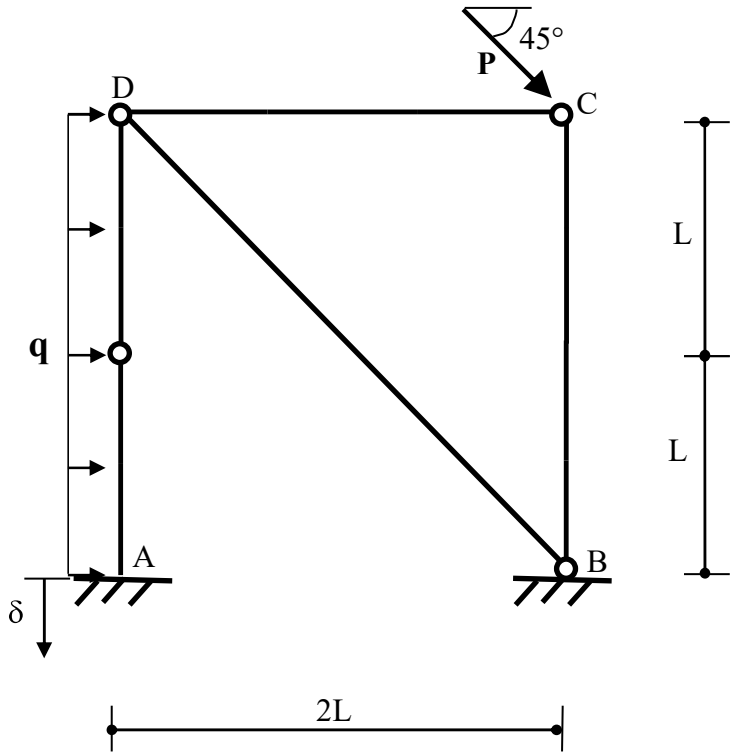
DE: Department of Engineering Ferrara
MECHANICAL ENGINEERING

CORSO DI LAUREA IN INGEGNERIA MECCANICA
PROVA SCRITTA DI STATICA
Ferrara, 10/01/18

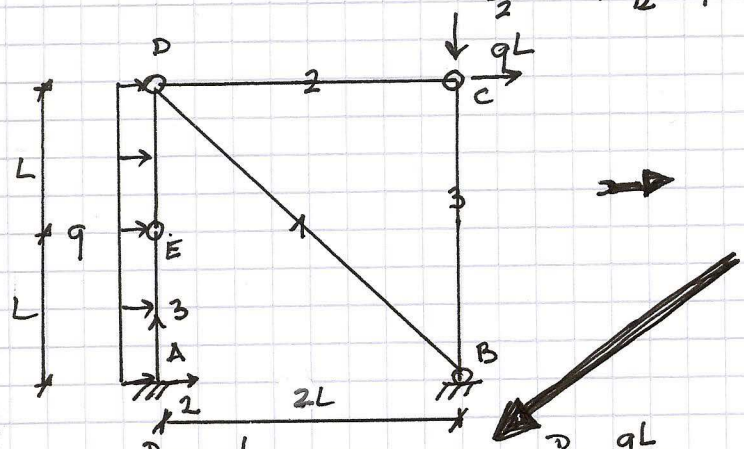


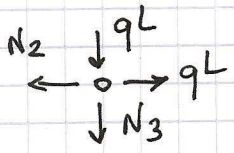
L = 1 m, q = 20 kN/m, P=$\sqrt{2}$qL
E = 210 GPa, σ_{AMM} = 240 MPa
δ = 1 cm

La travatura di figura è realizzata con profilati IPE.

1. Disegnare i diagrammi delle caratteristiche della sollecitazione (N, T, M) in presenza dei carichi q e P.
2. Progettare la travatura.
3. Calcolare lo spostamento orizzontale del nodo C.
4. Calcolare nuovamente lo spostamento orizzontale del nodo C considerando anche il cedimento del vincolo in A.

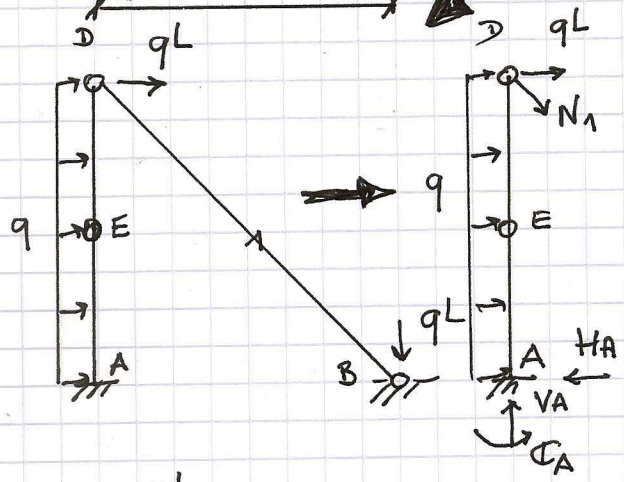
$P\frac{\sqrt{2}}{2} = \sqrt{2}qL\frac{\sqrt{2}}{2} = qL$



