JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIROMENTAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

HIGHWAY ENGINEERING STREAM

Investigation on the Causes of Pedestrian Accidents at Roadside Walkways and its Possible Interventions, Case Study in Jimma Town.

A Thesis submitted to the School of Graduate Studies of Jimma University in Partial fulfillment of the requirements for the Degree of Masters of Science in Civil Engineering (Highway Engineering)

By

Melkamu Gizaw Gobena

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M.Sc. Thesis
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Approved by Board of Examiners

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DECLARATION

I, undersigned, declare that this thesis entitled "Investigation on the Causes of Pedestrian Accidents at Roadside Walkways and its Possible Interventions, Case Study in Jimma Road., and has not been presented by any other person for an award of a degree in this or any other university.

NAME: Melkamu Gizaw Gobena

Signature_____ Date _____

Acknowledgment

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Finally, I extend my gratitude to my family and friends for their limitless help from the beginning of my study.

Abstract

One of the most important forms of transport is by walking and contributing to safe and comfortable environment. Eventually increase in vehicular traffic for faster connectivity has led to the widening of roads and subsequently degradation of walking environment. Urban sidewalks are the spaces provided for the pedestrians and their varied activities but are undervalued in terms of pedestrians' needs such as comfort, mobility, safety and convenience.

The aim of this study is to investigate on the cause of pedestrian accidents at roadside walkway and possible interventions in Jimma town road, In Jimma town sufficient and comfortable pedestrian walkways are not constructed for the pedestrians who account the major trip percentage in the city and miss-use of the existing facilities, Based on the results of the analysis to set conclusions and recommendations for possible future considerations during roadside walkway design in the town.

Different researchers and writers use various types of approaches for identification of causes of pedestrian accident. The literature review part covers mechanisms used by some of the scholars and organization to identify causes and analyze their impact.

The result of the study revealed that, 104 pedestrian Accidents have occurred in the town in the study period from 2013 to 2015 and also the analysis result show that out of four selected routes which were included in this study area only one route meet the standard; the other three routes not satisfy the standard roadside walkway from those routes two of them have no walkway. The main reasons rose from respondents and document review results those taken from filed measurement, Jimma town administration and Jimma town police office recorded accident data and jimma town structural master plan comparing the existing condition of the walkways.

It was concluded that, the frequency of occurrence of pedestrian accidents and number of casualties is escalating from time to time and the most roadside walkway are not fit to the standard so that the town administration must redesign according to the international standard roadside walk way, provide buffers, upgrade the existing walkways and construct standard roadside walkway the place where there is no walkway at all.

Key Words: Pedestrians, Walkway, Jimma town Road.

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Abbreviations

AASHTO	American Association of Highway Transportation Officials
ADA	Americans with Disabilities Act
ADAAG	ADA Accessibility Guidelines
CSA	Central Statistical Agency of Ethiopia
DOT	Department of Transportation
ERA	Ethiopian Road Authority
GIS	Geographic Information Systems
GPS	Global Positioning Systems
HCM	Highway Capacity Manual
IMI	Irvine Minnesota Inventory
LOS	Level of Service
NHTSA	National Highway Traffic Safety Agency
NJDOT	New Jersey Department of Transportation
NJTPA	New Jersey Transportation Planning Authority
PDA	Personal Device Assistant
PDI	Pedestrian Deficiency Index
PPI	Pedestrian Potential Index
RA	Round About
SNNPRG	South Nation Nationality People Regional Government
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

One the most important mode of transport is by walking as it not only acts as a crucial link for intermodal transfers in major activity centers, but also helps to fulfill recreational and utilitarian trips. When designing circulation systems, it is important to recognize that walking is not only an integral part of the network, but that it can also fulfill many activities in an environmentally sensitive way. A comfortable environment makes a journey by foot pleasant and enjoyable [1]. However, in Jimma town, about 80% trips are making on foot but the pedestrians are facing many problems while using the walkways

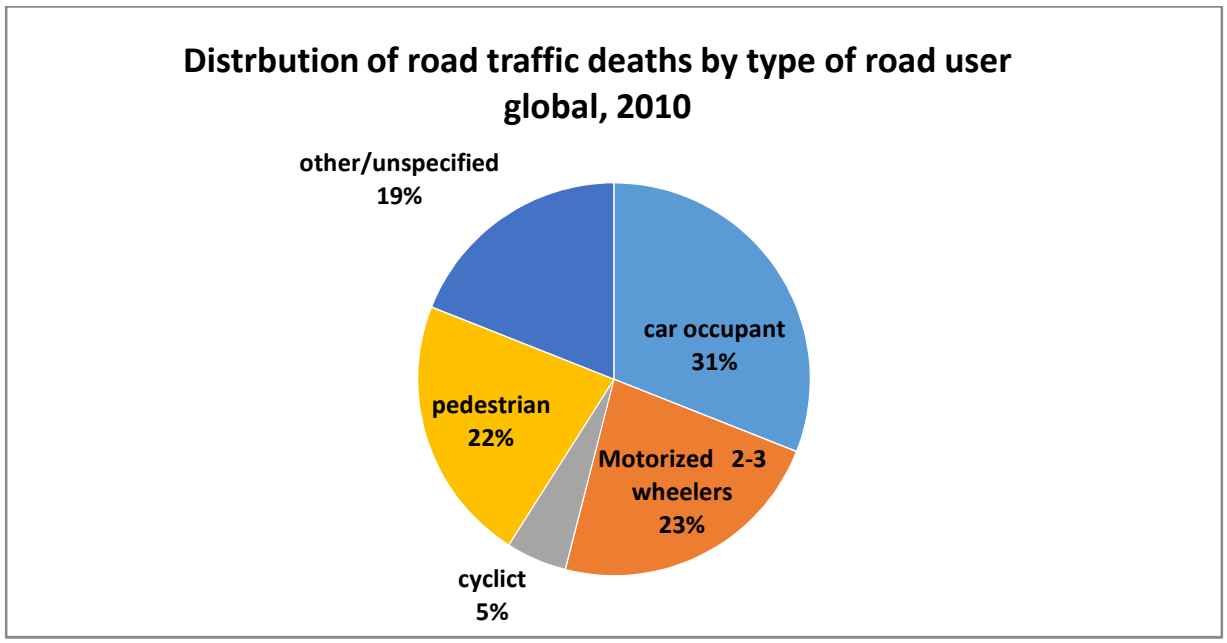

Figure 1.1 Distribution of road traffic deaths by type of road user, global, 2010

Everybody travels, whether it is for work, school, or simply pleasure. Lately the government agencies have pushed enthusiastically for sustainable and low-carbon emission transportation development, and people are advised to walk when possible. Inarguably, walking is most desirable method of transportation for sustainable development and engineers can inspire people to walk more by designing pedestrian friendly urban streets [2].

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However, to promote walking in a city and increase its patronage to a desirable level, engineers and policy makers must make pedestrians feel more comfortable walking than driving in urban streets. Walkways are the portion of the public right-of-way that provides a separated area for people traveling on foot.

Walkways that are safe, accessible, and aesthetically pleasing attract pedestrians. People walk for many reasons: to go to a neighbor's house, to run errands, for school, or to get to a business meeting. People also walk for recreation and health benefits or for the enjoyment of being outside. Some pedestrians must walk to transit or other destinations if they wish to travel independently. It is a public responsibility to provide a safe, secure, and comfortable system for all people who walk.

In order to lead pedestrians into thinking that their sidewalk pavements are really walker-friendly, engineers should focus on providing pedestrians with very attractive side walk pavements that are significantly wider than the minimum value specified in the highway design standard.

A recent study on pedestrian behavior indicates that, of the various reasons that people give up walking in favor of carouse for their travel, a side walk pavement with a too-narrow width is the main reason for their car use [2]**.**

The decision to build a narrow sidewalk pavement can be attributed to several factors, including current highway design standards and the engineers assigned to the project. Current highway design standards suggest that engineers choose from typical street cross-sections composed of vehicle lanes and sidewalk pavement [3]**.**

The cross-sections only indicate the minimum values. However, when the final right of way acquisition for an urban street is determined, it is often greater than the minimum value. As a result of this, engineers must decide how to assign the extra value and deciding which mode of transportation is going to have a wider design value than the suggested minimum is a matter of engineer discretion, and engineers traditionally choose courser interests over the pedestrians, thus leaving the side walk pavement width at the minimum. State, city and community-level land use and transportation plans often incorporate sidewalk guidelines to address pedestrian travel.

In developing countries, levels of motorization are generally low and pedestrians constitute significant proportion of users of road space. The requirements of pedestrians in the road transport system have not been given the needed attention thus pedestrians suffer considerable risks as a result of exposure to

vehicular traffic. It is reported that pedestrians account in Jimma have no recoded data but for 86% of the fatalities in Addis Ababa and in five other Sub-Saharan countries over half of all road fatalities were reported to be pedestrians [4].

Many research works are going on for assessing the pedestrian's level of services in the developed nations but in developing countries like Bangladesh, it is not a significant one for the transport planners. It is because; the transport planners or researchers are always emphasizing the problems of the motorized vehicles.

Besides, budget allocation is not sufficient to continue research in the field of pedestrians. For instance, this thesis tries to explore the qualitative level of comfort of the pedestrians in Jimma town by offering a method. The above mentioned eight broad categories have been observed during the field survey to assess the roadside walking environment in terms of i) Existing Geometric features, ii) Existing traffic and pedestrian volume, iii) safety, iv) security, v) convenience and comfort, vi) continuity of the walkway, vii) system coherence and viii) attractiveness by some specific facilities.

Five different blocks have been selected to assess the qualitative data. Those five blocks have different characteristics like: shopping area, residential area, Central Business District, Mixed use area and Transit area. We use primary data to compare the roadside walkway environment. Qualitative data have been collected from observation survey whereas the walker's responses have been recorded through questionnaire survey from the field.

1.2 Statement of the problem

Many studies about traffic safety focus on drivers, but pedestrian safety is equally important; according to National Highway Traffic Safety Association (NHTSA) report that each year nearly 5,000 pedestrians die in motor vehicle related accident, and approximately 76,000 pedestrians in 2012 suffered injuries when hit by a car or track. These accidents can occur when pedestrians attempt to cross highways, because of poor maintenance side walkway, construction of other debris on walkways and parking lot defects can cause these accidents [5].

Different peoples of the region migrate to Jimma town. Because of this, the town becomes congested by motorized and non-motorized vehicle while accident is occurring around existing pedestrian roadside walkway. Pedestrian Road side walkway is one of components of the urban infrastructure system for the movement persons from place to place. The lack of sufficient and

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comfortable pedestrian walkways are not constructed for the pedestrians who account the major trip percentage in the city, this cause, accident and improper flow of the around road way.

Pedestrians are the most vulnerable ones in Jimma; over 81% of accident fatalities are of accident type "car hit pedestrian". Moreover, 81% of crashes in Ethiopia are attributed to driver error ("Road traffic accidents in Ethiopia: magnitude, causes and possible interventions", April 2008.)

Therefore, the intent of this paper was to research the capacity of the walkway with respect to comfortable environment of pedestrian and to propose remedial action for the town [7]**.**

1.3 Research Questions

- Which of the road section have a problem according to pedestrian safety?
- What are the main factors that cause accidents at the road side environment and what time of day is the highest risk?
- Are the existing geometric roads lay-out compared with standard plan?

1.4 Objective of the study

1.4.1 General Objective

The main objective of this study is to investigate the cause of pedestrian accidents in Jimma town.

1.4.2 Specific objectives of the study

- To identify the location of high risks pedestrian accident prone area at roadside.
- To determine the cause of accident at the roadside environment which time of day is the highest risks.
- To determine comparisons of existing geometric road lay-out with the standard plan.

1.5 Scope of the Study

This study shall be covered the major analysis of the pedestrian safety and capacity of roadside walkway based on identification of their major cause. It would be possible to full fill the gap between side walkway and pedestrian by minimizing the cause of pedestrian accidents and factors that affect the capacity of the walkway while considering the present condition.

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It will be conducted in Oromia region Jimma zone which is found in southwestern part of Ethiopia, is the largest city in southwestern Ethiopia and a center accessing to four different major routes those are form Oromia, SNNPR and Gmbela region.

1.6 Significance of the study

A comprehensive understanding of the local pedestrian safety situation is essential to effective action. Development of an action plan for pedestrian safety requires collaboration across a wide range of stakeholders and different levels of government.

It is often important to recognize the cause pedestrian accidents at roadside walkways; this research will be helpful to all practicing engineers as well as post graduate students who want to pursue similar studies and to come up with appropriate remedial measures to minimize the cause of pedestrian accidents at roadside walkways.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Background

We are all pedestrians. Walking is a basic and common mode of transport in all societies around the world. Virtually every trip begins and ends with walking. Walking comprises the sole means of travel on some journeys, whether a long trip or a short stroll to a shop. In other journeys, a person may walk for one or more portion of the trip, for example, walking to and from bus stops, with a bus trip in between.

Walking has well established health and environmental benefits such as increasing physical activity that may lead to reduced cardiovascular and obesity-related diseases, and many countries have begun to implement policies to encourage walking as an important mode of transport. Unfortunately, in some situations increased walking can lead to increased risk of road traffic crashes and injury. Due to the dramatic growth in the number of motor vehicles and the frequency of their use around the world – as well as the general neglect of pedestrian needs in roadway design and land-use planning – pedestrians are increasingly susceptible to road traffic injury. Pedestrian vulnerability is further heightened in settings where traffic laws are inadequately enforced [8]**.**

In order to lead pedestrians into thinking that their sidewalk pavements are really walker-friendly, engineers should focus on providing pedestrians with very attractive sidewalk pavements that are significantly wider than the minimum value specified in the highway design standard. A recent study on pedestrian behavior indicates that, of the various reasons that people give up walking in favor of car use for their travel, a sidewalk pavement with a too-narrow width is the main reason for their car use [2].

