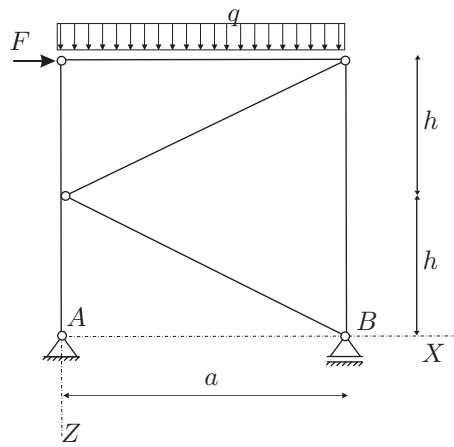


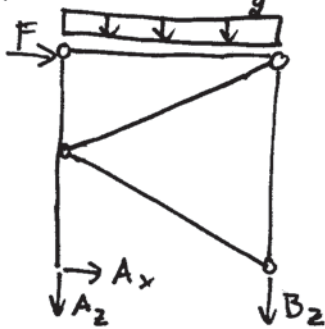
Za konstrukcijo na sliki izračunajte stopnjo
statične nedoločnosti, reakcije in notranje
statične količine (N_x , N_z , M_y)! Rezultate no-
tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 4$ m, $h = 3$ m,
 $q = 10$ kN/m, $F = 5$ kN,.



a.) $\tilde{m}_{PS} = 3 \cdot 5 - 2 - 1 - 2 \cdot 2 - 2 \cdot 4 = 0$

b.) REAKCIJE

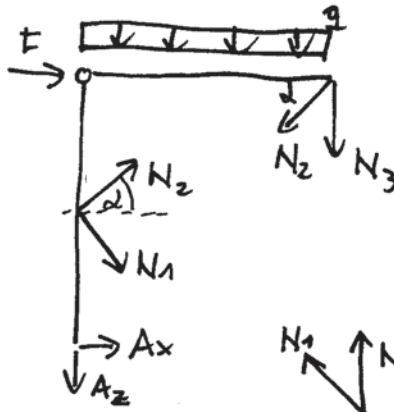


$A_x = -F$ $A_x = -5 \text{ kN}$

$A_z + B_z = -q \cdot a$ $A_z = -12.5 \text{ kN}$

$-B_z \cdot a - q \cdot a \cdot \frac{a}{2} - F \cdot 2h = 0$ $B_z = -27.5 \text{ kN}$

+ IZREZ PALIC



$N_1 = 0$

$N_3 = -27.5 \text{ kN}$

$A_x \cdot 2h + N_2 \cdot \cos \alpha \cdot h = 0$

$N_2 = -\frac{2A_x}{\cos \alpha}$

$\tan \alpha = \frac{3}{4}$
 $\cos \alpha = \frac{4}{5}$
 $\sin \alpha = \frac{3}{5}$

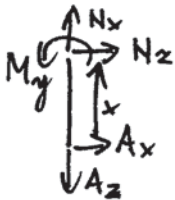
$N_2 = 12.5 \text{ kN}$

KONTROLA

$-N_3 \cdot a - N_2 \cdot \sin \alpha \cdot a - q \cdot a \cdot \frac{a}{2} = 0$

$27.5 - 12.5 \cdot \frac{3}{5} - 10 \cdot 2 = 0 \checkmark$

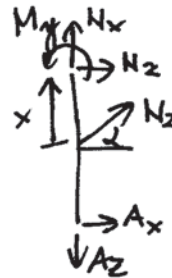
c.) NOTRANJE SILE



$N_x = -12.5 \text{ kN}$

$N_z = -A_x$ $N_z = 5 \text{ kN}$

$M_y = -A_x x$ $M_y = 5x$



$N_x = -12.5 - N_2 \cdot \sin \alpha$
 $= -12.5 - 12.5 \cdot \frac{3}{5}$

$N_x = -20 \text{ kN}$

$N_z = -A_x - N_2 \cdot \cos \alpha$
 $= 5 - 12.5 \cdot \frac{4}{5}$

$N_z = -5 \text{ kN}$

$M_y = -A_x(x+h) - N_2 \cdot \cos \alpha \cdot x$

$M_y = 15 - 5x$

$N_x = -N_2 \cdot \cos \alpha$

$N_x = -10 \text{ kN}$

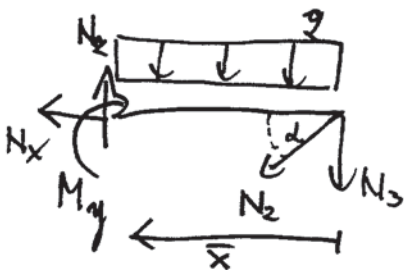
$N_z = N_2 \cdot \sin \alpha + N_3 + q \cdot \bar{x} = -20 + 10\bar{x}$

$N_z = -20 + 10\bar{x}$

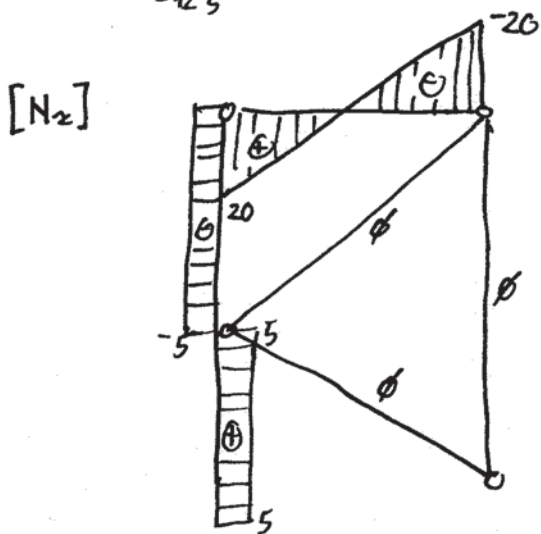
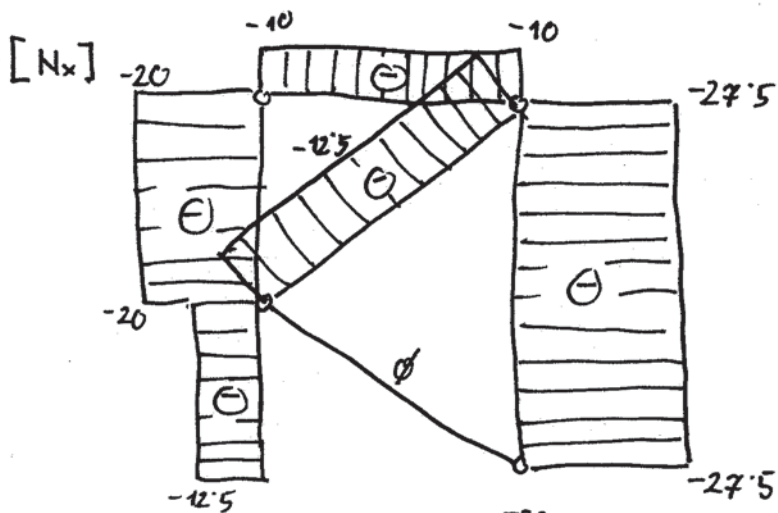
$M_y = 20\bar{x} - 5\bar{x}^2$

$M_y = 20\bar{x} - 5\bar{x}^2$

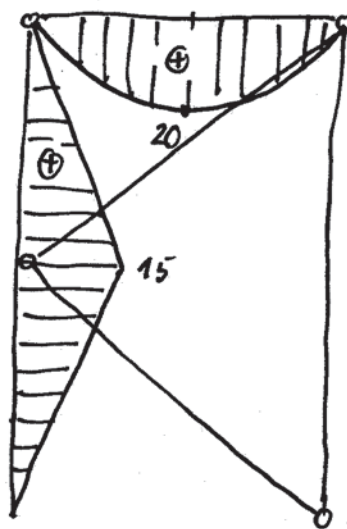
$M_y(2) = 20 \text{ kNm}$



d.) DIAGRAMI

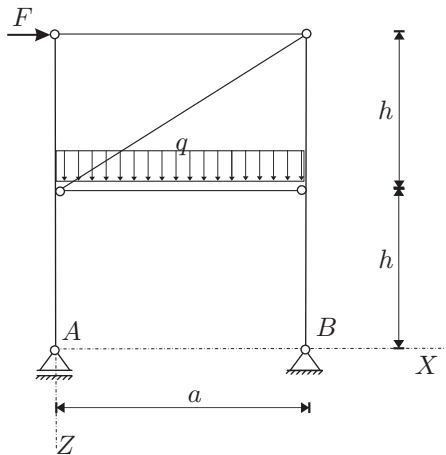


$[M_y]$



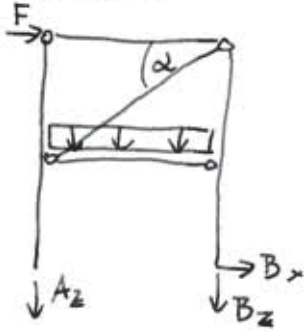
Za konstrukcijo na sliki izračunajte stopnjo
statične nedoločenosti, reakcije in notranje
statične količine (N_x , N_z , M_y)! Rezultate no-
tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 4$ m, $h = 2.5$ m,
 $q = 4$ kN/m, $F = 10$ kN,.



a.) $\tilde{n}_{ps} = 3 \cdot 5 - 1 \cdot 2 - 2 \cdot 2 - 2 \cdot 4 = 0$

b.) REAKCIJE



$$\sum X: B_x + F = 0 \quad \boxed{B_x = -10 \text{ kN}}$$

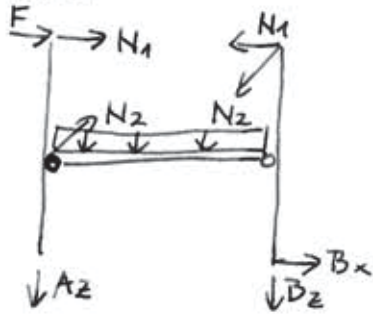
$$\sum Z: A_z + B_z + g \cdot a = 0$$

$$\sum M^D: A_z \cdot a + g \cdot a \cdot \frac{a}{2} - F \cdot 2h = 0$$

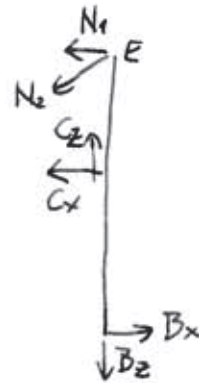
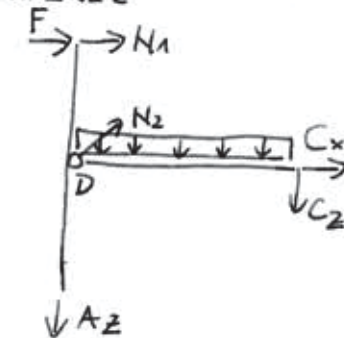
$$\boxed{A_z = 4.5 \text{ kN}}$$

$$\boxed{B_z = -20.5 \text{ kN}}$$

c.) SILE V PALICAH



IN RAZREZ



$$\sum M_{CD}^D: -C_z \cdot a - g \cdot a \cdot \frac{a}{2} = 0$$

$$C_z = -g \cdot \frac{a}{2}$$

$$\boxed{C_z = -8 \text{ kN}}$$

$$\sum M_{BE}^E: B_x \cdot h \cdot 2 - C_x \cdot h = 0$$

$$\boxed{C_x = -20 \text{ kN}}$$

$$\sum Z_{BE}: N_2 \cdot \sin \alpha - C_z + B_z = 0$$

$$\tan \alpha = \frac{h}{a} = \frac{2.5}{4}$$

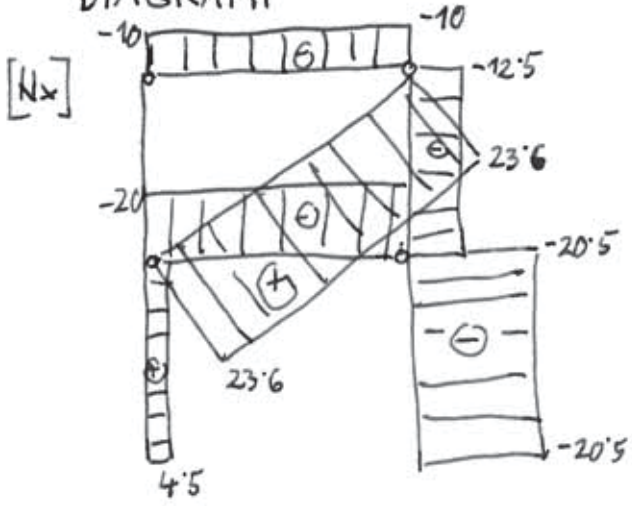
$$\alpha = 32^\circ$$

$$\boxed{N_2 = 24 \text{ kN}}$$

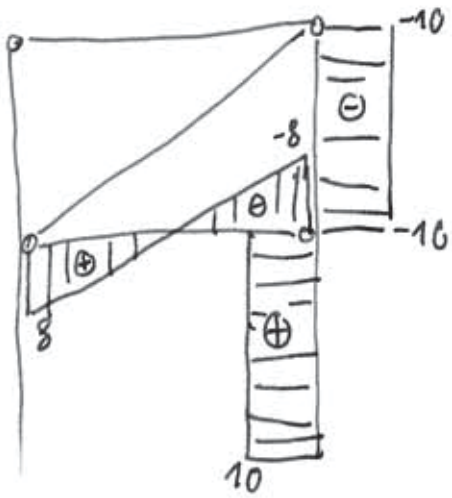
$$\sum X_{BE}: N_1 + N_2 \cdot \cos \alpha + C_x - B_x = 0$$

$$\boxed{N_1 = -10 \text{ kN}}$$

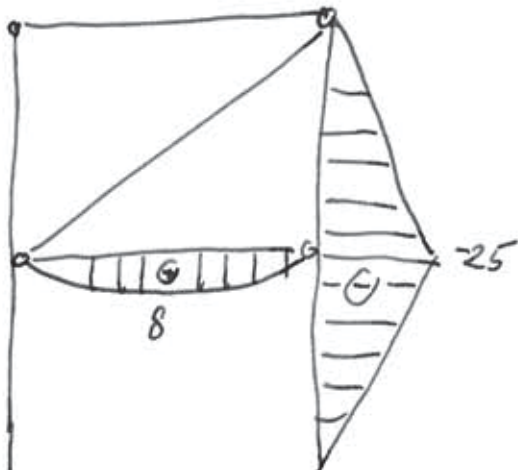
DIAGRAMI



$[N_z]$

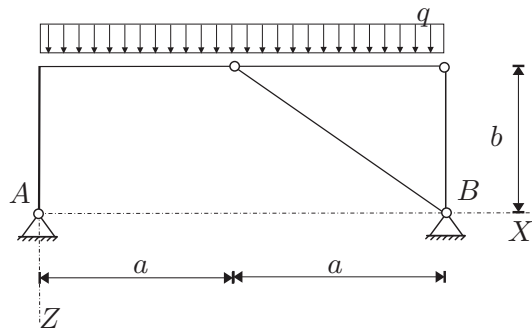


$[M_y]$



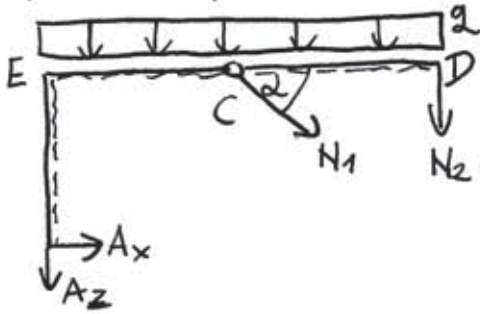
Za konstrukcijo na sliki izračunajte stopnjo
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tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 4$ m, $b = 3$ m,
 $q = 10$ kN/m.



$$a.) \hat{m}_{PS} = 4 \cdot 3 - 2 \cdot 2 - 2 \cdot 2 - 4 = 0$$

b.) REAKCIJE IN PALICE



$$\sum X: A_x + N_1 \cdot \cos \alpha = 0$$

$$\sum Z: A_z + N_1 \sin \alpha + N_2 + q \cdot 2a = 0$$

$$\sum M^A: -q \cdot 2a \cdot a - N_2 \cdot 2a - N_1 \sin \alpha \cdot a - N_1 \cos \alpha \cdot b = 0$$

$$\sum M^C: -N_2 \cdot a - q \cdot a \cdot \frac{a}{2} = 0$$

$$N_2 = -\frac{q \cdot a}{2}$$

$$N_2 = -20 \text{ kN}$$

$$e = \sqrt{a^2 + b^2} = 5 \text{ m}$$

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

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

$$N_1 (a \sin \alpha + b \cos \alpha) = -q \cdot 2a^2 - N_2 \cdot 2a$$

$$N_1 = -\frac{10 \cdot 2 \cdot 16 - 20 \cdot 2 \cdot 4}{4 \cdot \frac{3}{5} + 3 \cdot \frac{4}{5}} = -\frac{20 \cdot 16 - 10 \cdot 16}{2 \cdot \frac{12}{5}}$$

