Flexión Compuesta

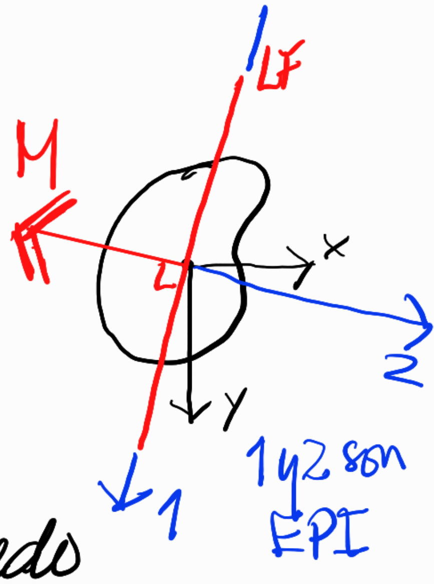
Flexión → simple → $N=0$
Flexión → Compuesta → $N \neq 0$

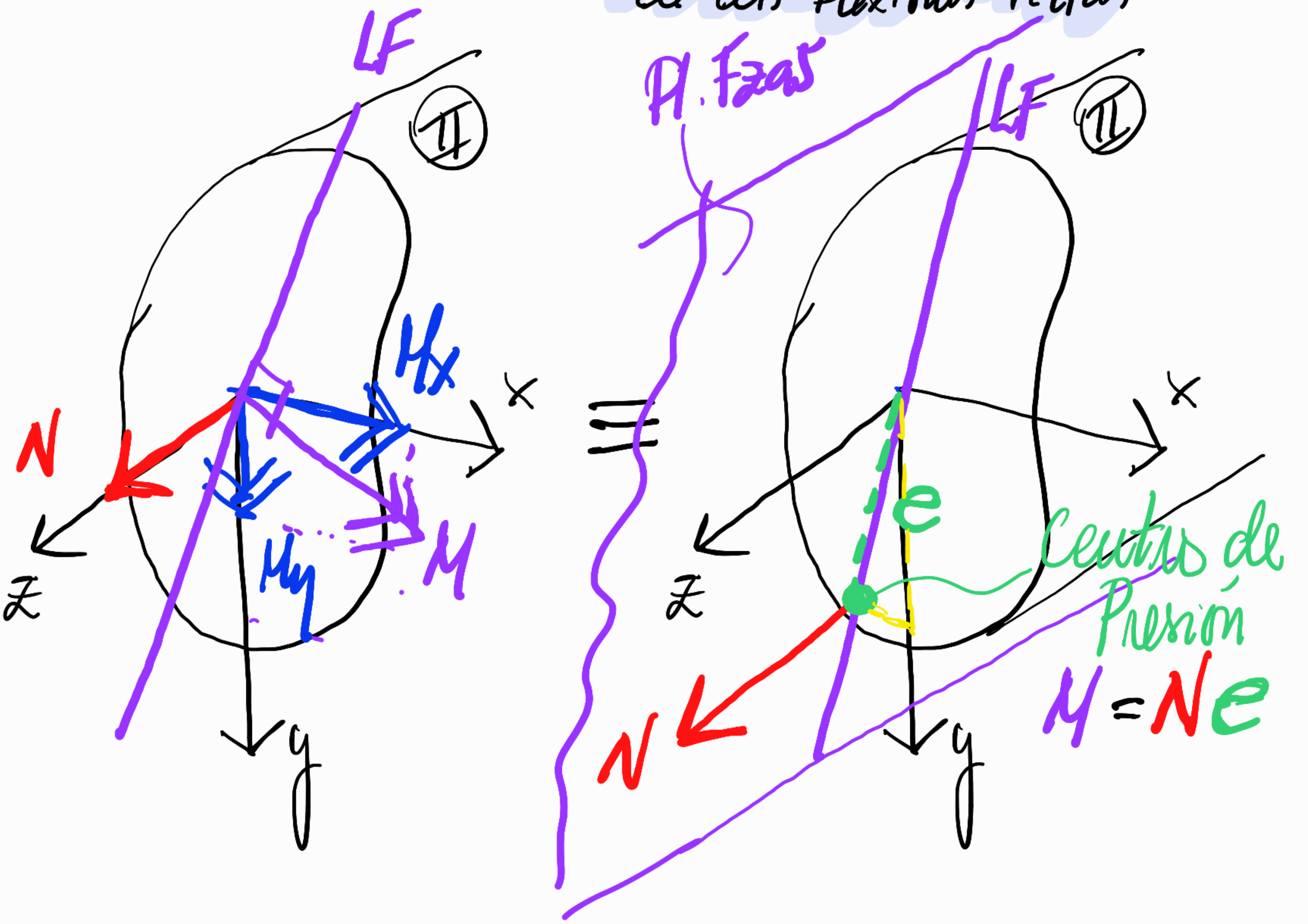
Flexión → Recta → $LF \equiv EPI$
Flexión → Oblicua → $LF \not\equiv EPI$