The decision to build a narrow sidewalk pavement can be attributed to several factors, including current highway design standards and the engineers assigned to the project. Current highway design standards suggest that engineers choose from typical street cross-sections composed of vehicle lanes and sidewalk pavement, where these cross-sections only indicate the minimum values. However, when the final right-of-way acquisition for an urban street is determined, it is often greater than the minimum value. As a result of this, engineers must decide how to assign

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the extra value. Deciding which mode of transportation is going to have a wider design value than the suggested minimum is a matter of engineer discretion, and engineers traditionally choose car user interests over the pedestrians, thus leaving the sidewalk pavement width at the minimum.

The goal of the research presented in this paper is to examine the effect of the sidewalk pavement width on pedestrian levels of comfort. This paper provides a balanced urban cross section design methodology with which one can fix the problem of the inappropriate distribution of urban street width.

The essence of this methodology is to determine the sidewalk pavement width based on pedestrian levels of service rather than the minimum width criterion set forth by highway design standards. The Korean Highway Capacity Manual includes the pedestrian level of service determination procedure, but this procedure was designed to perform operational analyses of pedestrian flow for existing sidewalk pavements and basically imitated vehicle flow analysis theory which is different from pedestrian flow theory. Realizing this weakness, researchers indicate that the current procedure cannot be used for the case where pedestrian comfort levels are to be included in the analysis [3].

2.2 Pedestrian assessment and prioritization methods

Within recent research and practice, approaches to prioritize pedestrian projects incorporate federal accessibility guidelines, new technologies for data collection, and research linking built environment characteristics to walk ability, pedestrian safety, and non-motorized travel demand. Federal, state, and local guidelines recommend that safe and accessible pedestrian infrastructure incorporate elements such as passable slopes, sufficient sidewalk widths, and smooth walking surfaces. Additionally, recent studies suggest that parameters such as sidewalk presence and buffer from vehicular traffic may predict walk ability, sense of security, and convenience of the pedestrian environment. Although methodologies for sidewalk inventory and assessment are emerging, local agencies have utilized GIS-based surveys, level-of-service models, and other techniques to support pedestrian planning, regulatory compliance, and asset management.

2.3 Pedestrian Accessibility Guidelines

The Americans with Disabilities Act (1990) established transportation access to public facilities and buildings as a civil right, including access to public transportation. In terms of pedestrian

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infrastructure standards, The Americans with Disabilities Act provides clear design specifications to bring infrastructure into compliance. The aim of ADA design standards is to enable safe transportation for disabled persons to public facilities. ADA-compliant infrastructure also promotes safety, mobility, and accessibility for all users. Although the ADA Accessibility Guidelines (ADAAG) did not specifically address sidewalks, standards relating to "accessible routes" and curb ramps are applicable to the pedestrian environment (U.S. Access Board, 2002; U.S. Access Board, 2011). For example, ADAAG requires specific widths, surface conditions, grade and cross-slope for "accessible routes" [9]**.**

Table 2-1 ADA Design Guidelines, Public Right-of-Way

Design Feature	Federal Guidance
Clear Sidewalk Width	36 inches minimum
	If less than 60 inches, provide passing space every 200 feet
Running Slope	5% maximum or equal to roadway slope
Cross-Slope	2% maximum
Obstructions	None within pedestrian access route
Pavement material	Firm, stable and slip-resistant
Changes in Level	Vertical changes up to 1/4 inch allowed without edge treatment
Vertical Clearance	80 inches minimum
Curb Ramp Width	36 inches minimum

Source; from Americans with disabilities act guideline

Subsequent federal regulations and design guidelines published by the U.S. Access Board have given guidance for the implementation of ADA requirements for design and alteration of accessible public facilities and programs. According to these regulations, all new construction and "major alterations" must comply with ADA accessibility design guidelines.

Pedestrian infrastructure is legally considered part of the "public right of way" and local governments are liable for physical injury resulting from negligent maintenance of infrastructure. Recent case law established that sidewalks are included in ADA requirements, municipalities are

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responsible for removing barriers to reasonable accessibility, and expanded the definition of roadway "alterations" to include maintenance projects[10]**.**

The issue of sidewalk maintenance has been addressed in recent case law, in which plaintiffs sought injunctive relief under Title II of ADA and argued that pedestrian facilities be considered a public service or program administered by governments[11].

According to proposed guidelines, the running slope of pedestrian access routes should not exceed the slope of the adjacent roadway and should be 5% maximum at pedestrian crossings. Additionally, the Access Board's design guide identified cross-slopes greater than 2% as a barrier to accessibility. Appropriate cross-slope is an access issue both on the sidewalk environment and at driveway crossings (Proposed Accessibility Guidelines, 2011). Design guidelines for accessible pedestrian infrastructure recommend minimum clear width and clear length at transit boarding areas, as well as a "level and stable" surface at the boarding area. Generally, sidewalk pavement should be "stable, firm and slip-resistant," and certain construction materials are not recommended for safety reasons.

Design guidelines also specify maximum changes in level to ensure a continuous path of travel (Proposed Accessibility Guidelines, 2011). Accessibility design guidelines and technical specifications provide a framework for assessing pedestrian conditions. Traditional sidewalk data collection methods require significant time and resources for public works departments. However, new methods are emerging to streamline the sidewalk assessment process and aid municipalities in developing their ADA transition plans and planning for pedestrian facilities. Volunteer labor, automated data collection systems, and GIS technologies have been utilized by state agencies in order to streamline pedestrian and ADA data collection processes. As an example, The City of Bellevue estimated that the inertial profiler system for ADA inventory would realize 70% savings when compared with the estimated cost of a traditional, manual sidewalk inventory [12].

2.4 Pedestrian Quality-of-Service Indices

Thus, researchers and practitioners have developed evaluation and planning tools to assess the suitability of facilities and corridors for pedestrian improvements, including variables such as pedestrian comfort, accessibility to facilities and infrastructure condition. Although many of these models utilize the term "level of service," a distinction should be made between capacity-

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based vehicle level of service methods and pedestrian suitability or comfort-based pedestrian LOS models and indices. For example, Landis et al. proposed a pedestrian LOS model based on built environment variables correlated with pedestrian response to identify factors important for pedestrian comfort and walk ability (2005). The authors selected several primary factors to include in the pedestrian LOS model, including lateral separation from traffic (sidewalk presence), traffic speed, traffic volume, and driveway access points. Recent studies have identified sidewalk width, presence and buffering/amenities as predictors of pedestrian travel, perceived safety and quality of the pedestrian environment [13].

In an index based on perceived importance to wheelchair users, effective sidewalk width, pavement condition and material were found to be important variables for sidewalk accessibility. Additionally, a review of 25 pedestrian indices found that objective variables for measuring walk ability included sidewalk width, presence, slope and presence of a buffer [14]**.** In developing pedestrian indices, several studies incorporated survey data or objective built environment measures to assess the relationship between perceived pedestrian comfort or quality of service and the physical condition of the pedestrian environment.

For example, Boarnet et al. analyzed the relationship between built environment variables and walking and physical activity behavior using the Irving Minnesota Inventory (2011). The IMI is a built environment audit tool, based on in-person field observations of variables that contribute to environments supporting walking, including density, street network, presence of mixed-use development, pedestrian infrastructure, and social and economic variables.

This study utilized physical activity, obesity and socioeconomic data corresponding to its 716 research subjects. In addition, the researchers utilized the IMI to survey the built environment characteristics near the study subjects' residences. Based on the results of this study, the authors concluded that the indicators most associated with walking measured the presence of destinations, traffic, and presence of sidewalks [15]**.**

A growing body of public health research evaluates the relationship between physical activity and the built environment to aid in obesity prevention.According to a review of the "first generation" of built environment audit tools to measure physical activity, studies utilize interview and/or survey data, in-person environmental audits or available GIS datasets to analyze built environment data.

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The authors noted that the use of observational measures tends to be time-consuming and require prior knowledge of built environment design features. Additionally, Brownson notes that training and monitoring can be used to address inter-rater reliability issues when a research study uses observational measures of the 50 GIS-based studies reviewed, five included a "sidewalk coverage" variable in its analysis, and the authors indicate that pedestrian infrastructure data are often lacking from local, electronic databases.

The most common GIS-based measures include population and intersection density, land-use mix, sidewalk presence and traffic characteristics. According to Brownson and co-authors, one methodological challenge in using GIS datasets is the dearth of research testing the extent and effect of inaccurate or incomplete data (i.e. by comparing field results with existing datasets).

Additionally, the authors stated that the differing environmental variable specifications made it difficult to test reliability of GIS measures across multiple studies. Pedestrian Infrastructure Prioritization: State of the Practice Within transportation planning and engineering practice, methods and "best practices" for pedestrian transportation data and prioritization are emerging.

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In 1994, the City of Portland developed two indices to prioritize pedestrian projects, the Pedestrian Potential Index and the Pedestrian Deficiency Index.

The PPI consisted of three factors (designation of urban activity centers, pedestrian activity variables and proximity to pedestrian generators), while the PDI included variables such as sidewalk presence, street connectivity and traffic characteristics.

Demonstrating two approaches to pedestrian prioritization tools, Moudon and co-authors utilized census-block level and parcel-level land use and density data to identify clusters of latent Pedestrian demand. However, the authors noted that future research will require additional transportation infrastructure and travel behavior data to link transportation and land use considerations in pedestrian prioritization.

However, NJDOT developed an approach to assess the "barrier severity" of crossing a roadway, based on roadway characteristic data and a calculation of available gaps in traffic. NJDOT analysts estimated pedestrian demand Based on a combination of population and employment data with a transit accessibility measure. More detailed information on the estimation of the statewide pedestrian demand index was not publicly available. Land-use data was not utilized in this study because it was not available on a statewide basis. The results of this combined supply/demand analyses indicated that 55% of roadway miles should be prioritized for pedestrian projects, largely in urban and suburban areas in New Jersey [17].

2.5 Improving Pedestrian Data through Technological Advances

As noted in the previous section, both researchers and practitioners often lack pedestrian facility data, to assess existing conditions and prioritize improvements. In addition, the dearth of local, regional and statewide pedestrian facility data has been a barrier to assessing and enforcing ADA compliance (US Government Accountability Office, 2007) as well as the development of regional transportation models incorporating non-motorized trips (Pratt, Evans & Levinson, 2012).Traditional methods of sidewalk inventory are often time and cost-prohibitive, particularly for large-scale implementation. A literature review of 29 jurisdictions' pedestrian and bicycle data collection initiatives found a variety of methodologies used, including user surveys, to facility inventory and spatial analysis [18].

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Additionally, the use of audit or survey data introduces potential validity and reliability concerns, as many inventory tools use subjective scales to measure infrastructure condition (i.e., "poor," "fair" and "good" sidewalk quality). Few studies have tested the validity and reliability of built environment audit instruments.

However, the Irvine Minnesota Inventory audit instrument results were analyzed to test both predictive validity and inter-rater reliability. During reliability testing of the Irvine Minnesota Index, audits were conducted in Minnesota and California with multiple raters in several audit sites. Most audit parameters had high reliability; with higher reliability in the Minnesota tests when compared with the California reliability tests (76.2% compared with 99.2% of variables had greater than 80% agreement). Additionally, the authors noted that raters in both locations found it necessary to sample block segments due to the time-consuming nature of the audit instrument [19].

However, emerging technologies such as mobile devices and applications enable the collection of non-motorized infrastructure and travel behavior data without the use of costly and time-consuming built environment surveys. A review of ADA compliance efforts at state departments of transportation details the growing use of technology to make pedestrian data collection more cost-effective and to improve data quality.

Based on interviews with agency staff, best practices for cost-effective data collection include the use of volunteer labor, GIS-based data collection, and database integration. Several agencies incorporated sidewalk inventory into their annual paper-based roadway inventory procedure and later digitized these data into GIS or other database systems. For example, Oregon DOT conducts both sidewalk and roadway inventory using manual data entry from video logs.

New technologies such as GIS-enabled devices have been utilized to improve the efficiency and database integration of built environment inventories. For example, University of Oregon researchers collected data on sidewalk width and condition using GPS-enabled personal device assistant (PDA) units. This audit tool was utilized by Oregon DOT to supplement their sidewalk inventory data with digitized curb ramp field data in cooperation with the Federal Highway Administration, the city of Bellevue, Washington completed a sidewalk and curb ramp inventory for its ADA transition plan.

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In recent years, mobile devices have been utilized to automate the process of data collection and to collect infrastructure and travel behavior data using built-in sensors. The use of mobile phone data, particularly location capabilities, has a wide range of intelligent transportation systems applications, such as automatic vehicle location systems in public transit [20]**.** Mobile data collection has also been utilized within non-motorized transportation planning and research to track transportation activity. For example, researchers at Georgia Tech, in collaboration with the City of Atlanta and other partners, piloted an app to monitor the travel behavior of bicyclists within the city.

The data from this crowd-sourced app, Cycle Atlanta, is to be used to assess existing pedestrian and bicycle transportation travel patterns and to guide future planning and project implementation. In addition to GPS capabilities, video data from mobile devices has been used to detect and track vehicles and pedestrians**.** Image processing techniques and inertial profiling systems have been utilized to monitor roadway condition, including crack detection integrated with GIS software [21].

