PROVISION AND UTILIZATION OF PEDESTRIAN FOOTBRIDGES IN CITIES: A CASE STUDY OF MOMBASA ROAD CORRIDOR, NAIROBI

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A Research Project Report submitted in partial fulfillment for the award of the Degree of Master of Arts in Urban and Regional Planning

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DECLARATION

This Research Project Report is my original work and it has not been submitted for examination or for any award in this or any other University.

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This Research Project Report has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

This work is dedicated to my family. My parents, Mr. and Mrs. David Maigo who saw value and believed in educating me and spurred me to go to the greatest levels that I was determined to reach; to my husband, Mr. Godino Mwasaru for his encouragement and support during the times that I was away from home pursuing my studies and to our children; Frida, Regina, Rita and Emmanuel for being patient with me as I studied and for cheering me on. I love them much.

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ABSTRACT

Footbridges and underpasses in urban areas are provided as part of pedestrian infrastructure and they are normally raised above ground or subdued in the sub-terrain. They are optimally designed to provide unhindered travel for pedestrians across potential barriers such as high-volume-high-speed motorways, railways, water channels and valleys thereby facilitating the much-needed accessibility and linkages between land uses. Footbridges and underpasses play other varied roles such as resolving complex interconnections between transport modes and as useful urban design elements. Whereas footbridges and underpasses consume scarce resources and play the varied roles, there has been limited study on the significant link between their provision and their utilization on urban highways.

This study sets out to explore the significant link between the provision and utilization of footbridges on Urban Highways in a developing country context. The research setting of Mombasa Road Corridor, Nairobi, which was purposively selected for empirical survey examined three footbridges, while non-random sampling was employed to collect quantitative and qualitative data from pedestrians who formed the basic unit of analysis. The sample size comprised of 180 respondents, business operators and key informants from significant stakeholder institutions. Secondary data was collected by reviewing pertinent background literature on pedestrian infrastructure, footbridges and underpasses.

The research findings show that the footbridges which have been provided on the busy Mombasa Road Corridor have led to a significant reduction in accidents due to their substantial utilization. The research findings however show that there are informal at-grade crossings between Nyayo and Imara Daima footbridges along the busy highway which render the footbridges potentially ineffective. Other barriers that lead to their ineffective utilization include the presence of bollards and their conversion into premises for informal economic activities. The study concludes by making recommendations for an integrated footbridge model that is all-encompassing and inclusive by incorporating interconnectivity for all users, which is geared towards enhancing maximum utilization.

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LIST OF ACRYONMS AND ABBREVIATIONS

NMT	Non-Motorized Traffic
MT	Motorized Traffic
GPD	Gross Domestic Product
WHO	World Health Organization
NCC	Nairobi City County
JICA	Japanese International Co-operation Authority
AASHTO	American Association of State Highway and Transportation Officials
GSPC	Grade Separated Pedestrian Crossing
RTA	Road Traffic Accidents
KShs	Kenya Shillings
USD	United States Dollar
KURA	Kenya Urban Roads Authority
KENHA	Kenya National Highways Authority
DCI	Directorate of Criminal Investigation
PSV	Public Service Vehicle
GM	General Motors
HDI	Human Development Index
NIUPLAN	Nairobi Integrated Urban Plan
PPP	Public Private Partnerships

CHAPTER 1 : INTRODUCTION

1.1 Background to the Problem

Cities are engines of growth. They are characterized by high industrialization attracting large workforce to the city; housing congestion due to increased migratory population; traffic congestion and rapid motorization caused by high earning power that enables a good number of city dwellers to own vehicles or afford public transport; conflicts between humans and motor traffic; air and land pollution among others (World Bank, 2005).

These high growth rates have had serious challenges on accessibility, safety, comfort, health and generally quality of life. In response, City authorities have increased transport infrastructure network and density. Cities have focused on providing elaborate infrastructure for motorized traffic and to some extent NMT, Non-Motorized Transport. However, City Authorities disregard the walking population albeit forming a sizeable proportion by modal share in cities. Other studies have revealed that in both Transport Policy and practice, active transportation has been overlooked and/or inadequately recognized (FC Hodgson, 2004). This results in the Planning process overlooking NMT leading to underinvesting with resultant inefficiencies in overall transport system (Litman, Evaluating Active Transport Benefits and Costs , 2016).

Walking does not burn fossil fuels, does not cause congestion neither does it detrimentally affect air quality. Therefore, it is a transport mode which responds to the longer-term needs for less dependence on non-renewable energy, land-use or spatial need for efficient travel and the biological need for clean air. Self-propulsion is the most resource-efficient way of making many urban trips, particularly short trips. Many trips begin and end with non-motorized travel. This includes walking from car parking, changing between two transport modes and when connecting to mass transit mode (World Bank, 2004).

In developing Countries however, walking represents the highest mode of travel. NMT users have to contend with high volume of motorized transport some of whom are aggressive and dangerous posing danger of traffic accidents, respiratory diseases, discomfort, isolation and discrimination especially for the elderly, children and persons living with disabilities. Conflicts between pedestrians and motorists result in accidents which costs people's lives, trauma, disability and

generally costs money. They also reduce throughput on highways leading to transport inefficiencies. Congestion on the roads also contribute to higher air pollution and destruction of green spaces in order to create room for more cars. Overdependence of a city on motorized traffic is also a great contributor to high energy usage (World Bank, 2004).

Various options exist for providing safe sharing of the roads and travelways (NCC, 2015). This includes use of signals, prioritizing NMT or segregation of pedestrians and cyclists from motorists. Besides providing safe and comfortable mode of transport for NMT users, pedestrian infrastructure may be used to reduce energy consumption of cities, create live environments for socialization, improve air quality, promote safety on the streets and generally improve aesthetic appeal of streets and cityscapes (World Bank, 2011).

Studies have shown that good provision of pedestrian infrastructure is an important factor that influences pedestrian use thereby volume. All the facilities should be accessible and located at the appropriate location that is safe, continuous and with good connectivity. Some studies have shown that the route of choice should result in shortened trips, convenient access and should be well designed to encourage and enhance pedestrian utilization (Hamsa, 2014). Although time taken to cross a barrier or reach a destination is often considered by pedestrians in choice of use of facility provided, it has also been shown to vary according to pedestrian type and journey purpose (FC Hodgson, 2004).

A route or facility is chosen it if is part of a network providing good connections and access to services (FC Hodgson, 2004). This gauges whether the pedestrian has direct access to places they wish to reach and if the facility/route connects to public transport and surrounding networks (NZ Transport Agency, 2009).

Land use is another important factor that affects route choice. This is because location of services impacts on where pedestrians actually walk. In addition, evidence is frequently presented that the trends in land use patterns mean greater travel distances to access services. This impacts negatively on directness and affecting both mode choice and route choice (FC Hodgson, 2004).

Alternative studies have shown that the level of use depends on convenience, security and walking distances compared with alternative crossing locations. Pedestrians generally would not use a facility if a more direct route is available. Pedestrian barriers may also be used to channel pedestrians to a footbridge or an underpass though these are not always effective (WHO, 2013)

Implementation of facility within desire lines is another factor that affects utilization where desire line is described as natural selection of path used by pedestrians and cyclists. Colville Andersen, a Danish urban mobility expert argues that pedestrian infrastructure need to be fashioned with a humanistic and design-oriented sensibility through observing human behavior and not standards based on algorithms that fail to account for human preferences and habit (Goodyear, 2012).

Urban form is also another factor that influences choice of route and utilization of pedestrian infrastructure. Urban form refers to morphology, structure and shape of the built environment and land use. It has been shown from past studies that Urban Public space with a lot of use and human activity encourages use (FC Hodgson, 2004). Pedestrians choose to use space that are enjoyable, interesting, quiet and clean with qualities encouraging social interaction (NZ Transport Agency, 2009). Urban environment should be designed and managed to make it an attractive space to be in thereby encouraging people to socialize and use walking environments as 'living spaces' (FC Hodgson, 2004).

Shortfalls in physical walking environment are deterrents to utilization of pedestrian infrastructure. These include, presence of litter, rubbish, poor condition of pavement, poo lighting, lack of shelter from inclement weather, lack of resting areas and restrooms, traffic fumes and noise and lack of interesting features on the route (NZ Transport Agency, 2009).

1.2 Problem Statement

It has been shown from past studies that over 40% of all trips in Nairobi are done by walking (JICA, 2013). This is due to the fact that nearly 60% of households earn monthly income of KShs 20,000, equivalent of USD225 and thereby would not own a car (NCC, 2015). An independent study found out that there is high pedestrian flow in 95% of the roads in Nairobi. There was also lack of safe pedestrian crossings in most of the city and where it was provided, it was poorly

maintained (Kjellqvist, 2014). Along Juja and Jogoo Roads in Nairobi, studies showed that about 96% preferred to walk to their regular destinations (NCC, 2015). Studies have shown that nearly 60% of Kenya's GDP is derived from informality. This translates into low incomes and vulnerability to exploitation due to under-representation (KIPPRA, 2013). This state of low incomes leaves the practitioners and their families to walk to most of their destinations and back home, which includes home trip, work trips and school trips.

In response, the City Authorities and Road agencies have provided pedestrian infrastructure via walkways, footpaths and footbridges inorder to aid pedestrian mobility. The main problem with pedestrian infrastructure is lack of use. Pedestrian overpasses allow for uninterrupted flow that is separate from vehicular traffic. This measure is used primarily in areas with high pedestrian volumes. The effectiveness of these facilities depends largely upon the likelihood that they will be used by most of the pedestrians crossing the highway (WHO, 2013).

Studies have shown that where provision is backed by use, the facility brought about desired results. For example in Tokyo, where this does occur, reductions in vehicle–pedestrian crashes increased up to 91%. However, where provision is not commensurate with utilization, there were challenges. In Uganda just over one third of pedestrians used the provided footbridge, users were mostly female at 49% and children at 39%. While the number of pedestrians killed dropped from eight to two after it was constructed, the number of pedestrians seriously injured increased from 14 before construction to 17 afterwards (WHO, 2013).

According to a study by NCC, only 23% of pedestrians were using the pedestrian footbridge in a selected study area. The reasons given for lack of use ranged from indirectness, non-existence of the facility, insecurity, noise and air pollution and poorly maintained walkways (NCC, 2015).

Pedestrian footbridges reduces potential of conflicts with motor vehicle, they allow pedestrians to cross a highway unhindered by traffic, can significantly reduce travel time, reduces delay in a motor highway increasing capacity and are easily integrated with existing buildings and other transport networks (NZ Transport Agency, 2009).

However, pedestrian footbridges also have challenges as discussed below. They are costly to construct, occupy prime land and may require relocation of utilities making them an expensive alternative. They can be visually intrusive destroying City vistas, they are also subject to vandalism, garbage dumping and patronage by thieves and muggers making them unattractive to use. They also increase the risk of those who cross at grade due to increased vehicle speed and locations where they are constructed is often not on the pedestrians desire line (NZ Transport Agency, 2009).

There exists opportunities however of making footbridges attractive to pedestrians as discussed below. Footbridges are the only solution which provides 100% separation of pedestrians from motorists, this factor however is not useful applied in isolation which has resulted to underuse by pedestrians even when provided. The footbridge should be provided integrated with other features inorder to ensure the benefit of segregation is fully realized (WHO, 2013). This may be achieved by firstly incorporating human behavior and habits during planning so as to ensure they are implemented within desire lines (Goodyear, 2012). Footbridges must also be provided to ensure directness, ease of access to other transport networks, incorporate vibrant livable spaces within the footbridge network with interesting features and amenities and lastly that footbridges are universal providing access to the lowest level of pedestrian in terms of ability and age (NZ Transport Agency, 2009). These factors when integrated provide a pedestrian footbridge that is attractive to the user leading to its utilization.

As mentioned above, footbridges are useful in ensuring pedestrian safety while crossing transport corridors. It is therefore expected that where these exist, pedestrians use them instead of risking their lives on the road with the vehicular traffic. However, this is not always the case. Some of the above mentioned footbridges are used to their full capacities, others are used below capacity while others are hardly used almost abandoned. There are a few others which have been (mis)appropriated for other uses e.g., street vending, hawking, site seeing and for exercising.

1.3 Research Aims, Objectives and Questions

1.3.1 Research Aims and Objectives

The main aim of this research is to examine the provision and level of utilization of pedestrian footbridges along Urban Highways. This includes the designers and implementers actual intention on provision and the resulting response from pedestrians through utilization. The research will examine the extent of use and dis-use of these facilities in order to gain insights into the emergent uses on the footbridges. A subsidiary aim of this research is to formulate planning and policy proposals and guidelines for better utilization of footbridges across urban Highways. The specific objectives of the research are:-

1. To examine the criteria for provision and utilization of pedestrian footbridges on Urban Highways.
2. To examine the situational analysis of pedestrian footbridges on the Mombasa Road Corridor in Nairobi.
3. To examine the provision and utilization of pedestrian footbridges on the Mombasa Road Corridor in Nairobi.
4. To formulate Planning interventions and Policy Proposals for better provision and utilization of pedestrian footbridges on Urban Highways.

1.3.2 Research Questions

This study seeks answers for the following key research questions

1. What is the Criteria for provision and utilization of pedestrian footbridges on Urban Highways?
2. What Planning interventions and policy proposals can be formulated for better provision and utilization of pedestrians' footbridges on Urban Highways?

1.4 Justification and Significance of the Study

Non-motorized modes are important because they play a unique and important role in an efficient and equitable transport system, including affordable basic mobility, access to motorized modes (motor and public transit) as well as providing means of exercising and enjoyment (Litman, Whose Roads?, 2013). Walking is also included in trips made by other modes. It is the first and last mode used providing an important link between land use and motorized travel (NZ Transport Agency, 2009).

Pedestrian Footbridges are an important component of the Pedestrian infrastructure in an urban area of city. Their primary function as transport facilities is to provide access to land use. A walkable, mixed-use neighborhood can provide a high level of accessibility by reducing the distances that people must travel to access common services such as health, education, shopping and recreation (Litman, Whose Roads?, 2013). Footbridges are provided to ensure safe crossing across barriers. These barriers include high speed motorways, railways, water channels and difficult physical terrain. Lack of Pedestrian facilities that separate pedestrians and motor vehicles was cited by WHO as a contributor to pedestrian risk to accidents on highways (WHO, 2013). It is also expected that where Pedestrian Infrastructure is provided it will be utilized in order to get the maximum benefit from it.

This study is important because there is no other study that has been done by the implementers, as confirmed by the Road Engineer[1]. It will therefore inform the stakeholders of the Pedestrian footbridges on their level of utilization. The Community around these facilities will understand the factors that guided the decision behind provision on those particular sites. If this study were not carried out, then it would not be easy to understand the relationship between provision and utilization of pedestrian footbridges. Whether they are used adequately or if they are left unused after all.

This study is significant because it provides a review of the relationship between provision and utilization and also forms a basis for Policy formulation for Planners and Engineers on providing Pedestrian footbridges that are utilized as intended. It will also add to knowledge on provision and utilization of pedestrian footbridges in Cities and Urban areas.

One of the main pedestrian infrastructure is the footbridge which provides pedestrian and vehicle segregation on a transport system. This is achieved by having a grade separated crossing for pedestrians and vehicles are left to travel at grade. This is one of the most effective way in eliminating pedestrian-vehicle collision. These collisions are the main cause of accidents leading to fatalities, disability and trauma. Footbridges are thereby important in linking two or more land-uses that are separated by roads, railway tracks, above surface pipelines and water channels; that

[1] Key Informant from KURA

is streams, rivers and canals. They are constructed principally for use by pedestrians, but they can also be used by cyclists. It is however not clear if the same may be used by domestic animals for example cattle.

1.5 Assumptions and Limitations of the Study

One of the limitations of this study is to examine the provision and utilization of all pedestrian infrastructure on Urban Highways in the City of Nairobi. An assumption therefore made by this study is that the pedestrian footbridges on the Mombasa Road Corridor, which have been purposively selected, will be representative of all those on Urban Highways in the City of Nairobi.

Another limitation of this study is to administer face to face interviews with all the users of pedestrian infrastructure on Urban Highways in the City of Nairobi. An assumption made by this study is therefore that the respondents selected though scientific methods are representative of all users of Pedestrian footbridges in the City of Nairobi of Nairobi. Their proposals on how better to provide and utilize pedestrian footbridges across urban highways in the City of Nairobi will be validated and generalized and will be considered to be representative of all urban residents, more generally.

1.6 Research Methodology

Research methodology details the process and procedure which was employed in order to investigate the Research Objectives. It describes the population and the type of sampling method used inorder to achieve the objectives. It further describes data needs, data collection methods, its analysis and presentation.

1.6.1 Research Setting of the Study

The research covered a section of Mombasa Road Corridor, a National Highway classified A109, study area ranging from City Cabanas junction to Nyayo Footbridge at the roundabout of Nyayo Stadium.

The study subjects for this research were identified as 3 footbridges in Nairobi City County as follows; Imara Daima, Belle Vue and Nyayo footbridges on Mombasa Road. These were selected under purposive sampling technique which is often used to predict outcomes (Ngechu, 2006). These footbridges are all provided on an Urban Highway which is representative of other Urban Highways in the City. The research entailed clearly stating the problem and the research questions

and objectives which guided in formulating the study. This study also conducted a survey design and not experimental one. This allowed the study to interact with the real environment and obtain information that can be used to model an acceptable footbridge for urban areas and cities.

1.6.2 Research Population and Sampling Procedure

The research aims to generalize its results to all urban residents. It is however limited inform of being able to administer field survey instruments to this target population because they are scattered over the entire wide geographical area of the City of Nairobi. This research therefore aims to draw samples from the accessible population which is defined as those that have been randomly selected as active users of the Pedestrian Footbridge on Mombasa Road Corridor.

It would be very costly and time consuming to interview all pedestrians on the footbridge. Therefore, a sampling plan was used whereby the sample size used was as representative as possible of the target population.

The Study chose a Pedestrian as the major unit of analysis due to their role in utilization of pedestrian footbridges. The study also included business people who are pedestrians themselves but were found on the footbridge for different reasons besides transportation. Key informants from stakeholder institutions were also included in the study due to their roles relating to provision of transportation systems. These institutions included Kenya Urban Highways Authority, KURA, and Kenya National Highway Authority, KENHA who were the implementers of the pedestrian facilities on this stretch of Mombasa Road Corridor. Traffic Commandant, Nairobi area was also contacted because his office was responsible for enforcing rule of law on safe use roads and highways in the City. The other participants were the City Planner and Transport Engineer from Nairobi City County in whose physical location the study area fell.

Systematic non-random method sampling plan was used to identify the next Pedestrian to be interviewed. This entailed approaching the n^{th} person to arrive at the point where the research assistants was located. For the three footbridges, there were 180no. questionnaires administered, 60no. for every footbridge. This was based on recommendation by a senior researcher, Ngechu who gives guidance on the number of questionnaires depending on area of study and she agrees that 50-1000 is adequate sample size for a District (Ngechu, 2006). The study area fell within Embakasi South Ward, Langata ward and Starehe ward and thus could be considered under a district. All the business operators on Nyayo and Imara Daima Footbridges were interviewed

because they were few and only 5no. business were picked on Belle Vue Footbridge, which represented all the trades on the Footbridge.

1.6.3 Research Design

Research design can be described as a scheme or plan used to generate reaction to research. It refers to the way a study is planned and conducted, the procedures and techniques employed to answer the research problems, the tools and resources required, costs involved and the time schedule of anticipated progress (Ngau, 2004).

The research reviewed past literature on the area of provision and utilization from a global view and good practices on the same. A situational analysis was then made, based on a comparative study over the three footbridges. It examined pedestrian characteristics, human behavior and land uses across the three different footbridges and how these factors have affected footbridge provision and use. The research also identified gaps for future research and made recommendations for planning and guidelines on provision of better footbridges. The research fieldwork was carried out over three days, one weekend and two weekdays, i.e. Saturday 23rd, Tuesday 26th and Wednesday 27th June 2017. This was to allow a mixed composition of pedestrian population who use the footbridges on different days to be reached. It would have been more preferable if data was collected during the whole week but due to resource constraints, this was not possible.

1.6.4 Data needs Matrix

Objectives	Data needs	Data Sources	Data collection method	Techniques of Data Analysis	Expected Research Outcomes
Examine Criteria for Provision and utilization of footbridges	Design parameters, siting considerations, operation and maintenance obligations	Secondary Literature Review	Desktop study	Descriptive analysis	Standards prescribed for provision and utilization, world best practices, Lessons learnt
Situational analysis on provision and utilization of footbridges on Mombasa Road Corridor	Current use, challenges or impediments to footbridge use, traffic characteristics, pedestrian experiences, non-users experience, law enforcement experience	Pedestrians, Business operators, Key informants	Questionnaires, key informant interviews, observation through photography	Statistical package (SPSS), mapping	Pedestrians attitudes and preferences with regards to footbridge, Institutional roles in provision and utilization of footbridges and land use patterns
To examine provision and utilization of footbridges on Mombasa road	Land use patterns, traffic characteristics, conflicts, terrain	Pedestrians, Key informants	Questionnaires, key informant interviews, observation, photography	Descriptive analysis, cross tabulation, mapping	Criteria behind provision. Factors affecting utilization of footbridges
To formulate planning and policy proposals	Case study on best practices across the world.	Secondary literature journals, reports	Desktop study	Descriptive analysis	Guidelines for provision and utilization of footbridges

Source: Adapted from Majanja (2013)

1.6.5 Methods of Data Collection, Analysis and Presentation

In order to answer the research questions, suitable methods of data collection and analysis were employed. Administration of questionnaires, Interviews, observations coupled with secondary data analysis were identified as the most appropriate means of data collection. Under instrument administration, questionnaires were distributed to both footbridge pedestrians and business operators at the nominated footbridges. The Pedestrian questionnaire sought to know the age-sex characteristics of the pedestrians, their income and education levels, level of awareness of road safety rules, whether they felt safe on the footbridge, why they preferred the footbridge as compared to walking across the road, challenges they faced and improvements they would like on the footbridges.

The business operators' questionnaire sought to find out age-sex characteristics of the operators, their level of education, their incomes from the activities on the footbridges, if they were registered to operate on those specific areas and the challenges they encountered. The exercise was done over three days, starting from 6am to 6pm for three days with one of the days being a weekend day. The data collection was conducted by 6 research assistants who were trained prior to the dates of the exercise. Another method of data collection was to conduct interviews with the key informants, i.e. Institutional Road's Engineers/Transport Planners, Nairobi City County Planner, Nairobi City County Transport Engineer and Area Traffic Commandant. Interview schedules were developed for the key informant interviews where open ended questionnaires were used.

Photography was used to collect observation data including Pedestrian characteristics, spatial form characteristics and Physical form of footbridge. Under observation, the study sought to find the character of the footbridges i.e. slope, stairs or ramp, protection from elements, infrastructure e.g. lights and drainage, level of cleanliness, obstructions to walking e.g. hawking activities among others. The study was also keen to see if there were any pedestrian signage deterring them from roads onto the footbridge or encouraging them to use the footbridge.

