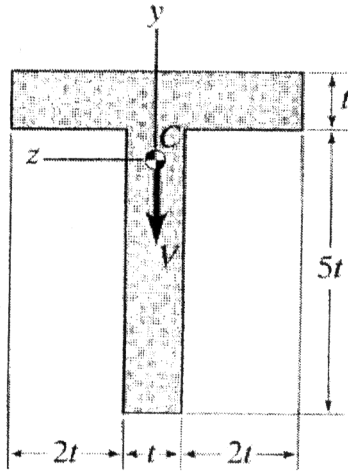
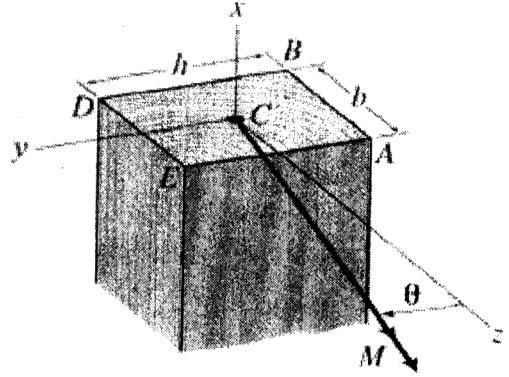
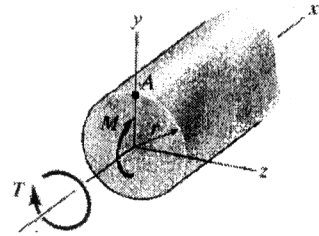




Şekil-1



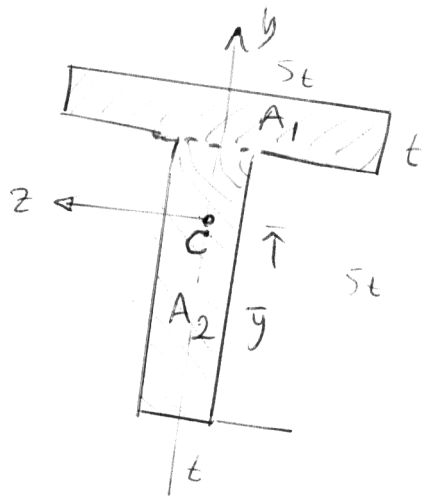
Şekil-2



Şekil-3

- 1- Şekil-1'de görülen kiriş kesitindeki kesme gerilmesi dağılımını y ekseninin fonksiyonu olarak bulunuz. $t=1\text{mm}$, $V=100\text{ N}$ olarak alınız.
- 2- Kesiti Şekil-2'de verilen kirişe emniyetli olarak uygulanabilecek eğilme momentinin değerini bulunuz. Kesitte tarafsız eksenin doğrultusunu tespit ediniz. $b=40\text{mm}$, $h=20\text{mm}$, $\theta=30^\circ$, emniyet gerilmesi $\sigma_{em}=200\text{Mpa}$.
- 3- Şekil-3'de görülen kirişin A noktasındaki gerilme durumunu belirleyiniz ve Mohr dairesinde gösteriniz. Bu noktada asal gerilmeleri tespit ediniz. Maksimum kesme gerilmesinin değerini ve oluştuğu düzlem doğrultularını bulunuz. $M=T=100\text{ Nm}$, $r=10\text{mm}$.

G-1)



$$t = 1 \text{ mm}$$

$$A_1 = 5t \cdot t = 5 \text{ mm}^2$$

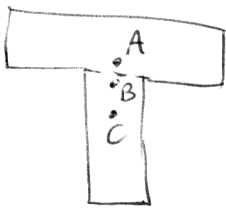
$$A_2 = t \cdot 5t = 5 \text{ mm}^2$$

$$\bar{y} = \frac{\sum \bar{y} A}{\sum A} = \frac{(5 \cdot 5) \cdot 5 + (2 \cdot 5) \cdot 5}{5 + 5}$$

$$= \frac{8 \cdot 5}{10} = 4 \text{ mm}$$

$$I = \left[\frac{1}{12} \cdot 5 \cdot 1^3 + \underbrace{(6 - 4 - 0.5)^2}_{1.5} \cdot 5 \right] + \left[\frac{1}{12} \cdot 1 \cdot 5^3 + \underbrace{(4 - 2 \cdot 5)^2}_{1.5} \cdot 5 \right]$$

$$= [0.4167 + 11.25] + [10.4167 + 11.25] = 33.33 \text{ mm}^4$$

A noktası :

$$Q = \bar{y}' A_1 = (1.5) \cdot 5 = 7.5 \text{ mm}^3$$

$$\tau_A = \frac{V \cdot Q}{I \cdot t} = \frac{100 \cdot (7.5)}{33.33 \cdot (5)} = 4.5 \text{ N/mm}^2$$

