Impact Analysis of Bus-Stop on Urban Traffic Characteristics-A Case Study of Urban Mid-Block-Rajkot

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Abstract— Efficient transportation system is a crucial factor for the growth of a nation's economy. Many arterial roads in many developing countries exhibit deteriorated capacity and poor performance. Various studies are done on this problem in some developing countries and found that because of urbanization, there is often a great deal of activity on and alongside these roads, which affects the way in which they operate. This interference to the smooth flow of traffic is known as "side friction. Urban roadway capacity is influenced by various factors like speed of vehicles on the road, width of road, structure of the road, construction work on roads (e.g. work undertaken for Metro Rail construction), various land uses that attract motorized / pedestrian traffic bound to hospitals, institutional, commercial area, shoulder and roadway width, access points, terrain etc. However for urban roads, the impact of side frictions i.e. bus stops, encroachments, on -street parking, pedestrian crossing, entries and exits from major roads etc. are also much significant. Among all the friction generators, understanding the impact of bus-stops is particularly important from planning perspective in the Indian context. Therefore, this study presents a methodology to quantify the impact of bus-stops on the speed of other motorized vehicles under heterogeneous traffic conditions. To analyse the impact of bus stop on urban traffic characteristics road inventory, classified volume count, speed studies with friction data will be collected on urban mid-block in Rajkot city. Data collection will be done by manual method. Using this data travel time delay and reduction in speed will be obtained. Based on the results further recommendations will be given.

Key words: Road Side Friction, Traffic Composition, Bus Stops

I. INTRODUCTION

Transportation plays major role in economic growth of a country. Traffic performance is affected by many factors like surface of road, shoulder and roadway, driver skills, width, side friction or side activities, terrain, road maintenance, etc. In developing countries like India side friction influences the traffic performance of roads to a considerable extent. Side friction include bus stops of all types, petrol pumps, entries and exits from major roads, on-street parking, road side trading etc. In this study side friction elements kerbside bus stop, is considered for study and an attempt has been made to find the effect of these friction types on travel time and travel speed of urban arterials of Rajkot city. An urban mid-block is selected for the data collection of travel time and speed data. With side friction data and without side friction data will be collected and travel time delay and speed reduction due to bus stop will be calculated. Based on the results appropriate solution will be provided to reduce the amount of side friction.

II. OBJECTIVES OF STUDY

- To assess the impact of road side friction due to bus stop on urban traffic characteristics.
- To analyse the speed reduction, travel time delay and due to bus stop.
- To give recommendations to improve the travel speed and travel time of urban mid-block.

III. LITERATURE REVIEW

A. Pratik Bansal, Rishab Agrawala, and Geetam Tiwari (2014) studied on "Impact of bus stop on the speed of motorised vehicles under heterogeneous traffic condition-A case study of Delhi, India"

It mainly represents a methodology to quantify the impact of bus stops on the speed of motorized vehicles. This methodology is validated on urban arterial roads in Delhi, India. They have collected mainly 2 types of data 1) location of bus stops 2) speed profiles of vehicles were collected by GPS and V-BOX respectively. These data sets were mapped and merged using ARCGIS. They have computed influenced region of the bus stop and found average speed in that influenced speed of vehicle in that influenced area. Than they have perform regression analysis to quantify the impact of bus stops on the vehicular speeds. They found that influenced area near bus or bus stop is 140-170 meters and average speed reduction in that influenced area is 26-38%.

B. Suprita D K, Archana Shagoti, Somnath Khot (2016) studied on "Influence of bus stop on urban traffic flow characteristics"

The main objective of this study is to identify the effects of number of buses stopping at field location on flow parameters like congestion and delay. This study also aims to study the spacing of bus stop on one route and finding optimum spacing between the bus stops on a particular route. The spacing of bus stops and number of buses on a bus stop will clearly affect the traffic characteristics. To carry out the study they have selected a study area having three bus stops on a same route in Bengaluru. Spot speed analysis and vehicle composition data collected on the survey locations. After data collection they have found that the speed of any vehicles is reducing significantly when the number of buses stopping increases. And delay and congestion also increases as there is less spacing between two bus stops.

