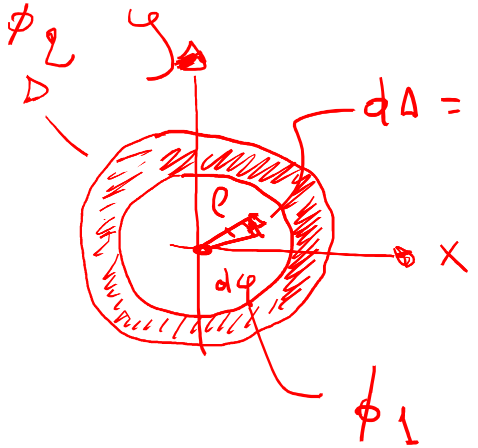


$dA = \rho \, d\rho \, d\varphi$

$R_1 = \dfrac{\phi_1}{2}$

$R_2 = \dfrac{\phi_2}{2}$

I_o

I_x

I_y

$$I_o = \int_A \rho^2 \, dA$$

$$= \int_0^{2\pi} \int_{R_i}^{R_e} \rho^2 \rho \, d\rho \, d\varphi = \int_0^{2\pi} d\varphi \int_{R_i}^{R_e} \rho^3 \, d\rho$$

$$= 2\pi \left[\frac{\rho^4}{4} \right]_{R_i}^{R_e} = \frac{\pi}{2} \left(R_e^4 - R_i^4 \right) = \frac{\pi}{32} \left(\phi_e^4 - \phi_i^4 \right)$$

$$I_o^{\odot} \overset{?}{=} I_o^{\bullet} - I_o^{\cdot}$$

$$I_o = \frac{\pi}{32}\left(\phi_e^4 - \phi_i^4\right)$$

1.

$\int I_o \quad \int I_x \quad \int I_y$

$$\int_A \rho^2 dA = \int_A x^2 dA + \int_A y^2 dA = I_x + I_y$$

I_x

I_y

$I_x = I_y$;

$$I_x + I_y = I_o$$

$$I_x = I_y = I_o/2$$

$$I_x = \frac{I_o}{2}$$

$$I_y = \frac{I_o}{2}$$

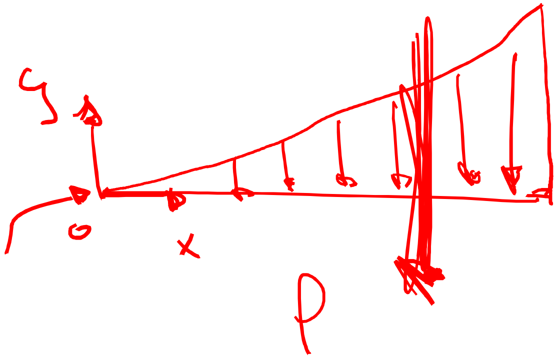
$$I_o = \frac{\pi}{32}\left(\phi_e^4 - \phi_i^4\right)$$

$$2 I_x = I_o \Rightarrow$$

$$I_x \Rightarrow I_o$$

$$I_y = I_x$$

$$I_y = I_x = \frac{\pi}{64}\left(\phi_e^4 - \phi_i^4\right)$$



$$q(x) = q_0 \left(\frac{x}{\ell}\right)^3$$

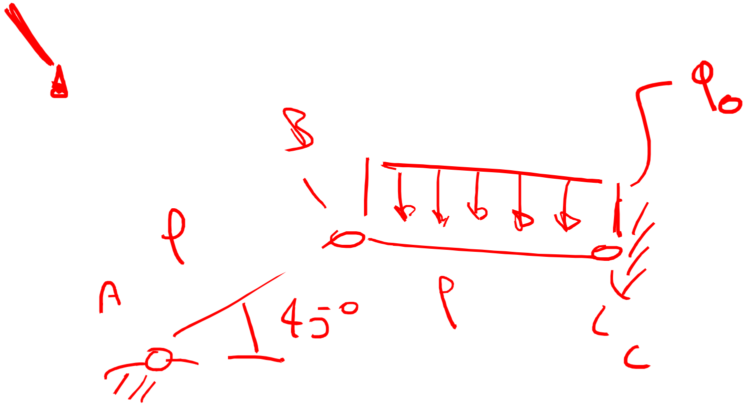
$$\Rightarrow \quad F_R$$

$$M_R$$

- $F_R = \int_\ell q(x)\,dx = \int_0^\ell q_0 \frac{x^3}{\ell^3}\,dx = \frac{q_0}{\ell^3} \int_0^\ell x^3\,dx = \frac{x^4}{4}\Big|_0^\ell \frac{q_0}{\ell^3}$

