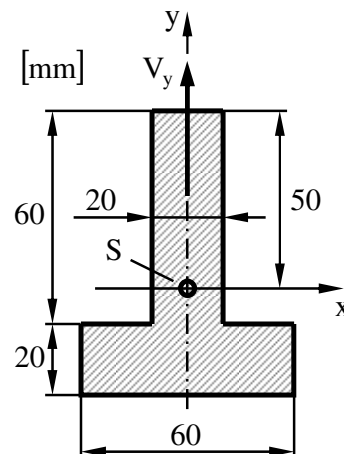


1.)

Rajzolja meg a nyírófeszültségek eloszlását az y tengely mentén! Számítsa ki a jellemző értékeket! Az ábrán a súlypont helyzetét is beméreteztük.

$$V_y = 50 \text{ kN}$$



2.)

Számítsa ki a bejelölt rúd kihajlással szembeni biztonsági tényezőjét!

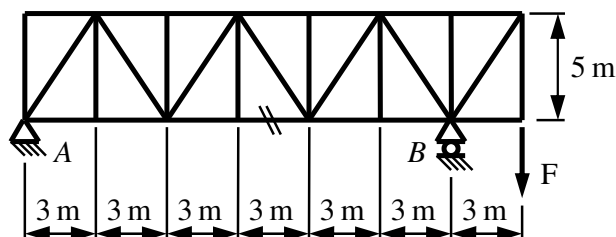
Adatok:

$$F = 50 \text{ kN}$$

A vizsgált rúd csőszelvény:

$$D = 60 \text{ mm}, d = 50 \text{ mm}$$

$$E = 210 \text{ GPa}, \sigma_t = 310 - 1,14\lambda, \lambda_0 = 100$$

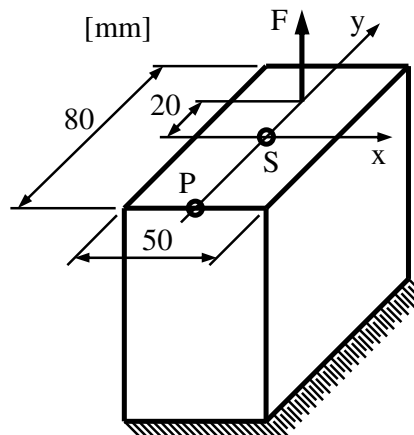


3.)

Számítsa ki a központosan húzott hasáb P pontjában ébredő feszültség értékét! Húzó- vagy nyomófeszültségről van szó?

Adatok:

$$F = 200 \text{ kN}$$



4.)

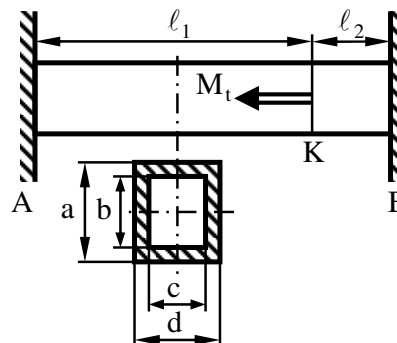
A vékonyfalú alkatrész mindkét végén befogott. Számítsa ki a reakciónyomatékokat! Mekkora az alkatrészben ébredő legnagyobb feszültség? Mekkora a K keresztmetszet elfordulása?

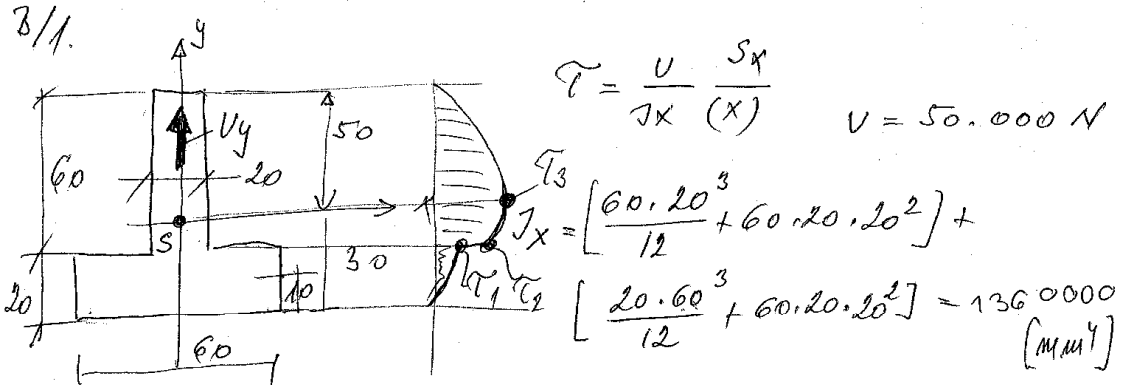
Adatok:

