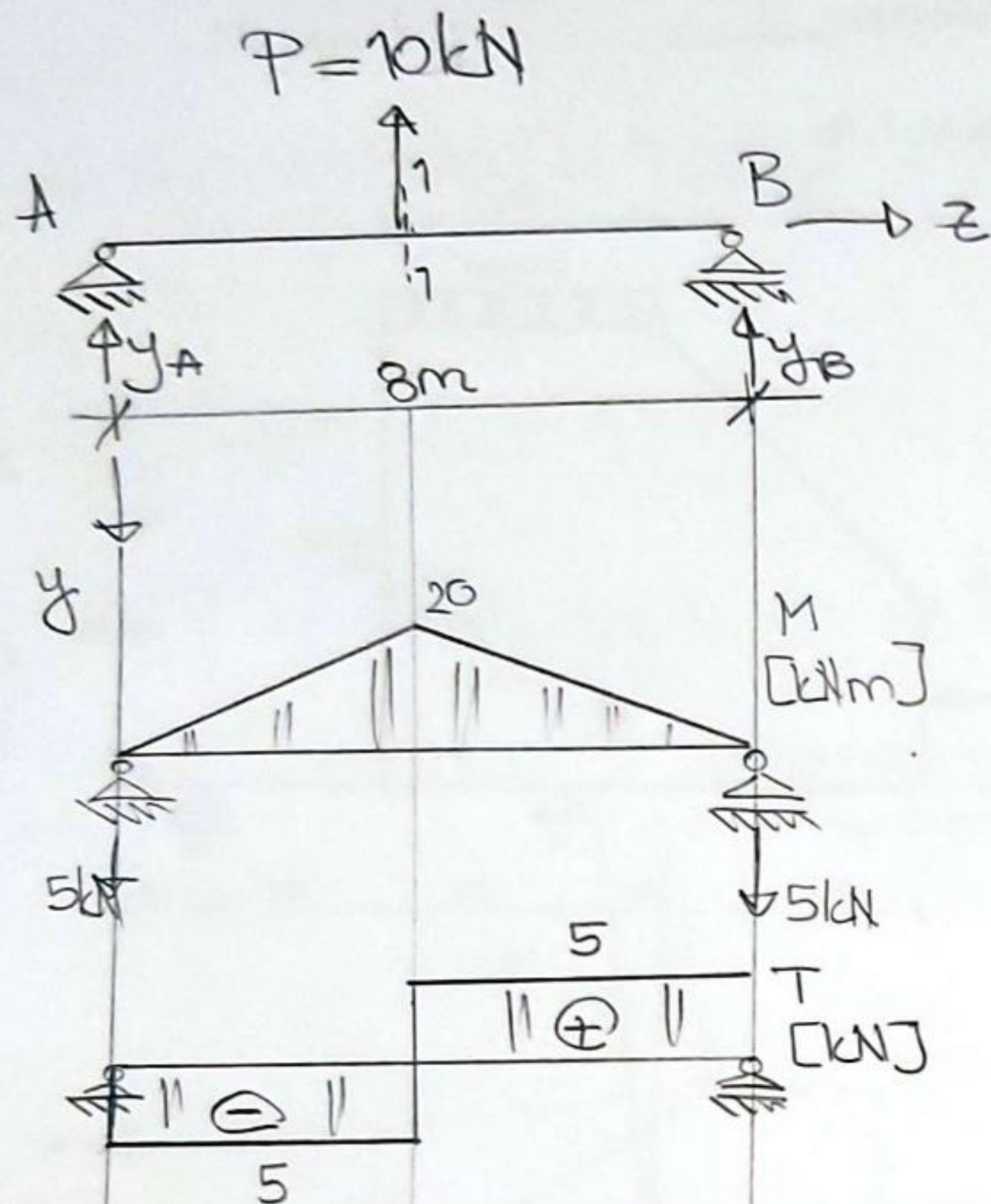


1. Za nosač na slici:

a) dijagrame presječnih sila

b) za presjek u sredini raspona nacrtati dijagram normalnih napona



$$\sum y = 0, y_A + y_B + 10 = 0$$

$$\sum M_A = 0 (\oplus)$$

$$y_B \cdot 8 + 10 \cdot 4 = 0, y_B = -5 \text{ kN}$$

$$y_A = -5 \text{ kN}$$

Geometrijske karakteristike presjeka

$$C_1 (10, 6,6667), A_1 = 75 \text{ cm}^2$$

$$C_2 (2,5; 5), A_2 = 50 \text{ cm}^2$$

$$x_c = \frac{75 \cdot 10 + 50 \cdot 2,5}{75 + 50} = \frac{875}{125} = 7 \text{ cm}$$

