Università degli Studi di Padova – Dipartimento di Ingegneria Industriale

Corso di Laurea in Ingegneria Meccanica

Relazione per la prova finale «Analisi cinematica del deragliatore anteriore del gruppo Shimano 105»

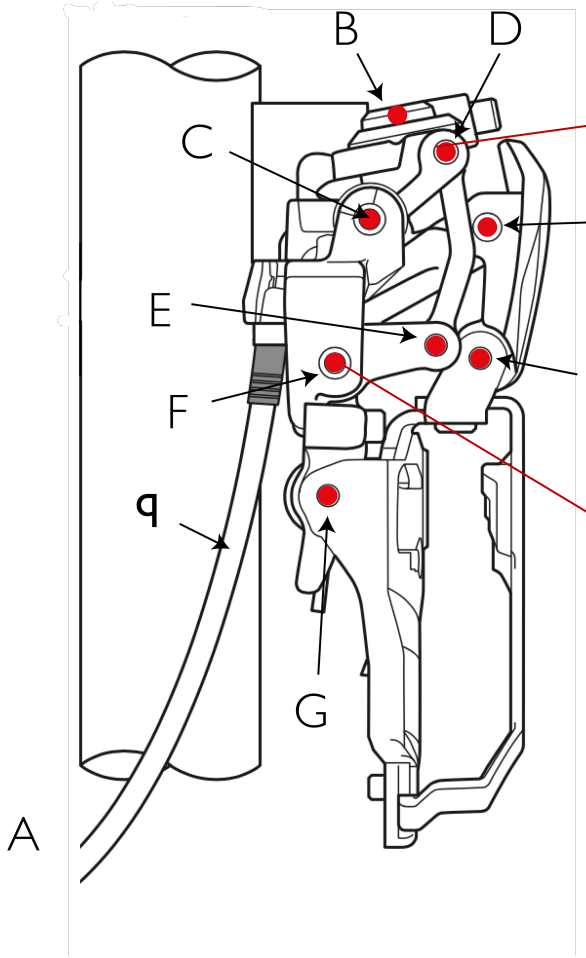
Tutor universitario: Prof. Giulio Rosati

