



ADDIS ABABA UNIVERSITY
ETHIOPIAN INSTITUTE OF ARCHITECTURE, BUILDING CONSTRUCTION, AND
CITY DEVELOPMENT

**Assessment of Walkability on Selected Streets and
Neighborhoods of Hawassa City**

BY: MESAY MATUSALA

Advisor: Nebyou Yonas (Ph.D.)

January 2024

Addis Ababa



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A Thesis Submitted to The Ethiopia Institute of Architecture, Building Construction and City Development (EiABC) in Partial Fulfillment of The Requirements for The Degree of Masters in Urban Design and Development.

January 2024

Addis Ababa

D e c l a r a t i o n

I confirm that I conducted the research for my Master of Science program in Urban Design and Development on the topic of “Walkability Assessment on Selected Streets and Neighborhoods of Hawassa City” under the advice and guidance of *Nebyou Yonas (Ph.D.)*, Assistant Professor at EIABC, Addis Ababa University, during the academic year 2022-2023. I assure you that I have not submitted this work to any other institution or university to obtain any degree

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The thesis can be submitted for examination with my approval as an institute’s advisor

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Approval

This thesis has been submitted to The Ethiopia Institute of Architecture, Building Construction and City Development (EiABC in Partial Fulfillment of The Requirements for The Degree of Masters in Urban Design and Development.

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ABSTRACT

This study aims to evaluate the walkability in selected streets and neighborhoods in Hawassa City by identifying the built environment features that affect walkability in inner-city, intermediate, and suburban areas. Additionally, it aims to create a local walkability index for Hawassa. To achieve this, the research has identified the indicators, parameters, and indexes associated with walkability. To determine the walkability status of Hawassa City's inner-city, intermediate, and suburbs, various qualitative and quantitative methods were employed. The study assessed the walkability factors related to the built environment features and examined indicators that impact walkability on Hawassa City streets, then measured the local walkability index. The results indicate that the suburbs are not walkable and mostly lack pedestrian-friendly features, with an average 36.54 local walkability index. The Inner City, also known as Arab Sefer, has an average of 71.69, indicating moderate walkability. The intermediate area has an average of 74.77, indicating that it is mostly walkable. Overall, Hawassa City has an LWI ranging from 58.76 to 64.44, with an average of 62.6, which means it is moderately walkable.

The study evaluated the quality of footpaths, street patterns, street lighting, visibility, safe pedestrian crossings, even slope or gradient along the route, continuity of routes, a well-connected street network, easy access to facilities and services, proximity to destinations such as schools, shops, other local services, and public transport, and developed a local walkability index by measuring perception using a Likert scale, rating weights assigned to the indicators based on their relevance and importance. The study findings from the walkability assessment revealed several factors that affect the walkability of streets and neighborhoods in Hawassa City. These were categorized into five safety-related factors: orientation, comfort, diversity, and local destinations. In conclusion, the study highlights the need for safe, comfortable, secure, diverse, and accessible streets that prioritize pedestrian-friendly urban design

Key Words: *Walkability Concept, Walkability, Walkability Assessment, Walkability Indicators, Local Walkability Index.*

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List of Acronyms

E.C - Ethiopian Calendar

G.C - Gregorian Calendar

EPA - Environmental Planning Authorities

GIS - Global Information System

GWI - Global Walkability Index

LWI - Local Walkability Index

TfL - Transport for London

UN - United Nations

PEI - Pedestrian Environment Index

WIOP - Walkability Index for Older People

1. CHAPTER ONE: INTRODUCTION

1.1. Background of the study

Walkability refers to the extent to which an urban environment is designed to encourage walking and other forms of physical activity. A walkable city has been built to promote active transportation, such as walking or cycling. Walkability assessments evaluate how walkable a city or neighborhood is based on factors like the availability of sidewalks, crosswalks, and the quality of pedestrian infrastructure. There are numerous benefits associated with walkability. For instance, walkable cities tend to be more environmentally sustainable and socially inclusive than cities that rely heavily on cars. They provide greater access to public spaces and amenities for people of all ages and abilities (Abdulla, 2021).

Walkability is a crucial aspect of urban design. Cities need to boost social and economic prospects for pedestrians while enhancing their physical and mental health. Walkability plays a vital role in urban growth and city function, making it a crucial aspect of creating sustainable and livable cities (Arefi, 2021). Walkable city centers attract both domestic and foreign tourists, making them a significant part of contemporary urbanism. By improving the physical and psychological health of pedestrians, creating additional opportunities for social interaction, and promoting economic development, walkability is essential for developing sustainable and livable cities. Cities with walkable downtowns are more likely to attract domestic and international tourists (Choi, 2012).

Walkability assessments are used to evaluate the extent to which a city or neighborhood is conducive to walking and other forms of physical activity. Factors such as the availability of sidewalks, crosswalks, and the quality of pedestrian infrastructure are typically considered in these assessments (EPA, 2021). Walkable cities tend to be more environmentally sustainable and socially inclusive than those that rely heavily on automobile transportation. They also promote physical activity and reduce the risk of chronic diseases such as obesity, diabetes, and heart disease. Walkable city hubs attract both domestic and foreign tourists, making them a significant part of contemporary urbanism. Improving the physical and psychological health of pedestrians while creating additional opportunities for social interaction and economic development is essential for developing sustainable and livable cities. Cities with walkable downtowns are more likely to draw both domestic and international tourists (Li, 2014).

1.2. Statement of the problem

Walkability refers to the measure of how friendly an area is for pedestrians, encouraging and enabling walking as a means of transportation within a community (Ak, 2018). Understanding and improving walkability has gained importance for urban designers, planners, and policymakers as it promotes public health, reduces traffic congestion, and enhances the overall livability of the city. Walkability is determined by several factors like infrastructure design, pedestrian safety, proximity to amenities, quality of public spaces, land use patterns, and provisions for people with disabilities.

In Hawassa City, walking is a significant mode of transportation. However, some streets and neighborhoods in the city do not support walkability due to inadequate sidewalks, unsafe roads, and missing amenities. These conditions discourage the residents from walking, resulting in limited opportunities for physical activity, negatively impacting public health, social cohesion, and environmental sustainability. To understand the current walkability conditions in Hawassa City and develop strategies to improve them, it is crucial to identify these factors and measure the local walkability index of Hawassa City. Therefore, this study aims to assess the walkability of selected streets and neighborhoods in Hawassa City. The research will identify built environment features that affect walkability and develop a local walkability index for the inner-city, intermediate, and suburbs. The results will provide valuable insights for urban designers, planners, and decision-makers.

1.3. Objectives of the study

1.3.1. General Objective

This study aims to assess the walkability of streets and neighborhoods in Hawassa City.

1.3.2. Specific Objectives

This thesis has specific objectives which are aimed at achieving an overall goal. These objectives include:

- To assess the built environment features that affect walkability in Hawassa City.
- To measure the local walkability index for the inner city, intermediate area, and suburbs of Hawassa City.
- To develop a strategy for the improvement of walkability in the inner-city, intermediate, and suburbs of the city.

1.4. Research Question

The research questions of this study are:

1. What are the key features and factors that affect walkability in Hawassa City in the inner, intermediate, and suburban areas?
2. What is the existing level of walkability in the inner city, intermediate, and expansion suburbs streets and neighborhoods of Hawassa city?
3. What strategies can be suggested to enhance walkability?

1.5. Scope of the Study

1.5.1. Thematic Scope

This study aims to investigate the factors that contribute to walkability in urban areas. It analyzes the characteristics of the built environment feature in selected streets and neighborhoods to determine the key attributes that affect walkability in those areas. The study also evaluates the overall level of walkability in the city of Hawassa and identifies important parameters and indicators of walkability that can be used to measure a local walkability index.

1.5.2. Spatial Scope

This research investigated the eight sub-cities in the city, focusing on the municipal boundary and three specific areas categorized by the age of their settlement. These areas include the inner city, settled between 1952 and 1991 G.C., with a particular emphasis on the "Areb sefer" district; the intermediate period, settled between 1991 and 2010 G.C., with a specific focus on the "Sefere selam/Kero" district; and the suburban settlements, which are informal areas settled since 2010 until today, specifically the "Dato" area.

1.5.3. Temporal Scope

The study took place from February to December 2023, beginning with proposal preparation and ending with the completion of the work.

1.6. Significance of the Study

Assessing the walkability of streets and neighborhoods in Hawassa City holds significant importance for multiple reasons. Firstly, it will offer valuable insights into how the built environment of different areas affects the pedestrian experience. The study on walkability assessment of selected streets and neighborhoods in Hawassa City highlights various factors that contribute to creating a pedestrian-friendly environment. Safety, orientation, comfort, diversity,

and accessibility to local destinations are some of the essential factors that determine the walkability of an area. Developing a local walkability index for Hawassa can serve as an effective tool to evaluate the pedestrian experience in different parts of the city and identify areas that require improvement. Improving walkability can promote sustainable urban development and foster healthier, more livable communities. This research can guide urban designers, policymakers, and city planners to create pedestrian-friendly streets and neighborhoods for all residents and visitors of Hawassa. Ultimately, the research aims to offer evidence-based recommendations for professionals such as architects, urban designers, planners, researchers, and policymakers to enhance walkability in Hawassa City by addressing the shortcomings in the built environment and improving the identified factors. This research will contribute to the broader goal of creating a more walkable, sustainable, and livable urban environment in Hawassa City, benefiting both residents and visitors alike

1.7. Limitation of the Study

The study gathered primary and secondary data from various sources, including governmental organizations, specialists, officials, and pedestrians, using field observations and surveys. The research focused on identifying the key factors that affect walkability and evaluating the local walkability index. This was due to the lack of local research on walkability, time constraints to study the entire city of Hawassa, and resource limitations.

1.8. Organization of the Document

The research is divided into five chapters. Chapter One provides an introduction to the study, which includes background information about the research topic, the problem statement, research objectives, research questions, limitations of the research, and the organization of the research. Chapter Two reviews relevant literature on the concept of walkability, defines related terms, identifies factors and indicators of walkability, urban design quality related to walkability, and the walkability index. Chapter Three outlines the research design and methodology for analyzing the data collected from the questionnaire, including the methods for analyzing the research. Chapter Four covers the findings and discussion of the research, including questionnaire responses and document investigation of the analysis of the data. Finally, Chapter Five presents the conclusion and a recommendation of the study.

2. CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This chapter has the objective of defining the term "walkability" and examining its origins. It also covers the assessment of walkability, indicators, and measures of walkability, built environmental features that influence walkability, urban design qualities related to walkability, and the relationship between urban design and walkability. The aim of all this is to provide information for the design of the studies within this thesis. To conduct this review, the review carried out an academic journal search of peer-reviewed publications up to the end of 2023 using keywords like "walkability," "walkability index," and "walkable."

2.2. The Concept of walkability

Walkability is a widely used term in the fields of urban planning, geography, and public health. However, there has been limited work on developing a clear definition for it. The term was introduced in academic literature in the late 1990s when researchers began investigating the relationship between neighborhood design, physical activity, and obesity (Tobin et al., 2022). In the 1960s, Jane Jacobs came up with the term "walkability," which transformed the field of urban planning. Walkability refers to the ease with which people can move around a city or neighborhood on foot (Zuniga et al., 2019).

Table 2.1 The Concept of Walkability in Various Fields of Study Source: (Forsyth, 2015)

<i>In transport planning</i>	<i>walkability is an important consideration in designing the transportation system of an area. It involves creating streets, sidewalks, and other infrastructure that are safe and convenient for pedestrians (Farnian, 2014).</i>
<i>In civil engineering,</i>	<i>walkability involves designing and constructing sidewalks, crosswalks, and other pedestrian facilities that are well-maintained and accessible to a wide range of users, including people with disabilities.</i>
<i>In urban planning</i>	<i>walkability is a key component in creating livable communities that are attractive to residents and visitors. It involves considering the physical layout of the area, its connectivity to other neighborhoods and destinations, and its mix of land uses.</i>
<i>In urban design</i>	<i>walkability is a fundamental principle for creating pleasant and functional public spaces. It involves creating streetscapes that are visually appealing and interesting, providing street furniture, planting trees, and other design elements that encourage people to walk and spend time in public spaces</i>

Table 2. 2 Definitions and Defined Indicators of Walkability

First author (year)	Research field	Description of main findings (actual definitions are highlighted in bold)
<i>Burden & Florida Department of Transport (1995)</i>	Transport	A walkable area provides: continuously linked walkways, pedestrianized intersections, special accommodations for people with disabilities, signal placement, illumination, simplified median crossings, safe access to schools, eliminated backing out of parking spaces, commercial development access to have options other than vehicles, auto restricted zones, combine walking and transit, walkable scale land use planning (traditional neighborhood design, planned mixed unit development, transit orientated design)
<i>City Of Portland (1998b)</i>	Transport	Variables: Land use mix, destinations, connectivity, scale, topography. Pedestrian potential factors: transportation element, policy element, school proximity factor, other destinations factor, environmental variables factor (mixed uses and density, proximity to destinations, interception density/connectivity, parcel size scale, slope). Deficiency Index: missing sidewalks, pedestrian-vehicle crashes, traffic speed, traffic volumes, roadway width, block length)
<i>Mayor Of London (2004)</i>	Transport	A walking-friendly city is a city where people select walking as their preferred choice of travel for health and to relax and one which exhibits a high degree of 'walkability'. Walkability may in turn be defined as the extent to which walking is readily available to the consumer as a safe, connected, accessible, and pleasant activity. A walkable city is: Connected, Convivial, Conspicuous, Comfortable and Convenient
<i>Southworth (2005)</i>	Planning	Fine-grained land uses, quality of the path, connectivity, linkage to other modes, path context, and safety
<i>Ewing (2006)</i>	Mixed (Urban Design)	Human scale, transparency, tidiness, enclosure, and imageability

<i>Southworth (1997)</i>	Planning	Grain and pattern of development (including density), land use patterns, public open space, street design and circulation systems, public transport access, pedestrian access, and catchments implied as good for pedestrian activity. Noted character, suitability for children, teens, and elderly, and market success.
<i>Henson (2000)</i>	Transport	Level of service, comfort, convenience, safety, security and economy
<i>Congress Of the New Urbanism (2001)</i>	Planning	Walkability alongside: connectivity, mixed-use and diversity, mixed housing, quality architecture and urban design, traditional structure, increased density, green transportation, sustainability, and quality of life.
<i>Moudon (2003)</i>	Urban Design	Elements from the following groupings: Spatio physical (roadway characteristics, environment along roadway, network, area), Spatio behavioral (non-motorized traffic, vehicular traffic, safety), Spatio psychosocial (perception) and area policy that affects walking
<i>Urban Design Compendium (2007)</i>	Urban Design	Connected, Convivial, Conspicuous, Comfortable and Convenient
<i>Mehta (2008)</i>	Urban Design	Hierarchy of walking needs on the neighborhood main street: feasibility, accessibility, usefulness, safety, comfort, sensory pleasure, sense of belonging
<i>Gehl Architects (Van Deurs, 2009)</i>	Urban Design and Architecture	Place: park of public space network, part of public space hierarchy, sense of place. Protection: Protection against traffic & and accidents – feeling safe, protection against crime & and violence – feeling secure, protection against unpleasant sensory experiences. Comfort: opportunities for walking, opportunities to stand/stay, opportunities to sit, opportunities to see, opportunities to talk and listen, opportunities for play and exercise. Delight: Human scale, opportunities to enjoy the positive aspects of climate, positive sensory experience

Source: (Fitzsimons, 2013)

Several factors, such as the quality and availability of pedestrian paths, sidewalks, and other rights-of-way, traffic and road conditions, land use patterns, building accessibility, and safety, can influence walkability (Singh, 2016). Depending on the means, outcomes, and proxies used,

walkability can be defined in different ways. Some scholars see walkable cities as places that encourage people to walk or ride bikes instead of using cars or public transportation (Erturan, 2023). Others define it in terms of land use density, street connectivity, diversity, and sidewalk access (Tobin et al., 2022). Walkability can also be affected by physical attributes like the width of the street sidewalk, building height, number of pedestrians, range canopy, weather, and traffic volumes (Spoon, 2005). Walkable environments are typically attractive, pleasant, clean, sociable, and lively (Joachim, 2023). The walkability of a city is a measure of how friendly, safe, and attractive a city is to walk within it.

Key Themes or Dimensions of Walkability

Table 2.3 Definitions related to community environment and as a proxy for better design

<p><i>The first group of definitions includes themes or dimensions related to the community environment and the means for creating walkability</i></p>	<ul style="list-style-type: none"> • <i>Traversable environments are places where people can move from one place to another without significant obstacles. These environments have basic physical conditions, such as smooth paths.</i> • <i>Compact places offer short distances to destinations, especially for those who walk for practical reasons.</i> • <i>Safe environments for walking are determined by several factors, including the perception and actual levels of crime and traffic safety. Both of these dimensions are related to the potential harm to individuals.</i> • <i>Physically enticing environments include full pedestrian facilities such as sidewalks or paths, marked pedestrian crossings, appropriate lighting and street furniture, useful signage, and street trees. Additionally, these environments may also feature interesting attractions.</i>
<p><i>The second set of definitions relates to perceived outcomes of walking.</i></p>	<ul style="list-style-type: none"> • <i>A walkable environment is often desirable because it is vibrant and social, with a pleasant, clean atmosphere and interesting people. This concept is usually applied to shopping areas and mixed-use neighborhoods.</i> • <i>Walkability is considered a means of achieving the environmental preservation and social equity components of sustainable urban form, providing sustainable transportation options. This not only saves energy, but also creates opportunities for people who cannot use cars due to age, income, or disability.</i> • <i>Many people seek an environment that encourages physical activity, with features that promote higher-than-average levels of walking for transportation or exercise.</i>

Finally, walkability is often used as a kind of proxy for better design

- For some people, walkability is not just about being able to walk, but it encompasses various dimensions that can be measured. This definition of walkability gives rise to indicators that can be used to assess the walkability of a place, similar to how livability or development is assessed using indicators.
- Lastly, walkability is a comprehensive concept that refers to environments that are simply better. It is not just about walking, but it represents a solution that can improve urban areas in many ways, such as making them slower-paced, more human-scaled, healthier, and happier. Walkability integrates many other definitions into a single package that aims to create a generally good place to be.

Source: (Forsyth, 2015)

2.3. Origin of The Term Walkability

The term "walkability" is commonly used by street designers and advocates of walking for health and recreation, but its origins and meaning are not entirely clear. Urban designers and spatial planners were the first to use the term in academic papers, but they did not give a clear definition. Instead, they identified elements of the built environment and factors that contributed to walkability (Fitzsimons, 2013). New Urbanist principles also frequently use the terms "walkable" and "walkability" concerning positive associations with walkable neighborhoods, but they also do not provide a clear definition. New Urbanism or neo-traditional design of neighboring units provides a set of principles for planning that prioritize walking ability, livable neighborhoods, and creating a friendly atmosphere for pedestrians. While the goal is not necessarily to remove automobiles from daily life, it aims to create a sense of security, comfort, satisfaction, and convenience for pedestrians despite cars moving through the city (Rahnama, 2012). New Urbanist ideals, and the term walkability, were also spreading out of spatial planning and urban design into other disciplines.

The concept of walkability originated in the field of urban planning and design. It emerged as a response to the negative consequences of urban sprawl and car-dependent development patterns that became prevalent during the mid-20th century. In the earlier part of the 20th century, cities were designed with a focus on accommodating cars and providing ample space for automobile traffic. As a result, neighborhoods became disconnected, streets were widened, and walking became less safe and convenient. This approach prioritized vehicular mobility and undermined the walkability of cities (AREA, 2017). However, in the 1960s and 1970s, a growing awareness of the

negative impacts of car-oriented development, such as increased traffic congestion, air pollution, physical inactivity, and social isolation, led to a reconsideration of urban planning principles. Researchers, activists, and professionals in the fields of urban planning, public health, and transportation began to advocate for more pedestrian-friendly urban environments (Annunziata, 2020).

One of the early influential figures in promoting the concept of walkability was Jane Jacobs, an urban activist and author. Her book, "The Death and Life of Great American Cities," published in 1961, critiqued urban renewal policies that prioritized automobile traffic and emphasized the importance of vibrant, walkable neighborhoods. She highlighted the importance of mixed land uses, short blocks, diverse buildings, and pedestrian-oriented streetscapes for creating livable and walkable cities (Tsutsui, 2020). Since then, numerous studies and research have been conducted to understand the benefits of walkability and its relationship to various aspects of urban life, including public health, social interactions, environmental sustainability, and economic vitality. Walkability has become an important component of urban planning and design, with many cities and organizations now prioritizing policies and interventions that promote walking and create more walkable communities (Ewing, 2013).

The concept of walkability continues to evolve and adapt to changing urban contexts, technological advancements, and the increasing demand for sustainable transportation options. It continues to be recognized as an essential aspect of creating healthy, equitable, and enjoyable urban environments. Nowadays, walkability is becoming more popular because of its many benefits, including economic, environmental, and health advantages (Fonseca, 2022). It is a crucial aspect of sustainable urban design (Mouzas, 2022). However, defining walkability can be challenging since several factors affect it, such as the existence of pedestrian paths, sidewalks, and other rights-of-way, traffic and road conditions, land use patterns, building accessibility, and safety (McMahon, 2002). Although design factors are crucial, non-design determinants such as housing density, land use, and street patterns also significantly impact walkability (Arefi, 2021).

2.4. Walkability Assessment

A walkability assessment is a systematic evaluation of how easy and safe it is to walk in a particular area, such as a city, neighborhood, or even a single street (Tulin, 2018). The assessment involves analyzing various factors and characteristics that impact walking in that area. There are different

ways to assess walkability, but generally, it should consider the quality of walking for different groups of people, including standard pedestrians, vulnerable groups (like disabled people, seniors, parents with strollers, and school children), and people moving around the city with vehicles (like cyclists, car drivers and passengers, and public transport and service users). Additionally, the assessment should consider the quality of public spaces, such as the quality of routes, accessibility, and related facilities. When evaluating the walkability of a street, it's essential to consider features such as qualified sidewalks and adequate crosswalks. Finally, at the community level, the assessment should consider local destinations, continuity, and quality of connections (Ghadimkhani, 2011).

1. ***Sidewalks and Pedestrian Infrastructure***: Assessing the presence, condition, and connectivity of sidewalks, crosswalks, curb ramps, and other pedestrian infrastructure (Tobin et. al, 2022)
2. ***Street Design and Traffic Calming***: Evaluating the design of streets, including the width, speed limits, and presence of traffic calming measures like speed bumps or traffic islands, to ensure pedestrian safety (Arefi, 2021).
3. ***Land Use and Density***: Examining the mix of land uses, density of residential, commercial, and recreational areas, and proximity to essential amenities like grocery stores, schools, parks, and public transit options (Frank, 1994).
4. ***Safety and Security***: Considering the presence of street lighting, visibility, and any safety concerns, such as crime or high traffic volumes, that may reduce perceived or actual safety for pedestrians (Arefi, 2021).
5. ***Accessibility***: Assessing the level of accessibility for people with disabilities, including the availability of ramps, elevators, and other accommodations (Annunziata, 2020).
6. ***Streetscape and Aesthetics***: Considering the quality of the urban environment, including the presence of trees, landscaping, public art, and seating that may contribute to a pleasant walking experience (DONG, 2019)
7. ***Community Engagement***: Involving the local community in the assessment process to gather input, insights, and suggestions for improving walkability and addressing community-specific needs (Ahmadi, 2021).

2.5. Indicators of Walkability

Walkability indicators are measurements or factors used to assess the walkability of a neighborhood, city, or area. Here are some common walkability indicators (Zhang, 2020): Compiled from various literature. There is no agreement on a single tool for measuring and quantifying walkability. The walkability indicators are broad, Park(2008) defines, measures, and evaluates fifty-two (52) path walkability indicators (Moayedi et al., 2013). These indicators help measure and understand the current state of walkability in an area, identify areas for improvement, and guide urban design and planning efforts to enhance walkability (Edensor, 2016).

2.6. Walkability measures

Walkable public spaces have six major attributes: safety, orientation, attractiveness, comfort, diversity, and local destinations (Lambert, 2005).

2.6.1. Safety

Ensuring safety in public spaces is crucial, particularly in walkable areas (Southworth, 2005). This can be achieved through various physical design methods and other factors that promote safety, as pointed out by Lambert (2005). To ensure safety, urban areas must be both physically and perceptually secure. However, the issue of safety is complex and multi-faceted. People, whether they are pedestrians or drivers, perceive safety differently. Hence, safety is evaluated based on both actual and perceptual aspects of streets and sidewalks, as highlighted by Harun and Nashar (2020).

2.6.1.1. Actual safety

Achieving safety in urban spaces involves ensuring physical safety through various measures (Lekareva & Zaslavskaya, 2018). The safety of streets and sidewalks can be enhanced using different methods (Litman, 2011). It's important to acknowledge that streets are three-dimensional spaces that include not only vehicular roads but also sidewalks, buildings, and street furniture (AK, 2018). Actual safety in streets is influenced by several factors, including street pattern, lighting, traffic calming measures, continuous pavement, pedestrian enclosure, separation, floor quality, street crossings, and vehicle mix (Neylmaz, 2020). In the following sections, we will discuss each of these elements in detail.

1. Street Pattern

According to Southworth and Owens (1995, cited in Asli, 2018), there are five types of street patterns, such as grid-iron, fragmented parallel, warped parallel, loops and lollipops, and lollipops on a stick. The evaluation of street patterns depends on the configuration of streets and the shape of intersections (Louf, 2014). The grid or modified grid (Neo-Traditional Street Types) is considered a more walkable street pattern as it has shorter trips, a higher amount of paved surface, and ensures easy pedestrian accessibility to parallel streets (Rifaat, 2014). However, some people argue that the grid-iron pattern is less safe than the curvilinear pattern because of its intersections (Ibid). These people suggest that cul-de-sacs are more preferable in residential areas. But, complex street patterns such as dead-end cul-de-sacs and curvilinear streets, combined with low-density development patterns, make it necessary for urbanites to use cars to reach their destinations. This is not conducive to walkability and pedestrian safety. New Urbanism and Smart Growth approaches believe that grid or modified grid street patterns increase walkability and livability (AK, 2018). However, The Institute of Transportation Engineers' Traditional Neighborhood Development does not have a clear opinion on the best street pattern. They believe that factors such as street width may affect the safety level of pedestrians (Lambert, 2005).

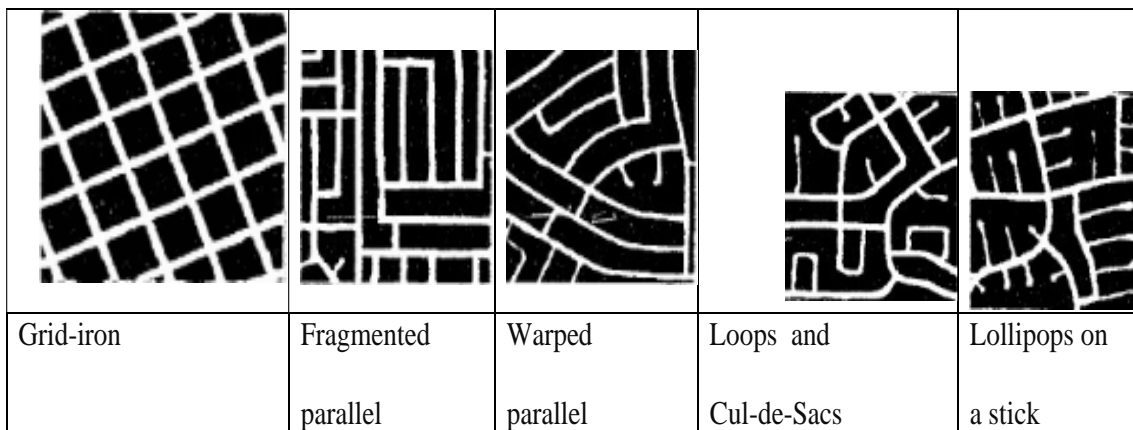


Figure 2 1 Five types of street patterns are classified by Southworth and Own (1995)

2. Traffic Calming

Traffic calming is a crucial factor in promoting safety on streets. Studies have shown that high speeds are often the cause of severe accidents, which is why traffic calming measures are essential to ensure pedestrian safety (Ghadimkhani, 2011). In addition, the width of the street, availability of on-street parking, and design details also play a significant role in slowing down traffic (Litman, 1999). The physical width of the street or how it is perceived can influence drivers' behavior (Kubota, 2013). Factors such as parking, sidewalks, and street trees all impact how wide a street

is perceived to be. Wider streets tend to encourage drivers to speed up, which can reduce walkability and overall street safety. Conversely, narrow streets, whether physical or perceived, make drivers feel less secure and, as a result, discourage them from accelerating their car's speed (Markvica, 2019). Moreover, street parking acts as a buffer between pedestrians and cars, contributing significantly to pedestrian safety (Ghadimkhani, 2011).

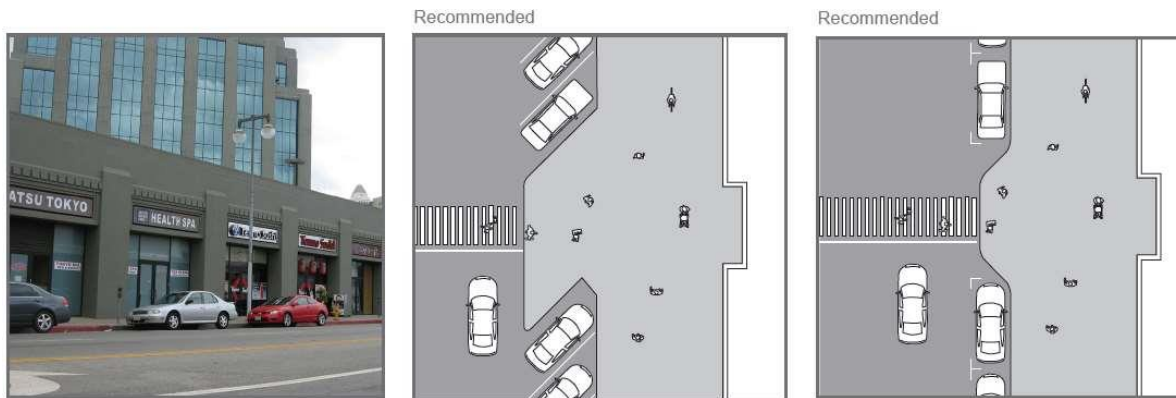


Figure 2 2 On-street parking and its effect on sidewalk width and street crossing.
(Resource: LA-Walkability Checklist, 2008: (Ghadimkhani, 2011)).

Design features such as using raised or textured pavement at crosswalks, and creating a barrier effect, can be helpful in calming traffic. These measures help to slow down vehicles and allow pedestrians and cyclists to safely cross the street (AK, 2018).

3. Lightening and visibility

Lighting and visibility play a vital role in ensuring the safety of pedestrians. A suitable and sufficient lighting system can significantly enhance the safety of drivers and pedestrians by improving visibility (Tetri, 2017). The primary objective of using appropriate lighting is to provide glare-free lighting systems, also known as "dark sky," which are considered the correct lighting systems (Ghadimkhani, 2011).

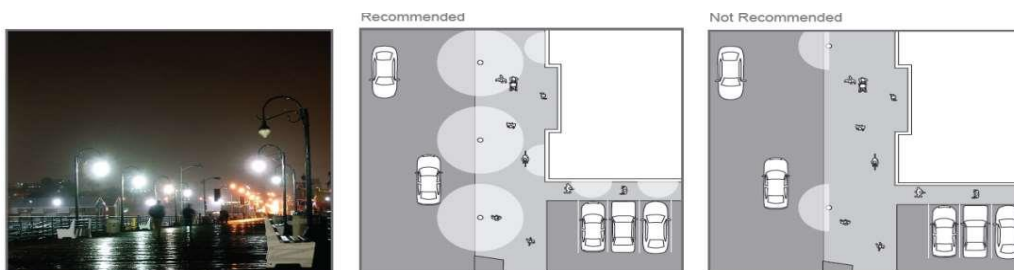


Figure 2 3 Parking areas and sidewalk illumination.
(Resource: LA-Walkability Checklist, 2008: (Ghadimkhani, 2011)).

4. Continuous pavement

A crucial feature of a well-designed pedestrian system is a continuous sidewalk pattern that enhances "walkability." According to Majumdar (2021), this design enables pedestrians, especially those with physical disabilities, to navigate the sidewalks with ease. Physical modifications to the sidewalk pattern aim to remove any interruptions in the path, thus encouraging pedestrians to walk (Shaaban et.al, 2018). Additionally, street furnishings such as light poles and canopies that are of the same height provide perceptual continuity and create a harmonious rhythm (Lambert, 2005). Grid-iron street patterns offer more continuous and walkable sidewalks for pedestrians, as they are highly interconnected, compared to cul-de-sacs, crescents, loops, and lollipops street patterns (Ghadimkhani, 2011). However, it is worth noting that walkable cities can still be achieved through other effective factors such as human scale dimensions, diversity, and special landmarks (Cysek & Monika, 2021).

5. Pedestrian enclosure

Enclosure is a term used to describe the extent to which buildings, walls, trees, and other vertical elements visually define public spaces including streets. When the height of these vertical elements is proportional to the space between them, it creates a room-like feeling. Pedestrian safety is also influenced by pedestrian enclosure, both physically and perceptually (Ewing, 2013). To achieve this, special attention must be paid to factors such as human scale, building orientation, and street furniture (Long, 2019).

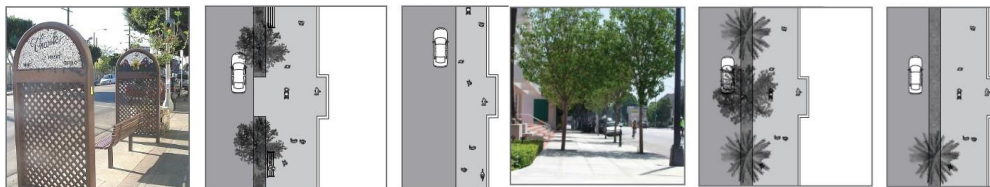


Figure 2 4 Pedestrian enclosure by considering urban elements, building scale, and orientation (Resource: (Ghadimkhani, 2011)).

Human-scale standards refer to the appropriate width of sidewalks, which are essential for pedestrian movement and activity (Ewing, 2013). It also pertains to building height, which should be determined according to the sidewalk width. The term "human scale" denotes the size, texture, and articulation of physical elements that match the size and proportions of humans and correspond to the pace of human walking (Lambert, 2005). Jacobs (1993) suggests a ratio of building height to street width of 1:2. Generally, a suitable sidewalk width enables pedestrians to understand the

layout of a route, its use, and the location of entrances (Sung, 2015). Moreover, a proper sidewalk width enables different parts of the sidewalk to function appropriately, allowing pedestrians to move around freely.

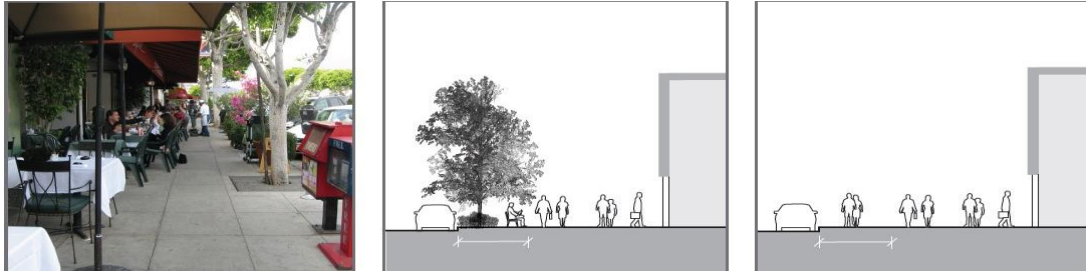


Figure 2 5 Perceptual continuity created by urban elements (Resource: LA-Walkability Checklist, 2008: (Ghadimkhani, 2011)).

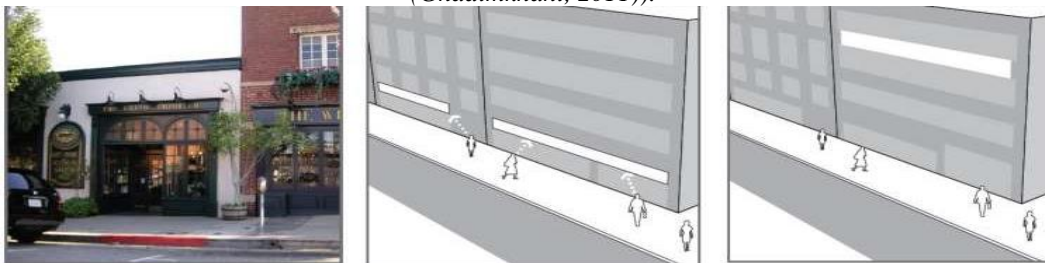


Figure 2 . 1 Perceptual building components according to human scale standards

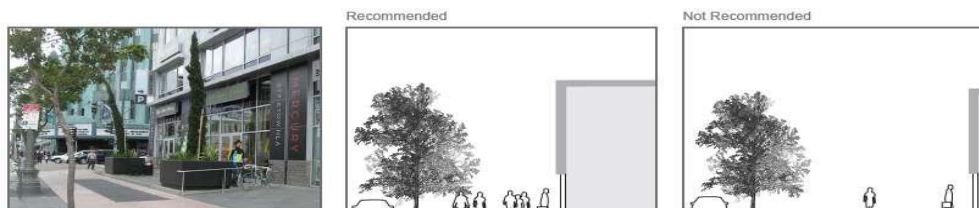


Figure 2 6 Adequate sidewalk width by pedestrian volume(Ibid),

Creating pedestrian enclosures involves incorporating street furniture, such as trees, benches, and other fixtures, to serve as a protective barrier between pedestrians and vehicles. This also helps to minimize the impact of traffic noise and potential hazards to walkers. Trees, in particular, are useful in defining pedestrian boundaries by reducing the proportion of building height to open space, as well as slowing down traffic and making streets narrower. Additionally, their contribution to pedestrian safety and the environment makes them crucial in enhancing 'walkability' (Ak, 2018).



Figure 2 7 The role of street furniture in walkway enclosure (Ibid)

6. Separation

Separation is an important safety measure for pedestrians. Pedestrians can be separated from vehicles by utilizing sidewalks, medians, boulevards, on-street parking, and parallel routes (Kolody, 2002).

7. Floor quality

Floor quality is an important factor in enhancing the safety of sidewalks. High-quality pavements can make walking more comfortable and enjoyable for all individuals, including those with disabilities (Tumlin, 2012).

8. Street crossing

Street crossings play a vital role in evaluating safety. Short, visible, and secure crossings that physically and perceptually connect both sides of the road ensure pedestrian security.

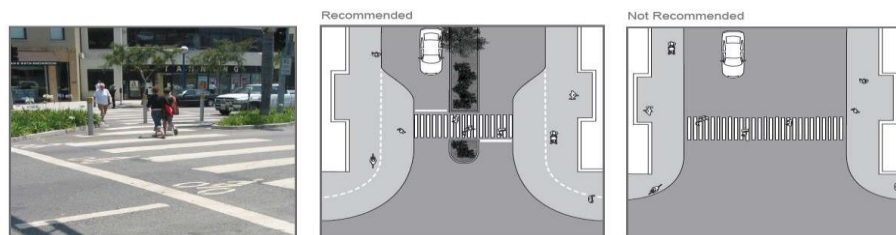


Figure 2 8 Mid-Street crossing islands and curbs extended out have decreased street crossing distance(Ibid).

