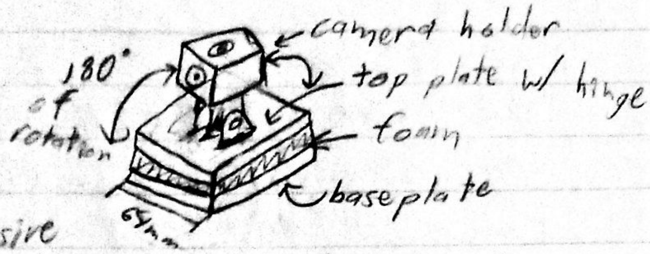
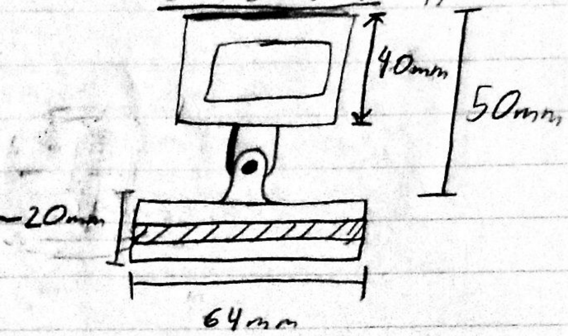
Unit #3: Concepts

Concept 1:

- Foam material sand whiched between 2 hard plastic or composite plates
- Held together w/ a strong adhesive
- Hinge holds camera in position with friction from screw tension.



Side view (approx specs)



Analysis

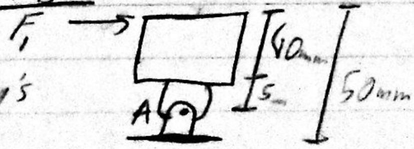
- Moment on hinge (under load)
- Power needed to adjuct camera
- Moment pulling Plates from foam

Assumptions

- Endures 5.5 g's

Calculations

- Moment on hinge → FBD



should be able to endure 5.5 g's

$F_1 = ma = (.074kg)(5.5 \cdot 9.81)$

$F_1 = \underline{3.99N}$

Moment around hinge A

$\Sigma M_A = 0$

$\Sigma M_A = 3.99N \cdot 45mm = \boxed{0.18 N \cdot m}$

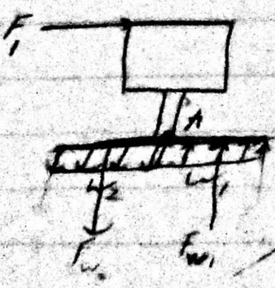
The hinge should be able to endure this moment w/o moving.

- Power needed to rotate tightened hinge.

Let's assume the angular velocity is $\frac{\pi}{4}$ rad/s and torque must be $\tau = 0.19 N \cdot m$

$P = \tau \omega$

$P = 0.19 N \cdot m \cdot \frac{\pi}{4} rad/s = \boxed{0.149 W}$



$w_1 = w_2$

w_1 = foam pushing up

w_2 = foam pulling down

$M_1 = F_{w_1}(16 mm)$

$M_2 = F_{w_2}(16 mm)$

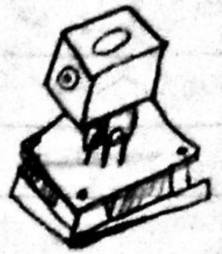
$\Sigma M_A = M_1 + M_2 - F_1(50mm) = 0$

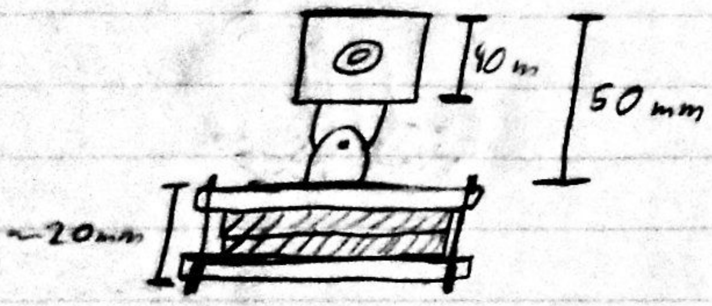
$M_1 + M_2 = 0.1995 N \cdot m$

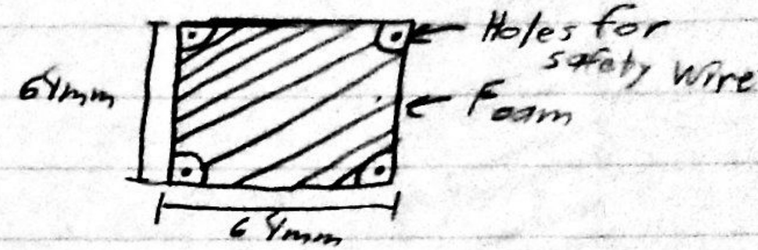
$M_1 = M_2 = \boxed{0.0998 N \cdot m}$

Concept 2

- Foam material sandwiched between 2 hard baseplates
- Held together w/ adhesive and safety wire to hold pieces together.
- Hinge holds camera in position w/ friction from screw tension.





