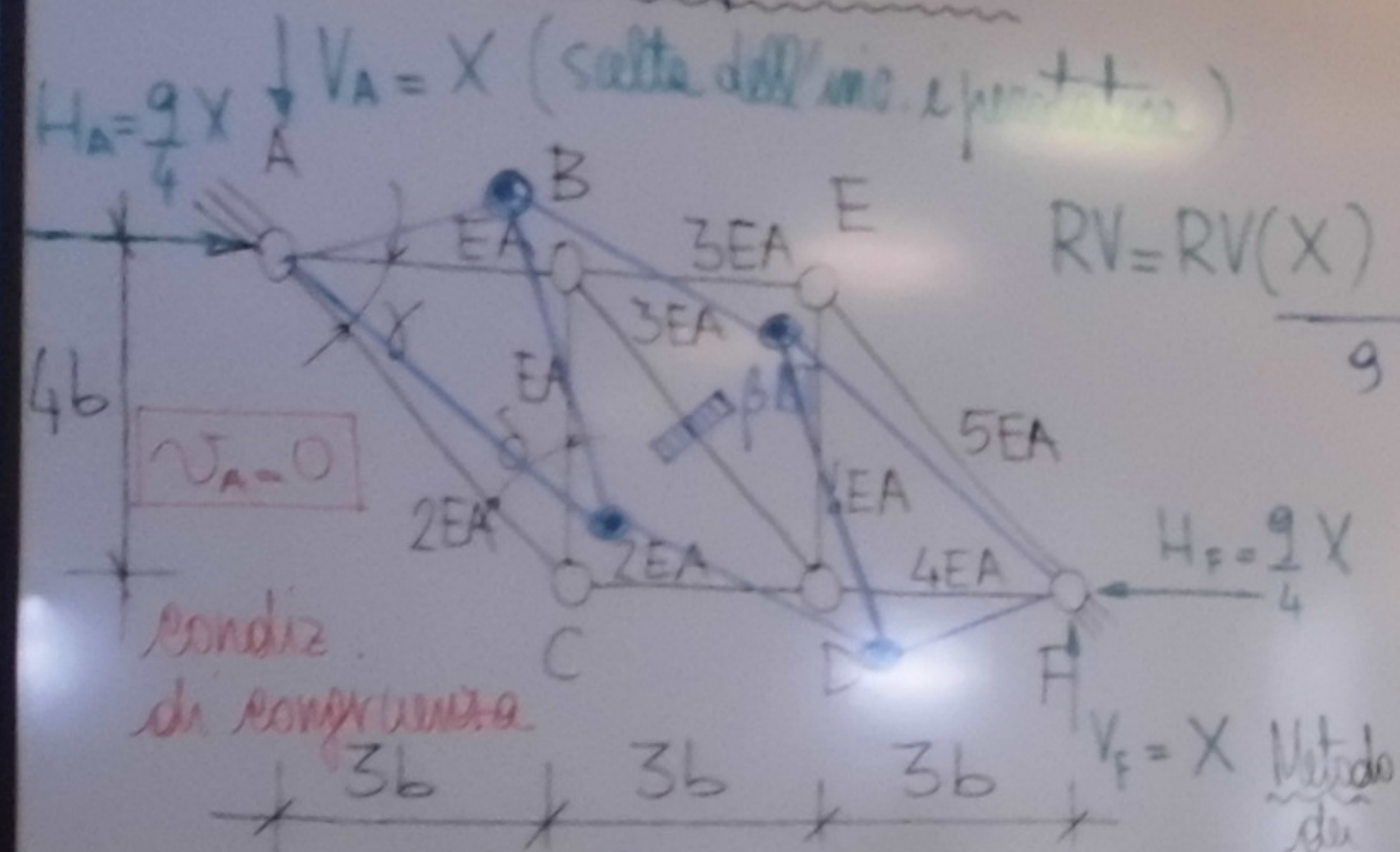


Trav. reticolare iperstatica



Condiz. di congruenza

$d_{AC} = 5b$

$\sin \gamma = \frac{4}{5}, \cos \gamma = \frac{3}{5}, \tan \gamma = \frac{4}{3}$

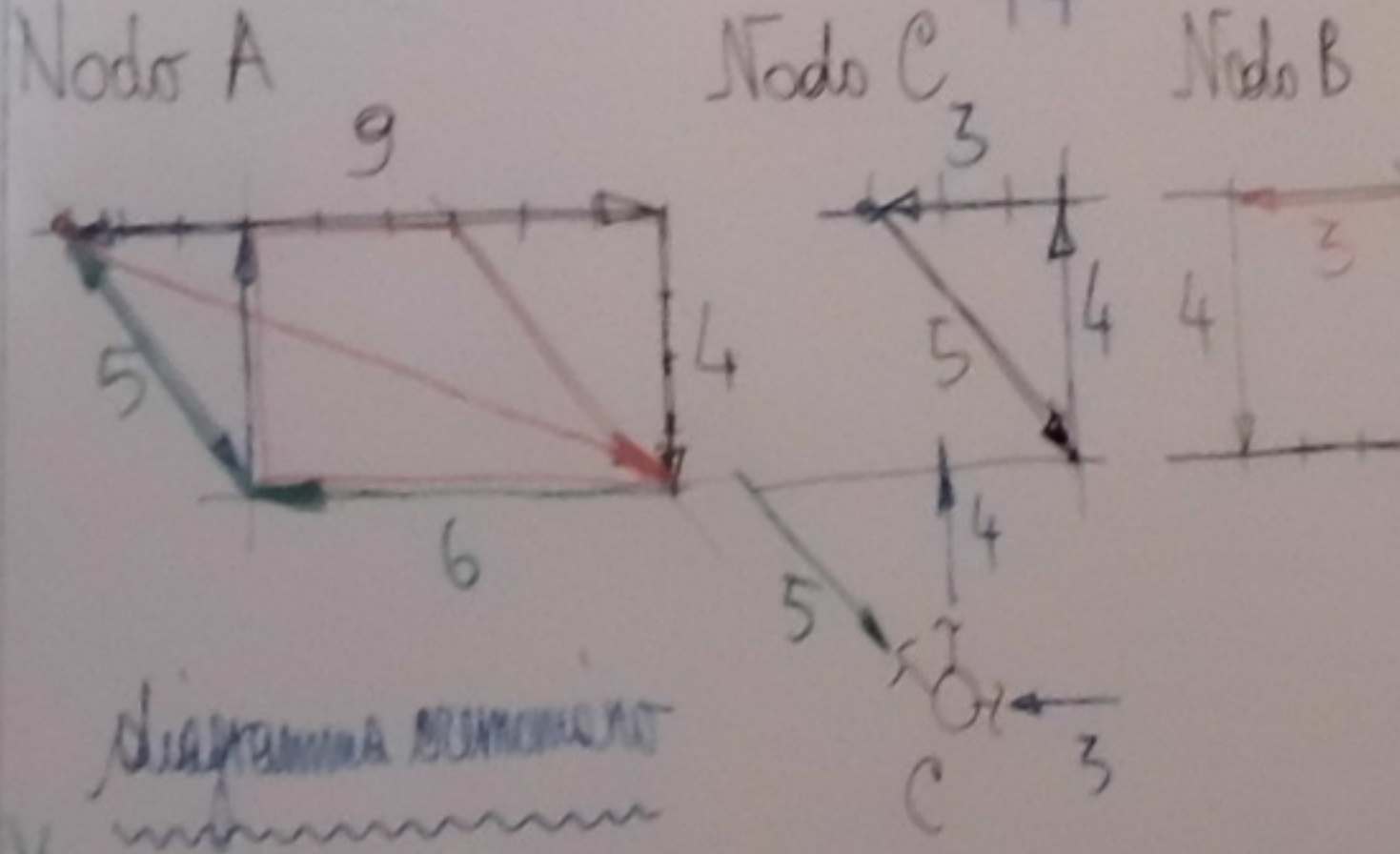
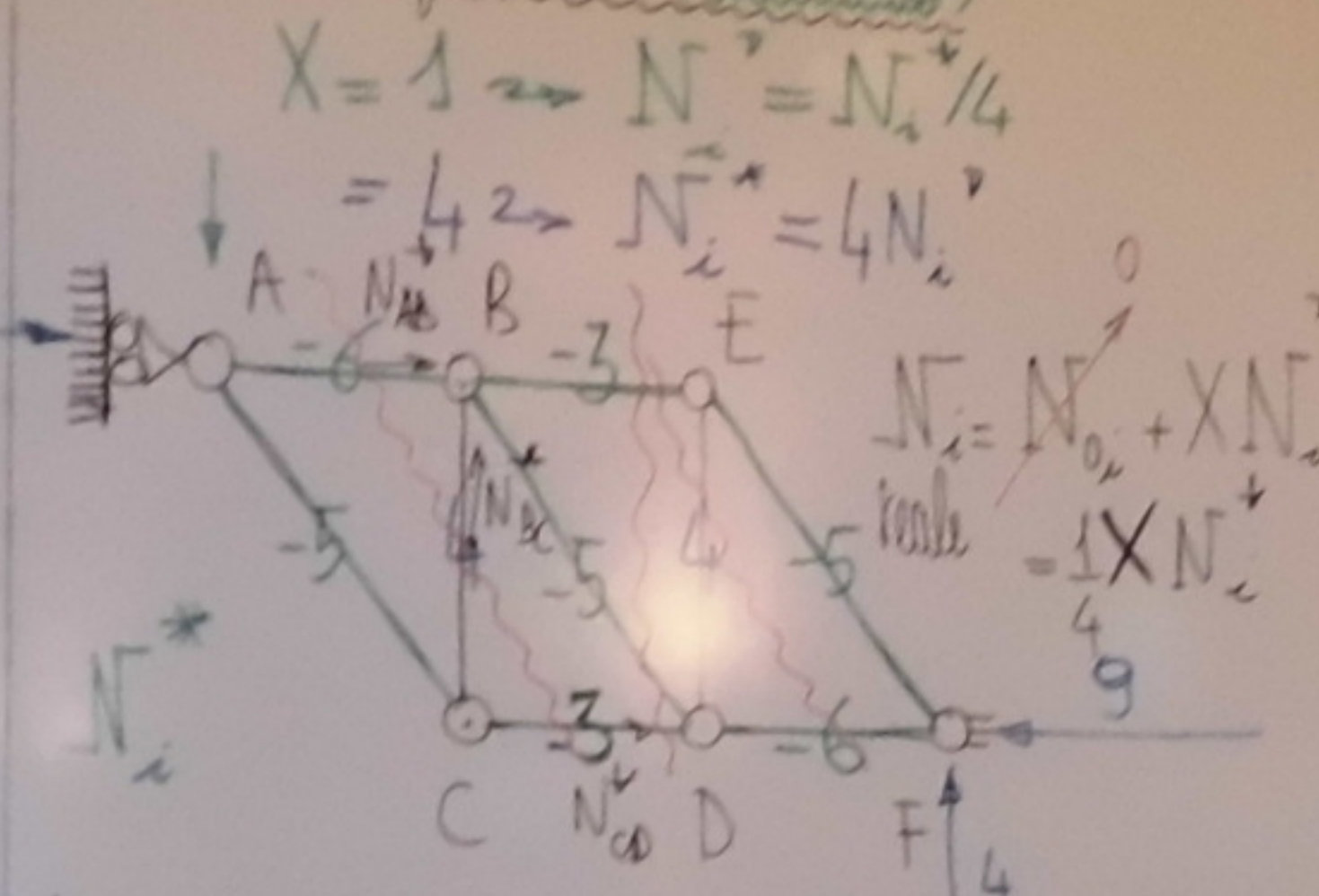
$\sin \delta = \frac{3}{5}, \cos \delta = \frac{4}{5}, \tan \delta = \frac{3}{4}$

