

## Improving Route Capacity of Public Bus Transport: A Case Study of Route no. 298 of PMPML

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### Abstract

Pune Mahanagar Parivahan Mahamandal Ltd. (PMPML) is the public transport bus service provider for the twin cities of Pune and Pimpri-Chinchwad in the Pune Metropolitan Region of the Indian state of Maharashtra. In 2016-17, PMPML had a fleet of 2045 buses maintained at 13 depots spread across Pune City. However due to several buses being in repair, only 1382 buses are operational on 371 routes.

Out of all the buses, the bus assigned to Route No. 298 travels a round trip between Katraj Bus Stop to Chinchwadgaon Bus Stop covering 30 km in single journey. The buses which are assigned for this route faces various problems like overcrowding throughout the day. This overcrowding is dangerous for the passengers as they have to stand at corners near the gates which hazardous regarding their safety of life. To mitigate the problems there is need to give a suitable solution.

**Keywords:** Chinchwadgaon (CHG), Katraj (KTJ), Occupancy, Boarding, Alighting, Passenger load, Bus Rapid Transit System (BRTS).

### 1. Introduction

Pune Mahanagar Parivahan Mahamandal Ltd. (PMPML) is the public transport bus service provider for the twin cities of Pune and Pimpri – Chinchwad in the Pune Metropolitan Region of the Indian state of Maharashtra. In 2016-17, PMPML had a fleet of 2045 buses maintained at 13 depots spread across Pune City. However due to several buses being in repair, only 1382 buses are operational on 371 routes.

Out of all the buses, the bus assigned to route no. 298 travels a round trip between Katraj Bus Stop to Chinchwadgaon Bus Stop covering 30 km in single journey. The buses which are assigned for this route faces various problems like overcrowding throughout the day. To mitigate the problems there is need to give a suitable solution.

### 2. Literature review

Dr. Vinita Nawalakh (1) studies public opinion on preferred mode of local transport in the areas of PMC and PCMC. Public opinion about what steps and improvisations in PMPML would shift the demand towards public transit is also studied. Also, efforts already taken by PMPML in order to popularize public transit have been studied. A detailed study of the recently implemented BRT system has been done. They concluded by giving recommendation to increase use of PMPML bus service instead of private vehicles.

Dr. V. R. Nagarale, D.V. Harpale (2) studies different modes of urban transport which are necessary in congested areas. The development of cheap and efficient means of urban transport is necessary for the progress of large cities in developing country like India. They have concluded that future management plans of

Government in Pune city like monorail, skyline bus etc. will help the ease in transportation in the city.

Ananth Rangarajan (3) displays a model of old bus service and a model of BRTS. It compared the administration of both the systems. It discusses the effect of traffic on the travel time of buses operating in old bus service system and BRTS. It states that the BRTS is a smoother functioning system than the old bus service system.

Avishai Ceder (4) portrays the various stages involved in planning of a new bus network. It includes Level A: Network design, Level B: Frequency setting, Level C: Timetable development, Level D: Bus scheduling, Level E: Driver scheduling which are implemented in the order respectively. It also discusses the parameters to be considered while designing a bus network that is route spacing, route length, stop spacing etc. The features that have to take into considerations for designing are Demand, Objective function, Constraints, Passenger behavior and solution technique. It suggests a two-level methodological approach to route network design which includes an algorithm to construct a feasible bus service. It also concludes the limitations of modifications for an existing bus network.

Dr. Mrs. Pradnya B. Vhankate (5) studies how PMPML is a backbone of Pune's public transport system. It aims to satisfy the commuter's requirements through its services. But the mindset of the employees has to be positive if available services need to be reached to the end users. Organized Human Resource Policies normally help the organizations to make better use of available human resources. PMPML being the public enterprise should have such policies and practices. This article is an attempt to study whether there exist such policies, if not, suggest suitable suggestions to PMPML to introduce and implement such policies to improve the performance of the PMPML. It concluded that there is a non-availability of human resource policies.

Manish U. Parate (6) examines the problem faced by the public like traffic jams, roads are not wider for more traffic and as there is no enough of smart transportation is there in the city. It also discusses various solutions like redesigning of streets, footpaths, smart multi-level car parking to accommodate more space for running the BRT. It concluded that the quantity of buses required per lac of population is below the required quantity.

