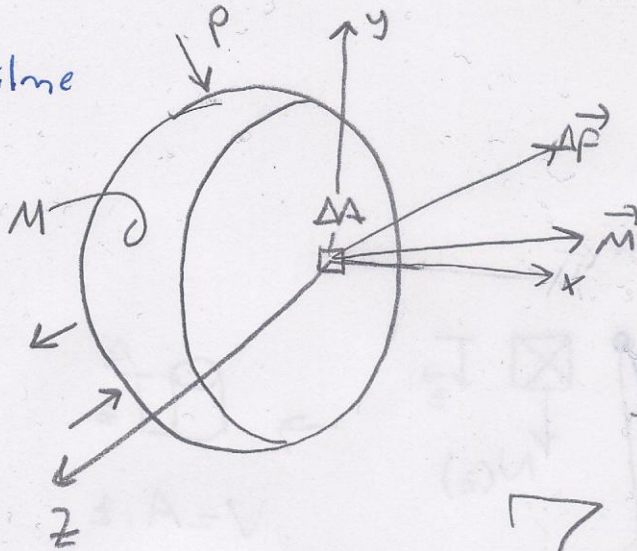


- Mukavemet -

Gerilme



Normal kuvvet

$$\vec{F} = F_x \cdot \vec{i} + F_y \cdot \vec{j} + F_z \cdot \vec{k}$$

$$\vec{M} = M_x \cdot \vec{i} + M_y \cdot \vec{j} + M_z \cdot \vec{k}$$

signa

$$\sigma_{xx} = \sigma_x = \lim_{\Delta A \rightarrow 0} \frac{\Delta F_x}{\Delta A} = \frac{dF_x}{dA}$$

$$\tau_{xy} = \lim_{\Delta A \rightarrow 0} \frac{\Delta F_y}{\Delta A} = \frac{dF_y}{dA}$$

$$\tau_{yz} = \lim_{\Delta A \rightarrow 0} \frac{\Delta F_z}{\Delta A} = \frac{dF_z}{dA}$$

$$\text{Gerilme} = \frac{\text{Kuvvet (N)}}{\text{Alan (m.m}^2\text{)}}$$

$$Pa = \frac{N}{m^2}$$

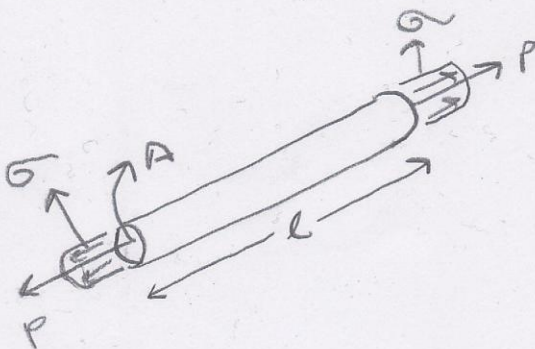
$$1 MPa = 10^6 \frac{N}{m^2}$$

$$10^6 = \text{Mega}$$

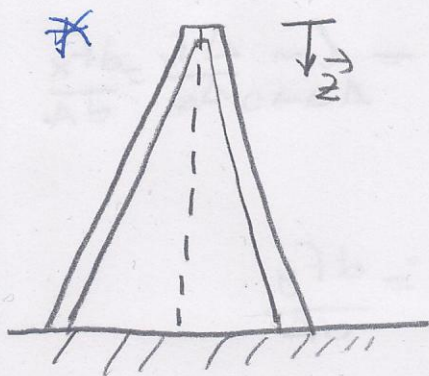
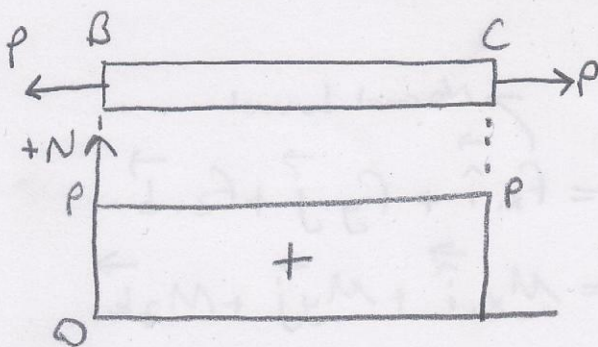
$$MPa = \frac{N}{mm^2}$$

