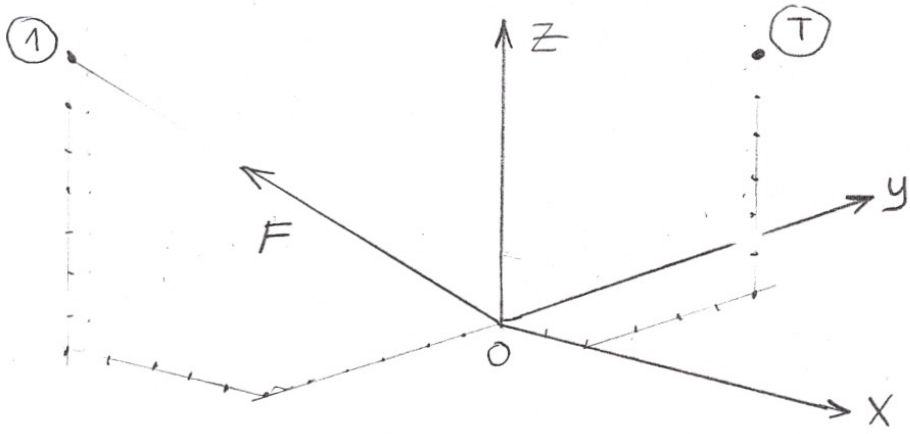
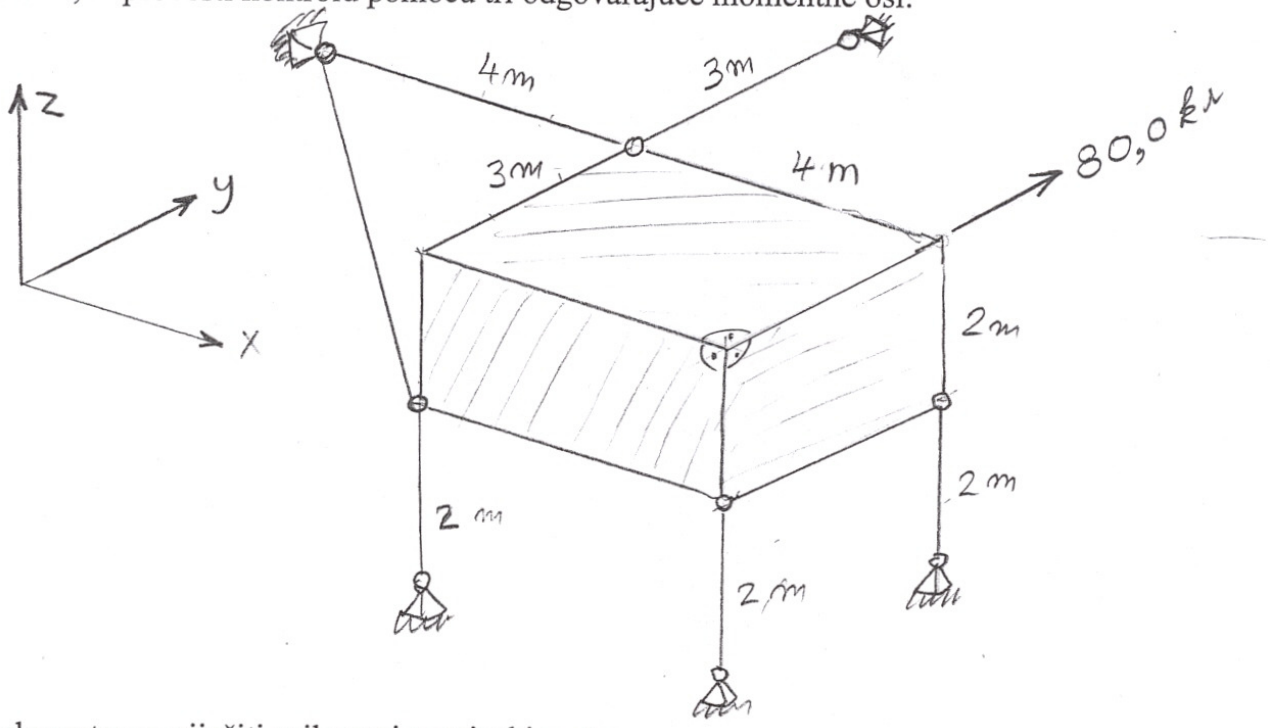
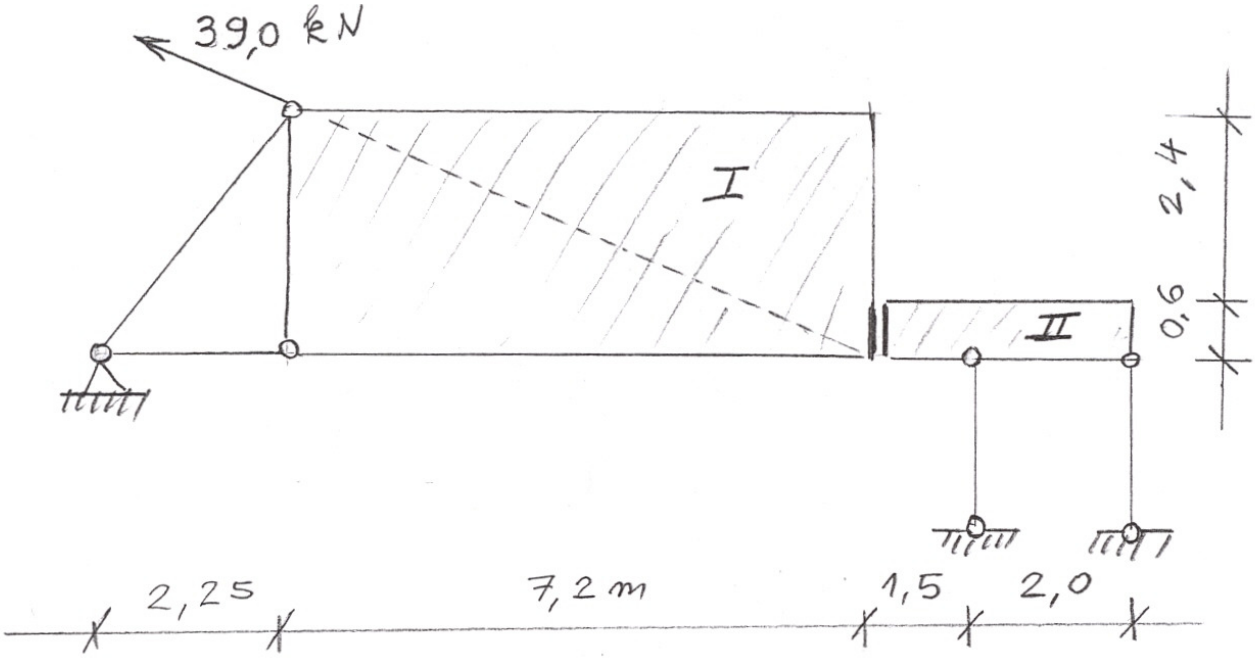
1. Vektor sile F leži na spojnici (0,1), koja je zadana koordinatama točke 1: (-5.; -6.; +7.) i ishodištem. Vektor F je usmjeren od ishodišta prema točki 1. Zadana je točka T(2.; 4.; 6.). Promatra se vektor momenta sile F na točku T. Veličina tog vektora momenta je označena s M. Vektor F treba odrediti tako da apsolutni iznos M bude jednak 200.