$q+v = 9+4 \cdot 13 > 2n = 2 \cdot 6 = 12$

iperstatica (una volta)

Utilizzo di un metodo volto a caratterizzare le deformazioni della trussatura $\Rightarrow$ e.v. di congruenza

Struttura fittizia (Sistema A)



Valore della reazione (Ritter)

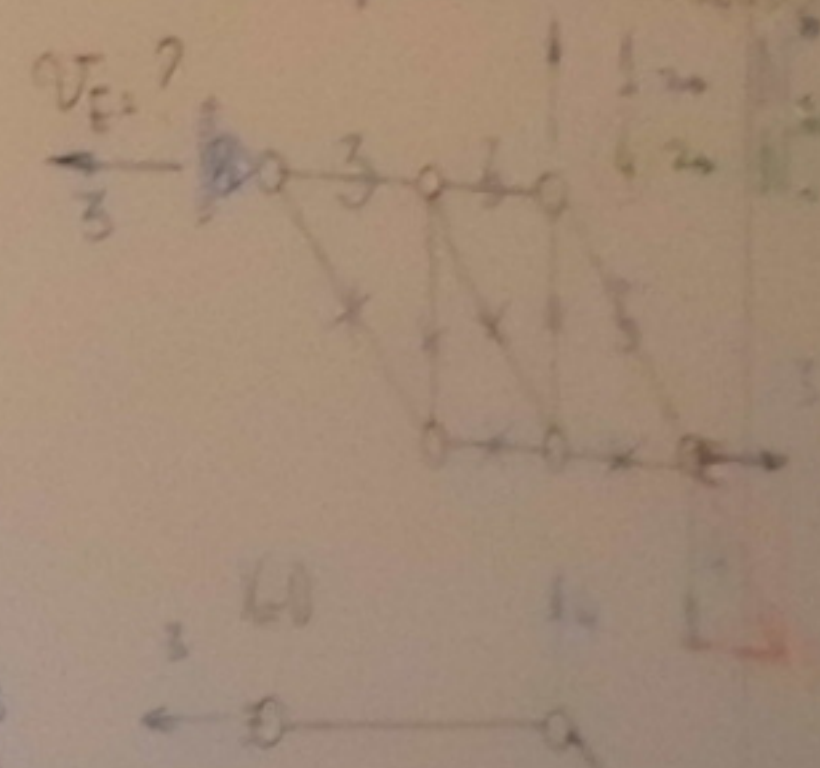
$$\begin{aligned} \sum F_y = 0 &\Rightarrow N_{BC} = 4 \\ \sum M_B = 0 &\Rightarrow N_{CA} = -3 \\ \sum M_C = 0 &\Rightarrow N_{AB} = -6 \end{aligned}$$

Scrittura del PLV (PFV)

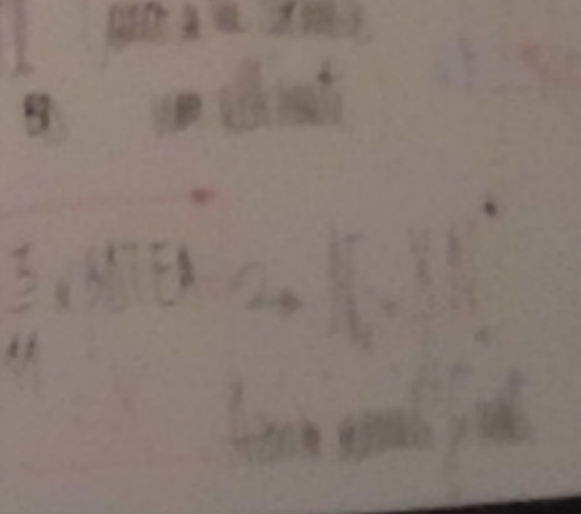
$$\begin{aligned} \delta_{AB} &= 1(-v_A) = \int \frac{N' N_0}{EA} ds + \int \frac{N' \epsilon_0}{\epsilon_0} ds \\ &= \sum \frac{N'_i N_{0i} l_i}{EA_i} + X \sum \frac{N'_i l_i}{EA_i} + N'_i \delta_{0i} \end{aligned}$$

$$X = - \frac{\sum \frac{N'_i N_{0i} l_i}{EA_i} + N'_i \delta_{0i}}{\sum \frac{N'_i l_i}{EA_i}}$$

Calcolo dei spostamenti nodali



Struttura applicata



Trav. reticolare iperstatica

$V_A = X$ (sola incognita)



$EA = 5b$
 $l_1 = 0, l_2 = 1, l_3 = 1, l_4 = 1$
 $q = 4, v = 9 + 4 + 3 = 2, b = 12$
 $q = 4, v = 9, b = 12$