9. Vehicle mix

The last factor related to actual safety is *vehicle mix*. The existence of big vehicles, except for public vehicles which inevitably should be used, hurts pedestrians' safety (AK, 2018).

2.6.1.2. Perceived safety

Perceived safety, as defined by Evans (2009) and Wheeler (2001), is the protection of pedestrians from the fear of crime or danger from vehicular traffic. It differs from physical safety, which concerns the separation of sidewalks from vehicular routes (Evans, 2009). Perceptual safety, on the other hand, relates to the noise of cars on streets that makes people anxious. Both types of

safety are crucial for pedestrians and drivers, but pedestrians are more vulnerable to safety issues (Wheeler, 2001). The feeling of safety directly impacts the tendency of people to walk around neighborhoods. As Kolody (2002) stated, "The safer pedestrians feel on the street, the more they will use it".

Jane Jacobs (1961), in her book "The Death and Life of Great American Cities", defines three main qualities necessary for perceptual safety as below (Campanella, 2017):

- i. A clear delimitation between public and private space
- ii. Buildings oriented towards the street to provide 'eyes on the street'
- iii. Common use facilities to add more 'eyes' on the street

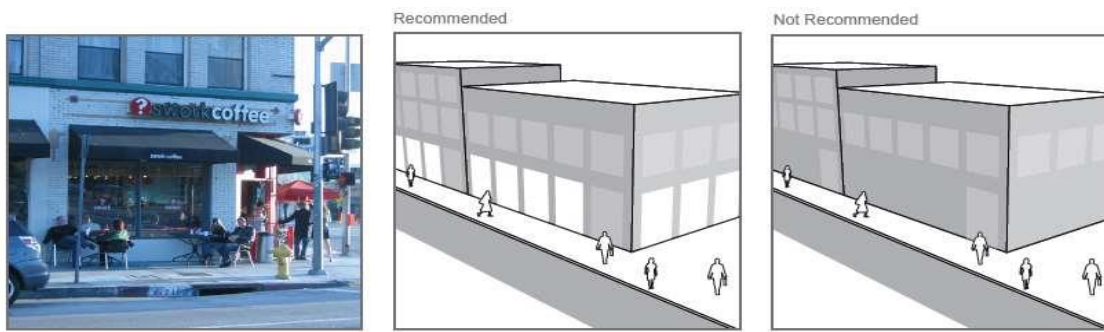


Figure 2.9. Shops that have a direct relation with streets provide 'eyes on the street' and create safety (Ibid).

2.6.2. Orientation/ Legibility

strong sense of orientation is crucial for pedestrian safety and walkability, particularly for elderly people, children, and those who struggle with orientation. It enables them to navigate the public space network effectively, locate landmarks, avoid getting lost, and feel secure while walking (Ewing, Eight qualities of pedestrian-and transit-oriented design, 2013). Kevin Lynch's "mental maps" theory emphasizes how critical orientation is to the way pedestrians perceive and navigate their surroundings. Mental maps are based on the paths and nodes that pedestrians encounter during their journeys (Zavadska, 2020). The path is crucial because it forms the foundation of the public space network, without which pedestrians would feel lost. Nodes are also essential because they define the destination that walkers want to reach. Legible street patterns, landmarks, continuity, built form and location, and architectural and environmental features, among other factors, all play a significant role in enabling pedestrian wayfinding (Bentley, 2002; Kolody, 2002; LA-Walkability Checklist, 2008; Burton and Mitchell, 2006, cited in Ghadimkhani, 2011).

Having a good sense of orientation is a critical aspect of pedestrian safety and walkability. It allows individuals to navigate unfamiliar environments, avoid traffic hazards, and remain situationally aware. Achieving this necessitates a comprehensive understanding of the key factors that contribute to the legibility, landmark, imageability, continuity, and built form of the urban landscape (Carmona, 2019).

i. Legibility of street patterns and urban components

Legibility refers to the ease with which people can read and interpret the urban surroundings, including the layout of streets, buildings, and public spaces. This is crucial for pedestrians to identify and follow established pathways, as well as locate important landmarks and destinations. Clear signage and wayfinding systems, along with consistent street numbering and block patterns, can enhance legibility and make it easier for people to navigate the urban environment (Taylor, 2009). When street patterns are simple and regular, pedestrians can navigate and reach their destination quickly. It is important to have straightforward street patterns along with urban components that make it easier to find one's way since pedestrians are the slowest of all urban travelers. Regular street patterns are more intelligible than irregular, complex hierarchical ones, especially when buildings are positioned around them (Ghadimkhani, 2011). This has been discussed in the works of Bentley (2002) and Kolody (2002) and can be observed in Figure 2.10.

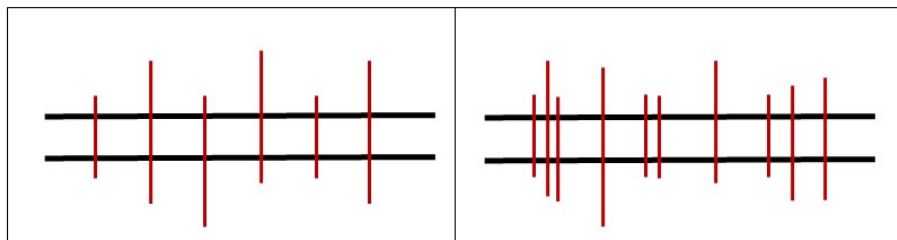


Figure 2 10 The street network provides a regular rhythm (left) and that which provides an irregular rhythm (right) (Resource: Adapted from Ghadimkhani, 2011).

Imageability refers to the visual and aesthetic qualities of the built environment that make it unique, memorable, and recognizable. This includes factors such as architecture, streetscape design, public art, and landmarks that create a sense of place and leave a lasting impression on pedestrians. A visually appealing built environment can enhance a person's sense of orientation and encourage them to explore and walk more frequently (Ewing & Handy, 2009). Landmarks also contribute to the legibility of an environment by creating a familiar image that helps pedestrians navigate and orient themselves. The physical elements and their arrangement capture attention, evoke emotions,

and generate unforgettable landmarks. Building forms, junctions, and differentiation within a place serve as "nodes" in our mental map, creating simple mental maps and memorable landmarks. However, in cases where urban components in public spaces lack harmony, it can be challenging for people to remember all parts of such complicated elements (King, 2016).

ii. Landmarks

Landmarks are distinctive features within the urban landscape that assist with navigation and provide orientation cues to pedestrians. They could include well-known buildings, monuments, natural features, or other elements that stand out and are easily recognizable. Incorporating prominent landmarks and maintaining their visibility can help improve the overall walkability and safety of a neighborhood (Millonig, 2007).

iii. Continuity

Continuity is a term used to describe how different parts of public spaces are connected seamlessly. This makes the environment more attractive and easier to navigate for pedestrians. Grid street patterns are particularly good for achieving continuity through indirect connections. To ensure that people can move around safely and easily, it's important to pay attention to design principles such as sidewalk width and accessibility. Visual elements like street trees and lights can also be used to enhance pedestrian continuity (Edensor, 2016).

iv. Built form and its location

The placement and form of urban elements such as buildings are crucial to enhance the legibility of a city. Therefore, it is essential to carefully select their characteristics and merits. This will enable everyone to easily perceive them, and ultimately, contribute to the legibility of the urban environment (Kolody, 2002, cited in Asli, 2018).

Finally, the design and layout of the built environment are crucial to supporting pedestrian safety and increasing walkability. This includes the placement and design of buildings, street networks, and public spaces that prioritize pedestrian safety and ease of movement. Incorporating features such as crosswalks, pedestrian islands, and traffic calming measures can also help improve the safety and flow of pedestrian traffic.

In conclusion, a strong sense of orientation is essential for promoting pedestrian safety and walkability in urban environments. By prioritizing legibility, landmarks, imageability, continuity,

and built form, urban designers can create spaces that are navigable, inviting, and safe for pedestrians.

2.6.3. Comfort

Comfort in urban spaces is determined by both physical and visual aspects, as stated by Lynch (1991). Urban spaces must be physically accessible and visually understandable for pedestrians. If these qualities are absent, it can lead to decreased comfort and safety for pedestrians (Ghadimkhani, 2011). Visual understanding is related to the Gestalt principles of orientation and legibility, which have been effectively applied in Italian cities to create comfort for pedestrians (DONG, 2019). Physical usability, on the other hand, is concerned with four factors that affect pedestrian comfort, regardless of age or ability. Firstly, public spaces should be protected from environmental elements like sun, rain, snow, and wind. Secondly, clean air is essential, which can be achieved through calm traffic in cities. Thirdly, safety (both actual and perceived) is critical for pedestrian comfort. Attention should be given to street patterns, traffic calming measures, lighting, continuous pavement, pedestrian enclosure and separation, street trees, floor quality, street crossings, design details, clear separation of walkways from vehicular traffic, and eyes on street factors to achieve safety. Lastly, accessibility is essential for the comfort of both healthy and disabled people (Ghadimkhani, 2011).

2.6.4. Diversity

The relationship between walkability and the physical, social, and economic diversity of urban areas is closely intertwined. Physical diversity refers to the variety of urban elements such as dwelling types, architectural styles, and land-use activities. Social diversity refers to the mixture of people from different ages, family types, and socio-economic backgrounds, while economic diversity refers to the variety of building types with different property values (Baobeid, 2021).

These diversities are crucial for bringing different groups of people together and making use of urban public spaces, resulting in lively and livable public areas (Lambert, 2005). The impact of diversity on the walkability of public spaces differs between residential sites and commercial centers. For instance, a neighborhood with a variety of dwelling types allows people of different ages, ethnicities, family types, and socio-economic backgrounds to interact with each other daily, forging personal and civic bonds that are essential for creating livable communities. Shops and services that provide basic daily needs not only create local employment opportunities but also add visual interest for pedestrians, enhancing the walkability of public spaces (AK, 2018).

2.6.5. Local Destinations

The walkability of an area is greatly influenced by the distance between home and destination. Studies show that people are generally not willing to walk more than 10 minutes to reach places that meet their daily needs. As per the accessibility standards of Time Saver Standards, the maximum walking distance is between 400m and 800m (i.e., between 5 and 10 minutes). Interconnected street patterns facilitate quick and direct connections between destinations, distribute traffic equally on multiple roads, and make it easier to navigate. Grid-iron street patterns, in particular, are highly interconnected and have the potential to create more pedestrian-friendly streets than other types of street patterns. Thus, interconnected street patterns are recommended for increasing the accessibility and walkability of public spaces, (Kolody, 2002).

2.7. Walkability Index

A walkability index is a tool that is used to evaluate the quality and attractiveness of an area for pedestrian activities. It provides a numerical score or rating that illustrates the level of convenience, safety, and accessibility for walking within a neighborhood, city, or region. Walkability indexes usually consider various factors related to the built environment, such as street design, land use patterns, availability of sidewalks and crosswalks, accessibility to amenities and services, and proximity to public transportation (Guzman, 2022).

Walkability indexes typically rely on a combination of objective data and subjective evaluations, which may include factors such as Street design, Land use patterns, Accessibility to services and amenities, Safety, and Walkability perception (Gori, 2014).

1. **Street design:** This considers factors such as the presence of sidewalks, crosswalks, and protected bike lanes, as well as the width and connectivity of pedestrian pathways. A well-designed street network can enhance walkability and encourage pedestrian-friendly behavior (Gerike, 2021).
2. **Land use patterns:** Evaluating land use patterns involves assessing the mix of residential, commercial, and institutional uses within a neighborhood. The presence of amenities such as shops, parks, schools, and workplaces within walking distance can greatly contribute to walkability (Brown, 2009).
3. **Accessibility to services and amenities:** This factor examines the proximity and ease of access to essential services, including grocery stores, healthcare facilities, public

transportation, restaurants, and recreational areas. The availability and convenience of these amenities play an important role in walkability (Baobeid & Sami, 2021).

4. **Safety:** Assessing safety factors includes considering variables such as crime rates, the presence of well-lit streets, traffic calming measures, and pedestrian-friendly infrastructure. Safe and secure environments are crucial for encouraging walking and active transportation.
5. **Walkability perception:** Some walkability indexes also incorporate subjective evaluations by surveying residents and pedestrians about their perceptions and experiences with walking in the area. This can provide valuable insights into the lived experiences of pedestrians and their perceptions of safety, comfort, and convenience (Harun & Nashar, 2020).

2.7.1. A local walkability Index

Assessing the ease of walking around a particular area is the aim of a local walkability index. This index takes into account several factors that contribute to the overall walkability of a neighborhood or city, including the availability of sidewalks, bike lanes, street connectivity, and proximity to amenities such as grocery stores, schools, parks, and public transportation (Ensari, 2018). A higher score on the walkability index indicates that the area is more pedestrian-friendly and encourages active transportation and healthier lifestyles. The score is typically calculated on a scale of 0 to 100 (EPA, 2021).

The local walkability index serves the purpose of evaluating the quality of the built environment and guiding urban planning and development decisions. It can also assist city planners, policymakers, and developers in identifying areas that need improvements in infrastructure and amenities to make a community more walkable and encourage walking as a mode of transportation (Fitzsimons, 2013). Walkability indexes are usually created by using geographical information systems (GIS) and can be calculated at different levels, such as city-wide indexes or neighborhood-specific indexes. These indexes can be used to compare different areas within a city or compare walkability scores between cities for benchmarking purposes (Reisi, 2019).

Some commonly used walkability indexes are the Walk Score, Pedestrian Environment Index (PEI), and Walkability Index for Older People (WIOP). Each of these indexes has its methodologies and factors considered when calculating the overall walkability score (EPA, 2021)

The local walkability index is a measure of how easy and pleasant it is to walk in a given area. Different methods of measuring the local walkability index may include:

- Using geographic information systems (GIS) to analyze spatial data on density, diversity, street connectivity, and transit accessibility. For example, the National Walkability Index developed by the U.S. Environmental Protection Agency uses selected variables from the Smart Location Database to rank block groups according to their relative walkability (Thomas, 2017).
- Conducting walkability audits to assess the physical and environmental characteristics of the pedestrian infrastructure, such as sidewalks, crossings, lighting, signage, and aesthetics (Keyes, 2020).
- Applying pedestrian accessibility evaluation to compare walking conditions in different city zones based on the availability and quality of pedestrian facilities, the attractiveness and safety of the walking environment, and the proximity and diversity of destinations (Thomas, 2017).

2.7.2. Methods of Measuring Local Walkability Index

There are many ways to measure walkability, depending on the data sources, methods, and indicators used. Some of the common measures of walkability are:

- ***Walk Score:*** This is a popular online tool that calculates the walkability of any address based on the distance to nearby amenities, such as restaurants, shops, parks, schools, etc. The Walk Score ranges from 0 to 100, with higher scores indicating more walkable locations (Score, 2014).
- ***Street network characteristics:*** These are features of the urban street layout that affect the connectivity, accessibility, and attractiveness of walking routes. Some of the common indicators are block size, intersection density, street width, sidewalk availability, street trees, etc. (Koohsari, 2014). These indicators can be measured using GIS tools or field surveys. You can find some examples of how street network characteristics influence walking behavior in this article (Telega, 2021).

There are other tools to measure walkability besides the ones I mentioned. Here are some examples:

- ***Pedestrians First*** is a tool developed by the Institute for Transportation and Development Policy that evaluates walkability based on indicators such as accessibility, safety, comfort, and convenience. The tool also guides how to improve walkability in different urban contexts (Moura, 2017).
- ***Walkability Appraisal Tool*** is a tool created by the University of Melbourne that assesses walkability based on four dimensions: functionality, safety, aesthetics, and destination. The tool uses a combination of GIS data, field surveys, and user feedback to generate walkability scores and maps (Ahmad, 2017).
- ***State of Place*** is a tool that measures walkability based on 290 built environment features that influence people’s decisions to walk. The tool also calculates the economic value of walkability and provides recommendations on how to enhance it (Baobeid & Sami, 2021).

2.8. Urban Design and Walkability

Urban design plays a crucial role in shaping the walkability of a city. Walkability is influenced by factors such as footpaths, sidewalks, traffic, road conditions, land use patterns, building accessibility, safety, and air quality (Turon, 2017). Urban design can influence these factors by creating pedestrian-friendly environments that encourage walking and other forms of active transportation. Here are some ways in which urban design can affect walkability:

1. Sidewalks and footpaths: Urban design can create safe and accessible sidewalks and footpaths that are well-connected to other parts of the city (Southworth, 2005).
2. Street design: Urban design can create streets that are designed for all users, including pedestrians, cyclists, and public transit users.
3. Mixed-use development: Urban design can encourage mixed-use development that brings together residential, commercial, and institutional uses in the same area. This can reduce the need for car travel and make it easier for people to access essential services and amenities by foot within a reasonable distance (Neylmaz, 2020).
4. Public spaces: Urban design can create public spaces that are safe, attractive, and accessible to all users. This can include parks, plazas, and other gathering places that encourage social interaction and physical activity (Carmona, Principles for public space design, planning to do better, 2019).

5. Building design: Urban design can create buildings that are designed to be accessible to pedestrians and cyclists. This can include features such as bike parking, showers, and changing rooms for cyclists (Evans, 2009).

2.9. Studies and guidelines on urban design for a walkable environment

In this section, we will discuss recent studies and guidelines from the field of urban design that focus on creating environments that are supportive of pedestrians. There have been many studies conducted on walkability.

2.9.1. Pedestrian and Transit-friendly Design

A Primer for Smart Growth (Ewing, 1999, cited in Choi, 2012)

This guide draws primarily on classic urban design literature and other transit-oriented design manuals and studies. It contains a checklist of urban design features that are categorized into three groups: Essential features, Highly Desirable Features, and Nice Additional Features (Choi, Walkability as an Urban Design Problem: Understanding the activity of walking in the urban environment, 2012).

Essential features:

1. Medium-to-High Densities
2. Mix of Land Uses
3. Short to Medium Length Blocks
4. Transit Routes Every Half-Mile
5. Two- or Four-Lane Streets (with Rare Exceptions)
6. Continuous Sidewalks Wide Enough for Couples
7. Safe Crossings
8. Appropriate Buffering from Traffic
9. Street-Oriented Buildings
10. Comfortable and Safe Places to Wait

Nice Additional Features:

11. Street walls
12. Functional Street Furniture
13. Coherent, Small-Scale Signage
14. Special Pavement
15. Lovable Objects, Especially Public Art

Highly Desirable Features:

16. 11. Supportive Commercial Uses
17. 12. Grid-like Street Networks
18. 13. Traffic Calming along Access Routes
19. 14. Closely Spaced Shade Trees along Access Routes

20. Little Dead Space, or Visible Parking

21. Nearby Parks and Other Public Spaces

22. Small-Scale Buildings (or Articulated Larger Ones)

23. Classy Looking Transit Facilities

The checklist aims to help ensure that urban design is efficient and effective in creating livable and sustainable cities.

2.9.2. Physical Activity Planning Guide *(Edwards & Tsouros, 2008, cited in Choi, 2012)*

The World Health Organization's Regional Office for Europe has published a healthy city guidebook that offers a planning guide for creating a healthy and active city by increasing physical activity in the urban environment. The guidebook provides various strategies at the urban design level, which include:

- Embedding workplaces, shops, schools, and healthcare facilities within integrated neighborhoods that encourage walking and cycling, thereby reducing urban sprawl.
- Providing easy access to seashores, rivers, lakes, and forests on the city's periphery.
- Conserving and developing green spaces.
- Providing incentives for developing vacant lots and run-down areas into green and open spaces.
- Establishing an urban green network accessible to all residents, complemented by a network of squares and other small outdoor places for active living.
- Providing convenient and visible stairs and signage for public spaces that encourage people to take the stairs.
- Designing buildings that encourage the use of stairs and ensuring that stairwells are unlocked in office buildings and healthcare facilities.

It's important to note that these strategies encourage physical activity in general and may differ from those specifically aimed at encouraging walking activity. While they share the same goal of enhancing public health, some of the suggestions made here may contradict existing findings from correlation studies on walkability. Nevertheless, these suggestions are based on existing literature and share more similarities with the theories and guidelines on pedestrian-friendly design from the urban planning and design field. Some of the design features encouraged here, however, have failed to be proven valid in statistical studies (Choi, 2012).

2.9.3. Research Project on Walkability Index

by Space Syntax Limited (Stonor et al., 2002, cited in Choi, 2012)

Transport for London (TfL), which is responsible for regional transportation in Greater London, conducted a project to create a monitoring framework for walking. They needed an analytic toolkit to index walkability and decided to use "space syntax" techniques for pedestrian movement analysis. This technique involved making predictions based on "spatial integration" calculations, where the accessibility of individual pedestrian route segments is calculated based on their position in the overall movement network. The main objectives of the project were: (a) to identify the factors that influence the degree of usage of a particular footway, (b) to determine which of these factors can be controlled and affected by walking policy, design, and implementation, (c) to rank the various factors according to their degree of influence, and (d) to develop a walking policy that responds as much as possible to various factors, prioritizing those that affect walkability the most. This research work aimed to quantify the degree to which different factors influence pedestrian flows (Stonor et al, 2002, cited in Choi, 2012).

The following factors that influence walkability were identified: the presence or absence of other moving people, the presence or absence of other stationary people, footway quality, footway width, footway accessibility, proximity to road, traffic gradient, pedestrian crossing design, traffic signal phasing, ground level activity, movement generators (e.g., transport nodes, and tall buildings) and others. Among these factors, Footway Accessibility, ground-level activity, Pedestrian Crossing Design, Traffic Signal raising, and Time of Day were found to be the most important (Choi, 2012).

2.9.4. Measuring the Unmeasurable:

Urban Design Qualities Related to Walkability (Ewing & Handy, 2009, cited in Choi, 2012)

A recent study in the field of urban design aimed to measure the subjective qualities of the street environment, to provide researchers with operational definitions that they can use to measure the street environment and test for significant associations with walking behavior. The study argued that physical features alone may not capture people's overall perceptions of the street environment. Therefore, the study investigated numerous perceptual qualities that may affect the walking environment, as pointed out in the urban design literature. Although the urban design literature has not attempted to objectively measure these perceptual qualities, with few exceptions, this study tried to objectively measure seemingly subjective qualities of the walking environment. The conceptual framework presented in the study is an interesting analysis of the relationship between

the perception of the environment, physical features of the built environment, and walking behavior (Choi, 2012).

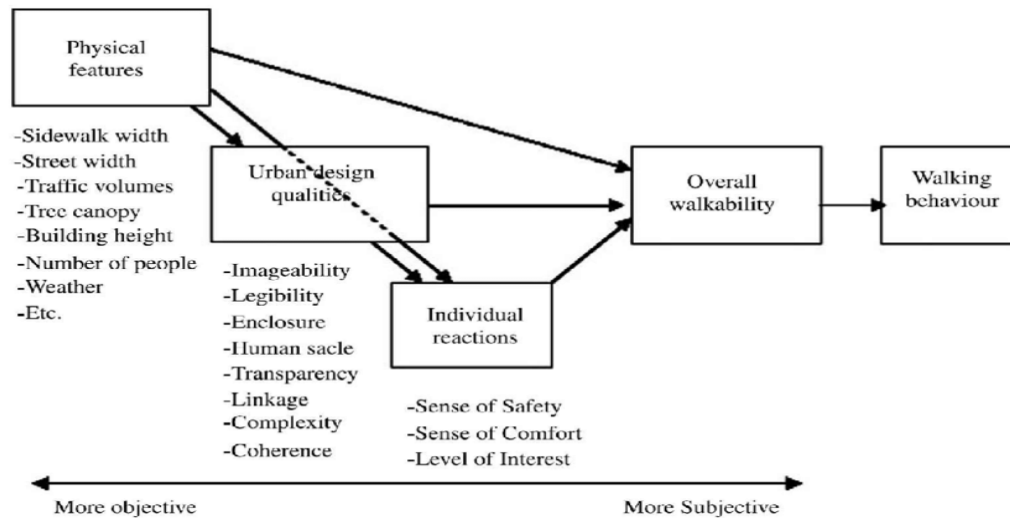


Figure 2 11. Conceptual framework for the influence on walking behavior (Resource: Ewing & Handy, 2009)

The methodology connects particular physical features to ratings of urban design quality, which are provided by a group of professionals for a set of commercial streets. After assessing their importance in the literature, eight out of the 51 perceptual qualities were chosen for further examination: imageability, enclosure, human scale, transparency, complexity, legibility, linkage, and coherence. The first five were successfully put into practice, with their operational definitions based on video clips of 48 commercial streets throughout the United States and rated by the expert panel (Choi, 2012). A brief overview of the consensus qualitative definition of urban design qualities will be provided, followed by a table that shows the important physical features of each quality.

- Imageability refers to the quality of a place that makes it distinctive, recognizable, and memorable. When specific physical elements and their arrangement capture attention, evoke feelings, and create a lasting impression, a place has high imageability (Choi, 2012).
- Enclosure refers to the extent to which streets and other public spaces are visually defined by vertical elements such as buildings, walls, trees, etc. Spaces with proportional vertical elements to the space between them have a room-like quality (DONG, 2019).

- Human scale refers to the size, texture, and articulation of physical elements that match the size and proportions of humans and correspond to the speed at which humans walk. Building details, pavement texture, street trees, and street furniture are all physical elements contributing to human scale (Forsyth, 2015).
- Transparency refers to the degree to which people can see or perceive what lies beyond the edge of a street and, more specifically, the degree to which people can see or perceive human activity beyond the edge of a street. Walls, windows, doors, fences, landscaping, and openings in mid-block spaces are physical elements that influence transparency (Evans, 2009).
- Complexity refers to the visual richness of a place. The complexity of a place depends on the variety of the physical environment, specifically the numbers and types of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage, and human activity (Gerike, 2021).

Table 2. 4 Urban design qualities related to walkability)

<i>Urban Design Quality</i>	<i>Significant Physical Features</i>
Imageability	<ul style="list-style-type: none"> ✓ Courtyards/plazas/parks ✓ Major landscape features ✓ The proportion of historic buildings ✓ Buildings with identifiers ✓ Buildings with non-rectangular silhouettes ✓ Noise level (rating) ✓ Outdoor Dining ✓ People (#)
Enclosure	<ul style="list-style-type: none"> ✓ Long sight lines ✓ Proportion street wall—same side ✓ Proportion street wall—opposite side ✓ Proportion sky ahead ✓ Proportion sky across
Human Scale	<ul style="list-style-type: none"> ✓ Long sight lines ✓ Proportion first floor with windows ✓ Building height—same side ✓ Small planters ✓ All street furniture and other street items
Transparency	<ul style="list-style-type: none"> ✓ Proportion first floor with windows ✓ Proportion active uses ✓ Proportion street wall—same side
Complexity	<ul style="list-style-type: none"> ✓ Buildings ✓ Dominant building colors ✓ Accent colors ✓ Pedestrians ✓ Outdoor Dining ✓ Public art

(Resource: Ewing & Handy, 2009, cited in Choi, 2012)

The above table shows the significant physical features that have been defined for each urban design quality.

***2.9.5. Development and Implementation of Walkability Audits
In Greek medium-sized cities: The case of the Serres City Centre in 2017***

Walking is a great way to stay healthy, but many people feel discouraged by poor infrastructure and the surroundings. Therefore, urban planners must evaluate the condition of the walking environment and pedestrian infrastructure. This paper discusses how walkability audits can be used to monitor, evaluate, and improve walking conditions in urban areas. The study designed a walkability audit comprising 16 parameters, which were divided into three main categories: Traffic factors, Geometry/Environmental/Footpath factors, and Pedestrian movement factors. Each parameter was assessed using a Likert scale, ranging from 0 (negative impact on walking conditions) to 2 (positive impact on walking conditions). The audit was conducted in the central area of the city of Serres to assess walkability along pedestrian streets.

3. CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

This chapter offers an in-depth and thorough overview of the study area, research methodology, materials, and methods used in the research study to provide readers with a deeper understanding of the subject. Begin by presenting the study area's relevance and significance in the research, followed by a detailed explanation of the research methodology. This includes the research design, data types, sources, and collection methods used in the study. In addition, we discuss the data analysis techniques employed in the study and how the findings are presented. This section provides a comprehensive explanation of the statistical tools and software used to analyze the data, as well as the methods used to present the results. Overall, this chapter serves as a valuable resource for anyone seeking to understand the research process behind this study. It offers a clear and detailed account of the methods used and the reasoning behind them, providing readers with a deeper understanding of the research study and its outcomes.

3.2. Study Area

Hawassa City is a bustling urban area located in the beautiful Southern region of Ethiopia, situated on the shores of Lake Hawassa. This city serves as the capital of the Sidama National State. Hawassa is located at the heart of the Great Rift Valley region, 273 km south of Addis Ababa via Mojo, and 1125 km north of Nairobi. Geographically, the city lies between 7° 03' latitude North and 38° 28' longitude East, bordered by Lake Hawassa to the west, the Oromia Region to the north, Wendogenet Woreda to the east, and Shebedino Woreda to the south. The city is rich in history, dating back to 1952 E.C. when it was founded by Ras Mengesha Siyoum with permission from Emperor Haile Selassie. In 1953 E.C., 404 soldiers and their families were granted approximately 1,000m² plots of land in the city's eastern part, which is now known as Addis Ababa "Sefer", Harar Sefer, Korem "Sefer", and Wukro "Sefer". Arab merchants also arrived in Hawassa at this time and opened shops in the area now known as the Arab Sefer, which helped to stimulate the city's growth and development. Hawassa City is divided into eight sub-cities, namely Hayek Dare, Menaharia, Tabor, Misrak, Bahile Adarash, Addis Ketema, Hawela Tula, and Mehal Ketema sub-city. It encompasses a total of 32 Kebeles and covers an area of 157.2 sq. km. The urban center was once a camp and grazing ground for Sidama pastoralists, surrounded by forests that offered sanctuary to wildlife.

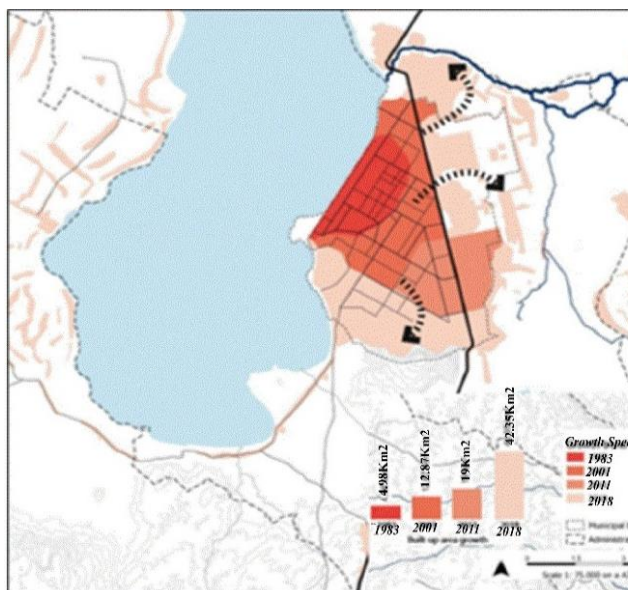


Figure 3. 1 Historical development of Hawassa since 1983 (Source: UN-Habitat, 2019)

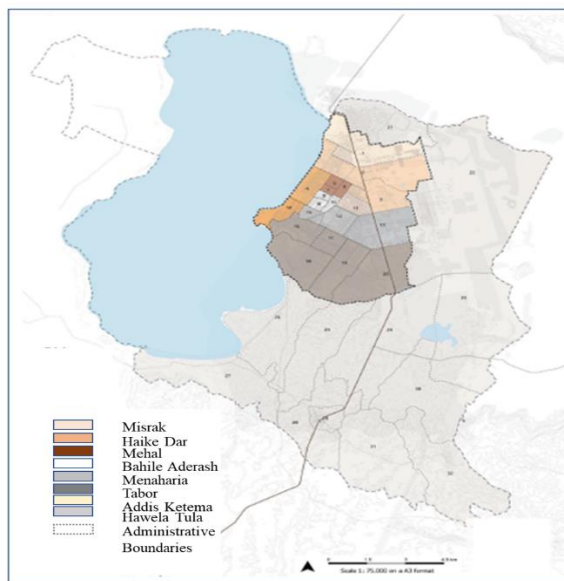


Figure 3. 2 . Administrative map of Hawassa City (Source: UN-Habitat, 2019)

3.2.1. Population and Demography

In the last few decades, the population of Hawassa's urban area has increased significantly, with almost a doubling of inhabitants every ten years. According to the national census, its population was 36,200 in 1984, 69,200 in 1994, and 157,100 in 2007. As of 2017, the Central Statistical Agency estimated that the urban population was 335,000, while the rural population within the city administration's administrative boundary was approximately 120,000, resulting in a total population of 455,658, consisting of 227,614 men and 228,044 women. By 2015 E.C., the urban population had grown even further from 372,721 to 514,017 (as per Hawassa City in 2023). The UN-Habitat report states that Hawassa's urban population has an average annual growth rate greater than the national average of 5.4 percent (according to CSA projections) for urbanization in Ethiopia. In the last few decades, Hawassa has experienced an average annual growth rate of 7%, and this is expected to increase even further in the future because of public investments and development (UN-Habitat, 2019).

Table 3. 1 Hawassa City 2015 E.C Projected population

	Year	Male	Female	Total
Urban	2015	181,935	170,938	352,873
Rural		82,537	78,607	161,144
Total		264,472	249,545	514,017

Source: Hawassa City Finance and Economic Development Department

3.3. Research Design

The research design framework is crucial for conducting a study and it involves making several interrelated decisions. One of the significant decisions made during the research design process is the choice of research approach as it determines the information relevant to the study. This study used a mixed-method approach that consisted of two designs: a well-structured questionnaire for dwellers, managers, and technical experts, and observations made in selected streets and neighborhoods.

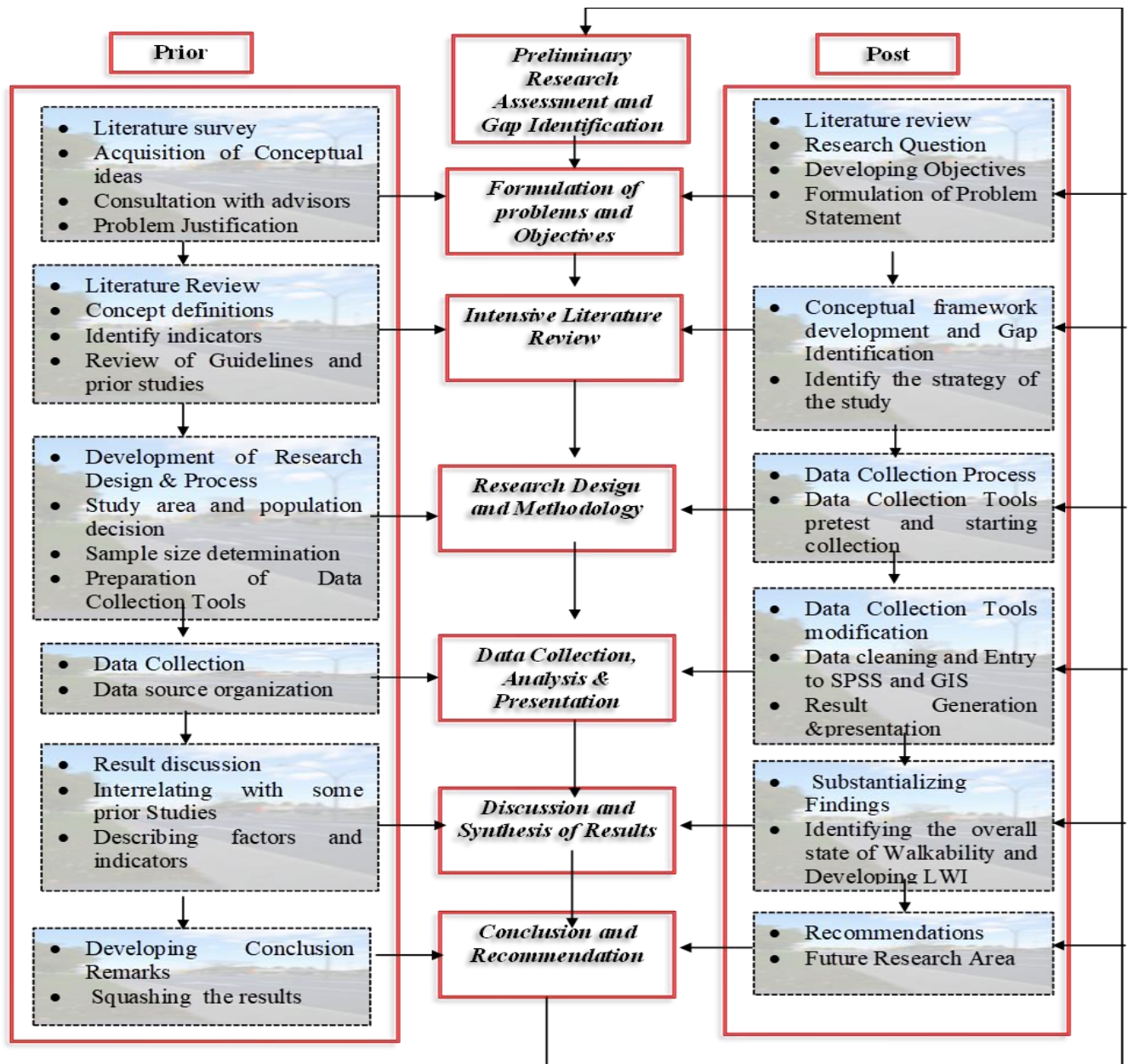


Figure 3. 3 Framework for the Research Design

3.4. Data Type

This study aimed to evaluate the walkability of selected streets and neighborhoods in Hawassa City. The study intended to identify the built environment features that affect walkability and compute the local walkability index for the inner city, intermediate areas, and suburbs. To achieve this, the researchers collected both qualitative and quantitative data by assessing the current state of the streets and identifying the factors and built environment features that impact walkability. The study employed a robust research strategy that included field surveys, Geographic Information System (GIS) analysis, surveys and questionnaires, data collection from relevant agencies, walkability audits, and the development of a walkability index.

Table 3. 2 Data Types and sources with the research question

	<i>Research Question</i>	<i>Type of data</i>	<i>Source of data</i>
1	What are the key features and factors that affect walkability in Hawassa City in the inner, intermediate, and suburban areas?	Qualitative and Quantitative	Primary Data Sources <ul style="list-style-type: none"> • Hawassa city dwellers, • Traffic police report, • Photographs taken during field observation, • Field survey notes, • Maps, • Perception survey, Secondary Data Sources <ul style="list-style-type: none"> • Central Statistics Agency (CSA), • Hawassa City Administration sectoral offices related documents • Road and transport officials from the city administration relevant documents,
2	What is the existing level of walkability in the inner city, intermediate, and expansion suburbs streets and neighborhoods of Hawassa city?	Qualitative and Quantitative	Primary Data Sources <ul style="list-style-type: none"> • Perception survey,

(Source: Researcher)

3.5. Sources of Data

To achieve the objective of the study, it is necessary to collect both qualitative and quantitative data. The data for this study was gathered from primary and secondary sources.

