THE EFFECTS OF ON-STREET PARKING ON PEDESTRIANS' SAFETY ALONG MAIN ROADS IN ADAMA CITY

Tsega Lema

A Thesis Submitted to the Department of Architecture

College of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of

Masters of Science in Urban Planning and Design

Office of Graduate Studies

Adama Science and Technology University

May, 2025

Adama, Ethiopia

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Declaration

I hereby declare that this Master Thesis entitled **"The Effects of On-Street Parking on Pedestrians' Safety along Main Roads in Adama City"** 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

Tsega Lema	_____	_____
Name of student	Signature	Date

Recommendation of Advisors

I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled **“The Effects of On-Street Parking on Pedestrians' Safety along Main Roads in Adama City”** prepared under my guidance by Tsega Lema submitted in partial fulfillment of the requirements for the degree of Masters of Science in Urban Planning and Desing. Therefore, I recommend the submission of revised version of the thesis to the department following the applicable procedures.

Dr. Sileshi Azagew _____ _____

Major Advisor Signature Date

Approval of Board of Reviewers

We, the advisors of the thesis entitled **"The Effects of On-Street Parking on Pedestrians' Safety along Main Roads in Adama City"** and developed by Tsega Lema, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

_____	_____	_____
Major Advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by Tsega Lema have read and evaluated the thesis entitled **"The Effects of On-Street Parking On Pedestrians' Safety along Main Roads in Adama City"** 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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LIST OF ABBREVIATIONS AND ACRONYMS

AASHO: American Association of State Highway Officials

AS: Arterial Street

CAD: Computer Aided Design

CBD: Centre of Business District

EPHI: Ethiopian Public Health Institute

ERA: Ethiopian Road Authority

GIS: Geographical Information System

NHTSA: National Highway Traffic Safety Administration

NUPI: National Urban Planning Institute

OUPI: Oromia Urban Planning Institute

POS: Parking Occupancy Surveys

SPSS: Statistical Package for Service Solutions

WHO: World Health Organization

ABSTRACT

In both developed and developing nations, the rising population and growing urban areas have been followed by rising car ownership. Adama is a transportation hub for central Ethiopia, connecting various regions. The purpose of this study was to examine the impact of on-street parking on pedestrians' safety along the main roads in Adama City, which run from Derartu Square to Wonji Mazoria. In order to create a suitable plan for improving pedestrian safety, the study specifically aims to examine the existing state of the study area's main route in accordance with national requirements as well as the implications of on-street parking on pedestrian safety. In this study, both quantitative and qualitative methods were used to achieve the intended objectives. Purposive sampling was used to gather data for this study from 384 respondents using survey questionnaires regarding their perceptions of the built environment's infrastructure, the effect of on-street parking on pedestrian movement, and pedestrian walking. The findings of the study indicate that pedestrians in the study area face a range of safety issues related to on-street parking. Inappropriate parking and the encroachment of vehicles onto sidewalks lead to reduced pedestrian space and increased conflicts between pedestrians and vehicles. The study further reveals problems related to inadequate sidewalk conditions, such as poor maintenance and insufficient width, which further impact pedestrian safety. Furthermore, the study highlights that the current on-street parking situation creates congestion, negatively affecting the flow of pedestrian and vehicular traffic. The presence of illegally parked vehicles obstructs sidewalks and forces pedestrians to navigate through unsafe conditions. To this end, the study developed a strategy and proposed a recommendation for improving a pedestrian walking environment and a better space where pedestrians can walk without any disturbance with the surrounding space through widening sidewalks in line with standards, ensuring proper maintenance and enforcing parking regulations, raising awareness about the importance of pedestrians' safety to enhance the overall pedestrian experience, and ensuring a safer environment. Therefore, it is highly recommended that the proposed strategies be incorporated into the future strategic and master plan of the city to sustainably curb problems related to pedestrian safety.

Key words: On-street, Parking, Pedestrian, Safety, Main Road, Adama town.

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the study

Motorization is growing quickly due to a high rate of urbanization and a strong desire for automobile ownership in developing nations (Suzuki et al., 2013). Cities are locations with a high level of accumulation and concentration of economic activities, which form complex spatial structures supported by transport systems (Rodrigue & Notteboom, 2013). Parking is a significant issue in planning, both locally and strategically (William, Russell, & Michael, 2013). The challenges of parking spaces in urban cities are attributed to urbanization, rapid increases in car dependence, high densities, and economic transition (Pojani & Stead, 2015). On-street parking is a popular form of parking due to its ability to maximize available space and provide drivers with the convenience of leaving their cars closer to their destinations (Litman, 2016). While it offers benefits, there are also drawbacks, depending on the circumstances (Raza et al., 2022). The decision to permit or prohibit on-street parking requires careful investigation of its various corollaries (Biswas et al., 2017).

On-street parking is closely related to the security of drivers and pedestrians, the capacity and quantity of traffic on a street, and the prosperity of nearby businesses. Allocating on-street parking in central business district (CBD) areas to satisfy parking demand affects road capacity and service levels (Parmar et al., 2020). Studies show that average travel speed and traffic operations are affected by parked vehicles (Cao et al., 2017). The capacity of streets is reduced due to lane blockage (Cao et al., 2017) inflow and outflow parking maneuvers (Chiu et al., 2011) and illegally double-parked vehicles, which create bottlenecks (Kladeftiras & Antoniou, 2013). While on-street parking provides convenience, it can also result in decreased visibility, congested sidewalks, and increased traffic, making it more challenging for pedestrians to cross safely (Bereket et al., 2019).

The World Health Organization (WHO, 2018) reports an estimated 270,000 pedestrian fatalities on roadways annually, making pedestrian safety a global concern (Simons et al., 2018). Creating safe, walkable streets is crucial, and pedestrian safety is a fundamental human right (WHO, 2015). African cities are experiencing rapid urbanization and acute changes (Aliyu & Amadu, 2017), with

urban sprawl and population concentration posing serious challenges (El Ghorab & Shalaby, 2016). Mobility is essential, but increasing urban mobility needs, longer distances, and economic congestion negatively impact business and attractiveness (Butler et al., 2020).

Ethiopia's on-street parking situation mirrors that of other developing nations, often characterized by disorder and risk (Weldetsadik & Sokido, 2022). On-street parking has a detrimental impact on pedestrian safety along main roads due to lax enforcement of parking regulations, poor parking management infrastructure, and low public awareness of pedestrian safety (Gössling & McRae, 2022). Sidewalks are frequently too narrow, increasing the risk of accidents and injuries. A study by Abebe et al. (2019) found that on-street parking contributes to rising pedestrian fatalities in Addis Ababa.

Adama City, located in central Ethiopia, serves as a transportation hub connecting various regions. With a rapidly growing population and increasing vehicle ownership, the city faces significant challenges related to on-street parking and pedestrian safety. According to recent data, Adama has experienced a surge in traffic congestion and pedestrian accidents due to inadequate parking infrastructure and poor urban planning. The city's main roads, particularly those in the CBD, are heavily affected by on-street parking, which encroaches on pedestrian spaces and disrupts traffic flow.

In many urban areas worldwide, on-street parking has become a standard feature, with both positive and negative effects on pedestrians. While it provides convenient access to businesses and services, it also reduces visibility, narrows walkways, and increases traffic, posing risks to pedestrian safety. The motivation for this research stems from the urgent need to address these challenges in Adama City, where pedestrian safety is compromised by the current on-street parking practices.

The absence of prior specific studies on the effects of on-street parking on pedestrian safety in Adama City highlights a critical gap in understanding urban mobility challenges. The prevalence of long-term parking along main roads, coupled with high pedestrian activity, underscores the necessity for this research. The study aims to investigate the negative effects of on-street parking on pedestrian safety and propose solutions to enhance walkability and safety in the city. By addressing these issues, the research seeks to contribute to sustainable urban transportation planning and improve the quality of life for Adama's residents. The initiative to investigate these

complex dynamics reflects a deep-seated commitment to enhancing the well-being and safety of pedestrians in Adama Town.

1.2 Statement of the Problem

The presence of on-street parked cars can reduce visibility, narrow sidewalks, and force pedestrians to walk in the street, increasing the risk of accidents. In addition, on-street parking can create conflicts between drivers and pedestrians, as drivers may not always yield to pedestrians in crosswalks or other pedestrian areas (Vignali et al., 2019). The National Highway Traffic Safety Administration (NHTSA) conducted a study that found pedestrian fatalities in the U.S. have been rising in recent years, increasing by 3.4% from 2017 to 2018 (Bernhardt & Kockelman, 2021). Similarly, a study by the Ethiopian Public Health Institute reported a 16.8% increase in pedestrian fatalities in Ethiopia from 2017 to 2018 (Eyasu, 2020). On-street parking is one of the many factors contributing to pedestrian fatalities that can be addressed through policy and design interventions (Eyasu, 2020).

Adama City, a major transportation hub in central Ethiopia, faces severe challenges due to rapid urbanization and increasing motorization. The city's growing population and rising vehicle ownership have led to a critical shortage of parking spaces, forcing drivers to occupy sidewalks and roadways illegally. According to recent reports from the Adama City Transport Authority (2023), the city has experienced a 20% increase in traffic congestion over the past five years, with on-street parking identified as a leading cause. The lack of designated taxi and Bajaj stations, as well as freight terminals, exacerbates the problem, as drivers are forced to stop in the middle of roads to load and unload passengers and goods. This disrupts traffic flow and forces pedestrians to navigate dangerous conditions.

In Adama City, traffic accidents were a major cause of fatalities, injuries, and property damage, in addition to being a social and economic issue. Population growth and car numbers have been associated over the past ten years, as was noted in the city profiles. The rate of growth in motorization in particular is the fastest in the city. In the traffic accident in Adama city, out of the total accidents that have been recorded over the last three years, property damage accounted for 45%, followed by light injury (25%), fatal/death (18%), and worst body injury (12%). The proportion of fatalities indicates the highest when compared to the record for Ethiopia (12%). In

Adama's major road corridors, particularly along the Derartu Tulu street to Wonji Mazoria corridor**,** high vehicle and pedestrian traffic creates hazardous conditions. The absence of properly planned parking spaces leads to chaotic on-street parking, obstructing pedestrian pathways and increasing accident risks. Pedestrians, including schoolchildren, are frequently forced to walk on the road due to blocked sidewalks, leading to "dart-out" incidents, which is a common cause of midblock pedestrian accidents. While some studies, such as Miresa (2017) and Abas (2019), have examined on-street parking's impact on traffic flow, there remains a critical research gap regarding its effects on pedestrian safety in Adama City. This study aims to fill that gap by using statistical and spatial analysis tools to assess how on-street parking influences pedestrian safety along major roads. The findings will provide evidence-based recommendations for urban planners, policymakers, and transport authorities to improve parking management, enhance pedestrian safety, and promote sustainable transportation in Adama City.

1.3 General Objective

The general objective of the study is to identify the negative effects of on-street parking on pedestrians' safety along main roads in Adama City and to come up with certain design solutions.

1.4 Specific objective

1. To investigate the existing conditions of on-street parking along main roads in Adama City in relation to national standards.
2. To examine the current effects of on-street parking on pedestrians' safety in the study area.
3. To propose appropriate planning and design solutions for Adama City.

1.5 Research Questions

1. Is the existing on-street parking along the main road system in Adama City in line with national standards?
2. How does on-street parking affect pedestrians' safety?
3. What planning and design strategies can mitigate these effects?

1.6 Significance of the study

The significance of this study lies in its potential to improve pedestrians' safety and promote sustainable transportation in Adama city, Ethiopia. This study can pinpoint specific risks related to on-street parking and create viable remedies to mitigate those risks by examining how it affects pedestrian safety along major roads. For local city citizens and drivers, as well as scholars, thus, this study is very important. In order to promote better urban planning and transportation solutions that will enhance quality of life, city people must be aware of the effects that on-street parking has on pollution, illicit activity, traffic congestion, and accidents. Drivers benefit by making informed decisions about routes, practicing safer driving, and protecting themselves against theft or vandalism. Researchers find value in contributing to the existing knowledge on urban mobility, using the study as a foundation for further investigations and policy recommendations, ultimately promoting evidence-based decision-making and sustainable urban development.

Furthermore, this study can contribute to the broader field of transportation planning and pedestrian safety research. On-street parking is a common practice in many cities around the world, and the negative effects on pedestrian safety have been documented in various studies. By conducting this study in the context of Adama city, Ethiopia, this research can contribute to a global understanding of the impacts of on-street parking on pedestrian safety and inform best practices for promoting sustainable transportation and pedestrian safety in cities around the world.

1.7 Scope of the study

1.7.1 Spatial scope

Geographically, the study is limited to the left and right lanes of the study area, the main roads from Derartu Tulu square to Wonji Mazoria, which are 1.5 km long. The research was conducted with the theme of examining pedestrian safety along main roads in Adama City, Ethiopia. The research has concentrated on the particular dangers connected to parking on public property, including impaired vision, constricted walkways, and collisions between automobiles and pedestrians.

1.7.2 Thematic scope.

The study employed both the left and right sides of Derartu Tulu square to Wonji Mazoria road, which is the main street in Adama City that has high on-street parking and walkability problems. The study investigated the experiences of obstructing pedestrians with drivers' parking habits, pedestrian walking behaviors, and perceptions about the sidewalk facilities, performance, infrastructure, amenities, and safety of the pedestrian walkways along the study route, with a focus on the effects of on-street parking on pedestrian safety along main roads in Adama City. The study also evaluated the system for protecting pedestrians from on-street parking and produced plans to encourage lawful on-street parking at suitable locations in the metropolitan region.

1.8 Limitation of the study

One potential limitation of the study could have been the security concerns that were present during the on-street parking count and field observation. Due to the lack of complete and current records or files in the town's office and the lack of support or willingness from relevant stakeholders, such as local authorities and organizations, for the research, it was difficult to gather accurate and current information during the qualitative data collection from various organizations. These problems had an effect on data collection and analysis in one way or another.

1.9 Organization of the Report

Five chapters make up this study. Introduction and background of the study, a statement of the issue with research questions, study objectives, significance of the study, scope, and limitations are covered in Chapter 1. A review of the literature was covered in Chapter 2. The third chapter of the research discusses the research plan, resources, tools, sampling strategies, and methods of data collection for the study. Results and discussions were contained in Chapter 4, together with the survey outcomes. Chapter five provides the conclusion and recommendations of the study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Introduction

This chapter reviews related literature that is relevant to the research. The theoretical and empirical literatures are included, together with the conceptual definitions of terminology. This publication covers specific implications of on-street parking on pedestrian safety issues, parking concepts, forms of parking, and the benefits and drawbacks of parking through a survey of several literature sources. Lastly, a conceptual framework that supports the key ideas that the study project will address is constructed.

2.2 Theoretical Literature Review

In this section, the study explored facts and theories that help the issue under the study area reviewed and presented underneath.

2.3 Definition of Terminologies

Pedestrian

A pedestrian is somebody traveling on foot and therefore a mobility-impaired person employing a wheelchair, not just for transportation purposes but also for social interaction, shopping, leisure, recreation, exercise, and protest (Nielsen et al., 2019). A pedestrian may be a person walking instead of traveling through a vehicle. Pedestrian behavior is especially defined because of the transportation mode compared to vehicles, transit, or bicycles. (Johnsen, 2020) Sidewalk A sidewalk is a paved surface along a road or street that is raised from the street level and separated by a curb (Southworth & Ben-Joseph, 2013). Sometimes the term‘sidewalk’ is used interchangeably with the word ‘walkway’. Technically, however, walkways incorporate a broader range than a sidewalk (Hicks, 2022).

Walkability

Walking is one of the simplest and least costly forms of physical activity (Andrews & Andrews, 2010). Walking keeps people healthy and can help prevent, among other things, heart disease, diabetes, hypertension, and obesity. (You, 2015) "Walkability is the extent to which the built

environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within an inexpensive amount of your time and energy, and offering visual interest in journeys throughout the network" (Wood, 2022). A Street that encourages people to stroll, makes walking safe and enjoyable, and does not prioritize heavy and rapid vehicle traffic is considered walkable (Kinyingi et al., 2020). Any street that has infrastructure that is accessible, safe, and comfortable for pedestrians will be more walkable. (Kinyingi et al., 2020) appropriate design Building a walking environment is essential to boosting walkability because it produces streets that are more aesthetically pleasing, practical, efficient, and healthy (Patil, 2021).

