ASSESSING WALKABILITY OF BUILT ENVIRONMENT IN MAIN STREET CORRIDORS OF ARADA SUB-CITY,

ADDIS ABABA

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A thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements of the Degree of Master of Science in Urban planning

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Declaration

I, the undersigned, declare that this thesis is my own and original work and has not been presented for a degree in any other University, and that all sources of material used for the thesis has been duly acknowledged, following the scientific guidelines of the institute.

Student's name: Kalkidan Kumelachew

Date: ________________________

Signature: ________________________

Confirmation

This thesis has been submitted for examination with my approval as an Institute's advisor.

Advisor's Name: Dr. Berhanu Woldetensae

Date: ________________________

Signature: ________________________

This thesis is submitted to the Ethiopian institute of Architecture, Building Construction and City Development (EiABC) and to the School of Graduate Studies of Addis Ababa University in the Partial fulfillment of the requirements for the degree of Masters of Science in urban planning.

Title of Thesis:

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Approved by Board of Examiners:

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Chair Person	**Signature**	**Date**

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Lists of Acronyms

CSP – Complete streets policies

GIS – Geographic information system. It is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface.

ITDP – Institute for transportation and development policy

LRT – light rail transit

LUM – Land use mix

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Abstract

Different components influence the walkability of places, and one of them is the built environment. Urban design, land use patterns, and transportation system infrastructure are attributes of the built environment. The main objective of this research was to assess the walkability of Arada Sub-City's built environment using macro and micro scale indicators. Three broader categories were used for classifying features of the built-up environment: Land Use, Street Networks, and Urban Design. Pedestrians' perceptions about the corridors were gathered to understand how they assessed safety and comfort. The data showed that some qualities enhancing walkability do exist; these include dwelling and commercial density, land-use mix, and public transportation infrastructure. Conversely, unequal distribution of street amenities, lack of maintenance for walkways, usage of pedestrian space as an extension area for commercial frontages, and a lack of universality are among the downsides. Based on data collected from pedestrians, Churchill Ave. ranked highest in comfort and safety. General recommendations were drawn to enhance walkability: adopt design standards with design review for current or new infrastructure projects; pedestrian infrastructure management to prevent wrong practices; improvement in building control regulations to make frontages more active and vibrant; and better integration between pedestrian infrastructures with other institutions.

Key Words: *Walkability, built environment, walkability indices*

CHAPTER ONE: INTRODUCTION

1. Introduction

This research is divided into five chapters, each addressing a specific aspect of the study. The first two chapters focus on introducing the topic and reviewing the relevant literature. The introduction chapter provides a background of the study, outlines the problem statement and specific research questions, highlights the objective of the research, and defines the scope and limitations of the research. The second chapter, the literature review, defines key terms such as walkability and built environment and explores various measures of walkability.

Chapter three of the research examines into the methodology used in the study. This section briefly covers how the study area was selected, the research design, the types of data used, the source of data, the sampling design, the methods of data collection, the assessment methods, and the methods of data analysis and presentation.

The fourth chapter presents the results of the study and a discussion of these findings. This chapter highlights the conclusions drawn from the data analysis and links these results to the research questions and objectives.

Finally, chapter five provides a summary of the research findings and gives recommendations based on the research outcomes.

1.1. Background of the study

Well-designed pedestrian infrastructure is a crucial aspect of sustainable city development. According to the World Bank Group (2019), pedestrian infrastructure is essential to achieving a more livable and sustainable urban environment. Evidence from around the world suggests that street designs focused on vehicle movement instead of mobility for people can undermine the quality of life and character of public spaces (ITDP, 2020).

Walking is a fundamental mode of transportation that always occurs either at the beginning, in between, or at the end of every other mode of transportation. As noted by Nuzir and Dwancker (2016), walking provides basic mobility and is the most natural way of moving for human beings. Additionally, walking is a crucial means of connecting to public transport and brings significant health and recreational benefits (World Bank Group, 2019).

While walking is a mode of transportation, walkability is a concept that measures the pedestrian-friendliness of an area. As defined by Rafiemanzelat et al. (2016), walkability refers to the accessibility of destinations that can be quickly, conveniently, and safely reached by foot. For this particular study, walkability is defined as an area that is accessible, well connected, inclusive, safe, and with destinations within walking distance.

To achieve a walkable built environment, a sufficient pedestrian network must be in place, and many environmental factors contribute to the accessibility of the pedestrian network, such as safety, pleasant surroundings, the presence of plenty of destinations, and sufficient walking infrastructure (Rafiemanzelat et al., 2016).

Streets are the most valuable asset in any city and an essential element of the cityscape. To maximize their potential, a set of well-defined principles and standards targeting street design, building design, and network design must be applied (ITDP, 2020). By implementing these principles, cities can achieve a more sustainable and livable urban environment that prioritizes the mobility and well-being of pedestrians.

1.2. Statement of the problem

Despite a dramatic increase in motorization in Addis Ababa, walking remains the largest mode of transportation in the city (54 percent), followed by public transport (31 percent) (ITDP, 2020). However, many Ethiopian cities have largely been unsuccessful in providing the necessary infrastructure for people to walk or cycle (ITDP, 2020), despite the high reliance on non-motorized transportation. For residents of cities like Addis Ababa, walking is a necessity rather than a choice due to economic circumstances. However, the experience of walking varies across different locations, and one of the factors that influence the walkability of places is the built environment. Physical features of an urban environment can directly and indirectly influence the quality of the walking environment (Ewing & Handy, 2009; Nass, 2015). The attributes of the built environment include urban design, land use patterns, and transportation system infrastructure (Duncan et al., 2010). To identify a place as walkable, the characteristics of the built environment that support walkability should be examined (Rafiemanzelat et al., 2016; Robert Cervero et al., 2009; Reisi et al., 2019). However, the researcher did not find any previous research that assessed the walkability of the built environment in Addis Ababa specifically. Therefore, this research aims to understand how the design and layout of the built environment affects the walkability of places, examining the three major built environment features of land use, street network, and urban design characters.

1.3. Objective of the study

1.3.1. General Objective

The main objective of this study is to evaluate the walkability of the built environment in Arada sub-city using macro and micro scale indicators of walkability that have been previously developed.

1.3.2. Specific Objectives

The specific objectives of the study are:

1. To assess the current state of land use in the study area.
2. To examine the characteristics of the existing street network within the selected corridors.
3. To inspect the existing urban design of the chosen corridors.
4. To collect pedestrians' perceptions regarding the walkability of the selected corridors.
5. To provide recommendations that will enhance the walkability of the built environment.

1.4. Research questions

The research questions that need to be answered in this research are:

1. What is the current state of land use in the study area?
2. What are the characteristics of the existing street network within the chosen corridors?
3. What is the existing urban design of the chosen corridors?
4. What is the pedestrian perception towards the selected corridors
5. What lesson could be extracted regarding making places more walk able for future developments?

1.5. Scope of the study

Walkability is a multidimensional concept that encompasses various aspects that make a place suitable for walking. In this research, the definition of walkability is taken as a combination of five essential characteristics that are accessible, well connected, inclusive, safe, and comfortable. Accessible means that the place should be easily reachable by pedestrians. Well-connected refers to the presence of a network of pedestrian-friendly streets and pathways that enable easy movement within and between different parts of the study area. Inclusive means that the place should cater to the needs of people from different backgrounds and abilities, including children, elderly, and disabled individuals. Safe means that the place should provide a secure environment for pedestrians by minimizing the risks of accidents, crime, and other hazards. Finally, comfortable means that the place should provide a pleasant walking experience by addressing factors such as noise, pollution, shade, and seating.

The contextual study of this research is limited to Arada sub city, which is a densely populated area in the central part of Addis Ababa, Ethiopia. For the macro-scale assessment, the entire Arada sub city was analyzed, while for the micro-scale assessment, only a set of purposely selected corridors were selected for analysis. These corridors include Churchill Ave., Arada building area, Giorgis to Merkato road, Giorgis to Semen Hotel road, Griogis to Afincho ber road, Arat kilo square to Sidist kilo square, and Arat kilo square to Kebena road. The selection of these corridors was based on their significance as pedestrian routes and their potential to influence the overall walkability of the study area.

1.6. Significance of the study

This research can help to uncover areas for improvement of built environment to increase the walkability of the area. The findings of this research will provide insight on how to optimize urban planning for improved pedestrian experiences.

1.7. Research Limitations

The researcher encountered limitations in obtaining the most up-to-date NORTECH line map. The NORTECH line map produced in 2011 by the Arada sub-city plan & development commission office did not accurately reflect the current urban structure of the study area due to redevelopments that had taken place since its production. To compensate for this gap in resources, the researcher used Google 2022 Satellite images to produce different mappings.

1.8. Description of the study area

The research was conducted in Addis Ababa, the capital and largest city of Ethiopia, located in the central part of the country. It serves as the political, cultural, and economic hub of Ethiopia. Specifically, the study was conducted within the Arada Subcity. Arada is a sub-city located in the heart of Addis Ababa. It is an active area, home to many established educational and administrative institutions, including government offices, schools, and universities. The majority of the total coverage of Arada sub-city is formed by a combination of residential and commercial land uses. This sub-city, considered one of the oldest parts of Addis Ababa, has a rich history and is home to numerous landmarks and tourist attractions. In addition to its historical and cultural significance, the Arada Subcity is also a hub for new buildings and developments continually taking place, presenting different built environment characteristics.

To conduct the micro-scale walkability analysis study, seven main corridors were selected across the Arada sub city. These corridors include Churchill Ave., Arada Building Area, Giorgis to Merkato Road, Giorgis to Semen Hotel Road, Giorgis to Afincho Ber Road, Arat Kilo Square to Sidist Kilo Road, and Arat Kilo Square to Kebena

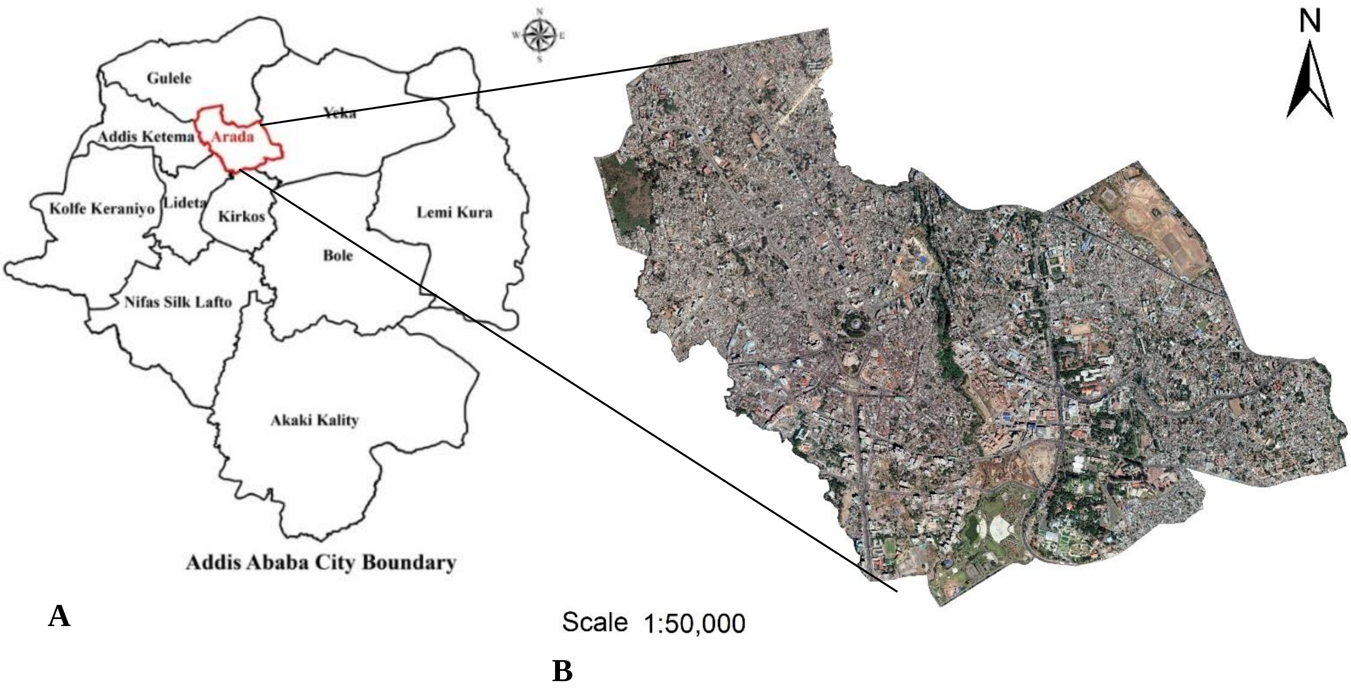


Figure 1. 1: Map A Shows the Addis Ababa City Boundary and Map B shows the Arada Sub city

Source: Addis Ababa City plan & development commission (edited by the author)

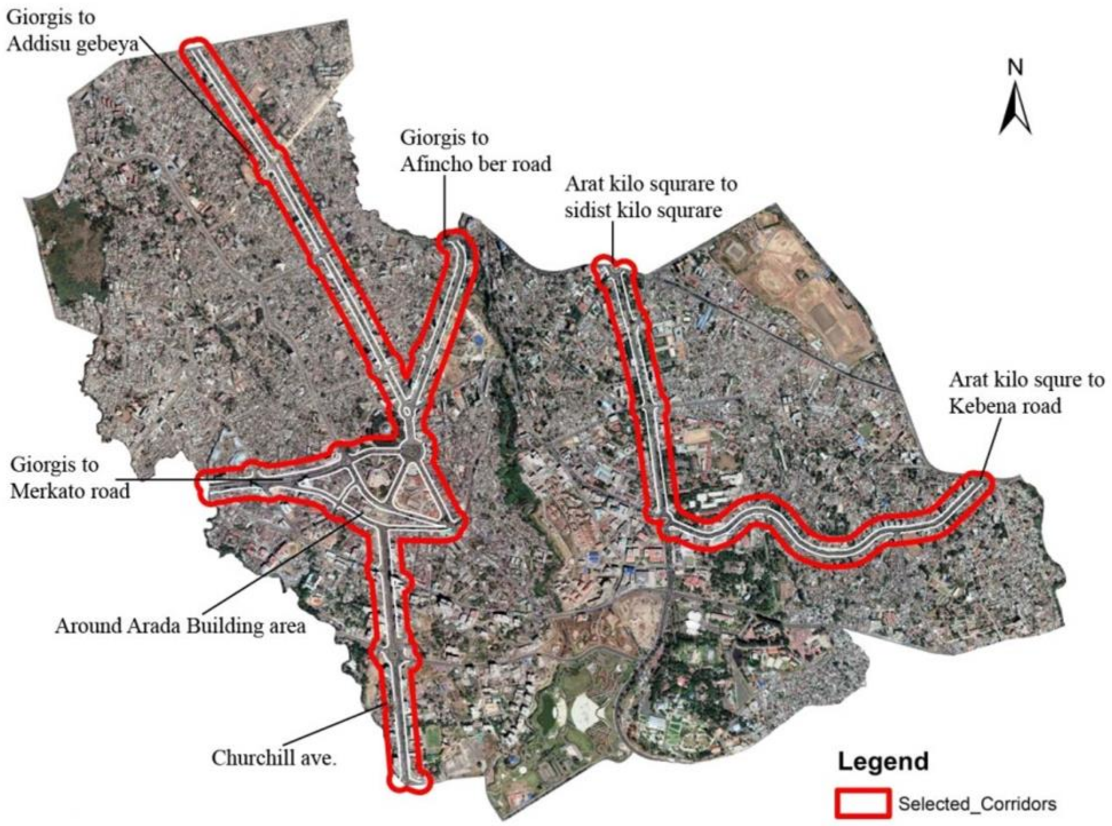


Figure 1. 2: A map showing the selected main corridors for micro scale walkability study

1.9. Organization of the document

This thesis is structured into five chapters. The first chapter serves as an introduction and sets the context for the research. It includes a detailed background of the study, the statement of the problem, objectives, research questions, scope, and limitations of the study. Additionally, the significance of the study is highlighted to provide a clear understanding of its relevance and importance.

The second chapter is dedicated to the literature review, which is an essential part of any research study. It includes a thorough examination and critical analysis of literature relevant to the study topic. In this case, the literature review covers the concept of walkability, the built environment, and measures of walkability and the built environment. This chapter provides a theoretical foundation for the study and helps in developing a conceptual framework.

The third chapter focuses on the research methodology, which outlines the various methods used to conduct the study. It covers the selection of the study area, including its description, design of research, types and sources of data, sampling design, and methodologies for data collection and analysis. Additionally, this chapter also covers the data presentation, which includes the visual representation of the data collected during the research process.

The fourth chapter presents the results of the study and the discussions that followed. It covers the assessed built-up environment indices such as dwelling and commercial density, street connectivity, distance to transit stops, presence of street furniture, and active frontage along with sidewalk material. Moreover, this chapter includes the pedestrian's perceptions about comfort and safety, which are crucial in evaluating the effectiveness of the built environment on pedestrian mobility.

Finally, the last chapter comprises the conclusions and recommendations drawn from the study. It summarizes the key findings of the research and provides recommendations for future studies.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

In this study, the literature review is organized into four main sections that aim to provide a comprehensive understanding of the relationship between walkability and the built environment.

The first two sections of the literature review focus on providing a clear and in-depth definition of walkability and the built environment, respectively. Each of these sections is further divided into subsections, which aim to cover every aspect of these two concepts thoroughly. Providing clear definitions of these concepts is essential as it ensures that the reader understands the terminology used in the study and helps to set the foundation for the rest of the literature review.

The third section of the literature review is of great significance as it examines the connection between walkability and the built environment. This section analyzes the most important features of the built environment that affect walkability and provides a clear description of these features for further research. This section also identifies gaps in existing research, which provides the basis for the current study.

Finally, the fourth section of the literature review provides an overview of the various walkability indices used in different studies. The section presents the information in a table format, which provides a quick and easy reference. This section is particularly important as it helps to provide a comprehensive understanding of the various indices used in different studies.

2.2. Walkability

In designing walkable cities, urban planners must recognize that different definitions of pedestrians will substantially affect how they are accommodated in both infrastructure and environmental design. For instance, a pedestrian may include not just people on foot, but also those with disabilities, older adults, children, and even pets. Hence, the definition of walkability must include the needs of these different groups to ensure that everyone can move around the city safely and comfortably. Moreover, walkability should not only refer to utilitarian purposes such as walking for transportation but also encompass the provision of pedestrian comfort and safety, as well as offering visual interests throughout the network. According to Mayne et al. (2013), walkability should provide a comfortable and enjoyable walking experience for pedestrians. This includes safe and accessible sidewalks, adequate lighting, and green spaces. Walkable cities should also offer visual stimulation and interest, such as public art and landscaping, to enhance the walking experience.

Another essential aspect of walkability is ensuring reasonable walking times between destinations. According to Lo (2009), walkable cities should have well-connected pedestrian networks that connect people to varied locations without requiring an unreasonable amount of effort. This means that sidewalks, crossings, and other pedestrian infrastructure must be strategically placed to minimize walking distances and travel times.

Improving walkability in urban areas has been recognized as an essential step in reducing urban transport challenges such as congestion, pollution, road accidents, and personal security. According to the World Bank Group (2019), promoting conditions that support walking as a mode of transportation can help to reduce the demand for motorized vehicles. This, in turn, leads to less traffic on roads, less pollution, and a decrease in the number of accidents. Also, it can improve personal security as pedestrians become more visible and streets become more active.

The concept of walkability has been a subject of discussion and research for some time now. The meaning of walkability varies with different studies, and it has been broken down into different categories. According to Forsyth's study (2015), there are three categories: traversable, compact, physically-enticing or safe. These categories describe the aspects that make an area walkable, including having well-connected streets, compact development, and providing pedestrian comfort and safety.

The outcome of creating a walkable environment has also been studied and discussed. Walkability is seen as a solution to various urban problems, including increasing transportation options, inducing exercise, and making places lively and sociable. A walkable environment can encourage people to walk to their destinations, reducing the need for private cars and improving physical health. Additionally, a more walkable environment can encourage social interaction and contribute to a sense of community.

In the post-modernist planning era, walkability has been identified as a critical component of creating efficient, accessible, equitable, sustainable, and livable communities (Lo, 2009). In recent years, there has been an increasing focus on promoting walkable environments in urban areas, and this has led to the development of various definitions of walkability.

Rafiemanzelat et al. (2016) define walking as a mode of transportation and walkability as a concept that quantifies the "pedestrian-friendliness" degree of an area. This definition highlights the importance of creating an environment that is safe and comfortable for pedestrians, and that promotes walking as a viable mode of transportation.

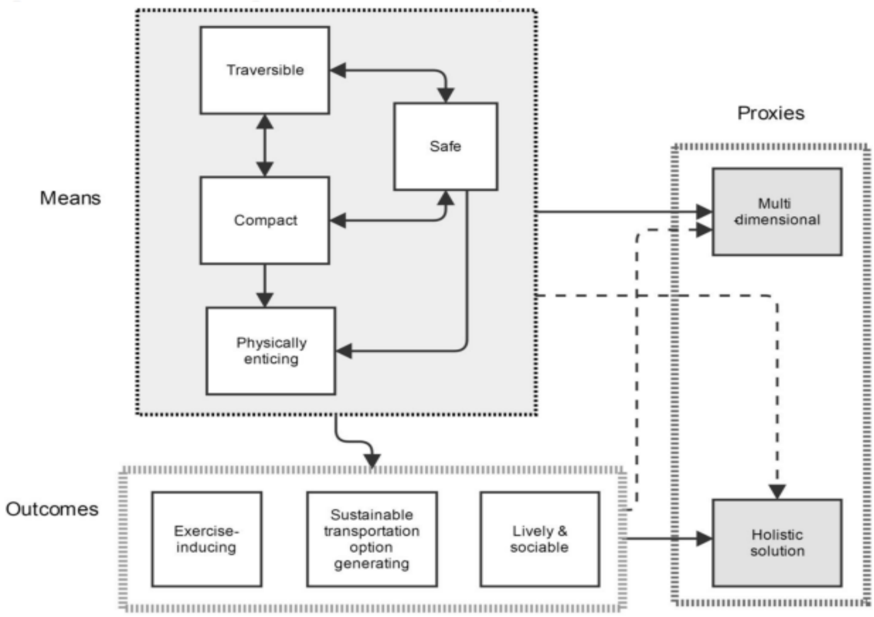


Figure 2. 1: Framework Linking Definitions of Walkability and Walkable Places

(Source: what is a walkable place? The walkability debate, Forsyth, 2015)

Overall, promoting walkability in urban areas has become a critical goal for urban planners and policymakers. By creating more walkable environments, we can reduce the reliance on motorized transportation, decrease congestion, pollution, and accidents, improve personal security, and promote physical and social health. With the increasing recognition of the importance of walkability, it is likely that we will see more efforts to create more pedestrian-friendly communities in the future.

Improving walkability in urban areas has multiple benefits, including reducing traffic, pollution, and accidents, increasing personal security, and improving physical and social health. The meaning of walkability varies with different studies, and it can be broken down into different categories, including traversable, compact, physically-enticing or safe. The outcome of a walkable environment includes providing transportation options, inducing exercise, and making places lively and sociable. Finally, providing for pedestrian comfort and safety in roads and pathways is crucial in ensuring walkability. The design of pedestrian infrastructure should take into account the needs of different groups, including those with disabilities, older adults, and children. The design should also incorporate safety features such as crosswalks, traffic calming measures, and signals to ensure pedestrian safety.

