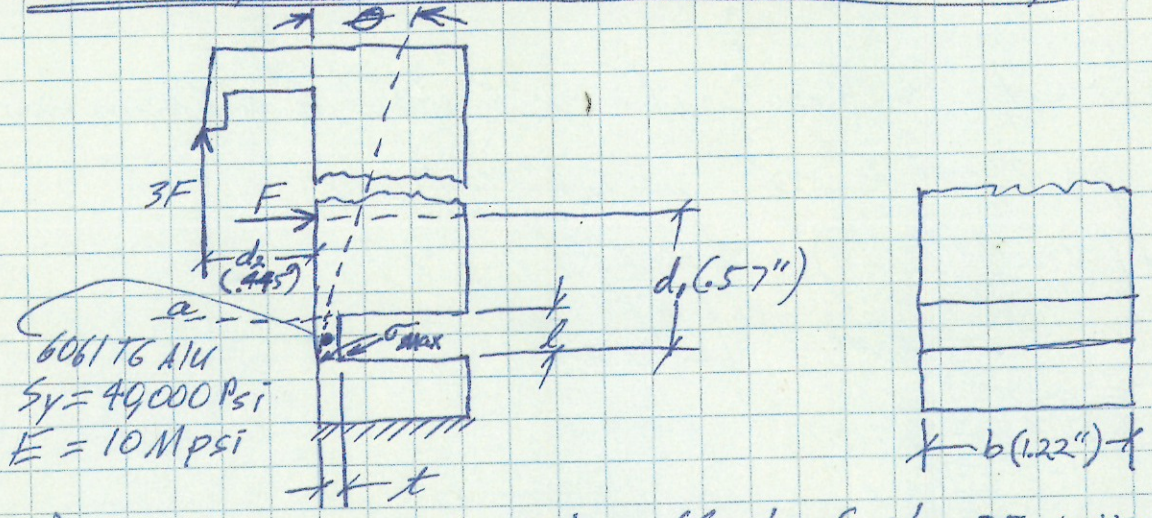
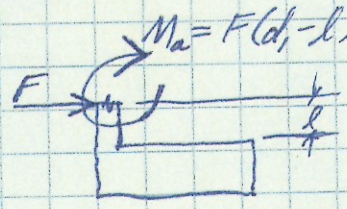
Primary Mirror Flexure (Transmon)



1) assume pure tensile effect of the 3F vertical load is minor.

Superimpose effects at a:

$$M_a = F(d_1 - \ell) + 3F\left(d_2 + \tfrac{t}{2}\right) = F\left(d_1 + 3d_2 - \ell + \tfrac{3t}{2}\right)$$



$$\theta = \frac{F}{EI}\left[\underbrace{\ell\left(d_1 + 3d_2 - \ell + \tfrac{3}{2}t\right)}_{M_a} + \underbrace{\frac{\ell^2}{2}}_{F}\right] \quad \text{(superimposed beam equations)}$$

$$\theta = \frac{F}{EI}\left(\ell d_1 + 3\ell d_2 - \frac{\ell^2}{2} + \frac{3\ell}{2}t\right)$$

$$I = \frac{bt^3}{12} = \frac{F}{E\theta}\left(\ell d_1 + 3\ell d_2 - \frac{\ell^2}{2} + \frac{3\ell}{2}t\right)$$

— Objective: $\frac{1}{2}^\circ$ of flexion for F = 13.5 lb

$$\Rightarrow \theta = \tfrac{1}{2}^\circ\left(\frac{2\pi}{360}\right) = \frac{\pi}{360}$$

design 1: $\ell = .\bar{3}3"$

$$t^3 = \underbrace{\frac{12(360)F}{b\pi E}}_{1.5216 \times 10^{-3}}\left(\ell d_1 + 3\ell d_2 - \frac{\ell^2}{2} + \frac{3\ell}{2}t\right)$$

Primary Mirror Flexure (Transmon, contd.)

$$t\left(t^2 - \underbrace{1.5216\times10^{-3}\left(\frac{3l}{2}\right)}_{7.5732\times10^{-4}}\right) = \underbrace{1.5216\times10^{-3}\,l\left(d_1+3d_2-\frac{l}{2}\right)}_{8.7372\times10^{-4}}$$

$\boxed{t = .098"}$ (by numerical method)

Check 1)

$$\frac{3(13.5\,lb)}{.098"(1.22")} = 340\,psi \quad \text{(very small)}$$

Stress:

$$M = M_a + Fl = F\left(d_1 + 3d_2 + \tfrac{3}{2}t\right) = 27.7\,lb\text{-}in$$

$$\sigma_{max} = \frac{Mt}{2I} + 340psi = \frac{27.7(.098)(6)}{1.22(.098)^3} + 340psi = 14{,}500\,psi$$

(36% of S_y)

$$\sigma_s \cong \frac{13.5\,lb}{.098"(1.22")} = 110\,psi \quad \text{(very small)}$$