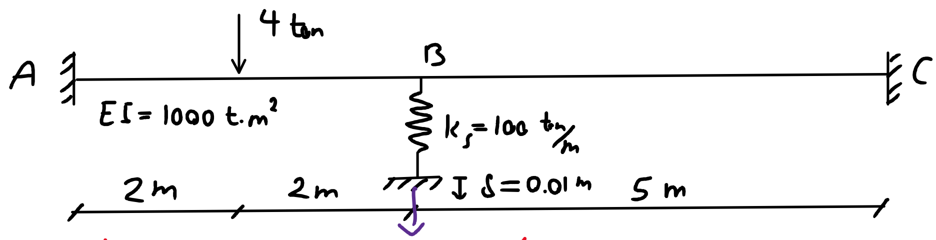
Slope-Deflection 12

Wednesday, March 27, 2024 16:11

مثال: تیر شکل زیر را تحلیل کنید.



۳ مجهول نیرویی: نرمی

۲ مجهول تغییر مکانی Δ , θ_B : سختی

روش شیب - افت (1)

$$M_{AB} = \underbrace{\frac{2\times1000}{4}}_{500}\left(\theta_B - \frac{3\Delta}{4}\right) - \underbrace{\frac{4\times4}{8}}_{2} = 500\theta_B - 375\Delta - 2$$

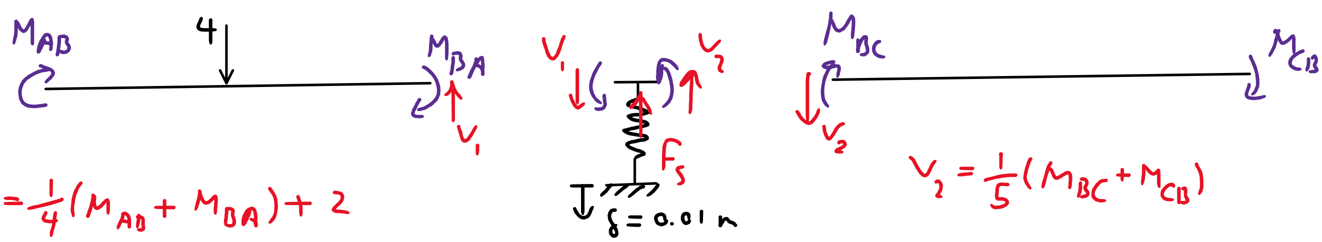
$$M_{BA} = 500\left(2\theta_B - 3\frac{\Delta}{4}\right) + 2 = 1000\theta_B - 375\Delta + 2$$

$$M_{BC} = \underbrace{\frac{2\times1000}{5}}_{400}\left(2\theta_B + \frac{3\Delta}{5}\right) = 800\theta_B + 240\Delta$$

$$M_{CB} = 400\left(\theta_B + \frac{3\Delta}{5}\right) = 400\theta_B + 240\Delta$$

(1) $M_{BA} + M_{BC} = 0$

$$1800\theta_B - 135\Delta + 2 = 0$$



$$V_1 = \frac{1}{4}(M_{AB} + M_{BA}) + 2 \qquad V_2 = \frac{1}{5}(M_{BC} + M_{CB})$$

(2) $V_2 - V_1 + F_s = 0$

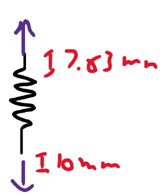
$$\frac{1}{5}(1200\theta_B + 480\Delta) - \frac{1}{4}(1500\theta_B - 750\Delta) - 2 + \overset{100}{k_s}(\Delta - 0.01) = 0$$

$$-135\theta_B + 383.5\Delta = 3$$

$$\begin{cases} 1800\theta_B - 135\Delta = -2 \\ -135\theta_B + 383.5\Delta = 3 \quad \times\frac{40}{3} \end{cases}$$

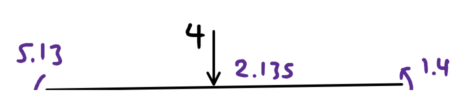
$$4978.3\Delta = 38 \longrightarrow \boxed{\Delta = 7.63\times10^{-3}\ m = 7.63\ mm}$$

$$\boxed{\theta_B = -5.47\times10^{-4}\ rad}$$



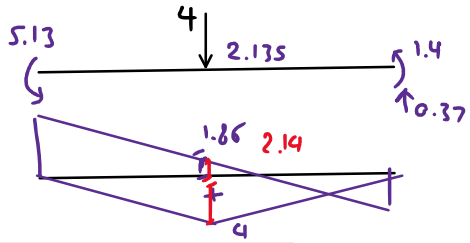
$$F_s = 100(7.63\times10^{-3} - 0.01) = -0.237\ ton \qquad \boxed{F_s = 0.237\ ton}$$

