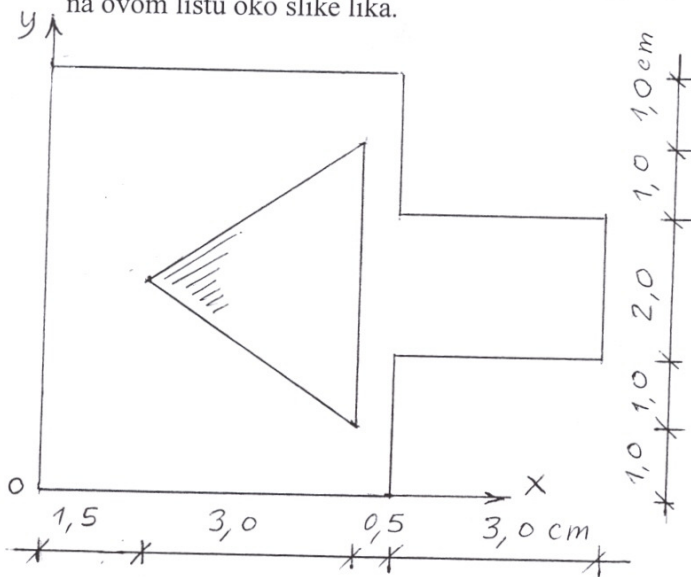


1. Na slici je u mjerilu prikazan poligonalan lik iz kojeg je izrezan trokut. Treba:

a) očitati y -koordinatu težišta

b) računski odrediti x -koordinatu težišta i provesti računsku kontrolu

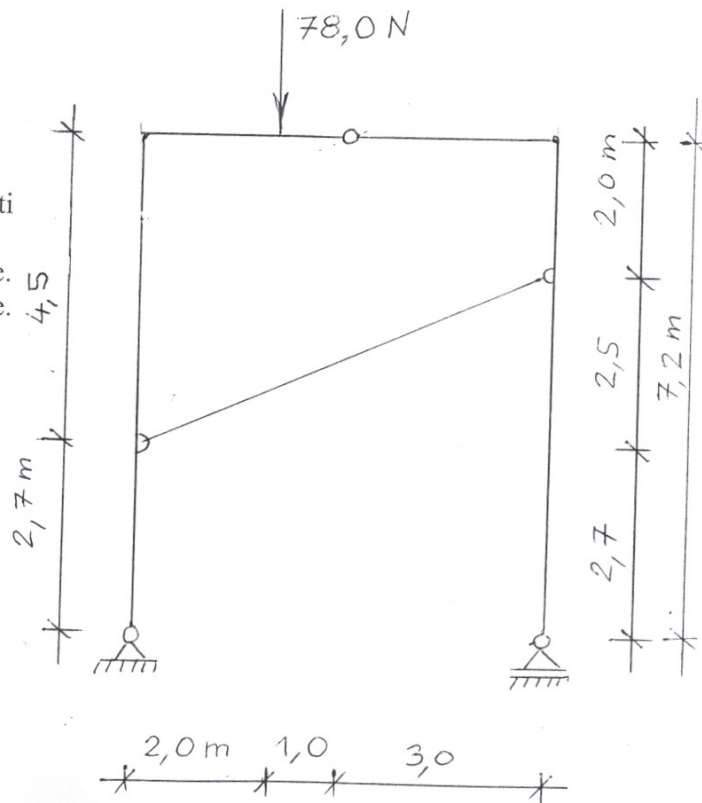
c) odrediti x -koordinatu težišta pomoću verižnog poligona. Smije se koristiti prazan prostor na ovom listu oko slike lika.



2. Za prikazani ravninski štapni sustav treba na standardan način odrediti djelovanja u svim spojevima i provesti odgovarajuće kontrole.

