Effect of On-Street Parking on Speed Flow Characteristics of Urban Arterial

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Abstract: The urban transportation system is the key of all economic activities which are taking place in country. As population increases it lead to increase in vehicle ownership. Currently all over the world it has been observed an increase in the road traffic and transport demand. The land resources are constant so increase in vehicular growth have serious effect on uninterrupted traffic flow. The neighbouring activities or activities which are taking place around the carriageway of the road are directly or indirectly affecting the capacity of the roadways. The various activities like on street parking and vehicle are parked on shoulder so pedestrian need to use the carriage way for their movement which decrease the speed of vehicle. Due to all these activities which are running on the carriage way or at side of it creates confusion in the mind of the drivers and affects the movement of vehicle in these areas. The present work aims at analysing the impact of road side activities on traffic characteristics of urban roads in Ahmedabad. Multiple linear regression analysis is taken to relate the factors which influence the reduction in speed caused by side friction factors. From the study it can be concluded that the hindrance offered by parked vehicle and non-motorised vehicle (not including bicycle) is to a higher extent. Thus it is recommended that while planning urban road facilities, the parking facilities should be given due importance and provide proper facilities for parking so that its impact does not affect the traffic flow to a higher level there by reducing the speed of traffic flow.

Index Terms: On-street parking, Side frictions, Speed prediction, Pedestrians.

Introduction

In India, the numbers of vehicles on road (specially two wheelers) have been growing at remarkable rate caused by liberal government policy for production of vehicles and inadequacy of public transport necessitating the purchase of two wheelers by the common man. The urban transportation system is the engine of the economic activities in all-urban communities all over the world, and consequently sustains livelihood of the people living in them. Typical urban transportation facilities include railways, waterways, airways and roads. Among these, the large percentage consists of roads. Logically, most planning and research efforts have focused on the road system. In essence, road transportation system is the major player in the economic activities of most urban centres. In current time, many cities have seen a large increase in road traffic and transport demand, which has consequently lead to deterioration in capacity and inefficient performance of traffic systems. In the past, it was assumed that in order to resolve the capacity problem it was simply to provide additional road space. This was the main strategy applied in the U.S.A at the wake of 1960's and 1970's. A lesson learnt from this strategy is that adding capacity alone is ineffective because it induces travel growth that negates the benefits of highway expansion. Moreover, there is complexity in so doing for one reason that most cities are already built-up areas, hence it is difficult to carry out any substantial expansion works. In practice, it may be neither socially nor economically acceptable to balance supply and demand solely by increasing road capacity.

Similarly an additional problem which especially developing countries are facing right now is improper or ineffective use of their road ways. This particular problem in general term is known as road side friction. These road side friction along with heterogeneous traffic conditions prevalent in developing countries, have a detrimental effect on capacity of urban roads as well as pose a serious threat to the safety of road users. Quantification of these side friction factors is a challenging task to traffic engineers. It is generally refers to a situation in which the neighbouring activities or activities which are taking place around the carriageway of the road are directly or indirectly affecting the capacity of the road ways. Which are caused due to the shoulder is being utilized by the parked vehicle due to which pedestrian need to use the carriage ways for their movement which result in either reduction of vehicular operational speed or reduces capacity of that road, due to undisciplined parking along road side in market areas by various classes of vehicles such as LCV & NMV for the transfer of goods and services to various shops in those areas or Undisciplined stopping of various kinds of vehicles on carriage ways in market places for pickup and drop down of good and people. As these kinds of activities are taking place everywhere in India but still a very small research work has been done to study this.

Some description of side friction:

Side friction is defined as a composite variable describing the degree of interaction between the traffic flow and activities along the side(s) and sometimes across or within the carriageway (Bang et al. 1995). Activities likely to disrupt traffic flow include the following;

• Blockage of the travelled way (i.e. reduction of effective width) which include:
(a)Public transport vehicles which may stop anywhere to pick up and set down Passengers
(b) Pedestrians crossing or moving along the travelled way
(c) Non-Motorized vehicles and slow moving motor-vehicles

• Shoulder activities
(a) Parking and un-parking activities
(b) Pedestrians and non-motorized vehicles moving along shoulders

• Roadside activities

(a)Roadside accessibility including vehicles entering and leaving roadside premises via gates and driveways.

(b) Trading activities (i.e. food stalls, vendors), and movement of vehicles and Pedestrians depending on land use type.