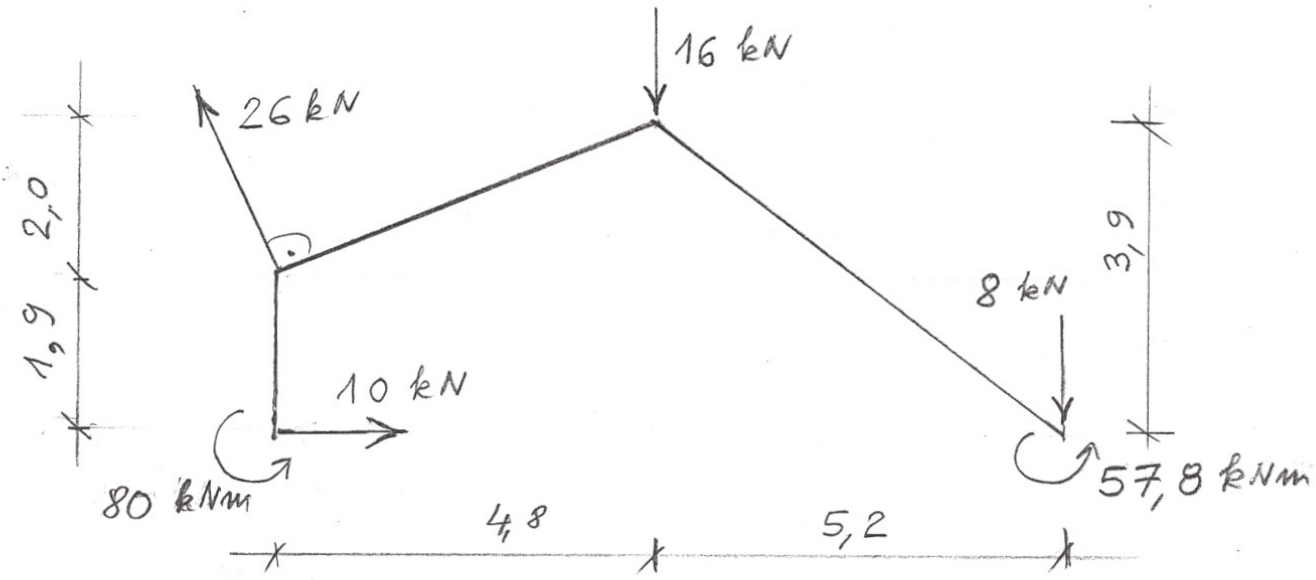
2. Treba odrediti sile u zglobnim štapovima prikazanog prostornog sustava koji se nalazi u ravnoteži, te provesti kontrolu pomoću tri odgovarajuće momentne osi.



