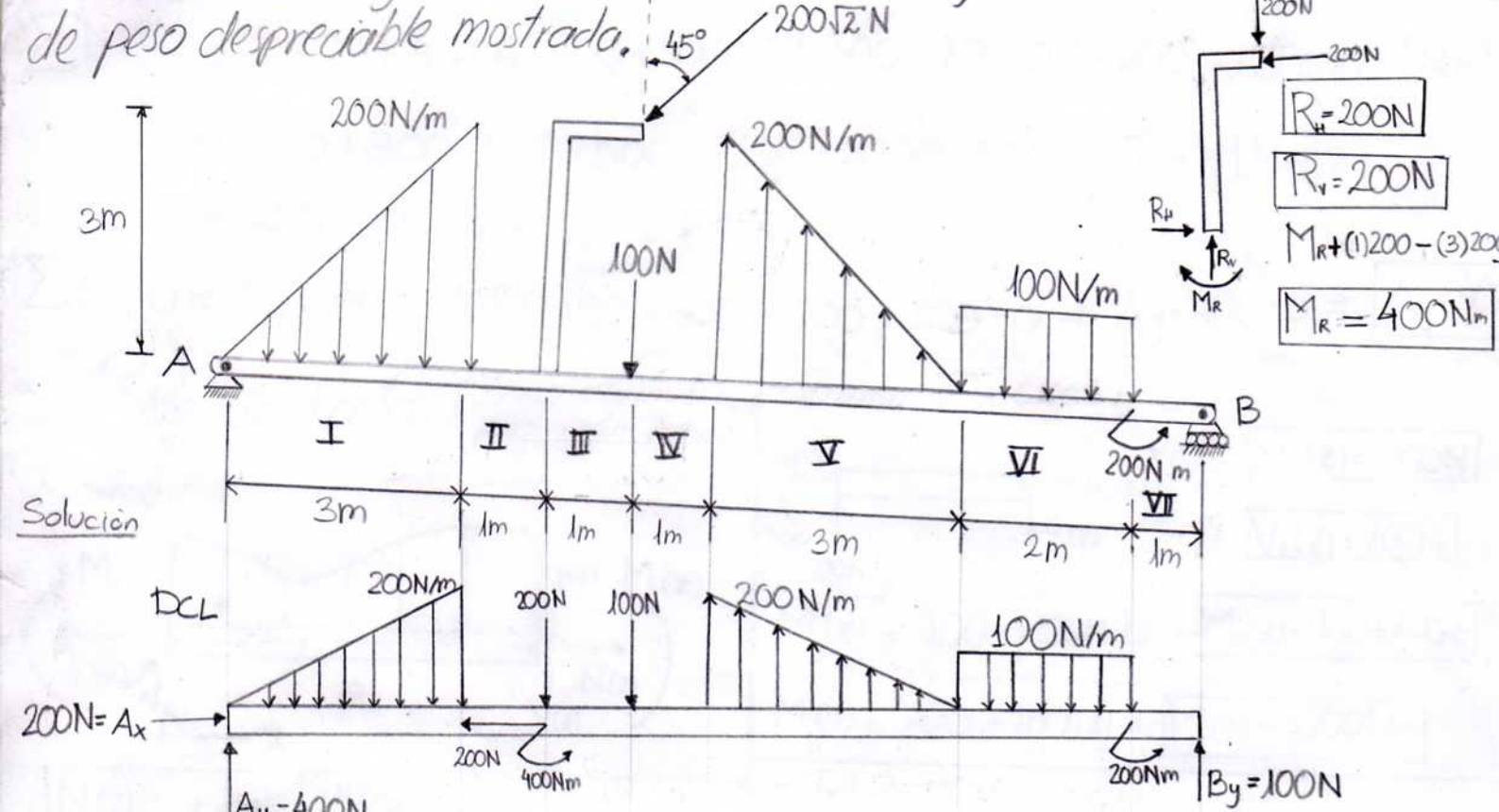
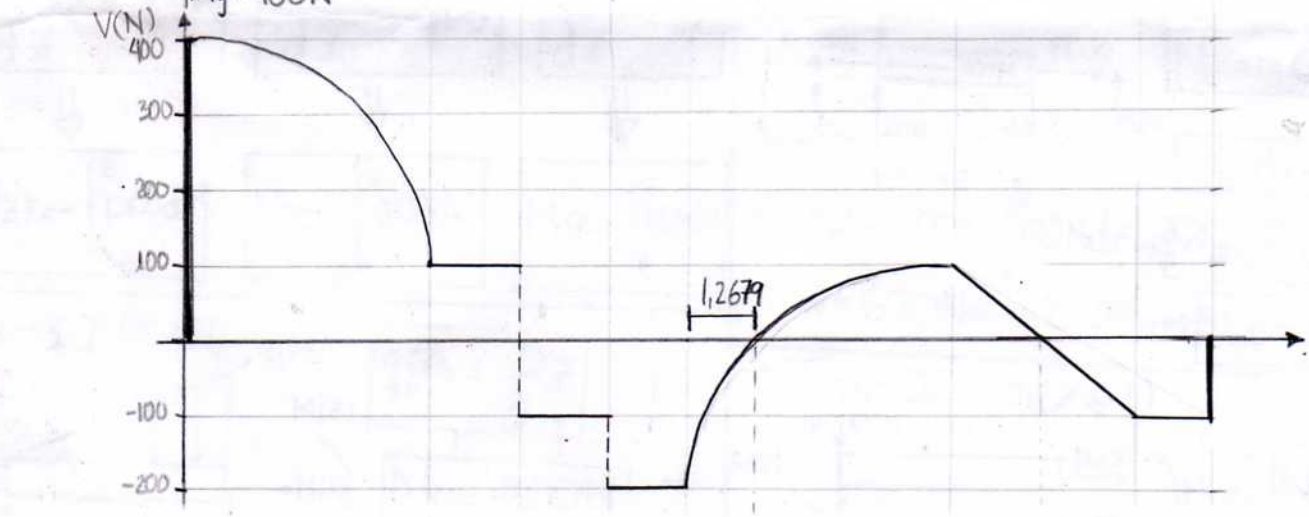
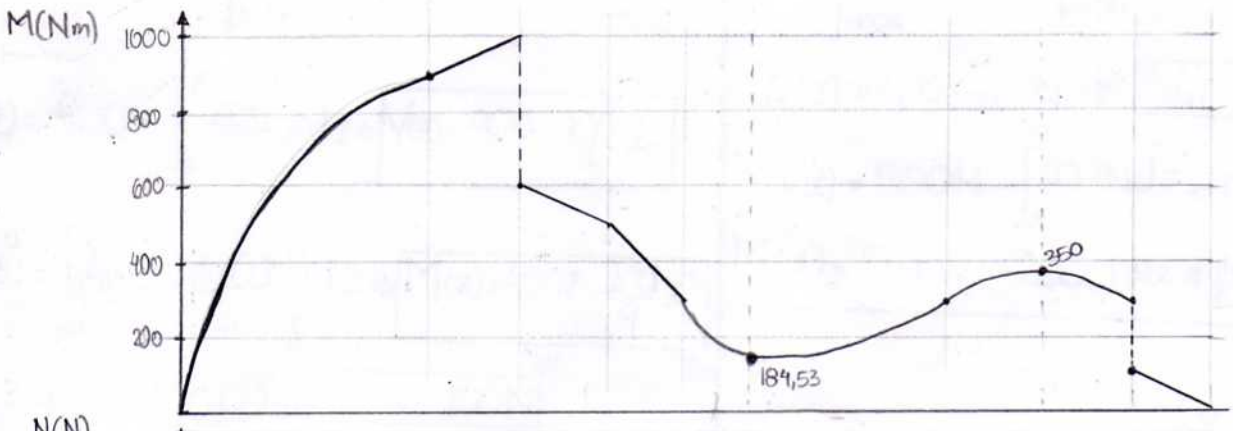
* Problema 84, Página 157. Problemario del Profesor Bruzual.
Construir los diagramas de fuerza cortante y momento flector de la v
de peso despreciable mostrada.



