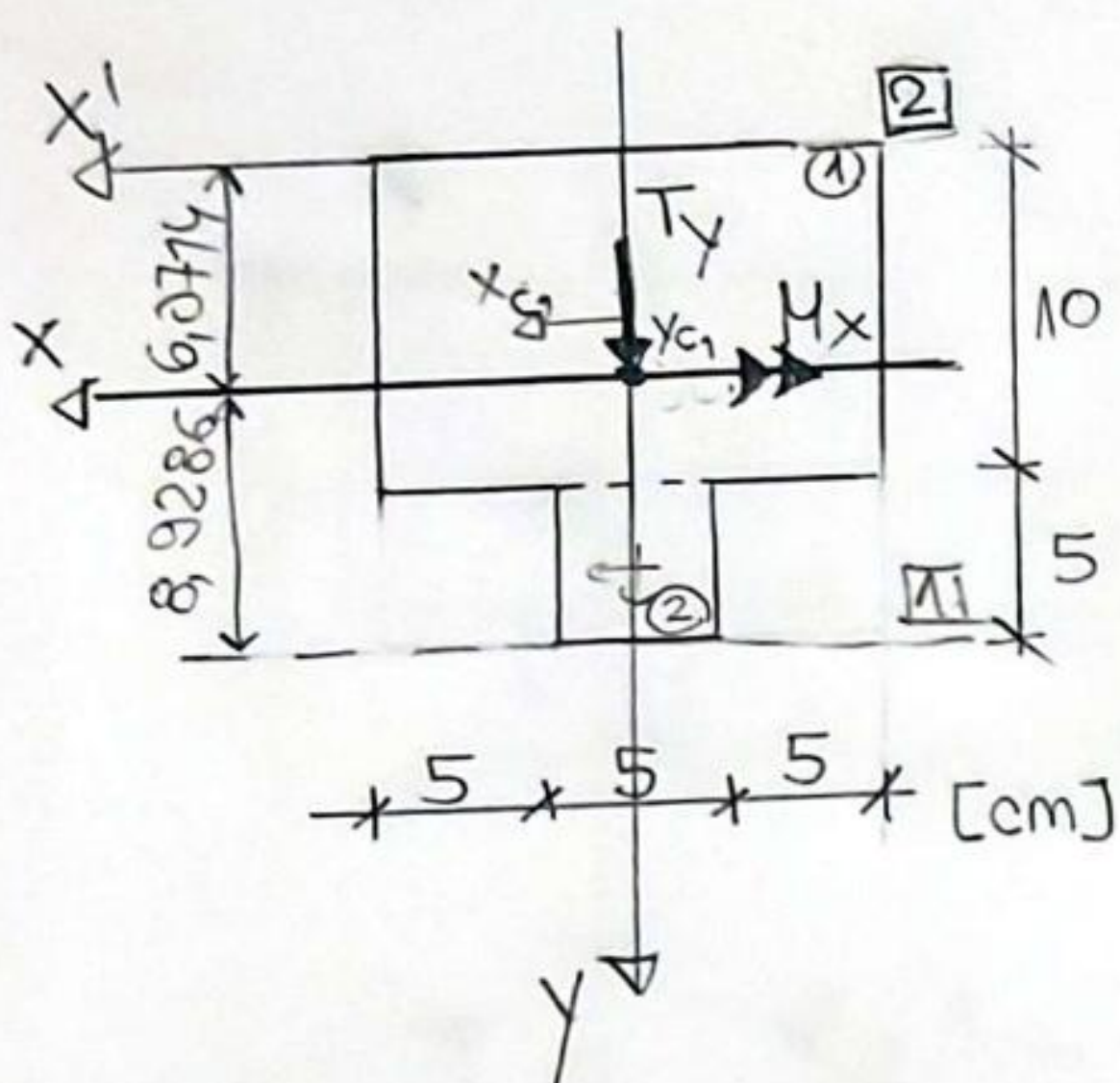


1. Poprečni presjek na slici je opterećen transverzalnomo silom i momentom savijanja ( $T_y = 300 \text{ kN}$ ,  $M_x = 50 \text{ kNm}$ ). Nacrtati dijagrame komponentalnih napona.



