

Influence of Bus-Stops on Urban Traffic Flow Characteristics

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Abstract— Transport is an important part of India economy. since the economic liberalization 90's there has been a tremendous increase in economic activities followed closely by great increase in the travel demand in the cities. A variety of transport modes are being used in different cities to meet the ever increasing travel demand. public transport is the main source of transportation in cities very few in Indian cities currently have and organized transportation system. There are only seven cities with local commuter rail service. Organized bus service now operates in 65 cities as compared to 20 cities in 2006. Bengaluru city has one of the most extensive bus transport network in India. Buses are the main mode of transportation in the Bengaluru city. The buses in Bengaluru city are maintained and owned by Bengaluru metropolitan transport corporation or BMTC, which operates on about 2400 routes and has a fleet six of 6700 buses, these buses are the main source of mobility in Bengaluru city, besides the buses the auto rickshaws also play an important role in transportation. The main objective of the present study is to study the effect of number of buses stopping at field location on flow parameters like delay, congestion etc. of traffic flow. Based on the studies three alternate proposals are suggested for implementation which would have tremendous effect on the smooth flow of traffic. If proposition is implemented it will reduce traffic congestion, increase speed of vehicles and cause less noise, air pollution and accident. Also, this study is aimed at studying the spacing of bus-stops on the chosen route and finding the optimal spacing between the bus-stops on this route. The main aim of the work is to help in optimization of the stop spacing on the route which will help in reducing the travel time on the route and reduce the number of buses plying per hour on this route. By carrying out optimization of bus-stops it is possible to increase the spacing between bus-stops which results in the reduction of number of bus-stops on the transportation in Bengaluru.

Key words: Transportation, Travel demand in Bengaluru, Bengaluru metropolitan transport corporation (BMTC)

I. INTRODUCTION

The share of travel by buses in the cities is very small compared to the two wheelers, auto rickshaws and cars. As per the National Transport Development Policy Committee report the share of buses has declined from 11.6 percent to 1.1 percent in last five decades and the share of two wheelers has increased from 8.8% in 1951 to 71.8% in 2011. This is an indication that there has been a tremendous growth in two wheelers and cars but the government has not invested significantly in the public transport especially buses.

The lack of reliability of public transport especially bus transport is one of the main reasons that has led to the people shifting from buses to other modes of transport. The best and the cheapest mode of transportation for the large section of our population in all the cities is the public

transport system, various modes of public in different cities includes metro rail, buses, auto rickshaws, taxis, rickshaws and local trains. As the income of the families has started to increase in past two decades the dependence on the bus transport has started to decrease due to the fact that many people can afford two wheelers and four wheelers now and prefer to make trips in their own vehicles. Liberalization followed with licenses to manufacture of the different brands, types, etc., made it a buyers' market offering innumerable choices to buy two wheelers, this followed by attractive financing schemes. Even though the usage of public transport has started to decrease but its importance to the cities can never be neglected. Public transport still remains the cheapest mode of transport and it is safer than most other modes of transport. Usage of private vehicles may be possible for smaller families on certain particular occasions but it is not possible for even small families to use private vehicles all the time so they also have to make use of public transport. A large section of our society still cannot afford to travel in private vehicles, so it becomes very important to have an efficient public transport system.

Traffic congestion significantly affects economic performance of the nation. In majority of urban areas, travel demand exceeds highway capacity occasionally during peak periods. In addition, events such as crashes, vehicle breakdowns, work zones, adverse weather, suboptimal signal timing, etc. cause temporary losses in capacity, often deteriorating the situations on already congested road networks. These temporary capacity losses have significant impact on delay, reduced mobility, and reduced reliability of the roadway network. They may also cause the drivers to change their routes or reschedule their trips. The traffic characteristics of a road section can be influenced by various factors such as surface type, shoulder and roadway width, terrain, driver skills, side friction or side activities, road maintenance, etc. However, among all the factors, side frictions like bus-stops, on-street parking, encroachments and Frontage access significantly reduce the performance of an urban road. through traffic stream. The methodology however does not directly account for capacity constraints such as on-street parking, narrow bridge, bus stop, bottlenecks, etc.

