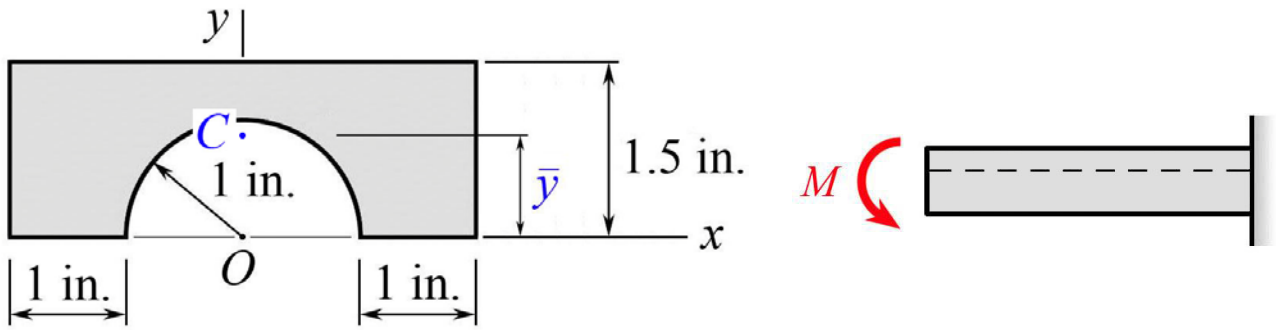
MEEG 3013 Quiz #4.m16.103

A moment **M** acting on a cantilever beam is shown, where *C* is the centroid of the beam cross section. If the allowable stress is 12 ksi in tension and 16 ksi in compression, determine (*a*) $\bar{y}$, (*b*) the largest value $M_{\max}$ of the moment allowed.



(*a*) $A_1 = 6 \text{ in}^2$ $A_2 = -\pi/2 \text{ in}^2$ $\bar{y}_1 = 0.75 \text{ in.}$ $\bar{y}_2 = 4/(3\pi) \text{ in.}$ ①

POM$_1$: $A = A_1 + A_2 = (6 - \pi/2) \text{ in}^2 = 4.429203673 \text{ in}^2$

POM$_2$: $\bar{y}A = \bar{y}_1 A_1 + \bar{y}_2 A_2$ $\bar{y} = 0.865467839 \text{ in.}$ $\bar{y} = 0.865 \text{ in.}$ ②

PAT: $I_x = \left[\frac{1}{12}(4)(1.5)^3 + 6(0.75)^2\right] - \frac{\pi}{8}(1)^4 = 4.107300918$

$I_x = \bar{I} + A\bar{y}^2$ $\therefore$ $\bar{I} = 0.7896742 \text{ in}^4$ ② $\sigma_{\max} = Mc/\bar{I}$

(*b1*) $12 \times 10^3 = \frac{M(1.5 - \bar{y})}{\bar{I}}$ $M = 14933.98$ $M = 14.93 \text{ kip}\cdot\text{in.}$ ②

(*b2*) $16 \times 10^3 = \frac{M\bar{y}}{\bar{I}}$ $M = 14598.79$ $M = 14.60 \text{ kip}\cdot\text{in.}$ ②

$\therefore$ $M_{\max} = 14.60 \text{ kip}\cdot\text{in.}$ ①