Impact study of Indore BRTs corridor on Mixed Vehicle Traffic along old AB Road

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Abstract— This paper illustrates the analysis conducted on traffic data collected along the Indore BRT for BRT lane as well as mixed vehicle lane. The BRT system in Indore was implemented with full technical specifications and details in May, 2013. The main objective of the project study was to investigate the impact of BRT corridor implementation on mixed vehicle lane. As the BRT corridor was constructed on existing busy route of the city which connects various business and educational hubs and serves the maximum traffic of Indore city. For evaluation various traffic surveys were conducted along the BRT corridor parameters which includes traffic flow, passenger flow, occupancy level, speed and delay and spot speed study. The study reveals that after the implementation of BRT the carriage way width for MV lane is reduced which impacts directly the traffic flow, queue length and speeds as the free maneuver was affected due to limited carriage way.

Keywords: BRT corridor, BRT lane, MV lane, Traffic Flow, Passenger Flow

I. INTRODUCTION

With an increased population and changing lifestyles the mobility needs of large cities is increasing unscrupulously. The mobility needs are fulfilled by the transportation system of any city. Normally the transportation system comprises of vehicles, road/ rail network and the associated ancillaries viz. signals and islands on crossings, fly-over, grade separation etc. The vehicles can be personal or can be public. In recent times the number of personal vehicle ownership is rampant. This fact has been pointed out in the work of Tsay and Herrmann (2013), "When cities do not provide effective public transit or safe spaces to walk or bike, urban dwellers increasingly turn to cars, the most energy-consuming form of transportation". This is leading to lot of traffic problems viz. perpetual congestion on the roads in the peak hours, time delays, noise, accidents, air pollution, deterioration of the public health etc. Most of the personal vehicles are automobiles and require tremendous quantities of fossil fuel. The Indian economy has lots of impact since the import of oil constitutes 70% of its crude requirements. Moreover, the personal vehicle possession in India is considered to be a pride and prestige. In recent times SUVs and Sedans have come on road and the occupancy of each vehicle on road is ranging from one person to three persons at the most. The road area used is quite large in comparison to its occupancy. This causes long queues at intersections and the road lanes are congested. The solution to the problems mentioned earlier is development of fast, well connected, convenient and smart public transportation system that will carry bulk of passengers to the destinations. Though, such public transportation is a solution, door to door connectivity offered by the private vehicles is very difficult to be matched. The best medium solution is any city should have a blend of private and public transportation working in conjunction to generate a better transportation system. Traditionally, the various modes of urban public transportation in India are buses, Para-transit vehicles like auto-rickshaws and vans, passenger trains, local trains etc. In recent times faster transits like Metro Rail Train Transit, Light Rail Transit etc. are also getting popularity in large metros of the country. However, these require high initial investment for creation of infrastructure and subsequent operation. But a cheaper mode is also getting popularity which is based on the bus transport system. The main difficulty of slow speed of the bus movement in mixed traffic condition is alleviated by providing a dedicated bus lane and special buses carry the passengers on these lanes. The system is popularly known as the Bus Rapid Transit System (BRT). BRT can run along the common roads in a special dedicated lane and specially designed stops and prioritized signals. Wright (2005) defines it as "bus-based mass transit system that delivers fast, comfortable, and cost-effective urban mobility".

II. THE PROBLEM

The Indore BRT system is of about 11.4 km length and includes 21 bus stations. There are two right of way on which the BRTS is running. A central section from Navlakha to LIG Square has a width of 31.5 m whereas on both the sides the total width of the road is 63 m. All the stops e centrally placed having a median aligned BRT lane except one stop at the Palasia Square which is a curb sided station. For 200 m of the length the divided BRT lane is absent around this stop. The dedicated BRT lane is absent. 7 of the stops are located on the narrower lane and 13 stops are located on broader road. 7 stops are in the mid-section and all the remaining stops are close to major road intersections. The BRT system in

Indore was implemented with full technical specifications and details. However, the main drawback of the system was that it was created on an already existing road and the execution work had many difficulties. This included difficulties in traffic management, acquisition of land and other difficulties in other sundry items. The BRT was implemented in May 2013. The traffic woes of mixed lanes on both sides of BRT have increased manifold though a two lane road is provided on both the sides in the narrow portion of BRT. The main reason for the higher traffic flow in the mixed lane is rampant personal motorization in the city of Indore, the road on which the BRTS is built has poor network of adjoining parallel roads and the road is having dense commercial/official land use and is crossing the main arteries that connect the city of Indore to different surrounding places. According to Ministry of Transport and Highways (2012) Indore has 560 vehicles registered per 1000 population which is second highest after the city of Coimbatore with 577 vehicles/1000 persons the highest in India The share of two wheeler traffic is varying from about 54 to 67 percent and the share of passenger car traffic is varying from 22 to 33 percent along the corridor and the hike in vehicular share is during peak hour is about 40 to 60 percent. This indicates the high traffic intensity on road. Hence the traffic density on this road is quite high during peak hours. Owing to the poor traffic conditions in the Mixed Vehicle (MV) traffic lane, a Public Interest Litigation (PIL) was filed in the Indore Bench of the Hon. High Court of M.P. The PIL was about to scrap the BRT and running the buses in the mixed lane.