$$F_R = \frac{q_0 \ell}{4} = \frac{F}{4}$$

- $M_R = \int_\ell q(x)\,x\,dx = \int_0^\ell q_0 \frac{x^4}{\ell^3}\,dx = \frac{q_0 \ell^2}{5} = \frac{F \ell}{5}$



i. 6 g.d.l. , d.o.f. ;

ii. $\underline{2}$ − A

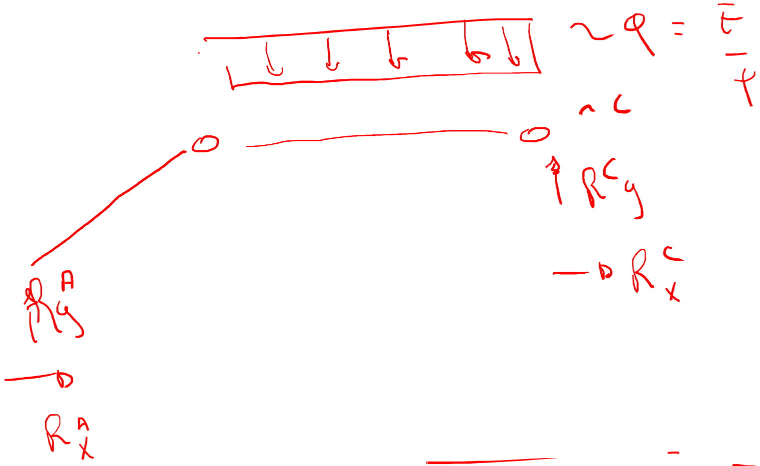
$\underline{2}$ − C

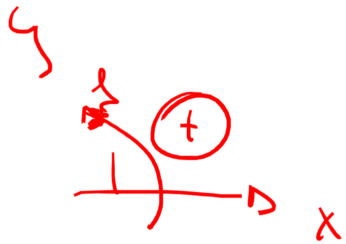
$2(n-1)$ − B

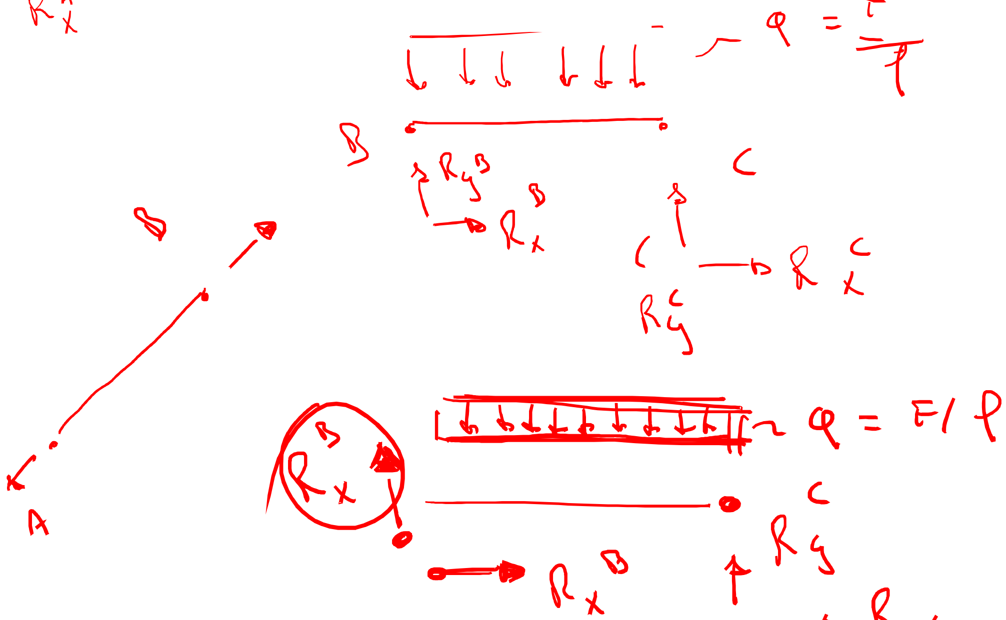
$= 2$

$\boxed{6}$ | → − d.o.f.