2.2.1. Mobility Choice & walking

Travel has many underlying factors of influence that include spatial, infrastructural, socioeconomic, cultural, and demographic elements (Nass, 2015). Transportation planners are interested in a person's journey from one street address to another - known as 'trips' - which includes frequency, destination, length of the journey and mode or method of travel. Generally trip purpose is differentiated into categories such as work-related activities, shopping, and recreation and so on. When investigating the link between the environment and travel behavior it is beneficial to analyze individual and household level data (disaggregated) opposed to looking at the traffic analysis zone or larger metropolitan area (aggregated). An increased understanding of individual behavior enables more sophisticated models to be developed when analyzing travel behavior over time (Handy et al., 2002).

The choice of mode of transportation is influenced by economic resources and an individual's mobility needs, as well as geographic elements like employment opportunities and services. These factors can lead to disparities in access to different forms of transport, which could affect urban development (UN-Habitat, 2010).

Handy et al. (2002) stated that planners often label neighborhoods as "pedestrian-oriented" if they possess relatively high development densities, a mix of land uses, a street network with high connectivity, human-scale streets, and desirable aesthetic qualities that make walking both more viable and appealing. On the other hand, areas with the opposite characteristics are deemed "automobile-oriented," as they render walking, transit, and other alternatives to cars a practical impossibility or at least a significant challenge. However, these labels are based more on intuition than empirical testing of the connection between their characteristics and pedestrian behavior.

The perception of walking and cycling has frequently had a negative connotation, since they are often associated with poverty rather than being seen as an indicator of progress and efficiency (UN-Habitat, 2010). This perception can significantly inhibit the development of infrastructure to facilitate pedestrian and cycling activities. On the basis of social equity, the definition of pedestrians could be further expanded to include those using wheelchairs or other aids such as mobility scooters, prams or even individuals pushing carts and strollers. Such amendments have been supported by legislation such as the Americans with Disabilities Act and the Australian Disability Discrimination Act (Lo, 2009). These acts are designed to ensure that disabled persons are provided with sufficient access to public spaces and have equitable opportunities for participating in everyday life on an equal basis with others. By promoting the development of coherent strategies for sustainable urban mobility, government agencies can transform this perception from a negative one into a positive one that encourages greater use of these modes of transport.

In Nass's (2015) research, the urban built environment was discussed as having a significant influence on travel behavior that goes beyond just the distance between locations. Factors such as overall city density, neighborhood design and transport infrastructure all had an impact on the type of trips people take and the modes of transport they use, thus confirming that city and local-level design is essential in encouraging people to use non-auto-dependent transports. This further supports the importance of cities emphasizing designs that prioritize reducing reliance on automobiles and support active transportation methods.

2.2.2. Complete Street

A Complete Street is a type of roadway that prioritizes the safety and accessibility of all users, including pedestrians, cyclists, transit riders, and drivers, regardless of age or abilities. The concept of Complete Streets involves changing the planning process to ensure that every individual using the roadway is taken into account when constructing and maintaining roads (Burden & Litman, 2011). Complete Streets programs have gained momentum in recent years, with cities and towns across the United States adopting policies that prioritize the needs of all users.

Babb and Watkins (2016) identified ten essential components of a high-quality Complete Streets program. The first component is a clear vision for how and why the community wishes to complete its streets. This vision should include a commitment to prioritizing the safety and accessibility of all users, and a plan for how the community will work to achieve this goal. The second component specifies that all users, including pedestrians, bicyclists, transit passengers of all ages and abilities, trucks, buses, and automobiles alike, should be included in the planning process.

The third component is that the program applies to both new and retrofit projects in terms of design, planning, maintenance, and operations across the entire right-of-way. This means that Complete Streets principles should be applied not just to new projects, but also to existing roadways that are being updated or maintained. The fourth component requires that any exceptions to the Complete Streets policy be specific, with a clear procedure set in place that requires higher-level approval.

The fifth component encourages street connectivity towards creating a comprehensive, integrated network for all modes. This means that streets should be designed with connectivity in mind, to ensure that all users can easily and safely access all parts of the community. The sixth component is that the program should be adoptable by all agencies to cover roads as needed. This means that the Complete Streets policy should be flexible and adaptable to the needs of different communities and agencies.

The seventh component is that the program utilizes the latest design criteria and guidelines with flexibility when balancing user needs. This means that Complete Streets principles should be based on the latest research and best practices, but also flexible enough to accommodate the unique needs of each community. The eighth component requires that solutions provided fit the context of the respective community. This means that Complete Streets solutions should be tailored to the specific needs and characteristics of each community.

The ninth component establishes performance standards with measurable outcomes. This means that communities should track their progress in implementing Complete Streets policies and measure the impact of those policies on safety and accessibility for all users. Finally, the tenth component includes specific next steps for policy implementation. This means that communities should have a clear plan for implementing Complete Streets policies and should take concrete steps towards achieving their goals (Babb & Watkins, 2016).

In general, a Complete Street is a roadway that prioritizes the safety and accessibility of all users, regardless of age or abilities. Complete Streets programs have become increasingly popular in recent years, with cities and towns across the United States adopting policies that prioritize the needs of all users. Babb and Watkins (2016) identified ten essential components of a high-quality Complete Streets program, which include a clear vision, inclusion of all users, application to new and retrofit projects, specific exceptions, street connectivity, adoptability by all agencies, use of the latest design criteria, solutions that fit the context of the community, performance standards with measurable outcomes, and specific next steps for policy implementation. By implementing Complete Streets policies, communities can create safer, more accessible, and more equitable streets for everyone.

2.2.3. New urbanism movement

New Urbanism is a planning and development movement that seeks to create more livable urban communities. This movement emerged as a progressive intervention to the conventional form of car-oriented, low-density, separated-use sprawl development that has been transforming the urban fabric of cities in the US and elsewhere since the 1960s' (Trudeau D., 2013).Its main concerns are with promoting the qualities of traditional urbanism, such as walkability, diversity, public transit use, sense of community and regional diversity. Many different sets of planning and design principles are circulating around the New Urbanism banner, but most definitions include the ideas of walkable neighborhoods oriented around the five-minute walk, public transit systems, and greater integration of different types of land uses at the neighborhood level. (William Fulton, 1996). New Urbanists emphasize the importance of design in making sustainable cities that foster diverse social activity. It supports a range of policies that are intended to combat the negative environmental and social impacts of vehicle-oriented development such as air pollution and quality of life issues arising from extensive car use, while providing walkable neighborhoods with desirable amenities.

2.2.4. Compact city

The design of commercial land use and population density in urban areas can greatly impact the walkability of communities. According to Wei et al. (2016), a compact city with medium to high-density housing can contribute to the sustainability of the city by promoting physical activity through walkability. The authors also suggest that efforts to improve density and compact design should continue, as these elements can significantly improve neighborhood walkability and encourage people to walk more. This is in contrast to sprawling urban patterns, which can hinder physical activity and walking.

The history of urban development also highlights the importance of compactness in promoting walkability. As Dieleman (2004) notes, the compactness of medieval cities was primarily driven by the need for fortification and the fact that most travel had to be done on foot. This underscores the idea that technical conditions can shape the internal organization of cities.

Compact design of commercial land use and higher population density can contribute to more walkable communities, promoting physical activity and sustainability. The historical context of urban development also highlights the importance of compactness in promoting walkability. Therefore, efforts to improve density and compact design should be prioritized in urban planning and development.

2.3. Built environment

Urban design (arrangement of physical elements within the city), land use patterns (the distribution of functions across space), and transportation system infrastructure (including roads, railways, etc.) are attributes of the components of the built environment (Duncan et al., 2010).

According to Nass (2015), the built environment can influence human actions, well-being and social life in several ways via different dimensions including relative space, material qualities, density, layout, shape, visual appearance and building style. Additionally, these influences may be determined at various scales from the distribution of urban settlements of different sizes at a national or international level to individual neighborhoods within cities. Consequently, research into the effects of the built environment on travel behavior must consider key influencers at all relevant scales and dimensions.

The EPA (2013) discusses how the built environment, such as land development and infrastructure, can have both direct and indirect impacts on the natural environment. Direct effects are changes to ecosystems from building projects and land development, while indirect effects involve transportation options and accessibility of different activities in a given area.

2.4. Measures of walkability in a built Environment

Walkability and physical variables of the built environment are directly linked. The features of an area's built environment can impact its walkability. In order to measure an area's walkability, it is necessary to measure the effect of physical features of the built environment upon it (Rafiemanzelat, Emadi & Kamali, 2016). According to the study by Ewing and Handy (2009), physical features of an urban environment influence the quality of walking environments both directly and indirectly via individual perceptions and sensitivities. Understanding what constitutes a high-quality pedestrian environment is essential for efforts to improve walking conditions (World Bank Group, 2019). Characteristics of the built environment sway individuals' transportation mode choices (Ewing & Cervero, 2001).

The World Bank Group (2019) identified that the built environment surrounding pedestrian routes must be conducive to walking. Streets with many kiosks, shops, and vendors oriented toward pedestrian spaces help create a feeling of safety while producing a more active and vibrant atmosphere. Architectural design elements such as building setbacks, the ratio of building height to street width, and the articulation and permeability of building street walls (e.g., doors and windows) have a major impact on the quality and safety of pedestrian spaces.

Based on their research, Robert Cervero et al. (2009) identified five major dimensions of the built environment that are determined for walking and walkability: density, diversity (land use mix), design (including street connectivity), distance to transit, and destination accessibility. To understand the impact of the built environment on physical activity, Brownson et al. (2009) categorized measurement of the built environment into perceived measures from interviews and self-report questionnaires, observational measures from audits, and archival data sets which are often layered and analyzed using Geographical Information Systems (GIS).

Saelens, Sallis, and Frank (2003) reviewed findings from the transportation, urban design, and planning literatures in order to identify the physical elements of local environments that may influence walkability. They argued that the choices to use motorized or non-motorized transport are based on two dimensions of the way land is used: proximity (distance) and connectivity (directions of travel). Walkability is the extent to which the surroundings are suitable for walking, pleasant and interesting, and inviting of walking (Knapskog et al., 2018).

In the article by Reisi, Nadoushan, and Aye (2019), they categorized the built environment indicators that affect walkability into three areas: safety, quality, and amenities. Safety includes indicators such as lighting, crossing availability, potential for vehicle conflicts, sidewalk width and obstructions; quality includes support facilities, facilities for disabled people, natural features (e.g., trees or parks), cinemas, cultural centers, and historical places; and amenities include retail trade, fixed furniture and places to rest, public toilets, and public transportation.

The World Bank Group (2019) listed three key elements that can significantly impact the quality of pedestrian environments and should be taken into consideration when designing pedestrian structures and transport networks: street design, building and land use mix, and street network. Jaroslav Burian (2012) included in his book a connectivity index, an entropy index (Shanon index), a floor area ratio index, a household density index, with the summation of these four values providing the walkability index. A high value in this Walkability Index indicates that a particular urban arrangement encourages people to engage in physical activities, as opposed to a low value which leads to less physical activity due to car dependency.

Listed several important attributes of a walkable network (Southworth, 2005): Connectivity of the path network, both locally and in the larger urban setting; linkage with other modes including buses, streetcars, subways, and trains; fine grained and varied land use patterns, especially for local serving uses; safety from traffic and social crime; quality of paths including width, paving, landscaping, signing, and lighting; and path context including street design, visual interest of the built environment, transparency, spatial definition, landscape, and overall exportability.

walkability operationalized as a composite of four environmental attributes: residential dwelling density (the number of residential dwellings per square kilometer of residential land uses), intersection density (the number of intersections with three or more road junctures per square kilometer of total land area), land use mix (the entropy of five land use classes divided by the ratio of each Census Collection District’s land area to the smallest in the study region to adjust for differences in the size of spatial units), and retail floor area ratio (the amount of retail floor area in square meters divided by the total amount of commercial land use in square meters) (Mayne et al., 2013).

In the article by Frank, Devlin, Johnstone, and Loon (2010), walkability indices are listed as residential density, commercial density, land use mix, and street connectivity.

2.4.1. Urban design & walkability

According to Reid Ewing (1999), urban design is distinct from planning in terms of its scale, orientation, and treatment of space. While planning often takes a broader, more comprehensive approach to urban development, urban design focuses on the tangible characteristics of the built environment, typically on a small to medium scale. However, achieving objectivity in assessing the quality of urban design can be challenging. As Ewing et al. (2006) note, these qualities should be strongly associated with physical features and experienced similarly by most people.

When it comes to creating a positive walking experience, a variety of factors can contribute. Southworth (2005) emphasizes the importance of visual interest in the built environment, as well as the design of the street as a whole. Additionally, transparent fronting structures, visible activity, street trees and other landscape elements, lighting, and views can all play a role in making walking more pleasant and inviting. These elements can be particularly important in urban areas where foot traffic is common and sidewalks are an integral part of the public realm.

a. **Visually active frontage**

Active frontages are an important element of walkable urban environments. They provide a sense of vitality and human scale to the streetscape, and create a welcoming environment for pedestrians. The presence of active frontages, particularly street-level retail and other commercial uses, has been shown to have a positive impact on pedestrian behavior, including increased foot traffic and improved safety (Southworth, 2005).

The potential role of active frontage designs in enhancing the physical environment and providing an inviting atmosphere conducive to human interaction. Access to destinations, including commercial areas, parks, and other amenities, is a key factor in creating a walkable environment (Handy et al., 2002).

Effective active frontages can help create vibrant, aesthetically pleasing places, thereby enriching cities and towns. According to an article from the World Bank Group (2019), buildings with large windows on the ground floor contribute to greater safety and vibrancy for pedestrians in urban areas. Lacking this active frontage compromises pedestrian safety and can result in frightening and uncomfortable experiences for people walking about the street. To improve the streets, building façades should be designed to invite pedestrians in and feel secure during all times of day.

active frontages and walkability are important concepts in urban design that contribute to creating livable and attractive urban environments for pedestrians. By designing buildings and neighborhoods with active frontages and walkability in mind, we can create more sustainable and pedestrian-friendly cities that are better suited to the needs of all residents.

b. Paving materials and street surface conditions

The choice of paving materials plays a significant role in creating safe and attractive pedestrian environments in urban areas. Different paving materials have varying qualities that can impact the durability, comfort, and aesthetic of pedestrian pathways. For example, some materials may be more durable and better suited for high-traffic areas, while others may provide a more visually appealing and comfortable walking surface. The selection of paving materials should take into account factors such as the expected level of foot traffic, the surrounding environment, and the overall design goals of the street.

In addition to the choice of paving materials, street surface conditions also play an important role in pedestrian safety and accessibility. Uneven ground surfaces, loose gravel, and cobblestones can pose significant safety hazards, particularly for individuals with mobility challenges. According to Gehl (2011), the presence of such obstacles can greatly reduce the safety and comfort of pedestrians, making it difficult for them to navigate through urban environments. Ensuring that street surfaces are well-maintained and free from hazards is critical for creating safe and accessible pedestrian environments.

To create pedestrian-friendly streetscapes that are safe, comfortable, and accessible for all, it is important to consider both the choice of paving materials and the maintenance of street surfaces. By using durable and appropriate paving materials and regularly maintaining street surfaces, cities can promote pedestrian safety, comfort, and accessibility. In turn, this can help to create more vibrant and livable urban environments that are attractive to residents, visitors, and businesses alike.

c. Street lighting

Street lighting has beneficial effects on evening pedestrian walkability and safety, particularly in areas characterized by higher numbers of people out at night. Pedestrian scaled path lighting can enhance nighttime walking and provide a greater sense of safety. (Southworth, 2005). Increased levels of illumination can eliminate feelings of fear when going out during dark hours, while also potentially reducing crime rates. Although more studies need to be conducted focusing on other contexts, the current body of evidence suggests that investments into street lighting may lead to numerous positive impacts for pedestrians wanting to take part in evening activities.

Street lighting is an important element in creating safe and walkable urban environments. Adequate lighting can improve pedestrian safety, comfort, and accessibility, while also reducing crime rates. By using new lighting technologies and smart lighting systems, we can create more efficient and effective street lighting systems that enhance the overall walkability of our cities.

d. Street seats

Streetscape design reflects the extent to which pedestrian spaces are attractive and functional for walking. Streetscape design is related to street-level features, such as the presence of attractive pedestrian facilities and furniture (Fernando et al., 2022). Street seating is a vital element of public space, providing areas for social interaction, relaxation, and people-watching. The concept of street seating has gained popularity in recent years, as cities seek to create more vibrant and livable public spaces that encourage pedestrian activity.

Street seats, are temporary public spaces or interventions that are easily installed on sidewalks and streets. They can be used to reclaim a space and create a visually aesthetically pleasing environment, as well as encouraging people to interact with their surrounding environment and take part in social activities. The goal of street seats is to improve walkability by making the pedestrian experience more enjoyable and enhancing aesthetic appeal.

Street seating is an important element of public space, providing areas for social interaction, relaxation, and people-watching. By creating effective and attractive street seating, cities can improve the perception of safety, promote social interaction, and support local businesses, making public spaces more vibrant and livable.

2.4.2. Land use pattern & walkability

Land use mix has been shown to be a significant factor in influencing transport related physical activity, notably walking. Duncan et al. (2010) found that an area's land use mix can facilitate residents to engage in active transportation, specifically through a diversified range of land uses within a 0.2 – 1.6 km geographical area. They proposed that the best way to quantify the heterogeneity of land uses is by taking into account only those conceptually relevant to the desired behavior - in this case walking for transportation. Furthermore, it has also been suggested that administrative boundaries be used to match available complementary census data resulting in a more varied geographical size.

Eva Leslie et al. (2007) suggest that the proximity of one location to another is largely determined by the density or compactness of land and by the degree of heterogeneity with which functionally different uses are located in the same space. The more condensed an urban environment is and the more different functions it contains that are co-located, the shorter distances between destinations will be, encouraging people to walk instead of relying on vehicles for transportation. This relationship between transport and land use planning has been further described by Dieleman (2004), who explains how related decisions create a feedback loop wherein the distribution of land uses affects the distance between activities and access to them in turn; this, in turn, results in changes to both the transport system as well as land use patterns.

a. Urban Density

Urban density and walkability are two interrelated concepts that have received significant attention in urban planning and design literature. Urban density refers to the number of people living in a given area, while walkability refers to the ease and safety with which people can walk to destinations within that area. Both concepts are important in creating livable and sustainable cities. Urban density is an important component of walkability because it brings people and places closer together. This decreased distance allows for easier walking access to destinations, making an area more desirable (Kim Dovey, 2019).

Higher urban density has been associated with increased walkability, as it often leads to the development of more compact and mixed-use neighborhoods, which offer a greater range of amenities and services within walking distance (Ewing & Cervero, 2010). Research has also shown that higher urban density and walkability are linked to a range of positive health outcomes. For example, studies have found that people living in more walkable neighborhoods tend to be more physically active and have lower rates of obesity and chronic diseases (Saelens et al., n.d.).

Overall, the relationship between urban density and walkability is complex, and the benefits and drawbacks of both concepts need to be carefully considered when designing livable and sustainable cities.

b. **Land use mix**

Land use mix examines the heterogeneity of land uses within an area (Giles-Corti et al., 2014). Functional mix, such as density, can reduce the distances between a person's current location and the locations that they need to be (Kim Dovey, 2019). However, fundamental questions such as how to define the components necessary for a suitable urban mix and methods used to measure and map them still remain unresolved (Kim Dovey, 2019). The presence of more residences and offices in an area can lead to increased services and other facilities available for residents and workers alike (World Bank Group, 2019).

In order to calculate land use mix (LUM), Hayes-Corti et al. (2014) & Mavoa et al. (2018) applied an equation to identify relevant land uses - including residential areas; retail spaces; offices; health, welfare and community settings; entertainment centers; culture centers; recreation facilities - in each service area. This was completed by determining the area of each land-use category in a given participant's vicinity using ArcGIS software. Additionally, Frank et al.'s formula was adapted by Christian et al., forming the same method employed by Hayes-Corti et al. (2014) & Mavoa et al. (2018) to calculate land use mix.

The land use mix component of the walkability measure used was calculated using a variant on the original formula used by Frank et al. This was used to calculate the proportion of each land use as the ratio of the area of a land use to the sum area of all land uses of interest within a service area, as follows:

$$LUM = -1\left(\sum_{i=1}^{n} pi * \ln(pi)\right)/\ln(n)$$

Giles-Corti, et al., (2014), Mavoa, et al., (2018)

Where LUM is the land-use mix score, pi is the proportion of the neighborhood covered by the land use i against the summed area for land-use categories of interest, and n is the number of land-use categories of interest, a score of 1 indicates the highest mix possible and is considered "most walkable". In contrast, a score of 0 indicates that the area contains a single land use which is considered "least walkable" (Mavoa, et al., 2018).

2.4.3. Transportation system infrastructure & walkability

According to EPA (2013), the development of cities and towns was drastically transformed after World War II due to the advancements in the automobile industry. This led to the creation of infrastructure that connected distant areas, and opened up rural areas for development. However, in recent years, there has been a shift in focus towards city and town centers due to their historic architectures, walkable neighborhoods, and vibrant street life. As a result, many people and businesses are now choosing to relocate or invest in these areas.

The World Bank Group (2019) emphasizes the importance of well-designed urban streets in protecting pedestrians from hazardous motor vehicles. This can be achieved by dedicating a sidewalk solely for pedestrians or by designing streets that limit the speeds of vehicles. The American Association of State Highway and Transportation Officials (2004) recognizes the typical behavior of pedestrians and states that they tend to travel less than 1.5 km (1 mi) to work, with 80% of their travels being under 1 km (0.5 mi). Furthermore, a study by Frank et al. (2010) found that street networks that span 1 km can serve as a 10-15 minute walking zone, which highlights the critical role of urban street design in ensuring the safety, well-being, and transportation needs of pedestrians.

These sources highlight the importance of designing urban streets with pedestrian safety in mind. By considering the behavior of pedestrians and their transportation needs, designers and policymakers can create streets that are not only safe but also encourage active and sustainable forms of transportation. Such efforts can help create more livable and vibrant cities and towns that benefit both residents and businesses.

a. Side walks

In cities where people are at the center of design processes, sidewalks provide opportunities for walking and cycling both of which have physical and mental health benefits, with less reliance on volatile oil markets and emissions from vehicles. They also provide access to local business and cultural nodes often overlooked by larger transportation demands. Not only are these beneficial on local levels, but there is evidence that sidewalks can potentially reduce CO2 emissions on a global scale. Overall, pedestrians tend to prefer walking in an unobstructed, continuous path representing the shortest distance between two points. In order to ensure pedestrian safety and maximize material efficiency (AASHTO, 2004), appropriate crossings should be installed in addition to street corners and signalized intersections. Furthermore, a well-functioning sidewalk system should feature sidewalks that are elevated 150 mm above carriageway level, have a smooth surface, feature grade no steeper than 1:12 with ramps for easier accessibility including those with disabilities, have minimal abrupt level differences and driveways into parking or drop-off areas; while also incorporating detectable warning strips, bollards and other various amenities (World Bank Group, 2019).

b. **Intersection density**

Higher intersection densities create a more connected street system and consequently reduce walking distances between nodes. Streets characterized by high intersection densities offer more destinations to users and thus tend to be perceived as safer than low-density streets with fewer pedestrian crossings. Research supports the idea that reducing distance between intersections increases levels of perceived safety among pedestrians, particularly in low income or disadvantaged areas where personal safety is an important consideration when selecting walking routes. Pedestrians typically seek out short, direct routes that provide more convenient therefore direct routes with minimum detour distances and the key to good pedestrian mobility is a high ratio of intersection nodes to road links that prioritize connectivity and create finer grained networks for walking (World Bank Group, 2019). Connectivity measures the directness of the pathway between land uses and the design of street network (Eva Leslie et al., (2007). Direct travel is facilitated where there is an absence of barriers and where there are a number of options for travel routes.

c. Public transport stations

Public transport stations and walkability play a vital role in influencing the attractiveness of cities and urban areas. Improved access to public transport has become increasingly seen as key to creating more efficient and sustainable transportation systems. There is ample evidence that easy access to public transportation services can encourage the use of such services, leading to reductions in motorized private vehicle transport and ultimately better mobility outcomes. One important attribute of public transport networks is station "walkability" or how pedestrian-friendly they are. Achieving station walkability requires considering various aspects, including spatial design, land-use patterns, safety concerns, user preferences, and service levels. This literature review surveys recent research relating to public transport stations and walkability, highlighting what factors influence pedestrians' behavior when using public transport stations. Stations need to be spaced frequently enough to allow pedestrian access for residential and commercial zones, usually 1/4 - 1/2 mi (400m – 805m), or 10-20 min walk (Southworth, 2005).