A review of best practices in pedestrian infrastructure planning demonstrates the potential of emerging technologies for accurate and cost-effective asset management. Quantitative inventories of sidewalk and curb ramp infrastructure assist in ADA compliance efforts, municipal repair prioritization to increase safety and walk ability. However, current gaps in literature and practice indicate a need for development of a replicable, objective, cost-effective system to assess pedestrian infrastructure quality and prioritize future pedestrian projects on local, regional and state wide scale.

Finally relative to investigating pedestrian movements on the sidewalk pavement is the pedestrian group size, that is, the number of pedestrians walking in parallel. This number can vary, and its pattern must be understood so that its impacts can be reflected in the changes in pedestrian service levels. In this research the pedestrian group size is expressed based on the moving direction and group size.

2.6 Summary

Road traffic crashes kill about 1.24 million people each year More than one fifth of these deaths occur among pedestrians. Pedestrian collisions, like all road traffic crashes, should not be accepted as inevitable because they are, in fact, both predictable and preventable. Key risk

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factors for pedestrian road traffic injury are vehicle speed, alcohol use by drivers and pedestrians, lack of safe infrastructure for pedestrians and inadequate visibility of pedestrians. Reduction or elimination of the risks faced by pedestrians is an important and achievable policy goal.

Proven interventions exist, yet in many locations pedestrian safety does not attract the attention it merits. The Safe System approach provides a viable, comprehensive framework to examine risk factors for pedestrians and to develop integrated interventions that address the road environment, road users and vehicles, and that maximize pedestrian safety. The key risk factors for pedestrian road traffic injury are speed, alcohol, lack of infrastructure facilities for pedestrians and inadequate visibility of pedestrians.

A comprehensive understanding of the local pedestrian safety situation is essential to effective action. Development of an action plan for pedestrian safety requires collaboration across a wide range of stakeholders and different levels of government. Core components of the action plan include a well-defined problem, clear objectives, realistic targets, performance indicators, timeline and milestones, adequate resources, monitoring and evaluation, and sustainability options.

CHAPTER THREE

METHODOLOGY

3.1 Study area

The study was conducted in Oromia region the largest town in southwestern Ethiopia called Jimma. This town is divided in to 12 kebeles administrative covering an area of 50.52 Km^2 with a population number of 120,960. The town Jimma is located 356Km from Adis Abeba. It is bounded by Jimma zone and the capital city of the zone.

Therefore the study was conducted in jimma town on four selected blocks to investigate the cause of pedestrian accidents at walkways. Those four blocks have different characteristics like: shopping area, Central Business District, Mixed use area and Transit area.

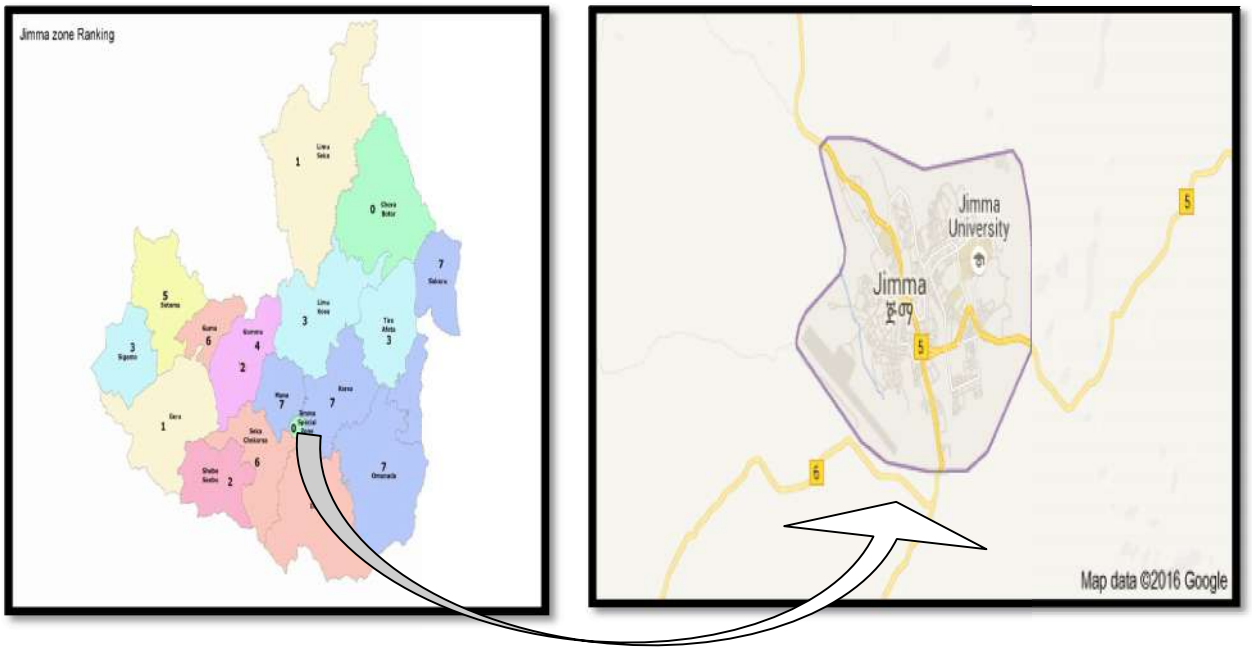

Figure 3.1 Jimma zone Adminstrative Figure 3.2 Jimma town /study area/

3.2 Research design

The methodology was conducted in this research is statistical analysis; the data were used to show the present level of services of the walkways in Jimma. For primary data collection, questionnaire survey, field surveys and Jimma town structural master plan, while secondary data collection, from Jimma town police office and Jimma town road and transport office obtained from different consultant office; Moreover, different books, reports, international organization

publications, and internet was collected. Furthermore, to get a general picture of the problems, informal interviews have to be conducted with professionals, policemen, government officials and dwellers.

Eight different criteria are used for identifying cause of pedestrian accident and evaluating the conditions and capacity of walkways with the qualitative data through observation and questionnaires. After reviewing some research works in some developed nations, this study considered the following eight criteria and emphasizes as very important aspects to assess the roadside walking environment in the developing country's cities:

a) Safety: Basic concern of pedestrian safety is the reduction of the pedestrian and vehicle conflicts;

b) Security: While designing the street, the presence of police and people should be considered for improving the security of the pedestrians like social security and the security in the night time;

c) Convenience and comfort: It can be defined as the relief of problems while walking on the walkways. Smooth walking environment and easy access to necessary services can be added as well;

d) Continuity: It defined as the continuation of the walkways besides the road space without altering the ideal situation:

e) System coherence: Clear visibility of some transit facilities and social facilities can be added as system coherence in this research; and

f) Attractiveness: It is the combination of color, scale and balance, shape, street character, view to convoy the positive visual attributes etc. for the pedestrians.

g) Existing condition of Geometric features: A geometric feature is one of the most important parts of developing a roadway design focuses on the selection and configuration of the elements that comprise the roadway cross-section.

h) Existing condition of pedestrian and traffic volume: Traffic data, indicates the service for which the highway is being planned and directly affects the geometric features such as width, alignment etc.

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3.3 population

The data was collected from pedestrian, educated people from surrounding walkway, Jimma town police office, Jimma town road and transport office and town administration, and Moreover, reports, international organization publications.

3.4 Sample and sampling techniques

The method of sampling to select the area used purposive sampling technique (i.e based on their purpose) the area to be sampled in this study focused on four selected blocks from the town administration and the method of sampling to select population used random sampling technique.

Sample size determination

To represent sample size of the population, if it is more than 10,000 the precise magnitude is not likely to be very important; but if the population is less than 10,000 then a smaller sample size may be required.

The required sample size was determined by using single population proportion formula by considering 50% estimated proportion of pedestrian walkway problems because there is no such study conducted in the study area.

When:- n - sample size

- P – proportion
- Z – degree of confidence
- d – Margin of error /degree of precision

$$n = \frac{Z_{\frac{\alpha}{2}}^{2} P(1-P)}{d^{2}}$$

Where Z=1.95 d=5% (0.05)

P=50% (0.5) n=sample size

$$n = (1.96)^2.0.5(1-0.5)/(0.05)^2 = 384$$

`

Taking 5% non response rate = 5% of 384 becomes 19. Adding to the previous one it becomes **403** (pertinent sample size) from those distributed 403 questioners respond 360 respondents the rest 43 none respondent this means response rate become 89.33%.

3.5 Instrument for data collection

The major instrument or tool used for data collection is Jimma town structural master plan, tally sheet, meter, Digital camera, clipboard, local umbrella and document schedule or data sheet. The data needed for the study was collected from observation survey and well prepared and recorded data from Jimma town police office, Jimma town road and transport office and Jimma town administration.

Furthermore questions prepared for which is considered pedestrian, educated people from surrounding walkway. Primary data was collected using questioner and filed survey like pedestrian count data and width measurement.

3.6 Data collection procedure and analysis

The main data collected from those four selected blocks questionnaire survey and observation survey data, measurements data, Jimma town police station and town administrative recorded accident data, Jimma town structural master plan. The collected data, processed using statistical analysis method on micro software excel & AutoCAD, thus, the organized data interpreted using descriptive methods in the form of tables, charts, and graphs. To identify cause of pedestrian accident and to evaluate the condition and capacity of the walkway among streets of the town; based on safety, continuity, system coherence, attractiveness, convenience and comfort, existing condition of geometric features, existing condition of pedestrian and traffic volume, and subjective evaluation was conducted to each road segment.

3.7 Study variables

- Independent variables
  - ✓ Drivers behavior
  - ✓ Pedestrian behavior
- Dependent variable
  - ✓ Cause of accidents , condition of roadside walkway

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3.8 Ethical consideration

The permission of Jimma University Institute of Technology is mandatory in order to precede the research.

- Make sure the confidentiality of data.
- Approval of research by an ethics review committee to make sure the study is not contradicting any of the above considerations.
- Follow procedure that is required to deal with concerned organization.
- When addressing the results makes sure, that on every section of report, which represent observed.

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4. CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Criteria for Evaluating and Identifying Cause of Pedestrian Accident in the Walkways in Jimma Town

Eight major criteria have been considered for identifying cause of pedestrian accident and evaluating the roadside environment of Jimma road. They encompass some sub-groups as well. We got some observation results and some subjective values from the pedestrians through questionnaire survey. Observation survey clearly revealed that the existing situation is not suitable for the walkers with some respective criteria to get a minimum level of service. However, the pedestrians were asked to give some values for some specific criteria. This also reflects the pedestrian's impression on the walkway's environment in a Jimma road.

4.1.1. SAFETY

Safety is one of the eight major criteria to know the present condition of the walkways in Jimma road. We divided safety issue into three categories as: existence of buffers in the roadways, enough sight distance for the walkers and the accident types commonly taken place. A pedestrian's safety in the roadway environment is largely dependent on the width and quality of the buffer between the sidewalk and the roadway. If there are well maintained buffers beside the walkway will increase pedestrian safety, therefore encourage higher levels of walking. Buffers have been used made up with steel sheets or by using concretes. Buffers allow a rigid wall in between the walkways and carriage ways of vehicles. In the developed countries, trees or small parallel land are used as a buffer item to save walkers from the motorized vehicles. But in the developing countries like Jimma, there is not enough space to dedicate the land for creating buffers with small trees or saplings. Besides, people are trying to cross the roads if there are no rigid buffers in place.

Another important aspect for evaluating the safety is named as sight distance. If the sight distance is absent then the pedestrian could collide with other pedestrian or fixed obstacles. Most of the cases in Jimma City, we can see the sight distance opportunity is hindered with some illegal vendors and illegal parked car. For instance, it also decreases the pedestrian safety.

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Table 4-1 Safety base on buffer used, sight distance and Pedestrians' Accident types in different routes of the study area in Jimma Town.

Safety			
Study Routes	**Sub Criteria**		
	Buffer (type)	**Sight Distance**	**Accident Type**
Hermata Bank – Tsehay Abebe RA	None	Poor	Dart-out type
Dashen Bank(Merkato) – Legehar	None	Poor	Multiple threat
Tsehay Abebe RA – Farmid RA- Awetu River	None	Good	Multiple threat
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	None	Poor	Dart-out type

As we seen from the above Table.4-1 none of the road uses any type of buffer that is in the case of study area but in our country developed town like Adis ababa one of the claim from the authority is that using the steel sheets as a buffer, is People certainly steals the steel sheets at the night time and sale them in the local market to earn some money, in Jimma case considering the above ideas.

Another important aspect for evaluating the safety is named as sight distance. If the sight distance is absent then the pedestrian could collide with other pedestrian or fixed obstacles. Most of the cases in Jimma City, we can see the sight distance opportunity is hindered with some illegal vendors and illegal parked car. For instance, it also decreases the safety of the walkers. Among the four different study route, the sight distance opportunity is very poor in the area from Hermata Bank – Tsehay Abebe RA,Dashen Bank(Merkato) – Legehar and From Cenetral Hotel – Feidi RA – Shenen Gibe Hospital the reason for this is, In peak hours high volume of pedestrian wait taxi or bus on walkway this hinder the sight distance of ongoing pedestrian, many people parked their cars illegally on the sidewalks and illegal vendors, this offers a poor sidewalk situation and decreases the sight distance of the sidewalks.

Accident data is one of the major items to know the safety situation for the pedestrians in Jimma city. Three different types of accidents have been identified in four different study routes. We have collected the information whether the walkers face any small or major injury in the last three years while using the footpaths. The respondents give their responses as well; Almost 60% of the respondents (who at least faced small injury in the last three years) have faced small injuries. They claimed mostly for not having any buffer in between the walkways

and carriage ways and also for the discontinuation of the walkway. In Dart-out type crash, a pedestrian enters the street and either runs into or hit by a moving vehicle.

