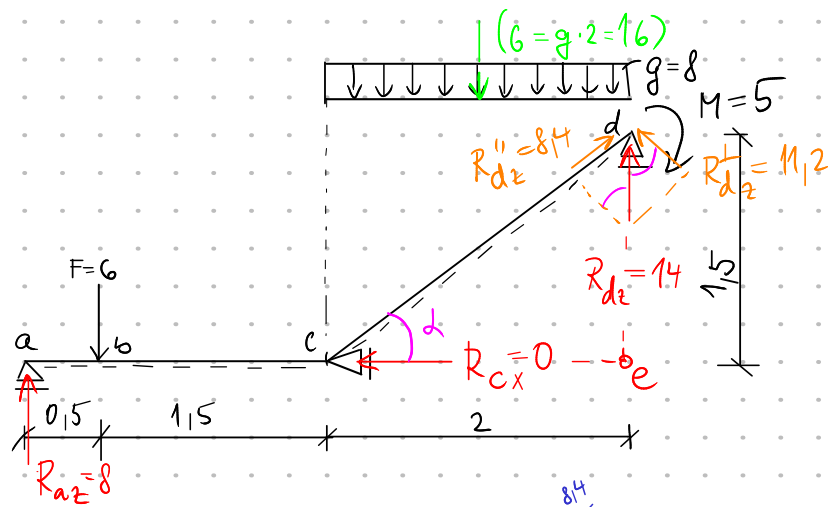


[m, kN, kNm, kN/m]

Vykreslete vnitřní síly N, V a M, parabolu včetně 2 hlavních tečen a vypočítejte případný lokální extrém. Složitější výpočty rozpíště (včetně x_p a M_{max}).



Reakce: $\sum F_{xi} = 0 \oplus \leftarrow R_{cx} = 0$

$\sum M_{ai} = 0 \oplus \curvearrowright$

$$F \cdot 0,5 + G \cdot 3 - R_{dz} \cdot 4 + M = 0$$

$$R_{dz} = \frac{6 \cdot 0,5 + 16 \cdot 3 + 5}{4} = \underline{\underline{14 \text{ kN}}}$$

$\sum M_{ei} = 0 \oplus \curvearrowright$

$$R_{az} \cdot 4 - F \cdot 3,5 - G \cdot 1 + M = 0$$

$$R_{az} = \frac{6 \cdot 3,5 + 16 \cdot 1 - 5}{4} = \underline{\underline{8 \text{ kN}}}$$

kontrola: $\sum F_{zi} = 0 \oplus \uparrow$

$$R_{az} - F - G + R_{dz} = 0$$

$$8 - 6 - 16 + 14 = 0 \checkmark$$

$$\sin \alpha = \frac{1,5}{2,5} = \frac{3}{5}$$

$$\cos \alpha = \frac{2}{2,5} = \frac{4}{5}$$

$$R_{dz}^\perp = R_{dz} \cdot \cos \alpha = 14 \cdot \frac{4}{5} = 11,2 \text{ kN}$$

$$R_{dz}^{\parallel} = R_{dz} \cdot \sin \alpha = 14 \cdot \frac{3}{5} = 8,4 \text{ kN}$$

$$q_{\perp x} = q_{\perp} \Rightarrow q' = q \cdot \frac{2}{2,5} = 6,4 \text{ kN/m}$$

$$q_{\parallel} = q' \cdot \cos \alpha = 6,4 \cdot \frac{4}{5} = 5,12 \text{ kN/m}$$

