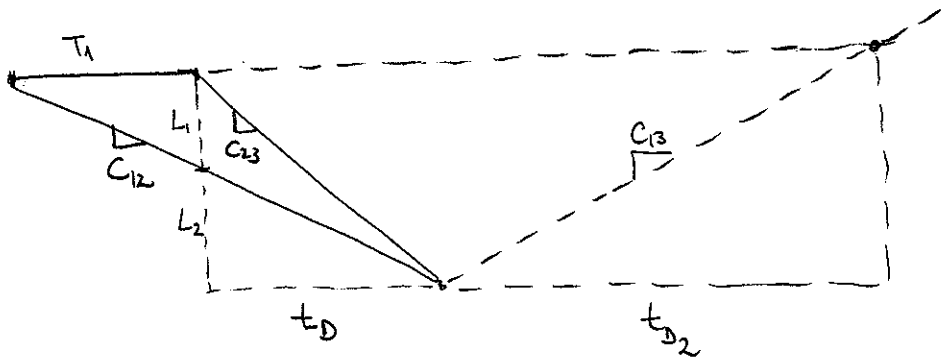
CI43C-C1

P4

- T_1 : autopista bloqueada
  t_D : tpo disipación cola.

(Caso simple) : cálculo de largo y tiempo de disipación de cola.



$$\frac{L_1+L_2}{t_D} = C_{23}$$

luego $t_D = \frac{L_1+L_2}{C_{23}}$

además $\frac{L_1}{T_1} = C_{12} \Rightarrow L_1 = C_{12}T_1$

$\frac{L_2}{t_D} = C_{12} \Rightarrow L_2 = C_{12}t_D$

$$t_D = \frac{C_{12}(T_1+t_D)}{C_{23}}$$

$t_D C_{23} = C_{12}T_1 + C_{12}t_D$

$t_D(C_{23}-C_{12}) = C_{12}T_1$

$$\boxed{t_D = \frac{C_{12}T_1}{C_{23}-C_{12}}}$$

y además : $\frac{L_1+L_2}{t_{D_2}} = C_{13}$

luego

$$\boxed{t_{D_2} = \frac{L_1+L_2}{C_{13}} = \frac{C_{12}}{C_{13}}T_1\left(1+\frac{C_{12}}{C_{23}-C_{12}}\right)}$$

luego

$\boxed{L_1 = C_{12}T_1}$ largo orginal cola

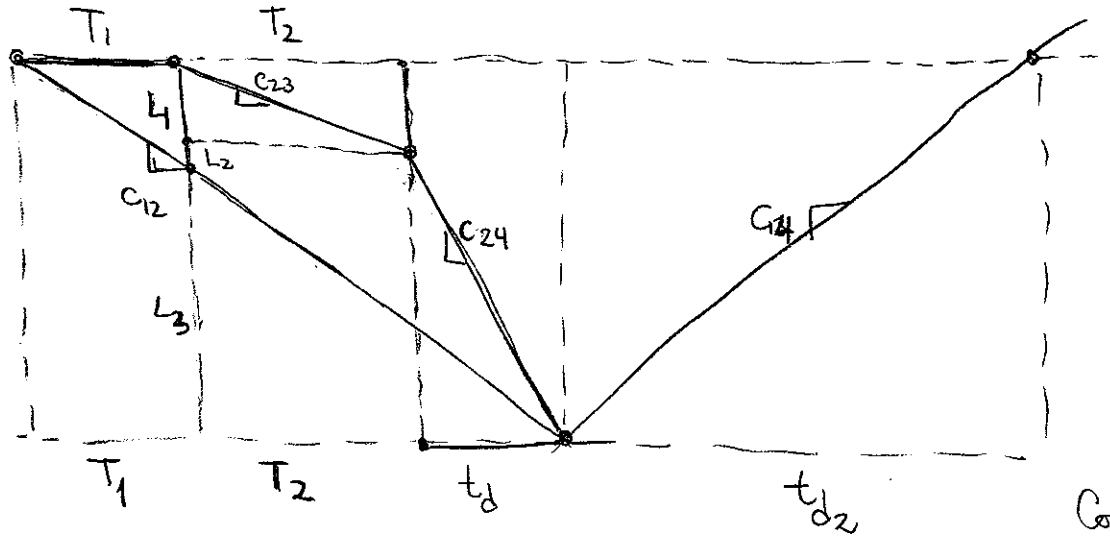
$\boxed{L_2 = \frac{C_{12}^2 \cdot T_1}{C_{23}-C_{12}}}$ Largo extra