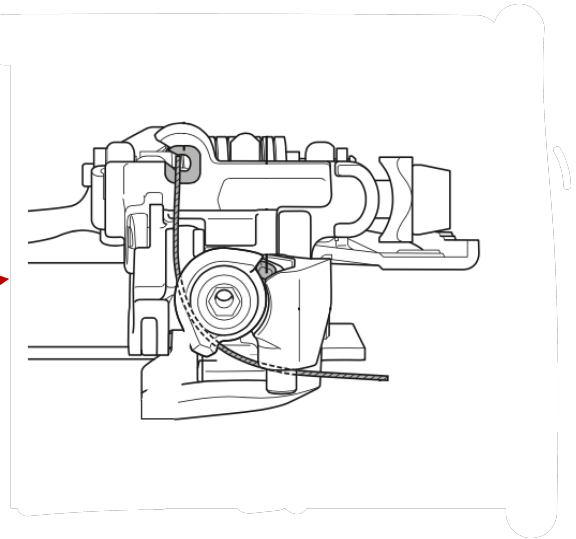
Laureando*: Filippo Russo*

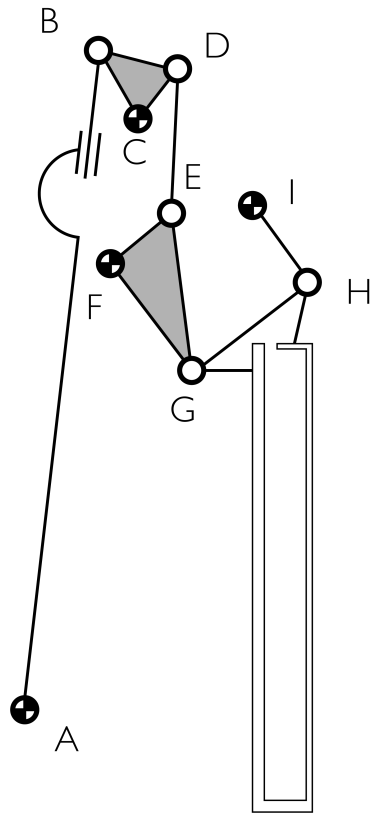
Padova, 9/03/2022

GRUPPO SHIMANO 105

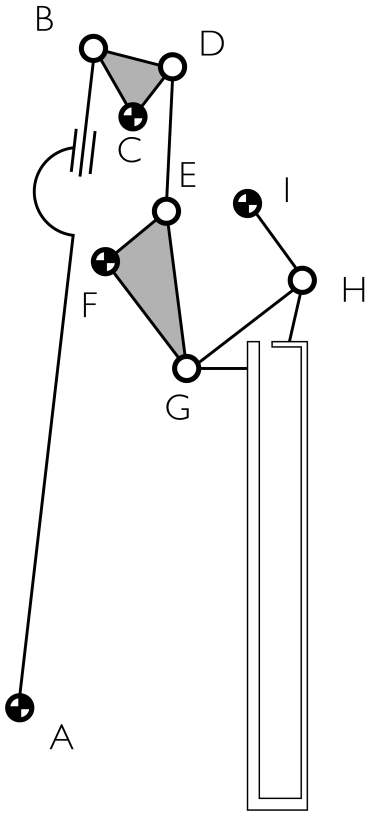
DERAGLIATORE ANTERIORE GRUPPO SHIMANO 105

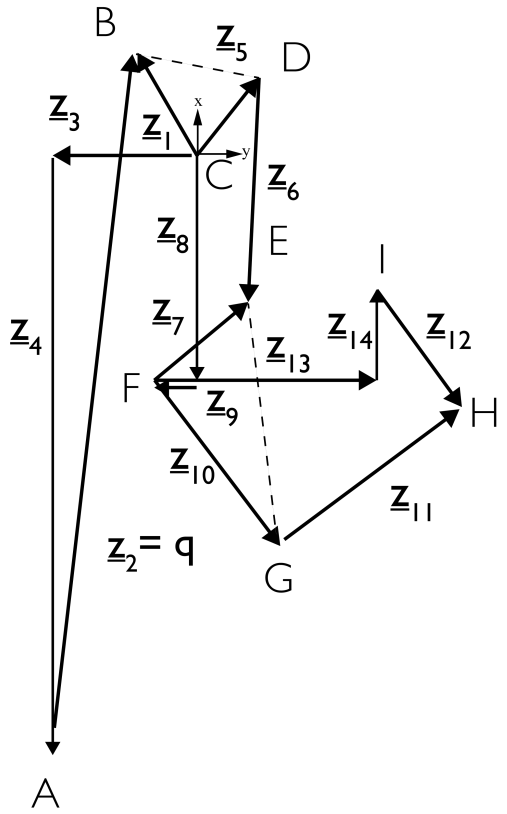






ANALISI DEL MECCANISMO





MAGLIE DEL MECCANISMO

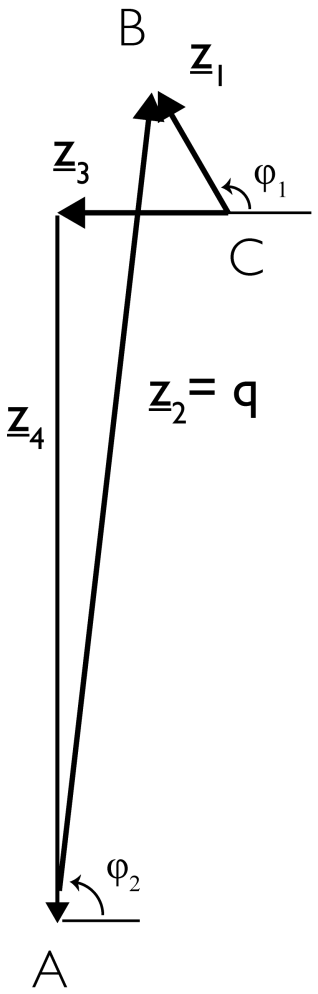
$$\underline{z_2} - \underline{z_1} + \underline{z_3} + \underline{z_4} = \underline{0}$$

