Spatial analysis of sidewalks and students' neighbourhood mobility in Mumbai metropolitan region

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Abstract

One of the important parameters of neighbourhood mobility and pedestrian friendly city life is the availability of good quality sidewalks (footpath). This ensures a hassle free and independent movement. This is particularly true for students in the age group of 10 to 15 years as they walk and move in their very neighbourhood daily for various activities. Availability of better surfaced, clean and continuous sidewalks with ideal width, green cover and walkers' friendly seating facility is, therefore, a prerequisite of any urban design. The present paper aimed at evaluating the current status of sidewalks in the Mumbai Metropolitan Region (MMR) from students' perspectives, along with regional variation, if any. Availability and condition of sidewalks are evaluated by a personal interview of 2085 sample students randomly selected from sample schools spread across MMR through a structured questionnaire. The responses thus received from students were analysed with the help of suitable statistical techniques. The outcome of the research is surprising. Despite being one of the prominent metro city regions of the nation, the overall status of the sidewalk in the Mumbai Metropolitan region is far from satisfactory. A sidewalk has rarely received scarce attention and priority in urban planning. The provision of sidewalks shows a tremendous intracity variation. While some neighbourhood pockets are provided with sidewalks; others show total apathy and ignorance towards it. This paper discusses various measures to be taken to address the basic issue of sidewalks in the Mumbai Metropolitan Region.

Keywords: *Sidewalks, urban transport, neighbourhood mobility, sustainability.*

Introduction

Current transport policies in developing nations like India favour motorization. Even the new townships and planned cities like New Mumbai, Panchkula, NOIDA, OKHLA, Hyderabad and many more such places are emphasising MT (Motorized Transport) rather than NMT (Non-Motorized Transportation) and pedestrians' needs. Achieving sustainable urban mobility in urban India, therefore, remains a distant dream.

Past Studies

Attempts to keep a balance of both MT and NMT are visible. 'Walkability' is a term used to describe and measure the connectivity and quality of walkways, sidewalks (footpaths) and other pedestrians friendly infrastructure. The draft strategy for the Philippines states that reserving and reclaiming space for pedestrian traffic is as important as providing lanes for cars (Government of the Philippines, 2009). Similarly, as per the Traffic and Road Transport Act of Indonesia,

motorists must give priority to the safety of pedestrians and bicyclists (Government of Indonesia, 2011). Abu Dhabi also has developed an Urban Street Design Manual that integrates the concept of the pedestrian realm into the overall street composition. Similarly, the Vision Statement of the City of Bam in Iran says that they wish to achieve their collective dream towards the creation of a child-friendly, peaceful and ecologically efficient city (UNICEF, 2005)**.** There is yet another school of thought that advocates sustainable mobility and its essential relatedness to NMT. According to this view, 'walkability' provides a foundation, safety, security and comfort for a sustainable city (Battacharyya & Mitra, 2013).

In India, the Ministry of Urban Development (MoUD) used a 'walkability index' to study the availability of sidewalks and a pedestrian facility rating for 30 cities of all sizes. (Government of India, 2008) Mumbai Metropolitan Region has more density, better infrastructure and independent bodies like MMRDA to look after its transportation needs. The city has pedestrian friendly infrastructure such as sidewalks, road dividers, road crossings, traffic islands, pedestrian signals, skywalks, subways, better-tiled sidewalk, etc. However, students are still not in a position to enjoy the infrastructure independently and their exposure to neighbourhood is rapidly declining.

Research Question and Objective

The sidewalk is the basic amenity of any urban transport system. It separates vigorous road traffic from other land use activities. A good sidewalk protects pedestrians from vehicular traffic. It also provides an avenue to social life and ultimately encourages dwellers to go by walk. It is necessary to see the conditions of sidewalk availability along with its quality aspects in study areas of MMR, particularly from students' perspective with the assumption that if sidewalks are satisfactory for students, it is satisfactory for the rest of the city dwellers as well.

The present study, therefore, aims at measuring the comfort level of mobility by assessing the provision of the sidewalks available for students to move around in Mumbai and surrounding areas. However, it was also felt that a mere provision of sidewalk is not a sufficient parameter unless its relative ranking based on satisfaction of the end user is tested in comparison with other pedestrians friendly urban infrastructure. The present research addresses the basic quest to gauge the provision as well as the status of sidewalks as pedestrian friendly infrastructure for students in their very neighbourhood. Objectives of the paper include 1) evaluating the provision of sidewalks around Secondary schools in MMR, and 2) measuring the degree of satisfaction students have about sidewalks in comparison to other pedestrians friendly urban infrastructure and facilities.

