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Bus Rapid Transit System- A Case Study of Bhopal

Kumar Amal Vats[1] and Arvnendra Kr.Thakur[2]

[1]Dept. of Arch. NIT Patna LAL Nikunj, Ward No 19 Station Road Madhubani
[2]Dept. of Man. Lmnu Darbhanga Lal Nikunj, Ward No 19 Station Road Madhubani
E-mail: 1amalvats@gmail.com, 2arvnendrathakur@gmail.com

Abstract—*Earlier the public transport system in Bhopal (India) was not managed by the concern authorities and users. The people of Bhopal felt various traffic problems like accident, congestion and crowding on the road, this is because of increasing population (traveller) and older transport system which is not efficient.*

After the scheme Jawaharlal Nehru National Urban Renewal Mission (JnNURM) launched by the Ministry of Urban Development, Government of India, the Bus Rapid Transit System (BRTS) subject to serve as public transport in Bhopal. On 1st June 2013 buses ran along 6 km stretch as a trial run. After the trial of BRTS starts, it was seen that the public were interested to travel from a new system. After that the mode of transport is also changed from the cars and private vehicle to the public transport.

The whole corridor of the first phase of BRTS Bhopal was 24 km long, but the small section which operational first was about 6 km only, it showed the success of BRTS in Bhopal. Now progress towards completing the infrastructure of second phase noticed. This paper presents the surveys and the out coming data which reflect different facts and statements.

1. INTRODUCTION

Bhopal is the capital and the second largest city in the state of Madhya Pradesh. Is a fascinating amalgamation of scenic beauty, old historic flavour and modern urban planning. It is also known as the "City of Lakes". Today Bhopal has blossomed into a city, which in spite of being modern, upholds the patrician mark of its bygone rulers. With time, the city has emerged as a multifunctional regional hub of social-political and economic activities. Bhopal city can be divided into two parts - the old city and newly developed area with administrative, institutional, industrial, commercial and residential activities. The Government of India, Ministry of Urban Development and Poverty Alleviation (MoUD & PA) have classified Bhopal as a "National Priority City"[1] in the report of the National Commission on Urbanization.

The Bhopal district has a population of 23,68,145[2] (2011) persons over 2,772 sq. km. The gross density of the population is 854 persons per sq. km. The district has a literacy rate of 82.3%.

2. PUBLIC TRANSPORT IN BHOPAL

Bhopal was allocated 225 buses under the JnNURM scheme in 2009. A special purpose vehicle- Bhopal City Links Limited (BCLL) was formed with 50% shareholding each of the Bhopal Municipal Corporation and Bhopal Development Authority to supervise, control and manages the city bus system. The buses operate on a net cost model wherein the private operator has been allocated 150 buses on 8 routes (Table1), wherein bus operate as per schedule given by BCLL. The operator pays a monthly premium for each bus to BCLL. Also, 38% of the cost of the bus has been paid by the operator upfront.

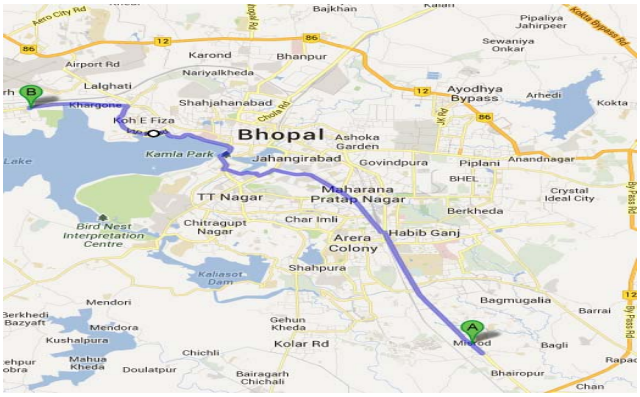

Fig. 1: BRT Corridor

Table 1: Route Description

S. No.	Route No.	Route Description	Route Length	Existing Headway(min)	No. of Buses

[1] As per national commission of India
[2] As per census of India

S. No.	Route No.	Route Description	Route Length	Existing Headway(min)	No. of Buses
1.	TR1	Chirayu Hospital-Akriti Ecocity	25	10	23
2.	TR2	HEG Mandideep-Bus Stand	23	8	20
3.	TR3	Ayodhya Nagar-Nariyal Kheda	27	32	13
4.	SR2	Nehru Nagar-Katara Hills	20	16	13
5.	SR4	Karond Choraha-Bairagarh Chichli	26	8	24
6.	SR5	Chirayu Hospital-Avadhpuri	29	12	21
7.	SR6	Oriental College-Rajiv Gandhi Trilanga	24	12	15
8.	SR8	Bairagarh Chichli-Coach Factory	22	10	21

In addition, around 583 minibuses are run by private operators. Auto-rickshaws and Tata Magic Vans are also available as a mode of transport.

