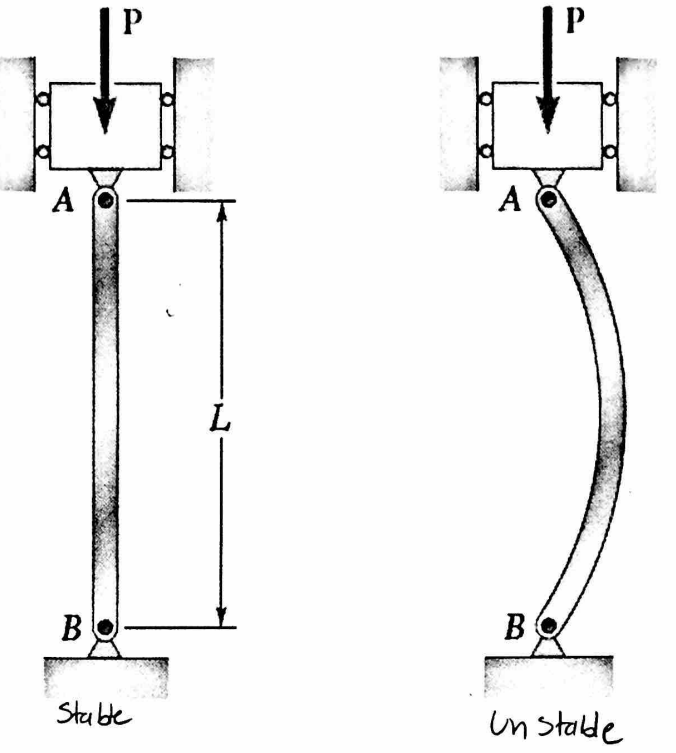
* Stability of Columns or Buckling of columns

* Increase force (P) → Buckling



From mechanics of materials

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

$$\Rightarrow \frac{d^2y}{dx^2} + \frac{P}{EI}y = 0 \quad , \lambda^2 = \frac{P}{EI}$$

$$y'' + \lambda^2 y = 0$$

To solve $y(x) = Ce^{rx}$

$$\Rightarrow \lambda^2 + r^2 = 0 \quad , r = \pm i\lambda \quad , i = \sqrt{-1}$$

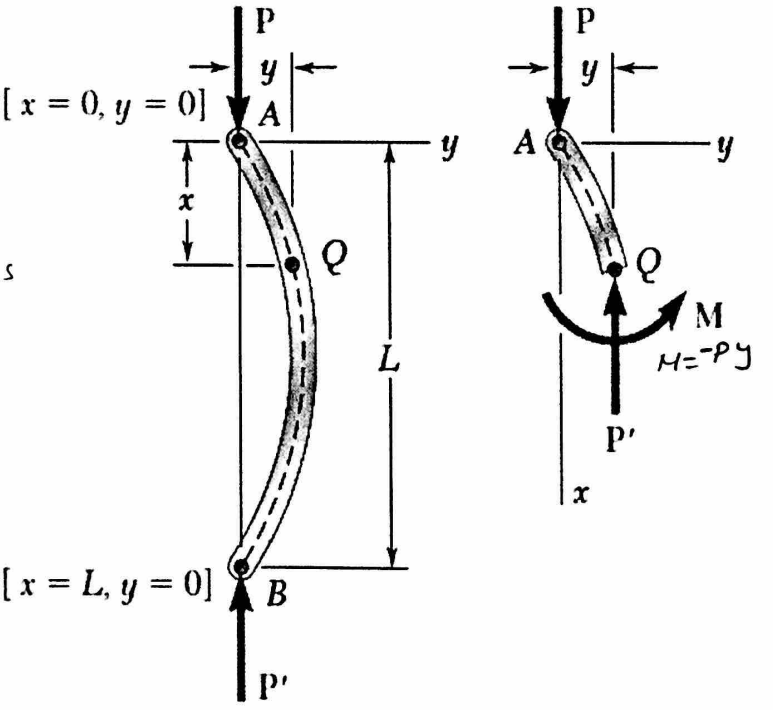
$$y(x) = A\cos\lambda x + B\sin\lambda x$$