It is expected that the findings of this paper will help improve the pedestrian friendly infrastructure like sidewalks. NGOs can take up the issue of sustainable commuting to local bodies and the State Government. NGOs and neighbourhood community can undertake a drive for usable sidewalks across MMR.

Study Area

Mumbai Metropolitan Region (MMR) is carved out from 5 Districts of Maharashtra and it has a separate Administrative body known as Mumbai Metropolitan Region Development Authority (MMRDA). MMR comprises two complete districts of 'Mumbai City District' and 'Mumbai Suburban District'. The MMR also has a significant presence in parts of three other districts namely Palghar, Thane and Raigad. The geographical area of MMR is 4,355 km²; it is one of the top ten most populated urban agglomerations in the world. With almost 43 years of its existence, it will be appropriate to put MMR under scrutiny for its role in the development of Mumbai and the adjacent regions.

Any research has limitations of time and resources. The present study has a very microscopic and yet significant approach to understanding only one aspect-the provision and status of sidewalks with reference to only one section of society, i.e. the students. In order to delineate the study area which will be manageable, with limited resources and time, but without losing the relevance of the study, it was decided to focus only on the urban pocket of MMR. All Municipal Corporations and Councils were, therefore, considered as the basic units of study. However, Mumbai city is too large to squeeze in just one study unit. Hence, for Mumbai city, its four administrative *talukas* were considered as separate study units.

Methodology and Sources of Data

Condition of the sidewalk and its Parameters

There are many aspects relevant to the nature of the sidewalk. It must be wide enough to accommodate the daily pedestrian traffic; it must be continuous and evenly levelled which shall not compel the pedestrian to step up and step down while walking. Anti-skid tiling work must be of good standards and its appearance must be sufficiently attractive to encourage the end user. Parameters to study the sidewalk are thus endless. From the students' point of view, detail discussions with many people ruled out certain parameters to be verified from students. For example, it was practically impossible to ask students whether the width of the sidewalk is sufficient, as the intensity of pedestrian traffic is beyond the understanding of the students. Similarly, the questions relating to the tiling of the sidewalk were also out of reach of students, as one cannot expect students to know the basics of tiles or overlaying material. Therefore, after due deliberations and dialogue, the researcher reached the conclusion that the condition of sidewalks to be verified from students should include only those aspects which concern them the most. Therefore, the students were asked to select only one of the following options related to sidewalk conditions in their neighbourhood. These are 1) No sidewalk at all 2) Irregular sidewalk with encroachments 3) Irregular sidewalk 4) Continuous but poor quality sidewalk 5) Continuous, good and wide sidewalk.

Status of Sidewalk and its Parameters

Cleanliness, cycle parking, sidewalks, greenery, vehicle parking, pedestrians, road crossing, street light, traffic signal, zebra crossing are important pedestrian friendly facilities and infrastructure. The sidewalk is just one of these ten facilities. The status of the sidewalk can be measured

only based on of students' ranking based on their level of satisfaction to all pedestrian friendly infrastructure. Students were asked to give a score 1 for the best facility; while score 10 is for the very bad facilities in their neighbourhood. This was indirectly students' preferential voting to the best pedestrian friendly infrastructure in their neighbourhood, including sidewalks. From this ranking, the hierarchy of pedestrian friendly infrastructure was derived in descending order.

Sampling Methods

The sample size increases at a diminishing rate and remains relatively constant at slightly more than 380 cases for a million population (Krejcie & Morgan, 1960). In the case of MMR, the total secondary students' population of MMR as per the 2011 Census is nearly 4 million. Therefore, the ideal sample size could have been 1520 school children. In reality, the actual samples surveyed in the present study across the MMR were 2581.