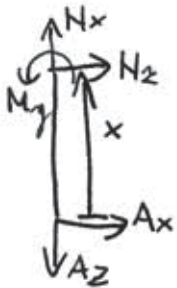
$$= -\frac{10 \cdot 16 \cdot 5 \cdot 5 \cdot 4}{2 \cdot 12 \cdot 3} = -\frac{100}{3} = -33.3 \text{ kN}$$

$$A_x = +\frac{100}{3} \cdot \frac{4}{5} = \frac{80}{3} = 26.67 \text{ kN}$$

$$A_z = \frac{100}{3} \cdot \frac{3}{5} + 20 - 10 \cdot 2 \cdot 4 = -40 \text{ kN}$$

c.) NOTRANJE SILE

polje AE $x \in [0, 3]$



$$N_x = A_z$$

$$N_x = -40 \text{ kN}$$

$$N_z = -A_x$$

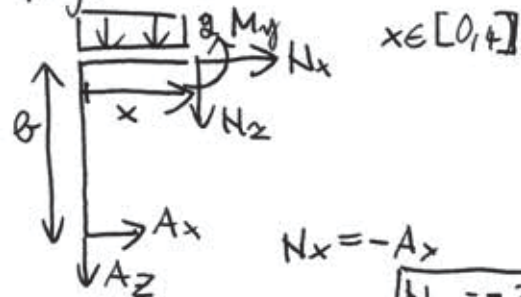
$$N_z = -26.7 \text{ kN}$$

$$M_y = -A_x \cdot x$$

$$M_y = -\frac{80}{3} x$$

$$M_y(0) = 0 \quad M_y(3) = -80 \text{ kNm}$$

polje EC



$$N_x = -A_x$$

$$N_x = -26.7 \text{ kN}$$

$$N_z = -A_z - q \cdot x$$

$$N_z = 40 - 10x$$

$$N_z(0) = 40 \text{ kN} \quad N_z(4) = 0$$

$$M_y = -A_x \cdot b - A_z \cdot x - q \cdot x \cdot \frac{x}{2}$$

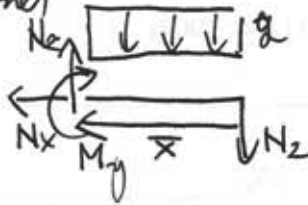
$$M_y = -80 + 40x - 5x^2$$

$$M_y(0) = -80 \text{ kNm}$$

$$M_y(4) = 0 \text{ (elastrom!)}$$

polje CD (z desne)

$$\bar{x} \in [0, 4]$$



$$N_x = 0$$

$$N_z = N_z + g \bar{x}$$

$$N_z = -20 + 10 \bar{x}$$

$$N_z(0) = -20 \text{ kN} \quad N_z(4) = 20 \text{ kN}$$

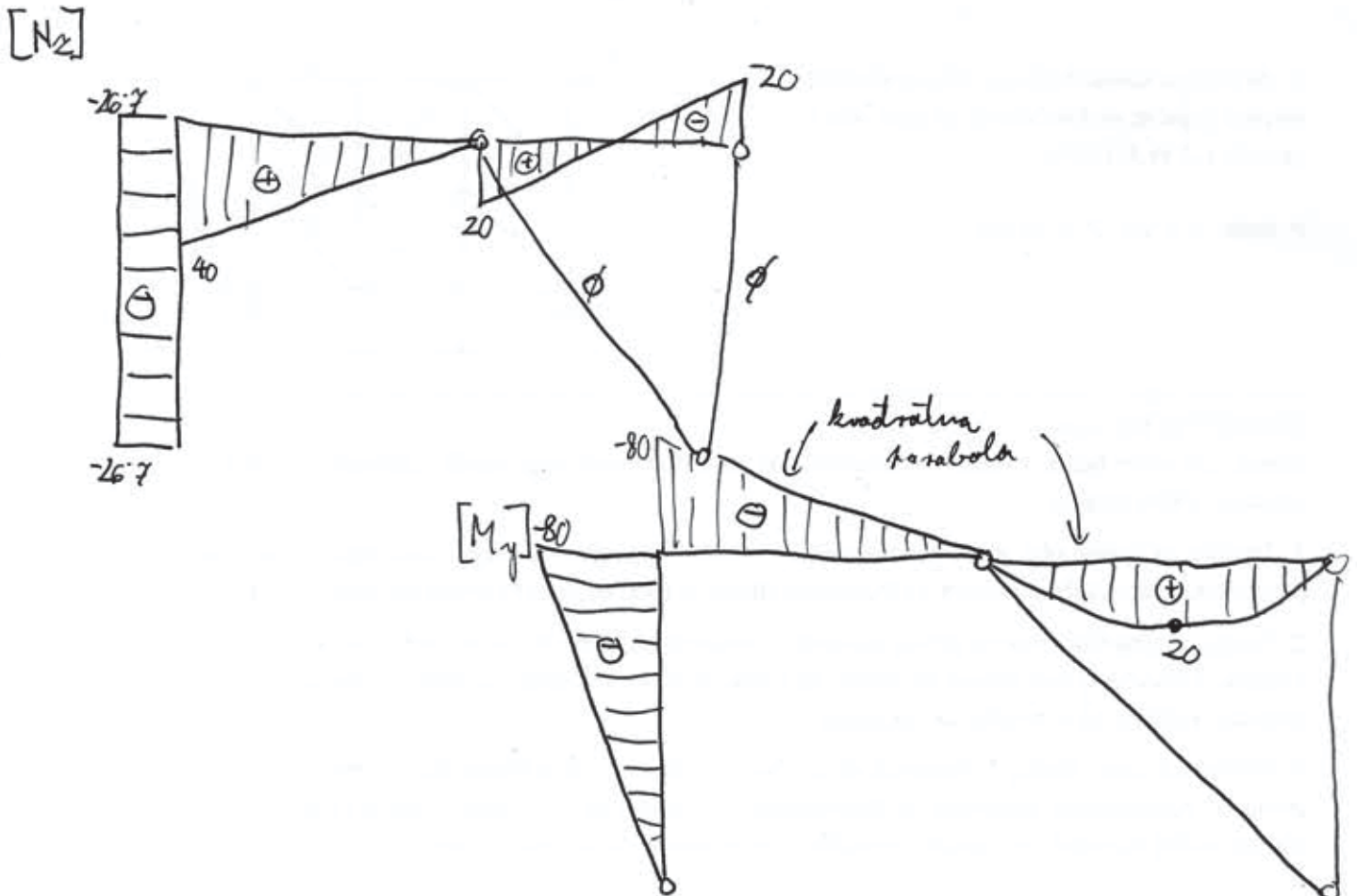
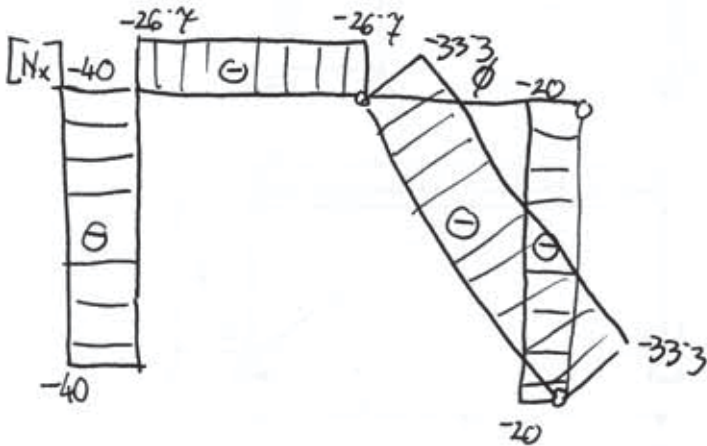
$$M_y = -N_z \cdot \bar{x} - g \bar{x} \frac{\bar{x}}{2}$$

$$M_y = +20 \bar{x} - 5 \bar{x}^2$$

$$M_y(0) = 0 \quad M_y(4) = 0$$

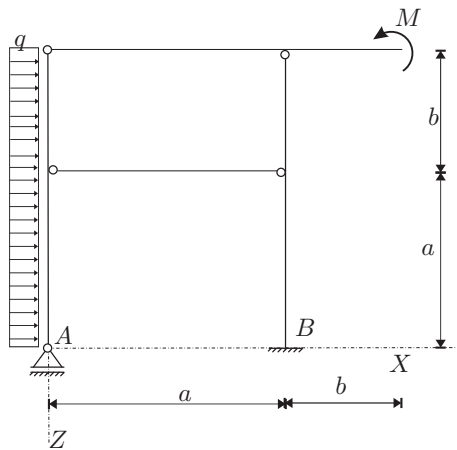
$$M_y(2) = 20 \text{ kNm (ekstrem)}$$

d.) DIAGRAMI



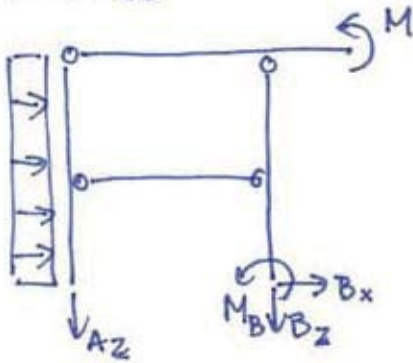
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x , N_z , M_y)! Rezultate notranjih statičnih količin prikažite z diagrami! (OBVEZNA NALOGA! 50%)

$$q = 5 \text{ kN/m}, M = 10 \text{ kNm}.$$



a.) $\tilde{m}_{PB} = 4 \cdot 3 - 4 \cdot 2 - 3 \cdot -1 = 0$

b.) REAKCIJE

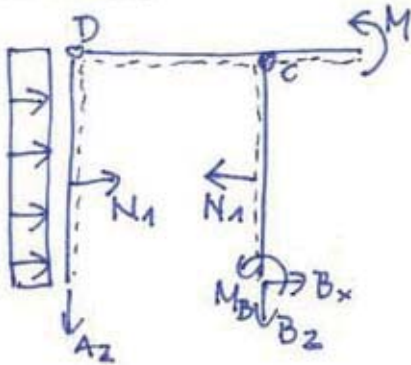


$$\sum X \quad B_x = -q(a+b) \quad \boxed{B_x = -25 \text{ kN}}$$

$$\sum Z: \quad A_z + B_z = 0$$

$$\sum M^A: \quad M_B - B_z \cdot a + M - q \cdot (a+b) \frac{a+b}{2} = 0$$

c.) RAZREZ



$$\sum M_{AD}^D \quad N_1 \cdot b + q(a+b) \left(\frac{a+b}{2} \right) = 0$$

$$N_1 = - \frac{5 \cdot 5 \cdot 5}{2 \cdot 2} = - \frac{125}{4}$$

$$\boxed{N_1 = -31.25 \text{ kN}}$$

$$\sum M_{BC}^C \quad -N_1 \cdot b + B_x(a+b) + M_D = 0$$

$$M_B = - \frac{125}{4} \cdot 2 + 25 \cdot 5$$

$$\boxed{M_B = \frac{125}{2} = 62.5 \text{ kNm}}$$

$$B_z = \frac{1}{3} \left(\frac{125}{2} + 10 - 5 \cdot 5 \cdot \frac{5}{2} \right)$$

$$\boxed{B_z = \frac{10}{3} = 3.3 \text{ kN}}$$

$$\boxed{A_z = -3.3 \text{ kN}}$$

d.) NOTRANJE SILE PO POLJH

POLJE $A N_1 \quad x \in [0, a]$



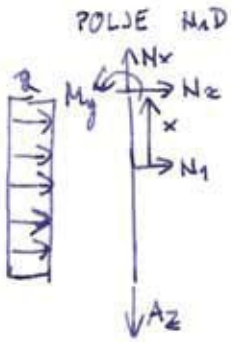
$$N_x = A_z \quad \boxed{N_x = -3.3 \text{ kN}}$$

$$\boxed{N_z = -qx} \quad N_z(0) = 0$$

$$N_z(3) = -15 \text{ kN}$$

$$\boxed{M_y = -q \frac{x^2}{2}} \quad M_y(0) = 0$$

$$M_y(3) = -22.5 \text{ kNm}$$



$$x \in [0, 2]$$

$$N_x = -3.3 \text{ kN}$$

$$N_z = -H_1 - q \cdot a - q \cdot x$$

$$N_z = 16.25 - 5x$$

$$N_z(0) = 16.25 \text{ kN} \quad N_z(2) = 6.25 \text{ kN}$$

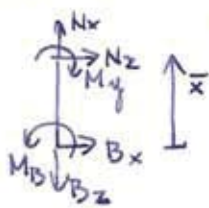
$$M_y = -N_1 \cdot x - q \cdot \frac{(a+x)^2}{2}$$

$$M_y = -22.5 + 16.25x - \frac{5}{2}x^2$$

$$M_y(0) = -22.5 \text{ kNm}$$

$$M_y(2) = 0$$

POLJE BN1 (z desne)



$$\bar{x} \in [0, 3]$$

$$N_x = B_z$$

$$N_x = 3.3 \text{ kN}$$

$$N_z = -B_x$$

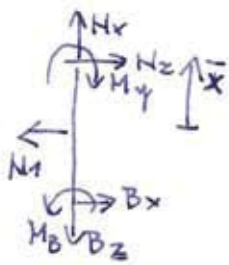
$$N_z = 25 \text{ kN}$$

$$M_y = M_b + B_x \bar{x}$$

$$M_y = 62.5 - 25\bar{x}$$

$$M_y(3) = -12.5 \text{ kNm}$$

POLJE N1C (z desne)



$$\bar{x} \in [0, 2]$$

$$N_x = B_z$$

$$N_x = 3.3 \text{ kN}$$

$$N_z = N_1 - B_x$$

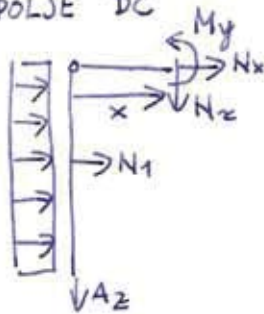
$$N_z = -6.25 \text{ kN}$$

$$M_y = M_b + B_x(a + \bar{x}) - N_1 \bar{x}$$

$$M_y = -12.5 + 6.25\bar{x}$$

$$M_y(2) = 0 \checkmark$$

POLJE DC



$$N_x + N_1 + q(a+b) = 0$$

$$N_x = 6.25 \text{ kN}$$

$$N_z + A_z = 0$$

$$N_z = +3.3 \text{ kN}$$

$$M_y + A_z \cdot x + N_1 \cdot b + q \cdot \frac{(a+b)^2}{2} = 0$$

$$M_y = +\frac{10}{3}x$$

$$M_y(3) = 10 \text{ kNm}$$

POLJE MC (z desne)



$$N_x = 0$$

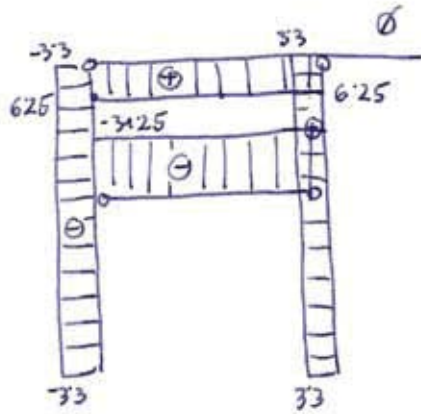
$$N_z = 0$$

$$M_y = M$$

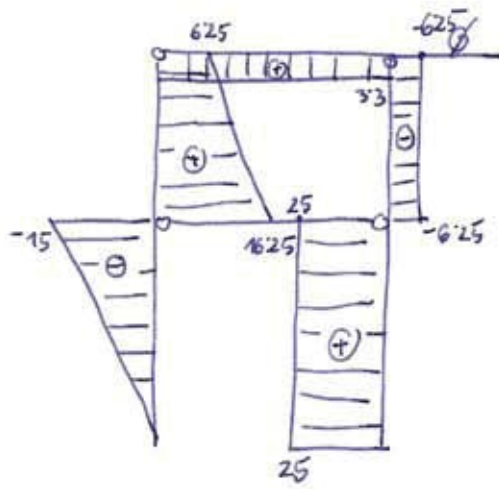
$$M_y = 10 \text{ kNm}$$

e.) DIAGRAMI

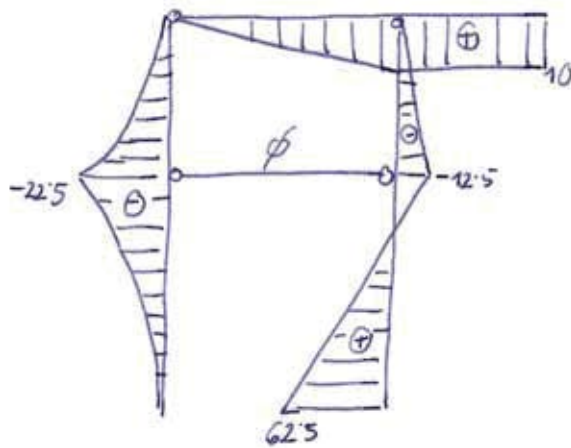
[N_x]



[N_z]

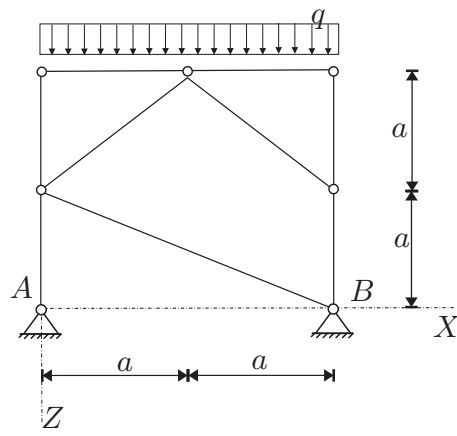


[M_y]



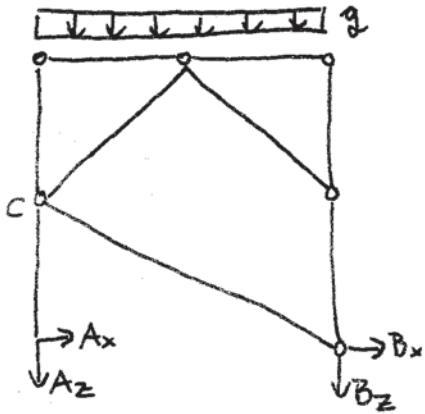
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tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 2.5$ m, $q = 4$ kN/m.



a.) $\tilde{m}_{PS} = 8 \cdot 3 - 2 \cdot 2 - 3 \cdot 2 - 2 \cdot 4 - 6 = 0$

b.) REAKCIJE



$\Sigma x: A_x + B_x = 0$

$\Sigma z: A_z + B_z + g \cdot 2a = 0$

$\Sigma M^A: -g \cdot 2a \cdot a - B_z \cdot 2a = 0$

$A_z = -10 \text{ kN}$

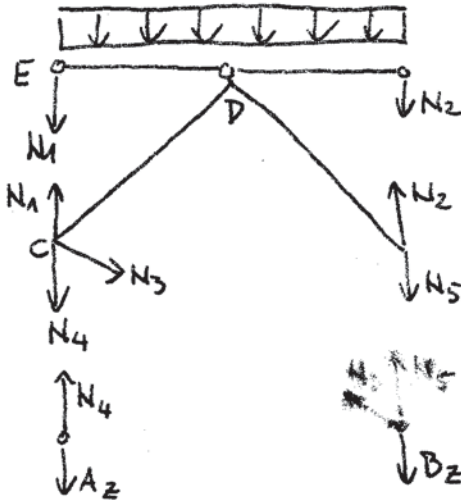
$B_z = -10 \text{ kN}$

DODATNA

$\Sigma M^C: A_x \cdot a = 0$

$A_x = 0$
 $B_x = 0$

c.) PALICE



$N_4 = A_z$

$N_4 = -10 \text{ kN}$

$N_5 = B_z = -10 \text{ kN}$

$N_3 = 0$

$N_1 \cdot a + g \cdot a \cdot \frac{a}{2} = 0$

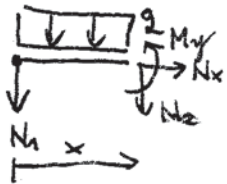
$N_1 = -5 \text{ kN}$

$-N_2 \cdot a - g \cdot a \cdot \frac{a}{2} = 0$

$N_2 = -5 \text{ kN}$

d.) NOTRANJE SILE (ZARADI SIMETRIJE LE ZA POLOVICU)

POLJE ED



$x \in [0, 2.5]$

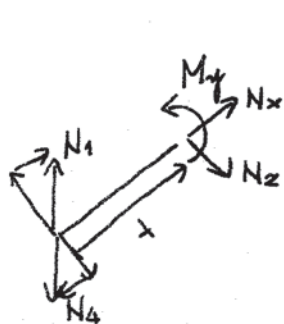
$\Sigma x: N_x = 0$

$\Sigma z: N_z = -g \cdot x - N_1 \quad N_z(0) = 5 \text{ kN} \quad N_z(2.5) = -5 \text{ kN}$

