

Study on Effect of Mixed Traffic in Highways

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Abstract — Heterogeneous traffic composed of both motorized and non-motorized vehicles are a common feature of Indian roads. In India there are no separate lane of non-motorized vehicles and motorized vehicles, therefore the theoretical models fail to analyse the situation completely. This research mainly analyses the impact of non-motorized vehicles on overall performance of traffic parameters. The use of non-motorized transportation such as cycling and walking is not only to reduce carbon but also healthy lifestyle and a physical activity. Non-Motorized Transportation includes all forms of travel that do not rely on an engine or motor for movement. This includes walking and bicycle, and using small-wheeled transport and wheelchair. These modes of transport can provide both recreation and transportation. For example, some people will choose to walk or bicycle rather than drive because they enjoy the activity. The importance of non-motorized transport can be summarized as In traffic engineering, speed is considered to be crucial part as it is directly or indirectly related with the geometric speed, traffic operations, congestion and capacity. If traffic is heterogeneous or mixed traffic, speed is affected as there is dependence of the variation and proportion of non-motorized vehicles like cycles, tricycles, cycle rickshaws, bullock carts and hand driven carts. 'Non-Motorized Vehicles' is refereed to different types of pedal powered vehicles used on the road. In developing countries like India, we generally can find heterogeneous or mixed traffic i.e. a traffic flow constituting of different types of vehicles like cart, cycle, rickshaw, car, bus etc. In Indian cities the share of non-motorized traffic at peak hours is almost more than 50 per cent. This share is even higher in medium-sized and small-sized cities. Different cities have different patterns of NMT use. Every public transport mode of transport involves access trips by NMT at each end. The flow of mixed or heterogeneous traffic is quite complicated. This mixed flow of vehicles leads to many problems like conflicts at intersections when number of non-motorized vehicle increases, when number of non-motorized vehicles increases it affects the speed and flow of other vehicles. It significantly lowers or reduces the capacity also leads to various safety problems.

Keywords — Non-motorized vehicles, mixed traffic, traffic congestion, traffic capacity.

1. INTRODUCTION

In developing countries like India, we generally can find heterogeneous or mixed traffic i.e. a traffic flow constituting of different types of vehicles like cart, cycle, rickshaw, car, bus etc. In Indian cities the share of non-motorized traffic at

peak hours is almost more than 50 per cent. This share is even higher in medium-sized and small-sized cities. Different cities have different patterns of mixed traffic use. Every public transport mode of transport involves access trips by motorize and non motorize at each end. Thus, mixed traffic plays a very important role in meeting travel demand in countries like India. The characteristics of sustainable transport are safe, comfortable and efficient in terms of economic and energy consumption and minimize environmental pollution. Today, transportation systems in most cities are no longer sustainable due to lack of natural materials such as oil reserves, increasing the number of deaths and injuries by motor vehicle accidents and traffic congestion. The carbon emissions into the atmosphere contribute to environmental pollution in terms of quality deficiencies that affects mobility of life in general. This study aimed is to design sustainable transport in terms of mixed vehicle for a city that promises a better world for future generations. It provides strategies to change the choice of transport modes to road users of motor vehicles to non-motor vehicles through integration of land use and transportation planning. By improving pedestrian path and cycling zone to increases non-motorized travel and reduce motor vehicles travel. The use of non-motorized transportation such as cycling and walking is not only to reduce carbon but also healthy lifestyle and a physical activity. Non motorized transportation includes all forms of travel that do not rely on an engine or motor for movement this includes walking, bicycle, using small-wheeled transport (skates, skateboards, push scooters and hand carts) and wheelchair. These modes of transport can provide both recreation and transportation. For example, some people will choose to walk or bicycle rather than drive because they enjoy the activity. The importance of mixed traffic can be summarized as in traffic engineering, speed is considered to be crucial part as it is directly or indirectly related with the geometric speed, traffic operations, congestion and capacity. If traffic is heterogeneous or mixed, speed is affected as there is dependence of the variation and proportion of non-motorized vehicles like cycles, tricycle, cycle rickshaw, bullock cart and hand driven cart. Non motorized vehicles are refereed to different types of pedal powered vehicles used on the road.

