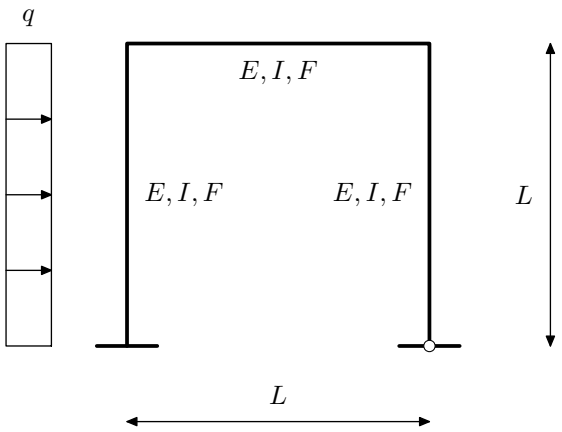
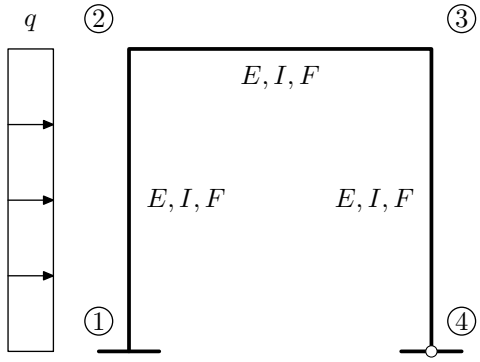
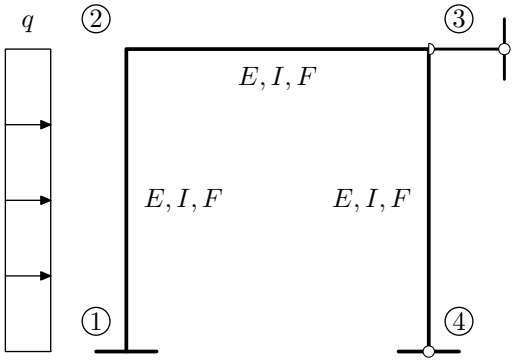
Na zadanom okviru metodom Crossa odredite momentni dijagram.



oznake čvorova



pridržani sustav



krutosti štapova:

$$k_{ik} = \frac{E_{ik} I_{ik}}{L_{ik}} \Rightarrow k_{12} = k_{23} = k_{34} = \frac{EI}{L}$$

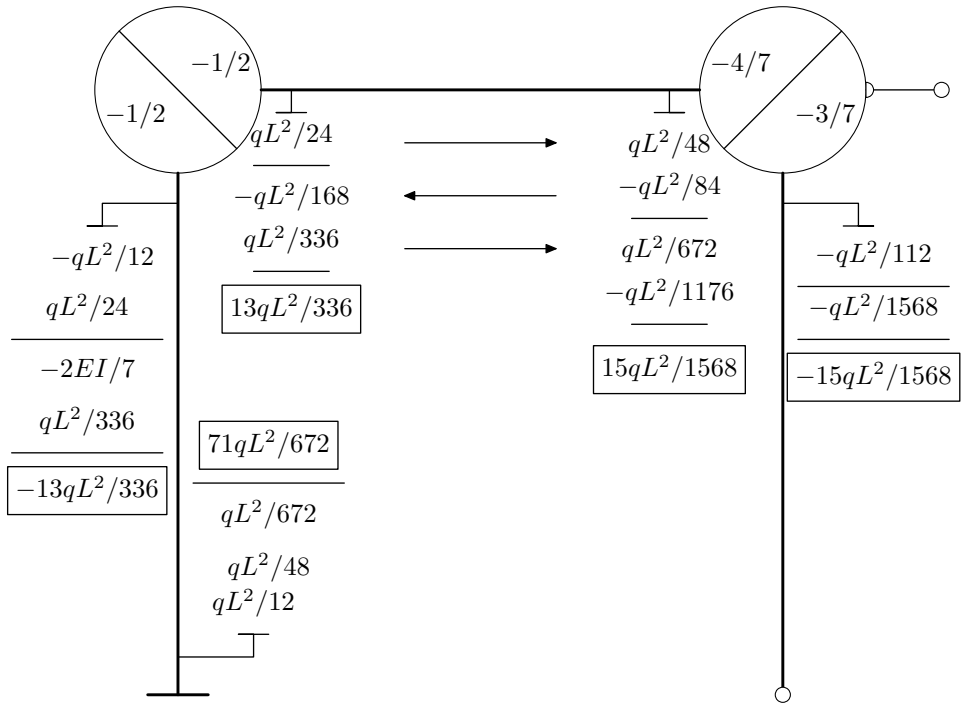
momenti upetosti:

$$\overline{M_{12}} = \frac{qL^2}{12},\ \overline{M_{21}} = -\frac{ql^2}{12}$$

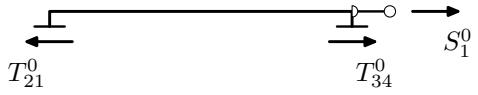
razdjelni koeficijenti:

$$a_{21} = 4k_{21} = \frac{4EI}{L} \quad \Rightarrow \quad \mu_{21} = -\frac{1}{2}$$
$$a_{23} = 4k_{23} = \frac{4EI}{L} \quad \Rightarrow \quad \mu_{23} = -\frac{1}{2}$$
$$A_2 = \frac{8EI}{L}$$