↳ Pero x PSE puedo descomponer M s/ los EPI

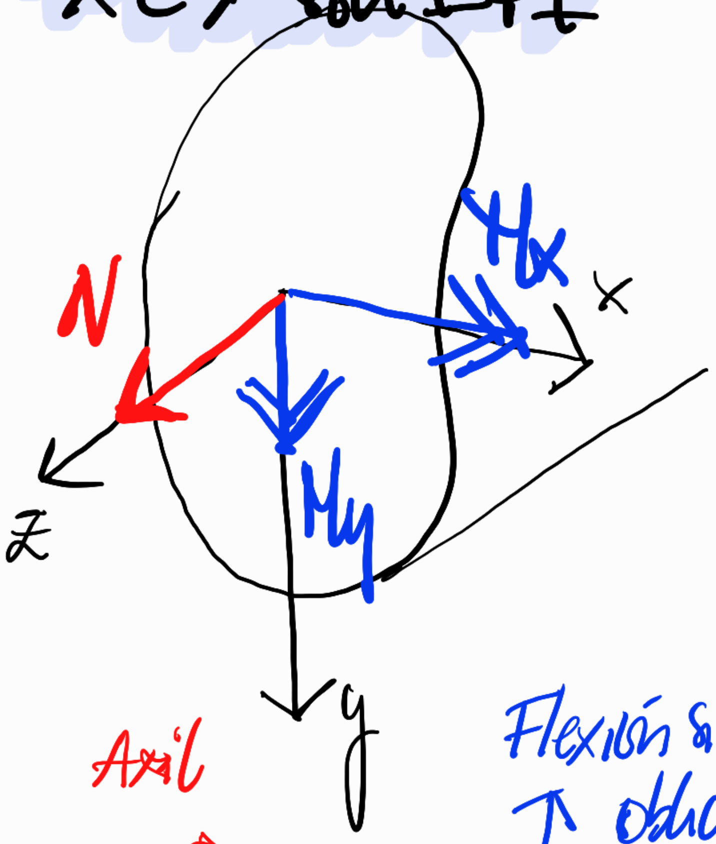
↓

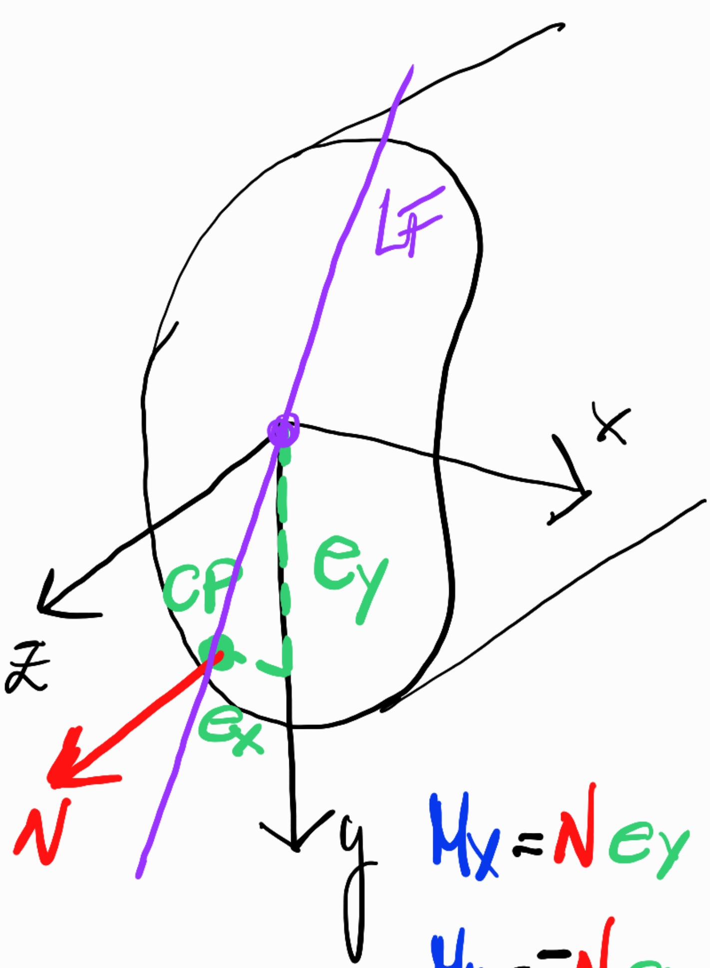
Flexión oblicua como suma de dos Flexiones rectas.





