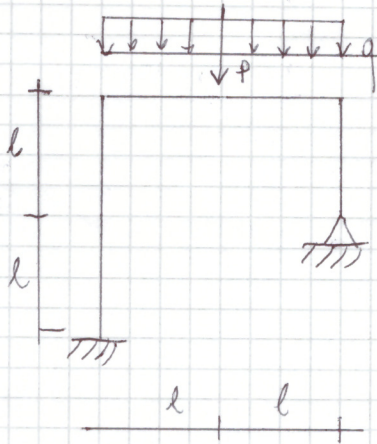


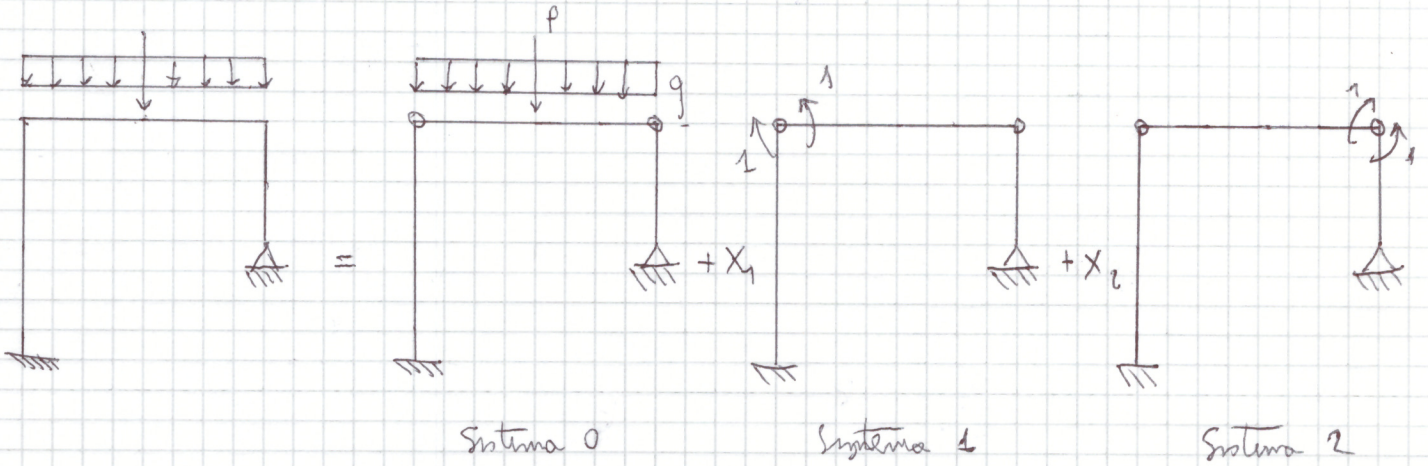
Soluzioni COMPITO SDZ 17/06/2022



$q = 3000 \text{ N/m}$

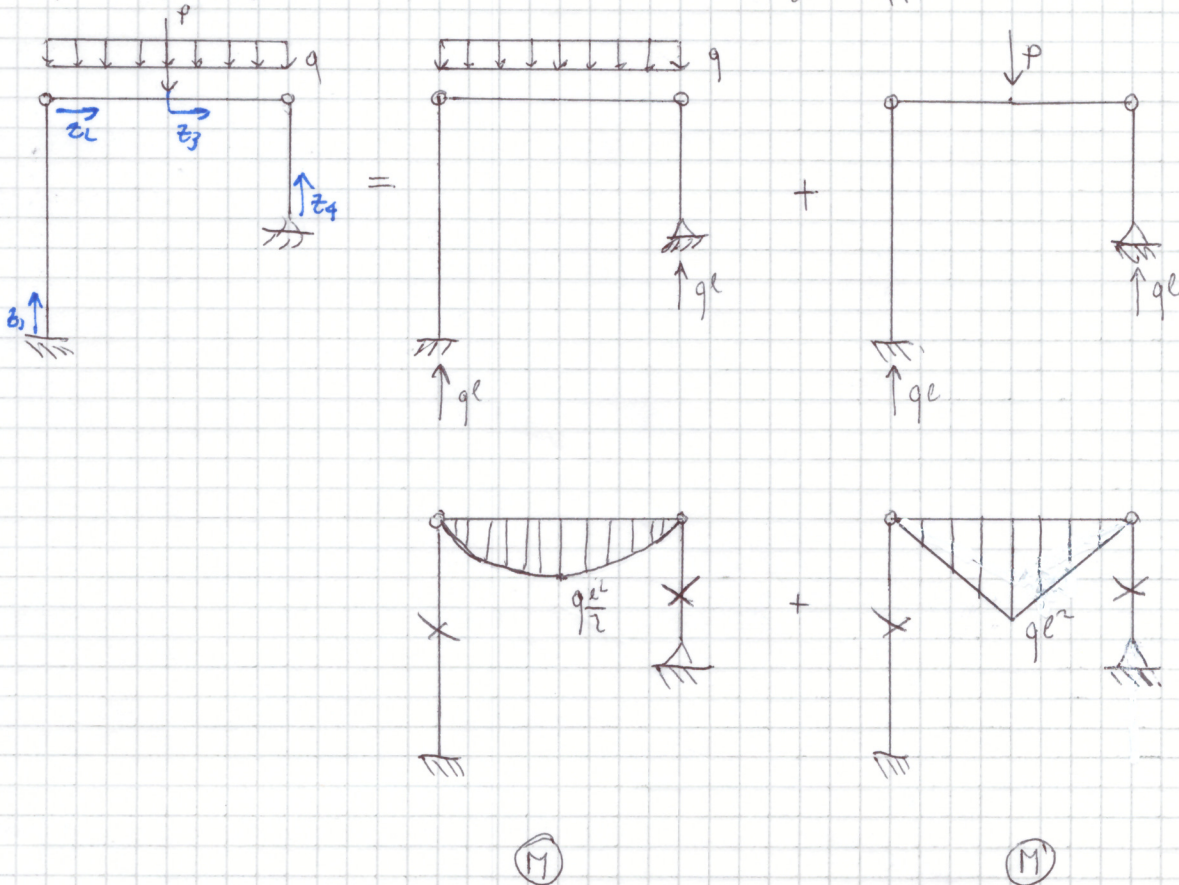
$l = 2 \text{ m}$

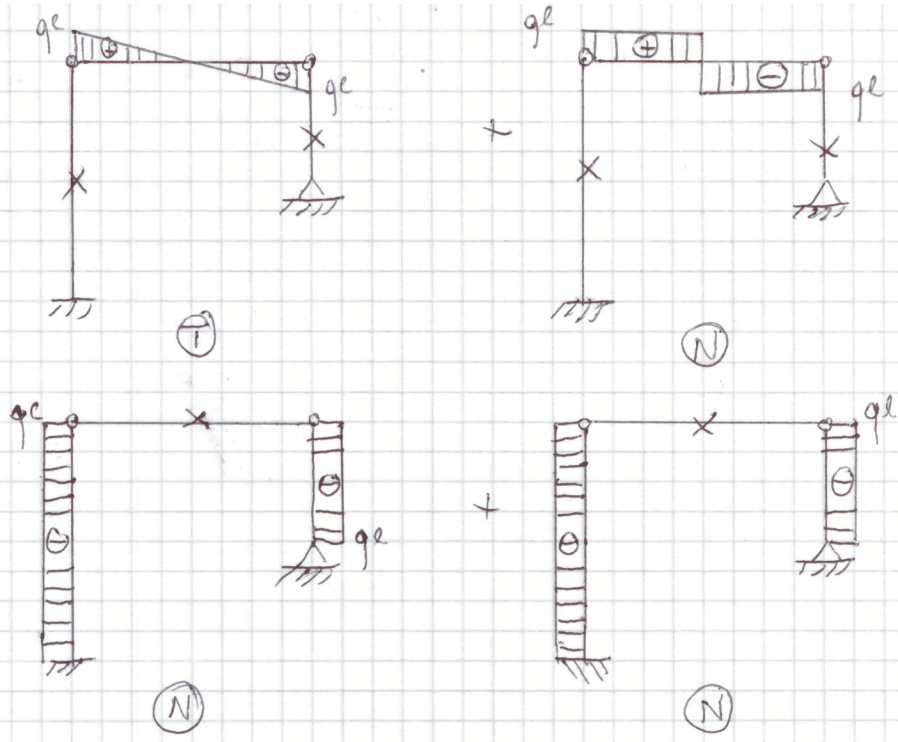
$P = 2ql = 1200 \text{ N}$



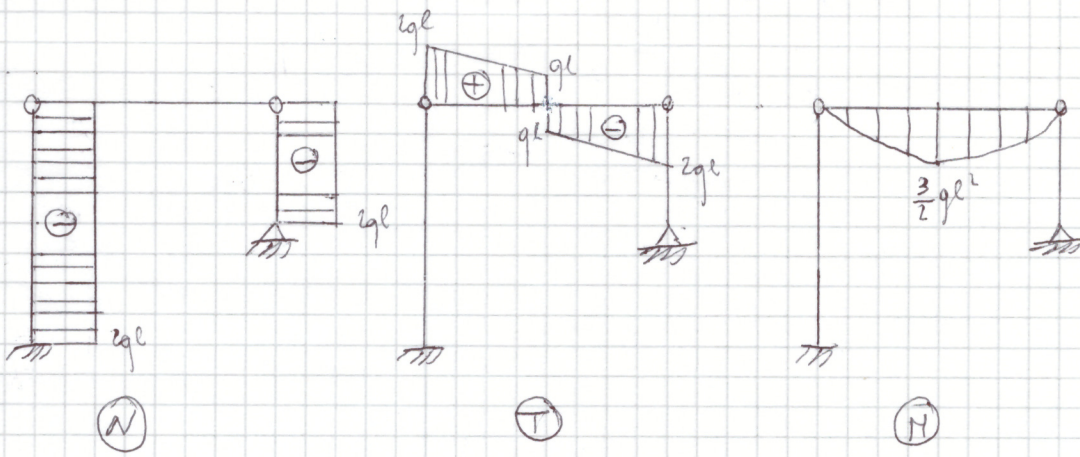
