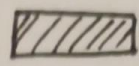
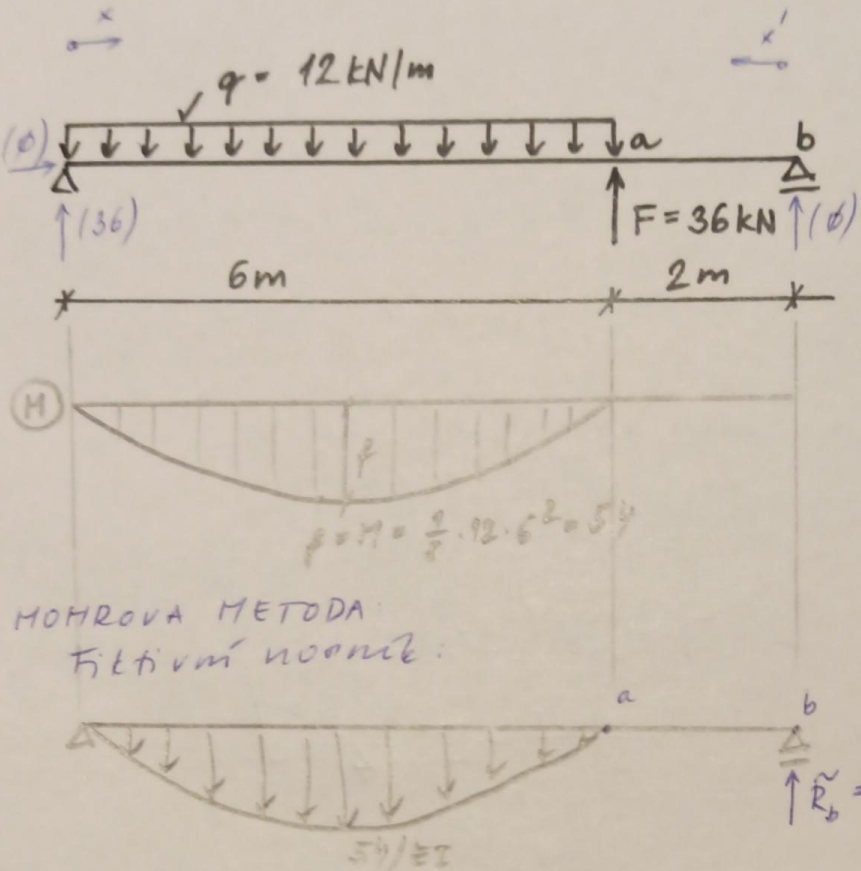
SPOČÍTEJTE PRŮHYB V BODĚ „a" A POOTOČENÍ V BODĚ „b". E = 240 GPa, PRŮŘEZ





$EI = 240 \cdot 10^6 \cdot \frac{1}{12} \cdot 0{,}4 \cdot 0{,}2^3$

$EI = 64000\ kPa \cdot m^4$

MOHROVA METODA
Fiktivní nosník:

$$w_a = \tilde{M}_a = \tilde{R}_b \cdot 2 = \frac{81}{EI} \cdot 2 = \frac{162}{EI} = \frac{162}{64000} = 2{,}53125 \cdot 10^{-3}\ m$$

$$\varphi_b = \tilde{V}_b = -\tilde{R}_b = -\frac{81}{EI} = -\frac{81}{64000} = -1{,}265625 \cdot 10^{-3}\ rad$$

CLEBŠCHOVA METODA:

$$M(x) = 36x - 12\frac{x^2}{2}\Big|_{+x>6} + 12\frac{(x-6)^2}{2} + 36(x-6)$$

$$\varphi(x) = -\frac{1}{EI}\left[C_1 + 36\frac{x^2}{2} - 6\frac{x^3}{3}\Big|_{+x>6} + 6\frac{(x-6)^3}{3} + 36\frac{(x-6)^2}{2}\right]$$

$$w(x) = -\frac{1}{EI}\left[C_2 + C_1 x + 18\frac{x^3}{3} - 2\frac{x^4}{4}\Big|_{+x>6} + 2\frac{(x-6)^4}{4} + 18\frac{(x-6)^3}{3}\right]$$

