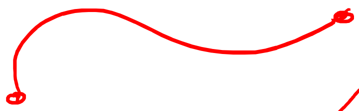
$m \rightarrow \bar{F}$

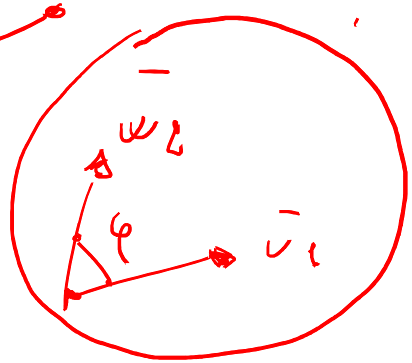
W

L ? ;

$F\,S$

$$W=\int_{\ell} \bar{F} \circ d\bar{S}$$





?

$\bar{v}_1 = (v_1, v_2, v_3)$

$\bar{w}_2 = (w_1, w_2, w_3)$

$\Rightarrow \quad \bar{v}_1 \circ \bar{w}_2 = v_1 w_1 + v_2 w_2 + v_3 w_3$

$\bar{v}_1 = (1, 0, 200)$;

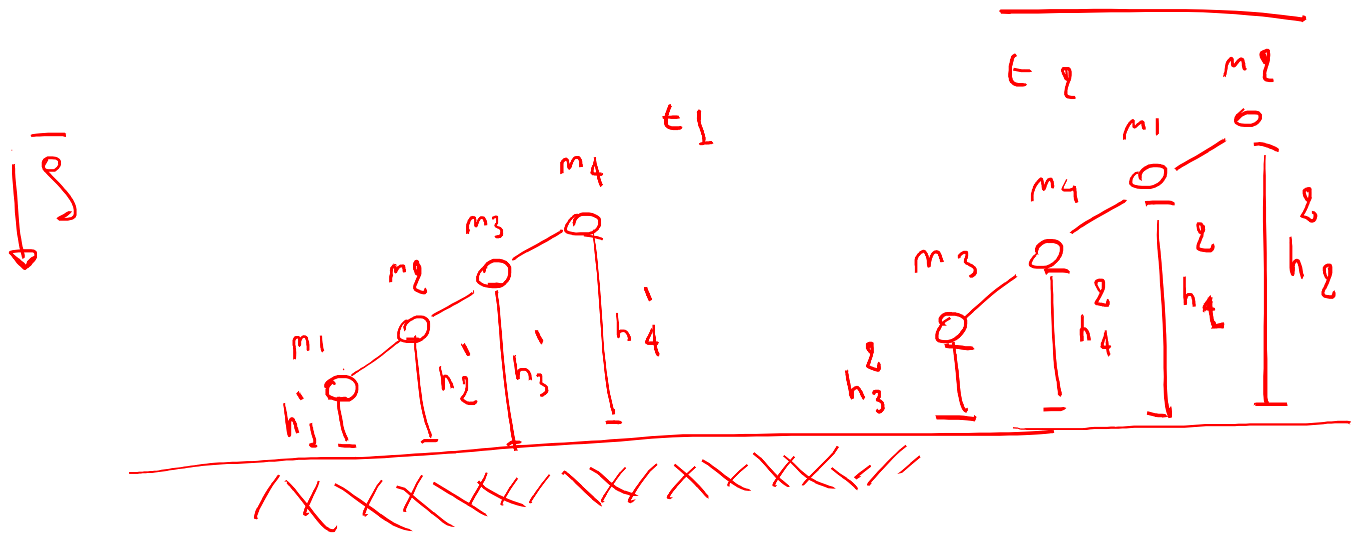
$\bar{v}_2 = (-1, 0, +0)$; $\quad \bar{v}_1 \circ \bar{v}_2$

$$L = \int_1^2 \bar{F}\cdot d\bar{s} = -(U_2 - U_1)$$

W

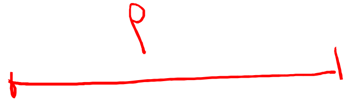
campo conservativo

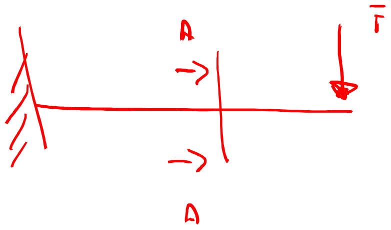
Pavolo ?

