Survey on Influence of Heavy Vehicle on Traffic Flow at Urban Roads.

Swapnil G. Pokulwar  
M. Tech Scholar  
Department of Civil Engineering  
G. H. Raisoni College of Engg, Nagpur  

Kuldeep Dabhekar  
Professor  
Department of Civil Engineering  
G. H. Raisoni College of Engg, Nagpur  

Bhalchandra Khode  
Professor  
Department of Transportation Engineering  
G. H. Raisoni College of Engg, Nagpur

Abstract

This research paper describes the impact of heavy vehicles on traffic flow at urban road. A number of factors that are thought of as determinants of this effect were considered in this investigation. The data are collected from the selected patch of 60 m from Hingna T-point to CRPF gate, Nagpur. Data collection is done with the help of video filming technique and data are collected at peak hour and off-peak hour. Some important parameter is considering such as traffic parameter (speed, time, and flow), the capacity of the lane, percentage of heavy vehicles, & congestion for this project. While the study results suggest some similarities between free-flow and congested traffic regimes concerning heavy vehicles. Some important dissimilarities exist due to the different mechanisms that govern heavy vehicles.

Keywords: Heavy Vehicle, Traffic Flow Parameter, Traffic Congestion, Capacity of lane, Passenger Car Equivalency, Impact

I. INTRODUCTION

The quantity of heavy vehicles and their proportion in traffic flow has risen significantly over the past decades, and this trend is likely to continue. Heavy vehicles or larger dimension vehicle is known for their substantial effect on traffic due to their larger dimension and mediocre performance compared to the smaller dimension vehicles. These heavy vehicles or larger dimension vehicles comprise bus, truck, recreational vehicle with different categories having an extensive variety of size, power and design concept. The Heavy vehicle or larger dimension vehicle needs larger road surface on the road, and due to their larger dimension they are not as much flexible as compared to the smaller dimension vehicle and because of this reason these heavy vehicle travels with slow speed as compared to the smaller dimension vehicles. When these heavy vehicles enter the traffic stream it affects the different parameter of the traffic stream. Heavy vehicle’s impact on traffic flow is usually attributed to two essential factors. First, the average space occupied by a heavy vehicle is more than that taken up by a typical passenger car. (Hesham Rakha et al, 2005) This is mainly because the dimensions of heavy vehicles are mostly larger than those of passenger cars and the average gaps in front of and behind heavy vehicles are larger than those related with passenger cars. Second, the operational characteristics (acceleration, deceleration, maneuverability, etc.) of heavy vehicles are dissimilar from those of smaller dimension vehicles.

There are two main traffic related issues associated with heavy vehicles in urban areas, namely: delays that they may cause to other vehicles and safety related effects. These are connected in urban areas, as accidents involving heavy vehicles create delays, while congestion affects the possibility of accidents. The use of heavy vehicles that are capable of carrying increased loads has sustained increase rapidly. Such vehicles, such as Buses, Trucks and other large sized vehicles. Three factors contribute to the impact of heavy vehicles on roads: the large size of trucks; the operating capabilities of trucks that are poorer to cars; and the physical impact on nearby cars and psychological effect on the drivers of those cars. It has been proposed by a number of authors that the presence of a truck in front of a passenger car may result in the driver being more careful due to the large size of the vehicle and the diminished sight distances (Maree Lake et al, 2002). Thus, the headways of the vehicles (not just the headways of the heavy vehicles), in mixed traffic may be more, effecting capacity, delays and congestion.

II. LITERATURE SURVEY

Heavy vehicles or larger dimension vehicles have dissimilar physical and operational characteristics (e.g., size, acceleration and deceleration capability) than the smaller dimension vehicles or passenger cars. The dissimilar behavior of heavy vehicle and smaller dimension vehicles in the traffic stream has been acknowledged on urban roads. They also have different behavior while following alternative vehicle. (Huddart et.al, 1990 and Sayer et al. 2000) described that passenger car drivers possess shorter
space headway behind heavy vehicles than passenger vehicles. (McDonald et al. 1997 and Yoo and Green 1999) concluded that the space headway before passenger cars is smaller when following another passenger car than a heavy vehicle. (Rakha et al. 2001) pointed to different function of heavy vehicles from that of passenger cars in terms of maximum acceleration that can be applied by each vehicle type. This study estimate, heavy vehicle maximum acceleration on the basis of the tractive exertion and aerodynamic properties of the vehicles and the grade and rolling resistance forces. (Peeta et al. 2005) considered the communication between passenger cars (smaller dimension vehicles) and heavy vehicles by introducing a nervousness level for passenger car drivers in the vicinity of heavy vehicles. The presence of heavy vehicles in the traffic stream can therefore cause diverse influences on the behavior of the surrounding vehicles than that of passenger cars (Stuster 1999; Kostyniuk et al. 2002).

A. Impact on Traffic Flow Parameter:

Heavy vehicles cause’s lots of inconvenience because of their larger dimension they are less flexible and travels with slower speed and acceleration and deceleration rate as compared to smaller dimension vehicle. Heavy vehicles or larger dimension vehicles affect the different traffic parameters of traffic when comes in contact with urban traffic or road mainly in term of speed, flow, travel time and density. When this heavy vehicle or larger dimension vehicles comes in contact with urban traffic it affects the traffic flow of smaller dimension vehicles. Heavy vehicles travel with slow speed and when this heavy vehicle comes in traffic stream it affects the speed, travel time of smaller dimension vehicles and as when the percentage of heavy vehicle increases the capacity of lane decreases hence there is formation of queue at the back of these heavy vehicle and time require to cover the distance of smaller dimension vehicles behind the heavy vehicle increases.

