

A Study of Non-Motorized Vehicles on Traffic Flow Parameters

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ABSTRACT- In countries like India we generally can find a mixed traffic i.e. a traffic flow consisting of all types of vehicles like cycle, rickshaw, car, bus etc. In Indian cities the share of non motorized vehicles at peak hours is too high. In every public transport, mode of transport involves access trips by non motorised vehicles at each end. Non-motorised vehicles provide door to door service in congested parts of cities. Thus, non-motorized mode of traffic plays a very important role in meeting travel demand in countries like India. To design a traffic facility it is necessary to understand the behaviour of the traffic stream. Understanding the behaviour of a traffic stream with mixed traffic is quite complex. In this work an attempt has been made to study the effect of non-motorized vehicles on mixed traffic movement. Traffic volume data was collected from Majri Crossing and Zirakpur-Patiala Crossing for 30 minutes. This data was then analysed with the help of fundamental diagrams. It was seen that with an increase in the percentage of non-motorised vehicles the flow, density and speed are adversely affected. Density decreases at a particular flow rate when the percentage of non- motorised vehicles increases. It was seen that with increased non-motorised vehicles adversely affects the capacity of the road. Along with this, a study on the pattern of vehicular occupancy of non motorised vehicles and motorised vehicles was done.

KEYWORDS- Non-Motorised Vehicles, Motorised Vehicles, Mixed Traffic, Flow Parameters.

I. INTRODUCTION

In traffic engineering, speed is considered to be a 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 on the variation and proportion of non-motorized vehicles like cycles, tricycles, cycle rickshaws, bullock carts and hand driven carts[1]. Non-motorised vehicles referred 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 consisting of different types of vehicles like cart, cycle, rickshaw, car, bus etc. In Indian cities the share of non-motorized vehicles 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 non-motorised vehicles use. Every public transport mode of transport involves access trips by NMT at each end. Thus, non-motorized mode of

traffic plays a very important role in meeting travel demand in countries like India. The flow of mixed or heterogeneous traffic is quite complicated. This mixed flow of vehicles leads to many problems like conflicts at intersections when the number of non-motorized vehicles increases, when the number of non- motorized vehicles increases it affects the speed and flow of other vehicles[2]. It significantly lowers or reduces the capacity and 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 NMV affects the mixed traffic. According to the United Nations Millennium Development Goals (MDG) programme 270 million or 21.9% people out of 1.2 billion of Indians lived below the poverty line of \$1.25 in 20112012. And these people depend on non-motorized vehicles for transportation of goods. These people depend on non motorized mode of traffic for the entire trip (for example, commuting, shopping)[3]. The demand for bicycles and rickshaws is therefore considerable at present and is likely to continue to be so. Cycle rickshaw is a popular para-transit mode that provides door-to-door service in congested parts of most Indian cities. The requirements of this mode need to be studied and better understood in relation to the socioeconomic environment. Hence to study behaviour and characteristics of non-motorized vehicles and how they affect the whole traffic is concerned in this work[4].

A. Non-Motorised Vehicles

Non-motorized vehicles are generally pedal powered vehicles, having different shapes and sizes which are used to transport passengers as well as goods [5]. The non-motorized vehicles are slow moving vehicles consisting of cycles, cycle rickshaws, hand carts, horse carts and bullock carts. In India, there is heterogeneous or mixed traffic where motorized and non-motorized vehicles flow together, so it is essential for traffic engineers to understand some of the characteristics of these non-motorized vehicles[6].

B. Basic Parameters of Traffic Flow

Basic traffic flow parameters to be studied are as follows:

1) Flow

It is the number of vehicles passing a specified point during a stated period of time. It is also known as volume. Flow of traffic is usually expressed in vehicles/time.

2) Density

It is also known as concentration, it is the number of vehicles present in a stated length of road at an instant. Density of vehicles can be measured by counting the number of vehicles in chosen length. The number of vehicles in this length is counted on each series of frames and the mean value of density can be found by averaging out the density in a number of frames. The density is generally averaged over a certain duration of time. Density can be expressed in vehicles/distance.

3) Speed

In traffic engineering language speed is rate of movement of traffic or of specified components of traffic and is expressed in Km/h. In actual practice it is not possible to calculate the speed of every individual vehicle. Due to this the average speed is taken into consideration as shown in fig 1.

4) Speed-Flow-Density Curve:

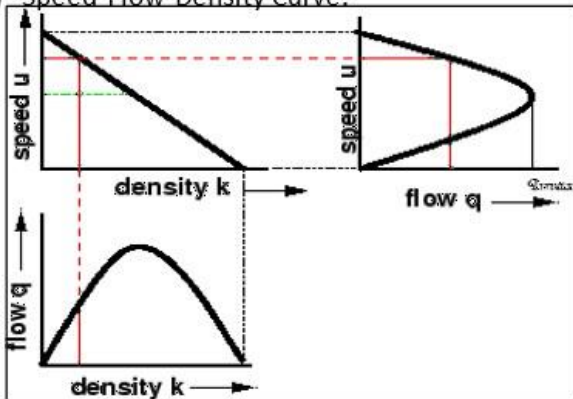


Figure 1: Fundamental Diagram of Traffic Flow

C. Passenger Car Unit (PCU)

The passenger car unit of a vehicle type has been found to depend upon the size and speed of vehicle, type and kind of road environment, for example rural road, urban road, roundabout, traffic signal. They are generally not dependent on the flow and road width. PCU can also be defined as the ratio of capacity of the road section having passenger cars only to the capacity of the same section of road having a particular class of vehicle only. Value of PCU for a passenger car is 1 and the passenger car unit of other types of vehicles can be found relative to a passenger car. To study characteristics of mixed traffic every vehicle should be converted to a single unit.