$$a_{32} = 4k_{32} = \frac{4EI}{L} \quad \Rightarrow \quad \mu_{32} = -\frac{4}{7}$$
$$a_{34} = 3k_{34} = \frac{3EI}{L} \quad \Rightarrow \quad \mu_{34} = -\frac{3}{7}$$
$$A_3 = \frac{7EI}{L}$$



proračun sile u pridržanju

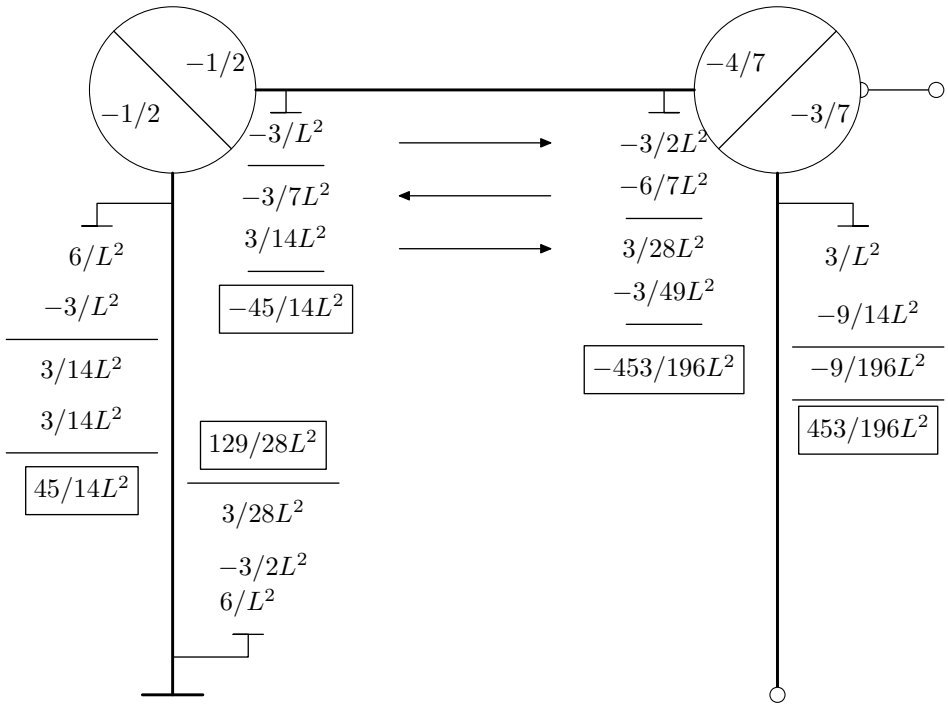


$$
\begin{aligned}
T_{21}^0 &= -\frac{qL}{2} + \frac{M_{12}+M_{21}}{L} = -\frac{291}{672}qL \\
T_{34}^0 &= -\frac{M_{34}+M_{43}}{L} = \frac{15}{1568}qL
\end{aligned}
$$

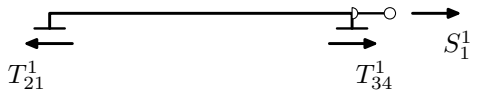
$$
\begin{aligned}
\sum F_x = 0 \quad &\Rightarrow \quad S_1^0 - T_{21}^0 + T_{34}^0 = 0 \\
&\Rightarrow \quad S_1^0 = \frac{347}{784}qL
\end{aligned}
$$

zadamo pomak $u^0 = \frac{1}{EI}$ u smjeru pridržanja
momenti upetosti:

$$\begin{aligned} \overline{M_{12}} = M_{21} &= \frac{6EI}{L^2}u^0 = \frac{6}{L^2} \\ \overline{M_{34}} &= \frac{3EI}{L^2}u^0 = \frac{3}{L^2} \end{aligned}$$



proračun sile u pridržanju



$$\begin{aligned} T_{21}^1 &= +\frac{M_{12}+M_{21}}{L} = \frac{219}{28L^3} \\ T_{34}^1 &= -\frac{M_{34}+M_{43}}{L} = -\frac{453}{196L^3} \end{aligned}$$

$$\begin{aligned} \sum F_x = 0 \quad &\Rightarrow \quad S_1^1 - T_{21}^1 + T_{34}^1 = 0 \\ &\Rightarrow \quad S_1^1 = \frac{993}{98L^3} \end{aligned}$$

$$S_1^0 + \alpha S_1^1 = 0 \Rightarrow \alpha = -\frac{S_1^0}{S_1^1} = \frac{347}{7944}qL^4$$

stvarni pomak

$$u = u^0 \cdot \alpha = \frac{347}{7944}\frac{qL^4}{EI} = 0.0436808\frac{qL^4}{EI}$$

momentni dijagram, $M_\varphi + \alpha M_{u^0}$

uz $L = 4,0$ m, $B = 30$ cm, $H = 40$ cm, $E = 3 \cdot 10^7$ kN/m^2, $q = 10\ kN/m$ slijede vrijednosti momenata na krajevima štapova

$$\begin{aligned} M_{12} &= 49.10 \text{ kNm} \\ M_{21} &= 16.27 \text{ kNm} \\ M_{23} &= -16.27 \text{ kNm} \\ M_{32} &= -14.62 \text{ kNm} \\ M_{34} &= 14.62 \text{ kNm} \end{aligned}$$