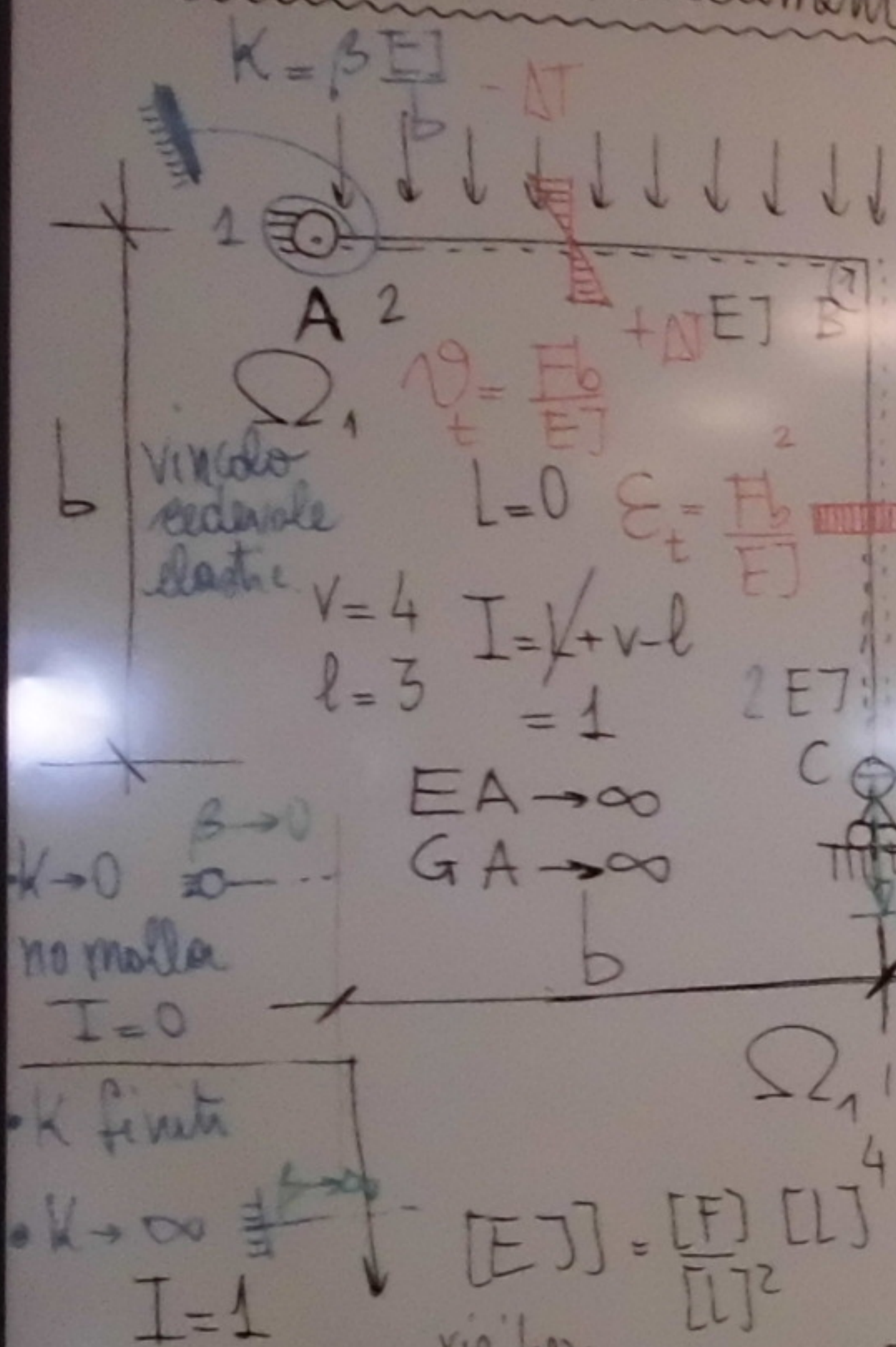
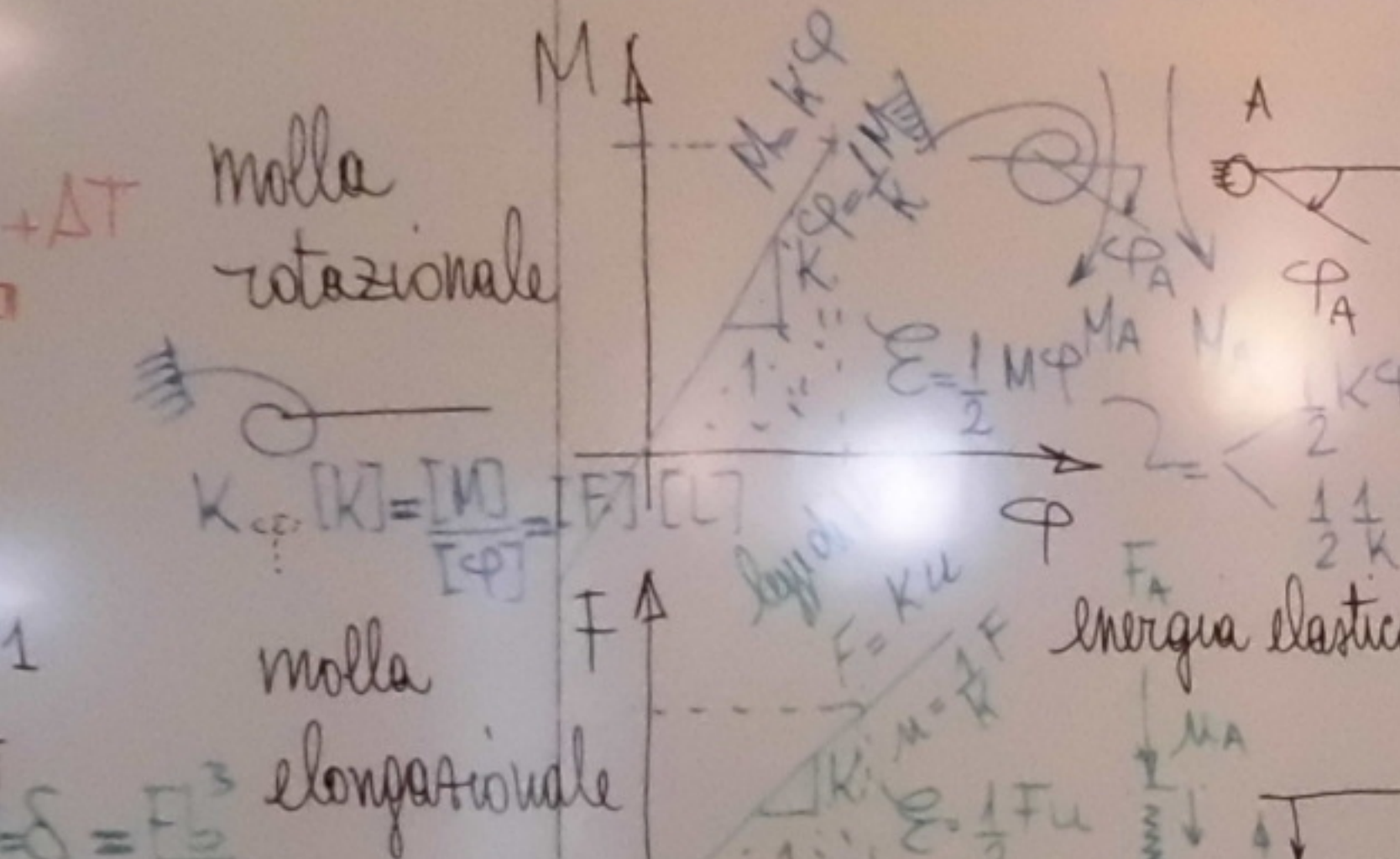


