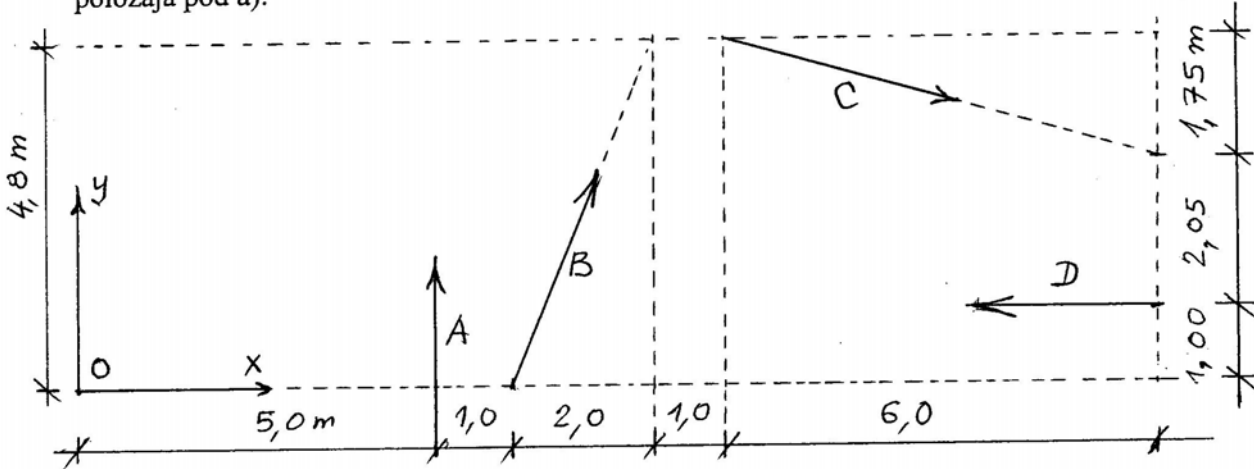


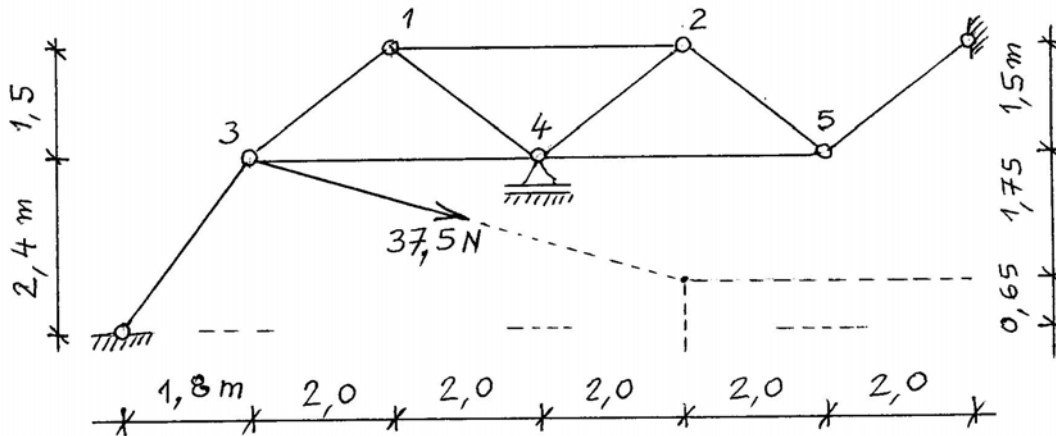
1. U ravnini xy zadani su pomoću skice položaji pravaca djelovanja sila čije su veličine označene sa A, B, C, D . Zadano je $A = 2.95 \text{ N}$, $B = 5.2 \text{ N}$, $C = 6.25 \text{ N}$, $D = 3.5 \text{ N}$.

Treba odrediti:

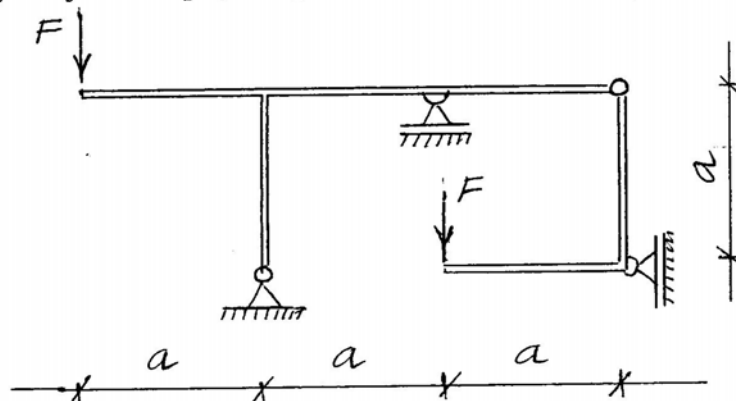
- Položaj pravca djelovanja i vektor rezultante grafički i to isključivo direktnim postupkom (veržni se poligon ne priznaje). Iskazati mjerilo i očitati R .
- Vektor rezultante (R_x, R_y, R) računskim postupkom, te jednadžbu pravca rezultante. Tako određeni pravac treba prikazati na zasebnoj skici ali u istom mjerilu koje je odabrano za plan položaja pod a).