3.5.1. Primary Data Sources

To complete this thesis, a wide variety of sources were used to gather primary data. These sources included households in specific settlements, street users, officials from the Hawassa city municipality, as well as relevant personnel from the city's road and transport departments. Additionally, various documents such as traffic police reports and photographs taken during field observations and surveys were examined.

3.5.2. Secondary Data Sources

This study conducted extensive research on the study area by collecting a wide range of secondary data. The collected data included population figures, socioeconomic indicators, street and road maps, land usage patterns, building elevations, traffic flow analyses, the city's structural planning document, and relevant literature. The study relied on various secondary sources, such as the Central Statistics Agency (CSA), relevant departments within the Hawassa City Administration, pertinent documents and books, online resources, and scholarly papers on related subjects to obtain this valuable information.

3.6. Sampling Design

The comprehensive research encompasses the entirety of the city and is segmented into three primary sections to facilitate the analysis of concerns. The study encompasses all residents and streets as the target population, with groups classified based on the era of settlement creation. These categories include early inner-city settlements (formed before 1991), intermediate planned settlements (formed between 1991 and 2011), and informal suburban settlements. The selection was made based on the age of settlement formation, geographic proximity, and availability of information for comparison (UN Habitat, 2019).

3.6.1. Sampling Techniques

To ensure that the sample accurately represented the study, this research study utilized both probability and non-probability sampling techniques. Specifically, the study intentionally selected three areas - 'Areb' sefer from the inner-city early settlement, 'Sefere selam/Kero' from the intermediate planned settlement, and 'Dato' from the informal suburban settlements. To identify potential participants, GIS data created for this study was used to randomly select 147 streets. A total of 388 sample households, street users, and professionals were then invited to participate in the study using convenient sampling techniques from the three neighborhoods of the city.

3.6.2. Sample Population

The thesis focuses on urban residents in the neighborhoods of Hawassa City, as well as the overall streets. Through an observational survey of the city's streets, it was discovered that there are 1,973 streets with widths ranging from 10 to 54 meters. These streets are located in the inner, intermediate, and suburban areas of the city.

3.6.3. Sample Size

Determining the appropriate sample size is a crucial decision that educational and organizational researchers often face. To determine the ideal sample size, researchers must consider various factors, including the expenses, time, labor, and data collection tools required, the size of the population being studied, the degree of similarity within the population, the desired level of accuracy, the potential for sampling error, and the reliability of the data collected. Inadequate, excessive, or inappropriate sample sizes can compromise the quality and precision of research. Therefore, it is important to balance the need for statistical power, economy, and timeliness when selecting a sample size. This thesis utilized Cochran's formula, which enables researchers to calculate the ideal sample size based on the desired level of precision, confidence level, and estimated proportion of the attribute present in the population. Cochran's formula is particular

useful in situations with large populations (Ahmad, 2017).

The Cochran formula is:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

- e is the desired level of precision (i.e., the margin of error)
- p is the (estimated) proportion of the population that has the attribute in question,
- q is 1 – p
- The z-value is found in a Z-table

The study utilized the aforementioned formula to calculate the required sample size based on the estimated popularity of city residents and street users. As a result, we gathered data from 388 sample respondents and 147 streets situated in the inner-city, intermediate, and suburban areas of Hawassa City, while taking into consideration various factors that influence sample size.

Table 3. 3 Sample Size

	<i>Sample household</i>		<i>Sample Streets</i>	
	<i>Frequency</i>	<i>Percent</i>	<i>Frequency</i>	<i>Percent</i>
Suburb/Outskirt(Dato)	121	31.2	40	27
Inner City(Areb Sefer)	126	32.5	61	41
Inter mediate(Sefere Selam)	141	36.3	46	31
Total	388	100	147	100

(Source: Computed Result using Cochran formula)

3.7. Methods of Data Collection

The research incorporated a diverse range of methods including surveys, on-site observations, document analysis, photography, mapping, and structured questionnaires. Through the use of figures, maps, and photos, the research aimed to provide a comprehensive understanding of the walkability aspects of the built environment. The approach encompassed in-depth questionnaires, thorough site investigations, and meticulous analysis of practical issues that surfaced during observations. The study delved into several facets of the issue, exploring the factors that influence walkability, strategies to augment local walkability, and the overall walkability of the city.

3.8. Method of Data Analysis

The research study utilized a thematic analysis method to examine the data gathered from the field. To ensure thorough and consistent data collection, both qualitative and quantitative analysis methods were utilized. Statistical tools were employed to analyze and interpret both primary and secondary data. Quantitative data was interpreted using charts, percentages, and frequency distributions, while tables, maps, and figures were used for interpreting the results. Qualitative data was analyzed and interpreted through descriptive, explanatory, and narrative texts. A variety of software tools, including GIS, SPSS, ACCESS, and Excel, were employed to facilitate the analysis and interpretation process.

3.9. Method of Data Presentation

Quantitative data can be presented through various mediums such as text, tables, charts, and maps. In contrast, qualitative data is conveyed through descriptions, narrations, and direct quotations.

3.10. Validation and Reliability

The study also assessed the reliability of the built environment indicators used in the LWI. An internal consistency test using Cronbach’s Alpha was conducted with SPSS 26, which showed all indicators had acceptable to high reliability across the studied neighborhoods.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1. Response Rate

The study involved the distribution of 400 questionnaires across three distinct neighborhoods, with 130 distributed in the inner city, 145 in the intermediate area, and 125 in the suburbs. This extensive distribution was deemed necessary to ensure that a sufficient number of responses were collected, given the likelihood of some individuals not responding and the possibility of defective sheets. Impressively, the study achieved a high response rate of 97% from the distributed questionnaires.

Table 4. 1 Response Rate in Neighborhood

Neighborhood	Distributed	Responded	Percent
Inner City('Areb Sefer')	130	126	31.5%
Inter mediate('Sefere Selam')	145	141	35.25%
Suburbs(Dato)	125	121	30.25%
Total	400	388	97%

(Source: Survey Result)

Table 4. 2 Gender of Respondent

Gender of Respondent		
	Frequency	Percent
Male	192	49.5
Female	196	50.5
Total	388	100.0

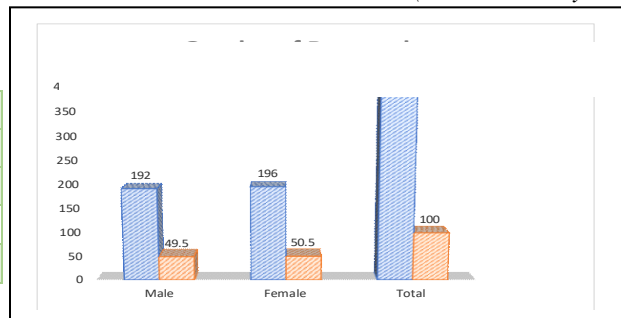


Table 4.3 presents the age range, frequency, and percentage of survey respondents by age group.

Table 4. 3 Age Range of Respondent

	Frequency	Percent	Cumulative Percent
Above 64	34	8.8	8.8
Below 18 Years	69	17.8	26.5
18 up to 24	75	19.3	45.9
45 up to 64	79	20.4	66.2
25 up to 44	131	33.8	100.0
Total	388	100.0	

(Source: Survey Result)

Table 4.4 provides a detailed breakdown of occupations based on frequency and percentage.

Table 4. 4 Occupation

	Frequency	Percent	Cumulative Percent
NGO	31	8.0	8.0
Public	93	24.0	32.0
Unemployed	113	29.1	61.1
Private	151	38.9	100.0

Total	388	100.0
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(Source: Survey Result)

It is worth noting that in Table 4.5, a significant 96.9% of respondents have lived in the study area or city for more than three years. Additionally, 99.5% of respondents are familiar with the research location.

Table 4. 5 The number of years the respondents have been living in this neighborhood.

	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative Percent</i>
less than one year	2	0.5	0.5
1-2 years	3	0.8	1.3
2-3 years	7	1.8	3.1
3-5 years	127	32.7	35.8
5 years and above	249	64.2	100.0
Total	388	100.0	

(Source: Survey Result)

4.2. Results

4.2.1. Assessment of the Built Environment Features

The study aimed to explore the factors that contribute to walkability in the streets and neighborhoods of Hawassa City. The research was based on several significant attributes of walkability like safety, orientation, comfort, diversity, and proximity to pedestrian destinations, as discussed in the literature review.

4.2.1.1. Assessing Safety Factors for Pedestrians in Hawassa City

Ensuring the safety of pedestrians is a complex task that involves implementing a variety of design techniques and measures. However, it's important to note that safety isn't just about physical security, as we've explored in the literature review. Both drivers and pedestrians may feel safe or unsafe for different reasons while navigating the streets. In the following subtitles under this section, the study takes a closer look at safety in Hawassa City, both in terms of actual and perceived safety.

i. The Street patterns of Hawassa City

To evaluate the street patterns, The research took into account whether the streets are continuous and whether there are direct and short routes with a significant number of paved surfaces. Additionally, the study examined whether the neighborhoods are connected to parallel streets at short distances.

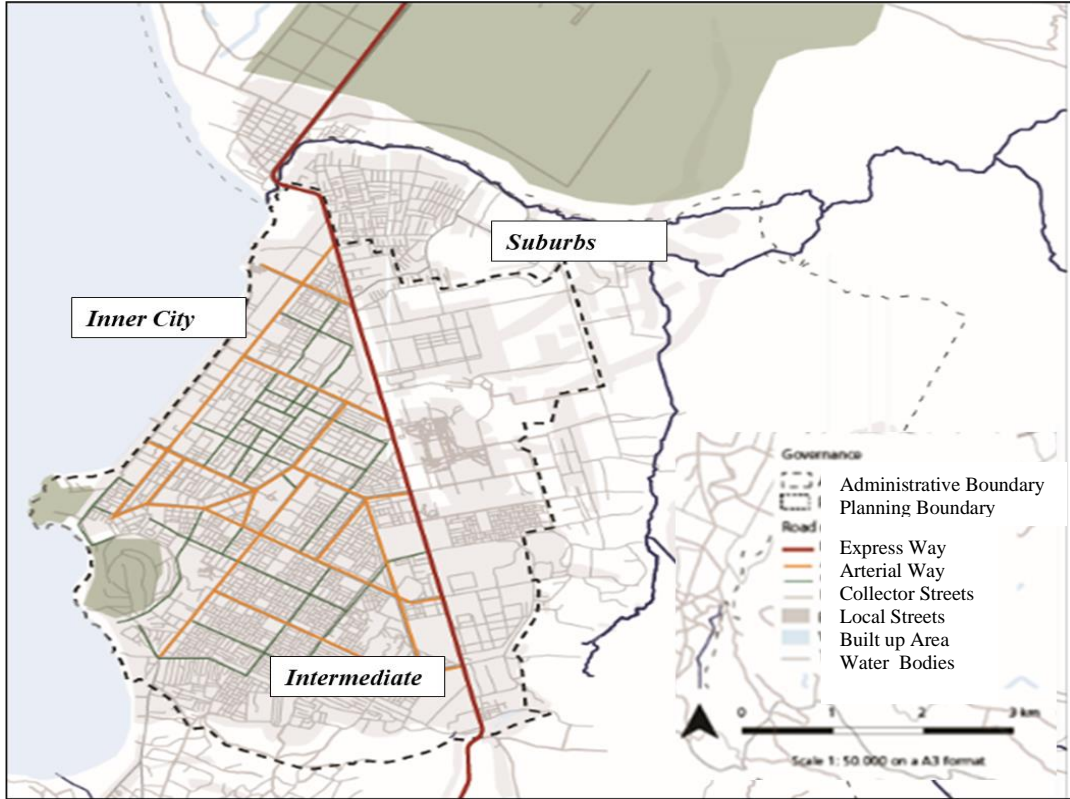


Figure 4. 2 Existing Street Pattern Map (Source: Hawassa City Urban Planning Department 2023)

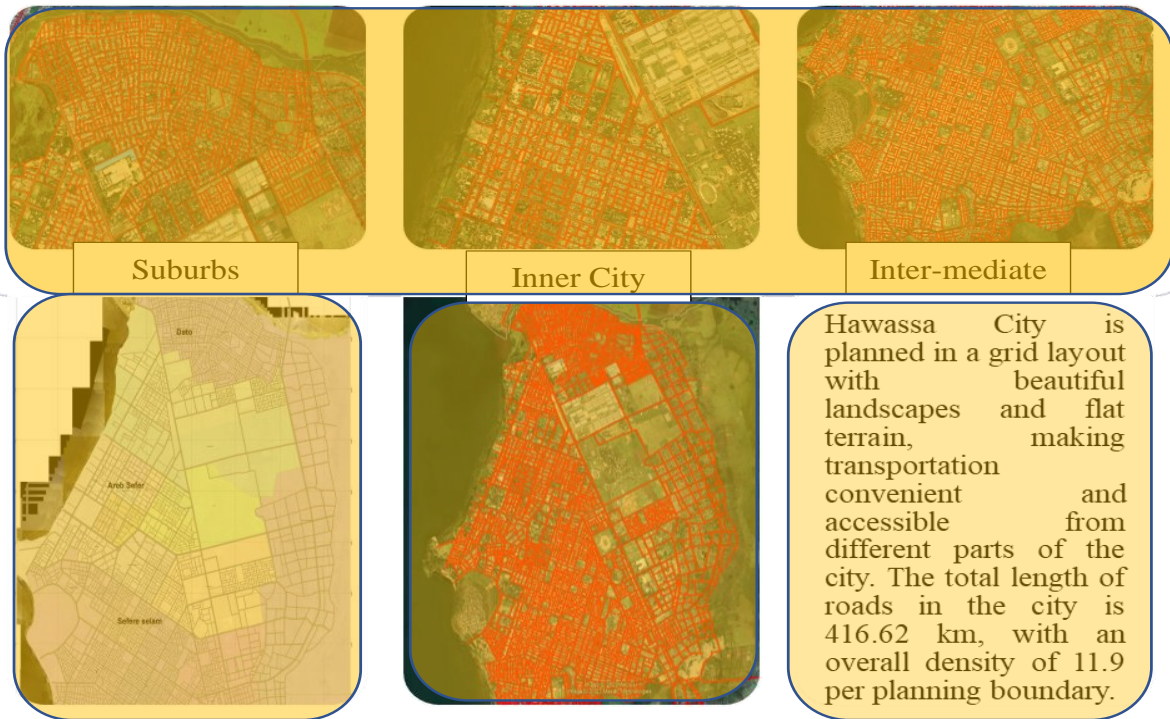


Figure 4. 3 Existing Street layout (Source: Researcher own rendering of GIS and Google Images, 2023)

This study was conducted using data provided by the municipality's planning department and

technical consultation with experts from Hawassa City. Based on the observations, it was found that the inner-city and intermediate areas of the city have a well-connected grid-like street pattern, which encourages pedestrian activity. These areas have shorter distances between streets and a higher percentage of paved surfaces, making it easier to travel between parallel streets. In contrast, the suburban area has an inconsistent street pattern that features loops and lollipops of varying widths. While some may argue that the curvilinear pattern is safer, as mentioned in the literature review, the inner-city and intermediate areas of the city are safer due to their street patterns. Unfortunately, Dato's suburban neighborhood falls into the less safe category due to its inconsistent street layout.

ii. Reporting information about street traffic calming measures in Hawassa City

Implementing traffic calming measures is crucial to ensure road safety and protect pedestrians from serious accidents caused by speeding.

a. Traffic accidents in Hawassa

According to data from the traffic office in Hawassa, road traffic accidents are a significant issue in the city, largely due to drivers exceeding the legal speed limit. Pedestrians are involved in 41.2 percent of these accidents, while vehicle-to-vehicle collisions account for 25.5 percent. The report states that since 2010, there have been a total of 1,980 registered traffic accidents in Hawassa, with 17.12 percent resulting in fatalities. The traffic office found that drivers are mainly responsible for these accidents, with more than 50 percent of deaths and injuries caused by careless speed or unqualified drivers. Figure 4.4 shows that there have been changes in accident rates in the city since 2010, with 2021 having the highest and 2016 having the lowest rates. The trend shows an average annual change of 7.92 percent.

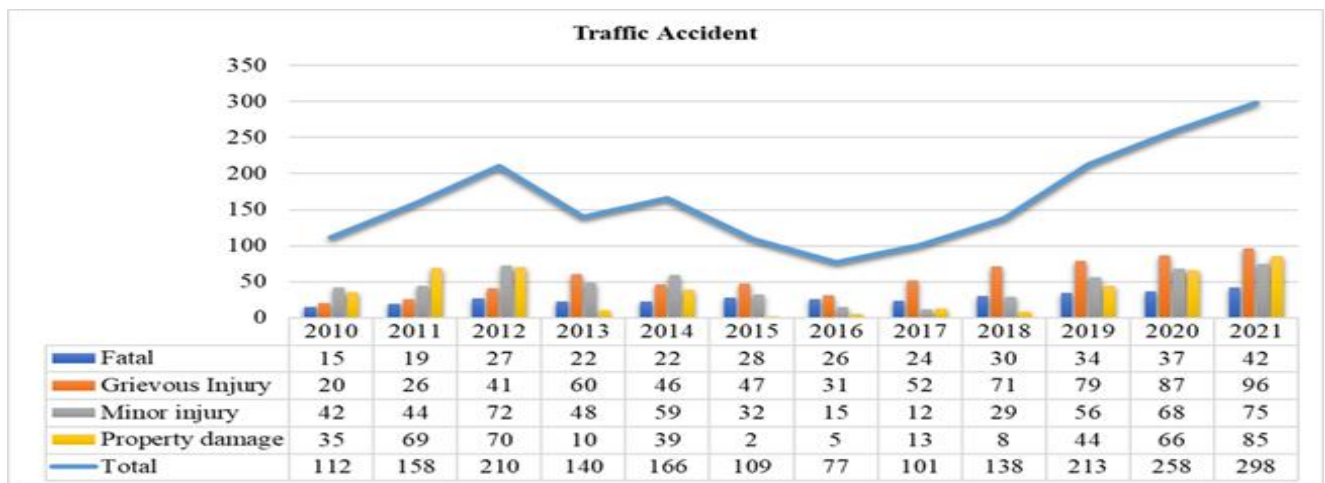


Figure 4. 4 Traffic Accident in Hawassa (Source data: Hawassa City Traffic Office (2023))

b. Other Traffic Factors

Based on the survey results, walkability in Hawassa City and its three selected neighborhoods - Inner City (Arab Sefer), Intermediate (Sefere Selam), and Suburbs (Dato) - is impeded by various traffic factors. The survey conducted identified specific challenges in each neighborhood. In Inner City, there were 11 car entrances leading to somewhere, 16 discontinuities caused by obstructions and illegality, and 12 cases of illegal street parking. Intermediate had 59 car entrances, 0 discontinuities, and 2 cases of illegal street parking, while Suburbs only had 1 car entrance, but 45 discontinuities and 0 cases of illegal street parking were observed. Overall, the survey results showed a total of 71 car entrances, 62 discontinuities, and 14 cases of illegal street parking in the three neighborhoods.

Table 4. 6 Traffic Factors

		Inner City	Intermediate	Suburbs	Total
Traffic factors	Car Entrances	11	59	1	71
	Discontinuities	16	0	45	62
	Illegal Street Parking	12	2	0	14
Total		40	61	46	147

(Source: Survey Results)

Table 4. 7 Traffic Signs on the Streets

Asked if they Would say that the traffic signs in your neighborhood are adequate.

		Strongly Disagree		Dis Agree		Neutral		Agree		Strongly Agree		Total
		Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Neighbo	Inner City	32	25.4	39	30.9	28	22.2	21	16.6	6	4.76	126
	Inter mediate	17	12.0	48	34.0	38	26.9	25	17.7	13	9.22	141
	Suburb(Dato)	48	39.6	52	42.9	4	3.31	10	8.26	7	5.79	121
Total		97	25.0	139	35.8	70	18.0	56	14.4	26	6.70	388

In the survey, 388 participants rated their level of agreement on the traffic sign using the following options: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree.

Table 4. 8 Traffic Calming Measures

		Not Available		Speed Breaks are Available		Speed Limit Sign		Total
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency
Neighborhoods	Inner City (Arab Sefer)	9	22.50	28	70.00	3	7.50	40
	Intermediate (Sefere Selam)	10	16.39	47	77.05	4	6.56	61
	Suburbs (Dato)	46	100.00	0	0.00	0	0.00	46
Total		65	44.22	75	51.02	7	4.76	147

(Source: Survey Result

A comprehensive survey was conducted to gather information about the availability of traffic calming measures in 147 streets located in three distinct areas. The data collected from the survey indicated that local cobblestone roads had speed breaks and speed limit signs installed. As per Table 4.8, it was found that 44.22% of these measures were not available in the overall areas, whereas 51.02% of streets had speed breaks installed and 4.76% had speed limit signs.

It was discovered that in Arab Sefer, which is located in the inner city, 77.5% of the streets have speed limits and breaks, while 22.5% do not have any. Similarly, in Sefere Selam, 83.61% of streets have traffic calming measures, while 16.39% do not. On the other hand, all streets in Dato, which is located in the suburbs, do not have speed-calming measures in place.



Figure 4. 5 Speed limit and speed break

(Source: Photographs taken for this thesis)

The presence of infrastructure for disabled individuals, clean air, and safe traffic varies across different neighborhoods in Hawassa City. Unfortunately, there is no information available regarding the total number of available ramps and speed calming signs in the suburbs. In the Inner City (Arab Sefer), 38% of the infrastructure includes ramps, while 13% is made up of speed-calming signs. The remaining 50% is unavailable. In Intermediate (Sefere Selam), 46% of infrastructure includes ramps, while 7% is made up of speed calming signs. 48% is unavailable. In the Suburbs (Dato), no ramps or speed calming signs are available for disabled individuals. Overall, only 35% of the infrastructure is available for disabled individuals, with 29% consisting of ramps, 6% of speed calming signs, and 65% being unavailable.

Table 4. 9 Infrastructure for Disabled

	<i>Not Available</i>		<i>Ramp</i>		<i>Speed calming sign</i>		
	<i>Frequen cy</i>	<i>%</i>	<i>Frequency</i>	<i>%</i>	<i>Frequency</i>	<i>%</i>	
Inner City	20	50	15	38	5	13	40
Intermediate	29	48	28	46	4	7	61
Suburbs	46	100	0	0	0	0	46
Total	95	65	43	29	9	6	147

(Source: Survey Result)

Furthermore, as discussed in Chapter 2, street width, on-street parking availability, and design elements all contribute significantly to traffic calming. Table 4.8 below presents the width of footpaths in meters across various neighborhoods, including the total number and percentage of footpaths with different widths such as no width, 1.00 meters, 1.20 meters, 2.00 meters, and 2.50 meters. For instance, in Inner City (Arab Sefer), 90% of the streets feature footpaths with varying widths ranging from 1.0m, 1.2m, 2.0m, 2.5m, and 7.5m. In contrast, all streets in the Intermediate area (Sefere Selam) have footpaths with widths of 1m, 1.2m, 2.0m, and 2.5m.

Table 4. 10 Footpath Width in Meters:

Neighborhood	Footpath Width in Meter												Total
	No Footpath		1.00		1.20		2.00		2.50		7.50		
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
Inner City	4	10	5	13	23	58	4	10	1	3	3	8	40
Intermediate	0	0	43	70	0	0	15	25	3	5	0	0	61
Suburbs	46	10	0	0	0	0	0	0	0	0	0	0	46
													147

(Source: Survey Result)

iii. Lighting and Visibility Survey Results

It is crucial to ensure the safety of pedestrians by providing sufficient lighting and visibility. To determine the level of visibility during dark hours, we inspected the lighting, sidewalks, streets, crosswalks, and park areas in the study neighborhoods. The study conducted 147 street surveys to evaluate the availability and visibility of lighting in various neighborhoods. Table 4.11 summarizes the frequency and percentage of available and unavailable lighting in each neighborhood. According to the data, all of the suburbs (Dato) have no lighting available, whereas the intermediate neighborhood (Sefere Selam) has the highest percentage of available lighting at 50.82% (31 locations). The Inner City (Arab Sefer) also has a significant number of unavailable lighting and visibility, with 42.50% (17 locations) of the data reporting it as not available.

Table 4. 11 Lighting and Visibility

Neighborhood	Available		Not Available		Total
	Frequency	Percent	Frequency	Percent	
Inner City (Arab Sefer)	17	42.50	23	57.50	40
Intermediate (Sefere Selam)	31	50.82	25	40.98	61
Suburbs (Dato)	0	0.00	46	100.00	46
Total	48	32.65	94	63.95	147



Figure 4. 6 Lighting and Visibility on Major Streets

Source: Image collected from Hawassa city 2023

Based on the survey responses, it seems that the level of lighting at night is perceived differently in various locations within the neighborhoods. In the inner-city area of Arab Sefer, only 10 respondents strongly agreed that the street is well-lit at night. However, in the intermediate area of Sefere Selam, 40 respondents agreed or strongly agreed with this statement. On the other hand, in the suburb or outskirts of Dato, the majority of respondents (51) disagreed or strongly disagreed with the statement. Overall, out of the 388 total respondents, 87 agreed or strongly agreed that the street is well-lit at night, while 194 disagreed or strongly disagreed with the statement.

Table 4. 12 It is a well-lit street at night

		<i>It is a well-lit street at night</i>					<i>Total</i>
		<i>Strongly Disagree</i>	<i>Dis Agree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>	
<i>Neighborhood</i>	Inner City(Areb Sefer)	24	37	16	39	10	126
	Inter mediate(Sefere Selam)	16	25	57	40	3	141
	Suburb/Outskirt(Dato)	41	51	14	8	7	121
<i>Total</i>		81	113	87	87	20	388

(Source: Survey Result)

iv. *Continuous pavement of Footpaths*

A well-designed pedestrian system should have a continuous sidewalk pattern that enhances "walkability." A continuous pattern enables unrestricted movement along sidewalks, especially for people with physical disabilities. Both physical and perceptual continuity can be improved by making adjustments to the main streets of the city to eliminate any obstacles on the paths and promote walking. Perceptual continuity can be achieved by using street furnishings in places like Piazza to the municipality, the old bus station to South Star Hotel Street, and the 'Atote' area. Consistent light pole height and canopies create a harmonious rhythm.

Based on field observations, the study classified the pavement continuity of 147 streets in different neighborhoods into four categories: continuous, not continuous, not paved, and relatively continuous. The results are presented in Table 4.13, in terms of frequency and percentage. In the Arab Sefer neighborhood (Inner City), out of a total of 40 areas, 17 have continuous pavement, 7

have non-continuous pavement, and 16 have relatively continuous pavement. In the Sefere Selam neighborhood (Intermediate), out of a total of 61 areas, 47 have continuous pavement, 11 have non-continuous pavement, and only 3 have relatively consistent pavement.



Figure 4. 7 Inner and Intermediate Area (Source: Adapted from Google Earth map, 2023)

In the Suburbs (Dato) neighborhood, out of a total of 46 streets, none of the areas have continuous pavement, only 1 street has continuous pavement, and the vast majority of streets (97.83%) are unpaved. Overall, out of a total of 147 streets, 64 streets have continuous pavement, 19 areas have non-continuous pavement, and the majority of areas (30.61%) are unpaved, while 19 streets have relatively consistent pavement.

Table 4. 13 Pavement Continuity

		Continuous		Not Continuous		Not Paved		Relatively Continuous		
		Frequency	Percent %	Frequency	Percent %	Frequency	Percent %	Frequency	Percent %	
Neighborhood	Inner City (Arab Sefer)	17	42.50	7	17.50	0	0.00	16	40.00	40
	Intermediate	47	77.05	11	18.03	0	0.00	3	4.92	61
	Suburbs	0	0.00	1	2.17	45	97.83	0	0.00	46
	<i>Total</i>	64	43.54	19	12.93	45	30.61	19	12.93	147

(Source: Survey Result)

A survey was carried out to gauge residents' perceptions of the condition of the pavement in their neighborhoods. Participants were asked to rate their level of agreement with the statement "continuous pavement" on a scale ranging from Strongly Disagree to Strongly Agree. The survey included Inner City (Arab Sefer), Intermediate (Sefere Selam), and Suburb/Outskirt (Dato). A total of 388 residents took part in the survey, with 80 strongly disagreeing, 1 disagreeing, 101 Neutral, 62 agreeing, and 35 strongly agreeing with the statement.

Table 4. 14 Pavement Continuity

		<i>Strongly Disagree</i>	<i>Dis Agree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>	
<i>Neighborhood</i>	Inner City(Areb Sefer)	24	35	36	21	10	126
	Inter mediate(Sefere Selam)	14	22	48	34	23	141
	Suburb/Outskirt(Dato)	42	53	17	7	2	121
<i>Total</i>		80	110	101	62	35	388

(Source: Survey Result)

v. Pedestrian enclosure

To fully comprehend pedestrian enclosure, it is essential to consider factors such as the human scale, building orientation, and street furniture such as trees, benches, and other fixtures that act as a protective barrier between pedestrians and vehicles. A survey conducted on the streets revealed that 34% of them lacked footpaths, while 66% had footpaths ranging from 1 meter to 7.7 meters wide. In most areas of the city, tall buildings are placed facing the footpaths, and the tallest building allowed on a 50-meter street is 38 meters. By taking these factors into account, it becomes clear that pedestrian areas are relatively secure and functional.



Figure 4. 8 Building orientation towards the footpath (Source: Image Taken for the study 2023)

Building height regulation for the urbanized area of Hawassa is to limit building heights to a maximum of 12 stories or ground plus eleven floors (G+11). This suggestion aligns with the compact city approach and reasonable densification in the city center. However, it also takes into consideration geological factors and potential seismic activity in the region. This height limit should be implemented within the city's planning boundary(Hawassa City Structure Plan, 2021).



Figure 4. 9 Pedestrian Enclosure

(Source: Adapted from Google Earth map, 2023)

vi. **Separation**

Upon observation of Hawassa City, it was discovered that these safety features are already present on most major streets in the inner and intermediate areas, including sidewalks, medians, on-street parking, and parallel routes. However, the situation in the suburbs (Dato) differs greatly from the inner city (Arab Sefer) and intermediate (Sefere Selam) areas. Pedestrians in these neighborhoods are not protected from vehicles by fences and level differences at intersections, and there are no separate walkways or medians in place.



Figure 4. 10 Separated pedestrians from vehicles (Source: Image Taken for the study 2023)

Table 4. 15 Pedestrian Protection from Traffic

		Inner City	Intermediate	Suburbs (Dato)	
<i>protection</i>	Available	3	1	0	4
	Curve stone	4	0	0	4
	Not Available	33	60	46	139
<i>Total</i>		40	61	46	147

(Source: Survey Result)

Tables 4.16 and 4.17 are created to demonstrate the level of pedestrian protection from traffic in each neighborhood. The tables show that the inner city has four curved stone protections, while the intermediate and suburbs have none. However, for other types of protection that are not specified, the inner city has 33 unavailable, the intermediate has 60, and the suburbs have 46, making a total of 139. Overall, there are 40 available pedestrian protections in the inner city, 61 in the intermediate, and 46 in the suburbs, making a total of 147. This report presents an analysis of footpath usage in various neighborhoods. According to Table 4.17, footpaths are mostly used for mixed purposes, with a total of 95 instances. Street parking comes in second with 20 instances. Among the neighborhoods, Intermediate (Sefere Selam) has the highest number of footpath usage for mixed purposes, with a total of 50 instances. In the suburbs (Dato), mixed purposes also dominate footpath usage with 27 instances, while the inner city (Arab Sefer) shows a total of 18 instances.

Table 4. 16 Footpath’s Existing use

	<i>Inner City</i>	<i>Intermediate (Sefere</i>	<i>Suburbs</i>	<i>Total</i>
<i>storage of Construction materials</i>	1	1	10	12
<i>Garage Storage Street Parking</i>	2	3	1	6
<i>Mixed uses</i>	18	50	27	95
<i>On Street Parking</i>	9	6	5	20
<i>Street Vending</i>	3	1	3	7
<i>Walking</i>	7	0	0	7
<i>Total</i>	40	61	46	147

(Source: Survey Result

vii. ***Footpath Floor quality***

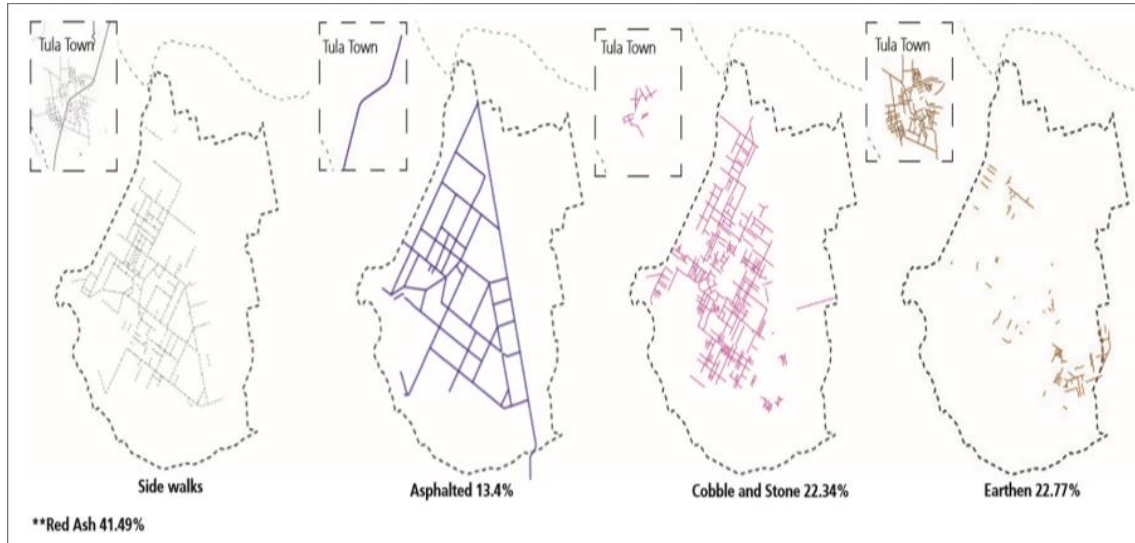
An excellently designed sidewalk is crucial for providing ease of movement, particularly for those with disabilities. Achieving this requires careful consideration of the materials used, as well as the inclusion of safe ramps, appropriate elevation changes, and parapets that can withstand local weather conditions. All of these factors contribute to a safer pedestrian environment.

Table 4. 17 Footpath Surface

	<i>Asphalt</i>		<i>Cobble Stone</i>		<i>Earthen</i>		<i>Red Ash</i>		<i>Terrazzo Tile</i>		<i>Total</i>
	<i>Frequ</i>	<i>%</i>	<i>Frequ</i>	<i>%</i>	<i>Frequ</i>	<i>%</i>	<i>Frequ</i>	<i>%</i>	<i>Frequ</i>	<i>%</i>	
<i>Inner City</i>	4	10	32	80	0	0	1	3	3	8	40
<i>Intermediate</i>	2	3	56	92	0	0	0	0	3	5	61
<i>Suburbs</i>	0	0	0	0	46	100	0	0	0	0	46
<i>Total</i>	6	4	88	60	46	31	1	1	6	4	147

(Source: Survey Result)

This study investigates the effectiveness of pavement materials and their placement, to identify any potential obstacles faced by different user groups, such as the elderly, disabled individuals, and parents with strollers while walking on account of floor quality. The results indicate that cobblestone (88%), Earthen (31%), Red Ash (1%), and Terrazzo Tile (4%) are prevalent materials used in pavement construction.



Hawassa city streets floor materials

<i>- Inner City (Arab Sefer)</i>	<i>- Intermediate (Sefere Selam)</i>	<i>- Suburbs (Dato)</i>
- Asphalt: 4 (10%)	- Asphalt: 2 (3%)	- Asphalt: 0 (0%)
- Cobble Stone: 32 (80%)	- Cobble Stone: 56 (92%)	- Cobble Stone: 0 (0%)
- Earthen: 0 (0%)	- Earthen: 0 (0%)	- Earthen: 46 (100%)
- Red Ash: 1 (3%)	- Red Ash: 0 (0%)	- Red Ash: 0 (0%)
- Terrazzo Tile: 3 (8%)	- Terrazzo Tile: 3 (5%)	- Terrazzo Tile: 0 (0%)
- Total: 40	- Total: 61	- Total: 46

(Source: Survey Result)

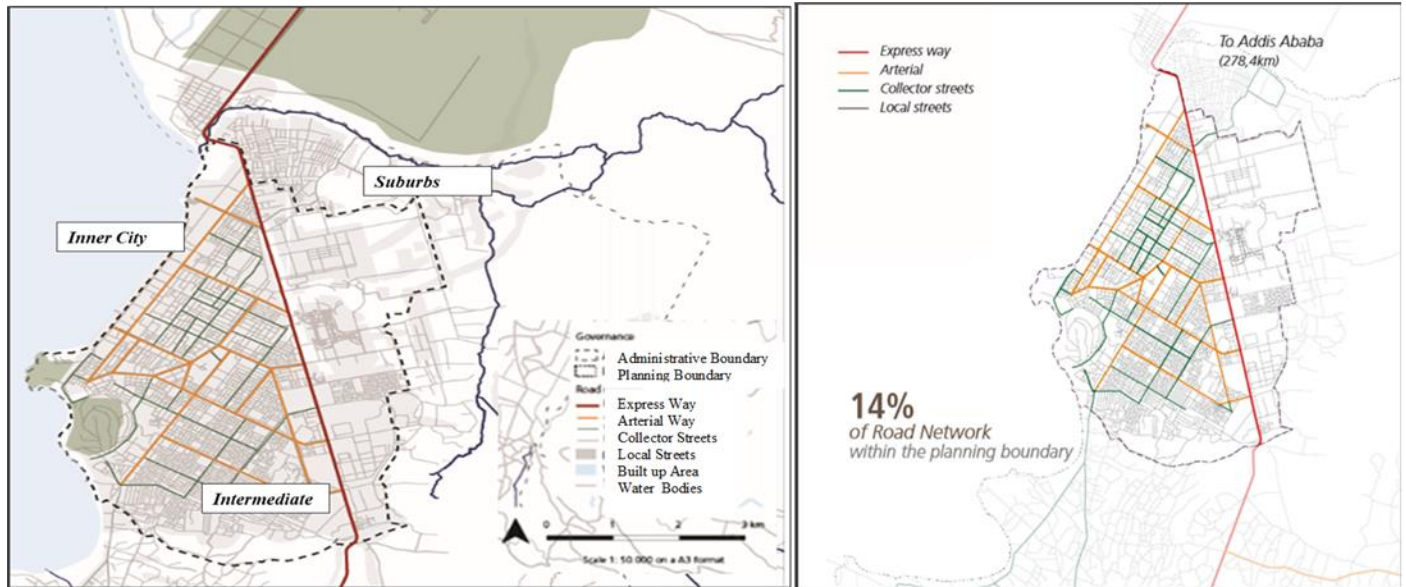


Figure 4. 12 Footpath quality and Pavement type (Source: Municipality of Hawassa City 2023)

The quality of footpath floors in various neighborhoods is shown in Table 4.19 below, categorized as bad, fair, or good. To determine the quality, surface materials, smoothness, gradient, physical conditions, and floor continuity were considered. The percentages of each category are also provided.

