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Walkable Street Design for Congested Urban Areas: Pedestrian's Perception and Attitude

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Abstract

Many people concerned with pedestrian safety and "walkability" cares about these issues because they feel that walking is good exercise or that walkable places are more attractive or that walking is better for the environment than driving. These are all valid arguments and may convince some of those reading this article that walkability is important. But from user point of view, that is, streets where walking is safe and enjoyable, that people are drawn to visit on foot, and where fast and extensive car traffic is not the #1 priority. Streets where walking is safe and easy are streets where businesses usually thrive. Streetscape enhancements add value to an area and are associated with higher rents and the attraction of new businesses. In addition there is good evidence to show that improving walking and cycling environments raises private property values by significant amounts. So the current study focuses on the design of walkable streets for congested areas. While doing so, the focus is also kept on user's perception and attitude towards walkable streets.

1.0 Introduction:

Walking is the most natural and simple form of movement for humans. Walking is a way of travelling used mainly for two purposes: short trips to specific destinations such as shops when there is probably not too much to carry and leisure trips where the walking in itself is the main purpose. Until recently, walking has been treated in transportation planning as a minor mode but this perception is changing as the importance of walking as a "green" and healthy mode of travel is being recognized. Other than transportation, it provides various health benefits like exercise, heart disease, diabetes, and hypertension. It has been in long- term decline, being considered as a secondary mode together with cycling. It has been proven beneficial to the environment, community health, and economy of the city. Walking also encourages social contact among people, thereby improving their mental health and wellbeing. Unlike vehicular trips, walking trips do not produce greenhouse gas emissions, thus contributing to cleaner and greener environments. Walkability in a street network increases potential trips by pedestrians through sidewalks and linked streets to create shorter travel distances. Street Walkability is an indication of the suitability of the built environment to walking. Walkability of any street will increase when safe, comfortable and accessible infrastructure is provided for pedestrians. Urban designs influence how an individual perceives the built environment, including the desirability of walking and all other physical activities involved.

Despite of positive effects of walking trips, many cities in India have witnessed drastic reductions in walking as a transportation mode over the last decades. Reductions in walking trips have coincided with unprecedented levels of car ownership and increased automobility during the same period. Most of Indian metro cities are observed with high dominance of private vehicle trips as shown in Figure 1.

Figure 1 shows that in metro cities like Pune, Bangalore, Surat, Ahemadabad, Chennai and Kolkata lower percentage of trips like cycle and walk

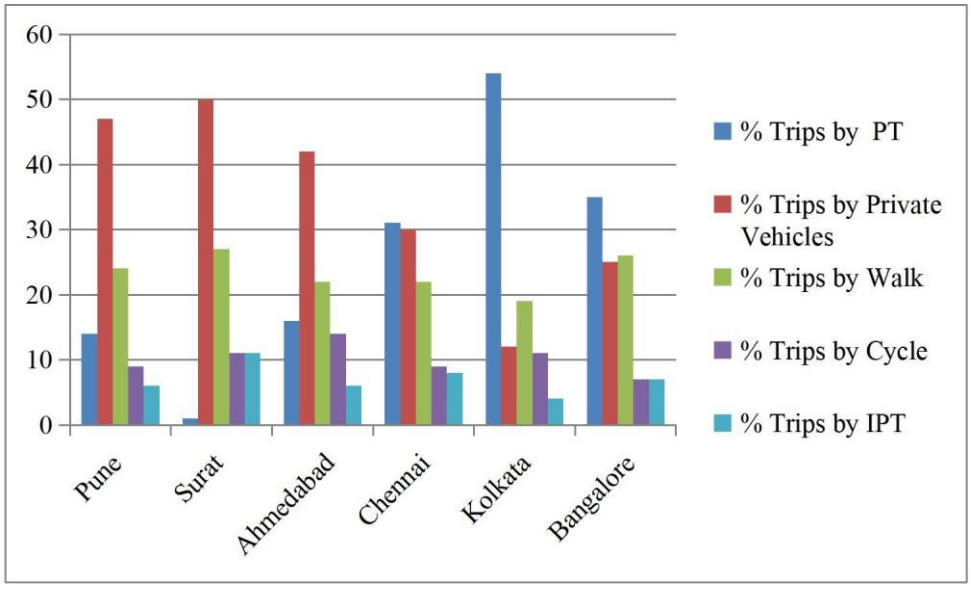

Figure 1: Mode share in Indian Metro cities (REFERENCE)

Other than increase in motorized trips, there are various other issues which contributed to the lower percentage of trips by walk. The issues like availability of footpaths, cleanliness on streets, presence of street hawkers, footpath parking, enjoyment of walking etc.

1.1 PROBLAM STATEMENT:

Lack of safe, convenient, clean and accessible walkable streets are one of the major challenges of urban areas. The design of walkable streets will help to develop better streets for people. Current study is focused on of such issue i.e. design of walkable streets. The basic aim of the current study is to understand user's perception and attitude for walkable streets. The study has focused on designing walkable streets in congested area.

1.2 OBJECTIVES OF THE STUDY:

The study has following objectives:

1. To study the characteristics of existing congested streets of Pune city.
2. To study the aspects of walkable street design

3. To understand the user's perception and attitude for walkable streets

4. To design the walkable streets for congested urban areas

1.3 SCOPE OF THE STUDY:

The study is focused on design of walkable streets emphasizing three aspects of walkable streets namely (i) Accessibility (ii) Congestion (iii) Cleanliness.

LITERATUREREVIEW

The literature review's primary objective is to articulate the studies and work conducted in the study's scope. A literature review has majorly four objectives (i) It surveys the literature in the selected research area of study (ii) It synthesizes the information into a summary (iii) It critically analyzes the information gathered by identifying gaps, shows limitations of theories; help to formulate area for further research and reviewing areas (iv) It presents the literature in an organized way.In the current study, literature review covered studies conducted in the area like pedestrian footpath, LOS of walkways, shared spaces, urban footpath analysis and simulation etc. The review helps to understand different aspects of walkable streets and to finalize the objectives.

Analysis on Urban Paths and Edges at Farlim Township in Penang, Ooi Wei, Ong Poh Yin, Ahmad Sanusi Hassan1, Yasser Arab, Khiensak Seangklieng, Boonsap Witchayangkoon, and Joesron Alie Syahbana, International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, (2021)

This study examines the place-making of Farlim, a Garden City in Penang, concentrating on two of Lynch's (1960) five urban design components, namely path and edge. Farlim is the first-largest privately created township in Penang and consists of a variety of housing developments as well as various auxiliary facilities such shops, offices, hospitals, and schools. This garden city's urban design is an uneven gridiron plan that has been modified to fit the site's natural contour. This study use qualitative approaches, such as site visits, online research, and interviews, to carry out the survey and analysis of the components that make up the mental image of this place. This analysis demonstrates that the walkway is the most important component of the urban planning at this location, ensuring efficient connectivity to handle the heavy traffic flow from nearby locations. Bukit Romania, which established a distinct barrier between the site and the undeveloped hill area, forms the identified strong edge. In Farlim, Penang, these two crucial aspects of urban architecture have successfully produced a noteworthy aesthetic impression.

Assessing accessibility of footpath-level walkability in old core cities of India for promoting Universal Mobility through Architectural Planning Research: Case Study of Central Kolkata, India, Gaurab Das Mahapatra ,Suguru Mori and RieNomur,(2021)

This study examined old core cities' footpath-level walkability in Central Kolkata, India. Universal mobility in the walkability sector has increased significantly since Goal 11 of the UN Sustainable Development Goals (Sustainable Cities and Communities) was implemented in 2015. Theoretical, conceptual, and methodological Architectural Planning Research was used to promote Universal

Mobility in old Indian cities. This research uses pedestrian infrastructure categorical variables.
This study found that Central Kolkata's footpaths are inaccessible. This research also shows that accessible walkability-related issues are difficult to modify, suggesting a new accessibility audit format for historic core Indian cities to achieve Universal Mobility criteria. Quantitative research methodologies are also suggested by the writers.