2.4. Safety, Comfort, and Convenience While Walking

2.4.1. Safety

Safety is the measure of a good quality of life. The safety of a city's streets and sidewalks is an indicator of whether or not a city can label itself "safe" (Ramírez et al., 2021). Studies show that people who live in areas that have good pedestrian transportation systems with lower crime rates will be more likely to walk (Badiora et al., 2020). According to Carmona et al. (2003), safety is about victims and the fear of victimization. A safe sidewalk environment, free from personal attack, encourages pedestrian use. Safety is to gain freedom from both physical and emotional hurt (Abdelmonem & Selim, 2019). Studies regarding real and perceived safety from traffic suggest the importance of many measures and physical features such as reducing street width and speed limits, introducing traffic calming measures, curbside parking, trees, or plantings to reduce or slow down traffic, separate pedestrians from fast-moving vehicles, and make street crossing safer for pedestrians (Hakkert & Gitelman, 2014).

2.4.2. Comfort and convenience

Comfort is relief from harm and problematic situations while walking on a smooth sidewalk with easy access (Bharucha, 2017). When a sidewalk is barrier-free and exudes a friendly environment, it will provide pedestrians with a high level of comfort (Livingston, 2005). Sidewalks that are smooth, have easy access, and are located in friendly neighborhoods provide pedestrians with a high level of comfort (Distefano et al., 2021).

2.4.3. Convenience

Convenience of pedestrians is a major factor in where the users choose to walk; convenience levels were inferred through level of compliance as well; convenience was the predominant reason pedestrians mentioned to choose from one route and the other (Patra et al., 2020).

2.5. Basic pedestrian Walkways Requirements

According to the Florida Department of Transportation (1997), all urban sidewalks need the following basic elements for success: adequate width of travel lanes, a buffer from the travel lane, curbing, minimum width, gentle cross-slope (2 percent or less), a buffer to non-public properties, adequate sight distances around corners and at driveways, shy distances to walls and other structures, a transparent path of travel freed from street furniture, continuity, a well-maintained condition, ramps at corners, and flat areas across driveways (Blomley, 2010). Sidewalks also require sufficient storage capacity at corners so that the expected volume of pedestrians can gain access to and depart from signalized intersections in an orderly and efficient manner (Blomley, 2010).

2.6. Major factors affecting the Safety and Comfort of pedestrian

According to a study by Ogombe (2016), safety for pedestrians Inadequate visibility, illegal crossings, drunk driving and walking, sidewalk vendors, pedestrian fatigue, institutional capacity, walking alongside the road, socioeconomic factors, poor land use planning, poor transportation, high annual growth in motorization, the percentage of two- and three-wheelers in the traffic mix, and lax enforcement of traffic regulations can all seriously impair comfort and convenience in developing nations.

2.6.1 Lack of pedestrian facilities and lack of perfect land-use planning

According to Litman and Steele (2017), pedestrian risk increases when roadway design and land-use planning fail to plan for and supply facilities like sidewalks or adequate consideration of pedestrian access at intersections. Additionally, infrastructure facilities and control mechanisms that separate pedestrians from motorized vehicles and enable pedestrians to cross roads safely are important mechanisms to ensure pedestrian safety, complementing vehicle speed and road system management (WH Organization, 2023).

2.6.2 Inadequate visibility of pedestrians

According to (Peden, 2004) visibility of pedestrians arises from inadequate, or lack of, roadway lighting, vehicles and bicycles not equipped with lights, and pedestrians not wearing reflective accessories or brightly colored clothes, especially at night and at dawn or dusk; and pedestrians sharing road space with fast-moving vehicles(Fotios & Gibbons, 2018).

2.7 Pedestrian Space Requirements

Pedestrian facility designers use body depth and shoulder breadth for minimum space standards, at least implicitly. A simplified body ellipse of 0.5 m by 0.6 m with a total area of 0.27 m2 is used as the basic space for a single pedestrian (Omollo, 2022). This represents the practical minimum for standing pedestrians. In evaluating a pedestrian facility, an area of 0.74 m2 is used as the buffer zone for each pedestrian (Orege, 2018). A walking pedestrian requires a certain amount of forwarding space, which is a critical dimension since it determines the speed of the trip and the number of pedestrians able to pass a point in a given period (Li et al., 2012).

2.8 Pedestrian Sidewalk Standards in 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 carriageway. The pedestrian capacity on a sidewalk should be a minimum of 30 and a maximum of 50 persons per minute per meter of width after deducting approximately 0.9 meters of 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.

Table 1: Pedestrian side walk standard in Addis Abeba.

Type of street	Width (on both sides in M)
Principal arterial	7-10m
Sub arterial	5-8m
Collector street	<2m
Local street	Should not be decided

Source: Norms and standards (2002)

2.9 Parking

According to Rayhan et al. (2019), parking is the act of stopping and disengaging a vehicle and leaving it unoccupied. Parking on one or both sides of a road is often permitted, though sometimes with restrictions.

2.9.1 Types of Parking

There are two types of parking facilities: off-street and on-street parking (Al-Jameel & Muzhar, 2020).

2.9.1.1 On-street Parking

According to a study performed in China (Małecki, 2018), due to on-street parking, the road segment's lower lane effective width has a substantial impact on both the neighboring lane's traffic flow volumes and the road's capacity. In these types of parking, bays are provided on one or both sides of the streets along the road. Pronounced attention should be given while providing these types of facilities, as the parked cars might affect the proper service of the facilities. On-street parking is explicitly marked either as individual parking bays or as lengths of the street where parking is allowed. The bays can be counted explicitly; for lengths of road where parking is allowed, it is reasonable to use an estimate of 5–7 meters of curb space for each car parking space (Davis et al., 2010). Slinn, Matthews, and Gues found in their study that 5 meters is a suitable figure to use in parking space calculation. They were derived empirically from the observation of many surveys (Munigety & Mathew, 2016).

2.9.1.2 Off-street Parking

In many urban centers, some areas are exclusively allotted for parking, which will be some distance away from the mainstream of traffic. Such parking is referred to as off-street parking. These include facilities like surface lots and garages (Taylor, 2021).

2.9.2 Parking norms and standard

On - street parking and standards. (UTS, 2005).

1. Parallel parking 2.5 x 5.9m per car P.No. = $L/5.9$
2. 30^0 angle parking 5 x 2.5 m P.No. = $L-1.25/5$
3. 45^0 angle parking 5 x 2.5 m P.No. = $L-1.77/ 3.54$

4. 60^0 angle parking 5 x 2.5 m P.No. = $L-2.16$ /2.89
5. 90^0 angle parking 5 x 2.5 m P.No. = L /2.5

Where: L= Length of kerb and P.No. = Number of parking spaces

2.10 Parking characteristics

The subsequent parking statistics are crucial (Alfaro et al., 2015). Prior to describing the analysis in the article (Parmar et al., 2020), Parking Attributes Analysis, some key terminology pertaining to the parking statistics shown below should be taken into account:

Parking accumulation: It is defined as the number of cars parked at a specific moment in time. This is typically expressed using an accumulation curve. Plotting the number of bays occupied versus time produces the accumulation curve graph.

Parking volume: total number of parked at any vehicular time is known as the parking volume. The same vehicle may be driven again; therefore, every single vehicle is counted. It keeps track of the precise number of cars that enter the parking lot.

Average parking duration: It is the ratio of total vehicle hours to the number of vehicles parked.

$$\text{Parking duration} = \frac{\text{Parking load}}{\text{Parking volume}}$$

Parking turnover: It is the proportion of cars parked during the course of a given amount of time to total parking spaces. This can be stated as the quantity of cars in each bay for each period of time.

$$\text{Parking turnover} = \frac{\text{Number of different car park}}{\text{No. of bays available}}$$

Parking load: The area under the accumulation curve is provided by parking load. It can also be calculated by multiplying the time interval by the number of cars that are parked in the lot at each time period. It is stated in terms of vehicle hours.

Parking index: An indicator of a parking space's efficiency is the parking index. It is described as the ratio of the total number of cars parked during the course of a given amount of time to the

entire amount of space, or capacity. It provides a summary of the overall effectiveness of parking spot utilization.

Parking occupancy: The ratio of the number of bays occupied over a certain period of time to the total amount of available space is known as parking occupancy or efficiency. It provides an overall indicator of how well parking spaces are used. In this way, it can be calculated:

$$\text{Parking occupancy} = \text{parking load} / \text{parking capacity} * 100$$

The writers of a paper for the journal (Rifai et al., 2020) came to the conclusion that parking on the street has to be limited along Main Road. On-street parking might be permitted on minor streets, they discovered, as it might, in that situation, create a safer environment for drivers. On-street parking should, when permitted, be parallel rather than angled because the latter is risky in every way (Moran, 2021). Also, they suggested banning on-street parking in close proximity to certain sites, such as a school, a crossroads, or a pedestrian crossing. Smart parking is the form of parking management that works the best. The essential components of this sort of parking are sensors and changeable messaging. At the very least, the main parking spaces should have these systems built or deployed to control parking demand (Zhang & Guhathakurta, 2017).

2.11 Importance of On-Street parking

Businesses located on city streets may easily obtain parking by using on-street parking, which also uses less area per space than off-street parking, which also needs access lanes (Litman, 2016). On-street parking places a barrier between those using the walkways and moving traffic for pedestrians, ensuring a certain level of safety and lowering the perceived noise level (De Cerreño, 2004). On-street parking may be important in a number of ways, according to Marshall et al. (2008).

2.12 On-street parking's effects

The American Association of State Highway and Transportation Authorities defines on-street parking (2004) as "parking automobiles on the side of the street itself." Usually, this will be under the supervision of the government itself (Guo, 2013). Parking on the street has advantages and disadvantages.

2.13 On-street parking's advantages

2.13.1 Impact of commercial area growth on the economy.

One important aspect of spot accessibility is the availability of on-street parking. It also increases the accessibility of roadside retail stores and provides opportunities for street sellers to engage with commuters (Soni & Soni, 2016). Parking lots are not practical for every tiny shop on the street. Consequently, parking on the street is their "life blood" (Biswas et al., 2017). According to Biswas, street vendors find it more convenient to park their cars on the street rather than off it, far away from their destinations (Biswas et al., 2017).

2.13.2 Impact on the safety of road users

For an extended period, transportation experts have maintained the belief that curbing on-street parking on urban streets is necessary to maintain traffic flow and road safety (Biswas et al., 2017) Road users are made safer by on-street parking in two main ways: (a) as a tool for traffic calming, which reduces speed and increases safety; and (b) as a buffer, which keeps pedestrian activity apart from vehicular traffic (Biswas et al., 2017).

2.14. The adverse consequences of parking on public streets

2.14.1 Effect on road user capacity

According to Al-Jameel and Muzhar (2020), parking on the street limits the capacity of the road in two basic ways. By surrounding the traffic stream, it first reduces the carriageway's width. Because of the need for vehicles to maneuver into this narrower space, the stream's total speed has decreased. Second, traffic jams on congested city highways are caused by frequent parking and parking maneuvers, which generate complicated situations.

2.14.2 Effect on road user’s safety

According to Al-Jameel and Muzhar (2020), road capacity is mostly decreased by on-street parking in two ways. Initially, it reduces the carriageway width by encroaching into the flow of vehicles. The limited breadth forces cars to move into it, which lowers the stream's overall pace. Second, parking a lot and doing complicated parking maneuvers lead to traffic jams on congested city streets. Parked cars can cause lane changes, side swipes, and rear-end collisions. They can also cause cars to stop or slow down when they enter curb spaces, side swipes, and rear-end collisions when they exit parking spaces. When parked cars open their street side doors, they can

cause collisions with the door or the departing occupant, and they can cause drivers to lose visibility by causing collisions with pedestrians who are crossing the road between parked cars. Parking-related blind spots prevent drivers from seeing approaching pedestrians entering the road, which can lead to collisions between pedestrians and automobiles and occasionally even fatalities (Biswas et al., 2017).

2.15 On-Street Parking and Surrounding Relationship

2.15.1 On-Street parking Vs Road capacity

On-street parking maneuvers can cause a lot of delays as well, especially if the route is congested. This results in a stop-start pattern of traffic in the lane next to the parking lane (Wijayaratna, 2015). Moreover, illegal double parking causes a bottleneck, reduces the average speed, and lengthens the trip (Alemi, 2015).

2.15.2 On-Street parking Vs Traffic safety

According to a number of early studies, on-street parking appears to be dangerous and prone to crashes in the eyes of traffic experts (Grahn et al., 2020). Both motorized and non-motorized vehicles are affected by this. The large concentration of on-street parking spaces in the urban region affects local traffic operations, particularly during periods of high traffic. (Parmar et al., 2020). Another prevalent issue that jeopardizes road safety is unlawful parking. Additionally, poor use of the parking lot area results from careless parking caused by a lack of parking place markings.

2.15.3 On-Street parking Vs Land use

The amount of parking available could overwhelm the road system, which would have a detrimental impact on how well it operates. Yet, failing to provide enough off-street parking spaces for specific land uses has a detrimental effect on the economy (Parmar et al., 2020).

2.16 Empirical Literature Review

This phase takes a look at related on-street parking with pedestrian safety centers based totally on discovered and measured phenomena that have been studied and implemented around the sector and responded to study questions raised, which helped to make clear the general idea of pedestrian walkability.

2.17 Parking facility on main roads

A Policy on Highway Types (Geometric), published by the American Association of State Highway Officials (AASHO, 1994: PP. 378) stated the following about parking: “The width of the parking lane depends upon the proposed method of parking and the character of traffic. For parallel parking of passenger vehicles, a width of 7 feet has been extensively used. It may be wide enough for side streets where few trucks use the streets and travel at low speed. "On through streets, lanes for parallel parking of passenger vehicles should be at least 8 feet wide if the adjacent traffic lanes are to be utilized without encroachment onto other traffic lanes.” The 2001 or Fourth Edition (6) of the Green Book (PP. 378) stated that for urban arterial roadways, a “parking lane width as narrow as 2.4 m (8 ft) may be acceptable” and recommended a width of 3.0 to 3.6 m (10 to 12 ft). On urban collector streets in residential areas, a width of 2.1 to 2.4 m (7 to 8 ft) was suggested to accommodate on-street parking. The chapter on local streets gave a width for residential area parking of 2.2 m (7 ft) in one place and a minimum of 2.1 m (7 ft) in another. An 8-foot (2.4-meter) width was the suggested minimum width in commercial areas. The 2004 Green Book “Cross Section Elements” chapter and other passages (7) contain similar statements. The discussion noted that a width of 10 to 12 feet (3.0 m to 3.6 m) was desirable to provide greater clearance, and this wider dimension should be used when bike routes are adjacent to the parked vehicles to permit bicyclists to pass by open car doors.” (PP. 454) Among the key elements influencing consumers' destination selections are accessibility and parking ease (Innes D. et al., 1990). In addition to potential economic development impacts, some policymakers and advocates have argued that on-street parking may be an effective traffic-calming measure. (Tefera Advisor & Ambo, n.d.)

2.18 Pedestrian mobility in Kigali, Rwanda

According to Kigali City (2013), the road network in the city was supposed to be developed to fully meet the requirements of a modern city that promotes the standard quality of life for its residents. The City of Kigali is doing well to improve the existing road networks in various projects, specifically in the project termed Kigali Urban Road Upgrading. The project, where road network widening and traffic management utilizing non-signalized and signalized junctions with traffic lights were implemented in 2016 until now,

2.19 Walkable Environment in Sydney

According to (Guldi, 2012), there are six ideas to start the walking revolution: First, make it easy to temporarily close streets. This could begin with trials and pop-up community activation. Second, start to close smaller local streets or create shared slow lanes with access only for residents. Streets with few cars could accommodate the passage of slow traffic when needed by residents while opening up new spaces for permanent gardens, planting, children's playgrounds, and more community space. Third, put human life before time savings. Thirty km/h should become the default speed for local residential streets. Fourth, start designing cities for children. Fifth, create a process that begins to charge drivers the real costs of alienating public space for street or public off-street parking. Lastly, we could expand on research by scholars.

2.20 On-street parking Management in Addis Ababa, Ethiopia.

Parking spaces must be paid for, and this expense must be covered by fees. On several streets, AATA has already started charging for on-street parking. The cost is Birr 0.5 for a half-hour of parking. Parking "attendants," the majority of who are women from low-income families, are responsible for collecting the charge. Manual fee collection is carried out, and a receipt is issued. Although parking meters were erected earlier, there has been vandalism on them.

2.21 Study on parking supply and Literature gaps

Several models have been developed for determining various parking requirements under various circumstances. To estimate the city of Hong Kong's future parking needs, S.C. Wong and associates created a parking demand model (Wong, Tong, Lam, and Fung, 2000). The land use variable and off-street parking were assumed to have a linear and additive connection when this model was built. Another work completed by J. Aderamo and K.A.Salau in 2013 also produced a parking demand model using linear regression analysis in SPSS tool (Aderamo & Salau, 2013).