$$y_c = \frac{75 \cdot 6,6667 + 50 \cdot 5}{125} = 6 \text{ cm}$$

$$C(7, 6)$$

$$I_z = I_z^{(1)} + I_z^{(2)}$$

$$I_z^{(1)} = \frac{10^3 \cdot 15}{36} + (6,6667 - 6)^2 \cdot 75 =$$

$$I_z^{(1)} = 450 \text{ cm}^4$$

$$I_z^{(2)} = \frac{10^3 \cdot 15}{12} + (5 - 6)^2 \cdot 50 = 466,66 \text{ cm}^4$$

$$I_z = 916,6667 \text{ cm}^4$$

$$I_\eta = I_\eta^{(1)} + I_\eta^{(2)} = 2729,1667 \text{ cm}^4$$

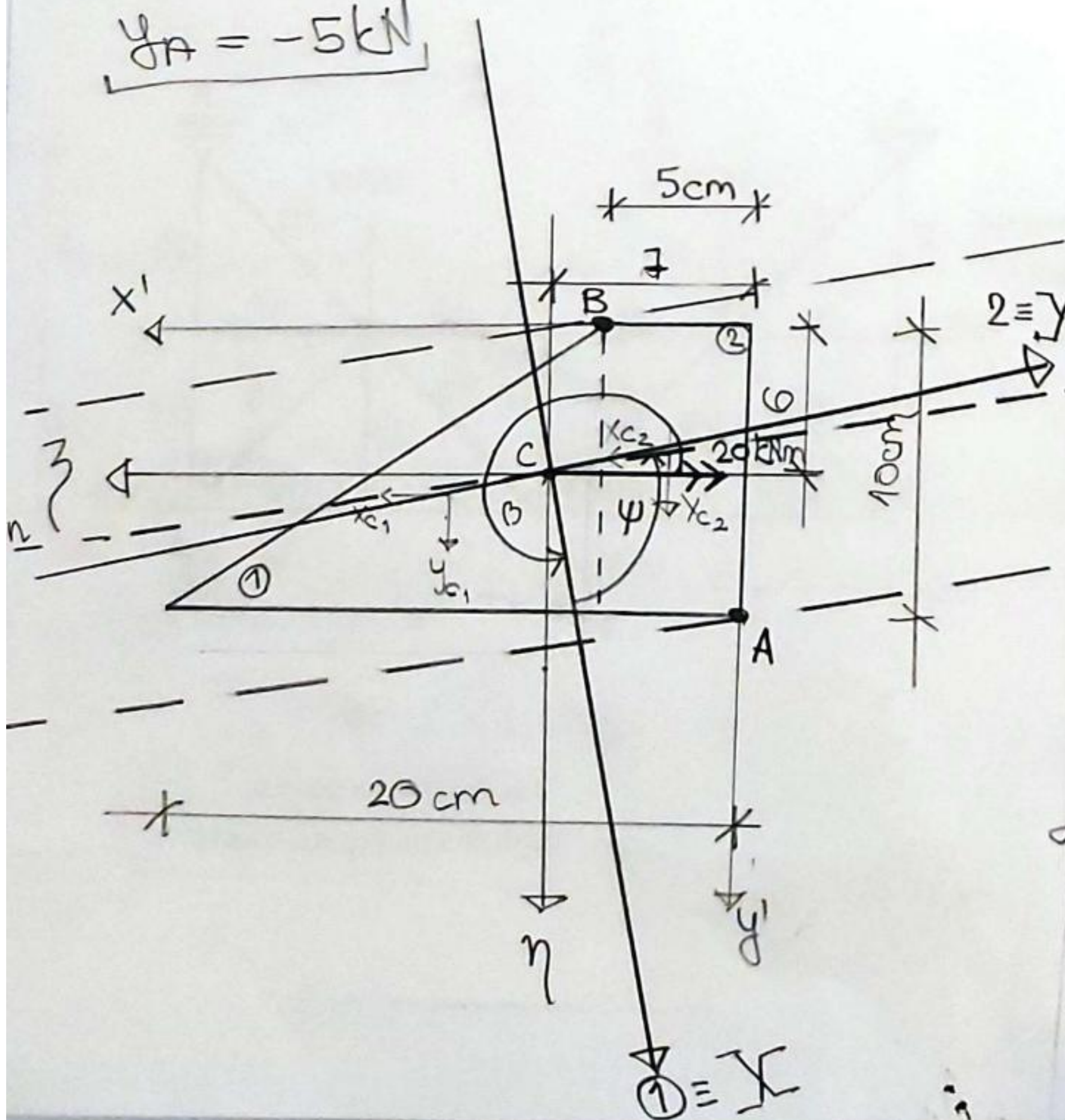
$$I_\eta^{(1)} = \frac{15^3 \cdot 10}{36} \cdot (10 - 7)^2 \cdot 75 = 1612,5 \text{ cm}^4$$