Built Environment Determinants of Pedestrian Activities and, Their Consideration in Urban Street Design Regine Gerike, Caroline Koszowski, Bettina Schröter, Ralph Buehler, Paul Schepers, Johannes Weber, Rico Wittwer and Peter Jones, Sustainability (2021)
Urban street design has long considered pedestrian amenities "leftover spaces," yet interest in walking and street quality is growing. Designing pedestrian facilities requires accommodating (1) pedestrians who want to walk safely and comfortably from A to B (movement function) and (2) users who want to rest, interact, buy, dine, and enjoy life in a pleasant environment (place function). This study compares international guidance material for urban street design's approach to building pedestrian facilities with scientific knowledge on pedestrian activity factors and makes recommendations for improving pedestrian amenities. Urban street design guidelines is advanced in assessing space requirements for known volumes of moving people but less in developing pleasant street settings that encourage pedestrian movement and place activities. Scientific evidence could improve guiding materials and help urban street designers create safe, comfortable, and attractive public environments that encourage people to walk and stay.

Efficient Street Planning and Designing: An Approach towards Developing Sustainable Cities, V K Kumar, J S Chadchan, (2021)
Cities attract social, economic, and cultural development. It encourages education, employment, and a better life. Rapid urbanization is straining land, infrastructure, and the environment, making it difficult to expand sustainably without depleting future resources. It sustains cities. The 2030 agenda for sustainable development set goals and targets to improve people, planet, and prosperity in 15 years. Better infrastructure, human welfare, sustainable energy, and resource efficiency were set as goals to make the city robust, inclusive, safe, and sustainable. Sustainable towns are created worldwide. This paper reviews global sustainable development literature. This research paper explains why streets are crucial to urban design and should be developed properly to achieve sustainable city goals. Sustainable cities are unattainable without sustainable street design. The literature assessment finds that street design should prioritize safety, mobility, and accessibility. Streets can boost city economy and sustainability. Vehicle emissions cause pollution worldwide. Efficient planning can fix the situation. Thus, sustainable mobility requires user-friendly, safe, and accessible streets.

Walkers and Hawkers of Footpath: A Design Proposal for Hawkers of Farmgate Area, Dhaka, Farjana Rahman and Masud Ur Rashid, International Journal of Architecture, Engineering and Construction, 2020
Street vendors (hawkers) are common in developing nations like Bangladesh. Street sellers sell affordable goods to all communities. Dhaka footpaths always have these. This enormous number of street vendors has hindered pedestrian traffic, but locals want them. Street sellers are key to the local economy on Indira Road Footpath of Farm gate, one of Dhaka's eighteen hawking points. Thus,

positioning them near pedestrian movement improves footpath conditions without vendor intrusion. Residents and street hawkers were surveyed for a design exercise. After examination, vendors are relocated to improve pedestrian and neighbourhood pathway hawing point conditions. This paper synthesized hawking point design ideas to maintain pedestrian flow.

Analysis of Existing Pedestrian Facilities at Selected Areas of Jaipur City, NishantSachdeva, Dr. Lalit Kumar Gupta, International Research Journal of Engineering and Technology (IRJET), (2020)

This research examines certain Jaipur pathway conditions. Location, population, connection, and industry and job availability determined the research locations.

Footpath conditions in selected localities were assessed. Footpath dimensions and conditions were compared to IRC recommendations. Comparison suggests pedestrian facility improvements. All locations measure footpath widths, clear heights, and kerb heights and compare them to IRC: 103 – 2012 (Guidelines for Pedestrian Facilities).

According to the study, pedestrians face barriers, hawkers, discontinuity of walkways, width and height, and parked automobiles. Improved pedestrian amenities in study areas are also suggested.

Creation and Operation of Recreational Footpath System, S M Romanov and AA Popov, IOP Conf. Series: Materials Science and Engineering, (2020)

The concept of "recreational footpath" is introduced as comfortable linear recreational facilities for mass pedestrian tourism, as element of path network of recreational areas. Proposals to improve the regulatory and methodological support for the creation and operation of a system of recreational footpaths have been developed. The definition of ecological footpath is proposed as a form of recreational footpath designed for eco-tourism. The classification of recreational footpath and their technical characteristics are proposed.

Analysis and Design of High Rise Building Subjected to Combined Effect of Earthquake and Strong Wind using E-Tab Software, Nitin R. Mule1, Prof. D.H. Tupe 2, Dr. G.R. Gandhe, International Research Journal of Engineering and Technology (IRJET), (2020)

This research proposes a three-part multi-hazard-based approach to analyze high-rise structure damage risk: hazard modeling, damage probability computation, and Modern tall buildings use economical structural technologies and high-strength materials to minimize building height, making them more thin, flexible, and damping. Wind excitation and earthquake load make these flexible constructions uncomfortable. Many studies have been done to reduce such excitation and improve tall building performance against wind and seismic loads. Numerical results show that damage severity affects story displacement, drift, depth–capacity ratio, and hazard contributions. The comprehensive application emphasizes the need to study multi-storied building responses to multi-hazards.

Designing a Safe Vibrant and Pedestrian Friendly Transport Facilities a Study in Rayer Bazar Area, Dhanmondi, Dhaka. Submitted By: Md. Jahedul Islam Mohibbullah Al MafiAfsana Mimi SamihaTasrinTonny, (Department of Urban and Regional Planning, BUET), (2020)

Pedestrian-friendly transportation enhances public health, environment, sociability, and child and women safety. It will provide safe, dynamic, pedestrian-friendly transport

infrastructure. Rayer Bazaar, Dhanmondi, hosts the study. The study evaluates transportation, improves walkability with design, and boosts circulation. All area highways have 12 similar segments. Dhanmondi Satmosjid Road links local roads. 12–18-foot roads are typical. Only three reach 25 ft. Two-way highways. Despite substantial pedestrian traffic, 11 of the 12 highway segments have no paths. No sidewalks endanger schoolchildren and ladies. Pedestrian-friendly transit can meet the study's goals. Goals split roads into four groups. Motorists and pedestrians use 25-foot-wide highways. 15–25-foot roads are pedestrian-only. Sellers traverse 15-foot roadways. Play on dead-end streets. Categorized streets increase pedestrian and environmental safety.

Analysis of Urban Drivable and Walkable Street Networks of the ASEAN Smart Cities Network, Pengjun Zhao, Yat Yen, Earl Bailey and Muhammad TayyabSohail, ISPRS Int. J. Geo-Inf. (2019)

This article used numerous network indicators to compare the 26 ASCN pilot cities' DSNs and WSNs. OSMnx downloaded and analyzed Open Street Map WSNs and DSNs. The findings show that WSNs and DSNs have varied topological and geometric properties. Orthogonal street grids, high street density, intersection density, and minimal cul-de-sacs make cities easily accessible. Other cities have more curving and circuitous SNs with many missing links to other streets, which can impede traffic. The study emphasizes critical SN elements that will affect future ASCN SN designs to make ASEAN cities smart and liveable.

Streets as Public Spaces: Lessons from Street Vending in Ahmedabad, India, Prithvi Deore and Saumya Lathia, Urban Planning, (2019)

This article examines street vending's role in Ahmedabad's urban fabric through extensive spatial analysis of 4,000 vendors at four different times of day, perception studies of their clientele disaggregated by gender, income, and age, and their relationship with surrounding land-use and street hierarchy. It shows how street vendors make streets more vibrant by increasing activities, safer by attracting people, and truly inclusive by allowing people from all backgrounds to exchange goods and services. Street traders improve public space.

Urban footpath analysis and simulation – a case study in Iran, Milad Rahmati, Ehsan Kashi, Proceedings of the Institution of Civil Engineers (2018)

Transport engineering often models and simulates urban pathway condition and pedestrian service. This article examines the capacity of Iranian city street walkways to accommodate existing and future pedestrian demand. A database of pedestrian position, speed, and number was created to measure footpath capacity. Finally, a US code and proprietary modeling tool determined LOS. The results showed that some sections of the route had LOSs that were too low for pedestrians. With expected increase, the LOS in these subpar parts was predicted to decrease furthermore and could hinder future economic growth if not improved.