Today BMTC carries over 5 million people each day, which is over 50% of the total population of Bengaluru (8.5 million people as in 2011 Census). BMTC is thus the single largest and dominant transportation mode for people of Bengaluru.

II. METHODOLOGY

The spacing of the bus-stops clearly or the number of stops, clearly affects operating speed of the system, the headway, the potential capacity and the fleet size. When the busstops are closely spaced and passengers can easily access these stops, however the problem of having closely spaced bus-stops is that there are frequent stops, increased travel times,

increased emission rates increased stress on the driver, and increased disruption on the traffic flow. However, if the bus-stops are spaced at larger spacing the problem that arises is that the accessibility to the bus-stops decreases and the commuters have to walk more. The basic aim of the transit agency is to maximize the accessibility and minimize tradeoff. The preferred policy for transit stop spacing is one that attempts to balance the two issues.

- 1) The review into the past research has revealed two categories of work. The first study is related to minimizing the total travel times and maximization of transit patronage. This approach gives an insight into the benefits that are derived from the optimization of the busstop spacing. The second category of research involves studying the effect of the bus-stops on the speed, acceleration and deceleration of the other vehicles in the interrupted flow.
- 2) This project work is the extension of both the categories of previous research. The optimization of bus-stop spacing can be used for determining the fleet size. The interrupted traffic flow due to bus-stops can be evaluated by carrying out surveys on field data, dwell time, volume count and speed of the other vehicles.
- 3) Small spacing between the bus-stops leads to increase in the travel time due to frequent stoppage at bus-stops. On the other hand, if the spacing between the bus-stops is large then the buses can attain a maximum speed which is the allowable speed limit on the road. However there exists a bus-stop spacing threshold beyond which the operating speed will not increase. From the various studies conducted throughout the world it has been found

III. FIELD STUDY

Field study is a general method for collecting data about the study area, advantages and disadvantages of the present facilities, population studies etc. A prominent route is selected, with three bus-stops. It includes the examination of the design of bus-stop on the streets within the urban area, minimum spacing of these bus-stops, usability of these bus stops and the bus-stop environment. Suitability of the study area to carry out the field work. (Magadi road junction Bengaluru).

The following is the field data collected:

Width of footpath: 1.6 meters.

Width of the road: 7 meters.

Median width: 2.5 meters.

Distance between each bus-stop:

From bus-stop A to bus-stop B: 190 meters.

From bus-stop B to bus-stop C: 400 meters.

Length of the Stretch: 600 meters

A. Growth of Urban Transportation In India

India has seen a tremendous surge in the number of vehicles in the past three decades. The per capita income of the people has increased which has led to people buying more personal vehicles. On the one hand there is a tremendous increase in the number of cars and two wheelers but there has been a decrease in the percentage of people using public transport particularly bus services. The governments have not been paying proper attention towards improving the bus network in cities. The focus has been to build the other modes of transportation like high speed railways and high

speed corridors, whereas the main source of mobility within a city has been ignored. The percentage of two wheelers increased tremendously in past five decades, whereas the percentage of buses in the total volume on the road has decreased substantially in the same time. This decrease in the volume of buses can be attributed to the lack of attention that has been paid to improve the bus transit system. The graphs below show the increase and decrease of various urban transport modes in India in last 50 years

B. BUS-STOP Requirement

it is clear that bus-stop system consists of numerous factors which play a vital role in bus-stop location and design. Additionally, it is important to emphasize the need for

Bus drivers and conductors need to be trained on how to approach and leave a bus stop. Drivers must be trained for service rather than for competing with other buses for monetary gains or perks. Showing appropriate hand and blinking signals while approaching a bus-stop and also at the time of leaving, would ensure the safe mobility of buses at bus-stops. It will also add to the credibility of the BMTC as a safe service.

Bus needs to have low flooring entrance as to accommodate elderly, disabled, children, people with luggage, etc. Bus should have a clear display system of route number and availability of seats inside the bus. This can be developed through research connecting the ticketing machine of the bus to online display unit.

Vehicles apart from bus should not be parked or moved between bus and bus-stops.

Each bus-stop should be convenient to passengers in terms of accessibility and services provided therein.