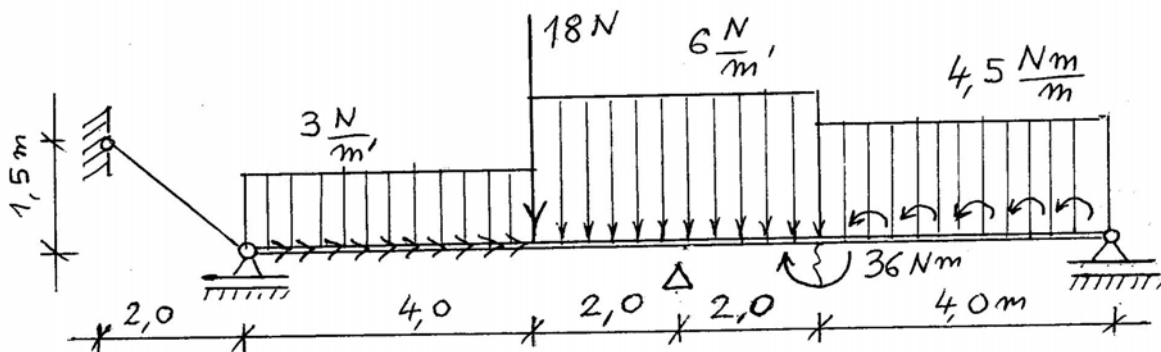
2. Treba odrediti sile u zglobnim štapovima prikazanog ravninskog rešetkastog sustava koji se nalazi u ravnoteži, te provesti odgovarajuće kontrole.



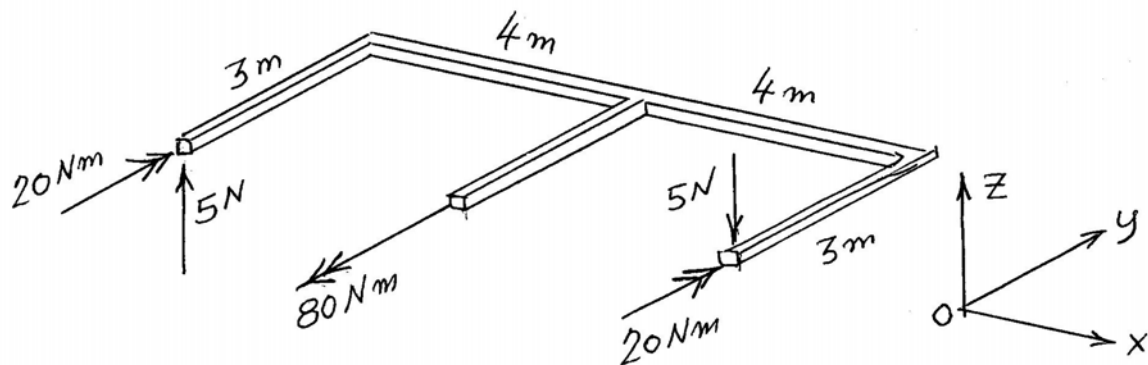
3. Treba potpuno riješiti prikazani ravninski štapni sustav za zadane opće brojeve a i F . U izrazima koji opisuju pojedine tražene veličine smiju se pojaviti ta dva opća broja, a osim njih smije se pojaviti još samo po jedan poseban broj. Skicirati dijagrame M, T, N .



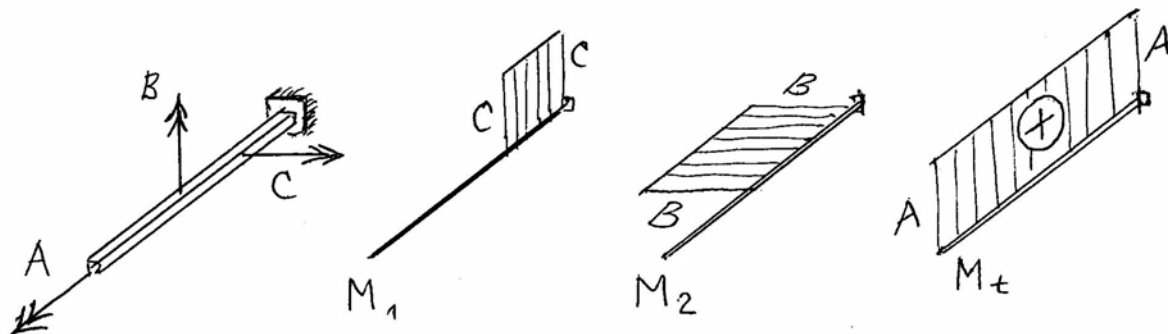
4. Za prikazanu gredu treba odrediti djelovanja u spojevima. Treba odrediti podatke za M, T, N dijagrame. Za svaki karakteristični presjek treba detaljno prikazati postupak. Za presjek označen trokutnim simbolom treba osim toga detaljno prikazati određivanje M, T, N i iz uvjeta ravnoteže preostalog dijela štapa. Za taj presjek treba provjeriti odstupanje linije dijagrama M od pravca. Treba skicirati dijagrame M, T, N.



