ACCESSIBILITY OF URBAN SIDEWALKS IN ADDIS ABABA CITY: IN CASE OF MEGENAGNA TO CMC PRINCPAL ARTERIAL STREET

Maedot Ermias Woredework

A thesis submitted to

The Department of Architecture

School of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Urban Planning and Design

Office of Graduate Studies

Adama Science and Technology University

June, 2022
Adama, Ethiopia

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Approval of Board of Examiners

I, the advisor of the thesis entitled "**Accessibility of Urban Sidewalks in Addis Ababa City: In Case of Megenagna to CMC Principal Arterial Street**" and developed by **Maedot Ermias Woredework**, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Professor Samson kassahun _____ _____

Major Advisor Signature Date

We, the undersigned, members of the Board of Examiners of the thesis **by Maedot Ermias Woredework** have read and evaluated the thesis entitled "**Accessibility of Urban Sidewalks in Addis Ababa City: In Case of Megenagna to CMC Principal Arterial Street**" and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Urban planning and design.

_____ _____ _____

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Eternal Examiner Signature Date

Finally, approval and acceptance of the thesis is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

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Department Head Signature Date

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School Dean Signature Date

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Office of Postgraduate Studies Dean Signature Date

Declaration

I hereby declare that this Master Thesis entitled "**Accessibility of Urban Sidewalks in Addis Ababa City: In Case of Megenagna to CMC Principal Arterial Street**" is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

Maedot Ermias Woredework	_____	_____
Name of the student	Signature	Date

Recommendation of Advisor

I, the advisor of this thesis, hereby certify that I/we have read the revised version of the thesis entitled "**Accessibility of Urban Sidewalks in Addis Ababa City: In Case of Megenagna to CMC Principal Arterial Street**" prepared under my/our guidance by **Maedot Ermias Woredewok** submitted in partial fulfillment of the requirements for the degree of Mater's of Science in urban planning and design. Therefore, I recommend the submission of revised version of the thesis to the department following the applicable procedures.

Professor Samson kassahun	_____	_____
Major Advisor	Signature	Date

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LIST OF ACRONYMS AND ABBREVIATIONS

GIS	Geographic information system
HCM	Highway Capacity Manual
PAS	Principal Arterial Street
PLOS	Pedestrian level of service
TOD	Transit oriented development
WHO	World health organization
SPSS	Statistical Package for the Social Sciences

ABSTRACT

Recently Addis Ababa city is experiencing a heavy pedestrian flows characterized by overcrowdings. Because of the shortage of satisfactory sidewalks, pedestrian walkways are often difficult to walk on. Since pedestrians are more vulnerable to accidents than other mode of transportation users, the primary objective of this research is evaluating the accessibility of sidewalks in case of Megenagna to CMC principal Arterial Street. Once the evaluation is made, the causes that affect the accessibility of sidewalks were identified and, their impacts on the pedestrians are also included. In a process of achieving the three objectives, three data collection methods were used. Observation to study the conditions of sidewalks by take measurements and photographs were conducted. In addition questionnaire survey and interview were conducted in order to identify the real life factors affecting the accessibility of sidewalks and the impacts posed on the pedestrians based on pedestrian's perception. Moreover in order to evaluate the accessibility of the sidewalks in relation to pedestrian level of service, pedestrian count was performed on different section of the pedestrian sidewalk on different days of the week. Once the data was collected, HCM and Australian pedestrian level of service were used to analyze the data in evaluating the accessibility. Secondly descriptive and photographic analysis with summery of questionaries' responses were used to identify the factors affecting accessibility of sidewalks and impacts faced by pedestrians. Finally as conclusions were made in that most of the sidewalks about 66.7% were grade D, showing that the pedestrian's Freedom to select individual walking speed and to bypass other pedestrians is restricted finally affecting the accessibility of the sidewalk. The major factors in causing this problems are design, location and user factors. In the perception of the pedestrian's, theft including physical and sexual abuse were the major challenges posed on pedestrians.

***Key words**: Accessibility, pedestrian level of service, street venders, overcrowding, LOS factors*

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Walking has been the most democrat type of mobility ever since transportation begun. It is the most common and oldest way, not to mention that it is the healthiest mood of transportation for both travelers and cities. However, the expansion of cities through time resulted in increased walking distance from place to place in cities. This makes walking less desirable by peoples in order to commute one's own activity. In order to minimize such problems, peoples has begun to give priority for motorized means of transportation along with substandard sidewalks (Paula Manoela dos Santos,Lara Schmitt Caccia, Ariadne Amanda Barbosa Samios, , 2019).

Everyone is a pedestrian, whether you are walking to school or work, or to your parked car, transit or bicycle. Pedestrians include people on foot and/or using an assistive device. Pedestrian sidewalk design should be accessible for all people. Pedestrians are the safety priority in street design as they are the most vulnerable and have the highest rates of fatalities among road users. The safety of pedestrians should be given priority over maximizing traffic capacity and speeds as the safety benefits can be reaped for all road users. (Toronto complete street guideline, 2016)

Successful public spaces in an urban design are generally characterized by four major qualities: it should be comfortable, have a good image, it should be accessible and have linkage engaging peoples in an array of activists and it should be sociable. Thus the major way through which access and linkage provided is, by provision of streets which are different size and function. Streets are basic units of urban area through which peoples experience a city life. As being part of a street, walkways are portion of a street having different zones generally dedicated to pedestrian movement. (Global street design Guide, 2016)

Sidewalks serves as spaces for pedestrian circulation and occupation and are comprised of elements that are far beyond paving walkways that run alongside street ways. Today, over 50% of the global population is concentrated in cities. What makes urban centers such attractive places is their capacity to promote social interaction and sidewalls are major places, by doing so, facilitate development of cities and people. Cities are home to millions of people

around the world, striving daily for opportunities to improve their lives. Sidewalks play a vital role so that cities can be places of social interaction, creative development and economic growth. Prosperous cities with a high quality of life have sidewalks and public spaces that foster the urban vitality necessary for these processes to advance in a streamlined and sustainable manner (Paula Manoela dos Santos,Lara Schmitt Caccia, Ariadne Amanda Barbosa Samios, , 2019).

Addis Ababa, with a population estimated at four million or above, is the largest urban center in Ethiopia. Recently, road traffic crashes, particularly pedestrian crashes have become a challenging problem within Addis Ababa. Addis Ababa has a high proportion of pedestrian casualties (Tariku Ayana Abdi and Belay Hagos Hailu, 2017) .

1.2. Statement of the problem

Addis Ababa, capital city of Ethiopia is the fastest growing city in Africa being home to 25 % of its urban population. The city contributes to half of the national GDP having 14 % of annual growth rate. The city has a vision of becoming among the middle income countries through achieving resilient economic development and creating carbon natural environment. Despite the above growing economic trend, the city faces different developmental challenges. Meeting the growing demand of transportation is among the major ones (World bank , 2015).

For the last century, streets have been designed with major consideration to automobiles only. Wide lane for automobile traffic and little space for peoples become rule of street design in most corner of the world (Paula Manoela dos Santos,Lara Schmitt Caccia, Ariadne Amanda Barbosa Samios, , 2019). This experience is also visible in the case of Ethiopia. Most cities in the country are characterized by non-motorized means of transportation. Even though there is high increment of motorization in Addis Ababa, due to unaffordable and insufficient transport facilities in Addis Ababa city, there are high proportion of pedestrians making 54% followed by 31% by public transportation and 15% private cars making the smallest share (Ethioian non motorized transport starategy, 2020).

In spite of the existence of large proportion of NMT (non-motorized transportation) mainly walking, transport and infrastructure planning has been car centered. Many streets lacks continuous sidewalks and safe facilities along which makes them less preferable. In addition more than 65% percent of streets in Addis Ababa lacks sidewalks. Even if they have, they are mostly full of obstacles which makes them inaccessible for different user groups of age and

ability. As previously mentioned by the General Manager of Addis Ababa City Roads Authority (AACRA), the capital city's roads were designed "for cars, not for people". As a result, 60% of all serious crashes and 73% of all road traffic crash-related fatalities affect pedestrians (SSATP, 2018).

According to my observation, recently in Addis Ababa city walking has become an unpleasant experience on sidewalks. This phenomena is widely expressed through overcrowding, absence of universal accessibility, issue of safety, unattractive pedestrian sidewalks which lack character, identity and comfort. The front line group of peoples facing such problems are aged persons, pregnant women and mothers carrying babies, people with cardiac problems, persons carrying heavy loads and persons with temporary and permanent impairment. This phenomena are pure manifestations of inaccessibility of sidewalks of Addis Ababa city.

The research gaps that was observed in pervious researches of the same topic were, they were more focused on providing only new sidewalks. Issues related to making the new provisions accessible were less emphasized and mostly missed. In addition previous road safety initiatives emphasized on road and intersection rather than sidewalks. The study of their conditions in relation to walkability and pedestrian experience is undermined. Since the provision is good beginning in case of our country, but ignoring the necessary considerations related to making them accessible leads to repeating the same old mistakes that we all encounter on streets of Addis Ababa. Therefore this research was conducted in bridging this gaps.

Therefore in terms of fulfilling the need to have sustainable transportation system as a country, making sidewalks inclusive since they serve as veins through which we lead city life and solving the everyday challenges faced while walking through Addis Ababa city, it is found that accessibility of sidewalks is an important area of study in creating spaces better suited for people walking and more dependency on walking and less on automobiles, cutting pollutant emissions and greenhouse gases which greatly benefits our countries sustainable development process and the whole world too.

1.3. Research objective

1.3.1. General objective

The general objective of the research is to study the accessibility of pedestrian sidewalks with their factors affecting them and the challenges faced by pedestrians in Addis Ababa city along the principal Arterial Street from Megenagna to CMC.

1.3.2. Specific objective

- Evaluating pedestrian sidewalk level of service of accessibility in Addis Ababa, in case of Megenagna to CMC principal arterial street
- Identifying the major causes affecting accessibility of pedestrian sidewalk, in case of Megenagna to CMC principal arterial street
- Identifying the major challenges of pedestrians in accessing the pedestrian sidewalks in case of Megenagna to CMC principal arterial street

1.4. Research questions

- What are the level of service of sidewalks of Megenagna to CMC principal Arterial Street?
- What are the major causes affecting the accessibility of pedestrian sidewalk?
- What are the challenges that pedestrians face in accessing sidewalks?

1.5. Significance of the research

The study will help the process of designing new and upgrading existing urban centers with creating accessible city environments which makes cites livable. In addition since cities are for people the conduction of such projects will help the design of cities which are accessible for all user groups in terms of both age and ability. As a result of accessible sidewalks increase, walkability of streets increase and peoples will be motivated to walk rather than using automobile transportation mood. Therefore there will be less emission of carbon dioxide into the environment which greatly contributes to sustainability.

1.6. Scope of the research

The research is focused on identifying level of service in relation to accessibility, factors affecting accessibility of pedestrian sidewalk and the challenges faced by pedestrians in Addis Ababa city. Since addressing the whole streets of Addis Ababa is vast, geographically the study area is confined to selected areas of the principal arterial streets which is in this case, Megenagna to CMC roundabout. Thematically the study is confined to identifying the

level of service for each section of the streets, factors affecting accessibility and the challenges due to this factors are addressed. Identification of the sidewalk accessibility factors and the challenges they create is limited to sidewalk's design (physical) factors, location factors, user factors and on street activities. The selection of street direction was, due the existence of pedestrian sidewalk having different character, which helps to study important areas and address with corresponding recommendations.

1.7. Limitation of the study

The major limitation of the study was convincing respondents to fill survey questionnaires since most of my respondents were pedestrians they were in hurry and not willing to cooperate. However I used friendly approach to help me in filling them properly. The other challenge that I faced was during study site observation. It was difficult to capture photographs and take measurement of different street amenities. Lastly on my way to collect secondary data few offices were not cooperating at all and most of the time, they were not present at the office. Despite all this challenges I was so determined and hopeful to make up all the data collection with patience and courage.

1.8. Organization of the research

The thesis is organized into five chapters. Each chapter systematically and effectively examines the content and data of the study accordingly. The contents of the chapters in the thesis are presented as follows:

Chapter One: Introduction chapter of the research introduces the thesis by lighting the main topic of the study, research problems, objectives, research questions, significance, scope, and limitation.

Chapter Two: The second chapter is literature review. The Part of the study in which main topics like**:** sidewalks, pedestrians, accessibility of sidewalks, sidewalk zones and the challenges related to them are well defined from scholarly perspectives and discussed from previous studies of the same topic.

Chapter Three: The third chapter is Research Methodology. The part of research in which the methods used for data collection and analysis are mentioned and explained.

Chapter Four: The fourth chapter is result and discussion. It is section of the research that discusses the results of qualitative and quantitative data findings.

Chapter Five: The fifth chapter is conclusion and recommendation, in which conclusions are made based on the findings from the data collected and recommendations are given as a part of solution for the observed problems.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

In the literature part of the study, important definitions and key terminologies are explained briefly. Topics related to the objective of the study are highly emphasized. The main causes for the challenges of the accessibility of pedestrian sidewalks and the impacts on the pedestrians in relation to Addis Ababa city is covered as the main targets of the study. Previous reports related to pedestrians and sidewalks in case of Addis Ababa streets are included. In addition to this, international sidewalk standards along major commercial streets, design principles, sidewalk corridor zones are covered with illustrative images.

2.2. Definition

Sidewalk: are exterior routes for pedestrians which are designed parallel to streets or highways. (Charles V. Zegeer, 1998). A sidewalk, or pavement, footpath, footway, and sometimes platform, is a path along the side of a road. This sidewalks may contain slight change in grade, strip of vegetation and separated from vehicular way using curb.

According to National Association of City Transportation Officials, sidewalk refers to space for the movement and access for pedestrian, with the aim of enhancing connectivity and promoting active mobility. Additionally, they serve as spaces for transition between the public and private space.

Accessibility: refers to a precondition for the full realization of the rights and inclusion of persons with disabilities in society and development. Accessibility can be understood as the provision of flexible facilities and environments, either virtual or physical, to accommodate each user's needs and preferences on sidewalks. (Toronto complete street guideline, 2016)

According to General Law for the Inclusion of Persons with Disabilities, Accessibility refers to the important measures taken in making sure that access for persons with disabilities to the physical environment, and other transport, information and communications facilities which are open to the public is equally served both in urban and rural areas (Jia, Fantta, and Mercado., 2022).

Pedestrian: refers to peoples who walk ,sit, stand in public places or use mobility aid like stick or wheelchair ,they can be children , teenagers , adults , elderly persons with disabilities workers, residents shop keepers and etc. (Universal accessibility guidlines for pedestrian , non motorized vehicle and public transport infrustructure , 2014).

Level of service: refers to the comprehensive measurement of walking experience on sidewalk paths, route or facility. It is directly related to the factors affecting pedestrian mobility, comfort and safety through which a sidewalk can be evaluated as pedestrian friendly (Gallin, 2001).