Another important aspect for evaluating the safety is accident. Accident data is one of the major items to know the safety situation for the pedestrians in Jimma town. The following tables will show the buffer used, sight distance and Pedestrians' Accident types in different routes of the study area in Jimma City. During road Maintenance of town section road project overlay practice is used, in the maintenance period most of the time they neglect curb stone height to increase parallel to the maintenance this will reduce pedestrian's feeling of safety and separation from adjacent traffic. This also makes it easier for drivers to park vehicles on the sidewalk.

Walking along the road way is another type of accident that can be seen almost everywhere in Jimma city. Often people faced accident while waiting for the buses or taxi on the walkways or just beside the walkway. Some buses, taxi or other human haulers collide with the pedestrians for not having the control of the speed in the places where they are supposed to stop. Walkers in the Cenetral Hotel – Feidi RA – Shenen Gibe Hospital are facing a crash so often while waiting for the taxi or bus. From Hermata Bank – Tsehay Abebe RA most of the cases pedestrians are not using the sidewalks due to some sort of problems are getting collided with some vehicles. In the route from Tsehay Abebe RA – Farmid RA- Awetu River area is somewhat good.

Figure 4.1 No Walkway No Buffer around Menaheria (Bus station)

Figure 4.2 Walkway without Buffer (Around Merkato)

Figure 4-3 Sample Walkway with buffer (Not in Jimma)

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4.1.2. SECURITY

The second criteria for knowing the pedestrians' level of service is the security and the researcher considered absence and presence of lighting facilities at the night time on the walkways, social security for pedestrian on the walkway is used to know the security concern in Jimma town.

Table 4-2 Security base on Lighting, Social and Security threats in different routes of the study area in Jimma town

Security		
Study Area	Sub Criteria	
	Lighting	Social and Security Threats
Hermata Bank – Tsehay Abebe RA	There is light but most of them are not working	Pick-pocketing Bad comments
Dashen Bank(Merkato) – Legehar	There is light but most of them are not working	Pick-pocketing
Tsehay Abebe RA – Farmid RA- Awetu River	Good	Nothing threat
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	There is light but most of them are not working	Pick-pocketing, Snatch bags and cell phone

The above Table 4-2 shows the summary of security issue in Jimma town. The researcher observed the lighting facilities in the night time while walking on the walkways. Light posts are placed at an interval of about 30m. Unfortunately, most of them are not working properly due to lack of proper maintenance at a regular interval. In the four studied routes, most of the case there is no lighting opportunities in the main roads (primary roads) in both sides and the access roads or the connecting secondary roads and this leads Presence of the illegal pick pocketing and the snatch bags in the four studied routes and the pedestrians are worried to walk though they want to make a short trip of 0.5 km or less. However, this situation encourages people not to use the road side walkway during the night time. My observations survey also revealed that the streets with good lighting like From Tsehay Abebe RA – Farmid RA- Awetu River and Hermata Bank – Tsehay Abebe RA facilities, at the same time in compare to the street with poor or no lighting facilities in the Dashen Bank(Merkato) – Legehar and From Cenetral Hotel – Feidi RA – Shenen Gibe Hospital which is most of street light is not functional. Besides, in each area there

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are some traffic polices are also performing duties on the roads to control the motorized and non-motorized vehicles as well.

Figure 4-4 the above picture shows with good light (Around Ferenj Arada and Mercato)

Figure 4-5. The above picture shows with bad light**(Around Bus station and Leghar)**

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4.1.3. CONVENIENCE AND COMFORT

Smooth walking with easy access is a desirable criterion while designing the walkways. Barrier free walkway and walker's friendly walkway can allow pedestrians a high level of comfort (Pushkarev& Zupan, 1969). During the hot summer, the walkers need some shade-tress and in the rainy season, walkers need some shades as well. Often the walkers feel tired on the walkway and need to sit on some benches or some other small places. These opportunities are completely absent in the four studied route in Jimma city. For knowing the level of services in terms of convenience and comfort, we use some criteria here as

- Movement/density of the pedestrians
- Presence of obstacles on the walkways
- Existence of Sign age for the pedestrians to cross the roads and
- Presence of benches and chairs for seating

The summary of the observation for existing situation in Jimma can be seen in Table 4-3.

Table 4.3 Convenience and Comfort based on Density, Obstacles, Sitting Benches and illegal occupants in different routes of the study area in jimma town.

Study Routes	Density(persons/min)		Sitting Benches	Illegal occupancy
	Peak	Off peak		
Hermata Bank – Tsehay Abebe RA	32	21	None	Illegal vendors, structures and parking car
Dashen Bank(Merkato) – Legehar	25	7	None	Illegal vendors, structures and parking car
Tsehay Abebe RA – Farmid RA-Awetu River	21	8	None	To some extent
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	28	14	None	Illegal vendors, structures and parking car

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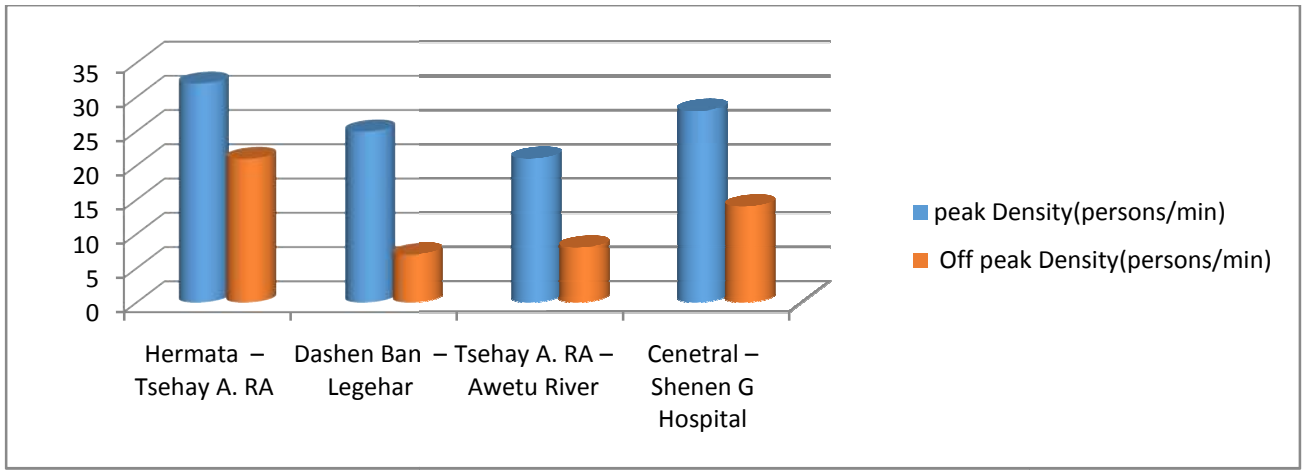

Figure 4.6 shows peak and off peak density of the selected blocks

Figure 4.6 the above figure shows illegal vendors (Around Merkato)

Figure 4.7 the above figure shows Obstacles (Around Merkato)

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The summary of the observation for existing situation of Convenience and Comfort in Jimma town can be seen in Table 4-7. There are lot of obstacles can be seen on the walkways like placement of presence of illegal vendors who are selling their goods, illegal car parking on walkway, waste baskets, and damaged manhole so on and so forth.

4.1.4. CONTINUITY

Continuity refers to the continuation of the walkways beside the road space without altering the ideal situation (Sheila, Sharkar 1993). Discontinuity of the walkways offers very uncomfortable situation to the walkers especially the old persons or the handicapped persons. People also responded that discontinuity offers them a lot of uncomfortable environment while walking through the way.

However, following reasons have been identified for breaking the continuation of the walkways in the study area:- a) Providing road access to the local houses. b) Presence of Illegal Shops or Vendors. c) Illegal Parking on the walkways. d) Illegal Temporary structures.

Table 4.6 Continuity base on Average width of walk way and Average break of walk way in different routes of the study area in Jimma town

Continuity		
Study Routes	Sub Criteria	
	Average width of walk way (m)	Average break of walk way (m)
Hermata Bank – Tsehay Abebe RA	2	5
Dashen Bank(Merkato) – Legehar	None	15
Tsehay Abebe RA – Farmid RA- Awetu River	2.5	0
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	None	20

The researchers consider the qualitative data from the observation in the four respective areas to analyze. But possibility of quantifying this aspect by estimating the average gaps of the walkway's alignment can be taken under consideration for further research.

Figure 4.10 walkway with good continuity (Around Farmid)

Figure 4.11 walkway with bad continuity (Around Legehar)

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4.1.5. SYSTEM COHERENCE

Clear visibility of some transit facilities like shops and public rest room and some social facilities like park and play grounds from the walkway is very essential. People feel encourage to walk when there are nice walkway connection in between attractive places like parks, shopping centers and transit bus stops (Fruin, J. 1971). To look at the street types, connectivity with the shopping areas and clear visibility of different services like small parks, seating places, public toilets and drinking fountains can attract more pedestrians to walk. For this, if we want to assess the walkway environment, we must look at the system coherence (Shelia, Sharkar 2003).

Table 4.7 Coherence base on Street type, Connectivity with shopping and Visibility in different blocks of the study area in Jimma town

Coherence			
Study routes	**Sub criteria**		
	Walkway type	**Connectivity with shopping**	**Visibility**
Hermata Bank – Tsehay Abebe RA	Cobble stone	Well Connected	Poor
Dashen Bank(Merkato) – Legehar	None	Not well	Moderate
Tsehay Abebe RA – Farmid RA- Awetu River	Terrazzo and Cobble	Well Connected	Good
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	None	Not well	Poor

System coherence can further be quantified by measuring the distances from the walkways to some shopping centers or to some activity centers in Jimma town. The walkways alignment and the connectivity with the activity centers can be a very important tool to assess the system coherence as well. Following figures will give an idea about good and bad design criteria in respect of system coherence in the selected routes for the study.

Figure 4.12 Walkway with bad visibility (Around Mercato)

Figure 4.13 Walkway with good visibility (Around Hermata)

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Figure 4.14 Walkway with good visibility (Around Hermata)

From Hermata Bank – Tsehay Abebe RA route and from Tsehay Abebe RA – Farmid RA- Awetu River, sidewalks are well connected with the shopping centers whereas from Dashen Bank(Merkato) – Legehar and Cenetral Hotel – Feidi RA – Shenen Gibe Hospital sidewalks not well connected , but visibility of route from Farmid RA- Awetu River can attract more pedestrians to walk, whereas routes from Dashen Bank(Merkato) – Legehar and Cenetral Hotel – Feidi RA – Shenen Gibe Hospital poor visibility and also walkway not properly constructed, from Hermata Bank – Tsehay Abebe RA has poor visibility, the existing walk way has sufficient width but the local merchant miss - use it to place their sells goods and their stairs.

4.1.6. ATTRACTIVENESS

Attractiveness is the combination of color, scale, balance, shape, and street character etc. The walkways should be well organized in those aspects to attract more people. Most pedestrians in Jimma town are observed walking not on the walkways. They use the carriage way instead because the walkways are not allowed enough width and no walkway to some parts. For this reason, people feel convenient to use the road space and many accidents take place indeed. Scale is one of the important aspects here to attract more people on the walkway. In developed countries, walkways often segregated with different colors. However, in Jimma town, observation survey reveals that height separates the walkways in most of the cases.

Table 4.7 Attractiveness base on Scale, Color and Street character in different blocks of the study area in Jimma town

Attractiveness			
Study routes	**Sub criteria**		
	Scale	**Color**	**Street character**
Hermata Bank – Tsehay Abebe RA	Good	Poor	Not good for walkers
Dashen Bank(Merkato) – Legehar	None	None	Bad to walk
Tsehay Abebe RA – Farmid RA- Awetu River	Very good	Very good	Good for walkers
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	None	None	Bad to walk

Figure 4.15 Walkway with high scale attractiveness (Around Hermata)

Figure 4.16 No Walkway with bad attractiveness (Around Menaheria/Bus station)

In the above picture and Figure 4.16 No walkway and bad road side approaches covered by mud and unlined ditch around Dashen Bank (Merkato) – Legehar and Cenetral Hotel – Feidi RA – Shenen Gibe Hospital that makes very difficult situation for the vulnerable walkers like the baby and disabilities. For instance, walkers do not want to use the footpaths for walking rather than using the carriage way which allow more pedestrians face for accidents as well. In the case of Farmid RA- Awetu River the walkway is attractive to the pedestrian.

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4.1.7. Existing condition of Geometric features

A geometric feature is one of the most important parts of developing a roadway design focuses on the selection and configuration of the elements that comprise the roadway cross-section. The cross-sectional elements in a highway design pertain to those features which deal with its width, specifically, aspects of the cross-section directly relate to the right of way, number of travel lanes to be provided and the width and location of shoulders, walkway, medians, slopes embankments, ditches and curbs. The existing Geometric features of the study were summarized in the following Table. 4-8

Table 4.8 Summery of the existing Geometric features of the study

Existing Condition of Geometric Features				
Study Block or Area	Sub criteria			
	Existing Right side Vs master plan	Existing Left side Vs master plan	Road width	Master plan Standard road with
Hermata Bank – Tsehay Abebe RA	2.5/2	2.5/2	14.4	15m/ 25m
Dashen Bank(Merkato) – Legehar	0/2	0/2	14	15m/ 25m
Tsehay Abebe RA – Farmid RA-Awetu River	3/2	3/2	15.12	20m/ 30m
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	0/2	0/2	14	30m

4.1.8. Existing condition of pedestrian volume

Traffic data, indicates the service for which the highway is being planned and directly affects the geometric features such as width, alignment etc. A further factor influencing the development of road design standards, and in particular the design speed, is the volume and composition of traffic. The design of a road should be based in part on factual pedestrian and traffic volumes.

