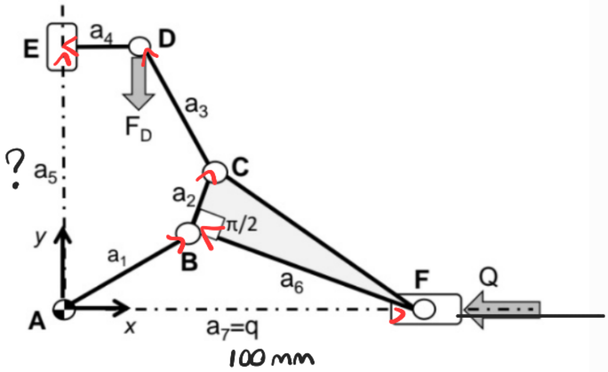
Dati numerici.

a1 = AB = 40 mm
a2 = BC = 25 mm
a3 = CD = 40 mm
a4 = DE = 20 mm
a6 = BF = 70 mm

q=a7=100 mm
qdot = a7dot = -15 mm/s

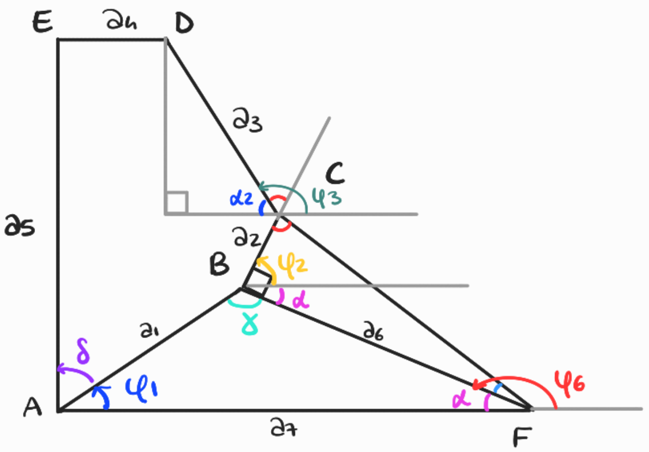
F_D = 140 N



NB: meccanismo NON in scala

$$a_1 = 40\,mm$$
$$a_2 = 25\,mm$$
$$a_3 = 40\,mm$$
$$a_4 = 20\,mm$$
$$a_6 = 70\,mm$$
$$q = a_7 = 100\,mm$$
$$\dot{q} = \dot{a}_7 = -15\,\frac{mm}{s}$$

$$F \begin{cases} x_F = 100\,mm \\ y_F = 0\,mm \end{cases}$$



$$a_6^2 = a_1^2 + a_7^2 - 2a_1a_7\cos\varphi_1$$

$$\varphi_1 = \arccos\left(\frac{a_1^2+a_7^2-a_6^2}{2a_1a_7}\right) = 33,12° \sim 33,1°$$

$$\alpha = \arccos\left(\frac{a_6^2+a_7^2-a_1^2}{2a_6a_7}\right) = 18,195° \sim 18,2°$$

$$\gamma = \arccos\left(\frac{a_1^2+a_6^2-a_7^2}{2a_1a_6}\right) = 128,682° \sim 128,7°$$

$$\varphi_2 = 90° - \alpha = 71,8°$$

$$\delta = 90° - \varphi_1 = 56,9°$$

$$CF = \sqrt{a_2^2 + a_6^2} = 74,33\ mm$$

$$B\hat{F}C = \arccos\left(\frac{a_6^2 + CF^2 - a_2^2}{2a_6 CF}\right) = 19,65°$$

$$B\hat{C}F = 180° - 90° - 19,65° = 70,35°$$

$$B \begin{cases} x_B = a_1\cos\varphi_1 = 33,5\ mm \\ y_B = a_1\sin\varphi_1 = 21,84\ mm \end{cases}$$

$$C \begin{cases} x_C = a_1\cos\varphi_1 + a_2\cos\varphi_2 = 41,3\ mm \\ y_C = a_1\sin\varphi_1 + a_2\sin\varphi_2 = 45,6\ mm \end{cases}$$