Choosing correct sampling for a vast and diverse area like MMR was a difficult task. There are different types of schools as well. While most of the schools are affiliated to Maharashtra State Board, there are also schools affiliated to central boards like CBSE (Central Board of Secondary Education), ICSE (Indian Certificate for Secondary education), International General Certificate of Secondary Education and even Business Schools. However, upon close scrutiny, it was realised that all types of schools do not exist in all the study units. In order to maintain uniformity and for a closer-to-reality observation, it was decided to concentrate only on State Board schools for this study. The main resource/reference used to select schools randomly was a booklet of about 262 pages published by Mumbai Divisional Board of Maharashtra State Board of Secondary and Higher Secondary Education (Maharashtra State Board, 2013) that gives an exhaustive list of all authorized schools located in Mumbai, Greater Mumbai, Thane, Palghar and Raigad districts along with their addresses and contact numbers. This book covers the entire Mumbai Metropolitan Region.

Steps followed to select sample schools and student respondents are given below:

Step 1: Based on the MMR land use map, study areas were finalised and demarcated on the base map as per MMR defined urban areas. It was also decided that at least two schools will be selected from each study unit. However, by default due to the simple random sampling method, more schools were selected from more populated areas. Step 2: Schools were selected from the booklet mentioned above by a simple random sampling method. Such schools were approached with a formal request letter to conduct the survey. When a school did not give permission, another school was approached from the same study area from the booklet. The researcher had personally visited each and every school surveyed. Total schools surveyed included Marathi Medium 24, English Medium 17 and Urdu Medium 2. Step 3: Upon reaching the school, students from a class of standard VI and one from standard IX were surveyed. School authorities, mostly the supervisor of the school used to assign the class randomly based on the time table as well

as the school authority's convenience. All children in that class present on that day were given the structured questionnaires, without exception. On an average, students roughly took 35 to 40 minutes to fill-in the questionnaire. Step 4: All incomplete questionnaires were excluded from the analysis. Thus, out of 2581 respondents, 2085 questionnaires complete in all respect were declared fit for data feeding and analysis.

Statistical Tools Used

In the case of the condition of the sidewalk, the responses thus received from students on condition of sidewalks were tabulated in frequency table separately for each study unit, as well as for the entire MMR. With the help of central tendency, the aggregate weighted score of the students expressing their satisfaction in percentages about the parameter selected was worked out. Summarising the overall condition of the sidewalk, the cumulative bar graph was prepared, which helped the researcher to get a collective to portray of sidewalk availability with reference to MMR average conditions.

In the case of the status of sidewalk, the rank score given by students for all the ten facilities was calculated with the help of the Hare-Clark system of counting preferential scores (Wikipedia, 2015). This enabled the researcher to measure the best to worst pedestrian friendly facilities existing in each study unit, as voted by students.

The rank score of sidewalks in each study unit was used to corroborate the observation of the availability of sidewalks with its status in each study unit of MMR.

Discussion

Variation in Availability and Conditions of Sidewalk

As mentioned earlier, students were asked to select only one of the following options related to the availability of sidewalks (footpath) in their neighbourhood: no footpath at all; irregular footpath with encroachments; irregular footpath; continuous but poor quality footpath; continuous, good and wide footpath

First two of the above parameters were considered negative parameters, while 4th and 5th parameters were considered as positive parameters about the availability of sidewalks. The 3rd parameter as 'irregular footpath' was considered as mid-point for the analysis. The frequency of students' responses to the above parameters was tabulated and further percentages were calculated for each study unit separately. The sum of these frequencies and percentages were also worked out for the entire MMR. Considering the mid-point of the average, the sum of MMR response is presented in the form of colour bands, while students' response in percentage is presented in a vertical line graph, imposed over these colour bands.

Graph lines are allowed to swing in proportion to the positive or negative inclination of the responses. In other words, this graph is drawn based on cumulative percentages from the midpoint of the irregular footpath. As a result, if the more students were happy about the availability of sidewalk, the graph line moved northwards; and in case the students were not happy about the footpath, or if the footpath was not at all available, the graph shifted southwards.

This very arrangement is giving the variation in the nature and quality of footpath in each study unit on the backdrop of the conditions of availability of sidewalks in MMR (Fig. 1).