Sistema 0

Applico principio di sovrapposizione degli effetti





$z_1:$	$N = -ql$	$T = 0$	$M = 0$		$N = -ql$	$T = 0$	$M = 0$
$z_2:$	$N = 0$	$T = ql - qz$	$M = qlz - \frac{qz^2}{2}$		$N = 0$	$T = ql$	$M = qlz$
$z_3:$	$N = 0$	$T = -qz$	$M = \frac{ql^2}{2} - \frac{qz^2}{2}$		$N = 0$	$T = -ql$	$M = ql^2 - qlz$
$z_4:$	$N = -ql$	$T = 0$	$M = 0$		$N = -ql$	$T = 0$	$M = 0$



$$z_1: N = -ql$$

$$T = 0$$

$$M = 0$$

$$z_2: N = 0$$

$$T = 2ql - qz$$

$$M = 2qlz - \frac{qz^2}{2}$$

$$z_3: N = 0$$

$$T = -ql - qz$$

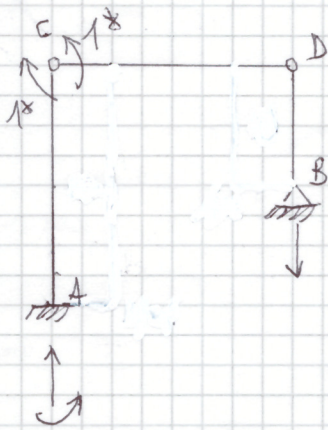
$$M = \frac{3}{2}ql^2 - qlz - \frac{qz^2}{2}$$