Figure 2. 2: How the design of the physical environment affects pedestrian mobility

(Source: World Bank Group: walking and its links to transportation, 2019)

2.5. Methodology literature review

Data triangulation method

The use of more than one approach to investigating a question is known as triangulation (Heale, 2013). Thurmond (2001) defines triangulation as the combination of two or more data sources, investigators, methodological approaches, and theoretical perspectives. Heale (2013) argues that this broad term can be divided into: data source triangulation, investigator triangulation, methodological triangulation, which is the most commonly used type theoretical triangulation and data analysis triangulation.

2.6. Summary of Literature review

The study topic is about assessing the walkability of built environment. Hence, the literature review focuses on different topics and terms that are related to this topic. In the literature review different terms have been discussed with sub titles under the main titles. The main terms in the literature include; the definition of walkability & built environment, the relationship between walkability and built environment.

Various definitions of walkability have been proposed in different literatures. Examples include assessing the suitability of the urban road environment for pedestrians, measuring the degree of pedestrian-friendliness in an area, quantifying the capacity of a built environment to support walking activities, such as commuting and exercising, judging the effects of a walkable environment on making places lively, providing transportation choices and increasing physical activity, and viewing walkability as a proxy for urban quality that is multi-faceted and measurable.

The choice of mode of transportation for trips can be heavily influenced by financial resources available to the individual, the mobility needs of communities, the quantity and quality of mobility options or complementary alternatives, land use factors such as employment opportunities or services and housing affordability, trip length, as well as personal characteristics of the traveler such as age, sex, professional status and health condition. This has been reviewed in the literature review on mobility choice and walking.

There are different approaches in urban planning that support the idea of walkability one of these is complete street. It is an approach in urban planning to provide suitable access to all modes of transportation users. This approach is about creating livable places for different types of users with related to age, economic status and people with disabilities. The other approach is new urbanism movement. This movement advocates the design of compact, pedestrian friendly, mixed use development to promote walking, minimize car dependence and enhance sense of community.

The other term that usually resonates with walkability is compactness of a place. Density and compact design are significantly improve neighborhood walkability and in contrast sprawling urban pattern increases individuals' uses of automobiles. This concept is anticipated by new urbanism proponents that it can help to achieve sustainable development goals.

The second main topic that has been reviewed on the literature review is built environment. Urban design (arrangement of physical elements within the city), land use pattern (the distribution of functions across space), and transportation system infrastructure (including roads, railway) are considered as the components of the built environment. As seen from different literatures the environment can influence human actions, wellbeing and social life in several ways on of these is walkability.

Urban design differs from planning in scale, orientation and treatment of space. The features of the urban design characteristics that can influence walkability include; visually active frontage, Physically permeable frontage, paving material and street surface conditions, presence of tree/shade, presence of lighting, functional street furniture.

Land use is the other attributes of built environment. The features of land use pattern that influences walkability include; urban density, land use mix, integration with public transport, and the presence of nearby parks and public space.

The final attributes of built environment is transportation system infrastructure. Pedestrian ways are part of the transportation infrastructure, thus a well design urban street can protect pedestrian from the negative impacts of motor vehicles. The features of transportation infrastructure that influences walkability include: the presence of proper sidewalks, width of sidewalks, the presence of safe crossings, intersection density.

Table 2. 1: Summary of walkability indices from literature

Walkability Indices	**References**
Density, Diversity, Design (including street connections), distance to transit, Destination accessibility	(Robert Cervero et al., 2009)
Connectivity, Linkage with other modes, Fine grained land use pattern, safety, quality of path and path context	(Southworth, 2005)
Land use mix, intersection density, human scale streets and aesthetics	(Handy et al., 2002)
Dwelling density, Street connectivity, Land use mix & Net retail area	(Eva Leslie et al., 2007)
Connectivity index, Entropy index, FAR (floor area ratio) index and Household density index	(Jaroslav Burian, 2012)
Residential density, Commercial density, Land use mix and Street connectivity	(Frank et al., 2010)
Residential dwelling density, Intersection density, Land use mix (the entropy) and Retail floor area ratio	(Mayne et al., 2013)
Traversable, compact and physically enticing	(Forsyth, 2015)
Proximity and connectivity	(Saelens et al., 2003)
Safety, quality and amenities	(Reisi et al., 2019)
Street design, land use mix and street network	(World Bank Group, 2019)
Dwelling density, street connectivity, land use mix and retail floor area	(Wei et al., 2016)

In general built environment influencing walkability can be categorized and summarized as follows;

Table 2. 2: Categories of Built Environment

Built Environment categories		**Features**
Macro scale	**Land use pattern**	Density, Diversity, , Fine grained land use pattern, intersection density, Residential density, Commercial density
	Transportation system infrastructure	street connections, distance to transit, Destination accessibility, Linkage with other modes, human scale streets
Micro scale	**Urban design,**	quality of path, path context, aesthetics, quality, amenities, street design

As explored in the literature review, different authors have written about the relationship between the built environment and walkability, including Rafiemanzelat et al. (2016), Robert Cervero et al. (2009), Saelens et al. (2003), and Reisi et al. (2019). However, the researcher did not come across any research that specifically assessed the walkability of the built environment in Addis Ababa. Therefore, this research aims to fill this gap by evaluating the walkability of the built environment along the main corridors of Arada sub-city.

CHAPTER THREE: RESEARCH METHODOLOGY

3. Introduction

The first section of this chapter is focused on the study area selection, which provides a detailed description of the selected area. The section provides information on the location and characteristics of the area.

The following sections provide insight into the research design, including details on data types and sources, sampling design, method of data collection, assessment methods, and method of data analysis. The research design section provides a detailed overview of the approach taken to conduct the study, including how data was collected and analyzed. The section on data types and sources outlines the various types of data used in the study, including primary and secondary data sources.

The sampling design section explains how the sample size was determined and provides details on the sampling procedure used in the study. The method of data collection section provides information on the techniques used to gather data, including surveys, observations, and interviews. The assessment methods section describes the tools used to assess the walkability of the study area, including walkability indices.

Finally, the chapter concludes by outlining the chosen approach for data presentation, which has been utilized to effectively communicate the findings of the research. This section explains how data was presented in tables, graphs, and maps to facilitate the understanding and interpretation of the results. Overall, this chapter serves as a comprehensive guide to the techniques and methods used in this research, providing a detailed overview of the various steps taken to ensure the credibility and accuracy of the results.

3.1. Study area selection

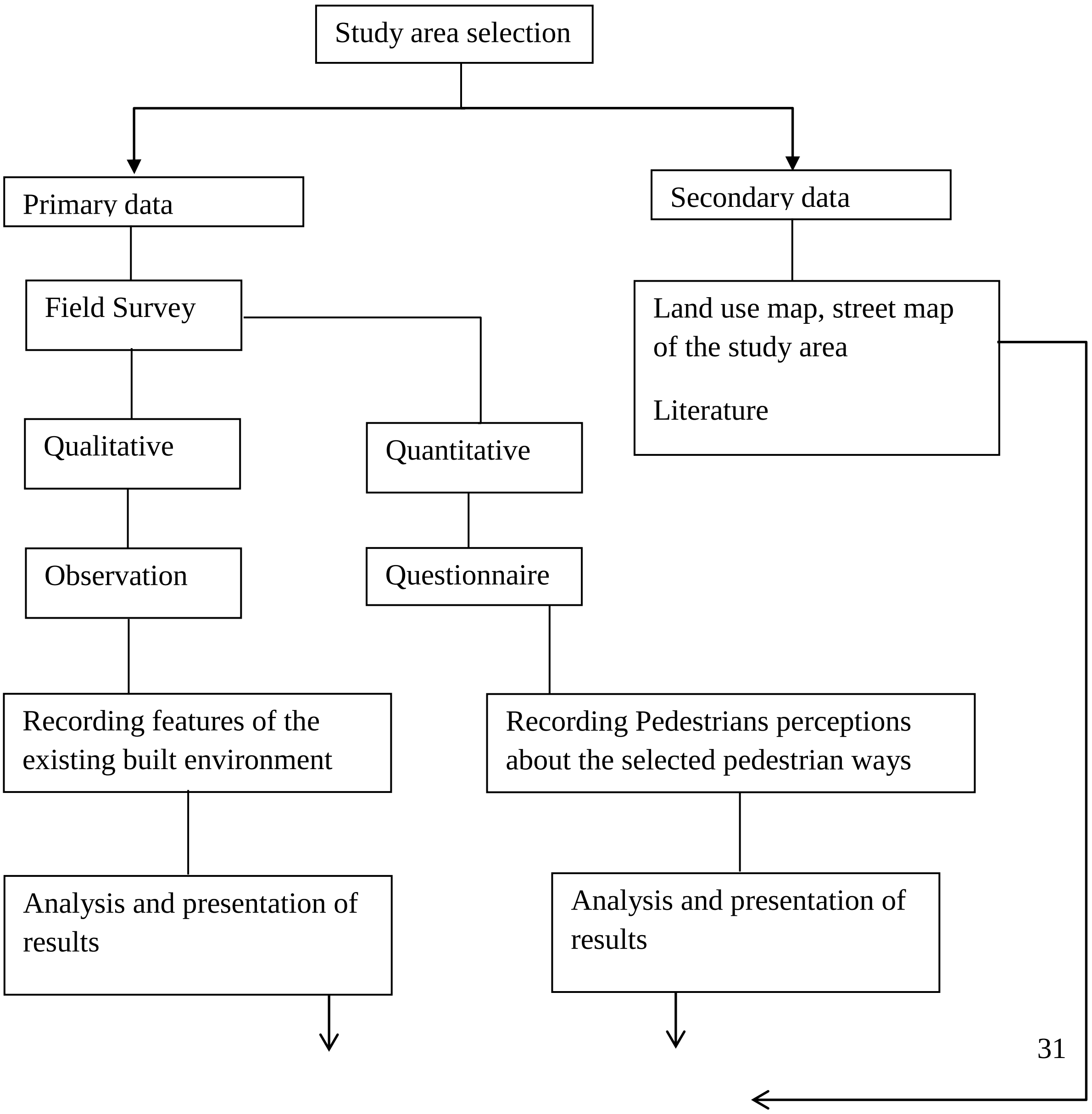
Based on the frames of location being within the inner part of the city and on a main corridor in Addis Ababa, Arada Sub-city was chosen as the macro scale analysis of this research with the following specific street corridors being used for micro scale analysis.

i. Arada building area
ii. Giorgis to Merkato road
iii. Giorgis toAddisu Gebeya road

iv. Girogis to Afincho ber road
v. Churchill ave.
vi. Arat kilo squre to sadist kilo square
vii. Arat kilo squre to Kebena road

3.2. Research Design

A research design is used to structure how data, measurement analysis of data for a research process is going to be conducted. It is a blue print for the collection, measurement and analysis of data. It helps to structure the research for collecting the relevant data and the techniques to be used in analysis, keeping in view the objective of the research and the availability of staff, time and money. The diagram below shows the structure of data collection method used for this research.



Identification of correlations

Results interpretation

Conclusion & recommendation

Figure 3. 1: Diagram showing research design of the research

The primary data collection through observation for this research was held from 14th of February 2022 to 15th of March 2022. Both primary and secondary data sources were used. Direct observations, photography, mappings and questionnaires were used then converted to writings, mappings and quantitative data. For secondary data collection Maps, NORTHECH line map, books and research papers were used. GIS (geographic information system) was used for data analysis and to produce different mappings for this research.

The indicators of walkability were extracted from different literatures. For macro scale analysis the following indicators were selected;

i. Dwelling & commercial density
ii. Street connectivity &
iii. Distance to transit stops

The indicators selected for micro scale analysis include;

i. Active frontage
ii. Side walk material
iii. Street seat
iv. Obstructions

Pedestrians who use these corridors were asked to fill questionnaires in order to analyze how pedestrians perceive these corridors.

3.3. Data Types

Primary and secondary data sources were used. The primary data included direct observations and photography which were translated into writings and mappings. Questionnaires were used to gather data concerning pedestrian perceptions of the selected corridors. Both qualitative and quantitative data were utilized in this research. Secondary sources such as land-use maps and street maps from the Addis Ababa City Government Plan and Development Office were also employed.

3.4. Source of data

This research employed both primary and secondary data sources and conducted a comprehensive study of relevant literature on walkability and its correlation with the built environment. Digital illustrations from the Addis Ababa City Government's Plan and Development Commission were modified and adjusted to create visual presentations. In addition, the researcher took photos that were accompanied by maps constructed using ArcGIS 10.6 software and Adobe software.

3.5. Sampling design

The frames that were used to limit the number of samples that are taken under consideration were as follows.

1. The location to be found at the inner part of the city &
2. The locations to be assessed are to be found on the main access corridors of Addis Ababa

3.5.1. Sampling Techniques

The sampling technique used for selecting corridors was purposive sampling. Locations with different built environment characteristics were selected. The sampling was done based on the purpose of the study and the need to answer the research questions. Following this sampling technique, the pedestrian networks along the main corridors in Arada sub-city were chosen.

3.5.2. Sample size

For the purpose of this research, the Arada Sub-city in Addis Ababa was selected for macro scale analysis. In addition, specific street corridors were chosen for micro scale analysis. These street corridors include the Arada building area, Giorgis to Merkato road, Giorgis to Addisu Gebeya, Girogis to Afincho ber road, Churchill Avenue, Arat kilo square to Sadist kilo square, and Arat kilo square to Kebena road.

A total of 140 pedestrians participated in the study by filling out questionnaires. Out of the 140 participants, 76 were male while 64 were female. Among the respondents, 1.4% of them were below the age of 18, 50% were between the ages of 18 and 36, 36.4% were between the ages of 37 and 55, and 12.2% were above the age of 55.

3.6. Method of Data collection

3.6.1. Primary Data

The primary data for the selected corridors were collected through a combination of direct observation and questionnaires. Direct observation was used to note the features of bus and LRT stations, active frontages, sidewalk material, street seats and obstructions. Further details on pedestrian perception about those areas were obtained through a series of questionnaires. After collecting the necessary information from these two methods, it was translated into various mediums such as mappings, graphs, tables, diagrams and writings to ensure comprehensive understanding.

3.6.2. Secondary Data

Data from a variety of sources was sourced for this project, including books, research papers, and government bodies such as the Addis Ababa City Government and Development Commission. The data included land use maps, street and transportation maps, and transportation service data. Collecting this secondary data enabled an understanding of the study area's physical characteristics, as well as its infrastructure.

3.7. Method of data analysis

GIS software is used for data analysis. The Esri Company's application, ArcGIS 10.6, was chosen for data processing and creating presentation maps. The walkability indices, which were selected to assess the walkability of the chosen location, were transformed into spatial information to produce the map. To make modifications and adaptations, Adobe software was utilized. Microsoft Excel was used to analyze the data collected via questionnaires, and the results were presented in tables and graphs.

3.7.1. Assessment methods

Both primary and secondary data were used for data analysis. The quantitative method was mainly used to analyze pedestrians' perceptions, which were collected through questionnaires. The qualitative method was used for the data collected through the direct site observation method. To develop a methodology to measure the walkability of the built environment, different literatures have been reviewed, and walkability indices were generated from these literatures. The indicators were chosen based on the relevance of the data sources available for the selected context. The relevance of the indices was chosen based on data collection time, data availability, and ease of data collection. Pedestrians' perceptions about the selected corridors with regards to comfort and safety were also collected through questionnaires.

The selected variables along with their indicators are summarized on table as follows;

Table 3. 1: Selected variables and their indicators to measure walkability

Built Environment categories		**Features**	**Description**
Macro scale	**Land use pattern**	Residential density Commercial density	To identify the percentage of residential and commercial densities
	Transportation system infrastructure	street connections distance to transit stops	To map out the features and show the street connectivity and the walkability of transit stops
Micro scale	**Urban design,**	quality of path (Pedestrian material, active frontages, obstructions) , amenities (presence of street furniture	Mapping the features and descriptive information of the area

3.8. Method of data presentation

The collected data is analyzed and presented in a way that can answer the research questions and they were presented through maps and written documents.

The discussion is divided into topics related to the walkability indices that were selected for the assessment. These indices are dwelling & commercial land use density, land use mix, street connectivity, distance to transit stops, number of transit stops, presence of street furniture, active frontages and side walk material. The mappings are done using GIS and adobe soft wares.

The data collected through questionnaires were analyzed and presented using tables, graphs and diagrams. Based on the results general summary and conclusions were forwarded. And finally, recommendations were forwarded on enhancing the walkability of pedestrian ways.

CHAPTER FOUR: RESULTS & DISCUSSION

4.1. Introduction

This chapter presents the findings and discussions of a research survey that aimed to identify and analyze existing indicators of walkability at both macro and micro scales. The study also sought to gain further insight into how pedestrians experience the selected corridors by exploring their perceptions

The study aimed to assess the existing indicators of walkability, which refers to how suitable an environment is for walking, at both macro and micro scales. This approach helped identify key factors that can make a place more walkable. The research also examined how individuals feel when walking in the selected corridors, and the participants' perceptions provided valuable insights into their experiences.

The chapter's results and discussions provide a better understanding of the factors that contribute to the walkability of an area and how they impact pedestrians' experiences. This information can be used by urban planners, policymakers, and designers to improve the walkability of urban environments, leading to more active and healthier communities.

4.2. Site survey findings

4.2.1. Dwelling & commercial density

The Arada Sub-city has the largest land use coverage at 88.96%, mainly composed of mixed residential and commercial uses as illustrated in Figure 4.4. The medium density mixed residence (R2) and high density mixed residence (R3) cover 85.45% of the total area, making it a preferred location for walkability - one of the criteria for a City's sustainability. Due to its high land use density, Arada Sub-city it support pedestrian movement by providing people with an increased access to services associated with their homes as well as more employment opportunities.