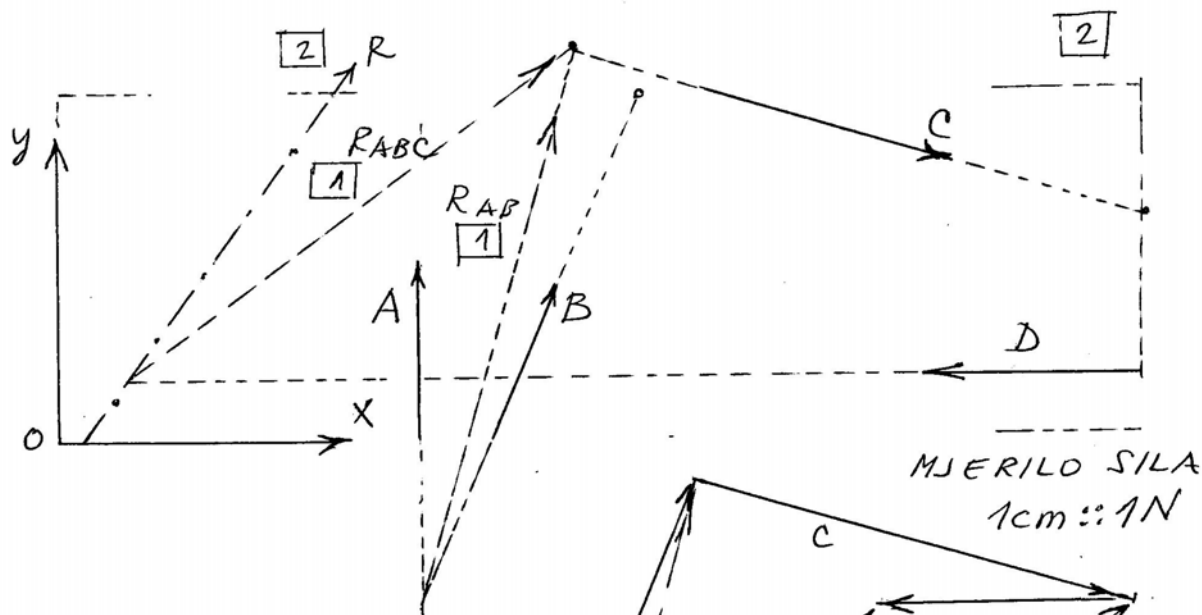
5. Na skici je aksonometrijski prikazan prostorni štap koji se nalazi u ravnoteži. Poprečni presjeci su pravokutni. Treba aksonometrijski skicirati dijagrame: M_1 (ravnine savijanja okomite na ravninu u kojoj leži os štapa) i M_2 (ravnina savijanja poklapa se s ravninom u kojoj leži os štapa). Nadalje treba skicirati dijagram M_t (ordinate prikazati okomito na ravninu u kojoj leži os štapa).



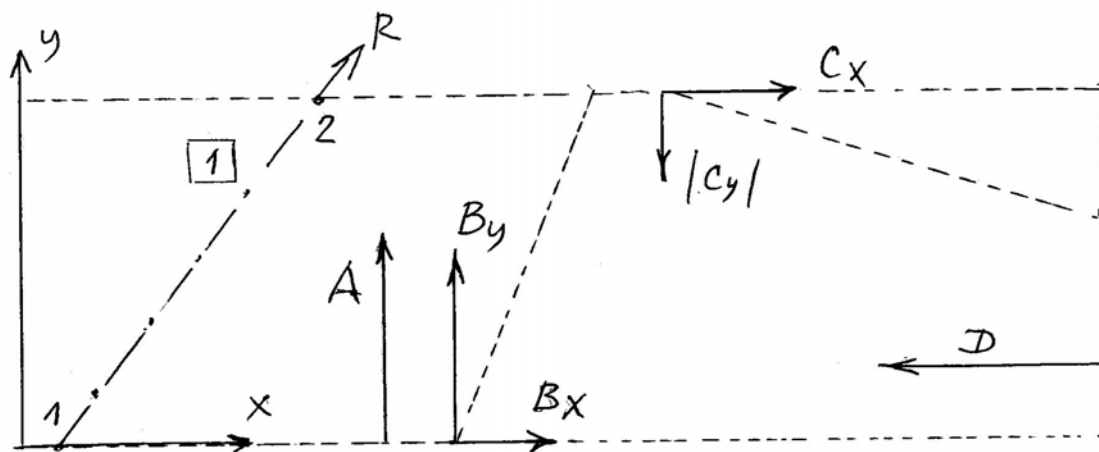
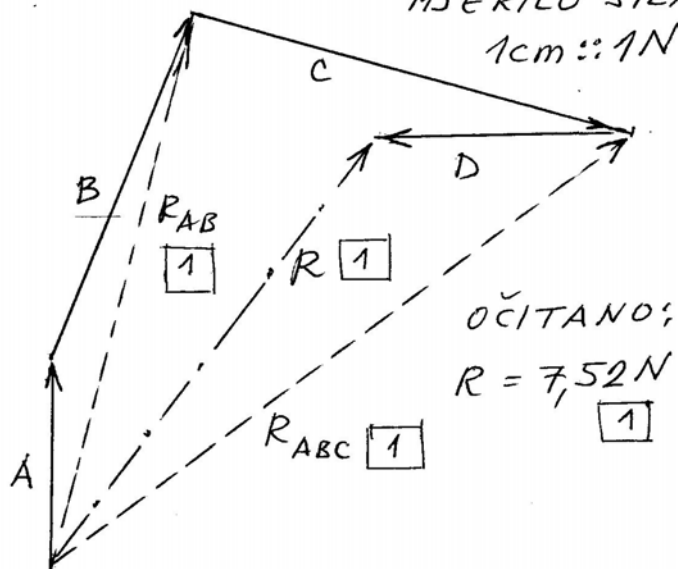
Radi lakšeg razumijevanja zadatka skicirano je rješenje jednostavnog primjera.