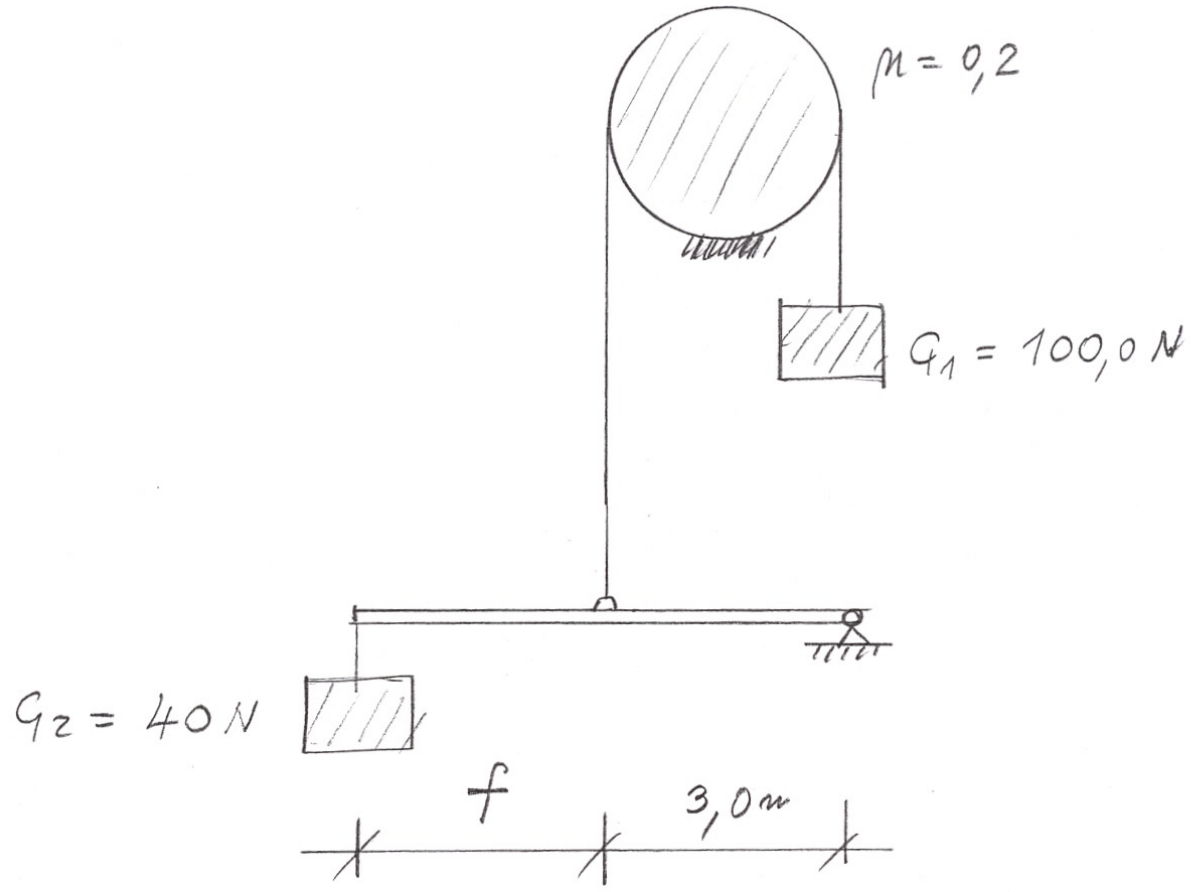
3. Treba potpuno riješiti prikazani ravninski sustav



4. Treba odrediti podatke za M,T,N dijagrame. Za svaku granu prikazati detaljno postupak za jedan presjek. Priznaju se samo podaci uneseni na pripadni dijagram (dovoljna je uredna skica slobodnom rukom)



5. Prikazani se sustav nalazi u stanju ravnoteže. Koeficijent trenja između valjka i idealne niti koja je bez težine je zadan i iznosi $\mu = 0.2$. Koje vrijednosti može poprimiti duljina f, a da pri tome sustav ostane u stanju ravnoteže?



