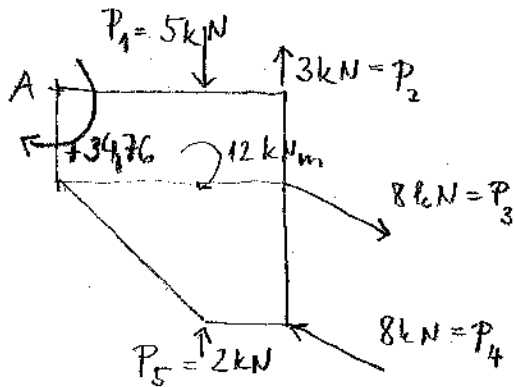


2-1.

a.)



$$P_{3x} = 8 \cdot \sin 60^\circ = 6,92$$

$$P_{3y} = 8 \cdot \cos 60^\circ = 4$$

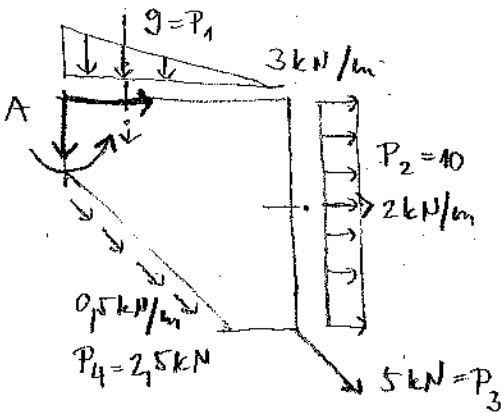
$$P_{4x} = -6,92$$

$$P_{4y} = -4$$

összegeles: $R_x = 0 \quad R_y = 0$

nyomaték: $M_A = +20 \text{ kNm} + 5 \cdot 4 - 3 \cdot 6 - 6,92 \cdot 2 + 4 \cdot 6 + 6,92 \cdot 5 - 6 \cdot 4 - 2 \cdot 4 = +34,76 \text{ kNm}$

b.)



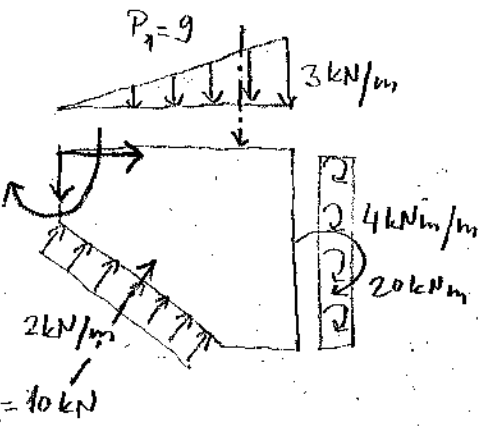
$$R_x = 10 + 3,53 + \frac{4}{5} \cdot 2,5 = 15,53$$

$$R_y = 9 + 3,53 + \frac{3}{5} \cdot 2,5 = 14,03$$

$$R = 20,92 \text{ kN}$$

$$M_A = 9 \cdot 2 - 10 \cdot 2,5 - 3,53 \cdot 5 + 3,53 \cdot 6 - 2,5 \cdot 1,6 = -7,47$$

c.)



$$R_x = \frac{3}{5} \cdot 10 = 6 \text{ kN}$$

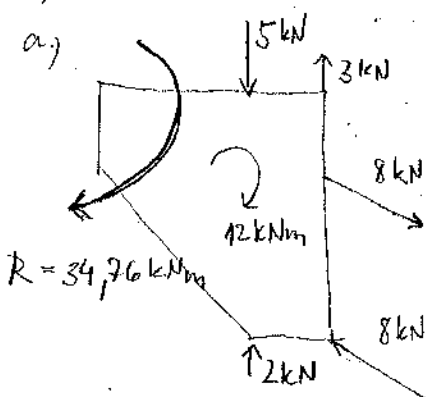
$$R_y = 9 - \frac{4}{5} \cdot 10 = 1 \text{ kN}$$

$$R = 6,08 \text{ kN}$$

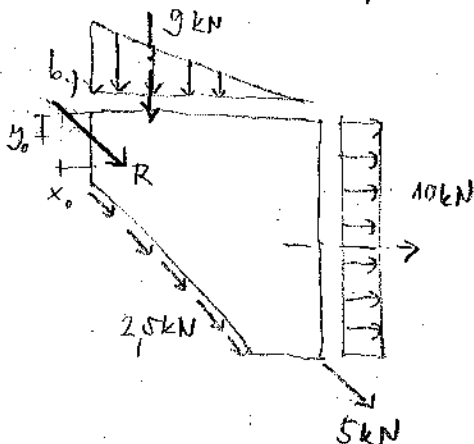
$$M_A = 9 \cdot 4 + 20 - 8 \cdot 2 - 6 \cdot 3,5 = 19 \text{ kNm}$$

2-2.)

