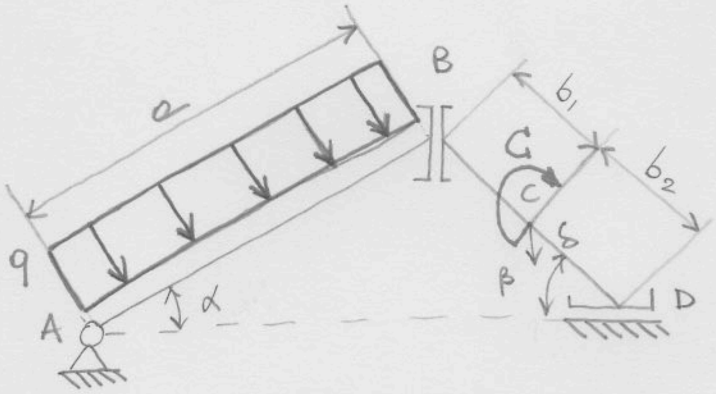
CALCOLO SPOSTAMENTO (TRACCIAMENTO DIAGRAMMI N, T, M SIST. FORZE E SIST. SPOST.)



$a = 1000$

$b_1 = 300$

$b_2 = 300$

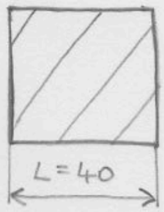
$q = 1\ N/mm$

$C = 2E6\ Nmm$

$E = 200\ GPa$

$G = 80\ GPa$

$\alpha = 30°$



1) calcolo spostamento verticale δ.

2) calcolo sforzi massimi.

NODO	GDV
A	2
B	2
D	2
TOT	6

GDV = GDL = 6

ISOSTATICA

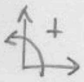
ARCO A 3 CERNIERE

STRUTT. NON LABILE

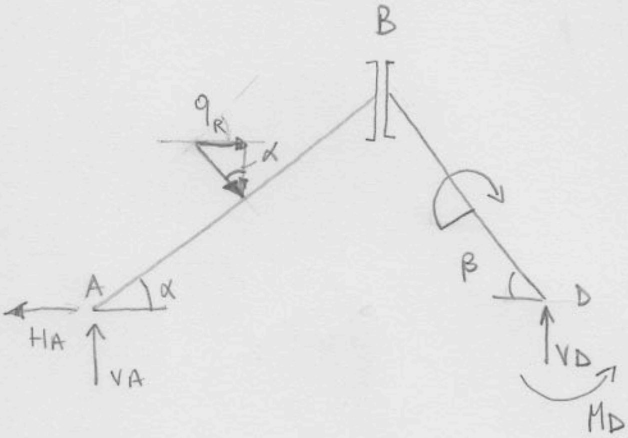
$$\frac{\sin\beta}{a} = \frac{\sin\alpha}{b_1+b_2}$$

$$\beta = a\sin\left(a \cdot \frac{\sin\alpha}{b_1+b_2}\right) = 56.4427°$$

EQUILIBRIO



$q_R = q \cdot a = 1 \cdot 1000 = 1000N$



$V_A + V_D = q_R \cdot C\alpha = 1000 \cdot C\alpha = 866.0254N$

$H_A = q_R \cdot S\alpha = 500\ N$

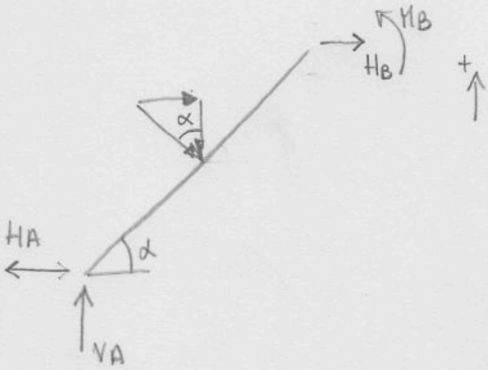
R.S.