$$z_4: N = -ql$$

$$T = 0$$

$$M = 0$$

Sistema 1



$$c) \rightarrow -1 + M_A = 0 \rightarrow M_A = 1$$

$$D) \uparrow dx \quad H_B = 0 \rightarrow H_A = 0$$

$$c) \downarrow dx \quad 1 - V_B l = 0 \rightarrow V_B = \frac{1}{l}$$

$$V_A = V_B$$

$$z_1: N = -\frac{1}{2l}$$

$$T = 0$$

$$M = -1$$

$$z_2: N = 0$$

$$T = \frac{1}{2l}$$

$$M = -1 + \frac{1}{2l} z$$

$$z_3: N = 0$$

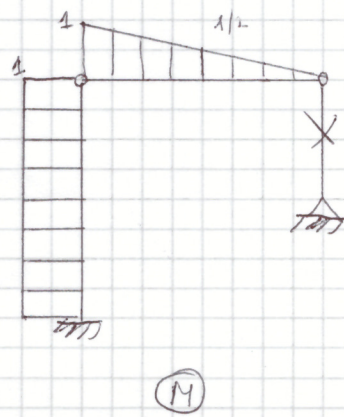
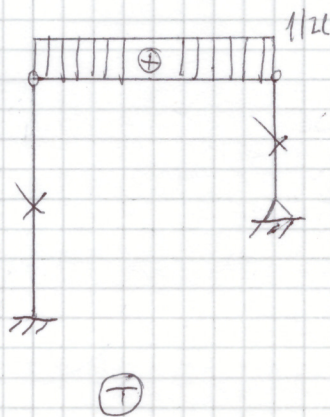
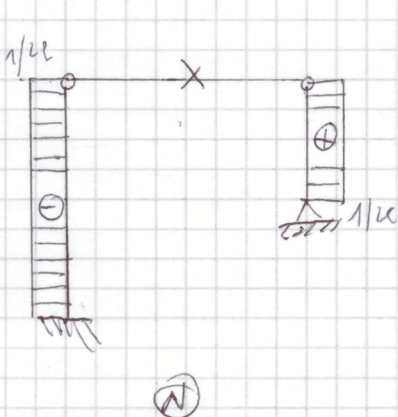
$$T = \frac{1}{2l}$$

$$M = -\frac{1}{2} + \frac{1}{2l} z$$

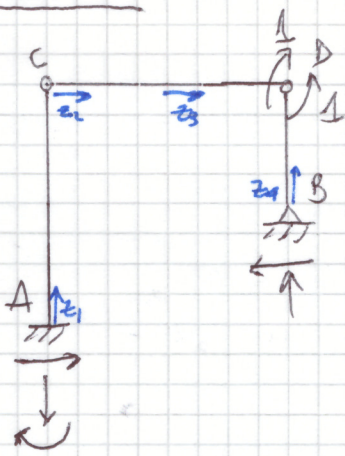
$$z_4: N = \frac{1}{2l}$$

$$T = 0$$

$$M = 0$$



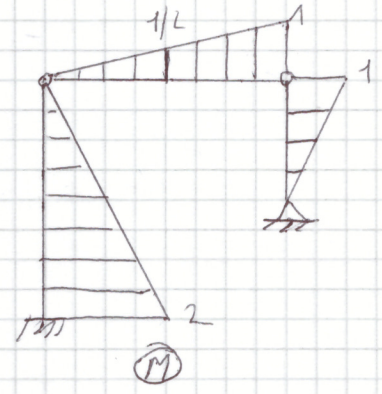
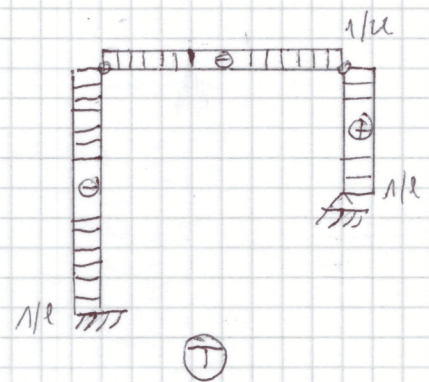
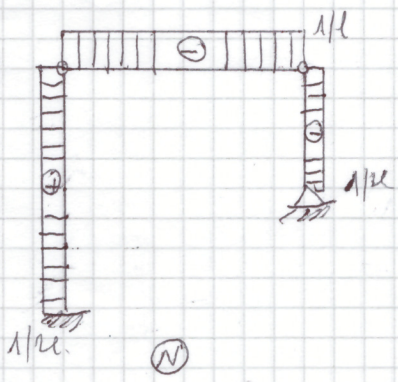
System 2



$$\begin{aligned}
 \overset{D}{\curvearrowright} \sum \mathcal{M} & 1 - H_B l = 0 & H_B = 1/l & \rightarrow H_A = 1/l \\
 \overset{C}{\curvearrowright} \sum \mathcal{M} & -H_B l + V_B 2l = 0 & V_B = \frac{1}{2l} & \rightarrow V_B = \frac{1}{2l} \\
 & & & V_A = \frac{1}{2l} \\
 \overset{C}{\curvearrowright} \sum \mathcal{M} & H_A 2l - \Pi_A = 0 & M_A = 2
 \end{aligned}$$