2.3. Sidewalk design principles

There are about eight sidewalk design principles which helps for better design of side walks (Linda Bailey, Matthew Roe, 2016)

1. Accessibility and mobility

   Top priority should be given to the clear, unobstructed, continuous, sufficiently (contextually) wide and direct sidewalk way for pedestrian flow regardless of age and ability limits.
2. Provide a network of continuous side walks

   Ensuring that sidewalks have a network of continuous paths with a dedicated space of pedestrians separated from cyclists, vehicles and other activities.
3. Place making

   Since sidewalks are public spaces where peoples interact, they should be designed in a way that they attract current and future use and users; by providing siting, trees, cafes, public art, lightings, signage and dustbins which greatly contribute to creating spaces to socialize.
4. Design for comfort

   It refers to greater consideration shall be given to the provision of contextually sufficient width, arrangement of street elements in a way that they support pedestrian activity and safe use of side walkways all year long during design phase.
5. Greening infrastructure and storm management

   While designing sidewalks, attention should be given on ways how to address the storm and integrated green infrastructure. This includes incorporation of passive storm water measurement where possible and direct storm water into planting beds or permeable paving to reduce potential of ponding in the middle of streets.

6. Design for efficient maintenance

   Designs should consider material selection in relation to its durability, availability, ease of maintenance, repairs, and upgrade to minimize its impact on pedestrians. In doing so refereeing to city standards mandatory.

7. Coordination with utilities

   Since the integration of utilities on streets is mandatory, their provision on sidewalks should first be carefully planned in design phase so that they will not conflict other street amenities and pedestrian activities.

2.4. Sidewalk corridor zones

Sidewalk areas refers to the different functional spaces of a street which are only dedicated to pedestrians. These zones include frontage and marketing zone: Areas of side walk which are located at the frontage of buildings along the streets. These spaces include building entrances and front yards, outdoor café seating spaces, vending areas, window shopping and building related utility areas. The second zone is pedestrian clear way zone: it is the most important area of sidewalks which is provided for clear, continuous and safe movement of pedestrians. The provision of its clear way width depend on the amount of pedestrian activity along the street. The third zone is Furnishing and planting zone: the area offside walk on which pedestrian amenities like dust bin, bicycles rack, siting benches, lighting poles and plantations are provided. The last zone is edge/buffer zone: the area of sidewalk which is behind the street curb stone, which serves as buffer between adjacent street and side walk. This zone may have sign posts, curb extensions, decorative pavers and garbage set outs, parklets, storm water management features, parking, cycle racks, cycle share stations, and curbside cycle tracks. (Linda Bailey, Matthew Roe, 2016)

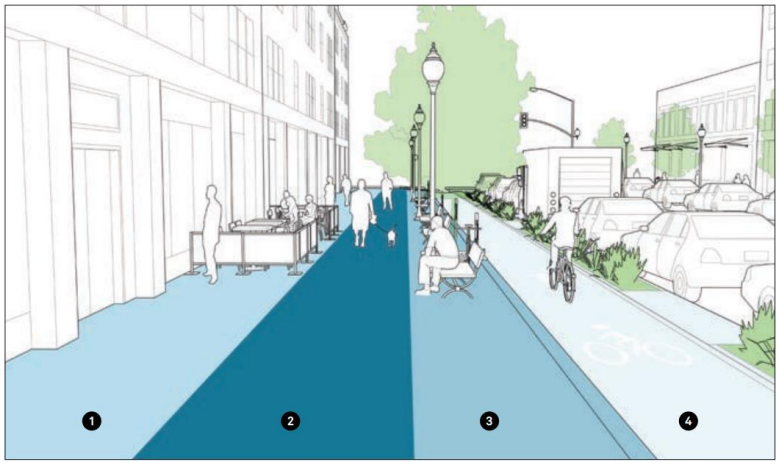


Figure 1 Sidewalk zones (source: *(Toronto complete street guideline, 2016)*

Clearway zone width provision varies depending on the place where they are provided and for whom they are provided for. (Toronto complete street guideline, 2016)

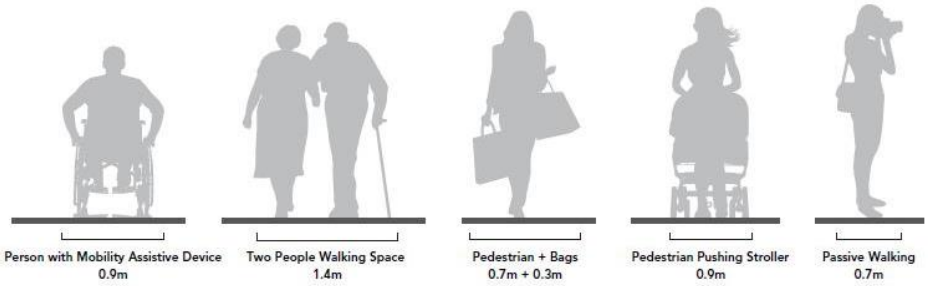


Figure 2 Standard size of walkways (Source: *(Toronto complete street guideline, 2016)*

2.5. Universal accessibility

2.5.1. Pedestrian ramps

Refers to inclined plans which are provided for disabilities with wheelchair and other pedestrian s with strollers, carts or heavy luggage in order to easily access the pedestrian sidewalks. This ramps should be constructed from non-slippery materials having maximum slope of 8 to 10 %. The ramp should be as wide as the pedestrian clearway zone which is a minimum of 1.8 meter wide, 2.4 meter is recommended. This ramps should be provided at every pedestrian crossings. (Global street design Guide, 2016)

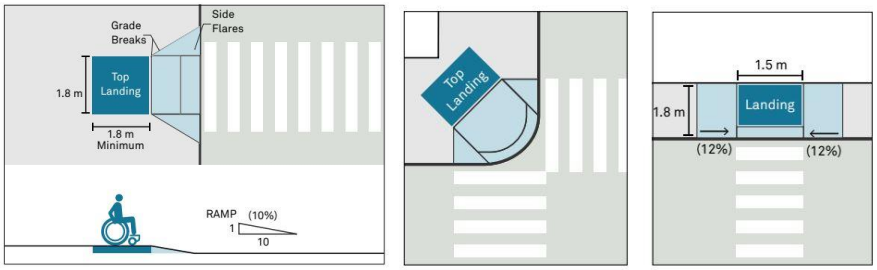


Figure 3 Ramp standard (source: *(Global street design Guide, 2016)*

2.5.2. Detectable surfaces

Refers to surfaces that have distinctive textures providing certain information for pedestrians with walking disability. This surfaces can be tactile pavers.

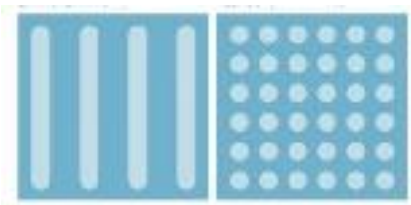


Figure 4 Tactile surfaces (Source: *(Global street design Guide, 2016)*

2.5.3. Pedestrian crossings

Since pedestrians mobility is highly sensitive to a change in grade, geometry, and surface materials quality while using sidewalks, high attention shall be given while designing them. This includes the provision of cross walks shall be provided every 80 -100 meter, in which distances more than 200m shall be avoided. It should also be as wide as the sidewalk it connects to and not to be less than 3 meter wide. In addition to this, if pedestrians take more than three minutes of walk without pedestrian crossing, they may choose to take more direct path to cross streets which is mostly unsafe. (National association of city transport officials, Global designing city initiatives , 2016)

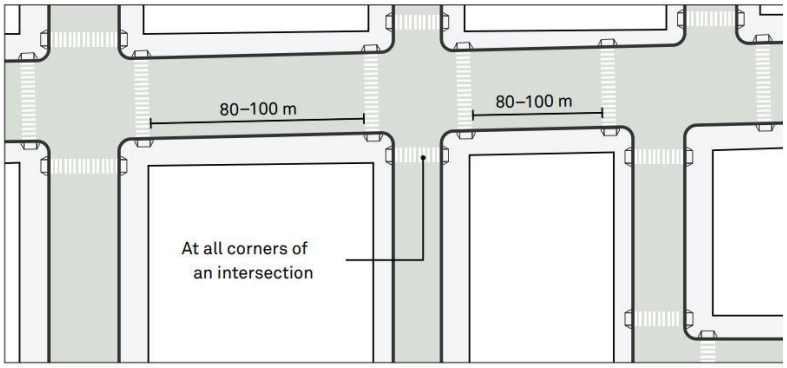


Figure 5 Pedestrian crossing distance (Source: *(Global street design Guide, 2016)*

2.6. Types of sidewalks

According to the global street design guide, there three sidewalk types. This are namely residential sidewalk, neighborhood main street sidewalk and commercial sidewalks. Residential sidewalks mainly used as places of socialization which includes walking and playing areas with plantations where possible. In this type of sidewalks curb cuts for vehicular access is minimized.

Neighborhood main street sidewalks are the type of sidewalks provided along land uses that alternate between commercial and residential activities. This sidewalks accommodate moderate volumes of pedestrians with large number of peoples stopping, sitting, pausing and a lot of extensions of ground floor activities.

Large pedestrian volumes, active street frontage and active ground floors, street facing entrances and commercial activity spilling on the sidewalks are the main characteristics of commercial streets. Sidewalks along such streets should be able to accommodate such

activities by having clearly defined frontage zones and street furniture zones to accommodate restaurant seating and benches, street plantings and other necessary infrastructures.

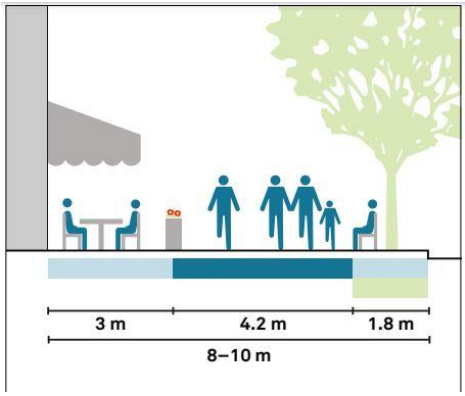


Figure 6 Standard width (Source: *(Global street design Guide, 2016)*)

2.7. Challenges of accessibility of sidewalks in case of Ethiopia

According to transport minister of Ethiopia, among the major reasons presented for inaccessibility of sidewalks of streets in case of Ethiopia the first one is, the design of streets are mainly for motor based transportation moods giving less attention for non-motorized ones. The second reason that educational curriculum in civil engineering and transport planning programs in the country has historically emphasized highway design and construction and has placed less emphasis on non-motorized transportation moods. The third major reason is, the involvement of only one type of expertise and lack of the diversified disciplines in the design and implementation process of streets. The involvement of civil engineers only and avoiding architects, urban planners and designers. (Addis Ababa structural plan draft final summary report , 2017)

2.8. Road traffic accidents

Road traffic injuries has become one of the leading causes of death worldwide. According to the world health organization report, the organization has calculated the risk of dying in road traffic rash by continent and Africa is among the leading continent followed by eastern Mediterranean. As compared to developed countries, road crashes in developing countries are more than two fold of that of developed countries at 13.4/100000 and 32.2/100000 peoples in Europe and Africa respectively. This shows that 90% of deaths occur in developing countries, especially in sub-Saharan countries. (Ashenafi Habte Woyessa a, Worku Dechasa Heyi b, Nesru Hiko Ture a, Burtukan Kebede Moti c, 2020)

According to reports conducted on road traffic deaths on selected regions of Africa, Ethiopia is ranked the second next to Kenya in the region of east Africa. The greater percentage of transportation mood in Ethiopia is natural moods like walking and animal transport. Despite of the existence of low non-motorized transportation mood, the issue of road safety has already become the issue of concern. (Ashenafi Habte Woyessa a, Worku Dechasa Heyi b, Nesru Hiko Ture a, Burtukan Kebede Moti c, 2020)

2.9. Impact of road traffic accident

Due to different reasons like road transportation with poor street infrastructure, low traffic enforcement and others, traffic accidents remain high in Ethiopia. Due to the increment of such accidents, there is tremendous, loss of life and property. More than 3000 peoples die and 10,000 peoples are injured due to road traffic accident as reported by local studies. A very recent study in Addis Ababa shows that the road traffic accidents fatality rate was 16.1 %. (Ashenafi Habte Woyessa a, Worku Dechasa Heyi b, Nesru Hiko Ture a, Burtukan Kebede Moti c, 2020)

According to world health organization and the above reports, it is concluded that, road traffic deaths highly affects non-motorized transportation users are/ pedestrians of the age 4-55 making them venerable. This has greater impact on the global, national economy and health of population.

2.10. Existing Arterial roads

According to my observation, Arterial streets carry significant amounts of traffic compared to other roads in the network, as they act as major connectors tying different parts of two cities together and to the wider region. They are used by traffic making local journeys and through traffic. As these routes often slice through local centers and edges of residential neighborhoods there is a conflict between pedestrian requirements to cross and the free flow of traffic and this makes these areas often hostile, unwelcoming places for those on foot. Arterial roads also form the first impression of Addis Ababa city for visitors which at present is often of a car-dominated, low quality environment dominated by overcrowding.

The design issues for arterial roads are: they are important ‘gateways’ to the towns, and their environmental quality needs to be improved. Upgrading of entire road corridors through holistic, integrated strategies; they need to become places that are more welcoming for pedestrians – for example, by providing defined, safe crossing points at locations convenient for those on foot and by providing quality public transport waiting facilities.; and At the same

time, they need to maintain their role as major traffic routes in terms of pedestrian sidewalk (Public Realm Design Guide, 2007) .

2.11. Sidewalk Standards of Addis Ababa

According to the Norms and Standards of the Addis Ababa structure plan outlined in May 2002, pedestrian sidewalks must be provided on both sides of arterial streets and should be raised 15-20 centimeters above the carriage way. The pedestrian capacity on a sidewalk should be a minimum of 30 and the maximum of 50 persons per minute per meter width after deducting approximately 0.9-meter dead width in shopping areas and 0.45 meters elsewhere. Pedestrian sidewalk width should be 2.5-4 meters on one side of a sub-arterial street and alongside a principal arterial it should be 3.5-5 meters. The gradient of continuous ramps should not be steeper than 10% Minimum height of 2.3 m should be provided for pedestrian ways.

In addition average width of pedestrian ways along sides of arterial streets in an Industrial areas is 1.8 m, Shopping frontages is 3.7 - 4.5 m, Business and commercial areas 3-5 m and Areas along all-purpose road is 2.7 m (Norms and standards of the Addis Ababa structure plan components, 2002).