Data analysis was performed in two parts, firstly, review of secondary data comprised of reviewing existing literature in form of magazines, journals, books, handbooks and other sources as deemed appropriate. This data was summarized and written out in a report in continuous form, forming descriptive analysis.

The second part comprised Primary data which was collected from the field. Once received, the data was cleaned by reviewing all the questionnaires one by one. Missing gaps were picked and cleaned. Four questionnaires for the Imara Daima Footbridge were discarded because they were administered to pedestrians on a wrong location. The sample size was thus reduced to 176no. which is still sufficient (Ngechu, 2006). Afterwards, computer program, Statistical Package for Social Scientist, SPSS, was used to analyze the data. Other computer packages include ArcGIS and MS Excel were used to plot the maps and develop graphical charts. Data was then presented in printed and bound hardcopies for distribution to the Supervisor, examiner and other lecturers of the Department of Urban and Rural Planning.

1. 7 Structure and Organization of the Study

The report is organized logically in six chapters. This chapter (Chapter 1) is the introduction which gives background to the problem. It also includes detailed evaluation of the research questions, objectives, justification and limitations of the study.

The second chapter is a thorough review of global literature as well as local literature for purposes of determining what has been done by researchers from other areas on the subject matter. From the various research findings, the study was able to identify world best practices and lessons learnt that can be applied to the local case, which is provision and utilization of pedestrian footbridges. This chapter also contains the conceptual framework which revealed that when the criteria for provision of footbridges is followed, it results in better utilization of the facility which also relate to sustainable use of resources. On the other hand, when these facilities are not properly and carefully provided, they result in under-utilized and mis-utilized.

The third chapter of the report contains a thorough situational analysis of the pedestrian infrastructure on Mombasa Road Corridor. It reveals the land use around the study area which is also shown spatially, it also profiles the pedestrians and footbridge users and their interaction with the environment. This is followed by Chapter four which is an analysis of the findings which is also an attempt to address research objective three. Chapter five discusses the implications for pedestrian footbridges on Mombasa Road Corridor. It paints a picture of applying various treatments to the current situation with expected outcomes.

The last chapter is a discussion on the synthesis of study findings, theory and practice. It gives recommendations, conclusions and identifies areas for further research.

CHAPTER 2 : PEDESTRIAN INFRASTRUCTURE ON URBAN HIGHWAYS

2.1 Introduction

The chapter reviews existing information about provision and utilization of pedestrian infrastructure on urban motorways. Specifically, the study focuses on pedestrian footbridges which are grade separated pedestrian infrastructure in transportation and urban planning. This includes a justification of walking as a mode of transport, study on the factors that influence provision of footbridges, determinants of their use and the legal and institutional framework for provision of footbridges. This study also considers the practice in other Countries and aims to synthesize lessons to be learnt for application in Nairobi.

2.2 Definition of Terms

The following area is a discussion in detail of the definition of terms used in the report and the references for the same.

A Pedestrian is defined as any person on foot or one using a powered wheelchair or mobility scooter or a wheeled means of conveyance propelled by human power, other than a cycle. Pedestrians are diverse and exhibit various characteristics reflecting the general Population. While many are fit, healthy and have satisfactory eyesight and hearing can pay attention and are not physically hindered, this is not the case for all pedestrians (NZ Transport Agency, 2009). Pedestrian and bicyclists may also be taken to include the range of pedestrian and bicycle-like types of travel, such as wheelchairs, strollers and mobility scooters (B. Bakkenta, 2013). A Pedestrian may also be defined as a person making his/her trip by walking for all or part of their journey. Besides ordinary form of walking, a Pedestrian may be running, jogging, sitting, lying down on a roadway. Alternatively, he/she may use walking aids e.g. wheel chairs, motorized scooters, walkers, canes, skateboards or roller blades. He/She may also carry items around their body (WHO, 2013)

This research study adopts a combined approach by defining a Pedestrian as a person of any age, gender, education level and economic status making a trip by walking, running, jogging or using different walking aids and may or may not be carrying items along their journey.

A footbridge or an overpass may be defined as a bridge that allows for uninterrupted flow that is separate from vehicular traffic (WHO, 2013). It may also be defined as a physical structure that enables separation of pedestrians from other road users by a difference in height (NZ Transport

Agency, 2009). Footbridges have also been defined as road furniture provided to segregate pedestrians from roadway dangers sometimes without regard for their comfort or convenience (FC Hodgson, 2004).

In most developing countries, walking modal share has been shown to be highest, this means there are people who make all their trips by walking. 'Captive Walkers' is a term used to refer to such pedestrians, who are economically oppressed, and who do not have any other alternative to mode of transport than walking (Roberts, 2008).

Accessibility refers to mobility of all pedestrians allowing them to reach desired destinations, access goods and services and make appropriate use of the built environment. Connectivity means the degree that roads are connected and allow direct travel between destinations (Roberts, 2008). Ease of accessibility is influenced by centeredness which refers to location of commercial, employment and other activities in major activity centers (NCC, 2015). Also influencing accessibility is walking and cycling conditions which are factors that must exist in order to ensure quantity and quality of walking space and pedestrian security as sufficient (TRB, 2012).

Security is key to pedestrians and is also another factor that influences whether to walk and whereabout to walk. 'Eyes on the street', is a term used to refer to a situation where there are many walkers on the street watching what is happening around thereby making streets safe to walk in (NCC, 2015). Living streets are more preferable to pedestrians, these may be defined as way to design and allocate road space to give priority to living and community interaction (NZ Transport Agency, 2009).

Besides security, pedestrian also consider their own safety against collisions with vehicles. Grade separated crossings are more preferable to at-grade crossing where at-grade refers to situation where two or more routes meet at the same vertical level while barrier means a physical barrier to prevent vehicles that leave the roadway from entering pedestrian areas (NZ Transport Agency, 2009). Grade separated crossing on the other hand represent infrastructure that puts pedestrians and vehicles at different heights (NZ Transport Agency, 2009).

2.3 Pedestrian Mode of Travel

From the operational definition, a pedestrian may access land use by way of walking, on wheel chair, using scooters, skates, prams etc. Pedestrians include persons who are fit and can walk unaided and the physically, verbally, mentally and visually impaired who need some aid(s) to assist them. Others are also too old or too young and may not be able to make quick and correct decisions hence require aid in one form or another (NZ Transport Agency, 2009).

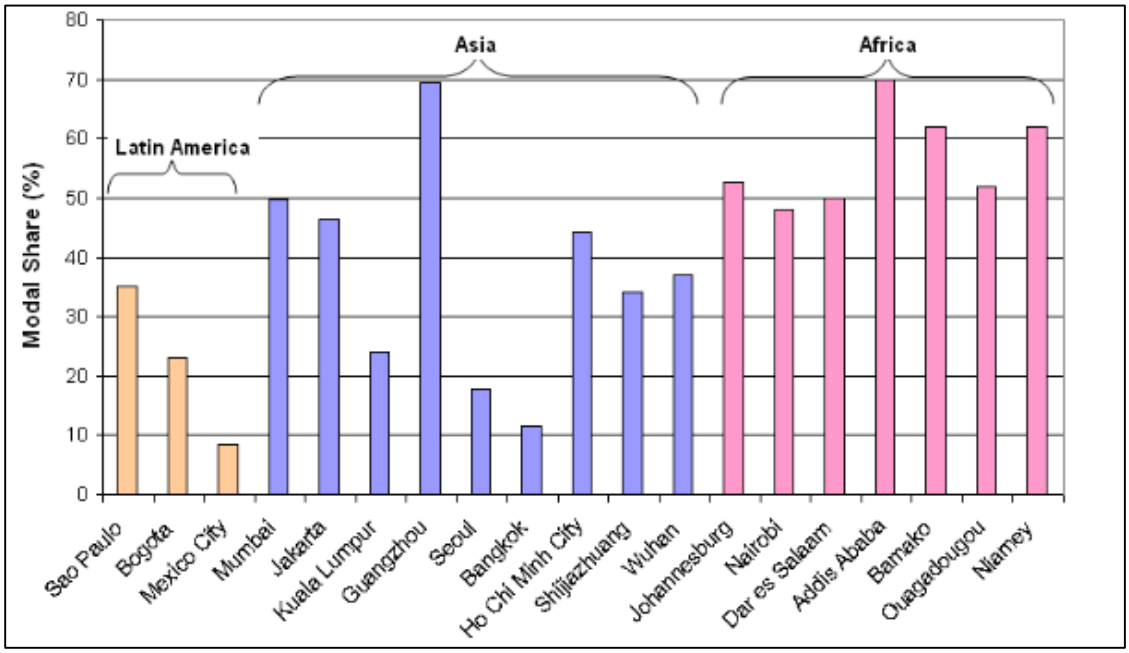
Walking is nature's mode of transport. In the developed countries, cycling and walking were in the Post World War II viewed as mainly recreational activities. It was however discovered that walking for short trips and cycling for medium to short trips represented an efficient, non-polluting, inexpensive mode of travel (Lahood, 2010). In addition, even in communities developed in the motor age, a large proportion of trips by car and almost every trip by bus, rail, air or boat began or ended with non-motorised travel. Therefore, from a transportation and community perspective, objectives of pedestrian and bicycle facility improvement have evolved to include numerous aspects of providing viable and safe active transportation options for all ages, abilities and socioeconomic groups.

For many people in the developing world, walking and cycling is sometimes the only mode of transport available. Africa however is rapidly urbanizing, from low to middle income status which is stimulating a demand for low cost, sustainable urban transport. A well-designed and maintained NMT network can satisfy this demand. This network would include walkways, footpaths and footbridges.

In urban areas of developing countries, where high rates of urban growth, large poor populations, and high densities prevail, walking is the only option available to a significant portion of the population. Many people are "captive walkers," meaning that they cannot afford an alternative; therefore, the state of the pedestrian environment is critical to allowing walkers to reach their daily needs (Roberts, 2008).

Increasing urban density, rapid growth rates, and large poor population stimulates a huge demand for high quality pedestrian environments. Sub-Saharan African cities hold the largest numbers of walkers, where many of the cities have greater than 50% of all trips made on foot (Pendakur, 2005). Figure 2.1 shows graphically the percentage values of walking as a mode in different cities in developing countries.

Figure 2.1: Walking Modal share in selected Countries in Developing World

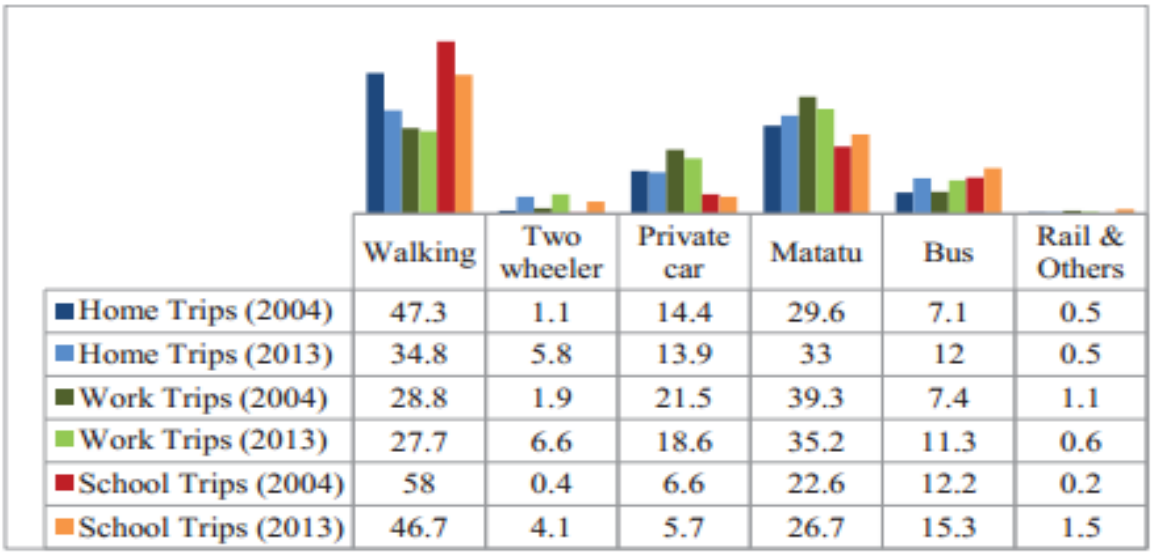


Source: Pendakur (2005)

Three cities in Latin America, i.e. Sao Paulo, Bogota and Mexico City had the lowest walking percentages, followed by cities in Asia and finally, cities in Africa which had the highest percentage of walking populations.

A study carried out in Central Area of Nairobi, observed that pedestrian mode of travel has not been fully incorporated into transportation planning process used by Planners and City Authorities (Onyiro, 1997). A review of modal split in Nairobi for years 2004 and 2013 showed that walking remained the most popular mode of transport from 2004 to 2013 as shown in figure 2.2.

Figure 2.2: Modal Split in Nairobi in 2004 & 2013



	Walking	Two wheeler	Private car	Matatu	Bus	Rail & Others
Home Trips (2004)	47.3	1.1	14.4	29.6	7.1	0.5
Home Trips (2013)	34.8	5.8	13.9	33	12	0.5
Work Trips (2004)	28.8	1.9	21.5	39.3	7.4	1.1
Work Trips (2013)	27.7	6.6	18.6	35.2	11.3	0.6
School Trips (2004)	58	0.4	6.6	22.6	12.2	0.2
School Trips (2013)	46.7	4.1	5.7	26.7	15.3	1.5

Source: JICA (2013)

Walking mode had a large share of about 28% work trips being done by walking which was largely unchanged from 2004. School trips however decreased from 58% in 2004 to about 47% in 2013. There is significant increase in trips made by two-wheelers, which include the bicycle and motorcycle. These are modes that are used mainly for short distances. Bus trips also increased for all trips. (JICA, 2013)

The graph shows clearly that most of Nairobi residents make their trips by walking. This is a considerable population which needs to be considered and appropriate pedestrian transport policies put in place inorder to facilitate their movement.

A study conducted in 1987 found out that the choice of mode of transport was affected by among other things, cost of trip, income, safety, comfort and availability. It also revealed that personal attributes e.g. sex, education level and age did not significantly affect commuters' decisions on choice of transport mode. Walking however was found to be more applicable for short distances. This mode however was not applicable when considering travelling while carrying luggage (Onyiro, 1997).

2.4 Role of NMT Infrastructure on Urban Highways

This section discusses the requisites for successful Pedestrian Infrastructure on urban motorways. It will review the needs of the pedestrians which can also be treated as factors that contribute to utilization of Pedestrian Infrastructure. The primary function of transport is to provide access to desired land uses. Land use refers specifically to the geographic arrangement of housing, activities, and destinations in general (TRB, 2012). If the geographic arrangement is compact and cohesive, then accessibility, especially accessibility via walking and bicycling will tend to be enhanced. If the arrangement is dispersed, as in urban sprawl, more motorized mobility will be required to maintain a basic level of accessibility (TRB, 2012).

Personal mobility can be defined as the ability to move about without incurring excessive travel time and cost. NMT mobility is provided by walking and bicycling, while motorized mobility is obtained through use of private vehicles, ridesharing, taxis, and public transportation. Walking contributes to sustainability through its characteristic impact on land use. Pedestrians use limited space. Efficient and effective foot travel depends on dense urban areas, rather than vast sprawling urban agglomerations. This trend is further reinforced since the walking mode enables public transit, contributing to more beneficial uses of urban space and further lowering demands on non-renewable energy sources. (TRB, 2012).

Integrated transport planning aims to embrace a range of perspectives that were traditionally addressed separately. This includes a variety of transport forms (private and public, motorized and non-motorized), the relationships between transport and land use and transport's contribution to other economic, social, health and environmental objectives (NZ Transport Agency, 2009).

2.5 Roles of Pedestrian Footbridges on Urban Highways

This section specifically narrows discussion to footbridges as Pedestrian Infrastructure reviewing their role, provision and best practices.

2.5.1 Rationale for Footbridges

Provision of footbridges is guided by requirements from NMT users, motorists and guidelines by City authorities and other governing agencies. City authorities and Road Agencies have developed guidelines and Standards that govern provision of footbridges, their siting and even design criteria.

This is further advanced by requirements by non-governmental groups, interest groups, residents associations among others.

Constructing pedestrian/bicycle grade separations, overpasses or footbridges entails major capital investment. However, if not carefully placed and designed, there may be drawbacks in addition to high investment cost. Walkers and cyclists have a basic resistance to changes in elevation and often avoid using special grade-separated facilities to cross roadways. In addition, such facilities may isolate or obscure pedestrian activity and thereby generate personal safety concerns (TRB, 2012).

Pedestrian footbridges or overcrossings serve a variety of functions, which are discussed in the next sub-section.

Footbridges are part of the walking environment. They provide a crossing over a problem. This might be a busy highway, a railway or a waterway. This form of crossing ensures safety for pedestrians against speeding vehicles, trains and water courses as well as providing convenience for the pedestrians. Footbridges are also useful as a response to natural terrain. Valleys, flood basins and other features which render access from one area to another impossible are overcome by constructing footbridges. In developed countries, where road network is already developed, there are complex interconnections between various modes of travel mainly built for motorized traffic. Footbridges are built in these areas to help NMT cross or traverse these intersections.

Footbridges are also useful in providing access from one land use to another. This is especially important for vulnerable users of the motorways such as children, the elderly, the disabled, cyclists, mothers with strollers among others. The Kenya Constitution also accords every Kenyan Citizen equal to movement right and protects them from discrimination (GOK, 2010). Inaccessibility of some areas by the disabled for example due to lack of requisite infrastructure goes against the spirit of the Constitution, the authorities must begin to take cognizance of this need and act accordingly. By linking one land use to another, footbridges therefore provide equality by according pedestrians and especially the persons living with disabilities an equal opportunity to access various land-uses unaided or with minimum help thereby granting them an equal right to transport.

Cities around the world are working towards livable green cities which are easy to walk through, with great vistas and plenty of fresh air. An increase in road network and thus increase in motor-

vehicle traffic is certainly not the way to go. Plenty of pedestrian infrastructure however, which includes sidewalks, footpaths, cycle tracks and footbridges are among the key ingredients to these new lifestyles. Footbridges may be constructed as part of the pedestrian network which promote green spaces, walking and jogging and for natural aesthetics when combined with other urban forms.

Finally, a walking environment, footbridges included, promote 'eyes on the street' which ensures safety. In a place where there are many people walking, it is difficult to muggers, pick pockets to cause any harm. The result of this safety feeling is that more people are attracted to the route all the more enhancing the security.

2.5.2 Safe Crossing over Conflicting Transport Modes

Safety is key in any transport mode. Footbridges or overcrossings can address real or perceived safety issues by providing users with a formal means or crossing a major barrier or a "problem area" hindering direct travel between origin and destination. Such barrier include waterways, valleys or transportation corridors e.g. railway track or highways. Pedestrian and bicycle grade separations are used where roadway volumes, conditions, NMT volumes, user group characteristics, or facility type cannot reasonably accommodate at-grade pedestrian crossings (Renfro, 2007).

Pedestrian footbridges are cited as among the safest pedestrian crossings against Road Traffic Accidents, RTA, promote safety and comfort (WHO, 2013). The proportion of RTAs is higher in developing countries than developed countries where taking into account that the developing countries have an estimated 52% of the World's registered vehicles. WHO further estimates that developing countries have a road fatality rate of 20 per 100,000 whilst high income countries have 8.7 in every 100,000 (Manyara, 2014).

A high incidence of pedestrian fatalities reveals significant flaws in the pedestrian environment, particularly in relation to managing the interaction and conflicts with motorized transport modes, traffic management and pedestrian infrastructure.

In New Zealand, it was observed that 40 people crossed the State highway, SH16 in a single day (Lautor, 2017). The SH16 is a high speed high volume four lane highway that separates a busy

shopping area from residential communities. It was also observed that pedestrians either crossed the highway at grade or used a nearby storm water culvert. The motorway acted as a barrier to pedestrian mobility. In 2004, a young boy was killed as a result of vehicle collision leading the City Council to develop the Westgate Pedestrian footbridge (NZ Transport Agency, 2009). Westgate footbridge was conceived to provide access to the Westgate Shopping Centre from Massey and West Harbor Communities. Figure 2.3 shows site layout of the footbridge which was constructed over conserved area of wetlands and a reserve, Lendich Reserve.

Figure 2.3: Site Layout of Westgate Footbridge

Source: Lautor (2017)

The footbridge was completed in 2013 at a cost of USD 6million. It featured the following design attributes, 3m wide deck over a gentle slope suitable for pedestrians and cyclists, steel trusses for the sides to allow unobstructed views of the reserve and better sightlines for safety of users. Over the motorway, anti-throw screens were installed to prevent items from being thrown at motorists. Trees were planted in the Lendich Reserve beneath the footbridge in order to provide a 'tree top' walk in the future when the trees were established as shown in figure 2.4 below.

Figure 2.4: Footbridge over Lendich Reserve

Source: Lautor (2017)

The deck was illuminated at night making it useable even during night fall. Due to the span of the footbridge, the slopes were kept very gentle which was desirable for pedestrians. The footbridge however did not have a cover to provide shade and protection from inclement weather. Figure 2.5 shows an aerial view of the footbridge in relation to its neighborhood.

Figure 2.5: Aerial View of Westgate Footbridge in Perspective

Source: Lautor (2017)

The footbridge was provided in a meandering path to dispense monotony of a straight path. It also provided great views of the landscape beneath it. The figure also shows some households in the vicinity of the footbridge which indicates that the residents were provided with an innovative yet safe crossing from residential areas to the shopping area beyond the highway. It is also noted that the footbridge does not have a cover hence it is not protected from inclement weather.

2.5.3 Response to Natural Terrain

Footbridges are required to overcome difficult terrain and provide people with access from one land use to another. Bridges crossing motorways and rivers may serve as the only crossing point in the immediate area, effectively forcing pedestrians and bicyclists to use the bridge regardless of its location on a convenient or inconvenient route (Renfro, 2007). One of the criteria for footbridges is where terrain lends itself to provide a footbridge.

Bridging the Gap, an American not for profit organization, has been involved in building bridges in Kenya since 1996 to provide safe and dignified crossings for marginalized communities. Their first footbridge was built in West Pokot over Moruny River. The organization observed that during rainy seasons, valleys and ravines become impassable preventing access to education, economic development, healthcare and inter-family socialization. In over 10years, over 6,000 deaths had been caused by raging waters in these valleys (Bridging the Gap, 2015).

Figure 2.6 shows two of the bridges constructed by the organisation in Kenya. It also shows the beneficiaries, mainly the old and children crossing the river using the footbridge.

Figure 2.6: Various Footbridges to Overcome Natural Terrain

Source: Bridging the Gap (2015)

When the bridge over Moruny River was first built, a safe crossing was provided and residents were able to cross from one end to another. One farmer reported that he was able to access the market where he sold his surplus crop enhancing his economic wellbeing and that of his family. Children were also able to access schools securing their education and thereby their future. It was further reported by the organization that the school enrollment increased by 250%. Community members were also able to access the health Centre and thereby cured of malaria which would have otherwise killed them (Bridging the Gap, 2015).