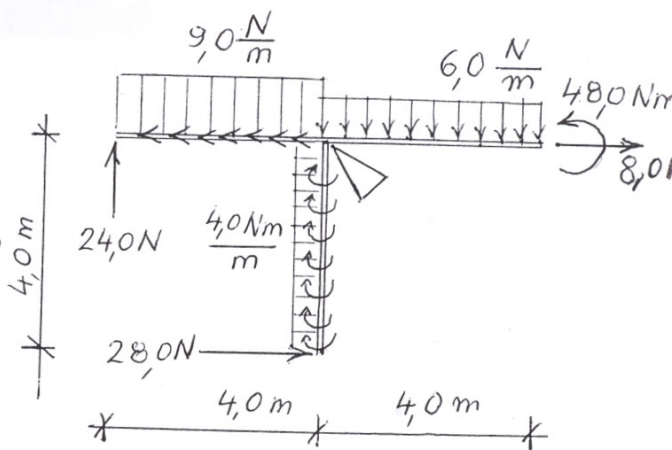
Treba prikazati samo M i T dijagrame.

Boduju se podaci uneseni u dijagrame.

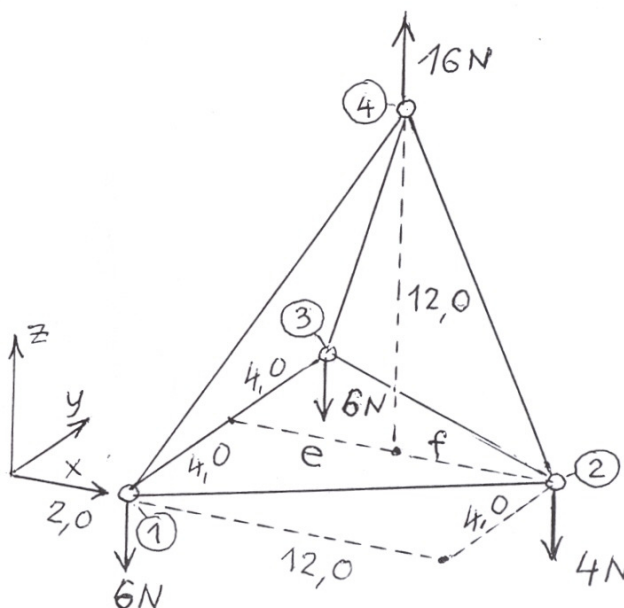


3. Prikazan je štapni element koji se nalazi u stanju ravnoteže.

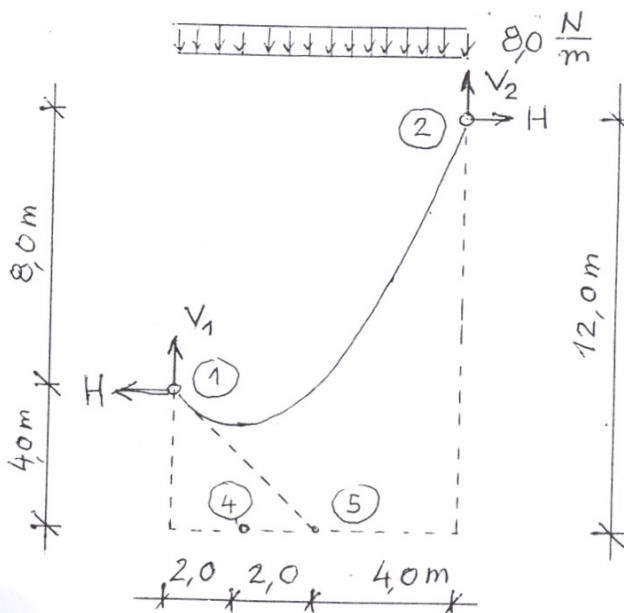
- Treba najprije prikazati cjeloviti postupak određivanja vrijednosti M , T , N za presjek označen trokutnim simbolom i to zasebno iz ravnoteže lijevog i zasebno iz ravnoteže desnog dijela.
- Samo ako je taj postupak točan treba prikazati M , T , N dijagrame. Prikazivanje postupka za ostale presjke nije obavezno. Bodovat će se samo podaci sa samih dijagrama i to samo ako je postupak pod a) bio cjelovit i točan.
- Treba zasebno prikazati element grananja i stvarna djelovanja na njega, te iskazati kontrolu pripadnih triju uvjeta ravnoteže.
- Treba kontrolirati odstupanje linije M od pravca
- Treba kontrolirati diferencijalne odnose za vertikalni dio elementa.