Rohit R. Galande (7) examines various traffic troubles in town areas which increase due to rapid growth of population and thus increasing the number of vehicles, which results into excessive delays, travel time and reduction in speed of urban road network. In order to reduce these problems there is a need for sustainable public transport system. Various traffic quality parameters needs to be analyzed like traffic flow, speed, travel time, delay time, stop time and fuel consumption to check the impact of BRT system as compared to mixed traffic. It is also mentioned how efficiently a bus station should be provided and what parameters are to be considered. It concludes the advantages and disadvantages of implementation of BRTS it emphasizes on the location of bus stops throughout the journey. It displays the importance of co-ordination of bus service with other modes of transport.

### 3. Methodology

#### 3.1 Data collected from PMPML Officials

Following is the Data collected from a meeting with the Katraj Depot Manager:

1. No. of buses: 11
2. No. of Trips: 2 trips of each bus
3. Start and end point for all 11 buses is Katraj bus depot only
4. Price for per ticket from Katraj to Chinchwadgaon is 35 Rupees
5. Revenue generated for Round trip for Bus 298 is 7 to 9 thousand rupees.
6. CNG Bus capacity: 34 seats
7. Non-CNG Bus capacity: 52 seats

8. In case of Breakdown of bus, the whole schedule of that bus is cancelled.
9. Design frequency of buses ranges from 20-30 minutes.
10. Travel time of the bus from both the end points varies from 1hr 45 minutes to 2hr.

### 3.2 Boarding alighting Survey

Boarding-alighting survey measures the quantity of people getting on and off a bus at each bus stop from start to the end point of a journey. This is an on-board survey which requires the observer to be seated within the bus; one observer for each door in the bus. The observer records the number of passengers that have boarded and alighted at each stop along with the time of arrival at each stop.

### 3.3 Time slot Selection

According to the information obtained from the PMPML officials, it was concluded that there is very less variation in the occupancy on weekend, throughout the day considering Saturday as well as Sunday.

In the sample Survey, it was concluded that morning time of the day is the best time period to carry out Boarding Alighting survey as, for the weekend, morning time period gives the maximum occupancy. This information was shared by the passengers themselves on board after having a one-to-one discussion regarding any up gradation to be made in service. It was discussed that the frequency and schedule shall be designed for a Fixed Demand and not variable Demand. Hence, morning time slot was selected for survey.

### 3.4 Route of the bus

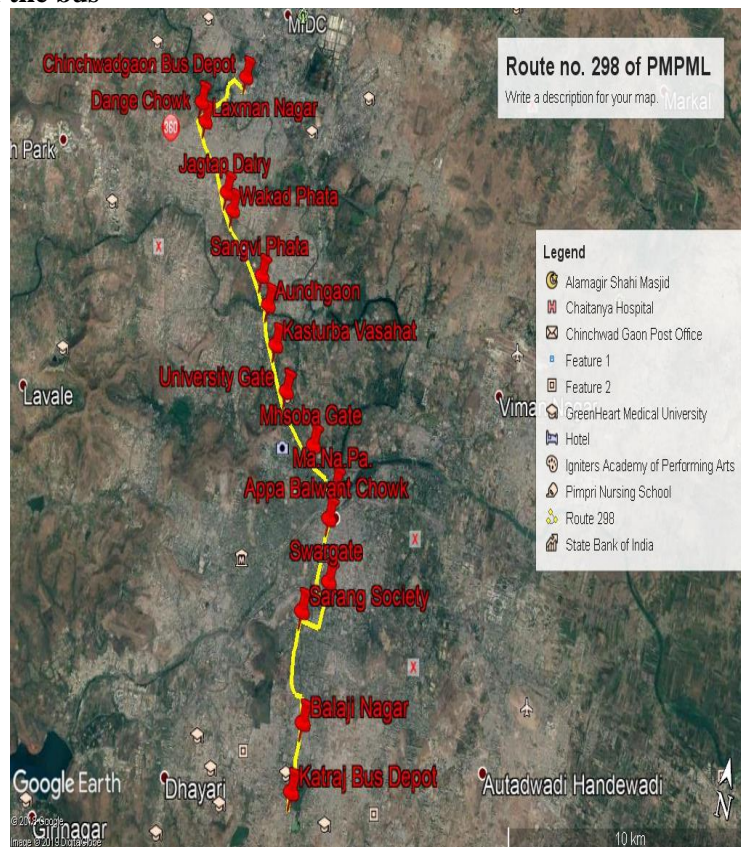


Figure 1. Route no. 298

### 3.5 Passenger Load Calculation for Weekends

A Boarding-Alighting Survey was carried out for weekend on 14<sup>th</sup> October 2018 to determine the passenger load on bus during the journey of the bus. The data collected from the survey is displayed below in Table 1 and Figure 2.

