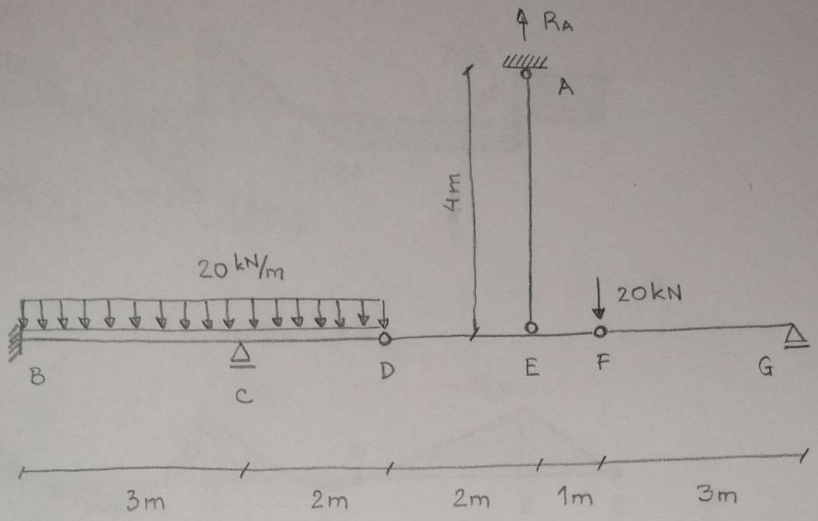
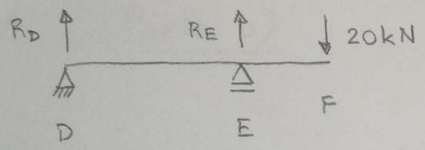
Parte a)

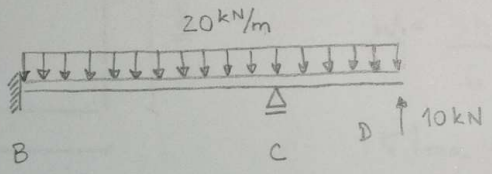




$\Sigma M_E = 0 \longrightarrow R_D = -10\,kNm$

$\Sigma F_V = 0 \longrightarrow R_E = 30\,kNm$

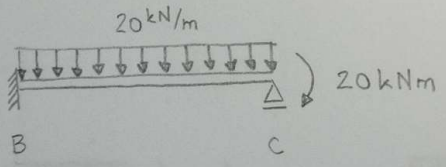
$R_A = 30\,kNm$



Estudio de C a la derecha:

$M_C = (10 \cdot 2 - 20 \cdot 2 \cdot 1)\,kNm$

$M_C = -20\,kNm$



Impongo $\theta_B = 0$ $\qquad \mathcal{L} = \frac{1}{4} q L^2$

$2M_B \cdot 3m + M_C \cdot 3m + \mathcal{L} \cdot 3m = 0$

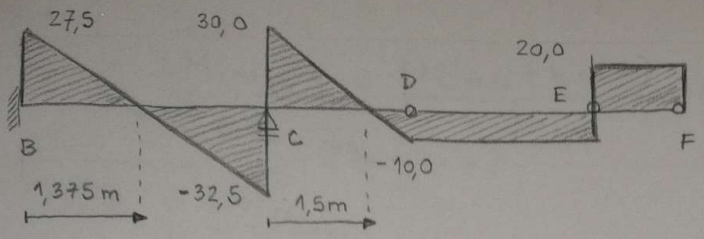
$2M_B - 20\,kNm + \frac{1}{4}(20 \cdot 3^2)\,kNm = 0 \longrightarrow M_B = -12,5\,kNm$

$M_B = -12,5\ kNm$

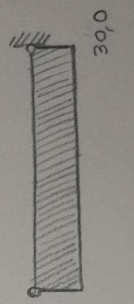
$M_C = -20\ kNm$

$\longrightarrow \begin{cases} R_B = 27,5\ kN \\ R_C^{izq} = 32,5\ kN \longrightarrow R_C = 62,5\ kN \end{cases}$