Table 1 Ethiopian Standard size of sidewalks

No	Type of Street	Width in meters along both direction
1	Urban motorway	No pedestrian ways
2	Principal Arterial	7 m - 10 m
3	Sub-arterials	2.5-4 both sides 5-8
4	Collector Streets	Should not be less than 2.00m
5	Local Streets	Should be decided based on local condition

Source: (Norms and standards of the Addis Ababa structure plan components, 2002)

2.12. New Paradigm for Streets and Mobility

The concept of developing transport and road network in the city and its environs is based on two premises i.e., a polycentric city with one strong center; and limiting traffic in the city core. The need to ensure high accessibility by public transit of the core with radial and ring road transit routes is considered. (Addis Ababa structural plan draft final summary report , 2017). Having a comprehensive transport plan and system in place is necessary for social, economic and environmental sustainability and competitiveness. Therefore transport

supply and services shall: ensure economic sustainability and competitiveness within the framework of affordability and efficiency; allow for all the basics access and development in the sector for social sustainability; limit emission to acceptable standard and use of renewable resources for environmental sustainability; increase the capacity of the street to move more people than more vehicles; promote sustainable transportation such as mass transit, walking, and cycling; adapt safety as a key concept in the design of streets; and design a street network with equitable distribution of space between the different users. (Addis Ababa structural plan draft final summary report , 2017)

2.13. Evaluation of sidewalk accessibility

2.13.1. Level of service

One of the major methods in evaluating the accessibility of pedestrian side walk is PLOS (pedestrian level of service). The concept of "Level-of-service (LOS)" is about the evaluation method in relation to quantity with respect to the considerations taken on sidewalks. The major factors that are included under this category are, distractive objects (obstructions), width of sidewalk, quality of the walkway surface, opportunities of crossing and existence of support facilities. PLOS shows the state this factors in a qualitative way for the selected time and location. This states are represented in LOS generally by levels from A up to F, where A shows high levels of comfort and/or available capacity, while F show grade level indicating congestion discomfort in that specific section of sidewalk. (Hediye Tuydes-Yaman and pınar karataş, 2018).

The other evaluation method is HCM, high way capacity manual. This method is used for analyzing different means of transportation. It is based on the pedestrian traffic flow and the width of sidewalk space. According to HCM, the speed of pedestrian is inversely proportional to pedestrian volume and density. As the density and volume increase, the speed of pedestrian's decline (Pedestrian Level of Service Study, 2006).

Table 2 Models of LOS by different researchers

Authors	Indicators LOS	Grade
Sarkar (1993)	(1) Safety, (2) Security, (3) Convenience and Comfort, (4) Continuity, (5) System Coherence, (6) Attractiveness	A-F
Khisty (1994)	(1) Attractiveness, (2) Comfort, (3) Convenience, (4) Safety, (5) Security, (6) System Coherence, (7) System	A-F

	Continuity	
Dixon (1996)	(1) Provision of Basic Facilities, (2) Path Conflicts, (3) Amenities , (4) Motor vehicle LOS, (5) Maintenance Problems, (6) Provision for multiple modes	A-F
Gallin (2001)	(1) Path Width, (2) Surface Quality, (3) Obstructions, (4) Crossing Opportunities, (5) Support Facilities, (6) Connectivity, (7) Path Environment, (8) Potential for Vehicle Conflict, (9) Pedestrian Volume, (10) Mix of Path Users, (11) Personal Security	A-E
Nelson & Zaly Shah (2010)	(1) Amenities, (2) Maintenance, (3) Pedestrian Paths, (4) Conflicts, (5) Pavement Material, (6) Security Perception, (7) Comfort, (8) Traffic Volume In The Adjacent Car Lane	A-F
Asadi-Shekhari & Zaly Shah (2013)	(1) Slope, (2) Elevator, (3) Curb ramp, (4) Wheelchair-accessible drinking fountain, (5) Tactile pavement (guiding), (6) Tactile pavement (warning), (7) Ramp, (8) Toilet, (9) Grade, (10) Signal	A-F

Source: (Safizahanin Mokhtar,Tetsuo Shimizu, Nabila Abdul Ghani, 2015)

The Australian model which was conducted by Gallin was selected for two basic reasons. The first one is it has more number of factors to be studied in order to determine the level of service. In addition all the factors mentioned under this model are visible on the pedestrian sidewalks of selected street, Megenagena to CMC.

2.13.2. Factors affecting level of service

Physical factors, location factors and user factors are the major categories of factories that helps to determine level of service on pedestrian sidewalks. This factors have a total of eleven elements to be studied.

A. Design factors (Physical characteristics)

The factor includes measurements of path width that is available for pedestrians, surface quality of the path in which excellent quality is expressed by a continuous, smooth but skid resistant surface, Obstructions which is a measure of the number of distractive obstructions per kilometer on the path being assessed. The study of this

factor is mandatory to know whether sidewalks are accessible or not for peoples with disabilities. Obstructions may be permanent (e.g. poles, signs, chairs etc.) or temporary (e.g. bins, parked cars etc.). Stairs are considered an obstruction if no alternative is available for people with mobility disabilities. The remaining two factors include crossing opportunity, which is type and number of facilities provided to assist in the safe crossing of roads and paths by pedestrians. Includes median refuges, pelican crossings, guarded crossings, crosswalks, underpasses, and overpasses. 'Delay in crossing' is also a characteristic of this factor and Support Facilities, the presence of facilities that assist pedestrians during their journey and includes tactile paving, color contrast curbing, provision of rest stops, curb ramps, lane markings, signage, landings on long ramps etc. (Gallin, 2001)

B. Location factors

Connectivity, is one of the major sub factor under this category. It is the assessment the extent to which sidewalks provide connection and link to critical and important points of departure and arrival. The second factors is path Environment, which is a measure of the quality of the path environment dictated by its surroundings. The degree of 'pleasantness' of the surrounding environment will often relate to distance from the roadway. Potential for Vehicle Conflict is the third sub factor in which a count of points on which conflict between vehicles and sidewalks can happen including driveways and intersections. It is measured every one kilometer. The potential for pedestrian conflict increases with increased intersection and driveway frequency (Gallin, 2001).

C. User factors

This factor also includes three sub factors. This includes Pedestrian Volume which is count (or estimate) of the number of pedestrians using the path expressed as an average daily count. The second sub factor is mix of path users which is an estimate of the various groups who use the path as a percentage of total pedestrians. Groups include pedestrians, cyclists, roller-skaters, etc. When assessing this factor, consideration should be given to the various types of pedestrians, including recreational. Pedestrians and pedestrians 'with a purpose' i.e. people walking to work, to shops etc. the last sub factor is Personal Security: qualitative measurement of the degree to which the path is safe for users. Other factors of this category include,

provision of sufficient lighting, visual permeability from the surrounding environment and sight distance etc. (Gallin, 2001)

Table 3 HCM LOS grading scale description

No	LOS level	Description
1	A	Pedestrians are free to move in every path they selected without changing their movement in relation to other pedestrian. Their walking speed is also in control of themselves in which conflict with other pedestrian is minimal.
2	B	In this level of service grade scale , even though there is enough space in determining their own walking speed, pedestrians begun to be conscious about the movement of other pedestrians and about their own walking direction.
3	C	Even though there is enough space for pedestrians to determine their own walking speed, revise direction or crossing movement can create little conflicts. The speed and flow rates are decreased.
4	D	In this grade scale, walking speed, cross passing and reverse direction movement are limited. This movements are under high risk of conflict with other pedestrians. This leads to the creation of repeated change in movement and direction increasing friction among pedestrians.
5	E	Almost all pedestrians limit their normal walking speed, frequently adjusting their gait. At the lower range, forward movement is possible only by shuffling. Space is not sufficient for passing slower pedestrians. Pedestrians will be in a very high difficulty to pass and cross on another. Design volumes approach the limit of walkway capacity, with stoppages and interruptions to flow.
6	F	Demining one's own Waking speed highly limited with passing by each and moving forward is suffering. Friction and conflict with other pedestrians cannot be avoided on this grade scale. The movement of reverse and cross direction are impossible. The movement of pedestrians will have a nature of queue than normal movement.

Source: *(Pedestrian Level of Service Study, 2006)*

Table 4 Australian method PLOS grading scale

No	Grade scale	Description	Conditions
1	A	Factors affecting the pedestrian sidewalk are minimized. This grade level is considered as an ideal condition for pedestrian environment.	Ideal
2	B	This level of grade is considered as standard, in which reasonable pedestrian conditions are present with few number of factors pose impacts affecting the safety and comfort.	Standard
3	C	This grade level shows basic pedestrian sidewalk environment exists making the sidewalk environment with significant amount of factors creating negative impact on pedestrian safety and comfort.	Basic
4	D	This grade level shows poor pedestrian conditions exist with high amount of factors which negatively affects pedestrian safety and comfort. The accessibility of sidewalks and safety of pedestrian's are highly compromised.	Poor
5	E	This grade level shows that all the level of service factors are below acceptable standards making the sidewalk environment unsuitable.	Unsuitable

Source: (Gallin, 2001)

The following three tables are assessment Sheet for Australian Model to Determine LOS for Pedestrians according to Australian method. Generally the Australian model has three assessment sheets having different factors under each main categorical factors. This factors are labeled with their own weight and point value according to the sidewalk conditions.

Table 5 Physical/ design factor grading

Category	Factor	Weight	Point 0	Point 1	Points 2	Points 3	Points 4
Design factors	Path Width	4	No pedestrian path	0-1m	1.1 - 1.5m	1.6 - 2.0m	more than 2m wide
	Surface Quality	5	Uncovered and/ or a lot of cracks	poor quality	moderate quality, i.e. some cracks/ bumps etc.	reasonable quality, i.e. acceptable standard	Excellent quality (continuous surface with very few cracks etc.)
	Obstructions	3	more than 21 obstructions per km	between 11 and 20 obstructions per km	between 5 and 10 obstructions per km	between 1 and 4 obstructions per km	no obstructions
	Crossing Opportunities	4	none provided, difficult to cross	some provided but poorly located	Some are reasonably provided and located but more are required	Sufficient crossing facilities are reasonably provided and located OR none are rendered considering them unnecessary	pedestrian crossing facilities are given at sufficient frequency
	Support Facilities	2	non existent	few provided and poorly located	few provided and reasonably well located	several provided and well located OR absent but unnecessary	many provided and well located

Source: (Gallin, 2001)

Table 6 Location factor grading

Category	Factors	Weight	0 Point	1 Point	2 Point	3 Point	Point 4
Location factors	Connectivity	4	None existent	Poor	Reasonable	Good	Excellent
	Path Environment	2	unpleasant environment, close to vehicular traffic	poor environment, may be within 1m of curb	acceptable environment, between 1 and 2m of curb	reasonable environment, between 2 and 3m from curb	pleasant environment, pedestrians more than 3m from curb
	Potential for Vehicle Conflict	3	unpleasant environment, close to vehicular traffic	poor situation,	10 to 15 potential vehicle conflict points per km is moderate	1 to 10 or less conflict points per km is reasonable	pleasant environment, pedestrians more than 3m from curb

Source: (Gallin, 2001)

Table 7 User factor grading

Category	Factors	Weight	0 Point	1 Point	2 Point	3 Point	Point 4
User Factors	Pedestrian Volume	3	More than 350 per day	226 to 350 per day	151 to 225 per day	81 to 150 per day	Less than 80 per day
	Mix of Path Users	4	majority of path users are non-pedestrians	approx. 51% to 70% of path users are non-pedestrians	between 21% and 50% non-pedestrian path users	less than 20% non-pedestrians	pedestrians only
	Personal Security	4	unsafe	poor	reasonable	good	excellent security provided

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Introduction

The methodology chapter is the part of the research on which data is collected and research techniques used will be grouped together in order to make coherent picture of the whole research. This chapter explains about the type of reach design used, type of data which are collected and the methods used to collect the data including the target populations which the research is conducted on are listed and discussed. As a methodology of study, different sequential steps are followed. It involves the comprehensive and systematic review of existing literatures on accessibility of pedestrian sidewalks in case of Addis Ababa city, Megenagna to CMC principal arterial street .In this chapter the methods used to analyze the collected primary sourced data is set with the main research questions and objectives to show how the data and the questions are connected and analyzed.

3.2. Research philosophy

The research philosophy used in this study is, Pragmatism, is a research philosophy based on the epistemology that there is no single way to learning but many different ways of understanding because there are multiple realities. Knowledge of the multiple realities is therefore gained through an integration of multiple research methods, in which this research encompassing both qualitative and quantitative research methods. Through this integration, the research hopes to gain a better understanding of the manifestation problem/s under study from the views of people who lived the experiences and from scientific modelling and testing of facts and figure. This mixed method approach will enhance a more detailed understanding of research questions and results leading to a balanced conclusion on the challenges and opportunities about the research problem.

3.3. Research design approach

The type of research approach that used is mixed research approach. Both the quantitative and qualitative data collection were conducted. Subjective and objective assessments were conducted among respondents. The subjective assessment was majorly about the understanding and perception of pedestrians towards the accessibility of sidewalks. Moreover it was focused on of opinions, behavior and attitudes of pedestrians on the

accessibility of sidewalks. In addition this description about the demographic and socioeconomic conditions of a sample population are also included.

The subjective assessment was conducted in order to evaluate the existing sidewalk conditions in comparison to different standards especially with the standard of Ethiopian transportation planning standard and using a pedestrian level of service to show qualification of the existing sidewalk facilities from qualitative point of view. The PLOS (pedestrian level of service) which is a qualitative measure is selected as an overall analysis method.

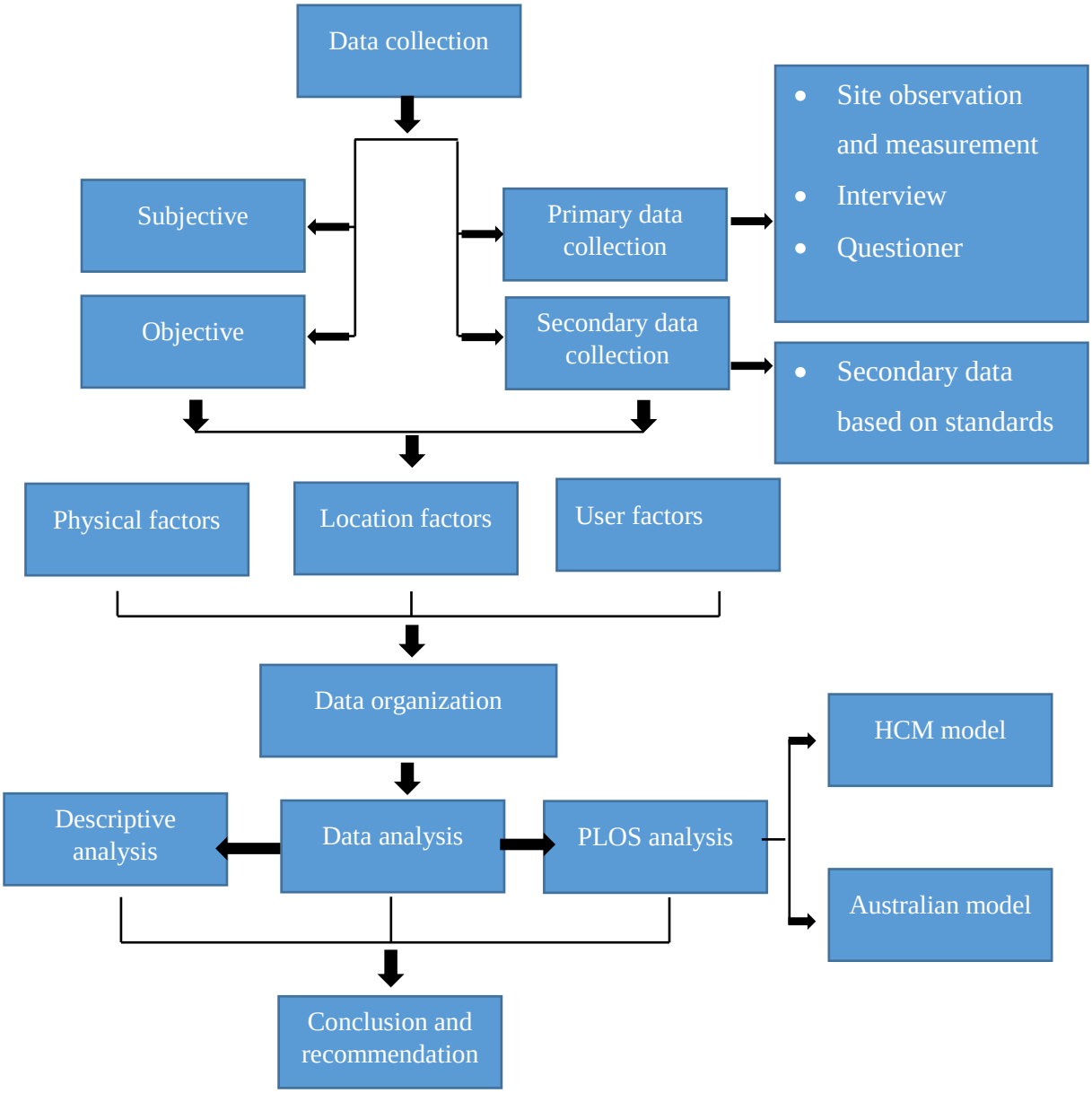


Figure 7 Flow diagram (source: Researcher)

3.4. Sampling Techniques and Sample Size

3.4.1. Sampling

Probability and non-probability sampling are both used as sampling method used in this research. For the non-probability sampling respondents of pedestrians like elderly, children adults and disabled were selected purposively while in the probability sampling the selection of respondents is random. The site of interest in this case is pedestrian sidewalks on Primary Arterial Streets (PAS) from Megenagna to CMC around about.