Okrajové podmínky:

$w(x=0)=0 \rightarrow \underline{C_2=0}$

$w(x=8)=0 \rightarrow 0+8C_1+1080=0 \rightarrow \underline{C_1=-135}$

$w_a = w(x=6) = -\frac{1}{64000}\left[0-135\cdot 6+6\cdot 6^3-\frac{1}{2}\cdot 6^4\right] = \frac{162}{64000} =$

$= \underline{2,53125\cdot 10^{-3}\,m}$

$\varphi_b = \varphi(x=8) = -\frac{1}{64000}\left[-135+18\cdot 8^2-2\cdot 8^3+2\cdot 2^3+18\cdot 2^2\right] = \frac{-81}{64000} =$

$= \underline{-1,265625\cdot 10^{-3}\,rad}$

CLEBSCHOVA METODA PRO X' JDOUCÍ ZPRAVA:

$$M(x') = \Big|_{x'>2} + 36(x'-2) - 12\frac{(x'-2)^2}{2}$$

$$\varphi(x') = -\frac{1}{EI}\left[C_1 \Big|_{x'>2} + 36\frac{(x'-2)^2}{2} - 6\frac{(x'-2)^3}{3}\right]$$

$$w(x') = -\frac{1}{EI}\left[C_2 + C_1 x' \Big|_{x'>2} + 18\frac{(x'-2)^3}{3} - 2\frac{(x'-2)^4}{4}\right]$$

Okrajové podmínky:

$w(x'=0)=0 \rightarrow \underline{C_2=0}$

$w(x'=8)=0 \rightarrow 0+8C_1+648=0 \rightarrow \underline{C_1=-81}$

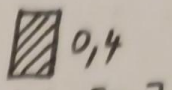
$w_a = w(x'=2) = -\frac{1}{64000}\left[0+(-81)\cdot 2\right] = \frac{162}{64000} = \underline{2,53125\cdot 10^{-3}\,m}$

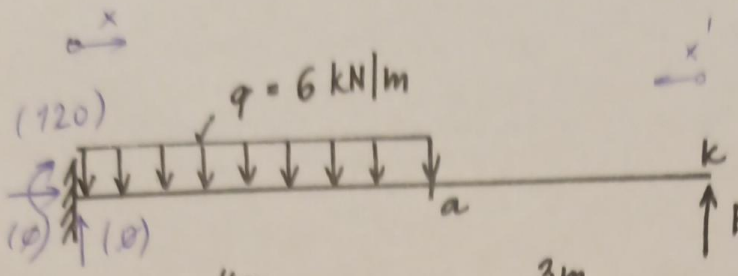
$\varphi_b = -\varphi(x'=0) = +\frac{1}{64000}\left[-81\right] = \frac{-81}{64000} = \underline{-1,265625\cdot 10^{-3}\,rad}$

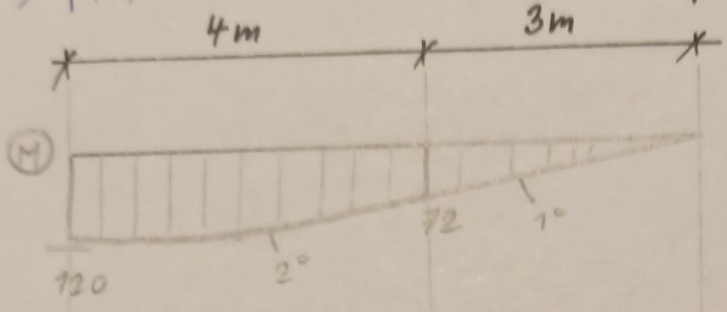
↓

OPAČNÉ ZNAMÉNKO PRO VÝPOČET ZPRAVA ($\varphi_L = -\varphi_P$)