Research Objectives

1. To identify and assess the impact of side friction on speed of urban road link
2. Develop velocity prediction model.

Data collection And Data Analysis

After the reconnaissance survey, sections were identified for analysis on the basis of the side friction levels. For the entire study, the traffic data collection and retrieval of data was carried out using the video filming method. Data collection was done using videography technique from a vantage point like a high-rise building during peak hour. For the present study, urban stretches along four lane divided roads in Ahmedabad. Two study stretches were chosen in Ahmedabad. The impact of pedestrian flow, non-motorized flow and on-street parking is studied. The data collected by videography technique were extracted at every two minute interval and tabulated in appropriate format to analyze and to achieve the objective of the study i.e. to identify the effect of on-street parking manoeuvres on the speed and capacity of a divided urban roadway. Traffic volume data and spot speed were extracted and analyzed at every Two minute interval during two hours morning time and evening time for two section base section and section with side friction. The road sections are divided four lane two way road section.

Traffic Composition

Stretch 1: Nikol Gam Road (With Sidefriction)

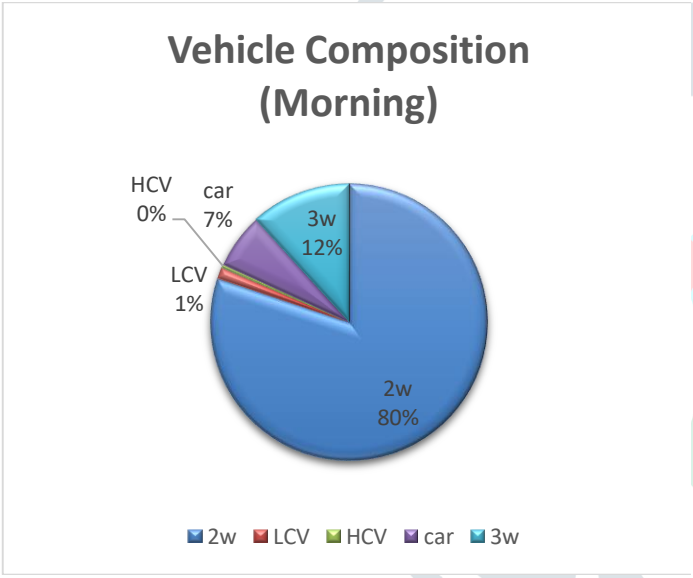

Fig 1. Vehicle Composition (Morning)

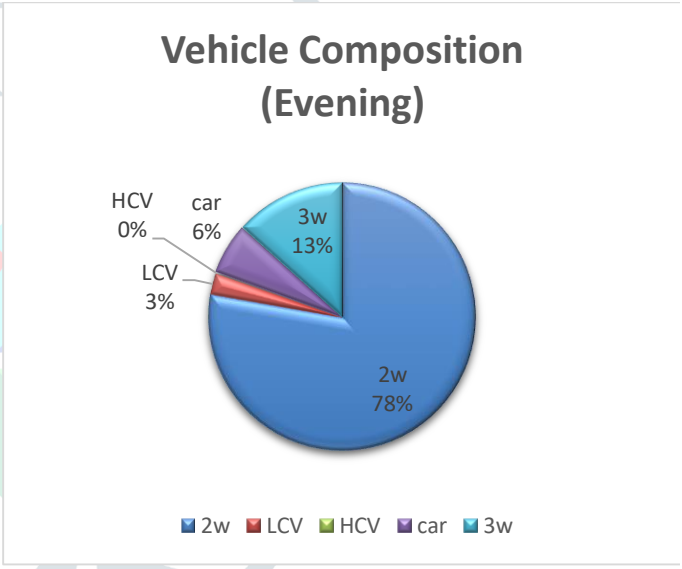

Fig 2. Vehicle Composition (Evening)

Stretch 2: Pramukhswami Marg (Stretch without Sidefriction)

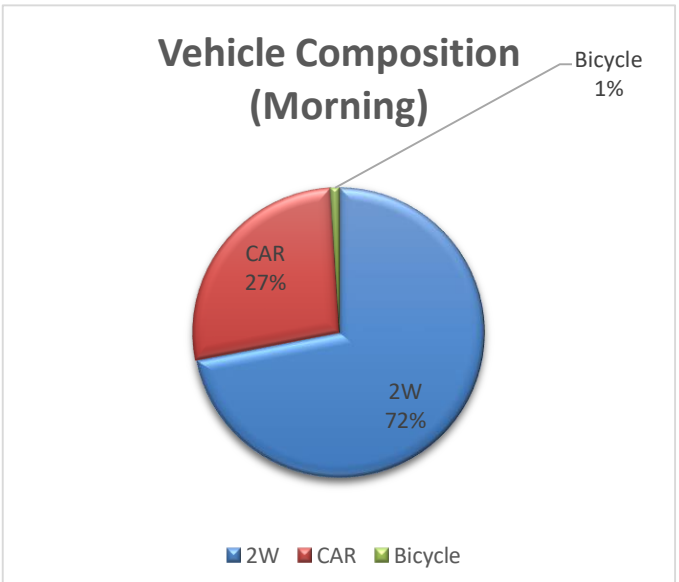

Fig 3. Vehicle Composition (Morning)

