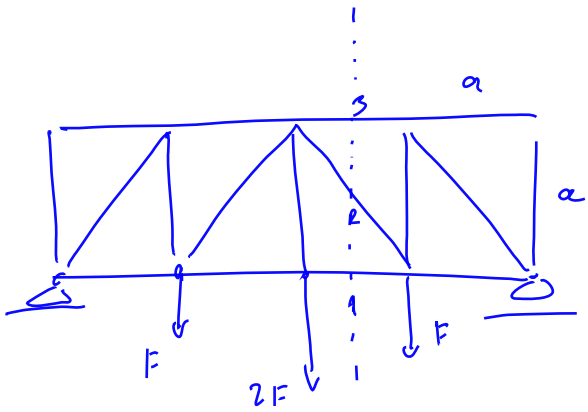
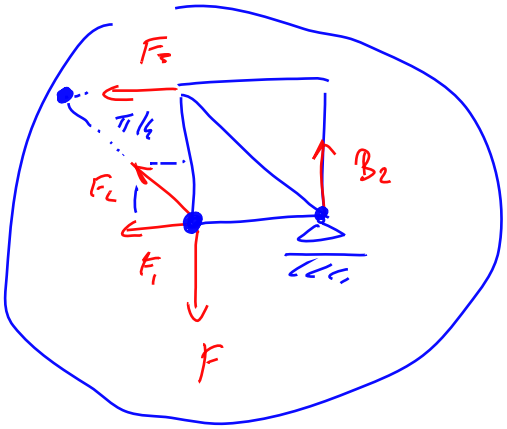
Vaje 1. april 2021

1. Za dano paličje v obliki mosta izračunaj:
   (a) sile v podporah;
   (b) sile v označenih palicah.



$$A_2 = B_2 = 2F$$



$$a F_3 + a B_2 = 0 \Rightarrow F_3 = -B_2 = -2F$$

$$-a F_1 - aF + 2a B_2 = 0$$

$$F_1 = -F + 2B_2 = -F + 4F = 3F$$

$$\frac{1}{\sqrt{2}} \quad F_2 + B_2 - F = 0 \Rightarrow F_2 = \sqrt{2}(F - B_2) = \sqrt{2}(F - 2F) = -\sqrt{2}F$$

$$-\frac{1}{\sqrt{2}} F_2 - F_1 - F_3 = F - 3F + 2F = 0 \checkmark$$

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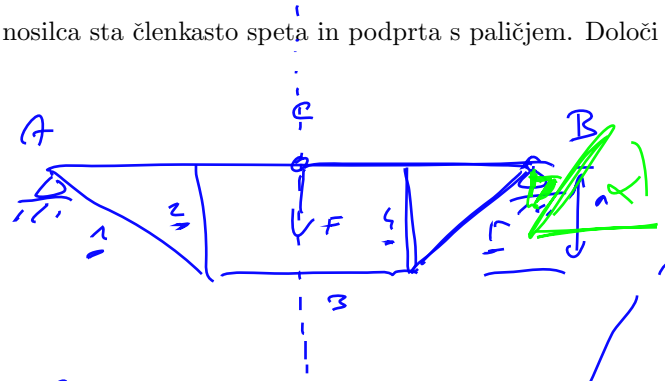
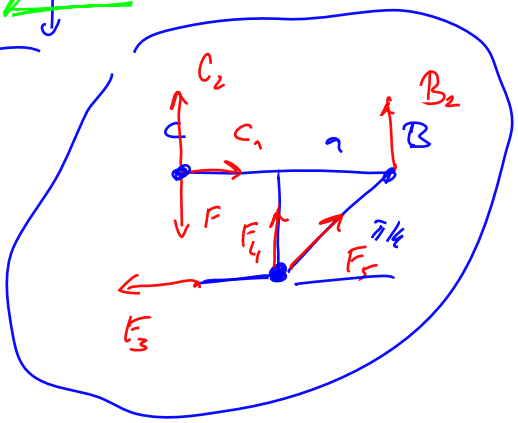
2. Dva nosilca sta členkasto speta in podprta s paličjem. Določi sile v palicah.



