

1)

a)

$$\delta_z = \frac{N}{A} + \frac{M_x}{I_x} y - \frac{M_y}{I_y} x$$

$$I_x = \frac{14 \cdot (16)^3}{12} - \frac{10 \cdot (12)^3}{12} = 3338,667 \text{ cm}^4$$

$$I_y = \frac{16 \cdot (14)^3}{12} - \frac{12 \cdot (10)^3}{12} = 2658,667 \text{ cm}^4$$

$$A = 14 \cdot 16 - 10 \cdot 12 = 104 \text{ cm}^2$$

$$M_x = 10 \cdot 6 = 60 \text{ kN} \cdot \text{cm}$$

$$M_y = 10 \cdot (-5) = -50 \text{ kN} \cdot \text{cm}$$

$$N = 10 \text{ kN}$$

$$\delta_z = 0,096154 + 0,017971y + 0,01881x$$

A(7,8) noktasında,

$$\delta_z = 0,096154 + 0,14377(-0,13164)$$

$$\delta_z = \mathbf{0,371569 \text{ kN} \cdot \text{cm}}$$

B(-7,8) noktasında,

$$\delta_z = 0,096154 + 0,14377 - 0,131645$$

$$\delta_z = \mathbf{0,108279 \text{ kN} \cdot \text{cm}}$$

C(-7,-8) noktasında,

$$\delta_z = 0,096154 + (-0,14377) - 0,131645$$

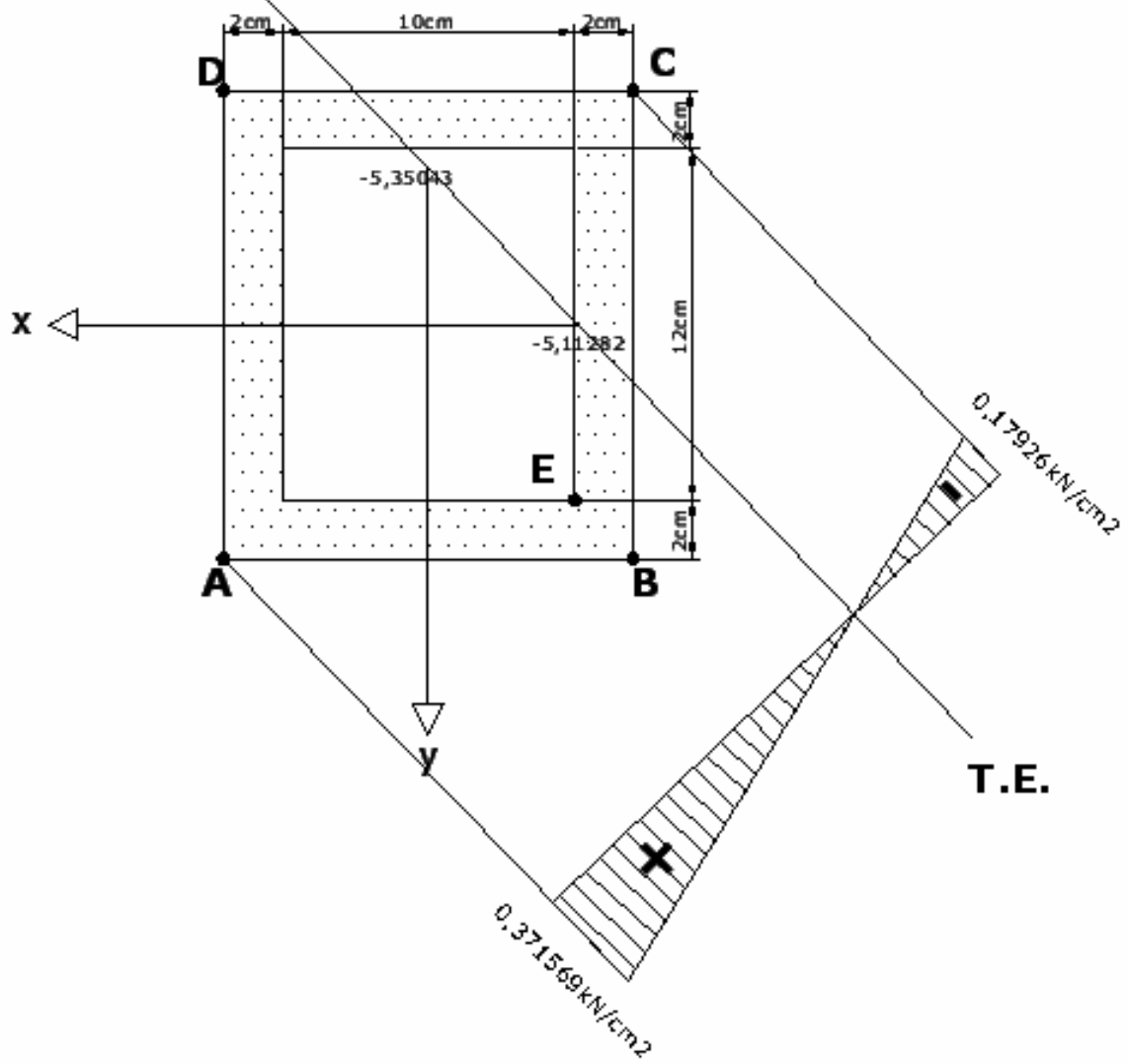
$$\delta_z = \mathbf{-0,17926 \text{ kN} \cdot \text{cm}}$$