$$10^9 = \text{Giga}$$

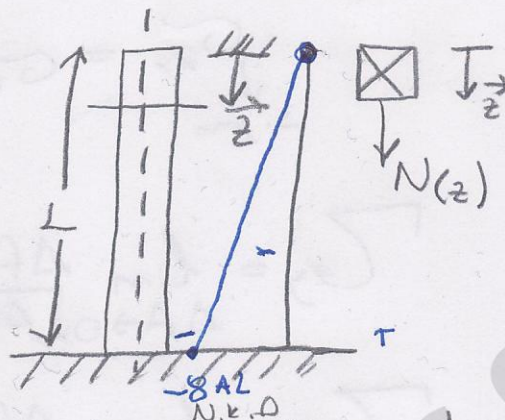
Tek Eksenli Gerilme Mali



$$\sigma = \frac{N}{A} = \frac{P}{A}$$



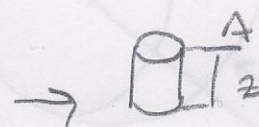
$$\sigma = \frac{N}{A}$$



$$\gamma = \rho \cdot g \text{ (N/m}^3\text{)}$$

$$g = \text{yapı malzeme (kg/m}^3\text{)}$$

$$g = m/s^2$$



$$V = A \cdot z$$

$$W(z) = \gamma \cdot V(z)$$

$$W(z) = \gamma \cdot A \cdot z$$

$$+\downarrow \sum f_z = 0$$

$$W(z) + N(z) = 0$$

$$N(z) = W(z) = -\gamma \cdot A \cdot z$$

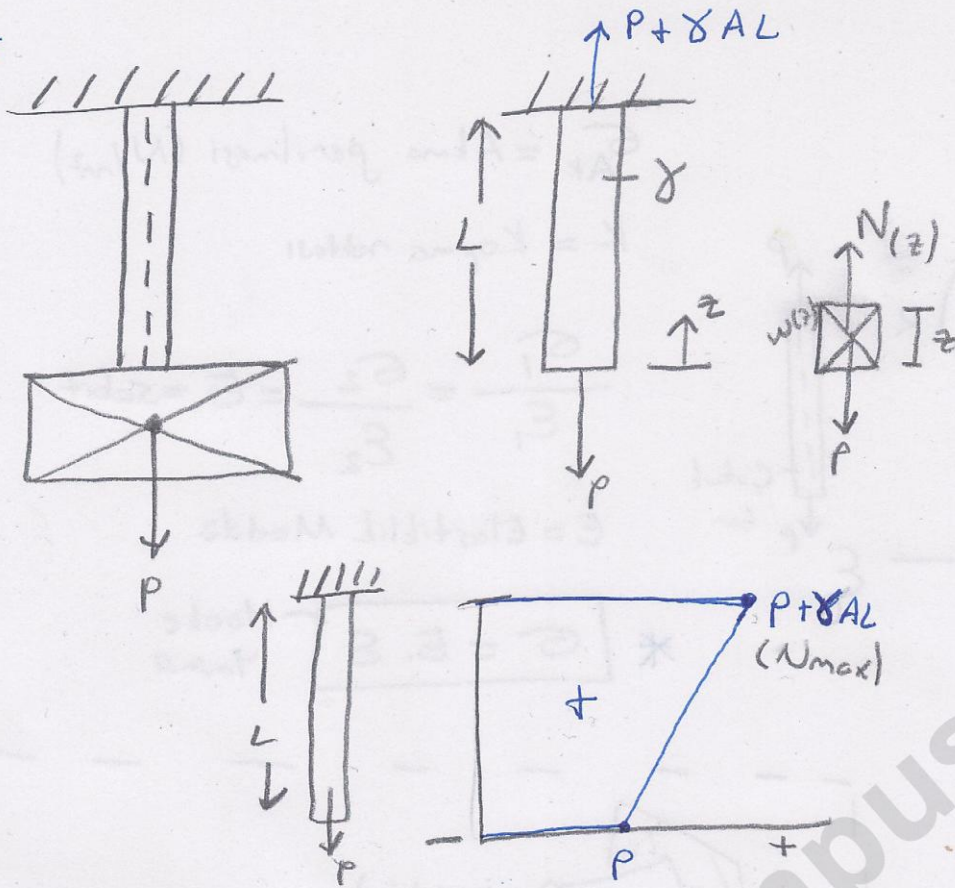
$$x=0 \quad N(0)=0$$

$$N_{\max} = x=L \quad N(L) = -\gamma \cdot A \cdot L$$

$$\sigma_{\max} = \frac{N_{\max}}{A}$$

$$\sigma_{\max} = \frac{-\gamma \cdot A \cdot L}{A} = -\gamma \cdot L$$

*



