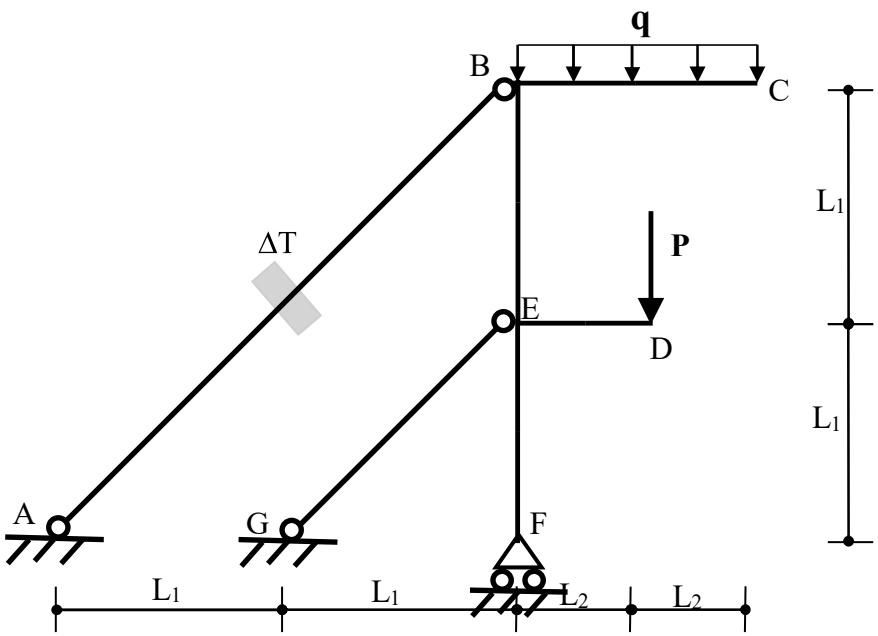
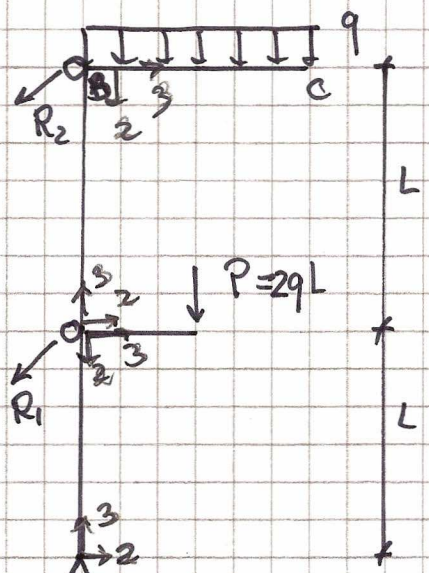
CORSO DI LAUREA TRIENNALE IN INGEGNERIA MECCANICA
PROVA SCRITTA DI STATICA
Ferrara, 15/02/18



L_1 = 1 m, L_2 = 0.5 m, q = 20 kN/m, P=40 kN
E = 210 GPa, σ_{AMM} = 240 MPa
$\Delta T = +10°C$, $\alpha = 10^{-5}\ °C^{-1}$

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 verticale del nodo C.
4. Calcolare nuovamente lo spostamento verticale del nodo C considerando anche il carico termico sul tratto AB.



