①

$a = 1\,m$

$q = 3\,kN/m$

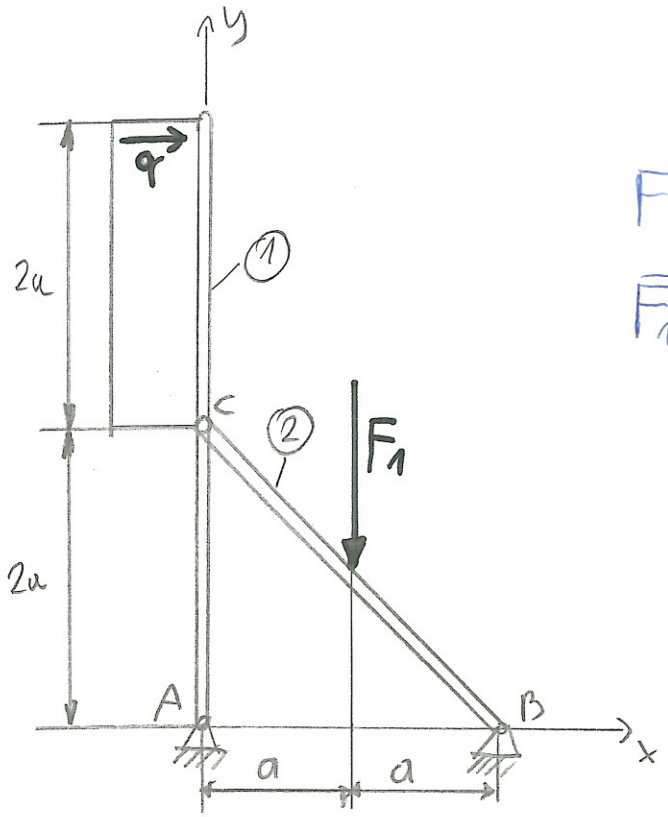
$F_1 = 10\,kN$

?:

$\vec{F}_A$

$\vec{F}_B$

$\vec{F}_{21}$



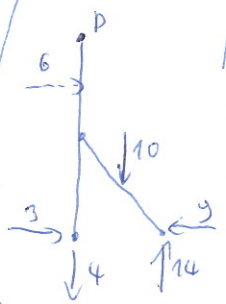
$F_q = 2 \cdot 3 = 6\,kN\,(\rightarrow)$