Sen, Ahmed, and Das observed that a high demand for on-street parking is caused by a lack of off-street parking spaces and a propensity to park close to one's destination. The amount of vehicles owned and the poor quality of transit are the additional factors that are contributing to the increase in demand for parking. These elements cause the average travel speed to drop, the main roadway

width to shrink, and needless traffic flow congestion that leads to parking lot cruising (Sen, Ahmed, & Das, 2016).

2.22 Parking management policy

The absence of parking regulations has emerged as a crucial element in the transportation system. Globally, there is a growing concern over parking, particularly in important business centers (Sen et al., 2016). User satisfaction and network operation maintenance are at odds when it comes to parking rules. Thus, in order to regulate demand, an appropriate parking management strategy needs to be put in place. According to different research studies, there have been three distinct types of parking policy approaches that have been developed in practice and studied (Heath et al., 2006). They are the supply-focused conventional approach, the market-oriented approach, and the parking management approach (Barter, 2015). The transport planner has a responsibility to study different strategies and provide a solution that has the best proficiency (Flöthmann et al., 2018).

2.23 On-Street parking conceptual framework

The conceptual framework for the issues with on-street parking facilities is established based on the studied literature. The framework includes the five requirements needed to investigate the negative effects of on-street parking: obtaining an adequate number of parking spaces, parking policy, on-street parking pricing structure, contemporary parking management techniques, effectiveness of the existing parking situation, and collaboration with other governmental or nongovernmental organizations. The purpose of this study was to determine how on-street parking currently affects pedestrian safety and to suggest a suitable planning and design remedy for existing issues. The report also suggested that authorities coordinate their efforts to create effective and efficient car parking facilities throughout the city.

CHAPTER THREE

3. METHOD AND MATERIALS

This chapter's major goal is to describe the fundamentals of research design and methodology, sampling design, acceptable research data collection procedures, and data analysis methodologies in accordance with the research questions.

3.1 Description of the Study Area

3.1.1 Location

Adama City is located in the East Shewa Zone of the Oromia Regional State, approximately 99 km southeast of Addis Ababa along the Addis Ababa–Djibouti highway (Fig. 1). Astronomically, the city lies at 8°33′N latitude and 39°16′E longitude, with an elevation of 1,712 meters above sea level. Adama is one of Ethiopia's fastest-growing urban centres and has undergone multiple structural plans since its establishment, with the latest revision in 2021 to accommodate its rapid expansion (Oromia Urban Planning Institute, 2021). The city covers approximately 10,500 hectares and has a population of over 500,000, making it one of the largest cities in Oromia (CSA, 2020). The city is administratively divided into 12 sub-cities (kebeles), including Bole, Total, Kuriftu, and Alem Gena, each serving distinct residential, commercial, and industrial functions.

Adama serves as a major transportation and logistics hub, connecting: Northwest to Addis Ababa (A1 Highway); East to Dire Dawa and Djibouti (Ethio-Djibouti Railway & Highway); South to Awash and the Afar Region and West to Mojo and Ziway. The city's strategic location along the Addis Ababa–Djibouti trade corridor makes it a critical node for freight transport, industrial activity, and urban mobility. However, this also contributes to heavy traffic congestion, particularly along Derartu Tulu Square to Wonji Mazoria corridor and the central business district (CBD), where on-street parking significantly impacts pedestrian safety.

Adama has experienced rapid urbanization. This growth has led to rising vehicle ownership and parking demand, exacerbating conflicts between motorized transport and pedestrian mobility particularly in high-traffic zones like Derartu Tulu Square to Wonji Mazoria, the focus area of this study.

Adama City's air temperature is slightly warm but comfortable for human health. Conventionally, this is a characteristic of Qolla/tropical climates (OUPI, 2019/20). Accordingly, the mean annual temperature of the city is about 25–30 °C. When we consider Adama City's air temperature, it is slightly warm but comfortable for human health.

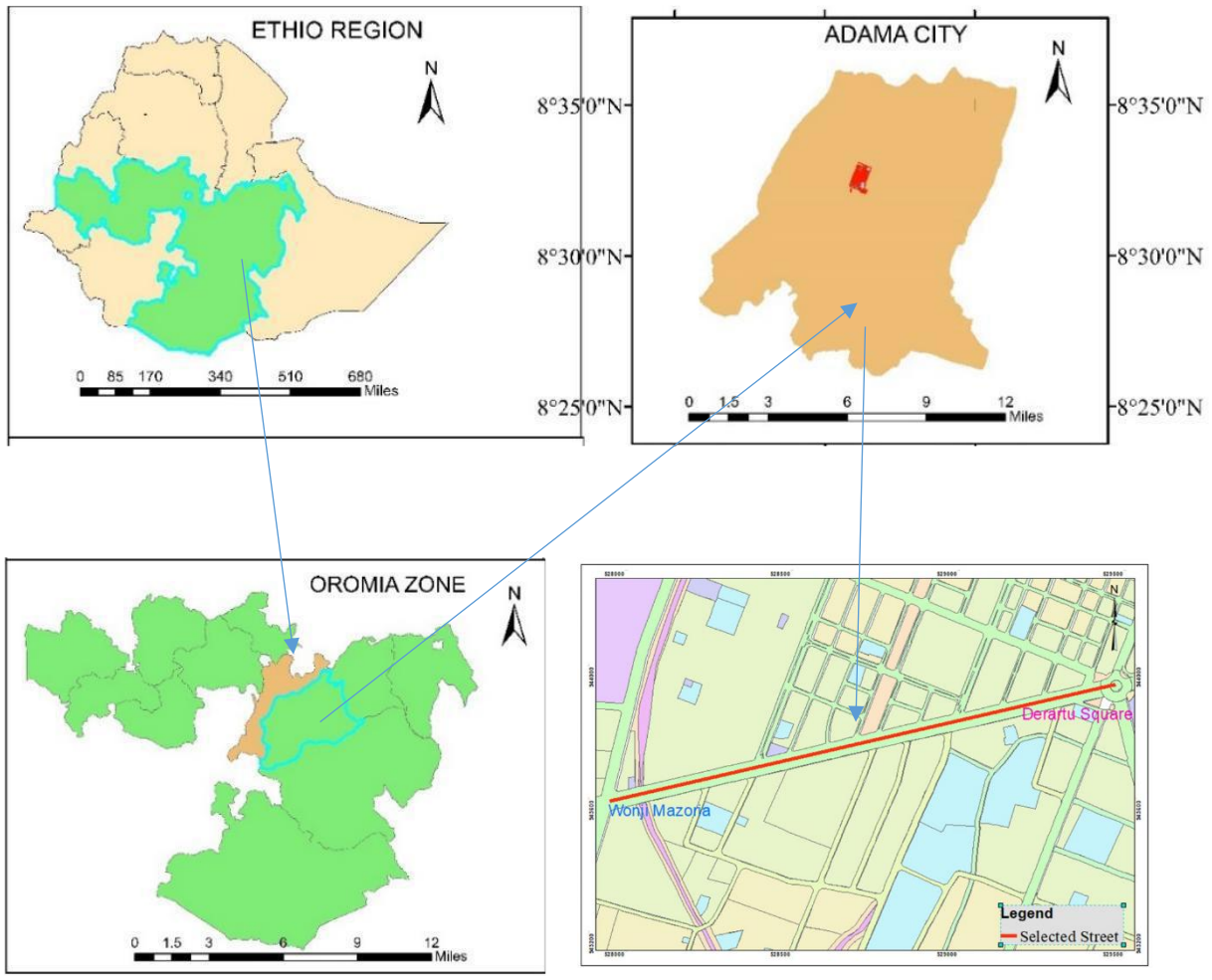


Figure 1: Study area map.

3.1.2 Demography

Adama is the capital city of the East Shewa zone and is located 99 km southeast of Finfinne (Addis Ababa). Currently, the city has a population of over 500,000 people and approximately 120,000 households. As a major economic and transportation hub, Adama serves as a center for zonal and regional political and administrative activities.

Data on the population size of Adama City can be traced back to 1965. In this year, during the first round of national sample surveys, Adama's population was recorded at 24,000. By the second round in 1970, the population had grown to 39,000. The national censuses of 1984 and 1994 reported populations of 76,000 and 127,000, respectively. According to the Central Statistical Agency (CSA) and recent city estimates (including expanded kebeles), Adama's population in 2019 stood at over 500,000, reflecting rapid growth due to industrialization and its strategic location along the Addis Ababa–Djibouti corridor.

3.1.3 Economy

Adama City is a major hub for commercial farming, including crops such as maize, teff, and horticultural products, per OUPI's 2019/20 report. The city is strategically located along the Addis Ababa–Djibouti trade corridor, serving as a critical junction connecting central Ethiopia to the eastern and southern regions. This prime geographic position enhances income opportunities for households in the area.

Tertiary economic activities (trade, services, and transport) form the backbone of Adama's economy, the city also generates significant revenue from industrial and agro-processing sectors. Unlike smaller urban centres, Adama's economy is diversified with a growing focus on industrial parks (e.g., Adama Industrial Zone) and tourism (due to its proximity to the Rift Valley lakes).

3.2 Background of the study area

The corridor was chosen for the fact that the Derartu Tulu Square to Wonji Mazoria corridor has a length of 1.5 km (figure 2) and has a high flow of vehicles and people. Currently, on-street parking is affecting pedestrians and all transportation activities. The central business district area is where the chosen road segment is located. The carriageway width of the existing road was below standards, and the walkways are very narrow compared to the surrounding land use. The study area was more dominated by commercial land-use types (Fig. 3), and on-street parking is experienced highly on selected main roads, and those activities have resulted in the obstruction and crowdedness of the main street.

Figure 2: Main Street of the study area

3.2.1 Land use map of study area

Figure 3 illustrates the existing land use category in the area. The study area has a variety of land use types, which are categorized as commercial, administrative, service, open space, and circulation in the legend parts. In the research area, commercial land use types predominate over all other types of land use.

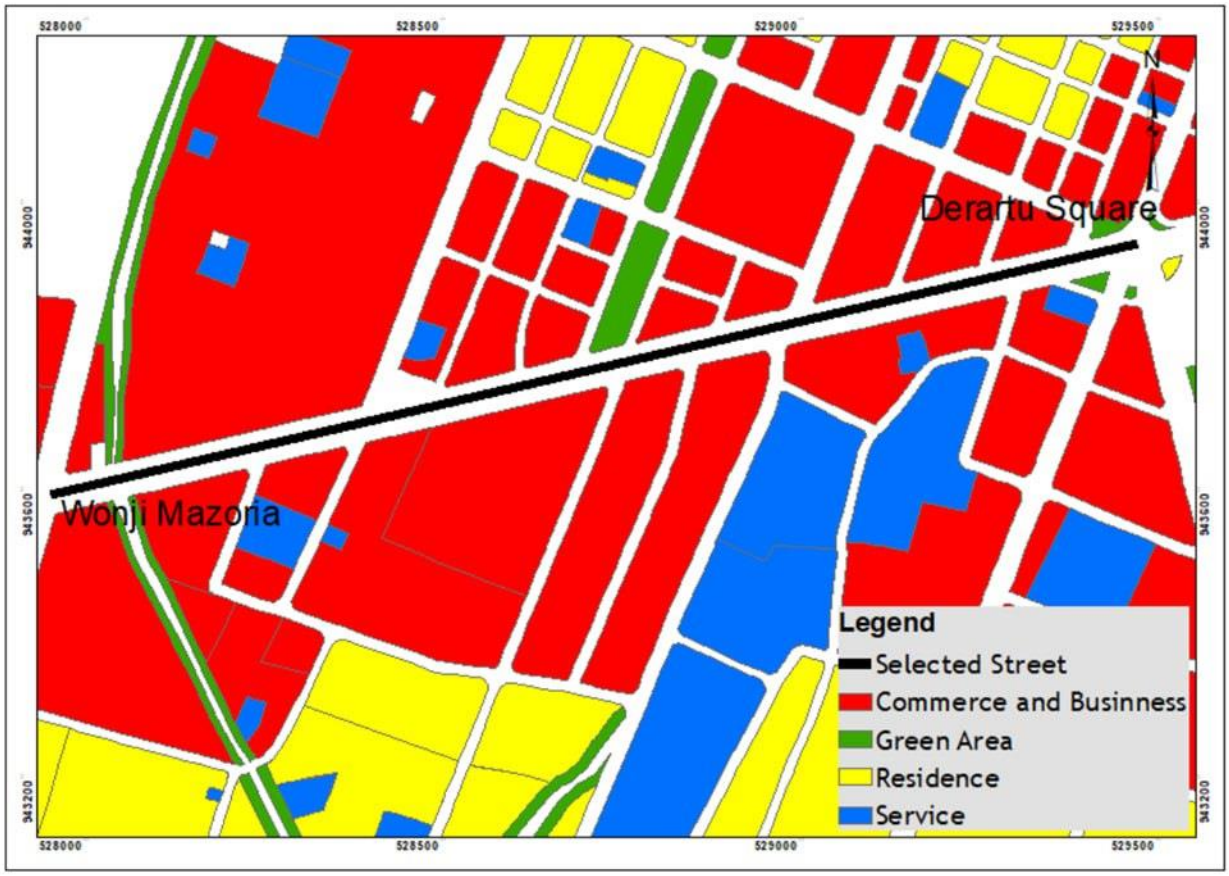


Figure 3: Existing land use of the study area.

3.2.2 On-Street Parking Distribution and Restricted area of study site

In the study area, there are specific guidelines for allowable parking places and restricted areas. The allowable parking places include designated areas where parking is permitted and encouraged. These areas are generally identified to facilitate parking convenience for residents, visitors, and commuters. On the other hand, there are restricted areas where parking is not permitted or regulated (Fig. 4). These restrictions may be in place due to security concerns, traffic flow management, or to maintain the aesthetic appeal of prominent areas. It is important for drivers to be aware of these restrictions to ensure compliance, avoid penalties, and contribute to the smooth functioning of the study area. The distribution of restricted parking spaces and on-street parking in the study area is depicted in Figure 4. The area's on-street parking is situated in both directions along the major road, which primarily affects the movement of vehicles and pedestrians.

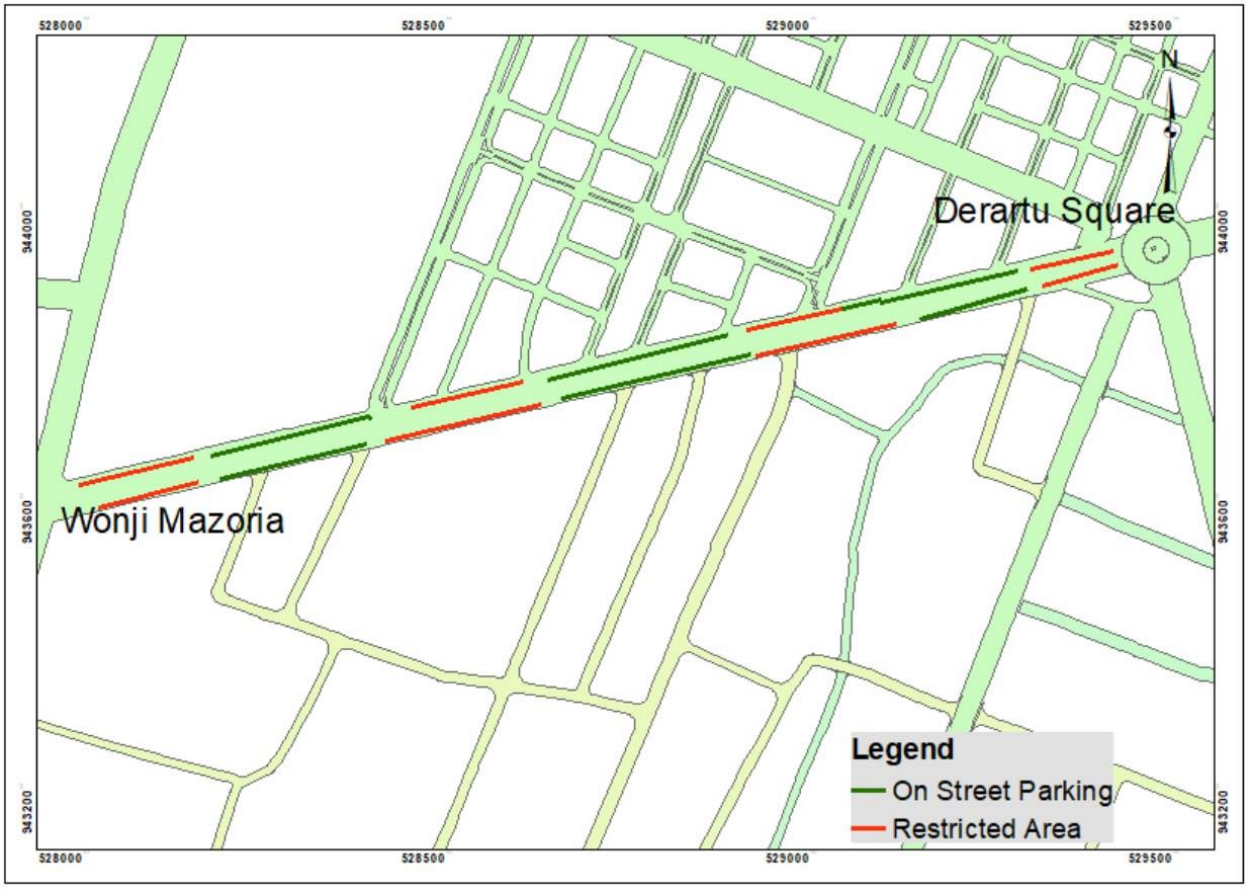


Figure 4: On-Street parking and Restriction area of the study area.