**Table 1. Sample Data for Weekends**

Date: 14/10/18			From: CHG To: KTJ		
Route no. 298			Time: 09:55		
Stop No.	Stop Name	Time	Boarding Passengers	Alighting Passengers	Occupancy
1	Chinchwadgaon	09:52	17	0	17
2	Chapekar Chowk	09:53	5	1	21
3	Aditya Birla	09:55	0	0	21
4	Datta Nagar	09:56	1	1	21
5	Thergaon Phata	09:58	0	1	20
6	Dange Chowk	10:00	20	1	39
7	Laxman Nagar	10:01	2	1	40
8	16 No. Stop	10:03	3	0	43
9	Kalewadi Phata	10:04	7	2	48
10	Shivraj nagar	10:08	2	0	50
11	Jagtap Dairy	10:11	0	0	50
12	Rakshak Chowk	10:14	1	0	51
13	Govt.Hospital Aundh	10:15	0	0	51
14	Sangavi Phata	10:16	0	0	51
15	Aundhgaon	10:18	1	1	51
16	Kasturba	10:22	0	0	51
17	University Gate	10:26	1	2	50
18	Ganeshkhind RBI	10:29	0	0	50
19	Ganeshkhind Central	10:30	1	1	50
20	LIC	10:32	0	2	48
21	COEP Ground	10:36	4	3	49
22	Shivaji Putala	10:37	0	0	49
23	Ma.Na.Pa	10:38	8	3	54
24	Dagdusheth	10:44	4	12	46
25	Mandai	10:50	5	1	50
26	Swargate	10:55	1	21	30
27	Sarang Society	11:08	8	9	29
28	KK Market	11:13	2	4	27
29	Balaji Nagar	11:15	1	13	15
30	Katraj	11:25	0	15	0

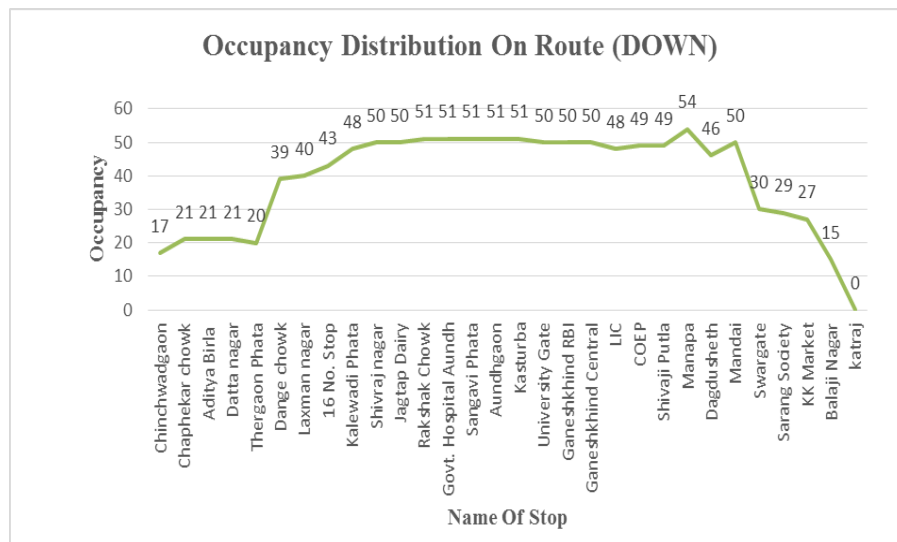


Figure 2. Occupancy Distribution chart

3.6 Pssenger Load Calculation for Weekdays

The data of Boarding-Alighting Survey for weekdays was obtained from Tripsheet Report issued by the PMPML Officials after a meeting with them. These Tripsheet Reports include all the details of the trip, that is, the scheduled time of the bus, the departing time of the bus, the number of current trip of the bus, the name of conductor and the total revenue generated from the each single trip. The Tripsheets obtained, were of the dates from 14<sup>th</sup> Jan 19 to 20<sup>th</sup> Jan 19. The representative data extracted is shown below in Table 2 and Figure 3.