$\vec{F}_{12} + \vec{F}_{21} = \vec{0}$

$F_{12x} = -F_{21x}$

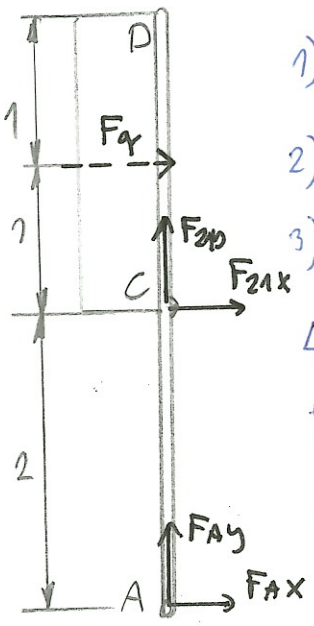
$F_{12y} = -F_{21y}$

ellenőrzés



$M_D = 1 \cdot 6 - 1 \cdot 10 + 4 \cdot 3 - 4 \cdot 9 + 2 \cdot 14 = 0$ ✓

①



1) $F_x = 0 = F_{Ax} + F_{21x} + F_q$

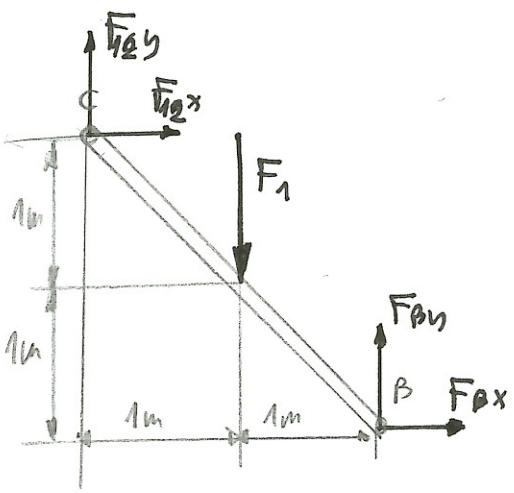
2) $F_y = 0 = F_{Ay} + F_{21y}$

3) $M_C = 0 = 2F_{Ax} - 1 \cdot F_q$

4) $F_x = 0 = F_{Bx} + F_{12x}$

5) $F_y = 0 = F_{By} + F_{12y} - F_1$

6) $M_C = 0 = -F_1 + 2F_{By} + 2F_{Bx}$



3) → $F_{Ax} = \frac{F_q}{2} = \frac{6}{2} = 3\,kN\,(\rightarrow)$

1) → $F_{21x} = -F_{Ax} - F_q = -3 - 6 = -9\,kN\,(\leftarrow)$

$F_{12x} = -F_{21x} = 9\,kN\,(\rightarrow)$

4) → $F_{Bx} = -F_{12x} = -9\,kN\,(\leftarrow)$

6) → $F_{By} = \frac{F_1 - 2F_{Bx}}{2} = \frac{10 - 2 \cdot (-9)}{2} = 14\,kN\,(\uparrow)$

5) → $F_{12y} = F_1 - F_{By} = 10 - 14 = -4\,kN\,(\downarrow)$

$F_{21y} = -F_{12y} = 4\,kN\,(\uparrow)$

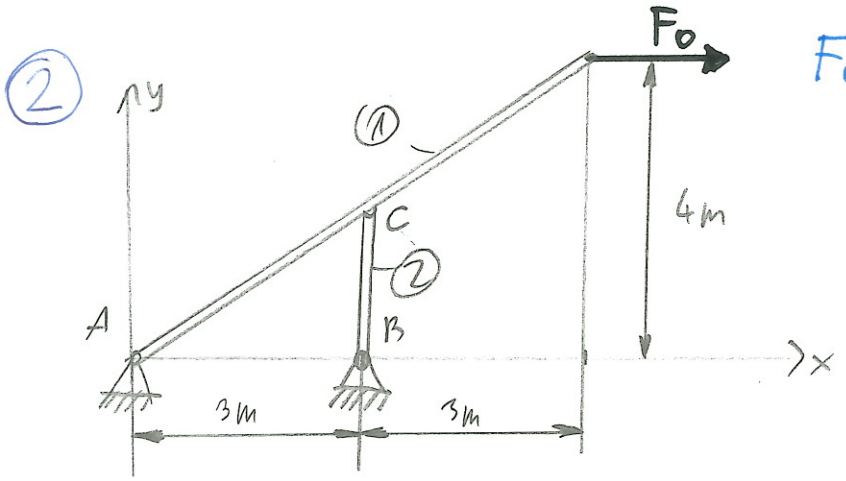
2) → $F_{Ay} = -F_{21y} = -4\,kN\,(\downarrow)$

eredmények:

$\vec{F}_A = (3\vec{i} - 4\vec{j})\,kN$

$\vec{F}_B = (-9\vec{i} + 14\vec{j})\,kN$

$\vec{F}_{21} = (-9\vec{i} + 4\vec{j})\,kN$



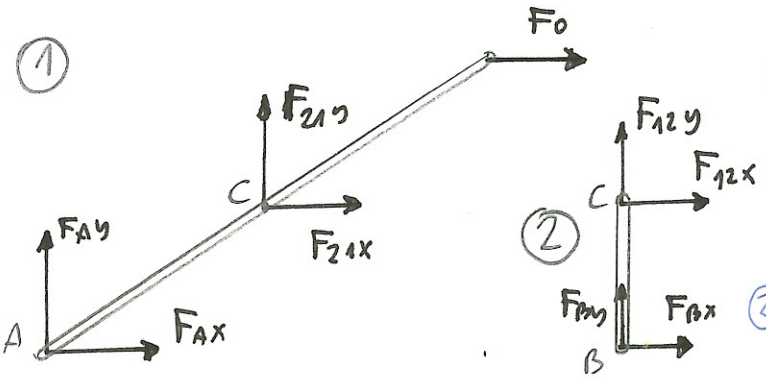
$F_0 = 12\,kN$

?: $\vec{F}_A$ $\vec{F}_B$ $\vec{F}_{21}$

a) számít

b) szerkeszt

$\vec{F}_{12} = -\vec{F}_{21}$



① 1) $F_x = 0 = F_{Ax} + F_{21x} + F_0$

2) $F_y = 0 = F_{Ay} + F_{21y}$

3) $M_C = 0 = 2F_{Ax} - 3F_{Ay} - 2F_0$

② 4) $F_x = 0 = F_{B1} + F_{12x}$

5) $F_y = 0 = F_{By} + F_{12y}$

6) $M_C = 0 = 2F_{Bx}$

6) → $F_{Bx} = 0$

4) → $F_{12x} = -F_{Bx} = 0$

$F_{21x} = -F_{12x} = 0$

1) → $F_{Ax} = -F_{21x} - F_0 = -0 - 12 = -12\,kN\,(\leftarrow)$

3) → $F_{Ay} = \frac{2F_{Ax} + 2F_0}{3} = \frac{2\cdot(-12) - 2\cdot 12}{3} = -16\,kN\,(\downarrow)$

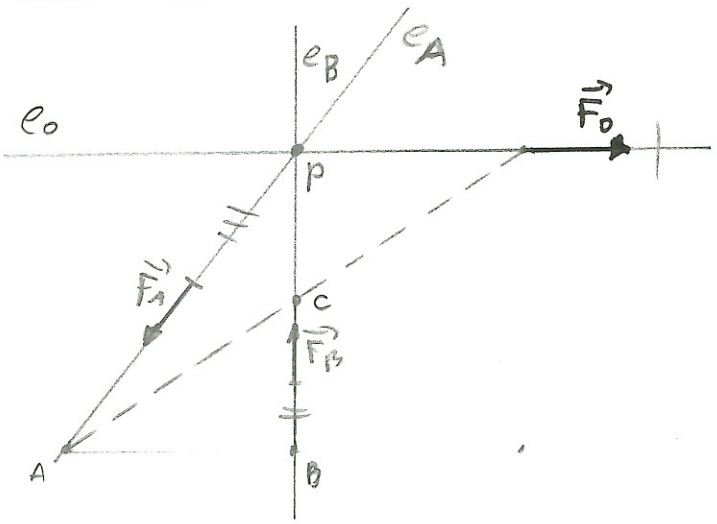
2) → $F_{21y} = -F_{Ay} = 16\,kN\,(\uparrow)$

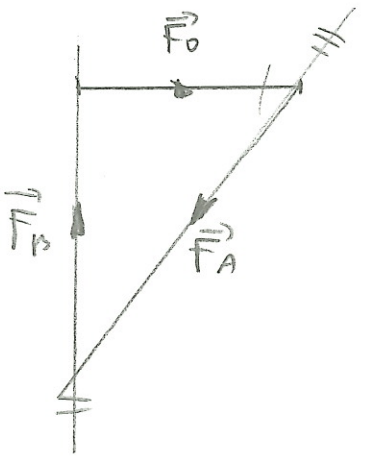
$F_{12y} = -F_{21y} = -16\,kN\,(\downarrow)$

