ASSESSING THE WALKABILITY OF A CITY- A CASE OF CHANDIGARH

Thesis Submitted for the Award of the Degree of

DOCTOR OF PHILOSOPHY

in

Planning

by

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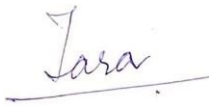
LOVELY PROFESSIONAL UNIVERSITY, PUNJAB

2025

DECLARATION

I, hereby declared that the presented work in the thesis entitled **"Assessing walkability of a city- A case study of Chandigarh"** in fulfilment of degree of **Doctor of Philosophy (Ph. D.)** is outcome of research work carried out by me under the supervision of **Prof. Tej Karki**, working as a **Professor** in the **School of Architecture and Design** of Lovely Professional University, Punjab, India. In keeping with general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of another investigator. This work has not been submitted in part or full to any other University or Institute for the award of any degree.



(Signature of Scholar)

Name of the scholar: Tara Singla

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CERTIFICATE

This is to certify that the work reported in the Ph. D. thesis entitled **"Assessing walkability of a city- A case study of Chandigarh"** submitted in fulfillment of the requirement for the award of degree of **Doctor of Philosophy (Ph.D.)** in the **School of Architecture and Design**, is a research work carried out by **Tara Singla , 41801071**, is bonafide record of her original work carried out under my supervision and that no part of thesis has been submitted for any other degree, diploma or equivalent course.

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Name of supervisor: Prof. Tej Karki

Designation: Professor

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ABSTRACT

Walkability is crucial in designing urban areas, impacting public health, environmental sustainability, social equity, and local economies. Cities that focus on walkability show air quality enhancements, traffic congestion reductions, and improved quality of life for their inhabitants. Nevertheless, despite widespread discussions surrounding pedestrian-friendly urban planning, many planned cities struggle to provide genuinely walkable spaces due to deficiencies in policy creation, planning execution, and implementation strategies. Chandigarh, known as India's first planned city, exemplifies how the modernist principles intended to cultivate an efficient and orderly urban form have, over time, unveiled obstacles to achieving walkability at a micro-level.

Conceived by Le Corbusier in the 1950s, Chandigarh was based on principles of equity and improved living conditions. Designed with functional zoning, hierarchical road layouts for various types of traffic, and neighbourhood planning, the city's design was groundbreaking. But with urban growth, problems like traffic congestion, poor maintenance of pedestrian facilities, and unsafe travel environment for pedestrians have adversely affected its walkability. The initial master plan featured wide roads, green areas, and pedestrian routes; however, today, the movement of pedestrians within the city is hindered by encroachments, insufficient last-mile connections, and the dominance of automobiles.

To understand walkability in planned cities like Chandigarh, it is important to look beyond just design and consider the policies and planning strategies in place. Although master plans and urban mobility policies may promote walkability, their implementation and effectiveness often fall short. Additionally, many walkability assessments rely on numbers, missing out on the personal experiences of those walking. There is a clear need for better methods combining factual data and personal feedback. Over the past two decades, walkability research has expanded significantly, drawing insights from various disciplines including urban planning, transportation research, environmental psychology, and public health. Numerous models and indices, such as Walk Score, the Pedestrian Index of the Environment (PIE), and Space Syntax, have been developed to measure walkability. These assessments analyse land-use diversity, street connectivity, infrastructure standards, and safety considerations. Global research

on parameter-based evaluations of walkability highlights shortcomings in current models, particularly in their inability to address the subjective aspects of pedestrian experiences. While these models provide valuable macro-level insights, they often overlook the nuanced details of walkability at a micro level, especially in contexts where pedestrian behaviors are influenced by sociocultural factors, climate, and governance structures. In India, walkability research is notably underdeveloped compared to international studies. There is a significant lack of empirical investigations focusing on planned cities and their specific contexts. Additionally, many existing studies rely on broad survey methods that do not adequately assess specific conditions or differentiate among various types of pedestrians. The absence of a customized methodological framework for evaluating walkability in planned cities creates a substantial research gap.

In 2008, the Ministry of Urban Development assessed Chandigarh's walkability. The study identified several shortcomings in its research methodology. The assessment failed to incorporate unique area-specific parameters relevant to Chandigarh's planning ideals; instead, it applied a one-size-fits-all approach that spanned multiple cities without considering local contexts. The methodology primarily focused on the availability of footpaths along significant roads, neglecting internal sector pathways, and the pedestrian ratings utilized limited criteria that did not adequately explain the city's low walking mode share. Additionally, the selection of respondents was insufficient, as household interviews did not accurately capture the purposive walking patterns critical for effective transport planning. Given that no updated assessment has taken place since 2008, there is a pressing need for a comprehensive mixed-method approach to evaluate Chandigarh's current walkability conditions accurately.

Chandigarh is oblivious to the needs of walkers and understanding of the concept of walkability. The research tries to address gaps in previous assessment and understanding of walkability. Focussed research of nine sectors, including Sector 17 helps understand the nuances of walkability in Chandigarh. Employing a mixed methods approach, the research combines Photographic documentation of pedestrian infrastructure with a survey of 209 regular purposeful walkers to uncover the challenges of walkability. The data is further analysed to prioritise the issues, followed by policy review to evaluate their alignment with Chandigarh's original framework. The study

reveals a range of issues hindering pedestrian mobility including obstructed zebra crossings, street harassment by strangers, poorly maintained sidewalks, single- zoned land use, fear of crime on streets at night, lack of crossing time at signalled junctions, discontinuous and obstructed sidewalks and poorly marked zebra crossings. Although envisioned as a model city, Chandigarh has gradually evolved into a car centric urban environment that undermines pedestrian movement. This study exposes a pronounced disconnect between the city's modernist equitable planning ideals and the urban experience. It underscores how even a meticulously planned city, intrinsically designed to support walking can fall short in delivering human- centric urbanism if its facets are not understood properly.

ACKNOWLEDGEMENT

The successful completion of this thesis would not have been possible without the invaluable support, guidance, and encouragement of several individuals.

My mentor and supervisor, **Dr. Tej Karki**, deserves special recognition for his unwavering guidance and inspiration, which directed all my endeavors. I extend my heartfelt gratitude to **Tara Bhusla** for her support during the research. I am thankful for **Prof. Jit Gupta** and his blessings. I am deeply indebted to the experts whose insights and support were instrumental in shaping this research. I am profoundly grateful to **Ar. Kapil Setia**, Chief Architect, Chandigarh, for his steadfast support and for providing essential information. My sincere thanks to **Er. N.P. Sharma**, Chief General Manager, Chandigarh Smart City Limited, and **Ar. Renu Saigal**, former Chief Architect of Chandigarh, for their detailed elaboration on the challenges faced during the planning and execution of city initiatives. **Ar. Sumit Kaur**, Former Chief Architect of Chandigarh, deserves special mention for raising sensitivity to the critical issue of walkability. **Ar. Deepika Gandhi,** my senior from Chandigarh College of Architecture, for her expert guidance with the facets of heritage of Chandigarh. Having worked closely with the Government Museum in Chandigarh, Ms. Gandhi's support was most valuable. I am equally grateful to **Mr. Navdip Asija**, Traffic Advisor, Government of Punjab, for his pioneering contributions to traffic management and expert mentorship, **Dr. Meenakshi Singhal**, for her unshakable faith in my abilities, and for her continuous mentoring and guidance. I sincerely appreciate the trust and support extended by **Ar. Surinder Bahgha** and the valuable inputs provided by **Ar. Bandana Singh** and **Ar. Vikram Pannu** during surveys. I would also like to thank **Ar. Manmohan Khanna** for his valuable advice.

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Date: 17 June 2025
Place: Jalandhar, PUNJAB

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1 Introduction

Chapter 1, titled **"Introduction**,**"** outlines how walking and walkability have evolved globally. It highlights the humble beginnings of cities in post-independence India. It charts the planning course of Indian cities. It explains how they were planned for both cars and pedestrians, despite the limited traffic data. Innovation was at the helm of planning these new post-independent cities. These cities aimed for equity, creating a better living environment while also alleviating and revitalizing the population after the exploitation endured during colonial rule. The development of these cities was unique, shaped by their contexts and cultural needs. Today, after years of conceptualization, these cities have undergone unprecedented growth; however, they have also suffered from inadequate planning, biased political discourse, and misguided planning initiatives. Consequently, the development of these cities has deviated from the principles of equality and livability, resulting in urban environments that are overly dependent on cars. Chandigarh is no exception. This chapter provides an in-depth analysis of Chandigarh's planning as an ideal city, examining how such developments have contributed to the transportation challenges of walking.

1.1 Background of walking

Walking was the primary mode of transportation until the invention of the wheel, with most travel occurring on foot until the seventeenth century (Amato, 2004). It is considered the oldest form of transport, and most cities were structured to support walking (P. Newman & Kenworthy, 2006). The first significant change to urban transport was the introduction of public transport for the masses. However, even then, walking was considered important for covering the first and last mile connectivity (Hare, 2006). Following World War II, the popularity of cars surged, promoting the idea of freedom of movement (Frohardt-Lane, 2012). The late 19th century led to the physical separation of functions. The single-zoned land use promoted the use of motor vehicles for traveling between uses, leading to city planning being vehicle-

centric (Dennis, 1986). This car-centric approach neglected the needs of pedestrians. In response to the traffic-created chaos, cities such as Paris, Amsterdam, and Copenhagen began reclaiming their urban spaces through concepts like ‘garden cities,’ aimed at decongesting the towns with cars. In post-colonial India in 1947, where car use was less prevalent, the ‘garden city’ model was adopted to foster balanced communities, focusing on promoting happiness through inclusive urban design that emphasizes green spaces and accessibility (Kalia, 1999; Koenigsberger Otto H, 1952; Osborn & Whittick, 1963). As India developed, vehicle ownership surged after the 1980s. The planning of Indian cities, too, became vehicle-centric. Ineffective master plans, unregulated growth, informal settlements, inadequate pedestrian infrastructure, deficient constitutional policies, and weak local governments that prioritize capital-driven growth in real estate and road expansion over pedestrian needs all increase pedestrian risks. (Tiwari, 2022).

Increased motor vehicle activity today exacerbates pollution and deepens the divide between the rich and the poor, marginalizing low-income groups in urban transportation. They face significant traffic risks from inadequate connectivity, personal safety threats in unsafe walking environments, and health hazards from vehicle emissions, despite contributing the least to the problem. Urban sprawl, driven by rising housing prices and limited public transit, further restricts their mobility. Expanding infrastructure, such as highways, also overlooks their needs. To address these disparities, cities must adopt inclusive urban planning and policies that enhance accessibility, prioritize pedestrian safety, and create a balanced transportation system. (Badami, 2005). Much of the renewed attention on urban walkability concerns the sustainability of car-dependent cities in the future, especially regarding energy costs, poor air quality, and the increasing reliance on fossil fuels. Additionally, the issue of equity is critically important, as a significant portion of the population cannot afford a private car, including those unable to drive, such as the elderly, children, and individuals with disabilities. With the focus on sustainability and equity, walking is once again recognized as an essential mode of urban transport (Hare, 2006).

After India's independence from colonial rule, equality was the foundation for the new towns. Additionally, India's Prime Minister, Pandit Jawaharlal Nehru,

reinforced the principle of modernism in the post-independence capital towns of Bhubaneswar, Gandhinagar, and Chandigarh. As a mark of modernity, Nehru highlighted secularism in Bhubaneswar; however, the image of old Bhubaneswar as a "temple town" influenced its final design. He commissioned Koenigsberger, a German-Indian architect, to plan Gandhinagar, the birthplace of Mahatma Gandhi. Gandhi's Indian ideals challenged their conceptualization. In contrast, Chandigarh (Refer Annexure- 1) was distinctive, lacking any previous context, and designed as a "model" for urban planning worldwide. However, political factors and bureaucratic influences soon impacted the city's development. These three capitals aimed to uplift society, restore order, and facilitate mobility, countering modernism. Their unique context shaped their development. Most new towns in post-independent India were initially designed to offer equitable urban amenities, but they have gradually become car-oriented due to planning gaps. The situation varies based on governance, economic activity, and urban expansion (Kalia, 1997, 2004).

1.2 Statement of the problem

Chandigarh, a 'model' city of post-independent India built on ideals of spaciousness, modern character, good living conditions, civic amenities, greens, and general cleanliness, has poor walkability today. During Chandigarh's planning, data on traffic was non-existent, as there were not many motor vehicles; however, it still incorporated planning for pedestrians to facilitate urban mobility. However, today, city walkers face a massive shortage of walking infrastructure and high levels of car interference on the streets. Chandigarh, a city planned and designed by Le Corbusier for the state of Punjab in India, is mainly auto-dependent today.

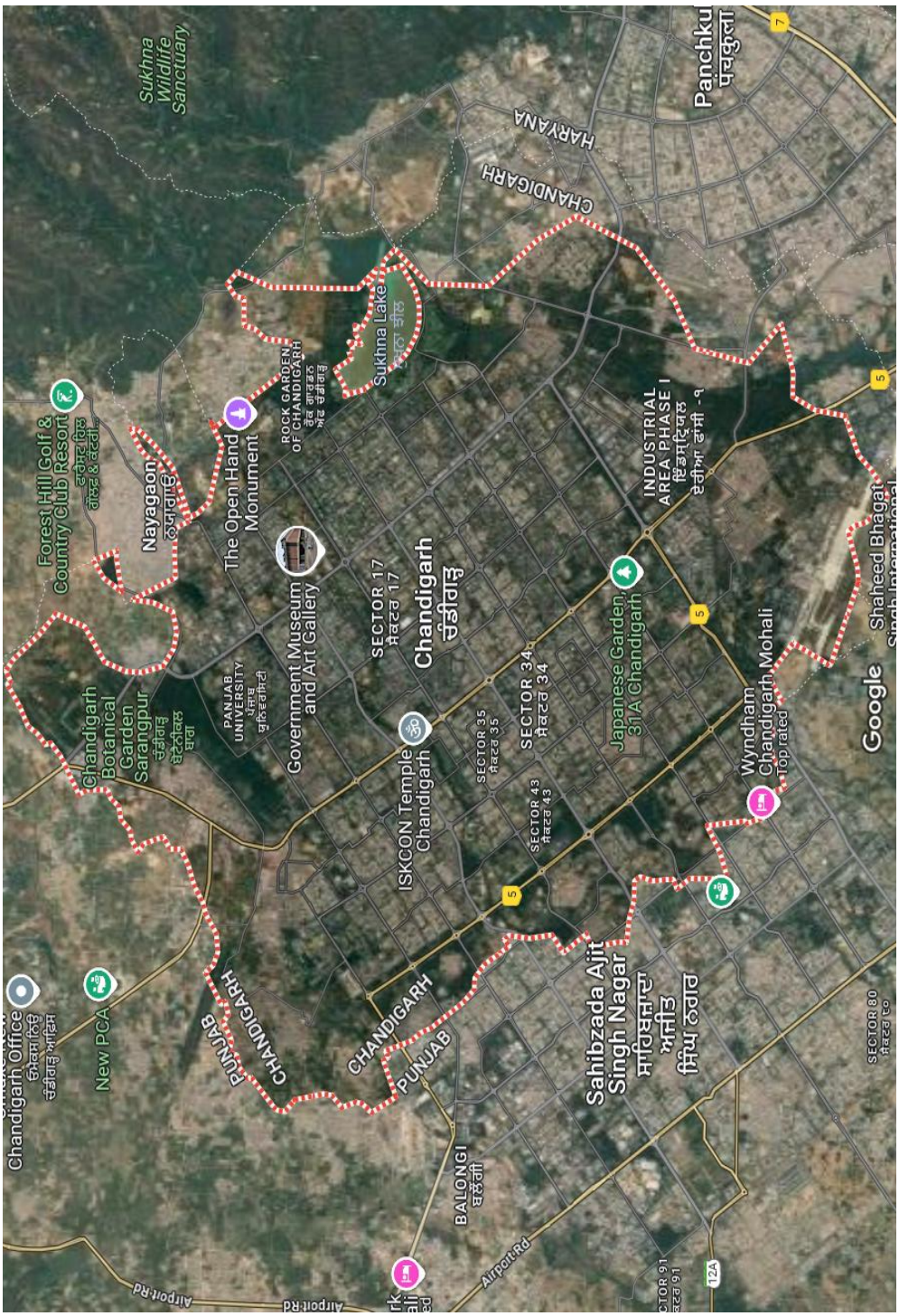


Figure 1.1- Google Map of Chandigarh showing the urban grid-iron pattern

(Source: Chandigarh Urban Lab Blog: Unpublished Chandigarh Metropolitan Region Development Plan)

1.3 Research aim and objectives

This research aims to find what makes Chandigarh city less walkable. The research sets the following objectives for exploration;

1. To identify gaps in the walkability of Chandigarh.
2. To analyse pedestrian experiences and find significant problems.
3. To find out policy weaknesses
4. To provide model framework to improve walkability.

For this, the study focuses on the Central Business District (Sector 17) and its eight adjacent sectors (Sectors 8, 9, 10, 16, 18, 21, 22, and 23) as the research area. The research employs a mixed-methods approach, utilizing triangulation. This research presents a refined methodology for evaluating walkability, emphasizing the significance of the walkability scale, types of walkability, urban context of Chandigarh, and pedestrian behaviors. By aligning walkability parameters with a city's specific planning context, this study demonstrates the existence of purpose-driven walkers—individuals who regularly walk along the roads of Chandigarh. These offer more precise and contextually relevant insights than standard pedestrian surveys.

A field photographic survey highlights the issues on ground. Subsequently, a survey of walkers, which includes qualitative and quantitative assessments, rates these issues and shares the underlying perceptions of the walking population. Then, a policy review is conducted, after which recommendations are made to address the identified problems. The study identifies significant obstacles to walkability, including obstructed zebra crossings, street harassment, poorly maintained footpaths (sidewalks), single-use zoning with scattered services, fear of crime, and limited crossing time intervals, as well as discontinuous and obstructed sidewalks with poorly marked zebra crossings. The study assesses three suitable parameters, as shown in Figure1.2, selected from an extensive literature review, which is further detailed in Chapter 3.

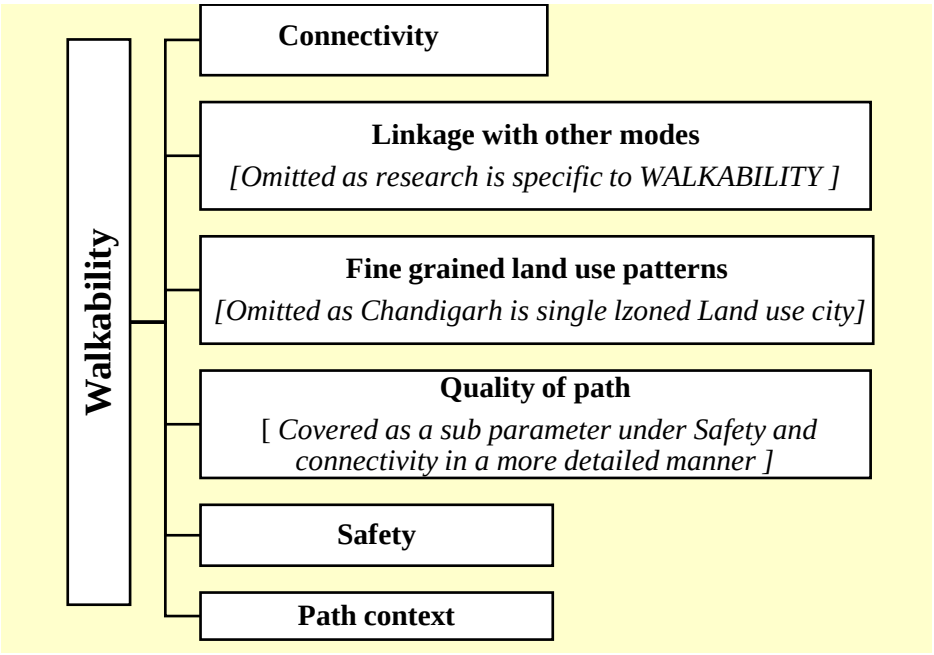


Figure 1.2 - Contextual Factors for Chandigarh

(Sources: (Southworth, 2005), (Hsieh & Chuang, 2021), (P. Newman et al., 2016), (Soderlund & Newman, 2015), (Ewing, 1996),(Ewing & Cervero, 2010a), (Campoli, 2012), (Cervero & Kockelman, 1997), (Frank et al., 2006), (Owens, 1993), (Sallis et al., 2009), (Lotfi & Koohsari, 2011), (Hino et al., 2014), (Siqueira Reis et al., 2013), (Koohsari et al., 2016).

1.4 Limitation of the study

The research is an academic, non-funded effort conducted by a single individual. It relies on a sample of 209 purposive walkers, which may be considered less representative of the scientific sample for a city. Nevertheless, it has effectively highlighted the key walkability issues that regular walkers encounter by targeting a selected area for detailed study. Additionally, with occasional or leisure walkers, along with middle-class and affluent residents of the city, and vulnerable groups such as older adults, disabled individuals, and children largely absent from the streets due to their preference for other modes of transport, the survey primarily emphasizes findings from the low-income group or those who walk out of necessity. This observation is aligned with earlier reports from the Ministry of Urban Development, which indicate low pedestrian shares. Finally, data collection targets mostly all peak hours but excludes very early mornings and very late evenings due to security issues faced during lean hours.

1.5 Benefits of the research

This study provides several benefits beyond the immediate advantages of increasing walkability. These have been discussed under the following headings.

Enhanced walkability assessment

This research presents a refined methodology for evaluating walkability, emphasizing the significance of local determinants, including climatic conditions, cultural norms, urban morphology, and pedestrian behaviors. By aligning walkability parameters with the specific planning context of a city, this study demonstrates that purpose-driven walkers—individuals who actively engage in walking for commuting, fitness, or leisure—provide more precise and contextually relevant insights compared to standard pedestrian surveys. Their feedback provides valuable input for urban policymakers and planners, facilitating the development of more effective transportation policies that take into account specific design elements and land-use patterns. The findings underscore the necessity of context-sensitive walkability evaluation frameworks that integrate micro-scale subjective experiences with conventional quantitative metrics, ensuring a more holistic assessment of pedestrian environments.

Improved policy accountability

A more rigorous evaluation of walkability challenges enables a critical examination of existing policy frameworks**,** leading to the formulation of targeted and actionable solutions. This study emphasizes the significance of a well-defined legal framework that mandates strict adherence to pedestrian-friendly urban design guidelines. In the Indian context, where rapid urbanization often leads to inadequate pedestrian infrastructure, establishing legally enforceable regulations can significantly enhance walkability by ensuring consistent policy implementation and accountability at the municipal level.

Scalability and replicability

The insights derived from this study offer a potential pilot framework for assessing and improving walkability in other planned cities. The methodology and

findings can serve as a benchmark for city administrations, encouraging urban policymakers to extend this research to diverse urban contexts. By adopting a data-driven, participatory approach, other cities can identify localized challenges and implement tailored interventions to improve pedestrian mobility.

Long-term impact and prospects

This research contributes to broader sustainability objectives by fostering pedestrian-friendly urban environments that support social equity, environmental responsibility, and economic viability**.** A deeper understanding of walkability challenges and insights into urban mobility dynamics and pedestrian behavior can inform the development of comprehensive roadmaps to achieve sustainable urban growth**.** By prioritizing walkability, cities can enhance public health, reduce carbon emissions, and create more inclusive and livable urban spaces**,** aligning with global sustainability and innovative city initiatives.

1.6 Applicability of the research

Addressing societal issues

The research addresses the fundamental right of a citizen to walk, regardless of their disability, special status, age, occupation, or literacy level. Evaluation of walkability in a city should be conducted in conjunction with a comprehensive demographic survey and infrastructure inventory, as well as psychological assessments, to better understand mobility plans and inform future policies.

Addressing environmental issues

The research aims to facilitate sustainable mobility plans by providing crucial parameters needed to address such planning initiatives. Incorporating sustainable mobility into future transport plans heralds a new phase of low— or zero-carbon-emission cities, thus promising a cleaner environment.

Addressing economic growth

Properly assessing walkability and pedestrian routes is also helpful in determining a better land use plan for local commercial advantages.

Addressing policy gaps

The evaluation of the important parameters needs to be addressed at the grassroots level of planning. In the case of pedestrians, the level of planning should ideally start from a 10-minute walk **(**500m) and go up to the city level. This research, by providing insight into the most important parameters, will encourage a chain reaction that further improves assessment and evaluation criteria at all planning levels, prompting a better understanding of first-mile to last-mile connectivity on foot and cohesively binding our city's mobility plans.

1.7 Research question

The research addresses the question: *"What makes the planned city of Chandigarh less walkable?"* While walkability has been widely studied globally, significant gaps remain in the Indian context, especially for planned cities like Chandigarh. The last assessment in 2008 adopted a generic Ministry of Urban Development (MoUD) framework, applying uniform parameters across 29 cities without accounting for Chandigarh's unique planning and socio-spatial context. Prior evaluations were limited, focusing mainly on footpath availability and broad household surveys, overlooking critical micro-scale factors such as intra-sector connectivity, path context, and perceived safety. This study bridges these gaps by developing a customized framework integrating subjective experiences of purposive walkers with quantitative measures, offering nuanced insights into walkability at the micro level.

