STATIKA OG, VSŠ

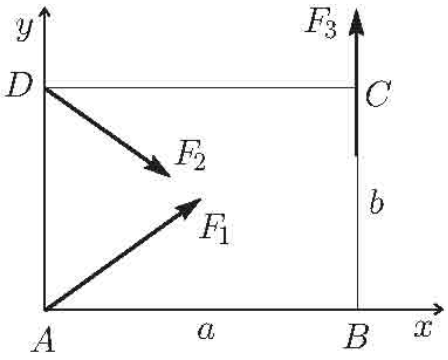
1. KOLOKVIJ, 24.04.2015

Naloga	Točke
1)	
2)	
3)	

Vpisna številka: 261 _ _ _ _ _

Ime in priimek:

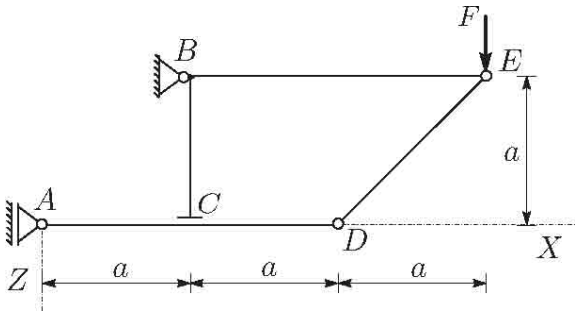
1) Na pravokotnik s stranicama a in b, ki leži v ravnini xy, deluje sistem treh sil, kot kaže slika. Prijemališče sile F_1 leži na premici skozi točki A in C. Smernica sile F_2 poteka skozi točki D in B, smernica sile F_3 pa skozi točki B in C.
Nadomesti dani sistem sil z:
a) silo in momentom v točki A;
b) silo in momentom v težišču pravokotnika;
c) eno samo silo!



Podatki: F_1 = 10 kN, F_2 = 20 kN, F_3 = 5 kN
a = 4 m, b = 3 m.

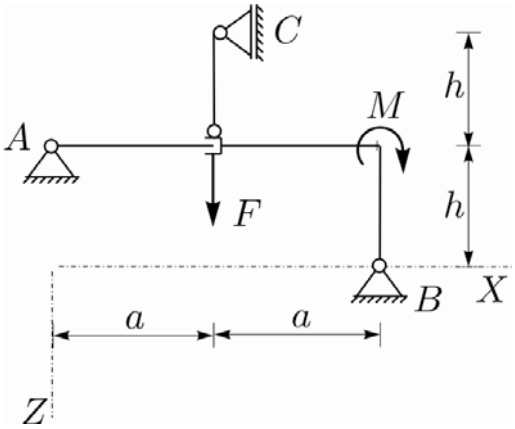
2.) Za konstrukcijo na sliki določi računsko število prostostnih stopenj, reakcije in sile v vezeh. Rezultate prikažite tudi grafično.

Podatki: a = 2 m, F = 10 kN.



3.) Za konstrukcijo na sliki določite računsko število prostostnih stopenj, reakcije in sile v vezeh. Rezultate prikažite tudi grafično.

Podatki: F = 10 kN, M = 20 kNm,
a = 4 m, h = 3 m.



Točkovanje: 20% + 40% + 40% = 100%

1. NALOGA $\vec{F}_1 = 10\,\frac{(4,3)}{5} = (8,6)$, $\vec{F}_2 = 20\,\frac{(4,-3)}{5} = (16,-12)$, $\vec{F}_3 = (0,5)$ $\Rightarrow$ $\vec{R} = (24,-1)$

$\boxed{R_x = 24\ kN}$

$\boxed{R_y = -1\ kN}$

a.) $M_e^A = -|F_{2x}| \cdot b + |F_{3y}| \cdot a = -16 \cdot 3 + 5 \cdot 4 \Rightarrow \boxed{M_e^A = -28\ kNm}$

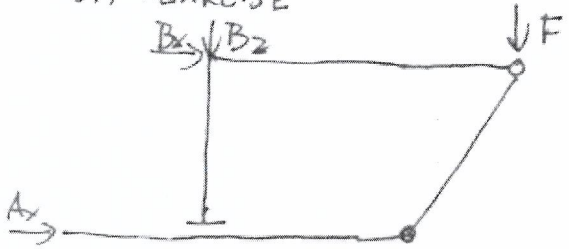
b.) $\boxed{M_e^T = F_3 \cdot \frac{a}{2} = 10\ kNm}$

c.) $M_e^A \cdot \vec{l}_z = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ x & y & 0 \\ 24 & -1 & 0 \end{vmatrix} \Rightarrow -24y = x - 28$ $\boxed{y = -\frac{x}{24} + \frac{28}{24}}$

