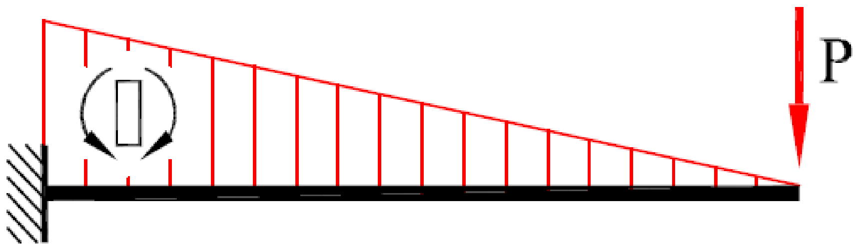
U 8 - **FLEXIÓN SIMPLE RECTA - OBLICUA – DOBLE**

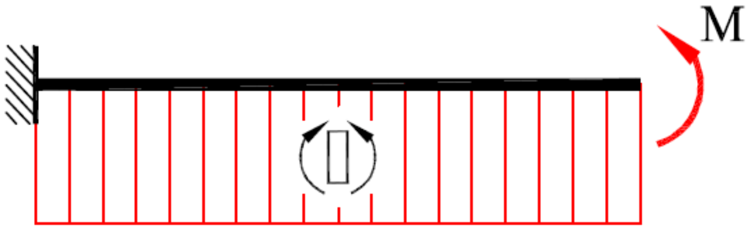
Una barra trabaja a flexión simple recta cuando

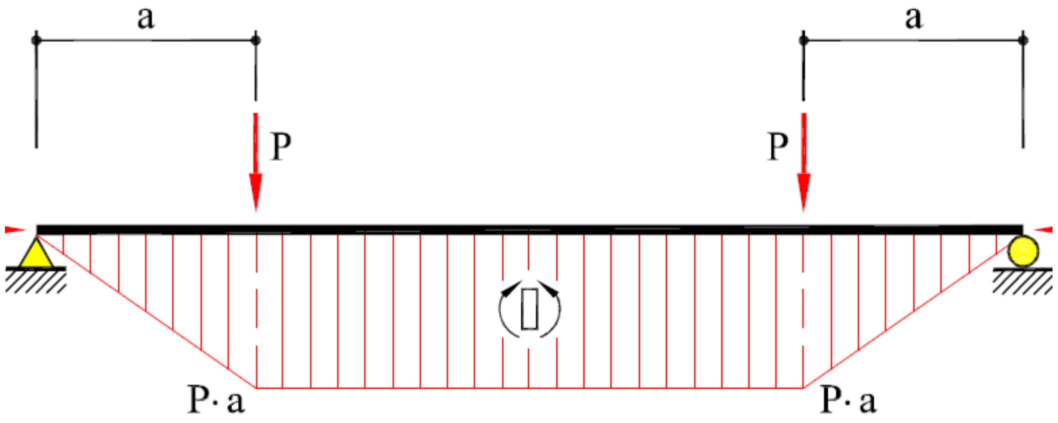
tiene eje longitudinal recto y es de sección constante

el plano en el que actúan las cargas (plano de solicitación) contiene a uno de los ejes principales de la sección recta de la barra y las cargas actúan perpendicularmente al eje longitudinal.