B. Effect of Heavy Vehicles During Congestion on Urban Road:

Several factors that are supposed of as determinants of this influence were considered in this investigation. Empirical data and microscopic traffic simulation were used in the investigation. The simulation model was calibrated and validated using field data. One site is located on level terrain while the other is located on a 1-km long 3% upgrade. (Al-Kaisy et al. 2002) The influence of heavy vehicles during congestion is significantly larger than that during free flow Conditions. This is generally due to the fact that the acceleration and deceleration cycles, a condition normally experienced during congestions or the stop-and-go conditions, impose an additional restriction on the performance of heavy vehicles. The passenger car equivalency factors provided in the HCM for uncongested flow mostly underestimate the influence of heavy vehicles on the traffic stream after the beginning of congestion, and their use for congested Conditions would involve a substantial amount of error. As congestion on urban roads has become ordinary, and many traffic engineers need to deal with congested facilities more or less on a daily basis, there is a fascinating need to develop PCE factors that authentically reflect the heavy vehicle’s effect during congestion. Simulation experiments were performed using the calibrated model at the two study locations. Passenger car equivalency (PCU) factor derived from queue discharge flow was expended as an indicator of heavy vehicles effect. Several essential factors on the influence of heavy vehicles during congestion using empirical data and traffic imitation. These factors involve grade length, grade, and lane use restriction by vehicle type, percentage of heavy vehicles, and the location of bottleneck relating to grade. This examination is estimated very essential due to the fact that recurrent and non-recurrent bottlenecks have become commonplace on urban roads and various traffic engineers need to deal with congested services on a regular basis. Further, not any guidance exists in the present practice concerning the treatment of heavy vehicle’s effect during congestion (Ahmed al-kaisy et.al, 2005).

C. Passenger Car Equivalency:

The Highway capacity manual (HCM) uses passenger car equivalency (PCE) factors for evaluation of the impact of heavy vehicles on traffic stream manners under free-flow situations. However, these factors have been used by specialists to organize analyses for all traffic conditions, i.e. free-flow as well as congested flow conditions. Recent empirical evidence recommends that the PCE factors for free-flow conditions largely underestimate the influence of heavy vehicles after the beginning of congestion. The current study aims at developing PCE factors for heavy vehicles on urban road during congestion. The study uses empirical data and microscopic traffic simulation to develop a set of PCE factors on level terrain and definite upgrades during congestion. The format of the suggested PCE factors is very similar to that of the HCM passenger car equivalency factors for free-flow conditions. It is believed that the use of the suggested PCE factors of oversaturated conditions will help to largely develop the estimate of heavy vehicles’ effect when congestion is present. The PCE factors proposed by the current research effort are enormously helpful in advancing the accuracy of the many traffic analyses when congestion exists. Examples of these analyses are queuing and congestion in work zones, recurrent freeway congestion in urban areas, and lane closures due to incidents and accidents. The recommended PCE factors are intended to complement those specified by the HCM as the latter does not apply to oversaturated traffic conditions (Younghan Jung et.al, 2005).

D. Impact of Heavy Vehicle Interactions in Car-Following:

Heavy vehicles thus influence other traffic in a different way than passenger vehicles, causing different levels of traffic variability. Increasing the number and proportion of heavy vehicles in the traffic stream may result in quite dissimilar traffic flow characteristics. The different car-following behavior of teamsters in congested heterogeneous traffic conditions. It specifically
focuses on the presence of heavy vehicles in general traffic and their communication with other vehicles. The Four different combinations of passenger car and heavy vehicle were studied. These combinations comprise passenger car-following a passenger car, heavy vehicle following a passenger car, passenger car following a heavy vehicle, and heavy vehicle at the back of another heavy vehicle. A data set from a freeway was used to display the different car-following behavior of drivers for every single combination. (Kayvan Aghabayk and William Young et.al, 2012) This study analyses space and time headways, vehicle accelerations, and drivers’ reaction times. It also introduces various car-following thresholds for each car-following combination. So, it was found that the presence of heavy vehicles causes more space and time headways, longer reaction time, and more robust car-following behavior.

E. Effect of Heavy Vehicles Percentage:

The first phenomenon is that as the number of heavy vehicles increases, the probability of occupying the two lanes at the location of the bottleneck by heavy vehicles would increase thus intensifying the impedance to traffic and subsequently the PCE factor. The additional phenomenon is that a higher percentage of heavy vehicles would increase the probability of successive arrivals of heavy vehicles at the bottleneck location (platooning). The influence of these consecutive arrivals (platoons) of heavy vehicles on smaller vehicles in the traffic stream would be obstructively lower than the sum of their discrete effects on traffic if arrived separately. Heavy vehicles accelerating and decelerating on the upgrade at the location of bottleneck would reason few impedance on other heavier vehicles than on passenger cars and other smaller dimension vehicles. Apparently, the impact of the first phenomenon is major at level terrain and low grades while the effect of the second phenomenon is most obvious at the steeper grades where the acceleration function of heavy vehicles climbing the upgrade becomes a critical issue (Younghan Jung et.al, 2005).

III. Conclusion

The impact of heavy vehicle on the smaller dimension vehicle is a critical issue in urban roads. In this paper, make a minor effort to put together some ideas and strategies which relate to the on urban traffic impacts. From the examination work, it was found that heavy vehicles are responsible for congestion and other complications on urban roads.

REFERENCES