Identifying potential complete street of Adama using multi criteria decision aiding approach, The case of Derartu Tulu street

Chala Efrem Mamo

A Master's 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

Adama, Ethiopia

june; 2025

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APPROVE OF BOARD OF EXAMINERS

I, the advisor of the thesis entitled "**Identifying potential complete street of Adama using multi criteria decision aiding approach, The case of Derartu Tulu street**" and developed by **Chala Efrem Mamo**, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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We, the undersigned, members of the Board of Examiners of the thesis by **Chala Efrem Mamo** have read and evaluated the thesis entitled "**Identifying potential complete street of Adama using multi criteria decision aiding approach, The case of Derartu Tulu street**" and examined the candidate during the 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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Finally, approval and acceptance of the thesis are 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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DECLARATION

I hereby declare that this MSc Thesis entitled "**Identifying potential complete street of Adama using multi criteria decision aiding approach, The case of Derartu Tulu 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.

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Name of the student Signature Date

RECOMMENDATION

I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled "**Identifying potential complete street of Adama using multi criteria decision aiding approach, The case of Derartu Tulu street**" prepared under my guidance by **Chala Efren Mamo** submitted in partial fulfillment of the requirements for the degree of Master's of Science in "**Urban Planning and Design"**. Therefore, I recommend the submission of the revised version of the thesis to the department following the applicable procedures.

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Major Advisor Signature Date

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AADT	Annual average daily traffic
CS	Complete street
CSDCS	Complete street design and construction standards
NCSC	National Complete Streets Coalition
ROW	Right of way
SAS	Sub-arterial street

ABSTRACT

The street which is designed for everyone regardless of ability, age and mode of transportation is called a complete street. They balance the needs of drivers, pedestrians, bicyclists, transit riders, and goods movement based on local context. The aim of a livable community is people get where they went to go by foot, bicycle, wheelchair, public transportation or any transportation means they prefer. Many urban streets lack proper sidewalk and bicycle lanes. Curb stone around sidewalk and median block wheelchair users. Adama city streets are facing problems such as traffic overcrowding, lack of bicycle lanes, lack of adequate parking, problems of pedestrian ways, exclusion of aging and disabled people, and problems of transportation choices. The objective of this research is To identify potentials of complete street of Adama street using multi criteria decision aiding approach. This research is carried out through questionnaires and observation. The subjective method was applied to collect street users' perceptions about the challenges of complete street design and their perception of the street. The questionnaire was conducted on the sample population of 384 people because the population of the area is large. The objective method was conducted to access the quality of street escape and to determine the existing situation of the street to complete street standards. By analyzing all input data, the main challenges of complete street design on Derartu Tulu street like the economy, social and physical challenges were identified. Derartu Tulu street was evaluated according to complete street design standards and it does not preserve the standards. People need the improvement of this street because they believe that Derartu Tulu street has many problems and has low quality. The analysis Derartu Tulu street result shows that this street does not include all street users and it is unsafe and uncomfortable for the street users. The research develops a planning and design solution for the enhancement of the current Derartu Tulu street.

Key words; livable community, complete street, inclusiveness, street users, pedestrian, disabled people, Adama, Ethhiopia.

CHAPTER ONE

INTRODUCTION

Cities are dense places that include different activities of people living together. As a result, the city is accessible and needs a minimum cost of travel. To make the city efficient and livable, the urban transportation system must allow walking, bicycling and public transportation which reduces re-secures use and increases the health of the urban community (As cited in Loukaitou and Ehrefeucht 2010,).

Streets must accommodate safe travel for everyone, including those with disabilities. Many streets, however, are difficult to access, navigate, cross, or do not provide adequate accommodations for people who use wheelchairs, have diminished vision or hearing, limited mobility, or even parents with strollers. Most people will face at least one of these challenges in their lifetime (Michael, et. al 2011 and Renae 2013. State of New Jersey 2017).

The street which is designed for everyone regardless of ability, age, and mode of transpositions is called the complete street. They balance the needs of drivers, pedestrians, bicyclists, transit riders, emergency respondents, and goods movement based on the local context. This concept had first emerged in America. It is the shift of priority of vehicles to all users. (Matthew et al. 2017, Kelly and Paul 2018,)

In Ethiopia, streets have many problems relative to the developed country. In Ethiopia street considers mainly the automobiles transportation. Public transportation are slow which increase the travel time of the community. The major consideration is given to vehicles and people with abilities.

This research focuses on Adama street mainly from Derartu square along Derartu Tulu street to Adama telecommunication. Adama city streets are facing problems such as traffic overcrowding, lack of bicycle lanes, lack of adequate parking, problems of pedestrian ways, exclusion of aging and disabled people, and problems of transportation choices.

This research investigates the current problems related to street users and enhances the street to solve this problem. Adama city road authorities can use this research to reduce the problem of

streets and to design the streets accordingly. It also helps as a reference for researchers to do their research.

This research aims To identify potentials of complete street of Adama street using multi criteria decision aiding approach.

1.1 Motivation

The following reasons are motivation to do this research: the first reason is observation, the poor quality of the street, poor safety for pedestrians, absence of bicycle lane, and dominance of automobiles on the street. The second reason is even though this street is the commercially active area of Adama city which is used as the city image, it is poorly designed and managed. Finally, for educational purpose to complete a master's degree from ASTU.

1.2 Background

In the early 1970s in Oregon, the idea of complete streets was initiated, which was the first complete street-like policy in the U.S. Modern or rebuilt policies were needed for the policy Roads for cyclists and pedestrians, and federal and local authority standards in the public right-of-way to fund walking and cycling infrastructure (Oregon Department of Transportation, 2011). Then, Complete was ratified by more than 16 additional state legislatures Laws on the streets (Smart Growth America, 2012). For 2010, the U.S. Department of Facilities Transportation released a policy statement on housing for bicycles and pedestrians in support of the full definition of streets in federal highway assistance programs. It also stimulated community organizations, public transportation agencies, and state and local governments to accept similar policies (U.S. Department of Transportation, 2010)

In the United States, cities have suffered from 80 years of growth formed by an undying dedication to the predominant mode of transportation as the car. This dedication has left a physical legacy in both old urban areas with air pollution and related health threats and effects, inadequate mass transport options, and dangerous conditions for pedestrians and bicyclists. (e.g., New York, Chicago, Atlanta, and Detroit) and newer urban centers (e.g., Denver, Los Angeles, Phoenix, and Las Vegas). Low-income and minority populations have experienced the worst consequences of auto-centric growth in many of these towns, and several other smaller cities. These communities have not only been used overwhelmingly as the locus of industrial

and other undesirable growth but they have also often been used as transport routes to encourage the rapid flow of people and products across their neighborhoods (or even through them). Suburban residents and downtown employers benefited from this, but not the highway-dissected population (Stephen and Julian 2018).

Complete street activities show an opportunity to move forward the nation's travel alternatives. A complete street is secure, comfortable, and helpful for travel by car, foot, bicycle, and transit in any case of age and ability. The center of complete street activities has been to energize neighborhood, regional, and state planning organizations to alter approaches and procedures so that multi modal lodging is a scheduled portion of venture improvement. The point is to right the balance in a transportation framework that's as of now titled toward the automobile. (Lynott, et. al. 2009, as cited in Smart Growth America 2015).

If the street is incomplete, people of both abilities lack sufficient lodging. An incomplete street may have unpaved, disconnected, short, or disabled sidewalks that not only obstruct movement for those with limited mobility but also make it virtually difficult to use wheelchairs. The absence of a curb ramp or an improperly positioned one will drive a pedestrian into the street or decrease mobility significantly. Broad intersections intended for the fast flow of motorized vehicles could not have enough time to cross safely for anyone with a disability. Pedestrian signals that use only visual signals (or no pedestrian signals) can lead visually impaired persons to complicated and/or hazardous situations. For certain pedestrians with disabilities, bus stops that are not attached to a curb are not available and could hinder them from going to where they need to go. In addition to constructing a new obstacle for people with disabilities, a building project that closes a sidewalk and does not provide alternative accommodations can lead to frustrating or unsafe conditions for the visually impaired. Many people with disabilities rely on sidewalks or public transportation to move, and incomplete streets will make this almost impossible (including for medical appointments, groceries, and exercise). As a consequence, many people with disabilities continue to rely on expensive para-transit programs or cannot get where they need to go (State of New Jersey 2017).

Complete streets are designed to be safe and comfortable for all users, including pedestrians, bicyclists, transit riders, motorists, and individuals of all ages and capabilities. These streets generally include sidewalks, bicycle lanes, transit stops appropriate street widths and speeds,

and are well-integrated with surrounding land uses. Complete Street design elements that emphasize safety, mobility, and accessibility for multiple modes may include crosswalks, bus lanes, landscaping, lighting, signaling systems, and adequate separation between sidewalks and streets (As cited in the UNC Highway Safety Research Center. 2016).

Adama is the most populous town in East Shewa Zone. The total population of the Adama town was 286,198 in 1997. The urban population was 59.8% of the total population in the same year. About 51.6% of the urban and 48.7% of the rural populations were females. The crude population density of the Adama district was 295 persons per km2 (RRT research response, 2009).

As the population increase in a city the density of people and vehicles also increases. This decreases the comfort, safety, and convenience of streets. Adama city is facing street problems like congestion, long travel time, exclusion of disabling and aging people, and the choice of transportation.

The number of vehicles in Adama city is rapidly increasing. Table 1 illustrates the number of vehicles in Adama city from 2002 to 2010 E.C.

Table 1: Depicts Number and means of public transportation service in Adama city.

Type of vehicle	2002	2003	2004	`2005	2006	2007	2008	2009	2010
Bajaj & minidor	1025	1060	1500	2000	3000	4200	3613	4416	5703
Mini bus	170	200	225	260	340	500	496	520	554
City bus	2	2	2	4	4	4	4	4	7
Motor-cycles	-	-	-	-	-	122	290	310	1900

Source: Adama city transport Authority office (2018)

1.3 Problem statement

According to new research (The Socioeconomic Profile of Adama City, 2019), The roads of Adama are used by all users and congested with overflows of motorbikes, Bajaj, tricycles, cars, minibuses, horse-drawn carts, pedestrians, among others. Bajaj is the most popular form of public transport service in the city that is providing livelihood earning opportunities to many owners and their operators in the city in addition to providing public transportation services in

the city. Minibuses are the second most utilized mode of transport and means of public transport in Adama.

The street of Adama city is primarily designed for vehicles. This does not provide a safe and comfortable space for pedestrians, bicyclists, and public transportation. This street does not consider the different parts of society like disabled people, elders, pregnant women, etc.

Driver Park their car on the pedestrian way which blocks the flow of walkers. The design of the street does not consider bicyclists, proper parking, and terminals for car and public transportation, it also does not consider active public transportation like bus transit and the use of disabled and aged people. There is a lack of street furniture like benches for sitting and space for standing. Furniture (dust bin, signage) which provided on the street have design problems and un proper placement. Some of the ditches are not functioning now and there is a pond in the rainy season along the street which is very dangerous for the health of people.

1.4 Objective

1.4.1 Main objectives

To identify potentials of complete street of Adama street using multi criteria decision aiding approach.

1.4.2 Specific objectives

1. To identify challenges of complete street design on Derartu Tulu street concerning street users.
2. To examine the determining factors influencing street users in Adama Town along the study route.
3. To explore the user's perception of Derartu Tulu Streets.

1.5 Research questions

1.5.1 Main question

What is Adama town street potential for comple street according to complete street multi criteria design approach?

1.5.2 Specific question

1. What are the challenges of inclusive street design associated with street users in Adama

town along Derartu Tulu street?

2. What are the determining factors, which influence street users in Adama Town along Derartu Tule street?
3. What is the street user's perception about Derartu Tulu street in Adama town along Derartu Tulu street?

1.6 Scope of the study

The physical scope of this proposal is to study the current problem and to plan a street for all users in Adama from Derartu square to the old railway. This street covers 860m in length and 25m right of way. Thematic scope of this research covers problem identification to the solution of the street of Adama city around Derartu square by adopting the principle of a complete street.

1.7 Significance of the study

A complete street is playing an important role in forming the visual image of cities, so this research analyzes the problem of Adama city street from Derartu square along Derartu Tulu street to the Ethiopia-Telecommunication office building, then fix this problem by principles of complete street design. This has different advantages such as Making streets for all users including all ages and disabilities, reducing traveling time, reducing traffic jams and overcrowding, and increasing the health of the society by encouraging walking and cycling.

This research helps the Adama town municipalities and Oromia urban development department (as a directly responsible and accountable entity) to identify gaps, weaknesses, and areas of inefficiency to improve the street quality of Adama town. The scope of this research covers problem identification to the solution of the street of Adama city around Derartu square by adopting the principle of a complete street. So, the final findings and output of this paper can also be used as a standpoint and spring for further research work in the related sectors and subject matter for one with interest.

CHAPTER TWO

LITERATURE REVIEW

2 Introduction

This section contains the review of published material related to complete streets which includes the definition, principles, and benefits of a complete street. This helps to understand the concept of a complete street, its principle, and its importance.

2.1.1 Complete street concept and why Complete Streets?

A complete street is a notable concept in transportation engineering that seeks to make sure safe provision of alternative transportation modes for users of all talents in the all-weather situation. In complete streets, transportation specialists are guided to make sure that design, construction, operation, and renovation of the transportation community of a community support travel via numerous modal selections: bicycles, assisted tool, foot, truck, public delivery, and automobile (Geoff et al, 2015). Complete Streets programs can offer numerous and widespread advantages, including streets that serve all users and are safer for everyone, including automobile drivers and passengers, and Complete Streets can include more mobility and convenience for people without an automobile. Complete streets will provide a variety of less expensive modes of transit, which can help people or families economically. Active travel can improve fitness and provide required physical exercise (City of Richmond 2016, Department of the health of Vermont 2012, WSP. Parsons Brinckerhoff. 2017).

2.2 The role of Complete Street Design for Urban Development

Streets are the cornerstone of transportation network. They're used by all modes of travel for extensive kinds of commercial, leisure, and journey functions. Street design subjects because properly designed streets are a tremendous community asset. Poorly designed streets, on the other hand, will have an unfavorable impact on business sports, recreational opportunities, private mobility, emergency reaction, and belongings values. Since the design of a road is so intently tied to how it performs and the way human beings enjoy the town, it's miles vital for

the town to carefully bear in mind the way it desires its streets to appearance and feature and to design them accordingly (Milwaukie Transportation gadget Plan, 2007).

2.3 Challenges of complete street design

According to Kienitz, (n.d.), Transportation networks, health and safety, the environment, and economies all benefit from complete Streets legislation. However, converting roads to Complete Streets can be difficult. Here are eight common complete Streets challenges and solutions for any town to consider. Land uses and street design are intricately related. So when designing street soroounding land use have to be considered. The other one is low cost transportation like public transportation have to be considered in street design. Streets are shared public space so one of the challenge of complete street is considering the asthethic value and safety of the street.

