

Flexión Simple

$$N = \int_A \sigma_z \cdot dA$$

$$\phi_x = \int_A \epsilon_{zx} dA$$

$$\phi_y = \int_A \epsilon_{zy} dA$$

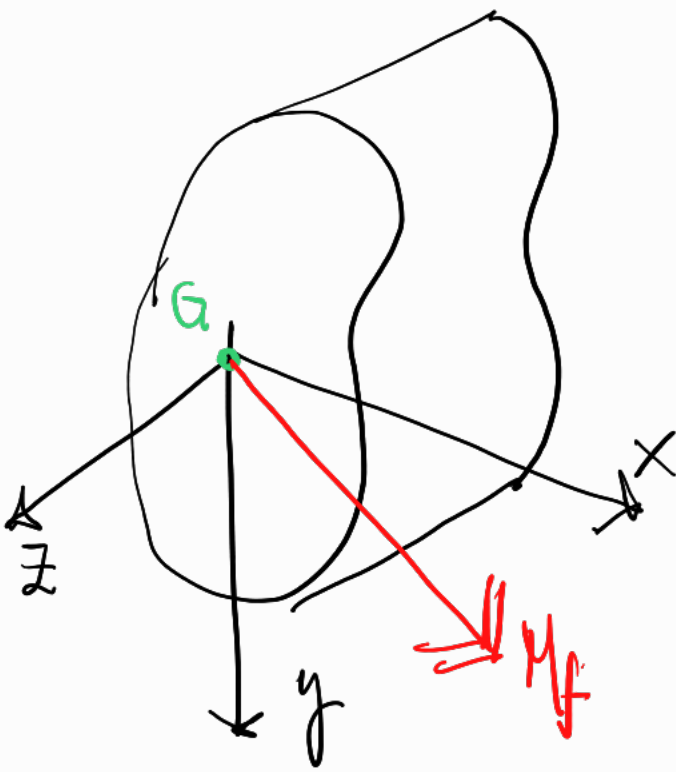
$$M_t = \int_A (\epsilon_{zy} x - \epsilon_{zx} y) dA$$

$$M_y = - \int_A \sigma_z x dA$$

$$M_x = \int_A \sigma_z y dA$$

Flexión $\rightarrow$ Simple $\rightarrow N = 0$
 $\downarrow$
junta σ_z
(tens. normales)
 $\rightarrow$ Compuesta $\rightarrow N \neq 0$

Flexión $\rightarrow$ Pura $\rightarrow \phi = 0$
 $\rightarrow$ NO pura $\rightarrow \phi \neq 0$

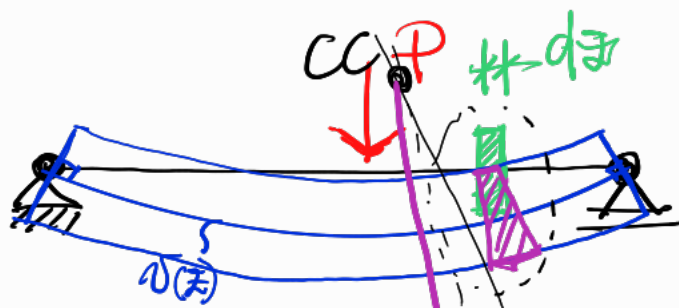


Hipotesis:

$\exists$ HL Estática
 $\exists$ HL Cinemática
 $\exists$ HL Mecánica } PSE

Principio de Saint Venant.

Hipotesis Bernoulli: las secciones se mantienen planas luego de la def.



