Vpisna številka: 261_ _ _ _ _

Ime in priimek:

| naloga	točk
1	
2	
3	
4	

1. Prostorski sistem treh sil deluje na togo kocko z robom $a = 3\,\mathrm{m}$, kot kaže slika. Prijemališče sile F_1 leži na premici skozi točki A' in C'. Smernica sile F_2 poteka skozi točki A in C, smernica sile F_3 pa skozi točki C' in D. Določi rezultanto sil in rezultanto momentov na točki B in C'! Določi še rezultantno momentov okrog osi, ki poteka skozi točki B in D'!
Podatki: $F_1 = 5\,\mathrm{kN}$, $F_2 = 15\,\mathrm{kN}$, $F_3 = 10\,\mathrm{kN}$.
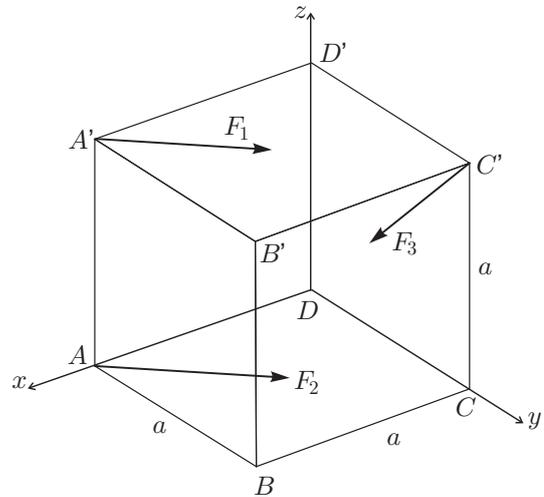
2. Za konstrukcijo na sliki določi računsko število prostostnih stopenj, navedi kinematične neznanke naloge in zapiši kinematične enačbe!
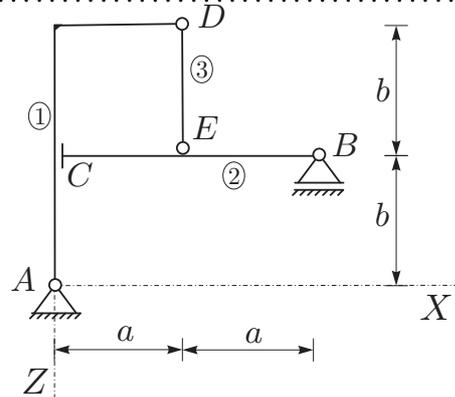

3. Za konstrukcijo na sliki določi računsko število prostostnih stopenj. Ali se dejansko število prostostnih stopenj ujema z računskim? Odgovor utemelji z uporabo ravnotežnih enačb!
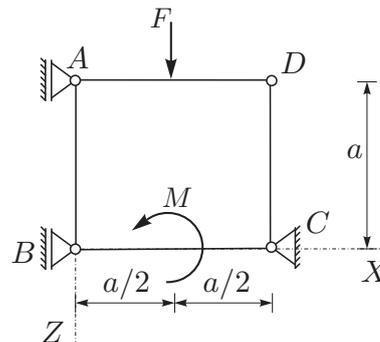

4. Za konstrukcijo na sliki določi računsko število prostostnih stopenj, reakcije in sile v vezeh B in C!
Podatki: $a = 2$ m, $F = 10\,\mathrm{kN}$, $q = 3\,\mathrm{kN/m}$.

