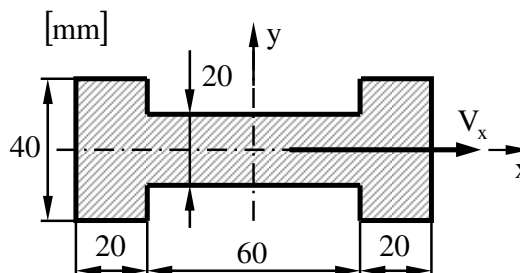


1.)

Rajzolja meg a nyírófeszültségek eloszlását az x tengely mentén! Számítsa ki a jellemző értékeket!

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



2.)

Számítsa ki a bejelölt rúd kihajlással szembeni biztonsági tényezőjét!

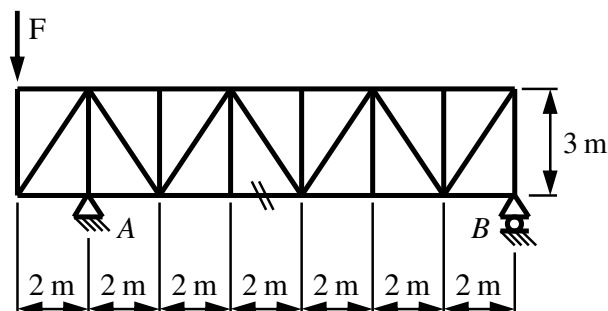
Adatok:

$$F = 45 \text{ kN}$$

A vizsgált rúd csőszelvény:

$$D = 50 \text{ mm}, \quad d = 40 \text{ mm}$$

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



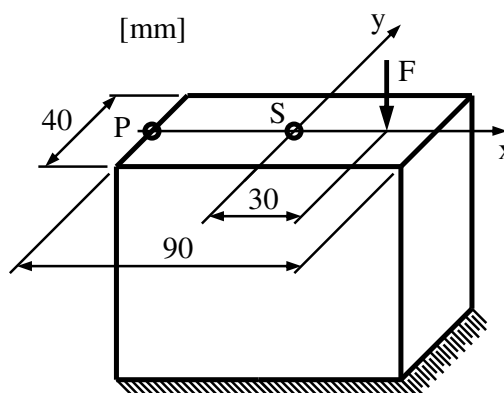
3.)

Számítsa ki a külpontosan nyomott hasáb P pontjában ébredő feszültség értékét!

Húzó- vagy nyomófeszültségről van szó?

Adatok:

$$F = 100 \text{ kN}$$



4.)

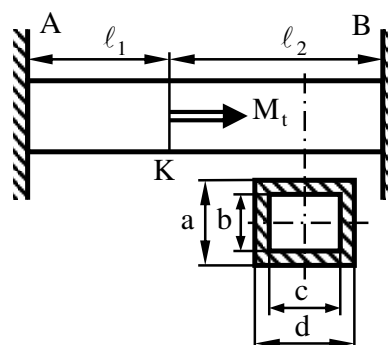
A vékonyfalú alkatrész mindkét végén befogott. Számítsa ki a reakciónyomatékokat! Mekkora az alkatrészben ébredő legnagyobb feszültség? Mekkora a K keresztmetszet elfordulása?

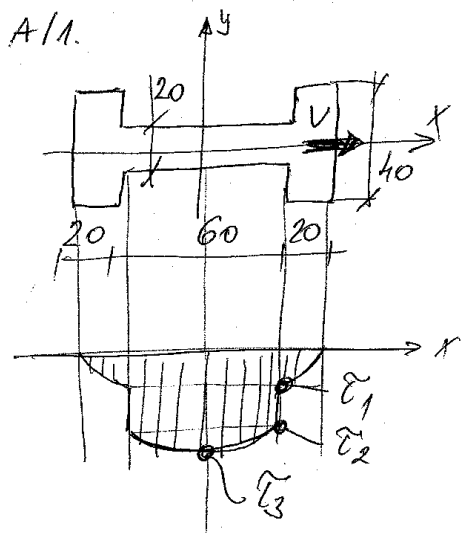
Adatok:

