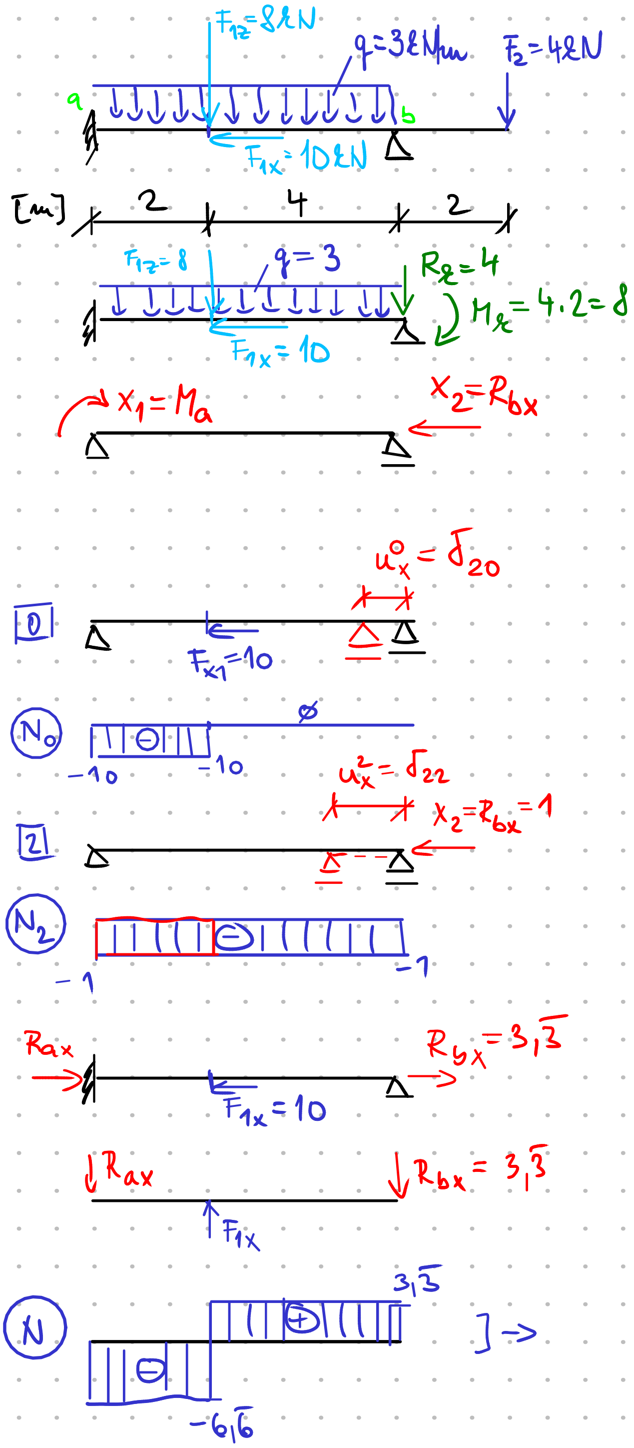
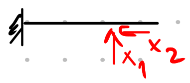


1) $n_s = 2\times$



2)

odebrání staticky určité části konstrukce (konzola, převislý konec) a nahrazení interakcemi R_{ℓ} a M_{ℓ}

3) podmínky

$\varphi_{ab} = 0$ ve vetknutí platí nulové pootočení

$u_b = 0$

2 rovnice (nezávislé) o dvou neznámých

3a) vliv osového zatížení

$u_b: \delta_{20} + \delta_{22} \cdot X_2 = 0$ $\qquad \delta = \int \frac{N\bar{N}}{EA}\,dx$

