SMART STREETS AND SMART CITY – A CASE STUDY OF PUNE'S ITI ROAD

Prasad PATHAK
FLAME University, Pune, India
prasad.pathak@flame.edu.in

Anup TRIPATHI
FLAME University, Pune, India
anup.tripathi@flame.edu.in

Aparna SHANKAR
FLAME University, Pune, India
aparna.shankar@flame.edu.in

Abstract
Improving walkability is an important aspect to consider, given growing urbanization in India and globally. Walkability has been studied as an outcome of the built environment and linked with better health outcomes and completeness of transportation network. In India, the Smart City Mission has considered improvement of non-motorized transport via projects like Smart Streets. This study is an attempt to look at one such smart street in Pune where a stretch of road segment was redesigned to facilitate pedestrian movement. This being a pilot attempt for the future street redesigning, a qualitative assessment is presented here depicting pros and cons of the same. Our initial findings indicate that despite its many obvious shortcomings at the moment, a dedicated walkability and Smart Street infrastructure is a welcome step in creating sustainable, equitable and inclusive smart cities of the future.
Keywords: Smart city, Walkability, Smart Street, Pune;

1. INTRODUCTION

Approximately 55% of the global population is urban. It is predicted that, by 2030, more than 68% people in the world would be living in the urban areas (Elmjid 2018). On one hand, urbanisation is viewed as an impetus to economic growth at local and regional scales. On the other hand, it presents challenges such as intensification of climate change, pollution, and depletion of resources. At the local level, challenges like transportation, health and sustainable supply of required resources may become extremely difficult to tackle. One of the issues confronting urban areas is the increasing dependency on motorized transportation. As the number of vehicles rise, they create a demand for more roads and allied infrastructure.

India has witnessed urban population growth of 31.8% between the census of 2001 and that of 2011. Cities with more than 1 million population have increased from 35 to 53 in 2011 and they are still growing in number. According to Vijyalakshmi and Krishnaraj (2019), there were only 9 vehicles per 1000 urban population during the years 1960-65 in India. That has changed to 402 vehicles per 1000 population within 2011-15. From 2001 to 2011, the total urban road length has gone up from 2.5 lakh kilometers to 4.64 lakh kilometers. In 2017, it has increased to 5.26 lakh kilometers (Transport Research Wing of the Ministry of Road Transport & Highways 2019). Increase in the road network is essential for connectivity, equitable access and socio-economic development in any region. However, in India, the rapidly expanding road network has led to the building of a vast network of less well-structured streets in which the movement of motorized transport is prioritised over non-motorized transport modes like walking and cycling. It has also ignored movement of individuals with disabilities. Despite the National Urban Transport Policy, 2014 highlighting the importance of non-motorized transport like walking and cycling and promising financial measures for the same, a lot remains to be implemented to reach the desired end (Ministry of Housing and Urban Affairs Government of India 2014). Thus, the current urban growth is confounded by increasing socio-economic inequalities, increased energy consumption and inactive lifestyles of the urban dwellers.

In 2015, the Government of India launched the Smart City Mission and the concept of a 'Smart Street' was put forth. The idea was to help cities achieve better infrastructure and quality of life, and to help them serve as "a replicable model which will act like a lighthouse to other aspiring cities" (Ministry of Housing and Urban Affairs Government of India 2015). The Smart City Mission has envisaged eight features of a smart city that were to be implemented in 105 selected cities (Ibid.). One of the important features is to promote a variety of transport options - Transit Oriented Development (TOD), public transport and last mile para-transport connectivity. Additionally, creating walkable localities is also envisaged as a feature of Smart Cities. It aims at reducing congestion, air pollution and resource depletion, boosting the local economy, promoting interactions and ensuring security. Urban mobility is also envisaged as Smart Solutions under the Smart Cities Mission. Consequently, the road network is created or refurbished not only for vehicles and public transport, but also for pedestrians and cyclists, and necessary administrative services are offered within walking or cycling distance.

In several projects under the mission, infrastructure for walking has been proposed and is being implemented. This research has qualitatively analysed the smart city infrastructure projects enhancing walkability in Pune and employs Geospatial analysis of the neighbourhood to gain a holistic perspective of Smart Street.