3.3. Criteria for selecting the Street

To select the study area for this study, the study developed criteria, principles, and various selection criteria based on the safety of pedestrians. Purposively, the route from Derartu Tulu Square to Wonji Mazoria street was selected, taking into account the city's physical features, traffic patterns, pedestrian activity, and on-street parking. Observations were made based on these selection criteria. This observation examines the physical form of the street, such as the width of the main road, sidewalk width and facilities, pedestrian movement, and pedestrian safety. Another factor was that the main street of the city is where many activities take place.

3.4 Research design

The plan and structure of an investigation that are created to produce answers to specific research questions are known as the research design (Mohajan, 2018). The research design sets the procedure for the specified data, the methods to be applied to gather and analyze this is often visiting to answer the research question (Wilkerson, 2014). A descriptive research design was employed for the study to research the situations thoroughly. This study modifies statistical analysis to allow for more accurate population inferences based on sample results. The communities are very worried about parking lots since they have an effect on daily life, time management, vehicle safety, accidents, and traffic flow. The collected primary and secondary data were processed and analyzed using Epidata, SPSS, and GIS to represent the output. Checking the validity and reliability of the data was needed to ensure data quality and different ethics were considered for the comfort of target groups and the success of the study. Cross-sectional data was used to determine cause-and-effect factors.

3.5 Research approach

The study uses quantitative and qualitative approaches to analyze the collected data. The mixed approach was adapted for the study to obtain data from relevant sources by using tools like field surveys, questionnaires, and interviews. Qualitative data was collected through interviews, and the questions were analyzed accordingly. In addition to this, quantitative data collection and analysis were carried out through field measurements.

3.6 Research method

To achieve the objectives of this research, both quantitative and qualitative approaches were employed. A qualitative approach follows to explore the current quality and condition of obtainable main road status and the extent to which these existing facilities serve pedestrian demand. For this study, primary data sources were used to gather information. Peak on-street parking volume from the research area was counted in order to measure the amount of on-street parking that now exists, its conditions as observed and measured through field surveys, and the level of services provided in relation to demand and sample size.

3.6.1. Investigating the existing conditions of on-street parking along main road in study area in relation to national standards.

To address this objective, personal observation and manual counts for on-street parking were the primary methods employed.

a. Evaluation of Street design from ERA, norms and standard in Ethiopia.

The standard is accompanied with existing situation analysis report and Sample Street designs for four cities Adama, Mekelle, Bahirdar and Hawassa presented separately for each city. The sample street designs incorporate designs for improvement of existing streets and/or building new streets as applicable with report for each city.

The Ethiopian Road Authority (ERA) compiles and records the yearly traffic statistics for urban areas. Studies on traffic volumes in Mekelle, Adama, and Addis Ababa have been conducted.

These experiences could be enhanced, expanded upon, and used in the analysis and planning of AADT for further Ethiopian urban locations. Projected AADT assists in determining the proper roadway network to support both short- and long-term traffic loads in metropolitan areas, which lowers compensation, relocation, and resettlement costs and guarantees the sustainability of developments as illustrated under table 4.

Table 2: Row of streets in periphery or new expansion area of urban centers.

No	Street category	Row (m)	Row (m) Industry zone
1	PAS	40,45,50,60 for urban streets 60-120 for expressway and toll roads	45,50,60
2	SAS	30,35	35,40
3	CS	20,25	25,30
4	LS	15	15,20

Source: Street design standard in Ethiopia 2017.

For example, a street that already exists and has a 22-meter right of way (ROW) will fall under CS 20 m. The remaining 2 m of the ROW will be planned and utilized as public space. So, Adama towns and study areas main highways were not in agreement with the Ethiopian Road Authority's guideline that it falls under Collector Street.

b. Observation method

The checklists were created based on the general elements of main road standards, main road width, main road elements, sidewalk status, buffer zone, ditch, and all the existing street amenities. The checklists were used for three consecutive days. The current physical character of the streets was documented based on those approaches. This method was applied and used in this research to deeply understand the extent of the existing physical condition of Main Road.

c. On-Street parking count

The parking survey was conducted from January 3 to January 10, 2025, for seven consecutive days, including all weekdays and weekends. The data were collected for 12 hours by dividing the duration of the day into four intervals: 12:00–3:00, 3:01–6:00, 6:01–9:00, and 9:01–12:00. In each interval of time, the survey was done within 1-hour intervals, and the maximum number of cars parked in the areas in each interval of time was considered to analyze the demands of cars in the studied areas. The purpose of this survey is to gather information on parking accumulation, volume, load, average parking time, capacity, and occupancy rates along the 1.5 km between Derartu Tulu Square to Wonji Mazoria. The survey consisted of a field visit (of the study area, figure 5) to conduct a comprehensive survey of data related to the calculation of parking capacity.

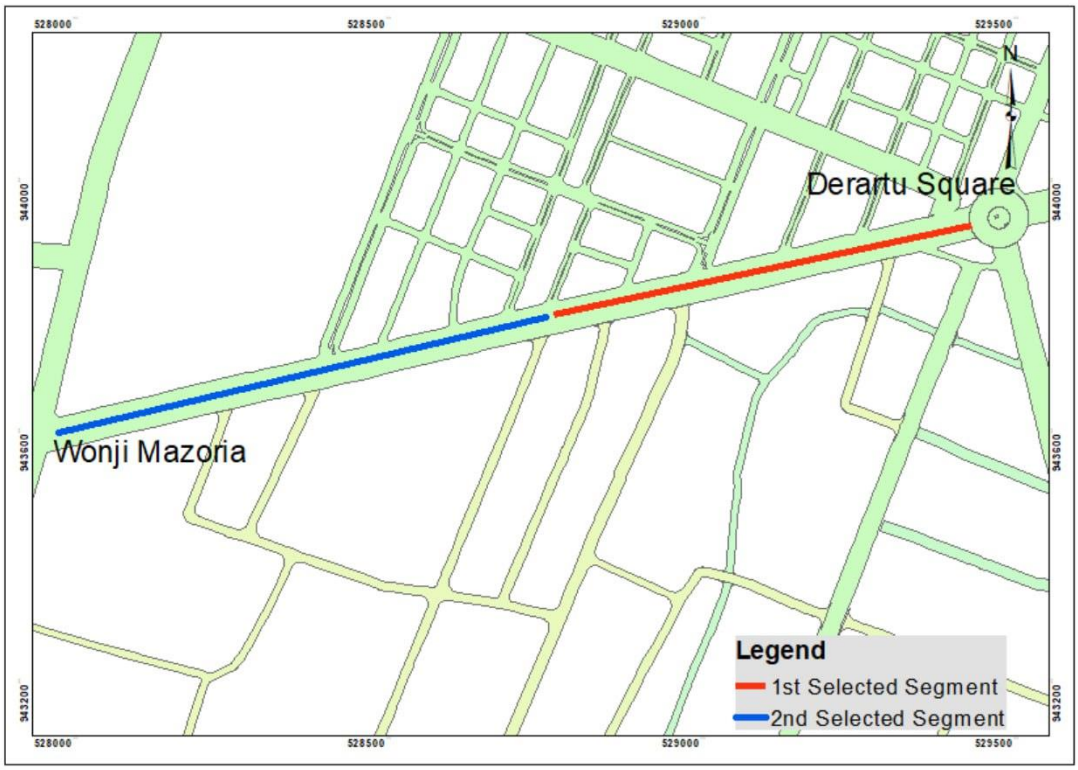


Figure 5: Selected site for parking count.

d. Material for the first objective

While documenting the actual scenario during the site observation, the study used a variety of materials. Samsung Galaxy A10s: to document the current state of the main road in comparison to standards and norms, as well as traffic flow and pedestrian movement in the study area. Notebooks were used to record the observed sidewalk conditions and to take notes during FGD discussions. A printed checklist on A4 paper is utilized to record and identify current main roads' widths in comparison to the norm and standard, as well as to look at pedestrian facilities and use Google Maps and Google Earth to determine the state of the environment.

3.6.2 Effects of on-street parking on pedestrians' safety

To identify the social, economic, safety and drive time effects of on street parking, different tools such as questionnaire, Key informant interview, and focus group discussions were employed.

a. Questionnaire and survey method

To achieve the study's second objective, a questionnaire survey and an interview were used. 384 questionnaires were printed and deployed by using 8 data collectors for 384 respondents. Because of their frequent exposure to the streets, personal knowledge of them, and difficulties emerging from the town's unusual on-street parking, pedestrians participated in this process by answering surveys.

b. Semi-structure interview method

Semi-structured interviews were used in the study to directly interact with drivers using on-street parking along Main Road and pedestrians. A FGD was also conducted with those close to the study area to deeply identify the reasons why drivers use on-street parking and to openly identify what types of approaches were used to control the inconvenience of on-street parking.

c. **Materials for the second objective**

An A4-sized printed questionnaire, a mobile phone, an audio recorder, and notebooks are tools that can be used during the interview. After they were gathered, the valid questionnaires were analyzed with the use of Epidata and SPSS software. Under illustrated table 5 shows prepared check list for interviews with key informants.

Table 3: Interview checklist issue

Interviewed office/body	Case	No
Adama city police and traffic agency	Traffic and policy issue related with on-street parking.	1
Adama City transport agency	Transport controlling management and current status of Adama city	1
Ethiopia Road authority	National highway norms and standard issue	1
FGD	Effects of on-street parking on communities	40
Parking attendants	Parking price, management and commuter.	4

3.6.3 Appropriate planning and design strategy

This objective was answered based on the investigation and findings of the study. Additionally, to fit with the guidelines of national new street planning and design, the norms and standards, manual from ERA, and structural plan of Adama city were examined. City wide structural plan of Adama city, own personal computer was used to cross-check it in line with norm and standards. In addition, software like Auto CAD, adobe Illustrator and GIS 10.8 was used.

3.7 Sampling Technique

The study was conducted in Adama City on an on-site pedestrian questionnaire survey, even though the total population is unknown. Cochran's formula (1963) was used to determine the sample size since the population size is unknown for street surveys.

$$n=\frac{z^2+pq}{e^2}$$

n = sample size in this case. Z represents 95% confidence level (standard value is 1.96), e = planned degree of precision plus five percent, P = estimated proportion of an attribute that is presented in a population with fifty percent, and q = 1-p.

$$n_o=\frac{(1.96)^2+(0.5)(0.5)}{(0.05)^2}=\frac{(3.84)(0.25)}{(0.0025)}=384$$

Thus, the study was conducted, and 384 samples were selected for the study. The decision to select 384 individuals from the population further underscores the significance of this sampling technique. This approach reflects a deliberate effort to attain a representative subset of the population for the survey, balancing the need for robust data with practical considerations related to resource constraints and the inherent challenges of conducting surveys within a dynamic urban environment. Consequently, through this structured sampling technique, the study sought to achieve a meaningful representation of the target population, thus enhancing the reliability and validity of the research findings and conclusions.

3.8 Type and sources of data

The study employed both primary and secondary data to accomplish its goals.

Primary data

The primary data was obtained through questionnaires that were distributed to pedestrians using the main roadside for walking and parking attendants. Field survey and counting the number of parked cars on the subject streets for five working days and two weekends for 12 hours each day. Interviews were also conducted with communities, the higher government officials of the Adama city Transport Authority, Adama City Road Authority, Adama city police, and traffic agency offices, as well as parking attendants on the subject streets.

Secondary data

The secondary data was collected from published and unpublished documents, relevant research works, street-related literature, books, journals, and documents. In addition, government policy, guidelines, reports, manuals, photographs, etc. were taken into consideration.

3.9 Data collection techniques

Various data collection methods were used for this investigation, depending on the type of research method used. Field surveys, interviews, questionnaires, photography, and mapping are some of the approaches used to gather primary and secondary data.

3.9.1 Traffic count survey

To determine the amount of parking in the study area, a field survey was condacted in the selected segments. The study was conducted from 12 a.m. to 12 p.m. on all weekdays and weekends for a period of 12 hours, divided into four intervals, and counted for 1 hour. From each interval, the researcher took the maximum amount of car parking that occurred during the 1-hour intervals and used it for analysis. The number of vehicles parked in a specific location for a predetermined amount of time was taken into account. In this regard, the collected data included the data on parking occupancy were collected during 12:00–3:00, 3:01–6:00, 6:01–9:00, and 9:01–12:00 for seven days, including weekdays and weekends. Tables were developed to collect numerical data from the parking occupancy survey and the given time was local time.

The study approach of collecting parking occupancy data during specific time intervals from 12 a.m. to 12 p.m. on both weekdays and weekends for duration of 12 hours over seven days is fundamentally justifiable for several reasons. Firstly, the extensive timeframe and diverse sampling across weekdays and weekends ensure the inclusion of various traffic patterns and behaviors, capturing a comprehensive picture of on-street parking dynamics in Adama city. The four distinct 3-hour intervals throughout the day allow for a nuanced analysis of parking demands during different times, thereby providing insights into fluctuations in parking occupancy based on varying time segments and days of the week. Additionally, the method of observing and recording the maximum car parking within each 1-hour interval within the predetermined timeframes offers a focused and precise approach, pinpointing peak parking periods for more targeted analysis. Overall, the chosen data collection methodology exhibits a comprehensive and meticulous approach, ensuring the capture of diverse parking behaviors and contributing to a robust analysis of on-street parking's implications for pedestrian safety in Adama city.

3.9.2 Interviews

The Adama City Transport Authority's Traffic Management Department, the Adama City Road Authority's Design Team Members, the Adama City Traffic Police Department, and other relevant stakeholders were all interviewed.

3.9.3 Focus Group Discussion

Focus groups included those pertaining to parking policies and regulations, on-street parking management systems and pricing techniques, the existence of new parking locations, the state of parking today, etc.

3.9.4 Questionnaires

The questionnaire was used to gather data, primarily regarding the perceptions and ideas of the survey participants, who were pedestrians. It was alarming to learn about the seriousness of issues related to street parking in the study locations and how this issue is currently affecting pedestrian safety.

3.9.5 Mapping

In order to identify the locations where the activities occur and to specify the area and territory of their activities for future spatial research, mapping of the activities was done during the interviews with the street users. Sketching was also employed to record some of the open space's physical characteristics and components during the observational analysis of the research area.

3.10 Data Analysis Techniques

Qualitative data analysis

The qualitative data that was obtained from the primary and secondary data are used and interpreted through description, narrating, and interpreting the situations deeply and contextually.

Quantitative data analysis

The data from questionnaires was coded by Epi Data (Epi v. 24) and analyzed using the Statistical Software program (SPSS v25.0). The analysis of the data from the questionnaire was carried out using descriptive statistics. AutoCAD and GIS v10.8 were used to illustrate current on-street parking places in the study area. EpiData 24 was used to code variables while SPSS software was used for data analysis. In the meantime, a reliability test was made to check the consistency of the data.