D(7,-8) noktasında,

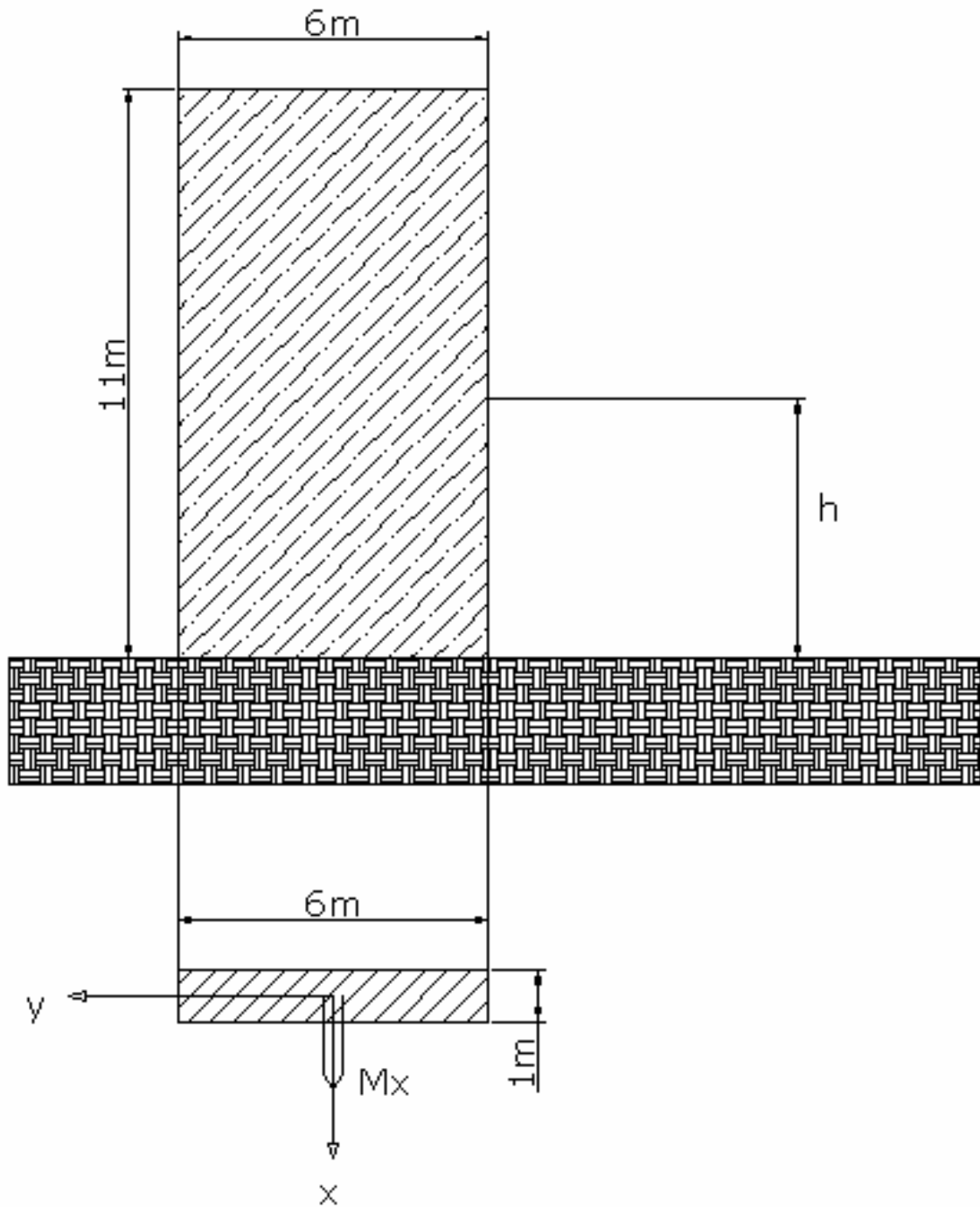
$$\delta_z = 0,096154 + (-0,14377) - (-0,13164)$$