1.8 Research Methodology

The research adopted a multi-stage methodological framework integrating qualitative and quantitative approaches to assess walkability in Chandigarh. It began with reconnaissance and literature studies to establish contextual parameters and assessment criteria, followed by expert consultations to refine these parameters and finalize the questionnaire. A purposeful sampling of 209 regular walkers across nine selected sectors was conducted, incorporating photographic surveys and perception-based assessments to identify ground-level challenges. These findings were triangulated with policy reviews covering 11 relevant documents, revealing critical

gaps between existing provisions and on-ground realities. The iterative process culminated in the identification of eight major problems impacting walkability, leading to policy and planning recommendations. This framework not only provides a comprehensive understanding of walkability in Chandigarh but also creates a replicable model for other urban, peri-urban, and neighborhood contexts.

This research contributes significantly to the existing body of knowledge on walkability by bridging the gap between policy-level provisions and ground-level user experiences in a planned Indian city context. Unlike previous studies that relied primarily on generic evaluation tools, this study integrates multi-stage qualitative and quantitative methods, combining expert insights, perception-based assessments, and policy analysis to deliver a holistic understanding of walkability. By doing so, it not only highlights the context-specific challenges of Chandigarh—a city often regarded as a planning benchmark—but also offers a replicable assessment framework for other urban, peri-urban, and neighborhood contexts. The findings advance scholarly discourse by refining microscale walkability assessment criteria and emphasizing the importance of incorporating user-centric perceptions in urban mobility planning, thereby aligning future research and practice toward more inclusive and sustainable city design.

2 Literature Review

Chapter 2, titled "**Literature Review**," draws insights on walkability from the year 1952 to the year 2025, covering more than three decades of research. It highlights the publications of the past two decades, during which there has been a significant improvement in the level of research, and the various facets associated with it have been explored in a much more nuanced manner. Firstly, the review establishes the multi-faceted nature of walkability by using Microsoft Excel observations and the VoS (Visualisation of Similarities) Viewer. The data reveals the varied alignments of walking with other research fields, providing an overview of the evolution of research in walkability. This helps formulate a generic framework for walkability research. Then, the study outlines the most fundamental parameters, as defined by Southworth, for assessing walkability. In the process of defining these parameters, their correlations become apparent. To further explore the development of a tool for assessment, the research examines 10 micro-assessment tools and compares them. All the learnings from the literature review are then aligned with the context of Chandigarh by studying the city's background, including its growth and evolution. Under the city's evolution, the various junctures that shaped its policies are studied in detail. Finally, the previous walkability assessment is analyzed to understand how walkability was evaluated in the city, and thereafter, research gaps are established.

Over the past two decades, research on walkability has expanded significantly, drawing insights from diverse disciplines, including urban planning, transportation research, environmental psychology, and public health. Numerous models and indices, such as the Walk Score, the Pedestrian Index of the Environment (PIE), and Space Syntax, have been developed to measure walkability. These assessments analyze land-use diversity, street connectivity, infrastructure standards, and safety considerations. Global research on parameter-based evaluations of walkability highlights shortcomings in current models, particularly in their inability to address the subjective aspects of pedestrian experiences. While these models provide valuable macro-level insights, they often overlook the nuanced details of walkability

at a micro level, particularly in contexts where sociocultural factors, climate, and governance structures significantly influence pedestrian behavior. In India, research on walkability is notably underdeveloped compared to international studies. There is a significant lack of empirical investigations focusing on planned cities and their specific contexts. Additionally, many existing studies rely on broad survey methods that do not adequately assess specific conditions or differentiate among various types of pedestrians. The absence of a customized methodological framework for evaluating walkability in planned cities creates a substantial research gap.

2.1 Understanding walkability

Walking serves as a primary mode of transportation and offers numerous health benefits. It stands out as one of the most straightforward sustainability practices, producing no carbon emissions while promoting a deeper connection to our environment. In an increasingly urbanized society, it is essential to guarantee that residents have easy access to clean and safe sidewalks, parks, grocery stores, local restaurants, and places of worship. Well-maintained walking paths are vital in metropolitan areas. (Lewis, 2024). A walkable city promotes livability, safety, security, and sustainability. (Lee et al., 2017). Walkable cities serve various purposes: promoting health, safety, convenience, and social harmony. Urban, walkable zones are "traversable, compact, physically inviting, and safe." A modern planned community is synonymous with a walkable or bike-friendly environment today. The concept of the fifteen-minute city, which encourages bike culture and walking, aligns with the United Nations Sustainable Development Goals and the New Urban Agenda. Today, Paris has become a model for major cities worldwide, successfully reducing car traffic in its core from a mode share of 12.8% in 2010 to just 6% by 2020, adhering to the core principle of the 15-Minute City (FMC). Barcelona, a grid-planned city, can be identified as an FMC, as most residents of this dense and compact city live near essential services.

2.2 Bibliometric analysis using VoS Viewer

For this analysis, 329 scholarly articles, journal papers, reports, and books were selected from Mendeley (a referencing manager), published between 1952 and 2025. Microsoft Excel is a powerful yet succinct spreadsheet data program used for organizing, analyzing and visualizing data. The Excel spreadsheet generated from the .csv File format of Mendeley highlights a few objective observations.

Table 2.1: Popular Journals in walkability research *(Source:Author Research)*

S.no.	Journal Name	No. of Articles
1	Sustainability	21
2	Health and place	15
3	American Journal of Preventive Medicine	13
4	Journal of Urban Affairs	12
5	Transportation Research Record	12
6	International Journal of Environmental Research and Public Health	10
7	Preventive Medicine	9
8	Transportation Research Part A: Policy and Practice	9
9	Landscape and Urban Planning	8

Analyzing journal publications on walkability reveals a highly interdisciplinary yet concentrated landscape. While over 120 journals have published on the topic, a small number of them—such as Sustainability, Health & Place, American Journal of Preventive Medicine, Journal of Urban Affairs, and Transportation Research Record—account for a significant portion of the literature, this suggests that although interest in walkability spans diverse fields, including urban planning, public health, transportation, and environmental science, scholarly discourse is primarily driven by a few key journals. The distribution also highlights a long-tail pattern, where most journals contribute only one or two papers, underscoring the widespread but shallow penetration of walkability research in many outlets. Thematically, the research reflects growing integration across sectors, moving from its public health origins to urban design, active transportation, and sustainable city development. For researchers entering this field, targeting the most prolific journals may enhance impact and visibility, while interdisciplinary collaboration remains vital to advancing comprehensive, real-world solutions around walkable environments.

The line graph in Figure 2.1 illustrates the number of research papers published on *walkability* from 1952 to 2025. For several decades, from 1952 until the early 1990s, there was little to no activity in this field, with publication numbers remaining at zero. A modest increase began in the mid-1990s, followed by a notable upward trend starting around the year 2000. This growth continued over the next two decades, peaking around 2022 with nearly 30 papers published. Despite some fluctuations, the overall trajectory indicates a rising interest in walkability research.

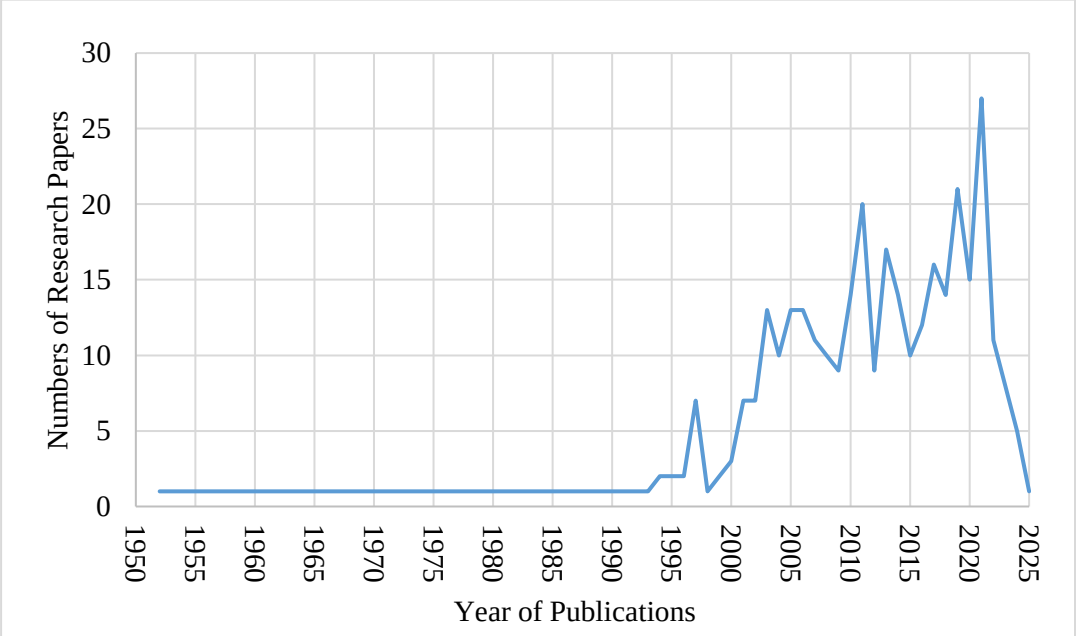


Figure 2.1-Number of published papers for walkability from 1952 to 2025

(Source:Author Research)

Note: A sharp decline in publications is observed from 2023 onwards, which could be attributed to incomplete data for the most recent years or a temporary dip in research output.

The VoS (Visualization of Similarities) viewer was employed for the preliminary bibliometric analysis. This program is utilized for the construction and visualization of bibliometric maps. It enables the creation of maps indicating authors or journals based on citation data, as well as maps representing keywords derived from co-occurrence data. This tool facilitates an extensive review of a substantial number of items, starting with a minimum of 100 entries. The distance-based maps generated by the software provide insights into the similarities present within the data. The first map, Figure 2.2, is generated for co-authorship and authors. Taking a

maximum of 25 authors per document and a minimum of 5 documents, only 17 met the set threshold of 938. For each of the 17 authors, the total strength of co-authorship links with other authors is calculated. The authors with the greatest total link strength were selected. Some of the 17 were not connected. The most extensive set of connected items consisted of 11 items. These 11 items formed 4 clusters.

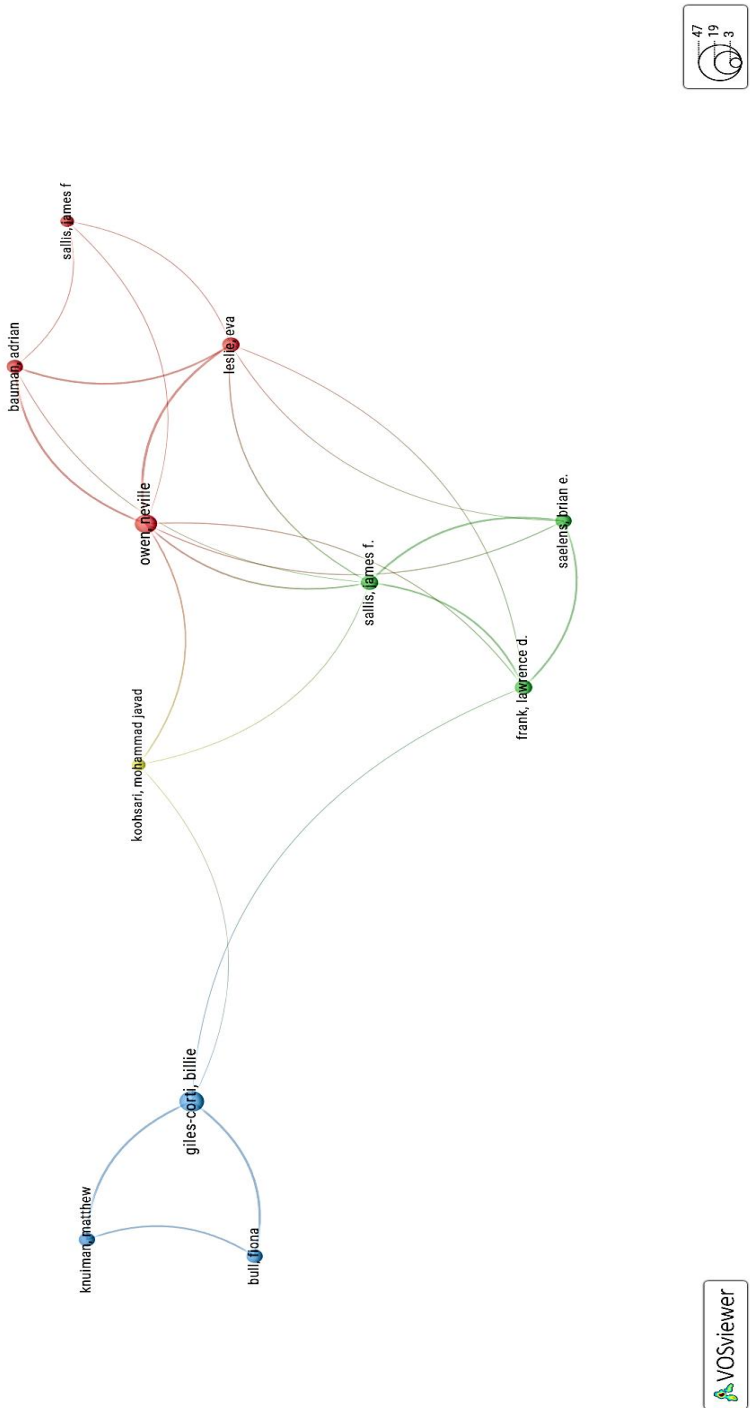


Figure 2.2: The VoS viewer map for Co-Authorship *(Source:Author Research)*

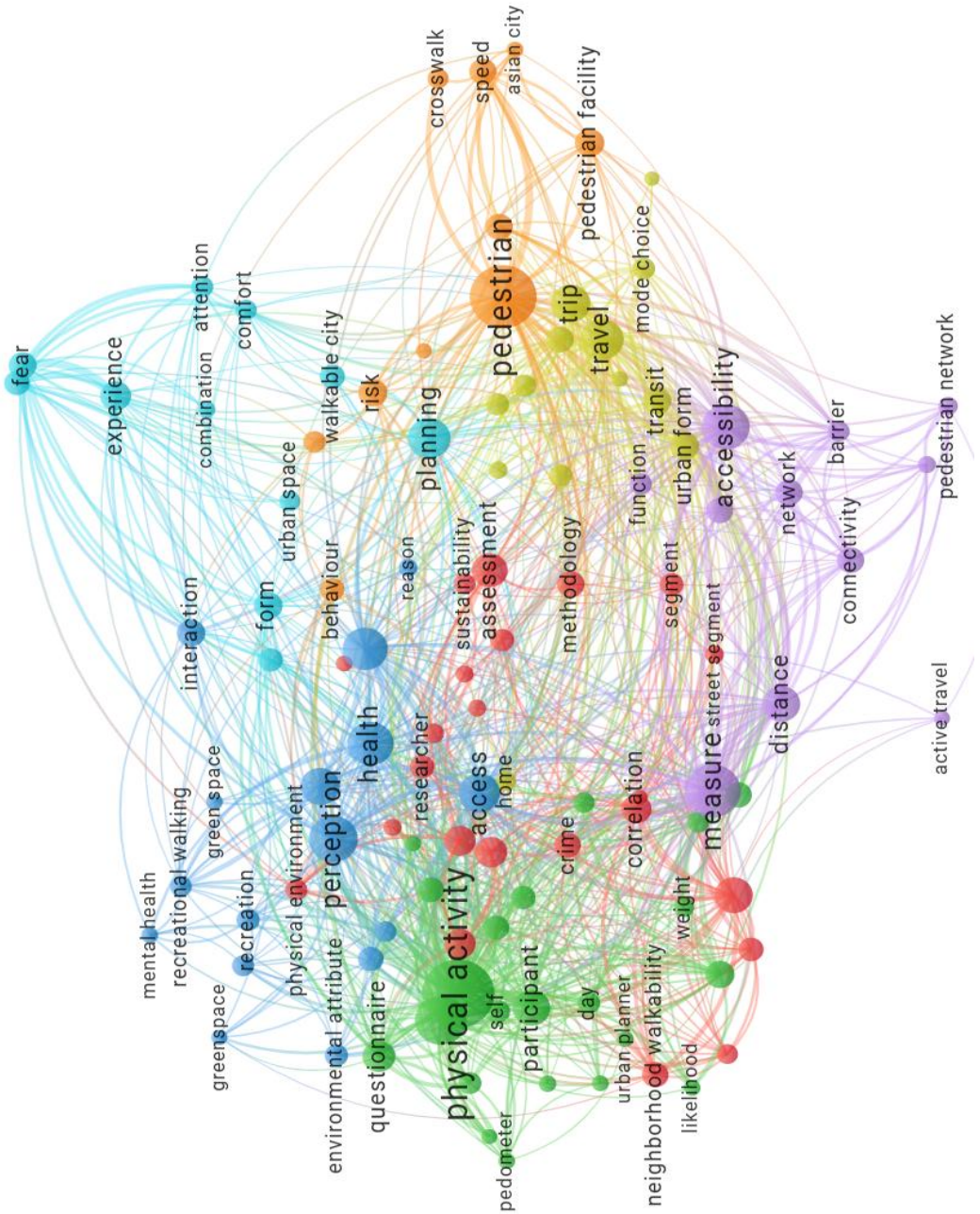


Figure 2.3-VoS Viewer map for co-authorship and authors based on text data

(Source:Author Research)

The second map, Figure 2.3, was created based on text data. The data source chosen was the RIS file from Mendeley. The data was extracted from the title and abstract fields. Out of 7873 terms, 284 met the minimum number of occurrences threshold, fixed at 10. The analysis of various clusters reveals significant interdisciplinary connections concerning walkability among urban planning, transportation, health, psychology, and environmental design. The Green Cluster emphasizes the relationship between built environments and physical activity, underscoring the critical role of urban planners in creating neighbourhoods that facilitate active transportation and enhance public health outcomes, such as reducing obesity rates through improved street connectivity. The Blue Cluster highlights the psychological benefits of access to green spaces, linking perceptions of safety and environmental attributes to walking behaviour and mental well-being. Furthermore, the Orange Cluster focuses on how pedestrian infrastructure, including crosswalks and speed regulations, influences mobility and decision-making, showcasing the need for safer urban spaces. The Cyan Cluster addresses the impact of fear and comfort on pedestrian interactions in urban settings, advocating for designs that mitigate fear and encourage engagement. Lastly, the Pink Cluster emphasizes the importance of connectivity in pedestrian networks, indicating that reduced barriers and well-connected street layouts are critical for enhancing accessibility and walking rates. These insights suggest that future research and policy initiatives should prioritize integrating walkability features into urban design to foster healthier, more sustainable communities, while also addressing psychological and behavioral factors that influence pedestrian movement.

2.3 The theoretical framework of research

Walkability is a **multifaceted concept** that extends beyond simply providing pedestrian pathways; it encompasses the **physical, social, environmental, and psychological dimensions** of urban life. It involves the quality of infrastructure—such as well-maintained sidewalks, safe crossings, and accessible public spaces—while also addressing **safety, comfort, and inclusivity** for all users, including vulnerable groups. Moreover, walkability integrates **environmental considerations**, like greenery and reduced pollution, with **social aspects**, such as opportunities for

interaction and community engagement. Thus, it reflects a complex interplay of **urban design, public health, sustainability, and human behavior**, making it a critical parameter for creating livable and thriving cities.

Health

The relationship between walkability and health has been extensively examined, establishing pedestrian-friendly environments as critical in promoting active lifestyles. Studies by (Frank et al., 1994), (Bauman et al., 2017), (Krenz et al., 2023), (De Bourdeaudhuij et al., 2003), (Owen et al., 2004), (Ewing et al., 2003), (McCann & Rynne, 2010), highlight that accessible and walkable neighborhoods encourage routine walking for transport and leisure purposes. This, in turn, contributes to reducing sedentary behavior, mitigating chronic health conditions, and enhancing overall physical and mental well-being. Thus, walkability emerges as a key determinant in urban health outcomes.

Environmental

Environmental factors, particularly the physical configuration of urban spaces, play a significant role in shaping walkability. Scholars such as (Boarnet, Joh, et al., 2011), (Cao et al., 2009), (Crane, 2000a), (Moudon et al., 2006), (Rodríguez & Joo, 2004), (Frank et al., 2008), (Ewing & Cervero, 2010b), emphasize the importance of urban form, mixed land use, and pedestrian infrastructure. Features such as proximity to neighborhood businesses, well-connected street networks, and the integration of sidewalks, benches, and street lighting enhance pedestrian comfort and usability. These findings reinforce that well-designed, amenity-rich environments are essential in encouraging walking as a viable mode of transport.

Attitudinal & Psychological

Walkability is influenced not only by physical infrastructure but also by attitudinal and psychological perceptions of the pedestrian environment. Research by (Cervero, 2002), (Kitamura et al., 1997), (Bagley & Mokhtarian, 2002), (Handy, 2005), (Frank et al., 2008), (Leslie et al., 2005), underscores the role of accessibility, convenience, safety, and attractiveness in shaping walking behaviors. Visible street activity, well-designed public spaces, and the presence of landscape elements contribute to a sense

of safety and place attachment, encouraging pedestrian engagement. This suggests that psychological comfort and subjective experience are integral components of walkability.

Social

The social dimensions of walkability, as explored by (Jacobs, 2016), (Leslie et al., 2005), (Nuzir & Dewancker, 2016), (M. E. J. Newman, 2005), (Kevin; Lynch, 1960), (Loukaitou-Sideris, 2006), (Asimakopoulos & Dix, 2017), highlight the importance of fostering inclusive and secure public realms. Pedestrian-scale design, moderated traffic speeds, visible public activity, and strategically placed crosswalks contribute to reducing perceptions of crime and increasing safety across diverse sociodemographic groups. Moreover, features such as adequate lighting and active frontages ensure walkability during nighttime, reinforcing social cohesion and accessibility for all users.

Aesthetic

Aesthetic considerations significantly enhance the appeal and usability of pedestrian environments. According to studies, the visual quality of streets—including materiality, public art, heritage integration, identity and overall design coherence—elevates pedestrian experiences (Bosselmann et al., 1999), (Southworth, 2016), (Jaśkiewicz & Besta, 2016). These elements do more than beautify spaces; they shape emotional responses and create culturally meaningful, memorable walking environments, thereby contributing to the overall vibrancy of urban life.

Figure 2.4 presents the condensed theoretical framework of research from the bibliometric analysis. The figure lists various parameters and attributes of walkability, primarily categorized under the following headings: Health, Physical, Environmental, Attitudinal, Psychological, Social, Aesthetic, and Policy. This research framework helps identify the varied facets of pedestrian activity.

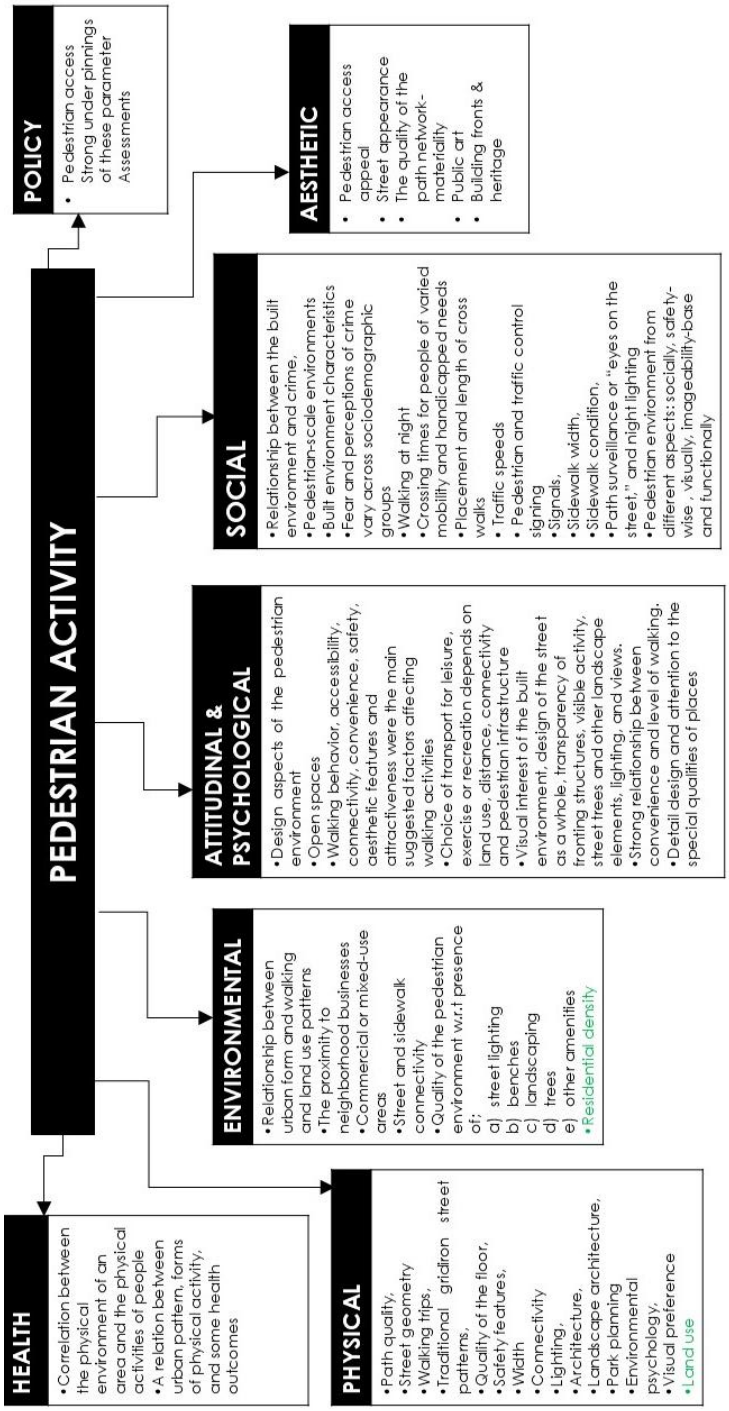


Figure 2.4: The theoretical framework for research for assessment of walkability

(Source:Author Research) *Note : Pedestrian density and land use options are less in Chandigarh*

2.4 Southworth's parameters of walkability

According to Southworth (2005), walkability is "the extent to which the built environment supports and encourages walking." He argues that environments with high walkability facilitate pedestrian movement through interconnected spaces that serve daily needs. Essential characteristics of walkable environments include safety, comfort, aesthetic appeal, and engaging surroundings alongside uninterrupted pedestrian networks. Walkability enhances livability, sustainability, and urban health by promoting active lifestyles and vibrant public spaces, while also reducing environmental impact. (Baobeid et al., 2021). It acknowledges older individuals' desires for control, independence, inclusivity, normalcy, and ease of travel through convenient access to services and grocery stores. (Musselwhite & Haddad, 2010). Hsieh & Chuang (2021) and Southworth (2005) identify six essential attributes that make up a walkable environment: (1) connectivity, (2) linkage with other modes, (3) fine-grained land use patterns, (4) quality of path, (5) path context, and (6) safety. These are explained as follows:

Connectivity

The continuity and adequacy of pathways impact walking behavior. The connectivity of walking paths precedes the aesthetic aspects of the built environment, as security concerns are prioritized in different age groups (Lucchesi et al., 2021). Connectivity thus closely relates to safety as well. Southworth (2005) emphasizes the importance of keeping pathways unobstructed. Street connectivity (Ozbil et al., 2011), smaller blocks (Singh, 2016) along with street and sidewalk connectivity (Ewing & Cervero, 2010a) are significant factors affecting walkability. The widths of streets, lengths of blocks, and dimensions of plot frontages and depths impact pedestrian accessibility in gridiron urban environments. (Sevtsuk et al., 2016).