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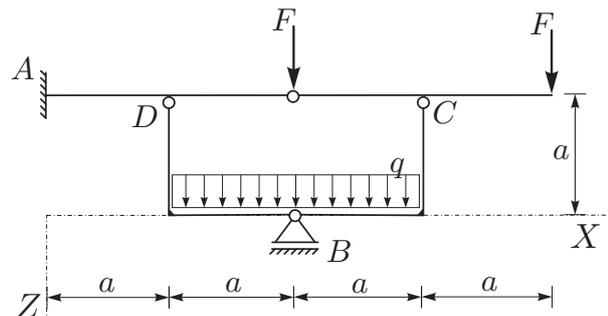
1. NALOGA
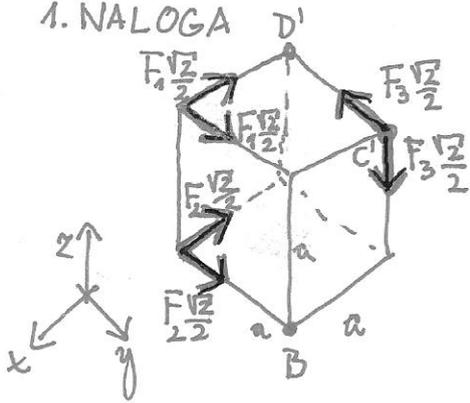
$$\vec{R} = \left(-F_1\frac{\sqrt{2}}{2} - F_2\frac{\sqrt{2}}{2}\right)\vec{e}_x + \left(F_1\frac{\sqrt{2}}{2} + F_2\frac{\sqrt{2}}{2} - F_3\frac{\sqrt{2}}{2}\right)\vec{e}_y - F_3\frac{\sqrt{2}}{2}\vec{e}_z$$

$$\boxed{\vec{R} = -10\sqrt{2}\,\vec{e}_x + 5\sqrt{2}\,\vec{e}_y - 5\sqrt{2}\,\vec{e}_z \ [kN]}$$

$$\vec{M}_R^B = a\left(-F_1\frac{\sqrt{2}}{2} + F_3\frac{\sqrt{2}}{2}\right)\vec{e}_x + a\left(-F_1\frac{\sqrt{2}}{2} - F_3\frac{\sqrt{2}}{2}\right)\vec{e}_y$$
$$+ a\left(-F_2\frac{\sqrt{2}}{2} - F_1\frac{\sqrt{2}}{2} + F_3\frac{\sqrt{2}}{2}\right)\vec{e}_z$$

$$\boxed{\vec{M}_R^B = \frac{15\sqrt{2}}{2}\vec{e}_x - \frac{45\sqrt{2}}{2}\vec{e}_y - 15\sqrt{2}\,\vec{e}_z \ [kNm]}$$

$$\vec{M}_R^{C'} = aF_2\frac{\sqrt{2}}{2}\vec{e}_x + aF_2\frac{\sqrt{2}}{2}\vec{e}_y + a\left(F_2\frac{\sqrt{2}}{2} - F_2\frac{\sqrt{2}}{2}\right)\vec{e}_z$$

$$\boxed{\vec{M}_R^{C'} = \frac{45\sqrt{2}}{2}\vec{e}_x + \frac{45\sqrt{2}}{2}\vec{e}_y \ [kNm]}$$

$$M_{BD'} = \vec{M}_R^B \cdot \vec{e}_{BD'} = \left(\frac{15\sqrt{2}}{2}, -\frac{45\sqrt{2}}{2}, -15\sqrt{2}\right) \cdot \left(-\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right) = 0 \quad \boxed{M_{BD'} = 0}$$

2. NALOGA

$$\widetilde{n}_{PS} = 3 \cdot 3 - 2 - 1 - 2 - 2 - 2 = 0$$
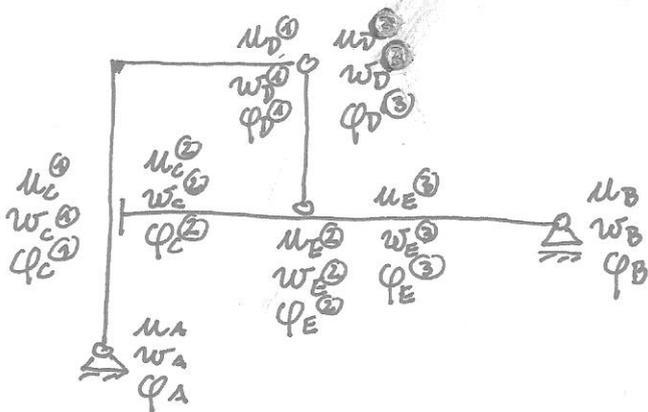
24 neznank ; $\widetilde{n}_{PS} = 0 \Rightarrow$ 24 enačb :