Since the total number of population of the selected area is unknown, the number of respondents will be calculated by Cochran's sample size formula.

Sample size formula for unknown population = $n= Z^2pq/ e^2$

Necessary Sample Size = (Z-score) 2 * StdDev*(1-StdDev) / (margin of error) 2

((1.96)2 x .5(.5)) / (.05)2 (3.8416 x .25) / .0025 .9604 / .0025

384.16 (385) respondents are needed

In addition pedestrian flow count was performed for 15 minutes during pick hours, morning and evening time. In order get the pedestrian unit flow rate (ped/min/m). It was obtained by taking the pedestrian 15-minute flow rate (ped/15- min) and dividing by the effective walkway width.

3.4.2. Target Population

In this research the target populations were mainly pedestrians. This mainly includes four categories of elderly, walking disabled, young (adults) and children pedestrians. The selection of pedestrians as a target population was due to, pedestrians were the majority individuals who were walking to travel from place to place .Since they were the main users of sidewalks, realistic and important data can be extracted in order to solve the problem from the different groups.

3.4. Data collection

3.4.1. Data Type

Primary and secondary data were the major data sources used in this study. The primary data were measurement of sidewalk width, and check for existence of sidewalk amenities including their functionality. Majorly the primary data were collected from distributing subjective and objective questionnaires on all sidewalk segments of the principal arterial

streets. Field observations were also conducted in the morning, midday and night time in order to experience the real life seniors experienced by pedestrians on sidewalks of streets. The subjective survey comprises of questions asked for pedestrians to express how they feel about the sidewalk accessibility in relation to sidewalk's facility, zone and activities in the form of questionnaire.

Secondary data like local and international standard width of sidewalks were collected from governmental and non-governmental offices in order to have reliable information in addition to the primary source. Review on policies, principles, theories and definitions of accessibility of pedestrian sidewalks in case of Addis Ababa city were also be presented a source of secondary data. In addition previous research in relation to accessibility of pedestrian sidewalk were referred and used.

3.5. Data collection method

3.5.1. Questionnaire

This study employed a set of questions to gather a respondent's perception. The questionnaire elicits answers to questions concerning sidewalk accessibility and their condition. The questionnaire had different sections that covered information from respondents having of different gender, age, monthly income, frequency of walking, and purpose of the trip. All the questions are under the subjective or the objective questionnaire category.

3.5.2. Interview

In addition to questionnaires, direct form of interview were conducted among different pedestrians in order to understand their perception about the accessibility of sidewalks of streets and their wishes on areas where improvements are needed in relation to sidewalk facilities, zones and activities.

3.5.3. Observation

The other data collection instrument were on site observation. The observation was conducted on different sidewalks of streets. Observations to pedestrian flow count, measuring of pedestrian standard zones, observation on the physical conditions of sidewalks and other related issues which generally affect the accessibility of them in terms of infrastructure also are observed and measured. Once the sidewalk was selected, pedestrian count was done manually to identify the pedestrian traffic flow and to differentiate which sections of the study area are high, medium and low volume.

3.6 Data analysis methods

The type of data analysis were, statistical and descriptive analysis. In addition Australian and HCM pedestrian level of service analysis were used in order to evaluate the pedestrian level of service on sidewalks, since there are no level of service evaluation models specifically to our country. Crosstab analysis was performed in which it is used to estimate the relationship between a set of variables. When it is conducted, it is possible to know if there's a correlation between a dependent variable (that's the variable or outcome needed to measure or predict) and number of independent variables (factors which may have an impact on the dependent variable). The aim of this analysis technique is to understand how one or more variables might impact the dependent variable, in order to identify trends and patterns. To analyze the qualitative data, descriptive analysis and statistical analysis from the responses of questionnaires were performed. In addition, in order to analyze the quantitative data, HCM and pedestrian Australian level of service models were used.

3.6.1. Descriptive analysis

It was conducted in analyzing the Reponses of survey questionnaire. The major variables which were analyzed using this method were the auxiliary variables and independent variables. Few dependent variables like safety during day and night time are also analyzed in description. The factors affecting accessibility of sidewalk and challenges of pedestrians are also presented descriptive analysis. In addition photographs are presented with descriptive analysis.

3.6.2. HCM model method

The HCM's methods for analyzing pedestrian LOS are based on the measurement of pedestrian flow rate and sidewalk space. In this model, in order to determine PLOS scores, pedestrian flow rate must be conducted. The pedestrian unit flow rate (ped/min/ft) was obtained by taking the pedestrian 15-minute flow rate (ped/15- min) and dividing by the effective walkway width. Pedestrian counts were conducted for 3-minutes and later changed to 15 minute. (Parma, K. D., Koprowski, Y., & Zhang, W., 2013). This pedestrian counts were made on the six sections of the main PAS Street. PLOS of the HCM rating uses grading from A to F. This result are compared with the Australian method presented grade values of PLOS which are presented below.

3.6.3. Australian PLOS method

This analysis model is majorly conducted depending on three categorical factors. Which are namely the physical factor, location factors and user factors. Under this categories there are 11 sub factors which greatly contribute to evaluating the level of service. This factors are given their own weight which the summation of each values leads to its grade scale vale defining pedestrian walking environment. This grade corresponds to adequacy of facilities in fluffing sidewalk safety, comfort and accessibility.

3.7. Variables

Table 8 List of variables

No	Category of Variables	Variable	Type
1	General	Gender	Auxiliary
		Age	Auxiliary
		Income	Auxiliary
		Health condition	Auxiliary
		Frequency of sidewalk use	Dependent
		Purpose of travel (walking)	Independent
2	Sidewalk amenities	Benches	Independent
		Existence of signage	Independent
		Trashcan	Independent
		Vegetation	Independent
3	Universal accessibility elements	Curb ramp	Independent
		Surface material	Independent
		Crosswalks	Independent
5	Safety and security	Public lighting	Independent
		Active frontage	Independent
		ditches and manholes	Independent
7	Other obstacles	Street vendors	Independent
		Shoeshine	Independent
		Transport waiting (long queues)	Independent
		Construction and material leftovers	Independent

		Illegal parking on pedestrians' sidewalks	Independent

Table 9 Methods and data sources

Objective	**Type of data collected**	**Method of data collection**	**Approach**	**Method of data analysis**
Evaluating pedestrian sidewalk accessibility	Primary and secondary	Questionnaire, interview and observation	Mixed design approach	Tabulation, Description, HCM and Australian P LOS
Identifying the factors affecting pedestrian sidewalks accessibility	Primary and secondary	Questionnaire, interview and observation	Mixed design approach	Tabulation, Graphic Description, HCM and Australian P LOS
Identifying the challenges of pedestrians in accessing of pedestrian sidewalks	Primary and secondary	Questionnaire, interview and observation	Mixed design approach	Description, Graphic Description , P LOS

3.8. Procedures of data collection

In order to better study the street, the total length of the street is divided into six sections. The total length of the pedestrian sidewalk from Megenagna to CMC roundabout is 5.5 kilometers. The total length of the street runs from west to east direction. The six section respectively from west to east direction are from to CMC round about.

Since the majority of pedestrian sidewalks are available on the principle atrial street, the study was only confined to identifying the factors and challenges of pedestrians' in accessing the sidewalk with important recommendations in solving the problems.

Figure 8 Megenagna to Shalite Mihret church sidewalk (source: Google earth)

The whole street section was divided into six different sections due the existence of different amount of pedestrians along the street. In addition to this the width of the sidewalks are not constant throughout the whole path, therefore sidewalks resembling the same width are categorized together. Among the six segments of the whole street, “Megenagna” to “century mall, century mall to Gured shola and Gured sholla I to Sahalite Mihret church ” principal Arterial Street is highly active area in which it is dominated by commercial activities both in the right and left direction. In addition to this, few service giving compounds are also found.

Figure 9 Sahalite Mihret church to CMC round about (source: Google earth)

Among the rest three from the total of six sections, the section which is from salite Meheret roundabout to civil service university and civivl service university to Michael church are highly active commercial zones at the right side coming from west to east direction. Howerver the last segment is lesss active which is the sidewalk from Mikael tchurch to CMC round about both in the left and right direction. As compared to the previous three sections of the sidewalk , the left side of this section is highly dominated by service giving zones like ethipian management institiute, Ethiopian electric utility compound, Civil service university, primery and secondary schools, and other governmnet institution compounds including CMC apartment compound at the right side of the main street which makes the sidewalk is less active area than the previoous sections.

Figure 10 Selected street path (source: NORTECH map of Addis Ababa)

Figure 11 Major landmarks (source: NORTECH map of Addis Ababa)

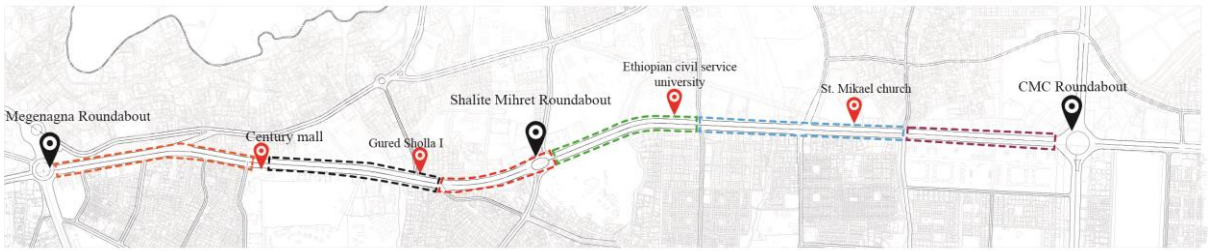


Figure 12 Classification of sidewalk (source: NORTECH map of Addis Ababa)

CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1. Introduction

This chapter is about the descriptive and statistical analysis of the data collected from 385 respondents and the discussions about the grading value of pedestrian level of service of each street section. The data collected where based on the objective focusing on the challenges of accessibility of pedestrian sidewalks and the identification their impacts on the pedestrians. Since data was collected in subjective and objective categories, they are both analyzed in descriptive analysis. A roadway characteristics based measurement of safer pedestrian walking environment is dependent on the provision and quality of the walkways or pedestrian facilities. These methods use pedestrian perceptions and attempt to quantify the comfort level of pedestrians while encountering specific roadway characteristics.

4.2. Evaluating pedestrian sidewalk level of service accessibility (objective one)

Table 10 Pedestrian flow count, sidewalk width and distance

Section of PAS street	Distance in kilo meters	Pedestrian count per 15 minutes	Width of sidewalk in meter	Code of section	Total rights of way
Megenagna to century mall,	1.3	549	3	M to CM	50 meter
Century mall to Gured Sholla I	0.8	474	2.5	CM to GS	
Gured Sholla I to Shalite Mihret church,	0.6	447	3	GS to SM	
Shalite Mihret church to Civil Service university	1	420	3	SM to CS	
Civil Service university to Michael church	1	588	2.5	CS to MC	
Michael church to CMC roundabout	0.8	357	3.5	MC to CMC	
Total	5.5 kilometer	-	5m	-	

4.2.1. Model 1- HCM model

Section one – Megenagna to Century mall (M – CM) having an effective width of 3 meters and pedestrian count for 15 minutes is 549 pedestrians.

$$PLOS = \frac{V15/15}{W} = \frac{549/15}{3} = 12.2 \quad 10 < \text{score} < 15 \quad \text{which is D grade}$$

Table 11 HCM grading values

No	HCM Grade	HCM flow rate (Ped/15/m)
1	A	Score ≤ 5
2	B	$5 \leq$ Score ≤ 7
3	C	$7 \leq$ Score ≤ 10
4	D	$10 \leq$ Score ≤ 15
5	E	$15 \leq$ Score ≤ 23
6	F	Score $\leq$

Conducting the same procedure for all the six sections, the following are the respective scores with their grade.

Table 12 HCM values of sidewalk (M to CMC)

No	Street sections	Measured HCM flow rate (ped/15/m) score	HCM Grade
1	M to CM	12.2	D
2	CM to GS	12.64	D
3	GS to SM	9.3	C
4	SM to CV	8	C
5	CV to MC	15.7	E
6	MC to CMC	6.65	B

The sidewalk from Megenagna to Gured shola is characterized by walking speed, cross passing and reverse direction movement are limited. This movements are under high risk of conflict with other pedestrians. This leads to the creation of repeated change in movement and direction increasing friction among pedestrians.

The sidewalk from Gured Sholla to Civil service pedestrians has enough space for pedestrians to determine their own walking speed, revise direction or crossing movement can create little conflicts. However the speed and flow rates are decreased.

The sidewalk from civil service to Mikael church, almost all pedestrians limit their normal walking speed, frequently adjusting their gait. At a lower range, forward movement is possible only by shuffling. Space is not sufficient for passing slower pedestrians. Pedestrians are in a very high difficulty to pass and cross on another. Design volumes approach the limit of walkway capacity, with stoppages and interruptions to flow.

Even though there is enough space on the sidewalk from Mikael church to CMC round about, pedestrians begun to be conscious about the movement of other pedestrians, determining their own walking speed and about their own walking direction.

4.2.2. Model 2: Australian method

According to Australian model pedestrian level of service evaluation, the following table 13 is the score value reference table. The following table was adapted from Australian model. (Gallin, 2001).

