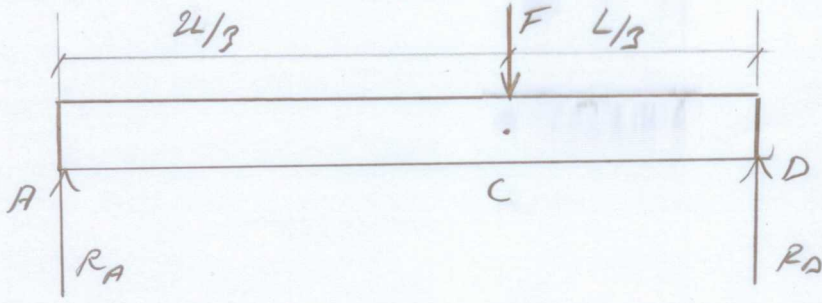


Castigliano Örnek Soru

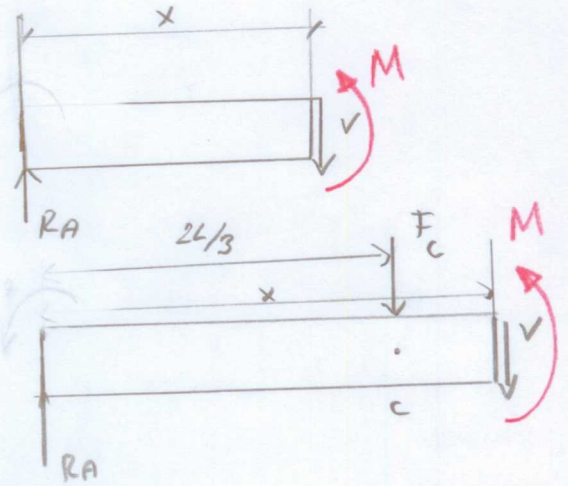
(Yer değiştirme)



C noktasındaki yer değiştirmeyi Castigliano teoremini kullanarak hesaplayınız. $\delta_c = ?$

$$R_A = \frac{F_c}{3} \quad R_D = \frac{2F_c}{3} \quad (\text{Tepeki kuvvetleri } F_c \text{ cinsinden hesaplanır.})$$

$$M_z = \begin{cases} \frac{F_c x}{3} & A < x < C \\ \frac{F_c x}{3} - F_c \left(x - \frac{2L}{3}\right) & C < x < D \end{cases}$$



$$\text{Strain Energy: } U_c = \int \frac{M_z^2 dx}{2EI}$$

C noktasındaki yer değiştirme için Castigliano teoremi yazılırsa,

$$\delta_c = \frac{\partial U_c}{\partial F_c} = \int \frac{M_z}{EI} \frac{\partial M_z}{\partial F_c} dx$$

$$\delta_c = \int_0^{2L/3} \frac{M_{AC}}{EI} \frac{\partial M_{AC}}{\partial F_c} dx + \int_{2L/3}^L \frac{M_{CD}}{EI} \frac{\partial M_{CD}}{\partial F_c} dx \dots \textcircled{1}$$

$$\frac{\partial M_{AC}}{\partial F_c} = \frac{x}{3} \quad \text{ve} \quad \frac{\partial M_{CD}}{\partial F_c} = \frac{x}{3} - x + \frac{2L}{3}$$

1 numaralı denkleme yerlerine yazılırsa;

$$\delta_c = \int_0^{2L/3} \left(\frac{F_c x}{3EI} \right) \left(\frac{x}{3} \right) dx + \int_{2L/3}^L \left(\frac{F_c x}{3EI} - \frac{F_c x}{EI} + \frac{2F_c L}{3EI} \right) \left(\frac{2L-2x}{3} \right) dx$$

Denkleme düzenlenirse,

$$\delta_c = \frac{1}{9EI} \int_0^{2L/3} F_c x^2 dx + \frac{4}{9EI} \int_{2L/3}^L (F_c L^2 - 2F_c Lx + F_c x^2) dx$$

İntegraller alınırsa,

$$\delta_c = \frac{1}{9EI} \left(\frac{8F_c L^3}{81} \right) + \frac{4}{9EI} \left[F_c L^3 - F_c L^3 + \frac{F_c L^3}{3} - \left(\frac{2F_c L^3}{3} \rightarrow \right. \right. \\ \left. \left. - \frac{4F_c L^3}{9} + \frac{8F_c L^3}{81} \right) \right]$$

$$\delta_c = \frac{12 F_c L^3}{729 EI} = \frac{4 F_c L^3}{243 EI}$$

$F_c = F$ için

$$\delta_c = \frac{4FL^3}{243EI}$$