Table 2. Sample Data for Weekdays

Date: 14/01/19		From: KTJ To: CHG		
Route no. 298		Time: 09:51		
Stop No.	Stop Name	Boarding Passengers	Alighting Passengers	Occupancy
1	Katraj	42	0	42
2	Balaji Nagar	50	1	91
3	KK market	0	0	91
4	Sarang Society	16	24	83
5	Swargate	8	19	72
6	A.B.C	9	34	47
7	Shaniwarwada	0	0	47
8	Manapa	0	0	47
9	shivaji putla	0	0	47
10	COEP	0	0	47
11	LIC	8	16	39
12	Ganeshkhind central	0	0	39
13	Ganeshkhind RBI	0	0	39
14	University Gate	3	11	31
15	Kasturba	0	1	30
16	Aundhgaon	4	9	25
17	Sangvi Phata	0	0	25
18	Govt. Hospital Aundh	8	0	33
19	Rakshak chowk	0	0	33
20	Jagtap Dairy	0	3	30
21	Shivraj Nagar	2	4	28



22	Kalewadi Phata	0	0	28
23	16 No.Stop	0	0	28
24	Laxman Nagar	1	16	13
25	Dange chowk	0	0	13
26	Thergaon Phata	0	0	13
27	Datta Nagar	3	8	8
28	Aditya Birla	0	0	8
29	Chaphekar chowk	0	0	8
30	Chinchwadgaon	0	8	0

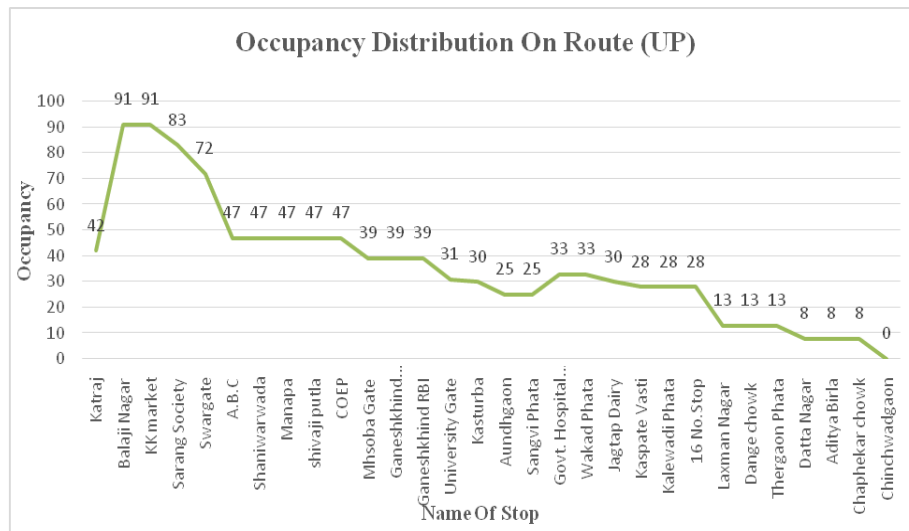


Figure 3. Occupancy Distribution Chart

**3.7 Revenue Generation**

After the completion of Boarding-Alighting Survey and the extraction of data from Tripsheet Report, nine bus stops with relatively high intensity of boarding and alighting were located and selected from the total 30 bus stops. It was concluded that these critical nine bus stops generate relatively greater revenue among the other bus stops. The details of revenue generation of these critical nine bus stops are displayed in tables below.

**3.7.1 Details of the trip of maximum contribution:**

1. Date of the trip : 16th January 2019
2. Scheduled time : 16:30
3. Trip No. : 2 (Time: 18:30)
4. Contribution : 66.67%

**Table 3. Maximum Revenue Contribution**

Stop No.	Name of bus stop	Boarding Passengers	Alighting Passengers on bus stop		Total Fare at each stop	Total Fare
1	Chinchwadgaon	16	Laxman nagar	08	80	305
			Aundhgaon			
			University Gate			
			Shimla House			
			Vasant talkies	04	100	
			Swargate	01	20	
			Balaji Nagar			

