omework-V

$\sigma = \frac{-My}{I}$

and 4.2 Knowing that the couple shown acts in a vertical plane, determine the stress at (*a*) point *A*, (*b*) point *B*.

n 1

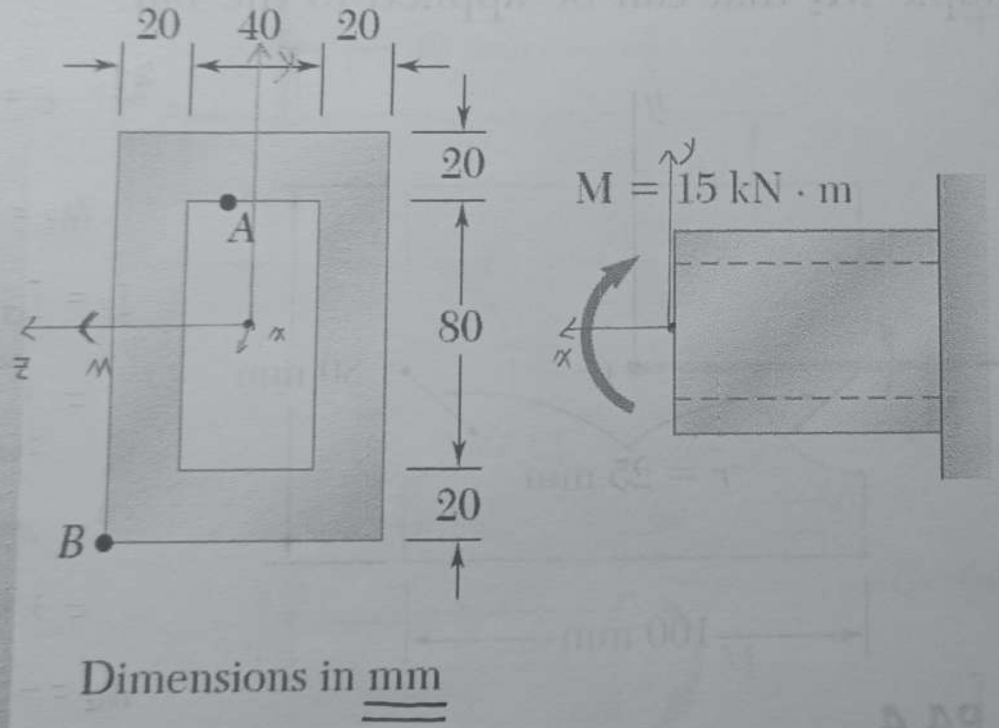


Fig. P4.2

解: $\sigma = \frac{-M_z y}{I_z}$

$I_z = I_o - I_i$

$= \int_{A_1} y^2 dA - \int_{A_2} y^2 dA$

$= \int_{-60\times10^{-3}}^{60\times10^{-3}} y^2 \cdot 80\times10^{-3}\, dy - \int_{-40\times10^{-3}}^{40\times10^{-3}} y^2 \cdot 40\times10^{-3}\, dy$

$= \frac{1}{3}\times 80\times10^{-3}\times\left[(60\times10^{-3})^3 + (60\times10^{-3})^3\right] -$

$\frac{1}{3}\times 40\times10^{-3}\times\left[(40\times10^{-3})^3 + (40\times10^{-3})^3\right]$

$= 9.813\times10^{-6}\ m^4$

$\therefore \sigma_A = \frac{-15\times10^3\times40\times10^{-3}}{9.813\times10^{-6}} = -6.114\times10^4\ kN/m^2$

$\sigma_B = \frac{15\times10^{+3}\times60\times10^{-3}}{9.813\times10^{-6}} = 9.172\times10^4\ kN/m^2$

Homework-V

n 2

σ_{allow}

4.4 A nylon spacing bar has the cross section shown. Knowing that the allowable stress for the grade of nylon used is 24 MPa, determine the largest couple $\mathbf{M}_z$ that can be applied to the bar.