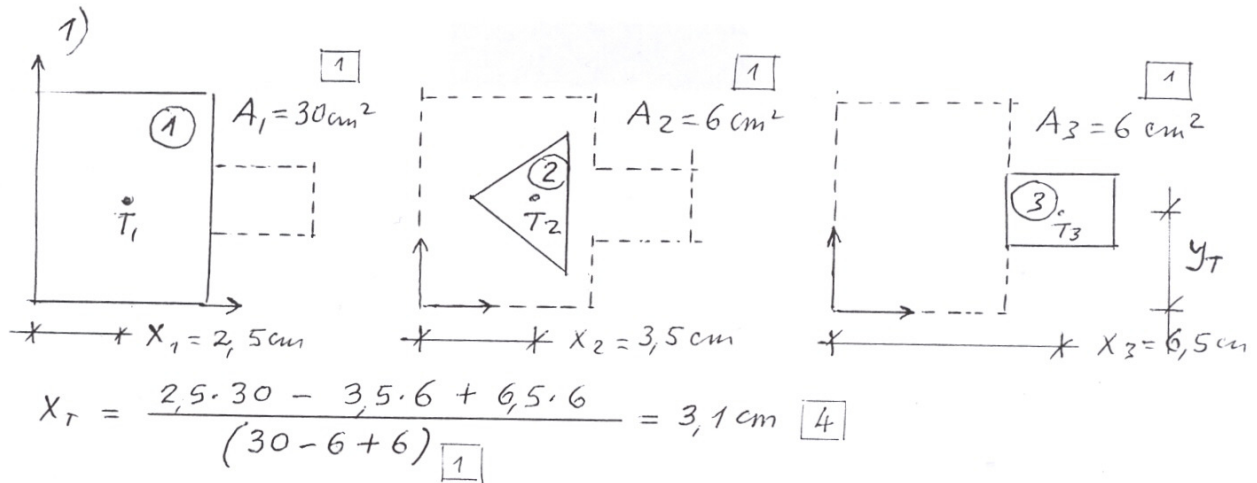


4. Promatra se prostorni rešetkasti sustav koji je prikazan na aksonometrijskoj slici. Sustav se nalazi u stanju ravnoteže. Na osnovi toga treba odrediti mjeru e . Nadalje treba potpuno riješiti sustav i provesti kontrolu $\sum M_y$ za ravnotežu zglobnog čvora 4.



5. Promatra se parabolična lančanica čija je geometrija određena skicom. Tangenta na lijevom kraju određena je spojnicom točaka 1 i 5. Zadano je pripadno konstantno opterećenje q_0 reducirano na os x . Treba odrediti veličine H , V_1 , V_2 . Zadatak je rješiv bez određivanja analitičkog izraza za oblik lančanice. Treba kontrolirati $\sum M_{(4)}$ za cijelu lančanicu.





