2.19) $E = 70 \times 10^9$ Pa

$F_P = 4 \times 10^3$ N

$$\delta_{AB} = \frac{F_P L_{AB}}{A_{AB} E}$$

$$= \frac{4 \times 10^3 \times 0.4}{\left(\frac{20}{2} \times 10^{-3}\right)^2 \pi \times 70 \times 10^9}$$

$= 0.07275654541$ mm

≈ 0.0728 mm

For the deflection at A to be 0,

$$\delta_{BC} = \frac{F_{P-Q} L_{BC}}{A_{BC} E}$$

$$0.07275654541 \times 10^{-3} = \frac{\frac{1}{2} F_{P-Q}}{\left(\frac{60}{2} \times 10^{-3}\right)^2 \times \pi \times 70 \times 10^9}$$

$F_{P-Q} = 28800$ N

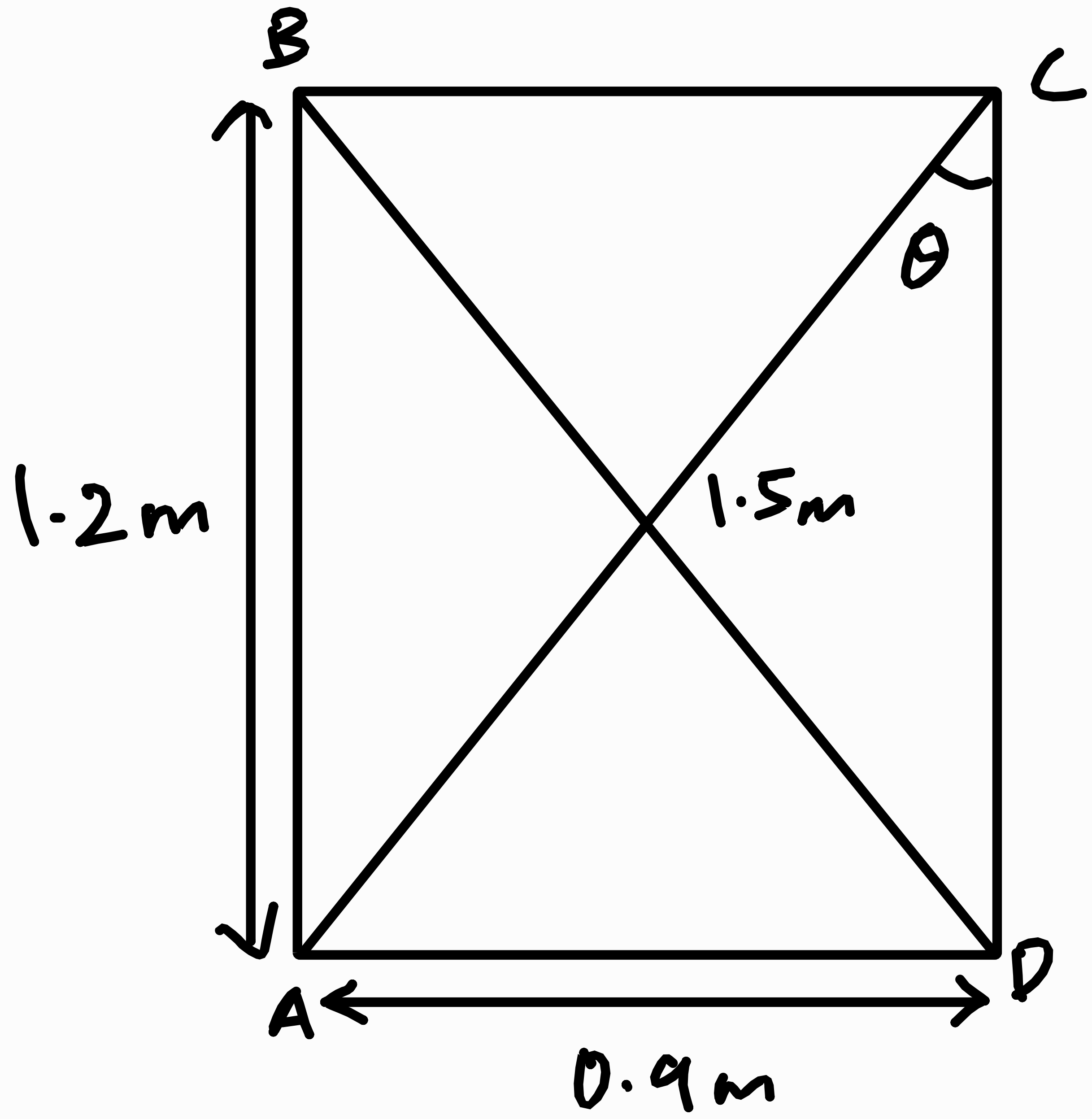
$F_Q = F_{P-Q} + F_P$

$= 32.8$ kN

$\therefore \underset{\sim}{Q}$ is 32.8 kN.

The corresponding deflection of B is 0.0728 mm.