2

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

b.) REAKCIJE



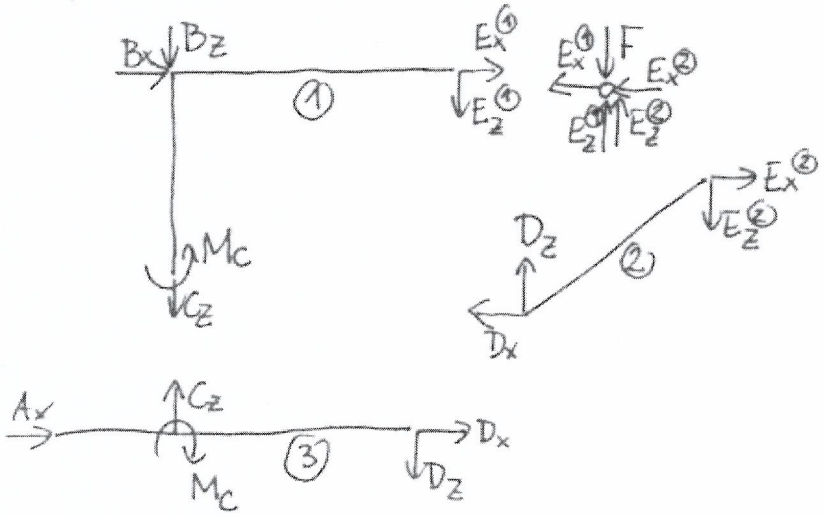
$\Sigma X: A_x + B_x = 0$

$\Sigma Z: B_z + F = 0 \Rightarrow \boxed{B_z = -10\,kN}$

$\Sigma M^B: A_x \cdot a - F 2a = 0 \Rightarrow \boxed{A_x = 20kN}$

$\boxed{B_x = -20kN}$

b.) SILE V VEZEH



③: $\Sigma X: A_x + D_x = 0$

$\boxed{D_x = -20kN}$

②: $\Sigma M^E_{DE}: -D_x \cdot a - D_z \cdot a = 0$

$\boxed{D_z = 20\,kN}$

$\Sigma X: \boxed{E_x^{②} = -20\,kN}$

$\Sigma Z: \boxed{E_z^{②} = 20\,kN}$

③: $\Sigma M^C_{AD}: -M_C - D_z \cdot a = 0$

$\boxed{M_C = -40\,kNm}$

$\Sigma Z: -C_z + D_z = 0$

$\boxed{C_z = 20\,kN}$

VEZ Ⓔ:

$\Sigma X: \boxed{E_x^{①} = 20\,kN}$

$\Sigma Z: \boxed{E_z^{①} = -10\,kN}$

TELO ① (KONTROLE):