A correlation and regression analysis

Summary of regression analysis Methods followed to determine the effects of different variables on safety of pedestrian. A Chi-Square ($\chi 2$) test of an independent variable was used to test the existence of a relationship or an association between two qualitative variables at a significance level of 0.05. A chi-square ($\chi 2$) is a probability distribution used to make statistical inferences about categorical data (proportions) in which the numbers of categories are two or more. A logistic regression model was fitted with pedestrian safety as the outcome variable to ascertain the impact of independent variables on the dependent variable. Because the dependent (outcome) variable in this study is nominal (categorical) in nature, it cannot be modeled using a linear regression technique, which is only appropriate for continuous dependent variables. Thus, after assessing the model fitness of the data for the regression model, a binary logistic regression model was fitted using pedestrian safety as an outcome variable to ascertain the impact of independent variables on the dependent variable. Binary logistic regression is a form of regression that is used when the dependent variable is a dichotomy and the independents are of any type. To fit the regression model, the dependent variable was recoded as 1 for good safety and 0 for poor safety. The effects of the identified factors, such as the effect of main road width on pedestrian safety, the effect of pedestrian walkway amenities on pedestrian safety, and the effect of on-street parking on pedestrian safety, were evaluated using the adjusted odds ratio and its 95 percent confidence interval. Variables (factors) having a P value of less than 0.05 were considered to have a statistically significant effect on the safety of the pedestrian.

3.11 Method of Data presentation

The gathered information was presented in the form of charts, graphs, and tables in order to ensure a clear presentation and better understanding. Thus, the organized data in the form of tables, figures, indices, graphs, and maps was analyzed and interpreted.

3.12 Validity and Reliability of the Data

For the validity and reliability of the knowledge, the questionnaire was not filled out by the respondents themselves but rather by the researcher and eight additional data collectors. Since the study was conducted with different ideas from interviews and field observations, the result of the study would reflect the particular situation of on-street parking and pedestrian safety along the study routes; thus, the study result would be valid and reliable.

3.13 Ethical Consideration

Before beginning data collection, different participants were provided with a consent letter to conduct the research. The study was extremely sensitive to the emotions, opinions, and dignity of the participants. The study purpose was thoroughly stated to the participants, along with how the data obtained from them was employed in this study. Further clarification was made to the respondent, stating that the knowledge gathered from the participants was only used for this specific research, and the study kept the confidentiality of all individuals who participated in the study.

3.14 Summary of methodology

The following table 4 enumerates the key elements of the research.

Table 4: Types of variables used in the study area

No	**Objectives**	**Data Source**	**Data used**	**Data Collection method**	**Software used**
1	To investigate Current status of Main Roads of Adama City	Oromia Urban planning Institute, ERA	Revised Structural plan and Norms and standard	Review of documents and Interview with FGD	Auto CAD Arch Cad 24 Epi data 24 Filmora 10 SPSS 25 Twin motion GIS 10.8
2	To investigate Effects of current on street parking on pedestrian safety	Users of the street, Documents, reports and manuals	Existing situations of study area. Users response of study area Secondary data	Observations Questionnaires Interview	

3	To generate appropriate plan	Norms and standard Manual from ERA	City wide structural plan	Personal computer	

CHAPTER FOUR

4. RESULT AND DESCUSION

4.1 Introduction

In this section, we present and discuss the results of the study on the effects of on-street parking on pedestrians' safety along a main road in Adama town. The study aimed to investigate the specific impacts of on-street parking on pedestrian safety and identify the challenges and opportunities for improving parking conditions and promoting sustainable transportation in the study area. To achieve these objectives, we used a combination of data collection techniques, including surveys, observations, and traffic analysis, and applied statistical methods to analyze and interpret the data.

4.1. The respondents' demographic characteristics

4.1.1. Rate of respondent

Economic and demographic factors, such as gender, age, educational background, employment, and income, were incorporated into the survey questions in order to identify the respondent's socioeconomic character. A total of 384 participants were selected for closed-ended questioning and distributed to street users in the study area. However, only 373 questionnaires were turned back. Hence, the researcher interpreted the collected 373 questionnaires as below table 5.

Table 5: Respondent's rate

Responded	No responses	Total
373 (97.8%)	11(2.2%)	384(100%)

4.1.2 socio-economic characteristics of respondent

The results of the questionnaire survey show that among 373 sampled street users, 40.2% are female and 59.8% are male. Concerning the ages of the respondents, it varies from a lower group of 4.0% for the age group above 50+ years, followed by the 41–50 age groups, which are 15.0% to 30.0% for the 18–30 age groups, followed by the age group of 31–40, which is 50.9%. Most of the samples attended a first-degree (BA/BSc) (29.8%), followed by higher educational students

(Others) (28.2%), certificates (17.4%), diplomas (17.2%), MA/MSc (6.7%), and Ph.D. (0.8%), respectively. Among street users employment, 48.5% were unemployed, followed by privately employed (32.7%), 15.0% were government workers, followed by the least number of NGO workers (3.8%). Furthermore, the samples showed that they were from different income groups that ranged from about 500 ETB to more than 10,000 ETB. However, a greater number of street users were found to have incomes between 1501 and 6500 ETB, while the remaining incomes of the household samples were more or less distributed in the same proportion as shown in the illustrated Table 6.

Table 6: Demographic characteristics of respondents.

Variables	Category	Frequency	Percentage
Sex	Female	150	40.2%
	Male	*223*	*59.8%*
Age in years	18-30	112	30.0%
	31-40	190	50.9%
	41-50	56	15.0%
	51+	15	4.0%
Educational background	Certificate	65	17.4%
	Diploma	64	17.2%
	BA/BSc	111	29.8%
	MA/MSc	25	6.7%
	Ph.D.	3	0.8%
	Others*	105	28.2%
Employment of Street user	Government	56	15.0%
	NGO	14	3.8%
	Private	122	32.7%
	Unemployed	181	48.5%
Monthly income	500-1500	30	8.0%
	1501-3500	74	19.8%
	3501-6500	103	27.6%
	6501-8500	72	19.3%
	8501-10000	50	13.4%
	>10000	44	11.8%

Others*(students currently following high school and other institution)

4.2 Current physical characteristics of Main Road in study area.

4.2.1 Public transport analysis and parking situation of study area.

According to the compiled file from the Adama town transport office for 2023–24, about 307 minibus taxis are deployed on a daily basis and make five trips per day on average, and a total of 280 Bajajs are deployed on average each day to cover nine road segments and make fifty daily trips to commute passengers per day in Adama town. However, there is no designated off-street parking space along each origin and destination area in Adama town or in the study area. In the study area, 147 taxis were deployed, making 735 daily trips and loading 14 passengers per taxi, commuting more than 10,290 people per day. 43 Bajajs were deployed per day from the 2nd square to the board, covering 645 daily trips per day and loading 3 persons per Bajaj, commuting 1,945 passengers per day. Based on this information, it can be observed that taxis have a higher deployment rate, greater load capacity, and serve a larger number of daily commuters compared to bajajs. However, Bajaj's still plays a significant role in providing transportation for a considerable number of daily commuters.

4.2.2 Investigating existing Main Road standards and conditions in study area

According to the ERA guidelines and specified above 4.2.1, arterial roads are classified as primary roads that connect major urban centers and provide inter-regional and international connectivity. These roads are expected to have a minimum width of 20 meters, four or more lanes, and a minimum design speed of 80 km/h (Himes & Donnell, 2010). In Adama town, the arterial roads are designed to meet these standards, with some variations based on the specific location and traffic conditions. For instance, the main arterial road that connects the town center to the main highway has a width of 20 meters and four lanes on both the left and right lanes, with a median strip and pedestrian sidewalks on both sides. The road also has traffic signals, speed limit signs, and road markings to regulate the flow of traffic and ensure safety for pedestrians and drivers. The illustrated figure 6 below shows the cross-sectional width of the main road in the study area with a 20-meter width, including transport ways, utility lines, and pedestrian ways in both directions.

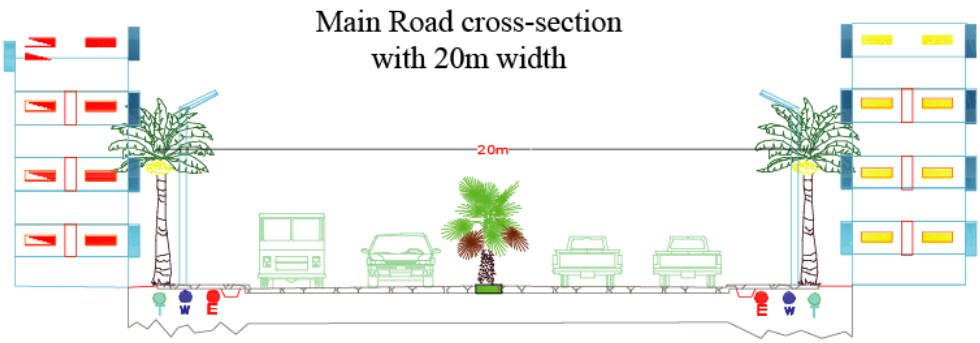


Figure 6: Cross section of main road

As shown under Table 7, the researcher's checklist shows that the main road in the study area is classified as a one-way arterial street with a 20-meter width, including the median and street light, and a poor enough sidewalk in both directions.

Table 7: Existing main road analyses in relation to standards in study area.

Element	Attribute	Direction				Need repair
		Left side		Right side		
		Yes	No	Yes	No	
Existing Main road standard check list	Is main road is one way with four lane as left and right direction?	✓		✓		✓
	Is main road Separated with median between left and right direction?	✓		✓		
	Is main road having pedestrian walkway?	✓		✓		
	Have this main road street furniture? (Sittings, street lights, dust bins….)	✓		✓		
	Is main road furnished with traffic signs, zebra cross and road marking	✓		✓		

4.2.3 Sidewalks condition and safety analysis in study area.

Sidewalks in a study area lack street amenities and are obstructed by different types of illegal parking, long-term on-street parking by trackers, etc. During site observation, the existing sidewalk condition indicated that the sidewalks were dirty, in poor condition, and not walkable. As observed, the safety and comfort of the sidewalk in the area are at risk due to the following factors shown in Table 8:

Table 8: Side walk and safety analysis check list

Element	Attribute	Direction				Need repair
		Left side		Right side		
		Yes	No	Yes	No	
Existing Side walk	Is pedestrian walk way wide is enough? (people can walk together easily)		✓		✓	✓
	Is Pedestrian walkway Separated from main road with green?		✓		✓	
	Is Pedestrian walkway continuous enough for free movement?		✓		✓	
	Is pedestrian walkway having street furniture? (Sittings, street lights, dust bins….)		✓		✓	
Safety	Is Pedestrian is blocked by illegal parking on side walkway, long time heavy trackers on-street parking and other activities?	✓		✓		
	Is pedestrian walkway furnished by street trees?		✓		✓	
	Is pedestrian walkway blocked by any activities	✓		✓		
	Is pedestrian walkway having benches, paved by pedestrian amenities?		✓		✓	

As analyzed and discussed above under Table 11, it appears that the walkways from each side are not safe and suitable for pedestrians. These are because of the absence of permitted parking, a lack of trees for shade, poor surface material, a lack of a buffer between the sidewalks and the vehicle way, the sideways, and the high speed of cars (Figure 7).

Figure 7: side walk and safety of pedestrians' condition

4.2.4 Existing sidewalk width with master plan and standards.

The existing sidewalk width in the study area is not wide enough when compared with the proposed master plan and sidewalk standards. Table 9 below illustrates that the existing sidewalk width is not wide enough when compared with the city's structural plan and with the standard walkway width. The existing sidewalk width on the ground and the structural plan are not fit, and this resulted in discouraging walkability.

Table 9: Table existing side walk width in study area.

Location	Width of main road in meter (m)	Existing pedestrian width in meter (m)	Width of main on structural plan in meter (m)	Side walk Standard	Gap
Study areas main road	20m	2m	25-30m	3.5-5m	1.5-2.5m

In the study area, the main road has a width of 20 meters. However, the existing pedestrian width is relatively narrow at 2 meters. The proposed width on the structural plan is 3.5–5 meters, which suggests an intended improvement in pedestrian space. Additionally, there is a standard gap of 1.5–2.5 meters between the road and the pedestrian area. While these measurements may vary depending on local regulations, a wider pedestrian area can enhance comfort and safety for pedestrians, while the gap provides a buffer zone and facilitates the incorporation of necessary infrastructure.

4.2.5 Pedestrian conflict with another street user in the study area.

On-street parking is physically manifested in the street along a single vehicular lane, holding up traffic flow and decreasing the safety of pedestrians since the sidewalk is not wide enough to move freely. When the sidewalks are too crowded, people are forced to step onto the road to walk, risking many lives. Drivers and other road users dislike them for their road encroachment.

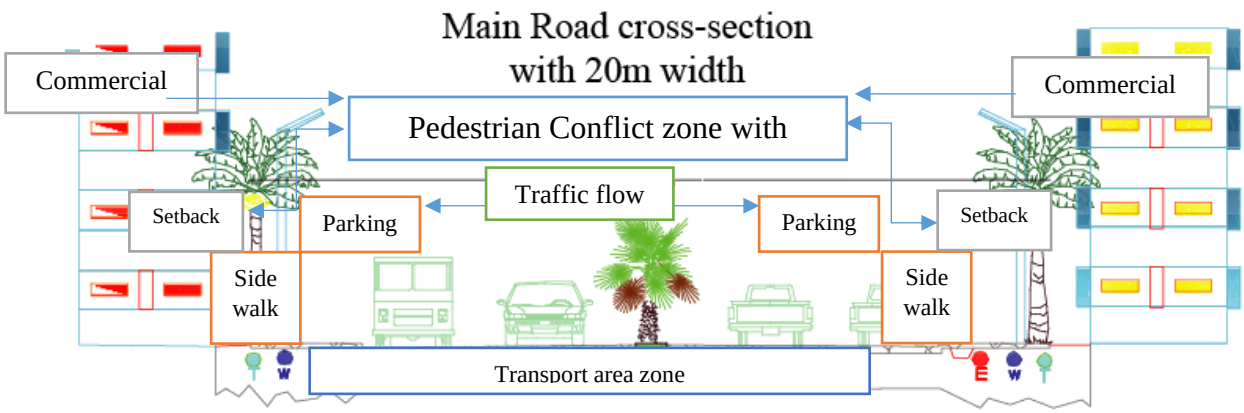


Figure 8: Street conflict with other road side users

The above figure 8 shows that from site observation, while pedestrians walk on the sidewalk, many informal activities are employed on the main road and along the sidewalk, and this leads to conflicts with on-street parking and illegal activities on the pedestrian walkway. This resulted in traffic congestion, walkway width minimization, traffic accidents, and pedestrian safety problems in the area.

4.2.6 On-street and off-street parking analysis checklist in study area.

According to Adama Town Transport Authority 2023/24, parking is done relatively close to important intersections on pedestrian walkways and carriageways. There is no freight terminal or formal on-street parking that has been run by the municipality for a long time. As a result, the respective business users, hotels and garages both use on-street parking as terminals. Based on on-site observation evidence, both planned and designed off-street and on-street parking are absent in the study area, and hence the street is obstructed by illegal on-street parking, which causes traffic problems and threatens the safety of pedestrians.

Table 10: On-street and off-street parking analysis in study area.

Element	Attribute	Direction			
		Left side		Right side	
		Yes	No	Yes	No
On-Street and Off-Street	Is there green buffer between On-Street parking and pedestrian way?		✓		✓
	Is there on-street parking provided along main street?		✓		✓

parking check list	Is there off-street parking provided along main street?		✓		✓
	Is heavy trackers use on-street parking for long time affecting safety of pedestrians?	✓		✓	

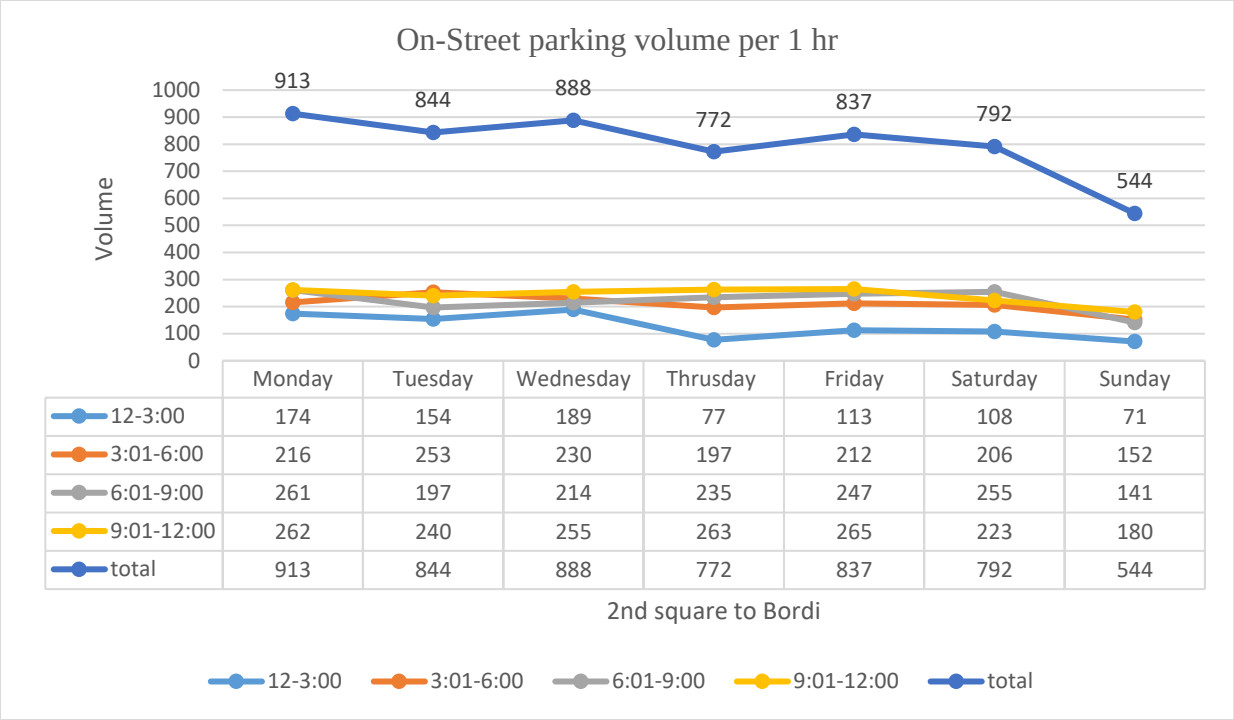
Due to a lack of adequate on-street and off-street parking, vehicles are parked on the pavements that run the length of the street on both sides.

