ABSTRACT

This thesis, entitled *Simulation of head-on queues: Case of rail-highway grade crossings* tries to build a simulation model to study the interaction of opposing queues of traffic that are formed due to the presence of a barrier. India has a vast road network summed up with a vast rail network. So, rail-highway grade crossings are often found on Indian roads. If there is a gate closing, vehicles at these crossings often wait for long periods of time and queues formations occur on either side of the barrier. This is a common phenomenon which is found at these rail-highway grade crossings. It is important to study these head-on queues as the delay of the vehicles caused at these intersections varies widely depending on the shape of the queues formed and the type of vehicle like cycle, scooter, car etc.

A bi-directional road is taken for the analysis and the formation of the queues (Stacking) and the way they dissipate (Dissipation) on either side of the barrier are represented realistically. A model is developed which represents the movements of different types of vehicles in a realistic sense. It makes an attempt to study the delay characteristics formed these rail-highway grade crossing. The queue formation on either side of the barrier with the increase in the gate closure time will be as shown in the Figure 1.

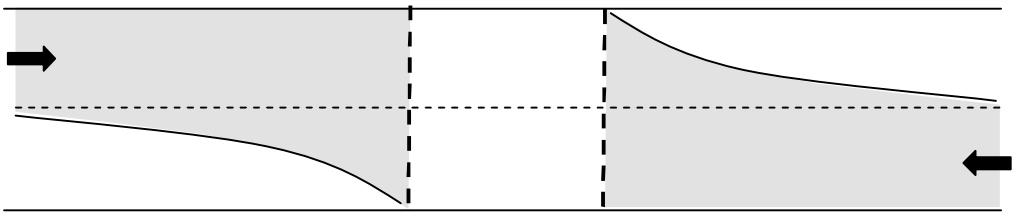

Figure 1: Shape of queues formed on either side of the barrier

It can be seen that the queues formed are not limited to the left lanes. The infiltration occurs to the other lane in the form of smaller vehicles which instead of waiting at the end of the queue waits at the barrier. The queues are formed in such a way that once the barrier is removed they should collide. But this is not happening and the vehicles are taking necessary action to avoid head-on collisions. The model can handle

the varied nature of the vehicles ranging from cycles and rickshaws to cars and trucks. The model proved to be effective in representing the vehicular movements generally found at these intersections. Like the absence of opposing traffic encourages the vehicles to occupy places in the wrong lane. Also the movements of the vehicles changes with the removal of the barrier resulting in interactions between the head-on queues and every vehicles tries to be a part of the left lane in order to escape from the opposing traffic. In addition to these a loss process phenomenon is also included in the model. It models a certain percentage of vehicles which pass through the barrier even if it is closed. A few other behaviors like similarity which makes smaller vehicles to stay close to each other are incorporated. The factors that effect the delay and the effect of provision of certain design features are discussed. A tool called Cellular Automata(CA) is used to model the above stated behaviors of the vehicles. The idea of CA lies in idealizing a physical system where space and time are discrete. It divides the whole road in the form of small cell lattice as show in the Figure 2. The state of cells is updated continuously with the help of position update rules which define the whole system.