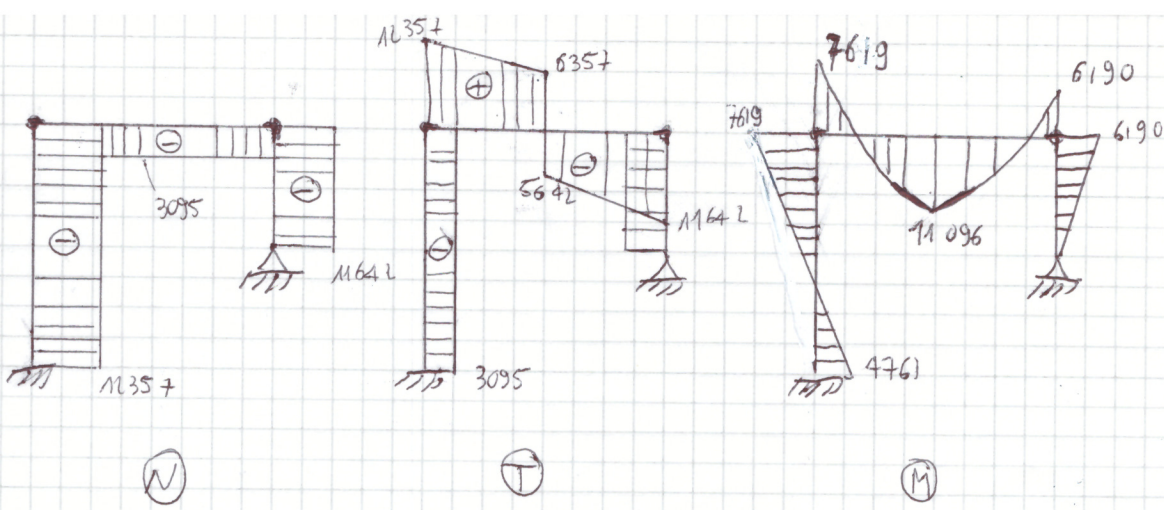
$$\begin{aligned}
 z_1: & N = \frac{1}{2l} \\
 z_2: & N = -\frac{1}{l} \\
 z_3: & N = -\frac{1}{l} \\
 z_4: & N = -\frac{1}{2l}
 \end{aligned}$$

$$\begin{aligned}
 T &= -\frac{l}{z} & M &= 2 - \frac{1}{l} z \\
 T &= -\frac{1}{2l} & M &= -\frac{1}{2l} z \\
 T &= -\frac{1}{2l} & M &= -\frac{1}{2} - \frac{1}{2l} z \\
 T &= -\frac{1}{2l} & M &= \frac{1}{l} z
 \end{aligned}$$



$$\begin{aligned}
 \eta_{10} &= \frac{1}{EJ} \left[\int_0^l (2qlz - \frac{qz^2}{2}) (-1 + \frac{1}{2l}z) dz + \int_0^l (-\frac{1}{2} + \frac{1}{2l}z) (\frac{3}{2}qc^2 - qc^2 - qc^2) dz \right] = -\frac{20000}{EJ} \\
 \eta_{20} &= \frac{1}{EJ} \left[\int_0^l (2qlz - \frac{qz^2}{2}) (-\frac{1}{2l}z) dz + \int_0^l (\frac{3}{2}qc^2 - qc^2 - qc^2) (-\frac{1}{2} - \frac{1}{2l}z) dz \right] = -\frac{20000}{EJ} \\
 \eta_{11} &= \frac{1}{EJ} \left[\int_0^{2l} (-1)^2 dz + \int_0^l (-1 + \frac{1}{2l}z)^2 dz \right] = \frac{16}{3EJ} \\
 \eta_{12} &= \frac{1}{EJ} \left[\int_0^{2l} (-1)(2 - \frac{1}{2l}z) dz + \int_0^{2l} (-1 + \frac{1}{2l}z) (-\frac{1}{2l}z) dz \right] = -\frac{10}{3EJ} \\
 \eta_{22} &= \frac{1}{EJ} \left[\int_0^{2l} (2 - \frac{1}{2l}z)^2 dz + \int_0^l (-\frac{1}{2l})^2 dz + \int_0^l (\frac{1}{2l}z)^2 dz \right] = \frac{22}{3EJ}
 \end{aligned}$$

