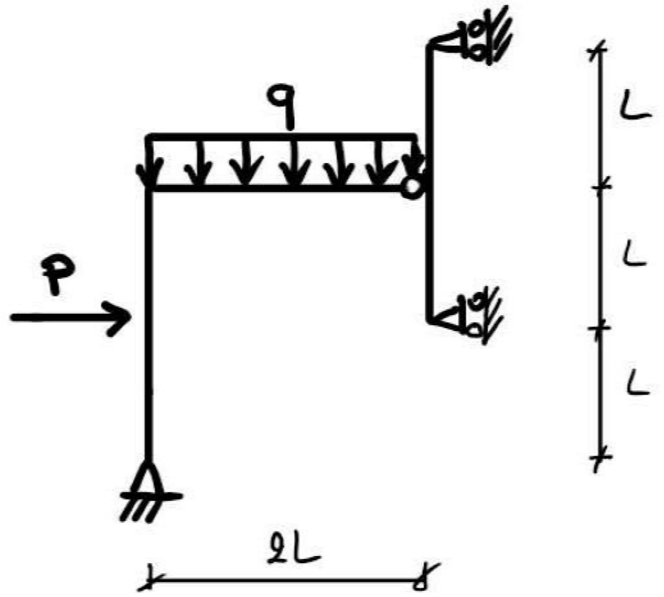
CORSO DI LAUREA IN INGEGNERIA MECCANICA
UNIVERSITÀ DI FERRARA
PROVA SCRITTA DI STATICA
04/02/2021

1)

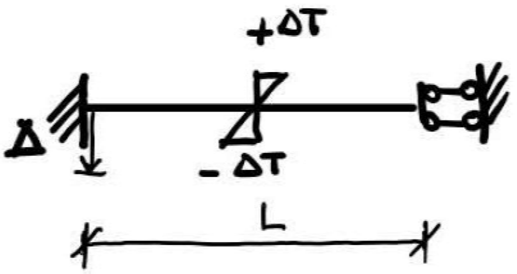


L= 1 m,
q = 20 kN/m,
P = 20 kN
σ_{AMM} = 240 MPa

La travatura isostatica in figura deve essere realizzata con profilati IPE.

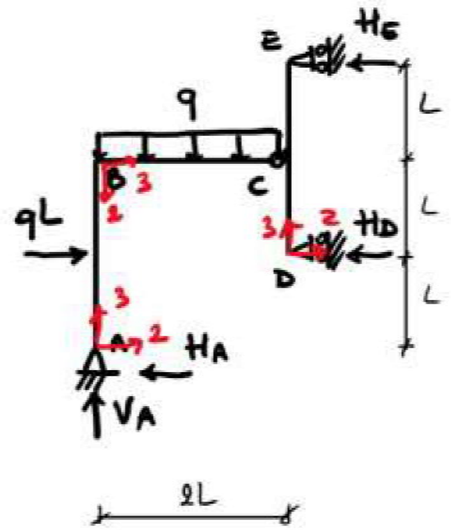
- Disegnare i diagrammi quotati (in kNm e kN) delle caratteristiche della sollecitazione.
- Dimensionare la travatura.

2)



L= 1 m, Δ = 1 cm, ΔT = 10°C, $\alpha=10^{-5}$ °C^{-1}
H=0.1 m, EI_1 = 1.14 MNm^2

La trave è soggetta al carico termico a farfalla e al cedimento verticale Δ nell'incastro a sinistra. Utilizzando l'equazione della linea elastica, disegnare i diagrammi di M e T (in kNm e kN) e calcolare lo spostamento verticale (in centimetri) nel doppio pendolo.



$(\uparrow)\quad V_A = 2qL$

$(C\uparrow)_{ABC}\quad H_A\,2L = -V_A\,2L + qL^2 + 2qL^2$

$\qquad\qquad \overset{!}{=} -4qL^2 + 3qL^2$

$\qquad\qquad \overset{!}{=} -qL^2$

$\qquad\qquad \hookrightarrow H_A = -q\frac{L}{2}$

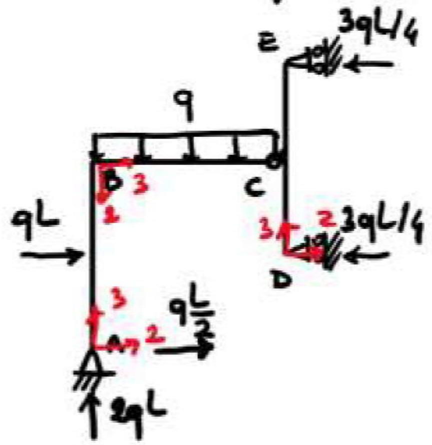
$(C\uparrow)_{CDE}\quad H_D \cancel{L} = H_E \cancel{L}$

