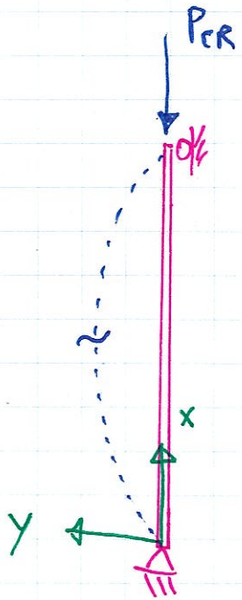
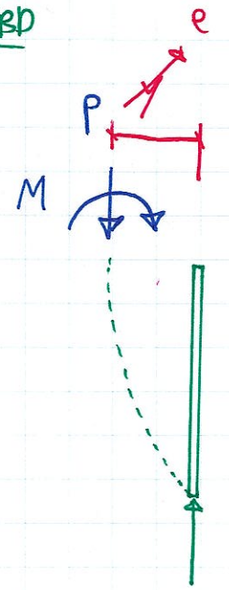


FBD



$+\circlearrowleft \Sigma M_{cut} = 0; \quad M = -Py$

ASSUMPTIONS:
1) Pinned End Conditions
2) Initially Perfectly Straight
3) Homogeneous Material ← Constant E over L
4) Prismatic ← Constant A & I over L

$$M = \frac{d^2y}{dx^2} EI = -Py$$

$$\frac{d^2y}{dx^2} EI + Py = 0$$

$$y'' EI + Py = 0$$

Solve w/

$$y = A\sin(wx) + B\cos(wx)$$

$$w = \sqrt{\frac{P}{EI}}$$

BNDY. COND.

$[x=0, y=0]$
$[x=L, y=0]$

$$y = A\sin(w\cdot 0) + B\cos(w\cdot 0) = 0 \Rightarrow B = 0$$

$$y = A\sin(wL) = 0 \Rightarrow A \neq 0$$

$$0 = A \sin(wL)$$

$$A \neq 0$$

$$\therefore \sin(n\pi) = 0$$

where $n = 0, 1, 2$

sub $w = \sqrt{\frac{P}{EI}} \Rightarrow \sqrt{\frac{P}{EI}} L = n\pi$

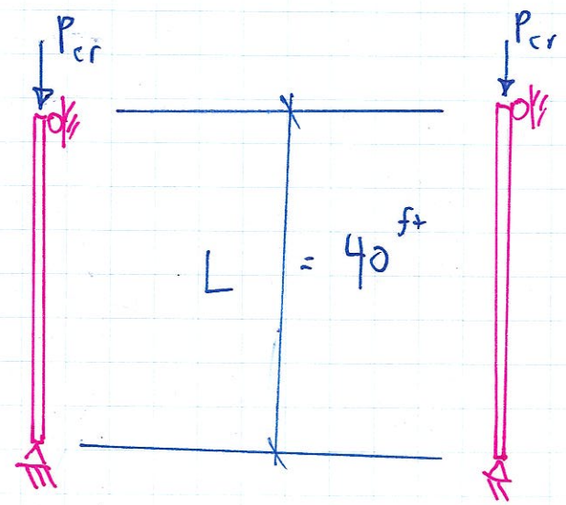
Solve P: $P = \frac{n^2 \pi^2 EI}{L^2}$

$$P_{cr} \ (n=1) = \frac{\pi^2 EI}{L^2}$$

$n = 1$

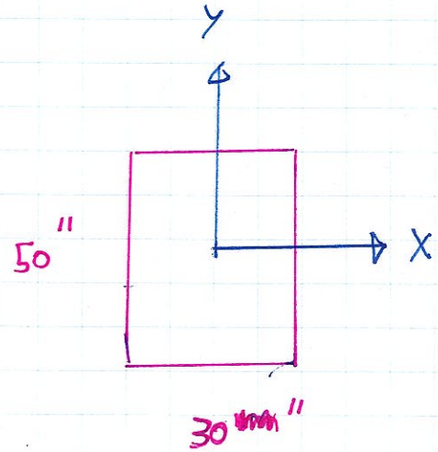
$n = 2$

EXAMPLE



STRONG AXIS
(X-X AXIS)

WEAK AXIS
(Y-Y AXIS)



$$I_x = \frac{1}{12}(30")(50")^3 = 312500\ in^4$$

$$I_y = \frac{1}{12}(50")(30")^3 = 112500\ in^4$$

$$E = 29000\ ksi$$

$$P_{cr} = \frac{\pi^2 EI}{L^2} = \frac{\pi^2 (29000\ ksi)(112500\ in^4)}{(40\ ft \times 12)^2} = 139755\ K$$