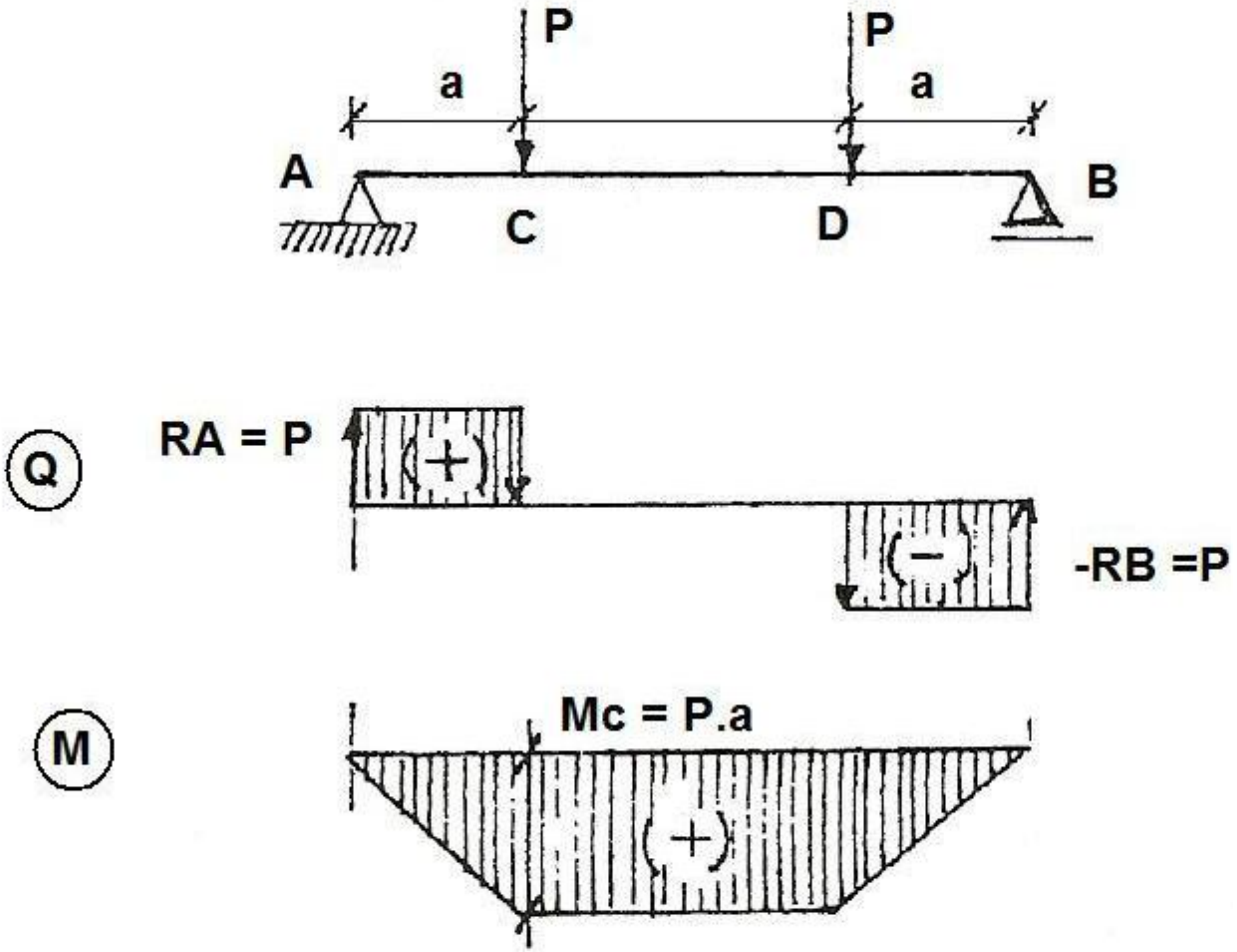


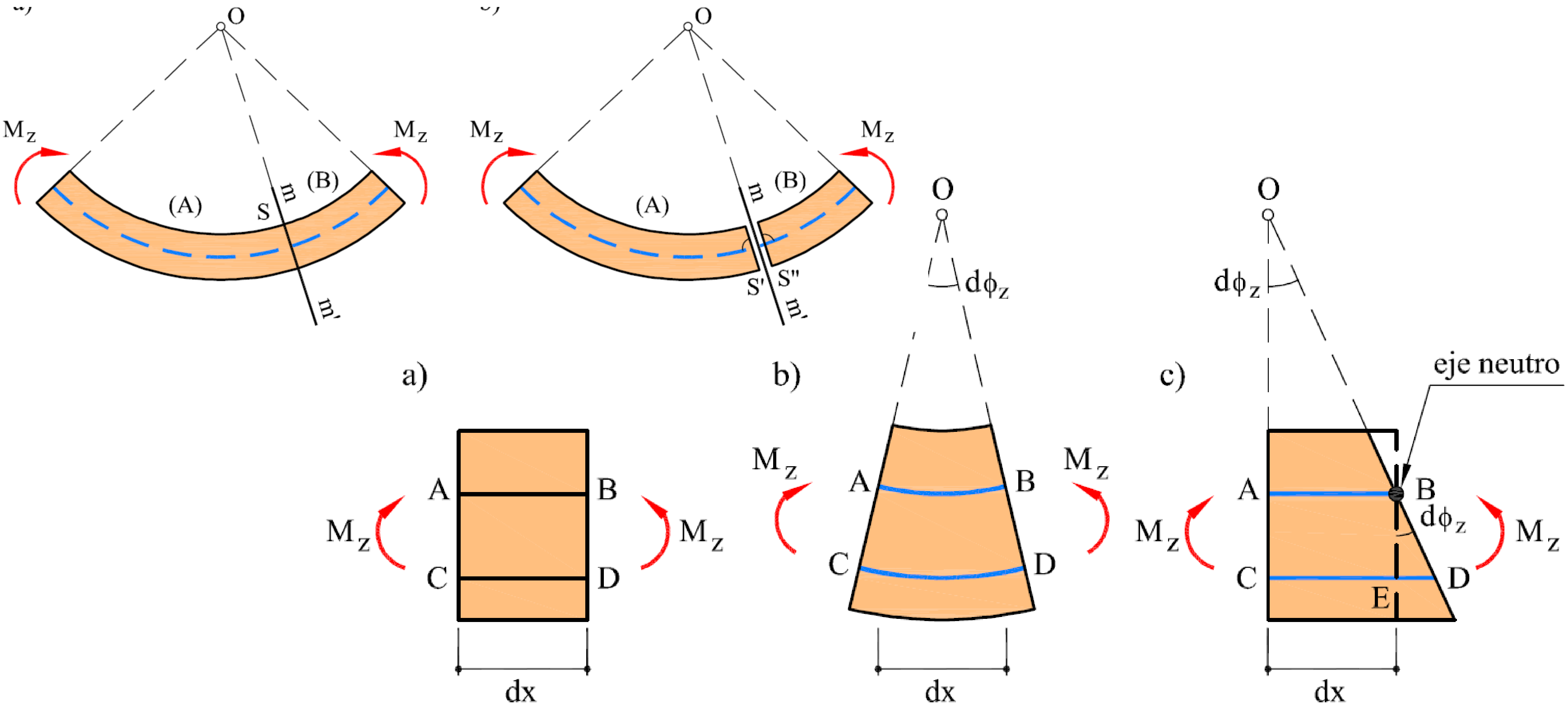
Flexión Pura

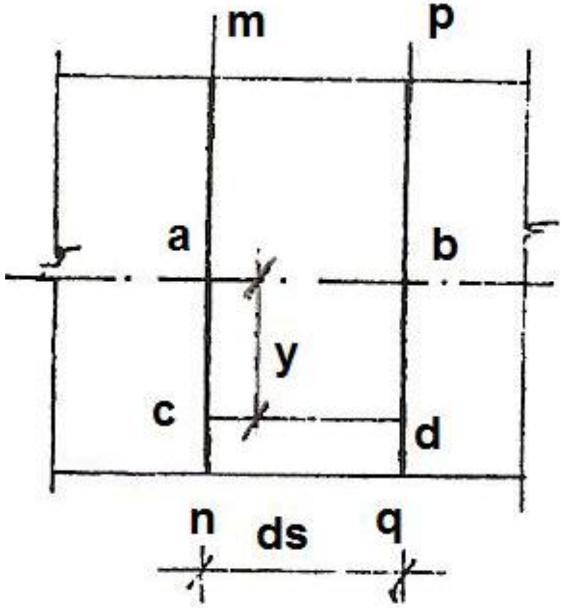


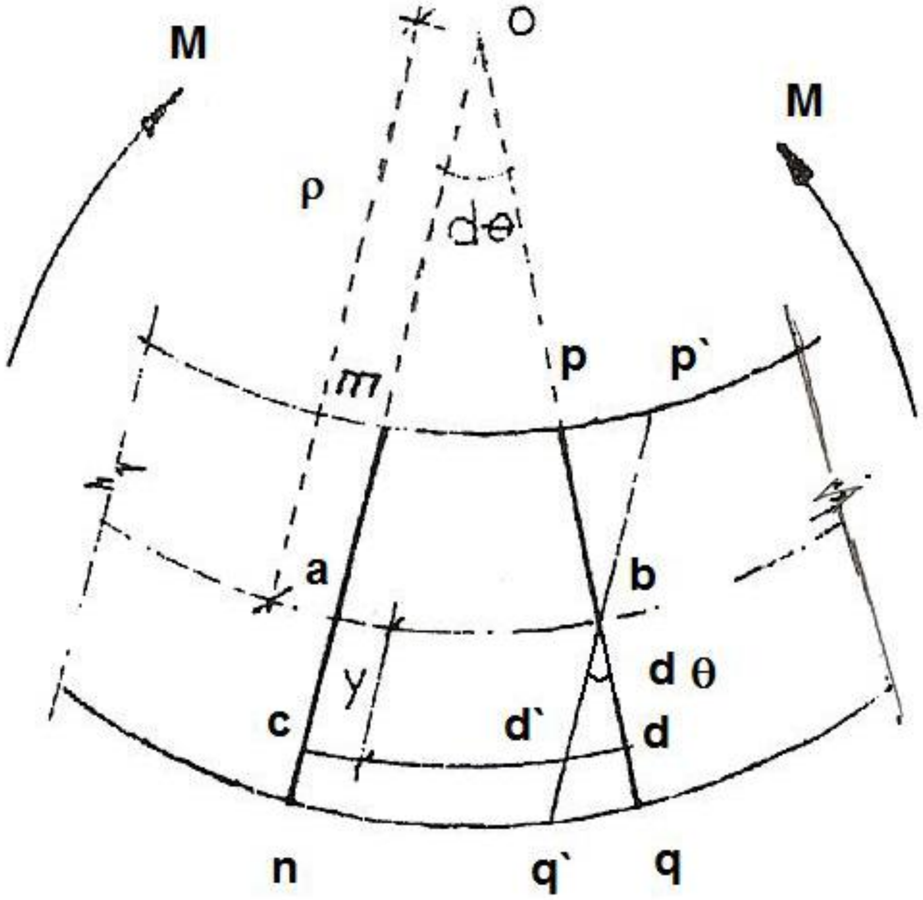


La flexión pura es un caso particular de la flexión que se presenta cuando de las seis componentes de los esfuerzos internos, solamente Mx es distinto de cero.


P