In 2012, a not for profit organization based in Ireland, WHEAT, completed a foot bridge known as 'Bridge of Hope' over the expansive Galana River in Kenya. The river was notorious for hippopotami and crocodile attacks on men, women and children as they tried to wade across the river to access schools, health services or travel to Malindi, a town in Kenyan Coast. The footbridge was able to link the community of Hawewanje and Shakahola making it possible to connect inhabitants of the two villages with one another and with transport to Malindi and other parts of the region (WHEAT, 2012).

2.5.4 Accessibility and Linkage between Land Uses

Accessibility as an analytical concept was originally developed within the transportation and land use planning community as a tool for forecasting land development, and valuing land, on the basis of existing and projected transportation facilities paired with defined land use patterns. (TRB, 2012).

It was later found useful as a mode choice forecasting parameter, where good accessibility to jobs, goods, and services via a particular travel mode indicated likely higher use of that mode than one with poorer accessibility. NMT accessibility measures are exceptionally useful for describing built environments amenable to the meeting of many daily needs by walking and cycling activity. They serve both as tools for pedestrian/bicycle-friendly development planning guidance and as walking and cycling activity estimation variables (TRB, 2012).

Land use planning is related to the irreversible land use changes and the pace at which land is being consumed by urban development and urban sprawl. Land use planning and development control in Kenya is weak and does not encourage compact land use that is supportive to better transport provisions, especially for NMT users. The current land use in Nairobi encourages increasing trip distances making the use of NMT and public transport less attractive (NCC, 2015).

The walking environment has the potential to dramatically change the urban fabric. It is important for contributing to the inclusiveness of a transport system and does much to determine whether children can access schools, if women have pre-natal care, and if the elderly and disabled can function independently in the society. The possibility to reach health services on foot can improve the willingness to seek medical attention, thereby increasing the frequency of this care. In addition, a well-connected walking network links "captive walkers" to a greater variety of market choices and food-source options, which could impact their capacity to consume a more nutritious diet (Roberts, 2008).

In South Africa more than 40% of trips to health care facilities are made on foot In many metropolises, development has occurred in such an uncoordinated manner that transport networks for essential services e.g. medical services has not accompanied the construction of housing settlements (Roberts, 2008).

Walking being the least expensive form of transport, monetary wise, is often the only form of transport available to the poor. Public and private transport services are often out of reach for the poor, due to un-affordability and non-availability. A study conducted in Mumbai revealed that even though the poorest income group had a walking modal share of 17% above average, they made fewer trips overall than do the non-poor (Pendakur, 2005).

Furthermore, due to disintegration of the walking environment, the urban poor above lacking monetary resources spend a lot of time walking which makes them "time poor." According to a study done in Morogoro Tanzania, 49% of walkers spend between 30 and 75 minutes on average per walking trip. Thus, the only resources the poor have; time and physical energy are depleted on transportation (Roberts, 2008).

Safe, secure, and serviceable walking environments are in high demand and can contribute to poverty reduction, saved lives, healthy citizens and increase in literacy levels. Furthermore, they can greatly address inequalities in transportation access thereby improving the quality of life for all potential users (Renfro, 2007).

Adequate pedestrian facilities can grant not only the opportunity to survive physically, but also the opportunity to access basic services such as education. Empowerment is closely linked to the idea of opportunity, enabling people to reach beyond their current capacities. Well-designed walking environments can give freedom of mobility to the disabled, thus giving them social and political access. Improved access and mobility are critical for reducing isolation, vulnerability, and dependency of elderly and/or people with disability (Soltani, 2014).

2.5.5 Resolving Complex Interconnections between Transport Modes

The presence of the car in cities is often times referred to as a result of the 'Faustian bargain'. The Faustian bargain may be explained as a situation in which the soul of the city is given up to private mobility (Parolotto, 2015). Urban quality is lost in favor of a search for solutions driven by road capacity, where road capacity is the attempt to achieve the maximum number of cars through a road or junction in a given time. In China, this loss of urban quality is evident in the powerful infrastructure of three and four level junctions of existing urban motorways (Parolotto, 2015).

In Guomao, China, pedestrian movement is relegated below large concrete decks that hide surrounding buildings from pedestrians' view and force people to percolate through incredibly noisy viaduct spaces (Parolotto, 2015). In Moscow, a sequence of split level junctions and run down overhead walkways characterize the stretch of the Leningradskoye Shosse road. It was further noted that no road was provided with pedestrian crossing points at grade and pedestrians are expected to use uninviting underpasses to reach the other side of the street (Parolotto, 2015).

2.5.6 Pedestrian Footbridges as Urban Design elements to promote Livability, Personal Wellness and Comfort

Livability index can be defined as a measure of high standard of living in cities, characterized by walkable, vibrant, sociable, charming and acceptable human scaled pedestrian experiences (Mugo, 2011). There is a paradigm shift in the way people want to live their lives today. Transit oriented development, downtown living that promotes walkability and live-work environment are becoming more important than dependence on automobile (Mugo, 2011).

Good urban forms have a safe, well-connected, dense and continous pedestrian network. Creation of quality spaces in urban areas involves collaboration of many disciplines resulting in a mixed use area with integrated transport modes. One way of tackling this challenge is by building green networks. Green spaces are an essential feature of energy efficient and livable cities (World Bank,

2014). A greenway is a linear open space established along either a natural corridor e.g. riverfront or a landscape course for pedestrian or bicycle passage (Mugo, 2011).

Greenways uplift quality of life which includes breathable air, spaces for movement, desirable habitat for living organisms, recreation and working social-physical health, mental health, access to education, housing and equity.

Cities hold the key to energy efficiency and livable future. To unlock this potential requires rethinking urban spatial development not on the premese of automobiles but on the principle of human scale solutions by walking, cycling and public transportation (World Bank, 2014).

In Paris, the Villetaneuse footbridge, shown in figure 2.7, built over railways unfurls like a leaf creating an aesthetically appealing sight whilst providing pedestrian and cyclist mobility.

Figure 2.7: Villetaneuse Footbridge

Source: AAS Architecture (2013)

The footbridge deck and sides are made from timber panels and are covered on one end from inclement weather. The slope is also very gentle making it suitable for use by all genre of pedestrians. The innovative design gives the footbridge a modern and welcoming look (AAS Architecture, 2013). Figure 2.8 shows the interior of the footbridge.

Figure 2.8: Interior of Villeteneuse Footbridge

Source: AAS Architecture (2013)

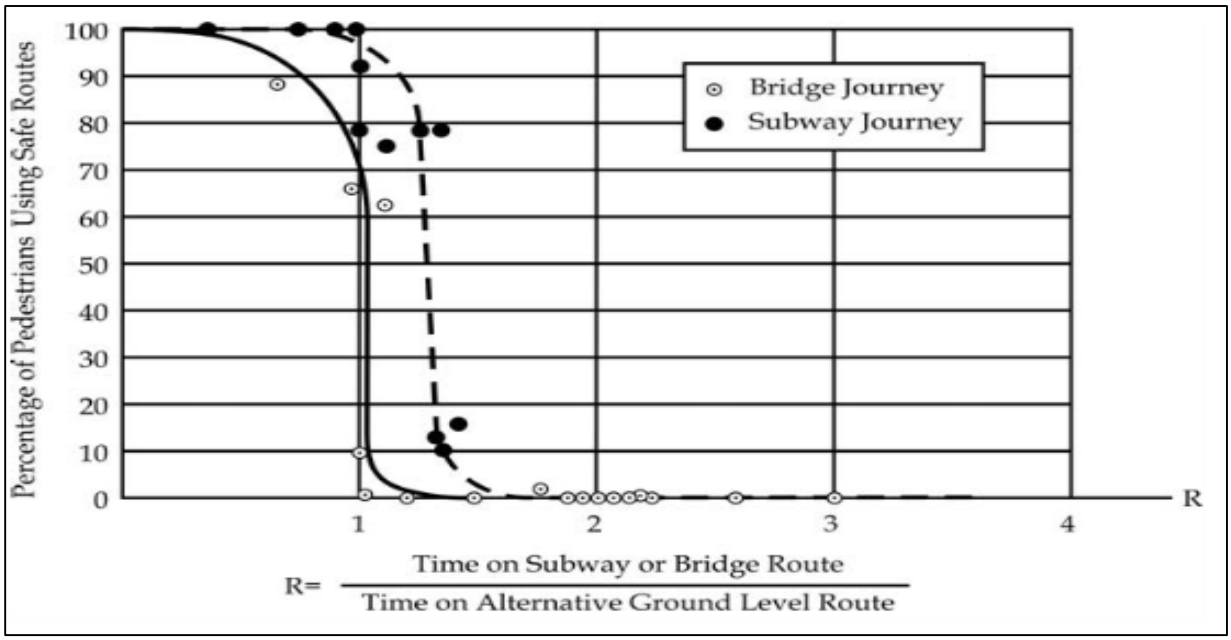
The interior of the footbridge reveals an modern look which is comfotable, clean and protected from inclement weather. These design features are aesthetically applealing which draw pedestrians to use the footbridge. It also shows that considerable investment and thought can also be accorded to the pedestrian footbridges which gives pedestrians a sense of pride that their comfort and convenience is taking into consideratin while providing safe crossing.

2.6 Considerations in the Provision of Pedestrian Footbridges

This section reviews the considerations that must be taken into account inorder to provide pedestrian footbridges that are useful to pedestrians and cyclists. Footbridges must be connected to other transport systems. Lack of NMT system interconnectivity forces detours on pedestrians and bicyclists and puts barriers in their way. The inherently slower speeds of walking and cycling, relative to driving, give heightened sensitivity to route circuitry in travel between places. There is evidence that pedestrians and bicyclists appreciate and respond to direct connections and that barriers to direct pedestrian and bicycle travel deter use of active transportation. Unfortunately, cities and suburbs are full of unconnected links and physical barriers such as sidewalks that end abruptly, cul-de-sacs, dead end streets and streams, rivers, busy highways, and expressways without suitable crossings (David Evans and Associates, 1992).

Time is also an important factor used by pedestrians to evaluate whether to use a footbridge or not. Figure 2.9 represents the relationship between pedestrians willingness to use an overpass against time taken.

Figure 2.9: Street Crossing Route Choice in Response to Pedestrian Grade Separation



Source: Renfro (2007)

From the graph, it shows that if it takes a shorter time to cross using a footbridge as to cross at grade, then 90% of pedestrians would use the footbridge. If the time taken was the same, then close to 65% of pedestrians would use the footbridge. If the time increased even by a slight margin, then willingness dropped to nearly 0% (Renfro, 2007).The ability of overcrossings to directly connect users with their desired destinations is related to a bridge's location relative to nearby pedestrian and bicycle trip generators, as well as its location within desired travel routes. Generally, pedestrian/bicycle overcrossings work best when they overcome major barriers hindering direct travel between origins e.g., residential neighborhoods and destinations e.g., schools, commercial areas, and transit stops (Renfro, 2007).

Pedestrians and cyclists normally consider the degree of real or perceived out-of direction travel when weighing their options. The vertical difference between an overcrossing and the natural ground line often influences this directness of travel. Freeways, railroads and major streets depressed below the natural ground line enable pedestrian/bicycle overcrossings to be sited flush

with surrounding streets or paths, thereby reducing or eliminating the need for lengthy access ramps. Overcrossings with "easy" and "convenient" access provisions have greater potential for attracting users. NMT users therefore require directness, safety, coherence and comfort (NCC, 2015). NMT users prefer shortest distances sometimes at the expense of safety. This explains why pedestrians dash across the road even though an overpass is provided.

NMT users also prefer to have coherence or continuity between origin and destination with no gaps or missing links in between. Missing links can be unpaved and muddy sections, lack of a bridge, dug up lanes due construction works, lack of facilities along the route (repair shops, convenience facilities) among others (TRB, 2012).

Comfort for NMT means movement with minimal hindrance by other users, i.e. less congestion; smooth and stable and clean road surface, proper waiting areas at bus stops and crossings; and convenience facilities along the route (NZ Transport Agency, 2009). This is also referred to as level of service where the highest level of service indicates liberal movement without any encumbrance while the lowest level of service means detrimental service, almost impossible to walk through (Majanja, 2013).

The Oregon Bicycle and Pedestrian Plan proposes various guidelines for a hypothetical pedestrian/bicycle bridge traversing a major roadway that is not depressed below the natural ground line. One consideration is that the bridge must achieve a minimum 5.5 m headroom from the roadway below. 1m is allowed for the bridge structure making the minimum clearance to be above 6m. The approach ramp is allowed at 5% maximum grade. These parameters result in access ramps approximately 135m long at each bridge end (Renfro, 2007).
In determining width, the following factors are to be considered, anticipated pedestrian volume, sufficient maneuvering space to avoid hitting fixed objects e.g. pillars, potential conflicts between differing users who are travelling at different speeds and in opposite directions, real or perceived safety issues e.g. tunnel effect created by enclosed spaces and lastly anticipated use by maintenance and emergency vehicles (Renfro, 2007).

Pedestrians and bicyclists both exhibit a resistance to change in grade. Climbing hills is more strenuous than traversing flat terrain and requires the individual to be more physically fit.

Moreover, the exertion associated with difficult terrain may cause sweating to be more of a concern and reduce the number of willing participants where condition upon arrival is a concern. A study of bicycle commuters in England revealed a strong negative correlation between the hilliness of an area and the level of bicycle commuting. The resistance of pedestrians to climbing is among the factors that help explain reluctance to use many of the overpasses that have been provided for crossing roadways (TRB, 2012).

In Iranian Metropolitan, a study found out that less pedestrians were likely to use overpasses despite increased funding to establish and maintain them. After studying 20 overpasses with 300pedestrians, the results showed that lack of lift or ramp was a crucial factor in using the bridge. Moreover, low perception of personal safety influenced use negatively. Other factors include physical obstacle under the bridge, history of residence, accident record and the appearance of the bridge which also affect usage negatively (Soltani, 2014).

On the other hand, bridges crossing surface streets typically compete with several alternative crossings. Surface streets may or may not include treatments discouraging at grade crossings. Observed treatments discouraging at-grade crossings include concrete center dividers, signage, or no measures altogether. In many cases, the street itself, in the form of high vehicle speeds or heavy traffic volumes, discourages at-grade crossings (Renfro, 2007).

A study done in Virginia USA revealed that many factors contributed to utilization of footbridges. One land use was among main influencing factor for example nearness to schools and/or traffic generators. Traffic generators can also be expressed as nodes in Planning and thus this are good indicator on the need for pedestrian infrastructure. Table 2.1 discusses factors that influence use of footbridges.

Table 2.1: Factors influencing Utilization of Pedestrian Footbridges

Criteria	Factors
Convenience	• Activity center (Pedestrian traffic Generators) near footbridge. • Vertical height of footbridge • Additional distance to travel using footbridge compared to crossing at grade • Accessibility for all vulnerable pedestrians
Alternative safe crossing instead of footbridge	• Traffic signals with • Pedestrian cross walk • School crossing guard
Vehicle Traffic Operation	• Low speed low volume traffic • Acceptable gaps in traffic (1 per min) • Volume of potential pedestrians using footbridge • Directional flow (one way, two way)
Pedestrian Safety	• Perception of risk • Preventable accidents • Conflicts between vehicles and pedestrians
Roadway Geometrics	• Distance to cross roadway or to median • Number of moving traffic lanes to cross to other side of roadway. Freeway usually has no safe alternative
Adjoining land use	• Residential to residential • Residential to shopping or bus terminal
Design features affecting usage	• Treatment preventing at-grade crossing • Lighting for the overpass • Litter control, routine cleaning • Signage to entrance of footbridge • Consideration for vulnerable pedestrians • Aesthetic design

Source: Adopted from Majanja (2013)

From the above illustration, it shows a footbridge is deemed convenient if it is situated along an activity center e.g. schools, shopping areas, residential areas etc. The vertical height should also be reasonable. Pedestrians also evaluate if there exists a safe crossing instead of the footbridge. This includes traffic signals, pedestrian crosswalk and school crossing guards. This is closely

connected to safety where pedestrians consider roadway geometrics in regard to ease of crossing at grade. Therefore they consider distance to cross the road, distance to reach the median, number of moving lanes to be crossed to reach safety among others. Design features of footbridge also affect usage in the following way; aesthetically appealing designs, lighting, litter control, signage at the entrance of the footbridge and consideration for vulnerable pedestrians appeal to users. Land use is another important factor which affects utilization of footbridges. Residential to residential land use or residential to shopping or bus terminal lend themselves to use of the footbridge.

Vehicle operation on the urban motorway also affect usage of footbridge. Low speed low volume traffic allow pedestrians to cross at grade while high speed high volume traffic as well as wide roadway with multiple lanes discourage crossing at grade.

2.7 Case Studies

Pedestrian/bicycles footbridges serve many different types of users and represent one of the most important elements of a community's non-motorised transportation network. They provide critical links by joining areas separated by a variety of barriers (Renfro, 2007). Although pedestrians and cyclists may continue to use existing footbridges with various handicaps, it is important to take into account pedestrians needs during design which promotes utility.

2.7.1 City of Palo Alto

City of Palo Alto in 2014 took the opportunity to showcase its commitment to innovation, aesthetics and forward thinking through use of design competition to solicit visionary ideas for the footbridges. The criteria that guided the design was as follows. By using innovation to inspire and engage community with contemporary and versatile designs to achieve balance between Engineering, efficiency,inclusiveness and comfort (City of Palo Alto, 2014).

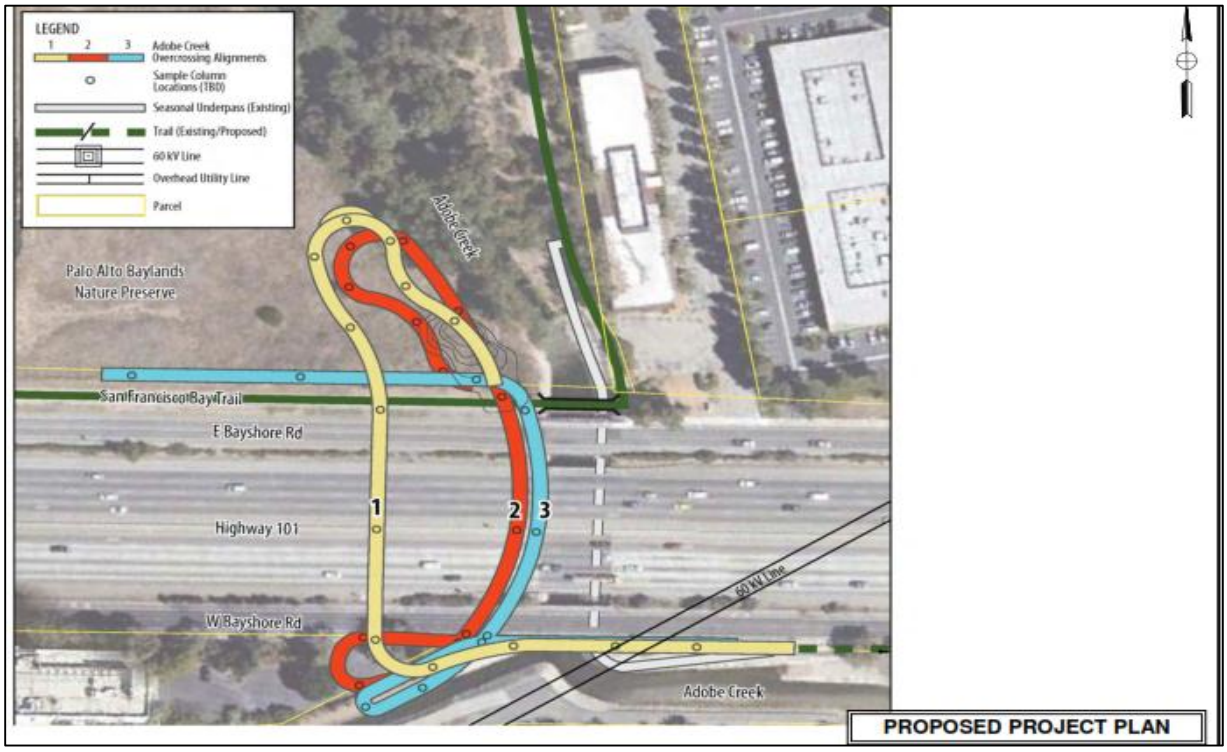
Secondly, the city wanted to improve connectedness. This involved respecting delicate ecosystem of Palo Alto and integrating it with nature. Finally, to incorporate state of the art design and guidelines to manage its fragile ecosystems.

From public participation, the stakeholders stated their design goals as follows; they wanted to provide safe and functional overcrossing for all cadres of NMT users, i.e. cyclists, casual and inexperienced riders, strollers, pedestrians etc. They also wanted to provide a seamless and enjoyable experience for users across the main highway; also to minimize distruption on

throughput on the highway. To provide an aesthetic/visual resource in confomity or harmony with nature. To conserve the fragile ecosystem and its history and finally to design cost effective project that efficiently solves technical challenges of maintenance costs (City of Palo Alto, 2014).

An evaluation of various participating teams was done and the most ideal design that represented the will of the community was chosen. Figure 2.10 shows diagrammatically the three different proposed crossings and also indicates the current underpass – which was undesireable and unuseable due to flooding and insecurity (City of Palo Alto, 2014).

Figure 2.10: Proposed Project Plan



Source: City of Palo Alto (2014)

A two dimensional artist's impression was part of the requirement for the participating teams. The winning proposal was picked as being innovative yet meeting the need of the community because it provided a living space where pedestrians could stop and take in the aesthetics of the creek below. It also allowed a resting place for tired pedestrians giving pedestrians a sense of pride (City of Palo Alto, 2014).

The winning team was also required to present 2 dimensional models of the proposal. Figure 2.11 shows proposed models of the footbridge.

Figure 2.11: Living Space on the Proposed Footbridge

Source: City of Palo Alto (2014)

Figure 2.11 further shows the footbridge physical structure against the background. It represented a lively space where pedestrians could walk safely from the vehicles. A meeting area or platform was incorporated to allow pedestrians and cyclists to stop and take in the magnificent views of the creek below. The area could also be converted into an art gallery where artists could draw or exhibit their work to the pedestrians. These extra features of the footbridge are important as they act as pull factors for pedestrians, drawing them away from the dangerous highways. Figure 2.13: Artist's impression of the footbridge Figure 2.12 further shows a side elevation of the proposed footbridge.

Figure 2.12: Safe and Functional Crossing for Pedestrians

Source: City of Palo Alto (2014)

Figure 2.12 shows pedestrians using the footbridge. It also shows the incline consists of four flights of stairs with corresponding landings which give pedestrian enough rest areas. The presence of the bicycle on the footbridge shows that cycle tracks or bicycle gutters are provided. It is however evident that wheelchairs, scooters, prams, skate board users may not be able to use this footbridge.