Strutture staticamente indeterminate



$q = \frac{F}{b}$ - Caricamento distr. di intensità $q = \frac{F}{b}$
 - Vincolo elastico elasticamente in A

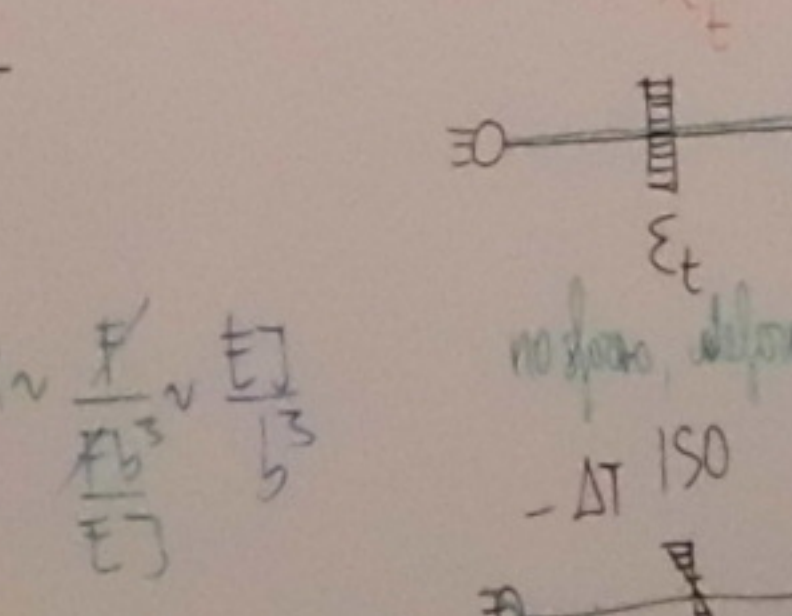


$K_v = \frac{EI}{L^3}$ molla rotazionale
 $K_u = \frac{EI}{L^3}$ molla elongazionale
 - Risposta flessionale:
 $\Delta \approx \frac{Fb^3}{EI}$; $\varphi \approx \frac{Fb^2}{EI}$
 $\chi = \frac{M}{EI} \Rightarrow \frac{Fb}{EI}$
 $[s] = [L]$ $[\varphi] = [1]$

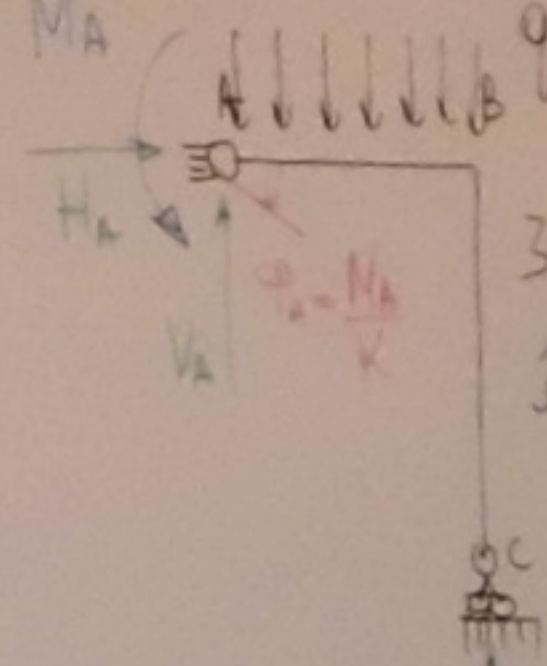
- Cedimento vincolo ambato co
 $\delta_c = \frac{Fb^3}{EI}$

- Deformazione termica elongazionale
 $\Delta L_t = \epsilon_t dx \Rightarrow \epsilon_t \sim \frac{Fb}{EI}$

- Curvatura termica
 $d\varphi_t = \varphi_t dx \Rightarrow \varphi_t \sim \frac{Fb}{EI}$



Analisi statica



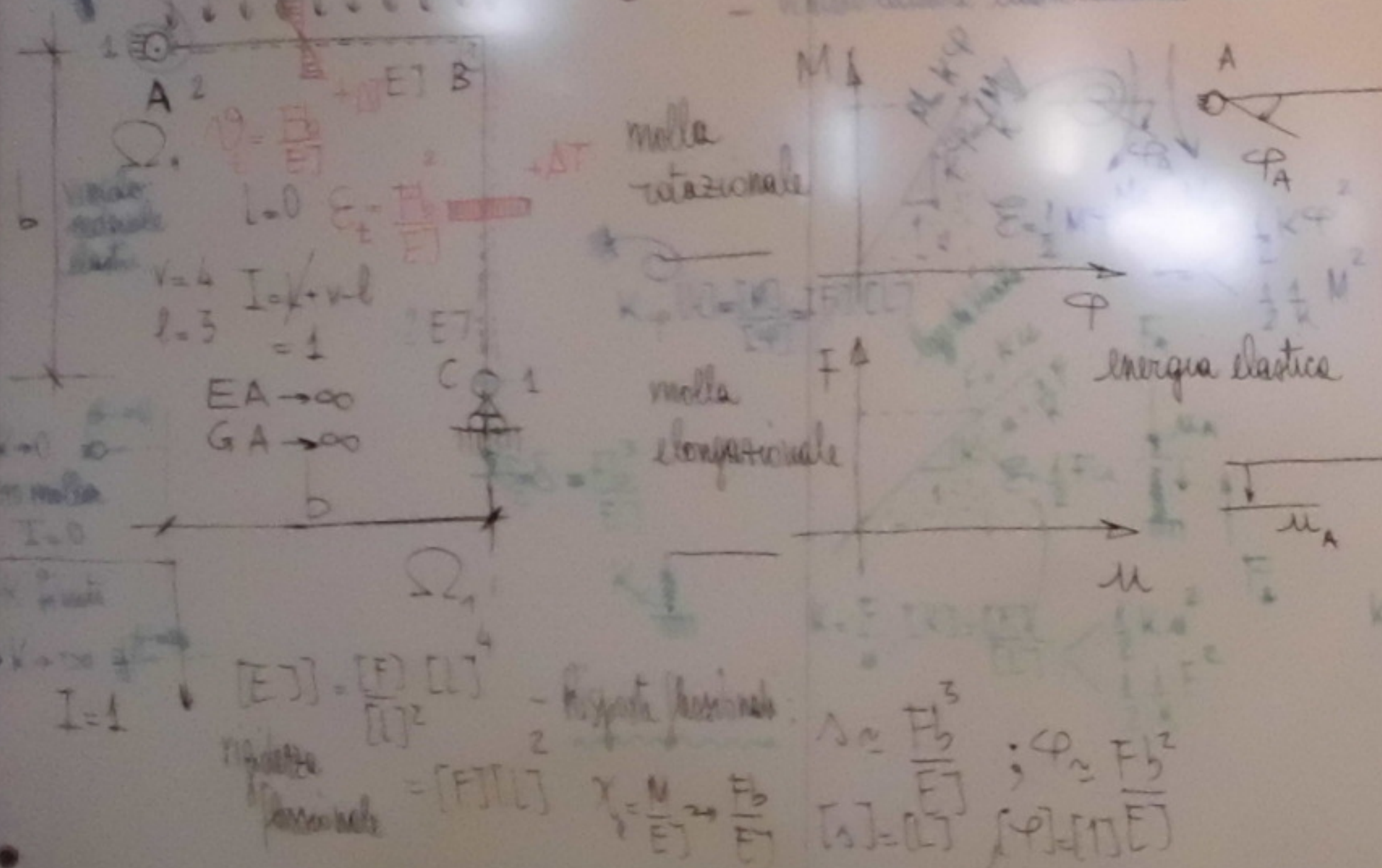
$\sum F_x = 0 \Rightarrow H_A = 0$ (dati del vincolo)
 $\sum M_A = 0 \Rightarrow V_b b - M_b = 0 \Rightarrow V_b = \frac{M_b}{b}$
 $\sum M_B = 0 \Rightarrow -V_b b + M_b = 0 \Rightarrow V_b = \frac{M_b}{b}$
 il po staticamente indeterminato in V_b, M_b