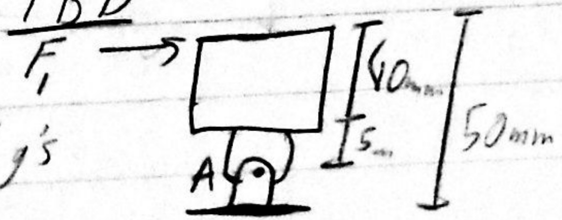


Analysis

- Moment on hinge
- Power needed to adjust camera
- Moment presses foam and pulls safety wire

Calculations

- Moment on hinge → FBD



should be able to endure 5.5 g's

$F_1 = ma = (.074\,kg)(5.5 \cdot 9.81)$

$F_1 = \underline{3.99\,N}$

Assumptions

- Endures 5.5 g's

Moment around hinge A

$\Sigma M_A = 0$

$\Sigma M_A = 3.99\,N \cdot 45\,mm = \boxed{0.18\,N.m}$

The hinge should be able to endure this moment w/o moving.

- Power needed to rotate tightened hinge.

Let's assume the angular velocity is $\frac{\pi}{4}$ rad/s and torque must be $\tau = 0.19\,N.m$

$P = \tau\omega$

$P = 0.19\,N.m \cdot \frac{\pi}{4}\,rad/s = \boxed{0.149\,W}$

Calculations (cont.)

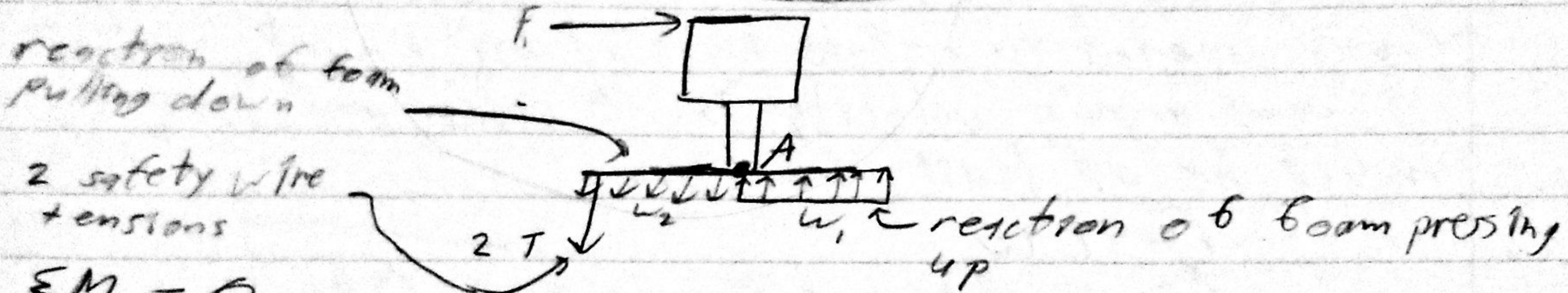
$F_1 = ma = (0.074\,kg)(5.5 \cdot 9.81)$

$F_1 = 3.99N$

Assumptions

- Safety wire assists in resisting loads

FBD under load



$\Sigma M_A = 0$

$\Sigma M_A = 2T(32mm) + W_1 + W_2 - F_1(50mm) = 0$

We cannot solve this because we don't know the density of the foam and how much that affects W_1, W_2, and T.

Force of foam given by $F = kx$

Concept 3:

- Ball mount for more degrees of freedom.
- Adhesive + safety wire holds together
- Holes in the foam and plate for reduced weight
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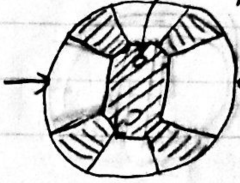
Cross-section



ball mount

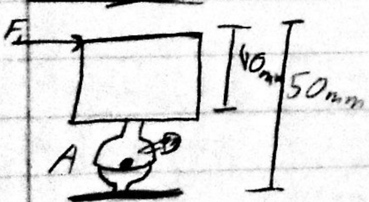
Analysis

- Moment on hinge can be applied in any direction.
- Power needed to adjust camera
- Moments pull on one side of foam and press down on another.

Assumptions

- Camera Endures a max of 5.5g's, weighing 0.074kg.

Calculation



$F_1 = ma = (0.074kg)(5.5 \cdot 9.81)$

$F_1 = 3.99N$

Moment on Mount

$\Sigma M_A = 3.99N \cdot 45mm = \boxed{0.18 N \cdot m}$

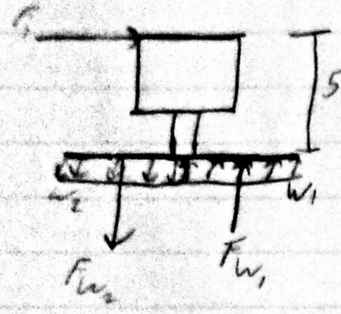
* The ball mount must remain rigid under this force.
- Power needed to rotate tightened ball mount. Assume angular velocity is $\frac{\pi}{4}$ rad/s and torque must be at least 0.19N·m

$P = \tau \omega$

$P = 0.19 N \cdot m \cdot \frac{\pi}{4} rad/s = \boxed{0.149W}$

Concept 3 (cont.)

FBD → Static hinge, moments on plate



- $W_1 = W_2$
- W_1 = upward reaction from foam
- W_2 = downward reaction from foam
- $F_{W_{1+2}}$ are the distributed loads as point loads

$$M_1 = F_{W_1}(16mm)$$ $$M_1 = M_2$$

$$M_2 = F_{W_2}(16mm)$$

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

$$M_1 + M_2 = F_1(50mm)$$

$$M_1 + M_2 = 0.1995 N \cdot m$$

$$\boxed{M_1 = M_2 = 0.0998 Nm}$$