$$\uparrow \sum F_z = 0$$

$$N(z) - W(z) - P = 0$$

$$W(z) = \gamma \cdot A \cdot z$$

$$N(z) = P + W(z)$$

$$N(z) = P + \gamma \cdot A \cdot z$$

$$\sigma_{\max} = \frac{N_{\max}}{A}$$

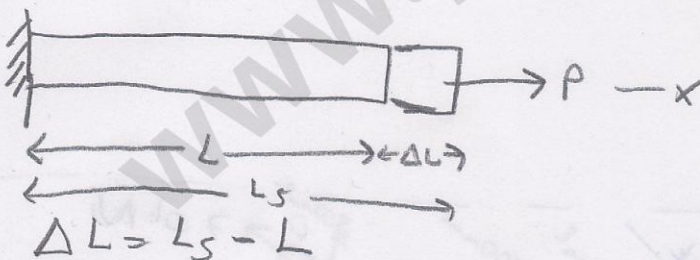
$$\sigma_{\max} = \frac{P + \gamma AL}{A}$$

$$\sigma_{\max} = \frac{P}{A} + \gamma A$$

$$\sigma(z) = \frac{N(z)}{A(z)}$$

$$\sigma_{\max} \text{! bulmak için } \frac{d\sigma(z)}{dz} = 0 \quad \begin{matrix} z = k \cdot L \\ 0 < k < 1 \end{matrix}$$

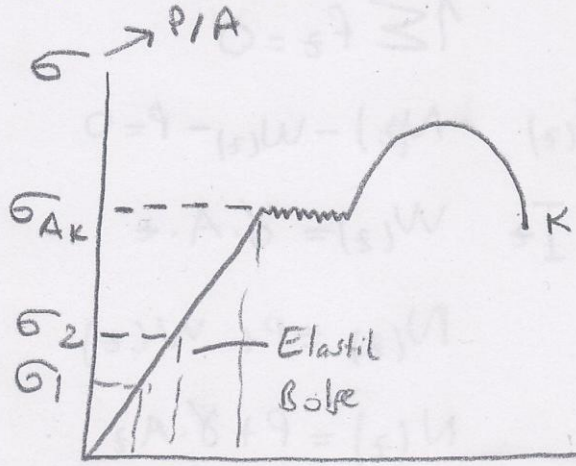
*



$$\boxed{\epsilon = \frac{\Delta L}{L}} \quad \epsilon = \epsilon_x$$

ϵ = Birim şekil değiştirme miktarı (oranı)

Hooke Yasası



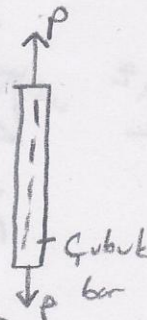
$$\sigma_{Ak} = \text{Akma gerilmesi (N/m}^2\text{)}$$