$$\underline{z_5} + \underline{z_6} - \underline{z_7} - \underline{z_8} - \underline{z_9} = \underline{0}$$

$$\underline{z_{13}} + \underline{z_{14}} + \underline{z_{12}} - \underline{z_{11}} - \underline{z_{10}} = \underline{0}$$

VARIABILI $q, \varphi_1, \varphi_2, \varphi_5, \varphi_6, \varphi_7, \varphi_{10}, \varphi_{11}, \varphi_{12}$

ANALISI POSIZIONE – 1A MAGLIA



$$\underline{z_2} - \underline{z_1} + \underline{z_3} + \underline{z_4} = \underline{0}$$

$$q\begin{Bmatrix}\cos\varphi_2\\ \sin\varphi_2\end{Bmatrix} - a_1\begin{Bmatrix}\cos\varphi_1\\ \sin\varphi_1\end{Bmatrix} + a_3\begin{Bmatrix}1\\ 0\end{Bmatrix} + a_4\begin{Bmatrix}0\\ 1\end{Bmatrix} = \begin{Bmatrix}0\\ 0\end{Bmatrix}$$

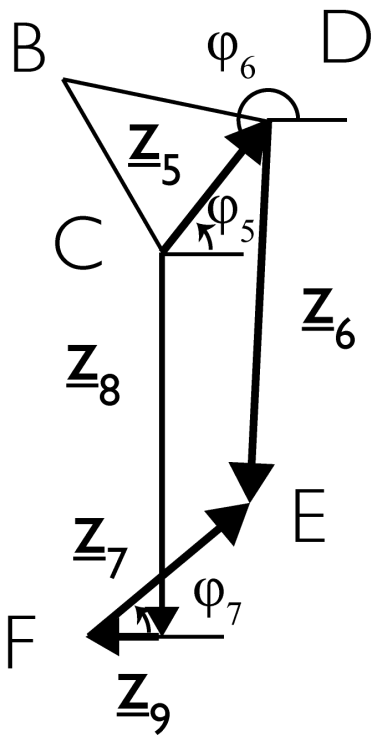
$$L_{AC} = \sqrt{{x_A}^2 + {y_A}^2}$$

$$\boldsymbol{\varphi_2} = \left(\sin^{-1}\left(\frac{-x_A}{L_{CA}}\right) + \cos^{-1}\left(\frac{q^2 + (L_{AC})^2 - {a_1}^2}{2qL_{AC}}\right)\right)$$

$$x_B = x_A + q\cos\varphi_2$$
$$y_B = y_A + q\sin\varphi_2$$

$$\boldsymbol{\varphi_1} = \pi - \cos^{-1}\left(\frac{-x_B}{a_1}\right)$$

ANALISI POSIZIONE – 2A MAGLIA



$$\underline{z_5} + \underline{z_6} - \underline{z_7} - \underline{z_8} - \underline{z_9} = \underline{0}$$

$$a_5 \begin{Bmatrix} \cos\varphi_5 \\ \sin\varphi_5 \end{Bmatrix} + a_6 \begin{Bmatrix} \cos\varphi_6 \\ \sin\varphi_6 \end{Bmatrix} - a_7 \begin{Bmatrix} \cos\varphi_7 \\ \sin\varphi_7 \end{Bmatrix} - a_8 \begin{Bmatrix} 1 \\ 0 \end{Bmatrix} - a_9 \begin{Bmatrix} 0 \\ 1 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$$

$$\varphi_5 = \varphi_1 - \cos^{-1}\left(\frac{{a_1}^2 + {a_5}^2 - {L_{BD}}^2}{2\,a_1\,a_5}\right)$$