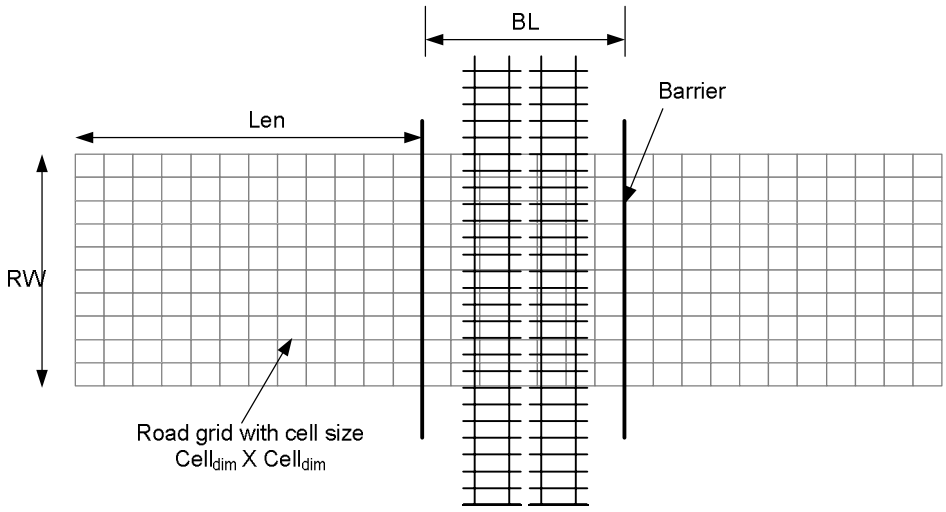

Fig 2 : The road section over which the simulation is done

A field survey was conducted at a local rail-highway grade intersection in Kanpur city and the validation of the model is also carried out. The Figures 3 and 4 shows the stacking and the dissipation processes on the bi-directional road. The numbered vehicles in the Figure 3 are not seen in the next time steps. These vehicles are lost after reaching the barrier. The figure 4 shows the interactions between opposing flows for various time steps.

