$$\boxed{\eta_{M_1}}$$

$$(EI)_{\mathrm{s}} = EI$$

$$(EI)_{\mathrm{g}} = 2\,EI$$

X_1

② ∞

$1,2$

1

①

$\delta_{1,0}$

$3,9$

$3,9$

$\boxed{\underline{m_1}}$

$0,127\,EI$

$0,127\,EI$

$0,127\,EI$

$\boxed{M}$

$$\delta_{1,0} = 2{,}6 \cdot 1 = 2{,}6$$

$$\delta_{1,1}\,X_1 + \delta_{1,0} = 0$$

$$\delta_{1,1}\,X_1 = -\delta_{1,0}$$

$$\delta_{1,1} = \frac{2}{EI}\left(\frac{1}{2}\cdot 3{,}9 \cdot 3{,}9\right)\left(\frac{2}{3}\cdot 3{,}9\right)$$
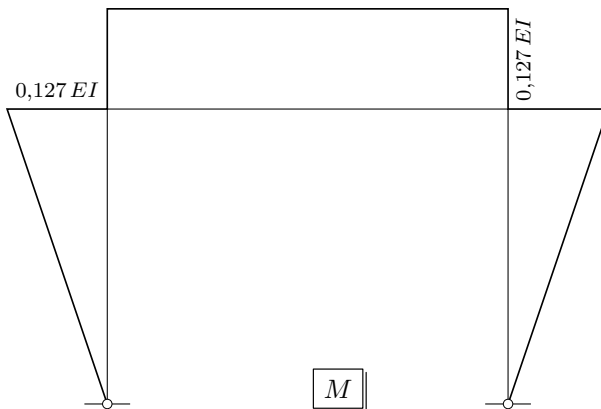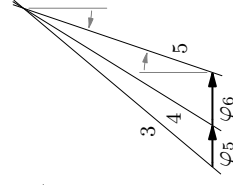
$$+ \frac{1}{2\,EI}\left(3{,}9 \cdot 5{,}3\right)\cdot 3{,}9$$

$$= \frac{79{,}852\,5}{EI}$$

$$\frac{79{,}852\,5}{EI}\,X_1 = -2{,}6$$

$$X_1 = -\frac{EI}{30{,}712\,5} = -0{,}032\,56\,EI$$

$$M(x) = X_1\,m_1(x)$$

$\eta_{M_1}^{\mathrm{h,d}}$

$\eta_{M_1}^{\mathrm{h},\ell}$

$\eta_{M_1}^{\mathrm{v}}$

κ

φ_1 φ_2 φ_3 φ_4 φ_5 φ_6

1,3

1,6
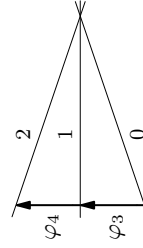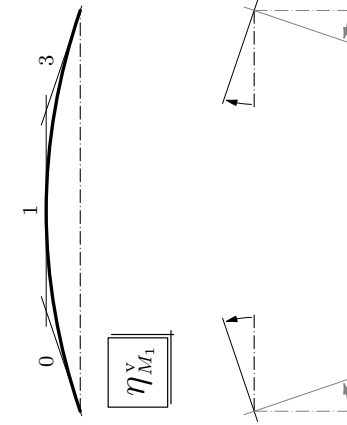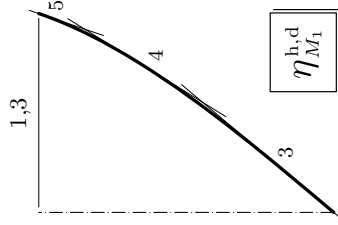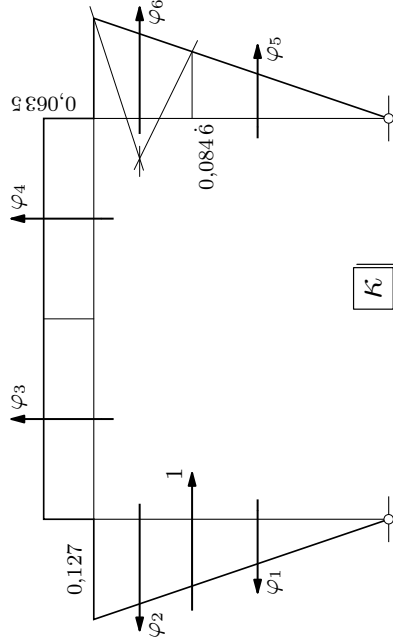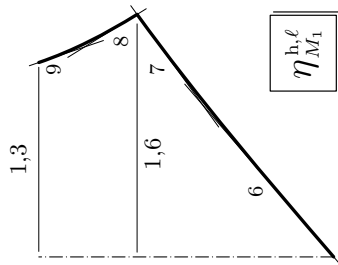
0,127