X e Y son EPI





Axil

Flexión simple oblicua

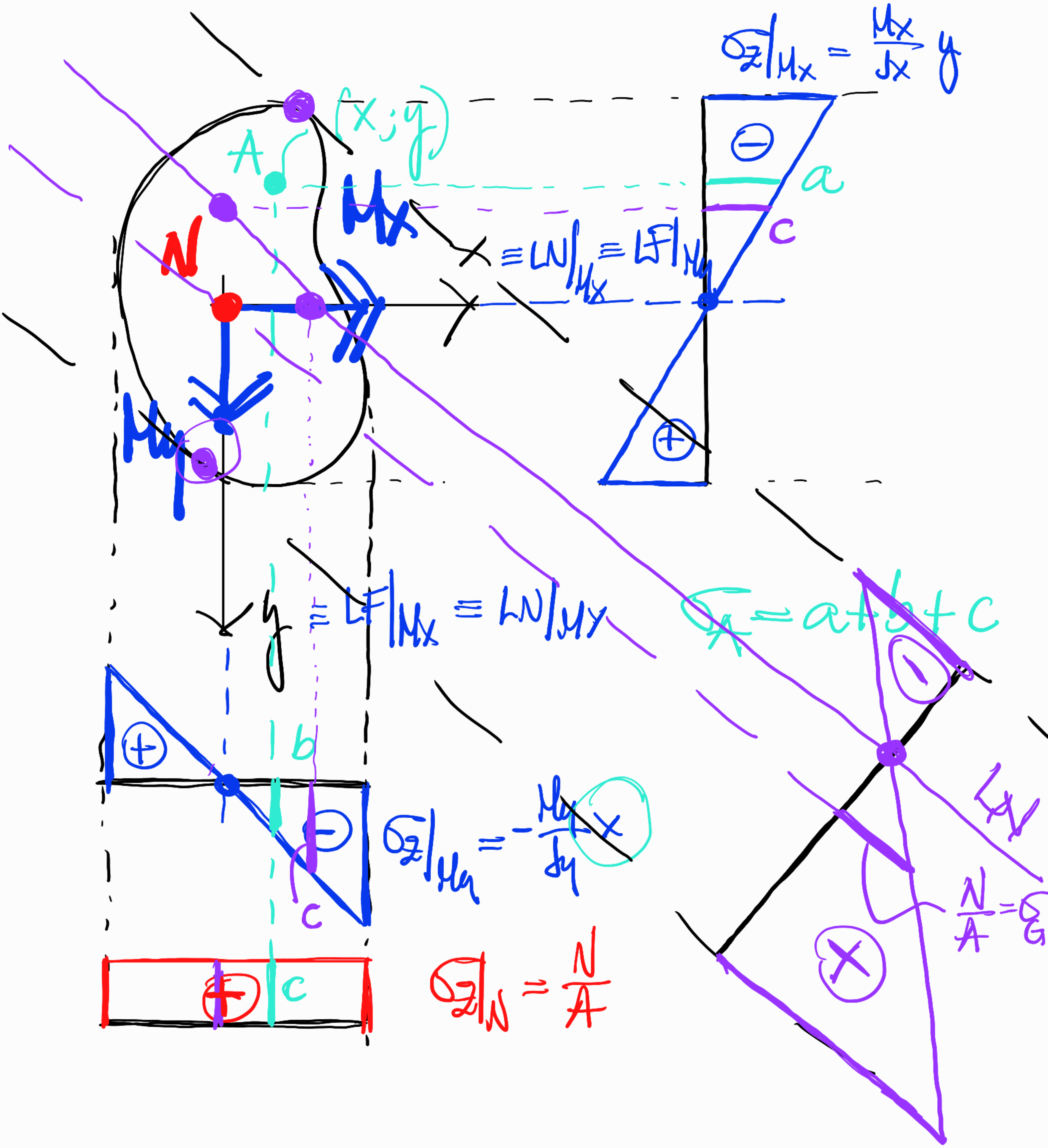
$M_x = N e_y$

$M_y = -N e_x$

$$\sigma_z = \frac{N}{A} + \frac{M_x}{J_x} y - \frac{M_y}{J_y} x \qquad \sigma_z = \frac{N}{A} + \frac{N e_y}{J_x} y + \frac{N e_x}{J_y} x$$