$$n = q' \cdot \sin \alpha = 6,4 \cdot \frac{3}{5} = 3,84 \text{ kN/m}$$

kontrola: $\sum F_{xi} = 0 \oplus \leftarrow R_{cx} = 0$

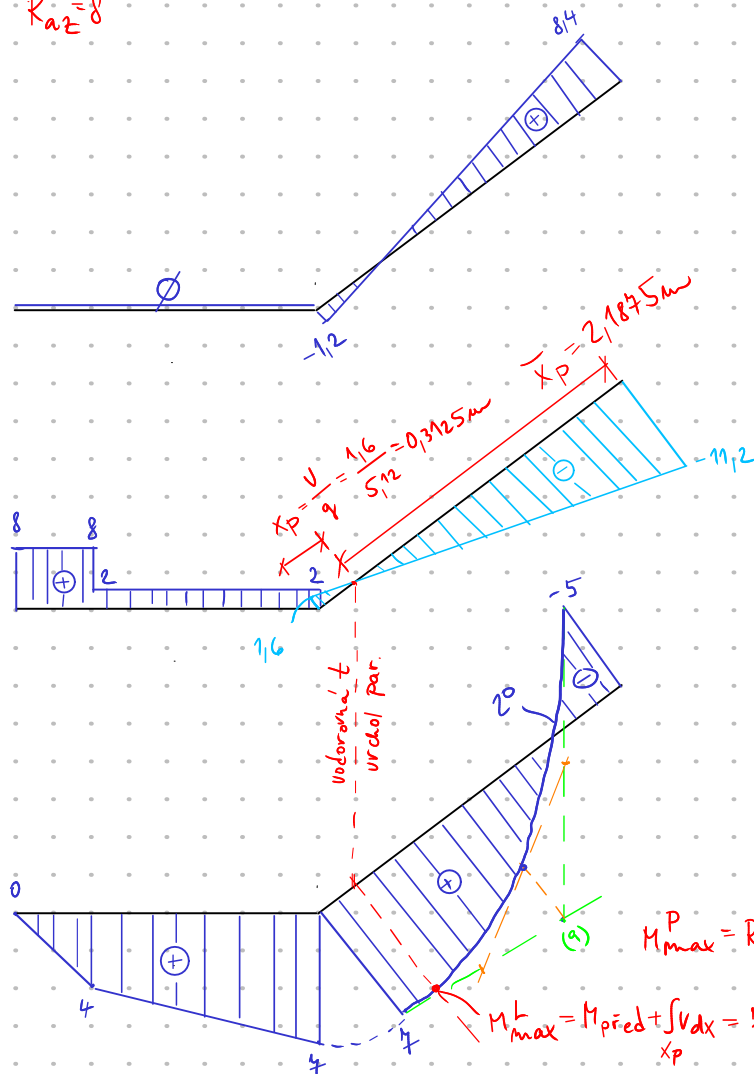
$$0 = N$$

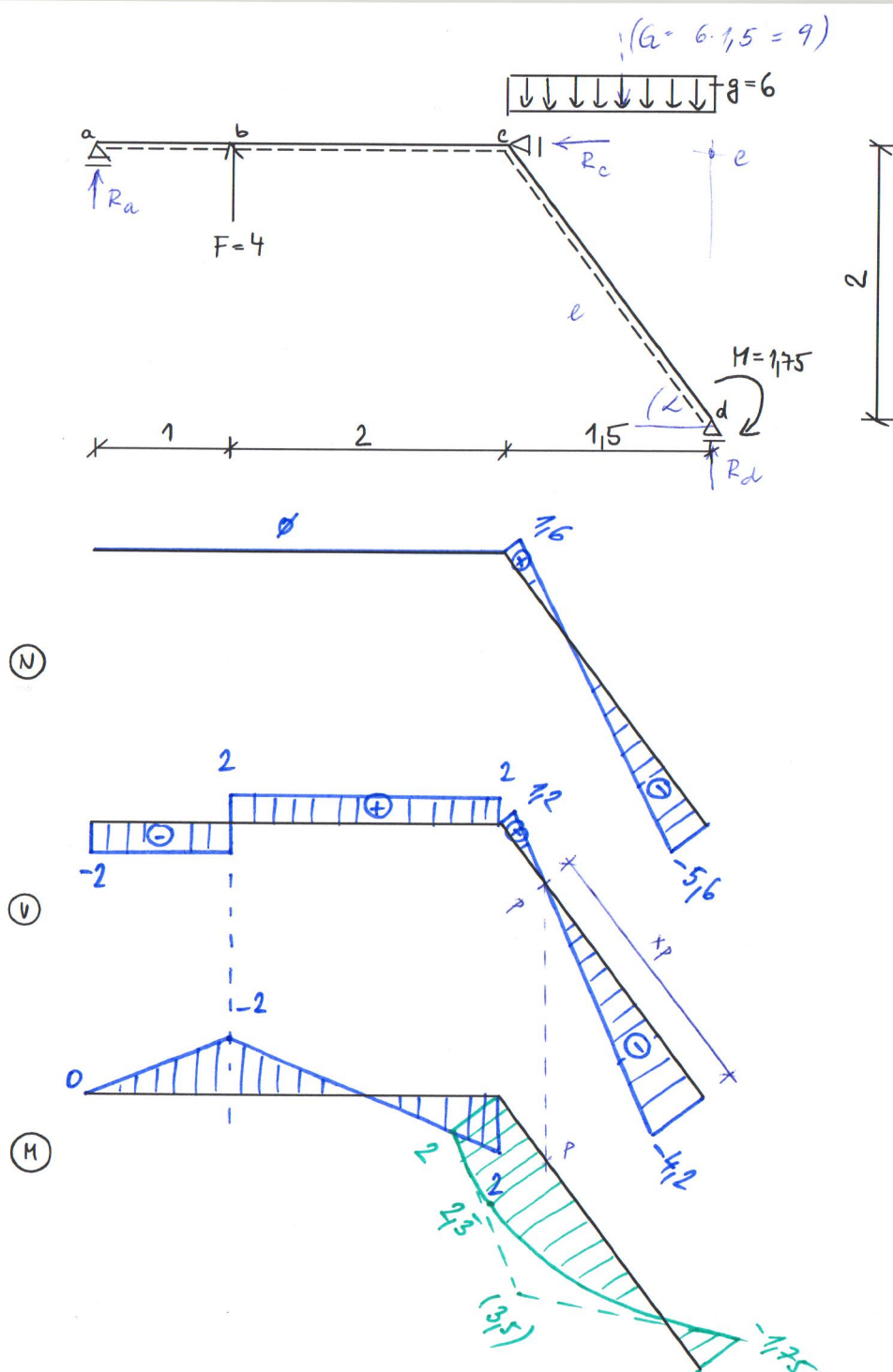
$$V^\perp = V_{cd} = V \cdot \cos \alpha = 2 \cdot \frac{4}{5} = 1,6 \text{ kN} \checkmark$$

$$V^{\parallel} = V_{cd} = V \cdot \sin \alpha = 2 \cdot \frac{3}{5} = 1,2 \text{ kN} \checkmark$$

$$M_{max}^P = R_{dz}^\perp \cdot \bar{x}_p - M - q_{\perp} \cdot \frac{\bar{x}_p^2}{2} = 11,2 \cdot 2,1875 - 5 - 5,12 \cdot \frac{2,1875^2}{2} = \underline{\underline{7,25 \text{ kNm}}}$$

$$M_{max}^L = M_{pred} + \int_{x_p} V dx = 7 + \frac{1}{2} \cdot 1,6 \cdot 0,3125 = \underline{\underline{7,25 \text{ kNm}}}$$





[m, kN, kNm, kN/m]

Vykreslete vnitřní síly N, V a M, parabolu včetně 2 hlavních tečen a vypočítejte případný lokální extrém. Rozkreslete včetně zvoleného úhlu.

Složitější výpočty rozepte (reakce, xp a Mmax, ...).

$$\begin{aligned} \textcircled{+} \sum M_{ia} = 0 &: F \cdot 1 - G \cdot 3,75 - M + R_d \cdot 4,5 = 0 \\ R_d &= \frac{-4 \cdot 1 + 9 \cdot 3,75 + 1,75}{4,5} = \underline{\underline{7 \text{ kN}}} \quad (1) \end{aligned}$$

$l = \sqrt{1,5^2 + 2^2} = 2,5 \text{ m}$

$$\textcircled{+} \sum F_{ix} = 0: -R_c = 0 \rightarrow \underline{\underline{R_c = 0}}$$

$$\begin{aligned} \textcircled{+} \sum M_{ic} = 0 &: -R_a \cdot 4,5 - F \cdot 3,5 + G \cdot 0,75 - M = 0 \\ R_a &= \frac{-4 \cdot 3,5 + 9 \cdot 0,75 - 1,75}{4,5} = \underline{\underline{-2 \text{ kN}}} \quad (2) \end{aligned}$$