1) NA PRAVCU SILE UVODI SE VEKTOR $\vec{p}$.

$\vec{p} = -5\vec{i} - 6\vec{j} + 7\vec{k}$

VEKTOR SILE $\vec{F} = \lambda \vec{p}$. λ JE NEPOZNATI SKALAR.

$\vec{M} = \vec{\ell} \times \vec{F}$; ODABRANO: $\vec{\ell} = -2\vec{i} - 4\vec{j} - 6\vec{k}$

$$\vec{M} = \lambda \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -2 & -4 & -6 \\ -5 & -6 & +7 \end{vmatrix} = \lambda(-64\vec{i} + 44\vec{j} - 8\vec{k})$$

$$|\vec{M}| = \lambda \sqrt{64^2 + 44^2 + 8^2} = \lambda \cdot 78,0769$$

$$200 = \lambda \cdot 78,0769 \; ; \quad \lambda = 2,56158$$

$$\vec{F} = \lambda \cdot \vec{p} = -12,8079\vec{i} - 15,3695\vec{j} + 17,9312\vec{k}$$ [15]

KONTROLA

NOVI GEOMETRIJSKI VEKTOR $\vec{\ell}_K = \vec{r}_1 - \vec{r}_T$

$\vec{\ell}_K = (-5-2)\vec{i} + (-6-4)\vec{j} + (7-6)\vec{k}$

$\ell_K = -7\vec{i} - 10\vec{j} + 1\cdot\vec{k}$

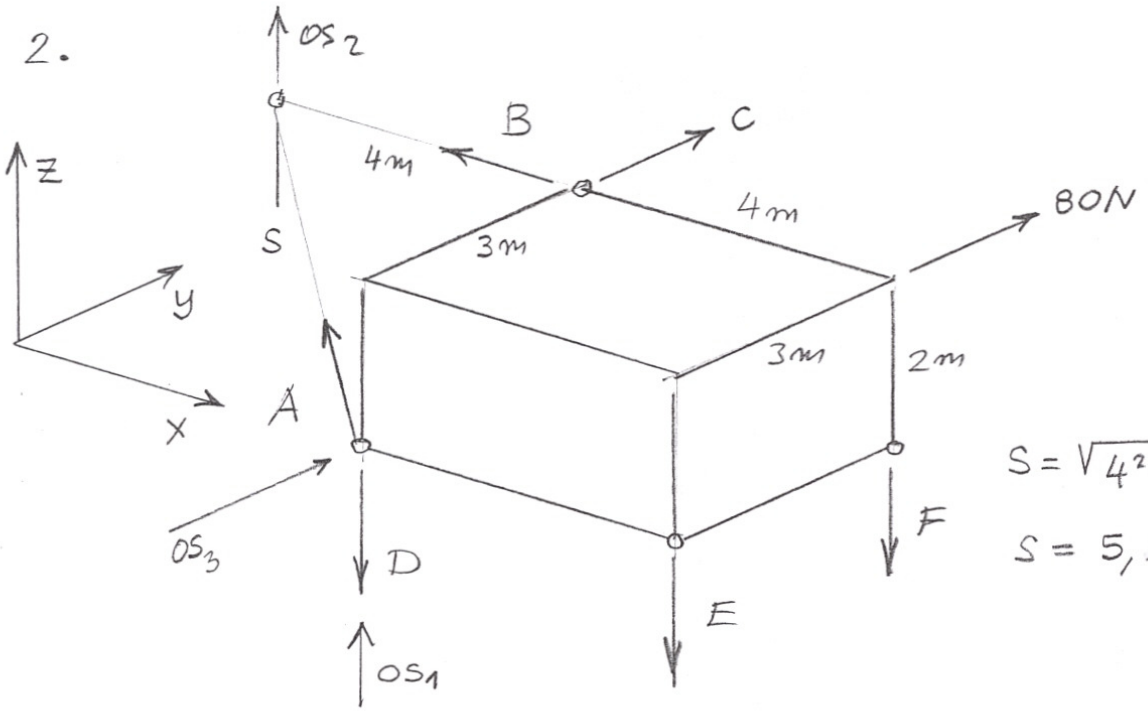
$$\vec{M}_K = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -7 & -10 & +1 \\ -12,8079 & -15,3695 & +17,9312 \end{vmatrix} =$$

$$= -163,943\cdot\vec{i} + 112,711\cdot\vec{j} - 20,493\cdot\vec{k}$$

$$|\vec{M}_K| = \sqrt{163,943^2 + 112,711^2 + 20,493^2} = 200,003 \checkmark$$

[5]

2.



