February 2010

Operations Design and Project Management Services for Pune BRTS Project

System Specification Report

Revised Report

Urban Mass Transit Company Limited

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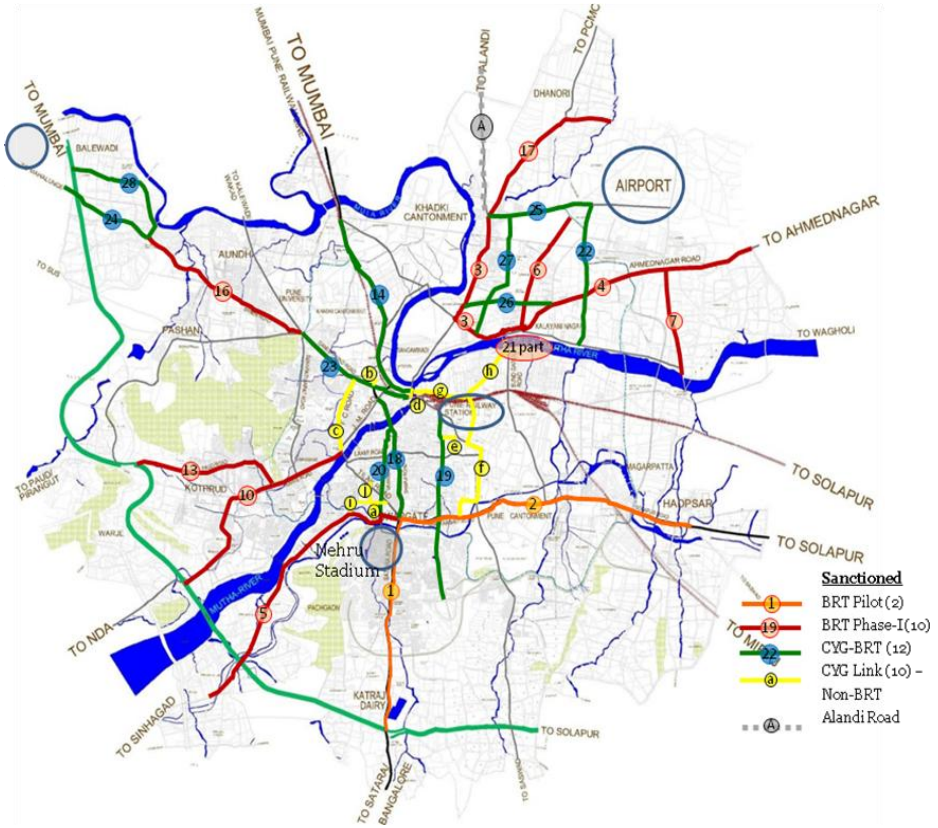
1 Introduction

1.1 Background

In Pune, the public transport within the city and its suburbs is operated by Pune Mahanagar Parivahan Mahamandal Limited (PMPML[1]). To improve the public transport system of the city, Pune Municipal Corporation (PMC) is implementing a Bus Rapid Transit System (BRTS), which would allow bus users to travel quickly

[1] The public transport system was traditionally provided by Pune Municipal Transport (PMT). However in June 2007 PMT was merged with the Pimpri Chinchwad Municipal Transport to form Pune Mahanagar Parivahan Mahamandal LTD., to provide passenger transport service to the commuters of Pune, Pimpri Chinchwad and adjoining areas



Picture 1-1: BRTS Corridors sanctioned for Pune

through the city.

The PMC in its report titled "Network Development for BRT for Pune City under the Scheme of JnNURM, July 2006" identified 30 roads adding up to 118.43 km in length for implementing the BRTS. These were approved under JnNURM for and are given in Table 1-1 and Figure 1-1.

Table 1-1: JnNURM approved 30 corridors

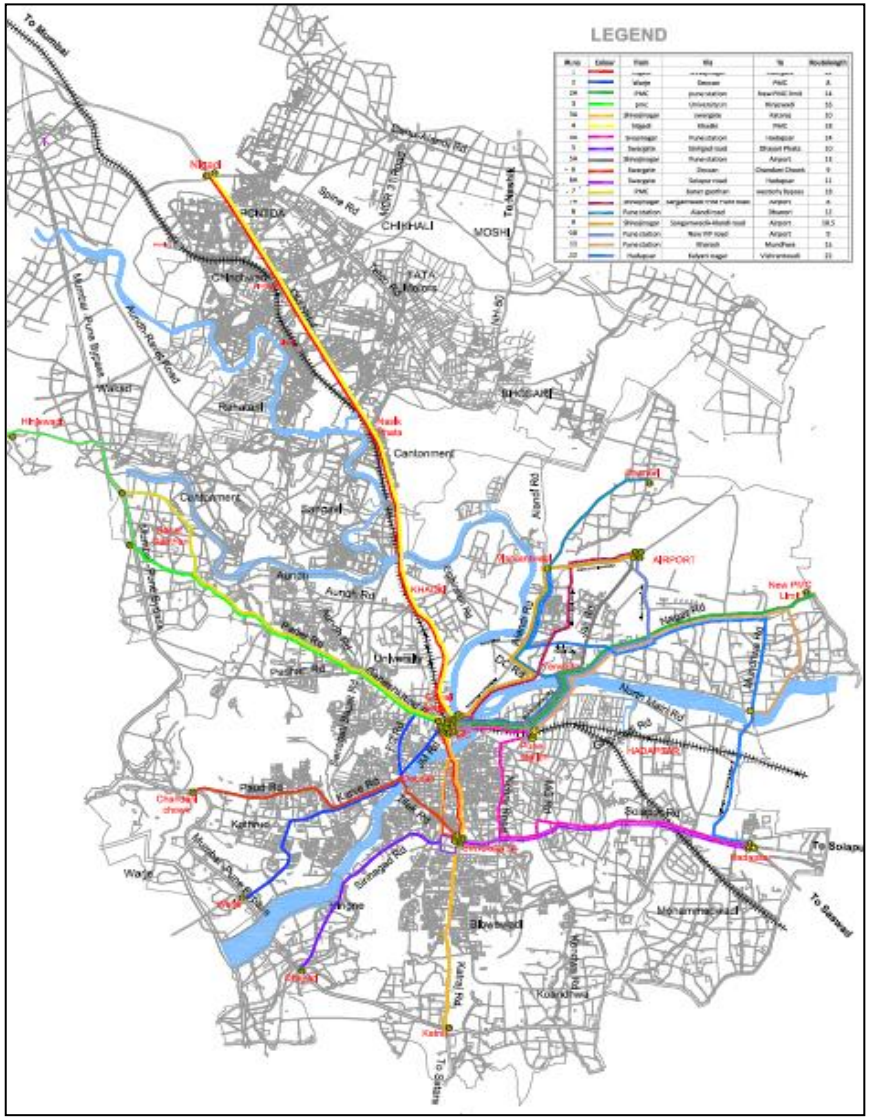
Sl.No.	Road Name	Length (km)
1	Bajirao Road	2.76
2	Shivaji Road	3.70
3	Nehru Road	5.00
4	Nagar Road	7.86
5	Airport Road	3.54
6	Old NH4	5.73
7	Airport Road to Deccan College	3.75
8	Vishrantwadi - Airport Road	2.23
9	Satara Road (Pilot BRT)	5.82
10	Karve Road	6.24
11	Paud Road	4.04
12	Ganeshkind Road	2.96
13	Baner Road (University to Green Park)	2.71
14	Baner Road (Green Park Hotel – Balewadi Stadium)	5.43
15	Baner Gaothan - Westerly Bypass	4.37
16	Solapur Road (Pilot BRTS)	11.38
17	Singhad Road	6.80
18	Tilak Road	2.4
19	Dhanori road	4.60
20	New Alandi Road	4.63
21	Airport-Ramwadi Naka	2.55
22	Mundwa Bypass	4.30
23	Kalyani Nagar Jn to Alandi Road	2.45
24	Sangamwadi to Sadalbaba	1.55
25	Bund Garden Road	4.5
26	JM Road	2.67
27	FC Road	2.24
28	Jahangir Jn to Maldhakka Jn	1.62
29	Laxminarayan to Mitramandal	0.3
30	Swargate to Tukdoji Maharaj Jn	0.3

The two stretches of Katraj- Swargate- Hadapsar have been implemented as a pilot corridor measuring about 17.0 km. The remaining corridors measuring about 101.43 kms are now to be implemented.

Considering the physical characteristics of the city, the availability of right of way (ROW), passenger demand scenario, percentage of interchange and based on various discussions with the stakeholders, it was finally decided to implement an open system of operations for Pune BRTS.

UMTC had prepared an "Operations Plan for BRTS in Pune" in 2009-10. The routes identified for operation in the report are given in Figure 1-2. A total of 18 routes were identified with an average length of 13 km and a fleet requirement of 737 buses. PMC started the implementation of BRTS based on this plan and accordingly most of the road work in terms of shifting of utilities, construction of footpaths, cycle track and carriage width were developed. The balance work included segregation of dedicated lanes and construction of bus stops.

At the same time BRTS was also being implemented in Pimpri Chinchwad Municipal Corporation (PCMC), however, the proposed operations were to be as a closed system. Thus, there was a mismatch between the designs of the two BRTS. Therefore with



Picture 1-2: The suggested BRT Route Plan for BRT Operations

the aim of implementing a High Quality BRT system in Pune Metropolitan Region, a meeting was called by OSD (UT) on August 18th, 2011. The agenda of this meeting was to resolve all outstanding issues related to operations plan, infrastructure design and arrive at an agreement on design and implementation of a high quality integrated Bus Rapid Transit System (BRTS) in Pune Metropolitan Region (PMR), which includes regions covered by PMC and PCMC. And find reasonably good solutions for the challenges existing on ground.

During the meeting various issues regarding the design and operations of BRTS in both the corporations were deliberated upon and the following decisions were taken:

- A closed system of BRTS would be implemented in the PMR region, with to the extent possible, dedicated bus corridors in the entire region.
- At level Boarding' without steps shall be provided in the dedicated corridors for BRTS. However, the Buses used for BRTS should be with doors on both sides so as to allow BRTS buses to go out of the BRTS corridors also if the operational requirements so necessitate.
- It was decided to develop the corridors in two phases. As part of Phase I, those corridors where civil works in terms of motor vehicle lanes, cycle tracks, foot paths and shifting of utilities have been completed shall be taken up. These corridor's, also connect natural destinations.
- BRT operations in PMR region shall be closed- hybrid with service extensions of BRTS routes outside dedicated corridor network for last mile connectivity.

The minutes of meeting held on 18th August 2011 are given in Annexure 1

1.2 The BRTS Plan for Pune city

The major elements of BRT which are critical for planning and implementation of a BRT system are:

- **Bus corridor/Running Ways** – they are directly responsible for enhancing travel speeds, reliability and identity. Options range from general traffic lanes to fully-grade separated BRT corridors.
- **Bus Stop/Stations** - Bus Stop/Stations act as the entry point to the system and are single most important customer interface, affecting accessibility, reliability, comfort, safety, and security, as well as dwell times and system image. BRT station options vary from simple stops with basic shelters to complex inter-modal terminals with many amenities.

- **Vehicles** – BRT vehicle are important for establishing and reinforcing the brand identity of the system. A wide variety of vehicles, ranging from standard buses to specialized vehicles can operate on BRT system. The specification of the vehicle selected impact the system performance, capacity and service quality. Aesthetics, both internal and external are also
- **Fare Collection** - Fare collection affects customer convenience and accessibility, as well as dwell times, service reliability and passenger security. Options available for BRTS range from traditional pay-on-board methods to pre-payment with electronic fare media (e.g. smart cards).
- **Intelligent Transportation Systems (ITS)** - To improve BRT system performance a wide variety of ITS technologies can be integrated into BRT systems which include vehicle priority, operations and maintenance management, operator communications, real-time passenger information, and safety and security systems.
- **Service and Operations Plan** - Designing a service plan that meets the needs of the system is a key step in defining a BRT system. The design can impact system capacity, service reliability, and travel times, including wait and transfer times.

In the following sections of the report, these elements of Pune BRTS shall be discussed in detail.

2 BRT Network and Roadway

2.1 Network/Corridor Assessment and Selection

As stated in Chapter 1, a total of 118.43 km of BRTS was sanctioned for Pune, of which a pilot corridor of 17km is operational. As per the decision taken on 18th August, 2011, those corridors where civil works in terms of motor vehicle lanes, cycle tracks, foot paths and shifting of utilities have been completed shall be taken up as part of Phase I.

Currently the road works have been complete on 101.23km the following road:

- BRT 3 – Yerawada to Vishrantwadi , via Deccan College and Bombay Sappers – 4.63km
- BRT 4 - Nagar Road (Yerawada to Ramwadi Jn to New PMC - 7.86km
- BRT 5- Sinhgad Road (Laxmi Mata Temple to Dhayari Phata) – 6.80km
- BRT 6 – Airport Road (Gunjan Talkies to Tata Guard Room to 509 Chowk) – 3.54km
- BRT 7 – Mundhwa Bypass - Infotech park Kharadi to Nagar Road – 4.30km
- BRT 10 – Karve Road (Khandojibaba to Warje Westerly Bypass) – 6.24km
- BRT 13 – Paud Road (Paud Phata to Chandini Chowk) – 4.04km
- BRT 14 a & b – Old NH 4 (Sancheti Hospital to Government Poultry Farm to Harris Bridge) – 5.73km
- BRT 16 – Baner Road (University Junction to Hotel Green Park) – 2.71km
- BRT 17 – Dhanori Road (Vishrantwadi to Dhanori) – 4.60km
- BRT 18 – Shivaji Road – 3.70km
- BRT 19 – Nehru Road – 5.00km
- BRT 20 – Bajirao Road (Netaji Palkar Chowk to Hegdewar Chowk) – 2.76km
- BRT 21 (Part) – Sangamwadi to Sadalbaba Road via Defense Land – 1.55km
- CYG I – Airport to Ramwadi Jakatnaka – 2.55km
- CYG II – Ganeshkhind Road (Sancheti Hospital to University Jn) – 2.96km

- CYG III – Baner Road (Hotel Green Park to Westerly bypass) – 5.43km
- CYG IV – Airport Junction to Vishrantwadi Chowk – 2.33km
- CYG V – Kalyani Nagar Junction to Alandi Road – 2.45km
- CYG VI – Airport Road to Deccan College via H M Plant – 3.75km
- CYG VII – Baner Gaothan to Westerly Bypass – 4.37km
- Tilak Road – 2.40km
- Laxmi Narayan Chowk to Mitramandal Chowk – 0.30
- Swargate Junction to Tukdoji Maharaj Chowk – 0.30km
- Jangli Maharaj Road – 2.67km
- Fergusson College road – 2.24km
- Bund Garden Road – Yerwada to Sancheti via RTO – 4.50km
- Jahangir ROB to Maldhakka Chowk – 1.62km

These roads would therefore form part of the proposed network.

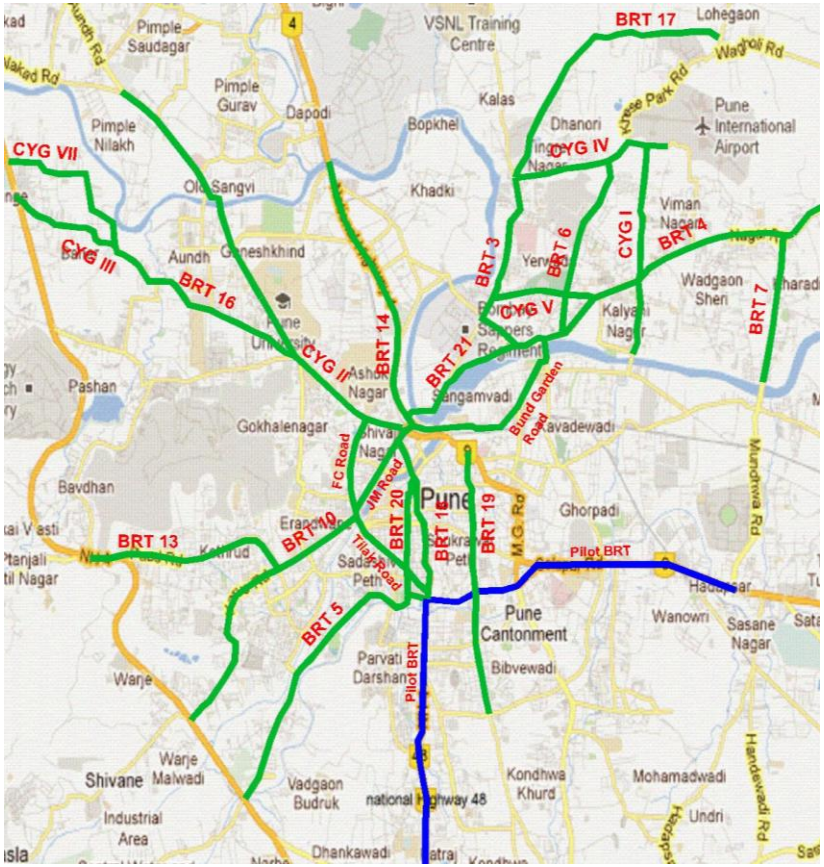


Figure 2-1: The Network where civil work is complete

2.2 Ridership Studies for BRTS

ITDP prepared an operations plan for PMPML in 2011. As part of the study ridership studies were done for PMPML buses/ routes on the proposed network. The study gives the volumes of passenger in peak hour in the entire route network of PMPML.

Corridor wise ridership is shown in Figure 2-2 below. It can be seen from the figure that maximum ridership is in the core area and along the following corridors:

- BRT 10 – Karve Road
- BRT 13 – Paud Road
- BRT 5 – Sinhgad Road
- Pilot BRTS – Satara Road
- Pilot BRTS – Sholapur Road
- BRT 4 – Nagar Road
- BRT 3 – Alandi Road
- BRT 14 – Old NH-4
- CYG II – Ganeshkhind Road & Aundh Road

While planning the BRTS in Phase I, all these roads would be considered, except Old-NH-4, as there are issues of land availability at Khadki Station and the minimum RoW required is not available. The corridor can be taken up at a later stage in Phase II, once the land is made available to PMC.

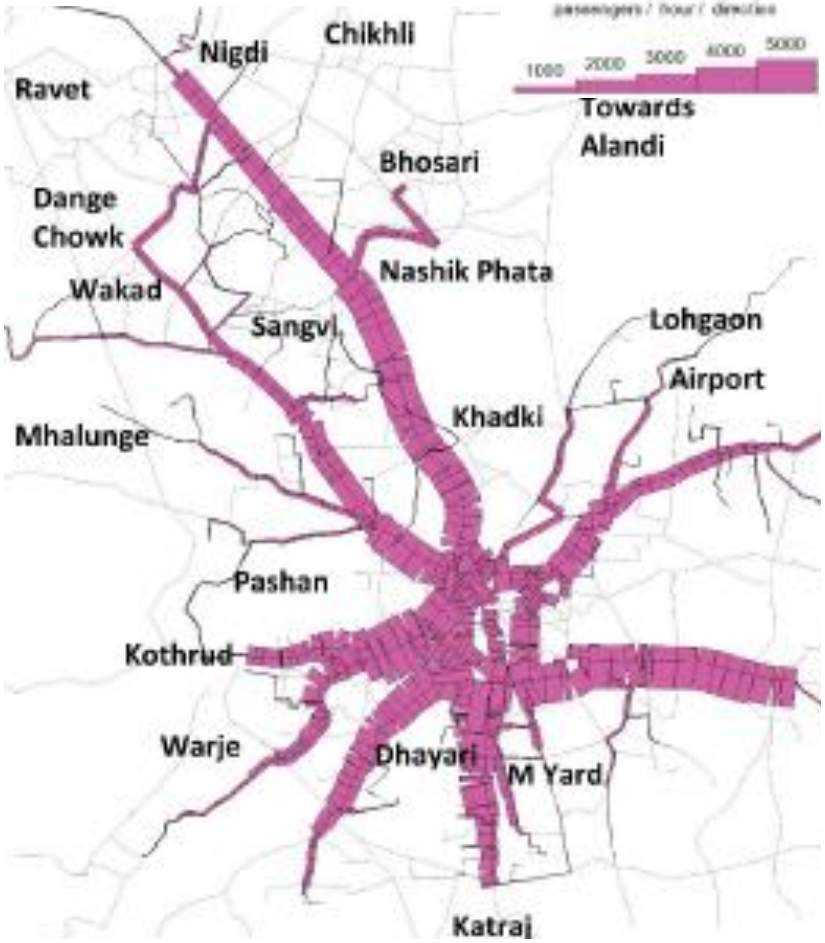


Figure 2-2: Ridership on PMPML buses along BRT Corridors

2.3 Alternatives for Pune BRTS

For developing the Pune BRT as decided in the meeting held by MoUD, 2 alternatives were developed and evaluated to identify the BRTS network to be developed as part of Phase I.

Alternative I

As Alternative I for proposed BRT network, 8 radial corridors and 1 ring are identified. The radial corridors would have dedicated BRTS and the ring could be developed as a dedicated/ mixed corridor. The total length of the corridors identified is 71 km which are as follows:

- Corridor 1 – Bund Garden road to Kharadi (BRT 4) - 11.5km
- Corridor 2 – Engineering College to Vishrantwadi (BRT 3 & 21) - 7km
- Corridor 3 – Sancheti hospital to Kalewadi Phata (CYG II) - 10km
- Corridor 4 – Deccan College to Warje (BRT 10) - 6km
- Corridor 5 – Kothrud Depot to Paud Phata (BRT 13) - 5km
- Corridor 6 – Dandekar Pul to Dhayari Phata (BRT 5) - 5km
- Corridor 7 – Swargate to Katraj (Pilot BRT already operational) - 6km
- Corridor 8 – Mammadevi Chowk to Hadapsar (Pilot BRT already operational) - 5km
- Corridor 9 - (Ring) via MG Road, Bundh Garden Road, Wellesley Road, Kennedy Road, JM Road, Shastri Marg, Sinhagad Road, Shankar Sheth Road, NH- 9 and Solapur Road (15km)

Of the total road length, 15km of ring Road, 3.5km of Corridor 3 and 3.5km of Corridor 4 totaling to 22km would be in mixed. i.e. 31% and the balance 69% or 49 km would be dedicated. The proposed network is given in figure 2-3 below. A total of 8 transfer stations are required to be developed, to operationalize a closed- Hybrid BRT network. These are required at the following locations:

- Ruby Hall Clinic
- Engineering College
- Sancheti Hospital
- Deccan College
- Paud Phata
- Dandekar Pul
- Swargate
- Mammadevi Chowk

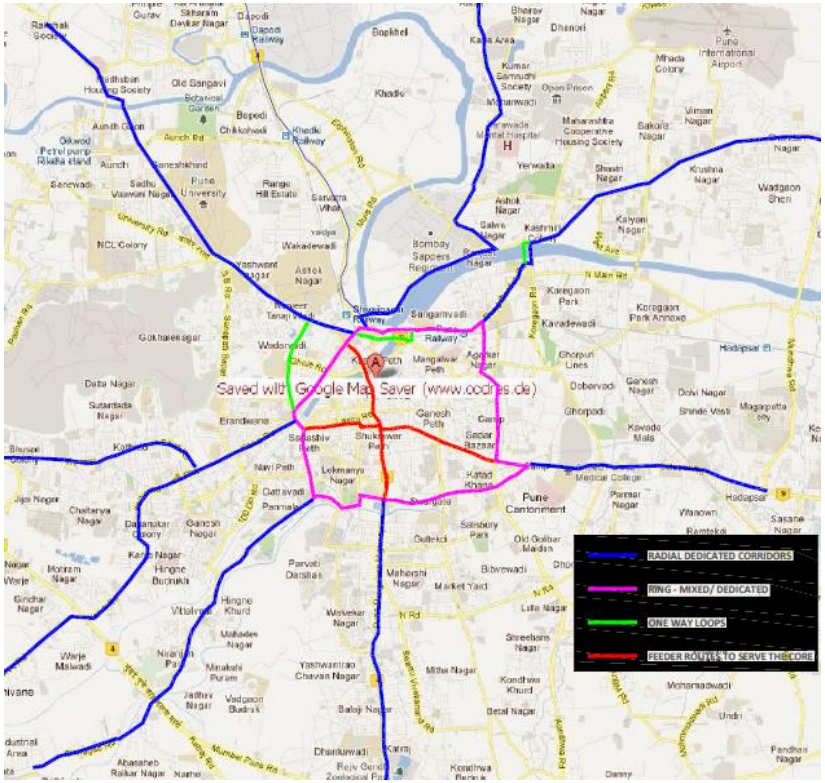


Figure 2-3: Alternative I for Pune BRTS

Alternative II

As alternative II, 4 corridors are identified as a Primary BRT Network to be implemented on a priority (Phase I) with a total length of 68.8km which are as follows:

- Corridor 1 - Warje to Kharadi (BRT 4, BRT 10, Jangli Maharaj Road, Bund Garden Road and Fergusson College Raod) – 22km
- Corridor 2 - Kothrud Depot to Vishrantwadi (BRT 3, BRT 10, BRT 13, Jangli Maharaj Road and Fergusson College Raod) – 17km (including 4.7km of corridor 1)
- Corridor 3 - Dhayari to Hadapsar Gadital (BRT 5, BRT 18 and Pilot corridor) - 17km
- Corridor 4 - Kalewadi Phata to Katraj (CYG II and Pilot corridor) - 17.5km

Of the total 68.8km proposed network, 53.3km (78%) is proposed to be dedicated and the balance 15.5km (22%) is proposed to be operated in mixed traffic. The proposed network is given in Figure 2-4 below. A total of 3 transfer stations are required to be developed and to operationalize a closed- Hybrid BRT network. These were required at the following locations:

- Sancheti Hospital
- Paud Phata
- Swargate

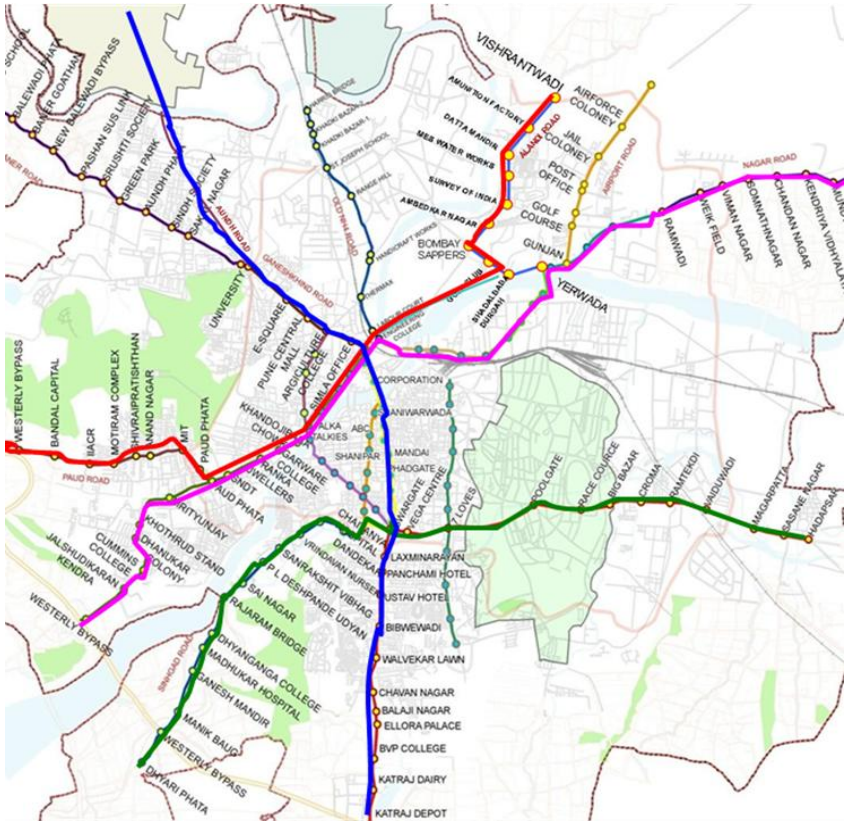


Figure 2-4: Alternate II for Pune BRTS

The two alternatives were evaluated for their pros and cons. Alternative I provided better clarity of the network, it required 8 transfer stations. In comparison to it, Alternate II required only 3 transfer station, though there was a compromise on the clarity on the network. The availability of space at the 8 locations, was however difficult. Accordingly, Alternative II was considered over Alternative I

2.4 BRTS Design Principles for Pune

The BRTS designs for Pune are based on the principles of improving safety, efficiency and convenience of all road users through the following steps:

- Improve throughput of Car/Motor Vehicle (MV) Traffic by removing all friction from car lanes such as stopping buses, slow moving non motorized vehicles, parked three wheelers etc.
- Improve safety of all motorized and non motorized users by segregating buses into bus lanes.
- Improve safety of pedestrians by providing safe and convenient signals at grade crossing/access to bus shelters.
- Improve safety of cycles and other NMV users by segregating them into safe, convenient and direct cycle lanes.
- Improve safety of pedestrians by providing safe, convenient, direct and barrier free (for all) pedestrian paths

2.5 Corridor Description

A total of four corridors from East to West and North to South are proposed for Pune. Corridor 1 is 22 km long. This corridor connects Nagar Road and Karve Road passing through Bundh garden Road and Jangli Maharaj (JM) Road the corridor passes though the city center. These provide an interchange option for routes heading from the South towards the East or West and vice-versa.

Corridor 2 is 17km in length (including 4.7km of overlap with corridor 1). It starts at Vishrantwadi and heads south along the river passing through the core city and finally turns westward towards Paud Raod. The corridor connects Pune with Pimpri Chinchwad.

Picture 2-1: Nagar Road (Corridor 1)

Corridor 3 is 17km in length and passes through the southern Part of the city. It connects Sinhgad Road with the Pilot Corridor along Sholapur Road. The corridor passes through Swargate which is the interchange point for the two pilot corridors.

Corridor 4 is 17.5km in length and connects the south with the north. The corridor passes through the Pilot Corridor along Satara Road, Shivaji road in the core area and Ganehkhind Raod. The corridor connects Pune BRT with Pimpri Chinchwad BRTS.

2.5.1 Corridor 1: Warje to Kharadi

The 22 km long corridor (shown in Figure 2-5) begins from Wagholi in the North- East and terminates at Warje in the South-West, passing through:

- Nagar Road - Chandan Nagar, Phoenix Market, Ramwadi, Agakhan Palace, Shastri Nagar
- Samrat Ashok Road – Gunjan Theater, Agricultural College
- Yerwada Bridge
- Bund Garden Road – Bund Garden, Ruby Hall, Jahangir Hospital
- Railway Station
- RTO Wellesley Road,

- Motilal Kennedy Road,
- NH4,
- JM Road - Sancheti Hospital, Balgandharva Sambaji Park, Deccan Gymkhana
- Karve Raod - Garware College, SNDT College, Paud Phata, Maruti Mandir, Karve Putla, Kothrud Stand, Dhanukar Colony, Karve Nagar .

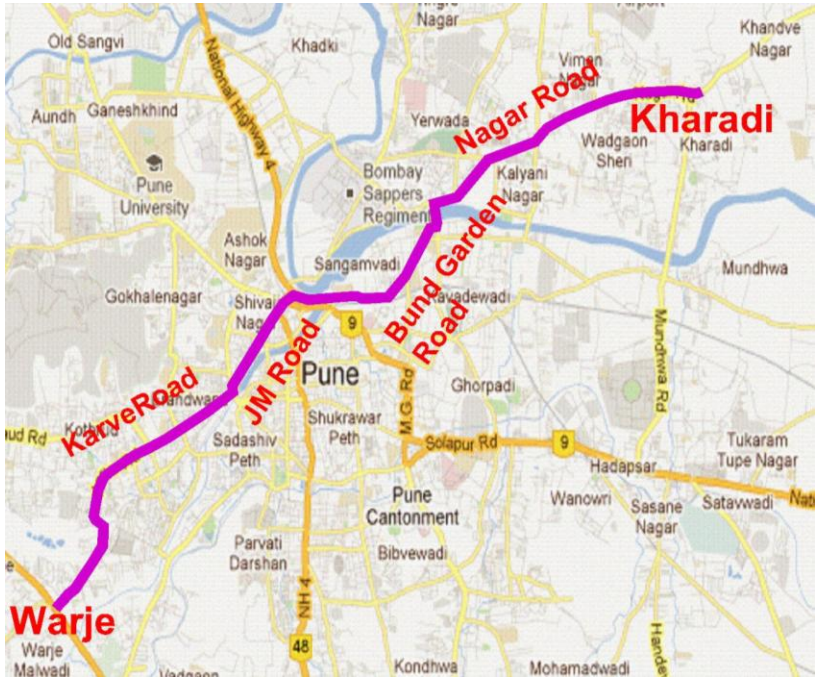


Figure 2-5: Alignment of Corridor 1

The importance of the corridor lies in the fact that it will serve a number of settlements in the immediate vicinity of the corridor. Two bus terminals, Kothrud Bus Stand and Wagholi Depot exist along the corridor and the railway station is also along the proposed corridors. The corridor also connects number of institutes such as international School of Business and Media on Nagar Road, Symbiosis Institute of Design, Cusrow Wadia Institute of Technology, Tehmi Grant institute of Nursing Education, Engineering College, Modern High School, Sharda Institute, Garware College, SNDT College,

Picture 2-2: Nagar Road (Corridor 1)

Apart from these, other important locations such as RTO, Deccan gymkhana, Sambaji Park, hospitals number of malls, and a large number of hotels and private offices are located along the corridor.

Picture 2-3: JM Road (Corridor 1 & 2)

The RoW availability ranges from 20m to more than 45m along different sections of the corridor. A detailed road inventory of the corridor is given in Annexure 2.The RoW along different sections of the roads is as follows:

- Karve road (from Warje to Paud Phata) – 30m to 36m along different sections of the road.
- Karve Road (from Paud Phata to Deccan Gymkhana) - 30m
- JM Road (from Deccan Gymkhana to Sancheti Hospital) – the RoW is 30m and under the present condition, one way is operational.
- From Sancheti Hospital to Yerwada Bridge (via NH4, Motilal Kennedy Road, Wellesley Road, Bund Garden Road) – 20m to 25m along different sections of the road
- Nagar Road (from Yerwada Bridge to Kharadi and Wagholi) – above 45m

A total of 25 important junctions/median openings were observed on corridor 1 as given in Table 2-1.

Table 2-1: Important junctions on Corridor 1

S.No.	Junction Name	No of Arms.
1	Khandoji Baba Chowk	3 arms - T Junction
2	Garware Prashala Junction	3 arms - T Junction
3	Garware College Junction	4 Arms
4	Ranka Jewellers Junction	4 arms
5	Nal Stop Junction	3 arms - T Junction
6	SNDT College Junction	4 arms
7	Paud Phata Junction	3 arms - Y Junction

S.No.	Junction Name	No of Arms.
8	Karishma Chowk	3 arms - T Junction
9	Mritunjay Junction	3 arms - T Junction
10	Karve Statue	3 arms - Y Junction
11	Kothrud Stand Junction	4 Arms
12	Dhanukar Colony	3 arms - T Junction
13	Cummins College Junction	4 Arms
14	Deccan Gymkhana Junction	3 arms - T Junction
15	Rani Laxmibai Park Chowk	4 Arms
16	SG Barve Chowk	4 Arms
17	Engineering College	3 arms - Y Junction
18	RTO Junction	3 arms - T Junction
19	Jahangir Hospital	3 arms - T Junction
20	Ruby Hall Junction	3 arms - T Junction
21	Boat Club road Junction	4 Arms
22	Yerwada Junction	3 arms - T Junction
23	Gunjan Talkies Junction	3 arms - T Junction
24	Kalyani Nagar Junction	5 Arms
25	Ramwadi Naka Junction	4 Arms

Picture 2-4: Karve Road (Corridor 1)

One of the most critical links along the corridor is JM Road. JM road has got a mixed land use of Residential – Commercial-Institutional mix. Many recreational & religious areas are also located on JM road.

Two important Transfer stations that are PMC Bldg and Deccan terminal are connected to STC Shivajinagar terminal via JM road. Currently bus frequency on JM road is 4.5 mins and around 144 buses use JM road to reach different destinations. As being the main connecting link and commercial centre of Pune JM road experiences huge traffic flow which result is high noise and

pollution level due to low speeds. The average traffic flow in each direction is around 1500 PCU.

To improve traffic flow and encourage Public transport, One Way system for JM road can be worked out. JM road can be made one way with Ferguson College (FC) road. River side road will also help the rerouting to some extent. JM-FC road are connected by Ganesh khind road, Ghole road, Modern college road and Apte road as shown in Figure 2-6.

Figure 2-7 shows the direction of one way proposed. After one way system the available right of way can be used for dedicated bus lanes, cycle tracks, parking lanes etc.

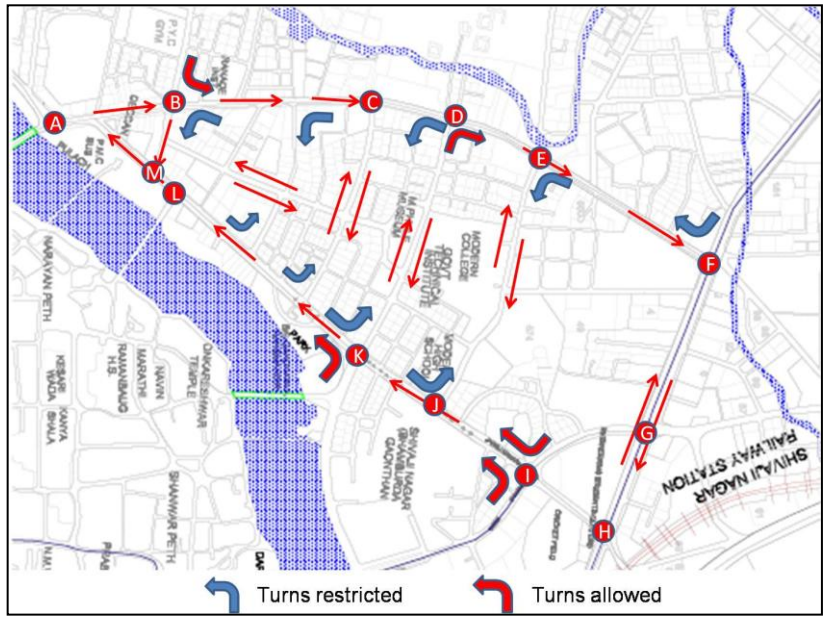


Figure 2-6: One way circulation Plan of JM road

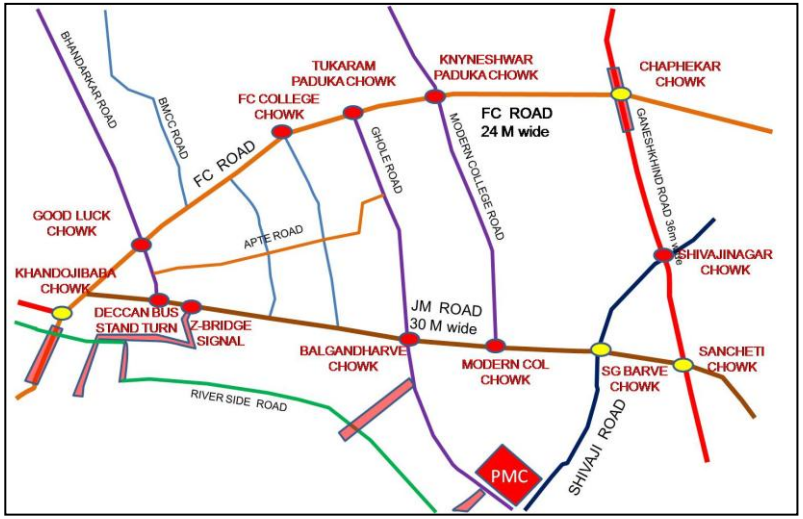


Figure 2-7: Road Network Map of JM Road

2.5.2 Corridor 2: Kothrud Depot to Vishrantwadi

This 17 km long corridor (shown in Figure 2-7) begins from Chandni Chowk at Paud Road and terminates at Vishrantwadi in the North along Alandi Road. The corridor passes through the following areas:

- Paud Road – Kothrud Depot, Bhusari Colony, Kachara Depot, Pratik Nagar, LIC Colony, Paudphata Police Chowki
- Karve Road – SNDT College, Garware College, Deccan Corner
- JM Road - Deccan Gymkhana, Balgandharva Sambaji Park, Sancheti Hospital

Picture 2-6: Alandi Road (Corridor 2)

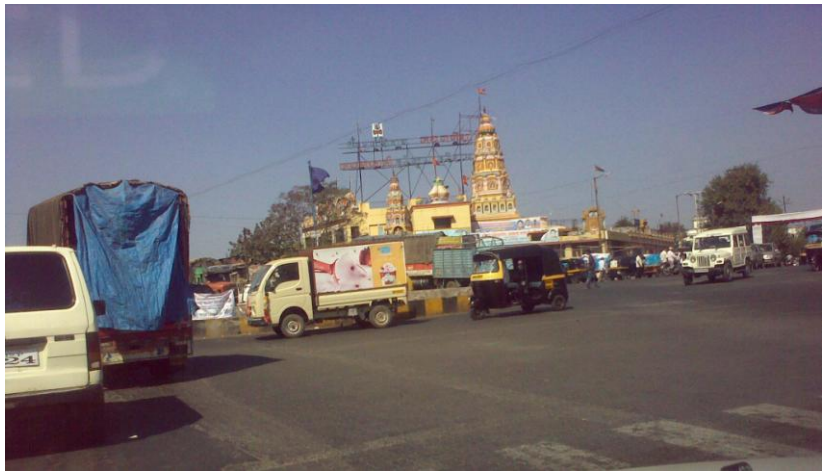
- NH4 – Engineering College, Patil Estate
- Sangamwadi Road & Sangamwadi Bridge
- Deccan College Road – Deccan College Library, Archaeology Department
- St. Gyaneshwar Road – Deccan College, Ambedkar Society, New RTO
- Alandi Road – MES water works, Mental Hospital Corner, Sathe Biscuit Company

Picture 2-5: Alignment of Corridor 2

The corridor over laps with Corridor 1 from Paud Phata to Engineering College for a total length of 4.7km. A large number of institutes, state government and private offices are located along this corridor, including the new RTO, Deccan College, Kendriya Vidyalaya etc. Apart from these offices, mixed land use is present all along the corridor.

