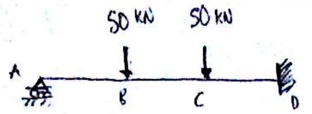
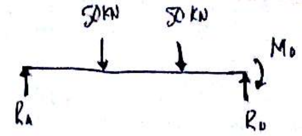
③





$+\uparrow \Sigma F_y = 0$

$R_A - 100 + R_D = 0$ --- (i)

$\circlearrowleft \Sigma M_A = 0$

$-50(1.2) - 50(2.4) + R_D(3.6) - M_D = 0$ --- (ii)

o Utilizando funciones de singularidad

$W(x) = -R_A\langle x\rangle^{-1} + 50\langle x-1.2\rangle^{-1} + 50\langle x-2.4\rangle^{-1}$

$V(x) = R_A\langle x\rangle^{0} - 50\langle x-1.2\rangle^{0} - 50\langle x-2.4\rangle^{0}$

$M(x) = R_A\langle x\rangle^{1} - 50\langle x-1.2\rangle^{1} - 50\langle x-2.4\rangle^{1}$

$EI\theta = \frac{R_A}{2}\langle x\rangle^{2} - 25\langle x-1.2\rangle^{2} - 25\langle x-2.4\rangle^{2} + C_1$

$EIy = \frac{R_A}{6}\langle x\rangle^{3} - 8.33\langle x-1.2\rangle^{3} - 8.33\langle x-2.4\rangle^{3} + C_1 x + C_2$

o Evaluando condiciones de frontera

$[x=0\ ;\ y=0] \rightarrow \boxed{C_2 = 0}$

$[x=3.6\ ;\ \theta=0] \rightarrow 6.48R_A - 144 - 36 + C_1 = 0 \rightarrow \underline{6.48R_A + C_1 = 180}$

$[x=3.6\ ;\ y=0] \rightarrow 7.776R_A - 115.15 - 14.4 + 3.6C_1 = 0 \rightarrow \underline{7.78R_A + 3.6C_1 = 129.5}$

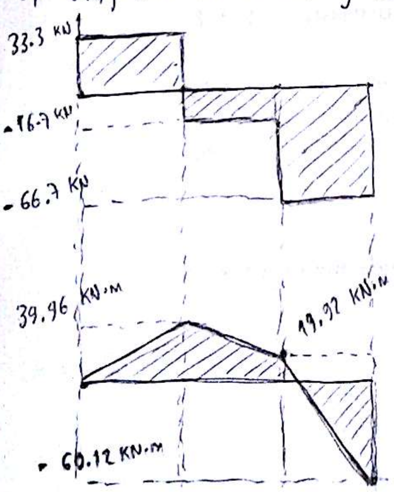
o Resolviendo para R_A y C_1 $\rightarrow$ $\begin{cases} R_A = 33.3 \text{ kN} \\ C_1 = -36.1 \end{cases}$

o De las ecuaciones de equilibrio obtenemos el valor de R_D y M_D $\begin{cases} R_D = 66.7 \text{ kN} \\ M_D = 60.12 \text{ kN}\cdot\text{m} \end{cases}$ a)

b) $\theta = \frac{1}{EI}\left[16.65\langle x\rangle^{2} - 25\langle x-1.2\rangle^{2} - 25\langle x-2.4\rangle^{2} - 36.1\right]\times 10^{3}$

$\therefore\ \theta_A = \theta(0) = -\frac{36.1\times10^{3}}{(200\times10^{9})(52.7\times10^{-6})} = \boxed{-3.43\times10^{-3}}$

c) Diagramas de cortante y momento



d) $\sigma_{max} = \frac{(60.12\times10^{3})(103\times10^{-3})}{(52.7\times10^{-6})} = \boxed{117.5 \text{ MPa}}$

$\tau_{max} = \frac{V_{max}}{A_{alma}} = \frac{66.7\times10^{3}}{(t_w)(d-2t_f)} = \boxed{46.7 \text{ MPa}}$

donde $t_w = 7.9\times10^{-3}$ m

$d = 206\times10^{-3}$ m

$t_f = 12.6\times10^{-3}$ m

c) Asumiendo que y_{max} estará en el segundo tramo, la ecuación que rige ese intervalo viene dada por:

$$y = \frac{1}{EI}\left[5.55x^3 - 8.33(x-1.2)^3 - 36.1x\right]\times 10^3$$

Derivando, igualando a cero y resolviendo para x

$$\frac{dy}{dx}=0 \rightarrow 11.1x^2 - 16.66(x-1.2)^2 - 36.1 = 0 \rightarrow -5.56x^2 + 39.98x - 60.1 = 0$$

$$x = \frac{-39.98 \pm \sqrt{(39.98)^2 - 4(-5.56)(-60.1)}}{2(-5.56)} = \begin{cases} x_1 = 2.14 \\ x_2 = 5.05\end{cases}$$

Tomamos $x = 2.14$ dado que está en el intervalo $1.2 \leq x \leq 2.4$

$$\therefore\ y_{max} = y(2.14) = -\frac{29.8\times 10^3}{(200\times 10^9)(52.7\times 10^{-6})} = \boxed{-2.83\ \text{mm}}$$