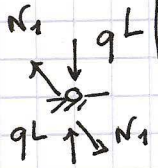


$N_2 = qL$

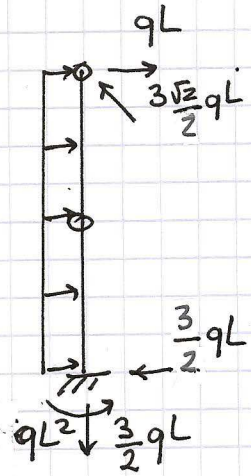
$N_3 = -qL$

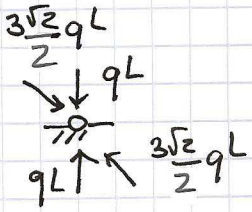


$$\begin{cases} (\rightarrow) \quad H_A = 3qL + N_1\frac{\sqrt{2}}{2} \\ (\uparrow) \quad V_A = N_1\frac{\sqrt{2}}{2} \\ (E\curvearrowright)_{AE} \quad C_A + q\frac{L^2}{2} = H_A L \\ (E\curvearrowright)_{DE} \quad N_1\frac{\sqrt{2}}{2} + qL^2 + q\frac{L^2}{2} = 0 \end{cases}$$



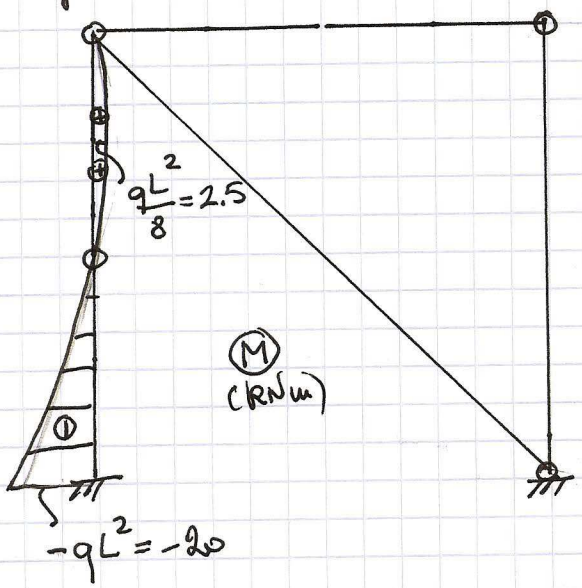
$\hookrightarrow \quad N_1\frac{\sqrt{2}}{2} = -\frac{3qL}{2}$

