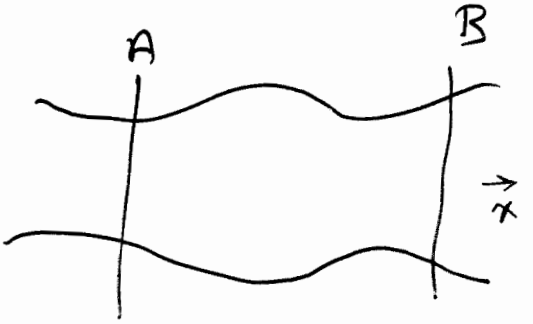
Deformation of Axially-Loaded Statically-Determinate Members

$\sigma = \frac{P}{A}$; $\varepsilon = \frac{\delta_{AB}}{\ell_{AB}}$; $\sigma = E\varepsilon$ ⇐ Note: these are f(x) in general. ⇒ .... ⇒

$$\delta_{AB} = e_{B/A} = u_B - u_A = \int_A^B \frac{P(x)}{A(x)\,E(x)}\,dx$$

↑ relative displacement

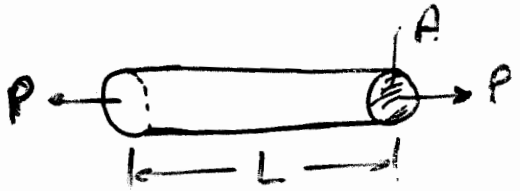


Methods of Solution:

1. Direct integration: normal integration of the eq. above
2. Discrete elements: finite number of segments with constant P/AE
3. Superposition: Take F_1, F_2, ... separately and sum the results (for linear elastic only)

For a <u>Uniform</u> rod (bar, member, ... etc.), A, E, and P are constant.

$$\Rightarrow \boxed{e = \frac{PL}{AE}}$$



E = material property

For more than one uniform rods:

$$\boxed{e_{Total} = \sum_{i=1}^{n} e_i = \sum_{i=1}^{n} \left(\frac{PL}{AE}\right)_i}$$

i = number of segments (elements)

$$\delta = e = \int_0^L \frac{P}{AE}\,dx = \frac{P}{AE}\int_0^L dx = \frac{PL}{AE}$$