Fig. 1 showing the availability and condition of sidewalks the shows an interesting variation. In a region surrounded by the city, none other than Mumbai reveals that the majority of the MMR areas do not have the basic facility like sidewalks of a standard quality, which urban dwellers seek. Only 8 study units out of 19 just touch or cross the MMR average line of good sidewalks. When the trend of the condition of sidewalks was placed on the MMR map, it reveals a very worrisome trend. Three talukas of Mumbai City and emerging municipal corporations like Vasai-Virar, Mira-Bhaynder, Navi-Mumbai, and Panvel indicate that these areas have sidewalks even better than MMR average (Fig.2). It also indicates that comparatively, areas well connected with Mumbai both by railways as well as highways show a better sign of development even in terms of pedestrian friendly facilities. Mira-Bhayander and Vasai-Virar Municipal Corporations are well connected by western railways as well as located on Mumbai-Ahemadabad national highway. The story for Thane, New-Mumbai, and Panvel is the same as these corporations are well connected by railways as well as located on Mumbai-Pune expressway. This is a classic example of the greater influence of proximity to Mumbai city.

In sharp contrast, Bhiwandi-Nizampur, Kalyan-Dombivali, Ulhasnagar, Ambernath, Badlapur situated in the suburban areas of Mumbai city and certainly have the legacy of old Municipal Councils and later elevated to Municipal corporations are unable to catch-up with the standards of Mumbai City even for the basic facility of sidewalks. These areas could neither come out from their subdued suburban psych; nor could these areas uplift themselves at par with other peer municipal corporations.

The poor performance of Uran, Pen, and Alibaug is understandable as the momentum of urbanisation is relatively recent there.

Sidewalks with encroachments constituted a very large proportion of all the sidewalks as reported by the students. It appears to be a general trend but it is also indicative that the sidewalk, which is the basic need of any pedestrian is not provided uniformly throughout the MMR. Its overall quality and maintenance across MMR are also not at par.

Variation in Status of Sidewalk and Degree of Students' Satisfaction

There are many pedestrian friendly facilities required for the convenience of city dwellers. The question was not about their availability. Local bodies have anyway made attempts to make those facilities available, albeit with varying degrees of success. The question was of their quality and utility. Therefore, as mentioned earlier, students were asked to give a rank from 1 to 10 in descending order based on their degree of satisfaction for following pedestrian friendly facilities: cleanliness, cycle parking, footpath (Sidewalks), greenery, vehicle parking, pedestrians' companion, road crossing, street light, traffic signal, zebra crossing.

This was aimed at assessing students' voting in descending order to the best service related to the pedestrian friendly facility in their neighbourhood. On the basis of ranking
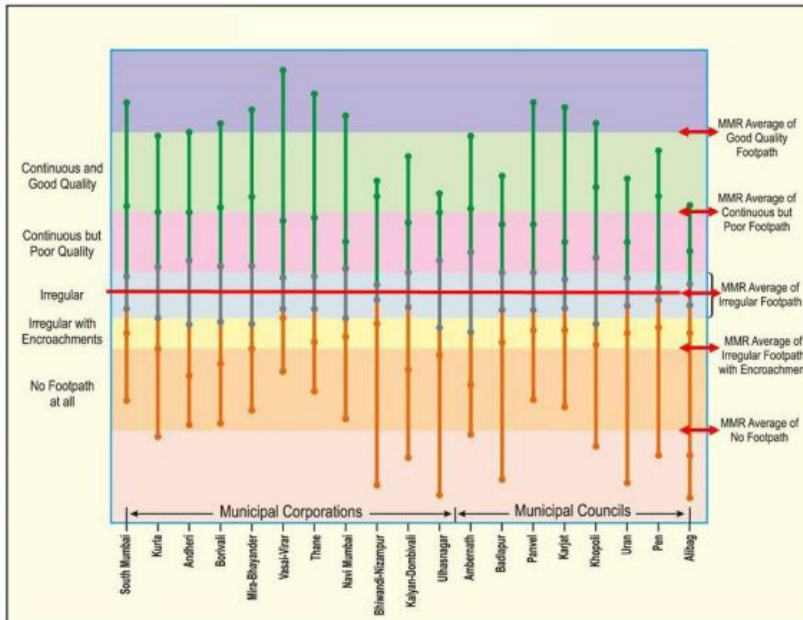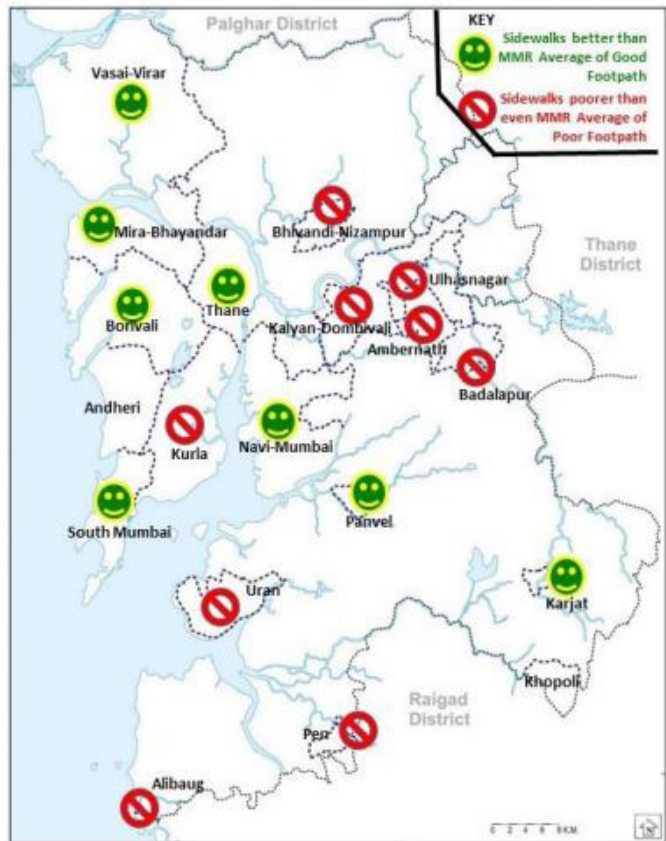
Fig. 1 Availability and Condition of Footpath

