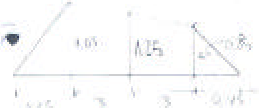
P1. $h_1(s) = (1253\,s^2 - 45.49\,s + 1250) \times 10^{-3}$

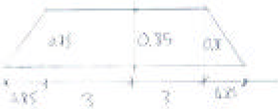
Ⓐ $S = 0 \Rightarrow h_1(s=0) = 1.250$ m

Ⓑ $S = \theta_1 R_1 = 73.82 \times 12.91 \times \frac{\pi}{200} = 14.970$ m $\Rightarrow h_1(14.970) = 2.85$ m

PARA EL TRAMO Ⓐ: $V_1 = \frac{1}{6}(S_A + 4S_m + S_B) \times L_1$ (VARIACIÓN NO LINEAL)

PARA S_m SE NECESITA $h(s = \frac{14.970}{2}) = 0.98$ m





$S_A = \frac{1.05^2}{2} + \frac{0.85^2}{2} + \frac{(0.85 + 1.05)}{2} \cdot 6$

$S_A = 9.2225\ m^2$

$S_m = \frac{1.14^2}{2} + \frac{0.75^2}{2} + \frac{(0.75 + 1.14)}{2} 6$

$S_m = 6.8573\ m^2$

$S_B = 0.85^2 + 0.85 \cdot 6$

$S_B = 5.8225\ m^2$

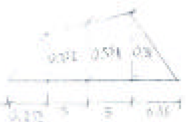
$\therefore V_1 = \frac{1}{6}(9.2225 + 5.8225 + 4 \cdot 6.8573) \times 14.970 = 105.97\ m^3$

PARA EL TRAMO ②: $V_2 = \frac{(S_B + S_C)}{2} L_2$

$L_2 = \theta_2 R_2 = 30.74 \times 77.39 \times \frac{\pi}{200} = 37.369$ m

$h_2(37.369) = 0.85 - \underbrace{0.008 \times 37.369}_{0.299} = 0.551$ m

PARA S_C:



$S_C = \frac{0.252^2}{2} + \frac{0.85^2}{2} + \frac{(0.252 + 0.85)}{2} \cdot 6 = 3.699\ m^2$

$\therefore V_2 = \frac{(5.8225 + 3.699)}{2} \times 37.369 = 177.9\ m^3$

CORRECCIÓN DE VOLÚMENES DEBIDO A LAS CURVAS:

TRAMO Ⓐ: $\begin{cases} C_{A\text{-}m} = \frac{L_1}{2R_1}(S_A \cdot e_A + S_m e_m) \\ C_{m\text{-}B} = \frac{L_1}{2R_1}(S_m e_m + S_B e_B) \end{cases}$

$e_A = \left(\frac{1.05^2}{2}(3 + \frac{1.05}{3}) + \frac{(1.05 + 0.85)}{2} \cdot 6 \cdot 1 - \frac{0.85^2}{2}(3 + \frac{0.85}{3})\right) \frac{1}{9.222}$

$e_A = 0.6556$ m

$$e_m = \left[\frac{1.11^2}{2}\times\left(3+\frac{1.11}{3}\right)+\frac{(1.11-0.25)}{2}\times 6\times 1-\frac{0.25^2}{2}\left(3+\frac{0.25}{3}\right)\right]\times\frac{1}{6.7573} = 0.244\ m$$

$$\therefore C_{A-m} = \frac{14.97}{2\times 12.91}\left(9.2225\times 0.656+6.8573\times 0.244\right) = 4.479\ m^3$$

$$C_{m-n} = \frac{14.97}{2\times 12.91}\left(6.7573\times 0.244\right) = 0.97\ m^3$$

$$\Longrightarrow V1_{corregido} = V1 + C_{A-m} + C_{m-n} = 105.97 + 4.479 + 0.97 = \underline{111.42\ m^3}$$

Tramo (2): $C_{B-C} = \frac{L_2}{R_2}\left(S_B\,e_B + S_C\,e_C\right)$

$$e_C = \left[\frac{0.75^2}{2}\times\left(3+\frac{0.75}{3}\right)+\frac{(0.75-0.252)\times 6}{2}\times 1-\frac{0.252^2}{2}\times\left(3+\frac{0.252}{3}\right)\right]\times\frac{1}{3.699} = 0.779\ m$$

Luego

$$C_{B-C} = \frac{37.309}{77.34}\left(3.699\times 0.779\right) = 1.39\ m^3$$

$$\Longrightarrow V2_{corregido} = V2 + C_{B-C} = 177.9 + 1.39 = \underline{179.29\ m^3}$$

Finalmente: $V_{TOTAL} = V1_{corregido} + V2_{corregido} = 111.42 + 179.29$

$$\boxed{V_{TOTAL} = 290.71\ m^3}$$

Si para el tramo (1) se utiliza la fórmula lineal: $V1 = \frac{S_A + S_B}{2}\times L$

$$V1 = \left(\frac{9.2225+6.8573}{2}\right)\times 14.97 = 120.357 \qquad C_{A-B} = \frac{L_1}{R_1}\left(S_A e_A + S_B e_B\right) = \frac{14.97}{12.91}\times 9.2225\times 0.656 = 7.015\ m^3$$

$V1^c = 127.37\ m^3$

$\Delta V1 = 15.95\ m^3$ Si el precio del vol. de relleno es de \$15000 → hay un ahorro de \$239.250 → despreciable para este tipo de proyecto