a) MJERILO POLOŽAJA 1:100



b) $A_x = 0; A_y = 2,95$
 $B_x = 2; B_y = 4,8$
 $C_x = 6; C_y = -1,75$
 $D_x = -3,5; D_y = 0$



$$R_x = 2 + 6 - 3,5 = 4,50 N; R_y = 2,95 + 4,8 - 1,75 = 6,00 N; \quad [1]$$

$$R = \sqrt{R_x^2 + R_y^2} = 7,5 N. \quad [1] [1]$$

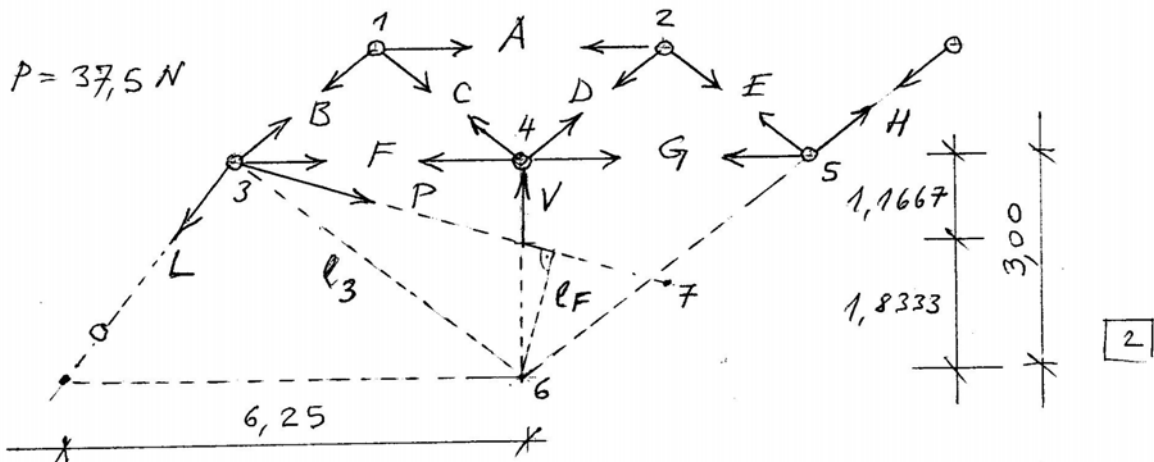
$$x \cdot 6,0 - y \cdot 4,5 = 5 \cdot 2,95 + 6 \cdot 4,8 - 4,8 \cdot 6 - 9 \cdot 1,75 + 1 \cdot 3,5$$

$$6 \cdot x - 4,5 \cdot y = +2,50 \quad [2]$$

$$x_1 = \frac{2,5}{6} = 0,4167; \quad x_2 = \frac{2,5 + 4,5 \cdot 4,8}{6} = 4,0167 m \quad [1]$$

$$y_1 = 0 \quad [1] \quad y_2 = 4,8$$

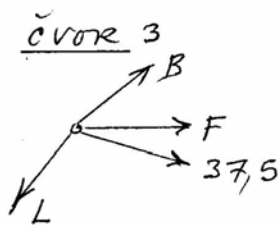
2.