$$\begin{vmatrix} \eta_{11} & \eta_{12} \\ \eta_{12} & \eta_{22} \end{vmatrix} \begin{vmatrix} X_1 \\ X_2 \end{vmatrix} = \begin{vmatrix} -\eta_{10} \\ -\eta_{10} \end{vmatrix} \iff \begin{aligned} X_1 &= 7619 \\ X_2 &= 6190 \end{aligned}$$



② Progetto e Verifica

$$M_{max} = 11096 \text{ Nm} \quad N = -3095 \text{ N}$$

$$W_{min} = \frac{11096 \cdot 1000}{190} = 58400 \text{ mm}^3 = 58.4 \text{ cm}^3$$

$$\text{Acciaio IPE 140} \quad A = 1643 \text{ cm}^2 \quad J_x = 541.2 \text{ cm}^4 \quad W_x = 77.32 \text{ cm}^3$$

$$\text{Verifica: } \sigma_z = \frac{N}{A} \pm \frac{M}{W} = -\frac{3095}{1643} \pm \frac{11096 \cdot 10^3}{77.32 \cdot 10^3} = -1.88 \pm 143 \begin{matrix} -114.8 \text{ V} \\ -141 \text{ V} \end{matrix}$$

③ Deformazioni assiali + cedimento

$$\eta_{10}^a = \frac{1}{EA} \left[\int_0^{2l} (-lgl) \left(-\frac{1}{2l}\right) dz + \int_0^l (-lgl) \left(+\frac{1}{2l}\right) dz \right] = \frac{6000}{EA}$$

$$\eta_{20}^a = \frac{1}{EA} \left[\int_0^{2l} (-lgl) \left(\frac{1}{2l}\right) dz + \int_0^l (-lgl) \left(-\frac{1}{2l}\right) dz \right] = -\frac{6000}{EA}$$

$$\eta_{11}^a = \frac{1}{EA} \left[\int_0^{2l} \left(-\frac{1}{2l}\right)^2 dz + \int_0^l \left(\frac{1}{2l}\right)^2 dz \right] = \frac{3}{8EA}$$

$$\eta_{21}^a = \frac{1}{EA} \left[\int_0^{2l} \left(-\frac{1}{2l}\right) \left(\frac{1}{2l}\right) dz + \int_0^l \left(\frac{1}{2l}\right) \left(-\frac{1}{2l}\right) dz \right] = -\frac{3}{8EA}$$

$$\eta_{22}^a = \frac{1}{EA} \left[\int_0^{2l} \left(\frac{1}{2l}\right)^2 dz + \int_0^l \left(-\frac{1}{2l}\right)^2 dz + \int_0^{2l} \left(\frac{1}{l}\right)^2 dz \right] = \frac{11}{8EA}$$

def. assiali
della asta

cedimento $L_{X1} = L_{X2}$

$$\eta_c^1 = +V_B \Delta u = \frac{1}{2l} \cdot 0.01 = \frac{1}{400}$$

$$\Delta u = 1 \text{ cm} = 0.01 \text{ m}$$

$$\eta_c^2 = -V_B^2 \Delta u = \frac{1}{2l} \cdot 0.01 = -\frac{1}{400}$$

$$\begin{vmatrix} \eta_{11} + \eta_{11}^a & \eta_{12} + \eta_{12}^a \\ \eta_{12} + \eta_{12}^a & \eta_{22} + \eta_{22}^a \end{vmatrix} = \begin{vmatrix} X_1 \\ X_2 \end{vmatrix} = \begin{vmatrix} -\eta_{10}^a + \eta_c^1 \\ -\eta_{20}^a + \eta_c^2 \end{vmatrix}$$

$$X_1 = 8597$$

$$X_2 = 5693$$