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

$$a = 40 \text{ mm}, \quad b = 36 \text{ mm}, \quad c = 56 \text{ mm}, \quad d = 60 \text{ mm}$$

$$G = 80 \text{ GPa}, \quad M_t = 600 \text{ Nm}$$





$$\tau = \frac{V \cdot S_y}{I_y (y)}$$

$V = 50.000 \text{ N}$

$$I_y = \frac{40 \cdot 100^3}{12} - \frac{20 \cdot 60^3}{12} =$$

$$I_y = 3.333.333,3 - 360.000 =$$

$$I_y = 2.973.333,3 \text{ mm}^4$$

$$S_{ly} = 40 \cdot 20 \cdot 40 = 32.000 \text{ mm}^3$$

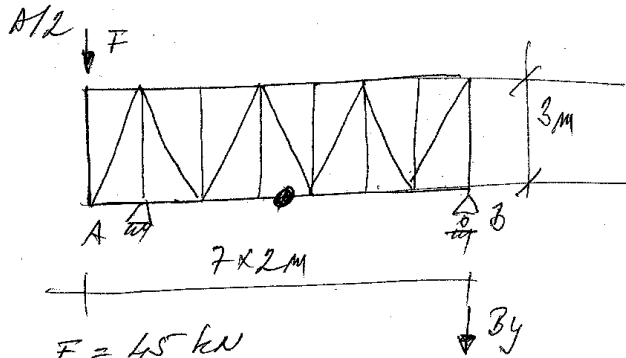
$$S_{3y} = S_{ly} + 30 \cdot 20 \cdot 15 = 41.000 \text{ mm}^3$$

$$\tau_1 = \frac{50.000 [\text{N}] \cdot 32.000 [\text{mm}^3]}{2.973.333,3 [\text{mm}^4] \cdot 40 [\text{mm}]} = 13,45 \left[\frac{\text{N}}{\text{mm}^2} \right] = \text{MPa}$$

$$\tau_2 = \frac{50.000 \cdot 32.000}{2.973.333,3 \cdot 20} = 26,90 [\text{MPa}]$$

$$\tau_3 = \frac{50.000 \cdot 41.000}{2.973.333,3 \cdot 20} = 34,47 [\text{MPa}]$$

É 25 pont



$$\sum H_A = 0$$

$$F \cdot 2 - B_y \cdot 3 = 0$$

$$B_y = \frac{2F}{3} = \frac{2 \cdot 45}{3} = 30 \text{ kN}$$

$$F = 45 \text{ kN}$$

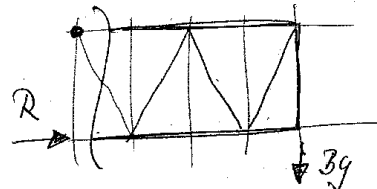
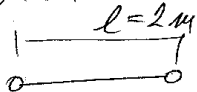
$$D = 50 \text{ mm}$$

$$d = 40 \text{ mm}$$

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

$$\sigma_t = 310 - 1,14 \lambda$$

$$\lambda_0 = 100$$



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

$$R = \frac{B_y \cdot 3}{3} = 20 \text{ kN}$$

A mûl valósl kûhelûk: 20 kN nyomó

$$l_0 = 2 \text{ m} = 2000 \text{ mm}$$

$$I = \frac{D^4 \pi}{64} - \frac{d^4 \pi}{64} = \frac{(50^4 - 40^4) \pi}{64} = 181.040,63 \text{ mm}^4$$

$$A = \frac{D^2 \pi}{4} - \frac{d^2 \pi}{4} = \frac{(50^2 - 40^2) \pi}{4} = 706,5 \text{ mm}^2$$

$$i = \sqrt{\frac{I}{A}} = 16 \text{ mm}$$

$$\lambda = \frac{l_0}{i} = \frac{2000}{16} = 125 \rightarrow \text{Euler}$$

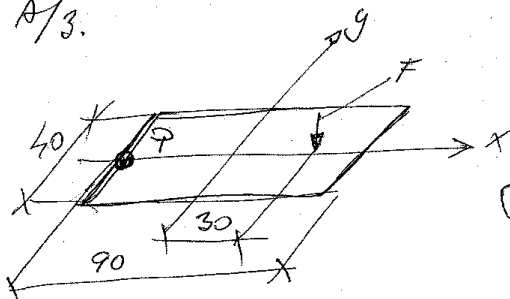
$$\sigma_t = \frac{\pi^2 E}{\lambda^2} = \frac{3,14^2 \cdot 210.000 \text{ N/mm}^2}{125^2} = 132,51 \text{ N/mm}^2$$