Linkage with other modes

Southworth (2005) highlights the importance of seamless navigation, emphasizing good connectivity and improved linkages to other modes within a 'reasonable' distance. There is a strong relationship between convenience and the extent of

walking. (Ball et al., 2001; Powell, 2003). The ease of transit access, convenience, and perceived pedestrian safety all influence pedestrian behavior (Lucchesi et al., 2021). In the rapidly expanding subtropical regions of the world, it is essential to recognize that climate and local topography will influence the distance people are willing to walk (Hare, 2006).

Fine-grained land use patterns

Mixed-use can prompt people to walk for leisure, errands, or recreation (Badoe & Miller, 2000; Crane, 2000b). The proximity of a destination acts as a movement generator (Loo & du Verle, 2017). On the other hand, the absence of mixed-use can demotivate people to walk (Leslie et al., 2007). Urban design tools like land use plans, zoning control, and urban design guidelines help shape suitable environments that encourage people to walk. (Hsieh & Chuang, 2021). The concentration of non-residential land use with grid-like street patterns induces walking. (Saelens, et al., 2003). However, the proximity of these land uses remains the deciding factor. (Boarnet, Forsyth, et al., 2011).

Quality of path

The quality of the pedestrian network can affect a place's walkability, even if the destinations are close. Poor path quality will restrict mobility and increase the use of private cars. (Bonatto & Alves, 2022). The ease of pedestrian travel can be achieved with smooth, obstacle-free paths. (Vichiensan & Nakamura, 2021) and adequate width for two-way pedestrian traffic (Muraleetharan et al., 2004). The presence of a good walkway gradient (Duncan et al., 2007) buffer zones (Jaskiewicz, 2000), utilities, and amenities help improve the path's quality (Forsyth et al., 2008; Kelly et al., 2011).

Path Context

Enticing and engaging environments with traversability are essential for a good path context (Amegah, 2022). Compact planning and safety enhance walkability in an area. (Forsyth, 2015). Critical factors such as human scale, avenues, refuge, complexity, positive connection, imageability, safety, identity, and social activities influence walkability. This can result in a “shorter” personal experience of a “longer” distance (Hassan & Elkhateeb, 2021, pp. 518-519). Jane Jacobs's concept of “eyes on the street” (1961) emphasized that mixed-use, high-density neighborhoods foster a

sense of safety in public open spaces, including streets (Jacobs, 2016)Issues related to infrastructure, such as chaotic parking and concerns regarding pedestrian safety, aggravate congestion and pollution, affecting walkability. Land use also affects walking activity (Toprakli & Satır, 2024). Shade, Shelter, and air movement can mitigate the discomfort and provide respite to pedestrians. Footpath awnings, at least at specific intervals (such as every 100-200 meters), can provide shelter from passing showers and storms. Street trees may be more beneficial to heat and humidity as they draw breezes down to footpath level due to differences in air pressure. The responsiveness of pedestrian crossing lights, the presence of resting places, and the presence of drinking water are essential for the comfort of pedestrians, too (Hare, 2006).

Safety

Safety and security are critical for enhancing walkability environments (Forsyth & Southworth, 2008). Well-maintained neighborhoods support walkability (Talen & Koschinsky, 2013). Lighting is another crucial factor affecting pedestrians' safety (Pikora et al., 2003). Mukherjee et al. identify five primary factors that significantly contribute to the likelihood of hit-and-run incidents involving Vulnerable Road Users (VRUs) in urban settings of Low- and Middle-Income Countries (LMICs). These factors include (a) crash timing, particularly during the night and early morning hours (10 PM to 6 AM), (b) vehicular speed, (c) midblock locations, (d) lack of pavement markings, and (e) inadequate lighting. Additionally, the study highlights poor road infrastructure (such as the absence of zebra crossings and sidewalks, undelineated bus stops, and restricted sight distances), land use patterns (residential and office areas), slum neighborhoods, and hazardous traffic movements as key contributors to hit-and-run crashes. (Mukherjee & Mitra, 2025)

There is a notable overlap among all these parameters. For example, road infrastructure listed under safety also finds its connection with connectivity. The overlap is understandable, as walking needs an environment with multiple evaluation sub-parameters, and connections to various categories may be found. However, for clarity in evaluation, the sub-parameters are evaluated independently.

2.5 Micro-scale walkability assessment tools

The analysis of ten micro-scale walkability assessment tools reveals a range of nuanced approaches to evaluating pedestrian environments across diverse global contexts. These tools are categorized based on their methodological framework, which involves either qualitative or quantitative methods, and whether they utilize subjective perceptions, objective measures, or a combination of both. They assess a wide range of environmental features, including sidewalks, trails, bike lanes, urban streetscapes, and access routes to public transit. Notable tools, such as SPACES, PEDS, and MAPS, provide comprehensive evaluations that integrate both subjective and objective elements, thereby capturing the complexity of pedestrian experiences. In contrast, tools like EAST-HK, IMI-C, and CURWAST emphasize detailed, objective measurements, making them particularly suitable for high-density urban settings or infrastructures, such as rail transit access. Specific tools, including WSAF and CUBEST, prioritize bikability alongside walkability, while PEAT and ANC focus more extensively on trails and neighborhood-level attributes. These tools have been developed and implemented in various international contexts, including Australia, the United States, Hong Kong, and several cities within China, signifying a widespread global interest in designing walkable environments that promote active mobility. Each tool is grounded in specific objectives, from evaluating environmental influences on walking and cycling to conducting comprehensive audits of built environments. The complexity of these tools also varies significantly, with item counts ranging from as few as 10 (as seen with WSAF) to as many as 286 (notably, IMI-C), reflecting different focal areas such as safety, aesthetics, connectivity, and amenity accessibility. Specific tools employ a more data-driven and structured approach, while others incorporate user perspectives to capture pedestrians lived experiences more effectively. The table highlights their distinct strengths, including comprehensive item coverage, detailed scoring systems, and adaptability to local contexts. However, the tools also possess limitations, such as insufficient attention to safety or limited incorporation of subjective evaluations. In summary, these assessment tools exemplify the progressive sophistication and contextual sensitivity inherent in walkability research.

Table 2.2: Micro-assessment tools in walkability

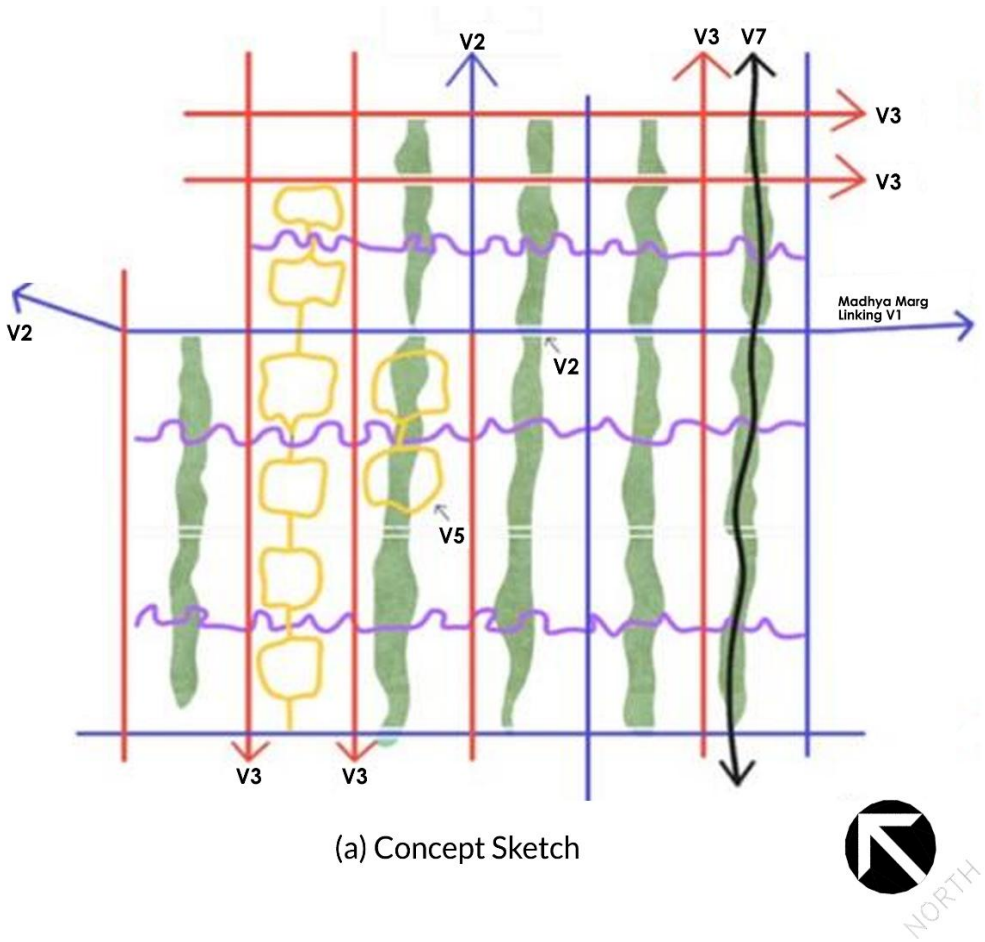
Sr. No.	Abbreviation/ Full form / *Qualitative or Quantitative or Mixed)*	Subjective (S)/ Objective (O)	Study area	Author(s)	Objective of the tool	Specifications of the tool	Comment
1	SPACES Space Syntax Walkability ***(Qualitative)***	S, O	Perth, Australia		To measure the physical environmental factors that may influence walking and cycling in local neighbourhoods	71 items in four dimensions (functional, safety, aesthetics, destinations)	Not only use audit data, but also GIS and desktop methods
2	WSAF Walking Suitability Assessment Form ***(Qualitative and Quantitative)***	S	North Carolina, USA	(Emery et al., 2003)	To assess the suitability of sidewalks for walking and roads for cycling.	10 items for walkability, 27 items for bikability	Focus more on bikability, few items on amenities and destinations
3	PEAT Path Environment Audit Tool ***(Qualitative)***	O	Massachusetts, USA	(Toprakli & Satır, 2024)	To develop reliable measures of trail characteristics	40 items in three dimensions (design features, amenities, maintenance /aesthetics)	Focus on trails in parks and outdoor recreation areas, more design and maintenance items
4	PEDS Pedestrian Environmental Data Scan ***(Qualitative)***	S, O	University of Maryland, College Park, USA	(Clifton & Kreamer-Fults, 2007)	To develop a tool to capture a range of elements of the built and natural environment efficiently and reliably	40 questions and 83 measures in five groups (subjective assessment, environment, pedestrian facility, road attributes, walking/cycling environment)	Few items on land use and destinations Include subjective assessment items
5	ANC Active Neighbourhood Checklist ***(Qualitative)***	O	St. Louis, USA	(Hoehner et al., 2007)	To assess major street-level features of the neighborhood environment	40 items in five major areas (land use, public transit stops, street characteristics,	Few items concerning safety and aesthetics

					that are related to physical activity behavior	quality of the environment for a pedestrian, and places to walk and bicycle)	
6	EAST-HK Environment in Asia Scan Tool – Hong Kong ***(Quantitative)***	O	Hong Kong	(Cerin et al., 2011)	To objectively measure aspects of the neighbourhood environment assumed to affect walking in Hong Kong and other ultra-dense Asian cities	91 items in four dimensions (functionality, safety, aesthetics, destinations)	Extensive selection of items on destinations tailored for local context
7	MAPS Microscale Audit of Pedestrian Streetscapes ***(Qualitative)***	O	San Diego, Seattle, and the Baltimore metropolitan areas, USA	(Millstein et al., 2013)	To develop a tool and create summary scores that can be used to assess detailed attributes of the built environment relevant to physical activity	160 items in four sections (overall route, street segments, crossings, and cul-de-sacs)	Extensive selection of items and structured scoring system in creating summary scores
8	CUBEST China Urban Built Environment Scan Tool **(Qualitative)**	O	Hangzhou, China	(Su et al., 2014)	To design an assessment tool of urban built environment related to adult physical activity in China	41 items in six dimensions (residential density, street connectivity, accessibility, sidewalk quality, bike lane quality, aesthetics)	More focus on bikability, and accessibility to various destinations, few items on amenities and subjective assessment

9	IMI-C Irvine-Minnesota Inventory-Condensed ***(Mixed-methods)***	O	Shanghai & Hangzhou, China	(M. Alfonzo et al., 2014)	To objectively measure "micro-scale" built environment features that may be tied to walking and bicycling	286 items in 11 dimensions (density, proximity, connectivity, form, parks and public space, pedestrian infrastructure, bike infrastructure, personal safety, traffic safety, aesthetics, and recreational facilities)	Extensive selection of items, but the detailed measurement items used in IMI-C is not available
10	CURWAST Comprehensive Urban Research Walkability Assessment System Tool ***(Mixed Methods)***	O	Nanchang, China	(Sun et al., 2017)	To measure the walking environments of access routes to urban rail transit	67 items in seven dimensions (building density, land use diversity, elements on sidewalk, design, road beside sidewalk, transferability, subjective assessment)	Target specifically on access routes to rail transit, few items on footpath condition and maintenance

2.6 Background study of the context

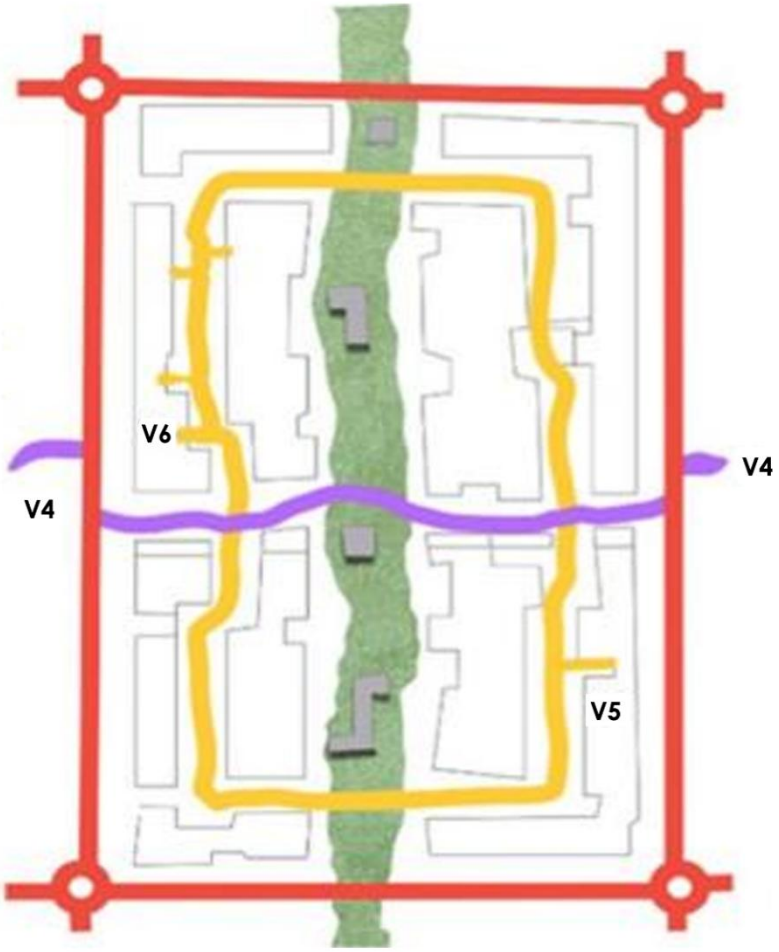
Following independence from British rule and the partition of the Punjab state, Nehru felt the urgency to establish a new capital for the Indian side of Punjab. For housing half, a million refugees, the city of Chandigarh was conceptualized as a “model” for the upcoming towns in India, encapsulating the essence of years of urban planning. Le Corbusier (LC), Pierre Jeanneret (PJ), Maxwell Fry, Jane Drew, and a few Indian architects were selected as the planning team for the city. (Kalia, 1999). The French architect Le Corbusier was appointed to lead the planning of Chandigarh. (Shaw, 2009). He initially emphasized greens, neighborhood planning, functional zoning, and traffic separation, creating a walkable environment. Figure 2.5 (a and b) presents the conceptual sketches by Le Corbusier for the city of Chandigarh alongside the current schematic layout of the city as shown in Figure 2.5 (c and d). It also illustrates the layout of the roads and pedestrian paths, V7, that run parallel to the green strips extending throughout the city, showing one of the walkable features. The city was laid out as a grid with a “Sector” as its basic unit (Figure 2(a), top left). The sector, conceived as a self-contained neighborhood, measured 800 meters by 1200 meters (Figure 2.5(b), top right). Each sector provided community amenities such as shopping centers, health facilities, and schools, supporting populations of 3,000 to 20,000 (Bahga & Bahga, 2014). On a city level, a segregation of functions existed. The administrative and legislative buildings, collectively known as the Capitol Complex, located in the northeast part, are the "head" of the city's plan, symbolizing governance and order. Complementing this are the city’s "limbs," the east industrial and west educational zones.



(a) Concept Sketch

V2 Arterial Road
V3 Fast Vehicular Road
V4 Free Flowing Shopping

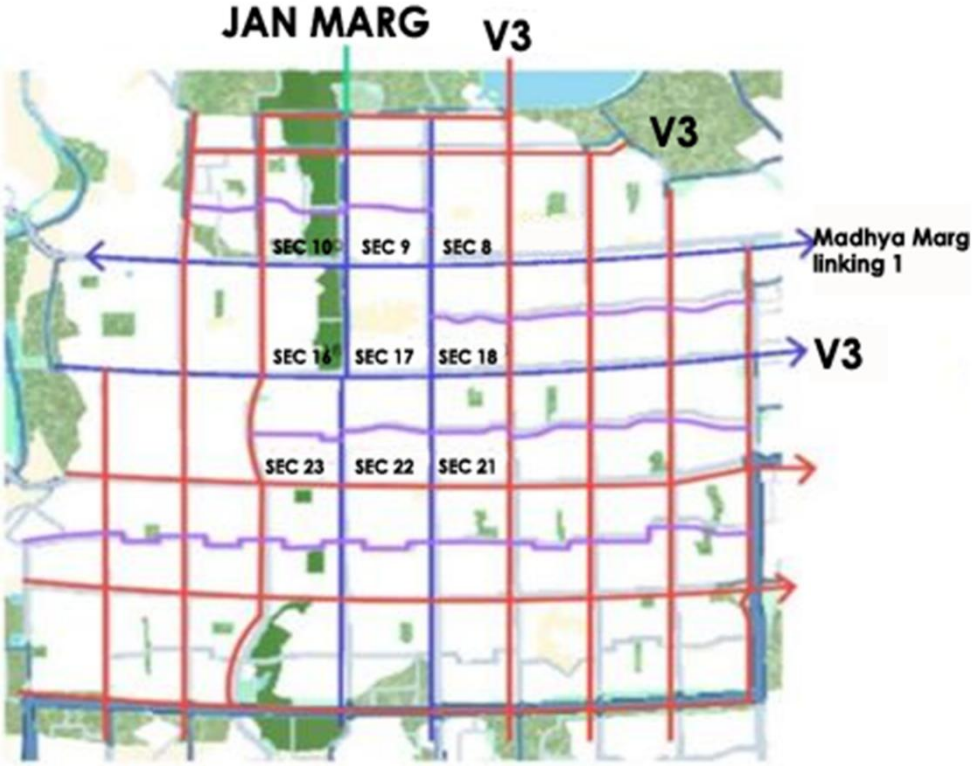
V2 Arterial Road
V3 Fast Vehicular Road
V4 Free Flowing Shopping



(b) Concept for the Sector

V2 Arterial Road
V3 Fast Vehicular Road
V4 Free Flowing Shopping

V2 Arterial Road
V3 Fast Vehicular Road
V4 Free Flowing Shopping



(c) Current Layout (with Study area)

V2 Arterial Road
V3 Fast Vehicular Road
V4 Free Flowing Shopping

V2 Arterial Road
V3 Fast Vehicular Road
V4 Free Flowing Shopping

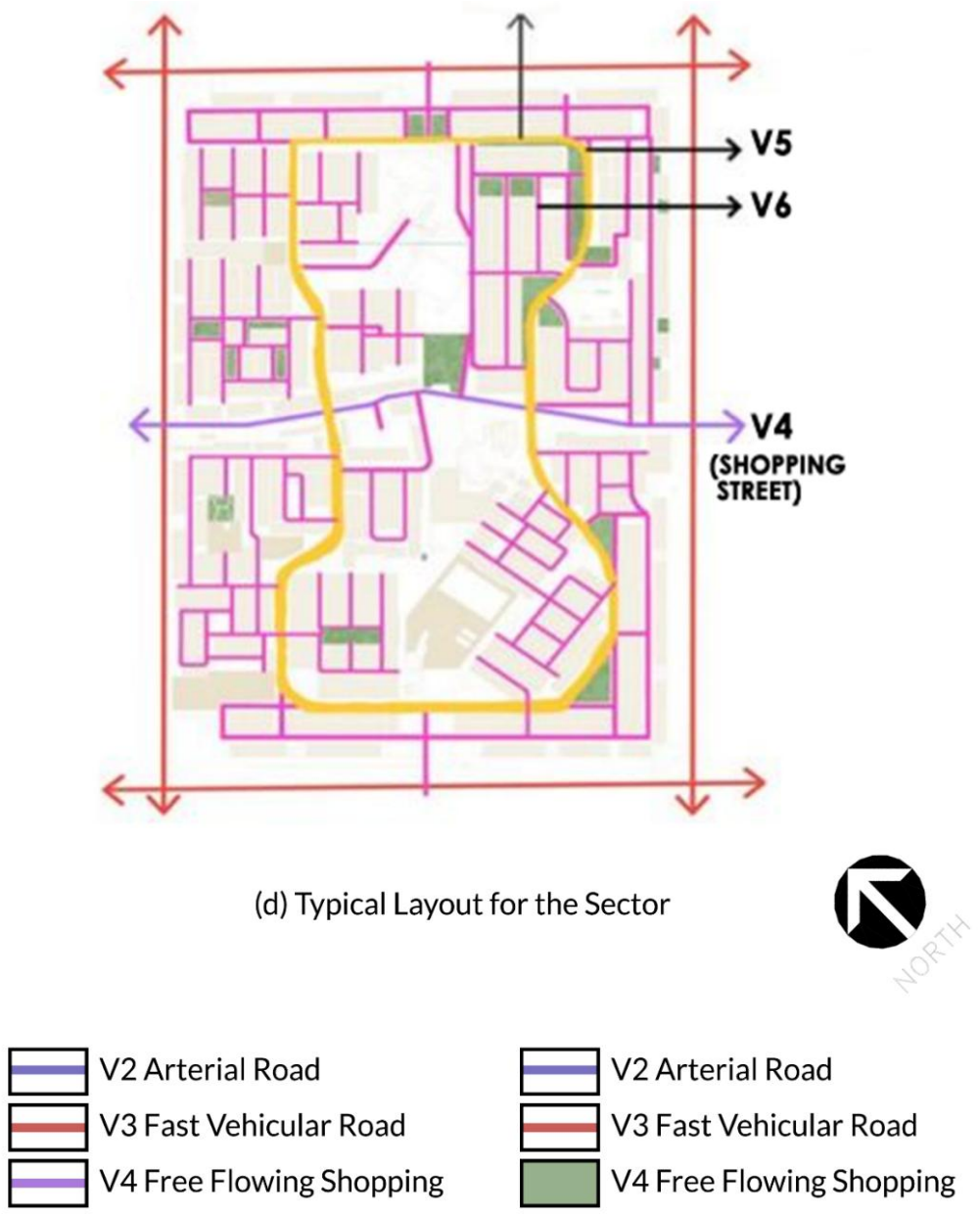


Figure 2.5 - The comparative sketches of Chandigarh - Concept and reality

(Source:Author Research)

Description of sketches from a to d. (Top Left) Le Corbusier's concept of Chandigarh plan showing the grid-iron pattern, the layout of the seven Vs of circulation and the greens running with V7 facilitating pedestrian movement across the length of all sectors (les sept vois); (Top Right) Shows a basic unit of 'Neighborhood' (Sector) (800m X 1200m) and the V4 passing under the V3s as subways facilitating walking across adjacent sectors Source: (Kiran Joshi, 1999) (Bottom left) Current Vs of Chandigarh Map which omit the V7; (Bottom Right) shows the current layout of typical sector with absence of connecting green belts. Source: (Google maps, 2025)

At the core, the city center serves as the "heart," while an integrated network of seven types of roads functions as the "circulatory system" (V1, V2, V3, V4, V5, V6, V7). Expansive parks and green belts (Figure 2.5, lighter green), particularly the Leisure Valley (Figure 2.5, darker green), which stretches from the northeast to the southwest, function as the city's "lungs," serving as a recreational space. (Bahga & Bahga, 2014).