SPOČÍTEJTE POOTOČENÍ V BODĚ „a" A PRŮHYB V BODĚ „k". $E = 60\ GPa$, PRŮŘEZ



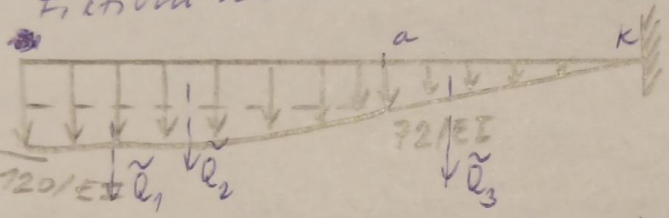




$EI = 60 \cdot 10^6 \cdot \frac{1}{2} \cdot 0{,}2 \cdot 0{,}4^3$

$EI = 64000\ kPa \cdot m^4$

MOHROVA METODA:
Fiktivní nosník:



$$\varphi_a = \tilde{V}_a = -\tilde{Q}_1 - \tilde{Q}_2 = -\frac{2}{3} \cdot 4 \cdot \frac{48}{EI} - \frac{72}{EI} \cdot 4 = \frac{-416}{EI} = \frac{-416}{64000} =$$

$$= -6{,}5 \cdot 10^{-3}\ rad$$

$$w_k = \tilde{M}_k = -\tilde{Q}_1 \cdot (3 + \frac{5}{8} \cdot 4) - \tilde{Q}_2 \cdot 5 - \tilde{Q}_3 \cdot 2 = -\frac{2}{3} \cdot 4 \cdot \frac{48}{EI} \cdot 5{,}5 - \frac{72}{EI} \cdot 4 \cdot 5 -$$

$$- \frac{1}{2} \cdot 3 \cdot \frac{72}{EI} \cdot 2 = \frac{-2360}{EI} = \frac{-2360}{64000} = -36{,}875 \cdot 10^{-3}\ m$$

CLEBSCHOVA METODA:

$$M(x) = 120 - 6\frac{x^2}{2}\Big|_{x>4} + 6\frac{(x-4)^2}{2}$$

$$\varphi(x) = -\frac{1}{EI}\left[C_1 + 120x - 3\frac{x^3}{3}\Big|_{x>4} + 3\frac{(x-4)^3}{3}\right]$$

$$w(x) = -\frac{1}{EI}\left[C_2 + C_1 x + 120\frac{x^2}{2} - \frac{x^4}{4}\Big|_{x>4} + \frac{(x-4)^4}{4}\right]$$

Okrajové podmínky:

$w(x=0)=0 \rightarrow C_2=0$

$\varphi(x=0)=0 \rightarrow C_1=0$

$\varphi_2=\varphi(x=4)=-\frac{1}{64000}\left[0+120\cdot 4-4^3\right]=\frac{-416}{64000}=-6{,}5\cdot 10^{-3}\,rad$

$w_K=w(x=7)=-\frac{1}{64000}\left[0+0\cdot 7+60\cdot 7^2-\frac{7^4}{4}+\frac{3^4}{4}\right]=\frac{-2360}{64000}=$

$=-36{,}875\cdot 10^{-3}\,m$

CLEBŠOVA METODA PRO X' JDOUCÍ ZPRAVA:

$M(x')=24\cdot x'|_{x'>3}-6\frac{(x-3)^2}{2}$

$\varphi(x')=-\frac{1}{EI}\left[\overset{C_1+}{24\frac{x'^2}{2}}\Big|_{x'>3}-3\frac{(x-3)^3}{3}\right]$

$w(x')=-\frac{1}{EI}\left[\overset{C_2+C_1x'+}{12\frac{x'^3}{3}}\Big|_{x'>3}-\frac{(x-3)^4}{4}\right]$

Okrajové podmínky:

$w(x'=7)=0 \rightarrow C_2+C_1\cdot 7+1308=0$

$\varphi(x'=7)=0 \rightarrow C_1+524=0 \rightarrow C_1=-524$

$C_2=2360$

$\varphi_a=\ominus\varphi(x'=3)=+\frac{1}{64000}\left[-524+12\cdot 3^2\right]=\frac{-416}{64000}=-6{,}5\cdot 10^{-3}\,rad$

↓ OPAČNÉ ZNAMÉNKO PŘI ŘEŠENÍ ZPRAVA ($\varphi_L=-\varphi_P$)

$w_K=w(x'=0)=-\frac{1}{64000}\left[2360\right]=\frac{-2360}{64000}=-36{,}875\cdot 10^{-3}\,m$