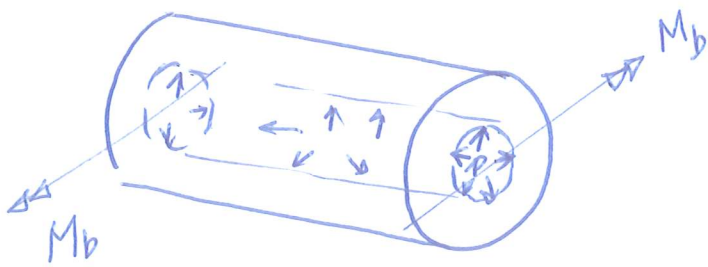


2.9.10



GIVET:

- Tjockväggigt rör med inre övertryck samt böjande moment:

$$p = 50 \text{ MPa}$$

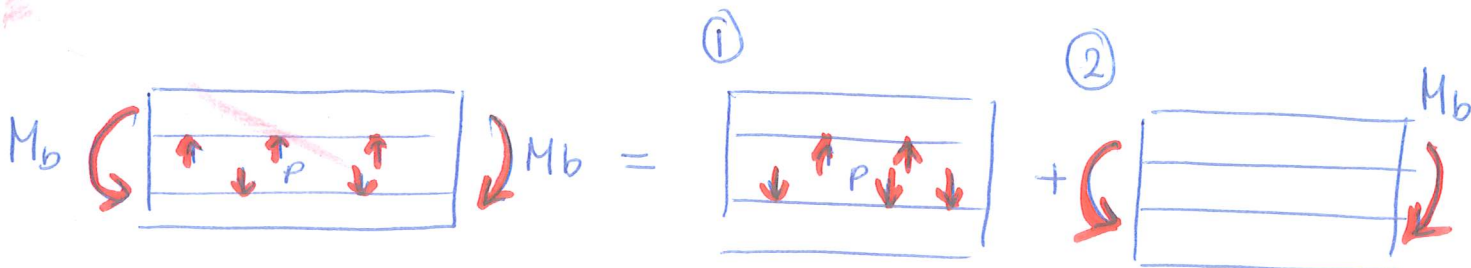
$$M_b = 100 \text{ Nm}$$

- Innerradi: $a = \frac{20}{2} = 10 \text{ mm}$
- Ytterradi: $b = \frac{40}{2} = 20 \text{ mm}$

SÖKT:

- Spänningstillståndet på inner och yterradien av röret.

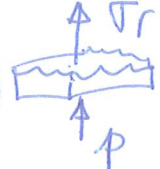
LÖSNING:



- ① Spänningar p.g.a. inre övertryck:

$$\text{F.S. [7.27]} \quad \begin{cases} \sigma_r^{(1)} = A - \frac{B}{r^2} & (1) \\ \sigma_\varphi^{(1)} = A + \frac{B}{r^2} & (2) \\ \sigma_z^{(1)} = 0 & (3) \end{cases}$$

Randvillkor:

$r=a \Rightarrow$ (snitta)  \Rightarrow (r.m.v) $\sigma_r^{(1)}(r=a) = -p$ (4)

$r=b \Rightarrow$  \Rightarrow (r.m.v) $\sigma_r^{(1)}(r=b) = 0$ (5)

Lösa (4), (5) i (1) (2):

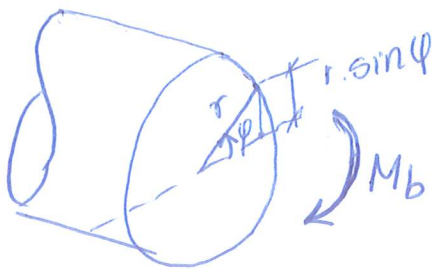
$$A = \frac{pa^2}{b^2 - a^2}$$

$$B = \frac{pa^2b^2}{b^2 - a^2}$$

$$\left. \begin{aligned} \sigma_r' &= \frac{pa^2}{b^2 - a^2} \left(1 - \frac{b^2}{r^2} \right) \quad (6) \\ \sigma_\varphi' &= \frac{pa^2}{b^2 - a^2} \left(1 + \frac{b^2}{r^2} \right) \quad (7) \end{aligned} \right\} \quad [F.S. 7.30]$$

$$\sigma_z' = 0 \quad (8)$$

② Spänningar p.g.a. böjmoment.



$$\sigma_z^{(2)} = \frac{M_b}{I} r \sin \varphi \quad (9)$$

$$\sigma_r^{(2)} = \sigma_\varphi^{(2)} = 0$$

① + ②:

$$\sigma_r = \sigma_r^{(1)} + \sigma_r^{(2)} = \frac{pa^2}{b^2 - a^2} \left(1 - \frac{b^2}{r^2} \right) \quad (10)$$

$$\sigma_\varphi = \sigma_\varphi^{(1)} + \sigma_\varphi^{(2)} = \frac{pa^2}{b^2 - a^2} \left(1 + \frac{b^2}{r^2} \right) \quad (11)$$

$$\sigma_z = \sigma_z^{(1)} + \sigma_z^{(2)} = \frac{M_b}{I} r \sin \varphi \quad (12)$$

SÖLT: Spännings tillståndet på:

- Innerradien $r=a$:

$$\sigma_r = \frac{pa^2}{b^2-a^2} \left(\frac{a^2-b^2}{a^2} \right) = -p$$

$$\sigma_\varphi = \frac{pa^2}{b^2-a^2} \left(1 + \frac{b^2}{a^2} \right) = \frac{p(a^2+b^2)}{b^2-a^2}$$

$$\sigma_z = \frac{Mb}{I} a \sin \varphi = \left\{ I = \frac{\pi}{4} (b^4 - a^4) \right. \quad 8.332 \left. \right\}$$

$$\begin{cases} \sigma_r = -50 \text{ MPa} \\ \sigma_\varphi = 83,3 \text{ MPa} \\ \sigma_z = 8,5 \sin \varphi \text{ MPa} \end{cases}$$

- Ytterradien $r=b$:

$$\sigma_r = \frac{pa^2}{b^2-a^2} \left(1 - \frac{b^2}{b^2} \right) = 0 \text{ MPa}$$

$$\sigma_\varphi = \frac{2pa^2}{b^2-a^2}$$

$$\sigma_z = \frac{Mb}{I} b \sin \varphi$$

$$\begin{cases} \sigma_r = 0 \text{ MPa} \\ \sigma_\varphi = 33,3 \text{ MPa} \\ \sigma_z = 17,0 \sin \varphi \text{ MPa} \end{cases}$$