0,0846

0,0635

mjerilo duljina: 1 cm :: 1 m

$$\varphi_1 \;=\; \varphi_5 \;=\; \frac{1}{2}\cdot 0{,}084\,\dot6 \cdot 2{,}6 \;=\; 0{,}110\,067$$

$$\varphi_2 \;=\; \varphi_6 \;=\; \frac{1}{2}\cdot 0{,}084\,\dot6 \cdot 1{,}3 + \frac{1}{2}\cdot 0{,}127 \cdot 1{,}3 \;=\; 0{,}137\,583$$
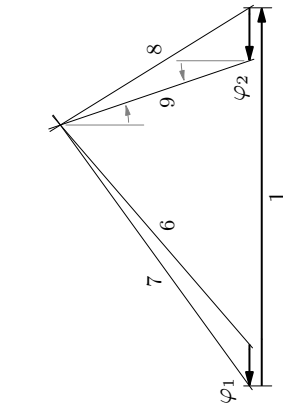
$$\varphi_3 \;=\; \varphi_4 \;=\; 0{,}063\,5 \cdot 2{,}65 \;=\; 0{,}168\,275$$

mjerilo kutova: 1 cm :: 0,2

$$\widetilde{\varphi}_1 \;=\; \widetilde{\varphi}_5 \;=\; 0{,}55\ \text{cm}$$

$$\widetilde{\varphi}_2 \;=\; \widetilde{\varphi}_6 \;=\; 0{,}7\ \text{cm}$$

$$\widetilde{\varphi}_3 \;=\; \widetilde{\varphi}_4 \;=\; 0{,}85\ \text{cm}$$

$$\tilde{1} \;=\; 5\ \text{cm}$$

$$\widetilde{\chi} \;=\; 2{,}5\ \text{cm} \qquad \Rightarrow \qquad \chi \;=\; \frac{1}{2} \quad \&\quad n \;=\; 2$$

$$\tilde{\eta}_3^{\mathrm{h}} \;=\; 2{,}6\ \text{cm} \qquad \Rightarrow \qquad \eta_3^{\mathrm{h}} \;=\; 1{,}3$$

$$\tilde{\eta}_4^{\mathrm{h}} \;=\; 2{,}6\ \text{cm} \qquad \Rightarrow \qquad \eta_4^{\mathrm{h}} \;=\; 1{,}3$$

skica progibne linije, zora radi:
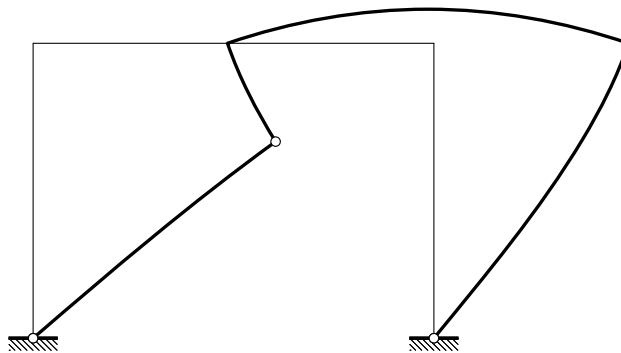
izračunavanje vrijednostī za crtanje momentnoga dijagrama netodom pomakā:
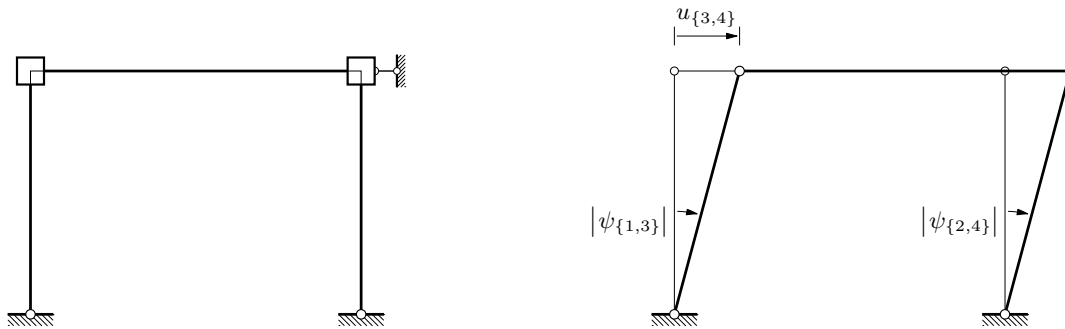
nepoznanice: φ_3, φ_4 $\&$ $u_{\{3,4\}}$