iii. isostatico

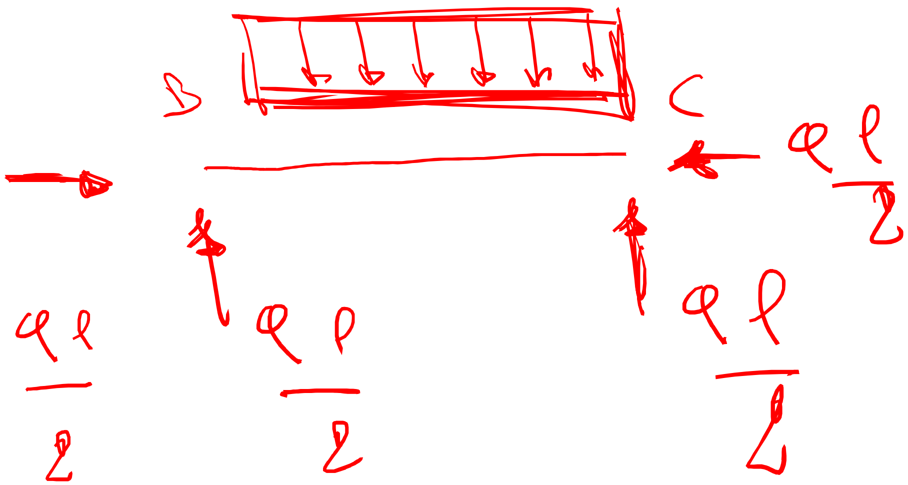


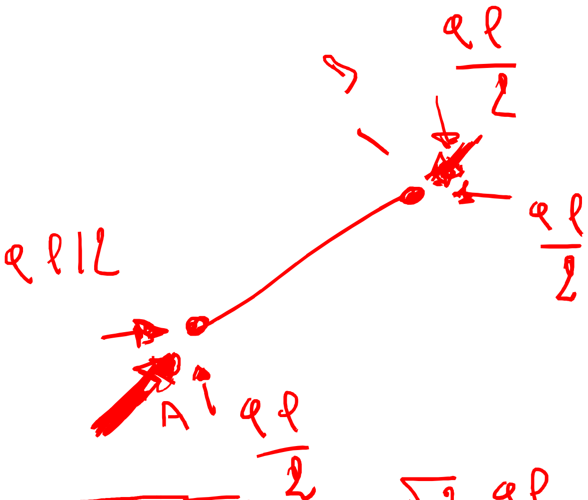




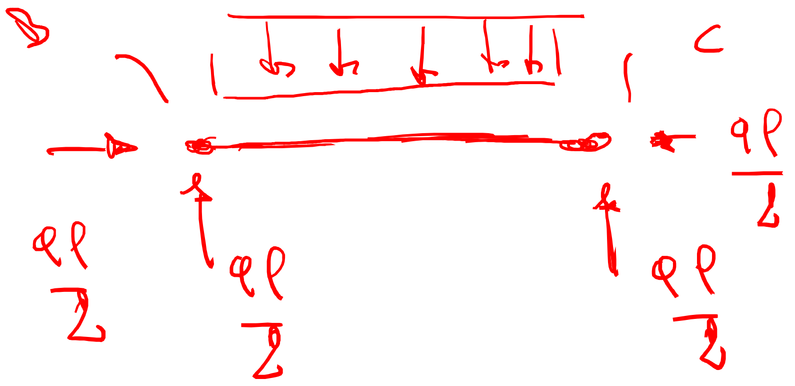
$$\begin{cases} R_x^B + R_x^C = 0 \\ R_x^B + R_y^C = q\ell \\ -q\ell\frac{\ell}{2} + R_y^C\,\ell = 0 \end{cases}$$