$$I_\eta^{(2)} = \frac{5^3 \cdot 10}{12} + (2,5 - 7)^2 \cdot 50 = 1116,6 \text{ cm}^4$$

$$I_{z\eta} = I_{z\eta}^{(1)} + I_{z\eta}^{(2)} = 687,4985 \text{ cm}^4$$

$$I_{z\eta}^{(1)} = + \frac{15^2 \cdot 10^2}{72} + (0,666 \cdot 3) \cdot 75 = 462,498 \text{ cm}^4$$

$$I_{z\eta}^{(2)} = 0 + (-1) \cdot (-4,5) \cdot 50 = 225 \text{ cm}^4$$



$$I_{1,2} = 1822,9167 \pm 1137,5162$$

$$\left. \begin{aligned} I_1 &= 2960,433 \text{ cm}^4 \\ I_2 &= 685,400 \text{ cm}^4 \end{aligned} \right\}$$

kontrola:  
 $3645,8335 = I_1 + I_2 = 3645,83 \text{ cm}^4$

$$\text{tg} 2\alpha = \frac{-2.687,4985}{916,666 - 2729,1667} < 0 \quad | \quad \text{tg} 2\alpha = 0,75862$$

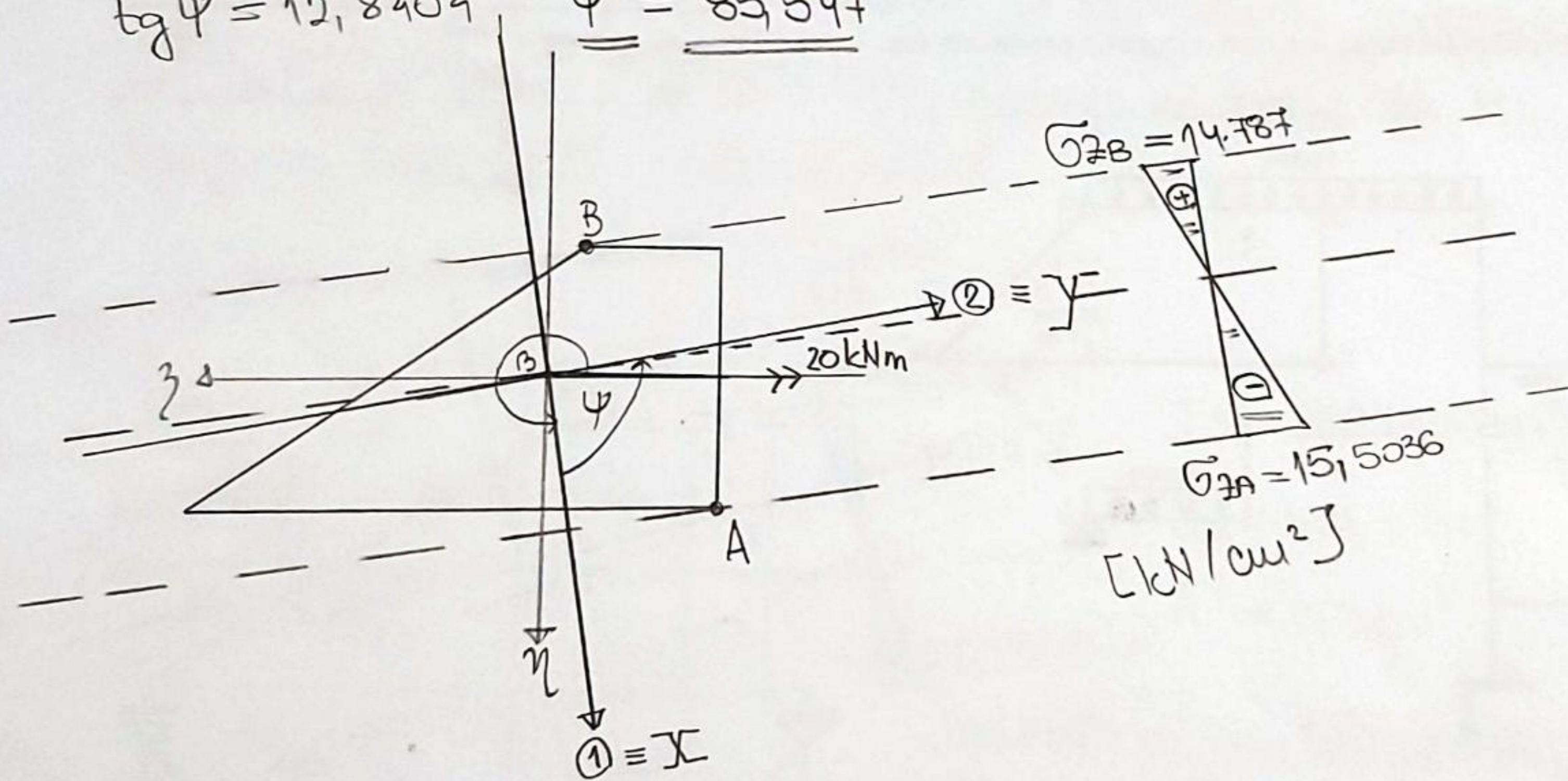
$$\alpha = 0,5 \arctg(0,75862) + 90^\circ, \quad \underline{\underline{\alpha = 108,592^\circ}}$$