2.7.2 Tabiat Footbridge, Tehran

Tabiat footbridge is a landmark in the city of Tehran. It was built in 2014 at a cost of USD18million. The footbridge is a masterpiece and a sight to behold. It consists of a 270-metre long steel pedestrian bridge, spanning over a major dual carriageway, Modarres Highway, in a valley and connecting two public parks, Taleghani and Abo Atash. The objectives of the bridge was to provide accessibility between the two public parks, to change urban form by creating a landmark and to create enjoyable pedestrian experience and not the vehicular. This was accomplished by inviting users to walk through, and retain them for sitting and viewing experiences.

Figure 2.13 shows an aerial view of the footbridge which provides access to the two parks as mentioned above.

Figure 2.13: Site Plan of Tabiat Pedestrian Bridge

Source: Radoine (2017)

The footbridge's primary function is to provide a safe crossing against a barrier in this case the Modarres multi-lane high speed high volume motorway. The area was found to be heavy with transport networks with two intersections before and after Tabiat footbridge. Besides providing a safe crossing, Tabiat footbridge was designed for pedestrian as a "place to stay" rather than a place "to pass" (Radoine, 2017). This was to be achieved by providing pedestrians with an environment that invited them to spend more time at the footbridge as opposed to simply traversing to their destinations. The choice of this location enabled spectacular vistas of Alborz Mountains and the

City of Tehran. The area was a strategic location in metropolitan Tehran with potential to become a center for open public space for social integration.

Figure 2.1 shows the footbridge in perspective to its surroundings. From the picture one can see pedestrians atop the bridge's top deck taking in the vistas of the land and a lower deck can be seen too. Importantly, the lower deck is protected from the elements which means that the bridge is still useable regardless of the weather. The bridge slopes very gently which is one of the features desired by pedestrians and provides inclusion for different pedestrian types.

Figure 2.14: Tabiat Pedestrian Footbridge

Source: Radoine (2017)

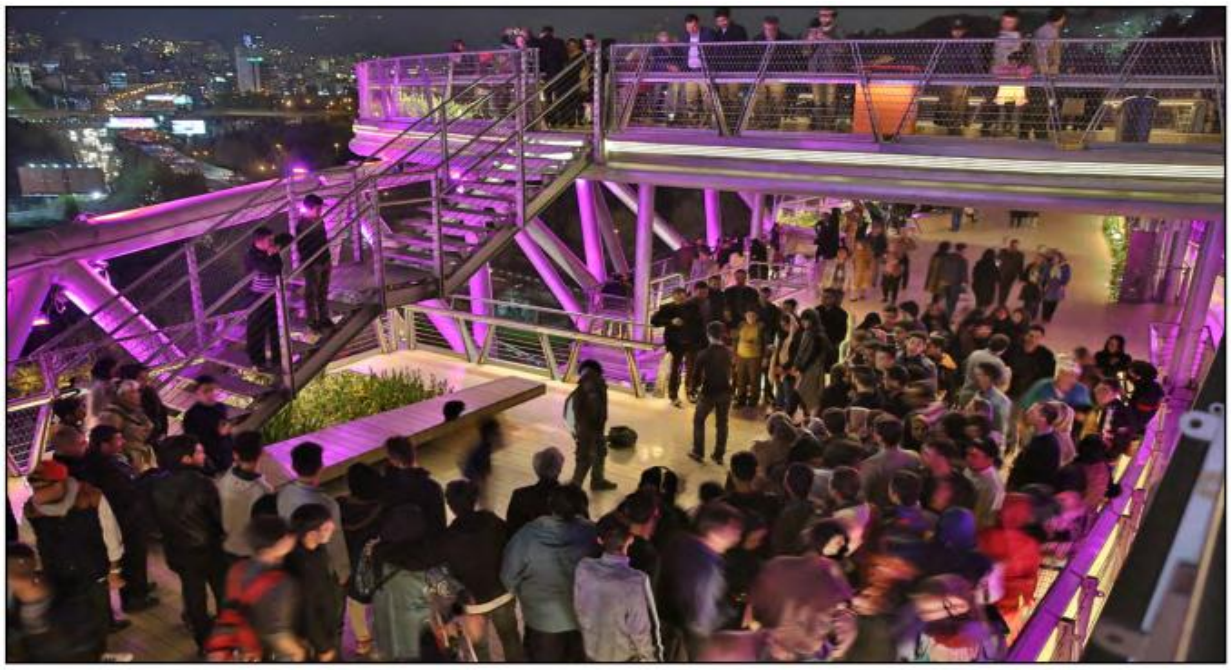
The figure shows the footbridge made up of principally of Steel, both the columns and the deck. It also shows that the footbridge at the entry being at grade with the land and the highway appearing depressed beneath it. This represent a minimal change in gradient which is desirable to pedestrians. The footbridge includes two walking lanes, one above the other which means the lower one is protected from inclement weather. It is also apparent the views are unobstructed from either of the two decks. Figure 2.15 below shows pedestrians resting and socializing on the footbridge.

Figure 2.15: Amenities within Tabiat Footbridge

Source: Radoine (2017)

The interior of the footbridge reveals benches for sitting or lying down. There was also a café provided which means pedestrians could refresh themselves as they sat or walked along. This is a useful characteristic of a creating a livable space. The bridge is also well lit which gives pedestrians a sense of security and thus encourage utilization of the facility. Figure 2.16 further shows livability of the footbridge.

Figure 2.16: Tabiat Footbridge at Night



Source: Radoine (2017)

The figure shows a very large number of pedestrians using Tabiat Footbridge. It also shows some pedestrians standing still taking in the views of the surroundings while others are seen gathered around a space watching some two people who are presumably performers. It is therefore concluded that the footbridge was able to meet its objective of inviting pedestrians to stay and not just pass.

2.7.3 Central Puget Sound Region Vision 2040

Central Puget Sound Region prepared Vision 2040 a long range vision aimed at maintaining a healthy region and to guide planning and implementation for about 27years as it was prepared in 2013. It emphasized development of vibrant, mixed-use centers where people could live, work, and play.

Integrating affordable housing in mixed-use centers throughout the region was seen as a key player in achieving increased opportunities to members, to lower households' combined cost of housing and transportation and to ensure that infrastructure investments enhanced equity across the region. One of the guiding principles was to develop partnerships for sustainable livability principles. Key transport was herein included offering the people of Central Puget Sound region increased transport options by developing safe, reliable and economical choices to decrease household costs, reduce the region's dependence on foreign oil, improve air quality and promote health. The other principle was to promote diversity of the communities through enhancing unique characteristics of all communities by investing in healthy, safe and walkable neighborhoods (B. Bakkenta, 2013).

One of the key objectives of the Plan was to make the most of the regional investment in high-capacity transit by locating housing, jobs and services close enough to stations making transit attractive as a viable option for many people. The other was to improve pedestrian and bicycle connectivity in station areas inorder to increase transit ridership and enhancing livability (B. Bakkenta, 2013).

The overall transportation goal of the plan was to create a more complete, connected, and well balanced transportation system, while protecting neighborhoods from spillover traffic impacts and ensuring that transportation investments contribute to the area's sense of place and sustainability. A summary of adopted policies most relevant to bicycle and pedestrian connectivity are as discussed in the following section. Firstly, pedestrian and bicycle" was used to include the range

of pedestrian and bicycle-like types of travel, such as wheelchairs, strollers and mobility scooters (B. Bakkenta, 2013)

The alternatives provided in the Plan are as discussed below.

Firstly was to encourage mixed-use development, promoting opportunities to live, work, shop, and recreate within close proximity (will encourage walking and bicycling between these uses).

The other was to provide grade-separated road crossings of the proposed trail system along the West Tributary of Kelsey Creek, and of other separate trails where feasible. Figure 2.17 and 2.18 show an illustration of a proposed aesthetically appealing footbridge with features to cater for all pedestrians.

Figure 2.17: Illustrative Design Concepts for the Pedestrian-Bicycle Bridge Across SR520 at Overlake

Source: Bakkenta (2013)

The illustration shows an aesthetically appealing footbridge with large spaces for walking, a gently sloping ramp and stairs. These two options cater for both able bodied and disabled pedestrians. The slope is very gentle as the road appear depressed which means the pedestrians will not expend

a lot of energy to use it. This is a desirable feature which impacts the energy and time it takes to cross the barrier at grade. The footbridge is also provided with a cover to protect pedestrians against extreme weather. This is also provided above a motorway thereby providing a safe yet comfortable crossing.

Figure 2.18: Sound Transit's Concept for the Overlake Village Light Rail Station

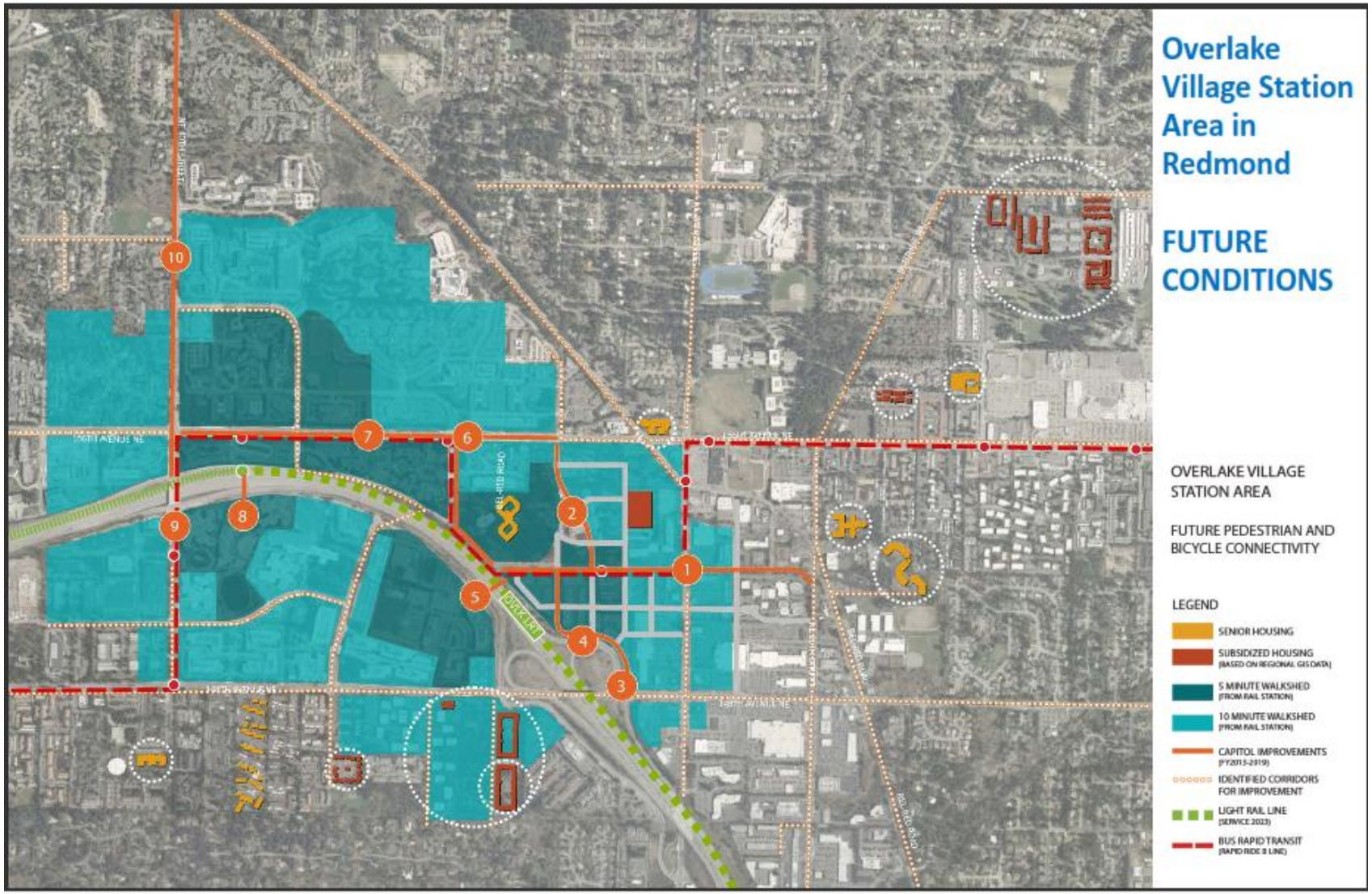
Source: Bakkenta (2013)

The figure shows the connectivity of walking mode and public service mode using light rail. The footbridge was located near the station for light rail which channeled pedestrians to and from the footbridge. The providers also wanted to reap from the light rail transit investment by locating residential areas, jobs and services close to the station thereby attracting people to use it.

Thirdly, the provided wanted to develop "green streets" throughout the corridor, with an abundance of street trees and areas of landscaping to improve and reduce the amount of storm water runoff, be aesthetically pleasing, and provide an attractive pedestrian experience. The other was to provide an interconnected system of non-motorized trails for mobility within the study area, connected to the larger, regional trail system. The plan also promoted using design guidelines to promote pedestrian-friendly and transit-oriented design, ensure quality and a sense of permanence, promote environmental sustainability, and create a distinct sense of place. Another was to ensure

the design paid special attention to creating a pedestrian-friendly environment, by helping to create vibrant, interesting, safe, walkable and interconnected sites. The final one was to implement a land use incentive system that makes available additional floor area ratio (FAR) and height in exchange for infrastructure and amenities that contribute to the public good including public open space, trails, environmental enhancements, affordable housing, and other public amenities (B. Bakkenta, 2013). The plan proposal below in figure 2.19 shows the integrated transportation alternative with land uses being re-defined with areas within 10minutes walking, 5minutes walking, motorized transport corridors and other corridors marked for redevelopment so as to incorporate pedestrian infrastructure (B. Bakkenta, 2013).

Figure 2.19: Overlake Village Station Area in Redmond, Future Conditions



Source: Bakkenta (2013)

2.7.4 Pedestrian Footbridge in Kampala, Uganda

In 2010, statistics from Mulago National Hospital revealed that nearly 40% of people killed in road traffic crashes were pedestrians (Naddumba, 2015). Majority of the victims were also found to be males aged around 27years, an important age-group for economic production.

Like most African Cities and Urban areas, walking is the dominant mode of transport for most people in Kampala City. However, pedestrian infrastructure is inadequate or underdeveloped. In an effort to address the safety of pedestrians, a footbridge was constructed at Nakawa Trading Centre at a cost of about US$ 100,000 in 1998. Nakawa is a busy trading centre, 6kilometers from Kampala City. It is of mixed land use consisting of commercial as represented by small retail shops, industries and offices. Another land use is residential as represented by low cost residential estate. Nakawa also serves as public purpose due to presence of a sports stadium.

The area therefore had a large population and construction of the footbridge over the Kampala-Jinja Highway was justified. This also happened at the time of heightened public outcry due to the number of fatal accidents in Nakawa (WHO, 2013).

An evaluation of the overpass was conducted in 2002 and the following were the observations. Only just over one third of pedestrians used the footbridge, that is 49% female and 79% children. The low usage of the footbridge was attributed to design oversights and its condition which pedestrians said was untidy, poorly lit and had children loitering on it. Most pedestrians also found the footbridge inconvenient and difficult to access, as a result, they choose to cross the road at grade through motorized traffic. At the time of the report, no changes had been done on the footbridge. Another observation was that whilst the number of pedestrians killed dropped by 75%, the number of serious injuries rose by 21% (WHO, 2013).

Figure 2.20 below shows the Nakawa footbridge, sited in a busy trading centre.

Figure 2.20: Nakawa Trading Centre Footbridge

Source: WHO (2013)

The footbridge was constructed principally of steel and accessed one way on each side of the road only using a stairway. The area around the footbridge seemed to be used as parking area which led to blockage of the entrance and exit to the footbridge. The figure also shows pedestrians crossing the road at grade in a near-run.

The mixed outcomes associated with this isolated intervention indicate need for integrated and comprehensive approach to planning for pedestrian safety (WHO, 2013).

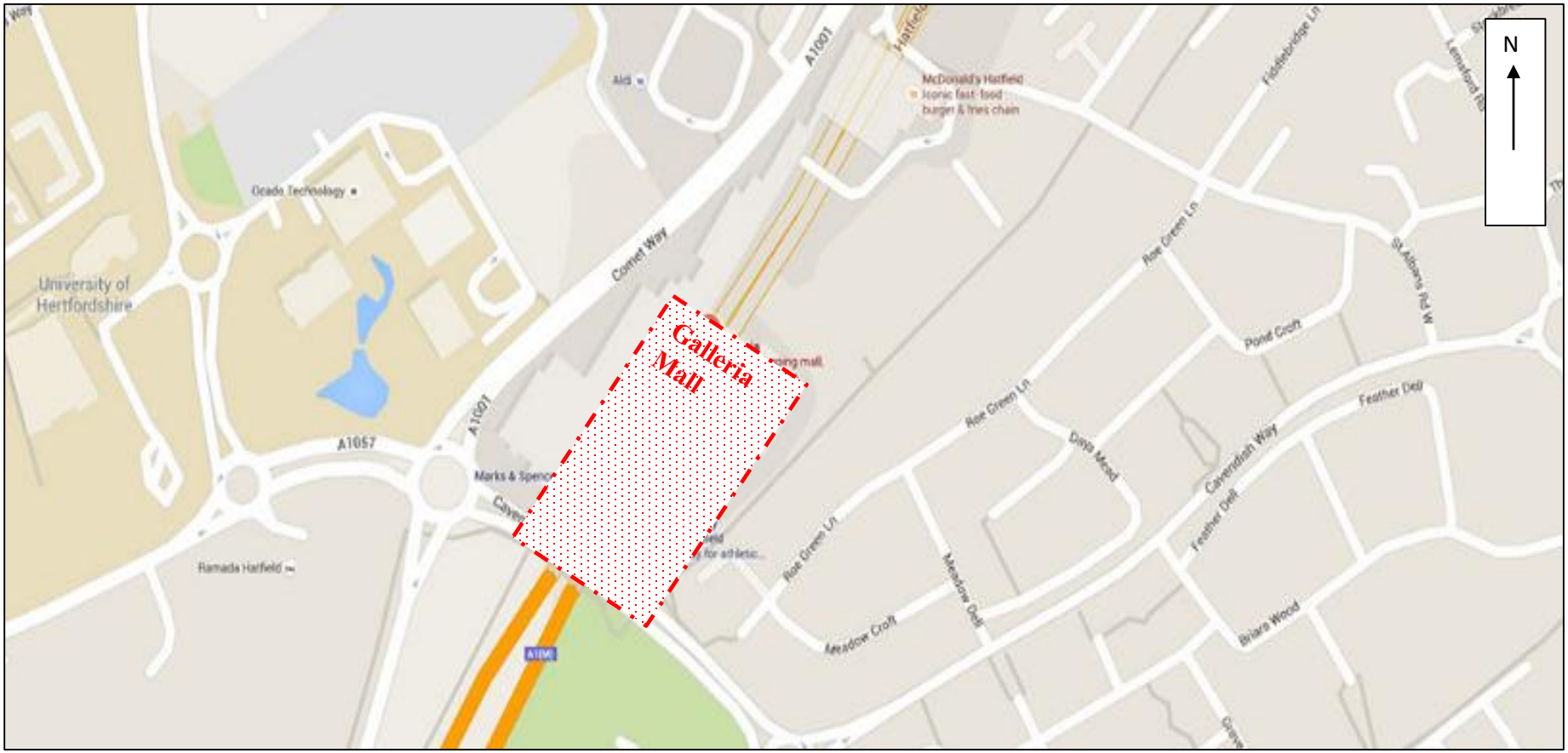
2.7.5 The Galleria Shopping Mall, Hatfield, UK

Hatfield is a town in Hertfordshire, England, in the borough of Welwyn Hatfield, located 30km North of London. It is historically an aircraft and general engineering manufacturing area with recent introduction in electronics manufacture from 1930s until 1990s when the British Aerospace closed their factories. In 1949, aircraft manufacturing was the largest employer in the area and it is from Hatfield, that the World famous Commercial jetliner, 'Comet' was developed. In 1948, Hatfield was accorded Town status by British Planners to accommodate population overspill from London. The town was allocated 2,340acres and together with Stevenage, Welwyn Garden City and Letchworth formed part of Hertfordshire (Wikipedia, 2018).

The choice of the new Hatfield Town was influenced by the need to move the site to the right side of the railway; also to move into an area with room for future expansion and also to change the village character which was out of scale with the town it would have to serve. From its background, Hatfield was historically an aviation area with large aviation yards, engineering workshops making industrial land use as the most prevalent in Hatfield.

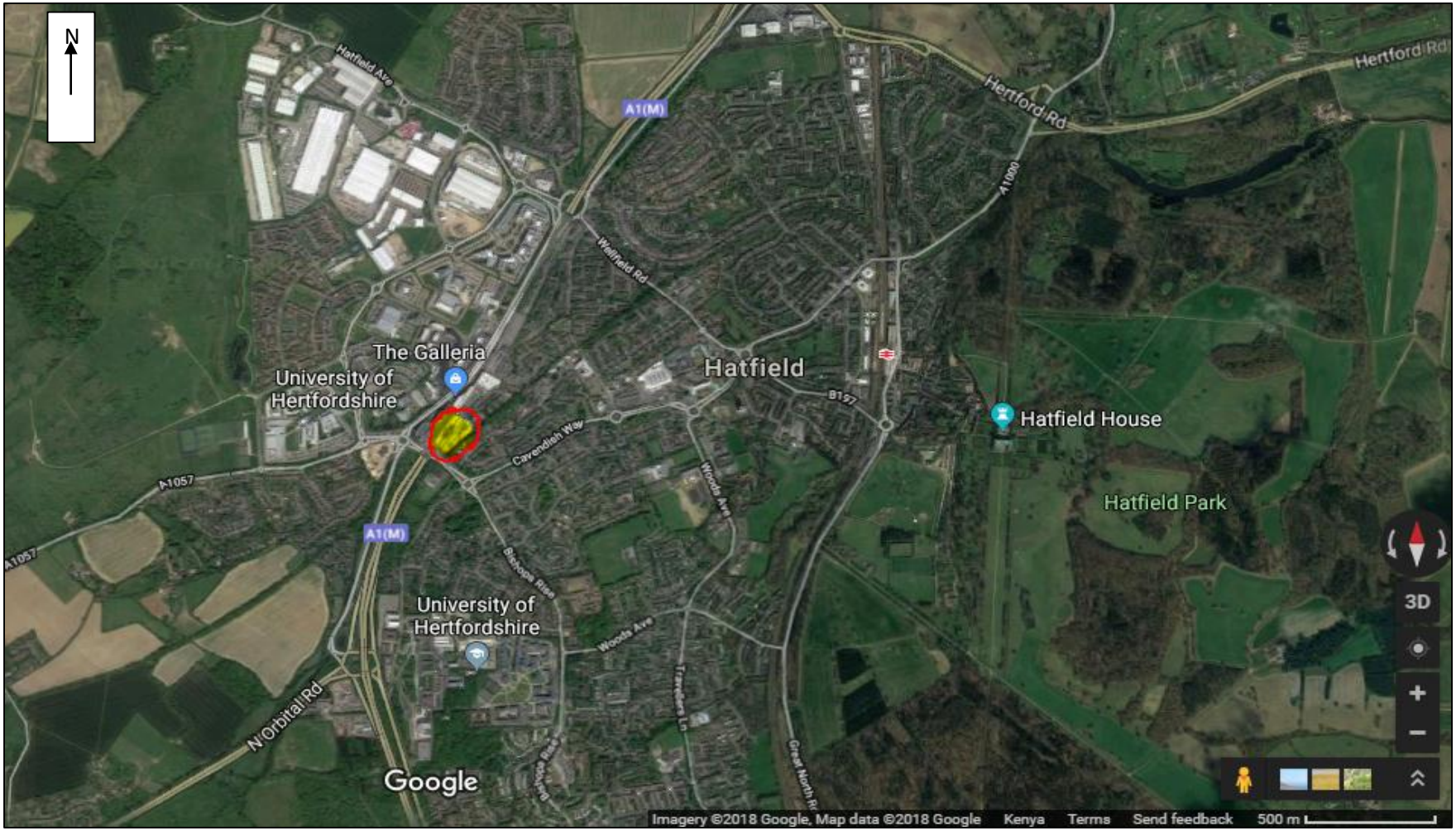
In 1991, the Galleria mall was constructed the main objective being to provide a place for social gathering for the residents of Hatfield who lacked a high street (Landsec, 2018). The mall was constructed over the busy A1 highway which was found to convey 29,000 cars per day in 2018 (Landsec, 2018). Besides social interaction, the mall provided safe crossing for pedestrians over the busy A1 highway. Figure 2.21 is a map showing the location of the Galleria Shopping Mall on the A1 Highway.