P
a
a
A
B
C
D
Q
RA = P
(+)
(−)
-RB =P
M
Mc = P.a
(+)


O
M_z
(A)
(B)
S
m
m'
S'
S''
a)
b)
c)
A
B
C
D
E
$d\phi_z$
eje neutro
dx



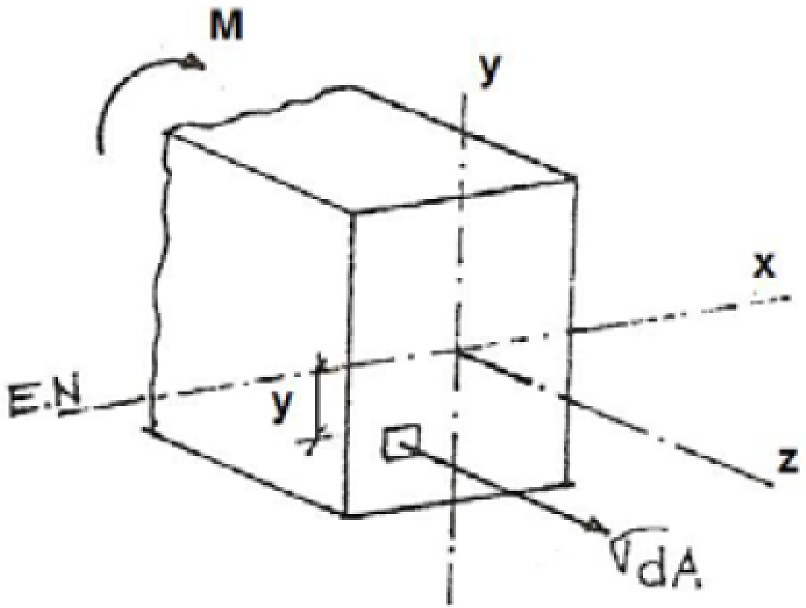


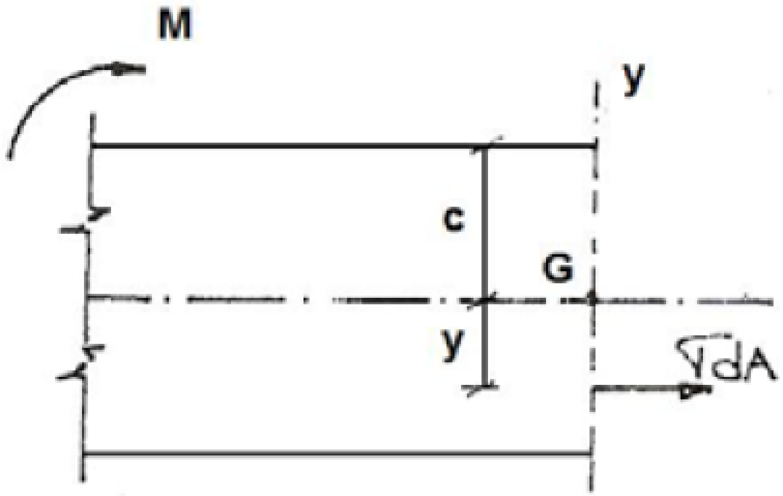
$$d\theta = \frac{ds}{\rho}$$

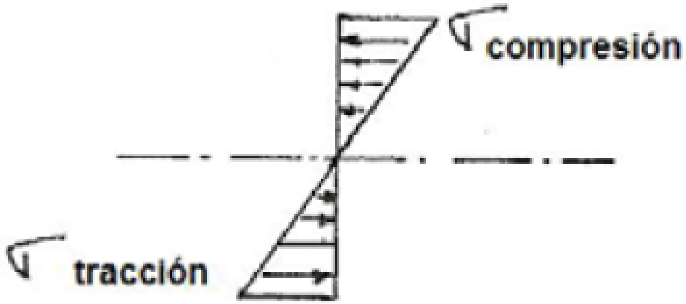
$$\varepsilon = \frac{y \cdot d\theta}{ds} = \frac{y}{\rho}$$

