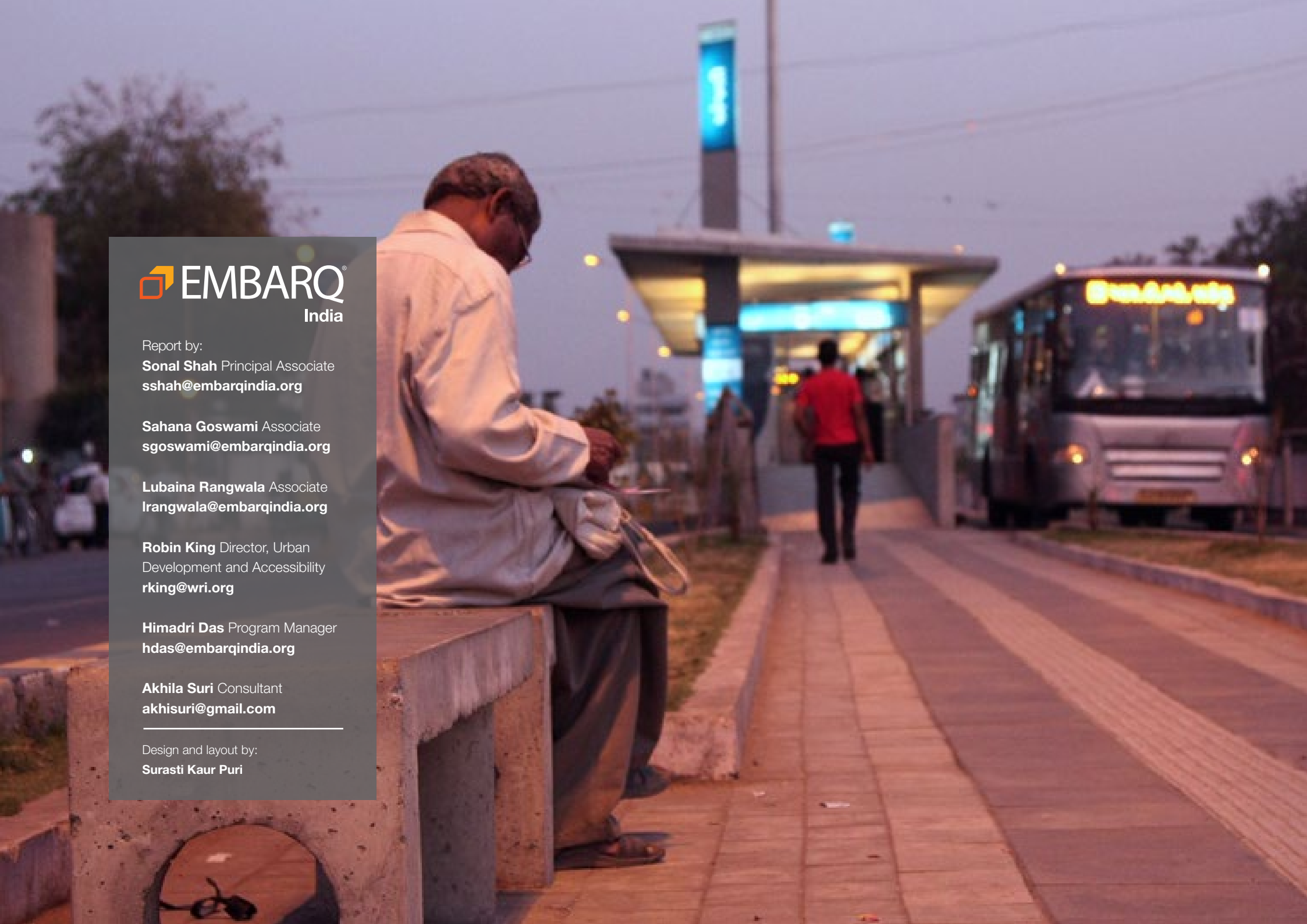
SAFE ACCESS **MANUAL**

Safe access to mass transit stations in Indian cities

EMBARQ India | WRI INDIA



EMBARQ India

Report by:
Sonal Shah Principal Associate
sshah@embarqindia.org

Sahana Goswami Associate
sgoswami@embarqindia.org

Lubaina Rangwala Associate
lrangwala@embarqindia.org

Robin King Director, Urban Development and Accessibility
rking@wri.org

Himadri Das Program Manager
hdas@embarqindia.org

Akhila Suri Consultant
akhisuri@gmail.com

Design and layout by:
Surasti Kaur Puri

WRI INDIA

WRI India is a research organisation with experts and staff who work closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being. We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people. WRI India works on a unique three-fold approach highlighed below;

Count It : We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies.

Change It : We use our research to influence government policies, business strategies and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

Scale It : We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve peoples' lives and sustain a healthy environment.

www.wri-india.org

EMBARQ India

EMBARQ catalyzes and helps implement environmentally, socially, and financially sustainable urban mobility solutions to improve quality of life in cities. Founded in 2002, EMBARQ operates through a global network of offices in Brazil, China, India, Mexico, Turkey, and the United States. EMBARQ collaborates with local and national authorities, businesses, and civil society to reduce pollution, improve public health, and create safe, accessible, and attractive urban public spaces. EMBARQ serves as an independent, trusted advisor, fostering the global transfer of best practices and spearheading projects that lead to impact on the ground and at scale.

EMBARQ India has been actively promoting the development of sustainable transport in a number of Indian cities, its projects and research work spans various fields, like bus operations; Bus Rapid Transit; road safety audits; transit oriented development; station accessibility; non-motorised transport; and para-transit services. EMBARQ India also works actively in the areas of research and policy for sustainable transport.

www.embarqindia.org

CONTENTS

EXECUTIVE SUMMARY

PROVIDING SAFE ACCESS TO **MASS TRANSIT STATIONS**

Urbanization in India has been accompanied by an increase in the use of motorized vehicles. While mass transit projects and transit-oriented development (TOD) have been adopted by some Indian cities to arrest motorized vehicular use, the direct impact of improved accessibility in increasing public transport ridership has received less attention.

Improving access to mass transit in India can serve multiple objectives—leverage 15 billion USD invested in building new public transport systems and provide safe, affordable commuting options, create vibrant public spaces and serve the communities' needs.

Station areas are places where different transport modes come together seamlessly to facilitate access to transit and working, living, recreation etc. However, existing toolkits in India emphasize individual aspects such as feeder bus or auto-rickshaw services, road safety, on-street parking management or evaluation of non-motorized transport (NMT) infrastructure along transit corridors. Therefore, there is a need to integrate these approaches to ensure seamless access to mass transit stations by all modes. While there are international manuals focusing on station area accessibility; high urban densities, higher NMT modal shares, informal employment, lower levels of enforcement with limited public participation and uncoordinated institutional structures pose different opportunities and challenges in India and developing countries.

Thus, using a case study approach to learn from existing initiatives, the manual has multiple objectives. **First, it suggests a participatory process to tie the planning, implementation, maintenance and evaluation of station areas in four broad stages.** These are (i) preliminary understanding of the station area; (ii) documentation, analysis and draft master list of projects; (iii) final master list of projects, implementation and maintenance strategies; and (iv) implementation and evaluation. It guides planners on how to identify different types of stakeholders and involve them in different stages through diverse platforms – visioning workshops, design charrettes and public exhibitions – to ensure a participatory process. The role of multi-stakeholder Working Committees and specifically a nodal agency in building consensus and ensuring an inclusive process is highlighted. The Bay Area Rapid Transit Authority (BART), San Francisco demonstrates a case for preparing public participation plans to shape engagement with communities with an emphasis on minorities. Canada has multiple tools to cover different types of public participation, depending on the intention i.e. disseminate information or invite public input and opinion etc. It highlights how inclusive consultations can be facilitated through choice of meeting locations, times, provision of transport subsidies and translations amongst others.

Second, the manual outlines the objectives and guidelines for planning safer access to mass transit stations through - (i) pedestrian and cyclist priority; (ii) seamless integration with feeder routes, services and infrastructure; (iii) parking management; and an (iv) enhanced public realm. **There is an emphasis on NMT safety and infrastructure, women's security and universal accessibility, recognizing the role of existing providers such as street vendors, informal bicycle renting systems etc. and the use of streets as public spaces.** The Hubli-Dharwad BRT Station Accessibility Plan demonstrates how an existing street network can be managed to create the most direct and shortest NMT routes to the mass transit station. A comparison of the skywalks and subways in Mumbai, Istanbul, Munich and Hong Kong demonstrate the importance of connecting destinations, universal accessibility, public art and street vendors in creating safe, comfortable and enjoyable grade-separated pathways. Thane in the Mumbai Metropolitan Region illustrates an example

of grade-separated feeder bus and auto-rickshaw services. MIDC Marol, Mumbai highlights the importance of mapping and designing for multiple users of streets and public spaces in a station area.

Third, the manual suggests key takeaways for planning, institutional structures and financing mechanisms to facilitate timely implementation of station accessibility plans. **Specifically mass transit agencies and municipal corporations are recommended as nodal agencies for implementation and maintenance; along with a need for state or metropolitan authorities to ensure coordination between multiple agencies.** It makes a case for including station accessibility within planning stages of mass transit projects. The Metro Railway (Amendment) Act (2009) is an opportunity for metro-rail authorities to provide integrated transport services for commuters. Medellin, Colombia illustrates how the Metro authority introduced cable services to connect favelas[1] at the city periphery to the Metro rail network and upgraded infrastructure—public spaces, streets, libraries etc. along the route. The manual also explores statutory tools like Local Area Plans (LAPs), where municipal corporations are the nodal agencies for preparation, implementation and maintenance of station areas. The LAPs of Delhi illustrate how local governance and planning can be tied at electoral ward levels and the challenges faced in the process.

The manual outlines three types of financial mechanisms in implementing station accessibility plans. These include direct finances like budget allocations and funds embedded within mass transit projects; indirect finances leveraging the potential of urban land through betterment charges, land banks, urban development incentives; and the role of the private sector in urban amenity and service provision like public bicycle sharing schemes.

Fourth, **the manual embeds evaluation as a critical aspect of station accessibility planning, implementation and maintenance.** It recommends conducting plan assessments after they are prepared. This can be useful for funding agencies and civil society organizations to evaluate the priorities of the plan and to track impact in later stages. It also identifies indicators to assess the station area immediately after implementation and monitor impacts and the quality of service annually. The indicators assess safety and security, pedestrian and cyclist prioritization, feeder service and infrastructure integration, parking management and the quality of the public realm.

While this volume specifically focuses on station areas, Volume 2: Cities Safer by Design extends the benefits of safer access to cities as a whole. Finally, it is acknowledged that a holistic approach of enhancing accessibility and reforming development control regulations together create transit-oriented development districts and these need to be addressed together.

Key terms **defined**

Bus Rapid Transit (BRT): BRT is a bus-based mass transit system designed to provide high quality service akin to a rail-based system, and yet flexible and cost-effective. Global data on BRT systems indicates that 186 cities have a total of 4 757 kilometres of bus ways and carry more than 31.5 million passengers every day.

Floor Space Index (FSI): FSI indicates the intensity of development at the plot or an area level. For a building, it is a ratio of the total built area to the total plot area.

Geographic Information Systems (GIS): GIS is a technological tool, which collates multiple types of information to create georeferenced spatial maps and visualisations of various environments.

Intermediate Public Transport (IPT): IPT networks support public transit systems by providing commuters with last mile connectivity. These can be in the form of cycle, auto rickshaw (or e-rickshaw), taxis, mini-buses or vans.

Local Area Plans (LAPs): LAPs are considered as one of the four interdependent levels of planning by the Urban and Regional Development Plan Formulation and Implementation Guidelines developed by the Ministry of Urban Development, Government of India. LAPs are land use, urban form and infrastructure plans conceived at the neighbourhood level and designed to fit within city development plans.

Lux: A unit to measure the intensity of light or illuminance per unit area of a flat surface as defined by the International System of Units is known as lux.

Non-motorized transport: NMT refers to all modes of transport where no motorized system is used and only human powered movement occurs. Thus trips by modes such as walking, cycling, on wheelchairs, push carts and so on are considered as NMT.

Privately Owned Public Spaces (POPS): POPS are urban public spaces owned by private entities but are made accessible for public use. These spaces integrate a variety of amenities such as seating spaces, drinking water fountains and so on.

Transit Oriented Development (TOD): TOD is a tool for urban development which emphasizes compact, mixed use, high density development around mass transit nodes to create walkable, low carbon neighbourhoods and cities.

INTRODUCTION

IMPROVING SAFE ACCESS TO **MASS TRANSIT STATIONS**

A good station area can maximize transit ridership, create streets for all users, offer affordable commuting options and make vibrant public spaces which generate economic development opportunities for the station area.

Access to mass transit is defined as “both the trip to the station, and from the station to the final destination” (BART 2003). The quality of access, while a fraction of the cost of the system, directly influences its ridership (Jaiswal, Sharma and Bisaria 2012). A good station area can not only maximize transit ridership, but also create streets for all users, provide affordable commuting options, make vibrant public spaces, manage parking effectively, help realize the economic development benefits of transit investments and serve its communities’ needs (HCRRA 2013); (BART 2003).

Thus in India, improving access to mass transit stations can serve multiple objectives in addition to leveraging investments of at least 15 billion USD[2] (DIMTS 2014) in building new public transport systems. There are about 19 BRT systems and 10 metro-rail systems in different stages of planning, construction, operation or expansion (MoUD 2013). In addition, two cities (Lucknow and Guwahati) are evaluating options between BRT and metro-rail systems (BRT Centre of Excellence 2014).

However, station areas in India have yet to be perceived as places of connectivity, i.e. where large volumes of people interact with multiple modes of transport, and as places for living, working and recreation. In fact, these mass transit systems are being inserted within poor quality NMT infrastructure, characterized by a lack of safety, security, comfort and convenience (Tiwari and Jain 2013). With 140,000 deaths in India per year due to road traffic crashes (NCRB 2011), road safety poses a serious concern for non motorized transport (NMT) commuters. For example, pedestrians, cyclists, and motorized two-wheeler riders constituted 60–90 percent of all traffic fatalities in the cities of Mumbai, Delhi, Kota and Vadodara (Mohan and Tiwari 2000). In Bengaluru, pedestrians accounted for around 51 percent of the total road traffic deaths (NIMHNS 2009).

In addition, the Nirbhaya incident[3] in December 2012 brought sharp focus to the lack of safety for women traveling in and to public transport. Studies across Mumbai (World Bank 2011) and Delhi (Jagori and UN Women 2010) have also demonstrated that women and girls face a high level of sexual harassment on streets, public transport and during boarding and alighting. Additionally universal access is also increasingly being recognized as an essential parameter in public transport systems (Ramachandran, “Elderly, disabled-friendly features mandatory in metro rail blueprints,” *The Hindu*, September 27, 2013.)

However, station accessibility projects across the country vary in their approach and area of intervention. For example, the Station Area Traffic Improvement Schemes (SATIS) in Mumbai were limited to the construction of 37 skywalks to suburban railway stations. Pedestrian access, buses, intermediate para-transport services or at-grade street infrastructure were not integrated with the skywalk projects at most station areas (EMBARQ India 2010). Additionally, the SATIS projects implemented around the metro-rail corridor limit their intervention to 330m around the station (BEST, Railways & MMRDA plan seamless connectivity with dedicated stops at Metro Stns.” *Rail News.* 18 March 2014) and do not address the pedestrian catchment area. In Delhi, interventions have been limited to the provision of feeder bus services (DMRC n.d.), whereas Bengaluru has adopted a more holistic approach. It has initiated a request for proposals (RFP) for the preparation of station accessibility plans for 10 stations along the Namma Metro system. The RFP suggests a

pedestrian catchment area of 500-750m with proposals aiming at improvement of NMT infrastructure, mobility management and place-making (DULT 2013). In the case of Bus Rapid Transit Systems (BRT), non-motorized infrastructure improvements have been restricted to the BRT corridors and not to the catchment area. If pedestrian access is not designed well, the segregated lanes could impede local accessibility for other modes and worsen the road safety scenario (EMBARQ India 2012b). Finally, limited public participation or consultation with key stakeholders in the evolution of the mass transit systems results in a lack of understanding of the neighbourhood's needs, a lack of ownership of the proposals and lesser willingness to implement them (Rietbergen-McCracken and Narayan 1998).

Therefore, there is a need for a manual to tie the different objectives of station areas to provide improved connectivity, accessibility, safety, security, economic possibilities and enjoyment for its users. Safety has to be embedded when (re-)designing public transport corridors and their feeder networks to prevent pedestrian and cyclist fatalities and injuries. Further, conscious efforts need to be made to understand women's met and unmet needs, as well as the barriers that impede universal access in station areas. Additionally the role of informal service providers in facilitating access to affordable goods and services needs to be acknowledged (Bhowmik and Saha 2012). Finally planning, institutional and financial frameworks need to prioritize station areas for implementation, maintenance and evaluation.

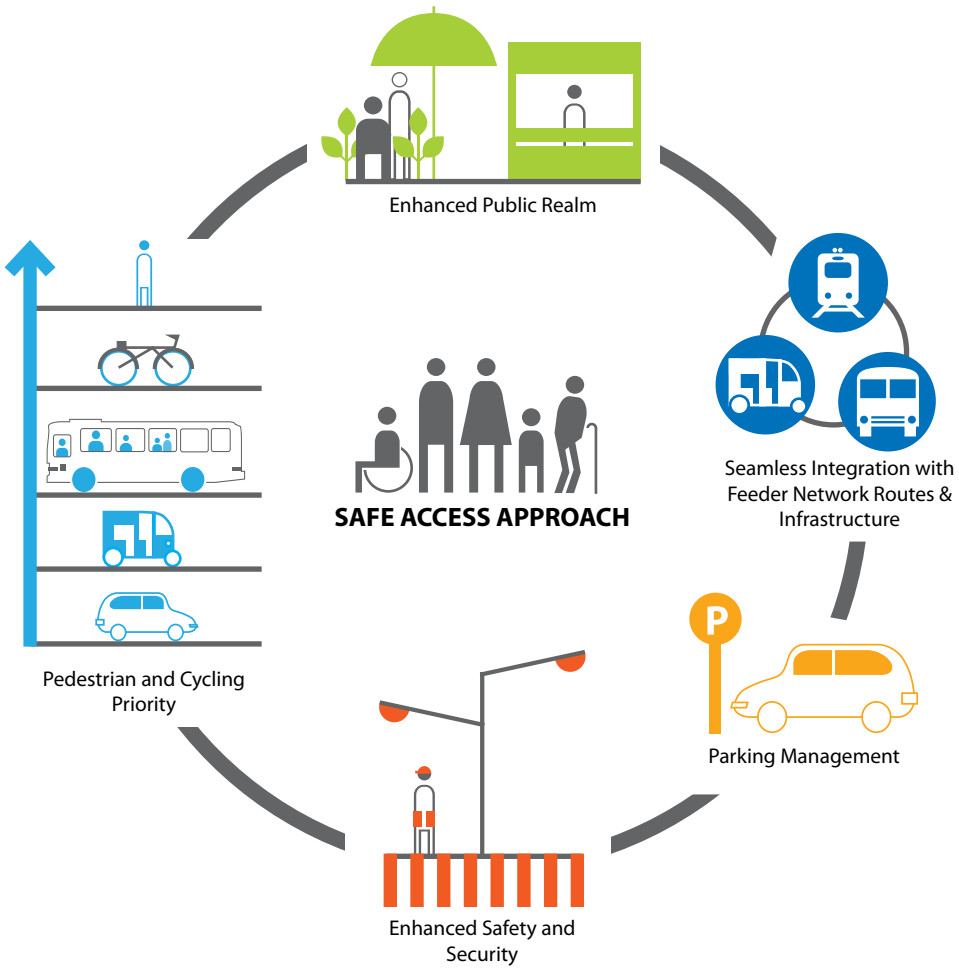
The existing toolkits in India generally focus on the city-scale or public transport corridors. They address different aspects of accessibility either as part of comprehensive mobility plans, transport demand management measures, non-motorized infrastructure, land-use transport integration, broad implementation strategies and evaluation indicators (Institute of Urban Transport (India) 2013), but do not focus on the scale of station areas. Similarly, existing TOD guidelines generally tend to focus on urban codes and regulations for the private realm (UTTIPEC 2012). They do not focus on projects that can be implemented in the public realm in the short term. Additionally, sustainable transport- oriented guidelines[4] have focused on street design, furniture and signage guidelines for different types of roads, and have not specifically addressed the context of station areas.

Further, a number of international manuals provide guidance on improving station area accessibility[5]. While their principles may be relevant for Indian and other developing country cities, the guidelines need to be contextualized and / or reinterpreted to address higher urban densities and NMT modal shares, informal transit / service providers, lower levels of enforcement of traffic rules, speed limits and people behaviour and multiple uses of streets for livelihoods or as public spaces.

Thus, EMBARQ India has developed this Safe Access Manual, Volume 1, which focuses on improving accessibility to mass transit stations. In consonance with the National Urban Transport Policy (NUTP) (MoUD 2006b), the manual places people at the centre and highlights strategies, guidelines and case studies to achieve pedestrian and cycling priority, seamless integration with feeder network and infrastructure, improved safety and security, parking management and an enhanced public realm in station areas. Figure 1 is a guide on what should be emphasized when preparing a station accessibility plan, how can the plan be implemented, how can the plan, its implementation and impact be evaluated and what are the learnings from different cities.

The manual targets a diverse audience – decision-makers, urban planning and design professionals in local governments, transit agencies, civil society organizations and transit funding agencies. Further, it hopes to provide guidance to other cities with similar urban conditions.

Figure 1 Safe access approach, Source: EMBARQ India



SCOPE AND LIMITATIONS

This manual limits its scope to the feeder areas around mass transit stations, particularly those of metro-rail and BRT, to leverage the investment in these public transit systems across the country. Volume 2: Cities Safer by Design focusses on improving safety and access across cities as a whole.

Since a comprehensive approach to last mile connectivity has previously not received attention in India, there is a paucity of case study literature on process, design, implementation, maintenance and evaluation. Therefore, EMBARQ India projects in Mumbai, Bengaluru and Hubli-Dharwad, which provide detailed insights on process and methodology are heavily referenced. Once executed these projects can be evaluated and updated as implemented case studies.

Additionally, EMBARQ India publications on feeder bus service integration and BRT road safety guidelines are also used as references. The context, scope and focus of each project and publication are outlined in Section D.

Further, while numerous international case studies are used throughout this manual, the Mobility Hub Guidelines for the Greater Toronto and Hamilton Area (Metrolinx 2011), BART Station Area Guidelines (BART 2003) are significantly referred to for depth of insight

HOW TO READ THE MANUAL

The Manual is composed of 6 chapters, briefly described below.
Figure 2 illustrates the layout of each page.

- **Chapter I: Station Area Improvement Process** outlines broad activities to prepare and implement a station accessibility plan in a participatory process and enable ongoing maintenance of the station area

- **Chapter II: Defining a Station Area** describes the process of identifying the type of station area, demarcating different influence zones and the planning boundary.

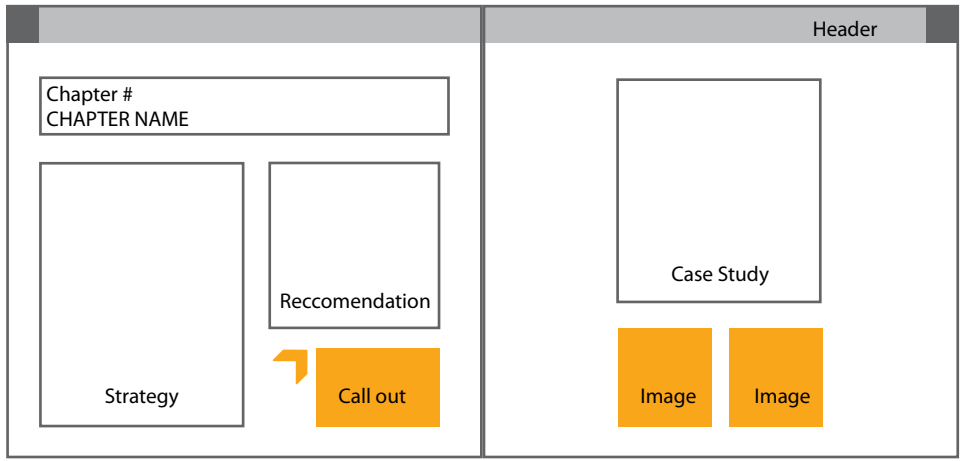
- **Chapter III: Station Area Planning Guidelines:** *List of Objectives, Strategies and Guidelines* outlines the objectives of a Station Accessibility Plan, the strategies and guidelines for achieving them; and assessments for evaluating the plan.

- **Chapter IV: Implementation and Maintenance Strategies** outlines the planning, financial, institutional challenges and initiatives undertaken to implement station accessibility plans. It provides guidance measures to ensure regular maintenance of station areas; and

- **Chapter V: Evaluation Indicators** identifies indicators to evaluate the station accessibility plan, its implementation and impact. The overlaps between the themes are referenced in each section.

- **Appendix:** The Appendix offers additional reference material to support the content in the main text. It includes different types of surveys and indices to guide the process of data collection depending on the emphasis of a station accessibility plan. It also includes case studies to further substantiate specific guidelines.

Figure 2 Diagram explaining the page layout, Source: EMBARQ India



EMBARQ INDIA CASE STUDIES AND PUBLICATIONS

EMBARQ India has partnered with agencies in various Indian cities to prioritize safe bicycle and pedestrian access to mass transit stations. It has developed guidelines for road safety along public transport corridors and feeder bus integration. The projects and publications form the core of this manual and are referenced throughout to support key recommendations. However, a broad overview of the projects, their context and status are described in this section. The reports and guidelines can be accessed on the EMBARQ India Hub under “Project Reports” and “Publications”.

1. INDIRANAGAR METRO STATION ACCESSIBILITY PLAN, BENGALURU[6]

The Namma Metro or Bengaluru Metro Rail is being built by the Bengaluru Metro Rail Corporation Limited (BMRCL), created as a joint venture by the Government of Karnataka and Government of India. The construction of Phase 1 began in 2007. Reach 1 (6.7km) from MG Road to Baiyappanahalli Station (Figure 3), is in operation since October 2011 (BMRCL 2011).

The Indiranagar Metro Station Accessibility Plan was prepared by EMBARQ India in partnership with the Directorate of Urban Land Transport (DULT)[7], and Bruhat Bangalore Mahanagara Palike (BBMP)[8] in 2011. The objective was to demonstrate a methodology for station accessibility plan preparation, which could be scaled up to all 40 metro stations along Phase I. Indiranagar Metro Station, located along Reach 1, was chosen due to the intense land use transformation in the area.

The station area was delineated within 500m of the metro station. It is a predominantly residential neighbourhood with commercial activities along the main roads and large generators like medical and educational institutions (Figure 4). The residential population is around 34,000[9] (Census India 2000) with an average density of 900 to 1200 persons per hectare.

The pedestrian origin-destination surveys revealed that at least 50 percent of the trips originated or terminated in Indiranagar. Further, at least 75 percent of the residents, visitors and passers-by felt that either there were no footpaths or they were obstructed or in poor

Figure 3 Map of Namma Metro Bangalore showing the Indiranagar Metro Station

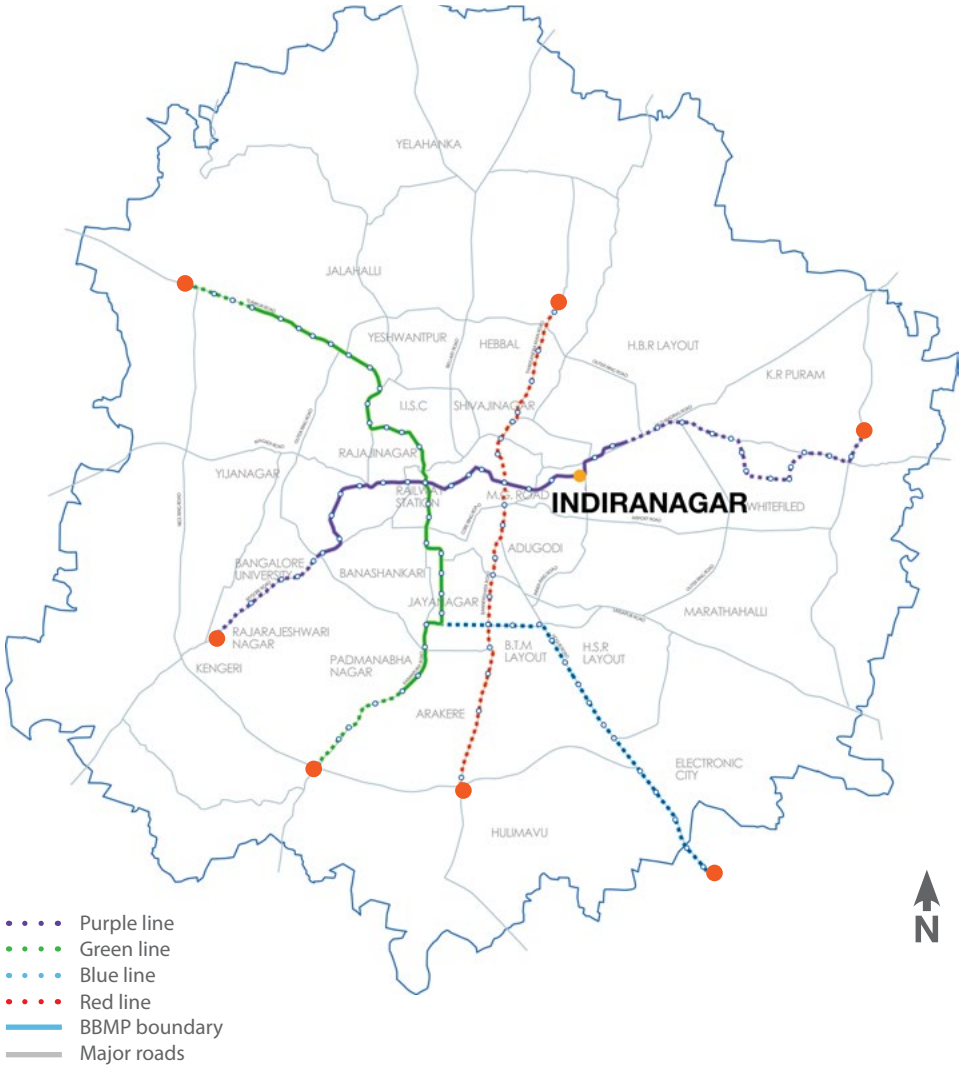
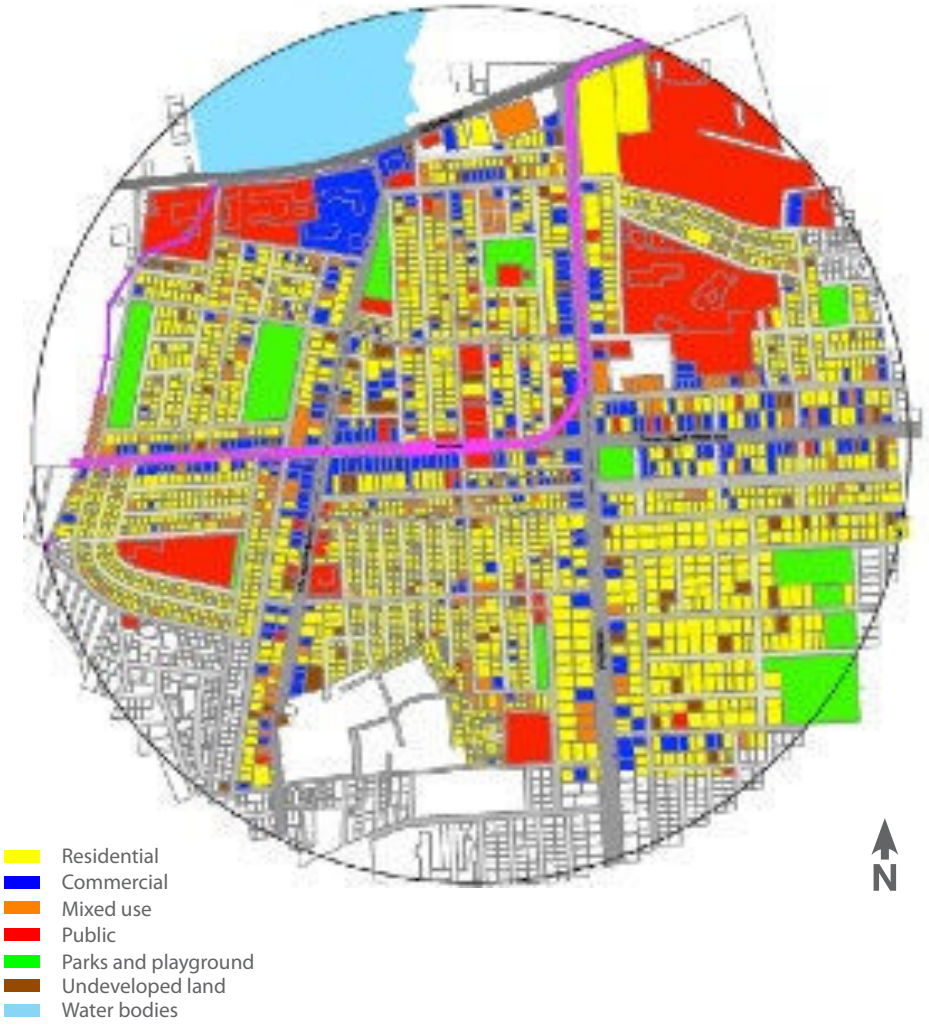


Figure 4 Existing land use around Indiranagar Metro Station (2011), Source: EMBARQ India; (right) View towards metro corridor in Indiranagar



condition. Additionally, street rating maps were created to analyse the condition of the streets (EMBARQ India 2013b).

The plan proposals include restricting motorized vehicular access along feeder roads, provision of safe pedestrian and cycling infrastructure and integration with buses and auto-rickshaws. The detailed street design is limited to 150m around the station as per consideration of Urban Development Department (UDD) notification[10] (Government of Karnataka 2008). The proposals are prepared for three time frames – immediate, 5 years and 15 years.

At present DULT has undertaken scaling up of the methodology for station accessibility plans for various stations on the Namma Metro lines (on Reaches 3, 3A, 4 and 4A) (DULT 2014, 11). DULT is preparing the Swastik Metro Station Accessibility Plan; the contract to prepare plans for 12 stations have been awarded to 3 consultants (Government of Karnataka 2014, 120).

2. NAVANAGAR BRT STATION ACCESSIBILITY PLAN, HUBLI-DHARWAD

The twin cities of Hubli and Dharwad in Karnataka are located 22kms apart and are connected by a State Highway (SH17) (Figure 5). Hubli and Dharwad were combined in 1962 to create the Hubli Dharwad Municipal Corporation (HDMC). HDMC has a population of about 10 lakh (1,000,000) and covers an area of 202 square kilometres, of which 96 square kilometres (47 percent) is developed (CEPT University 2011).

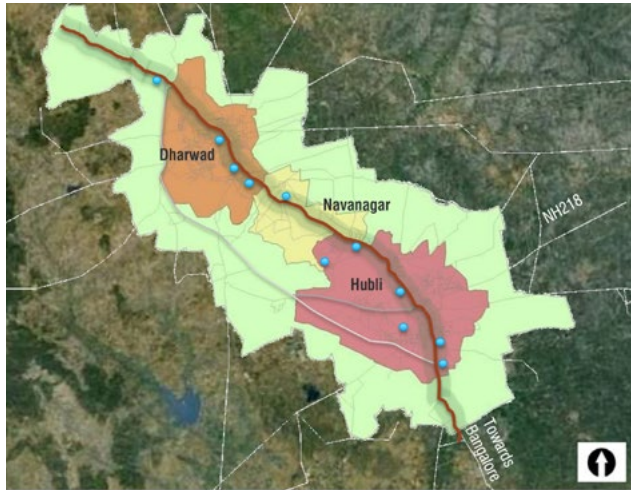
The city attracts large volumes of traffic from within and outside the region as Hubli and Dharwad are centres of trade and commerce, and education respectively. Currently a bus service is operated by North Western Karnataka State Road Transport Corporation (NWKSRTC) between Hubli and Dharwad. A BRT system is proposed on SH 17 with an express stop at Navanagar. The Navanagar station area functions as a commercial centre for the hinterland and consists of a mix of undeveloped land along with housing layouts, government institutions, markets, hotels etc.

A preliminary study between Hubli and Dharwad found that the average trip length (including walk trips) is around 5 km and the share of private modes and public transport is 70 percent and 30 percent respectively (CEPT University 2011). Currently the roads only consist of storm water drains and a carriageway with no pedestrian or cyclist infrastructure.

The Navanagar BRT Station Accessibility Plan was prepared as part of the Hubli-Dharwad Transit-Oriented Development Project in consultation with the Directorate of Urban Land Transport (DULT), Hubli-Dharwad Municipal Corporation (HDMC) and Hubli-Dharwad Urban Development Agency (HDUDA). A detailed study and analysis of Hubli-Dharwad and the Navanagar BRT station area was initiated by EMBARQ in 2011 (EMBARQ India 2013c).

The objective of the proposal is to provide safe pedestrian and cycling access within 300m of the Navanagar BRT station. The proposal includes rerouting vehicular movement to prioritize NMT movement, street and transit-oriented public space design (Figure 5), improved signage and parking. A number of stakeholder meetings have been held to receive feedback on the proposal. At present good-for-construction drawings are being developed by a consultant and the project implementation is slated to begin in April 2015.

Figure 5 (left) Hubli-Dharwad location map; (right) Navanagar project proposal, Source: EMBARQ India



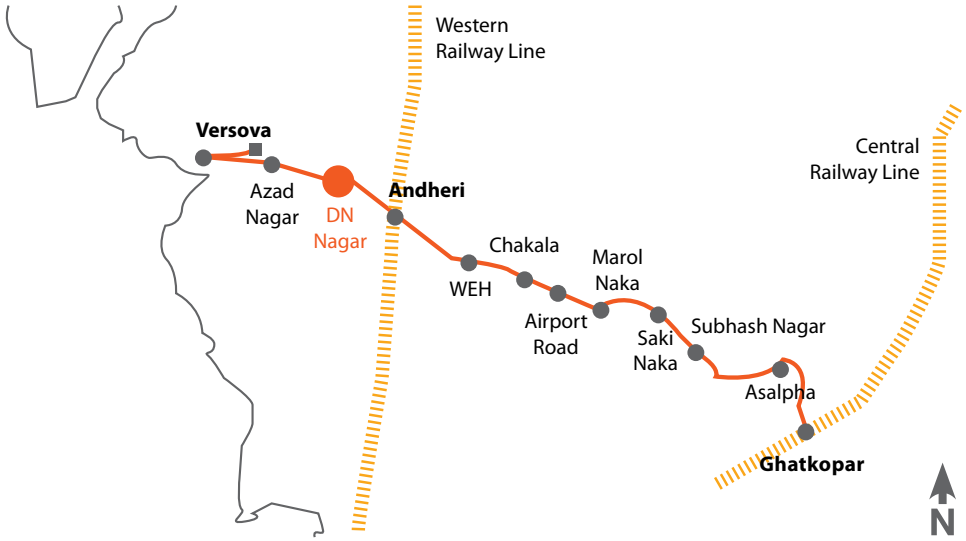
3. DN NAGAR STATION ACCESSIBILITY PLAN, MUMBAI

The Mumbai metro network consists of three metro lines spanning a total of 63km. The first line is the 11km long Versova-Andheri-Ghatkopar (VAG) corridor with 12 stations. Towards the western end of this metro line is the DN Nagar metro station (Figure 6). An estimated 1500 and 1900 persons (2011) were expected to board and alight respectively at DN Nagar Metro station during peak hours. These are estimated to increase to around 1950 and 2440 by 2021 (DMRCL 2005).

DN Nagar is a predominantly residential area with institutions, commercial buildings and open spaces (Figure 7). Most of the land in the area is privately owned. The station area has a disconnected street network with few direct pedestrian routes to the station. A walkability rating of the three main access routes to the station revealed insufficient and poorly maintained pedestrian infrastructure.

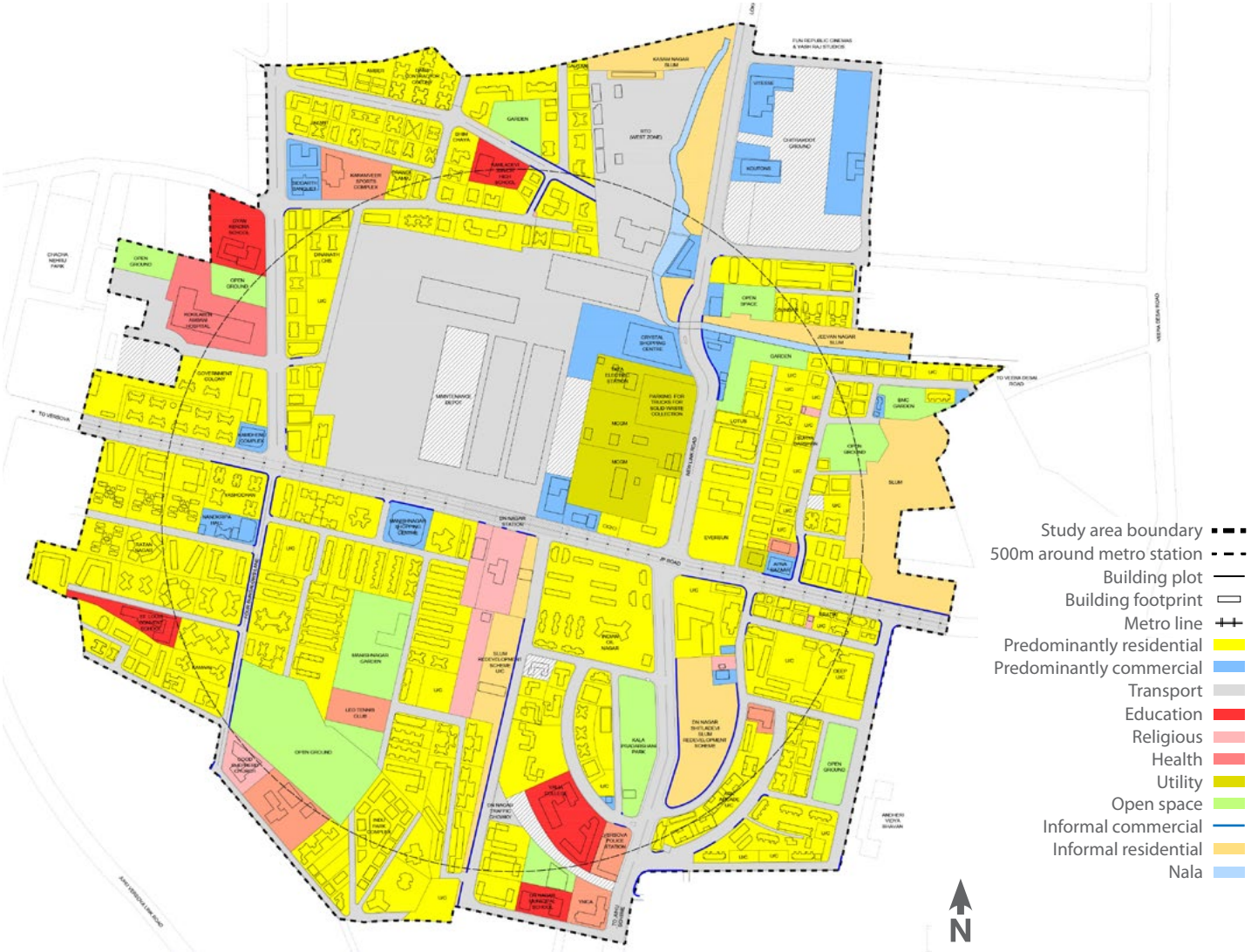
The DN Nagar Station Accessibility Plan was initiated in 2011 by EMBARQ and focuses on 500m around DN Nagar Metro Station. The proposal aims at reducing walking distance to the metro station by proposing routes through public and private lands and improving the walkability of existing streets.

Figure 6 DN Nagar station marked on the VAG corridor in Mumbai, India; Source: Mumbaimetro1



Existing pedestrian infrastructure along roads feeding to the metro corridoralong the metro corridor in DN Nagar

Figure 7 Land use around DN Nagar Metro Station in 2011, Source: EMBARQ India



4. PROVIDING SAFE ACCESS AND IMPROVING PEDESTRIAN ENVIRONMENTS IN MIDC MAROL, MUMBAI

MIDC Marol is a planned industrial-cum-business district located within 1km of Chakala Metro station (along the VAG Metro corridor) in Mumbai (Figure 8, left). It is also well connected by rail, bus and air transport to the rest of the city. MIDC Marol is around 127 hectares in area and has a floating population of approximately 1.8 lakh (180,000) people per day (EMBARQ India 2013a). An estimated 2000 and 2400 persons (2011) were expected to board and alight respectively at Chakala Metro station during peak hour (DMRCL 2005).

EMBARQ and MIDC Marol Industries Association (MMIA) initiated the project to improve pedestrian access to Chakala Metro Station and within the business district (Figure 8, right). The proposals were developed in consultation with Maharashtra Industrial Development Corporation (MIDC), Traffic Police and Municipal Corporation of Greater Mumbai (MCGM).

A detailed study and documentation of the area was undertaken by EMBARQ as part of the project (EMBARQ India 2013a). The findings from visitor sample surveys (2011) indicated that around 46 percent people travel by public transport. There are at least 1.2 lakh (120,000) (66 percent) pedestrians and cyclists in MIDC Marol during each peak hour[12]. People currently walk approximately 4-5km currently to the nearest transit station, i.e. Andheri Station. However, by improving physical access to the upcoming Chakala metro station, last mile connectivity can be reduced by two-thirds of the distance. Survey findings revealed that 62 percent people step out at least once a day for lunch, leisure or work purposes; and that 85 percent of all trips are under 15 minutes. Perception surveys revealed inaccessible and poorly maintained footpaths, garbage accumulation on streets, lack of amenities like public toilets, public open spaces, vegetable markets and restaurants, pharmacies etc. A Master List of Proposals is prepared to improve overall mobility in the area (Figure 9). These are phased over three years: 2015, 2018 and 2020; and two streets are identified as part of Phase I (EMBARQ India 2013a).

Figure 8 (left) Chakala Station marked on the VAG corridor in Mumbai, India, Source: Mumbaimetro1; (right) Location of MIDC Marol, Source: EMBARQ India

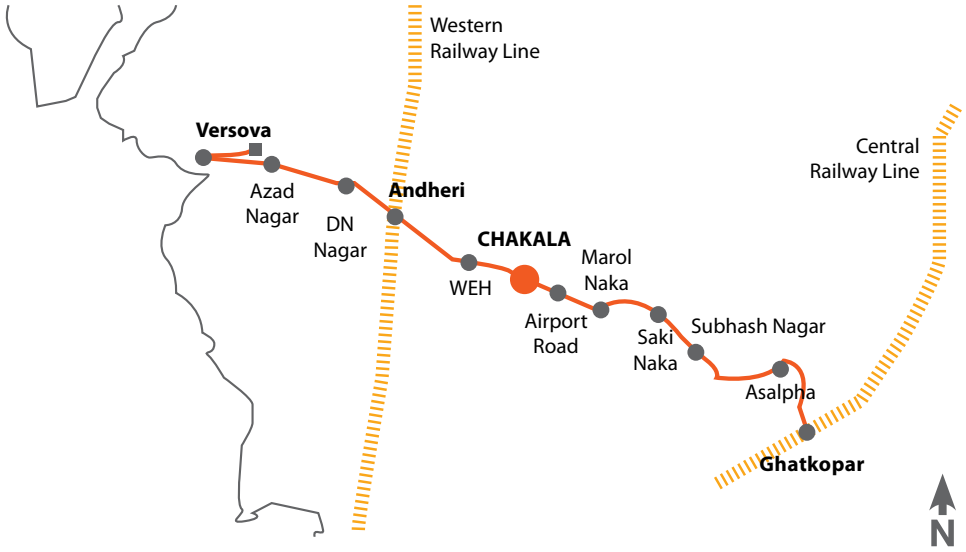
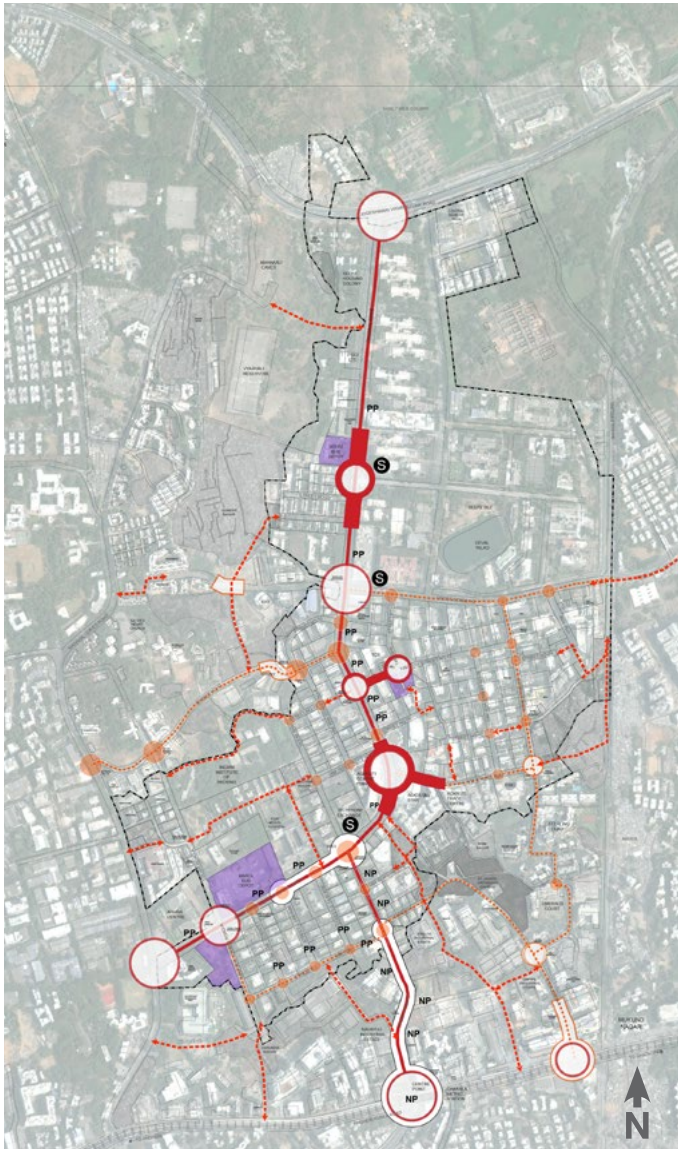


Figure 9 (left) MIDC Marol Satellite Image showing list of proposals, Source: EMBARQ India; (right) Pedestrian infrastructure in MIDC Marol



Treatment of primary corridors and segments

Treatment of secondary corridors and segments

Managing transforming segments

Identifying potential plots for multi use

Introducing pedestrian networks

Articulation of nodes

Intersection geometry corrections

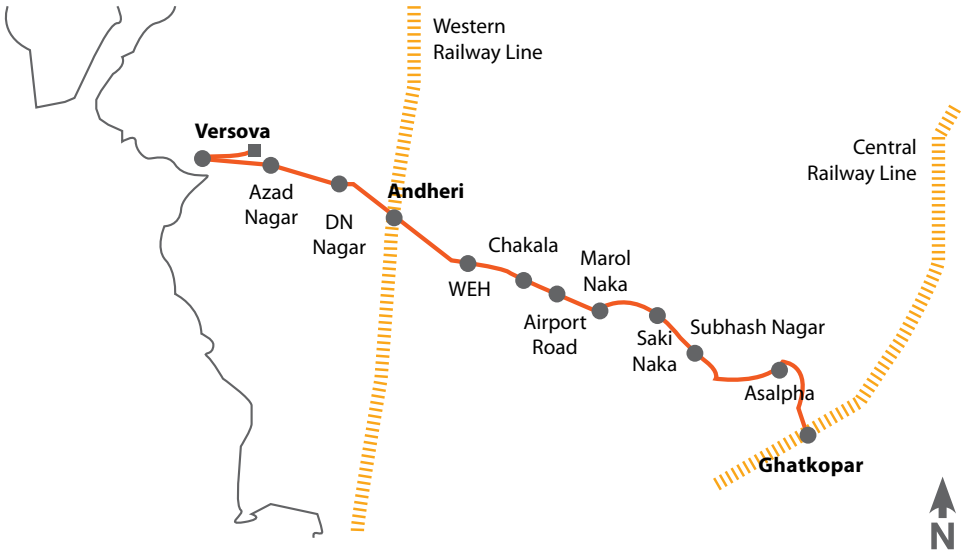
PP Management of traffic signals and parking

5. ROAD SAFETY IMPROVEMENT PROJECT, VERSOVA-ANDHERI-GHATKOPAR (VAG) CORRIDOR, MUMBAI

The Versova-Andheri-Ghatkopar (VAG) corridor is the first line of the proposed Mumbai metro network. It is 11km long with 12 stations (Figure 10). 55,000 people are estimated to travel per hour in one direction during peak hours. The total daily passenger demand is estimated to be 15 lakh people (DMRCL 2005).

While the metro stations are elevated, they disperse their passengers onto the road corridor below. This corridor has an inconsistent right-of-way with poor quality pedestrian infrastructure (as seen in the photographs.). The objective of the project is to ensure safe, comfortable and convenient pedestrian access within the dense built environments along the metro corridor.

Figure 10 Phase 1 of Mumbai Metro Network – Versova-Andheri-Ghatkopar Corridor, Source: MumbaiMetro1



The project scope involves a redesign of the corridor within the Station Area Traffic Improvement Scheme (SATIS) initiated by the Mumbai Metropolitan Region Development Authority (MMRDA). EMBARQ conducted road safety audits with Consia Consultants, and made recommendations on improving pedestrian safety, physical integration with feeder bus, auto-rickshaws and signage.