$$\boxed{L_1 + L_2 = C_{12}T_1\left(1+\frac{C_{12}}{C_{23}-C_{12}}\right)}$$

CI43C-C1

P4

Caso más complejo (corresponde a P4)



Cola afectada

$L_{TOT} = L_1 + L_2 + L_3$

Tiempo de disipación

$T_D = T_1 + T_2 + t_d$

Vuelta a cond normales

$T_V = T_D + t_{d2}$

$$\frac{L_1+L_2}{T_1} = C_{12} \Rightarrow L_1+L_2 = C_{12}T_1 \Rightarrow \boxed{L_2 = C_{12}T_1 - L_1}$$

$$\boxed{L_2 = C_{12}T_1 - C_{23}T_2}$$

$$\frac{L_1}{T_2} = C_{23} \Rightarrow \boxed{L_1 = C_{23}\cdot T_2}$$

$$\frac{L_2+L_3}{t_d} = C_{34} \Rightarrow L_3 = C_{24}t_d - L_2 = C_{24}t_d - C_{12}T_1 + L_1$$

$$\boxed{L_3 = C_{24}t_d - C_{12}T_1 + L_1}$$

$$\boxed{L_3 = C_{24}t_d - C_{12}T_1 + C_{23}\cdot T_2}$$

$$\frac{L_1+L_2+L_3}{t_{d2}} = C_{14}$$

luego $$\boxed{t_{d2} = \frac{L_1+L_2+L_3}{C_{14}} = \frac{C_{24}t_d + C_{23}T_2}{C_{14}}}$$

$$\frac{L_3}{T_2+t_d} = C_{12} \Rightarrow C_{12}(T_2+t_d) = C_{24}t_d - C_{12}T_1 + L_1$$

$$C_{12}T_2 + C_{12}t_d = C_{24}t_d - C_{12}T_1 + L_1$$

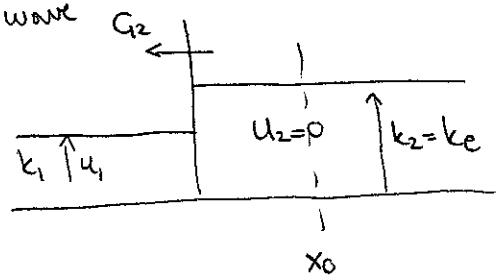
$$t_d(C_{12} - C_{24}) = C_{23}T_2 - C_{12}(T_1+T_2)$$

$$\boxed{t_d = \frac{C_{23}T_2 - C_{12}(T_1+T_2)}{(C_{12}-C_{24})}}$$

P4

$$Q = \frac{u_f k_e}{4} = \frac{80 \times 80}{4} = \frac{6400}{4} = 1600 \text{ veh/hr-pista} = 3200 \text{ veh/hr}$$

stopping wave



$C_{12} = u_f [1-(\eta_1+\eta_2)]$ con $\eta_2 = 1$

$u_1 = 65$ km/hr.

$q_1 = 1950$ veh/hr

Como $q = ku \Rightarrow k_1 = \frac{q_1}{u_1} = \frac{1950}{65}$

$k_1 = 30$ veh/km $\Rightarrow$ $\frac{k_1}{k_e} = \frac{30}{160} = 0.1875$

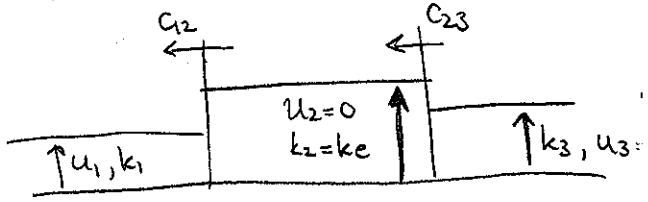
$u_f = 80$ km/hr.