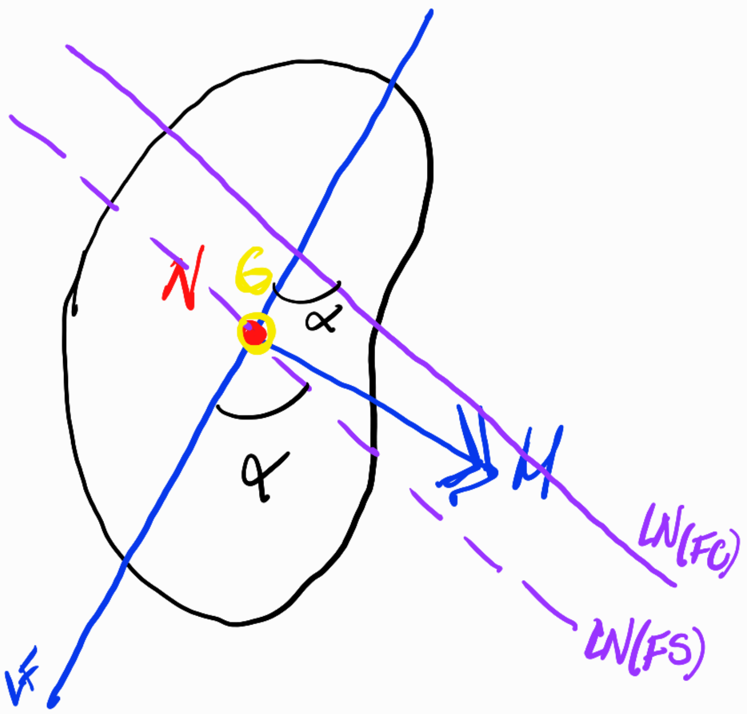
Ecuación de la LN

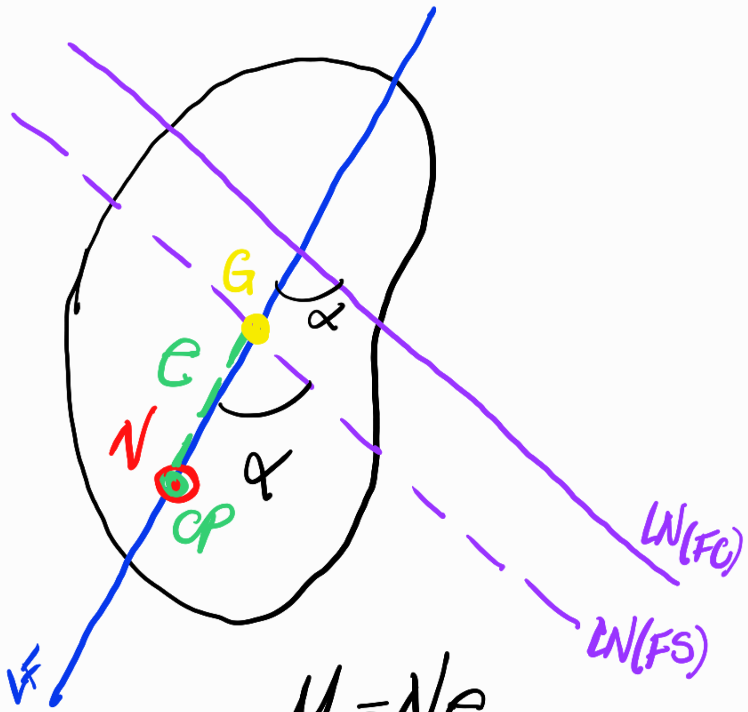
$$0 = \frac{N}{A} + \frac{M_x}{J_x} y_{LN} - \frac{M_y}{J_y} x_{LN} \qquad 0 = \frac{N}{A} + \frac{N e_y}{J_x} y_{LN} + \frac{N e_x}{J_y} x_{LN}$$



$\sigma_z|_{M_x} = \frac{M_x}{J_x} y$
A
(x;y)
M_x
N
M_y
$\equiv LN|_{M_x} \equiv LF|_{M_y}$
a
c
$y \equiv LF|_{M_x} \equiv LN|_{M_y}$
b
c
$\sigma_z|_{M_y} = -\frac{M_y}{J_y} x$
c
$\sigma_z|_N = \frac{N}{A}$
$\sigma_A = a+b+c$
LN
$\frac{N}{A} = \sigma_G$