The analysis of factors affecting the pedestrian level of service on footpaths in Uppal X Road at Hyderabad, Meruga Siva Parvathi Assistant professor, International Journal of Scientific Research and Review, (2018)

Hyderabad, the capital of Telangana, has over one million people, and Uppal is one of its Mandals with

3.8 lakh people. Motorized and non-motorized traffic are rising due to population growth. Traffic engineers focus on motorized traffic for safety, speed, and capacity.
Thus, pedestrians and non-motorized vehicles occupy motorized vehicle space. HCM 2010 states that improving car roadways cannot improve service for diverse traffic. Removing footpath encroachment has reclaimed pavement for pedestrians. The questionnaire-based study at Uppal X road examines pedestrian variables. To assess service, analyze all answers' ratings. Due to varied reasons and perceptions, LOS's worth cannot be determined. Inverse variance analysis was used. The area was assigned one of six levels of service.

Modern Approach of Street Space Design, Evgeniya Prelovskaya, Alexey Levashev, 12th International Conference "Organization and Traffic Safety Management in large cities SPbOTSIC-2016, 28-30 September 2016, St. Petersburg, Russia, Science Direct, Transportation Research Procedia, (2017)
According to urban sustainable development, urban boulevards, transit-friendly streets, and shared space should be added to Russian streets. This study offer a list of criteria for road network classification based on the results of a comparative analysis of road network classification systems in other countries and the uniqueness of the proposed street class design. Study also audited street space in central Irkutsk. The study recommended road network transformation based on the specified street classes. The new network calculated traffic demand and flow redistribution. Inter-regional individual transport transit flows in the city center decreased significantly in the experiment.

Pedestrian Footpath Level of Service (FOOT-LOS) Model for Johor Bahru, Basil David Daniel, SitiNaquiyah Mohamad Nor, MunzilahMdRohani, JoewonoPrasetijo, Mohamad YusriAman and KamarudinAmbak, MATEC Web of Conferences, (2016)
Walkability is measured by pedestrian level of service (LOS). This immediately affects mobility, comfort, and safety, reflecting pedestrians' impressions of the facility's pedestrian-friendliness. FOOT-LOS (pedestrian footpath level of service) was created to measure LOS. Physical, geographic, and user aspects are examined. Based on LOS characteristics, pedestrian situations can be graded from LOS A (excellent) to LOS F (unsuitable). LOS variables are assessed desktop and on-site. The model was tested and refined iteratively. LOS for pedestrian walkways can be measured using the research and LOS model. The model calculates LOS and identifies pedestrian pathway LOS components.

Shared Space Evaluation: O'Connell Street, Auckland AuttaponeKarndacharuk, PragatiVasisht, Mitra Prasad, Australasian Transport Research Forum (2015)
This article analyzes O'Connell Street after its 2014 pedestrian-vehicle conversion. A multidimensional assessment framework established by the University of Auckland and Auckland Transport was used to collect and analyze quantitative and qualitative performance data. To track 24-hour vehicle speed and volume changes, automatic tube counts were used. Qualitatively, on-street pedestrian perception surveys measured how well the street functioned against the five assessment criteria of Place making, Pedestrian attention, Vehicle behavior modification, Economic impetus, and Safety for all users.
The qualitative analysis of the five performance metrics showed that the "after" shared space environment functioned better than the "before" scenario, but to properly run shared spaces, vehicle speeds and user perception of driver behavior must be addressed.

Pedestrian study on road links in major urban centre T. Subramani, IOSR Journal of Engineering, (2016)

Walking is essential. Urbanites walk a lot of 1-2Km journeys. Every expedition begins and finishes with a stroll. Guard rails, guarded crossing places, footpaths, and grade separations are needed to protect pedestrians, who are more likely to be in accidents. Integrating pedestrian amenities ensures continuous flow. Thus, a strategic plan should consider pedestrian demands for an entire area. The goal is to minimize pedestrian-vehicle interactions. Make sure pedestrians are safe and motorists respect them. Planning should prioritize pedestrian convenience. Otherwise, facilities will go unused. Traffic control methods to protect pedestrians from automobile traffic

METHODOLOGY

This chapter focuses on the methodology adopted for the project. A stepwise methodology is illustrated in Figure 3.1. Basically, a methodology is a collection of steps or processes adopted at each stage of project. It presents a systematic chart used for finding solution to the selected real life problem. All the steps adopted in the current study for designing walkable streets in congested urban areas are explained in this chapter.

3.1 Problem Identification:

The first stage of the methodology is the identification of problem. In this step a broad area is selected and then it is narrowed down to a one specific problem. In the current study, problem of lower percentage of walk trips in most of Indian cities is considered for analysis. For the same, need of walkable streets is one of the major issues. The issue of walking trips becomes more difficult in congested areas. Also the user's role in the design process and user's acceptability will play a crucial role. So, the problem statement finalized for the study is "Design of Walkable streets in Congested Urban Area: User's Perception and Attitude".

3.2 Literature Review:

The second stage of the project is of literature review. For understanding of any area or problem, it is important to understand previous studies, theories and practices adopted in the field. In the current study, literature review covered studies conducted in the area like pedestrian footpath, LOS of walkways, shared spaces, urban footpath analysis and simulation etc. The review helps to understand different aspects of walkable streets and to finalize the objectives.