Figure 2.21: Galleria Shopping Mall, Hatfield



Source: Landsec (2018)

Figure 2.22: Galleria Shopping Mall, Locational Map



Source: Landsec (2018)

Figure 2.21 and 2.22 show the strategic location of Galleria mall constructed on top of the dual carriageway A1 road where vehicles use the tunnel as shopping and social activities take place in the mall. This shopping mall provides land use linkage, safe crossing for pedestrians over the barrier (A1) and enhanced pedestrian experience as they find shopping areas, eating and relaxation at the Galleria mall.

The mall has also become a landmark in Hatfield which has improved the landscape of the previously monotonous aircraft manufacturing area. This is as shown in figure 2.23.

Figure 2.23: Galleria Mall Aerial View

Source: Landsec (2018)

It was constructed in the shape of an Aircraft Hangar to celebrate Hatfield's aeronautic history. The mall was used as a design element whereby it provided a change in landscape which was monotonous with factories, airfields and residential areas. It also provided families with a place to socialize, meet and relax which was not existing before (Landsec, 2018). Figure 2.24 shows the tunnel which was constructed for use by motorists.

Figure 2.24: Tunnel under Galleria Mall, Hatfield

Source: Landsec, 2018

The tunnel was constructed wide enough to carry three lanes of vehicles. It was also well lit making it safe to use day as well as night. The construction of Galleria mall also brought about many visitors to Hatfield due to its unique design thereby developing tourism.

2.7.6 Synthesis of the Lessons Learnt

Walking is the oldest mode of transport. City authorities must therefore find ways of integrating it as a significant mode of transport within Cities and Urban areas. A walkable environment should be encouraged as it beneficial to the pedestrians, motorists and City authorities as well. Integrating walking in the urban infrastructure goes beyond providing mobility. It reduces air pollution, creates reasonable walking spaces, promotes health and well being and improves the environment. City authorities must diversify their offering to the citizens. A transport network must be all inclusive, that is to all ages, gender and abilities. Footbridges, which are pedestrian infrastructure can be provided to meet mobility needs but the provider must take care to incorporate desirable features so as to ensure they are utilized as envisaged.

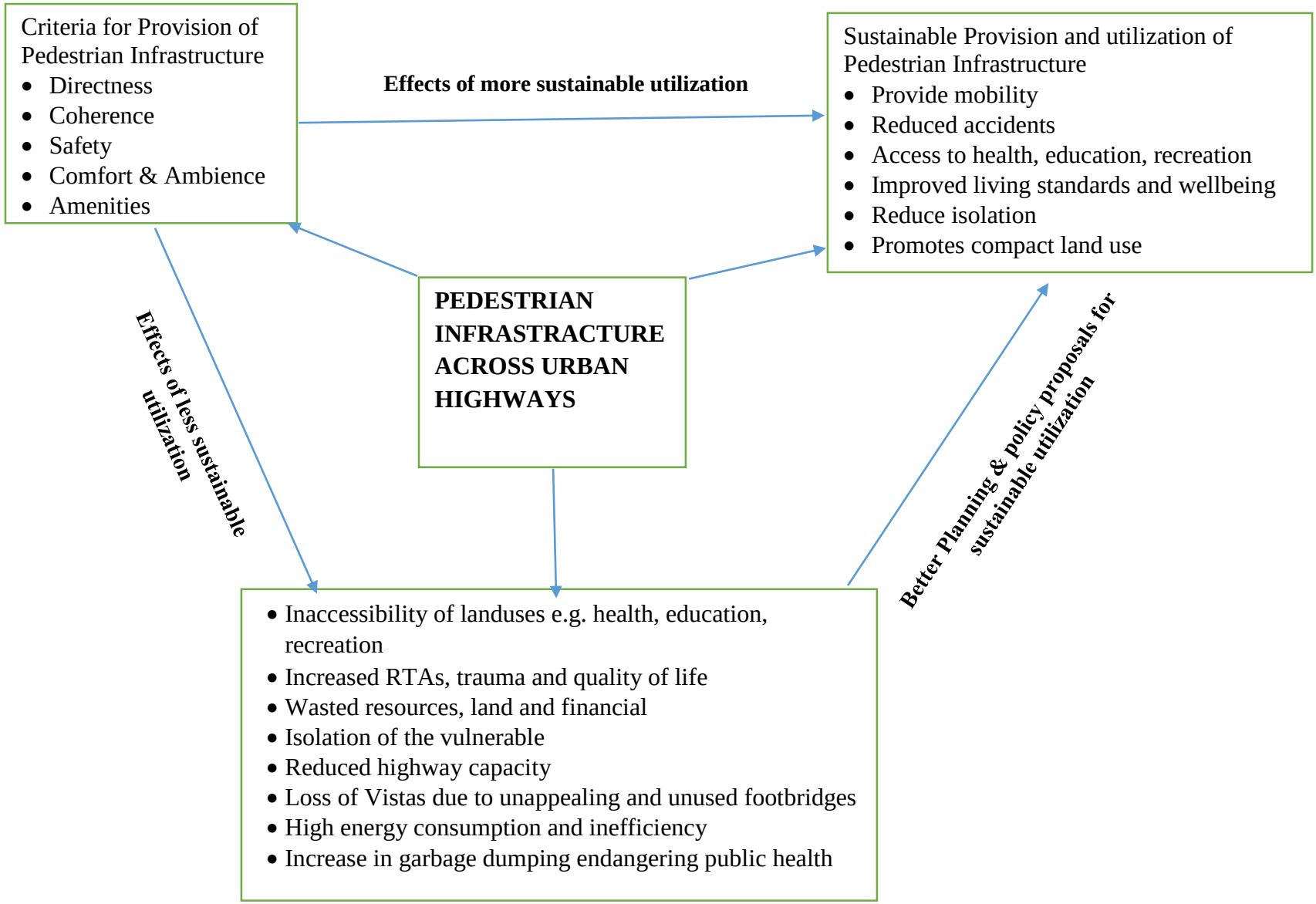
Road users must also be equipped with knowledge on safe use of roads to ensure they use provided facilities to meet their mobility needs. Lastly, infrastructure is permanent and occupies land, the choice of land use must be chosen carefully. In other economies, the city authorities have matched infrastructure with residential areas and other services. This kind of planning ensures that schools for example are located within walking distances from residential areas.

2.8 Conceptual Framework

Footbridges are pedestrian infrastructure constructed to aid pedestrian mobility. These facilities are especially important to remove barriers and hindrances on the way of pedestrians and cyclists. Proper provision of pedestrians leads to better utilization of these facilities. Improper provision on the other hand leads to mis-use, dis-use or complete abandonment.

Sustainable provision of footbridges follows a defined and scientific criteria which seeks to provide suitable and preferred crossings for the pedestrians whilst enabling motorists to travel unhindered. These preferences and considerations include minimum lift height to avoid much use of energy, directness and coherence to ensure pedestrians points of crossing are at the shortest distance and are interconnected without barriers. Comfort and ambience is another consideration that is important for pedestrian footbridges. These involve inclusion of amenities, proper design to provide shade and cover from inclement weather, provision of restrooms, shops, siting areas etc.

Figure 2.25: Conceptual Framework



Source: Author, 2017 (Adapted and Developed from Literature Reviewed)

CHAPTER 3 : SITUATIONAL ANALYSIS OF PEDESTRIAN INFRASTRUCTURE ON MOMBASA ROAD CORRIDOR, NAIROBI

3.1 Introduction

The following chapter discusses the findings from the study area. It discusses in depth the land-use, provision and utilization of Imara Daima, Belle Vue and Nyayo footbridges.

3.2 Situational Analysis of Footbridges in Nairobi

There are many footbridges in Nairobi. Most of them are found over major arterial roads e.g. Lang'ata road at Madaraka, Mombasa road at Nyayo Stadium, Bellevue, General Motors, Imara Daima and past City Cabanas at Tusky's head offices. On Waiyaki way, footbridges are found at Aga Khan High school, at Kangemi and at Uthiru. On Thika Road, these are found at Jamhuri High School, at Pangani interchange, near Muthaiga round about and at Kenyatta University. On Haile Selassie Avenue, there is a footbridge at the City Square Post office and another at Muthurwa market. University footbridge is also recently opened and it spans over 8lanes of University way linking University of Nairobi to the Central Business District, CBD. The railway footbridge is also popular with people traveling to and from the City Centre from Industrial area.

Mombasa road corridor is a major international highway that cuts across the City of Nairobi. The following section gives a detailed discussion of the existing situational analysis of pedestrian infrastructure on Mombasa Road Corridor. Mombasa road is an international highway in Kenya. It connects the cities of Mombasa and Nairobi over a length of 434km.

3.3 Physical Setting of Study Area

Kenya is an East African Country, which as the name suggest is located in the Eastern side of the Continent of Africa. The Country lies in the tropics with the Equator running across the Country. It neighbours Tanzania to the South, Uganda to the west and Somalia to the East. Northwards, it neighbours Ethiopia and South Sudan touching borders North West.

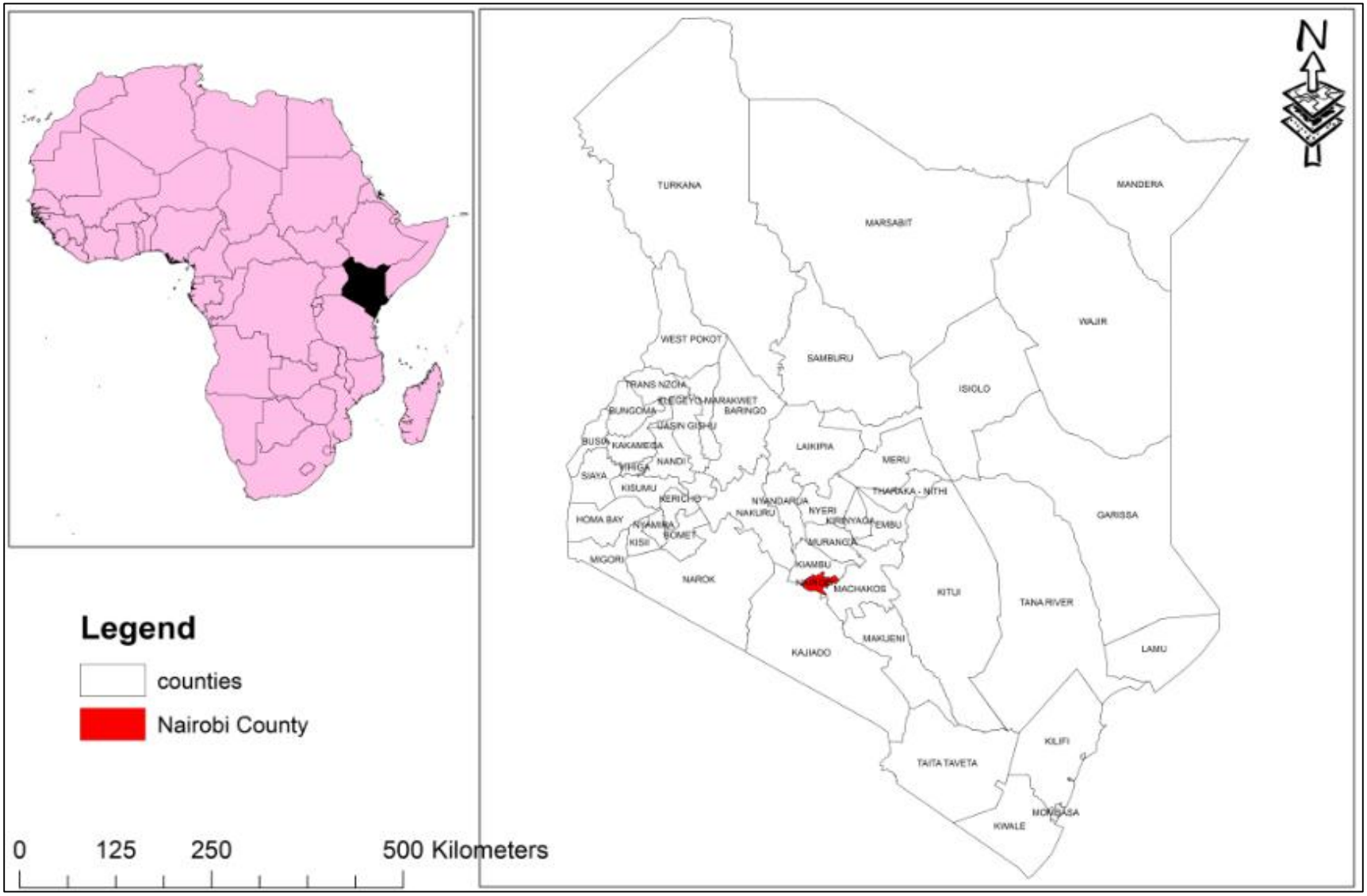
Socio-Politically, Kenya is a member of the East African Community, a regional block including Uganda, Tanzania, Rwanda, Burundi and South Sudan (East African Community, 2018). The Community was founded in year 2000 with an aim of bringing the six countries together inorder to promote trade. Currently, the size of the market is 168million persons which is a sizeable market that can spur production and trade amongst the trade partners (East African Community, 2018)

Kenya occupys a land mass of 581,309km^2 with a shoreline of 574km at the border of Tanzania and Somalia (KIPPRA, 2013). The shoreline puts Kenya at a vantage point compared to her landlocked neighbours as it has developed the Port of Mombasa which opens Kenya and the region to the outside world. It is a key enabler of trade by providing entry and exit of goods.

Nairobi is one of the 47 Counties. It is currently the Economic Capital City of the Republic of Kenya. The City is over 100years old having been established as a stop-over facility during construction of Kenya-Uganda railway in 1899 (Kjellqvist, 2014). The area's permanence was confirmed in 1905 when it was declared the capital town on Kenya. The town became an incorporated municipality in 1919 and finally a city in 1950. The original township was within the area presently defined by the central business district, bound by Uhuru Highway, Nairobi railway station, Nairobi River, Pumwani Road and Wakulima Lane, (JICA, 2013).

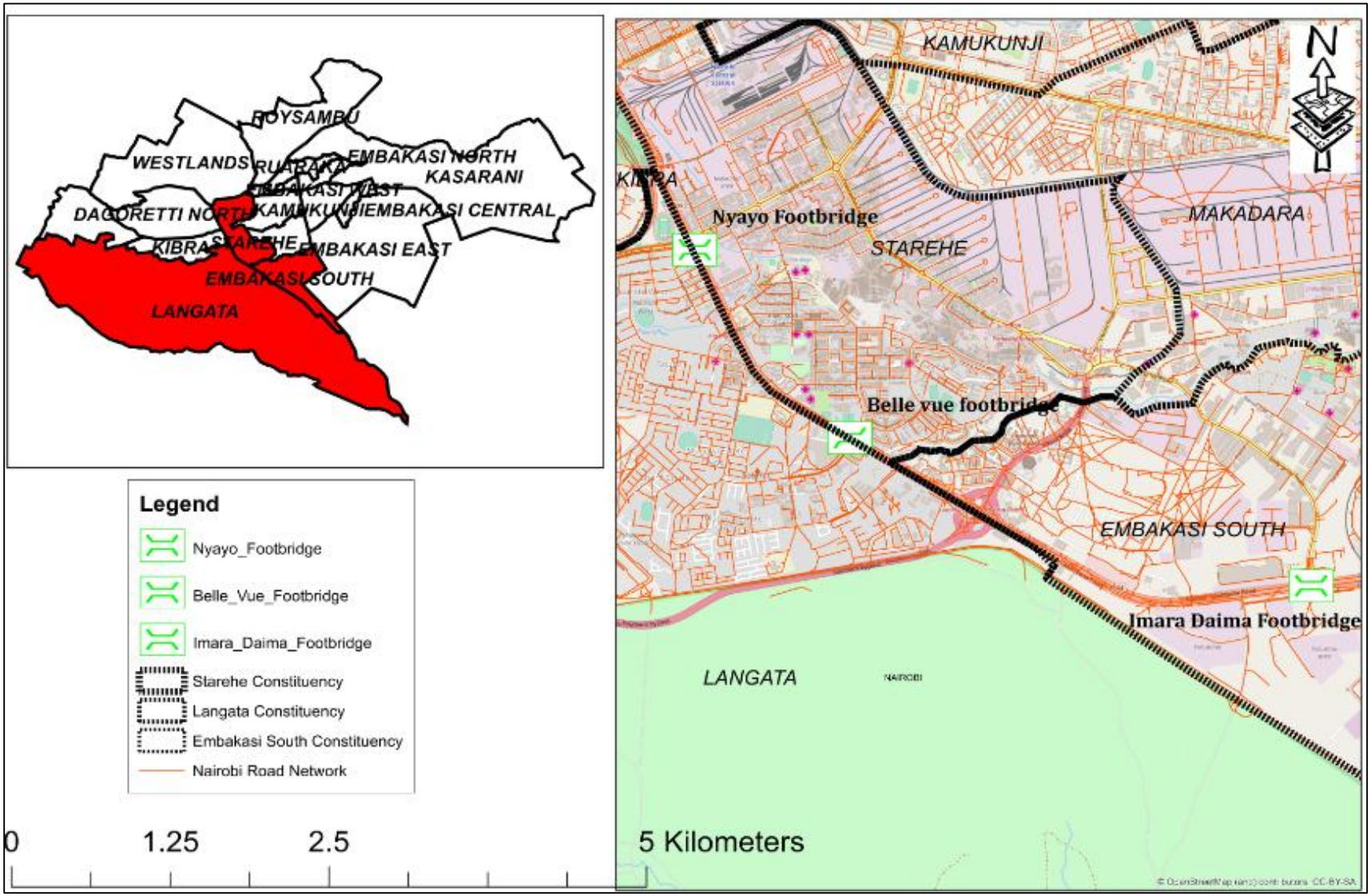
Nairobi is located approximately 1^o 9'S. 1^o 28'S and 36^o 4'E, 37^o 10'E and occupies an area of approximately 696km^2 at an altitude of between 1600m and 1850m above sea level. The Study area, that is Mombasa road Corridor, is located in three different wards, Langata Constituency Southwards and westwards, Embakasi to the East and Starehe Constituency in the North. Imara Daima footbridge is found in Embakasi South while Belle Vue and Nyayo footbridges is located on the border of Starehe and Lang'ata constituencies. This is located within the Urban Area of with neighbouring landuses being residential, commercial, industrial, institutional and conservational which is unique to Nairobi, it is densely populated and heavily built up. Map 3.1 shows Kenya in the Continent's Context and Nairobi County in Kenya's context, Map 3.2 shows the Urban context, Map 3.3 shows the Neighbourhood context while Map 3.4 shows detailed context of the Study Area.

Map 3.1: Continental and National Context of Study Area



Source: Adapted from Survey of Kenya, 2017

Map 3.2: Urban Context of Mombasa Road Corridor

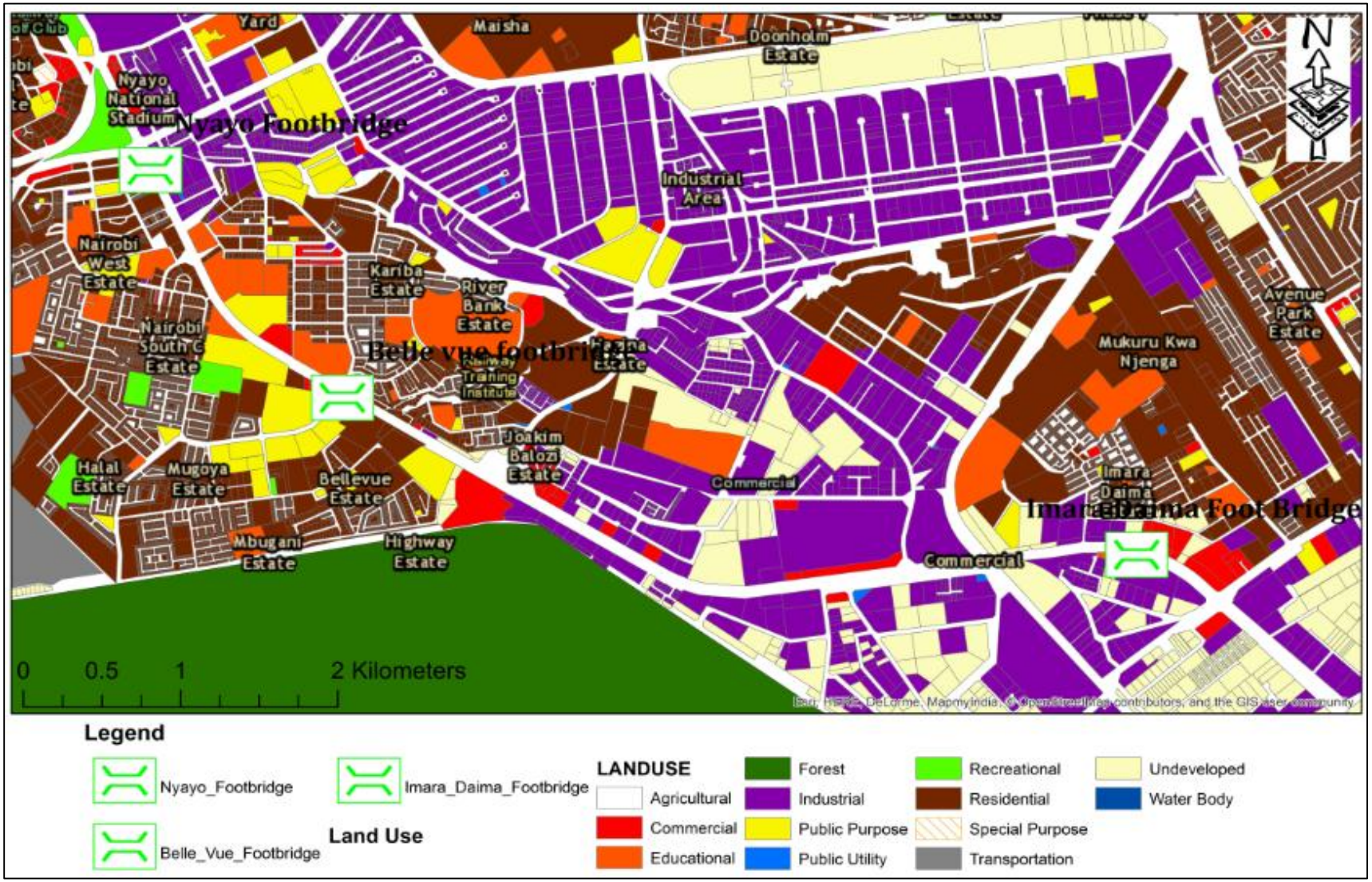


Source: Adapted from Survey of Kenya, 2017

Map 3.3: Neighbourhood Context of Mombasa Road Corridor

Source: Adapted from Google Maps, 2017

Map 3.4: Detailed Context of Mombasa Road Corridor



Source: Adapted from Survey of Kenya, 2017

3.4 Physical and Natural Environmental Characteristics

Nairobi is located on high ground, about 1700metres above sea level and is therefore of temperate climate with trees, shrubs, and plenty of natural vegetation. Nairobi was originally a swampy watering hole on the border of Maasai grazing land and the Kikuyu agriculture land. The Maasai called the land *Enkare Nyirobi*, meaning 'The place of Cool Waters' which later became Nairobi by the British (Kjellqvist, 2014). The vegetation is therefore plentiful especially towards the Limuru and Kiambu areas. However as it tends towards the Machakos plains, the vegetation changes to dry area characterized by open fields with savanna grasslands.