$d_{3,7} = 6,25 \text{ m}$ $l_3 = 0,8 \cdot 6,25 = 5,0 \text{ m}$ $l_F = 1,8333 \frac{6,25}{6}$
 $l_F = 1,76 \text{ m}$

RAVNOTEŽA REŠETKE (1, 2, 3, 4, 5)

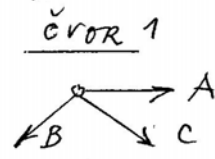
$\sum M(6) = \phi$; $L = \frac{1,76 \cdot 37,5}{5} = 13,2 \text{ N}$ [2]



$\sum F_{yi} = 0$; $B = \frac{1}{0,6} (0,8 \cdot L + \frac{1,75}{6,25} \cdot 37,5) = 35,1 \text{ N}$ [1]

$\sum F_{xi} = \phi$; $F = -0,8 \cdot B + 0,6 \cdot L - \frac{6}{6,25} \cdot 37,5$ [2]

$F = -56,16 \text{ N}$ [1]

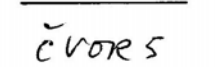


$\sum F_{yi} = \phi$; $C = -B = -35,1 \text{ N}$ [1]

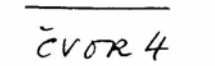
$\sum X_i = \phi$; $A = 0,8(+B - C) = +56,16 \text{ N}$ [1]



ANALOGNO Č-1; $D = -35,1 \text{ N}$; $E = +35,1 \text{ N}$ [1]

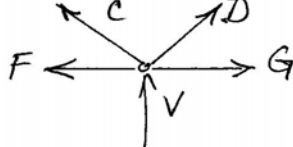


ANALOGNO Č-1; $H = -35,1$; $G = -56,15$ [1]

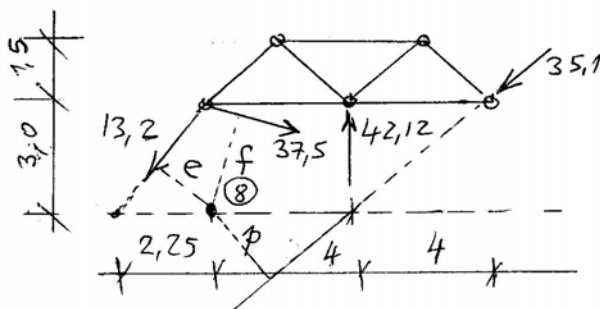


$\sum F_{yi} = \phi$; $V = 0,6 \cdot (-C - D) = 42,12 \text{ N}$ [1]

KONTROLA $\sum F_{xi} = -P + G + 0,8(-C + D) = 0,0$ [2]



KONTROLA - RAVNOTEŽA REŠETKE (1, 2, 3, 4, 5) [2]



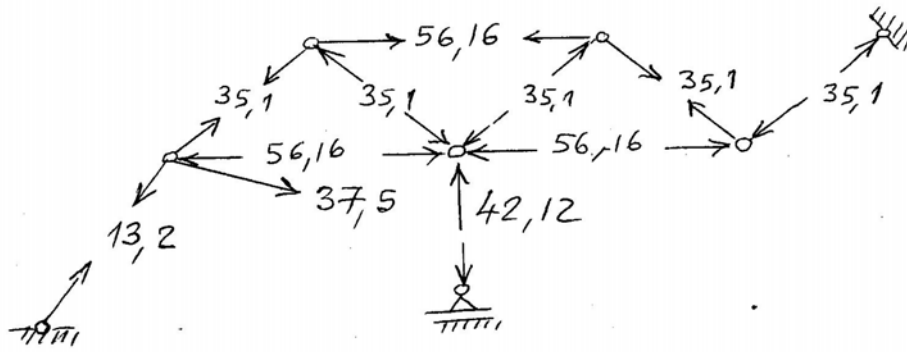
$e = 0,8 \cdot 2,25 = 1,8 \text{ m}$

$f = 3,00 \frac{6}{6,25} = 2,88 \text{ m}$

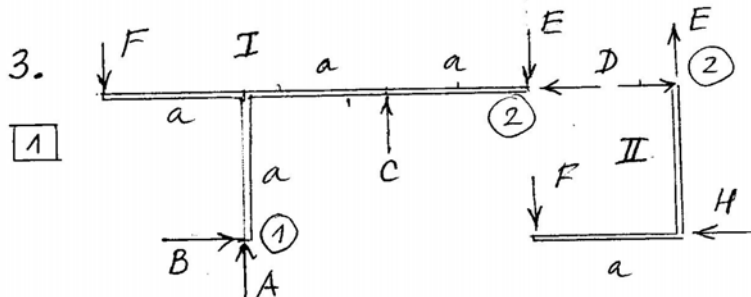
$p = 0,6 \cdot 4 = 2,4 \text{ m}$

$\sum M_{(6)} = 1,8 \cdot 13,2 - 2,88 \cdot 37,5 + 4 \cdot 42,12 - 2,4 \cdot 35,1 = 0,00 \checkmark$