The first BRT corridor 'My Bus' from Misrod to Bairagarh (24km) is operational now which have some important features like Open System, On Board Fare collection, Multiple Operators etc. On June 1, 2013 part of the corridor from Misrod to RRL(6.7km) was opened for trial runs. The remaining stretch is under construction. The entire corridor will have 82 Bus Stops which will be staggered. 20 low floor AC buses along with the existing non AC buses on the existing routes will play on the corridor. The AC buses will be operated on a net cost model by another private operator.

3. SURVEYS

Various surveys were conducted, both inside and outside the bus corridor namely:

- Bus Docking
- Travel time surveys of buses on various routes both inside and outside the corridor
- Bus headway monitoring
- BRT bus passenger feedback survey
- Bunching and idling of bus.

Bus Docking

Docking implies the precision with which the driver is able to stop the bus at the bus stop such that there is very little horizontal gap between the edge of the platform and the edge of the door of the bus. Moreover, the vertical difference between the platform height and floor height of the bus is also measured. The objective is to judge whether the drivers who were used to operating in a non BRT environment are able to perform satisfactorily driving the buses in the BRT corridor.

All the buses operating in the corridor were subjected to measurements for docking each day of operation. The table below provides a summary of the daily averages.

Table 2: Bus Average Docking

Date	Vertical difference (inch)	Horizontal difference (inch)	Over/under shot (inch)
17-06-2013	2	8	7
18-06-2013	1	6	5
19-06-2013	2	9	6
20-06-2013	2	9	5
21-06-2013	1	7	6
22-06-2013	2	8	4
24-06-2013	1	6	4
25-06-2013	2	6	3
28-06-2013	1	6	1
29-06-2013	1	6	1

The overall average horizontal difference is about 8 inches with a standard deviation of 3 inches implying that the drivers were able to dock the buses properly and are within the acceptable limit of 12 inches. Similarly the buses on an average were able to be docked properly with the average over/undershot distance being 4 inches on an average.#

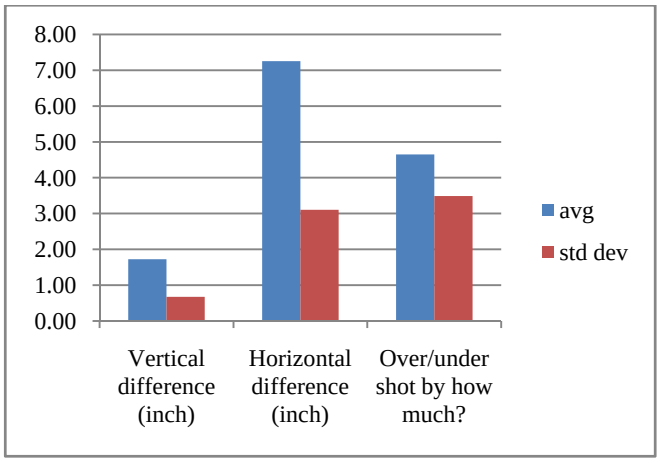

Fig. 2 Docking Survey Result

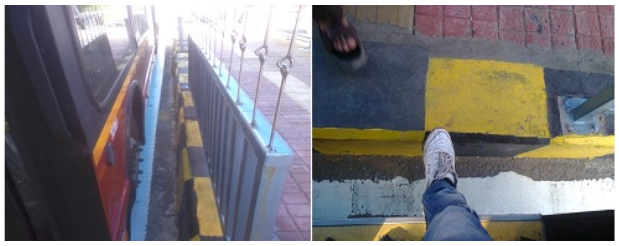

Fig. 3: Docking of Bus in BRT Corridor

Travel time survey

The travel times of the buses on all the 8 routes were studied with a view to understand the difference in travel times in the morning and evening peak and the off peak period which has a direct bearing on the scheduling and consequently on the fleet size[3]. The routes TR1 and TR2 were studied to compare the travel times outside the bus corridor as these 2 routes cover the entire stretch on which the BRT shall operate. Moreover, by measuring the travel time on the RRL-Bairagarh section, an estimate of the travel time on the corridor is arrived at which will feed into the ultimate scheduling of the buses on the corridor.

During the dry run it was observed that travel time for the bus is about 18 minutes, while layover time is about 5 minutes i.e. 1 way travel time of 23 minutes. The average travel time in this section (RRL- Misrod) is almost equal to that of buses out of the BRT corridor (TR2) of that section which is attributable to a number of stops on the BRT and relatively less traffic outside the corridor.

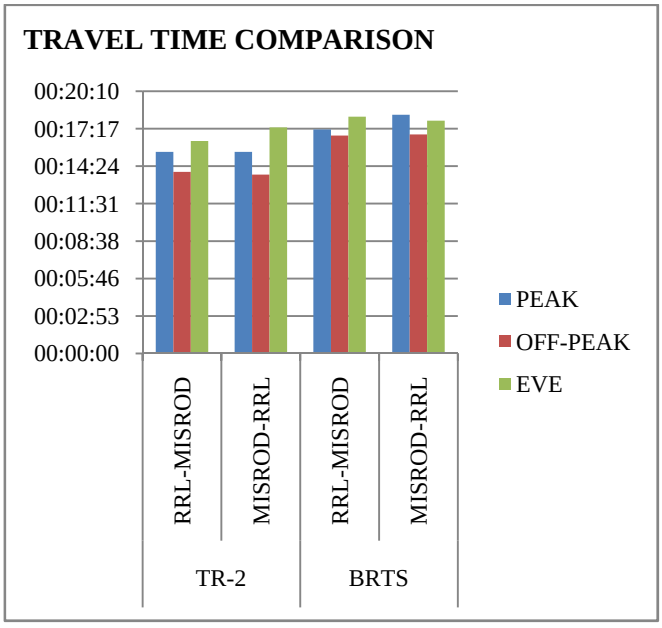

Fig. 4: Travel Time on TR-2

It is observed that:

- Travel time of BRT bus towards MISROD is more than that of towards RRL. Deviation in travel time towards MISROD is less than that of buses towards RRL. Travel time may vary from 15 minutes to 19 minutes.
- Travel time of MISROD-RRL is on average 17 minutes while standard deviation is about 2 minutes. Similarly, travel time of RRL-MISROD is about 18 minutes and standard deviation is about 3 minutes. The cycle time of buses in this section is 47 minutes.

As we see that the average cycle time of Misrod –RRL is 47 minutes and the deviation is about 2 minutes. It means the cycle time will vary from 45 minutes to 49 minutes. Cycle time[4] of RRL-MISROD is 45 minutes, but the deviation is about 7 minutes.

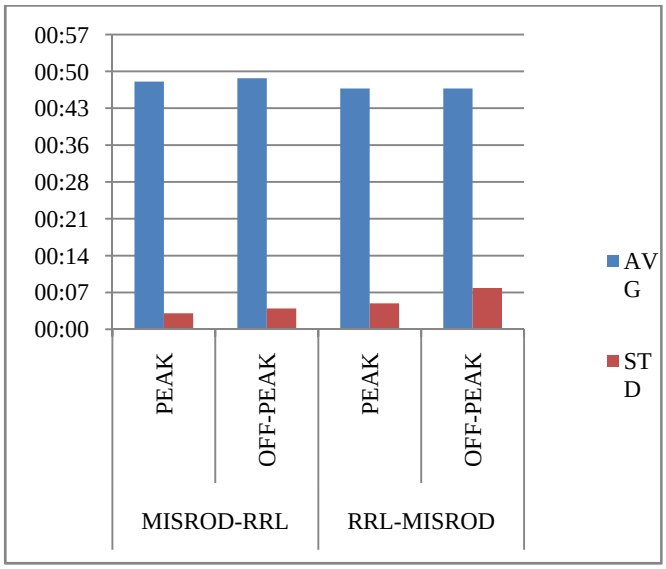

Fig. 5: Cycle Time on BRTS

The one-way travel times of all the 8 routes have been analyzed and presented in **Table 3.**

Table 3: Travel Time of Buses across Bus Routes

Route	Travel times at different times of day(min)		
	Morning Peak	Off-peak	Evening Peak
TR1	90	75	89
TR2	79	72	80
TR3	84	82	85
SR2	75	64	75
SR4	88	81	88
SR5	94	90	95
SR6	77	67	77
SR8	82	81	90

[3] Fleet Size- It is the ratio of bus cycle time to the headway.

[4] Cycles time- it is the addition of two way run time and the stop time at terminal.

Fig. 6: Headway Survey is in Progress

Bus headway survey

In order of operations to run smoothly it is imperative that the buses are dispatched at the designated time so that the headway can be maintained.

With the trial runs being performed using 10 buses, the headway to be observed was 6 minutes.

Passenger feedback survey

During the first few days of the passenger trials, More than 130 passengers were interviewed in which more than 25 % are female. Safety on a BRT bus was appreciated by more than 70 % females. 50 % of female passengers used scooter earlier. 90% of the passengers found the system to be comfortable and like the AC bus system more. 95 % of male passengers feel that the BRT is faster than ordinary services and would travel because it would save time. More than 25% of male passengers were car users. About 80% of the passengers liked the BRT. 55%passengers are users of private modes. More than one third of the passengers used city buses earlier.

Some suggestions are as under

- Parking to be provided near major bus stops.
- Provision of music.
- Increase number of AC buses.
- Lower fares

Table 4: BRT Passengers Earlier Mode of Travel

Mode of transit	Percentage of people used.
Bus	34 %
Cars	20 %
Auto	10 %
Two wheeler	30 %
Others	6%

4. FINDINGS/CONCLUSION

This report is based on the traffic and transportation surveys on Bhopal BRTS during June, July 2013. The respondents are the different buses, already running either on BRTS corridor in trail run or on the outside corridor as the service for people. Some questions are asked by the bus drivers and staffs. The passenger feedback obtained by different passengers.

Summary of the out coming facts is as follows:-

- The average docking is 8 inches, which is less than the acceptable limit of 12 inches.
- Travel time of one side transit run is 15 minutes.
- The cycle time of a bus is 47 minutes.
- 25 % are the female respondents. 70 % of them appreciate the safety concept of BRTS.
- 90 % of the respondents found the system more comfortable.
- 55 % of passengers are user of private modes.

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