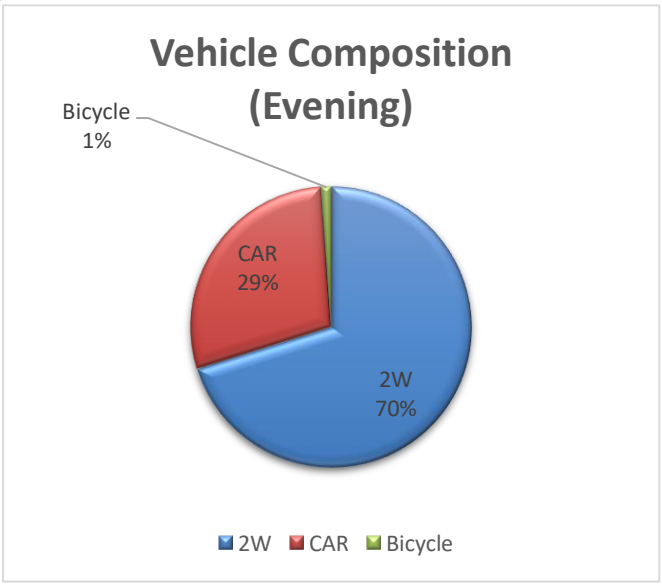

Fig 4. Vehicle Composition (Evening)

Speed Profile

Speed distribution profiles gives us idea about the maximum and minimum speed which was obtained by each category of vehicle to cross the study stretch marked at that location or it is the space mean speed of various categories of vehicle which crossed the stretch throughout the study period.