$A_2 = B_2 = F/2$



$C_1 - F_3 = 0$

$C_2 - F + B_2 = 0$

$-a F_3 + 2a B_2 = 0 \Rightarrow F_3 = 2B_2 = F$

$-F_3 + \frac{1}{\sqrt{2}} F_5 = 0 \Rightarrow F_5 = \sqrt{2} F_3 = \sqrt{2} F$

$F_4 + \frac{1}{\sqrt{2}} F_5 = 0 \Rightarrow F_4 = -\frac{1}{\sqrt{2}} F_5 = -F$

$F_1 = F_5 = \sqrt{2} F \; ; \quad F_2 = F_4 = -F$

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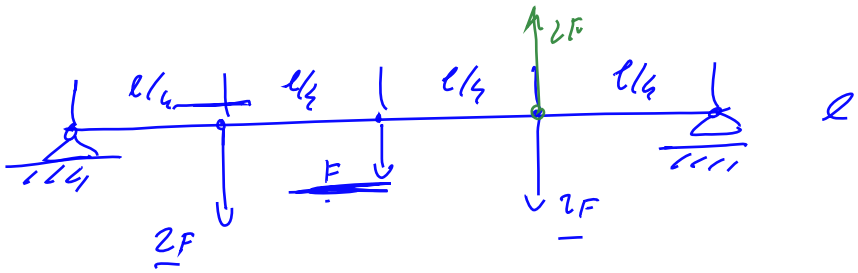
3. Določi potek prečne sile in upogibnega momenta za točkovno obremenjen enostavno podprti nosilec.