K = Kopma noktesi

$$\frac{\sigma_1}{\epsilon_1} = \frac{\sigma_2}{\epsilon_2} = E = \text{sabit}$$

E = Elastiklik Modülü

$$\sigma = E \cdot \epsilon \quad \text{Hooke Yasası}$$



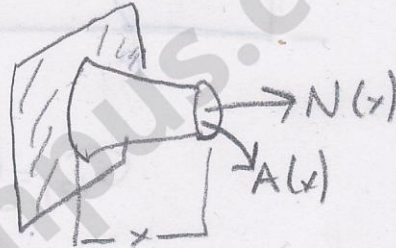
$$\sigma = E \cdot \epsilon$$

$$\downarrow$$

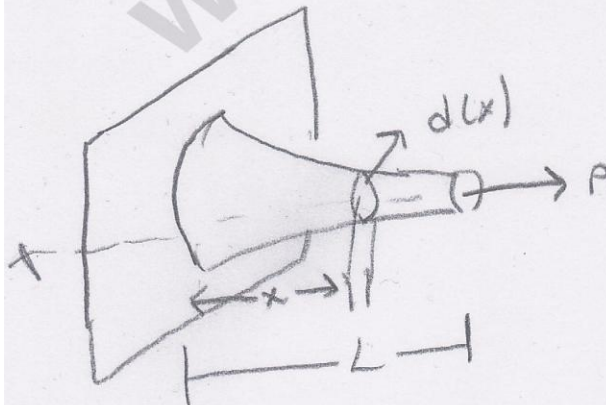
$$\frac{N}{A} = E \cdot \frac{\Delta L}{L}$$

$$\Delta L = \frac{N \cdot L}{E \cdot A}$$

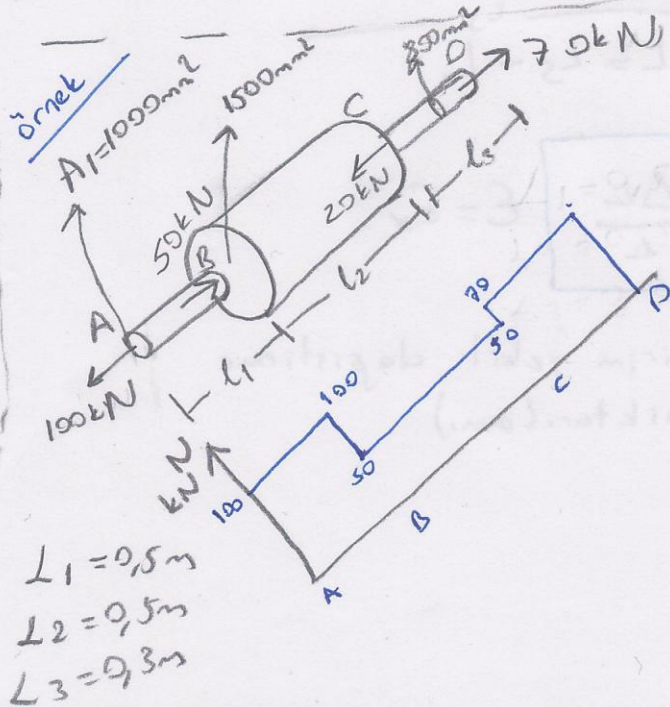
→ Prizmatik çubuk için boyca değişim miktarı.



$$\Delta L = \int_0^L \frac{N(x) \cdot dx}{E \cdot A(x)}$$



İntegrasyon yapılır.



örneğin gözetimi

$$\sigma_{AB} = \frac{N_{AB}}{A_{AB}}$$

$$\sigma_{AB} \leq \sigma_{em}$$

$$\sigma_{BC} = \frac{N_{BC}}{A_{BC}}$$

$$\sigma_{BC} \leq \sigma_{em}$$

$$\sigma_{CD} = \frac{N_{CD}}{A_{CD}}$$

$$\sigma_{CD} \leq \sigma_{em}$$

$$\sigma_{em} = \sigma_{max} = 120 \text{ MPa}$$

$$\sigma \leq \sigma_{em}$$

→ emriyet sentri

$$E = 210 \text{ GPa}$$

$$N_{AB} = 100 \text{ kN}$$

$$\sigma_{AB} = \frac{100 \cdot 10^3 \text{ N}}{1000 \text{ mm}^2} = 100 \text{ MPa} \leq 120 \text{ MPa}$$

$$N_{BC} = 50 \text{ kN}$$

$$\sigma_{BC} = \frac{50 \cdot 10^3 \text{ N}}{1500 \text{ mm}^2} = 33,33 \text{ MPa} \leq 120 \text{ MPa}$$

$$N_{CD} = 70 \text{ kN}$$

$$\sigma_{CD} = \frac{70 \cdot 10^3 \text{ N}}{800 \text{ mm}^2} = 87,5 \text{ MPa} \leq 120 \text{ MPa}$$

perilme
yönünde

$$\Delta L_{AD} = ?$$

$$\Delta L = \sum_{i=1}^n \frac{N_i \cdot L_i}{E_i \cdot A_i}$$

$$\Delta L_{AD} = \frac{N_{AB} \cdot L_{AB}}{E \cdot A_{AB}} + \frac{N_{BC} \cdot L_{BC}}{E \cdot A_{BC}} + \frac{N_{CD} \cdot L_{CD}}{E \cdot A_{CD}}$$