$\sum F_y = 0 \Rightarrow V_A + V_b - F = 0$
 combinate $V_A + V_b = F$
 linea dei nodi

Il po staticamente indeterminato e, se possibile, possibile
 dati V_b, M_b valori di X , al righe del vincolo, con uguale proba, al di
 qual del X $\Rightarrow$ $\chi = \frac{M_b}{EI}$ $\Rightarrow$ $\chi = \frac{Fb}{EI}$
 Qualche metodo $\Rightarrow$ $\chi = \frac{Fb}{EI}$ $\Rightarrow$ $\chi = \frac{Fb}{EI}$

Strutture staticamente indeterminate

caricamento distribuito di intensità $q = \frac{F}{b}$
 - vincolo elastico in A



- Caricamento vincolare ambidirezionale

$$\delta = \frac{Fb}{EJ}$$

- Deformazione termica longitudinale

$$d\epsilon_t = \epsilon_t dx \Rightarrow \epsilon_t \sim \frac{Fb}{EJ}$$

- Curvatura termica

$$d\phi_t = \phi_t dx \Rightarrow \phi_t \sim \frac{Fb}{EJ}$$

$$\chi_t = \frac{Fb}{EJ}$$

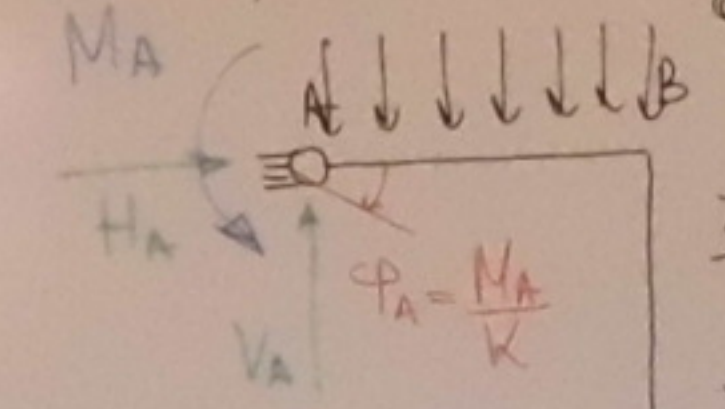
$$\chi_t = \frac{Fb}{EJ}$$

$$\chi_t = \frac{Fb}{EJ}$$

$$\chi_t = \frac{Fb}{EJ}$$

$$\chi_t = \frac{Fb}{EJ}$$

- Analisi statica



$$\begin{aligned} \sum F_x = 0 &\Rightarrow H_A = 0 \\ \sum M_A = 0 &\Rightarrow V_C b + M_A - \frac{qb^2}{2} = 0 \\ \sum M_C = 0 &\Rightarrow -V_A b + M_A + \frac{qb^2}{2} = 0 \end{aligned}$$

il pb. resta staticamente indeterminato in V_A, V_C, M_A

$$\sum F_y = 0 \Rightarrow V_A + V_C - F = 0$$

combinare
 linearmente le pred.

- Il pb. risulta staticamente indeterminato e, se pure risulta possibile, non appare possibile, nel solo equil. del X.
- Qualsiasi metodo (P.N., E) utile a det. ϕ consente di risolvere X

RV "isostatica"

Scelta della incognita apert.

$$\begin{aligned} V_C &= \frac{F}{2} - \frac{M_A}{b} = \frac{F}{2} - \frac{X}{b} \\ V_A &= \frac{F}{2} + \frac{M_A}{b} = \frac{F}{2} + \frac{X}{b} \\ RV &= RV(q, X) \end{aligned}$$

nel rispetto dello equilibrio

RV isobianca

det. del solo equil.