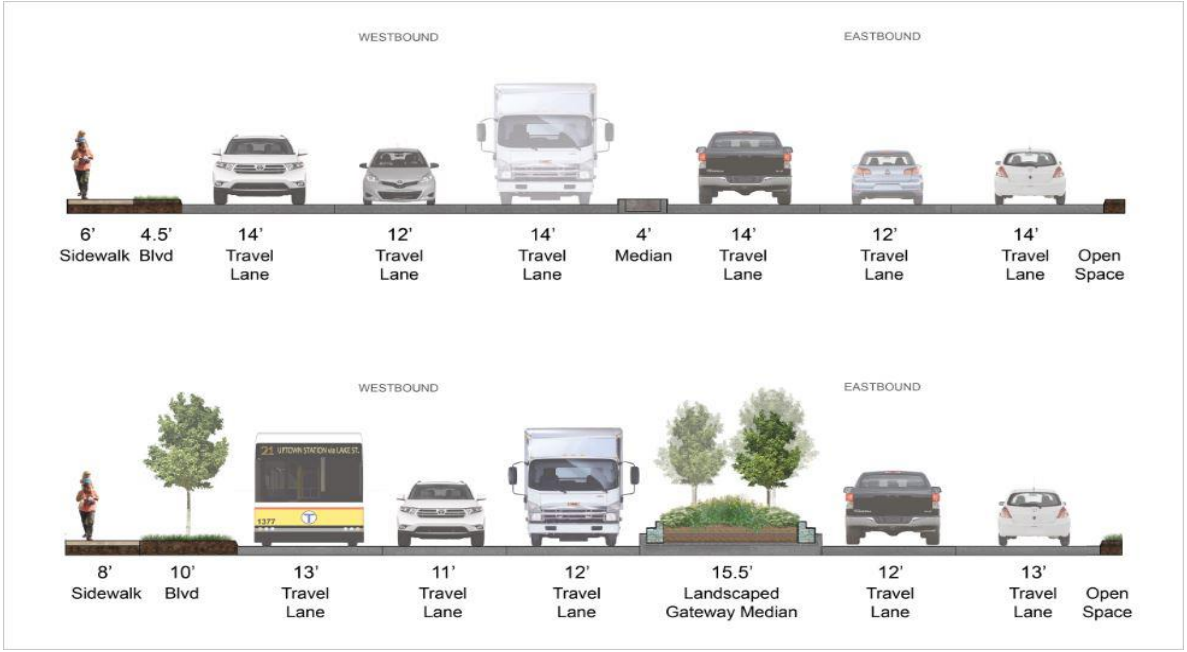


Figure 1: Changing incomplete street to complete street

Source: Google: https://www.sehinc.com/news/how-address-8-common-challenges-complete-streets-projects (2022)

According to Kienitz, (n.d.), It should be quick, safe, and simple to cross the street. There's a reason why the main streets are so congested. Important destinations and connections are included, often across a physical barrier such as a road or a body of water. Making room for

bicyclists on these roads can be difficult because most riders find riding alongside heavy traffic uncomfortable. There are a lot of moving parts in transit. Many of the streets would be incomplete without public transportation. The presence of on-street parking is frequently influenced by the surrounding land use. However, removing or reducing on-street parking as part of a project is typically seen as a burden by companies and property owners.

2.4 Design Standards

2.4.1 Vehicle (lane) way standard

The width allocated to lanes for motorists, buses, trucks, bikes, and parked automobiles is a sensitive and vital element of road design. Lane widths should be considered in the assemblage of a given road delineating space to serve all wishes, together with travel lanes, safety islands, bike lanes, and sidewalks(countrywide association of city Transportation officers, 2013). In line with the AASHTO green book, for rural and urban arterial, lane widths may range from 3 to .65m. It goes on to say that 3.65m lanes ought to be used where sensible on higher speed, loose flowing, principal arterial.

Figure 2: Lane width

Source: google, https://nacto.org/wp-content/themes/sink_nacto/views/design-guides/retrofit/urban-street-design-guide/images/lane-width/lane-width-existing.png (2022)

2.4.2 Public transport (bus lane) standard

Dedicated Bus Lane presents for the excessive-potential high-quality public delivery system at comparatively lower expenses. Special ROW for a bus is the primary need for the successful implementation of BRTS. Dedicated bus lanes are encouraged on roads with ROW 30m and above. The width of the bus lane is suggested to be min 7 m undivided for 2-way bus float (Pune Municipal organization, 2016).

2.4.3 Bicycle way standard

Bicycle lanes provide safe, dedicated travel lanes for bicyclists. Bicycle lanes are commonly applied on arterial streets with travel ways in each direction (town of la, 2013). The standard width for Bicycle lanes is 1.68m. A mixed lower parking/bike lane should be a minimum width of 3.81m, with 4m suitable. In locations where there may be no on-street parking, the 1.68m desired width applies. In first-rate circumstances wherein no different reasonable alternatives exist or retrofit conditions, a 1.22m minimal is permitted as long as there's no on-avenue parking (the metropolis of Redmond, 2012).

2.4.4 Sidewalk standard

The pedestrian region is the region of the sidewalk corridor this is specially reserved for pedestrian tours. This area must be freed from all limitations, sticking out objects, and any vertical obstructions unsafe to pedestrians, specifically for people with vision impairments. The pedestrian area should be at least 1.8 m-3.0m wide or extra to fulfill the favored stage of the carrier in areas with better pedestrian volumes. This allows pedestrians to stroll aspect through aspect or for pedestrians going in the opposite route to pass each other. The pedestrian quarter must be not less than 1.2 m, that's the minimal width required for people the use of a manual dog, crutches, and walkers. Wheelchair customers need about 1.5 m to turn round and 1.8m to skip different wheelchairs (Boodlal, 2016).

2.4.5 Street furniture standard

The planter/fixtures zone lies among the curb and the pedestrian travel area. Planters/furniture zone nearby and on collector streets, 1.2 m is preferred and on arterial and principal streets 1.8 m is favored. additional space may be required for transit stops and bus shelters which may additionally encompass a boarding pad commonly 1.5 m x 2.4 m. Signage inside the public right-of-way is a ubiquitous feature of the city streetscape. At a minimum, signs and symptoms

deliver crucial statistics to motorists, cyclists, and pedestrians (Boodlal, 2016 and city of la., 2013).

Public seating contributes to active pedestrian surroundings by enhancing the position of the sidewalk as an exciting public area Pedestrian road lighting is generally spaced 12-15m aside and about 6m from street trees relying upon on-site situations and light sorts. The space among light poles is 2.5-3 times the height of the pole. For pedestrian and bicycle light pole distance range from 4.5-6m (The City and County of Denver Public Works Department, 2019 and Town of Los Angeles, 2013).

2.5 Principle of complete street

The safety and security of all users of the transportation system, including pedestrians, bicyclists, bus users, freight and motor vehicle passengers, shall be accommodated and balanced in all forms of transportation and construction programs and at all steps of the project, so that even the most disadvantaged children, the elderly and people with disabilities can move safely within the public environment. From range to repair, all mobility initiatives and services would benefit pedestrians first, then bus users, bicycles, and cars (Department of Transportation 2013).

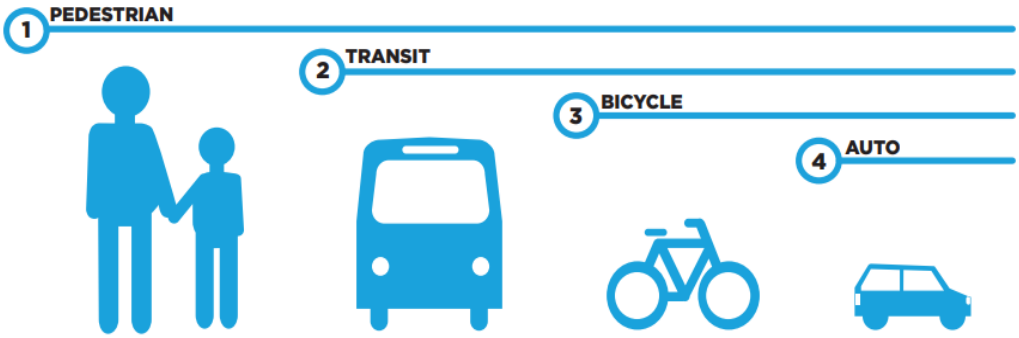


Figure 3: Complete Street Chicago: Design guideline, user ranking

Source: Complete Streets Design Guide 2017 State of New Jersey, book

The Complete Streets Project seeks to ensure that the planning, development, service, and maintenance of a comprehensive, integrated, linked multi-modal transport network balances the needs of all users, including people with disabilities, the elderly, infants, youth, and families, for accessibility, mobility, health, and safety. These guiding principles are used to guide the

planning and maintenance of the complete Street Strategy. The city complete street principle requires the following (Engineering and land survey, P.C. and WSP. Parsons Brinckerhoff. 2016, Denver the mile-high city 2020).

Smart-complete streets are the cornerstone of connectivity technology, delivering knowledge to transfer residents effectively and securely on buses, bike-sharing, and automated vehicles, and promoting future mobile networks for the city (Denver the mile-high city 2020).

Safe-complete streets provide priority to the protection of all users, with a focus on protecting the most vulnerable users (Denver the mile-high city 2020).

Green- streets are public spaces that incorporate green infrastructure to enhance the protection of street trees, treat storm-water runoff, and improve the overall quality of the community (Engineering and land survey, P.C. and WSP. Parsons Brinckerhoff. 2016).

Active-complete streets value the context of the culture and tradition of land use of the local area and build active, multi-functional spaces along with private property (Engineering and land survey, P.C. and WSP. Parsons Brinckerhoff. 2016).

Healthy - complete streets are built to allow everyone to bike, cycle, and ride transit, so they feel safe and secure and foster the well-being and freedom of all residents (Denver the mile-high city 2020).

Multi modal-complete streets are designed for motor vehicle drivers, walkers, bicyclists, and bus users of all ages and abilities. Multi modal designs guarantee the streets are shared, balancing everyone's needs (Engineering and land survey, P.C. and WSP. Parsons Brinckerhoff. 2016)..

2.6 Empirical literature Case study

2.6.1 Complete street city of Edmonton

2.6.1.1 Modal priority for Edmonton city

The hierarchy of transportation modes (such as walking and wheeling, cycling, transit, driving, and goods movement) that a street is constructed for, depending on the street type, is referred to as a modal priority. The city of Edmonton is currently constructing and certifying city-wide

modal priority networks for existing neighborhoods and new areas. These networks will map out the locations of multi-modal routes and linkages on a city-wide scale, assisting street designers in identifying which modes should be prioritized if space limits necessitate trade-offs between design components.

2.6.1.2 Lane width

Driver behavior, sidewalk animation, and the safety of users of all kinds of transportation are all affected by lane width. All users, including those walking and wheeling, cycling, taking public transportation, driving, and delivering goods, require lane widths that balance safety, access, and comfort. The designer should evaluate the following thorough considerations stated in the 2017 Fireseeds North report "Minimum Lane Widths for the City of Edmonton" before determining lane widths: Speed, available right-of-way, land use, street categorization, prioritizing of travel modes, volume, and level of service Sectional view History of collisions, Utilization and turnover of parking spaces Deliveries and loading at the curb, Utility installations, emergency services Topography and curvature, as well as snow cleaning and storage needs

Table 2: Design domain for lane widths (in m): design speed 50 km/h or less

Parameter: lane widths	Design domain recommended range		City of Edmonton target value
	Recommended lower limit	Recommended upper limit	
Standard travel lane (non-transit, non-truck route)	3	3.5	3
Parking lane	2.35	2.65	2.45

Source: Complete streets design and construction standards, city of Edmonton, book

2.6.1.3 Bicycle facilities and standards

The width of a protected bike lane should be determined by its directional. The suggested lower limit width of the bike lane for unidirectional protected bike lanes is based on single file bicycle traffic. When there is a high volume of bicycle traffic (e.g., more than 1,500 bicycles per day), the upper end of the stated range is advised to make passing maneuvers easier and to

accommodate varying cycling speeds. The proposed width of the bike lane component for bidirectional protected bike lanes is set to accommodate the full operational envelope for single file bicycle traffic in each direction, including minimal horizontal clearances to allow passing motions for persons traveling in opposing directions.

2.6.1.4 Pedestrian Through Zone

The horizontal operating envelope of individuals walking and wheeling, as well as the volumes of these activities, determine the pedestrian through zone width. To support the greater walking and wheeling volumes and allow individuals to stroll in groups, the suggested Pedestrian Through Zone width for a high activity area is 3.0 m. The minimum through zone width is 1.8 m in areas with lower volumes. This width allows a person holding a child's hand to pass another person, as well as a wheelchair user to pass a person walking or maneuvering, or two wheelchair users passing.

Table 3: Design Domain: Pedestrian Through Zone (in m)

Parameter: Width, Pedestrian Through Zone		Recommended Lower Limit	Recommended upper Limit
Collector Street	Moonwalk	2.3	Unlimited
	Separated sidewalk	1.8	Unlimited
Street Oriented Arterial Street	Separated sidewalk	2.5	Unlimited
Main Street/High Activity Area	Separated sidewalk	3.0	Unlimited

Source: Complete streets design and construction standards, city of Edmonton, book

2.6.1.5 Intersections (corner radii)

The purpose of the corner radius is to link the curbs of two crossing streets. To lower the speed of vehicle turns, corner radii should be constructed using the Design Vehicles' minimal vehicle turning route. Smaller corner radii provide a more waiting area for individuals walking and wheeling, allow for shorter crossing distances, allow for straight and direct connections, and improve pedestrian visibility. When choosing smaller curb radii, keep in mind that adequate

drainage around the corner must be considered.

Table 4: Design Domain: Intersection Corner Radii (in m)

Parameter: Intersection Corner Radii (Departing Street/Receiving Street	Design Domain Recommended Range Recommended Lower Limit	Recommended Upper Limit
Collector/Arterial Non-Truck Route	6.5	10.0
Collector/Collector	7.5	10.0
Main Street/Any Street OR Any Street/Main Street	4.5	10
Local/Any Street OR Any Street/Local	4.0	6.0

Source: Complete streets design and construction standards, city of Edmonton, book

2.6.2 Ethiopian street design standard

In this part, the street standard developed by the Federal Democratic Republic of Ethiopia Ministry of Urban Development and Housing was discussed shortly.

2.6.2.1 Pedestrian way standards

According to the Ethiopian street design standard, the width of the pedestrian way for sub-arterial street (SAS) of 30m ROW was 3.5m to 5m. The pedestrian crossing is a distance throughout a street reserved for pedestrians according to move while vehicular and bike traffics are stopped at street intersections or junctions. In streets having non-stop length, as would possibly keep tiresome than boring for pedestrians, mid-block crossings are essential. Minimum concealment over opposite bank shall lie 4m for SAS.

2.6.2.2 Public Transport Lanes

The scarcity concerning transport consequences between wastage of time and resources which on the lousy hand reduces productiveness or typical development. Therefore, all cities are proposed according to reserve suitable section regarding ROW on collector, and arterial streets because of transit lanes beginning from their preliminary stage. The minimum standard lane width for public transportation is 3.5m and for a 0.5million population of a town area, at least one bus lane be provided. Public transit lanes shall be made at the same level including other lanes.

2.6.2.3 Vehicular Lanes or Carriage Ways

Vehicular lanes or carriageways are areas reserved for motors from the ROW of streets. They streamline, organize and direct vehicular traffic. By offering separate lanes for motorized transport, they assist to shield pedestrians from traffic accidents. Vehicular lanes shall be segregated by full 30cm thick lines where crossing is not allowed and broken lines where it is allowed. The recommended lane width for a vehicle is 3m.