2. LITERATURE REVIEW

Walkability or rather lack of it is gaining attention globally. It is being studied with respect to health aspects such as active lifestyle benefits, cardiovascular conditions, and age wise walkability requirements; to mention a few. While studying the connection between walkability at neighborhood level and health aspects such as cardiorespiratory fitness (CRF), muscular strength, and rigorousness of physical activities, research in Calgary (Canada) found that the general physical environment provided by the neighborhood was important. Walkability was an integral component of it (McCormack et al. 2020). Earlier, Hoehner et al. (2011) explored the relationship specifically between CRF and walkability. Among the three neighbourhoods studied in Texas, the authors observed that the neighborhood in which residents travelled less for work and opted for walking had better CRF and Body Mass Index (BMI). Walkability is definitely important for urban areas where an older population exists. A cross-sectional study of the older population in Hong Kong found out that environmental walkability was strongly linked with health-related quality of life. It was observed that aesthetics and physical barriers were correlated with walkability and mental health of the 340 participants (Zhao & Chung 2017). Nonetheless, there is an implicit connection between land use planning, walkability, air pollution and health. In a study carried out in Shenzhen city of China, neighbourhoods with less walkability were observed to have more exposure to particulate matter pollution and higher rates of cardiopathy (Su et al. 2017).

In urban transportation establishments, success of any public transport depends on its last mile connectivity. As illustrated by Ozbil in his dissertation, the last mile connectivity in terms of walkability around mass transit stations is critical for station patrons (Ozbil 2010). The study looked at street networks within 1-, 0.5-, and 0.25-mile radii around the public transit stations. The streets with denser intersections and linear alignments of roads exhibited longer walking distance thresholds. When the city of Manila (Philippines) was studied to understand when people choose walking as their first and last-mile mode of transport, the accessibility, egress time, cost over time and safety were the major influencing factors (Fillone & Mateo-Babiano 2018). Similar findings were arrived at in Singapore when first and last-mile choices were studied. Land use mix, higher levels of socioeconomic activities and closeness to the mass rapid transit stations encouraged walking as the choice for first or last-mile connectivity (Mo et al. 2018).

Promotion and improvement of walkability requires several aspects as prerequisites. Safety and security aspects includes presence of dedicated sidewalks, barrier free infrastructure, road crossing with safety measures such traffic lights or speed bumps, and rescue islands; to name a few. Similarly, design of the walkable infrastructure should be supportive and pleasant. For example, vendors and commercial extensions should occupy some portion of it to develop active edges but should not cause obstruction in walking. It must be emphasized that the most important aspect, the policy and its implementation are a must (Barman & Daftardar 2010; Kumar & Ramakrishnan 2020; Bhattacharya et al. 2019). Several indices have been proposed and used by walkability research communities. Shashank and Schuurman (2018) have discussed three indices which are widely used. They are, namely, index by Frank et al (2005), index by Sundquist et al (2015), and index by Buck et al (2011). The common factors used in these indices are land use mix, residential density, and street connectivity.

In India, Clean Air Initiative, Asia (CAI, Asia) has carried out walkability analysis in six cities (Gota et al. 2010). While the authors categorized selected cities into different zones such as industrial, educational, residential, and commercial; they used nine parameters to assess walkability. These factors dealt with availability of sidewalks, quality of amenities, and modal interactions. Bhubaneshwar was the most walkable city according to their survey. This study commented about Pune that it has good enough walkability. The limitation of this study was, however, that not a significant amount of road segments was included to derive this conclusion. Therefore, at the most, this could be an indicative study.

Most of the above mentioned studies lack the consideration of walking and cycling as a right, and road as a space being shared by motorized and non-motorized transport. The treatment of walking as a solution to health conditions or walking being a secondary or supportive non-motorized transportation mode disables larger considerations about improving walkability in urban setup. Therefore, through this study we want to bring walkability into the discussion wherein the focus is on walking as the primary mode of transportation that shares transportation space on the road with other motorized transport.

Currently, there is an attempt to implement Complete Street Design via Smart Street development in Indian Smart Cities (Institute for Transportation Development and Policy India n.d.). It is considered as a pilot redesigning of the streets. Replication of the same is assumed to be a solution to improve walkability in these cities. Complete street design has provided infrastructure guidelines for different road types. The three major road categories that are considered are – arterial roads which connect major areas in a city, connector streets which connect local streets to arterial roads, and the local streets which indicate the locations of trip origin or destinations. The Complete Street Design treats these road categories separately. Separate footpath/sidewalk is suggested for arterial streets and connectors. Local streets could have sidewalks only if they are wider than 12 meters. The same way, a separate cycle path could be there for arterial roads only if they are wider than 24 meters. Other road types will have mixed mode transportation. On street parking is discouraged on arterial roads but other road types can have it. At-grade crossing is suggested for all the road types. Arterial and connectors should have public transport modes. While mass rapid transit and service lanes could be there only for arterial roads.