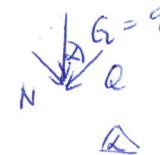
$$\text{KO: } \sum F_{iz} = 0: \uparrow \textcircled{+} \quad R_a + F + R_d - G = 0$$

$$-2 + 4 + 7 - 9 = 0 \quad \checkmark$$

$$\sin \alpha = \frac{2}{2,5} = 0,8$$

$$\cos \alpha = \frac{1,5}{2,5} = 0,6$$

$$\begin{aligned} R_d^{\parallel} &= R_d \cdot \sin \alpha = \underline{\underline{5,6 \text{ kN}}} \\ R_d^{\perp} &= R_d \cdot \cos \alpha = \underline{\underline{4,2 \text{ kN}}} \end{aligned}$$

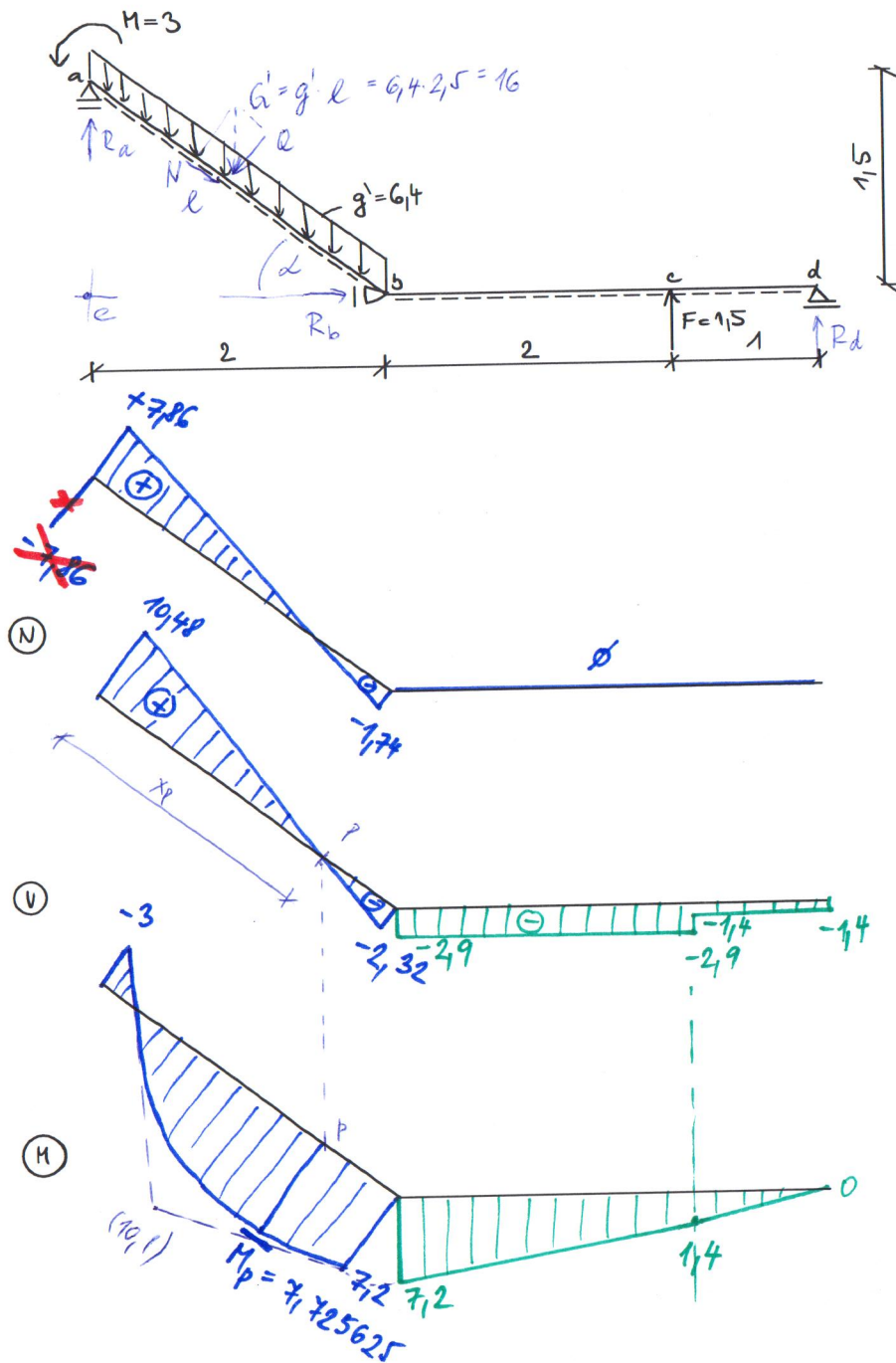


$$\begin{aligned} Q &= G \cdot \cos \alpha = 5,4 \text{ kN} \rightarrow q = \frac{Q}{l} = \underline{\underline{2,16 \text{ kN/m}}} \\ N &= G \cdot \sin \alpha = 7,2 \text{ kN} \rightarrow n = \frac{N}{l} = \underline{\underline{2,88 \text{ kN/m}}} \end{aligned}$$

$$\begin{aligned} \parallel &= 2 \cdot \sin \alpha = 1,6 \text{ kN} \\ \perp &= 2 \cdot \cos \alpha = 1,2 \text{ kN} \end{aligned}$$

$$x_p = \frac{4,2}{q} = \frac{4,2}{2,16} = \underline{\underline{\frac{35}{18} \text{ m}}}$$