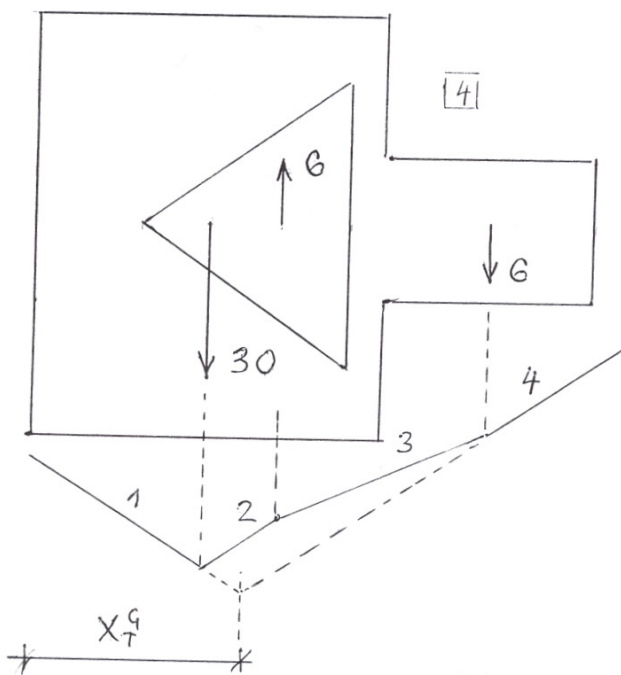
KONTROLA

$$\xi_1 = 2,5 - 3,1 = -0,6; \quad \xi_2 = 3,5 - 3,1 = 0,4; \quad \xi_3 = 6,5 - 3,1 = 3,4.$$

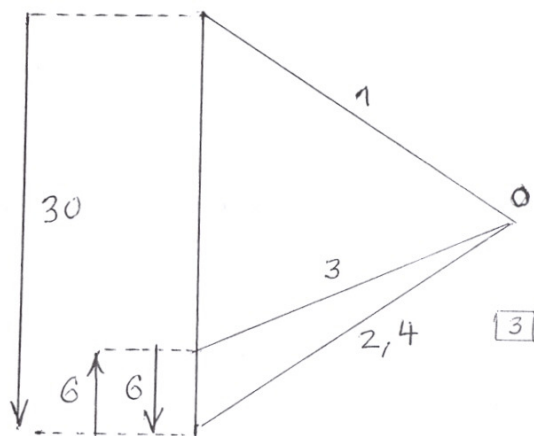
$$\sum \xi_T = \frac{-0,6 \cdot 30 - 0,4 \cdot 6 + 3,4 \cdot 6}{30} = 0,000 \checkmark \quad [3]$$

$$y_T = 3,0 \text{ cm} \quad [1]$$

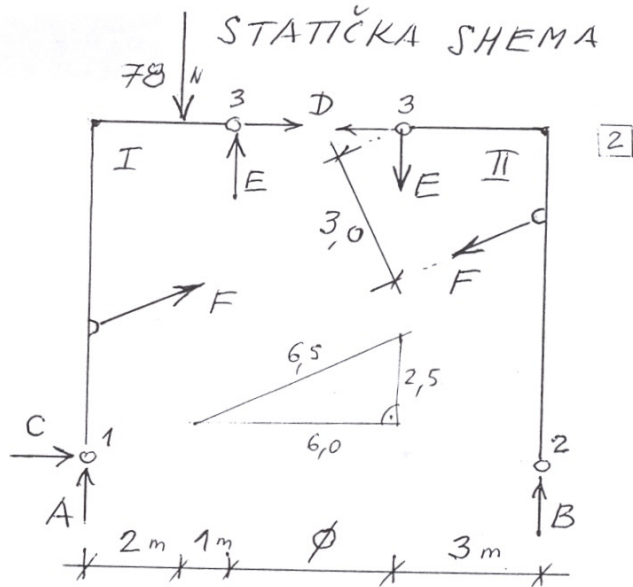
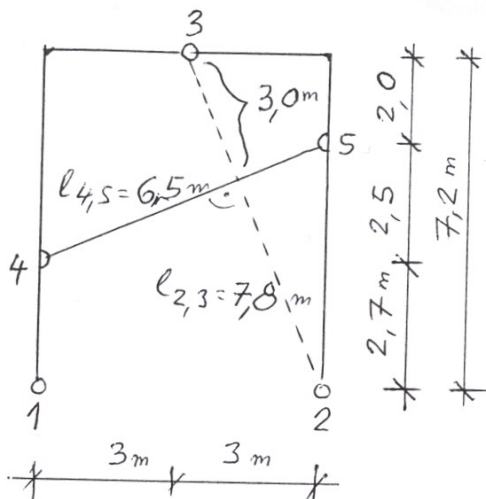
MJERILO PLOŠINA 1cm :: 5cm²