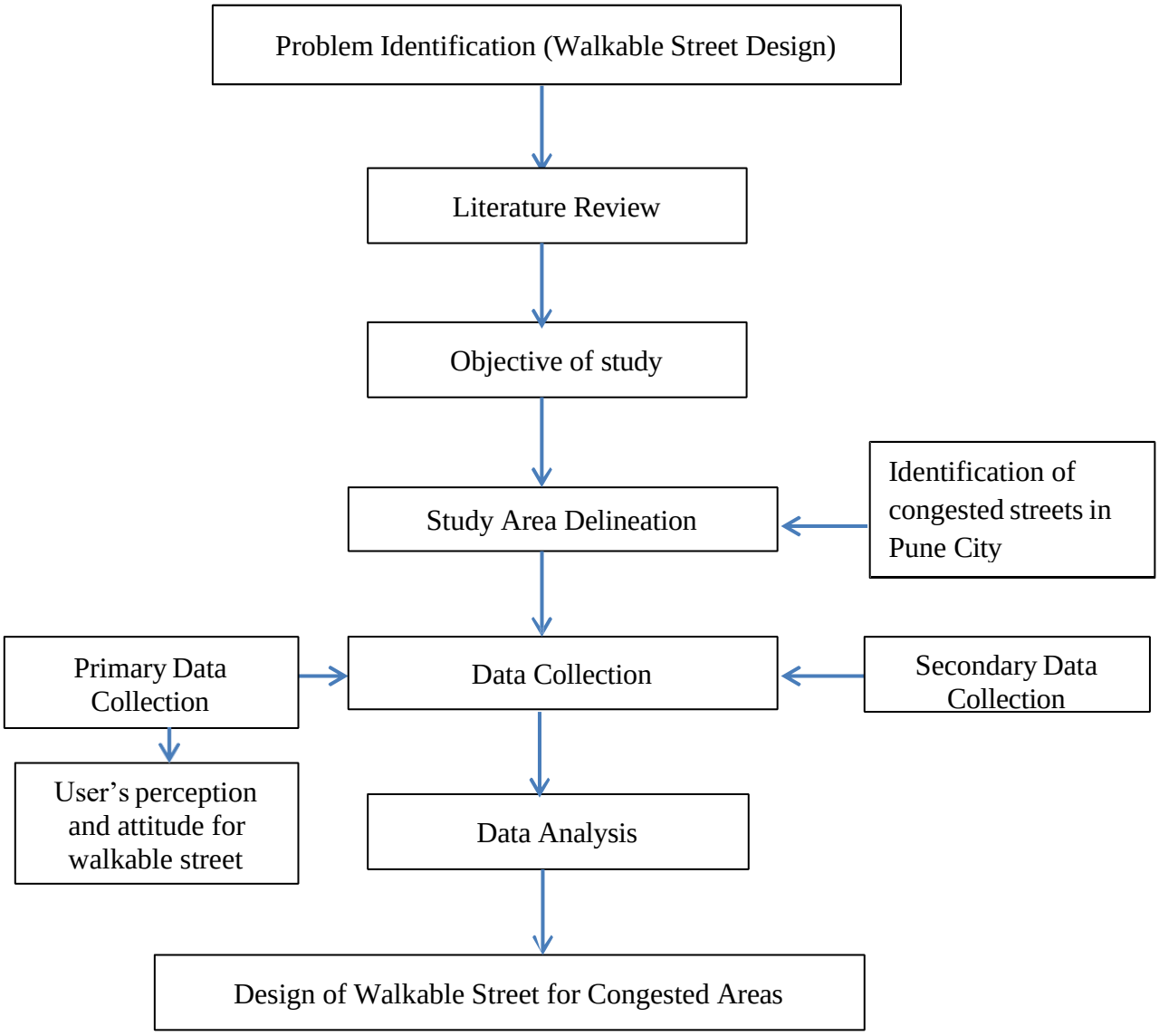

Figure 3.1: Methodology Flow Chart

3.3 Study Area Delineation

The next stage of the projects is study area delineation. For designing the walkable streets for Pune city, three streets are selected as study area. One street from Pimpri Chinchwad Municipal Corporation (PCMC) will be selected. A study will be conducted for street and based on user's perception and attitude, walkable streets will be designed. We have visited Sai Chowk, Shagun Chowk and Arya Samaj Chowk.

3.4. Data Collection:

Good data is always the basis of good analysis. It improves the effectiveness of efforts taken. It helps to identify possible issues and opportunities for improvement. In the current study, data is collected in two stages (i) primary data and (ii) Secondary Data. Primary data comprised of user's perception and attitude about walkable cities. For the same, the data will be collected under four different heads (i) demographic characteristics (ii) accessibility (iii) congestion and (iv) cleanliness. A questionnaire

addressing all above points will be prepared and a survey will be conducted along three streets from PMC and PCMC. Secondary data comprised of guidelines prepared by various agencies for street design and walkable street design. There are various agencies who have worked on street and walkable street design. The guidelines will help to articulate the design process.

3.5 Data Analysis:

This stage of the project will involve the analysis of collected primary and secondary data. Statistical analysis of collected data would help to understand user's role and acceptability of walkable streets. The Statistical Package for Social Scientists (SPSS) series 24 and Microsoft Excel Software will be used in particular for analysis.

3.6 Results and Conclusion:

The last stage of the study is to draw conclusion from the results obtained. The outcomes of the analysis would help to decide different aspects of walkable street like street physical characteristics, accessibility, congestion, street maintenance, cleanliness etc.

DATA COLLECTION AND DATA ANAYSIS

This section discusses the case study area profile with the geographical setting, physical and demographic characteristics, economic profile, and social structure. In the current study, Pune city is selected as Case Study area. Pune is one of the most important industrial and educational hubs of India, with an estimated population of 7.4 million as of 2020. As of 2021, Pune Metropolitan Region is the largest in Maharashtra by area, with a geographical area of 7,256 sq km. It has been ranked "the most liveable city in India" several times. Pune is also considered to be the cultural and educational capital of Maharashtra. Pune is the largest IT hub in India. It is also the most important automobile and manufacturing hub of India.Pune has several world class educational institutions and is widely regarded as "Oxford of the East".The city has emerged as a major global educational hub in recent decades, with nearly half of the total number of international students in the country studying in Pune.Distinguished institutes of engineering, information technology, film school as well as management science and advanced training, attract students and professionals from India and overseas.Figure 1 shows the case study area selected for the study.

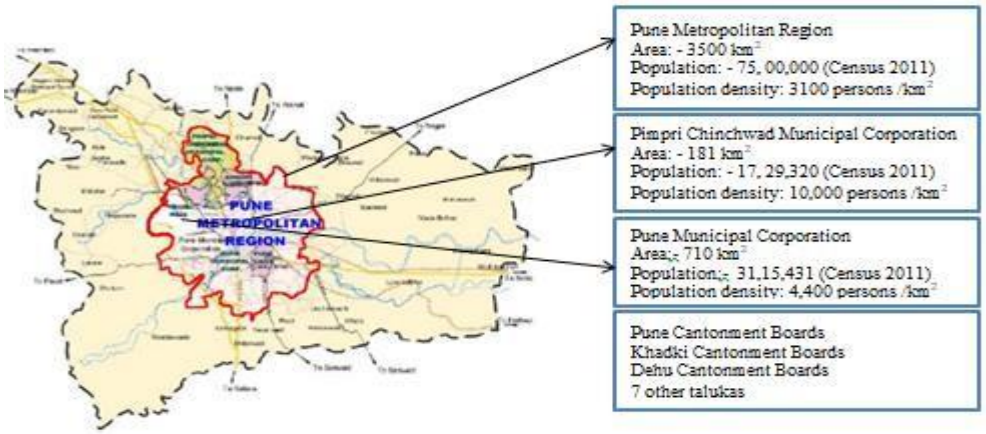

Figure 4.1: Study Area selected for the study

Three streets are selected as study area. One street from Pimpri Chinchwad Municipal Corporation (PCMC) will be selected. A study will be conducted for street and based on user's perception and attitude, walkable streets will be designed. We have visited Sai Chowk, Shagun Chowk and Arya Samaj Chowk.

The Pimpri Chinchwad city is facing various issues related to walkability. In the recent study by a Pimpri Chinchwad city, it is revealed that the poor quality of facilities for walking along the city has made the walkability difficult. As per the report, lack of pedestrian facilities such as footpaths, safe road crossings and other modal conflicts has led to the low score for walkability in Pimpri Chinchwad city. The report stated that the city needs to have deliberate policies to improve the situation. Current study aims to understand issues of walkability in Pimpri Chinchwad city and probable solution for issues through user's perception and attitude for acceptance of better walkability.

Streets Selected for the Study

In order to evaluate the walkability in Pune city, three streets are selected for the study. Two streets from Pimpri Chinchwad Municipal Corporation are selected. Shagun Chowk Road and Sai Chowk are two streets from Pimpri Chinchwad Municipal Corporation (PCMC). It is complete Commercial Street and almost all categories of items like food, fashion, etc. It is ruled by the Youngster's of Pimpri Chinchwad. Street is crowded by the youngsters for shopping and food purpose. Many Restaurants are located serving good quality and tasty dishes. Another attraction is the "Mobile Market" which is a Long lane with small shops popular for hand bags, belts and artificial jewellery. Popular Book House, Arcade, Various Traders and International Book Service are some of the prime Commercial sectors. Temples of the "Padukas" of Sant jhulelal Maharaj and SantTukaram Maharaj is the main attraction.

Figure 4.2: Pimpri Market in PCMC

Data Collection Method:

The target population consisted of population from above listed streets. A judgmental sampling was employed to get the sample size of 40 pedestrians and randomly interviewed. Random sampling is a method of choosing a sample of observations from a population to make assumptions about the population. It is also called as probability sampling. For understanding user perception and attitude, 40 a questionnaire is prepared and responses are recorded. For the data analysis, a 95% desired level of confidence, which is equivalent to standardized normal deviate value of 1.96 and an acceptable margin of error of 5% (standard value of 0.05) is considered. For the collected data, coding of built

environment is maintained in order to provide ease.