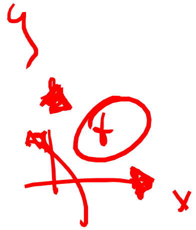
$$\Rightarrow R_x^B = R_y^C = R_y^B = \frac{q\ell}{2}$$





$$\sqrt{\frac{q^2 l^2}{2^2} + \frac{q^2 l^2}{2^2}} = \sqrt{2}\,\frac{ql}{2}$$





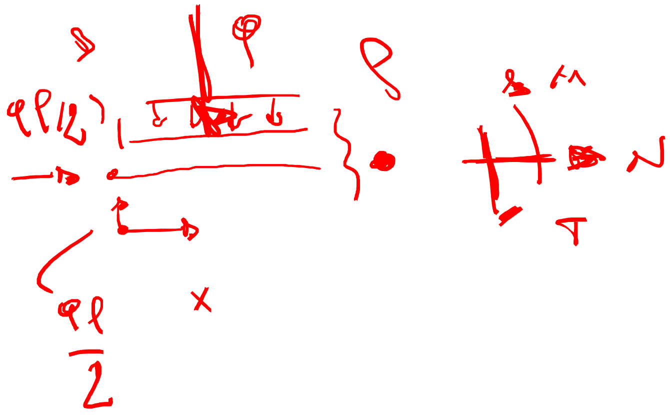
[N]

[T]

[M]

$q(x)$

[M]

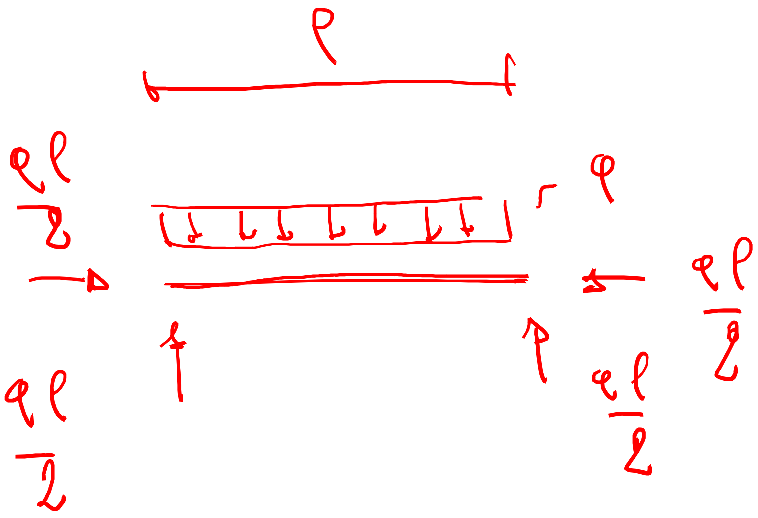


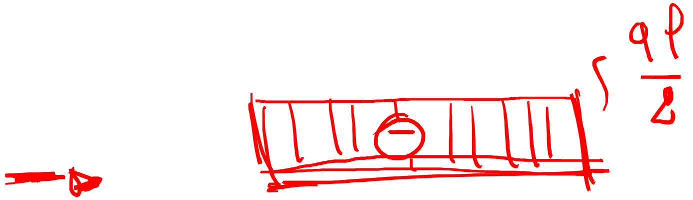
$[N]: \frac{q\ell}{2} + N = 0 \Rightarrow N = -\frac{q\ell}{2}$

$[T]: \frac{q\ell}{2} - T - qx \Rightarrow T = q\left(\frac{\ell}{2} - x\right)$

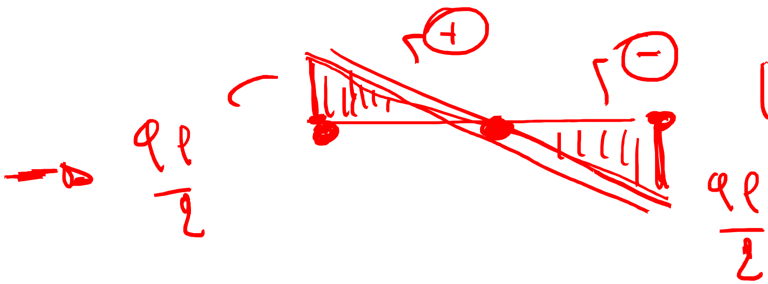
$[M]: -\frac{q\ell}{2}x + M + qx\frac{x}{2} = 0;$ $\quad M = \frac{q\ell}{2}x - \frac{qx^2}{2} = \frac{q}{2}x(\ell - x)$

$\boxed{DC}$



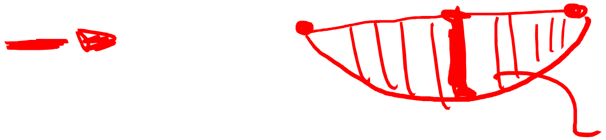


[N]



[T]

