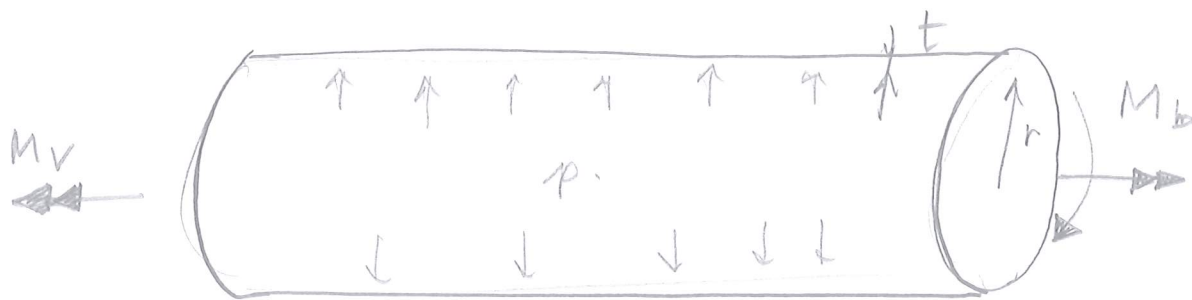


2.9.9

GIVET: tunnväggigt.



$$p = 10 \text{ MPa}$$

$$M_b = 1000 \text{ Nm}$$

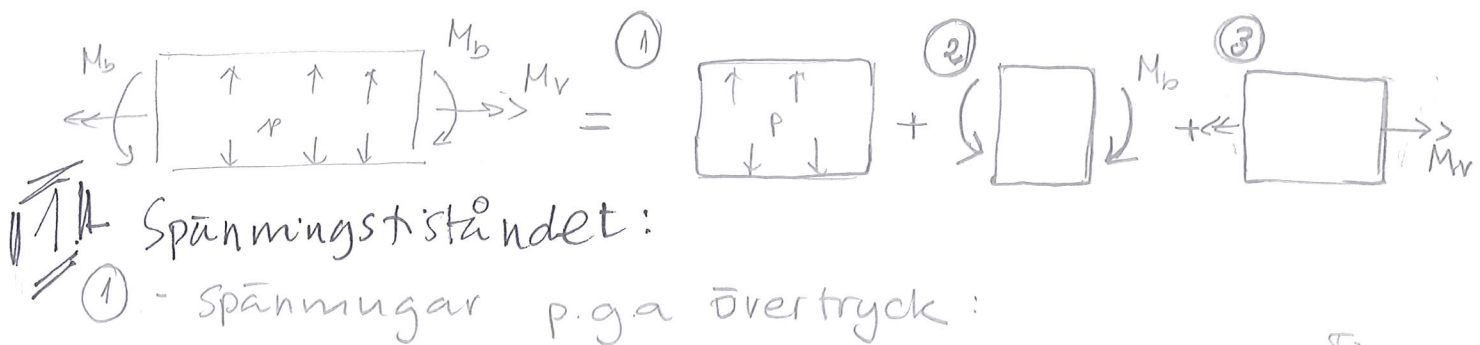
$$M_v = 500 \text{ Nm}$$

$$r = \text{medelradie} = 20 \text{ mm}$$

$$t = 2 \text{ mm}$$

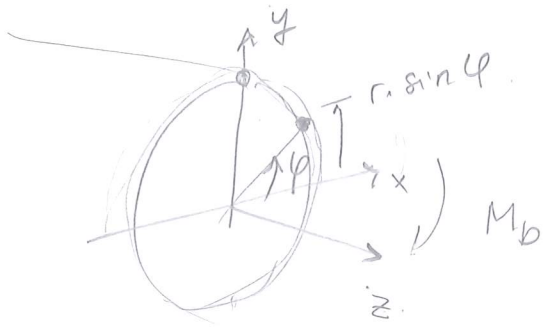
SÖKT: Största skjuvspänningen i mandelytan.