$(\rightarrow)\ R_1\frac{\sqrt{2}}{2} + R_2\frac{\sqrt{2}}{2} = 0$

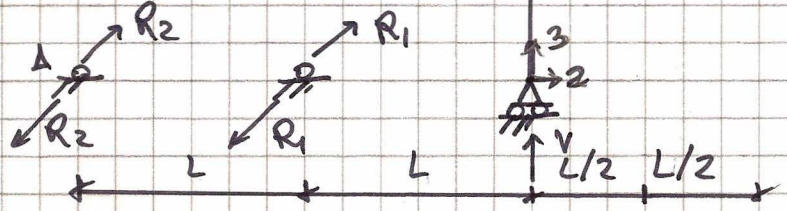
$\hookrightarrow R_1 = -R_2$

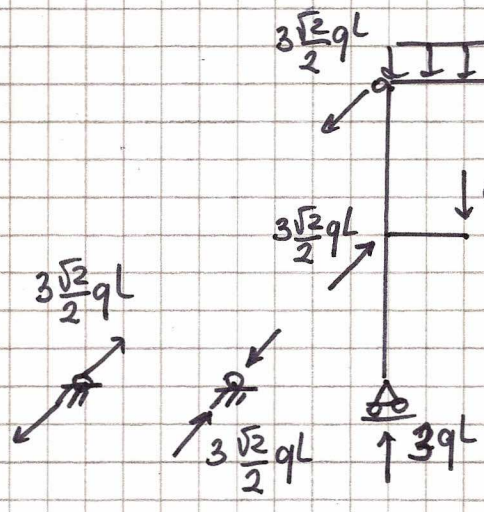
$(\uparrow)\ V - R_1\frac{\sqrt{2}}{2} - R_2\frac{\sqrt{2}}{2} = 3qL$

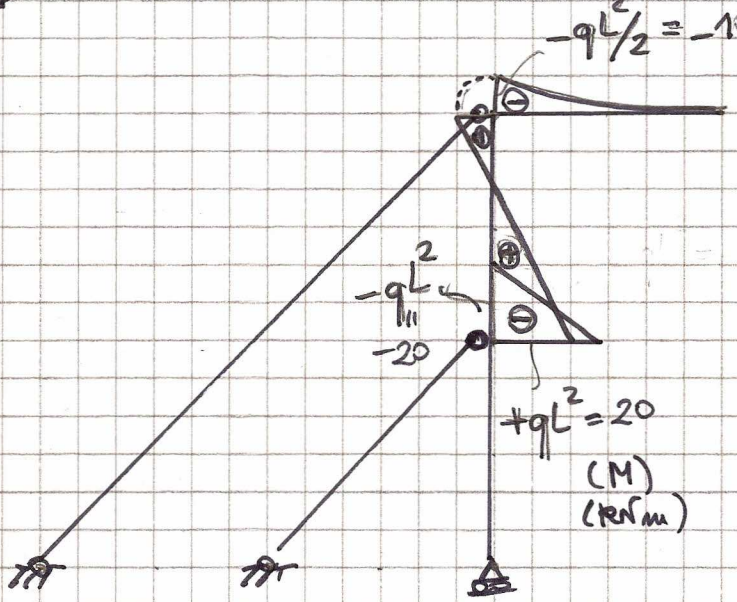
$\hookrightarrow V = 3qL$

$(B\uparrow)\ R_1\frac{\sqrt{2}}{2}L + \frac{1}{2}qL^2 + q\frac{L}{2} = 0$

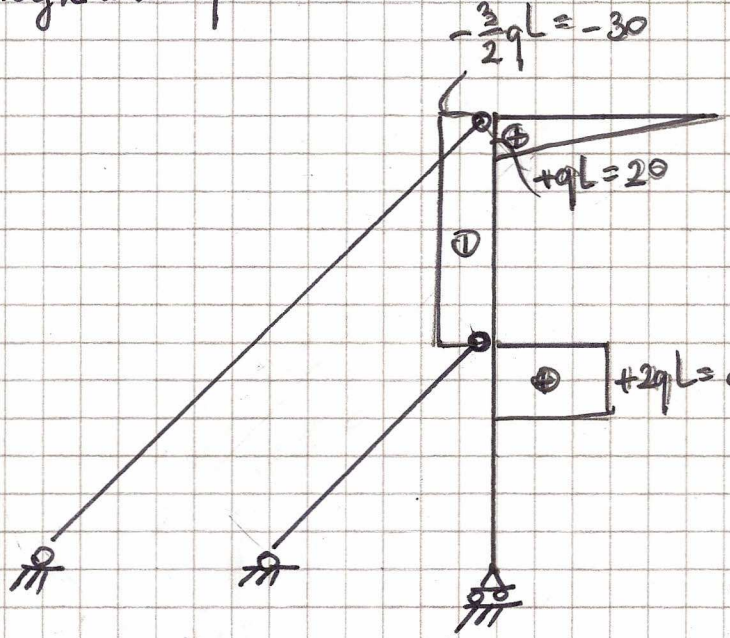
$\hookrightarrow R_1 = -\frac{3\sqrt{2}}{2}qL$