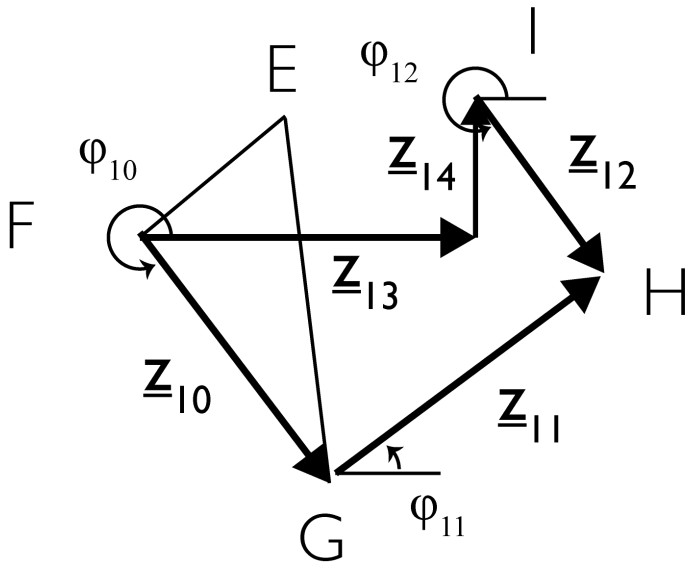
$$x_D = a_5 \cos\varphi_5$$
$$y_D = a_5\, sin\varphi_5$$

$$\varphi_6 = \pi + \cos^{-1}\left(\frac{(x_D - x_F)}{(L_{FD})}\right) + \cos^{-1}\left(\frac{{a_6}^2 + {L_{FD}}^2 - {a_7}^2}{2a_6 L_{FD}}\right)$$

$$x_E = x_D + a_6 \cos\varphi_6$$
$$y_E = y_D + a_6\, sin\varphi_6$$

$$\varphi_7 = \cos^{-1}\left(\frac{x_E - x_F}{a_7}\right)$$

ANALISI POSIZIONE – 3A MAGLIA



$$\underline{z_{10}} + \underline{z_{11}} - \underline{z_{12}} - \underline{z_{14}} - \underline{z_{13}} = \underline{0}$$

$$a_{13}\begin{Bmatrix}1\\0\end{Bmatrix} + a_{14}\begin{Bmatrix}0\\1\end{Bmatrix} + a_{12}\begin{Bmatrix}\cos\varphi_{12}\\ \sin\varphi_{12}\end{Bmatrix} - a_{11}\begin{Bmatrix}\cos\varphi_{11}\\ \sin\varphi_{11}\end{Bmatrix} - a_{10}\begin{Bmatrix}\cos\varphi_{10}\\ \sin\varphi_{10}\end{Bmatrix} = \begin{Bmatrix}0\\0\end{Bmatrix}$$

$$\varphi_{10} = \varphi_7 - \cos^{-1}\left(\frac{{a_7}^2 + {a_{10}}^2 - {L_{GE}}^2}{2a_7 a_{10}}\right)$$

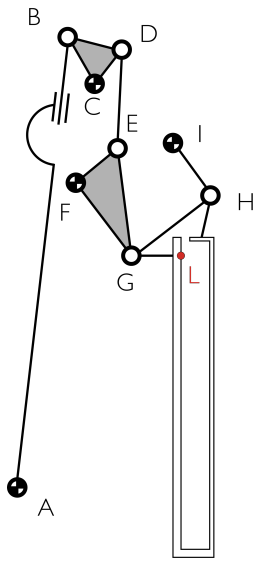
$$x_G = x_F + a_{10}\cos\varphi_{10}$$
$$y_G = y_F + a_{10}\sin\varphi_{10}$$

