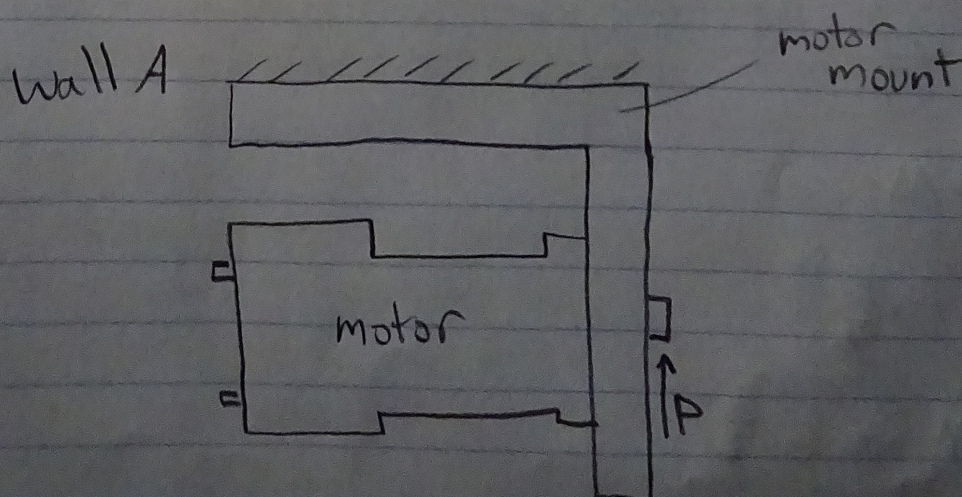


A4: Motor Mount

Design for S_y then δ_{max} (0.30mm)Select ABS, PETG, or PLA materialgood
but
a hot motor
would make
it badokay with
heat
super high E
high densitygreat even at high
temp
low density
high EFor SW custom material - Source Matweb.com
using avg metric values

Mass Density	1.00-3.41 g/cc	SW 2205 $\frac{\text{kg}}{\text{m}^3}$
Elastic Modulus	0.00232-13.8 GPa	6001.16 N/mm ²
Tensile Strength		
Tensile Strength, Yield	8.00-103 MPa	55.5 N/mm ²



★ Safety Factor = 3
neglect motor weight

Feature 1:

mount that attaches to the motor
model as a cantilever beam

Known

shaft length
= 146 mm

$$E = 6801.16 \text{ MPa}$$

$$S_y = 55.5 \text{ MPa}$$

$$SF = 3$$

motor $\phi = 27.7 \text{ mm} \times 36 \text{ mm}$

$$P = 300 \text{ N}$$

$$\delta_{\max} = 0.30 \text{ mm}$$

unknown

$$b > 28 \text{ mm}$$

$$h < 1/2 \cdot 18 \text{ mm}$$

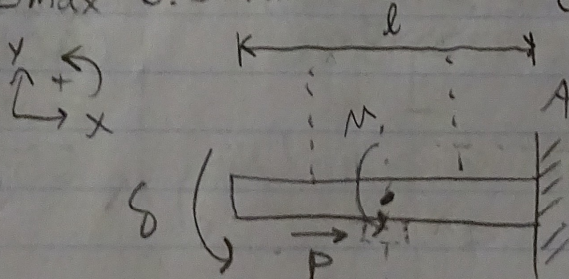
$$l > 28 \text{ mm}$$

← from
motor
dimensions

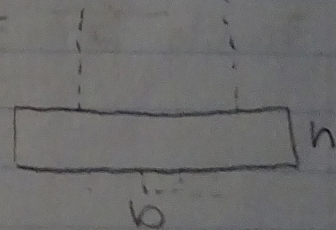
$$I$$

$$M$$

$$C = \frac{h}{2}$$



cross section



$$I = \frac{bh^3}{12}$$

$$P \rightarrow M$$

$$M = P \cdot \frac{\text{shaft}}{2}$$

$$M \text{ acts @ } \frac{l}{2}$$

I want
1/2 of shaft
to stick
out

Feature 1 Design For Stress

$$\sigma_{\max} = \frac{S_y}{SF}$$

$$I = \frac{bh^3}{12}$$

$$c = \frac{h}{2}$$

$$\sigma_{\max} = \frac{Mc}{I}$$

$$M = P \cdot \frac{\text{shaft}}{2}$$

$$\frac{S_y}{SF} = \frac{\left(P \cdot \frac{\text{shaft}}{2}\right) \left(\frac{h}{2}\right)}{\frac{bh^3}{12}} = \frac{P \cdot \text{shaft} \cdot h \cdot 12}{2 \cdot 2 \cdot b \cdot h^3}$$