$A_z = B_z = \frac{5}{2}F$

$\frac{dM}{dx} = Q$

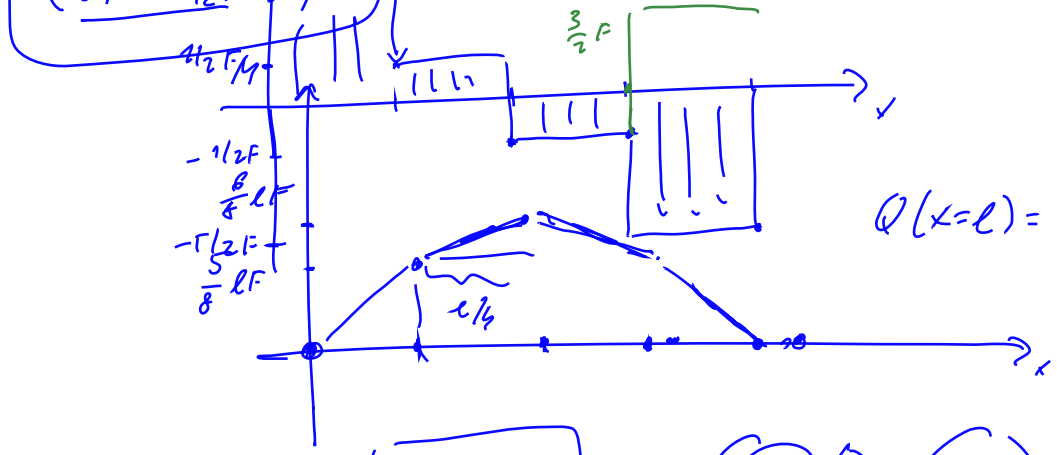
$Q = 5/2\,F$

$0 < x < l/4 \qquad \frac{dM}{dx} = \frac{1}{2}F$

$M = \frac{1}{2}Fx$

$M(x=\frac{l}{4}) = \frac{1}{2}F\cdot\frac{l}{4} = \frac{1}{8}lF$

$Q(x=l) = -\frac{5}{2}F = -B_z$



$\frac{l}{4} < x < \frac{l}{2} \qquad \frac{dM}{dx} = \frac{1}{2}F$

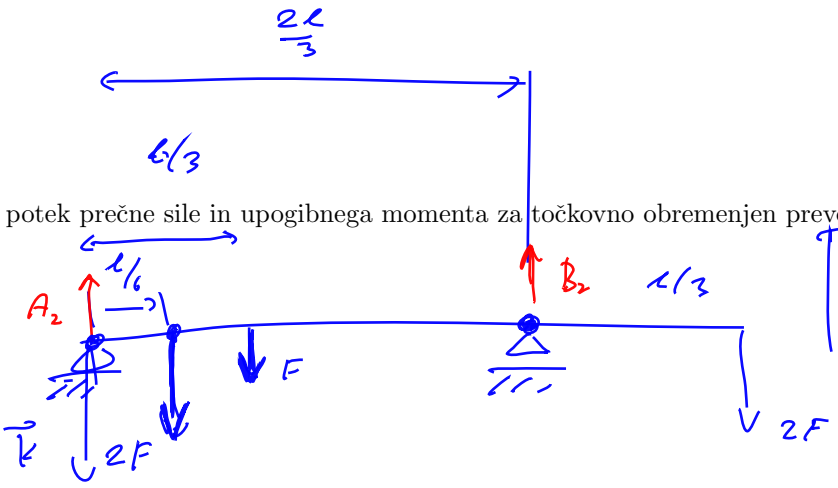
$\frac{1}{2}F\cdot\frac{l}{4}$ $\qquad lF\frac{1}{8}$

$Q = \frac{1}{2}F$

$\frac{l}{2} < x < \frac{3l}{4} \qquad Q = -\frac{1}{2}F \qquad \frac{dM}{dx} = -\frac{1}{2}F$

$\frac{3l}{4} < x < l \qquad Q = -\frac{5}{2}F \qquad \frac{dM}{dx} = -\frac{1}{2}F$

4. Določi potek prečne sile in upogibnega momenta za točkovno obremenjen prevesni nosilec.



$A_2 + B_2 = 5F$ ✓

$2F\vec{k}$

$\vec{Q} = Q|x|\vec{k}$

$$-\frac{l}{6}\cdot 2F - \frac{l}{3}\cdot F + \frac{2l}{3}B_2 - l\cdot 2F = 0$$

$$\frac{2}{3}B_2 = \frac{1}{3}F + \frac{1}{3}F + 2F = \left(\frac{2}{3}+2\right)F = \frac{8}{3}F$$