LÖSNING:



$$\left\{ \begin{array}{l} \sigma_z^{(1)} = \frac{p \cdot r}{2h} \quad \left(-p \pi r^2 + \sigma_z \cdot 2\pi r \cdot h = 0 \right) \\ \sigma_\varphi^{(1)} = \frac{p \cdot r}{h} \quad \left(p \cdot 2r \cdot \Delta z - \sigma_\varphi \Delta z \cdot 2h = 0 \right) \\ \sigma_r^{(1)} = 0 \end{array} \right.$$

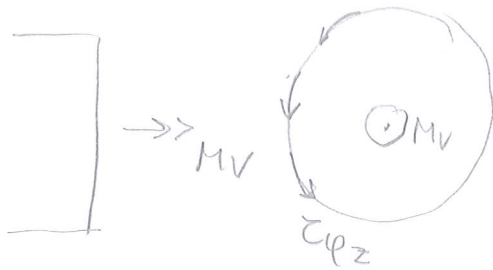
②. - Spänningar p.g.a böjmoment:



$$\sigma_z^{(2)} = \frac{M_b}{I} r \sin \varphi \quad \text{där } I = \pi a^3 t$$

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

③. - Spänningar p.g.a vridning.



$$\hookrightarrow -M_v + \underbrace{\tau_{\varphi z} 2\pi r \cdot h}_{\substack{\text{Area} \\ \text{kraft}}} \cdot r = 0$$

$$\tau_{\varphi z} = \frac{M_v}{2\pi r^2 h}$$

Spänningstillstånd: ① + ② + ③:

$$\left\{ \begin{array}{l} \sigma_z = \frac{pr}{2h} + \frac{M_b}{I} r \sin \varphi \\ \sigma_r = 0 \\ \sigma_\varphi = \frac{pr}{h} \\ \tau_{\varphi z} = \frac{M_v}{2\pi r^2 h} \end{array} \right.$$

$$\Rightarrow \text{Störst} \Rightarrow \varphi = \pm 90^\circ$$

$$I = \pi a^3 t$$

$$447,88 \text{ MPa}$$

$$\sigma_z = \frac{pr}{2h} \pm \frac{Mbr}{I} \quad \left. \begin{array}{l} \text{DBS!} \\ \text{huvudspänning} \end{array} \right\} \begin{array}{l} 447,88 \text{ MPa} \\ - 347,8 \text{ MPa} \end{array}$$

\uparrow
[N, mm, Mb]

$$\sigma_\varphi = \frac{ph}{h} = 100 \text{ MPa}$$

$$\tau_{\varphi z} = \frac{Mv}{2\pi r^2 h} = 99,47 \text{ MPa}$$

$\sigma_r = 0 \Rightarrow$ Platt spänning.

2 Huvudspänningar 2D, Mohrs cirkel.

Ans 1: $(-M_b, \varphi = -90^\circ)$

$$\sigma_z = -347,8 \text{ MPa}$$

$$\sigma_\varphi = 100 \text{ MPa}$$

$$\tau_{\varphi z} = 99,47 \text{ MPa}$$

$$\Rightarrow \left\{ \begin{array}{l} R = \left(\left(\frac{\sigma_z - \sigma_\varphi}{2} \right)^2 + \tau_{\varphi z}^2 \right)^{1/2} \\ \sigma_{1,2} = \frac{(\sigma_z + \sigma_\varphi)}{2} \pm R \end{array} \right.$$

$$\sigma_1^{2D} = 21,09 \text{ MPa}$$

$$\sigma_2^{2D} = -468,98 \text{ MPa}$$

Ans 2: $(+M_b) \varphi = 90^\circ$

$$\sigma_z = 447,8 \text{ MPa}$$

$$\sigma_\varphi = 100 \text{ MPa}$$

$$\tau_{\varphi z} = 99,47 \text{ MPa}$$

$$\Rightarrow \left\{ \begin{array}{l} \sigma_1^{2D} = 374,32 \text{ MPa} \\ \sigma_2^{2D} = -26,4 \text{ MPa} \end{array} \right.$$

3 Huvudspänningar 3D.

Ans 1. $\left\{ \begin{array}{l} \sigma_1 = 21,09 \text{ MPa} \\ \sigma_2 = 0 \text{ MPa} \\ \sigma_3 = -468,98 \text{ MPa} \end{array} \right.$

Ans 2 $\left\{ \begin{array}{l} \sigma_1 = 374,32 \text{ MPa} \\ \sigma_2 = 0 \text{ MPa} \\ \sigma_3 = -26,4 \text{ MPa} \end{array} \right.$

14.1 Största skjuvspänningen

Ant 1:

$$\tau_{\max} = \frac{\sigma_1 - \sigma_3}{2} = \underline{\underline{245,04 \text{ MPa}}}$$

Ant 2:

$$\tau_{\max} = \frac{\sigma_1 - \sigma_3}{2} = 200,37 \text{ MPa}$$

STÖRST.
när $\varphi = -90^\circ$
(-Mb)