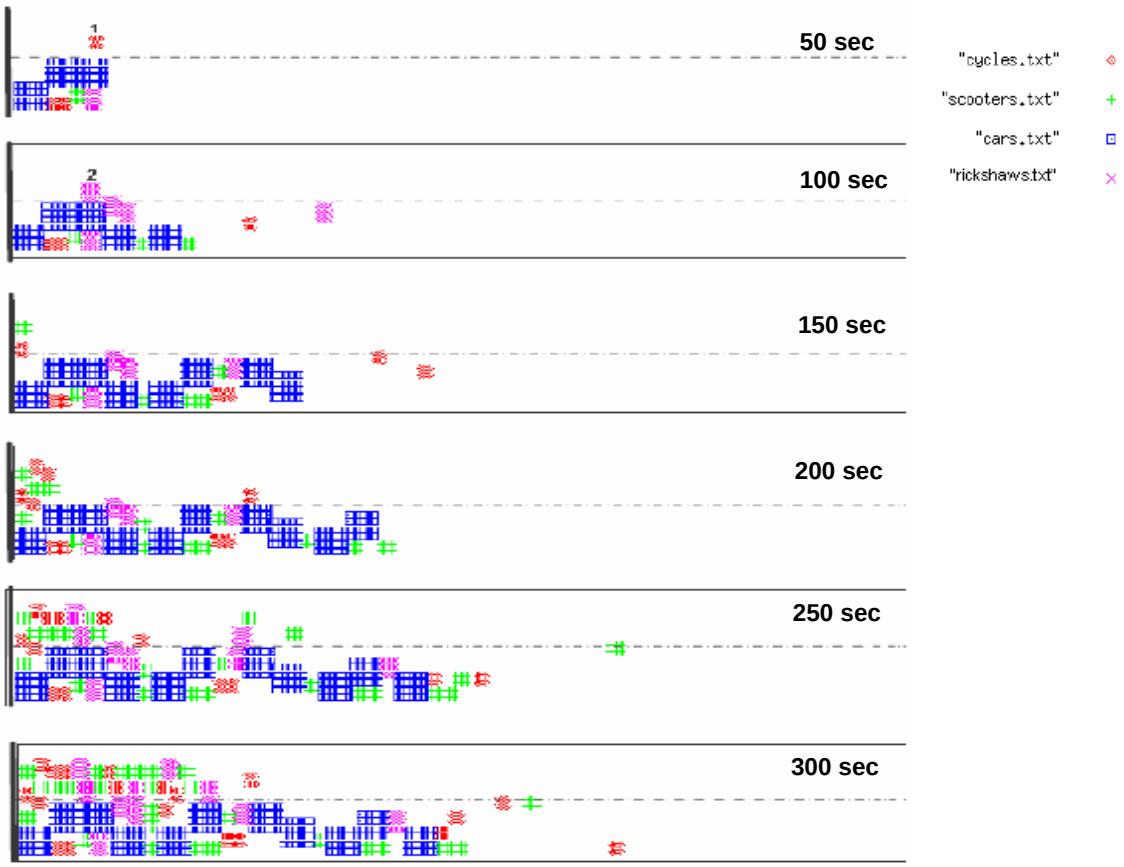

Figure3: Stacking process on single side of the barrier

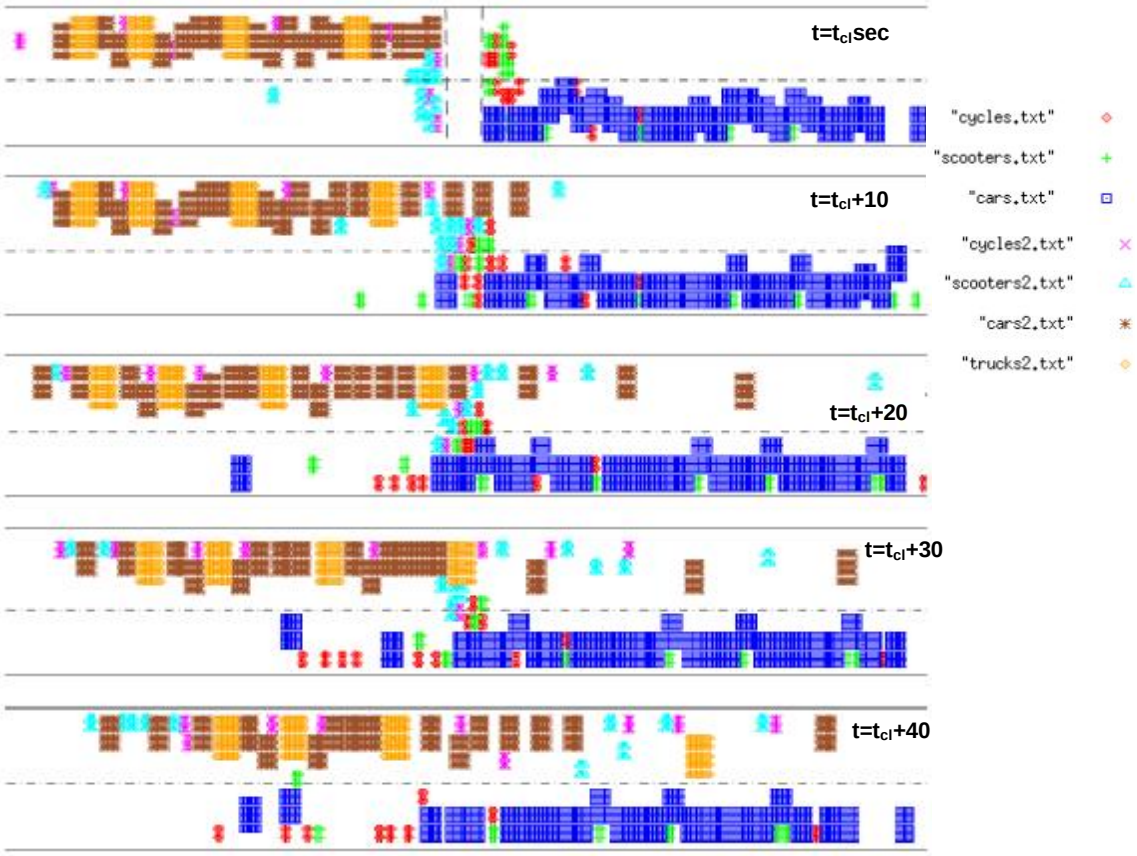

Figure 4: Dissipation Process after the removal of the barrier