$$\delta_z = \mathbf{0,084029 \text{ kN} \cdot \text{cm}}$$

b)
 $S_x = -5,11282\text{cm}$
 $S_y = -5,35043\text{cm}$



2)
a)



$$M_x = \frac{\gamma_{su} \cdot h^3}{6}$$

$$N = 6 \cdot 1.1 \cdot 1 \cdot \gamma_{\text{beton}}$$

$$e_x = \frac{M_x}{N}$$

$$e_{\text{max}} = \frac{b}{6}$$

$$e_x = e_{\text{max}} \text{ (kritik durum)}$$

$$\frac{Y_{su} \cdot h^3}{6} \frac{1}{N} = \frac{b}{6}$$

$$h^3 = \frac{6N}{10}$$

$$h = \sqrt[3]{\frac{6N}{10}}$$

$$\mathbf{h=9,831855m}$$

b)

$$\delta_z = \frac{N}{A} + \frac{M_x}{I_x} y$$

$$\delta_{emzemin} = 600 \text{ kN/m}^2$$

$$I_x = 0,5 \text{ cm}^4$$

$$\frac{1584}{6} + \frac{10h^3}{6(0,5)} = 3$$

$$h^3 \leq \frac{336}{10}$$

$$\mathbf{h=3,2269m}$$

3)



a)

$$P = q \cdot A_{\text{üçgen}}$$

$$A_{\text{üçgen}} = 2,5 \text{ m}^2$$

$$M_b = P \cdot 0,833$$

$$M_e = P \cdot 6$$

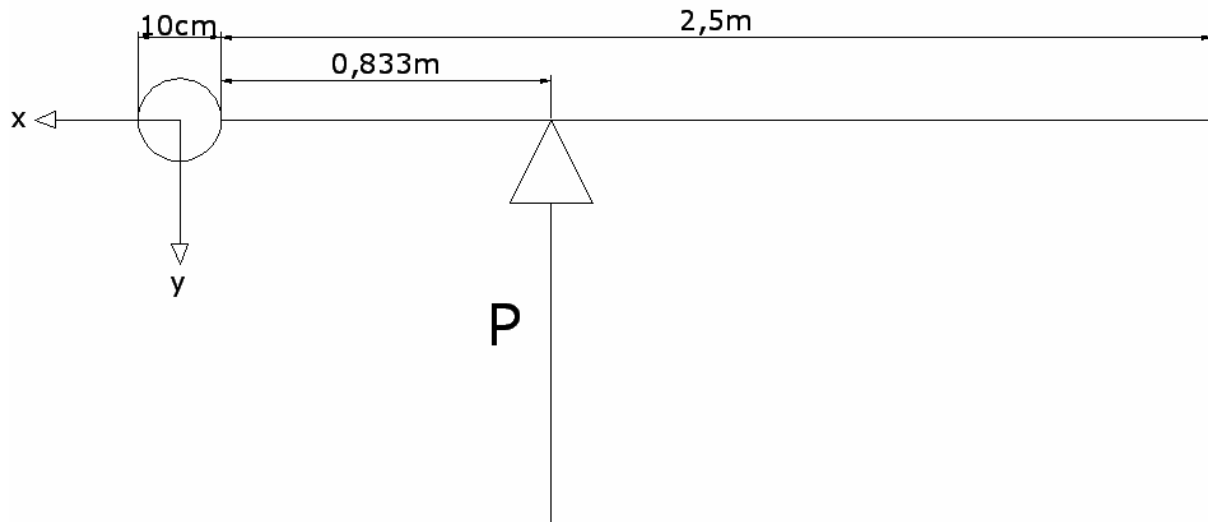
$$I_0 = \frac{\pi R^4}{2} = 9,81748 \cdot 10^{-6} \text{ m}^4$$

