

①



$$\sigma_{max} = \frac{M_{max}}{I} z_{max} ; z_{max} = R+t$$

2

2. Votli enostavno podprt nosilec dolžine 2 m s tankostenskim kvadratnim presekom $a = 4$ cm in debelino $t = 4$ mm je enakomerno linijsko obremenjen z gostoto q_0 . Določi q_0 obremenitve, da bo napetost po velikosti manjša od $\sigma_0 = 120$ MPa.

②



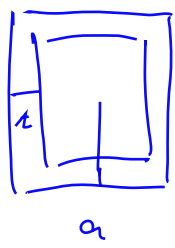
$$z_{max} = R$$

$$\textcircled{1} = I = \frac{1}{4} \pi ((R+t)^4 - R^4) = \underline{\underline{\pi R^3 t}}$$

$$\textcircled{2} I = \frac{1}{4} \pi (R^4 - (R-t)^4)$$

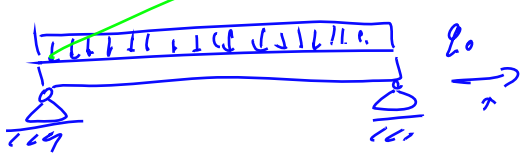
$$= \frac{1}{4} \pi (R^4 - (R^4 - 4R^3 t + 6R^2 t^2 - 4R t^3 + t^4))$$

$$= \frac{1}{4} \pi (4R^3 t - 6R^2 t^2 + 4R t^3 - t^4) \approx \underline{\underline{\pi R^3 t}}$$



$$t = \frac{a}{2}$$

$$\sigma = \sigma_0 ; \sigma = \frac{M}{I} z ; \sigma_{max} = \frac{M_{max}}{I} z_{max}$$



$$\frac{dM}{dx} = Q ; \frac{dQ}{dx} = -q_0$$

$$\frac{d^2 M}{dx^2} = -q_0 ; \frac{dM}{dx} = -q_0 x + C_1$$

$$M = -\frac{1}{2} q_0 x^2 + C_1 x + C_2$$

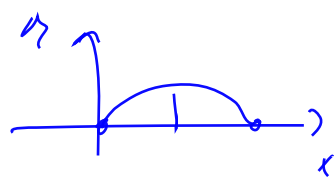
$$M(x=0) = 0 ; M(x=l) = 0$$

$$C_2 = 0$$

$$-\frac{1}{2} q_0 l^2 + C_1 l = 0$$

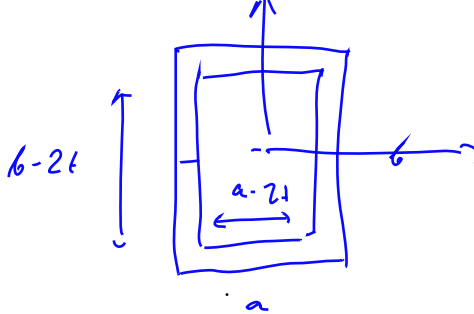
$$C_1 = \frac{1}{2} q_0 l$$

$$M = \frac{1}{2} q_0 x (l-x)$$



$$M_{max} = M(x = \frac{l}{2}) = \frac{1}{8} q_0 l^2$$

$$\frac{dM}{dx} = 0 \Rightarrow -q_0 x + \frac{1}{2} q_0 l = 0 \Rightarrow x = \frac{1}{2} l$$



$$\begin{aligned}
 \bar{I} &= \bar{I}_1 - \bar{I}_2 = \frac{1}{12} a b^3 - \frac{1}{12} (a-2t)(b-2t)^3 = \\
 &= \frac{1}{12} (a b^3 - (a-2t)(b^3 - 3b^2 \cdot 2t + 3b(2t)^2 - (2t)^3)) = \\
 &= \frac{1}{12} (a b^3 - (a b^3 - 2t b^3 - 6b^2 t)) = \\
 &= \frac{1}{12} (2t b^3 + 6a b^2 t) = \frac{1}{6} (b + 3a) b^2 t
 \end{aligned}$$

