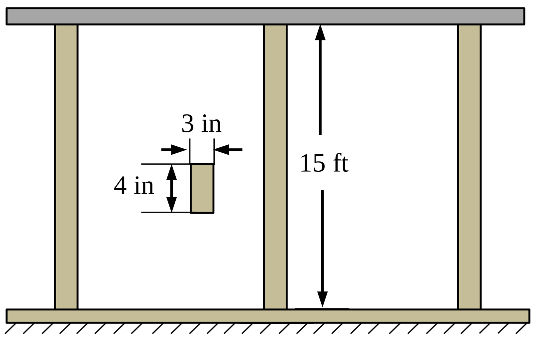
8-5. Rectangular columns are used to support a roof. The ends of a column are pin connected. The dimension of the column is shown in the figure. If the modulus of elasticity follows a normal distribution $E \sim N\left(1.9\times10^3, 150^2\right)$ ksi, determined the distribution of the critical load of the column. Assume that Euler's formula is valid.



Solution:

According to the cross section of the column, we can get

$I_x = \frac{3(4)^3}{12} = 16\,\text{in}^2$, $I_y = \frac{4(3)^3}{12} = 9\,\text{in}^2$ (Controls!)

Since the ends of the column are pin connected, $K = 1$. Thus the critical buckling load of this column can be calculated by

$$P_{cr} = \frac{\pi^2 EI_y}{(KL)^2} = \frac{(3.14)^2 \times 9}{(1\times15\times12)^2} E = 2.74\times10^{-3} E$$

Thus

$$\mu_{P_{cr}} = 2.74\times10^{-3}\mu_E = 2.74\times10^{-3}\times1.9\times10^3 = 5.21\,\text{kip}$$

$$\sigma_{P_{cr}} = 2.74\times10^{-3}\sigma_E = 2.74\times10^{-3}\times150 = 0.41\,\text{kip}$$

The critical load of the column follows a normal distribution of $P_{cr} \sim N\left(5.21, 0.41^2\right)$ kip. **Ans.**