The flow of mixed or heterogeneous traffic is quite complicated. This mixed flow of vehicles leads to many problems like conflicts at intersections when number of non-motorized vehicle increases, when number of non-motorized vehicles increases it affects the speed and flow of other vehicles. It significantly lowers or reduces the capacity also

leads to various safety problems. So in that case a proper study of non-motorized vehicle characteristics should be done along with study of how these non motorized vehicles affects to the mixed traffic. In this study, the data is collected from two stations i.e. Civil Hospital Derabasi and Metro Shopping Mall near fly over Zirakpur on NH-152. These locations are having high volume of traffic which includes motorized vehicles and non-motorized vehicles. a non-motorized vehicle which is slow moving vehicle act as a hurdle till it is not overtaken by the motorized vehicle. As this highway is having high traffic volume so it becomes necessary to study the effect of mixed traffic. Based on the study in the field of work, modification shall be tried to implement in the smooth traffic movement.

2. LITERATURE REVIEW

This work is based on motorized and non-motorized vehicles properties and its effect on highways hence a literature survey is done. So many studies done in this field and some of them are presented below:

A. C. Sarna., (1990) discussed the importance of non-motorized transport in India. According to her, cycle rickshaw is a popular para-transit mode that provides door-to-door service in congested parts of most Indian cities. According to the author, to improve the transport infrastructure, transportation studies should be conducted in Indian cities of all sizes so that more realistic transportation plans could be prepared in keeping with the prevalent socioeconomic environment. Greater attention was needed to be paid to non-motorized modes, pedestrians, and poorer sections of society, which formed a majority of the urban residents.

Minderhoud et al., (1997) made a research on "Assessment of Road Way Capacity Estimation Methods". The estimation methods were classified into direct empirical and indirect empirical methods. They calculated methods for finding capacities using headways, traffic volumes and speeds, traffic volumes, speeds and headways. Only two approaches are used in calculating capacity estimation, they are using observed maxima or using a set of flow observations.

Tiwari, Fazio, and Pavitravas., (2000) developed "Passenger Car Units for Heterogeneous Traffic Using a Modified Density Method." This method is very useful for Indian traffic conditions. At first all the traffic was divided into 8 groups and Indian roads into 6 groups. The camcorder recorded traffic on the video tape along with a time stand during peak hours and characteristics were obtained. This modified density method requires comparison of density for various traffic types at the same speed. One should ensure that the obtained density must be divided by the lane width to obtain the PCU values.

Md. Mizanur Rahman., (2003) examines macroscopic flow relationships of fundamental traffic parameters (speed-flow-density) for heterogeneous traffic flow based on cross-section basis. Furthermore passing/overtaking model for

heterogeneous traffic flow will be developed. The results of macroscopic flow relationships show that non-motorized vehicles have adverse effect on fundamental traffic parameter relationships. The straight line relationship observed between passing/overtaking and total volume due to data range covered the uncongested flow region. There was no clear pattern for passing/overtaking and proportion of non-motorized vehicles.

Oketch., (2003) developed a special model to investigate the effects of various non- conventional vehicles on stream performance including lane capacity and saturation flows. He concluded that such heterogeneous streams have peculiar flows that may not confirm fully to the basic traffic theories. In addition, heterogeneous flows are generally associated with higher number of lateral movements as the faster vehicles try to overtake the slower ones.

Chandra. S., (2004) conducted several studies on "Capacity Estimation Procedure for Two Lane Roads under Mixed Traffic Conditions." In this study, he considered the impact of influencing parameters like lane width, gradient, shoulder width, pavement surface conditions, traffic composition, directional split and slow moving vehicles on capacity of two-lane roads under mixed traffic conditions is evaluated and adjustment factors for each of these conditions are proposed. Based on these adjustment factors, a schematic procedure to evaluate the capacity of a two-lane road under mixed traffic conditions is proposed.