C. Sai Chand, Sathish Chandra, Ashish Dhamaniya (2014) studied on "Capacity drop due of urban arterial road due to curb side bus-stop"

The primary object of the study is to obtain capacity drop of a roadway due to curb side bus stop. To estimate capacity drop they selected a study area of 6-lane divided urban arterial

road in New Delhi. They choose seven sections for the survey and data collection. Out of those seven, three section is having no side friction and other four section is having side friction due to curb side bus stop parking. Speed and volume data were collected to estimate the capacity of the section. Average mid-block capacity of section without side friction on 3 section found 3614 pcu/hour and it is termed as base capacity of the section.

On the seven intersection data collection have been carried out like composition of traffic, road inventory and spot speed studies, bus flow and average dwell time of bus flow. Analysis of the data has been done using statistical analysis methods and found that there id increase in capacity drop as increase in bus frequency and dwell time. And found that there is significant loss in capacity of 8-13% compared to base capacity of section having no side friction.

IV. DATA COLLECTION

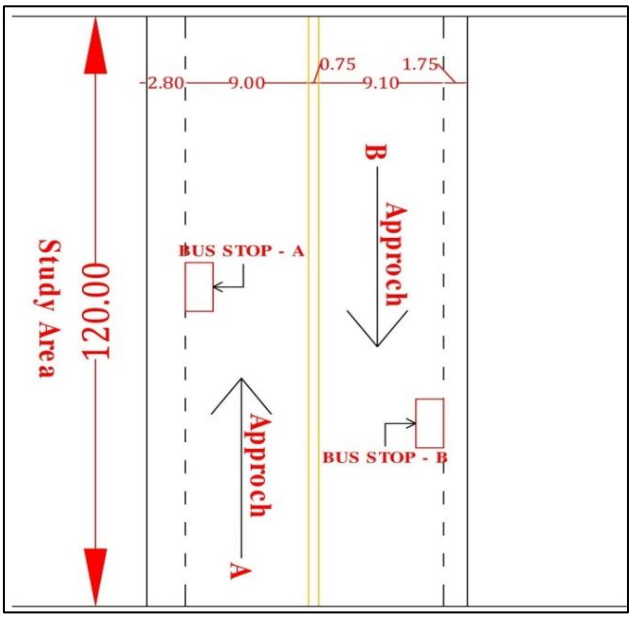
To obtain speed reduction and travel time delay data of classified volume count and travel time of particular vehicles are collected on an urban mid-block. 120m stretch of an urban arterial road is selected for data collection. Classified volume count data is collected by using videography method and travel time of vehicles are collected by manual method from the top of 5 storey commercial building. Data I collected on two RMTS bus stop on both the direction of arterial road.

- Kotecha chowk RMTS bus stop
- Dhulesia collage RMTS bus stop

Travel time data is collected at one minute interval for 8 hours in regular day from morning 9:00AM to 1:00PM and in evening 5:00PM to 9:00PM. As the bus enters in the study area that particular minute will be noted as friction minute and further analysis is done.

V. DATA ANALYSIS

A. Road Inventory Drawing;



(all dimensions are in meter)
Fig. 1: Road inventory drawing

B. Travel time delay due to bus stop

Travel time survey is carried out manually at urban mid and based on the with friction and without friction data travel time delay is obtained as under,