$$I_x = \frac{\pi R^4}{4} = 4,90874 \cdot 10^{-6} \text{ m}^4$$

Kritik noktalar $y=5$ ya da -5 cm de oluşur.

$$\tau_{\text{kritik}} = \frac{M_b}{I_0} y = 4242,434 P \cdot \frac{\text{N}}{\text{m}^2}$$

$$\delta_{\text{kritik}} = \frac{M_e}{I_x} y = 61115,5 P \cdot \frac{\text{N}}{\text{M}_2}$$



Tresca;

$$\sqrt{\delta^2 + 4\tau^2} \leq \delta_{\text{güvenlik}}$$

$$\sqrt{\delta^2 + 4\tau^2} = \sqrt{3735104114 \cdot P^2 + 4 \cdot 17998248 \cdot P^2} = 61701,6783 \cdot P$$

$$\delta_{\text{güvenlik}} = 1,2 \cdot 10^8 \frac{\text{N}}{\text{m}} = 61701,6783 \cdot P$$

$$P = 19448,4175 \text{ N}$$

$$\mathbf{q = 7,779367 \text{ kN}}$$

b)

Von-Mises;

$$\sqrt{\delta^2 + 3\tau^2} \leq \delta_{\text{güvenlik}}$$

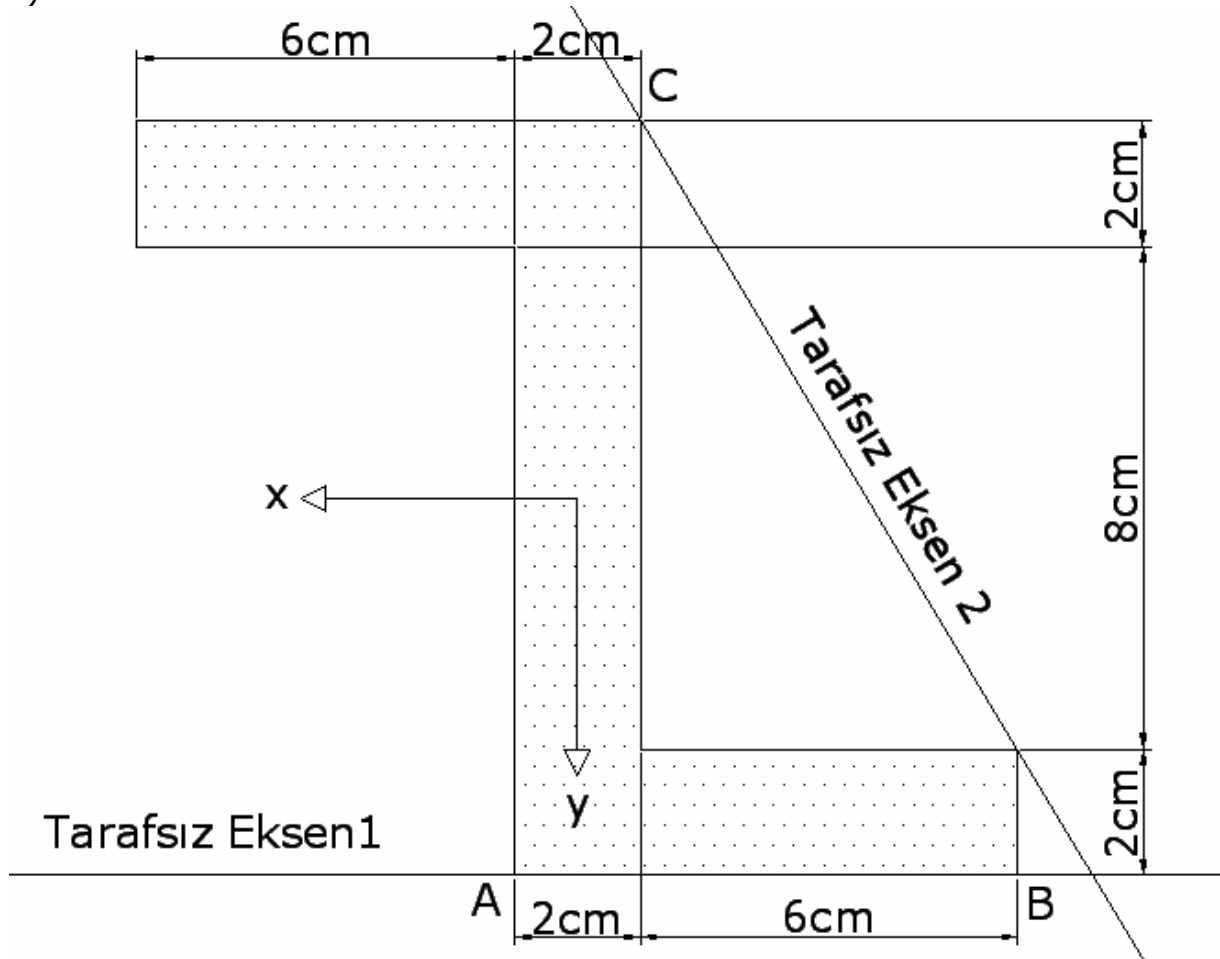
$$\sqrt{\delta^2 + 3\tau^2} = \sqrt{3735104114 \cdot P^2 + 3 \cdot 17998248 \cdot P^2} = 61555,6566 \cdot P$$