Geometrijske karakteristike:

$$C_1(0, 5); C_2(0, 12,5); A_1 = 10 \cdot 15 = 150 \text{ cm}^2; A_2 = 5 \cdot 5 = 25 \text{ cm}^2$$

$$A = 175 \text{ cm}^2$$

$$y_c = \frac{5 \cdot 150 + 12,5 \cdot 25}{175} = 6,0714 \text{ cm}$$

$$I_x = \frac{10^3 \cdot 15}{12} + (5 - 6,0714)^2 \cdot 150 + \frac{5^3 \cdot 5}{12} + (12,5 - 6,0714)^2 \cdot 25$$

$$I_x = 2507,4405 \text{ cm}^4$$

\* Normalni naponi:

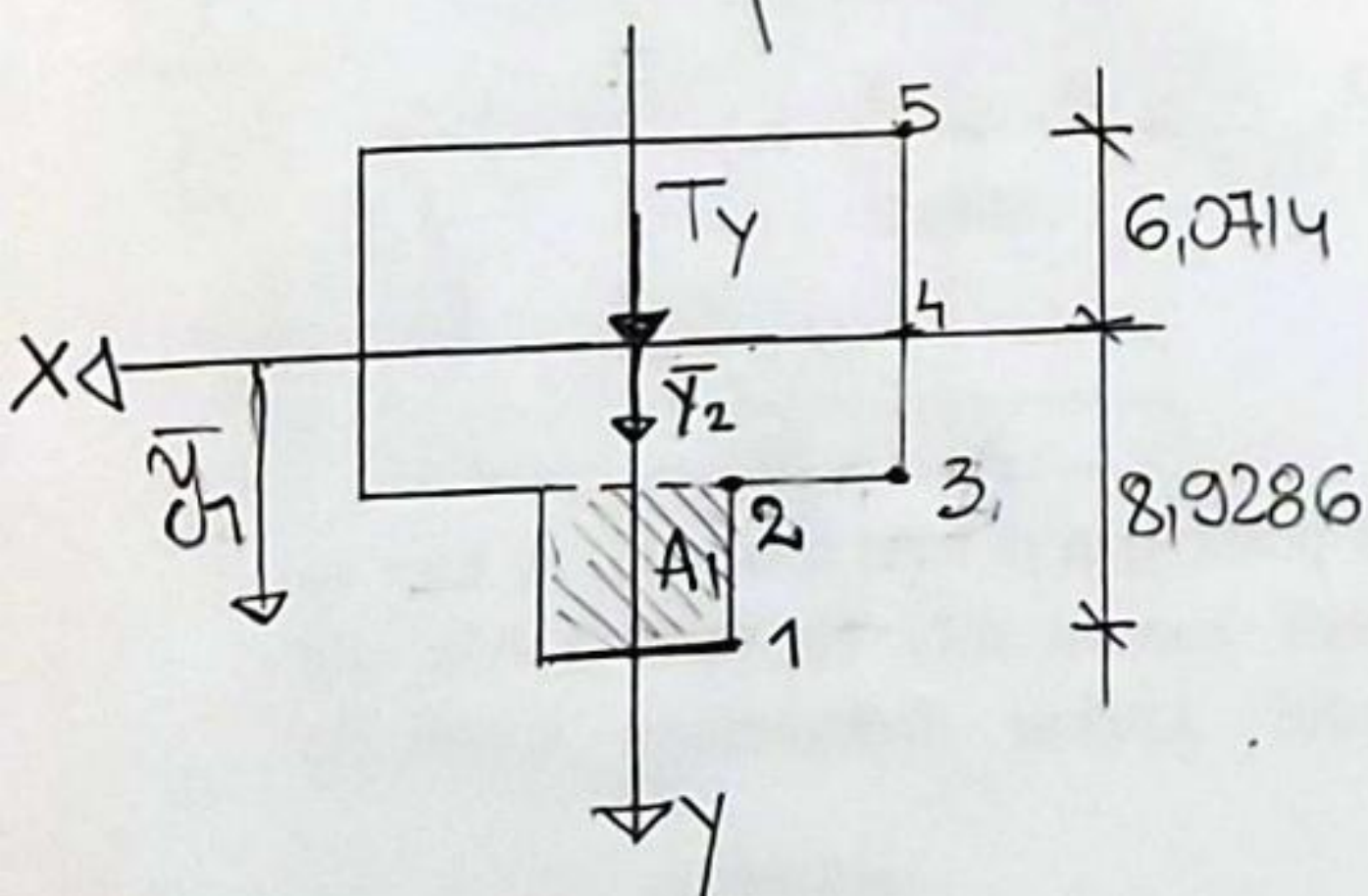
$$M_x = 50 \text{ kNm}$$

$$\sigma_{\pm} = \frac{M_x}{W_x} = \frac{M_x}{I_x} \cdot y_{\text{max}} \quad (\text{pritisak})$$