Utilizzo di un metodo scelto a
 scelta per la determinazione della
 trave, con il di conseguenza (PLV)

Struttura fittizia (Sistema A)

$$X = 1 \Rightarrow N_i^* = N_i / 4$$

$$= 4 \Rightarrow N_i^* = 4 N_i$$

$$N_i = N_{0i} + X N_i^*$$

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Metodo delle sezioni (Ritter)

$$\sum F_y = 0 \Rightarrow N_{BC} = 4$$

$$\sum M_B = 0 \Rightarrow N_{CD} = -3$$

$$\sum M_C = 0 \Rightarrow N_{AB} = -6$$

$$N_i = N_{0i} + X N_i^*$$

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$$N_i = N_{0i} + X N_i^*$$

Scrittura del PLV (PFV)

$$\alpha_i = 1 (-v_A) = \int N_i^* N_{0i} + X N_i^* ds + \int N_i^* \epsilon_i ds$$

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Calcolo di spostamenti nodali (PLV)

$$v_E = ?$$

$$v_E = ?$$

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$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

$$v_E = ?$$

Scrittura del PLV

$$1 v_E = \sum N_i^* N_{0i} + X N_i^* l_i$$

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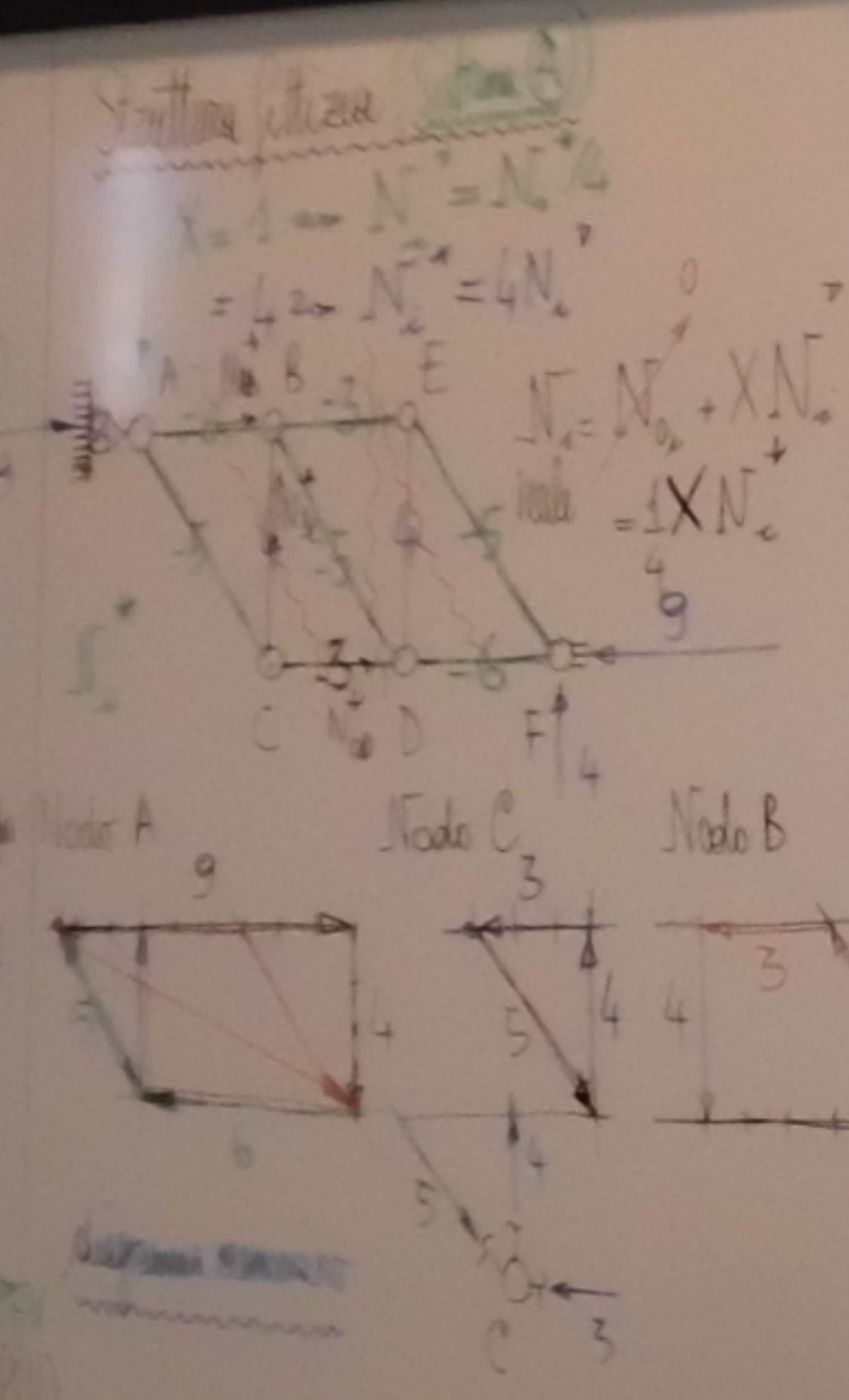
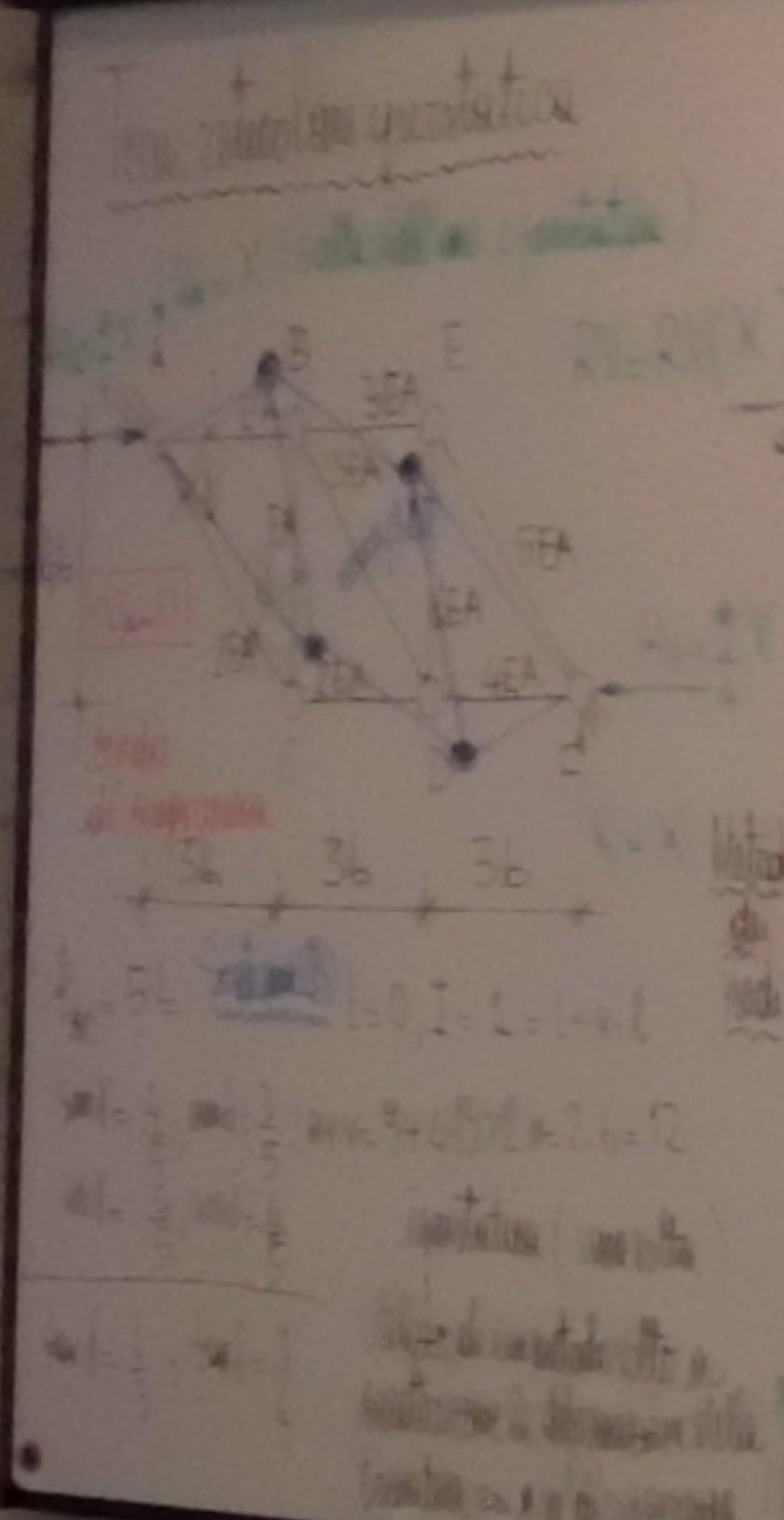
$$1 v_E = \sum N_i^* N_{0i} + X N_i^* l_i$$

