

ZÁKLADY STAVEBNÍ MECHANIKY

BDA001

Rovinné pravoúhle lomené nosníky a konzoly, výpočet reakcí ve vazbách,
diagramy vnitřních sil.

Zdeněk Kala

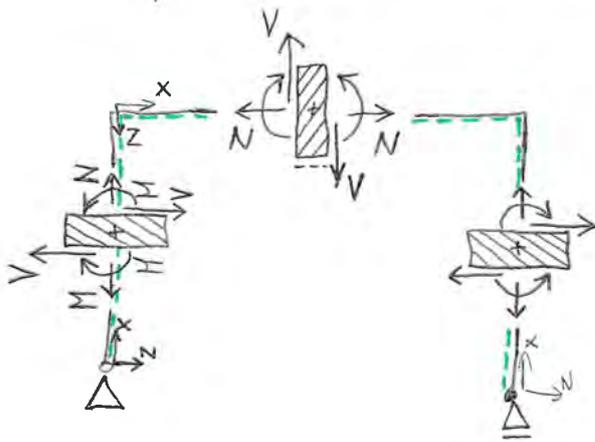
Rovinný rám



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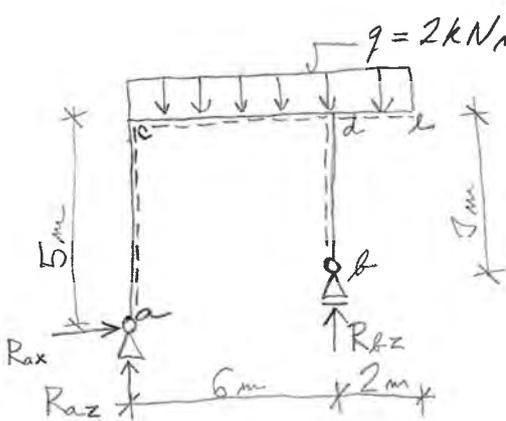


Jednoduchý rovinný lomený nosník pravoúhlý



- spodní částka ... rozvineme nosník do úsečky. U slábičejších nosníků volíme libovolně.

Příklad: Máte prvek ovládnutí sil na nosníku.



- reakce

$$\sum M_a = 0$$

$$-2 \cdot 8 \cdot 4 + R_{bz} \cdot 6 = 0 \Rightarrow R_{bz} = 10,6 \text{ kN} \approx 10,67 \text{ kN}$$

$$\sum F_y = 0$$

$$2 \cdot 8 = R_{az} + R_{bz} \Rightarrow R_{az} = 5,33 \text{ kN}$$

$$\sum F_x = 0 \Rightarrow R_{ax} = 0$$

N $N_{ac} = -R_{az}$
 $N_{cd} = R_{ax} = 0$

$N_{de} = 0$
 $-N_{bd} = R_{bz} = 10,67 \text{ kN}$

V $V_{ac} = R_{ax} = 0$
 $V_{cd} = R_{az} - 2 \cdot x$

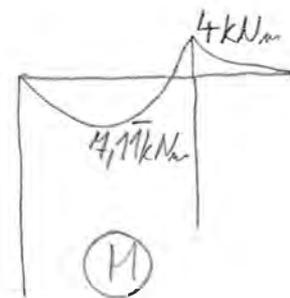
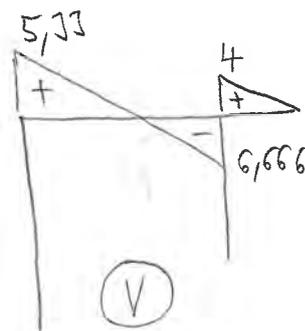
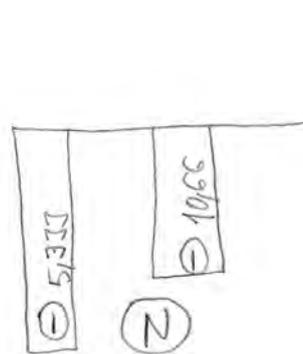
$V_{de} = R_{az} - 2 \cdot 6 + R_{bz} - 2 \cdot x$