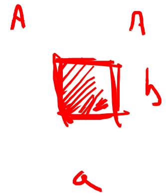


$$U|_1 = m_1 g h_1^1 + m_2 g h_2^1 + m_3 \cancel{g h_3^1 + m_4 g h_4^1} = g\sum_i m_i h_i^1$$

$$U_2|_2 = g\sum_i m_i h_i^2 \Rightarrow g\left(\sum_i m_i h_i^2 - \sum_i m_i h_i^1\right) = W$$







[Pa]

↑

→ modulo di elasticità → Young → E

→ ν → [m/m]

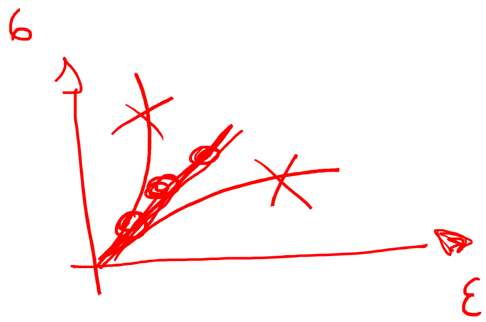
materiale elastici

(?)

(0.3)

materiali plastici

0.5



E(?) → $\sigma = E\,\varepsilon$

$E = \sigma / \varepsilon$

ε - 0.05 σ → 2 MPa

ε - 0.1 σ → 4 MPa

ε - 0.15 σ → 6 MPa

ε = 0.2 σ → 8 MPa

$E \to \sigma/\varepsilon$

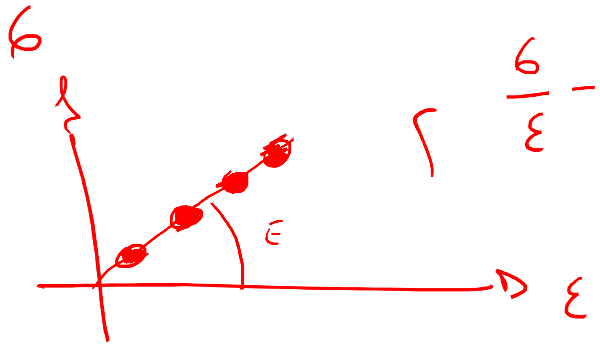
2/0.05

4/0.1

6/0.5

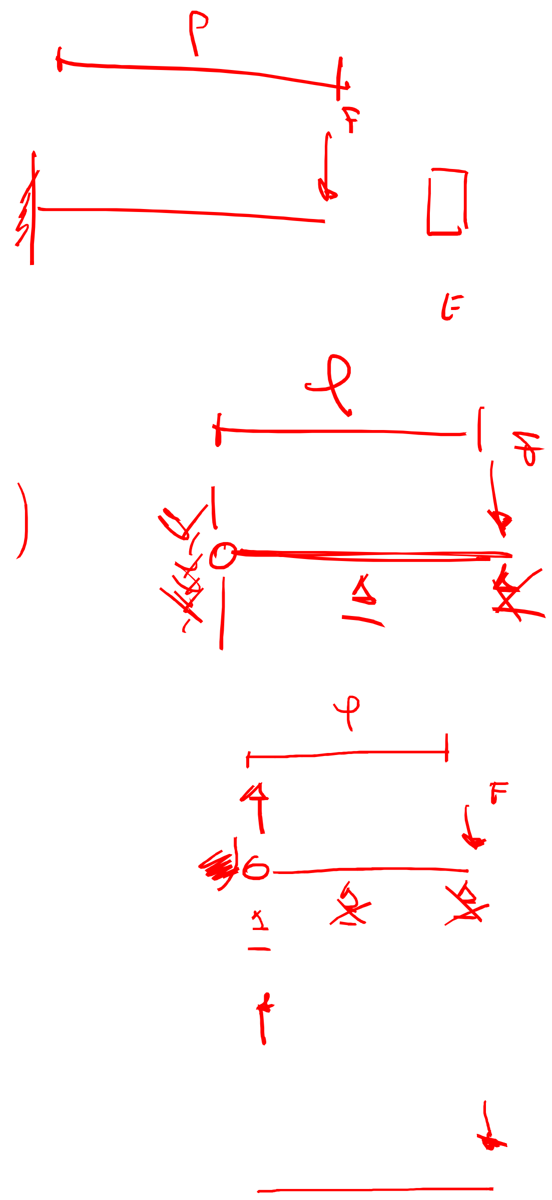
8/0.2

σ E → 40 MPa

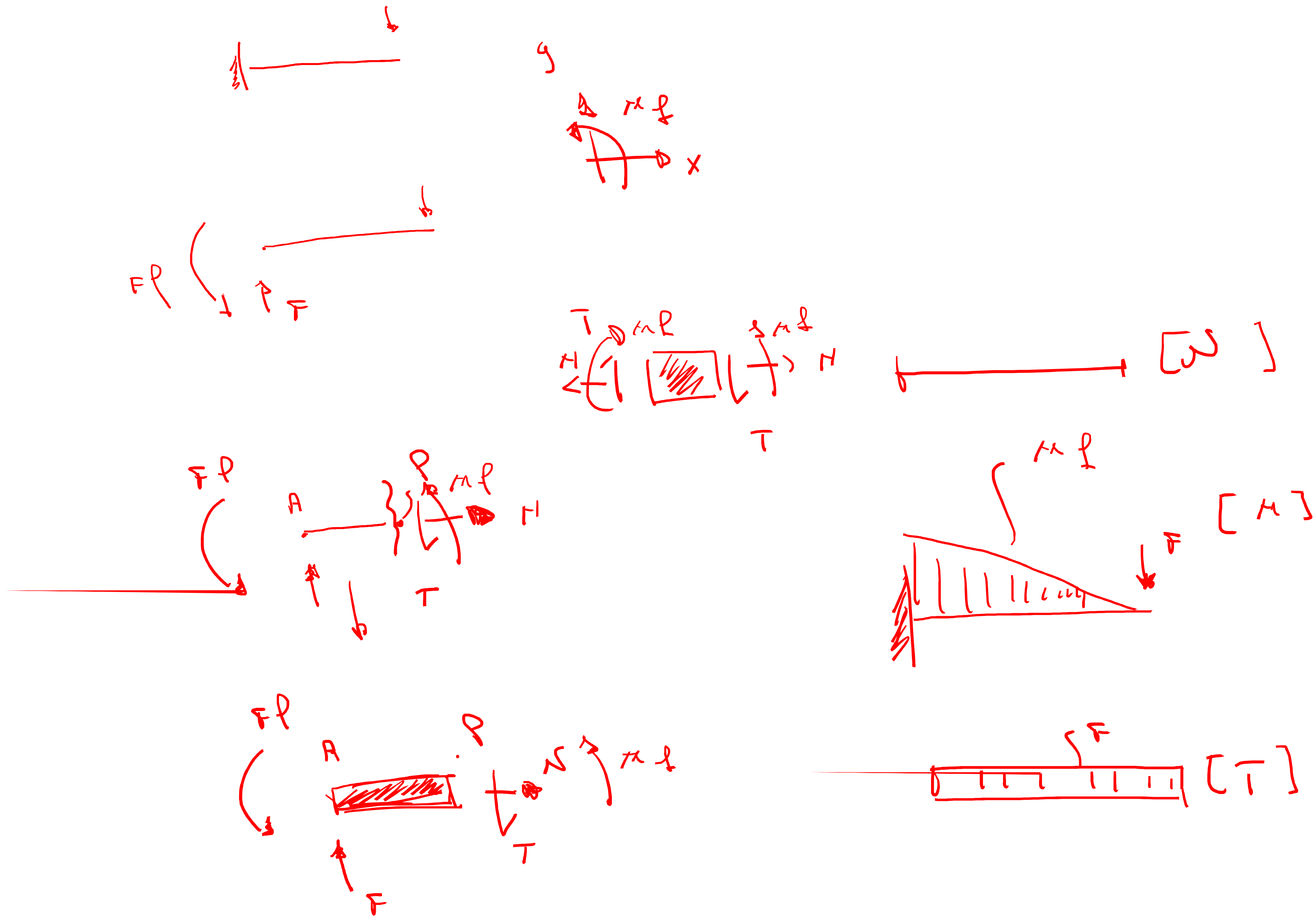


$\frac{\sigma}{\varepsilon} \to E$

2D → (3 × N)