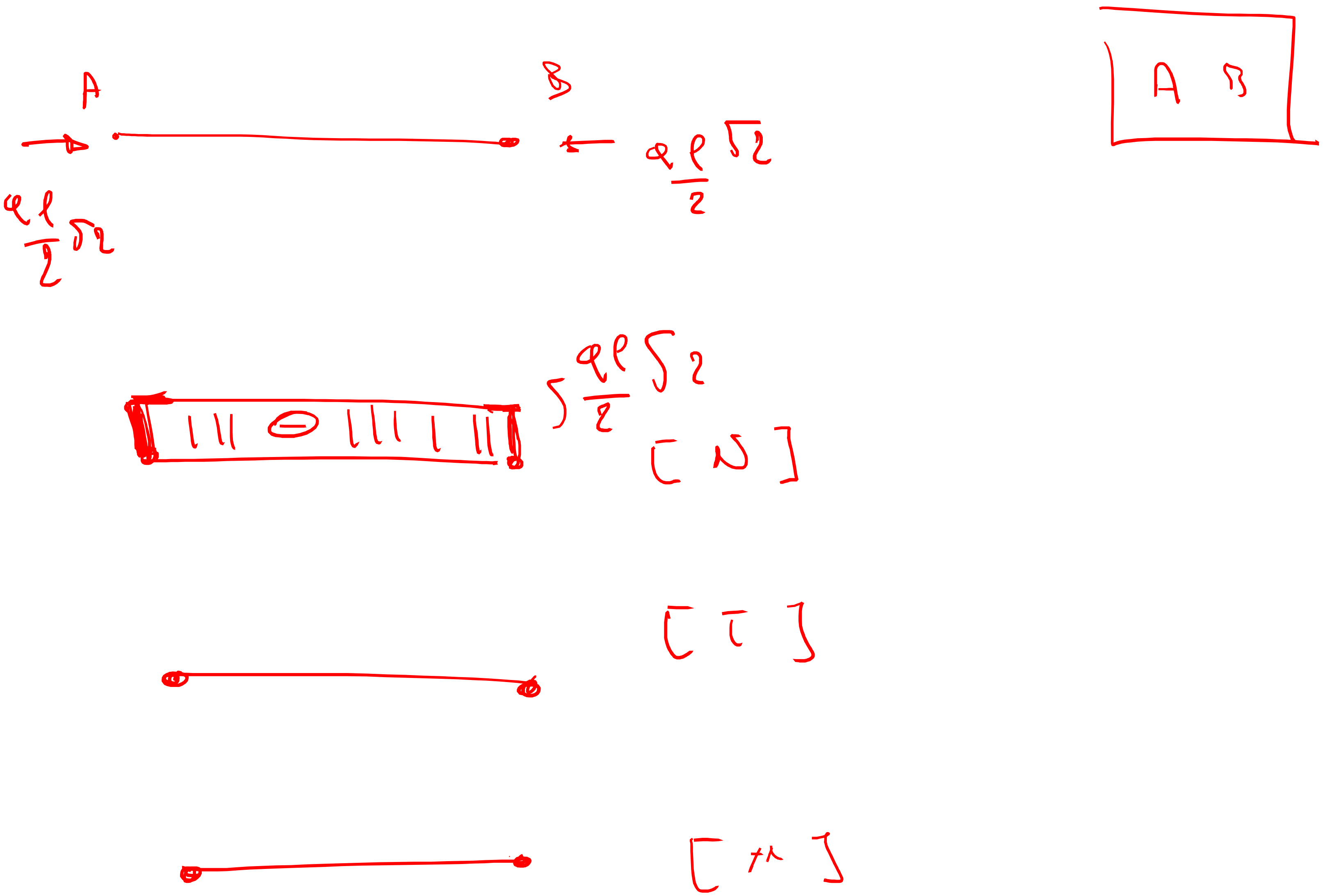
$T = q\left(\frac{l}{2} - x\right)$



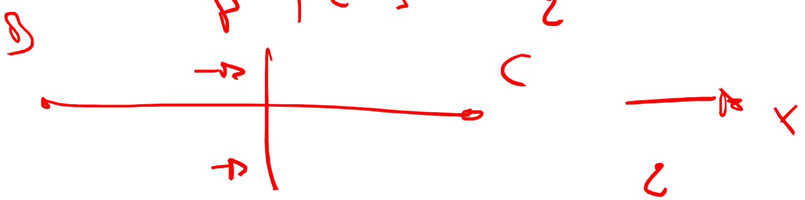
[M]