For Pune, specifically, certain streets are being redesigned. Major examples are – Fergusson College Road, Jangli Maharaj road and ITI road. Most of them are implementing the Complete Street Design and adding more public spaces along the sidewalks. These activities are being done under Smart City Mission as Pune was one of the first cities selected under the mission. Within the smart city mission, there are various projects being implemented in Pune. Metro rail is being built in order to reduce vehicular traffic. Technology projects such CCTV installation, central monitoring facility, and solar light installation are also being implemented. Within the Aundh-Baner-Balewadi (ABB) area, Aundh ITI road is developed as a Smart Street. Pune requires improvement in walkability because of the steady rise in the population. Pune's population has increased by 2.69% during 2001-2011 census period. In 2011, it was approximately 50 lakhs and by 2020, the population estimates are of 66 lakhs, given that official census is yet to occur (World Population Review n.d.).

At the same time, there is an overall increase of 2 to 3 lakh vehicles in the city per year. By 2018-19, there were approximately 39 lakh vehicles on Pune's streets (Ranjan 2019). Pune has been consistently recording pedestrian injuries and fatalities due to accidents.

FIGURE 1 - GRAPHICAL REPRESENTATION OF PEDESTRIAN INJURIES AND FATALITIES FOR THE YEARS OF 2016, 2017 AND 2018
Source: Open Data Portal – Road fatalities, Pune

As given in Figure 1, the numbers indicate that more than 100 people get injured and more than 200 fatalities are observed annually among pedestrians in Pune. These numbers approximately range 26% and 28% of total injuries and fatalities, respectively, for the city in 2018 and similar is the case for the other two years. Thus, there is an urgent need to improve walkability. Therefore, in this research, a qualitative approach is adopted to study one of the smart streets in Pune and visualize it in geospatial aspects linked with it to understand its usefulness in isolation and at neighborhood scale.

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3. METHODOLOGY

Study area: Pune city is located approximately 200 km east of Mumbai, the financial capital of India. It has its own importance in the region for education institutes, biodiversity, pleasant climate, and in recent years, IT industries. As mentioned earlier, it has gained place in the first 20 cities selected via smart city proposal competition by the central government. It has a huge road network spread connecting various parts of the city (Figure 2).

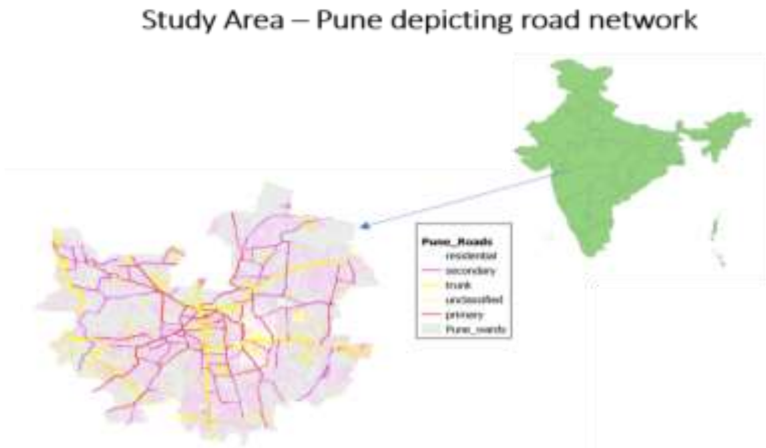

FIGURE 2 - STUDY AREA – INDIA, PUNE WARD SHAPEFILE, OPENSTREETMAP BASED STREET NETWORK

TABLE 1 - DATA AND THEIR SOURCES

Data	Source
Road segments with "Type" attribute	OSM data
Building footprints	OSM data
Shops	OSM data
Bus stops	Google maps and field observation
Crossings	Google maps and field observation
Speed calming measure/speed bump	Field observation