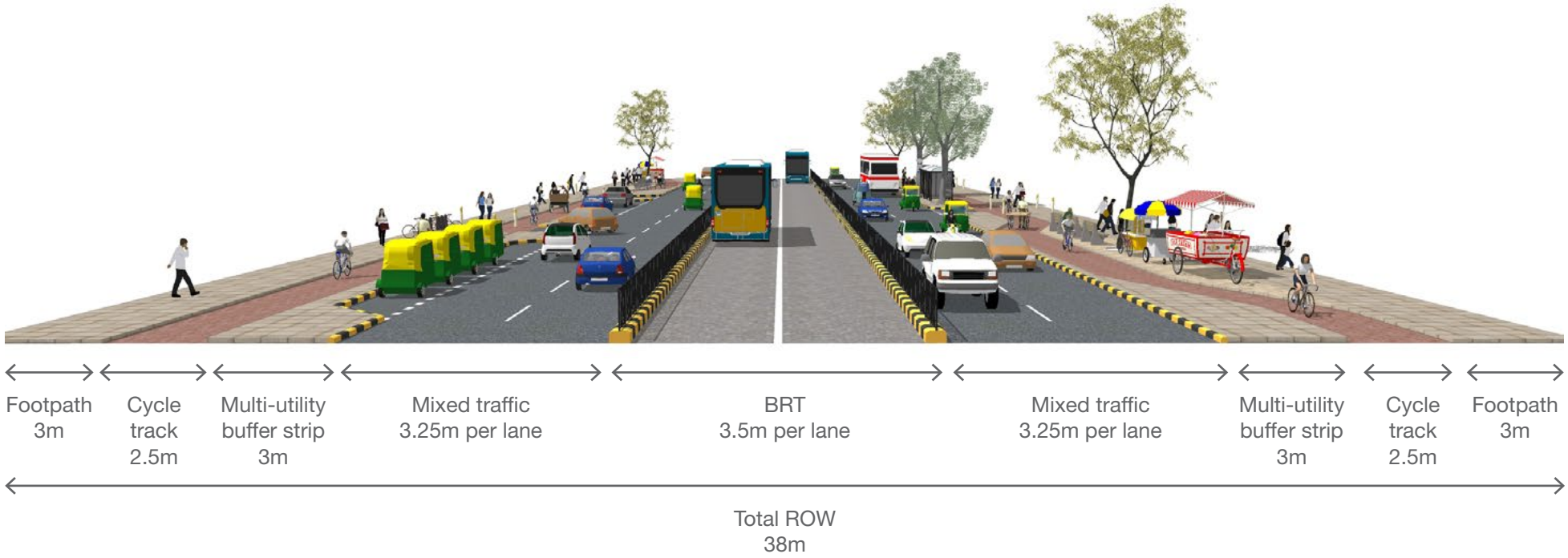
Pedestrian infrastructure along the Versova-Andheri Ghatkopar corridor

6. ROAD SAFETY DESIGN GUIDELINES FOR BUS RAPID TRANSIT IN INDIAN CITIES, EMBARQ INDIA

The BRT Road Safety Guidelines (forthcoming in 2015) were created from EMBARQ's experience in conducting road safety audits on a number of BRT corridors in India and internationally. In the last few decades, Bus Rapid Transit (BRT) has emerged as a cost-effective, flexible and environmentally sustainable form of public transportation. There are 168 cities worldwide operating a total number of 4424 kilometres of BRT, serving around 30,891,343 passengers per day (BRT Centre of Excellence 2014).

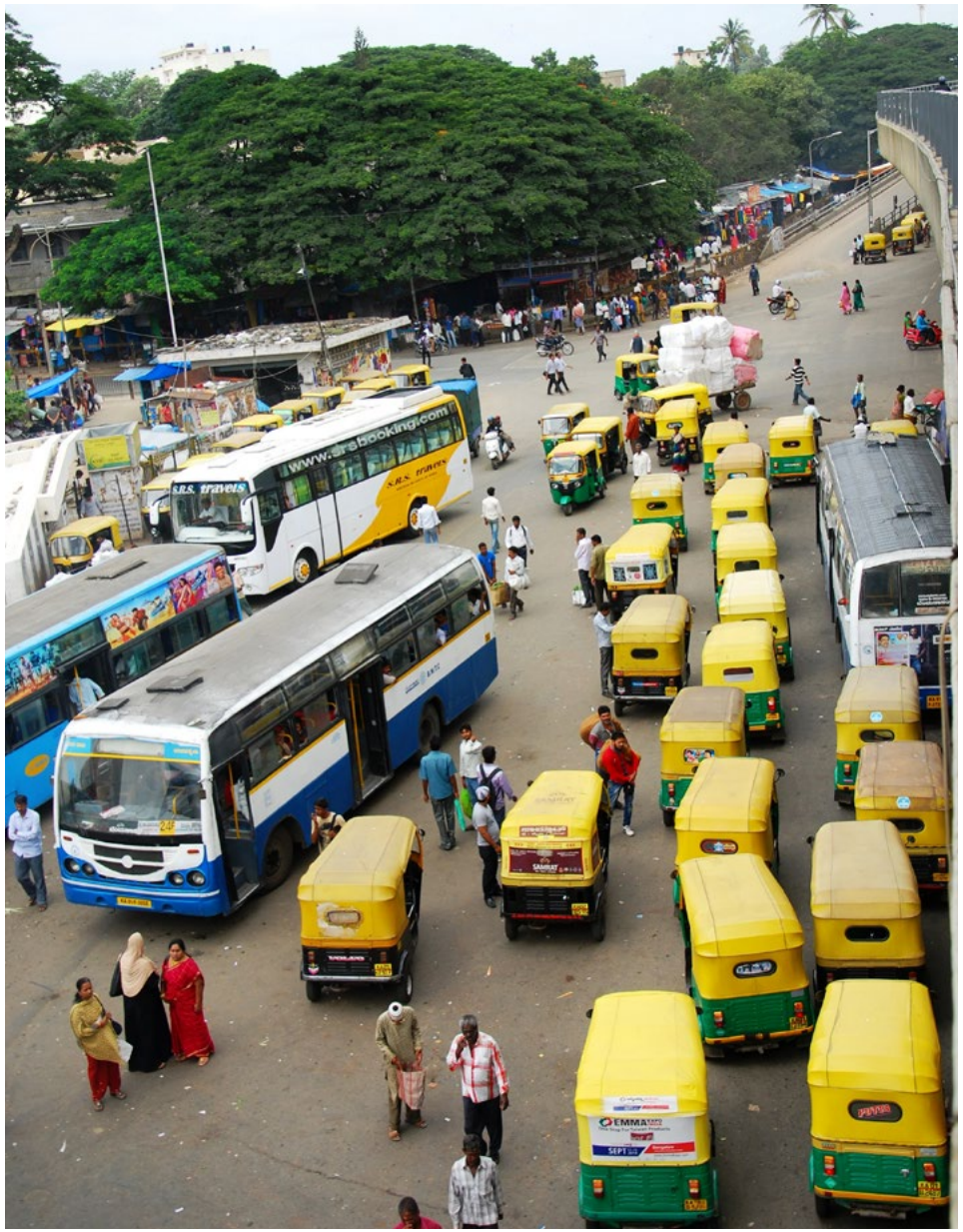
A BRT system typically improves the traffic safety scenario, as it segregates the movement of buses from all other transport modes (Figure 11). It also introduces other infrastructure changes associated with safety, such as shorter pedestrian crossings and refuge islands. A BRT design that neglects the local accessibility needs of the population cannot be a safe system. Thus, while the focus of these guidelines is on road safety, the problems of local accessibility are also considered. The guidelines provide recommendations for BRT road elements such as midblock crossings, U-turns, BRT stations, intersections, signal configurations etc.

Figure 11 Typical BRTS corridor section with street space allocations, Source: EMBARQ India



7. BUSKARO 2: A GUIDEBOOK ON BUS PLANNING AND OPERATIONS, EMBARQ INDIA

In the last decade, more than a dozen cities globally have transformed their mobility through bus-based public transport solutions. Cities across India have received new buses under the Jawaharlal Nehru National Urban Renewal Mission (JnNURM). BusKaro 2.0: Case Studies from India (2014a) presents existing reforms undertaken by city bus authorities in the last five years in selected Tier I and Tier II cities in India and highlights their achievements and challenges. This guidebook builds on Bus Karo (2009), which presented case studies, recommendations and methodologies to operate, monitor and improve city bus services. Bus Karo 2.0 was released in December 2014.



Safer and integrated access to **mass transit stations is critical**

As mass transit systems are being built in India to arrest the increase in motorized vehicular growth, safer and integrated access to the stations is a critical component that is inadequately addressed.

The case studies and publications above illustrate planning and design approaches to enable safe and seamless multi-modal integration. These include counting and mapping existing NMT users, planning for safer pedestrian and bicycling access with feeder service integration and creating an inclusive public realm. The documentation process, strategies and proposals are described in subsequent sections to illustrate how this has been done.

CHAPTER I

STATION AREA IMPROVEMENT PROCESS

As cities build transit systems, there is a need to outline a streamlined planning, implementation and evaluation process to ensure that station areas provide a high quality of experience and comfort for their users.

Preliminary evidence from cities like Mumbai, Delhi and Bengaluru reveal inconsistency in processes such as level of data collection, documentation, and public participation processes. There are no guidelines on how different stakeholders can be identified or how public participation processes can be conducted to ensure timely preparation and implementation of station accessibility plans through an inclusive and transparent process [12].

Participatory planning is a complex process undertaken to ensure the involvement of the various types of stakeholders within a planning zone, in this instance, a station area and address their often conflicting requirements (Davis, et al. 2013). Participatory processes therefore have to be carefully organized, facilitated, cultivated and nurtured by nodal agencies. Successful participation depends on a number of criteria like: How do we measure or evaluate it? To what degree are all of the participants represented? Are the rules governing who gets to speak, fair and equally distributed? Is the discussion open? Is the deliberative agenda transparent to all participants, or do particular elements remain undisclosed? Is there a difference between how the participants might be represented and how they think they are represented? (Fischer 2006).

Transparency (including about time and cost), involving key decision-makers and actors from the start, planning for micro-macro geographic linkages (including across modes of transport), providing additional support to marginalized groups, emphasizing respect of differences of opinion within the process, and concerted follow-up with local stakeholders are key strategies to obtain a successful process (Rietbergen-McCracken and Narayan 1998).

Local area plans (LAPs) provide an important insight in developing neighbourhood-based solutions and providing an avenue for stakeholder participation. The context of Delhi demonstrates the numerous ways (be it street plays, sustained discussions with key stakeholders) in which public participation was elicited. It underscores the need for systematic public awareness campaigns and strong facilitation of discussions by the lead agency (in this case, Municipal Corporation of Delhi) in building consensus (TCGI 2009).

A public participation plan could be prepared at the outset by the nodal agency to devise strategies and tools to educate, inform and involve specific types of groups, especially the urban poor, women, minority groups and informal service providers.

This manual outlines four broad stages in the preparation, implementation and evaluation of station accessibility plans and identifies the critical junctures where stakeholder participation is required Figure 12.

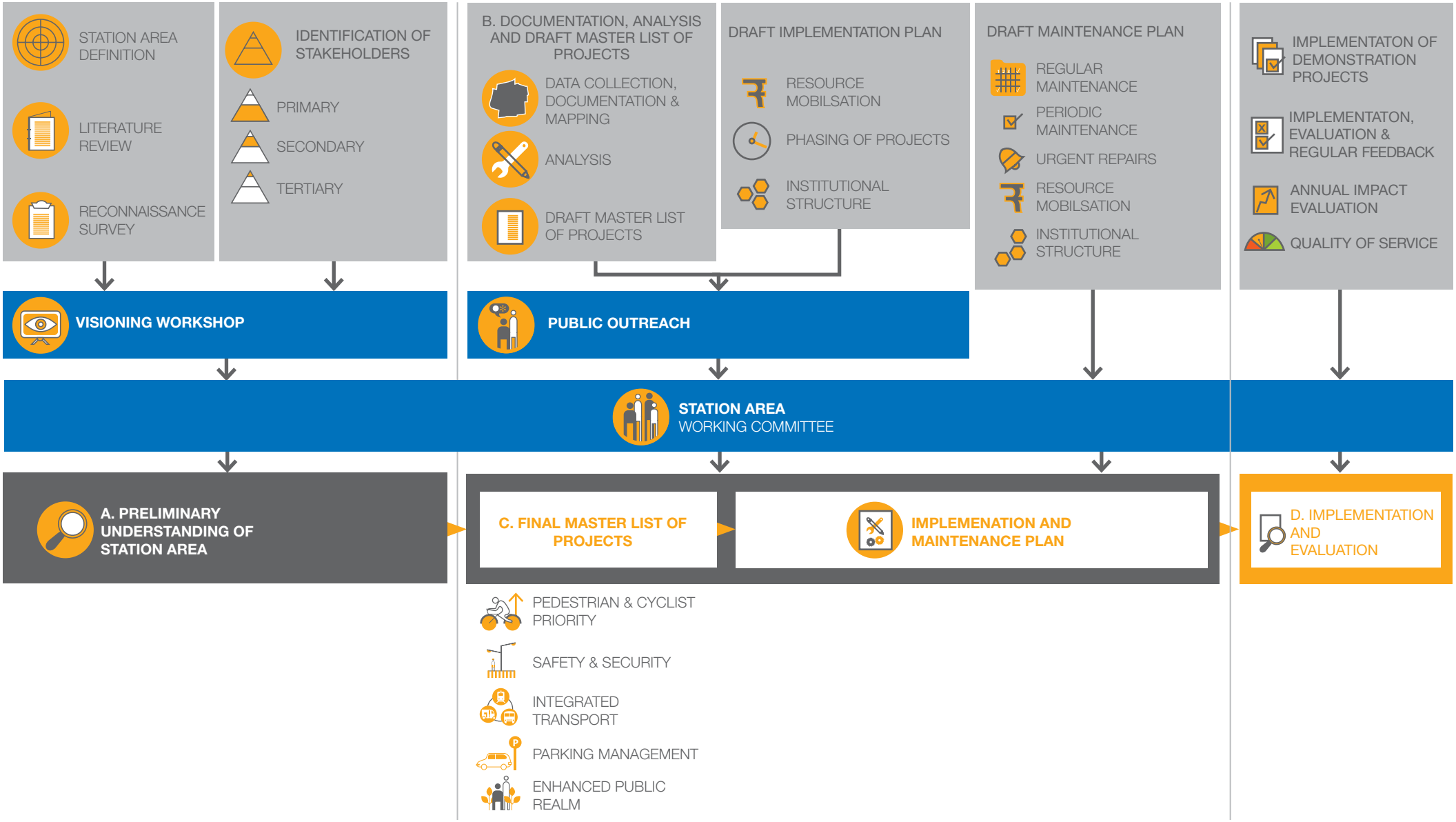
A: Preliminary Understanding of the Station Area

B: Documentation, Analysis and Draft Master List of Projects

C: Final Master List of Projects, Implementation and Maintenance Plans

D: Implementation and Evaluation

Figure 12 Flowchart describing the Station Area Improvement Process, Source: EMBARQ India



Public Participation Plan:
Case Study: Bay Area Rapid Transit (BART) SAP, California, USA

The Bay Area Rapid Transit operates services that span four counties comprising several cities including San Francisco and Oakland as the biggest urban centres. BART has undertaken several initiatives to increase the reliability of its service so as to increase its ridership, reduce car-dependency, increase comfort and accessibility for its diverse commuter groups. In order to support these initiatives financially, BART decided to develop its significant land holdings within the region. To that effect, the Strategic Plan adopted by BART for its Station Areas advocated Transit-Oriented Development around it within a reasonable walking distance (BART 2008).

The planning process of the agency has been noted for the inclusive approaches to include government officials, business groups, commuters, and citizens. Additionally, in accordance with a circular issued by the Federal Transit Administration (FTA), beneficiaries of federal funding were mandated to seek out the needs of minorities and represent them better in their planning decisions. In response, the BART created the Public Participation Plan, a guide designed and passed in 2010, to shape existing engagement with communities better with an emphasis on minorities. Special attention was paid to engage low-income groups, minorities (racial), and those with limited-English proficiency (LEP). The aim of the Public Participation Plan was to offer early and continuous engagement between various communities and BART.

The Public Participation Plan was formulated after extensive meetings conducted with the citizens in various forms (community meetings, written responses, consultations with community organizations, participation surveys, extensive outreach, etc.). According to the plan, every public participation engagement was prescribed to address the scale (neighbourhood, county, or region) of the meeting, specific participation method that responded to the issue at hand (walking tours, community meetings, outreach at cultural gatherings, surveys, suggestion boxes, and so on), partner with community-based organizations (CBO) working with a wide range of groups as they helped create more trust between BART and local citizens, provide language interpreters and translators at meetings to facilitate a richer engagement between communities, and produce documents that could be more accessible for LEP groups.

A. PRELIMINARY UNDERSTANDING OF THE STATION AREA

Once station locations are finalized as per the mass transit plan, the initial scoping work can commence. A preliminary understanding of the station area is essential to set goals, targets and determine the priority of the plan. This will streamline data collection and documentation in the subsequent stages. The delineation of the station area, preparation of an accurate base map, mapping and spatial documentation, literature review, identification and consultations with stakeholders, and reconnaissance site visit are activities undertaken in this stage.

A.1 DEFINE STATION AREA TYPOLOGY, INFLUENCE ZONES AND BOUNDARY.

This involves defining the station area typology, influence zones for different modes and setting limits for the plan. Chapter II outlines this in detail. A brief summary of each activity is presented here.

- The station area typology can be identified by determining its scale of influence, predominant use and presence of historic or environment overlays (Section A: Station Area Typology).

- The station area influence zones help determine the pedestrian, cycling, feeder bus and auto-rickshaw catchment areas (Section B: Station Area Influence Zones).

- The station area boundary can be finally delineated to determine the extents of the plan (Section C: Delineating the Station Area).

A.2 PREPARE AN ACCURATE BASE MAP OF THE STATION AREA.

The lack of an accurate base map is a major obstacle in identifying property boundaries and hence the extents of land in the public realm. The National Urban Information System (NUIS) Scheme was launched in 2006 by the Ministry of Urban Development, to develop GIS databases within urban local bodies for planning, management and de-centralized governance. This would enable the preparation of accurate Master/Development plans, zonal plans and detailed town planning schemes (MoUD 2006a). As of 2009, GIS databases of 32 towns have been completed and forwarded for clearance (MoUD 2014a). This database, where available, can become a unique opportunity for preparing accurate base maps for station accessibility plans.

If the NUIS database is not accessible, CAD base maps can be created using development plan sheets and satellite images as a base reference. It is recommended that the base map be verified on site to record the transformations in the station area over time. This is useful for preparing schematic base maps and broad proposals. Total station surveys will be required for detailed designs. However a cadastre and topographic survey, highlighting key geographic and land features along with delineation of individual land parcels and properties, may be required for the purpose of preparing LAPs (TCGI 2009). Thus the station accessibility plan can become an opportunity for incremental preparation of up-to-date local plans.

A.3 CONDUCT A RECONNAISSANCE SITE VISIT, MAPPING AND SPATIAL DOCUMENTATION OF THE STATION AREA AND LITERATURE REVIEW.

A reconnaissance site visit, preliminary mapping, spatial and photo-documentation is recommended to understand the existing condition of the station area infrastructure, services and its physical fabric (EMBARQ India 2013b). This can assist in framing the approach, identify key strengths and challenges of the station area and streamline data collection in subsequent stages by providing the following information:

- Land uses and building uses: Major land uses (employment centres, institutions, etc.), ground and first floor building uses must be classified.

- Compound walls: The compound walls can be classified as porous (those that allow visual connection and physical access), semi-porous (those that permit visual connection) and opaque (those that inhibit physical access and visual connection) (EMBARQ India 2013a).

- Transport infrastructure: Existing street hierarchy, sections and width, transit infrastructure, stations, exits and entrances, existing bus shelters and stops, depots, terminals, intermediate para-transport stands, undesignated pick-up and drop-off points and tempo or goods vehicles stands. Signalised and un-signalised intersections and crossings, designated and undesignated parking.

- Topography and water flows or wind flows where relevant.

This should be supplemented with a comprehensive literature review to determine the major issues and priorities of the station accessibility plan.

TOOLS AND RESOURCES

Indiranagar Metro Station Area Accessibility Plan, EMBARQ India, 2013b
Improving Safe Access and Pedestrian Environments in MIDC Marol, EMBARQ India, 2013a

A.4 IDENTIFY AND CONSULT WITH DIFFERENT TYPES OF STAKEHOLDERS.

The different types of stakeholders can be identified as primary, secondary or key stakeholders (Chappell 2008).

- Primary stakeholders are beneficiaries of the station accessibility plan. These could include commuters, residents of the station area, resident welfare associations (RWAs) etc.

- Secondary stakeholders are people or groups who are indirectly affected. These may include those who offer services to the target groups, or whose jobs may be affected by the improvements resulting from the station accessibility plan. These will include auto-rickshaw or taxi drivers, street vendors, private bus operators, business owners and their groups.

- Key stakeholders are those who can frame and enforce regulations or implement the projects in the station accessibility plan. These include local or state government agencies, elected representatives like corporators, members of parliament or legislative assemblies, businesses, etc.

These may include those who offer services to the target groups such as auto-rickshaw or taxi drivers, street vendors, private bus operators, business owners and their groups. These stakeholders must be consulted in order to understand their issues and needs vis-à-vis access to mass transit stations. It is recommended to create a Working Committee to participate in, monitor and review the progress of the station accessibility plan. The Committee must include the primary, secondary and key stakeholders along with domain experts and elected representatives.

Additional tools must be explored to regularly apprise the public. Electronic bulletin boards or a resource centre (Local Government Commission 2013) at a convenient location can be considered where the larger public can obtain information and review station accessibility plans and their progress. Local newspapers, radio and television stations could be used to reach out to a wider audience. It is essential that when publishing in newspapers, appropriate segments of the public are reached (Davis, et al. 2013).

Create a Working Committee to participate in, **monitor and review station accessibility plans.**

A.5 CONDUCT A VISIONING WORKSHOP.

Visioning is a technique to develop a shared vision for the future by a group. It is generally done after the existing situations analysis and before undertaking a detailed planning exercise. It broadly defines where we are now and where we want to be (DFID 2003). A design charrette with station area stakeholders can be explored as a tool to imagine a future vision of the station area. This could be followed by a participatory workshop with the Working Committee to crystallize a vision and goals for the station area. Mediation sessions should be considered to resolve differences between conflicting groups (Davis, et al. 2013) at this stage to facilitate implementation and prevent the collapse of the project later on. The role of elected representatives in creating a wider participation process as well as becoming champions of the projects must be considered. While RWAs and business associations are important and powerful actors, care must be taken that they do not dominate and appropriate the vision of the plan (Coelho, Kamath and Vijaybaskar 2011). Thus special effort must be made to include vulnerable groups, those from economically weaker sections of society, women, minority groups, differently-abled and the elderly, and workers in the "informal sector" like informal transit providers or street vendors. Due to their lack of access to formal services, their voice is often left out of public participation practices (Bhowmik and Saha 2012, 11).

A.6 CREATE GOALS AND TARGETS FOR THE STATION ACCESSIBILITY PLAN.

The station accessibility plan should outline clear goals and targets within the city's overall vision and targets to increase public transport and NMT modal shares, reduce demand for private motorized vehicular parking, improve road safety and women's perception of security. It is recommended that the station accessibility plan period coincide with that of the mass transit with 5 year and annual targets. Additionally, proposed transport projects or services within the next ten years must be considered to evaluate and enhance their impact on the station accessibility plan.

TOOLS AND RESOURCES

The census, city master plan, regional plan, comprehensive mobility plan, comprehensive traffic and transport study and local or neighbourhood plans can provide useful resources.

Some guidelines for inclusive consultations **which are relevant for India are:**

- Proactively reach out to marginalized women and men to ensure they are included, especially street vendors, other workers in the informal economy in the station area.
- Partner with local women's and membership based organizations to access their networks and expertise
- Hold consultation meetings where women or particular communities already gather (i.e.informal settlements, markets, schools, childcare centres, parks etc.), and in settings that are accessible and comfortable for diverse groups of women.
- Plan meetings at different times of the day and not only evenings. Women might be more reluctant to go out at night and may have many family responsibilities in the evenings.
- Ensure safety at consultation events such as lighted areas, easy access to public transportation, etc. Provide practical support such as transportation subsidies, childcare, translation, buildings that are accessible for women and men with disabilities.
- Ensure that information is disaggregated by gender, age, caste, income and other relevant socio-economic factors; and provided in a lucid manner in all major languages.
- Identify gender gaps, i.e. inequalities between women and men which have to be considered in the outcomes and follow-up actions.

Source: Adapted from Local Government Participatory Practices Manual: A toolkit to support public participation. International Centre for Municipal Development, Federation of Canadian Municipalities, 2007.

B. DOCUMENTATION, ANALYSIS AND DRAFT MASTER LIST OF PROJECTS

A preliminary understanding of the station area is essential to determine its priority issues. This can be followed with a detailed documentation, analysis and guide the formulation of a draft master list of projects. Chapter III: Station Area Planning Guidelines recommends strategies and guidelines for the five objectives of a station area, i.e. pedestrian and cyclist priority, seamless integration with feeder bus and para-transit services, networks and infrastructure, enhanced safety and security, parking management and an enhanced public realm. The draft proposals must be opened up publicly to engage stakeholders at this stage. The feedback can be used by the Working Committee to finalize the proposals and their priority.

B.1 UNDERTAKE DATA COLLECTION OF THE STATION AREA.

It is recommended to understand the specific travel patterns, issues, perceptions and priorities of the users within the station area. These must be compared with the city's overall demographic and transport patterns to evaluate how the station area is positioned vis-à-vis the city.

B.1.1 Collect population, demographic and travel data (of residents and visitors) of the station area and compare it with the rest of the city.

A sample survey of resident and visitors is attached in Appendix I-A and Appendix I-B respectively. The data should include questions on:

- Demography: Age, gender, monthly household income, household size and vehicle ownership. The need for education and employment data is necessary, and might be of special importance for areas undergoing transformation and in commercial and employment centres.

- Overall travel pattern: Frequency of visit, duration, trip origins and destinations, modes of travel separated by stages, time spent in the area, travel times and trip lengths by mode.

- Walking patterns: Number of walking trips/day, percentage of total trips and purpose.

- Cycling patterns: Number of cycling trips/day, percentage of total trips and purpose.

- Perceptions and willingness to walk, cycle, use mass transit and bus services and improvements suggested.

- Perceptions of rickshaw and taxi services and how these can be improved.

- Issues with parking and how much are people willing to pay for on-street parking.

- Identification, perception of pleasant public open spaces and improvements suggested.

- Priority of improvement of services and infrastructure.

NOTE:

- When interviewing residents, care should be taken to interview households residing within different housing types i.e. flat, row house, slum and bungalow.

- Since women tend to be underrepresented in public spaces, care should be taken to ensure that they are equally represented (50 percent) in the survey distribution.

- Since a greater percentage of women's trips are during afternoon off-peak hours, followed by reduced travel during the night (Deike 2013), at least a quarter of all the interviews should be taken during these times.

- In order to ensure consistency with other existing data sources, it is recommended that the demographic distributions correspond to existing city-level distributions, based on the Census or data from the National Council of Applied Economic Research.

The data collection at this stage can be streamlined based on the reconnaissance survey, which will determine the major issues and priorities of the station accessibility plan.

TOOLS AND RESOURCES

The census, city master plan, regional plan, comprehensive mobility plan, comprehensive traffic and transport study and local or neighbourhood plans can provide useful resources.

B.1.2 Undertake traffic and pedestrian counts, pedestrian and cycling origin-destination surveys, gender counts by time of day, road safety audits, women's security assessments[13] and universal accessibility audits.

Traffic and pedestrian counts can provide relevant data in understanding the volume of through movement versus station area vehicular traffic, the level of service for pedestrians and cyclists, making decisions on the pedestrianisation of streets, developing time-based proposals, undertaking traffic management, recommending bus priority measures or suggesting grade separation.These can be undertaken at major intersections within the primary or secondary zone, along major vehicular, pedestrian or cycling routes, or where there is a conflict In addition, midblock pedestrian, cycling or counts of non-motorized vehicles (NMV) can be undertaken to assess demand for crossing.

Collecting data disaggregated by gender and age illustrates the use of public spaces **by women, children and the elderly during different times of the day.**

The counts should be based on the operating hours of the mass transit and should distinguish between public transport, motorized and non-motorized modes. These could be the following categories: pedestrians, cyclists, other non-motorized vehicles(NMV) (if relevant), public transport buses, motorized two-wheelers and motorized four wheelers. If the area has a significant number of heavy vehicles, then these can be included as a separate category.

Pedestrian or cycling origin-destination surveys can be conducted to understand the needs of specific user groups (Appendix II). These can be substantiated with perception surveys to understand the barriers affecting access to public space for vulnerable users. Road safety audits assess vehicular speeds, street and intersection geometry. Universal accessibility audits specifically assess infrastructure from the perspective of the elderly and persons with disabilities. Women's security assessments privilege their experiences in identifying safe and unsafe spaces in a neighbourhood and recommend how the unsafe spaces can be improved (Whitzman, et al. 2009).
(Chapter III Section A: Pedestrian and Cyclist Priority and Section C: Enhanced Safety and Security).

TOOLS AND RESOURCES

Road Safety: Road Safety Guidelines for Bus Rapid Transit Systems in Indian Cities, EMBARQ India
Universal Access: Guidelines for Pedestrian Facilities, IRC 103: 2012
Women's Security Assessments: A Handbook on Women's Safety Audits in Low-income Urban Neighbourhoods: A Focus on Essential Services, Jagori and WICI. This audit methodology though developed for low-income neighbourhoods has been applied in different parts of India and can be used for station areas too.

B.2 ANALYSE THE STATION AREA AND PREPARE A DRAFT MASTER LIST OF PROJECTS.

The station area must be analysed in its ability to achieve the objectives of pedestrian and cyclist priority, seamless integration with feeder bus and para-transit networks, services and infrastructure, parking management, enhanced safety and security, and an enhanced

public realm. The indicators developed to evaluate the station accessibility plan (Chapter V Section A: Station Area Plan Assessments) can provide guidance in the analysis and development of projects. The strategies and projects for:

- **Safety and security** must aim to reduce fatalities, major and minor injuries, with special attention to women's security and universal accessibility.

- **Pedestrian and cyclist priority** must aim to increase pedestrian and cycling modal shares by evaluating levels of service, increasing road space allocation for NMT infrastructure; and providing public amenities, street furniture and signage for pedestrians and cyclists.

- **On-street parking management** must aim to discourage demand and supply of motorized vehicular parking within the station area. At the same time, they must estimate and provide for NMT parking including cycles and cycle-rickshaws, where relevant.

- **Improved feeder services and integration** must aim to reduce waiting times for transfer to feeder bus and rickshaw (or taxi) services and improve waiting experience.

- **Enhanced public spaces** must aim to increase supply, improve the experience, and use of public open spaces within the station area.

- **Economic activity and opportunity** must evaluate the economic activity generated in a station area.

These must be finalized after consultations with the public at large and the Working Committee. Public presentations and exhibitions are one way to share the findings and obtain opinions on the proposed projects as was done in Panaji, Goa (NIUA 2011).

Public Participation Project:
Case Study: Panaji, India

This case study illustrates a best practice for Stakeholder Participation in preparing Detailed Project Reports (DPRs) under JnNURM (NIUA 2011). The consultants created a public participation plan to provide information on the DPRs and prioritise projects in the Urban Renewal, Heritage Conservation and Mobility Plan for Panaji. The objective was to provide information on the DPRs and prioritize projects for implementation.

The consultations were held with line agencies, RWAs, CSOs, NGOs, associations of shop owners, taxi and auto associations etc. as well as residents, regular visitors and tourists. The process of public participation was conducted in seven stages: (1) Data Collection and Assessment; (2) Analysis and Diagnosis; (3) SWOT; (4) Conceptual Design Stage; (5) Interim Project Report; (6) Draft Detailed Project Report; and (7) Final Detailed Project Report. Primary and secondary stakeholders were consulted through meetings, focused group discussions, questionnaires and field visits in every stage of the project, except in the last two stages.

Additionally, exhibitions of the proposals were organized during the conceptual design and the interim project stages. These Open-House events were held over 3 days at various locations across the city to enable discussions with the public at large. The public were informed of the exhibition through multiple media like fliers, posters, press notes, television and radio announcements. The outcome of the sustained campaign to engage the public to participate in the development of DPRs led to 450 people attending six open-house events over 3 days (NIUA 2011, 95).

Thus a detailed documentation and analysis is suggested based on the station area priority issues around five major themes: pedestrian and cyclist priority, improved feeder services and integration, on-street parking management, safety and security and enhanced public spaces. Indicators are recommended (Chapter V: Evaluation and Performance Indicators) to tie the analysis to the proposed projects, implementation and impact evaluation in subsequent stages. However, these must be finalized after consultation with the public at large and the Working Committee.

C. FINAL MASTER LIST OF PROJECTS, IMPLEMENTATION AND MAINTENANCE STRATEGIES

It is recommended that at this stage a final master list of projects be developed along with an implementation and maintenance plan. The Implementation Plan must recommend the phasing of projects, identify how resources will be mobilized and suggest institutional structures. The Maintenance Plan must outline items and processes for regular maintenance, periodic maintenance, urgent repairs, resource mobilization and institutional structures for the same. The Draft Implementation and Maintenance Plans must be finalized after it is reviewed by the Working Committee, to agree upon timelines, financial commitments and ensure inter-agency coordination.

Chapter IV: Implementation and Maintenance Strategies broadly suggests planning, institutional and financial strategies to ensure timely implementation and maintenance.

D. IMPLEMENTATION AND EVALUATION

This stage involves monitoring the progress of implementation, evaluation of the implemented projects and their impact. The Working Committee can play a key role in overseeing the progress of the work. Chapter V: Evaluation and Performance Indicators suggests three evaluations. The first evaluation is recommended to assess the station accessibility plan (SAP). The second is recommended right after implementation to assess the extent and quality of implementation of the station area projects. And the third is recommended annually to evaluate the impact of the projects and assess the quality of service provided to users. This can be substantiated with a comprehensive evaluation every 5 years.


MARUTI
TOWER
Handicraft

CHAPTER II

DEFINING **A STATION AREA**

Station areas need to be defined to understand the influence area of the new transport infrastructure, achieve its ridership potential and minimize its adverse impacts on surrounding neighbourhoods.

A station area is more than just an area adjacent to a transit node. It is a place of connectivity where different modes of trasportation – from walking to riding transit – come together seamlessly and wehre there is a concentration of working, living, shopping and playing (Metrolinx 2011). A well functioning station area is defined by more than its adjacency to a mass transit station. A station area is described by the ease and number of connections it offers its users and the multiple activities that occur here. Table 1 lists a few parameters to classify station areas (EMBARQ India 2014b). The following 3 stages are identified as critical steps in understanding and defining a station area.

A. Station Area Typology
B. Station Area Influence Zones
C. Delineating the Station Area

A station area is a place of connectivity where different modes of **transportation come together seamlessly and where work, live, shop and play can happen simultaneously.**

A. STATION AREA TYPOLOGY

Station area typology can be identified by the scale of the transit stations, the predominant land use in the area around it with any special historic or environmental features (Table 1; Figure 13).

- **Scale:** Refers to the scale of the transit stop and the adjoining area. These can be classified as regional, city-level, sub-centre level, neighbourhood and suburban. The number of people boarding and alighting at the station, function of the station (terminal, transfer, origin or destination), intersection of transit lines, people density and attractors or generators around the station are indicators of these scales.

- **Predominant use:** Refers to the predominant land use surrounding the station. It can be classified as commercial-office, commercial-retail, institutional, industrial node, transport hub, mixed or purely residential neighbourhood or a recreational node.

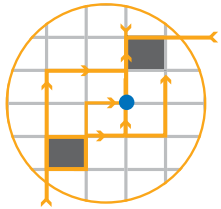
- **Historic precinct and environment overlays:** Refers to historic precincts or environmental features around the station, which can be preserved and enhanced in the plan.

Table 1 Station area typologies and overlays; Source: EMBARQ India adapted from EMBARQ India 2014, CTOD 2008 and Metrolinx 2011

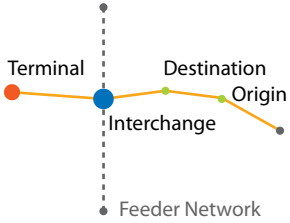
TYPOLOGY	DESCRIPTION	EXAMPLES
Regional	Regional centres with multiple destinations. These are central business districts, administrative centres, special economic zones regional transfer and terminal stations.	Churchgate and Victoria Terminus, Dadar, Andheri and Ghatkopar stations in Mumbai
City	City-level employment, commercial, institutional nodes with multiple destinations, terminals and transit and traffic management centres.	Hubli and Dharwad BRT stations in Hubli-Dharwad; Chakala Metro Station in Mumbai; Vijayanagar and Banashankari stations in Bengaluru
Sub-Centre	Located in different parts of the city. The predominant land use is residential but the key influencing factor is the presence of a large generator such as stadium, university or theme park, shopping malls or institutions etc.	DN Nagar Metro Station in Mumbai
Neighbour-hood	Located in different parts of the city. The predominant land use maybe residential with mixed uses.	Halasuru, Magadi Road, South End Circle, Rajajinagar, Bengaluru
Suburban	Maybe located on the outskirts of the city and characterized by multiple land uses. They predominantly have low density and undeveloped land.	Navanagar BRT Station in Hubli-Dharwad
OVERLAYS		
Historic	Historic precincts include multiple types of urban fabrics – from fishing villages to dense urban cores with city markets etc. These may not be listed on city heritage inventories, but they are characterized by dense street networks and compact built form.	Hubli, Dharwad, Amargol village in Hubli-Dharwad; Walled City in Ahmedabad; Chandni Chowk in Delhi
Environmental	Environmentally sensitive features such as natural drains, water bodies, mangroves, beaches and city level parks or playgrounds etc.	Lalbaug and Cubbon Park in Bengaluru

STATION AREA TYPOLOGY

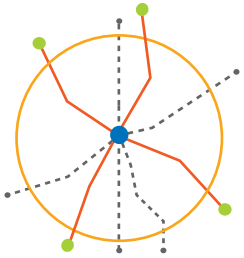
People Density



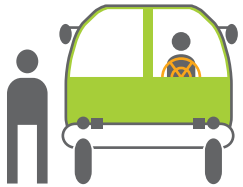
Generators And Attractors



Transport Function



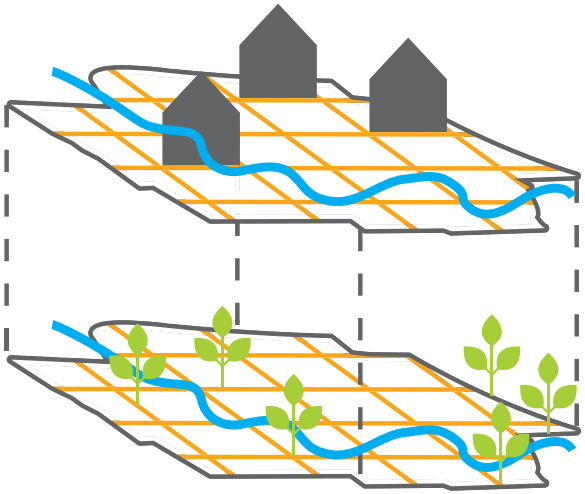
Intersection Of Transit Lines



Boarding And Alighting Patterns

SCALE

HISTORIC AND ENVIRONMENTAL OVERLAYS



PREDOMINANT USE

Residential

Commercial Office

Commercial Retail

Institution

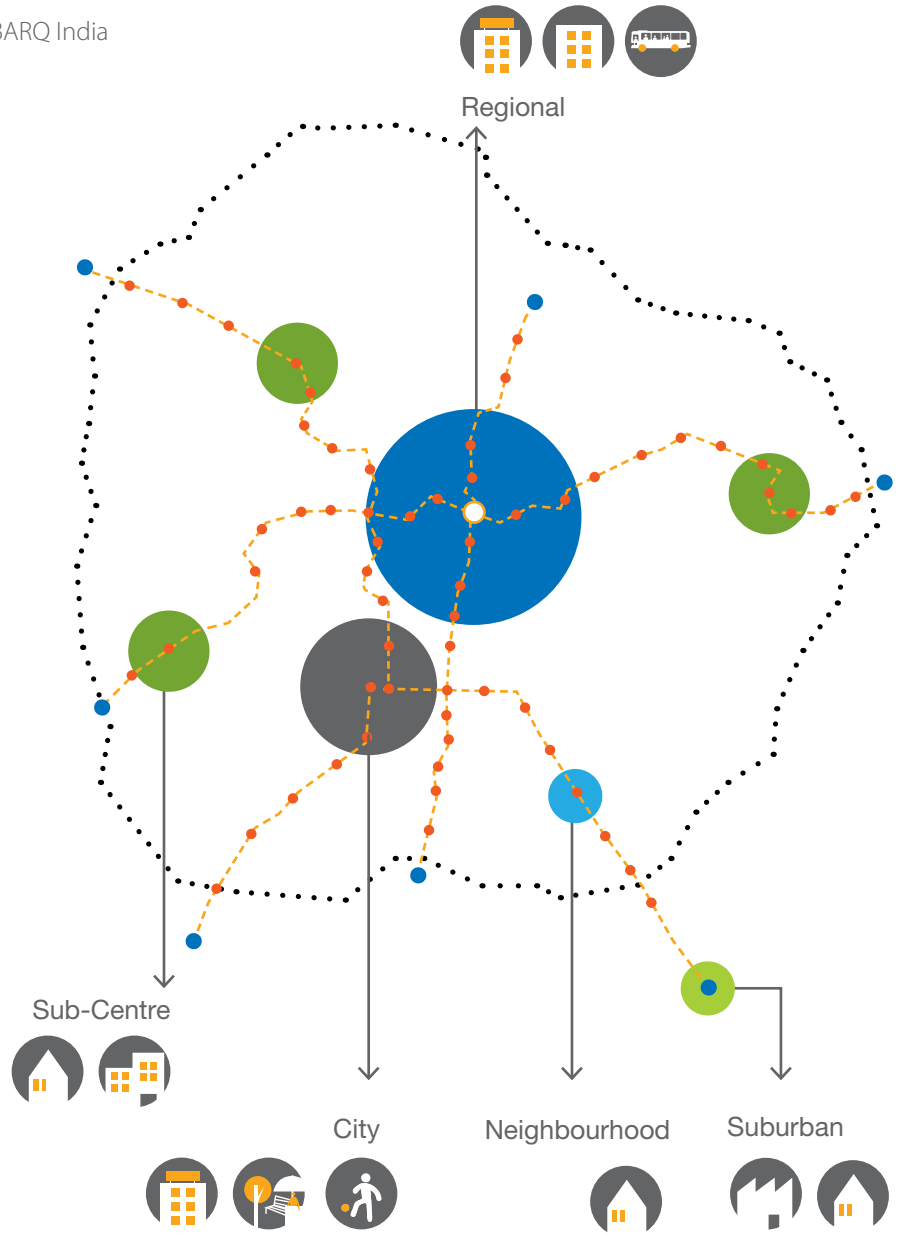
Industry

Transportation

Recreation

Mixed Use

Figure 13 Station area typologies, Source: EMBARQ India



B. STATION AREA INFLUENCE ZONES

The transportation and land use conditions typically vary with distance from the transit station. When planning in a station area, it is useful to divide it into zones to scope the planning exercise and understand the needs and opportunities in each area (Metrolinx 2011). For example, direct and safe walking connections are most important in close proximity to the station, where there is often the highest levels of pedestrian activity. Farther away from the station, bicycle, bus and rickshaw/taxi connections become relatively more important to ensure convenient access. The station area boundary includes primary zone, secondary zone and tertiary zones (Figure 14). The catchment area includes the larger feeder area for the mass transit station. Broad guidelines are suggested to assist in defining the influence zones.

TOOLS AND RESOURCES

Comprehensive Mobility Plan
Comprehensive Traffic and Transport Studies
City Non-motorized Transport Plan

Retail activities and street use in the primary station area of the Indiranagar Metro Station

Table 2 Defining station area influence zones with accessibility considerations, Source: EMBARQ India, adapted from (Metrolinx 2011), (BART 2003), (CTOD 2008)

ZONE	DESCRIPTION	ZONE AND ACCESSIBILITY CONSIDERATIONS
Primary Zone	Includes the transit station and the immediate access routes.	• Generally within 5 minutes or 150m-250m of the station exits; • The zone must prioritize pedestrian and cycling access and transfer to feeder bus, auto-rickshaws and taxis; • Care must be taken to manage conflicts between different modes.
Secondary Zone	Includes the area and major destinations around the station, which can be accessed by walking and cycling. An intermediate tertiary zone maybe considered beyond the secondary zone when prioritizing cycling access.	• Direct, safe walking and cycling connections are most critical and are to be prioritized. • 500m - 750m is generally adopted internationally. Since walking distances in India tend to be longer, this zone can be larger based on the station typology or average city-level walking distances, whichever is higher*. • When delineating tertiary zones, the cycling trip lengths of the station area should be considered**.
Catchment Area	Catchment areas include the broader area of influence from the mass transit station. They provide significant number of passengers for regional and city-level stations.	• Access by feeder buses, auto-rickshaws and cycle rickshaws are critical for the catchment areas. • The catchment areas vary depending on the route lengths of feeder bus services and areas served by auto-rickshaws (and taxis)***

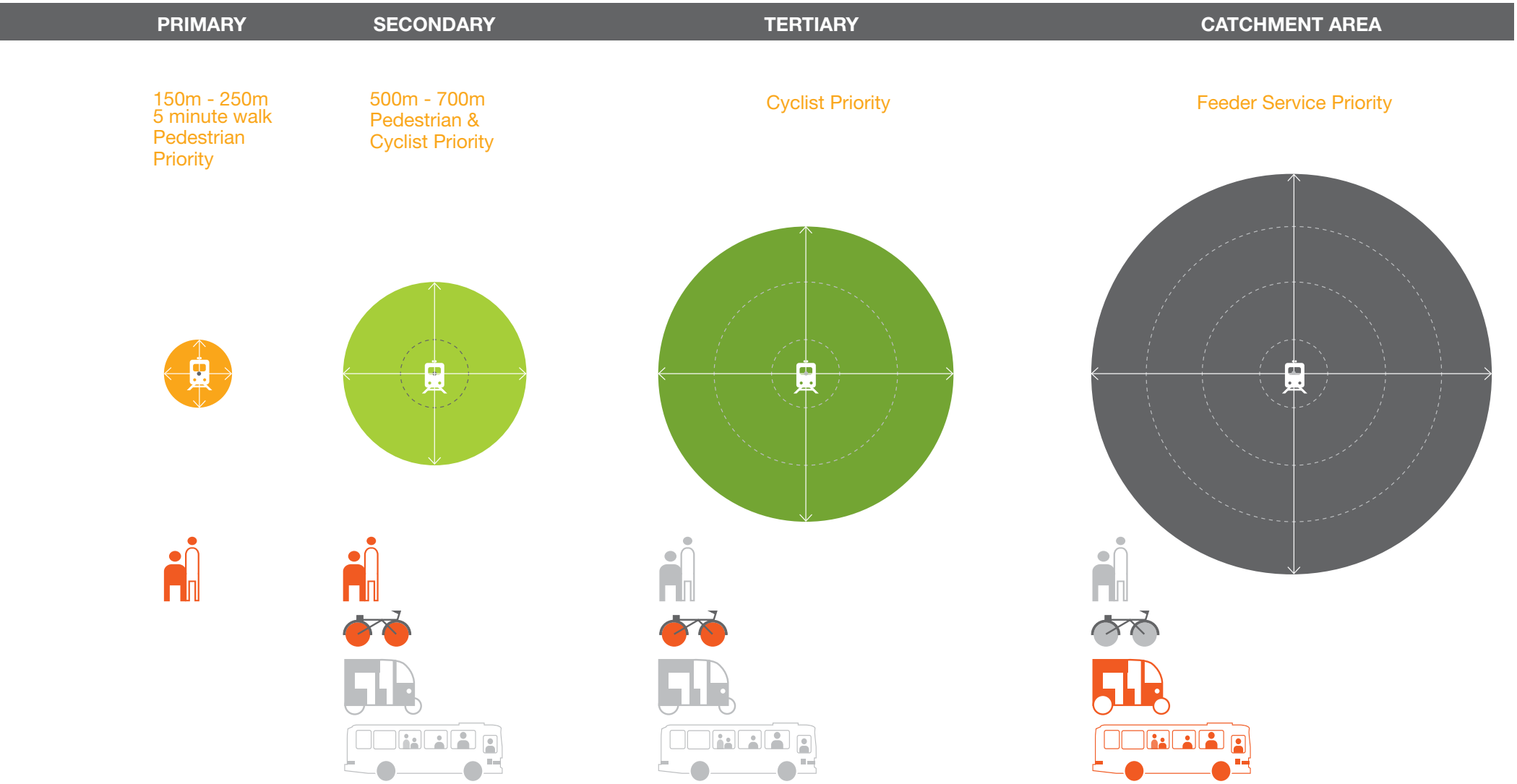
NOTES:

*Churchgate and Victoria Terminus are the terminal stations for the Western and Central and Harbour Suburban railway lines in Mumbai. These are within a 2km distance of each other, situated within the central business district of Mumbai. While a special feeder bus service operated by BEST, known as Fort Pheri connects major destinations to the terminals, it is not uncommon for people to walk 1-2km to these stations (EMBARQ India 2014a).

**The average trip lengths for bicycles vary from 1.9 to 3.1km in small cities, 3.1km to 4.5km for medium and large cities. In Delhi, the average bicycle trip length is 5.1km (Tiwari and Jain 2008).

***The feeder routes operated by BEST in Mumbai vary from 2-5km for residential neighbourhoods, 3-8km in the central business district (Mulukutla and Vasudevan 2013).

Figure 14 Station area influence zones, Source: EMBARQ India



C. DELINEATING THE STATION AREA

The station area primary, secondary and tertiary zones can be can be delineated based on the following guidelines (Figure 15):

Plot boundary: Each zone should follow plot boundaries.

Major Attractors or Generators: Regional, city-level or sub-centre generators or attractors outside the zone but within close proximity of it have the potential to attract transit ridership and hence must be included within the station area. Special attention should be given to include informal settlements or urban villages.

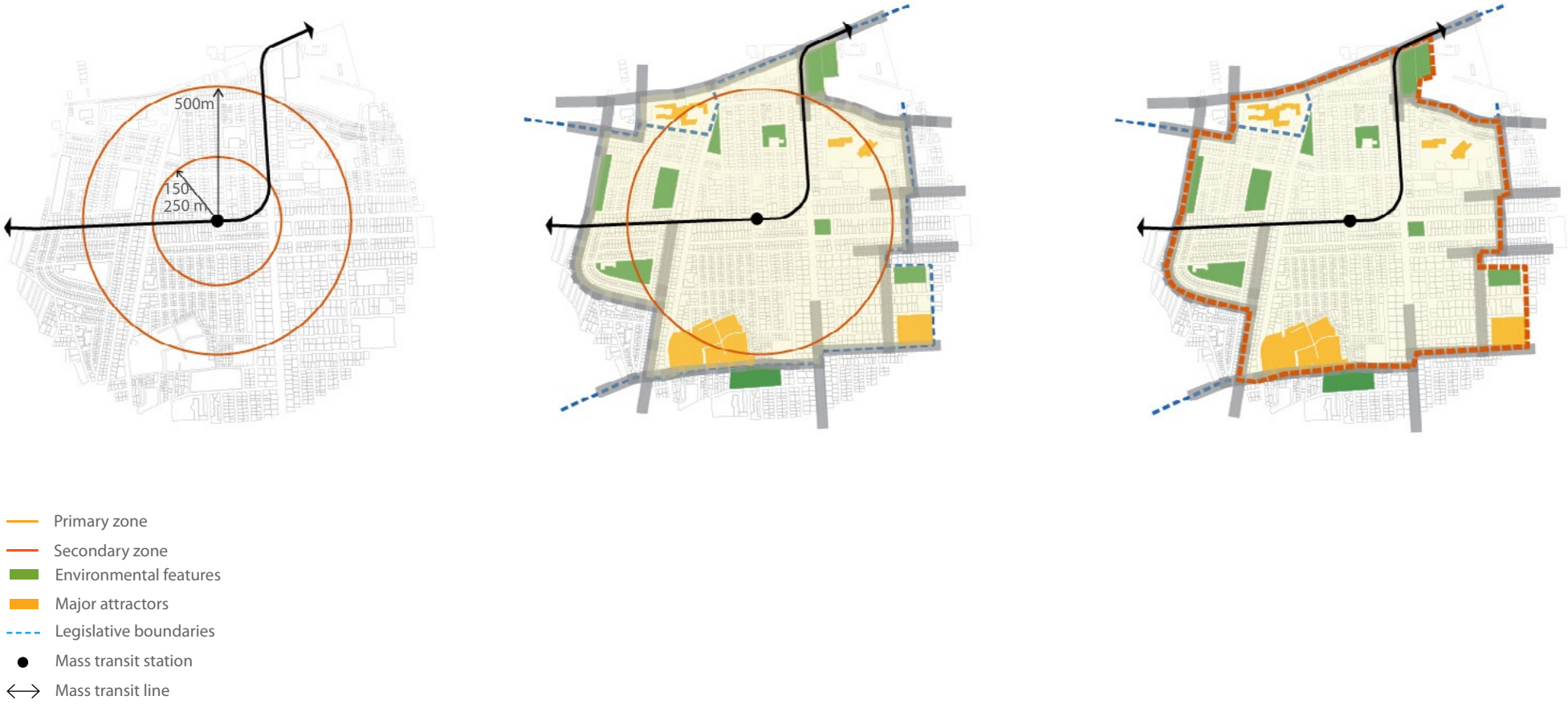
Environmental Features: Natural reserve forests, environmentally sensitive areas like mangroves, rivers etc. can serve as boundaries of a zone.

Infrastructure Barriers: Infrastructure such as highways, rail corridors should not become a barrier in defining the station area. In fact, the plan should develop strategies to facilitate access across these barriers.