$\Sigma M: M_y = -g \cdot \frac{x^2}{2} - N_1 \cdot x \quad M_y(0) = M_y(2.5) = 0$

$M_y(1.25) = 3.125 \text{ (ekstrem)}$

POLJE CD



$\Sigma x: N_x - N_4 \cdot \frac{\sqrt{2}}{2} + N_1 \cdot \frac{\sqrt{2}}{2} = 0$

$\Sigma z: N_z + N_4 \cdot \frac{\sqrt{2}}{2} - N_1 \cdot \frac{\sqrt{2}}{2} = 0$

$\Sigma M: M_y + (N_4 - N_1) \cdot x \cdot \frac{\sqrt{2}}{2} = 0$

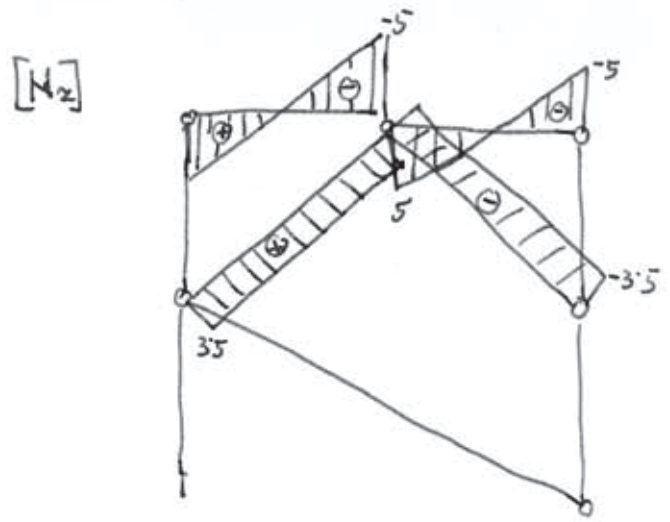
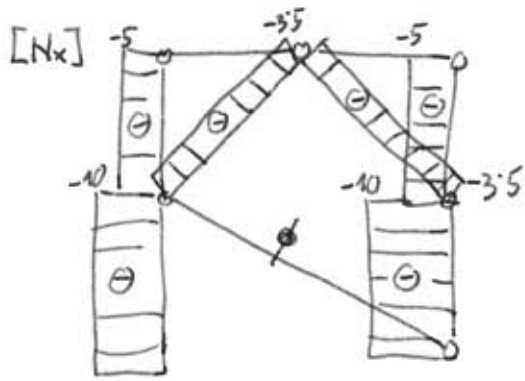
$N_x = -3.5 \text{ kN}$

$N_z = 3.5 \text{ kN}$

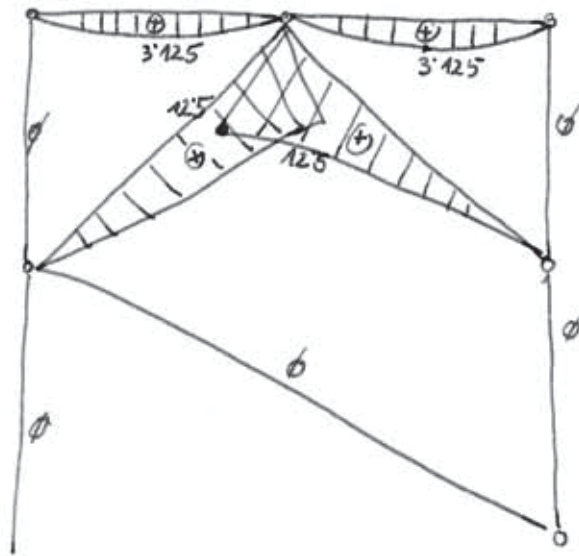
$M_y = 3.5 \cdot x$

$M_y(2.5 \cdot \sqrt{2}) = 12.5 \text{ kNm}$

e.) DIAGRAM 1

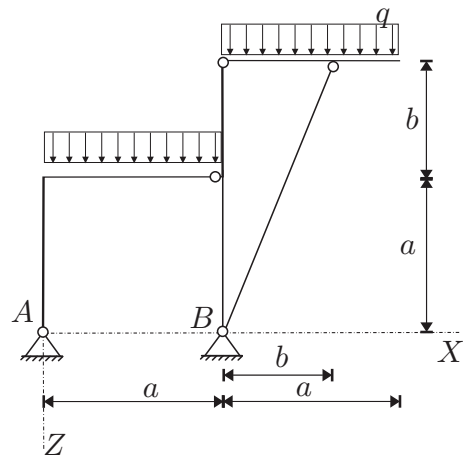


$[M_y]$



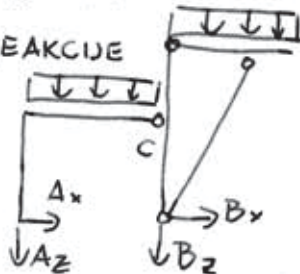
Za konstrukcijo na sliki izračunajte stopnjo
statične nedoločenosti, reakcije in notranje
statične količine (N_x , N_z , M_y)! Rezultate no-
tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 3\text{ m}$, $b = 2\text{ m}$,
 $q = 6\text{ kN/m}$.



a.) $\tilde{n}_{PS} = 4 \cdot 3 - 4 \cdot 2 - 2 \cdot 2 = 0$

b.) REAKCIJE



$$\begin{aligned} \sum X: A_x + B_x &= 0 \\ \sum Z: A_z + B_z + q \cdot 2a &= 0 \\ \sum M^A: -B_z \cdot x - q \cdot 2a \cdot a &= 0 \end{aligned}$$

$B_z = -36 \text{ kN} \quad A_z = 0$

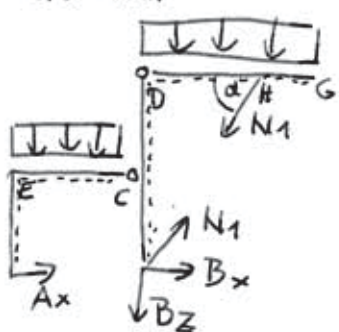
dodatno:

$$\sum M_{AC}^C: A_x \cdot x + A_z \cdot a + q \cdot a \cdot \frac{a}{2} = 0$$

$A_x = -2 \cdot \frac{a}{2}$

$A_x = -9 \text{ kN}$
 $B_x = 9 \text{ kN}$

c.) SILA V PALICI



$l_{palice} = \sqrt{25+9} = \sqrt{34}$

$tg \alpha = \frac{a+a}{a}$

$$\sum M^D: -N_1 \cdot \sin \alpha \cdot b - q \cdot a \cdot \frac{a}{2} = 0$$

zgoraj desno

$\alpha = 68.2^\circ$

$N_1 = -14.5 \text{ kN}$

d. NOTRANJE SILE PO POLJIH

POLJE AE

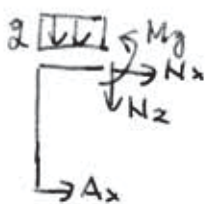


$N_x = 0$

$N_z = -A_x \quad N_z = 9 \text{ kN}$

$M_y = -A_x \cdot x \quad M_y = 9x \quad M_y(3) = 27 \text{ kNm}$

POLJE AC

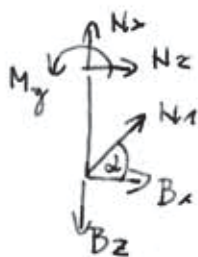


$N_x = -A_x \quad N_x = 9 \text{ kN}$

$N_z = -qx \quad N_z = -6x \quad N_z(3) = -18 \text{ kN}$

$M_y = -A_x \cdot a - q \cdot x \cdot \frac{x}{2} \quad M_y = 27 - 3x^2 \quad M_y(3) = 0 \checkmark \text{ (členek)}$

POLJE BC



$N_x = B_z - N_1 \cdot \sin \alpha \quad N_x = -22.5 \text{ kN}$

$N_z = -B_x - N_1 \cdot \cos \alpha \quad N_z = -3.6 \text{ kN}$

$M_y = -B_x \cdot x - N_1 \cdot x \cdot \cos \alpha \quad M_y = -3.6x \quad M_y(3) = -10.8 \text{ kNm}$

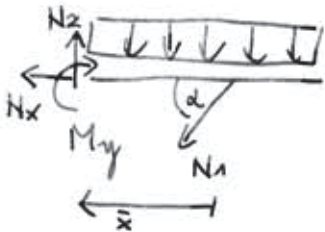
POLJE GH (z desne)



$N_x = 0$
$N_z = +g\bar{x}$
$M_y = -g \frac{\bar{x}^2}{2}$

$N_z(1) = +6 \text{ kN}$
 $M_y(1) = -3 \text{ kNm}$

POLJE HD (z desne)



$N_x = -N_1 \cdot \cos \alpha$
 $N_z = N_1 \cdot \sin \alpha + g\bar{x} + g \cdot 1$
 $M_y = -N_1 \cdot \sin \alpha \cdot \bar{x} - g \frac{(\bar{x}+1)^2}{2}$

$N_x = 5.4 \text{ kN}$

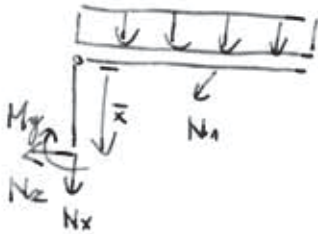
$N_z = -7.5 + 6\bar{x}$ $N_z(2) = 5.4$
 $-7.5 + 6\bar{x} = 0$
 $\bar{x} = \frac{7.5}{6}$

$M_y = +13.5\bar{x} - 3(\bar{x}^2 + 2\bar{x} + 1)$

$M_y = -3\bar{x}^2 + 7.5\bar{x} - 3$ $M_y(2) = 0$

$M_y(\frac{7.5}{6}) = 1.7 \text{ kNm}$
 (ekstrem)

POLJE CD (z desne)



$N_x = -N_1 \sin \alpha - g \cdot a$
 $N_z = -N_1 \cos \alpha$
 $M_y = -g \cdot a \cdot \frac{a}{2} - N_1 \sin \alpha \cdot b + N_1 \cos \alpha \cdot \bar{x}$

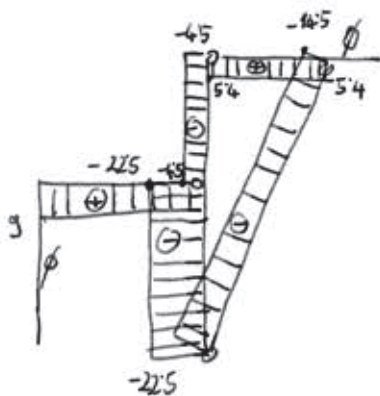
$N_x = -4.5 \text{ kN}$

$N_z = 5.4 \text{ kN}$

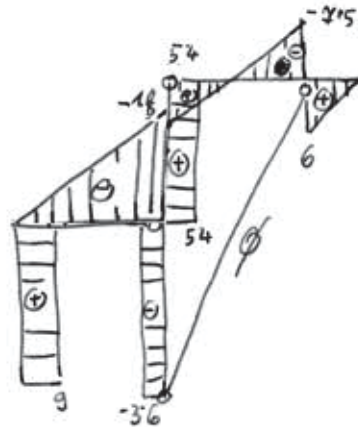
$M_y(2) = -10.8 \text{ kNm}$

e.) DIAGRAMI

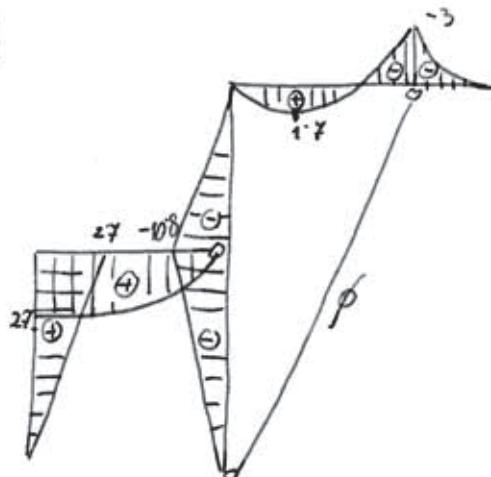
$[N_x]$



$[N_z]$

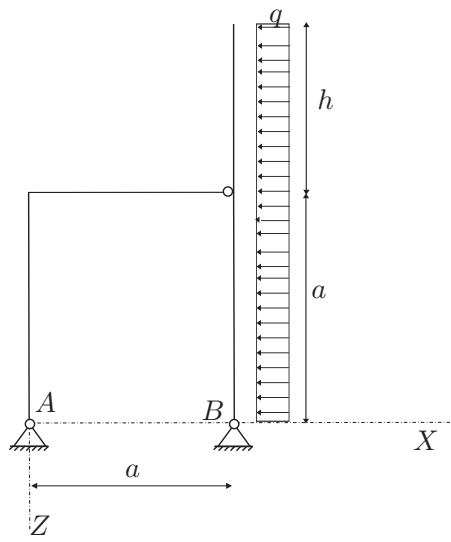


$[M_y]$



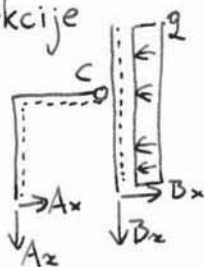
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x , N_z , M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 4$ m, $h = 2$ m,
 $q = 10$ kN/m.



a.) $\tilde{m}_{ps} = 2 \cdot 3 - 2 \cdot 2 - 2 = 0$

b.) reakcije



$$A_x + B_x = q \cdot (a+h)$$

$$A_z + B_z = 0$$

$$\sum M^A: -B_z \cdot a + q \cdot (a+h) \frac{a+h}{2} = 0$$

dodatna enačba:

$$\sum M^C: A_z \cdot a + A_x \cdot h = 0$$

$$A_x = -A_z$$

$$A_z = -45 \text{ kN}$$

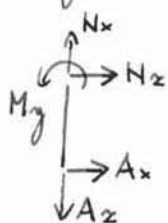
$$B_z = 45 \text{ kN}$$

$$A_x = 45 \text{ kN}$$

$$B_x = 15 \text{ kN}$$

c.) notranje sile

polje I



$$N_x = -45 \text{ kN}$$

$$N_z = -A_x$$

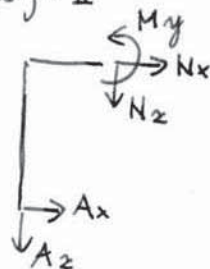
$$N_z = -45 \text{ kN}$$

$$M_y = -A_x \cdot x$$

$$M_y = -45x$$

$$M_y(4) = -180 \text{ kNm}$$

polje II



$$N_x = -A_x$$

$$N_z = -A_z$$

$$M_y = -A_z x - A_x \cdot a$$

$$N_x = -45 \text{ kN}$$

$$N_z = +45 \text{ kN}$$

$$M_y = -180 + 45x$$

polje III



$$N_x = B_x$$

$$N_z = -B_z + qx$$

$$M_y = -B_z \cdot x + q \cdot \frac{x^2}{2}$$

$$N_x = 45 \text{ kN}$$

$$N_z = -15 + 10x$$

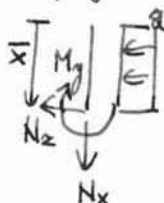
$$M_y = -15x + 5x^2$$

$$N_z(x) = 0 \Rightarrow x = \frac{15}{10} = \frac{3}{2} = 1.5$$

$$M_y(1.5) = -11.25 \text{ (ekstrem)}$$

$$M_y = x(-15 + 5x) = 0 \Rightarrow x = 3 \text{ (ničla)} \quad M_y(4) = 20$$

polje IV



$$N_x = 0$$

$$N_z = -qx$$

$$M_y = q \frac{x^2}{2}$$

$$N_x = 0$$

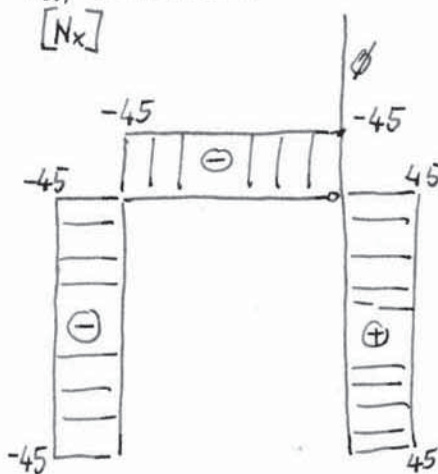
$$N_z = -10x$$

$$M_y = 5x^2$$

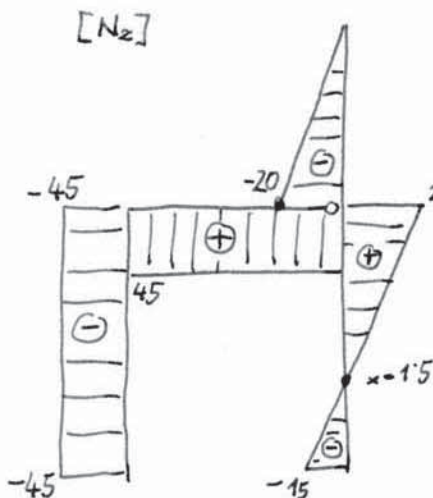
$$M_y(2) = 20 \text{ kNm}$$

d.) DIAGRAMI

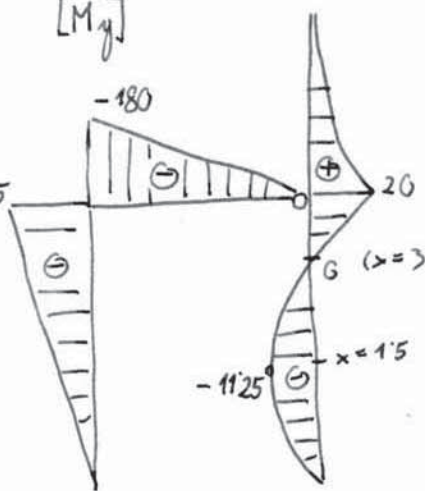
[Nx]



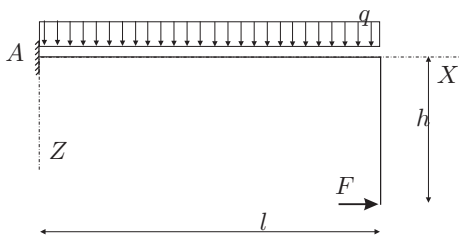
[Nz]



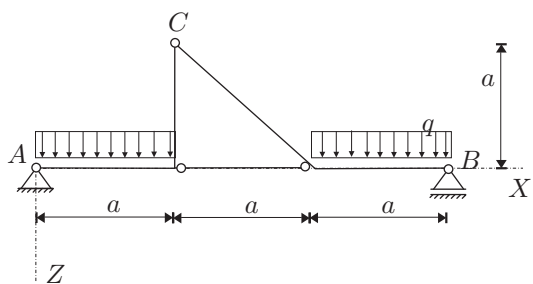
[My]



Za nosilec na sliki izračunajte in prikažite diagrame notranjih statičnih količin!