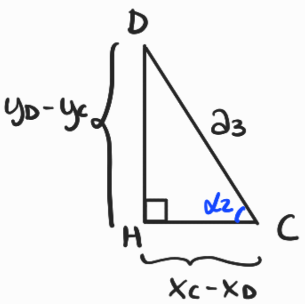
$$DC = a_3 = \sqrt{(x_C-x_D)^2+(y_C-y_D)^2}$$

$$40^2 = (41,3-20)^2 + (45,6^2 + y_D^2 - 91,2y_D)$$

$$y_D^2 - 91,2\,y_D + 933,05 = 0 \qquad \sqrt{\Delta} = 67,7$$

$$y_{D_{1,2}} = \frac{91 \pm 67{,}7}{2} \left\langle \begin{array}{l} 79{,}35 \quad \text{VA BENE} \\ 11{,}65 \end{array} \right.$$

$$D \begin{cases} x_D = 20 \text{ mm} \\ y_D = 79{,}35 \text{ mm} \end{cases}$$



$$a = x_C - x_D = 21{,}3 \text{ mm}$$

$$b = y_D - y_C = 33{,}75 \text{ mm}$$

$$\alpha_2 = \arccos\left(\frac{a_3^2 + a^2 - b^2}{2 a_3 a}\right) = 57{,}8^\circ$$

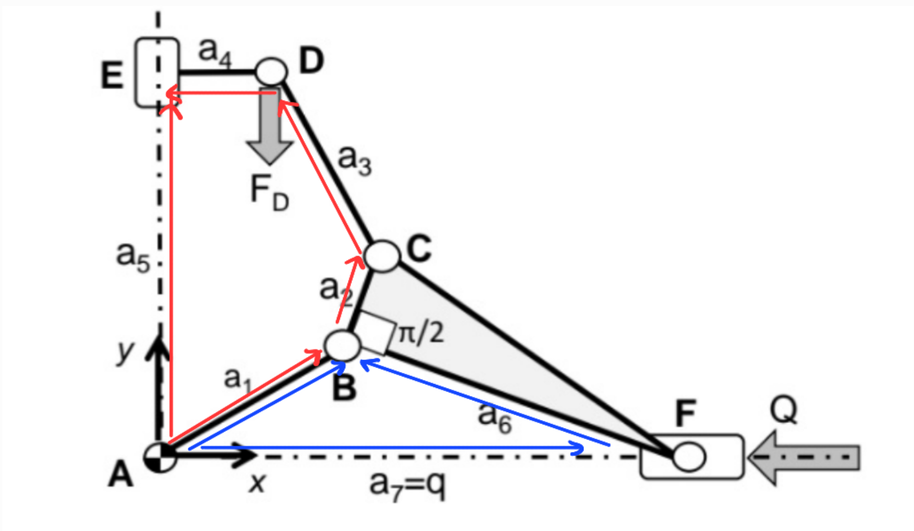
$$H\hat{D}C = 180 - 90 - \alpha_2 = 32{,}5^\circ$$

$$\varphi_3 = 180^\circ - \alpha_2 = 122{,}2^\circ$$

$$\varphi_6 = 180^\circ - \alpha = 161{,}8^\circ$$

$$AD = \sqrt{(x_A - x_D)^2 + (y_A - y_D)^2} = 81{,}83 \text{ mm}$$

$$a_5 = \sqrt{AD^2 - a_4^2} = 79{,}3 \text{ mm}$$



$$\begin{cases} a_1 \cos\varphi_1 + a_2 \cos\varphi_2 + a_3 \cos\varphi_3 + a_4 = 0 \\ a_1 \sin\varphi_1 + a_2 \sin\varphi_2 + a_3 \sin\varphi_3 - a_5 = 0 \end{cases}$$

$$\begin{cases} a_1 \cos\varphi_1 - a_6 \cos\varphi_6 - a_7 = 0 \\ a_1 \sin\varphi_1 - a_6 \sin\varphi_6 = 0 \end{cases}$$

ANALISI DI POSIZIONE

$$\begin{cases} -a_1 \sin\varphi_1 \cdot \dot{\varphi}_1 + a_6 \sin\varphi_6 \cdot \dot{\varphi}_6 - \dot{a}_7 = 0 \\ a_1 \cos\varphi_1 \cdot \dot{\varphi}_1 - a_6 \cos\varphi_6 \cdot \dot{\varphi}_6 = 0 \end{cases}$$