2.23)



Length of $AC = \sqrt{1.2^2 + 0.9^2}$

$= 1.5\,m$

$$\delta_{CD} = \frac{F_{CD} L_{CD}}{A_{CD} E}$$

$$1 \times 10^{-3} = \frac{F_{AC} \cos\theta (1.2)}{\left(\frac{30}{2} \times 10^{-3}\right)^2 \pi (200 \times 10^9)}$$

$$37500\pi = F_{AC}\left(\frac{1.2}{1.5}\right)$$

$$F_{AC} = 147262.1556$$

$$\approx 147.3\,kN$$

2.69) $E = 87\times10^9\,Pa$

$v = 0.34$

$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{v\sigma_y}{E} - \frac{v\sigma_z}{E}$$

$$= \frac{1}{E}\left(\sigma_x - v(\sigma_y + \sigma_z)\right)$$

$$= \frac{1}{87\times10^9}\left(120\times10^6 - 0.34(0 + 160\times10^6)\right)$$

$$= \frac{41}{54375}$$

$$\varepsilon_x = \frac{\delta_x}{L}$$

$$\delta_x = \varepsilon_x L_x$$

$$= \frac{41}{54375}(100\times10^{-3})$$

$$= 0.0754002298 85\,mm$$

$$\approx 0.0754\,mm$$

$$\varepsilon_z = \frac{1}{E}\left(\sigma_z - v(\sigma_x + \sigma_y)\right)$$

$$= \frac{1}{87\times10^9}\left(160\times10^6 - 0.34(120\times10^6 + 0)\right)$$

$$= \frac{149}{108750}$$

$$\delta_z = \varepsilon_z L_z$$

$$= \frac{149}{108750}(75\times10^{-3})$$

$$= 0.01027586207\,mm \approx 0.1028\,mm$$

2.69) $\delta_{AC} = \sqrt{(100+0.0754)^2 + (75+0.1028)^2} - \sqrt{75^2 + 100^2}$