SKICA STVARNIH DJELOVANJA



2



RAVNOTEŽA II

$$\sum M(e) = 0; \quad H = F$$

$$\sum F_{xi} = \phi; \quad D = F$$

$$\sum F_{yi} = \phi; \quad E = F$$

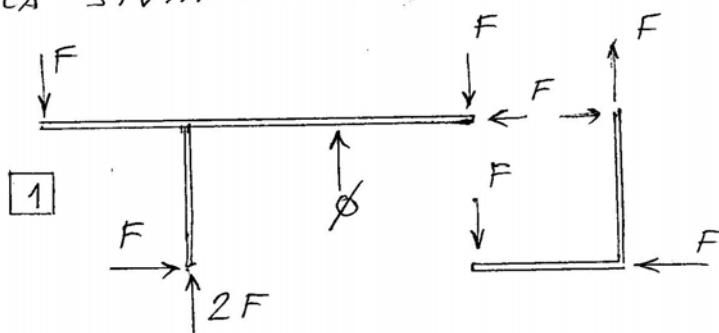
RAVNOTEŽA I

$$\sum M(1) = \phi; \quad C = \phi$$

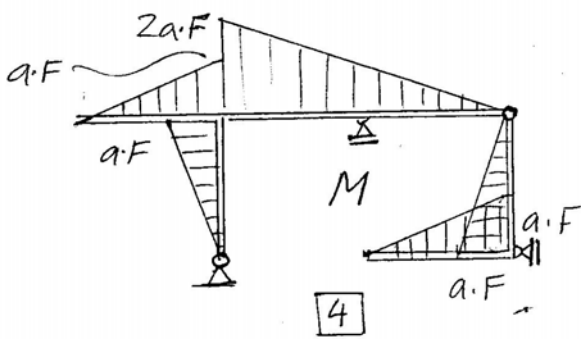
$$\sum F_{xi} = \phi; \quad B = F$$

$$\sum F_{yi} = \phi; \quad A = 2 \cdot F$$

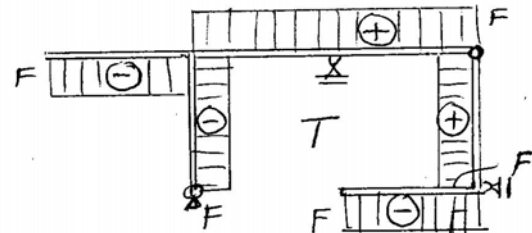
SKICA STVARNIH DJELOVANJA



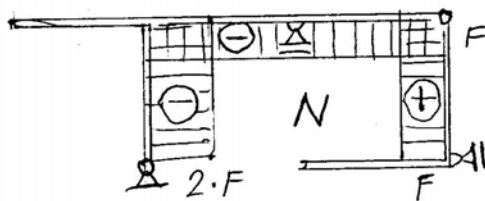
6 x 1



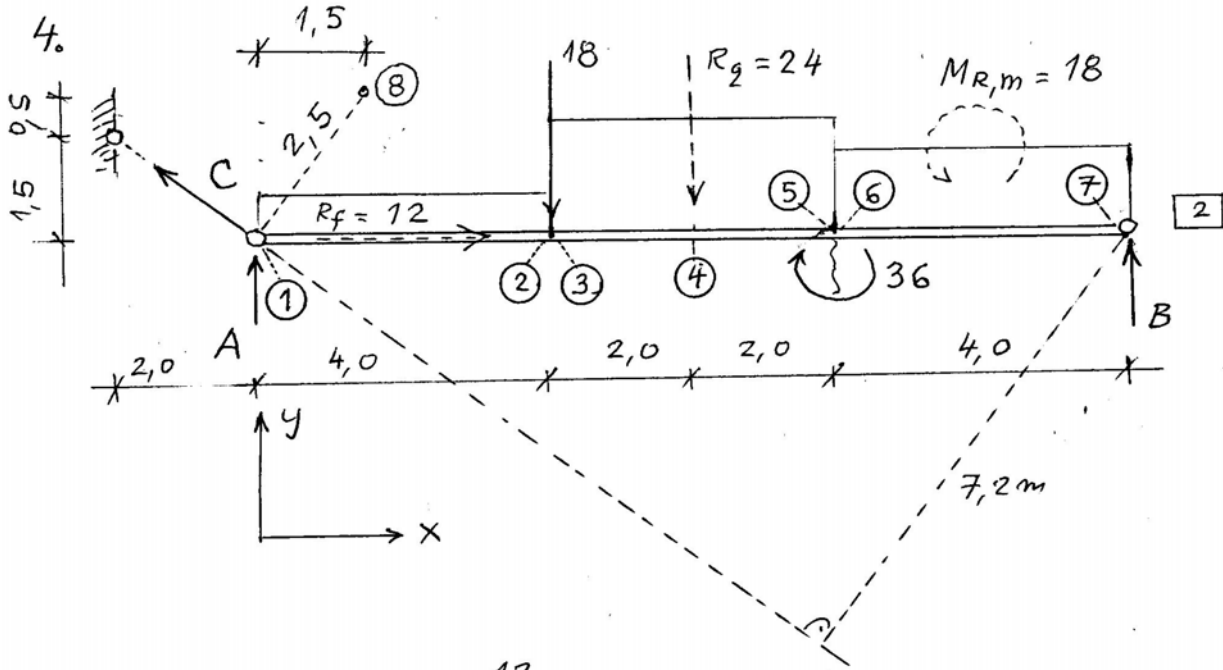
4



5



3



$$\sum F_{xi} = \phi. \quad C = \frac{12}{0,8} = 15,0 \text{ N} \quad \boxed{1}$$

$$\sum M_{(7)} = \phi. \quad A = \frac{1}{12} (-7,5 \cdot C + 8 \cdot 18 + 6 \cdot 24 - 36 + 18) = 13,5 \text{ N} \quad \boxed{1}$$