II. METHODOLOGY & DATA COLLECTION

In this study, traffic data is collected from various locations by videography method. Traffic data is collected from Majri Crossing, Panchkula and Zirakpur-Patiala Crossing, Zirakpur. Majri Crossing is falling on roads crossing Panchkula-Dehradun NH07 and Kalka-Zirakpur NH05. Whereas Zirakpur-Patiala Crossing is falling on roads at T-junction of Panchkula-Zirakpur NH07 and Chandigarh-Ambala NH152. These two locations have a high volume of mixed traffic which also includes non motorised vehicles. At these two locations, there is a divided road so data is collected separately for traffic movement in both directions.

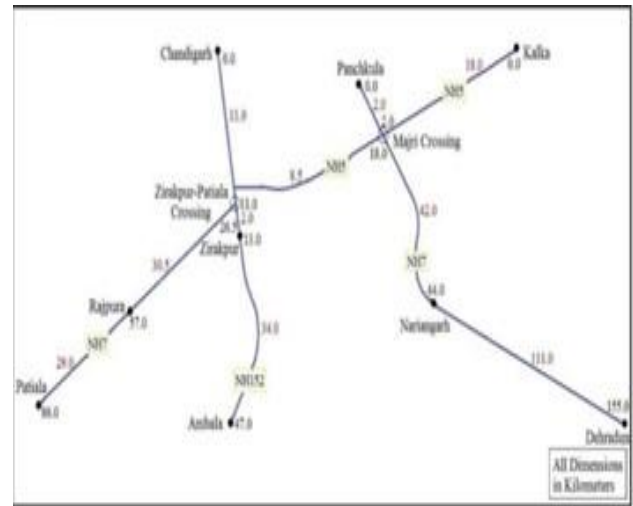


Figure 2: Layout Plan of Majri Crossing and Zirakpur patiala crossing

A section of 5m length has been selected and video has been recorded for 30 minutes for each location. At each location, data is collected for an interval of 30 minutes between 8:30AM to 9:00AM of the day. This session is selected such that they have the highest volume of traffic. Further the recorded data was decoded by playing the video in the computer system as shown in fig2.

III. OBJECTIVES OF THE STUDY

The study aims at the following objectives:

- To study the effect of %age of non-motorized vehicles on the speed, flow and Density in different sections.
- To study the different fundamental diagrams i.e. the inter-relationships between the three fundamental variables.
- To study the lateral occupancy of vehicles in mixed traffic conditions.
- To find the capacity of the observed sections from the flow-density curve.

IV. DATA EXTRACTION

Data extraction consists of the following:

- Study of the fundamental diagrams of traffic flow from the data obtained from various locations.
- Study of vehicular occupancy of the road section.
- Study of the capacity of the road section.

A. Study of Fundamental Diagrams

Fundamental diagrams means diagrammatic representation of the relationship between various traffic parameters such as density, flow and speed. These traffic parameters are already discussed in chapter 1. In this study the data is collected from various locations are as follows:

- Dehradun Road at Majri Crossing, Panchkula
- Patiala Road at Zirakpur-Patiala Crossing, Zirakpur

B. Study of Vehicular Occupancy of the Road Section

In this study vehicular occupancy is to see how the motorised vehicles and non-motorised vehicles vary on the road with respect to adjacent moving vehicles. For finding

the vehicular occupancy of the section, the width of the road is divided into seven equal parts on the cellophane paper and the video is then analysed. While analysing the video, every motorised and non motorised vehicle's speed and the strip number in which they are entering is noted. To make the data decoding easy, the cellophane paper is divided in seven equal segments.

C. Study of Capacity of the Section

The capacity of the section is defined as the maximum number of vehicles that are occupying a space under specified traffic conditions at a certain time. After plotting the fundamental diagrams for each location, the value of maximum flow in the flow-density curve is taken as the capacity of the section.