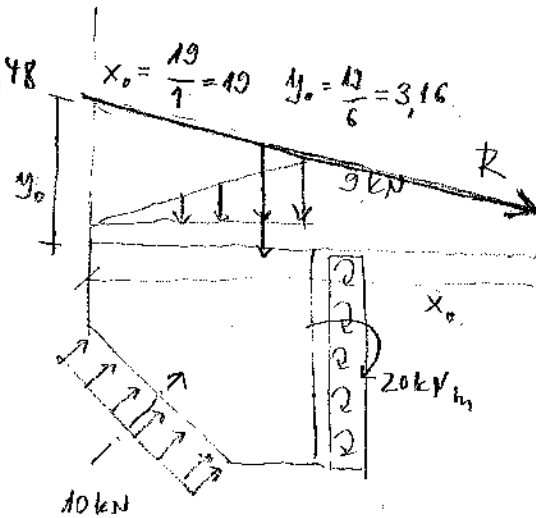
a.)

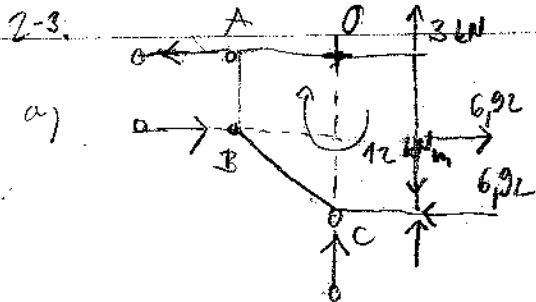


$$x_0 = \frac{-7,47}{14,03} = -0,53 \quad y_0 = \frac{-7,47}{15,53} = -0,48$$



$$x_0 = \frac{19}{7} = 2,71 \quad y_0 = \frac{19}{6} = 3,16$$





a)

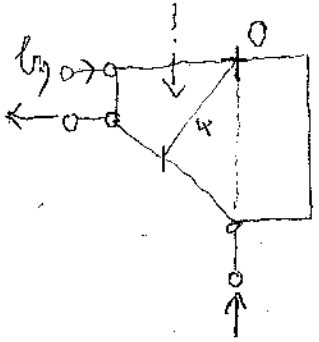
$$\sum M_O = 0$$

$$+12 - 3 \cdot 2 - 6,92 \cdot 2 + 6,92 \cdot 5 - B \cdot 2 = 0$$

$$B = 13,38 \text{ kN}$$

$$\sum H = 0 \quad A = -B = -13,38$$

$$\sum V = 0 \quad C = 0$$



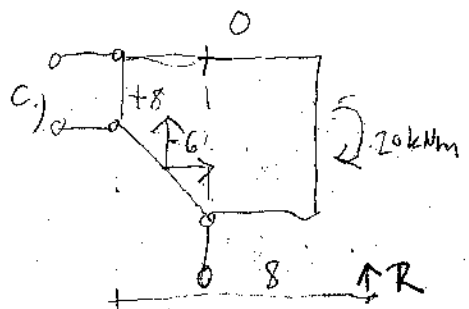
$$-3 \cdot \frac{6}{2} - 2 \cdot 5 \cdot \frac{5}{2} - 3,53 \cdot 5 + 3,53 \cdot 2 - 2,5 \cdot 4 + B \cdot 2 = 0$$

$$B = 31,79 \leftarrow$$

$$\sum H = 0 \quad -A - 31,79 + 10 + 3,53 + \frac{4}{5} \cdot 2,5 = 0$$

$$A = 16,26 \rightarrow$$

$$\sum V = 0 \quad C = 9 + 3,53 + \frac{3}{5} \cdot 2,5 = 14,03 \uparrow$$



$$+20 - 6 \cdot \frac{3}{5} + 8 \cdot 2 - B \cdot 2 = 0$$

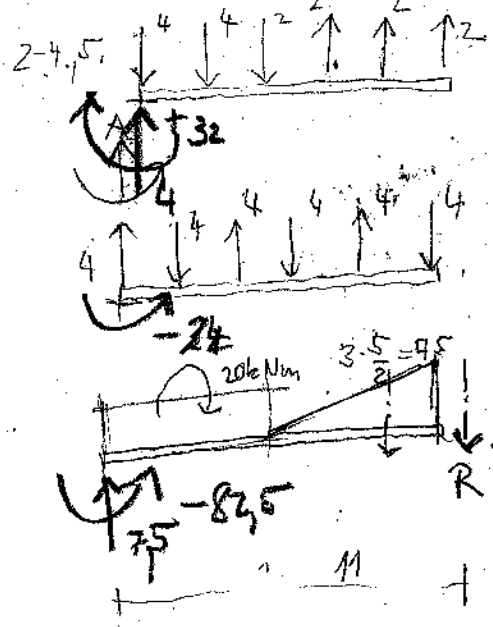
$$B = 7,5$$

$$\sum H = 0 \quad +6 + 7,5 = -A \leftarrow$$

$$A = 13,5$$

$$\sum V = 0 \quad +9 - 8 - C = 0$$

$$C = 1 \uparrow$$



$$\sum M_A = 4 \cdot 2 + 2 \cdot 4 - 2 \cdot 6 - 2 \cdot 8 - 2 \cdot 10 = -32 \text{ kNm}$$