5) → $F_{By} = -F_{12y} = 16\,kN\,(\uparrow)$

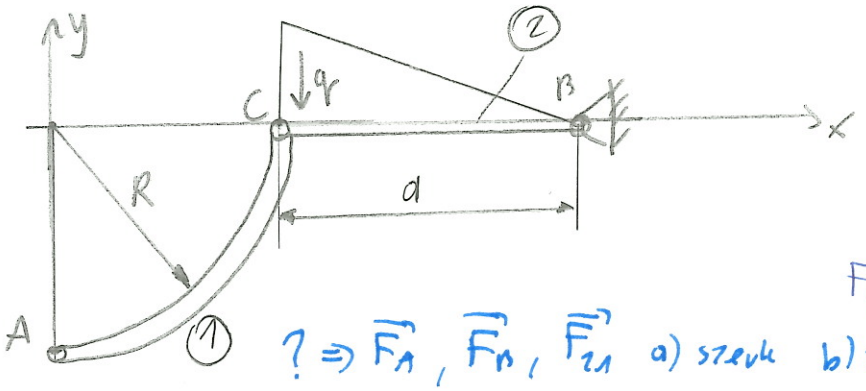
Szerkesztés: 1 cm ≙ 1 m szerkezeti ábra

1 cm ≙ 4 kN erőábra





(3)



$a = 4m$

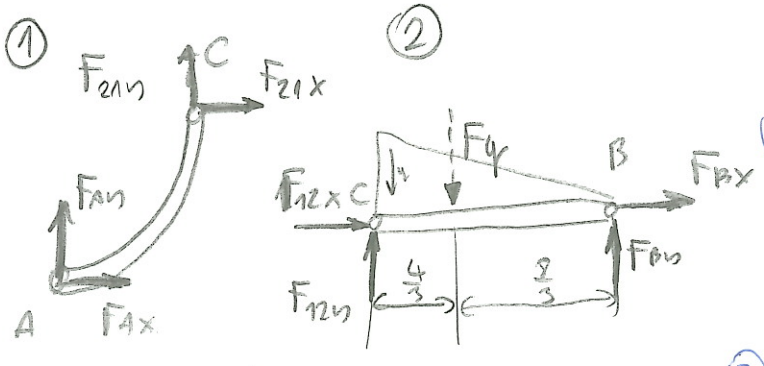
$R = 3m$

$q = 3\,kN/m$

$\Downarrow$

$F_q = \frac{3 \cdot 4}{2} = 6\,kN\,(\downarrow)$

? $\Rightarrow \vec{F_A}, \vec{F_B}, \vec{F_{21}}$ a) szerk b) szám $\quad \vec{F_{12}} = -\vec{F_{21}}$



① 1) $F_x = 0 = F_{Ax} + F_{21x}$

2) $F_y = 0 = F_{Ay} + F_{21y}$

3) $M_C = 0 = 3F_{Ax} - 3F_{Ay}$

② 4) $F_x = 0 = F_{12x} + F_{Bx}$

5) $F_y = 0 = F_{12y} - F_q + F_{By}$

6) $M_C = 0 = -\frac{4}{3}F_q + 4F_{By}$

6) $\rightarrow F_{By} = \frac{\frac{4}{3}F_q}{4} = \frac{1}{3}F_q = \frac{1}{3} \cdot 6 = 2\,kN\,(\uparrow)$