Fig.2 MMR: Conditions of Sidewalks

Table 1. Study Area-wise Consolidated Hierarchy of Pedestrian Friendly Facilities

No.	Rank → Study Area	TOP THREE			IV	V	VI	VII	Worst three		
		I	II	III	IV	V	VI	VII	VIII	IX	X
1.	South Mumbai	CL	SL	Gr	CP	P	FP	Z	TS	RC	Ped
2.	Kurla taluka	Gr	CL	SL	FP	Ped	P	TS	RC	CP	Z
3	Andheri taluka	Gr	SL	CL	RC	FP	TS	Ped	Z	P	CP
4.	Borivali taluka	CL	SL	Gr	TS	CP	FP	P	RC	Ped	Z
5.	Mira-Bhayander	SL	CL	Gr	P	Ped	FP	CP	RC	Z	TS
6.	Vasai-Virar	SL	CL	FP	Gr	P	Z	CP	RC	Ped	TS
7.	Thane	SL	Gr	CL	RC	Ped	FP	CP	Z	TS	P
8.	Navi Mumbai	SL	P	CP	Gr	TS	Z	FP	RC	CL	Ped
9.	Bhiwandi	SL	P	CL	CP	RC	Ped	Gr	FP	TS	Z
10.	Kalyan-Dombivali	SL	Gr	FP	CL	Ped	Z	RC	P	CP	TS
11.	Ulhasnagar	Gr	SL	Ped	RC	CL	FP	P	CP	Z	TS
12.	Ambernath	Gr	CL	SL	FP	P	Ped	CP	RC	Z	TS
13.	Badlapur	CL	Gr	SL	P	CP	FP	RC	Z	TS	Ped
14.	Panvel	Gr	SL	CL	P	FP	CP	Z	RC	Ped	TS
15.	Karjat	Gr	CL	SL	FP	Ped	RC	CP	P	TS	Z
16.	Khopoli	Gr	CL	P	SL	CP	FP	RC	Ped	Z	TS
17.	Uran	CL	Gr	FP	SL	RC	CP	P	TS	Ped	Z
18.	Pen	Gr	CL	SL	Ped	RC	CP	P	FP	TS	Z
19.	Alibaug	Gr	Ped	CL	RC	SL	CP	P	FP	Z	TS
	Entire MMR	Gr	CL	SL	FP	P	CP	Ped	RC	TS	Z

Key: CL: Cleanliness CP: Cycle Parking FP: Footpath Gr: Greenery P: Parking Ped: Pedestrians Companion RC: Road Crossing SL: Street Light TS: Traffic Signals Z: Zebra Crossing