Solución





$\rightarrow \sum F_x^E = 0 \Rightarrow A_x - 200N = 0 \Rightarrow \boxed{A_x = 200N}$

$\circlearrowleft \sum M_A^E = 0 \Rightarrow 2\cdot 300 + 4\cdot 200 - 400 + 5\cdot 100 - 7\cdot 300 + 10\cdot 200 - 200 - 12B_y = 0$ [Nm]

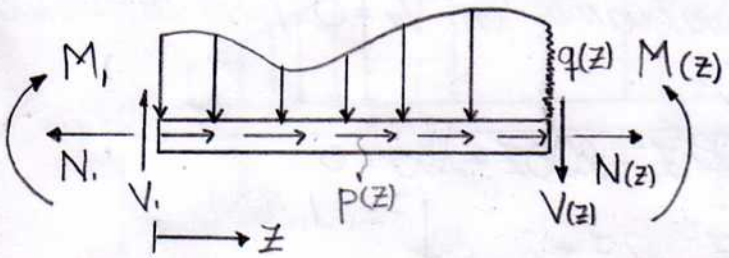
$\Rightarrow 600 + 800 - 400 + 500 - 2100 + 2000 - 200 = 12B_y$ [Nm]

$\Rightarrow 1200 = 12B_y \Rightarrow \boxed{B_y = 100N}$

$\uparrow \sum F_y^E = 0 \Rightarrow A_y - 300 - 200 - 100 + 300 - 200 + 100 = 0 \Rightarrow A_y - 400 = 0 \Rightarrow \boxed{A_y = 4}$

Método de Cortes. (z no acumulativo para cada tramo)

Recordamos:

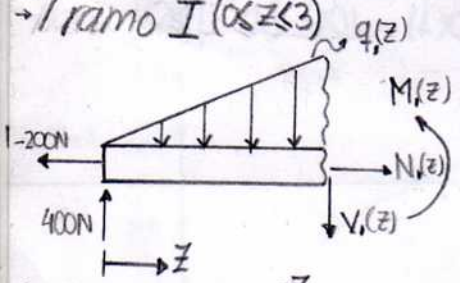


$$\frac{dN(z)}{dz} = -p(z) \Rightarrow N(z) = -\int_0^z p(z)dz$$

$$\frac{dV(z)}{dz} = -q(z) \Rightarrow V(z) = -\int_0^z q(z)dz$$

$$\frac{dM(z)}{dz} = V(z) \Rightarrow M(z) = \int_0^z V(z)dz$$

→ Tramo I ($0 \leq z \leq 3$)



$\boxed{q_1(z) = \frac{200}{3}z}$

$\boxed{N_1(z) = -200N}$

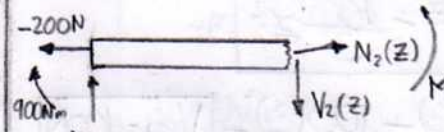
$$V_I(z) = 400 - \int_0^z \frac{200}{3} z\,dz \Rightarrow \boxed{V(z) = 400 - \frac{100}{3}z^2}$$

$$M_I(z) = \int_0^z \left(400 - \frac{100}{3}z^2\right)dz \Rightarrow \boxed{M(z) = 400z - \frac{100}{9}z^3}$$

$$V(3) = 400 - \frac{100}{3}(3)^2 \Rightarrow \boxed{V(3) = 100N}$$

$$M(3) = 400(3) - \frac{100}{9}(3)^3 \Rightarrow \boxed{M(3) = 900Nm}$$

→ Tramo II ($0 \leq z \leq 1$)



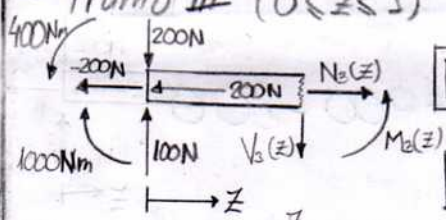
$\boxed{N_2(z) = -200N}$

$\boxed{V_2(z) = 100N}$

$$M_{II}(z) = 900 + \int_0^z 100N\,dz \Rightarrow \boxed{M_{II}(z) = 900 + 100z}$$

$$M(1) = 900 + 100(1) \Rightarrow \boxed{M(1) = 1000Nm}$$

→ Tramo III ($0 \leq z \leq 1$)



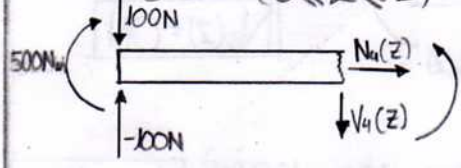
$\boxed{N_3(z) = 0N}$

$\boxed{V_3(z) = -100N}$

$$M_{III}(z) = 600N - \int_0^z 100N\,dz \Rightarrow \boxed{M_{III}(z) = 600 - 100z}$$

$$M(1) = 600Nm - 100(1)Nm \Rightarrow \boxed{M(1) = 500Nm}$$

→ Tramo IV ($0 \leq z \leq 1$)