$$\begin{aligned} M_p = M_{\max} &= -1,75 + R_d^{\perp} \cdot x_p - q \cdot \frac{x_p^2}{2} \\ &= -1,75 + 4,2 \cdot \frac{35}{18} - 2,16 \cdot \left(\frac{35}{18}\right)^2 \cdot \frac{1}{2} = \underline{\underline{2,3 \text{ kNm}}} \end{aligned}$$



[m, kN, kNm, kN/m]

Vykreslete vnitřní síly N, V a M, parabolu včetně 2 hlavních tečen a vypočítejte případný lokální extrém. Rozklady zakreslete včetně zvoleného úhlu.

Složitější výpočty rozepište (reakce, x_p a M_{max} , ...).

$$\sum M_{id} = 0 : M + G' \cdot 4 - F \cdot 1 = R_a \cdot 5 = 0$$

$$R_a = \frac{3 + 16 \cdot 4 - 1.5 \cdot 1}{5} = 13.1 \text{ kN}$$

$$\sum F_{ix} = 0 : R_b = 0$$

$$\sum M_{ie} = 0 : M - G' \cdot 1 + F \cdot 4 + R_d \cdot 5 = 0$$

$$R_d = \frac{-3 + 16 \cdot 1 - 1.5 \cdot 4}{5} = 1.4 \text{ kN}$$

$$KO : \sum F_{iz} = 0 : R_a + R_d + F - G' = 0$$

$$13.1 + 1.4 + 1.5 - 16 = 0 \checkmark$$

$$\sin \alpha = \frac{1.5}{2.5} = 0.6$$

$$\cos \alpha = \frac{2}{2.5} = 0.8$$

$$R_a^\perp = R_a \cdot \cos \alpha = 10.48 \text{ kN}$$

$$R_a^\parallel = R_a \cdot \sin \alpha = 7.86 \text{ kN}$$

$$Q = G' \cdot \cos \alpha = 12.8 \text{ kN} \rightarrow q' = \frac{Q}{l} = \frac{12.8}{2.5} = 5.12 \text{ kN/m}$$