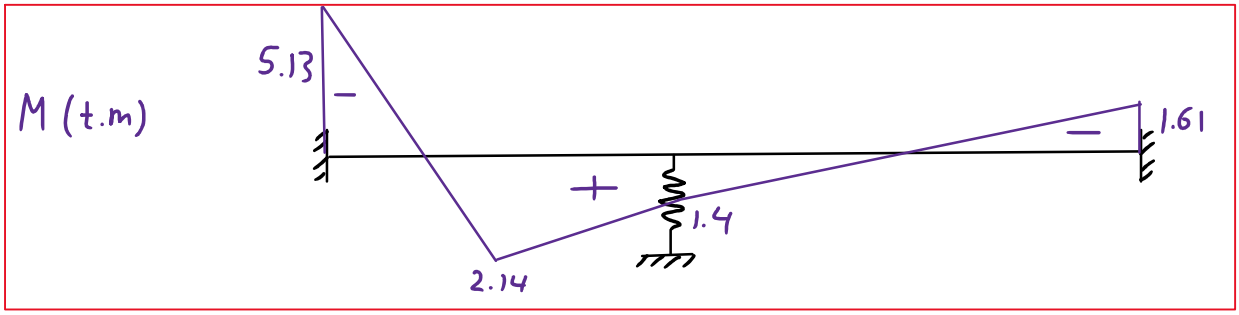
$$\boxed{M_{AB} = -5.13\ t.m \qquad M_{BC} = 1.4\ t.m}$$



$M_{AB} = -5.13$ t.m $M_{BC} = 1.4$ t.m

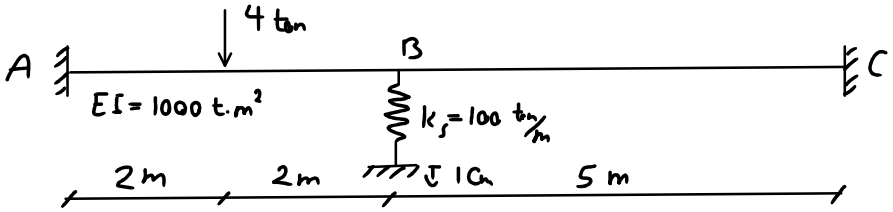
$M_{BA} = -1.4$ t.m $M_{CB} = 1.61$ t.m

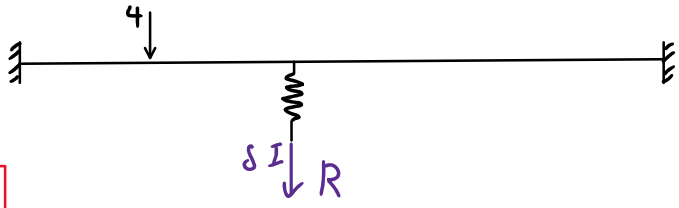




(۲)

دوتی نیردی





$\delta = 0.01$

$\delta_p + R\,\delta_i = 0.01$

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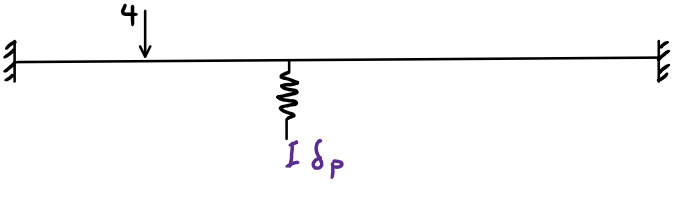

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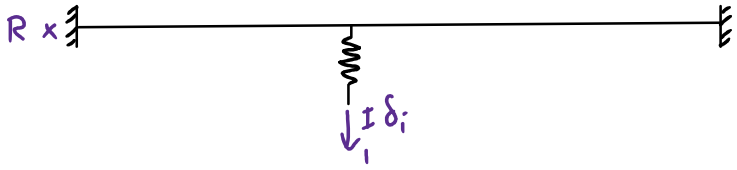
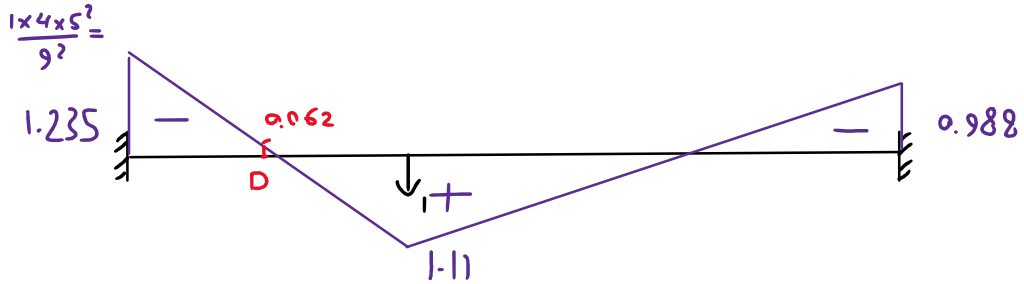
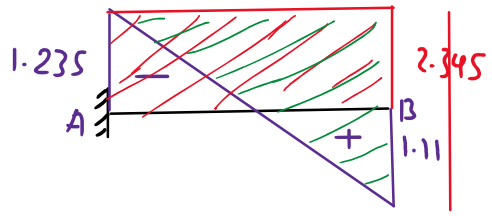