$= 0.121982472 \text{ mm}$

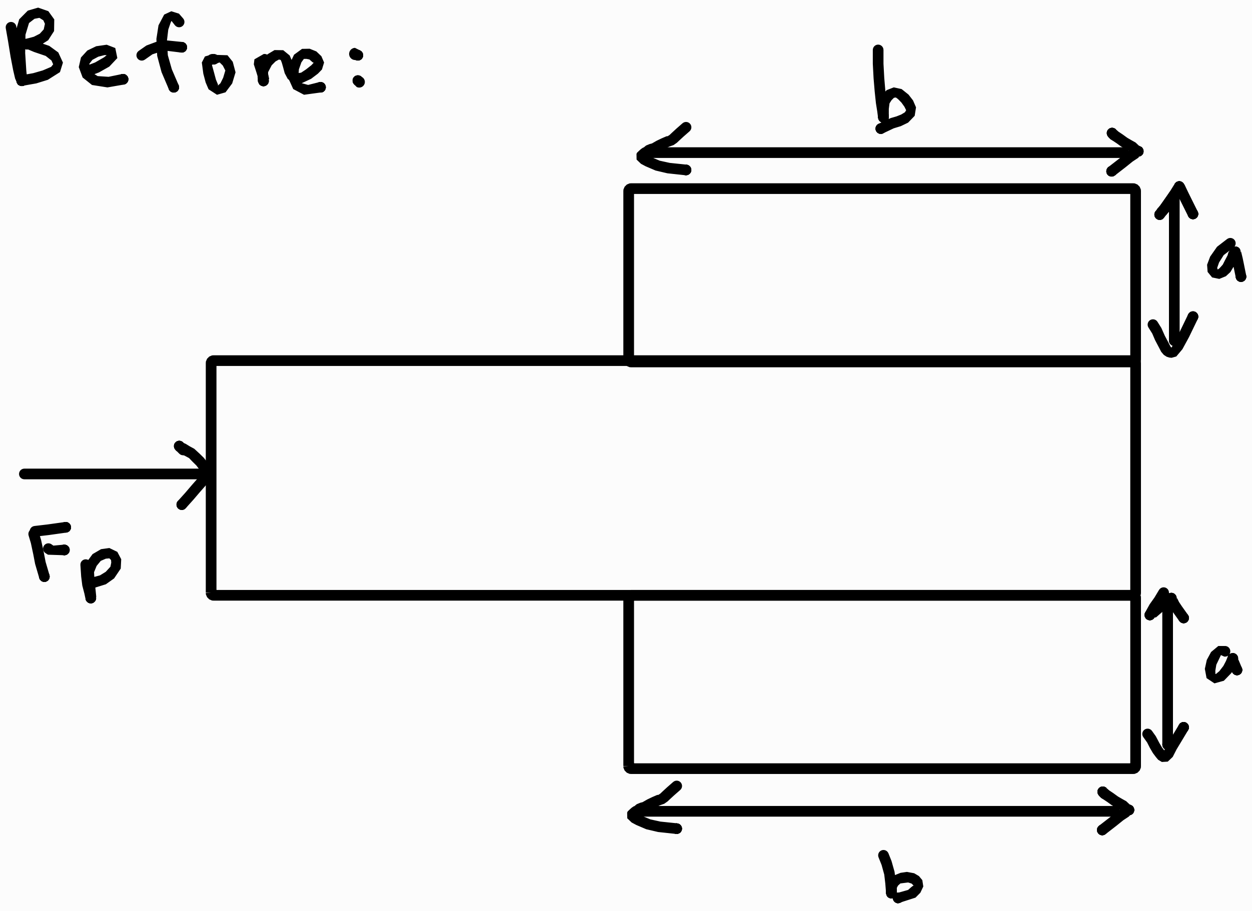
$\approx 0.122 \text{ mm}$

2.79) $G = 12 \times 10^6 \, Pa$

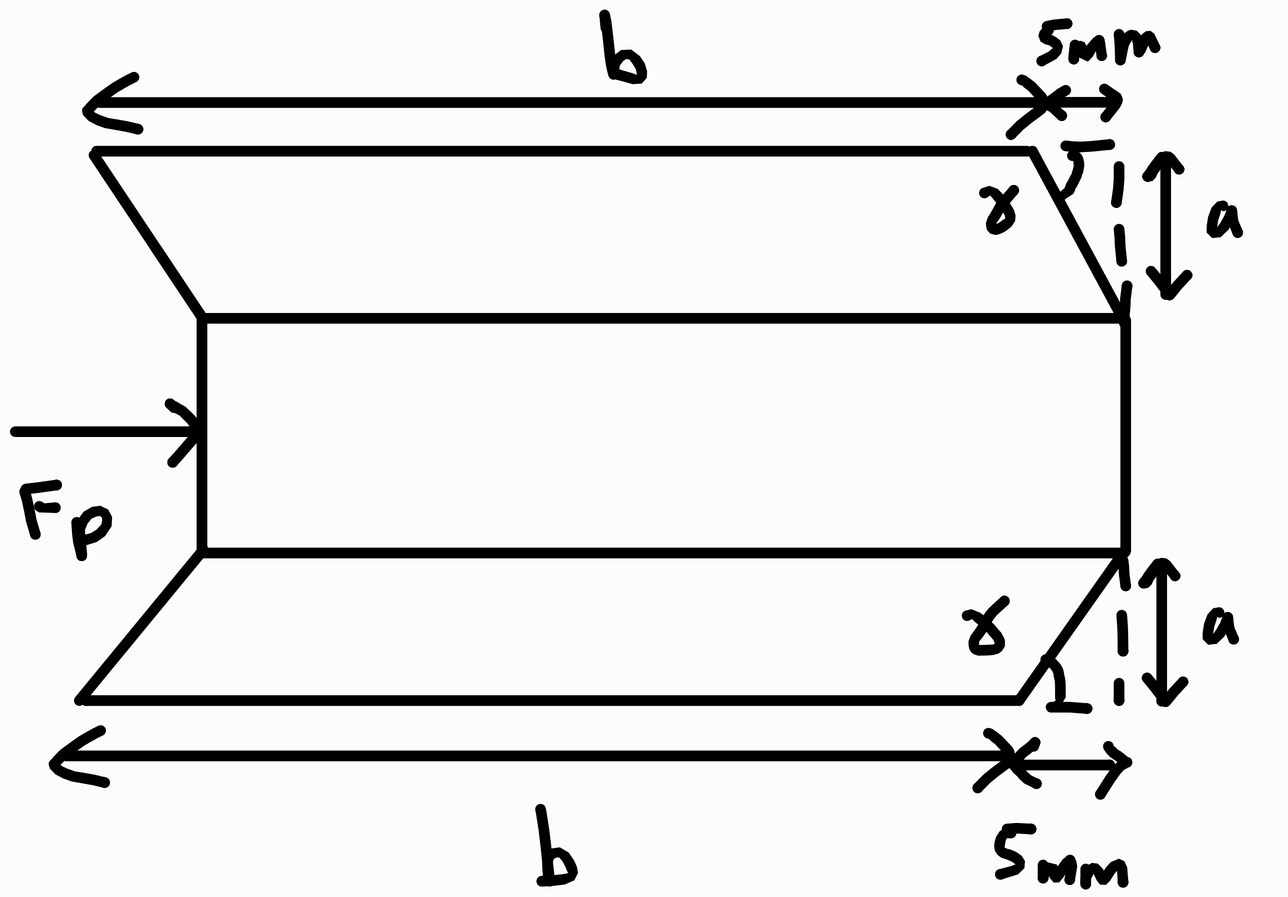
$F_p = 40 \times 10^3 \, N$

$c = 100 \times 10^{-3} \, m$

Before:



After:



$\tau = G\gamma$

Since γ is small,

$\tau = G \tan\gamma$

$1.4 \times 10^6 = 12 \times 10^6 \left(\frac{5}{a}\right)$

$a = 42.85714286 \, mm$

$\approx 43 \, mm$

2.79) Since the above is a double shear (after diagram),

$$\tau = \frac{\frac{1}{2}F_p}{bc}$$

$$1.4\times10^6 = \frac{\frac{1}{2}(40\times10^3)}{100\times10^{-3}b}$$

$$b = 142.857142 9\,mm$$

$$\approx 143\,mm$$