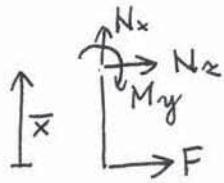
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!



Podatki: $a = 3 \text{ m}$, $q = 2 \text{ kN/m}$.

1. NALOGA

polje ② :



$$N_x = 0$$

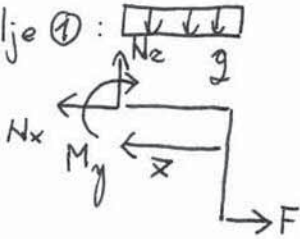
$$N_z = -F$$

$$M_y = Fx$$

$$M_y(0) = 0$$

$$M_y(l) = F \cdot l$$

polje ① :



$$N_x = F$$

$$N_z = g \cdot x$$

$$M_y = F \cdot h - g \cdot x \cdot \frac{x}{2}$$

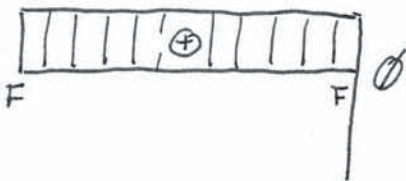
$$N_z(0) = 0 \quad N_z(l) = g \cdot l$$

$$M_y(0) = F \cdot h$$

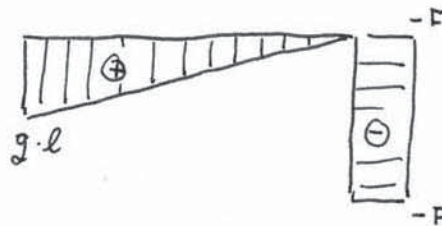
$$M_y(l) = F \cdot h - g \frac{l^2}{2}$$

DIAGRAMI

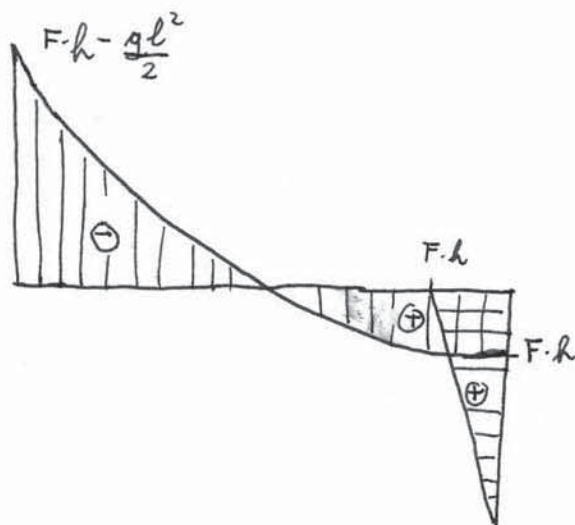
[Nx]



[Nz]



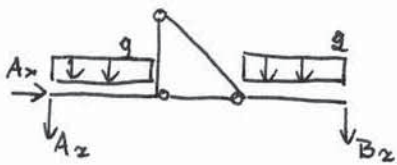
[My]



2. NALOGA

a.) $\tilde{m}_{ps} = 3 \cdot 3 - 3 \cdot 2 - 3 = 0$

b.) REAKCIJE



$$A_x = 0$$

$$A_z + B_z = -g \cdot 2a$$

$$-B_z \cdot 3a - g \cdot a \cdot \frac{a}{2} - g \cdot a \cdot \frac{5a}{2} = 0$$

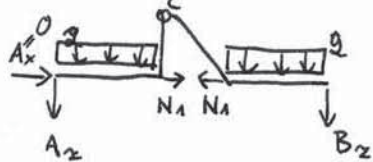
$$A_z = -g \cdot a$$

$$B_z = -g \cdot a$$

$$A_z = -6 \text{ kN}$$

$$B_z = -6 \text{ kN}$$

c.) RAZSTAVLJANJE

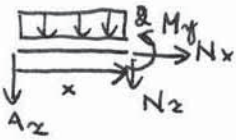


$$\sum_{AC} M^C: A_z \cdot a + g \cdot a \cdot \frac{a}{2} + N_1 \cdot a = 0$$

$$N_1 = -A_z - g \cdot \frac{a}{2}$$

$$N_1 = 3 \text{ kN}$$

d.) NOTRANJE SILE



$$N_x = 0$$

$$N_z = -A_z - g \cdot x$$

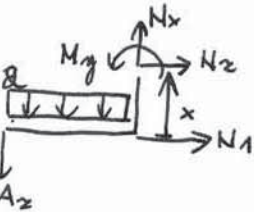
$$M_y = -A_z x - g \frac{x^2}{2}$$

$$N_z = 6 - 2x$$

$$M_y = 6x - x^2$$

$$N_z(3) = 0$$

$$M_y(3) = 9 \text{ (ekstrem) kNm}$$



$$N_x = A_z + g \cdot a$$

$$N_z = -N_1$$

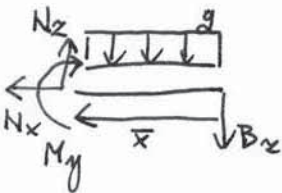
$$M_y = -A_z \cdot a - g \frac{a^2}{2} - N_1 \cdot x$$

$$N_x = 0$$

$$N_z = -3 \text{ kN}$$

$$M_y = 9 - 3x$$

$$M_y(3) = 0 \text{ kNm}$$



$$N_x = 0$$

$$N_z = B_z + g \cdot x$$

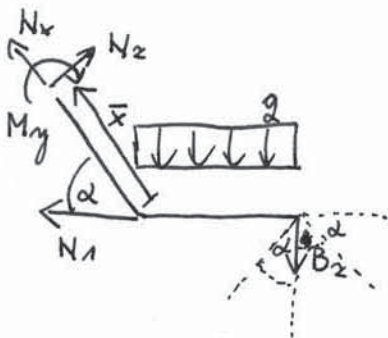
$$M_y = -B_z x - g \frac{x^2}{2}$$

$$N_z = -6 + 2x$$

$$M_y = 6x - x^2$$

$$N_z(3) = 0$$

$$M_y(3) = 9 \text{ kNm}$$



$$\alpha = 45^\circ$$

$$N_x = -N_1 \cdot \cos \alpha + B_z \cdot \sin \alpha + g \cdot \sin \alpha \cdot a$$

$$N_z = N_1 \cdot \sin \alpha + B_z \cdot \cos \alpha + g \cdot \cos \alpha \cdot a$$

$$M_y = -N_1 \cdot x \cdot \sin \alpha - B_z (a + x \cdot \cos \alpha) - g \cdot a \left(\frac{a}{2} + x \cdot \cos \alpha \right)$$

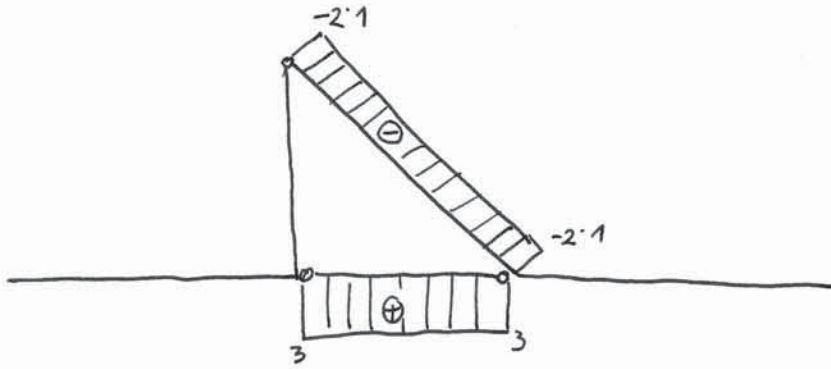
$$N_x = -2.1 \text{ kN}$$

$$N_z = 2.1 \text{ kN}$$

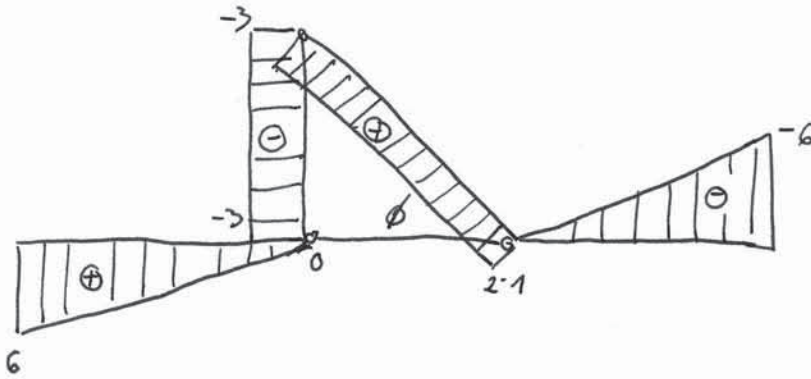
$$M_y = 9 - 2.1x$$

$$M_y(3 \cdot \sqrt{2}) = 0$$

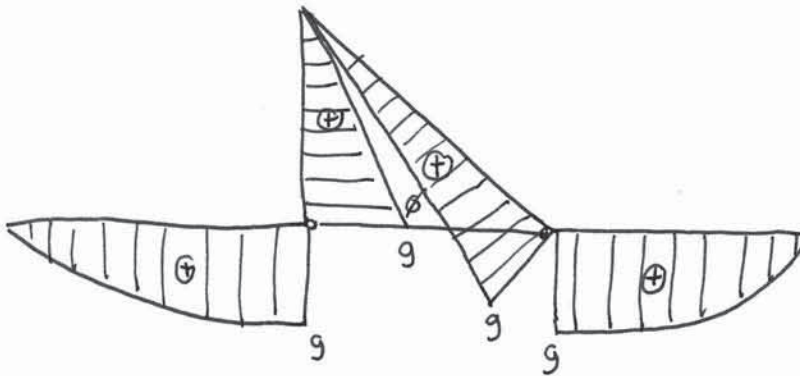
[N_x]



[N_z]

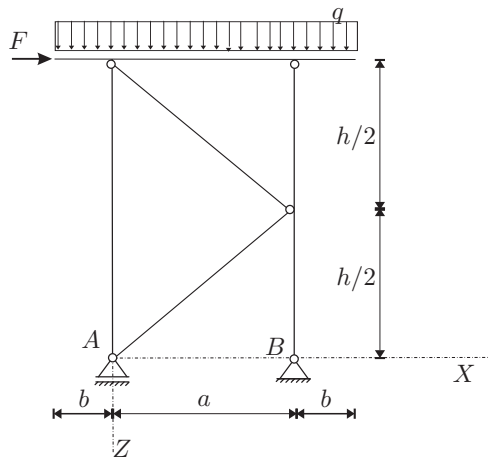


[M_y]



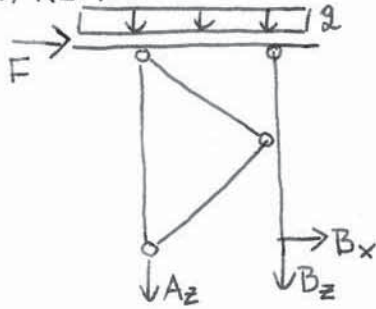
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 3 \text{ m}$, $h = 5 \text{ m}$,
 $b = 1 \text{ m}$, $F = 1 \text{ kN}$, $q = 2 \text{ kN/m}$.



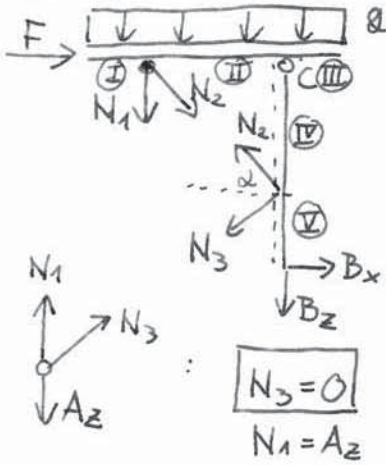
a.) $\tilde{m}_{ps} = 5 \cdot 3 - 3 - 2 \cdot 2 - 2 \cdot 4 = 0$

b.) REAKCIJE



$$\begin{aligned} \Sigma X: B_x &= -F & \boxed{B_x = -1 \text{ kN}} \\ \Sigma Z: A_z + B_z &= -q \cdot 5 \\ \Sigma M^B: A_z \cdot 3 + q \cdot 4 \cdot 2 - q \cdot 1 \cdot \frac{1}{2} - F \cdot 5 &= 0 \\ & A_z = -\frac{10}{3} \text{ kN} \\ & B_z = -\frac{20}{3} \text{ kN} \\ \boxed{A_z = -3.3 \text{ kN}} & \quad \boxed{B_z = -6.7 \text{ kN}} \end{aligned}$$

c.) PALICE

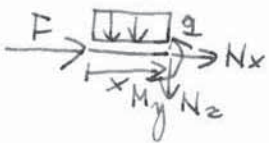


$$\begin{aligned} \Sigma M_{BC}^C: B_x \cdot h - N_2 \cdot \cos \alpha \cdot \frac{h}{2} &= 0 \\ N_2 &= \frac{2B_x}{\cos \alpha} \\ \tan \alpha &= \frac{2.5}{3} \Rightarrow \alpha = 39.8^\circ \\ \boxed{N_2 = -2.6 \text{ kN}} \end{aligned}$$

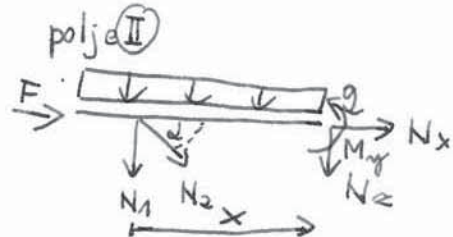
$$\begin{aligned} N_3 &= 0 \\ N_1 &= A_z \\ \boxed{N_1 = -\frac{10}{3} \text{ kN}} \end{aligned}$$

d.) NOTRANJE SILE PO POLJIM

POLJE I

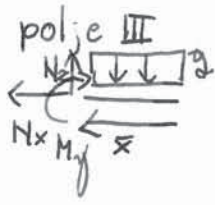


$$\begin{aligned} x &\in [0, 1] \\ \boxed{N_x = -1 \text{ kN}} \\ \boxed{N_z = -2x} & \quad N_z(1) = -2 \text{ kN} \\ \boxed{M_y = -x^2} & \quad M_y(1) = -1 \text{ kN} \end{aligned}$$



$$\begin{aligned} \Sigma X: N_x &= -F - N_z \cos \alpha \\ \Sigma Z: N_z &= -N_1 - N_2 \sin \alpha - q \cdot 1 - q \cdot x \\ \Sigma M^T: M_y &+ N_1 \cdot x + N_2 \sin \alpha \cdot x + q \frac{(x+1)^2}{2} \end{aligned}$$

$$\begin{aligned} \boxed{N_x = 1 \text{ kN}} \\ \boxed{N_z = 3 - 2x} & \quad N_z(3) = -3 \text{ kN} \\ \boxed{M_y = 1 + 3x - x^2} & \quad M_y(3) = -1 \text{ kN} \\ M_y\left(\frac{3}{2}\right) &= 1.25 \text{ (elastrom)} \end{aligned}$$



$$N_x = 0$$

$$N_z = q \bar{x}$$

$$M_y = -q \frac{\bar{x}^2}{2}$$

$$N_z = 2\bar{x}$$

$$M_y = -\bar{x}^2$$

polje V (z desne)



$$N_x = B_z$$

$$N_z = -B_x$$

$$M_y = B_x \bar{x}$$

$$N_x = -\frac{20}{3} \text{ kN} \quad N_z = 1 \text{ kN}$$

$$M_y = -\bar{x} \quad M_y(2.5) = -2.5 \text{ kNm}$$

polje IV (z desne)

$$\bar{x} \in [0, 2.5]$$



$$N_x = B_z - N_z \sin \alpha$$

$$N_z = -B_x + N_z \cos \alpha$$

$$M_y = B_x \cdot (2.5 + x) - N_z \cos \alpha \cdot \bar{x}$$

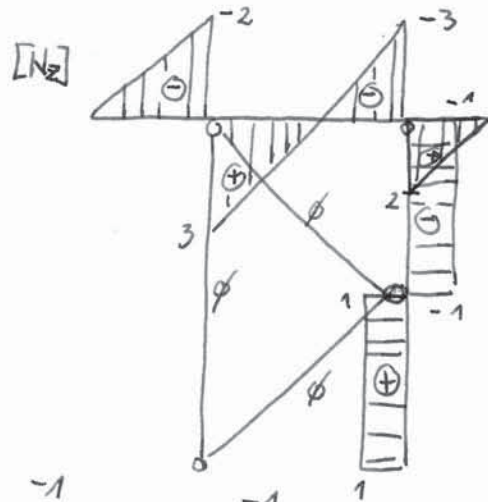
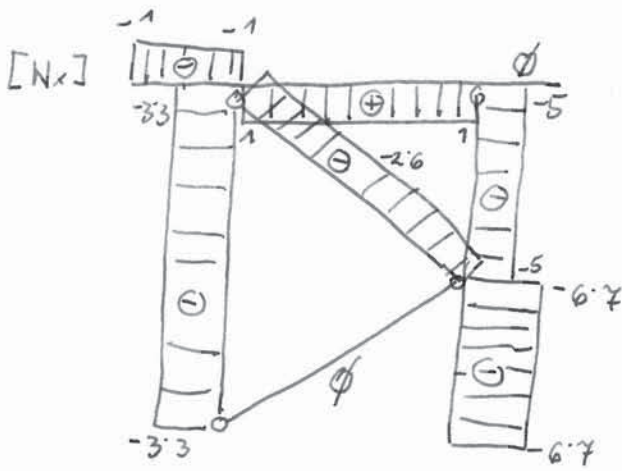
$$N_x = -5 \text{ kN}$$

$$N_z = -1 \text{ kN}$$

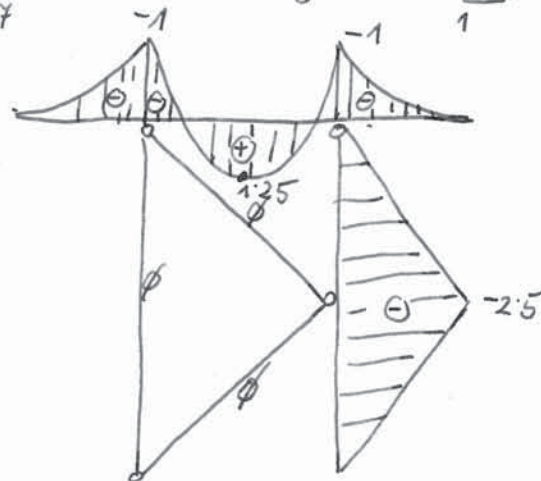
$$M_y = -2.5 + x$$

$$M_y(2.5) = 0$$

e.) DIAGRAMI

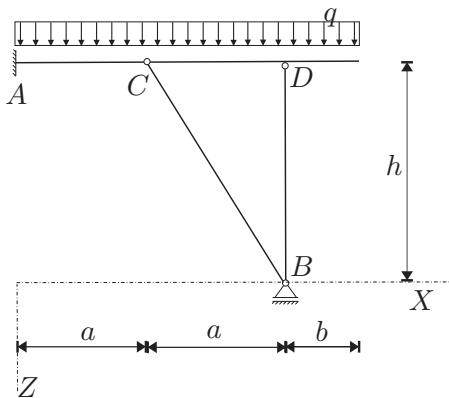


[M_y]