$$\sigma_{\pm}^{[1]} = \frac{50 \cdot 100}{2507,4405} \cdot 8,9286 = 17,804 \frac{\text{kN}}{\text{cm}^2}$$

$$\sigma_{\pm}^{[2]} = \frac{50 \cdot 100}{2507,4405} \cdot 6,0714 = 12,1067 \frac{\text{kN}}{\text{cm}^2} \quad (\text{zatezanje})$$

\* Smičući naponi:



\* tačka ①

$$S_x^{[1]} = A_1 \cdot \bar{y}_1 = 0$$

\* tačke ②, ③

$$S_x^{[2]} = S_x^{[3]} = A_1 \cdot \bar{y}_1 = 55 \cdot (8,9286 - 2,5)$$

$$S_x^{[2]} = S_x^{[3]} = 160,715 \text{ cm}^3$$

$$S_x^{[4]} = S_x^{[3]} + A_2 \cdot \bar{y}_2 = 160,715 + 15 \cdot 3,9286 \cdot \frac{3,9286}{2}$$

$$S_x^{[4]} = 276,469 \text{ cm}^3$$

tačka ⑤

$$S_x^{[5]} = S_x^{[4]} - 15 \cdot 6,0714 \cdot \frac{6,0714}{2} = 0$$

\* Vrijednost smičućeg napona u karakterističnim tačkama:

$$\tau_{zy}(T_y) = \frac{T_y \cdot S_x}{b \cdot I_x}$$

$$\text{① } b = 5 \text{ cm}, \tau_{zy}^{[1]} = \frac{T_y \cdot 0}{b \cdot I_x} = 0$$

$$\text{② } b = 5 \text{ cm}, \tau_{zy}^{[2]} = \frac{300 \cdot 160,715}{5 \cdot 2507,4405}$$

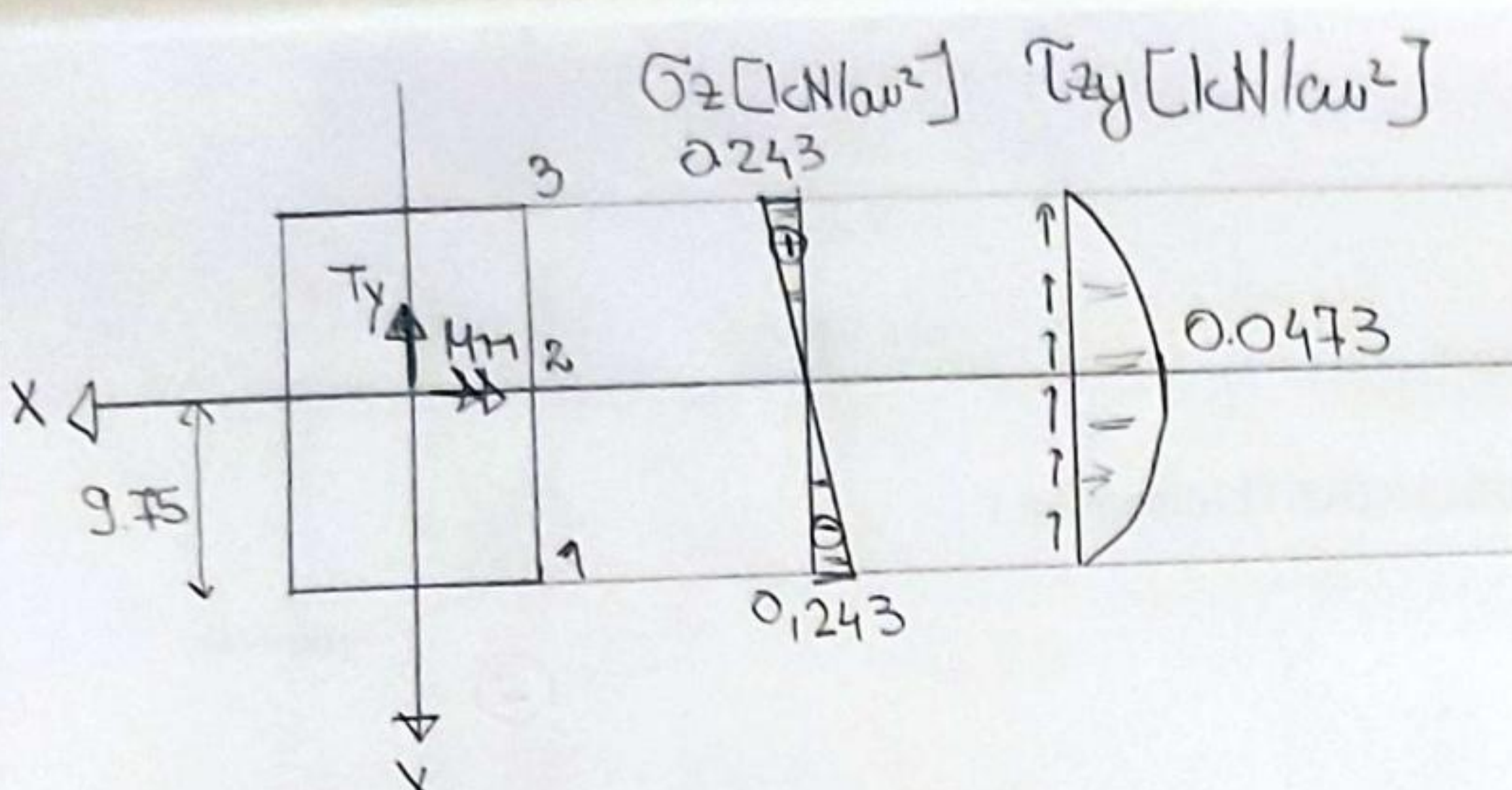
$$\tau_{zy}^{[2]} = 3,846 \text{ kN/cm}^2$$

