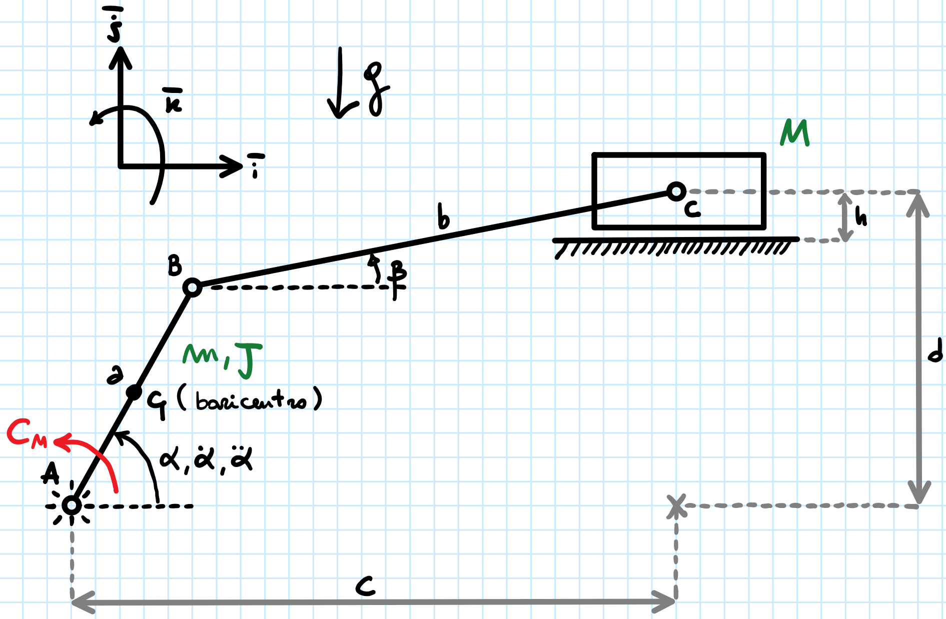


DATI

$a = 0{,}021\ m$

$b = 0{,}053\ m$

$c = 0{,}063\ m$

$d = 0{,}024\ m$

$\alpha = 62\ deg.$

$\beta = 6\ deg.$

$C_M = 1{,}5\ Nm$

$J = 0{,}1\ kgm^2$

$m = 1{,}9\ kg$

$h = 0{,}002\ m$

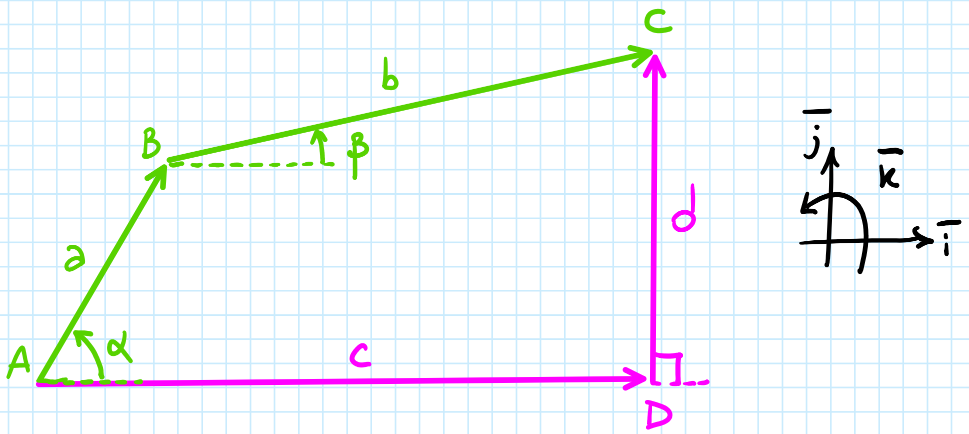
$\dot{\alpha} = 12\ rad/s$

$\ddot{\alpha} = -2\ rad/s^2$

CALCOLARE

1) $\bar{V}_G$ e $\bar{a}_G$
2) $\bar{V}_C$ e $\bar{a}_C$
3) M applicando il P.L.V.
4) REAZIONI VINCOLARI TRA TERRA E CORSOIO ($\bar{N}$ e $\bar{L}$)