$V_{bd} = 0$

M $M_{ac} = 0$
 $M_{cd} = R_{az} \cdot x - 2 \cdot \frac{x^2}{2}$

$M_{ed} = -2 \cdot \frac{x^2}{2}$

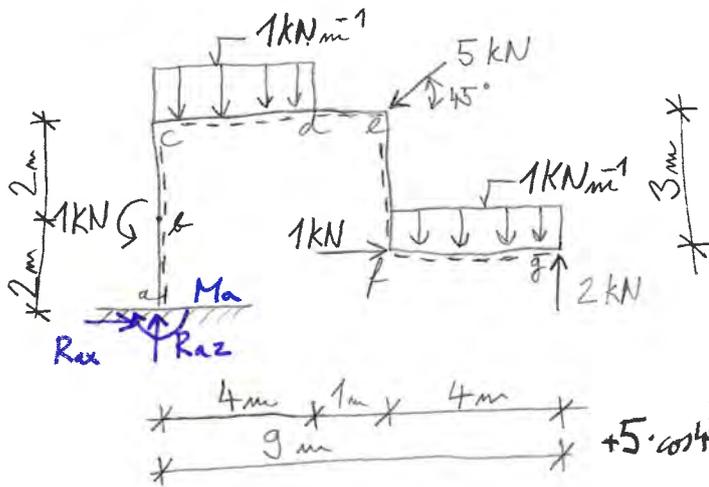
$M_{bd} = 0$



$$M_{\max} = 5,3 \cdot 2,6 - 2 \cdot 2,6^2 = 7,11 \text{ kNm}$$

$$x = \frac{5,33}{2} = 2,66 \text{ m}$$

Prüfung: Skizze N, V, M



$$\sum F_z = 0$$

$$1.4 + 5 \cdot \cos 45^\circ + 1.4 - 2 - R_{az} = 0$$

$$R_{az} = 9,535 \text{ kN}$$

$$\sum M_a = 0$$

$$2 \cdot 9 - 1.4 \cdot 4 - 1.1 - 5 \cdot \sin 45^\circ \cdot 5 +$$

$$+ 5 \cdot \cos 45^\circ \cdot 4 - 1.4 \cdot 2 + 1 - M_a = 0$$

$$M_a = -21,536 \text{ kNm}$$

$$\sum F_x = 0$$

$$R_{ax} + 1 - 5 \cdot \cos 45^\circ = 0$$

$$R_{ax} = 2,5355 \text{ kNm}$$

$$N_{ab} = N_{bc} = -R_{az} = -9,535 \text{ kN}$$

$$N_{cd} = N_{de} = -R_{ax} = -2,5355 \text{ kN}$$

$$N_{ef} = 1.4 - 2 = 2 \text{ kN} \quad N_{fg} = 0$$

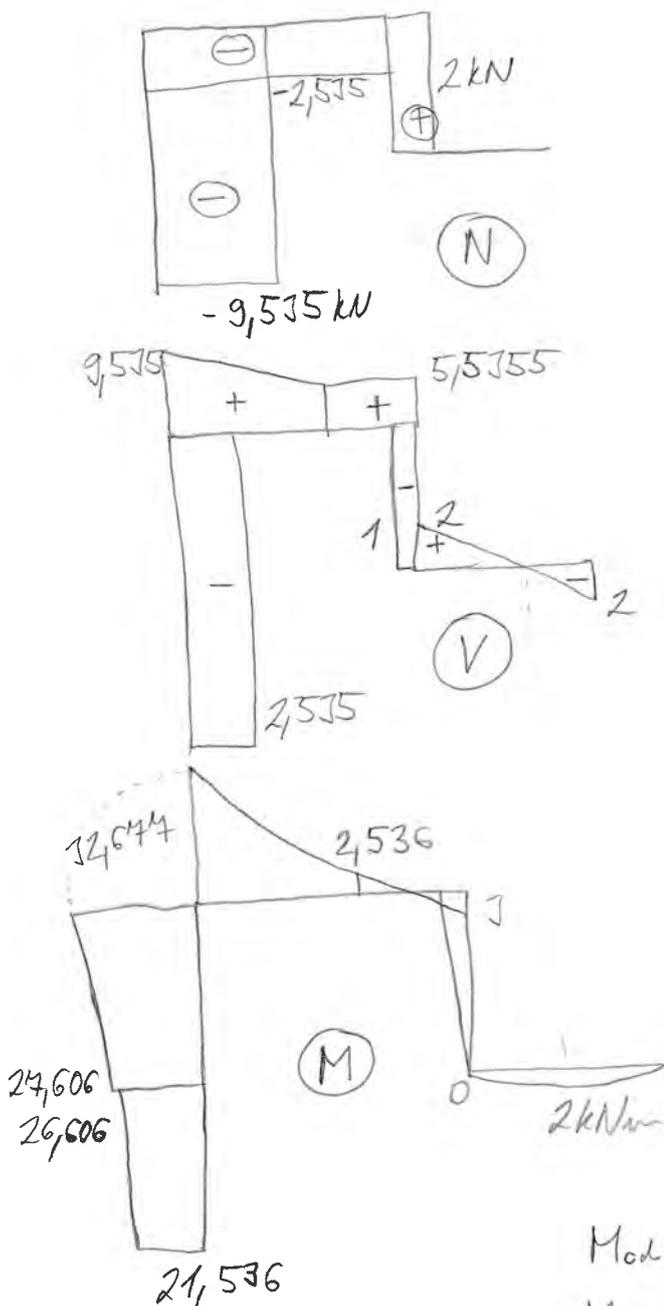
$$V_{ab} = V_{bc} = -R_{ax} = -2,535 \text{ kN}$$

$$V_{cd} = R_{az} - 1 \cdot x$$

$$V_{de} = R_{az} - 1.4 = 5,535 \text{ kN}$$

$$V_{ef} = -1 \text{ kN (Kipava)}$$

$$V_{fg} = V_{de} - 5 \cdot \sin 45^\circ - 1 \cdot x$$



$$M_b^1 = M_a - R_{ax} \cdot 2 \text{ m} = -26,607 \text{ kNm}$$

$$M_b^2 = M_a - R_{ax} \cdot 2 - 1 = -27,607 \text{ kNm}$$

$$M_c = M_a - R_{ax} \cdot 4 - 1 = -32,678 \text{ kNm}$$

$$M_{cd} = M_a - R_{ax} \cdot 4 - 1 + R_{az} \cdot x - 1 \cdot \frac{x^2}{2}$$

$$M_d = M_a - R_{ax} \cdot 4 - 1 + R_{az} \cdot x - 1.4(x-2)$$

$$M_e = M_a - R_{ax} \cdot 4 - 1 + 9,53 \cdot 5 - 1.4 \cdot 3 = 3 \text{ kNm}$$

$$M_f = 2 \cdot 4 - 1.4 \cdot 2 = 0 \text{ (Kipava)}$$