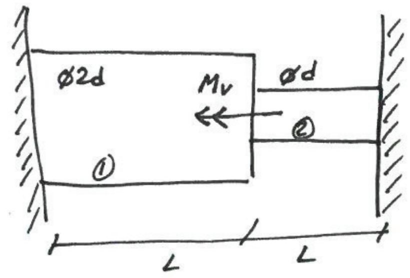
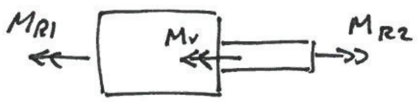
2.6.29 Massiv axel.

× Elastiskt-idealpl. mtrl
$G \quad \tau_s$



Sökt Förhållande M_s och M_f
beg. pl. fullst. pl

1. Frilägg

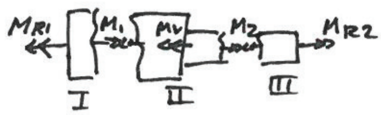


2. Jmv

$\rightarrow: -M_{R1} - M_v + M_{R2}$

$\iff \underline{M_{R2} - M_{R1} = M_v}$

3. Snitta



4. Jmv

$\underset{I}{\rightarrow}: -M_{R1} + M_1 = 0 \implies M_1 = M_{R1}$

$\underset{II}{\rightarrow}: -M_1 - M_v + M_2 = 0 \implies M_2 - M_1 = M_v$

$\underset{III}{\rightarrow}: -M_2 + M_{R2} = 0 \implies M_2 = M_{R2}$

dvs 2 obekanta
1 ekvation

5. Skjuvspänning /Vridmoment

$$\left[M_v = \int_a^b 2\pi \tau r^2 dr\right]$$

6. Konstitutivt samband

$$\left[\begin{array}{ll} \text{El. område:} & \tau = G\gamma \\ \text{Pl. område:} & \tau = \tau_s \end{array}\right]$$

7. Kompabilitet

$[\gamma \cdot L = \theta \cdot r]$ och $\theta_1 + \theta_2 = 0 \implies \underline{\theta_1 = -\theta_2}$ ty fast inspänt

Sätt ihop 5.+6.+7. alt. använd direkt FS. 6.75

Behöver θ och har M_v

$$\because \theta = \frac{2 M_v L}{\pi G (b^4 - a^4)} \implies \theta_1 = \frac{2 M_1 \cdot L}{\pi G\left(\left(\frac{2d}{2}\right)^4 - 0^4\right)} = \frac{2 M_1 \cdot L}{\pi G d^4}$$

$$\theta_2 = \frac{2 M_2 \cdot L}{\pi G\left(\left(\frac{d}{2}\right)^4 - 0^4\right)} = \frac{32 M_2 \cdot L}{\pi G d^4}$$

$$\implies \frac{2 M_1 L}{\pi G d^4} = -\frac{32 M_2 L}{\pi G d^4} \iff \underline{M_1 = -16 M_2} \implies \begin{cases} M_2 = \frac{1}{17} M_v \\ M_1 = -\frac{16}{17} M_v \end{cases}$$

Vilket rör plasticerar först? Den med |störst| skjuvspänning.

$$\implies \left[\tau(r) = \frac{G\theta r}{L}\right] \text{ FS. 6.74} \implies \begin{cases} \tau_1^{max}(r = r_{max} = d) = \frac{G}{L} \cdot d \cdot \frac{2 \cdot \frac{-16}{17} M_v \cdot L}{\pi G d^4} = \frac{-32 M_v}{17 \pi d^3} \\ \tau_2^{max}\left(r = r_{max} = \frac{d}{2}\right) = \frac{G}{L} \cdot \frac{d}{2} \cdot \frac{32 \cdot \frac{1}{17} \cdot M_v \cdot L}{\pi G d^4} = \frac{16 M_v}{17 \pi d^3} \end{cases}$$

Obs skjuvspänning störst längst ut på röret

Obs2 alt. FS.6.76

dvs $|\tau_1^{max}| > |\tau_2^{max}| \implies \tau_s = \frac{32 M_s}{17 \pi d^3} \iff \underline{\underline{M_s = \frac{17 \pi d^3 \tau_s}{32}}}$

Moment vid begynnande plasticering

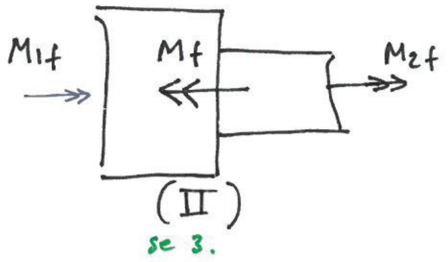
2.6.29

forts 1.

Nu behöver vi M_f, dvs då **båda** rören plasticerat

Då gäller följande

Obs
Detta vridmoment motverkar M_v, ty vi fick $M_1 < 0$ i föregående jmv



Jmv

$\rightarrow$: $+M_{1f} - M_f + M_{2f} = 0$

$\Longleftrightarrow$ $\underline{M_{2f} + M_{1f} = M_f}$

Återhaller från 5.

$$\left[M_v = \int_a^b 2\pi\tau r^2 dr \right] \Longrightarrow$$

$$M_{1f} = \frac{2\pi\tau_s\left(\left(\frac{2d}{2}\right)^3 - 0^3\right)}{3} = \frac{2\pi d^3 \tau_s}{3}$$

$$M_{2f} = \frac{2\pi\tau_s\left(\left(\frac{d}{2}\right)^3 - 0^3\right)}{3} = \frac{\pi d^3 \tau_s}{12}$$

$$\Longrightarrow M_f = \frac{\pi d^3 \tau_s}{12} + \frac{2\pi d^3 \tau_s}{3} = \frac{3\pi d^3 \tau_s}{4}$$

$$\therefore \frac{M_f}{M_s} = \frac{\frac{3\pi d^3 \tau_s}{4}}{\frac{17\pi d^3 \tau_s}{32}} = \frac{3}{4} \cdot \frac{32}{17} = \frac{24}{17} \approx \underline{\underline{1.41}}$$