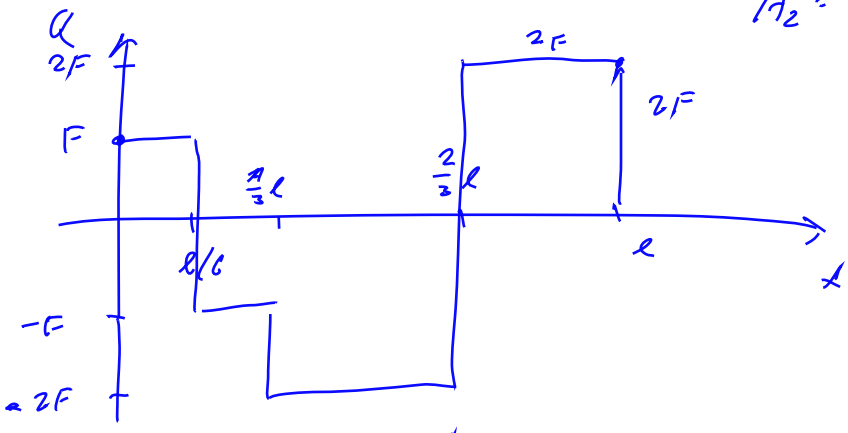
$$B_2 = 4F$$ ✓

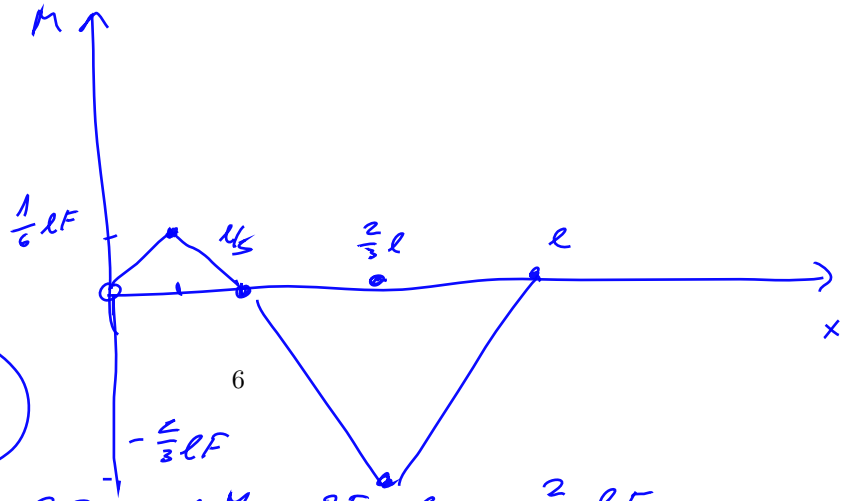
$$-\frac{2l}{3}A_2 + \left(\frac{2l}{3}-\frac{l}{6}\right)\cdot 2F + \frac{l}{3}F - \frac{l}{3}\cdot 2F = 0$$

$\frac{1}{2}l$

$$\frac{2l}{3}A_2 = \frac{1}{2}l\cdot 2F + \frac{l}{3}F - \frac{2l}{3}F = l\left(1+\frac{1}{3}-\frac{2}{3}\right)F = \frac{2}{3}lF$$

$A_2 = F$ ✓





$\frac{dM}{dx} = Q$

$\Delta l = \frac{l}{3}$

$\frac{l}{3} \le x \le \frac{2}{3}l \Rightarrow Q = -2F \quad \Delta M = -2F\cdot\Delta l = -\frac{2}{3}lF$

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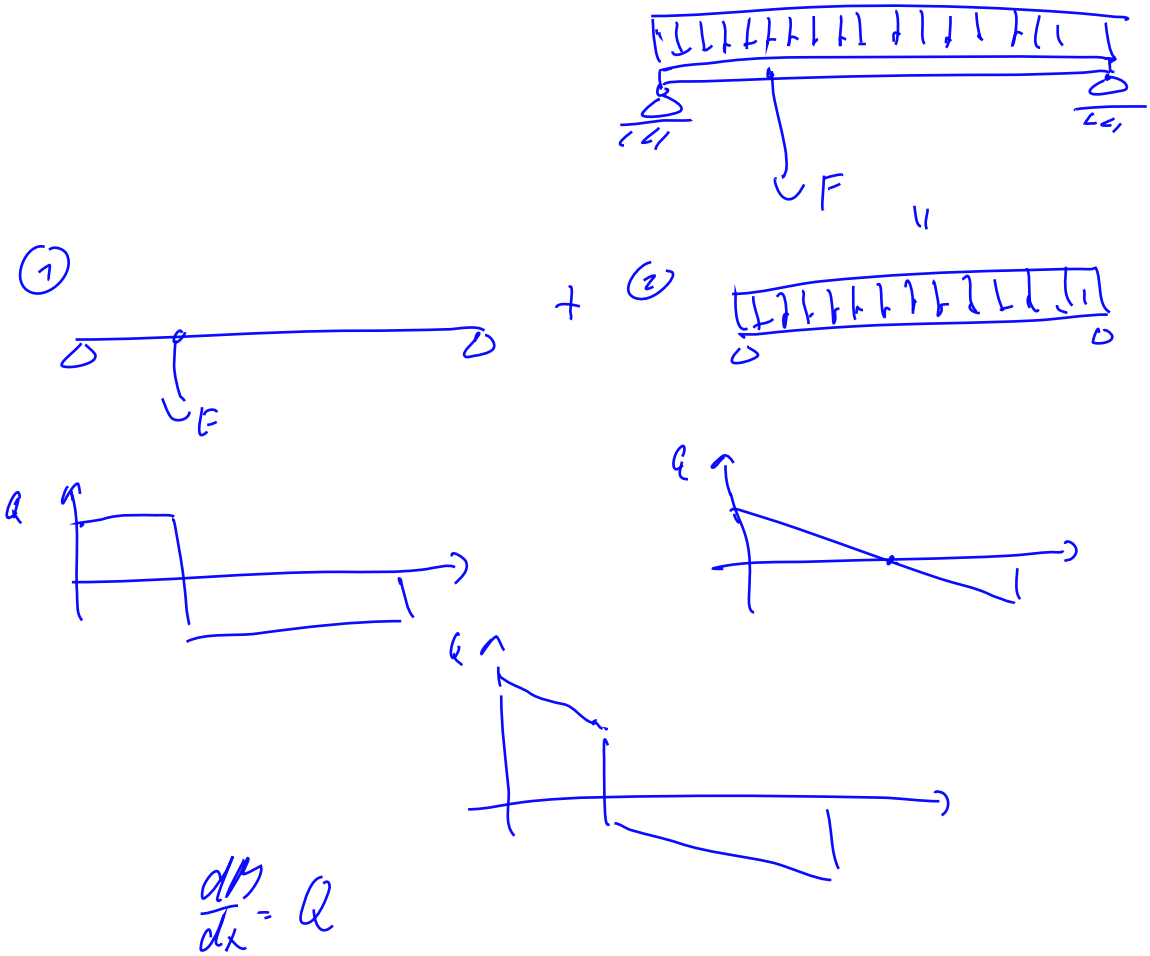
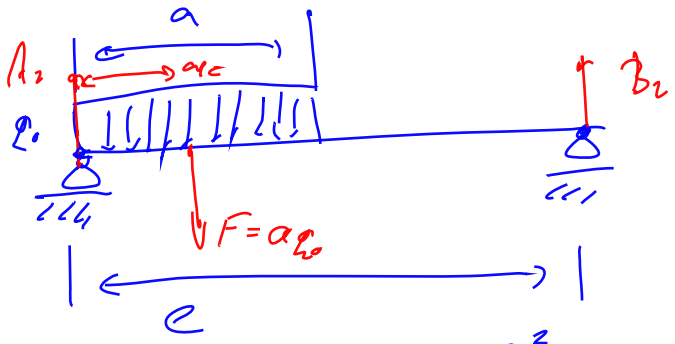
5. Določi potek prečne sile in upogibnega momenta za enakomerno obremenjen nosilec s točkovno obremenitvijo. Nosilec je enostavno podprt.



