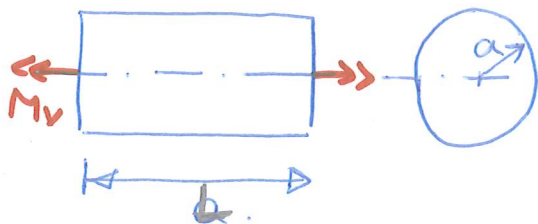


2.6.31

GIVET:



- cylindrisk stång
- radien: a
- längden: L
- elastiskt ideal-plastisk mat: (G, τ_s)

- M_v överskrider 20% momentet vid begynnande plastcening.

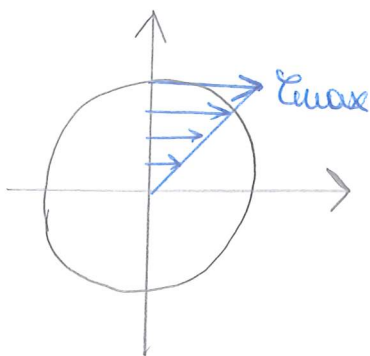
SÖKT: A) Plastcenningsdjupet ξ_s

B) återpjädnng ($\Delta\phi$), kvarstående deformation (ϕ_{rest})

C) Restspänningstillståndet (τ_{rest})

LÖSNING:

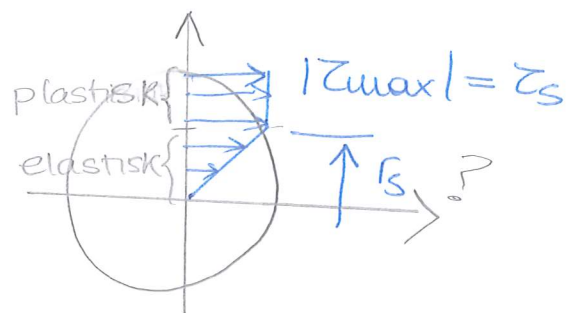
När man lastar till $M_v = 1.2 M_{vs}$.



Elastisk
pålastning

till $|\tau_{max}| = \tau_s$
då $M_v = M_{vs}$

momentet vid
begynnande
plastcening



Elastisk-plastisk
pålastning

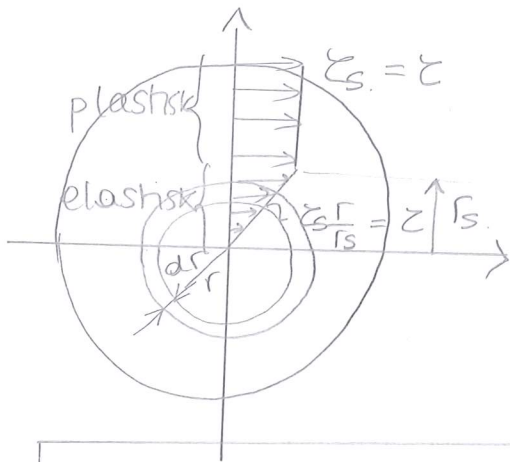
$M_v = 1.2 M_{vs}$

A) Plasticeringsdjupet, r_s ?

J_{mv}

$$M_v (= 1.2 M_{vs}) = \int_0^{r_s} \underbrace{\zeta_s \frac{r}{r_s}}_{\text{kraft}} \underbrace{2\pi dr r}_{\text{moment}} + \int_{r_s}^a \zeta_s 2\pi dr r \Rightarrow$$

spänning vid elastiska zonen.



$$M_v = \int_0^{r_s} \zeta_s 2\pi \frac{r^3}{r_s} dr + \int_{r_s}^a \zeta_s 2\pi r^2 dr$$

$$M_v = [F.S. 6.84] = 2\pi \zeta_s \left(\frac{a^3}{3} - \frac{r_s^3}{12} \right) \quad (1)$$

$$M_v = 1.2 M_{vs} \quad (2)$$

Hur mycket är M_{vs} ?

$$\left. \begin{array}{l} \text{- cylindrisk stång} \\ \text{- radie } a \end{array} \right\} \zeta = \frac{M_v r}{K} \rightarrow \zeta_{max} = \frac{M_v r_{max}}{K}$$

$$\text{eller } \zeta_{max} = \frac{M_v}{W_v}$$

$$[F.S. 6.77] \quad W_v = \frac{\pi}{2b} (b'^4 - a'^4) \left\{ \begin{array}{l} b' = a \\ a' = 0 \end{array} \right\} W_v = \frac{\pi a^3}{2}$$

$$\zeta_{max} = \frac{2 M_v}{\pi a^3} \quad \text{vid begynnande plast} \quad |\zeta_{max}| = \zeta_{till}$$