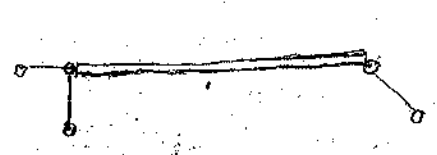
$$A_v = 4 \downarrow$$

$$\sum M_B = 4 \cdot 2 - 4 \cdot 4 + 4 \cdot 6 - 4 \cdot 8 + 4 \cdot 10 = +24 \text{ kNm}$$

$$A = 0$$

$$A = 7,5 \downarrow$$

$$\sum M_A = +20 + 7,5 \cdot \frac{5}{6} \cdot 10 = 82,5 \text{ kNm}$$



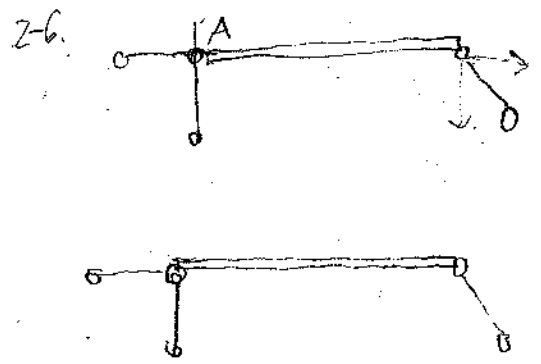
$$\sum M_A = 0 \quad +20 + 7,5 \cdot \frac{5}{6} \cdot 10 - B_v \cdot 10 = 0$$

$$A_H = 8,2 \rightarrow$$

$$A_v = 0,7 \downarrow$$

$$B_v = 8,2 \uparrow$$

$$B_H = 8,2 \leftarrow$$



$$\sum M_A = 0 \quad 4 \cdot 2 + 2 \cdot 4 - 2 \cdot 6 - 2 \cdot 8 - 2 \cdot 10 + B_v \cdot 10 = 0$$

$$\sum H = 0 \quad A_H = B_H = 3,2 \leftarrow$$

$$\sum V = 0 \quad 4 + 4 + 2 - 6 + 3,2 - A_v = 0 \quad B_H = 3,2 \rightarrow$$

$$A_v = 7,2 \uparrow$$

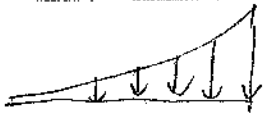
$$\sum M_A = 0 \quad 4 \cdot 2 - 4 \cdot 4 + 4 \cdot 6 - 4 \cdot 8 + 4 \cdot 10 - B_v \cdot 10 = 0$$

$$\sum H = 0 \quad A_H = 2,4 \rightarrow$$

$$\sum V = 0 \quad A_v = 2,4 \downarrow$$

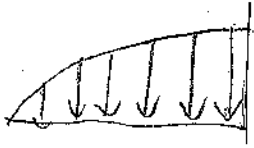
$$B_v = 2,4 \uparrow \quad B_H = 2,4 \leftarrow$$

2-7.



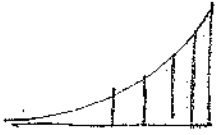
$$R = \int f(x) dx = \int \frac{x^2}{100} dx = \frac{x^3}{3} \cdot \frac{3}{100} = 10$$

$(\frac{1}{3} \cdot 10 \cdot 3 = 10)$



$$R = \int \left(3 - \frac{3 \cdot (x-10)^2}{100} \right) dx = 0,3 \cdot x^2 - \frac{x^3}{100} = 20$$

$(\frac{2}{3} \cdot 10 \cdot 3 = 20)$



$$S = \frac{1}{R} \int x \cdot f(x) dx = \frac{1}{10} \cdot \frac{x^4}{4} \cdot \frac{3}{100} = 4,5$$

$\frac{1}{4}a = 2,5$

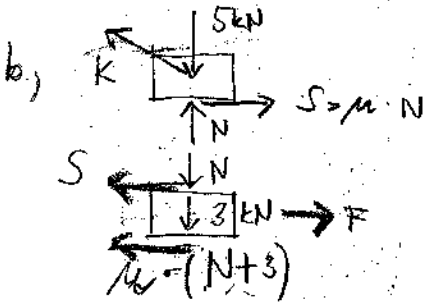


$\frac{3}{8}a = 3,75$

$$S = \frac{1}{R} \int \left(3x - \frac{3x \cdot (x-10)^2}{100} \right) dx = \frac{1}{20} \int \left(-\frac{3}{100} x^3 + \frac{6}{10} x^2 \right) dx =$$

$$= \frac{1}{20} \cdot \left(-\frac{3}{100} \cdot \frac{x^4}{4} + \frac{6}{10} \cdot \frac{x^3}{3} \right) = 6,25$$