OČITANO $x_T^G = 3,05 \text{ cm} \quad [1]$



2. GEOMETRIJA



RAVNOTEŽA (I + II)

$$\sum M_{(2)} = \phi; \quad A = \frac{4 \cdot 78}{6} = 52 \text{ N}; \quad \sum F_{xi} = 0; \quad C = \phi.$$

$$\sum M_{(1)} = \phi; \quad B = \frac{2 \cdot 78}{6} = 26 \text{ N}; \quad \text{KONTROLA}$$

RAVNOTEŽA II

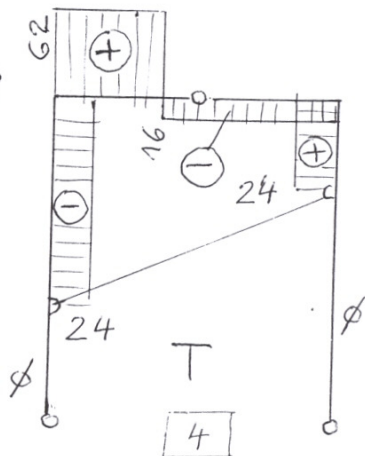
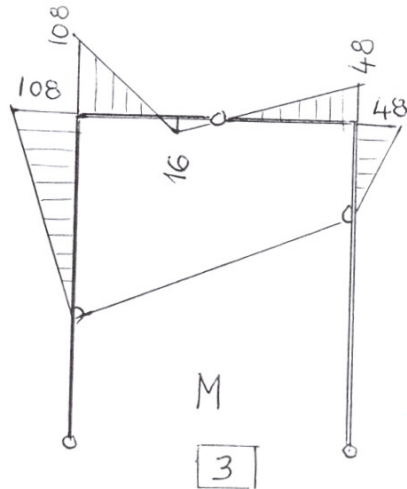
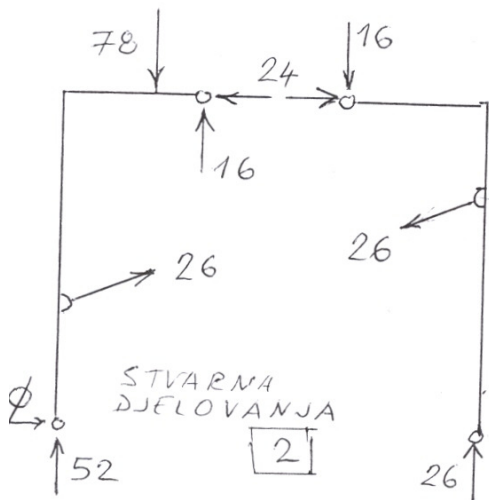
$$\sum M_{(3)} = \phi; \quad F = \frac{3 \cdot B}{3} = 26 \text{ N}$$

$$\sum F_{xi} = \phi; \quad D = -\frac{6}{6.5} F = -24 \text{ N}; \quad E = B - \frac{2.5}{6.5} F = 16 \text{ N}$$

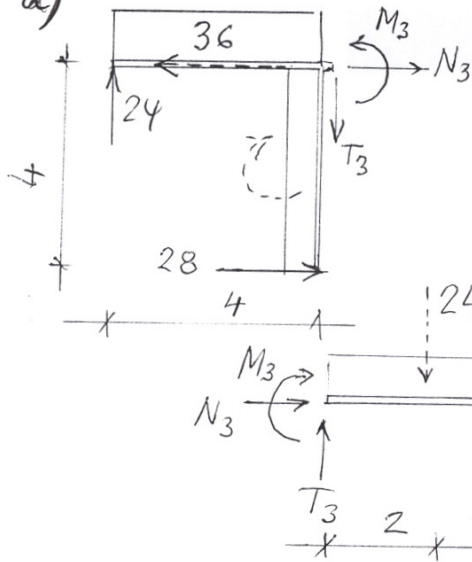
KONTROLA: RAVNOTEŽA I

$$\sum M_{(3)} = \phi \quad F = \frac{3 \cdot A - 1 \cdot 78}{3} = 26 \text{ N}$$