Table – Peak hour volume for Hermata bank - Tsehay Abebe RA

Table 4.9 Summery of the existing Geometric features of the study

Study routes from Hermata bank - Tsehay Abebe RA	
Time (Local time)	Pedestrian volume
4:00-4:15	469
4:15-4:30	406
4:30-4:45	532
4:45-5:00	558
Total	**1965**

Table 4.10 off peak hour volume for Hermata bank - Tsehay Abebe RA

Study routes from Hermata bank - Tsehay Abebe RA	
Time (Local time)	Pedestrian volume
8:00-8:15	308
8:15-8:30	268
8:30-8:45	317
8:45-9:00	383
Total	**1276**

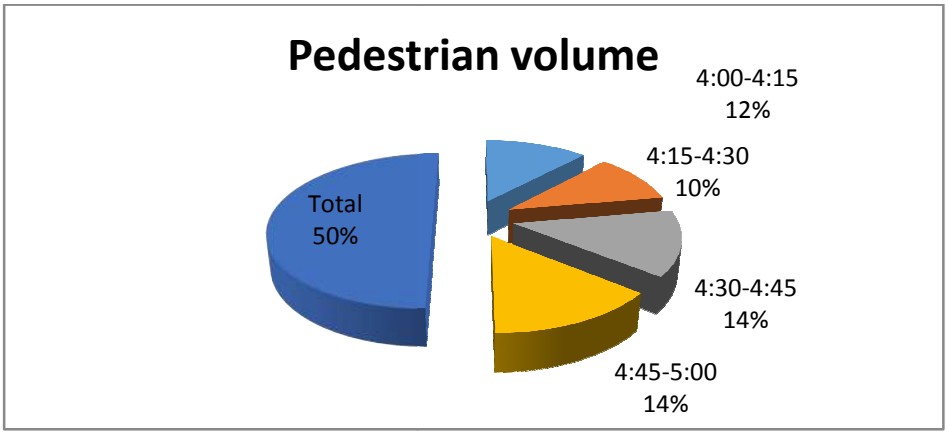

Figure4.17 Summery of the existing Geometric features of the study

Table 4.11 peak hour volume for Dashen Bank (Mercato) to Legehar)

Study routes from Dashen Bank (Mercato) to Legehar	
Time (Local time)	Pedestrian volume
4:00-4:15	328
4:15-4:30	370
4:30-4:45	417
4:45-5:00	440
Total	**1555**

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Table 4.12 off peak hour volume for Dashen Bank (Mercato) to Legehar

Study routes from Dashen Bank (Mercato) to Legehar	
Time (Local time)	Pedestrian volume
2:00-2:15	99
2:15-2:30	111
2:30-2:45	95
2:45-3:00	147
Total	**452**

Table 4.13 peak hour volume for Tsehay Abebe RA- Farmid - Awetu River

Study routes from Tsehay Abebe RA- Farmid - Awetu river	
Time (Local time)	Pedestrian volume
6:30-6:45	290
6:45-7:00	342
7:00-7:15	346
7:15-7:30	298
Total	**1276**

Table .14 off peak hour volume for Tsehay Abebe RA- Farmid - Awetu River

Study routes from Tsehay Abebe RA- Farmid - Awetu river	
Time (Local time)	Pedestrian volume
3:50-4:05	113
4:05-4:20	126
4:20-4:35	113
4:35-4:50	148
Total	**500**

Table .15 peak hour volume for Central Jimma hotel – feidi RA- Shenen Gibe Hospital

Study routes from Central Jimma hotel – feidi RA- Shenen Gibe Hospital	
Time (Local time)	Pedestrian volume
5:45-6:00	370
6:00-6:15	431
6:15- 6:30	415
6:30-6:45	468
Total	**1684**

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Table 4.16 off peak hour volume for Central Jimma hotel – feidi RA- Shenen Gibe Hospital

Study routes from Central Jimma hotel – feidi RA- Shenen Gibe Hospital	
Time (Local time)	Pedestrian volume
9:00-9:15	222
9:15-9:30	172
9:30-9:45	220
9:45-10:00	275
Total	**889**

Generally the existing condition of the geometric features of roadside walkways around study blocks or area summarized as peak hour volume pedestrian count, existing walkway width vs master plan and standard walkway width show in table herein under.

Table 4.18 pedestrian count, walkway width Vs Master plan and Standard walkway width

Study Blocks or Area	**Sub criteria**				**Remark**
	Pedestrian count (peak/hour)	**Existing Walkway width**	**Master plan walkway width**	**Standard walkway width**	
Hermata Bank – Tsehay Abebe RA	1,965	2.5	3	4.5	it doesn't satisfy the standard and master plan It needs upgrading
Dashen Bank(Merkato) – Legehar	1,555	None	2	4.5	it needs to construct standard walkways
Tsehay Abebe RA – Farmid RA- Awetu River	1,276	3	3	3.5	Some parts It satisfy the standard
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	1,684	None	2	3.5	it needs to construct standard walkways
Farmid RA- Awetu River	1,276	3.3	3	3.5	It satisfy the standard

Pedestrian volumes were relevant to traffic and highway engineering practice. In addition, other pedestrian volume influences the geometric features. Such as pedestrian over and under passes,

elevated walkways, and crosswalks. Walking characteristics play a major part in the design geometric features and some of controls devices. Generally as we compare the walk way roadsides with the standard highway capacity manual they are not satisfy the criteria except Farmid RA- Awetu River route.

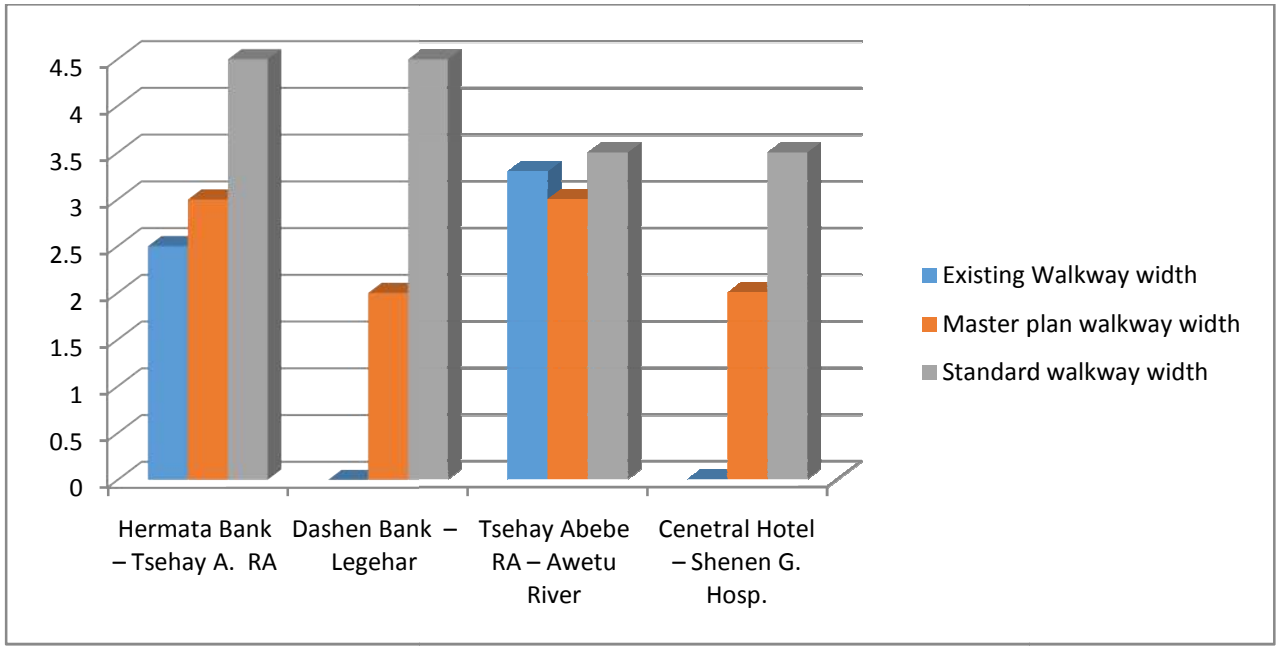

Figure 4.18 shows Existing, Master plan and Standard walkway width description

Standard Pedestrian LOS

The HCM's methods for analyzing pedestrian LOS are based on the measurement of pedestrian flow rate and sidewalk space. The pedestrian flow rate, which incorporates pedestrian speed, density, and volume, is equivalent to vehicular flow. According to the HCM:

"As volume and density increase, pedestrian speed declines. As density increases and pedestrian space decreases, the degree of mobility afforded to the individual pedestrian declines, as does the average speed of the pedestrian stream."

The pedestrian unit flow rate (ped/min/ft) is obtained by taking the pedestrian 15-minute flow rate (ped/15-min) and dividing by the effective walkway width. The HCM suggests collecting pedestrian opposing flow volumes at 15-minute intervals. The sum of the two directional flows is used as the 15-minute flow rate. Effective width of the sidewalk is calculated by taking the total

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width of the sidewalk and subtracting obstacle widths and a 1 to 1.5 ft buffer width per obstacle. Obstacle widths can be measured from the field.

Table 4.4 shows average flow LOS criteria for walkways and sidewalks

LOS	Space (tf^2 /Ped)	Flow rate (Ped/min/ft)	Speed (ft/sec)	v/c ratio
A	>60	≤ 5	>4.25	≤0.21
B	40 – 60	5 – 7	4.17 – 4.25	0.21 – 0.31
C	24 – 40	7 – 10	4.00 – 4.17	0.31 – 0.44
D	15 – 24	10 – 15	3.75 – 4.00	0.44 – 0.65
E	8 – 15	15 – 23	2.50 – 3.75	0.65 – 1.00
F	≤ 8	Variable	≤2.50	Variable

LOS A

Pedestrians move in desired paths without altering their movements in response to other pedestrians. Walking speeds are freely selected, and conflicts between pedestrians are unlikely.

LOS B

There is sufficient area for pedestrians to select walking speeds freely to bypass other pedestrians, and to avoid crossing conflicts. At this level, pedestrians begin to be aware of other pedestrians, and to response to their presence when electing a walking path.

LOS C

Space is sufficient for normal walking speeds, and for bypassing other pedestrians in primarily unidirectional streams. Reverse-direction or crossing movements can cause minor conflicts, and speeds and flow rate are somewhat lower.

LOS D

Freedom to select individual walking speed and to bypass other pedestrians is restricted. Crossing or reverse-flow movements face a high probability of conflict, requiring frequent changes in speed and position. The LOS provides reasonably fluid flow, but friction and interaction between pedestrians is likely.

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LOS E

Virtually all pedestrians restrict their normal walking speed, frequently adjusting their gait. At the lower range, forward movement is possible only by shuffling. Space is not sufficient for passing slower pedestrians. Cross- or reverse-flow movements are possible only with extreme difficulties. Design volumes approach the limit of walkway capacity, with stoppages and interruptions to flow.

LOS F

All walking speeds are severely restricted, and forward progress is made only by shuffling. There is frequent unavoidable contact with other pedestrians. Cross-and reverse-flow movements are virtually impossible. Flow is sporadic and unstable. Space is more characteristic of queued pedestrians than of moving pedestrian streams.

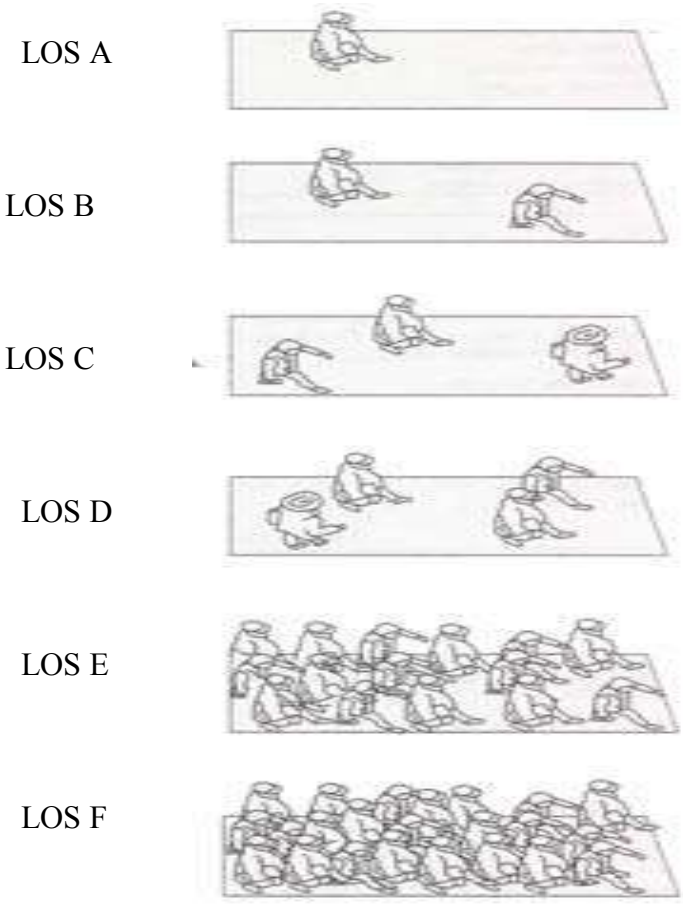

Figure 4.8 shows pedestrian level of service /LOS

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The foremost important aspect that has been considered here to evaluate the Side walkways in terms of Convenience and Comfort in Jimma town is the pedestrian flow rate and flow density of the walkers. The Highway Capacity Manual (Transportation Research Board, 2000) defines 6 ranges of Level of Service (from A to F), depending on the following variables: space available per pedestrian, flow rates and speeds. The main indicator, flow rate, is calculated using pedestrian counts in a given point of the pavement and effective width of the pavement in that point. We observed the pedestrians density on the major roads in four different Routes. The flow rate has been counted as persons are walking in a specific segment of the road per minute along the roadway and space allocation per pedestrian has been observed in a specific area to get the actual data of the study route. Following table will focus the pedestrian flow rate and the space required per person in Jimma town in compare to the standard level given in some books and literatures.