The RoW availability ranges from 20m to more than 45m along different sections of the corridor. A detailed road inventory of the corridor is given in Annexure 3. The RoW along different sections of the roads is as follows:

- Paud road (from Kothrud Depot to Paud Phata) –36m
- Karve Raod (from Paud Phata to Deccan Gymkhana) - 30m
- JM Road (from Deccan Gymkhana to Sancheti Hospital) – the RoW is 30m and under the present condition, one way is operational.
- From Sancheti Hospital to Bombay Sappers (via NH4, Sangamwadi Road & Sangamwadi Bridge and Deccan College Road) – 30m
- Alandi Road (from Bombay Sappers to Vishrantwadi) – above 45m



Picture 2-7: Vishrantwadi Chowk (Corridor 2)

Picture 2-8: Sangamwadi Road (Corridor 2)

The demand for parking facilities is very high along JM Road the on account of a large number of retail markets and hotels in the area. To meet this demand, off street parking lots need to be developed.

Picture 2-9: Paud Road (Corridor 2)

A total of 22 important junctions/median openings were observed on corridor 2. Table 2-2 details these.

Table 2-2: Important junctions on Corridor 2

S.No.	Junction Name	No of Arms.
1	Khandoji Baba Chowk	3 arms - T Junction
2	Garware Prashala Junction	3 arms - T Junction
3	Garware College Junction	4 Arms
4	Ranka Jewellers Junction	4 arms
5	Nal Stop Junction	3 arms - T Junction
6	SNDT College Junction	4 arms
7	Paud Phata Junction	3 arms - Y Junction
8	Karishma Chowk	3 arms - T Junction
9	Mritunjay Junction	3 arms - T Junction
10	Karve Statue	3 arms - Y Junction
11	Kothrud Stand Junction	4 Arms
12	Dhanukar Colony	3 arms - T Junction
13	Cummins College Junction	4 Arms
14	Deccan Gymkhana Junction	3 arms - T Junction
15	Rani Laxmibai Park Chowk	4 Arms
16	SG Barve Chowk	4 Arms
17	Engineering College	3 arms - Y Junction
18	Patil Estate	3 arms - T Junction
19	Shadgal Baba Darga	3 arms - T Junction
20	Bombay Sappers Junction	3 arms - T Junction
21	Dutta Temple	3 arms - T Junction
22	Yerwada Temple	3 arms - T Junction

2.5.3 Corridor 3 – Dhayari to Hadapsar Gadital

This 17 km long corridor (shown in Figure 2-8) begins from Dhayari Phata on Singhad Road in south and terminates at Hadapsar Gadital East along Sholapur Road. The corridor passes through the following areas:

- Singhad Road – Dhayari Phata, Wadgaon Phata, Manik Bag, Anand Nagar, Vithalbadi Jakat Naga, Dandekar Pul, Saras Baug
- Shankar Sheth Road – Swargate, ST Depot, ST Divisional Office
- Sholapur Road – Mammadevi Chowk, Race Course, Bhairoba Nala, BT Kawde Junction, Ramtekadi, Magarpatta, Hadapsar Depot

There are 2 depots on this corridor – Hadapsar Depot and ST Depot. A large number of state government and private offices are located along this corridor, including the St Divisional Office, MSEB Office etc. The corridor also passes through defense area near the Armed Forces Medical College.

Picture 2-10: Big Bazaar, Sinhgad Road (Corridor 3)

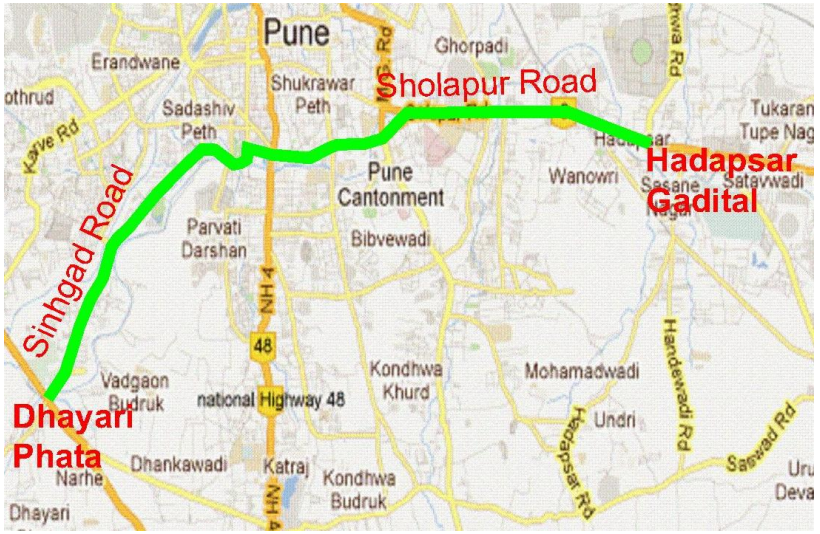


Figure 2-8: Alignment of Corridor 3

The RoW availability ranges from 24m 36m along different sections of the corridor. A detailed road inventory of the corridor is

Picture 2-11: Seven Love Junction (Corridor 3)

given in Annexure 3. The RoW along different sections of the roads is as follows:

- Sinhgad Road (Dhayari Phata to Swargate) – mostly 36m
- Sholapur Road (Cantonment part) – 24m
- Sholapur Road (including Shankar Sheth Road from Swargate to Hadapsar Depot excluding cantonment part) – 36m (part of pilot BRTS)

A total of 28 important junctions/median openings were observed on corridor 3. Table 2-3 details these.

Table 2-3: Important junctions on Corridor 3

S.No.	Junction Name	No of Arms.
1	Savarkar Chowk	3 arms - T Junction
2	Dandekar Chowk	4 Arms
3	Vrindavan Nursery	3 arms - T Junction
4	Sanrakshit Vibhag Junction	3 arms - Y Junction
5	Deshpande Garden Junction	3 arms - T Junction
6	Big Bazaar Junction	3 arms - T Junction
7	Karve Nagar Raod Junction	3 arms - Y Junction
8	Dhyanganga College Junction	3 arms - T Junction
9	Ghar Sansar Junction	3 arms - T Junction
10	Madhukar Hospital Junction	3 arms - Y Junction
11	Ganesh temple Junction	4 Arms
12	Western Bypass Junction	4 Arms
13	Dhyari Phata Junction	3 arms - T Junction
14	Swargate	4 Arms
15	Ghorpade Peth Colony	4 Arms
16	Golibar Maidan Junction	4 Arms
17	Napler Road Junction	4 Arms
18	Mammadevi Chowk	3 arms - Y Junction

S.No.	Junction Name	No of Arms.
19	Mammadevi Chowk- 2	4 Arms
20	Turf Club	4 Arms
21	AFMC	3 arms - T Junction
22	Fatima Municipal Shala junction	3 arms - T Junction
23	BT Kawde Junction	3 arms - T Junction
24	Hadapsar MIDC Road junction	3 arms - T Junction
25	Ramtekdi Junction	3 arms - T Junction
26	Vaidwadi Junction	3 arms - T Junction
27	Magarpatta Junction	3 arms - T Junction
28	Hadapsar Depot	3 arms - T Junction

Picture 2-12: Bhairon Nala (Corridor 3)

2.5.4 Corridor 4 – Kalewadi Phata to Aundh PMC limit to Katraj

This 17.5 km long corridor (shown in Figure 2-9) begins from Kalewadi Phata on Aundh Road and terminates at Katraj on Satara Road (NH4). The corridor passes through the following areas:

- Aundh Road – Kalewadi Phata, Jagtap Dairy , Wakad Phata, ESI Hospital, Aundh Chest Hospital, Sangvi Phata, Aundh Gaon,
- University Road – Bremen Chowk, Pune University, Raj Bhawan
- Ganeshkhind Road – Government Polytechnic, Agricultural College, Sancheti Chowk
- JM Road – Sancheti Hospital, Engineering College
- Shivaji Road (NH4) – PMC Mangala, Shaniwar Wada, Vasant Talkies, Gadikhana, Shahu Chowk, Mamledar Kacheri, Swargate
- Satara Road (NH4) – Swargate ST Stand, Laxmi Narayan Theatre, Natu Baug, Balaji Nagar, Chaitanya Nagar, Bharti Vidyapeeth (BVP), Katraj Dairy, Katraj Bus Terminal

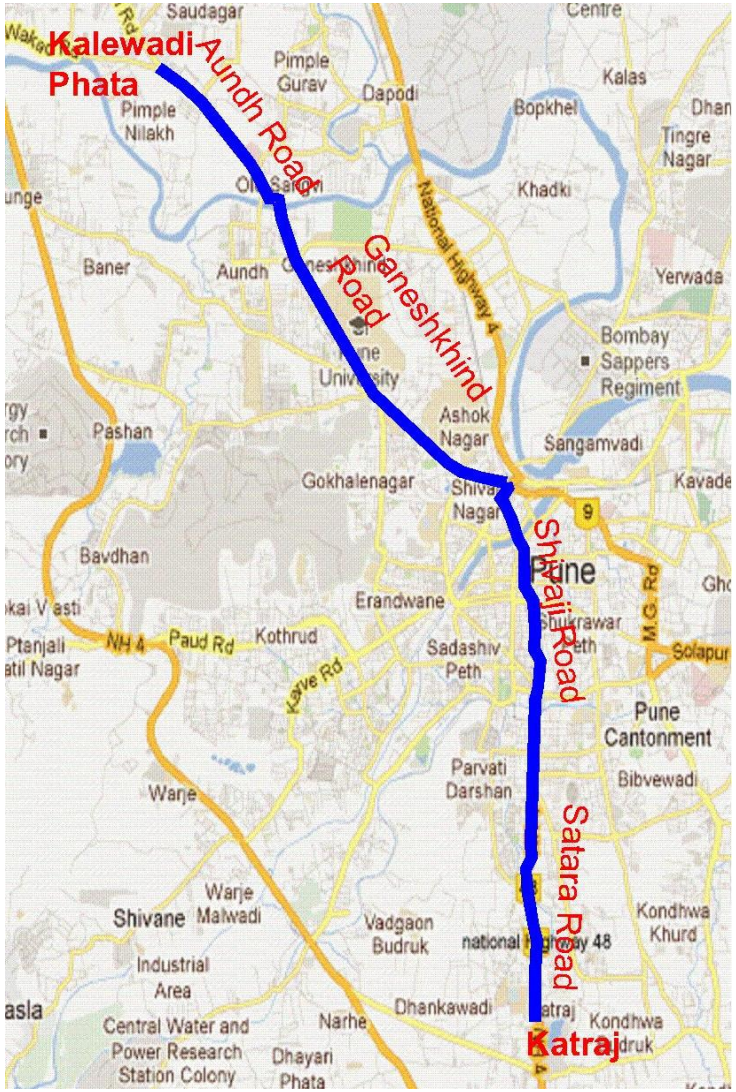


Figure 2-9: Alignment of Corridor 4

There are 2 terminals on this corridor – Katraj Bus Terminal and Swargate ST Stand. The corridor connects large institutional areas such as Pune Unicversity, engineering college, agricultural college, BVP etc with other parts of the city. the corridor also passes through government offices such as PMC and residential areas. There are 4 flyovers on the corridor along Ganeshkhind Road

The RoW availability ranges from 24m 36m along different sections of the corridor. A detailed road inventory of the corridor is given in Annexure 3. The RoW along different sections of the roads is as follows:

- Aundh Road (Kalewadi Phata to University Junction

Picture 2-13: Satar Road (Corridor 4)

Picture 2-14: Katraj Junction (Corridor 4)

including University Road) –30m

- Ganeshkhind Road (University Junction to) – between 30m to 36m
- Shivaji Road (including JM Road) – 24m
- Satara Road (Swargate to Katraj Bus Terminal) – 36m (part of pilot BRTS)

A total of 47 important junctions/median openings were observed on corridor 4. Table 2-4 details these.

Table 2-4: Important junctions on Corridor 4

S.No.	Junction Name	No of Arms.
1	Kalewadi Phata	4 Arms
2	Jagtap Dairy	3 arms - T Junction
3	Wakad Phata	3 arms - Y Junction
4	Rakshak Chok	3 arms - T Junction
5	Sangvi Phata	3 arms - T Junction
6	Old Aundh Bridge Junction	3 arms - Y Junction
7	Aundh gaon Junction	3 arms - T Junction
8	Police Chowki university Chowk	3 arms - T Junction
9	Sangavi Kesri road Junction	3 arms - T Junction
10	Aundh Gaon Fire Station Junction	3 arms - T Junction
11	Breman Chowk	3 arms - T Junction
12	Sindh Colony Gate 2	3 arms - T Junction
13	Gole Market Junction	3 arms - T Junction
14	Pune University Gate	4 Arms
15	Shree Anandmayee Ashram junction	3 arms - T Junction
16	Under E Square Flyover	4 Arms
7	Pune Central Junction	4 Arms

S.No.	Junction Name	No of Arms.
18	Hare Krishna Mandir Road Junction	3 arms - T Junction
19	FC Road Junction under Agriculture College Flyover	5 Arms
20	Shimla Office Junction	4 Arms
21	Sancheti Chowk	4 Arms
22	Ashoka Training Institute Junction	4 Arms
23	Shivaji Putla Junction	4 Arms
24	Mangala Petrol Pump junction	4 Arms
25	PMC junction	4 Arms
26	Ghorpade Raod Junction	3 arms - T Junction
27	Shaniwar Wada Kasabapeth Police Chowki	3 arms - T Junction
28	Ganesh road Junction	4 Arms
29	AB Chowk	4 Arms
30	Laxmi road Chowk	4 Arms
31	Aakalkot Maharaj Math	3 arms - T Junction
32	MG Road junction	4 Arms
33	Shahu Chowk	4 Arms
34	Mamledar Kacheri Chowk	3 arms - T Junction
35	Durga Mata Temple Chowk	4 Arms
36	Gokul Bhawan Chowk	3 arms - Y Junction
37	Swargate	4 Arms
38	Laxmi Narayan theatre	4 Arms
39	Panchami Hotel Junction	3 arms - T Junction
40	Panchami Hotel Junction-2	3 arms - T Junction
41	Shivneri Path Junction	3 arms - T Junction
42	Swami Vivekanand Road Junction	3 arms - Y Junction
43	Natu Bagh	4 Arms
44	Govalkar Guruji Path Junction	3 arms - T Junction
45	KK market Junction	4 Arms
46	BVP Gate	4 Arms
47	Moore Bagh Junction	3 arms - Y Junction

3 Roadway and service design concept

The design approach was based on 3 key factors. These are:

- Kind of BRT system best suited for application on the selected corridors in Pune
- The character and location of bus lanes on the corridor
- Kind of bus stations required and their ideal location on the corridor

These have been discussed in the following sections:

3.1 System selection

The comparative analysis of the different types of BRT systems i.e. Open, Closed and Hybrid were evaluated as given in Table 3-1.

Table 3-1: Comparison between Closed, Open and Hybrid system

Closed System	Open System	Hybrid System
Only BRT buses use the main corridor, called the trunk route, shuttling between both ends of the corridor. These buses do not leave or go out of the corridors. Implemented in areas where there is consistent demand along the corridor.	Most public transport modes are allowed to use the bus infrastructure and these vehicles can enter or leave the corridor at almost all intersections. Implemented in areas where there are high demand variations along the corridor	BRT buses are the primary users of the corridor, shuttling between both ends of the corridor. An additional public transport mode (usually the city bus service) is allowed to use only designated parts of the corridor to cater to additional segmental demand.
Pros		
• Gives a brand image to public transport • Ensures high service of quality and reliability	• Increases the catchment area of buses • Transfers are minimized, decreasing journey time.	• Combines the benefits of closed and open system while minimizing disadvantages • Ideal system for corridors which have segmental demand variations. Examples

Closed System	Open System	Hybrid System
• Allows ease of control and enforcement • Fare structure and fare collection system is generally simpler and uniform. • Simpler junction design and signal plan. Can be managed in maximum of 4-5 phases as turning buses is controlled	• Does not need a separate feeder network • Suitable for cities where majority trips are less than 10 km. • Works well in corridors with high segmental demand variations • Extends segregated lane benefits to all public transport and high occupancy modes on the corridor. • Can work within the existing institutional and regulatory framework using the existing operators.	are corridors whose origin and/or destination are outside the core city area. Base demand is met by BRT routes while segmental demand is catered by city bus routes • Brand image and reliability is ensured by BRT buses • Does not require a separate feeder network • As limited (mostly BRTS) and identified city bus services are allowed to use the corridor, enforcement is easy. • Can work well in cities with long or short average trip lengths • Provides high flexibility to adapt to varying demands in the city.
Cons		
• Heavy dependence on feeder infrastructure • Transfers are increased, thereby increasing the journey time. • In some cases, separate and dedicated infrastructure for transfers (called transfer stations) is required to be developed. • Suitable for cities where majority trips are	• Predictability and reliability of public transport is decreased because the buses have to move in mixed conditions • Difficult to regulate and control • Has generally complex fare structure and fare collection system	• The complexity fare structure and collection system may be retained. • Heavier reliance on enforcement may be required on some intersections. • Some intersections where city bus service is allowed to join or leave the corridor may require more phases in the signal cycle.

Closed System	Open System	Hybrid System
more than 10km. • Not suitable for corridors with high segment demand variations. • High quality feeder network is essential • Restricts use by non BRT public transport modes		
Examples		
• Mexico City • León, Guanajuato • New York City, New York • Bogotá D.C. : TransMilenio • Curitiba: Rede Integrada de Transporte • Santiago: Transantiago • Quito: "El Trole“	• Bangkok • Jakarta : TransJakarta • Lagos, Nigeria : Lagbus • Cape Town Johannesburg • Helsinki, Finland • Istanbul, Turkey • Paris • Sydney • New Delhi, India	• Bejeing • Changzhou • Hangzhou • Jinan • Xiamen • Seoul • Port Elizabeth • Washinton • Miami, • Florida • São Paulo: Expresso Tiradentes • Ahmadabad

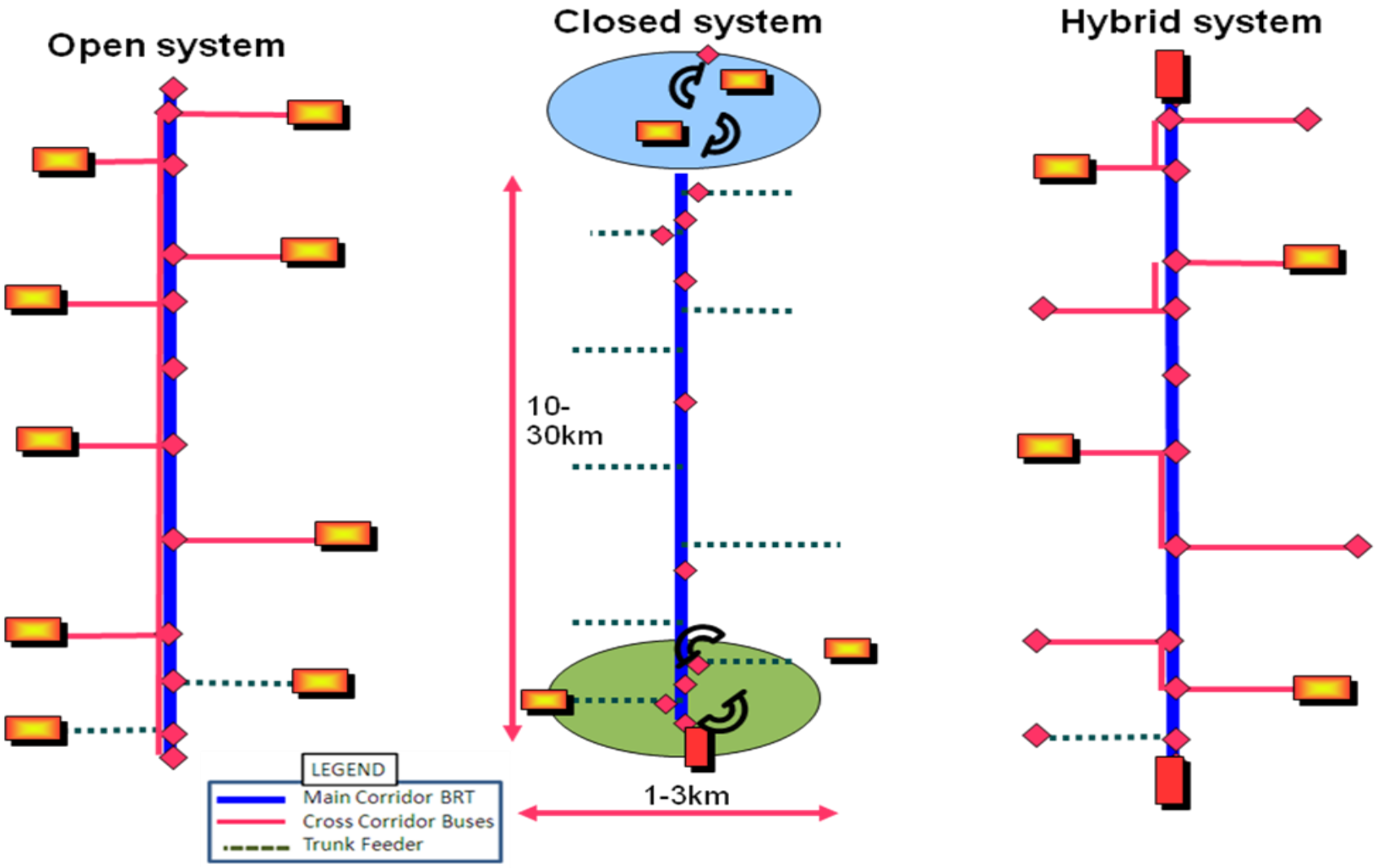


Figure 3-1: Graphical Representation of an Open, Closed and Hybrid System of Operations

Picture 3-1: Ahmadabad BRTS – Closed BRTS

Picture 3-2: Delhi BRTS - Open BRTS

Picture 3-3: Changzou BRTS – Hybrid BRTS

Pune has an existing fleet of 1,454 buses operated by PMPML operating on 271 routes. These buses/routes have various origin and destination points within the city and use only parts of the proposed corridors. The 4 corridor identified for development of BRTS have a variable demand on different stretches (refer Annexure 2). Under these conditions, a closed system based on uniform demand across the corridor appears undesirable.

ITDP has prepared an operations plan for BRTS in PMR region. As part of the plan route rationalization was done for the buses/ routes being operated by PMPML. The broad guiding principles for rationalizing and rerouting of PMPML services for BRT are as follows:

a. PMPML routes on BRT corridors can be converted into BRT exclusive routes.

b. BRT routes can be extended beyond the corridor for up to 3kms to enable direct service. These extensions can occur where future BRT corridors are proposed or where they can reduce passenger inconvenience due to transfers between trunk and feeder services.

c. Extensions beyond 3km where the ridership branches out from the BRT corridor will function as feeder routes, operated by PMPML regular buses.

d. Passenger transfers from BRT exclusive corridor to feeder routes will be facilitated by means of interchange stations.

Based on the route rationalization strategy adopted by the PMR region, and a HYBRID system of operations is proposed for Pune. However, in a hybrid system, identified city bus services are also allowed to use the corridor, but in case of Pune only BRTS buses would be using the dedicated corridors. The system, therefore, proposed is between a closed and a hybrid system and is hence proposed to be termed as **Closed- Hybrid System**.

3.2 Runway Segregation

The level of separation from other traffic is the primary running way planning parameter. An existing mixed flow lane on an arterial is the most basic form of running way where BRT vehicles operate with no separation from other vehicle traffic. Segregated BRTS ranges from arterial lanes to grade separated lanes or exclusive transit ways on separate rights-of-way. The pros and cons of mixed flow lanes and segregated lanes is given in table below.

Table 3-2: Comparison between mixed flow lanes and dedicated lanes

Dedicated/Reserved Lane BRT System	Mixed Lane BRT System
In a dedicated/reserved lane BRT system, a designated arterial lane, a traffic lane within an arterial roadway aside is set for the operation of BRT vehicles. Other vehicles are restricted from using the lane. This is enforced through a physical barrier or through police enforcement.	This system is often called as 'Traditional' BRT system which operates in mixed traffic flow where physical, traffic, land-use and environmental conditions preclude bus ways or bus lanes, where streets are "free flowing; on "branch" BRT lines; and in residential collection.
Pros	
• The average travelling speed is very high as BRT has its own dedicated lanes to move. • The travel reliability and punctuality is very high. • This kind of system creates a very good image and identity as mass transit system for the city. • Due to the movement of buses on dedicated lanes, the traffic conditions are good on the corridors. (no often traffic jams) and no	• The system is cost effective as the construction, operation and maintenance cost is very low. • The implementation can be done very fast as less amount of infrastructure is required. • The system is sparingly suitable for Trunk line BRT routes where the constraints of RoW are on the corridors. • The system can provide very easy accessibility and connectivity as

Dedicated/Reserved Lane BRT System	Mixed Lane BRT System
overall delay in travelling. • The boarding and alighting is very smooth and comfortable as the system has dedicated spaces for the same. • The traveler/commuters are very safe and secure in this kind of system. • The overall capacity in terms of ridership is high in this system.	bus routing continuity is there. • Integration with other modes of public transport such as city bus, feeder bus, para-transit modes etc. is very easy. • The accessibility for all groups of people (slum areas, residential areas etc.) is very good in this system. • Coverage of the system for daily trips is very good.
Cons	
• The system is not cost effective as the construction cost is high due to more infrastructures and implementation takes time to provide the services to commuters. • The construction, operation and maintenance cost is high. • The implementation takes a little high time as the components are more. • The system is sparingly suitable for Trunk line BRT routes where the enough RoW is available on the corridors. • The bus routing continuity is not possible and the system cannot provide easy accessibility and connectivity. • To attract the ridership, some kind of dedicated feeder system is required on feeder routes. • Coverage of the system is very less as the most of the routes are on major corridors in the city.	• The average travelling speed is very limited as BRT has to move with mixed traffic. • The travel reliability and punctuality is very low. • This kind of system does not create a very good image and identity as mass transit system for the city. • Due to the movement of buses and mixed traffic, the traffic conditions are not good on the corridors. (often traffic jams) • Due to frequent traffic jams, bunching at traffic signals, the overall delay in travelling is observed. • Problems in boarding and alighting due to movement of mixed traffic (cycle, rickshaw, auto, two wheelers etc.) at bus stops. • The traveler/commuters are not quite safe and secure in this kind of system. • The overall capacity in terms of ridership is less in this system.
Examples	
• Boston silver line • Las Vegas's RTC Transit • New York, Select Bus Service	• Los Angeles' Metro Rapid Lines • Honolulu's City Express • Vancouver's Broadway-Lougheed "B" Line

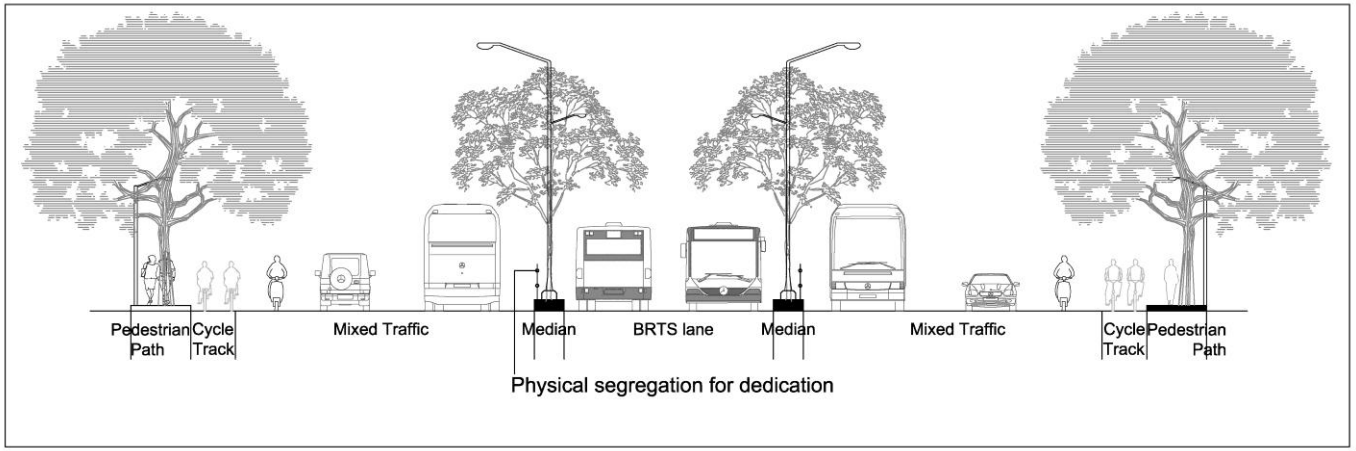


Figure 3-3: Schematic cross section showing Dedicated Lane Bus Rapid Transit System

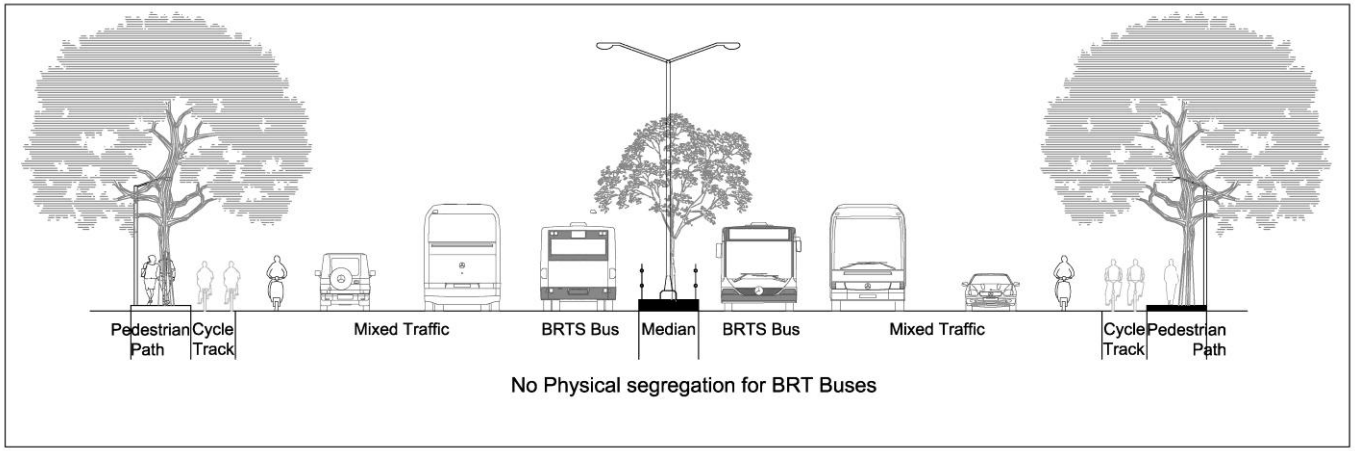


Figure 3-2: Schematic cross section Mixed Lane Bus Rapid Transit System

In case of Pune, the available ROW along different sections of the corridors is given in Table3-3 and shown in Figure3-4 below.

Table 3-3: The available Row along different road sections of the BRT corridors

I	Route Name / Chainage	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000	16000	17000	18000	19000	20000	21000	22000
	Warje to Kharadi																							
		Warje				Paud phata			Deccan coner		Sancheti					Yerwada						Kharadi		
		(Karve Road 30-36mwide)					(30m wide)		JM Road (30m wide)			(Sancheti to Yerwada 20-25mwide)					Nagar Road (>45m Wide)							
	Kothrud Depot to Vishrantwadi																							
		Kothrud Depot				Paud phata			Deccan corner		Sancheti				Bombay Shappers				Vishrantwadi					
		(Paud Road 36mwide)					(Karve rd 30m)		JM Road (30m wide)			(Sancheti to Bombay Shappers 30m wide)				Alandi Road (>45m Wide)								
	Dhayari Phata to Hadapsar Gadgital																							

I	Route Name / Chainage	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000	16000	17000	18000	19000	20000	21000	22000
		Dhyari phata							Swargate				Bairoba Nallha						Hadpsar Gadital					
		Sinhgad road – (mostly 36m wide)								Solapur Road-Cantonment Part (24m Wide)					Solapur Road-(36 m Wide)									
	Kalewadi Phata to Aundh PMC Limit to Katraj																							
		Aundh PMC Limit				University Junction			Shivaji Nagar				Swargate							Katraj				
		Aundh Road (30m Wide)					Ganeshkhind Road (>30 m wide)			Shivaji Road (24m wide)			Swargate to Katraj (36m wide)											

It can be seen from the table above and section 2.5 above, that along Corridor 1, the RoW is in the range of 30m and above in most of the areas except between Sancheti and Yerwada, which is along Kennedy Road, Bund Garden Road etc. Along corridor 2, the RoW available is above 30m and along Corridor 3 it is above 36m except along the cantonment part along Sholapur road. In case of Corridor 4 also the RoW is generally 30m and above except along Shivaji Road in core area of the city.

Since RoW availability is not a constraint on most of the roads, **it is proposed that the BRT is developed with a segregated lane** as this would improve the travel time of BRT vehicles considerably. The presence of other bus service such as PMPML in

the mixed traffic lanes would not only undermine the rider ship and hence profitability of the new system (BRT) under consideration; it will also congest the already reduced lanes for other traffic. Along the roads where RoW is not available i.e. between Sancheti Hospital and Yerwada along Corridor 1, Sholapur Road (cantonment part) along Corridor 3 and Shivaji Road along Corridor 4, BRTS would operate in mixed traffic conditions. In addition, there are 4 flyovers along Ganeshkhind road and on Karve Road between Paud Phata and Deccan Corner, here dedicated BRTS would not be possible and hence BRTS would operate in mixed conditions.

Of the total proposed network, 53.3km (78%) is proposed to be dedicated and the balance 15.5km (22%) is proposed to be operated in mixed traffic. Table 3-4 below shows the section wise mixed and dedicated lengths along the four corridors.

Picture 3-4: Brisbane Dedicated Bus Ways

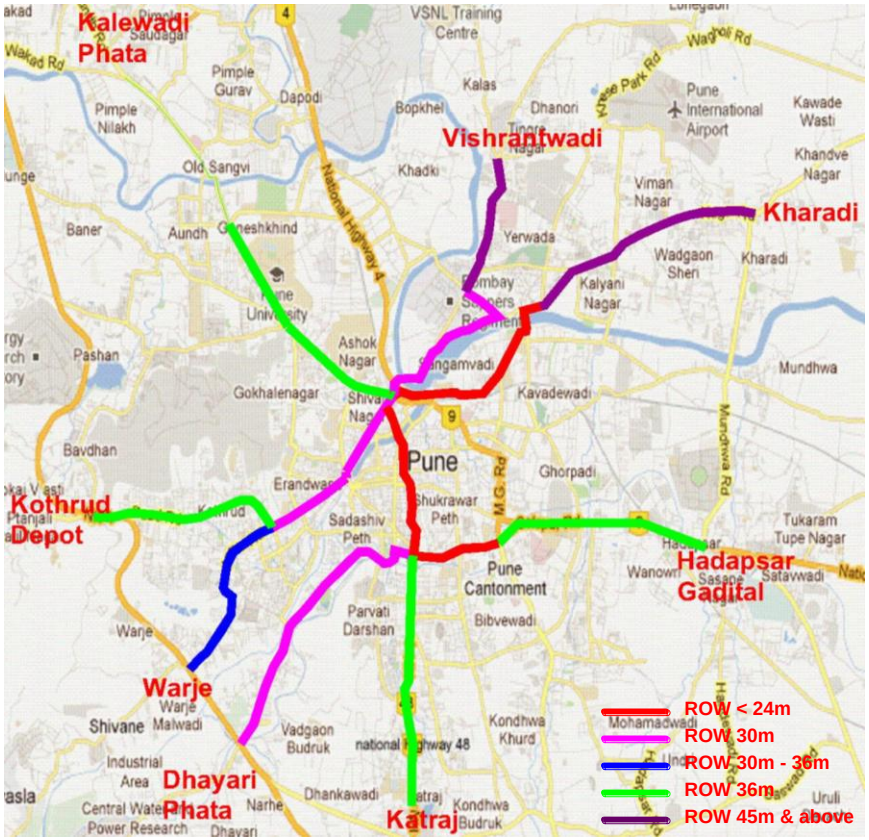
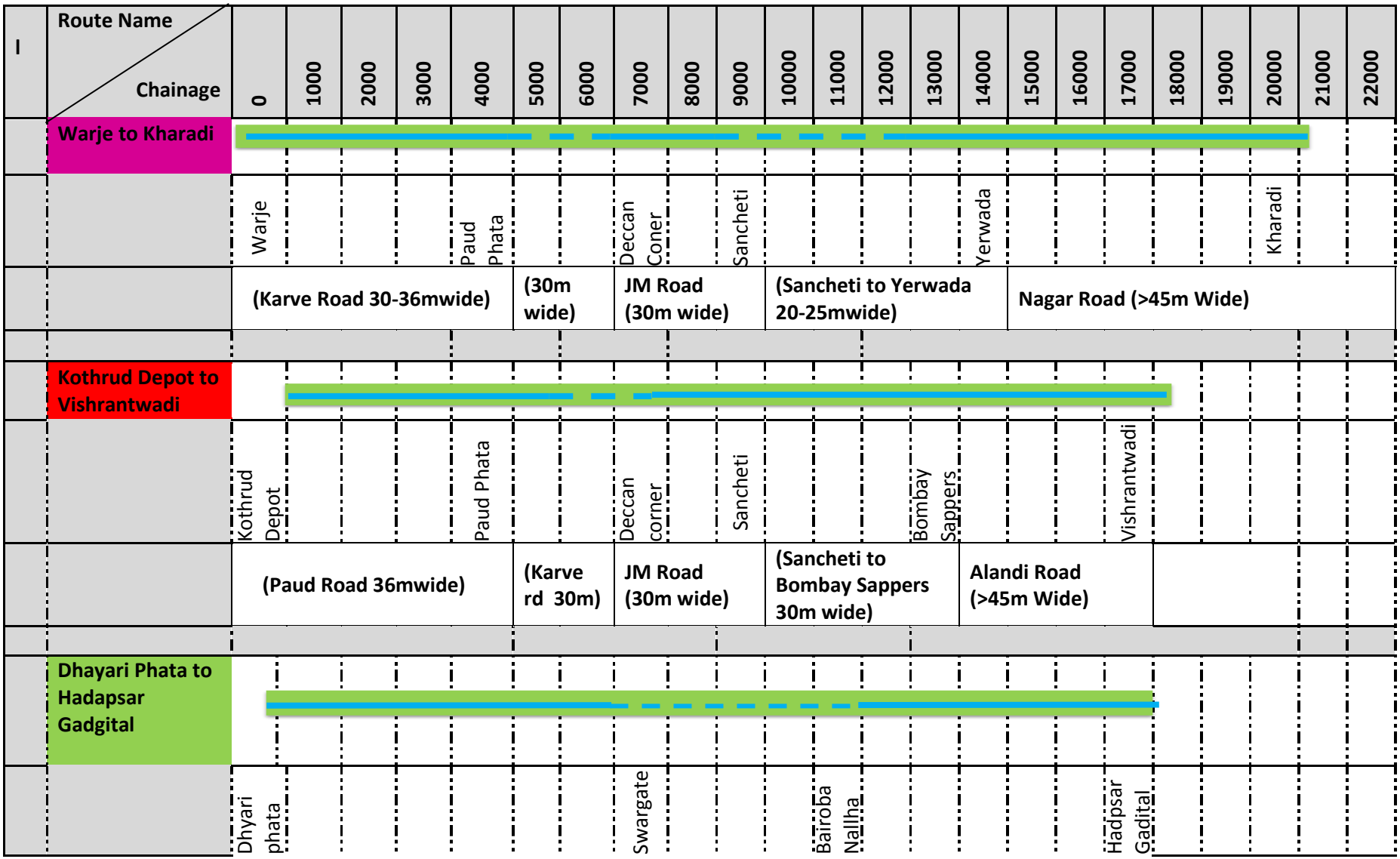


Figure 3-4: The RoW along the BRT corridors

Urban Mass Transit Company Limited

Table 3-4: Dedicated and Mixed Sections along BRT corridor



Urban Mass Transit Company Limited

I	Route Name / Chainage	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000	16000	17000	18000	19000	20000	21000	22000
		Sinhgad road – (mostly 36m wide)								Solapur Road-Cantonment Part (24m Wide)					Solapur Road-(36 m Wide)									
	Kalewadi Phata to Aundh PMC Limit to Katraj																							
		Aundh PMC Limit				University Junction			Shivaji Nagar				Swargate							Katraj				
		Aundh Road (30m Wide)					Ganeshkhind Road (>30 m wide)			Shivaji Road (24m wide)			Swargate to Katraj (36m wide)											

The width of the segregated bus lanes is proposed to be 3.1 to 3.3m at mid blocks, which is the minimum required for operation of buses. While the bus boarding lane at bus shelters would be 3.0m wide. The roads having mixed and dedicated lanes have also been shown in Figure -- - below.