Table 4. 18 Footpath Floor Quality

Footpath Floor quality	Neighborhood			Total
	Inner City (Arab Sefer)	Intermediate	Suburbs	
Bad	5	2	46	53
Fair	27	55	0	82
Good	8	4	0	12
Total	40	61	46	147

(Source: Survey Result)

viii. Comfort and Deformation of the Pavement slabs

A survey was conducted to gather insights from participants on the comfort and deformation of pavement slabs in different neighborhoods. Respondents were asked to rate their level of agreement, ranging from "Strongly Disagree" to "Strongly Agree." The survey results showed that in the Inner City (Areb Sefer), 21 individuals strongly agreed, 28 agreed, 39 Neutral d, and 18 strongly disagreed. In the Intermediate (Sefere Selam) neighborhood, 13 people strongly agreed, 55 agreed, 28 Neutral d, 17 disagreed, and 141 strongly disagreed. In the Suburb/Outskirt (Dato), 7 people strongly agreed, 5 agreed, 14 were Neutral d, 52 disagreed, and 121 strongly disagreed.

Overall, out of the 388 participants, 119 agreed, 81 were Neutral d, 70 partially disagreed, 78 disagreed, and 40 strongly disagreed.

Table 4. 19 Comfort and Deformation of the Pavement Slabs

		<i>Strongly Disagree</i>	<i>Dis Agree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>	
<i>Neighborhood</i>	Inner City(Areb Sefer)	18	39	28	21	20	126
	Inter mediate(Sefere Selam)	17	28	28	55	13	141
	Suburb/Outskirt(Dato)	43	52	14	5	7	121
<i>Total</i>		78	119	70	81	40	388

(Source: Survey Result)

ix. ***Street crossing***

When it comes to crossing a street, it's important to have crosswalks that are properly placed, accessible, and visible. Pedestrian safety is ensured by short, visible crossings that connect both sides of the street. Unfortunately, during street surveys, it was observed that many cobbled stone roads in local and residential areas only have one-meter-wide walkways on one side, long pedestrian crossings on asphalt roads, and a lack of crossing facilities.

To get a better understanding of the situation, the availability of crossing facilities in different areas was assessed. In the inner city (Arab Sefer), 19 crossings are available while 12 are not. In the intermediate area (Sefere Selam), 30 crossings are available while 10 are not. In the suburbs (Dato), there are no crossing facilities available. When it comes to the availability of crossings on one side of the street, the following percentages were found: 9% available on both sides in the inner city, 23% available on one side in the inner city, 21% available on both sides in the intermediate area, 34% available on one side in the intermediate area, and 100% not available on both sides in the suburbs. Overall, there are 49 crossings available on both sides and 22 crossings available on one side (total 48% availability). However, there are 76 crossings not available on both sides and 52 crossings not available on one side (a total of 48% unavailability).

Table 4. 20 Availability of Walkway

		<i>Available</i>			<i>Not Available</i>		<i>Total</i>
		<i>Both sides</i>	<i>One side</i>	<i>%</i>	<i>Both sides</i>	<i>%</i>	
<i>Neighborhood</i>	Inner City (Arab Sefer)	19	12	78	9	23	40
	Intermediate (Sefere Selam)	30	10	66	21	34	61
	Suburbs (Dato)	0		0	46	100	46
<i>Total</i>		49	22	48	76	52	147

(Source: Survey Result)



Figure 4. 13 Footpaths and Crossings Length (Source: Image Taken for the study 2023)

The survey results presented in tables 4.21 and 4.22 detail neighborhood residents' perceptions of safe crossings. Responses were sorted into five categories: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree. In the Inner City, 126 individuals participated, with 28 strongly disagreeing, 19 disagreeing, 18 Neutral, 41 agreeing, and 20 strongly agreeing. Intermediate had 141 responses, with 17 strongly disagreeing, 28 disagreeing, 48 Neutral, 25 agreeing, and 23 strongly agreeing. In the Suburb/Outskirt, 121 individuals responded, with 55 disagreeing, 52 disagreeing, 7 Neutral, 5 agreeing, and 2 strongly agreeing. The survey captured a total of 388 responses, including 100 individuals strongly disagreeing, 99 disagreeing, 73 Neutral, 71 agreeing, and 45 strongly agreeing.

Table 4. 21 Availability of Safe Crossings

		<i>Strongly Disagree</i>	<i>Dis Agree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>	
<i>Neighborhood</i>	Inner City(Areb Sefer)	28	19	18	41	20	126
	Inter mediate(Sefere Selam)	17	28	48	25	23	141
	Suburb/Outskirt(Dato)	55	52	7	5	2	121
<i>Total</i>		100	99	73	71	45	388

(Source: Survey Result)

Crossing Facility in the Neighborhood

The crossing facility does not have any available data, but there are 8 zebra crossings in the inner city (Arab Sefer), 5 in the intermediate area (Sefere Selam), and none in the suburbs (Dato), for a total of 13 zebra crossings.

Table 4. 22 Crossing Facility

		<i>Inner City (Arab Sefer)</i>	<i>Intermediate (</i>	<i>Suburbs (Dato)</i>	
<i>Crossing Facility</i>	Not Available	32	56	46	134
	Zebra crossing	8	5	0	13
<i>Total</i>		40	61	46	147

(Source: Survey Result)

x. *Vehicle mix*

Another factor that affects safety is the mix of vehicles on the road. Large vehicles, except for public transportation, can hurt pedestrian safety.



Figure 4. 14 *Other Transportations with Pedestrians* (Source: Image Adapted from UN_habitat report, 2019)

In Table 4.23, you will find the frequencies and percentages of conflicts between pedestrians and other modes of transportation. The incidents are divided into four categories based on the respondents' perceptions: very low, low, medium, and high. Out of the total 388 recorded incidents, only 7 were classified as very low, accounting for 1.8% of the total. The low category had 15 incidents, which represented 3.87% of the total. The medium category had the highest number of incidents, with 156 cases, comprising 40.21% of the total. Lastly, the high category had 210 incidents, which account for 54.12% of the total. It's important to note that the percentages displayed in the table are cumulative and valid, reflecting the total percentage up to that specific category.

Table 4. 23 Modal Conflict (other transportation with pedestrians)

	Neighborhood						<i>Total</i>	
	<i>Inner City</i>		<i>Inter mediate</i>		<i>Suburb/</i>			
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
<i>Very Low</i>	4	3.17	3	2.13	0	0.00	7	1.80
<i>Low</i>	3	2.38	12	8.51	0	0.00	15	3.87
<i>Medium</i>	34	26.98	65	46.10	57	47.11	156	40.21
<i>High</i>	85	67.46	61	43.26	64	52.89	210	54.12
<i>Total</i>	126	100.00	141	100.00	121	100.00	388	100.00

(Source: Survey Result)

4.2.1.2. *Orientation*

In the literature review chapter, we highlighted the importance of orientation for safety and walkability, especially for older individuals, those with children, or those who struggle with orientation. In Hawassa City and the surrounding areas, there are significant nodes within the

intermediate zone that allow pedestrians to navigate public spaces, recognize important locations, and avoid feeling lost or confused. This ultimately encourages more walking in the intermediate area. Based on the city's data and the images below, we can see that pedestrians mentally map their surroundings as they walk along Sumuda (St. Gabriel) from the internal 'Atote,' Old bus station, Mount Tabor, 'Gudumale,' and 'Wolde Amanuel' sidewalk in the intermediate area. The path they take and the nodes they encounter are crucial in their wayfinding process. In the Dato (suburb), without a clear and straightforward public space network, pedestrians may feel disoriented. Landmarks, junction continuity, building form, location, and architectural and environmental features are relatively abundant in the inner and intermediate areas of the city but are scarce in the suburbs (Dato).



Figure 4. 15 Building orientation, Landmarks (Source: Images Adapted from SP report and Taken for the study)

Participants were asked to rate their level of agreement with the statement "Street furniture is sufficient" on a scale ranging from Strongly Disagree to Strongly Agree. Results indicated that in the Inner City (Areb Sefer), 63 participants partially and strongly agreed, while 35 disagreed and 28 strongly disagreed. In the Intermediate area (Sefere Selam), 74 partially and strongly agreed, while 43 disagreed and 24 strongly disagreed. In the Suburb/Outskirt (Dato), 37 partially and strongly agreed, while 56 disagreed and 28 strongly disagreed. Overall, out of the 388 participants, 174 disagreed, 118 partially and strongly agreed, and 51 strongly disagreed. No participants strongly agreed. Additionally, it was noted that street furniture may hinder pedestrian movement in the city.

Table 4. 24 Street Furniture

		Street furniture is sufficient Street furniture obscures pedestrian movement,					Total
		<i>Strongly Disagree</i>	<i>Dis Agree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>	
Neighbor hood	Inner City(Areb Sefer)	28	35	47	14	2	126
	Inter mediate	24	43	46	25	3	141
	Suburb/Outskirt(Dato)	28	56	25	12	0	121
Total		80	134	118	51	5	388

(Source: Survey Result)

i. Legibility of street pattern and urban components

When assessing the legibility of a city, it is important to determine whether there is a clear and easy-to-follow street pattern. This means that the neighborhoods and side streets should be well-connected and easy to navigate.



Figure 4. 16 The layout of streets, buildings, and public spaces (*Source: Images Taken for the study*)
Hawassa boasts several prominent streets with straightforward and easily navigable designs. Among these is Sumuda to Lake Hawassa (Piazza), South Spring to Monopol, 'Zero Amidst', Atote, Menaharia (the old bus station) to St. Gabriel, and Atote to Wolde Amanuel. Such a layout proves especially advantageous for pedestrians, who often move at a slower pace than other urban users. To optimize the experience of those on foot, it's crucial to maintain uncomplicated and predictable street patterns with strategically placed structures. Complex or irregular layouts can create confusion and hinder efficient navigation.

ii. Landmarks

In mental maps, nodes refer to visually distinctive buildings or structures that are memorable, while paths and junctions represent the routes that people follow between them. These landmarks help pedestrians navigate and remember their location within a city. The uniqueness of built forms, such as buildings and streets, plays a crucial role in defining these nodes, according to Kevin Lynch and Gestalt theory. The differentiation, detail, and junctions of these nodes contribute to creating simple yet unforgettable mental maps. The areas of Areb Sefer and Sefere Selam in the inner city have more landmarks than other areas, but it's important to balance the level of differentiation

throughout the city to avoid confusion. Detailed building forms and junctions also play a vital role in creating a legible environment.



Figure 4. 17 Landmarks (Source: Images Adapted from SP report and Taken for the study)

iii. Continuity

Currently, there are four small sports fields attached to a youth center and a high school in the city. These open fields are used as football fields by the public. In addition, there are four stadiums in Hawassa, two of which are located within the Hawassa University Compound. One of the stadiums is a national stadium equipped to hold international competitions, while the other is the oldest stadium in the city and is used for Ethiopian Premiere League matches. The open spaces found within the newly developed residential areas show a fair distribution of outdoor play and green spaces to serve residential areas. However, the public sports fields are inadequate in terms of the available services and fair distribution throughout the city. In addition, the number of other types of sports fields, except for football, is very low. The public park along the lake serves both citizens and tourists. However, it is limited in terms of continuity along the lake and connection with other public spaces, such as Amora Gedel Park and the Chambalala celebration gathering area. The Tabor Mountain Park is another public destination within the city, where the city administration is fencing the border to preserve the land from indiscriminate settlement encroachment and deforestation.

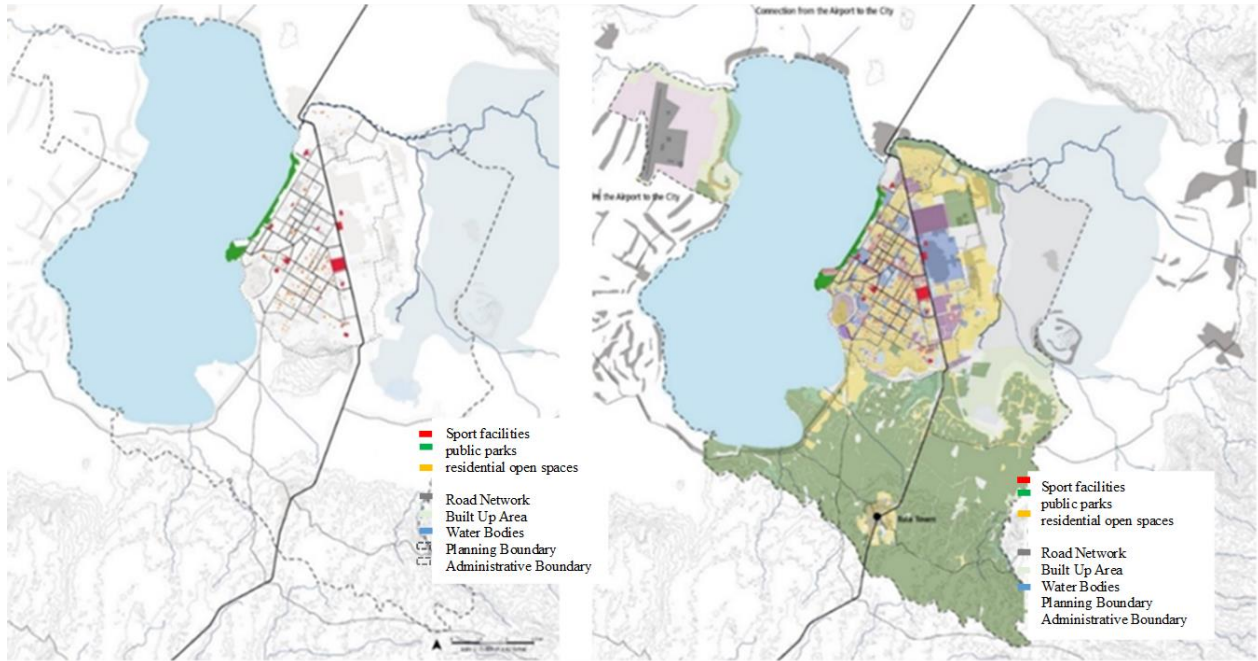


Figure 4. 18 Distribution of recreational services (Source: Adapted from SP report 2023)

In general, Hawassa has more green spaces as compared to other cities in the country. However, as mentioned above, not all urban green spaces provide the same services. Some neighborhoods lack safe parks or green areas. In this regard, equity is a principle that should be fostered.

iv. **Built form**

Examining the legibility of a city can involve analyzing the placement and form of buildings, which can become memorable landmarks for pedestrians. Some buildings, due to their form and position, become memorable for pedestrians and they contribute to their orientation.

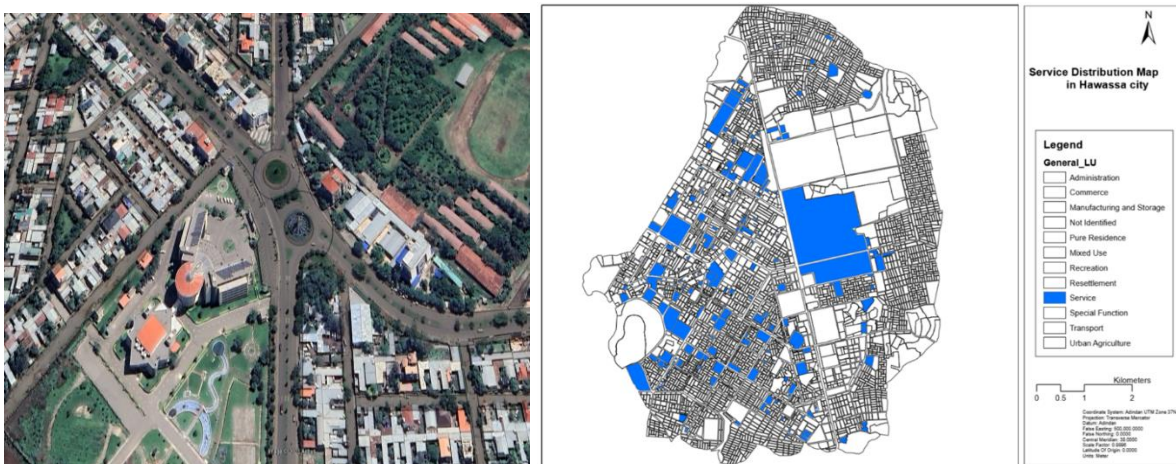


Figure 4. 19 The placement and form of urban elements and service distribution (Source: Adapted from SP report)

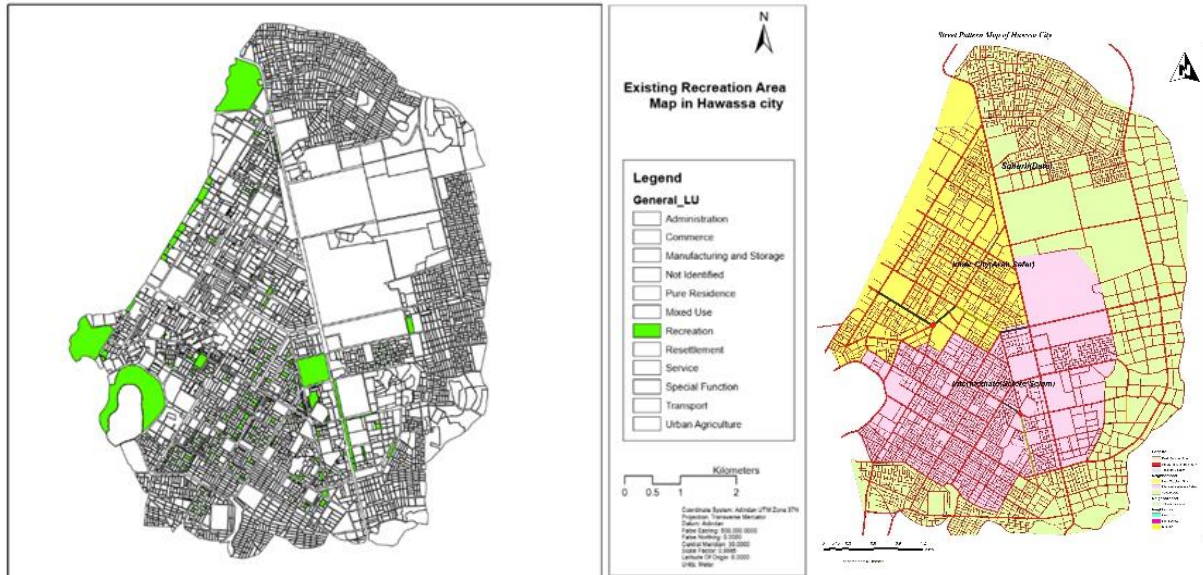


Figure 4. 20 . Connected public spaces (Source: Researcher rendering on GIS 2023)

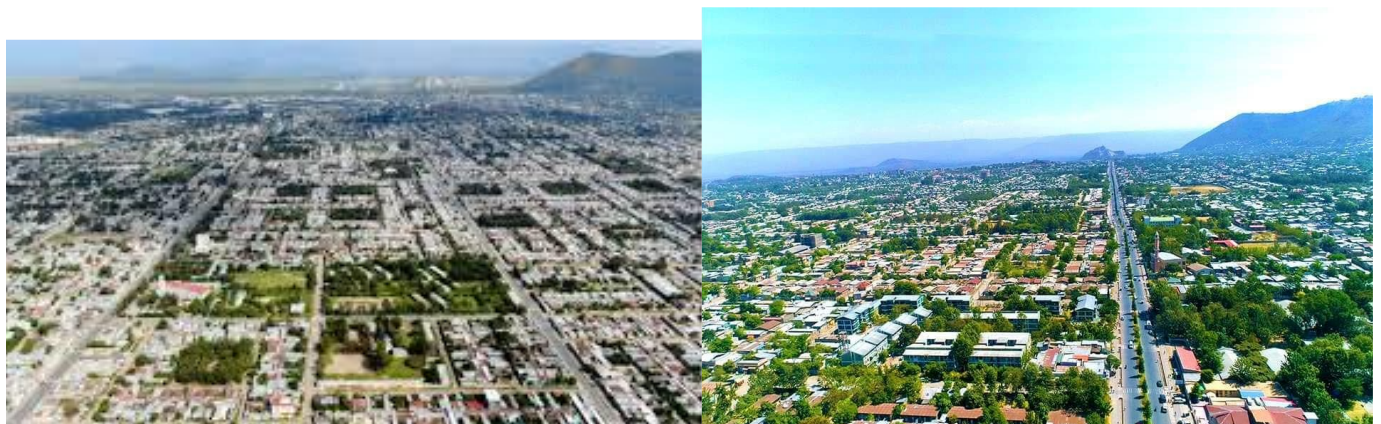


Figure 4. 21 Hawassa main streets Continuous Street pattern (Source: Adapted from SP report)

4.2.1.3. **Comfort**

As we discussed earlier in the literature review, physical usability is determined by four factors that contribute to the comfort of walking for people of all ages and abilities. The research has examined how Hawassa City fares in terms of these factors. The first factor is the availability of public spaces that protect pedestrians from harsh weather conditions such as sun, rain, snow, ice, and wind. Based on the city's data and my observations, it is evident that most of the streets in the inner city and intermediate areas are well-equipped to protect pedestrians from these weather conditions, as seen from the accompanying images.



Figure 4. 22 Intermediate Areas Streets are physically usable and visually understandable for pedestrians to feel safe and comfortable when interacting with their environment (Source: Adapted from Municipality 2023)



Figure 4. 23 Inner city Areas are physically usable and visually understandable for pedestrians to feel safe and comfortable when interacting with their environment (Source: Adapted from SP report)

Based on the data presented in Table 4.26, out of the 388 individuals who were surveyed, only 2 reported a high level of security (0.5%), 4 reported a very high level of security (1.0%), 140 reported a low level of security (36.1%), and 242 reported a medium level of security (62.4%). The majority of individuals surveyed reported a medium level of security from criminals. It's worth noting that these categories include high, very high, medium, and low.

In addition to these findings, a survey was conducted in three different areas: Inner City (Areb Sefer), Intermediate (Sefere Selam), and Suburb/Outskirt (Dato). The results of this survey are presented in the following table.

Table 4. 25 Security from Criminals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	2	0.5	0.5	0.5
	Very high	4	1.0	1.0	1.5
	Low	140	36.1	36.1	37.6
	Medium	242	62.4	62.4	100.0
	Total	388	100.0	100.0	

(Source: Survey Result)

Based on the survey conducted, it appears that the majority of respondents agree that the street is safe at night and has good lighting. However, opinions differ based on the neighborhood. In the inner city (Arab Sefer), 31% strongly agree and 38% are Neutral, while in the intermediate area (Sefere Selam), 35% agree and 68% are Neutral. On the other hand, in the suburb/outskirt (Dato), 45% disagree and 52% strongly disagree. Overall, out of 388 respondents, 76% agree that the street is safe at night with good lighting.

Table 4. 26 Safety Feelings at Night

		<i>It is a safe street at night, with good lighting</i>					<i>Total</i>
		<i>Strongly Disagree</i>	<i>Dis Agree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>	
<i>Neighborhood</i>	Inner City(Areb Sefer)	27	19	38	31	11	126
	Intermediate	17	18	68	35	3	141
	Suburb/Outskirt(Dato)	45	52	14	10	0	121
	<i>Total</i>	89	89	120	76	14	388

*(Source: Survey Result)***Table 4. 27 Safety Feelings on Day**

		<i>I feel safe walking in my neighborhood during the day</i>					<i>Total</i>
		<i>Strongly Disagree</i>	<i>Dis Agree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>	
<i>Neighborhood</i>	Inner City(Areb Sefer)	11	6	48	45	16	126
	Intermediate(Sefere Selam)	7	12	47	52	23	141
	Suburb/Outskirt(Dato)	17	28	34	35	7	121
	<i>Total</i>	35	46	129	132	46	388

(Source: Survey Result)

The infrastructure for disabled individuals in the neighborhood is currently not available on 140 streets. However, there are a total of 147 streets, ramps, and signs in the Inner City (Arab Sefer), Intermediate (Sefere Selam), and Suburbs (Dato). Out of these, 4 ramps are available while the remaining 7 have both ramps and signs. This is a table showing the level of cleanliness in different neighborhoods. The neighborhoods are divided into the Inner City (Arab Sefer), Intermediate

(Sefere Selam), and Suburbs (Dato). The table shows the number of areas that are clean, not clean, and relatively clean in each neighborhood. The total number of areas in each neighborhood is also listed.

Table 4. 28 Infrastructure for Disabled

		<i>Inner City (Arab Sefer)</i>	<i>Intermediate (Sefere Selam)</i>	<i>Suburbs (Dato)</i>	
<i>Infrastructure for Disabled</i>	Not Available	33	61	46	140
	Ramp	4	0	0	4
	Ramp and sign	3	0	0	3
<i>Total</i>		40	61	46	147

(Source: Survey Result)

Table 4. 29 Street Cleanness

		<i>Inner City (Arab Sefer)</i>	<i>Intermediate (Sefere Selam)</i>	<i>Suburbs (Dato)</i>	
<i>cleanness</i>	Clean	1	1	0	2
	Not Clean	31	57	46	134
	Relatively Clean	8	3	0	11
<i>Total</i>		40	61	46	147

(Source: Survey Result)

4.2.1.4. **Diversity**

As mentioned earlier in the literature, there is a close relationship between the physical, social, and economic diversity of urban space and walkability. The presence of such diversity in urban space is important in terms of bringing different groups of people together and therefore making them use urban public spaces.

i. Physical Diversity

Based on the 2021 Structure Plan Report by the Hawassa City Municipality, a significant 75% of housing typologies in the area are single-story, with 3.8% being two-story and 19.8% being homes. This data suggests that the city is expanding horizontally, utilizing low-density development and taking up more land. According to data from Finance and Economic Development, Hawassa is primarily comprised of a young population, with 65% of residents being under the age of 25 and only 5.5% being over 50 years old. A recent household survey conducted by the city administration’s internal planning team supports this finding, with 77.6% of participants between the ages of 0 and 29. Interestingly, the survey also revealed that only 10% of urban households are headed by women. The average household size was found to be 5, with maximum and minimum family sizes of 19 and 1, respectively.

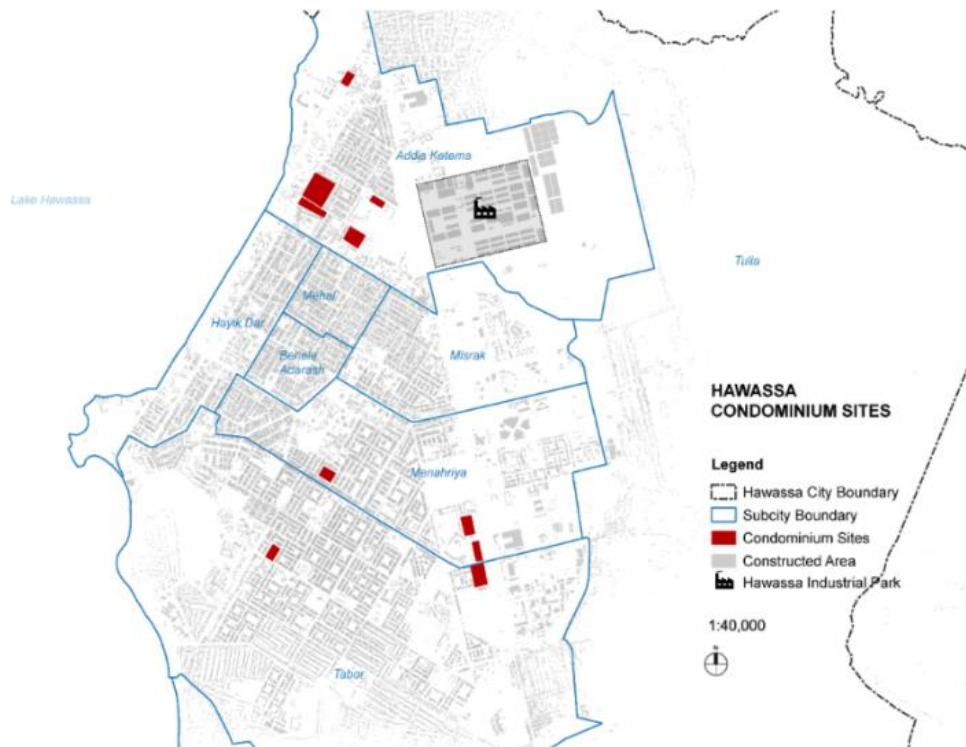


Figure 4. 24 Expanding horizontally, utilizing low-density development (Source: Adapted from SP report)

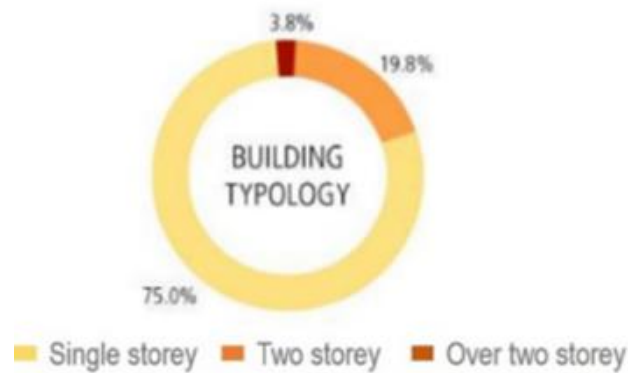


Figure 4. 25 Unit typology percentages (Source: Adapted from SP report)

ii. **Economic Diversity**

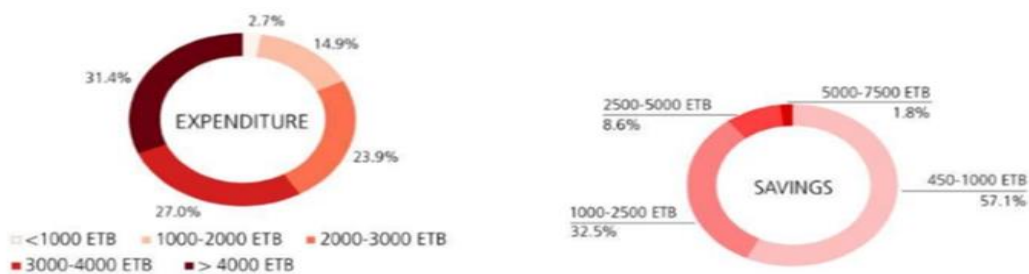


Figure 4. 26 Average monthly expenditure (left) and saving (right) (Source: Adapted from SP report)

The financial well-being of a city greatly impacts its urban environment. The income levels of its residents influence the character and function of their neighborhoods. To assess the economic status of Hawassa's inhabitants, we analyzed the city's structure plan report and data on monthly income, expenses, and savings. Our analysis highlighted areas of the city with promising economic potential, with the highest expenditures and savings marked in red and the lowest figures in blue. Our findings revealed that roughly 80% of households in the city earn less than the international poverty line of US\$1.9 per person per day.

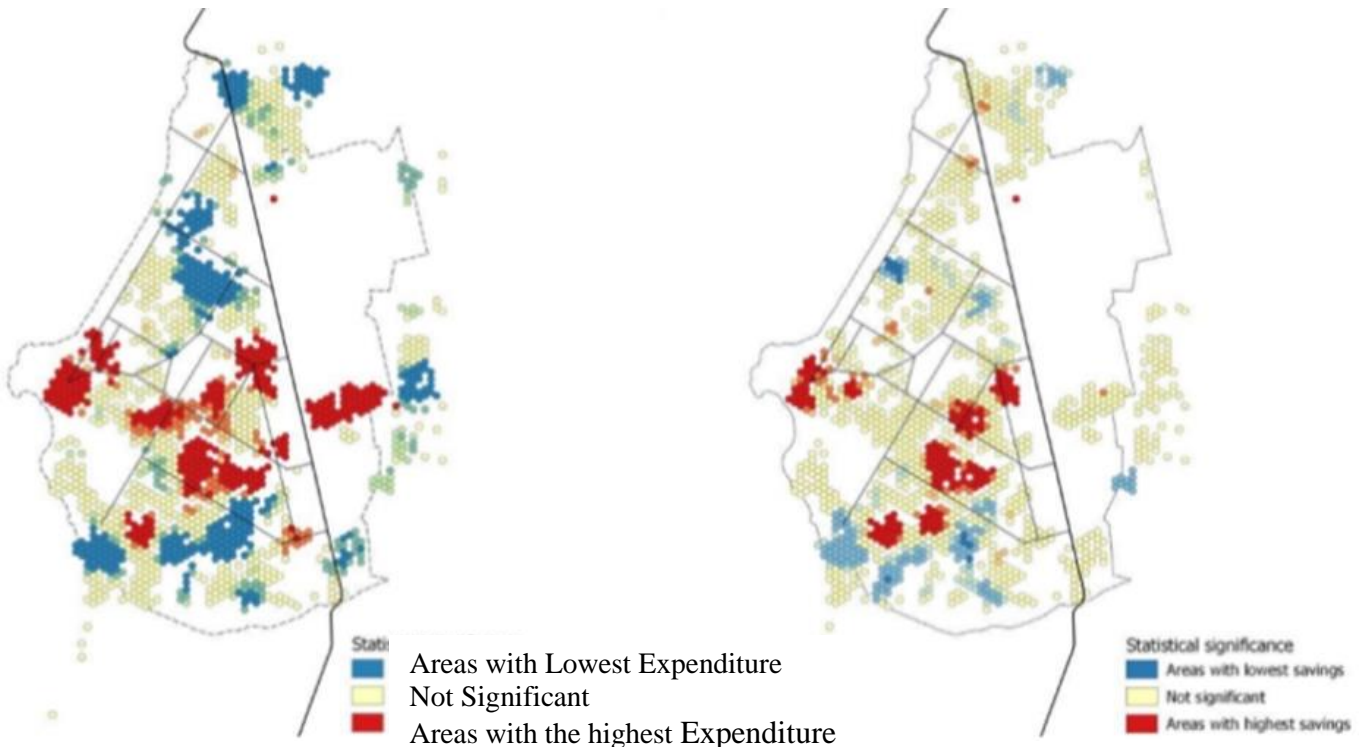


Figure 4. 27 . Hotspot analysis of monthly expenditure and savings(Source: UN_habitat,2021)

iii. Social Diversity

The impact of diversity on the walkability of public spaces varies depending on whether the location is a residential site or a commercial center.

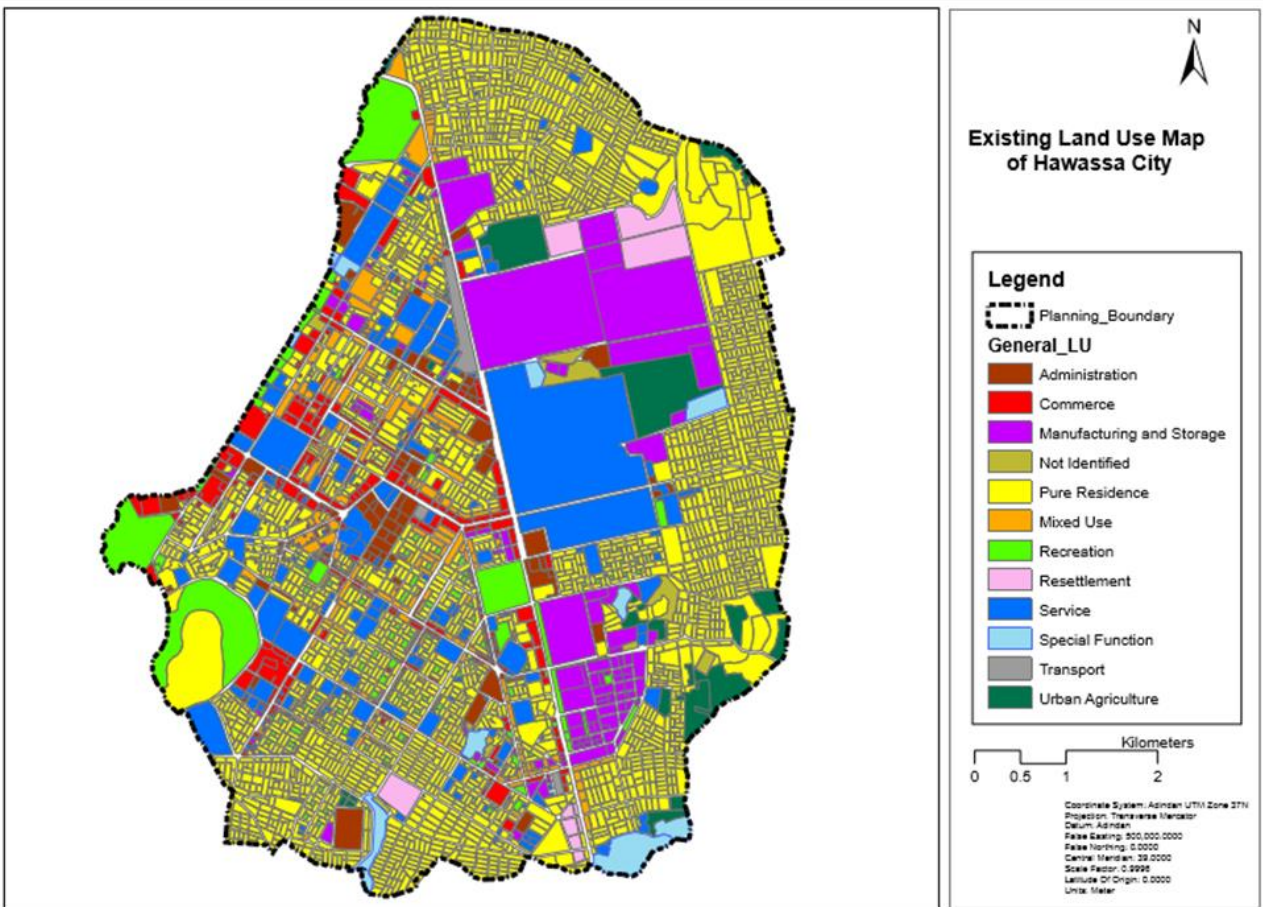


Figure 4. 28 . Existing Land Use Map (Source: UN_habitat,2021)

In Hawassa City, all neighborhoods feature a mix of dwelling types, allowing individuals of different ages, ethnicities, family backgrounds, and socioeconomic statuses to interact and build personal and civic connections. This diversity is essential for creating livable communities. The city's land use is primarily characterized as mixed-type settlement, with residential use dominating followed by road and transport, service, manufacturing and storage, recreation, commerce and trade, and urban agriculture. Other land use types include administration, mixed-use, and recreation. Commercial activity in Hawassa City is concentrated along major roads, with varying levels of employment density. However, parking space is inadequate in these areas, and the city needs to consider adding more parking spaces in busy commercial corridors such as Arab Sefer, Piazza, Old Bus Station, Sefere Selam, Atote Membo/Teacher's Training College (TTC), Hawassa Industrial Park (HIP), Hawassa University (HU), and the New Bus Station surroundings. Additionally, some of the back roads in these corridors are located very close to informal and dilapidated kebele houses.