$$\sum F_{yi} = \phi \quad E = 78 - A - \frac{2.5}{6.5} F = 16 \text{ N}$$



3. a)



$$M_3 = 4 \cdot 24 + 16 - 4 \cdot 28 = \phi$$

$$T_3 = +24 \text{ N}$$

$$N_3 = +36 - 28 = +8 \text{ N}$$

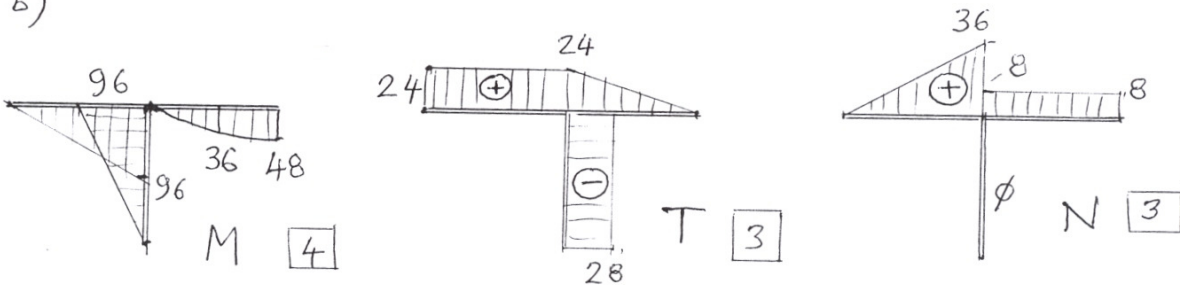
4

$$M_3 = -2 \cdot 24 + 48 = \phi$$

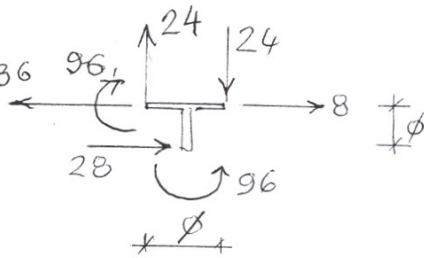
$$T_3 = +24 \text{ N}$$

$$N_3 = +8 \text{ N}$$

b)



c)



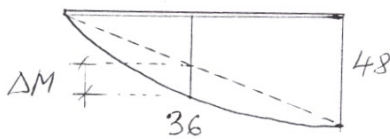
$$\sum M = -96 + 96 = \phi$$

$$\sum F_{xi} = -36 + 28 + 8 = \phi$$

$$\sum F_{yi} = +24 - 24 = \phi$$

3

d)



IZ MOM. DIJAGRAMA

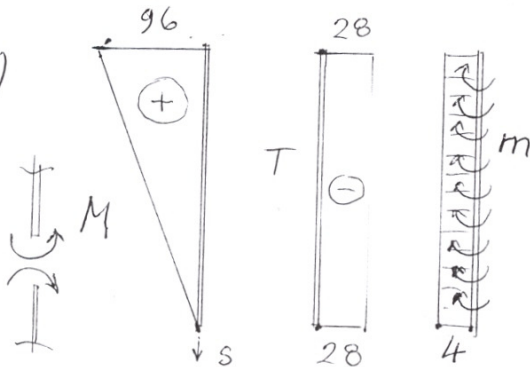
$$\Delta M^G = 36 - \frac{0 + 48}{2} = 12 \text{ Nm}$$