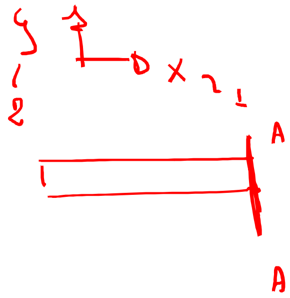


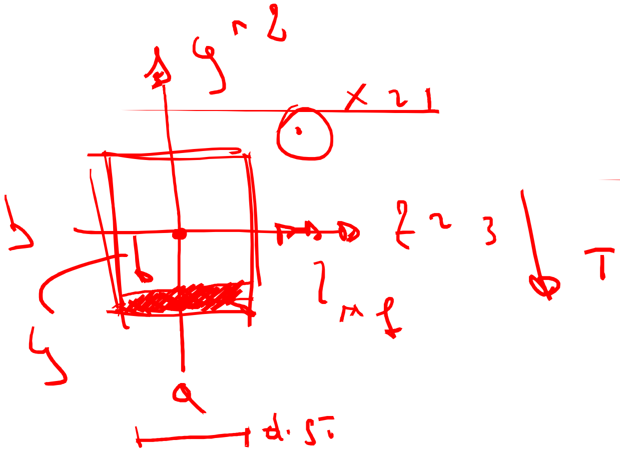
1. n° D.O.F struttura
2. n° D.O.C → constraint
3. Isostatica?
4. Reazioni vincolari
5. Reazioni interne



x
[M]
[T]
F
T
A
P

A - A ⇒ Tensioni:





① $N \rightarrow \sigma_{11}^{(N)} = \dfrac{N}{ab}$

② $M_f \rightarrow \sigma_{11}^{(M_f)} = \dfrac{M_f}{I_2}\, y \quad \Big| \quad \sigma_{11\,max}^{(M_f)} = \dfrac{M_f}{I_2} \dfrac{b}{2}$

$I_2 = \left(\dfrac{a b^3}{12}\right)$

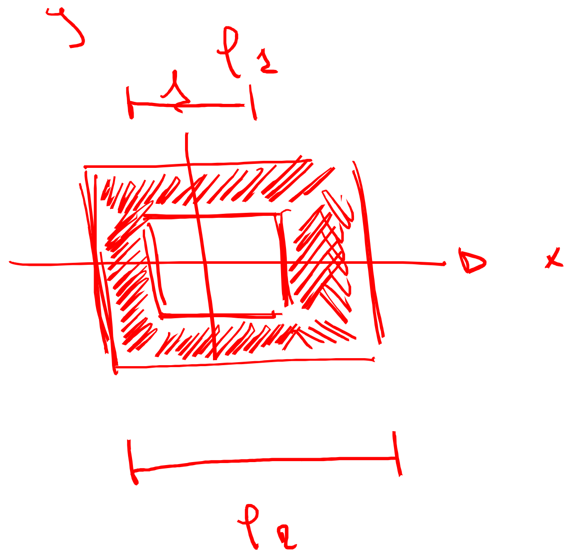
③ $T \rightarrow \sigma_{12} = \dfrac{T\, S_2'}{I_2\, a}$

corda

Tensioni: $\sigma^N \rightarrow \sigma_{11} \rightarrow (N, M_f)$

$\tau \rightarrow \sigma_{12} \rightarrow (T)$

σ_{13}



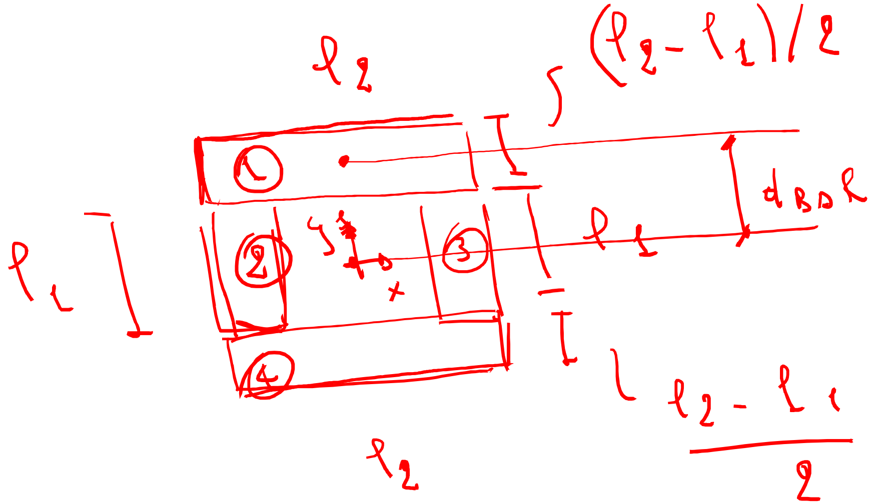
$\bar{I}_x = \bar{I}_{x_1} + \bar{I}_{x_2} + \bar{I}_{x_3} + \bar{I}_{x_4}$