Picture 3-5: Los Angeles Metro Bus in Mixed Lane

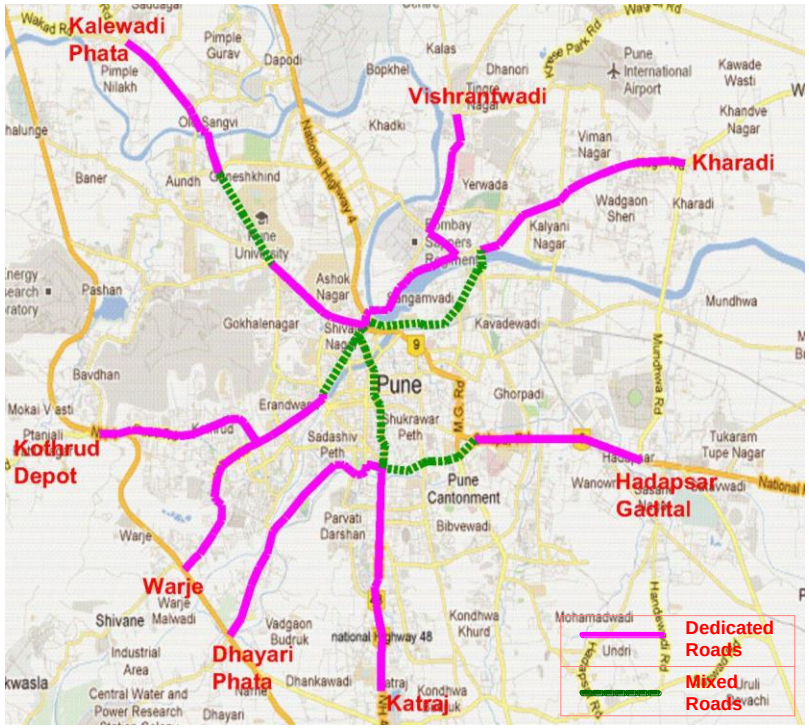


Figure 3-5: Mixed and Dedicated Sections along BRT Corridors

3.3 Bus lane type and location

Location of bus lanes can either be on kerb side which is traditionally used in India or in centre of the ROW which has been adopted in other countries. The comparative analysis is given in Table 3-5.

Picture 3-6: Central Bus Lane in Janmarg, Ahmadabad BRTS

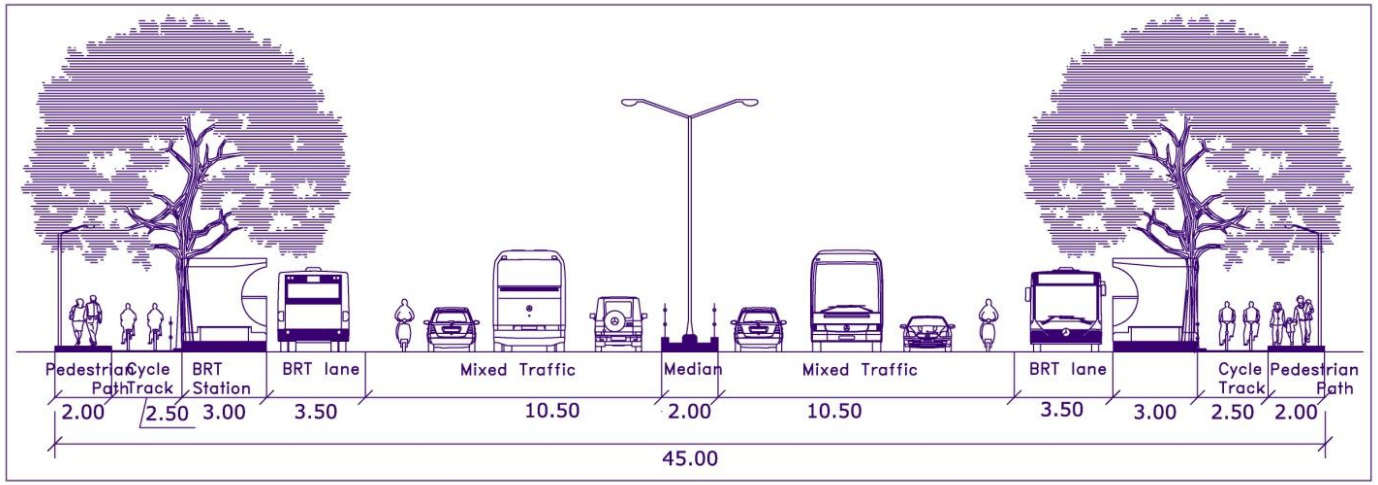


Figure 3-6: 3-7: Schematic cross section showing Kerb Side BRT Lane

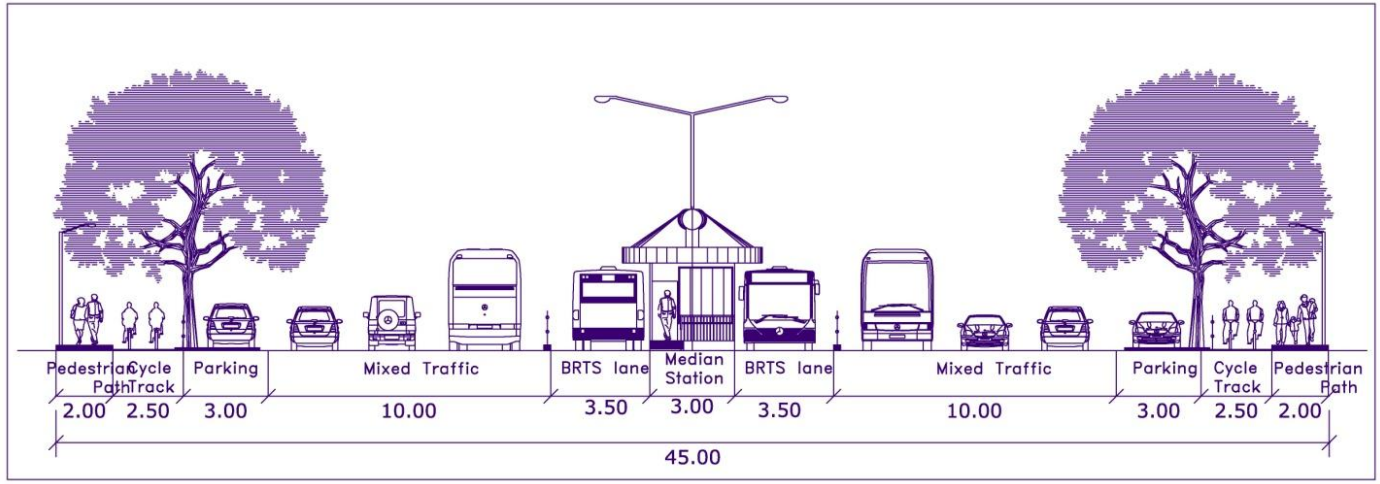
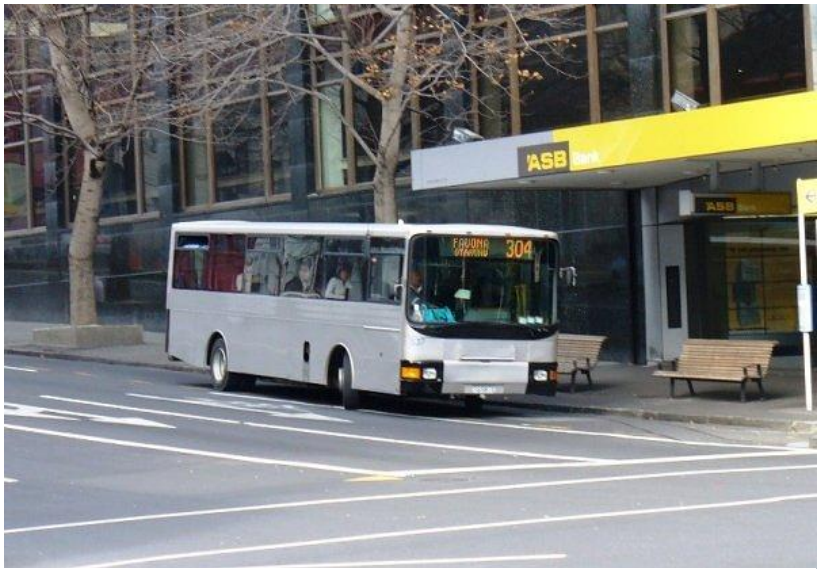


Figure 3-7: Schematic cross section showing Center BRTS with Median side Station

Table 3-5: Comparison of Central and kerb-side bus lanes

S.No.	Central Bus Lane	Kerb-Side Bus Lane
1.	Excessive side-entries for vehicles into service lanes or individual plots.	Limited access to service lanes or widely spaced entry points into adjoining areas.
Rationale	The high volume of turning traffic interferes with the through movement of bus traffic if the bus uses the same kerb-side lane as the turning vehicles.	
2.	Closely placed traffic lights for vehicles may be combined with bus shelters.	Traffic lights at larger intervals.
Rationale	Buses using the kerb-side lane face interference by turning traffic, therefore central bus lanes are preferred. If traffic lights are at larger intervals, distance between two buses may be too long and a mid-block bus stop with pedestrians' traffic light may be required.	
3.	Higher volume of two-wheeler and three-wheeler vehicles	Lower volume of two-wheeler and three-wheeler vehicles
Rationale	High volumes of two-wheeler and three-wheeler vehicles interfere with the movement of buses in the kerb-side lane especially at the bus-shelters where buses often cannot approach the designated bus-bays due to the three-wheelers parked there and the two-wheelers trying to overtake from the left-. Also, the difference in the size of these vehicles sharing the kerb-side lane makes the situation unsafe for the smaller vehicles.	
4.	Arterials through heavy commercial land use areas.	Highways through large institutional areas.
5	Easy to integrate bus flow with other flow at intersection	Compatible with conventional bus door configuration on curb side (left side).
6	Optimum road width for both direction movements.	Easier accessibility from the pedestrian pathway.
7	Infrastructure created can be utilized even if BRTS withdrawn.	Total road width occupied for bus lane is double.
8	Slight diversion to other traffic when a bulge is provided to accommodate the bus stops.	Cost intensive treatment at junctions would have to be carried out as free left turn for regular traffic would be cut off.



Picture 3-8: Curb Side bus Lane in Auckland BRTS

BRTS ensures bus priority through segregation of bus services from other traffic. At mid block this is achieved through segregation of bus lanes. Kerb side lanes may not be possible where access to property needs to be provided as they may be blocked by the segregation. In case of Pune, the proposed corridors are passing through the densely populated city core and other parts of the city were important activity centers are located. On most of these roads, there are no service lanes available and the properties open out onto the main carriageway, which cause friction and discontinuity in the bus lane. A service lane would require to be provided, if a curb side bus lane is desirous. Since the available RoW in most of the cases does not permit the same and also after analyzing this and other reasons listed in Table3-5, a median side bus lane is proposed. On roads where buses would be operating under mixed conditions, curb side lanes are proposed as shown in Figure 3-8.

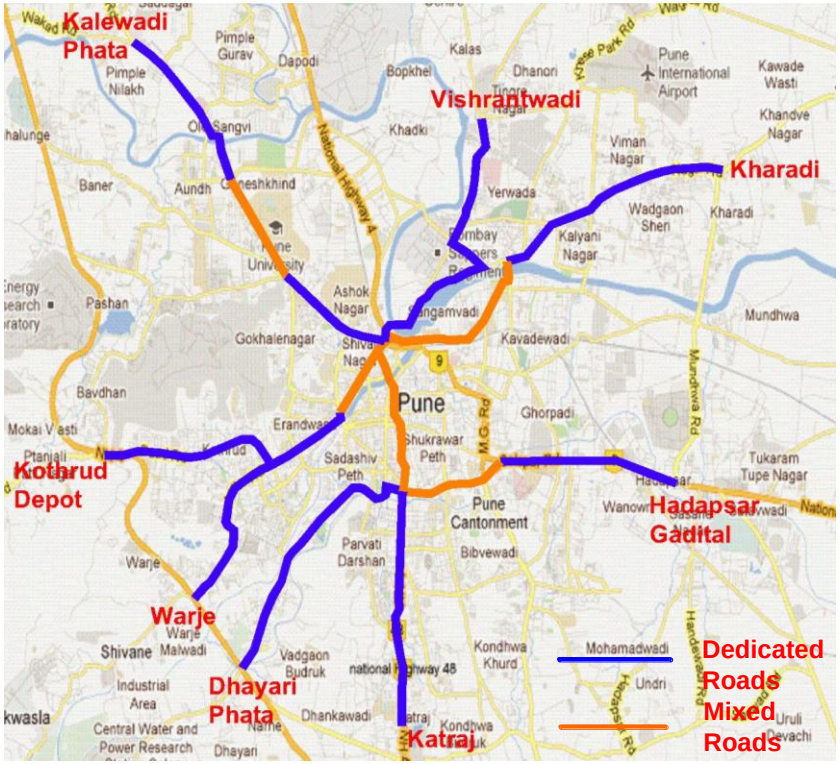


Figure 3-8: Proposed Median and Curb Side Lanes along BRT Corridors

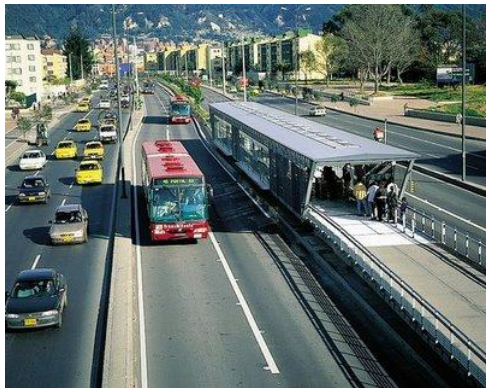
3.4 Lane Segregators

Just as a track indicates where a train travels for rail transit passengers and the community, treatments or markings to differentiate a running way can effectively convey where a BRT service operates. Differentiation in the appearance of the running way can be accommodated through a number of techniques including:

- Pavement markings – Marking using a yellow line is the most basic form of marking a lane as reserved for BRT service.
- Lane delineators - Delineators such as raised curbs, bollards, or bumps in pavement can highlight the distinction between general Purpose lanes and BRT running way lanes.
- Alternate pavement colour/ texture - Implementing alternate pavement color through colored asphalt or concrete can reinforce the notion that a particular lane is reserved for another use, thereby reducing conflicts with other vehicles.

The pros and cons of using each type of lane separators is given in Table 3-6 below.

Picture 3-9: Pavement Markings in Amsterdam Bus ways



Picture 3-11: Lane Delineators in Bogota BRTS

Picture 3-10: Alternative Pavement Colour in Seoul Bus ways

Table 3-6: Comparison between different type of lane segregators

Pavement Markings	Lane Delineators	Alternative Pavement Color/Texture
Pros		
• One of the major advantages of the pavement markings is that they are significantly cheaper than any other type method and they have high retro-reflectivity level. • Pavement markings provide good guidance for bus services, separate opposing lanes of traffic, prohibit passing maneuvers, and delineate roadway edges for bus operations. • Pavement markings convey good traffic regulations and warnings to the other modes on the same corridors. • The effectiveness of the marking depends on their visibility as pavement markings are reflective. • They are very cost effective and very easy to implement on the dedicated BRT corridors. • They are suitable for the corridors where the other traffic volume is less and there is no need of physical segregation of the traffic. • An effective pavement marking system facilitates driver guidance, improves traffic flow, contributes to driving	• Lane Delineators are particularly beneficial at locations where the alignment might be confusing or unexpected. • Delineators are effective aids for night driving and under other conditions of reduced visibility. They are devices to guide rather than warn. • They are very useful on long continuous sections of BRT corridors or through short stretches where there are changes in horizontal alignment of traffic. • One of the major advantages of the lane delineators is that they are significantly cheaper than the alternative pavement color/texture. • Lane Delineators are effective guidance devices at night and during adverse weather. • They provide good guidance in the form of continuous line for bus services, separate opposing lanes of traffic, prohibit passing maneuvers, and delineate roadway edges for bus operations. • The effectiveness of the lane delineators depends on the type of delineators used	• One of the major advantages of the Alternative pavement color/texture is that they create an individual expression for the movers to that particular section. • They enhance the normal paving condition and informality and natural appearances to the BRT corridors. • Colored/textured Pavements are more resistant to the rutting that can occur at high temperatures as compare to the pavement markings. • Such surfaces also have the effect of reducing light reflection from the pavement as not in normal asphalt pavements. • They made with materials that are mixed and laid at normal temperature offer excellent flexibility as regards color, texture and shape. • They contribute to traffic safety by delimiting BRT lanes with color and also segregating other traffic visually. • They enhance road appearance and reduce accidents on the corridors. • They offer the flexibility to develop an

Pavement Markings	Lane Delineators	Alternative Pavement Color/Texture
comfort, and enhances traffic safety at a certain level. • Pavement markings have easy clean-up procedures. • The setting time of pavement markings is very quick.	as they are a kind of physical barrier to other modes. • They are moderately cost effective and not very easy to implement on the dedicated BRT corridors as one has to consider the technical parameters such as size, spacing, • They are suitable for the corridors where the other traffic volume is moderate and there is a need of physical segregation. • An effective lane delineator system facilitates driver guidance, improves traffic flow, contributes to driving comfort, and enhances traffic safety at a certain level.	effect that matches the landscape. • They cannot be worn away rapidly on high volume roadways, and consequently not creating uneven surface for the movement. • Major contribution of the colored pavement/textured pavement is on safety of the commuters as they distinguish very clearly the running way and other areas.
Cons		
• Pavement markings create only visible segregation and not physical segregation which may create traffic congestion/jam if the volume is very high on the corridor. • They can be worn away rapidly on high volume roadways, and consequently these roadways need to be re-striped more than once a year. • These kinds of markings do not adhere properly to the concrete and asphalt roads. • They are suitable for only short term (9-12	• Lane delineators create segregation up to a limit which **may** create traffic congestion/jam if the volume is extremely high on the corridor. • They can be worn away rapidly on high volume roadways, and consequently create uneven surface for the movement. • After some time, they do not adhere properly to the concrete and asphalt roads if not properly fixed. • They are suitable for only light segregation of traffic on the BRT	• Colored/textured pavements are more costly as compare to the pavement markings, lane delineators and normal asphalt pavement. • Such types of pavement cannot be used without proper consideration of their basic content, mixture etc. • An expertise is required to lay down these type of pavement as it is different from our conventional laying systems of pavement. • The replacement procedure at later, if one

Pavement Markings	Lane Delineators	Alternative Pavement Color/Texture
months) implementation of the bus services. • They saddle with increasing traffic levels and the need to re-apply pavement markings more frequently. • They are not suitable for old asphalt or concrete surface.	corridors. • There are some limitations with them such as types, materials, fixing procedures etc.	has wish to change the pavement type, is very difficult in this kind of pavement.
Examples		
• R-Bus, Montreal, Canada • Amsterdam, Netherland •	• Ahmedabad, India • Delhi, India • Optibus Lanes, Mexico • Bangkok, Thailand • Beijing, China • Bogota, Brazil • Jakarta, Indonesia	• Key routes, Nagoya, Japan • Seoul, South Korea

It can be inferred from the above table that physical segregation using lane delineators is most effective for BRTS. Amongst the available option, raised curbs are most commonly used and are easy to implement (eg. Delhi BRTS). The same are therefore proposed to be used in Pune along the dedicated corridors. Along the section of the road where buses are proposed to be operated in mixed traffic, a bus lane would be demarcated using a yellow line along the curb side (refer Figure 3-9).

Picture 3-13: Raised curbs used in Delhi

Picture 3-12: Lane delineators in Ahmadabad BRTS

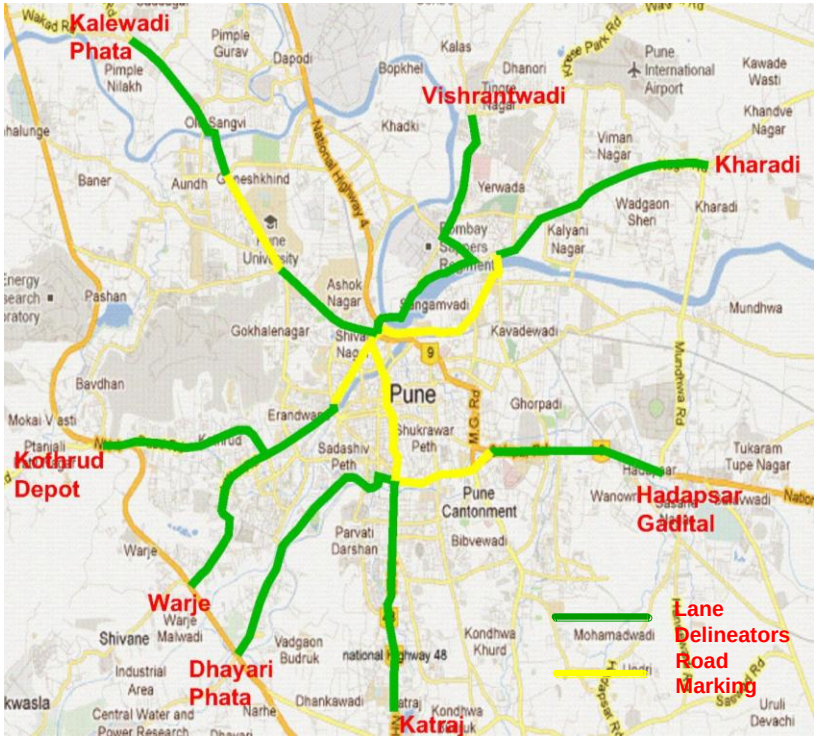


Figure 3-9: Proposed Segregation by Lane Delineators and Pavement Marking along BRT Corridors

3.5 Pavement Design

A pavement is a multi-layer structure which deflects or flexes under loading. The structure is composed of several layers of materials. Each layer receives load from the layer above, spreads it out and passes it on to the layer below. Since the stress is highest at the uppermost layer, stronger materials are used at the top while materials of lower strength are provided in the layers below where the stress is less. The purpose of pavement design is to limit the stresses induced in the sub-grade by traffic load to a safe level at which sub-grade deformation is insignificant. At the same time it ensures that the road pavement layers themselves do not deteriorate to any serious extent within a specified period of time.

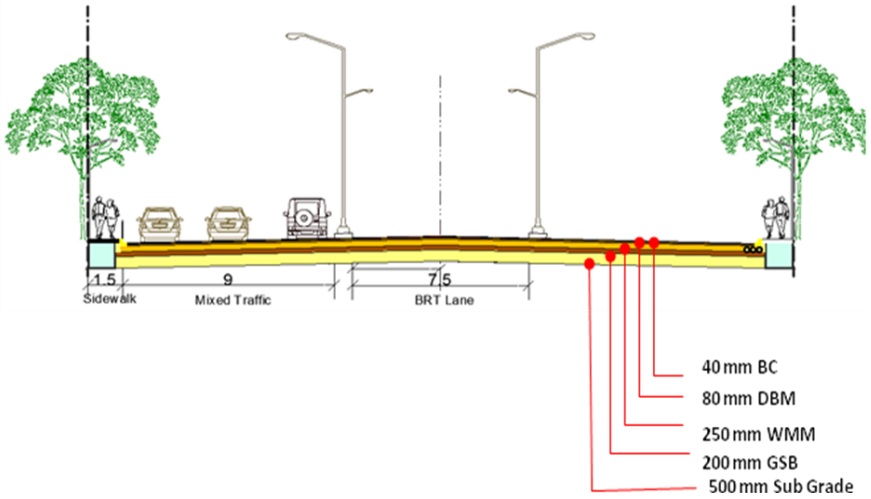


Figure 3-10: Flexible Pavement Cross Section

The basic structure of the pavement comprises of the following layers:

- Sub-grade
- Granular Sub-base
- Base Course
- Wearing Course or Wearing Surface

The Top 500mm of the foundation soil (natural soil) is generally considered as the sub-grade of the pavement. Sub-grade soils play an integral part in pavement performance. The strength of the sub-grade soil for pavement design is usually designated by its CBR value. The sub-grade whether in cut or fill shall be well compacted to utilize its full strength and to economize on the overall thickness of pavement required.

Sub-base consists of well drained materials placed on the sub-grade. It is a structural layer below the sub-grade to further distribute the load to the weaker sub-grade below and it also drains away water infiltrating from the top. The sub-base material may be made up of granular material such as sand, mooram, gravel, laterite,

kankar, brick metal, crushed stone, crushed slag or a combination thereof or other material such as stabilized soil which remains static during saturated condition. The sub-base (drainage layer) material should not be crushed during the rolling operation and should retain permeability after the construction.

The base course consists of granular bound or unbound course placed above the sub-base and transmit load and shear stress to the sub-grade through the sub-base. The base may be Water Bound Macadam (WBM), Wet Mix Macadam for Flexible Pavement and Dry Lean Concrete (DLC) for Rigid Pavement.

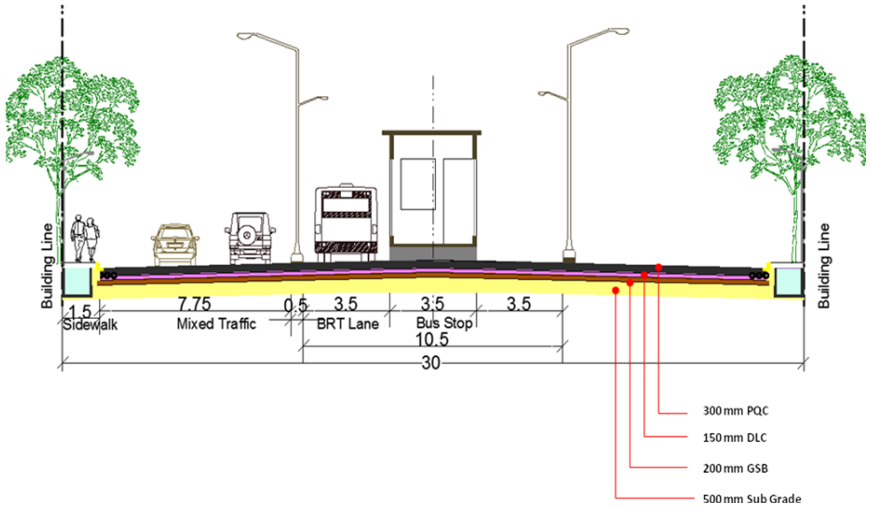


Figure 3-11: Rigid Pavement Cross Section

Picture 3-14: Flexible Pavement in Bangkok BRTS, Thailand

Picture 3-15: Flexible Pavement in Bangkok BRTS, Thailand

Wearing Course or Wearing Surface is the hard top crust of the pavement which comes in contact with the load. In the rigid pavement this consists of cement concrete slab and in the flexible pavement this consists of a wearing course only or a wearing course over a binder course. The function of the wearing course is to withstand the abrasive and attrition stress due to traffic, provide a good riding surface and prevent ingress of moisture to the road bed. It also prevents the base course from reveling. A binder course is bitumen bound layer between the granular base course and the wearing course to give better load transmission and to act as a superior bound layer. It also helps in reducing the overall thickness of granular base and adds to the structural stability of the pavement as a whole. While wearing course may be Surface Dressing, open graded Pre-Mix Carpet, Semi-Dense Bituminous Concrete or Bituminous Concrete, binder course is generally either Bituminous Macadam or Dense Bituminous Macadam.

A comparative analysis of the wearing Course in terms of rigid pavement and flexible pavement is given in Table 3-7 below.

Table 3-7: Comparison between a Rigid and Flexible Pavement

Flexible Pavement	Rigid Pavement
Flexible pavements reflect the deformation of sub-grade and the subsequent layers to the surface. Flexible, usually asphalt, is laid with no reinforcement or with a specialized fabric reinforcement that permits limited flow or repositioning of the roadbed underground changes.	The rigid characteristic of the pavement are associated with rigidity or flexural strength or slab action so the load is distributed over a wide area of sub-grade soil. Rigid pavement is laid in slabs with steel reinforcement. The rigid pavements are made of cement concrete either plan, reinforced or pre-stressed concrete.
Pros	
• The one of the major advantages of flexible pavement is that it is very low cost pavement. • The initial design life of this pavement is approx. 20 years but after white-topping at the end of 10th year, its life is 30 years. • After white-topping at the end of 10th year, no repair works are needed for this pavement. • No bitumen is needed after white-topping is done at the end of 10th year. • Repair work to the utilities buried below can be done very easily after the laying of pavement. • After construction of flexible pavement, Road can be used for traffic within 24 hours	• The one of the advantage of the rigid pavement is its durability in all weather conditions especially in rainy season. • The initial design life of this pavement is more than 20 years without any repair work regularly. • No repair work is needed at all during the initial 10 years, at the end of 10th year only renewal of seal coat is required. • No bitumen is needed at all over its entire life. • High efficiency in terms of functionality • The road users cost saving is very high in this type of pavement. • In the long run it is about half the cost to install and maintain. • Less Maintenance cost and Continuous Traffic and Flow.
Cons	
• The road users cost saving is very less in this type of pavement. • The one of the disadvantage of this pavement is its less durability in all weather conditions especially in rainy season. • The initial design life of this pavement is less than 20 years without any repair work regularly.	• The one of the major disadvantages of flexible pavement is that it is very high cost pavement. • Repair work to the utilities buried below cannot be done very easily after the laying of pavement as it is very tough to break the already constructed pavement surface.

• Regular repair work is needed after the construction of the pavement. • As such the flexible pavement may be constructed in a number of layers and the top layer has to be strongest as the highest compressive stresses. • Strength of the road is highly dependent on the strength of the sub grade	• After construction of rigid pavement, Road cannot be used until 14 days of curing. • In the case of rigid pavement, the force of friction is high which may increase the chances of accidents.
Examples	
• Ahmedabad, India • Delhi • Silver Line, Boston • Chicago BRT • Bangkok, Thailand • Beijing, China	• Rajkot, India • Surat, India • Los Angeles, USA • Orlando, Lymmo • Amsterdam, Netherland • Bogota, Brazil • Brisbane, Australia

Picture 3-17: Flexible Pavement in Beijing BRTS, China

Picture 3-16: Rigid Pavement in Rajkot BRTS, India

A road inventory and condition survey was carried out along the project corridors to have detailed information of the existing carriageway, shoulder width, side drains and visual condition of the pavements. Based on the survey results and also considering that Pune has heavy rainfall during considerable part of the year, the durability of flexible pavement may be difficult to maintain and hence it is concluded that rigid pavement using cement concrete would be constructed in Pune.

3.6 Conclusion

Based on the recommendations in the previous sections, the following is recommended for Pune as given in Table 3-8.

Table 3-8: Proposed Corridor Design

Sl.No.	Item	Recommendation
1	Number of Corridors	Total of 4 corridors with a total length of 68.8km as follows: • Corridor 1 - Warje to Kharadi - 22km • Corridor 2 - Kothrud Depot to Vishrantwadi - 17km (including 4.7km of corridor 1) • Corridor 3 - Dhayari to Hadapsar Gadital - 17km • Corridor 4 - Kalewadi Phata to Katraj - 17.5km
2	System of Operations	Closed- Hybrid
3	Runway Segregation	Dedicated lanes along most part of the corridors except along some identified sections where buses would operate under mixed condition due to limited RoW or presence of flyovers
4	Bus lane type and location	Median bus lane except where buses operate in mixed traffic
5	Lane Segregators	Raised curb to be used except in areas where the buses would be operating in mixed traffic. Under such condition, lane marking would be provided.
6.	Pavement design	Rigid pavement using cement concrete

4 Station Design

Stations form the critical link between the BRT system, its customers, and other public transit services offered in the region. Stations are the first point of interaction between a system and the customers and they create a brand identity that distinguishes the BRT system from other public transit services.

Because BRT systems serve high demand corridors and have only a limited number of stops, the number of customers using each BRT station will be significantly higher than would be the case for a typical local bus line. Accordingly, BRT stations are much more significant than a sign on a pole as is typically the case for conventional local transit bus services. They range from simple stops with well-lit basic shelters to complex intermodal terminals with amenities such as real time passenger information, newspaper kiosks, coffee bars, parking, pass/ticket sales and level boarding.

4.1 Station Characteristics

Stations have seven primary characteristics

- Station Type

- Platform Height
- Platform Layout
- Passing capability
- Station

4.1.1 Basic Station Type

There are several type of BRT station which ranges from simple stop to enhanced stop, designated station, and intermodal transit center. BRT stations can be designed to convey a brand identity that distinguishes the BRT system from other public transit services, portraying a premium-type service, while integrating with the local environment.

There are four basic BRT station types:

- Simple Stops
- Enhanced Stop
- Designated Station
- Intermodal Terminal or Transit Center

The pros and cons of each type of station are provided in Table 4-1 below

Table 4-1: Comparison between different station types

Simple Stops	Enhanced Stops	Designated Stations	Intermodal Terminals
This is the simplest form of the four BRT station types listed within this section. It consists of a "basic" transit stop with a simple shelter to protect waiting passengers from the weather.	Enhanced BRT stations include enhanced shelters, which are often specially designed for BRT to differentiate it from other transit stations and to provide additional features such as more weather protection and lighting. This BRT station type often incorporates additional design treatments such as walls made of glass or other transparent material, high quality	The designated BRT station may include level passenger boarding and alighting, a grade separated connection from one platform to another (in case curb side stations are provided) and a full range of passenger amenities including retail service and a complete array of passenger information.	The intermodal terminal or transit center is the most complex and costly of the BRT stations listed in this section. This type of BRT facility will often have level boarding, provides a host of amenities, and accommodates the transfers from BRT service to local bus, other public transit modes, e.g., rail transit, and even intercity bus and rail.

	material finishes.		
Pros			
Lowest capital cost	Low capital cost	Creates a good brand identity and image for the city	Creates a very good brand identity and image for the city
Low maintenance cost	Low maintenance cost	Possible to have a complete array of ITS facilities	Possible to have a complete array of ITS facilities
Very easy to erect	Takes a little time to erect	Off board ticket collection facilities possible	Off board ticket collection facilities possible
Require less design and less elements	Comfortable for passengers/commuters	Scope of revenue from advertisement very high – both on boards and LED displays	Very high scope of revenue from advertisement very high – both on boards and LED displays
	Creates a brand identity	Good comfort for passengers/commuters	Very good comfort for passengers/commuters
		They also offer higher capacity than simple or enhanced stops and are easy for passengers to identify and locate in a street environment. In addition, they may have enhanced security features	Can increase convenience for transferring riders, allow for creation of a fare-paid zone that further eases transfers, and maximize the interface of BRT and local services.
			They also may provide a greater opportunity for commercial and food services and for TOD
Cons			
Low passenger amenities	Limited ITS facilities – only PIS	High capital cost	Very high capital cost
Very limited scope of advertisement revenue	Off board ticket collection facilities not possible	High maintenance cost	Very high maintenance cost

– only on board			
No space for ITS facilities	Limited scope of advertisement revenue – on boards and limited PIS	Takes time to erect the structure	Takes much time to erect the structure
Off board ticketing is not possible	Low passenger amenities	Design and planning is a little complex	Design and planning is very much complex
They do little to distinguish BRT from traditional bus service and do not communicate permanence	Typically, these stops are smaller in size and scale than other bus stops and may only moderately distinguish the BRT service from traditional bus service	The stations are not suitable/recommended for most BRT applications when the demand expected is very low	The intermodal terminals/end-of-line facility are not suitable/recommended for most BRT applications when the BRT lines do not ends or interface with a network of other transit services
These features reduce a basic stop's ability to attract choice riders and its ability to encourage transit-oriented development (TOD)	They may offer few, if any, passenger amenities; and may provide limited encouragement for TOD	The stations are not suitable/recommended for most BRT applications when it is not desired to protect passengers from weather conditions	
Examples			
Bus Rapid System, Pittsburg MetroLink Scotia Square stop (Halifax) Metro Rapid Stop (Los Angeles).	Delhi Ahmedabad Brisbane South Easy Buswa Cleveland HealthLine	EmX Eugene Station (Eugene, Ore.	Singapore

Picture 4-1: Enhanced Stop, Los Angeles Rapid Bus

Picture 4-2; Enhanced Bus Stop, BRTS, Ahmedabad

Considering the various parameters listed above, it is proposed to construct DESIGNATED STATIONS along the BRTS corridors in Pune as they would create a strong brand identity of the BRTS in the city. However since the cost of these types of bus stops is very high, to economize the overall cost of the project, it is proposed that beyond the dedicated length, where the buses would be operating in mixed traffic condition, along the curb side, ENHANCED STOPS would be installed. Also designated stops encompass a larger array of facilities and hence require larger area. Since along the mixed sections of the BRT corridors, the availability of land is a major

Picture 4-3: Simple Bus Stop Philadelphia Rapid Bus

concern it would not be possible to install dedicated stations.

There would be a total of 133 stations (including Pilot BRTS) that includes 94 designated stations and 39 enhanced stations. The number of stations required along each of the corridors is as follows:

- **Corridor 1** – total 43 stations of which 29 stations would be designated stations and 14 would be enhanced stations
- **Corridor 2** – total 33 stations of which 26 stations would be designated stations and 7 would be enhanced stations. These include 4 enhanced stations of Corridor 1.
- **Corridor 3** – total 32 stations of which 24 stations would be designated stations and 8 would be enhanced stations
- **Corridor 4** – total 35 stations of which 21 stations would be designated stations and 14 would be enhanced stations.

The location of BRTS stations is shown in Figure 4-1 and a detailed list of stations along each of the corridors is given in Annexure 4

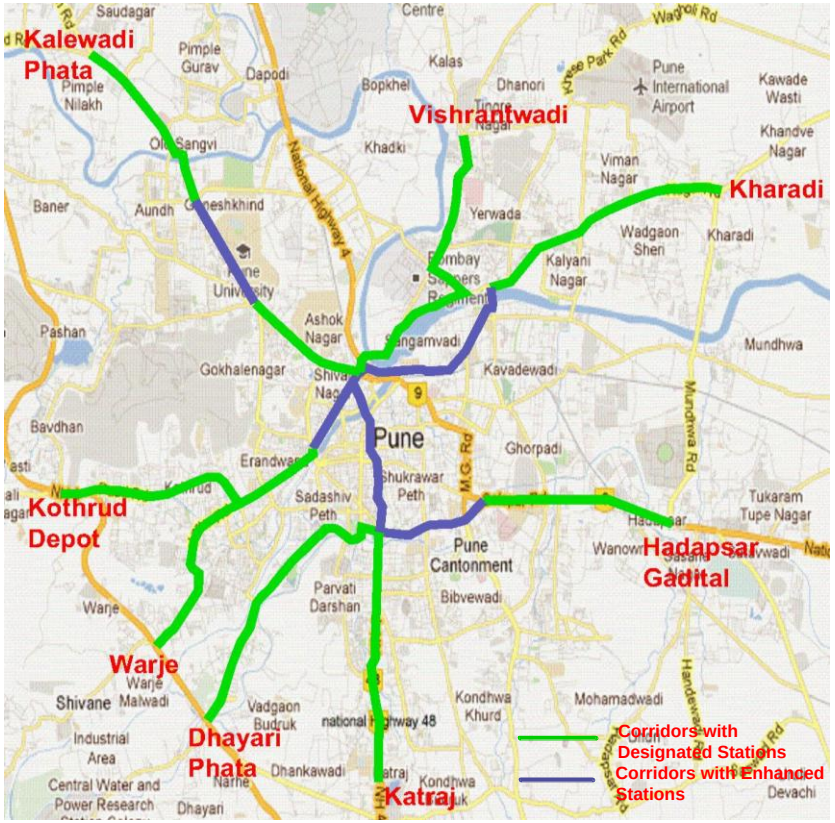


Figure 4-1: Location of Enhanced and Designated Stations along BRT Corridors

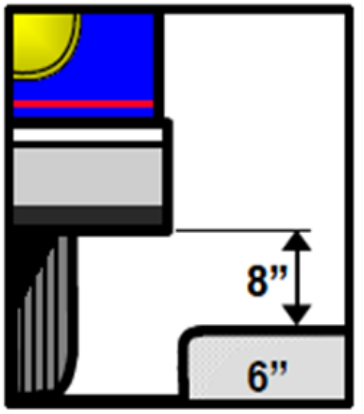
4.1.2 Platform Height

Platform height affects the ability of disabled or mobility-impaired passengers to board the vehicle. Passengers traditionally board vehicles by stepping from a low curb up to the first step on the vehicle, then climbing additional steps. Given the trend toward widespread adoption of low-floor vehicles, boarding has become easier for all passengers. Platforms at the same height as vehicle floors can enhance customer experience and reduce dwell times if some approach to providing no-gap, no-step boarding and alighting is adopted through provision of drop ramps or precision vehicle docking.