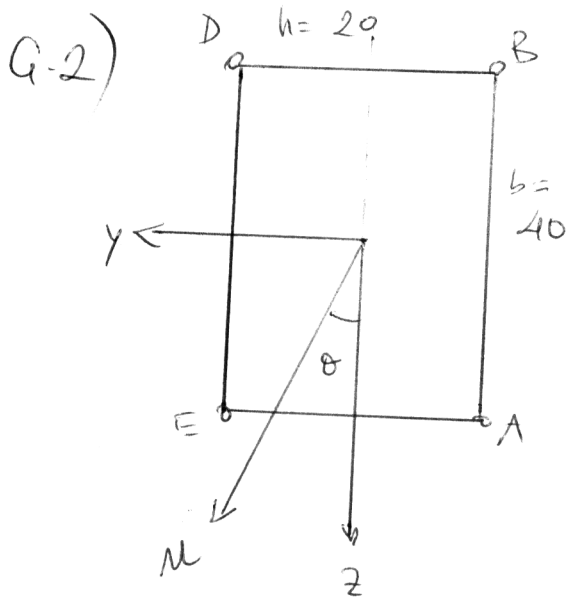
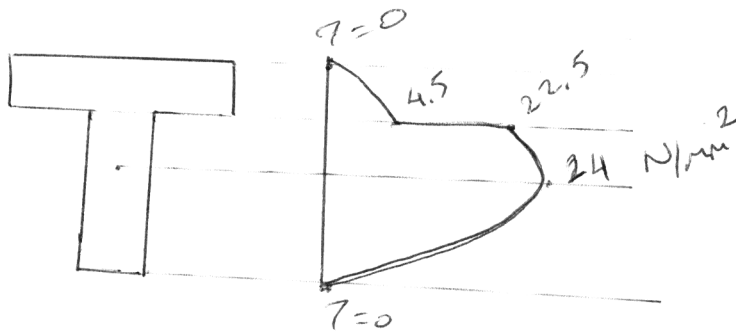
B noktası :

$$\tau_B = \frac{V \cdot Q}{I \cdot t} = \frac{100 \cdot (7.5)}{33.33 (1)} = 22.5 \text{ N/mm}^2$$

C solution :

$$Q = (1.5) \cdot 5 + 1 \cdot (6-4-1) \cdot (6-4-1)/2 = 7.5 + 0.5 = 8 \text{ mm}^3$$

$$\tau_c = \frac{V \cdot Q}{I \cdot t} = \frac{100 \cdot 8}{33.33 \cdot 1} = 24 \text{ N/mm}^2$$



$$\sigma = -\frac{M_z \cdot y}{I_z} + \frac{M_y \cdot z}{I_y}$$

$$M_y = M \cdot \sin \theta = 0.5 M$$

$$M_z = M \cdot (\cos \theta) = 0.866 M$$

$$I_z = \frac{1}{12} \cdot b \cdot h^3 = \frac{1}{12} \cdot 40 \cdot 20^3 = 26666.67 \text{ mm}^4$$

$$I_y = \frac{1}{12} \cdot h \cdot b^3 = \frac{1}{12} \cdot 20 \cdot 40^3 = 106666.67 \text{ mm}^4$$

