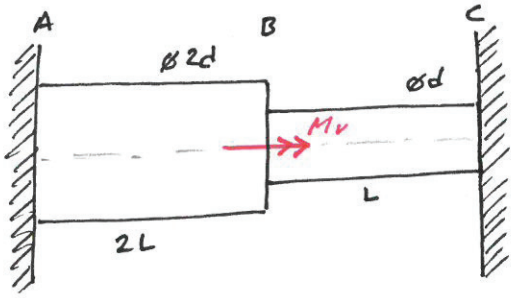
2.6.14 Givet — Inspänd axel



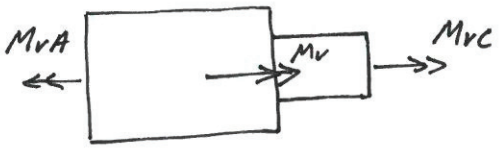
× Tillåten skjuvspänning τ_{Till}

× Vridmoment M_v

Sökt M_v då $\tau = \tau_s$

Lösning

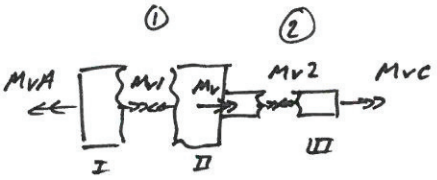
1. Frilägg



2. Jmv

$\rightarrow\!\!\!\rightarrow$: $-M_{vA} + M_v + M_{vC} = 0$

3. Snitta



4. Jmv

$\rightarrow\!\!\!\rightarrow_{I}$: $-M_{vA} + M_{v1} = 0 \Rightarrow M_{v1} = M_{vA}$

$\rightarrow\!\!\!\rightarrow_{II}$: $-M_{v1} + M_v + M_{v2} = 0 \Rightarrow M_{v2} = M_v + M_{v1} = M_v + M_{vC}$

$\rightarrow\!\!\!\rightarrow_{III}$: $-M_{v2} + M_{vC} = 0 \Rightarrow M_{v2} = M_{vC}$

(dvs 3. och 4. ger ingen ny information ... vi har 1 ekvation 2 obända $\Rightarrow$ statiskt obestämt)

5. Förvridning

$$\left[\theta = \frac{M_v \cdot L}{G K}\right] \text{ FS 6.75} \Rightarrow \begin{cases} \theta_1 = \dfrac{M_{vA} \cdot 2L}{G \cdot K_1} \\ \theta_2 = \dfrac{M_{vC} \cdot L}{G \cdot K_2} \end{cases}$$

$$\left[K = \frac{\pi a^4}{2}\right] \text{ FS. 30.1.3}$$

$$\Rightarrow \begin{cases} K_1 = \dfrac{\pi d^4}{2} \\ K_2 = \dfrac{\pi d^4}{32} \end{cases}$$

6. Kompabilitet ("AB" "BC")

$\theta_1 + \theta_2 = 0$

ty fast inspänd

$\Leftrightarrow \underline{\theta_1 = -\theta_2}$

$$\Rightarrow \frac{M_{vA} \cdot 2L}{G \cdot \left(\frac{\pi d^4}{2}\right)} = -\frac{M_{vC} \cdot L}{G \cdot \left(\frac{\pi d^4}{32}\right)} \Leftrightarrow \underline{M_{vA} = -8 M_{vC}}$$

(+ $[-M_{vA} + M_v + M_{vC} = 0]$ ger att $M_{vA} = M_v + M_{vC} = M_v - \frac{M_{vA}}{8} \Rightarrow M_{vA} = \frac{8M}{9}$

$M_{vC} = \ldots = -\frac{M_v}{9}$

$\Rightarrow$ Sökt är $\tau_{max} = \tau_{Till}$; vilket fås av:

$$\left[\tau_{max} = \frac{M_v}{W_v}\right] \text{ FS. 6.76}$$

$$\left[W_v = \frac{\pi r^3}{2}\right] \text{ FS. 30.1.3}$$

$$W_{v1} = \frac{\pi\left(\frac{d}{2}\right)^3}{2} = \frac{\pi d^3}{2}$$

$$W_{v2} = \frac{\pi\left(\frac{d}{2}\right)^3}{2} = \frac{\pi d^3}{16}$$

$$\Rightarrow \tau_{max,1} = \frac{M_{vA}}{W_{v1}} = \frac{\frac{8M_v}{9}}{\frac{\pi d^3}{2}} = \frac{16 M_v}{9\pi d^3}$$

$$\tau_{max,2} = \frac{M_{vC}}{W_{v2}} = \frac{-\frac{M_v}{9}}{\frac{\pi d^3}{16}} = -\frac{16 M_v}{9\pi d^3}$$

$$\Rightarrow \underline{M_{v,max} = \tau_{Till} \cdot \frac{9\pi d^3}{16}}$$

De går alltså sönder samtidigt!