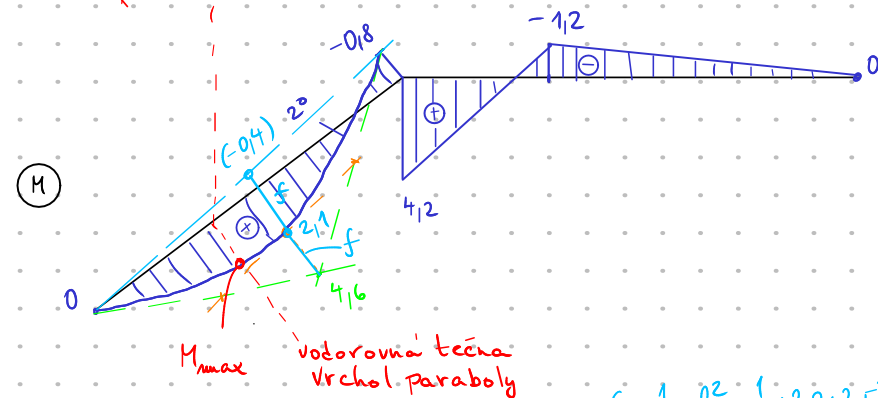
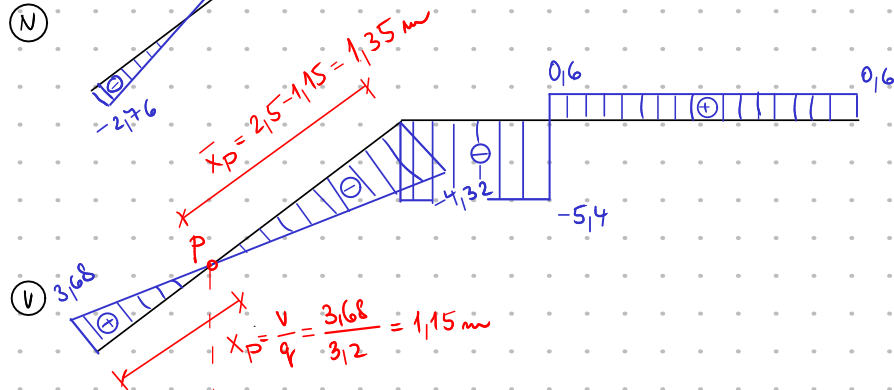
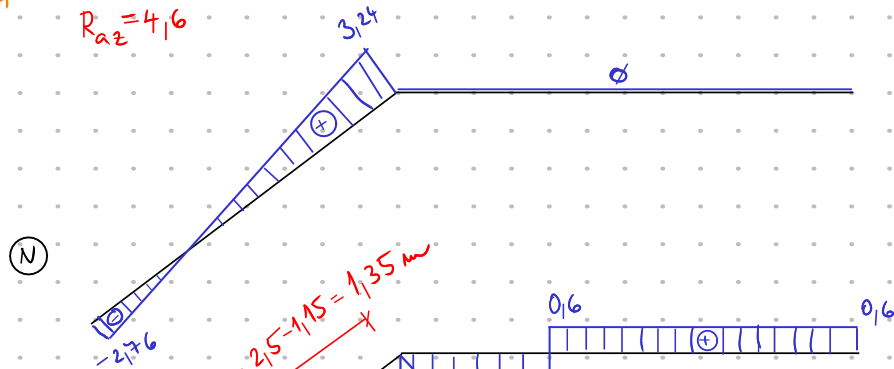
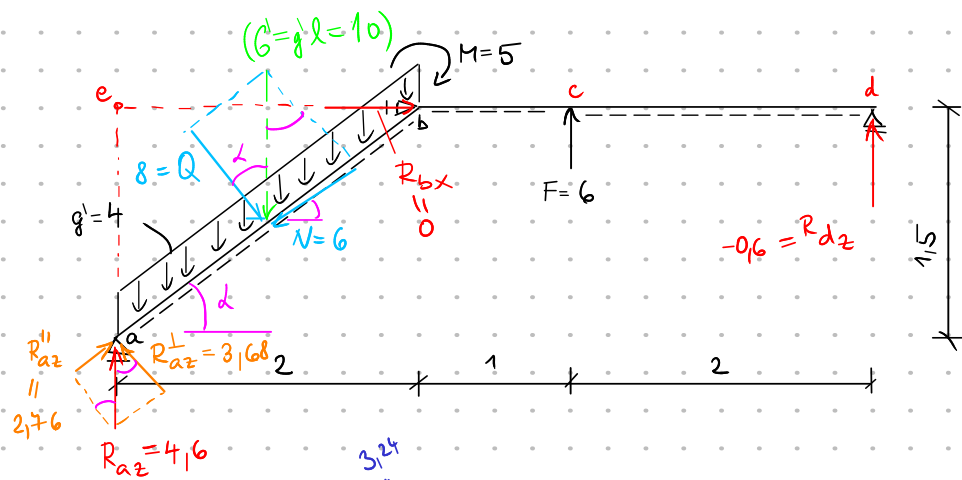
$$N = G' \cdot \sin \alpha = 9.6 \text{ kN} \rightarrow n = \frac{N}{l} = \frac{9.6}{2.5} = 3.84 \text{ kN/m}$$