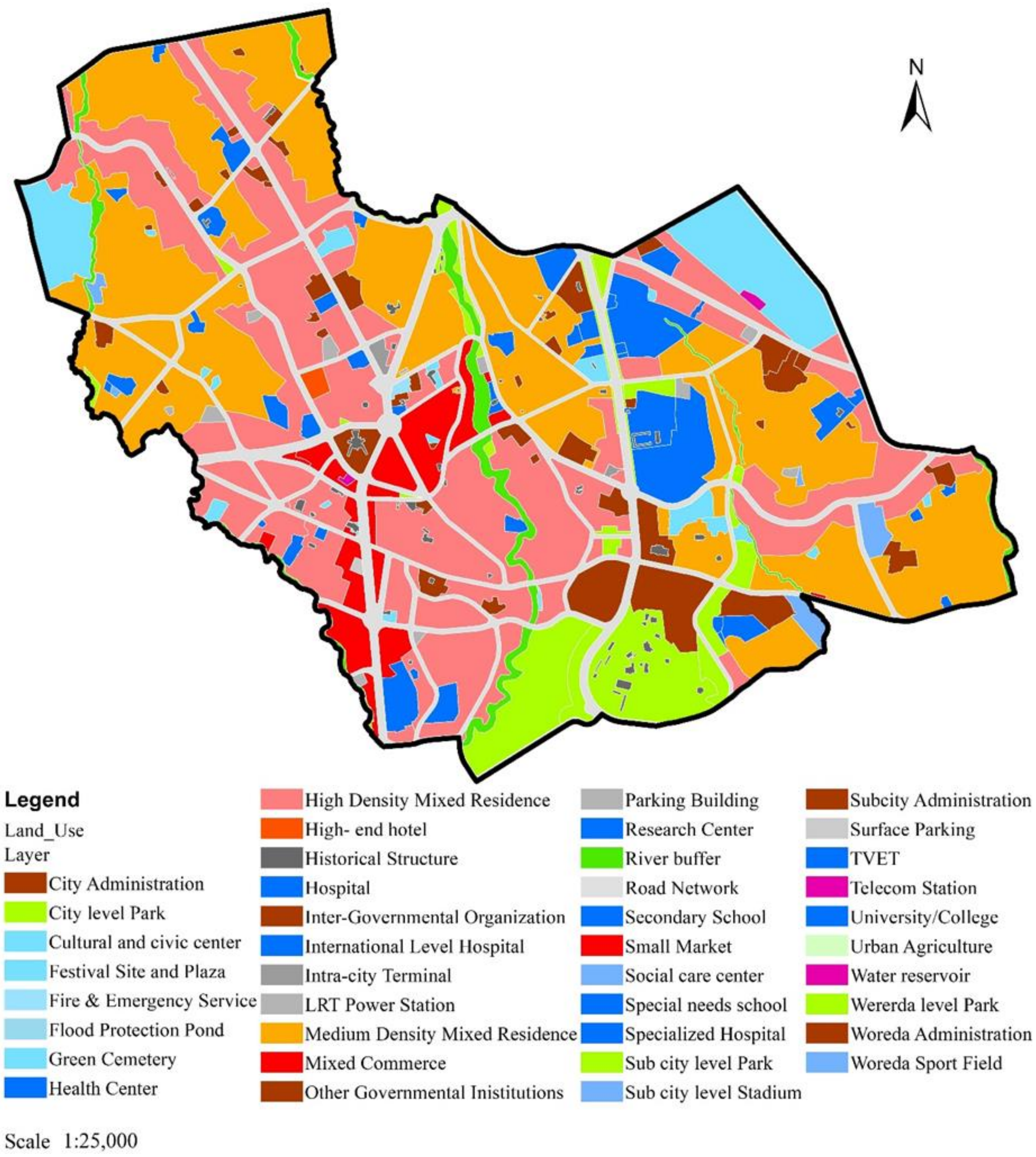


Figure 4. 1: Land Use map of Arada Sub city

Total Area of Arada = 9,926,864.5 m2

R-2 & R-3 area = 8,482,023.9 m2 = 85.45% of the total Arada sub-city

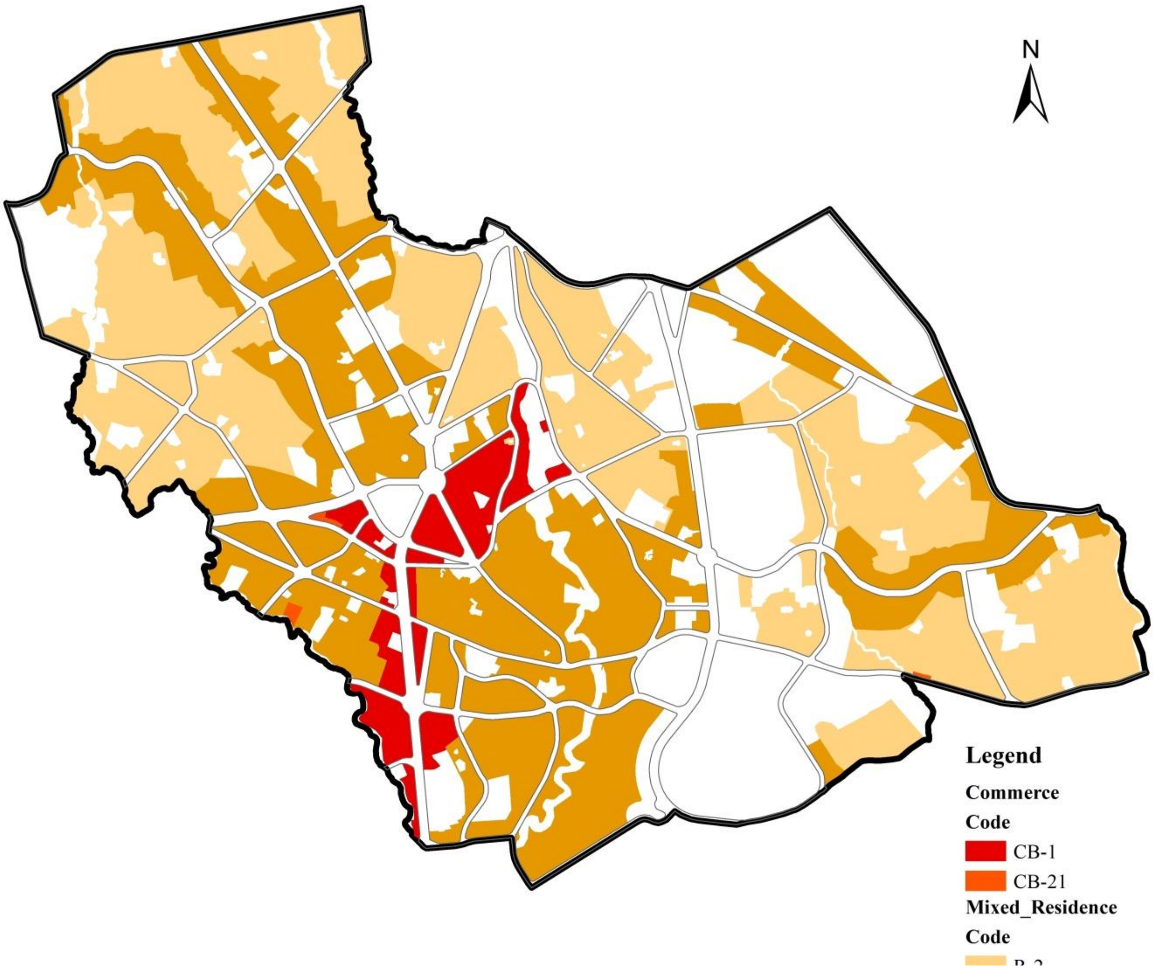


Figure 4. 2: Mixed residence and commercial land use map of Arada Sub city

CB-1 & CB-21 = 348,836.7 m2 = 3.51% of the total Arada sub-city

4.2.2. Street Connectivity

Figure 4.5 illustrates the road networks in Arada sub-city, and Figure 4.6 further emphasizes this point by exhibiting a 1 km x 1 km grid that shows the intersection density across the sub-city. Darker brown regions indicate areas with a high density of intersection nodes, while lighter brown regions correspondingly stand for areas with a low density of internode links. The inadequate number of intersections disconnects road linkages and could lead to an increase in traffic congestion or unsafe crossing conditions. To ensure effective and safe pedestrian traffic flow within cities, it is important to strategically plan integration nodes between roads.

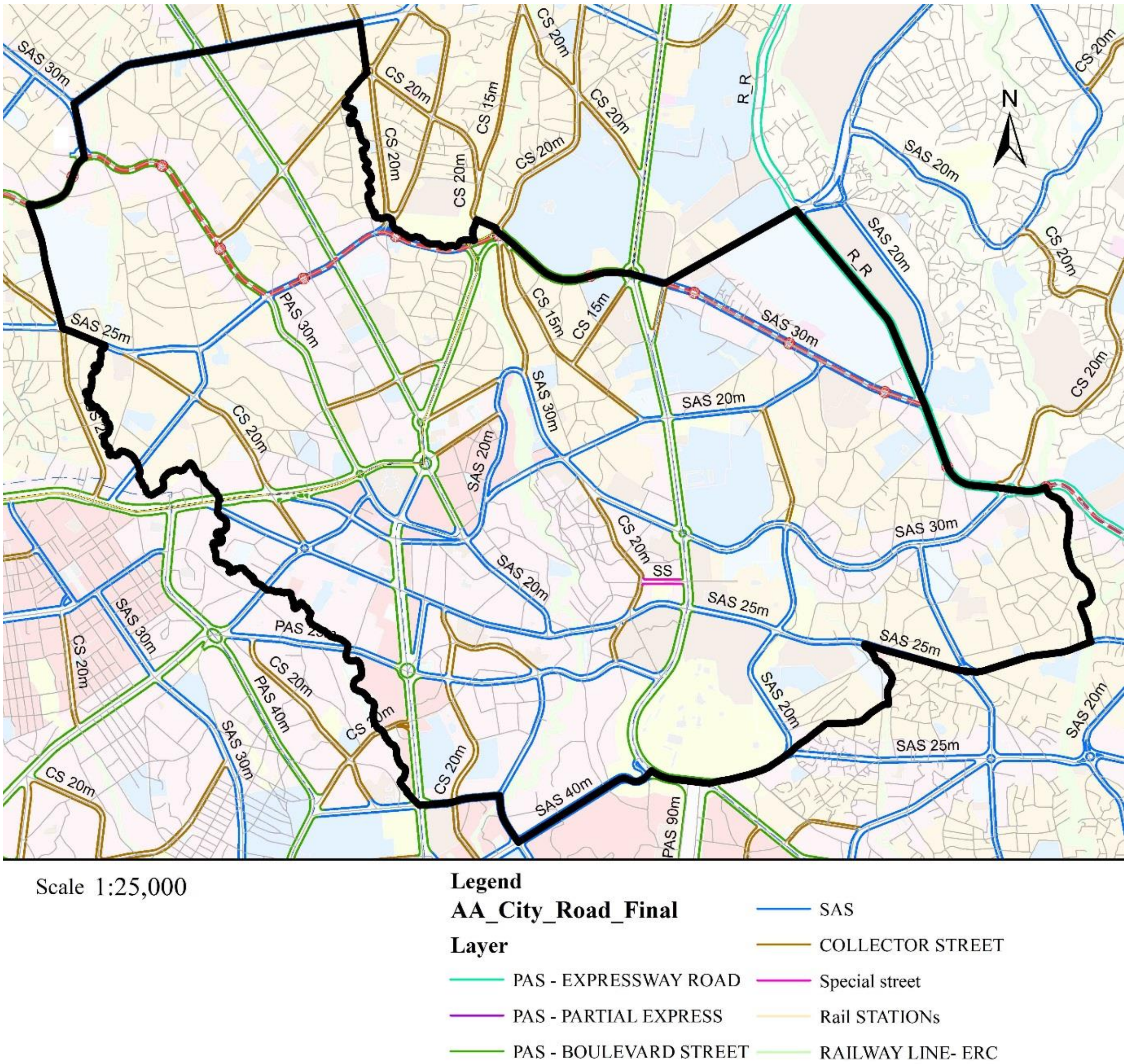


Figure 4. 3: A map showing street network of Arada sub city

(Source: Addis Ababa government plan and development commission and modified by the researcher for presentation purposes)

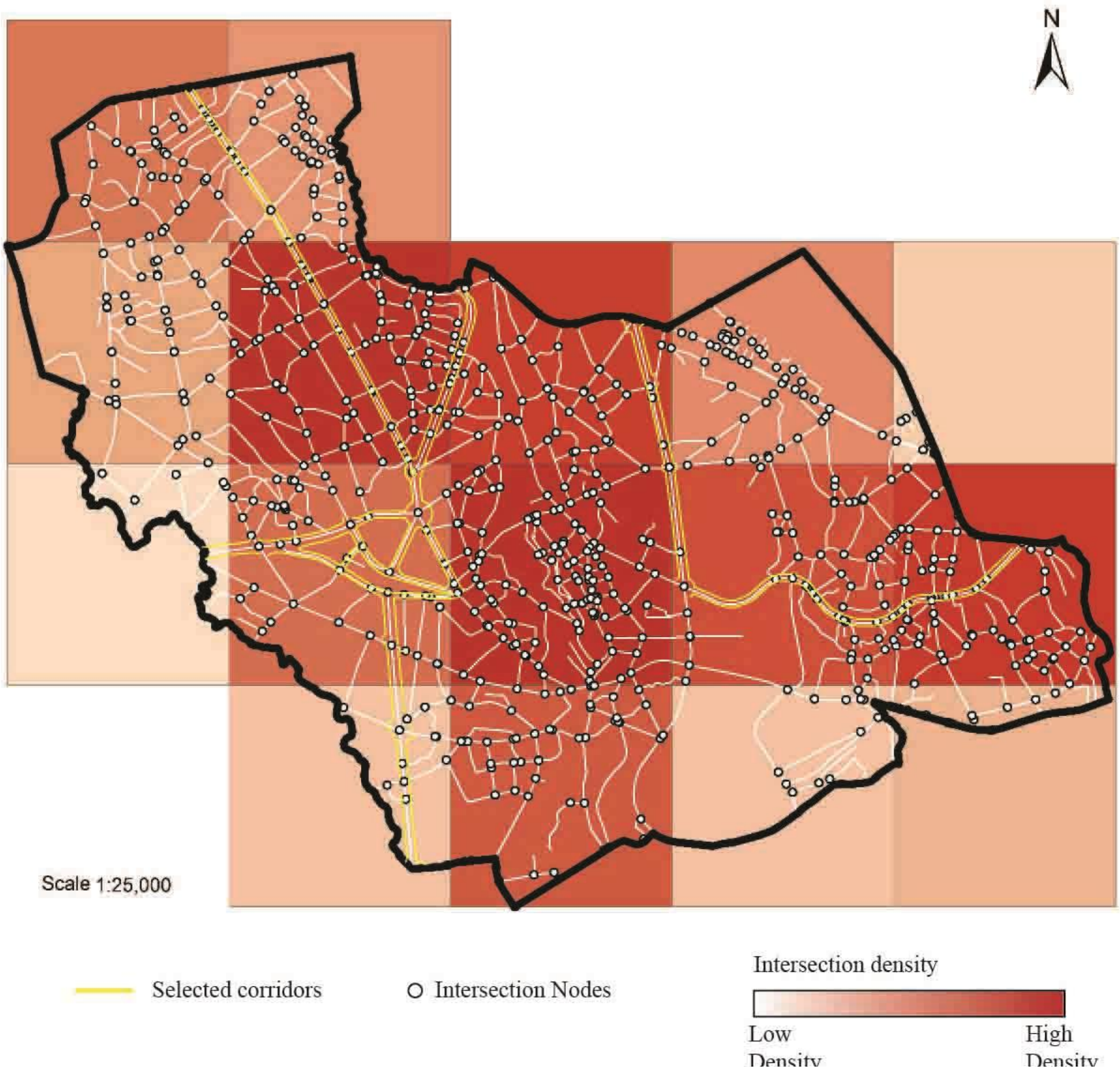


Figure 4. 4: Map showing Intersection density

(Source: Addis Ababa government plan and development commission and modified by the researcher for presentation purposes)

4.2.3. Distance to transit stops (Bus & LRT stations)

In this study, the bus transport and LRT transit stops were mapped, but taxi transportation was not included. Figure 4.7 shows the locations of bus and LRT transit stops, with yellow dots representing the bus stations and red dots representing the LRT stations. As seen on the map, the bus and LRT stations are not distributed equally throughout the study area. In some locations, there are no bus stations at all, which means that people have to walk long distances between stations when using bus transport. The walkable distance between bus stations is 400 m.

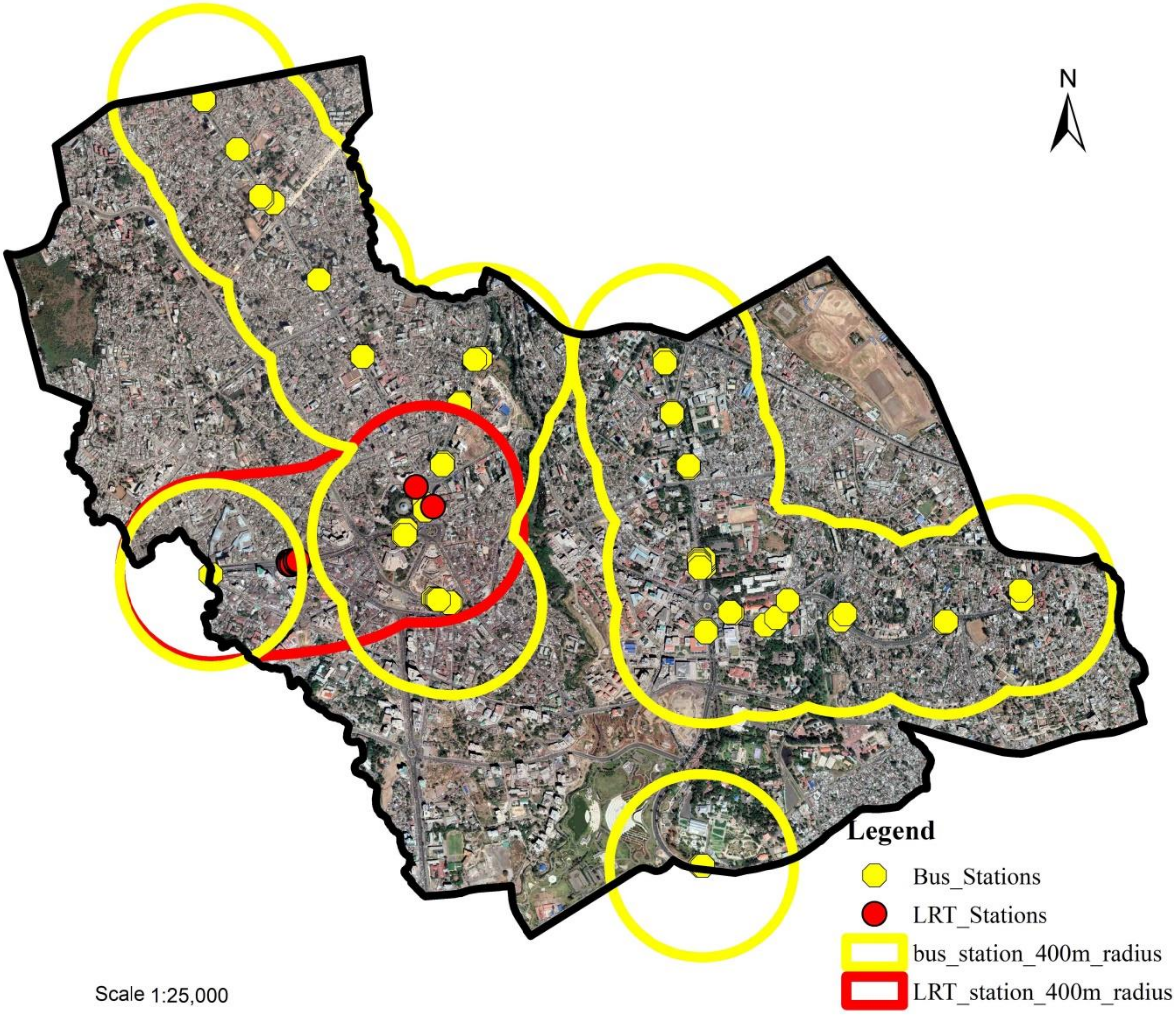


Figure 4. 5: Bus & LRT stations map & 400m radius from bus stations & LRT stations

(Source: Map produced through direct site survey by the researcher)

4.2.4. Active frontage

An active frontage is a continuous line of businesses or retail spaces that open directly onto the footpath. These establishments provide activity on the streets, enhance public security and passive surveillance, and improve the amenity of the public domain by encouraging pedestrian activity.

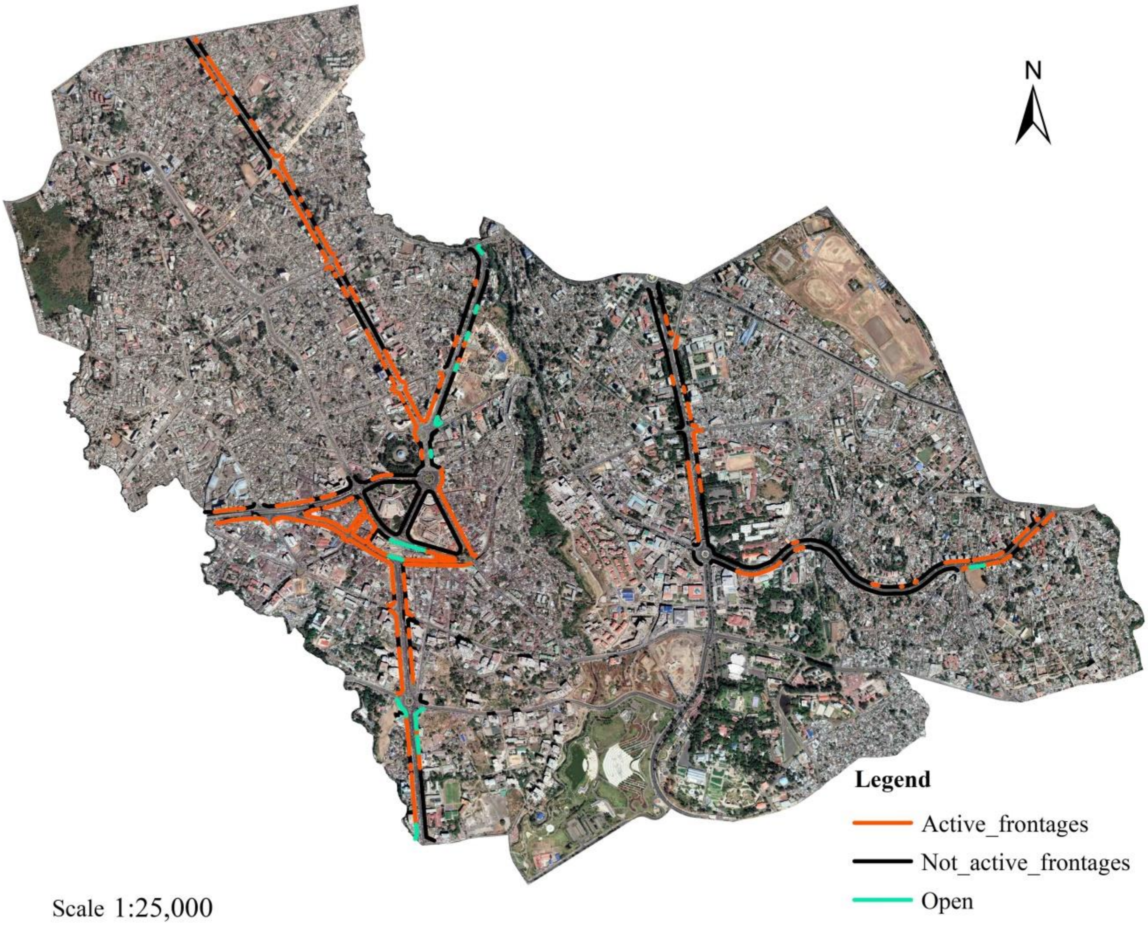


Figure 4. 6: Active frontage map

(Source: Map produced through direct site survey by the researcher)

i. Churchill Ave.

As seen on the map in Figure 4.9 below, Churchill Avenue has the largest portion of active frontage. This type of frontage has buildings with permeable ground floors that house shops, cafes, restaurants, and boutiques. There are also frontages that are fenced with blocks and metal frames, which are grouped under non-active frontages. The Black Lion Secondary School and the Lycee Guebre-Mariam schools are examples of buildings with non-active frontages. The other non-active frontages are the result of construction sites or newly constructed sites in the area, which are fenced with metal sheets or may include open parking areas without fences.

Figure 4. 7: Picture map of Churchill ave. showing active frontages and non-active frontages (Source: all pictures are taken by the researcher)

ii. Around Arada Building area & Giorgis to Merkato road

Figure 4.10 shows the area around Arada building and the road from Giorgis to Merkato. As seen on the map, the mayor’s office and the neighboring construction site are marked as non-active frontages, both of which are fenced. The mayor’s office is fenced with half masonry and metal frames at the top, while the neighboring site is fenced with sheet metal. On top of the mayor’s office, there is a St. George church, which is also fenced with masonry. Other non-active frontages seen on the map are construction sites fenced with metal sheets.

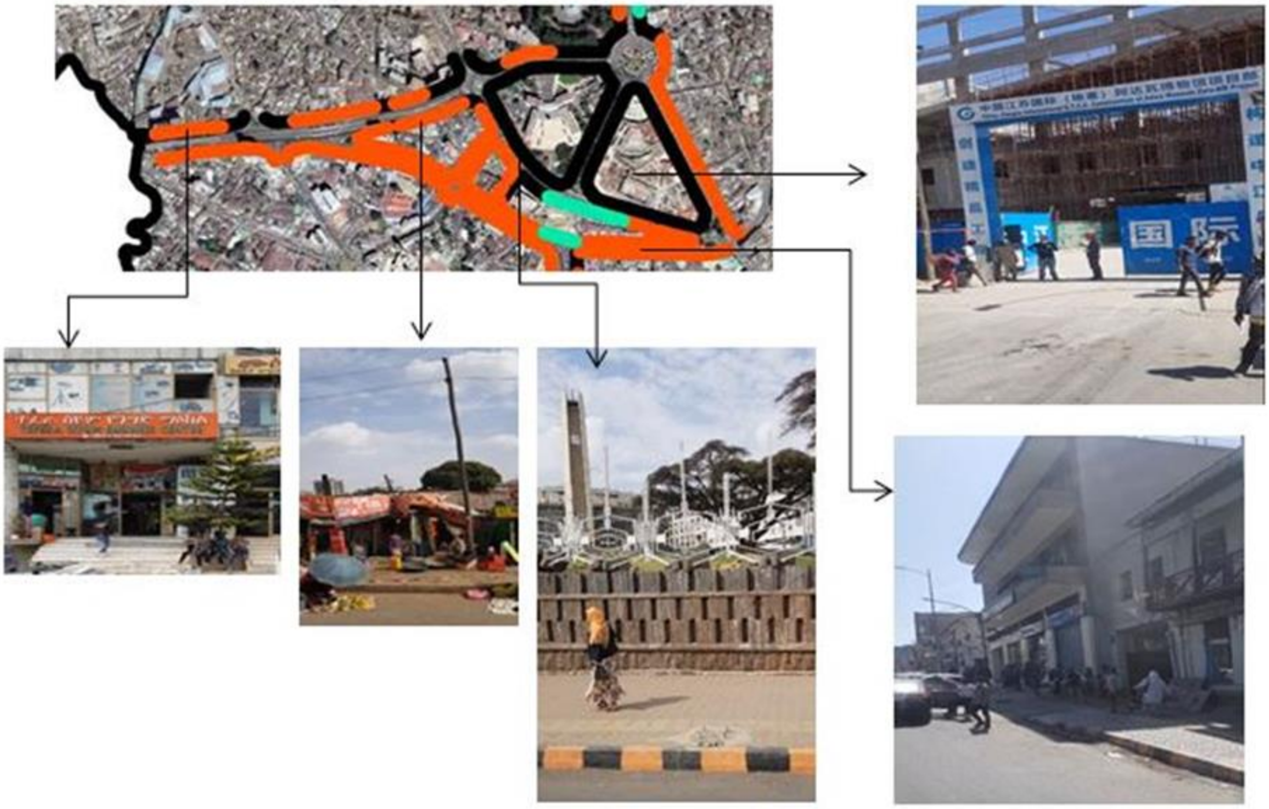


Figure 4. 8: Picture map of Arada building area showing active frontages and non-active frontages (Source: all pictures are taken by the researcher)

iii. Giorgis to Merkato road

The active frontages primarily consist of commercial functions. As seen on the map in Figure 4.10, there are also open markets that are marked as active frontages.

iv. Giorgis to Addisu Gebeya road

The non-active frontages seen on the map in Figure 4.11 are fenced with masonry, metal bars, and metal sheets. Schools, institutions such as the Federal Prison Commission and Addis Ababa Police Commission, and different buildings have fences, which makes the frontages non-active. There are also pedestrian-restricted zones along the Federal Prison Commission and Addis Ababa Police Commission, where anyone coming from this direction is ordered to cross to the other side of the road. The building frontages that are marked as active frontages mainly consist of commercial functions. These buildings have activities such as boutiques, shops, cafes, restaurants, banks, and so on on their ground floors and have permeable frontages.