2.6.2.4 Bicycle Ways

In urban centers where the topography and climate allow separate bicycle ways shall be provided in SAS and PAS. Bicycle routes shall be segregated with curbs or concrete posts of a maximum of 15cm. Bicycle lines shall be marked with the sketch of a bike and a written description. The maximum design speed for the bike-way is 20km/hr and the minimum width for a one-way bicycle lane is 1.5m.

2.6.3 Lesson learned from the theoretical and empirical literature

The inclusive street also called complete street is a movement started around 1970 in America to close the gap created by automobile dominance after world war the second. The complete street has many benefits like creating a safe place for all street users, enhancing street accessibility, encouraging the city economy, and the health of residents. The complete street concept is an idea that has principles and elements to enhance the use of the street.

Defining complete streets at the project level is difficult and many professionals and organizations define complete streets according to their perspective. A complete street is defined as a street that allows the movement of pedestrians, bicycles, transit, and automobiles which include people of all abilities and aging. Complete street prioritizes the movement according to the sequence of pedestrian, transit, bicycle, and automobile. This increases the safety and health of the community.

Most of the streets especially in a developing country are incomplete streets. As a result, they have many problems like the exclusion of disabling and aging people, lack of bicycle lanes, lack of transportation alternatives, in the adequacy of the street facility, etc. this and the like problems increase cost and travel time, decrease the economy of a nation, decrease community healthy, decrease the safety, convenience, and comfort of the street.

This literature describes the complete street as a modern approach that comes to closing the gap created by the dominance of vehicles on the street. The complete street has many benefits like creating a safe place for all street users, enhancing street accessibility, encouraging the city economy, and the health of residents. The complete street concept is an idea that has principles and elements to enhance the use of the street.

Adama city street gives priority for the vehicles so understanding the inclusiveness of the street according to complete street (street for all) concepts improve the street by providing safety for street users, increasing the accessibility of the street, encouraging the city economy, and increasing the health of the resident.

From both national and international case study using the standard for the street is the backbone to design a street for all users. This standard includes lane standard, bicycle standard, walkway standard, etc. Using this standard, it is possible to make safe and comfortable spaces for street users. The street standard has a slight difference from country to country or city to city so it is necessary to adapt the standards according to city context.

2.7 Research gap

According to the Department of Transportation (2013), The safety and security of all users of the transportation system, including pedestrians, bicyclists, bus users, freight and motor vehicle passengers, shall be accommodated and balanced in all forms of transportation and construction programs and at all steps of the project, so that even the most disadvantaged children, the elderly and people with disabilities can move safely within the public environment. However, Adama city streets are mainly considered vehicle way which created different kinds of problems. So, this paper focuses on identifying the challenges of complete street design of Derartu Tulu street, examining the determining factors of complete street design, and exploring the user perception of this street.

The complete street has many profits like safety, accessibility, economy, and healthy for the street users and the country however Adama city streets are incomplete which are having many problems currently. Derartu Tulu street does not consider different parties of the society like disabled people and elders.

CHAPTER THREE

MATERIALS AND METHODS

3 Introduction

In this section, the methodology going to employ for the intended research work will be resented. These include the general approach of research design, types and sources of data, data collection methods, data analysis, and presentation.

3.1.1 Description of the Study Area

Adama town is located at 8.6^0 N and 39.3^0 E coordinates and lies at an elevation of 1712 meters above sea level. The town has mainly flat topography with a grid layout of the street pattern and is surrounded by steep mountains. The study accomplished Derartu Tulu Street starting from Derartu square to the telecommunication building. The street has a 1km length and 25m width.

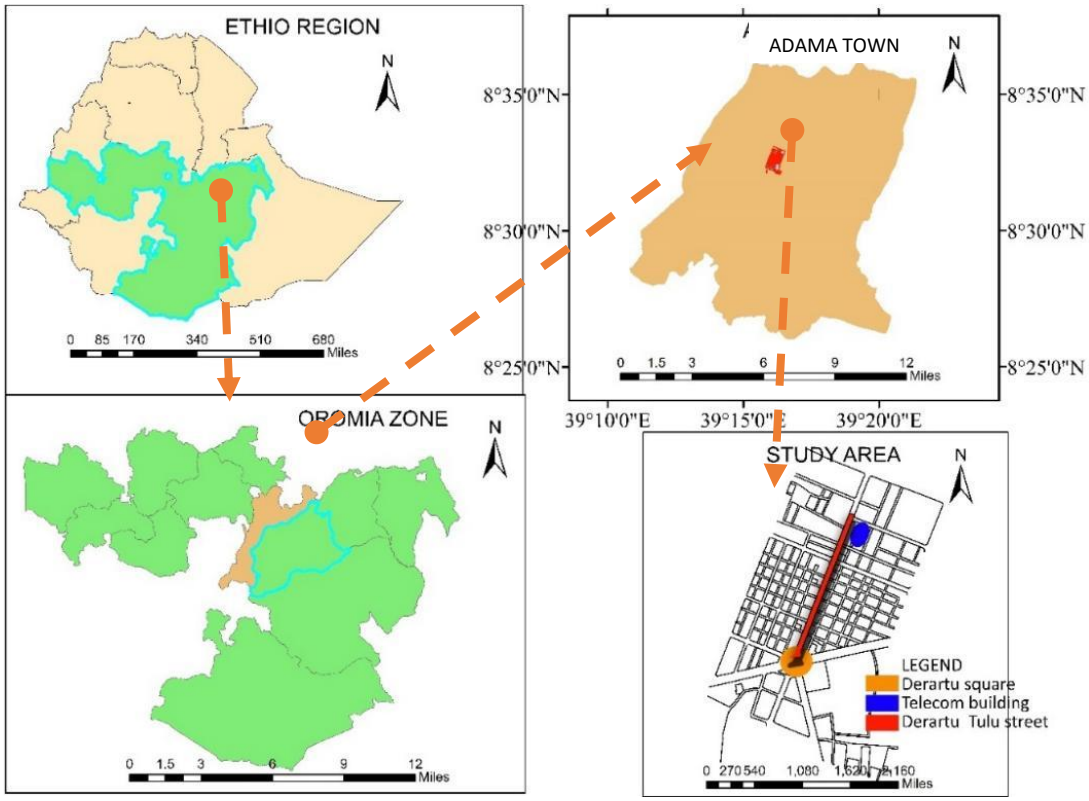


Figure 4: *Location map*

3.2 Research design

For this research descriptive approach is applied. These approaches were intended to define and include the magnitude and complexity of the challenges of complete street design. This brings up what is and to what degree, these challenges are happening on the real ground. It also provides a detailed view of the issues through observational and surveys studies and their effect on all street users (Dukale 2012).

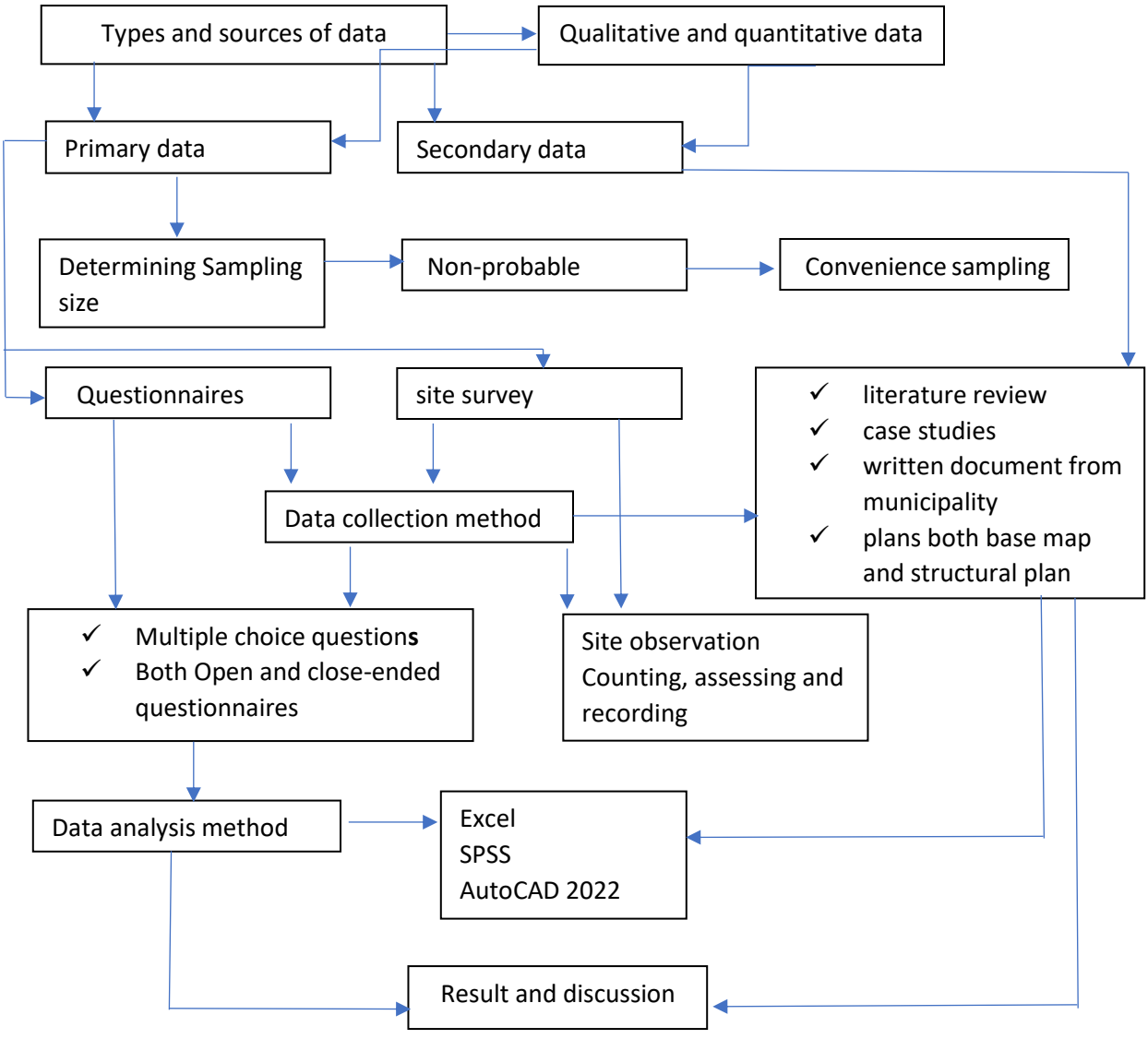


Figure 5: Methodological design

3.3 Types and sources of data

Different kinds of data were used to carry out this research. They are categorized into two. The first one is primary data and the second one is secondary data.

3.3.1 Source of data

Primary data like the existing reality on the field and sample members were collected through observation and structured and semi-structured of both close-ended and open-ended questionnaires. The secondary data were collected from various police documents, project documents, books, articles, journals, and other published and unpublished relevant materials.

3.3.1.1 Primary data

Different kinds of primary data were collected by the researcher. The density and flow of vehicles and pedestrians were among the main data collected. Counting pedestrian and car flow for a specific period and Measuring street width, pedestrian ways, medians, etc. are also conducted. structured questionnaire of open and close-ended are applied to the sample population to collect the opinion of street users.

3.3.1.2 Secondary data

Secondary data like the base map and structural plan of the area were collected from the city municipality. Text documents related to planning and design preparation and standards were gathered.

3.4 Sampling method

The population of the site is unknown because it includes anybody who uses the street. Even though the total population of the site is infinite, the study was conducted the on-site street users interview survey. For this Cochran's formula (1963), was used to determine the sample size since the population size is infinite for street surveys (Hamed 2017).

$$n=z^2pq/e^2$$

where;

n is the sample size

z is the selected critical value of desired confidence level which is 95% (standard value 1.6)

p is the estimated proportion of an attribute that is present in the population with 50% q=1- p which is 1-0.5=0.5

e is the desired level of precision which is ±5%

$n= (1.96)^2(0.5)\ (0.5)/\ (0.05)^2 = (3.84)\ (0.25)/\ (0.0025) = \underline{384}$

Thus, this research was conducted 384 sample population size for those who were willing to interview.

3.5 Data collection method

The primary data collection method was involved in collecting data through self-administered questionnaires with the aid of trained data collectors, and field studies done through site observation..

3.5.1 Qualitative data collection techniques

The data relating to ideas, opinions, values of street users, field notes from observation of several activities, taking a photograph of the area, recording videos were collected qualitatively.

Observation: - A checklist for site survey was prepared and applied to collect data from the site through observation.

Questionnaire: -The questionnaire was prepared and organized in a relevant and understandable manner in the language of the local communities and the respondents, primarily being prepared in English and then translated to Amharic and Affan Oromo. The questionnaires included both open-ended and close-ended questions which were supplied to the different respondents. These questionnaire were collected by data collectors from different types of street users including pedestrians, drivers, cyclists, and public transportation users of different ages, abilities, and sex.

3.5.2 Quantitative data collection techniques

The quantitative method was applied to investigate the requested and observed numerical data.

Measuring: This included measuring the pedestrian way, vehicle way, counting car flow per time, counting pedestrian and bicycles flow per time, street amenities, and street construction material. Meter tape was used to measure the different distances on Derartu Tulu street.

3.6 Data analysis

Content analysis: The collected data were processed and categorized into verbal or behavioral data to classify, summarize, and organize the data. In this data like notes, video, audio recordings, images, and text documents were analyzed.

Framework analysis: Formalization, identifying a thematic framework, coding, charting, mapping, and interpretation was employed.

The numerical data collected by observation and measuring of the site situation was analyzed by comparing them with standards reviewed in literature.

3.7 Derartu Tulu street classification

For this research, the selected street starts from Derartu square to Ethiopia-telecommunication biro. These covers 860m in length and 25m in width. To simplify data collection on this street, it is necessary to classify the Derartu Tulu street in parts. As shown in the figure 6 this street is divided into nine parts and named by alphabetical letters from Derartu square to the end.

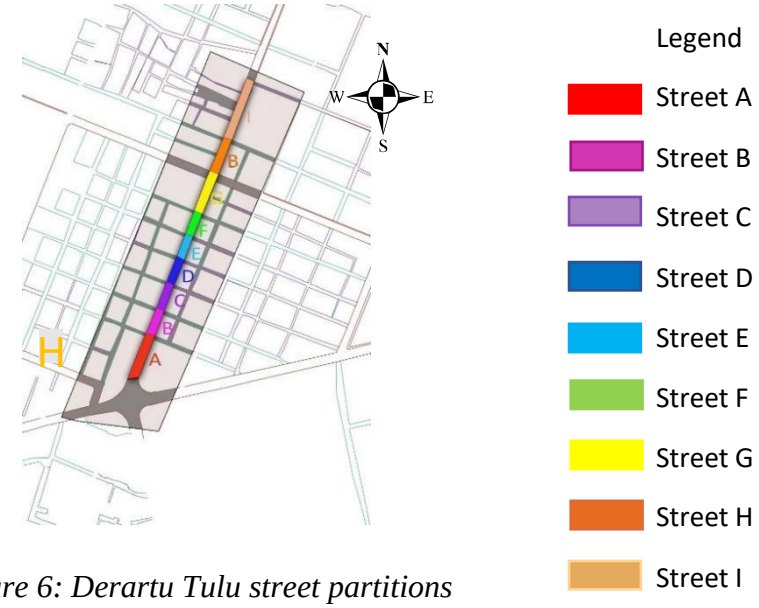


Figure 6: Derartu Tulu street partitions

CHAPTER FOUR

RESULT AND DISCUSSION

4 Introduction

The main chapter of the research is the result and discussion of a study that works to fulfill the objective proposed by the researcher. In this research, both primary and secondary data were analyzed and reported qualitatively and quantitatively through the evaluation of the self-administered questionnaires, and field study.

