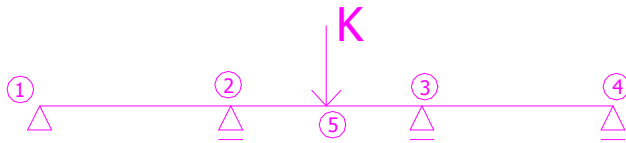


Odredite pomak točke 5!



$$K=100\text{kN}$$
$$EI= 90000\text{kNm}^2$$

-nepoznanice: φ_2, φ_3

-momenti upetosti:

$$\bar{M}_{21} = \bar{M}_{34} = 0$$

$$\bar{M}_{23} = \frac{K \cdot l}{8} = 50\text{kNm}$$

$$\bar{M}_{32} = -50\text{kNm}$$

-momenti od pomaka/zaokreta:

$$m_{21} = 3 \cdot \frac{EI}{4} \cdot \varphi_2$$

$$m_{23} = 4 \cdot \frac{EI}{4} \cdot \varphi_2 + 2 \frac{EI}{4} \cdot \varphi_3$$

$$m_{32} = 4 \cdot \frac{EI}{4} \cdot \varphi_3 + 2 \frac{EI}{4} \cdot \varphi_2$$

$$m_{34} = 3 \cdot \frac{EI}{4} \cdot \varphi_3$$

-ravnoteža čvora 2:

$$\frac{3}{4} \cdot \varphi_2 + \varphi_2 + \frac{1}{2} \cdot \varphi_3 + 50 = 0$$

$$\frac{7}{4} \cdot \varphi_2 + \frac{1}{2} \cdot \varphi_3 = -50$$

-ravnoteža čvora 3:

$$\frac{1}{2} \cdot \varphi_2 + \varphi_3 + \frac{3}{4} \cdot \varphi_3 - 50 = 0$$

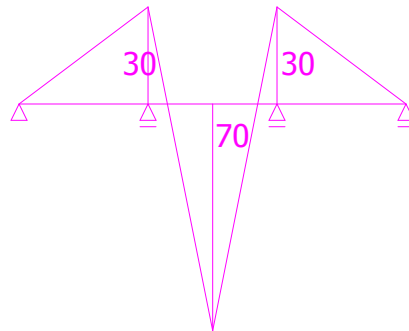
$$\frac{1}{2} \cdot \varphi_2 + \frac{7}{4} \cdot \varphi_3 = 50$$

-rješenje sustava:

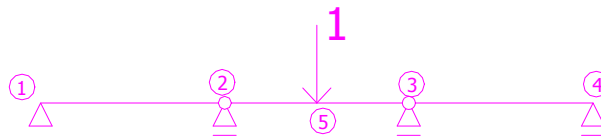
$$\varphi_2 = -40$$

$$\varphi_3 = 40$$

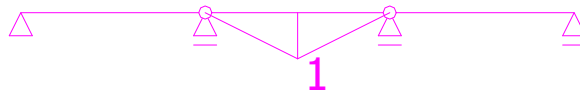
-momentni dijagram:



-osnovni sistem za primjenu redukcijskog stavka s jediničnom silom na mjestu i na pravcu traženog pomaka:



-momentni dijagram na osnovnom sistemu od jedinične sile:

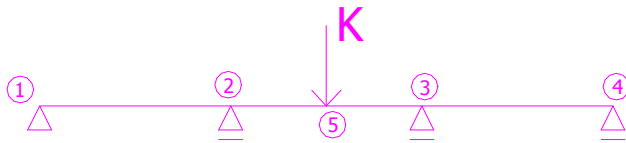


-vrijednost pomaka točke 5:

$$v_5 = \frac{2}{EI} \cdot \left[-\frac{30 \cdot 2}{2} \cdot \frac{1}{3} + \frac{70 \cdot 2}{2} \cdot \frac{2}{3} \right] = \frac{73,33}{EI} = 0,000815\text{m} = 0,82\text{mm}$$

Zadatak se može riješiti koristeći se simetrijom sistema!

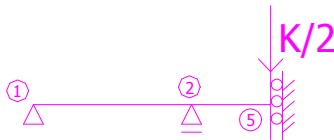
-zadani sistem:



-točka 5 se nalazi na osi simetrije sistema pa je njezin zaokret nula ($\varphi_5=0$)

-momentni dijagram je simetričan jer je i opterećenje sistema simetrično

-iz gornjih razmatranja proizlazi da početni sistem možemo zamjeniti sa sljedećim:

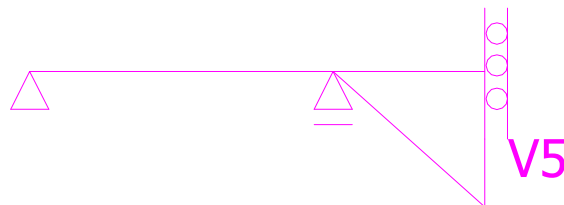


-gornji sustav rješavamo metodom pomaka gdje su nepoznanice φ_2, v_5

v_5 je traženi pomak

-momenti upetosti su nula!

-plan pomaka:



$$\psi_{25} = -\frac{v_5}{2}$$

$$m_{21} = 3 \cdot \frac{EI}{4} \cdot \varphi_2'$$

$$m_{25} = 4 \cdot \frac{EI}{2} \cdot \varphi_2' + 6 \frac{EI}{2} \cdot \frac{v_5'}{2}$$

$$m_{52} = 2 \cdot \frac{EI}{2} \cdot \varphi_2' + 6 \frac{EI}{2} \cdot \frac{v_5'}{2}$$

$$EI \cdot \varphi_2' = \varphi_2$$

$$EI \cdot v_5' = v_5$$

-ravnoteža čvora 2:

$$\frac{3}{4} \cdot \varphi_2 + 2 \cdot \varphi_2 + \frac{3}{2} \cdot v_5 = 0$$

$$2,75 \cdot \varphi_2 + 1,5 \cdot v_5 = 0$$

-jednadžba rada:

$$-\frac{1}{2} \left(\varphi_2 + 2 \cdot \varphi_2 + 2 \cdot \frac{2}{3} \cdot v_5 \right) + 50 \cdot 1 = 0$$

$$-1,5 \cdot \varphi_2 - 1,5 \cdot v_5 = -50$$

-rješenje sustava:

$$\varphi_2 = -40$$

$$v_5 = 73,33$$

-stvarna veličina pomaka točke 5:

$$v_5' = 73,33 / EI = 0,815 \text{ mm}$$