como $\sigma = \varepsilon\, E$

$$\sigma = \frac{E}{\rho} \cdot y$$







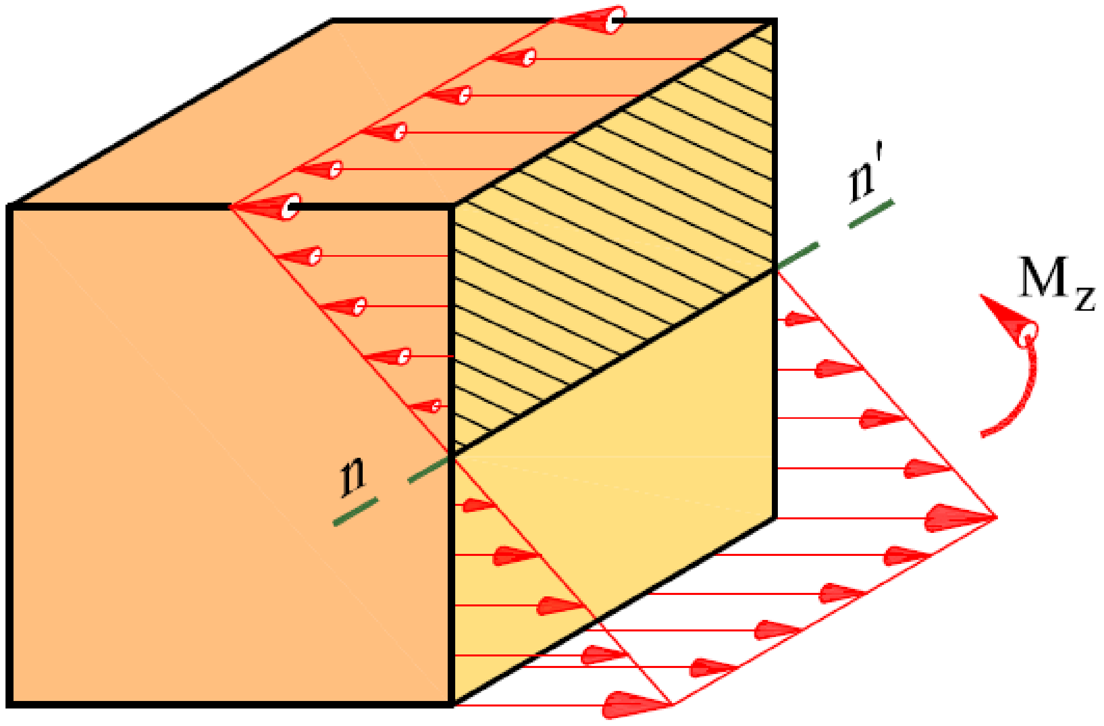
$$M = \int_A \sigma \cdot y \cdot dA$$

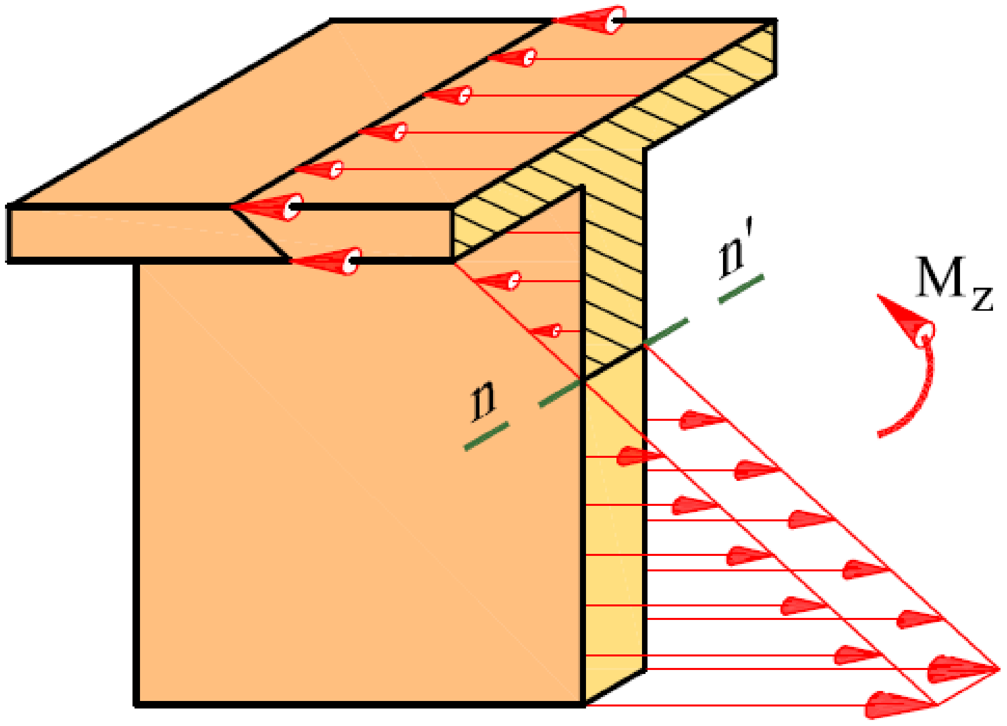
$$M = \frac{E}{\rho} \cdot \int_A y^2 \cdot dA = \frac{E}{\rho} \cdot I_n$$