D. Fundamental Diagrams

Comparison between the curves obtained from different fundamental diagrams having different percentages of non- motorized vehicles has been done. Fig. 3 shows the Flow Vs Density

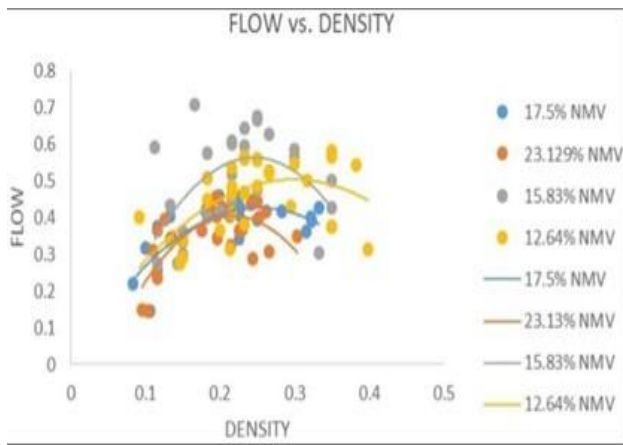


Figure 3: Flow Vs Density

Here Flow vs. Density graph is showing the comparison between the flow-density curves drawn for four different locations which are having different percentages of non-motorized vehicles. From the figure it can be seen that when the percentage of non-motorised vehicles is 23.12% then the flow and density of traffic is lesser, but when the percentage of non-motorised vehicles is 12.64% then density is comparatively more. And when the percentage of non-motorised vehicles is 15.83% then the flow is Maximum.

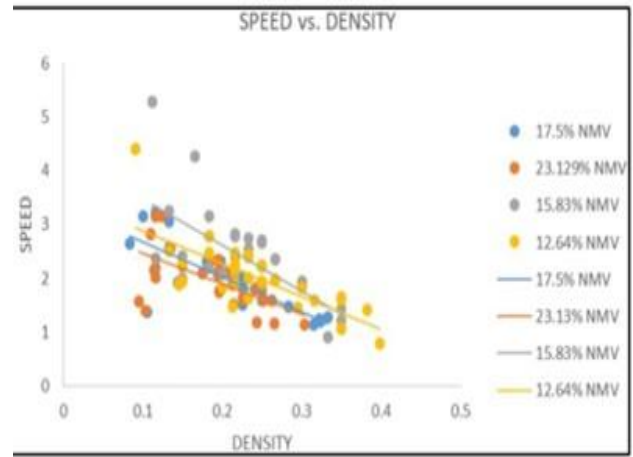


Figure 4: Speed Vs Density

Speed vs. Density graph shows the comparison between speed-density relations for each location having a different percentage of non-motorised vehicles. It can be seen that when the percentage of non-motorised vehicles is 23.12% then the speed with respect to density is lesser and it is showing higher value when the percentage of non-motorised vehicles decreases.

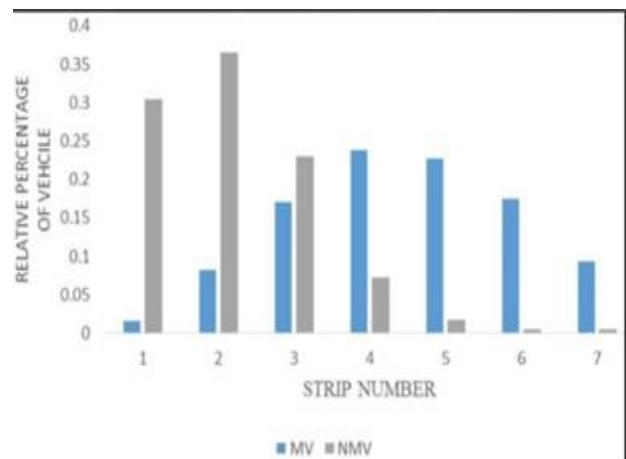


Figure 5: Vehicular occupancy graph

Fig 5 is showing vehicular occupancy graphs which are combined for all locations. From fig. It can be seen that most non-motorised vehicles are moving on the left side of the road and very few non-motorised vehicles are moving in the centre and right side of the road. While the motorised vehicles occupy the centre and right side of the road.

V. CONCLUSION

From the study done following are the conclusions:

- From the graphical representation of the density-flow curve it can be seen that with the increase in density, flow also increases up to a certain limit and with further increase in density results in decrease in the flow. From the density-speed curve it can be seen that when density increases speed starts to decrease, meaning thereby density is inversely proportional to speed.
- By comparing the curves obtained from different locations, it can be seen that with the increase in non-motorised vehicles, traffic parameters such as flow,

density and speed are greatly affected and are decreased. From the capacity analysis it can be seen that non-motorised vehicles also affect the capacity of roads. When the volume of non-motorised vehicles on the road is high, the capacity of the road is found to be less.

- From the study of lateral occupancy of vehicles it has been seen that non-motorised vehicles are mostly found in outermost lanes while motorised vehicles are found in middle and innermost lanes.
- In this study it has been seen that lane driving is not followed properly in our country causing great noise pollution by use of vehicular horn, road accidents and decreased speed of vehicles.
- It has been seen that non-motorised vehicles are mostly found in 1st, 2nd, and 3rd strips while motorised vehicles are found in 4th, 5th, 6th and 7th strips. Motorised vehicles which are fast moving vehicles try to overtake the slow-moving vehicles and are mostly found in the middle and right side of the road. As India follows left hand rule, so that slow moving vehicles run on the left side and fast moving vehicles shift to the right side, try to overtake slow moving vehicles. A conclusion section is not required.
- Although a conclusion may review the main points of the paper, do not replicate the abstract of the conclusion. A conclusion might elaborate on the importance of the work or suggestion applications and extensions.

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