4.1 Result

Under this, all data collected from the site and secondary data were analyzed and their result was described.

4.1.1 Identifying challenges of inclusive street design

4.1.1.1 Street user's choice of transportation on Derartu Tulu (Mebrat Hayle) street

Figure 7 illustrates that approximately half the street users (49.75) use public transportation. This public transportation includes Minibus, Bajaj, Service Bus and public Buses. People prefer public transport because of mainly transportation cost and travel time. Of 384 respondents, 112 responded that they use public transportation as a result of their economy. 48 people responded that they use public transportation to reduce their travel time by foot. Approximately one-third (125 or 32.6%) of the respondents use walking on this street. Of these 125 respondents, 67 of them use walking because of proximity. 42 of them responded that it is economically safe.

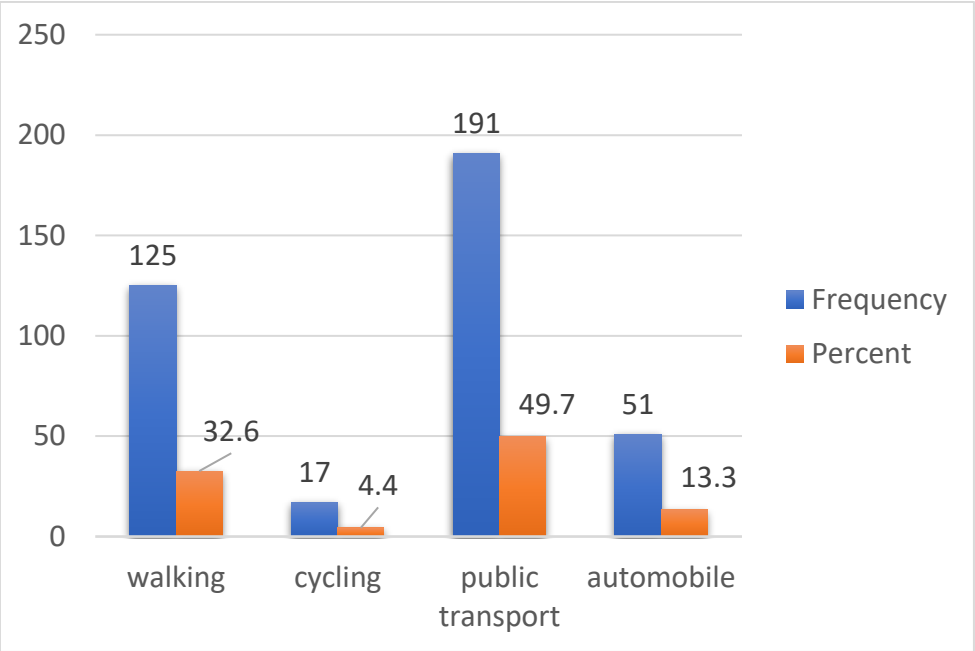


Figure 7; Transport choice of the respondents

4.1.1.2 Suitability of Derartu Tulu street for all movements

The respondent asked whether Derartu Tulu street is suitable for all movements or not and they replied the following.

As shown in Table 5 1.3% of the respondent agreed that Derartu Tulu street is not suitable for all movements. This was caused as a result Derartu Tulu street is not wide enough to hold all the movement so there is overcrowding on this route. About 97 (25.26%) respondents mention overcrowding and the narrowness of the street on the open question. The other reason respondents mention the problem of the Derartu Tulu street is the design problem which doesn't include bicycles, safe walkways, and disabled people and around 117 (30.47%) persons mention this issue. Some (around 88 or 22.92% persons) of the respondents mention about lack of traffic lights and traffic signals which made Derartu Tulu street difficult for movement. The other 18.7% of the sample population responded that Derartu Tulu street is suitable for any kind of movement.

Table 5: Suitability of Derartu Tulu street

		Frequency	Percent
	Yes	72	18.7
	No	312	81.3
	Total	384	100.0

4.1.1.3 Most difficult situations to street users on Derartu Tulu street

Respondents are asked what matters more to them on Derartu Tulu street and their response is organized as below in figure 8.

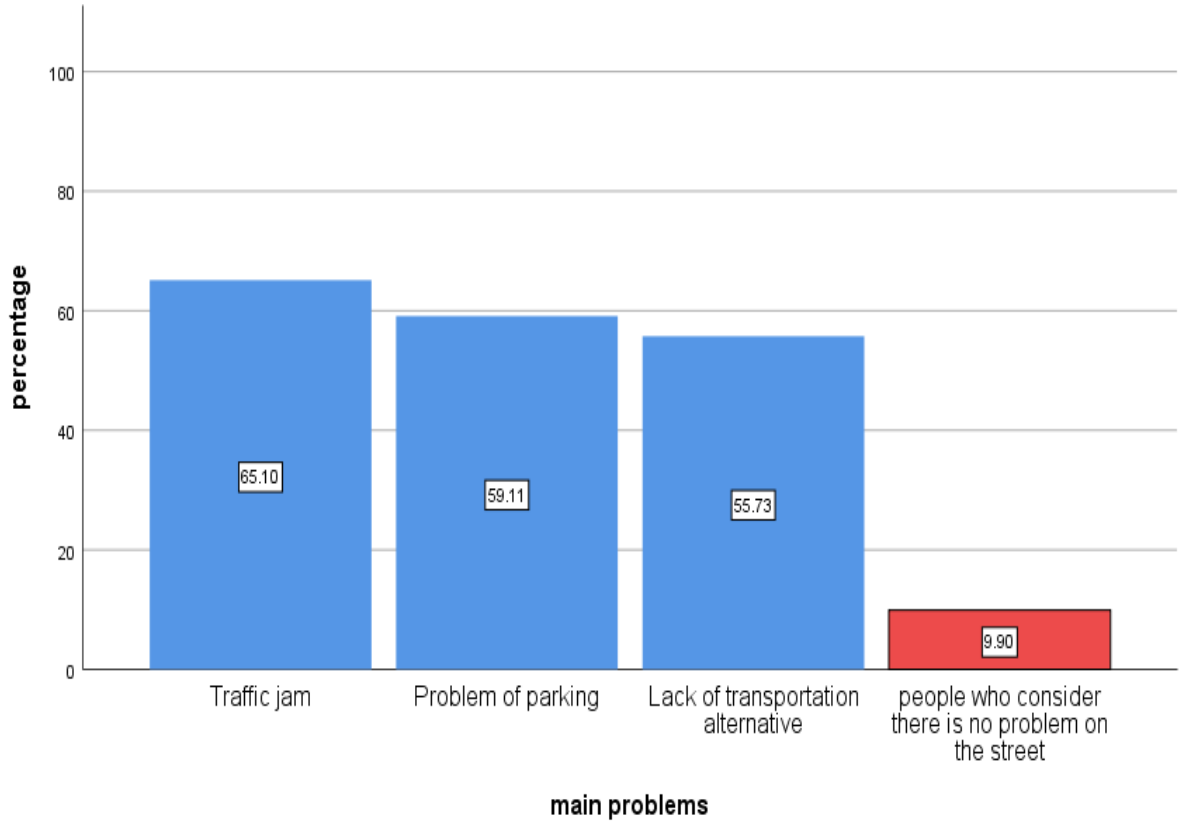


Figure 8: Factors matter more to street users on Derartu Tulu street

As indicated in figure 8. according to around one-third of respondents (65.10%), traffic jam is the Most difficult situation on Derartu Tulu street. This traffic extent the travels time, harm the economy, and also made the street users uncomfortable. The other factor that 59.11% of the respondents mention is the parking problem. Derartu Tulu street is a two-lane street and there is no proper on-street or off-street parking provided. So, drivers park their vehicle on the second lane and on the pedestrian way which made the street overcrowded and difficult for movement.

The other factor which 55.73% of respondents mention is lack of the transport alternative. Minibus and automobiles are dominating this street. Bajaj is not allowed after the awash bank on this street and the street is not suitable to use bicycles so people are forced to use only minibusses, automobiles, and walking which is difficult because of overcrowding and unseparated walkway. 9.9% of the sample population disagree on any problems of the street.

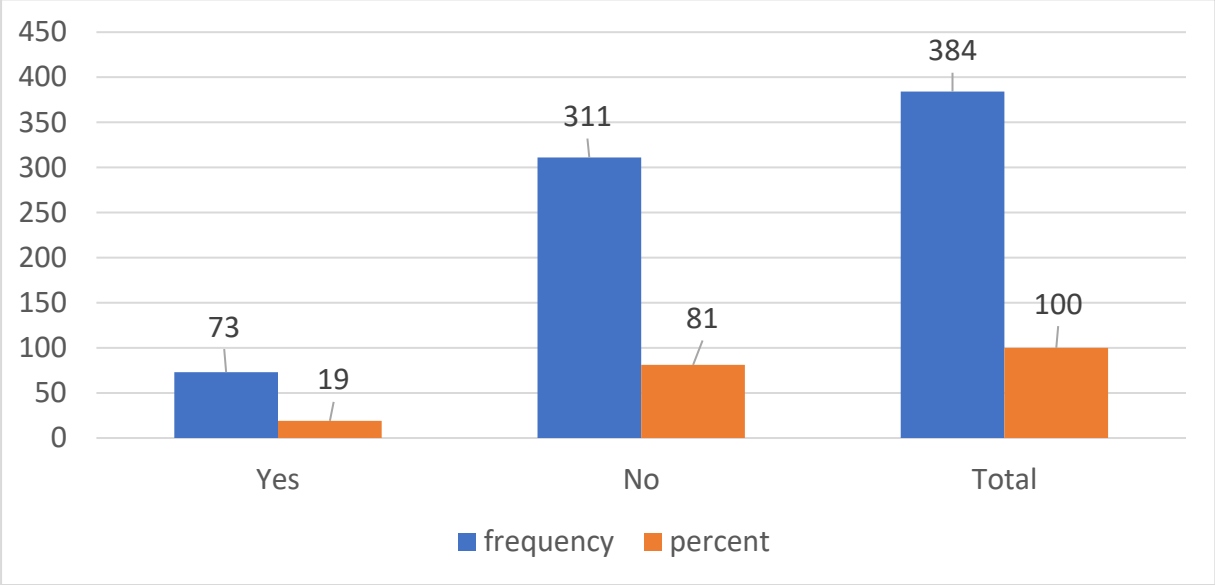
Figure 9: Image shows traffic jams and parking problems

4.1.1.4 Usage of bicycle on Derartu Tulu street

Respondent asked about whether they use a bicycle or not on Derartu Tulu street and they replied the following

Figure 10 illustrates 384-sample population, 311 (81%) respondents do not use a bicycle on Derartu Tulu street. This is because of different kinds of problems around there which made bicycle use difficult. The main problem of the Derartu Tulu street to not use bicycle is there is no lane separated for a bicycle so it is very dangerous to use bicycle between other vehicles.

Figure 10: Usage of bicycle on Derartu Tulu street



As indicated on figure 11 more than half (55.47%) of respondents mention the lack of bicycle lanes as a problem for not to use a bicycle on Derartu Tulu street.

The other problem which made using bicycles difficult on Derartu Tulu street is the lack of bicycle parking. There is no bicycle parking place and bicycle parking furniture on this street so, 42.45% of the sample population address this problem as not to use a bicycle. The other thing is people have no awareness to use a bicycle. 39.59% of the respondent don't use the bicycle because of lack of interest. Using bicycles has many advantages as individuals and as a country like healthy for the individuals and air quality as a country so awareness to use bicycle is mandatory.

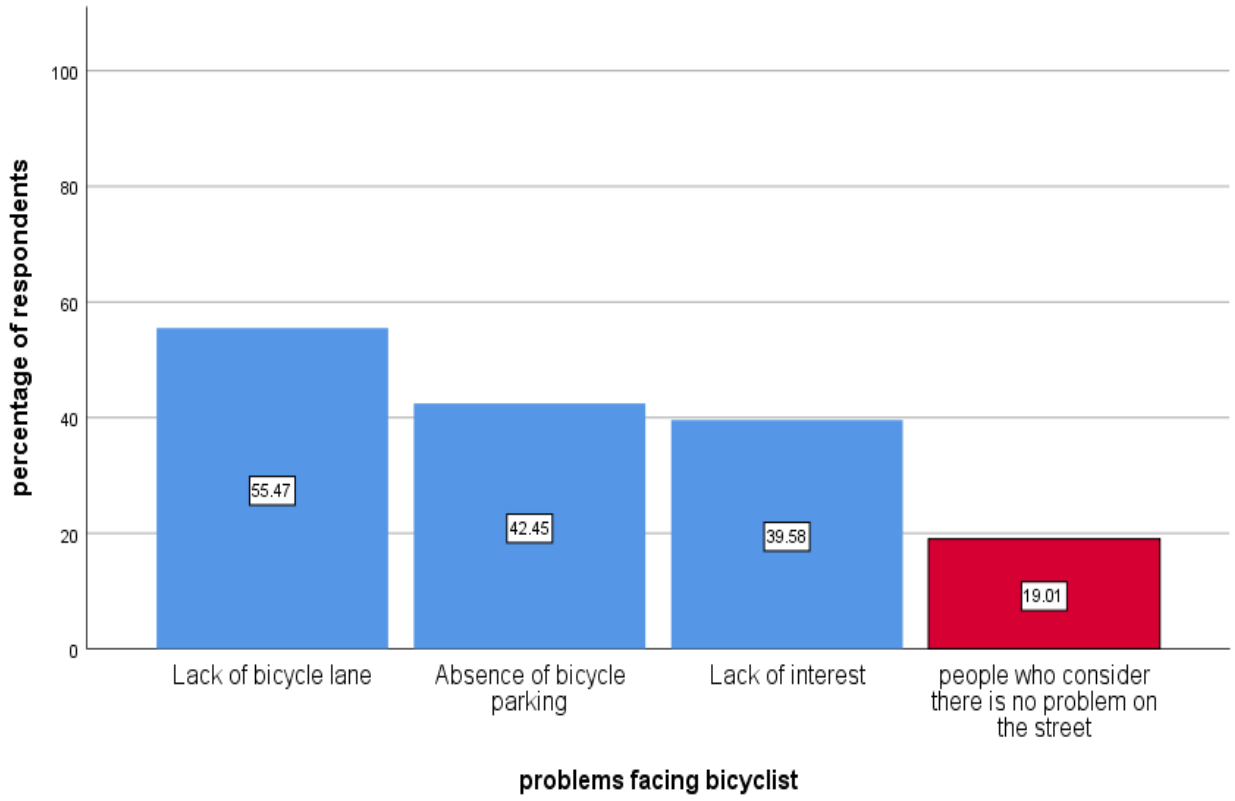


Figure 11: Problems mentioned as not to use a bicycle on Derartu Tulu street.

4.1.1.5 Congestion on the Derartu Tulu street according to respondents

Respondent asked about the existence of congestion and their duration and replied the following.

Figure 12 illustrates more than three fourth (83%) of the sample population replied that Derartu Tulu street is a congested street. Congestion extends travel time, increases air pollution, increases traffic accidents, harms the economy, etc.

