

**CORSO DI STATICA E SCIENZA DELLE COSTRUZIONI**

A.A. 2021-2022

Prova scritta in aula del 21.10.2022

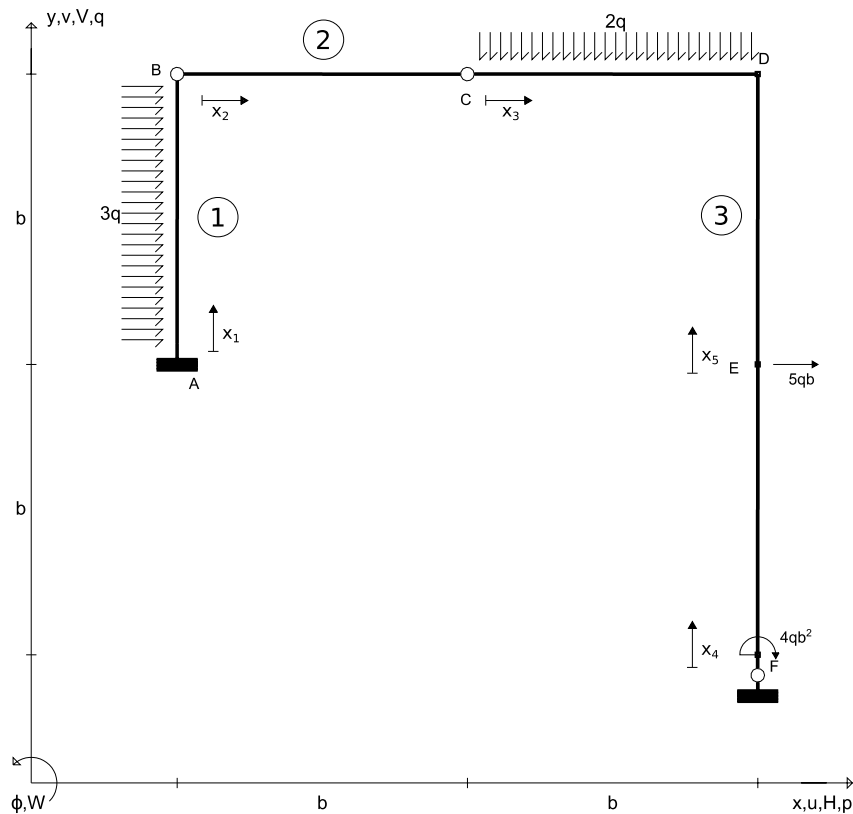
Parte I - Testo 1

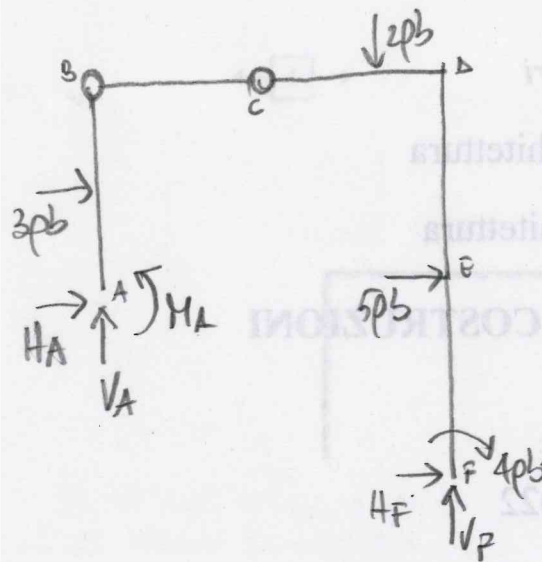
*Nota: I risultati numerici vanno riportati a penna su questo stesso foglio, nei riquadri predisposti; i calcoli (in forma ordinata) vanno allegati sui soli fogli a quadretti che sono stati forniti. Esprimere i risultati in forma frazionaria o con almeno 3 cifre decimali.*

Allievo:.....e-mail:..... Matricola:.....