$V_D = q_R \cdot C\alpha - V_A = \emptyset$

$\overset{\curvearrowleft}{A})\ -q_R \cdot \frac{a}{2} - C + M_D = \emptyset$

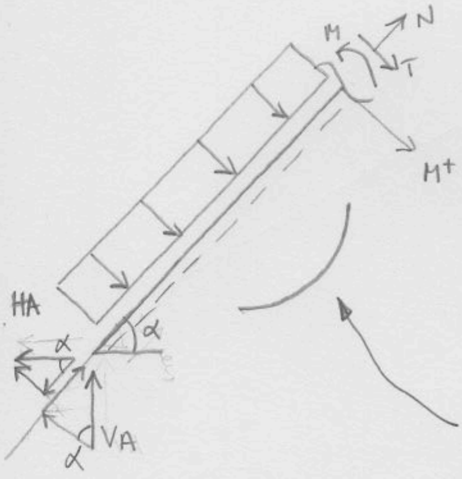
$M_D = q_R \cdot \frac{a}{2} + C = 2\,500'000\ Nmm$

EQ. AB



$\overset{+}{\uparrow}\ V_A = q_R \cdot \cos(\alpha) = 866.0254N$

AB



$0 < \xi < a = 1000$

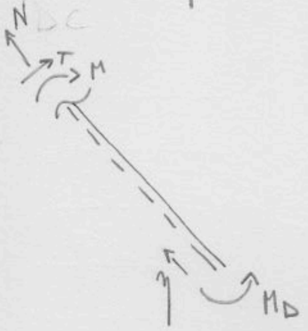
$N_0 = H_A \cdot \cos(\alpha) - V_A \cdot \sin(\alpha) = \emptyset$

$T_0 = H_A \cdot \sin(\alpha) + V_A \cdot \cos(\alpha) - q\,\xi = 1000 - 1\,\xi$ — $T(0) = 1000\ N$; $T(1000) = \emptyset$

$M_0 = (H_A S_\alpha + V_A C_\alpha) \cdot \xi - \dfrac{q\,\xi^2}{2}$ — $M(0) = \emptyset$; $M(1000) = 500'000\ Nmm$

