space. The actuator moves linearly up, and the bar is free to rotate in the xy plane

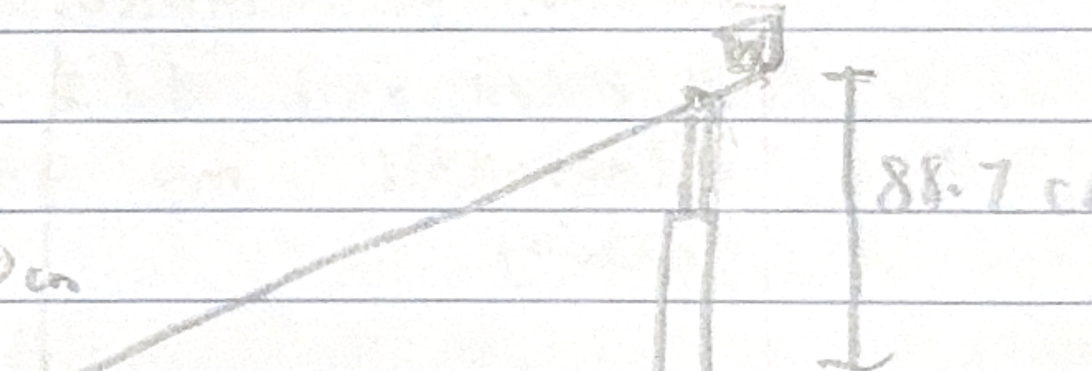
b. I used the IMA-33 Actuator with 37.4 cm of stroke and a max thrust of 4.67 kN. I used this information to sum the Moments about the pivot and find the max load the mechanism could lift. $\sum M_A = 0 = 1.45\,m(4.67\times10^3\,N) - 1.5\,m(W)$ $W = 4514\,N$ a mass of 460 Kg. This initial position is the limiting case, as while the actuator lifts the payload the mechanism allows weight increase over its range of motion.

c

Initial



Full extension



Portfolio continues...

Step 2: I'll model the bar as a cantilever loaded at its tip. The max deflection for this setup is

$\delta = \frac{WL^3}{3EI}$ $\delta_{max} = 0.02L = 0.0316\ m$

I'll use steel for the material,

so $E = 200 \times 10^9\ Pa$ $0.0316\ m = \frac{(4514\ N)(1.58\ m)^3}{3(200\times10^9\ Pa)I}$

I_z $9.39 \times 10^{-7}\ m^4$ or $9.39 \times 10^5\ mm^4$

I'll use a C130 X 10.4 channel with an I_x of $3.11 \times 10^6\ mm^4$ and an Area of $1270\ mm^2$ $\delta = \frac{(4514\ N)(1.58\ m)^3}{3(200\times10^9)(3.11\times10^{-6}\ m^4)}$

$= 0.00954\ m \rightarrow 9.54\ mm$, below deflection limit of 31.6 mm with a density of 7860 kg/m^3 the mass of the total beam is 15.8 kg

Max Bending moment at the tip is

$M = wL = 4514\ N \cdot 1.58\ M = 7132.12\ N \cdot m$

$\sigma = \frac{Mc}{I}$ $c = 65\ mm$ $\sigma = \frac{7132.12 \cdot 0.065}{3.11\times10^{-6}} = 149\ MPa$

Steel has a yield strength of 250 MPa

$\frac{250}{149} = 1.68$ which is a reasonable factor of safety for this scale.

C130 x 10.4