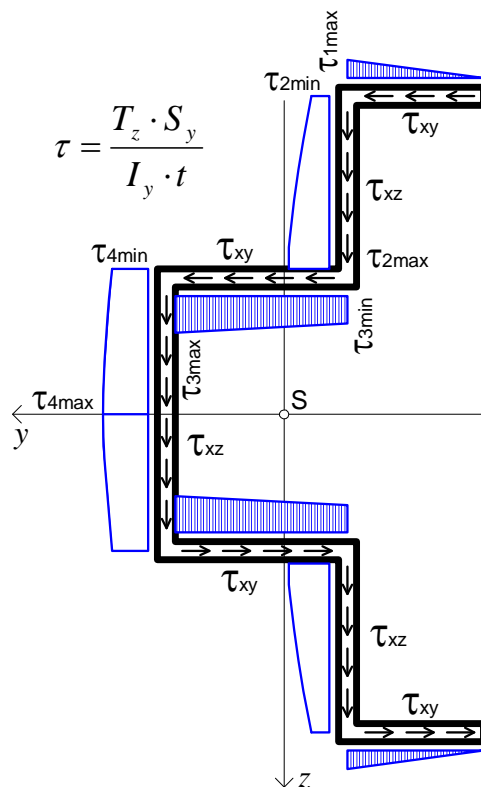
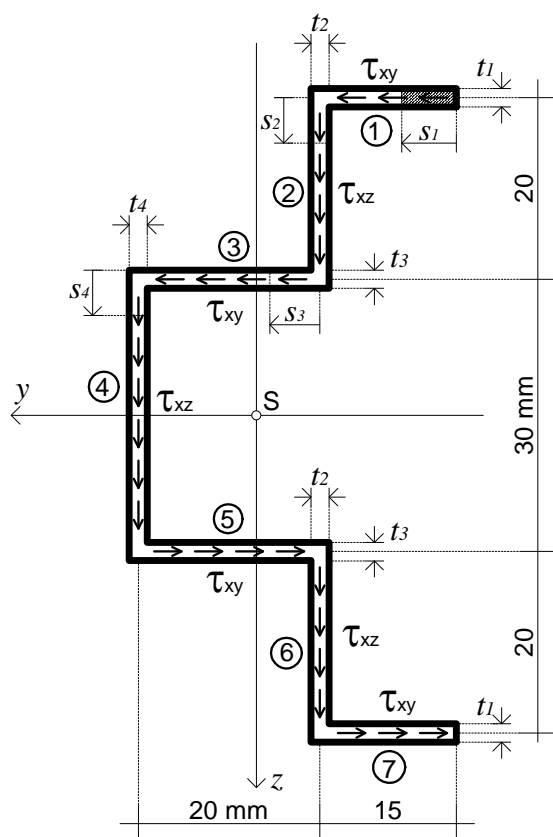


SREDIŠTE POSMIKA

ZADATAK 7.

Treba odrediti središte posmika tankostijenog otvorenog profila.

Debljine stijenki profila su: $t_1 = t_2 = 3 \text{ mm}$
 $t_3 = t_4 = 4 \text{ mm}$.



Dijagram posmičnih naprezanja i njihov tok

Moment tromosti tankostijenog profila:

$$I_y = \left(\frac{15 \cdot 3^3}{12} + 15 \cdot 3 \cdot 35^2 + \frac{3 \cdot 20^3}{12} + 3 \cdot 20 \cdot 25^2 + \frac{20 \cdot 4^3}{12} + 20 \cdot 4 \cdot 15^2 \right) \cdot 2 + \frac{4 \cdot 30^3}{12} = \underline{234,531 \cdot 10^3 \text{ mm}^4}$$

Određivanje rezultante posmičnih naprezanja po pojedinim dijelovima tankostijenog profila