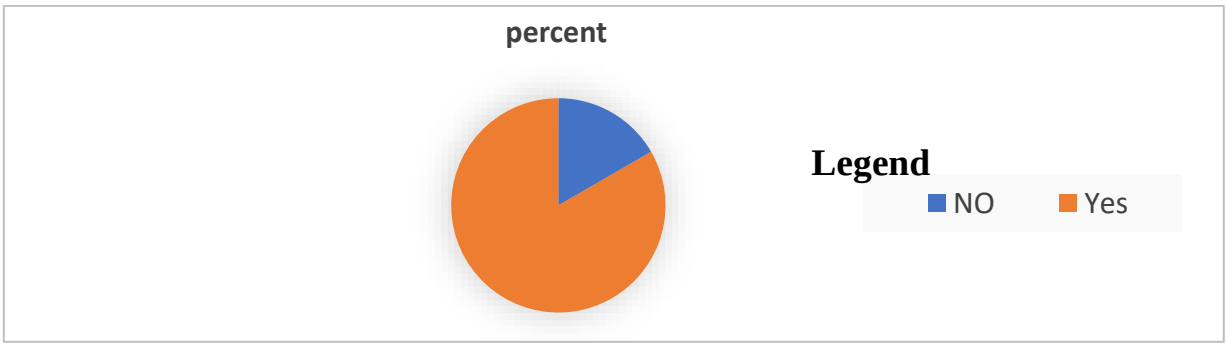


Figure 12:conjection on Derartu Tulu street

Figure 13 illustrates Derartu Tulu street is congested all day. Congestion on this street reduced around nighttime. This street is very congested around morning when people go to work 35% of respondents mentioned it. The other 30% mention congestion worth en around 8:00-12:00 local time that is when people go from work to home. As shown in figure 26, from the sample population, 17% replied that there is no congestion on Derartu Tulu street.

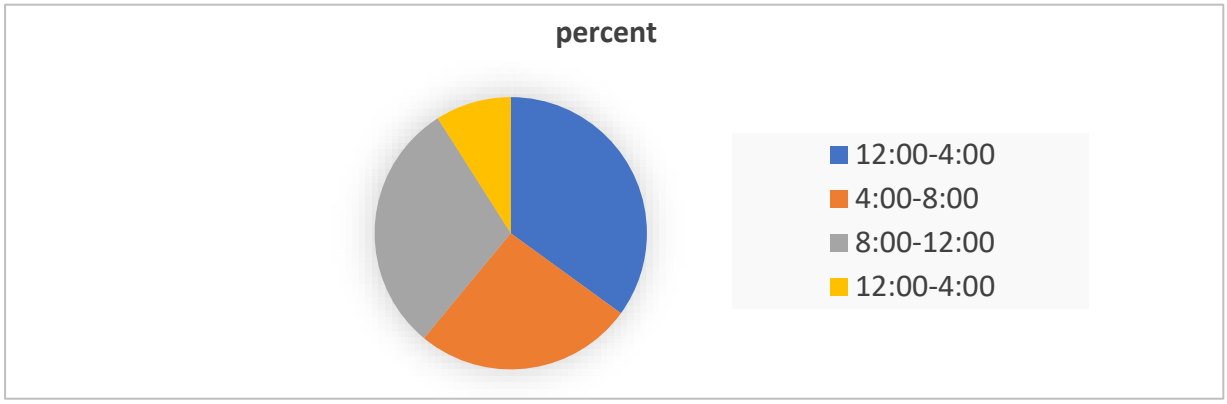


Figure 13: Time of congestion on Derartu Tulu street(local time

4.1.1.6 Derartu Tulu street at night time

The Respondent asked about the difficulty of Derartu Tulu street during the night and their reaction was organized as follows.

Table 6: Is Derartu Tulu street difficult at night?

	Frequency	Percent
yes	272	70.8
no	112	29.2
Total	384	100.0

Table 6 illustrates more than two-third (272 respondents or 70.8%) replied that using Derartu Tulu street is difficult at night time. This is because of Poor Street lights, traffic signals problems, traffic lights, street vandalism, etc. Respondent's idea toward this problem is shown

in figure 14. Around 112 (29.1%) of the respondent replied that Derartu Tulu street is not difficult during nighttime.

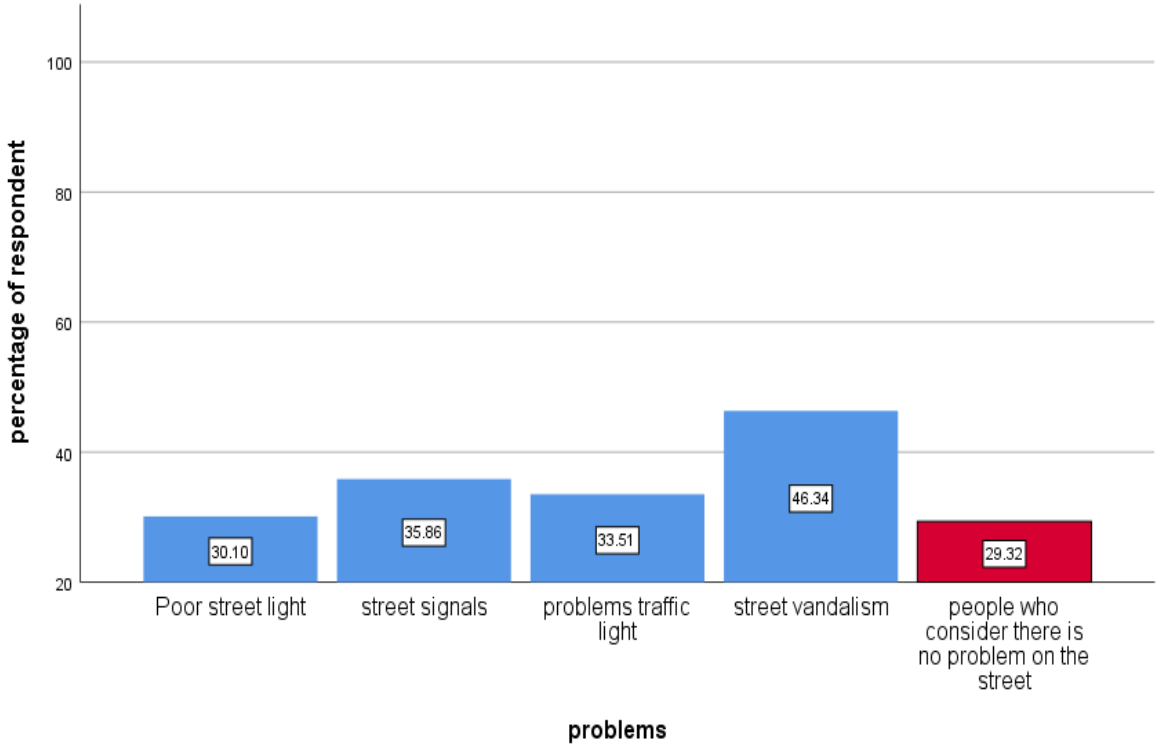


Figure 14: Problems of Derartu Tulu street at night

4.1.2 Examining the determining factors influencing street users on Derartu Tulu street

Field survey checklist prepared as on Appendix III to access the different elements of Derartu Tulu street. The data was gathered and its result was analyzed as below. Both national and international standards were used to analyze the data.

4.1.2.1 Land use along the Derartu Tulu street

Along Derartu Tulu street commercial activity has dominated the area and there are also some service, greenery, and administration areas. As a result of commerce around this area, many people come and use Derartu Tulu street from day today. As indicated in the figure 15 there are many intersections on Derartu Tulu street. These are 8 cross junctions and 6 T-junctions. This intersection made the street difficult to move and create overcrowd a street.

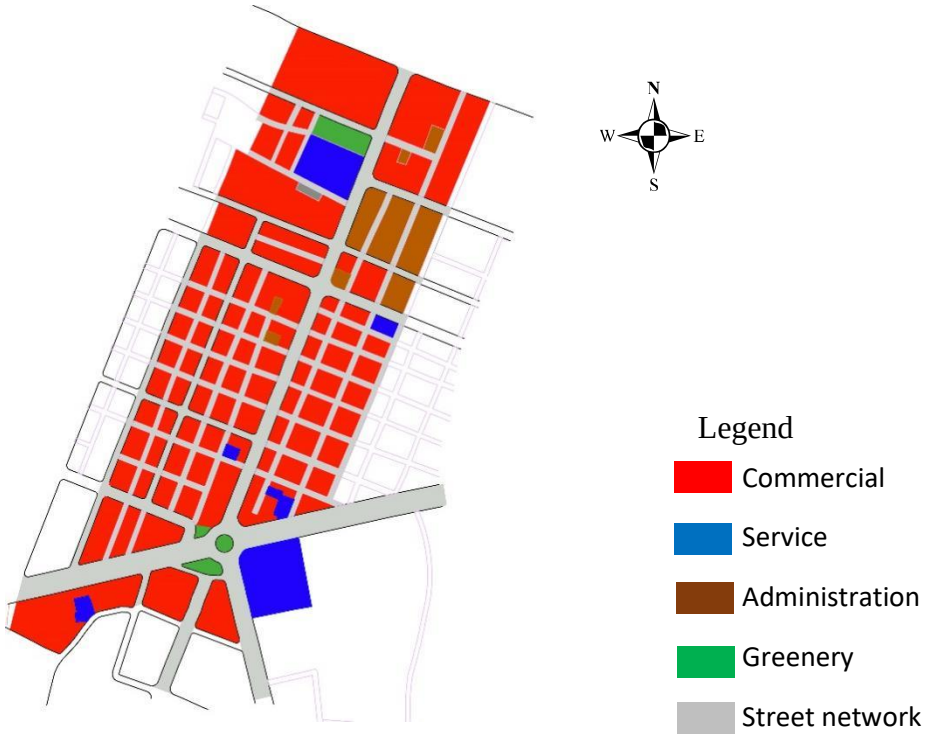


Figure 15: Structural plan land use along the Derartu Tulu street

4.1.2.2 Derartu Tulu street traffic volume

Street users on Derartu Tulu street use different kinds of transportation like Minibus as public transport, Bajaj, Automobile, walk, and bicycle. Medium cargo also uses this street. The volume of traffic on Derartu Tulu street was summarized in Table 7. This data was collected on three different days at different duration of the day and summarized by average.

Table 7: Traffic volume counted on Derartu Tulu street for 15 minutes

Days	Bajaj	Automobile	Minibus	Bicycle and motorcycle	Cargo Vehicle	Pedestrians
Day 1	272	75	96	49	16	612
Day 2	309	106	114	42	18	661
Day 3	221	91	116	36	13	586
Average	267	91	109	42	16	620

Table 7 illustrates Averagely within 15 minutes around 267 Bajaj, 91 Automobiles, 109 Minibuses (taxis), 42 bicycles and motorbikes, 16 Cargo vehicles, and 620 pedestrians were

passed through the segment line on Derartu Tulu street. There are also a few service buses for workers but they show up like twice a day so their number is neglected.

4.1.2.3 Street light along Derartu Tulu street

A field survey checklist is prepared to count and measure the number and distance between street lights along Derartu Tulu street and the result is organized as in Table 8.

Table 8: Street light on Derartu Tulu street

Street section	No Of Street Light	Length of the road (m)	Street width (m)	Street lighting width in (m)	quality Good-G, Bad-B, Medium-M
A	7	126	27	30	b
B	5	70	25	30	b
C	4	72	27	34	b
D	5	71	30	26	b
E	4	60	28	27	b
F	4	64	25	29	b
G	8	112	24	30	b
H	6	95	26	29	b
I	9	162	28	28	b
Total	52	832			

Table 8 illustrates the street light on the Derartu Tulu street is averagely placed by 30m gap and good as per Ethiopian standard. Some of the street light is placed above the giant tree and their light is blocked. Some of them are not working needs maintenance.

4.1.2.4 Walkway along Derartu Tulu street

Data about quality, width, and material of walkway on Derartu street were gathered by questionary survey and its result is organized below on Table 9.

Table 9 illustrates the width of the pedestrian way is varied on Derartu Tulu street. The maximum width of the walkway recorded on Derartu Tulu street is 4.2m and also in someplace there is no walkway at all because it is blocked with other activities. The width of pedestrian way is varied along Derartu Tulu street. Street vendors are one of the problems on Derartu Tulu street which blocks the walkway. There are also obstacles like trees in the middle of a walkway,

signage, and some street furniture. Drivers Park their cars on the walkway which block pedestrians and made the street overcrowded. The following image shows the problems of a walkway on Derartu Tulu street.

Table 9: Walkway along Derartu Tulu street

Street section	Walkway Width(m)	Pedestrian width (m) standard	Curbstone(m)	Material Type	quality Good-G, Bad-B, Medium-M
A	2.8	3-5	irregular		B
B	3	3-5	irregular		B
C	2.5	3-5	irregular		B
D	1.8	3-5	irregular	Poor quality asphalt, Cobblestone, terrazzo.	B
E	1.5	3-5	irregular		B
F	3	3-5	irregular		B
G	2	3-5	irregular		B
H	2.2	3-5	irregular		B
I	3	3-5	irregular		B

Figure 16: Image show walkway problems on Derartu Tulu street

4.1.2.5 Trees along Derartu Tulu street

Data about trees on the Derartu Tulu street were collected by questionnaire survey and they are organized as the below Table 10.

Table 10 illustrates there are different types of trees along Derartu Tulu street. The shade of the trees along the sidewalk is different starting from the minimum 1.5m radius and maximum 6m radius. This indicates trees along pedestrian way are not appropriately selected by both their function and aesthetics. Most of the gaps between trees along the walkway are 6m which is good for shading especially for Adama climate but in some places, they are far apart up to greater than 20m which is very difficult to gate shade. Some of these trees are not placed in the appropriate place and they block pedestrian movements.

Table 10: Trees along Derartu Tulu street

Street section	No of trees	On median	Block length	The gap between the tree on a sidewalk	The gap between the tree on the median	Shade in radius
A	10	10	126	20	9	4
B	14	6	70	8	12	5
C	10	5	72	11	16	6
D	13	6	71	9	10	5
E	10	7	60	9	8	4
F	9	7	64	12	8	3
G	17	8	112	9	11	5
H	19	10	95	8	9	5
I	29	15	162	10	10	3
Total	131	64	832			

Figure 17: Image shows about trees on Derartu Tulu street

4.1.2.6 Street crossing on Derartu Tulu street

From Table 11 data, almost all crossings are not painted. it makes the people confuse since it cannot be seen clearly. The curbs do not have a level difference with the carriageway due to this, the pedestrian is not feeling safe to crosswalk. The total crossing width is 18m which is acceptable as standard and there are no street signals to cross the street which make it difficult for pedestrian and increase the accident. There is also no ramp for disabled people and it is very difficult for them to cross the street.

Table 11: Crossing on the Derartu Tulu street

Street section	Crossing Painted	Crossing from the pedestrian (m)	Crossing width(m)	Minimum Crossing standard	Crossing Signage	Ramp
A	No	8	18	13	no	no
B	No	8	18	13	no	no
C	No	8	18	13	no	no
D	No	8	18	13	no	no
E	No	8	18	13	no	no
F	No	8	18	13	no	no
G	No	8	18	13	yes	no
H	No	8	18	13	yes	no
I	No	8	18	13	no	no

4.1.2.7 Lane width

On Derartu Tulu street there is no separate lane for vehicles and bicycles. The width of Deratu street for vehicles varies from 7m to 9m. There is no marked lane for vehicles on this street and there is no marked lane for on-street parking.