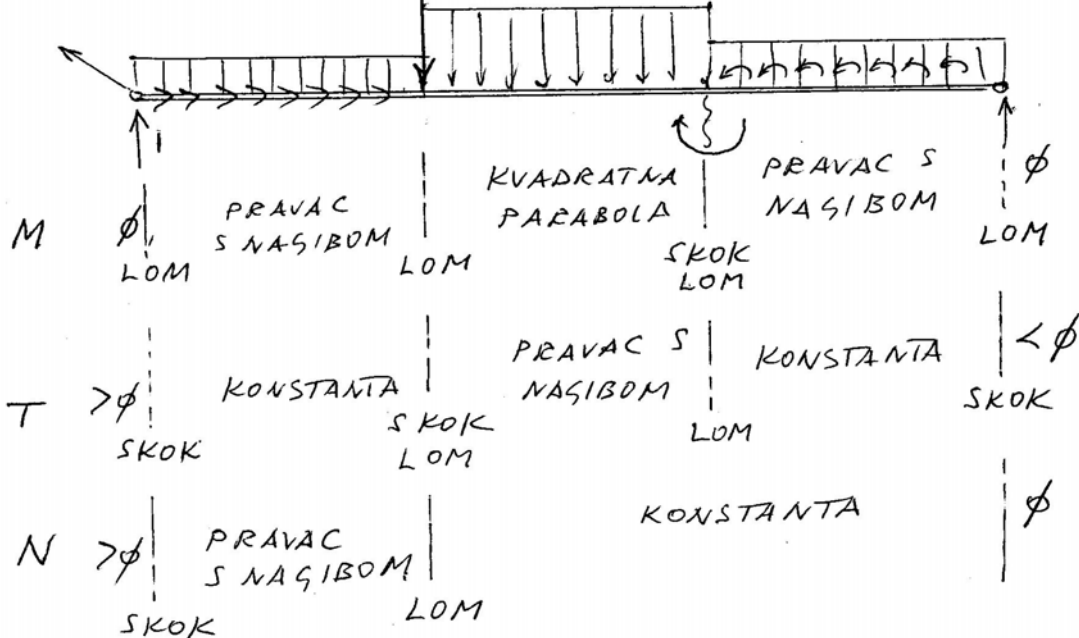
$$\sum M_{(1)} = \phi. \quad B = \frac{1}{12} (4 \cdot 18 + 6 \cdot 24 + 36 - 18) = 19,5 \quad \boxed{1}$$

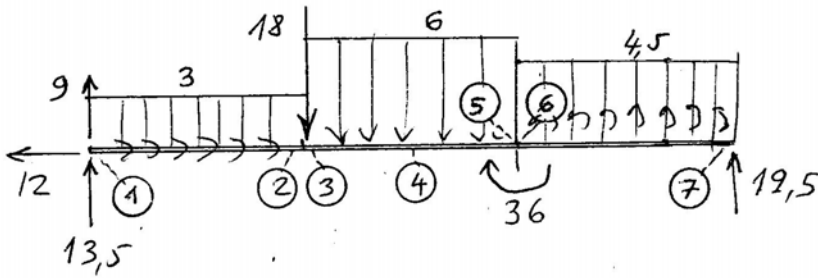
KONTROLE

$$\sum F_{yi} = 0,6 \cdot C + A - 18 - 24 + B = 0,00 \checkmark \quad \boxed{1}$$

$$\sum M_{(8)} = -2,5 \cdot C - 1,5 \cdot A + 2 \cdot 12 - 2,5 \cdot 18 - 4,5 \cdot 24 - 36 + 18 = 0,00 \checkmark \quad \boxed{1}$$

KVALITATIVNA ANALIZA TOKA M, T, N



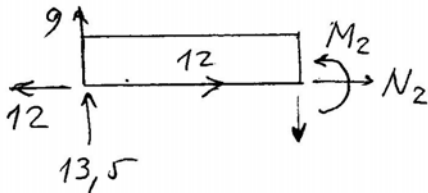


ISKAZANI SU SAMO PODACI POTREBNI ZA ODREĐIVANJE PRIPADNE FUNKCIJE

PRESJEK 1

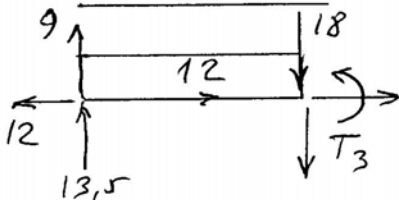
$$M_1 = \phi \quad T_1 = 22,5 \text{ N} \quad N_1 = 12 \text{ N}$$

PRESJEK 2



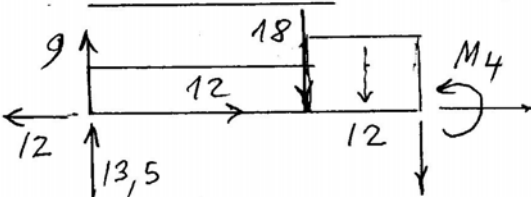
$$M_2 = 4 \cdot 22,5 = 90 \text{ Nm} \quad N_2 = \phi$$