Table 13 Australian PLOS grade scale

No	PLOS grading	Score value
1	A	132 or higher
2	B	101 t0 131
3	C	69 to 100
4	D	37 to 68
5	E	36 or lower

By taking the first pedestrian sidewalk as a representative procedure for all the rest 5 sections, LOS Grading procedure of first section Megenagna to Century mall (M to CM)

Table 14 LOS grading for street section 1

LOS categories	Included factors	Measurement value	Number of points	Weight	Weight score
Physical factors	Sidewalk width (m)	3 m	3	4	12

	Surface quality	moderate quality, i.e. some cracks/ bumps etc.	2	5	10
	Obstruction per kilo meter	more than 21 obstructions	0	3	0
	Crossing opportunities	some provided but poorly located	1	4	4
	Support facilities	few provided and poorly located	1	2	2
Location factors	Connectivity	poor	1	4	4
	Path environment	poor environment, may be within 1m of curb	1	2	2
	Vehicle conflict	poor situation	1	3	3
User factors	Pedestrian volume	More than 350 per day	0	3	0
	Mix of path users	between 21% and 50% non-pedestrian path users	2	4	8
	Personal security	Poor	1	4	4
LOS grade D					49

Table 15 Results of PLOS analysis

No	Street sections	HCM model	Australian PLOS grade scale	Respondents (pedestrian) rating
1	Megenagna to century mall	D	D	D
2	Century mall to Gured shola	D	D	D
3	Gured shola to Shalite Mihret church	C	C	C
4	Shalite Mihret to Civil service	C	D	D
5	Civil service to Michael church	E	D	D
6	Michael church to CMC	B	C	C

4.3. Factors affecting sidewalk accessibility and pedestrian's challenges

4.3.1. Descriptive analysis of Socioeconomic and physical analysis of pedestrians on sidewalks

As we can see from the table among the total number of respondents which are 385, almost half of the respondents 50. 4% were males and 49.6 % respondents were females.

Table 16 Gender of respondents

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	194	50.4	50.4	50.4
	female	191	49.6	49.6	100.0
	Total	385	100.0	100.0	

4.3.1.1. Age group

Most of the data were collected from age group 13- 29 and 30- 45 having total percent of 31.7 and 30.7 respectively. From the whole respondents the least participants are children only 27 respondents were participated among 385. The classification of the respondents' age group were based on the respondents' age. This shows that the sidewalks are used by different age groups (children, young, adults, old) in which provisions should be based on their need.

Table 17 Age group of respondents

Age group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7-12	27	7.0	7.0	7.0
	13-29	122	31.7	31.7	38.7
	30-45	116	30.1	30.1	68.8
	46-62	80	20.8	20.8	89.6
	above 62	40	10.4	10.4	100.0
	Total	385	100.0	100.0	

4.3.1.2. Work status

Among the total respondents, 42.1 % of the respondents are working class of the society who are active and mostly has the chance to experience the real situations of sidewalks.

Table 18 Working status of respondents

Working status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	student	100	26.0	26.0	26.0
	employed	162	42.1	42.1	68.1
	unemployed	56	14.5	14.5	82.6
	pensioner	67	17.4	17.4	100.0
	Total	385	100.0	100.0	

4.3.1.3. Transportation choice

As we can see from the below chart, majority 49.09 % of the respondents are pedestrians. This shows that the real cause for the challenges of the accessibility of sidewalks can be extracted. I addition there is a high demand in using this sidewalks. Walking is preferred among other modes of transportation, thus provisions should be accordingly.

Table 19 Respondents' transportation choice

Transportation choice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	taxi	111	28.8	28.8	28.8
	walking	189	49.1	49.1	77.9
	biking	27	7.0	7.0	84.9
	train	38	9.9	9.9	94.8
	private automobile	20	5.2	5.2	100.0
	Total	385	100.0	100.0	

3.2.1.4. Disability status

More than half of the total respondents are not disabled. However among the disabled groups respondents with waking disability are the highest. Even though there are disability pedestrians users, sidewalks were less considerate of them.

Table 20 Respondents' disability status

Disability status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	walking disability	96	24.9	24.9	24.9
	visual disability	65	16.9	16.9	41.8
	hearing disability	8	2.1	2.1	43.9
	other	9	2.3	2.3	46.2
	don't have	207	53.8	53.8	100.0
	Total	385	100.0	100.0	

3.2.1.5. Purpose of travel

As it can be seen from the below diagram the majority of pedestrian's purpose of travel are first to go to work and secondly is to go to school. This shows that there is high tendency that this pedestrian sidewalks are always busy serving a purpose. In addition it shows that pedestrian sidewalks in from Megenagna to CMC round about are mostly active.

Table 21 Respondent's purpose of travel

Reason of travel

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	to go to work	120	31.2	31.2	31.2
	to go to market	46	11.9	11.9	43.1
	to go to school	81	21.0	21.0	64.2
	visiting relatives	43	11.2	11.2	75.3
	to go to sport exercise	50	13.0	13.0	88.3
	relaxing	45	11.7	11.7	100.0
	Total	385	100.0	100.0	

4.3.2. Factors affecting sidewalk accessibility (objective two)

4.3.2.1. Frequency of sidewalk use

As it can be seen from the above diagram of frequency of use of pedestrian sidewalks and purpose of travel, sidewalks are used frequently by pedestrians in relation to they every day to day task they are engaged in like work and school primary.

Table 22 Respondents' frequency of travel

Frequency of use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	everyday	234	60.8	60.8	60.8
	sometimes	151	39.2	39.2	100.0
	Total	385	100.0	100.0	

4.3.2.2. Sidewalk distractive activities

As it can be observed from the below table, street vending takes the lion's share (36.62 %) for being the major distractive/ obstructive activity on pedestrian sidewalks. In addition, on street shoeshine, taxi and bus queue, construction works with their leftovers and on pedestrian vehicular parking are the major distractive activities on sidewalks posing difficulty to circulate.

Table 23 Sidewalk distractive activities

Distractive activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	taxi and bus waiting (queue)	65	16.9	16.9	16.9
	street vending	141	36.6	36.6	53.5
	street shoeshine	87	22.6	22.6	76.1
	construction work and material leftover	53	13.8	13.8	89.9
	on pedestrian vehicular parking	39	10.1	10.1	100.0
	Total	385	100.0	100.0	

4.3.2.3. Existence of obstructions

In addition to the activity factors on the previous table, it can be observed that 31.17 % of physical obstructions are from inappropriate placement of street amenities followed by

slippery and cracked surface, missed curb ramps, open manholes and ditches and missing cross walks respectively.

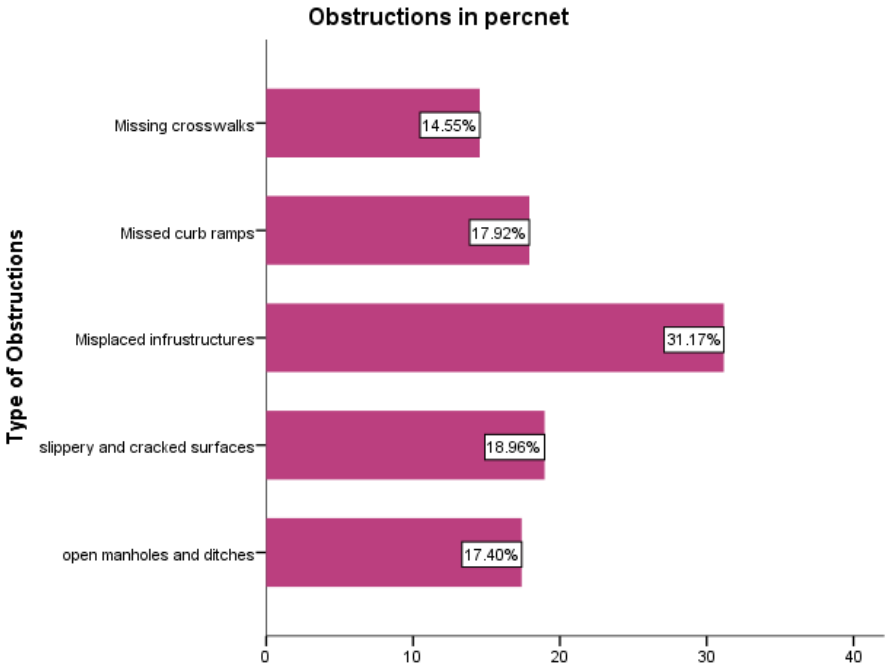


Figure 13 Types of obstructions (source: SPSS)

4.3.2.4. Frequency of facing obstacles

As it can be seen from the following table, more than half of the respondents face different types of obstructions always. This shows that the sidewalks are not accessible. The more pedestrians face this obstacles the lesser they will use them.

Table 24 Frequency of facing obstacles

Frequency of facing obstacles

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	always	230	59.7	59.7	59.7
	sometimes	155	40.3	40.3	100.0
	Total	385	100.0	100.0	

4.3.2.5. Sidewalk width

In the perspective of pedestrian's, 71.8% of the respondents replied that the existing sidewalk width is not sufficient, mentioning the main reason that, since walkways are taken over by other commercial activities minimizing the space for walking.

Table 25 Sidewalk width

Sidewalk width

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	109	28.3	28.4	28.4
	no	275	71.4	71.6	100.0
	Total	384	99.7	100.0	
Total		385	100.0		

4.3.2.6. Orientation of street amenities

As it can be observed from the following table, 67.27 % respondents said that the orientation of existing sidewalk amenities are responsible for the narrowing of clear way zones, which leads to insufficient space.

Table 26 Orientation of street amenities

Orientation of street amenities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	259	67.3	67.3	67.3
	No	126	32.7	32.7	100.0
	Total	385	100.0	100.0	

4.3.2.7. Less active street frontage

As it can be observed from the following table, more than half of the pedestrians do not feel safe along less Active Street's sidewalk. Respondents were facing physical abuse on less active street frontages, because such sidewalks lacks activity which makes them active comfortable for robbery without being noticed. This is due to lack of natural surveillance.

Table 27 street frontage safety

Less active street frontage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	.3	.3	.3
	Yes	185	48.1	48.1	48.3
	No	199	51.7	51.7	100.0
	Total	385	100.0	100.0	

4.3.2.8. Existence of slippery and cracked surface

Sidewalks with cracks and slippery nature were among the major characters of the sidewalks. As it can be seen from the following table 55.2 % of the respondents said that they face slippery and cracked surfaces on pedestrian sidewalks very often making their movement highly obstructed.

Table 28 Existence of slippery and cracked surfaces

Existence of slippery and cracked surfaces

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	204	53.0	53.0	53.0
	no	178	46.2	46.2	99.2
	3	3	.8	.8	100.0
	Total	385	100.0	100.0	

4.3.2.9. Existence of unsafe manholes

Most of the existing manholes on the side walk are unsafe making 57.66 %. During observation this manholes were mostly open uncovered and placed at the middle of pedestrian clear way zone making movement difficult. Pedestrians at the night time were highly vulnerable to falling dawn.

Table 29 Existence of unsafe manholes

Existence of unsafe manholes and ditches

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	163	42.3	42.3	42.3
	No	222	57.7	57.7	100.0
	Total	385	100.0	100.0	

4.3.2.10. Distribution and Functionality of lighting

Street lightings along the sidewalks were not working and few are missing and not functioning. As it can be seen from the following table, majority (29.9 %) of the respondent's evaluation on the existence and functionality of lighting are graded as bad by 29.87 %. This leads to creating uncomfortable environment during night time. Placement of this lighting poles were at the middle of the sidewalks.

Table 30 Distribution and functionality of lighting

Functionality of lighting					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very good	62	16.1	16.1	16.1
	good	99	25.7	25.7	41.8
	fair	109	28.3	28.3	70.1
	bad	115	29.9	29.9	100.0
	Total	385	100.0	100.0	

4.3.2.11. Distribution and functionality of curb ramps

As it can be observed from the following table, the existence and functionality of curb ramps are bad (42.86 %) in the perception and daily exposure of pedestrians.

Table 31 Distribution and functionality of curb ramps

Existence and functionality of curb ramps					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very good	30	7.8	7.8	7.8
	Good	62	16.1	16.1	23.9
	fair	128	33.2	33.2	57.1
	bad	165	42.9	42.9	100.0
	Total	385	100.0	100.0	

4.3.2.12. Distribution and functionality of Pedestrian cross walk

As it can be seen from the following table majority of the pedestrian (61.6 %) crosswalks are not unsafe to cross from one side of the sidewalk to the other. This is due to their placement. They were not placed at the appropriate distance in which respondents were forced before getting cross walks which leads them to accident and creating traffic jam.

Table 32 Distribution and functionality of crosswalks

Existence and functionality of crosswalks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	safe	148	38.4	38.4	38.4
	unsafe	237	61.6	61.6	100.0
	Total	385	100.0	100.0	

4.3.2.13. Existence and functionality of benches, signage, trash can and plantations

As it can be observed from the following table, according to the perception of pedestrians, majority of respondents (32.73 %) the existence and functionality of plantations are bad.

Table 33 Distribution and functionality of benches

Distribution and functionality of benches

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very good	38	9.9	9.9	9.9
	good	54	14.0	14.0	23.9
	fair	107	27.8	27.8	51.7
	bad	186	48.3	48.3	100.0
	Total	385	100.0	100.0	

Table 34 Distribution and functionality of signage

Distribution and functionality of signage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very good	67	17.4	17.4	17.4
	good	85	22.1	22.1	39.5
	fair	99	25.7	25.7	65.2
	bad	134	34.8	34.8	100.0
	Total	385	100.0	100.0	

Table 35 Distribution and functionality of trash cans

Distribution and functionality of trash cans

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very good	23	6.0	6.0	6.0
	good	79	20.5	20.5	26.5
	fair	94	24.4	24.4	50.9
	bad	189	49.1	49.1	100.0
	Total	385	100.0	100.0	

Table 36 Distribution and functionality of plantations

Distribution and functionality of plantations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very good	44	11.4	11.4	11.4
	good	108	28.1	28.1	39.5
	fair	107	27.8	27.8	67.3
	bad	126	32.7	32.7	100.0
	Total	385	100.0	100.0	

Summary of perception evaluation by respondents

Table 37 Summary of perception evaluation by respondents

	Rate the distribution and functionality of sidewalk facilities			
	Very good %	Good %	Fair %	Bad %
Curb ramp	7.79	16.10	33.25	42.86
Sitting bench	9.87	14.03	27.79	48.31
Signage	17.40	22.08	25.71	34.81
Trash can	17.04	20.52	24.42	49.09
Plantations	11.43	28.05	27.79	32.7

From the above table, it can be seen that majority of the sidewalks amenities like benches, signage, trash cans and plantations are placed and functioning in a way that they make accessibility of sidewalks difficulty.

4.3.2.14. Location of sidewalks and their corresponding distractive activates

Since the different section of the sidewalks have different characteristics, there are different types of distractive accordingly. From the below figure, the major obstructive activity on all the six sidewalk section is street vending. The second major obstruction is the existence of street shoeshine boys which is highly observed from Megenagna to St. Michael church incorporating the first 5 sidewalk sections. Except for section three which is from Gured shola to Sahalite Mihret church, on all rest sidewalks the third major distractive activity is taxi and bus waiting queue. The forth and the fifth major distractive activities respectively are construction left overs and on pedestrian parking.