$\Sigma X \; B_x + E_x^{①} = 0$ ✓

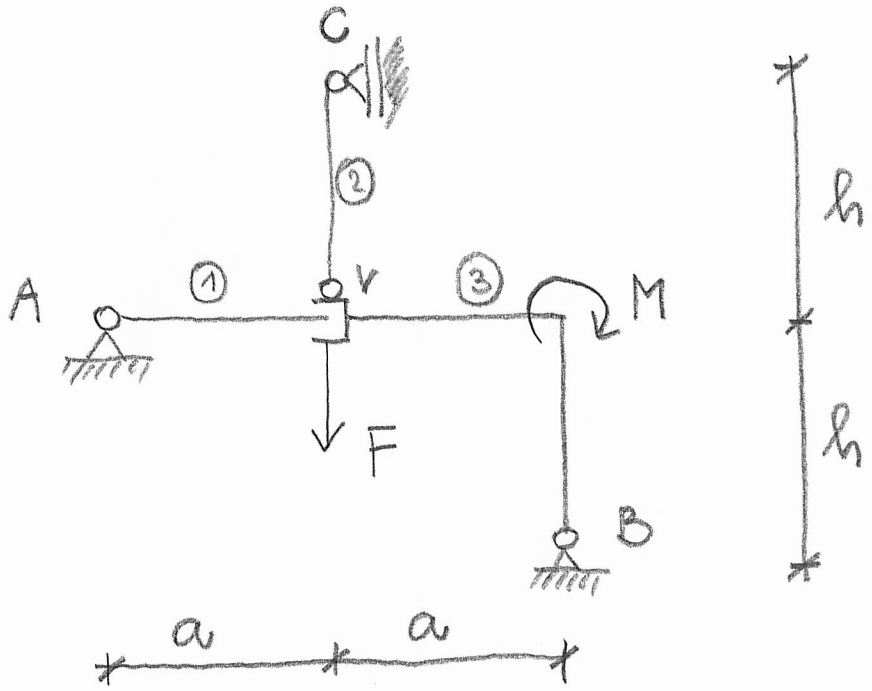
$\Sigma Z: C_z + B_z + E_z^{①} = 0$ ✓

3 $a = 4m$

$h = 3m$

$F = 10kN$

$M = 20kNm$



3.1 IZRAČUN $\tilde{M}_{ps}$:

$$\tilde{M}_{ps} = 3K - \sum M_{opsp} - \sum M_{opsv}$$

VSE PODPORE VSE VEZI

$$= 3 \cdot 3 - (2+2+1) - 4 = 0$$

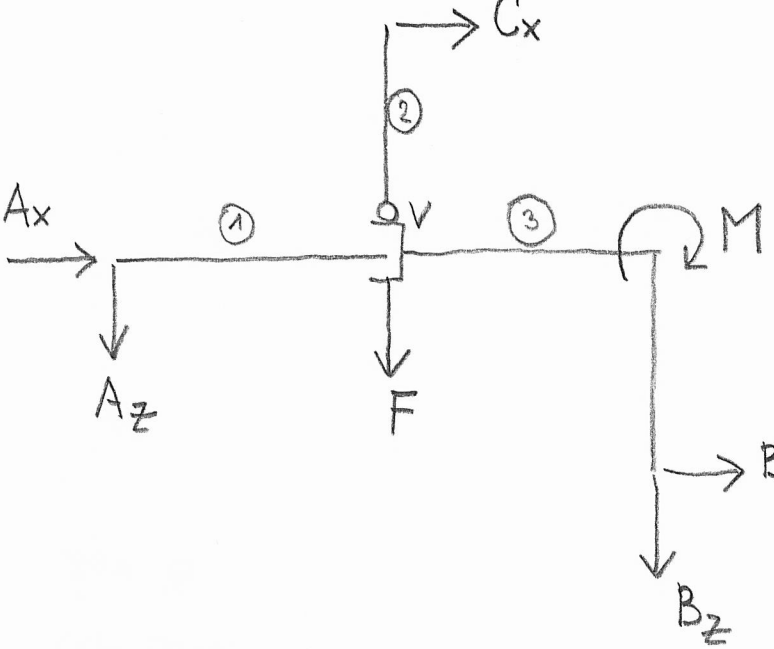
$$M_x^{(2)} = M_x^{(3)} \quad 1$$

$$M_z^{(1)} = M_z^{(2)} \quad 2$$

$$M_z^{(1)} = M_z^{(3)} \quad 3$$

$$p_y^{(1)} = p_y^{(3)} \quad 4$$

3.2 IZRAČUN REAKCIJ



1.) $\sum_{(1)} x = 0 \rightarrow \boxed{A_x = 0}$

2.) $\sum_{(2)} M_y^V = 0 \rightarrow \boxed{C_x = 0}$

3.) $\sum_{(1)(2)(3)} x = 0 \rightarrow \boxed{B_x = 0}$

4.) $\sum_{(1)(2)(3)} z = 0$

$\Rightarrow A_z + B_z + F = 0$

5.) $\sum M_y^{A\,(1,2,3)} = 0 \rightarrow -F\cdot a - M - B_z \cdot 2a = 0$

$$B_z = \frac{-F\cdot a - M}{2a} = \frac{-10\cdot 4 - 20}{8} = \frac{-60}{8}\ kN$$