Institutional and Planning Framework: The station area should consider boundaries established by LAPs, Special Planning Authorities, administrative boundaries of transit authorities, and nodal implementation agencies (MRTS SPVs or municipal corporations). Electoral ward boundaries must be considered to facilitate implementation.

If the station area crosses multiple institutional boundaries i.e. Special Planning Authorities, Indian Railways, Housing Boards or Authorities, whose development is likely to have an impact on ridership, they must be included within the Working Committee or consulted with while preparing the station accessibility plan (Chapter I: Station Area Improvement Process).

Figure 15 Station area delineation, Source: EMBARQ India




SHARDA
The Meadows and Water Lily:
Back on the menu.
Shantigram
RTO Circle
Maninagar

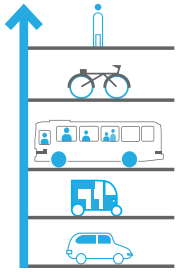
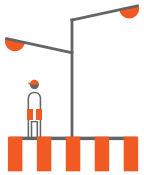
CHAPTER III

STATION AREA **PLANNING GUIDELINES**

A successful station area under a safe access approach prioritizes pedestrians and cyclists, provides seamless integration in a multimodal network, enhances the public realm, and increases economic vibrancy for all within a safe and secure environment.

This manual presents an approach to station accessibility plans based on a people-centred and sustainable development framework. Specific objectives and strategies of such an approach are presented in Table 3. The following sections A, B, C, D, and E describe each of these objectives and the strategies to achieve them.

Table 3 Objectives and strategies for station accessibility plans, Source: EMBARQ India, adapted from (Metrolinx 2011), (EMBARQ India 2012b); (EMBARQ India 2013a); (EMBARQ India 2014a).

 **A.** PEDESTRIAN AND CYCLIST PRIORITY	**A1.** Create a continuous and connected pedestrian and cycling network; **A2.** Connect existing city-level routes or local routes within the area to the station; **A3.** Evaluate and provide safe and comfortable pedestrian infrastructure; **A4.** Evaluate and provide safe and comfortable bicycling infrastructure; **A5.** Provide sufficient, secure parking for bicycles at station entrances; **A6.** Improve pedestrian and cyclist convenience by providing amenities.
 **B.** SEAMLESS INTEGRATION WITH FEEDER BUS, RICKSHAW AND TAXI ROUTES AND INFRASTRUCTURE	**B1.** Provide and coordinate feeder bus services and routes within the station area to minimize waiting times; **B2.** Adopt bus priority measures in the station area for efficient movement of feeder buses; **B3.** Facilitate access by auto-rickshaws, cycle-rickshaws and taxis.
 **C.** ENHANCED SAFETY AND SECURITY	**C1.** Traffic calm the entire station area as a non-motorized transport and bus priority zone; **C2.** Traffic calm the streets to create a safe environment for commuters; **C3.** Design intersections to enable safe crossings; **C4.** Provide for effective management of conflict points between pedestrians and cyclists; **C5.** Improve women's sense of security, comfort and convenience.
 **D.** PARKING MANAGEMENT	**D1.** Create a parking management plan with the objective of minimizing need and supply of parking.
 **E.** AN ENHANCED PUBLIC REALM	**E1.** Undertake activity counts and map different types of street activity and uses; **E2.** Enhance the role of streets as public spaces; **E3.** Create a secure, comfortable and imageable public realm; **E4.** Introduce a coordinated pedestrian and traffic signage system to improve safety and way-finding.

A. PEDESTRIAN AND CYCLIST PRIORITY

Indian cities generally have high non-motorized modal shares (25-55 percent) and low-medium public transport modal shares (13-60 percent) (Pai 2009). A significant percentage of trips to and from mass transit are on foot. For example, 60 percent of trips to the suburban railways in Mumbai (MCGM 2013) and 46-64 percent of trips to the BRTS in Ahmedabad (Mahadevia, Joshi and Datey 2013) are on foot.

However, NMT users (cyclists and pedestrians) are the most vulnerable road users. When combined with motorized two-wheeler riders, they account for 60–90 percent of all traffic fatalities in cities like Mumbai, Delhi, Kota, Vadodara and selected highway locations (Mohan and Tiwari 2000). Indian cities are generally characterized by poor pedestrian and cycling environments—large block sizes and disconnected streets resulting in increased walking or cycling distances and insufficient, unmaintained and uncomfortable pedestrian infrastructure (Tiwari and Jain 2013). Research demonstrates that increased NMT trip lengths increases their probability of fatal crashes (Bhalla, et al. 2007). Further, the conflict between pedestrians and cyclists also needs to be addressed through design measures.

Indian cities have a range of NMVs including bicycles, cycle rickshaws, goods carriers etc. Many cities do not have cycling infrastructure and cyclists are forced to share the road with other vehicles. In cities like Pune, Delhi, Bengaluru and Ahmedabad, poor planning, design, parking and street vending have rendered cycle lanes/ tracks unusable (Mahadevia, Joshi and Datey 2013). While informal bicycle renting systems exist in a number of cities (TERI 2014), they have yet to be integrated with mass transit systems. On the other hand, formal, organized bicycle sharing schemes are still in their nascent stage and have faced challenges in scaling up (TERI 2014).

Further, cycle-rickshaws tend to not be counted as a separate mode and therefore their positive contribution to the city mobility system or required infrastructure is not discussed. It is estimated that at least 24 percent of Delhi metro trips are dependent on cycle rickshaws (Advani 2010). The role of cycle rickshaws, both as a separate mode and as an important feeder mode to public transport systems should be recognized and planned for (Tiwari and Jain 2013).

A number of initiatives in India have enabled the evaluation of pedestrian and cycling infrastructure. IRC 103-2012: Guidelines for Pedestrian Facilities, introduced a level of service approach for design of footpaths along with guidelines to facilitate universal access and incorporate street vendors, street furniture and utilities (IRC 2012). Similarly, Parisar[14] has prepared a framework to evaluate the quality of cycling infrastructure in Pune (Singh and Gadgil 2011). IRC 86-1983: Geometric Design Standards for Urban Roads in Plains, recommends cycle tracks of 2-3m for arterial, sub-arterial and collector roads (IRC 1983).

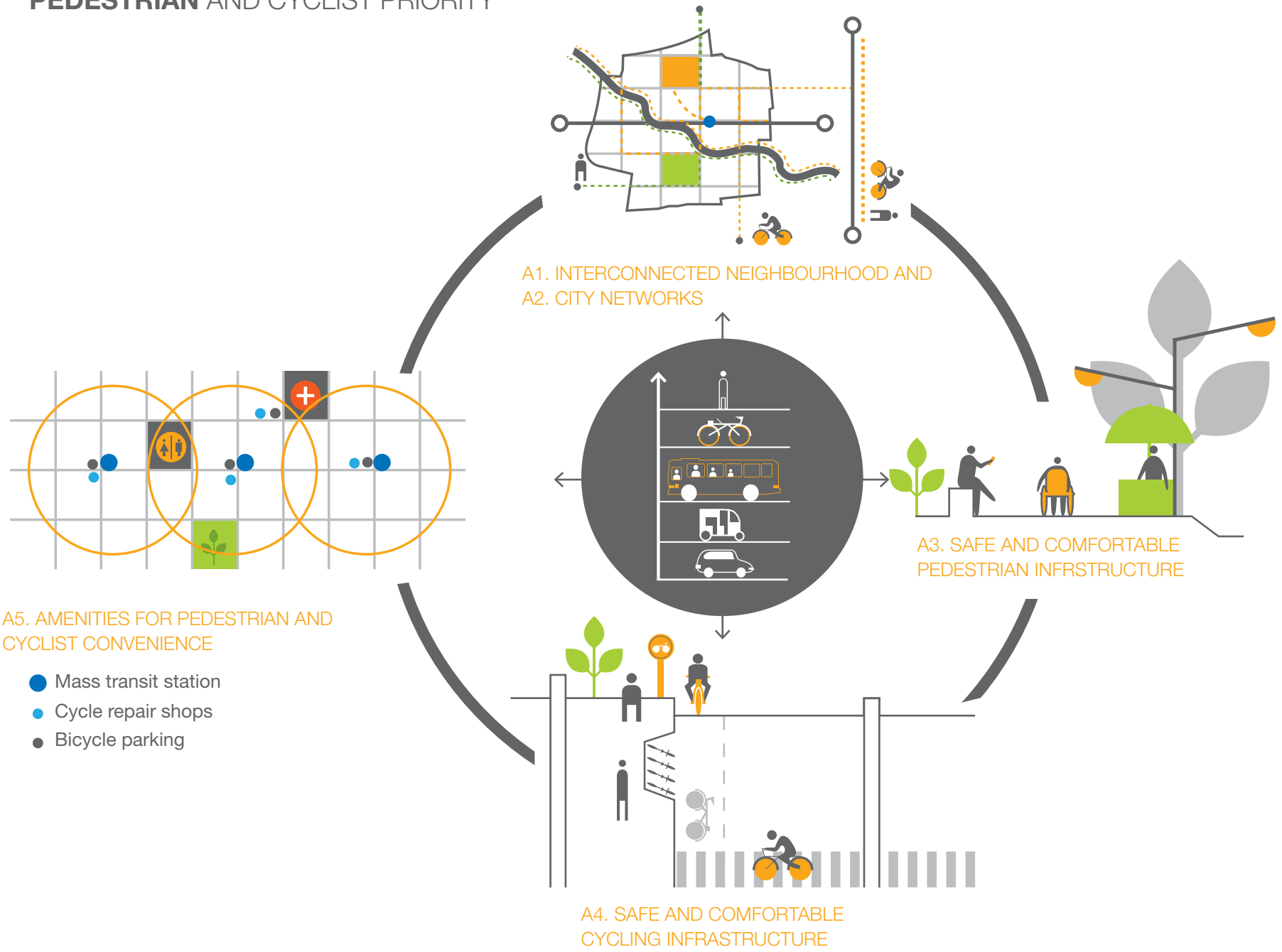
Prioritizing NMT access aims to reduce walking and cycling distances, create connected and complete networks, improve pedestrian and cycling infrastructure and create a high quality public realm that supports street level activity and uses. The station accessibility plan also needs to account for future NMT growth, infrastructure and amenities. Table 4 recommends strategies and guidelines for prioritizing NMT in station accessibility plans.

Prioritizing NMT access aims to reduce walking and cycling distances, **create connected and complete networks and improve pedestrian and cycling infrastructure.**

Table 4 Strategies and guidelines for pedestrian and cycling priority in station areas

STRATEGIES	GUIDELINES
A1. Create a continuous and connected pedestrian and cycling network	**A.1.1** Identify major destinations and create direct, shortest pedestrian and cycling routes to the station; **A.1.2** Create "green grids or networks" through existing public open spaces, along rivers and natural drains within the station area; **A.1.3** Integrate grade-separated access to key destinations from MRT stations.
A2. Connect existing city-level routes or local routes to the station	**A.2.1** Map the existing pedestrian and cycling networks within and through the station area and connect these to the station.
A3. Evaluate and provide safe and comfortable pedestrian infrastructure	**A.3.1** Understand the walking patterns, demography, trip purpose, needs and perceptions; **A.3.2** Evaluate the level of service of pedestrian infrastructure along major routes within the primary and secondary zones; **A.3.3** Create street rating maps to evaluate quality of existing pedestrian infrastructure, universal access, road safety and security; **A.3.4** Traffic-calm the station area and design streets and intersections to facilitate safe pedestrian access (Chapter III Section C: Enhanced Safety and Security: Section C1, C2, C3 and C4).
A4. Evaluate and provide safe and comfortable bicycling infrastructure	**A.4.1** Understand the cycling patterns, demography, trip purpose, needs and perceptions; **A.4.2** Create street rating maps to evaluate quality of existing cycling infrastructure; **A.4.3** Traffic-calm the station area and design streets and intersections to facilitate safe cycling access; **A.4.4** Provide sufficient, protected and secure bicycle parking. (Chapter III Section D: Parking Management; Section E: Enhanced Public Realm, E.3.2)
A5. Improve pedestrian and cyclist convenience by providing amenities	**A.5.1** Provide amenities through design, planning and regulatory recommendations to improve pedestrian, cyclist and user conveniences; **A.5.2** Consider public-bicycle sharing schemes between major destinations and stations.

PEDESTRIAN AND CYCLIST PRIORITY



A1. CREATE A CONTINUOUS AND CONNECTED PEDESTRIAN AND CYCLING NETWORK.

A.1.1 Identify major destinations and create a network of direct and shortest possible pedestrian and cycling routes to the station.

This involves identifying and improving NMT infrastructure along existing routes, and creating new routes. Identify shortest routes along existing roads and improve NMT infrastructure along these (Chapter III, Section A: Pedestrian and Cyclist Priority, A3 and A4) Identify and create NMT public-right of ways or privately-owned public access within the primary and secondary zones (and tertiary zones, if relevant)

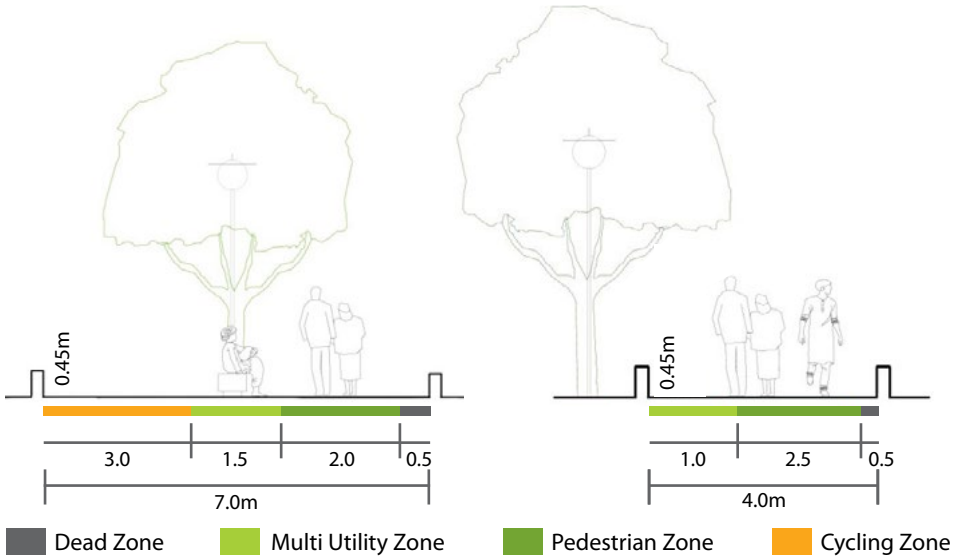
Walkable station areas can be created by increasing the porosity of urban blocks and offering multiple options to a single destination. These can be evaluated through multiple indicators such as street density, intersection density, connectivity or accessibility indices (UN Habitat 2013). The walkability of different cities like London, New York, Chandigarh and Naya Raipur is compared in Appendix III. It demonstrates that indicators such as land allocated to streets, by themselves, are not a good measure of walkability as they do not account for street widths or spacing.

Maximum urban block sizes or accessibility and connectivity indices, can be used as guidelines to determine regulations for plot sizes and amalgamation in primary, secondary and tertiary zones of station areas. The urban block sizes could become larger as we move further from the station.

There are three aspects to creating porous blocks – first is through the development of a continuous network, second is the development of breathing/break out spaces in the network such as plazas and pocket parks (ground) and finally is through the design and upgrading of spaces for activities so as to encourage people movement through these blocks (Stratis 2012, 47). New NMT routes through traffic rerouting and public lands must be considered first. These can be supplemented with a network of paths through private plots to create walkable blocks in station areas. Appendix V - A, B and C demonstrate examples of privately owned public spaces (POPS) in Mumbai and New York and privately owned public open spaces (POPOS) in San Francisco.

The following street sections can be considered when proposing new NMT paths. Ideally, a NMT street should include a pedestrian and cycling path. They are separated by a shared multi-utility zone (MUZ) as seen in Figure 16, left. When only a pedestrian or cycling route is proposed, a minimum of 4m is recommended with an uninterrupted walking or cycling zone (2.50m), dead zone (0.50m) and a multi-utility zone (1m) (Figure 16 right). The MUZ can be considered at one of the curb edges.

Figure 16 (left) Non-motorized transport street; (right) Pedestrian or cycling path only, Source: EMBARQ India

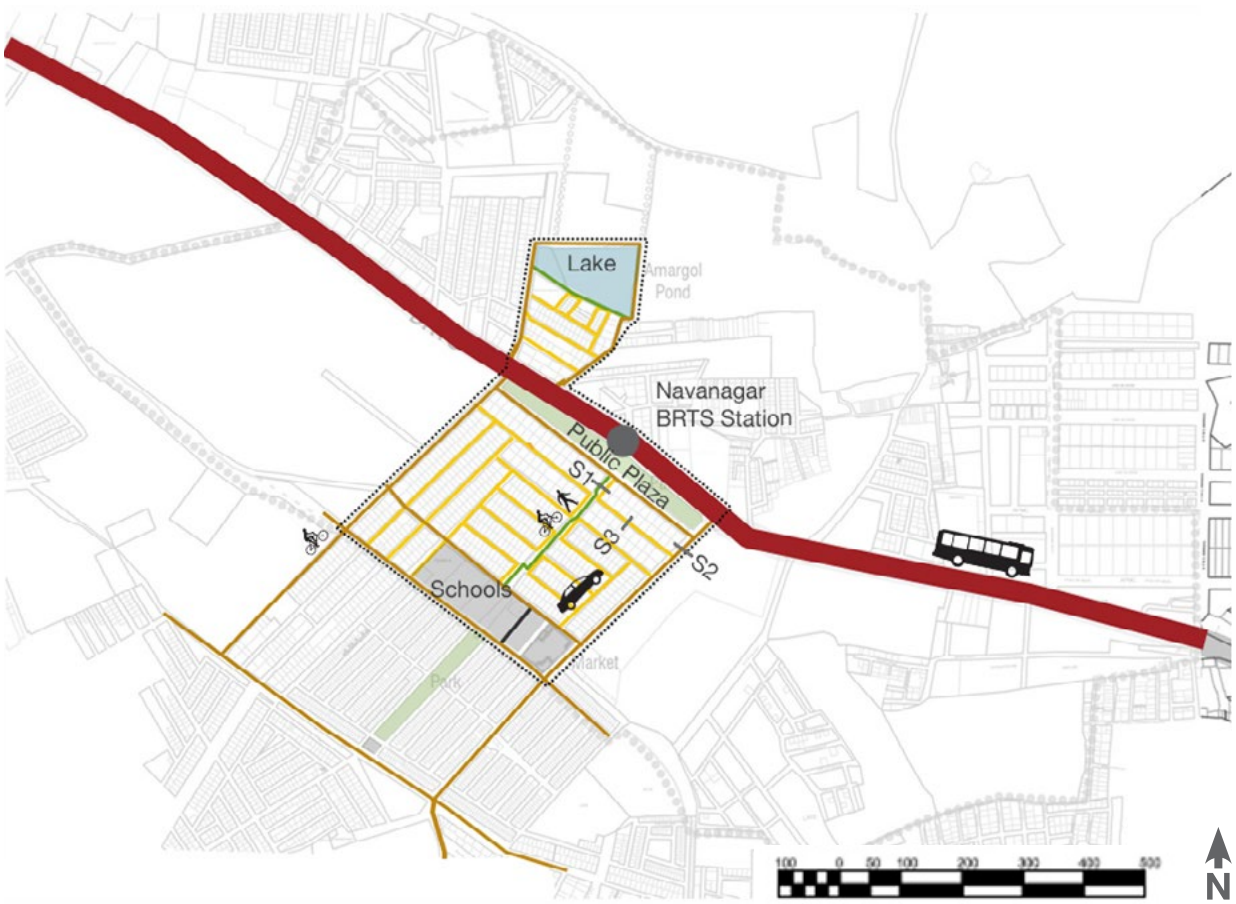


NMT Network Plan:
Case Study: Navanagar Station Area Accessibility Plan, Hubli-Dharwad:

Navanagar station area has linear blocks with a perimeter of 400m, but a length of around 300m. There are two major destinations from the station – a lake and a primary and secondary school (Figure 17). A non-motorized network plan is created to reduce the block sizes and facilitate NMT access. The shortest route to the BRT station from the school is proposed as a non-motorized street; and roads feeding it are looped to restrict through vehicular movement (Figure 17). The streets (9m wide or more) are designed with dedicated cycle tracks (Figure 18, left), whereas those less than 9m have footpath improvements (Figure 18, middle). The 18m NMT street is divided into three components – a cycle track, pedestrian pathway and activity areas (Figure 18, right). All streets are traffic- calmed. Existing streets have no footpaths (as seen in the photographs below). A tree grove adjoining the station is designed as a transit- oriented public space for the arrival and dispersal of commuters and with recreation activities.

Existing streets in Navanagar with low priority to pedestrian infrastructure

Figure 17 Plan showing NMT network in Navanagar in Hubli-Dharwad, India, Source: EMBARQ India



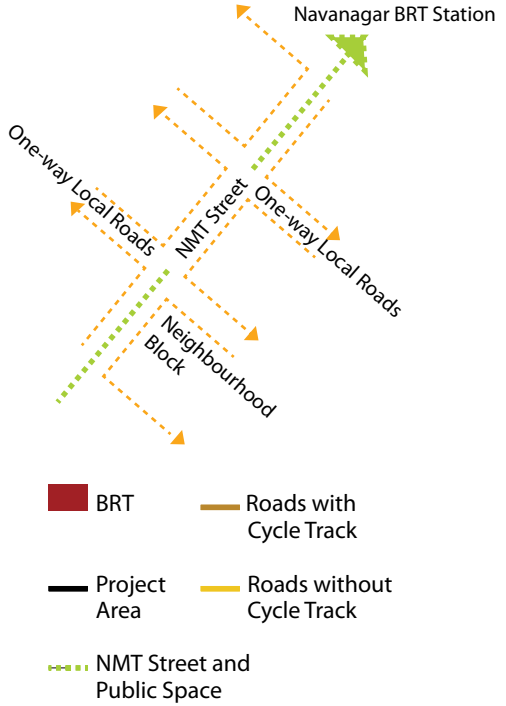
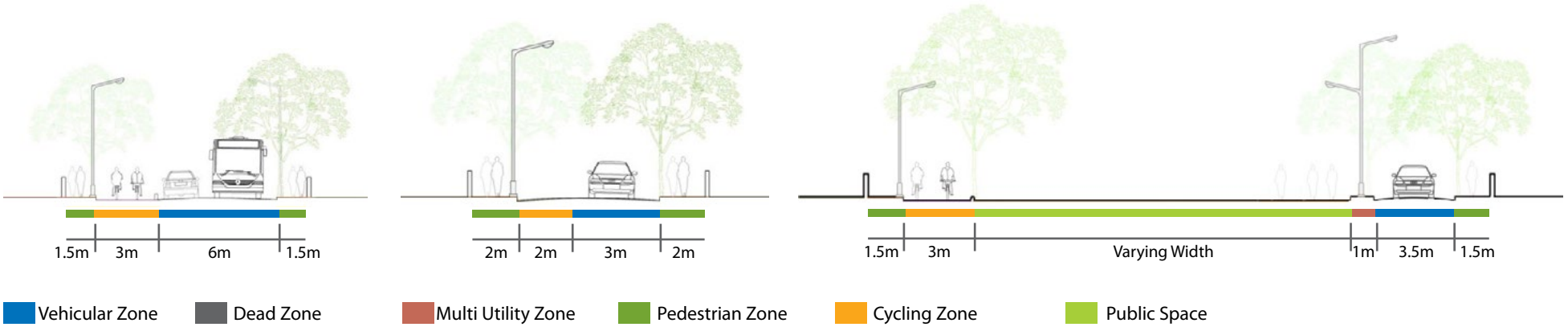


Figure 18 (left to right) Street with dedicated cycle track; street without dedicated cycle track; NMT street section, Source: EMBARQ India

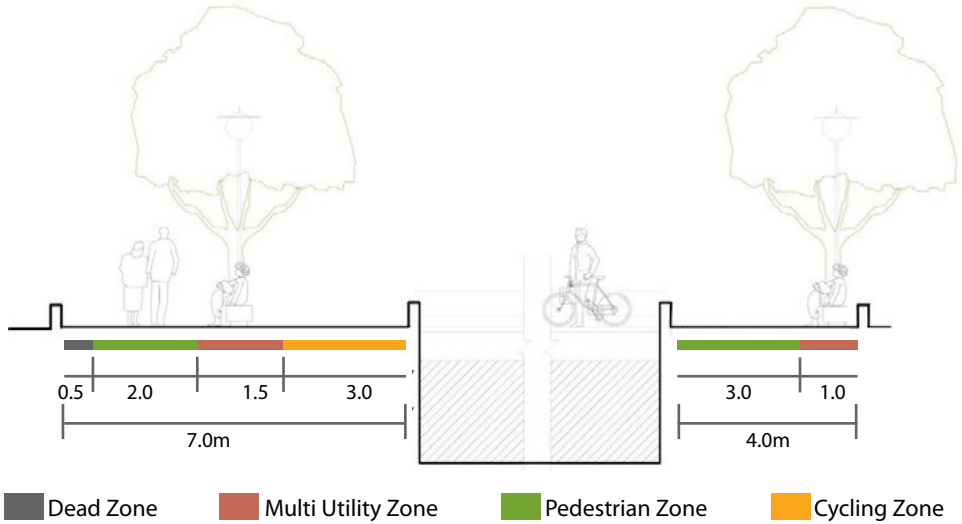


A.1.2 Create "green grids or networks" through existing public open spaces, along rivers and natural drains within the station area.

Public open spaces tend to be bound by compound walls, restricting through movement. Similarly natural drains and rivers in Indian cities are considered as backyards and used for discharge of sewage effluents. Over a period of time, lands adjoining them have been occupied by informal settlements. Thus there is an opportunity to initiate NMT improvements and upgrade these settlements in the process.

The proposed section below (Figure 19) recommends 7.0m on each side of the drain to include a pedestrian path, cycling track, dead zone, a multi-utility zone and a buffer zone. If there are space constraints, a minimum 4m is recommended, of which 3m can be used for service vehicles to clean the natural drain. An additional minimum 1m is recommended as a multi-utility zone. Pedestrian and cycling paths must be separated and can be provided on different sides of the natural drain. Cross connections can be provided depending on the larger pedestrian network plan, but not exceeding 100m.

Figure 19 Proposed section of NMT routes along natural drains, Source: EMBARQ India



A.1.3 Integrate grade-separated access to key destinations from MRT stations.

The objective of grade-separated access is to provide safe pedestrian and cycling access on high speed or high volume corridors. They consist of foot-over bridges, skywalks and subways. Global experience demonstrates that when planning skywalks, the following must be considered:

Skywalks maybe considered for high speed corridors, railways, or for regional hubs with the intersection of multiple mass transit lines, where there is restricted space on the ground to facilitate the arrival or dispersal of passengers. However, at-grade options must be exhausted first, and a comparison of the levels of service achieved by both options must be evaluated.

- Skywalks must directly provide access to buildings within the primary zone or to major destinations within the secondary zone. Station areas in some Indian cities have developed with commercial retail uses and informal markets. Therefore, the skywalks could adjoin buildings and be programmed with these uses or with planned street vending to attract pedestrians. These also create natural surveillance systems, especially during off-peak hours.

- Security guards must be present especially early morning and late nights.

- The skywalks should be designed in relation to the surrounding urban and architectural fabric. The entrances or exits should not block pedestrian access at grade. Either adjoining land can be acquired or footpaths widened to enable pedestrian movement.

- Sufficient lighting, escalators or elevators should be provided for persons with disabilities and the elderly.

- Skywalks tend to be unmaintained and funds need to be allocated for regular cleaning and maintenance.

- Finally, skywalks cannot be seen as an isolated intervention and need to be integrated with feeder bus, auto-rickshaw or taxi services, improvements in NMT access and with on-street parking management.

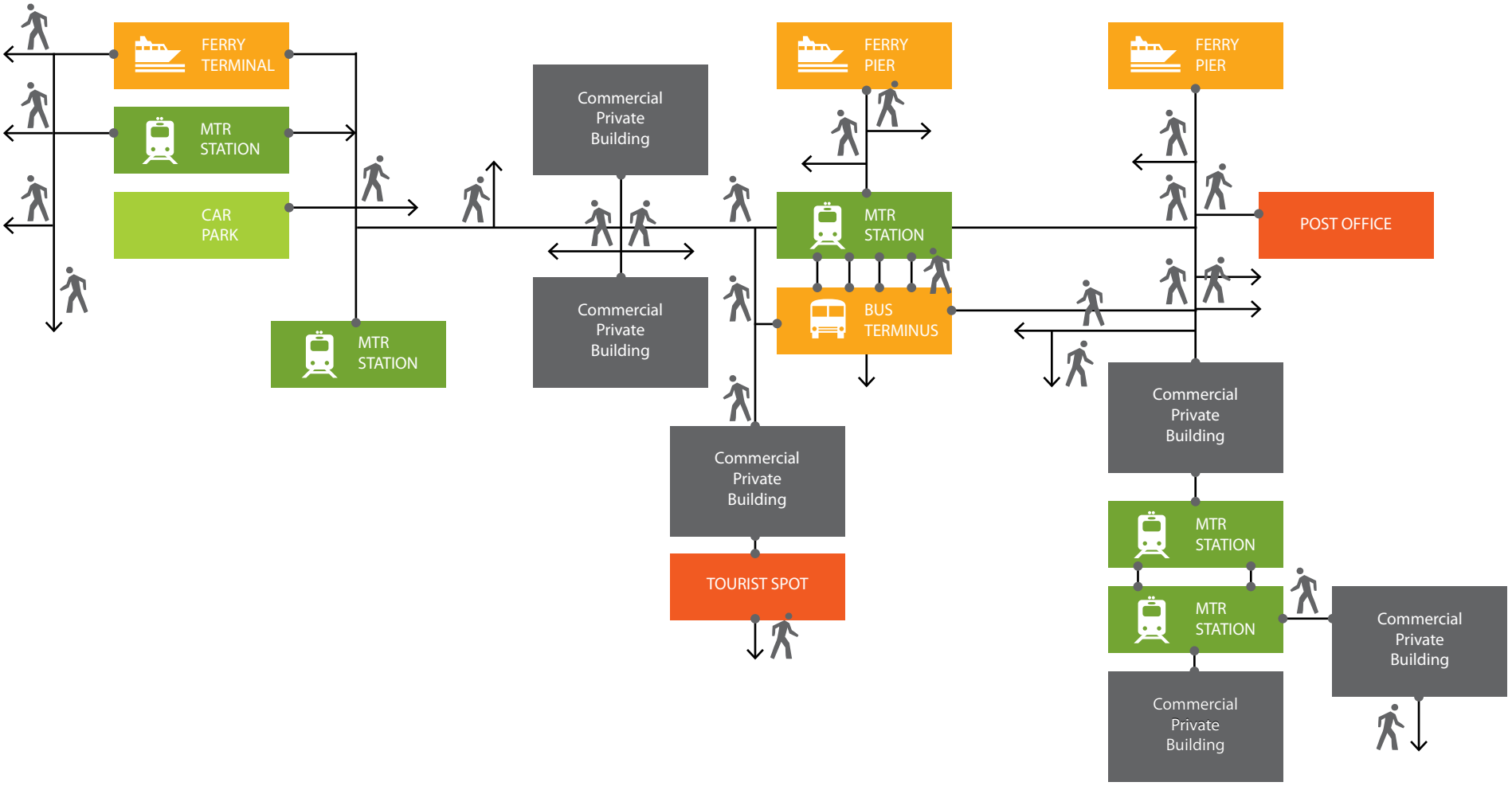
The case studies from Istanbul, Mumbai and Hong Kong highlight the key challenges faced in each city. An assessment of the Metrobus in Istanbul in 2011-12 revealed that while the stations were connected to the catchment area by over bridges, pedestrian and universal access posed a challenge due to a lack of ramps, escalators and elevators and poor integration with other bus routes (Bülay and Can Yüce 2011). (Appendix VI: Foot-over bridges: Case Study of Istanbul BRT).

Skywalks:
Case Study: Mumbai and Hong Kong

The 36 skywalks built across Mumbai from 2008, are intended to facilitate the dispersal of commuters from suburban stations and reduce conflicts between vehicles and pedestrians. They are 4-7m wide and their lengths vary from 150-1395m (MMRDA 2010). A study conducted by EMBARQ India in 2010 at Bandra station revealed that of the 28,000 commuters, only 9,000 used the skywalks. While planned for a Level of service C-D during the peak hours, a Level of service A was observed, indicating underuse or overdesign. In order to achieve the proposed Level of service, pedestrians would have to increase by 25-65 percent in peak hours and 200 percent in the off-peak hours. Further the skywalks seemed imposed upon the areas such that they obstructed pedestrian access to existing footpaths. While the objective of the skywalks was to connect the suburban railway station to the bus terminal and auto-rickshaw stands, the first access point of the skywalks was too far to achieve the purpose. Further, a Level of C or D could be achieved by widening the existing pavements (EMBARQ India 2010). There have additionally been concerns around women's safety on skywalks, especially early in the mornings and at night (Sharma and Mehta, "Skywalks don't rise to safety needs," *Hindustan Times,* December 19, 2011). However some of the critiques include the creation of physical and psychological barriers by property management companies to keep out the poor and other "undesirable" people and behaviours and a system that promotes consumerism (Woo and Malone-Lee 2011)."

In Hong Kong, skywalk systems are usually closely integrated with a variety of activity hubs and residential projects. Hence, apart from the transport-related function, there are a wide variety of attractions as the user moves along the system. For example, skywalk systems connect residential complexes, commercial buildings, major shopping malls, MTR stations, bus interchanges, town hall, shopping malls and markets (Figure 20). They are bound by active uses and function as elevated streets or as extension of adjoining buildings. The skywalks also act as public spaces as people use the system for a variety of activities, including shopping, having meals, or even conducting educational classes. However some of the critiques include (i) the conscious effort of property management companies to keep out "undesirable" people and behaviours; (ii) the creation of physical and psychological barriers for the poor to enter; (iii) and a system that promotes consumerism (Woo and Malone-Lee 2011).

Figure 20 Schematic network diagram of skywalk system in Hong Kong, Source: Patricia Woo



Skywalks in Hong Kong connecting commercial and business destinations to transit stations

Subways or underpasses present a similar challenge to skywalks. Higher costs, personal safety, uninviting design, poor ventilation, lack of maintenance and the physical change in level are some of the issues associated with subways. Principles to guide the location and design of underpasses are suggested below (NZTA n.d.); (Community Design and Architecture 2002).

- The subways must be integrated with the wider transport project and with adjacent land uses;
- Their locations must serve an identified desire line along which people already travel;
- The approach must cater to wheelchair users and the paths leading to the underpass must be direct and straight. Bends or curves must be avoided as they can create hidden places, which decrease the sense of security;
- Natural surveillance must be encouraged through visibility, street vending or retail stores;
- The subways must provide adequate lighting and maximize light penetration and ventilation;
- They must provide for pedestrians and cyclists;
- They must be well maintained and built with robust, vandal-proof materials;
- They can provide a pleasant environment through murals and art, and complement the external environment;
- They must be designed with a good drainage system;
- Acoustic measures must be considered to reduce noise for pedestrians.

While Mumbai demonstrates a case where the presence of security guards maybe required in the subways in off-peak hours, Munich illustrates a good practice of how underground stations and subways can be designed to be attractive to passengers.

Subways:
Case Study: Mumbai and Munich

A field visit and interviews with shop owners were conducted at two terminal stations i.e. Churchgate and VT Stations along the Western and Central and Harbour railway lines respectively. The subway lengths vary from 60- 100m and cross under immediate roads and junctions abutting the station. They are maintained by the Municipal Corporation of Greater Mumbai (MCGM). The suburban trains operate from 6am-1am, while the subways are open from 6am to 11pm. The shops are generally open from 10am to 8.30pm, after which the subways begin to get deserted. Street vendors maybe observed until 11pm. This poses a concern for both stations as the adjoining roads are not designed for safe pedestrian crossings. The subways are around 2.5m in height. There is insufficient natural light and the subways are under-ventilated, creating a sense of claustrophobia with high volumes of people (as seen in the photographs below). Further, the materials used in the subway are uninviting. During the monsoons, MCGM sweepers ensure that water is drained.

The renovated stations in the underground Munich Metro System have been designed with a view to help make the passengers' wait more pleasant. They are known for their bright colour schemes and art pieces (sculptures, special designs, drawing) and video screens. They integrate elements of a station's surroundings into its interior by including references to the buildings and attractions above ground. Thus they create a unique character for the station, tie it to the cityscape and visually convey to the passengers a sense of where they are.

Churchgate and VT station subways

A2. CONNECT EXISTING CITY-LEVEL ROUTES OR LOCAL ROUTES WITHIN THE AREA TO THE STATION.

A.2.1 Map the existing pedestrian and cycling networks within and through the station area and connect these to the station.

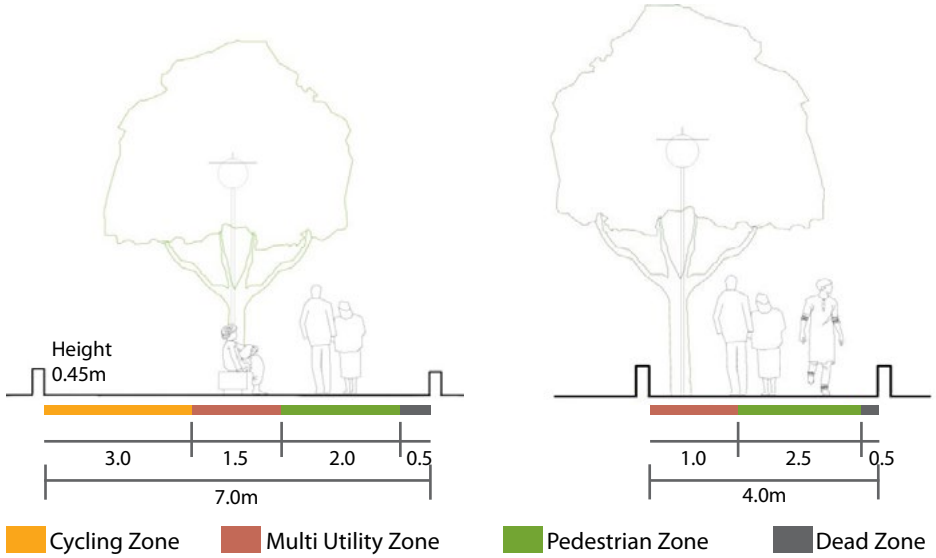
Cities like Hubli-Dharwad have begun to prepare NMT plans with the specific objective of mapping and improving NMT infrastructure. These can be used to identify existing local or city routes through the station area and connected to mass transit stations. When such plans are not available, these must be documented with field visits and updated in neighbourhood mobility plans.

Documenting existing pedestrian pathways:
Case Study: MIDC Marol, Mumbai

Pedestrian paths are not mapped in the master plan of MIDC Marol (EMBARQ India 2013a). During field visits, these were mapped and the master plan was updated to show these routes. These routes exist as “gaps” or left over spaces between compound walls or roads where the entire right-of-way could not be acquired, or as alleys through settlements and large plots (Figure 24). The pedestrian paths should be upgraded with street lights, seating, porous paving and lowering of compound walls (if possible) to enable street visibility and security.

When new paths are proposed, the following street sections can be considered. Ideally, a NMT street should include segregated pedestrian and cycling paths. They can be separated by a shared multi-utility zone (MUZ) (Figure 25, left). If only a pedestrian or cycling route is proposed, a minimum of 4m is recommended with an uninterrupted walking or cycling zone (2.50m), dead zone (0.50m) and a multi-utility zone (1m) (Figure 25, right).

Figure 21 (left) NMT street; (right) Pedestrian or cycling path only; Source: EMBARQ India



Existing pedestrian and cycling paths in MIDC Marol

A3. EVALUATE AND PROVIDE SAFE AND COMFORTABLE PEDESTRIAN INFRASTRUCTURE.

A.3.1 Understand the walking patterns, demographics, trip purpose, needs and perceptions.

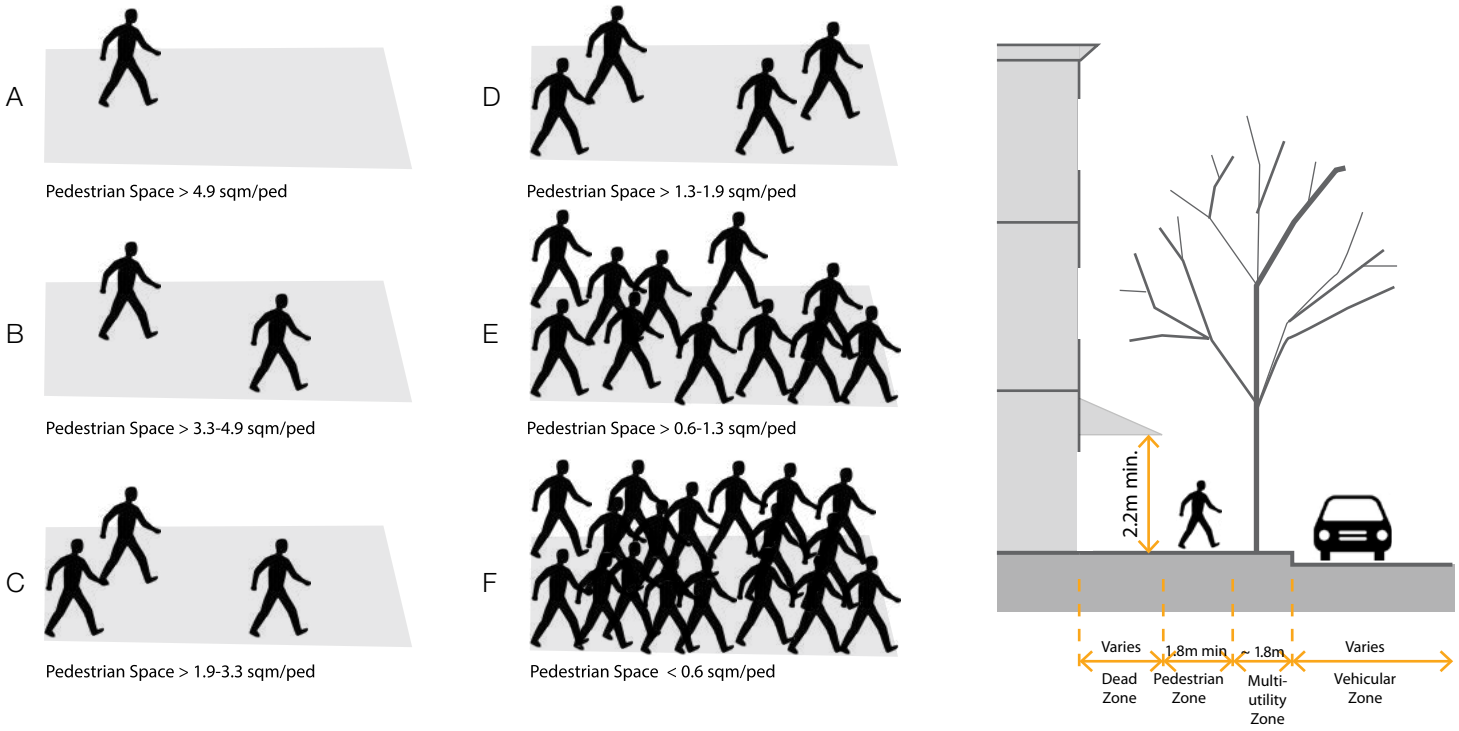
While the walking patterns within the station area can be understood from the travel surveys, pedestrian origin-destination surveys can provide specific information about the demography, trip lengths, time of day, type of trips (work, leisure, education, health etc.), routes, frequency, requirements of specific amenities, quality of experience of the walking trip and the willingness to walk longer distances. (Appendix II: Pedestrian-Origin Destination Surveys)

A.3.2 Evaluate the level of service of pedestrian infrastructure along major routes within the primary and secondary zones.

- **Provide level of service B or C for pavements**

A level of service approach to evaluate the quality of pedestrian infrastructure is recommended over minimum standards (Figure 22, left). IRC 103-2012: Guideline for

Figure 22 Pedestrian levels of service; (right) ideal section for pavements, Source: EMBARQ India, data source: IRC code 103, 2012



Pedestrian Facilities, proposes a level of service B or C. It divides the pavements into a dead zone, uninterrupted walking zone and a multi-utility zone (Figure 22, right).

The footpaths in the central business district of Fort Area in Mumbai accommodate the three different zones, thereby creating a relatively uninterrupted pedestrian walkway).

- **Consider major feeder streets to mass transit stations as NMT-only streets**

Through traffic and parking management plans, feeder streets to existing mass transit stations with high pedestrian and cyclist volumes can be converted to and enhanced as NMT-only streets.

The feeder streets to the suburban railway stations in Mumbai such as the Andheri station below function as shared streets due to significant numbers of people. The adjoining buildings are commercial retail with active front edges. These streets have developed as market streets. The building uses are largely commercial with active front edges. While currently all vehicles ply on these streets, these can be developed as NMT routes with bus entry- only and dedicated times for delivery of goods.

- **Consider shared streets for historic areas**

Historic areas with narrow streets, compact built form and mixed uses may necessitate a different approach. These may require a traffic and parking management plan to reroute traffic, manage on-street parking, create pedestrian or one-way streets or shared streets versus a level of service approach.

Footpaths in the Fort area, Mumbai with an uninterrupted walking zone, multi-utility zone and a dead zone

Feeder lane to Andheri Station with shops on both sides and high volume of pedestrians

Streets in Historic areas:
Case Study: Metrobus Line 4, Mexico

The historic district of Mexico is a commercial, institutional, cultural and tourist hub and sees a lot of pedestrian activity through the day. The design of the new bus line Metrobus Line 4, was adapted to its historic core and is different from that in the rest of the city. The bus moves over cobbled streets suggesting a traffic-calmed street. Due to limited street widths (10m), there are no footpaths, and the pedestrian access is separated from the BRT lane by bollards (Hidalgo 2010).

Pedestrian and cyclist infrastructure along Metrobus Line 4, Mexico City

A.3.3 Create street rating maps to evaluate the quality of existing pedestrian infrastructure, universal access, road safety and women's security.

It is recommended that street rating maps be created to assess not only the quality of pedestrian and cycling infrastructure, but also road safety, gender security and universal access. (These must be undertaken while referring to guidelines in Chapter III, Sections C: Enhanced Safety and Security and E: Enhanced Public Realm).

- **Assess provision of pavements, usage and heights.**

This evaluates the continuity and provision of pavements and their heights.

- **Assess road safety by undertaking a road safety audit.**

Pedestrian safety can be assessed by measuring vehicular speeds in the primary and secondary zones, spatializing accident data to identify accident prone zones, and evaluating road and intersection geometry.

- **Assess access for people with disabilities and the elderly.**

IRC 103:2012-Guidelines for Pedestrian Facilities, outlines measures to facilitate access for the elderly and people with disabilities (IRC 2012). These include access ramps along the footpaths, at bus stops, textured tiles for people with limited visibility and consistent, continuous, adequate space for people with wheel chairs and other slower-moving users.

- **Evaluate women's sense of safety, comfort and convenience by undertaking a security assessment.**

A security assessment of the station area can help understand women's experience of safety, comfort and convenience. Perceived safety might not be the same as real safety, and it relates closely to the experience of the urban environment. These assessments are "a process which brings individuals together to walk through a physical environment, evaluate how safe it feels to them, identify ways to make the space safer and organize to bring about these changes" (WACAV 1995). Therefore it is recommended that the assessments of the station area be undertaken with women, across age and income groups, to map perceived safe and unsafe streets, corners and public open spaces. The assistance of women's advocacy organizations may be taken to facilitate the process. The existing crime data can be spatialized if possible to understand crime and harassment-prone areas and how planning or design can address these. This needs to be complemented with counting the number of women across income groups in the public open spaces through different times of the day to understand if the environment is responsive to women's needs. (Chapter III Section E: Enhanced Public Realm, E1). Finally, the consistency of street lighting in the station area needs to be evaluated along with the porosity of the compound walls.

- **Assess interruptions, parking and building obstructions and hawker conflicts.**

This evaluates the obstructions in the pavements such as retail storage or display, gates, street vending, street furniture, parking that impedes access to the pavement and the interruptions such as difference in levels between the pavement and the ground. Street vendors provide goods and services at affordable prices (S. Bhowmik 2005). However, since they are not incorporated in street design and planning, they are considered as "obstructions" to pedestrian movement. This needs to be kept in mind when assessing hawker conflicts.

- **Evaluate crossing opportunities, waiting times, widths and distance.**

This evaluates the number of crossing opportunities, their distances, waiting times and their widths.

- **Evaluate street lighting, shade, street furniture and signage.**

This evaluates the consistency of street lighting and shade, the provision of street furniture, especially seating in areas with high numbers of people and pedestrian way-finding systems.

- **Evaluate quality of maintenance of pedestrian infrastructure.**

This evaluates whether the pavement is well maintained or uneven, broken etc.

Street Rating Maps:
Case Study: DN Nagar Metro-Station Accessibility Plan, Mumbai

A street rating system was created by EMBARQ India to assess the quality of pedestrian infrastructure along collector roads around DN Nagar Metro-station (Figure 23). This rating system looked at three major components – pavements, crossings and amenities. The parameters considered in each of these were overall provision and usage, physical design, and their management and maintenance. Each parameter was rated on a scale of 1-5, with 1 being the worst and 5 being the best. The overall rating was then spatialized to compare different roads. The rating criteria and scores are attached in the Appendix IV: Walkability Rating Index.

Figure 23 Street rating map showing pavement conditions in different parts of DN Nagar, Source: EMBARQ India; (right) photo documentation of pedestrian infrastructure in DN Nagar

Women's Security and Street Lighting:
Case Study: Istanbul

In a study undertaken by EMBARQ Turkey and Gehl Architects to improve the historic core of Istanbul, both men and women were counted in different areas across the day. It was observed that there is a negligible female share at night in the old city, especially at one of the connections to the Grand Bazaar, Nuruosmaniye Caddesi. When street lighting in different neighbourhoods was mapped it was observed that large areas in the historic core of Istanbul, for example, the Grand Bazaar, have only scattered or almost no street lighting or it is not oriented towards pedestrians (Figure 24). A negative side effect is an uneven and unfriendly pedestrian environment consisting of over exposed areas followed by more dark and obscure areas.

Figure 24 Plan showing scattered street lighting in Istanbul; illustration of quality of public space during the day and night, Source: EMBARQ Turkey and GEHL Architects

LIVELY DURING THE DAY
During the day plenty of merchants and visitors perform a fascinating pulse of activity. No street is found empty - everywhere there are people

PERCIEVED UNSAFETY AT NIGHT
During the night the central city appears absolutely deserted. The lack of residents, the closing of the Grand Bazaar and adjoining streets and the general lack of activity makes passers-by uneasy

A.3.4 Traffic-calm the station area as an NMT and bus priority zone and design streets and intersections to facilitate safe access (Chapter III, Section C: Enhanced Safety and Security: c1, c2, c3 and c4).

Station areas are expected to attract high pedestrian and NMT volumes and Indian cities often have high pre-existing NMT users in such zones. To reduce conflict with motorized modes in station areas priority must be given to NMT users and pedestrians. Strategies can include setting speed limits for motorized traffic, prioritizing pedestrian movement at intersections and redesigning streets to facilitate NMT and pedestrian movement.

A4. EVALUATE AND PROVIDE SAFE AND COMFORTABLE BICYCLING INFRASTRUCTURE.

NMVs in India consist of wheel chairs, wheel barrows, cycle-rickshaws, bullock carts and load-carrying bicycles. These need to be considered when planning for NMV infrastructure within the station area. There is a general lack of understanding of who the cycle users are and what are their needs.

Further, women are less likely to cycle and the difference in cycle use is largely explained by women's higher concern for safe riding environments (Srinivasa 2008). This, when combined with limited access to NMVs such as carts or load-carrying bicycles, results in frequent strain injuries, neck and back pain due to excessive head loading (Peters 2013). Therefore it is recommended to provide cycle tracks as far as possible and consider shared space only in traffic- calmed local streets.

A.4.1 Understand cycling patterns, demography, trip purpose, needs and perceptions.

While the cycling patterns within the station area can be understood from the travel surveys, cycling origin-destination surveys can provide specific information about the demography, trip lengths, time of day, type of trips (work, leisure, education, health etc.), routes, frequency, requirements of specific amenities, quality of experience of the cycling trip and the willingness to cycle longer distances.

A.4.2 Create street rating maps to evaluate quality of existing cycling infrastructure.

- **Assess continuity, width and surface of the cycle infrastructure**

This evaluates continuity, provision and width of the cycle lane or track vis-a-vis the type of NMV in the city.

- **Assess road safety by undertaking a road safety audit.**

Cyclist safety can be assessed by evaluating whether they are segregated from pedestrians and motorized vehicles, measuring vehicular speeds in the primary and secondary zones and spatializing accident data for cyclists to identify accident- prone zones. Intersection designs can further be evaluated for protected waiting area and continuity of lanes or tracks (Chapter III, Section C: Enhanced Safety and Security).

- **Assess interruptions and obstructions.**

This evaluates the interruptions such as uneven surfaces, man-hole covers, loose interlocking blocks, and obstructions in the cycling infrastructure such as storm water drain covers, street vending, trees and parking.

- **Evaluate intersections, crossing opportunities, waiting times, widths and distance.**

This evaluates the number of crossing opportunities, their widths, distances and waiting times. The safety at intersections is evaluated by the presence of marked lanes and signage, continuity and access ramps.

- **Evaluate street lighting, shade and signage.**

This evaluates the consistency of street lighting and shade, signage and markings indicating the presence of cycle tracks or lanes.

- **Evaluate quality of maintenance of cycling infrastructure.**

This evaluates whether the infrastructure is well maintained or has debris etc.

A.4.3 Traffic-calm the station area as an NMT and bus priority zone and design streets and intersections to facilitate safe cycling access (Chapter III, Section C: Enhanced safety and security: c1, c2, c3 and c4).

The evaluation of the pedestrian and cycling network and infrastructure can provide information to design both the station area network, streets and intersections for safety and security.

