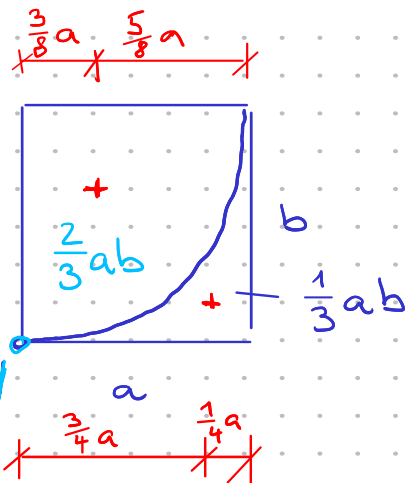


Parabola



Reakce:

$$\frac{2}{3} \cdot l \cdot \frac{1}{8} q l^2 \cdot \frac{1}{2} = R$$

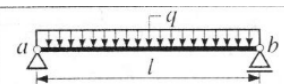
$$R = \frac{q l^3}{24}$$

$$\tilde{M}(x = \frac{l}{2}) = R \cdot \frac{l}{2} - \frac{2}{3} \cdot \frac{l}{2} \cdot \frac{1}{8} q l^2 \cdot \left(\frac{3}{8} \frac{l}{2}\right) =$$

$$= \frac{q l^4}{48} - \frac{q l^4}{128} = \frac{5}{384} q l^4$$

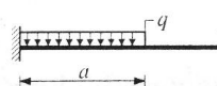
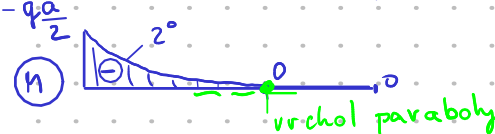
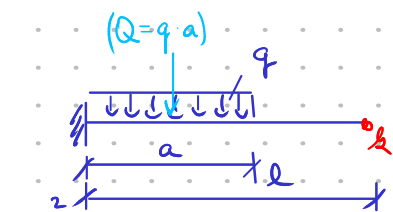
$$w_{\max} = w(x = \frac{l}{2}) = \frac{\tilde{M}}{EI} = \frac{5 q l^4}{384 EI}$$

15



$$w_{\max} = \frac{5}{384} \frac{q l^4}{EI} \text{ v } x = 0,5l$$

$$\varphi_a = \varphi_b = \frac{1}{24} \frac{q l^3}{EI}$$



$$w = \frac{q a^3}{24 EI} (4l - a)$$

$$\varphi = \frac{q a^3}{6 EI}$$

$$\tilde{M}_k = \frac{1}{3} \cdot a \cdot \frac{q a^2}{2} \cdot \left(l - \frac{1}{4} a\right) = \frac{q a^3}{24} (4l - a)$$

$$w_k = \frac{\tilde{M}_k}{EI} = \frac{q a^3}{24 EI} (4l - a)$$

Pozn. parabola musi' mit vrchol V a musi' w zhat vypočet téžistě (\$1/4a, 3/4a\$)

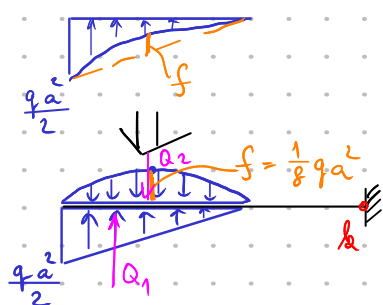
$$\tilde{V}_k = \frac{1}{3} a \cdot \frac{q a^2}{2} = \frac{q a^3}{6} \Rightarrow \varphi_k = \frac{q a^3}{6 EI}$$

parabola nemusí mit vrchol V a stačí znalost \$A = \frac{2}{3} ab\$ - rozklad na 2 obrazce

$$\tilde{V}_k = \underbrace{\frac{1}{2} \left(\frac{q a^2}{2}\right) \cdot a}_{Q_1} - \underbrace{\frac{2}{3} \left(\frac{1}{8} q a^2\right) \cdot a}_{Q_2} = \frac{1}{4} q a^3 - \frac{1}{12} q a^3 = \frac{q a^3}{6} \checkmark$$

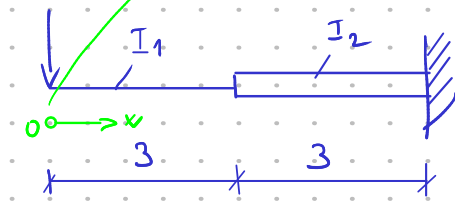
$$\tilde{M}_k = Q_1 \cdot \left(l - \frac{1}{3} a\right) - Q_2 \cdot \left(l - \frac{a}{2}\right) = \frac{q a^3}{4} l - \frac{q a^4}{12} - \frac{q a^3}{12} l + \frac{q a^4}{24} = \frac{q a^3 l}{6} - \frac{q a^4}{24}$$