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Metodo delle sezioni (Ritter)

$$\begin{aligned} \sum F_y = 0 &\Rightarrow N_{BC} = 4 \\ \sum M_B = 0 &\Rightarrow N_{CD} = -3 \\ \sum M_C = 0 &\Rightarrow N_{AB} = -6 \end{aligned}$$

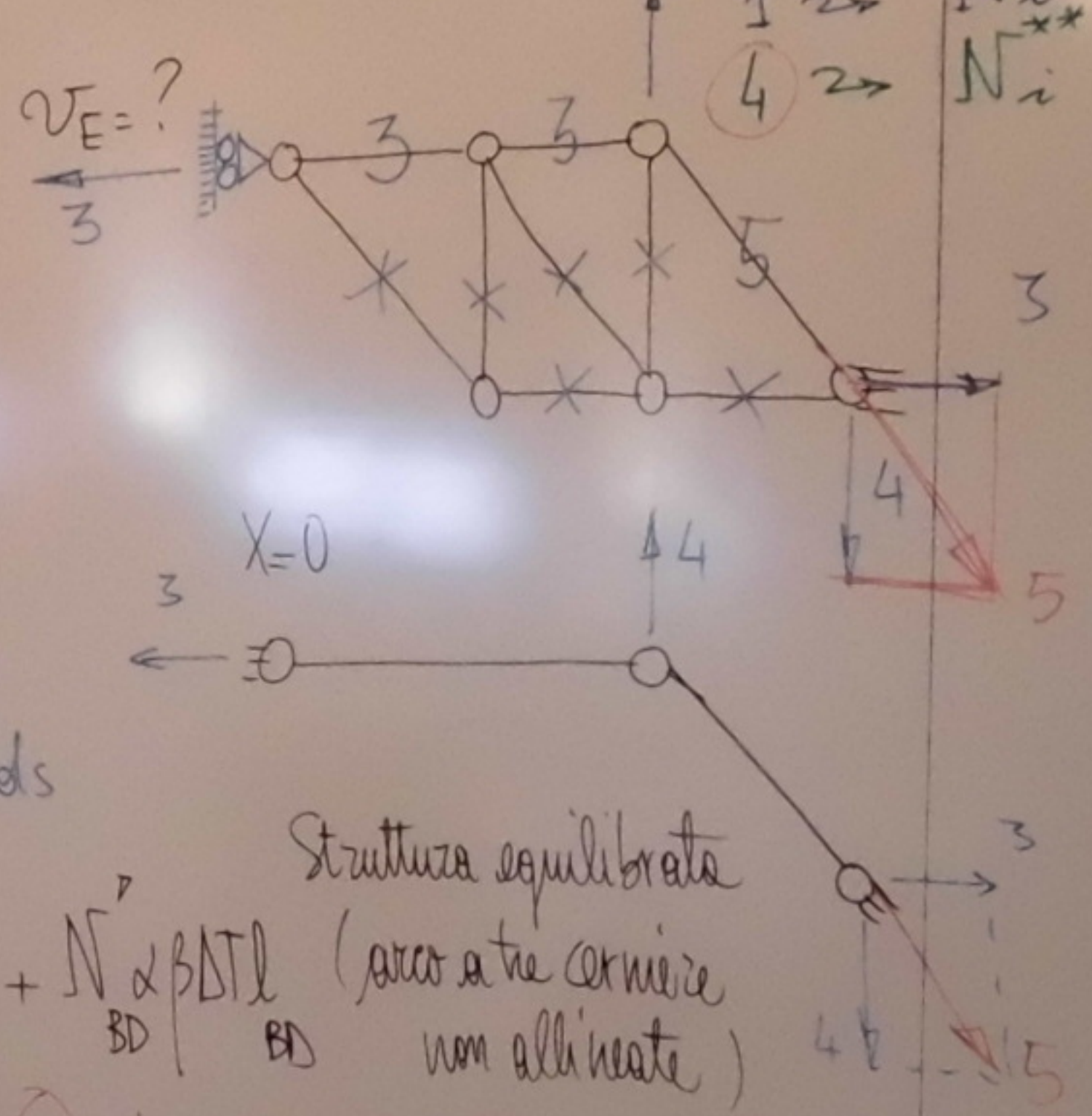
Scrittura del PLV (PFV)

$$\Delta \epsilon = 1 \left(\frac{\sigma}{E} \right) = \int \frac{N}{EA} \frac{N_0 + X N_1}{EA} ds + \int \frac{N}{EA} \epsilon_t ds$$

$$= \sum \frac{N_i N_{0i} l_i}{EA_i} + X \sum \frac{N_i^2 l_i}{EA_i} + N_{BD} \alpha \beta \Delta T l_{BD}$$

$$X = - \frac{\sum \frac{N_i N_{0i} l_i}{EA_i} + N_{BD} \alpha \beta \Delta T l_{BD}}{\sum \frac{N_i^2 l_i}{EA_i}} = - \frac{3}{11} \alpha \beta \Delta T EA = - \frac{3}{11} \alpha \beta \Delta T$$

Calcolo di spostamenti nodali (PLV)



Struttura equilibrata (per a tre cerniere non allineate)

Scrittura del PLV

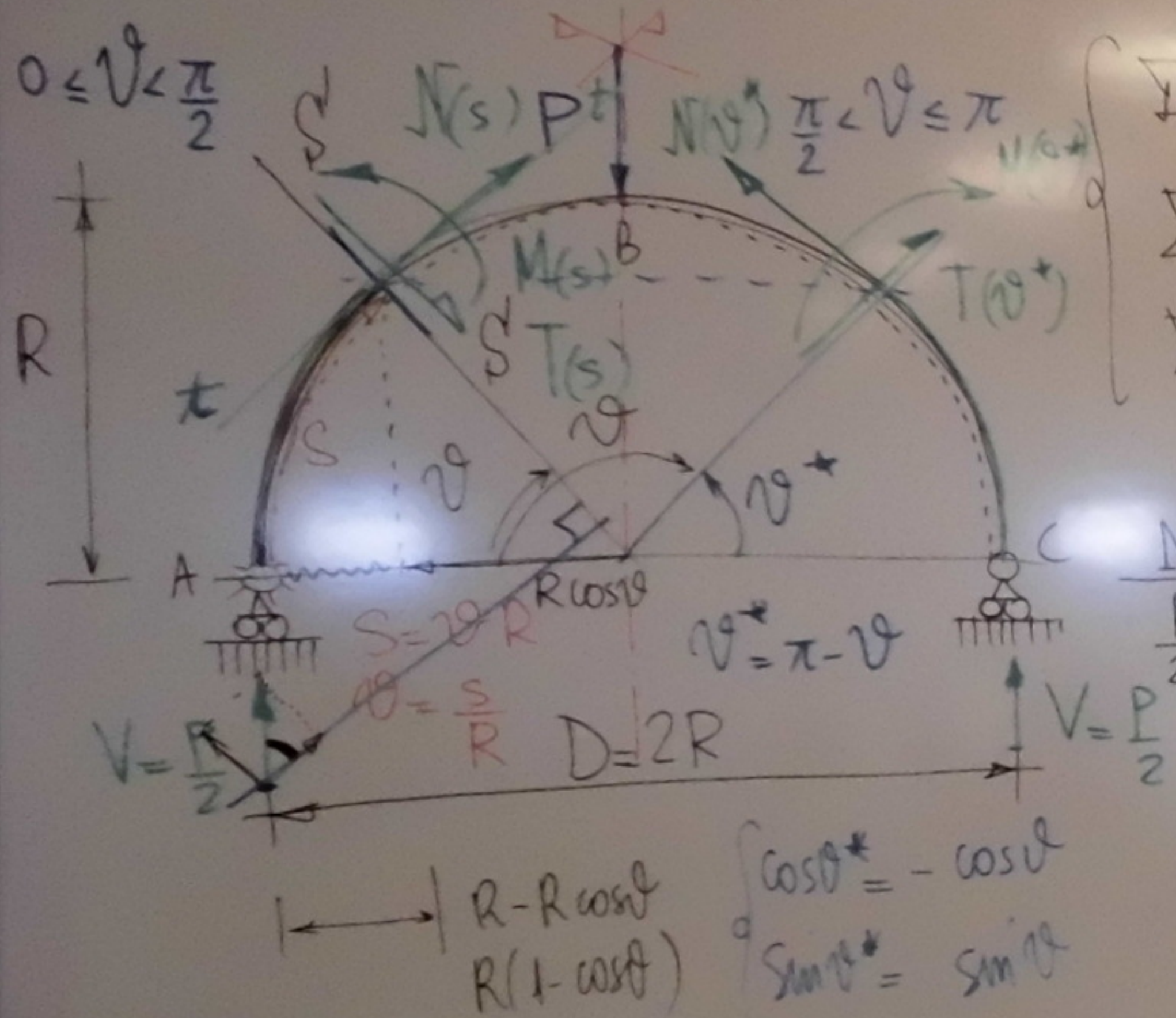
$$\begin{aligned} 1 v_E &= \sum_i N_i \frac{N_{0i} + X N_{1i} l_i}{EA_i} + \sum_i N_i \epsilon_{ti} l_i \\ &= \sum_i \frac{N_i X N_{1i} l_i}{EA_i} \\ &= - \frac{3}{2} \alpha \beta \Delta T b \end{aligned}$$