$$\frac{1}{\rho} = \frac{M}{E \cdot I_n}$$

$$\boxed{\sigma = \frac{M}{I_n} \cdot y}$$

Distribución de tensiones en flexión pura recta



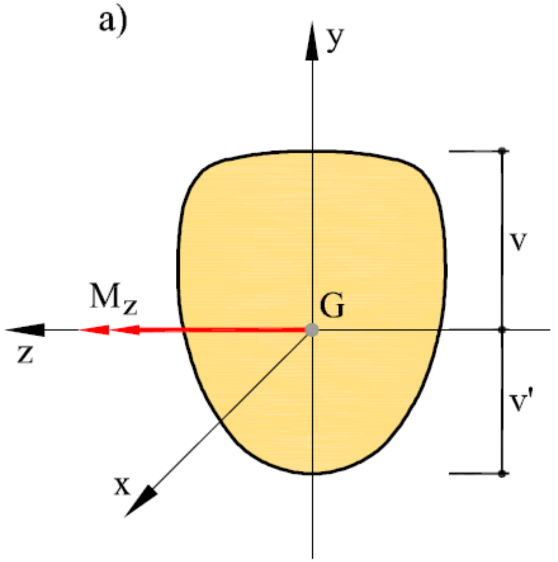


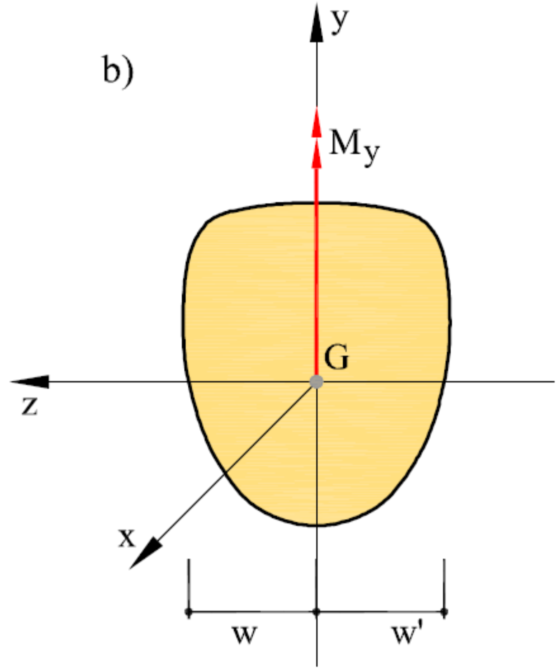
$$N = 0 \qquad \Rightarrow N = \int_A \sigma \cdot dA = \frac{E}{\rho} \cdot \int_A y \cdot dA = 0 \qquad \int_A y \cdot dA = 0$$

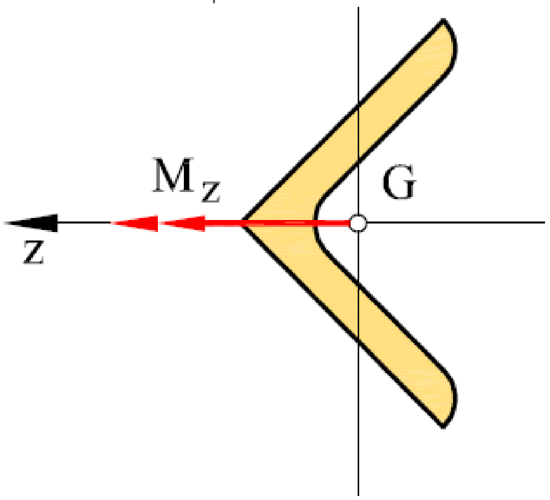
El eje neutro es un eje baricéntrico

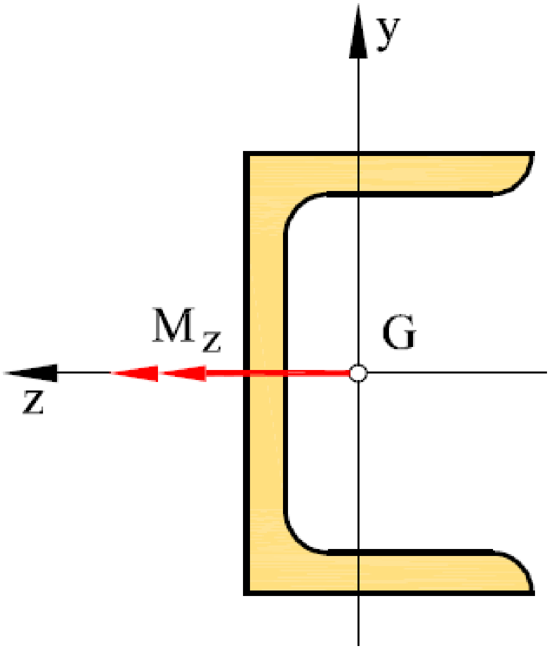
La curvatura de la viga es: $\dfrac{1}{\rho} = \dfrac{M}{E \cdot I_n}$

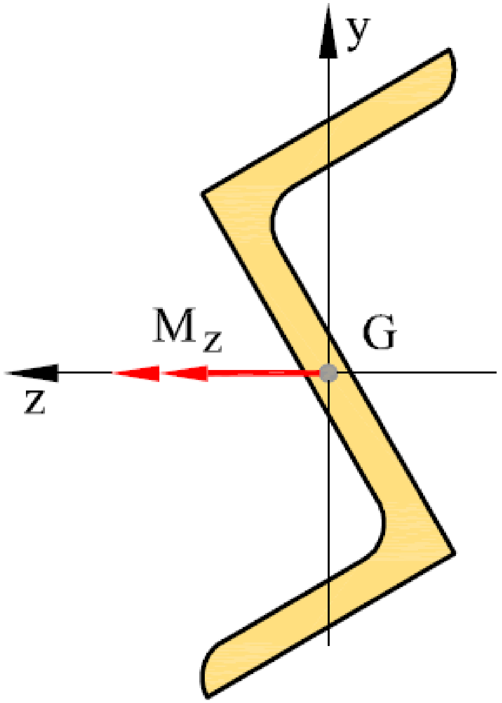
$$\boxed{\sigma_{MÁX} = \frac{M}{I_n} \cdot c = \frac{M}{I_n / c} = \frac{M}{W}}$$