$$\text{③ } b = 15 \text{ cm}, \tau_{zy}^{[3]} = \frac{300 \cdot 160,715}{15 \cdot 2507,4405} = 1,282 \text{ kN/cm}^2$$





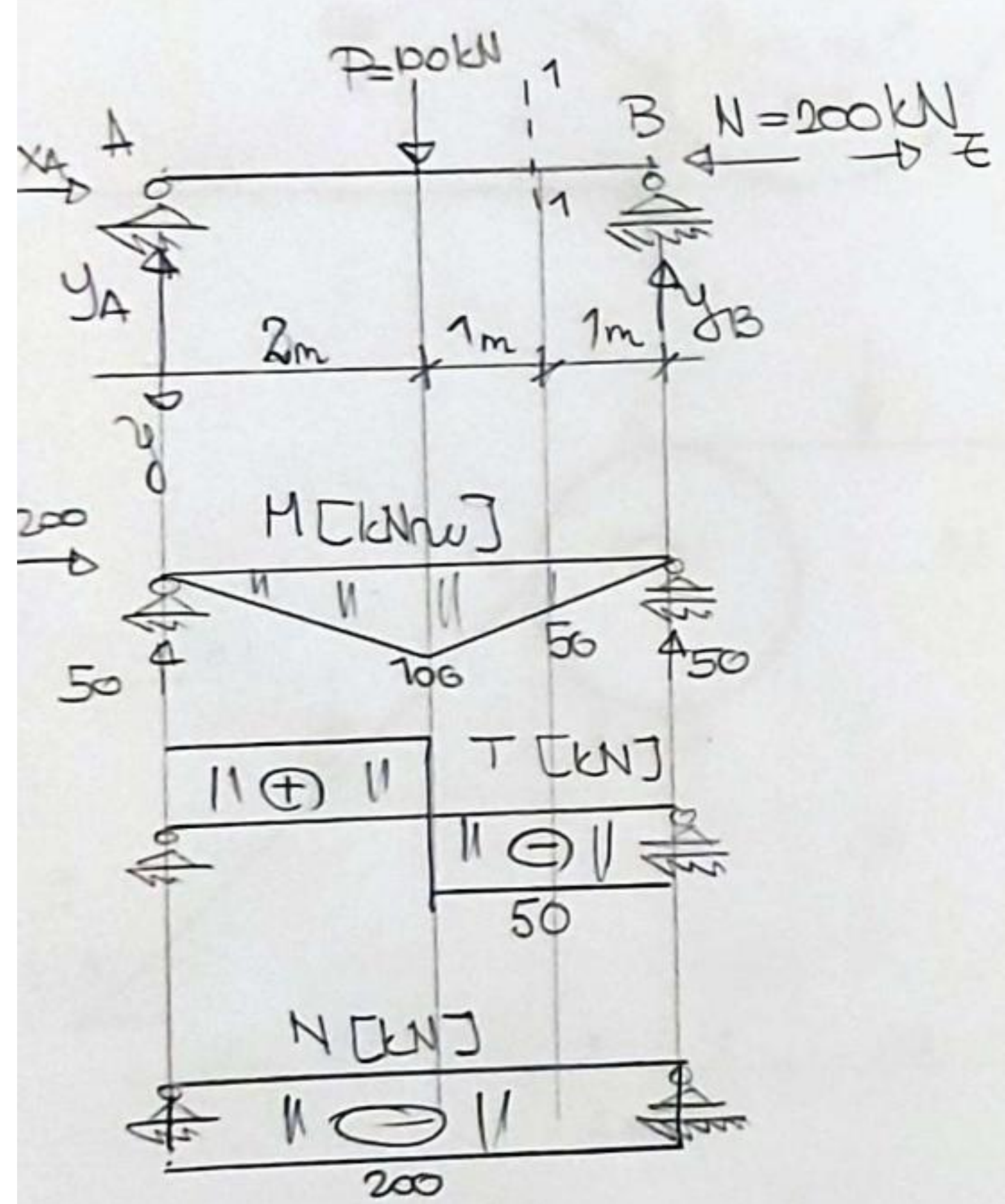




①  $S_x^{(1)} = A_1 \cdot \bar{y} = 0$   
 ②  $S_x^{(2)} = 13 \cdot 9,75 \cdot \frac{9,75}{2} = 617,9 \text{ cm}^3$   