$\bar{I}_y = \bar{I}_x$

$\bar{I}_o = 2\bar{I}_x = 2\bar{I}_y$

$\Rightarrow I_o = \int_A \rho^2 \, dA = \int_A (x^2+y^2)\, dA = I_y + I_x$

$\cdot \; \bar{I}_x^1 = \dfrac{\ell_2 (\ell_2 - \ell_1)^3}{12 \cdot 8} + \dfrac{\ell_2 (\ell_2 - \ell_1)}{2} \cdot d_{BAR}^2$



$d_{BAR} = \left(\dfrac{\ell_1}{2} + \dfrac{a}{2}\right) = (\ell_1 + a)\dfrac{1}{2}$

$\cdot \; \bar{I}_x^2 = \dfrac{1}{12} \dfrac{(\ell_2 - \ell_1)}{2} \ell_1^3$

$\cdot \; \bar{I}_x^3 = \dfrac{1}{12} \dfrac{(\ell_2 - \ell_1)}{2} \ell_1^3$

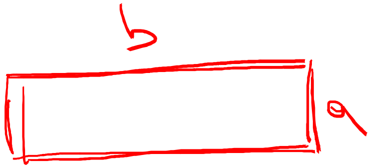
$\cdot \; \bar{I}_x^4 = \bar{I}_x^1 = \dfrac{\ell_2 (\ell_2 - \ell_1)^3}{12 \cdot 8} + \dfrac{\ell_2 a}{2} d_{BA}^2$

$\bar{I}_x$

$\bar{I}_y$

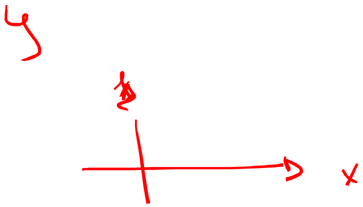
$\bar{I}_o$

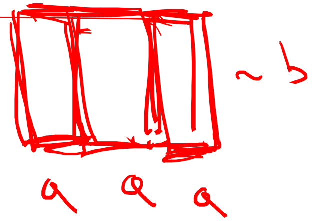
$$\bar{I}_x = \frac{1}{12}\left(l_2^4 - l_1^4\right)$$



→ 3

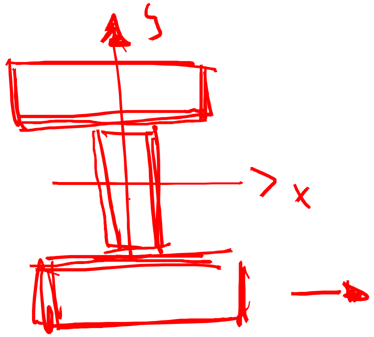
1 I'_x





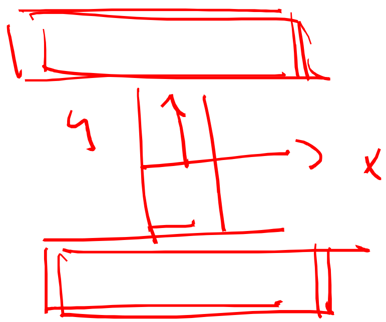
2 I''_x

$I \downarrow$



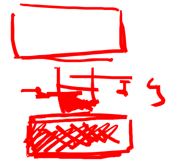
$$\boxed{I'_x \overset{\geq}{\leq} I''_x}$$