$S = \sqrt{4^2+3^2+2^2}$

$S = 5,3852\ m$

$\sum M_{OS1} = \phi$; $+3 \cdot B + 4 \cdot 80 = \phi$; $B = -106,667\ N$ [2]

$\sum X = \phi$; $-B - \frac{4}{S} A = \phi$; $A = +143,604\ N$ [2]

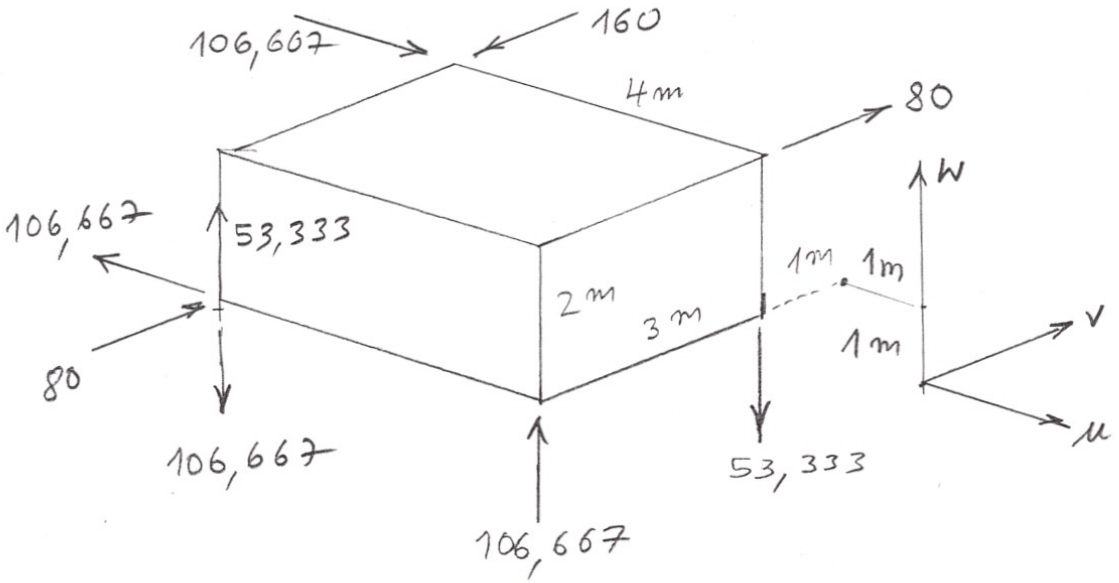
$\sum M_{OS2} = \phi$; $+4 \cdot C + 8 \cdot 80 = \phi$; $C = -160,000\ N$ [2]

$\sum M_X = \phi$; $2 \cdot C + 2 \cdot 80 + 3 \cdot F = \phi$; $F = +53,333\ N$ [2]

$\sum M_{OS3} = \phi$; $-2 \cdot B + 4 \cdot E + 4 \cdot F = \phi$; $E = -106,667\ N$ [2]

$\sum Z = \phi$; $\frac{2}{S} A - D - E - F = \phi$; $D = +106,667\ N$ [2]

STVARNA DJELOVANJA [2]