PODPORE: $\quad u_A = 0 \qquad\qquad w_B = 0$
$$w_A = 0$$

VEZI: $\quad u_C^{(1)} = u_C^{(2)} \qquad u_D^{(1)} = u_D^{(3)} \qquad u_E^{(2)} = u_E^{(3)}$
$$\varphi_C^{(1)} = \varphi_C^{(2)} \qquad w_D^{(1)} = w_D^{(3)} \qquad w_E^{(2)} = w_E^{(3)}$$

TELESA:

① : $\quad u_C^{(1)} = u_A - b\varphi_A$
$\quad\quad w_C^{(1)} = w_A$
$\quad\quad \varphi_C^{(1)} = \varphi_A$

② $\quad u_B = u_C^{(2)}$
$\quad\quad w_B = w_E^{(2)} - 2a\varphi_E^{(2)}$
$\quad\quad \varphi_B = \varphi_C^{(2)}$

③ : $\quad u_D^{(3)} = u_E^{(3)} - b\varphi_E^{(3)}$
$\quad\quad w_D^{(3)} = w_E^{(3)}$
$\quad\quad \varphi_D^{(3)} = \varphi_E^{(3)}$

$\quad\quad u_D^{(1)} = u_A - 2b\varphi_A$
$\quad\quad w_D^{(1)} = w_A - a\varphi_A$
$\quad\quad \varphi_D^{(1)} = \varphi_A$

$\quad\quad u_E^{(2)} = u_C^{(2)}$
$\quad\quad w_E^{(2)} = w_C^{(2)} - a\varphi_C^{(2)}$
$\quad\quad \varphi_E^{(2)} = \varphi_C^{(2)}$

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3. NALOGA $\tilde{n}_{PS} = 0$
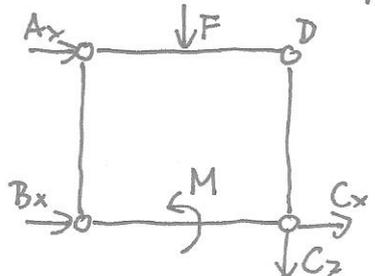
$\sum M^C: \quad -A_x \cdot a + F \frac{a}{2} + M = 0$

$\Rightarrow \quad \boxed{A_x = \frac{M}{a} + \frac{F}{2}}$

$\sum Z: \quad \boxed{C_z = -F}$

$\sum M^D: \quad B_x \cdot a + C_x \cdot a + M + F \frac{a}{2} = 0$

razrez:

$\text{II} \quad \sum_{DC} M^C: \quad \boxed{D_x = 0}$
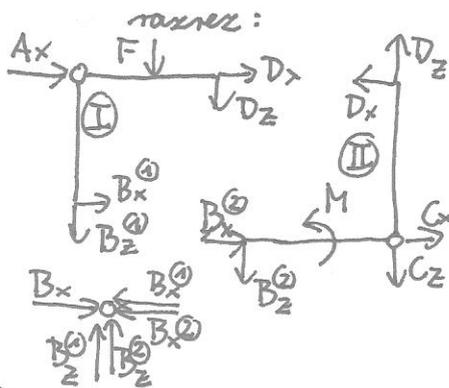
$\text{I} \quad \sum_{AB} M^A: \quad \boxed{B_x^{(1)} = 0}$