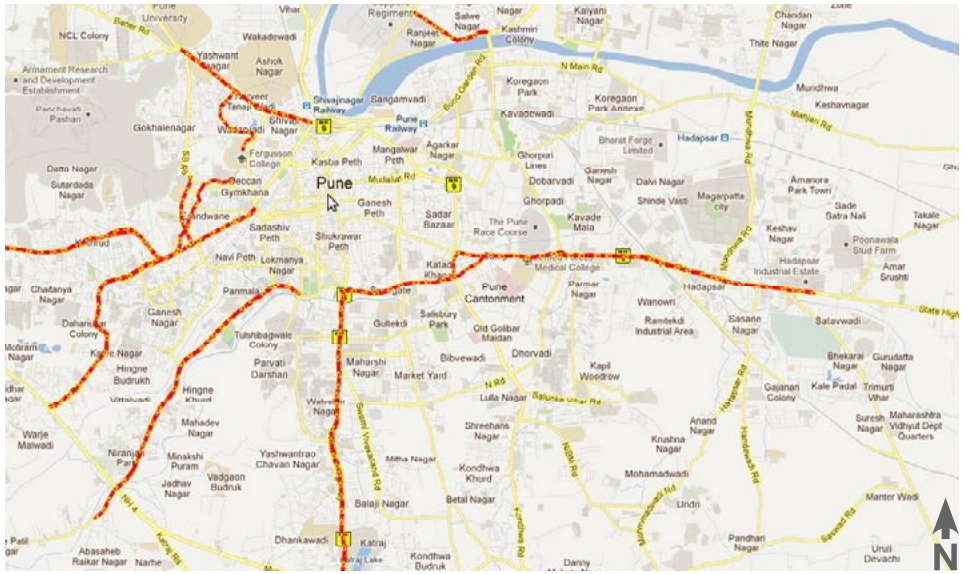
A.4.4 Provide sufficient, protected and secure bicycle parking (Chapter III, Section E: Enhanced public realm, E.3.2).

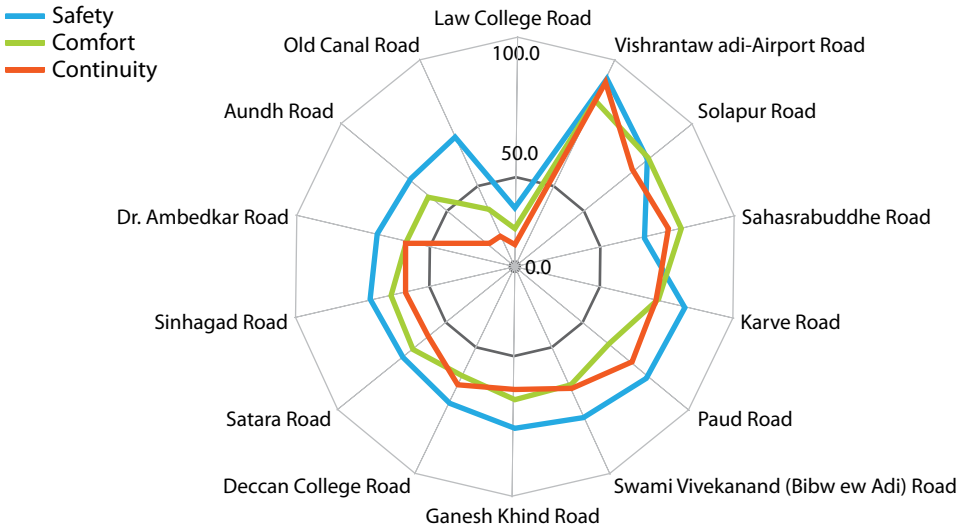
A mode shift to bicycle use, especially for trips to and within station areas, can be induced by providing adequate, secure and protected bicycle parking options. Furthermore a range of parking options including unguarded parking slots and guarded parking and lockers must be provided in station areas to accommodate the various needs of users (Martens 2006).

Bicycle Infrastructure Assessment:
Case Study: Cycle Assessment Toolkit, Pune

Pune has built over 115km of cycle tracks, as part of JnNURM along the designated BRT corridors and non-BRT routes (Figure 25 left). Parisar, an organization advocating for sustainable transport in Pune, created a Cycle Track Assessment Toolkit and evaluated 12 cycle tracks in Pune (Figure 25, right). It focusses on three key parameters – continuity, safety and comfort. It observed that only two tracks were of good quality. All cycle tracks fared poorly with regards to safety, whereas comfort and continuity generally lay within a narrow band.

Figure 25 (left) Map showing cycle tracks in Pune; Source: Google Maps; (right) Cycle Track Analysis in Pune; Source: Parisar





A5. IMPROVE PEDESTRIAN AND CYCLIST CONVENIENCE BY PROVIDING AMENITIES.

A.5.1 Provide amenities through design, planning and regulatory recommendations to improve pedestrian, cyclist and user conveniences.

Pedestrian and cyclist convenience in station areas can be greatly improved by assessing their needs for amenities and providing these through design, planning and regulatory recommendations. Specifically, the role of cycle repair shops, retail stores, street vending, public toilets and day care centres amongst others needs to be acknowledged.

Ground floor retail stores and street vending within station areas provide the daily goods and services enroute to the mass transit station. NMT friendly land uses can be encouraged in the primary zone and along major NMT routes. Street vending can be incorporated within station accessibility plans and street design based on the Street Vendors Act (Protection of Livelihood and Regulation of Street Vending, 2014) and IRC 103:2012, Guidelines for Pedestrian Facilities. Cycle repair shops can be specifically encouraged within close proximity of the station and well distributed within the station area.

Public toilets in India are generally not considered an important amenity and are poorly designed or maintained. Further, women contend with vast health issues due to the absence of public bathrooms. They tend to avoid the need to urinate and often withhold hydration commonly resulting in high rates of urinary-tract infections, heat strokes and other health problems (Christakis, “Are Toilets a Feminist Issue?” *Time Magazine*, June 19, 2012.)

A.5.2 Consider public-bicycle sharing schemes between major destinations and stations.

Planners must consider public bicycle sharing schemes to increase ridership and encourage non-motorized travel from the secondary and tertiary zones to the station. The Ministry of Urban Development, Government of India constituted sub-groups in 2011 with the objective of encouraging public- bike sharing schemes in Indian cities. A few initiatives like ATCAG-BikeShare, Namma cycle (Bengaluru), Cycle Chalao (Mumbai) have been launched. Some challenges faced are limited registrations, unsafe cycle infrastructure and lack of scale up opportunities (TERI 2014). Indian cities have existing bicycle renting systems, which are an opportunity for integration within a comprehensive public bicycle sharing scheme.

TOOLS AND RESOURCES

2011. Ministry of urban development, government of india.

Bicycle Renting System:
Case Study: Indore

Bicyclists constitute 20 percent of the total trips in Indore. The 2012 survey by EMBARQ (EMBARQ India 2012a) found that most of the renters are labourers, factory workers, hawkers, painters, masons, etc. Traders coming from small towns around Indore rent bicycles to navigate the inner city market areas. While there is no systematic set up to rent bicycles, there are around 2000 bicycle rental and repair shops in the city with around 60 bicycles available at each location (Figure 26). Bicycle rentals are limited to a small user group at most locations, and bicycles rented from one place must be returned to the same place. These informal initiatives can be scaled-up to provide services within or across station areas.

Figure 26 Bicycle sharing locations in Indore, Source: EMBARQ India

Pedestrian Amenities and Street Vending Strategy:
Case Study: MIDC Marol

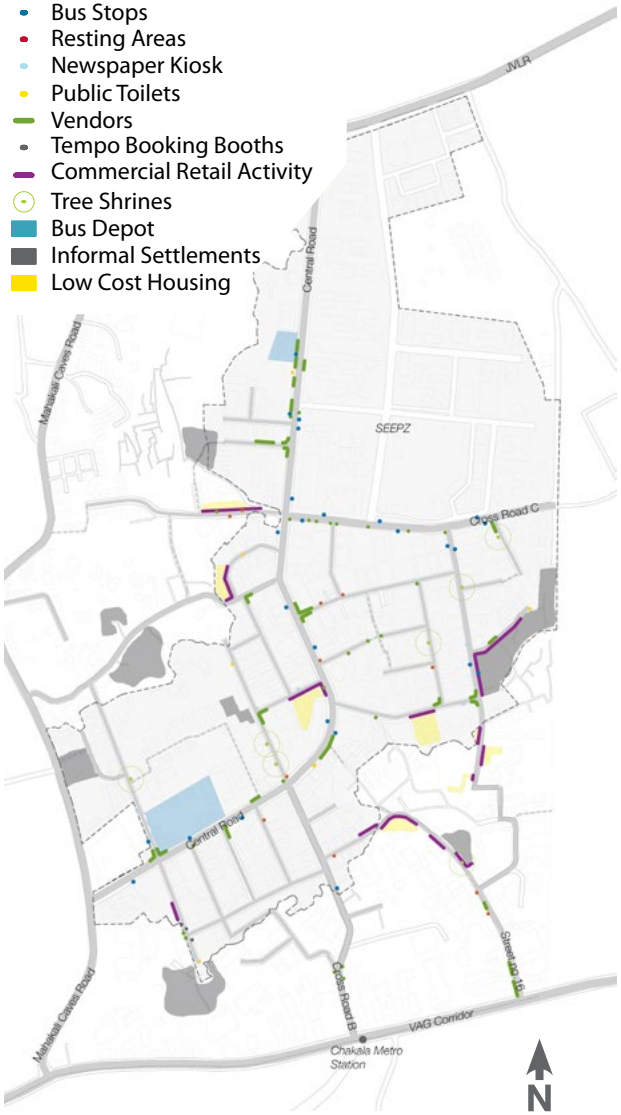
The existing pedestrian amenities and activities were mapped in MIDC Marol along with the adjoining land uses to understand who they served. In addition, a pedestrian origin-destination survey was conducted to understand the needs of the people walking in this area (Figure 27, left).

The pedestrian origin-destination surveys identify a need for public open spaces to rest and stroll especially during lunch hours, additional public toilets, vegetable markets and daily services within walking distance like pharmacies, grocery stores, restaurants and cafes. The mapping of street activities in MIDC Marol reveals multiple activities and users of public spaces. These include employees, workers for loading and unloading of goods, auto-rickshaw drivers, tempo drivers and conductors, people delivering couriers etc. Further a number of amenities like public toilets and reading, sitting and resting areas are provided and often in the proximity of informal settlements, intersections, and tempo waiting stands respectively. Community garbage bins are observed on the road. Since no land has been reserved for these amenities, they are built on the footpath, thereby obstructing pedestrian movement.

At present there are no public open spaces in MIDC Marol. The Development Control Regulations (DCR) stipulates that at least 10 percent (12.7 hectares) of the land area be reserved for the same.[15] While these provisions are less than other cities globally[16], the current reservation is taken as a starting point. Currently, two vacant plots with a total area of 3600 square metres are identified (Figure 28, left) and additional areas specified within 500m walking distance.

The existing public toilets are mapped in the business district. Currently, the number of tertiary jobs created by MIDC Marol is estimated at 89502, with 31 percent of employees (26851) being women. Field visits conducted in 2013 reveal a severe deficiency with 20 toilet seats for women (1 toilet seat per 1342 women) compared to 35 toilet seats (1 toilet seat per 590 men) and 14 urinals for men (1 urinal per 3000 men). The current estimated requirements are 172 toilet seats and 70 urinals for men, and 250 toilet seats for women (MoUA&E 1995). These figures seem ambitious to achieve. Hence it is reccomended that public toilets be included within public open spaces and on publicly owned plots. The potential locations of new public toilets are identified within 500m walking distance (Figure 28, middle).

Figure 27 (left) Map showing amenity distribution in MIDC Marol, Mumbai, Source: EMBARQ India; photographs of amenities in MIDC Marol (clockwise) public toilet, tempo booking booth, ground floor commercial retail, street vendors, newspaper kiosk, resting place



Land allocations for public open spaces and toilets will need to be made within the master plan of MIDC Marol. It is recommended that existing unused lands be considered first. DCRs (2009) stipulate that for plots over 1 hectare of industrial land and 0.5 hectares of residential land, 10 percent shall be reserved for open spaces. These regulations must be extended for educational and institutional uses and the subsequent land be made available for public use.

Since MIDC Marol is predominantly a single-land use business district, mixed uses are recommended to facilitate access to services. The scale of uses are suggested based on the street hierarchy, with medium scale uses recommended along Central Road and Cross Road C (Figure 28, right). A street vending strategy is proposed for MIDC Marol based on the Street Vendors Act (Protection of Livelihood and Regulation of Street Vending, 2014), and IRC 103-2012: Guidelines for Pedestrian Facilities.

EMBARQ India conducted studies in MIDC Marol in 2011 and 2013 to map the type and time of street vendors (Appendix I-C: Survey Form - Businesses) and their role in providing food and services (Figure 29). In 2011, 269 vendors were mapped, of which 49 were surveyed. The survey questions included vendor profile, employee profile, business cycles, social events and perceptions. In 2013, these were followed up with surveys of customers at three different types of eating providers i.e. vendors, MIDC Canteen and the Hotel Tunga Paradise. Since 81 percent of vendors in MIDC Marol are food vendors, only these were surveyed.

Street vendors in MIDC Marol provide access to affordable food within 3 minutes walking distance (Figure 29). They are observed around land uses with high pedestrian footfalls and within 10m around intersections. The sample surveys revealed that such vendors cater to 90 percent (1.66 lakh) of the floating population. Further, they are the only provider that caters to approximately 14 percent (25,900) population with an annual household income of Rupees 90,000. They therefore facilitate access to those who “may not be catered to” by formal establishments with higher costs/ meal.

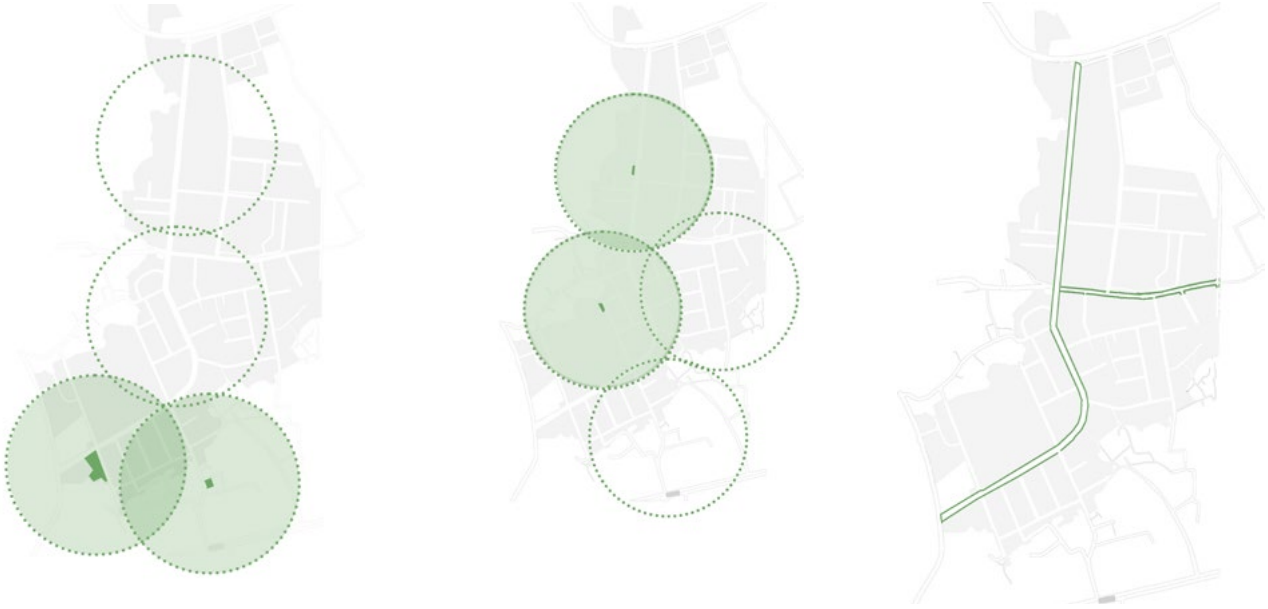
Therefore, the following parameters are considered when planning for vendors in MIDC Marol:

- In principle, all streets are considered as permissible vending areas. The existing locations are retained i.e. at junction intersections, as far as possible. In case of a conflict with pedestrian movement, alternate locations can be considered on adjacent internal streets to a maximum of 10m from intersections.

- Some parameters for delineating no vending areas include those immediately adjacent to plot accesses and bus shelters. At mass transit stations, a no-vending zone of 10m around the station entrances can be considered. However, where transit-oriented markets have developed, these must be retained and designed for pedestrian priority.

- Areas with street canteens (Zunka Bhakars) could be treated as mini-canteens

Figure 28 Map showing proposed public open spaces, public toilets and mixed building uses, Source: EMBARQ India



and land allocated for the same within 15 minutes walking distance with (common) cooking, washing, storage areas. These need to be designed to maintain “street food / café”- like quality.

- Streets with a significant number of vendors (SEEPZ Depot, Street 16, 13, 7) can be considered as food streets or mini-markets and designed for pedestrian priority.

- Vending areas in street design must be delineated adjacent to large activity generators, public open spaces and within intervals of 5-15 minutes walking distance along major pedestrian and cycling routes. Additional design strategies that can be explored are ones that (i) disperse the number of pedestrians through multiple entries/exits at large land uses; (ii) provide a multi-utility zone of minimum 1.8m within pedestrian infrastructure to accommodate vending areas, trees, bus shelters, utilities, seating etc. and (iii) include the parking bay within the footpaths especially for high concentration of pedestrians and vending activities.

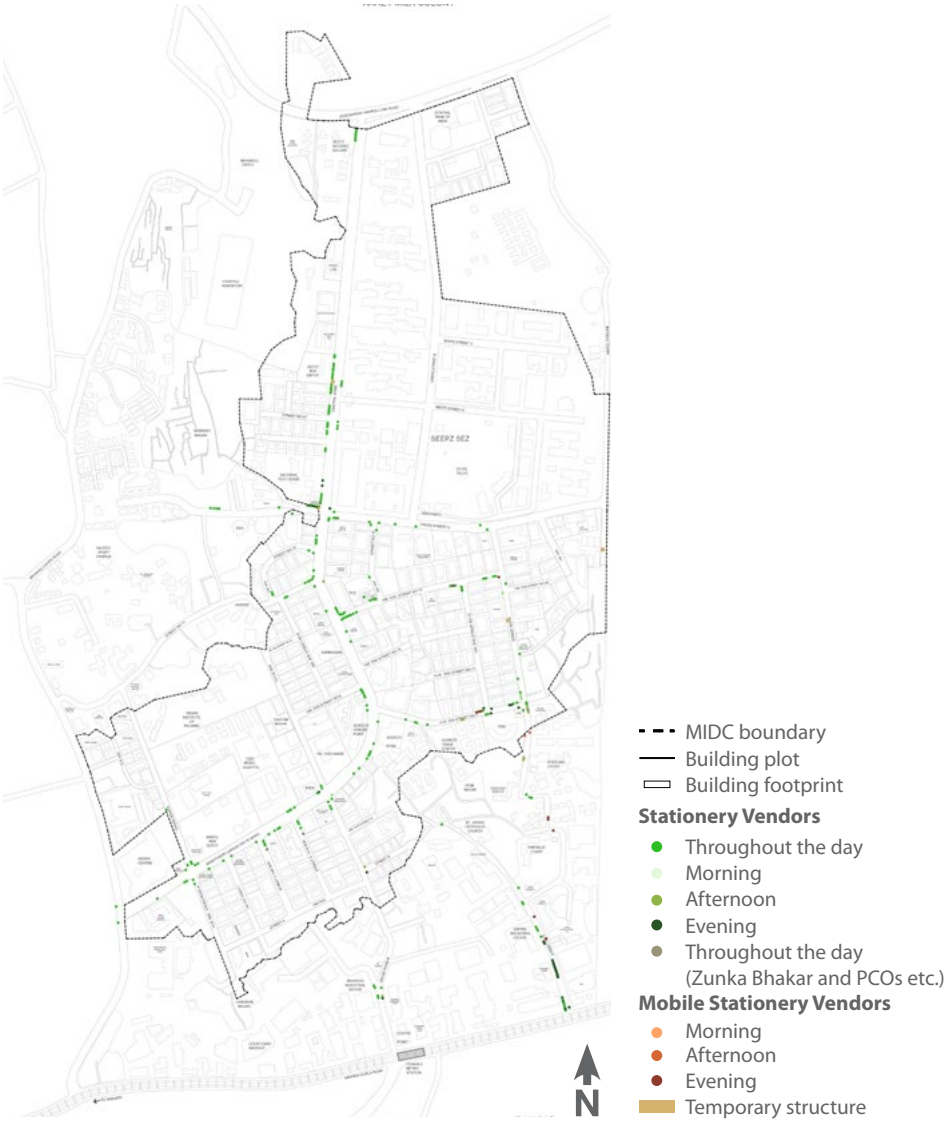
- When planning vending areas, rickshaw and taxi parking needs to be considered.

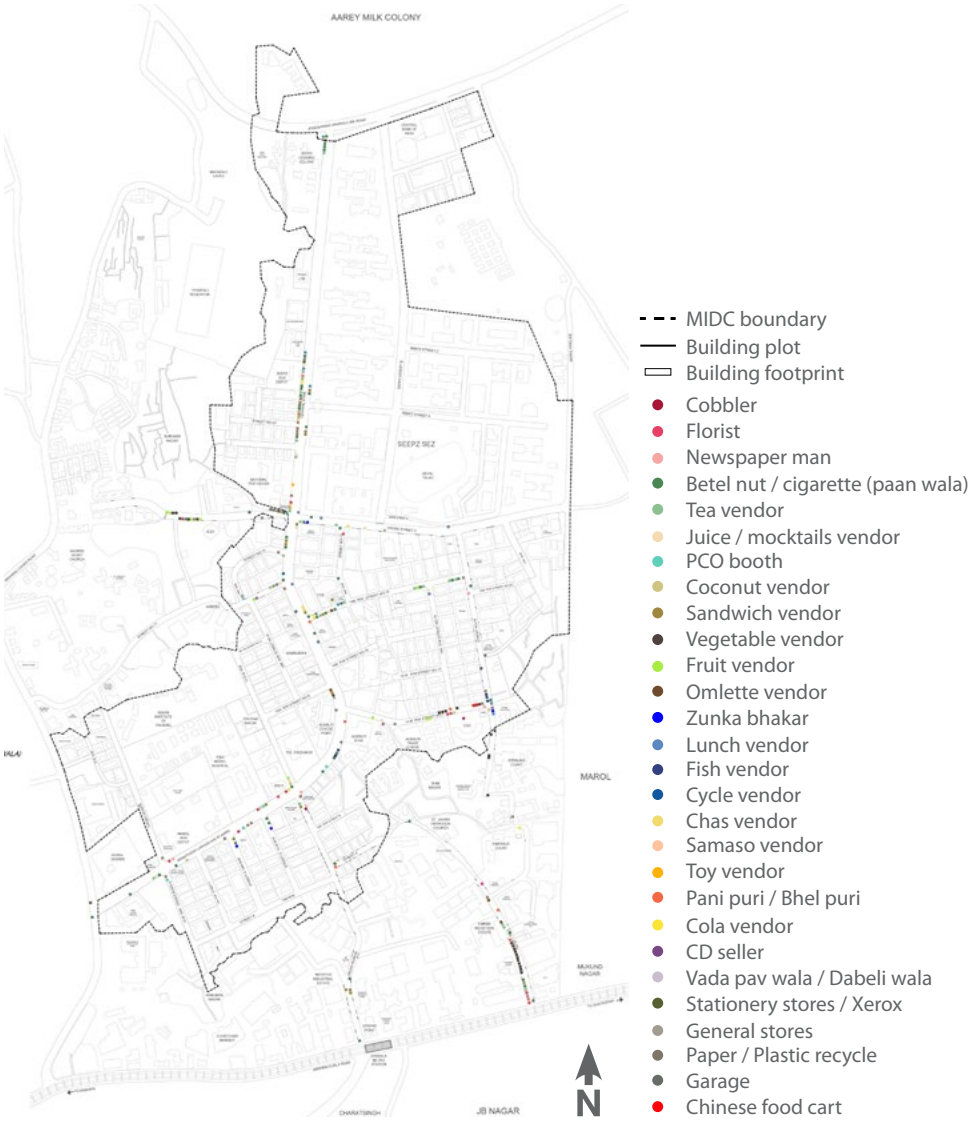
- The vending areas should be supplemented with amenities like public toilets within 15 minutes walking distance, shade, seating areas and dustbins.

- The existing carts are made from used materials and found objects. There is a need to conceptualize alternative cost-effective, collapsible cart designs, which could address the limited street space in MIDC Marol and Mumbai, and become part of street furniture, when not in use.

- Awareness programs to maintain cleanliness can be undertaken.

Figure 29 Time and type of street vending in MIDC Marol (2011), Source: EMBARQ India






GIVE YOUR FAMILY A WHOLESOME MEDICAL COVER

B. SEAMLESS INTEGRATION WITH FEEDER BUS, RICKSHAW AND TAXI ROUTES AND INFRASTRUCTURE

It is important to seamlessly integrate feeder bus, rickshaw and taxi services with mass transit stations in order to reduce waiting times and discourage the use of private vehicular modes for last mile connectivity and hence demand for vehicular parking. These provide an opportunity to increase the catchment areas of mass transit, especially in lower density station areas. These services should be characterized by short distance routes and high frequency services.

Some of the challenges confronting feeder bus services are the lack of predictability of the service due to increasing traffic congestion, restricted roadways near station areas, poor physical integration with mass transit infrastructure and conflict with rickshaws, taxis, pedestrians and cyclists at the stations resulting in delays (Mulukutla and Vasudevan 2013).

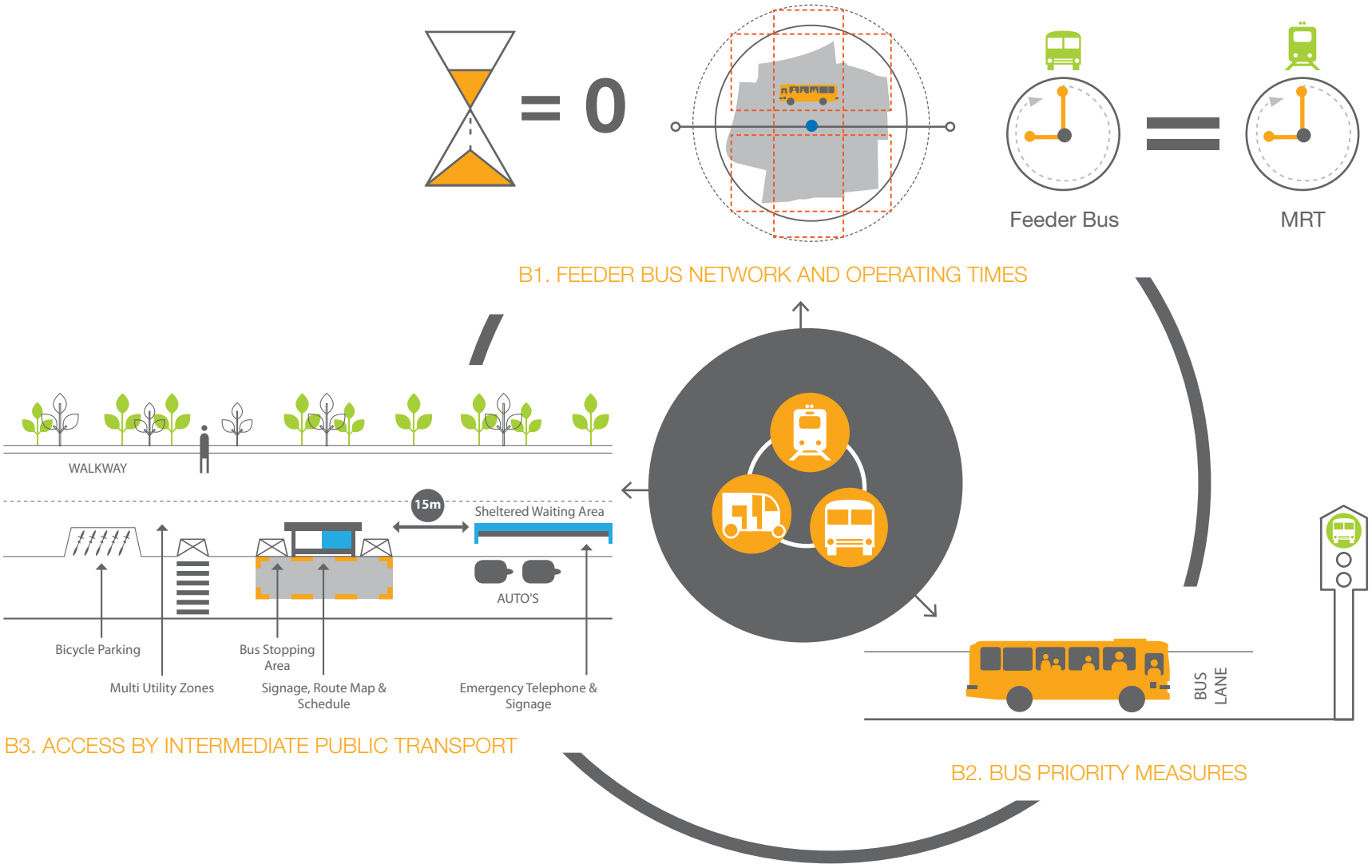
Integration of feeder buses exists at five levels – institutional integration, physical integration, fare integration, operational integration and identity integration (Mulukutla and Vasudevan 2013). The case studies presented below achieve some of these aspects. While comprehensive guidelines are beyond the scope of this document, further resources are listed to provide details in each of these aspects (Table 5).

Rickshaw and taxi pick-up and drop-off or shared services, have either been planned or have emerged organically around mass transit stations. Some of the challenges include the perceived threat to livelihoods because of the mass transit, and provision of dedicated pick-up and drop off points at stations. This results in unorganized rickshaws or taxis parking very close to railway stations, thereby conflicting with pedestrian and bus movement. The flexibility of the rickshaw systems provides last mile connectivity possibilities and sets India apart from many other countries. Formal transportation network and infrastructure thus must ensure adequate space and integration for this predominantly informal system.

Table 5 Seamless Integration with Feeder Bus, Rickshaw and Taxi routes and Infrastructure

STRATEGIES	GUIDELINES
B1. Provide and coordinate feeder bus services and routes within the station area to minimize waiting times	**B.1.1** Provide and coordinate feeder bus service schedules and routes with regional, and mass transit services;
B2. Adopt bus priority measures to encourage use of feeder bus services and ensure efficient movement to and from the station area	**B.2.1** Develop a transit priority program to encourage use of feeder bus services by men and women; **B.2.2** Restrict or prohibit motorized vehicular parking within primary zone of the station (Chapter III Section D:Parking Management); **B.2.3** Consider dedicated bus lanes with priority signals within the station area, when required by traffic congestion; **B.2.4** Consider signal priority at congested intersections and at stations to speed up access in and out of station; **B.2.5** At bus terminals or depots, minimize conflicts by providing dedicated access points for buses and clearly demarcated protected passenger waiting areas; **B.2.6** Design terminals and bus shelters to a high level of comfort.
B3. Facilitate access by auto-rickshaws, cycle-rickshaws and taxis	**B.3.1** Provide pick-up and drop offs by cycle-rickshaws, auto-rickshaws and taxis (whenever relevant) without restricting bus, pedestrian and cycling access at the station area; **B.3.2** Propose rickshaw or taxi stands (as relevant) at major destinations along with resting or seating facilities; **B.3.3** Consider shared auto-rickshaw and taxi services between the station and major destinations.

FEEDER BUS NETWORK COVERAGE AND WAITING TIME



B1. PROVIDE AND COORDINATE FEEDER BUS SERVICES AND ROUTES WITHIN THE STATION AREA TO MINIMIZE WAITING TIMES.

B.1.1 Provide and coordinate feeder bus service schedules and routes with mass transit services.

- Modify existing bus routes or introduce new routes to serve the catchment areas of the station.

The distances of the feeder routes can be limited to ensure higher frequencies or express services operated during peak hours. Additionally, partnerships can be developed with major destinations to operate feeder services.

- Coordinate the feeder service schedules with mass transit services to minimize waiting times.

Feeder buses should operate during mass transit hours and be coordinated with first and last mass transit service times. This may be particularly relevant for new mass transit systems or those operating in suburban conditions with low frequencies.

- Utilize Information Communication Technologies to provide real time data on MRT/ BRT arrivals.

Integrate technology solutions to allow commuters access to real time location/ arrival times of bus/train, etc. on personal devices, public display boards and announcement systems. NextBus is an example of an innovative technology solution which uses Global Positioning Systems to provide updated information on transit schedules and also accounts for delays due to traffic volumes on transit routes (for bus- based transit). Similarly i-Stops are solar powered bus stops, which consist of a flashing beacon, overhead security lighting and an illuminated timetable. These are solar charged in the day and can be activated by bus commuters after dark. The flashing beacon notifies the driver of a stop request (Easter Seals Project ACTION 2011).

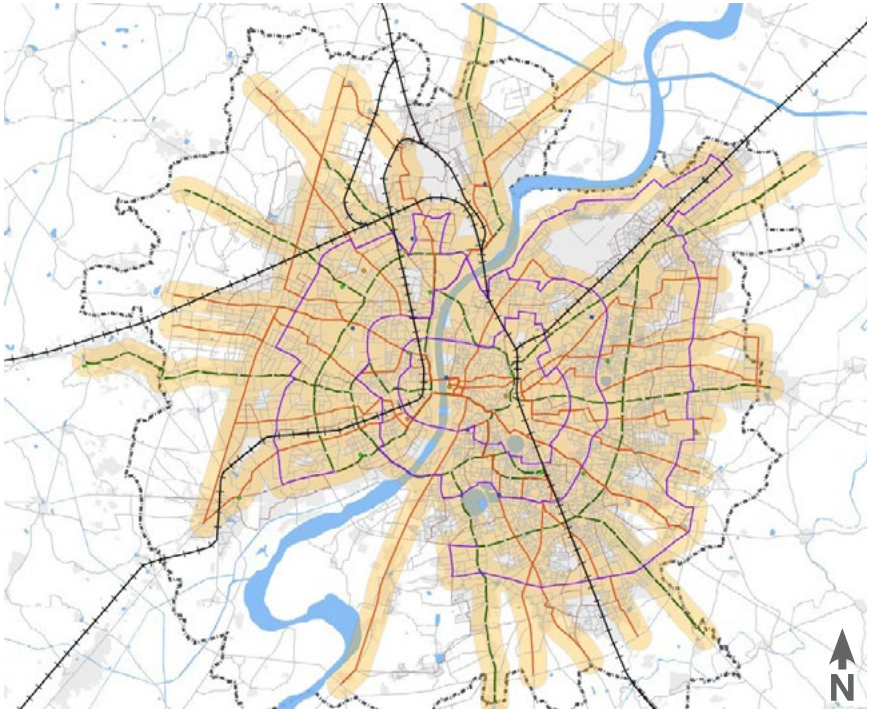
TOOLS AND RESOURCES

Bus Karo 2.0, EMBARQ India

Coverage by Trunk and Feeder Bus Services:
Case Study: Ahmedabad

A study conducted by CEPT University demonstrated that 84 percent of the city was within 500m of the radial-ring trunk routes of Janmarg, the city's bus rapid transit system (BRT). The coverage increases to 95 percent when 20 additional feeder route zones are added to the influence zone of the trunk service (Figure 30). This study demonstrates that with low investments in feeder bus planning, Ahmedabad can expand its ridership and operational efficiency (CEPT University 2013). The areas outlined in red, are zones within the municipal boundary of the city of Ahmedabad which lie at a distance greater than 500m from the Janmarg and feeder bus routes.

Figure 30 Trunk (BRTS) and feeder bus influence zones in Ahmedabad, Source: CEPT University



B2. ADOPT BUS PRIORITY MEASURES TO ENCOURAGE THE USE OF FEEDER BUS SERVICES AND ENSURE EFFICIENT MOVEMENT TO AND FROM THE STATION AREA.

B.2.1 Develop a transit priority program to encourage the use of feeder bus services by men and women.

- Consider lower fares for feeder services during the initial period of the transit operation.

- Consider lower fares during off-peak hours to encourage the use of feeder buses by women.

B.2.2 Restrict or prohibit motorized vehicular parking within the primary zone of the station (Chapter III, Section D. Parking Management).

B.2.3 Consider signal priority and dedicated bus lanes within station area when required by traffic congestion.

While dedicated bus lanes have been successful in cities like London, the lack of enforcement, mixed traffic and mixed land use on Indian roads question their efficacy. Demonstration projects can be considered in pilot station areas in consultations with stakeholders with adequate enforcement and monitoring.

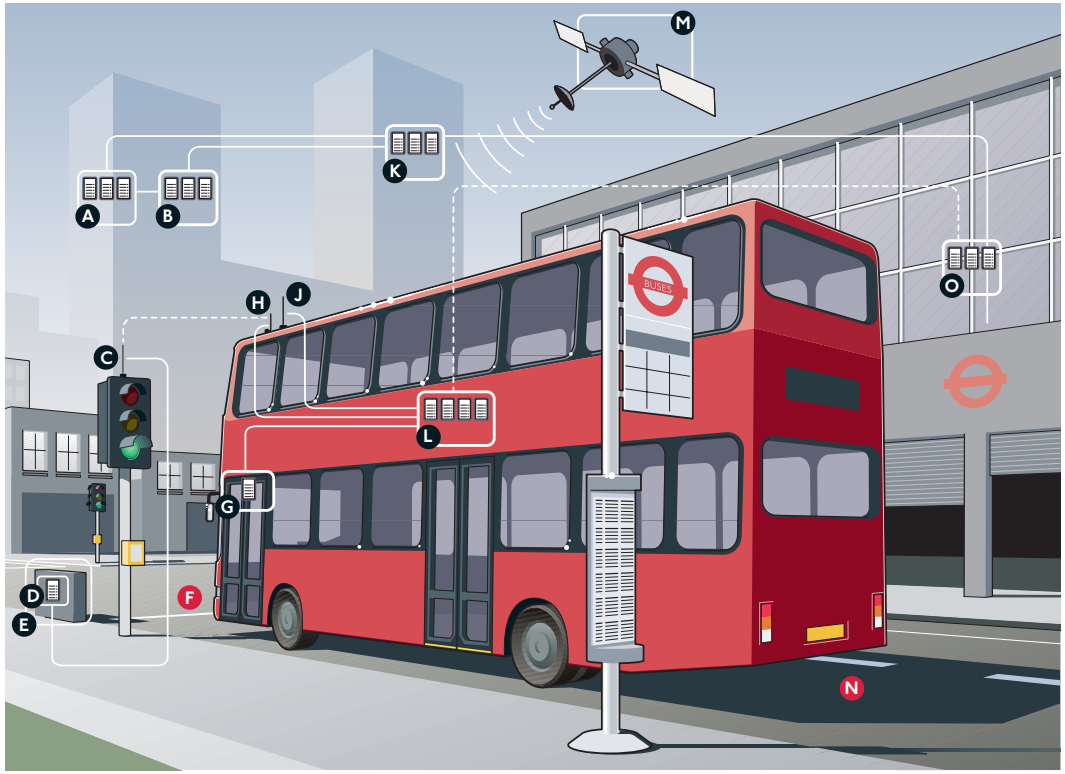
Bus Priority Measures:
Case Study: Transport for London, London

Since the 1980s, Transport for London (TfL) has progressively introduced measures to prioritize buses, such as bus priority signals, bus lanes (outside London) and red routes (where stopping, loading and unloading is severely restricted) (Butcher 2010). A number of studies have been conducted to evaluate the efficacy of these measures. For example, selective vehicle detection (SVD) prioritizes bus passage through traffic signals to improve speed and reliability for passengers. When a bus passes a roadside beacon, the bus transceiver sends a signal to the beacon which then transmits a signal to the traffic signal controller. The traffic signal controller then manages the sequence of the lights to assist bus movement at the junction. This can be by extending a green phase, skipping a stage or shortening the green phase for other traffic in order to give the bus a green signal earlier (Figure 31). Since the inception of SVD, overall bus delays have reduced by approximately one-third at the SVD signal priority installations within London (Transport for London 2006a).

The London Bus Initiative, which involved the introduction of over 100 extra bus lanes, 50 new pedestrian crossings, 300 signalized junctions equipped with bus priority and 140 junction improvements across 27 routes, was introduced from 2000-03. It was observed that passenger waiting times reduced by about one-third; usage along the routes increased by one-fifth (Department for Transport 2004).

Further, a study by TfL on the enforcement of bus lanes (outside London) revealed that roadside static cameras, bus-mounted cameras and constant enforcement, improved the effectiveness and overall compliance of the lane (Transport for London 2006b). Recently, local authorities have been recommended to consult with the public and stakeholder groups to ensure effective planning and compliance (Department for Transport 2008).

Figure 31 Selective Vehicle Detection (SVD) to prioritize buses and reduce overall delays, Source: Transport for London



Key

- A Bus priority fault detection and performance monitoring reports
- B System databases
- G H Bus priority radio link
- D Bus processor (contained within traffic signal controller)
- E Traffic signal controller
- F N Bus detection points
- G Bus door sensor
- J GPS receiver
- K Central system server (located remotely)
- L iBIS plus unit
- M GPS satellites
- O Bus garage (when bus is in garage, it is linked to the central system server to send and receive bus priority data)

B.2.4 At bus terminals or depots, minimize conflicts by providing dedicated access points for buses and clearly demarcated protected passenger waiting areas.

B.2.5 Design bus terminals and shelters for a high level of comfort.

Transport for London Interchange Best Practice Guidelines and the Washington Metropolitan Area Transit Authority, Station Site and Access Planning Manual are good resources for planning and designing bus interchanges. The design and placement guidelines for bus shelters are detailed in Chapter III Section E. An Enhanced Public Realm.

TOOLS AND RESOURCES

Transport for London Interchange Best Practice Guidelines
The Washington Metropolitan Area Transit Authority, Station Site and Access Planning Manual

Aerial view of the Thane SATIS

Grade Separation of Feeder Bus and IPT Services: Case Study: Thane Station Area Traffic Improvement Scheme, Thane

The Thane Station Area Traffic Improvement Scheme introduced in 2009, is an infrastructure project around Thane suburban railway station. It was implemented by the Mumbai Metropolitan Region Development Authority and Thane Municipal Corporation (Phadke and Dave, "The Big Battle for a Way Out," *Indian Express*, February 12, 2014). In this project, bus and IPT infrastructure are grade-separated. An elevated deck is constructed for public and state transport buses. It connects to the suburban railway ticketing booths and skywalks and foot over bridges. There are at-grade auto-rickshaw pick up and drop off points with waiting and queuing areas for passengers. A lane has also been reserved for private motorized vehicles.

However, concerns have been expressed that traffic diversion measures could have been explored first. The exit and entry paths of the bridge are placed in high-traffic prone zones, due to which buses get stuck as they descend the elevated deck. Since only Thane Municipal Transport and state buses are permitted on the elevated deck, private buses line alongside the main roads. Overall, the safety and facilities for bus passengers seem insufficient and can be improved. Further there are insufficient footpaths for pedestrians and no designated parking for bicycles.

Thane SATIS with lower level for auto-rickshaws and upper levels for bus bays. It connects to the road level via elevated walkways




B3. FACILITATE ACCESS BY AUTO-RICKSHAWS, CYCLE-RICKSHAWS AND TAXIS.

B.3.1 Provide pick-ups and drop-offs by cycle rickshaws, auto rickshaws and taxis (wherever relevant) without restricting access at the station area to buses, pedestrians and cycles.

- Cycle rickshaws, auto rickshaws and taxis can be described as intermediate public transport (IPT) services. The IPT stands must be provided after leaving a gap of 10-70m from the station exits to allow dispersal of passengers. The order of priority is as follows: a demarcated bus shelter with waiting area, auto stand and then car parking. Care must be taken to ensure that the waiting area for passengers does not obstruct through pedestrian movement.

- Ensure that the pick-up and drop-off sites are well-lit, with access ramps, emergency telephones and where necessitated, security guards during off-peak night operating hours.

B.3.2 Propose rickshaw or taxi stands (as relevant) at major destinations, along with resting or seating facilities.

B.3.3 Consider shared auto-rickshaw and taxi services between the station and major destinations.

TOOLS AND RESOURCES

Sustainable Urban Transport: The Role of the Auto-rickshaw Sector, World Resources Institute, 2012.
IPT Policy for Tamil Nadu, EMBARQ India, 2013

Auto-rickshaw Services: Case Study: Bandra Station

This case study demonstrates the need for integrating metered and shared auto-rickshaw (and taxi) pick-up and drop-off areas in the primary zone. Bandra suburban railway station in Mumbai is a regional transit node with an interstate railway terminus, an interchange point between the western railway and harbour line, and an express stop. Bandra (West) is a dense, predominantly residential area with significant retail and commercial enterprises.

Field surveys conducted in 2013 revealed that shared autos serve multiple destinations within 2.5km to 4km radius from the station. The auto-rickshaw drivers work in 6 hour-long shifts, conducting an average of 7 to 8 round trips, between 6am to 10pm every day. The shared service carries three passengers per trip at a fixed fare of INR 10 per passenger. Bandra has a well-defined pick-up drop-off stand for metered auto-rickshaw services. However, there is no designated sheltered space for shared autos. Commuters often do not know where to stand; as a result, autos are scattered and pick up commuters in an ad hoc manner. Further, there is double or triple auto-rickshaw parking, which interrupts the movement of other vehicular traffic. Shared autos need to be organized as per destinations with designated sheltered queuing area, and signage indicating destinations. (Appendix VII: Taxi Services: Case Study: Churchgate Station)

Auto-rickshaw pick-up and drop-off points at Bandra west and east stations

C. ENHANCED SAFETY AND SECURITY

Road safety is emerging as a major concern across the developing world, especially in India, which leads the world in the number of road fatalities, with over 140,000 reported each year (NCRB 2011). The most vulnerable road users are pedestrians and cyclists, who along with two-wheelers account for about 60-90 percent of road fatalities in megacities (Mohan and Tiwari 2000). Indian urban roads and station areas particularly, are characterized by a heterogeneous traffic mix, a variety of NMVs besides bicycles, high pedestrian density, poor traffic rules awareness, discipline and enforcement, significant road edge development, street vendors and utilities. These need to be considered when designing for road safety.

Additionally, there has been an increased focus on how urban environments are inaccessible for the differently-abled and unsafe for women, and therefore their accessibility needs must be incorporated to create a safe and secure station area.
Table 6: Strategies to enhance safety and security in station areas

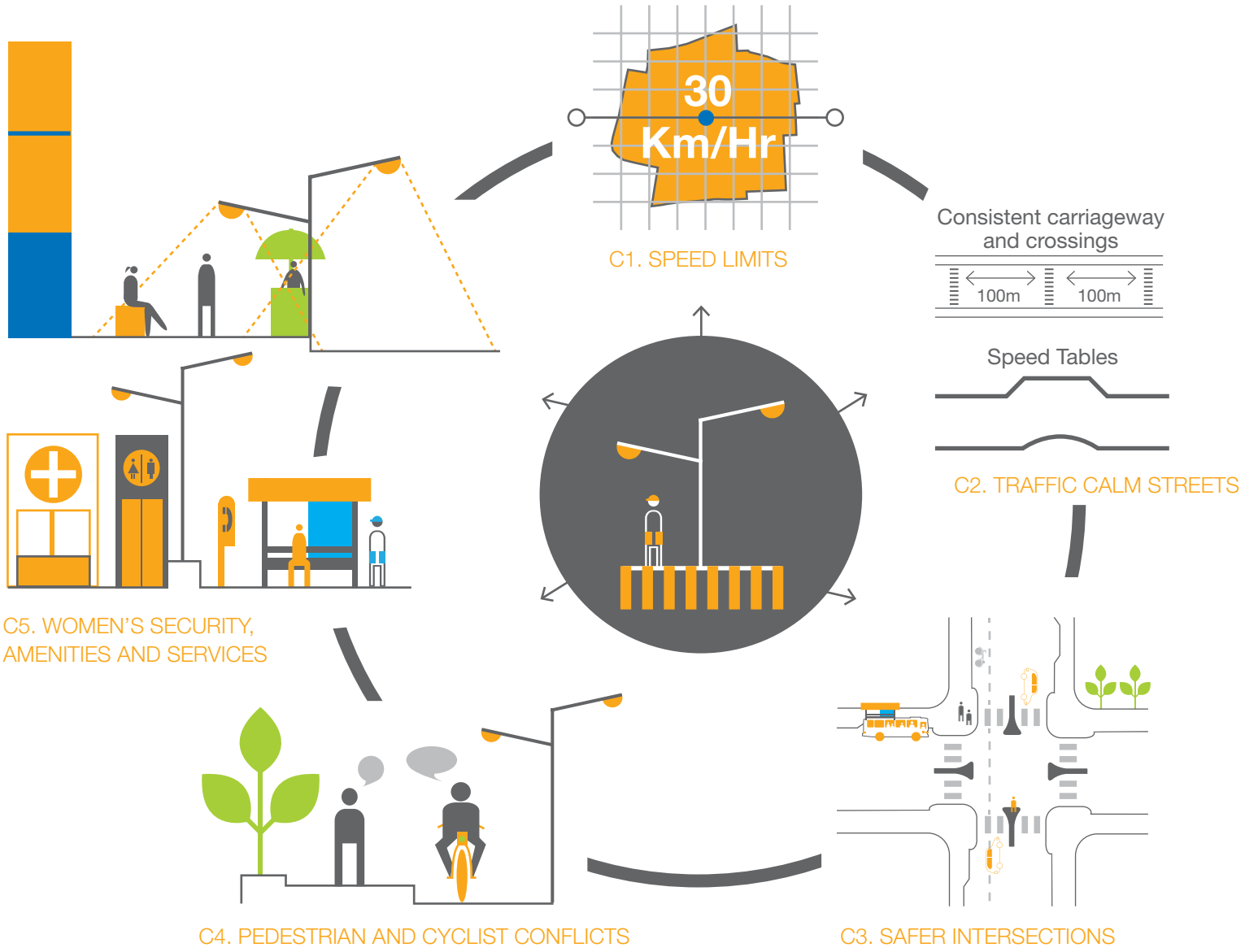
TOOLS AND RESOURCES

IRC 103-2012: Guidelines for Pedestrian Facilities
Road Safety Guidelines for Bus Rapid Transit Systems in Indian Cities, EMBARQ India
UTTIPEC Street Design Guidelines, Delhi Development Authority

Table 6 Strategies to enhance safety and security in station areas

STRATEGIES	GUIDELINES
C1. Traffic-calm the entire station area as a non-motorized transport and bus priority zone	**C.1.1** Set speed limits for the station area and encourage through design.
C2. Traffic-calm the streets to create a safe 'environment for commuters	**C.2.1** Traffic-calm all streets to achieve the desired speed limits and improve pedestrian, cyclist and two-wheeler safety.
C3. Design intersections to enable safe crossings	**C.3.** Traffic-calm intersections for safe pedestrian and cyclist crossing.
C4. Provide for effective management of conflict points between pedestrians and cyclists	**C.4.1** Address conflicts between pedestrians and cyclists at crossings and intersections.
C5. Improve women's sense of security, comfort and convenience	**C.5.1** Design streets for a safer experience. **C.5.2** Encourage natural surveillance through street eyes. **C.5.3** Improve services, provide amenities and encourage building uses to address women's unmet needs.

ENHANCED SAFETY AND SECURITY



C1. TRAFFIC-CALM THE ENTIRE STATION AREA AS AN NMT AND BUS PRIORITY ZONE.

C.1.1 Set speed limits for the station area and encourage through design.

Research has proven that when vehicular speeds increase to more than 40 km/hr, the likelihood of a fatality exponentially increases with a collision (Tefft 2013). Countries like the United Kingdom and the Netherlands are taking active measures to traffic-calm their roads and have enacted legislation to create '30km/hr zones' in residential areas. Netherlands adopts a three- tiered approach of 70-50-30km/hr speeds for its expressways, urban roads and home zones (Wegman and Wouters 2002). Since a large number of pedestrians are anticipated in station areas, it is recommended that the station area be designated as an NMT and bus priority zone with 30km/hr speed limit. When a mass transit-system is proposed along urban arterial roads, higher speeds of 50km/hr may be considered with grade-separated access.

However for local streets in station areas, it is recommended to have lower speeds ranging from 15-25km/hr, as was observed in the woonerfs[17] in the Netherlands (Kraay 1986). In the United Kingdom, streets in residential areas have been developed as home zones. These aim to extend the benefits of slow traffic speeds within residential areas and give greater priority to non-motorized users (Department for Transport 2005). It is recommended that these speeds be applicable for station areas and unlike woonerfs or home zones[18], footpaths are still recommended for local streets (where possible).

C2. TRAFFIC-CALM THE STREETS TO CREATE A SAFE ENVIRONMENT FOR COMMUTERS.

C.2.1 Traffic-calm all streets to achieve the desired speed limits and improve pedestrian, cyclist and two-wheeler safety.

The design strategies include:

- Proposing speed tables or raised intersections at 50-150m to achieve the desired speed limits;
- Providing Level of Service B-C for pavements, access ramps and tactile paving as per IRC 103-2012: Guidelines for Pedestrian Facilities;
- Providing a consistent carriageway;
- Maximum lane widths of 3.5m for arterial, 3m for sub-arterial and collector roads and 2.7m for local streets (subject to a total carriageway of 5.50m);
- Proposing crossings at distances not more than 100m. The speed tables can be combined to become pedestrian crossings, or speed humps can also be used with a pedestrian crossing at 3-5m distance.

Safe Streets:
Case Study: MIDC Marol, Mumbai

Since MIDC Marol is a business district adjoining a metro station, speeds are proposed to be regulated at 30 km/hr. Thus, a number of traffic calming measures are used to regulate motorized vehicular speeds. This includes raising major intersections, which are at approximately 200m (Figure 32, left). These are proposed at both signalized and unsignalized intersections as the signals often don't work along this corridor and vehicles are observed to wait over zebra crossings. In addition, pedestrian crossings are proposed within 50-100m (Figure 32, middle). These are proposed considering existing demand and are combined with bus stops to serve both pedestrians and bus commuters. A consistent carriageway is proposed with a lane width of 3m (Figure 32, right). Bus shelters are provided with additional waiting space so that a clear pedestrian walkway is maintained and a defined waiting space is also present Figure 33. The width of the raised crossing ensures that the wheel-base of a car can be accommodated (Figure 34). The median is widened to 1.5m at crossings to accommodate street vendors and cyclists.