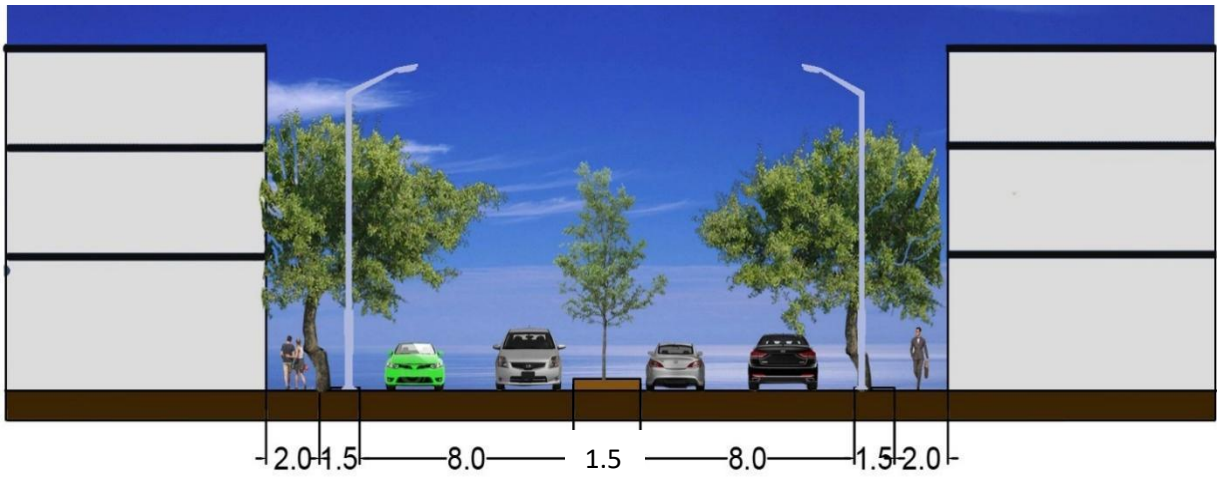


Figure 18: Existing Derartu Tulu street section front view

The existing sample lane, walkway, and street furniture were shown below in figure 19. All the measurements were in meters.

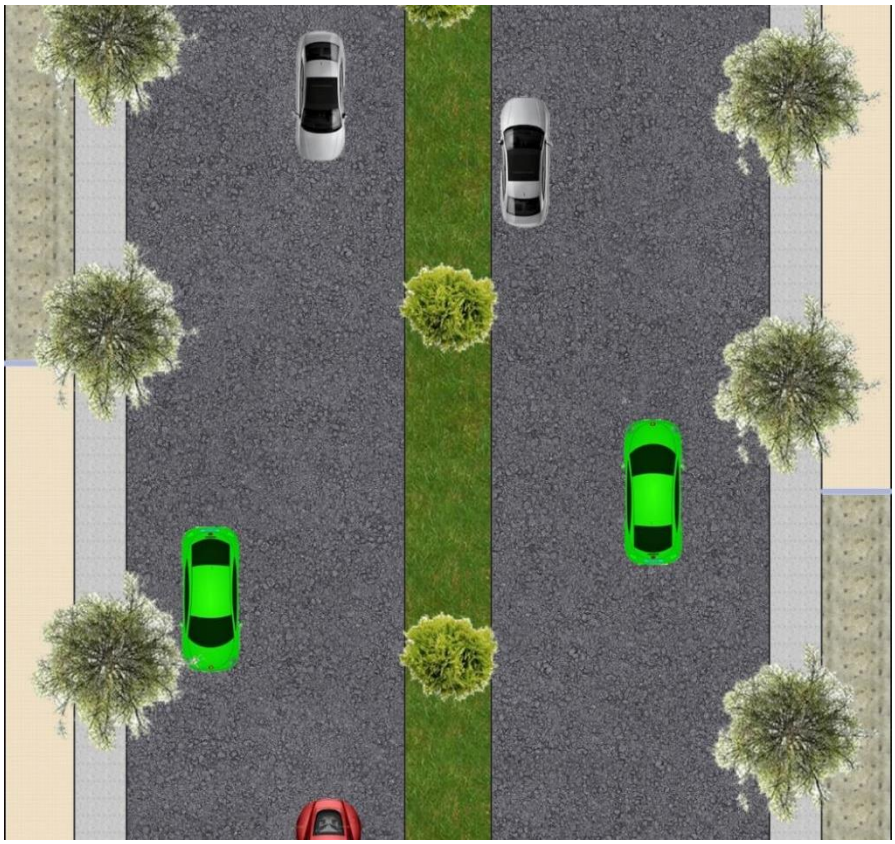


Figure 19: Existing Derartu Tulu street section top view

4.1.3 Perception of street users about Derartu Tulu street

4.1.3.1 The safety and comfort of the street according to respondents

Respondents asked that whether they are safe and comfortable or not when they use Derartu Tulu street and their responses are organized as above in Table 12.

Table 12 illustrates that more than one-third of the total respondents, that is 71.9% (276 people) replied that they don't feel safe and comfortable when they use Derartu Tulu street. This is because of problems like Parking problems like Un separated walkways, Obstacles on the pedestrian way, Un separated Lane for vehicles, Lack of bicycle lane, etc. The other 28.1% (108 people) replied that they are safe and comfortable when they use this street.

Table 12: safety and comfort of respondents

Safe and comfort	Frequency	Percent
Yes	108	28.1
No	276	71.9
Total	384	100.0

4.1.3.2 The favorite part of Derartu Tulu street for users

The sample population asked that from the vehicle and pedestrian way which they prefer the most and they replied as the following.

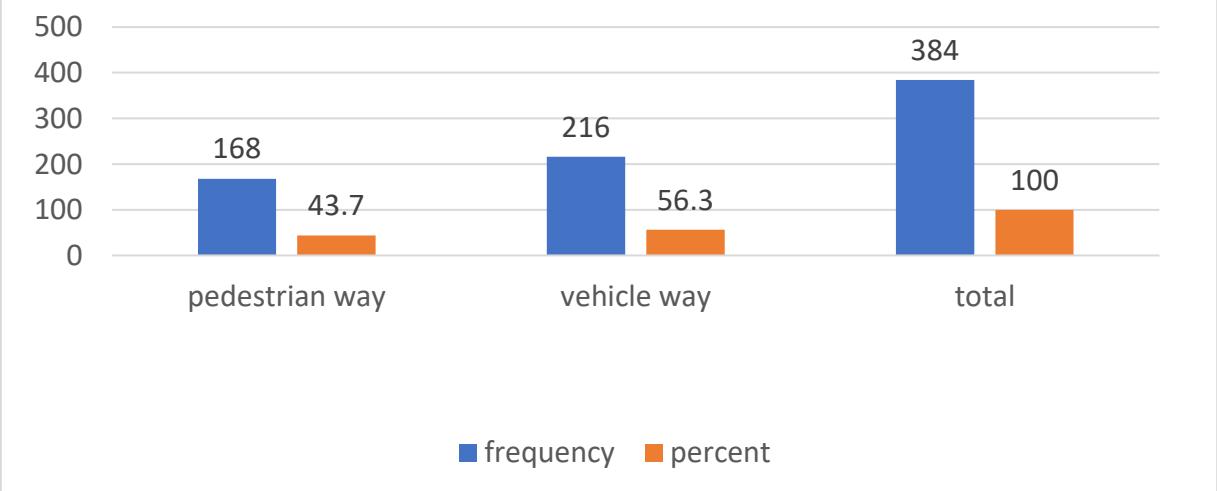


Figure 20: street preferences of respondents

Figure 20 illustrates more than half (56.3%) of the sample population prefer vehicle way on Derartu Tulu street. This implies that the vehicle way is more comfortable than the pedestrian way on Derartu Tulu street. The other 43.7% of the respondent replied that they use pedestrian ways than vehicle ways. This indicates even though the pedestrian way has some backward, people still use it.

4.1.3.3 Street users feeling on Derartu Tulu street

The respondents were asked their perceptual feeling about Derartu Tulu street and their reaction is organized in below figure 21.

Figure 21 illustrates 35.4% of the respondent don't precept any safety when they use Derartu Tulu street and around half (47.4%) of the sample population feel less safe on this street. This indicates that people worry about their safety on Boku street. The other 15.4% (59 people) replied that they feel safe when they use Derartu Tulu street. 1.8% of the respondent feel safe on Derartu Tulu street. This all implies that people concern about their safety when they use Derartu Tulu street because of the un separated walkway, un separated vehicle lane, un separated bicycle lane, lack of enough traffic signals, etc.

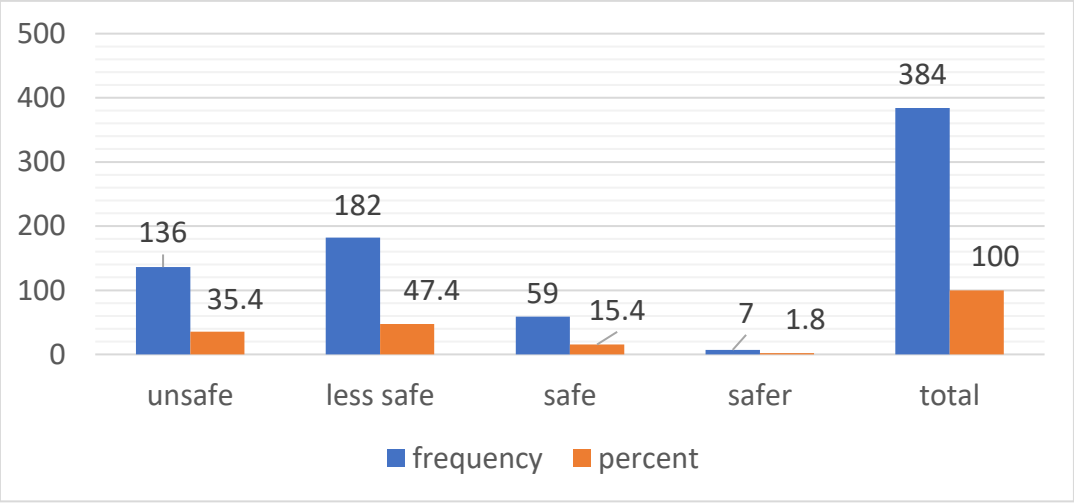


Figure 21: Safety perception of inhabitant on Boku street

4.1.3.4 Perception of people about a conflict between pedestrian, cycle, and drivers on Derartu Tulu street

People are asked about the conflict between street users (conflict between pedestrian and vehicles, vehicles and bicycle, bicycle and pedestrians and vehicles and vehicles.) and their responses are organized in the above figure 22.

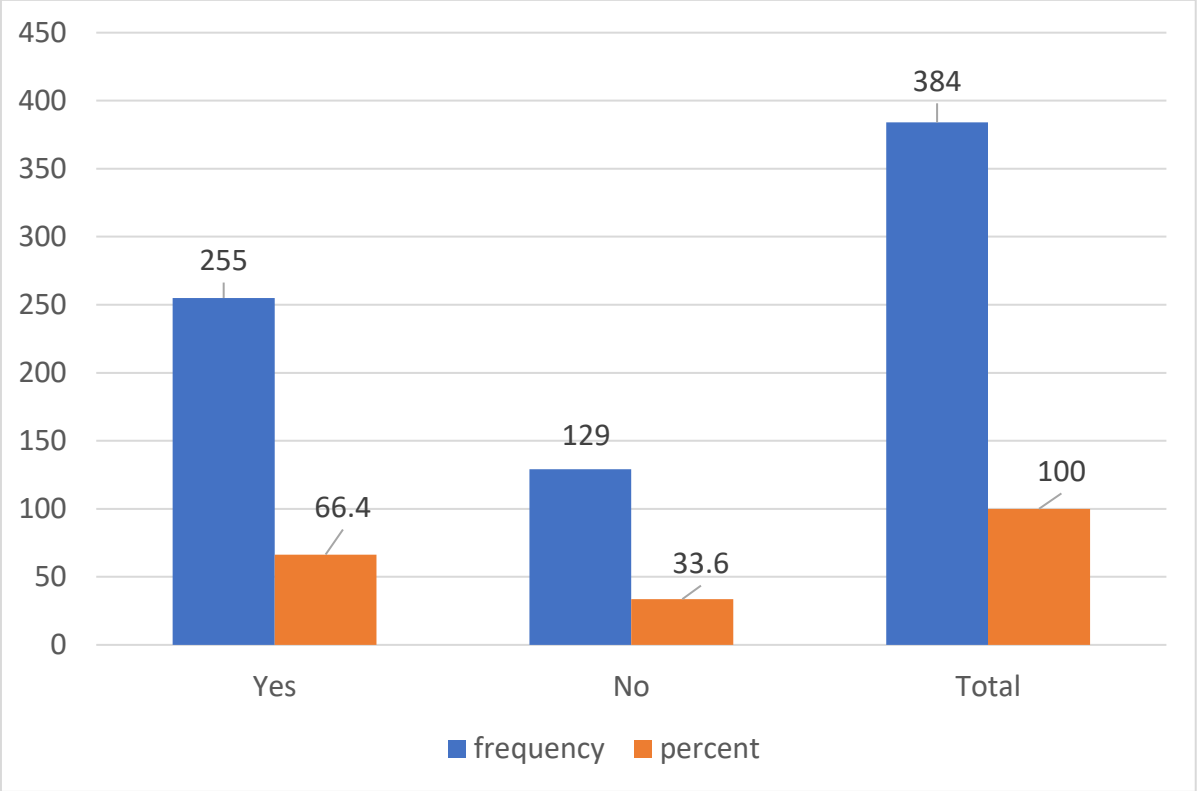


Figure 22: people perception about conflict on the Derartu Tulu *street*

Figure 22 indicate that around two-thirds (66.4%) of the respondent mention there is a conflict between different kinds of street users on Derartu Tulu street. This is because Derartu Tulu street is a very crowded street and the place commercial area which collect too many population pair days. People feel differently when they face this type of conflict between street users and their feeling described in figure 27. The other 33.6% (129 people) replied that they do not face traffic conflict on Derartu Tulu street.