ANALISI DI VELOCITÀ

$$\begin{bmatrix} -a_1 \sin\varphi_1 & a_6 \sin\varphi_6 \\ a_1 \cos\varphi_1 & -a_6 \cos\varphi_6 \end{bmatrix} \begin{Bmatrix} \dot\varphi_1 \\ \dot\varphi_6 \end{Bmatrix} = \begin{Bmatrix} \dot a_7 \\ 0 \end{Bmatrix}$$

dove $\dot a_7 = -15$

$$\begin{Bmatrix} \dot\varphi_1 \\ \dot\varphi_6 \end{Bmatrix} = \frac{1}{a_1 a_6 \sin(\varphi_1 - \varphi_6)} \begin{bmatrix} -a_6 \cos\varphi_6 & -a_6 \sin\varphi_6 \\ -a_1 \cos\varphi_1 & -a_1 \sin\varphi_1 \end{bmatrix} \begin{Bmatrix} \dot a_7 \\ 0 \end{Bmatrix}$$

$$\begin{Bmatrix} \dot\varphi_1 \\ \dot\varphi_6 \end{Bmatrix} = \frac{1}{a_1 a_6 \sin(\varphi_1 - \varphi_6)} \begin{bmatrix} -a_6 \cos\varphi_6 \\ -a_1 \cos\varphi_1 \end{bmatrix} \cdot \dot a_7$$

$$\dot\varphi_1 = \frac{-\cancel{a_6} \cos\varphi_6}{a_1 \cancel{a_6} \sin(\varphi_1 - \varphi_6)} \cdot \dot a_7 = \frac{-\cos(161{,}8) \cdot (-15)}{40 \cdot \sin(33{,}1 - 161{,}8)} = 0{,}45 = 25{,}78 \sim 26$$

OK

$$\dot\varphi_6 = \frac{-\cancel{a_1} \cos\varphi_1}{\cancel{a_1} a_6 \sin(\varphi_1 - \varphi_6)} \cdot \dot a_7 = \frac{-\cos(33{,}1)(-15)}{70 \; \sin(33{,}1 - 161{,}8)} = -0{,}23 = -13{,}17$$

OK

$$\begin{cases} a_1 \cos\varphi_1 + a_2 \cos\varphi_2 + a_3 \cos\varphi_3 + a_4 = 0 \\ a_1 \sin\varphi_1 + a_2 \sin\varphi_2 + a_3 \sin\varphi_3 - a_5 = 0 \end{cases}$$

$$\varphi_2 = \varphi_6 - \frac{\pi}{2}$$

$$\begin{cases} -a_1 \sin\varphi_1 \cdot \dot\varphi_1 - a_2 \sin\varphi_2 \cdot \dot\varphi_6 - a_3 \sin\varphi_3 \cdot \dot\varphi_3 = 0 \\ a_1 \cos\varphi_1 \cdot \dot\varphi_1 + a_2 \cos\varphi_2 \cdot \dot\varphi_6 + a_3 \cos\varphi_3 \cdot \dot\varphi_3 - \dot a_5 = 0 \end{cases}$$

ANALISI DI VELOCITÀ

$$\dot\varphi_3 = \frac{-a_1 \sin\varphi_1 \cdot \dot\varphi_1 - a_2 \sin\varphi_2 \cdot \dot\varphi_6}{a_3 \sin\varphi_3} = -7{,}6$$

$$\dot a_5 = a_1 \cos\varphi_1 \cdot \dot\varphi_1 + a_2 \cos\varphi_2 \cdot \dot\varphi_6 + a_3 \cos\varphi_3 \cdot \dot\varphi_3 = \frac{927{,}957 \cdot \pi}{180^\circ} = 16{,}3$$

ANALISI STATICA

$$-F_D \, \delta y_D - Q \, \delta x_F = 0$$

$$Q = \frac{-F_D \, \dot y_D}{\dot q} = \frac{-140 \cdot 16{,}3}{-15} = 152{,}13 \sim 152{,}5$$

OK

$$\dot y_D = \dot a_5$$