p = radio de curvatura

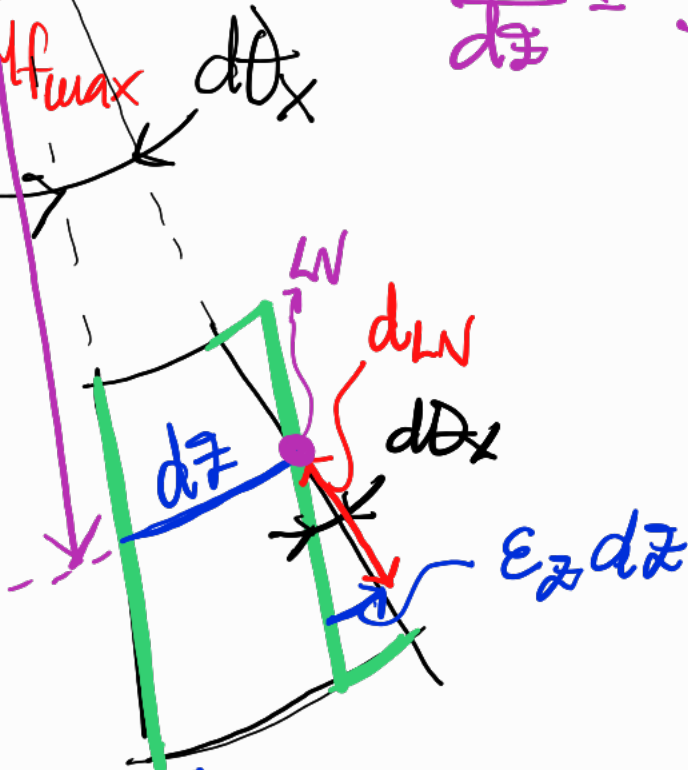
$$p \cdot d\theta_x = dz$$

$$\frac{d\theta_x}{dz} = \frac{1}{p} = \chi_x$$

$$\chi_x \cdot d_{LN} = \epsilon_z dz$$

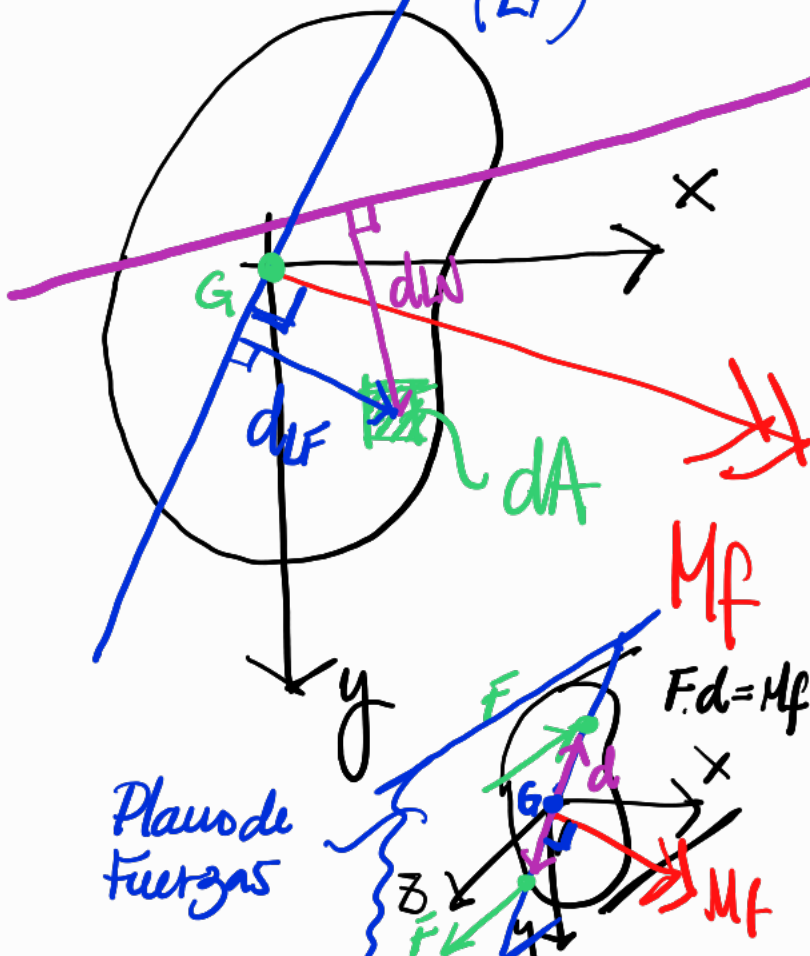
$$\chi_x \left(\frac{d\theta_x}{dz} \right) d_{LN} = \epsilon_z$$

$$\chi_x d_{LN} = \epsilon_z$$



Línea de Fuerzas (LF)