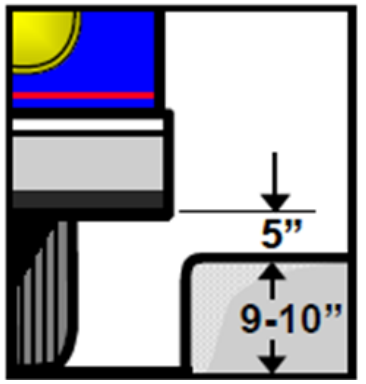
There are three basic platform height options:

- standard curb
- low curb
- level platform

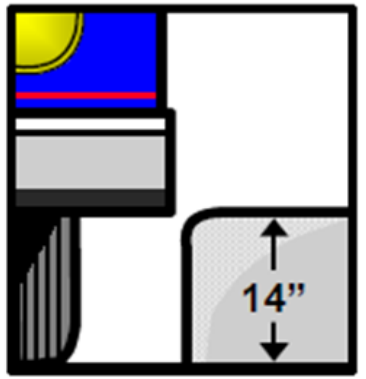
The pros and cons of providing each type of platform height are provided in Table 4-2 below and a schematic representation of the platform heights is shown in Picture 4-5, 4-6 and 4-7.



Picture 4-4: Schematic representation of Raised Curb



Picture 4-5: Schematic representation of Standard Curb



Picture 4-6: Schematic representation of Level Platform

Table 4-2: Comparison between standard curb, low curb and level platforms

Standard Curb	Raised Curb	Level Platform
In a standard curb the station platform is provided at the level of the footpath that causes customers to step up to enter the BRT vehicle and step down to exit the BRT vehicle. In most instances, this type of platform treatment is used when the station right-of-way cannot be altered.	In a raised curb, the station is provided at about 10 inch higher than the level of the BRT running way or arterial street on which the BRT system operates. In some cases, the raised curb will more closely match the height of BRT vehicle's entry step or floor to accommodate "near" level boarding.	Level boarding platforms are the safest, easiest, and efficient manner of customer boarding and alighting. The platforms level with BRT vehicle floors. Level station platform boarding and alighting platforms enhances the customers traveling experience by creating a seamless transition between station and vehicle.
Pros		
No additional cost for station platform	Some additional cost only as 3-4 inches of additional concrete is required at stations	At level boarding – easy accessibility for the BRT vehicle
Very easy and comfortable pedestrian movement as the level of curb and footpath is same	The raised platform addresses the problem of potential vehicle damage, reducing risk concerns	Suggests a seamless transition into the vehicle and a perception of reduced dwell times and faster boarding attributed to customer ease
Provide good accessibility for low-floor buses (i.e. 300/450 mm ht)	improved accessibility for the BRT vehicles (650/750 mm vehicles)	Enhanced safety and increased customer perception of the service
Takes very little time to construct the structure	Takes a little time to construct the structure	Disabled friendly, strong brand identity and greater similarity to Rail type service
	Reduced vertical gap between the platform and the vehicle floor	Level boarding consistently eliminates the step up into the vehicle
Cons		
Vertical gap between the height of the station platform or the curb and the vehicle entry	Vertical gap between the height of the station platform or the curb and the vehicle entry	Very much additional cost due to higher platform height

Standard Curb	Raised Curb	Level Platform
step or floor: poor accessibility of BRT vehicles (for high floor height)	step or floor: poor accessibility of BRT vehicles (for high floor height vehicles)	
Very high boarding alighting time	High boarding alighting time	Not suitable for standard low floor buses
Cannot be used by physically handicapped people	Cannot be used by physically handicapped people	Increased total area/space as designer has to provide extra steps/ramp to approach to the station
Safety of passengers a concern	Safety of passengers a concern	Takes very much time to construct the structure
This option does require one to two steps up into the vehicle, even with low-floor coaches	may be described as still requiring passengers to take one step up to board the vehicle	Potential slowing of operations as inexperienced drivers approach the station
This could increase dwell times, especially for customers who are mobility impaired, elderly or traveling with small children	Accessibility implications regarding the sloped access from the street level to the end of the platform, requires additional mitigation measures i.e. bridge plates or guidance system	Accessibility implications regarding the sloped access from the street level to the end of the platform, requires additional mitigation measures i.e. bridge plates or guidance system
Access into the coach for passengers with disabilities is achieved with standard ramps or lift deployment, the use of which may increase dwell times		Concerns may include maintenance issues (e.g., possible damage to the vehicle body or lug nuts if the platform is hit); risk (potential liability if a customer falls from the platform)
Examples		
Los Angeles Metro Rapid Kansas City MAX York VIVA	Kunming Seoul	Ahmadabad Bogota Curitiba

Picture 4-7: Raised Curb Bus Boarding

Picture 4-8: Standard Curb Bus Boarding

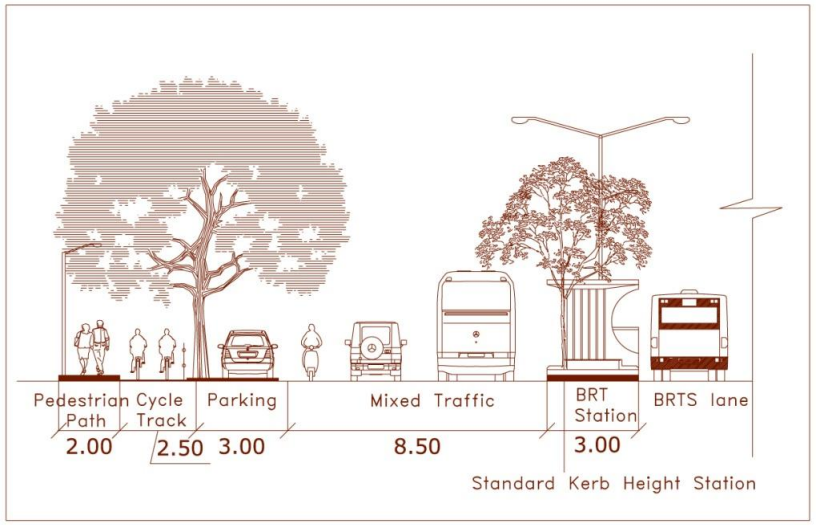


Figure 4-2: Schematic cross section showing Standard Height Platform in BRTS

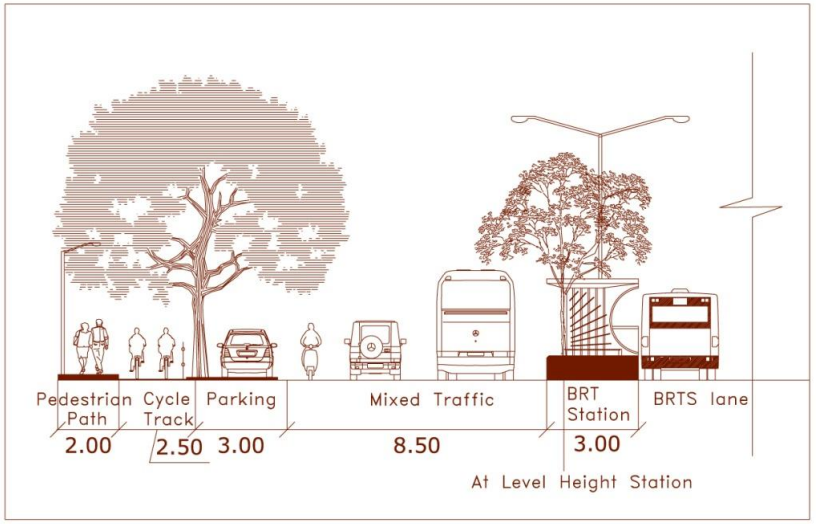


Figure 4-3: Schematic cross section showing At Level Platform in BRTS

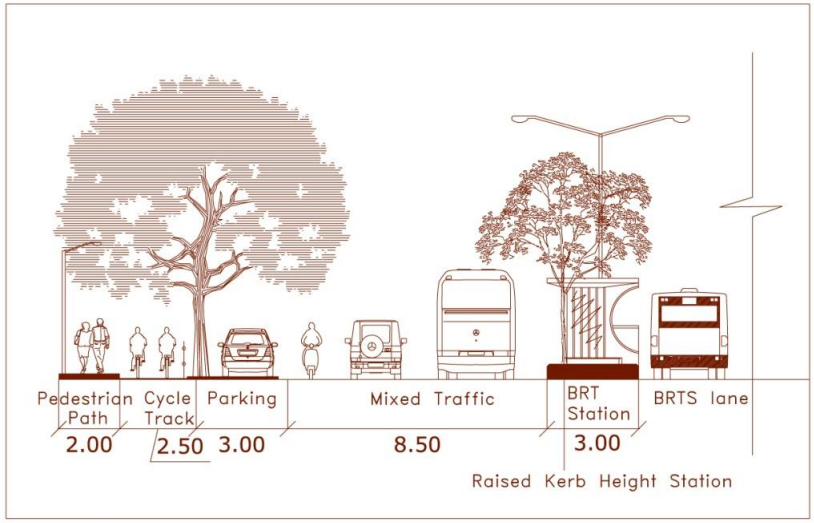


Figure 4-4: Schematic cross section showing Raised Height Platform in BRTS

Picture 4-9: Raised Curb Bus Boarding, Rapid Bus, Goteborg, Sweden

It can be inferred from the table above that stations having level platform are best suited and hence the same are proposed to be constructed for Pune BRTS along the dedicated sections of the corridors. On roads where operations are proposed to be in mixed traffic condition and curb side lanes are being provided, standard curb platforms would be created at level with the footpath. The same is proposed to maintain the continuity of the footpath, though there would be some compromise on the travel time and accessibility.

The height of the platform is dependent on the floor height of the buses and visa versa. The pros and cons of different floor

Picture 4-10: Level Platform Bus Boarding

height buses are discussed in detail in the Service Specification report. In case of Pune, traditionally standard buses of 1050mm floor height are operated and all the new buses being procured by the city authorities are of 900mm height, therefore stations are proposed to be of the same height to enable level boarding and alighting of passengers at stations. The location of standard curb and level platforms is shown in Figure 4-5.

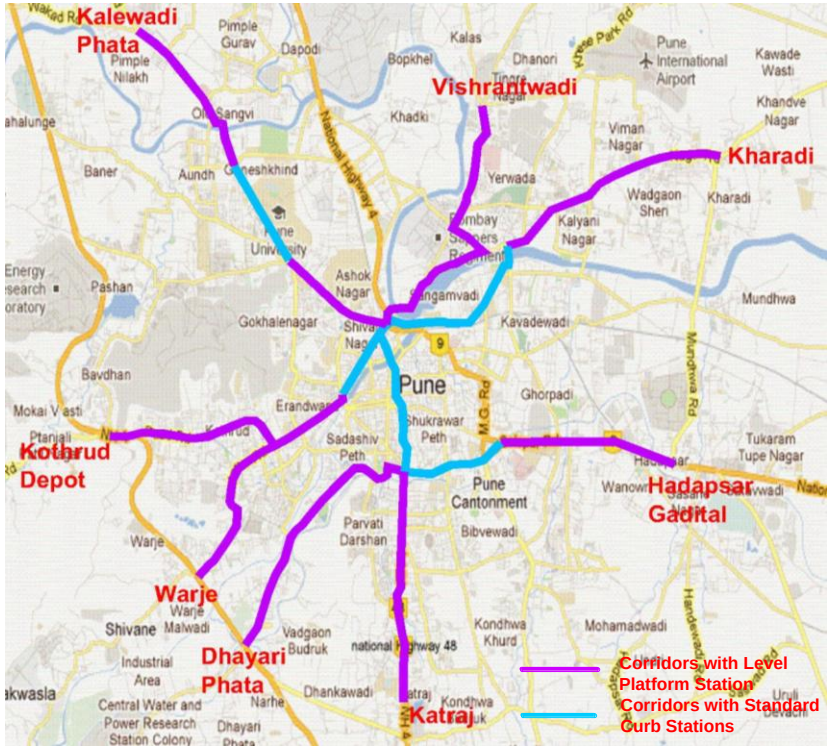


Figure 4-5: Location of Standard Curb and Level Platform Stations along BRT Corridors

There would be a total of 133 stations (including Pilot BRTS) that includes 94 stations with level platform and 39 stations having standard curb. The numbers of stations required along each of the corridors are as follows:

- **Corridor 1** – total 43 stations of which 29 stations would have level platform and 14 would have standard curb
- **Corridor 2** – total 33 stations of which 26 stations would have level platform and 7 would have standard curb. These include 4 stations in Corridor 1.

Picture 4-11: Level Platform, BRTS Delhi

- **Corridor 3** – total 32 stations of which 24 stations would have level platform and 8 would have standard curb
- **Corridor 4** – total 35 stations of which 21 stations would have level platform and 14 would have standard curb

A The detailed list of stations along each of the corridors is given in Annexure 4

4.1.3 Platform Layout

Platform layout is a major element of station design. It describes the length and extent of berthing assignment. It affects how many vehicles can simultaneously serve a station and how passengers must position themselves along a platform to board a given service.

Platform layouts range from single vehicle length with a single berth (boarding position), usually from 60 feet where only conventional 40 foot buses are used, to as long as 300 or more feet where multiple articulated buses must be accommodated. These could be identified as:

- Single Vehicle Length Platform
- Extended Platform with Un-Assigned Berths
- Extended Platform with Assigned Berths

The pros and cons of each type of station are provided in Table 4-3 below:

Table 4-3: Comparison between different Platform Layouts

Single Vehicle Length Platforms	Extended Platform with Un-Assigned Berths	Extended Platforms with Assigned Berths
This is the shortest platform length necessary for the entry and exit of one BRT vehicle at a time at a station.	Extended platforms usually accommodate no less than two vehicles and allow multiple vehicles simultaneously to load and unload passengers.	Extended platforms with assigned berths have all of the features of extended platforms but also assign vehicles serving specific routes to specific positions on the platform.
Pros		
Low Cost	Allows more than one bus to stop at a station	Allows more than one bus to stop at a station
Low space requirement	Reduced travel time	Reduced travel time
Less design and planning requirements	Very much suitable for BRT corridors having high frequency of vehicles	Minimum boarding time as bays are pre-assigned for each route

Single Vehicle Length Platforms	Extended Platform with Un-Assigned Berths	Extended Platforms with Assigned Berths
Very much suitable for BRT corridors having frequency of maximum 10-12 buses per hour	Option is suitable for both the types of stations i.e. curb side and median side	Option is suitable for both the types of stations i.e. curb side and median side
Option is suitable for BRT stations at curb side i.e. pair of stations as the load is distributed equally on both	Suitable for the BRT corridors where the ridership is high	Suitable for the BRT corridors where the ridership is high
Suitable for the BRT corridors where the ridership (phpdt) is less	Much space for revenue generations (i.e. advertisements)	Very Much space for revenue generations (i.e. advertisements)
Very less design, planning and construction efforts	Good brand, image and identity of rapid transit system for the city	Very Good brand, image and identity of rapid transit system for the city
Cons		
Only one bus can stop at the station at a time	High Cost	Very high cost
High travel time as there is time loss by the bus to wait for its turn to berth at the station – queuing of BRT vehicles	Higher space requirement	Very high space requirement
Problems in boarding and alighting if the ridership increases in the future	Some loss in boarding time by passengers as there may be confusion as to bus would berth at which bay	Very high design and planning efforts
Very less space for revenue generation (i.e. advertisements)	Risk of accidents or stampede if the ridership is very high as the berths are not assigned	Takes very much time to construct the structure
	Docking of vehicles is very difficult if the vehicles are lined up	Only suitable for long corridors having very high ridership
	High design and planning efforts	
	Takes very much time to construct the structure	

Single Vehicle Length Platforms	Extended Platform with Un-Assigned Berths	Extended Platforms with Assigned Berths
Examples		
Ahmedabad Delhi Rajkot	Beijing Kunming	Bogota Curitiba Changzou

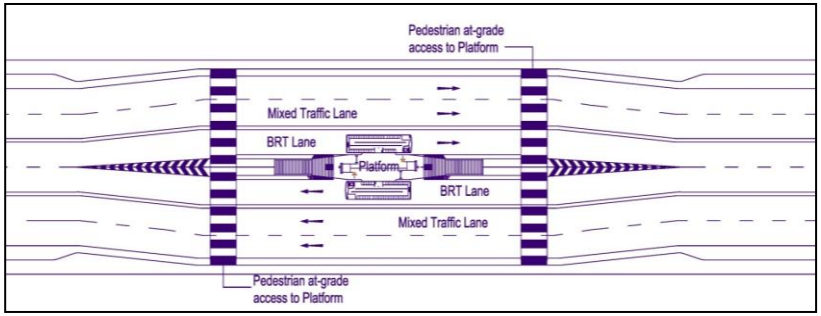


Figure 4-6: Schematic Diagram of Single Length Platform

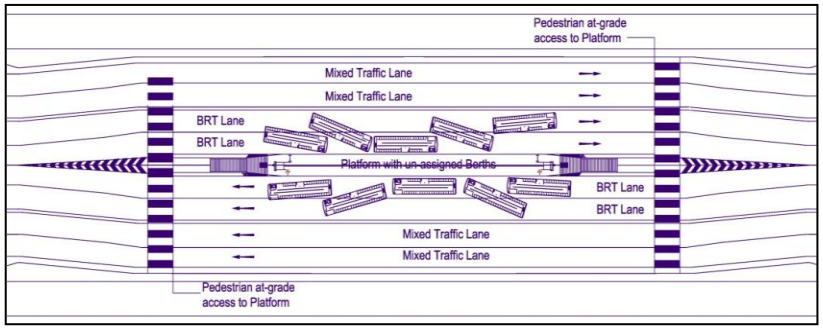


Figure 4-7: Schematic Diagram of Extended Platform with Unassigned Berths

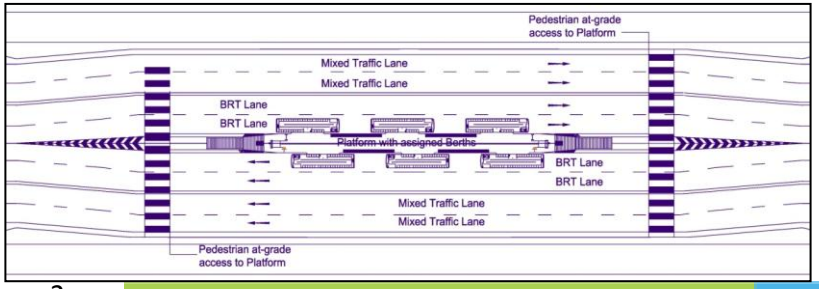


Figure 4-8: Schematic Diagram of Extended Platform with Assigned Berths

The size of the station platform required at a particular location is dependent on the number of passengers boarding and alighting there. The capacity of a single vehicle platform is --- passengers with a throughput of ---- buses per hour per direction. UMTC had earlier submitted a report on "Preparation of Elements of Operations Plan for the Bus Rapid Transit System for Pune City". As part of the study

Picture 4-12: Extended Bus Platform with assigned berths, Bogota

boarding alighting survey was conducted along all the BRT corridors. Based on the surveys, the number of platforms/ bays required at each location was estimated, which are given in Table 4-4 below.

Picture 4-13: Extended Bus Platform with unassigned berths, china

Table 4-4: Number of Platforms required along each Corridor

Corridor	Road	Number of Bays Required
Corridor 1	Nagar Road - Yerwada	3
	Sancheti Hospital to Yerwada	3
	JM Road	2
	Karve Road	2
Corridor 2	Paud Road	2
	Karve Road	2
	JM Road	2
	Sancheti to Bombay sappers	2
	Bombay Sappers to Vishrantwadi	2
Corridor 3	Sinhgad Road	3
	Sholapur Road	3
Corridor 4	Aundh Road	2
	Ganeshkhind	2
	Shivaji Road	5
	Satara Road	2

As can be seen from the table that at most of the stations the minimum of 2 bays are required at each station. Accordingly extended platforms with un-assigned berths are proposed for Pune BRTS. The number of bays proposed at each station are given in Annexure 4 and shown in Figure 4-9. A minimum width of 2.5 m has been proposed for the platform at the bus shelter / stop. At places where heavy boarding and alighting takes place the platform width has been widened to 3.5 m.

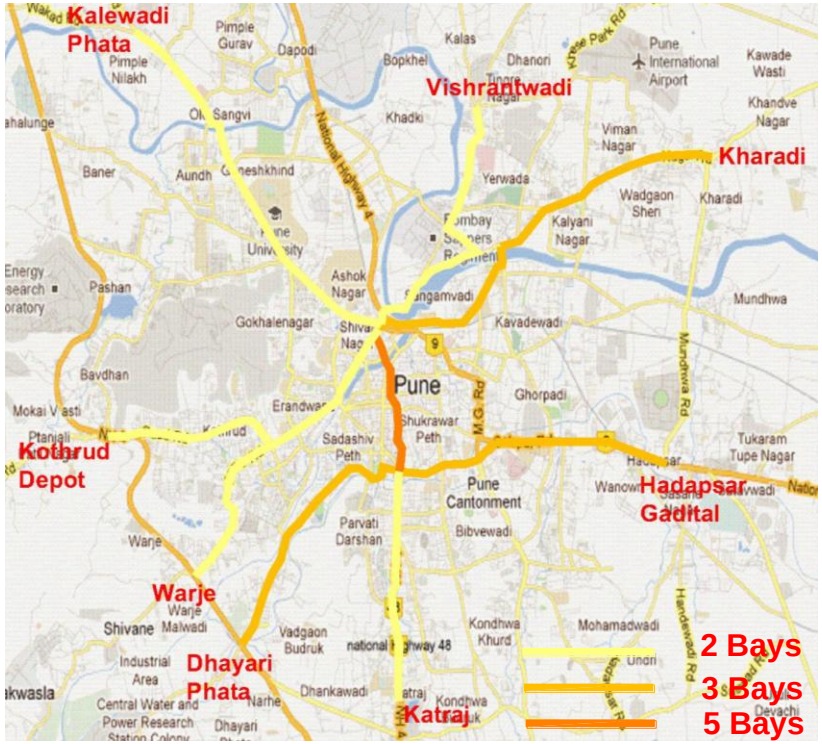


Figure 4-9: Number of Bays at Stations along BRT Corridors

4.1.4 Passing Capability

When service on a running way is so dense that vehicles operate in quick succession, the ability of vehicles to pass each other can maximize speed and reduce delay, especially at stations. Passing capability can be accommodated through a number of means including multiple lanes, passing lanes at stations or intersections, or ability to use adjacent lanes with mixed flow traffic.

The ability for BRT vehicles in service to pass one another at stations is important in two primary cases:

- In mixed flow operation, where frequency is high and travel times are highly variable
- In cases where multiple types of routes (local and express) operate along the same running way and serve uneven levels of demand

Picture 4-14: Station with no passing lane, Ahmadabad BRTS

The pros and cons of both are given in Table 4-5 below.

Table 4-5: Comparison between Passing Capacity at Stations

Passing lanes not provided at Stations	Passing Lanes provided at Stations
	Passing lanes at stations allow a vehicle in express services to pass through a station at full speed or a vehicle to overtake stopped.
Pros	
Very much suitable for corridors having RoW constraints	Improved travel time as buses can overtake at station
Minimum space requirement	No que formation
Reduce the risk of accidents/stampede as the vehicles have to dock one to one	In case of breakdown, the additional lanes available at stations could act as a refuge area.
Require less design and planning efforts	Express or Rapid BRT service can be provided as overtaking of buses is not possible
Less cost of pavement/running way construction	Direct BRT or Skipped Stop service can be provided as overtaking of buses is not possible
Additional road space for other modes if the traffic volume is very high on the corridor with enough RoW	Very much suitable for BRT corridors having enough RoW
Cons	
Increased travel time as buses have to wait for the bus in front to move on	Not suitable for corridors having RoW constraints
Que formation at stations if the frequency is very high	Additional space required at stations
In case of breakdown, the complete BRT operation can get stalled	More design and planning efforts
Repair work of pavement/running way is difficult and create the system stalled if the pavement is of concrete	No additional space for other modes if the RoW is not enough

Passing lanes not provided at Stations	Passing Lanes provided at Stations
Express or Rapid BRT service cannot be provided as overtaking of buses is not possible	High cost of additional pavement/running way construction
Direct BRT or Skipped Stop service cannot be provided as overtaking of buses is not possible	
Examples	
Ahmedabad Delhi Rajkot	Curitiba Bogota Beijing

Picture 4-15: Station with Passing Lane, Guangzhou BRTS

Picture 4-16: Station with Passing Lane, Bogota BRTS, Brazil (Latin America)

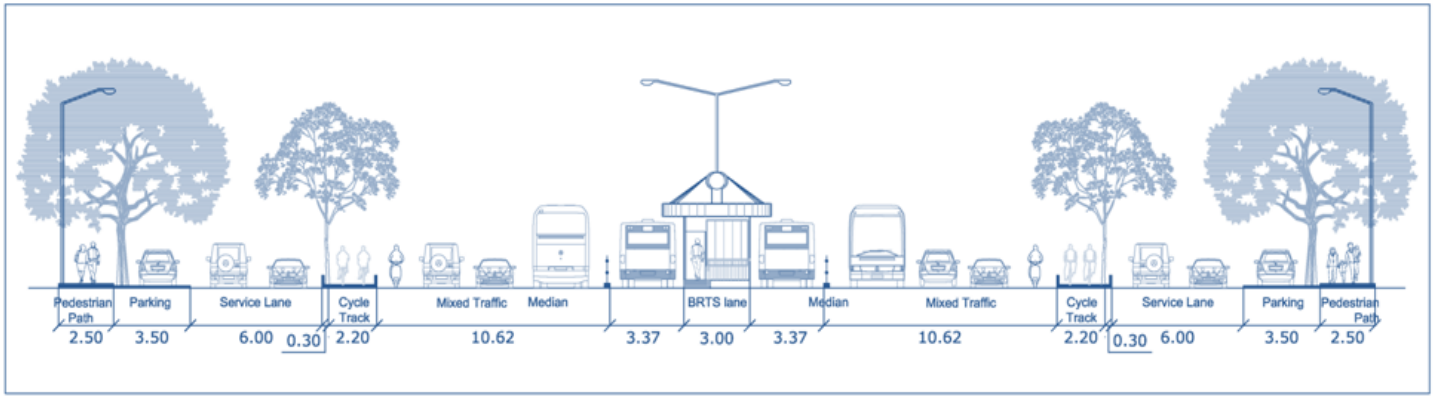


Figure 4-10: Schematic cross section showing BRTS Running way with No Passing Lane

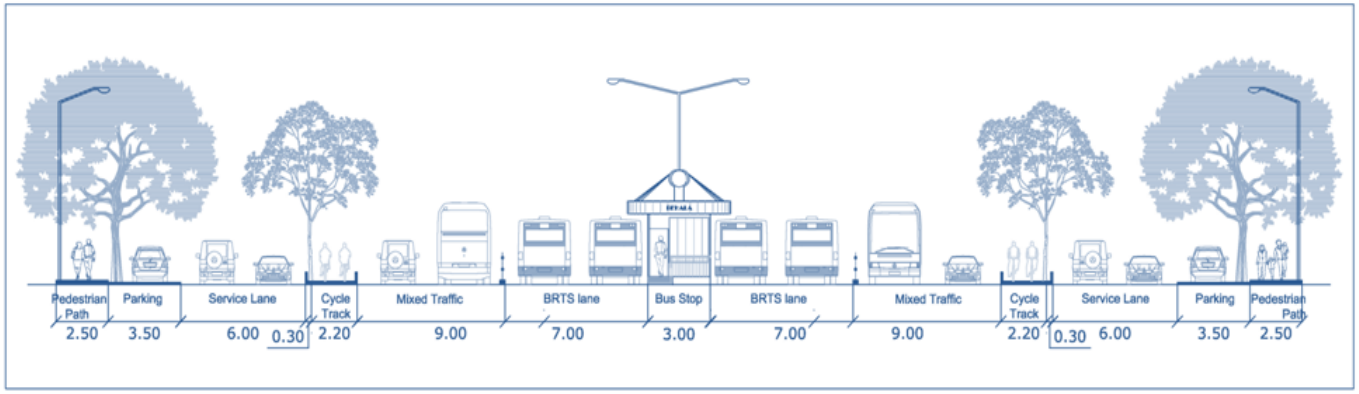


Figure 4-11: Schematic cross section showing BRTS Running way with Passing Lane

As evident from the table above that the provision of overtaking lane at stations is essential as it improves the overall travel time and also acts as a refuge in case of a breakdown. It is therefore proposed that overtaking lanes shall be provided at the stations along the dedicated sections of the BRTS corridors in Pune. Along the sections where BRT buses would be operating in mixed traffic condition, overtaking lanes are not required as demarcation of bus lane is by a painted yellow only.

4.1.5 Station Access

Station access describes how the BRT system is linked to surrounding communities and primarily focuses on pedestrian access to adjacent land uses and parking facilities. The provision of parking at the appropriate BRT stations can save overall travel time for customers arriving by automobile from outside the station area and can expand the reach of the system.

Transit systems require linkages to adjacent communities in order to draw passengers – either through pedestrian linkages to adjacent sites or connections through the roadway network to adjacent neighborhoods by automobile or non-motorized modes. Pedestrian linkages, such as sidewalks, overpasses and pedestrian

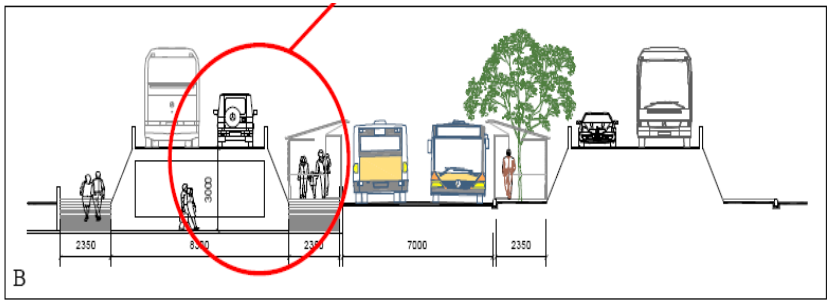
paths are important to establish physical connections from BRT stations to adjacent sites, buildings, and activity centers.

Park-and-ride lots allow stations, especially those without significant development, to attract passengers from a wide area around BRT stations. The BRT service can be linked with existing

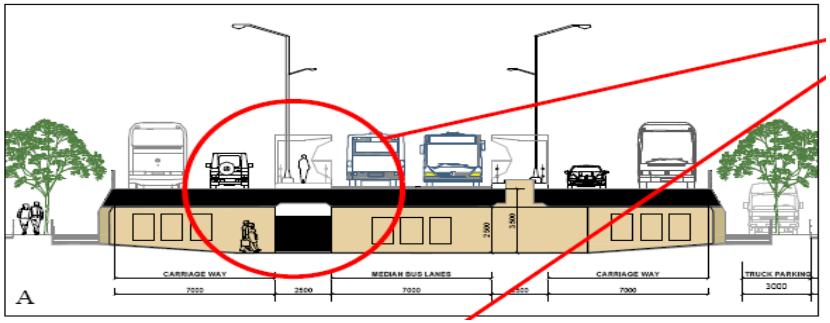
Picture 4-19: At Grade station access to BRT station, Ahmedabad BRTS

parking lots, potentially reducing capital investment costs.

For the Pune BRTS it is proposed to provide both pedestrian access facilities as well as linkages to park and ride facilities to improve the catchment area of BRTS and also to bring on maximum users to BRTS thereby facilitating a modal shift from personalized modes to public transport.



Picture 4-17: Motor Vehicle lane is elevated to create grade separated pedestrian crossing



Picture 4-18: Grade separated pedestrian crossing - subway

- **AT GRADE**

Picture 4-20: Grade Separated Pedestrian Crossing, Bogota BRTS Grade

Picture 4-21: separated Station and its access, BRTS, Xiamen, China

accessed through at grade zebra crossing.

- In signalized junction pedestrian phasing can be done for easy access to transit station

GRADE SEPARATED – Foot over Bridge

Grade separated crossings are necessary

- On long roads with **RoW** varying in between **40 M & 60 M**
- Having a very **high traffic volume**
-

- **GRADE SEPARATED- Under Pass**
  - Major drawbacks for this particular design
  - Steeper access ramps to the stops
  - Lack of natural lighting and ventilation.
  - Problems of drainage

4.2

Station Placement

Station location can be defined by the following 3 parameters:

- kerb side or median station type
- Far side or near side of the intersection
- Bus Stop Spacing
- Spacing from the intersection

4.2.1 Curb side or Median side

As discussed in the previous chapter, it is proposed to construct median bus lanes along the dedicated sections of the BRTS. Generally there can be two kinds of bus station in a median running way: median side/curb station and median center station. In a curb side station the platform is located on each side of the median. The advantages are that conventional right-side boarding may be used, but this will require two station/stop units and more available space. Median side platforms can be located far side, side by side, near side or midblock. A median station or stop is located in the median of a divided street or roadway, associated with a

Picture 4-22: Curb side station

Picture 4-23: Curb Side Station on Median Bus Lane, Cleveland Health Line

median running way or bus lanes. In many cases, the option for a median station may not exist.

In a median side station a center platform is located on the center island of the median running way. The advantages of this option are the ability to have shared passenger facilities serving both directions of service and reduced space needs and costs. The disadvantages of this configuration are that it is necessary to have vehicles with left-side doors, and it also may complicate left turns for automobiles across the running way.

The characteristics of median curb side stations and median center stations are different as per the various parameters. Table 4-6 given below shows the comparison in the same:

Table 4-6: Comparison between a Median side and Kerb Side Station

Curb Side BRT Station	Median side BRT Station
Capacity	
Without overtaking lane – 8,000 to 14,000 passengers/hr/direction	Without overtaking lane – 19,200 to 24,000 passengers/hr/direction
With overtaking lane – 24,000 passengers/hr/direction	With overtaking lane – 38,000 passengers/hr/direction
Pros	
One of the major advantages of the Median Kerb Side BRT Station is that it has more accessibility for neighborhood access as the station is on the side of the running ways.	One of the major advantages of the Median Center BRT station is that it is very cost effective. It requires less cost to construct the structure as the both way's boarding and alighting take place at same station.
The technical specifications of the buses have not to be changed as the boarding and alighting is on same side (left side)	Fewer infrastructures are required as only one shelter has to be made and less pedestrian facilities have to be provided.
Enables straight flow without bulging for the bus lanes and mixed traffic lanes. The same bus could be used for on and off the main exclusive corridor	Overtaking at bus stops by provision of skipped stop service/direct service is possible with the median bus stop configuration.
Requires less amount of pedestrian infrastructure and less cost for it	Visibility obstructions to the driver is not there as the side of the both (driving and mirror) are same

Can be integrated very easily with sidewalks and buildings	Requires a little space (RoW) as only one station has to be built
Space for revenue generation (advertisements) is more than the median center BRT stations	The operation cost is less in case of median center BRT stations
With it, it is possible to use a standard bus stop and to share the facility with traditional bus services.	Requires less no. of utilities, man power and other services
	Such stops maximize speed by minimizing car conflicts and make transit signal priority (TSP) easier because of unique signals and signal phasing
	They do not create a visual obstruction for businesses and avoid having passengers waiting in front of nearby storefronts, which can be a concern for local businesses
Cons	
One of the major disadvantages of the Median Kerb side BRT station is that it is not cost effective. It requires more cost to construct the structures at both the sides as the both way's boarding and alighting take place at different stations.	One of the major disadvantages of the Median Side Center BRT Station is that it has less accessibility for neighborhood access as the station is on the center side of the running ways.
More infrastructures are required as only two separate shelters have to be made and more pedestrian facilities have to be provided.	The technical specifications of the buses have to be changed by providing doors on both the sides of the bus.
Overtaking at bus stops by provision of skipped stop service/direct service is possible with the median bus stop configuration	Does not enable straight flow without bulging for the bus lanes and mixed traffic lanes. The same bus could be used for on and off the main exclusive corridor.
Requires a little more space (RoW) as two stations on both the sides have to be built	Free transfers in pre-payment are easier as both the ways are on the same station
Visibility obstructions to the driver is there as the side of the both (driving and mirror) are not same	Requires high amount of pedestrian infrastructure and high cost for it
Free transfers in pre-payment are not easier as both the ways are on different stations	Integrated with sidewalks and buildings may have some problems

The operation cost is less in case of median center BRT stations	Space for revenue generation (advertisements) is very less.
Requires less no. of utilities, man power and other services	
Potentially create conflicts with right-turning vehicles, parked cars, bicycles etc.	In addition, median space may be limited, and the station may be more difficult to maintain
In commercial areas, it may be difficult to distinguish station/stop signs from other signage	
In cases where level boarding is desired, there may be grade issues, because the typical platform height (14 inches) is higher than the standard curb height (6 inches).	such stations require all passengers to cross some street traffic at every stop, and they increase the travel time for pedestrians if the crosswalk is lengthened
Examples	
Changzou Kunming	Ahmedabad Delhi Bogota

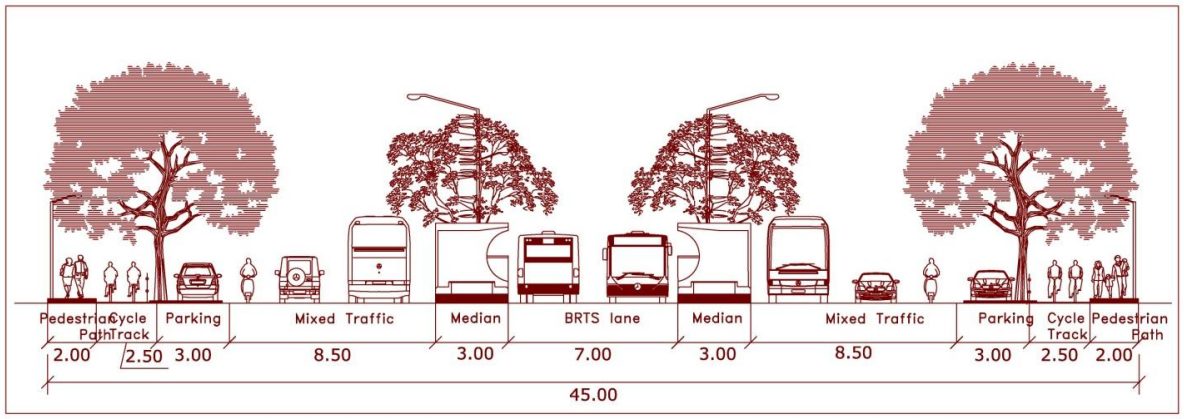


Figure 4-12: Schematic cross section showing Center BRTS with Kerb side Station

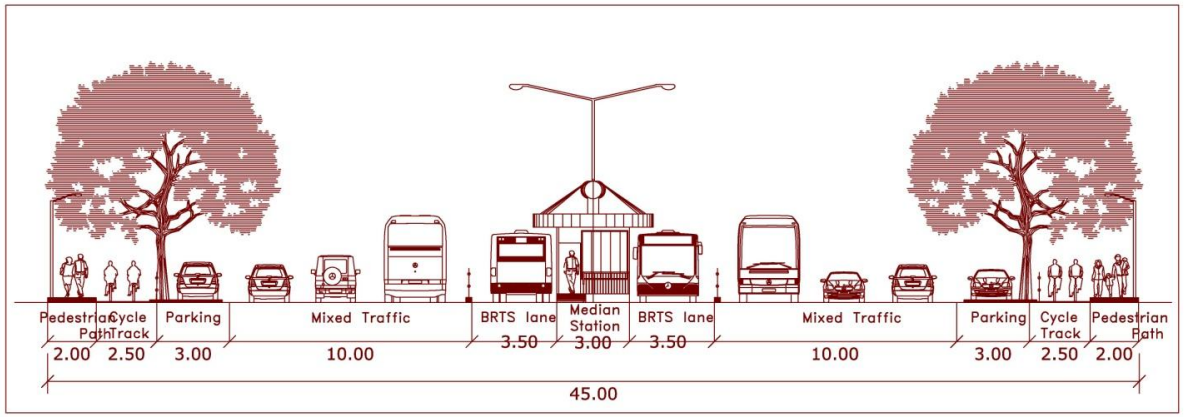


Figure 4-13: Schematic cross section showing Center BRTS with Median Station

As given above, median station reduces the space need and the cost and at the same time provides better interchange facilities. Therefore median stations are proposed along the dedicated sections of the BRT corridor. Along the mixed sections of the corridor, since the buses are proposed to operate along the curb side, due to constraints in RoW, curb side stations are proposed on the footpath.