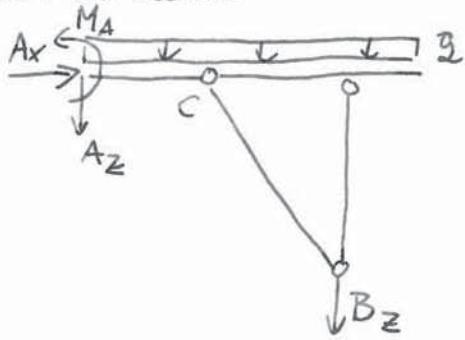
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 3 \text{ m}$, $h = 5 \text{ m}$,
 $b = 2 \text{ m}$, $q = 10 \text{ kN/m}$.



a.) $\tilde{m}_{ps} = 4 \cdot 3 - 3 - 1 - 2 \cdot 2 - 4 = 0$

b.) REAKCIJE



$\Sigma X: A_x = 0$

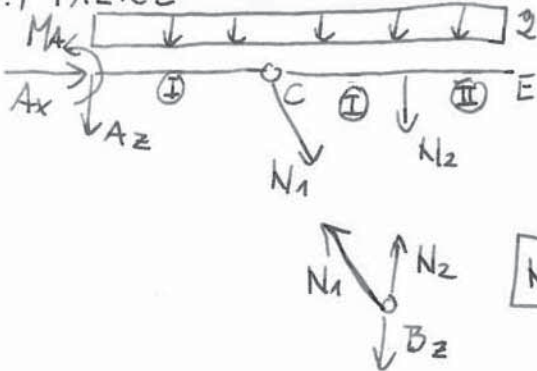
$\Sigma Z: A_z + B_z = -q(2a+b)$

$\Sigma M^A: M_A - q(2a+b)^2 \cdot \frac{1}{2} - B_z \cdot 2a = 0$

dodatna

$\Sigma M_{AC}^C: A_z \cdot a + M_A + q \cdot \frac{a^2}{2} = 0$

c.) PALICE



pomozna rovnice $\Sigma M_{EC}^C: -N_2 \cdot a - q(a+b)^2 \cdot \frac{1}{2} = 0$

$N_2 = -\frac{q(a+b)^2}{2a}$

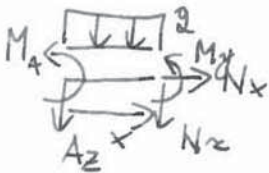
$N_2 = -4167 \text{ KN}$

$N_1 = 0 \quad N_2 = B_z$

$\Rightarrow B_z = -4167 \text{ KN}$
 $A_z = -3833 \text{ KN}$
 $M_A = 70 \text{ KNm}$

d.) NOTRANJE SILY

polje I



$x \in [0, 6]$ (raj je $N_1 = 0$)

$N_x = 0$

$N_z = -A_z - qx$

$M_y + M_A + A_z x - q \cdot x \cdot \frac{x}{2} = 0$

$N_x = 0$

$N_z = 3833 - 10x$

$M_y = -70 + 3833x - 5x^2$

$N_z(3) = 833$

$N_z(6) = -2167$

$M_y(3) = 0 \checkmark$

$M_y(6) = -20 \text{ KNm}$

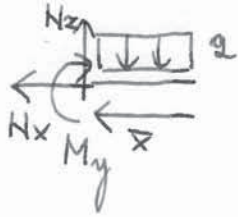
$M_y' = 3833 - 10x = 0$

$x = 383.3 \text{ m}$

$M_y(383.3) = 347 \text{ KNm}$

dstrem

polje II (z desne)



$$\bar{x} \in [0, 2]$$

$$N_x = 0$$

$$N_z = q \bar{x}$$

$$-M_y - q \bar{x} \frac{\bar{x}}{2} = 0$$

$$N_z = 10 \bar{x}$$

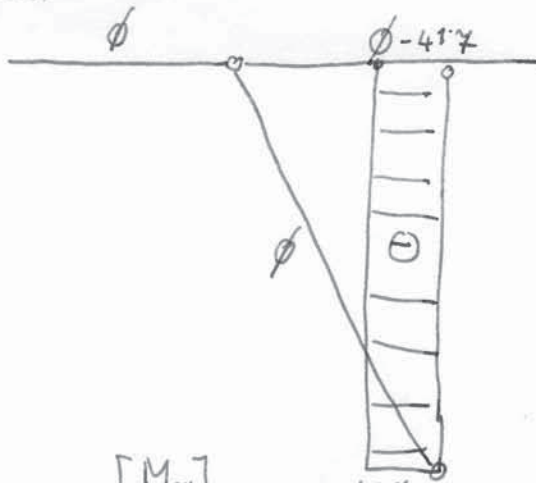
$$M_y = -5 \bar{x}^2$$

$$N_z(2) = 20 \text{ kN}$$

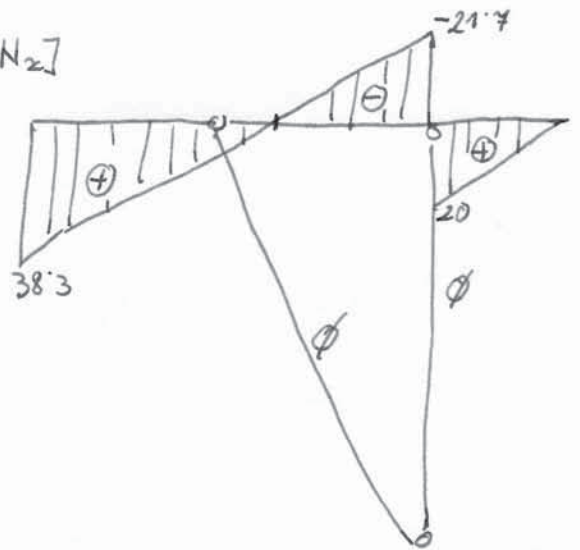
$$M_y(2) = -20 \text{ kNm}$$

e.) DIAGRAMI

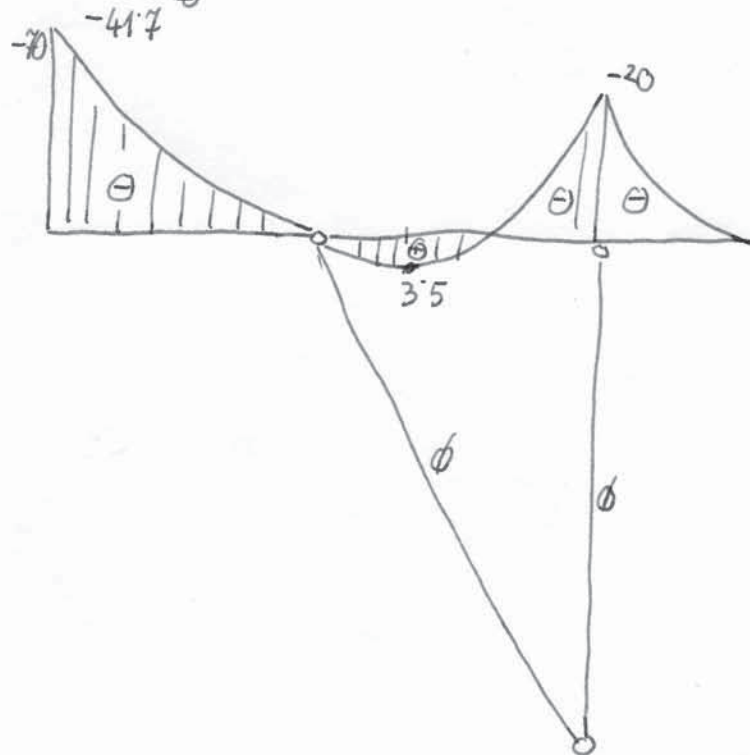
[Nx]



[Nz]

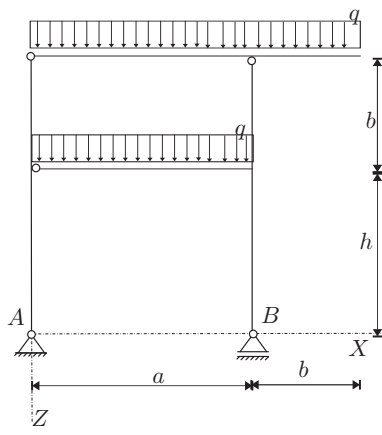


[My]



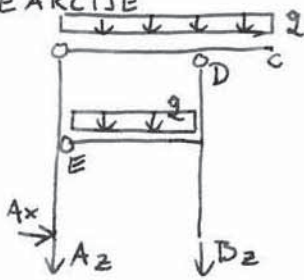
Za konstrukcijo na sliki izračunajte stopnjo
statične nedoločenosti, reakcije in notranje
statične količine (N_x , N_z , M_y)! Rezultate no-
tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 4$ m, $h = 3$ m,
 $b = 2$ m, $q = 2$ kN/m.



a.) $\tilde{m}_{PS} = 3 \cdot 3 - 3 \cdot 2 - 2 - 1 = 0$

b.) REAKCIJE



$\Sigma X: A_x = 0$

$\Sigma Z: A_z + B_z + q \cdot a + q(a+b) = 0$

$\Sigma M^A: -B_z \cdot a - q \cdot a \cdot \frac{a}{2} - q(a+b) \cdot \frac{a+b}{2} = 0$

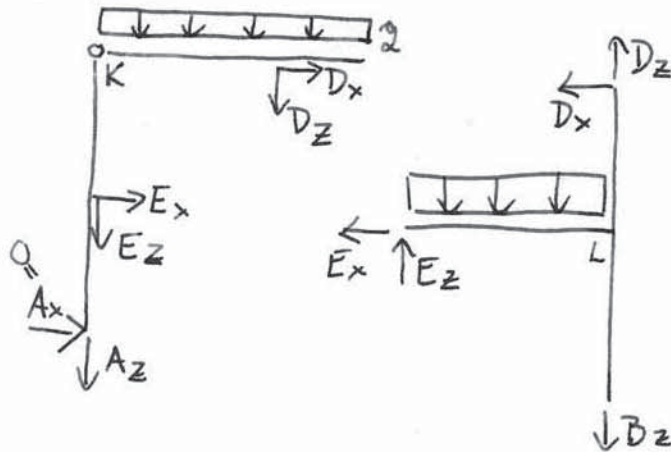
$B_z = -13 \text{ kN}$

$A_z = -7 \text{ kN}$

KONTROLA

$\Sigma M^C: B_z \cdot b + A_z(a+b) + q \cdot a(\frac{a}{2} + b) + q(a+b) \cdot \frac{a+b}{2} =$
 $= -13 \cdot 2 - 7 \cdot 6 + 2 \cdot 4 \cdot 4 + 2 \cdot 6 \cdot 3 = 0 \checkmark$

c.) RAZREZ V D I H E



$\Sigma X: E_x + D_x = 0$

$\Sigma Z: E_z + D_z = -q(a+b) - A_z$

$\Sigma M^K: E_x \cdot b = 0 \quad E_x = 0 \quad D_x = 0$

$\Sigma M^K: -D_z \cdot a - q(a+b) \cdot \frac{a+b}{2} = 0$

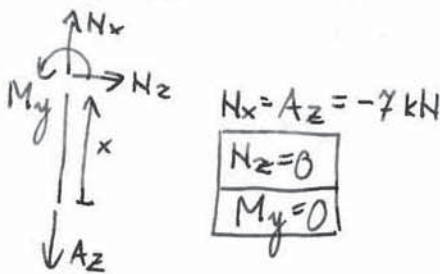
$D_z = -9 \text{ kN}$

$E_z = 4 \text{ kN}$

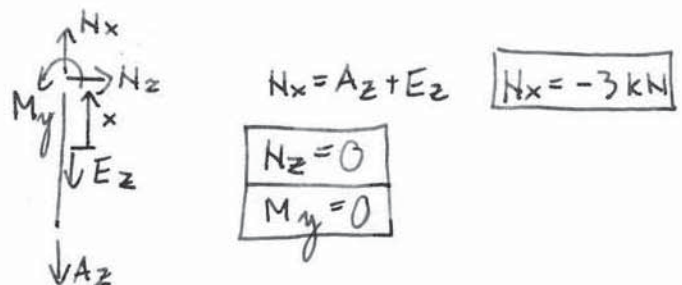
KONTROLA: $E_z + D_z = B_z - q \cdot a$
 $= 4 - 9 + 13 - 8 = 0 \checkmark$

d.) NOTRANJE SILE PO POLJIM

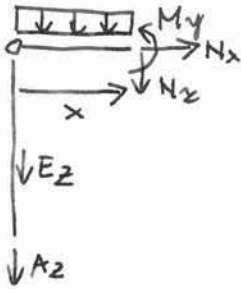
POLJE AE



POLJE AK



POLJE KD



$$N_x = 0$$

$$N_z = -A_z - E_z - qx$$

$$M_y + E_z x + A_z x + q \frac{x^2}{2} = 0$$

$$N_z = 3 - 2x$$

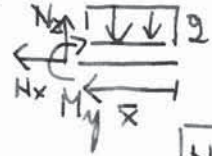
$$M_y = 3x - x^2$$

$$M_y(4) = -4 \text{ kNm}$$

$$M_y' = 3 - 2x$$

$$M_y(1.5) = 2.25 \text{ kNm (extrem)}$$

POLJE DC (z desme)



$$N_x = 0$$

$$N_z = q x$$

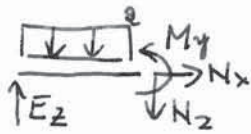
$$M_y = -q \frac{x^2}{2}$$

$$N_z = 2x$$

$$M_y = -x^2$$

$$M_y(2) = -4 \text{ kNm}$$

POLJE EL



$$N_x = 0$$

$$N_z = E_z - qx$$

$$M_y = E_z x - q \frac{x^2}{2}$$

$$N_z = 4 - 2x$$

$$N_z(4) = -4 \text{ kN}$$

$$M_y = 4x - x^2$$

$$M_y(2) = 4 \text{ kNm (extrem)}$$

POLJE BL (z desme)



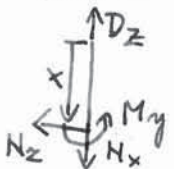
$$N_x = B_z$$

$$N_z = 0$$

$$M_y = 0$$

$$N_x = -13 \text{ kN}$$

POLJE DL

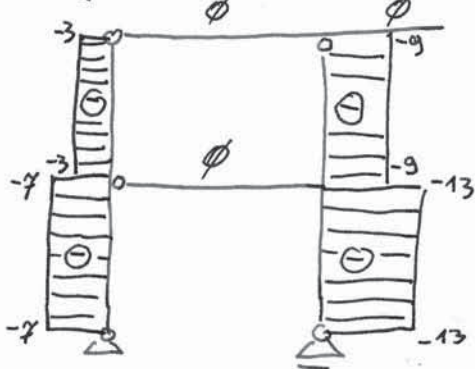


$$N_x = D_z = -9 \text{ kN}$$

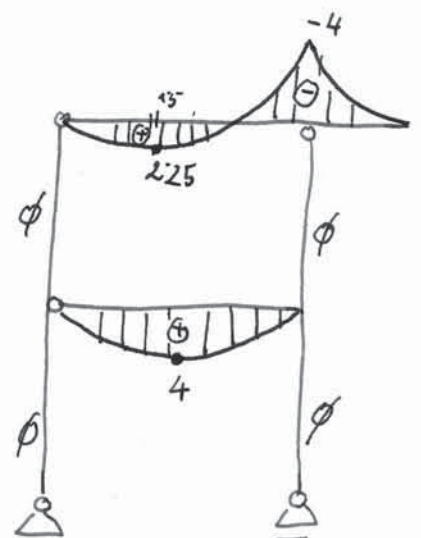
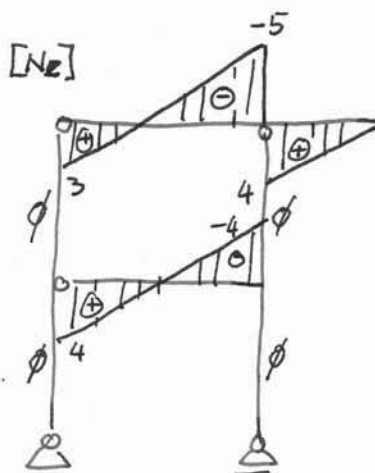
$$N_z = M_y = 0$$

e.) DIAGRAMI

[Nx]

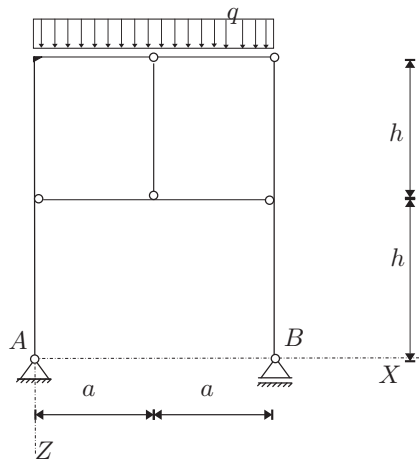


[Nz]



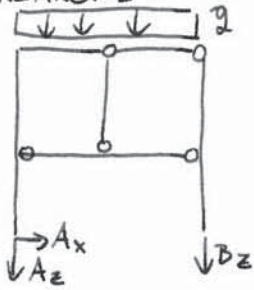
Za konstrukcijo na sliki izračunajte stopnjo
statične nedoločenosti, reakcije in notranje
statične količine (N_x , N_z , M_y)! Rezultate no-
tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 2$ m, $h = 3$ m,
 $q = 9$ kN/m.



a.) $\tilde{m}_{ps} = 5 \cdot 3 - 2 - 1 - 4 \cdot 2 - 4 = 0$

b.) REAKCIJE



$\sum X: A_x = 0$

$\sum Z: A_z + B_z + q \cdot 2a = 0$

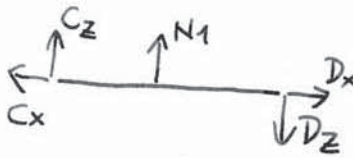
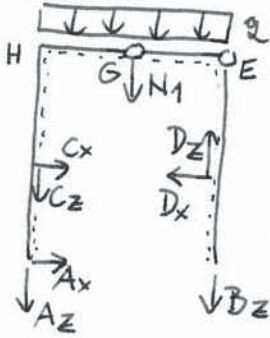
$\sum M^A: -B_z \cdot 2a - q \cdot 2a \cdot a = 0$