$\sum F_x = 0 \Rightarrow H_A = 0$

$\sum M_A = 0 \rightarrow V_C b + M_A - q \frac{b^2}{2} = 0 \rightarrow$

$\sum M_C = 0 \Rightarrow -V_A b + M_A + q \frac{b^2}{2} = 0 \rightarrow$

il pb. resta staticamente indeterminato in V_A, V_C, M_A

$\sum F_y = 0 \Rightarrow V_A + V_C - F = 0$

combinaz. $V_A + V_C = F$

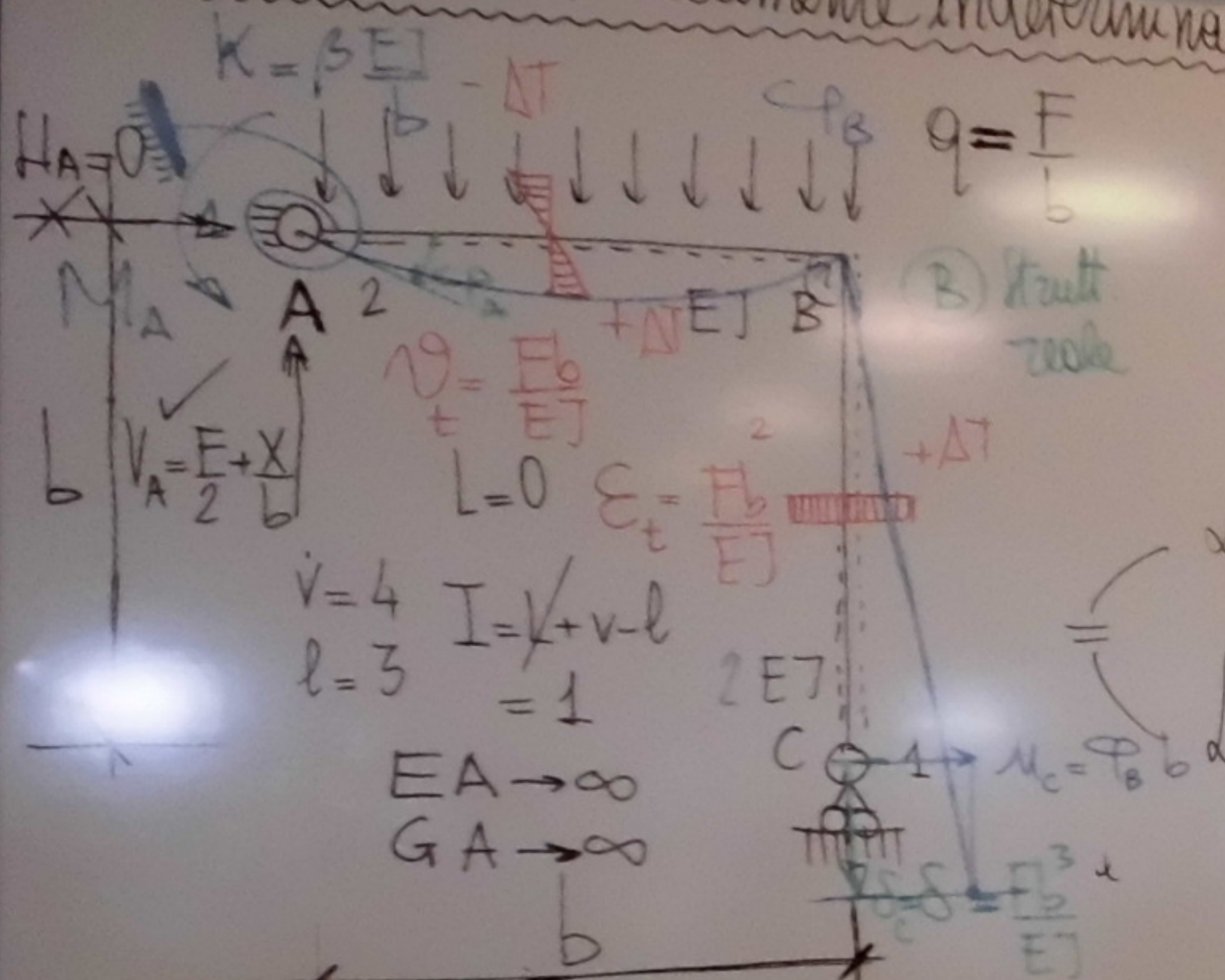
lineare delle reaz.

Il pb. risulta staticamente indeterminato
det. V_A, V_C $\forall$ valore di X , nel rispetto dell' eq. di equil. det. X

e, se pure risulta possibile
 equilibrio, non appare possibile, ed solo
 indizio di compressione
 e di risolvere X

$$P_A = \frac{M_A}{K} - \frac{X}{K}$$

Strutture staticamente indeterminate

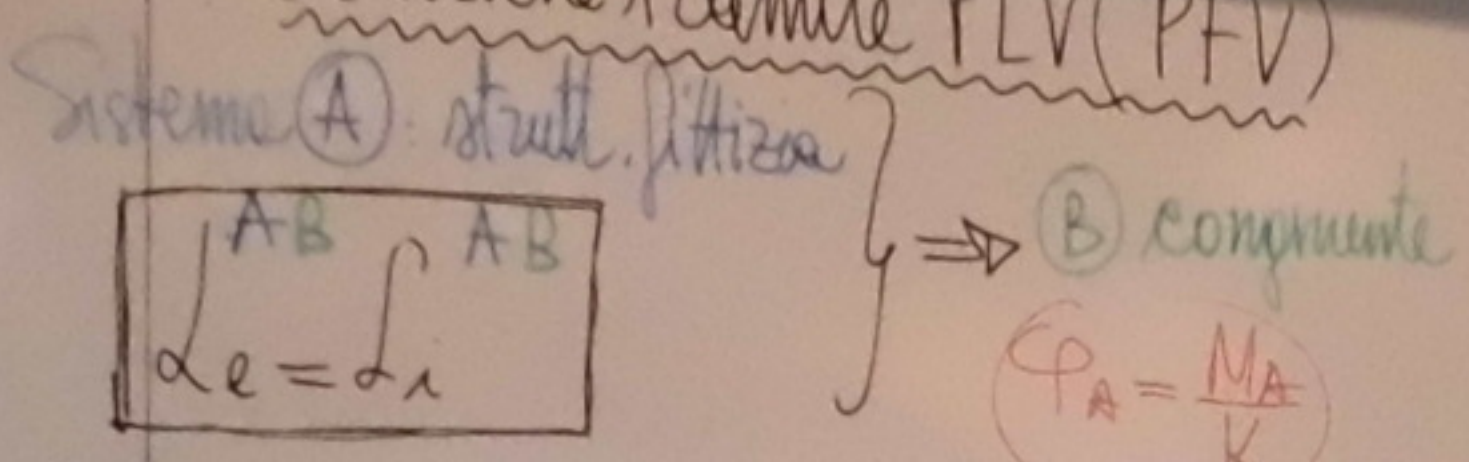


$$RV = RV_0 + X RV^*$$

$$AI = AI_0 + X AI^*$$

$$V_C = \frac{F}{2} - \frac{X}{b}$$

Soluzione tramite PLV (PFV)