For circulation, Le Corbusier proposed a hierarchy of roads, the seven Vs, les sept vois (V1 to V7), to structure the city's traffic management. Each type of road served a specific purpose, from regional highways to pedestrian paths within park areas, promoting pedestrian safety and comfort. (Evenson, 1966). Table 2.3 presents a hierarchy of roads and pedestrian facilitations as planned in the initial Corbusier Plan.

Table 2.3- Pedestrian facilities and the seven Vs, as planned by LC.

Source: (Evenson, 1966)

S. no.	Category	Width (meter)	Description	Pedestrian facilities proposed by Corbusier
1	V1	34	Roads connecting to other cities	An act of city periphery protection ensured adequate right-of-way for future pedestrian lanes.
2	V2	24	Major city roads	Accommodated all traffic classes separately, including pedestrians.
3	V3	18	Sector-defining roads	V4s would pass underneath the V3s as subways.
4	V4	12-13	Sector bisecting roads	Pedestrian facilities and tree shade are situated on one side. Frequent crossings are minimized due to the one-sided layout of the shopping area.
5	V5	8	Circulation within Sectors	Carrying slow-moving traffic and having footpaths on the sides.
6	V6	5	Access roads to homes within the sector	Dedicated to youth and community sports, this facility is designed to accommodate pedestrians and cyclists throughout the city's park belts.
7	V7	2	Sidewalks (pedestrian paths) through greenbelts	Footpaths through green belts allow pedestrians to traverse areas without encountering vehicular traffic or cycling paths.
8	V8	3.6	Cycle paths	Proposed to transport cyclists and walkers through the Leisure Valley, it has remained mainly on paper.

Political decisions significantly influenced Chandigarh's design, shaping its governance, urban structure, and long-term trajectory. Disagreements over site selection, differing opinions on architect choices, and government finances impacted the city's development in the 1950s (Kalia, 1999). Initially envisioned as high-rise housing, Le Corbusier's proposal evolved to include low-density buildings, complemented by wide avenues and open spaces. Iterations made with Indian authorities involved in the scheme altered this (Evenson, 1966). Once intended as Punjab's capital, the city became a Union Territory in 1960, placing it under central government control and leading to bureaucratic inefficiencies. The 1966 division of Punjab intensified conflicts between Punjab and Haryana, claiming Chandigarh as their capital, resulting in decades of political stalemate that hindered urban planning and infrastructure development. The deaths of Nehru and Le Corbusier left the city without strong advocates, allowing political interests to overshadow its original planning vision.

As political control shifted, the town faced unregulated expansion, policy failures, and administrative neglect. These political struggles stalled Chandigarh's progress, contributing to its social segregation, governance challenges, and infrastructural stagnation, which shaped the city into a politically contested and administratively constrained urban space (Kalia, 1999). However, many original concepts of the Chandigarh plan remain intact, including some green spaces, functional distribution, and sector planning. Much of the original circulation system also persists; however, minimal pedestrian provisions have been made as the city has evolved. As noted, the plan did not incorporate the provision for V4 to pass underneath V3 (the fast-moving vehicle road).

The implementation of the proposals for V7 is still pending. Cycle tracks along sector-dividing V3 roads remain incomplete and poorly designed, lacking safe continuity across busy roads (Chandigarh Master Plan, 2031). Initially designed for a smaller population, the city now accommodates over 1.5 million residents and has approximately 1.3 million registered vehicles, resulting in significant traffic congestion and compromised pedestrian safety (Chandigarh Road Safety Society, 2022). Limited pedestrian crossings, rising vehicular presence, and deteriorating air

quality have compromised walkability. The widening of roads encroaches on pedestrian paths, while open spaces are taken over for parking motor vehicles. Public transportation accounts for only 16 percent of total motorized trips. The limited share of walking as a transportation mode in Chandigarh, combined with insufficient pedestrian infrastructure, indicates that those who walk do so not out of choice but as 'captive' walkers compelled by necessity. The percentage of walking trips is significantly lower than the policy framework recommends in India. On some roads, the combined share of two-wheelers and three-wheelers exceeds 80%, showcasing the inadequacy of the public transport system (Chandigarh Master Plan, 2011). Currently, the 'planned' city suffers from poor walkability.

2.7 Walkability guidelines and rules

An overview of policies is conducted to understand the policy framework. This study examines national policies, legislative acts related to urban transport, traffic management regulations, and road governance frameworks, with a focus on their primary objectives. It also includes an analysis of local development controls, zoning regulations, architectural standards, and building codes specific to Chandigarh, aiming to uncover the connections between developmental policy and pedestrianism.

Table 2.4 - Fundamental policies, acts, guidelines, and regulations

(Source:Author Research)

<table>
<tr><td colspan="4">Policies, Acts, Rules, and Regulations in India that impact walking</td></tr>
<tr><td>Policy</td><td>Acts</td><td>Rules</td><td>Regulations</td></tr>
<tr><td>Guideline-No Legal Standing</td><td>Detailed rules-A broad law</td><td colspan="2">Legally binding laws</td></tr>
<tr><td>Directive Principle of State Policy (DPSP) (2023) under the Constitution of India</td><td rowspan="2">Motor Vehicle Act (1988) (discussed with Motor Vehicle Driving Regulation)</td><td rowspan="2">Bharatiya Nyaya Sanhita (BNS) (2023)</td><td rowspan="2">Motor Vehicles Driving Regulation (MVDR) (2017)</td></tr>
<tr><td>National Urban Transport Policy (NUTP) (2014)</td></tr>
</table>

The Constitution of India is the supreme legal document and is recognized as the longest written national constitution in the world. It outlines the framework that

defines the fundamental political code, structures, processes, powers, and responsibilities of government institutions, while enumerating fundamental rights, directive principles, and citizens' duties. It upholds constitutional supremacy, in contrast to the parliamentary supremacy prevalent in the United Kingdom. The Constitution was established as the "Basic Structure" doctrine. It declares India a sovereign, socialist, secular, and democratic republic, guaranteeing justice, equality, and liberty while promoting fraternity. Since its enactment, it has undergone 106 amendments, the latest of which was on September 26, 2023. The Constitution draws from various global models, including those of the United States, the United Kingdom, Ireland, Australia, France, Canada, the Soviet Union, South Africa, Japan, and the Weimar Republic. It remains the longest constitution for a sovereign nation, detailing fundamental duties, state policy directives, citizenship, trade, and emergency provisions, and includes 12 schedules categorizing bureaucratic activities and government policies.

The Directive Principles of State Policy (DPSP)

The Directive Principles of State Policy, outlined in Part IV (Articles 36-51) of the Indian Constitution, serve as fundamental guidelines inspired by the Irish Constitution, designed to promote social and economic democracy in India. Although they are not legally enforceable, these principles serve as critical foundations for governance, directing the State in formulating laws and policies. Key aspects include promoting the welfare of the populace through establishing a just social order, ensuring equal remuneration for equal work, the right to education, and access to public health services. As a moral compass for the legislature, these principles are vital for realizing the ideals of justice, liberty, equality, and fraternity enshrined in the Preamble.

The National Urban Transport Policy (NUTP)

The National Urban Transport Policy, revised in 2014, is the second key document that guides transport regulations. The policy aims to achieve its objectives through a comprehensive approach incorporating urban transport planning, infrastructure development, public transport, non-motorized transport, traffic management,

financing, governance, and capacity building. The equitable distribution of road space is essential, as stated in the policy. Currently, road space is allocated to whichever vehicle arrives first, prioritizing vehicles over individuals. This leads to lower-income groups bearing the burden of longer travel times and higher costs due to the disproportionate allocation of space to personal vehicles. Primarily, the policy aims to prioritize the safety of cyclists and pedestrians by promoting designated pathways for bicycles and foot traffic. It asserts that segregating vehicles moving at differing speeds would enhance safety, improve traffic flow, increase average speed, and reduce emissions caused by inefficient speeds. Such separated paths would benefit major roads for full trips, utilizing non-motorized transport, and provide better access to essential public transportation hubs. It highlights that safe access paths and bicycle storage facilities would encourage higher use of public transportation. Furthermore, innovative features such as shaded greenery, access to drinking water, and resting spots along cycling paths are crucial in mitigating the effects of adverse weather conditions. The policy acknowledges the need for improved design to address the challenges cyclists and pedestrians face adequately. It encourages open dialogues with experts and the community using these facilities. In addition, it emphasizes that obstructing sidewalks negatively impacts pedestrian safety, necessitating rigorous enforcement alongside public involvement.

The Bhartiya Nyaya Sanhita (BNS)

The Bhartiya Nyaya Sanhita (BNS) of 2023 is a contemporary criminal code designed to supersede the colonial-era Indian Penal Code of 1860. Its primary objective is to enhance the Indian criminal justice system, rendering it more focused on the needs of its citizens, efficient, and aligned with modern societal requirements. A notable feature of the BNS is its commitment to ensuring public safety, particularly benefiting pedestrians in urban settings. The legislation introduces stricter penalties for hit-and-run incidents and reckless driving, fostering safer road conditions. Additionally, it establishes heightened accountability for public safety, guaranteeing prompt justice in instances of assault or harassment in public spaces, which is especially critical for the protection of women and children. The act also acknowledges the importance of mitigating negligence in infrastructure-related accidents, thereby advocating for

improved maintenance of sidewalks and crosswalks. Ultimately, the BNS endorses the fundamental right to safe walking, promoting increased walkability and supporting sustainable urban mobility, aligning with enhanced urban planning and public health objectives.

The Motor Vehicles Driving Regulations (MVDR)

Established under the Motor Vehicles Act of 1988, the Motor Vehicles Driving Regulations are designed to enhance road safety, orderliness, and the movement of both vehicles and pedestrians. These regulations are essential for fostering walkability, particularly in urban and semi-urban locations. Key provisions include granting right of way to pedestrians, which compels vehicles to yield at zebra crossings and designated footpaths, thus enhancing the safety and assurance of individuals walking. Furthermore, the enforcement of speed limits in areas with high pedestrian traffic significantly mitigates the risk of accidents and creates a safer environment for those on foot. Strict parking prohibition on footpaths guarantees that walkways remain clear and accessible for pedestrians. In addition, the imposition of substantial fines and stringent enforcement measures for reckless driving serves to deter dangerous behavior near pedestrian zones. Collectively, these regulations are instrumental in cultivating a pedestrian-friendly urban landscape, promoting walking as a safe, healthy, and sustainable means of transportation.

Upon initial examination, various regulations—from the Directive Principles of State Policy to the Motor Vehicles Driving Regulation Act—seem to advocate for pedestrian rights and the concept of walkable, secure public spaces. However, a thorough analysis of these legal and policy documents uncovers notable gap.

A straightforward search for relevant terminology highlights the inadequate occurrence of essential terms such as "pedestrian," "pedestrian conflict," "traffic hazard," "sidewalk," "footpath," "jaywalking," "car-centric design," "pedestrian-centric design," "accident-prone," "vehicle encroachments," "right to walk," "walking," "pavement," "speeding," "fear," "connectivity," and "path context." The infrequent or inconsistent appearance of these terms indicates insufficient emphasis on pedestrian-related issues. Moreover, the terminological ambiguity, characterized by the use of terms like "footpath" and "sidewalk" interchangeably to describe

pedestrians, reveals a disoriented and non-uniform approach. Crucial concepts, such as the definition of "road," including whether it encompasses sidewalks or footpaths, as well as the minimum required width of pedestrian infrastructure, are either absent or vaguely articulated. Even significant terms like "connectivity," "context," "fear," and "pedestrian safety" are addressed only rarely. These lapses highlight a systemic undervaluation of the rights, safety, and spatial needs of the walking population, notwithstanding the superficial alignment of the policies with inclusive mobility.

Furthermore, comparing the National Urban Transport Policy (**NUTP)** (Handy, 1996) and the Motor Vehicles Driving Regulation (MVDR) (2017) against the United States Department of Transportation website reveals intriguing results based on identical word searches. This disparity necessitates thoroughly examining India's legal framework, particularly in Chandigarh, to ascertain how these policies and their components influence walkability in practice. Table 2.5 below provides the details of these gaps.

Table 2.5- Comparative Analysis of word search of Indian transport policies with the US Transport website *(Source:Author Research)*

S.no.	Terms concerning conflicts in walking /walking	NUTP	MVDR	US (Transportation)
1	Pedestrian conflict/ Conflict			•
2	Traffic/traffic hazard/hazard		•	•
3	Vehicle encroachment/vehicle			•
4	Sidewalk /sidewalk encroachment			•
5	Jaywalking (contrast term)			•
6	Motor vehicle dominance			•
7	Car-centric design/pedestrian-centric design			•
8	Vehicle-priority Road			•
9	Unsafe/ crossings/ unsafe pedestrian crossings			•
10	Speeding zones			•
11	Accident-prone zones/accident			•
12	Road fatalities/road			•
13	Traffic injuries/traffic			•
14	Walk/walking	•	•	•
15	Pedestrian /s	•	•	•
16	Footpath width /footpath	•	•	•
17	Pavement width/pavement			•
18	Sidewalk encroachment/sidewalk			•
19	Moving people	•		•
20	Injury	•	•	•
21	Fear			•
22	Pedestrian safety /safety	•		•
23	Connectivity			•
24	Path context			•
25	Land use	•		•

(Note: Blank represents "No Mention" and "DOT" represents "Mentioned")

2.8 Previous walkability study of Chandigarh

A 2008 study on urban transport, conducted by the Ministry of Urban Development, India (MoUD), analyzed 87 major cities with populations exceeding 500,000. Initially, based on criteria such as size, location, and significance, 30 cities were shortlisted. These cities included Gangtok, Panaji, Shimla, Pondicherry, Bikaner, Raipur, Bhubaneswar, Chandigarh, Hubli-Dharwad, Guwahati, Amritsar, Thiruvananthapuram, Madurai, Agra, Bhopal, Kochi, Patna, Varanasi, Nagpur, Jaipur, Kanpur, Surat, Pune, Ahmedabad, Hyderabad, Chennai, Bangalore, Delhi, Kolkata, and Mumbai. Subsequently, these thirty cities were further categorized into seven groups based on population. The cities are listed in Table 2.6, along with their respective categories (Category 1a, 1b-6), population in the study area, modal share, and walkability index. Chandigarh appeared in Category 2 with a population between 500,000 and 1 million. The other cities in this category (Category 2) were Pondicherry, Bikaner, Raipur, Bhubaneshwar, and Hubli Dharwad. Accessibility Index, Congestion Index, City Bus Supply Index, Safety Index, and Walkability Indices were calculated in the MoUD assessment 2008.

The findings predicted increased trip rates and trip lengths, but a decrease in the modal share for pedestrians by 2031. It estimated a sharp rise in the modal share of private vehicles and a considerable decline in travel speed, indicating potential traffic congestion problems and reduced equity among road users. Chandigarh scored the highest in the walkability index with a rating of 0.91, compared to an average of 0.52 among all thirty selected cities. Larger cities, such as Delhi, Ahmedabad, Mumbai, Pune, and Kolkata, scored above 0.80. Chandigarh had the highest-rated pedestrian facilities in Category 2 cities and ranked highest among all 30 cities, achieving a rating of 4.1, while the average for other cities was 1.9. This should have indicated a significant share of pedestrian traffic; however, Chandigarh recorded the lowest modal share of pedestrians at just 23 percent. This figure was considerably lower than that of other cities, even those with lower pedestrian facility ratings, such as Pondicherry (40), Bikaner (46), Raipur (35), and Bhubaneswar (28) in Category 2. The walkability assessment did not clarify why Chandigarh's modal share of pedestrians was low, despite having the highest pedestrian facility rating among the

30 cities. Understanding the calculated walkability index proved challenging. Was it simply a rating of facilities that no one wanted to use? This prompted the researchers to explore the gaps in the assessment.

Table 2.6 - Categories of Cities and their Walkability Index *(Source:MoUD, 2008)*

Category	Sr. No.	City	Population of Study area in Lakhs (2001)	Modal Share (Walk)	Walkability Index
Category 1a (<0.5 million with hilly terrain)	1	Gangtok	0.92	56	0.30
	2	Shimla	1.73	58	0.22
Category 1b (<0.5 million with plain terrain)	3	Panaji	0.97	34	0.32
Category 2 (0.5-1 million)	4	Pondicherry	5.08	40	0.37
	5	Bikaner	6.40	46	0.43
	6	Raipur	7.19	35	0.41
	7	Bhubaneswar	8.44	28	0.28
	8	**Chandigarh**	**9.66**	**23**	**0.91**
	9	Hubli Dharwad	9.68	23	0.39
Category 3 (1-2 million)	10	Guwahati	10.60	21	0.39
	11	Amritsar	10.85	27	0.31
	12	Trivandrum	11.22	26	0.34
	13	Madurai	11.85	34	0.40
	14	Agra	13.69	27	0.38
	15	Bhopal	14.58	26	0.47
	16	Kochi	18.18	16	0.57
	17	Patna	18.36	26	0.65
	18	Varanasi	18.95	24	0.33
Category 4 (2-4 million)	19	Nagpur	21.13	21	0.66
	20	Jaipur	26.80	26	0.64
	21	Kanpur	27.16	29	0.59
	22	Surat	30.90	27	0.62
Category 5 (4-8 million)	23	Pune	42.00	22	0.81
	24	Ahmedabad	59.34	22	0.85
	25	Hyderabad	63.83	22	0.68
	26	Chennai	70.14	22	0.77
Category 6 (>8 million)	27	Bangalore	86.25	26	0.63
	28	Delhi	138.50	21	0.87
	29	Kolkata	147.38	19	0.81
	30	Mumbai	177.02	27	0.85

2.9 Research gaps

The following are the gaps observed in the assessment done by MoUD in 2008, in line with the literature review done for walkability:

No area-specific parameters

Asian cities have unique street development and design needs, taking into account their specific functions and local contexts. The width of sidewalks, spatial connectivity, adequacy of crossing facilities, traffic flow, and visual integration impact safety and pedestrian accessibility (Zhao et al., 2022). Some studies within the Indian context suggest that these parameters must be further divided into sub-parameters to tackle the complexity of existing problems. (Bhattacharyya & Mitra, 2013). However, in this study, no specific parameters related to Chandigarh were examined.

Above all, the last assessment of Chandigarh's walkability was conducted in 2008. Considerable time has passed since then to evaluate the city's current situation accurately.

Selection of study area

The study was generic and did not appreciate the concept or Chandigarh's planning ideals. The same method was applied to 29 other cities, regardless of their unique characteristics, populations, cultures, and contexts. Consequently, it did not arrive at any suggestions for improving the walkability of these cities. Dragović et al. (2023), studied 41 different tools and purported that an in-depth study of an area is crucial to give more "authoritative" results than predefined instruments. Since the MoUD assessment could not provide any authoritative results, it further underscores a gap in the assessment.

Methodology of assessment and evaluation parameters

The walkability index calculated for the cities was primarily based on the availability of footpaths and pedestrian facility ratings derived from opinion surveys. The first factor, footpath availability, was measured as the ratio of total footpath length to the length of major roads in the city. It remains unclear why only major roads were selected for assessment. Each first-mile and last-mile journey begins with pedestrian travel (Naharudin et al., 2017). The reason footpaths within sectors were excluded from this method is unclear. The second premise, pedestrian ratings, included nine indicators: availability of footpaths, footway width, presence of obstructions, footpath maintenance, streetlights and other amenities, security from crime, conflicts

on walking paths, availability of pedestrian crossings, and safety. The authors' earlier bibliometric review, conducted in the initial stages of this research using VoS Viewer, deepened their understanding of the complex nature of walkability (Singla et al., 2024). The parameters used for assessment in the MoUD method are limited. It is unclear how the nine parameters suffice for calculating walkability in Chandigarh. Mixed methods are crucial in evaluating walkability, as they blend the depth of qualitative insights with the validation of quantitative data, resulting in a comprehensive understanding of the walking environment (Bojorquez et al., 2021; Moran et al., 2017; Resch et al., 2020). Although a mixed approach was used to assess walkability, the gap highlighted in the previous points did not produce accurate results. They also failed to explain why Chandigarh's walking mode share was low.

Selection of respondents

In urban design and mobility literature, Wunderlich (2008) distinguishes between purposive walking (utilitarian walking) and discursive walking (discretionary walking). Purposive walking is essential and destination-oriented, involving travel on foot to specific locations such as work, home, shops, or parks. Walkability analysis encompasses all forms of walking, highlighting their significance in understanding urban environments. However, purposive walking is the more relevant category in transport surveys. This is primarily because purposive walking is directly linked to destination-oriented travel. It has well-defined patterns associated with transport planning, making it critical for evaluating and addressing transport infrastructure needs. While both types of walking hold value, purposive walking is better suited for transport surveys due to its apparent connection with mobility and travel demand management (Hsieh & Chuang, 2021). In the MoUD study, household interviews were conducted to assess pedestrian ratings, rendering the sample set less than ideal.

3 Research Methodology

Chapter, titled "**Research Methodology**," outlines a comprehensive and systematic approach for evaluating walkability in Chandigarh's uniquely planned urban context. Base studies (comprising of secondary literature and reconnaissance surveys) and iterations (comprising of surveys and expert discussions), help consolidate the research method by giving a strong basis of selection of study area and respondents. The research method comprises of selection of study area, selection of respondents, photographic survey, survey of walkers, policy review. The method concludes with recommendations and future scope of research.

The methodology used to assess the walkability of Chandigarh is a structured, multi-stage approach that combines both qualitative and quantitative methods. Base study helps consolidates the contextual parameters of assessment for Chandigarh — connectivity, path context, and safety. Guided by this theoretical foundation, preliminary reconnaissance surveys observe on-site conditions and assist in iteratively developing an online trial questionnaire. This is first administered to the residents (laymen). Then post iterations and additions, a pilot survey engaging both non-expert participants and planning and traffic experts is done. The learnings help understand facets of walkability in Chandigarh. The discussions with experts help delineate the study area and streamline the final questionnaire document. The research employs a mixed-methods approach, combining a structured photographic documentation with a physical survey of randomly selected purposeful walkers in the selected study area. Quantitative rigor is ensured in the methodology through the objective ratings of the walkers that further reinforce the photographic survey problems and echo the problems of the qualitative findings during surveys. Following this a policy review highlights shortcomings in policy which deepen the issues of walkability. This is followed by recommendations and future scope of the research.