2.8.



$$N + K \cdot \sin 30^\circ = 5 \rightarrow K = (5 - N) / \sin 30^\circ = 10 - 2N$$

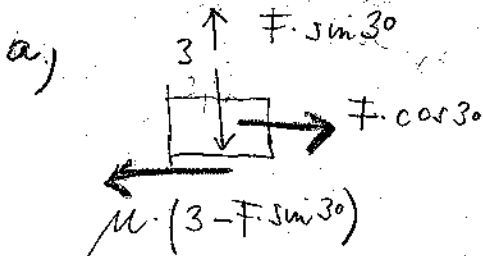
$$K \cdot \cos 30^\circ = N \cdot 0,2 \quad (10 - 2N) \cdot \frac{\sqrt{3}}{2} = N \cdot 0,2$$

$$F = S + 0,15 \cdot (3 + N)$$

$$F = 2 \text{ kN}$$

$$5 \cdot \sqrt{3} - \sqrt{3} N = 0,2 \cdot N$$

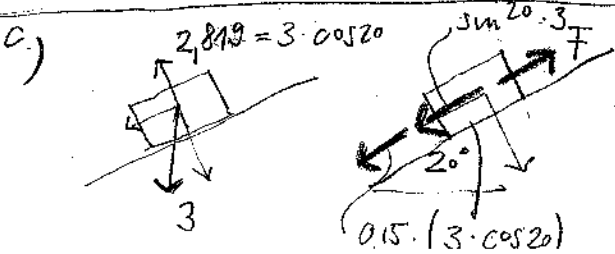
$$N = 4,482 \rightarrow S = 0,896$$



$$F \cdot \cos 30^\circ = 0,15 \cdot (3 - F \cdot \sin 30^\circ)$$

$$F \cdot \cos 30^\circ = 0,45 - 0,15 \cdot F \cdot \sin 30^\circ$$

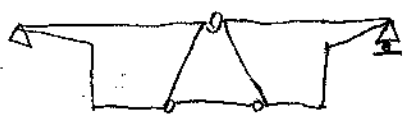
$$\frac{\sqrt{3}}{2} \cdot F = 0,45 - 0,075 \cdot F \rightarrow F = 0,478 \text{ kN}$$



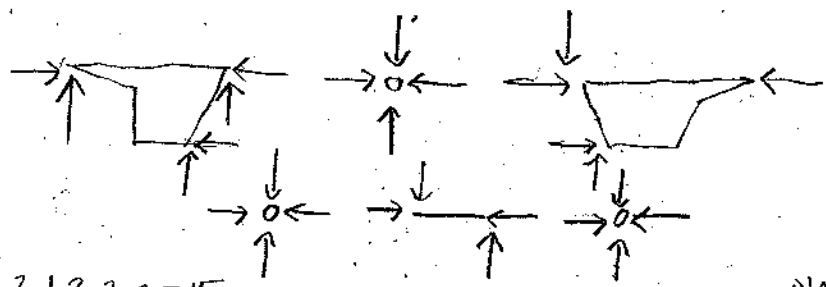
$$F = 3 \cdot \sin 20^\circ + 0,15 \cdot 3 \cdot \cos 20^\circ = 1,498 \text{ kN}$$

2-18.

a.)



szomszédosok:



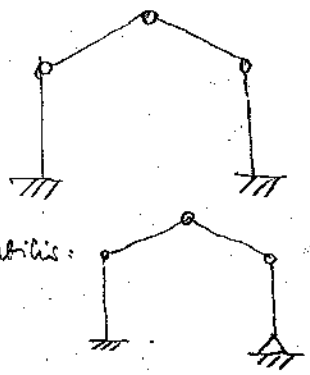
$$3 + 3 \cdot 2 \cdot 2 = 15$$

egyfokozott:

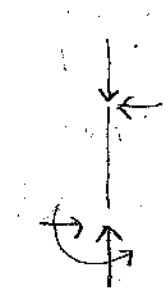
$$3 \cdot 3 + 3 \cdot 2 = 15$$

15 = 15 határozott

b.)