$A_x = 0$

$A_z = -18 \text{ kN}$

$B_z = -18 \text{ kN}$

c.) RAZREZ



$\sum M^E: D_x = 0$

$\sum M^G: -B_z \cdot a + D_z \cdot a - q \cdot a \cdot \frac{a}{2} = 0$

$D_z = -9 \text{ kN}$

$\sum M^C: -2a \cdot D_z + a N_1 = 0$

$N_1 = -18 \text{ kN}$

$\sum X: C_x = D_x = 0$

$\sum Z: C_z = D_z - N_1$
 $C_z = 9 \text{ kN}$

d.) NOTRANJE SILE PO POLJIH

POLJE AC



$N_z = M_y = 0$

$N_x = A_z = -18 \text{ kN}$

POLJE CH



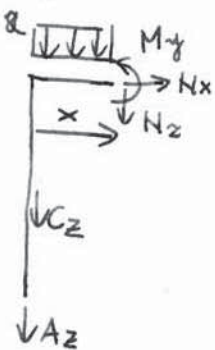
$N_z = M_y = 0$

$N_x = A_z + C_z$

$N_x = -9 \text{ kN}$

kovsem enakovredno je za polji BD in DE

polje HG



$N_x = 0$

$N_z = -A_z - C_z - q \cdot x$

$M_y = -A_z x - C_z x - q \cdot x \cdot \frac{x}{2}$

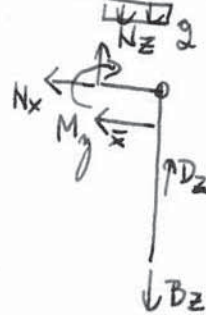
$N_z = 9 - 9x$

$N_z(2) = -9 \text{ kN}$

$M_y = 9x - \frac{9}{2} x^2$

$M_y(1) = 4.5 \text{ kNm}$
(obstrem)

POLJE EG (x darme)



$N_x = 0$

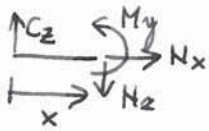
$N_z = B_z - D_z + q \cdot x$

$M_y = -B_z x + D_z x - q \cdot x \cdot \frac{x}{2}$

$N_z = -9 + 9x$

$M_y = 9x - \frac{9}{2} x^2$

POLJE CN₁



$$N_x = 0$$

$$N_z = C_z$$

$$M_y = C_z \cdot x$$

$$N_z = 9 \text{ kN}$$

$$M_y = 9x \quad M_y(z) = 18 \text{ kNm}$$

POLJE DN₁ (z desme)



$$N_x = 0$$

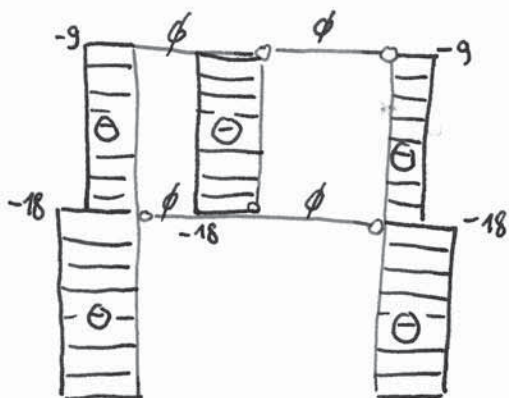
$$N_z = D_z = -9 \text{ kN}$$

$$M_y = -D_z \bar{x}$$

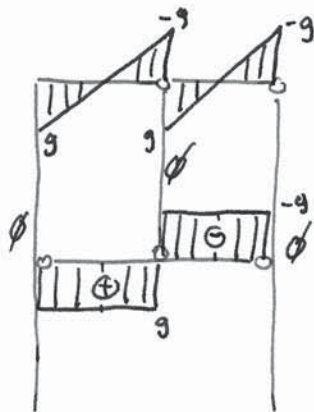
$$M_y = 9\bar{x}$$

e.) DIAGRAMI

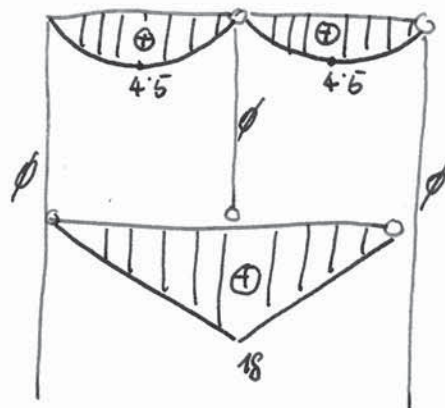
[N_x]



[N_z]

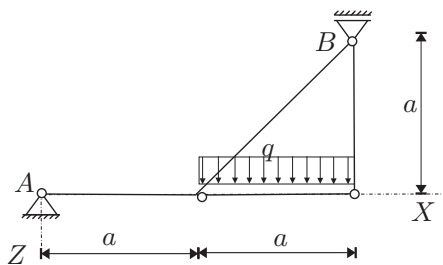


[M_y]



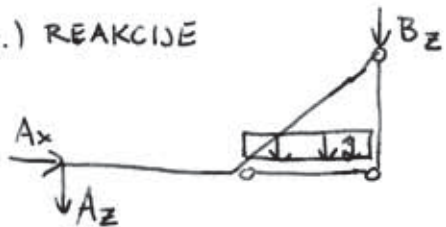
Za konstrukcijo na sliki izračunajte stopnjo
statične nedoločenosti, reakcije in notranje
statične količine (N_x , N_z , M_y)! Rezultate no-
tranjih statičnih količin prikažite z diagrami!

Podatki: $a = 2$ m, $q = 5$ kN/m.



a.) $\tilde{m}_{ps} = 3 \cdot 3 - 2 \cdot 1 - 3 \cdot 2 = 0$

b.) REAKCIJE



$A_x = 0$

$A_z + B_z + g \cdot a = 0$

$-B_z \cdot 2a - g \cdot a \cdot \frac{3a}{2} = 0$

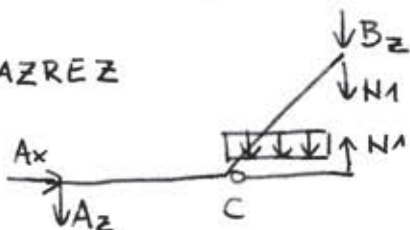
$A_z = -g \frac{a}{4}$

$B_z = -g \frac{3a}{4}$

$A_z = -2.5 \text{ kN}$

$B_z = -7.5 \text{ kN}$

c.) RAZREZ



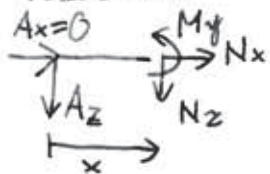
$\sum M_C: N_1 \cdot a - g \cdot a \frac{a}{2} = 0$

$N_1 = g \frac{a}{2}$

$N_1 = 5 \text{ kN}$

d.) NOTRANJE SILE PO POLJIH

POLJE AC



$N_x = 0$

$N_z = -A_z$

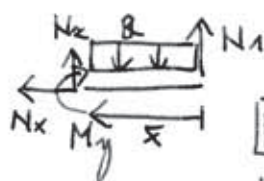
$M_y = -A_z \cdot x$

$N_z = 2.5 \text{ kN}$

$M_y = +2.5x$

$M_y(2) = +5 \text{ kNm}$

POLJE N1C (z desne)



$N_x = 0$

$N_z = -N_1 + g \cdot x$

$M_y = N_1 \cdot x - g \cdot x \frac{x}{2}$

$N_z = -5 + 5x$

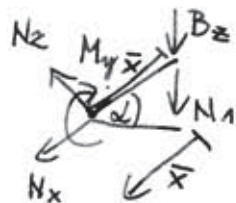
$M_y = 5x - 2.5x^2$

$N_z(2) = 5 \text{ kN}$

$M_y(1) = 2.5 \text{ kNm}$

↑ ekstrem

POLJE CB (z desne)



$\alpha = 45^\circ$

$N_x + B_z \cdot \frac{\sqrt{2}}{2} + N_1 \cdot \frac{\sqrt{2}}{2} = 0$

$N_z - B_z \cdot \frac{\sqrt{2}}{2} - N_1 \cdot \frac{\sqrt{2}}{2} = 0$

$-M_y - B_z \cdot x \cdot \frac{\sqrt{2}}{2} - N_1 \cdot \frac{\sqrt{2}}{2} x = 0$

$N_x = 1.77 \text{ kN}$

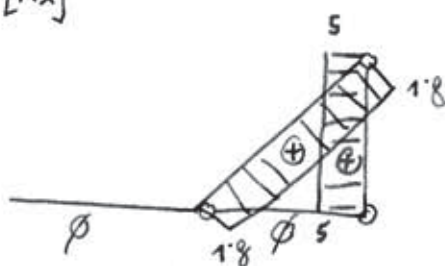
$N_z = -1.77 \text{ kN}$

$M_y = 1.77x$

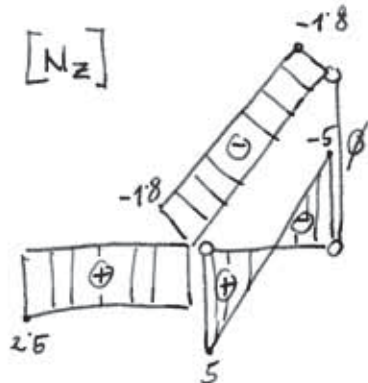
$M_y(2 \cdot \sqrt{2}) = 5 \text{ kNm}$

e.) DIAGRAMI

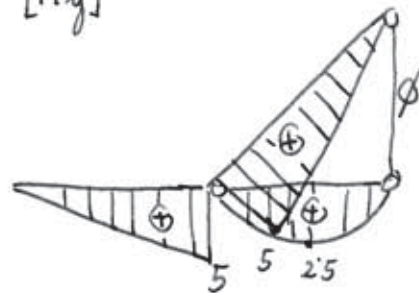
$[N_x]$



$[N_z]$

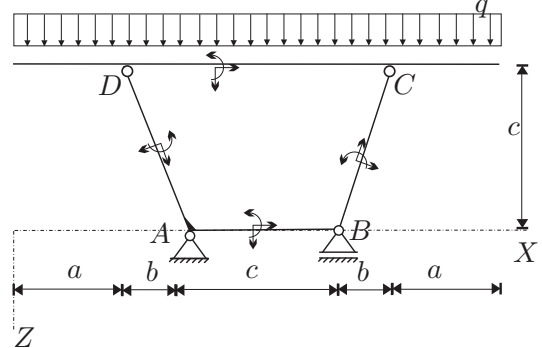


$[M_y]$



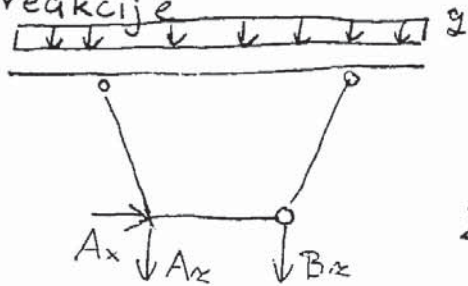
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 2 \text{ m}$, $b = 1 \text{ m}$, $c = 3 \text{ m}$,
 $q = 5 \text{ kN/m}$.



$$(i) \tilde{m}_{P3} = 3 \cdot 3 - 1 - 2 - 3 \cdot 2 = 0$$

(ii) reakcije



$$\Sigma X: A_x = 0$$

$$\Sigma Z: A_z + B_z + g(2a + 2b + c) = 0$$

$$\Sigma M^A: -B_z \cdot c - g \frac{(a+b+c)^2}{2} + g \frac{(a+b)^2}{2} = 0$$

$$B_z = \frac{1}{3} \left(\frac{5}{2} (3)^2 - \frac{5}{2} 6^2 \right)$$

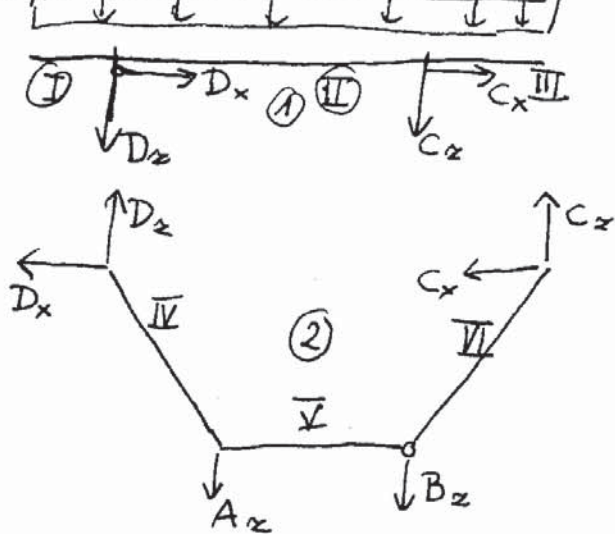
$$= -\frac{5}{6} (36 - 9)$$

$$B_z = -22.5 \text{ kN}$$

$$A_z = -5(4 + 2 + 3) + 22.5$$

$$A_z = -22.5 \text{ kN}$$

(iii) razrez



②:

$$\Sigma X: C_x + D_x = 0$$

$$\Sigma Z: C_z + D_z = A_z + B_z$$

$$\Sigma M^D: -A_z \cdot 3 - B_z \cdot 6 + C_z \cdot 9 = 0$$

$$C_z = \frac{1}{9} (A_z \cdot 3 + B_z \cdot 6)$$

$$C_z = -22.5 \text{ kN}$$

$$D_z = -22.5 \text{ kN}$$

$$\Sigma M^B_{BC}: C_x \cdot 3 + C_z \cdot 1 = 0$$

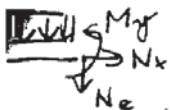
$$C_x = -C_z \cdot \frac{1}{3}$$

$$C_x = +7.5 \text{ kN}$$

$$D_x = -7.5 \text{ kN}$$

iv) notranje sile

polje I



$$N_x = 0$$

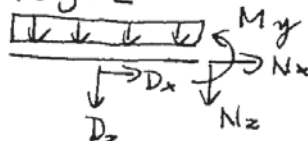
$$N_z = -5x$$

$$M_y = -\frac{g x^2}{2}$$

$$N_x(2) = -10$$

$$M_y(2) = -10$$

polje II



$$N_x = -D_x$$

$$N_z = -g(x+2) - D_z$$

$$M_y = -g \frac{(x+2)^2}{2} - D_z \cdot x$$

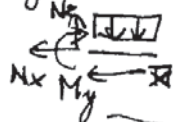
$$N_x = 7.5 \text{ kN}$$

$$N_z = 12.5 - 5x$$

$$M_y = -10 + 12.5x - \frac{5}{2}x^2$$

ekstrem $x = \frac{12.5}{5} = 2.5$ $M_y(5) = 0$
 $M_y(2.5) = 5.625$

polje III



$$N_x = 0$$

$$N_e = g x = 5x$$

$$M_y = -\frac{g x^2}{2} = -\frac{5}{2}x^2$$

polje IV



$$\sum x: +N_x - D_z \cdot \cos \alpha - D_x \cdot \sin \alpha = 0$$

$$\sum z: +N_z - D_z \cdot \sin \alpha + D_x \cdot \cos \alpha = 0$$

$$\sum M: -M_y - D_x \cdot x \cdot \cos \alpha + D_z \cdot x \cdot \sin \alpha = 0$$

$$\tan \alpha = \frac{1}{3}$$

$$\alpha = 18.435^\circ$$

$$x = \sqrt{1+9} = \sqrt{10}$$

$$N_x = -7.5 \sin \alpha - 22.5 \cos \alpha$$

$$N_z = 7.5 \cos \alpha - 22.5 \sin \alpha$$

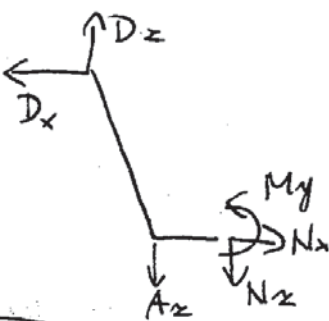
$$M_y = N_z \cdot x$$

$$N_x = -23.7 \text{ kN}$$

$$N_z = 0$$

$$M_y = 0$$

polje V



$$N_x = D_x = -7.5 \text{ kN}$$

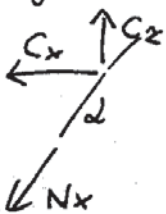
$$N_z = D_z - A_z = 0$$

$$M_y + A_z \cdot x - D_x \cdot (x+1) + 3D_x = 0$$

$$M_y = 3 \cdot 7.5 - 22.5 = 0$$

$$M_y = 0$$

polje VI



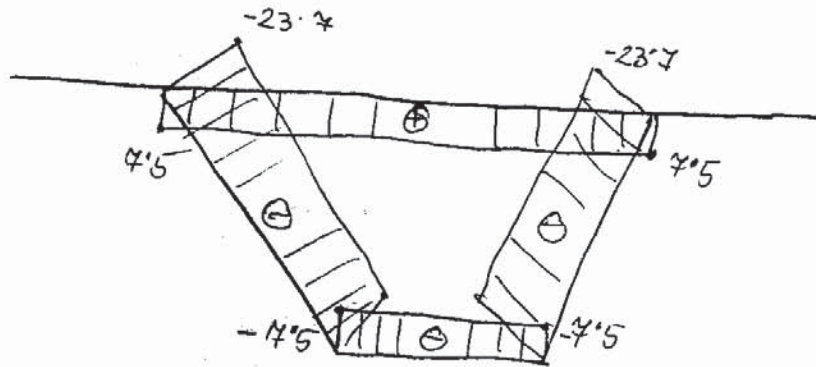
$$N_x = C_x \cdot \cos \alpha - C_z \cdot \sin \alpha$$