Md. Mizanur Rahman., (2005) stated that, the non-motorized vehicles (i.e. rickshaws) and small size motorized vehicles (i.e. auto-rickshaws) are popular para-transit modes that provided door-to-door service in congested parts of Dhaka metropolitan area. The objective of his study was to analyse the effects of rickshaws and auto-rickshaws on the capacity of signalized intersections. The results indicated that the estimated PCE value of rickshaws and auto rickshaws of this study are different from the assumed PCE values that were then used by traffic engineers of Bangladesh. He concluded that, at a higher proportion of the rickshaws discharge rate of mixed flow at signalized intersections was smaller than that at a lower proportion of rickshaws.

Pan and Kerali., (2007) conducted a research on the effects of non-motorized traffic flow on motorized vehicle speeds on the basis of field observations of vehicle speeds on Chinese roads. They developed a general congested speed model for predicting vehicle speeds under various road characteristics and traffic flow volumes, using the relationships of non-motorized flow effects obtained in their study along with free speed and speed-flow relationships investigated in other studies.

Dianhai, et al., (2007) made a study on bicycle conversion factor calibration at two- phase intersections in mixed traffic flows. The results indicate that the through bicycle conversion factor is 0.28 and the left-turn bicycle conversion

factor is 0.33. This conclusion differs from the values used in China.

Joseph Fazio, and Geetam Tiwari, (2008) has done an analysis of Delhi city and has plotted a few aspects like; the city of Delhi had more than 1,900 traffic fatalities in 1993. The author stated that, a positive correlation of 0.14 existed between conflict rates and fatalities for all traffic entities. The ranking of normalized conflict data and fatality data from police records for each site occurred from highest to lowest. Spearman correlations for various groups in reveal weak and moderate associations between conflict rates and fatal crashes. The author has, compared a few hypothetical scenarios and stated that Delhi has a higher proportion of NMV traffic fatalities than most other international locations.

Study Area

This study is carried out two stations i.e. Civil Hospital Derabasi area A1 and A2 and Metro Shopping Mall area B1 and B2 in Zirakpur near fly over on NH-152. These locations are having high volume of traffic which includes motorized and non-motorized vehicles. At these two locations, there is divided road so data is collected separately for traffic movement in both directions. These sections were selected such that they have high traffic of mixed traffic i.e. motorized vehicles and non- motorized vehicles. The various locations of the study area are enlisted below:

Location A1 is on RHS of Civil Hospital Derabasi on National Highway 152,

Location A2 is on LHS of Civil Hospital Derabasi on National Highway 152,

Location B1 is on RHS of Metro shopping mall near fly over Zirakpur on NH-152,

Location B2 is on LHS of Metro shopping mall near fly over Zirakpur on NH-152.

At each location, data is collected for an interval of 30 minutes i.e. Section A1 time between 8:00AM to 8:30AM, Section A2 time between 8:30AM to 9:00AM, Section B1 time between 8:00AM to 8:30AM, Section B2 time between 8:30AM to 9:00AM of the day. The session is selected because they have highest volume of traffic.

Method for Data Collection

The data is collected from various locations by video graphic method. In this method a high resolution camera Sony cyber-shot is used, which was capable to operate on 12 frames per second with tripod stand. This digital camera is 18 megapixel resolutions and it can record full HD 1080p video in both normal and wide aspect ratio.

Data Analysis and Graphical Representations

On the basis of traffic data collected, analysis is done in the form of graphical representation as shown and discussed

below. Where GVF, NMVF, MVF stands for flow of gross, non motorize and motorize vehicles and GVD, NMVD, MVD stands for density of gross, non motorize and motorize vehicles.

