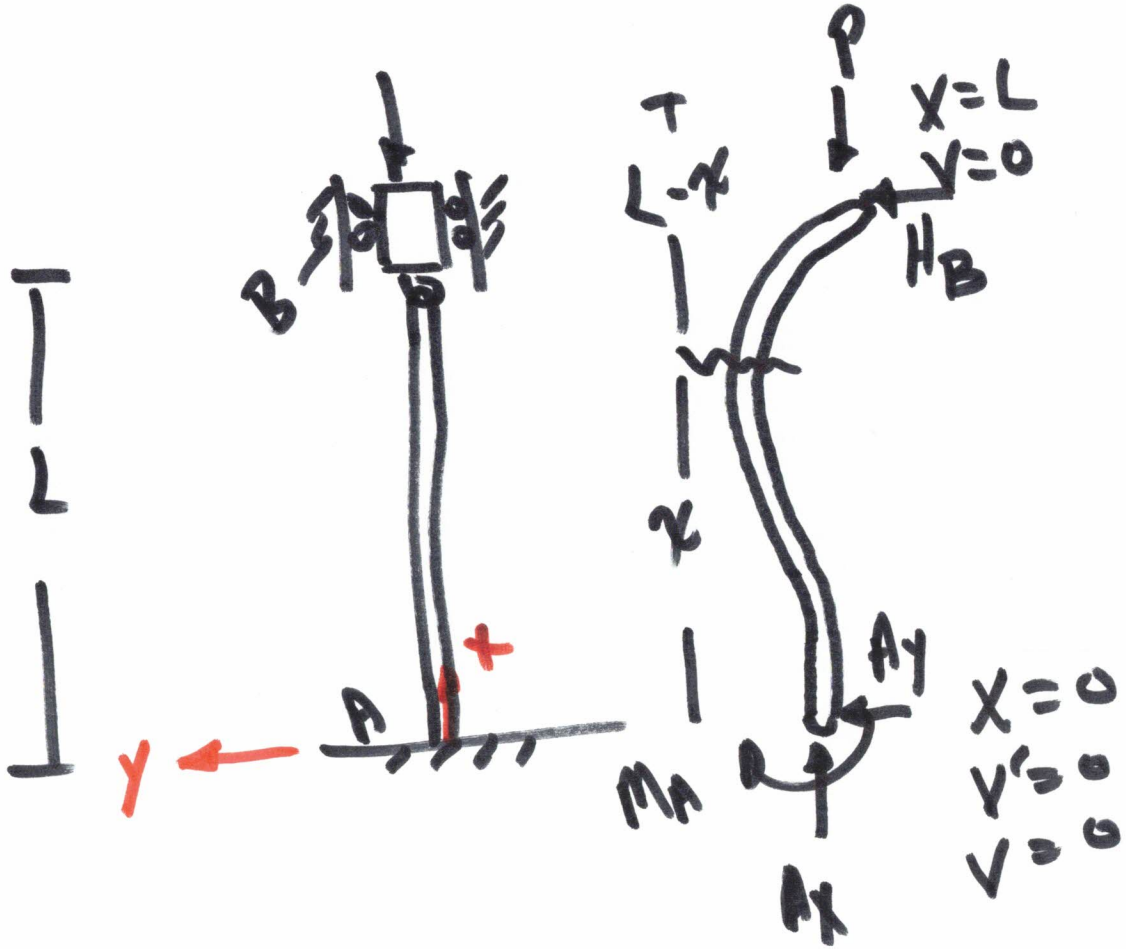
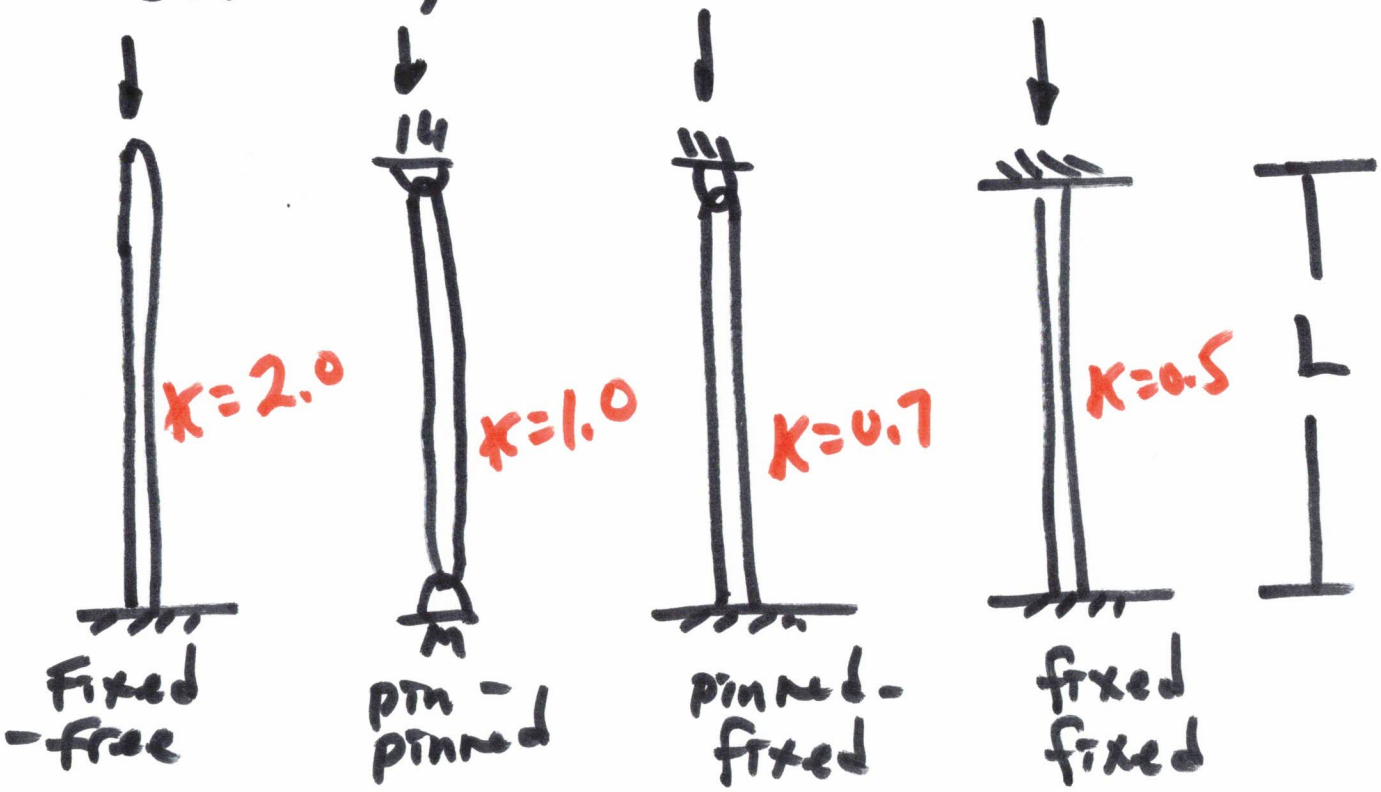
pinned - fixed