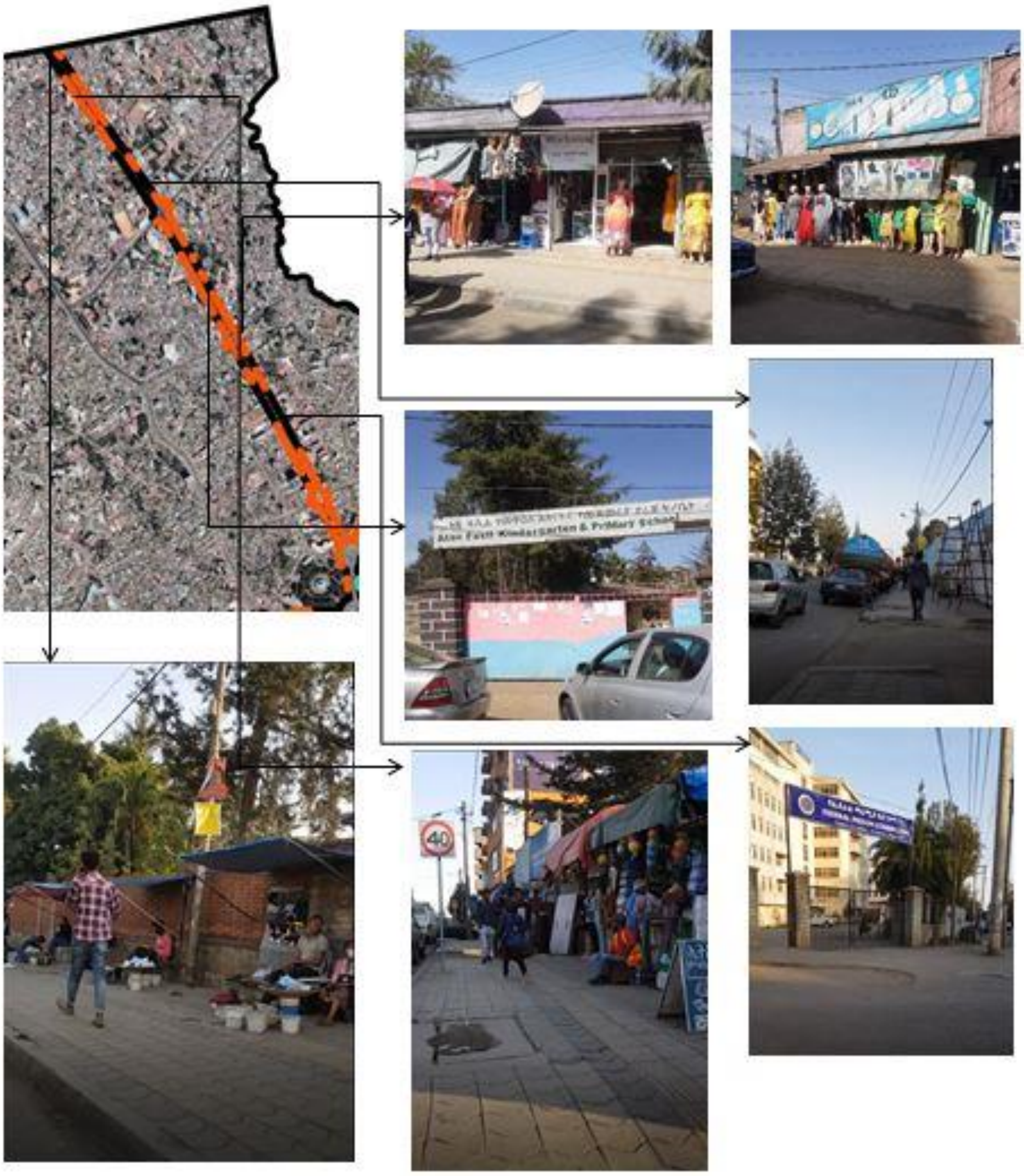


Figure 4. 9: Picture map of Giorgis to Addisu Gebeya road showing active frontages and non-active frontages

(Source: all pictures are taken by the researcher)

v. **Giorgis to Afincho ber road**

As clearly seen on the map in Figure 4.12, the dominating frontage on this corridor is non-active. This is due to one side of the road being mostly dominated by construction sites, which are fenced with metal sheets. As seen in the image, the other side of the road has a retaining wall constructed with a masonry wall.

This location is dominated by non-active frontages, resulting in a lack of visual engagement. It is not enjoyable to walk on these sidewalks, as pedestrians do not pass alongside shops, cafes, or windows, but instead by masses of concrete and security fences.

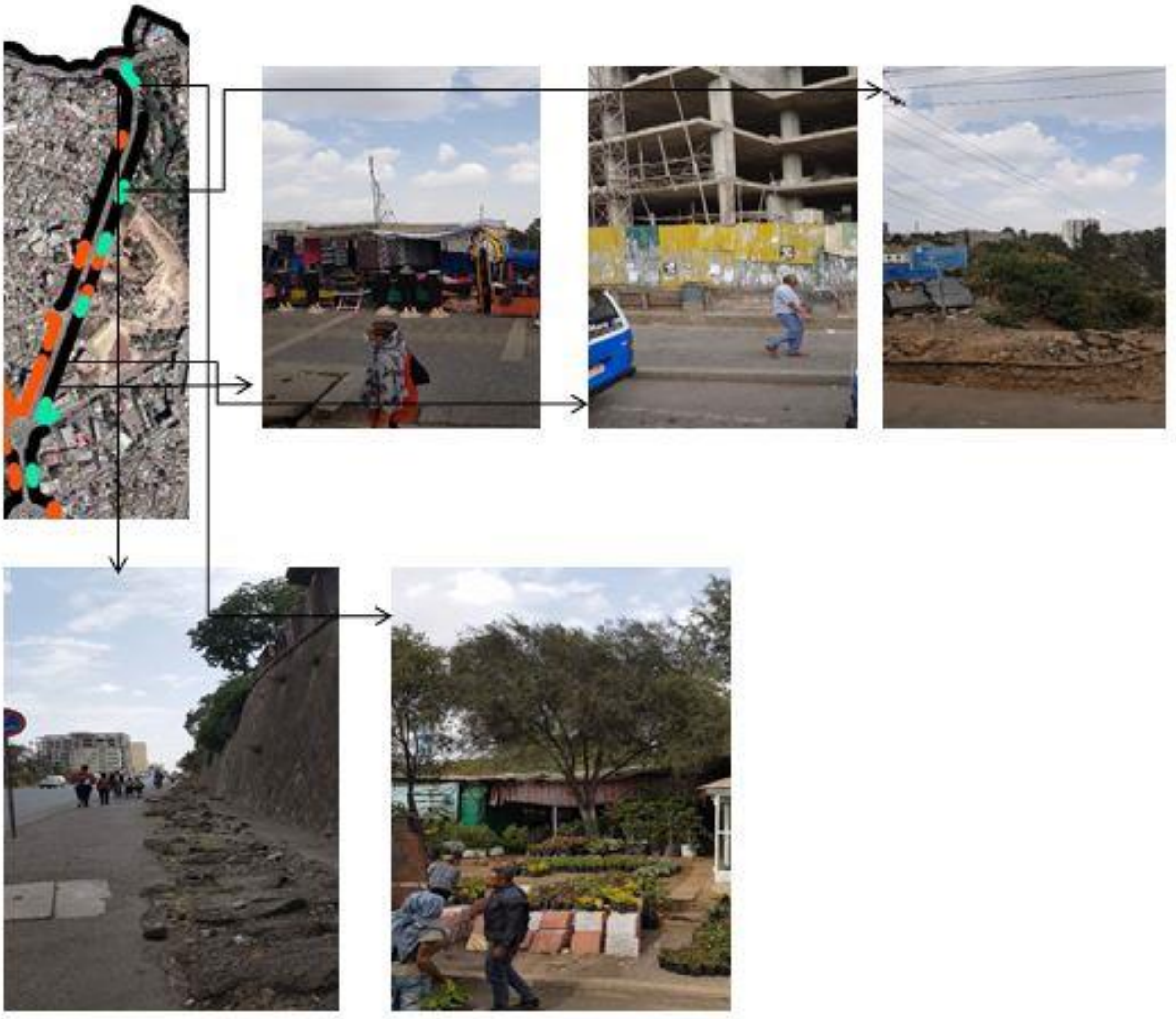


Figure 4. 10: Picture map of Giorgis to Afincho ber road showing active frontages and non-active frontages

(Source: all pictures are taken by the researcher)

vi. **Arat kilo square to Sidist kilo square**

On the corridor from Arat Kilo Square to Sidist Killo Square (Figure 4.13), there are big institutions such as Addis Ababa University 4 Kilo Campus, Addis Ababa University 5 Kilo Campus, the Federal Supreme Court, the Ministry of Finance, Minilik Secondary School, the Ministry of Education, and the National Educational Assessment and Examination Agency.

All of these buildings have non-active frontages and are fenced by half masonry and half metal bars. The other active frontages have functions such as stationery stores, cafes, shops, and boutiques.

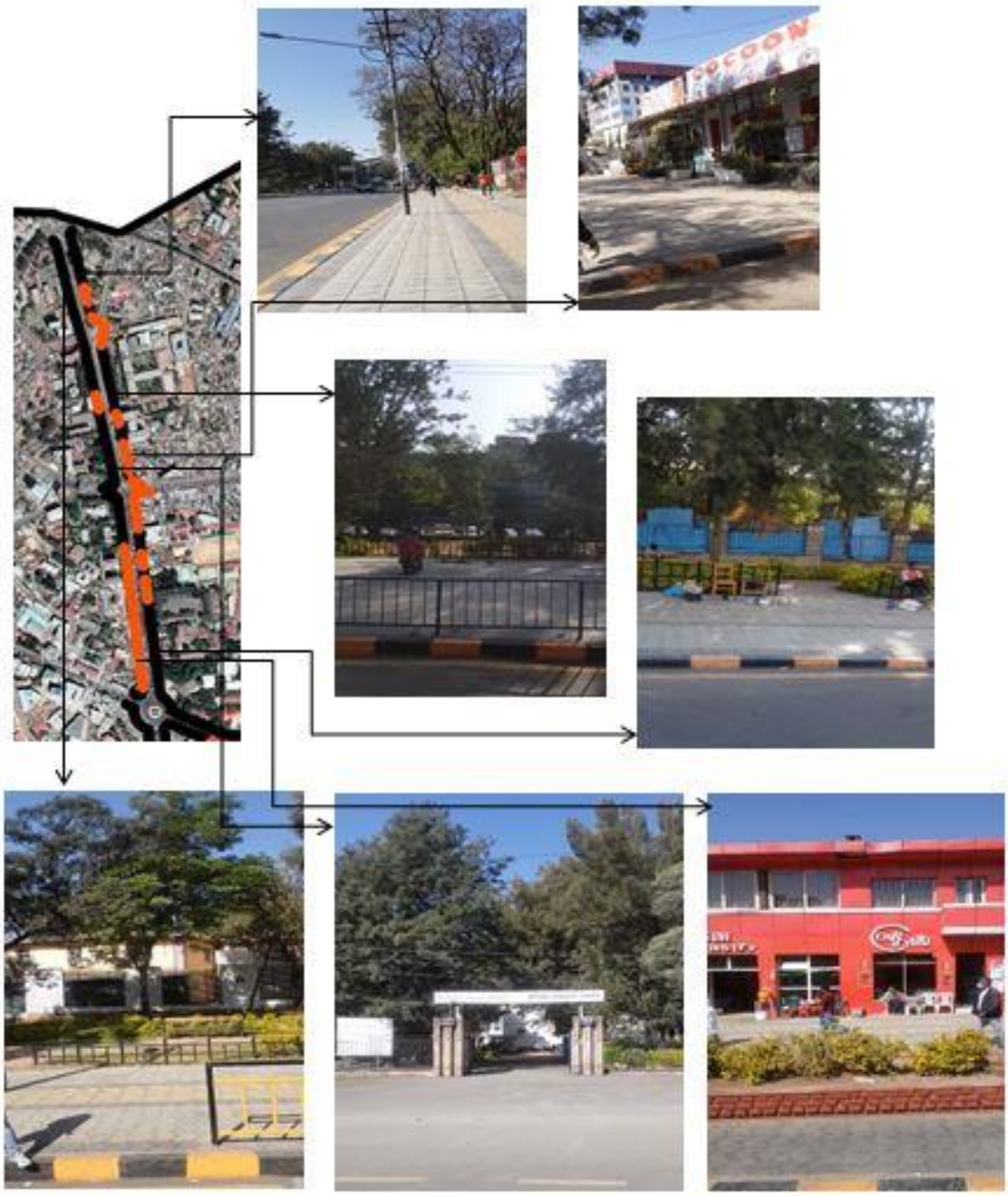


Figure 4. 11: Picture map of road from Arat kilo square to sidist kilo square showing active frontages and non-active frontages

(Source: all pictures are taken by the researcher)

vii. **Arat kilo square to Kebena road**

The non-active frontages in this location (figure 4.14) are structures that are fenced off. Due to the sloping topography, the buildings located next to the pedestrian ways are built on lower slopes, so the roads are fenced with metal grids for safety reasons. The sides of the roads are non-active, as seen in the picture. Other buildings are also fenced with masonry and blocks. The only active frontages in these locations are buildings with commercial activities.

Figure 4. 12: Picture map of Arat kilo square to kebena road showing active frontages and non-active frontages

(Source: all pictures are taken by the researcher)

4.2.5. Side walk material

The sidewalk materials found in the selected corridors include Terrazzo tile, asphalt, and aggregate/sand material. As seen on the map above, the largest coverage of pedestrian material is the Terrazzo tile. As stated in the literature review, sidewalks should have a smooth surface, and asphalt or concrete are preferable. The Terrazzo tile pavements attempt to include blind tactile pavements, but they are not fully functional due to obstructions along the way. The asphalt pavements have no pavement guides and are therefore uncomfortable for all users. The aggregate and sand material pavements are completely uncomfortable for people to walk on.

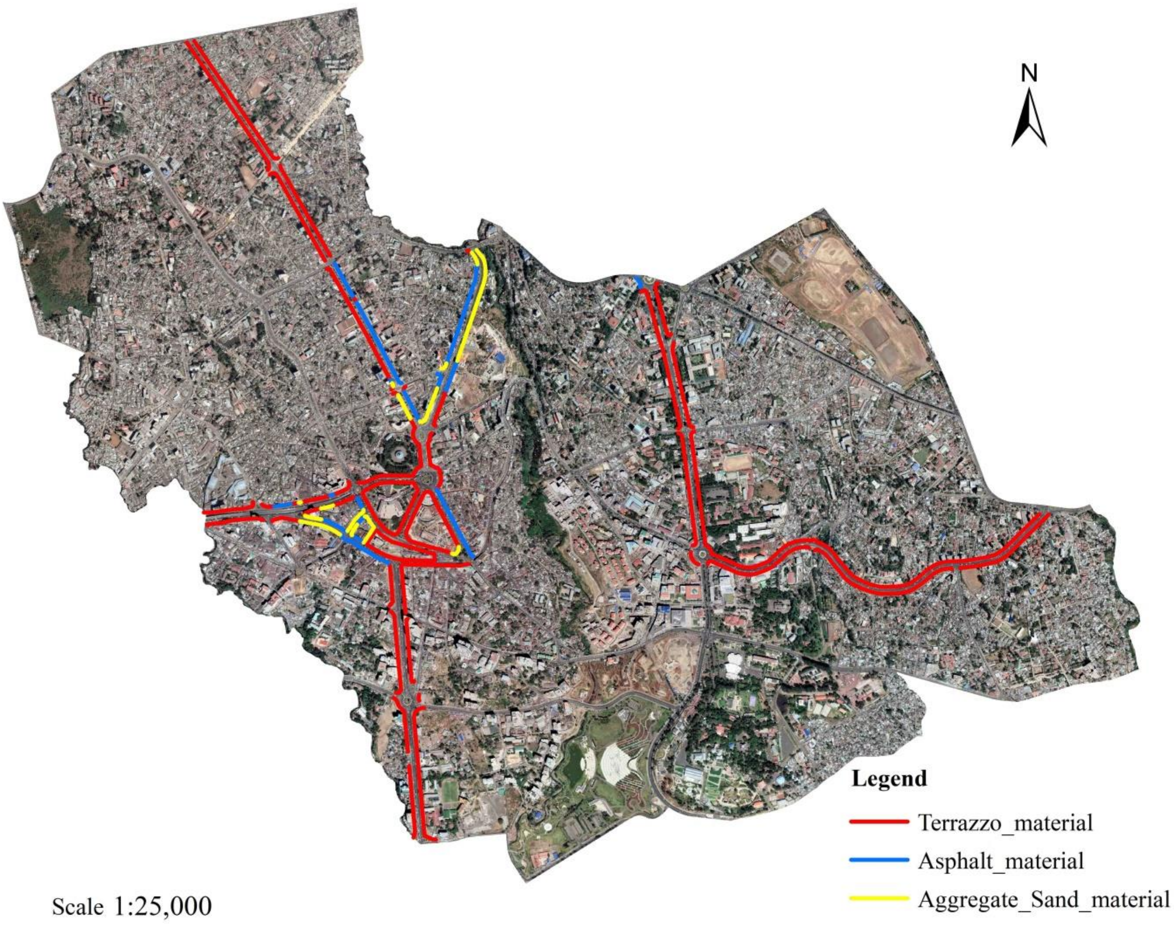


Figure 4. 13: Map showing the side walk material

(Source: Map produced through direct site survey by the researcher)

In figure 4.15, it is clear that the pedestrian ways in the study area are mainly composed of terrazzo material, which is positive for the comfort of walking. However, it is important to note that the use of terrazzo tiles alone does not necessarily guarantee walkability, as other factors such as the presence of obstructions can greatly affect the pedestrian experience. Unfortunately, in some areas, the pedestrian ways are raised at their ends, creating difficulties for people with disabilities. Additionally, there are holes and electric poles on the pavements which obstruct the free movement of pedestrians.

a. Terrazzo tile pavements

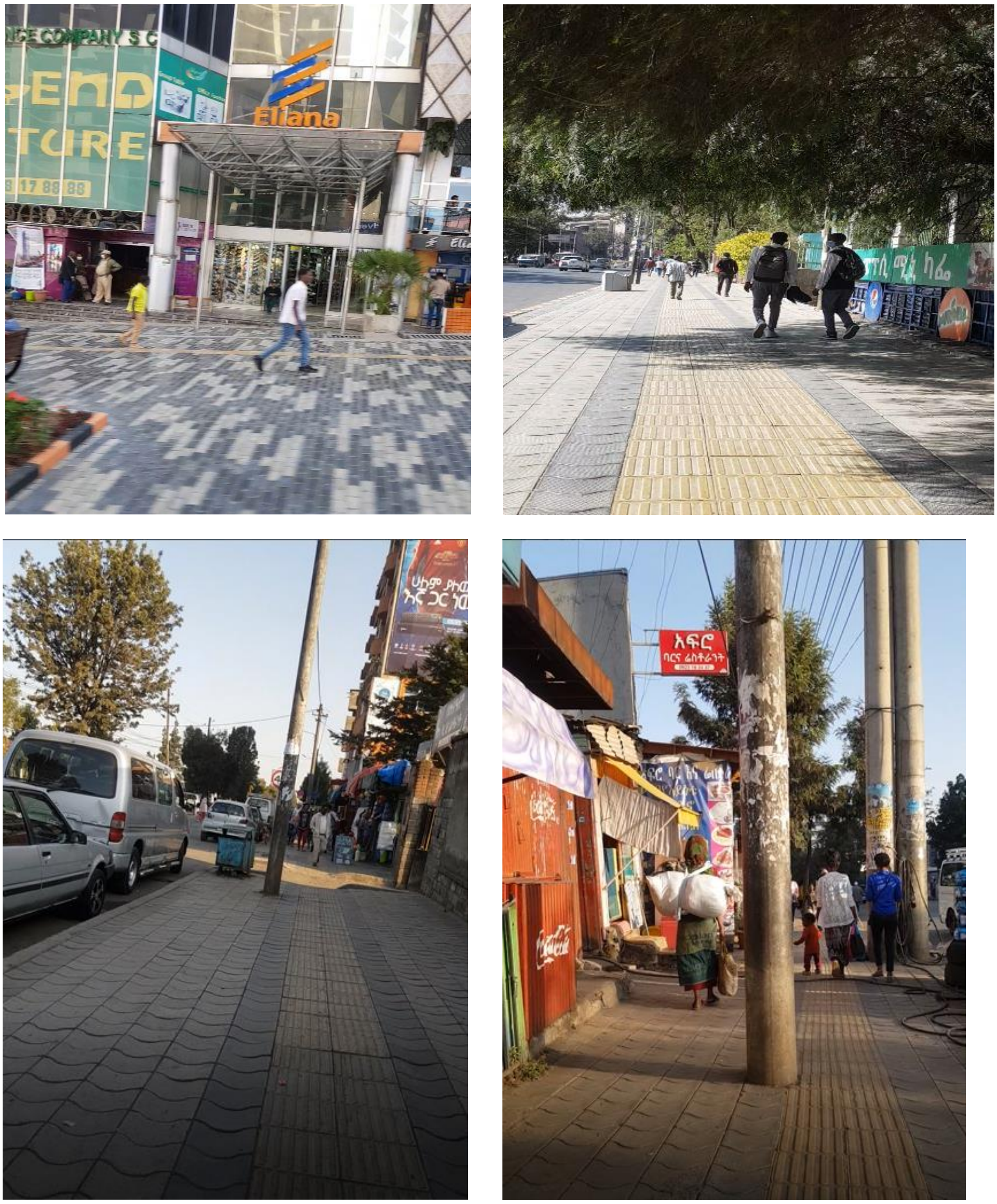


Figure 4. 14: Pictures showing different location on the site with terrazzo tile pavements

(Source: all pictures are taken by the researcher)

b. Asphalt Pavement

Figure 4. 15: Pictures showing different location on the site with Asphalt pavements

(Source: all pictures are taken by the researcher)

c. Aggregate / sand walkways

Figure 4. 16: Pictures showing different location on the site with aggregate/ sand pavements

(Source: all pictures are taken by the researcher)

4.2.6. Street Seat

Street furniture enhances the vitality of places as it creates settings for resting, sitting, eating, and social encounters with others. Such settings may be of great importance to the elderly, those with limited mobility, and adults with small children. Figure 4.19 shows the locations in the study area where street furniture is available. As seen on the map, street furniture is only available in a few locations. Street furniture makes sidewalks more inviting, and it is observed that people rest, relax, read, discuss, and wait for taxis in these areas. The presence of street furniture in one way or another has made these places lively.