$$\beta = ?$$

$$\beta = 180^\circ + \alpha = \underline{\underline{288,592}} \quad \text{ili} \quad \beta = -90^\circ + 18,592 = \underline{\underline{-71,408^\circ}}$$

$$\text{tg} \psi = -\frac{I_1}{I_2} \text{tg} \beta = -\frac{2960,433}{685,400} \cdot \text{tg} 288,592$$

$$\text{tg} \psi = 12,8404 \quad \underline{\underline{\psi = 85,547^\circ}}$$



\* koordinate tačkica A i B u sistemu  $z_0 \eta$ :

$$B(-2; 6); A(-7; 4) \quad ; \quad A(z_A, \eta_A); B(z_B, \eta_B)$$

\* koordinate tačkica A i B u sistemu glavnih osa  $X_0 Y_0$  (102)

$$x_A = z_A \cdot \cos \alpha + \eta_A \cdot \sin \alpha = -7 \cdot \cos \alpha + 4 \cdot \sin \alpha = 6,023 \text{ cm}, \quad \alpha = 108,592^\circ$$

$$y_A = -z_A \cdot \sin \alpha + \eta_A \cdot \cos \alpha = +7 \cdot \sin \alpha + 4 \cdot \cos \alpha = 5,3594 \text{ cm}$$

$$\boxed{A(6,023; 5,36)}$$

$$x_B = -2 \cdot \cos \alpha + 6 \cdot \sin \alpha = -5,05 \text{ cm} \quad B(-5,05; 3,8086)$$