$$\ell_1 = 1,5 \text{ m}, \ell_2 = 0,5 \text{ m}$$

$$a = 80 \text{ mm}, b = 72 \text{ mm}, c = 52 \text{ mm}, d = 60 \text{ mm}$$

$$G = 80 \text{ GPa}, M_t = 2 \text{ kNm}$$





$$S_{1x} = 20 \cdot 60 \cdot 20 = 24.000 \text{ [mm}^3\text{]}$$

$$S_{3x} = 50 \cdot 20 \cdot 25 = 25.000 \text{ [mm}^3\text{]}$$

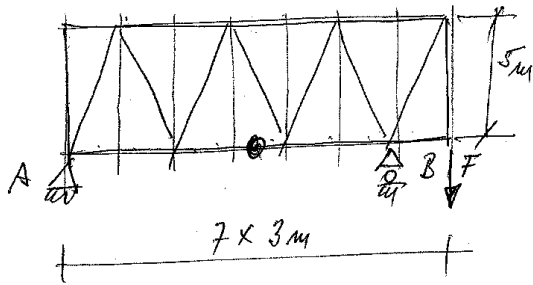
$$\tau_1 = \frac{50.000 \cdot 24.000}{136.0000 \cdot 60} = 14,71 \text{ [MPa]}$$

$$\tau_2 = \frac{50.000 \cdot 24.000}{136.0000 \cdot 20} = 44,12 \text{ [MPa]}$$

$$\tau_3 = \frac{50.000 \cdot 25.000}{136.0000 \cdot 20} = 45,96 \text{ [MPa]}$$

3x15 pont

3/2.



$$\sum M_B = 0$$

$$F \cdot 3 - 6 \cdot 3 \cdot A_y = 0$$

$$A_y = \frac{7.5}{3 \cdot 6} = \frac{50}{6} \text{ N}$$

$$F = 50 \text{ kN}$$

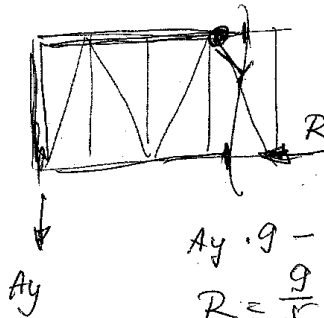
$$D = 60 \text{ mm}$$

$$d = 50 \text{ mm}$$

$$E = 210 \text{ GPa}$$

$$\sigma_t = 310 - 11,111$$

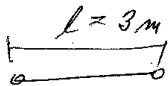
$$\lambda_0 = 100$$



$$A_y \cdot 3 - R \cdot 3 = 0$$

$$R = \frac{3}{3} A_y = \frac{3}{3} \cdot \frac{50}{6} = \frac{90}{6} = 15 \text{ kN}$$

A mild steel tube: 15 kN



$$l_0 = 3 \text{ m} = 3000 \text{ mm}$$

$$J = \frac{D^4 \pi}{64} - \frac{d^4 \pi}{64} = \frac{(60^4 - 50^4) \pi}{64} = 329209,4 \text{ mm}^4$$

$$A = \frac{D^2 \pi}{4} - \frac{d^2 \pi}{4} = \frac{(60^2 - 50^2) \pi}{4} = 863,5 \text{ mm}^2$$

$$i = \sqrt{\frac{J}{A}} = 19,53 \text{ mm}$$

$$\lambda = \frac{l_0}{i} = \frac{3000}{19,53} = 153,61 \rightarrow \text{Euler}$$