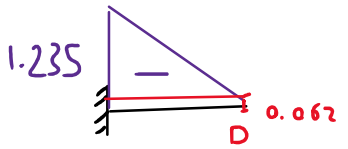
$$-\left(\frac{1.235+0.988}{2}\right)+\frac{1\times4\times5}{9}=1.11$$



$\delta_{B/A}=S\bar{X}$ $\quad -\frac{ML^2}{2}$ $\quad \frac{ML^2}{6}$

$$\delta_{B/A}=-1.235\times\frac{4^2}{2}+2.345\times\frac{4^2}{6}=\frac{-3.63}{EI}=-3.63\times10^{-3}\ m$$

$$\delta_i=\delta_b+\delta_s=-3.63\times10^{-3}-\frac{1}{100}=-13.63\times10^{-3}\ m$$

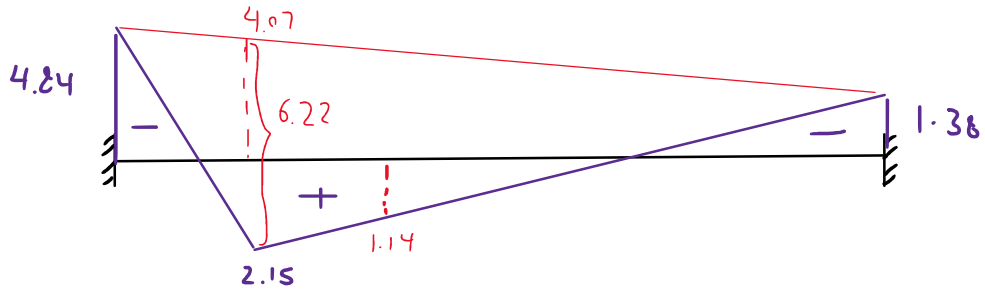


قانون ماکسول

$$\delta_{D/A}=-0.062\times\frac{2^2}{2}-1.172\times\frac{2^2}{3}=\frac{1.687}{EI}\longrightarrow\delta_p=4\times\frac{1.687}{EI}=\frac{6.75}{EI}=6.75\times10^{-3}\ m$$

$\delta_p+R\,\delta_i=0.01$ معادله سازگاری

$$6.75\times10^{-3}+R\,(13.63\times10^{-3})=0.01\longrightarrow R=0.238\ ton$$



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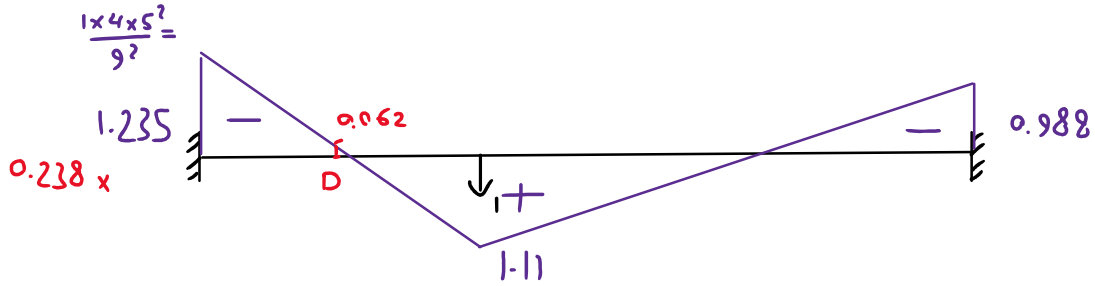

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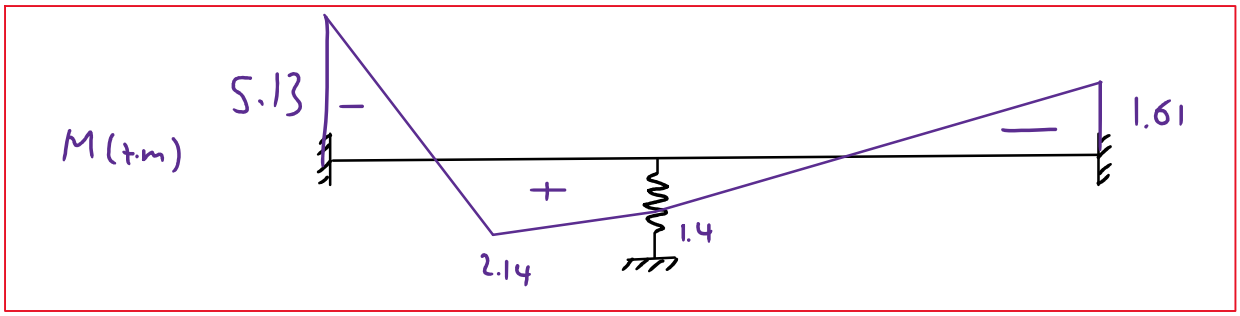
M (t.m)
5.13
1.61
2.14
1.4