III. THE OBJECTIVES OF STUDY

The objective of the study was to investigate the impact of BRT corridor on mixed vehicle lane as its constructed on existing busy route. In response to public interest litigation (PIL) filed at Indore Bench of the Honorable High Court of the State of Madhya Pradesh. The investigation parameters were traffic flow, queue length , spot speed and speed and delay study.

IV. PROPOSED METHODOLOGY AND DATA COLLECTION

In all kinds of traffic studies, the planning of a sequence of study is quite important aspect. A general traffic engineering problem includes data collection, analysis and interpretation and discussion. Based on the stated objectives the methodology has been proposed and accordingly data was collected. Table 1 presents a classification of different data collected.

Table 1 Different Data Collected/Surveyed

Type of Data	Along BRT corridor in MV lane
Traffic Volume @ Midblock	For MV Lane
Spot Speed study	For MV Lane
Queue Length	For MV Lane

4.1 Classified Traffic Volume Counts at Mid-Block Section

Classified traffic volume count survey was conducted at four mid-block sections along the BRT corridor, the survey at the above identified sections was conducted spread over three days covering one weekend and two week days. Further, the Passenger Car Unit (PCU) factor applied in this study to estimate vehicular volume in PCU. These studies were conducted spanning for 6 hours (9:00 AM to 11:00 AM, 1:00 PM to 3 PM and 6:00 PM to 8 PM)

4.2 Spot Speed Study

In order to assess road safety situation on BRT corridor, it is necessary to understand the operating speeds of the different vehicles. Consequently, the speed profile of the different vehicle types travelling on the corridor were determined by selecting a segment of 20m length on MV lane and BRT lane.

4.3 Queue Length Survey

As in the case of other types of traffic surveys, the queue length survey was also conducted at the four selected intersections falling on the corridor. The queue built-up along both sides of the intersections (along BRT corridor only) was accomplished by observing the strategic locations on each arm of the intersections falling along BRT corridor for the measurement of queue length. Having clearly outlined the methodologies for the conduct of the various types of traffic surveys, the succeeding part of the paper discusses on the results arrived from the exhaustive analysis carried out under the normal BRT operations on the study corridor.

The traffic volume count survey was conducted at four mid-block sections in MV lane for a period of 6-hours along the corridor. The collected traffic volume data (15-minute interval) was also analyzed hourly and timated peak hour flows presented in the form of both vehicles/hr and PCU /hr. The data collected and analysed. Summary of classified traffic volume at mid-block section is given in table

V. DATA ANALYSIS

5.1 Mid-Block Traffic Volume

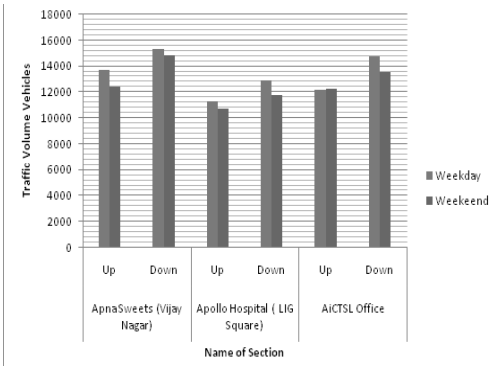

Figure1: Mid-Block Traffic Volume (Vehicles)

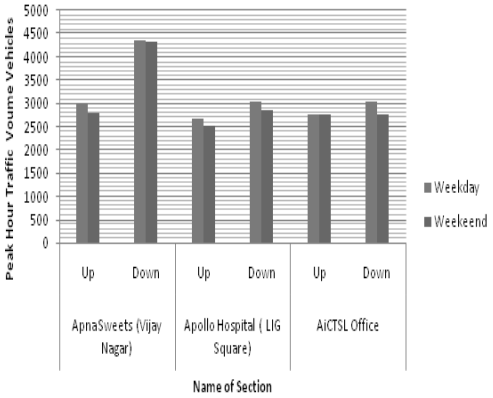

Figure2:Mid-Block Peak Hour Traffic Volume (Vehicles)

Table 2 Mid-Block Traffic Volume (two way two lane)