3.4.1 Climate

Nairobi is characterized by temperate cool climate with two rain seasons, highest rainfall of about 1050mm is received between March and April while short rains of average 850mm are received in November and December.

3.4.2 Drainage

Nairobi's drainage follows the regional slope of volcanic rocks towards the east. Water draining eastwards from the hill area catchments accumulate on the low-lying ground between parklands and Nairobi south. The Kerichwa valley tuffs lying to the east act like a sponge and forms a perfect aquifer so that underground water in adequate in Nairobi.

There are two rivers in Nairobi, Nairobi River which eventually joins Athi River towards Mavoko and Karura River which flows through the forest in the middle of town outwards towards eastern plains (Oyier, 2009). Mombasa Road is well drained with storm water drainage being provided on both sides of the road. The water eventually channels into Nairobi River.

3.4.3 Soils

Nairobi is dominated by volcanic soils which were deposited during the formation of the East African Rift Valley overlying metamorphic rock (A. Guth, 2018). Southern and Eastern areas have Nairobi phonolites from the Pliocene era and are black to blue in colour. Western side has the Nairobi Trachyte while the Northern side of Nairobi has upper Kerichwa tuffs. The main soils found around the Study area, are mainly the phonolites. Many of the volcanic rocks are quarried as building stones, especially the Kerichwa Valley Tuff which provides the "Nairobi Blue Stone" (A. Guth, 2018).

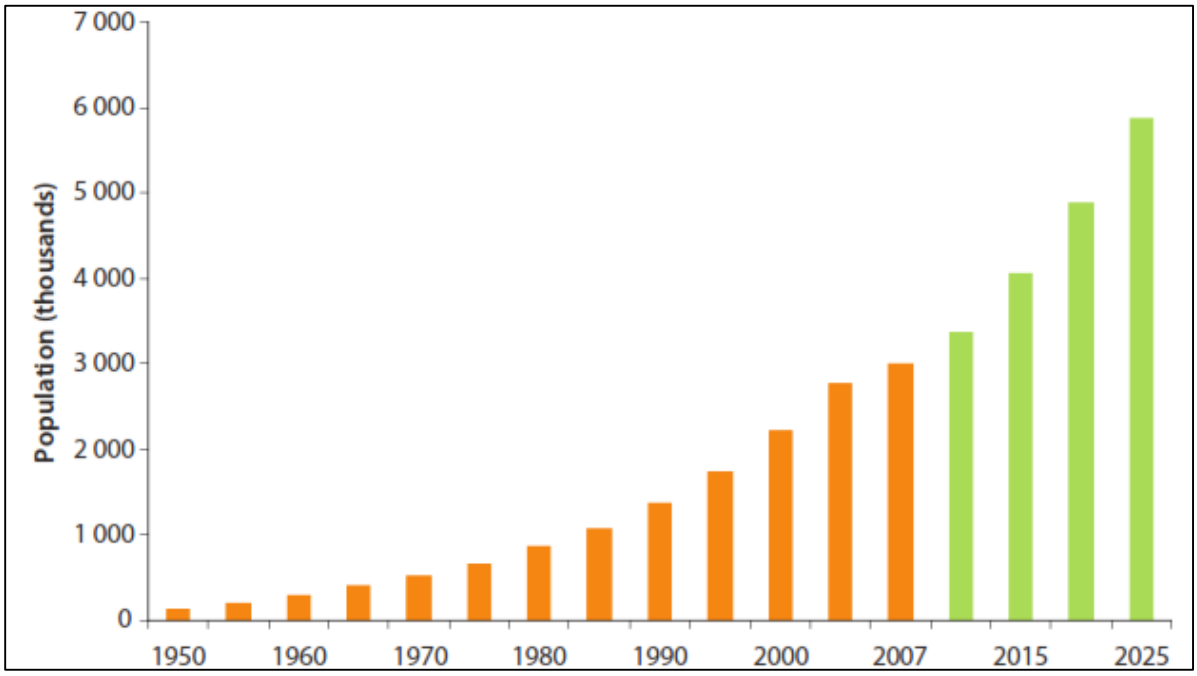
3.5 Population and Demographic Characteristics

In 1901, there were only 8,000 people living in Nairobi. By 1948, the population had grown to 118,000 and by 1962, the city had a population of 343,500 persons (UNEP, 2014). Population passed 1million in the 1980s, 2million in the 1990s and by 2009, Nairobi was home to 3.4million people with a density of 4,509persons per km^2 with 4.1% growth rate (JICA, 2013). About 60% of Nairobi's population lives in slums, and occupying only 5% of the land (KIPPRA, 2013).

Kenya is a growing economy and many people are being attracted to the Urban areas in search of opportunities. A significant number of commuters from satellite towns such as Thika, Naivasha, Ngong, and Machakos come into Nairobi daily to work or bring goods and supplies. Daily commuters from such satellite towns contribute an estimated additional half-million people to the city's population (UNEP, 2014).

Nairobi is listed as a vibrant city and among the fastest growing in Africa, (PWC, 2015). It also has among the most innovative human capital, as shown by a survey carried out by CNN in 2015. Nairobi was shown to have the highest uptake of ICT and mobile telephony with over 74% of all people owning mobile phones. (Court, 2015). Figure 3.1 shows historical and projected population between 1950 and 2025.

Figure 3.1: Nairobi's Historical and Projected Population, 1950 - 2025



Source: UNEP (2014)

The graph shows an exponential growth of population from 1950 to 2025, meaning by 2025, the City population reach nearly 6million. This high growth means more resources will be required inorder to provide services to the city dwellers. As the Country continues to grow economically, more people are expected to migrate to the Urban Areas, with Nairobi taking the highest number. As observed by UNEP, the ongoing rural to urban migration, high natural birth rates and poor or inappropriate City Planning system conspire to continue degrading the standards of living in the City which has a bearing on human health and the economy (UNEP, 2014).

3.6 Transportation System on Mombasa Road Corridor

The City is governed by the County system of Government which is headed by the Governor, assisted by the deputy governor with nominated County Executive members and elected County Assembly according to Article 176 Part 1 of the Constitution of Kenya of 2010 (GOK, 2010).

Nairobi is well served with infrastructure, which includes good roads, railway link, an international airport, schools, hospitals, electricity, Water provision and waste management system. Growth in formal and informal sector has attracted and continues to attract a high population into the city. Incomes have also increased with resultant increase in car ownership. The resulting scenario is increased traffic, both vehicular and non-vehicular.

Currently, there is lacking requisite infrastructure to support mobility around the city. Nairobi is cited as among the most congested urban areas. According to the PriceWaterhouseCoopers report of 2015, there seems to be a strong correlation between infrastructure, human capital, and economics. Cities that score well in infrastructure also score well in human capital, and, unsurprisingly, go on to score well in economics. This relationship makes sense, civilization – that is a City's life is literally built on infrastructure. The same report indicated that Nairobi is among the cities with clogged city centers due to an inefficient transport system which is a real threat to its growth (PWC, 2015).

Urban areas have in the past suffered from transportation challenges. It is recorded that in the first century, vehicular traffic except for chariots were prohibited from entering Rome during daylight hours. This is how the ancient Romans avoided traffic congestion, (Oyier, 2009). While traffic congestions have always been around for a long time now in urban areas, walking prevented the problem from being too serious until the arrival of the personal car, (Oyier, 2009).

As earlier discussed, 2004 & 2013 modal split of Nairobi revealed that non-motorized transport mode was more common than any motorized mode for each trip between the two years in question (JICA, 2013).

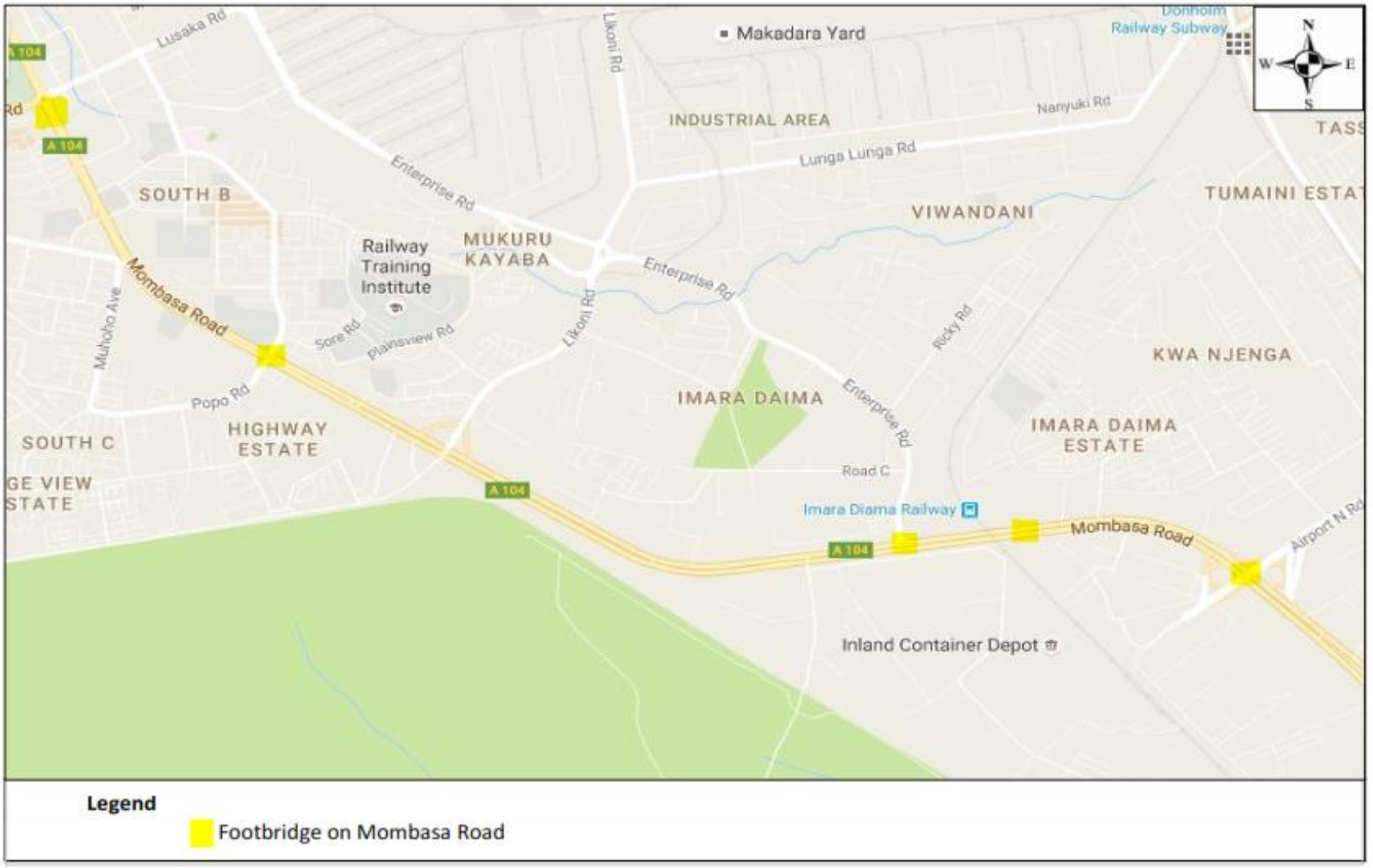
Walking in Nairobi was popularized by establishment of *Landhies,* barrack like accommodation initially built for the railway track maintenance staff during the colonial period that was established close to key suburbs and the Central Business District so that workers would not have too far to walk to work. Examples of these Landhies include Land Mawe and Muthurwa. Today however, most of the low-income segment of the population living in the slums walks to work every morning covering a distance of between 7km to 13km (Oyier, 2009). Studies done by JICA in 2013 showed that 42% of all trips in Nairobi were done by walking (JICA, 2013).

With nearly half of the trips being made by walking, the pedestrian infrastructure provided is firstly insufficient and secondly ineffective. In the past, city authorities and governing agencies did not provide sufficient pedestrian infrastructure. However, there has been improvements pedestrian infrastructure has improved as evidenced by pedestrianization on Mama Ngina Street, renovation of footpaths and cycle paths on Uhuru Highway, Jogoo road, Mombasa road and construction of numerous footbridges over numerous transport corridors in Nairobi (NCC, 2015).

Map 3.3, shows a dense network of transport links in the study area and its environs. The areas is well served by roads, railway tracks, airports and NMT infrastructure. It is also connected to the Mombasa Sea Port by the Mombasa Road Corridor. This means there is adequate provision of motorable infrastructure within the Study area.

Mombasa Road Corridor, classified as A104, is the largest and the busiest road in the study area. This is because of its nature as an international highway. There are five footbridges on the stretch from Nyayo Stadium to the intersection of Airport Road. These include Nyayo footbridge, Belle Vue footbridge, GM footbridge, Imara Daima footbridge and another beyond City Cabanas. Map 3.5 shows locational siting of footbridges along the busy Mombasa Road Corridor.

Map 3.5: Mombasa Road Corridor showing Selected Footbridges



Source: Adapted from Google Maps, 2016

The map shows that footbridges have been provided along Mombasa Road, which are near traffic generators. A closer view of the three selected footbridges shows unique characteristics of each.

Plate 3.2 shows the Belle Vue footbridge before it was installed.

Plate 3.1: Belle Vue Area before the Footbridge

Source: Adapted from Google maps, 2017

It is evident that this area of the Mombasa Road Corridor is a high traffic volume area. The land use around shows residential area, commercial area, shopping area and institutional as depicted by the school field. Mombasa road is a high volume corridor as shown by the heavy mixed vehicle traffic jam on the road around the area. Pedestrian infrastructure is represented by sidewalks and footpaths however, there is presence of informal paths which represent crossing.

Plate 3.3 on the other hand shows the same area after construction of the footbridge.

Plate 3.2: Belle Vue Area after the Footbridge

Source: Field Survey, 2017

The footbridge was constructed at the area that had the informal footpaths. The footbridge spans across the corridor with only one entry/exit on each side. The carriageway was separated at the median by way of metal plates in an attempt to prevent pedestrians from crossing at grade. There is also presence of street lighting as shown by the light tower which means the area is useable during the night. The footbridge construction was a welcome relief to pedestrians who had to risk their lives on the busy and high density road.

At the end of Mombasa Road is Nyayo Stadium Footbridge, being named after the Stadium in the neighborhood. This is a much older footbridge and pictures of the area before the footbridge were not easily obtained. Plate 3.3 shows a side view of Nyayo footbridge.

Plate 3.3: Nyayo Stadium Footbridge

Source: Oginde (2016)

The footbridge which spans over about 6lanes at the end of Mombasa Road Corridor. It consists of a single span of deck with staircase on both sides of the road. The pedestrian sidewalks and an island between the carriageways are part of the pedestrian infrastructure which are complemented by the footbridge. Presence of street lighting also show that the footbridge and pedestrian sidewalks are useable even at night.

Imara Daima Footbridge is a recent construction. Map 3.6 shows land use and neighborhood area before construction of the footbridge.

Map 3.6: Site Layout of Imara Daima Area before the Footbridge

Source: Mwaura (2014)

The picture shows area is heavily built up with Imara Daima and Villa Franca gated communities. There is also the sprawling Mukuru kwa Njenga slums which is also densely populated as shown by the ground cover of buildings. Industrial buildings can also indicate presence of industrial land use. The Imara Daima Railway Station is also shown to the Western side of the area.

Plate 3.4: Imara Daima Footbridge

Source: Field Survey, 2017

The picture shows that the footbridge is a longer spanning footbridge with gently sloping ramps on both sides of the footbridge with two entries each. The footbridge is also covered from inclement weather by a shade. The area around the footbridge however is however unkempt with long grasses, mounds of earth in the middle and poor drainage. The pedestrian path around is also discontinuous and not properly paved. The footbridge provides a safe crossing across the high speed high volume road, a barrier in this context.

3.7 Infrastructure Services and Facilities

Due to such rapid urban growth, provision of basic infrastructure for all has become an important concern of development planners in Nairobi. Basic infrastructural services that have deteriorated due to such rapid increase in population include: Solid Waste Management system; Water and Sewage systems; drainage and flood protection (Mwaura, 2014). Greater environmental pollution, congestion, disease outbreaks like cholera and other problems have been the result of under-provision of such basic services. The city is well served, with good communication and transport network such as air, road, and railway. The challenge however is with mass transportation where there is only commuter rail provided. This follows a defined route which is limited. Other mass transportation systems for example Bus Rapid Transit and Light rail are not provided which could go a long way in improving mobility around the city.

3.8 Land use Analysis of Mombasa Road Corridor

Mombasa Road is an international highway that conveys high volume and high speed traffic. It is used to access the City and its hinterland from Mombasa port. It also conveys cross border traffic. This is traffic destined for other countries. Land use around Mombasa Road is mixed use, including residential, commercial, industrial, institutional, conservational and infrastructure. Map 3.4 showed that residential and industrial land uses were shown to have higher proportion as compared to the other land uses.

3.8.1 Land use around Nyayo Footbridge

The Nyayo round about footbridge is located at the intersection of Lusaka road, Lang'ata road, Uhuru highway and Mombasa road. Pedestrians use this footbridge to access work areas, residential areas, business areas and the sports facility which is Nyayo Stadium. Residential areas include Nairobi West area and Makadara. These two areas consist of high density dwellings in form of flats and detached maisonettes.

3.8.2 Land use around Belle Vue Footbridge

Belle Vue is found along the Mombasa Road Corridor and is also of mixed land use. It comprises residential land use, industrial, institutional, commercial and infrastructural, for example Capital Centre and Oil Libya shopping areas. The schools found near the area are Highway Secondary School, St. Bakhita pre-school, Plainsview Primary School and Highway Educational school. There are also a lot of Government institutions around this area as shown by NEMA and KBS.

3.8.3 Land use around Imara Daima Footbridge

Imara Daima footbridge is found to the South of the Study area. The land use is largely industrial and high density residential. The main residential areas include Imara Daima estate, Villa Franca estate and further north of the footbridge is the expansive informal settlement of Mukuru kwa Njenga. There are also some schools e.g. Embakasi Girls and Riara Academy. Commercial land use is exhibited by several small businesses domiciled in rented buildings that includes hair salons, butcheries, shops selling basic household goods and small supermarkets.

3.9 Institutional, Legal and Policy Framework

NMT provision is supported in National and County Policies and development plans. The Bill of Rights according to the Kenya Constitution 2010 chapter 4 Article 19 accord recognition, protection of fundamental freedoms inorder to preserve the dignity of individuals and communities and to promote social justice and realization of potential of all human beings (GOK, 2010). Among the bill of rights is the right to freedom of movement. This right is infringed upon in the case of pedestrians if they are unable to access different land uses due to non-provision of facilities or infrastructure to overcome hindrances. Another right is in article 5 part (b) where the State is mandated when allocating resources to give priority to widest possible enjoyment of the right whilst considering the vulnerable of particular groups or individuals.

This means that all road users regardless of their ability, gender, age, ought to be provided with infrastructure that can enable them access various land uses.

The following is a discussion on the role of different institutions and their mandates and legal framework in protecting these rights.

3.9.1 Institutions

There are different Institutions that are mandated to look out for the good of pedestrians and cyclists. The Road Agencies, including Kenya National Highways Authority, KENHA; Kenya Urban Roads Authority, KURA and Kenya Rural Roads Authority, KERRA are mandated to provide and maintain roads within their areas of responsibility, which includes National highways, urban roads and rural roads respectively. Whilst providing roads, the agencies are mandated to provide for NMT users and thereby pedestrians facilities.

The County Government is also mandated to provide local and feeder roads within their Counties. They are also mandated to provide NMT facilities for ease of mobility of their residents.

3.9.2 Legal and Policy Framework

The Integrated National Transport Policy (2012) recognizes the importance of NMT in addressing the needs of the poor as well as in promoting the health of the population.

The policy also recognizes that transport policies have largely supported motorized transport at the expense of non-motorized transport and have denied the poor and disabled benefits inherent in NMT leading to marginalization of NMT users in the urban areas. The policy strongly recommends harmonization of NMT and their connected infrastructure into technical, legal and institutional mandates of transport agencies.

The Nairobi NMT policy was put in place inorder to develop and maintain a transport system that fully integrates NMT as part of the Nairobi transport system. This Policy is intended to create a safe, cohesive and comfortable network of footpaths, cycling lanes and tracks, green areas, and other support amenities. Further, it will put in place laws and regulations to ensure that NMT facilities and areas are not encroached upon by the MT modes and other street users. The objectives of the policy is to increase mobility and accessibility, to increase transport safety, to improve amenities for NMT, to increase recognition and image of NMT in Nairobi County last but not least to ensure that adequate funding/investment is set-aside for NMT infrastructure as summarized in table 3.1 below.

Table 3.1: Outputs and Outcomes of Nairobi NMT Policy

	Objective	Output	Outcome
1.	Increase mobility and accessibility	Safe and cohesive pedestrian facilities. Cohesive network of cycle paths	Increased modal share of walking for trips upto 5km Increased modal share of cyclists
2.	Improve transport safety and security	Safe NMT crossings. Increased footbridges and undepasses	Reduced pedestrian fatalities
3.	Improve amenities for NMT	Provide benches, repairs shops and stores along NMT	Level of service (LOS) rating of streets to be improved from current D to B
4.	Increase recognition and image of NMT in Nairobi	Percentage of road users considering NMT as a mode for poor reduces	Diverse income groups using NMT as a mode of choice besides the poor

Source: Adapted from NCCG (2015)

Some of the proposals fronted by users during one of the stakeholders meeting include integration of professionals, users, government in the provision of NMT facilities and infrastructure. They also proposed that land use planning should encourage walking or cycling through compact land use planning that support short distances between activity areas.