4.2.7 Existing On-Street parking Evaluation in study area.

On-street parking counts are crucial to knowing how many cars are parked in the limited space and what problems the parked vehicles bring to people, the streets, and the environment. To know these impacts, the study was done from Derartu Square to Wonji Mazoria, which covers a length of 1.5 km.

4.2.8 On-Street parking volume analysis in study area.

There is a daily variation in the amount of on-street parking activity in this area. On the working day, on-street parking activity has higher volumes than on weekdays. This activity becomes more low; when compared Sunday with Saturday, on-street parking volume was very low.



	Monday	Tuesday	Wednesday	Thrusday	Friday	Saturday	Sunday
12-3:00	174	154	189	77	113	108	71
3:01-6:00	216	253	230	197	212	206	152
6:01-9:00	261	197	214	235	247	255	141
9:01-12:00	262	240	255	263	265	223	180
total	913	844	888	772	837	792	544

Figure 9: On-Street parking volume analysis

Figure 9 illustrates on-street parking volume in the study area. From the graph above, Monday had the highest number of on-street parking volumes (913), owing to the fact that Monday is the beginning of the working day. Among the on-street parking counted on different days, Monday 913, Tuesday 844, Wednesday 888, Thursday 772, Friday 837, Saturday 792, and Sunday have 544 counted for 1 hour in descending order, respectively. The surveyor used the in-out survey technique to conduct parking analysis, which was conducted for seven days for 12 hours in four intervals of time. This descending trend in parking counts from the beginning of the week toward the weekend possibly suggests a correlation with fluctuating levels of commercial, recreational, or residential activities within Adama Town. The findings underscore the importance of day-specific analysis when evaluating on-street parking demand, providing critical data to inform urban planning and traffic management initiatives aimed at optimizing parking resources and enhancing pedestrian safety based on observed trends.

4.2.9 Respondents trip purpose of study area.

Under-illustrated Table 14 shows the trip purpose of respondents following the frequency of their trips and exceptional thinking on selected main roads during the studied period. Accordingly, 22.3% returned home, 19.3% for shopping purposes, 18.0% for work purposes, 13.1% for recreation and entertainment purposes, and 10.2% attended school, followed by 9.7% for medical purposes. 5.4% for religious centers and 2.1% for transit purposes. Additionally, among the 373 respondents, 49.1% had a high percentage of walking experiences occasionally, followed by 29.0% frequently, 20.4% used pedestrians very rarely, and 1.6% never used pedestrian walkways in the study area. However, 68.1% of respondents thought that the width of the main road in the study area was not wide enough and was dangerous for pedestrian safety, while 31.9% thought it was wide enough.

Table 11: Trip reason, frequency and pedestrian perception in study area.

Variables	Category	Frequency	Percentage
Which of the trips listed below are you making	Work	67	18.0%
	Medical	36	9.7%
	Return home	83	22.3%
	Business/Shopping	72	19.3%
	Transit	8	2.1%
	School	38	10.2%
	Recreation	49	13.1%
	Religion center	20	5.4%
How frequently do you use this street to have walk?	Frequently	108	29.0%
	Occasionally	183	49.1%
	Very rarely	76	20.4%
	Never	6	1.6%
Do you think this Main Road is wide enough?	Yes	119	31.9%
	No	254	68.1%

4.3. Current effects of on-street parking on pedestrians' safety in study area

Road access for cars and pedestrians is currently being restricted by an increase in on-street parking activities in the study area. Additionally, illegal parking is contributing to the increasing irregularity of road conditions. Road access for cars and pedestrians is currently being restricted by an increase in on-street parking activities in the study area. Additionally, illegal parking is contributing to the increasing irregularity of road conditions. This phenomenon reduces the quality of cleanliness, beauty, security, and safety for road users to move freely while feeling secure and

comfortable for pedestrians. It has an effect on the decline in public welfare in terms of access to public spaces.

On-street parking can have various impacts on traffic congestion, accidents, illegal activities (such as theft), and pollution, particularly noise pollution. Firstly, on-street parking can contribute to increased traffic congestion by reducing the available road space for moving vehicles, especially during peak times. This can lead to traffic bottlenecks and delays. Secondly, on-street parking can potentially contribute to accidents as it may obstruct visibility for drivers and create obstacles in the flow of traffic. In addition, illegal activities, particularly theft or vandalism, can occur more easily with parked cars providing potential cover for criminals. Lastly, on-street parking can contribute to noise pollution due to congested traffic flow, honking, and engine noise. Overall, effective management of on-street parking, considering factors such as designated parking areas, time limits, and enforcement, is crucial to mitigate these impacts and ensure smoother traffic flow, enhanced safety, reduced illegal activities, and minimized noise pollution.

4.3.1. Satisfaction of the respondents with current Main Street along study area.

Most of the respondents are not happy with the current main road in the studied areas due to a lack of street amenities and furniture, pedestrian walkway amenities, pedestrian walkway width, and the safety of the study area.

4.3.1.1 Cause of dissatisfaction of respondents

As shown in Table 12 below, the reasons for the respondent's perception of the current main road situation in the study area are: According to the survey, only 16.6% of respondents believe that the study area's main road is furnished with all amenities, while the remaining 83.6% do not believe that the main road is furnished with all amenities. 85.0% of respondents believe that the study area's main road is separated from the pedestrian walkway, while the remaining 15.0% do not believe that it's separated from the pedestrian walkway because sometimes most drivers stop their vehicles on the pedestrian walkway. According to the survey, only 5.9% of respondents believe that pedestrian walkways are furnished with all amenities, while 94.1% of them do not. In terms of pedestrian safety in the study area, 42.4% of respondents thought the footpath were very bad, 39.4% thought it was bad, 15.5% thought it was fair, and only 2.7% thought it was adequate.

Table 12: Cause of dissatisfaction of respondents in study area.

Variables	Category	Frequency	Percentage
Do you think road is furnished with all-street amenities?	Yes	62	16.6%
	No	311	83.4%
Do you think that vehicle movement is separated from the pedestrian?	Yes	317	85.0%
	No	56	15.0%
Does the pedestrian walkway have Amenities?	Yes	22	5.9%
	No	351	94.1%
How do you rate the footpath width and its safety in the town?	Very bad	158	42.4%
	Bad	147	39.4%
	Fair	58	15.5%
	Good	10	2.7%

The survey results present a comprehensive snapshot of public opinion relating to the provision of street amenities, vehicular and pedestrian segregation, the presence of pedestrian walkway amenities, and assessments of footpath safety and width within the town. These findings collectively highlight a pressing need for comprehensive improvements in street amenities, pedestrian safety measures, and footpath infrastructure within the town, signaling crucial areas for focused urban planning and infrastructure development initiatives.

4.3.2 Respondents perception of current On-Street parking issue in the study area.

According to the survey illustrated in Table 13, 93.8% of respondents agree that on-street parking affects pedestrian safety, while 6.2% don't agree, and 59.2% of respondents believe that on-street parking affects pedestrian safety through decreasing visibility, 24.4% through crime and robbery, and 16.4% through traffic accidents.

Table 13: Respondent's perception of current On-Street parking issue in study area.

Variables	Category	Frequency	Percentage
Do you think on street parking affect pedestrians safety?	Yes	350	93.8%
	No	23	6.2%
To what extent On-Street parking affect safety of pedestrians?	Traffic accident	61	16.4%
	Crime and robbery	91	24.4%
	Visibility	221	59.2%

Source: (Researcher, 2023)

The survey results yield crucial insights into public perceptions regarding the impact of on-street parking on pedestrian safety. These findings address multifaceted safety considerations,

emphasizing the significance of addressing visibility issues, crime prevention, and traffic safety concerns related to on-street parking to enhance pedestrian safety within the urban environment.

Figure 10: Carriage way and safety of pedestrian in study area.

4.3.3 Pedestrian perception on safety of pedestrian in study area.

The survey included questions about the perceived negative effects of on-street parking on pedestrians, as well as the comfort level of pedestrians while walking through sidewalks with on-street parking, as shown in Table 14. The majority of respondents (80.9%) acknowledged the detrimental effects of on-street parking. A considerable number of respondents rated the effect as very high (47.7%), indicating that they believe on-street parking has a substantial negative impact on pedestrians. Additionally, 32.2% of respondents rated the effect as high, further underscoring the perceived negative consequences. Furthermore, 18.0% of respondents indicated a slight effect, while a small proportion (2.1%) reported no effect. When asked about their comfort level while walking through sidewalks with on-street parking, the responses were largely negative. A significant majority of respondents (95.4%) reported feeling uncomfortable to some degree. More than half (54.4%) expressed feeling very uncomfortable, while 41.0% mentioned being slightly uncomfortable. Only a small proportion (4.6%) claimed to feel comfortable while walking in areas with on-street parking.

Table 14: Respondent's perception on safety of pedestrian in study area.

Variables	Category	Frequency	Percentage
Do you rate the negative effect of on street parking of pedestrians?	No effect	8	2.1%
	Slightly effect	67	18.0%
	High	120	32.2%
	Very high	178	47.7%
Do you feel comfortable walking thru this sidewalk in On-street parking?	Very uncomfortable	203	54.4%
	Slightly uncomfortable	153	41.0%
	Comfortable	17	4.6%

These results illuminate widespread apprehension among pedestrians related to the negative implications of on-street parking, underscoring the imperative need for remedial action and urban planning strategies aimed at addressing pedestrian comfort and safety within the context of on-street parking in the surveyed area.

4.3.4 Pedestrian generation land use and frequency of pedestrian in the study area.

According to Table 15 below, 42.6% of the respondents visit the study area on weekdays, followed by 36.5% of the respondents who visit the study area day by day, 12.6% of the respondents who visit the study area twice a day, and 8.3% of the respondents who visit 1-3 days a week. With reference to pedestrian-generating land use and pedestrian walkway width in relation to safety, 51.2% of respondents believe that the safety of pedestrians in the study area was poor, followed by 44.5% satisfactory, while 3.8% feel good and 0.5% believe that it was excellent. This means that most of the respondents visit the study area day-by-day and week-by-week. The purpose of these surveys is to better understand the problems with parking facilities in the area.

Table 15: Frequency of pedestrian spending time and land use generating in study area.

Variables	Category	Frequency	Percentage
How much time do you spend walking on main roads of Adama town?	Day by day	136	36.5%
	week day	159	42.6%
	for 1-4 days	31	8.3%
	Twice a day	47	12.6%
With reference to pedestrian generating land use, rate safety of street with pedestrian?	Excellent	2	0.5%
	Good	14	3.8%
	Satisfactory	166	44.5%
	Poor	191	51.2%

These behaviors signal a consistently high presence of pedestrians on the town's main roads, with a significant proportion engaging in daily or weekly walking activities. These findings underscore the critical need for urban planning strategies focused on enhancing pedestrian safety and walkability in Adama town, taking into account the considerable pedestrian presence and the perceived inadequacies in street safety for pedestrians within the surveyed area.

4.3.5 Traffic flow and activities around pedestrian walkway in study area.

Roadside and illegal parking are common phenomena in Adama town, especially in the central business district. Since the study area is in the CBD, there were different activities along selected main roads that blocked traffic flow and affected pedestrian safety. The amount of interest in the existing on-street parking along the main road, as well as the traffic flow and activities surrounding the pedestrian walkway, were all covered by the survey. The amount of interest in the existing on-street parking along the main road, as well as the traffic flow and activities surrounding the pedestrian walkway, were all covered by the survey. Most respondents (67.3%) thought there was a lot going on around the pedestrian walkway in terms of traffic flow and activities. This suggests that the area surrounding the pedestrian walkway experiences a significant amount of traffic and various activities. Additionally, a notable proportion of respondents rated the traffic flow and activities as very high (20.1%), indicating an even more intense level of movement around the pedestrian walkway. Conversely, some respondents perceived a low level of activity (12.6%) in the area. When it comes to interest in the current on-street parking along the main road, a considerable portion of respondents expressed uninterested or very uninterested (85.3% combined). This suggests that a significant number of respondents do not find the current on-street parking arrangements to be of particular interest. A smaller percentage of respondents are neutral and somewhat interested (14.7%) in the current on-street parking, according to Table 16.

Table 16: Respondent's perception on traffic flow and on-street parking in study area.

Variables	Category	Frequency	Percentage
How is the traffic flow and activities around the pedestrian walkway?	Very high	75	20.1%
	High activity	251	67.3%
	Low activity	47	12.6%
Are you interested in Current On-Street parking along this main road?	Very uninterested	135	36.2%
	Uninterested	183	49.1%
	Neutral interested	55	14.7%

These findings underscore a bustling and active environment surrounding pedestrian walkways, emphasizing the need for attentive traffic management strategies to ensure pedestrian safety in such dynamic settings. Additionally, the survey delves into the public interest in the existing on-street parking along the main road. These patterns of disinterest advocate for a critical reexamination of current on-street parking arrangements, particularly concerning their

harmonization with pedestrian safety and the overall flow of activities around pedestrian walkways within the town

4.3.6 The main problems that pedestrians encounter on the roadside obstruction.

The survey explored the discomforting activities on the sidewalk, the congestion faced by pedestrians due to on-street parking, and the types of vehicles that most affect pedestrian safety along the street. In terms of the activities that cause discomfort and affect safety on the road, inappropriate parking seems to be the most prevalent issue, with 54.2% of respondents reporting it as a concern. This is followed by garage-related activities at 14.7% and tire changing (gomista) at 29.2%. The presence of vendors seems to be a lesser concern, with only 1.9% mentioning it. When it comes to congestion caused by on-street parking, a significant proportion of respondents rated it as very bad (42.9%) or bad (42.1%). This indicates that the presence of on-street parking often leads to difficulties and inconveniences for pedestrians, affecting the overall flow of pedestrian traffic along the street. A smaller percentage of respondents rated the congestion as fair (12.9%) or good (2.1%). Regarding the types of vehicles that most affect pedestrian safety, heavy trackers were identified as having the highest impact, with 91.2% of respondents mentioning them. This suggests that the size and maneuverability of heavy trackers pose significant risks to pedestrians. Minibuses, buses, and pick-ups were also cited, albeit with much lower frequencies, as illustrated in Table 17.

Table 17: Problem that pedestrian encounter in study area.

Variables	Category	Frequency	Percentage
Activities on the sidewalk you find discomforting your safety on this road?	Un appropriate parking	202	54.2%
	Garage	55	14.7%
	Tire changing (Gomista)	109	29.2%
	Vendors	7	1.9%
Rate congestion you face on pedestrians due to On-Street parking on road?	Very bad	160	42.9%
	Bad	157	42.1%
	Fair	48	12.9%
	Good	8	2.1%
What kinds of vehicles more affect safety of pedestrians along this street?	Heavy trackers	340	91.2%
	Minibus	13	3.5%
	Bus	19	5.1%
	Pick up	1	0.3%

The responses from the survey provide significant insights into the factors contributing to pedestrian discomfort and safety concerns related to on-street parking in Adama town. These findings underscore a diverse array of sidewalk activities that contribute to pedestrian unease, emphasizing the multifaceted nature of safety concerns related to on-street parking. These comprehensive insights underscore the urgent need for systemic interventions and urban planning strategies to mitigate pedestrian discomfort and enhance safety in response to the identified concerns.

