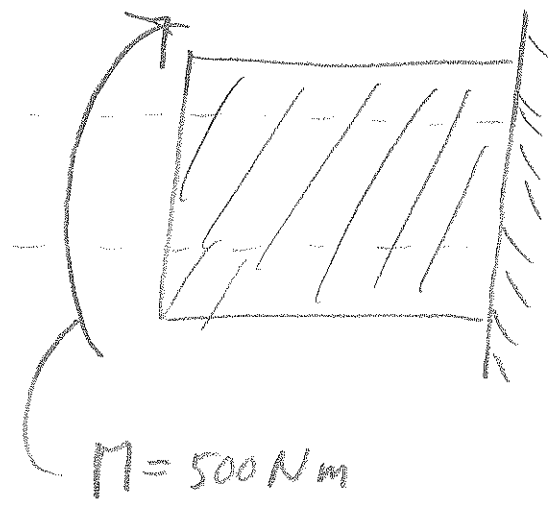
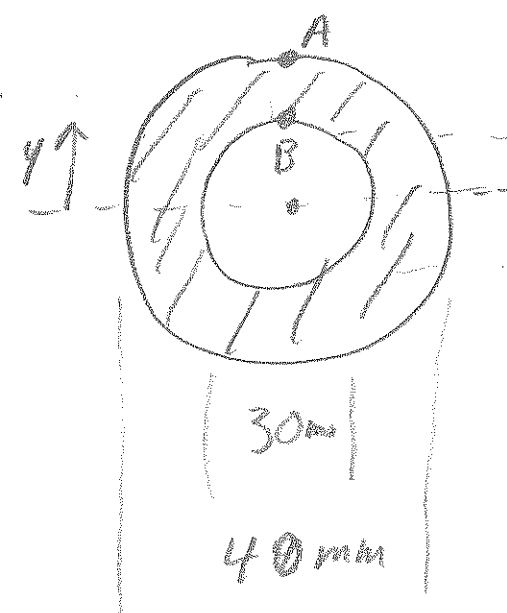


BPT  
11.1



$M = 500 \text{ Nm}$

$\sigma_A = ? \quad \sigma_B = ?$

symmetry ↙

$$I = \int y^2 dA = \int x^2 dA$$

$$= \frac{1}{2} \int (x^2 + y^2) dA = \int r^2 dA$$

$$= \frac{1}{2} \int_{R_i}^{R_o} r^2 (2\pi r dr) = \frac{\pi}{4} r^4 \Big|_{R_i}^{R_o}$$

$$I = \frac{\pi}{64} (D_o^4 - D_i^4) \quad \text{①}$$

$\uparrow$  40 mm  
 $\uparrow$  30 mm

500 Nm ↙  
D<sub>i</sub>/2 ↙

$$\sigma_B = \frac{-My_A}{I} = \frac{-500 \cdot 15 \cdot 10^{-3}}{\frac{\pi}{64} (40^4 - 30^4) \cdot 10^{-12}} \frac{\text{N}}{\text{m}^2} = \frac{-515.164 \cdot 10^7}{\pi (4^4 - 3^4)} \text{ N/m}^2$$

↙ from ①

$$= -8.7 \cdot 10^7 \text{ N/m}^2 = \boxed{-87 \text{ MPa} = \sigma_B}$$

$$\sigma_A = \frac{4}{3} \sigma_B = -116 \text{ MPa}$$