**Esercizio n. 1 (17 punti)**

Risolvere la struttura isostatica riportata in Figura calcolando le reazioni vincolari, le equazioni delle azioni interne e tracciando nello spazio predisposto nella pagina a fronte i corrispondenti grafici. Si rammenta che il diagramma del momento flettente va riportato dalla parte delle fibre tese.





$$\begin{cases} R_x = 0 \rightarrow H_A + 3pb + 5pb + H_F = 0 & [1] \\ R_y = 0 \uparrow V_A - 2pb + V_F = 0 & [2] \\ M_{z(A)} = 0 \rightarrow H_A \cdot 3pb \cdot \frac{b}{2} - 2pb \cdot \frac{3}{2}b - 4pb^2 + H_F b + V_F 2b = 0 & [3] \end{cases}$$

EQ. AUXILIARI:

$$\begin{cases} \text{I} \quad M_{z(B)} = 0, \quad 0 \quad M_{z(D)} = 0 \\ \text{II} \quad M_{z(C)} = 0, \quad 0 \quad M_{z(E)} = 0 \end{cases}$$

$$M_{z(B)} = 0 \rightarrow -2pb \cdot \frac{3}{2}b + 5pb \cdot b + H_F 2b + V_F 2b - 4pb^2 = 0 \quad [4]$$

$$M_{z(C)} = 0 \rightarrow -2pb \cdot \frac{b}{2} + 5pb \cdot b + H_F 2b + V_F b - 4pb^2 = 0 \quad [5]$$

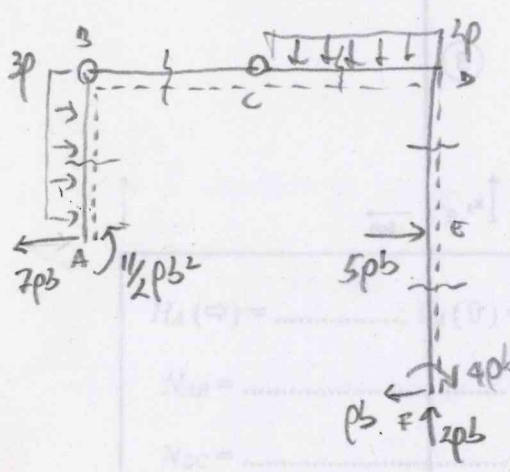
$$[5] \rightarrow -pb^2 + 5pb^2 + H_F 2b + V_F b - 4pb^2 = 0 \rightarrow H_F 2b = -V_F b \rightarrow H_F = -\frac{1}{2} V_F \rightarrow H_F = -9b$$

$$[5] \rightarrow [4] \rightarrow -3pb^2 + 5pb^2 - \frac{1}{2} V_F \cdot 2b + V_F 2b - 4pb^2 = 0 \rightarrow -2pb + V_F = 0 \rightarrow V_F = 2pb$$

$$[5] \rightarrow [1] \rightarrow H_A + 3pb + 5pb - pb = 0 \rightarrow H_A = -7pb$$

$$[4] \rightarrow [2] \rightarrow V_A - 2pb + 2pb = 0 \rightarrow V_A = 0$$

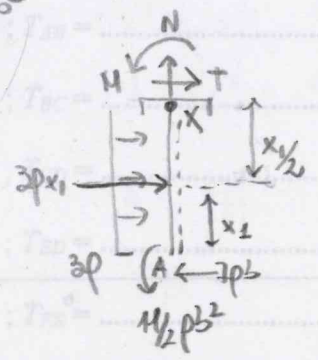
$$[4,5] \rightarrow [3] \rightarrow H_A - \frac{3}{2}pb^2 - 3pb^2 - 4pb^2 - pb^2 + 4pb^2 = 0 \rightarrow H_A = \frac{3}{2}pb^2 + 4pb^2 \rightarrow H_A = \frac{11}{2}pb^2$$



VERIFICA:

$$M_{z(D)} = 0 \rightarrow -4pb^2 - 5pb^2 + pb^2 - \frac{9}{2}pb^2 + \frac{11}{2}pb^2 + 7pb^2 = 0 \quad \checkmark$$

① A → B  $0 \leq x_1 \leq L$



$$\begin{aligned} R_1 = 0 \uparrow N(x_1) &= 0 \\ R_1 = 0 \rightarrow -7pb + 3px_1 + T(x_1) &= 0 \\ T(x_1) &= 7pb - 3px_1 \\ M_{z(x_1)} = 0 \rightarrow \frac{1}{2}pb^2 - 7pbx_1 + 3px_1 \frac{x_1}{2} + M(x_1) &= 0 \\ M(x_1) &= -\frac{1}{2}pb^2 + 7pbx_1 - \frac{3}{2}px_1^2 \end{aligned}$$