4.3.7 The impact of parking on the width of the roadway

Site observations clearly show that the study road segment's on-street parking trespasses on the carriageway's effective width. The planned street performance is diminished by road encroachment brought on by on-street parking. The study showed that there is a measurable decrease in the capacity of lane width. But there is no measurable decrease in urban street capacity when through lane widths are narrowed from 3.5 m to 2.5 m. Almost 2.5 meters of the carriageway from the street's curb were taken up by on-street parking during the busiest time of the day that the study road linkages had on-street parking. Thus, it's empirical to deduce that the safety, speed, and capacity of the urban arterial road were significantly reduced.

4.4 Couse effect factor analysis.

A Chi-Square ($\chi 2$) test of independence is used to test for the existence of a relationship or an association between two qualitative variables at a significance level of 0.05. A logistic regression model was fitted with pedestrian safety as the outcome variable to ascertain the impact of independent variables on the dependent variable. In this study, the safety of pedestrians, which is an outcome variable of interest, is a nominal (categorical) type of data and cannot fit a linear regression model, which is only used when the nature of the dependent (outcome) variable is continuous. Thus, after checking the model fitness of the data for the regression model, a binary logistic regression model was fitted with the outcome variable of pedestrian safety to ascertain the impact of independent variables on the dependent variable.

4.5 Result of Pearson Chi-Square test.

Due to the categorical (nominal) nature of the data, Pearson Chi-Square test was used to determine an association of pedestrian's safety and on street parking after fitting the assumptions of Pearson Chi-Square test.

4.5.1 Impact of street parking on the safety of pedestrians.

The results of the Pearson Chi-Square analysis indicate a statistically significant correlation between on-street parking and pedestrian safety. The Pearson Chi-Square (X2) test, together with the P-value (value significance level) and degree of freedom (df), is: X2 = 10.24, df = 1, N = 373, P-value = 0.001.

Table 18: Cross-tabulation of the impact of street parking on the safety of pedestrians

On-street parking * pedestrian safety Cross-tabulation					
			safety of pedestrian		Total
			Good	Poor	
On street parking	No	Frequency (n)	4	19	23
		Percentage (%)	17.4%	82.6%	100.0%
	Yes	Frequency (n)	12	338	350
		Percentage (%)	3.4%	96.6%	100.0%
Total		Frequency (N)	16	357	373
		Percentage (%)	4.3%	95.7%	100.0%

4.5.2 Effect of pedestrian walk way amenities on pedestrian's safety

Lack of amenities on pedestrian walkways was significantly associated with poor pedestrian safety. Pearson Chi-Square(X2) = 10.99, df = 1, N = 373; P value = 0.001.

Table 19: Cross tabulation of Effect of pedestrian walks way on pedestrian safety.

Does the pedestrian walkway have Amenities? * Safety of pedestrian Cross tabulation					
			safety of pedestrian		Total
			Good	poor	
	Yes	Frequency (n)	4	18	22

Do the pedestrian walkways have Amenities?		Percentage (%)	18.2%	81.8%	100.0%
	No	Frequency (n)	12	339	351
		Percentage (%)	3.4%	96.6%	100.0%
Total		Frequency (N)	16	357	373
		Percentage (%)	4.3%	95.7%	100.0%

4.5.3 Effects of sidewalks activities on pedestrian safety.

A side walk activity was found to be significantly associated with pedestrian safety. Pearson Chi-Square results: (X2 (df), N, P-Value), X2 = 13.69, df = 3, N = 373, P-value = 0.003

Table 20: Correlation analysis of Effects of sidewalks activities on pedestrian safety.

Activities on the sidewalk you find discomforting your safety on this road? * safety of pedestrian Cross tabulation					
			safety of pedestrian		Total
			Good	Poor	
Activities on the sidewalk you find discomforting your safety on this road?	Un appropriate parking	Frequency (n)	6	196	202
		Percentage (%)	3.0%	97.0%	100.0%
	Garage	Frequency (n)	7	48	55
		Percentage (%)	12.7%	87.3%	100.0%
	Tire changing (Gomista)	Frequency (n)	2	107	109
		Percentage (%)	1.8%	98.2%	100.0%
	Vendors	Frequency (n)	1	6	7
		Percentage (%)	14.3%	85.7%	100.0%
Total		Frequency (n)	16	357	373
		Percentage (%)	4.3%	95.7%	100.0%

4.6 Regression analysis model of the factors affecting pedestrian safety

Logistic regression analysis was used to determine the determinants of pedestrians' safety. In the final regression model, three potential factors were identified as having a significant effect on pedestrians' safety. The safety of pedestrians was found to be influenced by on-street parking, pedestrian walk-way amenities, and the width of the main road. The coefficient estimate for on-street parking (B = 2.81) is positive, which indicates that on-street parking increases the chances of poor pedestrian safety. We can also see that the significance level or p-value for street parking is less than 0.05, which means it has a statistically significant effect on the safety of pedestrians. Odds ratio (OR) with a 95% CI = 16 (10.62, 26.08), P-value = 0.00. The coefficient estimate for pedestrian walk-way amenities (B = 1.66) is positive, which indicates that a lack of pedestrian walk-way amenities increases the chances of poor pedestrian safety. The significance level or p-value for pedestrian walk-way amenities is less than 0.05, indicating a statistically significant effect on pedestrian safety. Odds ratio (OR) with a 95% CI = 5.26 (3.98, 6.93), P-value = 0.00. The coefficient estimate for main road width (B = 2.16) is positive, which indicates that the narrowness of the width of the main road increases the chances of poor pedestrian safety. We can also see that the significance level or p-value for the width of the main road is less than 0.05, which means it has a statistically significant effect on the safety of pedestrians. Odds ratio (OR) with a 95% CI = 8.66 (5.81, 12.89), P-value = 0.00 Table 21.

Table 21: Result of logistic regression analysis of factors affecting pedestrian safety in Adama Town.

	B	Sig.	Exp(B)	95% C.I.for EXP(B)	
				Lower	Upper
On street parking affect pedestrians' safety	2.81	.000	16.64	10.62	26.08
Pedestrian walkway Amenities effect on safety of pedestrian	1.66	.000	5.26	3.98	6.93
Effect of main road Width on pedestrian safety	2.16	.000	8.66	5.81	12.89

4.7 Results of Interview Survey Results

The checklist created by the researcher during the study, which focuses on responding to research questions, was listed and discussed. As detail discussed under methodology, a follow-up interview on transport regulation and management issues was conducted with the Adama town police and traffic agency offices on policy, parking regulations, and associated concerns with 1 representative and 1 person from the Adama town transport office. 40 participants from the FGD, representing communities, pedestrian users, drivers, and others, participated after one representative of Ethiopia's road authority spoke on topics relating to main road standards. Last but not least, four people worked as parking attendants because they directly contributed to daily on-street parking.

The field walkability survey was conducted in Adama town along the study area. The drivers, community of the main road, and pedestrians walking in both directions were surveyed. Respondents mentioned several sidewalk characteristics that may facilitate or hinder walking, such as sidewalk presence and continuity, sidewalk quality and maintenance, and temporary obstacles on sidewalks. Furthermore, they disliked the abrupt endings of sidewalks, which forced them to walk along the main street because of on-street parking. Some of the dislikes for pedestrian restriction areas along the main road made them not follow traffic rules in the town. Specifically, from Derartu square to Franko, there were two restricted areas around. Concerning sidewalk quality and maintenance, the respondents raised issues such as sidewalk width, smoothness of sidewalk surfaces, holes, and cracks. In addition, temporary obstacles on sidewalks were mentioned as a barrier to walking. Examples of such obstacles were open drainage (especially for those with impaired sight), illegal waste storage alongside walks, and parked cars. Concerning the safety of sidewalks, respondents raised different ideas affecting their safety. Sidewalk Path Conflict; Visibility of Crossings; Road Crossing Area Facilities; Motorist Behavior; Pedestrian Amenities; Disability Infrastructures; Obstructions on Pedestrian Environment; Pedestrian Security from Crime; Pedestrian Walkway System Coherence; Impacts of on-street Parking; Impacts of Drainage; Impacts of Roadside Illegal Activities on Pedestrian Safety; and Pedestrian Preferences towards Pedestrian Walkway Environments, respectively, since there is a narrow sidewalk and different illegal activities take place in the study area and all over the town.

The position of the pedestrian affects the way that drivers behave when they have to surrender. According to Davis and Hallenbeck (2008), the placement of the pedestrian, such as the shoulder, the sidewalk, or the center turn lane, will affect the vehicle's yielding behavior. They collected data for their investigation at six distinct locations and discovered a statistically significant variation in driver yield behavior. Pedestrians waiting in the center lane are far more likely to be given the right of way by drivers than those waiting on the sidewalk. In addition to pedestrian questionnaires and interviews, ten (10) drivers were asked to offer their opinions about the state of the roads and how pedestrians behave when crossing the street and walking as part of this study looking into the impacts of on-street parking on pedestrian safety. All of the respondents strongly agreed that vehicle yielding is directly influenced by the visibility of the crossings. They also stated that not all pedestrians act in a good manner when crossing the roads, and more pedestrians walk on the main carriageway, responding badly to drivers, especially when street water is splashed on them. The drivers stated, "The carriageway surface conditions were poor; narrow carriageway width, potholes, and the invisibility of pedestrian crossing areas and on-street parking were the main problems that made drivers not drive safely."

Figure 11: traffic way and pedestrian obstruction in study area.

According to the commissioner directly involved with the police and traffic agencies, the major road in Adama town has four lanes on both the left and right sides and is one-way. If we use right-side lanes, the lane closest to the street median aids in traffic mobility and transport flows, while the other second lane aids in vehicle overpasses, the delivery and pickup of people and goods along the main road, and on-street parking. "Any vehicle can use on-street parking for about six hours," according to the traffic police commissioner. "However, if they park on-street for over six hours, they can be punished even if it's damaged, but there is no policy to control such on-street parking along the main road." According to an interview with the Adama Town Transport Office, "Adama Town's Main Road Was Wide Enough When It Was Constructed." There are a lot of motorized vehicles in Adama town. Urban centers are growing, the population is rising, and car ownership is rising as well. There is no planned parking place for both freight and taxis along both on-street and off-street, which has resulted in serious parking problems due to large increases in the number of vehicles and a lack of enough parking space in the city. An officer stated, "At the moment, they take action to force trackers to only use on-street parking after 6 p.m. to 6 a.m. because extended periods of on-street parking harm pedestrian safety." Unless we try to make all streets safe for people with disabilities, pregnant women, elderly citizens, and kids going to school, it would be impossible to create a conducive environment for pedestrians. In this regard, the following interview results were provided by the interviewees: "I work the whole day in my office and I do not get enough exercise; so, when I leave the office, I want to walk to my home, but there are no sidewalk safety features since on-street parking covers the visibility of sidewalks and a huge number of pedestrians have walks. "I always want to walk from my work place to home, but the roads are too busy with heavy trackers using on-street parking and dangerous pedestrian sidewalks almost blocked with informal activities everywhere." "I see people walking along the medium lane of the street, which is very dangerous and causes traffic accidents along this main road." "It is not safe for me to walk with my girlfriends, especially after 5:00 p.m. since there are no safe sidewalks and almost all single lanes of main roads are occupied by on-street parking, especially trackers, which cover pedestrian visibility, so some people leave the sidewalk and use the middle of the main road because there is no choice." "There was no planned freight terminal in this town, and we used this main road for parking, paying some money for parking attendants." "They give us a place that is not occupied by parking, and we use it always for long periods of time, especially starting from 5:00 p.m. to the afternoon, which means the whole night. But I saw people using

pedestrians rather than taxis, buses, or any vehicles after 5:00 p.m., but it was not safe for pedestrians." "I see no one considering disabled people along this main street." Creating a more pedestrian-friendly environment will help increase the health of citizens and make the city more attractive to health-minded individuals when going to or coming from schools, health centers, and play stations, which could be assets to the community. Therefore, higher priority should be given to pedestrian walkways than motorized lanes because pedestrians are the largest number of travelers and are more vulnerable to several problems.

4.8 Discussion of the Existing condition of main road status in the study area.

The checklist was utilized in this study area to keep track of the amenities, pedestrian facilities, and status of the road width in the study region. Within the research area, it is more difficult to access the basic components of main road width with respect to norms and standards, traffic flow considerations, and walking amenities such as street lights for both pedestrians and vehicle drivers. On the other side, because the study location is in the CBD, the predominant roadway also lacks a green buffer for pedestrians, insufficient street signage, pedestrian-friendly lighting, pedestrian-friendly shading, and rush-can on-street parking opportunities. The absence of a control policy for on-street parking users, pedestrian circulation lanes, crossovers, and buffers between traffic and pedestrian lanes contributes to pedestrian safety and comfort. Transport options, vehicular stops, waiting area parking, pedestrian crossings, and traffic calming design don't seem to be located in the respected places. They are closed and covered by illegal activities, and more vehicles have used on-street parking for a long period of time, as observed.

The sidewalks in the study area were in poor condition, lacking the necessary amenities and proper maintenance. They are dirty, in disrepair, and not walkable. This poses a risk to pedestrian safety and discourages walking in the area. Pedestrian safety and comfort are jeopardized by the absence of a proper sidewalk surface, a buffer zone between the sidewalk and the road, and on-street parking. As observed during the study, there was a pedestrian conflict with other street users. On-street parking along the main road causes conflicts between pedestrians and other road users. The limited width of the sidewalks and the encroachment of parked vehicles onto the sidewalk space force pedestrians to walk on the road, increasing the risk of accidents and compromising pedestrian safety. The informal activities taking place on the main road and along the sidewalk further

exacerbate these conflicts. This was because the main road was not in sufficient compliance with standards. The existing main road width does not align with the proposed master plan and sidewalk standards for the city. This inconsistency discourages pedestrian activity and exposes pedestrians to safety risks. The inadequate width also hampers effective sidewalk use and contributes to traffic congestion.

4.9 Discussion about how on-street parking is currently affecting the safety of pedestrians in the study region.

The study area's pedestrian safety is significantly affected by the presence of on-street parking at the moment. Currently, the study area's growing on-street parking operations are restricting automobile and pedestrian access to the roads. It also leads to illegal parking, causing road conditions to become increasingly irregular. This phenomenon reduces the quality of cleanliness, beauty, security, and safety for road users to move freely while feeling secure and comfortable for pedestrians. The observation addresses respondents' perceptions and interests in the current on-street parking arrangements, as well as the detrimental effects of on-street parking on pedestrian comfort and safety. It mentions that a significant majority of respondents feel uncomfortable walking through sidewalks with on-street parking and that there is a strong negative sentiment towards this issue. The study also reveals that a considerable number of respondents acknowledge the negative impact of on-street parking, particularly in terms of safety. Additionally, it states that a significant portion of respondents are uninterested in the current on-street parking arrangements. Overall, the text suggests that improvements are needed in the management and design of on-street parking to enhance pedestrian safety and comfort. Overall, the context information indicates that on-street parking has significant negative effects on pedestrian safety in the study area. The majorities of respondents perceive these negative effects and feel uncomfortable while walking in areas with on-street parking. It is crucial to address these issues to improve pedestrian safety and enhance the overall experience of road users.

CHAPTER: FIVE

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

It's clear from the data collection and analysis that on-street parking has a major impact on pedestrian safety along the study area's main road. The research results show that the current on-street parking scenario presents a number of safety concerns as well as annoyance for pedestrians in the study region. The survey results highlight the perception of poor pedestrian safety among respondents, with a majority considering it to be unsatisfactory. The main issues identified include insufficient sidewalk width that was under norm and standard, poor sidewalk conditions, and conflicts with other street users such as vehicles and informal activities. These factors contribute to a compromised pedestrian experience, an increased risk of accidents, and hindered pedestrian mobility. It was evident that on-street parking significantly affects pedestrians' safety, congestion, and the overall flow of traffic. The presence of illegally parked vehicles obstructs pedestrian walkways, forcing pedestrians to share limited space with moving vehicles. This unsafe situation is further exacerbated by the lack of proper sidewalk amenities, inadequate compliance with width standards, and the absence of a buffer zone between pedestrians and vehicles. There aren't any designated places for on-street parking for taxis, Bajaj, and freight terminals for heavy trackers, so they use a single lane of the street, which is meant for other purposes for traffic mobility. This ends up in contestations and conflicts with urban authorities. There was also an intense struggle for space between the on-street parking, and therefore the pedestrians were forced to run in the middle of the streets, leading to a conflict between vehicular and traffic, which also resulted in a decline in pedestrian and roadway safety. In the study area, it was observed that there was high pedestrian congestion where there were also Taxi and Bajaj terminals along the corridor and heavy trackers used a single lane of roadway as freight terminals, which made walking very difficult. Overall, the assessment of how on-street parking affects pedestrian safety along the study area's main road emphasizes the necessity of immediate action and enhancements. It is important for urban planners, policymakers, and relevant authorities to prioritize pedestrian safety, address the identified challenges, and create a conducive environment that prioritizes the safety and well-being of pedestrians. Ultimately, enhancing pedestrian safety will contribute to the overall livability and sustainability of the town.