2. NASTAVAK

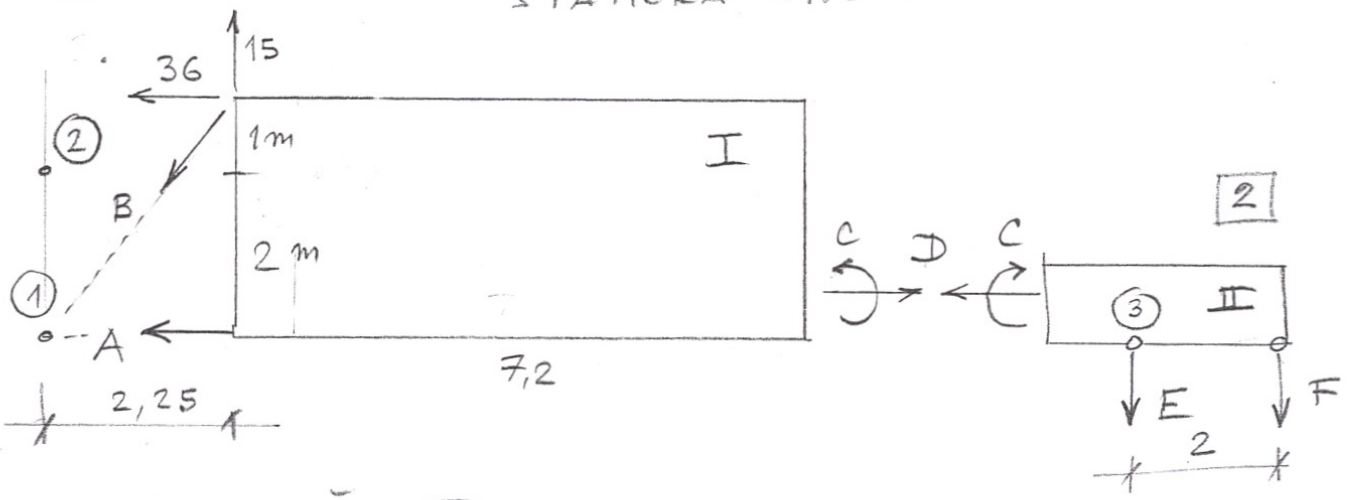
KONTROLA

$\Sigma M_u = +3 \cdot 160 - 3 \cdot 80 + 4 \cdot (106,667 - 106,667 - 53,333)$
$- 1 \cdot 80 + 1 \cdot 53,333 = +0,001$ ✓ [2]

$\Sigma M_v = +3 \cdot 106,667 - 1 \cdot 106,667 + 5 (53,333 - 106,667)$
$+ 1 \cdot (106,667 - 53,333) = -0,002$ ✓ [2]

$\Sigma M_w = +1 \cdot 106,667 + 5 \cdot 160 - 1 \cdot 80 - 4 \cdot 106,667 - 5 \cdot 80 = -0,01$ ✓ [2]

3. STATIČKA SHEMA



[2]

RAVNOTEŽA II

$\Sigma X = \phi$; $D = \phi$. [2]

12

RAVNOTEŽA I

$\Sigma Y = \phi$; $B = \frac{15}{0,8} = +18,75$ kN [2]

$\Sigma X = \phi$; $A = -36 - 0,6 \cdot B = -47,25$ kN [2]

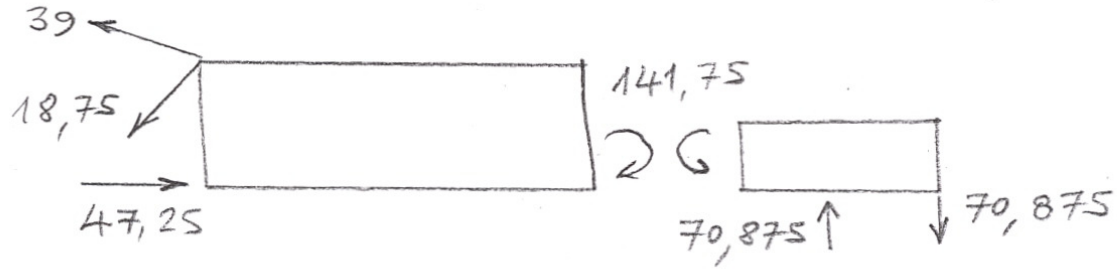
$\Sigma M_{(1)} = \phi$ $C = -2,25 \cdot 15 - 3 \cdot 36 = -141,75$ [2]

KONTROLA $\Sigma M_{(2)} = 2,25 \cdot 15 + 1 \cdot 36 - 1,2 \cdot 18,75$
$+ 2 \cdot 47,25 - 141,75 = 0,00$ ✓ [4]

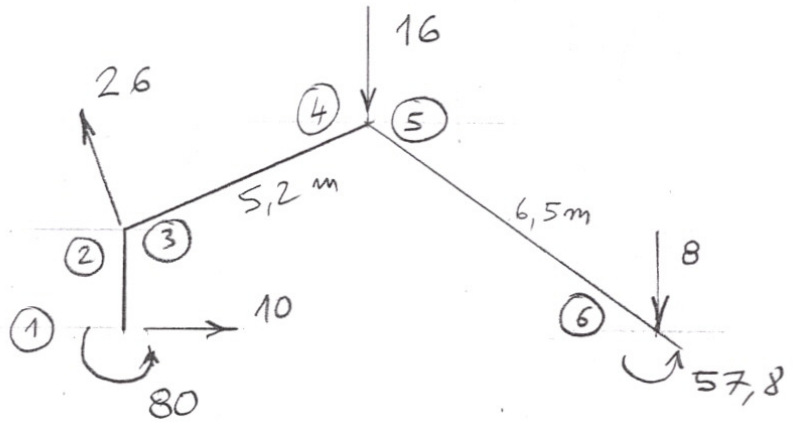
RAVNOTEŽA II [2]