a)
y
v
v'
Mz
G
z
x

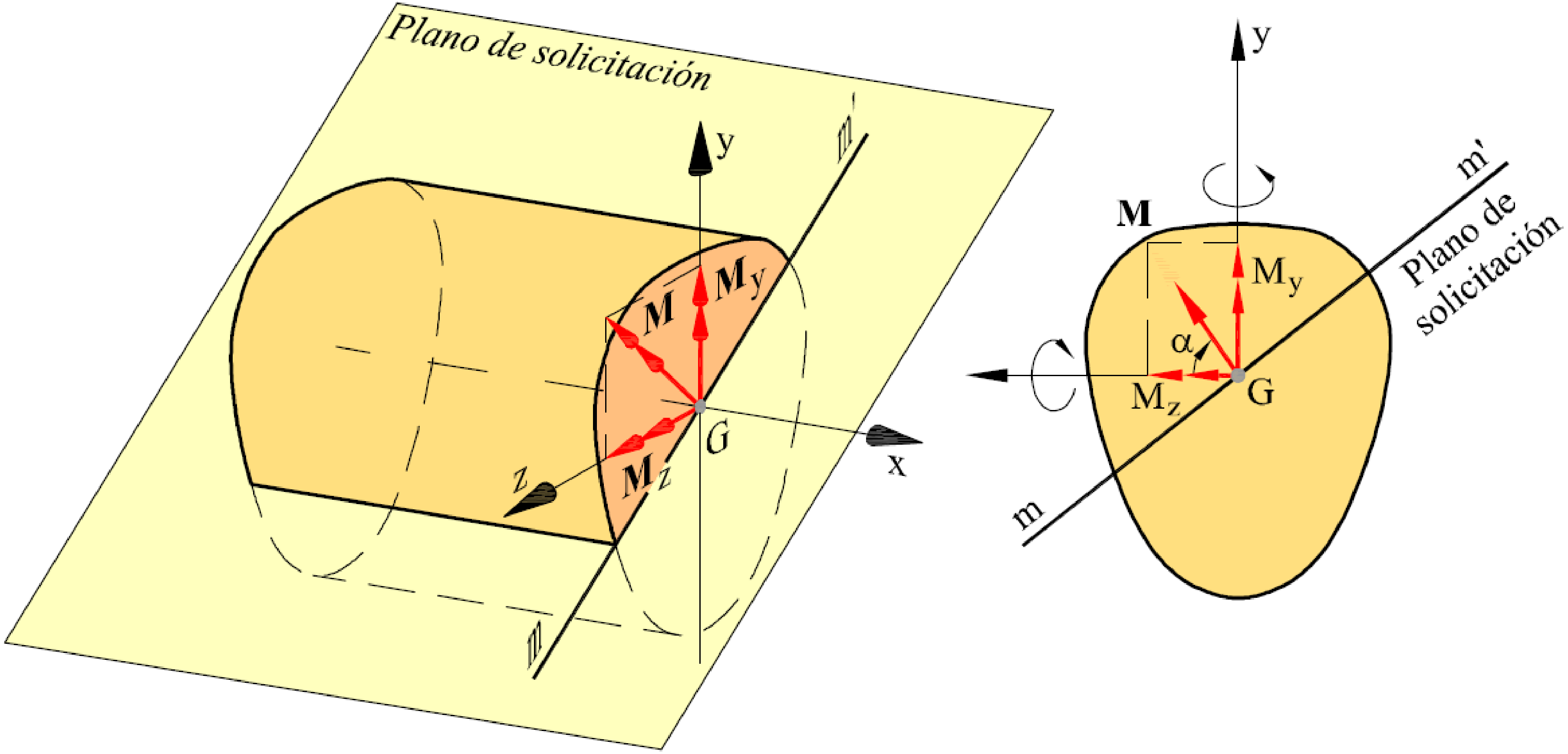

b)
y
My
G
z
x
w
w'