Línea Neutra (LN)



$$N = 0 = \int_A (\epsilon_z) dA$$

$$0 = \int_A (E \epsilon_z) dA$$

$$0 = E \int_A \chi d_{LN} dA$$

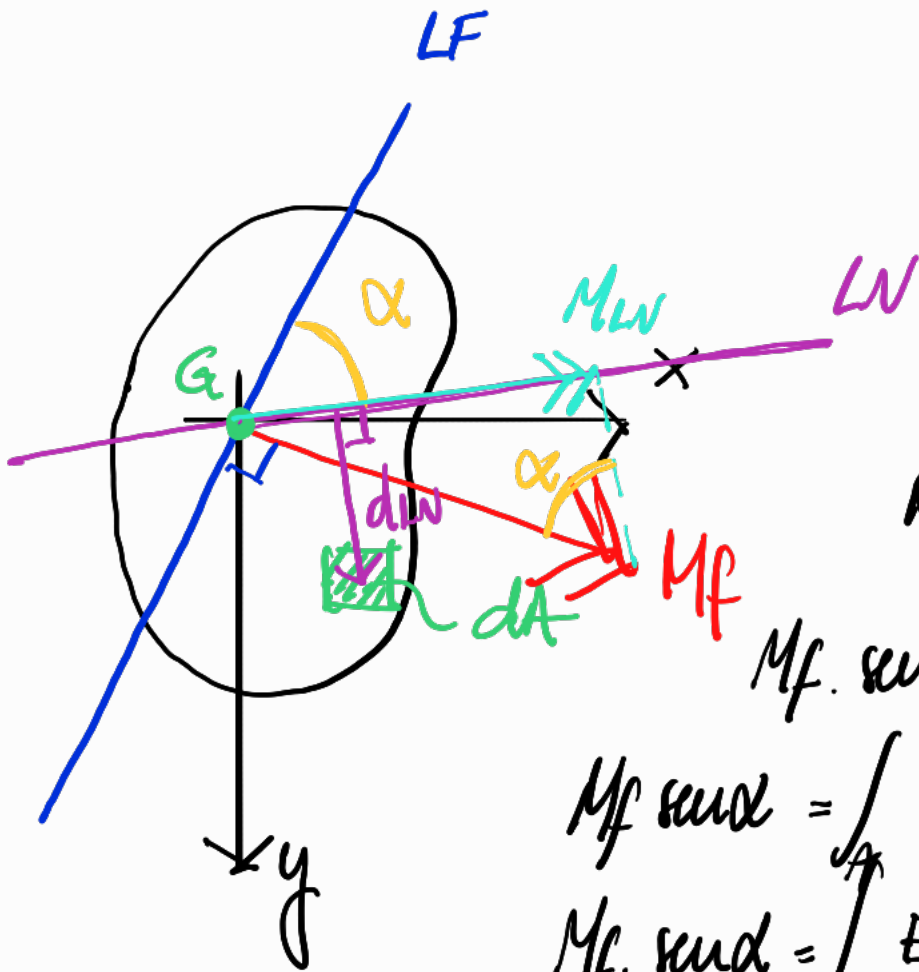
$$0 = E \chi \underbrace{\int_A d_{LN} dA}_{=0}$$

LN es Baricéntrica

$$M_{LF} = 0 = \int_A \sigma_z \cdot dA \cdot d_{LF} = \int_A (E \epsilon_z) dA d_{LF}$$

$$= E \int_A \chi d_{LN} d_{LF} dA = \cancel{E \chi} \underbrace{\int_A d_{LN} d_{LF} dA}_{=0}$$