Picture 4-24: Median side station with median side platform, BRTS Bogota

There would be a total of 133 stations (including Pilot BRTS) that includes 93 median stations and 39 stations located on curb side. The number of locations where bus stations which would be constructed as median stations and as curb stations along the proposed corridors is as follows:

- **Corridor 1** – total 43 stations of which 29 locations the stations would be on median side and 14 locations the stations would be curb side.
- **Corridor 2** – total 33 stations of which 26 locations the stations would be on median side and 7 locations the

stations would be curb side. This includes 6 median side stations and 4 curb side stations on Corridor 1.

- **Corridor 3** – total 32 stations of which 24 locations the stations would be on median side and 8 locations the stations would be curb side.
- **Corridor 4** – total 35 stations of which 21 locations the stations would be on median side and 14 locations the stations would be curb side.

The detailed list of stations along each of the corridors is given in Annexure 4

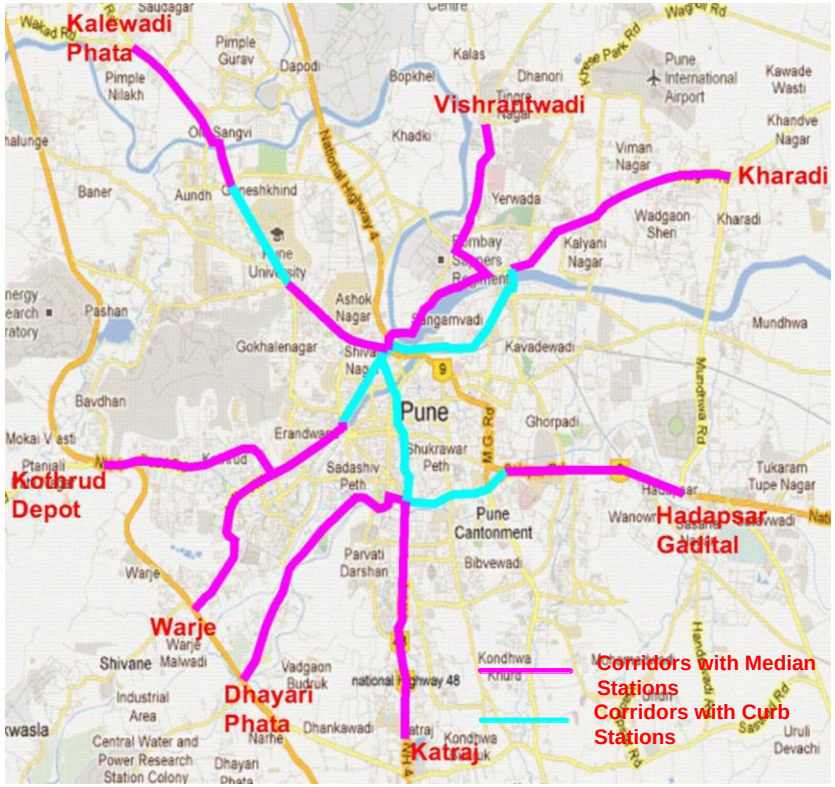
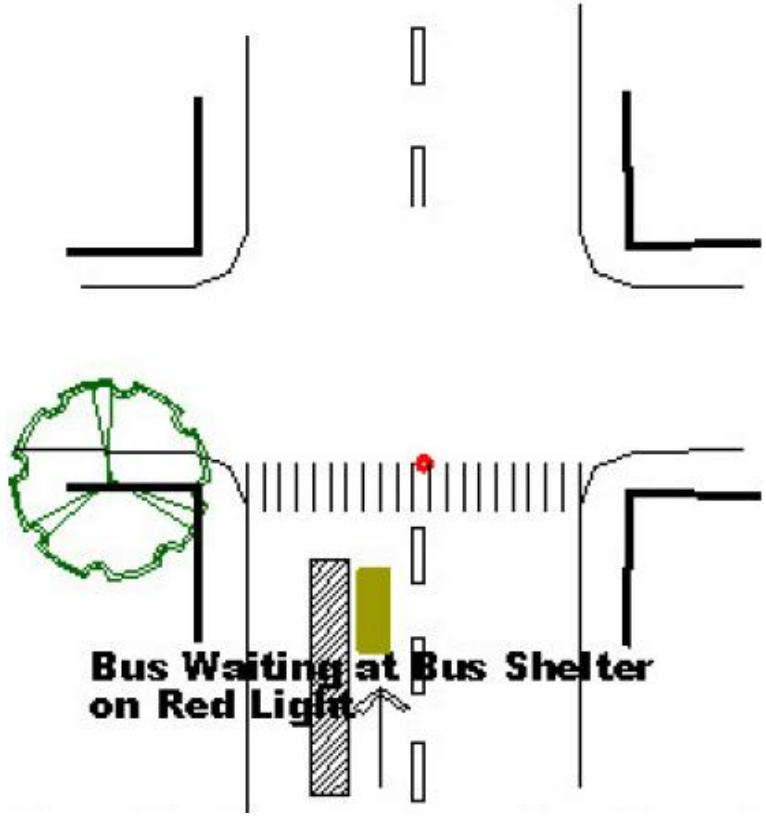


Figure 4-14: Location of Curb Side and Median Side Stations along BRT Corridors

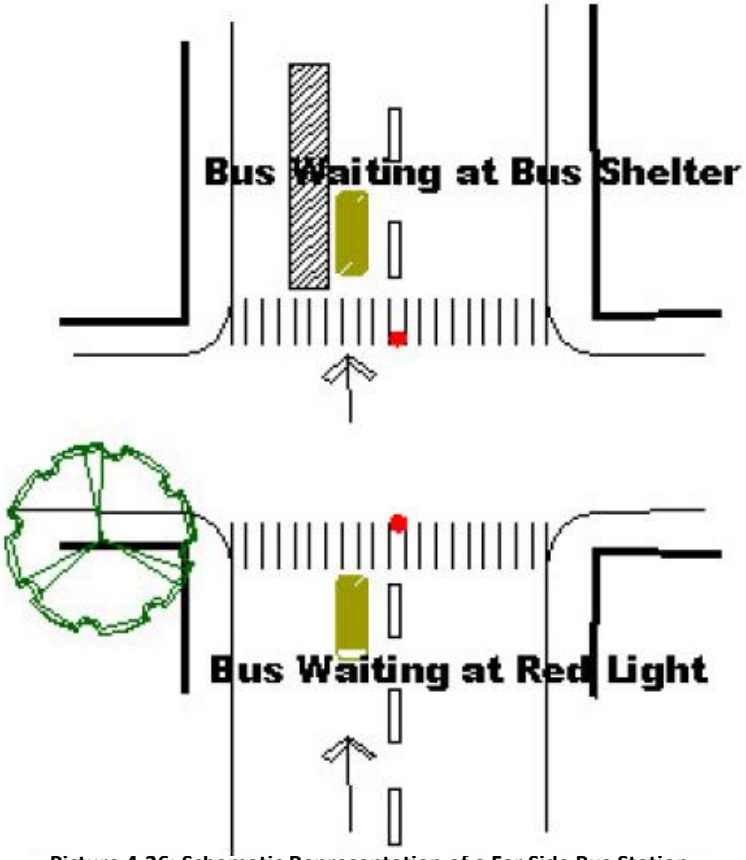
Picture 4-25: Median side station, Ahmedabad BRTS

4.2.2 Far side or near side of the intersection

Determining the proper location of bus stops involves choosing among far-side, near-side, and midblock stops. The following factors should be considered when selecting the type of bus stop:



Picture 4-27: Schematic Representation of a Near Side Bus Station

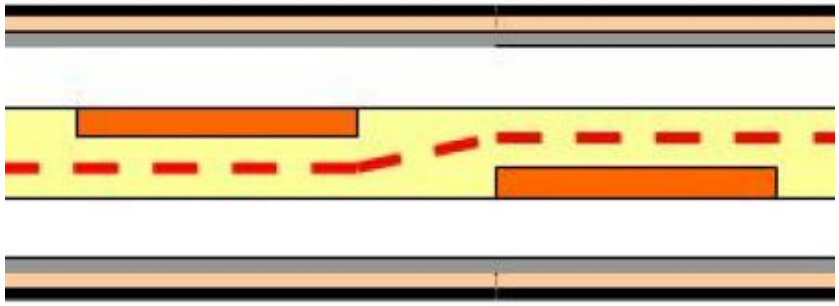


Picture 4-26: Schematic Representation of a Far Side Bus Station

- Adjacent land use and activities
- Bus route (for example, is bus turning at the intersection)
- Bus signal priority (e.g., extended green suggests far side placement)
- Impact on intersection operations

- Intersecting transit routes
- Intersection geometry
- Parking restrictions and requirement
- Passenger origins and destinations
- Pedestrian access, including accessibility for handicap/wheelchair patrons
- Physical roadside constraints (trees, poles, driveways, etc.)
- Potential patronage
- Presence of bus bypass lane
- Traffic control device

The pros and cons of each type of bus station are given in Table 4-7 below:



Picture 4-28: Schematic representation of Mid Block bus Shelters

Table 4-7: Comparison between Far Side, Near Side and Mid Block Station Location

Near Side of Intersection	Far Side of Intersection	Mid Block Bus Stops
Bus stop is located immediately prior to an intersection	Bus stop is located immediately after passing through an intersection	Bus stop is located within the block in between the intersections
Pros		
Minimizes interference when traffic is heavy on the far side of the intersection	Minimizes conflict between right turning vehicles and buses	Minimizes sight distance problems for vehicles and pedestrians
Allow passengers to access buses closest to crosswalks	Provides additional right turning capacity by making curb lane available for traffic	May result in passenger waiting areas experiencing less pedestrian congestion

Near Side of Intersection	Far Side of Intersection	Mid Block Bus Stops
Buses have to stop only once	Minimizes sight distance problems on approaches to intersection	Get more space for other modes/mixed traffic at intersection
Allows passengers to board and alight while bus is stopped at the red light	Pedestrians cross behind the buses	May create more spaces for additional activities such as parking, recreation etc
The operation plan and bus movement can be integrated with the signal synchronization (red and green lights)	Creates shorter deceleration distance for buses since the buses can use the intersection to decelerate.	May create closer/equal accessibility to nearby residential areas
May create easy and convenient accessibility to nearby commercial and shopping areas	Bus driver can take advantage of the gaps in the traffic flow that are created at signalized intersections	May create easy integration of above grade facilities to the nearby areas
For curbside stations, the near-side position can be used where the BRT route makes a right turn and provides an opportunity for a queue-jump lane	Improved travel time if signal priority is available, easier ability to implement bus bulbs, and facilitation of right turns by other vehicles	Both arrival and departure at the platform are independent of traffic signal timing, for curbside stations, the possibilities are better for exclusive use of the lane at the platform
Cons		
Increases conflict with right turning traffic	May result in intersections being blocked in peak periods by stopping buses	May result in jay walking
May result in stopped buses obscuring curb side traffic control devices and crossing pedestrians	May obscure sight distance for crossing vehicles	Increased walking distance if the residential areas are far away
May cause sight distance to be obscured for cross vehicles stopped to the right of the buses	May increase sight distance problem for crossing pedestrians	Fewer lanes to cross to reach to the BRT station
Increases sight distance problem for crossing pedestrians	May increase the travel time of the bus as it would have to stop twice- once for red light at intersection and then at bus stop	May not create easy and convenient accessibility to nearby commercial and shopping areas

Near Side of Intersection	Far Side of Intersection	Mid Block Bus Stops
Risky/unwanted behavior of pedestrian to access the bus station	Risky behavior of pedestrian to access the bus station	For safety of the pedestrians, a synchronized signal has to be provided
Pedestrian has to get across MV traffic of multiple directions in unsafe conditions	Pedestrian has to get across MV traffic of multiple directions in unsafe conditions	Maximizes interference when traffic is heavy on the far side of the intersection
Fewer lanes for MV traffic at junction results in longer cycle time and lower junction capacity	Fewer lanes for MV traffic at junction results in longer cycle time and lower junction capacity	Buses have to stop for at least two times if junction is next to it (at bus stops and at signal light)
Many buses cannot utilize GREEN signal since earlier bus blocks the bus bay because it is waiting at the RED signal	Many buses cannot utilize GREEN signal since earlier bus blocks the bus bay because it is waiting at the RED signal	Frequent stopping of buses (as in above) may create delay in travel time
Results in Long queues and bunching of buses and slows down the BRT system	Results in Long queues and bunching of buses and slows down the BRT system	Bulging at mid block due to the width of the bus station may create bottle neck to mixed traffic
passengers may be inclined to jaywalk, especially where they alight at the rear of the bus; and the near-side stop is set back from the intersection	They could require buses to stop twice at an intersection — once for a red signal and a second time to load and unload riders	Mid-block stations apply in unique situations, such as a large trip generator located midblock
they minimize the benefits or use of transit signal priority; that their platforms may conflict with right-turn lanes, especially where the bus stops at a green light (cars may try to pass the bus on the left)	with high-frequency BRT service, the stop may have to be moved two or more vehicle lengths beyond the intersection in order to accommodate multiple vehicles	If there is a midblock station, consideration should be given to providing a designated crosswalk to enable passengers to access the station
Examples		
Changzou	Kunming	Kunming

Picture 4-30: Near side BRT bus Station, BRTS Changzhou, China

Picture 4-29: Far side BRT bus Station, BRTS Zhengzhou, China

Picture 4-31: Mid Block BRT bus Station, Bogota, Colombia

It is evident from the table given above that all three type of placement options have their pros and cons, however the location of bus stations is dependent on lot of factors as given earlier. Considering these factors only the location of the bus stations was finalized and the list of the bus stations is given in Annexure 4. Since in case of Pune a Median side station is proposed along the dedicated corridors, in one direction the station would be located on the Near side and on the other it would be on the Far side. In addition 57 mid block bus stops would be located, wherever there is demand for the same. The list of bus stations to be located at mid block and at intersection (Far/ Near side) is given in Annexure 4.

Picture 4-32: Mid Block BRT Bus Station, Quito, Equador, South America

For the mixed sections of the BRT corridors, the stations are proposed to be constructed on near side, as the far side station may result in additional travel time. However if there are space constraints at any particular location, far side stations would be constructed.

4.2.3 Bus Stop Spacing

The spacing of bus stops is an optimizing issue that attempts to balance the needs of passengers and operators. The objective for passengers is to minimize the sum of their accessibility, while for agencies the focus is on revenues, operational costs, service reliability, and passenger satisfaction. Having fewer stops along a bus route benefits passengers not only by reducing the time it takes for them to make their trip, but by making the service more reliable and predictable. Therefore, appropriate spacing between bus stops along a route can have positive impacts on passenger experience, quality of service, and operational effectiveness and efficiency.

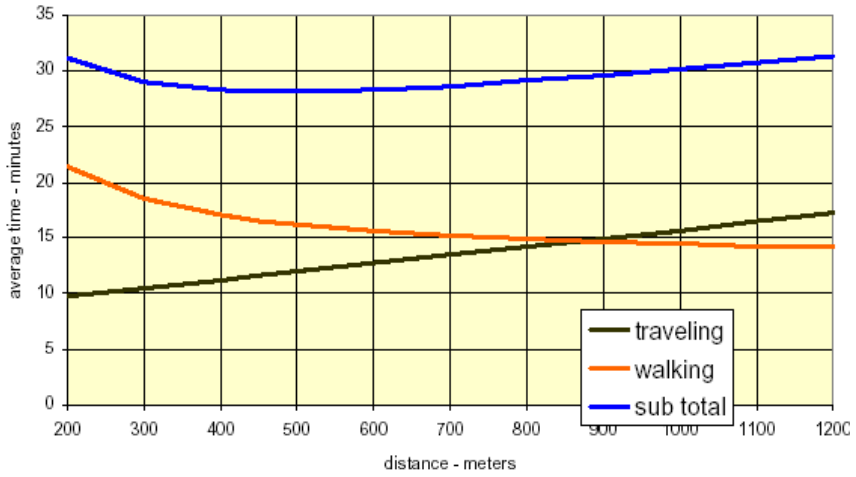


Figure 4-15: Travel time w.r.t. to spacing of Stations

A greater distance between bus stops presents a reduced number of potential occurrences of deceleration/acceleration, and therefore has the possibility to reduce the overall operating time of the route enough to provide customers with a more rapid and consistent ride. If time savings are significant (for example, an overall time savings of at least five minutes per trip), the transit system may be able to reduce the number of buses out on the road needed to meet headway guidelines. The downside to having a greater distance between bus stops is that some customers will be required to walk further to the nearest stop, and may find this inconvenience enough of a deterrent to choose transit, or even a hardship that prevents them from being able to ride (because of mobility limitations).

Station spacing for BRT systems are typically farther apart relative to standard bus services. Spacing stations farther apart concentrates passengers at stations, allowing vehicles to stop and encounter delays at fewer locations along a route. Longer stretch between stations allows vehicles to sustain higher speeds between stations. These factors lead to overall higher travel speeds. These higher speeds help to compensate for the increased amount of time required to walk, take transit, or drive to stations.

Table 4-8 below gives the impact of spacing of stations on the overall journey speed along the dedicated BRT corridors.

Table 4-8: Impact of Station Spacing on journey Speed

Station Spacing (km)	Stops per kilometer	Speed (kmph)	
		20 second dwell time	30 second dwell time
0.5	2.0	29	26
0.75	1.3	40	35
1.5	0.7	55	50
2.5	0.4	68	61
3	0.3	71	64

Bus Stop Spacing depends on the following factors:

- Density of Passenger demands
- Locations of large traffic generators
- Road Geometrics
- Level of Service

The above table reveals that the travel speeds of BRT lanes increase by 30% to 40% when the station spacing is increased by about 50%. However higher spacing may adversely impact the patronage on to the system as it would increase the access time. Figure4-15 shows that the average travel time is minimum for the passengers, when the bus stops are spaced 400 - 600m. Higher station spacing's are therefore best suited for suburban areas where

the intensity of development of low. Based on the distance between the bus stations distance, the bus stations can be categorized into the following:

- Closer Stops
- Far Stops

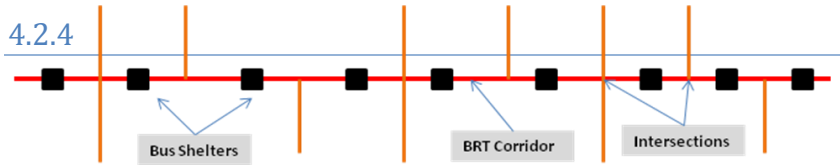
Some characteristics of Closer Stops and Far Stops are given in Table 4-9 below:

Table 4-9: Comparison between a Far Stop and Closer Stop

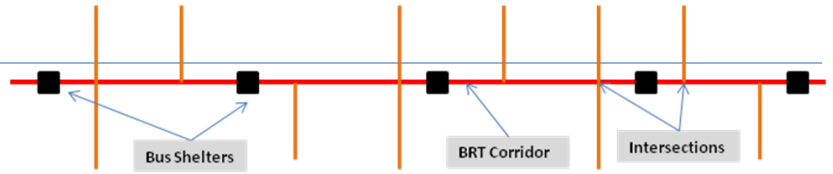
Closer Stops	Far Stops
Pros	
One of the main advantages of the closer stops is that the coverage of the BRT system is more on the corridors	Good efficiency in vehicle performance as no frequent acceleration and deceleration
The walking distance is very short for travelers/commuters	Very much suitable for corridor having long trips
May create good integration in trunk (BRT) and feeder (mini buses/para-transit) services at stops	Less overall journey time as no delay in frequent stopping and delay in boarding and alighting on the corridor
Very much suitable for corridors having short length of trips and frequent travelers/commuters	Good average travel speed as less no. of no. of stops between the major nodes/terminals
	The system with far stops/station is cost effective as the cost is low due to less no. of stops on the corridors
Cons	
Frequent acceleration and deceleration of vehicles create inefficiency in performance	The main disadvantages of the closer stops is that the coverage of the BRT system is less on the corridors
Frequent stopping and delay in boarding and alighting create delay in overall journey time	The walking distance is very long for travelers/commuters
the average travel speed is less due to more no. of stops between the major nodes/terminals	May not create good integration in trunk (BRT) and feeder (mini buses/para-transit) services at stops

Closer Stops	Far Stops
Not suitable for corridors/routes having long trips and destinations	Not suitable for corridors having short length of trips and frequent travelers/commuters
The system with closer stops/station is not cost effective as the cost is high due to more no. of stops on the corridors	

4.2.4



Picture 4-34: BRT corridor with closer bus shelters (bus stops)



Picture 4-33: BRT corridor with far bus shelters (bus stops)

The stop/station spacing range as per the different types of areas in a city for a transit system is given below in Table 4-10:

Table 4-10: Average spacing of bus stops

Type of Area	Stop Spacing in Meters
CBD	300-900
Urban Area	500-1000
Sub-Urban Area	600-1200
Rural Area	1000-2500

Source: TCRP, Vol-1, 2003

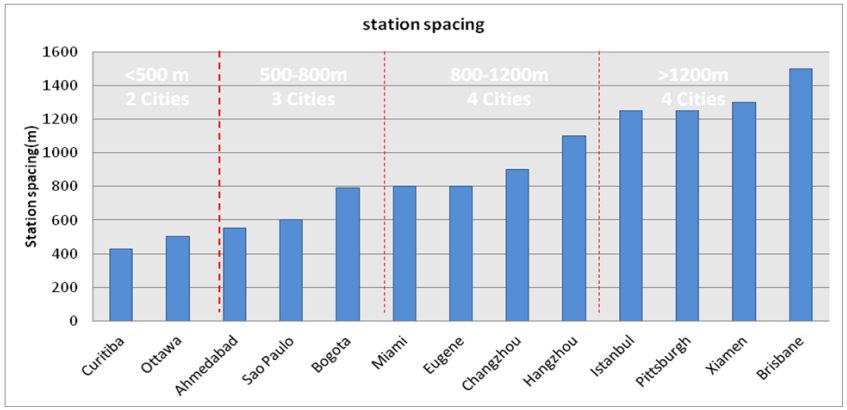


Figure 4-16: The Average Spacing between bus stops in different cities

In case of Pune, since the proposed BRT corridors are within the city limits and pass through densely populated areas, having a spacing of more than 750m may not be feasible. It is therefore proposed to setup BRT stations at a distance of 500m at an average along both the dedicated and mixed sections of the 4 corridors. However due to ROW constraints, boarding & alighting volume and also consideration for important trip generators the spacing may

vary from 350 m to 700 m. The average spacing between stations along BRT corridors is given in Table 4-11 below.

Table 4-11: Average spacing of Stations along BRT Corridors

Road	Length (km)	Number of Stations	Average Spacing of Stations (km)
Corridor 1			
Nagar Road - Yerwada	7.86	14	0.56
Sancheti Hospital to Yerwada	5.23	10	0.52
JM Road	2.67	4	0.67
Karve Road	6.24	15	0.42
Corridor 2			
Paud Road	4.04	9	0.45
Karve Road	2.1	6	0.35
JM Road	2.67	4	0.67
Sancheti to Bombay sappers	4.3	7	0.61
Bombay Sappers to Vishrantwadi	3.9	7	0.56
Corridor 3			
Sinhgad Road	6.7	15	0.45
Sholapur Road	11.38	17	0.67
Corridor 4			
Aundh Road	5	8	0.63
Ganeshkhind	2.96	8	0.37
Shivaji Road	3.7	8	0.46
Satara Road	5.82	12	0.49

4.2.5 Spacing of the Station from the Intersection

Depending on the expected frequency of the BRT buses on a corridor the requirement of the setback distance is warranted to accommodate the waiting BRT Buses which have finished the boarding and alighting of bus passengers at the bus stops and to provide the space for the boarding and alighting of bus passengers for the next expected BRT bus.

Therefore the decision of setback will be dependent on;

- Frequency of buses on the corridor
- Red signal time at junction
- Boarding/Alighting Time
- No. of Bus Shelters at the Bus stops

Following illustration from Fig. 4-17 to 4-20 describes the design guidelines for deciding the number of Bus shelters required at the proposed bus stops and the requirement of providing setback distance of the bus stop from the STOP line at the traffic signal.

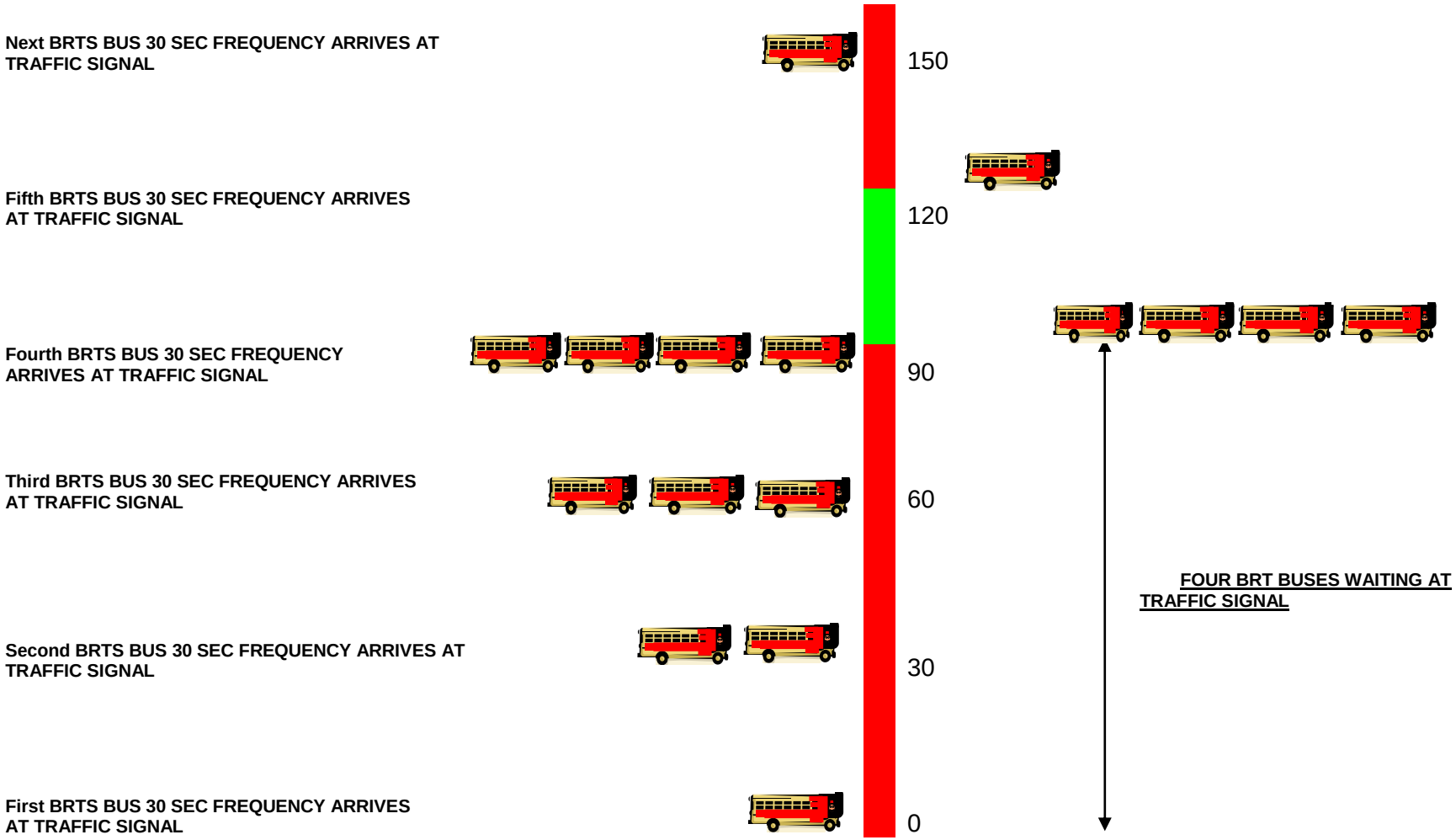


Figure 4-17: Schematic Diagram of Bus Queuing at Signal

Case 1

- 30 seconds bus frequency with two Bus-stops
- 80 sec green time : Cycle Time 150 sec

As could be seen from the illustration, with a bus frequency of as high as 30 sec with boarding/alighting of passengers at 25 sec (maximum) and cycle time of traffic signal as 120 to 150 seconds for a smooth operations of buses, four number of bus shelters would

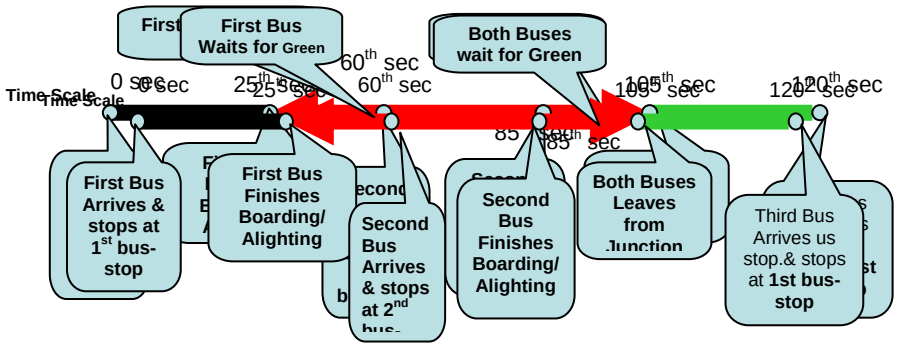


Figure 4-19: 30 second Bus Frequency

Case 2

- 1 minute bus frequency with Two Bus-stops
- 80 sec green time : Cycle Time 150 sec
- 25 sec boarding/alighting time

- 25 sec boarding/alighting time

be essential and a setback distance of 50 metres from the intersection would be provided to safeguard the overlapping of queued up buses over the bus stop.

Figure 4-18: 1 Minute Bus Frequency

From the above illustration it is clear that first bus do not interfere with the operations of second bus due to availability of **second bus-stop. If we provide only one bus-stop in above case,** second bus will have to wait from 60th sec to 105th sec to enter into bus-stop which warrants either setback of one bus space or second bus-stop.

Case 3

- 2 minutes bus frequency with two Bus Stops
- 80 sec Red time : Cycle Time 150 sec
- 25 sec boarding/alighting time

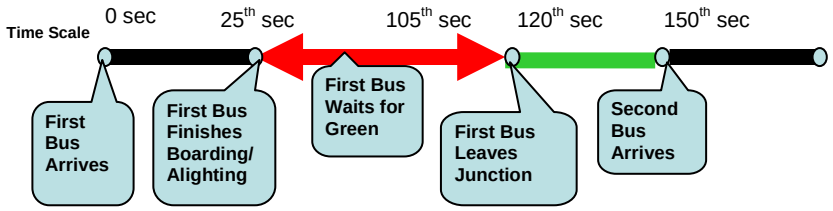


Figure 4-20: 2 minutes bus frequency

Similarly with a bus frequency of as low as 120 sec with boarding/alighting of passengers at 25 sec (maximum) and cycle time of traffic signal as 120 to 150 seconds for a smooth operations of buses, one number of bus shelters would be sufficient, but it is recommended to provide at least two bus shelters with no setback distance from the intersection as there would be no waiting bus to safeguard the overlapping of queued up buses over the bus stop. Due to some other design requirements like providing right turning pocket lanes or keeping the safe turning radii at the intersection it would be preferred to keep a minimum set back distance of 12.5 m as far as possible and as long as possible within the geometric constraints.

Table 4-12 presents the summarized recommendations regarding the required number of bus shelters and the setback distances preferred for various bus frequencies.

Table 4-12: recommendation regarding required number of shelters and setback distance

Bus Frequency	Boarding/ Alighting Time (Maximum)	Signal Cycle Time (Second)	Required Numbers of Bus Shelters	Setback distance (m)
30 sec	25 sec	60-120-180	Four	50.0
60 sec	25 sec	60-120-180	Three	37.5
90 sec	25 sec	60-120-180	Two	25.0
120 sec	25 sec	60-120-180	Two	12.5

4.3 Conclusion

Based on the recommendations in the previous sections,

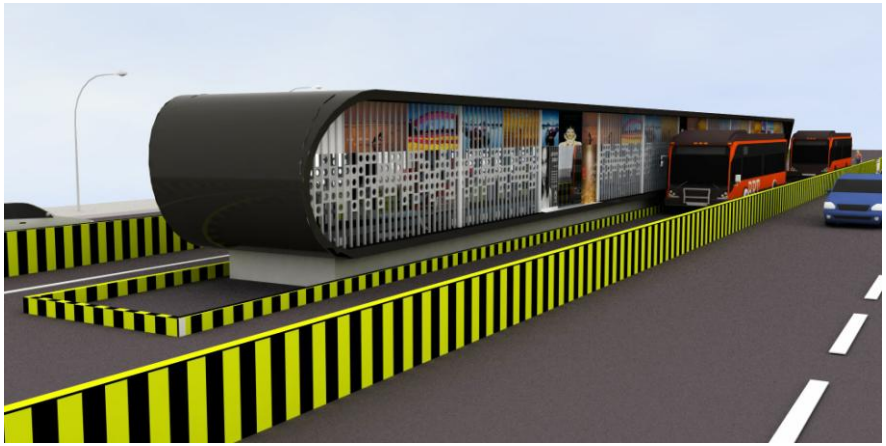
the following is recommended for Pune:

Table 4-13: Recommendation for Station Design in Pune

`	Item	Recommendation
1	Total number of stations	
2	Station Type	Designated Stations along the dedicated sections and Enhanced Stations along the mixed sections of BRT Corridors • Designated Stations - • Enhanced Stations -
3	Platform Height	Level platform along the dedicated sections and Standard Curb Platform along the mixed sections of BRT Corridors • Level Platforms – • Standard Curb Platform -
4	Platform Layout	extended platforms with un-assigned berths are proposed for Pune BRTS
5	Number of berths at each Stations	
6.	Passing Capability	Overtaking lanes shall be provided at the stations along the dedicated sections of the corridors.
7	Station Access	Both pedestrian access facilities as well as linkages to park an ride facilities
8	kerb side or median station type	Median stations along the dedicated sections of the BRT corridor and curb side along the mixed sections of the corridor.
9	Far side or near side of the intersection	In one direction the station would be located on the Near side and on the other it would be on the Far side. In addition mid block bus stops would be located, wherever there is demand for the same.

`	Item	Recommendation
10	Bus Stop Spacing	500 to 750m along both the dedicated and mixed section

Accordingly the proposed station design is given in Figure---



Picture 4-36: Proposed Median Station for Pune BRTS

Picture 4-35: Proposed Curb Side Stations for Pune BRTS

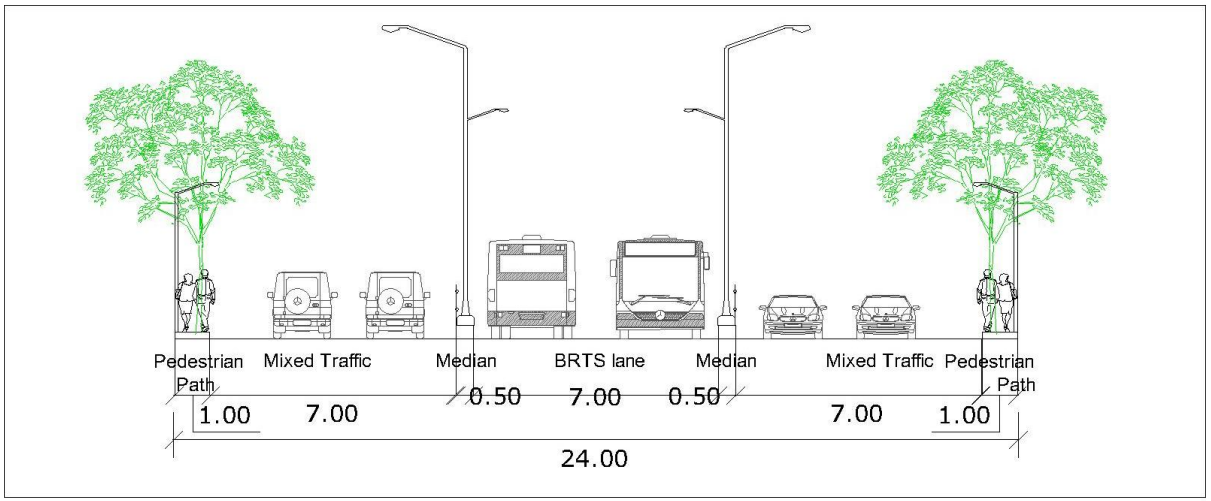


Figure 4-21: Typical Cross Section of a 24m RoW

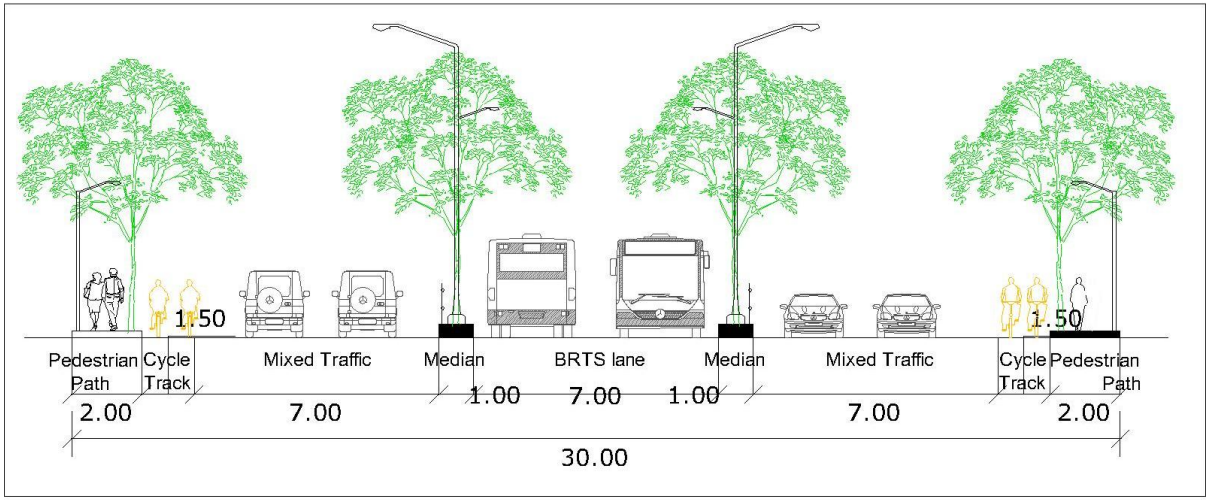


Figure 4-22: Typical Cross Section of a 30m RoW

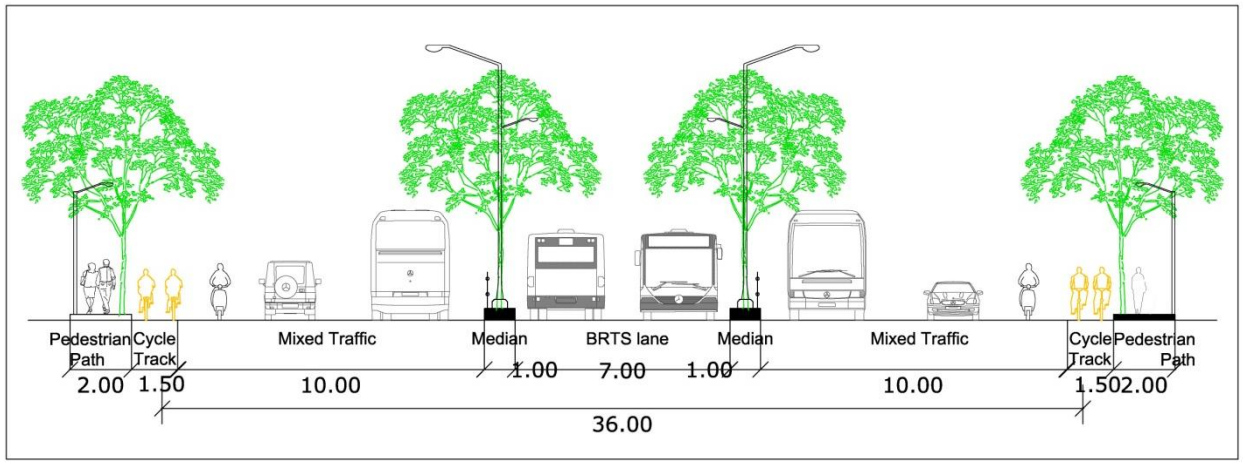


Figure 4-23: Typical Cross Section of a 36m RoW

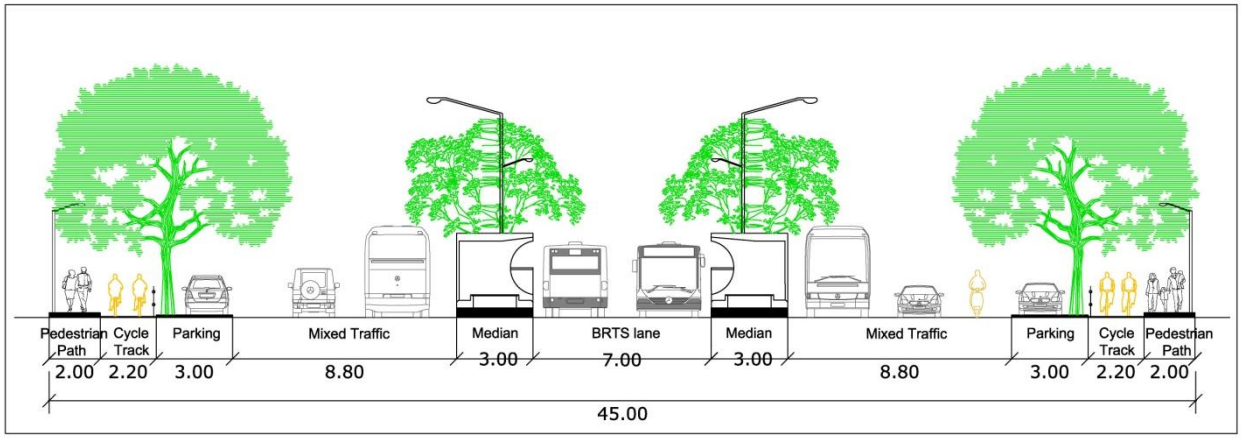


Figure 4-24: Typical Cross Section of a 45m RoW

5 Pedestrian Facilities

Walking is an important mode of transport. In urban areas, a significant proportion of trips up to 1 to 2 km in length is performed on foot. Moreover, every journey necessarily starts and ends as a walk trip. Since pedestrians are more vulnerable to being involved in accidents, it is imperative that adequate consideration should be given to their safety through provision of facilities like guard-rails, secured crossing areas, footpaths, and grade separations.