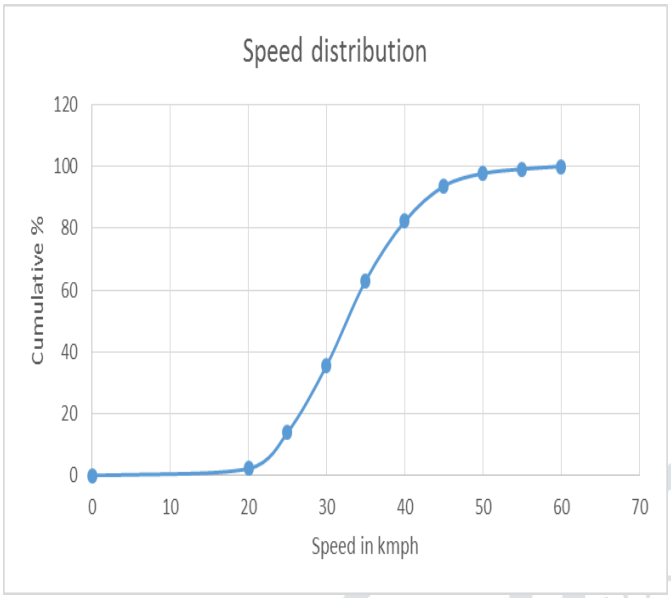

Fig 5. Speed Profile of Nikol Gam Road

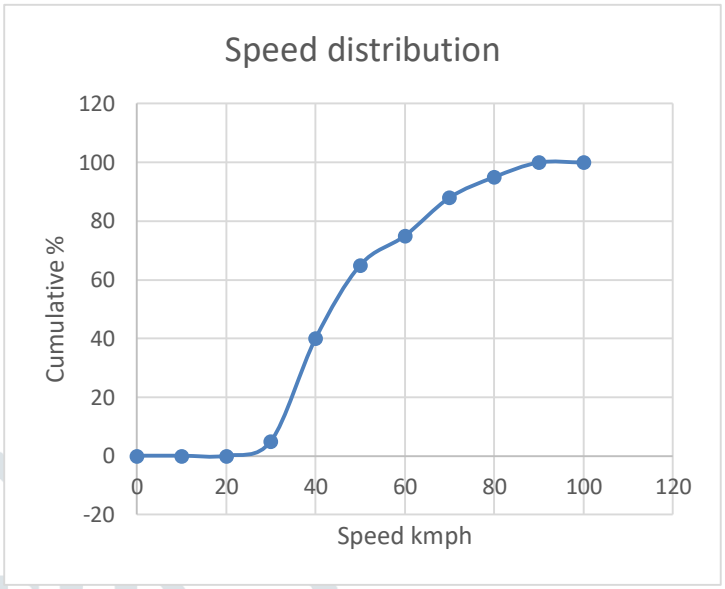

Fig 6. Speed Profile of Pramukhswami Marg

Traffic Flow Characteristics

This fig 8 below represents the flow vs density graph for Nikol Gam Road, Ahmedabad. From the graph it can be stated that the facility is uninterrupted facility. Further from Graphs the capacity of the section was found it was around 1770 PCU/hr/Direction. And the free flow speed for the section is found to be near about 57 kmph.

The q-k-v model developed from the graphs given below:

$$q = 42.32\,k - 0.0.2609k^2 \ldots (R^2 = 0.71)$$

$$v = 42.32 - 0.2609k \ldots (R^2 = 0.77)$$

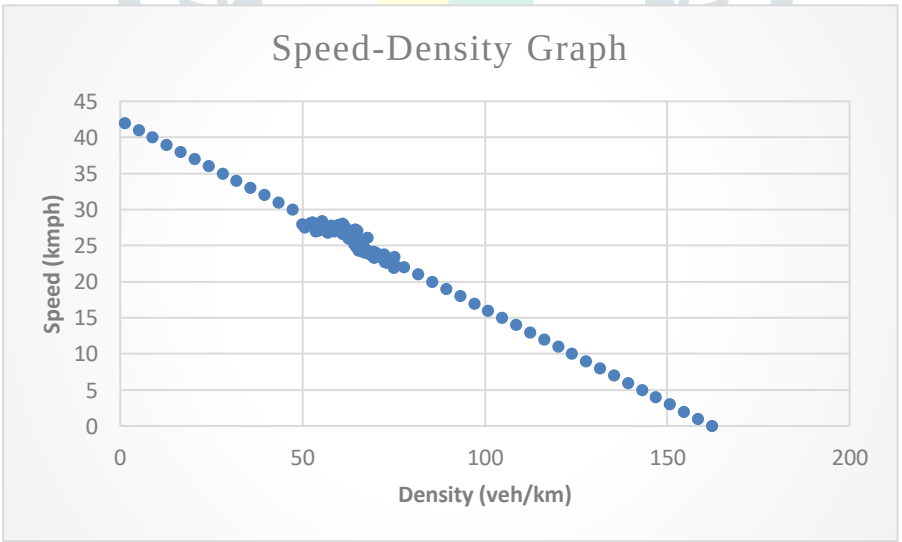

Fig. 7 Speed-Density graph

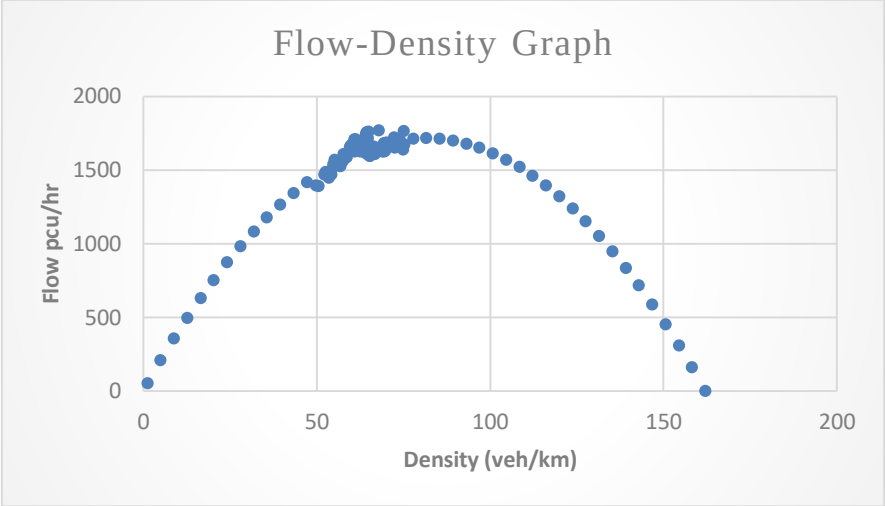

Fig. 8 Flow-Density graph

Stretch 2

This fig 10 below represents the flow vs density graph for Pramukhswami Marg. From the graph it can be stated that the facility is uninterrupted facility. Further from Graphs the free flow speed for the section is found to be near about 57.23 kmph.