Centro de Presión y Núcleo central





$$M = Ne$$

$$\left.\begin{aligned} \sigma_M &= \frac{M \operatorname{sen}\alpha}{J_{LN_G}} d_{LN_G} \\ \sigma_N &= N/A \end{aligned}\right\} \begin{aligned} \sigma &= \frac{N}{A} + \frac{M \operatorname{sen}\alpha}{J_{LN}} d_{LN} \\ \sigma &= \frac{N}{A} + \frac{Ne \operatorname{sen}\alpha}{J_{LN}} d_{LN} \end{aligned}$$

Ecuación de la LN

$$0 = \frac{N}{A} + \frac{Ne \operatorname{sen}\alpha}{J_{LN}} d_{LN} = \cancel{N}\left(\frac{1}{A} + \frac{e \operatorname{sen}\alpha}{J_{LN}} d_{LN}\right)$$

$$0 = 1 + \frac{e \operatorname{sen}\alpha \, A}{J_{LN}} d_{LN} = 1 + \frac{e \operatorname{sen}\alpha}{i_{LN}^2} d_{LN}$$

$$-1\, i_{LN}^2 = e \,\text{sen}\,\alpha\, d_{LN}$$

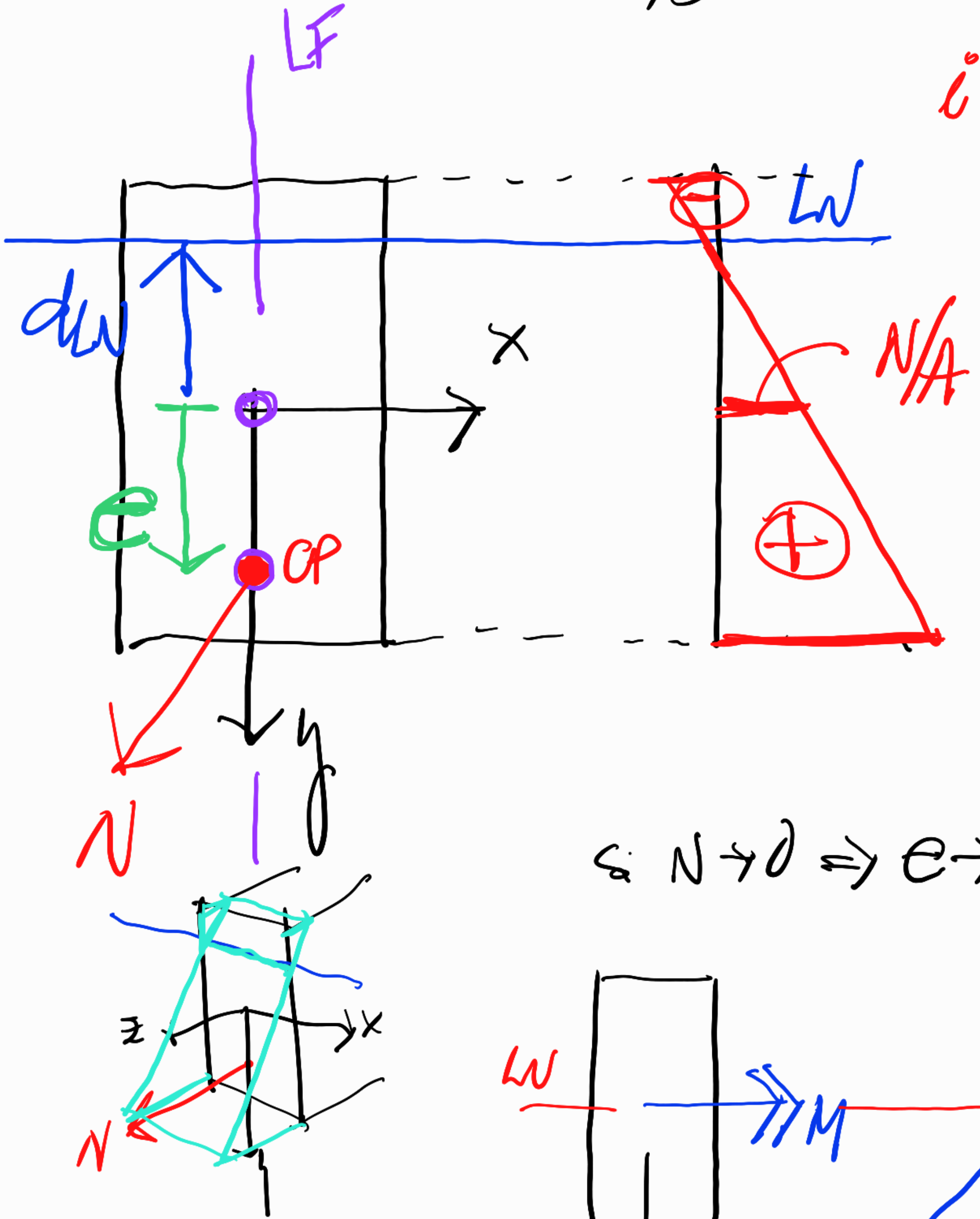
$\to \infty$ $\to 0$

$\to 0$ $\to \infty$

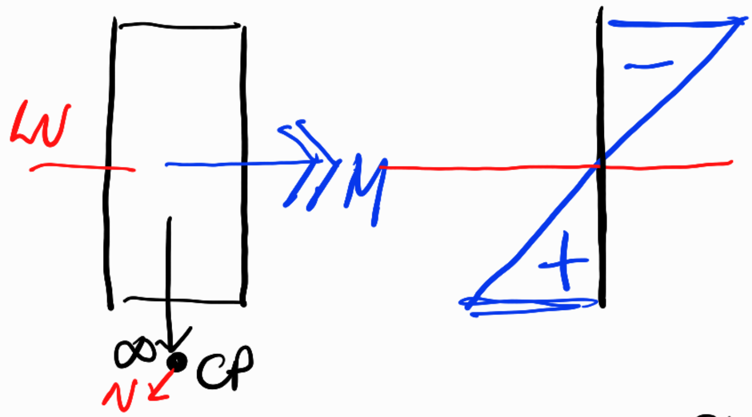
$$i_{LN} = \sqrt{\frac{J_{LN}}{A}}$$

radio de giro

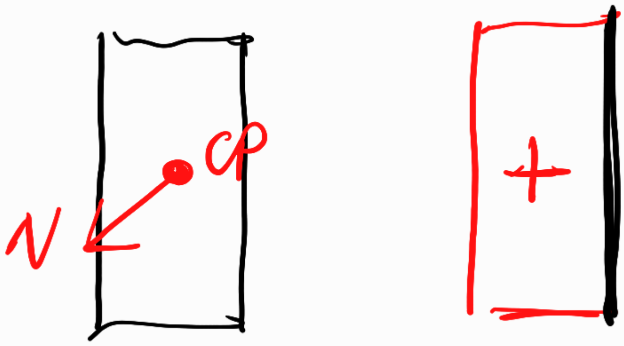
$$i = \sqrt{J/A}$$



si $N \to 0 \Rightarrow e \to \infty \to M = N e$



$d_{LN} = 0$



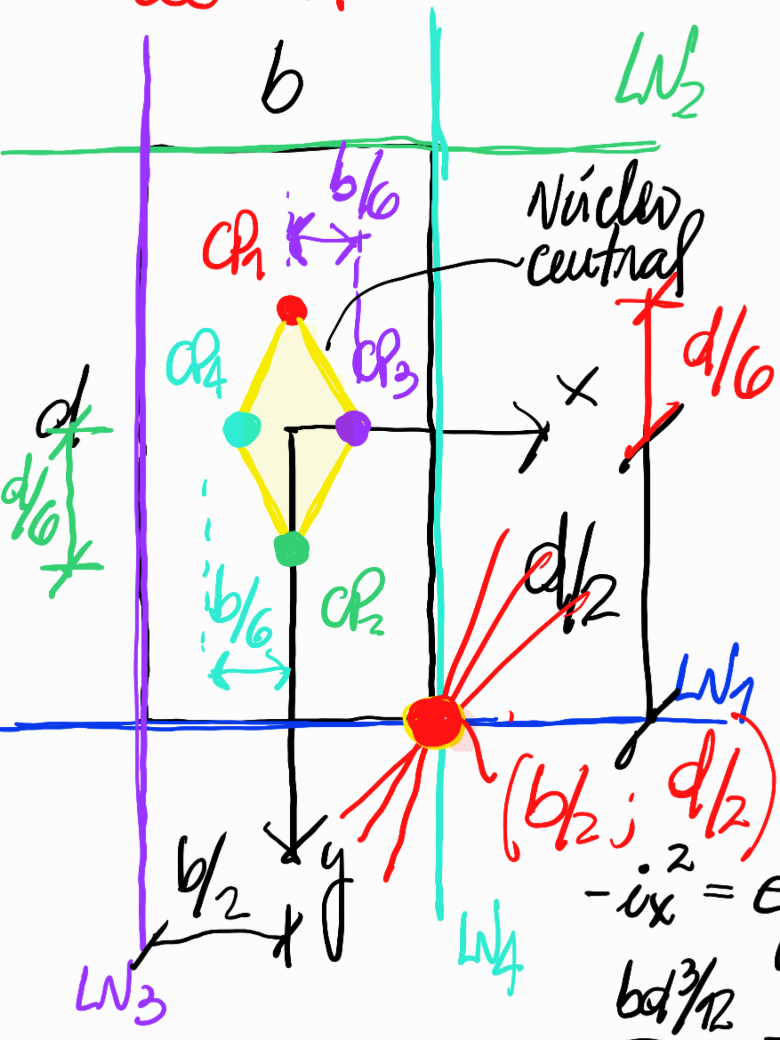
si $CP \to 0$

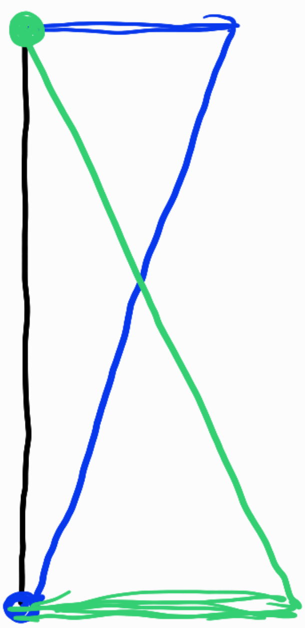
$\Rightarrow d_{LN} \to \infty$