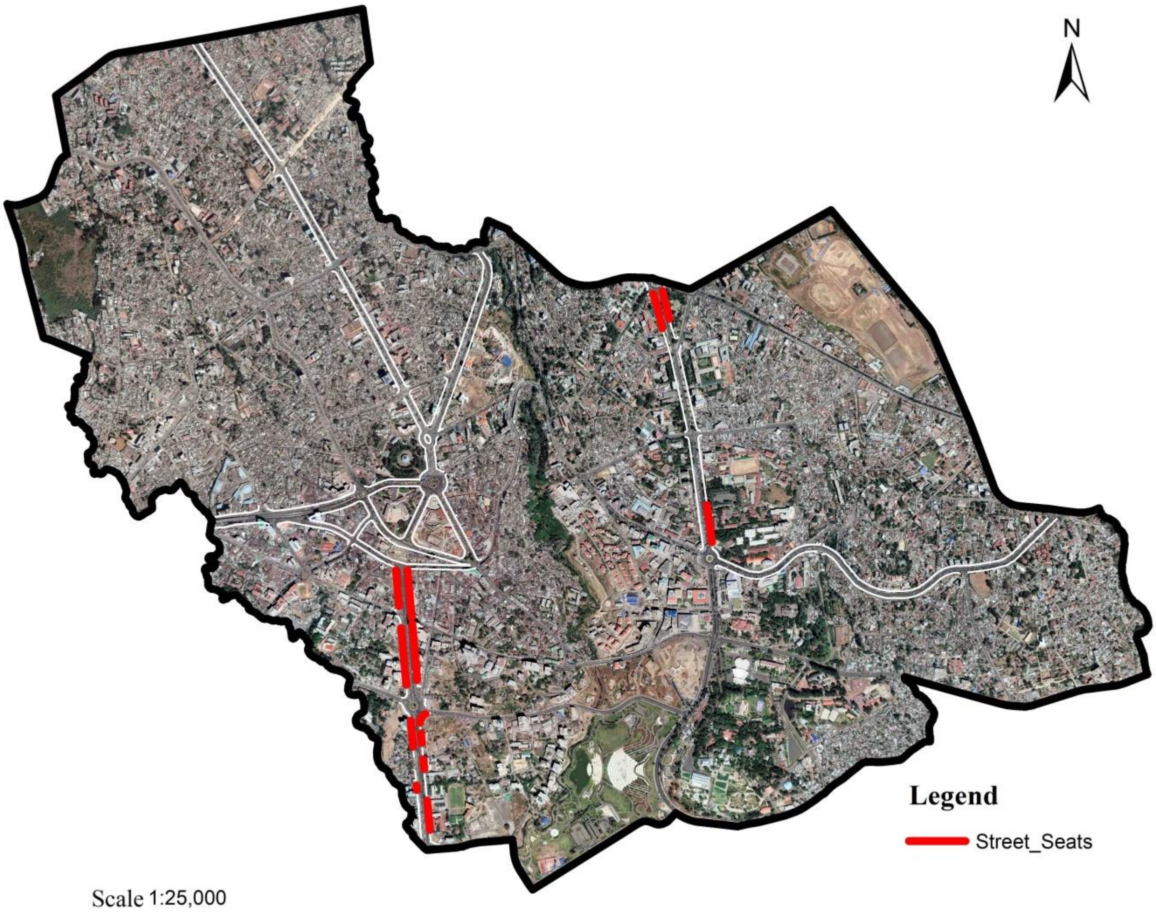


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Figure 4. 17: Street seat location map

(Source: Map produced through direct site survey by the researcher)

One of the locations with street seat present is Churchill ave. This location as it is seen on the previous maps it has terrazzo tile finishes and characterized by active frontages with commercial functions therefore the presence of these street seats enhances the walkability of the place.

Figure 4. 18: Map showing street seat availability on Churchill ave.

(Source: all pictures are taken by the researcher)

The other study area with street seat is found on the road from Arat kilo square to sadist kilo square. This location is also having terrazzo tile finishes. The activities around this area are universities and other public institutions yet the presence of the street seats made the places active.

Figure 4. 19: Map showing street seat availability on the road from Arat kilo square to Sidist kilo square

(Source: all pictures are taken by the researcher)

4.2.7. Obstruction

The following permanent & temporary obstructions were observed on the study area

a) Electric poles
b) Holes
c) Construction site debris
d) Construction site fences blocking the pedestrian ways
e) Pedestrian restricted areas due to security reasons
f) Individuals using the pedestrian ways for their private needs
g) Commercial activities on the pedestrian ways
h) Different structures such as Concrete structures, stones
i) Cars parked on pedestrian ways
j) Destroyed pavements
k) Taxi queues

a. Electric poles on pedestrian ways

Figure 4. 20: Images showing poles obstructing the pedestrian ways

(Source: all pictures are taken by the researcher)

b. **Holes on pedestrian ways**

Figure 4. 21: Images showing Holes obstructing the pedestrian ways

(Source: all pictures are taken by the researcher)

c. Construction site debris on pedestrian ways

Figure 4. 22: Image showing construction site debris obstructing the pedestrian ways

(Source: all pictures are taken by the researcher)

d. **Construction site fences blocking pedestrian ways and pedestrian restricted areas dues to security reasons**

Figure 4. 23: Image showing fences obstructing the pedestrian ways

(Source: all pictures are taken by the researcher)

e. **Different sturctures blocking the pedestrian ways**

Figure 4. 24: Image showing different structures blocking the pedestrian ways

(Source: all pictures are taken by the researcher)

f. Commercial activities on pedestrian ways

Figure 4. 25: Image showing different commercial activities blocking the pedestrian ways

(Source: all picturesare taken by the researcher)

4.2.8. Pedestrians' Perception

A total of 140 pedestrians participated in filling out the questionnaires. Among them, 76 were males and 64 were females. 1.4% of the respondents were below the age of 18, 50.0% were between 18 and 36, 36.4% were between 37 and 55, and 12.2% were above 55 years old.

Table 4. 1: Respondents response

Indicators	**Response from the total of 140 respondents**	**Response in percentage**
Safety during the day time	52	37.14%
Safety during the night time	30	21.43%
Enough lighting	40	28.6%
Material comfort	59	42.14%
Presence of obstructions	117	83.6%
cleanliness	69	49.3%
Enough intersections	45	32.14%
Needs maintenance	83	59.3%

(Source: Field survey by the researcher)

4.3. Discussion of Findings

4.3.1. Macro scale Analysis

a. Land use pattern

Land use is one of the attributes of built environment that has been shown to be associated with walking. It is discussed on the literature review how urban density is a key property of walkability because it concentrates more people and places with in walkable distances.

Functional mix, like density, shortens the distances between wherever we are and where we need to be (Kim Dovey, 2019).

According to the data available, Arada Sub-city appears to have a significant amount of mixed residential and commercial land use, accounting for 88.96% of the total area of the sub-city. This means that a vast majority of the land is being used for both residential and commercial purposes. Furthermore, the medium density mixed residence (R2) and high density mixed residence (R3) account for 85.45% of the total area in Arada. This indicates that both medium and high-density residential areas have the highest coverage in the sub-city.

This is particularly noteworthy since a walkable city requires a balance of land uses. Mixed-use areas with high residential and commercial densities promote walkability by providing residents with convenient access to a variety of amenities and services in close proximity. As a result, it can be inferred that the Arada sub-city has a land use pattern that encourages walkability.

A walkable city is an ideal that many urban planners strive for, and a high density of mixed-use areas is one of the key factors that contribute to its success. By combining residential and commercial spaces, people are more likely to use public transport or walk to their destination rather than relying on cars. This not only reduces traffic congestion but also promotes healthier and more sustainable lifestyles.

In general, Arada Sub-city's high coverage of mixed residential and commercial land use, particularly the medium and high-density mixed residence areas, is a significant advantage that contributes to the sub-city's walkability. This can be considered as a positive characteristic that promotes sustainable and livable urban environments.

b. **Transportation system infrastructure**

The key to good pedestrian mobility is a high ratio of intersection nodes to road links so that streets and pathways are well connected. Stations need to be spaced frequently enough to allow pedestrian access for residential and commercial zones, it is usually 1/4 - 1/2 mi (400m – 805m), or 10-20 min walk (Southworth, 2005).

The distribution of transportation infrastructure, specifically bus and LRT stations, within the study areas is not uniform. There are certain locations where these stations are sparse, and in some cases, completely absent. This creates a significant inconvenience for people who rely on bus transport to move around the area, as they have to travel long distances from one station to another. This can result in increased travel time, physical exertion, and potential loss of productivity.

Moreover, street connectivity also plays a crucial role in the ease of transportation. Some areas have a high density of intersections, allowing for multiple routes to reach a destination, whereas in other areas, the connectivity of streets is low. This can result in limited route options and longer travel times, further worsening the problem of limited transportation infrastructure.

In general, the uneven distribution of transportation infrastructure, including bus and LRT stations, coupled with varying levels of street connectivity in different areas of the study, can pose significant challenges for people trying to move around. It can lead to increased travel time, physical exertion, and potential loss of productivity.

4.3.2. Micro scale Analysis

a. Active Frontage

Buildings with a large number of windows on the ground floor contribute to a safer, more inviting pedestrian environment (World Bank Group, 2019). An active frontage is a continuous business or retail uses that open directly to the footpath. These uses provide activity on the streets. They enhance public security and passive surveillance and improve the amenity of the public domain by encouraging pedestrian activity.

Based on the data collected, it can be inferred that the stretch of road from Giorgis to Addisu Gebeya has the highest number of active frontages as compared to other locations. A closer examination of the active frontages revealed that they were primarily occupied by businesses such as shops, cafes, restaurants, groceries, and boutiques. These commercial establishments featured permeable frontages, which provided people with direct access to their activities. As such, it was observed that these frontages were active with human activity, with people going in and out of these establishments throughout the day.

On the other hand, the non-active frontages featured semi or non-permeable frontages. These frontages were mostly fenced compounds belonging to institutions, offices, and schools. Unlike the active frontages, the non-active ones were not accessible to the public, thus explaining the lack of human activity in these areas.

Table 4. 2: Table showing percentages of Active frontage of the studied areas

	Chrchill ave.	**Giorgis to Merkato road & around Arada building**	**Giorgis to Addisu gebeya road**	**Giorgis to Afincho ber road**	**Arat kilo square to Sidist kilo square road**	**Arat kilo square to kebena road**
Active	55.53%	56.39%	54.43%	25.67%	33.22%	27.99%
Not active	31.36%	39.80%	45.57%	64.21%	66.78%	70.23%
Open	13.11%	3.81%	0%	10.12%	0%	1.78%

(Source: Field survey by the researcher)

b. Side walk material

The side walk materials found on the study area include Terrazzo tile, asphalt and aggregate/ sand material. As it can be seen on the above map the largest pedestrian material coverage is the terrazzo tile material. As it is stated on the literature review, sidewalks should have a smooth surface. Asphalt or concrete are preferable.

After analyzing the collected data, it was found that the majority of the pedestrian ways, which accounts for 83% of the total, were covered with terrazzo tile, a type of flooring material made by combining marble chips and cement. The next most common material used was asphalt, which was found to cover only 9.6% of the pedestrian ways. However, a significant portion, 7.4%, of the pedestrian ways lacked proper finishes, and were made up of aggregate and sand materials that were mostly destroyed. Some of these pedestrian ways were found to be adjacent to construction sites, and were likely formed from debris left over from the construction process.

Further analysis revealed that Churchil avenue and 4 kilo to Kebena road were among the pedestrian ways with 100% terrazzo tile finishing. This indicates that these areas have prioritized the use of high-quality finishes, possibly to enhance their aesthetic appeal and durability. However, the Giorgis to Afincho Ber road was identified as poorly managed with regards to material finishes.

Interestingly, the pedestrian ways with terrazzo tile finishes were found to be built with tactile paving. Tactile paving is a type of flooring that is designed to assist visually impaired pedestrians by providing tactile cues to guide their movement. This indicates that the designers of these pedestrian ways had taken into consideration the needs of visually impaired pedestrians, which is a positive step towards creating an inclusive and accessible environment.

However, despite these efforts, it was also found that different obstructions often distract these paths, making it difficult for visually impaired pedestrians to access them. This highlights the need for continued efforts to ensure that pedestrian ways are designed and maintained to provide safe and accessible passage for all individuals, regardless of their physical abilities.

Table 4. 3: Table showing percentages of side walk material of the studied areas

Side walk material	**Churchill ave.**	**Girogis to merkato road & around Arada building**	**Giorgis to Addisu gebya road**	**Giorgis toAfincho ber road**	**Arat kilo to Sidist kilo road**	**Arat kilo to Kebena road**
Terrazzo	100%	69.22%	77.3%	36.8%	98%	100%
Asphalt	0%	17.06%	19.2%	29.1%	2%	0%
Aggregate/ sand	0%	13.72%	3.5%	34.1%	0%	0%

(Source: Field survey by the researcher)

c. Street Seat

Street furniture enhances the vitality of places. Street furnishings create the settings for resting, sitting and eating, and social encounters with others. Such settings may be of great importance to the elderly, those with limited mobility, and adults who have small children.

Street furniture, including elements such as benches, public seating areas, and other functional structures, plays a crucial role in enhancing the urban landscape by providing citizens with accessible and comfortable resting spots. Specifically, in Churchill Avenue and Arat Kilo to Sidist Kilo Road, street seating has been installed, which has transformed these sidewalks into lively and vibrant places.

The presence of these street furniture elements has created an environment that encourages people to take a break from their daily routines and engage in activities such as reading, relaxing, chatting, and waiting for taxis. These public amenities have added to the social and cultural fabric of the community, providing a sense of community spirit, and promoting social interaction among residents.

However, it is important to note that the distribution of street furniture in these areas is not uniform. While some corridors benefit from the presence of these amenities, others lack such installations.

4.3.3. Summary of pedestrian perception

The results from the collected questionnaires revealed important insights regarding pedestrian safety and satisfaction with the walking experience in different areas of the city.

During the day, Churchill Ave. was identified as the location where the highest percentage of respondents (95%) felt safe, while the respondents felt less safe accessing Giorgis to Merkato road and Giorgis to Afincho Ber.

When it comes to safety during the night, Arat Kilo to Sadist Kilo and Churchill Ave. were the areas where respondents felt safe to walk, while Giorgis to Merkato road, Giorgis to Addisu Gebeya, and Giorgis to Afincho Ber road were identified as places where a high number of respondents did not feel safe.

In terms of lighting, respondents felt that Churchill Ave. had sufficient lighting, whereas Giorgis to Merkato road, Giorgis to Addisu Gebeya, and Giorgis to Afincho Ber road had the lowest levels of lighting.

Regarding material comfort, a large number of respondents chose Churchill Ave. as a place with comfortable materials, while Giorgis to Merkato road, Giorgis to Addisu Gebeya, and Giorgis to Afincho Ber road had the lowest quality of materials.

The highest levels of obstruction were found on Giorgis to Merkato road, Giorgis to Addisu Gebeya, and Giorgis to Afincho Ber road, while Churchill Ave. had the lowest level of obstructions.

Cleanliness was rated highest on Churchill Ave. and the road from Arat Kilo to Sadist Kilo, while Giorgis to Merkato road and Giorgis to Afincho Ber road were rated lowest in terms of cleanliness.

Overall, the highest number of respondents reported satisfaction with the pedestrian way on Churchill Ave., while Giorgis to Merkato road, Giorgis to Addisu Gebeya, and Giorgis to Afincho Ber road had the lowest satisfaction ratings.

4.3.4. SWOT analysis on the walkability of the selected built environment in Arada sub city

SWOT analysis is a framework that is used to develop strategic planning in any field. It is a strategic planning framework used in the evaluation of an organization, a plan, a project, or a business activity (GÜREL & TAT, 2017).It evaluates the internal strengths and weaknesses, and the external opportunities and threats (Sammut-Bonnici & Galea, 2015) .

The aim of the SWOT analysis was to identify the strengths, weaknesses, opportunities, and threats in terms of walkability. The strengths of the area were identified as factors that contribute positively to the walkability of the place. On the other hand, the weaknesses were characteristics of the study area that impede walkability.

Furthermore, the opportunities were potential benefits that the site could provide in the future to enhance walkability, while the threats were factors that could negatively affect the walkability of the area. By conducting this analysis, the research aimed to provide insights that can be used to develop planning strategies to improve the walkability of the studied area.

The results of this analysis could be used as a guide to develop effective interventions that address the weaknesses and threats while maximizing the strengths and opportunities to enhance the walkability of the area.

Table 4. 4: SWOT analysis

SWOT analysis	
Strength i. Dense settlement ii. Land use mix iii. High Pedestrian volume iv. The availability of public transport system	**Weakness** i. Lack of proper maintenance of the pedestrian ways ii. Incomplete pedestrian infrastructures. For example pedestrian amenities are not equally distributed. iii. Lack of Universality in the design of pedestrian ways iv. Pedestrian space blocked by parked vehicles, extended activities by commercial frontages
Opportunities i. The mixed land use system has created social equity and belongingness ii. The attractive and vibrant character of the locations iii. Positive attitude of the community for the development of the pedestrian ways	**Threats** i. Less priority in the development of pedestrian infrastructure ii. Redevelopment of areas resulting in less dense and monotonous land use

In this chapter, an assessment was conducted on the walkability of the built environment in Arada sub-city using macro and micro scale indicators. Additionally, pedestrian perceptions towards the walkability of selected corridors were collected and presented.

For the macro scale analysis, indicators such as dwelling and commercial density, street connectivity, and distance to transit stops were mapped and discussed. Results showed that dwelling and commercial density is the highest land use coverage in the sub-city, accounting for 88.96% of the total area. Street connectivity varied in different areas, with some places having higher connectivity than others. Transit stops were found to be unequally distributed throughout the sub-city, resulting in longer walking distances for some people.

For micro scale walkability analysis, only the selected corridors were analyzed, and indicators such as active frontages, sidewalk material, street seat availability, and presence of obstructions were observed and mapped. Results showed that each corridor had different characteristics.

Based on the collected data, Churchill Ave and Arat kilo to Sidist kilo road were found to have better infrastructure that encourages walkability. The questionnaires revealed that most pedestrians were satisfied with the existing infrastructure on Churchill Ave, which was selected as the most comfortable and safe corridor to walk.

CHAPTER FIVE: CONCLUSION & RECOMMENDATION

5.1. Conclusion

The purpose of this study was to analyze the existing built environment of the pedestrian ways in Arada sub city. The results revealed that mixed residential and commercial land use accounts for a significant portion, 88.96%, of the total area of the sub-city. This makes it the largest land use coverage in Arada, and implies that medium density and high density mixed residences are prevalent in the area.

The high density of mixed-use buildings is a favorable condition for creating a walkable city, which is known to have numerous benefits, such as improving physical and mental health, reducing carbon emissions, and increasing social interaction. Therefore, the study concludes that the Arada sub city has the potential to become a walkable city, but it needs infrastructure improvements to support it.

The analysis revealed that Churchill Ave. and Arat Kilo to Sidist Kilo road have better infrastructure than other areas to encourage walkability. Pedestrian feedback from questionnaires also indicated that Churchill Ave. was a safe and comfortable road to walk on. The study found that corridors with walkability indicators such as high active frontages, intersection density, street amenities, and pedestrian ways with terrazzo tiles were considered safe and comfortable by pedestrians, while areas without these indicators were less favored.

Overall, the study highlights the potential for Arada sub city to become a walkable city, given its high-density mixed-use development. However, to achieve this, more work is needed to improve the infrastructure and incorporate walkability indicators that create a safe and comfortable environment for pedestrians.

5.2. Recommendations

After conducting a walkability assessment in Arada Sub city, specifically along the Bus transit and LRT roads, a set of general recommendations have been formulated to improve the overall walkability of these areas.

- Adoption of design standards and design review for ongoing and new infrastructure projects. To enhance the walkability of Arada sub city, it is advisable to adopt design standards and design review processes for both ongoing and new infrastructure projects. This involves conducting a thorough assessment of the pedestrian environment and reviewing the design of any new projects to ensure they meet the set standards. By implementing these measures, Arada sub city can ensure that all newly developed infrastructure projects comply with the walkability standards, making them more accessible and convenient for pedestrians. Generally, adopting design standards and conducting design reviews for ongoing and new infrastructure projects in Arada sub city is crucial for promoting walkability and enhancing pedestrian safety. It is a proactive measure that will help to ensure that all new projects are developed to the highest standards and meet the needs of the residents.

- Pedestrian infrastructure management to prevent wrong practices. Pedestrian infrastructure management plays a critical role in ensuring safe and efficient movement of people on foot within urban areas. However, the misuse of pedestrian ways can lead to compromised usability of public spaces. In some cases, vehicles may be parked on pedestrian ways, causing inconvenience and posing a safety risk to pedestrians. Street vendors may also occupy pedestrian ways, reducing the space available for pedestrian movement and contributing to congestion. Additionally, individuals may use walkways for private purposes, further hindering the mobility of pedestrians. To prevent such wrong practices and maintain the usability of pedestrian ways, effective management strategies are necessary. Such strategies may include monitoring pedestrian ways to identify and address misuse, developing regulations and guidelines that encourage responsible use of these spaces, and providing education and awareness programs to the public. Furthermore, the implementation of effective pedestrian infrastructure management practices can help ensure an equal distribution of pedestrian infrastructure throughout the city, promoting equitable access to safe and accessible pedestrian spaces for all individuals. Generally, pedestrian infrastructure management is crucial in ensuring the usability of public spaces, and effective management strategies must be put in place to prevent the misuse of pedestrian ways. Such efforts will promote safe and efficient movement of people on foot, while also ensuring equitable access to pedestrian infrastructure throughout the city.

- Improvement of building control regulations. Improving building control regulations to promote active frontages, we can create more engaging and vibrant streetscapes that enhance the quality of life for residents and visitors. Such efforts also help to create more sustainable and livable cities that are attractive to investors, businesses, and tourists. Encourage active facades by transforming non-active frontages into vibrant and engaging spaces. This can be achieved through the improvement of building control regulations, which play a crucial role in shaping the physical character of our built environment. To achieve this, building control regulations need to be reformed and updated to incentivize building owners and developers to invest in active frontages. This could include requirements for ground-level retail spaces, outdoor seating areas, public art installations, or other amenities that contribute to the vitality and liveliness of the street. Moreover, regulations should prioritize the inclusion of design features that encourage pedestrian activity and social interaction. These might include wider sidewalks, bike lanes, street furniture, and other pedestrian-friendly features. Such provisions not only create a safer and more enjoyable environment for pedestrians but also enhance the economic vitality of the area by encouraging foot traffic and supporting local businesses.