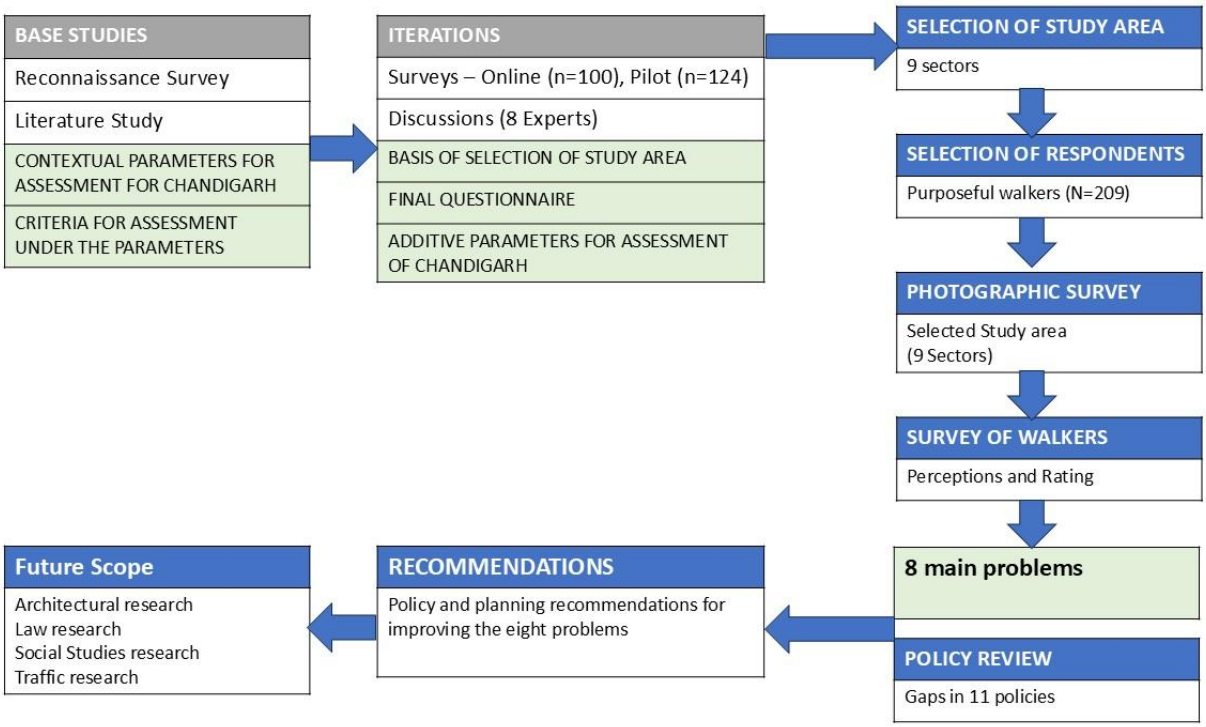


Figure 3.1- Research Methodology for assessing the walkability in Chandigarh

3.1 Base Studies – Finding contextual parameters of assessment

The base study uses learnings from the literature study and reconnaissance surveys to finalize the parameters of assessment that apply to the context of Chandigarh. Defining the evaluation parameters for Chandigarh, aligned with the literature review, is essential for facilitating an informed inquiry into the city's walkability. (Southworth, 2005) and (Zhou & Hsieh, 2024) identify six critical attributes that constitute a walkable environment: (1) connectivity; (2) linkage with other modes; (3) fine-grained land use patterns; (4) quality of path; (5) path context; and (6) safety. The following discussion provides insight into the selection of the final parameters.

The first parameter, ‘connectivity,’ includes path adequacy, obstructions, street and sidewalk connectivity, perceptions of path adequacy, plot frontages, block sizes, and traversability. Evaluating this parameter is crucial as it relates to the essential need for walking infrastructure; therefore, it is selected.

The second parameter, ‘linkage with other modes,’ examines how walking is

connected to other forms of travel. Since this research focuses solely on walking connections, they are already encompassed within the ‘connectivity’ parameter; hence, this parameter of linkage to other modes is not considered.

The third parameter, ‘fine-grained land use,’ is irrelevant to Chandigarh's context. Chandigarh is designed as a single-zoned land-use area, making it inappropriate to include the fine-grained land-use pattern in the walkability assessment. Thus, it is not selected for this study.

The fourth parameter, ‘path quality,’ is already addressed under the ‘connectivity’ parameter. It elaborates on the quality of the path in terms of materiality and maintenance, which in turn influences connectivity. Therefore, it is discussed under connectivity and excluded as a separate parameter.

The fifth parameter, ‘path context,’ focuses on inviting and engaging environments characterized by social activity and mixed land use. This understanding is crucial for grasping the environmental requirements for walking in Chandigarh, offering valuable insights into how the city's single-zoned land use affects pedestrian travel paths. This parameter was chosen to study the effects of Chandigarh's single-zoned planning on walking.

The sixth parameter, ‘safety,’ is vital for understanding walkers' safety, including personal, traffic, and criminal aspects. This aspect evaluates the city's conditions regarding essential services that may influence safety or perceptions of safety among walkers.

Thus, the three primary parameters selected for evaluation in this study are connectivity, path context, and safety. Table 3.1 presents the criteria for evaluation under each of the three selected parameters during the photographic survey for the assessment. Based on the literature, the following framework outlines the chosen parameters for this research.

Table 3.1-List of selected parameters and sub-criteria for evaluation

S.no.	Parameters	Criteria from the literature	Sources
1	Connectivity	Path Adequacy	(Lucchesi et al., 2021)
		Obstructions	(Southworth, 2005)
		Street-sidewalk connectivity	(Ewing & Cervero, 2010)
		Block sizes	(Singh, 2016)
		Traversability	(Mercy Lorlonyo Amegah, 2022)
2	Path Context	Enticing environments	(Mercy Lorlonyo Amegah, 2022)
		Compact planning	(Forsyth, 2015)
		Social aspect	(Hassan & Elkhateeb, 2021)
		Land Use	(Soni et al., 2024)
3	Safety	Well serviced neighborhoods	(Talen & Koschinsky, 2013)
		Lighting	(Pikora et al., 2003)
		Safety	(Mukherjee & Mitra, 2025)

3.2 Iterations – Surveys and Discussion

Two online trial surveys were conducted to explore specific evaluation parameters regarding the city of Chandigarh. The first survey included 100 residents of Chandigarh who were not experts, while the second survey included 124 residents and experts from the fields of planning, architecture, urban design, and heritage. Both surveys had some common questions with regard to the demographic profile of the respondents (gender, age group, income segment, qualification profile), a general walkability score of Chandigarh and the walking activity. However, in the second survey, the pilot survey, the questionnaire (Refer Annexure -2) was more detailed and had questions on the least walkable area, most walkable area and the reasons for it. It also had questions enquiring what were the deterrents and motivators for pedestrian activity.

The trial survey of residents helped gain a basic understanding of Chandigarh's walkability scenario. The sample consisted of consenting residents of Chandigarh aged 18 and above, selected using the snowball sampling technique. The

participants represented various demographics, professions, income levels, age groups, and residential sectors. Experts were excluded from this trial to capture the layman's perspective on walkability. Allowing the selection of residents from any industry in Chandigarh ensured that city-level feedback was thoroughly studied. The survey was conducted online using a Google Form. The questionnaire included both qualitative and quantitative questions, as well as demographic profiling questions. The chain of the survey began with eight consenting respondents, who then forwarded the study to an additional 8-10 pre-agreed participants. This survey was carried out online due to lockdown restrictions related to the pandemic. It proved to be an effective and safe method.

After iterations in the questionnaire and expert discussions, an online pilot survey was conducted with experts and residents. It was an improved and more intensive version of the trial survey. The survey selected a sample of residents and experts who had kindly consented to participate in the online poll, either by telephone or online. A variety of age groups with different professional backgrounds were also taken into consideration. The survey was conducted online using a Google Form. The questionnaire included both qualitative and quantitative questions, as well as demographic profiling questions. The survey chain began with eight consenting experts, who then forwarded the study to an additional 8-10 pre-agreed participants. This survey was carried out online due to lockdown restrictions related to the pandemic. It proved to be an effective and safe method.

Selection of the experts was done as per the following: (Refer Annexure -3)

1. Three experts from the field of Architecture, Department of Urban Planning, Chandigarh, with a minimum of 20 years' experience.
2. Two experts from the non-governmental field of architecture in Chandigarh have over 30 years of experience.
3. Two experts in Transport and Town planning are well-versed in the Chandigarh planning context.
4. One expert from the field of Heritage and an alumna of the Chandigarh College of Architecture

The results from both surveys were then compared, and a comparative chart was prepared to understand the various facets of evaluation. These are presented in Table 3.2.

Table 3.2-The details of the Online and Trial Survey

S.no.	Parameters	Trial (Non-Expert)	Pilot Trial (Resident + Expert)
1.	TOTAL NUMBER	100	124
	Male	56 %	45.2%
	Female	44%	54.8%
2.	AGE GROUP		
	18-25	13%	4%
	25-40	23%	41%
	40-55	29%	45%
	55-70	17%	24%
	70-above	18%	8%
3.	INCOME SEGMENT		
	0-300000	18 %	12%
	300000-600000	22%	20%
	600000-1200000	15%	26%
	1200000-1800000	25%	17%
	1800000-above	20%	25%
4.	QUALIFICATIONS PROFILE		
	Architect	0 (0%)	42 (33.8 %)
	Business Owners	22 (22%)	18 (14.52%)
	Home maker	9 (9%)	10 (8,06%)
	Retired	12 (12 %)	8 (6.45%)
	Service professional (Lawyer, Civil Servant, Doctor)	47 (47%)	20 (16.13%)
	Student	10 (10%)	26 (20.97%)
5.	WALKING ACTIVITY (more than 2 km daily)		
	Daily	40 (40%)	71 (57.26%)
	2-3 times a week	32 (32%)	21 (16.94%)
	Once a week	10 (10%)	12 (9.68%)
	Once a month	8 (8%)	10 (8.06%)
	None of the above	10 (10%)	10 (8.06%)
6.	WALKABILITY SCORE (Likert scale)	3.36 /5	3.43/ 5
	Infrastructure (footpaths)	3.5	3.4
	Safety and Security (from accident & crime)	3.01	3.3
	Comfort (Availability of public conveniences, shaded pathways, ease of crossings, and availability of street furniture)	4.5	4

	Attractiveness (presence of greens, public art, open green spaces, landscaping, public activity)	3.4	3.28
	Availability of Public transport	3	2.8

Understanding the facets of Walkability in Chandigarh

In-depth inquiries into the re-evaluation of walkability ratings for Chandigarh revealed several key parameters identified by residents that contribute to the city's walkability. These include the availability of pedestrian paths along select roads, abundant greenery, and ample open spaces. Important aspects cited were parks, green surroundings, clean air, trees, shaded pathways, favorable temperatures, cleanliness, and, in some instances, the quality of materials. Notably, some respondents who rated walkability positively (3+) indicated that they rarely walked near roads in Chandigarh; instead, they preferred regular morning and evening walks in the city's green open spaces and gardens. These respondents also expressed concerns regarding the pollution levels in Chandigarh as a deterrent to walking. Additional challenges identified included high vehicle speeds, insufficient pedestrian pathways, lack of safe crossings, reckless driving, absence of local public transport, inadequate shading, particularly near roundabouts, disregard for pedestrians, and public safety issues such as snatching and eve-teasing.

Furthermore, vendors' inadequate public conveniences and encroachment on footpaths posed significant obstacles to walking. Other problems cited included poor cleanliness due to cow dung and garbage, as well as construction materials obstructing roadways and blocked drains, which contributed to the unclean conditions. Additional discouragement for pedestrians stemmed from overgrown bushes, broken pathways, exposed electric wires, stray dogs, a lack of effective subways, unplanned crossings, and the absence of activities along pedestrian paths. Respondents also raised concerns about the isolation of specific paths, which instilled feelings of loneliness and fear of assault. Reckless driving and a lack of respect for pedestrians were further issues highlighted by the respondents.

Understanding the walkable areas of the city

Phase 1: Among the various sectors evaluated, the most walkable ones were Sectors 4, 5, 2.10, and 11, despite their low density. These areas received careful maintenance from the administration, attributed to the presence of high-impact personnel, celebrity residences, senior official housing, and the governor's residence, which is along his daily route to the secretariat. Sectors 15, 16, 5, 9, and 10 were also rated walkable, primarily due to their beautiful parks. The northern sectors, including Sectors 4-11 and Sector 26, were deemed walkable due to their low density, minimal traffic, wide roads, and favorable aesthetics, which contribute to safety and security. Sector 17 was highlighted for its walkability due to the Sector 17 Piazza, a fully paved area designated for pedestrians near local shops.

Phase 2: Sector 30, located in Phase 2 of Chandigarh, was rated as walkable due to its vast park and a one-kilometer walking loop that encourages pedestrian activity. This trend was also observed in Sectors 36 and 37, which feature substantial open spaces that function as main connectors to significant roads and facilitate walking within their respective areas.

Phase 3: Newly developed precinct (Sector 70) was appreciated for its walkability, owing to the presence of parks and presumably lower traffic and density.

Overall, residents found Phase 1 to be more walkable than the other phases. However, there were concerns regarding the internal roads throughout Chandigarh, as many were perceived to be less walkable. This was attributed to a lack of proper pathways, road debris, damaged pathways, unplanned signage and infrastructure, encroachment onto paths due to car parking on footpaths, and inadequate safety measures, particularly in areas with traffic police surveillance.

Understanding the real walkers of the city

It was surprising to see that in both the trial and online pilot surveys, 41 percent and 71 percent of respondents walk daily for more than 2 km. However, when evaluated in depth for their walk, 57 percent of them in the online pilot survey stated that they do so only for morning and evening walks. This was a significant finding of the online

pilot survey.

Table 3.3: Response of people related to the purpose of the walk

S.no	Major Purpose of Travel	Response in %age
1.	Morning walk/evening walk	57
2.	Going to bus station	7
3.	Grocery shopping	16
4.	Taking children to school	12
5.	Walking to work	8

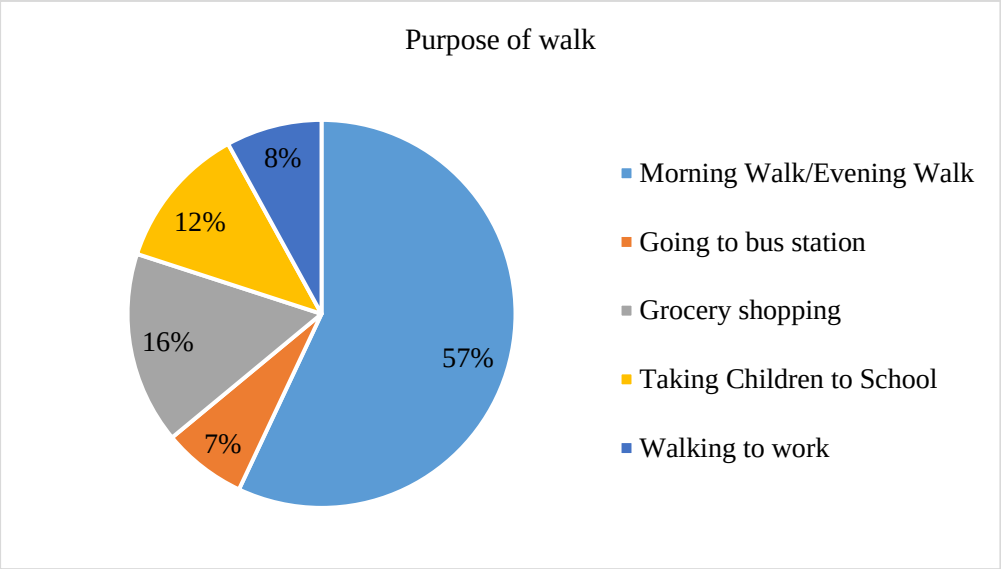


Figure 3.2- Pie- Chart showing response of people related to the purpose of the walk

Firstly, the understanding of walkability is still unclear among the masses in Chandigarh. This highlights the need for clear and specific evaluation criteria. Secondly, numerous factors — not just infrastructure — are essential for good walkability in the city, so the main parameters must be derived meticulously, considering all aspects of Chandigarh. Since we are aiming for a detailed evaluation, the study area needs to be delineated carefully. Walkable surroundings are defined by their purpose, so this purpose remains central to the investigation. The reason for the walk is important as it influences the attitude, duration, rating, and location of the walk. The concept of leisure walking obscures the idea of first-mile and last-mile connectivity, as respondents noted that most people travel to their walking

destinations by car or another mode of transportation. This walking needs to be assessed along the roads of Chandigarh, footpaths, and zebra crossings.

Understanding the criteria for evaluation in the photographic survey

The Table 3.4 lists the criteria from the Pilot Survey with the Criteria from Literature and presents a compendium of tentative criteria to be considered for evaluation of walkability.

Table 3.4 - Criteria for evaluation in the Photographic Survey from Pilot Survey

(Source:Author Research)

S.no.	Parameters	Criteria from Literature	Criteria from PILOT SURVEY	Sources
1	Connectivity	Path Adequacy	availability of sidewalks for pedestrians only (no bicycles)	(Lucchesi et al., 2021)
		Obstructions	continuous pathway (does not suddenly stop) presence of obstructions, encroachments, cow dung, potholes	(Southworth, 2005)
		Street-sidewalk connectivity	broken pavements, obstructions by signages and street furniture,	(Ewing & Cervero, 2010)
		Block sizes	long walking distances	(Singh, 2016)
		Traversability	broken paths	(Mercy Lorlonyo Amegah, 2022)
2	Path Context	Enticing environments	presence of nice things along the way (heritage, beautiful landscape, fountain), presence of public art,	(Mercy Lorlonyo Amegah, 2022)
		Compact planning	density,	(Forsyth, 2015)
		Social aspect /comfort	secluded areas, lack of civilised behaviour towards pedestrians, adequately shaded areas, presence of open green spaces serving as connectors	(Hassan & Elkhateeb, 2021)
		Land Use	lonely zones	(Soni et al., 2024)
3	Safety	Well-serviced neighbourhoods	open manholes, overgrown bushes, naked electric wires,	(Talen & Koschinsky, 2013)
		Lighting	absence of street light	(Pikora et al., 2003)
		Safety	high speed of vehicles, rash driving, fear of crime on streets at night, fear of assault,	(Mukherjee & Mitra, 2025)

Understanding the additive criterion for evaluation from reconnaissance

The list of parameters provided below was finalized after due consideration of issues in walkability highlighted in reconnaissance and pilot survey.

Table 3.5- The additive criterion for evaluation from reconnaissance *(Source:Author Research)*

S.no.	Parameters	Criteria from literature	Criteria from Pilot survey	Criteria from Reconnaissance
1	Connectivity	Path Adequacy	availability of sidewalks for pedestrians only (no bicycles)	presence of sidewalks on both sides, wide enough for at least two adults
		Obstructions	continuous pathway (does not suddenly stop) presence of obstructions, encroachments, cow dung, potholes	easy to push strollers, wheelchairs, without difficulty
		Street - sidewalk connectivity	broken pavements, obstructions by signages and street furniture,	easy to push strollers, wheelchairs, without difficulty
		Block sizes	long walking distances	connectivity to major streets
		Traversability	broken paths	easy to push strollers, wheelchairs, without difficulty
2	Path Context	Enticing environments	presence of nice things along the way (heritage, beautiful landscape, fountain), presence of public art,	
		Compact planning	density	
		Social aspect /comfort	secluded areas, lack of civilised behaviour towards pedestrians, adequately shaded areas, presence of open green spaces serving as connectors	presence of dustbins at convenient distance, presence of beggars,
		Land Use	lonely zones	
3	Safety	Well-serviced neighborhoods	open manholes, overgrown bushes, naked electric wires,	buffer between the street and sidewalks
		Lighting	absence of street light	
		Safety	high speed of vehicles, rash driving, fear of crime on streets at night, fear of assault	zebra crossings are well marked, pedestrian crossings, pedestrian signals allowing enough time to cross the street, fear of crime on streets at the day, presence of stray dogs,

Understanding the formulation of questionnaire

(Sundling & Jakobsson, 2023) systematically reviewed and compiled evidence from international empirical studies regarding the characteristics that impact pedestrian experience. They categorize physical and environmental features into activation and deactivation elements, which produce positive and negative effects, respectively. A lack of trees, dirt, street isolation, obstructions, pollution, traffic congestion, and poor aesthetics negatively impact walking. Compactness, street connectivity, and continuity, along with street linearity, ease of wayfinding, street lighting, mixed land use, lack of traffic, proximity to parks, shade, diversity of street activities, high population density, commercial ground floor façades, and the availability of bus stops have a positive impact on walking. A survey must address pedestrians' main concerns regarding their environment, demographics, and the relationship between individual traits and spatial conditions to assess the conditions necessary for walkability effectively. This survey should focus on three key dimensions: (a) the physical and sensory features of the environment; (b) the demographic characteristics of pedestrians, including age, gender, and occupation; and (c) the impact of personal attributes and perceptions on the walkability experience. Important issues to consider include: (1) sensory perceptions—such as visual, auditory, and olfactory signals that influence comfort and navigation; (2) imagability—the extent to which a place creates a vivid mental image or identity; (3) the architectural surroundings—its ability to facilitate public activity, aesthetic appeal, and cultural significance; and (4) physical aspects—such as infrastructure, terrain, weather conditions, greenery, and landscaping. These factors are crucial for developing a comprehensive understanding of pedestrian behavior and for designing effective urban spaces that promote walkability. The planners, architects, and transport professionals from Chandigarh have vetted the questionnaire to discuss the selection of the study area. Their names and qualifications were mentioned earlier in this section.

(Kroll, 2001) and (Moughtin, 1992) argue that entirely numerical standards fail to accurately represent the natural pedestrian environment, as pedestrians interact with their surroundings while engaging in activities such as chatting, looking around, and window shopping. The following factors highlight the need for qualitative

speculation:

a. Walking is a personal experience; thus, the experience of walking is unique to every walker.

b. The unit of design for vehicular movement (e.g., flow, volume, capacity) cannot be applied generally to pedestrians due to individual pedestrian behavior. This depends on demographic profiles, environmental variables, the purpose of the walk, path choice, the scale of pedestrian movement, and other factors.

In this context, the "Walkability Factors of Chandigarh" questionnaire is a carefully structured survey tool to evaluate the pedestrian experience within Chandigarh's planned urban spaces. Targeted at individuals walking during peak hours, the questionnaire gathers detailed information on walking patterns, preferred routes, perceived comfort levels, and infrastructural challenges. It includes both closed-ended and open-ended questions to collect quantitative and qualitative data. A significant part of the survey is a detailed Likert scale that assesses key walkability factors, including the presence and condition of sidewalks, pathway continuity, cleanliness, shading, lighting, safety, access to public transportation, and available amenities. Additionally, the survey captures respondents' perceptions of the city's overall walkability and seeks suggestions for improvement. Demographic information further enhances the analysis across different user groups. Overall, this questionnaire is a valuable methodological tool for understanding walkability in Chandigarh, supporting the broader discourse on urban mobility and sustainable planning in Indian cities.

Following the consolidation of the assessment criteria, this research method addresses the limitations of previous assessments and incorporates insights from the literature review. First, selecting a specific study area allows for focused and detailed research. Second, a mixed-methods approach that combines qualitative and quantitative evaluations enhances the validity of the results. This method offers a comprehensive view of pedestrian infrastructure by visually documenting the current conditions in the chosen study area. Third, gathering firsthand insights from regular

walkers through surveys and ratings helps identify additional issues and prioritize the most significant ones. Finally, reviewing existing policies provides insight into how the problems identified during the walkability assessment relate to the planning and policy framework of the 'planned' city of Chandigarh, enhancing our understanding of the contextual factors influencing walkability in the city. The method is explained in detail below and consists of four sequential steps: selecting the study area, conducting a detailed photographic survey, surveying selected walkers, and reviewing Chandigarh's policies.

Understanding the basis of selection of study area

The basis of selection of study area for this walkability research in Chandigarh, including secondary research, analytical tools, and expert consultation. The rationale for choosing the core of the city, specifically Sector 17 and its surrounding sectors, is grounded in multiple considerations:

Following Dragovic's recommendation for a detailed study to achieve more authoritative results, this research defines a specific area for a comprehensive inquiry into the walkability issues in Chandigarh. The theory of Urban Fabrics suggests that cities harmonize walking, public transportation, and automobile networks, indicating that the core, or central business district, integrates these three components. (P. Newman et al., 2016). This insight motivated the researchers to examine the core of Chandigarh. With numerous workplaces, a diverse land-use typology, and a vibrant interstate roadway connection, Madhya Marg (V2) and Sector 17—the heart of Chandigarh—present significant opportunities for exploring walkability. Conversations with experts in planning, urban design, and transportation who have engaged with Chandigarh further supported the focus on this area. For this research (Figure 2), Sector 17 of Chandigarh's Central Business District (CBD) and its eight adjacent sectors (i.e., Sector 8, Sector 9, Sector 10, Sector 16, Sector 18, Sector 21, Sector 22, Sector 23) have been selected. Figure 3.3 shows a recreated image of the selected area. The light brown highlights represent travel origins (i.e., residential land use), while the orange outlines indicate likely destinations (other land uses, such as educational, institutional, commercial, and corporate). The green area, displayed in two shades, signifies open green spaces, with the darker green highlighting the

Leisure Valley, a stretch of greenery that runs through the entire city. The white area represents Chandigarh's circulation system, including roads and pathways. The red dots in the image indicate transit nodes, such as bus stops, auto-rickshaw stands, and e-rickshaw stands. The blue line on the map shows the trail traversed by the corresponding author during the photographic and walking survey on foot.

Preliminary assessments using publicly available tools such as **WalkScore** indicated that the core of Chandigarh might naturally score higher in terms of walkability. However, it was observed that these analyses suffered from **inadequate or outdated datasets**, limiting their accuracy and applicability to the Indian urban context. This insight emphasized the need for a primary, data-rich study to fill the gap and provide a more accurate picture of Chandigarh's core walkability.

Online Surveys done in the preliminary stages aimed to identify the most walkable and least walkable areas of Chandigarh based on public perception. Respondents were asked to name specific sectors or areas they considered walkable or otherwise. The data from this survey were analyzed to determine commonalities, and the final selection of study sectors was derived from the area's most frequently mentioned topics.