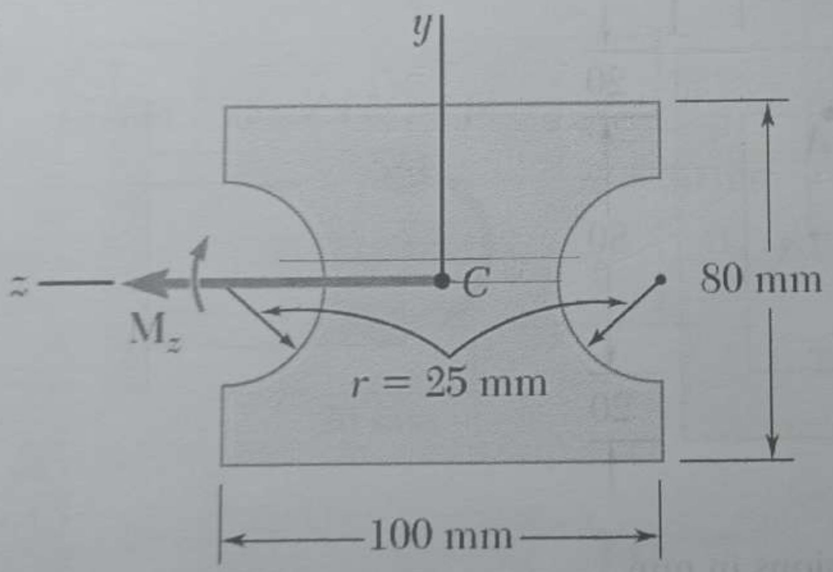


Fig. P4.4

解: $\sigma = -\dfrac{M_z y}{I_z}$

$M_z = -\dfrac{\sigma I_z}{y}$

$I_z = I_{\square} - I_{o}$

$= \int_{-40\times10^{-3}}^{40\times10^{-3}} y^2\, 100\times10^{-3}\, dy - \frac{1}{4}\pi(25\times10^{-3})^4$

$= 100\times10^{-3}\times\frac{1}{3}\times2\times(40\times10^{-3})^3 - \frac{1}{4}\pi(25\times10^{-3})^4$

$= 3.960\times10^{-6}\ m^4$

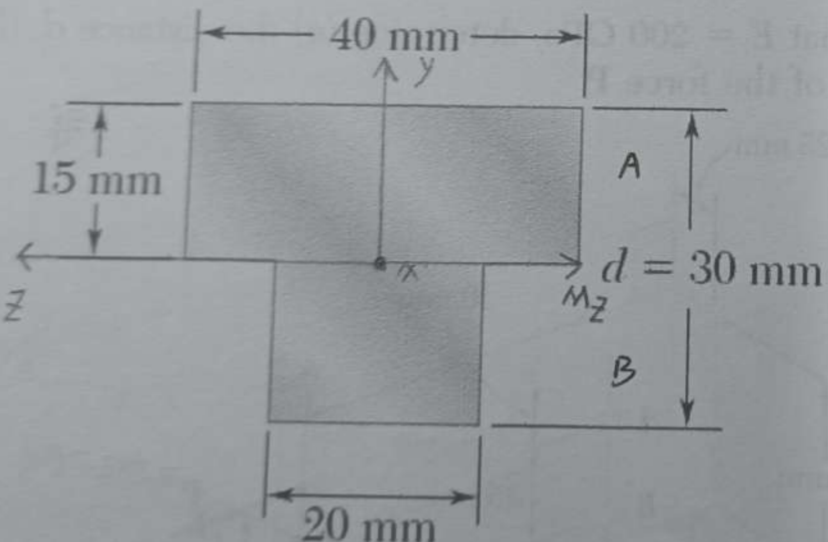
$M_z = -\dfrac{(-24\times10^6)\times3.960\times10^{-6}}{40\times10^{-3}} = +2.376\times10^3\ N\cdot m$

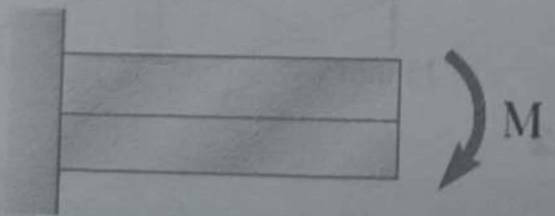
ework-V

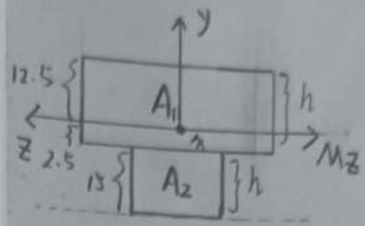
4.15 The beam shown is made of a nylon for which
is 24 MPa in tension and 30 MPa in compres
largest couple **M** that can be applied to the b

