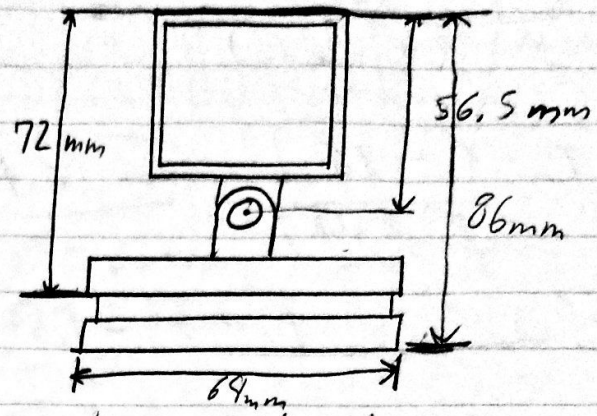
Modules Analysis

Analysis

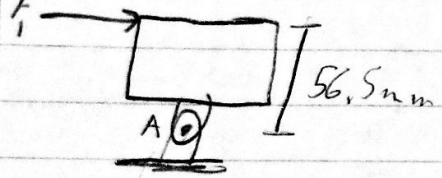
- Moment on hinge under 5.5G load
- Power needed to move tightened hinge (adjust camera)



★ For all three modules, these hinge calculations are the same, as they are all compatible with the same camera holder. ★

Calculations

FBD



$m = 74g = 0.074kg$

$a = 5.5g$

$F_1 = (0.074kg)(5.5 - 9.81 m/s^2)$

$F_1 = 3.99N$

$\Sigma M_A = 0$

$\Sigma M_A = 3.99N \cdot 56.5mm = 225.435 N \cdot mm$

$M_A = 2.25 N.m$

This is the max moment needed before hinge slips.

Power to rotate hinge

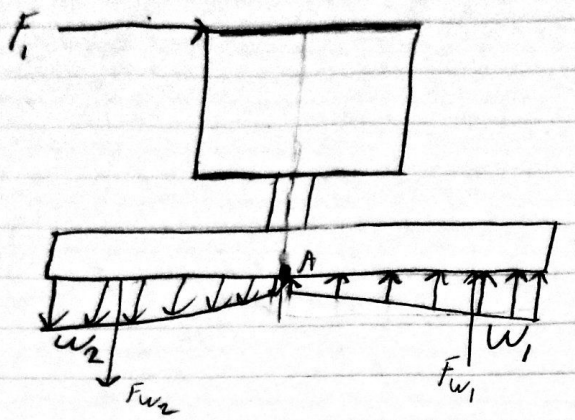
We need to adjust the camera 90° ($\frac{\pi}{2}$ rad) in 1 sec. So,

$P = T\omega$

$= 2.25 N.m \cdot \frac{\pi}{2} rad/sec.$

$P = 3.53 W$

Module #1



W_1 = foam pushing up
W_2 = foam pulling down
$W_1 = W_2$
$F_1 = 3.99N$

$M_1 = F_{W_1}(21,333)$
$M_2 = F_{W_2}(21,333)$

$M_1 = M_2$

$\Sigma M_A = 0$

$\Sigma M_A = M_1 + M_2 - F_1(72mm) = 0$

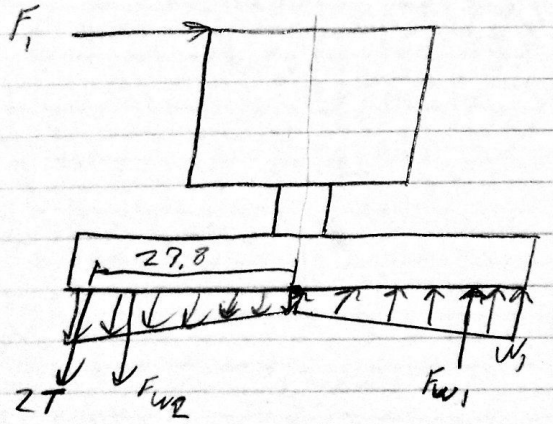
$M_1 + M_2 = F_1(72mm)$

$M_1 + M_2 = 3.99(72mm)$

$M_1 + M_2 = 287.28$

$\boxed{M_1 = M_2 = 143.64 N \cdot m}$

Module #2



W_1 = Foam pushing up
W_2 = Foam pulling down
$W_1 = W_2$
$F_1 = 3.99N$

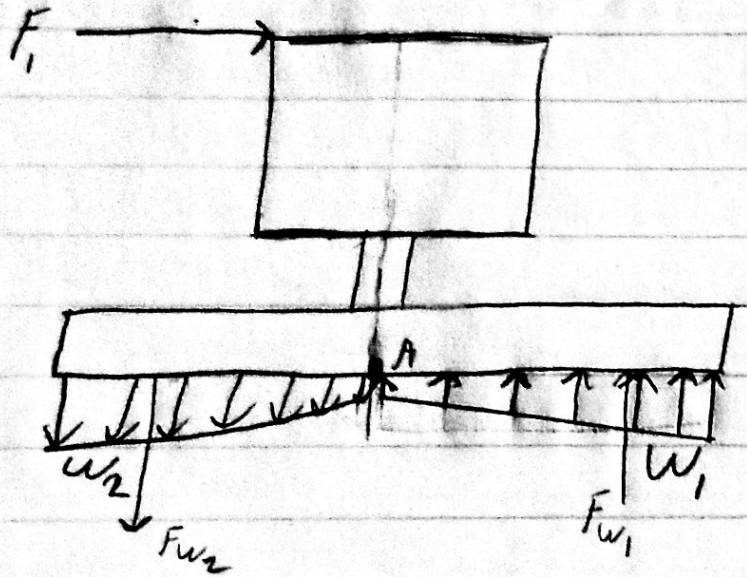
$M_1 = F_{W_1}(21,333)$
$M_2 = F_{W_2}(21,333)$

$\Sigma M_A = 2T(27.8mm) + M_1 + M_2 - F_1(50mm) = 0$

↳ cannot solve until materials are selected

→ $F = kx$ ← use for the force/deflection relationship of foam.

Module #3



W_1 = foam pushing up
W_2 = foam pulling down
$W_1 = W_2$
$F_1 = 3.99N$

$M_1 = F_{W_1}(21.333)$
$M_2 = F_{W_2}(21.333)$

$M_1 = M_2$

$\Sigma M_A = 0$

$\Sigma M_A = M_1 + M_2 - F_1(72mm) = 0$

$M_1 + M_2 = F_1(72mm)$

$M_1 + M_2 = 3.99(72mm)$

$M_1 + M_2 = 287.28$

$\boxed{M_1 = M_2 = 143.64 N\cdot mm}$