$$\begin{aligned} v_D &= ? \text{ (PLV), oppure } v_E = v_D + \Delta l_{ED} \\ v_D &= v_E - \frac{N_{ED} l_{ED}}{EA_{ED}} = - \frac{39}{22} \alpha \beta \Delta T \beta \end{aligned}$$

2 Deformata elastica

$$u_B = \Delta l_{AB} = \frac{N_{AB} l_{AB}}{EA_{AB}}$$

Azioni interne in arco curvo (circolare)



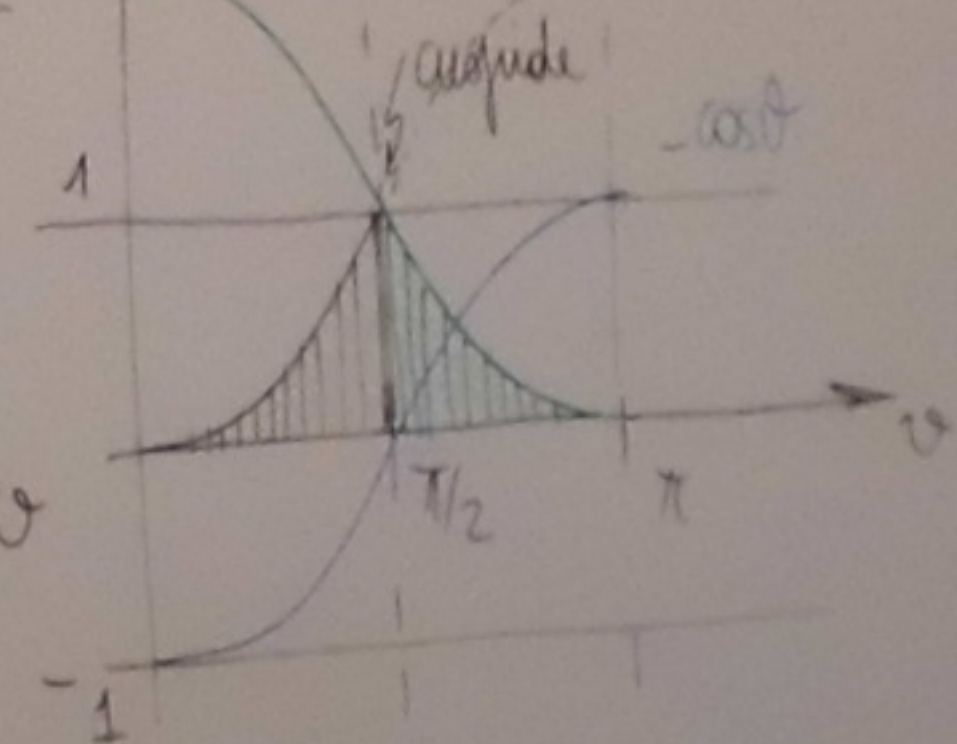
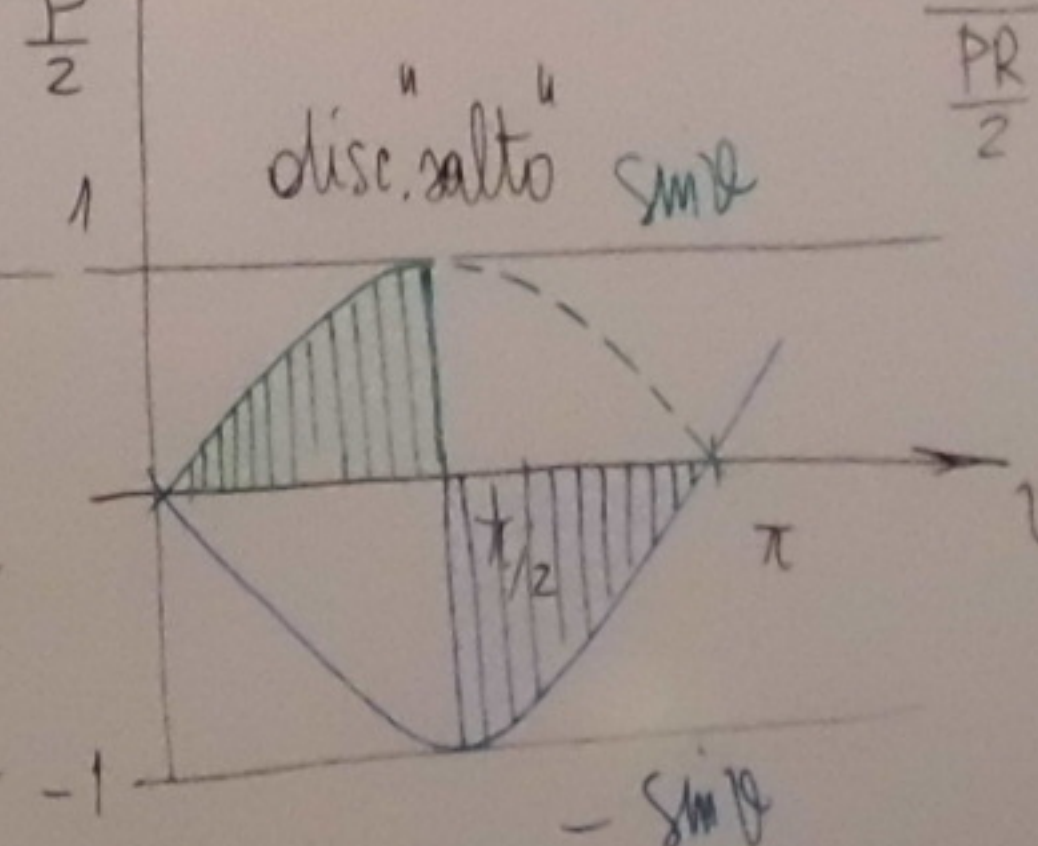
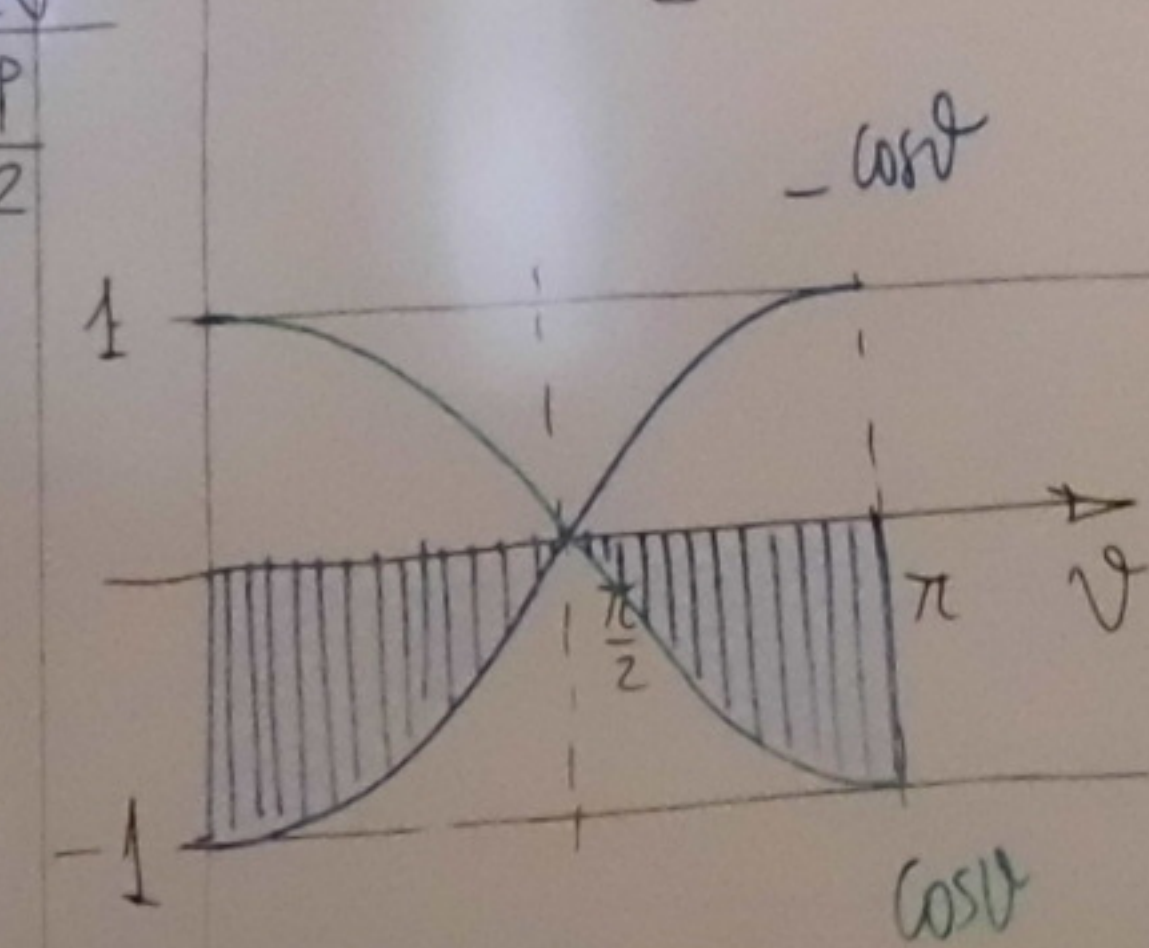
Equil. $AI = AI(\theta)$