4.2.1.5. *Local destinations*

The distance from home to the desired destination plays a crucial role in determining the walkability of a neighborhood. The goal is to assess the neighborhood's connectivity to local amenities, including shops, schools, recreational facilities, services, and commercial areas. According to the Time Saver Standards for accessibility, the maximum walking distance typically falls between 400m and 800m, which translates to a 5 to 10-minute walk. As previously noted, land use patterns are a vital aspect of accessibility. Walkable areas should have a compact and interconnected street pattern, with narrow roads and minimal parking facilities. Streets and paths need to provide a direct connection to local destinations that can be reached within a 5 to 10-minute walk. The presence of local amenities such as schools, markets, parks, religious institutions, and other services is a significant factor in achieving walkability, as discussed in the following section.

i. Average walking distance by pedestrians

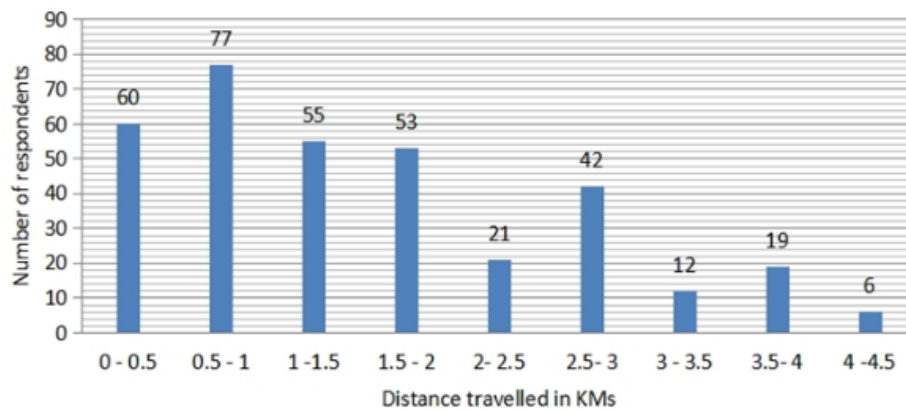


Figure 4. 29 Average walking distance to their destination Accessibility (Source: Adapted from SP report)

Based on the survey conducted by the municipality of Hawassa city planning department in 2021 adopted for this study. Pedestrians' average walking distance to their destination varies based on their location. Most respondents walking from St. Gabriel church(inner City) replied that their walking distance is less than 0.5 km to reach their destination. Most of the respondents from South Spring, Mobil, and Old Market(intermediate area) reported that they walked 0.5-1 km to reach their destination. Respondents from Monopol and referral hospitals(suburbs) reported that they walk relatively longer distances. The average walking distance of the pedestrians based on the survey data is 2.2 kilometers.

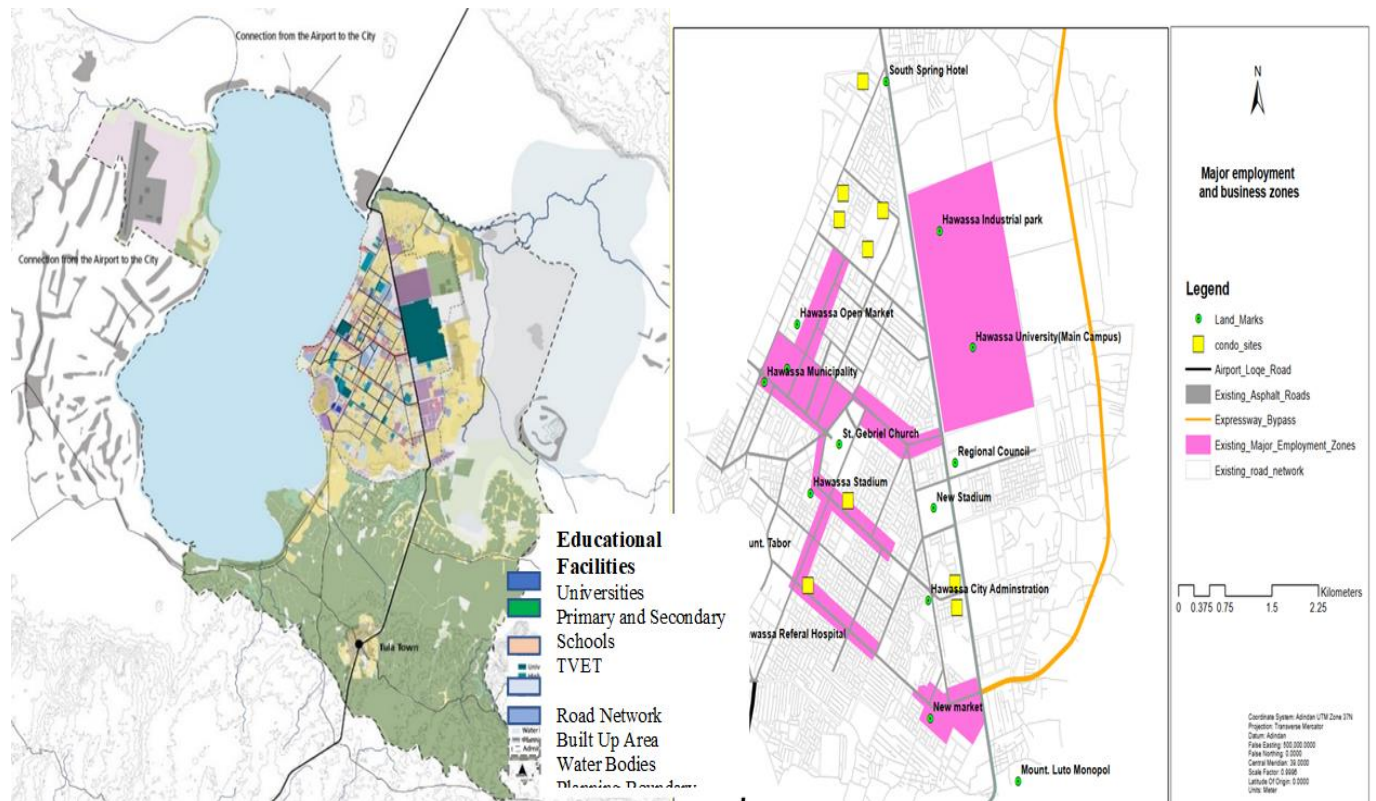


Figure 4. 30 Distribution of schools and surrounding employment land use(Source: Adapted from SP report)

A survey was conducted in the Inter Mediate area to determine the preferred mode of transportation for reaching different destinations. The results showed that a majority of the respondents preferred to walk. Specifically, 31.91 percent of the respondents walked to shops, 21.38 percent walked to a public transport stop, and 19.86 percent walked to religious institutions. In addition, around 14.18 percent and 11.35 percent of the respondents walked to schools and markets, respectively. Moreover, 19.15 percent of the respondents said they walked for leisure purposes.

The reasons for choosing to walk varied, but some of the common reasons were poor transport services, high transport costs, and longer waiting times to connect to a transport service. Respondents from the inner city regularly walked to their destinations, with 26.19 percent walking to shops, 20.63 percent walking to a public transport stop, and 18.25 percent walking to religious institutions. Furthermore, 24.6 percent walked to the place of exercise, 15.87 percent walked to schools, and 12.70 percent walked to markets. Finally, 17.46 percent of the respondents replied that they were walking for leisure.

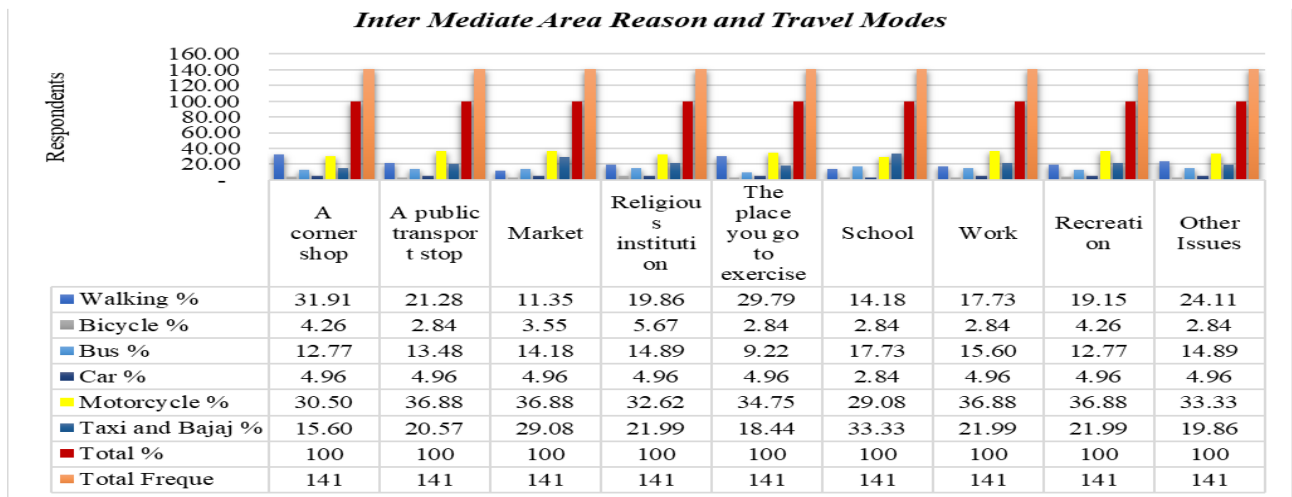
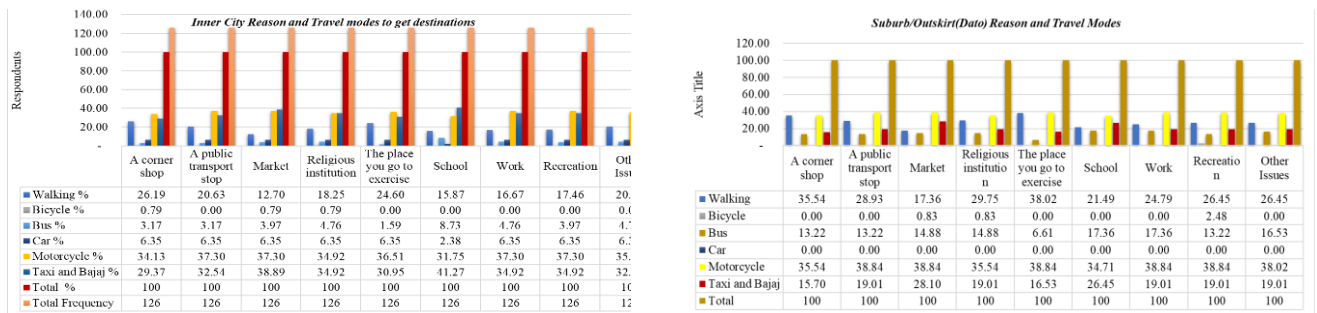


Figure 4. 31 The mode of travel and travel purpose of the neighborhoods (Source: Survey Result)

According to the survey results, a significant number of respondents residing in the Inter Mediate area prefer walking as a means of transportation. Out of all the respondents, approximately 31.91% reported that they walked to shops, while about 21.38% walked to public transport stops and roughly 19.86% walked to religious institutions. Additionally, around 14.18% and 11.35% of the respondents mentioned walking to schools and markets, respectively. Around 19.15% of the respondents stated that they walked for leisurely purposes.

ii. Walking Time and purpose

According to the city's structure plan report, the majority of respondents (59%) indicated that they walk between 5-10 minutes from their homes to reach transportation services. Only 1.4% reported walking a maximum of 40 minutes. On average, the walking time was found to be 13.3 minutes. The report further highlights that those traveling on the Dato, Chafe, Atote, and Gabriel routes have to walk the longest distance to reach public transportation services, with up to 40 minutes on foot. Conversely, the Nigest Fura route requires only a 5-minute walk to reach the stop. For more information, please refer to Table 4.31.

Table 4.31 provides additional details regarding the purpose of travel and walking time to the

destination. The reasons for travel are categorized as a corner shop/newsagent, public transport stop, market, religious institution, exercise, school, work, recreation, or other unspecified reasons. The travel time is further classified as less than 5 minutes, 5-10 minutes, 10-15 minutes, and more than 15 minutes. The destinations are classified into inner city (Arab Sefer), intermediate, suburb/outskirt (Dato), and total. The table reveals that people who go to a corner shop/newsagent, public transport stop, market, religious institution, or other unspecified reasons generally take less than 5 minutes to reach their destination. However, those headed to places of exercise, school, work, or recreation typically take more than 5 minutes. Furthermore, a higher number of people take more than 15 minutes to reach their destination in the inner city (Arab Sefer) and suburb/outskirt (Dato) categories compared to the intermediate category.

Table 4. 30 Purpose for Travel and Walking Time to Destination

Reason for Travel	Travel time to destination	Neighborhood						
		Inner City(Areb Sefer)		Inter mediate		Suburb/Outskirt(Dato)		Total
		Frequency	%	Frequency	%	Frequency	%	
A corner shop/newsagent	Less than 5min	27	21.43	19	13.48	10	8.26	56
	5 to 10min	29	23.02	36	25.53	10	8.26	75
	10 to 15min	20	15.87	36	25.53	35	28.93	91
	More than 15	50	39.68	50	35.46	66	54.55	166
A public transport stop	Less than 5min	27	21.43	23	16.31	10	8.26	60
	5 to 10min	27	21.43	28	19.86	11	9.09	66
	10 to 15min	20	15.87	35	24.82	33	27.27	88
	More than 15	52	41.27	55	39.01	67	55.37	174
A Market	Less than 5min	27	21.43	21	14.89	10	8.26	58
	5 to 10min	27	21.43	28	19.86	13	10.74	68
	10 to 15min	20	15.87	35	24.82	33	27.27	88
	More than 15	52	41.27	57	40.43	65	53.72	174
Religious Institution	Less than 5min	27	21.43	19	13.48	14	11.57	60
	5 to 10min	37	29.37	42	29.79	44	36.36	123
	10 to 15min	20	15.87	35	24.82	31	25.62	86
	More than 15	42	33.33	45	31.91	32	26.45	119
The place you go to exercise (e.g., a gym, stadium, or the park)	Less than 5min	27	21.43	19	13.48	11	9.09	57
	5 to 10min	43	34.13	39	27.66	14	11.57	96
	10 to 15min	17	13.49	32	22.70	33	27.27	82
	More than 15	39	30.95	51	36.17	63	52.07	153
School	Less than 5min	27	21.43	15	10.64	14	11.57	56
	5 to 10min	37	29.37	36	25.53	33	27.27	106
	10 to 15min	25	19.84	41	29.08	36	29.75	102
	More than 15	37	29.37	49	34.75	38	31.40	124
Work	Less than 5min	27	21.43	20	14.18	12	9.92	59
	5 to 10min	32	25.40	33	23.40	19	15.70	84

Reason for Travel	Travel time to destination	Neighborhood						Total
		Inner City(Areb Sefer)		Inter mediate		Suburb/Outskirt(Dato)		
		Frequency	%	Frequency	%	Frequency	%	
	10 to 15min	20	15.87	35	24.82	31	25.62	86
	More than 15	47	37.30	53	37.59	59	48.76	
Recreation	Less than 5min	27	21.43	19	13.48	14	11.57	60
	5 to 10min	38	30.16	34	24.11	26	21.49	98
	10 to 15min	20	15.87	42	29.79	36	29.75	98
	More than 15	41	32.54	46	32.62	45	37.19	132
Other issues not specified	Less than 5min	27	21.43	19	13.48	14	11.57	60
	5 to 10min	28	22.22	31	21.99	26	21.49	85
	10 to 15min	30	23.81	40	28.37	36	29.75	106
	More than 15	41	32.54	51	36.17	45	37.19	137

(Source: Survey Result)

4.2.2. Discussion of the walkability assessment and Findings

An analysis was conducted to evaluate the pedestrian experience in Hawassa City, taking into consideration safety, ease of navigation, comfort, diversity, and available destinations. The findings provided crucial insights into the walkability of the city. The study revealed that the inner-city and intermediate areas have a grid-like street pattern with a higher percentage of paved surfaces, making it safer for pedestrians. However, the suburban area has a less safe street pattern, with speeding being a significant issue leading to accidents. To ensure pedestrian safety, traffic calming measures are necessary. The survey identified illegal street parking, discontinuities, car entrances, and lack of traffic calming measures as the primary factors hindering walkability.

In Hawassa City, ensuring safe pedestrian infrastructure is a priority. Unfortunately, only 38% of the city has ramps for disabled individuals and 13% have speed-calming signs. Additionally, street lighting is lacking in suburban areas while intermediate neighborhoods have the highest percentage of available lighting at 31 (50.82%). To promote walking, adjustments to the main streets of the city should be made to eliminate any obstacles on the paths and ensure continuous pavement. Pedestrian safety is crucial, and factors such as building orientation, human scale, and street furniture need to be considered. Due to geological factors and potential seismic activity in the region, building heights are limited to 12 stories or ground plus eleven floors (G+11). Safety features such as sidewalks, medians, on-street parking, and parallel routes are present in the inner city and intermediate areas, but lacking in the suburbs where pedestrians are not separated from vehicles. The study also found that mixed purposes dominate footpath usage, with 95 instances, followed by street parking with 20 instances. A well-designed sidewalk with safe ramps,

appropriate elevation changes, and parapets that can withstand local weather conditions is crucial for ease of movement, particularly for those with disabilities. Commonly used materials include cobblestone (88%), Earthen (31%), Red Ash (1%), and Terrazzo Tile (4%).

The footpath flooring evaluation involved assessing various factors, including surface materials, smoothness, gradient, physical conditions, and floor continuity. To gather valuable insights into the comfort and deformation of pavement slabs in different neighborhoods, a survey was conducted, and the results were quite revealing. A significant number of participants disagreed with the notion that pavement slabs are not deformed and comfortable. Specifically, 119 strongly agreed, 81 Neutral d, 70 partially disagreed, 78 disagreed, and 40 strongly disagreed. Additionally, the lack of crossing facilities in the suburbs is a cause for concern. The inner city and intermediate areas have 19 and 30 crossings available, respectively, while none are available in the suburbs. The survey captured 388 responses, with varying levels of agreement or disagreement with the statement. Specifically, 100 individuals strongly disagreed, 99 disagreed, 73 Neutral d, 71 agreed, and 45 strongly agreed. It's essential to note that the presence of different types of vehicles on the roads can affect pedestrian safety. Large vehicles and motorcycles, as well as public transportation, can pose a danger to pedestrians. Figure 4.15 displays information on the number and percentage of incidents where pedestrians and other modes of transportation conflicted, categorized into four levels of severity: very low, low, medium, and high.

The city of Hawassa and its surrounding areas boast a variety of landmarks, environmental and architectural features, building forms, and junction continuity that greatly aid pedestrians in navigating public spaces. These features are especially helpful for those who move at a slower pace than other urban users. Notable streets and landmarks play a critical role in helping pedestrians keep track of their location within the city, and the differentiation, detail, and junctions of city-built forms contribute to the creation of simple yet unforgettable mental maps. However, a recent survey revealed that participants did not believe street furniture was sufficient in the Inner City (Areb Sefer), Intermediate area (Sefere Selam), and Suburb/outskirts (Dato), and that it could even obstruct pedestrian movement. Therefore, neighborhoods and side streets need to be well-connected and easy to navigate to ensure safe and efficient pedestrian movement throughout the city. While the public park located along the lake serves both citizens and tourists, it lacks connection with other public spaces and has limited continuity along the lake. Additionally, while

Hawassa has more green spaces than other cities in the country, not all of them offer the same services. Factors such as the placement and form of urban elements, distribution of services, connected public spaces, continuous street patterns, and comfort all contribute to the overall comfort of walking in Hawassa City. According to Table 4.26, the majority of respondents reported a medium level of security from criminals. While opinions differ based on the neighborhood, 76% of respondents agree that the street is safe at night with good lighting, and overall, people feel safe walking in their neighborhoods during the day.

According to the 2021 Structure Plan report by the Hawassa City Municipality, the city boasts a diverse range of housing types. The majority of the homes (75%) are single-story buildings, while a small percentage includes two-story (3.8%) and multi-story (19.8%) homes. This trend suggests that the city is expanding horizontally through low-density development, which requires more land. Hawassa is a vibrant city, with 65% of its population being under 25 years old and only 5.5% over 50 years old. The primary land use in Hawassa City is mixed-type settlement, with residential areas being the most common. Other land uses include road and transport, service, manufacturing and storage, recreation, commerce and trade, and urban agriculture. Commercial activities are mainly concentrated along major roads, but parking spaces are limited in these areas. Additionally, some back roads are near informal and dilapidated kebele houses.

The walkability of a neighborhood is determined by various factors, including the distance from home to the desired destination, local amenities, and land use patterns. The average walking distance can differ significantly depending on where the pedestrian is located. As per the Hawassa City Planning Department, pedestrians from St. Gabriel Church reported a distance of less than 0.5 km to reach their destination, while respondents from South Spring, Mobil, and Old Market walked 0.5-1 km. Respondents from Monopol and referral hospitals walked longer distances, with an average of 2.2 kilometers. According to the city's structure plan report, the majority of respondents walked for 5-10 minutes from their homes to access transport services, with only 1.4 percent reporting a maximum walking time of 40 minutes. On average, pedestrians walked for 13.3 minutes, with the longest walking time for passengers from the Dato, Chafe, Atote, and Gabriel routes taking up to 40 minutes. The Nigest Fura route was the shortest, with only a 5-minute walk to access the stop.

Table 4. 31 Summary of Observations and Survey Result

<i>Major Walkability Indicators</i>	<i>Inner-city</i>	<i>Intermediate</i>	<i>Suburbs</i>
<i>Footpath quality</i>	The most footpaths are well-maintained	The most footpaths are well-maintained	Poor footpath quality
<i>Street lighting and Visibility</i>	There is adequate street lighting and visibility	There is adequate street lighting and visibility	Not Available
<i>Safe Pedestrian crossings</i>	Lack of safe pedestrian crossing	Lack of safe pedestrian crossing	No safe pedestrian crossing at all
<i>Even slope or Gradient along the route</i>	Level variations along the sidewalks are safe, and separation from vehicles-	Level variations along the sidewalks are safe, and separation from vehicles-	No level difference and separation
<i>A route is continuous</i>	Lack continuity	Lack continuity	Not continuous
<i>Well-connected street network easily accessible to facilities and services</i>	Well-connected street easily accessible to facilities and services	Well-connected street easily accessible to facilities and services	Not Connected Not easily accessible to facilities and services
<i>Proximity to destinations Schools/ shops/ other local services/ public transport</i>	Most services are within walking distance	Most services are within walking distance	Are more than 10 minutes
<i>There are Mixed land uses</i>	Commercial-dominated mixed land use	Residence-dominated mixed land use	Not Mixed
<i>Safe from Crime</i>	Safe from Crime a day	Safe from Crime a day	Not Safe from Crime
<i>Social Policing from Passing Traffic</i>	Not regulated	Not regulated	Not regulated
<i>Feel safe when walking</i>	Other People usually Walking on the streets	Other People usually Walking on the streets	Other People usually Walking on the streets
<i>Building orientation</i>	The Routes are Overlooked by fence	The Routes are Overlooked by fence	The Routes are Overlooked by fence
<i>Good street and path lighting</i>	There are no obstacles along the sidewalks- Sufficient sight clearance	There are no obstacles along the sidewalks- Sufficient sight clearance	There are obstacles along the sidewalks- insufficient sight clearance
<i>Safety from Traffic or Separated</i>	Most local streets are not separated from traffic	Most local streets are not separated from traffic	Not separated
<i>Availability of Street furniture to stop and rest</i>	Street furniture is insufficient Street furniture obscures pedestrian movement,	Street furniture is insufficient Street furniture obscures pedestrian movement,	Not available on all streets
<i>Familiar faces when walking</i>	New faces when walking	New faces when walking	Familiar faces when walking
<i>Sidewalks width</i>	Sidewalks are wide enough – Sidewalk width	Sidewalks are wide enough – Sidewalk width	Not available
<i>Pavement quality</i>	The pavement slabs are not deformed	The pavement slabs are not deformed	The pavement slabs are deformed
<i>pavement- Continuity</i>	Not continuous	Continuous	disturb pedestrian movement
<i>Accessible</i>	There are many alternative routes for getting from place to place in my neighborhood by walking	There are many alternative routes for getting from place to place in my neighborhood by walking	Not accessible

(Source: Survey and observation Results)

4.3. *Parameters for Local Walkability Index*

To create livable urban environments, it is crucial to prioritize walkability. This means designing and maintaining streets that are safe and convenient for pedestrians. Walkable streets offer numerous benefits, including transportation options, reduced air pollution, increased physical activity, and social spaces for people. In addition, they improve community livability, economic development, public health, and efficient land use. Therefore, cities must invest in infrastructure such as sidewalks, lighting, and crosswalks, and implement policies that encourage pedestrian-friendly design while discouraging the use of cars. To measure the walkability of Hawassa City, a study identified 34 indicators across five factors to determine the local walkability index. These factors included well-maintained footpaths with street lighting and good visibility, safe pedestrian crossings, a continuous route with a well-connected street network, and easy accessibility to facilities and services. Additionally, the study considered proximity to destinations like schools, shops, and public transport, mixed land uses, safety from crime, social policing from passing traffic and pedestrians, good street and path lighting, safety from traffic, availability of street furniture to rest, and familiarity of faces when walking. To measure walkability, a comprehensive index was developed by assigning weights to relevant indicators before combining them. During the walkability audit, factors such as sidewalk width, undistorted pavement, unobstructed movement paths, separated and secure sidewalks, ample street furniture, pleasing store signs, traffic calming measures, well-lit and safe streets at night, sufficient greenery and trees that don't impede pedestrian movement, safe crossings, good quality flooring, accessible transit stops, multiple walking routes, and a feeling of safety while walking during the day were considered as weighting parameter. The reliability of built environment indicators used in the LWI was tested using Cronbach's Alpha and SPSS 26, and they showed acceptable to high reliability across all studied neighborhoods, as seen in Table 4.33 on the next page.

Table 4. 32 Parameters Developed from the Assessment to Measure Walkability

Safety	Orientation	Comfort	Diversity	Destinations
<ul style="list-style-type: none"> ✓ The footpaths are well-maintained ✓ Street lighting and Visibility ✓ Safe Pedestrian crossings ✓ Even slope or Gradient along the route ✓ A is route continuous ✓ Sidewalks are wide enough ✓ The pavement slabs are not deformed ✓ Traffic signs on the streets are sufficient for calming ✓ It is a safe street at night, with good lighting ✓ Safe Crossings ✓ Good floor quality ✓ I feel safe walking in my neighborhood during the day 	<ul style="list-style-type: none"> ✓ Well-connected street network ✓ The Routes are Overlooked by Buildings ✓ Good street and path lighting ✓ Availability of Street furniture to stop and rest ✓ Street furniture is sufficient ✓ Store signs aesthetically disturb pedestrians ✓ There is enough greenery in the street ✓ The sidewalks are safe and separated from vehicles. 	<ul style="list-style-type: none"> ✓ Safe from Crime ✓ Social Policing from Passing Traffic ✓ Other People usually Walking on the streets ✓ Safety from Traffic or Separated ✓ continuous pavement does not disturb movement ✓ There are no obstacles along the sidewalks ✓ It is a well-lit street at night ✓ The trees disturb pedestrian movement 	<ul style="list-style-type: none"> ✓ There are Mixed land uses ✓ Familiar faces when walking 	<ul style="list-style-type: none"> ✓ Easily accessible to facilities and services ✓ Proximity to destinations ✓ There are many alternative routes for getting from place to place in my neighborhood by walk ✓ It is easy for me to walk to a transit stop walking

(Source: Summarized Survey and observation Results for this thesis)

Table 4. 33 Internal Consistency Test Using Cronbach's Alpha (Inter-Item Correlation Matrix)

Walkability Indicators	The footpaths are well-maintained	Street lighting and Visibility	Safe Pedestrian crossings	Even slope or Gradient along the route	A is route continuous	Well-connected street network	Early access to facilities and services	Proximity to destinations Schools/ shops/ other local destinations	There are Mixed land uses	Safe from Crime	Social Policing from Passing Traffic	Other People usually Walking on the streets	The Routes are Overlooked by Buildings	Good street and path lighting	Safety from Traffic or Separated	Availability of Street furniture to stop and rest	Familiar faces when walking
1 <i>The footpaths are well-maintained</i>	1.000	0.967	0.595	0.660	0.563	0.690	0.650	0.664	0.666	0.660	0.679	0.677	0.734	0.709	0.689	0.662	0.607
2 <i>Street lighting and Visibility</i>	0.967	1.000	0.589	0.647	0.563	0.651	0.614	0.650	0.635	0.633	0.645	0.640	0.690	0.685	0.663	0.632	0.583
3 <i>Safe Pedestrian crossings</i>	0.595	0.589	1.000	0.620	0.634	0.752	0.675	0.765	0.739	0.726	0.679	0.651	0.656	0.762	0.680	0.687	0.676
4 <i>Even slope or Gradient along the route</i>	0.660	0.647	0.620	1.000	0.684	0.707	0.679	0.749	0.686	0.733	0.703	0.714	0.745	0.694	0.768	0.688	0.654
5 <i>A is route continuous</i>	0.563	0.563	0.634	0.684	1.000	0.661	0.682	0.737	0.675	0.685	0.670	0.644	0.698	0.661	0.707	0.654	0.630
6 <i>Well-connected street network</i>	0.690	0.651	0.752	0.707	0.661	1.000	0.789	0.815	0.840	0.780	0.755	0.741	0.775	0.795	0.772	0.738	0.727
7 <i>Easily accessible to facilities and services</i>	0.650	0.614	0.675	0.679	0.682	0.789	1.000	0.818	0.793	0.744	0.775	0.756	0.830	0.804	0.786	0.728	0.738
8 <i>Proximity to destinations</i>	0.664	0.650	0.765	0.749	0.737	0.815	0.818	1.000	0.822	0.809	0.763	0.772	0.806	0.826	0.803	0.795	0.755
9 <i>There are Mixed land uses</i>	0.666	0.635	0.739	0.686	0.675	0.840	0.793	0.822	1.000	0.808	0.780	0.748	0.777	0.806	0.815	0.766	0.800
10 <i>Safe from Crime</i>	0.660	0.633	0.726	0.733	0.685	0.780	0.744	0.809	0.808	1.000	0.774	0.748	0.748	0.788	0.842	0.814	0.773
11 <i>Social Policing from Passing Traffic</i>	0.679	0.645	0.679	0.703	0.670	0.755	0.775	0.763	0.780	0.774	1.000	0.748	0.788	0.789	0.759	0.763	0.737
12 <i>Other People usually Walking on the streets</i>	0.677	0.640	0.651	0.714	0.644	0.741	0.756	0.772	0.748	0.748	0.748	1.000	0.829	0.783	0.778	0.767	0.716
13 <i>The Routes are Overlooked by Buildings</i>	0.734	0.690	0.656	0.745	0.698	0.775	0.830	0.806	0.777	0.748	0.788	0.829	1.000	0.813	0.811	0.772	0.780
14 <i>Good street and path lighting</i>	0.709	0.685	0.762	0.694	0.661	0.795	0.804	0.826	0.806	0.788	0.789	0.783	0.813	1.000	0.776	0.791	0.748
15 <i>Safety from Traffic or Separated</i>	0.689	0.663	0.680	0.768	0.707	0.772	0.786	0.803	0.815	0.842	0.759	0.778	0.811	0.776	1.000	0.771	0.801
16 <i>Availability of Street furniture to stop and rest</i>	0.662	0.632	0.687	0.688	0.654	0.738	0.728	0.795	0.766	0.814	0.763	0.767	0.772	0.791	0.771	1.000	0.769
17 <i>Familiar faces when walking</i>	0.607	0.583	0.676	0.654	0.630	0.727	0.738	0.755	0.800	0.773	0.737	0.716	0.780	0.748	0.801	0.769	1.000

		Sidewalks are wide enough	The pavement slabs are not deformed	continuous pavement does not disturb movement,	There are no obstacles along the sidewalks Poles, Vending, and Other	The sidewalks are safe and separated from vehicles	Street furniture is sufficient	Store signs aesthetically disturb pedestrians	Traffic signs on the streets are sufficient for calming	It is a well-lit street at night	It is a safe street at night, with good lighting	There is enough greenery in the street.	The trees disturb pedestrian movement	Safe Crossings	Good floor quality	It is easy for me to walk to a transit stop	There are many alternative routes for getting from place to place in my neighborhood during the day	I feel safe walking in my neighborhood during the day
18	<i>Sidewalks are wide enough</i>	1	0.98	0.933	0.873	0.857	0.863	0.821	0.882	0.857	0.893	0.885	0.862	0.861	0.844	0.858	0.798	0.787
19	<i>The pavement slabs are not deformed</i>	0.98	1	0.954	0.889	0.866	0.877	0.841	0.888	0.858	0.898	0.89	0.865	0.873	0.856	0.87	0.791	0.795
20	<i>continuous pavement does not disturb movement,</i>	0.933	0.954	1	0.878	0.855	0.866	0.815	0.862	0.837	0.855	0.855	0.831	0.839	0.817	0.831	0.769	0.77
21	<i>There are no obstacles along the sidewalks Poles, Vending, and Other</i>	0.873	0.889	0.878	1	0.961	0.972	0.935	0.972	0.943	0.963	0.963	0.949	0.954	0.935	0.947	0.878	0.882
22	<i>The sidewalks are safe and separated from vehicles</i>	0.857	0.866	0.855	0.961	1	0.962	0.935	0.959	0.941	0.959	0.967	0.947	0.94	0.924	0.933	0.866	0.879
23	<i>Street furniture is sufficient</i>	0.863	0.877	0.866	0.972	0.962	1	0.935	0.965	0.958	0.961	0.964	0.933	0.933	0.91	0.922	0.867	0.876
24	<i>Store signs aesthetically disturb pedestrians</i>	0.821	0.841	0.815	0.935	0.935	0.935	1	0.928	0.941	0.926	0.93	0.903	0.914	0.911	0.918	0.888	0.868
25	<i>Traffic signs on the streets are sufficient for calming</i>	0.882	0.888	0.862	0.972	0.959	0.965	0.928	1	0.957	0.982	0.978	0.961	0.951	0.943	0.946	0.877	0.889
26	<i>It is a well-lit street at night</i>	0.857	0.858	0.837	0.943	0.941	0.958	0.941	0.957	1	0.967	0.962	0.937	0.926	0.914	0.922	0.9	0.897
27	<i>It is a safe street at night, with good lighting</i>	0.893	0.898	0.855	0.963	0.959	0.961	0.926	0.982	0.967	1	0.991	0.962	0.958	0.943	0.953	0.885	0.902
28	<i>There is enough greenery in the street.</i>	0.885	0.89	0.855	0.963	0.967	0.964	0.93	0.978	0.962	0.991	1	0.962	0.966	0.943	0.953	0.885	0.893
29	<i>The trees disturb pedestrian movement</i>	0.862	0.865	0.831	0.949	0.947	0.933	0.903	0.961	0.937	0.962	0.962	1	0.97	0.964	0.963	0.891	0.903
30	<i>Safe Crossings</i>	0.861	0.873	0.839	0.954	0.94	0.933	0.914	0.951	0.926	0.958	0.966	0.97	1	0.973	0.976	0.901	0.885
31	<i>Good floor quality</i>	0.844	0.856	0.817	0.935	0.924	0.91	0.911	0.943	0.914	0.943	0.943	0.964	0.973	1	0.988	0.91	0.9
32	<i>It is easy for me to walk to a transit stop</i>	0.858	0.87	0.831	0.947	0.933	0.922	0.918	0.946	0.922	0.953	0.953	0.963	0.976	0.988	1	0.923	0.898
33	<i>There are many alternative routes for getting from place to place in my neighborhood by walking</i>	0.798	0.791	0.769	0.878	0.866	0.867	0.888	0.877	0.9	0.885	0.885	0.891	0.901	0.91	0.923	1	0.846
34	<i>I feel safe walking in my neighborhood during the day</i>	0.787	0.795	0.77	0.882	0.879	0.876	0.868	0.889	0.897	0.902	0.893	0.903	0.885	0.9	0.898	0.846	1

S/N	Cronbach's alpha, α	Internal consistency
1	$\alpha \geq 0.8$	Excellent
2	$0.8 > \alpha \geq 0.7$	Good
3	$0.7 > \alpha \geq 0.5$	Satisfactory
4	$\alpha < 0.5$	Poor

As shown in Appendix A1 the first 17 walkability indicators related to factors that affect walkability in Hawassa city, as well as the inner-city, the intermediate, and the suburbs are rated. The summary of the weighted score is shown below in Table 4.34.

Table 4. 34 Summary of Weighted score for local Walkability Index 1

	<i>Walkability Indicators</i>	<i>Neighborhoods</i>			<i>Whole City</i>
		<i>Inner City(Areb Sefer)</i>	<i>Inter mediate(Sefere Selam)</i>	<i>Suburb/Outskirt(Dato)</i>	<i>Total</i>
1	The footpaths are well-maintained	3.60	4.06	1.34	3.28
2	Street lighting and Visibility	3.11	3.87	1.41	3.02
3	Safe Pedestrian crossings	3.71	3.57	1.67	3.02
4	Even slope or Gradient along the route	4.12	3.98	1.47	3.50
5	A is route continuous	3.61	3.87	1.74	3.18
6	Well-connected street network	3.75	3.93	1.97	3.26
7	Easily accessible to facilities and services	3.49	3.99	1.98	3.20
8	Proximity to destinations Schools/ shops/ other local services/ public transport	4.53	4.56	1.69	3.77
9	There are Mixed land uses	4.39	4.50	1.79	3.73
10	Safe from Crime	4.25	4.50	1.69	3.71
11	Social Policing from Passing Traffic	4.16	4.33	1.99	3.61
12	Other People usually Walking on the streets	4.06	3.96	1.69	3.42
13	The Routes are Overlooked by Buildings	3.70	4.01	1.72	3.19
14	Good street and path lighting	3.86	4.22	1.73	3.32
15	Safety from Traffic or Separated	3.62	4.01	1.96	3.24
16	Availability of Street furniture to stop and rest	2.66	3.11	1.69	2.52
17	Familiar faces when walking	3.92	4.18	2.28	3.50
	Total out of 85%	64.55	68.64	29.80	56.48
	Average out of 5	3.80	4.04	1.75	3.32
	Total out of 100%	75.94	80.75	35.06	66.44

(Source: Survey Result)

As shown in Appendix A1 the other 17 walkability indicators related to facilities that affect walkability in Hawassa city, as well as the inner-city, the intermediate, and the suburbs are rated. The summary of the weighted score is shown below in Table 3.35.