$$\tilde{M}_k = \frac{q a^3}{24} (4l - a) \checkmark$$



Integrace + různé průřezy

$F = 60 \text{ kN}$
stejný počátek
pro všechny
úseky



$$E = 210 \text{ GPa}$$

$$I_1 = 196,1 \cdot 10^6 \text{ mm}^4$$

$$I_2 = 305,65 \cdot 10^6 \text{ mm}^4$$

$$x \in \langle 0; 3 \rangle$$

$$M(x) = -60 \cdot x$$

$$x \in \langle 3; 6 \rangle$$

$$M(x) = -60 \cdot x$$

$$EI_1 w'' = 60 \cdot x$$

$$EI_2 w'' = 60 \cdot x$$

$$\textcircled{1} EI_1 w' = 60 \frac{x^2}{2} + C_1$$

$$\textcircled{3} EI_2 w' = 60 \frac{x^2}{2} + C_3$$

$$\textcircled{2} EI_1 w = 60 \cdot \frac{x^3}{6} + C_1 x + C_2$$

$$\textcircled{4} EI_2 w = 60 \frac{x^3}{6} + C_3 x + C_4$$

$$\textcircled{4} w(x=6) = 0$$

$$\textcircled{3} w'(x=6) = 0$$

$$\textcircled{2} L w(x=3) = P w(x=3) \textcircled{4}$$

$$\textcircled{1} L w'(x=3) = P w'(x=3) \textcircled{3}$$

$$0 = 10 \cdot 6^3 + 6C_3 + C_4 \Rightarrow C_4 = +4320$$

$$0 = 30 \cdot 6^2 + C_3 \Rightarrow C_3 = -1080$$

$$\frac{1}{EI_1} (10 \cdot 3^3 + 3C_1 + C_2) = \frac{1}{EI_2} (10 \cdot 3^3 + 3C_3 + C_4) \Rightarrow C_2 = \frac{I_1}{I_2} \cdot (10 \cdot 3^3 + 3C_3 + C_4) - 10 \cdot 3^3 - 3C_1 = 2965,18567$$

$$\frac{1}{EI_1} (30 \cdot 3^2 + C_1) = \frac{1}{EI_2} (30 \cdot 3^2 + C_3) \Rightarrow C_1 = \frac{I_1}{I_2} (30 \cdot 3^2 + C_3) - 30 \cdot 3^2 = -489,6826436$$

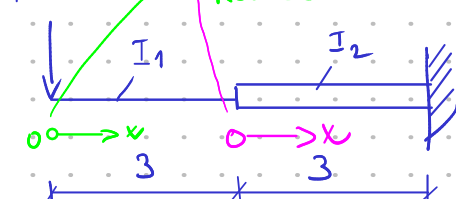
$$w(x=0) = \textcircled{2} = \frac{1}{EI_1} (0 + 0 + C_2) = \frac{2965,18567}{210 \cdot 10^6 \cdot 196,1 \cdot 10^6} = \underline{\underline{0,072 \text{ mm}}}$$

Integrace + různé průřezy

začátek souřadnic

na začátku
každého úseku

$$F = 60 \text{ kN}$$



$$x \in \langle 0; 3 \rangle$$

$$M(x) = -60 \cdot x$$

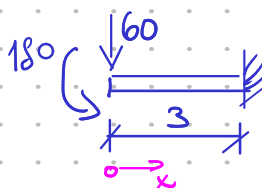
$$x \in \langle 0; 3 \rangle$$

$$M(x) = -180 - 60x$$

$$E = 210 \text{ GPa}$$

$$I_1 = 196,1 \cdot 10^6 \text{ mm}^4$$

$$I_2 = 305,65 \cdot 10^6 \text{ mm}^4$$



$$EI_1 w'' = 60x$$

$$EI_2 w'' = 180 + 60x$$

$$\textcircled{1} EI_1 w' = 30x^2 + C_1$$

$$\textcircled{3} EI_2 w' = 180x + 30x^2 + C_3$$

$$\textcircled{2} EI_1 w = 10x^3 + C_1 x + C_2$$

$$\textcircled{4} EI_2 w = 90x^2 + 10x^3 + C_3 x + C_4$$

$$\textcircled{4} w(x=3) = 0$$

$$\textcircled{3} w'(x=3) = 0$$

$$\textcircled{2} L w(x=3) = P w(x=0) \textcircled{4}$$

$$\textcircled{1} L w'(x=3) = P w'(x=0) \textcircled{3}$$

$$0 = 180 \cdot 3 + 30 \cdot 3^2 + C_3$$

$$\Rightarrow C_3 = -810$$

$$0 = 90 \cdot 3^2 + 10 \cdot 3^3 + 3C_3 + C_4$$

$$\Rightarrow C_4 = 1350$$

$$\frac{1}{EI_1} (10 \cdot 3^3 + 3C_1 + C_2) = \frac{1}{EI_2} C_4$$

$$\Rightarrow C_2 = \frac{I_1}{I_2} C_4 - 10 \cdot 3^3 - 3C_1 = 2965,18567$$

$$\frac{1}{EI_1} (30 \cdot 3^2 + C_1) = \frac{1}{EI_2} C_3$$

$$\Rightarrow C_1 = \frac{I_1}{I_2} C_3 - 30 \cdot 3^2 = -789,6826436$$

$$w(x=0) = \textcircled{2} = \frac{1}{EI_1} (0 + 0 + C_2) = \frac{2965,18567}{210 \cdot 10^6 \cdot 196,1 \cdot 10^{-6}} = \underline{\underline{0,072 \text{ m}}}$$