

Mukavemet

Uygulama: Normal Kuvvet, Kesme Kuvveti



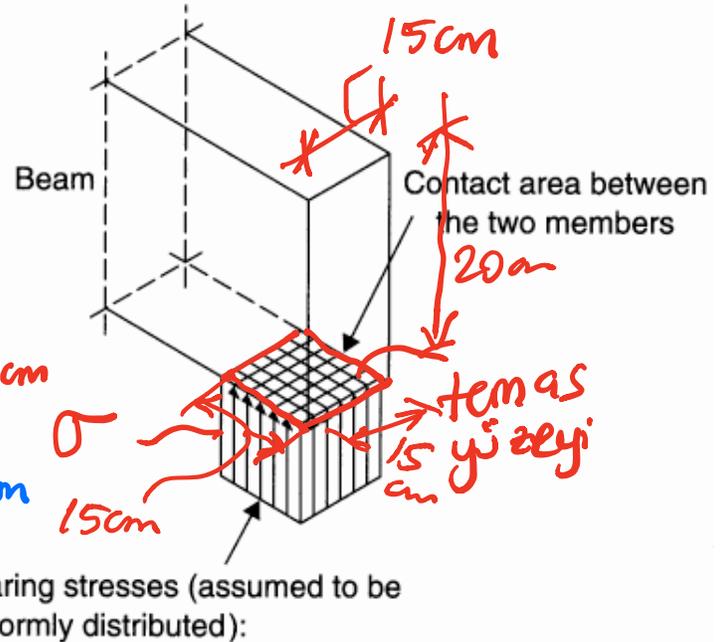
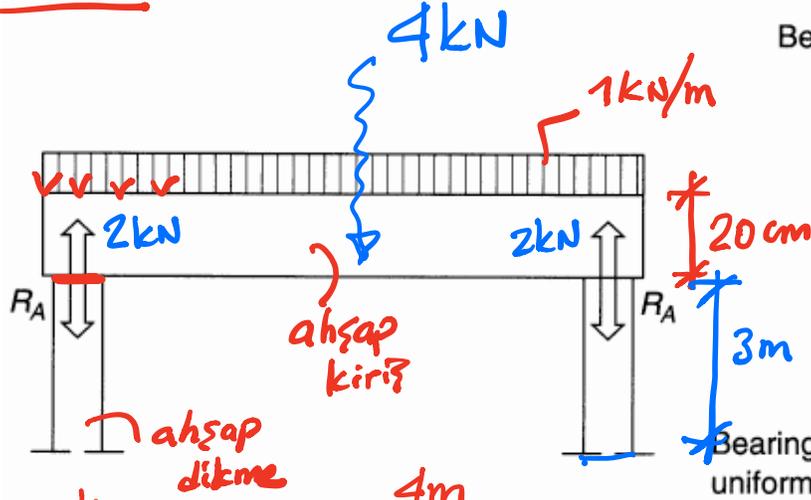
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Kirişte Ezilme Gerilmesi

ÖRNEK: $E = 10000 \text{ Mpa}$

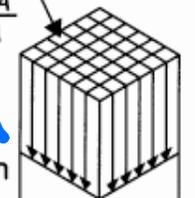


15cm dikme

a)
$$\sigma = \frac{\text{KUVVET}}{\text{ALAN}} = \frac{2 \text{ kN}}{15 \text{ cm} \times 15 \text{ cm}}$$

$$\sigma = \frac{2}{225} \approx 0,008 \text{ kN/cm}^2 \leq \sigma_{\text{emn}}$$

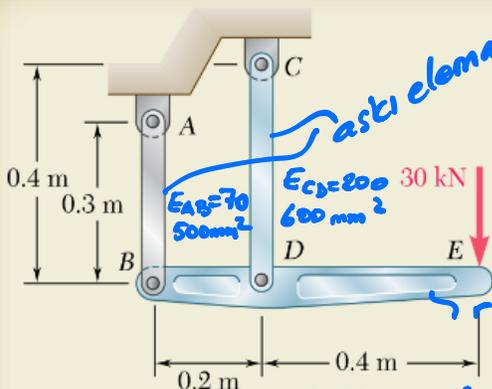
$$f_{bg} = \frac{\text{load}}{\text{area}} = \frac{R_A}{A}$$



b) Dikmedeki kısalma $\Delta = ?$

$$\Delta = \frac{P \times L}{E \times A} = \frac{2 \text{ kN} \times 3 \text{ m}}{10000 \frac{\text{N}}{\text{mm}^2} \cdot 15 \text{ cm} \times 15 \text{ cm}} = \frac{2000 \text{ N} \cdot 3000 \text{ mm}}{10000 \frac{\text{N}}{\text{mm}^2} \cdot 150 \text{ mm} \cdot 150 \text{ mm}} = \dots$$

SAMPLE PROBLEM 2.1



The rigid bar BDE is supported by two links AB and CD . Link AB is made of aluminum ($E = 70 \text{ GPa}$) and has a cross-sectional area of 500 mm^2 ; link CD is made of steel ($E = 200 \text{ GPa}$) and has a cross-sectional area of 600 mm^2 . For the 30-kN force shown, determine the deflection (a) of B , (b) of D , (c) of E .