A and B from Boundary conditions

$$y(0) = 0 \quad , \quad y(L) = 0$$

$$\Rightarrow A = 0 \quad , B = 1$$

$$\lambda = \frac{\pi}{L} \quad , \lambda^2 = \frac{\pi^2}{L^2}$$

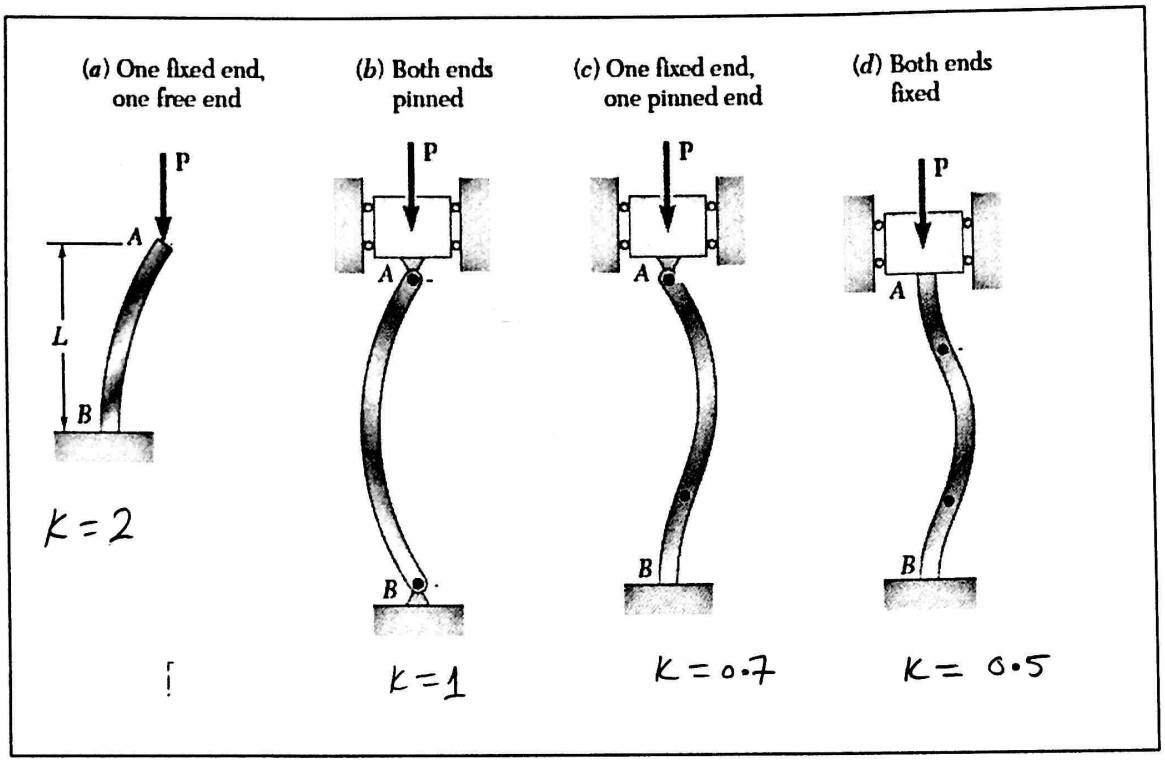


$$\Rightarrow P_{cr} = \frac{\pi^2 EI}{L^2}$$

Critical Buckling Force

In general $P_{cr} = \frac{\pi^2 EI}{K^2 L^2}$, K: Buckling factor depends on Support

$$P_{cr} = \frac{\pi^2 E I}{K^2 L^2}$$; K : depends on support type

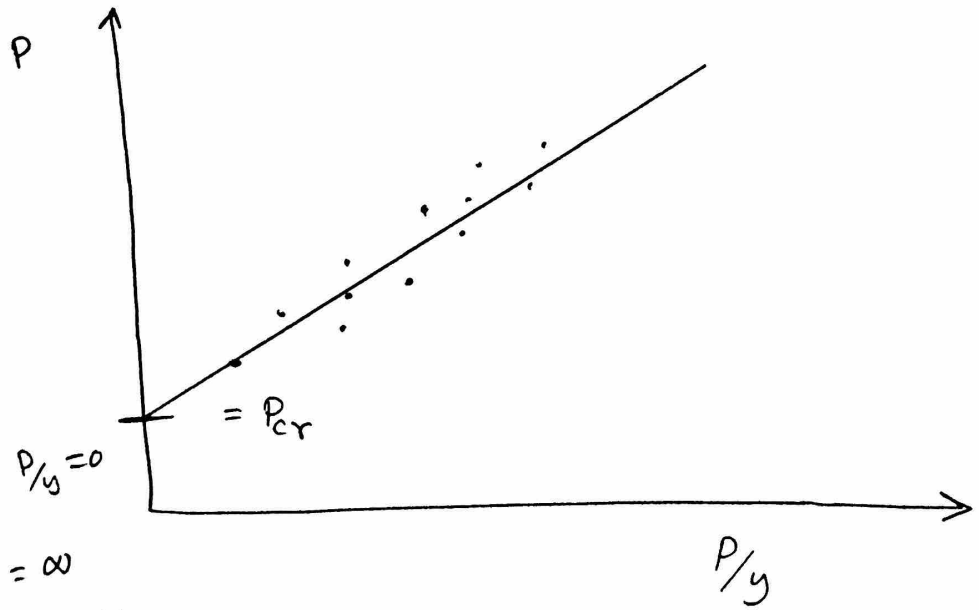


* what will we do in the lab ?

Column → add load P and increase → measure deflection y

Plot (P, P/y)

divde $\frac{P}{y}$



y = ∞

Buckling!