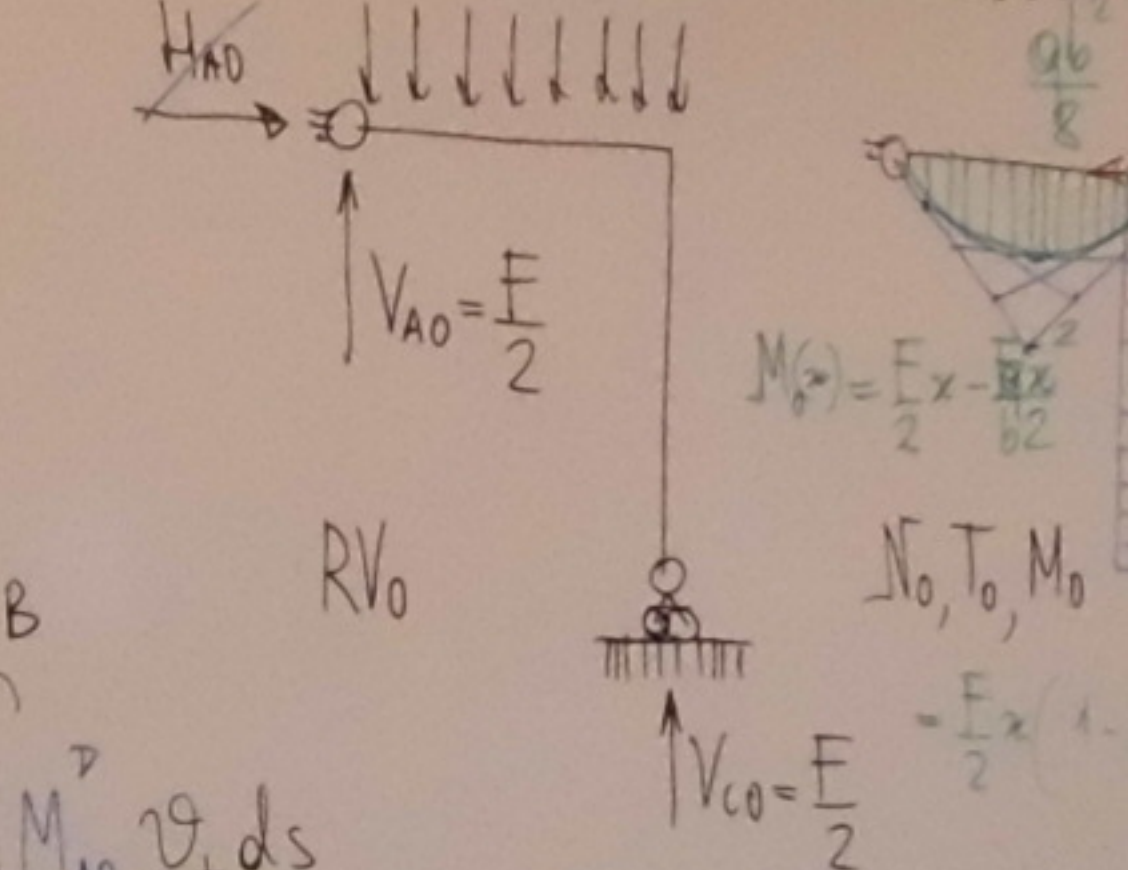


$$\Delta_e = \frac{1}{b} \Delta_A + \left(-\frac{1}{b}\right)(-\delta) + 1 \Delta_B$$

$$\Delta_i = \int_{s_1}^B M^p \frac{M_0 + X M^*}{EI} ds + \int_B^C N_{BC}^p \epsilon_t ds + \int_A^B M_{AB}^p \vartheta_t ds$$

$$X = \frac{\frac{F b^2}{EJ}}{\frac{1}{k} + \int_{s_1}^B \frac{M^p{}^2}{EI} ds + \int_B^C \frac{N_{BC}^p{}^2}{EI} ds + \int_A^B \frac{M_{AB}^p{}^2}{EI} ds}$$

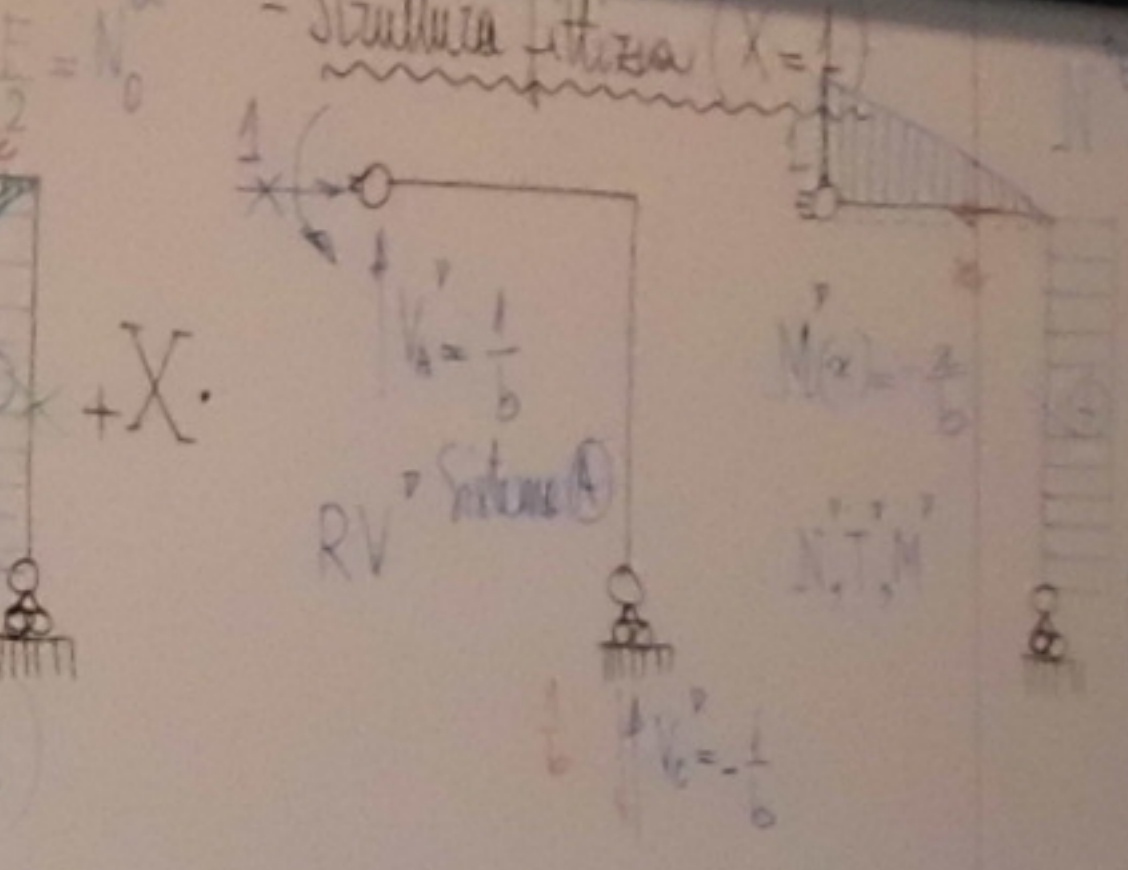
Struttura principale isostatica (X=0)



$$\int_{s_1}^B M^p M_0 ds = -\frac{1}{24} \frac{F b^2}{EJ}$$

$$\int_{s_1}^B M^p{}^2 ds = \int_0^b \frac{x^2}{6} \frac{dx}{EI} = \frac{b^3}{36 EI}$$