5.2 Recommendation

The research's conclusions indicate that the main road as it exists now has many drawbacks. A well-planned, comprehensive street reflects an urban growth and improvement strategy by creating not only safer, more accessible, but also appealing, dynamic, and economically active places to be. Here are recommendations for policymakers, urban planners, transport authorities, relevant focal groups, and design recommendations based on the findings of research on the effects of on-street parking on pedestrians' safety along the main road in the study area:

5.2.1 For policy makers, urban planners, transport authorities and relevant focal groups

1. **Develop and Enforce Parking Regulations:** Implement and enforce strict parking regulations to ensure compliance and discourage illegal and inappropriate on-street parking. This can help alleviate congestion, reduce conflicts between pedestrians and vehicles, and enhance overall pedestrian safety.
2. **Enhance Sidewalk Infrastructure:** Focus on widening sidewalks to meet recommended standards, ensuring sufficient space for pedestrians. Allocate dedicated buffer zones between pedestrians and vehicles to provide a safe and comfortable walking environment. Additionally, prioritize regular maintenance and repair of sidewalks to ensure their usability and safety.
3. **Promote Off-Street Parking Facilities:** Create and encourage the use of off-street parking facilities in accessible locations near the main road. This will help reduce the dependency on on-street parking, alleviate congestion, and provide a convenient parking option for vehicles.
4. **Improve Transportation Planning:** Integrate pedestrian safety considerations into transportation planning processes and policies. Prioritize pedestrian-friendly infrastructure design, such as dedicated pedestrian crossings, raised pavement markings, and signage, to enhance visibility and prioritize pedestrian safety in road design.
5. **Conduct Regular Evaluation and Monitoring:** Implement a robust monitoring and evaluation system to assess the effectiveness of implemented interventions and initiatives. Regularly review and update policies and strategies based on the evolving needs and challenges pertaining to pedestrian safety along the main road.

6. **Police and the traffic Management Authorities are the frontlines in traffic laws:** They should be mandated to enforce the rules and regulations binding vehicular traffic operations without any fear or favor in order to impose penalties and punishment on defaulters.
7. **Urban planners and designers should consider all three forms of parking:** on-street parking (curb parking), off-street parking (parking lot), and parking structures) provision in the master plan and choose the best form suitable for the facility or area and for the visual image of the city.
8. **Architects and designer** should consider smart parking spaces during plan and design preparation, especially in CBD, commercial, mixed, and all multistory buildings.

5.2.2 Planning and design recommendation

5.2.2.1 Parking determinant requirements in planning and design

As a component of the city's structural plan, the stage of creating a parking plan is crucial and influential. The quality of parking areas is also taken into account while planning parking areas, including the comfort and security of walking from parking spaces to destinations, the attractiveness and security of parking spaces, and the environmental needs of parking spaces. To prepare the parking plan for a city, the following items within the city should be determined:

a. Residential areas that are subject to the parking of commercial service vehicles are causing noise and overcrowding, causing inconvenience to citizens.
b. Areas of special nature that need to be designed for gardens and pedestrian walkways, such as museum, touristic, and commercial areas
c. Areas with high parking demand and traffic congestion
d. Traffic density on the main roads, which are congested because of subsidiary street bottlenecks or overcrowding,
e. Parking in front of the entrances to the main service areas makes it difficult to provide the service.

Parking plans in the city center are important plans to be prepared and managed and also considered with different variables associated with the city center:

a. Number of vehicle ownerships,
b. Future growth of the population

c. Ratio of daily trips and commuters during peak hours

d. Capacity of the street hierarchy public transit system

Table 22: Parking determinant requirements in planning and design

Parking determinant requirements in planning and design		
Variables	Consideration	Description
Demography	Vehicle ownership	The higher vehicle ownership, the more parking space required
	Users profile	All age group, level of economy, social interaction with development leads to vehicle ownership
Development and type of economy of the city	Mixed land use / land use nature	Institutions, restaurants for sit-down and takeaway require more parking spaces. Shops, services, visitors need more parking space at peak times.
	Density and accessibility of districts	Residence density needs to consider because at time to time vehicle ownership becomes crucial.
	Choice of transportation	Adequate transport option.
	Availability of parking	Vehicle users can use parking space with short radius from their development or from their economic zone
Time and finance	Time	Depend on overcrowded of the area and land use
	Parking price	Increasing parking space to decrease price
	Land value	Instead of parking space; development of higher complex building affects parking consideration. So, considering parking in each development in CBD area

5.2.2.2 Safe Pedestrian Focus Area

In these areas, the goal is to create livable streets to promote the safety of pedestrians from any obstacles like informal parking, illegal street vendors, crime, traffic accidents, and others.

a. A well-designed street provides:

Delineation between a numbers of zones each zone provides special functioning in the overall streets.

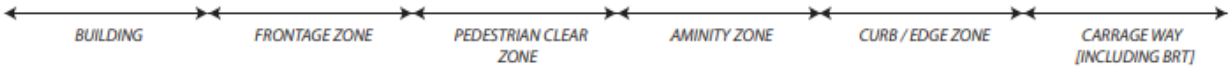


Figure 12: Safe pedestrian consideration sketches.

The frontage zone extends from the property line [3–4 feet]. Possible activities in this zone are things like outdoor tables, pools, and bicycle parking.

Pedestrian clear zone: uninterrupted, safe, comfortable movement for all age groups of people, including disabled people and elders, to promote safe walking and bicycle use rather than using transport.

The amenity zone [multi-function zone] consists of street furniture, lighting, recycling, garbage bins or containers, street trees, and rain gardens. It prevents cars from coming through the pedestrian area and also prevents pedestrians from crossing the vehicle lanes. Curb/edge zone: provides a buffer between the sidewalks and carriageway.

Curb ramps: are beneficial for people with disabilities for moving with wheel chairs, as well as the elderly and children who find it inconvenient to step up the curb height. **The vehicle-through zone** allows safe vehicle movement in lanes, including the BRT lane; it is interrupted by pedestrian cross-walks and speed breakers in order to minimize the speed.

b. Width of Lanes

In accordance with Ethiopia's 2017 street design standards, the right number and width of lanes allow professionals to allocate street space for ROW users in a proportionate manner, accommodate present and future traffic volumes and speeds, make streets efficient, lower accident rates, and improve traffic management. Streets will become safer and more affordable as a result of them.

Table 23: Standards for new street design of SAS 30, 35

No	category	Lane					
		Number on both	Width (m)				
			Public transport	Non-public vehicles	Service streets	On-street parking	Pedestrian walkway
1	SAS	6 and above	3.5-4	3.5-4	3.5-4	2.1-2.5	3.5-5

Source: Street design standard in Ethiopia 2017.

As illustrated on Table 24, the lane categorization for new street design includes public transport lanes, non-public vehicle lanes, service streets, on-street parking lanes, and pedestrian walkways. It is mentioned that Sub Arterial Street has six or more lanes. The width of these lanes falls within the range of 3.5 to 4 meters. Similarly, service streets have a width of 3.5 to 4 meters. On-street parking lanes have a width of 2.1 to 2.5 meters, allowing space for parked vehicles. Lastly, pedestrian walkways have a width ranging from 3.5 to 5 meters, providing ample room for pedestrians to walk comfortably.

Table 24: Proposed Sab Arterial Street with 35m in study area

No		Lane	
			Width (m)

	Category	Number on both direction	Transport Lane	Median	*On-street parking	Buffer	Bicycle	Pedestrian walkway
1	SAS	6	10.5	2	2.1	1	2	3

[*On-street parking is along third lane of the street where it's permitted]

As illustrated in Table 27 above, the proposed lane categorization in the study area includes transport lanes, medians, buffers, on-street parking, pedestrian walkways, and bicycle lanes with a 35-meter width. The number of lanes is one-way, with six lanes in both directions. The width of the transport lanes is 10.5 m, with 3.5 m for each lane. The median lane has a width of 2 meters, presumably serving as a central divider between opposing traffic flows. The buffer lane is 1 meter wide, potentially providing additional space between the transport lanes and other elements. On-street parking lanes have a width of 1 meter, allowing for parked vehicles. Pedestrian walkways are 3 meters wide, providing a dedicated space for pedestrians. Lastly, bicycle lanes have a width of 3 meters, offering a designated area for cyclists.

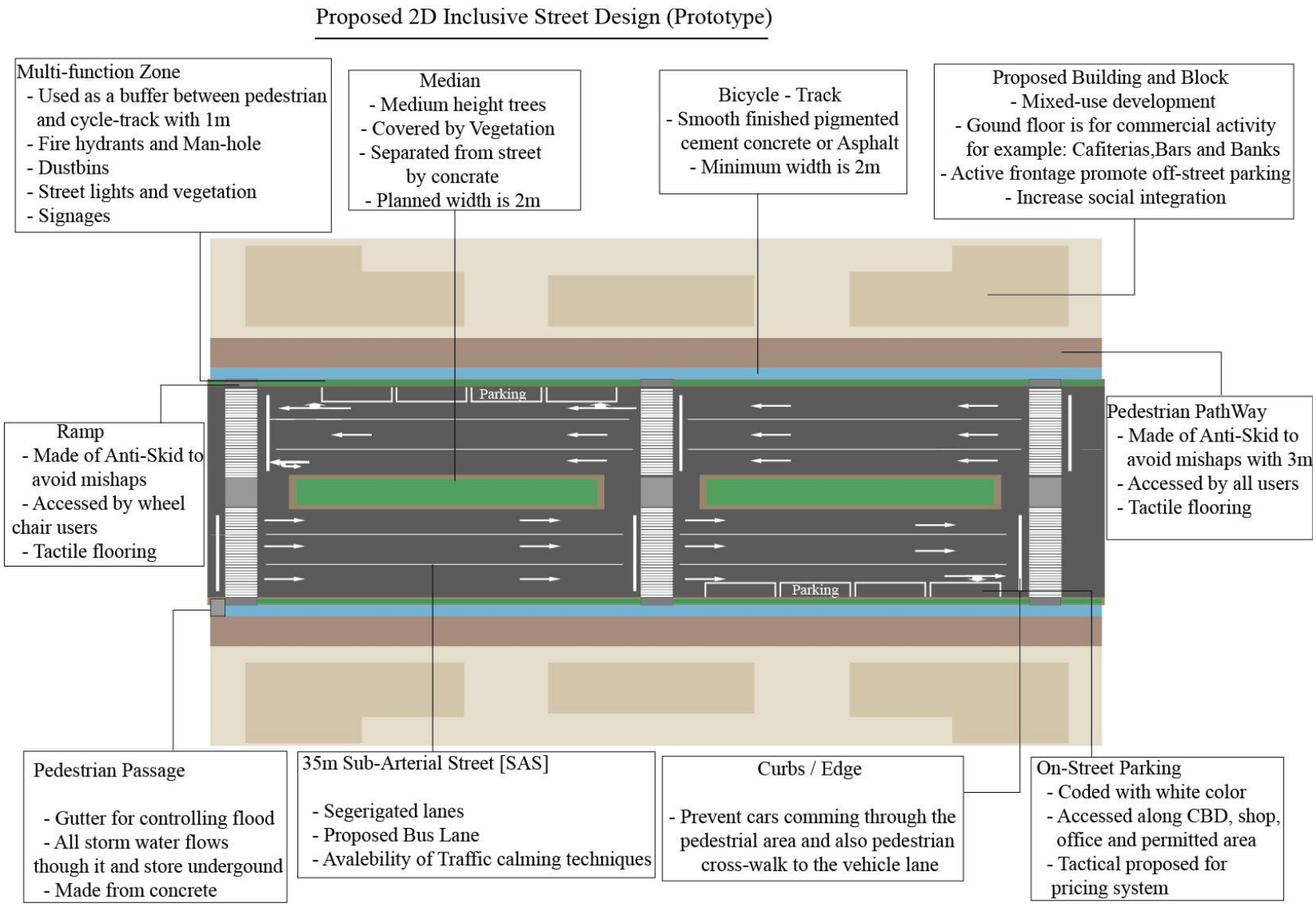


Figure 13: Proposed 2D Inclusive Street Design (prototype),

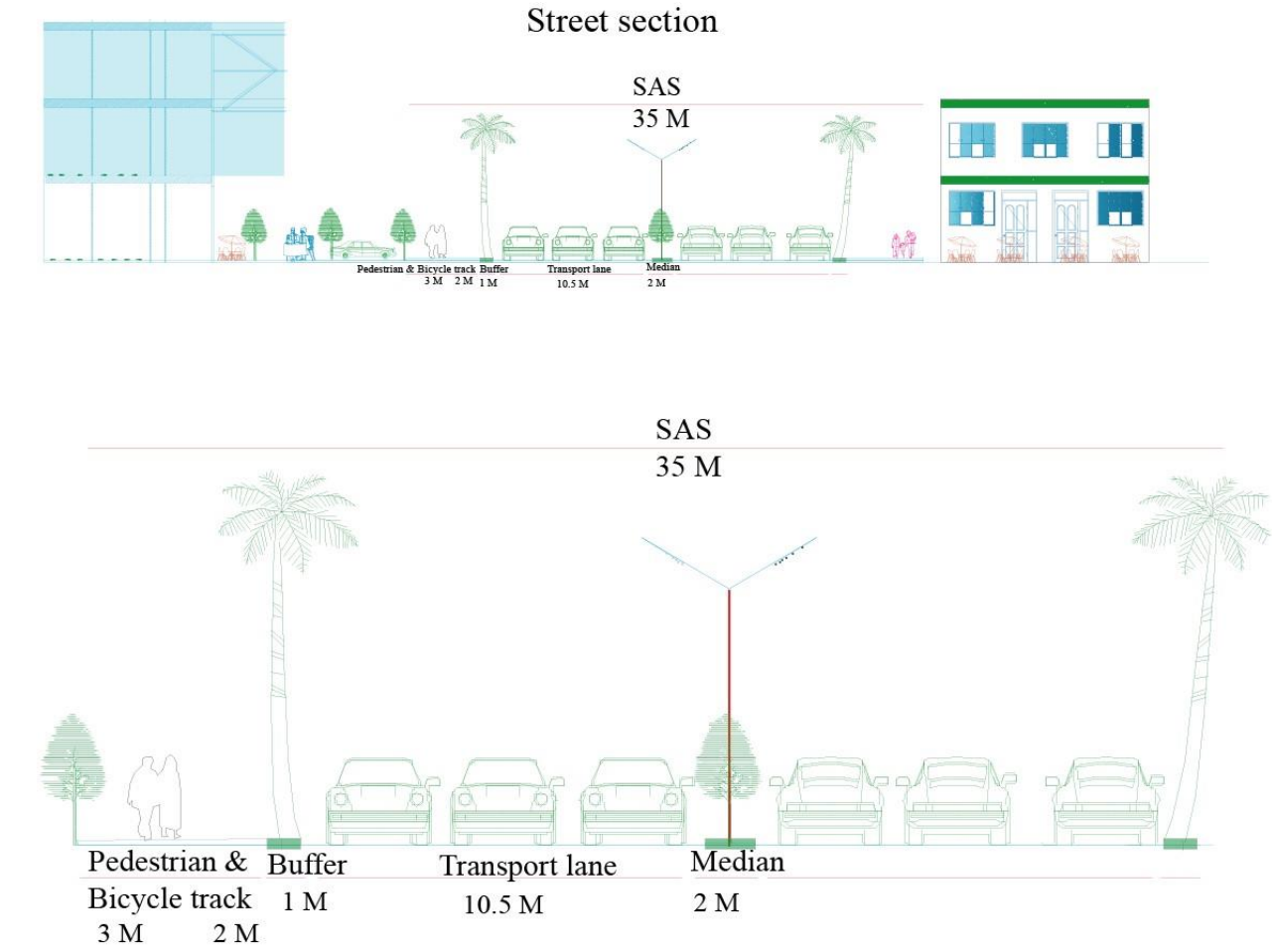


Figure 14: Proposed prototype Street section.

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