							Name of the Section
Monday	**Sunday**	**Monday**	**Sunday**	**Monday**	**Sunday**		**Day**
1.22E+04	1.23E+04	1.13E+04	1.07E+04	1.37E+04	1.24E+04	Up	Total Traffic Volume (Vehicles)
1.48E+04	1.36E+04	1.29E+04	1.18E+04	1.53E+04	1.49E+04	Down	Total Traffic Volume (PCUs)
1.20E+04	1.13E+04	9.81E+03	9.31E+03	1.19E+04	1.08E+04	Up	Peak hour Volume (Vehicles)
1.34E+04	1.22E+04	1.11E+04	1.01E+04	1.32E+04	1.27E+04	Down	Peak hour Volume (PCUs)
2.77E+03	2.76E+03	2.66E+03	2.52E+03	3.01E+03	2.80E+03	Up	
3.03E+03	2.76E+03	3.05E+03	2.86E+03	4.35E+03	4.33E+03	Down	
2.52E+03	2.49E+03	2.35E+03	2.23E+03	2.53E+03	2.35E+03	Up	
2.78E+03	2.50E+03	2.54E+03	2.41E+03	3.73E+03	3.71E+03	Down	

4.3 Spot Speed Study

As mentioned in previous chapters, the spot speed survey was conducted at two locations. These locations were selected to assess the operating speeds of the traffic plying on study Corridor on MV lane. The collected spot speed data was analyzed and the mean spot speeds were determined and presented in Table 4.38. From this table, it can be observed that the mean speed of two wheelers is ranging between 44 to 49 kmph followed by cars reported at 39 to 45 kmph. It is also observed that the mean speed of three wheelers about 33 to 36 kmph. Further, the 98th Percentile speeds on mid-blocks are presented in Table 4.30 From the Table 4.30 and, it can be observed that the 98th Percentile speeds at mid-blocks on the corridor of two wheelers ranges from 65 to 72 kmph followed by cars 53 to 61 and three wheelers 47 to 53 kmph. Figures 4.21 to 4.24 showing the normal distribution curve and cumulative curve of percentage of speeds of different vehicle type observed at two locations

Table: 98th Percentile Spot Speeds on Typical Locations of the BRT Corridor (MV Lane)

Vehicle Type	**Mean Speed (kmph)**	
	Hotel Shreemaya Residency	**CHL Apollo Hospital**
Two Wheelers	72.5	65
Three Wheelers	53	47
Cars	61	53

Table: Spot Speeds on Typical Mid-Block Sections of the BRT Corridor (MV Lane)

Vehicle Type	**Mean Speed (kmph)**	
	Hotel Shreemaya Residency	**CHL Apollo Hospital**
Two Wheelers	49.67	43.99
Three Wheelers	45.28	39.5
Cars	36.24	33.4

Table : 85th Percentile Spot Speeds on Typical Locations of the BRT Corridor (MV Lane)

Vehicle Type	**Mean Speed (kmph)**	
	Hotel Shreemaya Residency	**CHL Apollo Hospital**
Two Wheelers	57	52.8
Three Wheelers	43	38

Cars	50.2	43

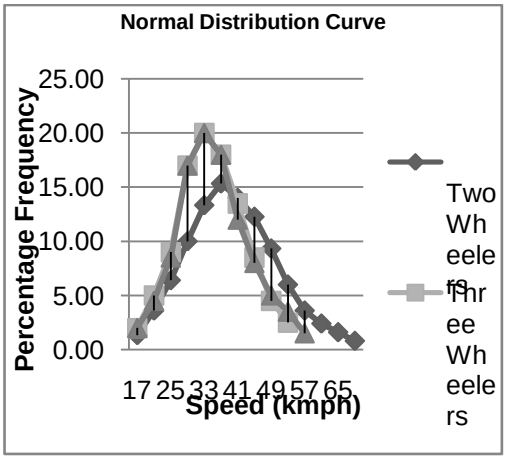

Figure 3

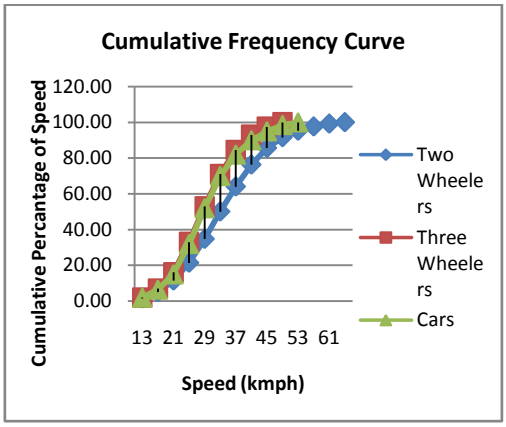

Figure4: Spot Speed Distribution across different vehicle type at Hotel Shreemaya Residency