$$\sum F_t = 0 \Rightarrow N(s) = -\frac{P}{2} \cos \theta ; \bullet N(\theta) = T(\theta)$$

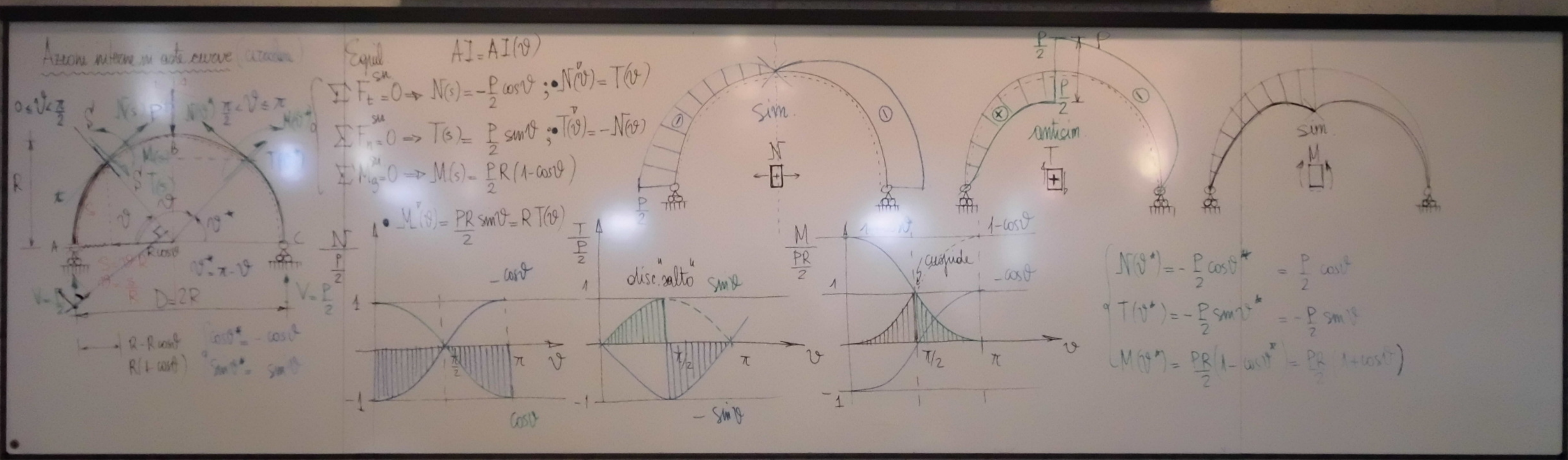
$$\sum F_n = 0 \Rightarrow T(s) = \frac{P}{2} \sin \theta ; \bullet T(\theta) = -N(\theta)$$

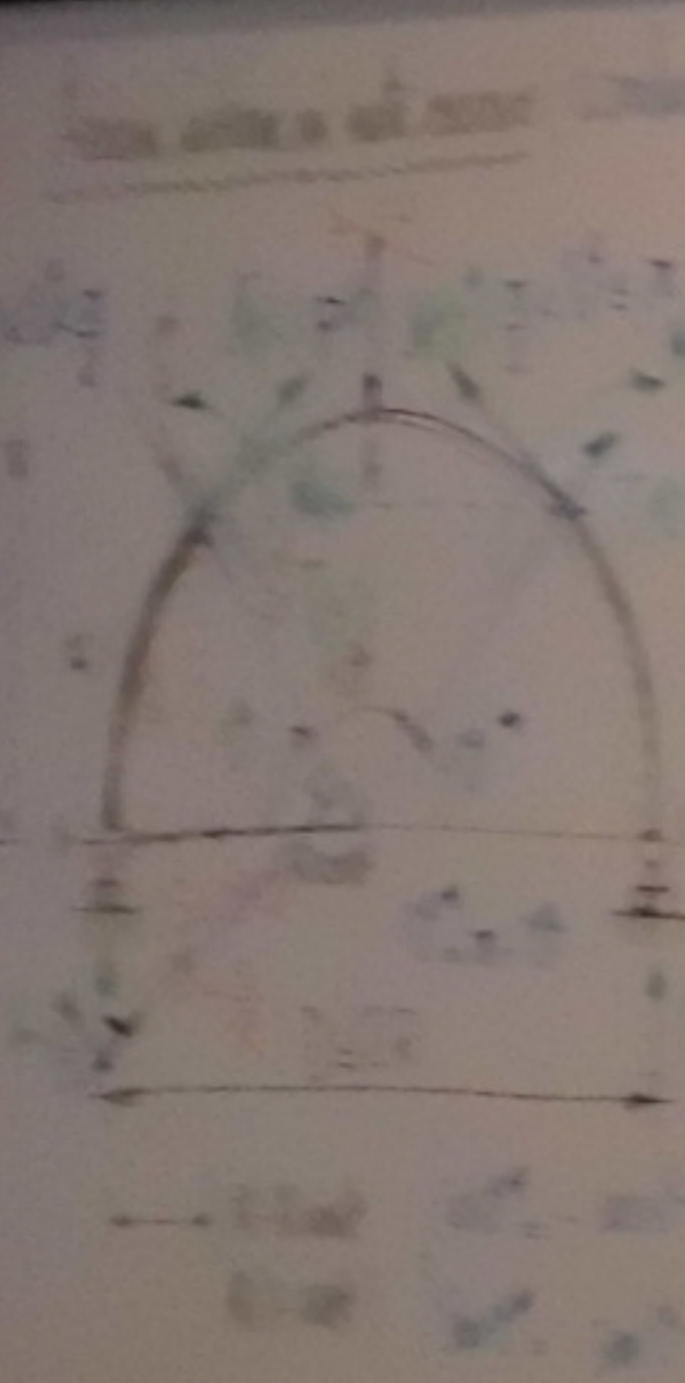
$$\sum M_g = 0 \Rightarrow M(s) = \frac{PR}{2} (1 - \cos \theta)$$

