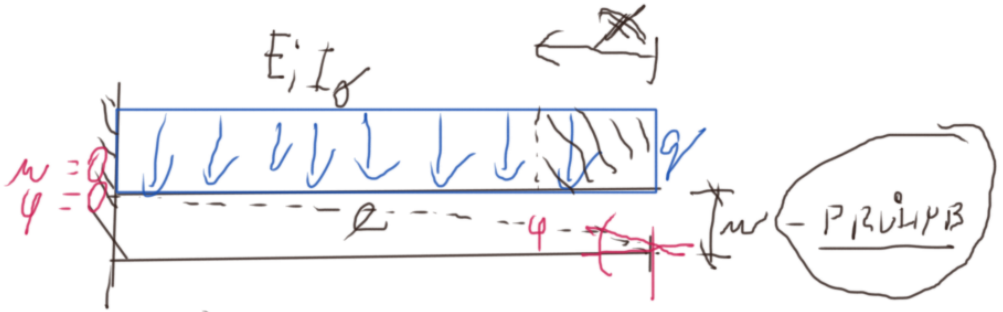


$$x \in \langle 0; l \rangle$$

$$M(x) = -q \cdot x \frac{x}{2}$$

$$-E \cdot I_g w''(x) = -q \cdot \frac{x^2}{2}$$

$$E I_g w'(x) = \frac{q x^3}{6} + C_1 \quad \leftarrow \varphi(x) = w'(x)$$

$$E I_g w(x) = \frac{q x^4}{24} + C_1 x + C_2 \quad \leftarrow w(x)$$

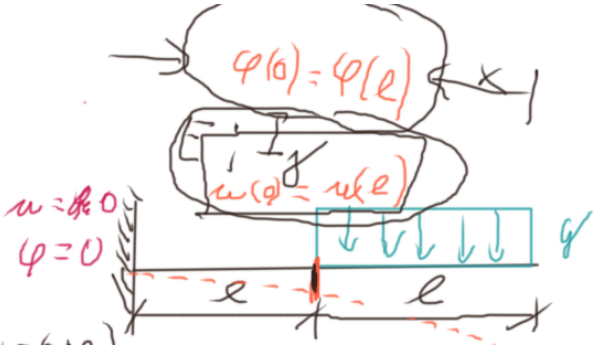
$$\varphi(l) = 0 \rightarrow 0 = \frac{q l^3}{6} + C_1 \rightarrow C_1 = -\frac{q l^3}{6}$$

$$w(l) = 0 \rightarrow 0 = \frac{q l^4}{24} - \frac{q l^3}{6} \cdot l + C_2 \rightarrow C_2 = \frac{1}{8} q l^4$$

$$\varphi(x) = \frac{1}{E I_g} \left(\frac{q x^3}{6} - \frac{q l^3}{6} \right)$$

$$w(x) = \frac{1}{E I_g} \left(\frac{q \cdot x^4}{24} - \frac{q l^3}{6} \cdot x + \frac{1}{8} q l^4 \right)$$

$$w_{max} = \frac{\frac{1}{8} q l^4}{E I_g} \qquad \varphi_{max} = \frac{-\frac{q l^3}{6}}{E I_g}$$



$w(x)$
$\varphi(x)$

$x \in (0; l)$

$M(x) = -\frac{1}{2} q x^2$

$+EI_y w''(x) = \frac{1}{2} q x^2$

$EI\,\varphi(x) = \frac{q x^3}{6} + C_1$

$EI\,w(x) = \frac{q x^4}{24} + C_1 x + C_2$

$\varphi(l) = 4l$

$\frac{q l^3}{6} + C_1 = -\frac{1}{2} q l^3 + \frac{q l^3}{2} - q l^3$

$C_1 = -q l^3 + \frac{1}{6} q l^3 = \boxed{-\frac{7}{6} q l^3}$

$w(l) = w(l)$

$\frac{q l^4}{24} - \frac{7}{6} q l^4 + C_2 = -\frac{1}{4} q l^4 + \frac{1}{6} q l^4 - q l^4 + \frac{4}{3} q l^4$

$C_2 = \left(-\frac{1}{4} + \frac{1}{6} - 1 + \frac{4}{3} - \frac{1}{24} + \frac{7}{6}\right) q l^4 = \frac{-6 + 4 - 24 + 32 - 1 + 28}{24} q l^4 = \frac{33}{24} q l^4$