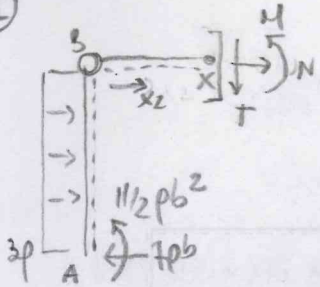
- A → B  $x_1$  [L]
- B → C  $x_2$  [L]
- C → D  $x_3$  [L]
- F → E  $x_4$  [L]
- E → D  $x_5$  [L]

$$M(x_1=0) = -\frac{1}{2}pb^2$$

$$M(x_1=L) = 0$$

B → C  $0 \leq x_2 \leq L$

II



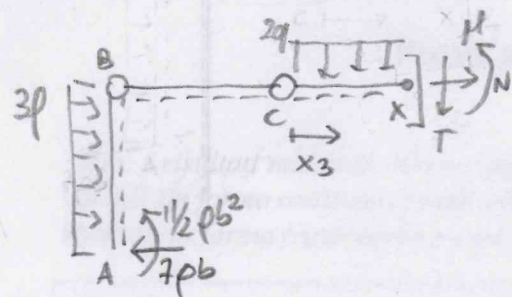
$$R_H = 0 \rightarrow N(x_2) - 7pb + 3pb = 0 \quad N(x_2) = 4pb$$

$$R_V = 0 \uparrow \quad T(x_2) = 0$$

$$M_{2x} = 0 \quad M(x_2) = 0$$

IL TRATTO BC È 1 BIELLA

III C → D  $0 \leq x_3 \leq L$



$$R_H = 0 \rightarrow N(x_3) = 4pb$$

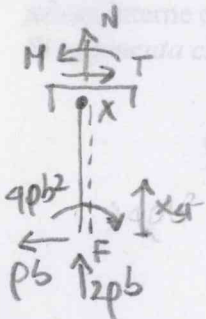
[NON CI SONO REATTI DI N NIPETTO AL TRATTO BC]

$$R_V = 0 \uparrow \quad -2qx_3 - T(x_3) = 0 \quad T(x_3) = -2qx_3$$

$$M_{2x} = 0 \quad 2qx_3 \frac{x_3}{2} + M(x_3) = 0 \quad M(x_3) = -qx_3^2$$

$$M(x_3=0) = 0 \quad M(x_3=L) = -qL^2$$

IV F → E  $0 \leq x_4 \leq L$

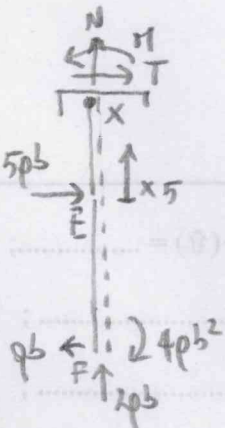


$$R_H = 0 \uparrow \quad N(x_4) + 2pb = 0 \quad N(x_4) = -2pb$$

$$R_V = 0 \rightarrow -pb + T(x_4) = 0 \quad T(x_4) = pb$$

$$M_{2x} = 0 \quad -4pb^2 + qb x_4 + M(x_4) = 0 \quad M(x_4) = 4pb^2 + pb x_4$$

V E → D  $0 \leq x_5 \leq L$



$$R_H = 0 \uparrow \quad N(x_5) = -2pb \quad [NON CI SONO REATTI DI N NIPETTO A FE]$$