Figure 32 (left and middle) Raised intersections and pedestrian crossings; (right) consistent carriageway & reduced lane widths, Source: EMBARQ India

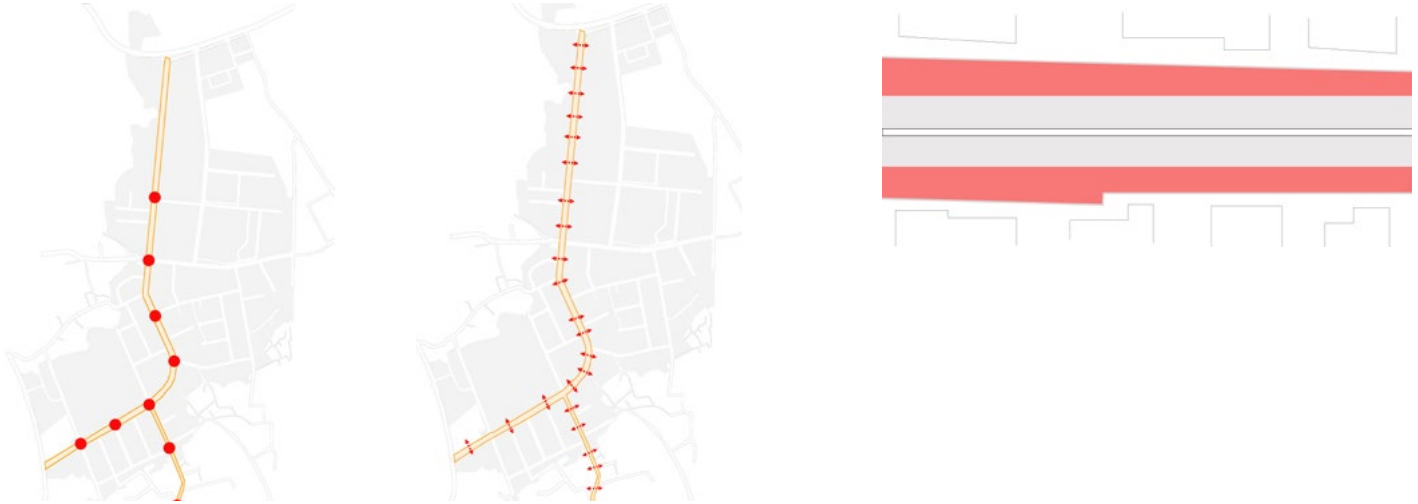


Figure 33 Conceptual recommendations for intersections at bus shelters, Source: EMBARQ India

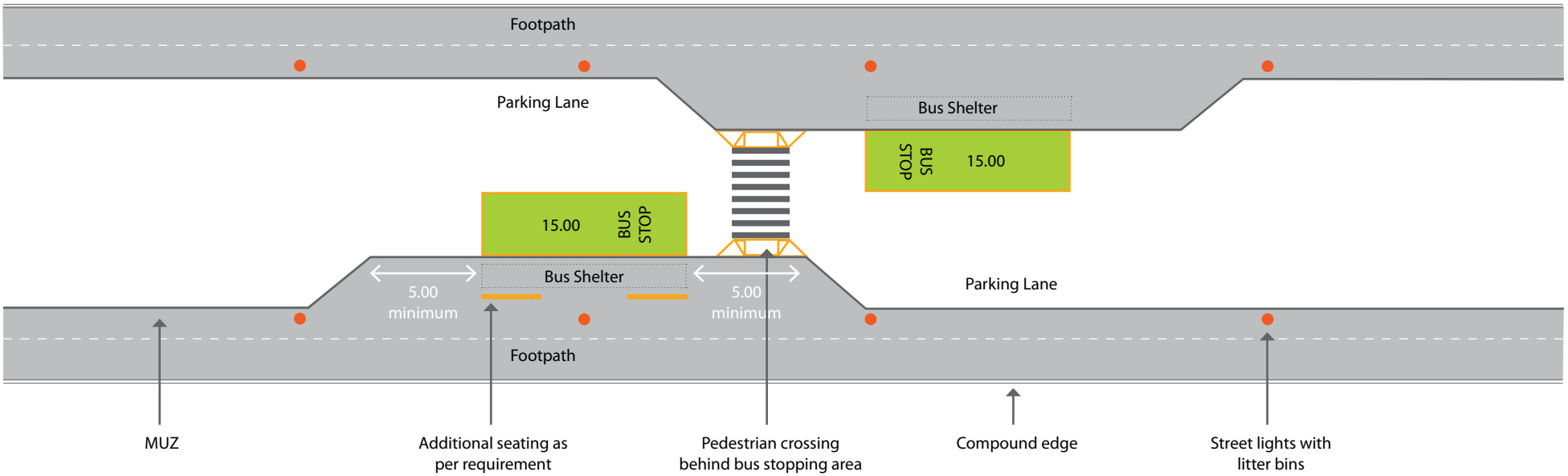
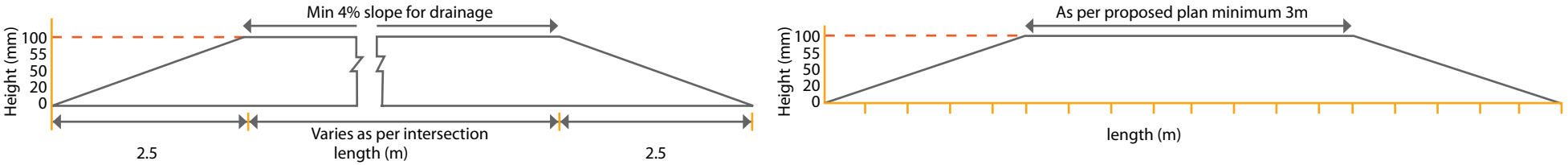


Figure 34 Conceptual drawings of a typical raised intersection and crossing; Danish street design standards



C3. DESIGN INTERSECTIONS TO ENABLE SAFE CROSSINGS.

C.3.1 Traffic-calm intersections for safe pedestrian and cyclist crossing.

It is critical to minimize conflict points between motorized road users and pedestrians and cyclists especially at intersections. Signalizing every intersection in station areas is neither feasible nor a desirable solution, but traffic- calming can be an effective strategy to improve pedestrian and cyclist safety at intersections. Some methods to traffic-cam are:

- Tightening turning radii to a maximum of 12m;
- Reduce crossing distances for pedestrians with curb extensions;
- Provide pedestrian refuges for roads exceeding 2 lanes in each direction;
- The width of the refuges should be minimum 3m long and 1.2m or 1.5m wide to accommodate bicycles;
- Provide bollards at 1.2m across medians or access ramps to ensure that a wheelchair can pass through;
- Reconsider slip lanes. However, they can add safety to skewed intersections, if there is adequate calming or signal along the slip lane. Slip lanes can create corner islands, which can serve as pedestrian refuges. This allows pedestrians to avoid conflicts with left-turning traffic when crossing the roads during their green phase.

Safe Intersections:
Case Study: Road Safety Improvement Project, VAG Metro Corridor

The following factors were considered when designing the DN Nagar-JP Road intersection—turning radii, geometrical alignment of roads, reducing crossing distances, and providing pedestrian refuge areas and optimizing signal phasing (Figure 35). The turning radii were proposed in the range of 4.5m to 7.5m for minor intersections and 9m to 12m for major ones. Junction areas are tightened by giving only enough area to accommodate all turning movements. The remaining areas are included within footpaths. Signal operation is optimized by specified reduced number of phases, and introducing longer pedestrian phases, where applicable (Figure 36).

Figure 35 Intersection design (from left) tighter turning radii; reduced intersection gaps; pedestrian refuge areas; road markings, Source: EMBARQ India

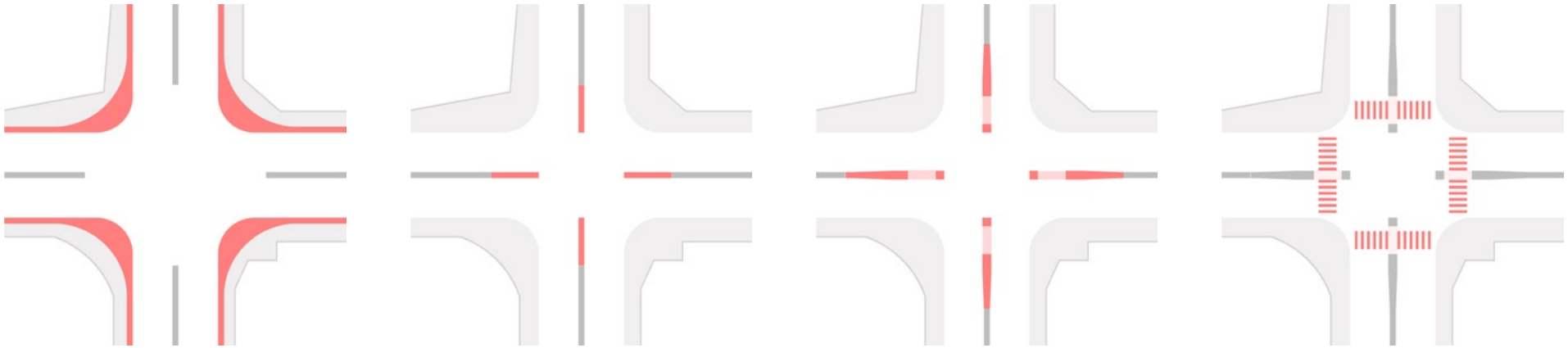
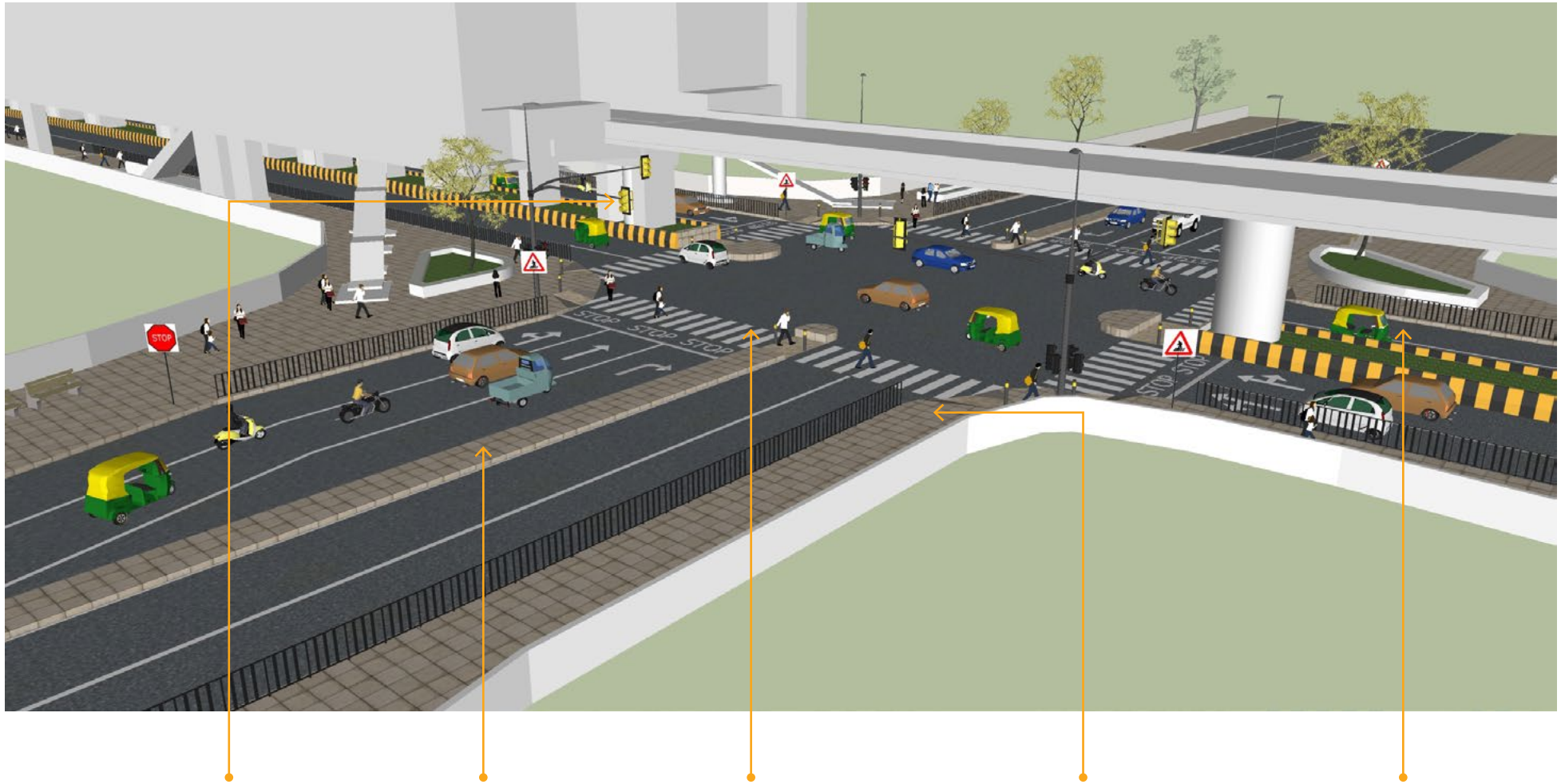


Figure 36 Designed intersection near DN Nagar Metro Station Mumbai, Source; EMBARQ India



Optimize signal seperation; reduce number of phases; longer pedestrian phases

Introduce built median along lane

Align pedestrian crossings with refuge areas; also provide stop lines and signage

Introduce turning radius of 9m-12m

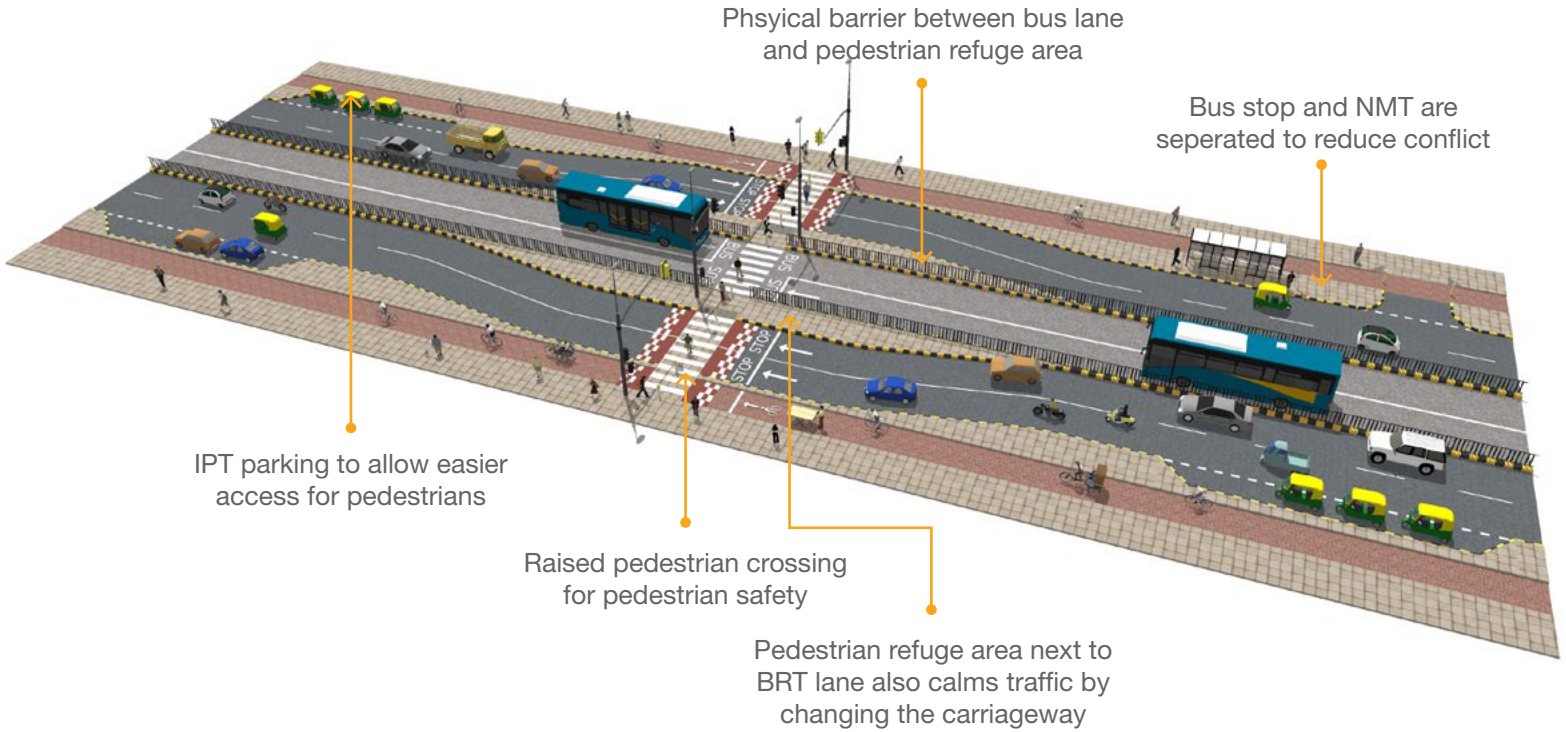
Variations in street width to be absorbed by footpath

C4. PROVIDE FOR EFFECTIVE MANAGEMENT OF CONFLICT POINTS BETWEEN PEDESTRIANS AND CYCLISTS.

There is a likelihood of conflict when different modes of transport—cyclists, pedestrians or vehicles – share the same space, especially at junctions or crossings. The relative speed, direction and mass of each will determine the severity of the outcome of an actual conflict. However, legible design can make potential conflicts obvious to all road users in advance, and address it to enable mutual resolution.

C.4.1 Address conflicts between pedestrians and cyclists at crossings and intersections.

Figure 37 Midblock crossings in BRT lane, Source: EMBARQ India



Pedestrian and Cyclist Conflict Management: Case Study: Road Safety Guidelines for BRT Systems in Indian Cities

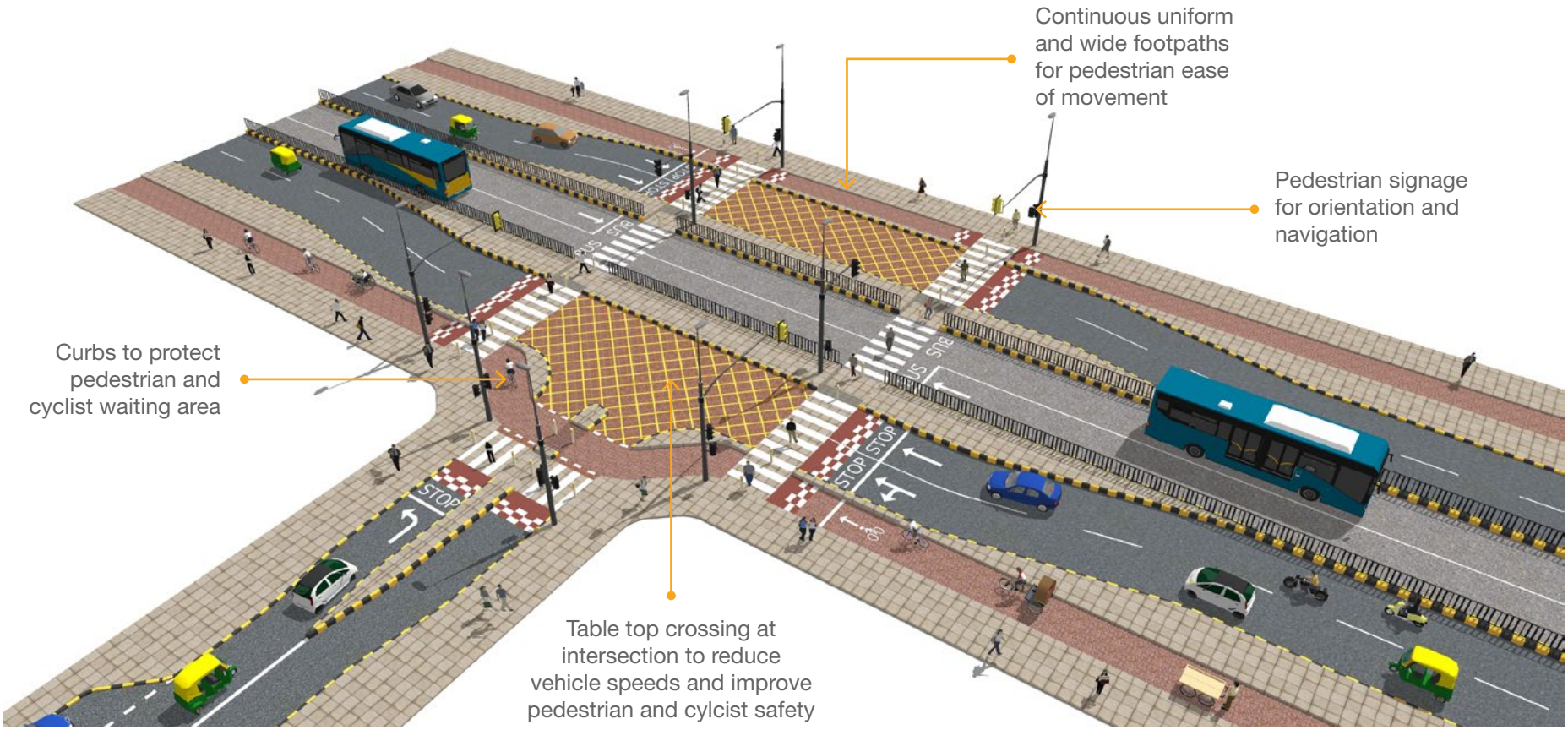
These guidelines provide a basis for designing non-motorized traffic infrastructure along BRT trunk corridors. They give design templates of intersections and crossings in which pedestrian and cyclist conflict is minimized. The key design features include increasing visibility of all road users, physical design interventions to separate users or manage speeds and signalized stops to manage movement of pedestrians and cyclist.

In the Indian context, keeping in mind that other informal vehicles such as vendors on carts may use the cycle lane as well, a minimum width of 2.5m is recommended for two-way NMT lanes, while a minimum width of 3.30m is recommended for the pavements. Additional design considerations to minimize conflict are:

- Path geometry – widening the path and creating cyclist waiting zones at certain points of conflict to avoid blind spots and to allow pedestrians to cross;
- Intersections with other roads and paths – slowing down cyclists approaching at an intersection, through treatment of cycling surface, ramps, speed breaks, chicanes etc.;
- Lighting – install good lighting for clear visibility;
- Signs – provide clear signs showing rules of operation of the path, location, navigation to nearby places etc.;
- Line marking – symbol use and centre line marking on two-way cycle paths;
- Physical separation – horizontal grade separation between cycling and pedestrian paths, fencing or landscape barrier that does not obstruct sight lines;
- Signalizing intersections and crossings – Allow movement of pedestrians and cyclists in different phases.

Another strategy to minimize such conflicts is by education and awareness, through promotional campaigns, posters, signage etc. The following images (Figure 37, Figure 38) from EMBARQ India's Road Safety Guidelines for BRT in Indian Cities illustrate the safety elements used to minimize the conflict between pedestrians and cyclists along BRT corridors:

Figure 38 Design of intersections to maintain safety and manage conflicts between pedestrian and cyclist, Source: EMBARQ India



C5. IMPROVE WOMEN'S SENSE OF SECURITY, COMFORT AND CONVENIENCE.

Specific measures must be undertaken based on security assessments, to make station areas secure for women.

C.5.1 Design streets for a safer experience.

- **Provide a Level of Service B for pavements, station exits and entries (Chapter III Section A: Pedestrian and Cyclist Priority, A1).**

Most station areas generally have a very poor level of service for pedestrians, resulting in overcrowding and increased chances of harassment, thereby disproportionately affecting women. IRC 103-2012: Guidelines for Pedestrian Facilities proposes a level of service B-C for pavements (IRC 2012). It is therefore recommended that this standard be followed to improve women's sense of safety.

- **Ensure streets and pavements are continuously well-lit.**

Improved street lighting can contribute towards increased safety. It can prevent road traffic crashes, injuries and fatalities. Street lighting not only reduces the risk of traffic accidents, but also their severity. Lighting needs of pedestrians are different from those of vehicular traffic and therefore need to be designed and integrated within the overall lighting strategy for the street. This would aid the safety of pedestrians, especially women, after dark.

The street lights should preferably be placed in the multi-utility zone, clear of pedestrian walkways. It can be coordinated with other street elements such as trees, hoardings etc., so that they do not impede proper illumination. Lighting must be directed downwards as up lighting might result in spillage of light, wastage of energy, and create night sky light pollutions.

Lighting engineers should be consulted for design calculations including pole heights, type of luminaries, etc. for achieving appropriate lighting levels in all parts of the street (IRC 2012); (UTTIPEC 2010). Chapter III: Section E.3.7 provides a design checklist for the height, lux and spread of street lighting.

C.5.2 Encourage natural surveillance through street eyes.

- Encourage mixed uses and discourage single land use zones;
- Plan for street vendors in neighbourhood-level plans and street design;
- Create porous compound walls to improve visibility on streets;
- Consider monitoring for times when street eyes are insufficient, tied to results from security assessments.

C.5.3 Provide amenities and encourage building uses to address women's unmet needs.

- Ensure that there are amenities like day care centres and public toilets within 15 minutes walking distance with sufficient toilet seats for women and children;
- Encourage building uses such as grocery stores, pharmacies etc. that can improve women's convenience.

C.5.4 Undertake gender sensitization trainings and advocacy campaigns.

- Undertake gender sensitization trainings with bus and IPT drivers and conductors to address sexual harassment and violence against women in their vehicles;
- Communicate existing safety initiatives adopted by different agencies and provide information on feedback systems;
- Undertake advocacy campaigns on harassment and gender stereotypes targeting male and female commuters;

Improved Security Through Street Lighting: Case Study: MIDC Marol, Mumbai

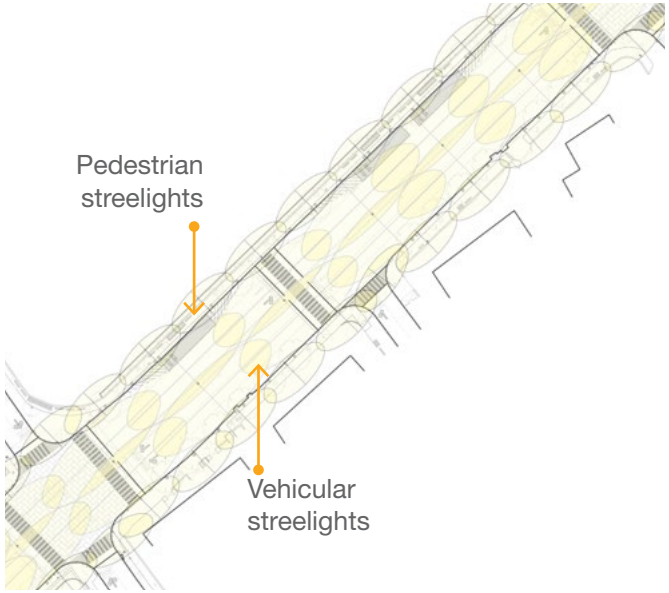
In MIDC Marol, two types of street lights are proposed: those that provide lighting to the carriageway and those that provide lighting to the pavements. The street lights are proposed in the multi-utility zone. Pedestrian street lights are placed at a distance of 12-15m, whereas carriageway street lights are proposed at around 20-30m. White lighting at 25-40 lux for footpaths is recommended to maintain a colour contrast from the road surface (IRC 2012). The height of light poles on all streets other than at major arterial intersections are restricted to 12m to avoid undesirable illumination of private properties. For pedestrian scale lighting, 3-5m tall light poles are recommended to illuminate the footpath adequately and avoid tree shadows. Wherever possible, street light and pedestrian lights are combined. There is an overlap of one-third of the coverage between successive street lights to ensure consistent well-lit paths (Figure 39).

MIDC Marol consists of large single land use plots, predominantly commercial and industrial in nature. The roads adjacent to these plots lack any street activity and are lined with cars, creating a dead edge. Hence, it is recommended to encourage mixed use land zoning. This will help create an active frontage, making the street more secure.

In order to improve visibility on the streets, which in turn affects the way the pavements are used, it is suggested that opaque compound walls higher than 1m be avoided as far as possible. Instead, porous and semi-porous edges such as those shown in the photographs are highly recommended. This will increase the number of people staying on the street, and thus create a natural surveillance mechanism.

Single building use creating inactive street spaces (top); mixed building uses with high people presence and multiple activities (bottom)

Figure 38 Plan of MIDC Marol with illumination range of streetlights highlighted, Source: EMBARQ India



Relationship between compound wall height and street activity in MIDC Marol

D. PARKING MANAGEMENT

Free parking provision incentivizes excessive car use by making driving the most convenient and affordable travel option (Kodransky and Hermann 2010). While parking is an essential component of the transportation system, a typical automobile is parked 23 hours each day, and uses several parking spaces each week. Parking convenience affects the ease of reaching destinations and therefore affects overall accessibility. The public provision of parking facilities is a cost to society, and designers, operators, planners and officials are faced with the conundrum of managing parking demand (Litman 2013).

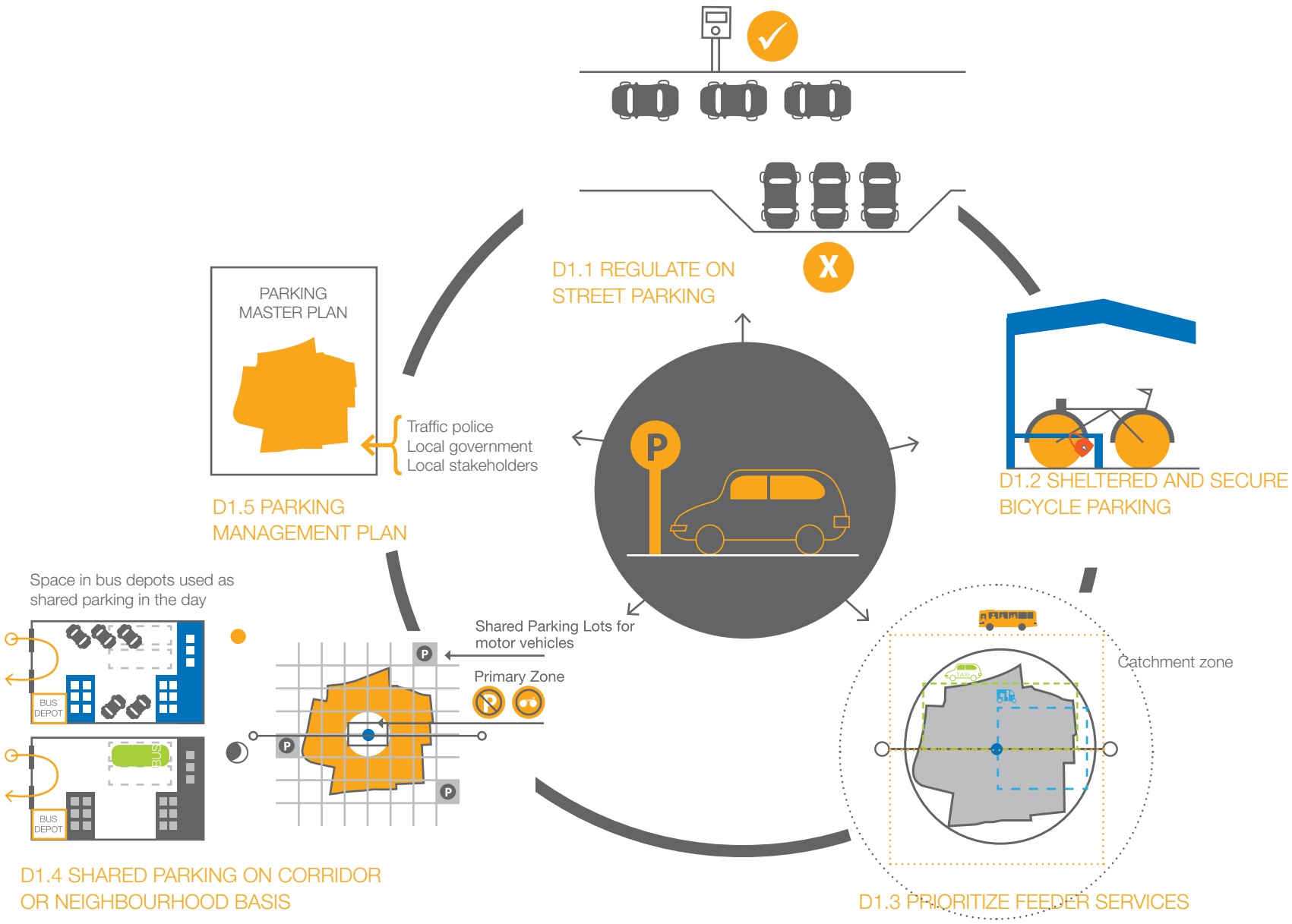
Despite Indian cities having lower levels of car ownership and higher dependencies on public transport, off-street (plot parking) parking requirements within plots in Indian cities in general, are much higher than corresponding parking requirements of cities such as Hong Kong, Singapore (MCGM 2013). The current approach to parking in Indian cities is almost no management of on-street parking and increasing parking supply through building regulations and incentives.

The concept of managing parking for sustainable growth has now started to gain traction in global cities. Parking management is focused on travel demand management by regulating the availability of parking in order to induce a mode split.

Table 7 Strategies for parking management in station areas

STRATEGIES	GUIDELINES
D1. Create a parking management plan with the objective of minimizing need and supply of parking	**D1.1** Regulate on-street parking provision in order to allocate road space for pedestrians, cyclists and transit feeder services;
	D1.2 Provide sufficient, secure parking for bicycles at station entrances;
	D1.3 Limit commuter parking expansion by prioritizing feeder bus, auto-rickshaw (and taxi) services (Chapter III Section B: Seamless Integration with Feeder Bus, Rickshaw and Taxi Routes and Infrastructure);
	D1.4 Assess commuter parking needs on a corridor or system basis and locate and design parking to maximize development and ridership potential at transit stations;
	D1.5 Develop parking management plan in consultation with local stakeholders, traffic police and urban local body.

PARKING MANAGEMENT



D1. CREATE A PARKING MANAGEMENT PLAN WITH THE OBJECTIVE OF MINIMIZING NEED AND SUPPLY OF PARKING.

D1.1 Regulate on-street vehicle parking provision for equitable distribution of road space for pedestrians, cyclists and transit feeder services.

- **Demarcate parking and no parking zones for motorized vehicles.**

The parking or no parking zones can be demarcated to ensure safe access for non-motorized trips, prioritise public transport and IPT, preserve special characteristics of areas such as heritage precincts, and access open/public spaces. Since the primary zone is the most hectic zone where pedestrian and cyclist access is prioritized along with transfers from feeder bus services, it is recommended to consider it as a no parking zone for private motorized vehicles. Similarly, major pedestrian and cycling routes to mass transit stations can be considered as NMT- priority streets. These could be considered as no parking streets, or on-street parking can be regulated through pricing.

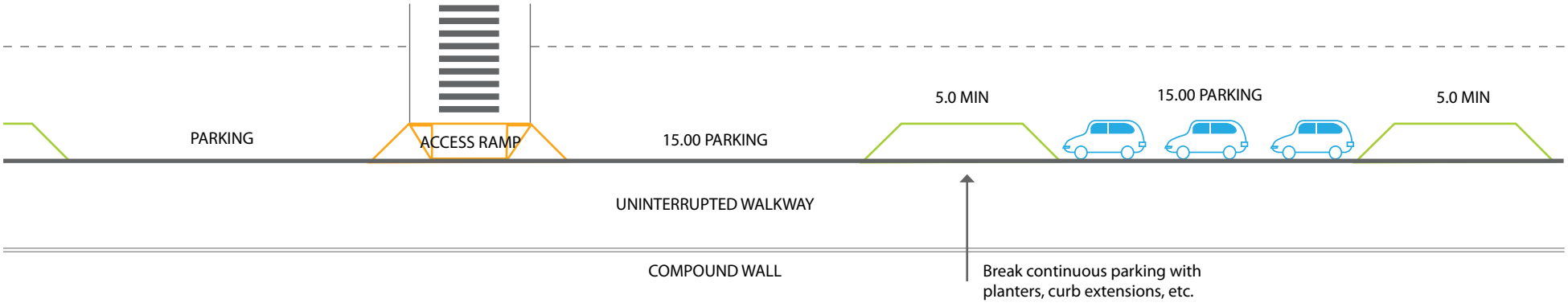
Perpendicular parking is observed in business districts or areas with high demand at the cost of pedestrian accessibility. When framing an on-street parking strategy, it should be discouraged to facilitate pedestrian access.

- **Regulate on-street parking through pricing and design.**

One of the most important tools for good on-street parking management is pricing. Pricing nudges long-stay users especially to park off-street and improves the willingness to pay for off-street parking. For good on-street management, the following components are critical (i) clarity on where it is legal/illegal to park, through signage, markings etc.; (ii) trustworthy time-based fees system (use of technology and parking metres); (iii) parking data collection capacities (initially simple inventory and occupancy surveys for problem areas); (iv) enforcement capacity (with supporting institutions); (v) pilot projects to determine the right pricing for parking that will work for a specific area. As a thumb rule, prices can be increased if the occupancy levels are above 85 percent and lowered if less than 85 percent (Shoup 1997).

On-street parking can be regulated through design by becoming a traffic-calming device, limiting the number of continuous on-street parking spots and reducing the width of parking bays depending on the type of vehicles observed.

Figure 40 On-street parking management to provide adequate pedestrian footpaths, Source: EMBARQ India

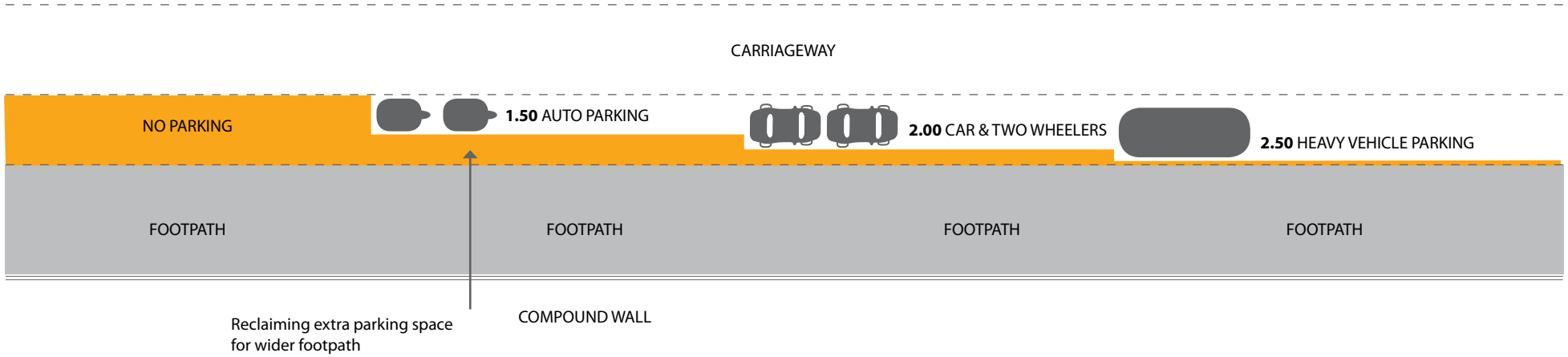


Design Guidelines for On-street Parking:
Case Study: Mumbai

These design guidelines for on-street parking were prepared by EMBARQ for Mumbai. The minimum width of a parking bay is taken as 1.50m for auto-rickshaws and cycles, 2m for cars and two-wheelers and 2.5m for heavy vehicles. After estimating the parking requirements for different types of vehicles, the width of the parking bay can be reduced to regulate on-street parking. This will help in reclaiming excess parking space for wider footpaths (Figure 40).

A continuous length of parking more than 3 vehicles or 15m should not be encouraged as it impedes access to the footpath. It can be broken down by mid-block curb extensions (Figure 41). Care should be taken that these interruptions do not block the visual connection between pedestrians and drivers. On shared streets with no footpath, parking can be used as a buffer. Protected waiting areas for pedestrians must be provided at plot entries.

Figure 41 On-street parking management for shared streets, Source: EMBARQ India



On-street Parking Reforms:
Case Study: Bogota, Colombia

From 1998-2000 the city of Bogota, Columbia introduced stringent on-street parking reforms to reclaim its street space for public purposes (Barter 2010). Below is the before/ after image of Carrera 15, a 5 km long avenue in Bogota in a fairly high income neighbourhood. The central avenue has several shops, offices and residential buildings along this stretch. Before the parking reforms, Carrera 15 had more than five thousand free parking spaces to facilitate the streets busy commercial and retail character. These were essentially occupied by shop owners to park their personal vehicles, leaving only 20 percent open slots for visitors. The provision of parking outnumbered the demand by three times - “166 cars parked in an area that had a total of 479 parking spaces” (Barter 2010).

After the reforms came into effect, on-street parking was strictly regulated with high pricing and stringent enforcement. Parking spaces were converted into public spaces for walking, cycling and leisure activities.

The additional demand for parking was then met by off-street parking provisions, by developing off-street parking lots ensuring that the unmet demand was met by the market. To encourage this, the city offered tax incentives (or discounts) to those investing in the development of public parking lots. Revenues from these parking lots were used to maintain infrastructure and improve feeder bus services within the station area (Chapter IV: Implementation and Maintenance Strategies). However, this manual suggests that the primary zone in station areas be treated as a no-parking zone for motorized vehicles (Refer Table 2). The demand for off-street parking must be determined at an area level and provided outside of the secondary zone.

Images of avenue Carrera 15, Bogota Colombia, before and after parking reforms were carried out.

D1.2 Limit commuter parking expansion by prioritizing feeder bus, auto-rickshaw (and taxi) services (Chapter III Section B: Seamless Integration with Feeder Bus, Rickshaw and Taxi Routes and Infrastructure).

D1.3 Assess commuter parking needs at an area level and enable efficient use of parking space through shared usage.

- **Consider parking at a neighbourhood level and not for individual plots.**

In station areas, requiring each use to provide separate parking facilities, can degrade the pedestrian environment and encourage driving from one site to the next rather than parking once and walking between nearby destinations. One solution to this is to allow developers to pay fees into a municipal parking fund in lieu of providing the required parking on site. The fees can then be used to provide centralized public parking or can also be used for transit, bicycle, and pedestrian improvements that can reduce parking demand. Example-City of Santa Monica-USA, Vancouver- British Columbia etc. (MAPC n.d.). The provision of public parking lots must be considered outside the secondary zone. These can be designed to ameliorate the impact of a dead edge along the street and planned with small-scale retail uses on the ground floor.

- **Consider sharing of parking spaces between uses.**

Parking spaces can be shared across commercial-office and residential uses thereby reducing the overall demand. Similarly, bus depots are generally underutilized during the day, as most buses are in operation. A public-private arrangement can be worked out such that heavy vehicles within the neighbourhood can be parked within the depots during the day.

Sharing Parking Spaces
Case Study: BEST Undertaking, Mumbai

In February 2013, BEST introduced a scheme for permitting the parking of private buses and cars in two depots adjacent to an industrial-business district of MIDC Marol. It is charging Rs. 100 per day for a 12 hour period and Rs 2500 per month for a 12 hour period. The charges for a private car are Rs. 75 per day for a 12 hour period and Rs. 2000 per month for a 12 hour period.

This proposal was discussed with private bus contractors serving the area and the MIDC Marol Industries Association. The MMIA members, whose employees are served by these buses, have agreed to pay for the parking charges. Discussions are under way regarding the number of buses, timings, identification cards for the drivers and conductors and provision of resting areas (Appendix VIII).

High Volume Bicycle Parking Station:
Case Study: Maua, São Paulo

The Maua bicycle station, located near Maua CPTM train station (São Paulo) provides parking, repair and maintenance facilities for around 2000 cyclists per day. It initially began with around 200 users and collaborated with ASCOBIKE, a bicycle riders association. Around 70 percent of ASCOBIKE users transfer to the CPTM train, which is a commuter rail that connects to the São Paulo metro system (Figure 42). The program has been replicated across the CPTM and São Paulo metro system, with 44 bicycle stations and 10,600 parking spaces (Figure 42).

The users pay a monthly fee of R$ 10.00 (approximately US$5.00) while non-members pay a daily fee of R$1.00 (approximately US$0.50). While users get discounts on bicycle parts and repairs, all users can access the showers and bathrooms/toilets, 24-hour bike parking, tire pumps, bicycle loans during repairs, health insurance plans, social workers, legal services and refreshments. There are reserved spaces for women and the elderly. Other bike stations along CPTM and the Metro provide free service, only requiring that users register their bikes.

In 2009, São Paulo also inaugurated Our Bike, a public bicycle sharing program, which offered 240 bicycles across 17 metro stations (Cavalcanti 2013). The São Paulo metro map represents the bicycle stations with green dots and bicycle sharing stations with green dots with a black circle (Hutchinson 2011).

Figure 42 (top) São Paulo's metro map, Source: CPTM; (bottom) bicycle parking station in Maua station, Sao Paulo

D1.4 Develop parking management plans in consultation with local stakeholders, traffic police and urban local bodies.

Working with local stakeholders such as Chambers of Commerce, Industrial Associations, Residential Associations and so on, who have some local authority to manage the local parking, would be instrumental in implementing parking management plans. This must be accompanied with capacity building of the stakeholders to emphasize the goal of the parking management plans. Additionally, the impact of the plan must be assessed to reduce the risk of over-provision.

D2. PROVIDE SUFFICIENT, SECURE PARKING FOR BICYCLES AT STATION ENTRANCES.

D.2.1 Locate protected and secure bicycle parking at station entrances

- A range of options can be provided to cater to the demand for bicycle parking, and increase in bicycle parking must be considered to provide for future demand;
- Bicycle parking should be located near the station entrances, areas with high cycling traffic and in publicly visible locations;
- The usage should be monitored regularly to ensure that sufficient parking is provided. For long-term bicycle parking, the parking can be staffed and nominal charges maybe imposed to provide additional security;
- Care should be taken to ensure that the parking does not impede existing pedestrian and traffic flow.

E. AN ENHANCED PUBLIC REALM

Streets in India not only serve as conduits of movement but also perform the role of public spaces. A large number of activities like sitting, resting, eating, vvending etc. are observed on the street. However, street vendors are often considered as “encroachment” and their role in providing access to affordable goods and services is often unacknowledged (Bhowmik 2005).

Place- making re-imagines public spaces as the heart of every community and is considered as a transformative approach that inspires people to create and improve their public places (Project for Public Spaces 2008). Existing identity of neighbourhoods and use of places can be augmented through innovative place-making strategies. However, these have been critiqued in the United States for creating gentrified public spaces (Moss, “Creative Placemaking Has an Outcomes Problem,” *Huffington Post*, September 05, 2012). Therefore, care must be taken to ensure that existing activities and poor (and often, informal) service providers are not evicted in the process.

The insertion of new mass transit infrastructure can be seen as an opportunity to build on existing activities along with the overall upgrade of the station area. Due to the dense context of station areas, multi-functionality of street furniture is recommended. For example, low compound walls or concrete pedestals of utility boxes can also become seating etc. The following strategies and guidelines illustrate how street furniture and signage can enhance the quality of the public realm.

TOOLS AND RESOURCES

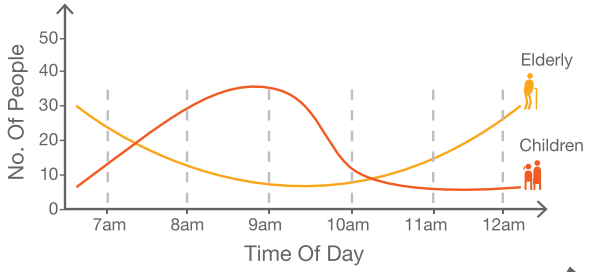
Street Design Guidelines for MIDC Marol, Mumbai
Street Furniture and Signage Guidelines for MIDC Marol, Mumbai

Place-making re-imagines **public spaces as the heart of every community**

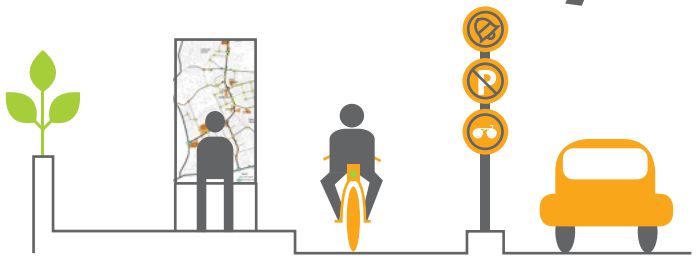
Table 8 Developing a station area as an enhanced public realm

STRATEGIES	GUIDELINES
E1. Undertake activity counts and map different types of street activity and uses	**E.1.1** Map the different types of activities, nodes, their location and times within the station area and understand their relationships; **E.1.2** Undertake activity counts in different types of public spaces and nodes.
E2. Enhance the role of streets as public spaces	**E.2.1** Design streets to cater to multiple activities; **E2.2** Enhance or design NMT priority and NMT-only streets to facilitate movement and as public spaces.
E3. Create a secure, comfortable and imageable public realm	**E.3.1** Propose contextual, coordinated and comfortable types of street furniture for all users; **E.3.2** Propose secure, sheltered parking for bicycles (Chapter III Section A: Pedestrian and Cyclist Priority); **E.3.3** Propose comfortable, light, transparent bus shelters; **E.3.4** Propose different types of seating and waiting depending on surrounding context; **E.3.5** Use utility boxes and transformers as public art; **E.3.6** Propose community and garbage bins; **E.3.7** Propose street lighting for carriageway and pavements; **E.3.8** Incorporate street vending in street design; **E.3.9** Incorporate landscape elements into street design; **E.3.10** Design well-ventilated, simple public toilets of high architectural standards; **E.3.11** Incorporate public art to create place markers.
E4. Introduce a coordinated pedestrian and traffic signage system to improve safety and way-finding	**E.4.1** Introduce traffic signage to guide vehicular traffic **E.4.2** Introduce a coordinated pedestrian signage system.

ENHANCED PUBLIC REALM



E1. ACTIVITY COUNTS BY TIME OF DAY

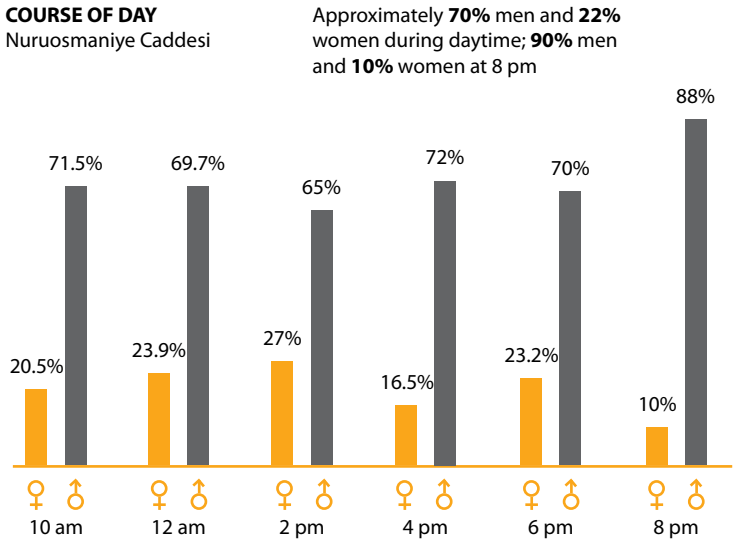


E4. SIGNAGE SYSTEMS

E2. STREET AS PUBLIC SPACE

E3. IMAGEABLE PUBLIC REALM

Figure 43 Percentage share of males and females at Nuruosmaniye Caddesi, Source: EMBARQ Turkey and GEHL Architects



E1. UNDERTAKE ACTIVITY COUNTS AND MAP DIFFERENT TYPES OF STREET ACTIVITY AND USES.

E1.1 Map the different types of activities, nodes, their location and times within the station area.

This includes mapping of street infrastructure, i.e. types of street shrines and amenities like street lighting, transformers, public toilets, seating or resting areas, community bins, informal reading areas, drinking water fountains / sources, street vending and the ensuing activities related to the adjoining land or building uses and street infrastructure.

E.1.2 Undertake activity counts in different types of public spaces and nodes.

Activity counts must be undertaken by age and gender at different times of the day to understand areas of predominant activity such as IPT stands, bus shelters, street vending nodes and shrines, and the use of public spaces. These can also help assess the presence or absence of women, children and the elderly. For example, in Nuruosmaniye Caddesi in the historic peninsula of Istanbul, Turkey, the number of males exceeded the number of females by almost nine times after the closure of the Grand Bazaar at 7 pm (Figure 43).

E2. ENHANCE THE ROLE OF STREETS AS PUBLIC SPACES.

E.2.1 Enhance NMT streets as public spaces.

Once a pedestrian or cycling network is proposed, these can be designed and enhanced as public spaces.

NMT Street Design:
Case study: Navanagar Station Accessibility Plan, Hubli-Dharwad

The street leading to the Navanagar BRT station is designed as an NMT street. A cycle track and a pedestrian pathway are placed on either side of the street, and activity areas are carved out (Figure 44, Figure 45) in the central area for different uses. These include a play area for children (placed towards the side of the schools), a park for elderly citizens, a community gathering space for the neighbourhood etc. (Figure 46).Thus, the different public spaces directly relate to the needs of the residential area.