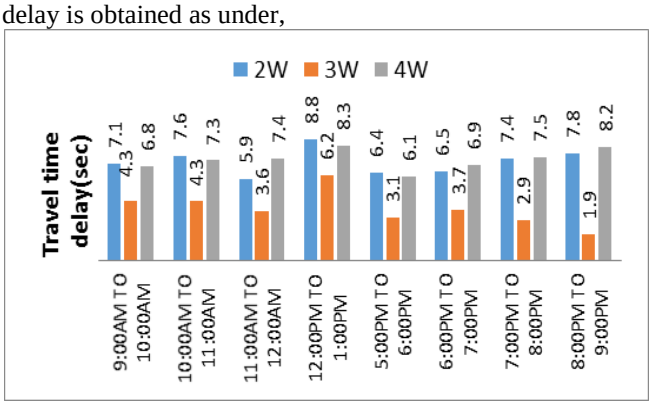


Fig. 2: Travel time delay(sec) Approach A

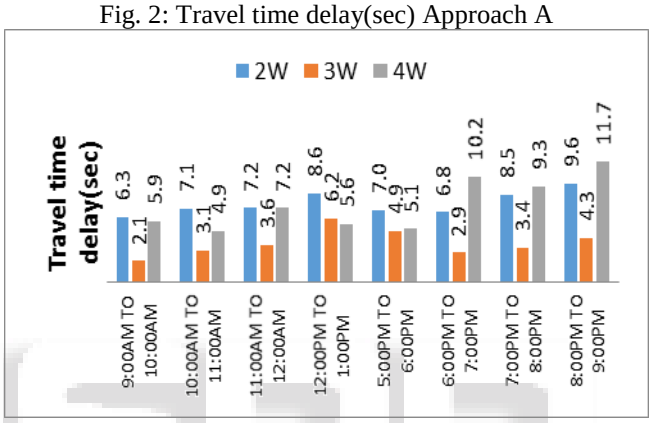


Fig. 3: Travel time delay (sec) Approach B

Further travel time delay for a day is obtained by using the with side friction data and without side friction data as under;

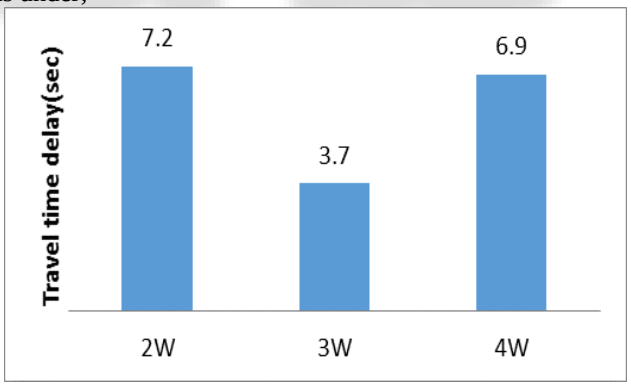


Fig. 4: Travel time delay (sec) Approach A

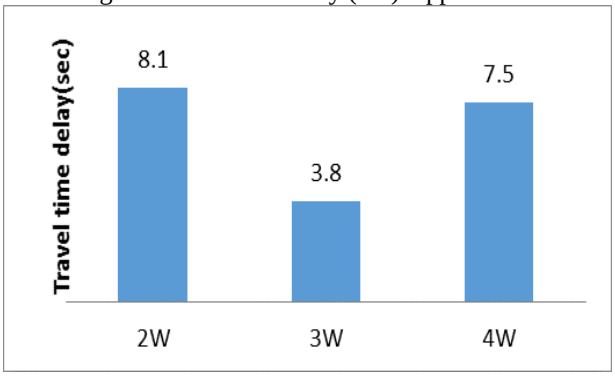


Fig. 5: Travel time delay (sec) Approach B

It is found that travel time delay for 2w, 3w and 4w is 7.2, 3.7, and 6.9 seconds for approach A and 8.1, 3.8, and 7.5 sec for approach B respectively.

C. Speed Reduction

From the data of travel time, speed of 2w, 3w and 4w are calculated as length of stretch is 120m and speed of particular vehicles are calculated. From with side friction and without side friction data speed reduction for particular hour is obtained as under;