$\bullet M'(\theta) = \frac{PR}{2} \sin \theta = RT(\theta)$

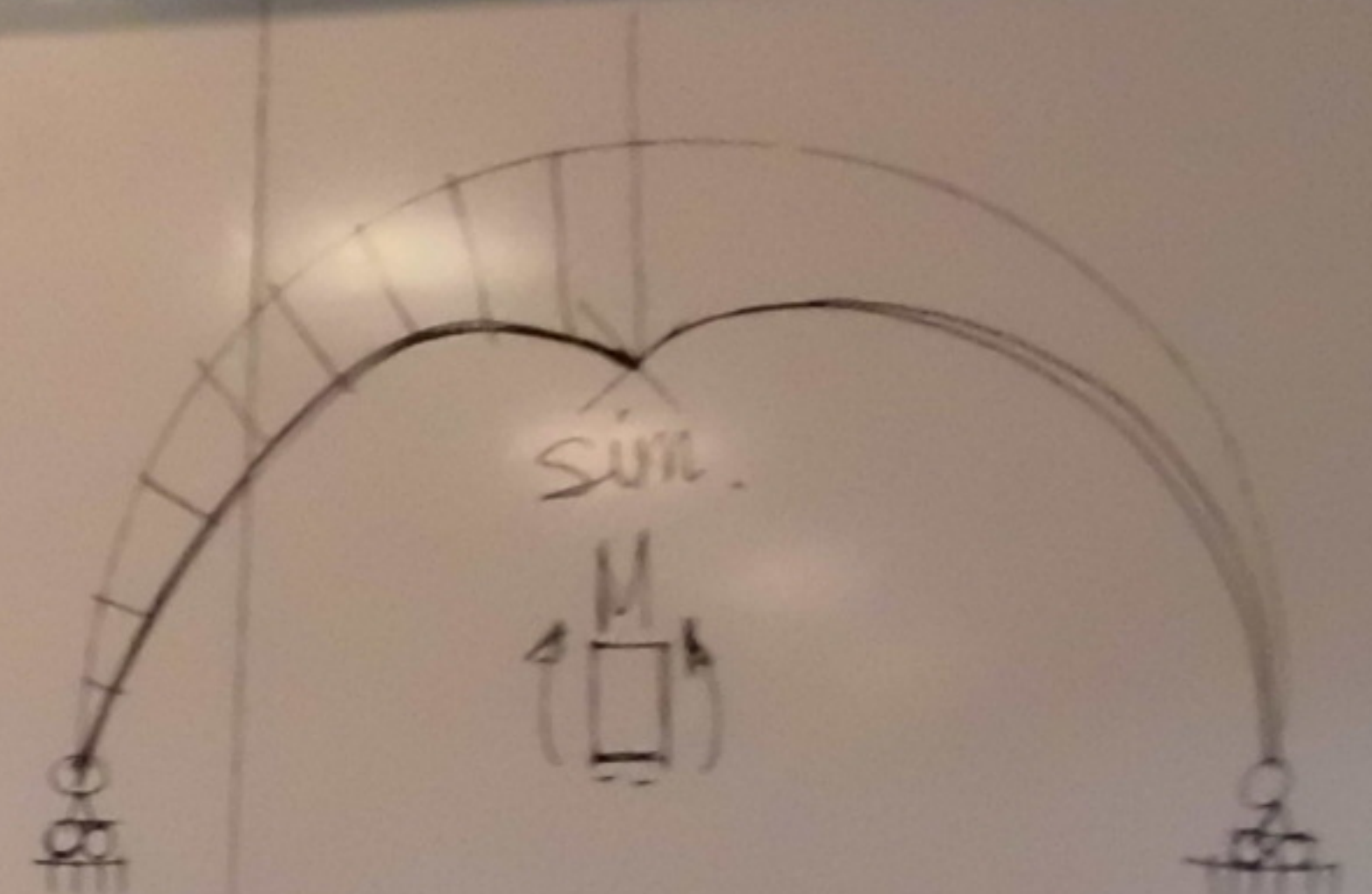
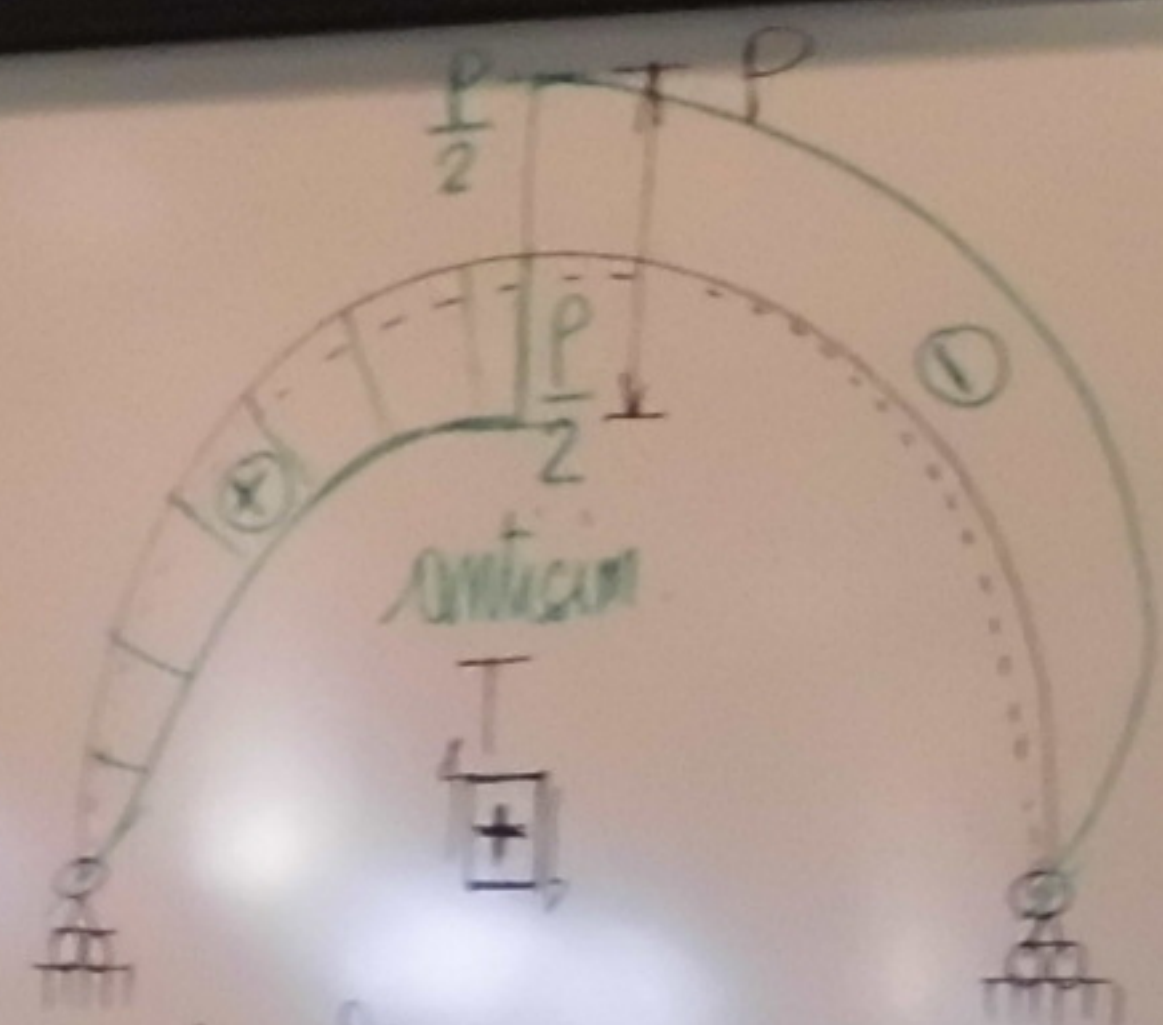
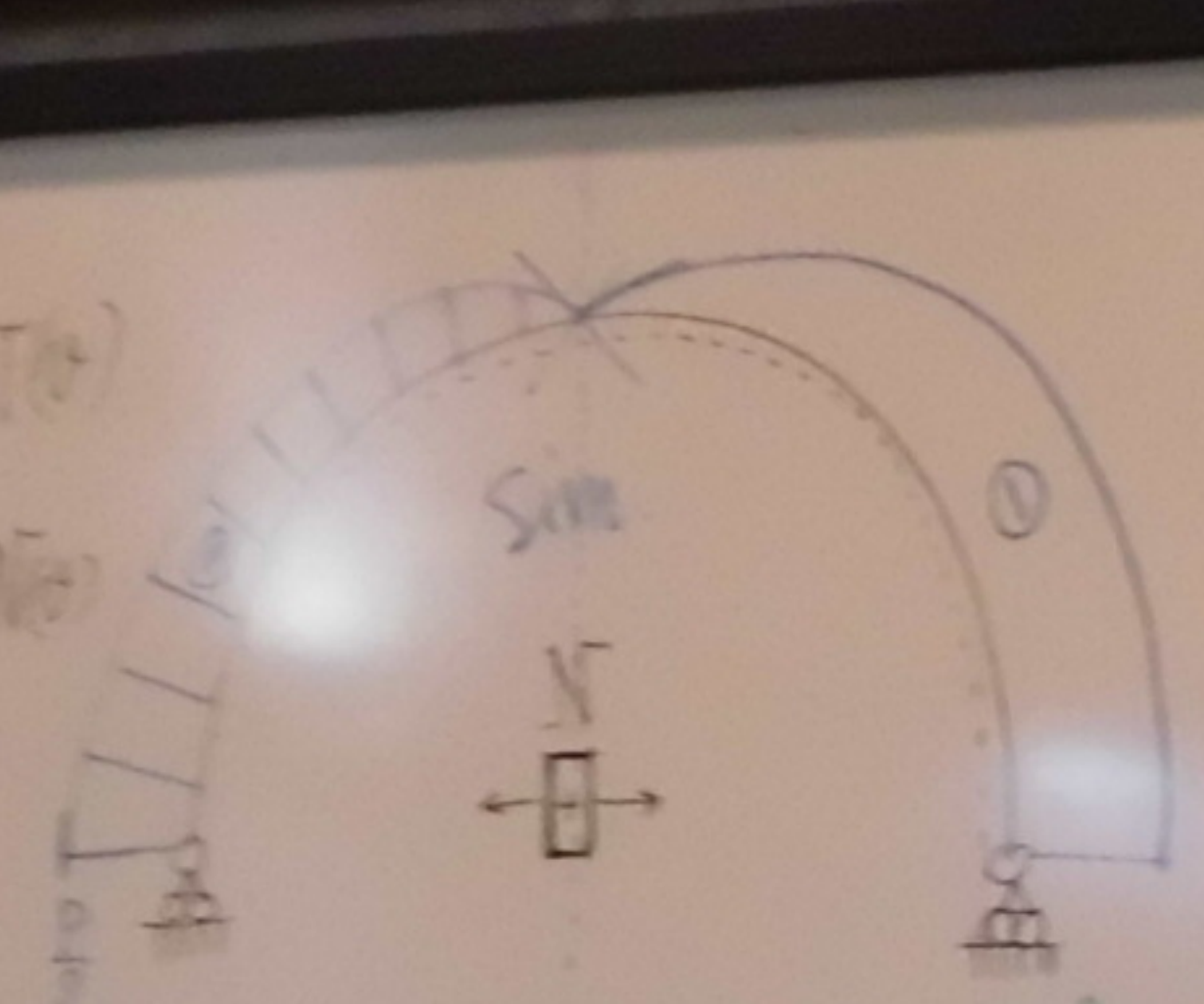
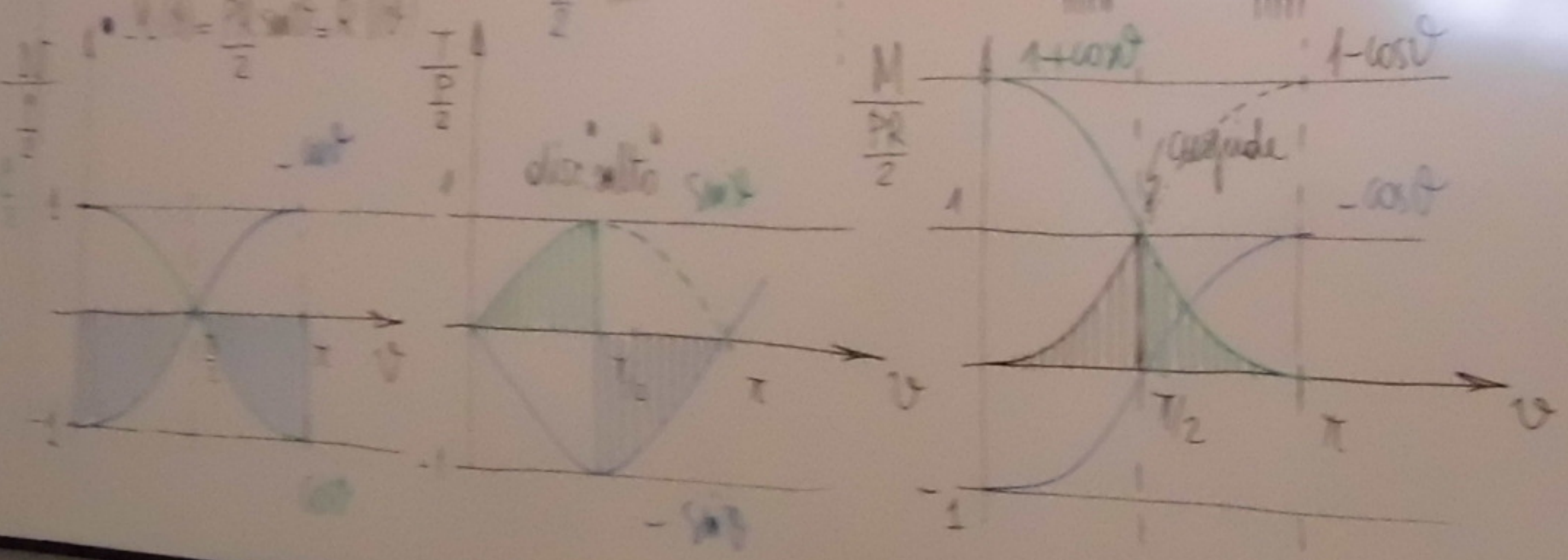