The construction of BRT corridors provides an opportunity to build improved pedestrian footways and bicycle paths to link with trunk line stations and feeder line bus stops as part of a larger approach toward “livable cities.” Indeed, BRT systems are best viewed as part of a package of reforms promoting sustainable urban environments.

Requirements of pedestrian facilities have been covered partially in some of the earlier IRC Standards, for instance IRC : 70-1977 'Guidelines on Regulation and Control of Mixed Traffic in Urban Areas' and IRC : 86-1983 'Geometric Design Standards for Urban Roads in Plains'.

The basic aim should be to reduce pedestrian conflicts with vehicular traffic to the minimum. Efforts should be made to create such conditions that pedestrians are not forced to walk in unsafe circumstances, and that the motorists respect the position of pedestrians.

Picture 5-1: Continuous footpath and grade separated access to BRT shelter, BRTS, Guangzhou, China

Picture 5-4: Continuous footpath and grade separated access to BRT shelter, BRTS, Guangzhou, China

Picture 5-2: Continuous footpath and grade separated access to BRT shelter, BRTS, Beijing, China

Picture 5-3: Grade separated access to BRT shelter, BRTS, Brisbane

The types of pedestrian facilities that are required to be provided along a BRT corridor are:

- Continuous Footpaths
- Refuge Island
- Crossing Facilities – at grade and grade separated.

For assessing the safety of pedestrians walking along and across various roads in Pune City and especially with the introduction of BRT reserved lanes, where the pedestrians will be faced to cross the multi lane roads, it becomes utmost essential to work out certain standards warranting grade separated facilities for

the safe crossing of roads by Pedestrians. Efforts have been made to provide and retain the existing footpaths all along the BRT corridors.

5.1 Footpath (Side-Walk)

In order to be effective, the side-walks have been provided on both sides of the road and above the level of the carriageway separated by non-mountable kerbs. The width of side-walks depends upon the pedestrian flows and has been fixed with the help of guidelines given in Table 5-1 below, subject to a minimum width of 1.5m.

Table 5-1: Proposed width of the side walks

Width of Side walk(m)	Capacity in number of persons per hour	
	In one Direction	In both directions
1.5	1200	800
2	2400	1600
2.5	3600	2400
3	4800	3200

For side-walks in shopping areas, the width, if possible, is increased by 1 m which is treated as the "dead width". In other situations where side-walks pass adjacent to buildings and fences, the dead width has been taken as 0.5 m. For areas of heavy pedestrian activity such as bus stops, railway stations and recreational area, the width of side-walk have been suitably increased to account for accumulation of pedestrians.

In purely residential areas, and special cases like shopping centers and industrial/office complexes, different principles apply to side-walk design than the capacity considerations given in Table I. Enhancement of environmental values and safety are the governing criteria in pedestrian sensitive situations such as these and layouts have been carefully planned keeping these points in view.

Picture 5-5: Refuge island and at-grade access to BRT shelter, BRTS, Ahmedabad, India

5.2 Refuge Island

While designing a BRT, pedestrian safety needs to be given highest priority in the design. All the intersections where pedestrians are provided with Zebra crossing, pedestrians refuges are to be provided for safety. The pedestrian refuge would have a minimum width of 1.2 meters and a minimum area of 7.5 sqm. It would be provided for any stretch where the walking distance is more than 2 vehicular lanes.

5.3 Pedestrian Crossing Facilities

Pedestrian crossing traffic at intersections is critical in terms of pedestrian safety. In order to define the level of pedestrian - vehicular conflict at a pedestrian crossing PV^2 value is usually adopted where 'P' is the peak hour crossing pedestrian traffic and 'V' is the corresponding peak hour vehicular traffic (in vehicles). As per IRC: 103 – 1988, ''Guidelines for Pedestrian Facilities'' at controlled crossings, when PV^2 value exceeds the critical value of $1x10^8$ for undivided carriageway and $2x10^8$ for divided carriageway, the situation warrants for need of one of the following facilities for pedestrian's safety and for the minimization of delay to the traffic movements.

Picture 5-7: Continuous footpath to access to BRT shelter, BRTS, Ahmedabad

Picture 5-6: Pedestrian crossing for access to BRT shelter, BRTS, Ahmedabad

- Realignment for facilitation of pedestrian and vehicular movement by provision of grade separated pedestrian facilities
- A traffic signal with exclusive facility for safe pedestrian crossings
- Grade separated facility for pedestrians.

The pros and cons of each are given in Table below

Table 5-2

Table 5-2: Pros and Cons of Pedestrian Crossing Facilities

Footpath (side walk)	Refuge Island	Pedestrian crossing (grade separated)
Pros		
• Footpath/sidewalk can be the most convenient in BRT facilities, and it also may be the safest option if you don't want to risk it on the road. • It provides a solid physical segregation between BRT lane, mixed lane and service lanes. • Provides safest option to users service lane is busy and very heavy traffic on mixed lanes. • Provides safe movement for end users to their destinations near BRT stops.	• Refuge island can also be the most convenient in BRT facilities, and it also may be the safest option if you don't want to risk it on the road. • Provides very safe option if the traffic on service lanes, mixed lanes and BRT lanes is very heavy. • Good option as compare to only pedestrian marking on the corridor.	• Pedestrian crossing (grade separated) is the safest mode for pedestrian movement to access the BRT bus stops. • Better than the pedestrian marking and Refuge Island as it provides all facilities level segregated. • It may also increase the aesthetic values of the BRT bus shelters/stops as it create good structure/framework.
Cons		
• They have to be provided in continuation along the corridor to maintain the profile of the corridor. • May create problems in implementation if constraints in RoW. • Apart from the raised kerb, needs physical barrier if the traffic movement is very fast	• May create problems in movement if the space is very less to provide it • Not suitable for corridors having RoW constraints • May create problems in level integration if space is not there.	• Very high cost of infrastructure as it requires more no. of elements and integration to BRT stops. • Not suitable if the space constraint is there near BRT shelter. • May create less comfort to end users to step up and step down and also for

Footpath (side walk)	Refuge Island	Pedestrian crossing (grade separated)
and heavy.		disabled users if proper ramp is absent.

The above standard, however, remains silent about the provision for the grade separated facility for the safety of pedestrians. In the absence of such warrants the designers and highway planners experience constraints/difficulties in recommending the most desirable facility. Efforts have been made to arrive at some cut-off point recommendations for the provision of such facility.

Picture 5-9: Refuge Island facilities for access to BRT shelter, Amsterdam Busways

For any value of PV^2 less than 40x108, though good pedestrian facility is demanded but may not be considered on several accounts including the economic constraints. To calculate the PV^2 values at critical intersections, pedestrian volume surveys were conducted at 59 intersections and 46 mid blocks to assess the characteristics of pedestrian traffic across the intersections and at mid blocks. The peak hour pedestrian flow across traffic at intersections and mid block are given in Annexure 5 & 7. In addition volume count was also done at the same intersections, which has

Picture 5-8: Refuge Island facilities for access to BRT shelter, BRTS, Kunming

been provided in Annexure 6.

Based on the traffic studies undertaken it was inferred that There are variations in pedestrian flow pattern ranging from 14 pedestrians to 935 pedestrian in morning peak and between 24 to 1526 pedestrian in evening peak across various locations.

The PV^2 values at different locations are given in Annexures 8 & 9. The Pedestrian vehicular interaction or PV^2 square values have been grouped as below:-

- Less than 70

Picture 5-11: Pedestrian foot over bridge facilities for access to BRT shelter, BRTS, Bangkok, Thailand

Picture 5-10: Grade separated pedestrian foot over bridge to access the BRT shelters, BRTS, Guangzhou, China

- Between 70 and 160
- More than 160

It has been concluded from the available set of data, the value of PV2 more or less stabilizes at around 160x10^8 crystallizing that Grade Separator for pedestrians is indispensable beyond the value of $160x10^8$. The PV^2 value was higher than the set benchmark of $160x10^8$ at the following intersections:

Table 5-3: Intersections with PV^2 higher than $160x10^8$

Location	Road Name	Corridor
Karve Chowk+ Bank of Maharashtra	Karve Road	Corridor 1
Garware College		
Karve Nagar Chowk (Cummins)		

Location	Road Name	Corridor
Korhrud Bus Terminal		
Nal Stop & Abhinav Chowk		
Khandojibaba Chowk		
Viman Nagar	Nagar Road	
Ramwadi Naka		
Yerwada Junction		
Mundhwa Bypass Junction + Rakshak Hospital		
Kendriya Vidalaya		
Nobili School/Weikfield Junction		
Vishrantwadi Chowk	Alandi Road	Corridor 2
Shivrai Pratishtan + Rahul Complex	Paud road	
MIT College		
Madhukar Hospital	Sinhgad Road	Corridor 3
Dandekar Chowk		
Ghar Sansar		
Dattawadi Police Chowki		
Shivaji Nagar Chowk	Ganeshkhind Road	Corridor 4
University Chowk		
Sancheti Hospital		
Swargate Chowk	Satara Road	
Hautatma Chowk	Shivaji Nagar	

But this is not sufficient to freeze or finalize these locations for recommending Grade separator facilities. Many locations fall in core city area were ROW is less than 20m and distance to be negotiated is too less. Accordingly 5 more parameters were adopted namely:

- **Number of Pedestrians crossing road + bus stop Boarding/Alighting number X V^2** as after BRT the existing B/A will happen in centre of road which today is on Kerb side.
- **Distance or number of lanes to be crossed -** As lower the number of lanes to be crossed lesser is the probability of people using grade separator.
- **Proximity to Intersection** - Closer the location to intersection, lesser the likelihood of usage of grade-separated facility; also there is possibility of designing for at-grade facility, coordinated with signals
- **Location of proposed BRT bus stop** as this needs to be integrated with proposed grade separator.
- **Adjoining Land use** – school, public bldg etc

Picture 5-12: FOB along BRTS, Guangzhou, China

Picture 5-13: FOB Bangkok

It is proposed that grade separated pedestrian crossings is to be provided at the following locations given in Table 5-4. At other locations, at grade, pedestrian crossings would be provided with a separate pedestrian phase for safe crossing of pedestrians.

Table 5-4: Locations at which Grade Separated Pedestrian Crossings are Proposed

Location	Road Name	Corridor
Karve Chowk + Bank of Maharashtra	Karve Road	Corridor 1
Garware College		
Korhrud Bus Terminal		
Karve Nagar Chowk (Cummins)		
Nal Stop & Abhinav Chowk		
Khandojibaba Chowk		
Yerwada Junction	Nagar Road	
Mundhwa Bypass Junction + Rakshak Hospital		
Ramwadi Naka		
Vishrantwadi Chowk	Alandi Road	Corridor 2
Shivrai Pratishtan + Rahul Complex	Paud road	Corridor 2
MIT College		
Ghar Sansar	Sinhgad Road	Corridor 3
Dandekar Chowk		
Dattawadi Police Chowki		
Shivaji Nagar Chowk/ Shimla Office	Ganeshkhind Road	Corridor 4
Swargate Chowk	Satara Road	

6 Parking Facilities

Parking facility is an important part of transport system. As one of the important activity of urban areas it is competing for space both for on-street as well as off-street. Planning and design of parking facilities demands an understanding of various characteristics including vehicle, driver behavior, parking operation and parking generation of different land uses served. To understand the parking supply and demand characteristics of the BRT corridors, on-street parking survey was conducted through 'Entry-exit Method' and 'Patrol Method', wherein parking demand on the identified places with noticeable incidence of parking was assessed along with the supply characteristics. On-street parking surveys have been carried out on various roads, which were subdivided into various stretches. This would give the maximum space utilization and accumulation of vehicles parked on the roadside. It would also identify stretches, which are over congested, and additional parking space would be required. Parking survey for all corridors except Paud, Karve and Shivaji Road was conducted at 1-hour intervals. Here parking surveys were also conducted at half hour intervals.

Picture 6-1: Provision of Parking facilities near BRT shelter, BRTS, Ahmedabad, India

The existing parking supply for on street parking along the BRTS corridors is given in Annexure10. As per the survey undertaken Nagar Road (BRT- 4) is the largest parking corridor on the project area, which forms about 18% of total number of parking spaces, followed by Sinhgad Road (BRT-5), which forms about almost similar to Nagar Road i.e 16% of total number of parking spaces. Road wise parking supply is given in Table 6-1 below.

Table 6-1: Parking Supply along BRT Roads

Road Name	Total Supply (ECS)	Percentage Share
Alandi Road (BRT-3)	680	12%
Paud Road (BRT-13)	834	15%
Shivaji Road (BRT-18)	834	15%
Karve Road (BRT-10)	394	7%
Nagar Road (BRT-4)	1057	18%
Singhgad Road (BRT-5)	899	16%
Total	**5726**	100%

In terms of volume, Nagar Road (BRT-4) corridor handles the largest volume of 4,286 ECS in a day followed by Sinhgad Road (BRT-5), which handles 4196 ECS in a day. Vishrantwadi to Dhanori (BRT-17) corridor which handles the minimum volume of 603 ECS in a day. The parking volume along different sections of the road is given in Table 6-2 below and details of each section wise load is given in Annexure 11.

Table 6-2: Parking Volume along BRT Roads

Road Name	Parking Volume (ECS)
Alandi Road (BRT-3)	1,670
Paud Road (BRT-13)-One hour Interval	1,688
Paud Road (BRT-13)-Half an hour Interval	3,616
Shivaji Road (BRT-18)-One hour Interval	1,435
Shivaji Road (BRT-18)-half an Hour Interval	2,193
Karve Road (BRT-10)-One hour Interval	1,489
Karve Road (BRT-10)-Half an hour Interval	3,147
Nagar Road (BRT-4)	4,286
Singhgad Road (BRT-5)	4,169

The average RoW of the above roads is given in Table 6-3 below. As per the table, Alandi Road and BRT-17 have a RoW of 45m and above and on these roads parking demand is not very high, therefore on street parking can be continued. Though Nagar Road also has a RoW of 45m and above, the road has very high parking demand, especially around Baburao Niwas, Deep Height complex, Gungan talkies and Hotel Guru Krupa. At these locations, on street parking would be required to be restricted to facilitate smooth movement of traffic.

Table 6-3: Road width along BRT Corridors

Road Name	RoW
Alandi Road (BRT-3)	>45m
Old NH-4 (BRT-14)	36m
Vishrantwadi Jn. to Dhanori (BRT-17)	>45m
Paud Road (BRT-13)-One hour Interval	36m
Shivaji Road (BRT-18)-One hour Interval	24m
Karve Road (BRT-10)-One hour Interval	30m
Nagar Road (BRT-4)	>45m
Sinhgad Road (BRT-5)	36m

Picture 6-2: Provision of Bike Parking facilities near BRT shelter, BRTS, Guangzhou, China

At old NH-4, Paud Road and Singhad Road the Row is 36m, of these Sinhgad road is most critical, as the parking demand is very high along this road as given in Table 6-2 above. Some parking restrictions may therefore be required on this road. Besides these, Shivaji Road and Karve Road do not have the requisite RoW to permit on street parking and the same would be required to be banned along the corridor. To accommodate the parking demand on these corridors, off street parking facilities are to be created on available land under the public amenities. Accordingly the proposed off street parking locations are as follows:

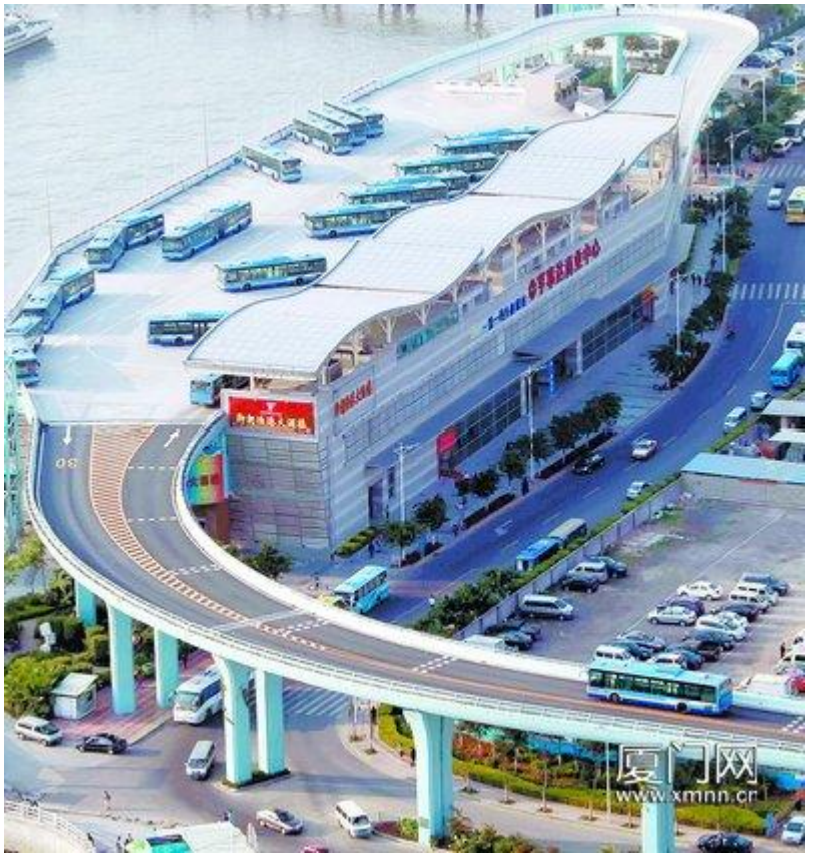
- Deccan Gymkhana building (PMPML depot & stand)
- Swargate Commercial Complex (PMPML depot & stand)
- Hadapsar Commercial Complex (PMPML depot & stand)
- Market yard Depot Office Building
- Kothrud Bus Stand

7 Terminals and Interchange Facilities

To ensure operational efficiency of the BRT network it is also necessary that there should be proper integration of the primary, secondary and tertiary route networks so as to have smooth functioning of the bus operating system. In this context, the location of the terminals plays a major role in successful operation of the system. Bus terminals are generally large sized and at the end-of-the-corridor. They are critical for providing seamless inter and intra modal transfers and generally have features such as:

- easy accessibility using bus bays / platforms,
- passenger amenities
- information center
- public conveniences
- reservation center
- off board ticketing facility
- parking

The size of the terminal and the extent of amenities envisaged there depend upon the quantum and intensity of operations.



Picture 7-1: Terminal near new port, BRTS, Xiamen, China

Picture 7-2: Interchange facilities, BRTS, Xiamen, China

Picture 7-3: Terminal cum depot facilities, BRTS, Curitiba, Brazil

Depending upon the type of operations, bus terminals can be categorised as origin-destination point terminals and transfer point terminals and accordingly the facilities in these terminals may differ.

7.1 Transfer Terminals

Of the existing terminals (including depot cum terminals) in Pune, PMPML currently has 5 Transfer terminals along the proposed BRT corridors, which are as follows:

- Pune Municipal Corporation (PMC) – Corridor 4
- Swargate – Corridor 3 & 4
- Puen Station – Corridor 1
- Deccan Gymkhana – Corridor 1 and 2
- Shivaji Nagar – Corridor 4

Many of the existing PMPML bus routes begin and end at these terminals. Most of the transfer terminals are located close to the central business district (CBD). While proposing the new terminals, the requirements of the operators as well as the passengers have been carefully examined. The operator's requirements are in respect of smooth entry and exit of buses,

adequate bus parking space and provision for park and ride facility. The passenger requirements are related to conveniences, waiting areas, adequate ticketing counters and related amenities

The recommended BRT route plan necessitates two additional transfer terminals at the following locations:

- Sancheti Hospital
- Paud Phata
-

7.2 O-D Point Terminals

The city has the following existing O-D point terminals:

- Katraj (Karve Road) – Corridor 1
- Swargate – Corridor 3 & 4
- PMC (Shivaji Road) – Corridor 4
- Kothrud (Paud Road) – Corridor 2
- Shivaii Nagar (Ganeshkhind Road) – Corridor 4
- Pune Railway Station – Corridor 1
- Chandni Chowk (Paud Road) – Corridor 2
- Deccan Gymkhana (JM Road) – Corridor 1 & 2
- Hadapsar (Sholapur Road)– Corridor 3

An adequacy analysis of the existing origin –destination point terminals terminal and study of arrivals and departures at peak hour and public transport demand was conducted and it was concluded that the following new terminals are required.

- Vishrantwadi (Alandi Road) - Corridor 2
- Wagholi (Nagar Road)– Corridor 1
- Warje (Karve Road)– Corridor 1
- Dhayari Phata (Sinhgad Road)– Corridor 3

Picture 7-4: Terminal cum depot facilities, BRTS, Bogota, Colombia, SA

7.3 Bus Depot

Depots are generally located adjacent to terminals to reduce the dead mileage. Normally, the BRT buses will enter the depot only if it is being taken out of service, either because it is a non-peak period or it is the end of the day, or because it is in need of repairs. A bus depot not only serves as an idle parking facility for buses but also houses facilities for day to day servicing, repair and maintenance of buses besides providing space for administrative and operations planning, monitoring and control activities.

The optimum utilization of all the facilities in depots occurs for a fleet size of about 100 vehicles. Depots for fleets of about 50 and 150 buses are also designed, if operational requirements so demand, though their utilization may be sub optimal. The existing PMPML depots along the proposed BRT corridors are as follows:

- Katraj Old (Karve Road) – Corridor 1
- Katraj New (Karve Road) – Corridor 1
- Swargate – Corridor 3 & 4
- Pune Station – Corridor 1
- Kothrud (Paud Road) – Corridor 2
- Hadapsar (Sholapur Road)– Corridor 3

7.3.1 Area Required for Terminals & Depots

It is recommended that the terminals be upgraded/ located as per the details given in table below. Capacity of the terminals has been suggested considering the future requirements also.

Table 7-1 Capacity of the proposed bus terminals & Depots

Name of the Depot /Terminal	Capacity (no. of buses to be parked)	Area required
Shivaji Nagar –Terminal (Existing Natawadi Depot may be upgraded to Depot cum Terminal)	100-125	1.50 acres
Dhairy Phata (Terminal)	75 –100	1.50 Acres
Hadapsar (Depot cum terminal) - Wadki depot	100	5.00 Acres
Swargate (Depot cum Terminal- existing Terminal needs to be upgraded operations)	125	3.00 Acres
Paud Road –Kothrud (Depot cum Terminal)	100	5.00 Acres
Warje (Depot cum Terminal)	100	5.00 Acres
Wagholi/ Chandan Nagar (Depot cum Terminal)	100-125	5.00 Acres
Near PMC Building – Terminal (Existing Terminal to be upgraded)	100-125	1.50 Acres
Pune Railway Station (Terminal)	100	2.5 Acres

*Minimum area requirement is 1.5 acres

These terminals would act both as major collectors as well as transfer points from one BRT route to another. Further, to ensure

Picture 7-5: Interchange facilities; LRT-Quality Bus (rapid bus) interface, Europe

smooth and convenient transfers a high frequency service may be operated between the terminals. These terminals will also facilitate the transfers from local trains and inter city traffic. Other existing terminals would continue to operate as collection points for regular bus operations.

The terminals and depots for the BRT network are also to be integrated with other public transport services, particularly with and long-distance services. Passengers should be able to easily transfer from the long-distance services into the BRT system and vice versa. The operators may also gain benefit in terms of any shared facilities with long-distance operators. It should therefore be necessary for Maharashtra State Transport Corporation (MSRTC) to relocate their inter-city terminals to the new terminal locations being proposed.

7.3.2 Minimum Facilities required at the Terminal

The proposed bus terminals need to have the following facilities which are essential:

	Min. Size
1. Control Cabin	10’ x 15’
2. Starter Cabin	6 ‘x 6’
3. Pass center	10’ x 15’
4. Driver and Conductor’s Rest rooms	20’ x 15’
5. Toilet blocks (Ladies and Gents)	30’ x 10’
6. Drinking Water facilities	8’ x 8’
7. Parking of personalized vehicles (Park & Ride)	
2- Wheelers	0.5 Acres
4- Wheelers	0.5 Acres

Annexures

Annexure 1 – Minutes of the Meeting Held on 18th August 2011

Implementation of High Quality BRT system in Pune Metropolitan Region
Minutes of Meeting
Date: 18 Aug 2011
Venue: Nirman Bhavan, New Delhi

Agenda: Implementation of High Quality Bus Rapid Transit System in Pune Metropolitan Region

The agenda of this meeting was to resolve all outstanding issues related to operations plan, infrastructure design, issues raised by World Bank and arrive at an agreement on design and implementation of a high quality integrated Bus Rapid Transit System (BRTS) in Pune Metropolitan Region (PMR), which includes regions covered by Pune Municipal Corporation (PMC) and Pimpri-Chinchwad Municipal Corporation (PCMC). The SPV, Pune Mahanagar Parivahan Mahamandal Limited (PMPML) is responsible for operation of public transport in the region. Govt of India has sanctioned longest length of BRTS in Pune and Pimpri chinchwad under JnNURM and now also SUTP. Accordingly the aim has to be to deliver a model BRTS which can be emulated by other cities as well. Though the project has suffered some setbacks earlier because of certain design, coordination and ownership issues, it is possible to find reasonably good solutions for the challenges existing on ground.

List of participants is annexed.

As per the agenda, following points were discussed and agreed upon -

BRT Corridor Physical Design

1. BRT corridors shall have, to the extent possible, dedicated bus corridors in the entire Pune Metropolitan Region. Mixed traffic portion of BRTS should be an exception only. Where it is not possible to have dedicated BRTS corridors for considerable stretch, it should not be called a BRTS corridor so that people do not confuse with the concept of BRTS.

2. Since one of the prime feature of BRTS is Level boarding and alighting, 'At level Boarding' without steps shall be provided in the dedicated corridors for BRTS. The Buses used for BRTS should be with doors on both sides so as to allow BRTS buses to go out of the BRTS corridors also if the operational requirements so necessitate.

3. ITDP shall provide the details of the location of bus stops/stations for all types of cross sections and accordingly preferably the Median stations shall be provided on all dedicated corridors after reviewing its feasibility.

4. On street parking on BRTS corridor specially has to be **strongly discouraged**. However, wherever possible parking can be provided on the BRT corridors and at locations where it is not feasible, offstreet parking locations may be identified for parking by the respective Municipal Corporations.

5. Wherever the RoW available is less than 24m and there are implementation difficulties, alternatives need to be worked upon for issues concerning parking and general traffic movement before approaching those sections. It may be noted that BRTS can be implemented even on narrow roads as has been done in other cities across the globe, by having 3.5 m wide dedicated lane for BRTS for one direction movement with proper traffic engineering in the entire area.

BRTS Corridor Network

6. A high quality BRT system needs to be created in Pune region that can be showcased. To implement the system quickly with public buy-in, it was decided to develop the corridors in two phases. As part of Phase I, those corridors where civil works in terms of motor vehicle lanes, cycle tracks, foot paths and shifting of utilities have been completed shall be taken up. These corridor's, also connect natural destinations. M/s IL&FS would prepare detailed construction and implementation plan including phasing.

7. In the DPRs approved under JnNURM as per the proposal from the city, there are some important missing links. To implement a closed system in the PMR region and provide connectivity to the BRT corridors in the PCMC area as part of a single integrated network, these corridors shall have to be reviewed so as to develop these missing links.

8. The Missing links that need to be developed are:

   i) Tilak Road (Alka Talkies to Swargate) – 2.4 KM
   ii) Nehru Stadium Road (Swargate to Sarasbaug) – 0.3 KM
   iii) Shastri Road (Alka Talkies to Dandekar Bridge) – 1.35 KM
   iv) Garware Circle to Alka Talkies – 0.39 KM
   v) Pune University to Rajiv Gandhi Bridge – 3.55 KM
   vi) Bund Garden (Yerwada to College of Engineering Pune) – 4.5 KM
   vii) Jehangir Hospital to Maldhakka Junction – 1.62 KM

   Accordingly the BRTS DPRs may be revised and submitted to MoUD for approval of CSMC under JnNURM before developing them as BRTS corridors. In order to manage within the approved project cost, some corridors which have earlier been approved under JnNURM for development of BRTS, but have low demand may be reviewed for dropping. These corridors are:

   a) Phase 1: Airport Road (Gunjan to TATA Guard Room) – 3.54 KM
   b) CWYG: New Airport Road (From Ramwadi Jakat Naka) – 2.55 KM
   c) CWYG: Airport Junction to Vishranwadi – 2.23 KM
   d) CWYG: Airport Rd to Deccan College (via Hotmix Plant) – 3.75 KM

e) CWYG: Balewadi Gaothan to Baner Gaon - 2.42 KM

f) CWYG: Westerly bypass to Balewadi Gaothan – 1.95 KM

Though RoW work in terms of motor vehicle lanes, cycle tracks, foot paths and shifting of utilities have been completed on these 6 corridors, work related to BRTS, such as segregated lanes and stations for BRTS, are yet to be completed. Deletion of these corridors may, therefore, be considered and the work undertaken may be treated as part of routine road improvement by PMC.

9. Funds that were previously allocated under JNNURM for the development of these 6 corridors may be used for development of other critical BRT links as listed in point no. 8 as well as other necessary BRT infrastructure. Approval may be taken urgently from CSMC (being a JnNURM project) for the proposed changes.

10. PCMC has started development of BRTS corridor on Old Mumbai-Pune NH. To provide connectivity between the BRTS being developed in PMC and PCMC area, it was decided that PMC would take up development of the extensions of this corridor in its area. However considering the RoW constraints on the NH near Kharki station, it was decided that efforts may be made to workout dedicated BRT on NH to the extent possible. Even if an elevated treatment is necessary for the section, a proposal supporting the solution may be presented urgently by PMC to MOUD.

11. PCMC has started work on the Aundh-Ravet Corridor. PMC will add the critical link of Rajiv Gandhi Bridge (Aundh) to Pune University in the revised DPR so that this corridor can be seamlessly connected to PMC.

12. It was pointed out by PMC officials that there were two existing flyovers and one under construction underpass on University road (Ganesh Khind Road). Here providing dedicated BRT lane may not be possible. PMC engineers were requested to study the corridor and

work out possible solutions to get dedicated BRT corridor to the extent possible. ITDP shall provide required advisory for designing the same. Since it may include rerouting of traffic, Traffic Police will need to be brought on board.

13. Based on the designs provided by ITDP (as per point no. 3 above), PMC engineering team and its consultants shall revise designs to include fully segregated BRTS with median stations on the two corridors viz Karve Road-Paud Road-JM Road & Sinhgad Road. Detailed implementation drawings shall then be developed. However due to constraints on these corridors, implementation of these corridors may be taken up subsequently (phase-II) after implementing the corridors without constraints.

14. On street parking issues shall be discussed by ITDP with Pune Traffic Police and alternate solutions for the same shall be work out. As already mentioned above, the Concept of dedicated BRTS corridor is not to be compromised for want of on street parking.

15. Old city of Pune has important destinations such as Pune station, Swargate and PMC Terminal. These are major destinations as well as interchange points for passengers from all over the city. ROW of roads connecting these important nodes is restricted and development of dedicated BRT lanes is difficult. An alternate traffic movement plan may be studied and the possibility of providing dedicated lane in the region may be explored by PMC with inputs from ITDP and its consultants. .

16. Pilot corridors (Satara Road and Hadapsar Road) are in operations but without level passenger boarding from BRT stations into buses. Since most of the corridor infrastructure is ready, it is possible to create median bus stations to provide level boarding convenience to passengers. PMC engineering team and its consultants, shall revise designs to include fully segregated BRTS with median stations on these two corridors (Satara Road & Hadapsar Road).

17. Left side stations on the pilot corridors mentioned above were created through private investment on BOT basis in lieu of advertizing rights for a period of 7 years. The BOT contract was entered into by PMPML. On date out of 7years, 5 years of the contract period have already elapsed. It was suggested that these contracts may be reviewed and possibilities of foreclosure may be explored. Alternately, PMC may construct new median stations and provide advertizing rights to the private investor for the remaining period of 2 years. Due to some constraints on these corridors, implementation of the new design may take some time and therefore to be taken up in Phase II.

18. PMC shall undertake all necessary studies required for corridors mentioned above. Revised DPR for corridor selection and design shall be sent to CSMC for approval at the earliest. PMC shall coordinate with concerned consultants and advisers for modifications in BRT bus station designs and corridor designs to accommodate fully segregated bus lanes and median bus stations.

19. There were concerns raised regarding acquisition of land under the jurisdiction of army or in cantonment areas. PMC may communicated the same to MoUD also so that the necessary follow up can be undertaken by MOUD with the Ministry of Defense in order to assist in implementation of dedicated BRTS system in PMR.

BRT Buses and facilities

20. Out of 650 buses of 900 mm floor height that have been funded under JnNURM, presently 500 buses have been ordered with doors on right side as well as left side of the buses so as to run exclusively on the BRTS corridors. It was suggested to buy additional 150 buses with doors on both the sides so that the entire requirement of BRTS is met comfortably.

21. It has been conveyed by PMPML that cleaning of all JNNURM buses on pilot basis has been started at one depot. For rest of the depots, tendering process is undergoing. The concern of lack of space for depot and terminals was raised in the meeting and Commissioner PMC was requested to urgently address the issue of providing additional land for bus depots.

22. PMPML has already submitted a proposal to PMC for depot spaces in PMC. PMPML shall submit the list of all depots, areas and other details to MoUD as well as soon as possible.

BRT Operations Planning

23. BRT operations in PMR region shall be closed- hybrid with service extensions of BRTS routes outside dedicated corridor network for last mile connectivity. Such operations shall be termed as Closed-Hybrid BRTS. Only BRTS buses will operate inside dedicated BRTS lanes and no other buses shall be allowed inside the dedicated lanes.

24. Bus fleet required for BRT operations in PMR in the first phase is well under the fleet of 650 buses being procured through JNNURM. This would allow operations of Closed-Hybrid BRT.

25. ITDP has prepared a detailed BRTS operations plan for PMR as well as route rationalization of PMPML services to complement BRTS operations. The normal city buses should complement BRTS routes and not compete. PMPML has studied the route rationalization plan for PCMC region and has accepted the same with necessary modifications.

26. PMPML is in the process of reviewing the operations plan submitted by ITDP for PMC region wherein the normal city buses do not compete with BRTS buses. PMPML shall review this route rationalization and BRTS operations plan within a month and make necessary modifications wherever possible. This would be reviewed in the next meeting.

27. PMC requested that PMPML should confirm the route rationalization plan / BRTS plan for the PMC area suggesting hybrid BRT system wherein only BRTS buses would ply on the BRTS lane and all other buses will ply on the non-BRTS lanes, before they can undertake any design changes.

28. PMC's Consultant, IL&FS, suggested that the feasibility and stakeholder acceptability of the hybrid scheme as envisaged by PMPML will need to be ascertained before embarking on detailed designs, as this would entail design of the system and already built infrastructure from scratch. Furthermore it will also have to be seen that the average number of passenger transfers do not go up. It was decided that PMPML and ITDP shall do it urgently within a month so that the detailed designs can be undertaken.

Technology (ITS)

29. PMPML shall provide on board and off board ITS facilities on all the BRTS buses and JnNURM sanctioned buses. The compatibility of on board and off board ITS must be taken care of. PIS inside the bus and on the bus stations, on board cameras, integrated controller, multiplexing, AFC etc must be implemented.

30. Decision on implementation of National common mobility card is pending since last year. PMPML shall ensure that a mutually acceptable solution is worked out urgently between M/s UTIITSL and existing E-Ticket company for incorporating the National common mobility card with in this financial year.

Utilization of available World Bank funds for PCMC

31. It was suggested that PCMC has a component that can provide funds for ITS procurement under ongoing loan support from World Bank. Same may be explored for implementation of ITS at the stations in PCMC area. PMC may equally allocate funds for the PMC area.

Commissioner PCMC added that on board and off board ITS will be implemented by PMPML only and suggested that the World Bank funds can be utilized for constructing bus stops on all the four BRT corridors of PCMC. It was suggested to explore this possibility with the World Bank officials at the earliest.

32. PMPML was asked to prepare an implementation schedule and final service plan for BRTS and submit it to the World Bank for review.

33. It was decided that the next meeting of all concerned agencies with OSD and ex-officio JS(UT) shall be held in Pune where the pending issues of the agenda will be discussed and site visits to critical sections on BRTS corridors shall be undertaken.

34. In the end it was reiterated that we should all strive for a consistent and consolidated BRTS for PMR and not in parts for Pune and Pimpri -Chinchwad.

There being no other item, Meeting ended with vote of thanks to the chair and all the participants.