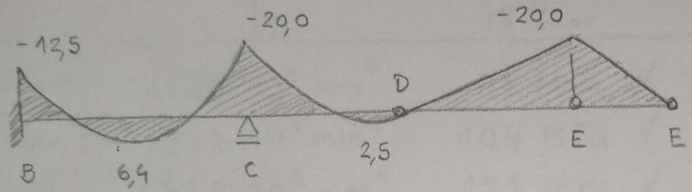
Cortante [kN]



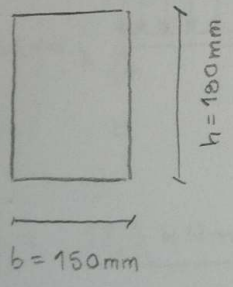
Directa [kN]



Momento [kN]



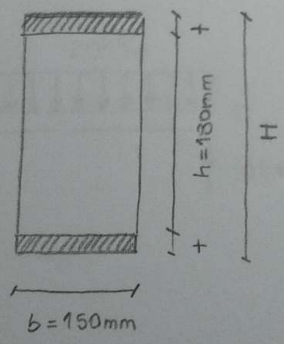
Parte b)

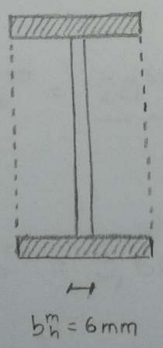


$|M|_{max} = 20\,kNm = 20 \cdot 10^6\,Nmm$

$W = \frac{bh^2}{6} \rightarrow W = 810 \cdot 10^3\,mm^3$

$|\sigma|_{max} = \frac{|M|_{max}}{W} \rightarrow |\sigma|_{max} = 25\,MPa > 4\,MPa$





Homogeinizo la sección tomando como material base al acero

$\eta = \frac{E^m}{E^a} \rightarrow \eta = \frac{1}{25}$

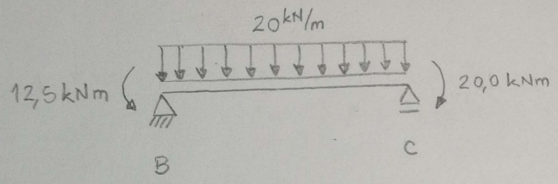
$$I_h = \frac{b_h^m h^3}{12} + 2\frac{b t^3}{12} + 2bt\left(\frac{h+t}{2}\right)^2$$

$$|\sigma^a|_{max} = \frac{|M|_{max}\, H}{2 I_h} = \frac{|M|_{max}\,(h+2t)}{2 I_h}$$

$$|\sigma^m|_{max} = \eta\,\frac{|M|_{max}\, h}{2 I_h}$$

t	I_h	$\lvert\sigma^a\rvert_{max}$	$\lvert\sigma^m\rvert_{max}$	
7 mm	$2128 \cdot 10^4\ mm^4$	91 MPa ✓	4,6 MPa ×	Toma $t = 6$ mm ←
6 mm	$1849 \cdot 10^4\ mm^4$	104 MPa ✓	3,9 MPa ✓	
5 mm	$1575 \cdot 10^4\ mm^4$	121 MPa ✓	3,4 MPa ✓	

Parte c)

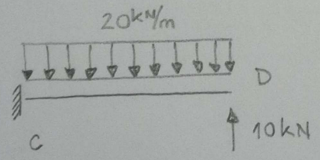


$A_{tensor} = 506,7\ mm^2$

$E^a I_h = 3698,9\ kN\,m^2$

$$\theta_C = \frac{12,5\ kNm \cdot 3m}{6\, E^a I_h} + \frac{20,0\ kNm \cdot 3m}{3\, E^a I_h} - \frac{20\ kN/m \cdot (3m)^3}{24\, E^a I_h}$$

$$\theta_C = 1,014 \cdot 10^{-3} \longrightarrow \delta_D^{BC} = \theta_C \cdot 2m \longrightarrow \delta_D^{BC} = 2,028\ mm$$