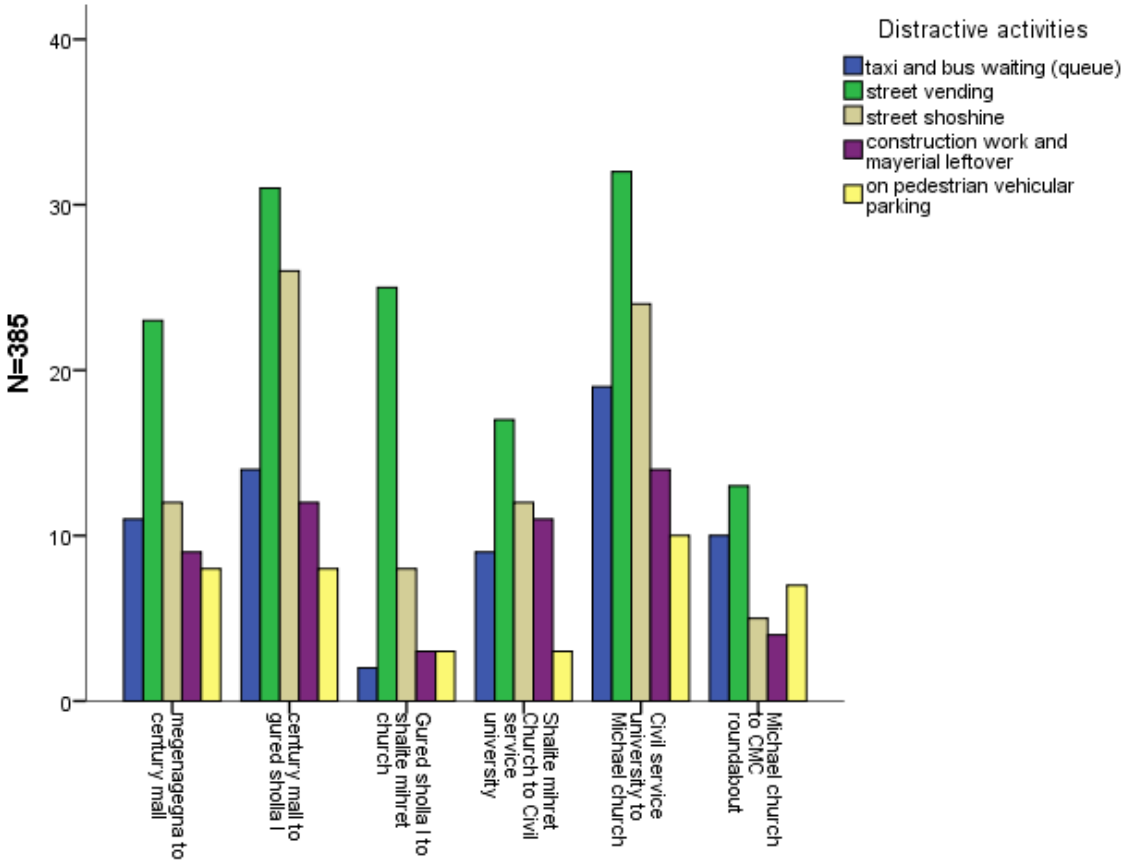


Figure 14 sidewalks with their distractive activities (source: SPSS)

4.3.3. Pedestrian's sidewalk accessibility challenge (objective three)

4.3.3.1. Physical challenges

As it can be seen from the following diagram, most common challenges faced by pedestrians include limitation in walking speed(30. 65 %) , overcrowding (19.74 %), difficulty to easily pass (15.58%), theft and physical abuse (15.32 %) , physical conflict (10.65%) and falling down (8.05%).

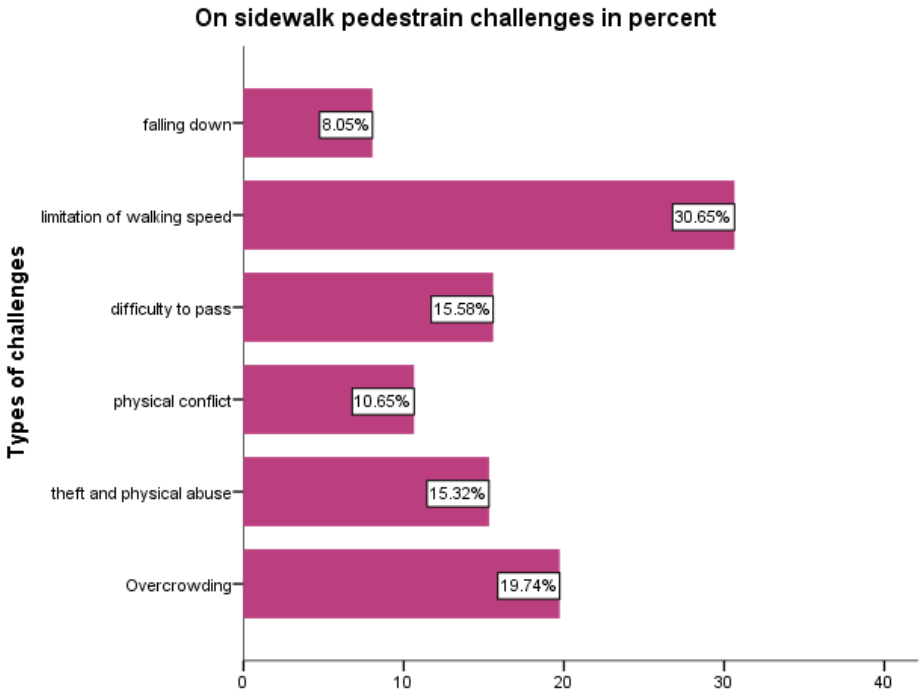


Figure 15 Common pedestrian sidewalk challenges (source: SPSS)

4.3.3.2. Safety during daytime

As it can be seen from the following table, majority of the pedestrians (59.74 %) do not feel safe while using this sidewalks on the day time, having the reason that they are highly exposed to theft due to the overcrowded environment.

Table 38 Safety during daytime

Safety of pedestrian sidewalk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	safe	157	40.8	40.8	40.8
	unsafe	228	59.2	59.2	100.0
	Total	385	100.0	100.0	

4.3.3.3. Safety during night-time

As it can be seen from the following table, 62.34 % of the pedestrians do not feel safe at night time and having the reason that they are highly exposed to different sexual and physical abuse in areas where there are no lighting and less active areas. In addition from the general safety issue of the sidewalk, the level of being unsafe is high at night as compared to the day time.

Table 39 Safety during nigh time

Safety of pedestrian sidewalk on night time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	safe	144	37.4	37.4	37.4
	unsafe	241	62.6	62.6	100.0
	Total	385	100.0	100.0	

4.3.3.4. Location of unsafe sidewalks

As it can be observed from the following diagram, majority of respondents (25.71 %) say that Civil service to Micheal church and Century mall to Gured shola are the first and second most unsafe section of the total sidewalk path.

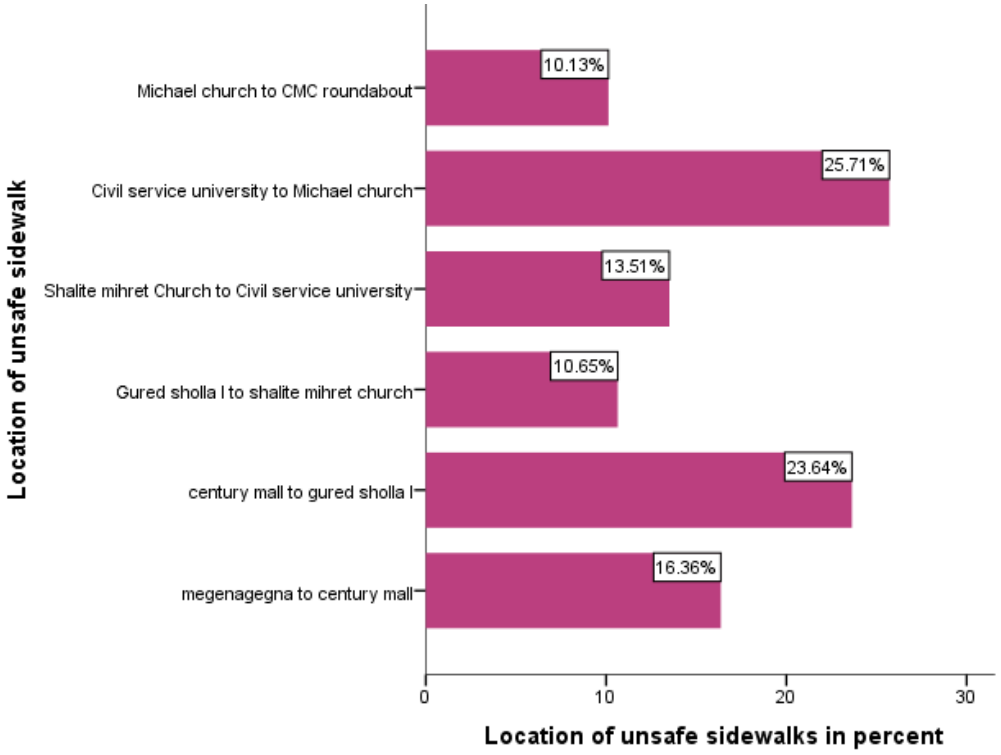


Figure 16 Location of unsafe sidewalks (source: SPSS)

4.3.3.5. Type of abuse

The major types of abuses that pedestrians face on sidewalks are, theft, sexual abuse, physical abuse and falling down are among the major ones. From this abuses, theft is the major type of abuse covering 42.08 %. Theft is frequently exercised along crowded sidewalks.

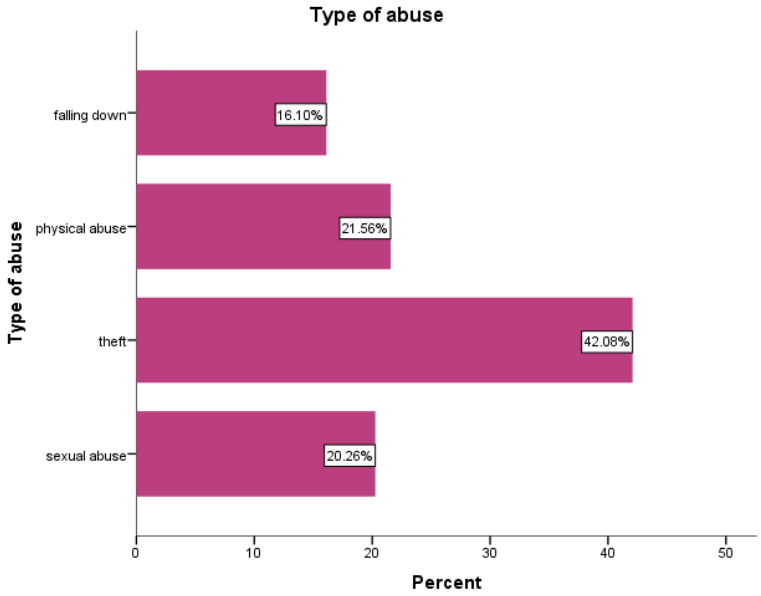


Figure 17 Type of abuse (source: SPSS)

4.3.3.6. Safety and night time experience

As it can be observed from the below graph, females are the highest group of the society who are feeling unsafe. This shows that the sidewalks are highly unsafe at night time.

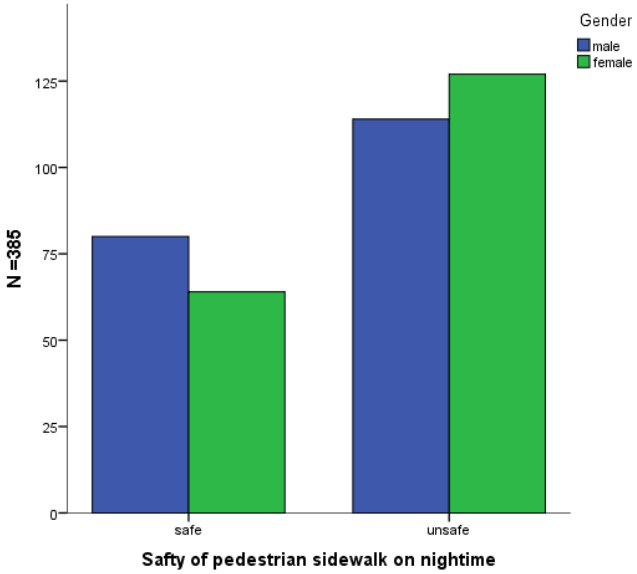


Figure 18 Gender vs. night time safety

4.3.3.7. Safety and lighting

As it can be seen from the following diagram, it is observed that on the sidewlks of unsafe streets, the distribution and functionality of lightings is bad. This shows that ligting can be one fatcor nagtively accefting the accesibility of sidewalks.

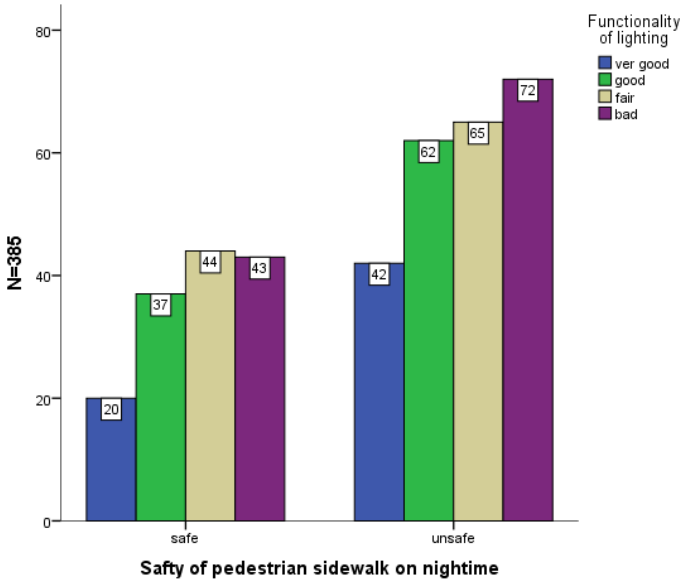


Figure 19 Safety and lighting

4.3.3.8. Frequency of travel vs. frequency of use

As it can be observed from the following diagram, most peoples tend to minimize their frequency of using sidewalks when the frequency of getting obstructions gets high / increase.

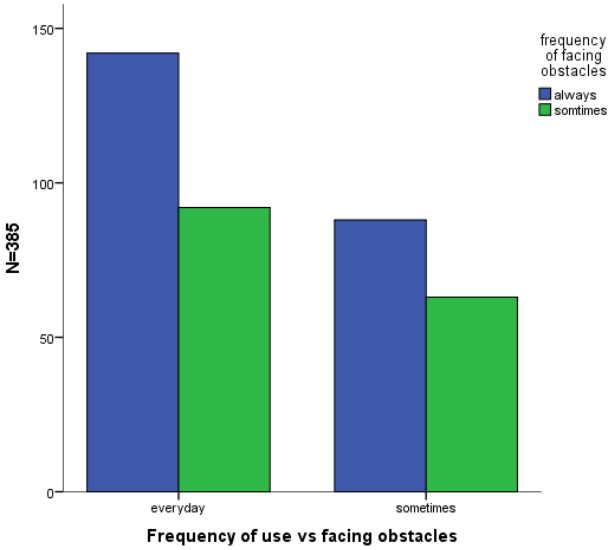


Figure 20 Frequency of travel and use

4.3.4. Photographic analysis (for all objectives)

As it can observed from the following pictures. Those Factors affecting accessibility of pedestrian sidewalks which are extracted from the Australian pedestrian level of service are visible on the pictures. In terms of activity the prevailing obstructions are street venders encroaching the sidewalk making the width very narrow. The second major factor is existence of shoeshine boys on furniture and curb zones. This also contributes to narrowing the width of other zones. Missing light poles are import factors to consider putting safety at greater risk during night time.

