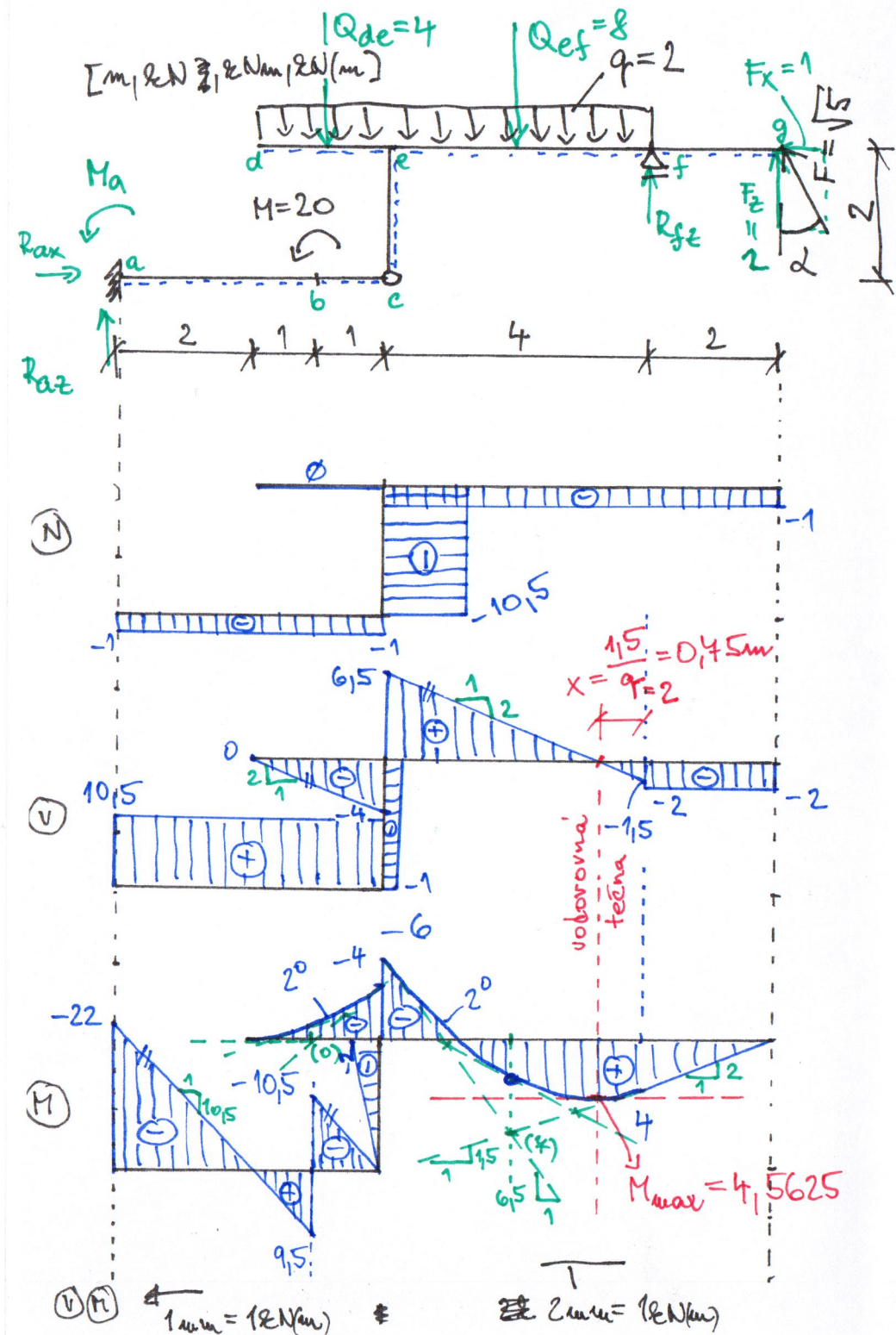




$$\alpha = 25.56505118^\circ$$

JMÉNO:

REAKCE: $\sum F_{xi} = 0 \oplus \rightarrow$

$$R_{ax} - F_x = 0 \Rightarrow \underline{R_{ax} = F_x = 1 \text{ kN}}$$

$\oplus \sum M_{ci}^P = 0$

$$F_z \cdot 6 + F_x \cdot 2 + R_{fz} \cdot 4 - q \cdot 6 \cdot 1 = 0 \Rightarrow \underline{R_{fz} = -\frac{2}{4} = -0.5 \text{ kN}}$$

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

$$M_a + M - q \cdot 6 \cdot 5 + R_{fz} \cdot 8 + F_z \cdot 10 + F_x \cdot 2 = 0$$

$$\underline{M_a = +22 \text{ kNm}}$$

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

$$R_{az} - q \cdot 6 + R_{fz} + F_z = 0$$

$$\underline{R_{az} = +10.5 \text{ kN}}$$

KONTROLA: $\sum M_{ci}^L = 0 \oplus \uparrow$

$$M_a + M - R_{az} \cdot 4 = 0 \Rightarrow \underline{0 = 0 \checkmark}$$

Rozdělení: (pro vyřešení a vykreslení uvnitř)