Table 1 summarises the various kinds of data used in the study and their sources. OpenStreetNetwork ((OpenStreetMap 2017)) data was one of the major sources. The data divides roads into Trunk, Primary, Secondary, Tertiary and residential categories. Comparison of these with the Complete Street design is as follows:

TABLE 2 - COMPARISON BETWEEN OSM AND COMPLETE STREET DESIGN ROAD CATEGORIES

OSM Categories	Complete Street Design categories
Primary	Arterial
Secondary	Connector
Tertiary	Connector
Residential	Local streets
Trunk (equivalent to highway)	Not included

To understand and analyse the smart street with respect to infrastructure for walkability, the research team carried out a preliminary survey of the stretch of the street that included transit walking and observation. Spatial data about road network and Points of Interests was availed from OpenStreetMaps. This data was used to understand, street type of the smart street, active edges, and distribution of other streets around the smart street. QGIS, an open-source geospatial tool, used visual interpretation of the information.

3. FINDINGS: SMART STREET AS THE SITE OF NORMATIVE DISPLAYS

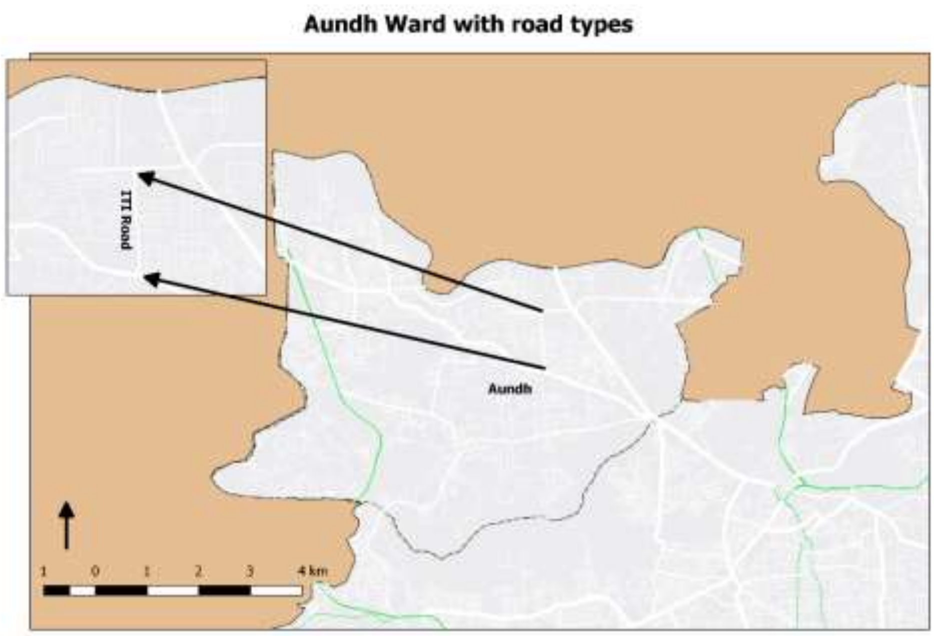

FIGURE 3 - LOCATION OF ITI ROAD AND ROAD CATEGORIES AROUND IT

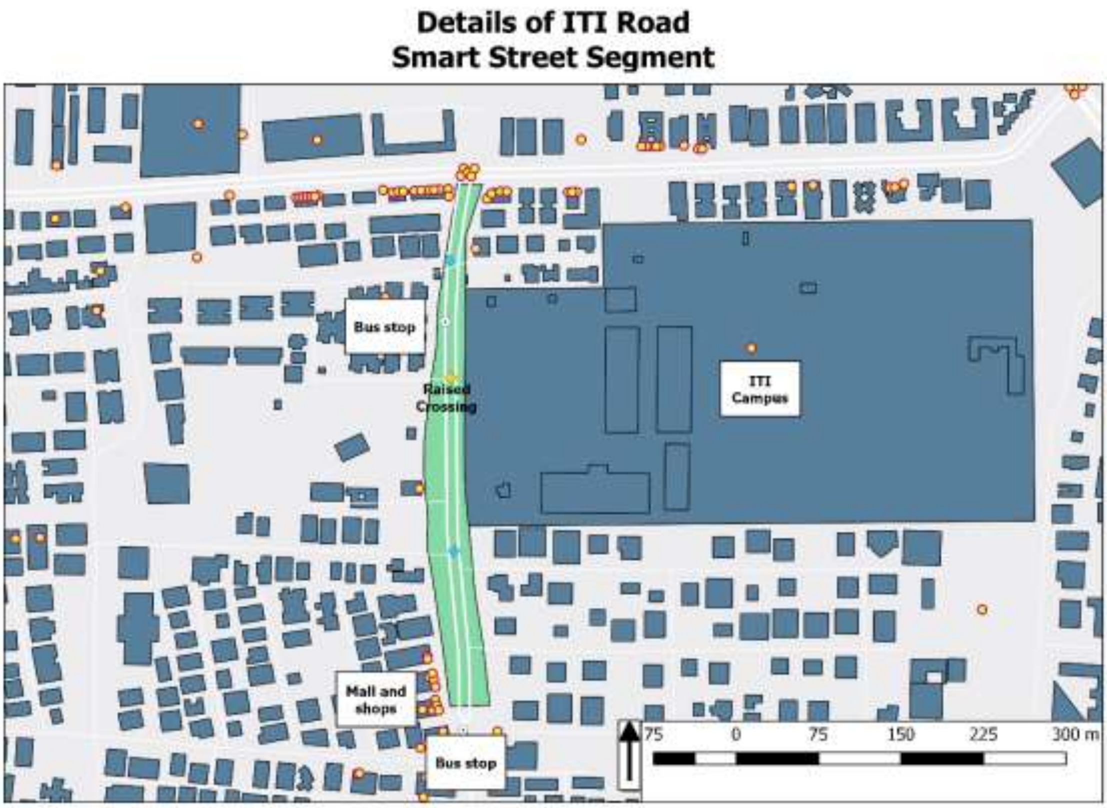

FIGURE 4 - SURROUNDINGS OF ITI ROAD, AND PROMINENT FEATURES ALONG THE ROAD

While conducting the assessment of smart city walkability infrastructure of the Aundh ITI Road, we came up with a number of observations regarding this project. ITI road is a secondary street according to OSM data and Connector Street according to the Complete Street Design. The total length of 500 meters out of 1.16 km has been modified under the Smart Street mission, and not the entire road segment. It abides by most of the recommendations for the connector streets. The components observed as per the design were – segregated footpaths, segregated cycle path (marked separate lane on the carriage way but not guarded), on-street parking, not more than 2 lanes of carriage way on each side, at-grade crossing, and public transport stops.