Taraf 12 eksen bulalım ; $\sigma = 0$

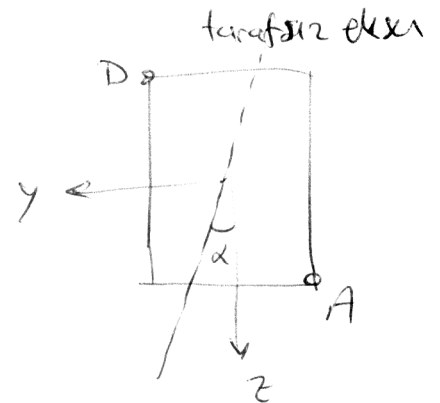
$$0 = - \frac{M_z y}{I_z} + \frac{M_y z}{I_y} \Rightarrow \frac{M_z y}{I_z} = \frac{M_y z}{I_y}$$

$$y = \frac{I_z}{I_y} \frac{M_y}{M_z} z = \frac{I_z}{I_y} \frac{M \sin \theta}{M \cos \theta} z = \frac{I_z}{I_y} \tan \theta \cdot z$$

$$y = \frac{26666.67}{106666.67} \cdot \tan 30^\circ \cdot z = 0.144 z$$

$$\tan \alpha = 0.144 \rightarrow \alpha = 8.21^\circ$$

En uzak noktalar A, D ;



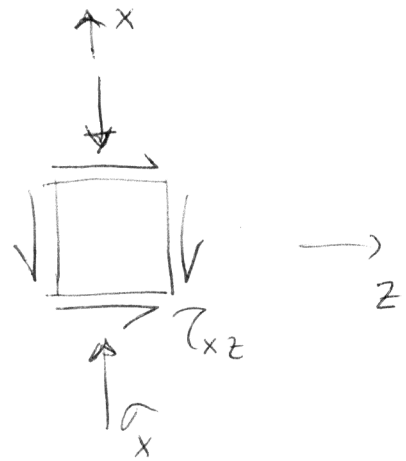
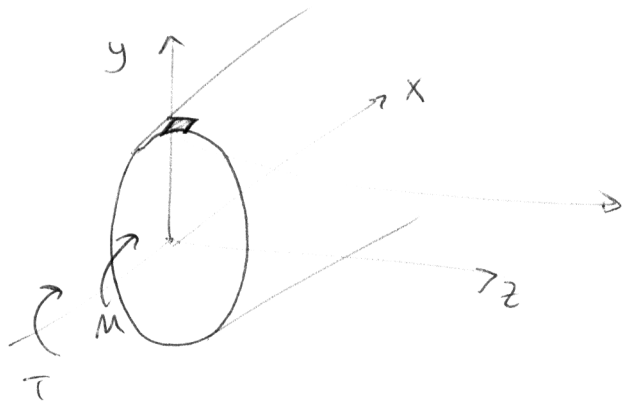
$$\sigma_A = -\sigma_D = - \frac{0.866 M (-10)}{26666.67} + \frac{0.5 M (20)}{106666.67} =$$

$$\sigma_A = M (3.2475 \cdot 10^{-4} + 4.7375 \cdot 10^{-5}) = 4.185 \cdot 10^{-4} M$$

$$\sigma_{em} = 200 \text{ MPa} = 200 \frac{\text{N}}{\text{mm}^2} = 4.185^{-4} M$$

$$\boxed{M = 477.897 \text{ Nm}}$$

Q-3)



Burulma :

$$\tau = \frac{T \cdot c}{J}$$

$$J = \frac{\pi}{2} \cdot r^4 \rightarrow$$

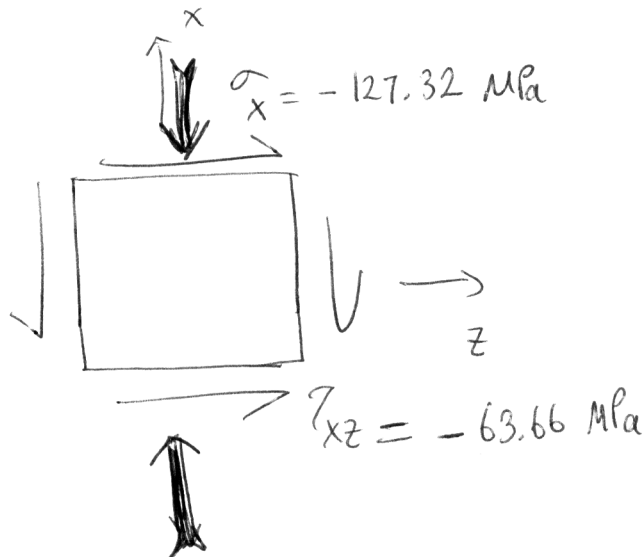
$$\tau = \frac{100 \cdot (10 \cdot 10^{-3})}{\frac{\pi}{2} \cdot (10 \cdot 10^{-3})^4} = \frac{10^2}{\frac{\pi}{2} \cdot 10^{-6}} = \frac{10^8}{\pi/2} = 63.66 \cdot 10^6 \text{ (N/m}^2\text{)}$$