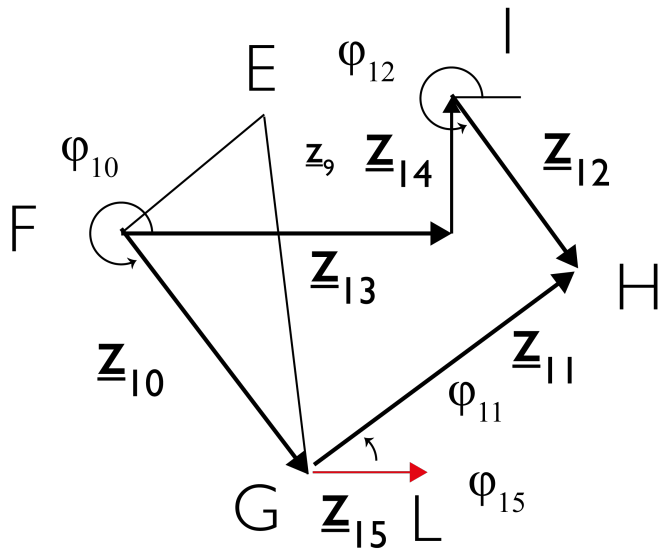
$$L_{GI} = \sqrt{(x_I - x_G)^2 + (y_I - y_G)^2}$$

$$\varphi_{11} = \frac{\pi}{2} - \left[\cos^{-1}\left(\frac{(x_I - x_G)}{(L_{GI})}\right) + \cos^{-1}\left(\frac{{L_{GI}}^2 + {a_{11}}^2 - {a_{12}}^2}{2a_{11}L_{GI}}\right)\right]$$

$$x_H = x_G + a_{11}\cos\varphi_{11}$$
$$y_H = y_G + a_{11}\sin\varphi_{11}$$

$$\varphi_{12} = \frac{3}{2}\pi + sin^{-1}\left(\frac{x_H - x_I}{a_{12}}\right)$$





PUNTO L

$$x_L = x_F + a_{10}\cos\varphi_{10} + L_{GL}\cos\varphi_{15}$$

$$\varphi_{15} = \varphi_{11} - H\hat{G}M$$

$$\dot{x_L} = -a_{10}\sin\varphi_{10}\dot{\varphi_{10}} - L_{GL}\sin\varphi_{15}\dot{\varphi_{11}}$$

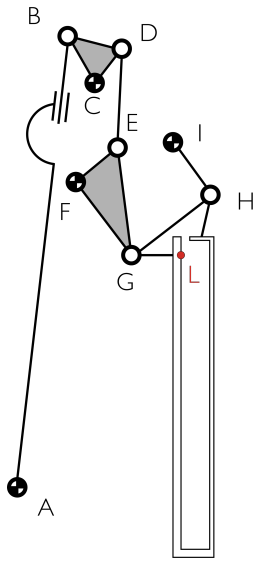
$$W_{x_L} = \frac{\dot{x_L}}{\dot{q}} = -a_{10}\sin\varphi_{10}W_{10} - L_{GL}\sin\varphi_{15}W_{11}$$

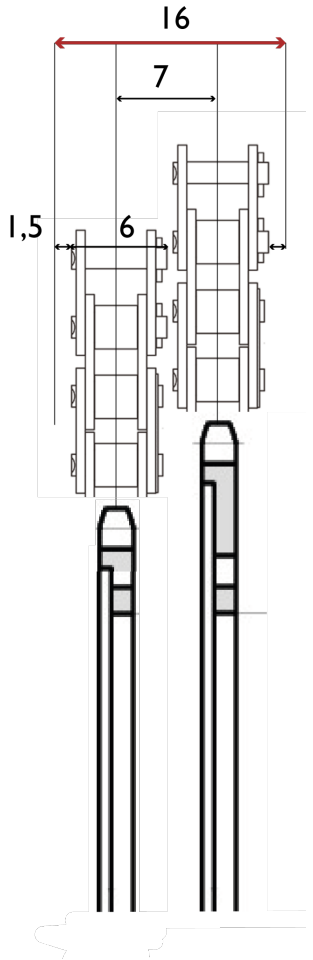
$$W_{\varphi_{11}} = -\frac{a_{10}\sin(\varphi_{10}-\varphi_{11})}{a_{11}\sin(\varphi_{11}-\varphi_{12})}W_{\varphi_7} \qquad W_{\varphi_{10}} = W_{\varphi_7} = -\frac{a_5\sin(\varphi_5-\varphi_6)}{a_7\sin(\varphi_6-\varphi_7)}W_{\varphi_5}$$