Figure 21 Activity factors on sidewalks (source: site observation)

In addition the the activity factors, there are physical factores which makes mobility of pedestrains very difficult. This includes missing curb ramps and sufficnet cross walk.the lack of This features greatly contribues to posing movment dificulty for disabilities. Uncovered manhoes and ditch are also major factors which leads pedestrains into faling down at night . discontinous pedestrian sidewalks are also imortant factors to consider limiting accssibity of sidewalks.

Figure 22 on site Physical factors (source: site observation)

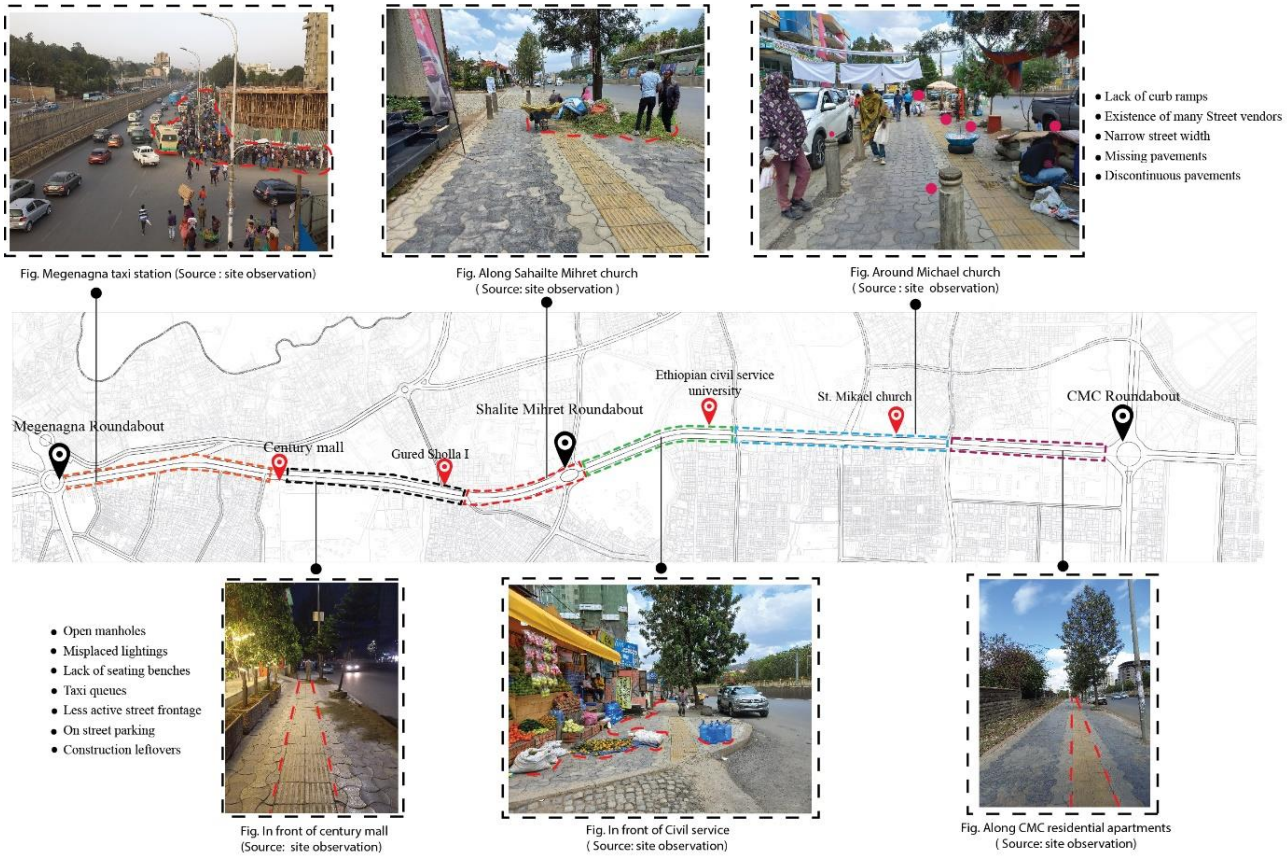


Figure 23 Characteristics of sidewalk (source: site observation)

4.4. Discussion

The pedestrian walking environment in any urban road segments like the footpath and different pedestrian facilities may tend to be affected due to various factors that decrease the pedestrian safety and accessibility. This factors are mainly categorized into three major factors. Namely, physical/design factors, location factors and user factors are among the major ones. This Factors affecting the service quality of pedestrians' are an overall measure of walking conditions on a route, path, or facility. Investigating these affecting factors links directly to the performance measure criteria's such as mobility, comfort, convenience, accessibility and safety, which reflects pedestrian perceptions of the degree to which a facility is pedestrian friendly.

From the above result it can be discussed that majority of the sidewalks along the whole path of Megenagna to CMC are not accessible. Most of them are dominated by both physical and activity obstructions. Thus using them is not interesting. As it has been checked using HCM and Australian pedestrian level of service, more than half of the sidewalks in this particular section falls under D and C grade. She shows that they are of poor standard in which they are not equipped with adequate amenities and proper orientation.

Most of the respondents of the questionnaire survey were pedestrians, of whom they were frequently using sidewalks. They were facing obstructions on more frequently. This obstructions include street venders, shoeshine boys, taxi and bus waiting queues, construction leftovers and on street vehicular parking. In addition to this factors, other design factors like, lack of curb ramps, misplaced pedestrian cross walks, open manholes and ditches, misplaced sidewalk amenities are also factors affecting accessibility.

Moreover the dominant land use type of the sidewalk is commercial. This creates a very active street interactive environment. However such activities are not placed on their distinct sidewalk corridor zones, distracting other zones and narrowing the standard width. This will lead to the creation of crowded environment when pedestrians try to use them. This crowd is characterized by in difficulty to pass one another, turn round and change direction and limiting one's own walking speed.

The other major factor affecting the accessibility is below standard design of sidewalks. This can be below standard width, surface material and width of zones. The biggest problem that sidewalks create is, it will not be used for the intended purpose and also pose safety related problems like sexual harassment, theft, physical conflict with other.

Even though the majority of the site is commercial, it has got some residential spaces, around CMC residential homes which is gated. Most respondents using that section felt that since it is less active, it comfortable to easily to attack pedestrians thus, less active areas are unsafe missing natural surveillance.

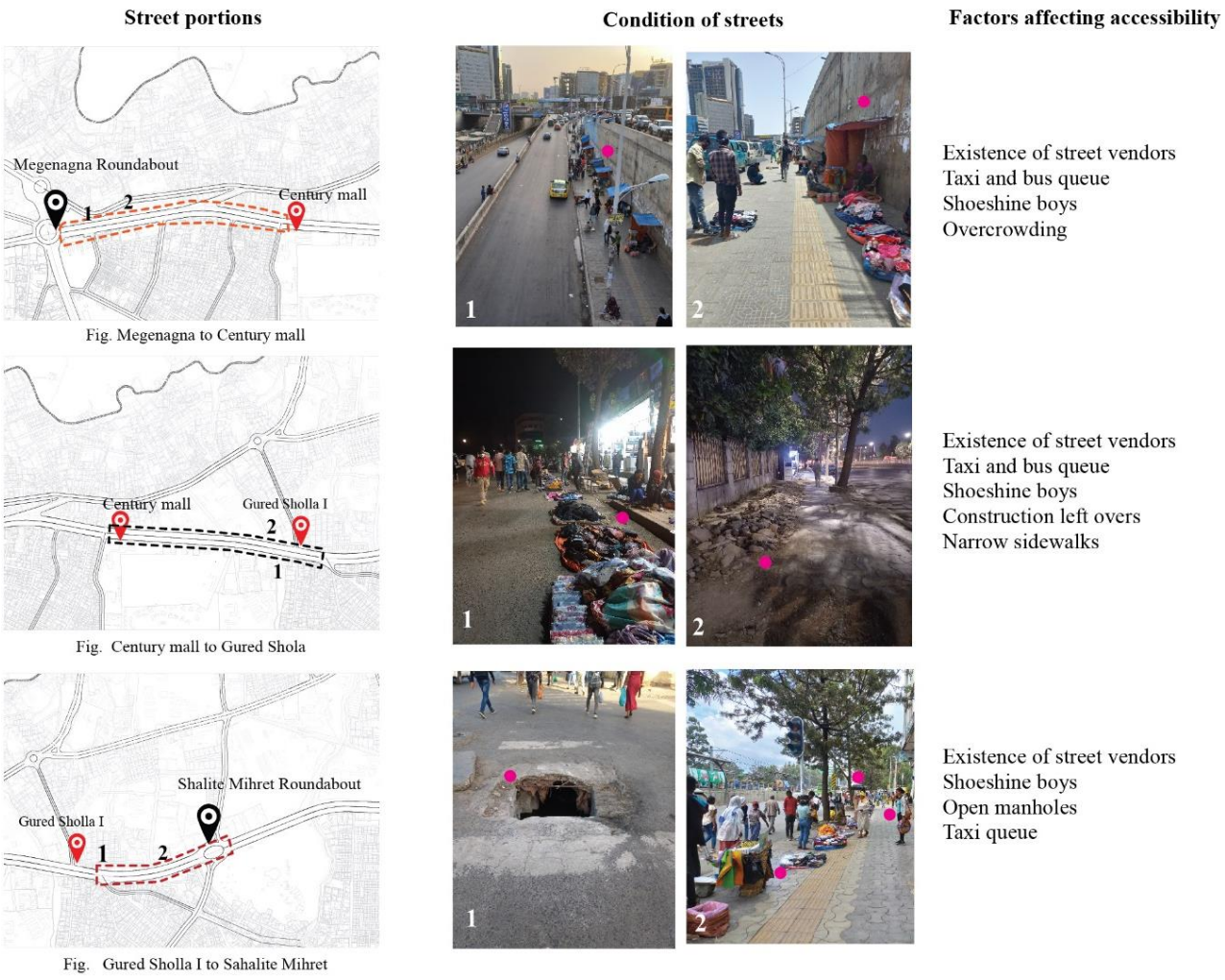


Figure 24 Summary of factors and challenges (source: site observation)

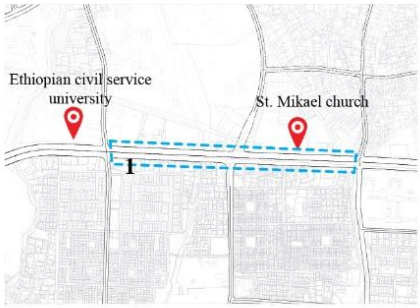
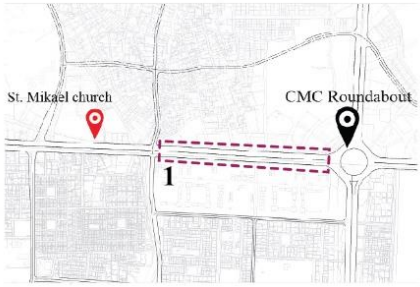
Street portions	Condition of streets	Factors affecting accessibility
 Fig. Sahlite Mihret to Civil service		Existence of street vendors Shoeshine boys Lack of curb ramps
 Fig. Civil Service to Mikael church		Existence of street vendors Shoeshine boys Lack of curb ramps Narrow sidewalks
 Fig. Mikael church to CMC compound		Existence of street vendors Misplaced lighting poles Lack of curb ramps Narrow sidewalks Less active street frontage

Figure 25 Summary of factors and challenges (source: site observation)

5. CONCLUSION AND RECOMMENDATION

5.1. CONCLUSION

Even though Walking is the dominant mode of transportation covering up to more than half of the total half of daily trips, it is highly underrated. Sidewalks are often characterized by narrow, uneven, obstructed, or nonexistent, making them a nuisance and a safety risk for the most vulnerable pedestrians. As it can be seen from the above evaluation it possible to say less attention is given to pedestrian sidewalks. Even though they are serving the majority of Addis Ababa's population, Sidewalks are taken for granted.

From the above analysis, all six pedestrian sidewalk section of the street Megenagna to CMC principal Arterial Street falls into the PLOS evaluation grade of C up to D on both method of PLOS analysis. This makes that the 33.3 % of the street is grade C and 66.7% are grade D. in terms of the HCM and Australian model ,this show that the majority of the sidewalks are poor standard in which pedestrian safety and comfort are highly affected.

The major cause that affect the accessibility of pedestrian sidewalks emanates from three main factors which are physical/design factors, location factors and user factors. In case of this research, existence of distractions like street vendors and shoeshine boys are the major distractive activities. In addition, existence of obstructions like open manholes and ditches, and misplaced street furniture are major causes. Lack of curb ramps and inappropriate allocation of cross walks are also significant contributors. Not only are this factors but also missing of lighting poles which highly aggravate the problems of safety at night time.

In appropriate location of street amenities are distractions. Moreover they are one of the major reasons for decreasing the pedestrian clear way zone. This leads to the sidewalk not being able to handle the pedestrian flow, which finally leads to crowded environment where pedestrians are in fear of facing physical conflict with other passerby, making pedestrians not accessible.

The other major factor which is resulted from the analysis of questionnaire survey, pedestrians do not feel safe on areas which are less active. This is due lack of natural surveillance from the surrounding passive environment. As a result pedestrians are venerable to abuses mostly at the night time.

According to the above conducted HCM and Australian PLOS method and including the summery of the pedestrian questionnaire survey, and the major challenges faced by

pedestrians are limitation on selecting one's own walking speed, difficulty to change direction, overcrowding and crossing is limited with much difficulty. In addition to this from majority of the respondents it can be concluded that safety of pedestrians are negatively impacted, I which it resulted in theft, sexual abuse and other physical harassments.

Walking in Addis Ababa in general is not safe experience, especially to disabled and those using mobility aid. This is because sidewalks are not built considering pedestrian need. Uncovered manholes and ditches are very common to see, causing many accidents. This accidents are even worse for disabilities aggravating the problem. Even if few tactile pavements are provided along the pedestrian clear walk way zone, they are distracted by miss located amenities and utilities in the middle leading them to fall down. Moreover the existence of lighting poles, construction materials, or street vendors in the middle of the sidewalks which forces pedestrians to walk alongside traffic.

Finally, the more numerous daily sidewalk encounters are the more sidewalks become places hosting peoples conflicting interests. Even though the public realm of the sidewalk serves places of socialization, they will remain as a visible site for contestation and conflict. Despite a hundred-year preoccupation with turning the sidewalk into an orderly pleasant space for unobstructed movement, widely varying activities are still contested on these narrow strips making pedestrians venerable.