 ③  $S_x^{(3)} = 617,9 - 9,75 \cdot 13 \cdot \frac{9,75}{2} = 0$   
 ①  $\tau_{zy}^{(1)} = \frac{8 \cdot 0}{I_x \cdot b} = 0$

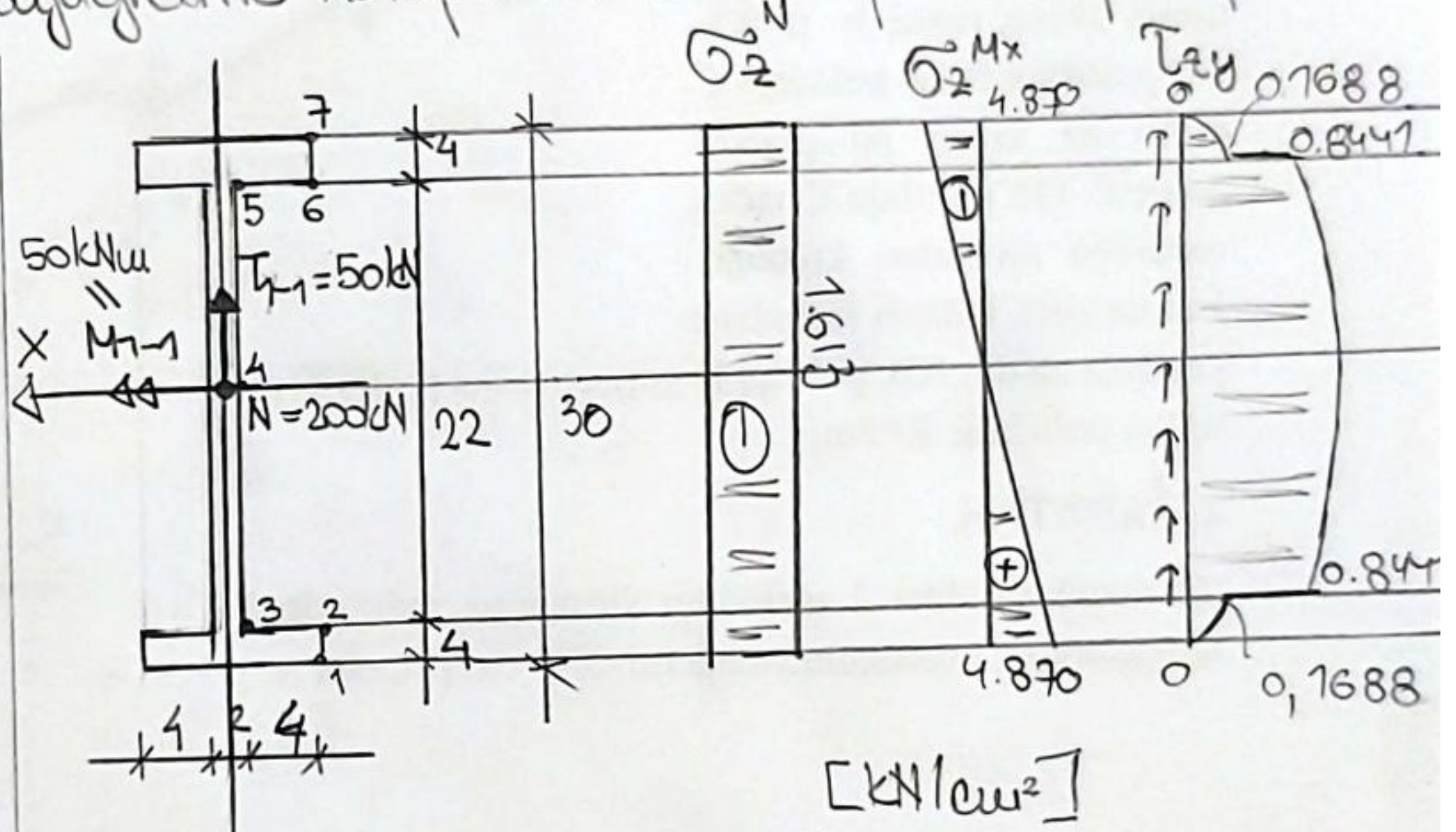
②  $\tau_{zy}^{(2)} = \frac{8 \cdot 617,9}{8032,78 \cdot 13} = 0,0473 \frac{\text{kN}}{\text{cm}^2}$