Figure 44 Plan of NMT-only street in Navanagar, Source: EMBARQ India

Figure 45 Graphic Illustration of street and proposed activities on the NMT street, Source: EMBARQ India

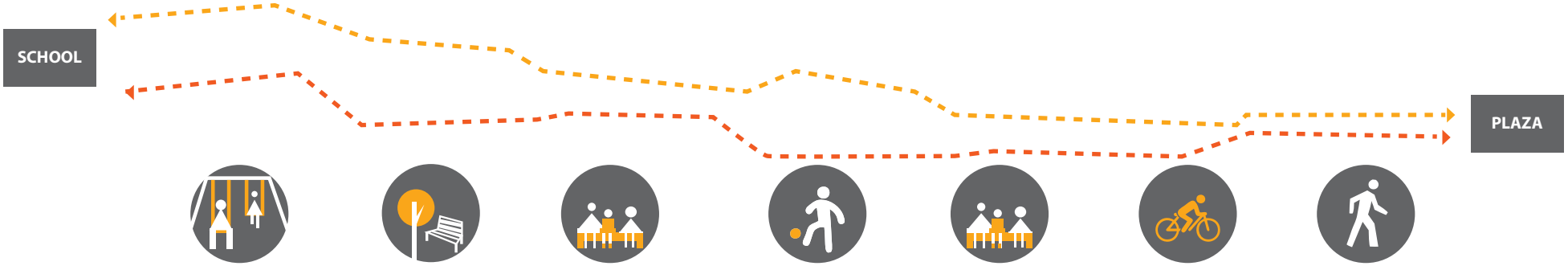


Figure 46 Before and after graphic representations of NMT street, Navanagar

E.2.2 Design streets to cater to multiple activities

While station areas are likely to witness large volumes of people, the role of streets as public spaces needs to be acknowledged by designing for multiple users. Multi-functional street furniture offers various users the flexibility to access and use public streets and public spaces in a variety of ways.

Multi-functional street furniture used for seating, public art and display of vending wares

Existing Seating Systems:
Case Study: MIDC Marol, Mumbai

A study of the different types of activities in MIDC Marol revealed that there are four types of nodes – transit nodes, street vendor nodes, landmarks and entry or exit points (Figure 48). The mapping of the street furniture for each type of node (Figure 47) revealed that they were used for multiple purposes in addition to their intended function. Thus the street furniture strategy for MIDC Marol emphasizes multi-functionality through plug-in elements.

Figure 47 Multiple uses of street furniture for different types of activities, Source: EMBARQ India

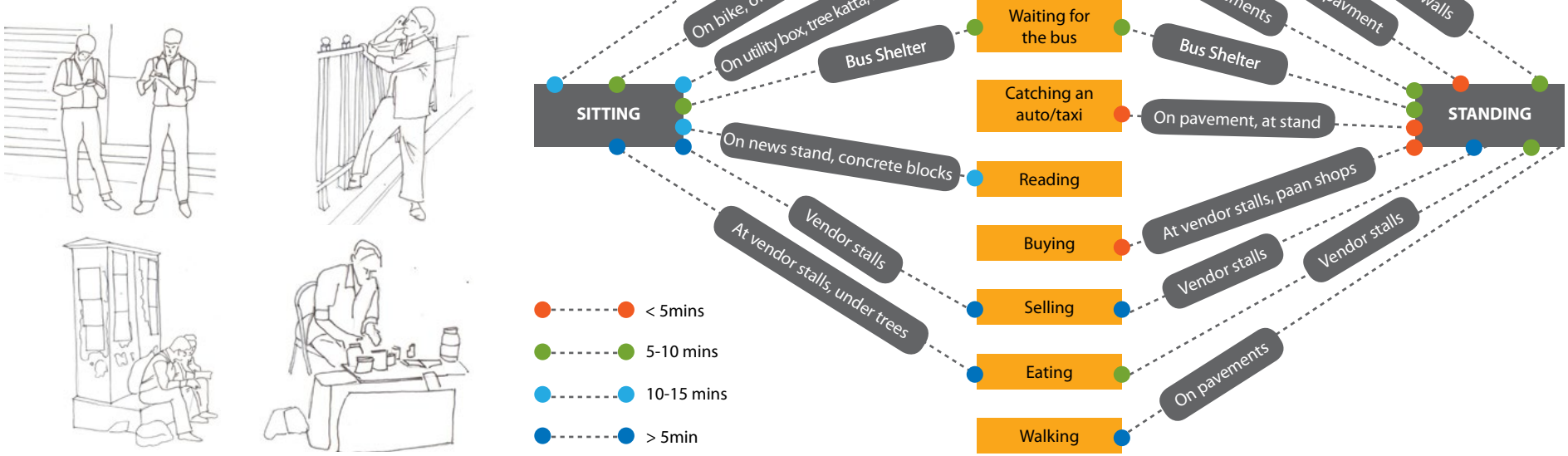


Figure 48 Mapping activity nodes and their components, Source: EMBARQ India

E3. CREATE A SECURE, COMFORTABLE AND IDENTIFIABLE PUBLIC REALM.

E3.1 Propose contextual, coordinated and comfortable street furniture for all users.

Coordinated Street Furniture Systems:
Case Study: South Mumbai

Most of the colonial architecture in Mumbai is found in the different parts of South Mumbai. Ballard Estate and Homi Mody Street are two such examples. Due to the dominant heritage context, street furniture designed for these areas, is required to fit in with the overall colonial image of the place. For both areas, this also determined the material to be used – cast iron. Coordinated families of street furniture are used which complement the architectural style of the buildings very well.

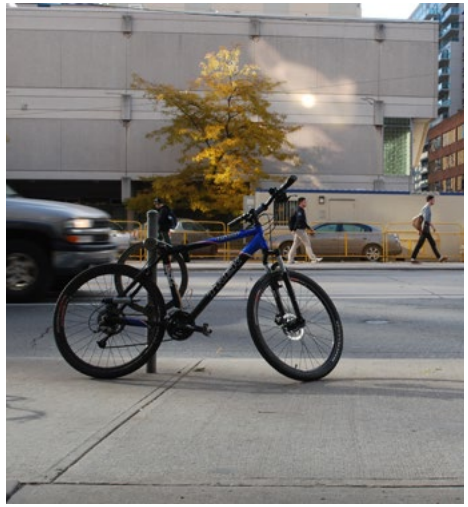
Coordinated street furniture at Homi Mody Street

E.3.2 Propose secure, sheltered parking for bicycles.

Safe, secure and sufficient bicycle parking is of great importance for cyclists and also for people who use the space where bicycles are parked. The City of Copenhagen published a Checklist for Bicycle Parking which addresses the following issues in bicycle parking – distance from major destinations, accessibility to parking, sufficient number and types of racks provided, quality of the bicycle racks, and security.

The Mobility Hub Guidelines, (Metrolinx 2011) suggest that a range of bicycle parking options can be provided depending on the requirements of different uses, volume of bicycles, existing and projected demand.

Bicycle parking options of post & ring, hanging rack, and bicycle shelters



E.3.3 Propose comfortable, light, transparent bus shelters.

It is recommended that existing bus poles or stops be replaced with bus shelters and the design be modified to address the surrounding context. For example, in areas with large pedestrian volumes multiple stops can be combined as in Bangkok and existing compound walls can be used as seating. In conditions where there is more space, stand alone bus shelters with multiple openings can be considered as in Seoul. Here the back panels of the shelters are transparent to facilitate street visibility and security at night.

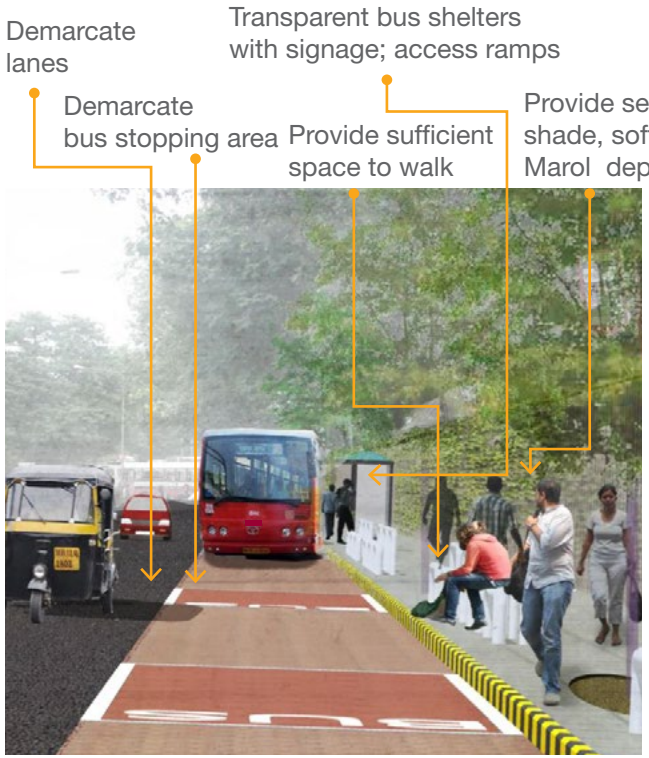
Bus shelters should not obstruct pedestrian movement when placed on footpaths. This can be achieved by placing them within the multi-utility zone of footpaths, towards the curb. Where space is a constraint, the parking lane can be included within the footpath. Further, access ramps and additional street furniture such as garbage bins, seating, waiting areas, shade, sufficient lighting, 24- hour telephone services (if possible), and traveller information through route maps and schedules, is recommended.

Semi-enclosed bus shelters at Bangkok (left) and Seoul (right) with seating and display panels for advertisements

Design of Bus Shelter Areas:
Case Study: MIDC Marol, Mumbai

This case study identifies the eight elements of an accessible and comfortable bus shelter, as demonstrated in MIDC Marol. It consists of a designated bus stopping area, sufficient street lighting, additional seating at the bus stops, trees to provide shade for the waiting passengers, signage to help direct people before/after alighting the bus, access ramps for people in wheel-chairs, garbage bins, and transparent back panels (Figure 49). (Chapter III Section E: An Enhanced Public Realm; E.3.3).

Figure 49 Existing and redesigned bus shelters in MIDC Marol, Source: EMBARQ India



Calculating waiting **area at bus stop:**

Total Waiting Area = Effective waiting area + 0.4 meter buffer from roadway
Effective Waiting Area = Average pedestrian space X Maximum pedestrian demand
Average pedestrian space is based on Level of Service as mentioned in Figure 22.

E.3.4 Propose different types of seating and waiting depending on surrounding context.

The type of seating and waiting is context- specific and depends on adjoining activities and user groups. It is observed that the demand for seating is met by various actors and by multi-functional use of elements. The provision of low-cost seating by multiple actors can be coordinated through design elements like colour and low-cost recycled materials, and enhanced by making it comfortable and universally accessible. Special care must be taken to ensure the provision of adequate seating near identified vending areas.

Seating, when provided, must be placed within the multi utility zone. The seating must be placed in such a way that it does not obstruct pedestrian movement, and where space is a constraint especially in high volume areas, the parking bay maybe incorporated within the footpath.

Existing Seating Systems:
Case Study: MIDC Marol, Mumbai

There are different types of seating in MIDC Marol, provided by various actors. These include seating at tempo stands, reading areas near informal settlements (by political parties), around trees (by local community, corporators or political parties), at bus stops (the city bus authority), around street vendors (by street vendors) and utility boxes (figure 50).

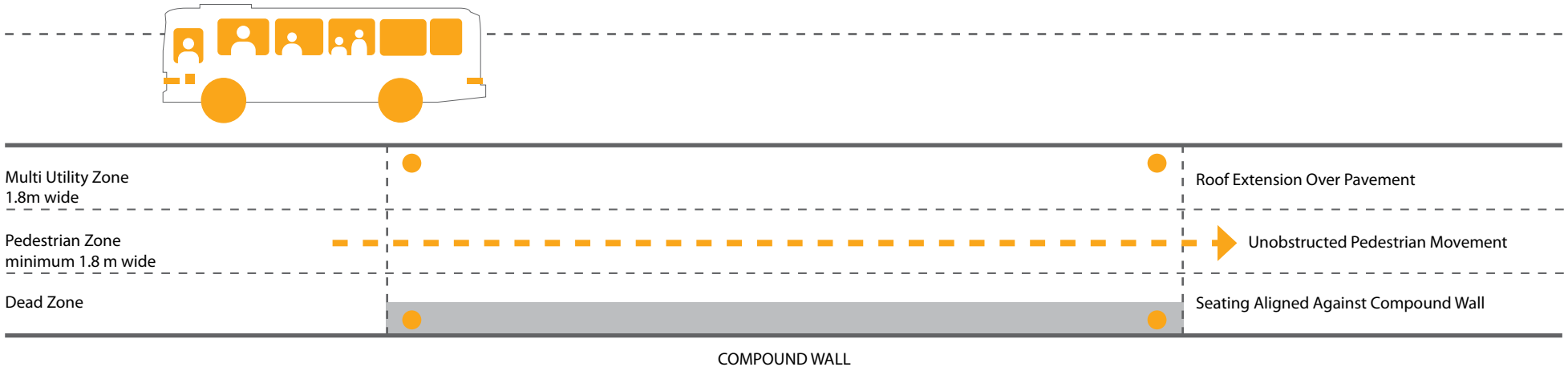
Seating and resting areas required at tempo stands and other heavy use IPT stands are provided along the pavement itself. However, since the current design of the stand obstructs pedestrian movement and occupies the entire pavement, it is proposed as a linear resting area with a roof that covers the entire pavement. Further other seating opportunities are capitalized – on compound walls, and resting bars along walls etc. (Figure 51).

From left) Seating around trees; additional seating at bus stops; seating around utility boxes; existing seating at tempo stands




Figure 50 Resting furniture along high compound walls and and lower compound walls as seating, Source: EMBARQ India

Figure 51 Recommended sheltered seating and resting area in MIDC Marol, Source: EMBARQ India



E.3.5 Use utility boxes and transformers as public art.

Utility boxes tend to be unmaintained and vandalized with printed advertisements. They can be treated as neighbourhood markers, and local stakeholders can be involved in street furniture maintenance. San Francisco has a Utility Box Mural Project that celebrates local artwork and encourages regional artists to share their creativity on unsightly utility boxes in the city. Artists were invited to participate in this program designed to create everyday works of art on the streets of San Francisco (City of South San Francisco 2013).

Painted utility boxes as artwork in San Francisco and San Diego

E.3.6 Propose community and garbage bins.

The frequent provision of dustbins and their cleaning and maintenance, are key aspects to the cleanliness of a city. It is seen that in many places in India, dustbins are stolen or detached from their body. They are also not identified as source-separated garbage bins, due to lack of awareness and legibility).

Dustbins must be provided at all intersections, near all public gathering points, bus stops etc. or at a distance of 30-40m from each other, whichever is lesser. It is also recommended that dustbins be placed near vending areas as and when possible. They will be placed in the Multi-Utility Zone as per IRC guidelines (IRC 2012).

Dustbins must be fixed to the ground to avoid theft, or other measures to ensure its security should be taken. Signs on the trash cans indicating the kind of waste to be put in, must consist of simple, legible graphic symbols that could be understood by the illiterate as well. Initiatives can be taken to involve the private sector in the manufacturing, placement and upkeep of these dustbins.

Movable bins with iconography to indicate waste type

E.3.7 Propose street lighting for carriageway and pavements.

Well-designed street lighting enables motor vehicle drivers, cyclists and pedestrians to move safely and comfortably, by reducing the risk of traffic accidents and improving personal safety. It is essential for mitigating the pedestrian's sense of isolation and is particularly important in isolated spaces such as under- and overpasses and walkways next to parks or blank façades. One of the major challenges in street lighting is its regular placement on a street as well as its regular upkeep and maintenance.

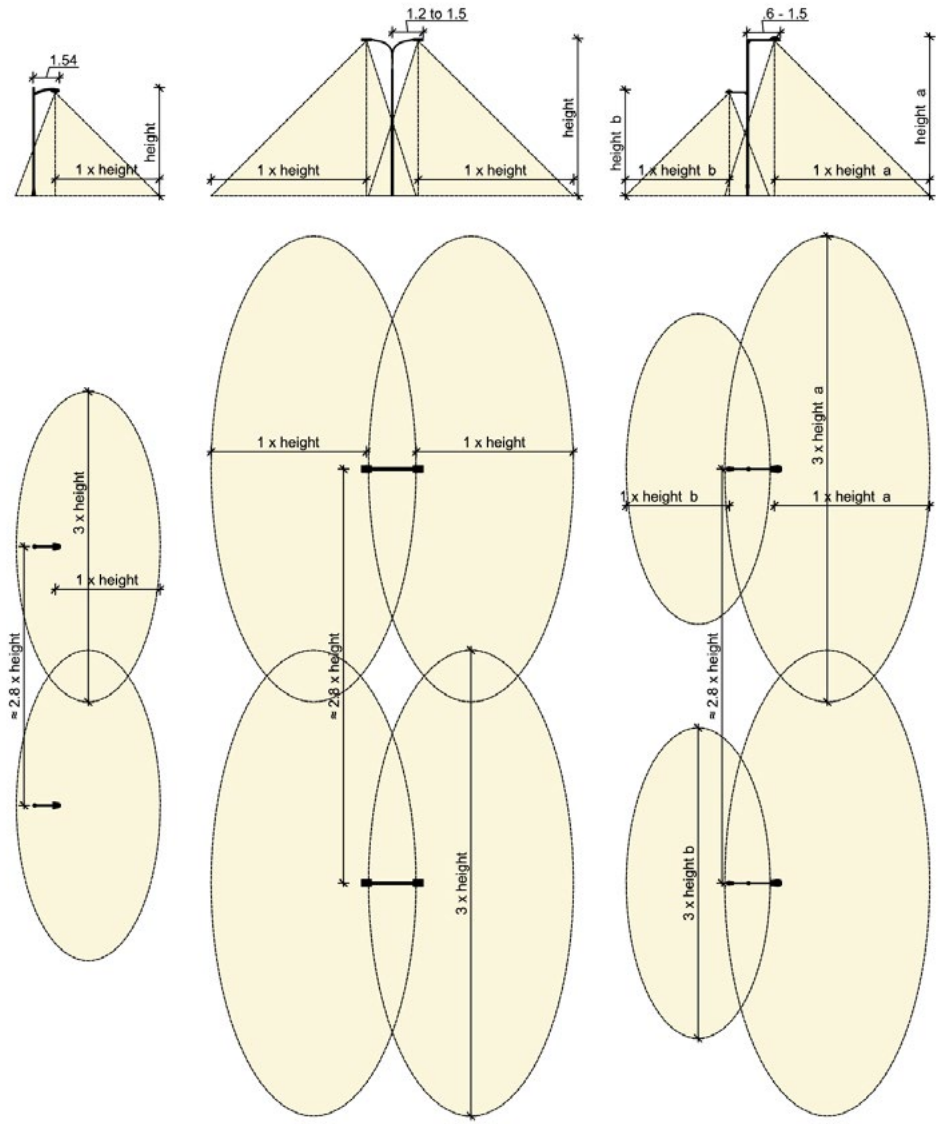
The placement of street lighting should be coordinated with other street elements to avoid street clutter and so that trees or advertisement hoardings do not impede proper illumination. Additional lighting should be provided at conflict points. The spacing between two light poles should be approximately three times the height of the fixture (Figure 52). The following principles could be used as broad thumb rules:

(a) A single row of light posts is generally sufficient for streets up to 12 m wide;

(b) On wider streets, dual lights can be mounted on a single central post;

(c) If a central post is insufficient or cannot be accommodated, multiple rows of posts can support lights at different levels.

Figure 52 Street lighting thumb rules for different street widths

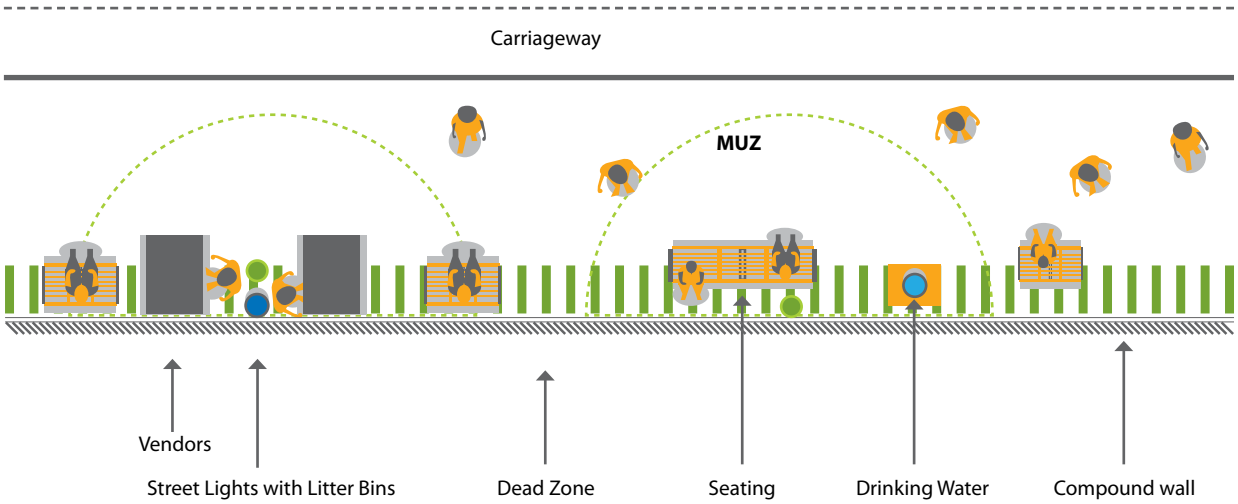


E.3.8 Incorporate street vending in street design.

There are three ways in which street vendors can be integrated within street design: (i) Disperse the number of pedestrians through multiple entries/exit when accessing large land uses; (ii) Provide a multi-utility zone of minimum 1.8m within pedestrian infrastructure to accommodate vending areas, trees, bus shelters, utilities, seating etc.; and (iii) Include the parking bay within the footpaths especially for high concentration of pedestrians and vending activities. The vending areas can be placed so as to not impede pedestrian movement (Figure 53).

The existing vendor carts are often recycled from used materials. There is a need to conceptualize alternative cost-effective, compact, collapsible carts, which could address the dense, limited street space around station areas. These could also become part of street furniture, when not in use.

Figure 53 Graphical representation of vending areas, Source: EMBARQ India



E.3.9 Incorporate landscape elements into street design.

Landscape elements, when incorporated into the street design, add aesthetic and functional value to the street experience. The placement of these elements is important within the streetscape. Care must be taken that they do not obstruct pedestrian flow. It is recommended that all planters etc. be placed within the multi-utility zone as proposed in the IRC (IRC 2012). A continuous tree canopy for shade is recommended, depending on the city and climate type. 10 feet tree- canopy clearance is also recommended.

Landscape elements can also play a functional role – i.e., they can be used as seating and create places for resting or interaction, their placement can help create a porous edge and define private property.

A tree pit of 1m or 1.8m x 1.8m is recommended. Different kinds of tree grates can be used to allow pedestrians to walk close to the tree, without discomfort to either.

E.3.10 Design well-ventilated, simple public toilets of high architectural standards.

Public toilets in India are generally not considered an important amenity and are insufficiently provided. Since station areas are high people-volume areas, toilets must be provided within the primary zone and within 15 minutes walking distance in secondary zones in station areas. This can be enabled by land reservation in LAPs or within public open spaces and public buildings with access from public roads.

Further, public toilets tend to be poorly designed and maintained. Their need at station areas must be assessed with special consideration for the needs of women. The provision of toilets seats must take into account that dependants are more likely to be accompanied by women. Further they must be designed to include changing stations for babies.

Street swale in Washington D.C.; grating directs runoff from street and footpath into swale; permeable brick tile tree pit

Community Public Toilets:
Case Study: Dharavi, Mumbai

City agencies are constantly challenged to improve the infrastructure provisions in informal developments in cities in India. Various government agencies and NGOs work towards building adequate number of toilets and developing a process to maintain and operate these services in slum settlements. A critical concern is that often these spaces are designed and built with little or no design input which lead to a user unfriendly environment. RMA Architects working in partnership with SPARC (an NGO working with slum rehabilitation and housing in Mumbai) engaged in redesigning public toilets in the city of Mumbai. SPARC would undertake the construction of 300 public toilets across the city. The design exercise undertaken by RMA Architects reconfigured the spatial layout while using existing government specifications. Critical concerns such as on-going maintenance of the facility and safety of women and children were addressed on the design. Further innovations were to introduce multiple use spaces in common areas and reducing the dependence on conventional electricity supply by providing solar panels (RMA Architects 2012).

E.3.11 Incorporate public art to create place markers.

Public art can be used to create nodes, landmarks, define districts, entry and exits of station areas and to activate dead edges within it.

The main entry/exit points of a station area call for the creation of some sense of an entry or exit. Empty walls can be painted by local artists and creepers can be grown on them. In places such as busy junctions where there are no space markings on the pavement, thisis a good way to indicate arrival in the district. These markings could indicate directions to nearby landmarks or destinations, and could be integrated with the pedestrian signage system. Local icons could be etched on the pavement to give a sense of context to persons arriving in the station area.

The canopy was created out of discarded oil cans, with 90 residents from Rajkori, an urban village in New Delhi. It was created for a public art festival in India in 2008 (Shankar 2013). It demonstrates a unique way in which discarded, found objects can be reused and recycled.

(from left) Directional marking on pedestrian path in Vancouver, artistic pedestrian crossing in Baltimore and canopy created as art installation in New Delhi

E4. INTRODUCE A COORDINATED PEDESTRIAN AND TRAFFIC SIGNAGE SYSTEM TO IMPROVE SAFETY AND WAY-FINDING.

In India, a cogent system of signage is available to manage vehicular traffic in the form of IRC guidelines. Also, the revised IRC: 67-2012 has included specific revisions to address pedestrian movement and way-finding. Additional challenges to way-finding in urban areas remains and includes a lack of consistency of signage systems, low awareness of and an inability to read available way-finding information and low maintenance by civic bodies. Improving safety, way-finding and access to mapping information is especially important in station areas to streamline people and traffic movement as large pedestrian volumes are expected.

E.4.1 Introduce traffic signage to guide vehicular traffic.

The IRC: 67-2012 offers significant guidance on signage systems for vehicular traffic including material, physical dimensions, location and content on signage. As described in the IRC: 67-2012, the purpose of road signs is to facilitate the ordered movement of all road users on urban and non-urban roads so as to improve safety and efficiency. Place signage as per IRC: 67-2012 guidelines for carriageways, crossings, intersections etc.

- There are 3 types of road signs – regulatory or mandatory signs, cautionary or warning signs and informational or guide signs;
- All signs are placed perpendicular to the direction of traffic movement to give drivers maximum visibility;
- Signage shall be located alongside a carriageway so as not to obstruct the movement of vehicular traffic, and when placed on footpath or pedestrian refuge will be so located to minimize disruption to pedestrians.

E.4.2 Introduce a coordinated pedestrian signage system.

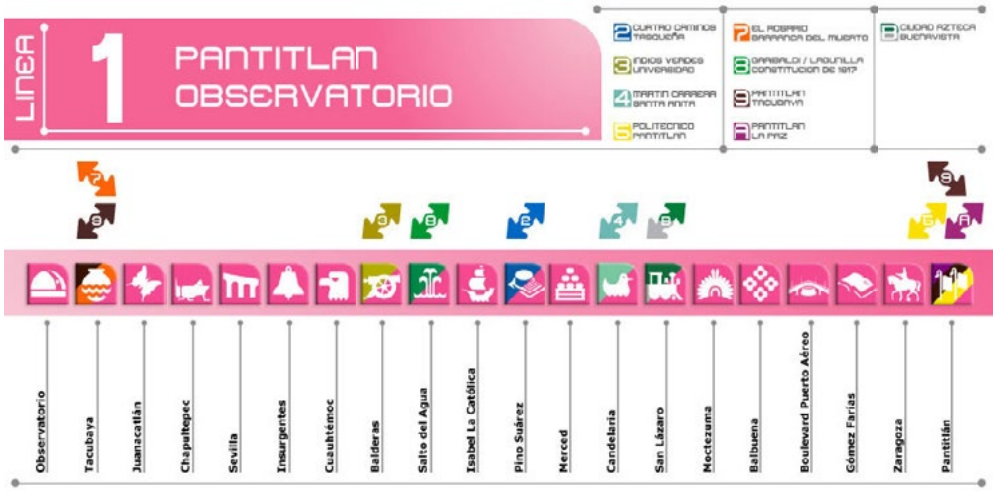
The IRC: 67-2012 makes special mention of the needs of vulnerable road users such as pedestrians, cyclists and disabled people, and emphasizes the importance of providing signage to cater to the needs of these user groups. While these suggested signage systems help with pedestrian movement, an appropriate way-finding strategy must be adopted by cities which ties in signage, destinations, accessibility options and so on. The Legible London program undertaken by Transport for London is a good example of integration of signage to improve the walkability experience of people in the city. This program builds heavily on the notion that walking helps develop a mental map of the city. Mental mapping improves familiarity with city landmarks and destinations and increases the likelihood of walking becoming a primary mode of travel (Transport for London 2007). Thus way-finding in station areas can be improved using the following recommendations:

- Map the hierarchies of arrival and dispersal points within the station area based on number of people i.e. mass transit station, terminals, bus stops, major pedestrian entry or exit routes, public open spaces etc.;
- Map major pedestrian and cycling routes, and activity nodes;
- Create a hierarchy of signage and information based on the principle of progressive disclosure;
- Service provisions around station areas to be effectively communicated via signage;
- Consider imagograms or iconograms to address multilingualism.

Signage systems at station areas:
Case Study: Mexico City Metro

The way- finding system for the Mexico City Metro by Lance Wyman represents in an excellent manner the image of the city in its design (Wyman 2005). The city square or Zócalo is the symbolic centre of the city; the logo was designed by cutting three lines of an “M” into a square representing the lines of the metro as they cut through the city. The logo is filled with orange since this is the colour of the metro cars. The form of the logo (which also suggests the profile of a metro car), was then used as the basis for the station icons and the rest of the identity and signage program. Each station is identified by a name and colour coded icon. These icons represent an important landmark or activity associated with the neighbourhood in which the station is located. The icons were an integral part of the way finding system on maps and signs helping passengers who are illiterate or do not speak Spanish, to navigate the subway system. This is essential in responding to the context of Mexico City, and points to a similar need in Indian cities given increased migration and multiple languages.

Signage for the Insurgentes Station on the Mexico City Metro Line 1; Graphic iconography developed for the Mexico City Metro system, Source: Metro de la Ciudad de México



Pedestrian Way Finding System:
Case Study: MIDC Marol, Mumbai

Site documentation and surveys conducted by EMBARQ India in 2011 and an online survey in 2013 formed the basis for the pedestrian way- finding system in MIDC Marol. The following components were studied in reference to pedestrian way finding – landmarks, arrival and departure points, dwelling points, major routes, pedestrian-only routes and major pedestrian nodes.

Pedestrian origin-destination and visitor surveys revealed that 85 percent of pedestrian trips were within 15 minutes and that regular visitors were aware of destinations within this radius of their work location. The online survey revealed that 40 percent of the respondents found it difficult to find their way in MIDC Marol. Despite the presence of very basic signage, barely 14 percent used them. The rest found their way using personalized landmarks (tea stalls, particular bus stops etc.), by asking people or by using GPS way finding applications (Apps) on their phones. When asked what could be improved in the existing signage, the following emerged as the most prominent: improving their placement and ensuring that they are present at all bus stops, providing up-to-date and accurate information, improving readability at night, and including local landmarks, street and plot names. A majority of the journeys originated on Central Road, the main road in MIDC Marol. These suggestions were then incorporated into the new signage system proposed at MIDC Marol (Figure 54).

The signage system adopts six main design principles – seamless integration, human scale, predictability, informational, inclusive and progressive disclosure (Transport for London 2007). The last of these principles i.e., progressive disclosure, is crucial in determining the kind of information displayed on the signage, depending on its location in the overall way- finding sequence. The system proposes a hierarchy of four sign types which serve different purposes. The major signage is placed at the dwelling points, which are generally major intersections, landmarks, attractors or generators. The bus shelter signage is placed at all bus shelters (Figure 55). The entry/exit signage is placed at all the access points of the business district. The street signage is proposed at every intersection and plot signage numbers identify each plot number or name. The existing traffic signage is recommended to be incorporated within the above system or integrated with common image, font and colour guidelines.

Figure 54 (from left) Pedestrian Movement Analysis Map; Signage Layout Plan, Source: EMBARQ India.

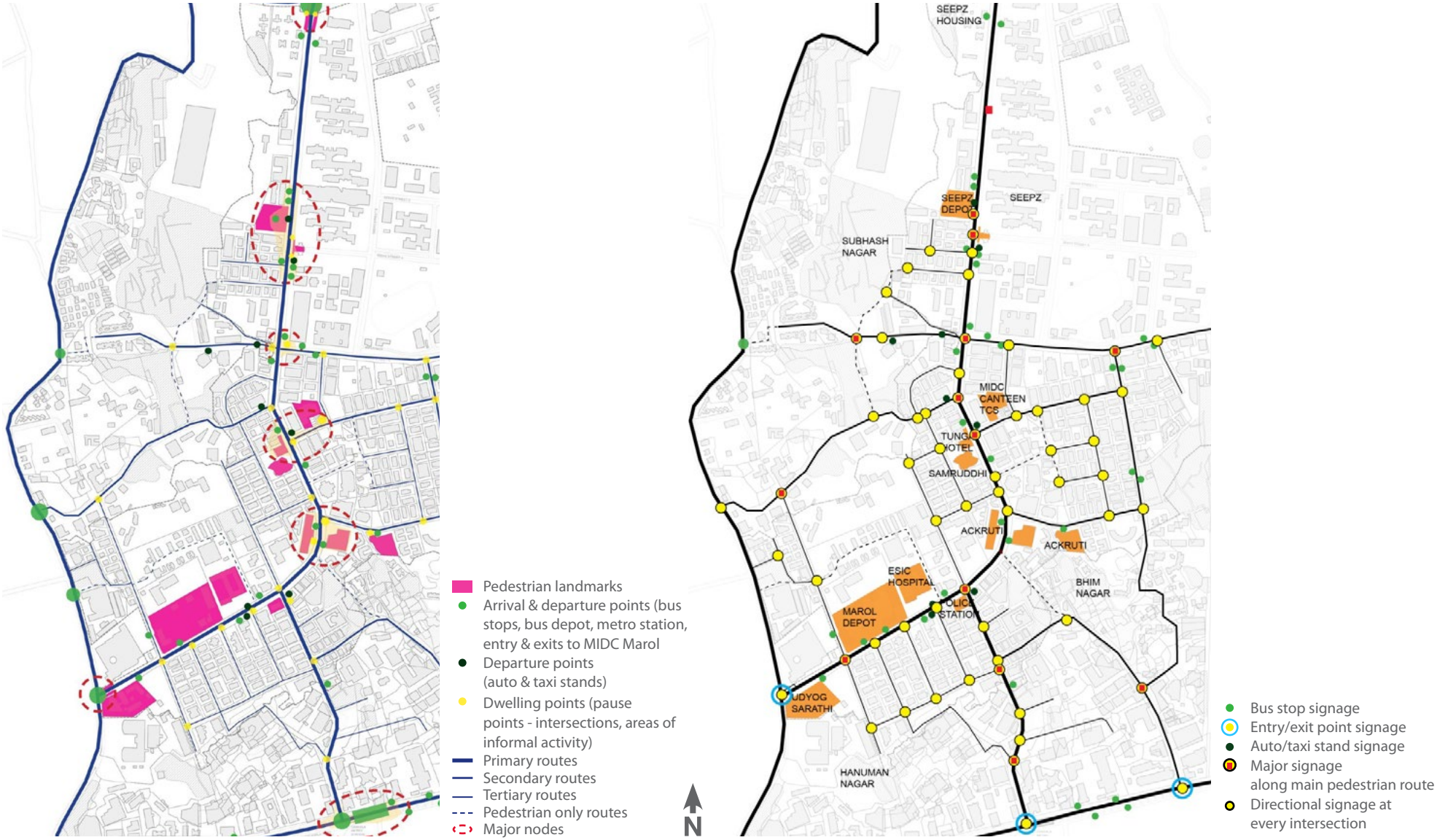


Figure 55 Hierarchy of bus shelter and bus stop signage in MIDC Marol, Mumbai, Source: EMBARQ India

BUS SHELTER SIGNAGE

Placed at all bus shelters in MIDC Marol. It will include information on the questions noted below, especially within a 250m distance:

- Where am I?
- What are the nearest landmarks?
- How far away is my destination street?
- Where is the nearest bus stop/ auto/taxi stand?
- Where are the nearest amenities and service provisions such as drinking water/ toilets?

Size: 0.6m x 2.7m

MAJOR SIGNAGE

Placed at major pedestrian dwelling points, large attractors or generators. It will include information on the questions noted below, especially within 15 minutes or 1km walking distance:

- Where am I?
- Where are the nearest landmarks?
- Where is the nearest bus stop/ auto/taxi stand? How far away is my destination street?
- Where are the nearest amenities and service provisions such as drinking water/ toilets?

Size: 0.8m x 2.7m

STREET SIGNAGE

Placed at all intersections to support the last leg of a pedestrian trip. Questions it should answer are:

- Where am I?
- What are the street names?
- Which direction is street no. so-and-so?
- Is plot no. so-and-so down that street?

Size: Flag size 0.6m x 0.2m, 2.7m high

PLOT SIGNAGE:

Located on every plot.

ENTRY/EXIT SIGNAGE:

Placed at the access points of MIDC Marol district. These should be similar to the “major signage” and must answer additional questions:

- How do I get out of MIDC Marol?
- How long will I have to walk to a bus stop, MRT Station or auto/taxi stands?

Size: 0.8m x 2.7


CNG
CNG

CHAPTER IV

IMPLEMENTATION AND **MAINTENANCE STRATEGIES**

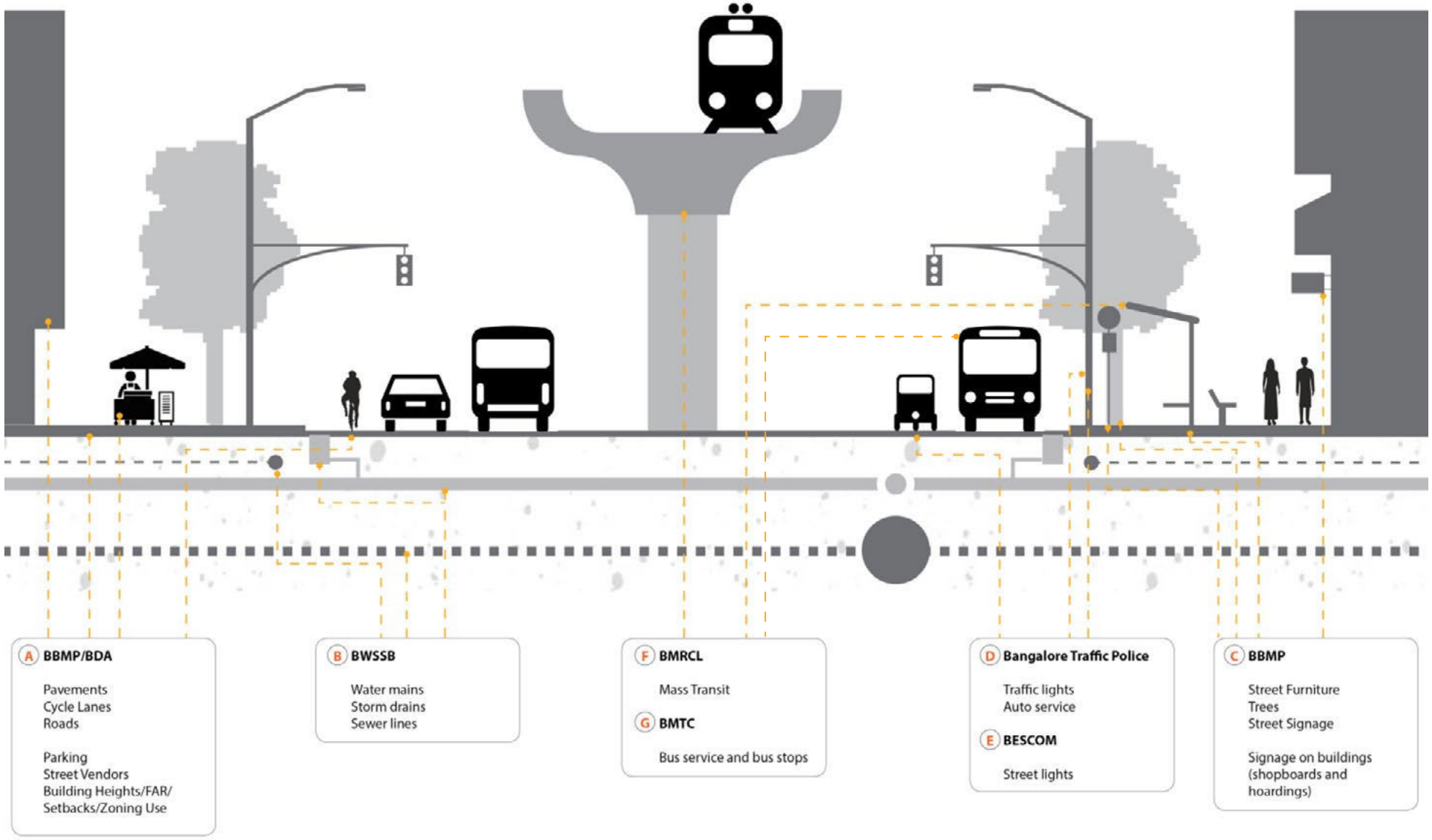
Station accessibility plans (SAPs) are a conglomerate of multiple projects facilitating improved access to transit stations. In many instances, station area access initiatives are being implemented independent of each other, often producing simultaneous efforts (MoUD 2014b)[19].

Moreover, the presence of multiple agencies, overlapping jurisdictions and formal and informal stakeholders, creates a complex web of institutions (MoUD 2014b) as illustrated in the case of Bengaluru (Figure 56).

An Implementation and Maintenance Plan (IM) must be prepared upfront, while preparing a Station Access Plan to ensure a steady availability of funding through the planning, implementation and maintenance process (Comptroller and Auditor General of India 2012). The Implementation Plan must phase projects based on priority to ensure construction management in a time-bound manner. The Maintenance Plan outlines the nature of routine, periodic and urgent maintenance work to be undertaken annually. Both plans must lay out a clear institutional structure identifying a nodal agency empowered to coordinate across other agencies and jurisdictions, specify institutional reforms for inter-agency coordination, and ensure adequate funding is made available (MoUD 2014b)[19].

Based on implementation challenges commonly encountered within Indian cities, as well as station area accessibility projects proposed by EMBARQ India, critical areas for immediate action are identified. This section suggests broad recommendations and guidelines with an emphasis on understanding the local specificities of each city and state. Issues discussed here are not exhaustive and may be used as a starting point to develop core strategies and regulations.

Figure 56 Typical section through station area outlining multiple agencies, stakeholders and service providers; Source: EMBARQ India, adapted from Street Design Manual, NYC DOT, 2013



A. PLANNING APPROACHES AND INSTITUTIONAL STRUCTURES

A comprehensive planning framework at multiple scales (MoUD 2014b) is suggested by the Urban and Regional Development Plan Formulation and Implementation (URDPFI) guidelines. In the present context, every city or regional authority develops its own plans, which are often in conflict with each other (Commissioner Manjula 2014). Indian cities are considering various institutional arrangements to mediate the challenges of both, a lack of capacity and inter-agency coordination (Comptroller and Auditor General of India 2012). Hence, while it is important to set the right planning approach, it is important to address institutional deficiencies as part of a single framework.

Station areas are governed and managed by multiple overlapping agencies and jurisdictions ranging from city municipalities, development authorities, parastatal agencies, traffic police and bus operators or special purpose vehicles (SPV). Furthermore, auto-rickshaw and taxi unions, resident welfare associations, business associations, or workers' groups, represent the needs and aspirations of their constituents. Hence, identifying a single nodal agency accountable to implement and maintain a station area, with the authority to enforce a station access plan, is significant to the planning approach adopted. Two key approaches are discussed here:

MASTER PLANNING APPROACH

City master plans across India are integrating a Transit Oriented Development strategy either through transit overlay zones (AUDA 2013), or special land use zones (DDA 2012). A second-tier planning process is taken up, where the City Municipal Corporation is the nodal agency responsible for local area planning (LAP). Even though LAP implementation is privately executed (by individual plot owners or developers) (Mr. Naik 2014). Station accessibility improvements can be the first step towards the realization of a transit- oriented development node.

Local Area Plans (LAPs): Since LAPs have followed electoral ward boundaries (TCGI and AECOM 2008), they may not coincide with transit influence areas. Therefore, care must be taken to ensure that both are co-terminus to the extent possible. This will link planning and governance, ensuring that implementation of Station Access Plans can be taken up by elected representatives. Chapter II Section C: Delineating the Station Area outlines guidelines on how planning and institutional aspects can be considered when delineating the boundary of a station area.

The learnings from pilot LAPs in 11 zones of the Municipal Corporation of Delhi suggest that institutional mechanisms and adequate public participation are integral to effective implementation (USAID 2008).

Role Of The City Municipal Corporations: As per the Twelfth Schedule of the Constitution (Article 243W, n.4 & 17), municipalities are responsible for functions like roads, street lighting, bus stops and other public conveniences. Since city municipalities are responsible for preparing LAPs, they can also become nodal agencies for implementing station accessibility plans and coordinating the maintenance of station areas. The Municipal Corporation can create a Station Access Planning Cell within it to coordinate the planning, implementation and maintenance of station areas.

Lastly, the nodal agency must either own or have the power to acquire land, or enter into land agreements for the implementation of a station access plan.

Role Of Mrt Special Purpose Vehicles (SPV): While embedding Station Access Plans in city master plans is a longer term approach, they can also become an integral part of mass transit projects, such that both are planned and implemented together.

MRT projects are generally built and managed by Special Purpose Vehicles created under a special mandate by a legal entity, for a limited period. The SPV is given the legal mandate to execute the MRTS project, including adequate pedestrian and NMT improvements along the corridor. The Medellin Metro Rail system, which integrates feeder networks, and public space designs into the MRT project plan, is a good case example. Similarly, the Washington Metropolitan Area Transit Authority (WMATA) presents an alternate model that not only manages station access, but also provides adequate maintenance services detailed in their Station Access Plans (WMATA 2008).

For Metrorail projects, SPVs are created under the Metro Rail Act, 2002. This Act is also applicable to the National Capital Region, metropolitan cities of Bombay, Calcutta, Delhi and Madras (Ministry of Law and Justice 2009). For BRT projects, SPVs are generally constituted under the Companies Act and are part of the Municipal Corporation with Traffic Police, Police, Urban Development Authority, State and, or City bus operators as members. Various acts (Ministry of Law and Justice 2009) and notifications (R. Singh 2013) outline the role of the mass transit agencies and their Special Purpose Vehicles in facilitating last mile connectivity. Further SPVs are empowered to develop any metro railway land for commercial use (Ministry of Law and Justice 2009). Hence, the SPV may also be considered as a nodal agency for Station Access Plan preparation, implementation and maintenance. It is recommended that the SPV is closely monitored by the Station Area Working Committee for quality assurance.

B. FINANCIAL MECHANISMS

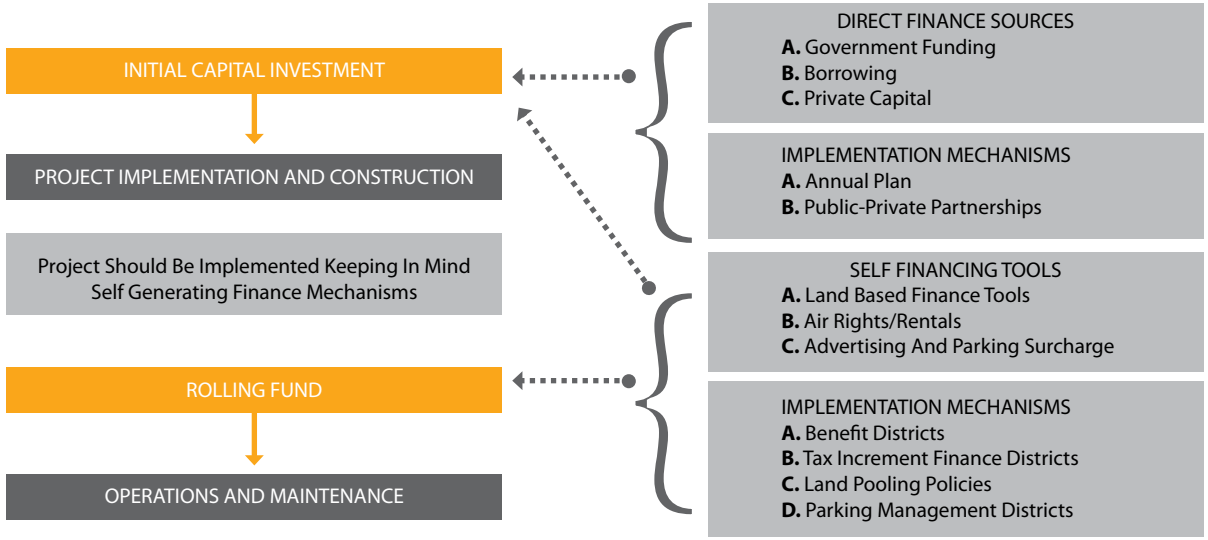
Since station accessibility projects are a fraction of the cost of the MRT system itself, they can be embedded within the project cost itself. However, station areas get much higher pedestrian loads than other areas in the city, requiring constant and often urgent maintenance. The costs can be summarized under three heads—planning and administration, construction of infrastructure, implementation and operations of associated services, and maintenance of the station area.

MRT projects require large capital investments during the construction phases, but smaller, more continual funds for operations and maintenance; this needs to be planned for at the onset of the project (MoUD-USAID 2011). The Urban Infrastructure Financing report, produced by the Ministry of Urban Development in India, reveals that annual budget allocations can only fulfil about 20 percent of India's infrastructure needs. A 'mixed finance approach' may be suggested that allows local governments and/ or implementing bodies to incentivize private investments by leveraging public resources, thereby expanding the overall funding envelope (MoUD-USAID 2011). Therefore, if a project integrates self-financing mechanisms like land monetization tools, selling air-rights, or using advertising and parking surcharges as a revenue generating source, a continuous rolling fund can be created for regular operations and maintenance.

The Planning Commission, Government of India, also recommends the creation of a dedicated urban transport fund at the state and city level by exploiting alternative sources of revenue generation, "especially land monetization, betterment levy, land value tax, enhanced property tax or grant of development rights, advertisement, employment tax, congestion, a cess on the sales tax, parking charges reflecting a true value of the land, traffic challans etc." Pimpri-Chinchwad (Umbrajkar, "PCMC sets up dedicated urban transport fund," *Times of India,* January 24, 2009) and State of Karnataka are examples of cities and states that have already set up a dedicated urban transport fund for urban infrastructure projects (Planning Commission of India 2011).

A finance plan (Figure 57) must be prepared taking into consideration various funding sources available to the nodal agency, and the kinds of mechanisms that can be operationalised to generate a rolling fund.

Figure 57 Conceptual structure for a SAP finance plan; Source: EMBARQ India



DIRECT FINANCE SOURCES

Government Funding: These are direct investments made in urban infrastructure by the Government of India, or State governments (Planning Commission of India 2011). These are allocated to cities and urban local bodies (ULB) by means of inter-governmental transfers, and urban development schemes like JnNURM and others. Since urban infrastructure demands often outpace the funds available, urban local bodies are actively seeking more autonomous means to fill the finance gap (MoUD-USAID 2011).

Borrowing: Autonomous loans and grants may be taken from multilateral development banks (channelled through government financial institutions) or international development agencies. Additionally, alternate borrowing mechanisms like municipal bonds and commercial borrowing through banks is being explored (MoUD-USAID 2011). Municipal bonds allow for long-term debt financing for urban infrastructure, substantially lowering annual debt burdens on local governments; however they are more complicated than obtaining a bank loan and require cities/ ULBs to show their creditworthiness (MoUD-USAID 2011). Since station access projects may have low cost intensiveness, local authorities may not require loans for implementation.

Private Capital: Attracting private capital allows for a mixed finance approach, significantly increasing the investment resources for urban infrastructure beyond the amounts available from government and foreign donors (MoUD-USAID 2011). Through direct investments and through private-public partnerships, cities can leverage government funding as a catalyst for private investments in infrastructure.

IMPLEMENTATION MECHANISMS

5 year Annual Plan: The city's Annual Plan regulates budgetary allocations for urban infrastructure projects. It includes a resource mobilisation plan specifying the amount of money that is expected to be mobilized through local authority resources, state assistance,

central-state assistance, central assistance, public private partnerships, institutional financing, market borrowing, and private sector funds (MoUD 2014b). Funds allocated to cities and urban local bodies are regulated by the central and/or state governments, and therefore fund allocations received may be uncertain and may vary each year (MoUD-USAID 2011). The nodal agency is responsible for preparing a list of projects with the required budgetary allocations coordinating across all other implementing agencies (Ms. Naik 2014).

Direct Private Investments: Private investments can be incentivized within station areas by means of tax credits or bonuses. Tax credit programs incentivize private investments in improving the public realm by awarding tax benefits (Government of Maryland n.d.). The Sustainable Communities Tax Credit Program, City of Maryland and the Heritage Tax Credit Program in Winnipeg, Manitoba, Canada (Metrolinx 2011) are two examples. Some cities employ a "height and density exchange approach" by exchanging additional height and floor space with the provision of amenities and services to enhance the public realm (SFPD n.d.). The 'Privately Owned Public Open Spaces' (POPOS) program in San Francisco is one example (Appendix V-C). Thus the city can employ different mechanisms to guide private investments to meet station access objectives. However, care must be taken to ensure that the design and construction of amenities, facilities and services are monitored to ensure access to all, and that they meet quality criteria.

Public Private Partnerships (PPP): Private investments can also be incentivized through public private partnerships (PPP). Different PPP models include Design Build Finance (DBF), Design Build Finance Maintain (DBFM) and Design Build Finance Operate Maintain (DBFOM) (Bhatt and Panda-Bhatt 2012). The core challenge in managing PPPs is to redistribute risks between the two entities in a manner that the bulk of the risks are absorbed by the entity best fit to manage the risks (J. Singh 2010). Local governments must outline clear terms of contract and guidelines to maintain quality and timelines, regularly monitor the process of implementation, and build capacities to enable these (Planning Commission of India 2011).