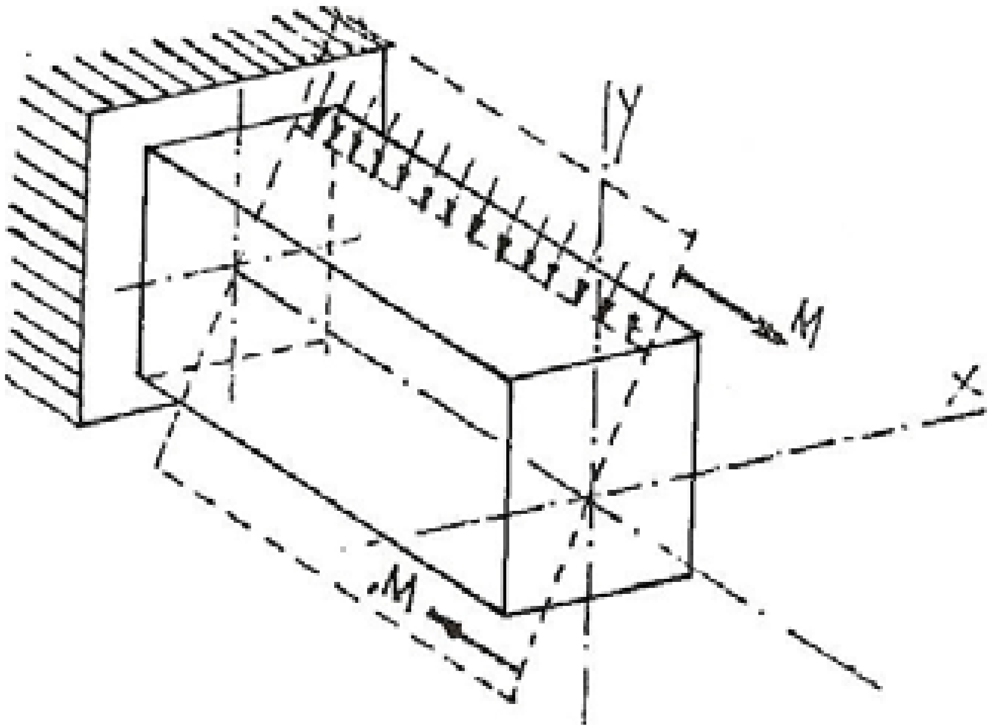

Mz
G
z

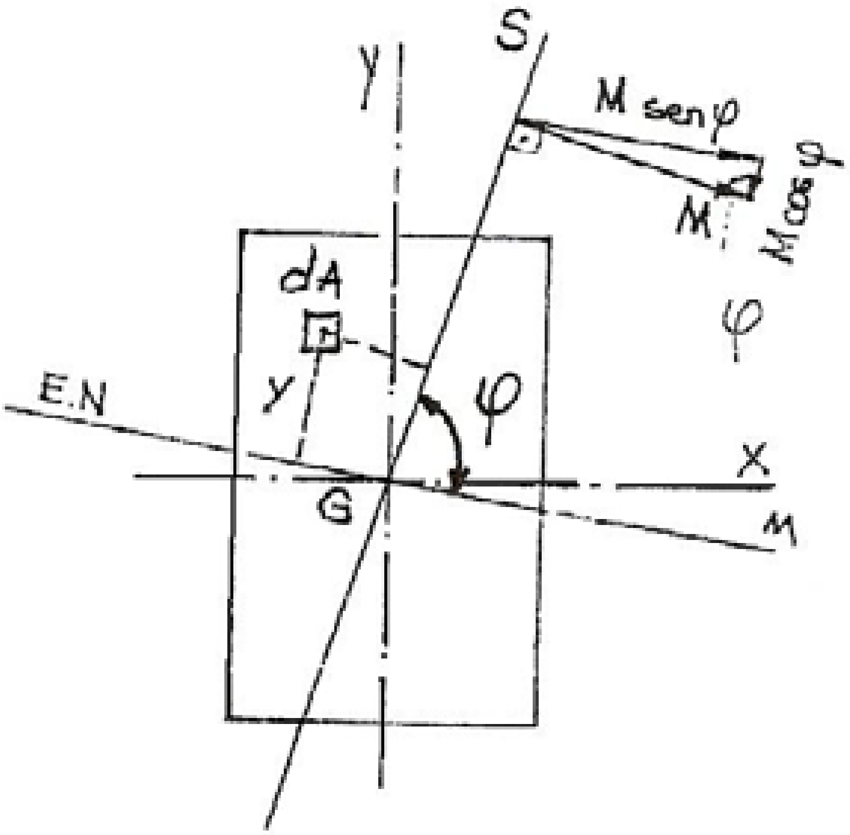

y
Mz
G
z


y
Mz
G
z

FLEXIÓN SIMPLE OBLICUA



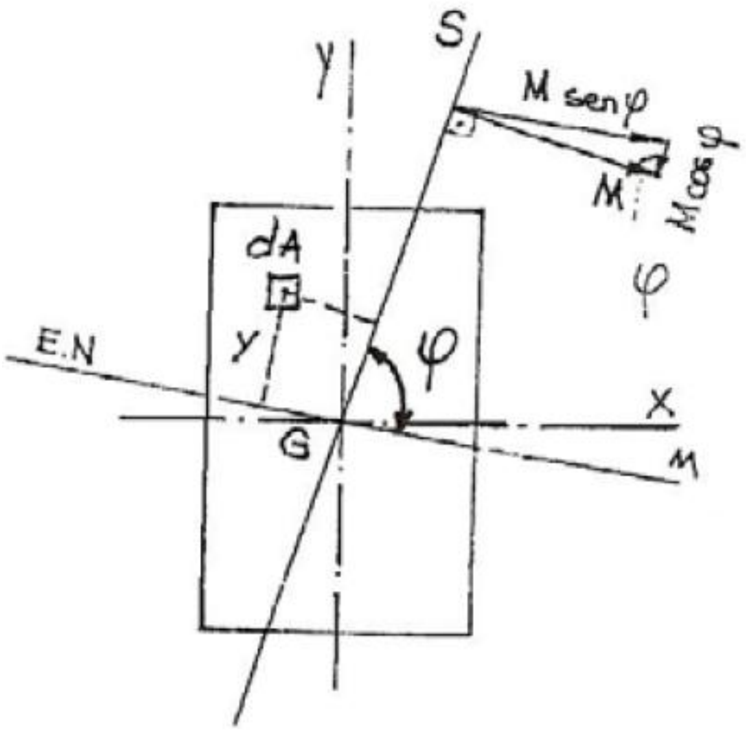




$$M \cdot sen\varphi = \int_A y \cdot \sigma \cdot dA = \frac{E}{\rho} \cdot \int_A y^2 \cdot dA = \frac{E}{\rho} \cdot I_n$$

$$\frac{M \cdot sen\varphi}{I_n} = \frac{E}{\rho}$$

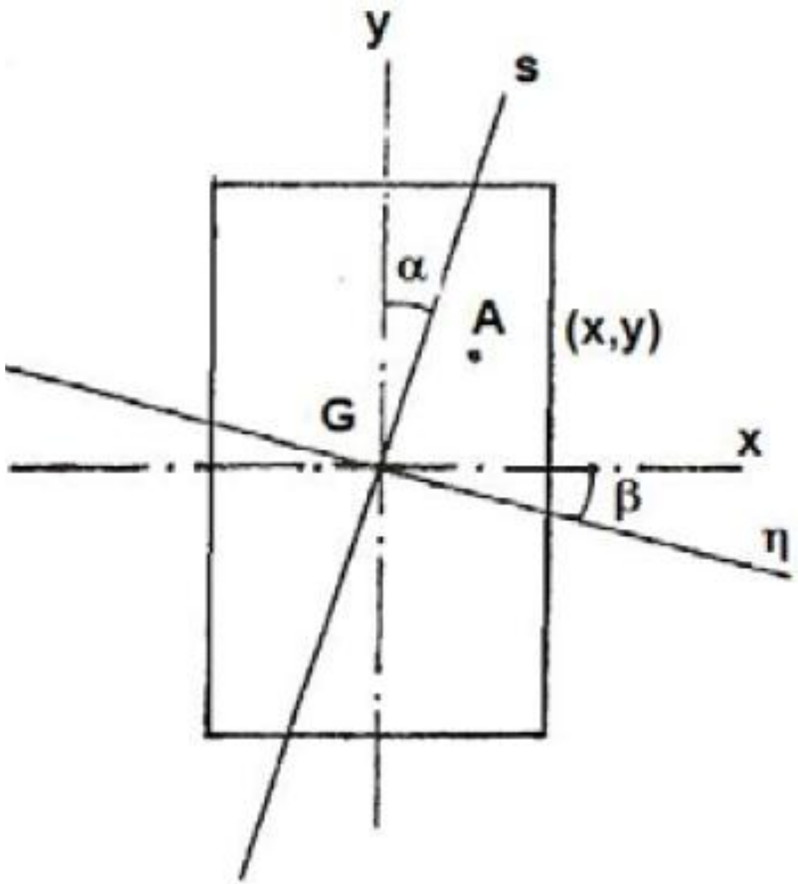
$$\boxed{\sigma = \frac{M \cdot sen\varphi}{I_n} \cdot y}$$



$$M \cdot \cos 90^{o} = 0 = \int_A x \cdot \sigma \cdot dA = \frac{E}{\rho} \cdot \int_A y \cdot x \cdot dA = \frac{E}{\rho} \cdot I_{ns}$$

Ins: momento centrífugo respecto a los ejes n y s, como en este caso su valor es nulo (dado que $E/\rho \neq 0$) resultan ser ejes conjugados de inercia