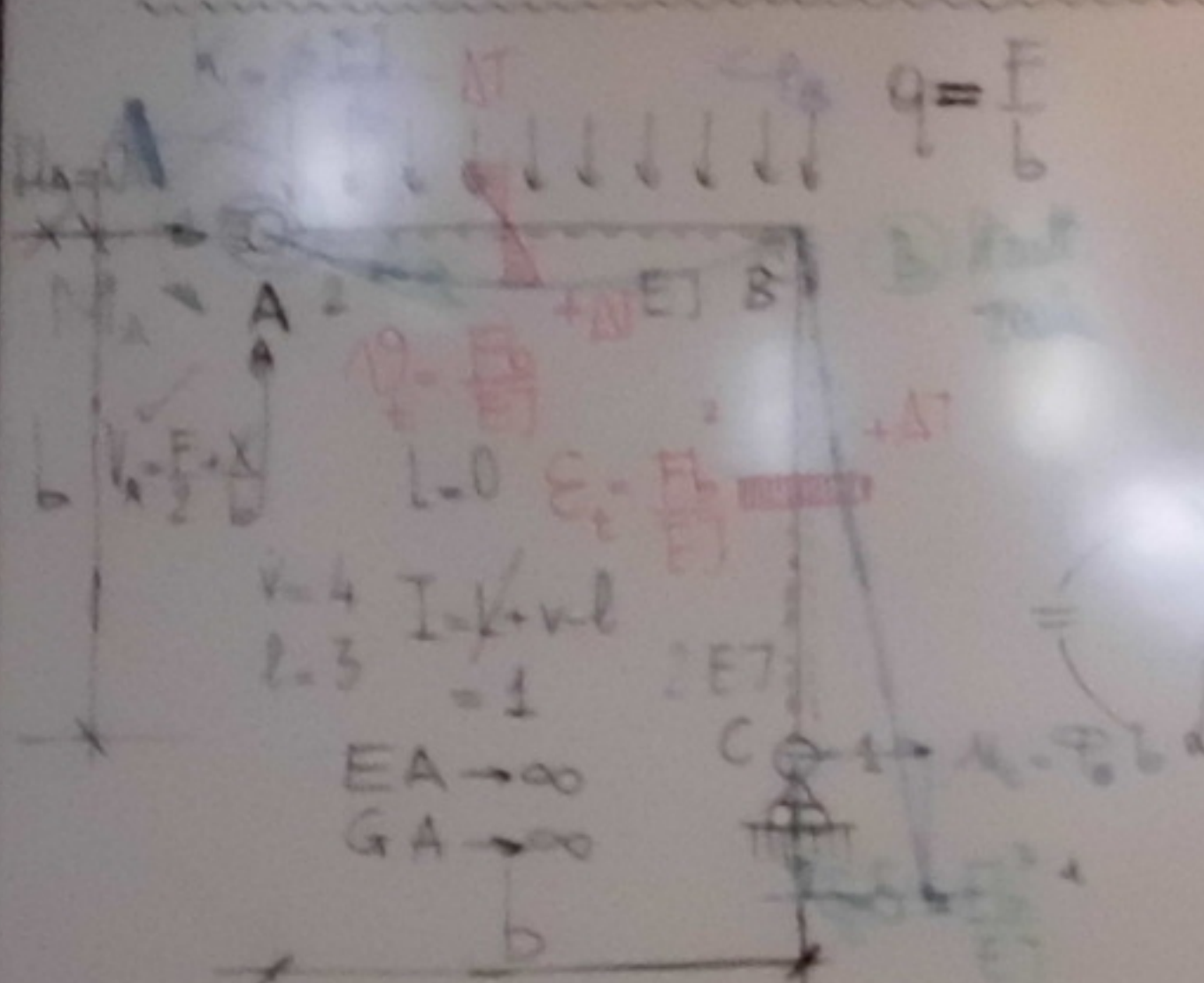
Struttura principale isostatica (X=1)



$$\int_{s_1}^B M^p M_0 ds = -\frac{1}{24} \frac{F b^2}{EJ}$$

$$\int_{s_1}^B M^p{}^2 ds = \int_0^b \frac{x^2}{6} \frac{dx}{EI} = \frac{b^3}{36 EI}$$

Struttura staticamente indeterminata



$$RV = RV_0 + X RV_1$$

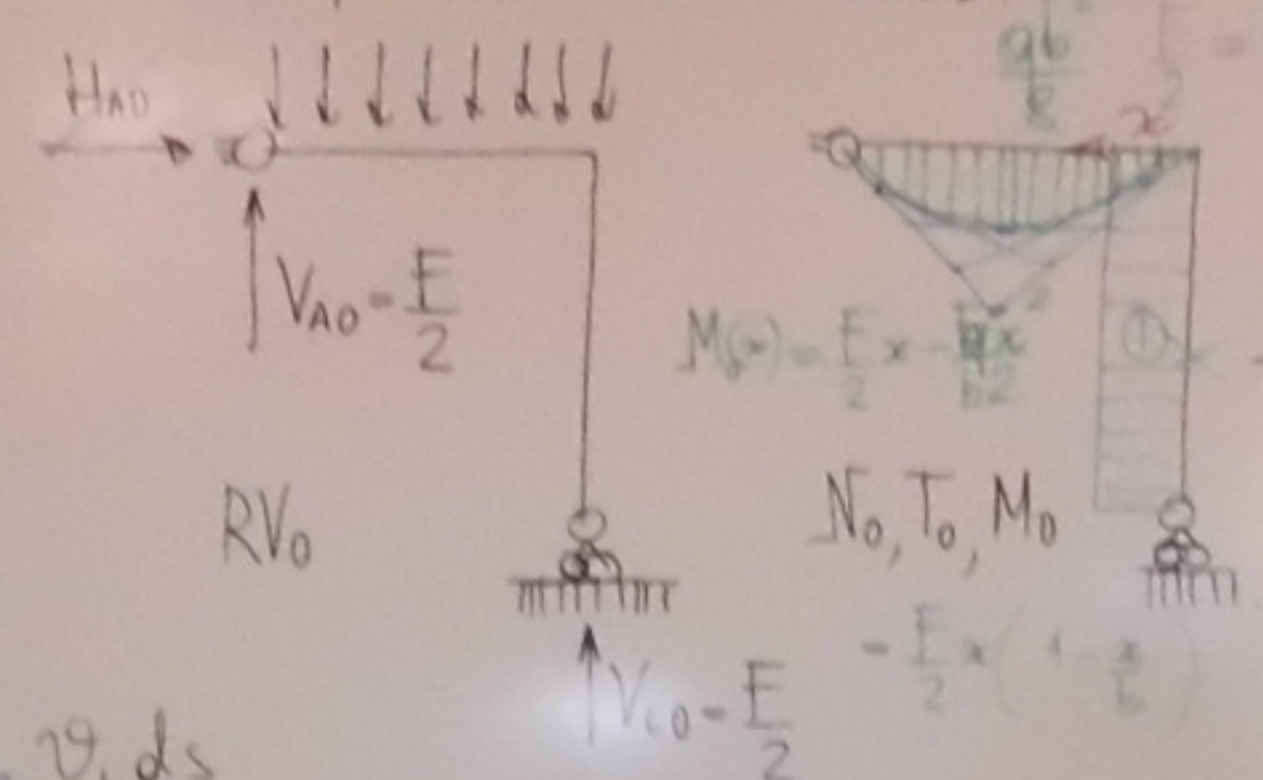
$$AI = AI_0 + X AI_1$$

Soluzione tramite PLV (PFV)

$$X = \frac{\int_{S_0} M^p M_0 ds}{\int_{S_0} M^p ds}$$

$$X = \frac{\int_{S_0} M^p M_0 ds}{\int_{S_0} M^p ds} = \frac{\int_{S_0} M^p M_0 ds}{\int_{S_0} M^p ds}$$