CINEMATICA



EQUAZIONE DI CHIUSURA (Posizione)

$$(B-A)+(C-B)=(D-A)+(C-D)$$

$$a(\cos\boxed{\alpha}\,\bar{i}+\sin\alpha\,\bar{j})+b(\cos\boxed{\beta}\,\bar{i}+\sin\beta\,\bar{j})=\boxed{c}\,\bar{i}+d\,\bar{j}$$

$$a(\cos\boxed{\alpha}\,\bar i + \sin\alpha\,\bar j) + b(\cos\boxed{\beta}\,\bar i + \sin\beta\,\bar j) = \boxed{c}\,\bar i + d\,\bar j$$

$$\left.\begin{matrix}\alpha\\ \beta\\ c\end{matrix}\right\}\ \text{INCOGNITE}$$

VELOCITÀ

$$a\dot\alpha(-\sin\alpha\,\bar i + \cos\alpha\,\bar j) + b\dot\beta(-\sin\beta\,\bar i + \cos\beta\,\bar j) = \dot c\,\bar i$$

$$\begin{matrix}\cdot\,\bar i\\ \cdot\,\bar j\end{matrix}\left\{\begin{matrix}-a\dot\alpha\sin\alpha - b\dot\beta\sin\beta = \boxed{\dot c}\\ a\dot\alpha\cos\alpha + b\boxed{\dot\beta}\cos\beta = 0\end{matrix}\right. \Rightarrow \dot\beta = \boxed{-\frac{a\cos\alpha}{b\cos\beta}}\,\dot\alpha$$

$$\left.\begin{matrix}\dot\beta\\ \dot c\end{matrix}\right\}\ \text{INCOGNITE}$$

JACOBIANO $= \dfrac{\partial\beta}{\partial\alpha}$

NOTA

$$\frac{\partial\beta}{\partial\alpha} = \frac{\dot\beta}{\dot\alpha} \Rightarrow \text{nel P.L.V.}$$

$$\delta\beta = \frac{\dot\beta}{\dot\alpha}\cdot\delta\alpha$$

$$\delta c = \frac{\dot c}{\dot\alpha}\cdot\delta\alpha$$

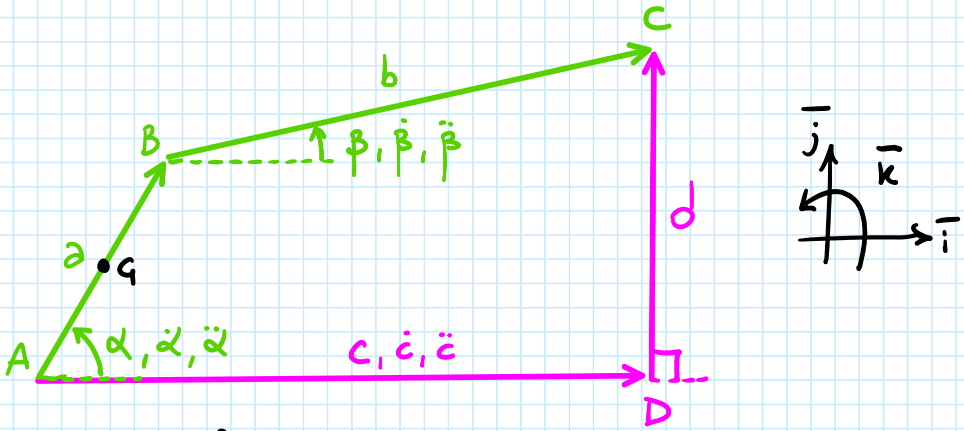
ACCELERAZIONE

$$\begin{matrix}\cdot\,\bar i\\ \cdot\,\bar j\end{matrix}\left\{\begin{matrix}-a\ddot\alpha\sin\alpha - a\dot\alpha^2\cos\alpha - b\ddot\beta\sin\beta - b\dot\beta^2\cos\beta = \boxed{\ddot c}\\ a\ddot\alpha\cos\alpha - a\dot\alpha^2\sin\alpha + b\boxed{\ddot\beta}\cos\beta - b\dot\beta^2\sin\beta = 0\end{matrix}\right. \Rightarrow \ddot\beta$$