$\dfrac{d^2M}{d\xi^2} = -q < \emptyset$ CONCAVA

DC $\quad 0 < \eta < b_1$

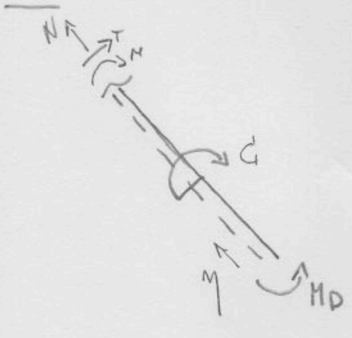


$N_0 = T_\emptyset = \emptyset$

$M_\emptyset = M_D = 2500'000\ Nmm$

CB

$b_1 < \eta < b_2 + b_1$

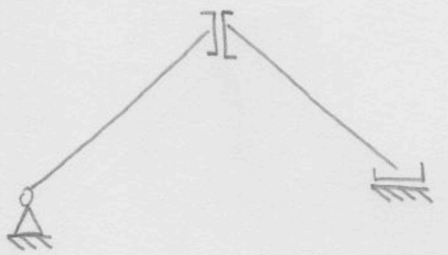


$N_0 = T_\emptyset = \emptyset$

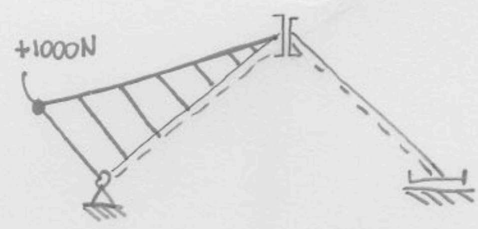
$M_\emptyset = M_D - C = 500'000\ Nmm$

AZIONI INTERNE

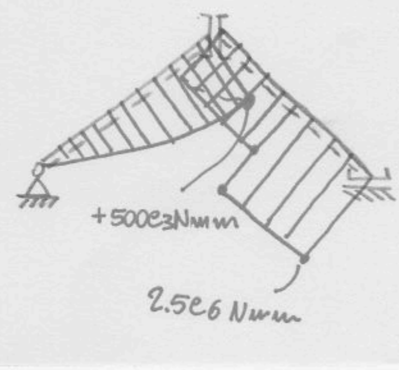
$\boxed{N}$



$\boxed{T}$

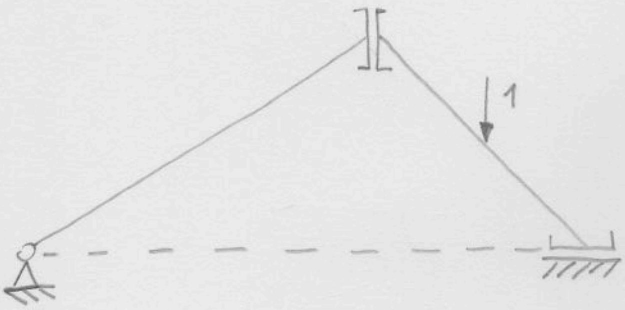


$\boxed{M}$

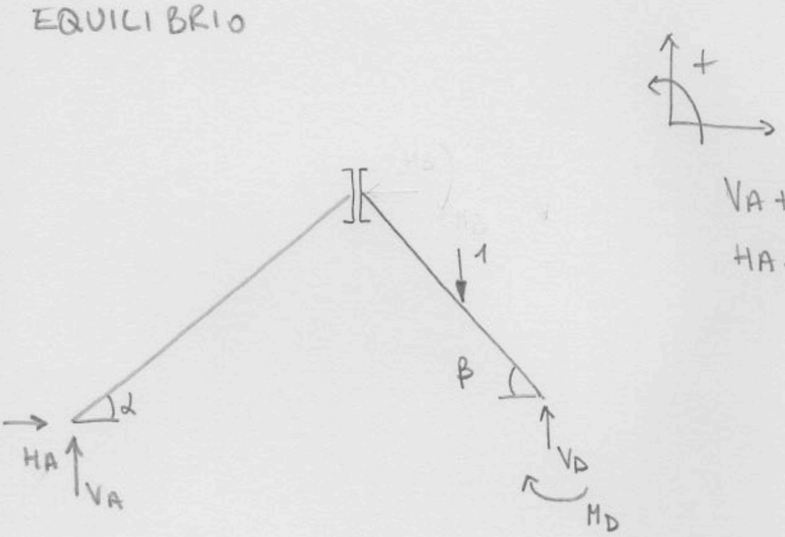


SISTEMA DELLE FORZE (o FITTIZIO) -> poniamo una forza esploratrice unitaria nel punto di cui vogliamo calcolare lo spostamento.

$$\tilde{b} = b_1 + b_2$$

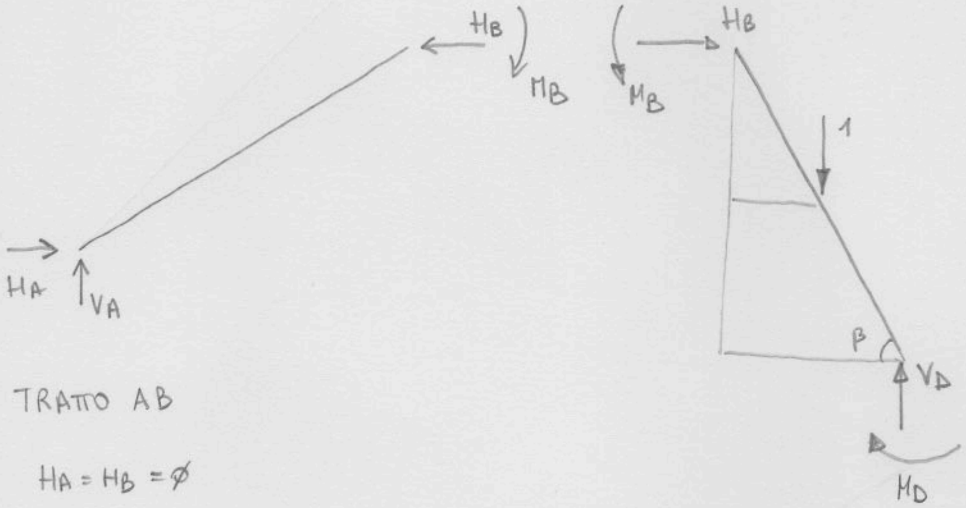


EQUILIBRIO



$$V_A + V_D = 1$$

$$H_A = \emptyset$$



TRATTO D-B

$$V_D = 1 \rightarrow \boxed{V_A = 1 - V_D = \emptyset}$$

$$B) \; -1 \cdot b_2 \cos(\beta) + V_{1D} \cdot \tilde{b} \cos(\beta) - M_D = \emptyset$$