6. Določi potek prečne sile in upogibnega momenta za enostavno podprti nosilec, ki je linijsko obremenjen samo na enem delu nosilca.



$$-\frac{a}{2} \cdot a q_0 + \ell B_z = 0 \Rightarrow B_z = \frac{1}{2}\frac{a^2}{\ell} q_0$$

$$-\ell A_z + \left(\ell - \frac{a}{2}\right) a q_0 = 0 \Rightarrow A_z = \frac{1}{\ell}\left(\ell - \frac{a}{2}\right) a q_0 = \left(1 - \frac{a}{2\ell}\right) a q_0$$

$$\frac{dQ}{dx} = q$$

$0 \le x < a$:

$$\frac{dQ_1}{dx} = q_0 \Rightarrow Q_1(x) = q_0 x + C_1$$

$$Q_1(x=0) = C_1 = A_z =$$

$a < x < \ell$

$$\frac{dQ_2}{dx} = 0 \Rightarrow Q_2 = C_2$$

$$Q_2(x=\ell) = -B_z \Rightarrow C_2 = -B_z$$

Dodatek: velja $Q_1(x=a) = Q_2(a)$; $Q_1(a) = q_0 a + \left(1 - \frac{a}{2\ell}\right) a q_0 = -\frac{1}{2}\frac{a^2}{\ell} q_0$

$$\frac{dM}{dx} = Q_1 \qquad 0 \le x \le a \Rightarrow \frac{dM}{dx} = q_0 x + A_z$$

$$M = \frac{1}{2} q_0 x^2 + A_z x + C_3 \qquad M(x=0) = 0 \Rightarrow C_3 = 0$$

$$M = \frac{1}{2} q_0 x^2 + A_z x$$

$$\frac{dM}{dx} = Q_2 \qquad a < x < \ell \Rightarrow \frac{dM}{dx} = -B_z \; ; \; M = -B_z x + C_4$$

$$M(x=\ell) = 0 \qquad -B_z \ell + C_4 = 0 \Rightarrow C_4 = \ell B_z$$

$$M = B_z(\ell - x)$$

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