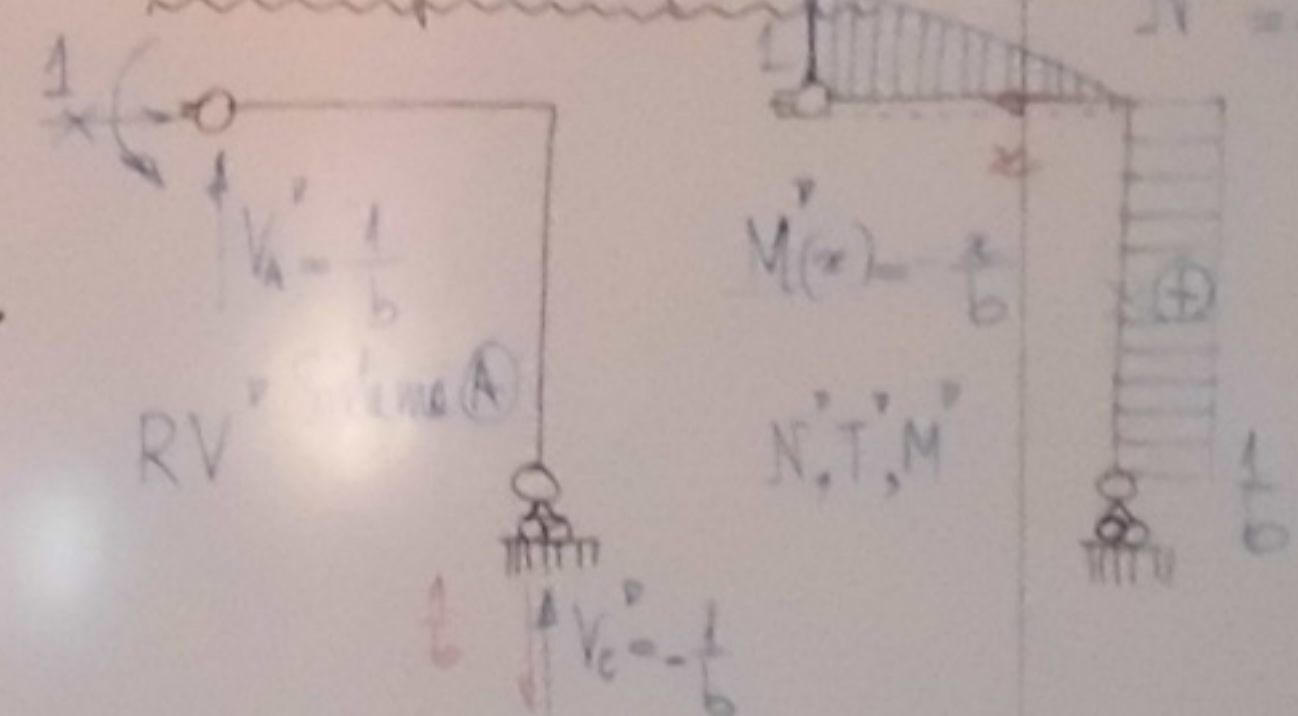
Struttura principale isostatica (X=0)



$$\int_{S_0} M^p M_0 ds = -\frac{1}{24} \frac{F b^2}{E}$$

$$\int_{S_0} M^p ds = \int_0^b \frac{x^2}{2} ds = \frac{b^3}{6}$$

Struttura fittizia (X=1)



$$Fb = \frac{13}{24} \frac{Fb}{3+\beta} Fb = \frac{3}{8} \frac{Fb}{3+\beta} Fb = X$$

$$RV(X) < V_0 - V_0(\beta)$$

$$N, T, M \text{ finali}$$

Struttura principale isostatica ($X=0$)

Diagramma di una trave con carico distribuito $q = \frac{E}{b}$ e reazione $V_{A0} = \frac{E}{2}$.