The design manual provides various sidewalk options suitable according to land use around the roads. The height of the pavement has also been suggested. In this qualitative survey, we did not carry our measurements for those parameters. We found that the sidewalk is better developed on one side of the road, whereas on the other side, it's only partially developed and there is a long stretch of discontinuity in it. The pavement is broad on the one side (varied width more than 10 feet at places), while on the other side it's narrower (remained around 6 feet approximately on the ITI campus side of the road). The broader side has indicative tiles for the visually impaired people throughout the modified stretch, however it loses its continuity in one place. There are ramps for the persons with disabilities at every 200 meters (Fig. 5).

An active edge of the road, a parameter suggested to enhance walkability, should have minimum or no boundary between the immediate shops, commercial areas or living spaces. For this street, the active edge could be observed at the very bottom where there is a mall and some other shops which are visited by walkers or other population more often. Other parts of the street, on both the sides, showed inactive edges, i.e., there were compound walls of significant heights. Usually, such broad sidewalks are prescribed to possess three zones, namely, multi-utility zone (MUZ), pedestrian zone and a dead zone or frontage. Even though we did not observe clear demarcation of such zones, MUZ was created purposefully at several locations with bus-stops and sitting places. Similar to the active edge, the frontage area was minimal (area occupied by shops).

There are two crossings for the walkers and the distance between both the crossings is approximately 150 meters. While a raised crossing was observed in front of the ITI campus gate. The sidewalk along the ITI is discontinuous and incomplete in certain places. There is only one traffic calming measure in the form of a marked, raised zebra crossing in front of the ITI Gate. There is also a traffic signal on this modified stretch. There are curb cuts as well as duly placed signboards on the studied stretch. There are bus stops on both sides of the road. There is a two wheelers parking space beside the sidewalk as well. A median was present within the smart street portion of the road while the other part of the road lacked median. It was decorated by plants protected under a wired compound. This was aesthetically pleasing in terms of visibility of the road on both sides. Pedestrian refuge areas were not frequent and only one such area was observed near the ITI gate.