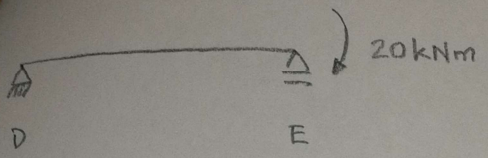
$$\delta_D^{CD} = \frac{20\ kN/m \cdot (2m)^4}{8\, E^a I_h} - \frac{10kN \cdot (2m)^3}{3\, E^a I_h}$$

$$\delta_D^{CD} = 3,606 \cdot 10^{-3}\ m \longrightarrow \delta_D^{CD} = 3,606\ mm$$

$$\delta_D = \delta_D^{BC} + \delta_D^{CD} \longrightarrow \delta_D = 5,634\ mm$$

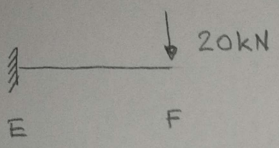
$$\delta_E = \frac{30\ kN \cdot 4000mm}{200\ GPa \cdot 506,7\ mm^2} \longrightarrow \delta_E = 1,184\ mm$$

$$\delta_F^{rígido} = -1,047\ mm$$



$$\theta_E = \frac{20\,kNm \cdot 2m}{3 E^a I_h} \rightarrow \theta_E = 3{,}606 \cdot 10^{-3}$$

$$\delta_F^{DE} = \theta_E \cdot 1m \rightarrow \delta_F^{DE} = 3{,}606\,mm$$



$$\delta_F^{EF} = \frac{20\,kN \cdot (1m)^3}{3 E^a I_h} \rightarrow \delta_F^{EF} = 1{,}803\,mm$$

$$\delta_F = \delta_F^{rígido} + \delta_F^{DE} + \delta_F^{EF} \rightarrow \underline{\delta_F = 4{,}37\,mm}$$

Ejercicio 3

Reacciones (verticales hacia arriba, horizontales hacia la izquierda).

Equilibrio vertical:

$$V_A + V_G = 67.5\ kN$$

Equilibrio horizontal:

$$H_A + H_G = 15\ kN$$

Equilibrio de momentos desde A:

$$3mR_G - 1mH_G = 92.375\ kNm$$

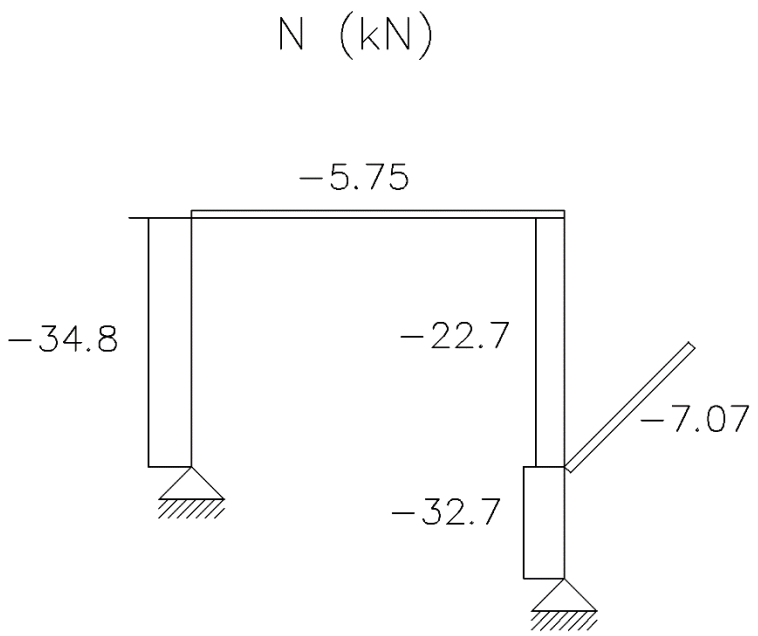
Equilibrio de momentos desde D (hacia la derecha):