Others proposals put forward include having Landscape architects design "dignified space" for pedestrians; making walking and cycling attractive through provision of continuous, coherent routes with direction signs, convenient and user-friendly; prioritizing NMT over MT, having elevated NMT facilities as opposed to elevated MT infrastructure which is expensive and also educating road users on the benefits of walking and cycling which include health, safety, energy efficient and environmentally friendly. In the context of this study, operationalization of this NMT policy will ensure provision of footbridges and change of attitudes and prejudices against NMT as being for the lower class in the society.

The Traffic Act provides the framework for the enforcement of traffic laws, including those relevant to NMT users. It gives police the authority to control and regulate traffic, both vehicular and non-vehicular to keep order and prevent obstruction. The police can also deny, close or restrict access of certain roads. The police therefore have authority to compel all pedestrians to use designated pedestrian infrastructure e.g. footbridges. They also regulate usage to ensure they are no encumbrances to use and criminal activity is prohibited from the footbridges.

Kenya Vision 2030 aspires for a Country firmly interconnected through elaborate network of roads, railways, ports, airports, water ways, and telecommunications. It aspires to setting up a strong institutional framework for infrastructure development, implementation of infrastructure projects that will target increased connectivity and reduced transport and other infrastructure costs. Integration of NMT infrastructure with the transport system would better improve the utilization of pedestrian footbridges on Urban Highways. In achieving these aspirations of Vision 2030 and in the context of this study, it is pertinent that the integration of pedestrian footbridges and corresponding connectivity would increase utilization of the facilities.

The Public Health Act makes provision for securing and maintaining health. Section 115 of the act guard against nuisance that can be injurious. Section 116 on the other hand gives local authorities powers to maintain their districts clean and in sanitary conditions. Drawing from the aspirations of his Act, it is important that the footbridges some of which are soiled must be kept clean by Nairobi City County so that they are useful to the pedestrians. The Act also highlights the need to maintain a clean healthy environment for the public devoid of pollution such as noise, air from vehicle fumes that is dangerous to people. Therefore mixing pedestrians with vehicles that are smoking excessively is not desirous and footbridges may help to thwart that threat. Planning proposals need to be formulated with a view to clearly formulate designs that separate pedestrian movement from vehicular traffic.

The Nairobi Master Plan, NIUPLAN that was launched by the Governor of Nairobi proposed the development of a compact Urban Center complete with creative, livable, green and competitive environment. It proposes that the urban center should be pedestrian friendly for an efficient, effective and inclusive transport system. In relation to this study, provision of pedestrian footbridges ought to meet the need of all users.

CHAPTER 4 : PROVISION AND UTILIZATION OF PEDESTRIAN FOOTBRIDGES ON MOMBASA ROAD CORRIDOR, NAIROBI

4.1 Introduction

This chapter aims to operationalize the third objective of the research. It aims to discuss the provision and utilization of pedestrian infrastructure and particularly footbridges on the Mombasa Road Corridor. Table 4.1 shows the distribution of Age-Sex Structure in the study area.

4.2 Age-Sex Structure of Respondents

Table 4.1 shows the age-sex structure of the Respondents

Table 4.1: Age-Sex Structure of Respondents

Age Bracket, years	Male, %	Female, %	Proportion, %
1-10	1	2	1
11-20	4	11	6
21-30	47	49	48
31-55	46	36	43
Over 55	2	2	2
Total	**69**	**31**	**100**

Source: Field Survey, 2017

From the findings, as shown in table 4.1, it was revealed that most of the pedestrians are among the productive age of 21-55 years, comprising about 91%. It was also revealed that most of the footbridge users were male, about 69% of total users. The respondents were also of able physical ability, 99% and only 1% persons living with Disabilities.

This high proportion of the active working age and mainly males can be attributed to the land use around these footbridges, where they are distributed within residential areas, industrial and commercial land uses. The industrial land use attracts young to middle aged males to work in the factories which explains the high proportion of males using the footbridges. Table 4.2 shows distribution of trips around the land use.

Table 4.2: Distribution of Trips by Purpose for Different Footbridges

Footbridge Location	Live	%	Work	%	Others	%	Total
Nyayo	9	*15%*	41	*69%*	9	*15%*	59
Belle Vue	16	*27%*	26	*43%*	18	*30%*	60
Imara Daima	22	*39%*	31	*54%*	4	*7%*	57
Total	**47**	***27%***	**98**	***56%***	**31**	*18%*	**176**

Source: Field Survey, 2017

It was shown that 27% of the respondents lived around the areas around the footbridges but 56% worked around the footbridges, hence they used these facilities mainly to access their work areas. As shown by the land use map earlier, the area has residential and industrial land use being among the most common. On all the footbridges however, it was noted that the percentage of person living in the areas against percentage of persons working in those areas does not match with the former being more. This implies that there are many people using these are corridors to access their work areas without necessarily residing in those areas. A look at the Nyayo Footbridge purpose distribution show that 69% of the pedestrians work around the area but only 15% reside in the vicinity. 'Other' trips were only done by 15% of the respondents which implies that the area is largely a work area. On the contrary, Belle Vue footbridge had 30% of the respondents attending to different trips from work and residence. A closer look at the land use at Belle Vue shows presence of schools, shopping area and Government offices which constitute 'Other' trips. Imara Daima, which is found in a dense residential and industrial area had cumulative 93% being these two trip purposes and only 7% constituted 'Other' trips. A further Origin and Destination study is recommended so as to understand the catchment area of these facilities.

Table 4.3 shows the distribution of educated respondents against occupation.

Table 4.3: Education and Occupation of Respondents

Educational Level	Employed, %	Business, %	Student, %	Others, %	Total, %	Cumm, %
Primary	14	17	2	29	13	13
Secondary	36	54	13	21	36	49
Tertiary	43	27	85	35	46	95
Not educated	5	2	0	10	3	98
No response	2	0	0	5	2	100
Total	**36**	**27**	**25**	**12**	**100**	

Source: Field Survey, 2017

From the field survey 95% of the respondents had some level of education. 46% of respondents had tertiary education and thus the reason why most were workers or employees. Another 36% had Secondary level of education. These two comprise 80% of the productive group, i.e. employed or in business. From the survey, it was also established that the average incomes per household were between KShs.20,000 and KShs.30,000 per month as shown by table 4.4.

Table 4.4: Household Incomes

Household Income, KShs.	Count	Mean	% of Total	Cumulative %
1-10,000	30	150,000	17	17
10,001-20,000	39	585,000	22	39
20,001-30,000	47	1,175,000	27	66
30,001-50,000	31	1,240,000	18	84
> 50,000	9	450,000	5	89
No response	20	0	11	100
Total	176	3,600,000	100%	

Source: Field Survey, 2017

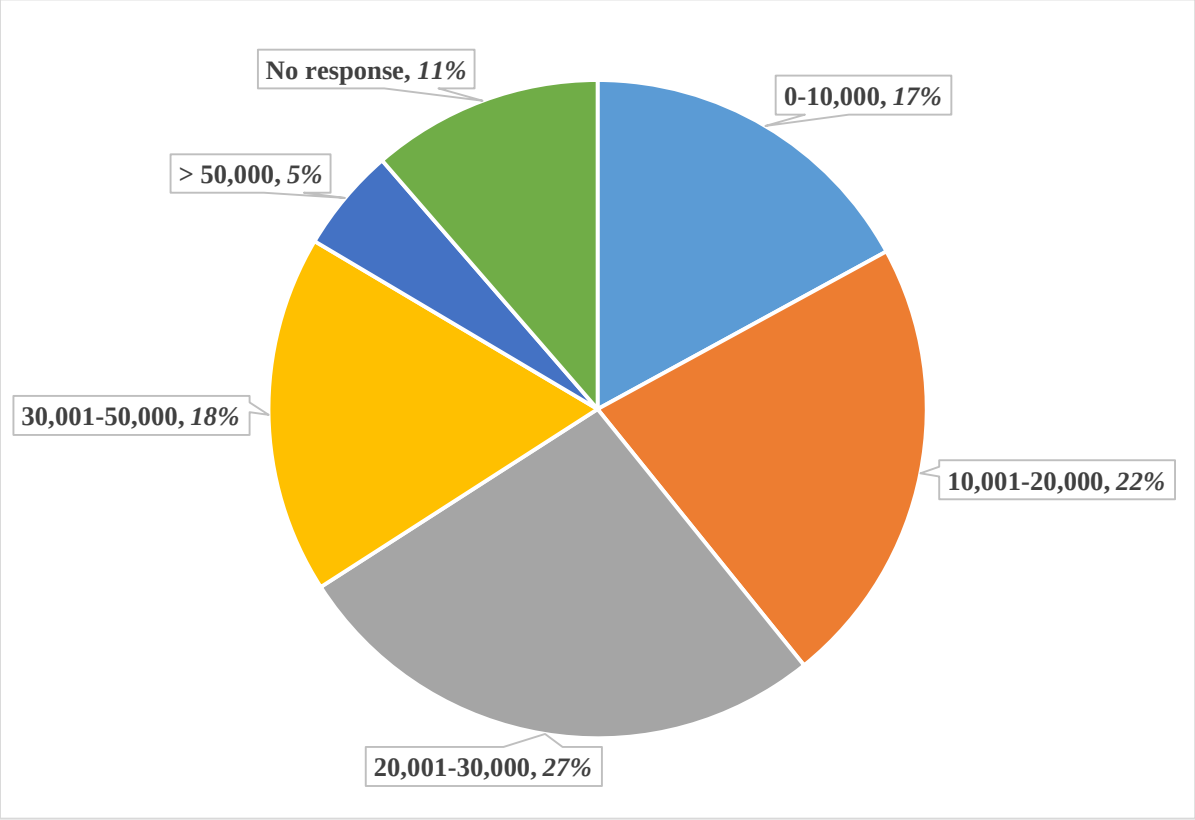
It was estimated that the average income was about KShs.20,454/-. The average monthly income, may be computed as follows;

Simple Mean, X =3,600,000/176=20,454.54/-

This monthly income was above the national per capita income of 2015 which was pegged at USD 1,361 (KIPPRA, 2017), translating to about KShs.11,682/- per month at an exchange rate of KShs103 to 1USD. However, Kenya is now recognized as a middle income country and threshold income is expected grow to USD5,600 (about 48,067/-per month) by year 2030 (KIPPRA, 2017).

From Figure 4.1 it was also noted that most households have a source of income monthly albeit 11% of the respondents did not give a response. It was observed that only 17% of the respondents earned below KShs10,000 while over 22% earned between KShs10,000 and 20,000. Formal employment and self-employment had a larger share of source of income by 33% and 36% respectively. 5% of the respondents earned more than KShs50,000 per month which is above the projected monthly income for middle income countries. Figure 4.1 shows distribution of Household Income

Figure 4.1: Distribution of Household Income



Source: Field Survey, 2017

From figure 4.1, it was observed that about 67% of respondents earned between KShs10,000/- and KShs50,000/-per month. It can also be assumed that all respondents had some income because only 11% did not give a response as to how much they earn. Table 4.5 below shows the duration of stay of the respondents in the study area.

Table 4.5: Duration of Stay in Present Residence

Duration of Stay	Frequency	Frequency, %	Cumm, %
less than one year	11	6	6
1-5 years	92	52	59
5-10 years	35	20	78
over 10 years	36	21	99
no response	2	1	100
Total	**176**	**100**	

Source: Field Survey, 2017

From the findings, only 6% has stayed for less than one year. The field study also showed that nearly 40% of the respondents have lived in the study area for 5 years and above. Hence, they were familiar with the subject of study and had seen the changes brought about by these transport facilities. 21% of respondents have lived in the area for over 10years which could suggest they are either homeowners or people with stable income if they are renting.

4.3 Trip Purpose

It was important to study the trip purpose inorder to better understand provision and utilization of the footbridges. From the field survey, it was observed that there were various trip purposes ranging from work trips, home trips, school trip and leisure trips. The three different footbridges had different proportions of each trip and the discussion herein seek to understand these dynamics.

4.3.1 Nyayo Footbridge

Nyayo footbridge is an older footbridge which was constructed in late 1990s by the then Local Government as part of the Langata road dualling project funded by the World Bank. With the expansion of Lang'ata road, it became clear that pedestrians would have difficulty crossing the four lanes of high speed high volume traffic. Inorder to provide a safe crossing, footbridges were

provided along the road which include Wilson footbridge, Makadara footbridge and Nyayo footbridge.

A close examination of these footbridges shows similar characteristics in term of design and age. It can therefore be deduced that the three footbridges were constructed round the same time, which is during the dualling of Lang'ata road. These are provided in accordance with the Transport Engineering Standards which require provision of Pedestrian infrastructure on urban motorways as a safe crossing.

Transport and Highway Engineers are concerned about minimizing delays on roads. Some of the strategies they employ include widening of the roads, limiting hindrances to speed, designing longer stretches with minimal changes in direction among others. Pedestrian crossings at grade are considered as contributors to delay on highways yet they are required to facilitate pedestrian mobility. The compromise in this case is a grade separated crossing which ensures pedestrians cross safely and the motorized traffic is not hindered in any way. Footbridges, being grade separated, are a viable solutions to this challenge.

Nyayo footbridge serves pedestrians crossing Mombasa road from Nairobi West, Makadara, Lang'ata and as far as Kibera. Table 4.6, shows the proportion of trips by purpose on the footbridge. Work trips were the highest at 69% followed distantly by home trips which were at 15%. The land use around Nyayo footbridge is mainly residential and industrial.

The footbridge being older follows conservative design with long flight of stairs on both landings and is of reinforced concrete construction. It is not shaded hence not protected from elements and has challenges with drainage and waste dumping.

Table 4.6: Trip Purpose

	Live, %	**Work, %**	**School, %**	**Shop/ recreation, %**	**Begging, %**	**Total, %**
Nyayo Footbridge	15	69	7	7	2	100

Source: Field Survey, 2017

The field study results show that showed that work trips were the most with 69% followed by home trips. This explains the previous findings where most respondents had a source of income and also the long duration of stay, about 10years, shows that these may be the homeowner. Table 4.7 shows pedestrian rating of Nyayo footbridge.

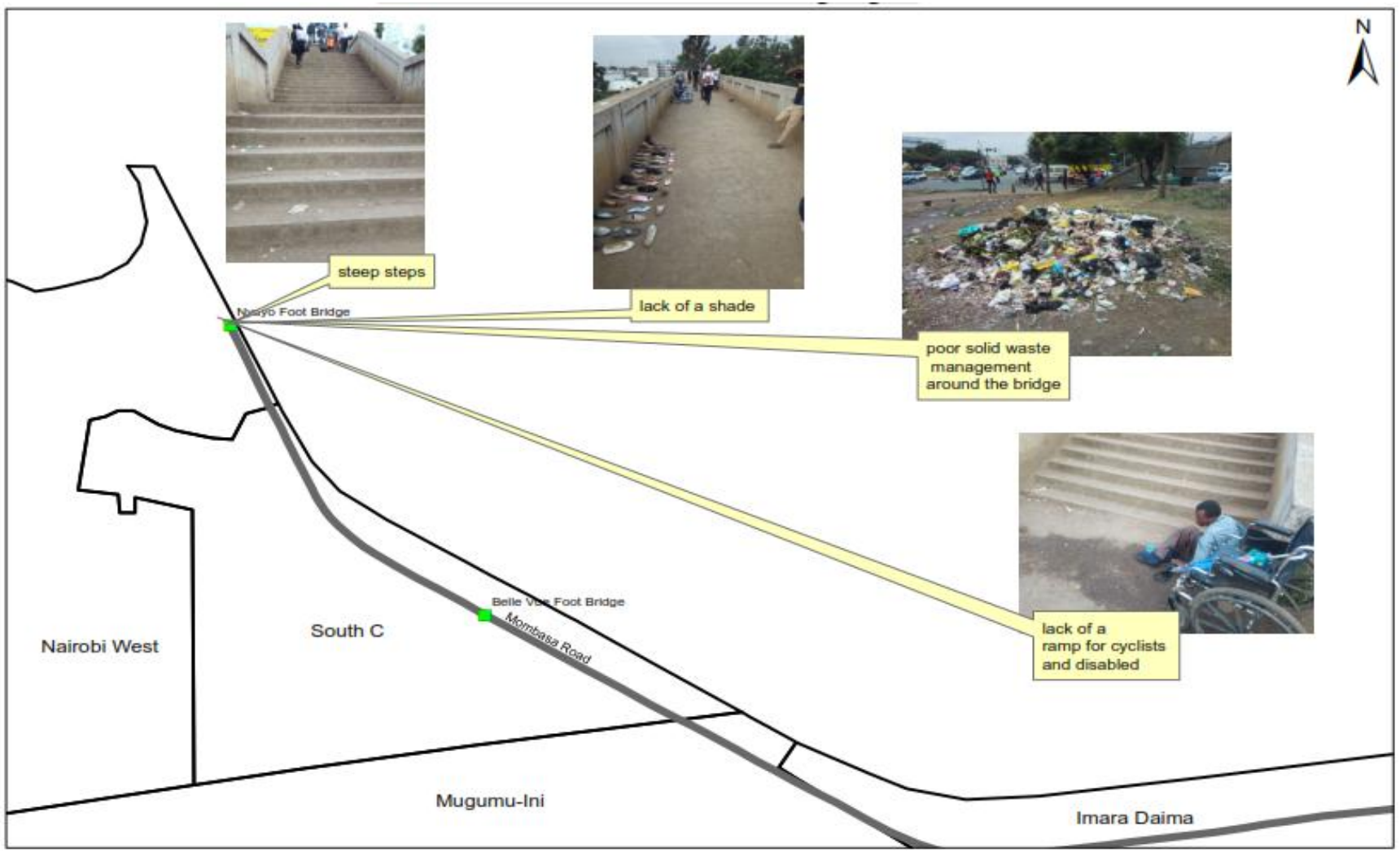
Table 4.7: Evaluation of Nyayo Footbridge

	Poor, %	**Fair%**	**Good %**	***Total, %***
Safety	10	17	72	***100***
Directness	29	28	43	***100***
Comfort	38	31	31	***100***
Amenities	74	11	16	***100***
Beauty	71	19	10	***100***

Source: Field Survey, 2017

Nyayo Footbridge was rated 'good' by 72% of the respondents in serving as a safety crossing to the road. This is because it separates pedestrians from vehicles hence protecting them against road accidents. In terms of directness, it was rated poor and fair by about 57% of the respondents. This shows that the origin and destination are not directly opposite but go through a longer way. There was equal split in terms of comfort which showed it was neither good nor poor. Comfort can be taken to mean the amount of energy expended to ascend the footbridge as shown by steep slope. Others include poor drainage, garbage damping, congestion of users, unavailability of bicycle rack for cyclists, unavailability of ramp for persons living with disabilities among others. Provision of amenities and aesthetic appeal were also ranked poorest for this footbridge with 74% and 71% rating it poorly respectively. This is because of lack restrooms, repair shops, lack of cover/shade and the demure design. Map 4.1 below shows the problem map of Nyayo footbridge.

Map 4.1: Nyayo Footbridge Problem Map



Source: Field Survey, 2017

The footbridge was found to have steep stairs which were cited as one of the challenges. The stairs also deny access to Persons living with Disability who are unable to use the stairs. The footbridge is also ill maintained making it unattractive to users. Lack of amenities, i.e. shade, seats and restrooms further contribute to its lack of appeal. The footbridge is also sited out the natural way of travel for pedestrians. Plate 4.1 shows the footbridge typology and the pedestrians using it.

Plate 4.1: Pedestrians using the Footbridge

Source: Field Survey, 2017

The pictures shows pedestrians going up the stairs, with some strain as shown by their posture. The pedestrians are also seen carrying items, some by the hand and others at the back. The pedestrians are also young and old. At the foot of the footbridge, there are some business activities going on. These businesses were selling clothes, garments, shoes and snacks. The existence of these businesses is a clear indication that there is a market for their wares which happens to be the pedestrians who use the facility, as shown by some pedestrians engaging the sales persons. These business operators provide relief for pedestrians by selling snacks, drinking water and other refreshments which re-energize them by way of replenishing lost energy. Plate 4.2 shows businesses taking place on the footbridge.

Plate 4.2: Businesses at Nyayo Footbridge

Source: Field Survey, 2017

The clothes vendors were also able to display their merchandise along the walls of the footbridges which is a larger area than they would find in formal shops or exhibition stalls. The business people spent their day on the footbridge hence for them it was more of a place to stay than pass through.

Begging was also witnessed especially by persons living with disabilities. Due to the footbridge being a corridor for passage by pedestrians, they are able to solicit collections from the pedestrians. It was also observed that these businesses are not legalized by the County Government and thus operate informally. These businesses did not pay rent and are therefore cheaper to operate. The County of Nairobi to a less extend is losing revenue.

From the field survey, it was observed that this footbridge mainly served work trips. With working hours being similar across different organizations, it is expected that during peak hours, that is morning and evening, there are more people using the footbridge than during off-peak hours. The challenge is congestion which is undesirable in terms of comfort.

Due to the business activities around the footbridge and around it, there is waste generated which is not properly disposed. A garbage heap was observed near one entry creating unsightly view which is also unsanitary for footbridge users. This as well as congestion make the footbridge less attractive to users.

4.3.2 Imara Daima Footbridge

Imara Daima Footbridge is situated on Mombasa road at the Imara Daima estate crossing. It was constructed in 2015 by the Kenya Rural Roads Authority as part of the Southern bypass project. It was constructed at a cost of KShs.70million funded by the Government of Kenya (KURA, 2017). Community participation at the planning stage was confirmed by an authoritative respondent the

Planning Project Manager, KURA. He also confirmed that their views were incorporated. It was however not possible within the operational confines of the study to obtain what the community had proposed.

The stretch of road along Imara Daima on Mombasa road is a heavy pedestrian corridor. A study in 2012 by a local consulting firm established that the area had an average daily NMT count of 6,425 consisting of 6,266-pedestrians, 123-Bicycle and 35-handcarts (Multiscope Consulting Engineers, 2012). The footbridge was constructed to serve the Eastern By-Pass/Airport North Road and not for Catherine Ndereba Road. It was also listed by the users as their top preference from the study for purposes of safety. The main function was to provide access to different land uses for NMT, to mitigate against Road Traffic Accidents, RTAs, by reducing NMT-MT conflicts, the footbridge was expected to increase road capacity leading to shorter travel times and less congestion. Construction of the footbridge was further justified so as to provide a common crossing on Mombasa Road Corridor as opposed to many indeterminate crossings across the Highway. Plate 4.3 is an image of the footbridge.