too many unknowns, let $b = l > 28 \text{ mm}$
 test $b = l = 30 \text{ mm}$ want $h < 9 \text{ mm}$

$$\frac{S_y}{SF} = \frac{3P(\text{shaft})}{bh^2} \quad \text{solve for } h$$

$$h = \sqrt{\frac{3P(\text{shaft})SF}{bS_y}}$$

$$\text{test } b = 30 \text{ mm} \rightarrow h = 5.4 \text{ mm}$$

$$h = \sqrt{\frac{3(300 \text{ N})(18 \text{ mm})3}{(30 \text{ mm})(55.5 \text{ MPa})}} = 5.4 \text{ mm}$$

dimensions of feature 1

$$b = l = 30 \text{ mm} \quad h = 5.4 \text{ mm}$$

Feature 1 Design for Deflection

$$\delta_{\max} = \frac{M l^2}{2EI}$$

$$I = \frac{b h^3}{12}$$

$$M = P \frac{l}{2}$$

$$\frac{\delta_{\max}}{SF} = \frac{P \frac{l}{2} l^2}{2E \left(\frac{b h^3}{12} \right)} = \frac{P \frac{l^3}{2}}{\frac{2E b h^3}{12}}$$

$$\frac{\delta_{\max}}{SF} = \frac{P_{\text{shaft}} l^2 12}{2 \cdot 2 E b h^3} = \frac{3 P_{\text{shaft}} l^2}{E b h^3}$$

$$h = \sqrt[3]{\frac{3 P_{\text{shaft}} l^2 SF}{E b \delta_{\max}}}$$

test $b = l = 30 \text{ mm} \rightarrow h = 8.90 \text{ mm}$

$$h = \sqrt[3]{\frac{3(300 \text{ N})(18 \text{ mm})(30 \text{ mm})^2 3}{(6901.16 \text{ MPa})(30 \text{ mm})(0.30 \text{ mm})}}$$

$$l = b = 30 \text{ mm} \quad h = 8.90 \text{ mm}$$

★

Feature 2:

known

$$E = 6801.16 \text{ MPa}$$

$$S_y = 55.5 \text{ MPa}$$

$$SF = 3$$

$$P = 300 \text{ N}$$

$$\delta_{max} = 0.30 \text{ mm}$$

unknown

b

h

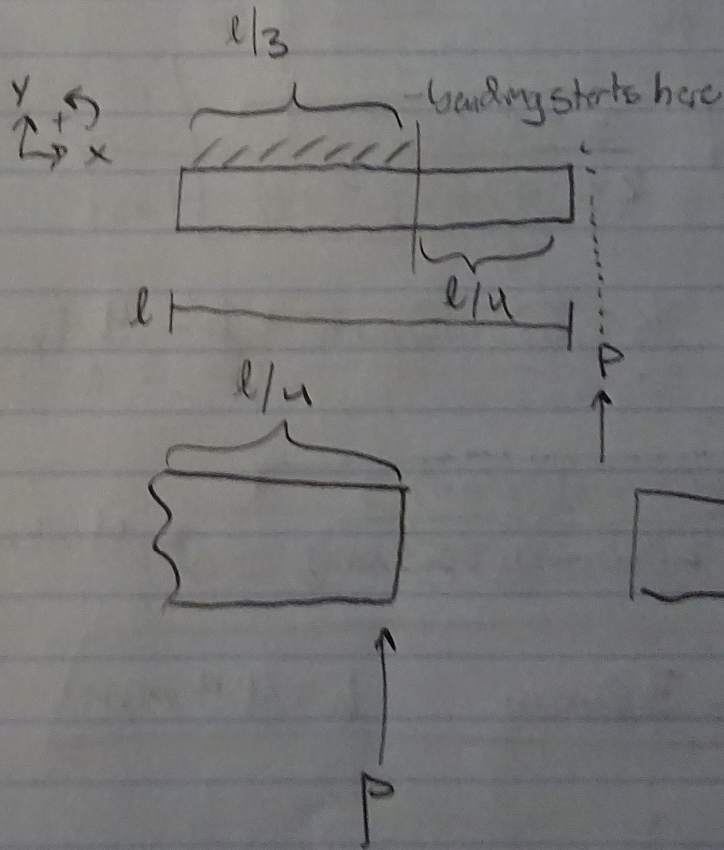
l

I

M

C

> no motor dimension restrictions



★ Assume only $1/4$ of L is not supported by screws & able to bend

Design for Stress

$$\frac{\sigma_{\max}}{SF} = \frac{WL}{Z} \quad Z = \frac{bh^2}{6}$$

$$W = P$$

$$L = \frac{l}{4}$$

$$\frac{\sigma_{\max}}{SF} = \frac{P \frac{l}{4}}{\frac{bh^2}{6}} = \frac{6Pl}{4bh^2} = \frac{3Pl}{2bh^2}$$