$$\psi_{\{1,3\}} \;=\; \psi_{\{2,4\}} \;=\; -\frac{u_{\{3,4\}}}{3{,}9}$$

$$M_{3,1} \;=\; 3\,k_{\{1,3\}}\,\varphi_3 \;-\; 3\,k_{\{1,3\}}\,\psi_{\{1,3\}} \;+\; \overline{M}_{3,1} \;=\; 3\,k_{\{1,3\}}\,\varphi_3 \;+\; 3\,k_{\{1,3\}}\,\frac{u_{\{3,4\}}}{3,9} \;+\; \overline{M}_{3,1}$$

$$M_{4,2} \;=\; 3\,k_{\{2,4\}}\,\varphi_4 \;-\; 3\,k_{\{2,4\}}\,\psi_{\{2,4\}} \;+\; \overline{M}_{4,2} \;=\; 3\,k_{\{2,4\}}\,\varphi_4 \;+\; 3\,k_{\{2,4\}}\,\frac{u_{\{3,4\}}}{3,9} \;+\; \overline{M}_{4,2}$$

$$M_{3,4} \;=\; 4\,k_{\{3,4\}}\,\varphi_3 \;+\; 2\,k_{\{3,4\}}\,\varphi_4 \;+\; \overline{M}_{3,4}$$

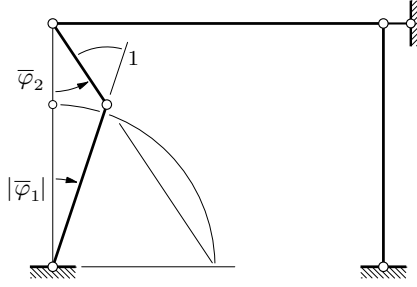$$M_{4,3} \;=\; 4\,k_{\{3,4\}}\,\varphi_4 \;+\; 2\,k_{\{3,4\}}\,\varphi_3 \;+\; \overline{M}_{4,3}$$

$$\overline{\varphi}_1 \;=\; -\frac{1,3}{3,9} \;=\; -\frac{1}{3}$$

$$\overline{\varphi}_2 \;=\; \frac{2,6}{3,9} \;=\; \frac{2}{3}$$

$$\overline{M}_{3,1} \;=\; -3\,k_{\{1,3\}}\,\overline{\varphi}_2 \;=\; -3\,k_{\{1,3\}}\,\frac{2}{3} \;=\; -2\,k_{\{1,3\}}$$

$$-M_{3,1} \;-\; M_{3,4} \;=\; 0 \qquad \Rightarrow \qquad M_{3,1} \;+\; M_{3,4} \;=\; 0$$

$$\left[3\,k_{\{1,3\}}\,\varphi_3 \;+\; 3\,k_{\{1,3\}}\,\frac{u_{\{3,4\}}}{3,9} \;+\; \overline{M}_{3,1}\right] \;+\; \left[4\,k_{\{3,4\}}\,\varphi_3 \;+\; 2\,k_{\{3,4\}}\,\varphi_4\right] \;=\; 0$$

$$\left(3\,k_{\{1,3\}} \;+\; 4\,k_{\{3,4\}}\right)\varphi_3 \;+\; 2\,k_{\{3,4\}}\,\varphi_4 \;+\; 3\,k_{\{1,3\}}\,\frac{u_{\{3,4\}}}{3,9} \;=\; -\overline{M}_{3,1}$$

$$\left(3\cdot\frac{EI}{3,9} \;+\; 4\cdot\frac{2\,EI}{5,3}\right)\varphi_3 \;+\; 2\cdot\frac{2\,EI}{5,3}\cdot\varphi_4 \;+\; 3\cdot\frac{EI}{3,9}\cdot\frac{u_{\{3,4\}}}{3,9} \;=\; 2\cdot\frac{EI}{3,9}$$

$$2,278\,66\,\varphi_3 \;+\; 0,754\,717\,\varphi_4 \;+\; 0,197\,239\,u_{\{3,4\}} \;=\; 0,512\,821$$

$$-M_{4,3} \;-\; M_{4,2} \;=\; 0 \qquad \Rightarrow \qquad M_{4,3} \;+\; M_{4,2} \;=\; 0$$