- Pedestrian infrastructure management & integration with other institutions. Prioritizing pedestrian infrastructure management and integration with other institutions can help create a safer and more efficient urban environment that promotes pedestrian mobility and supports sustainable urban development. To ensure safe and efficient pedestrian mobility, it is crucial to prioritize pedestrian infrastructure management and integrate it with other institutions involved in urban planning and development. By doing so, we can avoid conflicts and interference between pedestrian infrastructure and other infrastructure developments, such as electric poles, that can impede pedestrian movement. The integration of pedestrian infrastructure with other urban development efforts requires careful planning and collaboration among various stakeholders, including city planners, transportation departments, public utilities, and other relevant organizations. This collaboration should aim to create pedestrian-friendly environments that prioritize pedestrian safety, accessibility, and comfort. In order to achieve this, a comprehensive approach is necessary, which includes regular maintenance and repair of existing pedestrian infrastructure, as well as the development of new pedestrian infrastructure that is well-designed and well-integrated with the surrounding urban environment.

Additionally, the development of a comprehensive pedestrian network that connects key areas of the city is essential for promoting active transportation and reducing traffic congestion.

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Annex 1- Publishable article

Annex 1

Assessing Walkability of Built Environment in Main Street Corridors of Arada sub-city, Addis Ababa

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March, 2023

Addis Ababa

Abstract

Different components influence the walkability of places, and one of them is the built environment. Urban design, land use patterns, and transportation system infrastructure are attributes of the built environment. The main objective of this research was to assess the walkability of Arada Sub-City's built environment using macro and micro scale indicators. Three broader categories were used for classifying features of the built-up environment: Land Use, Street Networks, and Urban Design. Pedestrians' perceptions about the corridors were gathered to understand how they assessed safety and comfort. The data showed that some qualities enhancing walkability do exist; these include dwelling and commercial density, land-use mix, and public transportation infrastructure. Conversely, unequal distribution of street amenities, lack of maintenance for walkways, usage of pedestrian space as an extension area for commercial frontages, and a lack of universality are among the downsides. Based on data collected from pedestrians, Churchill Ave. ranked highest in comfort and safety. General recommendations were drawn to enhance walkability: adopt design standards with design review for current or new infrastructure projects; pedestrian infrastructure management to prevent wrong practices; improvement in building control regulations to make frontages more active and vibrant; and better integration between pedestrian infrastructures with other institutions.

***Key Words**: Walkability, built environment, walkability indices*

1. Introduction

Well-designed pedestrian infrastructure is essential for sustainable city development, as noted by the World Bank Group (2019) and the Institute for Transportation and Development Policy (ITDP, 2020). Walking is a fundamental mode of transportation that provides basic mobility and health benefits, as highlighted by Nuzir and Dwancker (2016) and the World Bank Group (2019). Walkability, defined by Rafiemanzelat et al. (2016) as accessibility, connectivity, inclusivity, safety, and proximity to destinations, is necessary for achieving a walkable built environment. To achieve this, a sufficient pedestrian network and environmental factors, such as safety and sufficient walking infrastructure, must be in place (Rafiemanzelat et al., 2016). To maximize the potential of streets as the most valuable asset in any city, well-defined principles and standards targeting street design, building design, and network design must be applied (ITDP, 2020) to achieve a more sustainable and livable urban environment that prioritizes the mobility and well-being of pedestrians.

Despite a dramatic increase in motorization in Addis Ababa, walking remains the largest mode of transportation in the city (54 percent), followed by public transport (31 percent) (ITDP, 2020). However, many Ethiopian cities have largely been unsuccessful in providing the necessary infrastructure for people to walk or cycle (ITDP, 2020), despite the high reliance on non-motorized transportation. For residents of cities like Addis Ababa, walking is a necessity rather than a choice due to economic circumstances. However, the experience of walking varies across different locations, and one of the factors that influence the walkability of places is the built environment. Physical features of an urban environment can directly and indirectly influence the quality of the walking environment (Ewing & Handy, 2009; Nass, 2015). The attributes of the built environment include urban design, land use patterns, and transportation system infrastructure (Duncan et al., 2010). To identify a place as walkable, the characteristics of the built environment that support walkability should be examined (Rafiemanzelat et al., 2016; Robert Cervero et al., 2009; Reisi et al., 2019). However, the researcher did not find any previous research that assessed the walkability of the built environment in Addis Ababa specifically. Therefore, this research aims to understand how the design and layout of the built environment affects the walkability of places, examining the three major built environment features of land use, street network, and urban design characters.

2. Literature review

Improving walkability in urban areas is crucial in reducing urban transport challenges such as congestion, pollution, road accidents, and personal security (World Bank Group, 2019). Promoting conditions that support walking can reduce the demand for motorized vehicles, resulting in less traffic, pollution, and accidents. Forsyth's study (2015) categorizes walkability into three aspects: traversable, compact, and physically-enticing or safe, which include well-connected streets, compact development, and pedestrian comfort and safety.

The physical variables of an area's built environment are linked to its walkability, and measuring the effect of these variables is necessary to assess walkability (Rafiemanzelat, Emadi & Kamali, 2016). Physical features of urban environments directly and indirectly influence the quality of walking environments, and understanding what constitutes a high-quality pedestrian environment is essential for improving walking conditions (Ewing & Handy, 2009; World Bank Group, 2019). Characteristics of the built environment also affect individuals' transportation mode choices (Ewing & Cervero, 2001).

Urban design (arrangement of physical elements within the city), land use patterns (the distribution of functions across space), and transportation system infrastructure (including roads, railways, etc.) are attributes of the components of the built environment (Duncan et al., 2010).

Table 1: Summary of walkability indices from literature

Walkability Indices	**References**
Density, Diversity, Design (including street connections), distance to transit, Destination accessibility	(Robert Cervero et al., 2009)
Connectivity, Linkage with other modes, Fine grained land use pattern, safety, quality of path and path context	(Southworth, 2005)
Land use mix, intersection density, human scale streets and aesthetics	(Handy et al., 2002)
Dwelling density, Street connectivity, Land use mix & Net retail area	(Eva Leslie et al., 2007)
Connectivity index, Entropy index, FAR (floor area ratio) index and Household density index	(Jaroslav Burian, 2012)
Residential density, Commercial density, Land use mix and Street connectivity	(Frank et al., 2010)
Residential dwelling density, Intersection density, Land use mix (the entropy) and Retail floor area ratio	(Mayne et al., 2013)
Traversable, compact and physically enticing	(Forsyth, 2015)
Proximity and connectivity	(Saelens et al., 2003)
Safety, quality and amenities	(Reisi et al., 2019)
Street design, land use mix and street network	(World Bank Group, 2019)
Dwelling density, street connectivity, land use mix and retail floor area	(Wei et al., 2016)

3. Data and Methods

3.1. Study area selection

Based on the frames of location being within the inner part of the city and on a main corridor in Addis Ababa, Arada Sub-city was chosen as the macro scale analysis of this research with the following specific street corridors being used for micro scale analysis.

i. Arada building area
ii. Giorgis to Merkato road
iii. Giorgis toAddisu Gebeya road
iv. Girogis to Afincho ber road
v. Churchill ave.
vi. Arat kilo squre to sadist kilo square
vii. Arat kilo squre to Kebena road

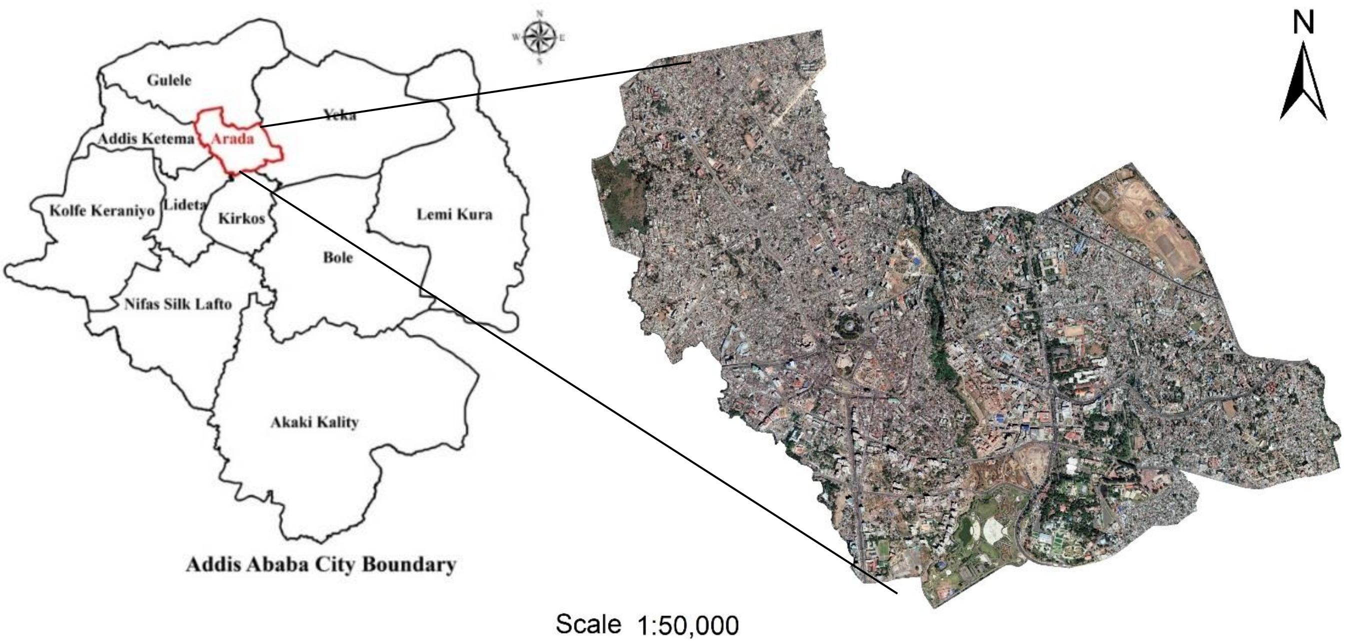

Figure 1: Map of Addis Ababa and the study area location

Source: Addis Ababa City plan & development commission (edited by the author)

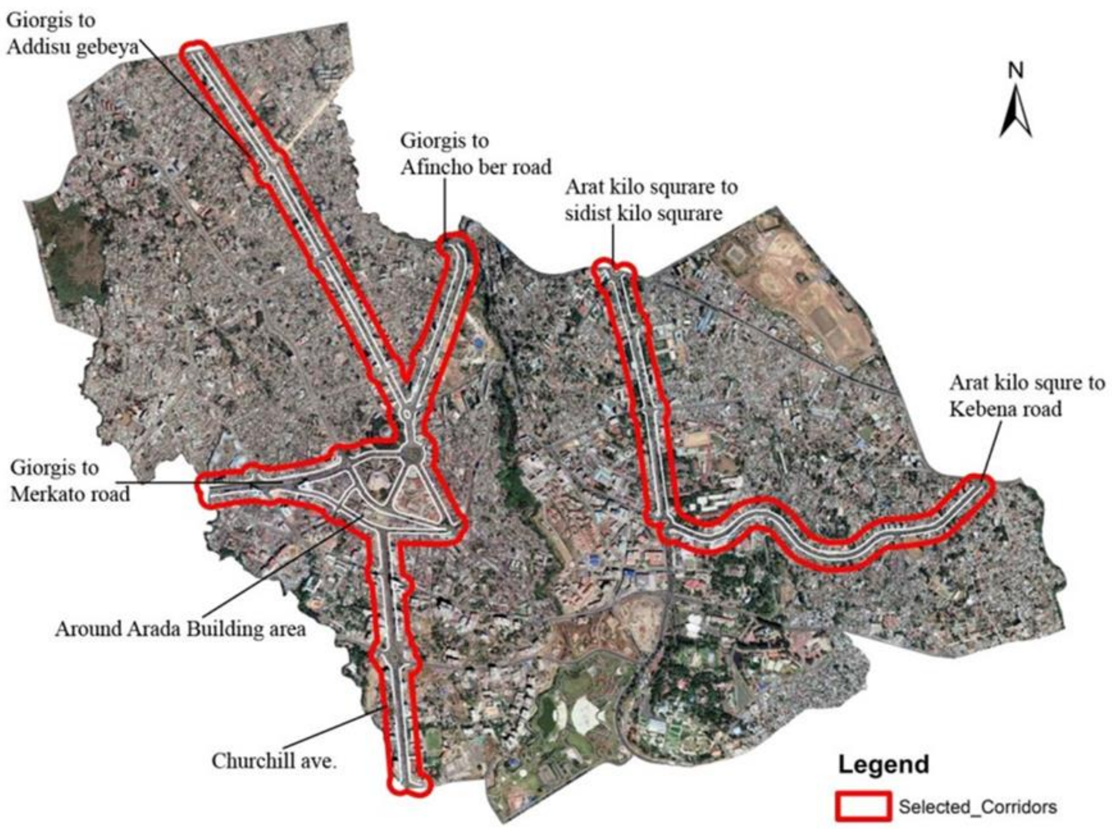

Figure 2: A map showing the selected main corridors for macro scale walkability study

3.2. Data types

The primary data for the selected corridors were collected through a combination of direct observation and questionnaires. Direct observation was used to note the features of bus and LRT stations, active frontages, sidewalk material, street seats and obstructions. Further details on pedestrian perception about those areas were obtained through a series of questionnaires. After collecting the necessary information from these two methods, it was translated into various mediums such as mappings, graphs, tables, diagrams and writings to ensure comprehensive understanding.

Data from a variety of sources was sourced for this project, including books, research papers, and government bodies such as the Addis Ababa City Government and Development Commission. The data included land use maps, street and transportation maps, and transportation service data. Collecting this secondary data enabled an understanding of the study area's physical characteristics, as well as its infrastructure.

GIS software is used for data analysis. The Esri Company's application, ArcGIS 10.6, was chosen for data processing and creating presentation maps. The walkability indices, which were selected to assess the walkability of the chosen location, were transformed into spatial information to produce the map. To make modifications and adaptations, Adobe software was utilized. Microsoft Excel was used to analyze the data collected via questionnaires, and the results were presented in tables and graphs.

Table 2: Categories of Built Environment

Built Environment categories		**Features**	**Description**
Macro scale	**Land use pattern**	Residential density Commercial density	To identify the percentage of residential and commercial densities
	Transportation system infrastructure	street connections distance to transit stops	To map out the features and show the street connectivity and the walkability of transit stops
Micro scale	**Urban design,**	quality of path (Pedestrian material, active frontages, obstructions) , amenities (presence of street furniture	Mapping the features and descriptive information of the area

4. Results and discussion

a. Macro Scale Analysis

i. Land use pattern

The largest land use coverage in the Arada Sub-city is mixed residential and commercial land, which comprises 88.96% of the total area. The majority of this land use is medium and high-density mixed residence (R2 and R3), covering 85.45% of the sub-city. This density of land use is beneficial for walkability, making Arada a walkable city.

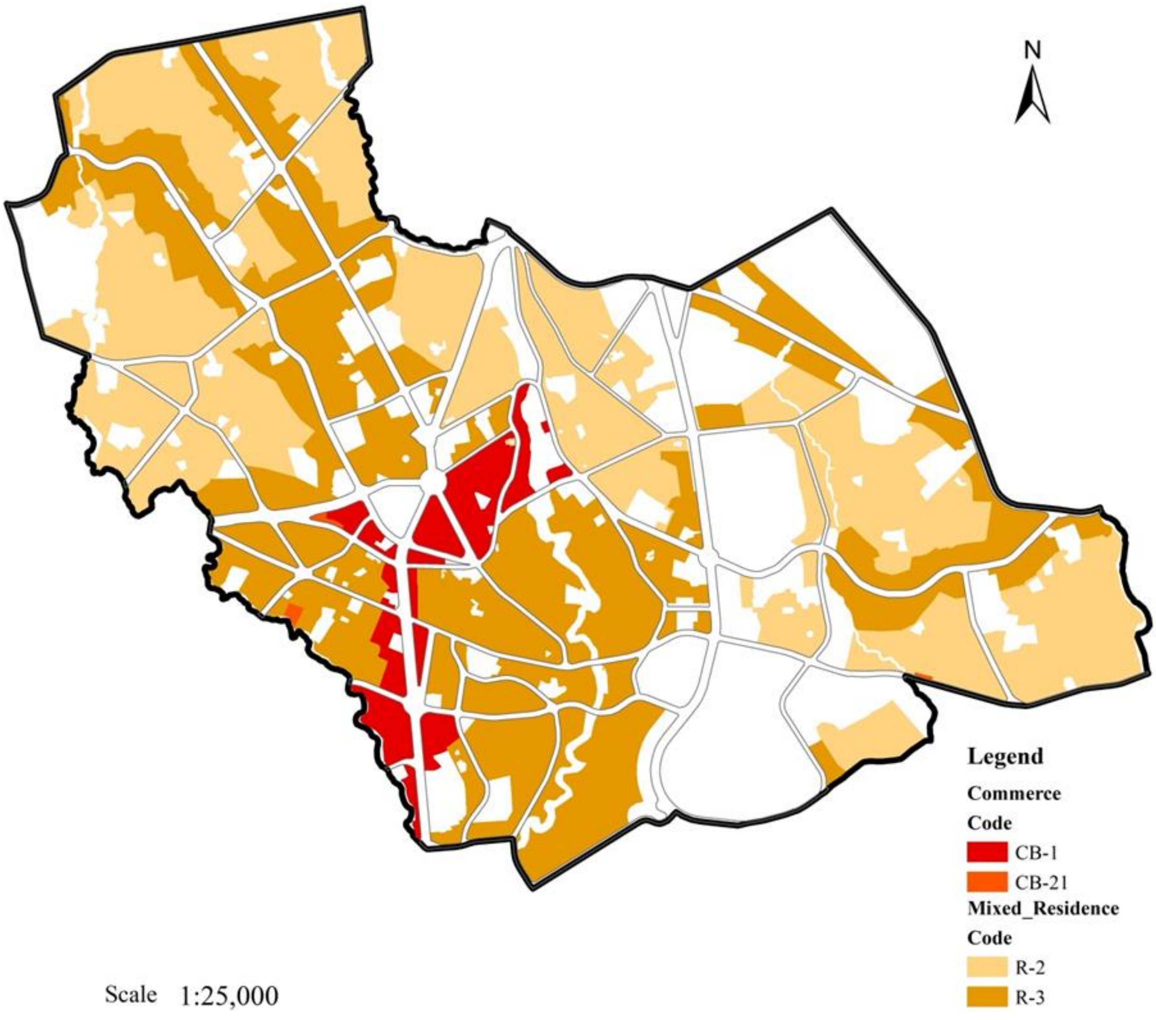

Figure 3: Mixed residence and commercial land use map of Arada Sub city

(Source: Addis Ababa government plan and development commission and modified by the researcher for presentation purposes)

ii. Transportation system infrastructure

The distribution of transportation infrastructure, including bus and LRT stations, is uneven within the study areas, creating inconvenience for those relying on bus transport. Some areas have a high density of intersections, allowing for multiple routes to destinations, while others have limited connectivity, resulting in longer travel times. Overall, this can lead to increased physical exertion and potential loss of productivity for those trying to move around.

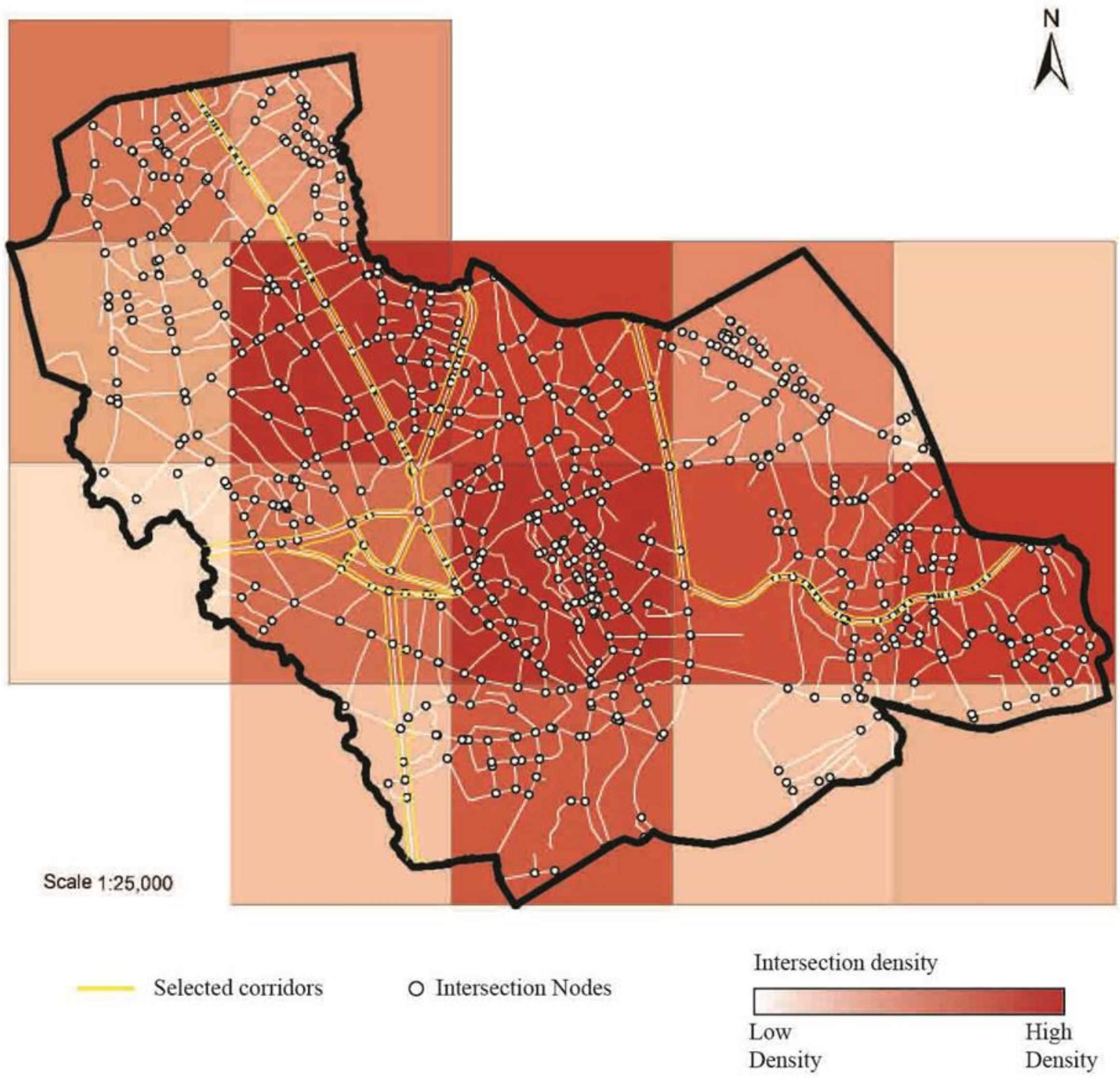

Figure 4: Map showing Intersection density

b. Micro scale analysis

i. Active Frontage

The stretch of road from Giorgis to Addisu Gebeya has the highest number of active frontages, primarily occupied by commercial establishments such as shops, cafes, and restaurants. These frontages are permeable and provide direct access to human activity. Non-active frontages are mostly fenced compounds belonging to institutions, offices, and schools, with semi or non-permeable frontages.