$$M_D = V_{1D}\, \tilde{b} \cos(\beta) - b_2 \cos(\beta) =$$

$$= 165.8312 \text{ Nmm}$$

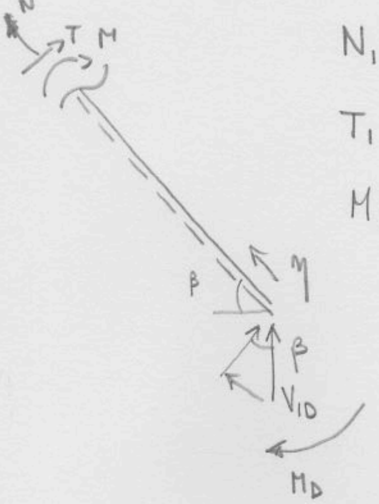
TRATTO AB

$$H_A = H_B = \emptyset$$

$$M_B = \emptyset$$

Il tratto AB è completamente scarico, quindi posso studiare solo il tratto BD.

TRATTO D-C $\quad 0 < \eta < b_1$

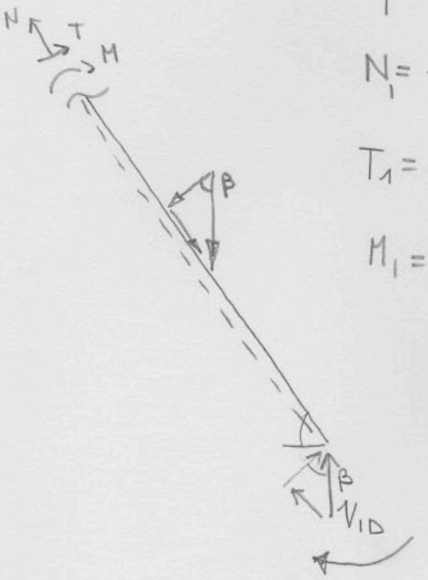


$$N_1 = -V_{1D} \cdot \sin(\beta) = -0.8333\,N$$

$$T_1 = -V_{1D} \cdot \cos(\beta) = -0.5528\,N$$

$$M_1 = -M_D + V_{1D} \cdot \cos(\beta)\,\eta = \begin{cases} M(0) = -M_D = -165.8312\,Nmm \\ M(b_1) = \emptyset \end{cases}$$

TRATTO C-B $\quad b_1 < \eta < \tilde{b}$



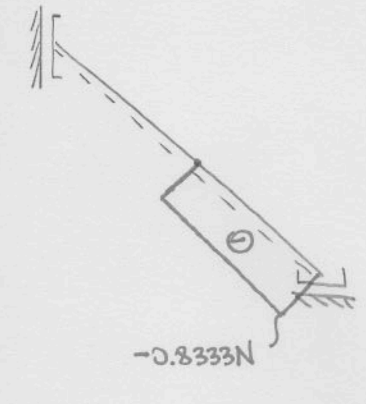
$$N_1 = -V_{1D}\,\sin(\beta) + 1\,\sin(\beta) = \emptyset$$

$$T_1 = -V_{1D} \cdot \cos(\beta) + 1 \cdot \cos(\beta) = \emptyset$$

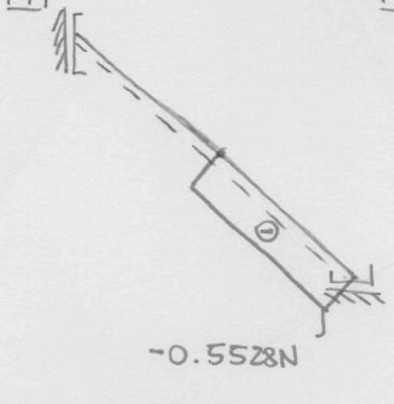
$$M_1 = -M_D + V_{1D} \cdot \cos(\beta)\,\eta - 1 \cdot \cos(\beta)\,(\eta - b_1) = \begin{cases} M(b_1) = \emptyset \\ M(b) = \emptyset \end{cases}$$