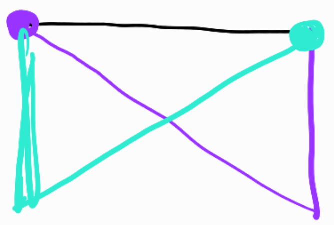
Nucleo central → un sector geometrico donde se encuentran los infinitos CP que generan tensiones de un solo signo (en la sección)

↓

SIEMPRE contiene al G







$$-i_x^2 = e_y\, y_{LN}$$

$$-\frac{bd^3/12}{bd} = e_y\, \frac{d}{2}$$

$$e_y = -d/6$$

$$-i_y^2 = e_x\, x_{LN}$$

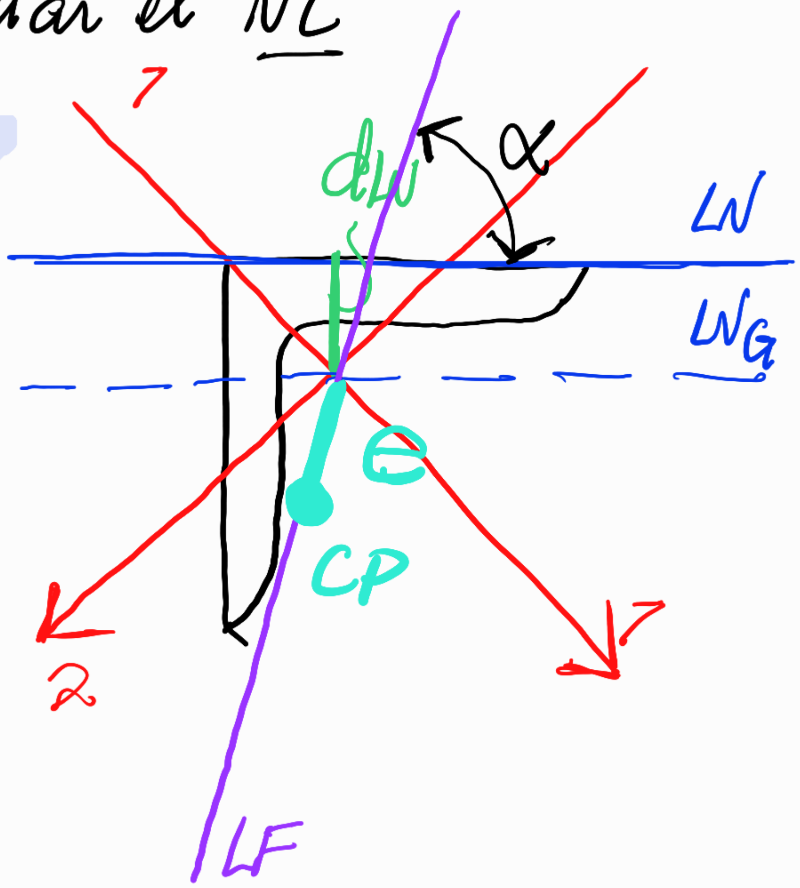
$$-\frac{db^3/12}{bd} = e_x\, b/2$$

$$e_x = \frac{-b}{6}$$

$$0 = \frac{\cancel{N}}{A} + \frac{\cancel{N}\, e_y}{J_x}\, \overset{+d/2}{y_{LN}} + \frac{\cancel{N}\, e_x}{J_y}\, \overset{+b/2}{x_{LN}}$$