Two ways in which PPPs can be operationalized are by leveraging land in exchange for physical infrastructure or to implement and manage urban services (MoUD-USAID 2011). The Gujarat State Road Transport Corporation's (GSRTC) bus terminals are an example of a Built-Transfer-Lease PPP model (Bhatt and Panda-Bhatt 2012). Privately managed public bicycle sharing (PBS) schemes like Velib in Paris, France (SUTP 2010) or the Parking Management Organization Ltd. Tokyo, Japan are some examples of privately managed urban services.

SELF-FINANCING TOOLS

Land- Based Tools: Allow local governments to recover land value (or profit) that public infrastructure projects generate for private owners or developers by assessing a tax (MoUD-SUTP 2013). The value is captured by using tools such as betterment levies, special assessment taxes, and exactions—that link fees to the increase in land value due to infrastructure improvements (World Bank 2013). Change of land use taxes, additional FSI charges, development charges and vacant land taxes are a few instruments recommended for use in Indian cities (Planning Commission of India 2011). However, taxes and exactions assessed may be a contested issue based on zone delineation as well as time of assessment. It is recommended that tax assessments be announced at the time of project planning and organizing public consultations to maintain transparency. The taxes may be eventually applied at the time of property assessment (Ms. Naik 2014).

Tax Increment Financing (TIF) districts (Honk Kong's 'Rail plus Property'), Community Benefit Districts in San Francisco and Oakland, Business Improvement Districts in New York, and Transportation Benefit Districts in Seattle, are some examples of generating land-based finances. Indian cities like Gujarat (IDFC 2010) and Delhi have introduced policies for land pooling and reconstitution (LPR), which allows land owners to benefit from the gain in the land value from the provision of infrastructure and services. In return, the land owners pay betterment charges and contribute a part of their land for the infrastructure and services in the city (IDFC 2010).

However, these models are highly speculative due to the dependency on market fluctuations, risk- laden investment climates and unexpected delays. Additionally traffic, environment or other impact fees are not factored into the above model, and any additional charges could dissuade construction or redevelopment (Serageldin, et al. 2008).

Air-rights and Rentals: Station areas are optimal locations for exploiting commercial spaces. CIDCO in Navi Mumbai has built and sold commercial spaces above railway stations, revenues from which have helped recover initial investment costs (MoUD-SUTP 2013).

Advertising and Parking Surcharges: MRT station areas are optimal locations for

exploiting advertisement revenues. High advertisement surcharges may be applied within transit areas to generate maximum revenues. Remunerations can be of two types—fixed fees or shared revenue systems. While shared revenues may be great in a healthy market, terms should be adjustable during downturns (MoUD-SUTP 2013). Public building façades and public infrastructure spaces such as transit stops, bus shelters and buses are some locations to generate advertising revenues. Bengaluru city raised revenues of INR 11.75 crores advertising licenses from 574 bus shelters (Suresh, et al. 2012). The city of Toronto has entered into a 20- year advertisement funded contract with Astral Media for manufacture, installation, maintenance and repair of its street furniture. The maintenance is monitored by a clear set of guidelines, which include financial penalties in failing to meet maintenance requirements, weekly street furniture preventive maintenance, submission of quarterly maintenance reports outlining cleaning and maintenance activities. The city also has a dedicated phone number for street furniture maintenance issues (City of Toronto 2012).

Similarly, high parking surcharges applied in these areas by means of tools such as congestion pricing and parking- in- lieu fees introduced within parking management districts, may form another sustainable revenue generating mechanism for station areas. This creates a roll- over fund to cover operations and maintenance costs within the district (Barter 2010). The Toronto Mobility Hub Guidelines may be referred to for insights into both—parking pricing models as well as reducing automobile dependency (Metrolinx 2011).

C. KEY TAKEAWAYS

Station Access Plans can be implemented through statutory provisions within city and LAPs, or embedded within mass transit projects. The city municipal corporation or the mass transit Special Purpose Vehicle can become the respective nodal agency for coordinating implementation and maintenance. It is recommended that the Unified Metropolitan Transportation Authorities (UMTA) or Land and Transport Authorities (LTA) monitor implementation and enable coordination between different agencies.

Thus, an implementation and maintenance plan must be a part of the Station Accessibility Plan and prepared by the nodal agency in consultation with multiple service and infrastructure providers and the Station Area Working Committee. The implementation plan must phase out projects based on priority. The maintenance plan must outline the nature of routine, periodic and urgent maintenance work to be undertaken annually. These must outline clear timelines and explore a mixed finance approach to increase the overall funding available. Such an approach strategically utilizes government funding sources, loans and private capital, while incorporating self-financing mechanisms for long-term financial sustainability (MoUD-USAID 2011).

Finally, public consultations must be conducted at various times through the course of station area project planning, implementation and maintenance; (Chapter I: Station Area Improvement Process).

Post- implementation and annual impact evaluations (Chapter V: Evaluation and Performance Indicators) can provide inputs into the quality of service and the required improvements. These can be enabled through crowd sourcing or electronic bulletin boards for users with access to the internet or through conveniently located resource centres (Davis, et al. 2013).

CHAPTER V

EVALUATION AND PERFORMANCE INDICATORS

Monitoring and evaluation is necessary to ensure that stated objectives are realised in the Station Accessibility Plan proposals, translated from the planning and design phase to implementation, and that station areas receive constant upkeep and maintenance.

The manual outlines four objectives of a station area in facilitating last mile connectivity. These are pedestrian and cycle priority, enhanced safety and security, improved feeder bus and para-transit infrastructure and services, and parking demand management of private motorized vehicles. The manual thus recommends evaluations and indicators that can be applied at three different stages i.e. Station Accessibility Plan assessments after the plan is prepared, implementation evaluation of the proposals, and periodic evaluations to assess the quality of service and impact of the plan. It also suggests parameters to measure the economic impacts of station area improvements.

The indicators for safety and security evaluate the reduction in fatalities and major and minor injuries due to the implementation and maintenance of the road safety elements. Special attention is given to women's security and universal access. The indicators for **pedestrian and cyclist priority** evaluate the change (increase) in pedestrian and cycling modal shares, change in road allocation from motorized to non-motorized modes, and overall increase in NMT infrastructure. It also evaluates comfort by measuring the levels of service, provision of public amenities, street furniture and signage systems. The indicators for **parking management** evaluate measures adopted to discourage demand and supply of motorized vehicular parking within the station area and the increase in bicycle or NMV parking. The indicators for **improved feeder services and integration** measure reduced waiting times for transfer to feeder bus and rickshaw (or taxi) services, and the strategies adopted to improve waiting experience. The indicators for **enhanced public spaces** measure the percentage of public open spaces improved (and maintained overtime), and the description of interventions to improve women's security, and the improved perception of the users. The indicators for **economic activity and opportunity**[21] evaluate the economic activity generated in a station area and reduction in travel costs.

While Station Accessibility Plan assessments can be undertaken by the nodal agency, it is recommended that the implementation evaluation, quality of service, and impact evaluation be undertaken by a trusted, unbiased third party. This may be a committee led by a local government agency thereby facilitating local ownership. Local beneficiaries can measure and record information on the status of a project or process, and based on these results, assist in adjusting the objectives or trajectory as necessary (Vernooy, Qui and Jianchu 2006). The equivalent of these in India i.e. Area Sabhas (Grant Thornton 2011) could take on the responsibility of assessing infrastructure as part of the Station Area Working Committees. Furthermore, innovative ways to gather the data for indicators must be envisioned by the nodal agency. Instead of considering the evaluation as a separate exercise, connecting it to existing systems of audits or studies done by the corporation or other agencies (such as transportation or mobility studies) can be an effective and efficient way to gather data (Commissioner Manjula 2014).

While the manual measures long-term impacts, the efficient functioning of a station area is dependent on robust feedback systems, routine and urgent maintenance works[22] (Burningham and Stankevich 2005), quality-control standards and processes.

A. STATION ACCESSIBILITY PLAN ASSESSMENTS

Station Accessibility Plan assessments evaluate the plan proposals and their estimated impacts to achieve NMT priority, enhanced safety and security, improved feeder bus and para-transit infrastructure and services, and parking demand management of private motorized vehicles (see Section D: List of Indicators). They are specific and measurable to enable a comparison with post-implementation scenarios. It is recommended that the assessments be considered as a mandatory activity by the nodal agency. These can be adapted by funding agencies to evaluate the emphasis of the plans, or by Station Area Working Committees and citizens to track progress of work.

B. IMPLEMENTATION EVALUATION

Implementation evaluation assesses the extent to which the station area projects have been successfully implemented (Section D: List of Indicators) by cross checking the design recommendations and detailed project reports against actual implementation. The indicators at this stage can be adapted from the Station Area Plan assessments. Since infrastructure and operations-based projects are implemented under different timelines, the evaluations can be project-based and phased accordingly. The quality and progress of implementation must be regularly monitored by the station area Working Committee through a project management consultant.

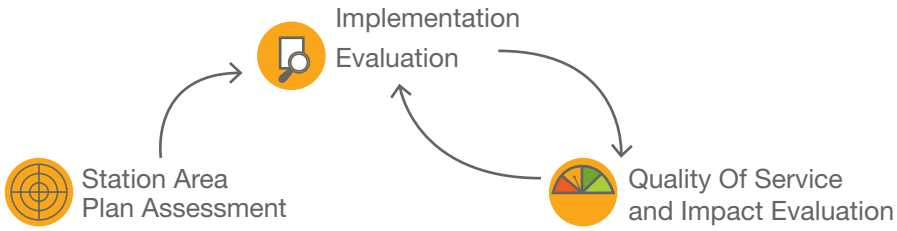
C. QUALITY OF SERVICE AND IMPACT EVALUATION

Finally, annual evaluations are recommended to assess the key impacts of station area improvements and quality of service provided to users (Section D: List of Indicators).

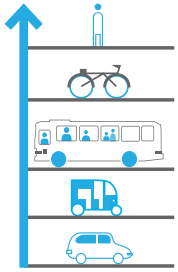
The increase in modal shares is considered a definitive indicator of the effects of implemented changes on travel choices. However, key safety impact indicators are also recommended due to India's primarily captive public transport ridership. The following categories of indicators, for example, are used in New York City to analyse public space improvements near transit hubs: crashes and injuries for motorists, pedestrians, and cyclists; volume of vehicles, bus passengers, bicycle riders, and users of public space; traffic speed, aiming to move traffic not too slowly, but also not too fast; economic vitality, including growth in retail activity; user satisfaction; and environmental and public health benefits (NYC DOT 2012). The data for assessing impacts can be collected from the respective implementing agencies and through technological aids such as speed guns, CCTVs, pollution monitors etc.

While level of service benchmarks measure the supply of infrastructure and services[23], they do not reveal people's perceptions and changing needs. User experience surveys are also therefore recommended to understand people's level of satisfaction. These can be used as indicators of improvements or problems. This method is currently in use in various programs in Latin America (by the Latin American Development Bank and the Como Vamos program, for example) (Hidalgo, Pai, et al. 2012). When undertaking these surveys, there should be a special emphasis on minority and vulnerable groups (women, people with disabilities and informal service providers). Since budget considerations may make extensive data collection unfeasible, small sample surveys are recommended to assess the quality of service. Another method becoming increasingly feasible and possible is crowd-sourcing, using inputs from citizens to gather and analyse whether and/or how well plans are being implemented (Bott and Young 2012).

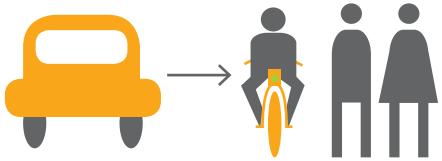
The post-implementation and annual evaluations can be supported with comprehensive assessments every five years (using public transport ridership 10 year forecasts as a reference). A common database is recommended to bring infrastructure layouts and multiple databases of station areas onto a single digital platform. This database should be constantly updated based on forthcoming plans of utility companies. Some municipalities in Indian cities are moving towards making these comprehensive databases but a system for sharing this data across agencies is required.



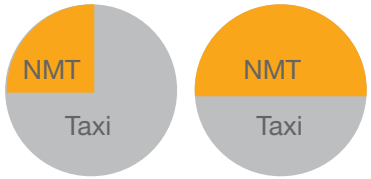
LIST OF INDICATORS



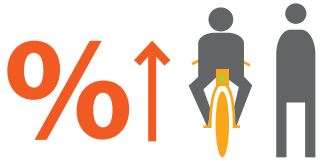
D1. PEDESTRIAN AND CYCLIST PRIORITIZATION



Increase in NMT modes



Increase in road space allocation for NMT

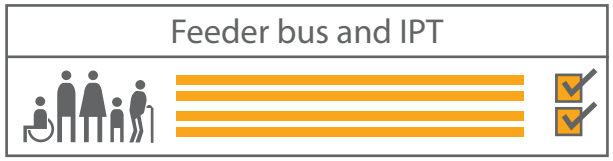


Increase in NMT kilometres routes

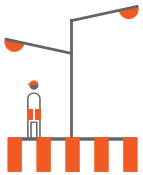
D2. INTEGRATED FEEDER SERVICES

Increase in feeder bus and IPT modes

Reduction in waiting times

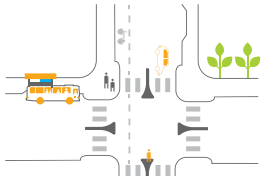


Measures focusing towards women and vulnerable users

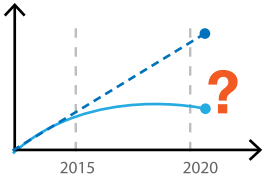


D3. SAFETY AND SECURITY FOR ALL

Regulated speeds



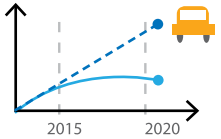
Inventory of road safety elements



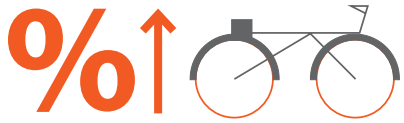
Reduction of fatalities, major and minor injuries

Degree of universal access and women's security

D4. PARKING MANAGEMENT



Demand management of motor vehicular parking



Increase in existing and future NMV parking

D5. PUBLIC SPACES ENHANCED

Increase in public spaces enhanced

Description of amenities and interventions

Measures focusing on women and vulnerable users

D. LIST OF INDICATORS

Table 9 List of indicators for station accessibility plan assessment, implementation, quality of service and impact evaluation

OBJECTIVES	INDICATORS	STATION ACCESSIBILITY PLAN ASSESSMENT	IMPLEMENTATION EVALUATION	QUALITY OF SERVICE AND IMPACT EVALUATION
D1. Pedestrian and cyclist prioritization	**D.1.1** Increase in modal shares of pedestrians and cyclists, disaggregated by gender.	Estimated increase in modal shares of pedestrians and cyclists anticipated annually and over a five year period, disaggregated by gender.		Actual increase in modal shares of pedestrians and cyclists, disaggregated by gender.
	D.1.2 Percentage increase in allocation of road space between cyclists, pedestrians, parking and carriageway.	Proposed percentage increase in allocation of road space between cyclists, pedestrians, parking and carriageway.	Actual increase in allocation of road space between cyclists, pedestrians, parking and carriageway.	User surveys, disaggregated by gender, to evaluate pedestrian and cyclist comfort and convenience – specifically sufficient infrastructure and continuity, reduced walking and cycling distances.
	D.1.3 Pedestrian and cycle infrastructure added and maintained.	• Proposed increase in percentage and length of pavements. • Proposed increase in percentage and length of cycle infrastructure. • Proposed increase in number and length of dedicated NMT routes.	• Actual increase in percentage and length of pavements. • Actual increase in percentage and length of cycle infrastructure. • Actual increase in number and length of dedicated NMT routes.	

OBJECTIVES	INDICATORS	STATION ACCESSIBILITY PLAN ASSESSMENT	IMPLEMENTATION EVALUATION	QUALITY OF SERVICE AND IMPACT EVALUATION
D2. Integrated feeder bus and IPT services and infrastructure	**D.2.1** Change in modal shares of men and women using feeder bus and IPT services.	Anticipated increase in modal shares of men and women using feeder bus and IPT services.		Actual increase in modal shares of men and women using feeder bus and IPT services.
	D.2.2 Reduction in waiting times for men and women using feeder bus services.	Estimated reduction in waiting times for men and women using feeder bus services.		Actual reduction in waiting times for men and women using feeder bus services.
	D.2.3 Changes in bus infrastructure, operations and services to facilitate universal access and improve women's safety and convenience.	• Proposed bus shelter design incorporating a dedicated bus stopping area, access ramps, signage, shade, transparent back panels, sufficient waiting / sitting area, lighting and garbage bins. • Proposed changes in feeder bus services to improve affordability, off-peak hour night travel, and serve destinations frequented by women. • Nature and period of gender sensitization program proposed for bus drivers and conductors.	• Number of bus shelters and terminals incorporating a dedicated bus stopping area, access ramps, signage, shade, transparent back panels, sufficient waiting / sitting area, lighting and garbage bins. • Implemented changes in feeder bus operations and services to improve affordability, off-peak hour night travel, and serve destinations frequented by women. • Nature and number of gender sensitization trainings undertaken with bus drivers and conductors. • Increase in transit surveillance vans or police personnel deployed at night.	User surveys to evaluate women's met and unmet needs vis-a-vis feeder bus operations, services and infrastructure.
	D.2.4 Measures to improve IPT services and infrastructure.	• Proposed design of IPT stands with sheltered waiting area, signage, lighting, garbage bins and emergency information.	• Number of designated IPT stands implemented with sheltered waiting area, signage, lighting, garbage bins and emergency information.	User surveys to evaluate experience of IPT infrastructure and services, with special emphasis on women and vulnerable users.

OBJECTIVES	INDICATORS	STATION ACCESSIBILITY PLAN ASSESSMENT	IMPLEMENTATION EVALUATION	QUALITY OF SERVICE AND IMPACT EVALUATION
		• Nature and period of gender sensitization program proposed for IPT drivers and conductors. • Additional measures proposed to improve IPT services and integration, with emphasis on women and vulnerable users (for example, the differently- abled and older riders).	• Nature and number of gender sensitization trainings undertaken with IPT drivers and conductors. • Additional measures implemented to improve IPT services and integration with special emphasis on women and vulnerable users.	
D3. Safety and security for all	**D.3.1** Regulated speeds on different types of roads.	Proposed vehicular speeds on different types of roads in the station area.	Actual vehicular speeds on different types of roads in the station area.	User surveys to evaluate perception of safety due to regulated speeds and implemented road safety elements in the station area.
	D.3.2 Inventory of road safety elements.	• Details of the design and average spacing of speed tables, NMT crossings, raised intersections, proposed maximum turning radii and reduction in lane widths.	Road safety audit to assess the detail of the design and average spacing of road safety elements implemented.	
	D.3.3 Reduction in fatalities, major and minor injuries.	Estimated annual and five year reduction in fatalities, major and minor injuries.		Actual reduction in fatalities, major and minor injuries from the base year.
	D.3.4 Degree of universal accessibility.	Percentage of streets proposed with access ramps, textured tiles and minimum width of footpaths as per IRC 103-2012: Guidelines for Pedestrian Facilities.	Percentage of streets with access ramps, textured tiles and minimum width of footpaths as per IRC 103-2012: Guidelines for Pedestrian Facilities.	User surveys to evaluate perception of accessibility focusing on the elderly and people with disabilities.

OBJECTIVES	INDICATORS	STATION ACCESSIBILITY PLAN ASSESSMENT	IMPLEMENTATION EVALUATION	QUALITY OF SERVICE AND IMPACT EVALUATION
	D.3.5 Measures to improve women's security	• Estimated reduction in crimes against women in the station area.		• Reduction in thefts, sexual harassment, eve teasing and violent crimes against women in the station area.
		• Number of unsafe spots identified and addressed.	• Number of unsafe spots improved.	
		• Planned percentage length of streets with continuous lighting on carriageway, pavements, around bus shelters and IPT stands.	• Percentage length of streets with continuous lighting on carriageway, pavements, around bus shelters and IPT stands.	• User surveys to evaluate perception of security, focusing on different income groups of women.
		• Minimum level of service B (as per IRC 103: 2012) proposed at station entrance, exits and major pedestrian paths.	• Level of service achieved at station entrance, exits and major pedestrian paths.	
		• Proposed communication strategies to create awareness on existing safety measures and proposed feedback system.	• Implementation of the communication strategies and feedback system.	• Increased awareness of existing safety measures and improved experience of feedback system.

OBJECTIVES	INDICATORS	STATION ACCESSIBILITY PLAN ASSESSMENT	IMPLEMENTATION EVALUATION	QUALITY OF SERVICE AND IMPACT EVALUATION
D4. Parking management	**D.4.1** Parking management measures undertaken to manage demand for motorized vehicles.	Reduction in parking estimated for private motorized vehicles annually and over a five- year period.		• Reduction in parking achieved for private motorized vehicles • Reduction in volume of private vehicles travelling to/from the station area.
	D.4.2 Increased number and percentage of NMV parking overall, and near station entrances.	Percentage increase in number and percentage of NMV parking overall, and near station entrances.	Actual increase in number and percentage of NMV parking overall, and near station entrances.	User surveys, disaggregated by gender, to evaluate whether existing NMV parking is sufficient, sheltered, safe and convenient.
D5. Public spaces enhanced	**D.5.1** Percentage area of public spaces enhanced and maintained.	Percentage change of public spaces proposed to be enhanced and maintained.	Percentage change of public spaces enhanced.	User surveys to evaluate experience of using and crossing through public spaces in the station area, with special emphasis on women and vulnerable users (elderly and people with disabilities).
	D.5.2 Description of the intervention in each public space.	• Proposed design and description of the intervention in each public space. • Proposed public toilets per capita, disaggregated by gender.	• Implemented design in each public space. • Provision of public toilets per capita, disaggregated by gender.	
	D.5.3 Specific measures undertaken and maintained to improve women and vulnerable groups' safety and previously unmet needs.	Specific measures proposed to improve women and vulnerable users' (elderly and people with disabilities) previously unmet needs – such as but not limited to the number of toilet seats and design of public toilets, signage, emergency information and day care centres.	Specific measures implemented to improve women and vulnerable users' (elderly and people with disabilities) previously unmet needs.	

OBJECTIVES	INDICATORS	STATION ACCESSIBILITY PLAN ASSESSMENT	IMPLEMENTATION EVALUATION	QUALITY OF SERVICE AND IMPACT EVALUATION
D6. Estimated economic activity and opportunity enhanced[25]	**D.6.1** Increase in in sales for businesses and street vendors (licensed and unlicensed).	Estimated increase in in sales for businesses and street vendors (licensed and unlicensed).		Actual increase in in sales for businesses and street vendors (licensed and unlicensed, disaggregated by gender).
	D.6.2 Reduction in travel costs for men and women.	Estimated reduction in travel costs for men and women.		Actual reduction in travel costs for men and women.
	D. 6.3 Increase in jobs in the station area.	Estimated increase in jobs in the station area by quintile, gender, and age.		Increase in jobs in the station area measured by quintile, gender, and age.
	D.6.4 Increase in land or property value.* * An increase in land or property value and change in building use also has negative externalities like inducing gentrification of existing residents and businesses from the station area.	• Estimated increase in property values. • Estimated increase in rental rates for housing and commercial property.		• Number of property sales within station area per quarter. • Percentage change in land use of plots within station area. • Change in rental rates for housing and commercial property.


मैजिक स्टैण्ड
केवल दो वाहनों के लिये
नोट:- दो से अधिक मैजिक खड़े पाये
जाने पर आगे वाले मैजिक के विरुद्ध
चालानी कार्यवाही होगी

Appendix I

APPENDIX I-A:
Survey Form – Residents

The attached survey form was developed to study the area of MIDC, Marol and the questions in the survey form are framed accordingly. The form must be adapted to survey other station areas.

Interviewer:						
Survey No.:	Time:	Date:		Location:		
Instructions: Enter ANNUAL HOUSEHOLD income in Question I. 6						
	I. Profile					
1.	Name of respondent			Gender:	M	F
2.	Name of head of household					
3.	Period of stay in residence (years)	>1	2 to 5	6 to 10	11 to 20	> 20
4.	House type	Flat	Row House	Slums	Other	
5.	Address			Ownership	Self Owned	Rented
6.	Annual HOUSEHOLD income	<90,000	90,000-2 lakhs	2-5 lakhs	5-10 lakhs	>10 lakhs
7.	Vehicle ownership	None	Cycle	Two-Wheeler	Car	
8.	Household size					
9.	Family member details					
	Name/ relation	Gender	Age	Employment status		
i		M F		Unemployed Self Employed	Salaried profession Other	
ii		M F		Unemployed Self Employed	Salaried profession Other	
iii		M F		Unemployed Self Employed	Salaried profession Other	
iv		M F		Unemployed Self Employed	Salaried profession Other	

v			M F		Unemployed Self Employed	Salaried profession Other	
vi			M F		Unemployed Self Employed	Salaried profession Other	
	I. Overall Travel Pattern						
10.	Number of trips per week for the following activities						
	Work	Education	Regular Shopping	Healthcare	Recreation	Other	
	Details of trip for the three (3) most frequent trip activity						
	Trip Activity (1):						
	Destination				Address / Location		
	Trip Time				Trip Distance		
	Rickshaw / taxi	Car	Two wheeler	Train	BEST	Cycle	Walk
	Trip Activity (2):						
	Destination				Address / Location		
	Trip Time				Trip Distance		
	Rickshaw / taxi	Car	Two wheeler	Train	BEST	Cycle	Walk
	Trip Activity (3):						
	Destination				Address / Location		
	Trip Time				Trip Distance		
	Rickshaw / taxi	Car	Two wheeler	Train	BEST	Cycle	Walk

	II. Perceptions					
A.	**Walking**					
11.	How would you rate walking in MIDC-Marol? 1 (Poor) 2 3 4 5 (Best)					
B.	**Cycling**					
12.	Would you cycle in MIDC-Marol if the cycling environment were improved?	Y	N	Already do	Not Sure	
13.	If no or not sure, why?	Too far from origin	Don't know how to cycle	Other		
C.	**Public Transport**					
14.	Will you use the Metro?	Y	N	Not Sure		
15.	If no or not sure, why?	Alignment does not serve origin	Other			
16.	Will you use BEST, if service was improved?	Y	N	Already do	Not Sure	
17.	If no or not sure, why?	Company provides private bus	Walk or cycle	Other		
18.	What needs to be improved?	Increase bus frequencies of Nos:	Better quality buses	Other		
D.	**Para transit**					
19.	How can the auto / taxi services be improved? Require auto stands at Require taxi stands at	Introduce shared services	NA	Other		
E.	**Parking**					
20.	What are the issues with parking?	No parking lots	Very difficult to find parking	Parking is not charged		
		Other	On-street parking takes up carriageway			
21.	Would you pay a parking fee if it were used to improve roads?	Y	N	Not Sure		
F.	**Public Spaces**					
22.	Which public spaces in MIDC-Marol are pleasant?	SEEPZ Garden	Street nos.	Other		
23.	Which streets require urgent improvement?	Central road	Cross road B	Other		

24.	Which intersections require urgent improvement?	Mahakali Caves and Central road	Central road and Cross road C	Other
25.	Which amenities are lacking in MIDC-Marol?	Retail shops	Primary school	Other

Appendix I-B:
Survey Form – Visitors

The attached survey form was developed to study the area of MIDC, Marol and the questions in the survey form are framed accordingly. The form must be adapted to survey other station areas.

Interviewer:								
Survey No.:		Time:		Date:			Location:	
Instructions: The interview will be taken for visitors who have at least 3-4 trips per month to the station area Enter ANNUAL HOUSEHOLD income in Question I. 5.								
	I. Profile							
1.	Name of Respondent						Gender:	M F
2.	Age	<14	15-25	26-50	51-65	>65		
3.	Education	<10th	11th - HSc		Undergraduate	Graduate	NA	
4.	Employment	Self Employed		Salaried-Professional		Salaried-Other	Unemployed	
5.	Annual HOUSEHOLD income	<90,000	90,000-2 lakhs		2-5 lakhs 5-10 lakhs		>10 lakhs	
6.	Vehicle Ownership None	Cycle	Two-wheeler		Car	None		
	II. Overall Movement Pattern							
7.	Frequency of visit Daily	2-4 / week		3–4 / month		Other		
8.	Duration of visit (Years)	<1	1-5	5-10	>10			
9.	Where did the trip originate?	Home	Work	School	Health facility	Other		
		Address:						
10.	What is the destination?	Home	Work	School	Health facility	Other		
		Address:						
	For 11 and 12 note denote each stage of the journey by mode by number. *For example if a trip from home to work is as follows – walk from home to rickshaw stand; take rickshaw to BEST stop; take BEST to work area; walk to work – then denote as shown below*							
	**Mode of travel to MIDC-Marol*	*Walk* *1 and 4*	*Cycle*	*Rickshaw / Taxi* *2*	*Two-wheeler*	*BEST* *3*	*Private Bus*	*Car*

11.	*Mode of travel to MIDC-Marol	Walk	Cycle	Rickshaw / Taxi	Two-wheeler	BEST	Private Bus	Car
12.	*Mode of travel to origin or next destination	Walk	Cycle	Rickshaw / Taxi	Two-wheeler	BEST	Private Bus	Car
13.	Time spent in MIDC-Marol	8am-4pm	9am-6pm	11am-8pm	12pm-4pm	Other		
	III. Walking Patterns							
14.	How many trips do you make in or through MIDC-Marol within a day?	1	2	3	4	5	>5	
15.	How many are walking trips?	0	1	2	3	4	5	>5
16.	Purpose	Work related	Leisure	Smoke	Eat	Shop	Other	
17.	Destinations	MIDC Canteen	SEEPZ Garden	ESIC Hospital	Others			
		Address (If required)						
	IV. Perceptions							
A.	**Walking**							
18.	Would you walk more in MIDC-Marol if the walking environment were improved?	Y	N	Not Sure				
19.	If no or not sure, why?	Walk even if street condition is poor?	Other					
B.	**Cycling**							
20.	Would you cycle to MIDC-Marol if the cycling environment were improved?	Y	N	Already do	Not Sure			
21.	If no or not sure, why?	Too far from origin	Don't know how to cycle	Other				
C.	**Public Transport**							
22.	Will you use the Metro?	Y	N	Not Sure				
23.	If no or not sure, why?	Alignment does not serve origin	Not aware of route alignment	Other				

24.	Will you use BEST, if service was improved?	Y	N	Already do	Not Sure	
25.	If no or not sure, why?	Company provides private bus			Walk or cycle	Other
26.	What needs to be improved?	Increase bus frequencies			Better quality buses	Other
D.	**Paratransit**					
27.	How can the auto / taxi services be improved?	Require auto stands at			Require taxi stands at	
		Introduce shared services		NA	Other	
E.	**Parking**					
28.	What are the issues with parking?	On-street parking takes up carriageway			No parking lots	
		Very difficult to find parking			Parking is not charged	Other
29.	Would you pay a parking fee if it were used to improve roads?	Y	N	Not Sure		
F.	**Public Spaces**					
30.	Which public spaces in MIDC-Marol are pleasant?	SEEPZ Garden	Street nos.		Other	
31.	Which streets require urgent improvement?	Central road	Cross road B		Other	
32.	Which intersections require urgent improvement?	Mahakali Caves and Central road			Central road and Cross road C	
		Other				
33.	Which amenities are lacking in MIDC-Marol?	Retail shops	Primary school		Other	
34.	Along which streets should they be located?	Central road	Cross road B		Other	

Appendix I-C: Survey Form – Businesses

The attached survey form was developed to study the area of MIDC, Marol and the questions in the survey form are framed accordingly. The form must be adapted to survey other station areas.

Interviewer:						
Survey No.:	Time:	Date:	Location:			
	I. Profile					
1.	Name of business					
2.	Name of business owner					
3.	Period of operation (years)	>5	5-10	>10	NA	
4.	Address					
5.	Type of industry	Manufacture	Service	Trade and commerce	Transport	Other
6.	Type of business					
7.	Employees					
8.	Workshift	9am-6pm	3pm-11pm	11pm-7am	Other	
	II. History					
9.	When was the business established in MIDC-Marol? Why?					
	III. Employee profile and services					
10.	What is the demography of the people employed? (Age, Sex ratio, Educational qualification, Religion)					
11.	Does the organization provide any bus / transport services for employees? From where and from whom?					
	IV. Business cycles					
12.	Where does the raw material come from? How and what time?					
13.	How long does it take to make / manufacture the finished good?					
14.	Where are the finished goods supplied to? How? What time?					
15.	When are the peak sales hours / days?					

	V. Social events
16.	Which festivals, special days are celebrated? Where are they celebrated in MIDC-Marol?
	VI. Perceptions
17.	Which government policies have impacted MIDC-Marol? How?
18.	What are the strengths and opportunities of MIDC-Marol as a business district?
19.	What are the weaknesses and threats of MIDC-Marol as a business district?
20.	How do you think MIDC-Marol has transformed?
21.	How has it affected transportation in MIDC-Marol?
22.	Which streets require urgent attention?
23.	Which intersections are unsafe and require urgent attention?
24.	Which streets and public spaces in MIDC-Marol are pleasant?
25.	Which amenities are lacking MIDC-Marol?

Appendix II

Pedestrian Origin – Destination Survey

The attached survey form was developed to study the area of MIDC, Marol and the questions in the survey form are framed accordingly. The form must be adapted to survey other station areas.

Interviewer:									
Survey No.:	Time:	Date:	Location:						
	I. Profile								
1.	Name of Respondent						Gender:	M	F
2.	Age	15-25	26-50	51-65					
3.	Education	<10th	11th - HSc	Undergraduate	Graduate	Not educated			
4.	Employment	Self Employed	Salaried-Professional	Salaried-Other	Unemployed				
5.	Annual HOUSEHOLD income	<90,000	90,000-2 lakhs	2-5 lakhs	5-10 lakhs	>10 lakhs			
6.	Vehicle Ownership None	Cycle	Two-wheeler	Car					
7.	Frequency of visit	More than once a day	Daily	2-4 / week					
8.	Purpose	Work related	Leisure	Eat	Other				
	II. Origin Destination Details								
9.	ORIGIN			DESTINATION					
1.	Where did this walking trip begin? Home Work or work related place School/ College Shopping/ Market Leisure / Recreational Social Visit Transport Mode If transport: BEST stop Para- transit drop off Private vehicle drop off			What type of place is your final destination? Home Work or work related place School/ College Shopping/ Market Leisure / Recreational Social Visit Transport Mode If transport: BEST stop Para- transit drop off Private vehicle drop off					
2.	Where is this located? (Street address, or nearest street intersection, or nearest street or landmark)			Where is this located? (Street address, or nearest street intersection, or nearest street or landmark)					

							How long is this trip (in minutes) Mark the route on the map	
	III. Perception							
10.	Which amenities does MIDC lack?		Retail Shops		Open spaces/ Recreational areas		Others (Please state)	
			Public Toilets		Vegetable market			
11.	How would you rate walking in MIDC- Marol?							
a)	Safety	1 (Poor)	2	3	4	5 (Best)	State why	1. High speed of vehicles 2. Unsafe junctions and crossings 3. Insufficient space for pedestrians 4. Streets are not lit in the night 5. Other (Please state)
b)	Convenience	1 (Poor)	2	3	4	5 (Best)	State why	1. Amenities are located close by. 2. Enough space to walk comfortably 3. Places to sit 4. Shaded 5. Other (Please state)`
c)	Pleasant	1 (Poor)	2	3	4	5 (Best)	State why	1. Buildings are human scale and engaging 2. Streets are visually appealing 3. Streets are well-maintained 4. Streets are clean 5. Streets are quiet 6. Other (Please state)

Appendix III

Walkability and Connectivity Indices

Existing indices, which assess the walkability of streets based on the availability and perception-based rating of footpaths, list Chandigarh, which has urban block sizes of 800m x 1200m, as the most walkable city in India (Wilber Smith Association 2008, xii). Recent scoring systems evaluating accessibility to public transport also look at comfort for NMT users, frequency of intersections and the vehicle-NMT interaction (MoUD 2013b). Walkable neighbourhoods cannot be created with large block sizes of 800m X 1200m. Street connectivity can be evaluated through multiple indicators such as street density, intersection density, connectivity or accessibility indices (UN Habitat 2013). Indicators such as land allocated to streets, by themselves, are not a good measure of street connectivity as they do not account for street widths or spacing.

Connectivity Index measures how well a road network connects destinations (VTPI 2012). One measure is the number of surface street intersections within a given area, such as a square kilometre; the more intersections, the greater the degree of connectivity. An Accessibility Index is a ratio of actual travelled distance to the direct travel distance. An index of 1.0 is considered best and an average of 1.5 is considered acceptable (UN Habitat 2013). A more direct method is the size of an urban block. A walkable block ranges from 400m to 800m (Ewing, Best Development Practices: Doing the Right Thing and Making Money at the Same Time 1996). The average block size in the high density Manhattan district of New York is 80m X 274m (Williamson 2013, 41).

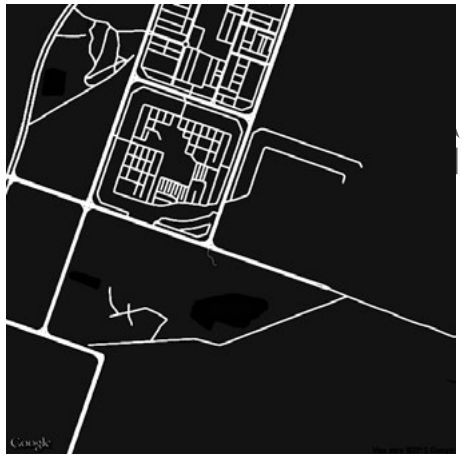
Regulations must establish a maximum urban block size, or minimum accessibility or connectivity index in station areas for primary, secondary and tertiary zones. These must become the basis for framing regulations for amalgamation of plots or plot sizes so that large parcels are converted into walkable blocks. Figure a highlights the urban street network in various global examples; the street density and intersection density are visible in these examples.

Figure a Comparative urban block sizes of different cities globally, Source: EMBARQ India

New York City

London

Chandigarh



Naya Raipur

Appendix IV

Walkability Rating Index for DN Nagar Metro Station Area, Mumbai

		New Link Road North	New Link Road South	4 Bungalows Road North	4 Bungalows Road South	JP Road
	I. PAVEMENT					
	OVERALL					
1.	**Pavement provision** i. Is there a pavement present for the entire length of the road?	1.00	3.50	3.50	3.00	3.00
2.	**Usage** ii. To what extent do pedestrians use the pavement?	1.00	2.50	3.00	1.00	1.00
	DESIGN					
3.	**Pavement width** iii. Can the pavement accommodate the traffic present? Do pedestrians have adequate space when walking?	2.25	2.25	3.00	2.00	1.00
	iv. Is there space for faster walkers to pass slower walkers or to walk in contraflow direction?	1.00	1.00	2.75	1.50	1.00
4.	**Pavement height** v. Is the pavement too high?	1.00	2.75	2.00	2.00	2.00
5.	**Obstructions and interruptions** vi. Are there obstructions because of placement of utilities?	2.75	2.75	2.25	2.25	2.00
	vii. Are there frequent interruptions in the pavement? (access to building plots)	2.50	2.50	1.50	2.00	1.00
6.	**Security** viii. Does it feel safe to walk on the street? Is there an appropriate security presence, or alternatively, is there safety from a high level of street activity?	2.00	2.50	2.75	3.00	2.75
	MANAGEMENT / MAINTENANCE / ENFORCEMENT					
7.	**Pavement maintenance** ix. How maintained are the pavements (Are there tripping holes, cracks, or other tripping hazards)?	1.50	2.50	2.75	1.00	1.00

	x. Is the pavement traversable in the rain?	2.50	2.50	2.50	1.00	2.00
	xi. Is there garbage/debris on the pavement? Is there foul odour?	1.50	1.50	3.00	2.00	2.75
8.	**Accessibility** xii. Do railings or on-street parking cut off access to the pavement?	1.50	2.75	2.00	2.00	2.00
9.	**Parking obstructions** xiii. Are motor vehicles parked on the pavement?	3.00	3.00	3.00	3.00	1.50
10.	**Building obstructions** xiv. Are there encroachments on the pavement like product displays, signs, industrial activity, flower beds, pavement dwellers, driveways etc.?	1.00	2.00	3.00	1.00	1.00
11.	**Hawker conflict** xv. Are there vendors obstructing the pavement where it would otherwise be clear?	2.50	2.50	2.75	1.00	2.25
	xiv. Does the presence of vendors force pedestrians to walk the road?	2.50	2.50	2.75	1.00	2.25
12.	**Motorists speeding** xvi. Does the speed of traffic create a walking environment that is unsafe?	1.00	1.00	1.00	1.00	1.00
	xvii. Is there a posted speed? Is traffic travelling above the posted speed?	1.00	1.00	1.00	1.00	1.00
	II. CROSSINGS					
	DESIGN					
13.	**Crossing opportunities** xviii.Are there sufficient opportunities to cross the road?	2.75	2.75	2.75	2.75	2.75
	xix. Do pedestrians have to walk too far to the nearest crossing opportunities?	3.00	3.00	3.00	3.00	3.00

	xx. Are there crossing opportunities at major activity centers?	3.00	3.00	3.00	3.00	2.50
	xxi. Is there a high temptation to jaywalk?	2.75	1.50	2.75	1.00	2.75
	xxii.Are the crossings designed for safety?	1.00	1.00	1.00	1.00	1.00
14.	**Crossing wait time and ease** xxiii. Do pedestrians have to wait too long for a safe gap in traffic to cross?	1.00	1.00	1.00	1.00	1.00
	xxiv. Are there traffic control devices if traffic volumes are high?	1.00	1.00	1.00	1.00	1.00
	xxv. Is the wait time from the control devices too long?	1.00	1.00	1.00	1.00	1.00
15.	**Crossing distance** xxvi. Do crossing distances leave pedestrians exposed to vehicles for long?	1.00	1.00	1.00	1.00	1.00
	xxvii. Are there refuge medians if a road is very wide?	1.00	1.00	1.00	1.00	1.00
	xxviii. Does the width of the motor vehicle lanes make the road feel like an insurmountable barrier?	1.00	1.00	1.00	2.00	1.00
	MANAGEMENT / MAINTENANCE / ENFORCEMENT					
16.	**Motorists yielding** xxix. Do motorists yield the right of way to pedestrians at crossings?	1.00	1.00	1.00	1.00	1.00
	xxx. Do motorists check for pedestrians before making turns?	1.00	1.00	1.00	1.00	1.00
	III. AMENITIES					
	DESIGN					
17.	**Lighting** xxxi. Is there adequate lighting at pedestrian level?	1.00	1.00	1.00	1.00	1.00

18.	**Coverage** xxxii. Is there protection from the sun and rain (tree cover, awnings, or arcades)?	1.50	3.00	3.00	3.00	2.00
19.	**Street furniture** xxxiii. Is the walking environment inviting, stimulating and pleasant?	1.00	2.50	3.00	1.00	1.00
	xxxiv. Are pedestrians' physical needs met (resting places, drinking fountains etc.)?	1.00	2.25	1.50	1.00	1.00
	MANAGEMENT / MAINTENANCE / ENFORCEMENT					
20.	**Maintenance of amenities** xxxv. Are the amenities well maintained / useable?	1.00	1.00	1.00	1.00	1.00
	Final score	58	70	75	58	57
	Rating	1.64	2.00	2.13	1.64	1.61

SCORE CARD

Rating		**Range of scores**	
1.	Very Poor	0-70	0-2
2.	Poor	71-122.5	2-3.5
3.	Good	122.6-157.5	3.5-4.5
4.	Excellent	157.6-175	4.5-5

Appendix V

Case studies for making walkable blocks

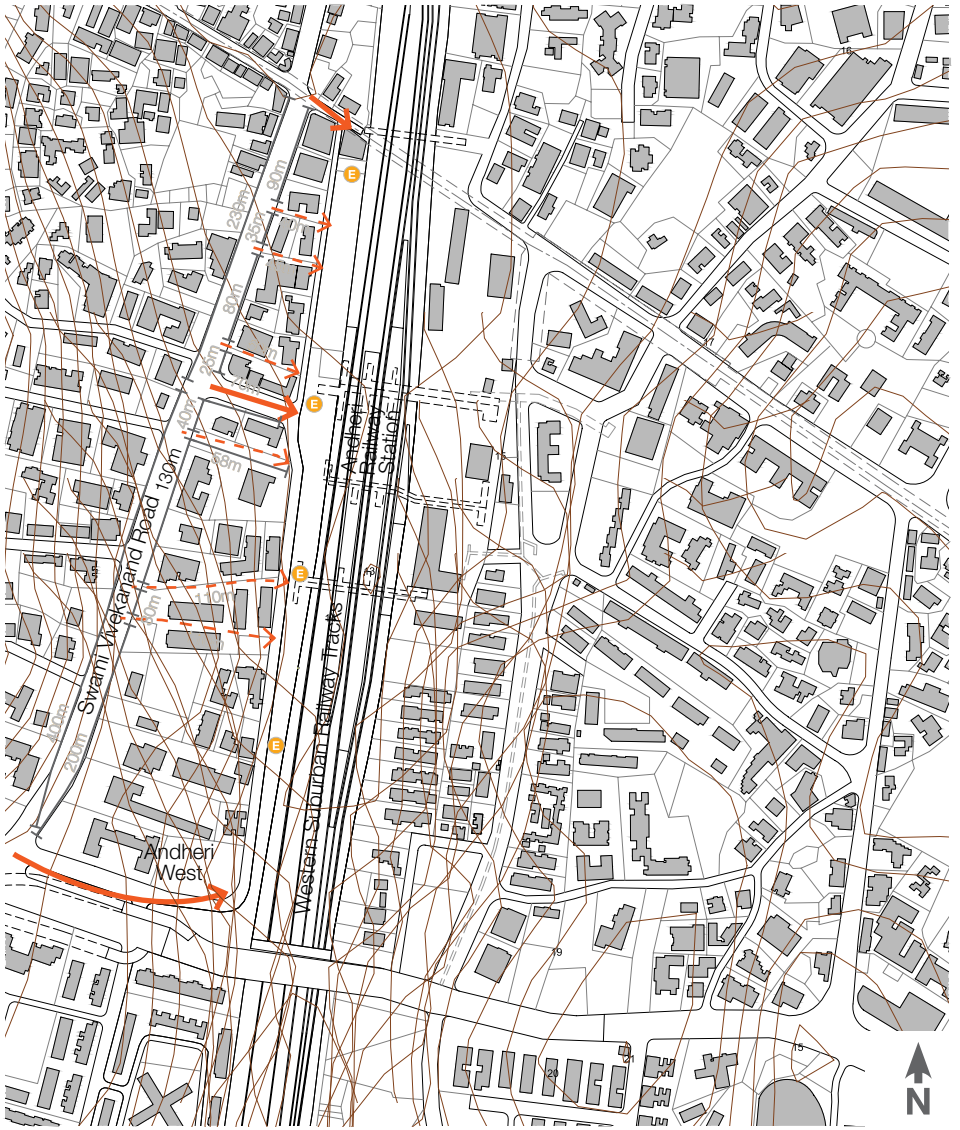
The following 3 case studies give examples of how urban blocks can be reconfigured to make walkable blocks with a dense grid and unimpeded pedestrian pathways. In Mumbai, the pedestrian pathways have developed organically as retail shop owners have opened access through their plot during the day and this space has been appropriated by people travelling to and from the commuter rail station adjacent to these plots. In New York City and San Francisco, a formal planning process has helped create these walkable blocks by carving out pedestrian paths by offering incentives through their premises.

APPENDIX V-A: Privately-owned publicly accessible streets - Andheri Station, Mumbai

At Andheri Station, Mumbai, side setbacks have organically developed as major pedestrian thoroughfares with retail shops on either side. These thoroughfares are generally open from 8am to 8pm, corresponding with the timings of the shops. This has made the urban block permeable by breaking up the block side from 400m to around 50-150m (Figure b). It also disperses pedestrian traffic at multiple points along Swami Vivekananda Road, a north-south sub-arterial road.

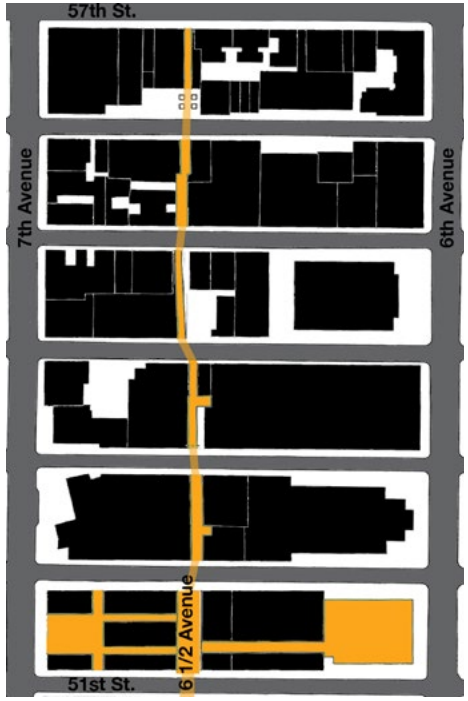
Pedestrian paths lined with retail shops; access is controlled by building gates

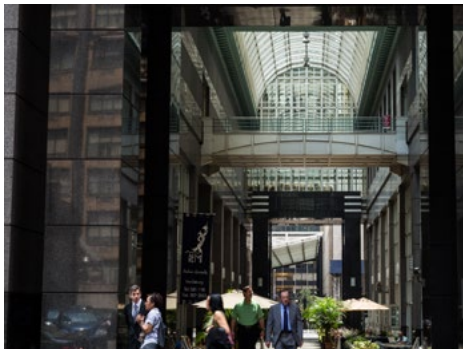
Figure b Pedestrian paths to Andheri Station through private property, Source: EMBARQ India adapted from



APPENDIX V-B: Privately-owned public spaces - New York City

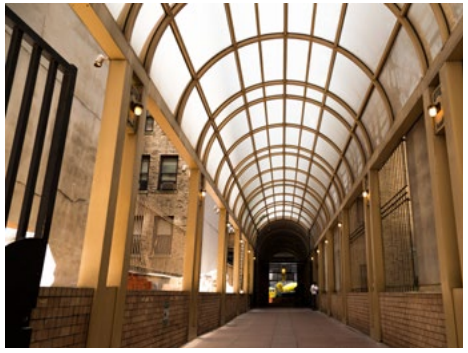
Plan of 6 ½ Avenue; Streetscape along 6 ½ Avenue Midtown Manhattan, NYC





New York passed a regulation in the 1960s allowing for the creation of Privately- owned Public Spaces (POPS). The 1961 Zoning Resolution spawned a variety of publicly used spaces ranging from parks and plazas to mid-block street connections like passageways and arcades. Private developers were offered the incentive of constructing taller buildings on the condition that they developed and maintained POPS. This scheme helped generate various public plazas and parks but was not as successful in developing circulation paths as private developers had concerns about allowing a public thoroughfare through their premises. To address this, the City of New York passed a Midtown Zoning Resolution in 1982, which involved breaking up large blocks by adding pedestrian passageways (Department of City Planning 1982). While the program had created more than 3.5 million square feet of public space/ thoroughfares (Department of City Planning 2007), some appear so private that most walkers would not even know of them. In other instances these were closed after 7pm (Schabas 2012).

A recent intervention completed in July 2012 demonstrates the role of civil society organizations in proposing POPS. 61/2 Avenue is a north-south pedestrian pathway connecting West 51st Street to West 57th Street between 6th and 7th Avenue in mid-town Manhattan. The pedestrian path is a combination of POPS through building lobbies or canopied paths which are open during the day. This initiative was brought to the Community Board 5 by Pedestrian Projects Group and was taken up by the New York Department of Transportation in their 2012 plans (NYC DOT 2012).



APPENDIX V-C: Privately-owned public open spaces - San Francisco

In San Francisco, the provision of Privately- Owned Public Open Spaces (POPOS) like plazas, terraces, atriums, small parks, and even snippets is governed by the city's 1985 downtown plan (SFPD n.d.). The plan requires 1 square foot of public space per 50 square feet of office space or hotels to meet the needs of workers, residents and visitors in the downtown office area. These are generally found in the office district area. An additional FSI is offered to developments which also incorporate POPOS.

POPOS in San Francisco with public amenities

Appendix VI

Elevated pedestrian infrastructure to BRT in Istanbul

The Istanbul Electric Tram and Tünel Company opened its BRT system, Metrobüs, for service in 2007. A median bus way with median stations was built along the freeway D100. Bus operation is counter-flow to reduce costs and implementation times and uses conventional buses with right-hand doors. A large share (37 percent) of Metrobüs riders walk to and from Metrobüs. Most of the walking trips are within 10 minutes with a higher share for egress from Metrobüs (Yazıcı, et al. 2013). An assessment conducted in 2011-12 observed that while the stations were connected to the catchment area by over bridges, pedestrian and universal access poses a challenge due to a lack of ramps, escalators and elevators and poor integration with other bus routes (Bülay and Can Yüce 2011).

Elevated pedestrian bridges to Metrobus

APPENDIX VII

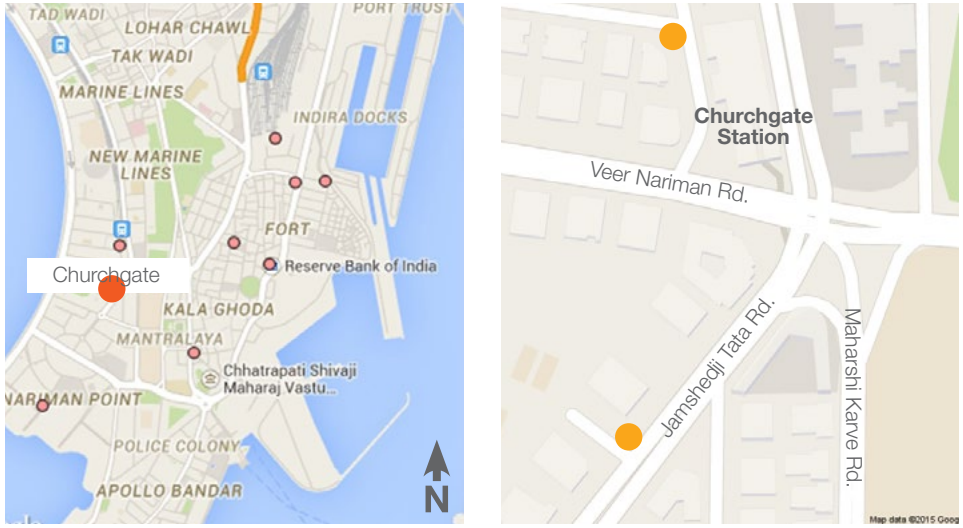
Taxi services at Churchgate Station, Mumbai

Churchgate Station is a terminal station on the western railway corridor in Mumbai. It is situated within an administrative and business district with multiple destinations in its vicinity. Since auto-rickshaws are not permitted within the Island city of Mumbai, taxis play an important role as a feeder service. Both metered and shared taxis are available at Churchgate Station.