Diagram of a free body for the control:

- Horizontal forces: $C_x \rightarrow$, $C_z \leftarrow$.
- Vertical forces: $C_z \uparrow$, $C_x \downarrow$.

$$\sum F_{xi} = 0 \oplus \rightarrow$$

$$C_x - F_x = 0 \Rightarrow \underline{C_x = 1 \text{ kN}}$$

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

$$C_z + R_{fz} + F_z - q \cdot 6 = 0$$

$$\underline{C_z = 10.5 \text{ kN}}$$

KONTROLA:

$$\sum F_{xi} = 0 \oplus \rightarrow$$

$$R_{ax} - C_x = 0 \checkmark$$

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

$$R_{az} - C_z = 0 \checkmark$$

Normalove' sily

$$N_{ab}^L = -R_{ax} = \underline{-1\text{ kN}}$$

$$N_{cb}^L = -R_{ax} = \underline{1\text{ kN}}$$

$$N_{cb}^P = -F_x = -1\text{ kN} \checkmark$$

$$N_{gf}^P = -F_x = \underline{-1\text{ kN}}$$

$$N_{ef}^P = -F_x = \underline{-1\text{ kN}}$$

$$N_{de}^L = \underline{0}$$

$$N_{ed}^L = \underline{0}$$

$$N_{ce}^L = -R_{az} = \underline{-10,5\text{ kN}}$$

$$N_{ce}^P = -q \cdot 6 + R_{fz} + F_z = \underline{-10,5\text{ kN}}$$

Posovajici' sily

$$V_{ab}^L = R_{az} = \underline{10,5\text{ kN}}$$

$$V_{cb}^L = R_{az} = \underline{10,5\text{ kN}}$$

$$V_{cb}^P = q \cdot 6 - R_{fz} - F_z = \underline{10,5\text{ kN}} \checkmark$$

$$V_{gf}^P = -F_z = \underline{-2\text{ kN}}$$

$$V_{fg}^P = -F_z = \underline{-2\text{ kN}}$$

$$V_{fe}^P = -F_z - R_{fz} = \underline{-1,5\text{ kN}}$$

$$V_{f-e}^P = -F_z - R_{fz} + q \cdot x = \underline{-1,5 + 2x}$$

$$V_{f-e}^P(x=0) = \underline{-1,5\text{ kN}} \checkmark$$

$$V_{f-e}^P(x=4) = V_{ef}^P = -1,5 + 2 \cdot 4 = \underline{6,5\text{ kN}}$$

$$V_{de}^L = \underline{0\text{ kN}} \quad V_{e-d}^L = -q \cdot x = \underline{-2x}$$

$$V_{ed}^L = V_{e-d}^L(x=2) = -2 \cdot 2 = \underline{-4\text{ kN}}$$

$$V_{de}^L = V_{e-d}^L(x=0) = -2 \cdot 0 = \underline{0\text{ kN}} \checkmark$$

$$V_{ab}^L = R_{az} = \underline{10,5\text{ kN}}$$

$$V_{ce}^L = -R_{ax} = \underline{-1\text{ kN}}$$

$$V_{ec}^L = -R_{ax} = \underline{-1\text{ kN}}$$

$$V_{ec}^P = -F_x = \underline{-1\text{ kN}} \checkmark$$

Momenty

$$M_{ab}^L = -M_a = \underline{-22 \text{ kNm}}$$

$$M_{ba}^L = -M_a + R_{az} \cdot 3 = \underline{9,5 \text{ kNm}}$$

$$M_{bc}^L = -M_a + R_{az} \cdot 3 - M = \underline{-10,5 \text{ kNm}}$$

$$M_{cb}^L = -M_a + R_{az} \cdot 4 - M = \underline{0 \text{ kNm}}$$

$$M_{fg}^P = 0$$

$$M_{fg}^P = F_z \cdot 2 = \underline{4 \text{ kNm}} + R_{fz} \cdot x$$

$$M_{f-e}^P = F_z \cdot (2+x) - q \frac{x^2}{2} = \underline{4 + 2x - x^2 - \frac{x}{2}}$$

$$M_{fe}^P = M_{f-e}^P(x=0) = \underline{4 \text{ kNm}}$$

$$M_{ef}^P = M_{f-e}^P(x=4) = 4 + 1,5 \cdot 4 - 4^2 = \underline{-6 \text{ kNm}}$$