Eğilme :

$$\sigma = \frac{M_z \cdot c}{I_z}$$

$$I_z = \frac{\pi}{4} \cdot r^4$$

$$\sigma = \frac{100 \cdot (10 \cdot 10^{-3})}{\frac{\pi}{4} \cdot (10 \cdot 10^{-3})^4} = \frac{10^8}{\pi/4} = 127.32 \cdot 10^6 \text{ (N/m}^2\text{)}$$



Gerilme hali :

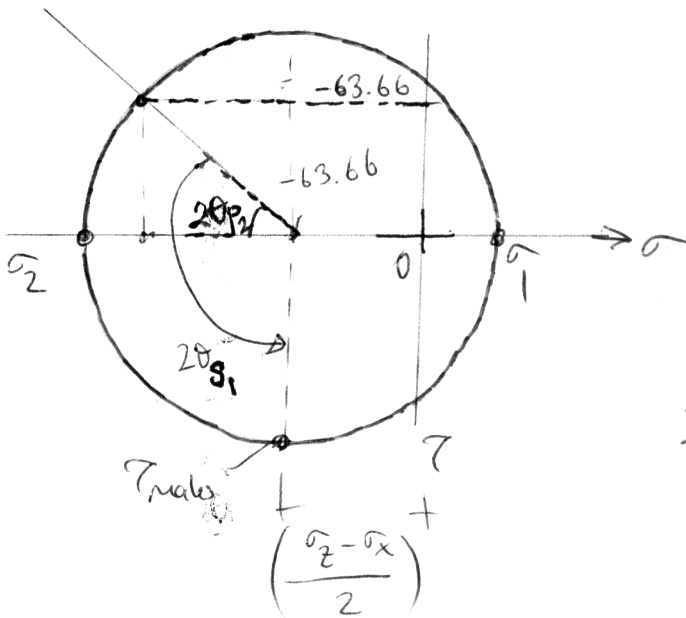
$$\sigma_z = 0$$

$$\sigma_x = -127.32 \text{ MPa}$$

$$\tau_{xz} = -63.66 \text{ MPa}$$

$$\sigma_{\text{ort}} = \frac{\sigma_z + \sigma_x}{2} = \frac{0 + (-127.32)}{2} = -63.66 \text{ MPa}$$

$$R = \sqrt{\left(\frac{\sigma_z - \sigma_x}{2}\right)^2 + \tau_{xz}^2} = \sqrt{\left(\frac{127.32}{2}\right)^2 + 63.66^2} \approx 90.03$$



$$\sigma_2 = -63.66 - 90.03 = -153.69 \text{ MPa}$$

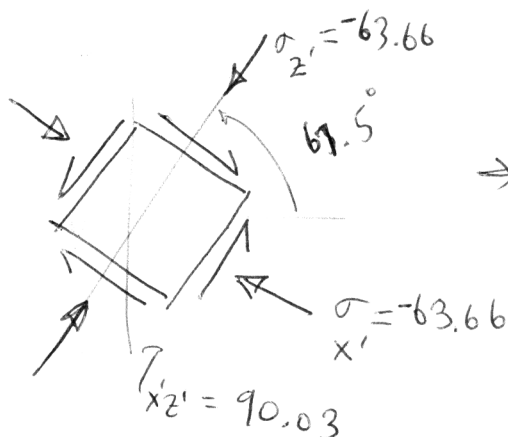
$$\sigma_1 = -63.66 + 90.03 = 26.37 \text{ MPa}$$

$$2\theta_{P_2} = \tan^{-1}\left(\frac{63.66}{63.66}\right) = 45^\circ$$

$$\theta_{P_2} = 22.5^\circ$$

$$2\theta_{S_1} = 2\theta_{P_2} + 90^\circ = 45^\circ + 90^\circ = 135^\circ$$

$$\theta_{S_1} = 135^\circ / 2 = 67.5^\circ$$



→ Maximum kesme gerilme
doğrultusu