5.2. RECOMMENDATIONS

Recommendations towards policies

- Integrate mobility management with urban planning, and include pedestrian demands earlier in urban development projects and transportation investments, with the goal of building seamless, high-quality pedestrian networks.
- Encourage the appropriate authorities to offer non-motorized traffic and public transportation in city centers a greater priority and more space. This includes a number of key actions, such as providing easy, safe, well-maintained, and secure pedestrian access to public transportation and all city center destinations; developing car-free areas; parking policies to discourage overuse of cars in city centers; and regulations to prevent parking on sidewalks and crossings, which degrades the quality of walking and, in extreme cases, makes walking impractical.
- Enhancing institutional coordination. A lack of coordination between institutions hinders the implementation and improvement of infrastructure. A number of city agencies are involved in sidewalk planning, design, construction, streetscaping, cleaning, and maintenance, requiring monitoring of conditions as well as coordination among stakeholders. Some examples of measures that can potentially improve coordination are assigning lead institutions to be responsible for improvements, and organizing regular consultations and meetings of key municipal entities around investment plans.
- Improving law enforcement is essential to alleviate or prevent sidewalk obstruction, reduce road accidents, and sustain the impact of sidewalk improvements.
- Encouraging the application of transit-oriented development refers to integrated urban places designed to bring people, activities, buildings, and public spaces together, with easy walking and cycling connections between them and near excellent transit service to the rest of the City, so that high attention shall be given to sidewalks.

Recommendations towards standards

- Using universal accessibility principles of for planning and designing sidewalks is mandatory. The benefits of universal design are not only confined to people with disabilities. This will help in integrating all user groups of different age and ability. Such deign of sidewalks will not exclude certain group of community from using the sidewalks.

- Since pedestrian sidewalks are one of the places of socialization, the provision of facilities are mandatory with the appropriate standard.
- The zonal classification of pedestrian sidewalks shall be up to standard width. The width provided should relate to the existing demand depending on the adjacent land uses. The municipality or any concerned institution shall set a minimum width standard and guidelines for each specific zones considering pedestrian volume and hierarchy of adjacent street types. Clear pedestrian walk way zone shall be provided with out the interference from other zones.
- Develop a guideline that informs designers, decision-makers and local authorities on the importance of correct sidewalk geometry design and how to achieve it.
- Implement traffic calming measures to decrease the severity of traffic-related crashes and increase the feeling of safety for pedestrians.

Recommendations towards planning, deigning and construction

- Since the major problem that we encounter on sidewalks of Addis Ababa are overcrowding, design stage of sidewalks shall consider the future population growth of the city depending on the population projection and high consideration of urbanization. Addressing the current and future demands of our changing society is also integrating universal accessibility principles to the design of pedestrian sidewalks.
- Build sidewalks wide enough, with correct slopes, adequate pavement, and the infrastructure needed to ensure universal accessibility.
- Making technology part of the solutions to the challenges faced by pedestrians both in planning and design. Pedestrians with vision impairments rely on nonvisual audible and tactile cues to travel. Cues in the environment include the sound of traffic, presence of curb ramps, verbal messages and audible tones in pedestrian signals, and detectable warnings. To accommodate the information needs of all pedestrians, it is important to provide information in formats that can be assimilated using more than one sense. Pedestrian information includes pedestrian signage, Accessible Pedestrian Signals (APS) - audible tones, verbal messages, and vibro tactile information, and detectable warnings.
- Regulate street vendors by designating suitable areas in furniture strips or other location

- Increase the urban furniture available on sidewalks, including benches, trees, weather protection, garbage bins, and other elements with proper zonal allocation in order to make sidewalks more comfortable
- Integrate utilities with each other and the rest of the sidewalk design in order to avoid continuous upgrading distracting sidewalks while integrating one.
- Exemplary sidewalks can be taken as reference and good designs which are previously implemented. A case in Addis Ababa which is around “Churchill street”, a side walk which is wide enough to accommodate the large pedestrian flow and distinct zonal classification.

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APPENDIX

APPENDIX A - SURVEY QUESTIONNAIRES PART I

Pedestrian sidewalk accessibility questionnaire

You are kindly invited to participate on a research held in solving the problems related to the accessibility of pedestrian sidewalks by filling out the following questionnaire.

(Megenagna to CMC principal Arterial Street)

Subjective section

Name _____

1. Gender?

   Male ☐ Femal☐

2. Age?

   _____

3. What is your current work status?

   _____

4. What is your frequent transportation choice?

   A. Taxi B. walking C. biking D. Train E. Private automobile

5. What type of disability do you have?

   A. Walking D. Visual C. Hearing D. Other E. I don't have any

6. Why do you use this pedestrian sidewalk?

   A. To go to work
   B. To go to market place
   C. To go to school
   D. Visiting relatives
   E. To go to sport exercise
   F. To relax

Mention if there is another

_____

_____

7. How often do you use the sidewalk?

A. daily/frequently B. sometimes/ occasionally

8. Which activities are destructive on pedestrian sidewalks?

A. Taxi and bus waiting area

B. Street vending

C. Street shoeshine

D. Construction work and material leftover

E. On pedestrian street parking

Mention if there is any other

_____

_____

9. What obstructions do find on pedestrian sidewalks that makes them difficulty to access?

A. Open manholes and ditches

B. Slippery and cracked surface materials

C. Misplaced street amenities

D. Missed (discontinuous) sidewalks

E. Lack of cur ramps

F. Missed and misplaced crosswalks

10. How often do you find obstacles on sidewalks?

A. Always B. Sometimes

11. Do you think the width of pedestrian sidewalks sufficient?

A. Yes B. No

12. Do you believe that it is necessary for market places to exist on this sidewalk?

A. Necessary B. not necessary C. I don't mind

13. Do you think that sidewalk facilities and infrastructure allocation (light and telephone lines, traffic signs, and trash can) on sidewalks leads to insufficient width?

A. Yes B. No

If yes why?

_____

_____

14. Do you feel safe to walk on pedestrian sidewalks at the day time?

A. Safe b. unsafe

Unsafe, why?

_____

_____

15. Do you feel safe to walk on pedestrian sidewalks at the night time?

A. Safe B. unsafe

Unsafe, why?

_____

_____

16. Which part of the street do you mostly fell unsafe?

_____

_____

17. Do you feel safe on pedestrian sidewalks which are adjacent to less active areas?

A. yes B. No

Mention if there is any other

_____

18. What type of abuse do you face while using pedestrian sidewalks?

A. Sexual abuse B. theft C. physical abuse D. falling down

19. Do you think the sidewalks are free from slippery and cracked surfaces?

A. Yes B. No

20. Do you usually face uncovered ditches and manholes on pedestrian sidewalks? If yes, where?

_____

_____

21. While using pedestrian sidewalks at night time, do you find places with no lighting?

If yes, where?

_____

_____

22. What are the most common problems that you face while using sidewalks?

_____

_____

23. What are your suggestions that makes pedestrian sidewalks to improve?

_____

_____

24. Street amenities

	Rate the distribution and functionality			
	Very good	Good	Fair	Bad
Sitting bench				
Signage				
Trash can				
Vegetation				

APENDIX B - SURVEY CHECKLIST

1. What type of land use does the streets include?
   A. Residential
   B. Commercial
   C. mixed use
   D. service zone
   E. other

2. Research site observation and measurement checklist

	Type of activities				
	Street vendors	Shoeshine	Construction and leftover materials	Transport queues (waiting lines)	On pedestrian sidewalk parking
Existence					
Remarks					

Pedestrian sidewalk corridor zones				
	Building frontage zone	Pedestrian clear way zone	Furniture zone	Curb zone
Distribution				
Width				
Remark				

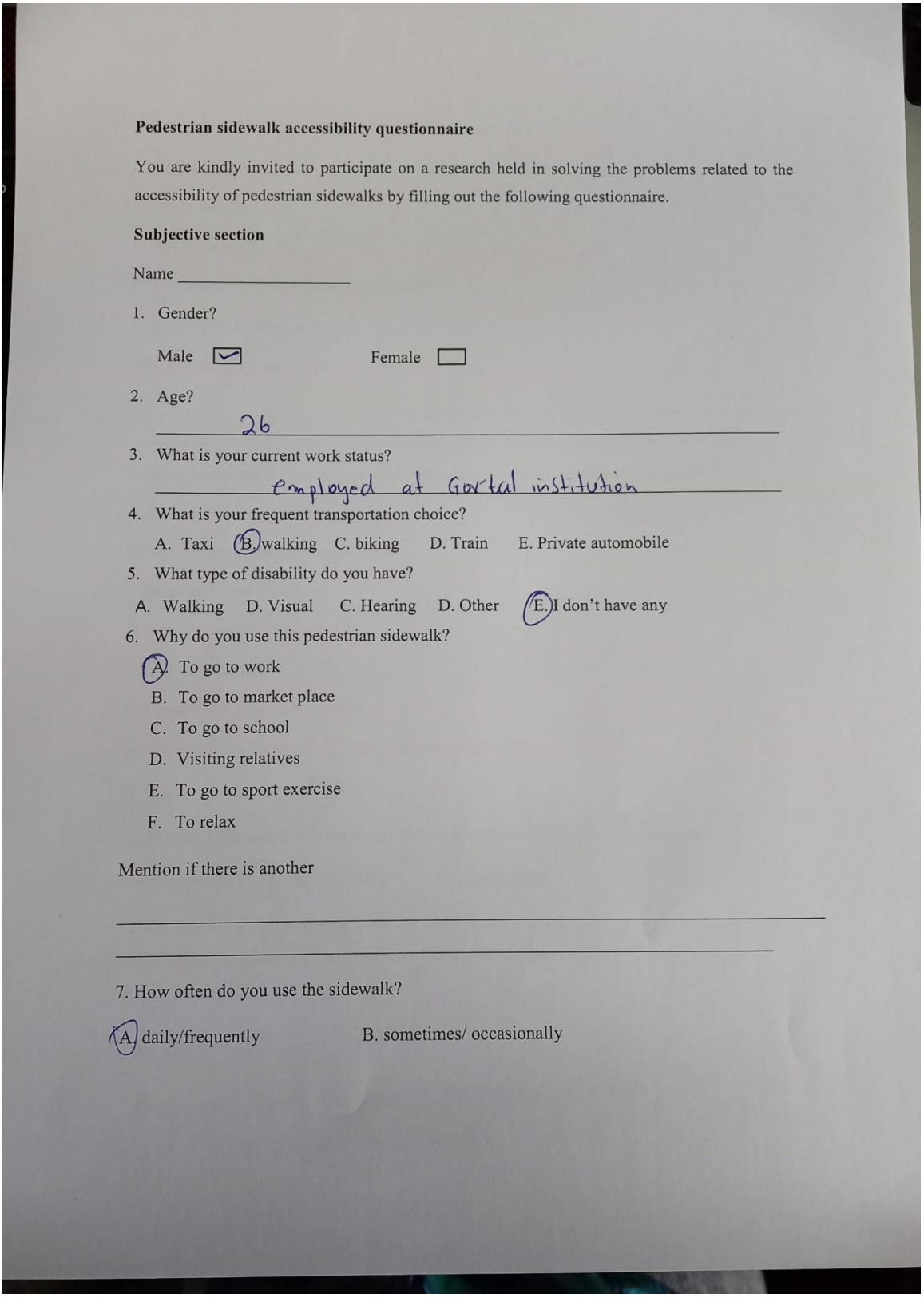
Physical condition of sidewalks					
	Curb ramps	Surface material	Cross walks	Obstructions	Crossing opportunities
Distribution					
Amount					
Remark					

Location factors			
	Connectivity	Path Environment	Path Environment
Distribution			
Amount			
Remark			

User factors			
	Pedestrian volume	Mix of path users	Personal security
Existence			
Amount			
Remark			

Effective drainage and utilities			
	Safe manholes	Ditches	Other utilities as obstacles
Existence			
Amount			
Condition remark			

APPENDIX C - PICTURE OF FIELD QUESTIONNAIRE



Pedestrian sidewalk accessibility questionnaire

You are kindly invited to participate on a research held in solving the problems related to the accessibility of pedestrian sidewalks by filling out the following questionnaire.

Subjective section

Name _____

1. Gender?

   Male ☑ Female ☐

2. Age?

   26

3. What is your current work status?

   employed at Gov'tal institution

4. What is your frequent transportation choice?

   A. Taxi (B.) walking C. biking D. Train E. Private automobile

5. What type of disability do you have?

   A. Walking D. Visual C. Hearing D. Other (E.) I don't have any

6. Why do you use this pedestrian sidewalk?

   (A.) To go to work
   B. To go to market place
   C. To go to school
   D. Visiting relatives
   E. To go to sport exercise
   F. To relax

Mention if there is another

_____

_____

7. How often do you use the sidewalk?

   (A.) daily/frequently B. sometimes/ occasionally

8. Which activities are destructive on pedestrian sidewalks?

A. Taxi and bus waiting area

B. Street vending

C. Street shoeshine

D. Construction work and material leftover

E. On pedestrian street parking

Mention if there is any other

_____

_____

9. What obstructions do find on pedestrian sidewalks that makes them difficulty to access?

A. Open manholes and ditches

B. Slippery and cracked surface materials

C. Misplaced street amenities

D. Missed (discontinuous) sidewalks

E. Lack of cur ramps

F. Missed and misplaced crosswalks

10. Do you think the width of pedestrian sidewalks sufficient?

A. Yes B. No

11. Do you believe that it is necessary for market places to exist on this sidewalk?

A. Necessary B. not necessary C. I don't mind

12. Do you think that sidewalk facilities and infrastructure allocation (light and telephone lines, traffic signs, and trash can) on sidewalks leads to insufficient width?

A. Yes B. No

If yes why?

Because they narrow side walks entering into paths of pedestrian walk ways.

13. Do you feel safe to walk on pedestrian sidewalks at the day time?

A. Safe (b.) unsafe

Unsafe, why?

Since they are overcrowded, I am scared of being exposed to theft.

14. Do you feel safe to walk on pedestrian sidewalks at the night time?

A. Safe (B.) unsafe

Unsafe, why?

there are areas which lacks lighting poles & few are not working properly

15. Which part of the street do you mostly fell unsafe?

~~Richard~~ around CMC residensial compound & Gured Shola

16. Do you feel safe on pedestrian sidewalks which are adjacent to less active areas?

A. yes (B.) No

Mention if there is any other

17. What type of abuse do you face while using pedestrian sidewalks?

A. Sexual abuse (B.) theft C. physical abuse D. falling down

18. Do you think the sidewalks are free from slippery and cracked surfaces?

A. Yes (B.) No

19. Do you usually face uncovered ditches and manholes on pedestrian sidewalks? If yes, where?

Yes, around gured sholla

20. While using pedestrian sidewalks at night time, do you find places with no lighting?

If yes, where?

Yes, around Shalite Mihret church

21. What are the most common problems that you face while using sidewalks?

- mostly I am in difficulty to pass with each other freely

22. What are your suggestions that makes pedestrian sidewalks to improve?

- widen the width of sidewalks, cover ditches avoid distractions like street vendors, constructions.

23. Street amenities

	Rate the distribution and functionality			
	Very good	Good	Fair	Bad
Sitting bench				✓
Signage			✓	✓
Trash can				✓
Vegetation				

x

APPENDIX D- EXISTING ILLUSTRATIVE PICTURES OF PEDESTRIAN SIDE WALKS

The following pictures are taken during site visit at different times of the day.