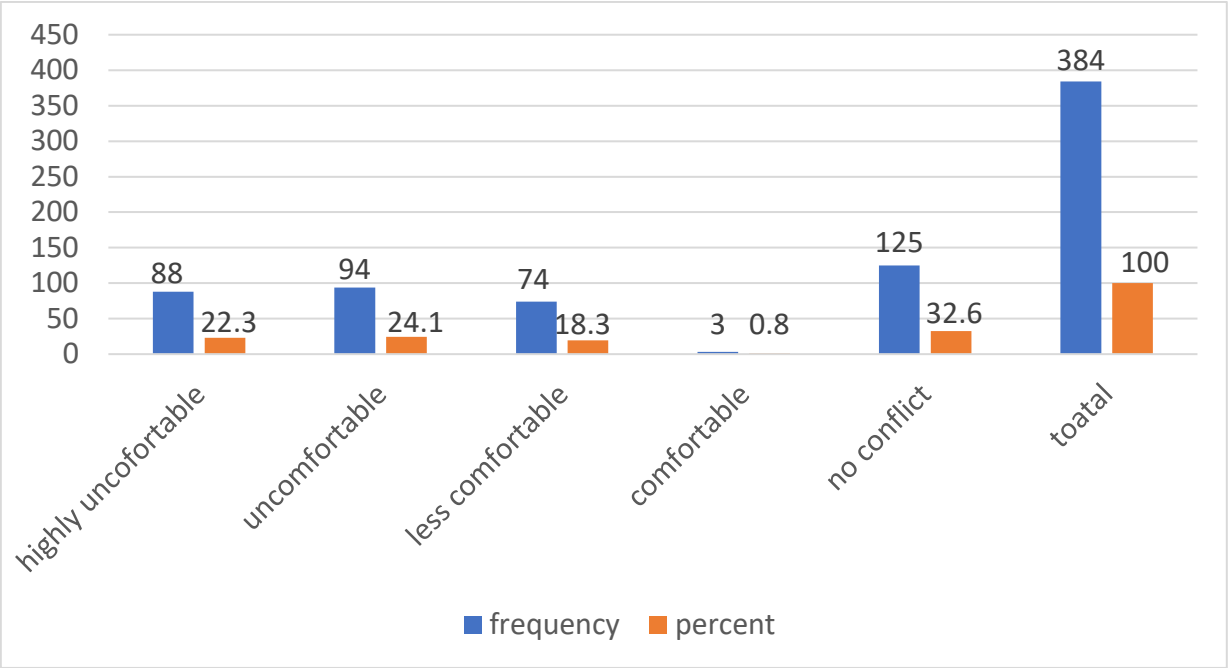


Figure 23: perception of the respondent about traffic conflict

Figure 23 illustrates 22.3% of the sample population are highly uncomfortable, 24.1% are uncomfortable, 18.3% are less comfortable on Derartu Tulu street as a result of traffic conflict. This implies that almost two-thirds (64.7%) of people are worrying about traffic conflict on Derartu Tulu street. The other 32.6 percent of respondents replied that they are not facing traffic conflict on this street and only 0.8% of the respondent feel comfort when they face traffic conflict.

4.1.3.5 People perception about the quality of street furniture along Derartu Tulu street

People asked about the quality of street furniture like electric lights, street benches, standing places, trash cans, etc. and their reaction is organized below in figure 24.

Figure 24 illustrates from the total respondent 35.4% replied that the quality of street furniture is worst, 37.0% replies Derartu Tulu street furniture quality is bad. This implies around three fourth of the population precept the quality of Derartu Tulu street as poor quality. There is a lack of some street furniture and fixture like benches for setting, standing places, proper pedestrian lights, etc. the other 25.3% of the respondent replies that Derartu Tulu street furniture quality is moderate and 2.3% mention them as good quality.

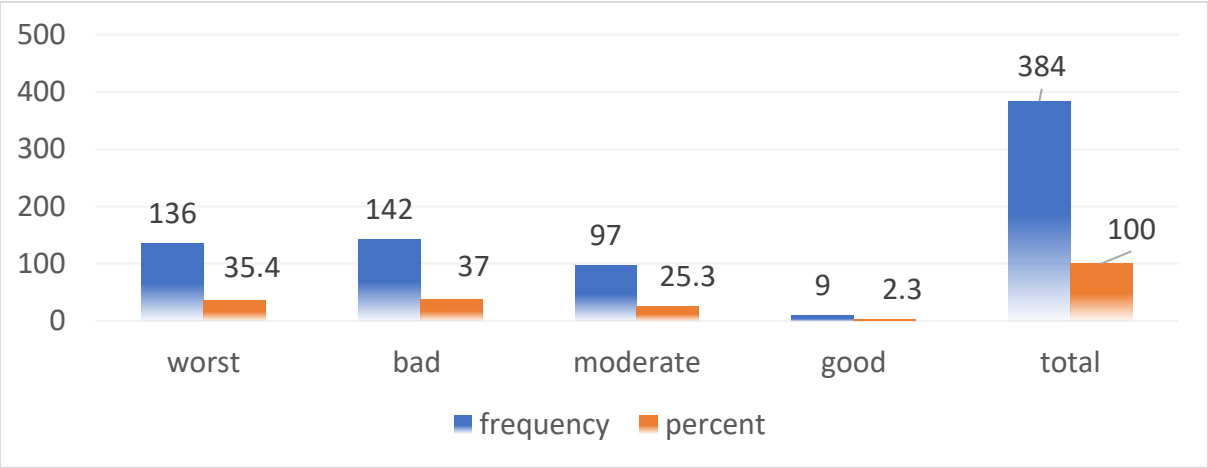


Figure 24: people perception about the quality of street furniture

4.1.3.6 People perception about the safety of street utility along Derartu Tulu street

People asked about the safety of utility installations like ditches, electric lines, telephone lines, and water lines along Derartu Tulu street, and their reaction is organized below in figure 25.

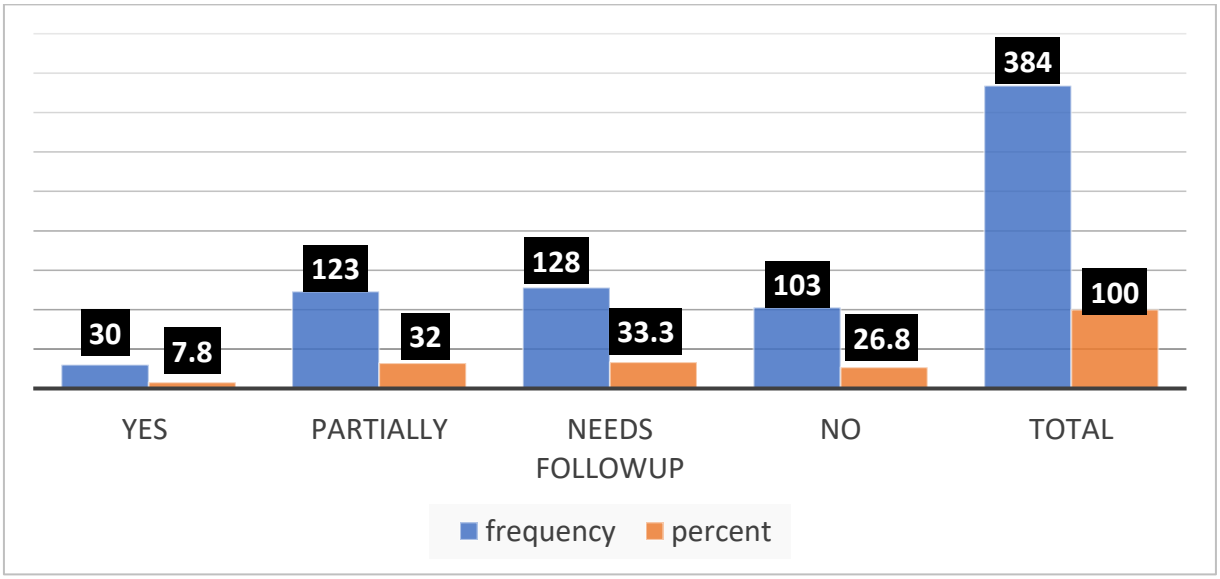


Figure 25: People perception about the safety of utility along Derartu Tulu *street*

Figure 25 illustrates 32% of the respondents mention that the installation of utility around Derartu Tulu street is partially safe. 26.8% responded replied that the utility along Derartu Tulu street is not safely installed. This implies people worrying about the utilities along Derartu Tulu street because of their installation. For example, electric lines are installed above the ground which can cause accidents especially during rainy. Around one-third (33.3%) of respondents mention that utility along Derartu Tulu street needs follow-up. This implies good management

and maintenance are needed for this utility. From the sample population 7.8% mention that utilities along Derartu Tulu street are safely installed.

4.1.3.7 People recommendation about Derartu Tulu street

Derartu Tulu street users asked about what they recommend to improve this street and they replied the following.

Table 13 indicates that 19.79% of the sample population recommend widening the width of Derartu Tulu street to increase traffic flow and decrease the overcrowding of the street. 21.61% recommend providing a parking place for the vehicles to overcome the parking problem that happens on the site. 18.75% of respondents recommend providing a separate bicycle lane. The walkway along Derartu Tulu street is not separated and it has many problem-like drivers park their car on the walkway, obstacles, street venders, totally blocking the walkway for construction purposes, etc. so 27.86% of respondents replied that this walkway has to be separated clearly from vehicle lane and all the problems have to be improved. 29.43% of respondents recommend that traffic signals like traffic lights and signals for pedestrians have to be provided to reduce traffic jams and to increase the safety of street users. Around one-fourth (25.26%) of the sample, population recommends that Derartu Tulu street has to consider disabled people so it has to be redesigned for them.

Table 13: people recommendation for the improvement of Derartu Tulu street

Recommendations	frequency	percent
Widening the street	76	19.79
Providing parking place	83	21.61
Separating bicycle lane	72	18.75
Separating the walkway clearly and enhancing it	107	27.86
Providing and enhancing traffic signals	113	29.43
Designing for disable people	97	25.26

4.2 Discussion

4.2.1 Challenges of complete street design in Adama town concerning street users

Subjective dimensions were executed to identify the perception of street users about the challenges of complete street design. People mention so many challenges on Derartu Tulu street and they can be classified as follows; physical challenge, economic challenge, and social challenge.

Physical challenge mention all about the physical structure along Derartu Tulu street. This includes the width of the street, buffers, medians, intersections, etc. According to (Kienitz, n.d.), Signal timing, lane width, and the number of lanes are all significant considerations for Complete Streets initiatives, especially when traffic congestion is an issue. Derartu Tulu street is an overcrowded street and about 25.26% of the population believe that this situation is caused because of the width of the street. 30.47% of the population mention that the other challenge for the completeness of Derartu Tulu street is the design of the street which does not include disabled people and does not provide a separated bicycle way and buffered sidewalks. Parking is one of the main challenges of complete street Design on Derartu Tulu street. There is not enough space to park vehicles so drivers park their cars on a walkway that blocks the pedestrian way and along the street which makes the street overcrowded. Around 59.9 percent of the population mention the parkin problem as a challenge for complete street design.

Economy is one of the challenges of complete street design in Adama town. This includes both costs of transportation and construction of the street. After fixing Derartu Tulu street as Complete streets it encourages cheaper modes of transportation (biking, walking, public transportation, etc.) rather than owning and maintaining a personal car (City of Richmond 2016).

One of the main social challenges on Derartu Tulu street is the lack of awareness. Drivers Park their car in every space they get which blocks the movement of others. For example, if one driver parks his car on the walkway for 15 minutes, it blocks the movement of 303 pedestrians. This shows that because of the lack of awareness of one person, 303 people change their line and lose their comfort and safety. Some pedestrian inters the vehicle lane which made the street overcrowded and may cause traffic accidents. Around 81% of the population do not use a bicycle as on transportation option. This shows that there is a lack of awareness of bicycle usage. Using

bicycles increases the health of people and reduces air pollution but 39.58% of street users have no interest to use a bicycle on Derartu Tulu street.

4.2.2 Determining factors influencing street users in Adama Town

The determining factor which influences street users on Derartu Tulu street can be categorized into four main groups. They are: factors influence automobile users, factors influence pedestrians, factors influence bicycle users and factors influence public transport users.

4.2.2.1 Determining factors influence automobile users

The main determining factors for automobile users are described as follows. Drivers Park their cars on street but there is no marked lane for on-street parking on Derartu Tulu street. The width allocated to lanes for motorists, buses, trucks, bikes, and parked automobiles is a sensitive and vital element of road design (countrywide association of city Transportation officers, 2013) but on Derartu Tulu street the width of the vehicle way is 8m which tried to hold three lanes but it is under standard according to the complete street. As described in a case study of Edmonton city complete street the width for on-street parking is 2.36m and the traveling lane is 3m. The lane Derartu Tulu street is not marked on the actual ground and also on the base map of Adama city so it is hard to measure the lane width.

Figure 26 illustrates the lane for vehicles on Derartu Tulu was improved according to complete street design. The median was removed and a greenery zone was provided on the shoulder of this street. The width of this street also widens by 5m as allowed on the Adama city structural plan. Five lanes were provided. Two lanes for Bus public transportation one each on both sides and three lanes for other vehicles, one each on both sides and the middle lane used timely according to overcrowding during the day. The width of this lane is 3.5m for the bus lane and 3m for other vehicles.

Figure 26: Improved Vehicle Lane according to complete street standard

4.2.2.2 Determining factors influence pedestrians

According to the Ethiopian street design standard, the width of the pedestrian way for sub-arterial street (SAS) of 30m ROW was 3.5m to 5m. However, the width of the sidewalk on Derartu Tulu street does not meet this standard. Its width is varying from 0m which is blocked by on construction building to 4.2m wide at some places. According to CS design standard furniture like sitting and pedestrian, lights have to be provided to encourage walkability but on Derartu Tulu street they are absent at all.

Figure 27 illustrates a separated pedestrian way provided on Derartu Tulu street. This walkway was improved both for able and disabled people. The width of the walkway is 3m. the tactile paving was provided for visually impaired people. The level of walkway and crossing is equal to reduce the difficulty for elders, pregnant women, and wheelchair users. A pedestrian facility like a street bench, dust bean, and pedestrian lighting is provided. Trees for shade are also provided to increase the comfortability of the walkway within the complete street standard. The pedestrian way material is improved to high-quality tile which is locally available.

Figure 27: Improved Pedestrian way according to complete street standard

4.2.2.3 Determining factors influence bicycle users

According to complete street standards, for a street that has posted speed up to 50 kilometers per hour and holds 1500 vehicles per day, painted or buffered bike lane or protected bike lane is recommended but on Derartu Tulu street there is no bicycle lane and bicycle facility at all. This made this street difficult to use bicycles.

Figure 28 shows the bicycle way and its facility. This bicycles way is a painted bicycle way with a width of 1.6m. The bicycle lane on Derartu Tulu street is unidirectional provide on both sides of the street.

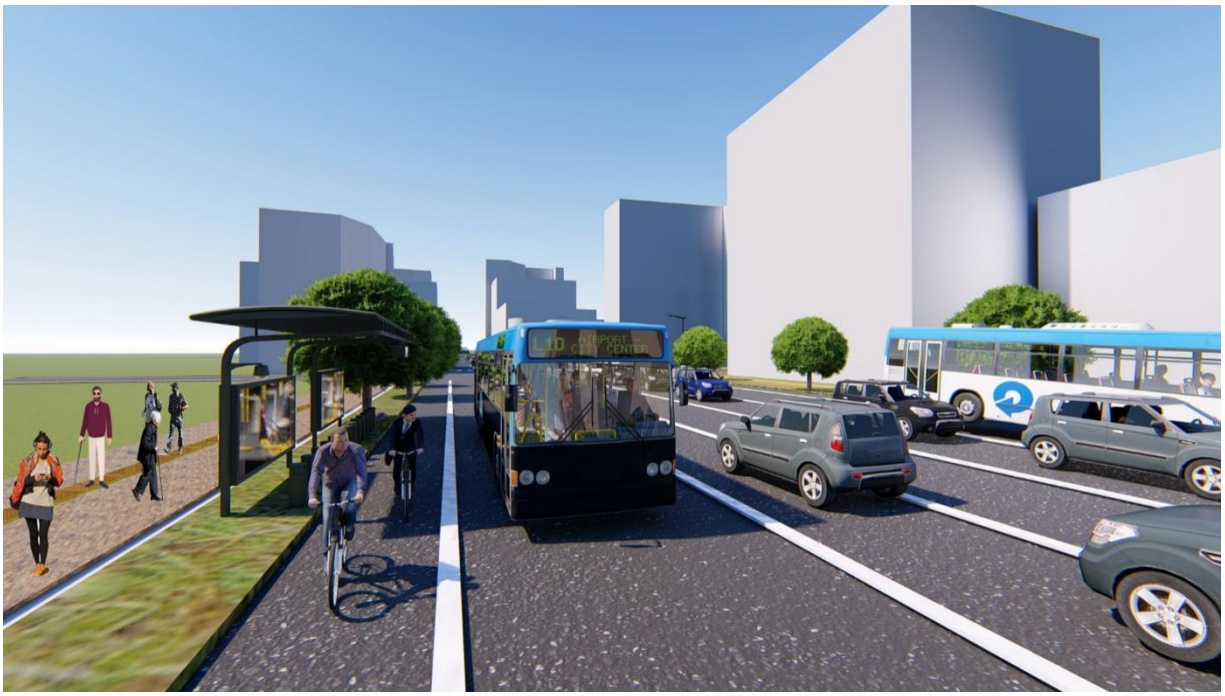


Figure 28: Improved Bicycle way and Bicycle parking facilities

4.2.2.4 Determining factors influence public transportation users

People use minibus and Bajaj as public transport on Derartu Tulu street. There are also some service buses and a few city buses on this street. According to CS standard separated lane for public transportation has to be provided to increase the flow speed and decrease travel time. On Derartu Tulu street none of the lanes is separated for movement so it creates overcrowding and accidents in the area. Dedicated bus lanes are encouraged on roads with ROW 30m and above. The width of the bus lane is suggested to be a minimum of 7 m (3.5m for each side) for a 2-way bus float (Pune Municipal organization, 2016).