$\delta_{22} = \frac{1}{EA}\left[1 \cdot 6 \cdot (1)\right] = \frac{6}{EA}$

$\delta_{20} = \frac{1}{EA}\left[+10 \cdot 2 \cdot (1)\right] = \frac{20}{EA}$

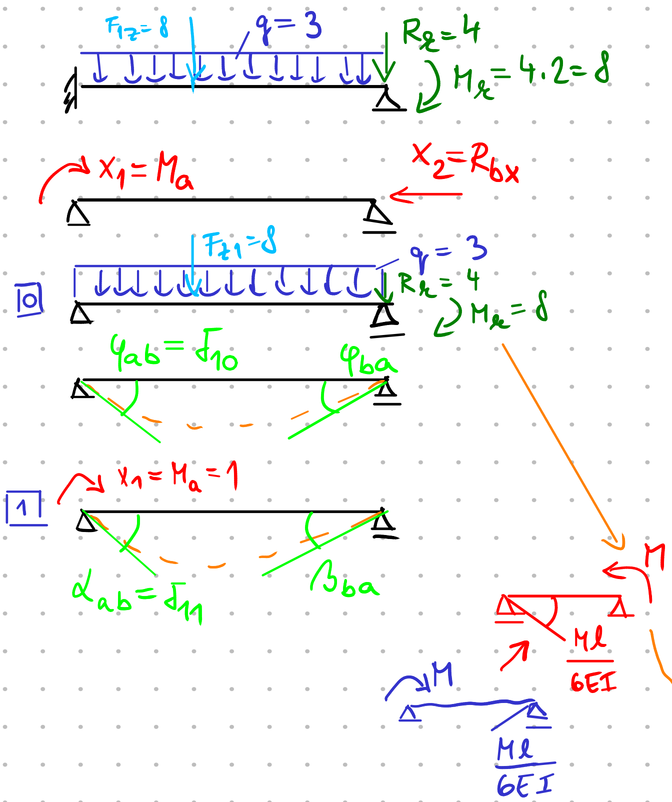
$X_2 = -\frac{\delta_{20}}{\delta_{22}} = -\frac{20}{6} = -3{,}\bar{3}\,kN = R_{bx}$

- analogie s řešením U

$\Sigma M_{ai} = 0$ ⊕ ↺

$F_{1x} \cdot 2 - R_{bx} \cdot 6 = 0$

$R_{bx} = \frac{20}{6} = 3{,}\bar{3}\,kN$



3b) řešení příčného zatížení

$$\phi_{ab} = 0$$

$$\varphi_{ab} + \alpha_{ab}\cdot M_a = 0 \qquad (\delta_{10}+\delta_{11}X_1=0)$$

$$\alpha_{ab} = |5.13a| = \frac{1}{3}\frac{l}{EI} = \frac{2}{EI}$$

$$\varphi_{ab} = \varphi_{ab}^{F_{1z}} + \varphi_{ab}^{q} + \varphi_{ab}^{M_e}$$

$$\varphi_{ab}^{F_{1z}} = |5.8a| = \frac{Fab}{6EIl}(l+b) = \frac{8\cdot2\cdot4}{6EI\,6}(6+4) = \frac{17,\overline{7}}{EI}$$

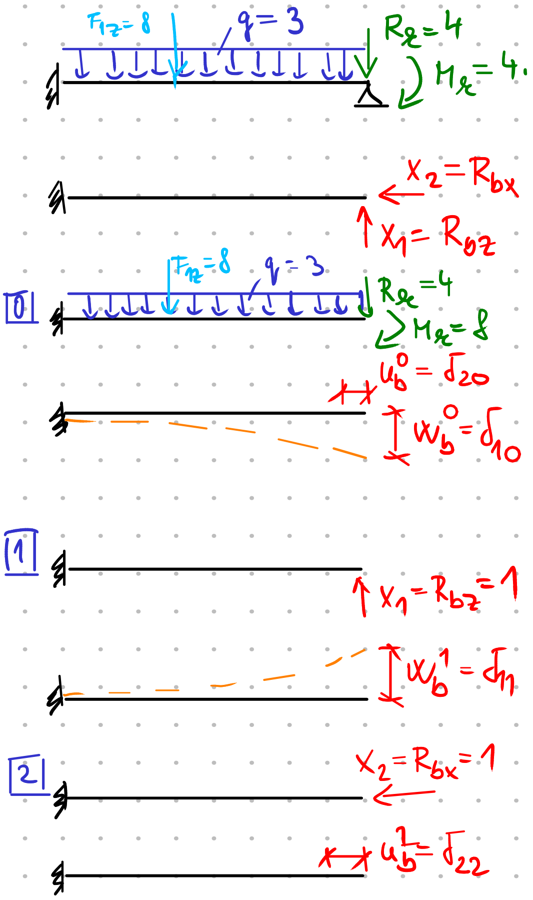
$$\varphi_{ab}^{q} = |5.14a| = \frac{ql^3}{24EI} = \frac{3\cdot6^3}{24\cdot EI} = \frac{27}{EI}$$