$N(\theta^*) = -\frac{P}{2} \cos \theta^* = -\frac{P}{2} \cos \theta$
 $T(\theta^*) = -\frac{P}{2} \sin \theta^* = -\frac{P}{2} \sin \theta$
 $M(\theta^*) = \frac{PR}{2} (1 - \cos \theta^*) = \frac{PR}{2} (1 - \cos \theta)$





$A_1 = A_2(\theta)$
 $\sum F_x = 0 \Rightarrow N_1 = -\frac{P}{2} \cos \theta^* ; N(\theta^*) = T(\theta)$
 $\sum F_y = 0 \Rightarrow T_1 = \frac{P}{2} \sin \theta^* ; T(\theta^*) = -N_1$
 $\sum M = 0 \Rightarrow M_1 = \frac{PR}{2} (1 - \cos \theta)$
 $M(\theta^*) = \frac{PR}{2} \sin \theta^* = R T(\theta)$



$N(\theta^*) = -\frac{P}{2} \cos \theta^* = \frac{P}{2} \cos \theta$
 $T(\theta^*) = -\frac{P}{2} \sin \theta^* = -\frac{P}{2} \sin \theta$
 $M(\theta^*) = \frac{PR}{2} (1 - \cos \theta^*) = \frac{PR}{2} (1 + \cos \theta)$