Figure 4.2: Shagun Chowk and Sai Chowk in PCMC

Figure 4.2: Sai Chowk in PCMC

Figure 4.2: Shagun Chowk in PCMC

Table 4.1: Criteria for analysis

Criteria	Groups of questionnaire survey	Type of Responses	Description and Role
The demographic characteristics	Respondents personal information	Choice and Open	To understand the social demographic attributes of the study respondents
Accessibility	Are the walkways wide enough for walking?	Likert Scale	To understand respondents' knowledge on the physical characteristics of the street's walkways and how it could affect walkability of the street
	Are the walkway paving surface broken?		
	Are the utility poles well placed along the walkway?		
	Are the walkways level changes even?		
	Are the feeder roads to the street narrow and congested?		
Congestion	Are there hawkers' activities taking place along the walkway?	Likert Scale	To understand respondents awareness of activities along the streets as well as the attitude towards the same on walkability of the street.
	Are there stalls placed along the street which encroach on to the walkway?		
	Are designated parking bays shared with pedestrian walkways or cars parked on walkways?		

Cleanliness	Is there construction materials dumped along the walkway?	Likert Scale	To understand respondents' attitude on how cleanliness may affect walkability on street.
	How do you rate the maintenance of walkways?		
	Do you experience water logging on the walkways during the rainy season?		

DATA ANALYSIS

Data analysis is a process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, informing conclusions, and supporting decision-making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, and is used in different business, science, and social science domains.

In the current study, statistical analysis is conducted to understand the user's perception and attitude. For analysis, computer-aided statistical packages are used. The Statistical Package for Social Scientists (SPSS) series 24 and Microsoft Excel Software were in particular was used for analysis.Data analysis involved simple descriptive statistics such as frequency counts and percentages to summarize the data and inferential statistics such as correlation analysis to determine how social demographic attributes of respondents affected their responses. Based on the responses obtained for the designed questionnaire, analysis conducted is discussed below.

Accessibility

Accessibility in cities is a fundamental element to guarantee equal access to goods and services for citizens. The walking accessibility enhances neighborhood diversity, participation, intergenerational accessibility, comfort, environmental integrity, and economic viability. So, respondents are asked questions based on width of street, paving surface condition, utility poles on streets.

Table 4.2: Percentages responses for walkways width

Sr. No	Are the walkways wide enough for walking?	Response (%)
1	1 (Highest Ranking)	6
2	2	8
3	3	53
4	4	31
5	5 (Lowest Ranking)	2

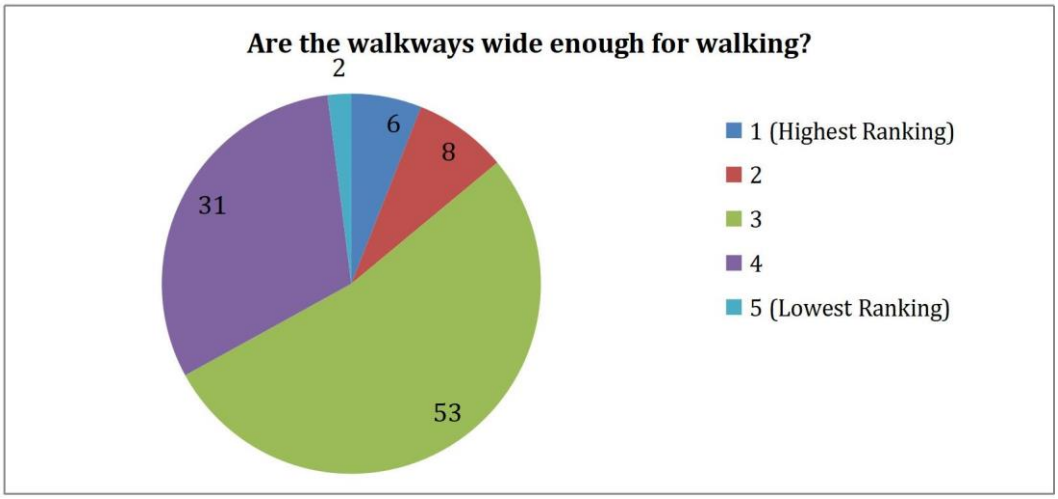

Figure: 4.3: Percentages responses for walkways width

- Around 53% respondents rank moderate walkable width availability.
- According to only 6% respondents, walkways are wise enough for walking

Table 4.3: Percentages responses for walkway paving surface broken

Sr. No	Are the walkway paving surface broken?	Percentage
1	1 (Highest Ranking)	6
2	2	52
3	3	21
4	4	19
5	5 (Lowest Ranking)	2

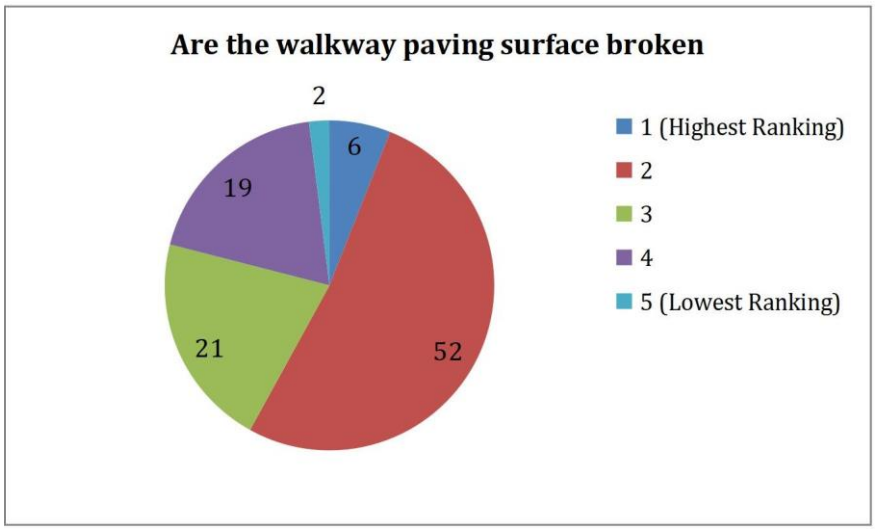

Figure 4.4: Percentages responses for walkway paving surface broken

- 52% respondents stated that reveals presence of broken paved surfaces in all the three streets selected for the study.

Table 4.4: Percentages responses for presence of utility poles

Sr. No	Are the utility poles well placed along the walkway	Percentage
1	1 (Highest Ranking)	32
2	2 (Moderate)	32
3	3 (Equal)	18
4	4(Lower)	12
5	5 (Lowest Ranking)	6

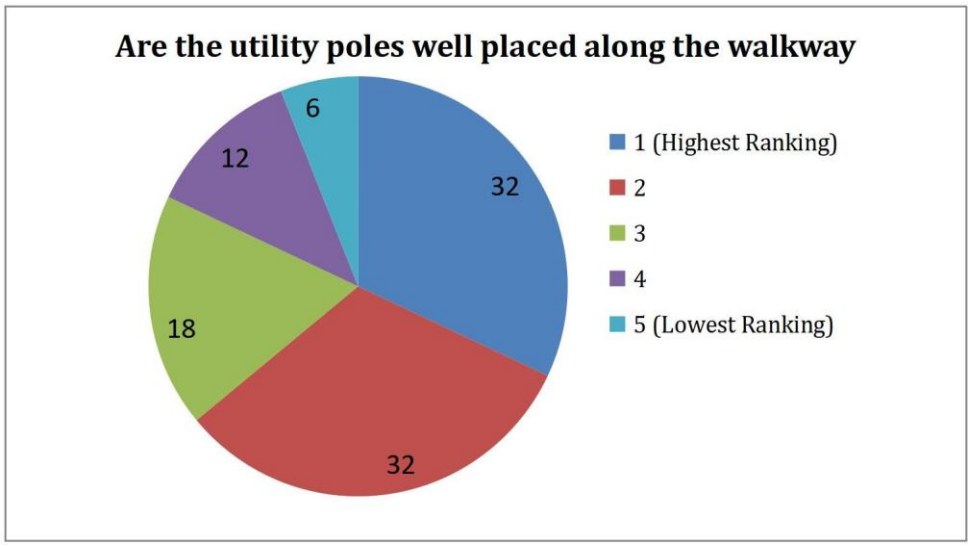

Figure 4.5: Percentages responses for presence of utility poles

- Around 64% of respondents reveal presence of utility poles creates disturbance to the walkability on streets.