$$\boxed{B_z = -7.5\ kN}$$

4.) $\rightarrow \quad A_z = -B_z - F = 7.5 - 10 = -2.5\ kN$

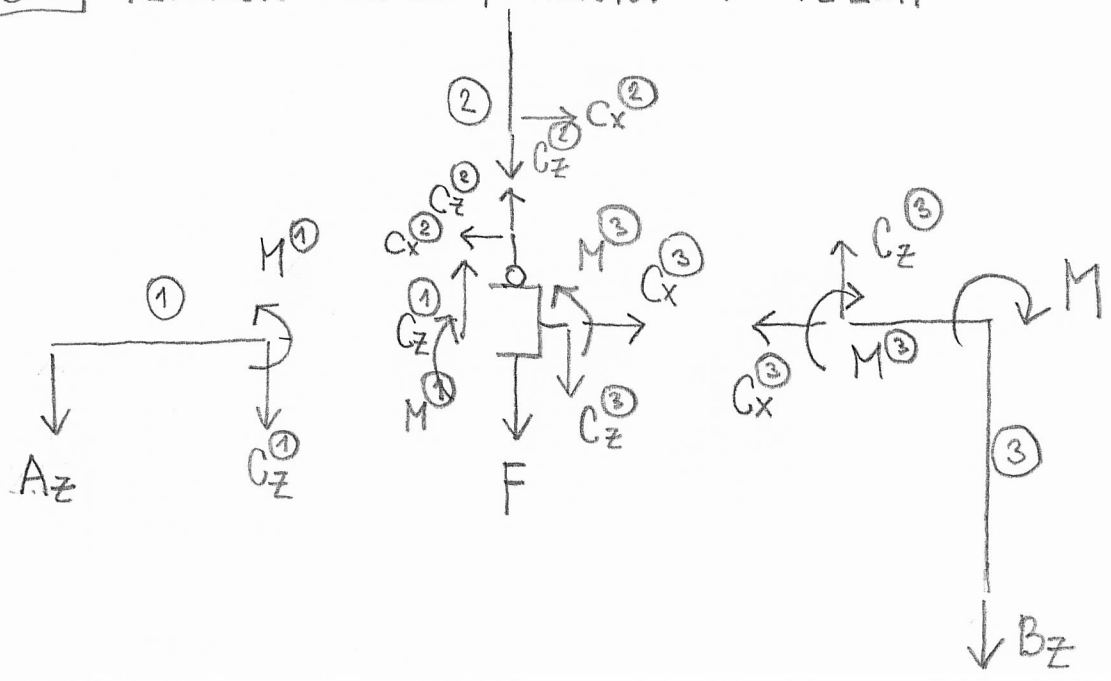
$$\boxed{A_z = -2.5\ kN}$$

KONTROLA: $\sum M_y^{B\,(1,2,3)} = 0$?

$$A_z \cdot 2a + F\cdot a - M = 0$$

$$-2.5\cdot 2\cdot 4 + 10\cdot 4 - 20 = 0 \quad \checkmark$$

3.3 IZRAČUN SIL IN MOMENTOV V VEZEH



1. T. T.

$$\Sigma z = 0 \rightarrow A_z + C_z^{(1)} = 0 \Rightarrow C_z^{(1)} = -A_z$$

$$\boxed{C_z^{(1)} = 2.5\ kN}$$

$$\Sigma M_y^{A\,(1)} = 0 \Rightarrow M^{(1)} - C_z^{(1)} \cdot a = 0$$

$$M^{(1)} = C_z^{(1)} \cdot a = 2.5 \cdot 4 = 10$$

$$\boxed{M^{(1)} = 10\ kNm}$$

2. T. T

$$\Sigma x = 0 \rightarrow \boxed{C_x^{(2)} = 0}$$

$$\Sigma z = 0 \rightarrow \boxed{C_z^{(2)} = 0}$$

3. T. T

$$\Sigma x = 0 \rightarrow \boxed{C_x^{(3)} = 0}$$

$$\Sigma z = 0 \rightarrow B_z - C_z^{(3)} = 0 \Rightarrow C_z^{(3)} = B_z$$

$$\boxed{C_z^{(3)} = -7.5\ kN}$$

$$\Sigma M_y^{B\,(3)} = 0 \Rightarrow -M^{(3)} - M - C_z^{(3)} \cdot a = 0$$

$$M^{(3)} = -M - C_z^{(3)} \cdot a$$

$$= -20 + 7.5 \cdot 4 \Rightarrow \boxed{M^{(3)} = 10\ kNm}$$

KONTROLA:

VEZ V

$$\Sigma x = 0 \rightarrow C_x^{(3)} = 0 \checkmark$$

$$\Sigma z = 0 \rightarrow -C_z^{(1)} + F + C_z^{(3)} - C_z^{(2)} = 0$$

$$-2.5 + 10 - 7.5 - 0 = 0$$

$$0 = 0 \quad \checkmark$$

$$\overset{\vee}{\Sigma} M_y = 0 \Rightarrow -M^{①} + M^{③} = 0$$

$$-10 + 10 = 0$$

$$0 = 0 \quad \checkmark$$

3.4 GRAFIČNI PRIKAZ REZULTATOV