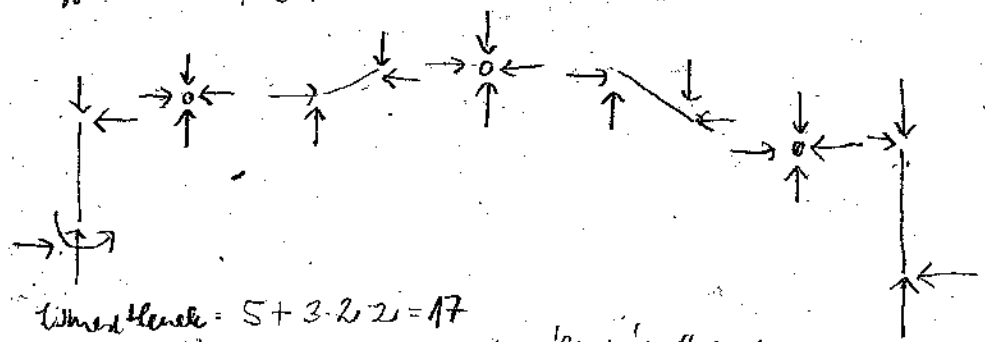
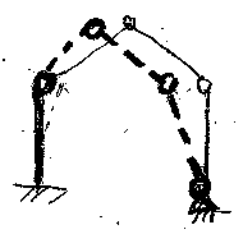
→ labilis:



szomszédosok: $6 + 3 \cdot 2 \cdot 2 = 18$

egyfokozott: $4 \cdot 3 + 3 \cdot 2 = 18$ határozott

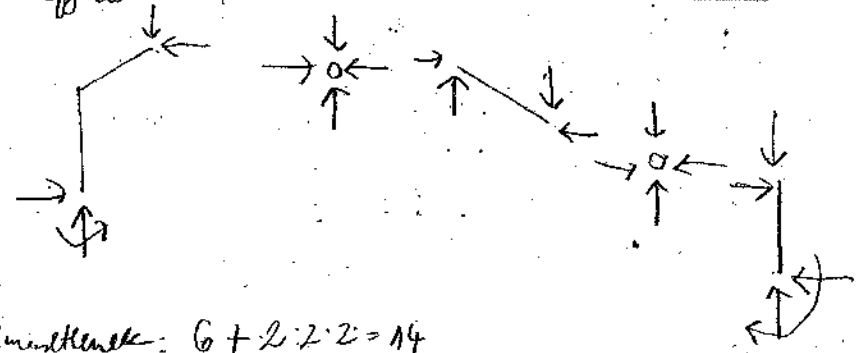
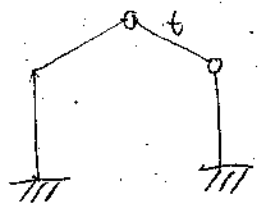
c.)



szomszédosok: $5 + 3 \cdot 2 \cdot 2 = 17$

egyfokozott: $4 \cdot 3 + 3 \cdot 2 = 18$ → határozatlan szerkezet

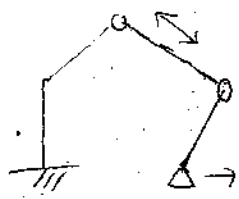
d.)



szomszédosok: $6 + 2 \cdot 2 \cdot 2 = 14$

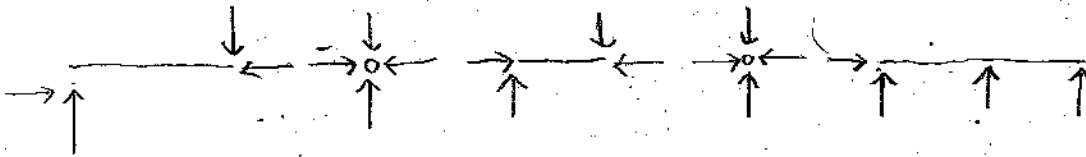
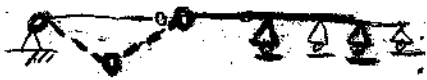
egyfokozott: $3 \cdot 3 + 2 \cdot 2 = 13$ → határozatlan szerkezet

pl. t. mind megvan a csatlakozás (ΔT határolás)



→ ha itt csukló lenne

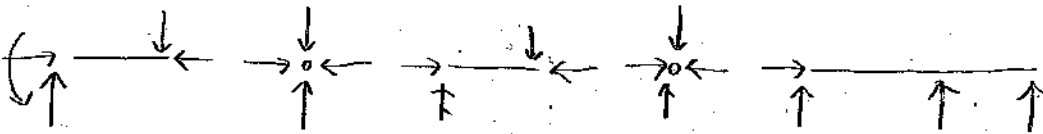
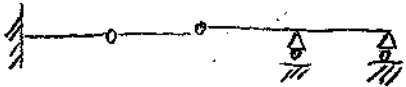
e.)



i merelemek: $4 + 2 \cdot 2 \cdot 2 = 12$
 e gyemelek: $3 \cdot 3 + 2 \cdot 2 = 13$

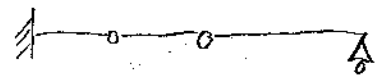
} talcheatározott szerk

f.)