$M = \frac{q}{2} x (l - x)$

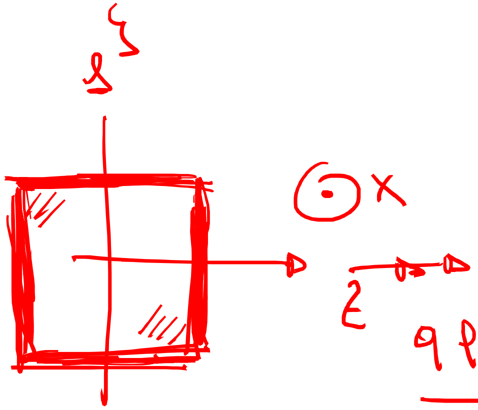
$M^{max} = \frac{q}{2}\frac{l}{2}\frac{l}{2} = \frac{ql^2}{8}$


A
B
ql/2 √2
ql/2 √2
ql/2 √2
[N]
[T]
[M]
A B

$P_r[M] = \frac{ql}{2}$



$P_c[M] \to \frac{ql^2}{8}$



$\frac{ql^2}{8}$

σ_{11}

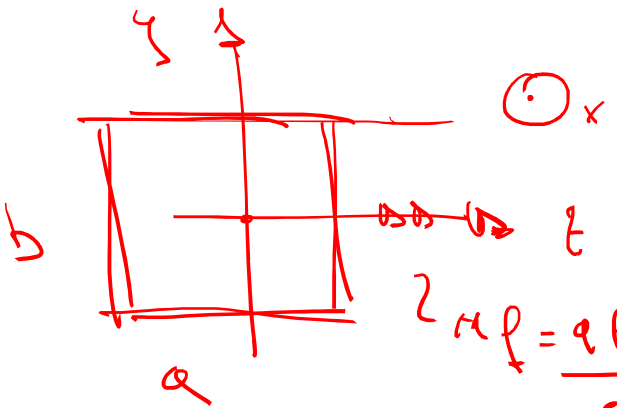
$\sigma_{12} \sim q$

$\sigma_{13} \approx 0$

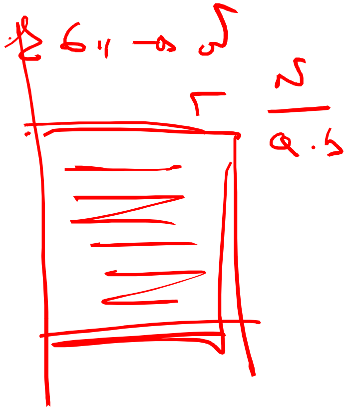
$\sigma_{11} \to N, M$

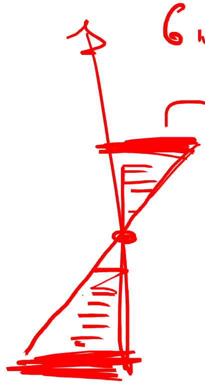
$\cancel{\sigma_{12}} \to T$

$\cancel{\sigma_{13}} \to T$



$$2\;M_f = \frac{q\ell^2}{8}$$





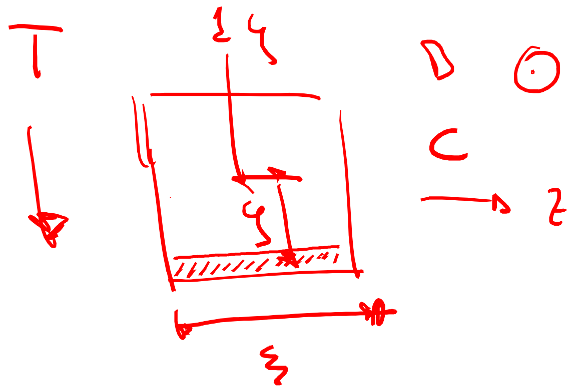
$$\frac{3}{2}\frac{q\ell^2}{ab^2}\cdot\frac{1}{2}$$

$$\simeq \frac{3}{2}\frac{q\ell^2}{a \cdot b^2}\cdot\frac{1}{8}$$

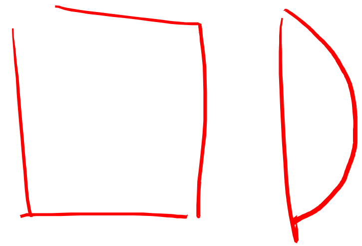
$$\sigma_n^{(N)} = \frac{N}{A} = \frac{N}{a \cdot b}$$