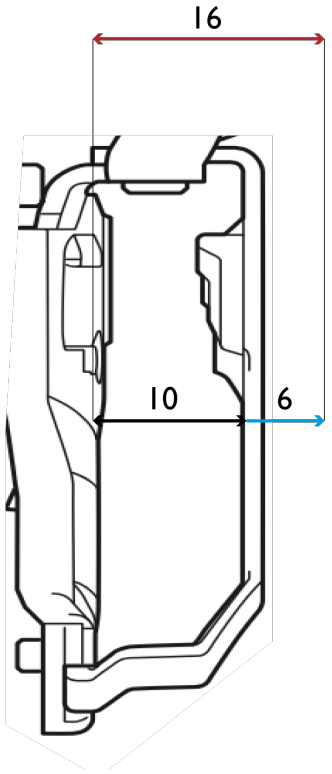
$$W_{\varphi_5} = W_{\varphi_1} = -\frac{1}{a_1\sin(\varphi_1-\varphi_2)}$$

$$\frac{dW_{x_L}}{dq} = \frac{\ddot{x}_L}{\dot{q}^2} = \frac{d}{dq}\left(-a_{10}\sin\varphi_{10}\frac{a_5\sin(\varphi_5-\varphi_6)}{a_7\sin(\varphi_6-\varphi_7)}\frac{1}{a_1\sin(\varphi_1-\varphi_2)} - L_{GL}\sin\varphi_{11}\left(-\frac{a_{10}\sin(\varphi_{10}-\varphi_{11})}{a_{11}\sin(\varphi_{11}-\varphi_{12})}\right)\left(\frac{a_5\sin(\varphi_5-\varphi_6)}{a_7\sin(\varphi_6-\varphi_7)}\right)\left(\frac{1}{a_1\sin(\varphi_1-\varphi_2)}\right)\right)$$