Expert opinions and stakeholder input: To validate the study area and align the research with ground realities, in-depth conversations and a group interview were conducted with seasoned experts in architecture, urban planning, and transport. The selection of experts was carefully curated to ensure diversity in professional background and firsthand experience with Chandigarh's urban fabrics. These experts provided strong validation for focusing on Sector 17, flanked by Sectors 8, 9, 10, 16, 18, 21, 22, and 23, forming the functional and perceptual heart of the city.

The selected area also presents an ideal testbed for walkability due to its diverse land-use typology, dense mix of institutional and commercial zones, interstate transit connectivity, and historical importance within the city's planning framework.

Group Interview of Experts: A structured online focus group discussion was conducted with the aforementioned experts. The group interview explored thematic areas including infrastructure performance, policy gaps, behavioral patterns, and the

unique challenges of pedestrianization in the Indian urban context.

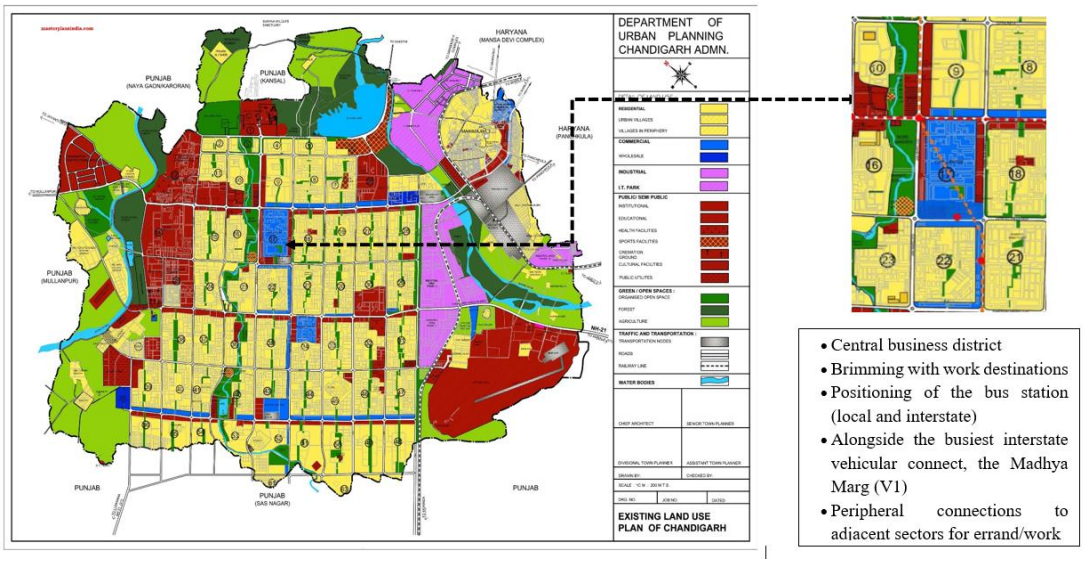


Figure 3.3- Selected Study area

(Source – The Chandigarh Master Plan, 2031)

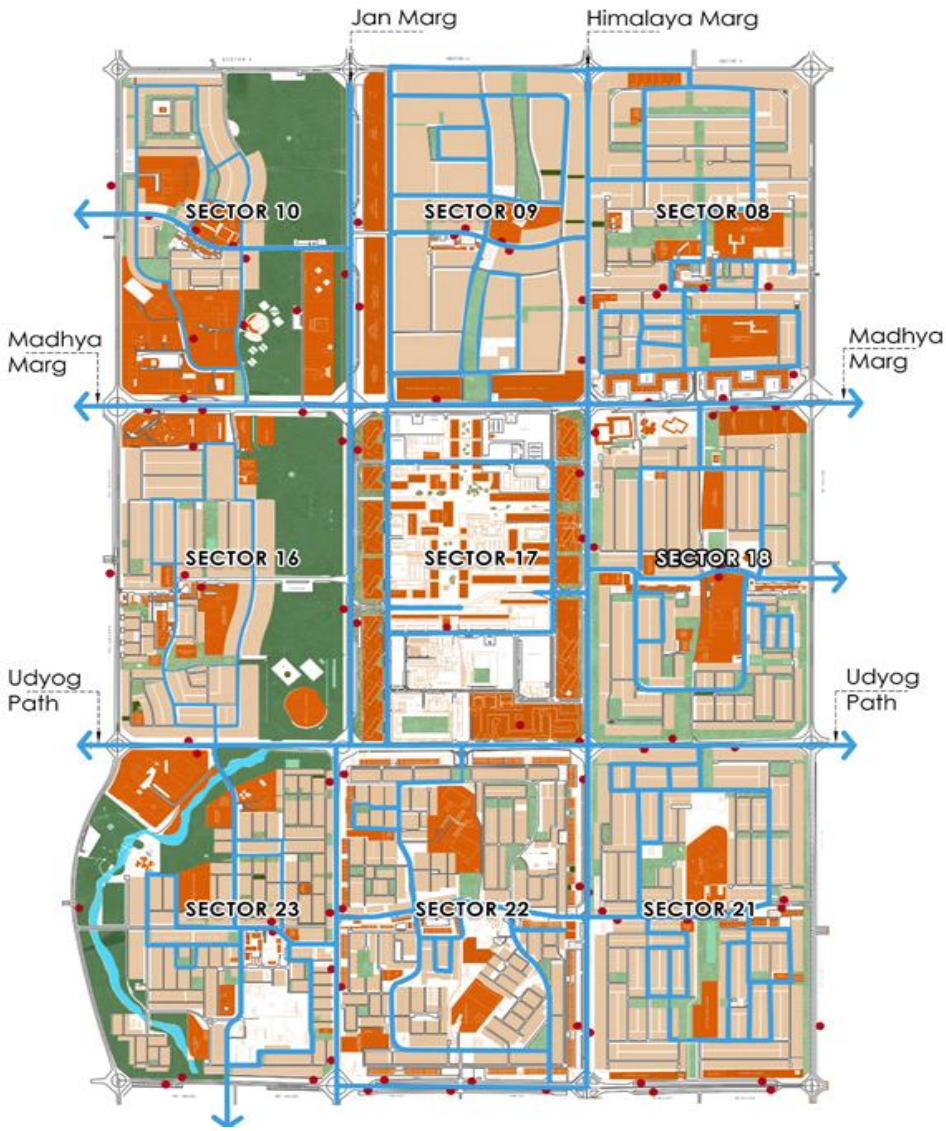
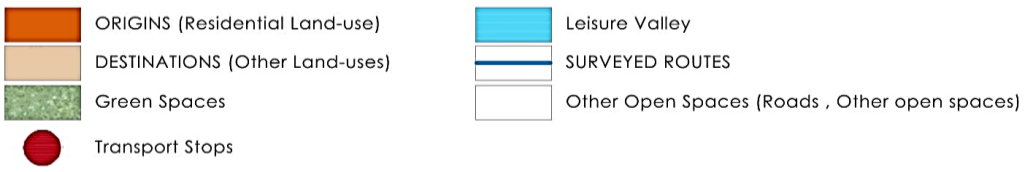


Figure 3.4- The surveyed trail in the selected areas



(Note: The light brown marks travel origins (residential land use), while orange outlines likely destinations (educational, institutional, commercial, corporate). The green areas indicate open spaces; darker green represents the Leisure Valley, a green stretch through the city. The white area depicts Chandigarh's circulation system, including roads and pathways. Red dots represent transit nodes, such as bus and auto rickshaw stand. The blue line shows the route taken by the author during the photographic and walking survey.)

3.3 Photographic survey

This photographic survey was conducted on foot across a selected area of approximately 8.64 sq. km in Chandigarh from August 2021 to July 2022. The primary author collected nearly 1,000 images along paths and sidewalks of various roads in nine designated sectors. The survey documented the main routes from origin to destination, as indicated by the blue lines in Figure 3.4. The timing was chosen during peak weekday hours to capture pedestrian activity, as a reconnaissance survey on weekends revealed very few pedestrians due to office, school, hospital, and market closures. Observations were conducted on weekdays (Monday to Friday) during three time slots: 8:30-10:30 a.m., 1:00-2:00 p.m., and 4:30 p.m. - 11:00 p.m. These timings covered the heavy traffic, working hours, and late-night slots. Mukherjee et al. highlight the timings of hit-and-run cases of vulnerable groups as late evening or early morning hours. This study covers the late evening hours. The key focus was to identify the purpose of pedestrians in Chandigarh. Before finalizing the research method, a preliminary online survey was conducted among Chandigarh residents via mobile phone. This survey collected demographic data, average daily walking distances, walking locations, and the purposes for which people walked. Among 200 participants evenly divided by gender, only 57 percent reported walking more than 2 km daily, primarily in city parks during morning or evening leisure walks. These individuals typically relied on their cars to reach green spaces for leisure walking, indicating that urban walking was mostly for work-related purposes. Most individuals were not walking for leisure; they walked out of necessity, often due to financial constraints or a lack of alternative transportation options. Thus, many were categorized as "captive walkers." This finding was further validated during interviews with the selected sample group of pedestrians in Chandigarh, as discussed in the ‘Findings’ section. Figure 3.6 shows the Photographic survey dependent on.

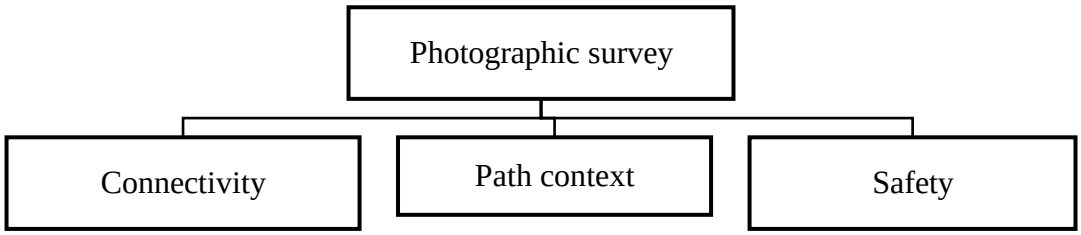


Figure 3.5 - Factors for assessment in the Photographic survey

3.4 Survey of walkers

The sample set for our study focused on walkers, which was determined using Slovin's Formula based on the 2011 Census data for nine selected sectors, with a total population of 105,545. With an acceptable margin of error set at 0.07, we calculated a required sample size of approximately 204 (Ang et al., 2023). Out of 223 collected responses, the most reliable findings emerged from 209 samples. Walkers were surveyed using the same parameters provided in Figure 3.6, specifically in Chandigarh. They were questioned about the routes connecting their origin (residential land use) and destination (other land uses) through direct questionnaires conducted via paper interviews. These routes are highlighted in blue. Considering users' diverse backgrounds in literacy, language, and understanding of walkability, the questions were presented in English and Hindi. This choice of language was appropriate since English and Hindi are the primary spoken languages in North India. The first question addressed the purpose of walking to identify 'purposive' walkers. The questionnaire was designed to include both quantitative and qualitative questions. A 5-point Likert scale was utilized in the quantitative section to assess the walkability metrics in Chandigarh, as identified during the photographic survey. A rating of 1 denoted that the metric had the least impact on walking, while a rating of 5 indicated that the metric was a crucial factor influencing walking behavior in Chandigarh. The quantitative section also featured a 5-point Likert rating for the overall walkability of Chandigarh. The qualitative questions examined the reasons behind the ratings given for overall walkability. Additionally, the qualitative questions highlighted other issues affecting respondents' walking behavior, supported by user ratings. The study provided insights into the extra challenges faced by walkers, categorized according to the three selected evaluation parameters.

3.5 Selection of respondents

The study randomly selected a sample of 209 consenting adults who walked purposefully in the study area on a regular basis (i.e., purposive walkers). The surveys were completed over six months, from August 2022 to January 2023. The timing of the study was from 8:30 am to 10:30 am (morning), 1:00 pm to 2:00 pm (afternoon), and from 4:30 pm to 6:30 pm (evening) during weekdays (i.e., Monday to Friday) as per the working days of the week to reach maximum 'purposive walkers.' These durations covered peak hours of walking for errand walkers and office goers. After 6:30 p.m., very few people were seen walking, and the author perceived the survey conditions as unsafe.

3.6 Policy Review

In India, governance and administration are guided by a structured hierarchy of **policies, acts, rules, and regulations**, each serving a distinct purpose in shaping legal and operational frameworks. **Policies** provide strategic direction but do not carry legal binding, while **acts** are laws enacted by the legislature, forming the legal backbone for governance. **Rules** detail the procedures for implementing these acts, and **regulations** are specific, enforceable standards issued by authorities to ensure compliance. This framework operates at both national and regional levels—such as in **Chandigarh**, where the central and state laws are complemented by city-specific policies, acts, and regulations that address its unique planning, transport, and urban management needs.

A review of policies is done to understand if the issues found during the walkability assessment connect with the city's planning and policy framework. The research examines National-level policies and legislative acts related to urban transport, traffic management regulations, and road governance frameworks, with a primary objective. It also includes an analysis of local development controls, zoning laws, architectural standards, and building regulations specific to Chandigarh to find connections between developmental policy and walking.

Table 3.6- Policies, Acts, Rules, and Regulations in INDIA and CHANDIGARH.

(Source:Author Research)

<table>
<tr><td colspan="4">POLICIES, ACTS, RULES, AND REGULATIONS IN INDIA</td></tr>
<tr><td>Policy</td><td>Acts</td><td>Rules</td><td>Regulations</td></tr>
<tr><td>Guideline-No Legal Standing</td><td>Detailed rules- A broad law</td><td colspan="2">Legally binding laws</td></tr>
<tr><td>Directive Principle of State Policy (DPSP) (2023) under the Constitution of India</td><td rowspan="2">Motor Vehicle Act (1988) (discussed with Motor Vehicle Driving Regulation)</td><td rowspan="2">Bharatiya Nyaya Sanhita (BNS)(2023)</td><td rowspan="2">Motor Vehicles Driving Regulation (MVDR) (2017)</td></tr>
<tr><td>National Urban Transport Policy (NUTP) (2014)</td></tr>
<tr><td colspan="4">POLICIES, ACTS, RULES, AND REGULATIONS SPECIFIC TO CHANDIGARH</td></tr>
<tr><td rowspan="3">Chandigarh Master Plan (CMP)</td><td>Capital of Punjab, Development & Regulation Act (CPDRA)</td><td>The Architectural Control and Zoning (ACZ)</td><td>Chandigarh Tree Preservation Order (CTPO)</td></tr>
<tr><td rowspan="2">Municipal Corporation Act, The Punjab Municipal Corporation 1976 (Law extension to Chandigarh) Act 1994 (MCA)</td><td rowspan="2">The Suvidha Handbook for Building Construction (SHBC)</td><td>Chandigarh Control and Regulations of Hedges and Fences Bye-laws (CCRFH)</td></tr>
<tr><td>Motor Vehicles Driving Regulation (MVDR) (2017)</td></tr>
</table>

Table 3.7 - Formulation level and objectives of the planning framework

(Source:Author Research)

S. No.	Level National /City	Policies/regulations/acts/guidelines, and their abbreviations, are used for reference.	Objective	Latest year
1	National	National Urban Transport Policy (NUTP)	National Policy	2014
2	National	The Bhartiya Nyaya Sanhita (BNS) & Motor Vehicles Act (1988) Amendment (2019) (IPC)	Law Enforcement	2023*
3	National	National Road Safety and Traffic Management Act (NRSTM)	Law Enforcement	2010
4	National	Rules of Road Regulation (RORR)	Law Enforcement	1989
5	City	Capital of Punjab, Development & Regulation Act (CPDRA)	Development framework of the city	1952
6	City	Municipal Corporation Act, The Punjab Municipal Corporation 1976 (Law extension to Chandigarh) Act 1994 (MCA)	Local Body Framework	1994
7	City	Chandigarh Tree Preservation Order (CTPO)	Landscaping rules	1952
8	City	Chandigarh Control and Regulations of Hedges and Fences Bye-laws (CCRFH)	Landscaping rules	1971
9	Site	The Architectural Control and Zoning (ACZ)	Zoning controls	2011
10	Site	The Suvidha Handbook for Building Construction (SHBC)	Development Controls	2011
11	City	Chandigarh Master Plan (CMP)	Future planning	2031

*Note: *The Bhartiya Nyaya Sanhita (BNS) replaces the Indian Penal Code (IPC), reducing the number of sections from 511 to 358 and adding 21 new offenses, including hate crimes and mob lynching.*

4 Results and Discussion

The chapter 4, titled "**Results and Discussion**," presents the core findings derived from the implementation of the research methodology discussed in Chapter 3. The photographic survey, conducted across nine selected sectors of Chandigarh, reveals visual evidence of key environmental and infrastructural barriers affecting walkability. The survey of 209 purposively selected walkers provides rich perceptual data, offering insight into user experiences and perceived ratings across three primary parameters: connectivity, path context, and safety. A policy review juxtaposes these field-based findings with existing planning documents and urban transport policies, highlighting critical gaps in implementation and vision. Collectively, the chapter bridges empirical data with qualitative findings, setting the stage for targeted recommendations in planning, design, and policy to enhance walkability in Chandigarh.

4.1 Photographic survey results

The photographic survey results analyze over 1,000 still images captured by a camera. This photographic data was assessed according to the parameters outlined in the research methodology section. Table 2 displays the parameters and associated issues in the Photographic Survey in the right column, along with the relevant figures. The parameters selected for analysis include connectivity, path context, and safety.

Issues under connectivity

The photographic study has identified seven connectivity-related issues. These include the absence of sidewalks on many roads, discontinuous and obstructed sidewalks, zebra crossing barriers, poorly maintained sidewalks, cars parked on sidewalks, vendor encroachment, and poor connections to main roads.

Absence of sidewalks

Planning and maintaining sidewalks seem challenging, as many roads do not have sidewalks, and pedestrians can be seen walking on the road (Figure 4.1).

Figure 4.1- Issues under connectivity- Absence of sidewalks *(Source:Author Research)*

Poorly planned infrastructure for pedestrians, without sidewalks on both sides of the road. (V5 road Sector 23) (Source: Primary research data collected by the Corresponding Author)

Discontinuous and obstructed sidewalks

Misplaced poles, signposts, trees, and transformers block pedestrians' right of way (Figure 4.2). Sometimes, sidewalks stop suddenly with government-erected boundaries. Seamless travel for all demographics, with accessible slopes or sound materiality, was also missing.

Figure 4.2- Issues under Connectivity-Discontinuous and obstructed sidewalks.
(Source:Author Research)

Carelessly designed boundary wall of a bridge (V3 road Sector 16), disrupting pedestrian travel (Source: Primary research data collected by the Corresponding Author)

Obstructed zebra crossings

Obstructed zebra crossings make walking difficult. Zebra crossings ending abruptly without seamlessly joining with the sidewalk pose a significant problem to walkers (Figure 4.3). The crossings are made discontinuous by poorly planned flowerbeds, higher levels of the central aisle on roads, or misplaced railings, all of which are planned by government agencies.

Figure 4.3-Issues under Connectivity- Obstructed Zebra Crossings
(Source: Author Research)

Zebra crossings are obstructed by flowerbeds or railings planned by government agencies. (V2 road, Sector dividing road of Sectors 9 and Sector 10 on the left, V5 the sector loop road for the Central Business District of Sector 17, right) (Source: Primary research data collected by the Corresponding Author)

Poorly maintained sidewalks

Poor sidewalk maintenance, primarily with overgrown greenery, weeds, garbage, broken pathways, or uneven mud pathways, further worsens walkers' connectivity (Figure 4.4). In addition, the absence of zebra crossing markings, pedestrian-designated areas, and pedestrian signage shows less appreciation for pedestrians as road users.

Figure 4.4- Issues under Connectivity - Poorly maintained sidewalks

Poor sidewalk quality, insufficient walking width, broken sidewalks, hampering traversability. (V5 of Sector 8, left and V4- V5 junction of Sector 9, right). (Source: Primary research data collected by the Corresponding Author)

Cars parked on sidewalks

With numerous vehicles encroaching on the sidewalk, pedestrian infrastructure is not a priority in the planned city of Chandigarh (Figure 4.5). In addition, the photograph demonstrates that the city has more cars than it has planned parking for.

Figure 4.5- Issues under Connectivity - Cars parked on sidewalks *(Source:Author Research)*

Motor vehicles encroach upon pedestrian space and open areas, making walking uninviting and dangerous for the pedestrian. (V6 road in Sector 8) (Source: Primary research data collected by the Corresponding Author)

Vendors encroaching on sidewalks

Pathways are encroached by vendors and deter walking. They occupy the space for pedestrian travel and block huge areas with their products, forcing pedestrians to use the road (Figure 4.6). Chandigarh's planning and governance seem lax in terms of pedestrian safety.

Figure 4.6- Issues under Connectivity- Vendors encroaching on sidewalks

(Source:Author Research)

Pathways encroached by vendors pose a deterrent to walking as they fully occupy the space meant for pedestrian travel. (Both V6 roads in Sector 21). (Source: Primary research data collected by the Corresponding Author)

Poor connections to major roads

Chandigarh's sector connectivity to outer roads seems challenged. The inward-looking residential sector seems less connected with its adjacent sectors or markets. The sector, 800m x 1200m (Figure 4.7), the neighborhood unit of Chandigarh, was designed to have peripheral roads for fast-moving traffic with four peripheral connections supplemented by these V4 subways, which have not been built. As proposed in the original concept, the connection via the long-running green belts has been broken by massive railings installed on the dividers of the V2 and V3 sectors surrounding roads. This has been done to facilitate fast traffic. This has discouraged pedestrian movement since it has one or no crossings in the middle. This has isolated the sector altogether and made travel on foot longer.

Figure 4.7- Issues under Connectivity - Poor connections to major roads.
(Source:Author Research)

The above figure shows the railings installed between the sectors(left) and the fewer number of pedestrian connections to the V3 (right) (Source: Primary research data collected by the Corresponding Author)

Issues under Path context

The walking environment is the least developed and the second most problematic issue under the 'path context' parameter in Chandigarh. A monotonous path in an uninviting built environment shall not prompt people to walk. In addition, stray dogs, poorly lit sidewalks, long blocks, far-away grocery stores, and unpaved transit stops make walking in Chandigarh uninviting and, in most cases, dangerous. Unlike traditional towns in India, Evenson points out that "the sectors lack spatial variety, visual interest, and functional viability as was present in the traditional Indian town," which discourages walking (Evenson, 1966).

Poor transit stops

Apart from addressing good connectivity within a pedestrian pocket' (a Sector as was planned), it is also essential that a residential unit be well equipped in terms of other transit modes to facilitate seamless navigation in and around the Sector. There are

ample transit stops in Chandigarh on every kind of road, but they seem poorly planned in their context of providing good linkage to pedestrians to other modes. The photograph (Figure 4.8) shows no proper waiting area for the walkers if they want to wait, rest, or change their mode of transport, hindering overall traversability in the city.

Figure 4.8: Issues under Path Context - Poor transit stops *(Source:Author Research)*

Transport nodes are poorly planned in providing good linkage to pedestrians. Newly built cycle stands to infringe on the sidewalk. Also seen in the picture is the lack of resting spaces for pedestrians. (Source: Primary research data collected by the Corresponding Author)

Single-zoned land use

Chandigarh's extended block sizes and distantly located services, which result in long walking distances, do not appeal to the human scale. The peripheries marking the Sector edges, government buildings, and residences do not create an appealing walking environment. The deficiency of vibrant public spaces discourages the city's walking population. There are no physical elements to encourage walking (café, fountain, heritage, public art, etc.) (Figure 4.9).

Figure 4.9 - Issues under Path Context- Single zoned land use *(Source:Author Research)*

No vibrant elements for walking, like cafes, fountains, heritage, or public art, engage the walkers. (Source: Primary research data collected by the Corresponding Author)

Issues under safety

Chandigarh is known for good governance and maintenance, being a planned city. However, the photographic analysis shows some threatening intuitions for walking in the city.

Unsafe Environment

Negligent driving, poorly lit pathways, insufficient walking space, and lax rule enforcement threaten personal and traffic safety. Walking under the constant threat of harm from a stranger or the risk of being struck by a car or any moving vehicle due to these environmental conditions can instill fear in the walker's mind and discourage them from walking (Figure 4.10).

Figure 4.10: Issues under Safety *(Source:Author Research)*

Unsafe environment, underlit paths, lax implementation of rules and regulations, seen across various road hierarchies - V2, V3-V4 intersection and V5.(Source: Primary research data collected by the Corresponding Author)

The walking conditions observed in Chandigarh reflect a significant gap between the city's urban planning frameworks, such as master plans, building codes, and municipal regulations, and their actual execution on the ground. The gradual breakdown of the planned green connections between sectors and the inefficiency of the designated circulation systems suggest that informal encroachments and passive land-use management have compromised walkability. These patterns indicate the absence of robust pedestrian-oriented policies, systematic evaluations, and collaboration among key city departments. To address these challenges, it is essential to implement enforceable guidelines that prioritize regular upkeep, reclaim inactive spaces, and encourage community involvement. Such measures would help re-establish the original vision of Chandigarh as a walkable and inclusive urban environment.