Table 4.5 Convenience and comfort base on Density, Current Level of Service in different routes of the study area in Jimma town

Study Routes	Pedestrian per minute (Ped/min)	Effective width (ft)	Flow rate (ped/min/ft)	LOS
Hermata Bank – Tsehay Abebe RA	32.75	2	16.38	E
Dashen Bank(Merkato) – Legehar	25.91	2.4	10.79	D
Tsehay Abebe RA – Farmid RA- Awetu River	21.27	4	5.32	B
Cenetral Hotel – Feidi RA – Shenen Gibe Hospital	28.06	2.2	12.75	E
Farmid RA- Awetu River	21.27	7	3.03	A

From the above table all the study route except from Farmid RA- Awetu River and some part of Tsehay Abebe RA – Farmid RA the rest are high level of service like, LOS D , and LOS E, In addition to this, the directional split of pedestrian is close to 50-50, At this level of congestion, crossing or reversing flow movements face a high probability of conflict, requiring frequent changes in speed and position. Questionnaires show that the most of respondents get annoyed because of conflicts with other pedestrians sometimes or very often.

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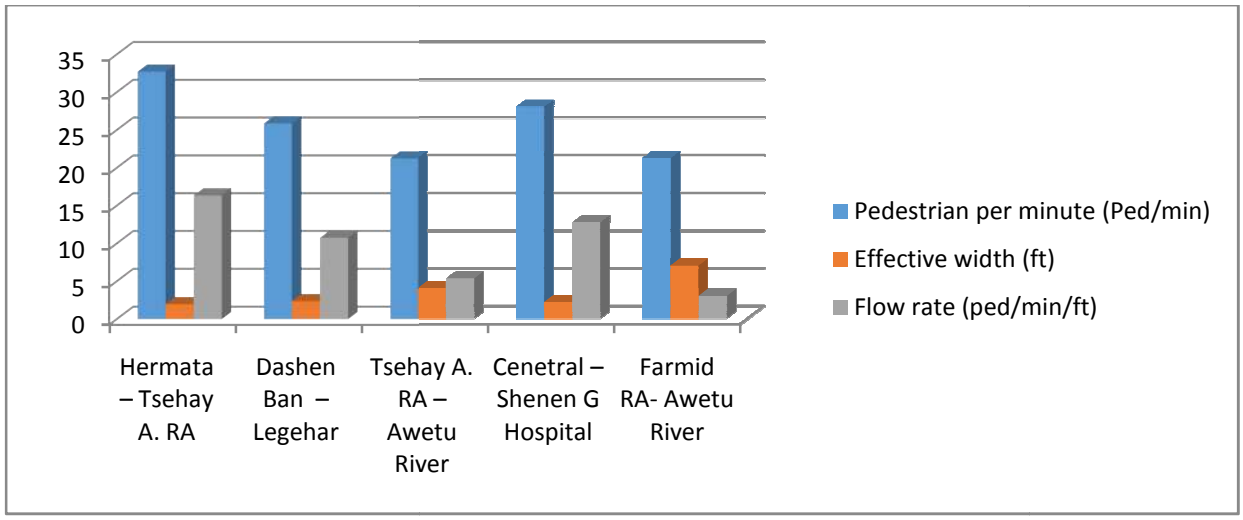

Figure 4.9 shows pedestrian per minute, Effective width and Flow rate

4.2. Identifying cause of pedestrian accidents on roadside walkway

The Spatial Distribution of RTAs in Jimma town in from 2013 – 2015 Jimma town for the last three years exhibits the occurrence of 104 spatially identified RTAs. The RTAs were unevenly distributed throughout the town administration in the last three years

Table 4.19 Cause of road traffic accident in Jimma town due to pedestrian behavior from 2013 – 2015

Pedestrian movement (Pedestrian behavior)	Severity of Accident			Total	%
	Fatality	Serious Injury	Slight Injury		
Crossing the road on zebra cross	0	1	0	1	0.99
Crossing the road without zebra cross	5	9	8	21	20.26
Crossing the road behind the vehicle	4	4	4	12	11.55
Walking on road side walkway	7	5	5	17	16.57
Walking without roadside walkway	4	8	4	16	15.57
Walking in road way against traffic	4	2	0	6	5.92
Walking in road way with traffic	2	1	2	5	4.98
Maintain vehicle on the road way	2	1	0	3	2.96
Other	3	3	3	9	8.66
Unknown	4	7	2	13	12.54
Total	35	41	28	104	100

`

The above table stipulates that, 104 RTAs were recorded form the last three years. This indicates that an average of 34.67 RTAs have occurred at every year. The highest numbers of RTA as well as the largest frequency of RTA incidents were recorded accident due to pedestrian crossing the road without zebra cross. crossing the road without zebra cross exhibits 21 (20.26) of RTAs the lowest frequency of RTA incidents were recorded accident due to pedestrian, Crossing the road on zebra cross exhibits 1 (0.99%) respectively. Ranking cause of pedestrian accident due to pedestrian behavior or pedestrian movement for the last three years is shown in Figure 4.19.

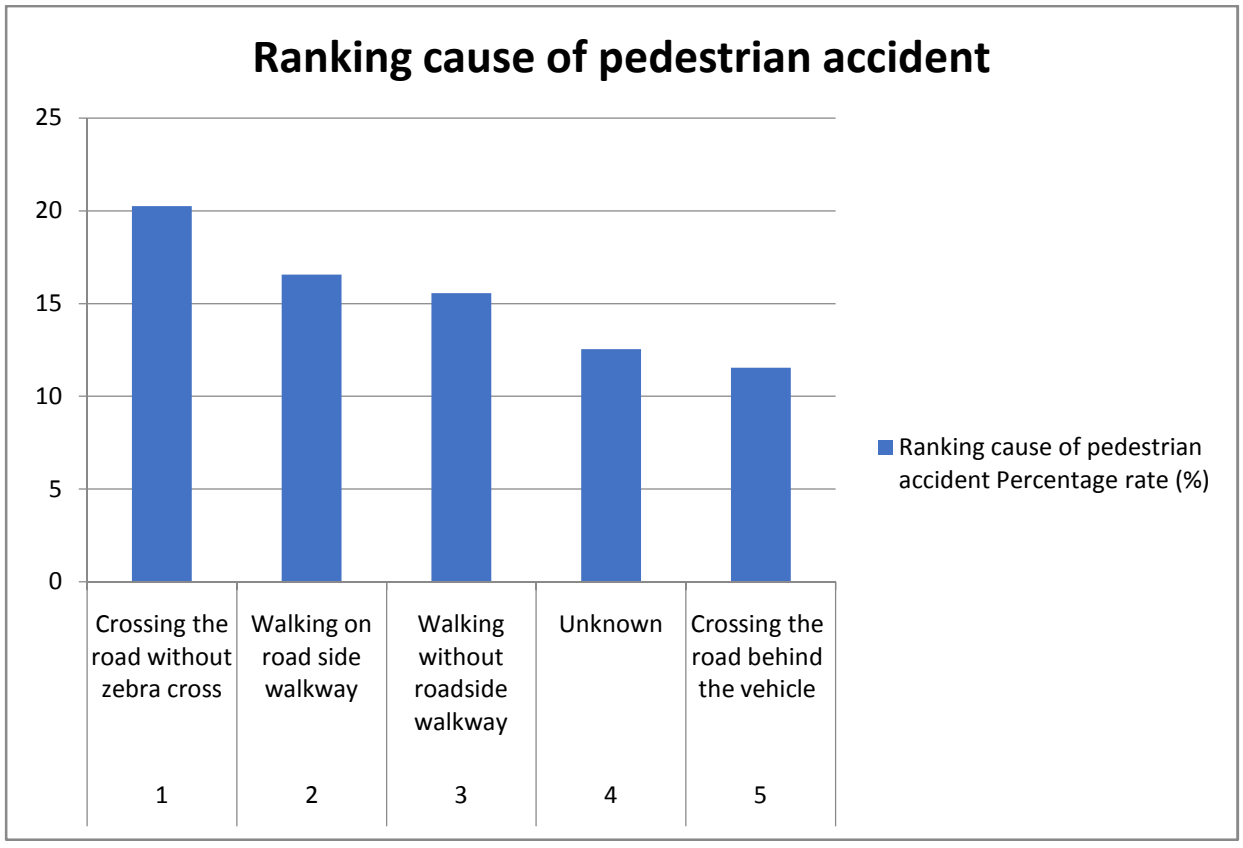

Figure4.19 Ranking cause of pedestrian accident based on pedestrian behavior

Crossing the road without zebra cross, walking on roadside walkway, walking without roadside walkway and crossing the road behind the vehicle these are the main identified cause of pedestrian accidents. The above problem indicates properly constructed roadside walkway is minimizing the accident which is happening big problem in the town.

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Table 4.20 Cause of road traffic accident in Jimma town due to driving failure from 2013-2015

Causes of Accident	Severity of Accidents			Total	%
	Fatality	Serious Injury	Slight Injury		
Unsafe lane change	1	2	2	4	3.95
Failure to give way for vehicle	0	2	0	2	1.94
Failure to give way for pedestrian	10	21	11	42	40.40
Going straight ahead	1	3	0	4	3.86
Improper turning	5	6	5	16	15.60
Speeding	9	3	4	16	15.60
Improper Starting from parked position	3	0	1	4	3.95
Breaking problem	2	0	0	2	1.94
Tire problem	1	1	1	3	2.90
Road surface condition	1	0	0	1	0.99
Unknown	2	2	4	8	7.88
Other	0	1	0	1	0.99
Total	35	41	28	104	100

Out of every 100 RTA casualties in Jimma town 33.66 have the probability of death, 39.42 the fate of serious injury and the rest 26.92 the possibility of suffering from slight injury due to RTAs (Table 4.21). The highest frequency of serious injuries and slight injuries in the town have been exhibited in the years of 2014 while the most shocking fatal accidents of road crashes have been unveiled in 2015 in the town. In general, 35 road users in the town became victims of RTAs every year from 2013 - 2015. More specifically, 22, 50 and 32 people suffer fatal accidents, serious injury and slight injury every year in the town between 2013 - 2015. This disaster shows that Victims of fatal road accidents died on the scene or in hospitals. Survivors also suffer from different types of injuries and disabilities which can affect their quality of life.

Table 4.21 Road traffic accident by accident severity class in Jimma town (2013 - 2015)

Accident severity type	Accident year			Total	%
	2005	2006	2007		
Fatal accident	8	13	14	35	33.66
Serious injury	12	18	11	41	39.42
Slight injury	2	19	7	28	26.92
Total	22	50	32	104	100

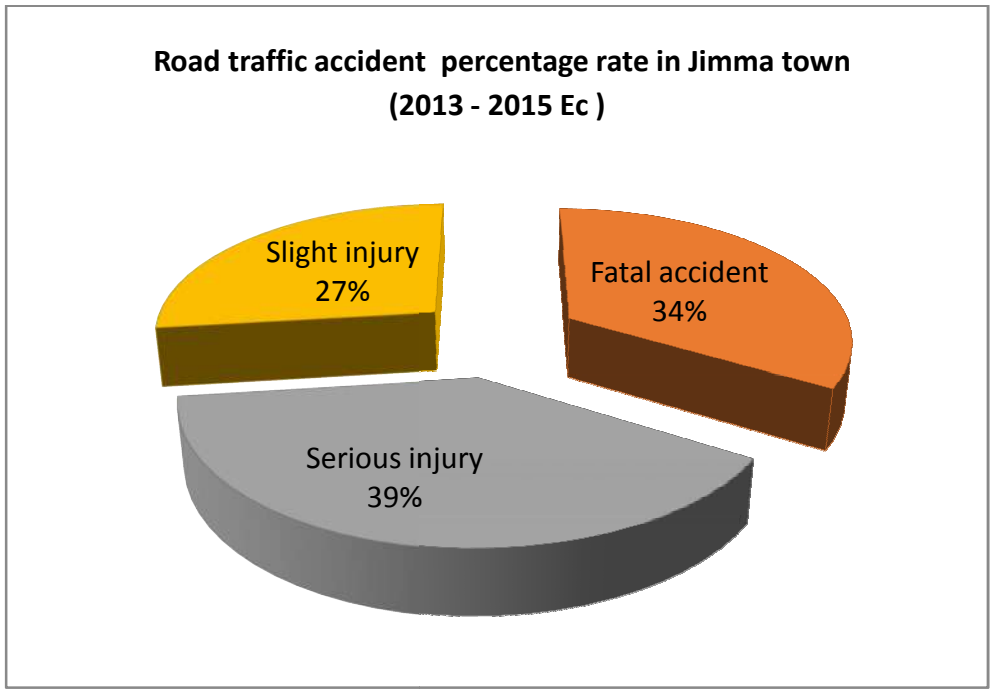

Figure 4.20 road traffic accident percentage rate in jimma town (2013 – 2015)

The Victims can be passengers, pedestrians, drivers; they can even be the cause of the accident themselves. As these victims suffer, their families and communities will suffer too; they must sometimes carry the burden of caring for the victims. The prevalence of people to RTAs can be a cause for social insecurity and social crisis. Road Traffic Accidents affect the physical and psychological wellbeing of an individual or groups. In terms of physical injury for instance, the victims of head and spinal injury may be unable to return to their normal lives.