- a) AB ve CD subukları gırentli mi? σ_{AB}, σ_{CD}
 b) E noktasının yer-değiřtirmesi? $\delta_E = ?$



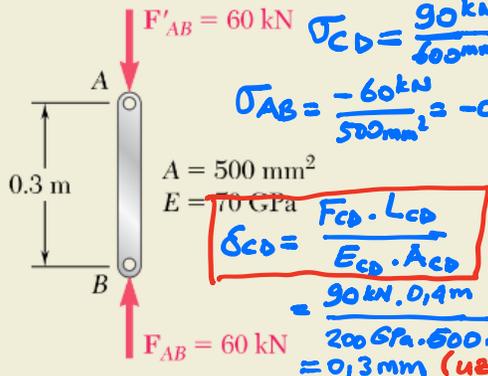
$\sum M_B = 0 \rightarrow 30 \cdot 0,6 - F_{CD} \cdot 0,2 = 0 \rightarrow F_{CD} = 90 \text{ kN}$ (çekme)

SOLUTION

Free Body: Bar BDE

$$\begin{aligned}
 +\uparrow \sum M_B = 0: & \quad -(30 \text{ kN})(0.6 \text{ m}) + F_{CD}(0.2 \text{ m}) = 0 \\
 & \quad F_{CD} = +90 \text{ kN} \quad F_{CD} = 90 \text{ kN} \text{ tension} \\
 +\uparrow \sum M_D = 0: & \quad -(30 \text{ kN})(0.4 \text{ m}) - F_{AB}(0.2 \text{ m}) = 0 \\
 & \quad F_{AB} = -60 \text{ kN} \quad F_{AB} = 60 \text{ kN} \text{ compression}
 \end{aligned}$$

SERBEST CİŞİM DİYAGRAMI



$\sigma_{CD} = \frac{90 \text{ kN}}{600 \text{ mm}^2} = 0,15 \text{ kN/mm}^2$ (çekme)
 $\sigma_{AB} = \frac{-60 \text{ kN}}{500 \text{ mm}^2} = -0,12 \text{ kN/mm}^2$ (basınç)

$A = 500 \text{ mm}^2$
 $E = 70 \text{ GPa}$

$$\delta_{CD} = \frac{F_{CD} \cdot L_{CD}}{E_{CD} \cdot A_{CD}}$$

$$= \frac{90 \text{ kN} \cdot 0,4 \text{ m}}{200 \text{ GPa} \cdot 600 \text{ mm}^2} = 0,3 \text{ mm} \text{ (uzama)}$$

$1 \text{ GPa} = 1000 \text{ MPa} = 1000 \frac{\text{N}}{\text{mm}^2}$

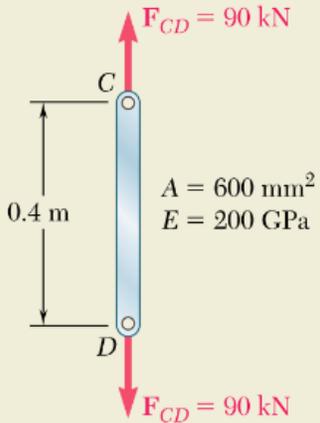
a. Deflection of B. Since the internal force in link AB is compressive, we have $P = -60 \text{ kN}$

$$\delta_B = \frac{PL}{AE} = \frac{(-60 \times 10^3 \text{ N})(0.3 \text{ m})}{(500 \times 10^{-6} \text{ m}^2)(70 \times 10^9 \text{ Pa})} = -514 \times 10^{-6} \text{ m}$$

$$\delta_{AB} = \frac{F_{AB} \cdot L_{AB}}{E_{AB} \cdot A_{AB}} = \frac{-60 \text{ kN} \cdot 0,3 \text{ m}}{70 \text{ GPa} \cdot 500 \text{ mm}^2} = -0,514 \text{ mm} \quad (\text{klusama})$$

The negative sign indicates a contraction of member AB, and, thus, an upward deflection of end B:

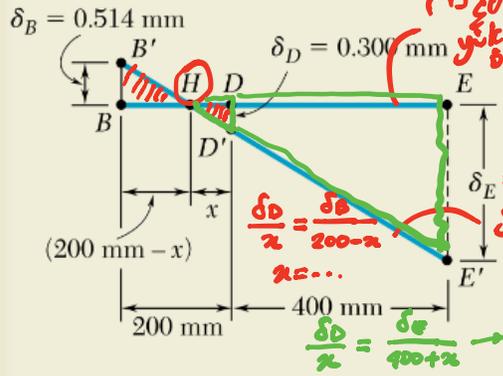
$$\delta_B = 0.514 \text{ mm} \uparrow$$



b. Deflection of D. Since in rod CD, $P = 90 \text{ kN}$, we write

$$\delta_D = \frac{PL}{AE} = \frac{(90 \times 10^3 \text{ N})(0.4 \text{ m})}{(600 \times 10^{-6} \text{ m}^2)(200 \times 10^9 \text{ Pa})} = 300 \times 10^{-6} \text{ m} \quad \delta_D = 0.300 \text{ mm} \downarrow$$

c. Deflection of E. We denote by B' and D' the displaced positions of points B and D. Since the bar BDE is rigid, points B' , D' , and E' lie in a straight line and we write



$$\frac{BB'}{DD'} = \frac{BH}{HD} \quad \frac{0.514 \text{ mm}}{0.300 \text{ mm}} = \frac{(200 \text{ mm}) - x}{x} \quad x = 73.7 \text{ mm}$$

$$\frac{EE'}{DD'} = \frac{HE}{HD} \quad \frac{\delta_E}{0.300 \text{ mm}} = \frac{(400 \text{ mm}) + (73.7 \text{ mm})}{73.7 \text{ mm}}$$

$$\delta_E = 1.928 \text{ mm} \downarrow$$

rijit cevrek yik lemeden once
*delta_D = delta_B / (200 - x) * x = ...*
delta_E = ? yik lendikce sonra
delta_D / x = delta_E / (400 + x) -> delta_E = 1,928 mm