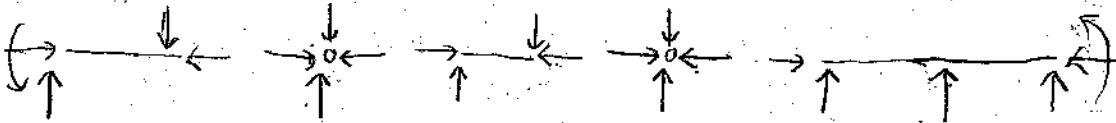
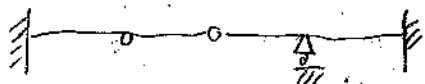


i om.: $5 + 2 \cdot 2 \cdot 2 = 13$
 e gy.: $3 \cdot 3 + 2 \cdot 2 = 13$

} lyrtározott → elbírós



g.)



i om.: $7 + 2 \cdot 2 \cdot 2 = 15$
 e gy.: $3 \cdot 3 + 2 \cdot 2 = 13$

} határozatlan

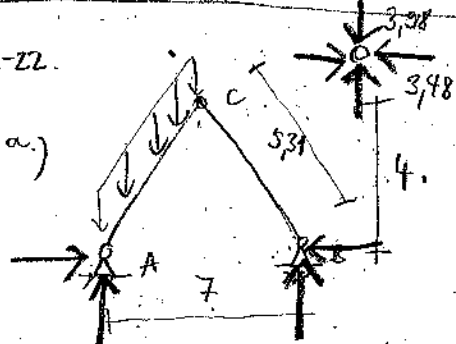
tűzválasztás:



→ ha itt nem lenne befogás

2-12.

a.)



$\sum M_A = 0 \quad 3 \cdot 5,31 \cdot 1,75 - B_y \cdot 4 = 0$

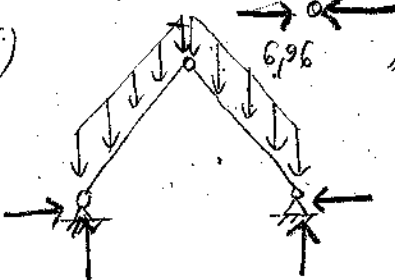
$B_y = 3,98$

$\sum M_{Cjobb} = 0 \quad B_x \cdot 4 - 3,98 \cdot 3,5 = 0$

$B_x = 3,48 = A_x$

$\sum F_y = 0 \quad 3 \cdot 5,31 = 3,98 + A_y \rightarrow A_y = 11,95$

b.)



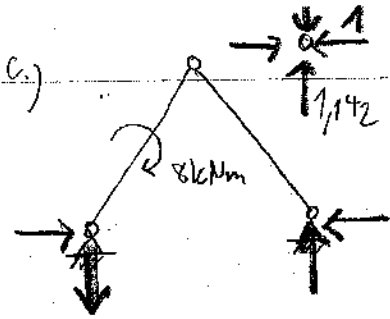
szimmetrikus terhelés:

$3 \cdot 5,31 = 15,93 = A_y = B_y$

$\sum M_{Cjobb} = 0 \quad 3 \cdot 5,31 \cdot 1,75 - 15,93 \cdot 3,5 + B_x \cdot 4 = 0$

$B_x = A_x = 6,96$

?



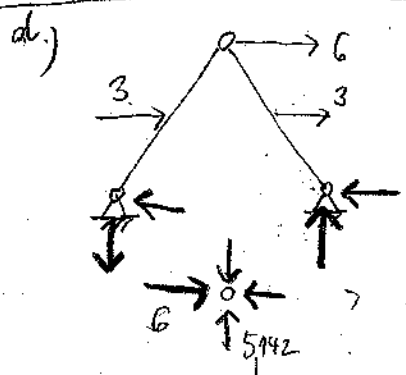
$$\sum M_A = 0 \quad 8 \text{ kNm} - B_y \cdot 4 = 0$$