4.3 SUBJECTIVE EVALUATION

From those 360 respondents through four different routes from different pedestrian in the study areas to give their impressions in six criteria. We made some questionnaire survey to know the views of the pedestrians. The impressions of the pedestrian in different criteria can be summarized in the following graph.

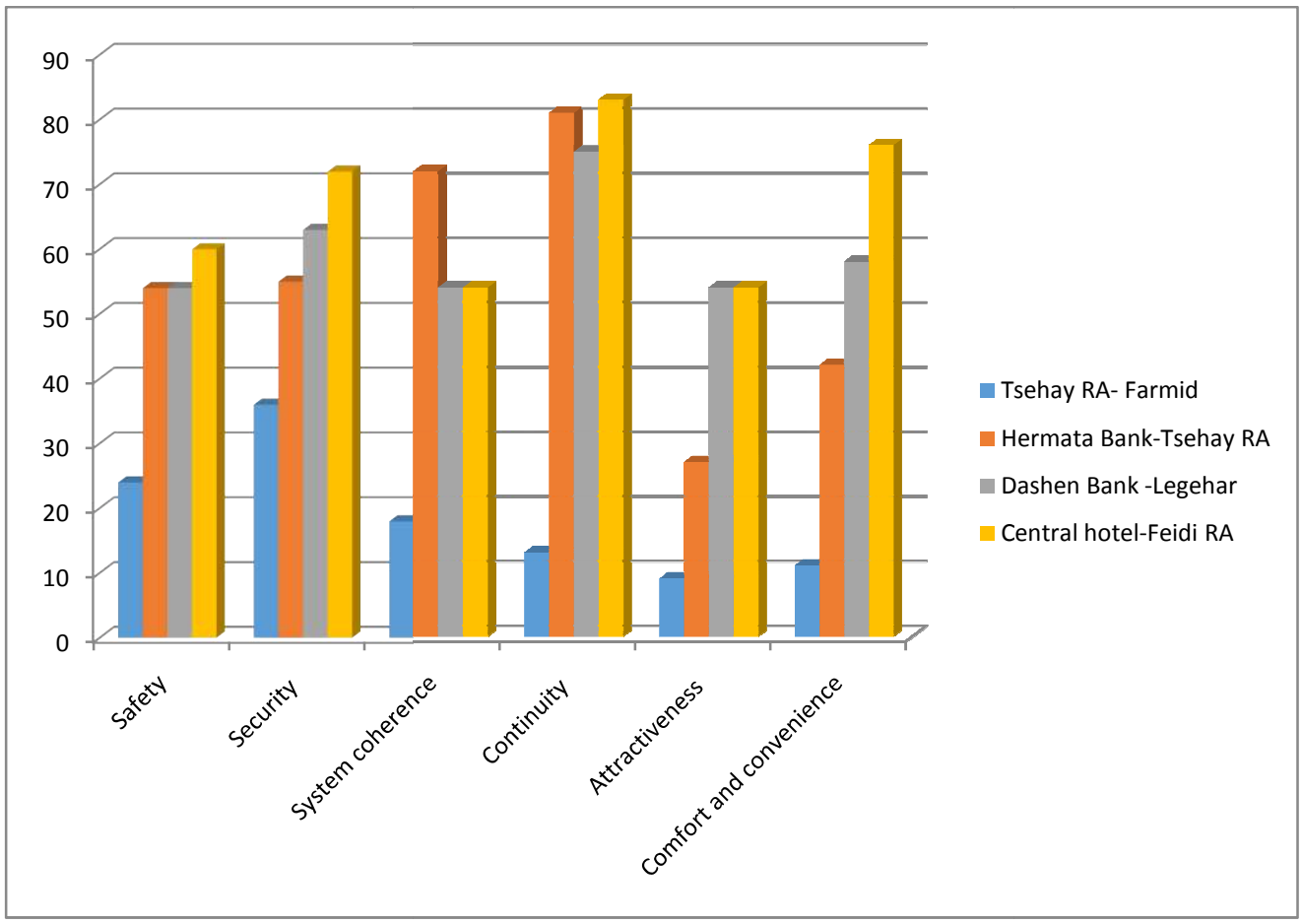

Figure 4.21 shows negative respondent summary of the impression of the walked different criteria

In the above figure 4.21 and figure 4.22, the 6 prescribed criteria have been placed and it also depicts the standing of four studied areas. We distributed 360 questionnaires to the pedestrians in four areas to give their impressions in 6 criteria. In the figure 4.21 and figure 4.22, safety, security and system coherence was measured based on 6 sub criteria, whereas continuity and attractiveness were measured with 2 sub-criteria. Convenience and comfort was measured based on 4 criteria.

For example In the case of Tsehay Abebe RA – Farmid Ra – Awetu River when the negative response is minimum means the magnitude of problem around the route is better than other study areas.

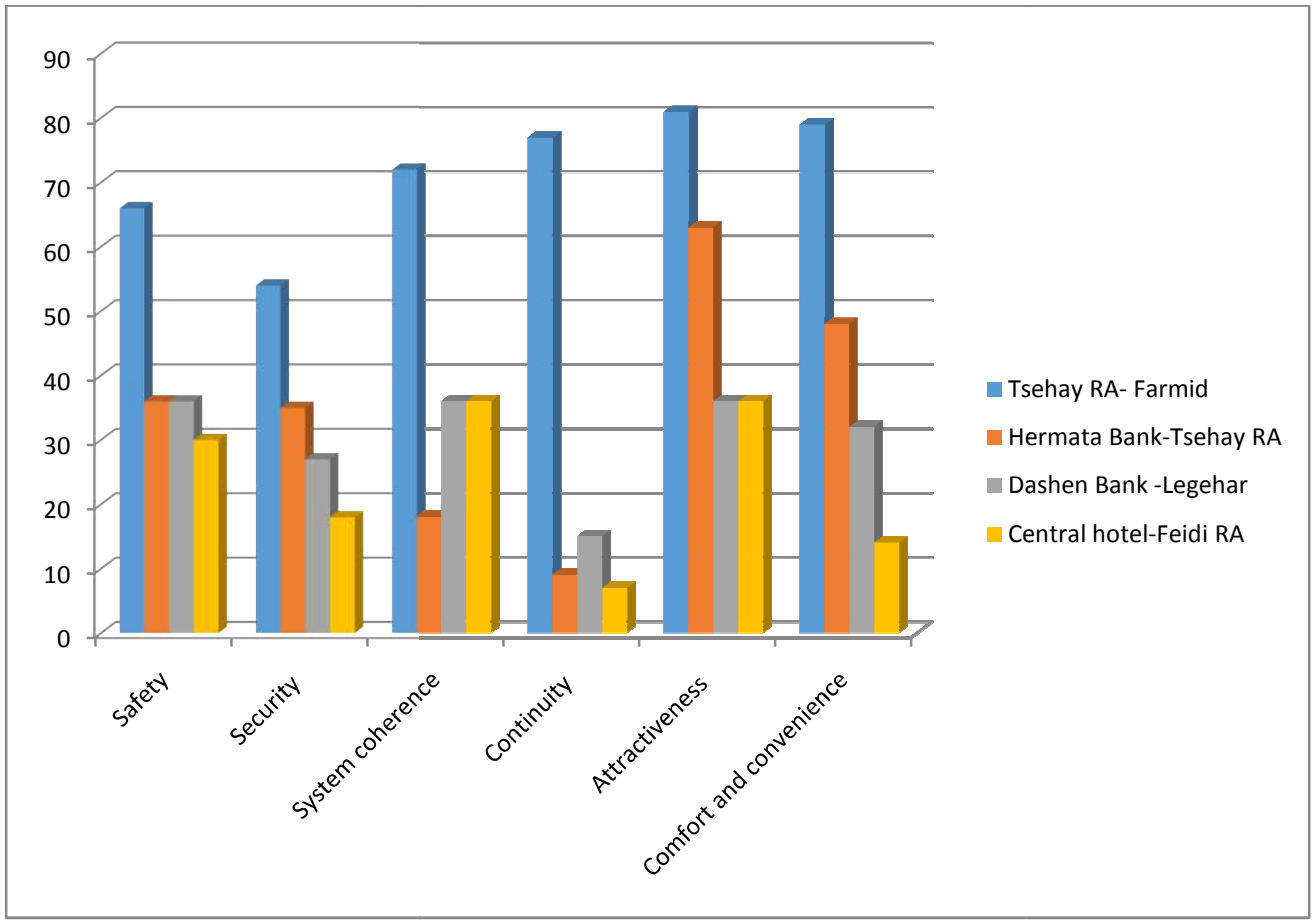

Figure 4.22 shows positive respondent summary of the impression of the walked different criteria

For example In the case of from Centeral Hotel – Feidi RA – Shenen Gibe hospital when the positive response is minimum means the magnitude of the problem around the route is higher than other study areas.

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5. CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

Nowadays, lot of advancement can be seen with many models and techniques for designing pedestrian walkway or roadside walkway around the world. But in Jimma town, the transport authorities or the researchers are still thinking with managing only the motorized vehicles.

In Jimma town 104 road traffic accidents were recorded form the last three years. This indicates that an average of 34.67 road traffic accidents have occurred at every year. For this reason, the most vulnerable road users in the transportation planning, the pedestrians are neglected for their safety as well as convenience.

This research is an attempt to aware the transportation planners and researchers about the existing problems related to roadside walkway in Jimma town. Thus, we believe that this study contributes much to those who need to understand the general causes of pedestrian accidents in Jimma town in terms of existing geometric feature, pedestrian and drivers behavior and inspire other stake holders to conduct further studies in the field.

5.2 Recommendations

Jimma town road authority must collect any pedestrian database from any secondary sources rather than fully depending on field and observation survey which could give some opportunities to analyze the problems in detail.

- From the research we can get that the most roadside walkway are not fit to the standard so that the town administration must redesign according to the international standard roadside walk way of mega city like width, passing space, slopes (cross and running), meandering, curbs, changes in level and stairs gratings, obstructions driveway, temporary construction, furnishings and public transit stops.
- When constructing roadside walkway must provide buffers either in steel or plant trees that is safe for pedestrian walking on it as well as for good esthetic pint of view. The town administration must explore other broad criteria that can be followed to assess the pedestrian's level of services in a rapidly growing town. In the same time, pedestrians' impressions have been included here to know the importance of some criteria.

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- During road Maintenance of town administration project overlay practice is used in the maintenance period most of the time they neglect curb stone to increase its height parallel to the maintenance this will reduce pedestrian's feeling of safety and separation from adjacent traffic. This also makes it easier for drivers to park vehicles on the sidewalk.
- The town administration must provide sufficient street light and maintenance should be made on timely (regular) for the safely of the pedestrian at night time.
- The town administration it must prevent the illegal vendors from roadside walkway.
- Curb ramps (wheelchair ramps) provide access between the sidewalk and roadway for people using wheelchairs, strollers, walkers, handcarts , and also for pedestrians with mobility impairments who have trouble stepping up and down high curbs.
- Also provide Pedestrian overpasses and used to allow for uninterrupted flow of pedestrian movement separately from the vehicular traffic. However, they should be a measure of last resort, and it is usually more appropriate to use traffic-calming measures or install a pedestrian-activated signal that is accessible to all pedestrians. This measure is used primarily in areas with high pedestrian volumes.
- Some roadside walkway which satisfies the standard are not sufficient to accommodate the existing pedestrian volume, previous assumption to design side walkway is by proportioning of 80% to 20% or 70% to 30% motorized vehicle vs pedestrian. This proportion must be revised by increasing pedestrian percentage because nowadays pedestrian volume is high.
- Utility line(like electric cable, water pipe) and manhole which goes parallel to roadway is provided in roadside walkway, during maintenance the walkway will be demolished but not construct the same as previously constructed structure this is also affect pedestrian safety. Neglected sidewalk surfaces can be uncomfortable. Potholes, cracks, caved in surfaces may lead to tripping and falls; additionally strollers and wheelchairs cannot negotiate uneven sidewalks.
- The town administration must construct standard walkway the place where there is no walkway on the study area or route, For example the route from Centeral Hotel – Feidi RA – Shenen Gibe Hospital and the route from Dashen Bank (Mercato) – Legehar there is no roadside walkway. It must provide roadside walkway because those areas are transit and shopping areas and also high volume of pedestrian.

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Generally: - The identified cause of pedestrian accidents at roadside walkways and its possible interventions at Jimma town some of them listed herein under:-

- Design and construction problem
  - not properly constructed roadside walkway for example the roadside walkway without buffer,
- From the pedestrian behavior or pedestrian movement like;
  - Crossing the road without zebra cross
  - Walking on road side walkway,
  - Walking without roadside walkway
- From failure to driver like:-
  - Failure to give way for pedestrian
  - Driving Speeding
  - Improper turning and unsafe lane change is the major cause of pedestrian accident appear mostly in Jimma town study areas.

Further research works can find more details with quantifying the problems in the line with different criteria so that the major problems can be truly identified and can be minimized.

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Appendix I

Questionnaire

JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

DEPARTEMENT OF CIVIL ENGINEERING

POST GRADUATE STUDIES

HIGHWAY ENGINEERING STREAM

General Information

A. General Objective

The main objective of this study is to investigate the cause of pedestrian accidents at road side walkways and its possible interventions in Jimma road.

And also this study is evaluating the condition & capacity of the walkway with respect to the criteria, and then recommends remedial actions to be taken for the identified problems for the roadside walkway of Jimma town to emphasizing the pedestrian though roadside walkway.

B. The Purpose of survey

The purpose of this survey is to obtain necessary data for the consumption of final Master's thesis in Highway Engineering at Jimma University, Ethiopia. All data's collected by the survey will be confidential and only used for academic purpose.