$$F_t = \sigma_t \cdot A = 132,51 \cdot 706,5 = 93.620,45 \text{ N} = 93,6 \text{ kN}$$

$$n = \frac{93,6}{20} = 4,68$$

E30 pont

A/3.



$$F = 100 \text{ kN}$$

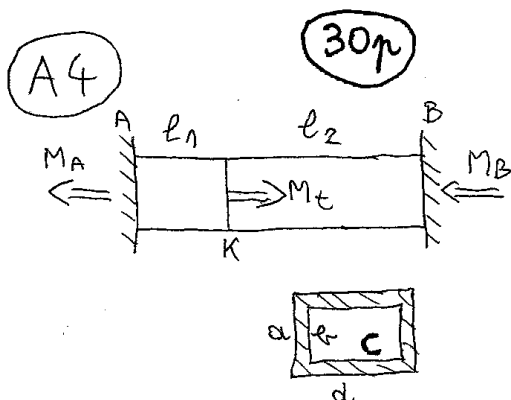
$$\sigma_P = -\frac{F}{A} + \frac{F \cdot 30}{J_y} \cdot 45$$

$$-\frac{F}{A} = \frac{100.000 \text{ N}}{90 \cdot 40 \text{ mm}^2} = -27,78 \text{ MPa}$$

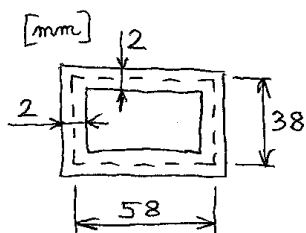
$$\frac{100.000 \cdot 30 \text{ Nmm} \cdot 45 \text{ mm}}{\frac{40 \cdot 90^3}{12} \text{ mm}^4} = 55,56 \text{ MPa}$$

$$\sigma_P = 27,78 \text{ MPa} \text{ (tension)}$$

Σ 15



$$\begin{aligned} l_1 &= 0,5 \text{ m} & \alpha &= 40 \text{ mm} \\ l_2 &= 1 \text{ m} & b &= 36 \text{ mm} \\ G &= 80 \text{ GPa} & c &= 56 \text{ mm} \\ M_t &= 600 \text{ Nm} & d &= 60 \text{ mm} \end{aligned}$$



$$A_k = 58 \cdot 38 = 2204 \text{ mm}^2$$

$$\oint \frac{ds}{r} = \sum \frac{s_i}{r_i} = \frac{58}{2} + \frac{38}{2} + \frac{58}{2} + \frac{38}{2} = 96$$

$$I_t = \frac{4A_k^2}{\oint \frac{ds}{r}} = \frac{4 \cdot 2204^2}{96} = 2,024 \cdot 10^5 \text{ mm}^4$$

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

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

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

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

$$\boxed{M_A = \frac{M_t l_2}{l_1 + l_2} = \frac{600 \cdot 1}{0,5 + 1} = 400 \text{ Nm} (\leftarrow)}$$

$$1.) \boxed{M_B = M_t - M_A = 600 - 400 = 200 \text{ Nm} (\leftarrow)}$$

$$M_A > M_B \rightarrow \boxed{\tau_{\max} = \frac{M_A}{2A_k r_{\min}} = \frac{400 \cdot 10^3}{2 \cdot 2204 \cdot 2} = 45,37 \text{ MPa}}$$

$$\boxed{\varphi_K = \varphi_1 = \frac{M_A l_1}{I_t G} = \frac{400 \cdot 10^3 \cdot 500}{2,024 \cdot 10^5 \cdot 80 \cdot 10^3} = 1,235 \cdot 10^{-2} \text{ rad} = 0,7077^\circ}$$