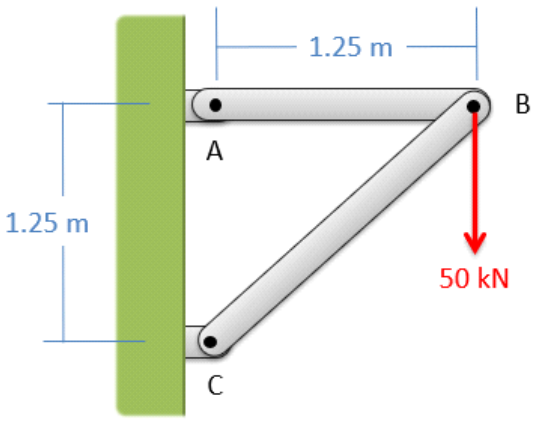
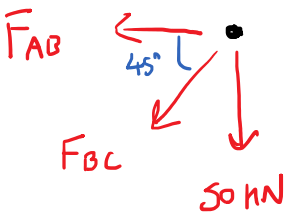
Problem 1

The truss shown below is loaded with a 50 kN force. Member AB has a cross sectional area of 650 square millimeters and member BC has a cross sectional area of 925 square millimeters. Assume both members are made of steel with a yield strength of 250 MPa, and a Young's Modulus of 200 GPa.

- Do we expect either member of to plastically deform under loading?
- What is the overall change in position we would expect for point B?





$$\Sigma F_x = 0 = -F_{AB} - \cos(45)\, F_{BC}$$

$$\Sigma F_y = 0 = -50\ kN - \sin(45)\, F_{BC}$$

$$F_{BC} = -70.7\ kN$$

$$F_{AB} = 50\ kN$$

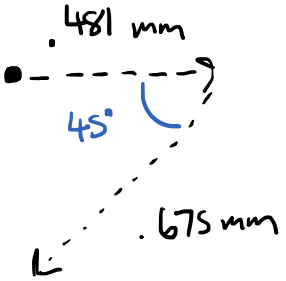
$$\sigma_{AB} = \frac{F}{A} = \frac{50{,}000\ N}{650 \times 10^{-6}\ m^2} = \boxed{76.9\ MPa}$$

$$\sigma_{BC} = \frac{F}{A} = \frac{-70{,}700\ N}{925 \times 10^{-6}\ m^2} = \boxed{-76.4\ MPa}$$

both < 250 MPa, so no danger of plastic deformation

$$\delta_{AB} = \frac{PL}{AE} = \frac{(50{,}000\ N)(1.25\ m)}{(650 \times 10^{-6}\ m^2)(200 \times 10^{9}\ \frac{N}{m^2})} = \boxed{.000481\ m}$$

$$\delta_{BC} = \frac{PL}{AE} = \frac{(-70{,}700\ N)(\frac{1.25}{\cos(45)})}{(925 \times 10^{-6}\ m^2)(200 \times 10^{9}\ \frac{N}{m^2})} = \boxed{-.000675\ m}$$



$$\delta_{Bx} = .481 - .675\cos(45) = .0037\ mm$$

$$\delta_{By} = -.675\sin(45) = -.477\ mm$$

$$\boxed{\delta_B = [.0037, -4.77]\ mm}$$