Figure 29 shows the Bus Lane and Bus terminal on Derartu Tulu street. The width of this Bus Lane is 3.5m. it was provided on both sides of the street. It is a marked lane to separate from another vehicular lane.

Figure 29: Improved Bus Lane and Bus terminal along Derartu Tulu street

4.2.3 Perception of street users about Derartu Tulu street

The perception of the street user was subjectively analyzed on Derartu Tulu street. Among 384 respondents, 226 or 71.9% do not feel safe and comfortable when they use Derartu Tulu street because of many problems found on this street. The reason street user doesn't feel safe and comfortable are parking problems which 54.95% of the sample population mention, an un separated walkway which 55.73% of respondent mention, obstacles on the street which 43.23% of the sample population mentioned, 45.85 of the sample population mention that lanes are not separated for different kinds of vehicles and it makes them unsafe and uncomfortable and there is also bicycle lane problems which made street users unsafe and 42.63% mentioned it.

More than half of the sample population (56.3%) prefer the vehicle way on Derartu Tulu street and the rest of the respondents prefer walkway. On Derartu Tulu street there is a conflict between pedestrians and vehicles, vehicles and vehicles, vehicles and bicycles. About 66.4% of respondents mention this problem and among them, 64.7% feel uncomfortable when they face these problems. Respondent rates the quality of street furniture as worst (35.4%), bad (37%), moderate (23.3%), and good (2.3%). Respondent also rates the safety of utility installation around Derartu Tulu street as follows: safe (7.8%), partially safe (32%), needs follow-up (33.3), and unsafe (26.8%). Pedestrians recommend the improvement of Derartu street for all users for their safety and comfort.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study aimed to identify challenges of complete street design concerning street users, to examine the determinants factors which influence street users, and to explore the perception of street users about Derartu Tulu street in Adama. To conduct this study different types of survey data were collected and analyzed in chapter four. from the results, the following conclusion is drawn.

Derartu Tulu street is challenged by the problems categorized as economic, social, and physical problems. These problems are interdependent and they are making street users unsafe and uncomfortable. Narrow street width and overcrowding are the main challenges of Derartu Tulu street which are mentioned as a physical challenge, cost for transportation, construction, and maintenance are mentioned as an economic challenge of this street, and awareness of the society are mentioned as a social challenge on Derartu Tulu street.

The determining factors which affect street users on Derartu Tulu street are examined according to CS design standards. The width of this street is very narrow to hold the volume of traffic on this street. The lanes are not marked and they are under standard according to CS standards which made Derartu Tulu street overcrowded. There is no separate parking for vehicles and bicycles. The width of the walkway is under standard and also there are many obstacles on the sidewalk. For public transport, there is no separated width and they are facing problems to pick and unload passengers. According to complete street design standards facility like sitting places, pedestrian lights, traffic signals, traffic lights have to be provided sufficiently to increase the convenience and comfort of the street. But on Derartu Tulu street some furniture is fully absent like a ramp for disabled people, sitting and pedestrian lights, and some furniture is provided in bad quality like dust beans and trees. There is a traffic light at one big intersection and they are not working currently.

In section 4 street users' perceptions are also analyzed. On Derartu Tulu street majority of street users, don feel safe and comfortable. They are caused as a result of different kinds of problems

that existed on that street. Even though the vehicle way has problems majority of the population prefer the vehicle way to pedestrian way on Derartu Tulu street. Street users rate the quality of street furniture as bad and worst and they also rate utility around Derartu Tulu street as unsafe for them when they use this street. Respondent also recommends the improvement of Derartu Tulu street.

Generally, the study of challenges of complete street design according to street users, the examination of determining factors that influences street users, and the subjective study about the perception of street users on Derartu Tulu street result shows that this street does not include all users and it is unsafe for the street users.

5.2Recommendation

Based on the knowledge gained from literature and result of challenges of complete street design, determining factors influencing street users and people perception about Derartu Tulu street, the following recommendations are drawn.

- The town should develop policies and strategies that support funding and resource offering for complete street design which includes all kinds of street users.
- The town should use complete street standards for the designing, implementation, and maintenance s of the street.
- The design, implementation, and maintenance of any street ideas of street users should have to cooperate.
- Awareness creation should be prepared by media and conferences at different levels about complete street and their use.
- Off-street parking must be provided by the municipality and commercial buildings should have parking areas in their basements.
- A complete street is not luxury but it is necessary. so, the government should consider all streets to be complete for people safety, accessibility, economy, and healthy.
- Three-wheel vehicles (Bajajs) must be disallowed to use Derartu Tulu street to reduce the overcrowding of the street.
- Derartu square has to be changed to signals or its diameter has to be widened to reduce the overcrowding caused by it.
- The lane has to be marked for different types of vehicles like buses, automobiles, and bicycles. Figure 30 shows the mark of the lane on Derartu Tulu street.

Generally, starting from planning, designing, implementation to maintenance work, all users of a street (pedestrians, bicyclists, transit or public transportation users, and automobile users) have to be considered regardless of their ability, sex, and age.

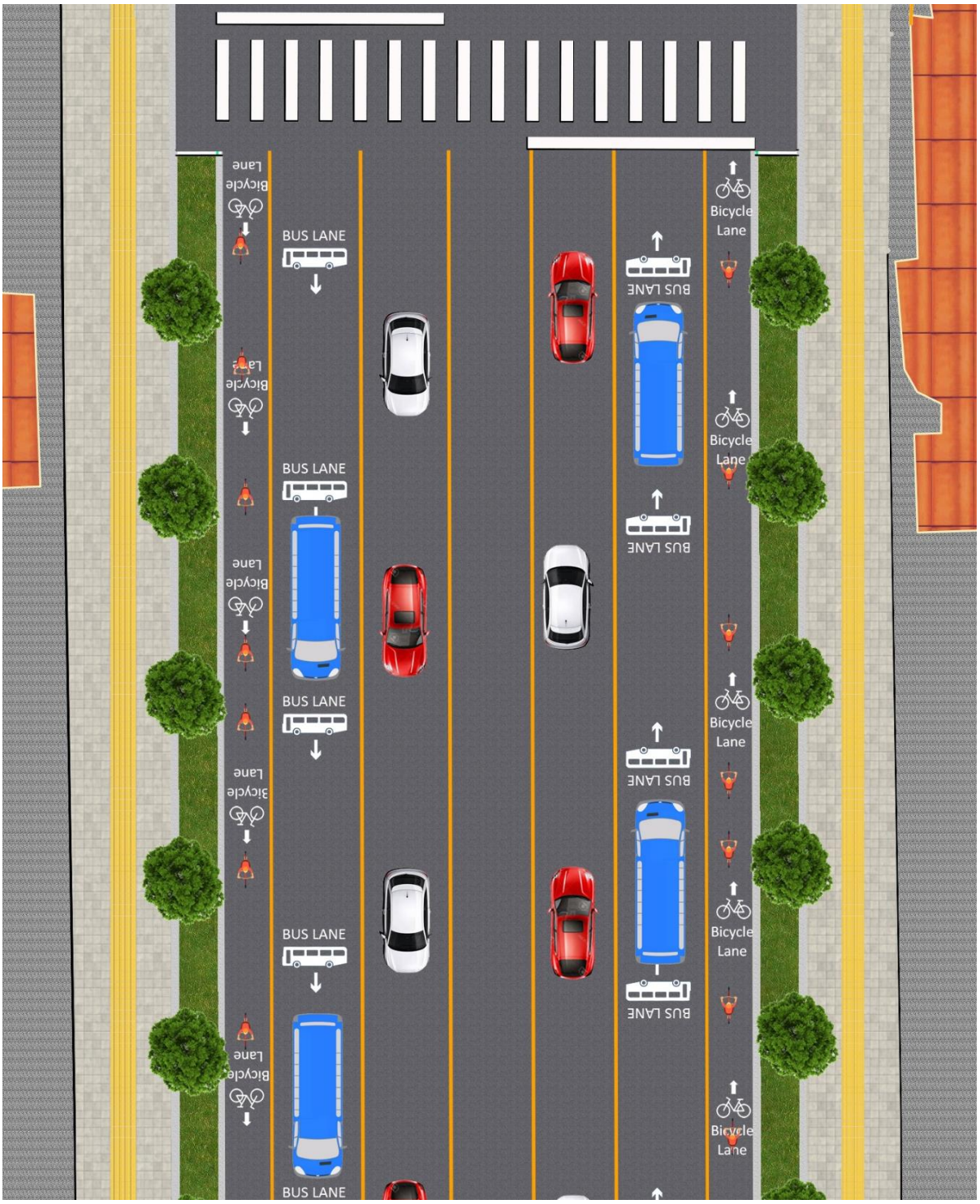


Figure 30: Lane separation

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APPENDIX

Appendix i. Questionnaires prepared for street users about challenges of complete street design in Adama

Please put √ in the appropriate box/ boxes for your answer

1. Sex
    1. Male ☐
    2. Female ☐
2. Please mark your age group in the appropriate box
    1. 15-20 ☐
    2. 21-30 ☐
    3. 31-40 ☐
    4. 41-50 ☐
    5. 51-60 ☐
    6. 61 and over ☐
3. What is the favorite mode of transportation you choose on Derartu Tulu (Mebrat Hayle) street?

    Walking ☐ cycling ☐ public transport ☐ automobile ☐
4. Depending on question three what reasons makes you choose that transport?

    ……
5. Is this street suitable for any movement? Yes ☐ No ☐
6. If your answer is No for number 7, what are the main factors which make it unsuitable?

    ……
7. What matters most to you on Derartu Tulu street?

    Traffic jam ☐

    Problem of parking ☐

    Lack of transportation alternative ☐

    Please write down any other reason

    ……
8. Is Derartu Tulu street include disabled people? Yes ☐ No ☐
9. If your answer is No, what makes it so?

Absence of curb ramp ☐

Absence of signals for different kinds of disabled people ☐

Disconnected sidewalk ☐

Broad intersection ☐

Please write down any other reason

……

10. Do you use a bicycle on this street? Yes ☐ ☐ No

11. If your answer is No then why?

Lack of bicycle lane ☐

Absence of bicycle parking ☐

Lack of interest ☐

Please write down any other reason

……..

12. Is the traffic-congested on this street? Yes ☐ No ☐

13. If your answer is yes to the above question, at what time (day local time)?

12:00-4:00 ☐ 4:00-8:00 ☐ 8:00-12:00 ☐ 12:00-4: 00 ☐

14. Is the street difficult to live in at night time? Yes ☐ No ☐

15. If your answer is yes, then what makes it difficult?

Poor street light ☐ street signals ☐ problems traffic light ☐ street vandalism ☐

Please write down any other cases

……

Appendix ii. Questionnaires were prepared for street users about their perception of Derartu Tulu street in Adama.

16. Do you feel safe and comfortable when you use Derartu Tulu street?

Yes ☐ No ☐

17. If you answer number 5 No then, why?

Parking problems ☐

Unseparated walkway ☐

Obstacles ☐

Unseparated vehicles lane ☐

Unseparated bicycle way ☐

Please write down any other related issues

……

18. What is your favorite part of this street?

Pedestrian way ☐ Vehicle way ☐

19. What do you feel when you use Derartu Tulu street?

Unsafe ☐ less safe ☐ Safe ☐ Extremely safe ☐

20. Is there a conflict between pedestrians, cycle, and drivers on this street? Yes ☐ No ☐

21. If your answer is yes then what do you feel?

Highly uncomfortable ☐ Comfortable ☐ Less comfortable ☐ Uncomfortable ☐

22. What do you think about the quality of street furniture (street lights, street benches, traffic signs, trash can…)?

Worst ☐ Bad ☐ Moderate ☐ Good ☐ Best ☐

23. What do you think about the safety of installation of utilities and street amenities along Derartu Tulu street?

Safe ☐ Partially ☐ Need follow-up ☐ Unsafe ☐

Please describe any other thing

……

24. If you have any thoughts or recommendations about Derartu Tulu street, please right down

……

Appendix iii. Checklists for field survey.

elements	Evaluation criteria	No at all	Rating					Remark
			worst	Bad	Moderate	good	best	
Vehicle's way	Is there a speed reducer							
	Is there a traffic light							
	Is there a traffic sign							
	others							
	Quality of vehicles way							
lane	Is the lane enough to hold the traffic?							
	Is the lane separated for movement?							
	What is the quality of the vehicle way?							
	others							
	Quality of lanes							
Street furniture	Sittings							
	Traffic light							
	Street light							
	Dust bean							
	others							
	Quality of street furniture							
Sidewalk	Have obstacles (poles, signs, plants, vehicles, etc)							
	Have no buffer							
	Have no shade							

	others							
	Quality of the sidewalk							
Street crossing	The street is too wide to cross							
	Traffic signals do not give enough time to cross the street							
	No crosswalk or poorly marked							
	A marked crosswalk is far apart							
	Are signals for pedestrians to cross							
	others							
	Quality of street crossing							
utilities	What is the condition of drainage							
	Do utility lines installed properly							
	others							
	Quality of utilities							
Parking	Is there a buffer for on-street parking and the drive lanes							
	Do they park on the sidewalk							
	Do the off-street parking hindering the continuity of sidewalk							
	others							
	Quality of parking							

Landscape	Does the sidewalk have green elements?							
	Do the plants block the movement?							
	Landscape quality							
	Quality of landscape							

Standard survey checklist

standard	Item number		The gap between by meter	Width by meter	Placement					Remark
	Right	left			worst	bad	moderate	good	best	
Trees along walkway										
Trees on the median										
Traffic signals										
Traffic signs										
Light pole										
Dust bean										
Street bench										
Vehicle’s lane										
Parking lane										
Sidewalk										
median										
Landscape(buffer)										
ramp										
Crossing(zebra)										
Curb extension										

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