Flexión Doble



$M_x = M.\cos\alpha$

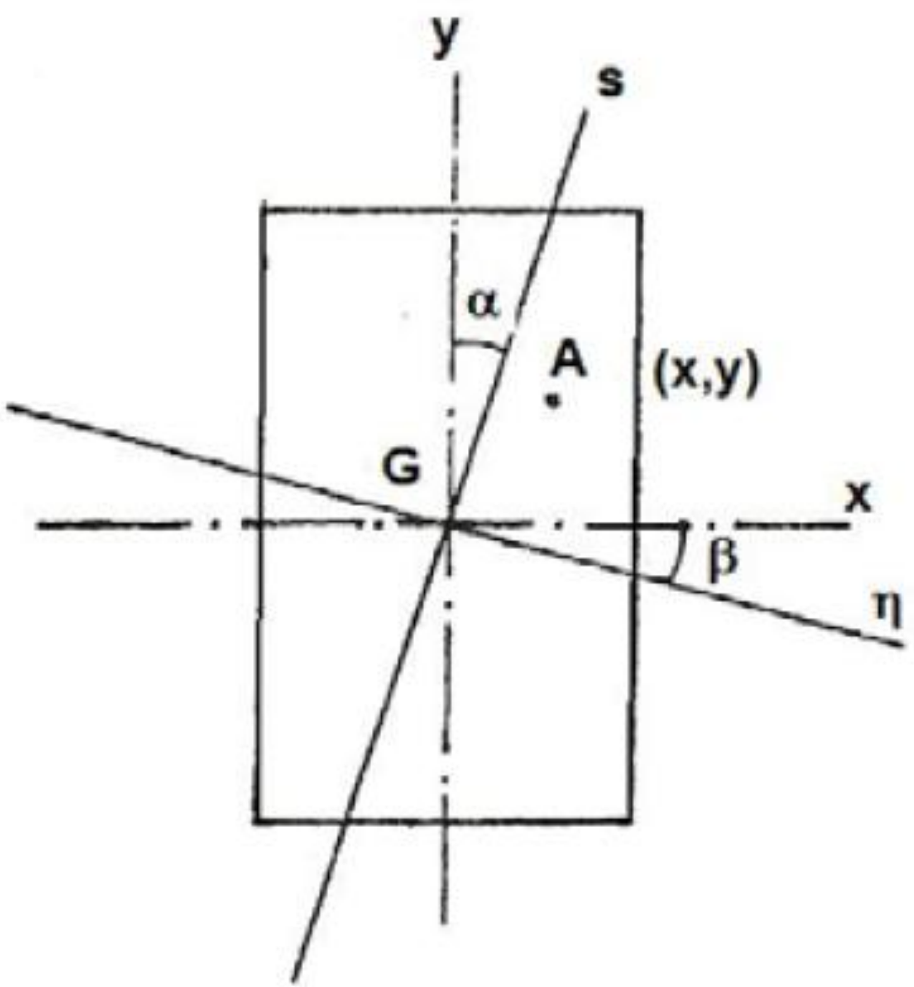
$$\sigma_x = \frac{M_x}{I_x} \cdot y$$

$M_y = M.\text{sen}\alpha$

$$\sigma_y = \frac{M_y}{I_y} \cdot x$$

$$\boxed{\sigma = \frac{M_x}{I_x} \cdot y + \frac{M_y}{I_y} \cdot x}$$

Posición de Eje Neutro

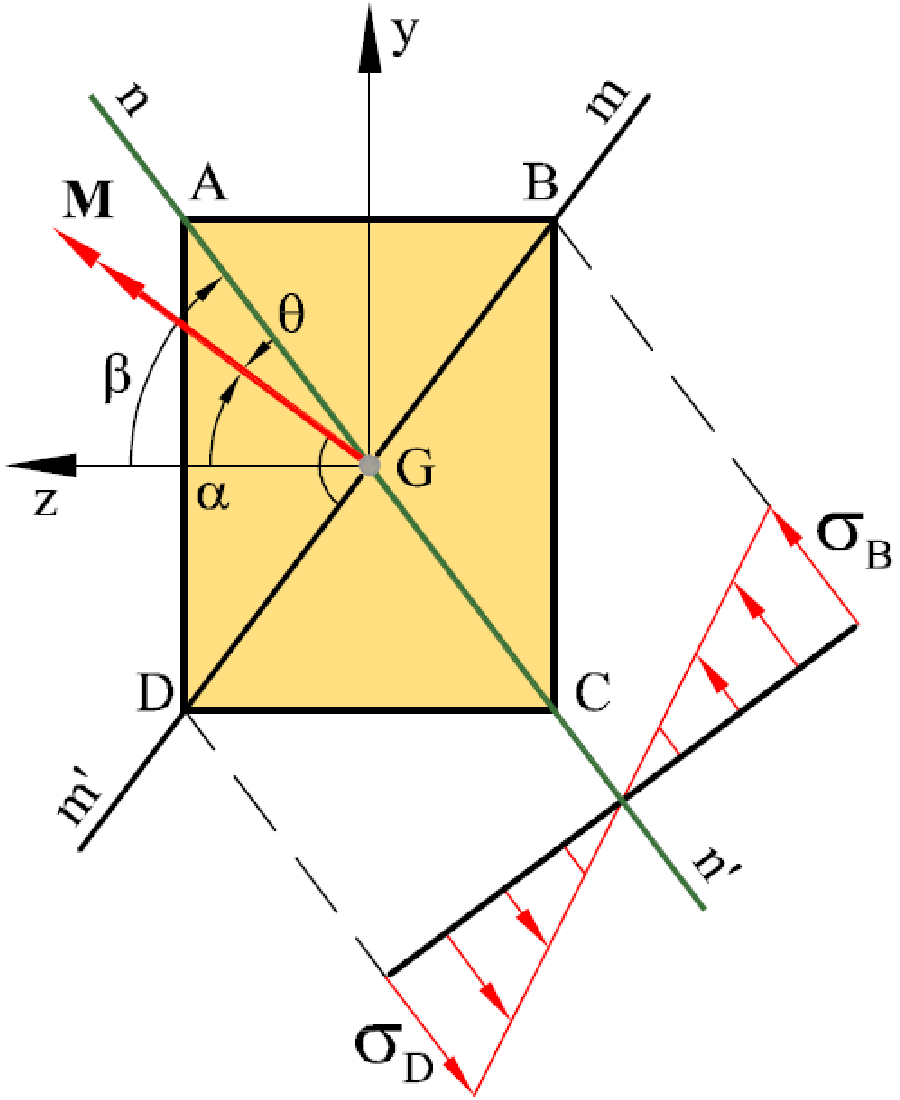


$$\sigma = \frac{M_x}{I_x} \cdot y + \frac{M_y}{I_y} \cdot x = 0$$

$$M\left(\frac{\cos\alpha}{I_x} \cdot y + \frac{sen\alpha}{I_y} \cdot x\right) = 0$$

$$y = -\frac{I_x}{I_y} \cdot tg\alpha \cdot x$$

$$\boxed{tg\beta = -\frac{I_x}{I_y} \cdot tg\alpha}$$


y
n
m
A
B
M
θ
β
G
z
α
σB
D
C
m'
n'
σD