$-1 + 2 = 1$

$-1 + \frac{4}{3} - 1 \quad -\frac{8}{6} + \frac{4}{3} = -\frac{4}{3}$

$x \in (l; 2l)$

$M(x) = -q l \left(x - \frac{l}{2}\right) = -q l x + \frac{1}{2} q l^2$

$EI_y \cdot w''(x) = -\frac{1}{2} q l^2 + q l x$

$EI_y \cdot \varphi(x) = -\frac{1}{2} q l^2 \cdot x + \frac{q l x^2}{2} + C_3$

$EI_y w(x) = -\frac{1}{4} q l^2 x^2 + \frac{q l x^3}{6} + C_3 x + C_4$

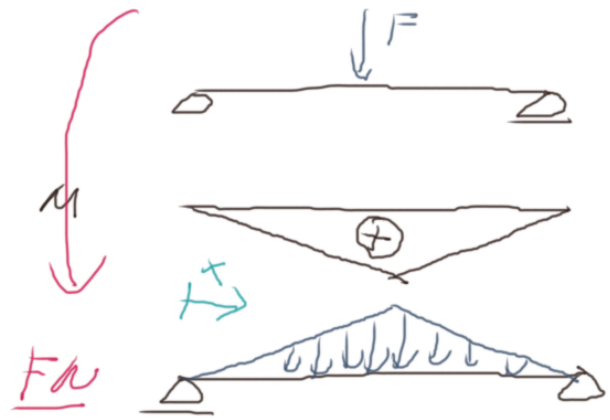
$\varphi(2l) = 0 \rightarrow 0 = -\frac{1}{2} q l^2 \cdot 2l + \frac{1}{2} q l \cdot 4 l^2 + C_3$

$C_3 = -q l^3$

$w(2l) = 0 \rightarrow 0 = -\frac{1}{4} q l^2 \cdot 4 l^2 + \frac{1}{6} l \cdot 8 l^3 - q l^4 + C_4$

$C_4 = \frac{4}{3} q l^4$

MOHROVA METODA

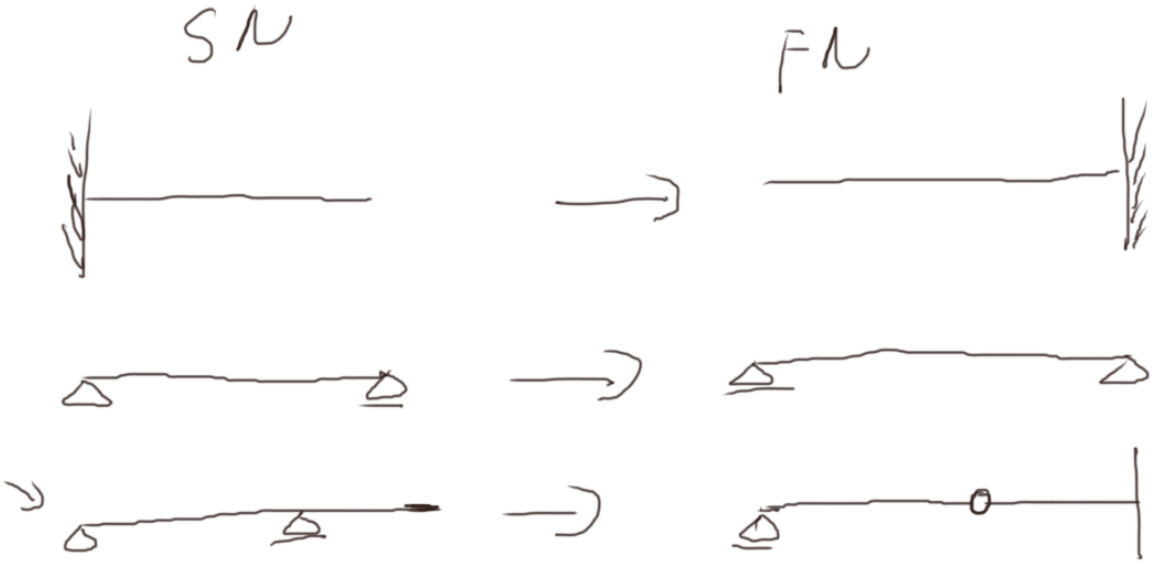


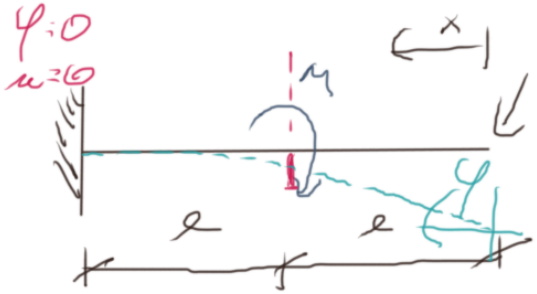
1) ZJISTIT PRŮBĚH OHYBOVÉHO M
2) FIKTIVNÍ NOSNÍK
3) ZATÍŽÍM OM ZE SKUTEČNÉHO NOSNÍKU