Deflections exaggerated

Columns, end conditions

$$P_{cr} = \frac{\pi^2 E I}{L_e^2}$$

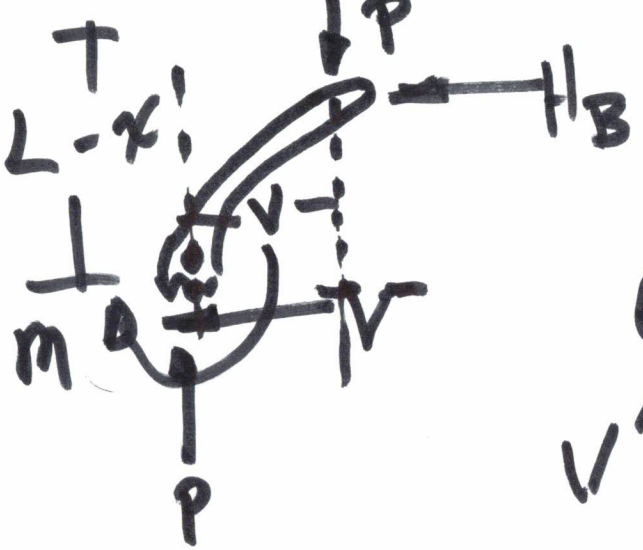


$L_e = KL$

Know K's for eton

last time, pin-pinned column, n=1 $P_{cr} = \frac{\pi^2 E I}{L^2}$

critical buckling load (force)



$\sum M_o$ $\quad -M - PV + H_B(L-x) = 0$

$+$

$$EIV'' = M = -PV + H_B(L-x)$$

$$V'' = \frac{H_B}{EI}(L-x) - \frac{P}{EI}V$$

let $\alpha^2 = \frac{P}{EI}$ $\qquad \frac{d^2V}{dx^2} = \frac{H_B(L-x)}{EI} - \alpha^2 V$

$$\frac{d^2V}{dx^2} + \alpha^2 V = \frac{H_B L}{EI} - \frac{H_B x}{EI}$$

Need complementary solution ($\frac{d^2V}{dx^2} + \alpha^2 V = 0$)

& particular solution (look at RHS)

$V'' + \alpha^2 V = 0$ soln: $V = A\sin\alpha x + B\cos\alpha x$

particular: $RHS = \frac{H_B L}{EI} - \frac{H_B x}{EI}$

looks like $C + Dx$

$V = C + Dx$

$V' = D$

$V'' = 0$

$V'' + \alpha^2 V$

$0 + \alpha^2 (C + Dx) = \frac{H_B L}{EI} - \frac{H_B x}{EI}$

then $C + Dx = \frac{H_B L}{P} - \frac{H_B x}{P}$

Total solu:

$$V = A\sin\alpha x + B\cos\alpha x + \frac{H_B L}{P} - \frac{H_B x_L}{P}$$

$x=0,\ V=0$

$$0 = 0 + B + \frac{H_B L}{P} + 0 \qquad B = -\frac{H_B L}{P}$$

$x=0,\ V'=0$

$$V' = \alpha A\cos\alpha x - \alpha B\sin\alpha x - \frac{H_B}{P}$$

$$0 = \alpha A - \frac{H_B}{P} \qquad A = \frac{H_B}{P\alpha}$$

$x=L,\ V=0$

$$0 = A\sin\alpha L + B\cos\alpha L$$

$$A\sin\alpha L = -B\cos\alpha L$$

$$\tan\alpha L = -\frac{B}{A}$$

$$\tan \alpha L = \frac{+\frac{H_B L}{P}}{\frac{H_B}{P\alpha}} = \alpha L$$

$$\tan \alpha L = \alpha L$$

$\alpha L = 4.4934$ is first solution

$$\alpha^2 L^2 = (4.4934)^2$$

$$\frac{P}{EI} L^2 = (4.4934)^2$$

$$P_{cR} = \frac{(4.4934)^2 EI}{L^2}$$ } Final equation