STIMA DELLA CORSA NECESSARIA

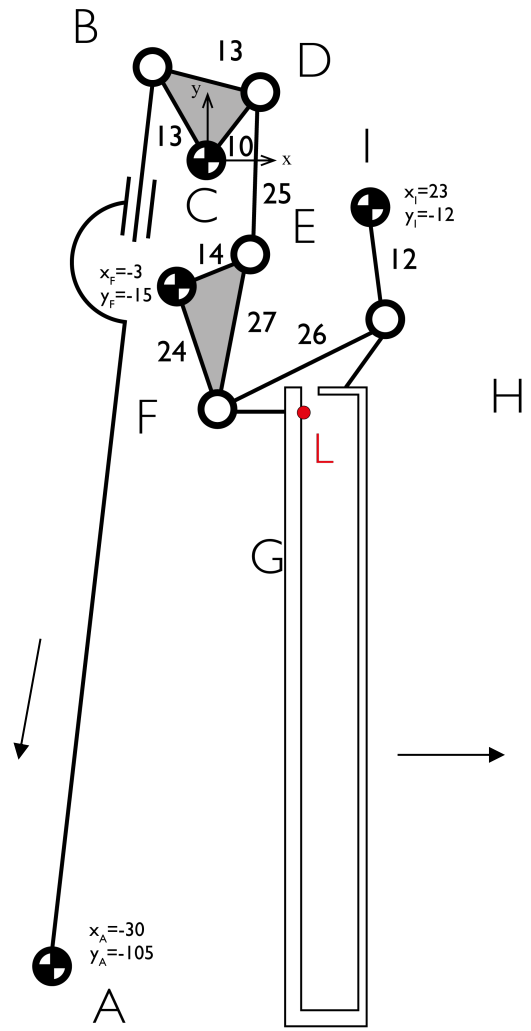


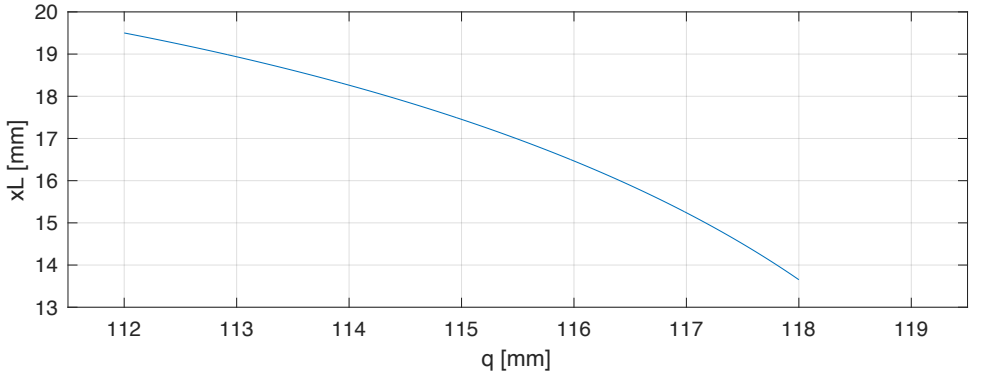


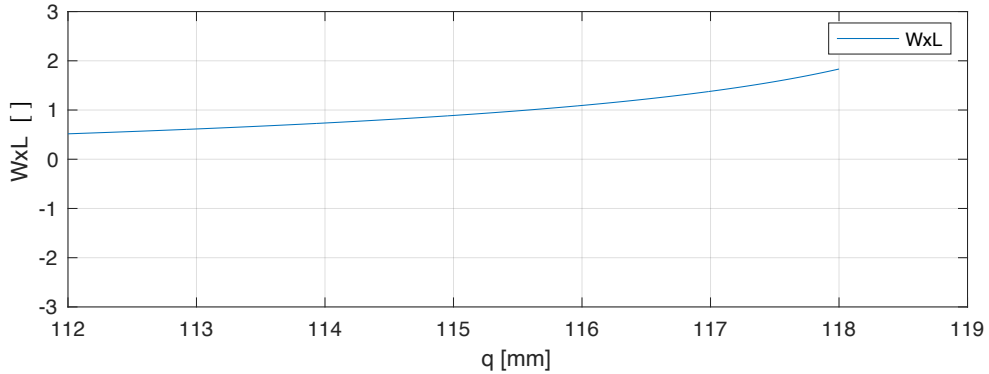


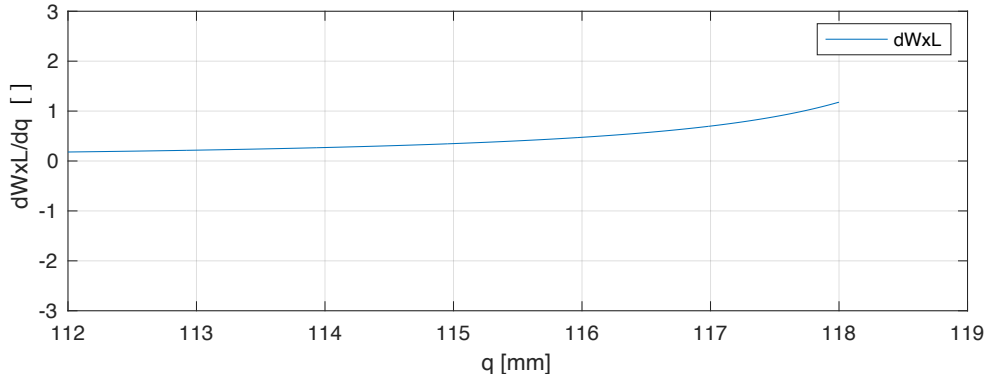
[mm]

ANALISI RISULTATI









SIMULAZIONE MECCANISMO