$$\left[2\,k_{\{3,4\}}\,\varphi_3 \;+\; 4\,k_{\{3,4\}}\,\varphi_4\right] \;+\; \left[3\,k_{\{2,4\}}\,\varphi_4 \;+\; 3\,k_{\{2,4\}}\,\frac{u_{\{3,4\}}}{3,9}\right] \;=\; 0$$

$$2\,k_{\{3,4\}}\,\varphi_3 \;+\; \left(3\,k_{\{2,4\}} \;+\; 4\,k_{\{3,4\}}\right)\varphi_4 \;+\; 3\,k_{\{2,4\}}\,\frac{u_{\{3,4\}}}{3,9} \;=\; 0$$

$$2\cdot\frac{2\,EI}{5,3}\cdot\varphi_3 \;+\; \left(3\cdot\frac{EI}{3,9} \;+\; 4\cdot\frac{2\,EI}{5,3}\right)\varphi_4 \;+\; 3\cdot\frac{EI}{3,9}\cdot\frac{u_{\{3,4\}}}{3,9} \;=\; 0$$

$$0,754\,717\,\varphi_3 \;+\; 2,278\,66\,\varphi_4 \;+\; 0,197\,239\,u_{\{3,4\}} \;=\; 0$$

$$M_{3,1}\,\delta\psi_{\{1,3\}} \;+\; M_{4,2}\,\delta\psi_{\{2,4\}} \;=\; 0$$

$$\left[3\,k_{\{1,3\}}\,\varphi_3 \;+\; 3\,k_{\{1,3\}}\,\frac{u_{\{3,4\}}}{3,9} \;+\; \overline{M}_{3,1}\right]\left(-\frac{\delta u_{\{3,4\}}}{3,9}\right)$$

$$+\; \left[3\,k_{\{2,4\}}\,\varphi_4 \;+\; 3\,k_{\{2,4\}}\,\frac{u_{\{3,4\}}}{3,9}\right]\left(-\frac{\delta u_{\{3,4\}}}{3,9}\right) \;=\; 0$$

$$\frac{1}{3,9} \cdot 3 \cdot \frac{EI}{3,9} \cdot \varphi_3 + \frac{1}{3,9} \cdot 3 \cdot \frac{EI}{3,9} \cdot \varphi_4 + \frac{1}{3,9} \cdot 6 \cdot \frac{EI}{3,9} \cdot \frac{u_{\{3,4\}}}{3,9} = -\frac{1}{3,9}\left(-2 \cdot \frac{EI}{3,9}\right)$$

$$0,197\,239\,\varphi_3 + 0,197\,239\,\varphi_4 + 0,101\,148\,u_{\{3,4\}} = 0,131\,492$$

$$2,278\,66\;\varphi_3 + 0,754\,717\,\varphi_4 + 0,197\,239\,u_{\{3,4\}} = 0,512\,821$$

$$0,754\,717\,\varphi_3 + 2,278\,66\;\varphi_4 + 0,197\,239\,u_{\{3,4\}} = 0$$

$$0,197\,239\,\varphi_3 + 0,197\,239\,\varphi_4 + 0,101\,148\,u_{\{3,4\}} = 0,131\,492$$

$$\varphi_3 = 0,168\,255, \qquad \varphi_4 = -0,168\,255 \qquad \& \qquad u_{\{3,4\}} = 1,30$$

(kut φ_3 jednak je (gotovo, uz grešku zaokruživanja) kutu φ_3 na stranicama 2 i 3;
isto je tako $|\varphi_4|$ jednak kutu φ_4, dok je duljina $u_{\{3,4\}}$ jednaka duljinama η_3^{h} i η_4^{h})

$$M_{3,1} = \frac{3\,EI}{3,9} \cdot 0,168\,255 + \frac{3\,EI}{3,9} \cdot \frac{1,30}{3,9} - \frac{2\,EI}{3,9} = -0,126\,983\,EI$$

$$M_{4,2} = \frac{3\,EI}{3,9} \cdot (-0,168\,255) + \frac{3\,EI}{3,9} \cdot \frac{1,30}{3,9} = 0,126\,983\,EI$$

$$M_{3,4} = \frac{8\,EI}{5,3} \cdot 0,168\,255 + \frac{4\,EI}{5,3} \cdot (-0,168\,255) = 0,126\,985\,EI$$

$$M_{4,3} = \frac{4\,EI}{5,3} \cdot 0,168\,255 + \frac{8\,EI}{5,3} \cdot (-0,168\,255) = -0,126\,985\,EI$$

(„neravnoteža” je posljedica grešaka zaokruživanja)

dijagram je prikazan na najdonjoj slici na stranici 1