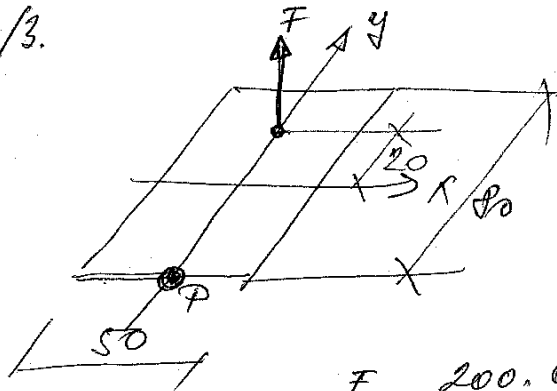
$$\sigma_t = \frac{\pi^2 E}{\lambda^2} = \frac{3,14^2 \cdot 210.000}{153,61^2} = 87,75 \text{ N/mm}^2$$

$$F_T = \sigma_t \cdot A = 87,75 \cdot 863,5 = 75.770,81 \text{ N} = 75,8 \text{ kN}$$

$$n = \frac{75,8}{15} = 5,05$$

Σ 30 pont

3/3.



$$F = 200 \text{ kN}$$

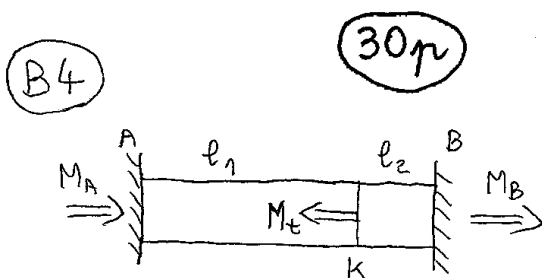
$$\sigma_P = + \frac{F}{A} - \frac{F \cdot 20}{I_x} \cdot 40$$

$$\frac{F}{A} = \frac{200.000}{50 \cdot 80} = 50 \text{ MPa}$$

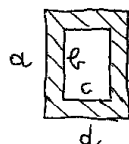
$$- \frac{200.000 \cdot 20 \cdot 40}{\frac{50 \cdot 80^3}{12}} = - 75 \text{ MPa}$$

$$\sigma_P = -25 \text{ MPa (nyomófeszítés)}$$

215

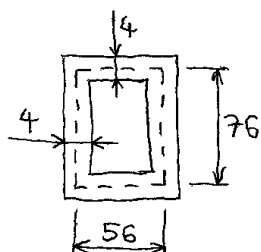


$$\begin{aligned} l_1 &= 1,5 \text{ m} & \alpha &= 80 \text{ mm} \\ l_2 &= 0,5 \text{ m} & b &= 72 \text{ mm} \\ G &= 80 \text{ GPa} & c &= 52 \text{ mm} \\ M_t &= 2 \text{ kNm} & d &= 60 \text{ mm} \end{aligned}$$



$$A_k = 56 \cdot 76 = 4256 \text{ mm}^2$$

$$\oint \frac{ds}{r} = \sum \frac{s_i}{r_i} = \frac{56}{4} + \frac{76}{4} + \frac{56}{4} + \frac{76}{4} = 66$$



$$I_t = \frac{4 A_k^2}{\oint \frac{ds}{r}} = \frac{4 \cdot 4256^2}{66} = 1,098 \cdot 10^6 \text{ mm}^4$$

$$1.) \sum M_t = 0 = M_A - M_t + M_B$$

$$2.) \varphi_K = \varphi_1 = \varphi_2 = \frac{M_A l_1}{I_t G} = \frac{M_B l_2}{I_t G}$$

$$1.) M_B = M_t - M_A$$

$$1 \rightarrow 2.) \frac{M_A l_1}{I_t G} = \frac{(M_t - M_A) l_2}{I_t G}$$

$$M_A = \frac{M_t \cdot l_2}{l_1 + l_2} = \frac{2000 \cdot 0,5}{1,5 + 0,5} = 500 \text{ Nm} (\Rightarrow)$$

$$1.) M_B = M_t - M_A = 2000 - 500 = 1500 \text{ Nm} (\Rightarrow)$$

$$M_B > M_A \rightarrow \tau_{\max} = \frac{M_B}{2 A_k \sqrt{r_{\min}}} = \frac{1500 \cdot 10^3}{2 \cdot 4256 \cdot 4} = 44,06 \text{ MPa}$$

$$\varphi_K = \varphi_1 = \frac{M_A l_1}{I_t G} = \frac{500 \cdot 10^3 \cdot 1500}{1,098 \cdot 10^6 \cdot 80 \cdot 10^3} = 8,538 \cdot 10^{-3} \text{ rad} = 0,4892^\circ$$