4.2 Survey of walkers

The Chandigarh Walkers Dataset comprises data from 209 individuals representing a realistic cross-section of the selected area’s pedestrian population. The sample maintains an equitable gender representation with an almost 50:50 male-to-female ratio. It spans a diverse age range, with walkers distributed across the 18–25, 26–40, 41–55, and 56–70 age groups, ensuring a balanced perspective from young adults to older citizens, as shown in Figure 4.10.

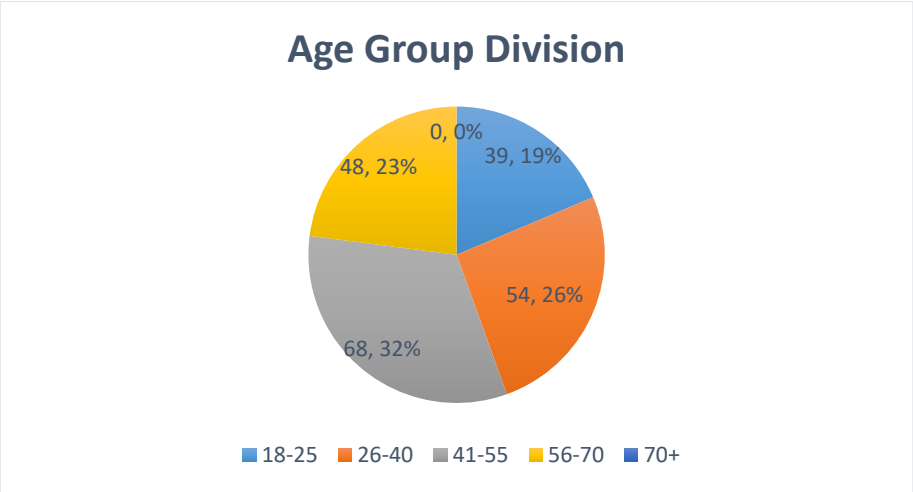


Figure 4.10 : Age group division of the real walkers

The first bar chart illustrates the total walkability score contribution segmented by occupation type. It is evident that students and in-house help report the highest cumulative walkability scores, indicating that these groups contribute significantly to the city's pedestrian activity levels. Housewives also account for a large share, whereas retirees, shop helpers, and the category labeled 'Others' show comparatively lower total scores, highlighting that active daily walking is more prevalent among students, domestic workers, and homemakers than among retirees or people in miscellaneous occupations. The trendline reinforces that the majority of the occupations hover around the mean, with only minor deviations.

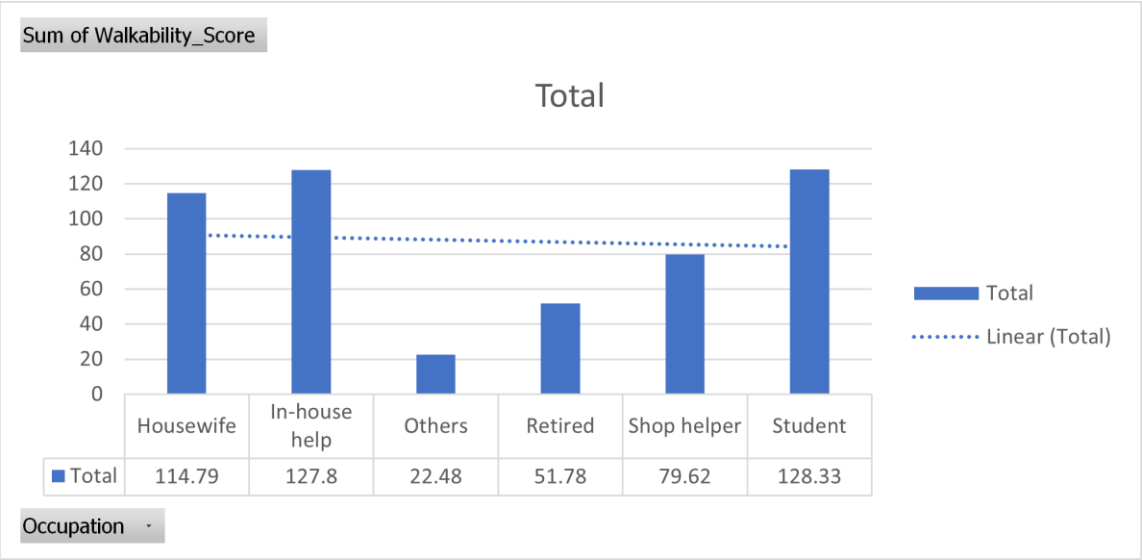


Figure 4.11 : Total walkability score contribution segmented by occupation type

The second clustered bar chart presents a cross-tabulation of occupation with daily walking distance categories: less than 1 km, 1–2 km, and more than 2 km. This visual confirms that the majority of housewives, in-house help, and students predominantly walk more than 2 km daily, aligning with their high total walkability scores observed in the first chart. In contrast, categories like 'Others' and retirees display a wider spread but with relatively lower counts in the highest distance bracket, suggesting that age or nature of work limits their daily walking range. Shop helpers show a balanced distribution but still maintain a preference for the longer walking distance, consistent with the demands of their job roles which often involve physical movement within markets or small shops.

Figure 4.12: Cross tabulation between cross-tabulation of occupation with daily walking distance categories

The scatter plot shows the relationship between age and individual walkability scores. The dense clustering of points between ages 20 and 60 confirms strong representation in these age ranges, with scores tightly grouped around the average value of 2.5. There are some outliers with slightly higher or lower scores, but overall, the scatter indicates a moderate consistency in perceived walkability regardless of age, with only minimal drop-offs visible among older individuals.

Figure 4.13 :The relationship between age and individual walkability scores

Collectively, these charts highlight that in Chandigarh, daily walking behavior and walkability perceptions are significantly shaped by occupation and age. Younger and working-age individuals—especially students and informal sector workers—are the city's most active walkers. Simultaneously, housewives form a substantial pedestrian demographic, likely due to daily errands and responsibilities close to home. Safety concerns must therefore address the needs of these dominant groups to sustain and improve walkability, especially since their activity patterns show high dependence on walking distances beyond 2 km. Overall, this dataset provides a grounded foundation for analyzing walkability from a demographic, socioeconomic, and behavioral perspective, supporting studies aimed at improving pedestrian infrastructure and safety in planned Indian cities. Walkers in Chandigarh were surveyed on the final questionnaire. They highlighted several issues affecting walkability across three parameters. The most important are listed as follows: obstructed zebra crossings (connectivity); street harassment by strangers (safety); poor maintenance of sidewalks (connectivity); single-zoned land use and scattered services, which led to longer walking distances (path context), the fear of crime and short durations of street lighting at traffic junctions (safety); discontinuous and obstructed pathways (connectivity) and poorly marked zebra crossings (safety). These findings are significant as they comprehensively understand the challenges pedestrians face in Chandigarh, which can inform policy decisions and urban planning strategies. The rating of the walkers against the issues of the selected parameters is given in Table 4.1.

Public sentiment and planning critique

The general opinion of the surveyed walkers in the selected study area aligned with the photographic survey and the walkers' assessment of issues. Participants in the survey, who were regular walkers in the chosen area, did not walk by choice but were compelled by financial circumstances or the lack of available transportation. They described themselves as "forced" walkers. They emphasized the government's biased approach to city planning. They noted that roads are designed solely for the 'wealthy' or 'car' owners, overlooking the needs of many who cannot afford a car in this city, including paying guests, visitors, students, and workers. An elderly woman working as a housekeeper, crossing Sector 22 road slowly, stated, "Every day, I come to work here

from the eastern periphery of Chandigarh. I change two buses and walk daily; I have been doing this for the past twenty years. Today, I am fifty years old, but the traffic situation in this city and the treatment of people like me on the roads have only worsened. For me, walking is the only way to get to work; I have no alternative, so I pray every time I reach home and pray again when I arrive at work. God listens to everyone, even if reckless drivers do not see us; God sees us and protects us." Walkers also noted that the roads are not safe for traveling short distances within the sector and reported incidents of crimes such as lewd comments, whistling, catcalls from car owners, and chain-snatching incidents by bikers. They observed that vehicles travel at higher speeds within the sector than on the fast-moving V3 roads, as there are no cameras or policing measures in place. Some pointed out that there is a lack of respect for pedestrians in Chandigarh, which discourages people with disabilities from walking along the road. A woman with a pram, returning with her school-age toddler, seemed flustered at the thought of Chandigarh being a planned city and remarked that vehicles never stop and there is no one to monitor accidents, in case someone is hit. Walkers expressed feeling looked down upon in the so-called 'cultured' city of Chandigarh. Many stated that Chandigarh is not 'planned' but mismanaged and uncoordinated in its design for the city's developments.

A common topic of discussion was the lack of maintenance of walking infrastructure. Some respondents mentioned that Chandigarh receives ample funding but does not know how to spend it wisely. The local government is perceived as weak and ineffective. The transit stops were criticized as standalone designs that fail to blend with the city's architecture. Unnecessary barriers and poorly thought-out infrastructure (high railings, long block lengths, inappropriate paving, reckless public transport planning) were labeled as 'poor' imitations of foreign examples. Such urban designs were described as a "waste of public money' and politicized targets of a few who visited the city briefly without understanding its spirit. Continuing this theme, users felt that barricading the sector connections of V3s to facilitate vehicle speed was a 'mindless' exercise since speed cameras were later installed to reduce the speed of cars. They argued that heavy traffic congestion already prevented vehicles from traveling quickly, so why was pedestrian movement curtailed? Purchasing a car with no designated

parking space was also considered absurd. Some attributed this to planning authorities, who have reduced setbacks, permitted multiple ownership of even small plots, and failed to update the need for parking spaces. Regular walkers in Chandigarh felt that most of the population now appears "ignorant" of walkability, believing that only parks and green belts are meant for pedestrians. At the same time, roads remain exclusively for motor vehicles. Some even emphasized that only the poor travel by foot.

Table 4.1-The main issues the walkers rated are the main walkability issues in Chandigarh.

Parameters (Literature and context)	**Photographic Survey (Nine selected sectors)**	**Survey of Walkers (n-209)**
Connectivity	Obstructed zebra crossings	81
	Poorly maintained sidewalks	78
	Discontinuous and obstructed sidewalks	72
	Car parked on sidewalks	71
	Vendors encroaching on sidewalks	70
Path Context	Single-zoned land use (distantly located service centres like grocery stores)	76
Safety	PERSONAL SAFETY - Street harassment by strangers	79
	CRIMINAL SAFETY - Fear of crime on streets at night due to underlit paths	76
	TRAFFIC SAFETY - The lack of time to cross at signalled junctions	76
	TRAFFIC SAFETY - Zebra crossings are not well-marked	72
	TRAFFIC SAFETY - Not enough pedestrian crossings	71

4.3 Policy Analysis Results

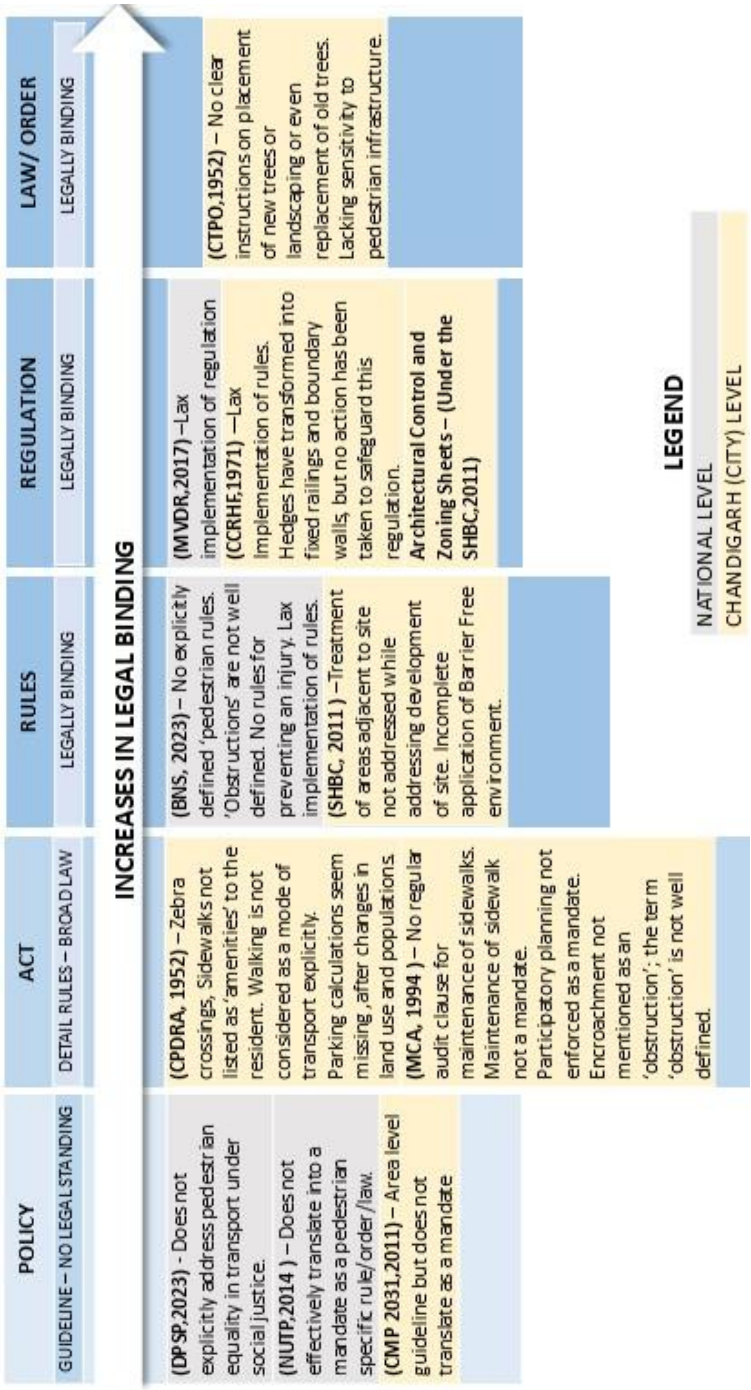


Figure 4.11: The Planning and Policy framework of walkability in India and Chandigarh

Policies serve as essential guidelines that inform the establishment of future regulations. The Directive Principles of State Policy (DPSP, amended in 2023), shape the framework for rule-making and legislative actions but rarely address transport needs. In the National Urban Transport Policy, some guidelines exist for pedestrians but do not effectively translate as rules or mandates under various laws concerning pedestrians. The Chandigarh Master Plan (CMP 2031, published in 2011) gives a detailed account of issues and the plan as a guideline, but it is not legally binding; therefore, the suggestions fail to translate to designs at the ground level.

Acts serve as broader laws. The Capital of Punjab, Development and Regulation Act (CPDRA), published in 1952 and Chandigarh Building Amendment Rules (Urban) 2020, pertains to urban building and development regulations. It considers roads as amenities, but surprisingly, does not consider sidewalks or zebra crossings as 'amenity' for the city. It fails to consider walking as a means of transport. This act has no guidelines for limiting the development of parking lots or protecting green areas. The Municipal Corporation Act of Chandigarh (MCA), published in 1994, focuses on city development at the municipal level. It outlines specific development rules for roads within sectors and general city infrastructure. However, it lacks a mandate for planning and designing infrastructure needs or regular maintenance and audits concerning pedestrian infrastructure. Furthermore, participatory planning is not a mandatory requirement in the planning process. The act does not mention signage, garbage bins, railings, poles, lights, or signage that is haphazardly placed in the city and reflects the disorder in the act.

Rules, regulations, laws, and orders are all legally binding documents applicable at the national and city level for penalty or punishments. Bhartiya Nyaya Sanhita (BNS, replaced the Indian Penal Code (IPC) in 2023), mentions all criminal procedures but does not mention the crimes against pedestrians. The definitions of road obstructions are generally broad in the document, often overlooking the issues pedestrians face with various obstructions on the sidewalk (footpath). Further, there are no rules regarding preventive injury. The definition of 'public nuisance' (Section 270, BNS) does not address any pedestrians. The Motor Driving Regulation Act (MVDRA), amended in 2017, addresses some issues regarding pedestrians (like 'pedestrians first 'to modulate

drivers' behavior), but its implementation is lax. At the city level, the Chandigarh Tree Preservation Order (CTPO), which was released during the city development in 1954, outlined the preservation of existing trees and the replacement of old ones. When a tree is replaced, it fails to consider whether it is blocking the pedestrian path. This policy does not include greens, flower beds, or landscaping elements. The Chandigarh Control and Regulations of Hedges and Fences Bye-laws (CCRHF, amended in 1971) clearly state that a 6' distance must be maintained from the edge of the road when planting any hedges or fences. Although this regulation is in place, its implementation has been lax, and hedges have infringed on the sidewalk. The Suvidha Handbook of Building Construction (SHBC, released in 2011) guides the procedures and construction of buildings in Chandigarh. However, this handbook does not address the management of adjacent areas during development. It also omits integrating sidewalks (footpaths) with the site under construction. While it includes details on Architectural Zoning and Control Sheets (ACZS, a legally binding drawing document), which are vital for maintaining building setbacks from the road, elevational (façade) controls, building heights, and the placement and height of services such as water tanks, it overlooks parking as an essential aspect of site development. Even if the site's land use changes from residential to another type, there is no requirement to submit specific parking details according to the new use and occupancy of the building, whether for visitors, clients, or residents. Amendments have been made to the controls sheets, ACZS to increase the height of buildings and reduce the setback from the site boundary, resulting in less space for parking and no room for green areas. This has affected two significant conditions, parking and shade on the sidewalks. Following another amendment enacted in 2017, a provision for self-certification of development was established. This allows certified architects, as recognized under the Architects Act of 1972 by the Council of Architecture, to affirm that their construction projects adhere to the regulations set forth by Chandigarh and the ACZS. Despite this positive step forward, it is essential to note that the oversight responsibilities remain with the estate officer and the administrator. Regrettably, according to the standards set by the Indian Government, the qualifications of these officers often lack sufficient technical expertise in planning and architecture, raising concerns about their effectiveness in such critical roles.

The government allows a graduate without any qualification in planning or architecture to be placed next to a civil services officer in Chandigarh.

4.4 Summary of findings

The study identifies significant obstacles to walkability, including obstructed zebra crossings (connectivity), street harassment (safety), poorly maintained sidewalks (connectivity), single-use zoning with scattered services (path context), fear of crime (safety), limited crossing time intervals (safety), and discontinuous and obstructed sidewalks (connectivity) along with poorly marked zebra crossings (safety).

Chandigarh's urban policies exhibit significant gap in pedestrian infrastructure and safety. Table 4.2 outlines the planning policy (Policy/regulation/act/guideline), its purpose, the formulating agency (National or city level), and its weaknesses.

Table 4.2-Review of planning and policy framework in Chandigarh

S. no.	Policy, regulations, acts, guidelines, and their abbreviations are used for reference.	Purpose/ Formulating Agency	Weakness
1,	Directive Principles of State Policy (DPSP)2023	General Guideline Government of India	It does not explicitly address the need for pedestrian equality in transport.
2.	National Urban Transport Policy (NUTP)2016	Transport Guideline/Government of India	Key guidelines lack enforceable mechanisms, putting pedestrian needs at risk.
3.	Chandigarh Master Plan 2031	Planning Guideline / Chandigarh Administration and Department of Urban Planning	Only a guideline, not legally binding
4.	Capital of Punjab, Development & Regulation Act (CPDRA)and Chandigarh Building Amendment Rules(urban) 2020	Development framework of the city/ Chandigarh Administration	Zebra crossings and sidewalks are not considered amenities for transportation. Walking is not appreciated as a mode of travel.
5.	Municipal Corporation Act, The Punjab Municipal Corporation 1976 (Law extension to Chandigarh) Act 1994 (MCA)	Local Body Framework/Municipal Corporation Chandigarh	No regular audit or maintenance clause is a mandate. Participatory planning is not a mandate. Encroachments are not mentioned as obstructions or are not well defined.
6.	The Bharatiya Nyaya Sanhita (BNS) 2022	Criminal Code /Traffic Police Chandigarh and Chandigarh Police	Pedestrian Rules are not explicitly defined; obstructions are not well defined—no rules for preventive injury.
7.	The Suvidha Handbook for Building Construction (SHBC)& The Architectural Control and Zoning Sheets (ACZS)2011	Development Controls/ Department of Urban Planning, Chandigarh Administration	Areas adjacent to the site were not addressed. Incomplete application of “Barrier Free Environment” Lack of technical expertise of the inspecting staff
8.	Motor Vehicles Driving Regulation (MVDR)2017	Regulation / Government of India	Lax Implementation
9.	Chandigarh Control and Regulations of Hedges and Fences Bye-laws (CCRFH)1971	Landscaping Rules/ Chandigarh Administration	Lax implementation of rules. Many aspects are not covered (flower beds, green areas, landscaping elements)
10.	Chandigarh Tree Preservation Order (CTPO)1954	Landscaping Rules/ Chandigarh Administration	Lacking sensitivity towards pedestrian infrastructure.

5 Conclusion

The transition from architectural design to urban planning often involves a paradigmatic shift—from focusing on individual buildings to understanding complex urban systems. Within this shift, the subject of walkability emerges as a critical yet underexplored domain in the Indian context. The selection of Chandigarh as the site of inquiry was informed by its status as a planned city and by the availability of historical data and planning documentation. Familiarity with its spatial structure, civic infrastructure, and lived culture provided a grounded context for undertaking a nuanced assessment of walkability.

The research commenced with a sense of clarity regarding objectives and scope. However, the onset of the COVID-19 pandemic disrupted conventional research modes, simultaneously catalyzing a deeper awareness of public space, mobility, and the human experience of the city. During prolonged periods of lockdown and restricted movement, the act of walking, once mundane, emerged as a vital, life-affirming activity. Walking became synonymous with connection, reflection, and reclaiming the public realm. The city was re-experienced at a human pace, uncovering the often-overlooked gaps in urban form and pedestrian infrastructure.

Technology enabled continuity in data collection and collaboration, with digital tools such as Google Forms and virtual meetings facilitating initial engagement. Nevertheless, the most profound insights emerged from direct, on-ground engagement. A comprehensive pedestrian audit was conducted through extensive fieldwork across various sectors of Chandigarh. Walking each stretch of road and experiencing the city on foot allowed for an embodied understanding of its challenges—uneven pavements, poor lighting, encroachments, traffic indifference, and unsafe crossings, among others. These impediments collectively pointed to a dissonance between the city's celebrated planning principles and its current pedestrian reality.

A mixed-method approach, combining qualitative narratives and quantitative analysis, was employed. The survey, comprising 209 respondents selected through purposive sampling, utilized a checklist-based tool derived from

Southworth's parameters of walkability, adapted to suit local conditions. The responses revealed recurring themes: concerns over safety, poor infrastructure maintenance, vehicular dominance, and marginalization of pedestrian needs. Notably, participants conveyed a deep yearning for dignity, accessibility, and a safer walking environment.

The empirical findings were supplemented by a historical and policy-based review of Chandigarh's planning trajectory. Analysis indicates a gradual departure from its original vision of equity, openness, and spatial balance, toward a car-centric urban transformation. The pedestrian, once central to the city's design, has increasingly been relegated to peripheral consideration in planning and policy discourse.

Furthermore, the study critically reflects on the relevance of global literature—largely originating from high-income nations of the Global North—and its applicability in the Indian urban context. While these models offer valuable theoretical frameworks, the need for locally grounded research becomes evident. The objective of this thesis is not the transplantation of foreign methodologies but the cultivation of indigenous knowledge—one that is culturally sensitive, socially inclusive, and contextually rooted.

In conclusion, this research extends beyond technical evaluation. It seeks to foreground the pedestrian experience as an essential dimension of urban livability. It underscores the importance of empathetic planning and evidence-based policy intervention. Above all, it aspires to contribute meaningfully to the discourse on urban equity—advocating for walkable cities that prioritize the needs, safety, and well-being of all citizens.

This research aimed to investigate the state of walkability in Chandigarh, focusing on its Central Business District, specifically Sector 17, and the eight adjoining sectors. Building on Dragovic's recommendation for detailed microscale studies, the research integrates expert interviews, dual-layered surveys, and a review of existing urban policy frameworks to provide a comprehensive understanding of the gaps between pedestrian needs and existing planning practices.

The study identifies significant obstacles to walkability, including obstructed

zebra crossings, street harassment, poorly maintained sidewalks, single-use zoning with scattered services, fear of crime, limited crossing time intervals, discontinuous and obstructed sidewalks, and poorly marked zebra crossings. These issues are primarily related to connectivity, safety, and path context, which together form the core parameters for assessing walkability.

Despite Chandigarh's reputation as a meticulously planned city, the findings reveal that infrastructural shortcomings and a lack of prioritization in planning policies mar the pedestrian experience. The analysis of planning documents and regulatory frameworks reveals that urban policies exhibit significant gaps in addressing pedestrian infrastructure and safety. While various policies, guidelines, and acts do exist at both the national and city levels, they are often broad in scope, vehicle-oriented, or inadequately implemented when it comes to pedestrian-specific concerns.

The responses from the second online survey, which asked participants to identify the most and least walkable sectors, further reinforce the idea that the perception of walkability does not always align with the intended design logic of planned spaces. This feedback, combined with insights from experienced professionals across architecture, planning, transport, and heritage, confirms the need for an urgent and focused intervention to address walkability in the city.