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List of participants:

1. Mr. S.K. Lohia, OSD(UT) & Ex-Officio JS, Ministry of Urban Development, GOI (In Chair)

Pune Municipal Corporation

2. Mr. Mahesh Pathak, Commissioner, PMC
3. Mr. Vinay Deshpande, OSD, Technical Advisor, JnNURM, PMC
4. Mr. Bipin Shinde, PMC

PimpriChinchwad Municipal Corporation

5. Mr. Asheesh Sharma, Commissioner, PCMC
6. Mr. Mahavir Kamble, Jt. City Engineer, PCMC
7. Mr. Bapu Gaikwad, Traffic Engineer, PCMC

Pune MahanagarParivahanMahamandal Limited

8. Mr. Ramchandra Joshi, Chairman and Managing Director, PMPML
9. Mr. Satish Kulkarni, Jt. Managing Director, PMPML
10. Mr. Sunil Burse, Chief Engineer, PMPML

Institute of Urban Transport (India)

11. Mr. B.I.Singal, Director General, IUT

Project Management Unit, GEF-SUTP

12. Mr. I.C. Sharma, National Project Manager
13. Ms. Rana Amani, Deputy Project Manager
14. Mr. Rajendra Nath, Team Leader, PMC-SUTP, Mott MacDonald
15. Ms. Surabhi Kureel, Transport Planner, PMC-SUTP, Mott MacDonald

Institute for Transportation and Development Policy

16. Ms. Shreya Gadepalli, Regional Director,
17. Mr. Anuj Malhotra
18. Mr. Christopher Kost
19. Mr. Nitin Warrier
20. Ms. Pranjali Deshpande

Infrastructure Leasing &Financial Services Ltd

21. Mr. Jiten Hindocha, Sr. Vice President

Urban Mass Transit Company Limited

22. Mr. Ramakrishna
23. Ms. Kanika Kalra, Asst. Manager, UMTC

Annexure 2 – Ridership along BRT roads

Annexure 3 – Road Inventory Details of BRT corridors

BRT Corridor	Length (Km)	DP Width (M)	Existing ROW	Existing Median	Abutting Land use
Nagar Road (Yerwada & New PMC limit)	7.9	Yerwada to Ramwadi Jakat Naka -45 Ramwadi Jakat Naka to New PMC Limit- 60		Yerwada to Gunjan Talkies -1.5 m width Gunjan Talkies to Shastrinagar Chowk – 3.2 m	Commercial activities and corporate offices up to Kalyani Nagar Junction Mixed/ Institutional as well as industrial land use
Singhagad Road (Swargate to Dhyaari Phata)	6.8	36	Ch 0+00 to Ch 1 +840 – ROW varies from 21 to 32 m	0.7 to 1.2 m	Residential and commercial
			Ch 1 + 840 to Ch 3 +390 – ROW varies from 32 to 38 m	1.2 m	Residential/commercial & amenity spaces
			Ch 3 +391 to Ch 5 +200– ROW varies from 33 to 37 m	2.2 m	Residential and commercial
Karve Road (Khandoji baba chowk to Warje)	6.4	Khandojibaba to Paud Phata – 30 Paud Phata to Warje – 3	Ch 0+00 to Ch 2 +200- ROW varies from 27 to 30 m	0.3 m	Residential/Commercial and Institutional
			Ch 2+ 201 to Ch 3+300 ROW is 36 m	0.6	Residential/ Commercial
			Ch 3+301 to Ch 5 +700 - ROW varies from 30 to 33 m Ch 5+701 to Ch 6 +400 –ROW is 23 m	2.1 No Median	Residential/ Commercial Residential/ Commercial

Paud Road (Paud Phata to Chandani Chowk)	4.5	36	Ch 0+000 to Ch 0 +690 - ROW is 36 m	0.6 m	Residential /Commercial
			Ch 0+700 to Ch 1 + 150 - ROW on L.H.S is 24 m (one Way) ROW on R.H.S is 9.5 m (one way)	Traffic Island	Institutional/ Mixed
			Ch 1+200 to Ch 2+480 ROW varies from 32 to 36 m	0.6 to 0.9 m	Residential /Commercial
			Ch 2+500 to Ch 2+ 920 ROW is 40 m	1 m	Residential /Commercial and Kachara Depot
			Ch 2+940 to Ch 4+034 ROW varies from 33 to 36 m	0.8 m No median from Ch 3 +780 to Ch 4 +034	Slums/ residential/commercial
Ganeshkhind Road (Sancheti Hospital to University)	3.4	36	Ch 0+000 to Ch 0+640 ROW varies from 34 to 36 m	0.5 to 1 m	Institutional / Commercial
			Ch 0+640 to Ch 1+060 C/W - 12 (L.H.S) & C/W of 8 m (R.H.S) with 17.2 two-way	0.7 median under Flyover	Institutional / Commercial

			Flyover		
			Ch 1+060 to Ch 1+950 ROW varies from 32 to 36 m	0.7 to 1 m	Residential /commercial and institutional
			Ch 1+950 to Ch 2+300 C/W of 7.9 (L.H.S) & C/W of 9.3 (R.H.S) with 8.2 one -way Flyover (RHS)	No Median	Residential /commercial and institutional
			Ch 2+300 to Ch 2+410 C/W - 6 & 13.2 Flyover (L.H.S) and C/W of 6.3 & 13.2 m Flyover (R.H.S)	No Median	Residential /commercial and institutional
			Ch 2+410 to Ch 2+830 C/W of 6-10 m (LHS) C/W of 15.5 to 17 m (RHS) Flyover of width 12.8 m	No Median	Institutional / commercial
			Ch 2+830 to Ch 3+110 C/W -9m (LHS) C/W – 9.9 m (RHS)	Landscaping under the Flyover	Institutional/ commercial

			Flyover – 12.8m		
Shivaji Road (Shivajinagar to Swargate)	3.9	24	Ch 0+000 to Ch 0+900 – The ROW varies between 21 to 24.5 m Ch 0+900 to Ch 2+000 and Ch 3+250 to Ch 3+800 the ROW varies between 16.6 to 18 m. Ch 2+200 to Ch 3+ 250 the ROW varies between 13 to 15.5 m.	The Median varies from 0.6 m to 0.8 m between Ch 0+ 150 to Ch 0+900. There is no median after this chainage as the traffic is one way after Hegdewar Junction i.e. Ch 1+300.	The land use is predominantly Mixed i.e. both commercial & residential.
Alandi	4.0	60m	Ch 50 to Ch 1950 – Row 60m Ch 2400-Ch 2750 – Row 45m	The Median varies from 0.3m to 0.6m	The land use is predominantly Mixed i.e. both commercial & residential.
JM Road	2.61	36m	30m	One way.	The land use is commercial.
Satara Road	5.82	45m	36m	Existing BRTS	The land use is predominantly Mixed i.e. both commercial & residential.
Sholapur Road	11.20	Swargate to Dhobhi ghat - 36m, Dhobhi ghat to Pul gate - 24m, Pul gate to Big	Swargate to Dhobhi ghat - 30m, Dhobhi ghat to Pul gate - 24m, Pul gate to Big Bazaar - 30m,	Existing BRTS with 2 km mixed BRT	The land use is predominantly Mixed i.e. both commercial & residential.

		Bazaar - 36m, Big Bazaar to Hadapsar Gadital - 45m	Big Bazaar to Hadapsar Gadital - 36m		

Annexure 4 – List of Bus stations with Station Type

Road Section	Stop Name	Station Type	Platform Height	Number of Bays	Location of bus station
Corridor 1					
Nagar Road (Yerwada - PMC limits)	PMC limit ends/ Octroi Naka	Designated	Level Platform	3	Mid Block
	Hadapsar Bypass	Designated	Level Platform	3	Intersection
	Chandannagar	Designated	Level Platform	3	Intersection
	Gharsansar sale	Designated	Level Platform	3	Mid Block
	Inorbit Mall	Designated	Level Platform	3	Mid Block
	Subway	Designated	Level Platform	3	Mid Block
	Phonix Market City	Designated	Level Platform	3	Mid Block
	Hyatt/Wadgaon Sheri	Designated	Level Platform	3	Intersection
	Satyam Arcade	Designated	Level Platform	3	Mid Block
	Megamart/Ramwadi Jakat Naka	Designated	Level Platform	3	Intersection
	After Kalyaninagar Junction	Designated	Level Platform	3	Mid Block
	Hotel Park Ornate	Designated	Level Platform	3	Mid Block
	Bajaj Alliance/Madhu Travels	Designated	Level Platform	3	Mid Block
	Yerwada Junction	Designated	Level Platform	3	Intersection
Sancheti Hospital to Yerwada (Bundh Garden road, Wellesley Road)	Band Garden	Enhanced	Standard Curb	3	
	Pune Central	Enhanced	Standard Curb	3	Intersection
	Guruprasad Bungalow	Enhanced	Standard Curb	3	Mid Block
	Wadia College	Enhanced	Standard Curb	3	Intersection
	Ruby Hall	Enhanced	Standard Curb	3	Intersection
	Jahangir Hospital	Enhanced	Standard Curb	3	Intersection
	Sohrab Hall	Enhanced	Standard Curb	3	Intersection
	Pune Railway Station	Enhanced	Standard Curb	3	Mid Block
	Raja Bahadur Mill	Enhanced	Standard Curb	3	Mid Block

Road Section	Stop Name	Station Type	Platform Height	Number of Bays	Location of bus station
	RTO Wellesley Road	Enhanced	Standard Curb	3	Intersection
JM Road	Engineering College Hostel	Enhanced	Standard Curb	2	Mid Block
	Modern High School	Enhanced	Standard Curb	2	Mid Block
	Balgandharva Sambhaji Park	Enhanced	Standard Curb	2	Mid Block
	Deccan Gymkhana	Enhanced	Standard Curb	2	Mid Block
Karve Road	Near Khandujibaba chowk	Designated	Level Platform	2	Intersection
	Garware College	Designated	Level Platform	2	Intersection
	Ranka Jwelers Junction	Designated	Level Platform	2	Intersection
	Near Sinhgad Business School/ Nal Stop	Designated	Level Platform	4	Intersection
	SNDT College	Designated	Level Platform	2	Intersection
	Paud Phata Flyover	Designated	Level Platform	2	Intersection
	Mritunjay Junction	Designated	Level Platform	2	Intersection
	Near Karve Statue chowk	Designated	Level Platform	2	Mid Block
	Kothrud Bus Stand	Designated	Level Platform	2	Intersection
	Kothrud Gaothan Junction	Designated	Level Platform	2	Intersection
	Dahanukar Colony Junction	Designated	Level Platform	2	Intersection
	Karvenagar Junction	Designated	Level Platform	2	Intersection
	Kakde city Bus stop	Designated	Level Platform	2	Intersection
	Near warje flyover	Designated	Level Platform	2	Mid Block
	westely Bypass	Designated	Level Platform	2	Mid Block
Corridor 2					
Alandi Road	In front of Food Bazaar	Designated	Level Platform	2	Intersection
	After Ammunition Factory road	Designated	Level Platform	2	Mid Block
	In front of Vishrantwadi Chowki	Designated	Level Platform	2	Mid Block
	MES Water works	Designated	Level Platform	2	Intersection

Road Section	Stop Name	Station Type	Platform Height	Number of Bays	Location of bus station
	Survey of India / Pragati Gas Agency	Designated	Level Platform	2	Mid Block
	Ambedkarnagar Junction	Designated	Level Platform	2	Intersection
	In front of Depot Battalion School	Designated	Level Platform	2	Intersection
Sangamwadi Road	Deccan College	Designated	Level Platform	2	Mid Block
	Shadal baba Dargah	Designated	Level Platform	2	Intersection
	Sangamwadi Gaon	Designated	Level Platform	2	Mid Block
	Near Sangamwadi bridge	Designated	Level Platform	2	Mid Block
	Patil Estate	Enhanced	Standard Curb	2	Intersection
	College of Engineering Pune	Enhanced	Standard Curb	2	Intersection
	Sancheti Hospital	Enhanced	Standard Curb	5	Mid Block
JM Road	Engineering College Hostel	Enhanced	Standard Curb	3	Mid Block
	Modern High School	Enhanced	Standard Curb	2	Mid Block
	Balgandharva Sambhaji Park	Enhanced	Standard Curb	2	Mid Block
	Deccan Gymkhana	Enhanced	Standard Curb	2	Mid Block
Karve Road	Shivaji Statue	Designated	Level Platform	2	Intersection
	Garware College	Designated	Level Platform	2	Intersection
	Shaniwarwada	Designated	Level Platform	2	Intersection
	Vasant Talkies	Designated	Level Platform	4	Intersection
	Mandai/Gadikhana	Designated	Level Platform	2	Intersection
	Shahu Chowk	Designated	Level Platform	2	Intersection
Paud Road	After Paud Phta Flyover	Designated	Level Platform	2	Mid Block
	MIT College Junction	Designated	Level Platform	2	Intersection
	Anandnagar Junction	Designated	Level Platform	2	Intersection
	In front of Pushpanjali Building	Designated	Level Platform	2	Mid Block
	Near New Friends circle	Designated	Level Platform	2	Intersection
	In front of Cosmos Bank	Designated	Level Platform	2	Intersection

Road Section	Stop Name	Station Type	Platform Height	Number of Bays	Location of bus station
	Bandal Capital Juction	Designated	Level Platform	2	Intersection
	Near Chandani Chowk	Designated	Level Platform	2	Intersection
	Paud road ends - Westerly Bypass	Designated	Level Platform	2	Intersection
Corridor 3					
Sinhgad Road	Dhayari Phata	Designated	Level Platform	3	Intersection
	Patil Colony	Designated	Level Platform	3	Mid Block
	Wadgaon Phata	Designated	Level Platform	3	Intersection
	Manik Baug	Designated	Level Platform	3	Intersection
	Anand Nagar	Designated	Level Platform	3	Mid Block
	Hingane Apte Colony	Designated	Level Platform	3	Mid Block
	Vitthalvadi	Designated	Level Platform	3	Mid Block
	Rajaram Pul	Designated	Level Platform	3	Intersection
	Vitthalvadi Jakat Naka	Designated	Level Platform	3	Mid Block
	Ganesh Mala	Designated	Level Platform	3	Mid Block
	Pan Mala	Designated	Level Platform	3	Intersection
	Dandekar Pul	Designated	Level Platform	3	Mid Block
	Nilayam Talkies	Designated	Level Platform	3	Intersection
	Parvati Payatha	Designated	Level Platform	3	Intersection
	Swargate	Designated	Level Platform	5	Intersection
Sholapur Road	ST Depot	Enhanced	Standard Curb	3	Mid Block
	Ghorpadi Peth Colony	Enhanced	Standard Curb	3	Intersection
	ST Divisional Office	Enhanced	Standard Curb	3	Mid Block
	Meera Society	Enhanced	Standard Curb	3	Mid Block
	Golibar Maidan	Enhanced	Standard Curb	3	Intersection
	Mammadevi Chowk	Enhanced	Standard Curb	3	Intersection

Road Section	Stop Name	Station Type	Platform Height	Number of Bays	Location of bus station
	Race Course	Enhanced	Standard Curb	3	Intersection
	Bhairoba Nala	Enhanced	Standard Curb	3	Intersection
	Fatimanagar Municipal Shala	Designated	Level Platform	3	Intersection
	BT Kawde Junction	Designated	Level Platform	3	Intersection
	Kalubai Mandir	Designated	Level Platform	3	Mid Block
	Ramtekdi	Designated	Level Platform	3	Intersection
	Vaiduwadi	Designated	Level Platform	3	Intersection
	Gurushankar Math	Designated	Level Platform	3	Mid Block
	Magarpatta	Designated	Level Platform	3	Intersection
	Hadapsar Gaon	Designated	Level Platform	3	Intersection
	Hadapsar	Designated	Level Platform	3	Intersection
Corridor 4					
Aundh Raod	Aundh Gaon	Designated	Level Platform	2	Intersection
	Aundh Gaon	Designated	Level Platform	2	Mid Block
	Breman Chowk	Designated	Level Platform	2	Intersection
	Sindh Colony Gate near Hotel Pichola	Designated	Level Platform	2	Intersection
	Central School	Designated	Level Platform	2	Mid Block
	DRDO Colony	Designated	Level Platform	2	Mid Block
	Bal Sansthan Gate	Designated	Level Platform	2	Mid Block
	After University Junction Ramp	Designated	Level Platform	2	Mid Block
Ganeshkhind	Near University Junction	Enhanced	Standard Curb	2	Intersection
	Near Khadaki Road	Designated	Level Platform	2	Intersection
	In front of Reserve Bank	Enhanced	Standard Curb	2	Mid Block
	In front of Pune Central Mall	Enhanced	Standard Curb	2	Mid Block
	After Petrol Pump	Enhanced	Standard Curb	2	Intersection

Road Section	Stop Name	Station Type	Platform Height	Number of Bays	Location of bus station
	Near HDFC House	Enhanced	Standard Curb	2	Intersection
	Shimla Office	Enhanced	Standard Curb	2	Intersection
	Sancheti Hospital	Enhanced	Standard Curb	5	Mid Block
Shivaji Raod	Shivaji Statue	Enhanced	Standard Curb	5	Mid Block
	Pune Municipal Corporation	Enhanced	Standard Curb	5	Mid Block
	Shaniwarwada	Enhanced	Standard Curb	5	Intersection
	Vasant Talkies	Enhanced	Standard Curb	5	Intersection
	Mandai/Gadikhana	Enhanced	Standard Curb	5	Mid Block
	Shahu Chowk	Enhanced	Standard Curb	5	Intersection
	Gokul Bhavan	Enhanced	Standard Curb	5	Intersection
	Swargate	Enhanced	Standard Curb	5	Intersection
Satara Road	Laxmi Narayan Theatre	Designated	Level Platform	2	Intersection
	Panchami Hotel	Designated	Level Platform	2	Intersection
	Bhapkar Petrol Pump City Pride	Designated	Level Platform	2	Mid Block
	Aryaneshwar Colony	Designated	Level Platform	2	Intersection
	Natu Baug	Designated	Level Platform	2	Intersection
	Padmavati Corner	Designated	Level Platform	2	Intersection
	Akshay Garden	Designated	Level Platform	2	Intersection
	Balaji Nagar	Designated	Level Platform	2	Intersection
	Nivara Housing Society	Designated	Level Platform	2	Mid Block
	Bharti Vidya Peeth	Designated	Level Platform	2	Intersection
	Katraj Dairy	Designated	Level Platform	2	Intersection
	Katraj	Designated	Level Platform	2	Intersection

Annexure 5 – Pedestrian Flow across Traffic at Intersections

S.No	Intersection	Total Pedestrian Traffic		Across Traffic							
		Morning Peak Hour	Evening Peak Hour	Morning Peak				Evening Peak			
				Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow		Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow	
1	Vishrantwadi Chowk	11-00-12-00	18-45-19-45	338	Air port	131	Alandi	640	Bombay Sappers	147	Alandi
2	Dr. Ambedkar Chowk	11-00-12-00	17-00-18-00	93	Bombay sappers	24	Alandi	117	Bombay sappers	24	Golf Club
3	Bombay Sappers Chowk	09-15-10-15	17-30-18-30	208	Khadki	55	Alandi	269	Khadki	83	Yerawada
4	Yerawada Junction	08-45-09-45	17-45-18-45	935	Alandi Road	873	Gunjan Talkies	496	Alandi Road	473	Gunjan Talkies
5	Gunjan Talkies Junction	09-15-10-15	18-15-19-15	803	Airport	55	Ramwadi Naka	525	Airport	295	Yerawada
6	Kalyani Nagar Junction	09-30-10-30	18-30-19-30	290	Yerawada	23	Golf Club Road	167	Yerawada	77	Kalyani Nagar Road
7	Ramwadi Naka Junction	08-45-09-45	18-15-19-15	248	Kalyani Nagar Road	54	Viman Nagar Road	264	Viman Nagar Road	81	Kalyani Nagar Road
8	Viman Nagar Junction	09-30-10-30	18-00-19-00	596	Mundhwa Bypass Road	217	Ramwadi Naka Road	710	Mundhwa Bypass Road	238	Ramwadi Naka Road
9	Mundhwa Bypass Jn.	09-15-10-15	17-45-18-45	248	Viman Nagar Road	134	Ahmadnagar Road	421	Viman Nagar Road	180	Ahmadnagar Road
10	Golf Club Junction	10-30-11-30	18-00-19-00	390	Gunjan Talkies	205	Airport	195	IBM Call Centre	91	Ambedkar Hall
11	509 Chowk	08-45-09-45	19-00-20-00	402	Airport	59	Vishrantwadi	184	Vishrantwadi	151	Airport
12	Hot Mix (HM)Road Junction	09-00-10-00	18-00-19-00	75	Golf Club Junction	14	Ambedkar College	165	Golf Club Junction	41	Agrasen Road
13	St. Joseph School Junction	11-00-12-00	17-30-18-30	136	Khadki Bazaar	27	Khadki Railway Station	89	Sancheti	50	Khadki Bazaar
14	Range Hill Chowk	11-00-12-00	17-00-18-00	204	Sancheti	23	Airport	86	Range Hill	30	Sancheti
15	Engineering College Chowk	08-30-09-30	17-00-18-00	274	Wakdewadi	78	Sancheti	105	Wakdewadi	74	Engineering College
16	Sancheti Junction	08-15-09-15	18-45-19-45	565	Engg. College	131	Shivaji Court	480	Shivaji Court	111	Jangli Maharaj temple

S.No	Intersection	Total Pedestrian Traffic		Across Traffic							
		Morning Peak Hour	Evening Peak Hour	Morning Peak				Evening Peak			
				Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow		Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow	
17	Shivaji Nagar Chowk	09-00-10-00	17-15-18-15	781	University	103	Bus Station	1029	University	202	Bus Station
18	Chaphekar Chowk	09-45-10-45	19-00-20-00	314	University	122	Joshi Marg	431	Sancheti	48	Joshi Marg
19	University Chowk	11-00-12-00	17-00-18-00	565	Baner	300	University	475	University	92	Baner
20	Balewadi Phata	08-45-09-45	18-15-19-15	687	University	166	Balewadi	601	University	215	Baner
21	Western Bypass Junction	08-30-09-30	18-45-19-45	65	Highway (Pune)	24	Highway (Mumbai)	157	Highway (Pune)	95	Highway (Mumbai)
23	Flyover Junction	09-45-10-45	19-00-20-00	69	Chandni Chowk	69	Chandni Chowk	74	Chandni Chowk	74	Chandni Chowk
24	Bandal Capital Junction	09-45-10-45	18-30-19-30	444	Deccan Gymkhana	172	Chandni Chowk	364	Deccan Gymkhana	255	Chandni Chowk
25	IIACR	11-00-12-00	18-00-19-00	123	Deccan	62	Military	515	Deccan	258	Military
26	Milind Dhole Chowk	09-45-10-45	19-00-20-00	298	Deccan Gymkhana	58	Sutarwadi	274	Deccan Gymkhana	82	Sutarwadi
27	Shivtirth Nagar Chowk	08-30-09-30	17-00-18-00	171	Chandni Chowk	86	Shivtirth Nagar	240	Chandni Chowk	120	Shivtirth Nagar
28	MIT Chowk	10-00-11-00	18-45-19-45	93	Chandni Chowk	47	MIT college	108	Chandni Chowk	36	Deccan
29	Paud Road Junction	10-00-11-00	17-30-18-30	119	Karve Road	51	Paud Road	124	Karve Road	49	Paud Road
30	Khandojibaba Chowk	08-45-09-45	17-15-18-15	355	Deccan Gymkhana	320	Tilak Road	675	Deccan Gymkhana	315	Tilak Road
31	Karve Chowk	08-45-09-45	17-30-18-30	347	Kothrud	84	Park Road	274	Paud Flyover	180	Sunder Nagar
32	S. G. Barve Chowk	11-00-12-00	18-30-19-30	186	Deccan Gymkhana	100	Sancheti Hospital	238	Deccan Gymkhana	67	Corporation (PMC)
33	Hegdewar Chowk	09-00-10-00	17-30-18-30	658	PMC Road	325	Shaniwarwada	626	PMC Road	454	Shaniwarwada
34	Hutatma Chowk	09-15-10-15	17-45-18-45	614	Mandi Chowk	243	Corporation (PMC)	1526	Corporation (PMC)	918	Mandi Chowk
35	Mandi Chowk	11-00-12-00	18-00-19-00	297	Shaniwarwada	111	Swargate	525	Shaniwarwada	76	Swargate
36	Phad Gate Chowk	11-00-12-00	18-00-19-00	175	Bahawani Road	79	Shaniwarwada	356	Bahawani Road	125	Swargate
37	Rashtra Bhushan Chowk	10-45-11-45	17-15-18-15	160	Shaniwarwada	84	Swargate	222	Swargate	91	Hirabaug

S.No	Intersection	Total Pedestrian Traffic		Across Traffic							
		Morning Peak Hour	Evening Peak Hour	Morning Peak				Evening Peak			
				Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow		Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow	
38	Swargate Junction	11-00-12-00	18-15-19-15	200	Shivaji Nagar	86	Dhanakwadi	254	Tukdoji Maharaj	108	Tilak Road
39	Savarkar Chowk	11-00-12-00	19-00-20-00	127	Shaniwarwada	88	Sinhgad Road	106	Sinhgad Road	82	Katraj
40	Dandekar Chowk	10-45-11-45	17-45-18-45	175	Laxmi Road	73	Sinhgad Road	472	Sarasbagh Road	89	Sinhgad Road
41	Karve Nagar Road Chowk	10-00-11-00	17-00-18-00	192	Swargate	47	Karve Nagar Road	219	Swargate	94	Western Bypass
42	Madhukar General Hospital	08-00-09-00	18-30-19-30	519	Swargate Road	59	Anand Nagar Road	388	Swargate Road	235	Sinhgad Road
43	Western Bypass Junction	08-30-09-30	19-00-20-00	135	Dhyari Phata	43	Katraj	101	Katraj	76	Dhyari Phata
44	Dhyari Phata	10-45-11-45	17-15-18-15	291	Dhyari Gaon	81	Swargate	632	Sinhgad Road	268	Swargate
45	Veer Netaji Palkar Chowk	09-45-10-45	17-15-18-15	263	Katraj	57	Maharishi Road	240	Katraj	75	Maharishi Road
46	Tukdoji Maharaj Chowk	10-45-11-45	17-00-18-00	215	Swargate	90	Sahakar Nagar	333	Swargate	155	Sahakar Nagar
47	NE Puram Chowk	11-00-12-00	17-00-18-00	163	Shaniwarwada	55	Deccan	267	Shaniwarwada	40	Deccan
48	Shanipar Chowk	11-00-12-00	17-15-18-15	562	Shaniwarwada	187	Saras bag	657	Bhaji Mandi	272	Saras bagh
49	Lakshmi Road Junction	10-45-11-45	17-00-18-00	415	Deccan	141	Belbag chowk	599	Saras bag	255	Belbag chowk
50	Appa Balwant Chowk	11-00-12-00	17-15-18-15	454	Shaniwarwada	197	Sarasbagh	493	Shaniwarwada	274	Deccan
51	Vasant Date Chowk	10-45-11-45	18-30-19-30	271	Saras Bagh	121	Pulachiwadi	663	Saras Bagh	217	Pulachiwadi
52	Ambedkar Bhavan Chowk	09-15-10-15	18-00-19-00	625	Maldhakka Chowk	98	Pune Station	297	Maldhakka Chowk	171	Nehru Road
53	Rajgopalchari Chowk	11-00-12-00	18-30-19-30	102	M. G. Road	70	Pune Station	175	Swargate	49	Kasaba Peth
54	Sant Kabir Chowk	10-15-11-15	19-00-20-00	184	Swargate	93	Pune Station	233	Laxmi Road	93	Pune Station
55	Police Chowki	10-30-11-30	18-30-19-30	259	Swargate	92	Pune Station	206	Swargate	128	Pune Station

S.No	Intersection	Total Pedestrian Traffic		Across Traffic							
		Morning Peak Hour	Evening Peak Hour	Morning Peak				Evening Peak			
				Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow		Arm with Max. Peak Hr. Flow		Arm with Min. Peak Hr. Flow	
	Junction										
56	Dhole Patil Chowk	09-15-10-15	17-45-18-45	234	Swargate	80	Pune Station	266	Swargate	57	Pune Camp
57	Bhide Chowk	09-45-10-45	18-00-19-00	140	Maharishi Nagar	84	Satara	151	Pune Station	42	Satara
58	Post Office Junction	10-45-11-45	17-00-18-00	102	Maharishi Nagar	57	Pune Station	122	Maharishi Nagar	37	Pune Station
59	Aai Maata Chowk	08-00-09-00	19-00-20-00	286	Kondhwa	91	Bibdewadi	330	Kondhwa	181	Bibdewadi

Annexure 6 - Directional Distribution of Traffic (PCUs) At Approach Arms of Intersections

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
1	Vishrantwadi Chowk (INT 01)	Bombay Sappers	2472	2230	1927	2655
		Alandi	2285	2609	2178	2069
		Dhanori	929	904	1236	856
		Airport	1159	1103	1295	1057
2	Dr. Ambedkar Chowk (INT 02)	Alandi	983	1365	994	2694
		Golf Club	629	948	1101	692
		Bombay Sappers	1665	964	2331	1040
3	Bombay Sappers Chowk (INT 03)	Yerawada	1774	1776	2244	1351
		Sangamwadi	937	1179	1050	998
		Khadki	2224	1345	1526	1888
		Alandi	1441	2077	1322	1906
4	Yerawada Junction (INT 04)	Bund Garden	2025	1440	2106	1489
		Alandi	1378	1923	1361	2026
		Ramwadi Naka	2194	2233	2165	2116
5	Gunjan Talkies Jn. (INT 05)	Yerawada	2935	2549	3424	2778
		Airport	1337	1502	1056	1788
		Ramwadi	1748	1968	2421	2336
6	Kalyani Nagar Junction (INT 06)	Kalyani Nagar Road	656	3703	902	1696
		Yerawada Road	3188	2440	2965	2718
		Golf Club Road	687	1064	1324	1176
		Shastri Nagar Road	346	176	395	394
		Nagar Road	5215	2709	4331	3932
7	Ramwadi Naka Jn. (INT 07)	Kalyani Nagar	1114	1175	1256	1708
		Gunjan Talkies	2942	3138	2904	2750
		Viman Nagar	4128	3872	4235	3937
8	Viman Nagar Jn. (INT 08)	Ramwadi Naka	4134	3514	4220	3043
		Viman Nagar	1370	2132	1890	2851

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
		Mundhwa Bypass	3657	3516	2934	3150
9	Mundhwa Bypass Jn. (INT 09)	Mundhwa Bypass	1751	2878	2417	2922
		Viman Nagar	3966	3421	3212	3305
		Ahmadnagar	3494	2911	4427	3829
10	Gold Club Jn. (INT 10)	Gunjan Talkies	2887	1734	3797	3226
		Ambedkar Hall	2084	3532	3159	5386
		Airport	1943	2635	4845	3942
		IBM Call Centre	2456	1469	3502	2749
11	509 Chowk (INT 11)	Gunjan Talkies	676	1310	706	1228
		Vishrantwadi	1256	563	1053	604
		Indira Nagar	128	120	64	190
		Airport	536	602	873	673
12	Hot Mix Junction (INT 12)	Golf Club Road	1169	939	1000	1801
		Ambedkar College	470	351	449	404
		Alandi Road	888	880	1349	815
		Agrasen Road	364	721	764	541
13	St. Joseph School Jn. (INT 13)	Sancheti	3058	2737	3790	3255
		Aundh	937	1241	1007	1565
		Khadki Railway Stn.	2071	2018	2534	2302
		Khadki Bazaar	446	516	490	698
14	Range Hill Chowk (INT 14)	Sancheti	3544	4086	2231	985
		Range Hill Road	394	925	252	819
		Khadki	4837	3312	1044	2309
		Airport Road	730	1182	915	329
15	Engineering College Chowk (INT 15)	Engineering College	3006	3086	3780	3208
		Sancheti	3094	4007	3523	3971
		Wakdewadi	3801	2808	3882	4006
16	Sancheti Junction (INT	Engineering College	3068	2935	3136	2411

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
	16)	Shivaji Nagar Court	1410	2274	1765	1886
		Jangli Maharaj Road	1253	1646	1326	1773
		University Road	3495	2372	2544	2703
17	Shivaji Nagar Chowk (INT 17)	Sancheti	2743	2463	2218	2575
		Shivaji Road	2588	3911	1989	2085
		University Road	5112	2862	2830	2642
		Bus Station Road	1235	2442	1818	1554
18	Chaphekar Chowk (INT 18)	Sancheti Road	1122	828	1162	689
		FC Road	2206	1869	1971	1529
		University Road	1705	1527	1134	2188
		Joshi Marg	1297	2106	1136	997
19	University Chowk (INT 19)	Sancheti Road	3885	4426	3192	4616
		Pashan Road	1097	503	1148	816
		Baner Road	1735	1436	1492	673
		Ganeshkhind Road	1112	1518	1943	1520
		University Road	511	456	45	195
20	Balewadi Phata (INT 20)	University Road	1344	923	1756	1218
		Baner Road	902	1118	711	1655
		Balewadi Stadium	1041	1246	1763	1357
21	Western Bypass Junction (INT 21)	Highway (Mumbai)	2396	2590	2758	2414
		Balewadi Bypass	376	600	495	578
		Highway (Pune)	2590	2173	2414	2676
22	Chandni Chowk Junction (INT 22)	Paud Road	429	2322	635	1115
		Bypass (Mumbai)	0	686	0	462
		Bypass (Pune)	1122	0	732	0
		Kothrud	2083	626	1093	882
23	Flyover Junction (INT 23)	Chandni Chowk	422	1578	1075	1139
		Westerly Bypass	961	0	1611	0

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
		Kothrud	1501	1312	991	2538
24	Bandal Capital Junction (INT 24)	Bus Depot	98	415	85	263
		Chandni Chowk	1456	1787	1566	1569
		Bhosari Colony	327	431	296	392
		Deccan Gymkhana	2266	1589	1947	1674
25	IIACR (INT 25)	Military	745	1157	1010	1850
		Deccan Gymkhana	1600	541	1327	619
		Chandni Chowk	1230	1878	1980	1847
26	Milind Dhole Chowk (INT 26)	Sutarwadi	329	144	535	271
		Deccan Gymkhana	1189	1751	1290	1842
		Chandni Chowk	1587	1209	1444	1157
27	Shivtirth Nagar Chowk (INT 27)	Shivtirth Nagar	683	1084	644	818
		Deccan Gymkhana	2979	1691	2958	2862
		Chandni Chowk	1601	2489	2568	2489
28	MIT College Chowk (INT 28)	MIT College	161	439	194	498
		Deccan Gymkhana	2045	1464	2420	1960
		Ideal Colony	323	316	567	447
		Chandni Chowk	1592	1902	2188	2464
29	Paud Road Junction (INT 29)	Khandojibaba Chowk	2677	4481	2842	3695
		Karanjkar Road	449	1555	724	1790
		Karve Road	2910	2078	2052	1821
		Paud Road	2749	672	2799	1111
30	Khandojibaba Chowk (INT 30)	Tilak Road	1834	2149	1892	2073
		Karve Road	2584	2359	2603	2326
		Deccan Gymkhana Road	2893	2803	2735	2830
31	Karve Chowk (INT 31)	Paud Flyover	1643	2486	3187	2453
		Park Road	1290	652	982	1149
		Kothrud Road	2577	1664	2637	2736

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
		Sundar Nagar Road	1646	2354	2303	2770
32	S.G. Barve Chowk (INT 32)	Sancheti Hospital	1583	1547	2093	1692
		Corporation (PMC)	3636	1914	2382	2526
		Deccan Gymkhana	1964	1679	2253	2009
		Shivaji Nagar	1930	3972	2257	2759
33	Hegdewar Chowk (INT 33)	Bajirao Road	3472	0	3881	0
		Corporation (PMC)	1461	1680	1696	1663
		Pune Station	544	654	805	900
		Kasaba Peth	238	485	335	596
		Shaniwarwada	0	2895	0	3558
34	Hutatma Chowk (INT 34)	Appa Balwant Chowk	1737	853	1823	881
		Corporation (PMC)	2432	0	4989	0
		Moti Chowk	0	1109	0	1243
		Mandi Chowk	0	2207	0	4689
35	Mandai Chowk (INT 35)	Mandi Road	241	491	562	416
		Shaniwarwada	1824	0	1697	0
		Swargate	0	1574	0	1843
36	Phad Gate Chowk (INT 36)	Bajirao Road	314	43	342	64
		Shaniwarwada	1652	0	2094	0
		Bahawani Road	243	627	296	564
		Swargate	0	1540	0	2104
37	Rashtra Bhushan Chowk (INT 37)	Hirabaug	559	933	1307	837
		Shaniwarwada	2012	0	2449	0
		Ghorpadi Path	869	966	1205	1386
		Swargate	0	1542	0	2737
38	Swargate Junction (INT 38)	Dhanakwadi	3479	2079	3281	2345
		Tukdoji Maharaj Chowk	1222	2418	1190	3105
		Tilak Road	1365	1809	2201	1187

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
		Shivaji Nagar	1959	0	2693	0
		Pune Camp	3298	5016	2604	5332
39	Savarkar Chowk (INT 39)	Katraj Road	2905	2321	2884	2717
		Sinhgad Road	2587	1937	2225	2496
		Bajirao Road	1457	2690	2826	2722
40	Dandekar Chowk (INT 40)	Sarasbagh Road	2605	2658	2798	2961
		Janta Vasahat Road	193	108	221	113
		Sinhgad Road	2501	2297	3083	2872
		Laxmi Road	1899	2135	2112	2269
41	Karve Nagar Road Chowk (INT 41)	Western Bypass	2291	1809	2706	2542
		Karve Nagar Road	1353	1153	1969	1504
		Swargate Road	1715	2398	2211	2839
42	Madhukar General Hospital (INT 42)	Swargate Road	1984	3109	6396	2433
		Suvarna Nagar Road	309	162	401	239
		Sinhgad Road	2131	1795	2192	6030
		Anand Nagar Road	1226	584	687	974
43	Western Bypass Jn. (INT 43)	Swargate Road	2166	2597	2605	2421
		Katraj Road	1937	667	1402	897
		Dhyari Phata Road	1617	2456	1927	2616
44	Dhyari Phata (INT 44)	Swargate Road	2170	1843	3360	1807
		Dhyari Gaon	1018	1143	908	2298
		Sinhgad Road	978	1180	1316	1479
45	Netaji Palkar Chowk (INT 45)	Saras Bagh	3141	3884	4118	3797
		Maharishi Road	1694	1926	1945	2445
		Katraj	1755	1522	1644	2146
		Mitra Mandal Sc.	460	13	307	25
		Parvati	679	384	673	274

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
46	Tukdoji Maharaj Chowk (INT 46)	Swargate	1894	1189	2326	1731
		Sahakar Nagar	1933	1206	2290	1623
		Shaniwarwada	335	1767	610	1873
47	N E Puram Chowk (INT 47)	Swargate	1695	913	1548	1083
		Saras Bagh	1605	564	1832	1126
		Nilayam talkies	1538	0	909	0
		Deccan	1231	1500	2170	1208
		Shaniwarwada	0	3091	0	3042
48	Shanipar Chowk (INT 48)	Saras bag	2580	0	1734	0
		Shanipar Road	39	556	46	625
		Shaniwar wada	0	2695	0	1749
		Bhaji Mandai	760	107	756	162
49	Laxmi Road Junction (INT 49)	Saras bag	2293	0	2396	0
		Deccan	0	1405	0	1608
		Shaniwar wada	0	2105	0	2334
		Belbag Chowk	1217	0	1546	0
			Inflow	**Outflow**	**Inflow**	**Outflow**
50	Appa Balwant Chowk (INT 50)	Sarasbagh	3702	0	4608	0
		Deccan	1197	1368	1292	1458
		Shaniwarwada	0	2870	0	3728
		Sonyamaruti	1144	1805	1213	1747
51	Vasant Date Chowk (INT 51)	Pulachiwadi	660	477	1045	647
		Shaniwarwada	0	2398	0	3763
		Saras Bagh	2214	0	3365	0
52	Ambedkar Bhawan Chowk (INT 52)	Maldhakka Chowk	626	874	609	809
		Pune Station	0	3261	0	3883
		Nehru Road	2152	0	2284	0

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
		Corporation (PMC)	2704	1347	3332	1532
53	Rajgopalchari Chowk (INT 53)	M. G. Road	994	914	1767	1146
		Swargate	1360	1036	1584	1601
		Kasaba Peth	690	854	774	1233
		Pune Station	478	719	543	687
54	Sant Kabir Chowk (INT 54)	Pune Camp	1146	917	1826	1189
		Swargate	1719	1031	2050	1356
		Laxmi Road	794	1150	991	2077
		Pune Station	755	1316	1108	1352
55	Ramoshi Gate Police Chowki (INT 55)	Swargate	1975	1631	1824	2493
		Timber Market	938	0	978	0
		Mandai	345	0	362	0
		Pune Station	1228	2079	2256	1919
		Pul Gate	90	865	98	1106
56	Dhole Patil Chowk (INT 56)	Pune Camp	1248	1892	1311	2027
		Maharishi Nagar	2526	2247	2321	2025
		Swargate	3476	1540	1629	1852
		Pune Station	2099	3669	2360	1718
57	Bhide Chowk (INT 57)	Kondhwa	998	1100	1227	1228
		Maharishi Nagar	1583	1204	2083	1667
		Satara	605	764	528	913
		Pune Station	1123	1240	1543	1573
58	Post Office Chowk (INT 58)	Maharishi Nagar	1499	931	1349	1393
		Satara Road	1721	1701	1629	1512
		Pune Station	1674	2263	1759	1832
59	Aai Mata Chowk (INT 59)	Kondhwa	2956	1816	1712	1247
		Saral Sukhsagar	486	901	690	924
		Bibdewadi	2486	1293	1846	1310

Sr. No	Location	Approach Arm	Morning Peak		Evening Peak	
			Inflow	Outflow	Inflow	Outflow
		Pune Station	978	2896	1114	1881