PRESJEK 3



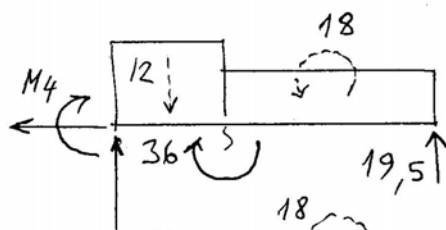
$$T_3 = 22,5 - 18 = 4,5 \text{ N}$$

PRESJEK 4 (DIO I)



$$M_4 = 6 \cdot 22,5 - 2 \cdot 18 - 1 \cdot 12 = 87 \text{ Nm}$$

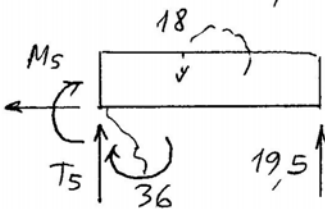
PRESJEK 4 (DIO II)



$$M_4 = -1 \cdot 12 - 36 + 18 + 6 \cdot 19,5 =$$

$$M_4 = 87 \text{ Nm}$$

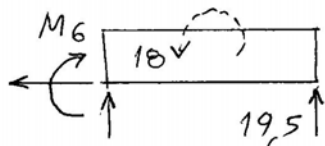
PRESJEK 5



$$M_5 = -36 + 18 + 4 \cdot 19,5 = 60 \text{ Nm}$$

$$T_5 = -19,5 \text{ N}$$

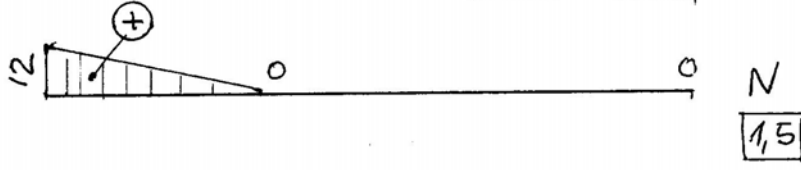
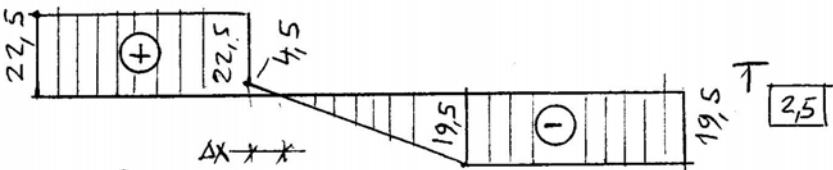
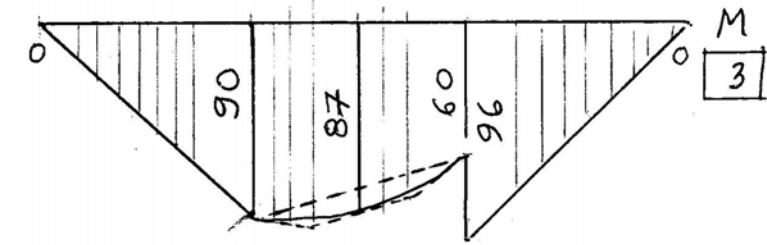
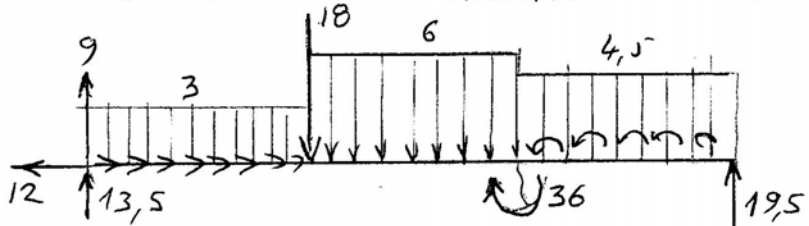
PRESJEK 6



$$M_6 = 18 + 4 \cdot 19,5 = 96 \text{ Nm}$$

PRESJEK 7

$$M_7 = \phi \quad T_7 = -19,5 \text{ N} \quad N_7 = \phi$$



KONTROLA ODSTUPANJA
PREMA DIJAGRAMU:

$$\Delta M^q = 87 - \frac{90+60}{2} = 12$$

STATIČKI IZRAZ:

$$\Delta M^s = \frac{6 \cdot 4^2}{8} = 12 \checkmark$$

DODATAK (NIJE ZADANO)
ANALITIČKI EXTREM
MOM. SAVIJANJA

$$\Delta x = \frac{T_3}{2} = \frac{4.5}{6} = 0.75 \text{ m}$$

$$\max M = 4.75 \cdot 22.5 - 0.75 \cdot 18 - 6 \cdot \frac{0.75^2}{2} =$$

$$\max M = 91.6875 \text{ Nm}$$

5.