$$I = 2.9 \cdot \cos \alpha = 2.32 \text{ kN}$$

$$II = 2.9 \cdot \sin \alpha = 1.74 \text{ kN}$$

$$x_p = \frac{10.48}{9} = \frac{10.48}{5.12} = 2.046875 \text{ m}$$

$$M_p = M_{max} = -M + R_a^\perp \cdot x_p - q' \cdot \frac{x_p^2}{2} = -M + \int V dx = 7.725625 \text{ kNm}$$



$$f = \frac{1}{8} q l^2 = \frac{1}{8} \cdot 3.2 \cdot 2.5^2 = 2.5$$

[m, kN, kNm, kN/m]

Vykreslete vnitřní síly N, V a M, parabolu včetně 2 hlavních tečen a vypočítejte případný lokální extrém. Rozklady zakreslete včetně zvoleného úhlu.

Složitější výpočty rozepište (reakce, xp a Mmax, ...).

$$\sum F_{xi} = 0 \Rightarrow R_{bx} = 0$$

$$\sum M_{di} = 0 \Rightarrow R_{az} \cdot 5 - G' \cdot 4 + M + F \cdot 2 = 0$$

$$R_{az} = \frac{10 \cdot 4 - 5 - 6 \cdot 2}{5} = 4.16 \text{ kN}$$

$$\sum M_{ei} = 0 \Rightarrow R_{dz} \cdot 5 + F \cdot 3 - M - G' \cdot 1 = 0$$

$$R_{dz} = \frac{-6 \cdot 3 + 5 + 10 \cdot 1}{5} = -0.6 \text{ kN}$$

kontrola:

$$\sum F_{zi} = 0 \Rightarrow R_{az} + R_{dz} - G' + F = 0 \quad 4.16 + (-0.6) - 10 + 6 = 0 \checkmark$$

$$\sin \alpha = \frac{1.5}{2.5} = \frac{3}{5}$$

$$\cos \alpha = \frac{2}{2.5} = \frac{4}{5}$$

$$R_{az}^\perp = R_{az} \cdot \cos \alpha = 4.16 \cdot \frac{4}{5} = 3.68 \text{ kN}$$

$$R_{az}^\parallel = R_{az} \cdot \sin \alpha = 4.16 \cdot \frac{3}{5} = 2.76 \text{ kN}$$

$$Q = G' \cos \alpha = 10 \cdot \frac{4}{5} = 8 \text{ kN}$$

$$N = G' \sin \alpha = 10 \cdot \frac{3}{5} = 6 \text{ kN}$$

$$q = \frac{Q}{l} = \frac{8}{2.5} = 3.2 \text{ kN/m}$$

$$n = \frac{N}{l} = \frac{6}{2.5} = 2.4 \text{ kN/m}$$

kontrola:

$$V^\perp = V \cdot \cos \alpha = 5.4 \cdot \frac{4}{5} = -4.32 \text{ kN} \checkmark$$

$$V \sin \alpha = 3.24 \text{ kN} \checkmark$$

$$M_{max}^\perp = R_{az}^\perp \cdot x_p - q \cdot \frac{x_p^2}{2} = 3.68 \cdot 1.15 - 3.2 \cdot \frac{1.15^2}{2} = 2.116 \text{ kNm}$$

$$M_{max}^P = M_{před} - \int_{x_p} V dx = -0.8 - \frac{1}{2} \cdot x_p \cdot (-4.32) = 2.116 \text{ kNm} \checkmark$$