The q-k-v model developed from the graphs given below:

$$\mathbf{q = 57.23k - 0.3958k^2 \ldots (R2 = 0.83)}$$

$$\mathbf{v = 57.23 - 0.3958k \quad \ldots (R2 = 0.72)}$$

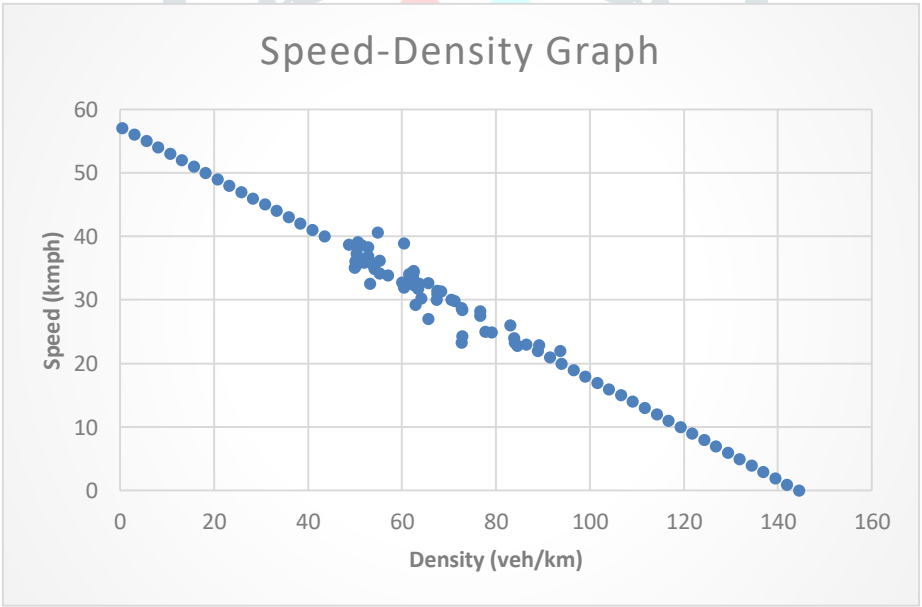

Fig. 9 Speed-Density graph

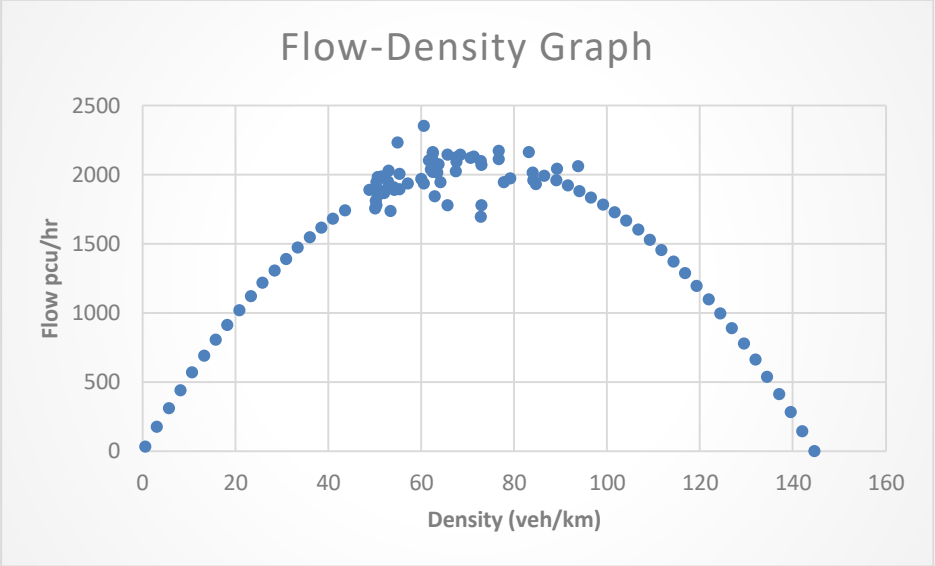

Fig. 10 Flow-Density graph

Development of Multi-Linear Regression Model for Reduction in Speed

For development of speed prediction model here we consider reduction in speed as dependent variable and parked vehicle (2w, 3w, and car), pedestrian flow, Number of NMV, bicycle flow, total flow.

Reduction in Speed = free Stream Speed – Actual Speed.