5) $\rightarrow F_{12y} = F_q - F_{By} = 6 - 2 = 4\,kN\,(\uparrow)$

$F_{21y} = -F_{12y} = -4\,kN\,(\downarrow)$

2) $\rightarrow F_{Ay} = -F_{21y} = 4\,kN\,(\uparrow)$

3) $\rightarrow F_{Ax} = \frac{3F_{Ay}}{3} = F_{Ay} = 4\,kN\,(\rightarrow)$

1) $\rightarrow F_{21x} = -F_{Ax} = -4\,kN\,(\leftarrow)$

$F_{12x} = -F_{21x} = 4\,kN\,(\rightarrow)$

4) $\rightarrow F_{Bx} = -F_{12x} = -4\,kN\,(\leftarrow)$

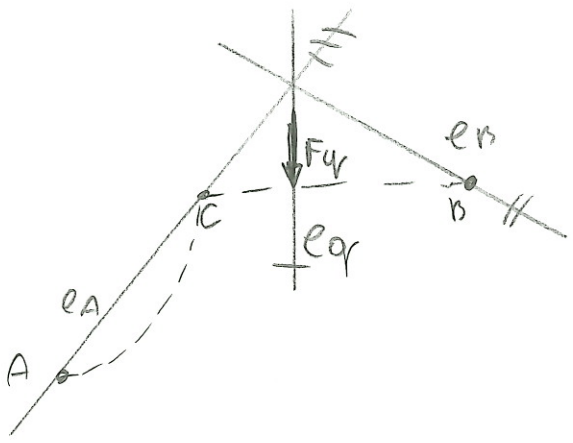
$\vec{F_A} = (4\vec{i} + 4\vec{j})\,kN$

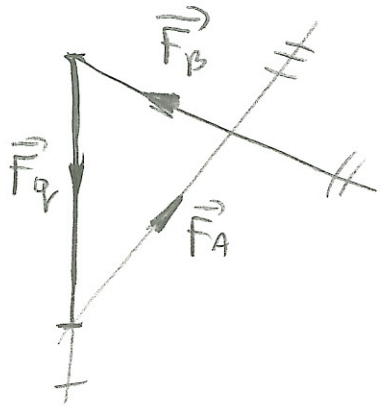
$\vec{F_B} = (-4\vec{i} + 2\vec{j})\,kN$