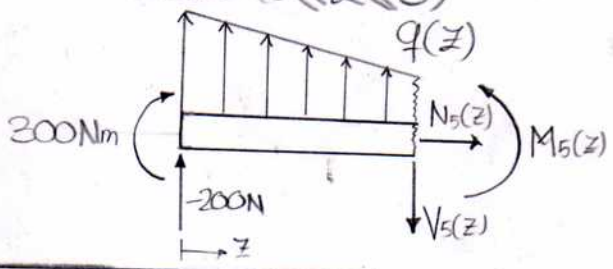
$\boxed{N_4(z) = 0}$

$$V_4(z) = -100N - 100N \Rightarrow \boxed{V_4(z) = -200N}$$

$$M_4(z) = 500Nm - \int_0^z 200N\,dz \Rightarrow M_{4(z)} = 500Nm - 20$$

$$M(1) = 500Nm - 200(1)Nm \Rightarrow \boxed{M(1) = 300Nm}$$

→ Tramo V ($0 \leq z \leq 3$)



$$q_5(z) = 200 - \frac{200}{3}z \qquad \boxed{N_5(z) = 0N}$$

$$V_V(z) = -200 + \int_0^z \left(200 - \frac{200}{3}z\right) dz$$

$$\boxed{V_V(z) = -200 + 200z - \frac{100}{3}z^2}$$

$$V(3) = -200N + 200(3) - \frac{100(3)^2}{3} \Rightarrow \boxed{V(3) = 100N}$$

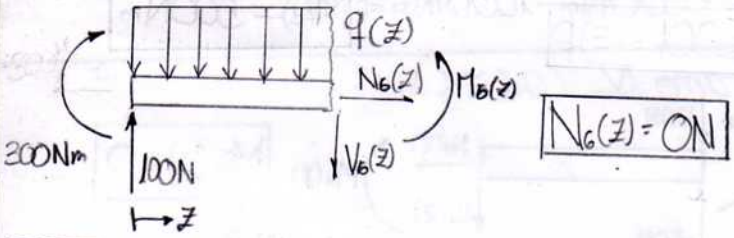
$$M_V(z) = 300 + \int_0^z \left(-200 + 200z - \frac{100}{3}z^2\right) dz$$

$$\boxed{M_V(z) = 300 - 200z + 100z^2 - \frac{100}{9}z^3}$$

$$M(3) = 300 - 600 + 900 - 300$$

$$\boxed{M(3) = 300Nm}$$

→ Tramo VI ($0 \leq z \leq 2$)



$$\boxed{N_6(z) = 0N}$$

$$\boxed{q_6(z) = 100} \qquad V(2) = 100 - \frac{100(2)^2}{2} \Rightarrow \boxed{V(2) = -100N}$$

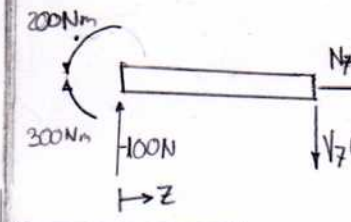
$$V_{VI}(z) = 100 - \int_0^z 100 \Rightarrow \boxed{V_{VI}(z) = 100 - 100z}$$

$$M_{VI}(z) = 300 + \int_0^z (100 - 100z)$$

$$\boxed{M_{VI}(z) = 300 + 100z - \frac{100}{2}z^2}$$

$$M(2) = 300 + 200 - 200 \Rightarrow \boxed{M(2) = 300Nm}$$

→ Tramo VII ($0 \leq z \leq 1$)



$N_7(z) = 0N$

$$\boxed{V_7(z) = -100N}$$

$$M_{VII}(z) = 300 - 200 - \int_0^z 100z\,dz$$

$$\boxed{M_{VII}(z) = 100 - 100z}$$

$$M(1) = 100 - 100(1) \Rightarrow \boxed{M(1) = 0Nm}$$

→ Evaluamos en $V_V = 0$ para determinar z.

$$\frac{100}{3}z^2 - 200z + 200 = 0$$

$$\frac{z^2}{3} - 2z + 2 = 0 \begin{cases} z_1 = 1{,}2679m \\ z_2 = 4{,}7321m \text{ N/A} \end{cases}$$

$z_2 \notin \{z \in \mathbb{R} / 0 \leq z \leq 3\}$

Ahora evaluamos $z = 1{,}2679m$ en $M_V(z)$

$$\boxed{M_V(1{,}2679) = 184{,}53Nm}$$

→ En el Tramo VII $V_{VII} = 0$ en $z = 1m$

$$\Rightarrow M_{VII}(1) = 300 + 100(1) - \frac{100}{2}(1)^2 \ [Nm]$$

$$\boxed{M_{VII}(1) = 350Nm}$$