DIO 1 $\tau_{xy} = \frac{T_z \cdot S_y}{I_y \cdot t_1}$

$$S_y = t_1 \cdot s_1 \cdot 35 = 105 \cdot s_1$$

$$\text{za } s_1 = 15 \text{ mm} \quad S_{1y} = 3 \cdot 15 \cdot 35 = 1575 \text{ mm}^3$$

$$\tau_{1\max} = \frac{T_z}{I_y \cdot t_1} \cdot S_{1y} = \frac{T_z}{234,531 \cdot 10^3 \cdot 3} \cdot 1575 = 2,24 \cdot 10^{-3} \cdot T_z$$

$$T_1 = \int_0^{15} \tau_{xy} \cdot t_1 \cdot ds_1 = \frac{T_z}{I_y} \cdot \int_0^{15} S_y \cdot ds_1 = \frac{T_z}{I_y} \cdot \int_0^{15} 105 \cdot s_1 \cdot ds_1 = \frac{T_z}{234,531 \cdot 10^3} \cdot 105 \cdot \frac{15^2}{2} = \underline{0,0504 \cdot T_z}$$

$$\text{ili } T_1 = \frac{1}{2} \cdot \tau_{1\max} \cdot t_1 \cdot 15 = \frac{1}{2} \cdot 2,24 \cdot 10^{-3} \cdot T_z \cdot 3 \cdot 15 = \underline{0,0504 \cdot T_z}$$

Zbog simetričnosti: $T_7 = T_1$

DIO 2 $\tau_{xz} = \frac{T_z \cdot S_y}{I_y \cdot t_2}$ $S_y = S_{1y} + t_2 \cdot s_2 \cdot \left(35 - \frac{s_2}{2}\right) = 1575 + 105 \cdot s_2 - 1,5 \cdot s_2^2$
 za $s_2 = 20 \text{ mm}$ $S_{2y} = 1575 + 105 \cdot 20 - 1,5 \cdot 20^2 = 3075 \text{ mm}^3$
 $\tau_{2\min} = \frac{T_z}{I_y \cdot t_2} \cdot S_{1y} = \tau_{1\max} = 2,24 \cdot 10^{-3} \cdot T_z$
 $\tau_{2\max} = \frac{T_z}{I_y \cdot t_2} \cdot S_{2y} = \frac{T_z}{234,531 \cdot 10^3 \cdot 3} \cdot 3075 = 4,37 \cdot 10^{-3} \cdot T_z$

$$T_2 = \int_0^{20} \tau_{xz} \cdot t_2 \cdot ds_2 = \frac{T_z}{I_y} \cdot \int_0^{20} S_y \cdot ds_2 = \frac{T_z}{I_y} \cdot \int_0^{20} (1575 + 105 \cdot s_2 - 1,5 \cdot s_2^2) \cdot ds_2 = \underline{0,2068 \cdot T_z}$$

Zbog simetričnosti: $T_6 = T_2$

DIO 3 $\tau_{xy} = \frac{T_z \cdot S_y}{I_y \cdot t_3}$ $S_y = S_{2y} + t_3 \cdot s_3 \cdot 15 = 3075 + 60 \cdot s_3$
 za $s_3 = 20 \text{ mm}$ $S_{3y} = 3075 + 60 \cdot 20 = 4275 \text{ mm}^3$
 $\tau_{3\min} = \frac{T_z}{I_y \cdot t_3} \cdot S_{2y} = \frac{T_z}{234,531 \cdot 10^3 \cdot 4} \cdot 3075 = 3,28 \cdot 10^{-3} \cdot T_z$
 $\tau_{3\max} = \frac{T_z}{I_y \cdot t_3} \cdot S_{3y} = \frac{T_z}{234,531 \cdot 10^3 \cdot 4} \cdot 4275 = 4,56 \cdot 10^{-3} \cdot T_z$

$$T_3 = \int_0^{20} \tau_{xy} \cdot t_3 \cdot ds_3 = \frac{T_z}{I_y} \cdot \int_0^{20} S_y \cdot ds_3 = \frac{T_z}{I_y} \cdot \int_0^{20} (3075 + 60 \cdot s_3) \cdot ds_3 = \underline{0,3134 \cdot T_z}$$

$$\text{ili } T_3 = \frac{\tau_{3\min} + \tau_{3\max}}{2} \cdot t_3 \cdot 20 = 3,92 \cdot 10^{-3} \cdot T_z \cdot 4 \cdot 20 = \underline{0,3134 \cdot T_z}$$