In conclusion, Chandigarh's walkability is hindered not by a lack of planning, but by a disconnect between policy, design, and implementation, particularly at the micro-level. The path forward must include:

- Immediate infrastructure upgrades based on user experience and safety
- Stronger enforcement of pedestrian-friendly norms
- Inclusion of microscale design principles in planning policy
- A shift toward mixed-use zoning that supports shorter, safer, and more pleasant walking trips
- Acknowledging and acting on these specific walkability issues, Chandigarh can move closer to becoming a model for sustainable, inclusive, and human-scaled urban living

5.1 Recommendations

Planned cities must uphold the principle of equity in urban mobility to ensure a high quality of life. The initial step toward establishing effective planning and policy initiatives is prioritizing rigorous research and reliable data.(Rani et al., 2017; Singhal, 2018). This can be achieved by fostering robust collaborations with educational institutions and non-governmental organizations to facilitate access to human resources and technical expertise for research.(Table 5.1)

Table 5.1:Recommendations for the eight main problems of Walkability in Chandigarh.

S.no.	Recommendation	Rationale	Responsible Party
1	Obstructed Zebra Crossings	1. Ensuring seamless integration with sidewalks by incorporating ramps, lowering central aisles, relocating flowerbeds, and improving visibility with high-visibility paint and lighting. 2. Establishing standardized guidelines, pilot testing, and aligning policies like CTPO & CCRHF with pedestrian needs.	Urban Planners, Policy-makers, Municipal Authorities
2	Street Harassment by Strangers	1. Strict enforcement of laws through strengthening the criminal code (BNS) with heavy penalties. 2. Increased police patrolling and surveillance to protect pedestrians from mental and physical harm.	Law Enforcement, Policy-makers, Local Government
3	Poorly Maintained Sidewalks	1. Comprehensive sidewalk maintenance plans including vegetation trimming, weed/litter removal, repairing pathways, crosswalk markings, signage. 2. Recognizing sidewalks as essential transport amenities with clear tax mandates.	Municipal Authorities, Urban Planners
4	Single-zoned Land Use	1. Reducing block sizes, 2. Adding mid-block crossings, 3. Activating sector edges with mixed-use spaces, public seating, fountains, heritage displays, and greenery. 4. Establishing a Comprehensive Mobility Plan	Urban Planners, Policy-makers, Transport Departments

5	Fear of Crime on Streets at Night	1. Performing multiple audits to address safety concerns, removing encroachments, 2. Reinforcing law and order frameworks (BNS), and penalizing offenders to ensure safe pedestrian pathways.	Law Enforcement, Local Government, Municipal Authorities
6	Lack of Crossing Time at Signalled Junctions	1. Conducting traffic audits focused on pedestrian travel times, prioritizing pedestrians with stringent regulations. 2. Enforcing the Motor Vehicle Drivers Regulations Act (MVDRA) for improved driver behavior.	Traffic Police, Urban Planners, Policy-makers
7	Discontinuous and Obstructed Sidewalks	1. Relocating poles, signposts, trees, and transformers; 2. Aligning CTPO and CCRHF with central and city-level laws; 3. Using accessible slopes and non-slip materials; 4. Implementing first/last-mile solutions with incentives and penalties.	Urban Planners, Municipal Authorities, Policy-makers
8	Zebra Crossings Not Well Marked	1. Upgrading basic infrastructure with proper signage and markings, 2. Categorizing these under specific regulations, 3. Defining departmental duties, raising walkability awareness, and retrofitting transport networks for pedestrian priority.	Municipal Authorities, Transport Departments, Policy-makers

Obstructed Zebra Crossings

Ensuring seamless integration with sidewalks by incorporating ramps for easy access is vital to enhancing walkability at obstructed zebra crossings. Central aisles should be lowered, and flowerbeds should be placed away from crossings to maintain continuity. Railings must be strategically positioned to guide pedestrians without obstructing pathways. Visibility can be improved through the use of high-visibility paint and adequate lighting. Standardized guidelines for pedestrian infrastructure should be established, and community feedback should be gathered through pilot testing before implementing them on a full scale. In 2010, the National Transport Development Policy Committee (NTDPC)

recommended that all cities be legally obligated to provide pedestrian facilities and ensure maintenance within 10 years (NTDPC, 2014). The policy needs to be translated into a legally binding document. At the city level, the tree preservation order (CTPO) and the hedges and fences regulation (CCRHF) need to align with pedestrian requirements concerning the placement of the hedges, trees, and fences on the sidewalk(footpath).

Street harassment by strangers

Strict and prompt enforcement of rules targeting road nuisances and injuries (both mental and physical) by strengthening the criminal code framework (BNS) with heavy penalties or punishment would help protect pedestrians' interests and promote social equity in travel. Police patrolling and surveillance will help monitor street harassment.

Poorly maintained sidewalks

A comprehensive sidewalk maintenance plan enhances pedestrian connectivity and safety. This plan must prioritize the regular trimming of overgrown vegetation, the timely removal of weeds and litter, and the repair of broken or uneven pathways. Furthermore, installing visible crosswalk markings, designated pedestrian zones, and appropriate signage will improve pedestrian safety and overall satisfaction. Such measures will create a more inviting atmosphere for walkers and show a commitment to pedestrian-friendly urban design planning. In Chandigarh, a detailed area study with user feedback should precede policy formulation. City development norms label footpaths as an ‘essential amenity’ alongside others and recognize walking as transport. A clear mandate to provide sidewalks is needed to facilitate tax levies on MCA residents.

Single-zoned land use

To enhance walkability in Chandigarh, it is advisable to reduce block sizes by adding mid-block crossings and shortcuts to minimize walking distances. Activating the edges of sectors with vibrant pedestrian zones featuring shops, cafés, and public seating can create a more inviting walking environment. Developing attractive public spaces with fountains, heritage displays, and public art will enrich the walking experience. Promoting mixed-use development to

integrate services and amenities within residential areas is essential, thereby reducing long walking distances. Furthermore, pedestrian-friendly landscaping, which includes shaded walkways, greenery, and street furniture, can significantly improve both comfort and visual appeal for pedestrians. Studies advocate for implementing a Comprehensive Mobility Plan alongside establishing a land use and transport integration (LUTI) cell to address these concerns and promote sustainability (Soni et al., 2024). The master planning of Chandigarh requires reinforcement by establishing a comprehensive mobility plan. Extensive public participation and surveys in formulating this plan can lead to a detailed roadmap for the city's growth. Such requirements should be articulated as mandates within the Comprehensive Mobility Plan and Master Plan documents to address the needs of users and residents adequately. Implementing standard section overlays mandated by the Indian Road Congress for various roads may prove inadequate given the contextual nature of walkability. Moreover, it is essential to synchronize the master plan (CMP) with focus on city development policies (CPDRA), controls (ACZS), regulations (SHBC), and various orders to ensure coherent collaboration among the different stakeholder agencies involved in the design process.

Fear of crime on the streets at night

The fear of crime on the streets largely stems from inadequate pedestrian infrastructure. Planning and governance agencies should perform multiple audits to ensure that pedestrian concerns are addressed by providing ample infrastructure, free from encroachments by cars, vendors, and strangers who harass them while they walk. The legal framework for law and order (BNS) and local governance should be reinforced and strictly enforced to penalize offenders.

Lack of crossing time at Signalled Junctions

The pedestrians perceived that the duration allocated for crossing was insufficient. Without stringent regulations prioritizing "Pedestrians first," they were at risk of injury and harbored apprehensions regarding foot travel. Conducting regular traffic audits focused on pedestrians and walking as a mode of transport will be highly effective in analyzing travel times and addressing the needs of pedestrians at various intersections. This issue can be mitigated by

enhancing governance and ensuring improvements in drivers' behavior towards pedestrians. The rigorous enforcement of the Motor Vehicle Drivers Regulations Act (MVDRA) will be instrumental in addressing this concern.

Discontinuous and obstructed sidewalks

To enhance walkability, it is imperative to relocate poles, signposts, trees, and transformers that obstruct pedestrian pathways. It is essential to align the policy framework for tree preservation, hedges, and fences (CTPO and CCRHF) with the rules and regulations under the legal frameworks at the central and city levels (such as BNS, MVDRA, and MCA) to outline penalties for obstructing pathways and address these issues promptly. It is essential to utilize accessible slopes and non-slip materials to facilitate seamless travel, particularly for individuals with disabilities. Effective urban planning and ongoing maintenance are crucial for maintaining safe and clear pathways. The National Urban Transport Policy (NUTP) outlines comprehensive mobility plans focusing on buses, light rail, and connectivity; however, it lacks clear definitions for first-mile and last-mile targets. This policy calls for implementing strategies that may involve incentives and penalties. Additionally, Chandigarh should require designated sidewalks on all major roads, ensuring effective first and last-mile solutions with incentives for compliance and penalties for non-compliance, thereby supporting the goals of the NUTP policy.

Zebra Crossings not well marked

In the absence of walking being regarded as a transport option and pedestrians being acknowledged as road users, the basic infrastructure needs to be uplifted with proper signage and markings. The agencies responsible for overseeing the various roads in Chandigarh should manage zebra crossings and their markings. This can only be achieved by categorizing these needs under specific regulations and ensuring their prompt implementation.

In addition, Chandigarh needs to explicitly define the duties of all the departments and enforce it by law. Municipal budgets in smaller cities generally need more resources to execute long-term plans, such as open street initiatives and options for non-motorized transport (NMT). In these settings, the decision-making process is heavily influenced by local elected officials, typically elected based on

their promises regarding infrastructure projects, including building new roads, widening existing ones, and constructing flyovers. Prioritizing space for NMTs, which naturally involves reducing space for vehicles, is often seen as contentious and tends to be ignored by local politicians in many cities throughout India (Ponkshe, 2020). Chandigarh's transport and pedestrian authority must focus on identifying and promoting shortcut walking routes to enhance walkability throughout the city. Retrofitting the existing transport network to prioritize pedestrian paths will help create a more vibrant and accessible urban environment. There is a significant need to raise awareness among the planning and transport departments and the city residents about the importance of walkability in urban life. Currently, the sense of walkability in Chandigarh could be more robust. Many residents and local authorities still believe that cars and automobiles should dominate their daily routines, a mindset influenced by a Western model that is increasingly criticized due to its reliance on auto dependency.

5.2 Future scope of research

Research on walkability in Chandigarh reveals considerable gaps in policy, planning, and legal frameworks, highlighting the need for a comprehensive, multi-disciplinary approach to future studies. This research provides a replicable methodological framework for assessing and improving walkability that can be extended to other urban contexts, including peri-urban and neighborhood settings. By integrating policy analysis, spatial assessment, and user perceptions, the study offers a comprehensive approach to identifying micro-level challenges—such as discontinuous pedestrian pathways, inadequate crossing infrastructure, single-zoned land use, and safety concerns—and translating them into context-specific recommendations. Such an approach can inform the development of localized Comprehensive Mobility Plans (CMPs) and support the alignment of land-use and transport integration strategies across diverse urban morphologies. Extending this framework to peri-urban and neighborhood areas, which often lack structured planning mechanisms and suffer from inequitable distribution of pedestrian infrastructure, can facilitate inclusive, sustainable mobility solutions. Furthermore, the study’s emphasis on stakeholder participation, regulatory alignment, and context-sensitive interventions creates opportunities for cross-

learning between cities, enabling a more equitable reallocation of urban space in line with the principles of sustainable urban mobility and the National Urban Transport Policy (NUTP).

Architectural investigations can play a crucial role in evaluating how the design and regulations of buildings across sectors, aligned with land use policies, influence walkability. Examining the spatial organization and built environment will help identify physical barriers and facilitators for pedestrians and suggest modifications to enhance pedestrian friendliness.

Traffic research also presents substantial opportunities. Future studies should explore evolving traffic regulations, assessing their impact on pedestrian safety and accessibility while addressing gaps to meet future needs. Detailed analysis is necessary to understand the travel patterns, preferences, and aspirations of residents—identifying which routes are most frequented, what transportation modes they prefer, and how to facilitate seamless integration with public transit.

Social science perspectives should focus on vulnerable groups—women, children, older adults, and persons with disabilities—probing the social, cultural, and behavioral factors that influence their reliance on walking. This includes understanding why these groups prefer walking and tailoring interventions to support their mobility needs.

Legal research must also scrutinize why, despite multiple amendments to Indian transport laws, regulations pertaining to pedestrians remain inadequate. It is critical to analyse structural and implementation gaps that hinder legal frameworks from fully supporting pedestrian safety and rights.

Furthermore, researchers should prioritize household surveys across all sectors to capture the needs and perceptions of diverse populations, including older adults, young adults, pregnant women, and caregivers. A deeper analysis of institutional capacity-building weaknesses—regarding various agencies and their roles—is essential to cultivating a pedestrian-friendly ethos in Chandigarh.

Additional areas for exploration include community education initiatives, technological solutions for safety enhancement, and the impact of environmental factors on walking activity. Methodologically, future research should seek more economical, rapid, and authentic documentation techniques, especially tailored to the context of developing countries, to inform sustainable and effective interventions that promote walkability.

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List of Publications

The list of Conference Publications, Conference presentations, Patents, Copyright and Scopus Publications is presented as follows:

- **Publication 1**

Title – "Optimizing Rain Water Harvesting Using a Novel Pavement Material" AUTHORS: Dr. Atul Singla, Tara Singla, Dr. Vijay Mishra

International Conference on Materials for Emerging Technologies-2021(ICMET-21) Organized by Lovely Professional University, Jalandhar (Punjab), India Date: February 18th-19th, 2022

- **Publication 2**

Title – "Pavement Material Technologies for a Wiser Walk: An Update"

AUTHORS: Tara Singla, Dr. Atul Singla, Dr. Vijay Mishra

International Conference on Materials for Emerging Technologies-2021 (ICMET-21) Organized by

Lovely Professional University, Jalandhar (Punjab), India

Date: February 18th-19th, 2022

- **Publication 3**

Title – "Walkability: Bibliometric Analysis and Review"

AUTHORS: Tara Singla, Dr Tej Karki, Dr. Vijay Mishra

3rd International Conference on Functional Materials, Manufacturing and Performance (ICFMMP)

Lovely Professional University, Jalandhar (Punjab), India

Date: July 29th-30th, 2022

- **Conference 1**

"PAPER PRESENTATION 1: Optimizing Rain Water Harvesting Using a Novel Pavement Material"

AUTHOR: Dr Atul Singla, Tara Singla, Vijay Mishra

"PAPER PRESENTATION 2: Pavement Material Technologies for a Wiser Walk: An Update

International Conference on Materials for Emerging Technologies-2021 (ICMET-21) Organized by Lovely Professional University, Jalandhar

(Punjab), India
Date: February 18-19, 2022

- **Conference 2**

PAPER PRESENTATION 3: "Walkability: Bibliometric analysis and review"

AUTHORS: Tara Singla, Dr. Tej Karki, Dr. Vijay Mishra

International Conference on Functional Materials, Manufacturing and Performances (ICFMMP-2022). Organized by Lovely Professional University, Jalandhar (Punjab), India
Date: July 29-30, 2022

- **Patent**

Title – "A Novel Paver for rainwater harvesting and Method thereof"

- **Design Registration**

Title – "Building Block"

- **Design Registration**

Title – "Building Block"

- **Copyright of Thesis**

- **Scopus Indexed Publication**

Title – "Walkability in Planned Urban Environments: Evaluating Policy and Planning Gaps – A Case Study of Chandigarh "

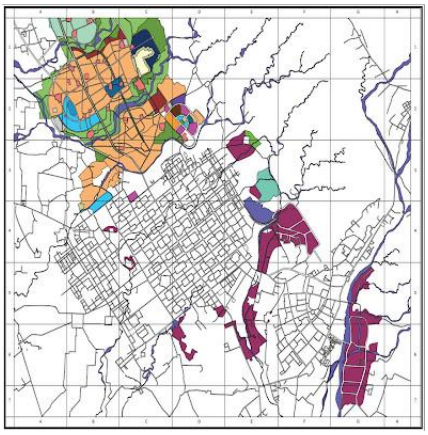
Journal name – Journal of Transport and Health (Q1)

The Journal of Transport & Health has an impact factor of 3.2. It is also ranked by Scopus with a Cite Score of 6.3. The journal focuses on research related to the interactions between transport and health and the policies that influence them, according to ScienceDirect.

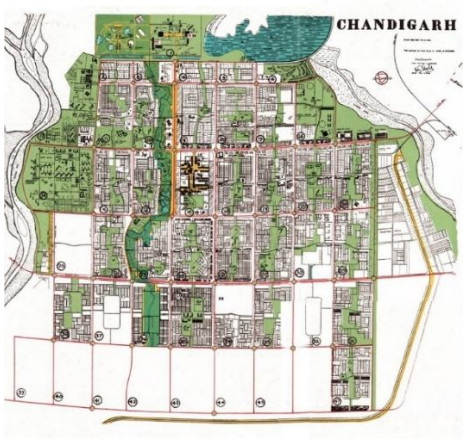
Impact Factor 3.6

ANNEXURES

- **Annexure 1**



(a)



(b)

a. This is a composite plan made by us using drawings from three different government agencies by CHANDIGARH URBAN LAB headed by AR. Vikramaditya Prakash son of Ar. Aditya Prakash who worked with Le Corbusier and retired as the Principal of Chandigarh College of Architecture. The basic grid-iron pattern along with the layout of roads is shown here.

b. The Original Planning of Chandigarh showing the distribution of greens and the planning of Leisure Valley along the Choe (as present on site) of Chandigarh

(Source: https://chandigarhurbanlab.blogspot.com/2010/07/unpublished-chandigarh-metropolitan.html)

- **Annexure 2**

Details of Experts

1. **From the Department of Urban Planning, Chandigarh (≥20 years of experience)**:

- *Ar. Renu Saigal* – Former Chief Architect of Chandigarh
- *Ar. Sumit Kaur* – Former Chief Architect of Chandigarh
- *Ar. Kapil Setia* – Chief Architect of Chandigarh during the COVID-19 pandemic

2. **From the private sector with over 30 years of experience**:

- *Ar. Bandana Singh* – Founder, Positive Axis
- *Ar. Surinder Bahga* – Principal Architect, Saakar Foundation

3. **From the fields of transportation and town planning**:

- *Dr. Navdip Asija* – Traffic Advisor, Government of Punjab
- *Prof. Jit Kumar Gupta* – Senior academic and author of nearly 300 publications on Chandigarh and urbanism

4. **From the field of architectural heritage**:

- *Ar. Deepika Gandhi* – Director, Le Corbusier Centre, Chandigarh, and alumna of Chandigarh College of Architecture

- # Annexure 3

Questionnaire for walkers

Walkability factors of Chandigarh *(for academic purpose)*

Ph.D. Research (PLANNNING) (Time of Survey: Peak working Hours Morning and Evening Mon-Fri)

1.	**I'm a researcher who's looking for people who walk to work. Are you going to work on foot?** If yes continue, If no, politely excuse myself from the situation if the purpose is not walking to Office/Work Place aapake vartamaan chalane ka uddeshy kya hai?					
2.	**Do you feel comfortable walking in Chandigarh City?**					
3.	**What is the biggest difficulty you face while walking in Chandigarh? (Long Answer – User Response)**					
4.	**How often do you walk on this route?** aap is maarg par kitanee baar chalate hain?					
	Once a month (mahinee mai ek baar)		2 - 3 Times in a week (hafte mai 2-3 baar)			
	Once in 15 days (pandhra din mai ek baar)		Daily (rozana)			
	Once in a week (hafte mai ek baar)					
5.	**How much time do you walk for? (at one time)** aap kitana samay chalate hain?					
	Less than 5 minutes (5 mint se kum)		10-15 minutes (1-15 mint)			
	5-10 minutes (5-10 mint)		20 minutes – above (20 mint ya zada)			
6.	**Do you take any alternative route, to walk for work?** (Self-plotting on map or sketch drawing) kya aap koee vaikalpik maarg apanaate hain, yadi haan, to kaun sa aur kyon? (maanachitr ya rekhaachitr par selph ploting)					
7.	**Does weather affect your decision to choose route? Give reasons for your answer.** kya mausam maarg chunane ke aapake nirnay ko prabhaavit karata hai? kyon?					
8.	**Do you find bus stops located at convenient locations on your route?** kya aap apane maarg par suvidhaajanak sthaanon par sthit bas steshan paate hain?					
	Yes (Haan)		No (Na)			
9.	**Do you find other modes of transport easily on this route? (Such as Auto, Taxis, Rickshaw etc.)** kya aapako is maarg par parivahan ke any saadhan aasaanee se mil jaate hain? (jaise oto, taiksee, riksha aadi)					
PARAMETERS						
10.	**How much are you affected by the following factors during your walk.** aap apane chalane ke dauraan nimnalikhit kaarakon se kitana prabhaavit hote hain.					
	PARAMETERS	1 Least Affected	2 Little Affected	3 Neutral	4 More Affected	5 Most Affected
a.	**Availability of sidewalks for pedestrians only (no bicycles)** (keval paidal chalane vaalon ke lie alag phutapaath kee upalabdhi)					
b.	**Presence of sidewalks on both sides** (donon taraph paidal maarg kee upalabdhi)					
c.	**Continuous pathway (doesn't suddenly stop)** (satat maarg (achaanak rukata nahin)					

d.	**Good Condition of pathway (Not Broken)** (Maarg kee achchhee sthiti)					
e.	**Cleanliness of pathway** (Raaste kee saphaee)					
f.	**Wide enough for at least two adults** (kam se kam do vayaskon ke lie paryaapt Chuodai)					
g.	**Presence of obstructions** (List what kind) (baadhaon kee upasthiti)					
h.	**Uneven surface of pathway** (path kee asamaan satah)					
i.	**Presence of Bench or other Resting spaces** (Bench ya koi vishraam sthalon kee upasthiti)					
j.	**Presence of encroachments blocking the way (Vehicles parked)** Raasta ke badhaak kee upasthiti (paark kie gae vahaan)					
k.	**Easy to push strollers, wheelchairs, without difficulty** (bina kisee kathinaee ke stroller, vheelacheyar, ko dhakka dena aasaan hai)					
l.	**Presence of nice things along the way (heritage, beautiful landscape, fountain)** (raaste mein dekhne ke lie dilachasp cheejon kee upasthiti)					
m.	**Presence of Public art** (saarvajanik kala kee upasthiti)					
n.	**Presence of Dustbins at convenient distance** (suvidhaajanak dooree par koodedaanon kee upasthiti)					
o.	**Buffer between the street and sidewalks** (Sadak aur phutapaathon ke beech baphar)					
p.	**Adequately Shaded** (Paryaapt roop se chhaaya)					
q.	**Presence of Amenities** (Toilets) suvidhaon kee upasthiti (shauchaalay)					
r.	**Zebra crossings are well marked** paidal yaatree ki krosing achchhee tarah se chihnit hain					
s.	**There are enough pedestrian crossings** paryaapt paidal yaatree ki krosing hain					

t.	**Pedestrian signals allowing enough time (to cross the street)** (paidal chalane vaalon ke sanket paryaapt samay (sadak paar karane ke lie) kee anumati dete hain)					
u.	**Cars obey traffic rules and the set speed limit.** (kaaren yaataayaat niyamon aur nirdhaarit gati seema ka paalan karatee hain)					
v.	**Bike lanes and paths are separated from pathways** (bike len aur path paidal chalane vaalon se alag hain)					
w.	**Walking routes are well lit at night** paidal maarg raat mein achchhee tarah se prakaashit hote hain					
x.	**Fear of Crime on streets at day** din mein sadakon par apraadh ka dar					
y.	**Fear of Crime on streets at night** raat mein sadakon par apraadh ka dar					
z.	**Presence of stray dogs** aavaara kutton kee maujoodagee					
aa.	**Presence of beggars** Bhikhaariyon kee maujoodagee					
ab.	**Presence of Street vendors** Street vendors ki mojoodagee					
ac.	**Connectivity to major streets** pramukh sadakon se kanektivitee					

ADDITIONAL PARAMETERS					
11.	**Do you have any other major issues that affect your walk?** kya aapake paas koee any samasya hai jo aapake chalane ko prabhaavit karatee hai?				
12.	**Is Chandigarh a walkable city? Rate the walkability of Chandigarh** .(LIKERT SCALE) kya Chandigarh ek chalane yogy shahar hai? chandeegadh kee chalane yogyata ka moolyaankan karen.				
13.	**Give reasons for choice.**				
14.	**Any suggestion you want to give to improve walkability?** chalane yogyata mein sudhaar ke lie aap koee sujhaav dena chaahate hain?				
DEMOGRAPHIC PROFILE					
15.	Name (Naam)				
16.	Email (Optional)				
17.	Gender (Ling)	Male (Pursh)		Female (Istri)	
18.	Age Group (umer)	18 years - 25 years		55 years - 70 years	
		25 years - 40 years		70 years – above	
		40years - 55 years			
19.	Profession (Pesha)	STUDENT		ARCHITECT	
		HOME - MAKER		BUSINESS OWNER	
		CIVIL SERVANT/ Government employee		SLUM DWELLER	
		DOCTOR		VENDOR	
		ENGINEER		OTHERS	