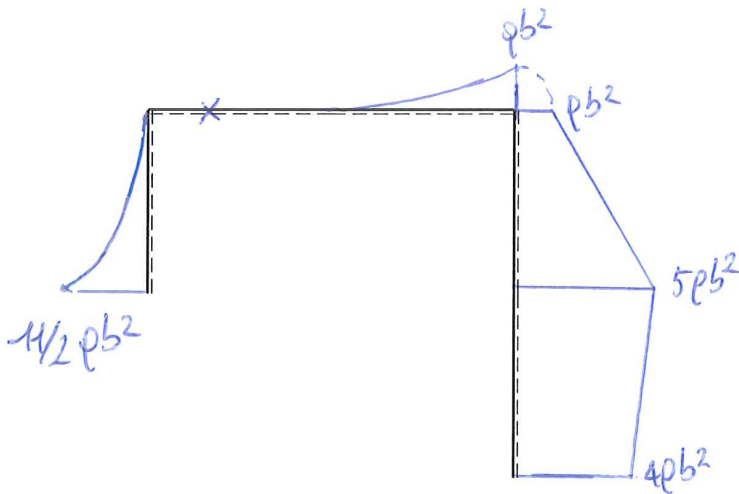
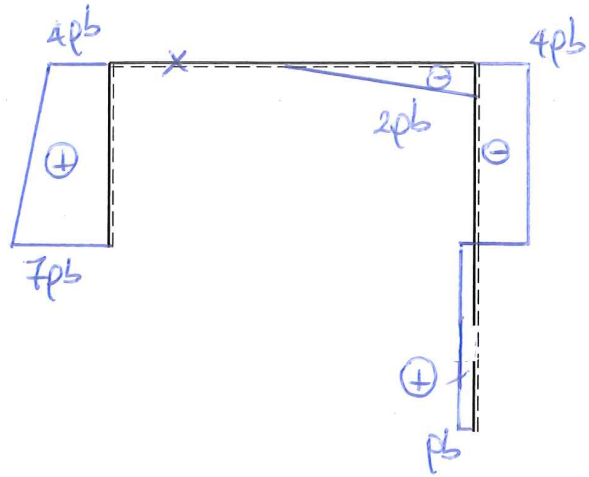
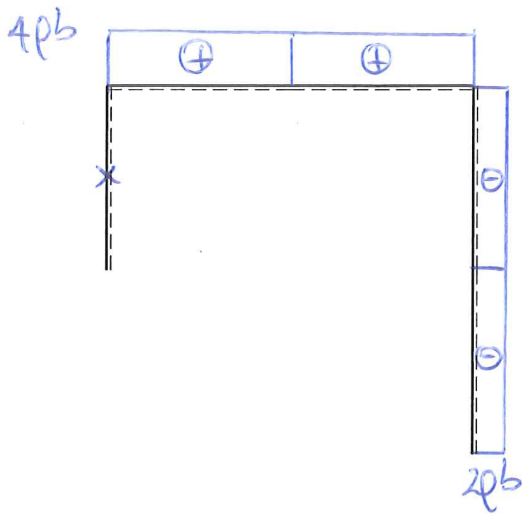
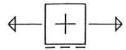
$$R_V = 0 \rightarrow -pb + 5qb + T(x_5) = 0 \quad T(x_5) = -4pb$$

$$M_{2x} = 0 \quad -4pb^2 - qb(b + x_5) + 5pb x_5 + M(x_5) = 0$$

$$-4pb^2 - pb^2 - pb x_5 + 5pb x_5 + M(x_5) = 0$$

$$M(x_5) = 5pb^2 - 4pb x_5$$

$$M(x_5=0) = 5pb^2 \quad M(x_5=L) = 9pb^2$$



$H_A (\Rightarrow) = -7pb$	;	$V_A (\hat{u}) = 0$	;	$M_A (\hat{\varphi}) = 1/2 pb^2$	;	$H_F (\Rightarrow) = -9b$	;	$V_F (\hat{u}) = 2pb$	;
$N_{AB} = //$	;	$T_{AB} = 7pb - 3qx_1$	;	$M_{AB} = -1/2 qb^2 + 7pbx_1 - 3/2 qx_1^2$	;				
$N_{BC} = 4pb$	;	$T_{BC} = //$	;	$M_{BC} = //$	;				
$N_{CD} = 4pb$	;	$T_{CD} = -2qx_3$	;	$M_{CD} = -qx_3^2$	;				
$N_{ED} = -2pb$	;	$T_{ED} = -4pb$	;	$M_{ED} = 5pb^2 - 4pbx_5$	;				
$N_{FE} = -2pb$	;	$T_{FE} = 9b$	;	$M_{FE} = 4pb^2 + 9bx_4$	;				