Procedimiento p/ hallar el NC

1) Propongo una LN tg a la figura



2) Determino d_{LN}

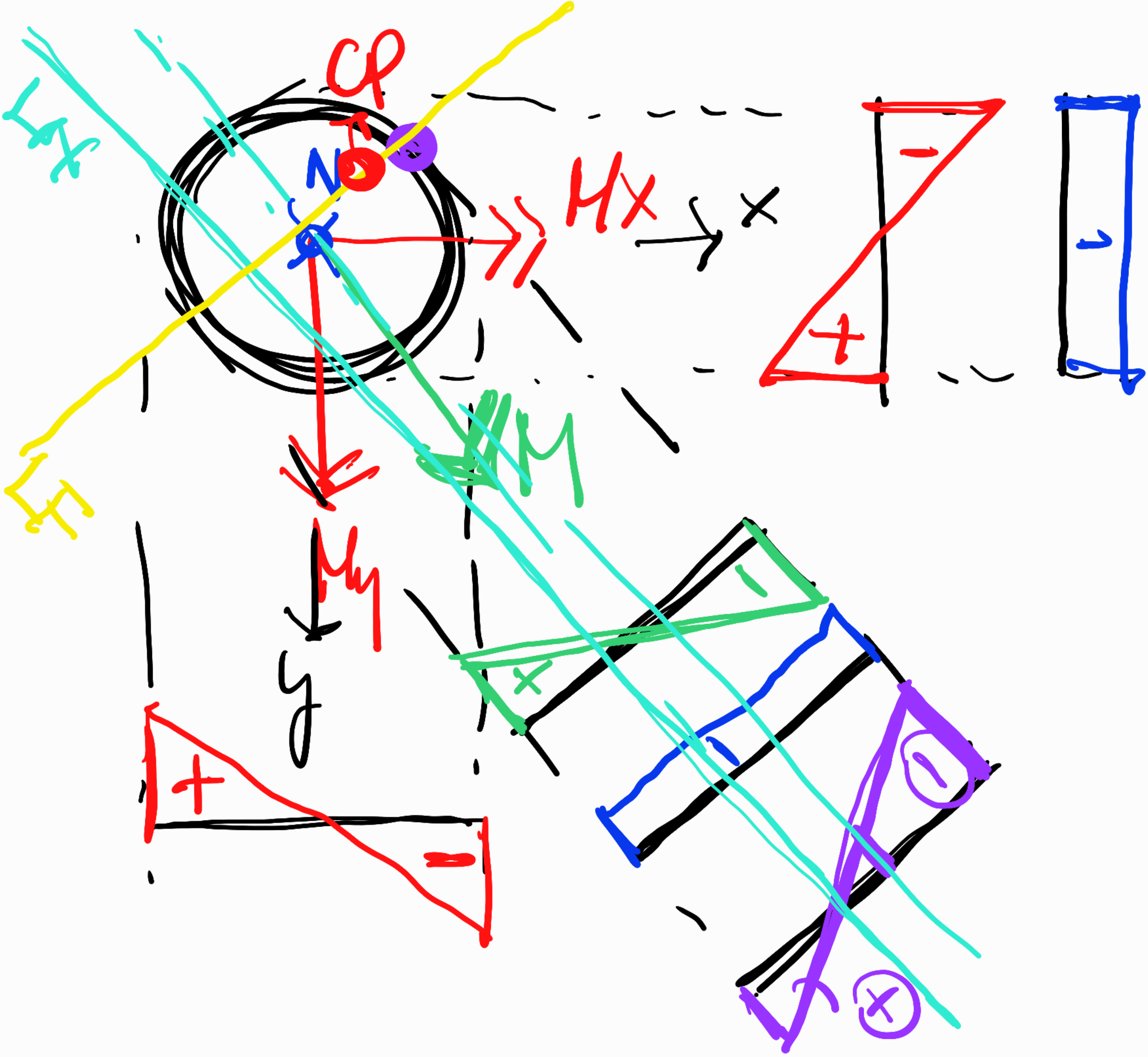
3) Hallar el conjugado de inercia de la LN

↓

LF

4) Determino α

5) Aplico → $-i_{LN}^2 = e \operatorname{sen}\alpha \, d_{LN}$ → e



CP
N
Mx
My
M
x
y
Lx
LE