$$h = \sqrt{\frac{3Pl SF}{2b \sigma_{\max}}}$$

$$\text{test } b = l = 30\text{mm} \rightarrow h = 4.9\text{mm}$$

$$h = \sqrt{\frac{3(300\text{N})(30\text{mm}) 3}{2(30\text{mm})(55.5\text{MPa})}} = 4.9\text{mm}$$

$$b = l = 30\text{mm} \quad h = 4.9\text{mm}$$

★

Design for Deflection

$$\frac{\delta_{\max}}{SF} = \frac{w L^3}{3EI}$$

$$I = \frac{bh^3}{12}$$
$$w = P$$
$$L = l/4$$

$$\frac{\delta}{SF} = \frac{P \left(\frac{l}{4}\right)^3}{3E \frac{bh^3}{12}} = \frac{12 P l^3}{64 \cdot 3 E b h^3} = \frac{P l^3}{16 E b h^3}$$

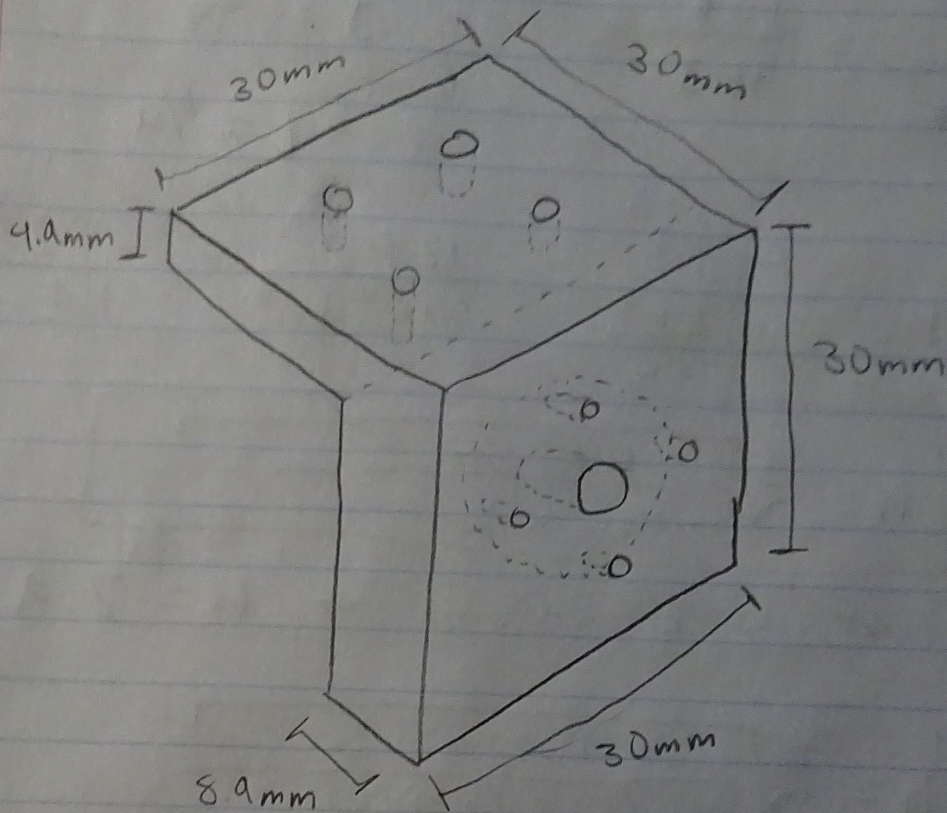
$$h = \sqrt[3]{\frac{P l^3 SF}{16 E b \delta}}$$

$$\text{test } b = l = 30 \text{ mm} \rightarrow h = 2.9 \text{ mm}$$

$$h = \sqrt[3]{\frac{(300 \text{ N})(30 \text{ mm})^3 3}{16 (6401.16 \text{ MPa})(30 \text{ mm})(.3 \text{ mm})}}$$

$$b = l = 30 \text{ mm} \quad h = 2.9 \text{ mm}$$

Isometric Sketch of Motor Mount



02 09 2026