Based on sample surveys and field observations, it was noted that shared taxis cover distances up to 2.5 km radius from the station, and are available from 6am to 11am and 4pm to 10pm. Each shared taxi makes approximately 20 round trips during a single shift and often provides metered services in between shifts. The shared service caters to six different destinations – Cuffe Parade, Nariman Point, Ballard Estate, Colaba, Gateway of India and VT Station. Passengers are dropped off to their destinations in these areas in the morning at specific destination points, which also become pick-up points to Churchgate Station in the evening. There are different fares for each destination ranging from Rs. 8 to Rs. 13 per passenger. Each taxi carries 4 to 6 passengers depending on the size of vehicle. There is a dedicated space allotted for shared taxis at each destination but there are no dedicated sheltered, well-lit waiting areas.

Boarding points for all destinations are within a 150m – 200m radius of the station or subway exits (Figure c and Figure d). Some of the boarding points are regulated by a person appointed by the taxi drivers to make sure that the taxis and passengers adhere to the agreed- upon queues. However, there is chaos at unmonitored destination points during peak hours.

Figure c Drop off and pick-up points from Churchgate station, Source: EMBARQ India, source data from Google Maps



Shared taxi stands and queues for shared taxi services at Churchgate Station

Appendix VIII

BEST Undertaking, Mumbai

The Brihan Mumbai Electric Supply & Transport Undertaking
(OF THE BRIHAN MUMBAI MAHANAGARPALIKA)

B.E.S. & T. Undertaking, Marol Depot,
Marol Divisional Traffic Office,
2nd Floor, Off. Nahakali Road,
M.I.D.C. Mumbai-400 093.
Tel.28328501

TELEPHONE : (022) 22856262
FAX : (022) 22851244
TELEX : 1165755 BEST IN
TELEGRAM : BEST, MUMBAI-400 001.

BEST BHAVAN,
BEST MARG,
POST BOX NO. 192,
MUMBAI - 400 001.

ADDRESS ALL COMMUNICATION BY TITLE NOT BY NAME

OUR REF. DM(MLD)/ 695 /2013

DATE : 26-4-2013

The President,
Marol Industries Association,
MIDC,
Andheri (east),
Mumbai 400 069.

By Hand delivery

Sub: Provision for parking of private buses in Marol & Majas depot.

Dear Sir,

With reference to the subject above, and in continuation with our discussion and joint inspection with the members of your association on 23rd April, 2013. We have to inform that our management has given approval to your proposal to park private buses in Marol and Majas depot.

The terms and conditions for parking of private buses in our depots laid down by the management are as under:

1. The charges for parking of outside buses in our depot premises is Rs. 100/- + Service Tax for a 12 hour period and charges of Rs. 2,500/- + Service Tax per month for a 12 hour period.
2. The charges for private cars per day for 12 hours is Rs. 75/- + Service Tax for cars per day of 12 hours and a monthly charge of Rs.2000/- + Service Tax per month.
3. It should be ensured that the parking does not obstruct the normal functioning of the depots.
4. The party will pay the monthly parking charges in advance based on the number of days in the month, as per the rate permissible in cash or demand draft drawn in favour of the B.E.S.&T. Undertaking payable at Cash Department' Colaba.

...2/-

"BEST Travel Saves Fuel"

"BEST Travel Safe Travel"

... 2 ...

5. The party is required to pay an interest free Security Deposit equivalent to one month charges which shall be refunded' provided no damage is caused to the property of the Undertaking.
6. The vehicles shall be parked only within the parking area earmarked in the bus depot in an orderly manner.
7. The party shall arrange for security checking of the vehicles entering and leaving the bus terminus and shall ensure that the vehicle arrive/leave only along the designated route.
8. In case of break down of any vehicle, the party shall arrange to tow the vehicle outside the depot premises. The defective vehicle should not be attended in the bus depot under any circumstances.
9. If any damage/injury is caused to the Undertakings property or person by the private vehicles, it shall be made good by the party at their own cost to the entire satisfaction of the General Manager or its official.
10. The Undertaking shall not be liable to pay any compensation in case any accident or injury is caused to the outside vehicle/ persons arising out of the egress and ingress of the vehicles in the bus depot.
11. The Undertaking reserves the right to deny/withdraw the parking permission granted at any time without assigning any reason and in that eventually the party will vacate the space immediately.

With regards,

Yours truly,

Depot Manager (Marol)

"Use Public Transport - Save Mumbai City"


Swathi
K.S.R.T.C., Kempegowda
Comprehensive Trauma Consortium
Emergency Medical Centre
4
Shimoga
Agumbe
Kollur
Dandeli
Gokarna

LIST OF FIGURES

Appendix

LIST OF TABLES

LIST OF ACRONYMS

AUDA Ahmedabad Urban Development Authority
BART Bay Area Rapid Transit
BBMP Bruhat Bengaluru Mahanagara Palike
BEST Brihanmumbai Electric Supply and Transport
BKC Bandra Kurla Complex
BRT Bus Rapid Transit
CAA Constitution Amendment Act
CAI Asia Clean Air Initiative Asia
CBD Central Business District
CDP City Development Plan
CMP Comprehensive Mobility Plan
CPTM Companhia Paulista de Trens Metropolitanos
DDA Delhi Development Authority
DMRC Delhi Metro Rail Corporation
DOT Department of Transportation
DP Development Plan
DULT Directorate of Urban Land Transport
FSI Floor Space Index
GIS Geographic Information Systems
GoI Government of India
HDBCL Hubli-Dharwad BRT Company Limited
HDMC Hubli-Dharwad Municipal Corporation
HDUDA Hubli-Dharwad Urban Development Authority
HUDCO Housing and Urban Development Company
IETT Istanbul Electricity, Tramway and Tunnel
INTACH Indian National Trust for Art and Cultural Heritage
IPT Intermediate Public Transport
IRC Indian Roads Congress
ITDP Institute for Transportation and Development Policy
IUT Institute for Urban Transport
JnNURM Jawaharlal Nehru National Urban Renewal Mission
LAP Local Area Plan

LTA Land Transport Authority
MCGM Municipal Corporation of Greater Mumbai
MIDC Maharashtra Industrial Development Corporation
MIDC Marol Industries Association
MMRDA Mumbai Metropolitan Region Development Authority
MoUD Ministry of Urban Development
MP Master Plan
MRT Mass Rapid Transit
MTC Metropolitan Transport Company
MUT Ministry of Urban Transport
MUZ Multi-Utility Zone
NHAI National Highway Authority of India
NIUA National Institute of Urban Affairs
NMT Non-Motorized Transport
NMV Non-Motorized Vehicles
NPIIC New Policy Initiatives and International Cooperation Cell
NUIS National Urban Information System
NUTP National Urban Transport Project
NWKRTC North-Western Karnataka Road Transport Corporation
POPS Privately Owned Public Spaces
POPOS Privately Owned Public Open Spaces
PPP Public Private Partnership
PT Public Transport
SAP Station Accessibility Plan
SATIS Station Area Traffic Improvement Scheme
SPV Special Purpose Vehicle
SUTP Sustainable Urban Transport Project
SVD Selective Vehicle Detection
TCPO Town and Country Planning Organization
TDM Travel Demand Management
TfL Transport for London
TOD Transit Oriented Development
UDD Urban Development Department
UMTA Urban Mass Transit Authority
UMTC Urban Mass Transit Company
URDPFI Urban & Regional Development Plan Formulation and Implementation
UTTIPEC Unified Traffic and Transportation Infrastructure (Planning and Engineering) Centre
VAG Versova-Andheri-Ghatkopar Corridor (Mumbai Metro Phase 1)
VT Victoria Terminus
WEH Western Express Highway
WHO World Health Organization
WMATA Washington Metropolitan Area Transit Authority
WRI World Resources Institute
WUF World Urban Forum

REFERENCES

Advani, Mukti. 2010. *Demand Estimation for Public Transport Systems: Case Study of Delhi.* Unpublished Thesis. New Delhi: Indian Institute of Technology.

AUDA. 2013. *Ahmedabad revised development plan 2012, Section C: Planning regulations*. Ahmedabad: Ahmedabad Urban Development Authority.

BART. 2003. *BART station access guidelines.* Bay Area Rapid Transit. http://www.bart.gov/sites/default/files/docs/access_guidelines.pdf

BART. 2008. *Strategic plan.* Bay Area Rapid Transit. http://www.bart.gov/sites/default/files/docs/strategicPlan.pdf

Barter, Paul. 2010. "Reinventing Parking." Accessed 22 April, 2014. http://www.reinventingparking.org/2010/10/parking-revolution-in-bogota-golden-era.html.

"BEST, Railways & MMRDA plan seamless connectivity with dedicated stops at Metro Stns." *Rail News.* 18 March 2014.

Bhalla, Kavi, Majid Ezzati, Ajay Mahal, Joshua Salomon, and Michael Reich. 2007. "A Risk-Based Method for Modeling Traffic Fatalities." *Risk Analysis* 27:125-136. doi:10.1111/j.1539-6924.2006.00864.x.

Bhowmik, Sharit K. 2005. "Street Vendors in Asia: A Review." *Economic and Political Weekly,* 28 May:2256-2264.

Bhowmik, Sharit K., and Debdulal Saha. 2012. Street vending in ten cities in India: Case study. Mumbai: School of Management and Labour Studies, Tata Institute of Social Sciences.

BMRCL. 2011. "Namma Metro." Accessed April 22, 2014. http://www.bmrc.co.in/about_us.htm

Bott, Maja, and Gregor Young. 2012. "The Role of Crowdsourcing for Better Governance in International Development." *Praxis: The Fletcher Journal of Human Security* 27: 47-70. http://fletcher.tufts.edu/praxis/~/media/Fletcher/Microsites/praxis/xxvii/4BottYoungCrowdsourcing.pdf

BRT Centre of Excellence, EMBARQ, IEA and SIBRT. 2014. "Global BRT Data." Accessed June 19, 2014. http://brtdata.org/

Bulay, Sibel, and Elif Can Yuce. 2011. *Avcilar-Beylikduzu Metrobus accessibility assessment.* Istanbul.

Burningham, Sally, and Natalya Stankevich. 2005. *Why Road Maintenance is Important and How to Get it Done.* Transport Note 4. The World Bank.

Butcher, Louise. 2010. *Buses: Bus Lanes and Priority Measures.* Parliamentary Note. United Kingdom.

CABE. 2007. *Paved with gold: The real value of good street design.* London: Commission for Architecture and the Built Environment.

Cavalcanti, Maria Fernanda. "Sao Paulo to integrate bike-sharing with other modes in a single transport pass." *The City Fix*. April 15, 2013. http://thecityfix.com/blog/sao-paulo-brazil-bike-sharing-integrated-transport-pass-maria-fernanda-cavalcanti/

Census India. 2000. *CensusData 2001/ Metadata*. Ministry of Home Affairs, Government of India. http://censusindia.gov.in/Metadata/Metada.htm.

CEPT University. 2011. *Bus rapid transit system: Hubli Dharwad detailed feasibility report.* Bangalore: Directorate of Urban Land Transport.

CEPT University. 2013. *Integrating public transport in Ahmedabad - AMTS Route Rationalization.* Ahmedabad: CEPT.

Chappell, Barbara. 2008. *Community engagement handbook: A model framework for leading practice in local government in South Australia*. Government of South Australia.

Chinappa, K. J. “Centre nod for Karnataka’s proposal on renaming cities.” *The Hindu.* October 18, 2014.

Christakis, Erika. “Are Toilets a Feminist Issue?” *Time Magazine.* June 19, 2012.

City of South San Francisco. 2013. “Utility Box Mural Project.” Accessed April 22, 2014. http://www.ssf.net/DocumentCenter/View/4067

City of Toronto. 2012. “Vibrant Streets: Toronto’s Coordinated Street Furniture Program.” Accessed July 5, 2014. http://publicspaces.ca/vibrant-streets-guidelines/

Coelho, Karen, Lalita Kamath, and M Vijaybaskar. 2011. *Infrastructures of consent: Interrogating citizen participation mandates in Indian urban governance*. Brighton: Institute of Development Studies. https://www.ids.ac.uk/files/dmfile/Wp362.pdf

Commissioner Manjula. Interview by EMBARQ India. 2014. *EMBARQ India’s Safe Access Manual Review process* (August).

Community Design and Architecture. 2002. *Planning and Designing for Pedestrians, Model Guidelines for the San Diego Region.* San Diego: CDA. http://www.sandiego.gov/planning/pdf/peddesign.pdf

Comptroller and Auditor General of India. 2012. *Performance audit of Jawaharlal Nehru National Urban Renewal Mission: Chapter 3.* New Delhi: Government of India.

CTOD. 2008. *Station area planning: How to make great transit-oriented places.* Reconnecting America - Center for Transit Oriented Development .

Davis, Dave, Josh Meyer, Aatisha Singh, Molly Wright, and Paul Zykofsky. 2013. *Participation tools for better community planning.* Sacramento: Local Government Commission. http://www.lgc.org/wordpress/docs/freepub/community_design/guides/Participation_Tools_for_Better_Community_Planning.pdf

DDA. 2012. *TOD Public Notice (Master Plan Section)-Chapter 19.* New Delhi: Delhi Development Authority.

Deike, Peters. 2013. *Global report on human settlements: Gender and sustainable urban mobility.* Nairobi: UN Habitat.

Department for Transport. 2004. *Bus priority: The way forward.* London: Department for Transport, UK. http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/pgr/regional/buses/bpf/buspriorityth ewayahead12/rioritythewayaheadpdfversion.pdf

Department for Transport. 2005. *Home zones: Challenging the future of our streets.* London: Department for Transport, UK. http://www.rudi.net/files/homezones.pdf

Department for Transport. 2008. *Provisional guidance on bus lane (including tramway) enforcement in England outside London.* London: Department for Transport, UK. http://webarchive.nationalarchives.gov.uk/20111005163411/http:/www.dft.gov.uk/pgr/regional/buses/gen/coll_provisionalguidanceonbuslan/isionalguidanceonbuslane3570.pdf

Department of City Planning. 1982. *Midtown Zoning: Zoning Regulations.* New York: City of New York. http://www.nyc.gov/html/dcp/pdf/history_project/midtown_zoning.pdf

—. 2007. “Privately Owned Public Space.” City of New York. Accessed July 20, 2014. http://www.nyc.gov/html/dcp/html/priv/priv.shtml

DFID. 2003. V*isioning: Sustainable sanitation and water management.* http://www.sswm.info/category/planning-process-tools/decision-making/decision-making-tools/deciding-community/visioning.

DIMTS. 2014. “Delhi Integrated Multi-Modal Transit System Ltd.” Accessed December 5, 2014. http://www.dimts.in/pdf/Symposium-on-Publi-Transportation/S-01-P1-Mr.DIMMTS-Jan10.pdf

DMRC. n.d. “Feeder Bus.” Accessed April 21, 2014. http://www.delhimetrorail.com/feederbus.aspx

DMRCL. 2005. *Mumbai MRTS project: Versova Andheri Ghatkopar project, Detailed Project Report.* Mumbai: MMRDA.

DULT. 2013. *Request for Proposal for Consultancy Services for Preparation of Station Accessibility Plans for Metro Stations in Bangalore, Karnataka.* Bangalore: Directorate of Urban Land Transport .

—. 2014. "Sustainable Transport Trends and Opportunities for Indian Cities: Planning for Integrated Mobility." *Connect Karo 2014.* Bangalore: EMBARQ India. 1-26. Accessed 2014. http://connectkaro.org/video-presentations/youtube/2014/Integrated%20Mobility%20Presentation%20-%20Ms.%20Manjula

Easter Seals Project ACTION. 2011. *Toolkit for the assessment of bus stop accessibility and safety.* Oregon Department of Transportation.

EMBARQ India. 2012a. *Bicycle Sharing in Indore.* Mumbai: EMBARQ India.

--. 2012b. *Road Safety Design Guidelines for Bus Rapid Transit in Indian Cities.* Mumbai: EMBARQ India.

EMBARQ India. 2014a. *Bus Karo 2.0 : Case Studies from India*. Mumbai: EMBARQ India.

--. 2014b. *Towards a walkable and sustainable bengaluru: Development control regulations for Indiranagar metro station area.* Bangalore: EMBARQ India.

EMBARQ India. 2013a. *Improving safe access and pedestrian environments in MIDC Marol, Mumbai.* Mumbai: EMBARQ India.

--. 2013b. *Indiranagar metro station accessibility plan.* Bangalore: EMBARQ India.

--. 2013c. *Shaping Hubli-Dharwad as a connected city - Volume 1.* Bangalore: EMBARQ India.

EMBARQ India. 2011. *Indore walkability study.* Mumbai: EMBARQ India.

EMBARQ India. 2010. *The Mumbai skywalks.* Mumbai: EMBARQ India.

EMBARQ Mexico. 2008. *Manual Desarrollo Orientado al Transporte Sustentable*. Mexico City: EMBARQ Mexico.

Ewing, Reid. 1996. *Best development practices: Doing the right thing and making money at the same time.* Tallahassee: Florida Department of Community Affairs.

Ewing, Reid, and Otto Clemente. 2013. *Measuring Urban Design: Metrics for Livable Places.* Washington D.C.: Island Press.

Fischer, Frank. 2006. "Participatory Governance as Deliberative Empowerment: The Cultural Politics of Discursive Space." *The American Review of Public Administration* 36:19-40. doi:10.1177/0275074005282582.

Gehl, Jan, and Brigitte Svarre. 2013. *How to Study Public Life: Methods in Urban Design.* Washington D.C.: Island Press.

Government of Karnataka. 2014. "Urban Development." *In Economic Survey of Karnataka 2013-2014,* 103-158. Bangalore: Planning, Programme Monitoring & Statistics Department, Government of Karnataka. http://planning.kar.nic.in/docs/economic%20survey%202013-14/Web%20Eng/14%20URBAN%20DEVELOPMENT.pdf

—. 2008. "Urban Development Department, Government of Karnataka." Accessed April 22, 2014. http://bmrc.co.in/pdf/news/zoning%20regulations.pdf

Government of Maryland. n.d. "Maryland.gov." Accessed 2014. http://www.maryland.gov/Pages/default.aspx

Grant Thornton. 2011. *Appraisal of Jawaharlal Nehru National Urban Renewal Mission (JnNURM).* New Delhi. http://jnnurm.nic.in/wp-content/uploads/2012/06/Appraisal-of-JnNURM-Final-Report-Volume-I-.pdf

Hack, Gary. 2013. *Business performance in walkable shopping areas.* Robert Wood Johnson Foundation. http://activelivingresearch.org/files/BusinessPerformanceWalkableShoppingAreas_Nov2013.pdf

HCRRA. 2013. *Project library.* Bottineau Transitway. http://www.bottineautransitway.org/library/planning_framework/Station%20Area%20Planning%20Fact%20Sheet%2005%2029%2013.pdf

Hidalgo, Dario. 2010. "The New Kid on the Block: Metrobus Opens Line 4 in Mexico City." *The City Fix.* April 30, 2010. http://thecityfix.com/blog/the-new-kid-on-the-block-metrobus-opens-line-4-in-mexico-city/

Hidalgo, Dario, Madhav Pai, Aileen Carrigan, Amit Bhatt, and Benjamin Owen. 2012. *National investment in urban transport: Towards people's cities through land use and transport integration.* EMBARQ. http://www.embarq.org/sites/default/files/National%20Investment%20in%20Urban%20Transport%20(EMBARQ%20India)_0.pdf

Hutchinson, Alex. "São Paulo Bike Parking: Mauá and More!" *The City Fix.* 30 June 30, 2011. http://thecityfix.com/blog/sao-paulo-bike-parking-maua-and-more/

IDFC. 2010. "Land Pooling and Reconstitution: A Self-Financing Mechanism for Urban Development." *IDFC Policy Group Quarterly No.7.*

"India gang-rape: Five suspects charged in Delhi." *BBC News.* January 3, 2013.

Institute of Urban Transport (India). 2013. "Capacity Building - Toolkits." Accessed April 6, 2014. http://www.iutindia.org/CapacityBuilding/Toolkits.aspx.

IRC. 1983. *Geometric design standards for urban roads in plains.* Indian Roads Congress.

IRC. 2012. *Guidelines for pedestrian facilities.* Indian Roads Congress.

ITDP and EPC. 2011. *Better streets, better cities: A guide to street design in urban India.* Institute for Transportation and Development Policies.

Jagori and UN Women. 2010. *Safe cities free of violence for women and girls: Report of the baseline survey Delhi 2010.* New Delhi: Jagori and UN Women.

Jaiswal, Anuj, Ashutosh Sharma, and Jigyasa Bisaria. 2012. "Estimation of Public Transport Demand in Million Plus Indian Cities based on Travel Behavior." *International Journal of Engineering and Advanced Technology (IJEAT)* 2:2249-8958. http://www.ijeat.org/attachments/File/v2i1/A0745102112.pdf

JanaUSP. 2011. *Tender S.U.R.E: Specifications for Urban Roads Execution.* Bangalore: City Connect.

Kodransky, Michael, and Gabrielle Hermann. 2010. *Europe's parking U-turn: From accommodation to regulation.* Institute for Transportation and Development Policies.

Kraay, J H. 1986. "Wonnerfs and Other Experiments in the Netherlands." *Built Environment* 12: 20-29. http://www.swov.nl/rapport/R-86-23.pdf

Litman, Todd. 2013. *Parking Management Strategies: Evaluation and Planning.* Victoria Transport Policy Institute.

Llewelyn-Davies. 2003. *Economic benefits of good walking environments.* A report to Transport for London from the Central London Partnership, London: Central London Partnership.

Mahadevia, Darshini , Rutul Joshi, and Abhijit Datey. 2013. "Ahmedabad's BRT System: A Sustainable Urban Transport Panacea?" *Economic and Political Weekly,* 30 11:56-64.

MAPC. n.d. *When private off-street parking isn't the best solution.* Boston: Metropolitan Area Planning Council. http://www.mapc.org/resources/parking-toolkit/strategies-topic/fees-lieu

Martens, Karel . 2006. "Promoting bike-and-ride: The Dutch experience." *Transportation Research* 41:326-338. doi:10.1016/j.tra.2006.09.010

MCGM. 2013. *Mumbai development plan: Preparatory studies report.* Mumbai: Municipal Corporation of Greater Mumbai.

Metrolinx. 2011. *Mobility hub guidelines for the Greater Toronto and Hamilton areas.* Ontario: Metrolinx, Government of Ontario. http://www.metrolinx.com/en/docs/pdf/board_agenda/20110218/mobilityhubguidelines_optimized.pdf

Ministry of Law and Justice. 2009. *The Metro Railways (Amendment) Act*. New Delhi: Ministry of Law and Justice, Government of India.

MMRDA. 2011. *Metro Line 3 – Expression of Interest Background Information.* Mumbai: Mumbai Metropolitan Region Development Authority. http://mmrda.maharashtra.gov.in:8080/documents/10180/400390/080-Metro+Line+3+%E2%80%93%20Expression+of+Interest.pdf/80ad0544-b5df-41e8-831c-2568c3a3fa86;jsessionid=6B0CC1868C2002752BD7E6A527715B0E?version=1.0

—. 2010. Proposed skywalks in Mumbai metropolitan region. *Mumbai: Mumbai Metropolitan Region Development Authority.* Accessed 2014. http://202.54.119.40/docs/skywalk-status.pdf

Mohan, Dinesh, and Geetam Tiwari. 2000. "Mobility, Environment and Safety in Megacities: Dealing with a Complex Future." *IATSS Research* 24:39-46. http://iatss.or.jp/english/research/24-1/pdf/24-1-05.pdf

Moss, Ian David. "Creative Placemaking Has an Outcomes Problem." *Huffington Post.* September 05, 2012.

MoUA&E. 1995. Guidelines on community toilets. *New Delhi: Ministry of Urban Affairs and Employment.* https://www.wsp.org/sites/wsp.org/files/publications/320200734151_guidelinesoncommunitytoilets.pdf

MoUD. 2014a. "National Urban Information System." Accessed November 2014. http://moud.gov.in/nuis.

-- . 2014b. *Urban and regional development plan formulation and implementation (URDPFI) model law.* New Delhi: Ministry of Urban Development, Government of India. http://moud.gov.in/URDPFI

MoUD. 2006a. *National urban information system: Design and standards.* New Delhi: Ministry of Urban Development, Government of India. http://tcp.cg.gov.in/nuis/Design_Standards.pdf

--. 2006b. *National Urban Transport Policy.* New Delhi: Ministry of Urban Development, Government of India.

MoUD. 2012. *Public cycle sharing systems: A planning toolkit for Indian cities.* New Delhi: Ministry of Urban Development, Government of India. http://moud.gov.in/sites/upload_files/moud/files/Public%20Cycle%20Sharing%20Systemf.pdf

MoUD. 2013a. *Outcome budget 2013-14.* New Delhi: Ministry of Urban Development, Government of India. http://www.performance.gov.in/sites/default/files/departments/urban-dev/Outcome%20Budget%202013-14.pdf.

MoUD. 2013b. *Public transport accessibility toolkit.* New Delhi: Ministry of Urban Development, Government of India. http://crisppproject.com/sutp_pdf/Public%20Transport%20Accessibility%20Toolkit.pdf

MoUD-SUTP. 2013. *Financing, fare fixation & cost benefit analysis.* New Delhi: Ministry of Urban Development, Government of India. http://embarqindiahub.org/training/Training-Module-on-Financing-Fare-Fixation-and-Cost-Benefit-Analysis

MoUD-USAID. 2011. "Urban Infrastructure Financing." In *Developing Sustainable and Inclusive Urban Infrastructure Services: A Guidebook for Project Implementers and Policy Makers in India,* by US-FIRE(D), 211-264. Silver Spring: TCG International, LLC.

Mulukutla, Pawan, and Priyanka Vasudevan. 2013. "Expanding the public transport network through a feeder bus system – Challenges and need." Paper presented at the Urban Mobility India Conference, New Delhi.

Naik, Anita. Interview by EMBARQ India. 2014. *EMBARQ India's Safe Access Manual Review* process (7 August).

Naik, Dinesh. Interview by EMBARQ India. 2014. *EMBARQ India's Safe Access Manual Review* process (7 August).

NCRB. 2011. *Accidental deaths and suicides in India.* New Delhi: National Crime Records Bureau, Ministry of Home Affairs. http://ncrb.gov.in/CD-ADSI2011/ADSI-2011%20REPORT.pdf

NIMHNS. 2009. *Bangalore road safety and injury prevention programme: Injury snapshots and activity profile.* Bangalore: NIMHNS. http://www.nimhans.kar.nic.in/epidemiology/bisp/brsipp2009.pdf

NIUA. 2011. *Peer experience and reflective learning (PEARL) under JnNURM.* Urban Initiatives - Volume 4. New Delhi: NIUA. http://jnnurm.nic.in/wp-content/uploads/2012/06/PEARL%20Urban%20Initiatives%20Report%20-%20Vol%204_%20Water%20Supply.pdf

NUIS. 2006. *National urban information system: Design and standards.* New Delhi: Ministry of Urban Development, Government of India. http://moud.gov.in/sites/upload_files/moud/files/pdf/Design_Standards.pdf

NYC DOT. 2012. *Measuring the street: New metrics for 21st century streets.* New York City: New York City Department of Transportation. http://www.nyc.gov/html/dot/downloads/pdf/2012-10-measuring-the-street.pdf

--. 2009. *Street design manual.* New York City: New York City Department of Transportation. http://www.nyc.gov/html/dot/downloads/pdf/sdm_lores.pdf

--. 2013. *The economic benefits of sustainable streets.* New York City: New York City Department of Transportation. http://www.nyc.gov/html/dot/downloads/pdf/dot-economic-benefits-of-sustainable-streets.pdf

NZTA. n.d. *Underpass: Urban design principles.* New Zealand Transport Agency. http://www.nzta.govt.nz/resources/urban-design/principles/underpass/docs/urban-design-principles-underpasses.pdf

Pai, Madhav. 2009. *Integrated transport indicators in India.* EMBARQ India. http://www.embarq.org/sites/default/files/India-Integrated-Transport-Indicators-EMBARQ.pdf.

Peters, Deike. 2013. *Gender and Sustainable Urban Mobility.* Global Report on Human Settlements 2013. Nairobi: UN Habitat. http://unhabitat.org/wp-content/uploads/2013/06/GRHS.2013.Thematic.Gender.pdf

Phadke, Manasi, and Priyal Dave. "The Big Battle for a Way Out." *Indian Express.* February 12, 2014.

Planning Commission of India. 2011. *Report of the working group on financing urban infrastructure.* New Delhi: Government of India. http://planningcommission.gov.in/aboutus/committee/wrkgrp12/hud/wg_Financing_rep.pdf

Project for Public Spaces. 2008. *Streets as places.* New York City: Project for Public Spaces. http://www.pps.org/reference/streets-as-places-initiative/

Ramachandran, Smriti. "Elderly, disabled-friendly features mandatory in metro rail blueprints." *The Hindu.* 27 September, 2013.

Rietbergen-McCracken, Jennifer, and Deepa Narayan. 1998. *Participation and social assessment:Tools and techniques.* Washington D.C.: The International Bank for Reconstruction. http://www.protectedareas.info/upload/document/participationtoolsandapproachs-worldbank.pdf

RMA Architects. 2012. "Community Toilets for SPARC". Accessed April 22, 2014. http://rmaarchitects.com/architecture/community-toilets-for-sparc/

Schabas, Jake. "Putting the Public Back in Midtown's Privately Owned Public Spaces." *StreetsBlog* NYC. May 22, 2012. http://www.streetsblog.org/2012/05/22/putting-the-public-back-in-midtowns-privately-owned-public-spaces/.

Serageldin, Mona, David Jones, Francois Vigier, and Elda Solloso. 2008. *Municipal financing and urban development, Human Settlements Global Dialogue, Series no. 3.* Nairobi: UN Habitat.

SFPD. n.d. "Privately Owned Public Open Spaces and Public Art." Accessed March 7, 2014. http://www.sf-planning.org/index.aspx?page=3339

Shankar, Sanjeev. 2013. "Jugaad Canopy." Accessed April 24, 2014. http://www.sanjeevshankar.com/jugaad.html

Sharma, Sharanya M., and Pankti Mehta. "Skywalks dont rise to Safey Needs." *Hindustan Times.* December 19, 2011.

Shoup, Donald. 1997. "The High Cost of Free Parking." J*ournal of Planning Education and Research* 17:3-20. http://www.uctc.net/papers/351.pdf

Singh, Abhimanyu, and Ranjit Gadgil. 2011. *Comprehensive assessment of cycle tracks in Pune.* Pune: Parisar. http://www.parisar.org/activities/analysesreports/144-cycle-track-assessment.html

Singh, Jaspal. 2010. "Public Private Parnerships in Urban Transport." Research India. http://www.slideshare.net/jaaaspal/publicprivate-partnership-in-urban-transport.

Singh, R.K. 2013. "Letter No.K-14011/1/2007-UT-IV." *MoUD Advisory/ Circular.* New Delhi: Department of Urban Transport, India, 30 August.

Srinivasa, Sumeeta. 2008. "A Spatial Exploration of the Accessibility of Low-Income Women: Chengdu, China and Chennai, India." *In Gendered Mobilities,* edited by Tanu Priya Uteng and Tim Cresswell, 143–158. Hampshire: Ashgate.

Stratis, Socrates. 2012. *Creating a porous urban connective tissue.* Vienna: Europan. http://admin.brainserver.net/uploads/aau/projects/ARTICLES/ARTICLES_BY_SOCRATES_STRATIS_/WelcomeBackToMyBackYard/WelcomeBackInMyBackYard.pdf

Suresh, B, H C Puneeth, K Dileep, K Jay, and B Deepak. 2012. *Bus stops and bus bays in Bangalore: A status report.* Status Report, Bangalore: Centre for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP). http://cistup.iisc.ernet.in/pdf/Bus%20Stop%20and%20Bus%20Bays%20in%20Bangalore%20A%20status%20report%202012.pdf

SUTP. 2010. Public bicycle schemes: Applying the concept in developing cities. New Delhi: Sustainable Urban Transport Project.

TCGI and AECOM. 2008. *Preparation of local area plans: Pilot project for Delhi, India.* New Delhi: United States Agency International Development (USAID). http://pdf.usaid.gov/pdf_docs/pnaea781.pdf

TCGI. 2009. *Delhi local area plans.* New Delhi: Indo - US Financial Institutions Reform and Expansion Project - Debt Market Component FIRE(D), The Communities Group International (TCGI), New Delhi: United States Agency for International Development - India. http://www.tcgillc.com/firenotes/41.pdf

Tefft, Brian C. 2013. "Impact Speed and a Pedestrian's Risk of Severe Injury or Death: Accident Analysis and Prevention." *Accident: Analysis and Prevention* 50:871-878. https://www.aaafoundation.org/sites/default/files/2011PedestrianRiskVsSpeed.pdf

TERI. 2014. *Pedalling towards a greener India: A report on promoting cycling in the country.* New Delhi: The Energy and Resources Institute. http://www.teriin.org/eventdocs/files/Cycling_Report_LR.pdf

Tiwari, Geetam, and Deepty Jain. 2013. *NMT infrastructure in India: Investment, policy and design.* UNEP. http://www.unep.org/Transport/lowcarbon/Pdf%27s/NMTInfrastructure_India.pdf

Tiwari, Geetam, and Himani Jain. 2008. "Bicycles in Urban India." Urban Transport Journal 7:59-68. http://tripp.iitd.ernet.in/publications/paper/planning/bicle%20in%20india-IUT-himani.o.pdf

Transport for London. 2006a. "Bus priority at traffic signals keeps London's buses moving: Selective Vehicle Detection." Accessed May 28, 2014. http://www.tfl.gov.uk/cdn/static/cms/documents/svd-brochure.pdf

--. 2006b. "Traffic enforcement: Impact analysis and future strategies." London: Transport for London. http://ec.europa.eu/transport/roadsafety_library/consultations/enforcement_20061106/enforcement_sparks_2.pdf

--. 2007. *Legible London: Yellow Book - A prototype wayfinding system for London.* London: Transport for London. https://www.tfl.gov.uk/cdn/static/cms/documents/ll-yellow-book.pdf

Umbrajkar, Manish. “PCMC sets up dedicated urban transport fund.” *Times of India.* 24 January 24, 2009.

UN Habitat. 2013. *Streets as public spaces and drivers of urban prosperity.* UN Habitat. http://unhabitat.org/streets-as-public-spaces-and-drivers-of-urban-prosperity/

USAID. 2008. *Preparation of Local Area Plans: Pilot Project for Delhi, India.* New Delhi: Indo-USAID Financial Institutions Reform and Expansion Project. http://pdf.usaid.gov/pdf_docs/pnaea781.pdf

UTTIPEC. 2010. *Street design guidelines.* Delhi: Unified Traffic and Transportation (Planning and Engineering) Center, Delhi Development Authority. http://www.uttipec.nic.in/StreetGuidelines-R1-Feb2011-UTTPEC-DDA.pdf

UTTIPEC. 2012. *Transit Oriented Development: Policies, Norms and Guidelines.* New Delhi: Delhi Development Authority. http://uttipec.nic.in/writereaddata/linkimages/1304972657.pdf.

Vernooy, Ronnie, Sun Qui, and Jianchu Xud. 2006. “The Power of Participatory Monitoring and Evaluation: Insights from South-West China.” *Development in Practice* 16: 400-411. doi:10.1080/09614520600792275.

VTPI. 2012. “Roadway Connectivity: Creating More Connected Roadway and Pathway Networks.” Accessed July 5, 2014. http://www.vtpi.org/tdm/tdm116.htm

WACAV. 1995. *Safety audit tools and housing: The state of the art and implications for CMHC.* Ottawa: Canada Mortgage and Housing Association.

Wegman, Fred, and Peter Wouters. 2002. *Road safety policy in the Netherlands: Facing the future.* Leidschendam: SWOV Institute for Road Safety Research.

Whitzman, Carolyn, Margaret Shaw, Caroline Andrew, and Kathryn Travers. 2009. “The Effectiveness of Women’s Safety Audits.” *Security Journal* 22:205–218. doi: 10.1057/sj.2009.1.

WHO. 2013 . “Global Status Report on Road Safety.” Accessed January 25, 2014. http://www.who.int/en/

Wilbur Smith Association. 2008. *Study on traffic and transportation policies and strategies in urban areas in India.* New Delhi: Ministry of Urban Development, Government of India.

Williamson, June. 2013. *Designing Suburban Futures: New Models from Build a Better Burb.* Washington D.C.: Island Press.

WMATA. 2008. *Station site and access planning manual.* Washington Metropolitan Area Transit Authority. http://www.wmata.com/pdfs/planning/station%20access/ssapm.pdf.

Woo, Patricia. “Skywalks in Hong Kong and their Consequences on Urban Communities.” *Places: A Critical Geographical Blog.* July 2, 2012.

Woo, Patricia, and Lai Choo Malone-Lee. 2011. *Assessing Skywalk Systems as a Response to High Density Living in Hong Kong. Unpublished Thesis.* Singapore: National University of Singapore.

World Bank. 2011. *A gender assessment of Mumbai’s public transport.* Washington, DC: World Bank. http://documents.worldbank.org/curated/en/2011/06/16234216/gender-assessment-mumbais-public-transport

--. 2013. *Planning, Connecting and Financing Cities--Now: Priorities for City Leaders.* Washington DC: The World Bank.

Wyman, Lance. 2005. “Lance Wyman Ltd.” Accessed April 22, 2014. http://www.lancewyman.com/

Yazıcı, Anıl M., Herbert S. Levinson, Mustafa Ilıcalı, Nilgün Camkesen, and Camille Kamga. 2013. “A Bus Rapid Transit Line Case Study: Istanbul’s Metrobüs System.” *Journal of Public Transportation* 16:153-177. http://www.nctr.usf.edu/wp-content/uploads/2013/03/16.1_yazici.pdf

Endnotes

1. Favelas is the term used for slums or shantytowns in Brazil and other Latin American countries.

2. It includes sanctioned investments of INR 4770.86 crores (0.8 billion USD) in 9 BRTS projects and 90,000 crores (15 billion USD) for 7 metro-rail systems.

3. The incident of violence against a woman, now known as the Nirbhaya incident in India happened on the evening of 16 December 2012 in New Delhi. A 23 year old woman and her male friend had boarded a private bus to go home when the other 5 men on board the bus assaulted both of them and raped the woman before throwing them out of the moving bus. The woman eventually succumbed to her injuries on 29 December 2012 while under medical care in Singapore. This incident followed a series of other instances of violence against women and became a trigger for widespread protests across the country. It compelled authorities to acknowledge the systemic lack of safety and security that impacted women while negotiating urban spaces in Indian cities. The young woman in this case was called Nirbhaya (Fearless) during the court case to protect her identity and the subsequent amendments were called the Nirbhaya Act (India gang-rape: Five suspects charged in Delhi," *BBC News*, January 3, 2013).

4. Street Design Guidelines (UTTIPEC 2010), Better Streets, Better Cities (ITDP and EPC 2011), Tender SURE (JanaUSP 2011)

5. Some examples include Mobility Hub Guidelines by (Metrolinx 2011), Station Site and Access Planning Manual by Washington Metropolitan Area Transit Authority (2008), BART Station Area Access Guidelines by Bay Area Rapid Transit (2003).

6. The anglicized version of the name Bengaluru is Bangalore. The name of the city was officially changed to Bengaluru on November 1, 2014 after approval from the Government of India (Chinappa, "Centre nod for Karnataka's proposal on renaming cities," *The Hindu,* October 18, 2014.)

7. The Directorate of Urban Land Transport (DULT), Government of Karnataka was set up in 2007 to coordinate planning and implementation of urban transport solutions. It functions under the Urban Development Department of the state, and has oversight over all land transport initiatives in the urban and local planning areas across the state of Karnataka.

8. In 2007 as per the notification of the Karnataka government the then municipal corporation of Bangalore merged with city and town municipal councils of adjoining areas and with 111 villages to form a single administrative agency called the Bruhat Bengaluru Mahanagara Palike (BBMP).

9. 80 percent of the station area is within the census ward, Hoysala Nagar, Ward 82

10. The 2009 notification from the UDD of the Government of Karnataka is an amendment to the Zoning Regulations of the Master Plan of the Bangalore Development Authority. It stipulates that a maximum permissible floor area ratio (FAR) of 4 is allowed on plots within 150 m of the outer boundary of a Metro station.

11. When considering walking and bicycling as main modes and for last mile connectivity.

12. For example, in Mumbai, the scope of work of consultants includes "planning and design of Station Area Traffic Improvement Scheme (SATIS) including validation through computer simulation" (MMRDA 2011). In Bangalore, the preparation of Station Accessibility Plans around metro stations includes seven tasks. These are confirming the scope, approach and methodology of the station accessibility plan; data collection and documentation required; preparing a master list of proposals; preparing an implementation program; detailing phase 1 proposals; supporting stakeholder participation workshops and finalizing proposals. This is expected to be completed within 20 weeks (DULT 2013). Both of these focus on the preparation of the station accessibility plan and implementation plan. In Mumbai, no stakeholder participation is outlined, whereas in Bangalore, it is to be conducted after the documentation stage and proposal stage. In Delhi, the preparation of LAPs "emphasized integration of participatory planning approaches at every stage". However, it was observed that there were varying degrees of public involvement and in some cases lack of representation of the urban poor (TCGI 2009).

13. While these are generally known as women's safety audits, the term women's security assessments is used here to differentiate from road safety audits.

14. Parisar is a civil society organization, based in Pune, lobbying and advocating for sustainable development.

15. The estimated population of MIDC Marol is 189290 in 2014.

16. Hong Kong and Tokyo have 2 and 4.5 square metres open space per person respectively (MCGM 2013)

17. Woonerfs are a concept from the Netherlands of traffic calmed shared street space where all modes use the same paved space but the priority of use is for walking, playing and a meeting place. Though traffic can move along these paths, through traffic is not allowed on woonerfs (Kraay 1986).

18. Home zones are an urban design concept in the United Kingdom wherein non-motorised users are prioritised in residential areas and streets are considered as places for people. Design is used to limit traffic speeds to less than 20mph in these zones (Department for Transport 2005).

19. The revised URDPFI Model law identifies the need for integration between the different levels of plans—including integration of city development plans and comprehensive mobility plans with other statutory planning systems (MoUD 2014b).

20. "The multiplicity of urban local bodies in large cities and overlapping jurisdiction has many a times led to confusion in their roles and cross-purpose functioning. Isolation in spatial planning and lack of coordination are among the common issues faced by all State Governments", (MoUD 2014b).

21. Economic activity and opportunity is often an indirect impact of a safer, comfortable and improved area. This impact is difficult to isolate to specific neighbourhoods or physical improvements as it could be attributed to changes at multiple scales, regulations or economic cycles. However, increasingly officials and leaders undertaking such improvements around the world, (notably in North America) are looking at this economic activity enabled as a result of street level improvements, including but not exclusively around stations (Llewelyn-Davies 2003); (CABE 2007); (Hack 2013).

22. Routine maintenance encompasses activities such as cleaning etc. which keeps the station area functioning smoothly and clean. This type of maintenance generally occurs on a daily basis and requires limited skills. Urgent maintenance refers to the interventions due to sudden disruptions such as weather damage etc.

23. Various toolkits developed by the Ministry of Urban Development. Source: http://urbanindia.nic.in/programme/ut/Service_level.pdf

24. Ewing and Clemente (2013) provide a detailed approach to measuring urban design itself, while Gehl and Svarre (2013) present key criteria for evaluating public life in such public spaces. These include protection against traffic and accidents, protection against crime and violence, protection against unpleasant climate and unpleasant sense experiences, possibilities for walking, sitting, and standing, possibilities to see, play/unwind, hear/talk, small scale services like public amenities and designing for positive experiences.

25. The Department of Transportation, New York City captures economic vitality due to street improvements through a number of indicators including the numbers of businesses in an area, the employment generated, retail sales logged, and visitor spending. The studies "Measuring the Street: New Metrics for 21st Century Streets" (2012) and "The Economic Benefits of Sustainable Streets" (2013) can be accessed for more detail. Indicators such as increased rental values, while beneficial for land owners can gentrify existing areas and thus are not included.

Authors

Sonal Shah is Principal Associate with Urban Development and Accessibility, EMBARQ India. She coordinates projects on improving accessibility to mass transit stations, within business districts and residential neighbourhoods through street and public space design. Sonal has over 10 years' experience in architecture, research, urban planning and design in the USA and India. She has worked on development plans, heritage management plans, urban redevelopment, and housing policy research. She holds a Master's in International Planning from Columbia University, New York and a Bachelor's in Architecture from Kamla Raheja Vidyanidhi Institute for Architecture and Environmental Studies, Mumbai.

Sahana Goswami is an Associate with Urban Design and Accessibility, EMBARQ India. Her work includes developing publication ideas based on projects undertaken by the UDA team and analysing the current state of transport and urbanism in India to identify design, policy or implementation gaps that EMBARQ India can address. Prior to EMBARQ India Sahana worked as an architect and urban planner in a private design firm handling a wide range of architectural and urban projects. She holds a Master's in Urban Planning from the University of Wisconsin-Milwaukee and a Bachelor's in Architecture from the School of Planning and Architecture, JNTU, Hyderabad.

Lubaina Rangwala is an Associate with Urban Development and Accessibility EMBARQ India. She coordinates projects on improving integration between land use and transportation in areas adjoining transit nodes within Mumbai. Prior to EMBARQ, Lubaina worked at the City of Emeryville and the City of Berkeley in California, USA, where she provided GIS support and research support for their programs. She holds a Dual Master's in Architecture and City and Regional Planning from the University of California, Berkeley and a Bachelor's in Architecture from Kamla Raheja Vidyanidhi Institute for Architecture and Environmental Studies, Mumbai.

Robin King is the Director of Urban Development and Accessibility at EMBARQ. In this role, she promotes collaboration across the EMBARQ network and integration of sustainable transportation and urban development using her experience working in policy matters in the Americas and Asia. Prior to EMBARQ, Robin worked as Principal Research Scholar at the Centre for Study of Science, Technology and Policy (CSTEP), in Bangalore, where she helped lead the Next Generation Infrastructure Laboratory since August 2008. She holds a PhD in Economics from the University of Texas at Austin, and a BS in Foreign Service from Georgetown University. She spent a year as a Rotary Exchange student in Oruro, Bolivia, and more than a year as a Fulbright Scholar in Mexico.

Himadri Das is the Program Manager for Urban Development and Accessibility at EMBARQ India. He works to make technical and managerial inputs in urban development and accessibility projects, and engages with the transport and GHG teams to coordinate components within project towards comprehensive outputs. Prior to EMBARQ, Himadri worked for organizations that advised and consulted with planning institutions in various part of India, as well as in Libya, Africa. Himadri has a Master's in Architecture (Urban Design) from India, an advanced Masters in Human Settlements from Katholieke University of Leuven, Belgium and a Bachelor's in Architecture from TVB School of Habitat Studies. New Delhi.

Akhila Suri was a consultant with Urban Development and Accessibility at EMBARQ India. During her tenure here she worked on safe access and sustainable mobility projects in Bangalore and Hubli. She has a Master's in Architecture (Urban Design) from CEPT, India and a Bachelor's in Architecture from Rachana Sansad Academy of Architecture, Mumbai.

Acknowledgements

This Manual was made possible through funding from Bloomberg Philanthropies.

The Safe Access Manual, Volume I: Safe Access to Mass Transit Stations in Indian Cities is an outcome of EMBARQ India's projects and research. The authors thank the entire EMBARQ India team for giving their valuable time to explain projects, share research and review the content. We would especially like to thank Madhav Pai, Director, EMBARQ India and staff – Binoy Mascarenhas, Pawan Mulukutla, Nikhil Chaudhary, Vijay Anadkat, Sreekumar Kumaraswamy, Surya Prakash V., Tejas Pande and Saurabh Jain. We would also like to thank Rekha Raghunathan for editing this manuscript and Sachin Aggarwal for communication and outreach

We also acknowledge the time and effort of our reviewers within the EMBARQ network: Amit Bhatt, Strategy Head -Integrated Urban Transport, EMBARQ India; Anjali Mahendra, Strategy Head– Research and Practice, EMBARQ India; Ben Welle, Senior Associate - Health and Road Safety, EMBARQ; Dario Hidalgo, Director - Research and Practice, EMBARQ; Lakshmi Rajagopalan, Managing Associate – Research and Practice, EMBARQ India; and Rejeet Matthews, Project Manager - Urban Development & Accessibility, EMBARQ India.

We are grateful to the experts outside of EMBARQ that made time to review a final draft of the report: Anita Naik, Urban Planner (Development Plan), Municipal Corporation of Greater Mumbai; Commissioner Manjula V., Directorate of Urban Land Transport, Government of Karnataka; Dinesh Naik, Town Planning Officer for Greater Mumbai and Deputy Chief Planner (Development Plan); Laghu Parashar, Manager, Infrastructure Leasing and Financial Services / Urban Mass Transit Company; Nilesh Rajadhyaksha, Architect- Urban Planner; Zachary Tofias, Director – C40 Sustainable Communities Initiative and C40 Cities Climate Positive Development Group.

Suggested Citation

Shah, Sonal, Sahana Goswami, Lubaina Rangwala, Robin King, Himadri Das, Akhila Suri. 2014. *Safe Access Manual: Safe Access to Mass Transit Stations in Indian Cities.* Bangalore: EMBARQ India.

Photo Credits

Cover Benoit Colin/ EMBARQ flickr; inside cover Meena Kadri/ flickr; facing contents page Benoit Colin/ EMBARQ flickr; p.iii EMBARQ/ flickr; facing key terms defined Meena Kadri/ flickr; p.8 EMBARQ India; p.10 EMBARQ India; p.13 EMBARQ India; p.14 EMBARQ India; p.16 Rajeev Malagi; p.17 Meena Kadri/ flickr; p.26 Suryaprakash V.; p.29 Velaparatodo/ flickr; p.34 EMBARQ India; p.39 Velaparatodo/ flickr; p.50 EMBARQ/ flickr; p.51 EMBARQ India, EMBARQ/ flickr, Ramkumar Ramachandra/ flickr; p.53 Sudeept Maiti, Cfaifayeas/ Wikimedia Commons; p.54 EMBARQ India; p.55 Benoit Colin/ EMBARQ flickr; p.56 EMBARQ India; p.58 Sonal Shah, Akhila Suri; p.59 EMBARQ Mexico; p.61 EMBARQ India; p.64 Meena Kadri/ flickr; p.67 EMBARQ India; p.69 EMBARQ India; p.74 EMBARQ India; p.75 Filip Krikava/ flickr; p.84 SMC Infrastructure; p.85 CONSIA, EMBARQ/ flickr; p.101 EMBARQ India; p.102 EMBARQ India; p.107 Paul Barter; p.108 Cycleinhel/ flickr; p.110 Juliana C. Silva; p.111 EMBARQ/ flickr; p.115 EMBARQ Turkey and GEHL Architects; p.118 Kahunapule Michael Johnson/ flickr, Alister Coyne/ flickr, Rajeev Malagi; p.121 Benoit Colin/ EMBARQ flickr; p.122 EMBARQ India; p.123 Hallgrimsson/ Wikimedia Commons, Sergei S. Scurfield/ Wikimedia Commons, Rept0n1x/ Wikimedia Commons, anabananasplit/ flickr; p.124 Sonal Shah; p.125 EMBARQ India; p.126 Design for Health/ flickr; p.129 Mike Carrick/ flickr, Lynn Friedman/ flickr, Peter Eimon/ flickr; p.130 Albert Bridge/ flickr; p.133 Dan Reed/ flickr, Dylan Passmore/ flickr, Sonal Shah; p.134 RMA Architects; p.135 Dylan Passmore/ flickr, Graham Coreil-Allen/ flickr, Sundeep Bali/ www.sanjeevshankar.com; p.137 GAED/ Wikimedia Commons; p.141 Rajeev Malagi; p.149 Benoit Colin/ EMBARQ flickr; p.158 Sonal Shah; Appendix V-A Akhila Suri; Appendix V-B William Vito/ flickr; Appendix V-C Steve Rhodes; Appendix VI Sonal Shah; Appendix VII EMBARQ India; facing list of figures Charles Haynes/ flickr

EMBARQ
10 G Street, NE, Suite 800
Washington, DC 20002
USA
+1 (202) 729-7600

EMBARQ BRASIL
Av. Independência, 1299 / 401
Porto Alegre, RS
BRASIL, 90035-077
+55 (51) 33126324

EMBARQ CHINA
Unit 0902, Chaowai SOHO Tower A
Yi No. 6
Chaowai Dajie, Chaoyang District
Beijing 100020, China
+86 10 5900 2566

EMBARQ INDIA
Godrej and Boyce Premises
Gaswork Lane, Lalbaug
Parel, Mumbai 400012
+91 22 24713565

EMBARQ MÉXICO
Calle Belisario Dominguez #8,
Planta Alta
Colonia Villa Coyoacán, C.P. 04000
Delegacion Coyoacán, México D.F.
+52 (55) 3096-5742

EMBARQ TÜRKIYE
Sürdürülebilir Ula□ım Derne□i
Gümü□suyu Mah. □nönü Cad.
No:29 Saadet Apt. Kat:6 D:7
Taksim, Beyo□lu, □stanbul
Tel: 0 (212) 243 53 05