$\sum X^{(1)}: \quad A_x + B_x^{(1)} + D_x = 0$

$\Rightarrow \quad \boxed{A_x = 0}$

$\longrightarrow$ PROTISLOVJE $\longleftarrow$

$\Rightarrow \quad \boxed{n_{PS} > 0}$

4. NALOGA
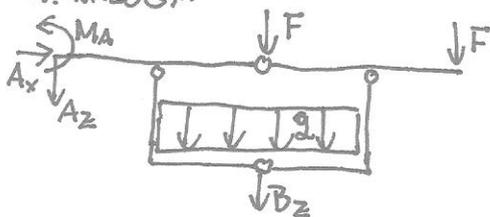
$\sum X: \quad \boxed{A_x = 0}$

$\sum Z: \quad A_z + B_z = -2F - g \cdot 2a$

$\sum M^A: \quad M_A - B_z \cdot 2a - F \cdot 2a - F \cdot 4a - g 2a \cdot 2a = 0$
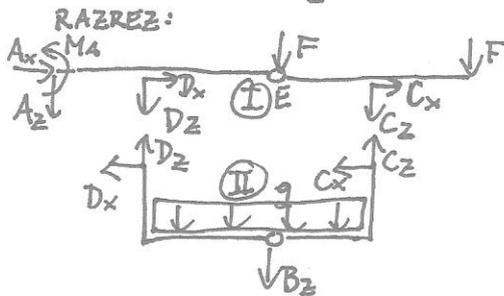
RAZREZ:

$\text{I}: \quad \sum_{\text{desni del}} M^E: \quad -C_z \cdot a - F 2a = 0 \quad \boxed{C_z = -2F} \quad \boxed{C_z = -20\,kN}$

$\text{II} \quad \sum_{BC} M^B: \quad C_x \cdot a + C_z \cdot a - g a \frac{a}{2} = 0 \quad \boxed{C_x = 2F + g \frac{a}{2}} \quad \boxed{C_x = 23\,kN}$

$\sum X: \quad -D_x - C_x = 0 \qquad D_x = -2F - g\frac{a}{2} \qquad D_x = -23\,kN$

$\sum_{BD} M^B: \quad D_x \cdot a - D_x \cdot a + g a \frac{a}{2} = 0 \quad D_z = -2F \qquad D_z = -20\,kN$

$\sum Z: \quad -D_z + B_z - C_z + g \cdot 2a = 0 \quad \boxed{B_z = -4F - 2ga} \quad \boxed{B_z = -52\,kN}$

$\Rightarrow \quad \boxed{A_z = 2F} \quad \boxed{A_z = 20\,kN}$

$\boxed{M_A = -2Fa} \quad \boxed{M_A = -40\,kNm}$

RAZREZ 2.
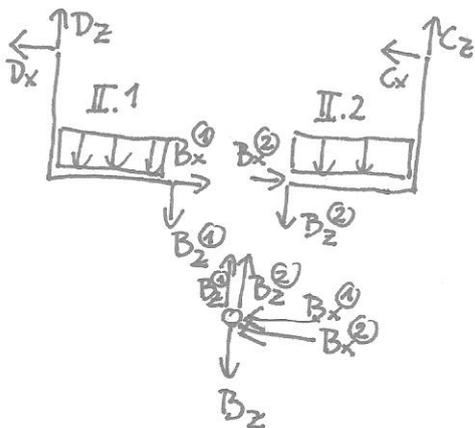
$\text{II.2}: \quad \sum X: \quad B_x^{(2)} = C_x \quad \boxed{B_x^{(2)} = 2F + g\frac{a}{2}} \quad \boxed{B_x^{(2)} = 23\,kN}$

$\sum Z: \quad B_z^{(2)} = C_z - ga \quad \boxed{B_z^{(2)} = -2F - ga} \quad \boxed{B_z^{(2)} = -26\,kN}$

VEZ B: $\quad \sum X: \quad B_x^{(1)} = -B_x^{(2)} \quad \boxed{B_x^{(1)} = -2F - g\frac{a}{2}} \quad \boxed{B_x^{(1)} = -23\,kN}$

$\sum Z: \quad B_z^{(1)} = B_z - B_z^{(2)} \quad \boxed{B_z^{(1)} = -2F - ga} \quad \boxed{B_z^{(1)} = -26\,kN}$