Mukavemet

Uygulama: Normal Kuvvet, Kesme Kuvveti

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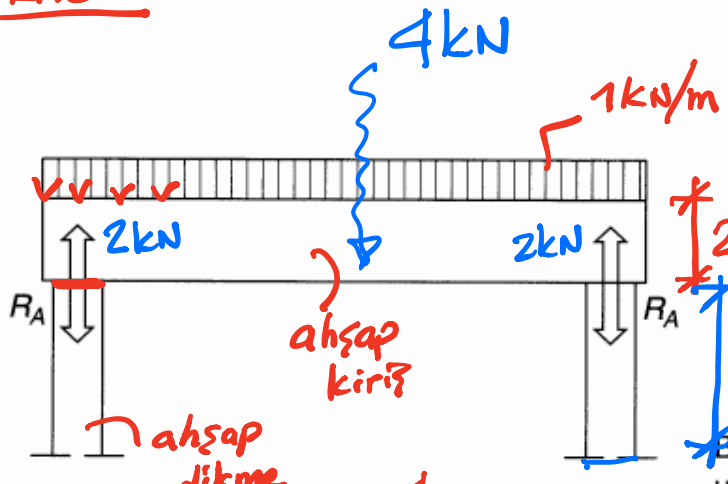
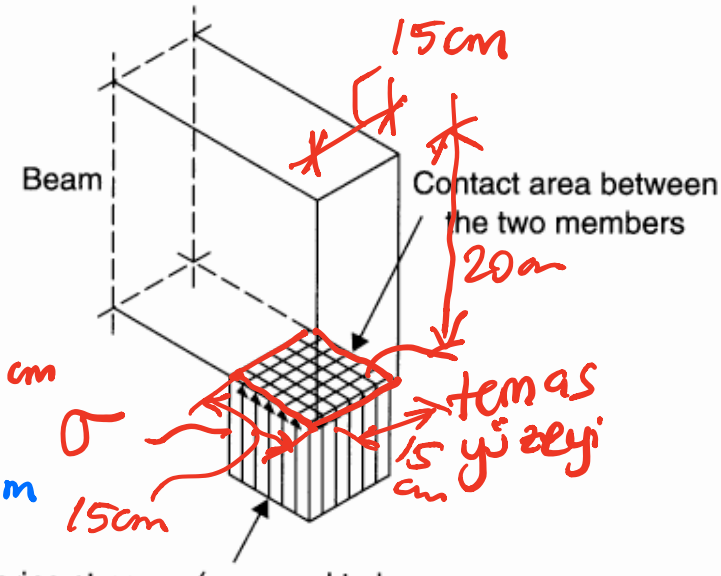
ÖRNEK: $E = 10000\ Mpa$





15 cm × 15 cm Dikme

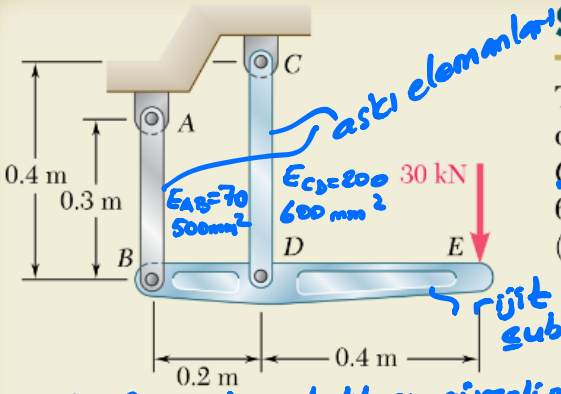
a) $\sigma = \frac{KUVVET}{ALAN} = \frac{2\ kN}{15^{cm} \times 15^{cm}}$

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

b) Dikmedeki kısalma $\Delta = ?$

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

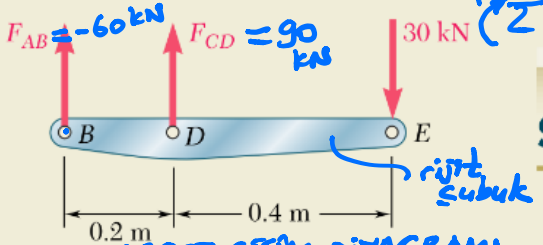
SAMPLE PROBLEM 2.1



The rigid bar BDE is supported by two links AB and CD. Link AB is made of aluminum ($E = 70$ GPa) and has a cross-sectional area of 500 mm^2; link CD is made of steel ($E = 200$ 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.

SOLUTION

Free Body: Bar *BDE*

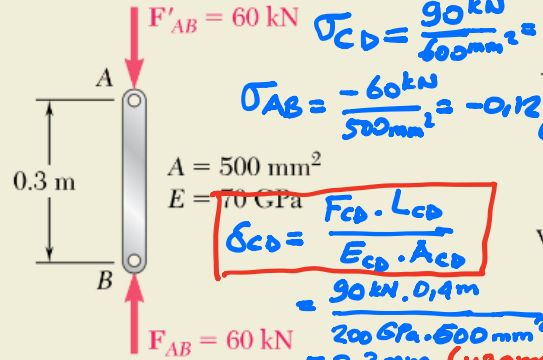


$+\circlearrowleft \Sigma M_B = 0$: $\quad -(30\text{ kN})(0.6\text{ m}) + F_{CD}(0.2\text{ m}) = 0$

$F_{CD} = +90\text{ kN} \qquad F_{CD} = 90\text{ kN}$ *tension*

$+\circlearrowleft \Sigma M_D = 0$: $\quad -(30\text{ kN})(0.4\text{ m}) - F_{AB}(0.2\text{ m}) = 0$

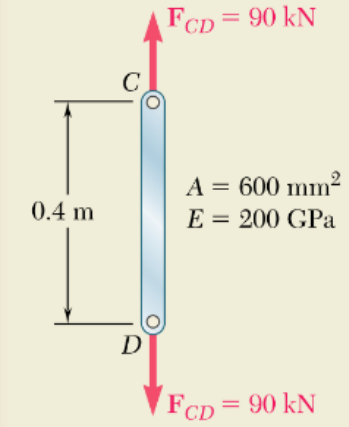
$F_{AB} = -60\text{ kN} \qquad F_{AB} = 60\text{ kN}$ *compression*



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

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

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

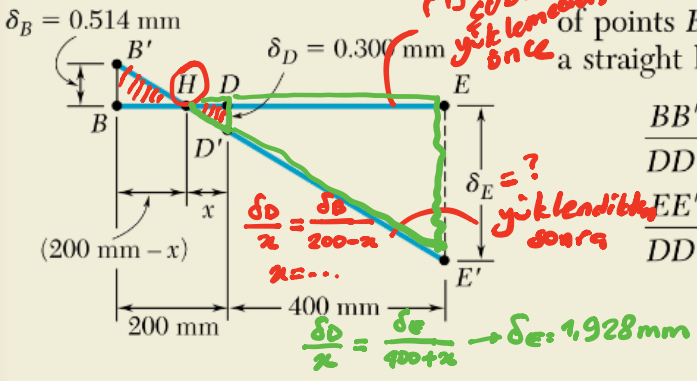


The negative sign indicates a contraction of member AB, and, thus, an upward deflection of end B:

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

b. Deflection of *D*. Since in rod CD, $P = 90$ kN, we write

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



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

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

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

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