			Katraj	03	105	
2	Laxman Nagar	6	Aundhgaon			170
			University Gate			
			Shimla House			
			Vasant talkies			
			Swargate	02	50	
			Balaji Nagar	01	30	
			Katraj	03	90	
3	Aundhgaon	2	University Gate	01	10	30
			Shimla House			
			Vasant talkies			
			Swargate			
			Balaji Nagar	01	20	
			Katraj			
4	University Gate	22	Shimla House	01	05	265
			Vasant talkies	05	50	
			Swargate	09	90	
			Balaji Nagar	04	60	
			Katraj	03	60	
5	Mhsoba Gate (Shimla House)	19	Vasant talkies	03	15	210
			Swargate	09	90	
			Balaji Nagar	02	30	
			Katraj	05	75	
6	Vasant talkies	16	Swargate	03	15	175
			Balaji Nagar	07	70	
			Katraj	06	90	
7	Swargate	3	Balaji Nagar	02	20	30
			Katraj	01	10	
8	Balaji Nagar	21	Katraj	21	105	105
9	Katraj	00	Total Fare of the Trip			1290/-
10			Grand Total of the Trip			1935/-

**3.7.2 Details of the trip of minimum contribution:**

1. Date of the trip : 17<sup>th</sup> January 2019
2. Scheduled time: 07:45
3. Trip No. : 1 (Time: 07:50)
4. Contribution : 45.64%

**Table 4. Minimum Revenue Contribution**

Stop No.	Name of bus stop	Boarding Passengers	Alighting Passengers on bus stop		Total Fare at each stop	Total fare
1	Katraj	23	Balaji Nagar	04	20	235
			Swargate	17	170	
			A.B.C	00	00	
			Shimla House	00	00	
			Pune University	01	20	
			Aundhgaon	01	25	
			Laxman Nagar	00	00	

			Chinchwadgaon	00	00	
2	Balaji Nagar	22	Swargate	07	70	275
			A.B.C	07	70	
			Shimla House	01	15	
			Pune University	06	90	
			Aundhgaon	00	00	
			Laxman Nagar	00	00	
			Chinchwadgaon	01	30	
3	Swargate	16	A.B.C	03	15	225
			Shimla House	02	20	
			Pune University	04	40	
			Aundhgaon	03	45	
			Laxman Nagar	03	75	
			Chinchwadgaon	01	30	
4	A.B.C	07	Shimla House	01	05	75
			Pune University	04	20	
			Aundhgaon	00	00	
			Laxman Nagar	01	25	
			Chinchwadgaon	01	25	
5	Mhsoba Gate (Shimla House)	04	Pune University	00	00	40
			Aundhgaon	04	40	
			Laxman Nagar	00	00	
			Chinchwadgaon	00	00	
6	Pune University Gate	00	Aundhgaon	00	00	
			Laxman Nagar	00	00	
			Chinchwadgaon	00	00	
7	Aundhgaon	04	Laxman Nagar	02	30	70
			Chinchwadgaon	02	40	
8	Laxman Nagar	05	Chinchwadgaon	05	50	50
9	Chinchwadgaon	00	Total Fare of the Trip			970/-
10			Grand Total of the Trip			2125/-

#### 4. Results

- [1] The Boarding-Alighting Survey requires a minimum of two observers, but the efficiency of the process can be enhanced by more than two observers.
- [2] The schedule of the bus is fixed by PMPML, but this schedule sometimes slightly changes depending upon prevailing traffic conditions en route.
- [3] The starting time of the journey may also change depending upon the Depot conditions so as to maintain the parking capacity of buses..
- [4] The bus does not halt on every stop assigned to it en route. The bus mostly skips small, internal stops sometimes, based on experience.
- [5] The peak time period in morning is from 07:30 to 10:30.
- [6] The peak time period in evening is from 16:30 to 19:30.

#### 5. Conclusion

There is a requirement of two new buses in the route. It is the decision of PMPML authority to either invest in two new buses or use buses from other existing routes to run them on route no. 298 during the peak time period in morning and evening only.



The two new buses shall be dispatched simultaneously from both the end bus stops, that is, Katraj Bus Depot and Chinchwadgaon Bus Depot during the start of peak time period in morning as well as evening. The two new buses introduced shall halt on the selected nine critical bus stops only, where the boarding and alighting intensity is high.

The two new buses introduced shall complete one round trip in the peak hours during morning and evening. After these two buses have completed their single round trip in peak time period of the day, they can be used to run on other routes.

## 6. Acknowledgments

The authors take this opportunity to thank Project guide **Mr. S. D. Kurhade**, Co-guide **Mr. S. P. Gaikwad**, PMPML officials **Mr. S. Kadam** and **Mr. H. N. Tapkir** who have been a constant source of inspiration and also took keen interest in each and every step of the project development.

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