$\Sigma M_3 = \phi$; $F = -\frac{C}{2,0} = 70,875$; $\Sigma Y = \phi$; $E = -70,875$ [2]

STVARNA DJELOVANJA [2]



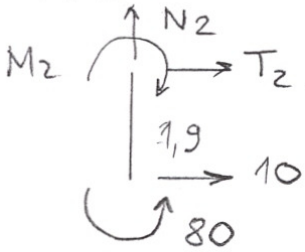
4.



$|M_1| = 80$ VLAK LIJEVO

$|M_6| = 57,8$ VLAK LIJEVO

PRESJEK 2



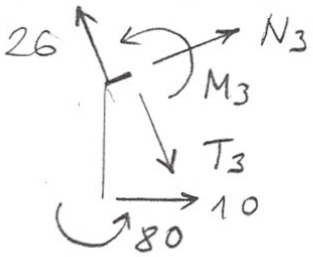
[2]

$M_2 = 80 + 1,9 \cdot 10 = +99$ (VLAK LIJEVO) kNm

$T_2 = -10$ kN [1]

$N_2 = \phi$ [1]

PRESJEK 3

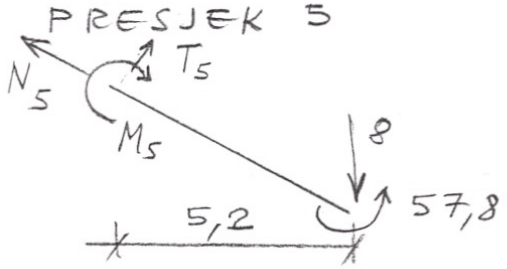


$M_3 = -99$ kNm (VLAK GORE) [1]

$T_3 = 26 - \frac{2}{5,2} \cdot 10 = 22,154$ kN [2]

$N_3 = -\frac{4,8}{5,2} \cdot 10 = -9,2308$ kN [1]

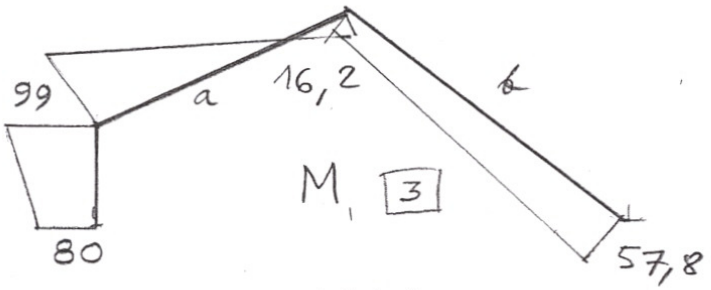
PRESJEK 5



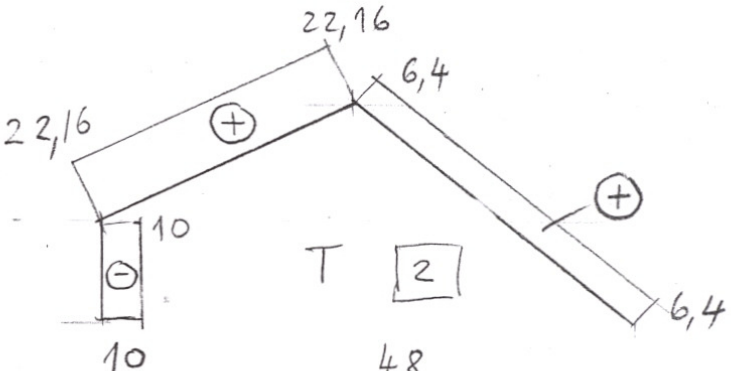
$M_5 = -5,2 \cdot 8 + 57,8 = 16,2$ kNm [2] (VLAK DOLJE)

$T_5 = 0,8 \cdot 8 = 6,4$ kN [1]

$N_5 = 0,6 \cdot 8 = 4,8$ kN [1]



M [3]