SKUTEČNÝ

$$\varphi(x) = \frac{T_F(x)}{EI_y}$$

$$w(x) = \frac{M_F(x)}{EI_y}$$


SN
FN



$x \in (0;l)$ ①

$M(x) = 0$

$-EI_y w''(x) = 0$

$-EI_y w'(x) = C_1$

$-EI_y w(x) = C_1 x + C_2$

$EI_y w(x) = -C_1 x - C_2$

$x \in (l;2l)$

$M(x) = -M$

$EI_y w''(x) = M$

$EI_y \cdot w'(x) = Mx + C_3$

$EI_y \cdot w(x) = M\frac{x^2}{2} + C_3 x + C_4$

②

$\varphi(2l) = 0 \rightarrow 0 = M \cdot 2l + C_3 \rightarrow C_3 = -2Ml$

$w(2l) = 0 \rightarrow 0 = M \cdot \frac{4l^2}{2} - 2Mll + C_4$

$C_4 = 2Ml^2$

$\varphi(l) = \varphi(l)$

$-C_1 = Ml - 2Ml$

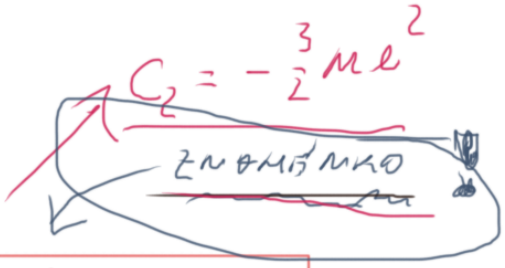
$C_1 = M \cdot l$

$w(l) = w(l)$

$-C_1 x - C_2 = M\frac{x^2}{2} + C_3 x + C_4$

$-Ml^2 - C_2 = M\frac{l^2}{2} - 2Ml^2 + 2Ml^2$

$C_2 = -\frac{3}{2}Ml^2$



$\varphi(0) = M \cdot l$

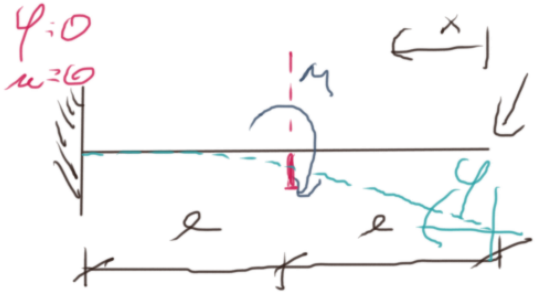
$\varphi(0) = \frac{Ml}{EI_y}$

$EI_y \varphi(x) = Ml$

$EI_y w(x) = -Ml \cdot x + \frac{3}{2}Ml^2$

$EI_y \cdot \varphi(x) = Mx - 2Ml$

$EI_y \cdot w(x) = M\frac{x^2}{2} - 2Mlx + 2Ml^2$



$x \in (0;l)$ ①

$M(x) = 0$

$-EI_y w''(x) = 0$

$-EI_y w'(x) = C_1$

$-EI_y w(x) = C_1 x + C_2$

$EI_y w(x) = -C_1 x - C_2$

$x \in (l;2l)$

$M(x) = -M$

$EI_y w''(x) = M$

$EI_y \cdot w'(x) = Mx + C_3$

$EI_y \cdot w(x) = M\frac{x^2}{2} + C_3 x + C_4$

②

$\varphi(2l) = 0 \rightarrow 0 = M \cdot 2l + C_3 \rightarrow C_3 = -2Ml$

$w(2l) = 0 \rightarrow 0 = M \cdot \frac{4l^2}{2} - 2Mll + C_4$

$C_4 = 2Ml^2$

$\varphi(l) = \varphi(l)$

$-C_1 = Ml - 2Ml$