$$\varphi_{ab}^{M_e} = |5.12b| = \frac{Ml}{6EI} = \frac{-8\cdot6}{6EI} = -\frac{8}{EI}$$

$$\varphi_{ab} = \frac{17,\overline{7}+27-8}{EI} = \frac{36,\overline{7}}{EI}$$

$$\frac{36,\overline{7}}{EI} + \frac{2}{EI}X_1 = 0 \qquad /\cdot EI$$

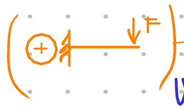
$$X_1 = -\frac{36,\overline{7}}{2} = -\underline{\underline{18,3\overline{8}\ \text{kNm}}}$$



3) řešení konzola

3a) viz předchozí

3b) $w_b = 0$



$$w_b^0 + w_b^1\cdot X_1 = 0 \qquad (\delta_{10}+\delta_{11}X_1=0)$$

$$w_b^1 = |14.1|2| = \frac{Fl^3}{3EI} = \frac{-1\cdot6^3}{3EI} = \frac{-72}{EI}$$

$$w_b^0 = {}^{F_{1z}}w_b^0 + {}^{q}w_b^0 + {}^{R_e}w_b^0 + {}^{M_e}w_b^0$$

$${}^{R_e}w_b^0 = |14.1|2| = \frac{Fl^3}{3EI} = \frac{4\cdot6^3}{3EI} = \frac{288}{EI}$$

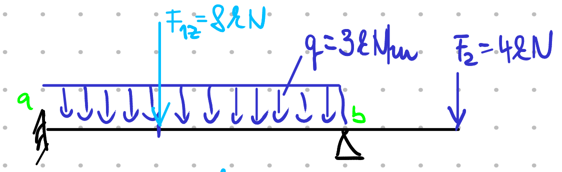
$${}^{q}w_b^0 = |14.1|5| = \frac{ql^4}{8EI} = \frac{3\cdot6^4}{8EI} = \frac{486}{EI}$$

$${}^{M_e}w_b^0 = |14.1|13| = \frac{Ml^2}{2EI} = \frac{8\cdot6^2}{2EI} = \frac{144}{EI}$$

$${}^{F_{1z}}w_b^0 = |14.1|1| = \frac{Fa^2}{6EI}(3l-a) = \frac{8\cdot2^2}{6EI}(3\cdot6-2) = \frac{85,\overline{3}}{EI}$$

$$w_b^0 = \frac{288+144+85,\overline{3}+486}{EI} = \frac{1003,\overline{3}}{EI}$$

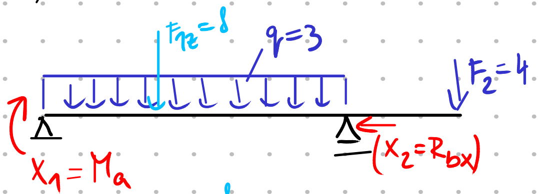
$$R_{bz} = -\frac{w_b^0}{w_b^1} = -\frac{1003,\overline{3}}{-72} = \underline{\underline{+13,935\ \text{kN}}}$$