Bus-stops should have connectivity to bus-stops, which should be kept in mind about blind and elderly people. There should be separate indicators for blind people to recognize a bus-stop.

Bus-stops should be secure. Safety to passengers during night hours and remote localities is a must. Well-lit bus-stop ensures safety to certain extent, hiring a security personnel is also advised for remote localities.

Bus-stops should possess flags and posts to indicate for both passengers as well as bus drivers.

An all season shelter should be provided in each bus-stop. Seasonal rains and hot summers are well marked in Bengaluru. Shelters should be able to withstand these conditions. Bus-stops should be covered from only two sides fully and on the third side it can be partially covered or covered fully with transparent covering. This side should be the approaching side of the bus, such that people will not stand on the carriage way to look at the approaching bus.

Each bus-stop should possess a waste bin, letter box, public telephone and passenger information system

IV. IDEAL BUS-STOP REQUIREMENTS

- Maximum usage of the bus-stops
- Rear entry and front exit for the buses can reduce the delay time of bus at the bus-stop preferably on one side of the bus.
- Reservation for senior citizens, ladies, physically challenged passengers.
- Spacing should be between 750-1000m.

- Based on the requirement of the community & to minimize traffic problems, the bus stop location should be established.
- The request stops should not be made permanent as it is untraditional.

A. Problems Associated With Urban Transportation

Congestion: There has been a tremendous surge in the number of vehicles in India in the past two decades, the increase in number of vehicles is due to the increase in the income of the people, having a vehicle in the family has brought lot of comfort and convenience to the people but it has created larger problems, even though the number of vehicles has increased by large proportions but the road width has not increased by same proportions which leads to the congestion on the roads. The roads are occupied with vehicles beyond their capacity which leads to congestion on the roads

Limitations to road widening: There has been a tremendous growth in the number of vehicles in past two/three decades but the expansion of the road network has not matched the increase in number of vehicles. There have been various factors which prevent the expansion of roads; the unplanned construction in the most cities has led to people constructing various establishments on the land reserved for road expansion. The situation is worsened by the improper design of roads which doesn't allow for segregation of vehicles travelling at different speeds. Mobility of all the vehicles is thus limited to the speed of the slowest vehicle on the road. The average speed on the Bengaluru city during peak hours is less than 15 to 20 km

Declining reliance on road transport: The most important factor that has led to increase in the problems of urban transport is that people have started to avoid the public transport system; one of the factors for decreasing dependence on the public transport is the inefficiency of the public transport and also the higher usage of private vehicles

Declining usage of non-motorized modes: The usage of non-motorized modes of transport has reduced drastically in the past decades, people hardly use bicycle for making trips anymore, and the walking which was a common thing of the past has literally vanished. The reason for the decrease in non-motorized trips is due to the increase in risk of walking and riding on the roads, the other reason for decrease in non-motorized trip is due to the increasing length of the trips.

High level of air pollution and noise pollution: The public transport has brought people close and made different places in city easily accessible but the urban transport has led to the high air pollution in cities. The petrol and the diesel cars used in the cities release a large amount of pollutants in the atmosphere which has led to degradation in the air quality of the cities causing various health problems to the people which are a matter of concern for the government.

Road accidents: There has been a tremendous increase in the number of accidents with the increase in the number of vehicles on the Indian roads. Due to the careless driving of few people the accidents have increased

Increase in consumption of petroleum products: With the increasing number of vehicles the consumption of the petroleum products has increased several folds, India has to import large amount of petroleum products and a large part of the foreign exchange is spend on it.

V. ANALYSIS OF DATA

The route is between KBS Majestic to Vijayanagar is of length 7.1 kilometres, it is a very busy route with high volume of vehicles, it serves as an important link in joining the areas around Majestic, Magadi road, Yeshwanthpur, towards Rajajinagar and Vijayanagara. This route has 8 bus-stops in total. In this route we have only selected Magadi Road stretch. The list of bus-stops considered:

- Magadi Road 1st cross bus-stop
- Magadi Road 5th cross bus-stop
- Magadi Road 10th cross bus-stop

Distance between each bus-stop:

From bus-stop A to bus-stop B: 190 meters.