→

$$\Delta L_{AD} = \frac{N_{AB} \cdot L_{AB}}{E \cdot A_{AB}} + N$$

$$= \frac{(100 \cdot 10^3 \text{ N}) \cdot (0,5 \cdot 10^3 \text{ mm})}{(210 \cdot 10^3 \text{ MPa}) \cdot (1000 \text{ mm}^2)}$$

$$+ \frac{(50 \cdot 10^3 \text{ N}) \cdot (0,5 \cdot 10^3 \text{ mm})}{(210 \cdot 10^3 \text{ MPa}) \cdot (1500 \text{ mm}^2)}$$

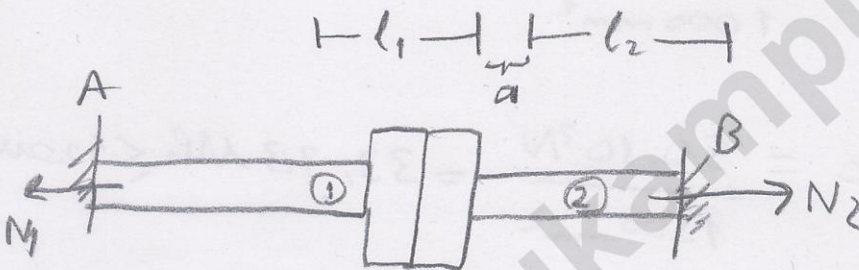
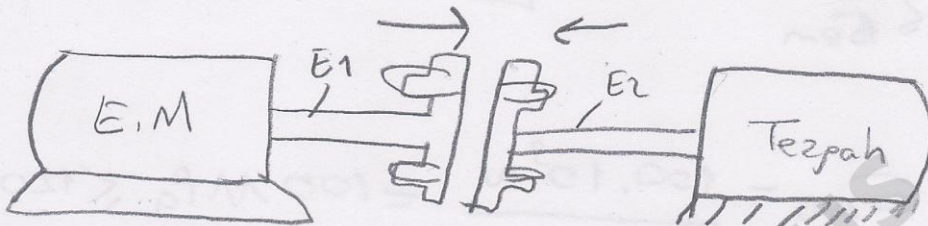
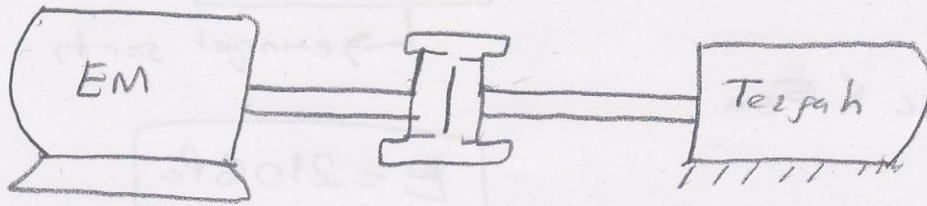
$$+ \frac{(70 \cdot 10^3 \text{ N}) \cdot (0,3 \cdot 10^3 \text{ mm})}{(210 \cdot 10^3 \text{ MPa}) \cdot (800 \text{ mm}^2)}$$

----- mm =

Hiperstatik Sistemler

1. wize de yok

6



$$\sum F_x = 0$$

$$-N_1 + N_2 = 0 \quad \boxed{N_1 = N_2} \rightarrow \text{denge denklemi}$$

$$\Delta L_1 + \Delta L_2 = a$$

$$\frac{N_1 \cdot L_1}{E_1 \cdot A_1} + \frac{N_2 \cdot L_2}{E_2 \cdot A_2} = a$$

$$\sigma_1 = \frac{N_1}{A_1}$$

$$\sigma_2 = \frac{N_2}{A_2}$$