$\vec{F_{12}} = (4\vec{i} + 4\vec{j})\,kN$

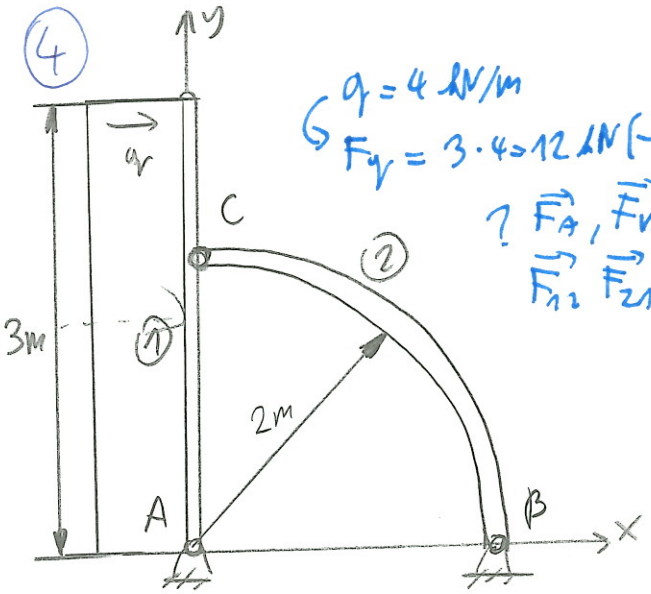
szerkesztés

1 cm ≙ 1 m





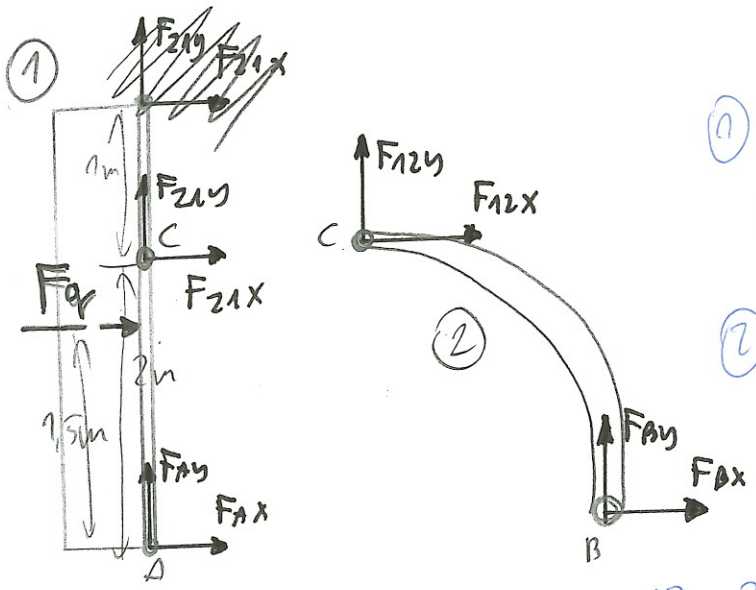
④



$q = 4\ kN/m$

$F_q = 3 \cdot 4 = 12\ kN (\rightarrow)$

? $\vec{F_A}, \vec{F_B}$, $\vec{F_{12}}$ $\vec{F_{21}}$ a) szám b) szerk



① 1) $F_x = 0 = F_{Ax} + F_q + F_{21x}$

2) $F_y = 0 = F_{Ay} + F_{21y}$

3) $M_C = 0 = 2F_{Ax} + 0{,}5F_q$

② 4) $F_x = 0 = F_{12x} + F_{Bx}$

5) $F_y = 0 = F_{12y} + F_{By}$

6) $M_C = 0 = 2F_{Bx} + 2F_{By}$

3) → $F_{Ax} = \frac{-0{,}5F_q}{2} = \frac{-0{,}5 \cdot 12}{2} = -3\ kN (\leftarrow)$

1) → $F_{21x} = -F_{Ax} - F_q = -(-3) - 12 = -9\ kN (\leftarrow)$

$F_{12x} = -F_{21x} = 9\ kN (\rightarrow)$

4) → $F_{Bx} = -F_{12x} = -9\ kN (\leftarrow)$

6) → $F_{By} = \frac{-2F_{Bx}}{2} = -F_{Bx} = 9\ kN (\uparrow)$

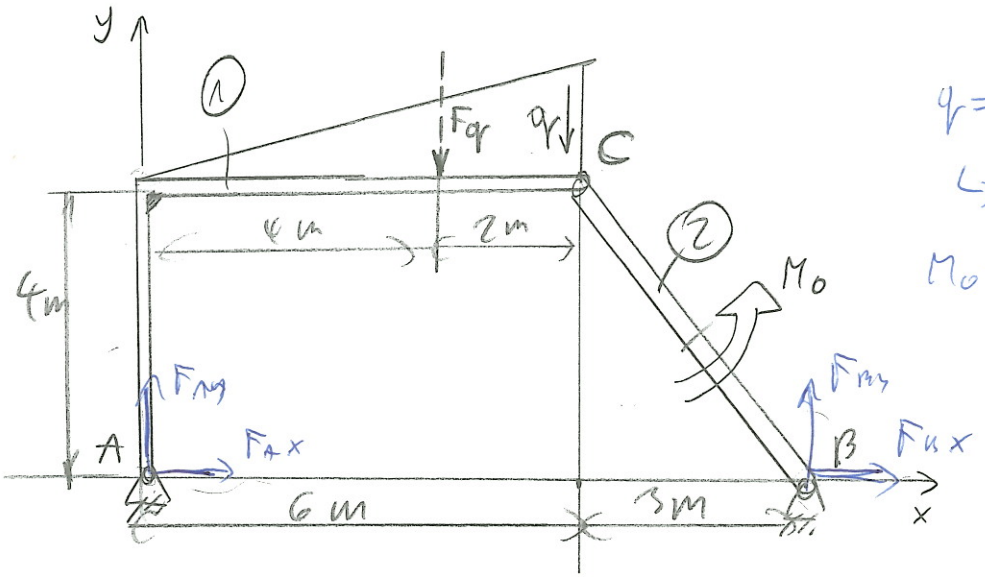
5) → $F_{12y} = -F_{By} = -9\ kN (\downarrow)$

$F_{21y} = -F_{12y} = 9\ kN (\uparrow)$

2) → $F_{Ay} = -F_{21y} = -9\ kN (\downarrow)$

$\vec{F_A} = (-3\vec{i} - 9\vec{j})\ kN$ $\quad \vec{F_B} = (-9\vec{i} + 9\vec{j})\ kN$

