4.1.

(a) $K_0(x) = K_c(1+x)$

$u = 100$ Km/hr

$w = 20$ Km/hr

$K_c = 25$ veh/hr

$Q_{max} = 2500$ veh/Km

$K_0(x_B') = K_c$

$\Rightarrow K_c(1+x_B') = K_c$

$x_B' = 0.$

$x_U = x - 100t$

$x_D = x + 20t$

$$G(x) = \int_x^5 K_0(x)\,dx = 25\left[\left(x + \frac{x^2}{2}\right) + 5 + \frac{5^2}{2}\right]$$

$$= 437.5 - 25x - 12.5x^2$$

$$f(x_U) = G(x_U) = -125000t^2 + 2500tx + 2500t - 12.5x^2 - 25x + 437.5$$

$$f(x_D) = G(x_D) + k(x_D - x)$$

$$= -5000t^2 - 500tx + 2500t - 12.5x^2 - 25x + 437.5$$

$$f(x_B') = G(x_B') + (t-0)Q - (x-0)K_c$$

$$= 2500t - 25x + 437.5$$

(X) not used

However $\frac{dK_0}{dx} = K_c > 0$.

So, $x_B' = 0$ is not an option.

$$\boxed{N(t,x) = \min\{f(x_U), f(x_D)\}}$$

eqn of shock trajectory:

$f(x_U) = f(x_D)$

$\Rightarrow -125000t^2 + 2500tx = -5000t^2 - 500tx$

$\Rightarrow 3000tx = 120000t^2$

$$\boxed{x = 40t}$$