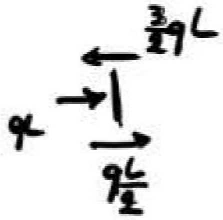
$(\rightarrow)\quad H_A + H_E + H_D = qL$

$\qquad 2H_E = qL - H_A = qL + q\frac{L}{2} = \frac{3qL}{2}$

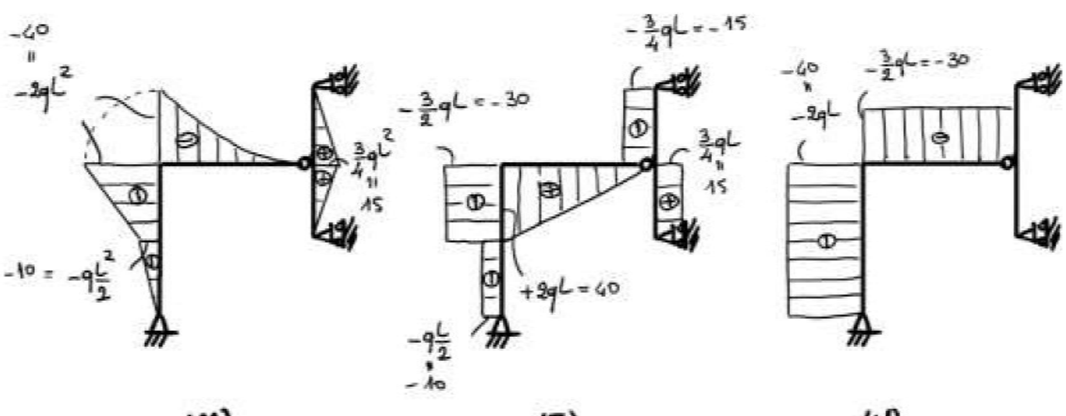
$\qquad \hookrightarrow H_E = 3q\frac{L}{4}$

Situazione all'equilibrio:





Diagrammi delle caratteristiche di sollecitazione:



(M) (kNm) (T) (kN) (N) (kN)

$q = 20$ kN/m
$L = 1$ m
$qL = 20$ kN
$qL^2 = 20$ kNm

Dimensionamento:

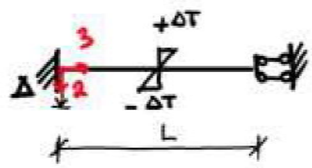
$$W_1 \geq \frac{|M_1|}{\sigma_{amm}} = \frac{40 \cdot 10^3\ Nm}{240 \cdot 10^6\ N/m^2} = \frac{1}{6}\,\frac{1}{10^3}\ m^3 = \frac{10^6}{6 \cdot 10^3}\ cm^3 = 167\ cm^3$$

IPE 200

$W_1 = 194.3\ cm^2$

$I_1 = 1943\ cm^4$

$A = 28,28\ cm^2$



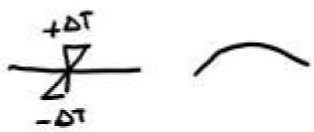
$$v(x_3) = C_0 + C_1 x_3 + C_2 x_3^2 + C_3 x_3^3$$

$$\begin{cases} \Delta = v(0) = C_0 \\ 0 = v'(0) = C_1 \\ 0 = v'(L) = C_1 + 2C_2 L + 3 C_3 L^2 \\ 0 = T(L) = -EI_1 v'''(L) = -EI_1 6C_3 \end{cases}$$

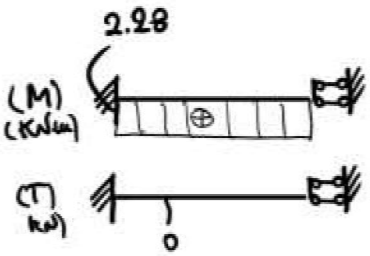
$$\begin{cases} C_0 = \Delta \\ C_1 = 0 \\ C_2 = 0 \\ C_3 = 0 \end{cases} \rightarrow v(x_3) = \Delta$$

$$M = +EI_1(-v'' - \chi_t) \quad (v'' = 0)$$

$$\stackrel{!}{=} -EI_1 \chi_t$$



$$\chi_t = -\frac{2\alpha\Delta T}{H}$$



$$\hookrightarrow M = \frac{2EI_1\alpha\Delta T}{H} = 2.28\ kNm$$

$$T = 0$$

$$v(L) = \Delta = 0.01\ m.$$