Annexure 7 - Pedestrian Flows at Mid Blocks

S. No.	Mid Block	Road Name	Peak Duration		Across Traffic	
			Morning Peak	Evening Peak	Morning Peak	Evening Peak
1	Jeevan Jyot Hospital	Nagar Road	0945 - 1045	1700 - 1800	91	159
2	Nobili School		1000 - 1100	1745 - 1845	230	255
3	Kendriya Vidyalala		1100 - 1200	1845 - 1945	240	343
4	Rakshak Hospital		1015 - 1115	1800 - 1900	306	543
5	Don Bosco School	Deccan College Road	0915 - 1015	1600 - 1700	89	215
6	Corporation School		0830 - 0930	1630 - 1730	213	260
7	Shivaji Nagar Railway Station	Old NH4	1100 - 1200	1715 - 1815	796	627
8	Sail Chambers (Hero Honda Showroom)		0915 - 1015	1900 - 2000	335	588
11	Aundh Road		1100 - 1200	1600 - 1700	580	604
14	MIT College	Paud Road	1100 - 1200	1845 - 1945	240	343
15	Krishna Hospital		0915 - 1015	1745 - 1845	61	92
16	Moti Ram Complex		0815 - 0915	1745 - 1845	104	125
17	Rahul Complex		0915 - 1015	1645 - 1745	414	335
18	Maharaja Complex		1045 - 1145	1800 - 1900	393	228
19	Garware College	Karve Road	1045 - 1145	1645 - 1745	712	463
20	Nal Stop Chowk		0845 - 0945	1745 - 1845	195	208
21	Abhinav Chowk		1100 - 1200	1645 - 1745	206	290
22	Kothrud Bus Station		0930 - 1030	1830 - 1930	392	429
23	Kaamat Hotel		1100 - 1200	1745 - 1845	467	269
24	Karve Nagar Chowk(Cummins College)		1100 - 1200	1800 - 1900	1065	919
25	Mangala Theatre	Shivaji Road	1015 - 1115	1715 - 1815	151	141
26	Shaniwarwada		0800 - 0900	1815 - 1915	253	310
27	Vasant Cinema		0915 - 1015	1630 - 1730	402	558
28	Peshwa Ganesh Temple		0845 - 0945	1630 - 1730	144	179

S. No.	Mid Block	Road Name	Peak Duration		Across Traffic	
			Morning Peak	Evening Peak	Morning Peak	Evening Peak
29	Kaka Halwai		1030 - 1130	1600 - 1700	550	510
30	Dagdu Halwai		0930 - 1030	1630 - 1730	634	655
31	Ambidwada	Sinhgad Road	1100 - 1200	1730 - 1830	233	283
32	Dattawadi Police Chowki		1100 - 1200	1730 - 1830	224	414
33	Deshpande Garden Chowk		1100 - 1200	1715 - 1815	79	172
34	Hotel Girija		1030 - 1130	1815 - 1915	158	148
35	Ghar Sansar		1030 - 1130	1715 - 1815	601	603
36	Hotel Sulabha		1100 - 1200	1745 - 1845	47	133

Annexure 8 - Pedestrian Vehicular Interactions at Intersections

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
1	Vishrantwadi	Bombay Sappers	Evening	640	5903	223.01
		Alandi		147	5048	37.46
		Dhanori		239	2791	18.62
		Air port		285	3262	30.33
2	Alandi Junction	Alandi	Evening	27	2585	1.80
		Golf Club		24	1783	0.76
		Alandi		117	2380	6.63
3	Bombay Sappers	Yerawada	Evening	83	3724	11.51
		Sangamwadi		224	2483	13.81
		Khadki		269	3815	39.15
		Alandi		231	3672	31.15
4	Yerawada Jn.	Alandi Road	Morning	935	3011	85
		Ramwadi naka		873	4466	174
5	Gunjan Talkies Junction	Yerawada	Evening	295	6544	126.33
		Airport		525	3116	50.97
		Ramwadi Naka		481	4686	105.62
6	Kalyani Nagar Junction	Kalyani Nagar Road	Evening	77	3128	7.53
		Yerawada Road		167	6492	70.38
		Golf Club Road		81	2376	4.57
		Shastri Nagar Road		88	1110	1.08
7	Ramwadi Naka Jn.	Gunjan Talkies Road	Evening	236	5577	73.40
		Viman Nagar Road		264	8634	196.80

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Kalyani Nagar Road		81	3439	9.58
8	Viman Nagar Jn	Ramwadi Naka Road	Evening	238	5029	60.19
		Viman Nagar Road		477	2516	30.20
		Mundhwa Bypass Road		710	5440	210
9	Mundhwa Bypass Junction	Viman Nagar Road	Evening	421	5384	122.04
		Ahmadnagar Road		180	6796	83.13
		Mundhwa Bypass		262	4278	47.95
10	Golf Club Junction	Ambedkar Hall	Morning	327	5403	95.46
		Airport		205	5400	59.78
		IBM Call Centre		308	4024	49.87
		Gunjan Talkies		390	5065	100.05
11	509 Chowk	Vishrantwadi	Morning	59	2015	2.40
		Airport		402	1210	5.89
12	Hot Mix Plant Junction	Ambedkar College	Evening	67	845	0.48
		Alandi Road		62	1820	2.05
		Agrasen Road		41	1515	0.94
		Golf Club Junction		152	2574	10.07
13	ST. Joseph High School Junction	Aundh	Evening	65	2296	3.43
		Khadki Rly Station		53	4860	12.52
		Khadki Bazaar		50	1791	1.60
		Sancheti		89	6291	35.22
14	Range Hill Road Chowk	Range hill Road	Morning	114	1374	2.15
		Khadki		127	6737	57.64

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Airport Road		23	1687	0.65
		Sancheti		204	6656	90.38
15	Engg. College Chowk	Engineering College	Morning	140	5753	46.34
		Sancheti		78	5545	23.98
		Wakdewadi		274	5616	86.42
16	Sancheti Hospital	Shivaji Court	Morning	131	2824	10.45
		Jangli Maharaj temple		289	2960	25.32
		University		367	4289	67.51
		Engg College		565	5321	160
17	Shivaji Nagar Chowk	Shivaji Road	Evening	338	5833	115.00
		University		1029	7079	515.65
		Bus Station		202	4426	39.57
		Sancheti		565	5884	195.61
18	Chaphekar Chowk	F.C. Road	Morning	163	3407	18.92
		University		314	3390	36.09
		Joshi Marg		122	2515	7.72
		Sancheti		166	1818	5.49
19	University Chowk	Pashan Road	Morning	376	2506	23.61
		Baner		565	2924	48.31
		Ganeshkhind		384	3225	39.94
		Sancheti		300	10016	300.96
20	Balewadi Phata	University	Evening	601	2953	52.41
		Baner		215	2656	15.17

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Balewadi		386	2917	32.84
23	Flyover Junction	Chandni Chowk	Evening	74	2366	4.14
24	Bandal Capital	Bus Depot	Evening	255	321	0.26
		Bhosari Colony		364	988	3.55
25	IIACR	Military	Evening	515	3679	69.71
		Deccan		357	3371	40.57
		Chandni Chowk		258	5409	75.33
26	Milind Dhole Chowk	Sutarwadi	Evening	274	932	2.38
		Deccan Gymkhana		163	3821	23.80
		Chandni Chowk		82	3267	8.70
27	Shivtirth Nagar Chowk	Shivtirth Nagar	Evening	199	1331	3.52
		Deccan Gymkhana		240	4215	73
		Chandni Chowk		120	3777	45
28	MIT College Chowk	MIT college	Morning	47	891	0.37
		Deccan		72	4255	13.04
		Chandni Chowk		93	4088	15.54
29	Paud Road Junction	Karve Road	Evening	124	4441	24.46
		Paud Road		49	4947	11.99
		Deccan Gymkhana Road		93	7762	56.03
30	Khandojibaba Chowk	Tilak Road	Evening	315	3542	39.52
		Karve Road		338	5894	117.42
		Deccan Gymkhana Road		675	6348	272.01
31	Karve Chowk	Park Road	Evening	273	3182	27.64

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Kothrud		248	6044	90.59
		Sundar Nagar		180	5789	60.32
		Paud Flyover		274	6499	115.73
32	S.G. Barve Chowk	Corporation (PMC)	Evening	67	6856	31.49
		Deccan Gymkhana		238	4742	53.52
		Shivaji Nagar		168	6660	74.52
		Sancheti Hospital		103	4278	18.85
33	Hegdewar Chowk	Corporation (PMC)	Evening	626	3697	85.56
		Shaniwarwada		454	4558	94.32
34	Hutatma Chowk	Corporation (PMC)	Evening	1526	3350	171
		Mandi Chowk		918	3245	97
35	Mandai Chowk	Swargate	Evening	76	3503	9.33
		Shaniwarwada		525	3553	66.27
36	Phad Gate Chowk	Shaniwarwada	Evening	171	2836	13.75
		Bahawani Road		356	446	0.71
		Swargate		125	2724	9.28
37	Rashtra Bhushan Chowk	Shaniwarwada	Evening	188	2881	15.60
		Ghorpadi Path		97	3279	10.43
		Swargate		222	1888	7.91
		Hirabaug		91	2558	5.95
38	Swargate Junction	Dhanakwadi	Evening	1465	5985	525
		Tukdoji Maharaj Chowk		415	4469	83
		Tilak Road		248	3294	27

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Shivaji Nagar		388	2991	35
		Pune Camp		776	7250	408
39	Sawarkar Chowk	Katraj	Morning	94	6650	41.57
		Sinhgad Road		88	5001	22.01
		Shaniwarwada		127	5887	44.01
40	Dandekar Chowk	Sinhgad Road	Evening	89	6019	32
		Laxmi Road		117	4546	24
		Sarasbagh Road		472	5445	140
41	Karve Nagar Road Junction	Western Bypass	Evening	94	5658	30.09
		Karve Nagar Road		132	3814	19.20
		Swargate		219	6048	80.11
42	Madhukar Hospital Chowk	Sinhgad Road	Evening	235	10193	244.16
		Anand Nagar Road		343	2020	14.00
		Swargate Road		388	11214	487.92
43	Western Bypass Junction	Swargate	Evening	94	6705	42.26
		Katraj		101	2552	6.58
		Dhyari Phata		76	6121	28.47
44	Dhyari Phata Junction	Swargate	Evening	268	4313	49.85
		Dhyari Gaon		392	2314	20.99
		Sinhgad Road		632	2771	48.53
45	Netaji Palkar Chowk	Saras Bagh	Evening	75	9101	62.12
		Maharishi Road		240	4970	59.28
		Katraj		86	4613	18.30

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Parvati		95	1354	1.74
46	Tukdoji Maharaj Chowk	Sahakar Nagar	Evening	155	4196	27.29
		Shaniwarwada		171	2858	13.93
		Swargate		333	3978	52.70
47	NE Puram Chowk	Swargate	Evening	199	3463	23.86
		Saras Bagh		50	3710	6.88
		Nilayam talkies		40	1064	0.45
		Deccan		267	4173	46.50
		Shaniwarwada		76	3572	9.70
48	Shanipar Chowk	Saras bag	Evening	647	3185	65.63
		Shanipar road		545	839	3.84
		Shaniwar wada		657	3232	68.63
		Bhaji Mandi		272	1318	4.72
49	Lakshmi Road Chowk	Saras bag	Evening	492	3020	44.87
		Deccan		398	1949	15.12
		Shaniwar wada		255	2905	21.52
		Belbag chowk		599	1834	20.15
50	Appa Balwant Chowk	Sarasbagh	Evening	274	5977	97.89
		Deccan		493	3225	51.28
		Shaniwarwada		450	5127	118.29
		Sonyamaruti		328	3759	46.35
51	Vasant Date Chowk	Pulachiwadi	Evening	434	1993	17.24
		Shaniwarwada		663	4074	110.04

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Saras Bagh		217	3971	34.22
52	Ambedkar Bhawan Chowk	Pune Station	Morning	98	2756	7.44
		Nehru Road		245	2289	12.84
		Corporation (PMC)		184	3431	21.66
		Maldhakka Chowk		625	1312	10.76
53	Rajagopalachari Chowk	Swargate	Evening	175	3604	22.73
		Kasaba Peth		49	2515	3.10
		Pune Station		90	1485	1.98
		M. G. Road		128	3486	15.55
54	Sant Kabir Chowk	Swargate	Evening	159	4261	28.87
		Laxmi Road		233	3718	32.21
		Pune Station		93	3082	8.83
		Pune Camp		170	3709	23.39
55	Ramoshi Gate Police Chowki	Swargate	Evening	206	5040	52.33
		Mandai		138	374	0.19
		Pune Station		128	5084	33.08
		Swargate		153	1497	3.43
56	Dhole Patil Chowk	Maharishi Nagar	Morning	81	4599	17.13
		Swargate		234	3823	34.20
		Pune Station		80	5109	20.88
		Pune Camp		172	3219	17.82
57	Bhide Chowk	Maharishi Nagar	Morning	140	4331	26.26
		Satara		84	1686	2.39

S.No.	Intersection	Pedestrian Crossing Arm/Direction	Higher Peak Period (Morning/Evening)	Heavy pedestrian Crossing Arm(P)	Peak Hr bi-directional Vehicular Traffic(V)	PV^2 Value Across the Arm(in 10^8)
		Pune Station		89	3669	11.98
		Kondhwa		114	2994	10.22
58	Post Office Chowk	Maharishi Nagar	Morning	102	2755	7.74
		Satara Road		97	3711	13.36
		Pune Station		57	4370	10.89
59	Aai Mata Chowk	Bibdewadi	Evening	181	3660	24.25
		Kondhwa		330	3357	37.19

Annexure 9 - Pedestrian Vehicular Interactions at Mid Blocks

S. No.	Mid Block	Higher Peak Period	Max Peak Value	Peak Hr bi-directional vehicular traffic	PV2 Value Across the Arm(in 10^8)
1	Jeevan Jyot Hospital	Evening	159	6188	60.88
2	Nobili School	Evening	255	7920	159.95
3	Kendriya Vidyalala	Evening	343	5398	117.10
4	Rakshak Hospital	Evening	543	5484	163.30
5	Don Bosco School	Evening	215	1721	6.37
6	Corporation School	Evening	260	2159	12.12
7	Shivaji Nagar Railway Station	Morning	796	6667	353.81
8	Sail Chambers (Hero Honda Showroom)	Evening	588	7757	353.81
11	Aundh Road	Evening	604	1631	16.07
14	MIT College	Evening	343	5628	172.00
15	Krishna Hospital	Evening	92	5396	26.79
16	Moti Ram Complex	Evening	125	5623	39.52
17	Rahul Complex	Morning	414	4640	89.13
18	Maharaja Complex	Morning	393	2907	33.21
19	Garware College	Morning	712	5391	206.93
20	Nal Stop Chowk	Evening	208	5820	70.45
21	Abhinav Chowk	Evening	290	8180	194.05
22	Kothrud Bus Station	Evening	429	5236	117.61
23	Kaamat Hotel	Morning	467	4248	84.27
24	Karve Nagar Chowk(Cummins College)	Morning	1065	4248	192.18
25	Mangala Theatre	Morning	151	3014	13.72
26	Shaniwarwada	Evening	310	4100	52.11
27	Vasant Cinema	Evening	558	3842	82.37
28	Peshwa Ganesh Temple	Evening	179	6156	67.83

S. No.	Mid Block	Higher Peak Period	Max Peak Value	Peak Hr bi-directional vehicular traffic	PV2 Value Across the Arm(in 10^8)
29	Kaka Halwai	Morning	550	2812	43.49
30	Dagdu Halwai	Evening	655	2945	100.43
31	Ambidwada	Evening	283	4711	62.81
32	Dattawadi Police Chowki	Evening	414	5942	146.17
33	Deshpande Garden Chowk	Evening	172	5920	60.28
34	Hotel Girija	Morning	158	4655	34.24
35	Ghar Sansar	Evening	603	6787	277.76
36	Hotel Sulabha	Evening	133	8317	92.00

Annexure 10 – Parking Supply

Location	Area (Sq.M)	Available ECS
Alandi Road (BRT-3)		
Bombay sapper (LHS)	360.00	29
Bombay sappers (RHS)	192.50	15
Rajiv Gandhi Hospital (LHS)	700.00	56
Guru Datta Temple-LHS	1080.00	86
Joshi Vadewalw (LHS)	390.00	31
Mayur Jewellers (LHS)	1300.00	104
Near Vishrantwadi Jn.-RHS	1190.00	95
Near Yerrawada Jn.-RHS	390.00	31
Satyam Arcade (LHS)	480.00	38
Vishrantwadi Jn. (LHS)	1625.00	130
Vishrantwadi Police Chowk-RHS	807.50	65
Total	**8515.00**	**680**
Paud Road (BRT-13)		
Bandal Capital LHS	1105.00	88
Bandal Capital RHS	640.00	51
Jai Bhavani Nagar-RHS	420.00	34
Krishna Hospital-LHS	330.00	26
Maharaja Complex-LHS	812.50	65
Before Milind Dhole Chowk-LHS	345.00	28
Rahul Complex-LHS	977.50	78
Raj Laxmi Garden-RHS	332.50	27
Reliance Fresh-LHS	660.00	53
Rohan corner-RHS	770.00	62
After Milind dhule chowk (RHS)	240.00	19
Beheda Complex,Bank of India	250.00	20

Location	Area (Sq.M)	Available ECS
Bhosale Complex	700.00	56
Ishana Complex (LHS)	140.00	11
KPCS House Bank ATM (RHS)	200.00	16
Lohiya Jain Complex (RHS)	425.00	34
Motiram Complex (LHS)	350.00	28
Navjot Market	175.00	14
Planet Ford (RHS)	600.00	48
Reliance fresh (RHS)	950.00	76
Total	**10422.50**	**834**
Shivaji Road (BRT-18)		
Bank of Maharastra-RHS	225.00	18
Before Hutatma Chowk-RHS	161.00	13
Belbag Chowk-LHS	187.50	15
Dhoniba Pisal Chowk	187.50	15
Before Gajraj Chowk-RHS	237.50	19
Khadak Police Station Chowk-LHS	225.00	18
Before Shivaji Chowk	200.00	16
Shivaji Status	487.50	39
After Gotiram Bhaiya Chowk-LHS	126.50	10
Before Swargate Chowk-LHS	332.50	27
Bhagirathi Balwant Niwas-LHS	402.50	32
Bhagirathi Balwant Niwas-RHS	187.00	15
fadgate Police Chowk-LHS	195.00	16
Opp.Shaniwadwada-LHS	507.50	41
Rastrabhusan Chowk-LHS	375.00	30
Shivaji Statue-LHS	490.00	39
Shivaji Statue-RHS	283.50	23
Total	**4810.50**	**385**

Location	Area (Sq.M)	Available ECS
Karve Road (BRT-10)		
Akshay Palace (LHS)	525.00	42
Akshay Palace (RHS)	330.00	26
BSNL Tower (LHS)	332.50	27
Goods carrier/Mrityunjay Mandir (RHS)	550.00	44
Kakade Plaza (LHS)	768.00	61
Sahyadri (LHS)	385.00	31
Savriya Sahkari Bank (LHS)	150.00	12
Cosmos Bank-LHS	272.00	22
Hotel Kamat-LHS	126.00	10
Hotel Yatri-LHS	0.00	0
Kimaya Hotel-RHS	210.00	17
Kothrud Bus Stand-RHS	495.00	40
Sampada Bank-RHS	144.50	12
Sarswat Bank-LHS	165.00	13
Shaswat Hospital-LHS	382.50	31
Universal(RHS)	250.00	20
Total	**4935.50**	**394**
Nagar Road (BRT-4)		
Baburao Niwas (RHS)	420.00	34
Chainage 4300 Truck Parking (RHS)	1350.00	108
Deep Height (RHS)	300.00	24
Gunjan talkies(RHS)	260.00	21
Hotel Guru Krupa (LHS)	1440.00	115
Infront of D'Mello Petrol Pump	275.00	22
In fornt of deep height (LHS)	562.50	45
In front of Navmi Garden Road (LHS)	960.00	77

Location	Area (Sq.M)	Available ECS
Kalyani Nagar Junction (LHS)	575.00	46
MIBS School (LHS)	800.00	64
Next to deep height (RHS)	600.00	48
Rajkamal Complex (RHS)	1100.00	88
Rakshak Hospital (RHS)	540.00	43
Ramwadi Junction (RHS)	900.00	72
Reliance Fresh (RHS)	770.00	62
Tata Consultancy (RHS)	1095.00	88
Tata Consultancy (LHS)	1250.00	100
Total	**13197.50**	**1057**
Singhgad Road (BRT-5)		
Bank of Maharastra (LHS)	245.00	20
Before western express flyover (RHS)	2200.00	176
Chaitanya Hospital (LHS)	300.00	24
City Financial (RHS)	960.00	77
Dass showroom (RHS)	157.50	13
Dhaireswar Mangal Karyalay (LHS)	487.50	39
Gajanan Krupa-Dutta Apartments (LHS)	220.00	18
Gajanan Krupa-Dutta Apartments (RHS)	420.00	34
Hero Honda showroom (RHS)	840.00	67
Infront of shwetambar Mandir (LHS)	135.00	11
Mauli Automobile (RHS)	840.00	67
Motorola Mobile shop (LHS)	247.50	20
MSEB Office (LHS)	200.00	16
Ram Krishnna Math (LHS)	754.00	60
Ram Krishnna Math (RHS)	275.00	22
State Bank of India (LHS)	240.00	19
Vitthal Rukmini Mandir (LHS)	380.00	30

Location	Area (Sq.M)	Available ECS
Pushpak Mangal Karlay-LHS	315.00	25
Narhari Smriti-LHS	845.00	68
Jailakshmi Plywood-RHS	405.00	32
Siddhath complex-RHS	765.00	61
Total	**11231.50**	**899**

Annexure 11 - Parking Volume

Alandi Road (BRT-3)

Location Name	Vehicles								ECS
	Car	2-Wheeler	Auto	Bus	LCV	Tempo	Truck	Total	
Bombay sapper (LHS)	25	82	25	18	1	6	4	161	**147**
Bombay sappers (RHS)	37	138	46	1	1	5	2	230	**136**
Rajiv Gandhi Hospital (LHS)	35	155	77	0	0	0	1	268	**154**
Guru Datta Temple-LHS	24	64	29	0	11	14	14	156	**149**
Joshi Vadewalw (LHS)	74	239	17	0	0	9	1	340	**167**
Mayur Jewellers (LHS)	78	240	8	0	0	7	2	335	**163**
Near Vishrantwadi Jn.-RHS	57	226	37	3	1	6	4	334	**182**
Near Yerrawada Jn.-RHS	9	191	32	0	0	0	0	232	**89**
Satyam Arcade (LHS)	41	329	15	0	1	11	3	400	**165**
Vishrantwadi Jn. (LHS)	66	349	33	2	0	10	5	465	**222**
Vishrantwadi Police Chowk-RHS	40	63	13	2	5	3	3	129	**96**
Total	**486**	**2076**	**332**	**26**	**20**	**71**	**39**	**3050**	**1669**

Paud Road (BRT-13)-One hour Interval

Location Name	Vehicles								ECS
	Car	2-Wheeler	Auto	Bus	LCV	Tempo	Truck	Total	
Bandal Capital LHS	28	277	10	0	1	0	0	316	**109**
Bandal Capital RHS	20	216	21	0	0	0	0	257	**95**
Jai Bhavani Nagar-RHS	14	141	54	24	0	0	4	237	**187**
Krishna Hospital-LHS	78	248	24	0	0	0	0	350	**164**
Maharaja Complex-LHS	33	226	29	42	0	0	0	330	**245**

Before Milind Dhole Chowk-LHS	62	196	59	2	1	0	0	320	**178**	
Rahul Complex-LHS	28	400	11	0	0	0	0	439	**139**	
Raj Laxmi Garden-RHS	39	438	40	4	0	0	0	521	**201**	
Reliance Fresh-LHS	11	371	10	0	0	0	0	392	**114**	
Rohan corner-RHS	39	112	97	0	0	0	3	251	**173**	
Shiv Prasad-LHS	35	90	22	0	2	0	0	149	**83**	
Total	**387**	**2715**	**377**	**72**	**4**	**0**	**7**	**3562**	**1686**	
Paud Road (BRT-13)-Half an hour Interval										
Location Name	**Vehicles**									**ECS**
	Car	**2-Wheeler**	**Auto**	**Bus**	**LCV**	**Tempo**	**Truck**	**Cycle**	**Total**	
After Milind dhule chowk (RHS)	73	153	48	0	2	6	0	21	**303**	**175**
Bandal Capital (LHS)	0	290	19	58	0	0	1	0	**368**	**269**
Bandal Capital (RHS)	62	228	109	29	0	23	3	7	**461**	**360**
Beheda Complex,Bank of India	39	197	7	0	1	3	0	1	**248**	**101**
Bhosale Complex	31	357	8	0	0	0	0	0	**396**	**128**
Ishana Complex (LHS)	54	273	14	1	0	6	0	0	**348**	**148**
Jaibhavani Nagar (RHS)	67	203	45	0	1	27	1	6	**350**	**209**
KPCS House Bank ATM (RHS)	56	160	82	15	1	14	2	4	**334**	**252**
Krishna Hospital (LHS)	58	162	41	4	4	6	0	2	**277**	**167**
Lohiya Jain Complex (RHS)	96	33	29	4	1	6	3	0	**172**	**165**
Maharaja Complex (LHS)	35	203	36	1	4	17	0	6	**302**	**157**
Motiram Complex (LHS)	48	216	47	5	3	12	3	0	**334**	**196**
Navjot Market	66	353	24	0	0	4	0	0	**447**	**184**
Planet Ford (RHS)	104	171	27	5	9	9	8	10	**343**	**242**

Rahul Complex (LHS)	48	411	41	0	2	0	0	0	**502**	**195**
Raj Laxmi Garden (RHS)	53	171	24	0	1	2	0	36	**287**	**131**
Reliance fresh (LHS)	72	278	24	0	3	14	0	24	**415**	**196**
Reliance fresh (RHS)	63	175	25	1	0	0	3	0	**267**	**144**
Rohan Corner (RHS)	47	95	114	0	2	3	1	8	**270**	**197**
Total	**1072**	**4129**	**764**	**123**	**34**	**152**	**25**	**125**	**6424**	**3616**
Shivaji Road (BRT-18)-One hour Interval										
Location Name	**Vehicles**								**ECS**	
	Car	**2-Wheeler**	**Auto**	**Bus**	**LCV**	**Tempo**	**Truck**	**Total**		
Bank of Maharastra-RHS	31	342	31	0	0	1	0	405	**149**	
Before Hutatma Chowk-RHS	12	201	27	12	0	0	4	256	**137**	
Belbag Chowk-LHS	33	292	48	0	1	0	3	377	**165**	
Bhagiratha Balawant Niwas	43	97	52	0	0	13	5	210	**154**	
Dhoniba Pisal Chowk	24	190	37	2	0	16	1	270	**142**	
Before Gajraj Chowk-RHS	0	65	34	19	0	1	1	120	**112**	
Khadak Police Station Chowk-LHS	45	243	92	4	2	8	1	395	**228**	
Before Shivaji Chowk	10	97	24	1	0	2	0	134	**64**	
Shivaji Status	3	150	108	44	0	0	1	306	**284**	
Total	**201**	**1677**	**453**	**82**	**3**	**41**	**16**	**2473**	**1433**	
Shivaji Road (BRT-18)-half an Hour Interval										
Location Name	**Vehicles**								**ECS**	
	Car	**2-Wheeler**	**Auto**	**Bus**	**LCV**	**Tempo**	**Truck**	**Total**		
After Gotiram Bhaiya Chowk-LHS	23	148	145	1	13	12	0	342	**246**	

Bank of Maharastra-RHS	32	310	31	0	0	1	3	377	**151**	
Before Gajraj Chowk-RHS	11	135	26	0	0	0	0	172	**71**	
Before Swargate Chowk-LHS	18	250	72	0	1	8	0	349	**166**	
Belbang Chowk-LHS	40	318	44	0	4	0	0	406	**170**	
Bhagirathi Balwant Niwas-LHS	17	104	62	13	0	1	0	197	**146**	
Bhagirathi Balwant Niwas-RHS	25	252	52	0	1	15	0	345	**164**	
fadgate Police Chowk-LHS	27	75	109	0	5	9	0	225	**176**	
Hutatma Chowk-LHS	28	171	31	1	1	11	1	244	**126**	
Khadak Police Station-LHS	24	183	27	1	1	2	0	238	**104**	
Opp.Shaniwadwada-LHS	59	166	21	1	0	1	0	248	**126**	
Rastrabhusan Chowk-LHS	6	109	14	0	0	0	0	129	**47**	
Shivaji Statue-LHS	116	50	67	0	0	8	0	241	**208**	
Shivaji Statue-RHS	62	161	167	0	0	7	4	401	**292**	
Total	**488**	**2432**	**868**	**17**	**26**	**75**	**8**	**3914**	**2191**	

Karve Road (BRT-10)-One hour Interval

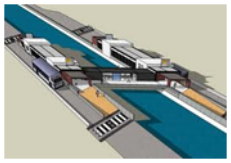
Location Name	**Vehicles**								**ECS**
	Car	**2-Wheeler**	**Auto**	**Bus**	**LCV**	**Tempo**	**Truck**	**Total**	
Akshay Palace (LHS)	4	23	39	5	0	0	0	71	**64**
Akshay Palace (RHS)	0	214	51	18	0	0	0	283	**159**
BSNL Tower (LHS)	0	255	86	1	0	0	1	343	**156**
Goods carrier/Mrityunjay Mandir (RHS)	35	46	28	3	10	3	32	157	**199**
Kakade Plaza-RHS	30	235	72	0	0	22	0	359	**194**
Kakade Plaza (LHS)	0	188	55	15	0	0	7	265	**168**
Sahyadri (LHS)	63	324	27	0	0	0	0	414	**171**

Savriya Sahkari Bank (LHS)	0	236	21	82	0	0	0	339	**326**	
Universal(RHS)	5	126	0	5	0	0	0	136	**52**	
Total	**137**	**1647**	**379**	**129**	**10**	**25**	**40**	**2367**	**1487**	
Karve Road (BRT-10)-Half an hour Interval										
Location Name	**Vehicles**									**ECS**
	Car	**2-Wheeler**	**Auto**	**Bus**	**LCV**	**Tempo**	**Truck**	**Cycle**	**Total**	
Akshay Palace (LHS)	11	45	13	2	4	50	5	2	**132**	**138**
Akshay Palace (RHS)	94	242	59	3	0	32	0	3	**433**	**271**
Bank of Maharastra (LHS)	83	112	126	2	5	12	0	8	**348**	**270**
BSNL Office (LHS)	47	292	57	0	0	3	0	32	**431**	**188**
Cosmos Bank (LHS)	77	259	80	3	12	9	0	29	**469**	**268**
Goods Carrier (LHS)	62	295	25	5	0	33	0	42	**462**	**234**
Hotel Kamat (LHS)	55	48	11	0	0	8	0	0	**122**	**90**
Hotel Yatri (LHS)	49	182	36	0	0	4	0	36	**307**	**144**
Kakade Plaza (LHS)	69	559	23	0	1	10	1	39	**702**	**259**
Kimaya Hotel (RHS)	73	425	40	0	1	3	0	49	**591**	**235**
Kothrud Bus Stand (RHS)	45	131	51	3	2	2	1	0	**235**	**147**
Sahyadri Hospital (LHS)	1	272	11	37	0	0	0	0	**321**	**191**
Sampada Bank (RHS)	130	213	58	0	1	0	3	12	**417**	**254**
Sarswat Bank (LHS)	84	214	87	3	0	6	1	17	**412**	**249**
Shaswat Hospital (LHS)	70	136	20	0	0	1	0	0	**227**	**126**
Universal Plaza (RHS)	18	159	12	0	2	6	0	6	**203**	**83**
Total	**968**	**3584**	**709**	**58**	**28**	**179**	**11**	**275**	**5812**	**3146**
Nagar Road (BRT-4)										

Location Name	Vehicles								ECS	
	Car	2-Wheeler	Auto	Bus	LCV	Tempo	Truck	Total		
Baburao Niwas (RHS)	102	296	80	5	0	23	3	509	**315**	
Chainage 4300 Truck Parking (RHS)	31	61	13	0	9	7	47	168	**224**	
Deep Height (RHS)	121	205	58	0	0	5	12	401	**274**	
Gunjan talkies(RHS)	107	112	128	1	0	0	0	348	**266**	
Hotel Guru Krupa (LHS)	103	200	43	0	0	0	0	346	**196**	
Infront of D'Mello Petrol Pump	29	32	42	4	4	2	14	127	**142**	
In fornt of deep height (LHS)	113	175	51	2	0	22	14	377	**289**	
In front of Navmi Garden Road (LHS)	13	24	7	0	0	13	62	119	**232**	
Kalyani Nagar Junction (LHS)	64	51	43	35	2	11	3	209	**253**	
MIBS School (LHS)	126	32	27	2	4	6	3	200	**191**	
Next to deep height (RHS)	99	123	27	2	9	21	4	285	**220**	
Rajkamal Complex (RHS)	86	121	21	1	0	5	1	235	**151**	
Rakshak Hospital (RHS)	94	33	26	5	11	13	68	250	**383**	
Ramwadi Junction (RHS)	48	88	68	0	64	43	74	385	**521**	
Reliance Fresh (RHS)	61	79	44	2	2	0	3	191	**143**	
Tata Consultancy (RHS)	1	24	11	15	0	2	58	111	**240**	
Tata Consultancy (LHS)	72	18	12	43	0	3	8	156	**246**	
Total	**1270**	**1674**	**701**	**117**	**105**	**176**	**374**	**4417**	**4284**	
Singhgad Road (BRT-5)										
Location Name	**Vehicles**								**ECS**	
	Car	**2-Wheeler**	**Auto**	**Bus**	**LCV**	**Tempo**	**Truck**	**Total**		
Bank of Maharastra (LHS)	51	64	63	1	0	27	10	216	**204**	

Before western express flyover (RHS)	34	128	82	39	0	8	2	293	**283**	
Chaitanya Hospital (LHS)	64	98	68	3	14	36	25	308	**316**	
City Financial (RHS)	85	170	39	2	0	5	2	303	**186**	
Dass showroom (RHS)	54	144	30	0	0	18	0	246	**147**	
Dhaireswar Mangal Karyalay (LHS)	53	190	23	0	0	47	4	317	**206**	
Gajanan Krupa-Dutta Apartments (LHS)	75	127	32	2	0	8	2	246	**163**	
Gajanan Krupa-Dutta Apartments (RHS)	29	228	37	40	1	4	2	341	**257**	
Hero Honda showroom (RHS)	0	54	81	61	0	0	0	196	**278**	
Infront of shwetambar Mandir (LHS)	41	207	34	1	1	0	2	286	**137**	
Mauli Automobile (RHS)	56	207	103	1	0	9	2	378	**233**	
Motorola Mobile shop (LHS)	40	117	23	5	4	0	0	189	**113**	
MSEB Office (LHS)	20	145	21	1	2	6	2	197	**98**	
Ram Krishnna Math (LHS)	45	87	76	3	6	4	0	221	**167**	
Ram Krishnna Math (RHS)	22	111	104	1	1	12	1	252	**179**	
State Bank of India (LHS)	66	385	73	12	0	22	1	559	**307**	
Vitthal Rukmini Mandir (LHS)	64	241	50	0	1	14	9	379	**224**	
Pushpak Mangal Karlay-LHS	49	227	75	0	0	0	0	351	**181**	
Narhari Smriti-LHS	63	158	20	0	0	8	0	249	**135**	
Jailakshmi Plywood-RHS	65	248	26	2	13	21	1	376	**213**	
Siddhath complex-RHS	52	181	33	2	0	4	0	272	**142**	
Total	**1028**	**3517**	**1093**	**176**	**43**	**253**	**65**	**6175**	**4167**	

Annexure 12 – Comparative Analysis of the BRTS across the World

City	Ahmedabad	Delhi	Jaipur	Rajkot	Surat	Bogota
						
General						
Population (mi)	6.4	16.7	3.1	1.6	4.46	6.84
Year of Opening	2009	2008	2010			2000
Total Functioning Length	44.5	14.5	7	29	29.7	86.5
Ridership Capacity (PHPDT)	5000-8000	5000-8000	5000-8000	5000-8000	5000-8000	34000
System Characteristics: Type of System						
Open	NO	YES	YES	NO	NO	NO
Closed	YES	NO	NO	NO	YES	YES
Hybrid	NO	NO	NO	YES	NO	NO
Run way Characteristics						
Run way Segregation						
Dedicated/Reserved Lane	YES	NO	NO	YES	YES	NO
Mixed BRT	NO	NO	NO	NO	NO	NO
Both	NO	YES	YES	NO	NO	YES
Bus Lane Location						
Median/Central	YES	YES	YES	YES	YES	YES
Curb Side	NO	NO	NO	NO	NO	NO
Lane Segregators						
Pavement Marking	NO	NO	NO	NO	NO	NO
Lane Delineators	YES	YES	YES	YES	YES	YES
Colored/Textures Pavement	NO	NO	NO	NO	NO	NO
Pavement Design						
Flexible	YES	YES	YES	NO	NO	NO

City	Ahmedabad	Delhi	Jaipur	Rajkot	Surat	Bogota
Rigid	NO	NO	NO	YES	YES	YES
Station Design						
Station Type						
Simple Stop	NO	YES	NO	NO	NO	NO
Enhanced Stop	YES	YES	YES	YES	YES	YES
Designated Stop	NO	NO	NO	NO	NO	NO
Platform Height						
Standard Curb	NO	NO	NO	NO	NO	NO
Raised Curb	NO	YES	NO	NO	NO	NO
Level Platform	YES	NO	YES	YES	YES	YES
Platform Layout						
Single Veh Platform	NO	YES	NO	YES	NO	NO
Extended Platform with Assigned Berths	YES	NO	YES	NO	YES	YES
Extended Platform with Un-assigned Berths	NO	NO	NO	NO	NO	NO
Passing Capability						
Station with Passing Lanes	NO	NO	NO	NO	YES	YES
Station without Passing Lanes	YES	YES	YES	YES	NO	NO
Station Access						
At grade	YES	YES	YES	YES	YES	YES
Grade separated	NO	NO	NO	YES	NO	YES
Station Placement						
Median Side	YES	YES	NO	NO	YES	YES
Curb Side	NO	YES	YES	YES	NO	NO
Pedestrian Facilities						
At grade	YES	YES	YES	YES	YES	YES
Grade separated	NO	NO	NO	YES	NO	YES

City	Ahmedabad	Delhi	Jaipur	Rajkot	Surat	Bogota
Parking Facilities						
Along the Corridor	YES	NO	NO	YES	YES	YES
At Bus Station	YES	NO	NO	NO	YES	YES
Terminal Facilities	YES	YES	YES	YES	YES	YES
Interchange Facilities	NO	NO	NO	NO	YES	YES

City	Curitiba	Beijing	Guangzhou	Changzhou	Bangkok
					
General					
Population (mi)	1.75	19.61	12.7	4.59	12
Year of Opening	1972	2004	2010	2008	2010
Total Functioning Length	74	54	22.5	44.9	15.3
Ridership Capacity (PHPDT)	20000	3800	27400	7400	1200
System Characteristics: Type of System					
Open	NO	NO	NO	NO	NO
Closed	YES	YES	NO	NO	NO
Hybrid	YES	NO	YES	YES	YES
Run way Characteristics					
Run way Segregation					
Dedicated/Reserved Lane	NO	NO	NO	NO	YES
Mixed BRT	NO	NO	NO	NO	NO
Both	YES	YES	YES	YES	NO
Bus Lane Location					
Median/Central	YES	YES	YES	YES	YES

City	Curitiba	Beijing	Guangzhou	Changzhou	Bangkok
Curb Side	YES	NO	NO	NO	NO
Lane Segregators					
Pavement Marking	NO	NO	NO	NO	NO
Lane Delineators	YES	YES	YES	YES	YES
Colored/Textures Pavement	NO	NO	NO	NO	NO
Pavement Design					
Flexible	YES	YES	YES	YES	YES
Rigid	NO	NO	NO	NO	NO
Station Design					
Station Type					
Simple Stop	NO	NO	NO	NO	NO
Enhanced Stop	YES	YES	YES	YES	YES
Designated Stop	NO	NO	NO	NO	NO
Platform Height					
Standard Curb	NO	NO	NO	NO	NO
Raised Curb	YES	NO	YES	NO	YES
Level Platform	YES	YES	YES	YES	YES
Platform Layout					
Single Veh Platform	YES	NO	NO	NO	NO
Extended Platform with Assigned Berths	YES	YES	NO	YES	YES
Extended Platform with Un-assigned Berths	NO	NO	YES	NO	NO
Passing Capability					
Station with Passing Lanes	YES	NO	YES	NO	NO
Station without Passing Lanes	NO	YES	NO	YES	YES
Station Access					
At grade	YES	YES	YES	YES	YES
Grade separated	NO	YES	YES	NO	YES

City	Curitiba	Beijing	Guangzhou	Changzhou	Bangkok
Station Placement					
Median Side	NO	YES	NO	NO	YES
Curb Side	YES	NO	YES	YES	NO
Pedestrian Facilities					
At grade	YES	YES	YES	YES	YES
Grade separated	NO	YES	YES	NO	YES
Parking Facilities					
Along the Corridor	YES	YES	NO	YES	YES
At Bus Station	NO	NO	NO	NO	NO
Terminal Facilities	YES	YES	NO	NO	YES
Interchange Facilities	YES	YES	YES	YES	YES

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