Luego

$$C_{12} = u_f(-\eta_1) = -15 \text{ km/hr.}$$ (1.2 pts)

Paran 15 min. (autopista cerrada)

$T_1 = 15$ min

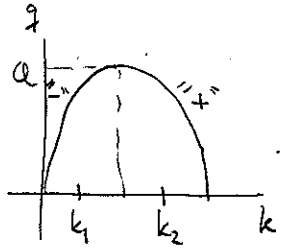


$$k_3 = \frac{k_e}{2}\left[1 \pm \sqrt{1-\frac{q_i}{Q}}\right]$$

Con $k_e = 160$ veh/km

$k_3^+ = 136.57$ veh/km

$k_3^- = 23.43$ veh/km

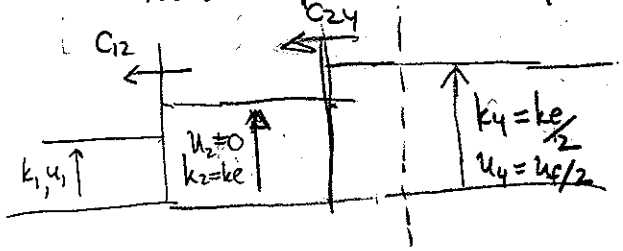


Luego $C_{23} = u_f(1-(\eta_2+\eta_3))$

$$C_{23} = 80\left(1-\left(1+\frac{23.43}{160}\right)\right) = -11.72 \text{ km/hr.}$$ (1.2 pts)

Acá, cuenta $k_3^- = 23.43$ veh/km

No se disipa la cola en T_1+T_2. Luego las condiciones son $k_4 = k_e/2 = 80$ veh/km descargando $Q = 3200$ veh/hr.

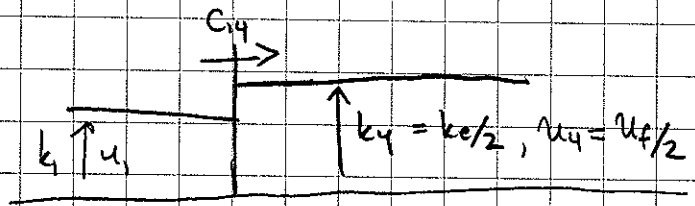


$$C_{24} = 80\left[1-\left(1+\frac{1}{2}\right)\right]$$

$$C_{24} = -40 \text{ km/hr}$$ (1.2 pts)

P4)

Una vez que se termina el régimen 2, el tráfico comienza a volver a tráfico normal, es decir



$$C_{14} = 80\left[1 - \left(\frac{30}{160} + \frac{1}{2}\right)\right]$$

$$\boxed{C_{14} = 25 \text{ km/hr.}}$$

(1.2 pts)

Luego es posible calcular todas las distancias y tpos. de disipación (tal como en página 2)

Así

$$T_1 = T_2 = 15 \text{ min} = 0.25 \text{ hrs}$$

Entonces

$$L_1 = C_{23} T_2 = 11.72 \times 0.25 = 2.93 \text{ kms.}$$

$$L_2 = C_{12} T_1 - L_1 = 15 \cdot 0.25 - 2.93 = 0.82 \text{ kms.} \quad (3.75 - 2.93)$$

$$t_d = \frac{11.72 \cdot 0.25 - 15(0.5)}{15 - 40} = \frac{-4.57}{-25} = 0.1828 \text{ hrs.} \approx 11 \text{ mins.}$$

luego $L_3 = 40 \times 0.1828 - 15 \cdot 0.25 + 11.72 \cdot 0.25 = 6.452$ kms.

Largo total afectado

$$L_T = L_1 + L_2 + L_3 = 3.75 + 6.452 = 10.202 \text{ kms.}$$

y además $t_{d_2} = \frac{10.202}{25} = 0.41 \text{ hrs.} \approx \underline{24.5 \text{ mins.}}$

Tpo total en volver a condiciones normales luego de los 30 min ($T_1 + T_2$)

$$T_{tot} = t_d + t_{d_2} = 11 + 24.5 = \underline{35.5 \text{ min}}$$