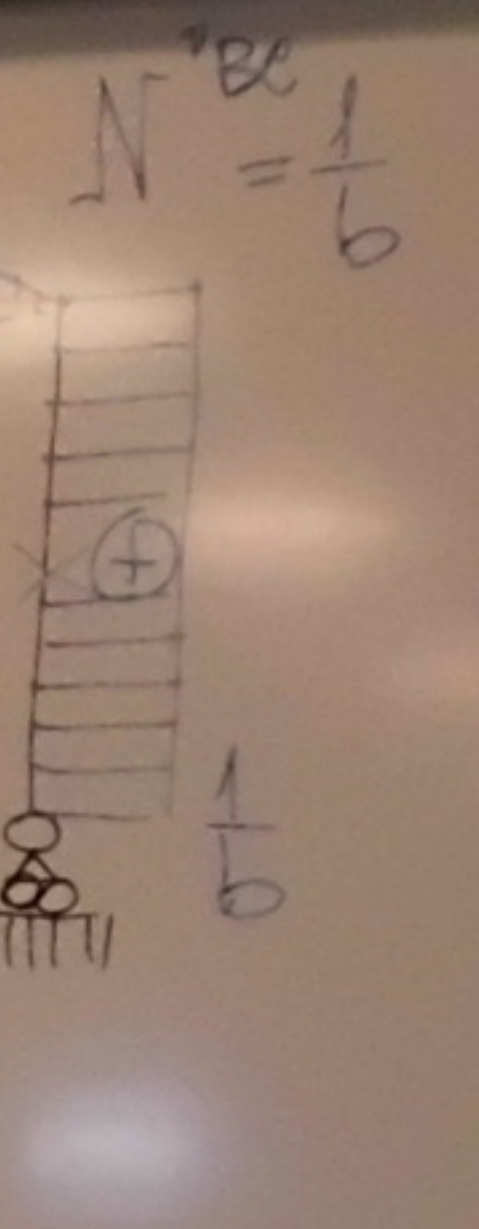
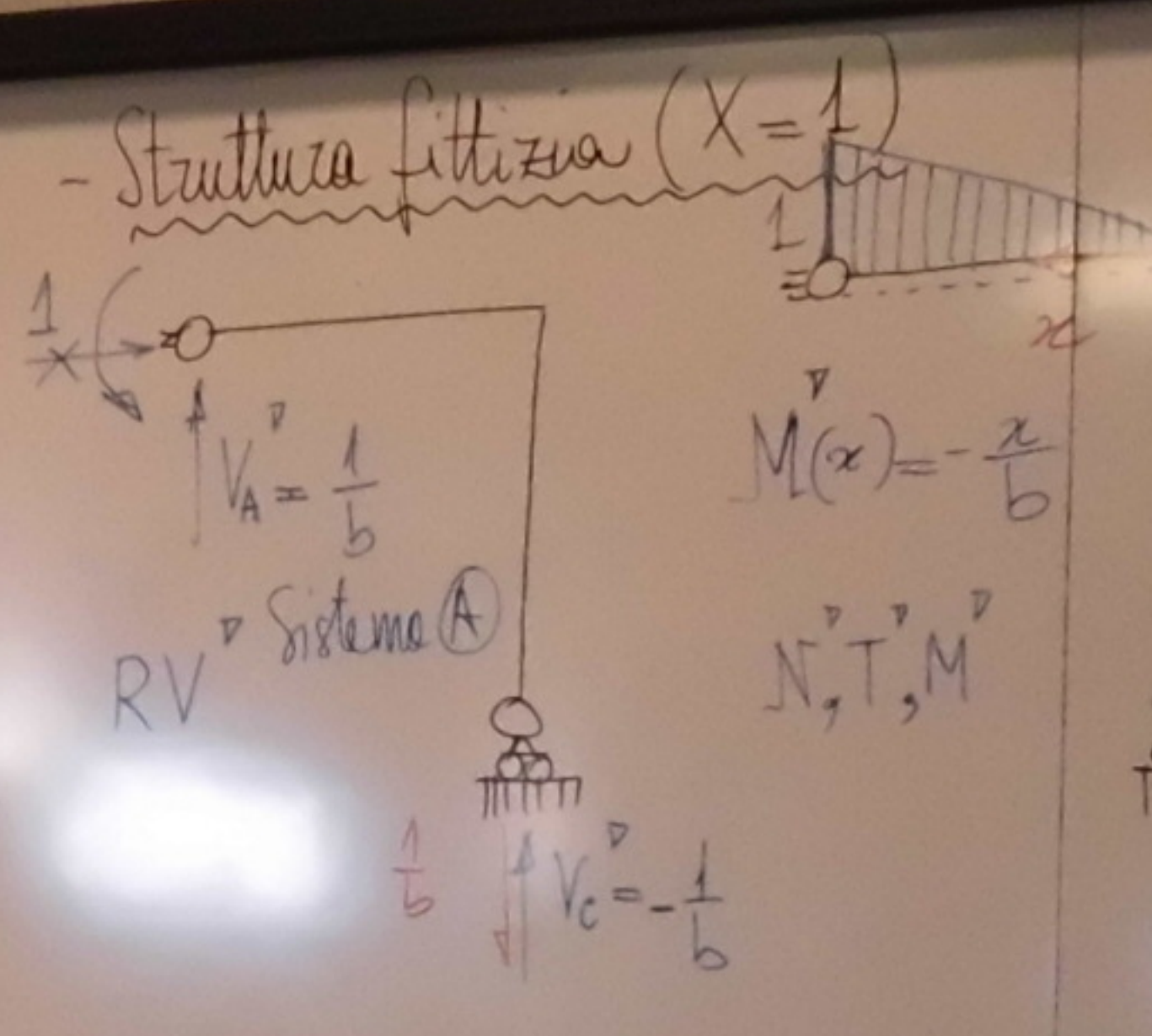
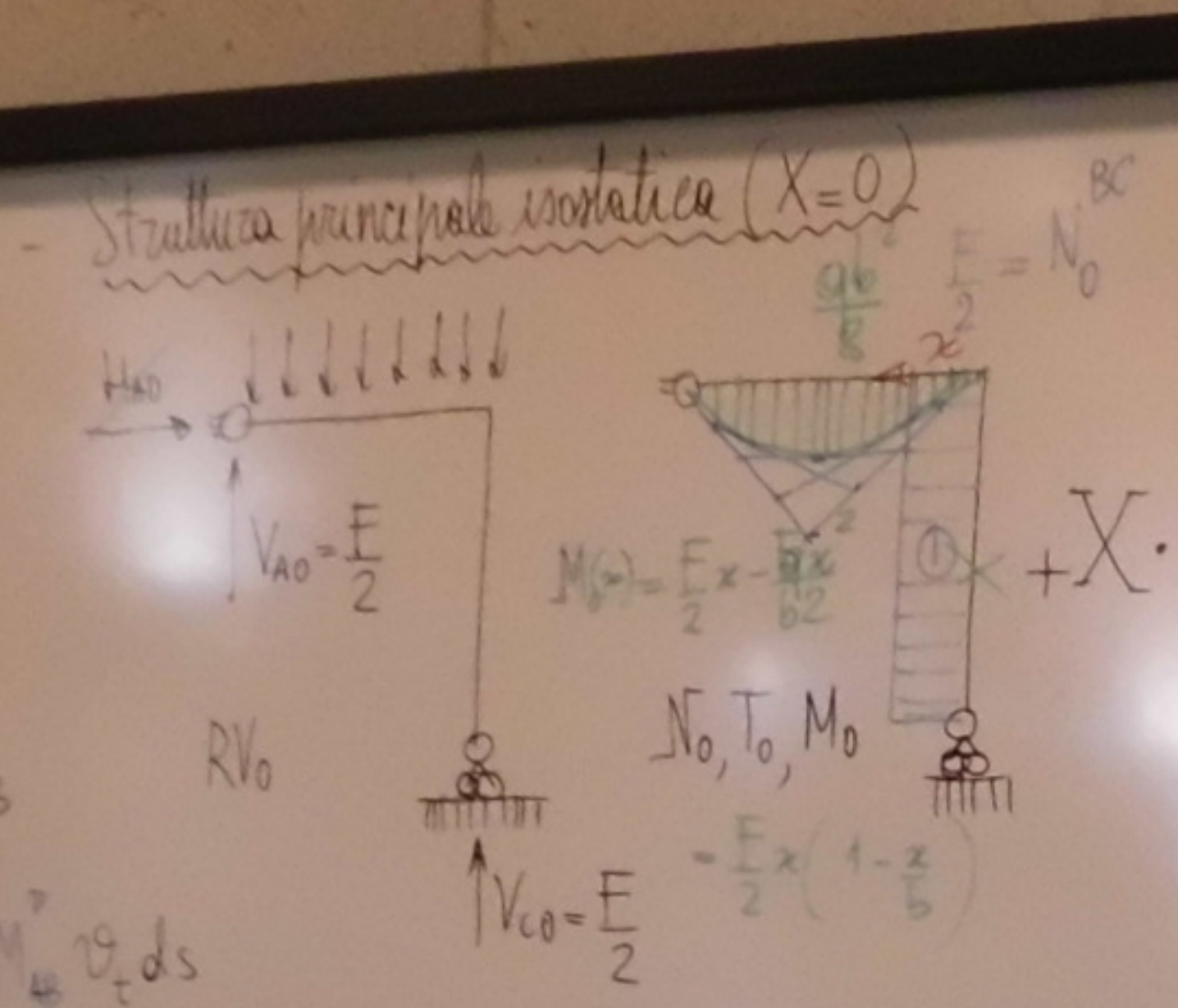
Calcolo di X :

$$X = \frac{\int_A^B M^p M_0 ds}{\int_A^B M^p ds} = \frac{\int_0^b \left(\frac{E}{2}x - \frac{E}{2} \frac{x^2}{b} \right) ds}{\int_0^b \left(\frac{E}{2}x - \frac{E}{2} \frac{x^2}{b} \right) ds}$$

Calcolo di F_b :

$$F_b = \frac{\int_0^b \frac{x^2}{b^2} ds}{\int_0^b \frac{x^2}{b^2} ds} = \frac{\frac{1}{24} + \frac{1}{24}}{\frac{1}{\beta} + \frac{1}{3}} = \frac{13}{24} \frac{\beta}{3+\beta}$$

Calcolo di X :

$$X = \frac{F_b}{\frac{1}{\beta} + \frac{1}{3}} = \frac{\frac{13}{24} \frac{\beta}{3+\beta}}{\frac{1}{\beta} + \frac{1}{3}} = \frac{13}{8} \frac{\beta}{3+\beta}$$


Calcolo di P_B

2 - nuova applicazione del PLV (PFV)

Calcolo di X :

$$X = \frac{\int_A^B M^p M_0 ds}{\int_A^B M^p ds} = \frac{\int_0^b \left(\frac{E}{2}x - \frac{E}{2} \frac{x^2}{b} \right) ds}{\int_0^b \left(\frac{E}{2}x - \frac{E}{2} \frac{x^2}{b} \right) ds}$$

Calcolo di F_b :

$$F_b = \frac{\int_0^b \frac{x^2}{b^2} ds}{\int_0^b \frac{x^2}{b^2} ds} = \frac{\frac{1}{24} + \frac{1}{24}}{\frac{1}{\beta} + \frac{1}{3}} = \frac{13}{24} \frac{\beta}{3+\beta}$$

Calcolo di X :

$$X = \frac{F_b}{\frac{1}{\beta} + \frac{1}{3}} = \frac{\frac{13}{24} \frac{\beta}{3+\beta}}{\frac{1}{\beta} + \frac{1}{3}} = \frac{13}{8} \frac{\beta}{3+\beta}$$

Calcolo di $RV(x)$:

$$RV(x) = V_0 = V_c(\beta)$$

Calcolo di N, T, M finali