LN y LF son conjugados de Inercia



$$M_{LN} = \int_A \sigma_z d_{LN} dA$$

$$M_f \cdot \sin \alpha = \int_A \sigma_z d_{LN} dA$$

$$M_f \sin \alpha = \int_A E \epsilon_z d_{LN} dA$$

$$M_f \sin \alpha = \int_A E \chi d_{LN} d_{LN} dA$$

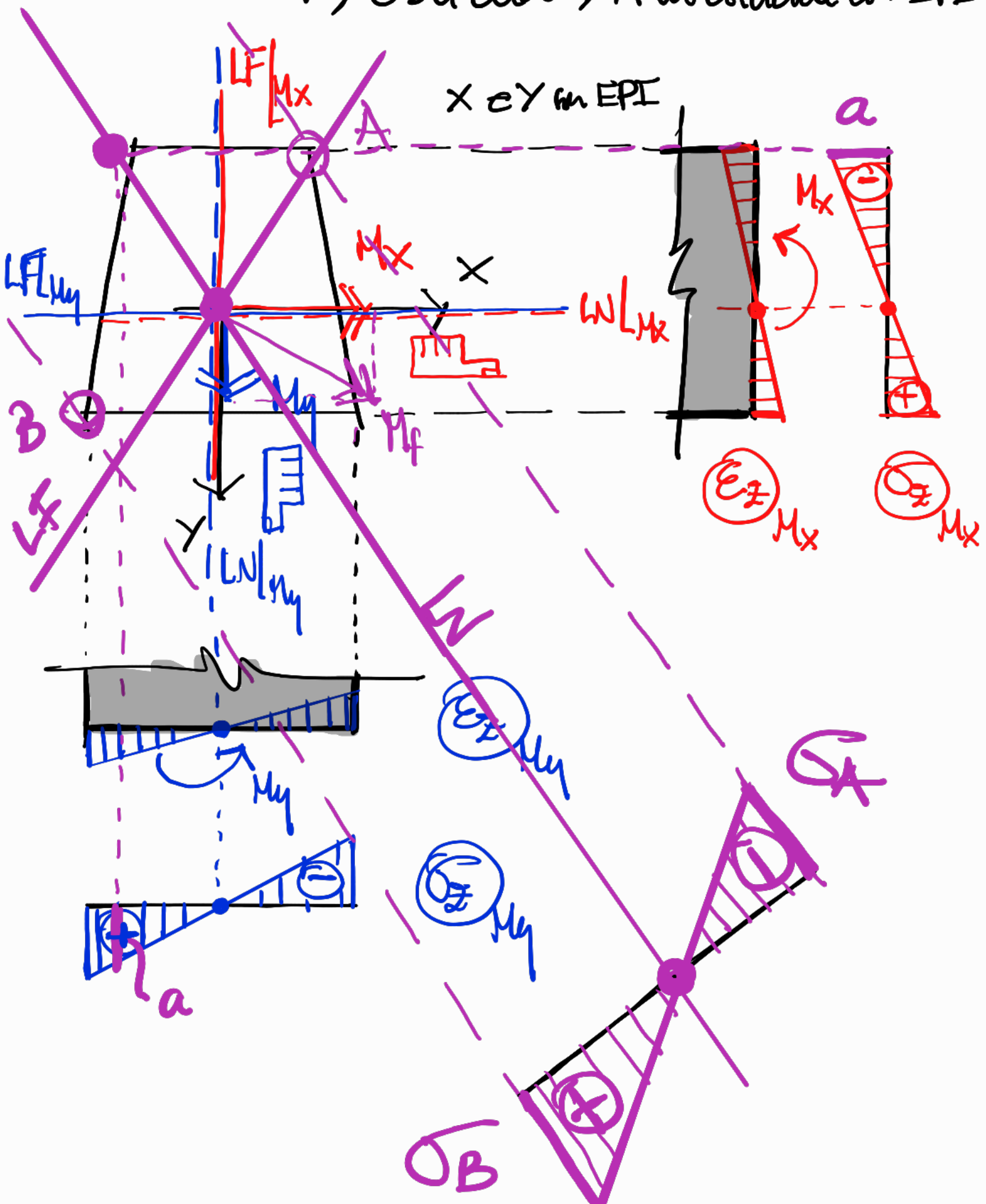
$$M_f \sin \alpha = E \chi \underbrace{\int_A d_{LN}^2 dA}_{J_{LN}} = E \chi J_{LN}$$

$$\chi = \frac{M_f \sin \alpha}{E J_{LN}}$$

$$\sigma_z = E (\chi \cdot d_{LN}) \epsilon_z$$

$$\sigma_z = \frac{M_f \sin \alpha}{J_{LN}} d_{LN}$$

Flexión $\rightarrow$ Recta $\rightarrow$ M coincide con el EPI
 $\hookrightarrow$ Oblicua $\rightarrow$ M no coincide con EPI



$$\sigma_z = \frac{M_x}{J_x} y - \frac{M_y}{J_y} x \rightarrow \text{Ecuación de los tensiones.}$$

$$0 = \frac{M_x}{J_x} y_{LN} - \frac{M_y}{J_y} x_{LN} \rightarrow \text{Ecuación de la línea neutra}$$