IZ UVJETA RAVNOTEŽE

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

1

e)



$$M(s) = 96 - 24 \cdot s \text{ Nm}$$

$$T(s) = -28 \text{ N}$$

$$m(s) = -4 \frac{\text{Nm}}{\text{m}}$$

$$\frac{dM}{ds} = -24$$

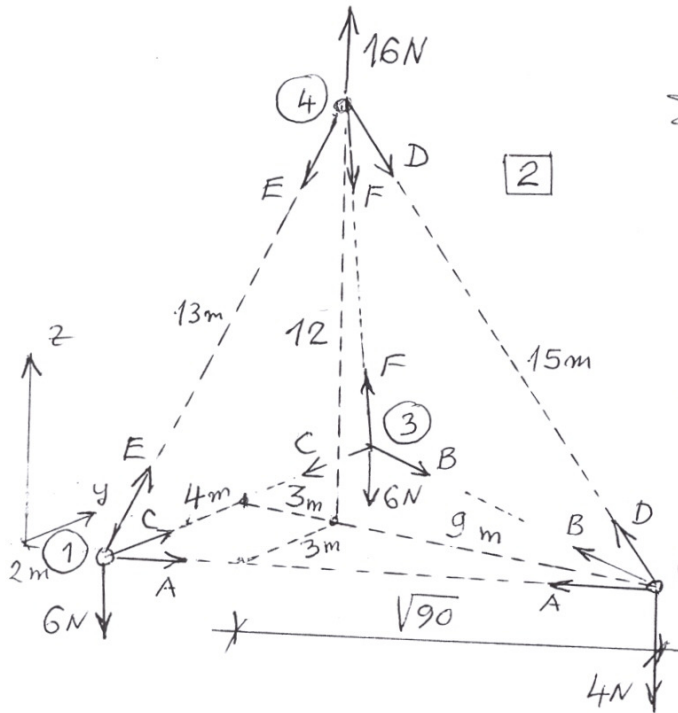
$$T - m = -28 - (-4) = -24 \checkmark$$

2

4. UVODI SE OS u KROZ TOČKE 1; 3, OS JE ORJENTIRANA OD 1 PREMA 3.

RAVNOTEŽA CIJELE REŠETKE:

$$\sum M_u = 0 \quad - e \cdot 16 + 12 \cdot 4 = 0; \quad e = 3; \quad f = 9 \text{ m} \quad [2]$$



ČVOR 2

$$\sum F_z = 0; \quad D = \frac{15}{12} \cdot 4 = +5 \text{ N} \quad [2]$$

ČVOR 1:

$$\sum F_z = 0; \quad E = \frac{13}{12} \cdot 6 = +6,5 \text{ N} \quad [2]$$

ZBOG SIMETRIJE: $F = +6,5 \text{ N} \quad [1]$

$$\sum F_y = 0; \quad C = \frac{-4}{13} E = -2,0 \text{ N} \quad [2]$$

$$\sum F_{xi} = 0; \quad A \frac{9}{190} + E \frac{3}{13} = 0$$

$$A = - \frac{190 \cdot E}{39} = -1,581 \quad [2]$$

ZBOG SIMETRIJE:

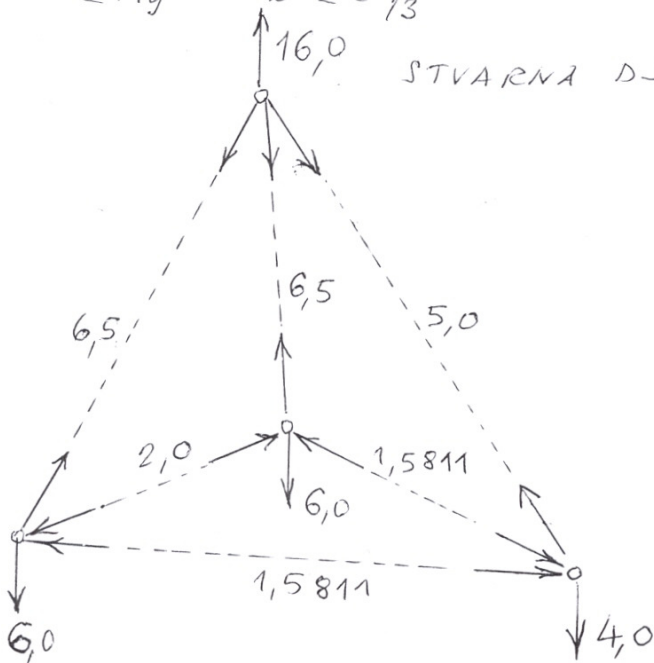
$$B = -1,581 \text{ N} \quad [1]$$

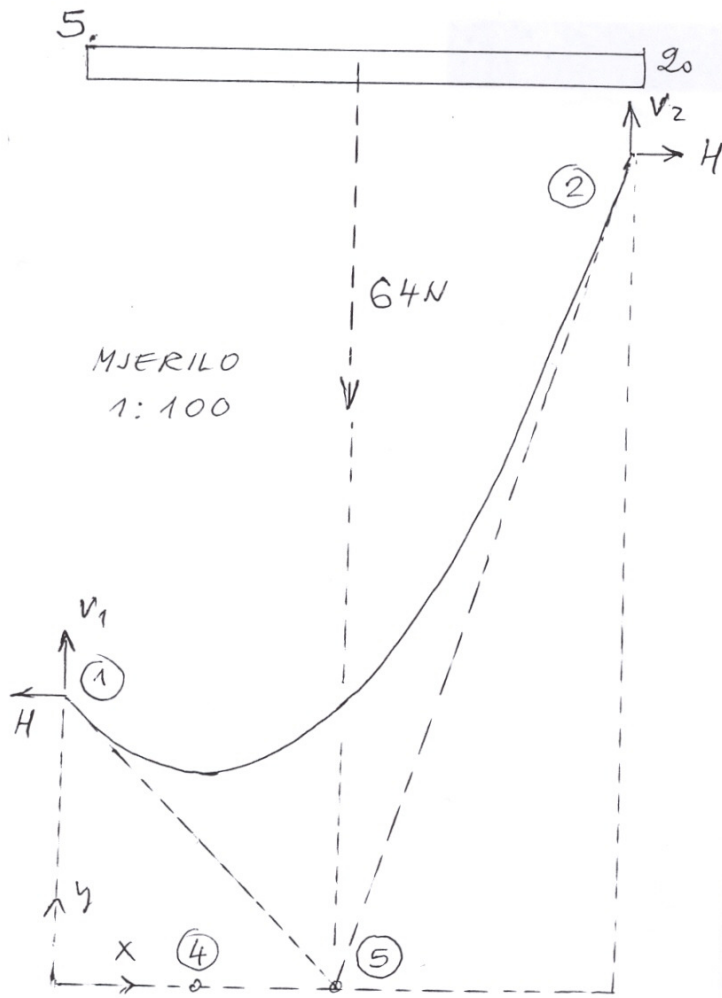
KONTROLA: ČVOR 2.; $\sum F_{xi} = -2 \cdot A \frac{9}{190} - D \frac{9}{15} = 0,000 \checkmark \quad [2]$

KONTROLA: ČVOR 4.;

$$\sum M_y = +2 \cdot 2 E \frac{12}{13} - 5 \cdot 16 + 14 \cdot D \frac{12}{15} = 0,000 \checkmark \quad [2]$$

STVARNA DJELOVANJA





OBLIK LANČANICE
JE KVADRATNA
PARABOLA.
TOČKA 5 JE SJECIŠ-
TE LIJEVE RUBNE
TANGENTE I PRAVCA
REZULTANTE
OPTEREĆENJA.
DESNA RUBNA
TANGENTA MORA
PROLAZITI TOM
TOČKOM. SLIJEDI:

$$y'(x_1) = -\frac{4}{4} = -1 \quad [1]$$

$$y'(x_2) = \frac{12}{4} = +3 \quad [1]$$

$$V_1 = -H \cdot y'(x_1) = H \quad [1]$$

$$V_2 = H \cdot y'(x_2) = 3 \cdot H \quad [1]$$

$$4 \cdot H - 64 = \phi \quad [2]$$

$$H = 16 \quad [4]$$

$$V_1 = 16 \quad [4]$$

$$V_2 = 48 \quad [4]$$

KONTROLA

$$\sum M(4) = -2 \cdot 64 + 6 \cdot 48 - 12 \cdot 16 - 2 \cdot 16 + 4 \cdot 16 = 0 \quad [2]$$