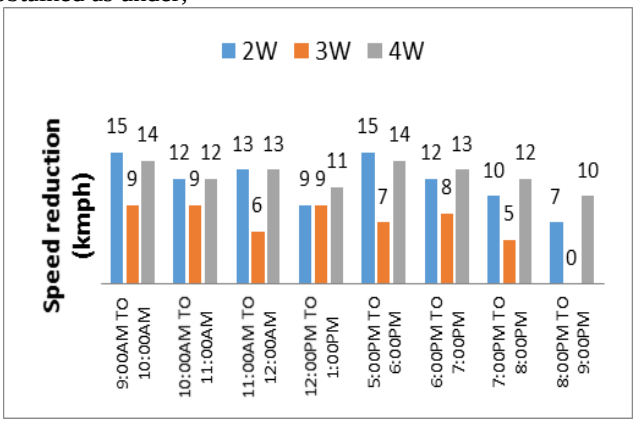


Fig. 6: Speed reduction (kmph) Approach A

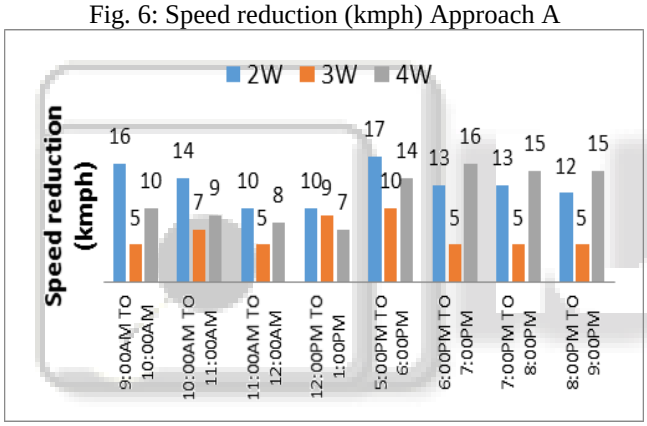


Fig. 7: Speed reduction (kmph) Approach B

Further comparison of speed with side friction and without side friction due to bus is obtained and speed reduction is calculated for day and found as under:

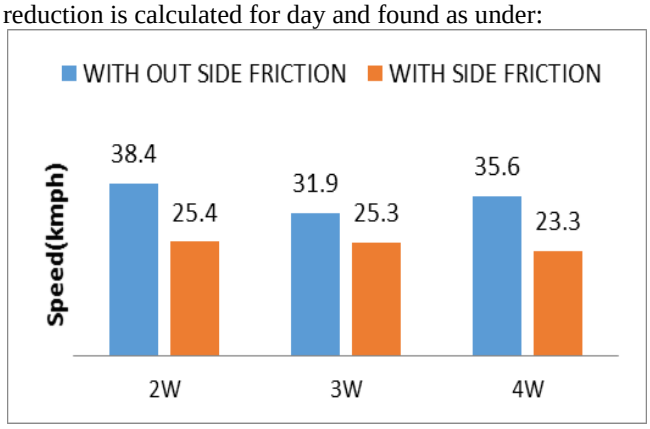


Fig. 8: Speed comparison (kmph) Approach A

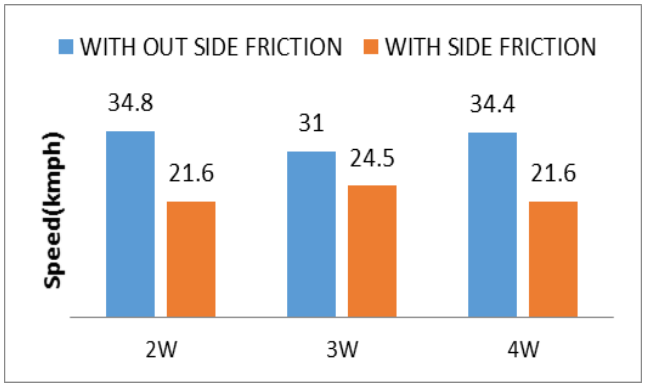


Fig. 9: Speed comparison (kmph) Approach B

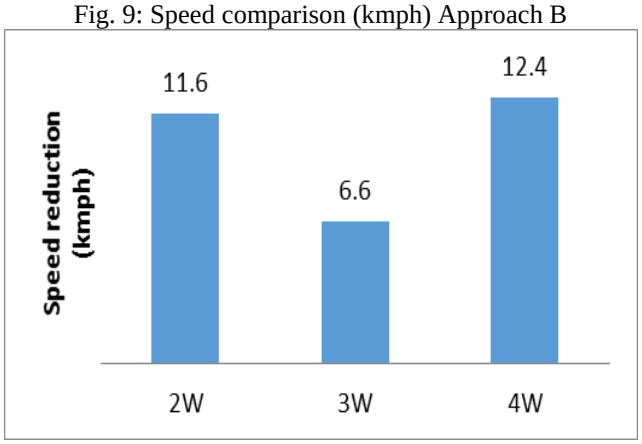


Fig. 10: Speed reduction(kmph) Approach A

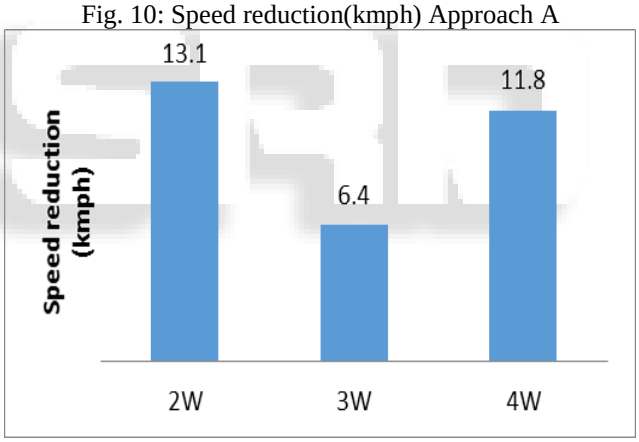


Fig. 11: Speed reduction (kmph) Approach B

It is found that speed reduction for 2w, 3w and 4w is 11.6, 6.6, and 12.4 kmph for approach A and 13.1, 6.4, and 11.8 kmph for approach B respectively.

From the data analysis it is found that the impact of bus stop on travel time and speed of other vehicles in the stretch is significantly high. It is required to find an alternate option of curb side bus stop on a heavy traffic urban arterial road.

VI. DESIGN OF BUS BAY

From the data analysis it is found that the amount of speed reduction and travel time delay due to bus stop is very high. To reduce the amount of the side friction due to bus stop bus bay is available option. For design a bus bay IRC: 86 – 1983 Geometric Design Standards for Urban Roads in Plains is used. Design of a bus bay is given over here;

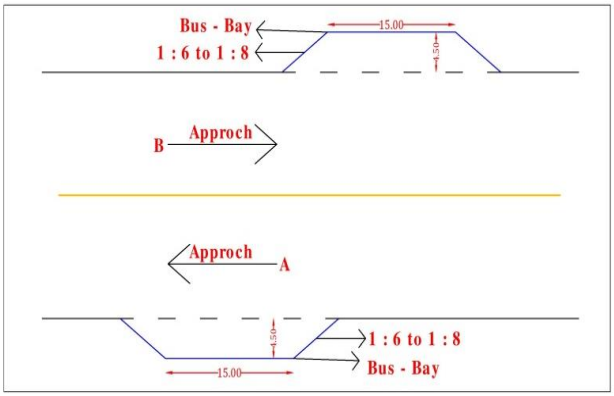


Fig. 11: bus bay drawing

A. Design Criteria for Bus Bay

- The length of bus bay should be 15m for single bus stop with increase of 15m for each extra bus for multiple bus stop.
- The taper should be desirable 1:8 bus should not be less than 1:6.
- The depth of recess should be 4.5m for single bus stop and 7m for multiple bus stop.

VII. CONCLUSION

- The amount of side friction due to RMTS bus stop on urban arterial road is significantly high.
- It is found that speed reduction for 2w, 3w and 4w is 11.6, 6.6, and 12.4 kmph for approach A and 13.1, 6.4, and 11.8 kmph for approach B respectively.
- It is found that travel time delay for 2w, 3w and 4w is 7.2, 3.7, and 6.9 seconds for approach A and 8.1, 3.8, and 7.5 sec for approach B respectively
- To improve the travel time and travel speed it is recommended to provide bus bay in stand of curb side bus stop.
- Design of bus bay and criteria for designing a bus bay is provided which reduces the travel time and to improve the travel speed of vehicles.

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IRC Code:

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