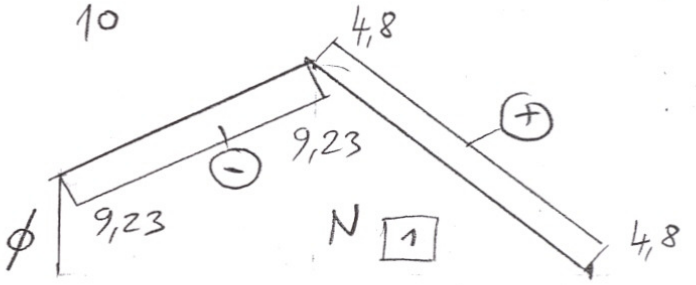


T [2]

KONTROLA

$\left(\frac{dM}{ds}\right)_a = \frac{16,2-(-99)}{5,2} = 22,154$ [1]

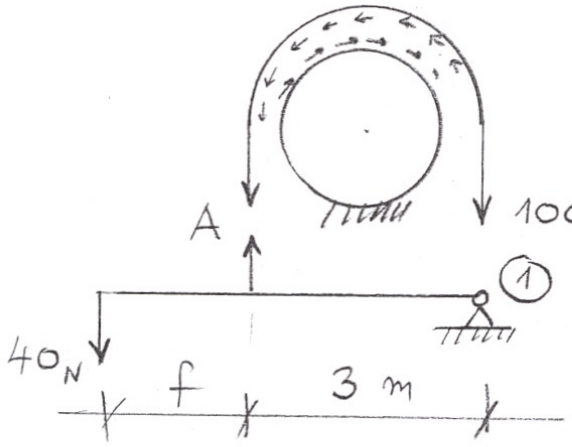
$\left(\frac{dM}{ds}\right)_b = \frac{57,8-16,2}{6,5} = 6,400$ [1]



N [1]

5.

a) TEŽNJA DIZANJA GREDE



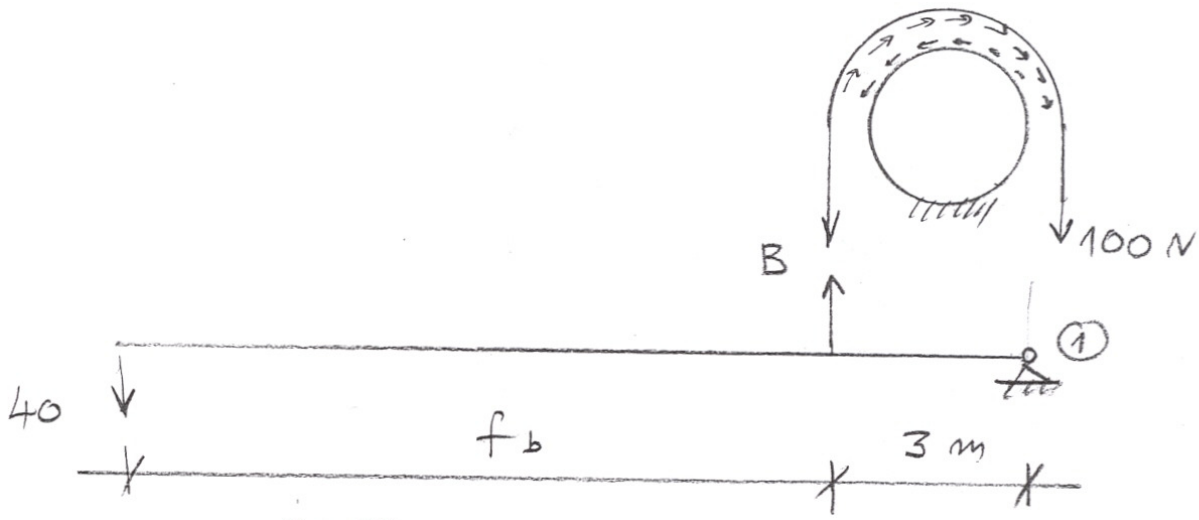
$$A = \frac{100}{e^{0,2\cdot\pi}} = 53,349$$

$$\Sigma M(1) = \phi$$

$$(f_a + 3)\,40 - 3 \cdot A = \phi$$

$$f_a = 1,001 \text{ m} \quad [8]$$

b) TEŽNJA SPUŠTANJA GREDE



$$B = 100 \cdot e^{0,2\cdot\pi} = 187,446$$

$$\Sigma M(1) = \phi \; ; \quad (f_b + 3) \cdot 40 - 3 \cdot B = \phi$$

$$f_b = 11,058 \quad [8]$$

$$1,001 \leq f \leq 11,058 \quad [4]$$