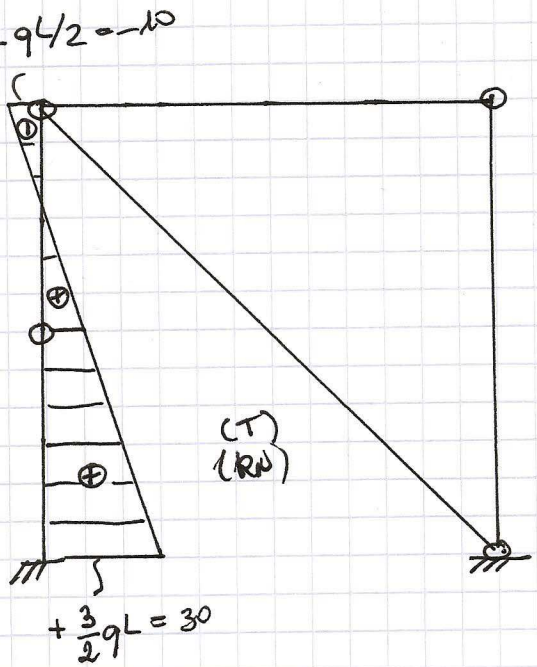


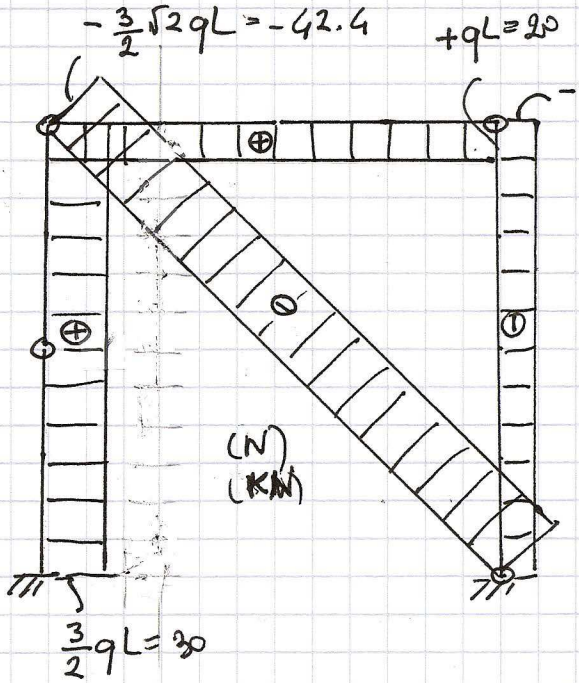


$$\begin{cases} N_1 = -\frac{3\sqrt{2}}{2}qL = -42.4 \text{ kN} \\ H_A = 3qL - 3\frac{\sqrt{2}}{2}qL\frac{\sqrt{2}}{2} = \frac{3}{2}qL = 30 \text{ kN} \\ V_A = -\frac{3qL}{2} = -30 \text{ kN} \\ C_A = \frac{3}{2}qL^2 - q\frac{L^2}{2} = qL^2 = 20 \text{ kN} \end{cases}$$

Diagrammi delle c. s. :





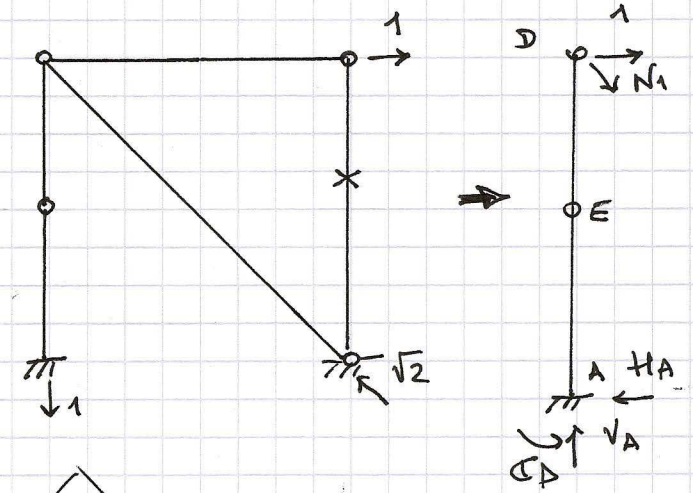


Progetto: $W_1 \geq \frac{qL^2}{6AMM} = \frac{20 \cdot 10^3 \cdot 1 \cdot 10^8}{240 \cdot 10^6}\ cm^3$

$= \frac{2000}{24}\ cm^3 = 83{,}3\ cm^3$

→ IPE 160 $\begin{cases} W_1 = 108{,}7\ cm^3 \\ I_1 = 869{,}3\ cm^4 \\ A = 20{,}1\ cm^2 \end{cases}$

Spostamento ortogonale in C:



$(E\mathcal{T})_{ED}$ $N_1 \frac{\sqrt{2}}{2} K + K = 0$

$\hookrightarrow N_1 = -\sqrt{2}$

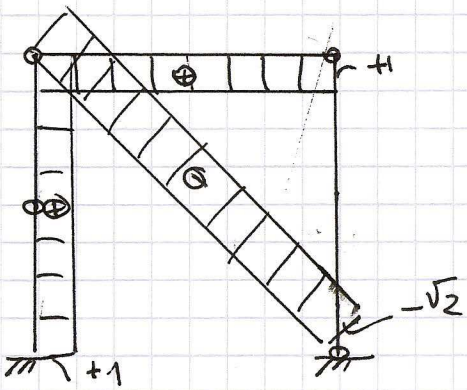
$(\uparrow)\ V_A = N_1 \frac{\sqrt{2}}{2} = -1$

N_1 $(\leftarrow)$ $H_A = 1 + N_1 \frac{\sqrt{2}}{2} = 0$

$\mathcal{C}_A = 0$

$\Downarrow$

$M^* = 0 = T^*$



$1 \cdot \delta_C = \frac{1}{EA}\left[1 \cdot \frac{3}{2}qL \cdot 2L + 1 \cdot qL \cdot 2L + \sqrt{2} \cdot 2L\sqrt{2} \cdot \frac{3}{2}\sqrt{2}qL\right]$

$= \frac{qL^2}{EA}\left[5 + 6\sqrt{2}\right] = 0.06\ cm$ (trascurabile!)

Spostamento ortogonale in C in presenza del cedimento in A: δ

$1 \cdot \delta_C + 1 \cdot \delta = (5 + 6\sqrt{2})\frac{qL^2}{EA}$

$\hookrightarrow \delta_C = (5 + 6\sqrt{2})\frac{qL^2}{EA} - \delta \cong -\delta = -1\ cm$