$40\times10^{-6}\times(7.5\times10^{-3})^2$

$5\times10^{-6}\times(7.5\times10^{-3})^2$







find 中性面 N.P

$$y(A_1+A_2) = A_2\cdot\frac{1}{2}h + A_1\cdot\frac{3}{2}h$$

$$y = \frac{\frac{1}{2}\times20\times15^2+\frac{3}{2}\times40\times15\times15}{20\times15+40\times15} = 17.5\ mm$$

$$\sigma = +\frac{M_z}{I_z}\cdot y$$

$$I_{z上} = \frac{1}{12}\times40\times15^3+40\times15\times(12.5-7.5)^2 = 26250\ mm^4$$

$$= 2.625\times10^{-8}\ m^4$$

$$I_{z下} = \frac{1}{12}\times20\times15^3+15\times20\times(17.5-7.5)^2$$

$$= 35625\ mm^4 = 3.5625\times10^{-8}\ m^4$$

$$M_{z_1} = \frac{24\times10^6\times(2.625+3.5625)\times10^{-8}}{12.5\times10^{-3}} = 118.8\ N\cdot m$$

$$M_{z_2} = \frac{30\times10^6\times(3.5625+2.625)\times10^{-8}}{17.5\times10^{-3}} = 106.1\ N\cdot m$$

$\therefore\ M_{max} = 106.1\ N\cdot m$

Homework-V

blem 4

4.122 An eccentric force **P** is applied as shown to a steel bar of 25 × 90-mm cross section. The strains at *A* and *B* have been measured and found to be

10^{-6}

$$\epsilon_A = +350\,\mu \qquad \epsilon_B = -70\,\mu$$

Knowing that E = 200 GPa, determine (*a*) the distance *d*, (*b*) the magnitude of the force **P**.

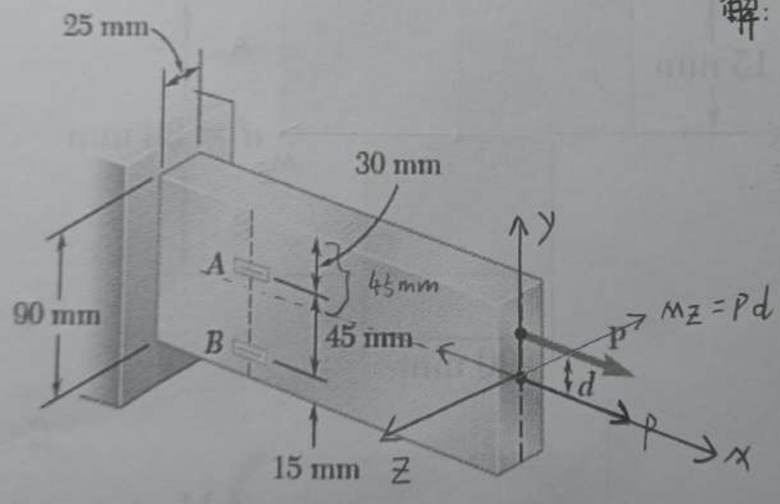


Fig. P4.122

解: $\sigma_x = \frac{P}{A} + \frac{M_z y}{I_z}$, $M_z = Pd$

$I_z = \frac{1}{12}\times 25\times10^{-3}\times(90\times10^{-3})^3 = 1.519\times10^{-6}\ m^4$

$\varepsilon_A = \frac{\sigma_A}{E}$, $\varepsilon_B = \frac{\sigma_B}{E}$

$\sigma_A = \frac{P}{A} + \frac{M_z}{I_z}\times 15\times10^{-3}$

$\sigma_B = \frac{P}{A} + \frac{M_z}{I_z}\times(-30\times10^{-3})$

Solve and get

$d = 30mm$

$P = 94500N$