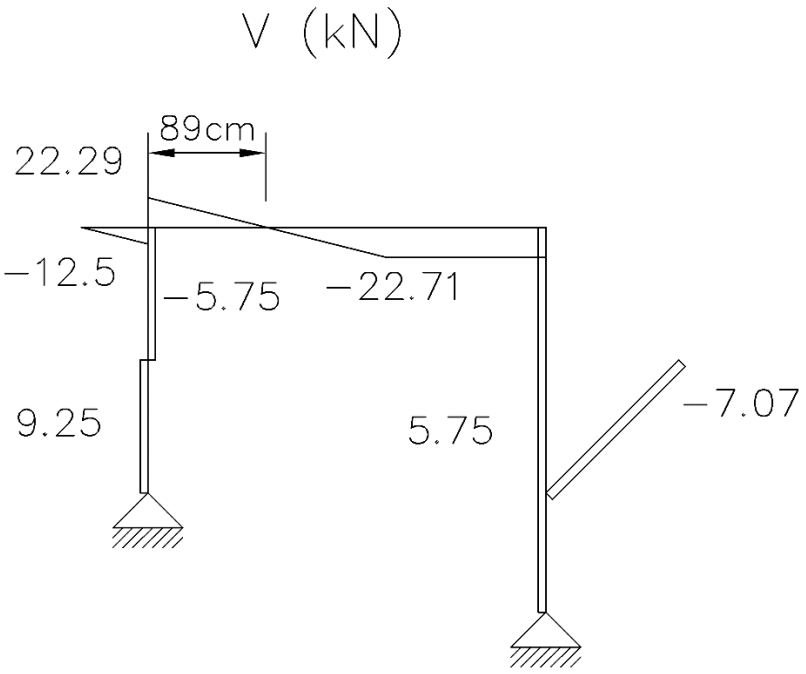
$$1.2mR_G - 3mH_G = 22\ kNm$$

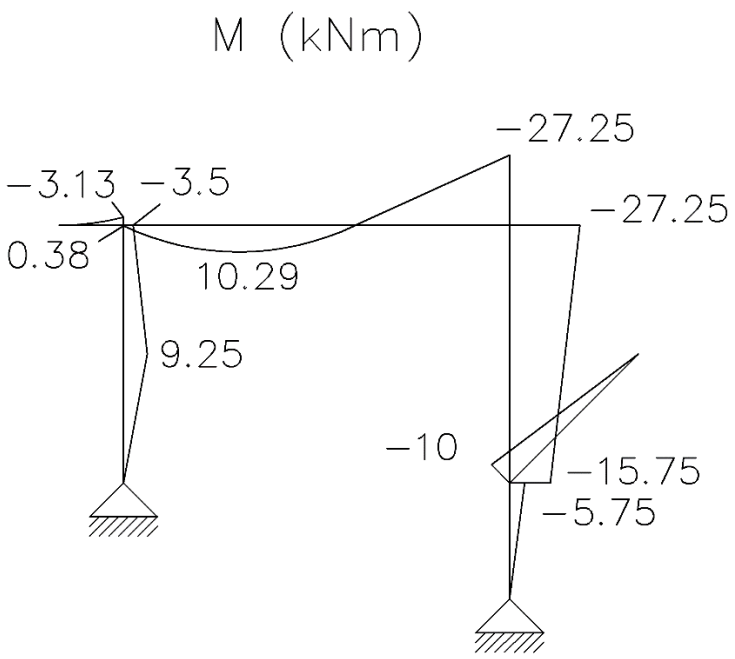
Resolviendo el sistema se obtiene:

$$V_A = 34.79\ kN$$
$$V_G = 32.71\ kN$$
$$H_A = 9.25\ kN$$
$$H_G = 5.75\ kN$$

A partir de ahí se trazan los diagramas de solicitaciones:







Se verifican las secciones:

	Sección 1		**Sección 2**		**Sección 3**	
$\tau_{max}\ (MPa)$	14.2	Verifica	13.1	Verifica	21.4	No Verifica
$\sigma_{max}\ (MPa)$	223.4	No Verifica	116.0	Verifica	125.36	Verifica

Por lo tanto se elige la sección 2.