Table 4.5: Percentages responses for the feeder roads to the street narrow and congested

Sr. No	**Are the feeder roads to the street narrow and congested?**	Percentage
1	1 (Highest Ranking)	27
2	2	31
3	3	21
4	4	15
5	5 (Lowest Ranking)	6

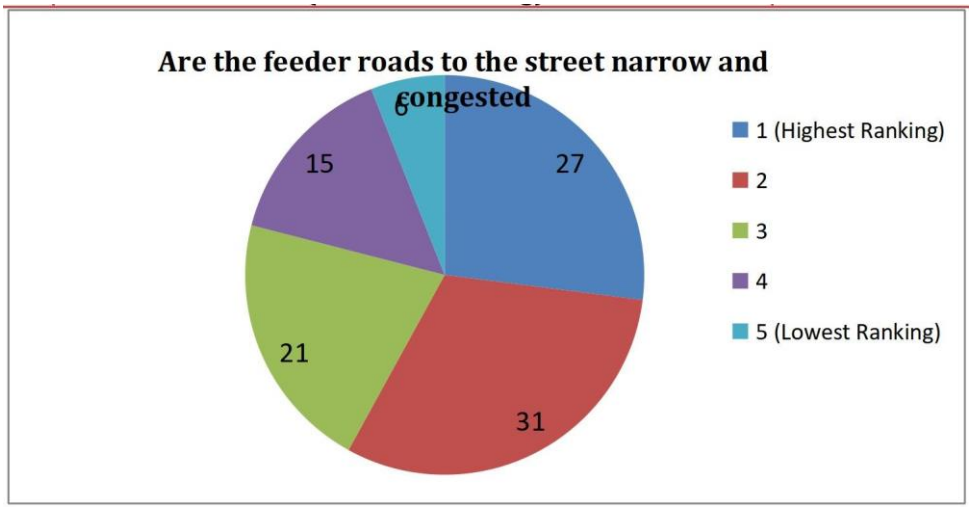

Figure 4.6: Percentages responses for the feeder roads to the street narrow and congested

- Around 73% of respondents reveal that narrow and congested feeder streets generated issues for walking perspectives in the area.

CONGESTION

Encroachment of pedestrian streets is another major issue. It leads to the congestion on streets making it difficult to walk. In the current study, respondents are asked to provide their perception about hawkers' activities on streets, sharing of streets by cars or other vehicles, presence of stalls on streets etc. The recorded responses are briefed as below.

Table 4.6: Percentages responses for hawkers' activities

Sr. No	Are there hawkers' activities taking place along the walkway?	Percentage
1	1 (Highest Ranking)	78
2	2	9
3	3	8
4	4	5
5	5 (Lowest Ranking)	0

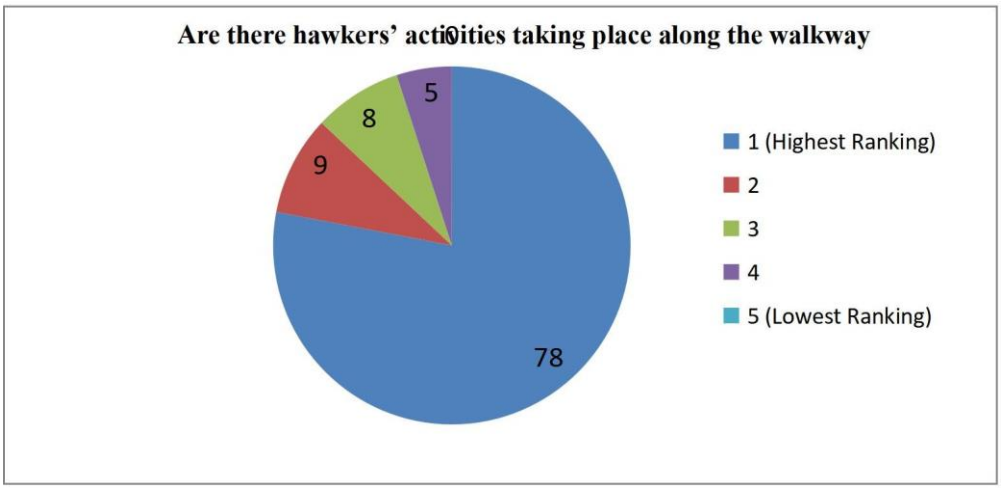

Figure 4.7: Percentages responses for hawkers' activities

- 78% respondents stated that hawker's activities are the major issue for walking perspectives.

Table 4.7: Percentages responses for walkways sharing

Sr. No	Are designated parking bays shared with pedestrian walkways or cars parked on walkways?	Percentage
1	1 (Highest Ranking)	64
2	2	19
3	3	12
4	4	5

5	5 (Lowest Ranking)	0

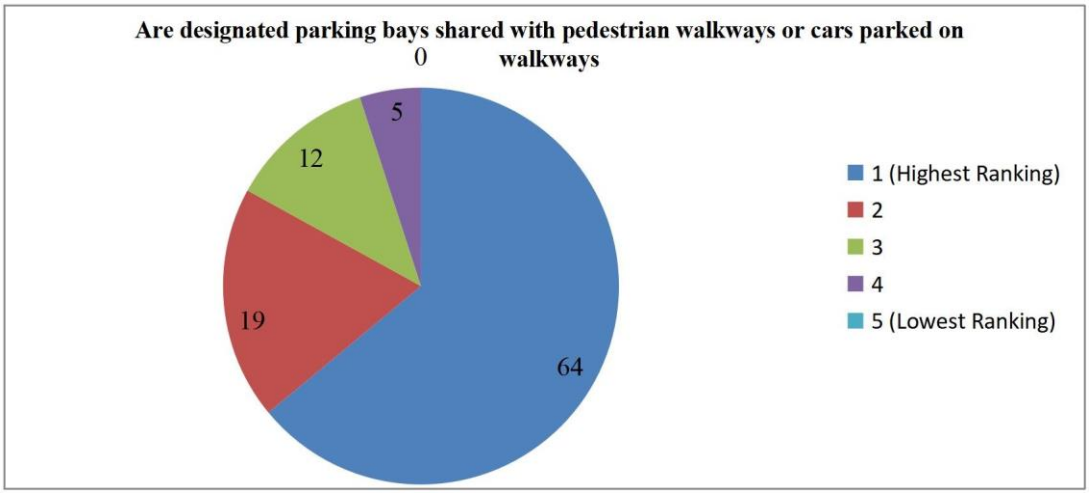

Figure 4.8: Percentages responses for walkways sharing

- Around 64% respondent from all three streets mentioned that pedestrian streets are shared by vehicles creating more issues for walkability.

Table 4.8: Percentages responses for walkways encroachment

Sr. No	Are there stalls placed along the street which encroach on to the walkway?	Percentage
1	1 (Highest Ranking)	68
2	2	17
3	3	10
4	4	5
5	5 (Lowest Ranking)	0

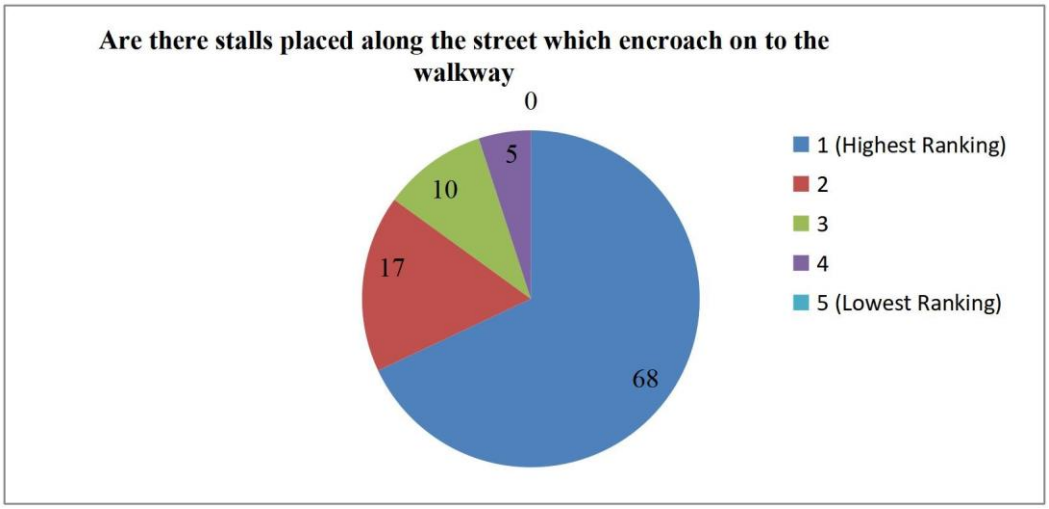

Figure 4.9: Percentages responses for walkways encroachment

- 68% respondents claim that the stalls placed along the street encroach the walkways.