Note- If one or more of the following questions doesn't concern you or if you don't want to answer, you can skip

Thank you!

Melkamu Gizaw

Email: gmg.amu@gmail.com

Post graduate student in Highway Engineering

Jimma University, Jimma Institute of Technology, Civil Engineering Department

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Questionnaire to assess the pedestrian walkway conditions at selected areas of Jimma town

1. The roadside walkway fenced with what type of buffer around the route?

A) Concrete ☐

B) Steel ☐

C) Tree ☐

D) No buffer at all ☐

2. Is it possible to see freely anything in front of you when you are walking on roadside walkway?

A) Yes ☐

B) No ☐

3. Have you ever encountered a traffic accident while walking through the pedestrian walkway?

A) Yes ☐

B) No ☐

C) There is no accident ☐

4. Is there enough electric light when you are walking on roadside walkway during night time?

A) Yes ☐

B) No ☐

5. Is there a security or police men around the walkway to help you as much as possible when you are walking on roadside walkway faces a security problem?

A) Yes ☐

B) No ☐

If your answer is yes, how far from you the security or police men are they found? (In kilometers) _____

6. What are the most misgiving factors while you are walking on roadside walkway?

A) Thieves, pick pocketing, ☐

B) Billings gate / Insulting ☐

C) Mentally ill people/mad ☐

D) I feel nothing ☐

7. Does the pedestrian roadside walkway have a reserved place to rest?

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A) Yes ☐

B) No ☐

8. What are the obstacles or obstructions while you are walking on roadside walkway?

A) Existence of Illegal vendors ☐

B) Existence of Illegal constructions ☐

C) Presence of trademarks ☐

D) All are obstacles ☐

E) There is no obstacle at all ☐

9. Is the roadside walkways have enough width to accommodate the pedestrian walking freely?

A) Yes ☐

B) No ☐

10. Is there any rest places or toilet around the walkway?

A) Yes ☐

B) No ☐

11. Can you see clearly different types of organizations, shops, public services that are found close to the walk way?

A) Yes ☐

B) No ☐

12. Is the pedestrian walkway attractive enough to walk on it or not attractive?

A) Yes it is attractive ☐

B) No, it is not attractive ☐

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AMHARIC VERSION

ጅማ ዩኒቨርሲቲ

የጅማ ቴክኖሎጅ ኢንስትቲዩት

በሲቪል ምህንድስና ት/ት ክፍል

የድህረ ምረቃ ፕሮግራም

የሃይዌ ኢንጂነሪንግ ዘርፍ

አጠቃላይ መረጃ

ሀ. ዋና አላማ

የዚህ ጽሁፍ ዋና አላማ የእግረኛ መንገድ አለመኖር እና ምቹ አለመሆኑ የሚያስከትለዉን ጉዳት ማጥናት እና በከተማዋ የሚንቀሳቀሱ እግረኞችን ከአደጋ እንዲጠበቁ ማድረግ በተጨማሪም ስታንደርዱን የጠበቀ ምቹ የሆነ የእግረኛ መንገድ በከተማዋ እንዲሰራ ማድረግ ነዉ።።

ለ. የመጠይቁ አስፈላግነት

የህንን መጠይቅ መሰብሰብ ያስፈለገዉ ፤ በሃይዌ እንጂነሪንግ የድህረ-ምረቃ ፕሮግራም የምረቃ ፅሁፍ ለማዘጋጀት ነዉ።። ማንኛዉም የተሰበሰበ መረጃ በጥሬዉ ለሌላ ሶስተኛ ወገን ተላልፎ አይሰጥም ፤ የሚዉለዉም ለመመረቅያ ፅሁፍ ማዘጋጃ ብቻ ይሆናል።

ማስታወሻ፡- ከዝህ በታች ከተዘረዘሩት መጠይቆች ዉስጥ የማይመለከትዎት አልያም መመለስ የማይፈልጉት ካለ፤ መተዉ ይችላሉ።

ከምሥጋና ጋር

መልካሙ ግዛዉ

የሃይዌ እንጂነሪንግ የድህረ-ምረቃ ተማሪ

ጅማ ዩኒቨርሲቲ ፣ በጅማ ቴክኖሎጅ ኢንስትቲዩት የሲቪል ምህንድስና ት/ት ክፍል

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በተወሰኑ በጅማ ከተማ በሚገኙ የእግረኛ መንገዶች ያለበትን ሁኔታ ለማወቅ የተዘጋጀ የጽሁፍ መጠይቅ፡

1. የእግረኛ መንገዱ በምን የታጠረ ነው?

ሀ. በግንብ ለ. በብረት ሐ. በዛፍ መ. ምንም የለውም

2. እግረኛ መንገዱ ላይ በሚንቀሳቀሱበት ወቅት ከፊት ለፊትዎ ካለው ሰው ወይም ሌላ ነገር ጋር በደንብ ይተያያሉ ወይስ አይተያዩም?

ሀ. እኩል ለመተያየት የሚመች ነው ለ. አይታይም

3. በእግረኛ መንገዱ ላይ በሚንቀሳቀሱበት ወቅት የትራፊክ አደጋ ኢጋጥሞት ያውቃልን?

ሀ. አዎ ለ. አያውቅም ሐ. የለም

4. ማታ በእግረኛ መንገዱ ላይ በሚጓዙበት ወቅት በቂ ሙበራት ወይም ብርሃን አለውን?

ሀ. አዎ ለ. የለም

5. በእግረኛ መንገድ ላይ በሚጓዙበት ወቅት ባለው የጸጥታ ችግር ፈጥኖ የሚደርስልዎ የጸጥታ ደንብ አስከባሪ ወይም ፖሊስ አለን?

ሀ. አዎ ለ. የለም

አዎ ካሉ በስንት ኪሎ ሜትር ርቀት ይገኛል? _____

6. በእግረኛ መንገድ ላይ በሚጓዙበት ወቅት የሚያስፈራዎ ነገር ምንድን ነው?

ሀ. ሌባ ለ. ፀያፍ አነጋገር ሐ. የአህምሮ ህመምተኞች መ. የለም

7. የእግረኛ መንቀሳቀሻ መንገድ ማረፊያ ቦታ አለው ወይስ የለውም?

ሀ. አዎ ለ. የለም

8. በእግረኛ መንገዱ መንቀሳቀሻ ላይ እንቅፋት የሚሆነው ነገር ምንድን ነው?

ሀ. ህጋዊ ያልሆኑ ነጋዴዎች ለ. ህጋዊ ያልሆነ የህንጻ ስራ

ሐ. የንግድ መልክቶች መ. ሁሉም ሠ. የለም

9. የግረኛ መንቀሳቀሻ መንገዱ ስፋት ለህብረተሰቡ አገልግሎት ብቁ ነው ወይስ አይደለም?

ሀ. ብቁ ነው ለ. ብቁ አይደለም

10. እግረኛ መንገዱ ላይ ብቁ የሆነ ሽንትቤት አለው ወይስ የለውም?

ሀ. አለው ለ.የለውም

11. በእግረኛ መንገዱ ጠርዝ የሚገኘው የተለያዩ አገልግሎት ሰጪ ድርጅቶች ለአገልግሎት ተጠቃሚው የሚታዩ ናቸው ወይስ አይደሉም? ሀ. ይታያሉ ለ. አይታዩም

12. የእግረኛ መንገዱ እንድትጓዙበት የሚስብ ነው ወይሰ አይደለም?

ሀ. ሳቢ ነው ለ. ሳቢ አይደለም

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Appendix II

Pedestrian Count Data

RESULT - 1

Location: From Central Jimma hotel – feidi RA- Shenen Gibe Hospital

Day(s) of the week: Thursday – Saturday

Observer(s) Name: Wondwosen K. and Kaleab G.

Date: April 21/2016 – 23/2016

Observation time: Start Time: - 2:00 a.m End time: - 11:45a.m

Weather: Sunny ☐ Cloudy ☐ Rainy ☐ Mixed ☐

Description of specific observation location

Date	Day	Time period (local time)	PEDESTRIAN COUNT RESULT			
			Central – R.A	R.A – Central	Total count	Remark
23/04/2016	Saturday	9:00-9:15	104	118	222	Cold weather
		9:15-9:30	97	75	172	
		9:30-9:45	105	115	220	
		9:45-10:00	110	165	275	
		TOTAL	**416**	**473**	**889**	
22/04/2016	Friday	7:30-7:45	238	145	383	Sunny weather
		7:45-8:00	216	98	314	
		8:00-8:15	193	85	278	
		8:15-8:30	140	110	250	
		TOTAL	**787**	**438**	**1225**	
21/04/2016	Thursday	5:45-6:00	195	175	370	Mixed weather of wind and rain
		6:00-6:15	250	181	431	
		6:15- 6:30	222	193	415	
		6:30-6:45	289	179	468	
		TOTAL	**956**	**728**	**1684**	

Observer's Name: Wondwosen K. and Kaleab G. Supervisor: Eng. Melkamu G.

Sign: _____ _____ Sign: _____

Date: 23/04/2016 Date: 23/04/2016

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RESULT - 2

Location: From CBE, Hermata branch to Ato Tsehay round about

Day of the week: Thursday – Saturday

Observer(s) Name: Wondwosen K. and Kaleab G.

Date: April 21/2016 – 23/2016

Observation time: Start Time: - 2:00 a.m End time: - 11:45a.m

Weather: Sunny ☐ Cloudy ☐ Rainy ☐ Mixed ☐

Description of specific observation location

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_____

Date	Day	Time period (local time)	PEDESTRIAN COUNT RESULT			
			Hermata –R.A	R.A – Hermata	Total count	Remark
23/04/2016	Friday	4:00-4:15	228	241	469	Normal weather, mild cold
		4:15-4:30	213	193	406	
		4:30-4:45	254	278	532	
		4:45-5:00	237	321	558	
		TOTAL	**932**	**1033**	**1965**	
22/04/2016	Thursday	8:00-8:15	193	115	308	Sunny weather
		8:15-8:30	185	83	268	
		8:30-8:45	162	155	317	
		8:45-9:00	232	151	383	
		TOTAL	**772**	**504**	**1276**	
21/04/2016	Saturday	10:45-11:00	247	190	437	Normal weather, mild rain
		11:00-11:15	186	179	365	
		11:15-11:30	305	195	500	
		11:30-11:45	235	186	421	
		TOTAL	**973**	**750**	**1723**	

Observer's Name: Wondwosen K. and Kaleab G. Supervisor: Eng. Melkamu G.

Sign: _____ _____ Sign: _____

Date: 23/04/2016 Date: 23/04/2016

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RESULT - 3

Location: From Tsehay Abebe RA- Farmid - Awetu river

Day of the week: Friday – Saturday

Observer(s) Name: Wondwosen K. and Kaleab G.

Date: April 22/2016 – 23/2016

Observation time: Start Time: - 3:50 a.m End time: - 1:00p.m

Weather: Sunny ☐ Cloudy ☐ Rainy ☐ Mixed ☐

Description of specific observation location

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_____

Date	Day	Time period (local time)	PEDESTRIAN COUNT RESULT			
			CBE, main – Ferenj Arada	Ferenj Arada – CBE, main	Total count	Remark
23/04/2016	Saturday	3:50-4:05	54	59	113	Normal weather
		4:05-4:20	59	67	126	
		4:20-4:35	58	55	113	
		4:35-4:50	67	81	148	
		TOTAL	**238**	**262**	**500**	
22/04/2016	Friday	6:30-6:45	110	180	290	Normal weather, mild sun
		6:45-7:00	110	232	342	
		7:00-7:15	131	215	346	
		7:15-7:30	118	180	298	
		TOTAL	**469**	**807**	**1276**	
21/04/2016	Saturday	12:00-12:15	93	75	168	Normal weather
		12:15-12:30	65	65	130	
		12:30-12:45	90	90	180	
		12:45-01:00	95	75	170	
		TOTAL	**343**	**305**	**648**	

Observer's Name: Wondwosen K. and Kaleab G. Supervisor: Eng. Melkamu G.

Sign: _____ _____ Sign: _____

Date: 23/04/2016 Date: 23/04/2016

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RESULT - 4

Location: From Dashen Bank (Mercato) to Legehar

Day of the week: Saturday and Sunday

Observer(s) Name: Wondwosen K. and Kaleab G.

Date: April 23/2016

Observation time: Start Time: - 2:00 a.m End time: - 10:30a.m

Weather: Sunny ☐ Cloudy ☐ Rainy ☐ Mixed ☐

Description of specific observation location

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Date	Day	Time period (local time)	PEDESTRIAN COUNT RESULT			
			Dashen Bank -Legehar	Legehar – Dashen Bank	Total count	Remark
24/04/2016	Sunday	2:00-2:15	56	43	99	Cold weather and very minor rain
		2:15-2:30	75	36	111	
		2:30-2:45	48	47	95	
		2:45-3:00	85	62	147	
		TOTAL	**264**	**188**	**452**	
23/04/2016	Saturday	4:00-4:15	173	155	328	Normal weather and mild sun
		4:15-4:30	200	170	370	
		4:30-4:45	247	170	417	
		4:45-5:00	233	207	440	
		TOTAL	**853**	**702**	**1555**	
23/04/2016	Saturday	9:30-9:45	148	170	318	Normal weather, sunny
		9:45-10:00	153	130	283	
		10:00-10:15	168	150	318	
		10:15-10:30	220	145	365	
		TOTAL	**689**	**595**	**1284**	

Observer's Name: Wondwosen K. and Kaleab G. Supervisor: Eng. Melkamu G.

Sign: _____ _____ Sign: _____

Date: 24/04/2016 Date: 24/04/2016

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Appendix III

Study Area Photo