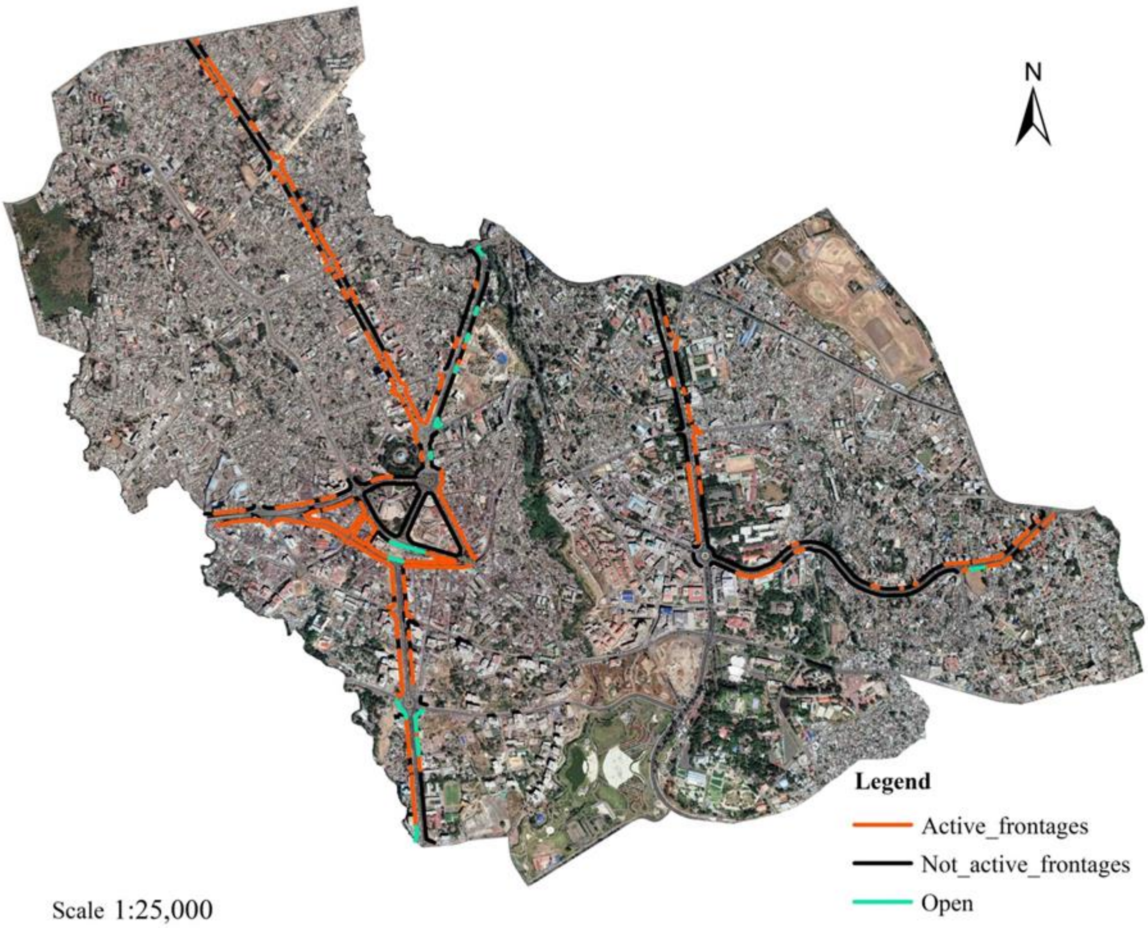

Figure 5: Active frontage map

(Source: Map produced through direct site survey by the researcher)

Table 3: Table showing percentages of Active frontage of the studied areas

	Chrchill ave.	Giorgis to Merkato road & around Arada building	Giorgis to Addisu gebeya road	Giorgis to Afincho ber road	Arat kilo square to Sidist kilo square road	Arat kilo square to kebena road
Active	55.53%	56.39%	54.43%	25.67%	33.22%	27.99%
Not active	31.36%	39.80%	45.57%	64.21%	66.78%	70.23%
Open	13.11%	3.81%	0%	10.12%	0%	1.78%

(Source: Field survey by the researcher)

ii. Side walk material

he majority of pedestrian ways in the study area are covered with terrazzo tile, while some lack proper finishes and are made up of aggregate and sand materials. Churchill Avenue and 4 kilo to Kebena road have 100% terrazzo tile finishing, while the Giorgis to Afincho Ber road is poorly managed with regards to material finishes. Tactile paving is present on pedestrian ways with terrazzo tile finishes, indicating consideration for visually impaired pedestrians, but obstructions still pose challenges to accessibility. Continued efforts are needed to ensure safe and accessible passage for all individuals.

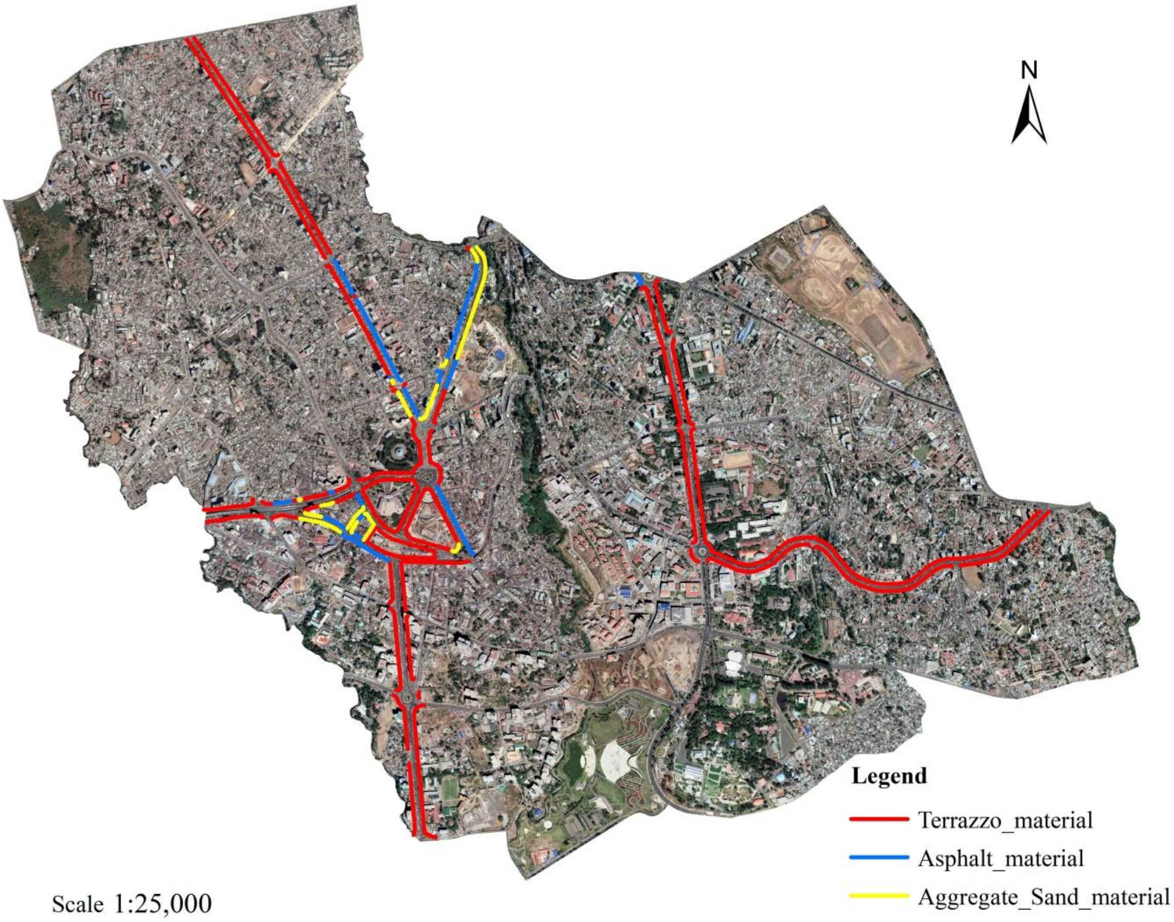

Figure 6: Map showing the side walk material

(Source: Map produced through direct site survey by the researcher)

Table 4: Table showing percentages of Side walk material of the study area

Side walk material	**Churchill ave.**	**Girogis to merkato road & around Arada building**	**Giorgis to Addisu gebya road**	**Giorgis toAfincho ber road**	**Arat kilo to Sidist kilo road**	**Arat kilo to Kebena road**
Terrazz o	100%	69.22%	77.3%	36.8%	98%	100%
Asphalt	0%	17.06%	19.2%	29.1%	2%	0%
Aggreg ate/ sand	0%	13.72%	3.5%	34.1%	0%	0%

(Source: Field survey by the researcher)

iii. Street Seat

Street furniture is important in enhancing urban landscapes by providing accessible and comfortable resting spots. Churchill Avenue and Arat Kilo to Sidist Kilo Road have installed street seating, creating lively and vibrant places for people to engage in activities like reading, relaxing, and chatting. The public amenities have added to the social and cultural fabric of the community, promoting social interaction among residents. However, the distribution of street furniture is not uniform across different corridors.

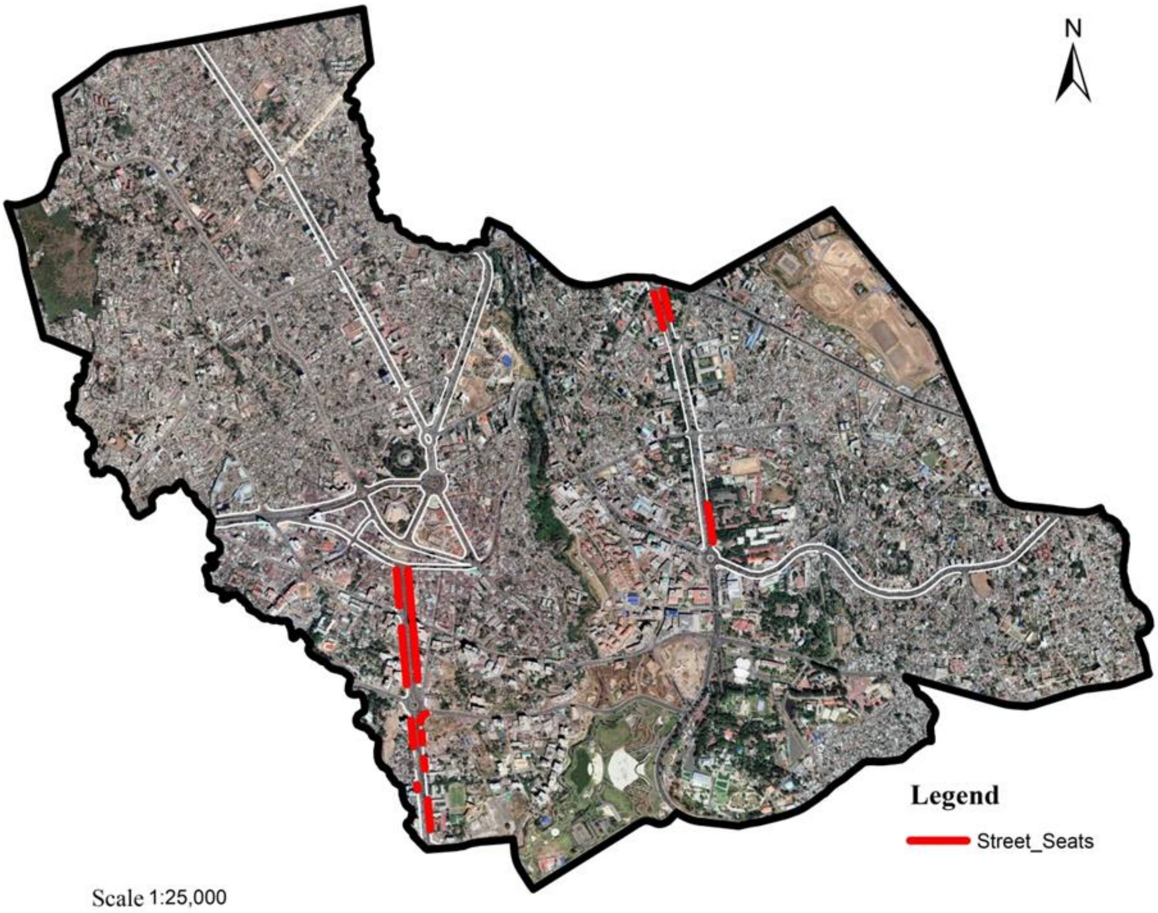

Figure 7: Street seat location map

(Source: Map produced through direct site survey by the researcher)

iv. Pedestrians' perception

The questionnaires provided insights on pedestrian safety and satisfaction in different areas of the city. Churchill Ave. was the safest and most comfortable area to walk during the day and night, with sufficient lighting and the lowest levels of obstruction and highest cleanliness rating. Giorgis to Merkato road, Giorgis to Addisu Gebeya, and Giorgis to Afincho Ber road were less safe and less comfortable to walk, with lower levels of lighting, more obstructions, and lower cleanliness ratings. Overall, respondents were most satisfied with the pedestrian way on Churchill Ave.

c. SWOT analysis for the selected built environment in Arada Sub city

The aim of the SWOT analysis was to identify the strengths, weaknesses, opportunities, and threats in terms of walkability. The strengths of the area were identified as factors that contribute positively to the walkability of the place. On the other hand, the weaknesses were characteristics of the study area that impede walkability.

Furthermore, the opportunities were potential benefits that the site could provide in the future to enhance walkability, while the threats were factors that could negatively affect the walkability of the area. By conducting this analysis, the research aimed to provide insights that can be used to develop planning strategies to improve the walkability of the studied area. The results of this analysis could be used as a guide to develop effective interventions that address the weaknesses and threats while maximizing the strengths and opportunities to enhance the walkability of the area.

Table 3: SWOT analysis

SWOT analysis	
Strength • Dense settlement • Land use mix • High Pedestrian volume • The availability of public transport system	**Weakness** • Lack of proper maintenance of the pedestrian ways • Incomplete pedestrian infrastructures. For example pedestrian amenities are not equally distributed. • Lack of Universality in the design of pedestrian ways • Pedestrian space blocked by parked vehicles, extended activities by commercial frontages
Opportunities • The mixed land use system has created social equity and belongingness • The attractive and vibrant character of the locations • Positive attitude of the community for the development of the pedestrian ways	**Threats** • Less priority in the development of pedestrian infrastructure • Redevelopment of areas resulting in less dense and monotonous land use

5. Conclusion and recommendation

5.1. Conclusion

The purpose of this study was to analyze the existing built environment of the pedestrian ways in Arada sub city. The results revealed that mixed residential and commercial land use accounts for a significant portion, 88.96%, of the total area of the sub-city. This makes it the largest land use coverage in Arada, and implies that medium density and high density mixed residences are prevalent in the area.

The high density of mixed-use buildings is a favorable condition for creating a walkable city, which is known to have numerous benefits, such as improving physical and mental health, reducing carbon emissions, and increasing social interaction. Therefore, the study concludes that the Arada sub city has the potential to become a walkable city, but it needs infrastructure improvements to support it.

The analysis revealed that Churchill Ave. and Arat Kilo to Sidist Kilo road have better infrastructure than other areas to encourage walkability. Pedestrian feedback from questionnaires also indicated that Churchill Ave. was a safe and comfortable road to walk on. The study found that corridors with walkability indicators such as high active frontages, intersection density, street amenities, and pedestrian ways with terrazzo tiles were considered safe and comfortable by pedestrians, while areas without these indicators were less favored.

Overall, the study highlights the potential for Arada sub city to become a walkable city, given its high-density mixed-use development. However, to achieve this, more work is needed to improve the infrastructure and incorporate walkability indicators that create a safe and comfortable environment for pedestrians.

5.2. Recommendations

After conducting a walkability assessment in Arada Sub city, specifically along the Bus transit and LRT roads, a set of general recommendations have been formulated to improve the overall walkability of these areas.

- Adoption of design standards and design review for ongoing and new infrastructure projects: The Arada sub city can begin conducting pedestrian environment assessment along with design review of new projects. This helps newly developments comply with the walkability standards.

- Pedestrian infrastructure management to prevent wrong practices: Poor management of pedestrian ways compromises the usability of space. For instance, cars parked on the pedestrian ways, street vending, people using the walkways for private use all of these affects the usability of pedestrian ways therefore good management is needed to prevent this issue. The pedestrian infrastructure management will also help to equal distribution of pedestrian infrastructure in the city.
- Improvement of building control regulations: to make non active frontages active and vibrant, building control regulations needs to be improved to encourage active facades.
- Pedestrian infrastructure management & integration with other institutions: this will avoid other infrastructure developments interfering with the pedestrian ways. One example of these interferences is electric poles on the pedestrian ways.

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Annex 2 - Questionnaire used for the survey on pedestrians perception

English translation of the questionnaire

This questionnaire is prepared for academic purpose related to pedestrian ways. I humbly request your cooperation in filling this questionnaire.

1. Name of place choose one or write it

Churchill ave. ☐ Around Arada building ☐

Arat kilo square to sidist kilo square ☐

Arat kilo square to Kebena road ☐

Giorgis to Addisu gebeya road ☐

Giorgis to Afincho ber road ☐

Giorgis to merkato road ☐

2. Age

Below 18 ☐ 18 - 36 ☐ 37-55 ☐ above 55 ☐

3. Sex Male ☐ Female ☐

4. I feel safe to walk on this road during the day time (in terms of crime) yes ☐ No, I don't feel safe ☐

If your answer was I don't feel safe please mention your reason

____

5. I feel safe to walk on this road during the night time(in terms of crime) yes ☐ I don't feel safe ☐

If your answer was I don't feel safe please mention your reason

____

6. Is the light from shops or street lights on this sidewalk enough to walk at night?

yes ☐ it is not enough ☐

7. What material is the pedestrian way made of?

Tiles ☐ Asphalt ☐ cobble stone ☐ Aggregate/sand ☐

other ______________________

8. Is the pedestrian material comfortable to walk?

yes ☐ It is not comfortable ☐

9. Do you think the width of the pedestrian way is adequate for the number of pedestrians? yes ☐ It's not enough ☐

10. Are there any obstructions on the pedestrian way?

yes ☐ there are no obstructions ☐ I don't know ☐

If there are objects blocking the pedestrian way, select the ones you see (there may be more than one).

Poles (Electric/Tele) ☐ Holes ☐

Street vendors ☐ for construction reasons ☐

Other ______________________

12. is the pedestrian way clean yes ☐ No ☐

13. Do cars access the road intended for pedestrians?

Yes ☐ No ☐

14. Are there any street furniture on the pedestrian way?

Yes ☐ No ☐

15. Is the pedestrian way suitable for pedestrians who require different types of assistance, such as the elderly and disabled?

Yes ☐ No, its not comfortable ☐

16. Does the pedestrian way have bus stations?

Yes ☐ No, there are no bus stations ☐

17. Are there any facilities such as shops and cafes in which pedestrians could use on there way?

Yes ☐ No ☐

18. is the pedestrian way quiet Yes ☐ No ☐

19. is the pedestrian way chaotic

Yes ☐ No ☐

20. Are there enough intersections?

yes ☐ there are no intersections ☐

21. The condition of the pedestrian way it is in good condition ☐ it needs maintenance ☐

22. Are you satisfied with the pedestrian way?

Yes ☐ No ☐

If you have a reason please write it ______________________

The Amharic version of the questionnaire

ይህ መጠይቅ የተዘጋጀው ከእግረኛ መንገድ ጋር በተያያዘ ለሚደረግ ትምህርታዊ ጥናት ነው።
መጠይቁን በመሙላት እንዲተባበሩኝ በትህትና እጠይቃለሁ።

1. የቦታው ስም አንዱን ይምረጡ ወይም ይፃፉ____________________

ቸርችል ጎዳና ☐ ፒያሳ አራዳ ህንፃ አካባቢ ☐

አራት ኪሎ አደባባይ ወደ 6ኪሎ መንገድ ☐

ከአራት ኪሎ አደባባይ ወደ ቀበና መንገድ ☐

ከጊዮርጊስ ወደ አዲሱ ገበያ መንገድ ☐

ከጊዮርጊስ ወደ አፍንጮ በር መንገድ ☐

ከጊዮርጊስ ወደ መርካቶ የሚወስደው መንገድ ☐

2. እድሜ

ከ 18 በታች ☐ ከ 18 - 36 ☐ ከ37-55 ☐ ከ55- በላይ ☐

3. ፆታ ወንድ ☐ ሴት ☐

4. በዚህ የእግረኛ መንገድ በቀን ስጓዝ ደህንነት ይሰማኛል (ከወንጀል አንፃር) አዎ ☐ አይሰማኝም ☐

አይሰማኝም ከሆነ መልስዎ እባክዎን ምክንያቱን ይግለጹ

____

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5. በዚህ የእግረኛ መንገድ በማታ ስጓዝ ደህንነት ይሰማኛል (ከወንጀል አንፃር)

አዎ ☐ አይሰማኝም ☐

አይሰማኝም ከሆነ መልስዎ እባክዎን ምክንያቱን ይግለጹ

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6. በዚህ የእግረኛ መንገድ ላይ ከሱቆች ወይም የመንገድ ላይ መብራቶች ያለው ብርሃን በማታ ለመንቀሳቀስ በቂ ነው?

አዎ ☐ በቂ አይደለም ☐

7. የእግረኛ መንገዱ የተሰራበት ማቴሪያል የትኛው ነው?

ታይልስ ☐ አስፋልት ☐ ኮብልስቶን ☐ ጠጠር/አሸዋ ☐

ሌላ ከሆነ ይጻፉት ____________________

8. የእግረኛ መንገዱ የተሰራበት ማቴሪያል ለእግረኞች አመቺ ነው?

አዎ ☐ አመቺ አይደለም ☐

9. የእግረኛው መንገዱ ስፋት ከእግረኛው ብዛት አንፃር በቂ ነው ብለው ያስባሉ? አዎ ☐ በቂ አይደለም ☐

10. የእግረኛ መንገዱን የሚዘጉ ቋሚ ወይም ጊዜያዊ ነገሮች አሉ?

አዎ ☐ የለም ☐ አላየሁም ☐

11. የእግረኛ መንገዱን የሚዘጉ ነገሮች ካሉ ያዩትን ይምረጡ (ከአንድ በላይ ሊሆን ይችላል)

ፖል (የኤሌክትሪክ/ቴሌ) ☐ ጉድጓድ ☐

የመንገድ ላይ ንግዶች ☐ በኮንስትራክሽን ስራዎች ምክንያት ☐

ሌላ ____________________

12. የእግረኛ መንገዱ ንፁህ ነው? አዎ ☐ አይደለም ☐

13. ለእግረኛ ተብሎ በተዘጋጀው መንገድ ላይ መኪኖች ይሄዳሉ?

አዎ ☐ አይሄዱም ☐

14. የእግረኛ መንገዱ ላይ እግረኞች የሚያርፉበት ወንበሮች አሉ?

አዎ ☐ የለም ☐

15. የእግረኛ መንገዱ የተለያዩ ድጋፍ ለሚሹ መንገደኞች ለምሳሌ አዛውንቶች እና የአካል ጉዳት ላለባቸው አመቺ ነው?

አዎ ☐ አይደለም ☐

16. የእግረኛ መንገዱ የአውቶብስ መጠበቂያ ጥላዎች አሉት?

አለው ☐ የለውም ☐

17. የእግረኛ መንገዱ አካባቢ ላይ እግረኞች ሲያልፉ ሊጠቀሙባቸው የሚችሉ እንደ ሱቅ ፣ካፌ ወዘተ አሉ

አዎ ☐ የሉም ☐

18. አካባቢው ጭር ያለ ነው አዎ ☐ አይደለም ☐

19. አካባቢው በጣም ግርግር የበዛበት ነው

አዎ ☐ አይደለም ☐

20. የእግር መንገዱ በቂ የእግር ማቆራረጫ አማራጭ መንገዶች አሉት?

አዎ ☐ የሉትም ☐

21. የእግር መንገዱ ያለበት ሁኔታ ጥሩ ነው ☐ ጥገና ያስፈልገዋል ☐

22. በአጠቃላይ በዚህ የእግረኛ መንገድ ደስተኛ ነኝ

አዎ ☐ አይደለሁም ☐

ምክንያት ካለ ይጻፉ____________________

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