Table 2: Facility Specific Count of Ranking in entire MMR

No.	Rank → Facility	I	II	III	IV	V	VI	VII	VIII	IX	X	Total Study Units
1.	Cleanliness	4	7	5	1	1	-	-	-	1	-	19
2.	Cycle Parking	-	-	1	2	3	4	5	1	2	1	19
3	Footpath (Sidewalks)	-	-	3	3	2	7	1	3	-	-	19
4.	Greenery	9	4	3	2	-	-	1	-	-	-	19
5.	Parking	-	2	1	3	3	1	5	2	1	1	19
6.	Pedestrian	-	1	1	1	5	2	1	1	4	3	19
7.	Road Crossing	-	-	-	4	3	1	3	7	1	-	19
8.	Street Light	6	5	5	2	1	-	-	-	-	-	19
9.	Traffic Signal	-	-	-	1	1	1	1	2	5	8	19
10.	Zebra Crossing	-	-	-	-	-	3	2	3	5	6	19

given by students, facilities' hierarchy of order (Ranking) was measured as per the Hare-Clark system of counting preferential score. From this ranking, a hierarchy of services was derived separately for each study area. This consolidated hierarchy is shown in Table 1.

In order to get a better visual impact as well as for better understanding and interpretation, these facilities were given a colour code; and the emerging trend is quite revealing. Significantly, facilities like greenery, street light, and overall cleanliness occupied the top three ranks across MMR. However, this pattern also shows some important variations. Emerging Municipal areas like Mire-Bhayander, Vasai-Virar, Thane, Navi Mumbai and even Bhiwandi-Nizampur are better with regard to the provision of streetlights. On the other hand, peripheral Municipal areas are rated higher as far as greenery is concerned. This is understandable as most of these peripheral municipal areas are a part of either coastal plains or have foothill locations. This peripheral region is also a catchment of many rivers of MMR and thus providing a good green cover. Cleanliness does not display any specific pattern, but its presence in all study units in the slot of the top three facilities speaks about overall neighbourhood conditions.

Pedestrian friendly facilities from students' point of view seem to be lacking in most parameters studied. Students across MMR have not listed footpath (sidewalks) it in the first three ranks. It is appropriate to clarify at this stage that the availability of facilities is different from their ranking. Sidewalks as a facility are not absent from MMR, but it is too poor in terms of its quality

and actual utility. Table 1 is specific to study-units and primarily focuses on the variations and pattern of pedestrian friendly facilities. However, there is also a need to see the facility specific pattern of ranking (Table 2).

Table 2 gives the number of occurrences of a specific rank appearing at a specific time for each facility. This table is for the entire MMR. Out of 19 study units of the present research, e.g., Cleanliness has secured 1st rank in four study units; 2nd rank in seven study units and the 3rd rank in five study units. This means 16 study units out of 19 study units gave cleanliness 1st, 2nd, or 3rd rank. This is a positive trend in the concentration of facilities. However, it shows a negative side as well. Sidewalks as a facility lie somewhere between 4th and 8th ranking. In only 3 study units, students give 3rd rank to sidewalk facility whereas in the remaining 16 study units they express their absolute displeasure about sidewalks facility.

Summary and Conclusion

It appears to be a general trend and indicative of gross negligence and casual approach by all Corporations and Councils towards making the provision and maintenance of sidewalk which by any account is an absolute necessity for better urban quality of life. Encroachment of the sidewalks is a serious problem that requires urgent attention from the civic authorities. Most of the sidewalks are converted into 'Food Park' or into a roadside market. The sidewalk is a basic requirement of every city area but it is best seen only in selected, better-off residential areas, commercial hubs and areas around power centres like important government and corporate offices leaving the common public, pedestrians- particularly the students-

deprived of a basic right to space and quality of life. This issue needs urgent attention and remedy as the common people have the first right to roads in any democratic country. The study raises important questions pertaining to peoples' right to urban space and its reclamation for the needy and the less privileged sections as equal citizens.

In order to improve the mobility comfort of students as well as other city dwellers, local authorities must understand that the sidewalk is close to the heart of every citizen. It is a barometer of the city's social and environmental health. It is the reason and the result of the very city life. Improving conditions of the sidewalk, keeping sidewalk approachable, clean and free from encroachments with green cover (trees) will enhance the overall ambiance of the neighbourhood. Civic authorities have a duty and responsibility to make the city people friendly and improving the sidewalks constitute an important urgent task as well as a challenge.

End Note: Matheran is a designated urban area of MMR. However, it is Asia's only automobile free town and a hill station. All citizens, including tourists, have to compulsorily walk. Mobility issues under discussion are not applicable and hence, Matheranis has been excluded from this research as an outlier.

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