Table 4. 35 Summary of Weighted Score for Local Walkability Index 2

	<i>Walkability Indicators</i>	<i>Neighborhoods</i>			<i>Whole city</i>
		<i>Inner City(Areb Sefer)</i>	<i>Inter mediate(Sefere Selam)</i>	<i>Suburb/Outskirt(Dato)</i>	
18	Sidewalks are wide enough	3.67	4.02	1.93	3.26
19	The pavement slabs are not deformed	3.47	3.52	1.98	3.02
20	Continuous pavement does not disturb movement,	2.67	3.21	1.96	2.64
21	There are no obstacles along the sidewalks Poles, Vending, and Other	3.25	3.44	1.93	2.91
22	The sidewalks are safe and separated from vehicles	3.39	3.40	1.92	2.93
23	Street furniture is sufficient	2.45	2.57	1.78	2.29
24	Store signs aesthetically disturb pedestrians	3.50	3.41	1.98	2.99
25	Traffic signs on the streets are sufficient for calming	3.53	3.48	1.79	2.97
29	It is a well-lit street at night	3.25	3.49	1.91	2.92
27	It is a safe street at night, with good lighting	3.48	3.51	1.75	2.95
28	There is enough greenery in the street.	3.48	3.47	1.79	2.95
29	The trees disturb pedestrian movement	3.55	3.48	2.19	3.10
30	Safe Crossings	3.50	3.43	1.88	2.97
31	Good floor quality	3.57	3.43	1.60	2.90
32	It is easy for me to walk to a transit stop	3.52	3.43	2.19	3.07
33	There are many alternative routes for getting from place to place in my neighborhood by walking	3.51	3.52	1.82	2.99
34	I feel safe walking in my neighborhood during the day	3.54	3.64	1.93	3.07
	Total out of 85%	57.33	58.47	32.32	49.94
	Average out of 5%	3.37	3.44	1.90	2.94
	Total out of 100%	67.44	68.79	38.03	58.76

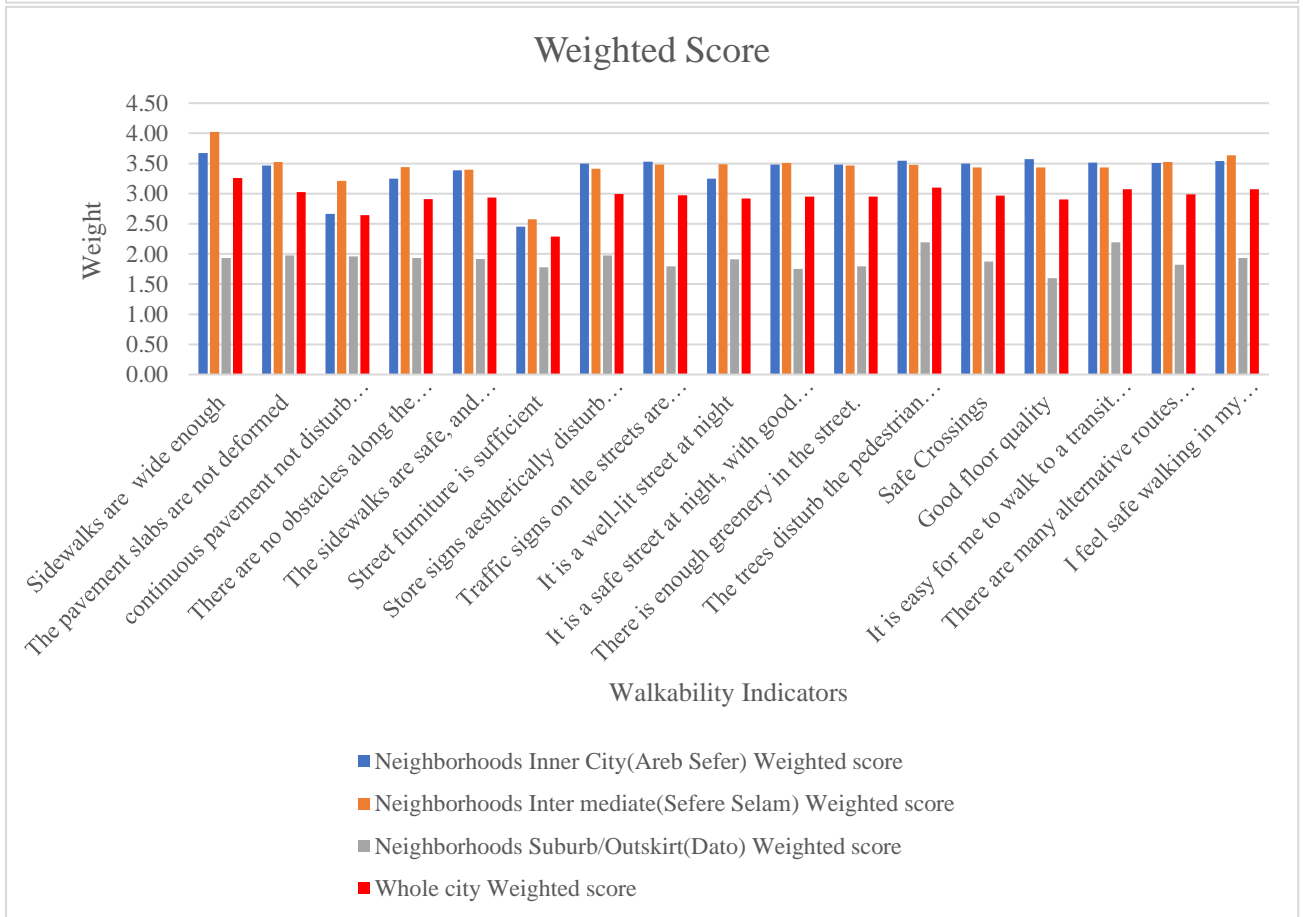
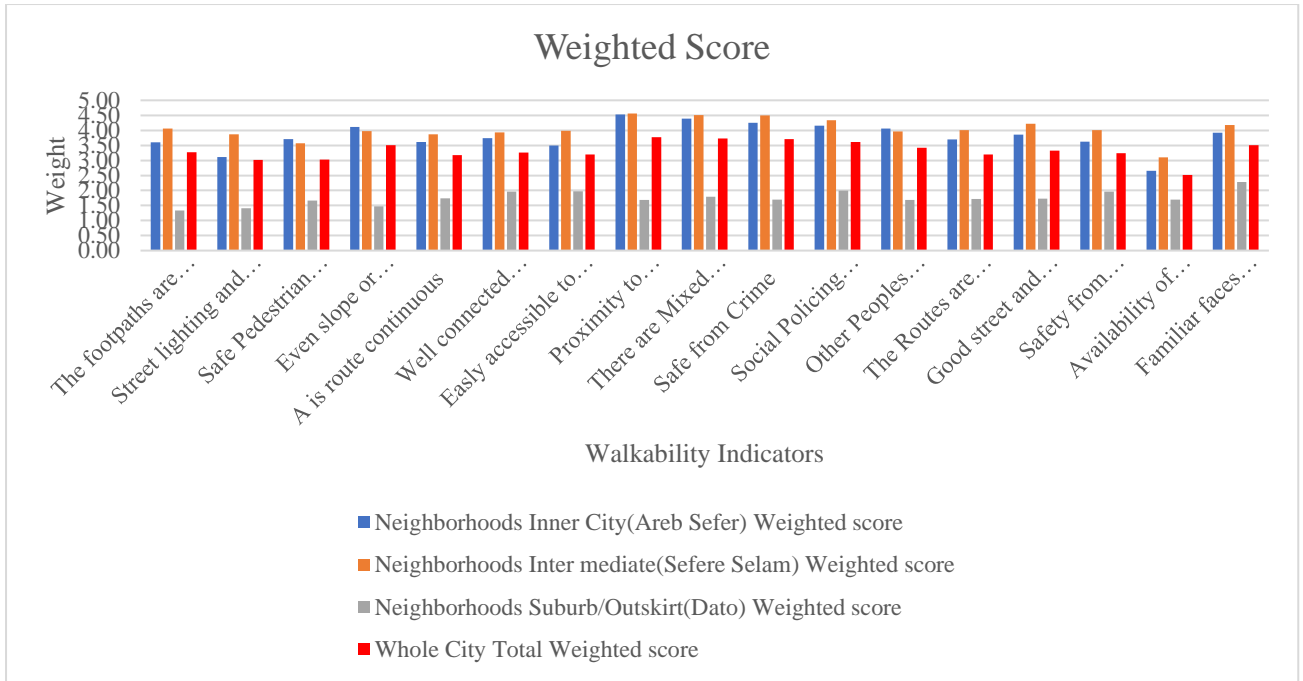


Figure 4. 32 Weighed walk score of indicators (Source: Survey Result)

Table 4. 36 Summary of the Computed Local Walkability Index of Hawassa City

<i>Local Walkability Index computed from the indicators related to walkability factors</i>				
	Inner City(Areb Sefer)	Inter mediate(Sefere Selam)	Suburb/Outskirt(Dato)	Whole city
Total out of 85%	64.55	68.64	29.8	56.48
Average out of 5	3.8	4.04	1.75	3.32
Total out of 100%	75.94	80.75	35.06	66.44
<i>The Walkability Index computed from the indicators related to the Facility</i>				
	Inner City(Areb Sefer)	Inter mediate(Sefere Selam)	Suburb/Outskirt(Dato)	Whole city
Total out of 85%	57.33	58.47	32.32	49.94
Average out of 5	3.37	3.44	1.9	2.94
Total out of 100%	67.44	68.79	38.03	58.76
<i>Average Walkability Index computed from the 34 indicators</i>				
	Inner City(Areb Sefer)	Inter mediate(Sefere Selam)	Suburb/Outskirt(Dato)	Whole city
Total out of 85%	60.94	63.555	31.06	53.21
Average out of 5	3.585	3.74	1.825	3.32
Total out of 100%	71.69	74.77	36.545	62.6

(Source: Survey Result)

4.3.1. Discussion on the local walkability index

The tables and appendices above show a weighted score out of 5 for the overall city, inner city, intermediate, and suburbs of Hawassa. The walk score was determined by evaluating 34 indicators such as pavement quality, sidewalk width, pedestrian safety, and availability of street furniture. The study also considered aesthetic disturbances caused by traffic and store signs, street lighting at night, greenery presence, obstruction of pedestrian movement by trees, safe crossings, floor quality, ease of walking to transit stops, availability of alternative walking routes, and pedestrian safety during the day. The study calculated the weighted scores for each feature in every neighborhood and combined them to obtain an overall weighted score of 85%. Additionally, the study calculated the average weighted score out of 5 for all neighborhoods and the total weighted score out of 100% for each neighborhood by combining all indicators.

The findings revealed that the Inner City and Intermediate neighborhoods had the highest overall weighted scores of 67.44% and 68.79%, respectively. The Suburb/Outskirt neighborhood had the lowest overall weighted score of 38.03%, while the entire city scored 58.76%. Based on the indicators, the Inner City and Intermediate neighborhoods had the highest overall weighted scores transformed into 100% (57.33% and 58.47%, respectively). The Suburb/Outskirt neighborhood had the lowest overall weighted score of 32.32%, while the entire city scored 49.94.

Table 4. 37 The Average, Maximum, and Minimum Local Walkability Index(LWI) computed from the factors and walkability indicators

	Inner City(Areb			Intermediate (Sefere			Suburb/Outskirt(D			Overall city		
	Mini mum	Maxi mum	Ave rag e	Mini mum	Maxi mum	Ave rag e	Mini mum	Maxi mum	Ave rag e	Mini mum	Maxi mum	Ave rag e
Total out of 85%	57.3	64.5	60.9	58.4	68.6	63.5	29.8	32.3	31.0	49.9	56.4	53.2
Average out of 5	3	5	4	7	4	5		2	6	4	8	1
	3.37	3.8	3.58	3.44	4.04	3.74	1.75	1.9	1.82	2.94	3.32	3.13
Total out of 100%	67.4	75.9	71.6	68.7	80.7	74.7	35.0	38.0	36.5	58.7	64.4	62.6
	4	4	9	9	5	7	6	3	4	6	4	

(Source: Survey Result)

4.3.2. Finding of the LWI

Based on the findings, it appears that the suburbs of the city are not designed for walking and lack pedestrian-friendly infrastructure. Specifically, the Dato suburbs and outskirts have an LWI ranging from 35.06 to 38.03, with an average of 36.54, indicating that driving is necessary for most activities. Meanwhile, the Inner City, also known as Arab Sefer, has an LWI ranging from 67.44 to 75.94, with an average of 71.69, indicating moderate walkability. The Sefere Selam neighborhood has an LWI ranging from 68.79 to 80.75, with an average of 74.77, indicating it is mostly walkable.

In summary, the LWI of the neighborhoods is as follows:

- ✓ The Inner City, also referred to as Arab Sefer, has a moderate LWI ranging from 67.44 to 75.94, with an average of 71.69. This means it is suitable for those comfortable with walking a few miles to access various amenities.
- ✓ The Sefere Selam neighborhood has a mostly walkable LWI ranging from 68.79 to 80.75, with an average of 74.77, allowing residents to run errands within a reasonable walking distance.
- ✓ The Dato suburbs and outskirts have a low LWI ranging from 35.06 to 38.03, with an average of 36.54, indicating the need for a car for transportation. These homes and apartments are typically situated on the outskirts of big cities, where urban facilities require a vehicle to reach.
- ✓ Overall, Hawassa City has a moderate LWI ranging from 58.76 to 64.44, with an average of 62.6, indicating that it is moderately walkable.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion Remarks

This study, conducted on the walkability assessment of selected streets and neighborhoods in Hawassa City, has identified key factors that are essential in creating a pedestrian-friendly area. To achieve walkability, safety, orientation, comfort, diversity, and access to local destinations must be considered in a locality. Developing a local walkability index for the city is not only important but also necessary to evaluate the pedestrian experience in various parts of Hawassa and identify areas that require improvement. By enhancing walkability, we can promote sustainable urban development and create healthier and more livable communities. Therefore, urban designers, policymakers, and city planners can utilize the findings from this research as a guide to design and create more walkable streets and neighborhoods for the benefit of all residents and visitors to Hawassa. Critical to enhancing pedestrian comfort are well-maintained sidewalks, safety measures, adequate lighting, access to amenities, greenery, and seating areas. Other fundamental factors that play a significant role in determining walkability are social, physical, and economic diversity. Neighborhoods that embrace these factors promote a healthy, active, and thriving community. The walkability of streets and neighborhoods is greatly influenced by the availability and proximity of local destinations. Creating a walkable environment involves a mix of land uses, higher density, accessibility, proximity, amenities, street connectivity, and safety. By focusing on these factors, we can build more vibrant and walkable neighborhoods that support the well-being of individuals and communities, ultimately resulting in a vibrant, pedestrian-friendly, and active neighborhood.

Various factors were studied to determine pedestrian safety in Hawassa City, including street patterns, traffic calming measures, lighting, visibility, pavement quality, pedestrian separation, continuous pavement, street enclosure, street crossing, and vehicle mix. The study analyzed the different neighborhoods of the city, which included the inner city, intermediate, and suburban areas. The research concluded that the inner city and intermediate neighborhoods were relatively safe for pedestrians, while the suburbs, specifically Dato, posed more risks. The study showed that prioritizing safety measures in neighborhoods encourages more walking and reduces accidents. Key factors that contribute to pedestrian safety include proper lighting, well-maintained sidewalks, clear sightlines, and reduced vehicle speeds. The intermediate area of the city was found to be relatively safe and walkable. The study also revealed that urban structures, such as street patterns, traffic control, and built forms, play a significant role in

pedestrian safety and comfort in all neighborhoods. While local cobblestone roads had speed breaks and speed limit signs, major roads lacked such traffic-calming measures. Additionally, the suburb of Dato had no lighting or visibility, while the intermediate neighborhood of Sefere Selam had the highest percentage of available lighting. Factors such as street width, on-street parking, street trees, and pavement continuity also helped to slow down traffic. While 66% of the streets had footpaths ranging from 1 meter to 7.7 meters wide, 34% had no footpaths at all. High-rise buildings were appropriately positioned towards footpaths in most parts of the city, creating safe and functional pedestrian areas. However, in the suburbs, there were no separate walkways or medians for pedestrians.

In any urban environment, walkability plays a crucial role in promoting physical activity, reducing traffic congestion, improving air quality, and encouraging social interactions. Pedestrian comfort is a key factor that influences walkability, encompassing the ease, safety, and enjoyment of walking in a particular area. Several elements contribute to pedestrian comfort, ultimately shaping the overall walkability of a neighborhood. Based on survey findings, Inner City (Areb Sefer) and Intermediate (Sefere Selam) neighborhoods boast relatively higher sidewalk quality. Survey participants generally found these sidewalks to be comfortable and easy to traverse. However, in the Suburb/Outskirt (Dato) neighborhood, more respondents had reservations about the quality of the sidewalks.

The walkability of streets and neighborhoods is influenced by several factors, including social, physical, and economic diversity. These three aspects are closely linked and play a crucial role in promoting and maintaining walkable urban environments. Below are some of the key factors related to social, physical, and economic diversity that affect walkability:

Social diversity refers to the presence of different ethnic, cultural, and socio-economic groups within a community. A diverse community promotes inclusivity, social cohesion, and a sense of community, which are essential for a walkable neighborhood. A community that embraces social diversity is more likely to have welcoming public spaces, streetscapes, and community amenities that cater to a broad range of individuals and are accessible to everyone. The physical diversity of a neighborhood contributes significantly to its walkability. Neighborhoods that have a mix of land uses, different types of buildings, and mixed housing options create a lively and dynamic streetscape that encourages walking. A diverse mix of commercial, residential, and office spaces fosters a vibrant community and enhances the walkability of the area. The economic diversity of a neighborhood is a crucial factor in promoting walkability. A

neighborhood with diverse employment opportunities, affordable housing options, and accessible public transport options allows individuals to live, work, and play in the same community. This reduces the need for car travel, promotes physical activity, and fosters a strong local economy.

The concept of orientation has been thoroughly examined concerning legibility, landmarks, and built form. By providing clear signage, recognizable landmarks, and well-designed urban features, pedestrians can navigate and orient themselves with ease, resulting in an overall better walking experience. Hawassa City boasts significant landmarks and pathways in the Inner City and Intermediate neighborhoods, which assist pedestrians in finding their way and avoiding confusion. While these areas have a multitude of landmarks, maintaining consistent differentiation throughout the city is essential to prevent any confusion. Our observations and data collection reveal that most streets in the inner city and intermediate areas are well-equipped to protect pedestrians from inclement weather. However, we could not obtain information on disabled infrastructure, air quality, and traffic control in the Suburb (Dato) neighborhood.

Public spaces, such as parks, plazas, and community centers, are essential in promoting walkability. They provide opportunities for social interaction, physical activity, and relaxation, contributing to a healthy and active community. The quality of public spaces is equally crucial since it creates a sense of place, encouraging individuals to explore and walk around their neighborhood. The human scale is a vital factor that impacts walkability. A neighborhood designed at a human scale, with buildings and streetscapes of similar size, fosters a more welcoming and accessible environment for pedestrians. Wider sidewalks, street furniture, and street trees reflect a human scale, making the surroundings more attractive and inviting for people to walk and enjoy the area.

The walkability of streets and neighborhoods is greatly influenced by the availability and proximity of local destinations. When local destinations are closer and more diverse, people are more likely to walk instead of relying on vehicles. A mix of different land uses within a neighborhood is an important factor in promoting walkability. The proximity of local destinations to residential areas greatly affects walkability. When essential destinations like schools, workplaces, grocery stores, and parks are located within a reasonable distance from homes, people are more inclined to walk instead of driving. Shorter distances reduce travel time, making walking a more convenient and attractive option. When there are multiple

destinations within walking distance, individuals are more likely to incorporate walking into their daily routines. The presence of desirable amenities within walking distance positively impacts walkability. Neighborhoods that offer quality parks, playgrounds, libraries, community centers, and other public spaces enhance the overall experience of walking. These amenities provide destinations and attract people to take regular walks, improving both physical and mental well-being.

The density of a neighborhood plays a significant role in its walkability, as higher population densities tend to support a greater number of local destinations within a smaller area. This increases the convenience and feasibility of walking. In densely populated neighborhoods, it is easier for individuals to access a range of amenities on foot, reducing the need for vehicular travel. The accessibility of local destinations is crucial for promoting walkability. Walkable streets and well-maintained sidewalks that provide direct and safe routes to local destinations encourage people to walk. Easy access to public transportation and bike lanes also enhances the accessibility of local destinations, enabling individuals to choose active transportation options.

In the study, a local walkability index was determined by utilizing Likert scales that assigned weights to relevant and important indicators and then combined them. The reliability of the built environment indicators used in the LWI was ensured through an internal consistency test using Cronbach's alpha with SPSS 26. The findings showed that the inner-city area has a local walkability index ranging from 67.44 to 75.94, with an average of 71.69, indicating moderate walkability. The intermediate area has a local walkability index ranging from 68.79 to 80.75, with an average of 74.77, indicating it is mostly walkable. However, the suburbs(Dato) and outskirts have a local walkability index ranging from 35.06 to 38.03, with an average of 36.54, indicating that is not pedestrian-friendly. Overall, Hawassa City has a local walkability index ranging from 58.76 to 64.44, with an average of 62.6, indicating moderate walkability.

5.2. General Recommendation

After assessing the walkability factors in selected streets and neighborhoods of Hawassa City, we propose the following recommendations to improve pedestrian experience:

1. **Safety:** Implement traffic calming measures such as speed humps, pedestrian crossings with clear markings, and accessible sidewalks to improve pedestrian safety. Adequate lighting should be provided in all public spaces, including streets, sidewalks, and parks.

Pedestrian infrastructure should be upgraded with safe crossings and improved street patterns in high-traffic areas.

2. Orientation: Improving the street pattern, providing clear signage, and improving access to public transportation will enhance the ease of navigating the city for pedestrians. Streets should be designed for pedestrians first, not vehicles.
3. Comfort: Creating a comfortable walking experience can be achieved by providing continuous, well-maintained sidewalks, shade, and seating. Private property owners should be encouraged to maintain public areas, including sidewalks in front of their buildings. Resting and socializing spaces should be provided to increase the appeal of walking.
4. Diversity: Encouraging diverse land uses, architectural styles, and public spaces will enhance the vibrancy of the built environment. Areas with businesses should cater to pedestrians, providing different types of shops, restaurants, and green spaces.
5. Local Destinations: Encouraging a mix of amenities and services within walking distance, such as open public spaces, parks, playgrounds, and community centers, will improve walkability. Mixed-use zoning that includes retail, residential, and commercial uses close to each other should be encouraged.

These recommendations can be applied at different scales, from the city level to the neighborhood and street level. Improving the safety, orientation, comfort, diversity, and local destinations of Hawassa City will make walking more attractive to people in the city.

5.3. Specific Area Recommendation

5.3.1. The Inner-city

To ensure safe and comfortable pedestrian experiences in the inner-city areas of the city, it's vital to maintain moderate walkability levels and widen sidewalks in urban areas, particularly in the city's core. Additionally, installing pedestrian-oriented street lighting and prioritizing pedestrian-designated zones can significantly improve safety. Promoting efficient mixed land use and higher-density development can also reduce the travel distance between destinations, making it easier to walk around the city.

5.3.2. The intermediate area of the city

To ensure a secure and easily navigable environment for foot traffic in the intermediate area of the city, several enhancements should be implemented. These include safety measures, clear directions, mixed land use, and local destinations. It is important that the entire area is equipped with pedestrian-friendly infrastructure, and that a wide, continuous sidewalk is created to provide maximum comfort and safety. Additionally, street furnishings like benches, pedestrian information kiosks, and bike racks can be incorporated to create a buffer between pedestrians and vehicles. These fixtures must follow a consistent pattern, such as uniform light pole height or tree shade patterns. Pedestrian crossings should be visible both day and night, with white markings, signage, and lighting. To further bolster pedestrian safety, curb extensions, and stop bars can be installed. On wider streets, mid-street crossing islands and minimal curb radius can be utilized to decrease crossing distance.

5.3.3. The Suburban areas of the city

To improve the walkability of suburban areas within the city, we suggest developing comprehensive local development plans (LDPs) for all suburbs. These plans should take into account various aspects related to urban planning and design standards, such as social, economic, environmental, and physical issues. The following principles should be integrated into the plan and design:

- ✓ Ensuring connectivity and accessibility
- ✓ Creating pedestrian-friendly spaces through street design and layout
- ✓ Encouraging mixed land use and higher density
- ✓ Providing safe and secure streets
- ✓ Promoting engagement and public participation

In assessing the walkability of a neighborhood, it is important to consider both the built environment and demographic features. To facilitate walking, we recommend implementing measures such as shorter blocks with frequent crossings, well-connected networks, wide sidewalks, and pedestrian-friendly infrastructure. Furthermore, introducing traffic calming measures and reducing curb cuts can enhance pedestrian safety.

5.4. Urban Design Level Recommendation

The way our cities, streets, and neighborhoods are designed can have a significant impact on their physical and functional characteristics. Urban planning, architecture, and landscape architecture all play important roles in managing and transforming urban life. By prioritizing

the safety of street users, creating human-scale structures, and designing attractive walkways, we can enhance a city's overall walkability, provide comfortable pedestrian spaces, promote social and economic diversity, and enable access to local destinations. Sustainable urban design combines these elements to encourage mobility, activity, and accountability.

To improve the walkability of Hawassa City, we suggest an urban design strategy that integrates recommendations and principles from urban planning, architecture, and landscape architecture. Here are some suggestions to consider: To promote walkability and reduce the need for car travel, several key strategies can be implemented. These include designing a connected street network with frequent intersections and short block lengths, ensuring convenient accessibility to public transportation, and creating well-designed public spaces such as parks and plazas. Additionally, it is important to prioritize pedestrian safety by using traffic calming measures and maintaining clear sightlines, as well as providing shade and comfort through street trees and shelters. Finally, community engagement is crucial in ensuring that the needs and preferences of pedestrians are heard and incorporated into the urban design process. By implementing these strategies, cities and neighborhoods can make walking a safe, enjoyable, and convenient mode of transportation.

By implementing these recommendations, cities and neighborhoods can make significant progress in enhancing walkability, and making walking a safe, enjoyable, and convenient mode of transportation.

Table 6 . 1 Recommendations and principles from urban planning, architecture, and landscape architecture

<i>urban design strategy</i>	<i>Recommendations and principles from urban planning, architecture, and landscape architecture</i>
1. <i>Sidewalks and Pedestrian Infrastructure:</i>	<ul style="list-style-type: none"> ✓ Provide well-maintained, wide, and continuous sidewalks throughout the city or neighborhood. ✓ Ensure they are accessible for people with disabilities and incorporate features like curb ramps, crosswalks, and pedestrian signals at intersections.
2. <i>Street Design:</i>	<ul style="list-style-type: none"> ✓ Create narrower streets with reduced vehicle speeds to improve pedestrian safety. ✓ Design streets with dedicated bike lanes where possible to accommodate multiple modes of transport. ✓ Implement traffic calming measures such as speed bumps, raised crosswalks, or chicanes to prioritize pedestrians.
3. <i>Mixed Land Use:</i>	<ul style="list-style-type: none"> ✓ Encourage mixed-use development that blends residential, commercial, and recreational spaces. ✓ Place essential services and amenities within walking distance of residential areas, reducing the need for car travel and promoting walkability.

4. <i>Connectivity:</i>	<ul style="list-style-type: none"> ✓ Design a connected street network with frequent intersections and short block lengths. ✓ This enables pedestrians to take direct routes, increases walkability, and reduces reliance on long, circuitous routes.
5. <i>Transit Integration</i>	<ul style="list-style-type: none"> ✓ Ensure convenient accessibility to public transportation by locating transit stops close to pedestrian pathways. ✓ Design transit stations with comfortable waiting areas, clear signage, and proper lighting to encourage walking as a first and last-mile connection.
6. <i>Public Spaces:</i>	<ul style="list-style-type: none"> ✓ Include well-designed public spaces such as parks, plazas, and pedestrian-friendly squares. ✓ Provide seating, greenery, and amenities to attract pedestrians, encourage rest, and support social interaction.
7. <i>Safety and Security:</i>	<ul style="list-style-type: none"> ✓ Enhance pedestrian safety by using traffic calming measures, installing adequate lighting, and maintaining clear sightlines. ✓ Collaborate with local law enforcement to establish a safe and secure environment for walkers.
8. <i>Shade and Comfort:</i>	<ul style="list-style-type: none"> ✓ Incorporate Street trees, canopies, or shelters to provide shade and protection from weather elements. ✓ Install benches, public art, and wayfinding signage to make the walk more comfortable and engaging.
9. <i>Inviting Streetscapes:</i>	<ul style="list-style-type: none"> ✓ Design visually attractive and inviting streetscapes using appealing materials, landscaping, public art, and street furniture to create a pleasant walking experience.
10. <i>Community Engagement:</i>	<ul style="list-style-type: none"> ✓ Involve the community in the urban design process to ensure their voices are heard. ✓ Conduct public consultations, workshops, and surveys to gather input and feedback on walkability needs and preferences.

5.5. Hawassa City and Local Administration

To prioritize the safety and comfort of pedestrians in Hawassa City, it is crucial to invest in developing pedestrian infrastructure such as sidewalks, crosswalks, and bike lanes. Collaboration between urban designers, planners, architects, landscape designers, and community members is necessary for effective planning and design. Regulations surrounding sidewalks must be followed and maintained to ensure the quality and safety of pavement, amenities, and other structures. Avoiding obstructions is crucial to guarantee pedestrian safety, comfort, and security. Education and awareness programs should also be established to promote the benefits of walking, and a supportive policy and regulatory framework should be established to encourage a walkable city. To achieve this, the following actions should be taken:

- Ensure proper maintenance of sidewalks and clear marking of crosswalks.
- Encourage a mix of residential, commercial, service, and recreational activities nearby.

- Make public transportation easily accessible to encourage alternative modes of transportation instead of relying on cars.
- Construct pedestrian walkways to reduce reliance on cars and promote walking.
- Ensure uninterrupted pathways throughout the city to enhance walkability for pedestrians.

5.6. Recommendation for future research

To enhance future research on walkability in Hawassa City, it may be beneficial to consider the limitations of this study. These may involve focusing on both objective and subjective measures, with an emphasis on residents' perceptions of safety, orientation, comfort, diversity, and local destinations. Additionally, contextual factors such as cultural or demographic characteristics should be taken into account, as they can influence walkability and residents' walking behaviors. By addressing these limitations, future research can provide a more comprehensive understanding of walkability in Hawassa City, ultimately leading to effective strategies and interventions to promote active transportation and improve walkability.

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ANNEX A Manuscript

Evaluation of Walkability on Selected Streets and Neighborhoods of Hawassa City

Abstract

Walkability is the extent to which an urban environment is designed to be pedestrian-friendly. It plays a crucial role in urban growth and city function, making it a vital component for creating sustainable and livable cities. Walkability is an essential aspect of cities, as it promotes the physical and mental health of pedestrians while improving their social and economic prospects. This study aims to evaluate the walkability of selected streets and neighborhoods in Hawassa City by identifying the built environment features that affect walkability in inner-city, intermediate, and suburban areas. The study identified several factors that affect walkability in Hawassa City, including footpath quality, street patterns, street lighting and visibility, safe pedestrian crossings, slope or gradient along the route, continuity of routes, well-connected street networks, easy access to facilities and services, proximity to destinations, mixed land uses, security measures, and obstruction-free walkways.

To determine the walkability status of Hawassa City's inner-city, intermediate, and suburbs, the study used various qualitative and quantitative methods. These included a resident and pedestrian survey, an audit of objectively measured features in the walking-built environment, and a walking facility rate. We conducted a literature review and collected data on built environment features and walkability indicators through an observational site study, questionnaire, and related document review. The assessment of walkability factors in selected streets and neighborhoods of Hawassa City reveals important insights into the overall pedestrian experience and safety in the city. The five major factors evaluated—safety, orientation, comfort, diversity, and local destinations—contribute significantly to the walkability of Hawassa City.

In conclusion, the study emphasizes the need for creating safe, comfortable, secure, diverse, and accessible streets that prioritize pedestrian-friendly urban design.

Keywords

Walkability, Built environment features, Walkability factors, indicators, and parameters.

1. Introduction

Promoting sustainable and livable cities has become a top priority with the rapid increase in urbanization and motorized transportation (Kenworthy, 2006). Walkability is an essential aspect of this, referring to the extent to which an urban area is conducive for pedestrians to walk, considering different factors. Pedestrian infrastructure such as sidewalks, crosswalks, and street furniture, as well as the overall design and layout of streets and neighborhoods, are all taken into account (Ali, 2023). High levels of walkability offer several benefits to urban areas. It promotes active lifestyles by encouraging people to walk instead of relying solely on motorized transportation, which positively impacts public health outcomes.

Several factors influence the walkability of streets and neighborhoods, including the quality of sidewalks, crosswalks, traffic signals, street connectivity, land-use mix, the presence of trees and shade, aesthetics, and overall pedestrian comfort (Gerike, Built environment determinants of pedestrian activities and their consideration in urban street design, 2021). Understanding these factors and their relative importance is crucial to comprehensively evaluate the level of walkability in a particular area and identify

potential areas for improvement. Therefore, it is essential to assess walkability accurately, which focuses on examining and evaluating the pedestrian-friendliness of selected streets and neighborhoods within Hawassa City.

To assess walkability accurately, various indicators and parameters can be considered, such as sidewalk availability, sidewalk conditions, street connectivity, pedestrian infrastructure quality, amenities like benches, water fountains, public restrooms, access to public transportation, and pedestrian and cyclist safety measures (Arellana, 2020). These parameters provide a holistic view of the pedestrian experience and can guide urban planners and policymakers in making informed decisions to improve walkability (Zakaria, 2013). By identifying the strengths and weaknesses of existing pedestrian infrastructure and highlighting the factors that affect walkability, this study will pave the way for creating more pedestrian-friendly environments and fostering sustainable and livable cities for the residents of Hawassa.

2. Literature Review

2.1. The concept of walkability

Walkability, introduced by Jane Jacobs in the 1960s, has transformed urban studies. It has gained popularity in recent years owing to its

numerous health, economic, and environmental benefits. In 2016, Singh defined walkability as the measure of how pedestrian-friendly an area is. Walkability offers various human benefits, from health to environmental and economic benefits, and is influenced by factors such as the quality of pedestrian paths, sidewalks, and other rights-of-way; traffic and road conditions; land use patterns; building accessibility; and safety (Singh R., 2016).

2.2. Walkability assessment

A walkability assessment is a comprehensive evaluation of the ease and safety of walking in a particular area, such as a neighborhood, city, or even a single street. It involves analyzing various factors and characteristics that impact the walkability of that area (Maram Ali, 2023). Typically, a walkability assessment includes the following components. According to various literature sources, a walkability assessment is a crucial tool for improving the walkability of an area. By examining these components, stakeholders can identify strengths and weaknesses and develop strategies to create safer and more accessible walking environments.

1. ***Sidewalks and Pedestrian Infrastructure:*** This component assesses the presence,

condition, and connectivity of sidewalks, crosswalks, curb ramps, and other pedestrian infrastructure (Coppola, 2021).

2. ***Street Design and Traffic Calming:*** This component evaluates the design of streets, including the width, speed limits, and presence of traffic calming measures like speed bumps or traffic islands, to ensure pedestrian safety (Minnema, 2006).

3. ***Land Use and Density:*** This component examines the mix of land use, density of residential, commercial, and recreational areas, and proximity to essential amenities like grocery stores, schools, parks, and public transit options (Cervero, 1996).

4. ***Safety and Security:*** This component considers the presence of street lighting, visibility, and any safety concerns, such as crime or high traffic volumes, that may reduce perceived or actual safety for pedestrians.

5. ***Accessibility:*** This component assesses the level of accessibility for people with disabilities, including the availability of ramps, elevators, and other accommodations.

6. ***Streetscape and Aesthetics:*** This component considers the quality of the urban environment, including the presence of trees,

landscaping, public art, and seating that may contribute to a pleasant walking experience.

7. **Community Engagement:** This component involves the local community in the assessment process to gather input, insights, and suggestions for improving walkability and addressing community-specific needs.

2.3. Walkability measures

According to Lambert, 2005 as cited by Asli Ak in 2018 Walkable public spaces have five major attributes: safety, orientation, comfort, diversity, and local destinations., These attributes of walkability are not haphazardly chosen. The key assumption behind these attributes is that walkable public spaces are safe, attractive, comfortable, and well-connected to their surroundings and local destinations and those that accommodate diversity. The following sections explain each of these attributes in detail. (AK, 2018)

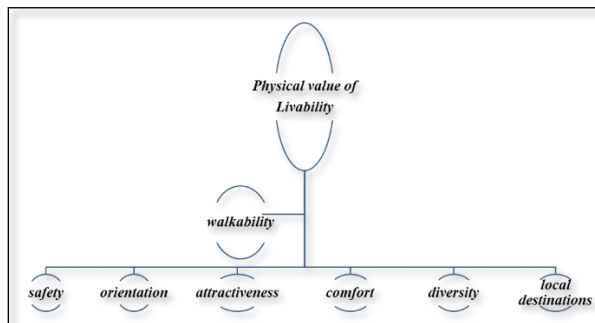


Figure 2 1. Walkability attributions, (AK, 2018) Author personal rendering

2.3.1. Safety

Safety is a crucial aspect of walkable public spaces, which can be achieved through physical design methods and other complex factors that promote safety. Therefore, urban areas must be both physically and perceptually safe. The issue of safety is complex and multi-faceted, and people on the streets, whether pedestrians or drivers perceive 'safety' or 'unsafety' in various ways (Lambert, 2005, as cited by Asli Ak, 2018). According to Lambert (2005), safety is assessed in both actual and perceptual aspects of both streets and sidewalks.

2.3.1.1. Actual safety

Actual safety in urban spaces refers to safety that can be attained through safe physical properties. Achieving safety in streets and sidewalks can be done in different ways. It's important to note that a street is a three-dimensional entity that includes vehicular roads, sidewalks, street furniture, and buildings (AK, 2018).

a) Street Pattern

Southworth and Owns (1995 cited by Ak, 2018) identified five street patterns: grid-iron, fragmented parallel, warped parallel, loops and lollipops, and lollipops on a stick. A connected street pattern like a grid or

modified grid is more walkable and provides easy pedestrian accessibility to parallel streets and public services. However, cul-de-sacs are often considered safer for residential areas. Complex street patterns and low-density development patterns make it necessary for people to use cars, which goes against walkability and pedestrian safety. New Urbanism and Smart Growth approaches believe that grid or modified grid street patterns increase walkability and livability(Ibid).

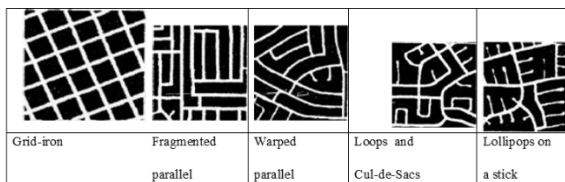


Figure 2.2. Five types of street patterns are classified by Southworth and Own (1995) (Kolody,

b) Traffic Calming

Traffic calming is crucial for pedestrian safety. High speeds cause severe accidents, and measures like street parking, sidewalks, and trees impact traffic. Wider streets encourage speeding, while narrower streets discourage it. Street parking acts as a buffer between pedestrians and cars, enhancing pedestrian safety(Lambert, 2005:15; Litman, 2009:14 cited in Asli, 2018:74-76) (Figure 2.3)

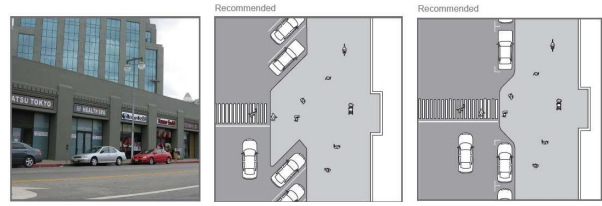


Figure 2.3. On-street parking and its effect on sidewalk width and street crossing. (LA-Walkability Checklist, 2008: 22)

c) Lightening and visibility

Lighting and visibility are essential factors for the safety of pedestrians. An appropriate and adequate lighting system can greatly improve driver and pedestrian safety by increasing visibility. Illuminating Park areas and crosswalks can also enhance safety. The objective of using appropriate lighting is to provide glare-free lighting systems, also known as "dark sky," which are considered correct lighting systems (LA-Walkability Checklist, 2008:67 cited in Asli, 2018:74-76) (Figure 2.4).