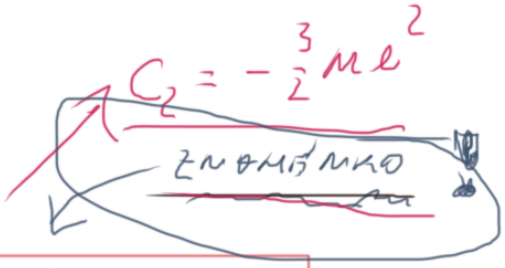
$C_1 = M \cdot l$

$w(l) = w(l)$

$-C_1 x - C_2 = M\frac{x^2}{2} + C_3 x + C_4$

$-Ml^2 - C_2 = M\frac{l^2}{2} - 2Ml^2 + 2Ml^2$

$C_2 = -\frac{3}{2}Ml^2$



$\varphi(0) = M \cdot l$

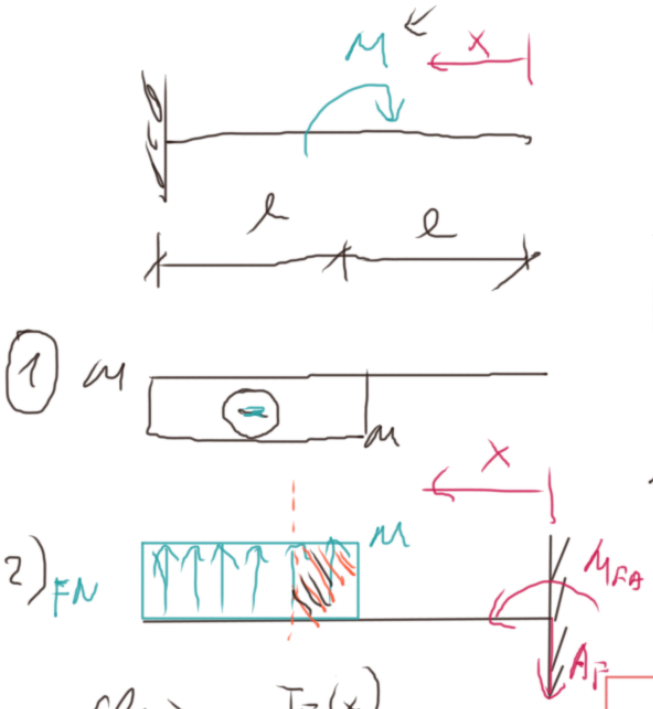
$\varphi(0) = \frac{Ml}{EI_y}$

$EI_y \varphi(x) = Ml$

$EI_y w(x) = -Ml \cdot x + \frac{3}{2}Ml^2$

$EI_y \cdot \varphi(x) = Mx - 2Ml$

$EI_y \cdot w(x) = M\frac{x^2}{2} - 2Mlx + 2Ml^2$



T_F i M_F

$\uparrow \; -A_F + M_0 \cdot l = 0$ $\quad \circlearrowleft \; M_{FA} - M \cdot l \cdot \frac{3}{2} l = 0$

$A_F = Ml$ $\quad M_{FA} = \frac{3}{2} M l^2$

$x \in (0; l)$

$T_F(x) = Ml$

$M_F(x) = M_{FA} - A_F \cdot x$

$= \frac{3}{2} M l^2 - M \cdot l \cdot x$

$x \in (l; 2l)$

$T_F(x) = Ml - M \cdot (x - l)$

$M_F(x) = \frac{3}{2} M l^2 - Mlx + \frac{M(x-l)^2}{2}$

$T_F(x) = 2Ml - Mx$

$M_F(x) = \frac{Mx^2}{2} - 2Mlx + 2Ml^2$

- $\varphi(x) = \frac{T_F(x)}{EI_y}$
- $w(x) = \frac{M_F(x)}{EI}$

$EI_y \varphi(x) = Ml$

$EI_y w(x) = \frac{3}{2} Ml^2 - Mlx$

$\varphi(0) = \frac{M \cdot l}{EI_y}$

$EI_y \varphi(x) = 2Ml - Mx$

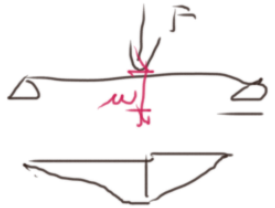
$EI_y w(x) = \frac{Mx^2}{2} - 2Mlx + 2Ml^2$

$$\rightarrow \boxed{U = \int \frac{M^2(x)}{2 \cdot E I_y}} = \frac{1}{2EI_y}\left[\int_0^e 0\,dx + \int_e^2 M^2\,dx\right] =$$

$$= \frac{1}{2EI_y}\left[M^2 x\right]_e^{2e} = \frac{1}{2EI_y}\left(M^2 \cdot 2e - M^2 \cdot e\right) = \frac{M^2 e}{2 \cdot E I_y}$$