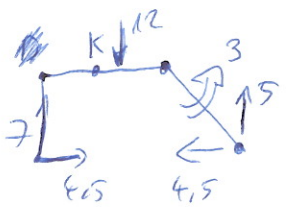
$\vec{F_{12}} = (9\vec{i} - 9\vec{j})\ kN$ $\quad \vec{F_{21}} = (-9\vec{i} + 9\vec{j})\ kN$



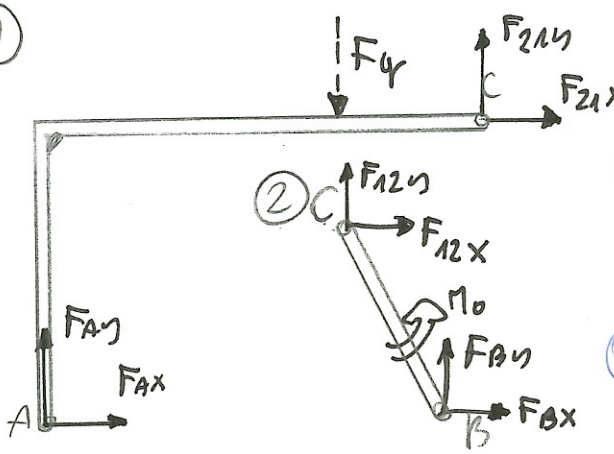
$q = 4\ kN/m$

$\hookrightarrow F_q = \frac{6 \cdot 4}{2} = 12\ kN(\downarrow)$

$M_0 = 3\ kNm$



$M_K = 4 \cdot 4{,}5 - 3 \cdot 7 - 1 \cdot 12 + 3 \cdot 5 - 4 \cdot 4{,}5 + 6 \cdot 9 = 0$ ✓



① 1) $F_x = 0 = F_{Ax} + F_{21x}$

2) $F_y = 0 = F_{Ay} - F_q + F_{21y}$

3) $M_C = 0 = 4F_{Ax} - 6F_{Ay} + 2F_q$

② 4) $F_x = 0 = F_{Bx} + F_{12x}$

5) $F_y = 0 = F_{By} + F_{12y}$

6) $M_C = 0 = M_0 + 4F_{Bx} + 3F_{By}$

1+2-re: $M_a = 0 = -4F_q + M_0 + 9F_{By}$

$\Rightarrow F_{By} = \frac{4F_q - M_0}{9} = \frac{4 \cdot 12 - 3}{9} = 5\ kN(\uparrow)$

$M_b = 0 = -9F_{Ay} + 5F_q + M_0 \Rightarrow F_{Ay} = \frac{5F_q + M_0}{9} = \frac{5 \cdot 12 + 3}{9} = 7\ kN(\uparrow)$

6) $\rightarrow F_{Bx} = \frac{-M_0 - 3F_{By}}{4} = \frac{-3 - 3 \cdot 5}{4} = -4{,}5\ kN(\leftarrow)$

5) $\rightarrow F_{12y} = -F_{By} = -5\ kN(\downarrow)$

$F_{21y} = -F_{12y} = 5\ kN(\uparrow)$

* 4) $\rightarrow F_{12x} = -F_{Bx} = 4{,}5\ kN$

$F_{21x} = -F_{12x} = -4{,}5\ kN$

* 2) $\rightarrow F_{21y} = -F_{Ay} + F_q = -7 + 12 = 5\ kN(\uparrow)$

$F_{12y} = -F_{21y} = -5\ kN(\downarrow)$

3) $\rightarrow F_{Ax} = \frac{6F_{Ay} - 2F_q}{4} = \frac{6 \cdot 7 - 2 \cdot 12}{4} = 4{,}5\ kN(\rightarrow)$

$\vec{F}_A = (4{,}5\vec{i} + 7\vec{j})\ kN$ $\quad \vec{F}_{12} = (4{,}5\vec{i} - 5\vec{j})\ kN$

$\vec{F}_B = (-4{,}5\vec{i} + 5\vec{j})\ kN$ $\quad \vec{F}_{21} = (-4{,}5\vec{i} + 5\vec{j})\ kN$