Reduction in speed is difference between free stream velocity and actual velocity measure at particular time. Free stream speed is measure during early morning hours where there is less or probably we can say that there is no effect of road side friction. Free stream speed is measure early morning at 6 o'clock.

Reduction in Speed = 8.526 + 0.119 (Pedestrian flow) + 0.293 (NMV) + 0.036 (Bicycle) + 0.134 (Number of Parked 2w) +0.174(Number of Parked 3w) + 0.294 (Number of parked car) + 0.047 (Total flow).

Pedestrian Flow	= Number of pedestrian (100m/ 2 min)
NMV	= Number of non-motorised vehicle for every (100m/ 2 min)
Bicycle	= Number of bicycle (100m/ 2 min)
2w	= Number of parked 2w (100m/ 2min)
3w	= Number of parked 3w (100m/ 2min)
Car	= Number of parked car (100m/ 2min)
Flow	= Total Flow (PCU/2min)
Reduction in speed	= Speed (kmph)

Validation of model with respect to field data

Reduction in speed prediction model has been developed using 70% of observed data. Therefore validation of model has been carried out using remaining 30% of data. Relationship between Predicted values of 30% data through above model and observed values are obtained and plotted as under.

The plot of estimated reduction in speed against observed values shows much closeness to the diagonal line. This shows that the model can estimate reduction in speed with reasonable accuracy, and can hence be used for further analysis. It can be assumed that the proposed reduction in speed model gives reasonably good predictions.

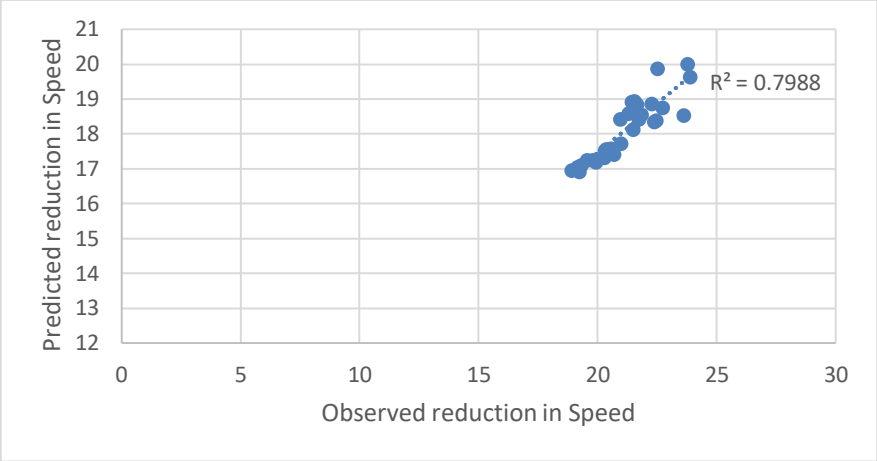

Fig. 11 Comparison of reduction in speed predicted and observed

Conclusion

Study was conducted to analyse in detail the impact of side friction factors on speed of four lane divided urban roads in Ahmedabad city, India. Analyses were conducted on speed variability observed on stretches with side friction factors like pedestrian dense sections and sections with on-street parking. Speed prediction models were developed with side friction parameters and traffic flow. These models were found to be statistically sound, can be used for predicting speeds and there by speed reduction caused by each of the side fiction parameters. All the frictional parameters considered were found to significantly contribute, but negatively to speed which is logically correct. The frictional parameter considered includes, number of pedestrians walking along sides of carriage ways and number of parked vehicles, number of non-motorised vehicle.

From traffic data analysis it was obtained that the share of two wheeler is predominant in both the section under study. The average capacity of 4 lane divided friction section was around 1754 PCU/hr which is less than base section (without side friction).From study, it was found that as the number of parked vehicle increases on stretch, the average speed decreases. On an average, 10 unit increase in parked 2w, 3w, car respective reduction in the speed by around 1.34 kmph, 1.74 kmph and 2.94 kmph. it was also found that as the number of non-motorised vehicle flow increases on stretch, the average speed decreases. On an average, 10 unit increase in non-motorised vehicle flow reduces the speed by around 2.93 kmph.

In general, from the study it can be concluded that the hindrance offered by parked vehicle and non-motorised vehicle (not including bicycle) is to a higher extent. Thus it is recommended that while planning urban road facilities, the parking facilities should be given due importance and provide proper facilities for parking so that its impact does not affect the traffic flow to a higher level there by reducing the speed of traffic flow.

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