$$B_y = 1,142$$

$$A_y = -1,142$$

$$\sum M_{C_{jobb}} = 0 \quad 1,142 \cdot 3,5 = B_x \cdot 4$$

$$B_x = 10 = A_x$$



$$\sum M_A = 0 \quad 3 \cdot 2 + 3 \cdot 2 + 6 \cdot 4 = B_y \cdot 4$$

$$B_y = 5,142$$

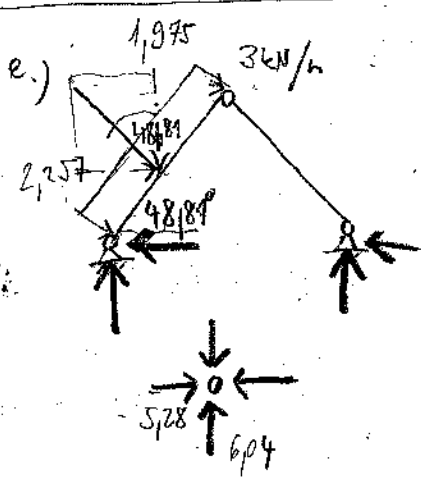
$$A_y = -5,142$$

$$\sum M_{C_{jobb}} = 0 \quad 3 \cdot 2 + 5,142 \cdot 3,5 = B_x \cdot 4$$

$$B_x = 6$$

$$\sum F_x = 0 \quad 3 + 3 + 6 - 6 - A_x = 0$$

$$A_x = 6$$



$$\sum M_A = 0 \quad 3 \cdot \frac{5,31^2}{2} - B_y \cdot 4 = 0$$

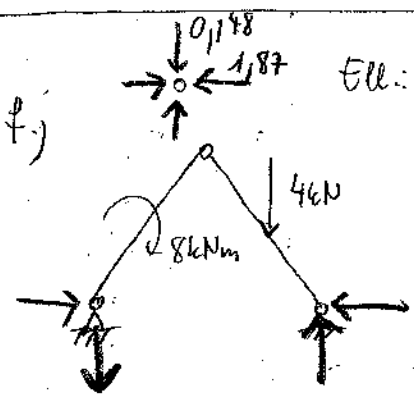
$$B_y = 6,04 \text{ kN}$$

maximale horizontale Komponente: 1,975

$$\sum F_y = 0 \quad 1,975 \cdot 5,31 - 6,04 = A_y = 4,44$$

$$\sum M_{C_{jobb}} = 0 \quad 6,04 \cdot 3,5 = B_x \cdot 4 \rightarrow B_x = 5,28$$

$$\sum F_x = 0 \quad 2,257 \cdot 5,31 - 5,28 - A_x = 0 \quad A_x = 6,70$$



Ell.: $\sum M_{C_{bal}} = 0 \quad 3 \cdot \frac{5,31^2}{2} - 4,44 \cdot 3,5 - 6,70 \cdot 4 = 0 \quad \checkmark$

$$\sum M_A = 0 \quad 8 + 4 \cdot 5,25 - B_y \cdot 4 = 0$$

$$B_y = 4,142$$

$$\sum M_{C_{jobb}} = 0 \quad 4 \cdot 1,75 + B_x \cdot 4 - 4,142 \cdot 3,5 = 0$$

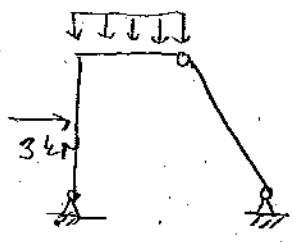
$$B_x = 1,87 = A_x$$

$$\sum M_{C_{bal}} = 0 \quad +8 - 1,87 \cdot 4 - A_y \cdot 3,5 = 0$$

$$A_y = 0,148$$

2-23.

a.)



$$\sum M_A = 0 \quad 3 \cdot 2 + 5 \cdot 4 \cdot 2 = B_y \cdot 4$$

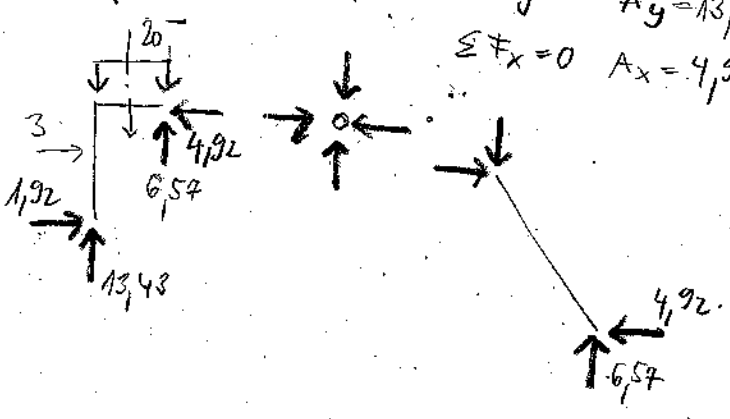
$$B_y = 6,57$$

$$\sum M_{\text{joint}} = 0 \quad 6,57 \cdot 3 = B_x \cdot 4$$

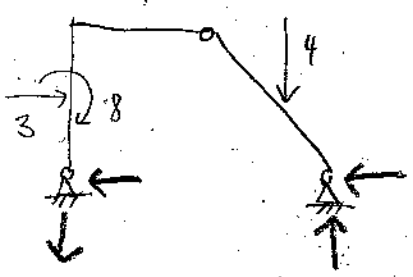
$$B_x = 4,92 \leftarrow$$

$$\sum F_y = 0 \quad A_y = 13,43$$

$$\sum F_x = 0 \quad A_x = 4,92 - 3 = 1,92 \rightarrow$$



b.)