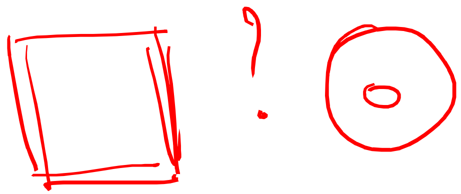
$$\sigma_n^{(M)} = \frac{M_f}{I_z}\,y = \frac{q\ell^2\,12}{8\,a\,b^3}\,y = \frac{q\ell^2\,3}{2\,a\,b^3}\,y$$

$$\sigma_n^{max} \left(= \frac{M}{a \cdot b} + \frac{3}{4}\frac{q\ell^2}{a\,b^2} \right)$$



$$\tau \equiv \sigma_{yb} = \frac{T\, S_z^{\text{rella}}}{\xi \cdot I_z}$$





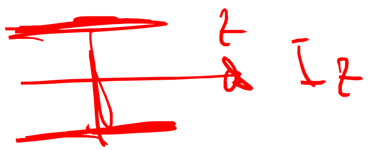
$$I_z^1 \gtrless I_z^2$$

$$I_z^1 = \frac{1}{12} a b^3$$

$$I_z^2 = \frac{\pi}{64}\left(\phi_e^4 - \phi_i^4\right)$$

$\rightarrow$ 1 $\rightarrow$ $I_z^1 \mid A_1$

2 $\rightarrow$ $I_z^2 \mid A_2$



B C

$$M(x) = \frac{q}{2}\,x(\ell - x)$$

$$① \quad \frac{d^2y}{dx^2} = \frac{M(x)}{EI}$$

$$\bullet \quad \frac{dy}{dx} = \int \overbrace{\frac{q}{2}\,\frac{1}{EI}}^{K}\, x(\ell - x)\,dx$$

$$= \int k(x\ell - x^2)\,dx = k\ell\,\frac{x^2}{2} - \frac{k x^3}{3} + C_1$$

$$\bullet \quad y = \frac{k\ell x^3}{6} - \frac{k x^4}{12} + C_1 x + C_2$$

C.C. $\rightarrow$ C_1

C_2

$1°$; $(x=0)$, $y=0 \Rightarrow C_2=0$

$2°$; $(x=l)$, $y=0 \Rightarrow \dfrac{Kl^4}{6} - \dfrac{Kl^4}{12} + C_1 l = 0$

$$\Rightarrow C_1 = Kl^3\left(\frac{1}{12}-\frac{1}{6}\right) = -\frac{Kl^3}{12};$$

$$E = \int_{\ell} \frac{1}{2}\frac{M^2}{EI} \longrightarrow M(x) = \frac{q}{2}x(\ell - x)$$

$$K = \left(\frac{q^2}{8EI}\right)$$

$$E_{\text{strain}} = \frac{1}{2}\int_{\ell(B-C)} \frac{q^2\,(x(\ell-x))^2}{2^2 EI} = \frac{1}{2}\left(\frac{q^2}{4EI}\right)\int_A^B (\ell x - x^2)^2\,dx$$

$$\rightarrow E_{\text{strain}} = K\int_A^B (\ell x - x^2)^2\,dx$$

$$= K\int_A^B (\ell^2 x^2 + x^4 - 2\ell x^3)\,dx$$

$$= K\left[\frac{\ell^5}{3} + \frac{\ell^5}{5} - \frac{2\ell\,\ell^4}{4}\right] = K\ell^5\left(\frac{1}{3} + \frac{1}{5} - \frac{1}{2}\right)$$

$$\circ \quad E = \frac{1}{2}\int_{\rho} \frac{M^2}{EI}\, dx \longrightarrow \mathrm{I}$$

$$\circ \quad \overset{\left(\frac{1}{\rho}\right)}{\frac{d^2 y}{dx^2}} = \frac{M}{EI} \Rightarrow \left(\frac{1}{\rho}\right) = \frac{M}{EI} \Rightarrow M^2 = \left(\frac{1}{\rho}\right)^2 E^2 I^2$$

$$\Rightarrow E = \frac{1}{2}\int_{\rho} \frac{M^2}{EI}\, dx = \frac{1}{2}\int_{\rho} \left(\frac{1}{\rho}\right)^2 EI\, dx \longrightarrow \mathrm{II}$$