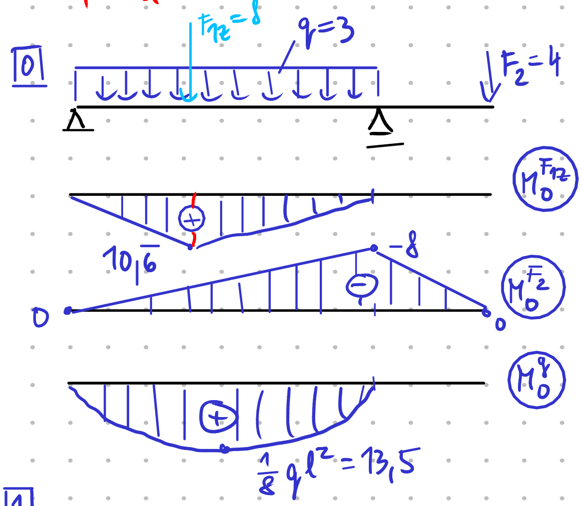


3) klasická silová metoda

3a) viz předchozí

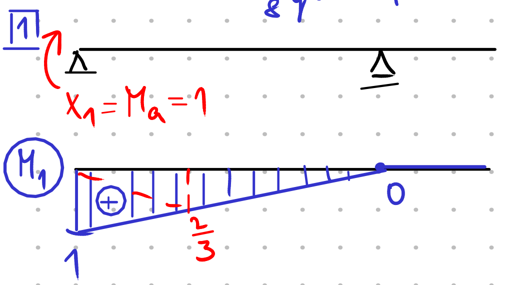
3b)





$$\delta_{10}+\delta_{11}X_1=0$$

$$\delta=\frac{1}{EI}\int M\bar{M}\,dx$$



$$\delta_{11}=\frac{1}{EI}\left[\frac{1}{2}6\cdot1\cdot\left(\frac{2}{3}1\right)\right]=\frac{2}{EI}=\alpha_{ab}$$

$$\delta_{10}={}^{q}\delta_{10}+{}^{F_{1z}}\delta_{10}+{}^{F_2}\delta_{10}$$

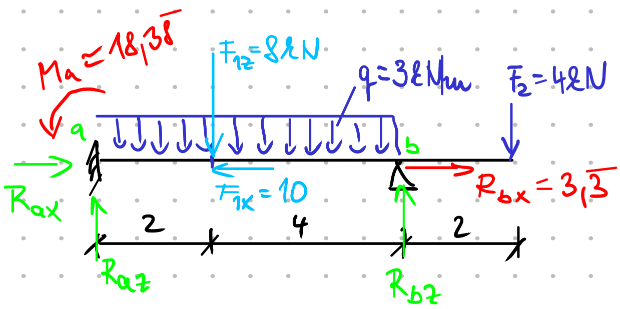
$${}^{q}\delta_{10}=\frac{1}{EI}\left[+\frac{2}{3}13,5\cdot6\cdot\left(\frac{1}{2}1\right)\right]=\frac{27}{EI}=\varphi_{ab}^{q}$$

$${}^{F_{1z}}\delta_{10}=\frac{1}{EI}\left[+\frac{1}{2}10,\bar{6}\cdot2\left(\frac{1}{3}1\right)+\frac{1}{2}10,\bar{6}\cdot2\left(\frac{2}{3}\frac{2}{3}\right)+\frac{1}{2}10,\bar{6}\cdot4\left(\frac{2}{3}\frac{2}{3}\right)\right]$$

$$=\frac{17,\bar{7}}{EI}=\varphi_{ab}^{F_{1z}}$$

$${}^{F_2}\delta_{10}=\frac{1}{EI}\left[-\frac{1}{2}6\cdot1\cdot\left(\frac{1}{3}8\right)\right]=-\frac{-8}{EI}=\varphi_{ab}^{M_k}$$

$$\delta_{10}+\delta_{11}X_1=0\quad\Rightarrow\quad X_1=-18,3\bar{8}\ kNm=M_a$$



4) vykreslení vnitřních sil

$\Sigma F_{xi}=0 \Rightarrow R_{ax}=+6,\bar{6}\ kN$

$\Sigma M_{ai}=0$ ⊕

$M_a-F_{1z}\cdot2-(q\cdot6)\cdot3+R_{bz}\cdot6-F_2\cdot8=0$

$R_{bz}=13,935\ kN$ (viz X_2)

$\Sigma M_{bi}=0 \Rightarrow R_{az}=16,065\ kN$

kontrola: $\Sigma F_{zi}=0$ ✓