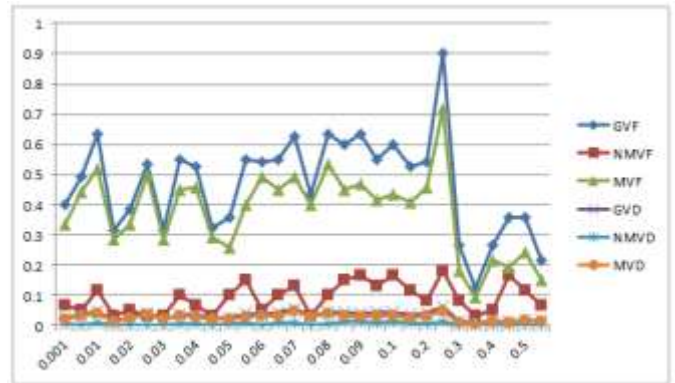


Fig. 1 Graphical representation for density and flow for location A1

Here Fig. 1 is showing density & flow graph for the data collected at location A1 at RHS of Civil Hospital Derabasi on National Highway 444. In this graph the shape of the flow and density of GV, NMV and MV are shown very clearly. It has been observed that the percentage of non-motorised vehicles are present at location A1 is 13.33%age and moterised vehicles are 86.67%age of GV.

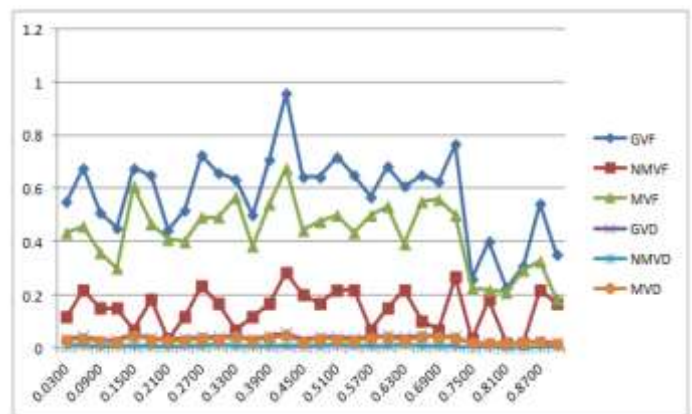


Fig. 2 Graphical representation for density and flow for location A2

Here Fig. 2 is showing density & flow graph for the data collected at location A2 at LHS of Civil Hospital Derabasi on National Highway 444. In this graph the shape of the flow and density of GV, NMV and MV are shown very clearly. It has been observed that the percentage of non motorized vehicles are present at location A1 is 16.25%age and motorized vehicles are 83.75%age of gross vehicles.

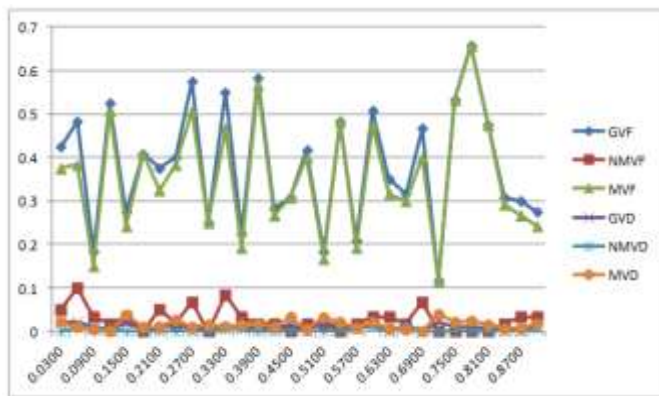


Fig. 3 Graphical representation for density and flow for location B1

Conclusions

Following are the conclusions regarding the study on effect of mixed traffic in highways:

Due to interference of non-motorized vehicles the speed of motorized vehicles are affected and more chances of occurrence of mishaps.

The mixed traffic flow is affected by non-motorizing vehicles for lane dividing principal by way of very lesser speed and very lesser size of non-motorized vehicles as compare to motorized vehicles causing lesser speed and more accidents.

The non-motorized vehicles movement be allow to move only in separate lanes-meant for them even in a mixed traffic movement.

Future Scope

Further study on individual non-motorized vehicles e.g. only bi-cycles movement, only pedestrians movement, hand carts movement etc. in motorized traffic can be carried out.

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