$\Rightarrow$ poi calcolo $\ddot c$

$$\left.\begin{matrix}\ddot c\\ \ddot\beta\end{matrix}\right\}\ \text{INCOGNITE}$$

SOLUZIONI CINEMATICA



$$|(G-A)| = \frac{a}{2}$$

$$\bar V_G = \dot\alpha\,\bar k \wedge (G-A)$$

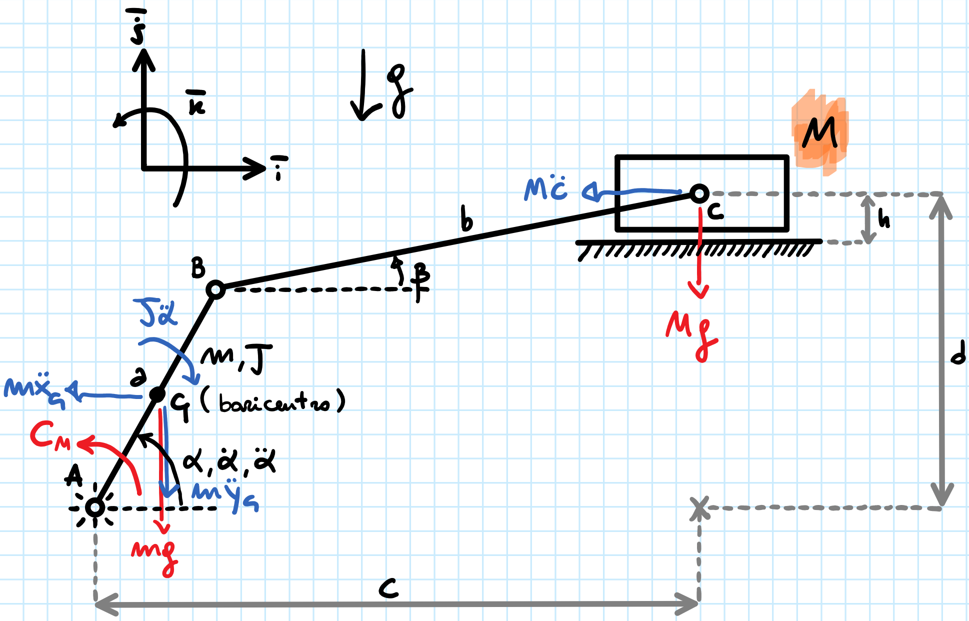
$= \dot{\alpha}\,\bar{k} \wedge \left[\frac{a}{2}\left(\cos\alpha\,\bar{i} + \sin\alpha\,\bar{j}\right)\right] = -0{,}11\,\bar{i} + 0{,}06\,\bar{j} \quad [m/s]$

$\bar{a}_G = \ddot{\alpha}\,\bar{k} \wedge (G-A) - \dot{\alpha}^2 (G-A) = -0{,}69\,\bar{i} - 1{,}34\,\bar{j} \quad [m/s^2]$

$\bar{V}_C = \dot{c}\,\bar{i} = -0{,}21 \frac{m}{s}$

$\bar{a}_C = \ddot{c}\,\bar{i} = -1{,}93 \frac{m}{s^2}$

DINAMICA



CALCOLARE M USANDO IL P.L.V.

$$\left(-m\ddot{x}_G\,\delta x_G - m\ddot{y}_G\,\delta y_G - J\ddot{\alpha}\,\delta\alpha\right) + \left(-M\ddot{c}\,\delta c\right) + C_M\,\delta\alpha - mg\,\delta y_G = 0$$

Gli spostamenti VIRTUALI li prendo con verso positivo secondo le convenzioni scelte

SOSTITUISCO I LEGAMI CINEMATICI TRA GLI SPOSTAMENTI VIRTUALI E $\delta\alpha$

p. es.: $\delta x_G = \frac{\partial x_G}{\partial \alpha} \cdot \delta\alpha \Rightarrow \frac{\partial x_G}{\partial \alpha} = \frac{\dot{x}_G}{\dot{\alpha}}$