We noticed the presence of dustbins on the sidewalk at regular intervals of 50 meters to 100 meters. It's heartening to find native vegetation even though trees on the sidewalk are protected by the stone platforms. Trees are not trimmed in the sidewalk area which might cause obstruction to tall pedestrians. On the sidewalk on the other side of the road, some trees obstruct the walking area for pedestrians. There is an open gym on the sidewalk which is frequently used by the citizens. The art installations on the sidewalk do not obstruct the walking area even though their modernist design does not gel with the surrounding environment. There are two children playing areas on the sidewalk. One of which has a broken surface as some anti-social elements seemed to have chipped away its rubber carpet. The other play area does not have a soft surface and so it is not cent percent safe for the kids. There are benches on the sidewalk which are useful especially for the elderly, persons with disability and women. The sidewalks are well lit due to the presence of streetlights and sidewalk lamps on both sides of the road thereby enhancing the safety perception of the studied stretch.

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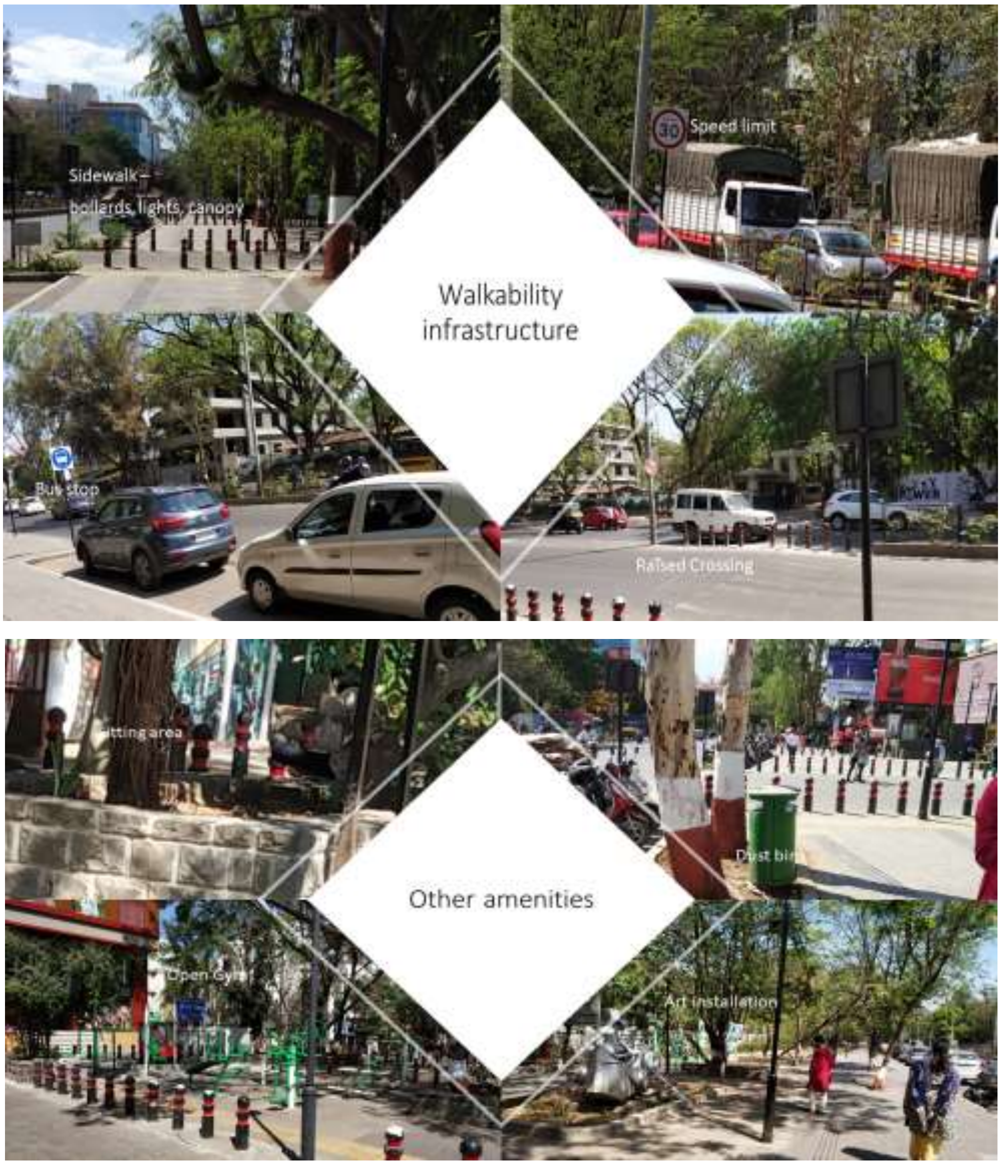