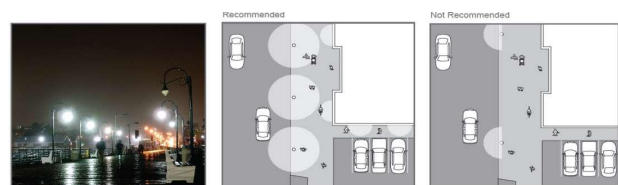


Figure 2.4. Parking areas and sidewalk illumination. (LA-Walkability Checklist, 2008:66)

d) *Continuous pavement*

Continuous sidewalks are crucial for walkability as they enable pedestrians to navigate easily. Physical modifications to the sidewalk pattern aim to remove interruptions, encouraging people to walk. Furnishings like light poles and canopies of the same height create a harmonious rhythm. Grid-iron street patterns offer more continuous sidewalks for pedestrians. Walkable cities can also be achieved through human-scale dimensions, diversity, and special landmarks. (Preiss and Shapiro, 2002: 3; Kolody, 2002: 50; Lambert, 2002: 13; Marshal, 2005: 77, 238, 243, 247; Bentley, 2002: 21)

e) *Pedestrian enclosure*

Enclosure refers to the degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other vertical elements. Spaces where the height of vertical elements is proportionally related to the width of the space between them have a room-like quality. *Pedestrian enclosure* also affects pedestrians' safety, physically and perceptually. It is provided by paying particular attention to *human scale, building orientation, and street furniture* factors (Lambert, 2005:15; Litman, 2010: 22, 24, 28) (Figure 2.5-8).



Figure 2.5. *Pedestrian enclosure by considering urban elements, building scale, and orientation in the enclosure sense. (LA-Walkability Checklist, 2008: 10)*

Human-scale standards refer to the functional width of sidewalks, which could provide pedestrian movement and activity. It is also related to building height, which should be determined according to sidewalk width (Lambert, 2005: 15; Litman, 2010: 22, 24, 28) (Figures 2.35). The appropriate sidewalk width is about 1.53 m which responds to the minimum needs of urbanites, those walking, resting, biking, and skating. Human scale refers to the size, texture, and articulation of physical elements that match the size and proportions of humans and, equally important, correspond to the speed at which humans walk.

Jacobs (1993) identifies the ratio of height of buildings to street width as 1:2. In general, scale, appropriate sidewalk width enable pedestrians to realize the structure of the

route, its use, and the entrance placements. In addition, appropriate sidewalk width enables different parts of the sidewalk to function properly, and therefore, pedestrians can move freely (Lambert, 2005:15; Litman, 2010:22, 24, 28 cited in Asli, 2018:76-80) (Figure 2.6).



Figure 2.6. Perceptual continuity created by urban elements (LA-Walkability Checklist, 2008:11)

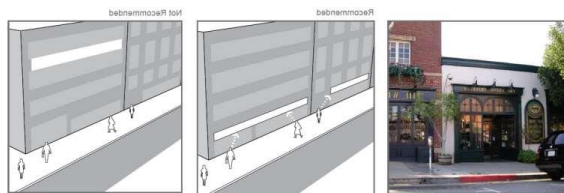


Figure 2.7. Perceptual building components according to human scale standards, (LA Walkability Checklist, 2008: 66)

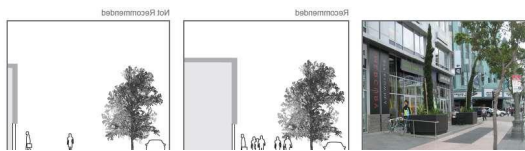


Figure 2.8. Adequate sidewalk width by pedestrian volume, (LA-Walkability Checklist, 2008: 66)

Building orientation is also important in terms of creating pedestrian enclosures, thereby creating walkable streets. Building

entrances, which consistently open to the same pedestrian realm, confine the sidewalk and increase pedestrian enclosure (Lambert, 2005: 16) (Figure 2.9).

The other important component of creating pedestrian enclosures is *street furniture*. Street trees and other street furniture act as a buffer between pedestrians and moving vehicles, and protect walkers from traffic noise and its danger (LA-Walkability Checklist, 2008: 10). Trees help to define pedestrian boundaries by decreasing the proportion of building height to open space. They also make streets narrower and slow down the traffic. Furthermore, because of their benefits to pedestrian safety and the environment, they contribute significantly to ‘walkability’ (AK, 2018: 79).



Figure 2.9. The role of street furniture in walkway enclosure. (LA-Walkability Checklist, 2008:10)

f) **Separation**

Separation is another component of the actual safety of pedestrians. “Sidewalks, medians, boulevards, on-street parking, and

parallel routes that allow pedestrians to avoid arterials all work to separate people from vehicles” (Kolody, 2002: 45 cited in Asli, 2018:76-80).

g) ***Floor quality***

Floor quality is another measurement that enhances the actual safety of sidewalks. Qualified floors of streets are important in terms of making walking more comfortable and pleasant for all groups of healthy and handicapped people (AK, 2018).

h) ***Street crossing***

Street crossing is a crucial factor in safety evaluation. Short, safe, visible crossings which have connect two sides of the street physically and perceptually ensure the security of pedestrians (LA-Walkability Checklist, 2008: 13, 17 cited in Asli, 2018:76-80) (Figure 2.10).

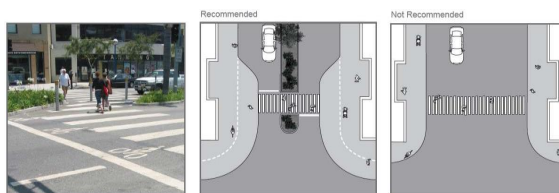


Figure 2 10. Mid- Street crossing island and curbs extended out have decreased street crossing

distance. (LA-Walkability Checklist, 2008: 17 cited in Asli, 2018:76-80).

i) ***Vehicle mix***

The last factor related to actual safety is *vehicle mix*. The existence of big vehicles, except for public vehicles which inevitably should be used, hurts pedestrians’ safety (AK, 2018).

2.3.1.2. ***Perceived safety***

According to Evans (2009) and Wheeler (2001), Perceived safety means the protection of pedestrians from the feeling of crime or the danger of vehicular traffic. Perceptual safety is different from physical safety. For example, the separation of sidewalks from vehicular routes is the concern of physical safety, while the noise of cars on streets that makes people anxious is related to perceptual safety (AK, 2018).

Jane Jacobs (1961), in her book “The Death and Life of Great American Cities”, defines three main qualities necessary for perceptual safety as below:

- iv. A clear delimitation between public and private space
- v. Buildings oriented towards the street to provide ‘eyes on the street’ (Figure 2.11)

- vi. Common use facilities to add more ‘eyes’ on the street (Jacobs. J, 1961: 35) (Figure 2.11).

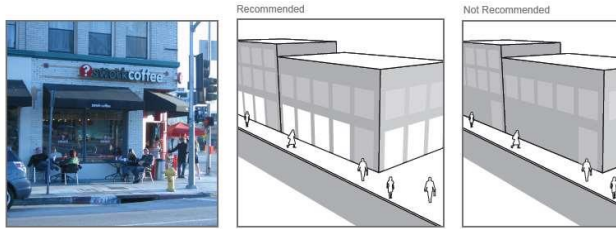


Figure 2 11. Shops that have a direct relation with streets provide ‘eyes on the street’ and create safety. (LA-Walkability Checklist, 2008: 60 45 cited in Asli, 2018:80)

2.3.2. Orientation

Having a good sense of orientation plays a crucial role in ensuring pedestrian safety and walkability. It is particularly important for elderly individuals, children, and those with orientation difficulties, as it allows them to navigate the public space network, easily locate important landmarks, avoid getting lost, and feel confident while walking. Kevin Lynch's theory of 'mental maps' highlights the significance of orientation in the way pedestrians perceive and navigate their surroundings. Mental maps are formed based on paths and nodes that pedestrians come across during their journeys. The path is important as it forms the basis of the public space network, without which pedestrians would feel lost. Nodes are also crucial as they

help define the destination that walkers want to reach. Factors such as legible street patterns, landmarks, continuity, built form and location, and architectural and environmental features, among others, all play a major role in facilitating pedestrian wayfinding. (Bentley, 2002: 174-180; Kolody, 2002: 44; LA-Walkability Checklist, 2008: 31; Burton and Mitchell, 2006: 6145 cited in Asli, 2018:81)

a) Legibility of street patterns and urban components

The legibility of a neighborhood plan refers to how easily it can be perceived and understood at a glance. When street patterns are easy to follow, pedestrians are better able to navigate and reach their destination quickly. Since pedestrians are the slowest of all urban travelers, it is important to have simple, regular street patterns and urban components that make it easier to find one's way. Regular street patterns are more intelligible than irregular, complex hierarchical ones, especially when buildings are positioned around them (Bentley, 2002: 193, 206 and Kolody, A.D, 2002: 44) (see Figure 2.12)

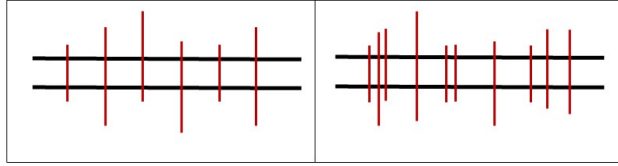


Figure 2 12. The street network which provides regular rhythm (left) and that which provides irregular rhythm (right) (Resource: Adapted from Rapoport (1977) in Asli, 2018, p.88).

b) **Landmarks**

Imageability refers to the unique, memorable, and recognizable qualities of a place. This is achieved through specific physical elements and their arrangement, which capture attention, evoke emotions, and leave a lasting impression. Landmarks also contribute to the legibility of an environment, creating a familiar image that helps pedestrians navigate and orient themselves. The built forms within a place serve as "nodes" in our mental map, and differentiation, detailed building forms, and junctions help create simple mental maps and unforgettable landmarks. In cases where urban components in public spaces lack harmony, it can be challenging for people to remember all parts of such complicated elements.

c) **Continuity**

Continuity refers to the spatial enclosure of various parts of the public space system

(Bentley, 2002, p.112). *Continuity and differentiation* balance together (Bentley, 2002, p.176). Continuity in public space contributes to the attractiveness and legibility of the environment. It is mostly possible indirect connections achievable in grid street patterns (AK, 2018).

d) **Built form and its location**

The forms of the buildings and other urban elements, and their placement are important in terms of increasing legibility. The position and form of the urban elements should be selected carefully according to their characteristics and merits. In this way, everybody can perceive them and consequently, they can contribute to the legibility of the urban environment (Kolody, 2002: 44 cited in Asli, 2018:87)

2.3.3. **Comfort**

Urban comfort is determined by physical and visual aspects, according to Lynch (1991). Spaces should be usable and understandable to pedestrians to ensure their safety. The absence of these qualities can lead to decreased comfort (Eraydın, 2007: 35 cited in Asli, 2018: 86). Visual understanding is related to orientation and legibility principles, successfully applied in Italian cities. Physical usability is concerned with

four factors: protection from elements, clean air, safety, and accessibility for all. (Kolody, 2002: 44-45; Akit, 2004: 37; Lambert, 2005:19- 22; Çiçek, 2009: 7; LA-Walkability Checklist, 2008: 10, 11, 13, 17, 22, 36, 66, 7 cited by Ak, 2018)

2.3.4. **Diversity**

Walkability and diversity in urban areas are closely linked. Physical diversity includes buildings and land use, social diversity includes people of different ages, family types, and socioeconomic backgrounds, and economic diversity includes building types. These diversities create livable public areas and allow different groups of people to interact with each other. Stores and services that provide daily needs and open public spaces such as playgrounds, nature preserves, squares, and plazas enhance the walkability of urban areas(Crowhurst-Lennard, 1987, cited in Lambert, 2005: 23-24).

2.3.5. **Local destinations**

Distance between home and destination is a crucial factor for walkability. People prefer not to walk more than 10 minutes to meet their daily needs. Time Saver Standards recommends a walking distance of 400m to 800m. Interconnected Street patterns can create walkable streets by connecting

destinations quickly, distributing traffic equally, and increasing legibility. Grid-iron street patterns are highly interconnected and pedestrian-friendly.

Therefore, interconnected street patterns are recommended to increase the accessibility and walkability of public spaces. (Preiss and Shapiro, 2002: Kolody, 2002: 50; Lambert, 2002: 20; Marshal.S,2005: 77, 238, 243, 247; Bentley, 2002: 21).

2.4. **Urban Design Qualities Related to Walkability**

Urban design plays a crucial role in shaping the walkability of a city. Walkability is influenced by factors such as footpaths, sidewalks, traffic, road conditions, land use patterns, building accessibility, safety, and air quality. Urban design can influence these factors by creating pedestrian-friendly environments that encourage walking and other forms of active transportation. Here are some ways in which urban design can affect walkability:

1. ***Sidewalks and footpaths***: Urban design can create safe and accessible sidewalks and footpaths that are well-connected to other parts of the city.

2. ***Street design***: Urban design can create streets that are designed for all users,

including pedestrians, cyclists, and public transit users.

3. **Mixed-use development:** Urban design can encourage mixed-use development that brings together residential, commercial, and institutional uses in the same area. This can reduce the need for car travel and make it easier for people to access essential services and amenities by foot within a reasonable distance⁷.

4. **Public spaces:** Urban design can create public spaces that are safe, attractive, and accessible to all users. This can include parks, plazas, and other gathering places that encourage social interaction and physical activity.

5. **Building design:** Urban design can create buildings that are designed to be accessible to pedestrians and cyclists. This can include features such as bike parking, showers, and changing rooms for cyclists ⁷ (AK, 2018).

3. Methods

The main goal of this study is to evaluate the level of walkability in Hawassa City and three of its neighborhoods. We will identify the built environment features that impact the walkability of intermediate areas, and suburbs. To achieve our desired outcomes, we collected both qualitative and quantitative

data by assessing the current state of the streets, and identifying the components, and built environment features that affect walkability. Having a solid research strategy is crucial to the success of this study. We utilized both descriptive and explanatory survey methodologies to meet the study objectives and provide further insight into the characteristics of urban walkability. Our research involved field surveys, Geographic Information System (GIS) analysis, surveys and questionnaires, data collection from relevant agencies, walkability audits, and the development of a walkability index.

The following methodology was used in this study:

Assessing the walkability of the inner city, intermediate area, and suburbs of the city is done through various methods. Here are some effective ways to collect data and insights on the built environment features that affect walkability:

1. **Field survey:** Physically observing and documenting features such as sidewalk conditions, pedestrian safety measures, street connectivity, the presence of amenities, and land use patterns is an effective way to assess walkability. This method can

collect data through checklists, photographs, or videos.

2. ***Geographic Information System (GIS)*** analysis: GIS technology can comprehensively understand the physical environment and its effect on walkability. We have gathered data on street network characteristics, land use patterns, the presence of destinations, and other relevant spatial variables. GIS analysis can help identify walkability indicators and their spatial distribution within the city.
3. ***Surveys and questionnaires:*** Engaging with the local community through surveys and questionnaires can provide valuable insights into their perceptions of walkability. This method involves developing a survey instrument that includes questions about their walking habits, perceived safety, access to amenities, and overall satisfaction with the pedestrian infrastructure. Surveys were conducted in person.
4. ***Data collection from relevant agencies:*** We have collected data from various relevant agencies in Hawassa City, including the City

Administration, municipality, traffic office, urban planning, and finance departments. These agencies are responsible for urban planning, transportation, and public spaces. The data collected includes information on land use regulations, zoning practices, pedestrian infrastructure investments, traffic safety records, and healthcare accessibility. To assess the neighborhood-built environment features such as safety, orientation, comfort, diversity, and local destinations, we analyzed documents, survey data, relevant reports, site observations, and the Hawassa City structure plan document. We also conducted an in-depth analysis of pedestrian facilities, mapped footpaths based on observation, and evaluated their availability.

5. ***Walkability audits:*** Recruiting trained volunteers to collect data from the selected streets and neighborhoods and assess various aspects of walkability, such as the presence of crosswalks, green spaces, sidewalk conditions, and traffic safety, can provide detailed and

objective information about the built environment's walkability features.

3.1. Study Area

Hawassa City is a bustling urban center located on the shore of Lake Hawassa in Southern Ethiopia's Sidama national regional state. It is situated in the Great Rift Valley region, 273 km south of Addis Ababa via Mojo and 1125 km north of Nairobi. The city serves as the capital of the Southern Nations Nationalities & Peoples Regional State and Sidama National State. Geographically, it is positioned between 7° 03' latitude North and 38° 28' longitude East and covers a total area of 157.2 sq. km, divided into eight sub-cities that, in turn, are divided into 32 Kebeles. Ras Mengesha Siyom founded the city in 1952 E.C. with Emperor Haile Selassie's permission. In the same year, four hundred and four soldiers and their families were granted approximately 1,000m² plots of land in the eastern part of the city, which is now known as Addis Ababa “Sefer”, Harar Sefer, Korem “Sefer” and Wukro “Sefer”. Arab merchants also arrived in Hawassa during this time and opened shops in the area that is now recognized as the Arab Sefer region. This spurred the town's growth and development.

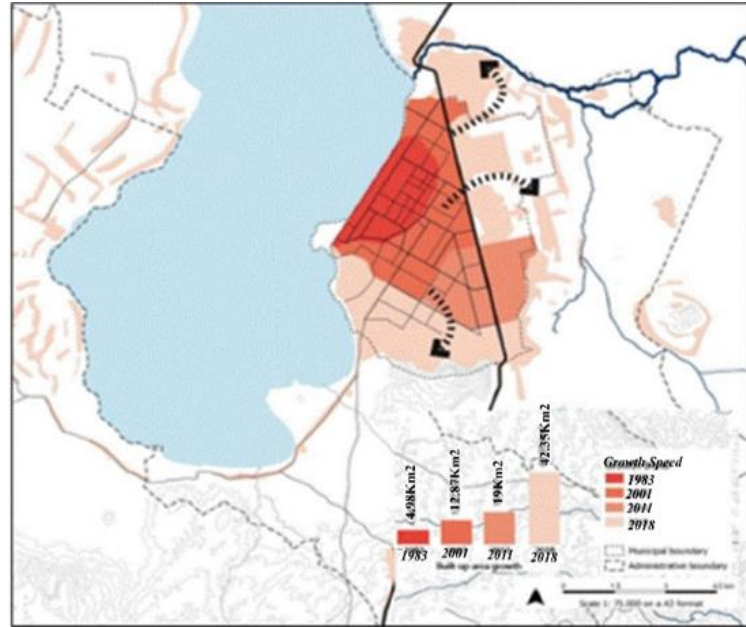


Figure 3 1 **Historical development of Hawassa since 1983 from the structural plan document (UN-Habitat 2019)**

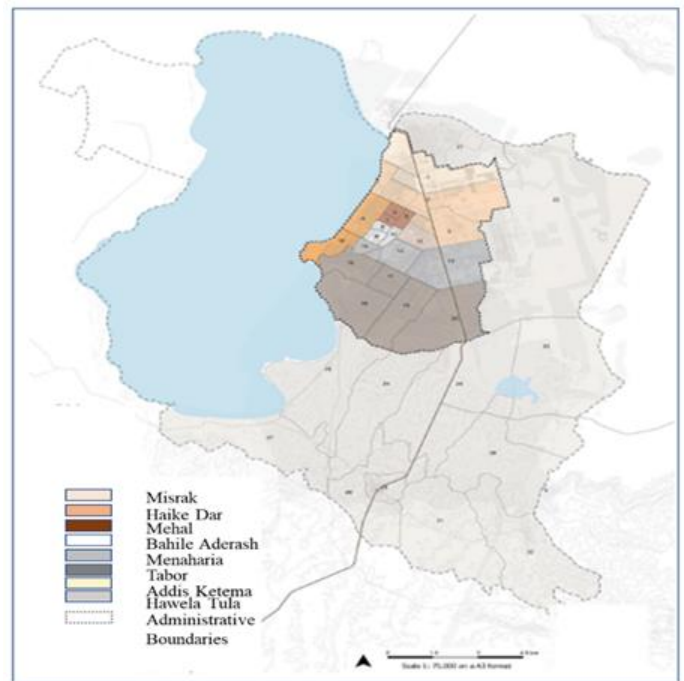


Figure 3 2. **Administrative representation of Hawassa City from the structural plan document (UN-Habitat 2019)**

3.1.1. Population And Demography

Demography and Population Dynamics

Over the past decades, the urban population of Hawassa grew exponentially and almost doubled every ten years. The national census reported 36,200 in 1984, 69,200 in 1994, and 157,100 in 2007. Ten years later the Central Statistical Agency (CSA) estimated the urban population at 335,000 and the rural population within the administrative boundary of the city administration at 120,000, a total of 455,658 (227,614 males and 228,044 females), and the urban population increased to 372,721 in 2019. The estimated total urban and rural population of the city is 514,017.

Table 3 1. Hawassa City 2015 E.C Projected population

	Year	Male	Female	Total
Urban	2015	181,935	170,938	352,873
Rural		82,537	78,607	161,144
	Total	264,472	249,545	514,017

3.2. Sources of Data

The data for this study was gathered from primary and secondary sources.

3.2.1. Primary Data Sources

For this thesis, information was gathered from various sources, including households in selected settlements, street users, Hawassa city municipality, road and transport officials from the city administration, technical officers from the urban plan preparation department, police, sub-city officials, photographs taken during field observation, field survey, mapping, perception survey, and experts. To collect the data, tools such as questionnaires, structured interviews, and detailed personal field observations were used.

3.2.2. Secondary Data Sources

We gathered a variety of information about the city including population statistics, socioeconomic data, street maps, road

Table 4 1. Traffic calming measures

	<i>Not Available</i>		<i>Speed Breakers Available</i>	
	Frequency	Percent	Frequency	Percent
Neighborhoods	Inner City (Arab Sefer)	9	22.50	28
	Intermediate (Sefere Selam)	10	16.39	47
	Suburbs (Dato)	46	100.00	0
	Total	65	44.22	75

networks, land use maps, building heights, traffic reports, the city's structural plan text document, and other relevant literature. To obtain this information, we utilized secondary data sources such as the Central Statistics Agency (CSA), the Addis Ababa University library, the Hawassa City Administration sectoral offices, related documents, books, the internet, and research papers on related topics.

4. Results

The assessment of walkability factors in selected streets and neighborhoods of

The study revealed that only local cobblestone roads had speed breaks and speed limit signs, while major roads lacked traffic calming measures in all areas.



Figure 4 1. Lighting and Visibility on Major Streets Source: Author Image Hawassa 2023

Hawassa City reveals important insights into the overall pedestrian experience and safety in the city. The five major factors that were evaluated - safety, orientation, comfort, diversity, and local destinations - contribute significantly to the walkability of Hawassa City.

The safety of pedestrians in Hawassa City is influenced by various factors, such as the design of street patterns, implementation of traffic calming measures, quality of lighting, enclosure, separation, availability of crossings, and types of vehicles on the road.

Additionally, the survey found problems with pavement continuity in different neighborhoods.

The suburbs (Dato) had no available lighting, while the intermediate neighborhood (Sefere Selam) had the highest percentage of available lighting at 31 (50.82%) percent. Moreover, the study found that while 66% of the streets had footpaths ranging from 1

meter to 7.7 meters wide, 34% had no footpaths at all.

The survey found that high-rise buildings in Hawassa City are designed to face pedestrian areas, making them safe and functional. However, the suburbs lack separate walkways or medians, and the quality of the ground is critical for sidewalk safety, particularly for those with disabilities. The Inner City (Arab Sefer) and Intermediate (Sefere Selam) neighborhoods have better

sidewalk surfaces, with most people agreeing on their comfort and ease of movement. In contrast, in the Suburb/Outskirt (Dato), more people disagree on the quality of the sidewalks. The city has a total of 71 walkway crossings, with 48% of them available on both sides. However, 128 crossings are not available, which affects the walkability of the city. This information can be used by urban designers, planners, and policymakers to make informed infrastructure decisions to improve pedestrian safety.

Table 4 2. Availability of Walkway

	<i>Neighborhood</i>	<i>Available</i>			<i>Not Available</i>		<i>Total</i>
		<i>Both sides</i>	<i>One side</i>	<i>%</i>	<i>Both sides</i>	<i>%</i>	
	Inner City (Arab Sefer)	19	12	78	9	23	40
	Intermediate (Sefere Selam)	30	10	66	21	34	61
	Suburbs (Dato)	0		0	46	100	46
Total		49	22	48	76	52	147

Effective orientation is crucial for pedestrians to be able to navigate and explore the city easily. This includes factors such as clear signage, easy-to-understand street layouts, and access to public transportation. By assessing orientation, we can gain valuable insights into the effectiveness of the street

patterns and wayfinding systems in Hawassa City.

The inner and intermediate neighborhoods in Hawassa City have a continuous street pattern, which allows for easy and direct travel with a high amount of paved surface. These areas are also well-connected to parallel streets at nearby distances, making it

easier for pedestrians to navigate. However, the suburbs of Dato lack such features, and most streets there do not have proper safety measures in place.

In Hawassa City and its surrounding neighborhoods, some important points and pathways help pedestrians find their way, locate important places, and avoid getting lost or disoriented. The major roads are easy to understand and legible. Although the inner city (Arab sefer) and intermediate (Sefere selam) areas have more landmarks than other areas, it's important to have a consistent level of differentiation throughout the city to prevent confusion. Detailed building shapes and forms also play a crucial role in creating a clear and understandable environment. They help identify areas where improvements are required to enhance the ease of navigating the city for pedestrians.

Regarding the comfort of pedestrians while walking involves evaluating the physical conditions they experience. Factors such as continuous pavement, pedestrian enclosure, and floor quality can all impact the level of comfort. Our research has identified areas where physical infrastructure could be improved to provide a more comfortable walking experience. This could mean addressing issues such as sidewalk

discontinuity, rough pavement, or lack of shade. Based on the data collected from the city and our observations, we found that most streets in the inner city and intermediate areas have some infrastructure to protect pedestrians from weather conditions. However, the availability of infrastructure for disabled people, clean air, and calm traffic varies across different neighborhoods. Unfortunately, we could not find ramps and speed calming signs in the suburbs of Hawassa City.

In the Inner City (Arab Sefer), 38% of the infrastructure includes ramps, while 13% consists of speed-calming signs. The remaining 50% is unavailable. In Intermediate (Sefere Selam), 46% of infrastructure includes ramps on the walkway, while 7% is speed calming signs. 48% is unavailable.

In Suburbs (Dato), 100% is unavailable for disabled people. This area has no ramps or speed-calming signs. Overall, the total percentage of infrastructure available for disabled people is 35%. 29% consists of ramps, 6% is speed calming signs, and 65% is unavailable. We also found obstructions in the neighborhood, such as illegal parking and street vending, which can be problematic.

There have been 55 cases of illegal parking in the Inner City, 35 in the Intermediate, and 45 in the Suburbs. Street vending has been reported four times in total across all three areas. Overall, there have been 40 obstructions in the Inner City, 61 in the Intermediate, and 46 in the Suburbs, totaling 147. Improving comfort for pedestrians encourages more people to choose walking as a mode of transportation, leading to a more walkable city.

Diversity refers to the range of different land uses, architectural styles, and public spaces that make up the built environment. In an

urban setting, a diverse environment tends to be more appealing and interesting for pedestrians, encouraging them to walk more frequently. This research assesses the diversity of the Hawassa city-built environment. The neighborhoods in Hawassa City have different types of housing, which allows people from different backgrounds and social statuses to interact regularly. This creates personal and community connections that are vital for establishing livable communities. The research also identifies areas where improvements can be made to enhance the pedestrian experience and make it more vibrant and varied.

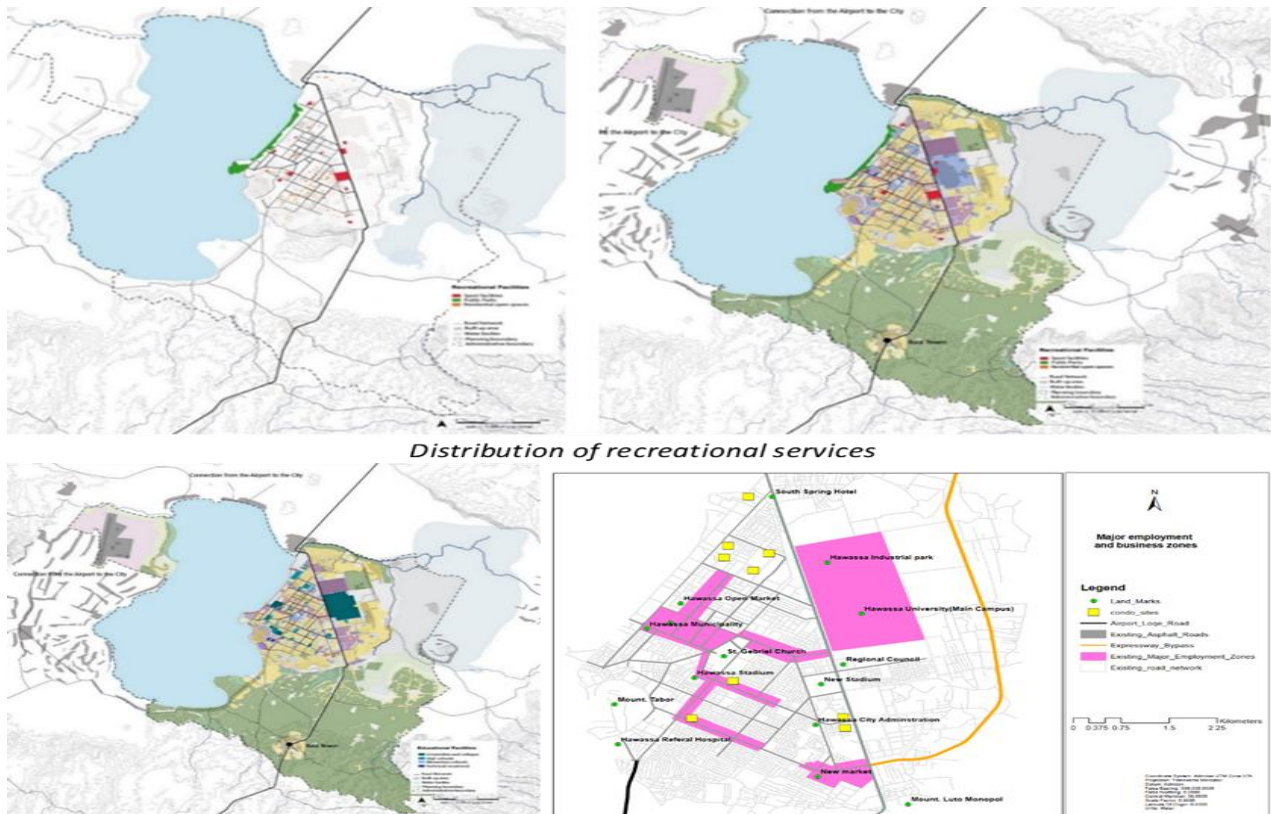


Figure 4 2. Distribution of schools and surrounding land use

Assessing local destinations is crucial for determining their availability and accessibility within a walkable distance. An ideal walkable city should have a mix of amenities such as shops, restaurants, parks,

and other facilities that cater to the needs of pedestrians.

<i>Connectivity</i>		<i>Table 4 3 . Trip Length to Destinations</i>						
		Inner City(Areb Sefer)		Inter mediate(Sefere Selam)		Suburb/Outskirt(Dato)		Total Freque ncy
		Frequen cy	Percent %	Frequenc y	Percent %	Freque ncy	Percent %	
Average Trip Length	Less than 5min	26	20.63	20	14.18	12	10.01	60
	5 to 10min	34	26.98	33	23.40	22	18.00	85
	10 to 15min	21	16.93	37	26.08	34	27.92	106
	More than 15	45	35.36	51	36.01	53	44.08	137
Total		126		141		121		388

The research identifies areas that can be improved to enhance pedestrian access to local destinations, such as adding more amenities or improving connectivity. According to the Hawassa City Planning Department, the average walking distance to the destination varies depending on the location of pedestrians. Respondents from St.

Gabriel Church reported a distance of less than 0.5 km to reach their destination, while respondents from South Spring, Mobil, and Old Market walked 0.5-1 km. Respondents from Monopol and referral hospitals walked relatively longer distances, with an average of 2.2 kilometers. Further, the city's structure plan report states that 59 percent of

respondents walked for 5-10 minutes from their homes to access transport services, with only 1.4 percent reporting a maximum walking time of 40 minutes. On average, pedestrians walked for 13.3 minutes, with the longest walking time for passengers from the Dato, Chafe, Atote, and Gabriel routes taking up to 40 minutes. The Nigest Fura route was the shortest, with only a 5-minute walk to

access the stop. This information is valuable for urban planners to create a walkable city where residents can easily access their daily needs on foot.

Table 4 4. Summary of observations and Survey result

Major Indicators	Walkability	Inner-city	Intermediate	Suburbs
<i>Footpath quality</i>		The most footpaths are well-maintained	The most footpaths are well-maintained	Poor footpath quality
<i>Street lighting and Visibility</i>		There is adequate street lighting and visibility	There is adequate street lighting and visibility	Not Available
<i>Safe Pedestrian crossings</i>		Lack of safe pedestrian crossing	Lack of safe pedestrian crossing	No safe pedestrian crossing at all
<i>Even slope or Gradient along the route</i>		Level variations along the sidewalks are safe, and separation from vehicles-	Level variations along the sidewalks are safe, and separation from vehicles-	No level difference and separation
<i>A route is continuous</i>		Lack continuity	Lack continuity	Not continuous
<i>Well-connected street network</i>		Well-connected street	Well-connected street	Not Connected
<i>easily accessible to facilities and services</i>		easily accessible to facilities and services	easily accessible to facilities and services	Not easily accessible to facilities and services
<i>Proximity to destinations Schools/ shops/ other local services/ public transport</i>		Most services are within walking distance	Most services are within walking distance	Are more than 10 minutes
<i>There are Mixed land uses</i>		Commercial-dominated mixed land use	Residence-dominated mixed land use	Not Mixed
<i>Safe from Crime</i>		Safe from Crime a day	Safe from Crime a day	Not Safe from Crime
<i>Social Policing from Passing Traffic</i>		Not regulated	Not regulated	Not regulated

<i>Feel safe when walking</i>	Other People usually Walking on the streets	Other People usually Walking on the streets	Other People usually Walking on the streets
<i>Building orientation</i>	The Routes are Overlooked by fence	The Routes are Overlooked by fence	The Routes are Overlooked by fence
<i>Good street and path lighting</i>	There are no obstacles along the sidewalks- Sufficient sight clearance	There are no obstacles along the sidewalks- Sufficient sight clearance	There are obstacles along the sidewalks- insufficient sight clearance
<i>Safety from Traffic or Separated</i>	Most local streets are not separated from traffic	Most local streets are not separated from traffic	Not separated
<i>Availability of Street furniture to stop and rest</i>	Street furniture is insufficient Street furniture obscures pedestrian movement,	Street furniture is insufficient Street furniture obscures pedestrian movement,	Not available on all streets
<i>Familiar faces when walking</i>	New faces when walking	New faces when walking	Familiar faces when walking
<i>Sidewalks width</i>	Sidewalks are wide enough – Sidewalk width	Sidewalks are wide enough – Sidewalk width	Not available
<i>Pavement quality</i>	The pavement slabs are not deformed	The pavement slabs are not deformed	The pavement slabs are deformed
<i>pavement- Continuity</i>	Not continuous	Continuous	disturb pedestrian movement
<i>Accessible</i>	There are many alternative routes for getting from place to place in my neighborhood by walking	There are many alternative routes for getting from place to place in my neighborhood by walking	Not accessible

5. Conclusion Remarks

The study on walkability assessment of selected streets and neighborhoods in Hawassa City has identified several factors that contribute to making these areas more pedestrian-friendly. The major factors that

determine the level of walkability in a given area are safety, orientation, comfort, diversity, and access to local destinations.

By enhancing walkability in the city, we can promote more sustainable urban development and create healthier and more

livable communities. Therefore, urban designers, policymakers, and city planners can use the findings from this research as a guide to design and create more walkable streets and neighborhoods for the benefit of all residents and visitors of Hawassa City.

Safety, orientation, comfort, diversity, and local destinations are the key determinants of the walkability of a neighborhood.

Various safety factors were examined for pedestrian safety, including street patterns, traffic calming measures, lighting, visibility, pavement quality, pedestrian separation, continuous pavement, street enclosure, street crossing, and vehicle mix. These factors were analyzed in the inner city, intermediate, and suburban neighborhoods of Hawassa City. The study found that the inner city and intermediate areas are relatively safe for pedestrians, while the suburbs (Dato) are not. Neighborhoods that prioritize safety measures generally encourage more walking and therefore reduce accidents. Key factors contributing to pedestrian safety include proper lighting, well-maintained sidewalks, clear sightlines, and reduced vehicle speeds. The intermediate area of the city is relatively safe and walkable. The study found that urban structures such as street patterns, traffic control, and built forms affect pedestrian

safety and comfort in all neighborhoods. Speed breaks and speed limit signs were found only on local cobblestone roads, while major roads lacked such traffic calming measures. The suburb of Dato had no lighting or visibility, while the intermediate neighborhood of Sefere Selam had the highest percentage of available lighting. Street width, on-street parking, street trees, and pavement continuity were additional factors that helped to slow down traffic. Although 66% of the streets had footpaths ranging from 1 meter to 7.7 meters wide, 34% had no footpaths at all. High-rise buildings are positioned towards footpaths in most parts of the city, creating safe and functional pedestrian areas. However, in the suburbs, there are no separate walkways or medians for pedestrians.

Walkability is an essential aspect of any urban environment as it encourages physical activity, reduces congestion, improves air quality, and enhances social interactions. One of the primary factors that affect walkability is pedestrian comfort, which refers to the ease, safety, and enjoyment experienced by individuals while walking in a particular area. Pedestrian comfort is enhanced by well-maintained sidewalks, safety measures, adequate lighting, access to amenities, and

the presence of greenery and seating areas. Social, physical, and economic diversity are other fundamental factors that play a significant role in determining walkability. Neighborhoods that embrace social diversity, physical diversity, economic diversity, accessibility, safety, public spaces, and a human scale promote a healthy, active, and thriving community.

The walkability of streets and neighborhoods is greatly influenced by the availability and proximity of local destinations. A mix of land uses, higher density, accessibility, proximity, amenities, street connectivity, and safety all contribute to creating a walkable environment. Urban designers, urban planners, and policymakers can create more walkable streets and neighborhoods by prioritizing and addressing these factors, promoting a healthier, more sustainable, and enjoyable lifestyle for residents. By focusing on these factors, we can build more vibrant and walkable neighborhoods that support the well-being of individuals and the community. This will result in neighborhoods that are vibrant, pedestrian-friendly, and promote active and healthy lifestyles.

Several factors contribute to pedestrian comfort and ultimately determine the overall walkability of a neighborhood. According to

survey results, the quality of sidewalks is relatively better in the Inner City (Areb Sefer) and Intermediate (Sefere Selam) neighborhoods. Most people agreed that these sidewalks were comfortable and easy to walk on. However, in the Suburb/Outskirt (Dato) neighborhood, more people disagreed on the quality of the sidewalks.

A diverse community promotes inclusivity, social cohesion, and a sense of community, which are essential for a walkable neighborhood. A community that embraces social diversity is more likely to have welcoming public spaces, streetscapes, and community amenities that cater to a broad range of individuals and are accessible to everyone.