$\zeta_{max} = +\zeta_{till}$

$$M_{vs} = \frac{\pi a^3}{2} \zeta_s \quad (3)$$

$$(3) \text{ i } (2) \Rightarrow \underline{M_V = \frac{1.2}{2} \pi a^3 \tau_s} \quad (4)$$

$$(4) \text{ i } (1) \Rightarrow$$

$$\frac{1.2}{2} \pi a^3 \tau_s = 2\pi \tau_s \left(\frac{a^3}{3} - \frac{r_s^3}{2} \right)$$

$$\frac{2 \tau_s^3}{12} = \left(\frac{2a^3}{3} - \frac{1.2 a^3}{2} \right)$$

$$r_s = \sqrt[3]{\frac{2/3 - 1.2/2}{2/12}} a.$$

$$\boxed{r_s = 0.737 a} \quad (5)$$

B) Återfjädring ($\Delta\psi$) kvarstående def. (Prest)
vid elastiskt avlastning

$$M_V = 1.2 M_V \rightarrow \text{Avlastning } \Delta M = -1.2 M_{Vs}$$

$$\text{Elastiskt avlastning} \Rightarrow \Delta\psi = \frac{\Delta M L}{G K}$$

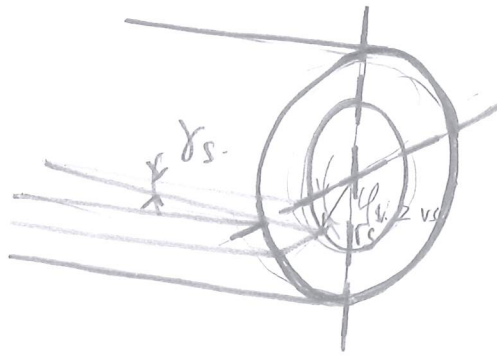
$$\Delta\psi = \frac{-1.2 M_{Vs} L}{G K} \Rightarrow K = \frac{\pi a^4}{2}$$

$$\boxed{\Delta\psi = -2.4 \frac{M_{Vs} L}{G \pi a^4}}$$

↖ Återfjädring

$$\varphi_{rest} = \varphi_{1.2vs} + \Delta\varphi$$

$\varphi_{1.2vs}$?



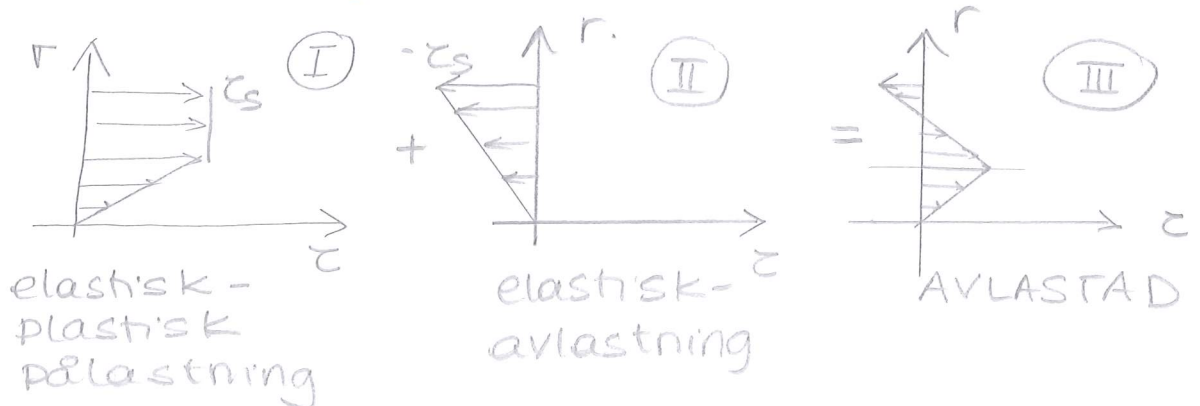
$$\varphi_{1.2vs} \cdot r_s = \gamma_s L$$

$$\varphi_{1.2vs} = \frac{\tau_s L}{G r_s}$$

$$\varphi_{rest} = \frac{\tau_s L}{0.737 a G} - 1.2 \frac{\tau_s L}{G a}$$

$$\boxed{\varphi_{rest} = 0.157 \frac{\tau_s L}{G a}}$$

c) Restspännings tillståndet $\tau_{rest} = \tau_{1.2} + \Delta\tau$



(I) - PÅLASTNING

$$\tau(r) \begin{cases} \tau_s \frac{r}{r_s} & 0 \leq r \leq r_s \\ \tau_s & r_s \leq r \leq a \end{cases}$$

Ⓐ AVLASTNING :

$$M_{vs} = \frac{\pi a^3}{2} \tau_s$$

$$\tau(r) = \frac{M \cdot r}{K} = \frac{(-1.2 M_{vs}) r}{\frac{\pi a^4}{2}} = -1.2 \tau_s \frac{r}{a}$$

Ⓑ AVLASTAD : $\tau_{rest} = \tau^{(I)} + \tau^{(II)}$

$$\tau_{rest} = \begin{cases} \left(\frac{1}{r_s} - \frac{1.2}{a} \right) \tau_s r & 0 \leq r \leq r_s \\ \left(1 - \frac{1.2 r}{a} \right) \tau_s & r_s \leq r \leq a \end{cases}$$