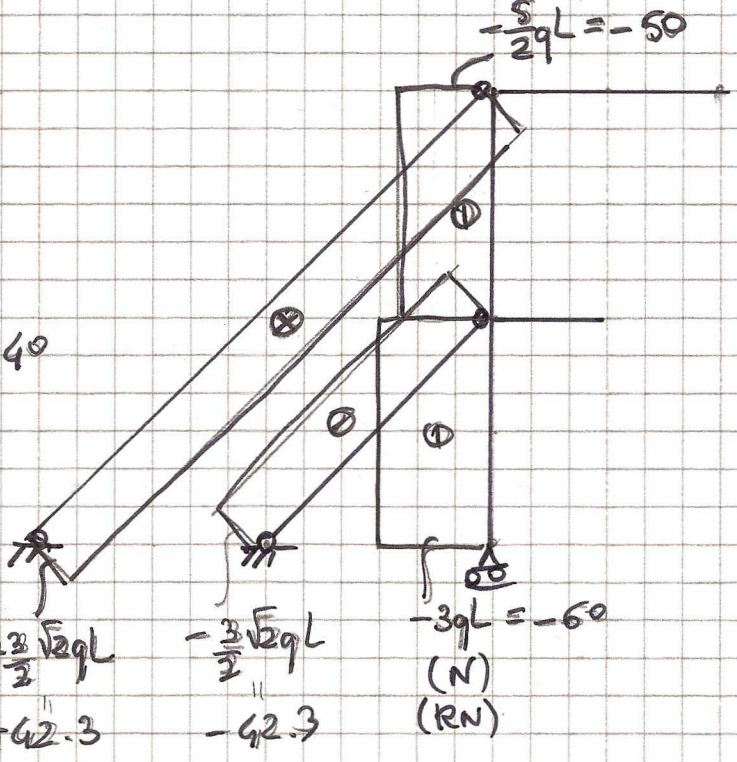






Diagrammi quotati:

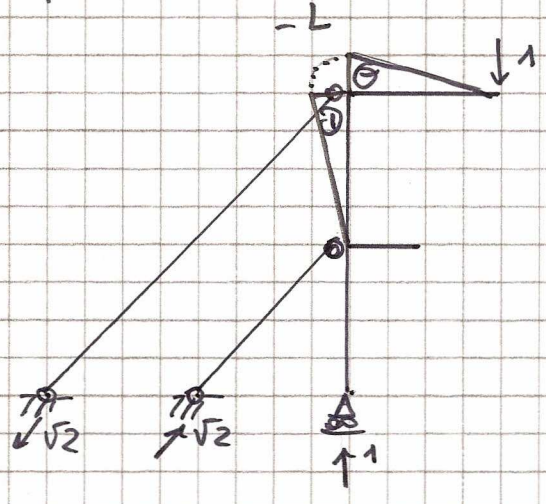




Progetto: $W_1 \geq \frac{M_{max}}{\sigma_{amm}} = \frac{qL^2}{\sigma_{AMM}} = \frac{20 \cdot 10^3 \, Nm^3}{240 \cdot 10^6 \, N} = \frac{1}{12} \frac{10^6}{10^3} cm^3 = 83.3 \, cm^3$

IPE 160 $\begin{cases} W_1 = 108,7 \, cm^3 \\ I_1 = 869,3 \, cm^4 \\ A = 20,08 \, cm^2 \\ h = 16 \, cm \end{cases}$

Spostamento:



$$1 \cdot \delta_c = \frac{1}{EI_1}\left[\int_0^L \left(-q\frac{x_3^2}{2}\right)(-x_3)\,dx_3 + \int_0^L (-x_3)\left(qL^2 - \frac{3}{2}qLx_3\right)dx_3\right]$$

$$= \frac{1}{EI_1}\left[q\frac{L^4}{8} - q\frac{L^4}{4} + q\frac{L^4}{4}\right]$$

$$= \frac{qL^4}{8EI_1} = \frac{20 \cdot 10^3 \cdot 1 \cdot 10^2}{8 \cdot 210 \cdot 10^9 \cdot 869,3 \cdot 10^{-8}} = 0,13 \, cm$$

Carico termico:

$$1 \cdot \delta_c = \frac{qL^4}{8EI_1} + \int_0^{2L\sqrt{2}} \sqrt{2} \cdot \alpha \Delta T \, dx_3$$

$$= \frac{qL^4}{8EI_1} + \sqrt{2}\alpha\Delta T \, 2L\sqrt{2}$$

$$= \frac{qL^4}{8EI_1} + 4\alpha\Delta T L = 0,13 + 4 \cdot 10^{-5} \cdot 10 \cdot 10^2 = 0,13 + 0,04 = 0,17 \, cm$$