3. Za nosač na slici nacrtati dijagrame komponentalnih napona u presjeku 1-1



$\sum X = 0, X_A = 200 \text{ kN}$   
 $\sum Y = 0, Y_A + Y_B - 100 = 0$   
 $\sum M_B = 0, Y_A \cdot 4 - 100 \cdot 2 = 0$   
 $Y_A = 50 \text{ kN}$

$Y_B = 50 \text{ kN}$



$\sigma_z^N = \frac{N}{A} = \frac{200}{124} = 1,613 \frac{\text{kN}}{\text{cm}^2} \text{ (pritisak)}$

$A = 10 \cdot 4 \cdot 2 + 2 \cdot 2 \cdot 2 = 124 \text{ cm}^2$

$I_x = 2 \cdot \left( \frac{43 \cdot 10}{12} + 13^2 \cdot 40 \right) + \frac{22^3 \cdot 2}{12} = 15401,327 \text{ cm}^4$

$y_{max} = 15 \text{ cm}$

$\sigma_z^{Mx} = \frac{M_x}{I_x} \cdot y_{max} = \frac{50 \cdot 100}{15401,327} \cdot 15 = 4,870 \frac{\text{kN}}{\text{cm}^2}$

\* Smičući napon:

$\tau_{zy} = \frac{T_y \cdot S_x}{b \cdot I_x}, T_y = T_{1-1} = 50 \text{ kN}$

tačka ①  $S_x^{(1)} = 0$

tačka ②  $S_x^{(2)} = 4 \cdot 10 \cdot 13 = 520 \text{ cm}^3$

tačka ③  $S_x^{(3)} = S_x^{(2)} = 520 \text{ cm}^3$

tačka ④  $S_x^{(4)} = 520 + 2 \cdot 11 \cdot 5,5 = 641 \text{ cm}^3$

tačka ⑤  $S_x^{(5)} = S_x^{(3)}$  ili  $S_x^{(5)} = S_x^{(4)} - 11 \cdot 2 \cdot 5,5 = 520 \text{ cm}^3$

tačka ⑥  $S_x^{(6)} = S_x^{(5)}$

tačka ⑦  $S_x^{(7)} = 0$



$$\tau_{zy}^{(1)} = \frac{50.0}{10.1x} = 0$$

$$\tau_{zy}^{(2)} = \frac{50.520}{10.15401,327} = 0,1688 \text{ kN/cm}^2$$

$$\tau_{zy}^{(3)} = \frac{50.520}{2.15401,327} = 0,8441 \text{ kN/cm}^2$$

$$\tau_{zy}^{(4)} = \frac{50.641}{2.15401,327} = 1,0405 \text{ kN/cm}^2$$