CLEANLINESS

Cleanliness has a great importance in walkable streets. Provision and maintenance of cleanliness always enhances walking perspectives. It rather leads to more use of pedestrian streets. So, respondents are asked to questions about presence of dumped construction materials, maintenance of walkways and water logging in rainy season etc.

Table 4.9: Percentages responses for construction material on walkways

Sr. No	Is there construction materials dumped along the walkway?	Percentage
1	1 (Highest Ranking)	23
2	2	27
3	3	32
4	4	9
5	5 (Lowest Ranking)	9

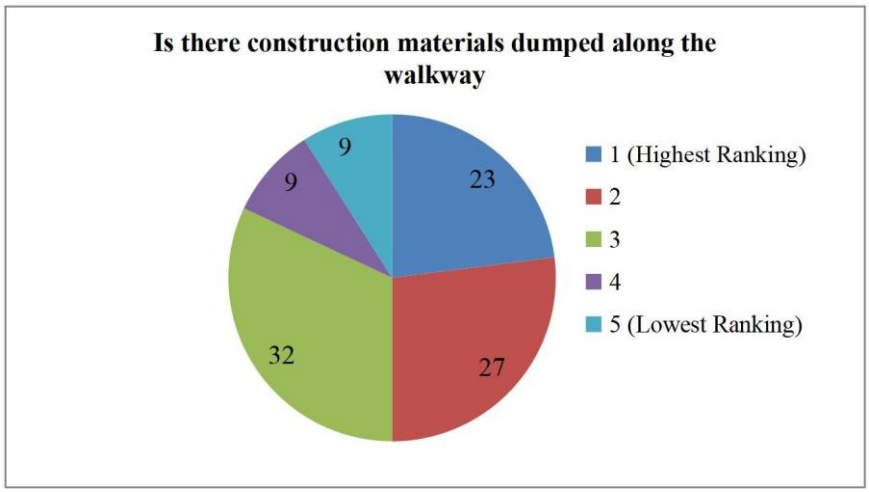

Figure 4.10: Percentages responses for construction material on walkways

- Around 59% percentage of respondents states that presence of construction materials and other dumped materials created issues for walkability.

Table 4.10: Percentages responses for maintenance of walkways

Sr. No	How do you rate the maintenance of walkways?	Percentage
1	1 (Highest Ranking)	2
2	2	3
3	3	13
4	4	13
5	5 (Lowest Ranking)	69

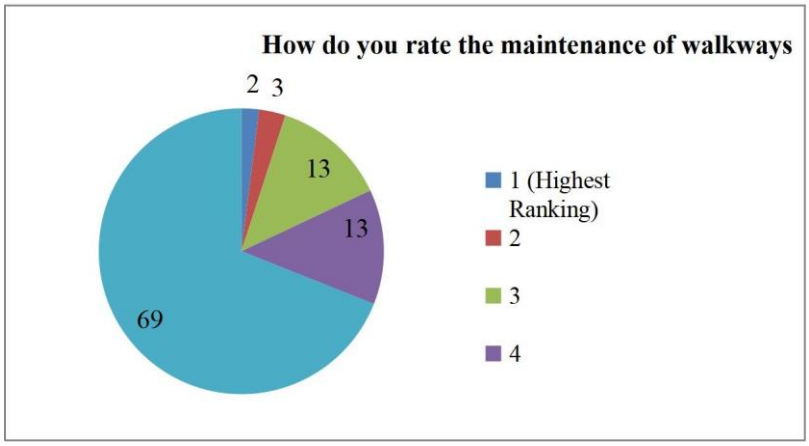

Figure 4.11: Percentages responses for maintenance of walkways

- 69 % respondents feel that there is need of walkways maintenance.

Table 4.11: Percentages responses for water logging on walkways

Sr. No	Do you experience water logging on the walkways during the rainy season?	Percentage
1	1 (Highest Ranking)	61
2	2	21
3	3	13
4	4	5
5	5 (Lowest Ranking)	0

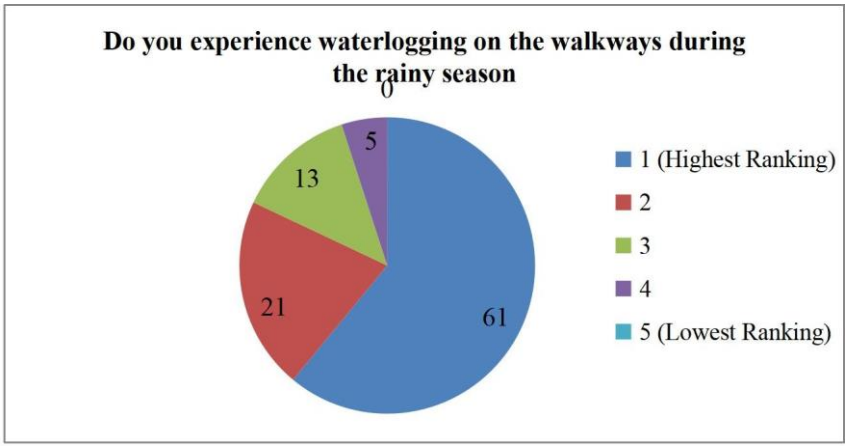

Figure 4.11: Percentages responses for water logging on walkways

- 61% of respondents experienced water logging on walkways either due to drainage system or during rainy season.

RESULTS AND DISCUSION

Urban designers are interested in the environmental qualities of places that make them better for walking, not only as settings for physical activity, but also as sensorial and social settings. Research in walkability lacks qualitative studies that address the microscale analyses of the environment. This paper is an empirical examination of the relationship of the physical, land-use, and social characteristics of the environment at the microscale to people's behavior and perceptions toward walking. Using the data from surveys and interviews, this research emphasizes the integration of user perceptions and subjective measures to understand the impact of environmental characteristics on walking behavior on Main Streets. Adding to previous research, this study demonstrates the significance of social qualities in supporting walking. The findings expand our understanding of the hierarchy and criteria of walking needs and suggest that, given a safe and comfortable setting, people look for usefulness, sense of belonging and pleasurability as additional and distinct needs to enhance their walking experience.

1. Street Physical Characteristics and Accessibility

In the survey, five measures were used to capture the degree of accessibility that users derived from the street's walking experience: walkway width, broken paving surface, obstacles by utility poles, uneven level changes, and feeder roads. Equally important were user responses to close-ended questions suggesting that accessibility was important in relation to walking.

Alfonzo (2005) suggests that the first-order need for walking is accessibility. Besides individual factors, choosing mobility, time, and other responsibilities may limit the viability of any strolling or destination-oriented walking trip. This study is concerned with the Street wideness, which supports walking. The larger part of the street has the driveway and walkway wide enough to offer good walking conditions except for the area between the cooperative bank and open-air market stretch, which has a narrow driveway.

Street configuration, pedestrian width, discontinuous pedestrian flow, paving materials affects the volume of pedestrians for comfortable walking (Kang, 2017) . Wide roads and higher traffic speeds tend to create barriers to walking, thus often conflicting street design goals for vehicles and pedestrians. Paving materials and pedestrian width were selected in this study according to the pedestrian flow that allows for easy access. According to Saeed & Furlan (2017) , a minimum of 2.5 m to 4 m walkway without front zone and furniture area in mixed- use to high-intensity commercial area is recommended for barrier-free walking.