$$= -22.5 \cos \alpha - 7.5 \sin \alpha$$

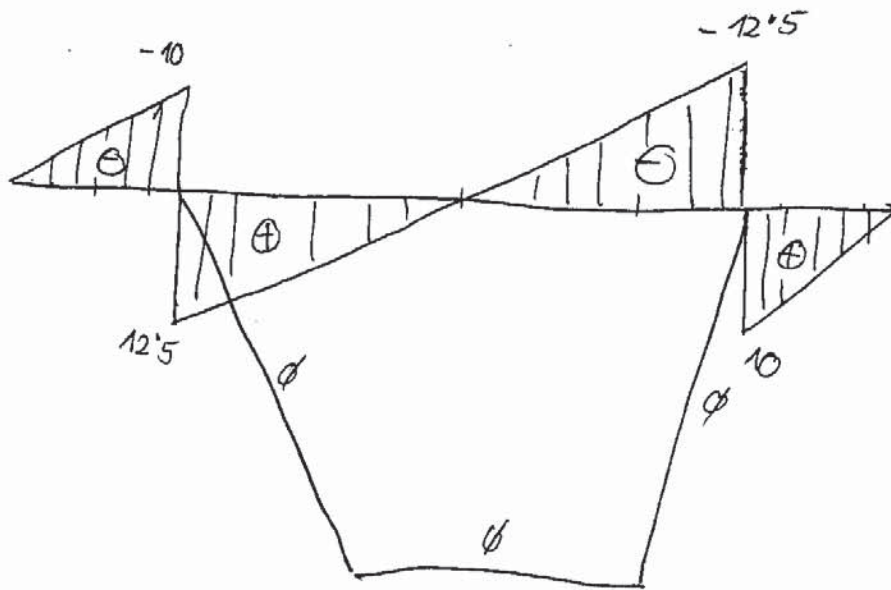
$$N_x = -23.7 \text{ kN}$$

$$N_z = M_y = 0$$

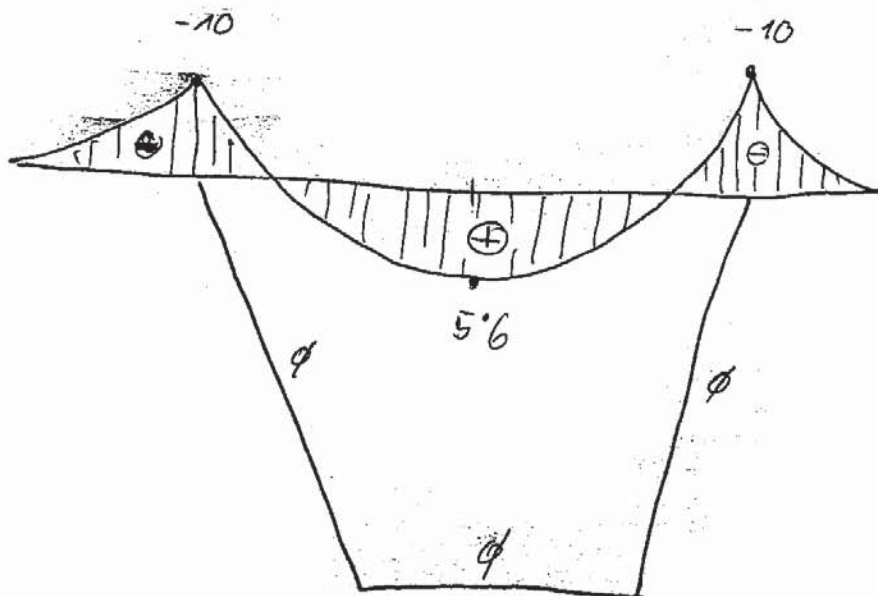
~) diagrammi



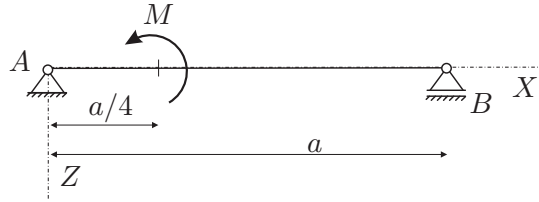
$[N_2]$



$[M_y]$

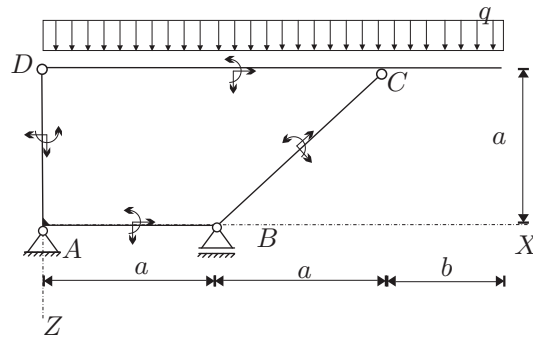


1. Za nosilec na sliki izračunajte reakcije v podporah ter izračunajte in prikažite diagrame notranjih statičnih količin!



2. Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 3\text{ m}$, $b = 2\text{ m}$,
 $q = 2\text{ kN/m}$.



1. ANALOGA

a.) reakcije



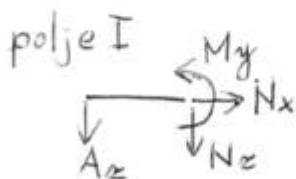
$$\sum X: A_x = 0$$

$$\sum Z: A_z + B_z = 0$$

$$\sum MA: M - B_z \cdot a = 0$$

$$B_z = \frac{M}{a} \quad A_z = -\frac{M}{a}$$

b.) notranje sile



$$N_x = 0$$

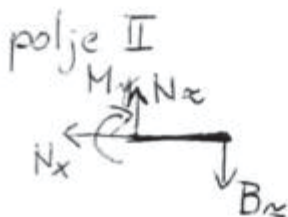
$$N_z = -A_z$$

$$N_z = \frac{M}{a}$$

$$M_y = -A_z x$$

$$M_y = -\frac{M}{a} x$$

$$M_y\left(\frac{a}{4}\right) = \frac{M}{4}$$



$$N_x = 0$$

$$N_z = B_z$$

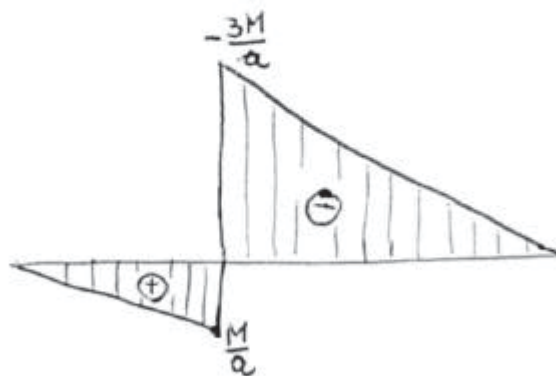
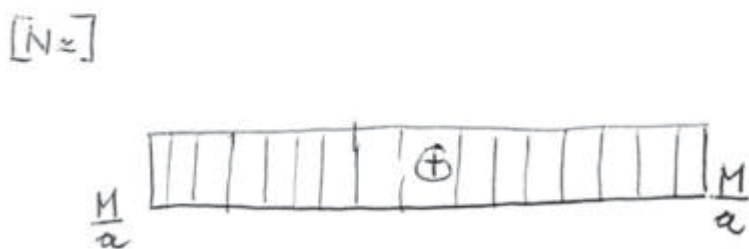
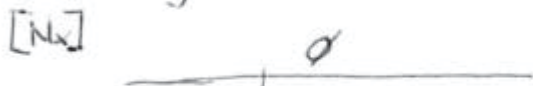
$$N_z = \frac{M}{a}$$

$$M_y = -B_z x$$

$$M_y = -\frac{M}{a} x$$

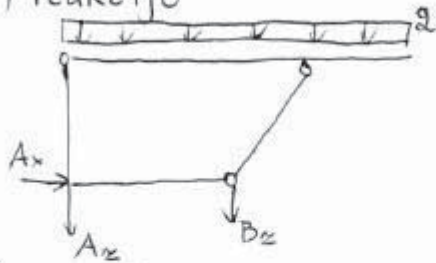
$$M_y\left(\frac{3a}{4}\right) = -\frac{3M}{4}$$

c.) diagrami



a.) $\tilde{m}_{PS} = 3 \cdot 3 - 2 - 1 - 3 \cdot 2 = 0 \checkmark$

b.) reakcije



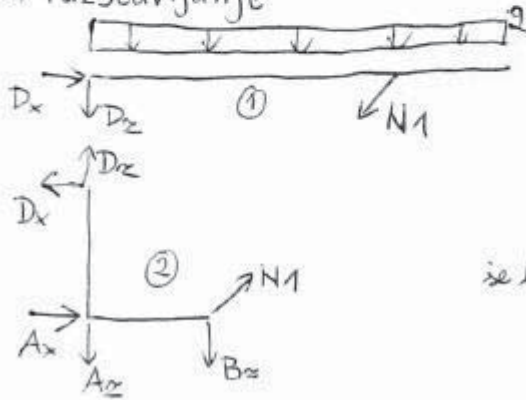
$\Sigma X: A_x = 0$

$\Sigma Z: A_z + B_z + q \cdot (2a+b) = 0$

$\Sigma M^A: -B_z \cdot a - q \cdot (2a+b) \cdot \frac{2a+b}{2} = 0$

$B_z = -21 \cdot 3 \text{ kN}$
 $A_z = +5 \cdot 3 \text{ kN}$

c.) razstavljanje



②: $\Sigma X: A_x - D_x + N_1 \cdot \frac{\sqrt{2}}{2} = 0$

$\Sigma Z: A_z + B_z - D_z - N_1 \cdot \frac{\sqrt{2}}{2} = 0$

$\Sigma M^A: -B_z \cdot a + D_x \cdot a + N_1 \cdot \frac{\sqrt{2}}{2} \cdot a = 0$ ← za kontrolo

je bolje $\Sigma M^D: A_x \cdot a - B_z \cdot a + N_1 \cdot \frac{\sqrt{2}}{2} \cdot a + N_1 \cdot \frac{\sqrt{2}}{2} \cdot a = 0$

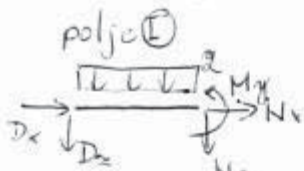
$N_1 \sqrt{2} = B_z - A_x = 0$

$N_1 = -15 \cdot 08 \text{ kN}$

$D_x = -10 \cdot 6 \text{ kN}$

$D_z = -5 \cdot 3 \text{ kN}$

d.) notranje sile



$N_x = -D_x \Rightarrow N_x = 10 \cdot 7 \text{ kN}$

$N_z = -D_z - q \cdot x$

$N_z = 5 \cdot 3 - 2x \quad N_z(6) = -6 \cdot 7 \text{ kN}$

$M_y = 5 \cdot 3x - x^2 \quad M_y(6) = -4 \text{ kNm}$

$x = \frac{5 \cdot 3}{2}$ (ekstrem) $M_y(\frac{5 \cdot 3}{2}) = 7 \text{ kNm}$



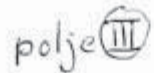
$N_x = 0$

$N_z = q \cdot x$

$M_y = -q \cdot x \cdot \frac{x}{2}$

$N_z = 2x \quad N_z(2) = 4 \text{ kN}$

$M_y = -x^2 \quad M_y(2) = -4 \text{ kNm}$



$N_x = D_z$

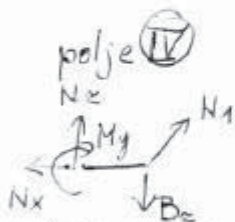
$N_z = -D_x$

$M_y = -D_x \cdot x$

$N_x = -5 \cdot 3 \text{ kN}$

$N_z = 10 \cdot 6 \text{ kN}$

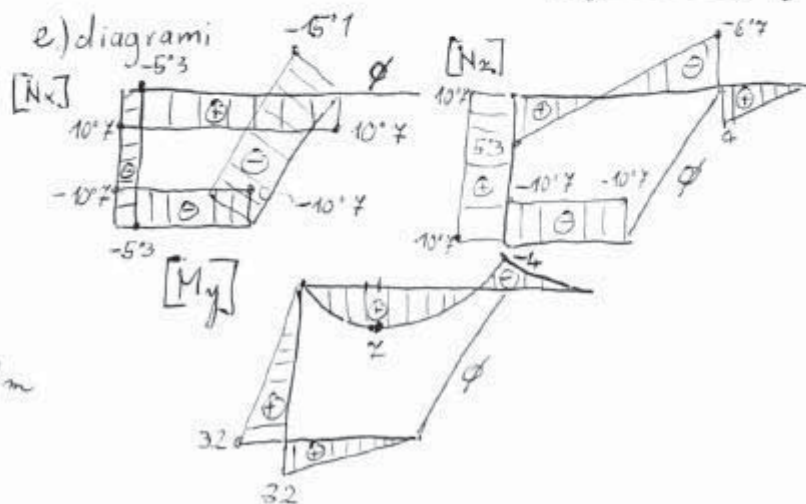
$M_y = 10 \cdot 7x \quad M_y(3) = 32$



$N_x = N_1 \cdot \frac{\sqrt{2}}{2} = -10 \cdot 7 \text{ kN}$

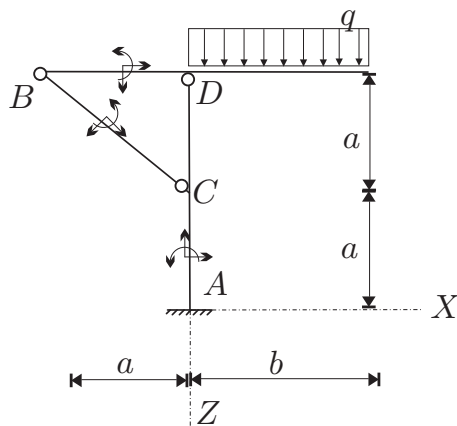
$N_z = B_z - N_1 \cdot \frac{\sqrt{2}}{2} = -10 \cdot 7 \text{ kN}$

$M_y = 10 \cdot 7x \quad M_y(3) = 32 \text{ kNm}$



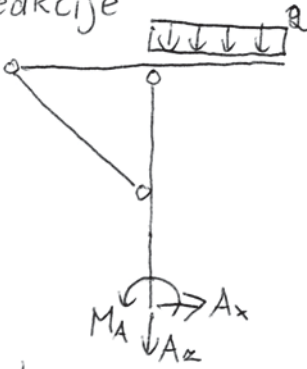
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločnosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 2 \text{ m}$, $b = 3 \text{ m}$,
 $q = 2 \text{ kN/m}$.



a.) $\tilde{m}_{ps} = 3 \cdot 3 - 3 - 3 \cdot 2 = 0$

b.) reakcije

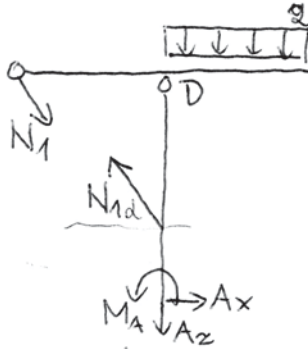


$\Sigma X: A_x = 0$

$\Sigma Z: A_z + q \cdot b = 0 \quad A_z = -6 \text{ kN}$

$\Sigma M^A: M_A - q \cdot b \cdot \frac{b}{2} = 0 \quad M_A = 9 \text{ kNm}$

c.) palica

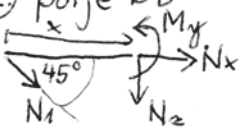


$\Sigma M_{AD}^D: M_A + A_x \cdot 2a - N_1 \cdot \frac{\sqrt{2}}{2} \cdot a = 0$

$N_1 = \frac{2}{\sqrt{2}} \frac{M_A}{a} \quad N_1 = 6.4 \text{ kN}$

d.) notranje sile

I) polje BD



$N_x = -N_1 \frac{\sqrt{2}}{2}$

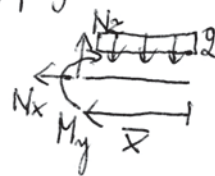
$N_z = -N_1 \frac{\sqrt{2}}{2}$

$M_y = -N_1 \frac{\sqrt{2}}{2} x$

$N_x = -4.5 \text{ kN} \quad N_z = -4.5 \text{ kN}$

$M_y = -4.5 x$

II) polje DE



$N_x = 0$

$N_z = q x$

$M_y = -q x \frac{x}{2}$

$N_z = 2x$

$M_y = -x^2$

III) polje AC



$N_x = A_z$

$N_z = -A_x$

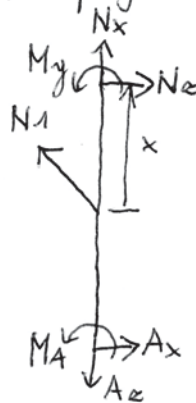
$M_y = -A_x x - M_A$

$N_x = -6 \text{ kN}$

$N_z = 0$

$M_y = -9 \text{ kNm}$

IV) polje CD



$N_x = A_z - N_1 \frac{\sqrt{2}}{2}$

$N_z = -A_x + N_1 \frac{\sqrt{2}}{2}$

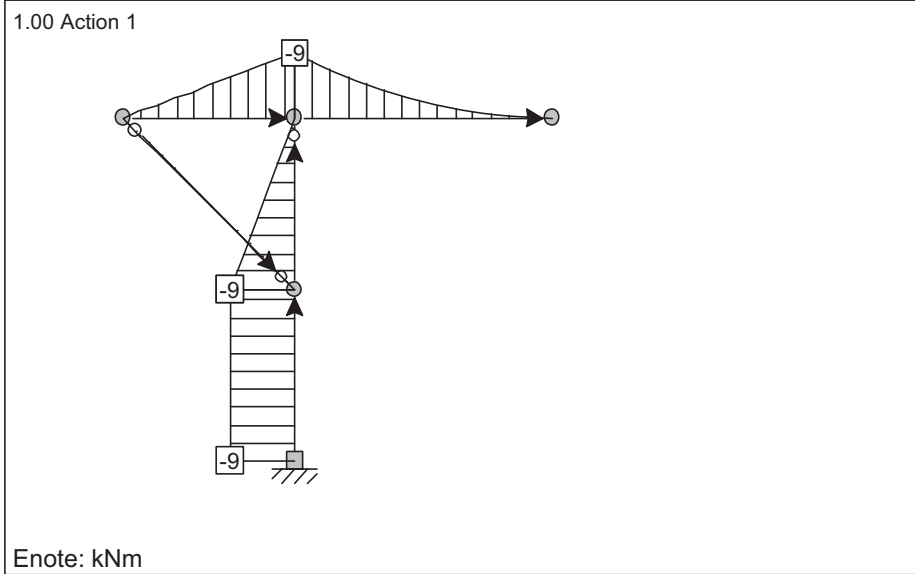
$M_y = -M_A + N_1 \frac{\sqrt{2}}{2} x - A_x (a+x)$