From bus-stop B to bus-stop C: 400 meters.

Length of the Stretch: 600 meters.

Analysis is done studying the data collected from the field.

A. Magadi Road 5th Cross Bus-Stop

Following is the field data collected:

Width of footpath: 1.6 meters.

Width of the road: 7 meters.

Median width: 2.5 meters.

Distance between the each bus-stop:

From 1st cross bus-stop to 5th cross bus-stop: 190 meters.

AVERAGE SPEED IN KMPH(PEAK HOURS)						
5 th CROSS BUS STOP	9AM TO 12PM	0	14.4	24	17.8	13.8
	12PM TO 4PM	1	14.2	15.18	10.8	6.4
	4PM TO 7PM	2	7.8	9.7	4.8	4.7
		3	4.8	4.9	4	3.2

Table 1:

From the above data, it can be inferred that, the speed of vehicle reduces when the number of buses stopping simultaneously increases.

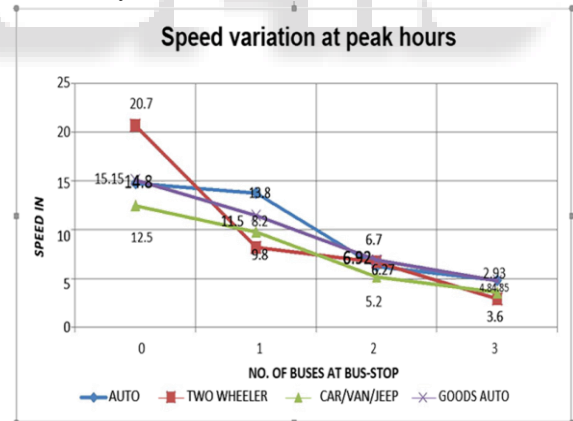


Fig. 1:

B. MAGADI ROAD 10th CROSS BUS-STOP

The following is the field data collected:

Width of footpath: 1.6 meters.

Width of the road: 7 meters.

Median width: 2.5 meters.

Distance between the each bus-stop:

From 5th cross bus-stop to 10th cross bus-stop: 400 meters.

AVERAGE SPEED IN KMPH(PEAK HOURS)						
10 th CROSS BUS STOP	9AM TO 12PM	0	14.8	20.7	12.5	15.15
	12PM TO 4PM	1	13.8	8.2	9.8	11.5
	4PM TO 7PM	2	6.27	6.7	5.2	6.92
		3	4.85	2.93	3.6	4.8

Table 2:

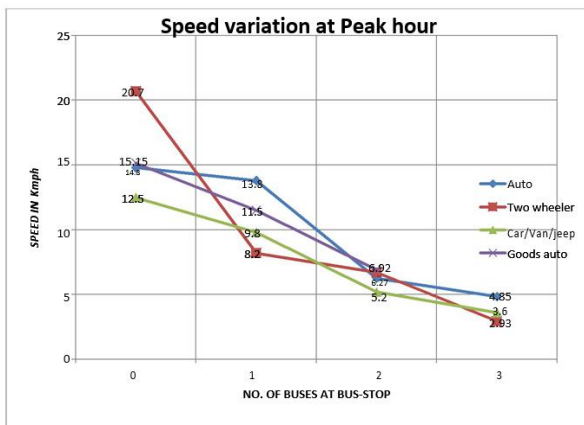


Fig. 2:

As seen in 5th cross the variation of speed is similar but the speed of vehicles is not reduced as it is in the 5th cross. The distance between the bus-stop is 400m thus it is very near to the IRC recommendation for the distance between the bus-Stop.

The 10th cross is also located near the Metro station thus this bus-stop is important, as it is easy for public to reach the destination being the connectivity as being very near.

VI. CONCLUSIONS

From the above discussions it can be inferred that, removing the first end bus-stop and shifting the middle bus outwards satisfies the minimum spacing distance.

Thus, optimization of bus-stops can be done. From the study it is clear that there is a possibility to reduce the frequency of buses. It is possible to reduce the number of buses plying on other routes by similar procedure. The change in the spacing of bus-stops helps in reducing the overall travel time. The change in spacing of bus-stops helps in reducing the operational cost.

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