$$M_{de}^L = \underline{0 \text{ kNm}}$$

$$M_{d-e}^L = -q \cdot x = -2x$$

$$M_{de}^L = M_{d-e}^L(x=0) = \underline{0 \text{ kNm}} \checkmark$$

$$M_{ed}^L = M_{d-e}^L(x=2) = -2 \cdot 2 = \underline{-4 \text{ kNm}}$$

$$M_{Qde}^L = (\text{bez } q) = \underline{0 \text{ kNm}} \quad (\text{vrchol tečnového polygonu})$$

$$M_{Qef}^P = (\text{bez } q) = F_z \cdot 4 + R_{fz} \cdot 2 = \underline{7 \text{ kNm}}$$

$$M_{max} = M_{f-e}^P(x=0,75) =$$

$$= 4 + 1,5 \cdot 0,75 - 0,75^2 = \underline{4,5625 \text{ kNm}}$$

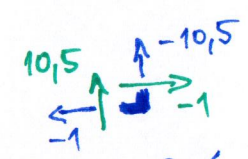
$$M_{ec}^P = R_{fz} \cdot 4 + F_z \cdot 6 - q \cdot 6 \cdot 1 = \underline{-2 \text{ kNm}}$$

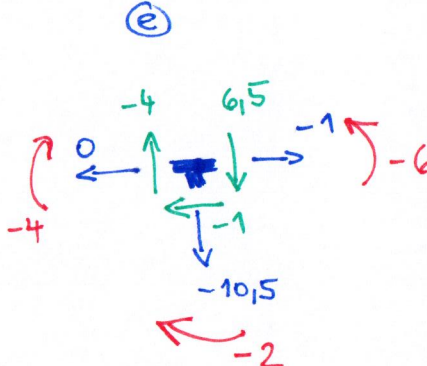
KONTROLA:

- úsečky v intervalech a-b a b-c v (M) jsou rovnoběžné $\Leftrightarrow \frac{dM}{dx} = V$ $V_{a-b} = 10,5$ a $V_{b-c} = -10,5$

- bod b osamělý moment $\Rightarrow$ skok v momentech

ROVNOVÁHA VE STYČNÍKU ©


$$\begin{aligned} \sum F_{xi} &= 0 \quad 1 - 1 = 0 \checkmark \\ \sum F_{zi} &= 0 \quad 10,5 - 10,5 = 0 \checkmark \end{aligned}$$


$$\begin{aligned} \sum F_{xi} &= 0 \quad \oplus \rightarrow \\ (-4) + (-1) + (-1) &= 0 \checkmark \\ \sum F_{zi} &= 0 \quad \oplus \uparrow \\ (-4) - 6,5 - (-10,5) &= 0 \checkmark \\ \sum M_{ei} &= 0 \quad \oplus \curvearrowright \\ -(-4) + (-6) - (-2) &= 0 \checkmark \end{aligned}$$

- sklon (H) na intervalu f-g

$$\frac{dM}{dx} = V_{f-g} = -2$$

- sklon tečen paraboly e-f (M)

↙ bod e je sklon 1: $V_{ef} = 1:6,5$
 ↘ bod f 1: $V_{fe} = 1:-1,5$

Pozor: v bodě (f) není posouvající síla definována

$$V_{fe} = -1,5 \quad \text{a} \quad V_{fd} = -2$$

⇒ parabola nenavazuje plynně

v bodě (f) na úsečku f-g

- sklon (V) d-f

$$\frac{dV}{dx} = -q = -2 \Rightarrow \text{úsečky na intervalech}$$

d-e a e-f jsou rovnoběžné

~~rozaměření~~

- osazené síly a momenty

↪ osová síla - nespojitosť ("skok") v (N)
 ↪ příčná síla v (V)
 ↪ moment v (M)

⇒ je třeba určit hodnotu těsně před

a těsně za bodem

např. M_{ba} a M_{bc}

V_{fe} a V_{fg}

N_{ed} , N_{ef} , N_{ec}

integrace:

$$M_{max}^P = M_f \overset{\text{zprava}}{\ominus} \int_f^x V_{f-x} dx = 4 - \frac{1}{2} (-1,5) \cdot x = \underline{4,5625 \text{ kNm}}$$

$$M_{max}^L = M_{ef} \overset{\text{zleva}}{\oplus} \int_e^x V_{e-x} dx = -6 + \frac{1}{2} 6,5 \cdot (4-x) = \underline{4,5625 \text{ kNm}}$$

$$M_{ba}^+ = M_a + \int_a^b V_{a-b} dx = -22 + 10,5 \cdot 3 = \underline{9,5 \text{ kNm}}$$

$$M_{be}^- = M_a + \int_a^b V_{a-b} dx + M = -22 + 10,5 \cdot 3 - 20 = \underline{-10,5 \text{ kNm}}$$

$$M_{bc}^P = M_c - \int_b^c V_{b-c} dx = 0 - 10,5 \cdot 1 = \underline{-10,5 \text{ kNm}}$$

$$M_f^P = M_g - \int_f^g V_{f-g} dx = 0 - (-2) \cdot 2 = \underline{4 \text{ kNm}}$$