$N_x = -10.5 \text{ kN}$

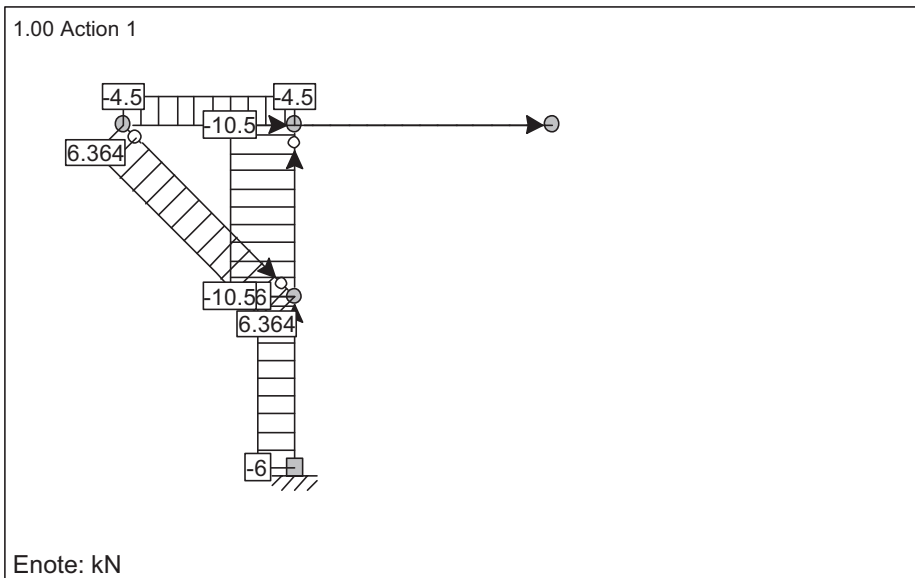
$N_z = 4.5 \text{ kN}$

$M_y = -9 + 4.5 x$

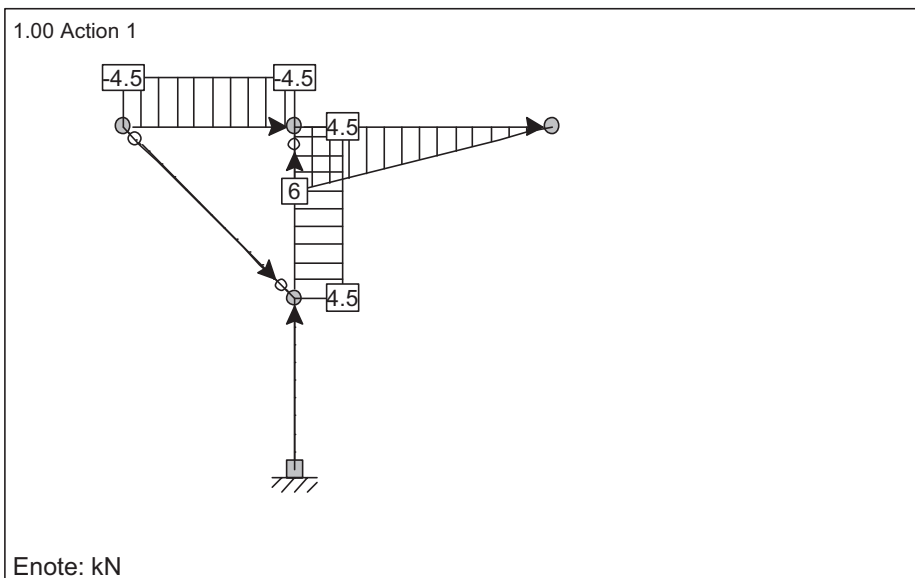
LC1: Load case 2: Upogibni moment My



LC1: Load case 2: Osna sila Fx

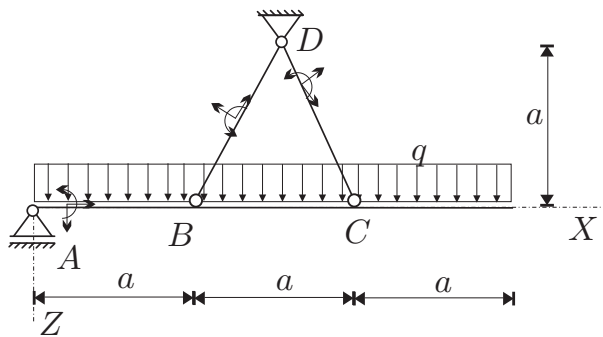


LC1: Load case 2: Preèna sila Fz



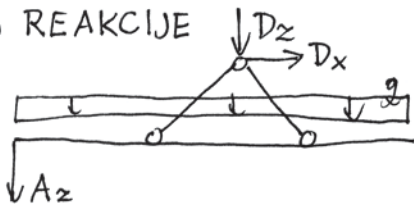
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločenosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 3 \text{ m}$,
 $q = 5 \text{ kN/m}$.



a.) $\widehat{m}_{ps} = 3 \cdot 3 - 2 - 1 - 3 \cdot 2 = 0$

b.) REAKCIJE



$\Sigma X: D_x = 0$

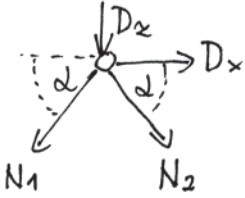
$\Sigma Z: A_z + D_z + g \cdot 3a = 0$

$A_z = 0$

$\Sigma M^A: -g \cdot 3a \cdot \frac{3a}{2} - D_z \cdot \frac{3a}{2} = 0$

$D_z = -45 \text{ kN}$

c.) SILE V PALICAH



$\Sigma X: -N_1 \cos \alpha + N_2 \cos \alpha + D_x = 0 \Rightarrow N_1 = N_2$

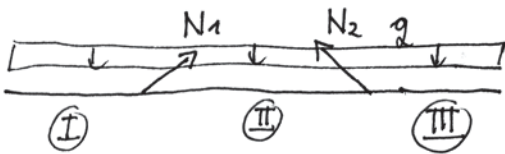
$\Sigma Z: D_z + N_1 \sin \alpha + N_2 \sin \alpha = 0$

$N_1 = -\frac{D_z}{2 \sin \alpha}$

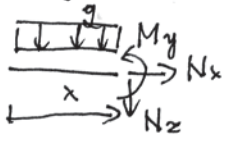
$N_1 = N_2 = 25.2 \text{ kN}$

$\text{tg} \alpha = \frac{3}{1.5} = 2$

d.) NOTRANJE SILE



polje I



$\Sigma x: N_x = 0$

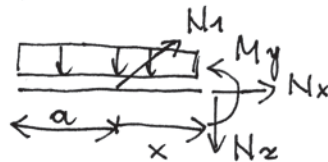
$\Sigma z: N_z = -g \cdot x$

$\Sigma M: M_y = -g \cdot x \cdot \frac{x}{2}$

$N_z = -5x$
 $M_y = -2.5x^2$
 $N_z(3) = -15 \text{ kN}$
 $M_y(3) = -22.5 \text{ kNm}$

polje II

$x \in [0, 3]$



$\Sigma x: N_x = -N_1 \cos \alpha$

$\Sigma z: N_z = -g(a+x) + N_1 \sin \alpha$

$\Sigma M: M_y = -g(a+x) \cdot \frac{a+x}{2} + N_1 \sin \alpha \cdot x$

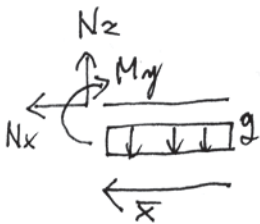
$N_x = -11.25 \text{ kN}$
 $N_z = 7.5 - 5x$

$M_y = -22.5 + 7.5x - 2.5x^2$

$x = 1.5 \text{ (ekstrem)}$

$M_y(1.5) = -16.8 \text{ kNm}$

polje III



$\Sigma x: N_x = 0$

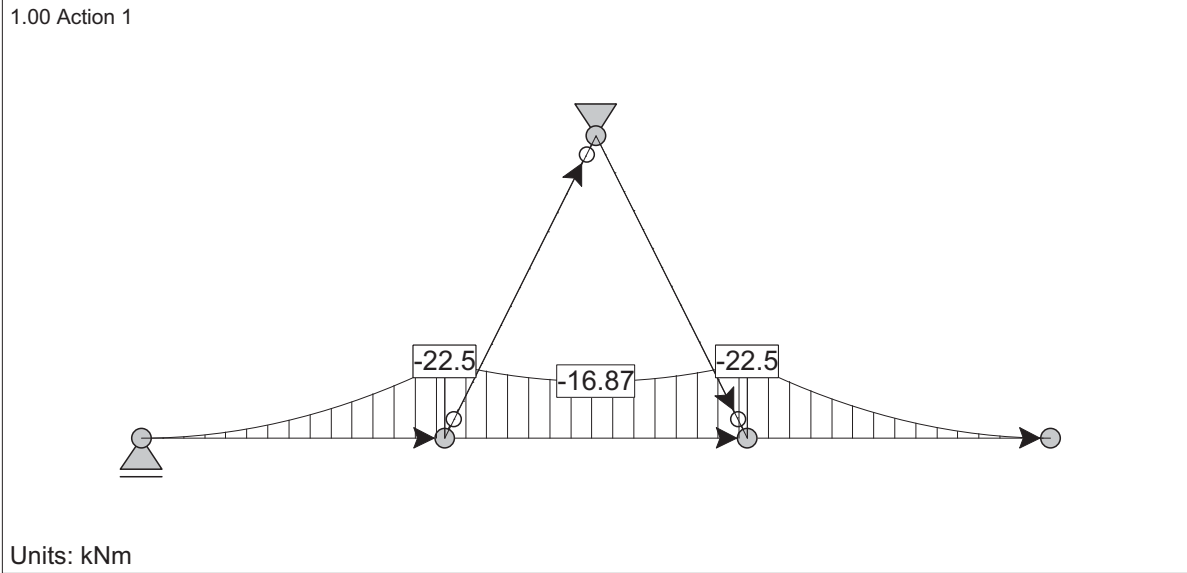
$\Sigma z: N_z = g \cdot \bar{x}$

$N_z = 5\bar{x}$

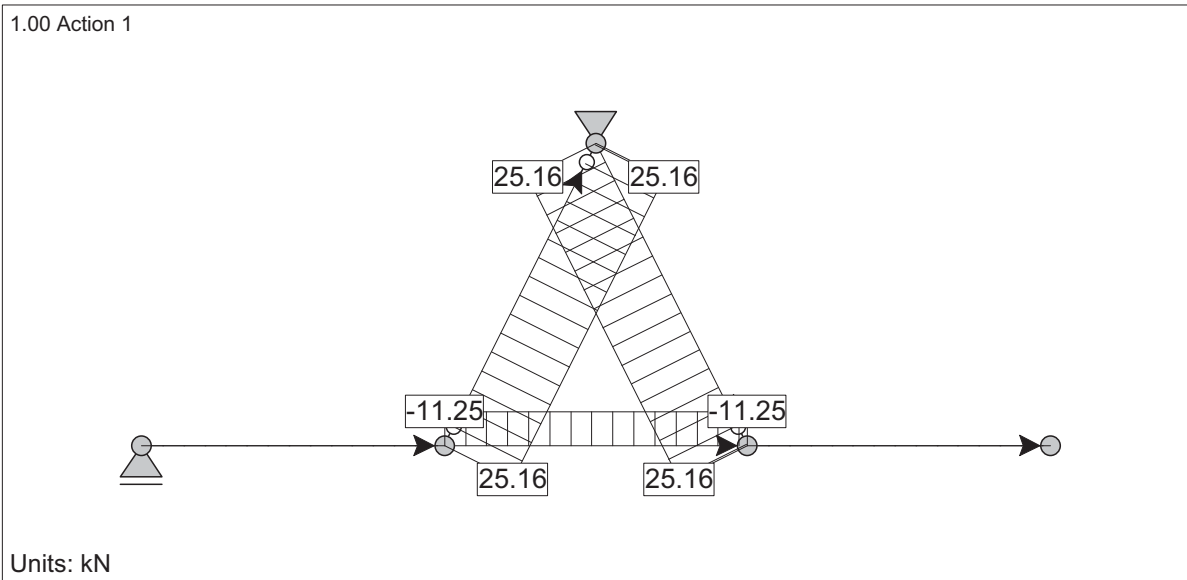
$\Sigma M: M_y = -g \cdot \bar{x} \cdot \frac{\bar{x}}{2}$

$M_y = -2.5\bar{x}^2$

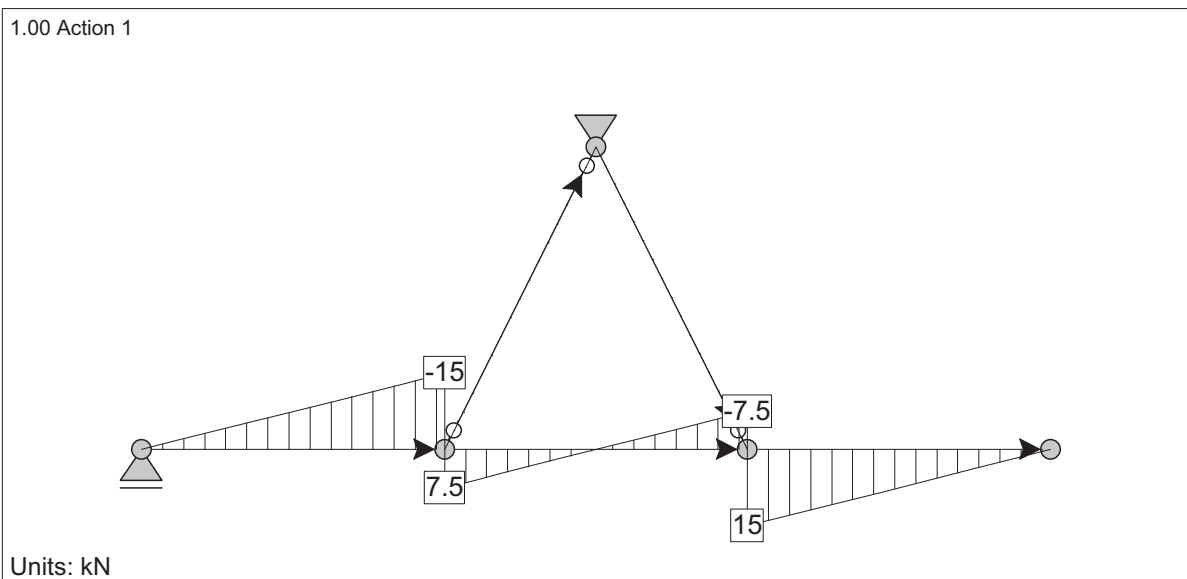
LC1: Load case 2: Bending Moments M_y



LC1: Load case 2: Axial Forces F_x



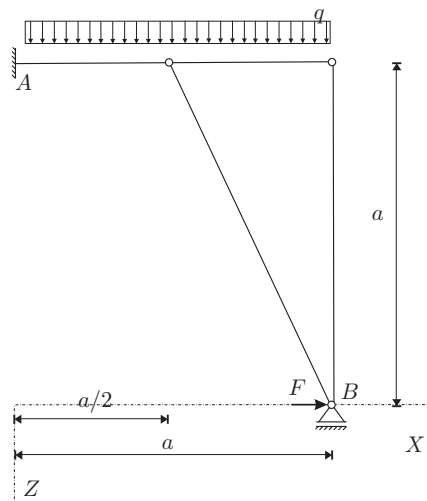
LC1: Load case 2: Shear Forces F_z



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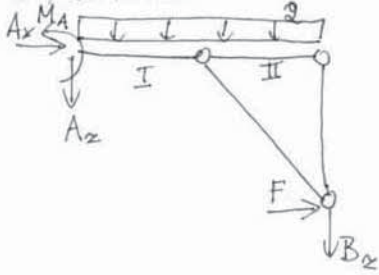
Za konstrukcijo na sliki izračunajte stopnjo statične nedoločnosti, reakcije in notranje statične količine (N_x, N_z, M_y)! Rezultate notranjih statičnih količin prikažite z diagrami!

Podatki: $a = 3\text{ m}$,
 $q = 10\text{ kN/m}$, $F = 20\text{ kN}$.



a.) $\tilde{m}_{ps} = 4 \cdot 3 - 3 \cdot 1 - 2 \cdot 2 - 2 \cdot 2 = 0$

b.) REAKCIJE

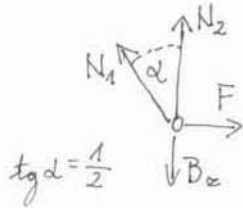


$\Sigma X: A_x + F = 0 \Rightarrow A_x = -F$

$\Sigma Z: A_z + B_z + q \cdot a = 0$

$\Sigma M^A: M_A - q \cdot a \cdot \frac{a}{2} + F \cdot a - B_z \cdot a = 0$

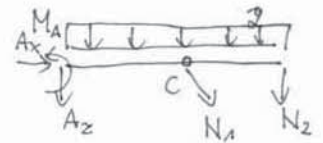
DODATNE ENAČBE: IZREŽEMO PALICI



$\Sigma x: N_1 \cdot \sin \alpha = F$

$\Sigma z: N_1 \cdot \cos \alpha + N_2 = B_z$

$A_x = -20 \text{ kN}$
 $B_z = 32.5 \text{ kN}$
 $A_z = -62.5 \text{ kN}$
 $M_A = 82.5 \text{ kNm}$

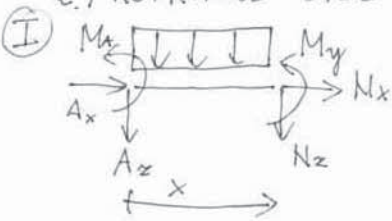


$\Sigma M^C: -N_1 \cdot \frac{a}{2} - q \cdot \frac{a}{2} \cdot \frac{a}{4} = 0$

$N_2 = -q \cdot \frac{a}{4} \Rightarrow N_2 = -7.5 \text{ kN}$

$N_1 = \frac{F}{\sin \alpha} \Rightarrow N_1 = 44.7 \text{ kN}$

c.) NOTRANJE SILE

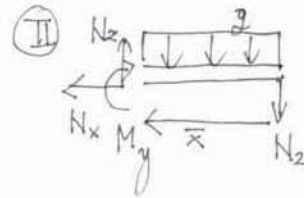


$N_x = 20 \text{ kN}$

$N_z = -A_z - q \cdot x$

$M_{ny} = -M_A - A_z x - q \cdot x \cdot \frac{x}{2}$

$N_z = 62.5 - 10x$
 $M_{ny} = -82.5 + 62.5x - 5x^2$



$N_x = 0$

$N_z = N_2 + q \cdot \bar{x}$

$M_{ny} = -N_2 \bar{x} - q \cdot \frac{\bar{x}^2}{2}$

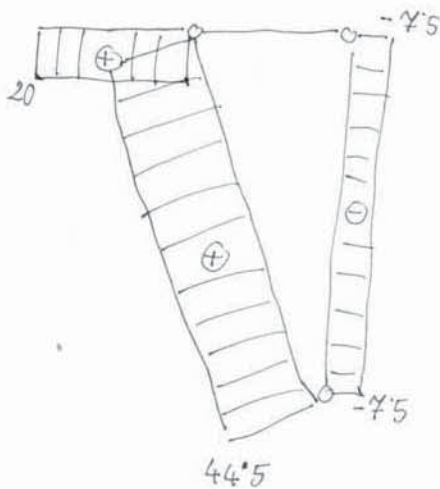
$N_z = -7.5 + 10\bar{x}$
 $M_{ny} = 7.5\bar{x} - 5\bar{x}^2$

$N_z(1.5) = 15 - 7.5 = 7.5 \text{ kN}$

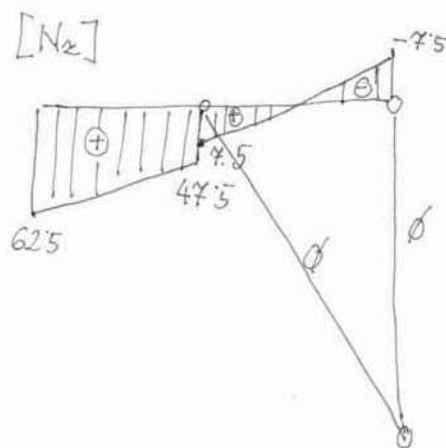
$M_{ny}(0.75) = 2.8 \text{ kNm (lebstrem)}$

d.) DIAGRAMI

[Nx]



[Nz]



[My]