5.4 Queue Length Studies

Queue length survey was conducted at the three intersections falling on the study corridor. The measurement of the queues building on the two approach roads of the intersections was accomplished by observing the strategic locations along the study Corridor. The queue build-up on the study corridor is primarily due to controlling of the signal on manual mode during morning and evening peak hours. Obviously, the major approach arms of the Shivaji Vatika Intersection is heavily congested during the morning and evening peak hours and hence the long queues was witnessed due to over-saturated status of this intersections and longer cycle length of signal. The results of observed queue lengths in meters are presented in Table 7

Table 7 Results of Queue Length Studies

Name of intersection	Maximum	Minimum	Average	SD
	in upward direction from Rajiv Gandhi to Niranjanpur			
Shivaji Vatika	103	37	64.8	15.2
MR- 9	73	26	49.06	10.3
LIG	62	24	41.69	8.37
	in downward direction from Niranjanpur to Rajiv Gandhi			
Shivaji Vatika	113	43	73.29	15.53
MR- 9	78	28	51.42	11.25
LIG	66	23	44.77	10.17
Shivaji Vatika	113	43	73.29	15.53
MR- 9	78	28	51.42	11.25
LIG	66	23	44.77	10.17

VI. RESULTS AND DISCUSSIONS

This research is conducted to know the impact of BRTs corridor as discussed in the previous sections. The key findings of the work are related to effect on MV lane traffic in terms of flow, spot speed and queue length .

1. The mixed vehicle lane have bottleneck from Navlakkha square to LIG square which reduces the number of lanes

2. The traffic flow between the bottleneck section is quite high and more than the capacities of mid-block sections

3. Because of bottleneck the spot speed gets reduced due to restricted maneuver.

4. The queue lengths on the all signals are high along the BRT lane approaches as compare to other approaches because of less number of traffic lanes.

VII. CONCLUSIONS

1. The study reveals because of implementation of BRTs the performance of MV lane is affected.

2. The traffic flow along the MV lane in each direction of travel in almost all the mid-block sections reach to its full capacity in the 60 m right of way. In the MV Lane in each direction of travel in almost all the mid –block sections suffer heavy congestion in peak hours in 31.6 m right of way. The study at AiCTSL Office section is indicating that the MV lanes reach its capacity but at CHL Apollo Hospital section the flow is much more than its capacity therefore the congestion to the traffic flow generally occurs in the bottleneck part scenario. At the same time the BRT lane is utilized to a very small fraction of its capacity.

3. The spot speed study also confirms that speed is quite low in the 31.6 m right of the way section as compare to 60m right of way.

4. The queue lengths were high just because of low saturation flow and more normal flow along the corridor approaches..

REFERENCES

[1] APTA (2007). 'Public Transportation: Benefits

for the 21st Century ‘, American Public Transport Association, 1666 K Street, N.W. Washington, DC 20006-1215

[2] Cham, L., Chang, M., Chung, J., Darido, G., Geilfuss, C., Henry, D., and Schneck, D. (2006). Honolulu Bus Rapid Transit (BRT) Project Evaluation (No. FTA-VA-26-7226-2006.1).

[3] Congress, I. R. (1990). Guidelines for capacity of urban roads in plain areas. IRC-106.

[4] Gandhi, S., Tiwari, G., and Fazio, J. (2013). “Comparative Evaluation of Alternate Bus Rapid Transit System (BRTS) Planning, Operation and Design Options” Journal of the Eastern Asia Society for Transportation Studies, 10(0), 1292-1310.

[5] Levinson H. S., Zimmerman s., Clinger J., Gast J., Rutherford S, and Bruhn E. (2003). ‘Bus Rapid Transit Volume 2: Implementation Guidelines’. TCRP Report 90, Transportation Research Board, Washington, D.C.

[6] Ministry of Road Transport and Highways (2012) Road Transport Yearbook (2009-10 & 2010-11), Transport Research Wing, Ministry of Road Transport and Highways, Government of India, New Delhi.

[7] Sekhar, C. R., and Velmurugan, S. (2013). “Micro Simulation based Performance Evaluation of Delhi Bus Rapid Transit Corridor.” Procedia-Social and Behavioral Sciences, 104, 825-834.

[8] Siddique, A. J., and Khan, A. M. (2006). “Microscopic simulation approach to capacity analysis of bus rapid transit corridors.” Journal of Public Transportation, 9(3), 10.

[9] Tsay S. and Herrmann V. (2013) “Rethinking Urban Mobility: Sustainable Policy for Century of the City”, Carnegie Endowment for International Peace, 1779 Massachusetts Avenue NW Washington, DC 20036

[10] Wright, L. and Hook, W (eds). (2007), “Bus Rapid Transit Planning Guide.”, Institute for Transportation and Development Policy, New York.