$$\delta_{\text{güvenlik}} = 1,2 \cdot 10^8 \frac{\text{N}}{\text{m}} = 61555,6566 \cdot P$$

$$P = 19494,5528 \text{ N}$$

$$\mathbf{q = 7,797821 \text{ kN}}$$

4)



$$I_x = 2\left(\frac{8 \cdot 2^3}{12} + 16 \cdot 5^2\right) + \frac{2 \cdot 8^3}{12}$$

$$I_x = 896 \text{ cm}^4$$

$$I_y = 2\left(\frac{2 \cdot 8^3}{12} + 16 \cdot 4^2\right) + \frac{8 \cdot 2^3}{12}$$

$$I_y = 688 \text{ cm}^4$$

$$I_{xy} = 16(5)(-3) + 16(-5)(3)$$

$$I_{xy} = 480 \text{ cm}^4$$

$$F = 48 \text{ cm}^2 \text{ (Kesit Alanı)}$$

Tarafsız Eksen 1 için;

$$Ay + Bx = 1$$

$$A(1,6) \quad B(-7,6)$$

$$6A + B = 1$$

$$6A - 7B = 1$$

$$B = 0,125$$

$$A = 0,45933$$

$$e_x = -\frac{(I_{xy}A + I_yB)}{F}$$

$$e_x = -\frac{(480 \cdot 0,45933 + 488 \cdot 0,125)}{48}$$

$$\mathbf{e_x = -3,25cm}$$

$$e_y = -\frac{(I_x A + I_{xy} B)}{F}$$

$$e_y = -\frac{(896 \cdot 0,45933 + 480 \cdot 0,125)}{48}$$

$$\mathbf{e_y = -3,97222cm}$$

Tarafsız Eksen 2 için;

B(-7,6) C(-1,-6)

$$6A - 7B = 1$$

$$-6A - B = 1$$

$$B = -0,16667$$

$$A = -0,02778$$

$$e_x = -\frac{(480 \cdot (-0,02778) + 488 \cdot (-0,16667))}{48}$$

$$\mathbf{e_x = 2,666667cm}$$

$$e_y = -\frac{(896 \cdot (-0,02778) + 480 \cdot (-0,16667))}{48}$$

$$\mathbf{e_y = 2,185185cm}$$