Measures to encourage walking will need to include some large-scale improvements to infrastructure, but overall this will only be successful if less high-profile measures are also given attention. For example, adequate funding for maintenance will be essential to ensure that issues such as cracked paving stones, puddles caused by blocked drains, utility poles on the walkways and broken lights do not dissuade people from walking. Similarly, where significant investment is made in an area's pedestrian environment, the intended increase in walking may occur unless accompanied by measures to promote vehicular roads.

Street segments were characterized by detailed field surveys of the pedestrian quality attributes that have been shown to affect navigation in urban environments through their impact on the perceptions of pedestrians.

2. Street Congestion

The usefulness of the walkway is the environment's ability to satisfy the basic everyday needs of the individual for shopping, safely cross from one store to the other, and entertainment, and this ability or lack of it affects walking attitude. Usefulness translates the general land-use diversity to make it meaningful to the individual whose walking needs are considered. Further, it was found that hawkers were displaying their goods on the walkway. This has rendered most of the walking area to be vending places leaving pedestrians with small or no room for walking. The same is noted with build stalls and storefronts encroaching to the walkways

A further important factor related to walking attitude is perceived safety from traffic. Studies on real and perceived traffic safety suggest the importance of many measures and physical features, such as reducing street width and speed limits, introducing calming measures for traffic, curbside parking, trees or plantings to reduce or slow down traffic, separating pedestrians from fast-moving vehicles, making street crossing safer for pedestrians, and segregation of parking bays and the walkways (Mehta, 2008) . This study found that 68.8% of the respondents strongly agreed that most sections of the streetcars were

being parked on the walkways, which obstructed pedestrians and eventually had to use the roadway.

3. Street Maintenance and Cleanliness

On maintenance and cleanliness of the street, 56% of the respondent confirmed that the area under study is well maintained and clean. On the contrary, the conditions of some pedestrian walkways are uneven, broken, and inadequate from support facilities and accessibility for persons with disabilities, which have a negative impact on Street walkability.

While the sense of walking is affected by the built environment, it also affects the real and perceived safety of pedestrians. As indicated in Figure 7 above, 57.3% of the respondent felt that the walkways adjacent to the construction sites where free from debris dumping which favored there errands in the street with the rest of the respondents 30.2% in disagreement, 2.1% neutral, 8.3% agreeing and 7.1% strongly agreeing.

This study found that associations with individuals, places, and events contribute to a sense of community familiarity and belonging. Places that help shape pedestrians' attitudes, provide continuity from past to present, often cater for ordinary but essential day-to-day functions, and help to establish the identity of their community, become meaningful to neighbors and attain a social value and significance.

This study also found out that the proper drainage on the walkways, which prevents water logging are all important to provide a useful, safe, comfortable, pleasurable and meaningful setting for walking in urban public spaces such as Street. It was also found that the association between the condition of the walkway of the Street and walking behavior, not only as a way of accessing different parts of the street but also the overall experience that it offers to the pedestrian.

CONCLUSION AND RECOMMENDATIONS

The last stage of the study is to draw conclusion from the results obtained. The outcomes of the analysis would help to decide different aspects of walkable street like street physical characteristics, accessibility, congestion, street maintenance, cleanliness etc.

1. On the street of Pimpri Market we have noticed that the traveler who want to go **Pimpri Waghere, Pimple Saudagar, Chinchwad,** they have to go from Pimpri market because there is no other road to go on. So we can do diversion so that the traveler can go direct to their destination and by doing this we can reduce the traffic.
2. We can keep their even and odd parking, using even and odd numbered parking can be an effective way to manage parking in areas with limited space. It can help reduce traffic congestion and make it easier to find parking in densely populated areas.
3. Paid parking can be very useful in certain situations, such as in urban areas where there is high demand for parking spaces and limited space available. It can help regulate the availability of parking spaces, reduce traffic congestion, and encourage turnover, making it easier for drivers to find parking.
4. Diversion of traffic can help reduce congestion on primary routes, improve traffic flow, and minimize disruption to business and residents in the affected areas.
5. Parking rules can help reduce congestion on roads and in parking areas. Illegally parked vehicles can create bottlenecks and cause delays, particularly in densely populated areas, to avoid these people

have to follow parking rules.

6. Hawkers on footpaths can provide a wider range of goods and services to pedestrian, including food, clothing, and other essential items. Thus, positioning them near pedestrian movement improves footpath conditions without vendor intrusion. Residents and street hawkers were surveyed for a design exercise. After examination, vendors should be relocated to improve pedestrian and neighbourhood pathway having point conditions.

7. Firstly, big vehicles such as trucks and buses take up a lot of space on the road and can cause congestion, especially during peak hours. This can lead to delays, longer travel times, and increased air pollution, which can have negative impacts on the environment and public health.

Secondly, big vehicles can also pose a safety risk to other road users, particularly pedestrians and cyclists. Their size and weight make them harder to stop, which can result in accidents, injuries, and fatalities.

Thirdly, restricting big vehicles can also help to reduce wear and tear on the road surface. Big vehicles tend to be heavier than smaller vehicles, and therefore cause more damage to the road over time. This can lead to the need for more frequent repairs and maintenance, which can be costly for local governments and taxpayers.

8. The provision of walkable streets is definitely possible and has become an important priority for many urban planners and designers. Walkable streets are those that are designed with the needs of pedestrians in mind and provide safe, convenient, and attractive routes for walking.

I. To create walkable streets, several factors need to be considered. Firstly, the street design should prioritize pedestrian safety by providing well-marked crosswalks, adequate lighting, and traffic calming measures such as speed bumps or roundabouts. This can help to reduce the risk of accidents and injuries and make the street more accessible to people of all ages and abilities.

II. Secondly, walkable streets should be designed to be attractive and comfortable for pedestrians. This may involve providing amenities such as benches, shade trees, or public art, as well as minimizing sources of noise and pollution such as car traffic.

III. Thirdly, walkable streets should be connected to other pedestrian-friendly routes and destinations, such as parks, shops, and public transportation hubs. This can encourage more people to walk and reduce reliance on cars, which can help to reduce traffic congestion and improve air quality.

IV. Finally, creating walkable streets requires a collaborative effort between local government, community organizations, and residents themselves. It is important to engage stakeholders in the planning and design process to ensure that the needs and preferences of local communities are taken into account.

V. Overall, while creating walkable streets may require some initial investment and planning, it is definitely possible and can have numerous benefits for communities, including improved health, safety, and quality of life.

Walkable streets support a sense of walking as an alternative to driving to reduce the town's vehicle congestion, and walking is also promoted as a fair means of transportation for people of different ages and classes. For Street or other commercial streets in the town, the lessons from this study are particularly important. Research findings confirmed by the pedestrian attitude identified

facilities to improve walkability, including improvement and addition of non-continuous pedestrian walkways, availability of cheap pedestrian crossing across all street segments, traffic management to reduce vehicle congestion, periodic walkways maintenance, and regular pavement cleaning. This is in terms of policy and planning with key stakeholders (e.g., urban developers, landscape designers, landscape architects, architects) to build a pedestrian-friendly walkway per the need for a safe environment. The study further suggests that priority should be given to public participation to capture the needs and views of the people regarding certain elements of street design. Lastly, this paper opens a discussion on various topical issues related to contribution of street walkability to reduction of greenhouse gases and how county governments can tap on this opportunity going into the future to mitigate climate change. Further, the paper sets a foundation for amendment and development of new county ordinances that promote smart urban designs that promote non-motorized means of transport in our local towns.

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VII. PLANNING SCHEDLE FLOW CHART FOR COMPLETION OF PROJECT

MONTHS	OPERATION
August	Topic finalisation
September	Literature review
October	Literature review
November	Scope of study and objective study finalised
December	Study Area Delineation (Identification of congested street in Pimpri Chinchwad City)
January	Data Collection(User's perception and attitude for walkable street)
February	Questionnaire Prepared for the Data Collection
March	Comparison between data gathered
April	Results and Discussion
May	Final report