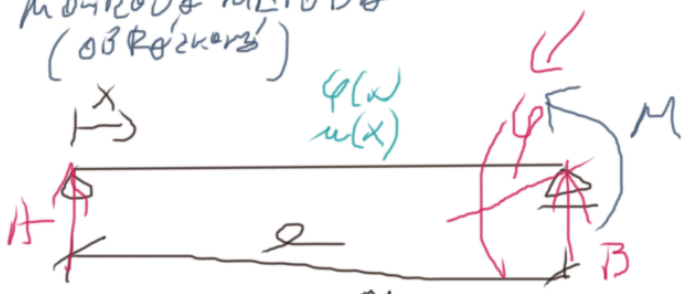
$$\frac{1}{2} M \cdot \varphi = \frac{M^2 \cdot e}{2EI_y}$$

$$\boxed{\varphi = \frac{M \cdot e}{E I_y}}$$



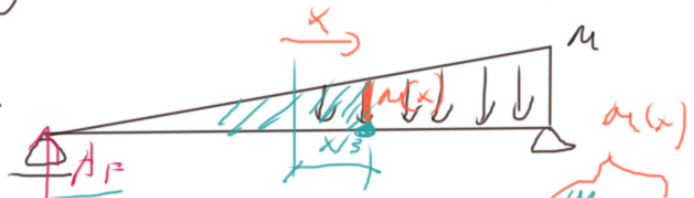
$$\rightarrow \boxed{\frac{1}{2} F w = \int \frac{M^2(x)}{2EI_y}}$$

MOHROVA METODA
(OBRAZKARJI)



$M(x) = A \cdot x = \frac{M}{\ell} \cdot x$

FN:



$T_F(x) = \frac{1}{6} M\ell - \frac{1}{2} x \cdot \frac{M}{\ell} \cdot x$

$M_F(x) = \frac{1}{6} M\ell \cdot x - \frac{1}{2} x^2 \frac{M}{\ell} \cdot \frac{x}{3}$

$u(0) = 0$

$u(\ell) = 0$

$\circlearrowleft B \cdot \ell + M = 0 \rightarrow B = -\frac{M}{\ell}$

$\circlearrowright A \cdot \ell - M = 0 \quad A = \frac{M}{\ell}$

$\frac{1}{6} - \frac{3}{6} = \frac{-2}{6} = -\frac{1}{3}$

$\circlearrowleft A_F \cdot \ell - \frac{1}{2} M \cdot \ell \cdot \frac{1}{3}\ell = 0 \rightarrow \boxed{A_F = \frac{1}{6} M\ell}$

$\frac{M(x)}{x} = \frac{M}{\ell} \qquad M(x) = \frac{M}{\ell} \cdot x$

$$\varphi(x) = \frac{1}{EI_y}\left(\frac{1}{6} M\ell - \frac{1}{2} x^2 \frac{M}{\ell}\right)$$

$$u(x) = \frac{1}{EI_y}\left(\frac{1}{6} M\ell \cdot x - \frac{1}{6} \frac{M}{\ell} \cdot x^3\right)$$

$\varphi(\ell) = \frac{1}{EI_y}\left(\frac{1}{6} M\ell - \frac{1}{2} M\ell\right)$

$\boxed{\varphi(\ell) = -\frac{1}{3EI_y} M\ell}$

$$M(x) = A \cdot x$$

$$M(x) = \frac{M}{\ell} \cdot x$$

$$E I_y w''(x) = -\frac{M}{\ell} \cdot x$$

$$E I_y w'(x) = -\frac{M x^2}{2\ell} + C_1$$

$$E I_y w(x) = -\frac{M x^3}{6\ell} + C_1 x + C_2$$

$w(0) = 0$

$$0 = -\frac{M x^3}{6\ell} + C_1 x + C_2 \Rightarrow \boxed{C_2 = 0}$$

$w(\ell) = 0$

$$0 = -\frac{M \ell^3}{6\ell} + C_1 \cdot \ell$$

$$\frac{M\ell^2}{6} = C_1 \ell \rightarrow \boxed{C_1 = \frac{M\ell}{6}}$$

$$E I_y w'(x) = -\frac{M x^2}{2\ell} + \frac{M\ell}{6}$$

$$E I_y w(x) = -\frac{M x^3}{6\ell} + \frac{M\ell}{6} x$$

(9)

$$C = \frac{1}{2EI_y} \int_0^l \frac{M^2 \cdot x^2}{e^2} dx = \left[\frac{M^2 \cdot x^3}{3e^2} \right]_0^l = \frac{M^2 e^3}{3e^2} = \frac{M^2 l}{3} \frac{1}{2EI_y}$$

$$\frac{1}{2} M \cdot \varphi = \frac{1}{2EI_y} \cdot \frac{M^2 \cdot l}{3}$$

$$\boxed{\varphi = \frac{Ml}{3EI_y}}$$