$$y_B = +2 \sin \alpha - 6 \cos \alpha = 3,8086 \text{ cm}$$

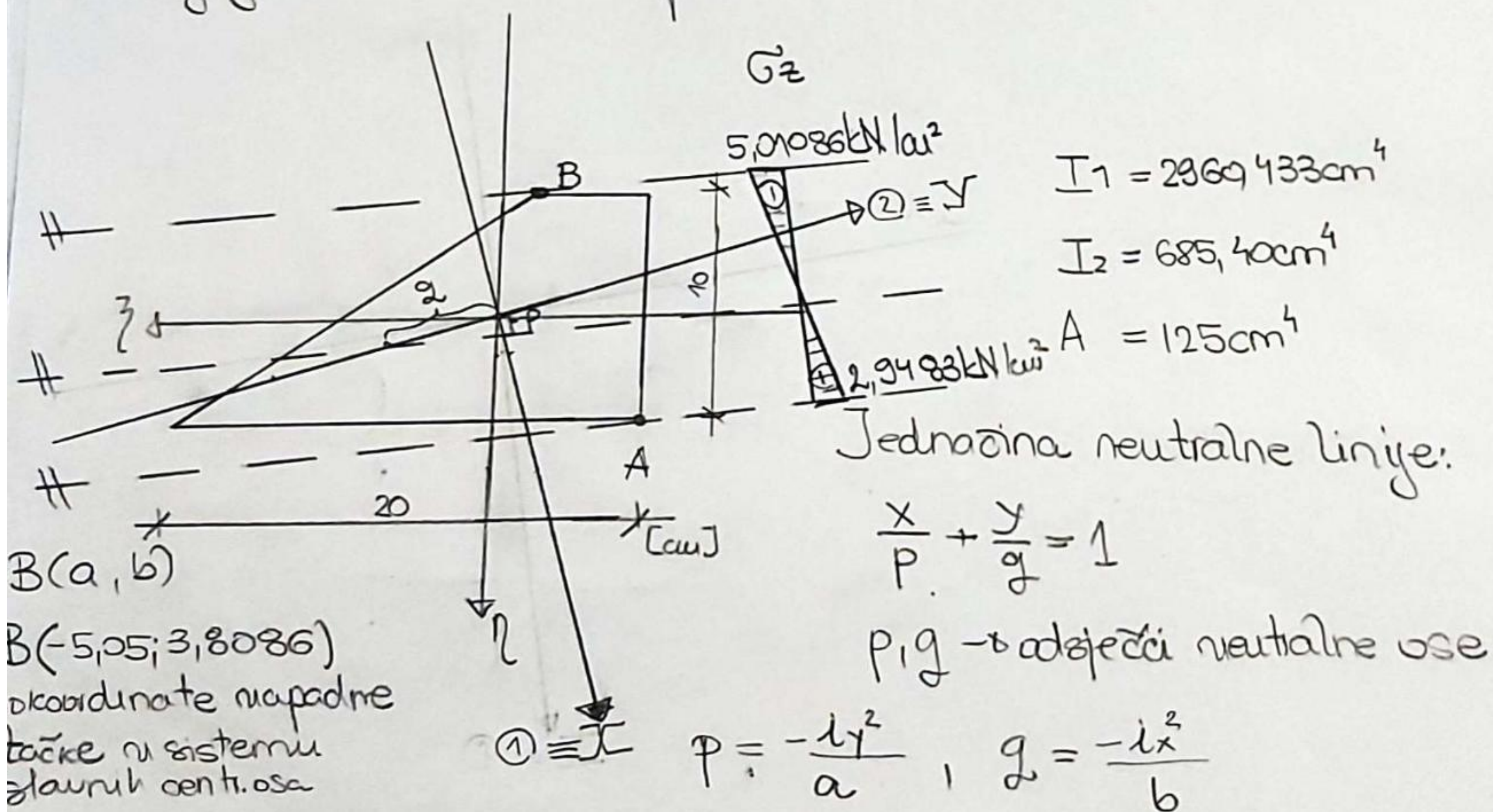
\* naponi:

$$\sigma_z^A = M \left( \frac{\cos \beta}{I_1} y_A + \frac{\sin \beta}{I_2} x_A \right) = 20 \cdot 10^2 \cdot \left( \frac{\cos 288,592}{2969433} \cdot 5,3594 + \frac{\sin 288,592}{685,400} \cdot 6,023 \right)$$

$$\sigma_z^A = -15,5036 \text{ kN/cm}^2 \text{ (pritiska)}$$

$$\sigma_z^B = 20 \cdot 10^2 \cdot \left( 1,07696 \cdot 10^{-4} \cdot 3,8086 - 1,3828 \cdot 10^{-3} \cdot (-5,05) \right) = 14,7872 \text{ kN/cm}^2 \text{ (zatezanje)}$$

2. Nosaoč poprečnog presjeka na slici je opterećen podužnom silom pritiska  $P = 100 \text{ kN}$  koja djeluje u tački B. Nacrtati dijagram normalnih napona.



$$I_x = I_1 = \sqrt{\frac{I_1}{A}} = \sqrt{\frac{2969433}{125}} = 4,866 \text{ cm}$$

$$I_y = I_2 = \sqrt{\frac{I_2}{A}} = \sqrt{\frac{685,400}{125}} = 2,3416 \text{ cm}$$

$$p = \frac{-(2,3416)^2}{-5,05} = 1,08576 \text{ cm}$$

$$q = \frac{-(4,866)^2}{3,8086} = -6,2185 \text{ cm}$$

$$\sigma_{zA} = \pm \frac{P}{A} \left[ 1 + \frac{b}{i_x^2} \bar{y} + \frac{a}{i_y^2} \bar{x} \right]$$

$$= -\frac{100}{125} \left[ 1 + \frac{3,8086}{4,866^2} \cdot 5,36 + \frac{-5,05}{2,3416^2} \cdot 6,023 \right] = 2,9483 \text{ kN/cm}^2$$

$$\Gamma A (6,023; 5,36)$$

$$\sigma_{zB} = -0,8 \left[ 1 + 0,16081 \cdot 3,8086 - 0,921 \cdot (-5,05) \right] = -5,01086 \text{ kN/cm}^2$$