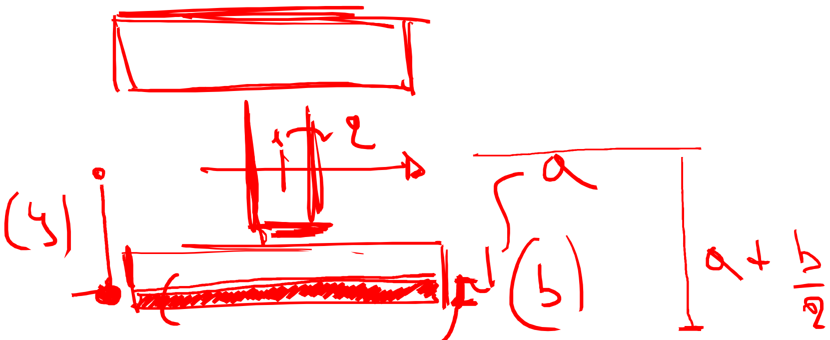
? → 6:2



$T \longrightarrow \sigma_{12}(T)$

$$\sigma_{12} = \frac{T \; S'_x(y)}{I_z(\text{corda})(y)}$$

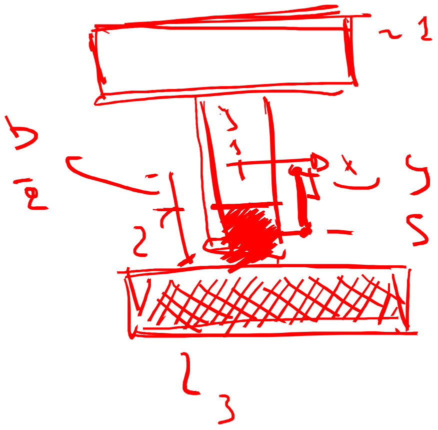




ℓ | corda $\rightarrow a$

$S'_x \rightarrow S'_{x_3} + S''_{x_3}$

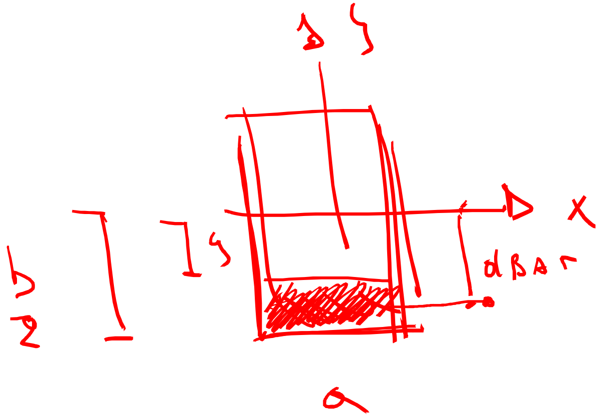
$$③ \quad \frac{T}{3}\Big[\underbrace{\left[\left(a+\frac{b}{2}\right)-y\right] b}_{\text{AREA}} \times \underbrace{\left(y+a+\frac{b}{2}\right)\frac{1}{2}}_{\text{dist baricentro}}\Big]$$



$- S_{x'_2}(y) \rightarrow \left(\frac{b}{2}-y\right) a \; d_{BAR} = \underbrace{\left(\frac{b}{2}-y\right)}\frac{a}{2}\underbrace{\left(\frac{b}{2}+y\right)}$

$\rightarrow \frac{a}{2}\left(\frac{b^2}{4}-y^2\right)$

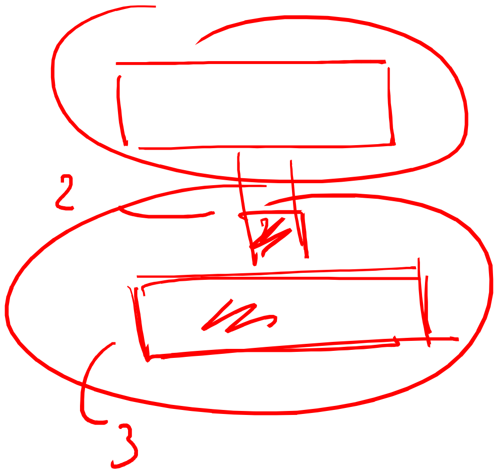
$- S_{x'_3} = \underset{ab}{A} \cdot \frac{(a+b)}{2}$



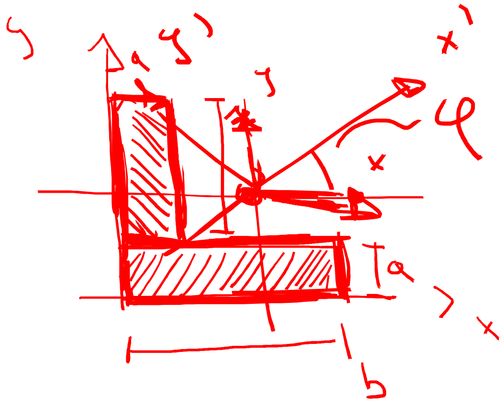
$\left(y+\frac{b}{2}\right)\frac{1}{2}$

$\Rightarrow S_x' = \frac{ab(a+b)}{2} + \frac{a}{2}\left(\frac{b^2}{4}-y^2\right)$

$\rightarrow \sigma_{12} = \frac{T S_x'}{a \; I_x}$



$\downarrow T \rightarrow \sigma, \tau$



1. BARICENTRO
2. $I_x, I_y \rightarrow$ momenti di inerzia baricentrici
3. $I_{x'}, I_{y'} \rightarrow$ momenti di inerzia principali

$I_{xy} = 0$