$$a = b \Rightarrow \boxed{\bar{I} = \frac{2}{3} a^3 t}$$

$$z_{max} = \frac{b}{2} = \frac{a}{2}$$

$$\frac{M_{max}}{I} z_{max} < \sigma_0$$

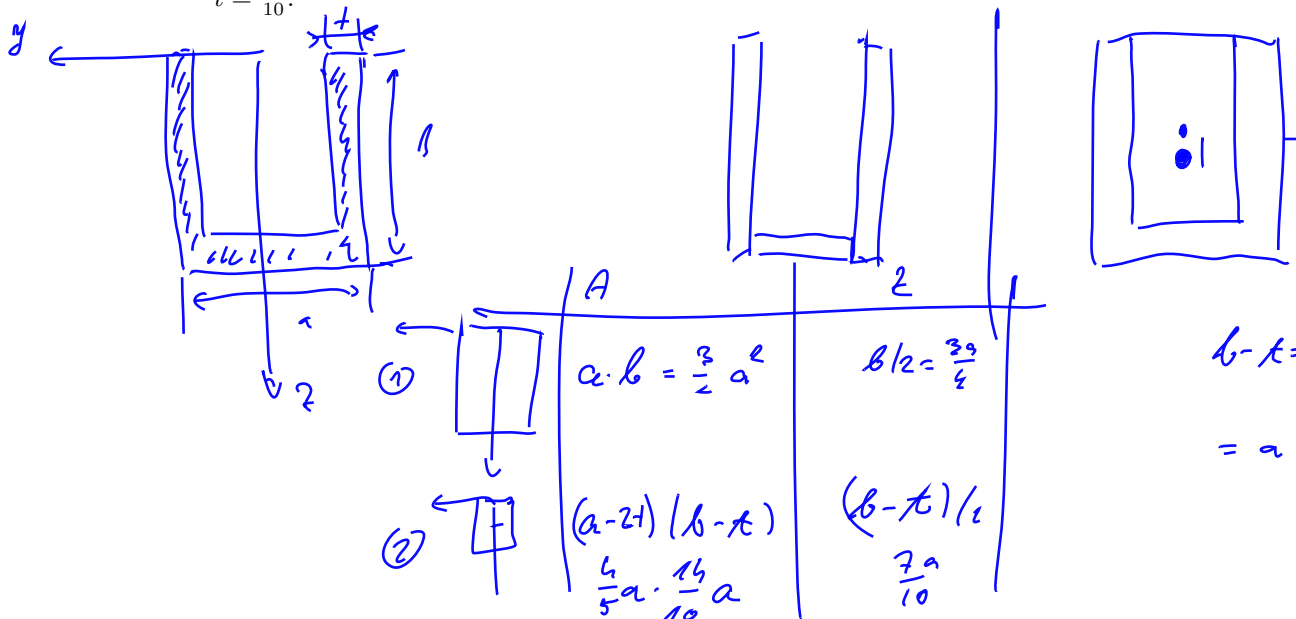
$$3 \cdot \frac{1}{8} l^2 q_0 \cdot a < \sigma_0$$

$$q_0 < \frac{\sigma_0 t \cdot a^2 \cdot 32}{3 l^2}$$

$$q_0 < \frac{120 \cdot 10^6 \text{ N} \cdot 4 \cdot 10^{-4} \text{ m} \cdot 16 \cdot 10^{-4} \text{ m}^2 \cdot 32}{3 \cdot 4 \text{ m}^2} = \frac{\text{N}}{\text{m}} 4 \cdot 16 \cdot 32 = \underline{\underline{2048 \text{ N/m}}}$$

$$\approx \underline{\underline{2.05 \text{ kN/m}}}$$

3. Za presek v obliki črke U na sliki izračunaj ploskovni moment. Račun naredi za $b = \frac{3a}{2}$ in $t = \frac{a}{10}$.



$$b-t = \frac{3a}{2} - \frac{a}{10}$$

$$= a \frac{15-1}{10} = \frac{14}{10} a$$

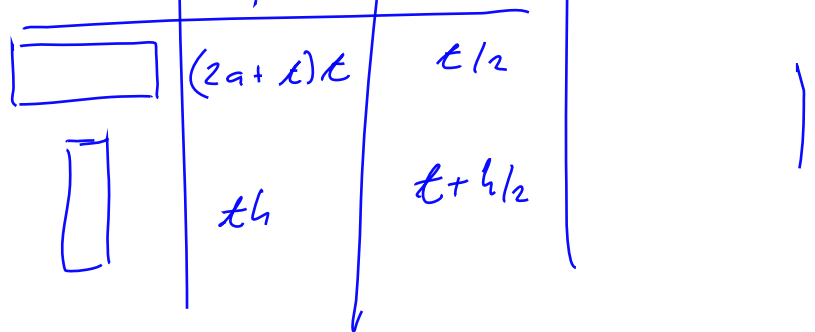
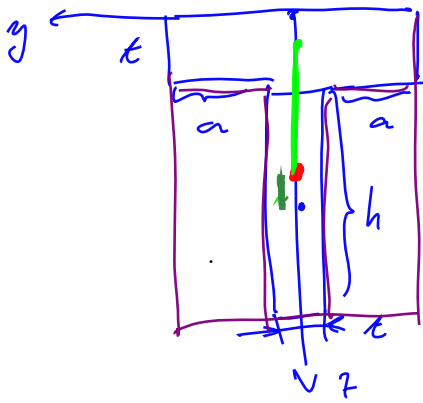
$$z_* = \frac{1}{A_1 - A_2} (z_1 A_1 - z_2 A_2) = 0.8973a$$

$$I = I_1 - I_2 \quad I_1 = z_0^2 A + I_0$$

$$I_1 = \frac{1}{12} a b^3 + \left(\frac{1}{2} b \cdot z_* \right)^2 A_1 = 0.3138 a^4$$

$$I_2 = \frac{1}{12} (a-2t)(b-t)^3 + \left(\frac{(b-t)}{2} - z_* \right)^2 A_2 = 0.2266 a^4$$

$$I = I_1 - I_2 = \underline{\underline{0.0873 a^4}}$$



$$z_x = \frac{1}{A_1 + A_2} (z_1 A_1 + z_2 A_2) = \dots$$

$$\underline{I = \underline{I}_1 + \underline{I}_2}$$

$$I_1 = (z_x - z_1)^2 A_1 + \frac{1}{12} (2a+t)t^3$$

$$I_2 = (z_2 - z_x)^2 A_2 + \frac{1}{12} t \cdot h^3$$