DIAGRAMMI AZIONI INTERNE

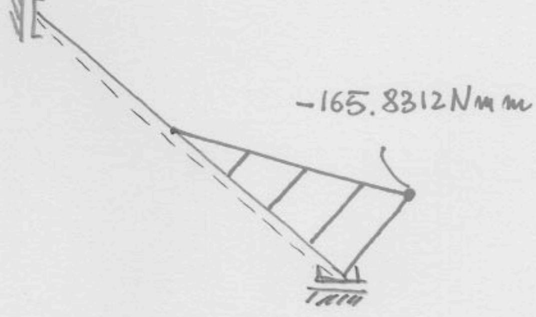
$\boxed{N}$



$\boxed{T}$



$\boxed{M}$



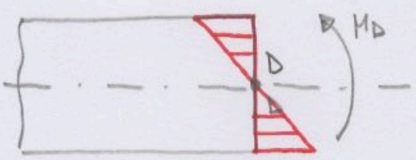
CALCOLO SPOSTAMENTO PLV

$$\mathcal{L}_{ve} = \mathcal{L}_{vi} \qquad \mathcal{L}_{ve} = 1\cdot\delta$$

$$1\cdot\delta = \int_{0}^{b_1} \frac{M_{0DC}\cdot M_{1DC}}{EJ}\,d\eta + \int_{b_1}^{b_2} \frac{M_{0BC}\, M_{1BC}}{EJ}\,d\eta = -1.4575 + \emptyset = -1.4575 \text{ mm}$$

Possiamo concludere che il punto C si sposta verticalmente in verso opposto alla direzione della forza esploratrice unitaria di $\delta = 1.4575$ mm.

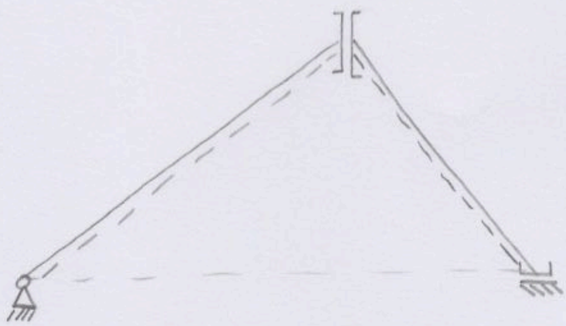
SFORZO σ MASSIMO -> solitamente il contributo preponderante nel calcolo delle σ proviene dal momento flettente. Calcoliamo le σ nel punto con il momento massimo (PUNTO D). N.B.: in questo caso l'azione normale è nulla su tutta la struttura, se ci fosse stata avrei dovuto fare delle verifiche.



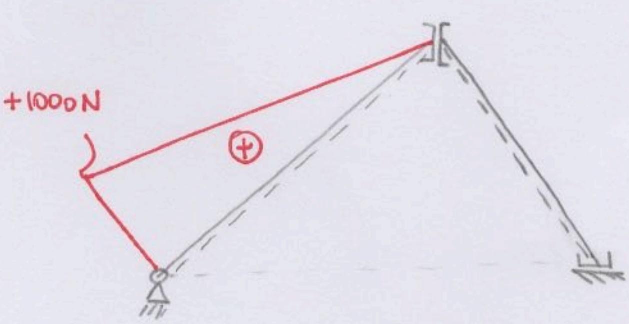
$$\sigma = \frac{M_D\, y}{J} = \frac{M_D \cdot 10}{\frac{20^4}{12}} = 234.3750 \text{ MPa}$$

AZIONI INTERNE STRUTT. Ø

N



T



M