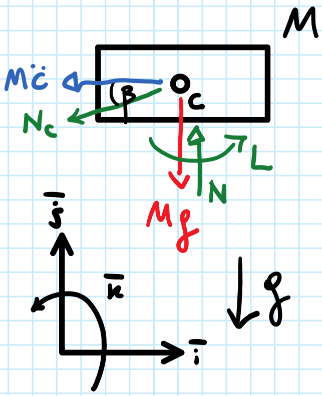
$$\left[-m\ddot{x}_G\left(\frac{\dot{x}_G}{\dot{\alpha}}\right) - m\ddot{y}_G\left(\frac{\dot{y}_G}{\dot{\alpha}}\right) - J\ddot{\alpha} - \boxed{M}\ddot{c}\left(\frac{\dot{c}}{\dot{\alpha}}\right) + C_M - mg\left(\frac{\dot{y}_G}{\dot{\alpha}}\right)\right]\cancel{\delta\alpha} = 0$$

INCOGNITA CHE CALCOLO

$\Rightarrow M = 47{,}52\ kg$

CALCOLO DELLE REAZIONI VINCOLARI (Equilibrio Dinamico)

CORSO 10



CALCOLO **L** FACENDO IL MOMENTO ATTORNO A "C" (POLO)

$L = 0$ (Tutte le Forze passano per C)

CALCOLO **N** FACENDO UN EQUILIBRIO DINAMICO VERTICALE

$$-Mg + \boxed{N} - \boxed{N_c}\sin\beta = 0$$

INCOGNITE

RICAVO N_c (2 MODALITÀ) E DI CONSEGUENZA N

1ª MODALITÀ (Equilibrio alla traslazione ORIZZONTALE)

$$-M\ddot{c} - N_c\cos\beta = 0$$

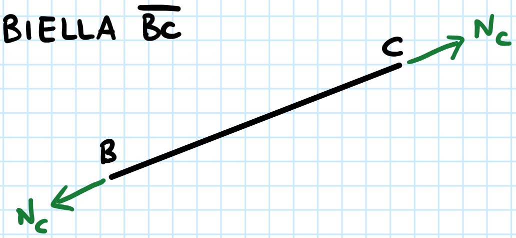
$$N_c = -\frac{M\ddot{c}}{\cos\beta} = -\frac{91,71\ N}{0,995} = -92,17\ N$$

Da cui ricavo

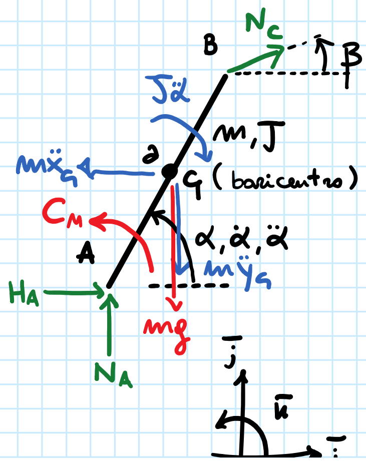
$$N = Mg + N_c\sin\beta = 475,4\ N$$

2ª MODALITÀ (Calcolo a ritroso lungo il S_{gs})

BIELLA $\overline{BC}$



MANOVELLA



TROVO **N_c** FACENDO L'EQUILIBRIO DEI MOMENTI ATTORNO AL POLO "A".

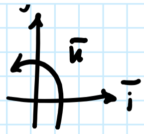
$$C_M - mg\cdot\frac{a}{2}\cos\alpha +$$

$$+ m\ddot{x}_G\cdot\frac{a}{2}\sin\alpha - m\ddot{y}_G\cdot\frac{a}{2}\cos\alpha - J\ddot{\alpha} +$$

$$-\boxed{N_c}\left(\cos\beta\cdot a\sin\alpha - \sin\beta\cdot a\cos\alpha\right) = 0$$

UNICA INCOGNITA

N_A



$$-\boxed{N_C}\left(\cos\beta \cdot a \sin\alpha - \sin\beta \cdot a \cos\alpha\right) = 0$$

UNICA INCOGNITA

CALCOLO N_C E LA SOSTITUISCO NELL'EQUAZIONE DEL CORSOIO, DA CUI RICAVO N