Zbog simetričnosti: $T_5 = T_3$

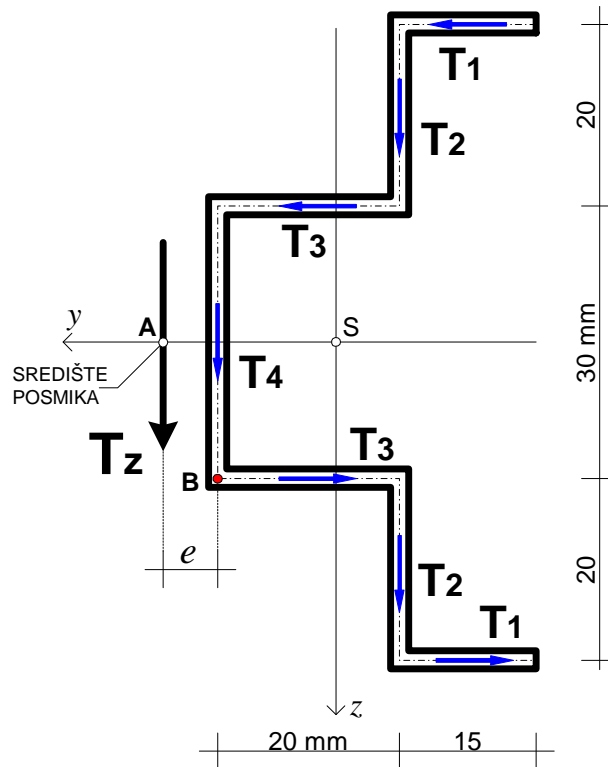
DIO 4 $\tau_{xz} = \frac{T_z \cdot S_y}{I_y \cdot t_4}$ $S_y = S_{3y} + t_4 \cdot s_4 \cdot \left(15 - \frac{s_4}{2}\right) = 4275 + 60 \cdot s_4 - 2 \cdot s_4^2$
 za $s_2 = 15 \text{ mm}$ $S_{4y} = S_{4\max} = 4275 + 60 \cdot 15 - 2 \cdot 15^2 = 4725 \text{ mm}^3$
 $\tau_{4\min} = \frac{T_z}{I_y \cdot t_4} \cdot S_{3y} = \tau_{3\max} = 4,56 \cdot 10^{-3} \cdot T_z$
 $\tau_{4\max} = \frac{T_z}{I_y \cdot t_4} \cdot S_{4\max} = \frac{T_z}{234,531 \cdot 10^3 \cdot 4} \cdot 4725 = 5,04 \cdot 10^{-3} \cdot T_z$

$$T_4 = 2 \cdot \int_0^{15} \tau_{xz} \cdot t_4 \cdot ds_4 = 2 \cdot \frac{T_z}{I_y} \cdot \int_0^{15} S_y \cdot ds_4 = 2 \cdot \frac{T_z}{I_y} \cdot \int_0^{15} (4275 + 60 \cdot s_4 - 2 \cdot s_4^2) \cdot ds_4 = \underline{0,5852 \cdot T_z}$$

Kontrola: $\sum T_{iz} = 0$ $2 \cdot T_2 + T_4 = 2 \cdot 0,2068 \cdot T_z + 0,5852 \cdot T_z = T_z$ $\underline{0,9988 \cdot T_z = T_z}$ ✓

Određivanje položaja središta posmika (točka **A**) u odnosu na točku **B**

Položaj središta posmika je pretpostavljen na lijevoj strani točke **B**.



Moment rezultante T_z na točku **B** jednak je zbroju momenata njezinih komponenti:

$$T_z \cdot e = T_1 \cdot 70 - 2 \cdot T_2 \cdot 20 + T_3 \cdot 30$$

$$T_z \cdot e = 0,0504 \cdot T_z \cdot 70 - 2 \cdot 0,2068 \cdot T_z \cdot 20 + 0,3134 \cdot T_z \cdot 30$$

$$\underline{e = +4,658 \text{ mm}}$$

Predznak (+) znači da je dobro pretpostavljen položaj središta posmika!