$$\sum M_A = 0 \quad 8 + 3 \cdot 2 + 4 \cdot 5,5 = B_y \cdot 4$$

$$B_y = 5,14 \uparrow$$

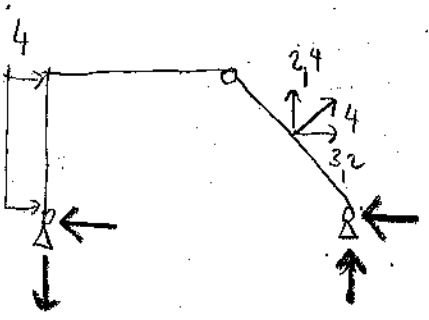
$$\sum F_y = 0 \quad A_y = 5,14 - 4 = 1,14 \downarrow$$

$$\sum M_{\text{joint}} = 0 \quad 4 \cdot 1,5 + B_x \cdot 4 - 5,14 \cdot 3 = 0$$

$$B_x = 2,35 \leftarrow$$

$$\sum F_x = 0 \quad A_x = 3 - 2,35 = 0,65 \leftarrow$$

c.)



$$\sum M_B = 0 \quad 4 \cdot 4 \cdot 2 + 4 \cdot 5 - A_y \cdot 7 = 0$$

$$A_y = 7,42 \downarrow$$

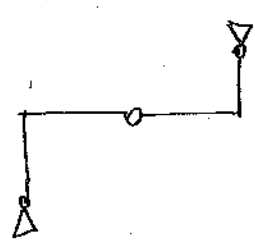
$$\sum F_y = 0 \quad 7,42 - 2,4 = 5,02 = B_y \uparrow$$

$$\sum M_{\text{joint}} = 0 \quad -4 \cdot 2,5 - 5,02 \cdot 3 + B_x \cdot 4 = 0$$

$$B_x = 6,26 \leftarrow$$

$$A_x = 4 \cdot 4 + 3,2 - 6,26 = 12,94 \leftarrow$$

2-24.

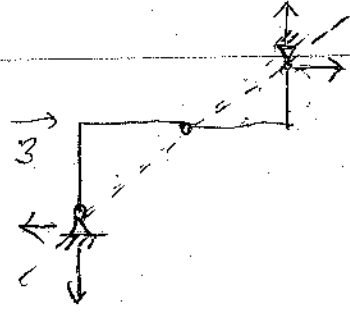


rechtereinek: $4 + 2 \cdot 2 = 8$

linkeineik: $2 \cdot 3 + 1 \cdot 2 = 8$

horizontaler's tekt.

a.)



$$\sum M_A = 0 \quad 3 \cdot 3 + B_x \cdot 6 - B_y \cdot 8 = 0$$

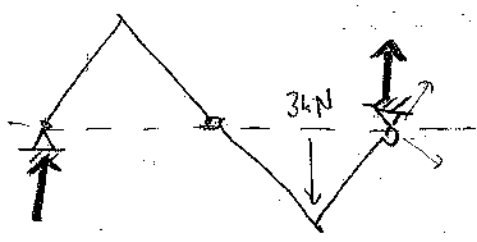
$$\sum M_{cjobb} = 0 \quad B_x \cdot 3 - B_y \cdot 4 = 0$$

$$B_x = \frac{4}{3} \cdot B_y$$

$$9 + \frac{4}{3} \cdot B_y \cdot 6 - B_y \cdot 8 = 0$$

$$9 = 0 \quad ?$$

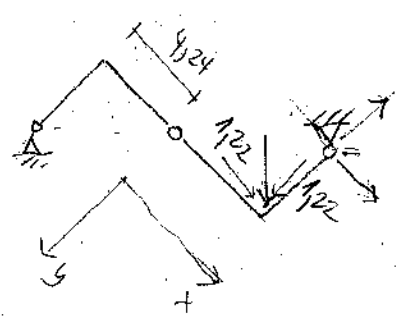
b.)



$$\sum M_A = 0 \quad 3 \cdot 9 - B_y \cdot 12 = 0$$

$$B_y = 2,25 \uparrow$$

$$A_y = 0,75 \uparrow$$



$$\sum M_A = 0 \quad 1,22 \cdot 8,48 + 1,22 \cdot 4,24 + B_x \cdot 8,48 - B_y \cdot 8,48 = 0$$

$$15,74 + B_x \cdot 8,48 - B_y \cdot 8,48 = 0$$

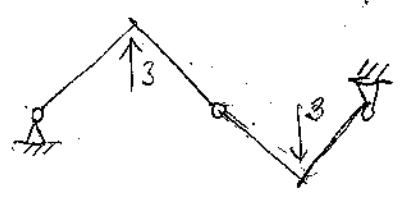
$$\sum M_{cjobb} = 0 \quad 1,22 \cdot 4,24 + B_x \cdot 4,24 - B_y \cdot 4,24 = 0$$

$$B_x = \frac{4,24 \cdot B_y - 5,17}{4,24}$$

$$B_x = B_y - 1,21$$

$$15,74 + (B_y - 1,21) \cdot 8,48 - B_y \cdot 8,48 = 0$$

c.)



kiélen az obblakat nem lehet
csak erre a képre van megoldás

Három pontot egy egyenlet esik!
Egyidejűleg határozatlanok és túlhatalozottak.