The proximity of local destinations to residential areas greatly affects walkability. When essential destinations like schools, workplaces, grocery stores, and parks are located within a reasonable distance from homes, people are more inclined to walk instead of driving. Shorter distances reduce travel time, making walking a more convenient and attractive option.

The presence of desirable amenities within walking distance positively impacts walkability. Neighborhoods that offer quality parks, playgrounds, libraries, community

centers, and other public spaces enhance the overall experience of walking. These amenities provide destinations and attract people to take regular walks, improving both physical and mental well-being.

Walkability not only promotes active transportation but also creates a sense of community, improves public health, reduces pollution, and drives economic growth. Therefore, we recommend using the results of this study as a framework for future urban design, planning, and development initiatives, with a focus on building more walkable streets and neighborhoods in Hawassa City.

5.1. General Recommendation

Based on the assessment of walkability factors in selected streets and neighborhoods of Hawassa City, the following general recommendations are proposed:

1. **Safety:** Improve pedestrian safety by implementing traffic calming measures such as speed humps, pedestrian crossings with clear markings, and accessible sidewalks. Provide adequate lighting in all public spaces, including streets, sidewalks, and parks. Upgrade pedestrian infrastructure, including providing safe pedestrian crossings and improving the street pattern in high-traffic areas.
2. **Orientation:** Enhance the ease of navigating the city for pedestrians by improving the street pattern, providing clear signage, and improving access to public transportation. Ensure that streets are accessible and designed for pedestrians first, rather than vehicles.
3. **Comfort:** Create a comfortable walking experience by providing continuous, well-maintained sidewalks, shade, and seating. Encourage private property owners to maintain public areas, including sidewalks, in front of their buildings. Provide spaces for resting and socializing to increase the appeal of walking.
4. **Diversity:** Enhance the vibrancy of the built environment by encouraging diverse land uses, architectural styles, and public spaces. Encourage areas with businesses to cater to pedestrians, with different types of shops, restaurants, and green spaces.
5. **Local Destinations:** Encourage walkability by providing a mix of amenities and services within walking distance. This could include open public spaces, parks, playgrounds, and community centers. Encourage the development of mixed-use

zoning that includes retail, residential, and commercial uses near each other.

These recommendations can be applied at different scales from the city level to the neighborhood and street level. By improving the safety, orientation, comfort, diversity, and local destinations of Hawassa City, the opportunities for walking will be more attractive to people in the city.

5.2. Specific Area Recommendation

5.2.1. The Inner-city

Particularly in the inner city, it is essential to focus on maintaining the existing moderate walkability and improving the width of sidewalks, installing pedestrian-oriented street lighting, and creating pedestrian-designated zones prioritizing pedestrians' safety and comfort. It is also crucial to promote efficient mixed land use and higher-density development to decrease the distance between destinations and enhance walkability.

5.2.2. The intermediate area of the city

To maintain a safe and accessible environment for pedestrians in the intermediate area of the city, several improvements should be made. This includes

implementing safety measures, providing clear directions, promoting mixed land use, and offering local destinations. Pedestrian-friendly infrastructure should be available throughout the entire area. To enhance safety and comfort for pedestrians, a continuous and wide sidewalk should be created. Street furnishings such as benches, pedestrian information kiosks, and bike racks can also be added to create a barrier between pedestrians and vehicles. These fixtures should follow a consistent pattern, such as uniform light pole height or tree shade patterns. Pedestrian crossings should be visible during the day and night with white markings, signage, and lighting. To further promote pedestrian safety, curb extensions, and stop bars can be installed. On wider streets, mid-street crossing islands and minimal curb radius can be used to decrease crossing distance

5.2.3. The Suburban areas of the city

To enhance the walkability of suburban areas in the city, we suggest developing detailed local development plans (LDPs) for all suburbs. These plans should consider social, economic, environmental, and physical issues related to urban planning and design

standards. The following principles should be incorporated into the plan and design:

- Ensuring connectivity and accessibility
- Creating walkable spaces through street design and layout
- Encouraging mixed land use and higher density
- Providing safe and secure streets
- Encouraging engagement and public participation

Considering the built environment and demographic features to determine the walkability of a neighborhood. To make walking more convenient, we recommend introducing shorter blocks with frequent crossings, creating well-connected networks, wide sidewalks, and pedestrian-friendly infrastructures. Additionally, implementing traffic calming measures and reducing curb cuts will enhance pedestrian safety.

5.3. Urban Design Level Recommendation

The way we design our cities, streets, and neighborhoods plays a crucial role in determining their physical and functional aspects. Urban planning, architecture, and landscape architecture are some of the

disciplines that must work together to manage and transform urban life. By integrating urban design activities that prioritize the safety of street users, human-scale structures, and attractive walkways, we can improve a city's overall walkability, create comfortable pedestrian spaces, promote social and economic diversity, and provide access to local destinations. Sustainable urban design incorporates these elements to encourage mobility, activity, and responsibility. To enhance the walkability of Hawassa City, we recommend an urban design strategy that integrates principles and recommendations from urban planning, architecture, and landscape architecture. Here are some recommendations to consider:

To improve walkability through urban design, here are some recommendations:

1. ***Sidewalks and Pedestrian Infrastructure:*** Provide well-maintained, wide, and continuous sidewalks throughout the city or neighborhood. Ensure they are accessible for people with disabilities and incorporate features like curb ramps, crosswalks, and pedestrian signals at intersections.
2. ***Street Design:*** Create narrower streets with reduced vehicle speeds to

improve pedestrian safety. Design streets with dedicated bike lanes where possible to accommodate multiple modes of transport. Implement traffic calming measures such as speed bumps, raised crosswalks, or chicanes to prioritize pedestrians.

3. **Mixed Land Use:** Encourage mixed-use development that blends residential, commercial, and recreational spaces. Place essential services and amenities within walking distance of residential areas, reducing the need for car travel and promoting walkability.
4. **Connectivity:** Design a connected street network with frequent intersections and short block lengths. This enables pedestrians to take direct routes, increases walkability, and reduces reliance on long, circuitous routes.
5. **Transit Integration:** Ensure convenient accessibility to public transportation by locating transit stops close to pedestrian pathways. Design transit stations with comfortable waiting areas, clear signage, and proper lighting to

encourage walking as a first and last-mile connection.

6. **Public Spaces:** Include well-designed public spaces such as parks, plazas, and pedestrian-friendly squares. Provide seating, greenery, and amenities to attract pedestrians, encourage rest, and support social interaction.
7. **Safety and Security:** Enhance pedestrian safety by using traffic calming measures, installing adequate lighting, and maintaining clear sightlines. Collaborate with local law enforcement to establish a safe and secure environment for walkers.
8. **Shade and Comfort:** Incorporate Street trees, canopies, or shelters to provide shade and protection from weather elements. Install benches, public art, and wayfinding signage to make the walk more comfortable and engaging.
9. **Inviting Streetscapes:** Design visually attractive and inviting streetscapes using appealing materials, landscaping, public art, and

street furniture to create a pleasant walking experience.

10. **Community Engagement:** Involve the community in the urban design process to ensure their voices are heard. Conduct public consultations, workshops, and surveys to gather input and feedback on walkability needs and preferences.

By implementing these recommendations, cities and neighborhoods can make significant progress in enhancing walkability, and making walking a safe, enjoyable, and convenient mode of transportation.

5.4. **Local Administration**

It is important to focus on pedestrian safety and comfort in Hawassa City by investing more resources in developing pedestrian infrastructure such as sidewalks, crosswalks, and bike lanes. Effective planning and designing require collaboration between urban designers, planners, architects, landscape designers, and community members. Regulations regarding sidewalks must be followed and maintained to ensure the quality and safety of the pavement, amenities, and other structures. Obstructions must be avoided to guarantee pedestrian safety, comfort, and security. Education and

awareness programs should also be established to promote the benefits of walking. Additionally, a supportive policy and regulatory framework should be established to encourage a walkable city. To achieve this, the following actions should be taken:

- Ensure proper maintenance of sidewalks and clear marking of crosswalks.
- Encourage a mix of residential, commercial, service, and recreational activities nearby.
- Make public transportation easily accessible to encourage alternative modes of transportation instead of relying on cars.
- Construct pedestrian walkways to reduce reliance on cars and promote walking.
- Ensure uninterrupted pathways throughout the city to enhance walkability for pedestrians.

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Annex B

Annex B1 Weighted Rate

<i>Internal consistency test using Cronbach's Alpha</i>																		
	<i>Walkability Indicators</i>	The footpaths are well maintained	Street lighting and Visibility	Safe Pedestrian crossings	Even slope or Gradient along the route	A is route continuous	Well connected street network	Easily accessible to facilities and services	Proximity to destinations Schools/ shops/ other local services/ public transport	There are Mixed land uses	Safe from Crime	Social Policing from Passing Traffic	Other Peoples usually Walking on the streets	The Routes are Overlooked by Buildings	Good street and path lighting	Safety from Traffic or Separated	Availability of Street furniture to stop and rest	Familiar faces when walking
1	The footpaths are well maintained	1.000	0.967	0.595	0.660	0.563	0.690	0.650	0.664	0.666	0.660	0.679	0.677	0.734	0.709	0.689	0.662	0.607
2	Street lighting and Visibility	0.967	1.000	0.589	0.647	0.563	0.651	0.614	0.650	0.635	0.633	0.645	0.640	0.690	0.685	0.663	0.632	0.583
3	Safe Pedestrian crossings	0.595	0.589	1.000	0.620	0.634	0.752	0.675	0.765	0.739	0.726	0.679	0.651	0.656	0.762	0.680	0.687	0.676
4	Even slope or Gradient along the route	0.660	0.647	0.620	1.000	0.684	0.707	0.679	0.749	0.686	0.733	0.703	0.714	0.745	0.694	0.768	0.688	0.654
5	A is route continuous	0.563	0.563	0.634	0.684	1.000	0.661	0.682	0.737	0.675	0.685	0.670	0.644	0.698	0.661	0.707	0.654	0.630
6	Well connected street network	0.690	0.651	0.752	0.707	0.661	1.000	0.789	0.815	0.840	0.780	0.755	0.741	0.775	0.795	0.772	0.738	0.727
7	Easily accessible to facilities and services	0.650	0.614	0.675	0.679	0.682	0.789	1.000	0.818	0.793	0.744	0.775	0.756	0.830	0.804	0.786	0.728	0.738
8	Proximity to destinations Schools/ shops/ other local services/ public transport	0.664	0.650	0.765	0.749	0.737	0.815	0.818	1.000	0.822	0.809	0.763	0.772	0.806	0.826	0.803	0.795	0.755
9	There are Mixed land uses	0.666	0.635	0.739	0.686	0.675	0.840	0.793	0.822	1.000	0.808	0.780	0.748	0.777	0.806	0.815	0.766	0.800
10	Safe from Crime	0.660	0.633	0.726	0.733	0.685	0.780	0.744	0.809	0.808	1.000	0.774	0.748	0.748	0.788	0.842	0.814	0.773
11	Social Policing from Passing Traffic	0.679	0.645	0.679	0.703	0.670	0.755	0.775	0.763	0.780	0.774	1.000	0.748	0.788	0.789	0.759	0.763	0.737
12	Other Peoples usually Walking on the streets	0.677	0.640	0.651	0.714	0.644	0.741	0.756	0.772	0.748	0.748	0.748	1.000	0.829	0.783	0.778	0.767	0.716
13	The Routes are Overlooked by Buildings	0.734	0.690	0.656	0.745	0.698	0.775	0.830	0.806	0.777	0.748	0.788	0.829	1.000	0.813	0.811	0.772	0.780
14	Good street and path lighting	0.709	0.685	0.762	0.694	0.661	0.795	0.804	0.826	0.806	0.788	0.789	0.783	0.813	1.000	0.776	0.791	0.748
15	Safety from Traffic or Separated	0.689	0.663	0.680	0.768	0.707	0.772	0.786	0.803	0.815	0.842	0.759	0.778	0.811	0.776	1.000	0.771	0.801
16	Availability of Street furniture to stop and rest	0.662	0.632	0.687	0.688	0.654	0.738	0.728	0.795	0.766	0.814	0.763	0.767	0.772	0.791	0.771	1.000	0.769
17	Familiar faces when walking	0.607	0.583	0.676	0.654	0.630	0.727	0.738	0.755	0.800	0.773	0.737	0.716	0.780	0.748	0.801	0.769	1.000

Annex B2 Internal Consistency Test

Inter-Item Correlation Matrix																	
	Sidewalks are wide enough	The pavement slabs are not deformed	continuous pavement not disturb movement,	There are no obstacles along the sidewalks Poles, Vending and Other	The sidewalks are safe, and separated from vehicles	Street furniture is sufficient	Store signs aesthetically disturb pedestrians	Traffic signs on the streets are sufficient for calming	It is a well-lit street at night	It is a safe street at night, with good lighting	There is enough greenery in the street.	The trees disturb the pedestrian movement	Safe Crossings	Good floor quality	It is easy for me to walk to a transit stop	There are many alternative routes for getting from place to place in my neighborhood by walking	I feel safe walking in my neighborhood during the day
Sidewalks are wide enough	1	0.98	0.933	0.873	0.857	0.863	0.821	0.882	0.857	0.893	0.885	0.862	0.861	0.844	0.858	0.798	0.787
The pavement slabs are not deformed	0.98	1	0.954	0.889	0.866	0.877	0.841	0.888	0.858	0.898	0.89	0.865	0.873	0.856	0.87	0.791	0.795
continuous pavement not disturb movement,	0.933	0.954	1	0.878	0.855	0.866	0.815	0.862	0.837	0.855	0.855	0.831	0.839	0.817	0.831	0.769	0.77
There are no obstacles along the sidewalks Poles, Vending and Other	0.873	0.889	0.878	1	0.961	0.972	0.935	0.972	0.943	0.963	0.963	0.949	0.954	0.935	0.947	0.878	0.882
The sidewalks are safe, and separated from vehicles	0.857	0.866	0.855	0.961	1	0.962	0.935	0.959	0.941	0.959	0.967	0.947	0.94	0.924	0.933	0.866	0.879
Street furniture is sufficient	0.863	0.877	0.866	0.972	0.962	1	0.935	0.965	0.958	0.961	0.964	0.933	0.933	0.91	0.922	0.867	0.876
Store signs aesthetically disturb pedestrians	0.821	0.841	0.815	0.935	0.935	0.935	1	0.928	0.941	0.926	0.93	0.903	0.914	0.911	0.918	0.888	0.868
Traffic signs on the streets are sufficient for calming	0.882	0.888	0.862	0.972	0.959	0.965	0.928	1	0.957	0.982	0.978	0.961	0.951	0.943	0.946	0.877	0.889
It is a well-lit street at night	0.857	0.858	0.837	0.943	0.941	0.958	0.941	0.957	1	0.967	0.962	0.937	0.926	0.914	0.922	0.9	0.897
It is a safe street at night, with good lighting	0.893	0.898	0.855	0.963	0.959	0.961	0.926	0.982	0.967	1	0.991	0.962	0.958	0.943	0.953	0.885	0.902
There is enough greenery in the street.	0.885	0.89	0.855	0.963	0.967	0.964	0.93	0.978	0.962	0.991	1	0.962	0.966	0.943	0.953	0.885	0.893
The trees disturb the pedestrian movement	0.862	0.865	0.831	0.949	0.947	0.933	0.903	0.961	0.937	0.962	0.962	1	0.97	0.964	0.963	0.891	0.903
Safe Crossings	0.861	0.873	0.839	0.954	0.94	0.933	0.914	0.951	0.926	0.958	0.966	0.97	1	0.973	0.976	0.901	0.885
Good floor quality	0.844	0.856	0.817	0.935	0.924	0.91	0.911	0.943	0.914	0.943	0.943	0.964	0.973	1	0.988	0.91	0.9
It is easy for me to walk to a transit stop	0.858	0.87	0.831	0.947	0.933	0.922	0.918	0.946	0.922	0.953	0.953	0.963	0.976	0.988	1	0.923	0.898
There are many alternative routes for getting from place to place in my neighborhood by walking	0.798	0.791	0.769	0.878	0.866	0.867	0.888	0.877	0.9	0.885	0.885	0.891	0.901	0.91	0.923	1	0.846
I feel safe walking in my neighborhood during the day	0.787	0.795	0.77	0.882	0.879	0.876	0.868	0.889	0.897	0.902	0.893	0.903	0.885	0.9	0.898	0.846	1

Annex B3 Weighted Score of The Local Walkability Index

Walkability Indicators	Importance Level	Rate	Neighborhood						Whole City	
			Inner City(Areb Sefer)		Inter mediate(Sefere Selam)		Suburb/Outskirt(Dato)		Total	
			Count	Mean Rate	Count	Mean Rate	Count	Mean Rate	Count	Mean Rate
1. The footpaths are well-maintained	Very Good for Walkability	5	29	1.15	41	1.45	0	0.00	70	0.90
	Good for walkability	4	39	1.24	68	1.93	1	0.03	108	1.11
	Neither good nor bad	3	39	0.93	31	0.66	13	0.32	83	0.64
	Bad for walkability	2	17	0.27	1	0.01	12	0.20	30	0.15
	Very bad for walkability	1	2	0.02	0	0.00	95	0.79	97	0.25
<i>Total</i>			126	3.60	141	4.06	121	1.34	388	3.06
2. Street lighting and Visibility	Very Good for Walkability	5	16	0.63	40	1.42	0	0.00	56	0.72
	Good for walkability	4	43	1.37	64	1.82	1	0.03	108	1.11
	Neither good nor bad	3	18	0.43	16	0.34	12	0.30	46	0.36
	Bad for walkability	2	37	0.59	21	0.30	23	0.38	81	0.42
	Very bad for walkability	1	12	0.10	0	0.00	85	0.70	97	0.25
<i>Total</i>			126	3.11	141	3.87	121	1.41	388	2.86
3. Safe Pedestrian crossings	Very Good for Walkability	5	38	1.51	40	1.42	0	0.00	78	1.01
	Good for walkability	4	44	1.40	33	0.94	2	0.07	79	0.81
	Neither good nor bad	3	15	0.36	46	0.98	13	0.32	74	0.57
	Bad for walkability	2	28	0.44	11	0.16	49	0.81	88	0.45

<i>Walkability Indicators</i>	<i>Importance Level</i>	<i>Rate</i>	<i>Neighborhood</i>						<i>Whole City</i>	
			<i>Inner City(Areb Sefer)</i>		<i>Inter mediate(Sefere Selam)</i>		<i>Suburb/Outskirt(Dato)</i>		<i>Total</i>	
			<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>
4. <i>Even slope or Gradient along the route</i>	Very bad for walkability	1	1	0.01	11	0.08	57	0.47	69	0.18
	<i>Total</i>		126	3.71	141	3.57	121	1.67	388	3.02
	Very Good for Walkability	5	36	1.43	26	0.92	3	0.12	65	0.84
	Good for walkability	4	69	2.19	86	2.44	2	0.07	157	1.62
	Neither good nor bad	3	21	0.50	29	0.62	5	0.12	55	0.43
	Bad for walkability	2	0	0.00	0	0.00	29	0.48	29	0.15
5. <i>A route is continuous</i>	Very bad for walkability	1	0	0.00	0	0.00	82	0.68	82	0.21
	<i>Total</i>		126	4.12	141	3.98	121	1.47	388	3.24
	Very Good for Walkability	5	36	1.43	54	1.91	1	0.04	91	1.17
	Good for walkability	4	35	1.11	20	0.57	2	0.07	57	0.59
	Neither good nor bad	3	35	0.83	62	1.32	22	0.55	119	0.92
	Bad for walkability	2	10	0.16	5	0.07	35	0.58	50	0.26
6. <i>Well-connected street network</i>	Very bad for walkability	1	10	0.08	0	0.00	61	0.50	71	0.18
	<i>Total</i>		126	3.61	141	3.87	121	1.74	388	3.12
	Very Good for Walkability	5	44	1.75	46	1.63	1	0.04	91	1.17
	Good for walkability	4	46	1.46	54	1.53	2	0.07	102	1.05
	Neither good nor bad	3	6	0.14	31	0.66	22	0.55	59	0.46

<i>Walkability Indicators</i>	<i>Importance Level</i>	<i>Rate</i>	<i>Neighborhood</i>						<i>Whole City</i>	
			<i>Inner City(Areb Sefer)</i>		<i>Inter mediate(Sefere Selam)</i>		<i>Suburb/Outskirt(Dato)</i>		<i>Total</i>	
			<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>
	Bad for walkability	2	20	0.32	5	0.07	63	1.04	88	0.45
	Very bad for walkability	1	10	0.08	5	0.04	33	0.27	48	0.12
	<i>Total</i>		126	3.75	141	3.93	121	1.97	388	3.26
7. Easily accessible to facilities and services	Very Good for Walkability	5	20	0.79	40	1.42	0	0.00	60	0.77
	Good for walkability	4	52	1.65	72	2.04	2	0.07	126	1.30
	Neither good nor bad	3	29	0.69	19	0.40	26	0.64	74	0.57
	Bad for walkability	2	20	0.32	7	0.10	60	0.99	87	0.45
	Very bad for walkability	1	5	0.04	3	0.02	33	0.27	41	0.11
	<i>Total</i>		126	3.49	141	3.99	121	1.98	388	3.20
8. Proximity to destinations Schools/ shops/ other local services/ public transport	Very Good for Walkability	5	69	2.74	92	3.26	1	0.04	162	2.09
	Good for walkability	4	55	1.75	36	1.02	1	0.03	92	0.95
	Neither good nor bad	3	2	0.05	13	0.28	26	0.64	41	0.32
	Bad for walkability	2	0	0.00	0	0.00	24	0.40	24	0.12
	Very bad for walkability	1	0	0.00	0	0.00	69	0.57	69	0.18
	<i>Total</i>		126	4.53	141	4.56	121	1.69	388	3.65
9. There are Mixed land uses	Very Good for Walkability	5	57	2.26	81	2.87	1	0.04	139	1.79
	Good for walkability	4	61	1.94	50	1.42	4	0.13	115	1.19

<i>Walkability Indicators</i>	<i>Importance Level</i>	<i>Rate</i>	<i>Neighborhood</i>						<i>Whole City</i>	
			<i>Inner City(Areb Sefer)</i>		<i>Inter mediate(Sefere Selam)</i>		<i>Suburb/Outskirt(Dato)</i>		<i>Total</i>	
			<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>
	Neither good nor bad	3	8	0.19	10	0.21	25	0.62	43	0.33
	Bad for walkability	2	0	0.00	0	0.00	30	0.50	30	0.15
	Very bad for walkability	1	0	0.00	0	0.00	61	0.50	61	0.16
	<i>Total</i>		126	4.39	141	4.50	121	1.79	388	3.62
<i>10. Safe from Crime</i>	Very Good for Walkability	5	52	2.06	74	2.62	3	0.12	129	1.66
	Good for walkability	4	54	1.71	63	1.79	2	0.07	119	1.23
	Neither good nor bad	3	20	0.48	4	0.09	27	0.67	51	0.39
	Bad for walkability	2	0	0.00	0	0.00	12	0.20	12	0.06
	Very bad for walkability	1	0	0.00	0	0.00	77	0.64	77	0.20
	<i>Total</i>		126	4.25	141	4.50	121	1.69	388	3.54
<i>11. Social Policing from Passing Traffic</i>	Very Good for Walkability	5	37	1.47	61	2.16	3	0.12	101	1.30
	Good for walkability	4	72	2.29	66	1.87	2	0.07	140	1.44
	Neither good nor bad	3	17	0.40	14	0.30	38	0.94	69	0.53
	Bad for walkability	2	0	0.00	0	0.00	26	0.43	26	0.13
	Very bad for walkability	1	0	0.00	0	0.00	52	0.43	52	0.13
	<i>Total</i>		126	4.16	141	4.33	121	1.99	388	3.55
<i>12. Other People usually</i>	Very Good for Walkability	5	51	2.02	44	1.56	3	0.12	98	1.26

<i>Walkability Indicators</i>	<i>Importance Level</i>	<i>Rate</i>	<i>Neighborhood</i>						<i>Whole City</i>	
			<i>Inner City(Areb Sefer)</i>		<i>Inter mediate(Sefere Selam)</i>		<i>Suburb/Outskirt(Dato)</i>		<i>Total</i>	
			<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>
<i>Walking on the streets</i>	Good for walkability	4	45	1.43	55	1.56	2	0.07	102	1.05
	Neither good nor bad	3	20	0.48	37	0.79	22	0.55	79	0.61
	Bad for walkability	2	7	0.11	3	0.04	21	0.35	31	0.16
	Very bad for walkability	1	3	0.02	2	0.01	73	0.60	78	0.20
	<i>Total</i>		126	4.06	141	3.96	121	1.69	388	3.29
<i>13. The Routes are Overlooked by Buildings</i>	Very Good for Walkability	5	38	1.51	42	1.49	0	0.00	80	1.03
	Good for walkability	4	38	1.21	70	1.99	1	0.03	109	1.12
	Neither good nor bad	3	30	0.71	19	0.40	29	0.72	78	0.60
	Bad for walkability	2	14	0.22	8	0.11	26	0.43	48	0.25
	Very bad for walkability	1	6	0.05	2	0.01	65	0.54	73	0.19
<i>Total</i>		126	3.70	141	4.01	121	1.72	388	3.19	
<i>14. Good street and path lighting</i>	Very Good for Walkability	5	44	1.75	60	2.13	0	0.00	104	1.34
	Good for walkability	4	30	0.95	61	1.73	2	0.07	93	0.96
	Neither good nor bad	3	44	1.05	14	0.30	24	0.60	82	0.63
	Bad for walkability	2	6	0.10	3	0.04	34	0.56	43	0.22
	Very bad for walkability	1	2	0.02	3	0.02	61	0.50	66	0.17
<i>Total</i>		126	3.86	141	4.22	121	1.73	388	3.32	

<i>Walkability Indicators</i>	<i>Importance Level</i>	<i>Rate</i>	<i>Neighborhood</i>						<i>Whole City</i>	
			<i>Inner City(Areb Sefer)</i>		<i>Inter mediate(Sefere Selam)</i>		<i>Suburb/Outskirt(Dato)</i>		<i>Total</i>	
			<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>
<i>15. Safety from Traffic or Separated</i>	Very Good for Walkability	5	34	1.35	41	1.45	0	0.00	75	0.97
	Good for walkability	4	38	1.21	67	1.90	2	0.07	107	1.10
	Neither good nor bad	3	30	0.71	27	0.57	29	0.72	86	0.66
	Bad for walkability	2	20	0.32	5	0.07	52	0.86	77	0.40
	Very bad for walkability	1	4	0.03	1	0.01	38	0.31	43	0.11
<i>Total</i>			126	3.62	141	4.01	121	1.96	388	3.24
<i>16. Availability of Street furniture to stop and rest</i>	Very Good for Walkability	5	5	0.20	17	0.60	0	0.00	22	0.28
	Good for walkability	4	26	0.83	35	0.99	0	0.00	61	0.63
	Neither good nor bad	3	40	0.95	54	1.15	10	0.25	104	0.80
	Bad for walkability	2	31	0.49	16	0.23	64	1.06	111	0.57
	Very bad for walkability	1	24	0.19	19	0.13	47	0.39	90	0.23
<i>Total</i>			126	2.66	141	3.11	121	1.69	388	2.52
<i>17. Familiar faces when walking</i>	Very Good for Walkability	5	26	1.03	47	1.67	3	0.12	76	0.98
	Good for walkability	4	64	2.03	72	2.04	2	0.07	138	1.42
	Neither good nor bad	3	36	0.86	22	0.47	38	0.94	96	0.74
	Bad for walkability	2	0	0.00	0	0.00	61	1.01	61	0.31
	Very bad for walkability	1	0	0.00	0	0.00	17	0.14	17	0.04

Walkability Indicators	Importance Level	Rate	Neighborhood						Whole City	
			Inner City(Areb Sefer)		Inter mediate(Sefere Selam)		Suburb/Outskirt(Dato)		Total	
			Count	Mean Rate	Count	Mean Rate	Count	Mean Rate	Count	Mean Rate
Total			126	3.92	141	4.18	121	2.28	388	3.50

Weighted score For Local walkability index, Facility Rating

Parameters	Level of Agreement	Weight	Neighborhood						Whole city	
			Inner City(Areb Sefer)		Inter mediate(Sefere Selam)		Suburb/Outskirt(Dato)		Total	
			Count	Weighted score	Count	Weighted score	Count	Weighted score	Count	Weighted score
18. Sidewalks are wide enough	Strongly Disagree	1	3	0.02	2	0.01	44	0.36	49	0.13
	Dis Agree	2	2	0.03	11	0.16	45	0.74	58	0.30
	Neutral	3	68	1.62	43	0.91	27	0.67	138	1.07
	Agree	4	13	0.41	11	0.31	4	0.13	28	0.29
	Strongly Agree	5	40	1.59	74	2.62	1	0.04	115	1.48
Total			126	3.67	141	4.02	121	1.95	388	3.26
19. The pavement slabs are not deformed	Strongly Disagree	1	3	0.02	3	0.02	33	0.27	39	0.10
	Dis Agree	2	2	0.03	11	0.16	66	1.09	79	0.41
	Neutral	3	69	1.64	47	1.00	16	0.40	132	1.02
	Agree	4	37	1.17	69	1.96	4	0.13	110	1.13
	Strongly Agree	5	15	0.60	11	0.39	2	0.08	28	0.36
Total			126	3.47	141	3.52	121	1.98	388	3.02
20. continuous pavement did not disturb movement,	Strongly Disagree	1	24	0.19	14	0.10	42	0.35	80	0.21
	Dis Agree	2	35	0.56	22	0.31	53	0.88	110	0.57

Walkability Indicators	Importance Level	Rate	Neighborhood						Whole City	
			Inner City(Areb Sefer)		Inter mediate(Sefere Selam)		Suburb/Outskirt(Dato)		Total	
			Count	Mean Rate	Count	Mean Rate	Count	Mean Rate	Count	Mean Rate
	Neutral	3	36	0.86	48	1.02	17	0.42	101	0.78
	Agree	4	21	0.67	34	0.96	7	0.23	62	0.64
	Strongly Agree	5	10	0.40	23	0.82	2	0.08	35	0.45
	Total		126	2.67	141	3.21	121	1.96	388	2.64
21. There are no obstacles along the sidewalks Poles, Vending, and Other	Strongly Disagree	1	13	0.10	3	0.02	37	0.31	53	0.14
	Dis Agree	2	2	0.03	17	0.24	59	0.98	78	0.40
	Neutral	3	67	1.60	47	1.00	21	0.52	135	1.04
	Agree	4	29	0.92	63	1.79	4	0.13	96	0.99
	Strongly Agree	5	15	0.60	11	0.39	0	0.00	26	0.34
	Total			126	3.25	141	3.44	121	1.93	388
22. The sidewalks are safe and separated from vehicles	Strongly Disagree	1	7	0.06	3	0.02	40	0.33	50	0.13
	Dis Agree	2	2	0.03	20	0.28	56	0.93	78	0.40
	Neutral	3	63	1.50	47	1.00	21	0.52	131	1.01
	Agree	4	43	1.37	60	1.70	3	0.10	106	1.09
	Strongly Agree	5	11	0.44	11	0.39	1	0.04	23	0.30
	Total			126	3.39	141	3.40	121	1.92	388
23. Street furniture is sufficient	Strongly Disagree	1	33	0.26	43	0.30	40	0.33	116	0.30
	Dis Agree	2	32	0.51	18	0.26	70	1.16	120	0.62
	Neutral	3	38	0.90	47	1.00	9	0.22	94	0.73
	Agree	4	17	0.54	22	0.62	2	0.07	41	0.42
	Strongly Agree	5	6	0.24	11	0.39	0	0.00	17	0.22

<i>Walkability Indicators</i>	<i>Importance Level</i>	<i>Rate</i>	<i>Neighborhood</i>						<i>Whole City</i>	
			<i>Inner City(Areb Sefer)</i>		<i>Inter mediate(Sefere Selam)</i>		<i>Suburb/Outskirt(Dato)</i>		<i>Total</i>	
			<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>	<i>Count</i>	<i>Mean Rate</i>
<i>27. It is a safe street at night, with good lighting</i>	Dis Agree	2	2	0.03	15	0.21	56	0.93	73	0.38
	Neutral	3	67	1.60	41	0.87	11	0.27	119	0.92
	Agree	4	39	1.24	71	2.01	3	0.10	113	1.16
	Strongly Agree	5	15	0.60	11	0.39	1	0.04	27	0.35
Total		126	3.48	141	3.51	121	1.75	388	2.95	
<i>28. There is enough greenery in the street.</i>	Strongly Disagree	1	3	0.02	3	0.02	56	0.46	62	0.16
	Dis Agree	2	2	0.03	16	0.23	40	0.66	58	0.30
	Neutral	3	67	1.60	45	0.96	21	0.52	133	1.03
	Agree	4	39	1.24	66	1.87	2	0.07	107	1.10
	Strongly Agree	5	15	0.60	11	0.39	2	0.08	28	0.36
Total		126	3.48	141	3.47	121	1.79	388	2.95	
<i>29. The trees disturb the pedestrian movement</i>	Strongly Disagree	1	3	0.02	3	0.02	30	0.25	36	0.09
	Dis Agree	2	2	0.03	16	0.23	56	0.93	74	0.38
	Neutral	3	56	1.33	47	1.00	21	0.52	124	0.96
	Agree	4	53	1.68	61	1.73	10	0.33	124	1.28
	Strongly Agree	5	12	0.48	14	0.50	4	0.17	30	0.39
Total		126	3.55	141	3.48	121	2.19	388	3.10	
<i>30. Safe Crossings</i>	Strongly Disagree	1	3	0.02	3	0.02	60	0.50	66	0.17
	Dis Agree	2	2	0.03	20	0.28	30	0.50	52	0.27
	Neutral	3	64	1.52	45	0.96	21	0.52	130	1.01
	Agree	4	43	1.37	59	1.67	6	0.20	108	1.11

Walkability Indicators	Importance Level	Rate	Neighborhood						Whole City		
			Inner City(Areb Sefer)		Inter mediate(Sefere Selam)		Suburb/Outskirt(Dato)		Total		
			Count	Mean Rate	Count	Mean Rate	Count	Mean Rate	Count	Mean Rate	
Total	Strongly Agree	5	14	0.56	14	0.50	4	0.17	32	0.41	
			126	3.50	141	3.43	121	1.88	388	2.97	
	31. Good floor quality	Strongly Disagree	1	3	0.02	3	0.02	71	0.59	77	0.20
		Dis Agree	2	2	0.03	20	0.28	29	0.48	51	0.26
		Neutral	3	52	1.24	45	0.96	20	0.50	117	0.90
		Agree	4	58	1.84	59	1.67	1	0.03	118	1.22
Total	Strongly Agree	5	11	0.44	14	0.50	0	0.00	25	0.32	
			126	3.57	141	3.43	121	1.60	388	2.90	
	32. It is easy for me to walk to a transit stop	Strongly Disagree	1	3	0.02	3	0.02	30	0.25	36	0.09
		Dis Agree	2	2	0.03	20	0.28	56	0.93	78	0.40
		Neutral	3	60	1.43	45	0.96	21	0.52	126	0.97
		Agree	4	49	1.56	59	1.67	10	0.33	118	1.22
Total	Strongly Agree	5	12	0.48	14	0.50	4	0.17	30	0.39	
			126	3.52	141	3.43	121	2.19	388	3.07	
	33. There are many alternative routes for getting from place to place in my neighborhood by walking	Strongly Disagree	1	3	0.02	2	0.01	49	0.40	54	0.14
		Dis Agree	2	2	0.03	18	0.26	49	0.81	69	0.36
		Neutral	3	62	1.48	47	1.00	20	0.50	129	1.00
		Agree	4	46	1.46	52	1.48	2	0.07	100	1.03
Total	Strongly Agree	5	13	0.52	22	0.78	1	0.04	36	0.46	
			126	3.51	141	3.52	121	1.82	388	2.99	

Walkability Indicators	Importance Level	Rate	Neighborhood						Whole City	
			Inner City(Areb Sefer)		Intermediate(Sefere Selam)		Suburb/Outskirt(Dato)		Total	
			Count	Mean Rate	Count	Mean Rate	Count	Mean Rate	Count	Mean Rate
34. I feel safe walking in my neighborhood during the day	Strongly Disagree	1	3	0.02	3	0.02	42	0.35	48	0.12
	Dis Agree	2	2	0.03	15	0.21	52	0.86	69	0.36
	Neutral	3	55	1.31	43	0.91	21	0.52	119	0.92
	Agree	4	56	1.78	49	1.39	5	0.17	110	1.13
	Strongly Agree	5	10	0.40	31	1.10	1	0.04	42	0.54
Total			126	3.54	141	3.64	121	1.93	388	3.07

Annex B4 Data Collection Format

Availability of Walkway					Total
Availability of Walkway	Neighborhood				
		Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
Both sides	36	61	0		
Not Available	4	0	46		
Total	40	61	46		

Footpath Width					Footpath Height
Footpath Width	Neighborhood				
		Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
.00	4	0	46		

Footpath Height					Total
Footpath Height	Neighborhood				
		Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
.00	4	0	46		50
.10	0	55	0		55
.20	36	6	0		42
Total	40	61	46		147

	Pedestrian protection from traffic			
	Neighborhood			Total
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
<i>Total</i>	32	56	46	
	40	61	46	
	obstruction			
	Neighborhood			Total
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
<i>protection</i>	Available	3	1	0
	Curve stone	4	0	0
	Not Available	33	60	46
<i>Total</i>	40	61	46	
	cleanness			
	Neighborhood			Total
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
<i>obstruction</i>	Not Available	0	3	0
	Available	0	1	0
	Available	1	0	1
	illegal parking	0	55	0
	Not Available	35	2	45
	Street Vending	4	0	0
<i>Total</i>	40	61	46	
	cleanness			
	Neighborhood			Total
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
<i>cleanness</i>	Clean	1	1	0
	Not Clean	31	57	46
	Relatively Clean	8	3	0
<i>Total</i>	40	61	46	

	Crossing Facility				Total
	Neighborhood				
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)		
<i>Crossing Facility</i>	Not Available	32	56	46	134
	Zebra crossing	8	5	0	13
<i>Total</i>	40	61	46	46	147
	Amenities				
	Neighborhood			Total	
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)		
<i>Amenities</i>	Available	0	2	0	2
	Bench's, Trees, Medians, Trash	6	2	0	8
	Not Available	34	57	46	137
<i>Total</i>	40	61	46	46	147
	Speed limit				
	Neighborhood			Total	
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)		
<i>Speed limit</i>	Not Available	5	18	46	69
	Speed Limit	35	43	0	78
	Available				
<i>Total</i>	40	61	46	46	147
	Traffic calming				
	Neighborhood			Total	

	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
<i>Traffic calming</i>	Not Available	5	13	46 64
	Speed Breaks are Available	31	44	0 75
	Speed Limit Sign	4	4	0 8
<i>Total</i>		40	61	46 147

Traffic factors

	Neighborhood			Total
	Inner City (Arab Sefer)	Intermediate (Sefere Selam)	Suburbs (Dato)	
<i>Traffic factors</i>	Car Entrances	1	59	1 61
	Discontinuities	27	0	45 72
	Illegal Street Parking	12	2	0 14
<i>Total</i>		40	61	46 147