FIGURE 5. FIELD OBSERVATIONS FOR QUALITATIVE ASSESSMENT OF THE SMART STREET

We observed that the bicycle lane along the sidewalk is unsafe and dangerous. Many vehicles are parked on this lane. The lane is only on one side of the road. It is narrow and is not painted in a different colour unlike bike lanes in most places. Safety of cyclists remains a concern on this particular road.

There are bollards on the sidewalk at regular intervals to check transgression of vehicles on the sidewalk. They do prevent use of sidewalks by vehicles and at the same time width between them was found sufficient for walking or passing of wheelchair. They are also used for parking bicycles. There is graffiti on one side of the road which makes for an aesthetically appealing pedestrian experience. The surface of the sidewalk is not too smooth and allows for enough friction for the pedestrians so as to help them not trip or slip while walking. In addition, there are anti-skid tiles at regular intervals to prevent people from skidding especially during the rainy season. There are not many hoardings or advertisement boards in the walking area which may obstruct walkability of the pedestrians.

While this section of the street is aesthetically pleasing, encourages social interaction and exercise, and is largely safe to walk, homeowners living in residential apartments along the side of the road faced acute water shortages for several months following the development, due to poor coordination with other service providers (Nitnaware 2019). The large footpaths have not adequately considered the existing flow of traffic on the road, leading to congestion, and promised improvements in parking and public transport have not materialised (Bari 2019). Such projects need to go further in their efforts to truly engage with local concerns and needs.

4. DISCUSSION: OPPORTUNISTIC COMPLIANCE OR TRAILBLAZERS?

Since the Smart Cities Mission spells out the creation of Smart Streets, it has become imperative for the urban local bodies (ULBs) to develop a few stretches of roads, if not all, as smart street infrastructures. Consequently, many of these smart street infrastructures are developed not organically or as per the needs of the local community but as a force-fitted measure for compliance. Additionally, only easy to do streets might be picked up for project implementation. All this makes it an opportunistic approach to create smart streets. In order to be a true Smart City with cent percent smart streets, we must ensure a model of Smart Street that can be replicated all over the city and not just in few patches or localities. For this, we may redefine certain features of the smart street infrastructure. In order to promote walkability and other non-motorized transport, there is a dire need of creating a network of pedestrian friendly streets. At the same time, multiple scientific studies for creating smart street infrastructure at neighbourhood or ward level, nodal level, pan-city level, regional and national level are required in the Indian context. Street is not only a space that is shared by vehicles of different types but it is a shared space used by motor vehicle commuters, non-motorized vehicle commuters, persons with disabilities, children, older adults, pedestrians as well as street vendors.

The smart street projects under the Smart Cities Mission present us with an opportunity to recalibrate the way we commute in the urban areas and align it with our goals of reducing emissions, tackling climate change, and promoting sustainable and healthy life-style for the urban dwellers, thereby reclaiming the right to the city for everyone. Such projects can put a value to non-motorized transportation through which costs saved in monetary terms as well as in terms of reduced emissions can be demonstrated as success stories that can be replicated all over the country as a ripple effect. Enhanced walkability and non-motorized transportation also help in creating an egalitarian society in the public space as people from different strata of the society get equal access to the street space and vehicle owners aren't privileged over pedestrians and cyclists. It makes our roads and footpaths more inclusive especially if the needs of visually impaired persons, PWDs, children, women and elderly are taken into account while formulating the smart street projects. As per the Justice Verma Committee Report, the presence of common spaces, street vendors and well-lit streets help in creating safer streets for women (Report of the Committee on Amendments to Criminal Law 2013). Creating provisions for street vendors on the smart streets will not only create livelihood opportunities for many but it will also increase the safety perception of our streets.

Thus, despite its many obvious shortcomings at the moment, a dedicated walkability and Smart Street infrastructure is a welcome step in creating sustainable, equitable and inclusive smart cities of the future.

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