Plate 4.3: Imara Daima Footbridge

Source: Field Survey, 2017

The footbridge is constructed from steel and concrete with the main members; columns, beams and trusses being made from steel. It has two ramps on each side and a translucent roof covering along the footbridge. The ramps were found to be of very gentle slope which enabled most pedestrians to access the different land uses across the footbridge. The interior of the footbridge is as shown by plate 4.4

Plate 4.4: Inside Imara Daima Footbridge

Source: Field Survey, 2017

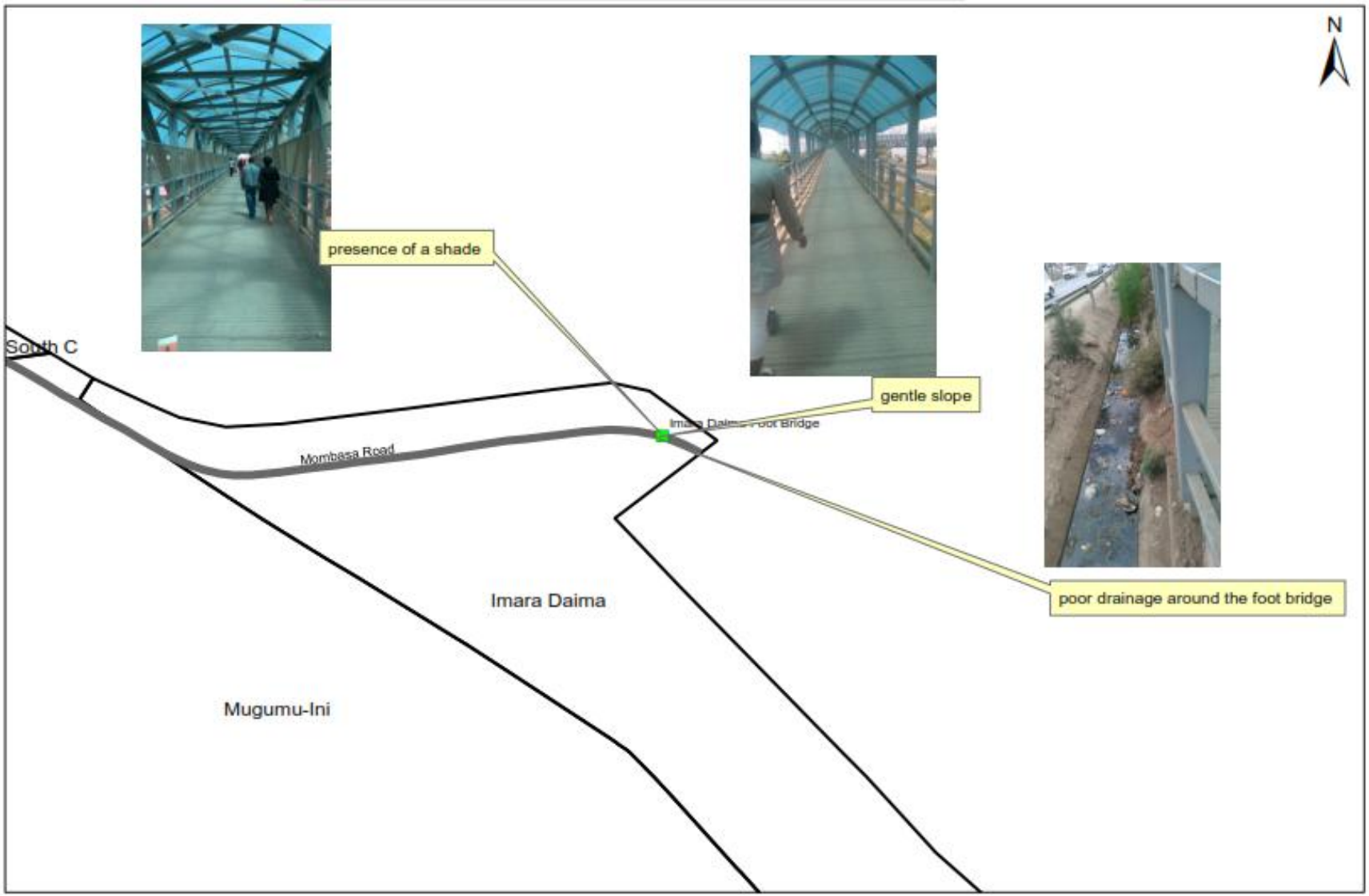
The walking surface was found clean and the sides well secured from accidental fall. This was further enhanced by providing a mesh shroud on the sides of the footbridge. This boosted the pedestrians confidence that they were within sight and hence safe from attackers. The roof covering provided a shelter from inclement weather. Inside the footbridge were also some business that were operated as shown by plate 4.5.

Plate 4.5: Businesses at Imara Daima Footbridge

Source: Field Survey, 2017

A food vendor and jeweler were found carrying their businesses inside the footbridge. Other businesses at the foot of the bridge included selling of water, fruits, sweets and cigarettes. These attested to having a good customer base. Some of the pedestrians crossing were college students and workers. The business provided pedestrians with relief along their journey especially the food and drinks. A problem map is shown on map 4.2.

Map 4.2: Imara Daima Footbridge Problem Map



Source: Field Survey, 2017

The map shows some desirable features for example presence of a shade, gentle slope, clean and clear walking areas. The surrounding area is however unkempt with poor drainage and stagnant water being seen around the footbridge.

The pedestrian walkway was observed to be clean, well aerated and ventilated providing a comfortable environment to walk through. The walkway is also well secured from accidental falls to the motor carriageway and see-through which mitigates cases of harassment and mugging. The footbridge surrounding were however were poorly drained with stagnant water causing unsanitary conditions for the environment. There was also litters of trash spread around the footbridge which was unsightly besides being an environmental hazard. The sidewalk leading up to the entry of the footbridge were also found to be discontinuous surface, while the footbridge pathway was finished with paving blocks, the sidewalk and the nearest bus lay by were earthen with uneven levels. These factors contributed to 78% of all respondents rating the footbridge poor in amenities as shown on table 4.8. Other contributors to this poor rating include lack of toilets, benches for resting, repair shops for bicycle repairs.

The footbridge is however provided with lighting from a stand alone flood lamp mast. There is also a shade provided along the footbridge making it useable during hot days as well as rainy days. Provision of a gentle slope allowed different pedestrians to use the footbridge with ease including young children, the elderly, the sick and persons living with disabilities. This gave the footbridge a good rating with 84% of respondents saying it was good in terms of comfort. However, the Assistant Inspector General, Nairobi County observed that the locational siting missed the natural pedestrian crossing point making the footbridge unattractive to some users. A further survey from the field showed that there was no physical treatment discouraging pedestrians from crossing at grade. There were cases of personnel from National Transport Service Authority, NTSA, enforcing used of the footbridge by arresting offenders. However at the time of the Study, the authority personnel were not available. This could explain the poor rating of the footbridge in terms of directness, 40% of respondents said the footbridge was indirect and out of way of way of travel as shown on plate 4.6.

Plate 4.6: Lack of Treatment discouraging at-grade crossing

Source: Field Survey, 2017

The picture shows that the median of the highway is open to pedestrians which allows them to cross from one end to another. The presence of vehicles also confirms that this is a heavy traffic corridor which poses danger to crossing at grade.

Field survey revealed that the footbridge was rated highly on safety, comfort and beauty. The pedestrians however rated it poorly for directness and amenities as shown on table 4.8.

Table 4.8: Evaluation of Imara Daima Footbridge

	Poor, %	**Fair, %**	**Good, %**	***Total, %***
Safety	4	5	91	***100***
Directness	41	29	30	***100***
Comfort	5	11	84	***100***
Amenities	78	7	15	***100***
Beauty	5	4	91	***100***

Source: Field Survey, 2017

The footbridge was rated as very safe, with 91% of respondents rating it good in terms of safety. It was also found to be comfortable which is a desireable feature for pedestrians. It was however not well provided with amenities, i.e. restrooms, resting benches etc. with 78% rating it poor. Poor drainage was observed around the footbridge as shown on the plate 4.7.

Plate 4.7: Poor Drainage around Imara Daima Footbridge

Source: Field Survey, 2017

Poor drainage is undesirable for public health, it is a ripe ground for breeding of mosquitoes. It is also unsightly and put off pedestrians especially due to strong odors that come from it.

The footbridge was designed for 2,400 pedestrians per hour. The design volume is much higher than what was observed in 2018. This is because that capacity is intended to be achieved by the end of the design life of the footbridge which in this case is 15years, (i.e. 2030) (Multiscope Consulting Engineers, 2012). The representative of the road agency[2], KURA also confirmed that an annual maintenance plan was in place though the details were not provided at the time of the study.

4.3.3 Belle Vue Footbridge

Belle Vue footbridge was constructed in 2013-2014 by KENHA funded by Kenya Roads Board Fuel Levy Fund, at a cost of construction of KShs177million [3], about USD1.8million (at an exchange rate of KShs101 to the USD. From the Consultant's report, it was observed that at Belle

[2] Project Manager, KURA, 2017
[3] Key Informant, KENHA, 2017

Vue, there were 9,635 NMT traffic comprising of 96% pedestrians, 3% bicycles and 1% hand carts (Multiscope Consulting Engineers, 2012). Here, the Consultant proposed a well-designed single sweep overpass with shops. This would enhance accessibility of the roadside economic activity centres while minimizing risk of accidents and eliminating community severance. Pedestrians would have to be channeled on top by some safety barriers/ railings to avoid jay-walking (Multiscope Consulting Engineers, 2012). The footbridge was designed for 23 to 33 persons per minute per meter with design life of 15years. It is constructed of steel with a concrete ramp running from one end to the other. The sides are made of steel railings which are sufficient to prevent falls and are clear to all preventing harassment and muggings. The footbridge does not have roof covering and the ramp was one sided. The opening of the ramp is protected from handcarts, motorcyclists by use of bollards.

The location of the site of the footbridge was informed by mix of parameters; firstly a study done of Mombasa road revealed its current site as one of the more accident-prone areas.
The footbridge was also designed to provide directness between origin and destination and also to offer safety and comfort. The designers of the footbridge were confident the footbridge would meet the needs of pedestrians and were confident the pedestrians would be enthusiazed to using it because it would crossing time (KENHA, 2017).

The footbridge is also provided with amenities which include shops and sanitary facilities. From the field survey, it was observed that there were many small businesses operational around the footbridge, licensed and unlicensed. The toilet block was however not operational as the road agency needed to enter into an operation and maintenance contract with the Nairobi City County where the latter would manage but the facility would remain solely owned by the road agency [4].
A comprehensive structural maintenance plan was also in place that focuses on structural integrity of the footbridge, i.e. joint detail, corrosion control, painting work and reinstatement of worn out parts. However, it was not determinate at the time of the study if a routine cleanliness and removal of encumbrances schedule was in place. Map shows the problem map of Belle Vue Footbridge.

[4] Project Manager, KENHA, 2017

Map 4.3: Belle Vue Problem Map

Source: Field Survey, 2017

The map shows the footbridge was made of a single ramp which was found quite steep. Presence of bollards at the entry/exit signified that handcarts were not allowed to use the footbridge, it was not clear where the handcarts were designated to cross even though they were low numbers using the footbridge. An evaluation of the Belle Vue footbridge is represented in table

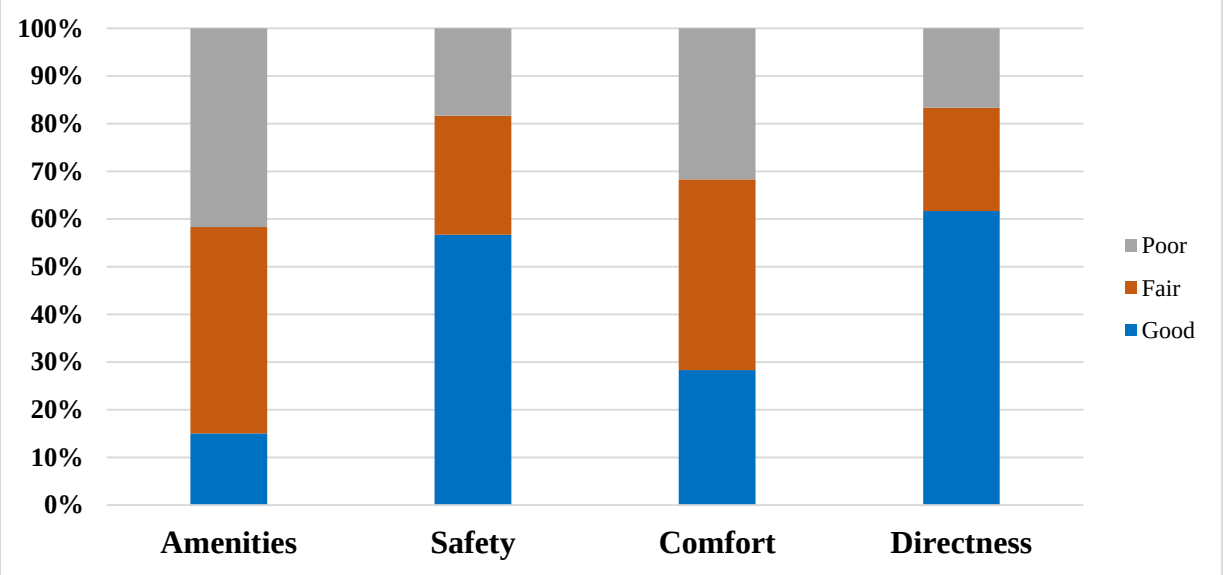
Table 4.9: Evaluation of Belle Vue Footbridge

	Amenities, %	Safety, %	Comfort, %	Directness, %
Good	15	57	28	62
Fair	43	25	40	22
Poor	42	18	32	17
Total	*100*	*100*	*100*	*100*

Source: Field Survey, 2017

The field survey, from the pedestrians, revealed that safety was improved by construction of the footbridge, with 57% saying it was good. Directness was also rated good at 62% by the pedestrians. Amenities however were rated poorly with only 15% saying they were good. The same is represented graphically by figure 4.2.

Figure 4.2: Belle Vue Pedestrian Rating



Source: Field Survey, 2017

The business people considered the footbridge appropriate for their activities due to the many customers who patronized their businesses, which is the footbridge users. It was also observed

that 99% of all businesses operated without proper legalization with under 1% saying they were authorized by the Nairobi City County Government. On the other hand, the business operators indicated City County harassment as being one of the impediments to their businesses.

From the Kenya police records, it was observed that there was a 54% reduction in accidents after the footbridge was constructed, as shown on table 4.10. Therefore the treatment applied can be said to have reduced the Road Traffic accidents, that is reduced by over half. However, they had not been completely eliminated.

Table 4.10: Traffic Accidents at Belle Vue Crossing

	Fatality	Serious	Slight	Total
2013 –before footbridge	6	7	0	13
2016 – after footbridge	4	1	1	6
% Change	*+20*	*-86*	*+100*	*-54*

Source: Kenya Police, 2017

The median of Mombasa road, between the two carriageways was divided by metal plate barriers to prevent pedestrians from crossing the road at grade. The barriers are shown in plate 4.8 below.

Plate 4.8: Treatment to prevent at-grade crossing

Source: Field Survey, 2017

The barriers however are not impenetrable, because these barriers stretch for about 200m before and after the footbridge.

The opening/landing of the footbridge was fitted with bollards, to prevent motorcycles, handcarts and vehicles from using the footbridge as shown on plate 4.9.

Plate 4.9: Bollards at the Landing of Belle Vue Footbridge

Source: Field Survey, 2017

From the study prior to the study, it was observed that there was considerable handcart traffic, about 1% of the traffic. It was however not evident, from its structural characteristics, if the footbridge would be able to serve handcart pushers, they would have to find alternative crossings. Cyclists are able to use the footbridge due to provision of a ramp as shown by plate 4.10.

Plate 4.10: Pedestrians using Belle Vue Footbridge

Source: Field Survey, 2017

The picture shows a cyclist pushing a bicycle as another pedestrian pushes a tyre. Various other pedestrians are seen walking out and into the crossing. There is presence of a beggar on the pavement who conducts her activities from the deck. The sides are well secured with steel which provide safety from accidental falls while remaining clear to prevent harassment of pedestrians. There were businesses also observed on the footbridge as shown in plate 4.11.

Plate 4.11: Business Operations at Belle Vue Footbridge

Source: Field Survey, 2017

Besides using the Belle Vue Pedestrian facility as a crossing of the motorway below, there were 'Other' pedestrians who used the footbridge for other activities. These include business people who sold items, food, airtime, mobile money services among other items around the footbridge. There was also another class of pedestrians who used the footbridge to solicit cash and food donations at the footbridge, these were mainly PWDs.

An interview with the Kenya Police[5] revealed that Mombasa road highway was one of the killer roads in the City. The main cause of accidents was attributed to drink driving and speeding. This section of the highway had a speed limit of 50kph but most motorists ignored the rule and oversped. Public Service Vehicle, PSV, motorists however were more aware of the road and conversant with driving on Mombasa Road.

The pedestrians were also ignorant on the road, they assumed that all drivers would reduce their speed upon approaching them even though a footbridge was already provided. Another assumption by pedestrians is that they could cross the road at any point within the corridor and thus ignored designated areas of pedestrian crossing. The police also attributed the accidents to lack of respect for pedestrians by motorists.

BodaBoda operators were also accused by police of causing accidents especially due to using wrong lanes.

[5] Chief Inspector, Industrial Area, 2017

4.3.4 Emerging Issues

The land use around Mombasa Road Corridor is varied, but there are dominant land uses which are found around all the three footbridges. This includes residential land use. At Imara Daima Footbridge, there are formal residential estates in the area for middle income earners, examples include Imara Daima estate, Villa Franca Estate and other apartments. To the north east of the footbridge are the Mukuru kwa Njenga informal settlement which is high density area for low income earners most of whom walk to and from their trips. At Belle Vue, there is residential land use, again housing estates and apartments. The low income informal settlement, known as Mukuru kwa Reuben is also within the vicinity of this footbridge. There is also institutional land use for example, Kenya Bureau of Standards, Kenya Intellectual Property, Kenya Red Cross, National Environmental Management Authority among others. There are also major schools along this area as shown by Highway Secondary School, Plainsview School, Highway Educational complex among others. At Nyayo Footbridge, the land uses consists of industrial and commercial land uses as shown by the auto companies, Public purpose as represented by Nyayo Stadium sports ground, residential land use as represented by Nairobi West residential area. A review of the income per footbridge is as shown in table 4.11 below.

Table 4.11: Distribution of Household income by Location

	0 -10,000 (%)	10,001-20,000 (%)	20,001 - 30,000 (%)	30,001-50,000 (%)	>50,000 (%)	No response (%)	Total (%)
Nyayo Footbridge	12	22	34	14	3	15	100
Belle Vue	17	22	22	22	5	13	100
Imara Daima	23	23	25	18	7	5	100

Source: Field Survey, 2017

Nyayo Footbridge recorded pedestrians with the highest household income, about 51% earned more than KShs20,000/-. This is in agreement with previous studies done on Mombasa road Corridor which confirmed that Pedestrians interviewed at Nyayo earned on average KShs 20,000/- – 30,000/- (Multiscope Consulting Engineers, 2012).

Imara Daima footbridge had 23% of the respondents earning upto KSh10,000. This is directly related to land use where the land use at Imara Daima is Industrial which has high employee numbers but lower wages compared to commercial land use which pays higher than factories and

industries. In terms of provision criteria, it was observed that Imara Daima was constructed to provide a safe crossing over the Mombasa Road Corridor. This was according to user preference survey. Belle Vue footbridge was constructed to provide a safe crossing over Mombasa Road Corridor as well as to prevent community severance, which means cutting off members of one community due to barrier. Nyayo footbridge was provided as part of NMT infrastructure during the dualling of Lang'ata Road, this was to provide a safe crossing for pedestrians but also to ensure the road capacity was not hampered by delays due to pedestrian crossing.

The Kenya Police Report was used to paint the Pedestrian Safety before and after treatment of Belle Vue footbridge. Table 4.12 below shows two of the footbridges under study, that is Belle Vue and Nyayo. It also shows other areas of Mombasa Road Corridor which did not receive treatment.

Table 4.12: Pedestrian Accident Records on Mombasa Road in 2013 and 2016

		2013			2016			
	Location	**Fatality**	**Serious**	**Slight**	**Fatality**	**Serious**	**Slight**	**% Diff**
1	**Belle Vue**	**6**	**7**		**5**		**1**	***-54%***
2	**Nyayo footbridge**		**3**	**1**		**5**		***25%***
3	Kapiti Road	2	1					
4	EKA Hotel	4	1		2	1		*-40%*
5	Total Airtel	3	4		2	2		*-43%*
6	Shell Petrol Station	4						
7	South C Fly Over	4	2	1	2	4		*-14%*
8	Vision Plaza		2		2	1		*50%*
9	Likoni Round About		1	1				
10	Panari Hotel	2	1			2		*-33%*
11	Police Band/ DCI training	4			5	1	1	*75%*
12	Sameer	3	2					*-100%*
13	Foton	1			1	1		*100%*
14	Standard Group		1		1			
15	Subaru Kenya	1						*-100%*
16	Bobmil					1		*100%*
17	Mantrac					1		*100%*
	Total	***43***	***30***	***3***	***24***	***23***	***2***	*-36%*

Source: Kenya Police, 2017

From table 4.12, it is evident that treatment at Belle Vue by way of construction of footbridge, reduced the accidents by -54%. Areas around Nyayo Footbridge, Vision Plaza, Police Training/DCI and Foton showed an increase in incidences of Pedestrian accidents although the treatment here can be termed as a 'Do nothing' case during the two years in focus. An important aspect of pedestrian behavior is evident here, where they cross the road at multiple locations, this includes Foton, Sameer, Bobmil, Mantrac among others.

The role of Police in ensuring road safety is by enforcing the rule of law, arresting offenders and conducting patrols. However, this can be further improved through education of pedestrians on road safety mainly over radio, Television and other appropriate media. KENHA was also challenged to put up signs to warn motorists and pedestrians alike and also have signage on way to pedestrian crossing.

Reduction of accidents around Belle Vue can be used as justification to build more footbridges on this dangerous corridor. Another consideration is to have an all-inclusive design of footbridges to enable all types of pedestrians including the old and the disabled to use these facilities too.

A review of the utilization of the footbridges found some similarities. All footbridges were in use, with pedestrians using them to cross from one side of the road to another. The pedestrians using the facilities were also of different ages, both male and women, the young and the old, able-bodied and persons living with disabilities and informal business operators. Only Belle Vue Footbridge had a formal business operator.

All the footbridges were constructed of different materials and featured different designs. Nyayo footbridge being the oldest was constructed of concrete with staircase of both ends. This design made it unattractive to old people and difficult to use by PWDs. Belle Vue and Imara Daima footbridges were constructed of steel and had ramps running from one end to another. The Belle Vue ramp was observed to be steeper than the Imara Daima and required pedestrians to expend more energy than normal. This was a drawback to the old, the sick and PWDs. Imara Daima footbridge had a gentle slope which made the facility user friendly.

It was also observed that only Imara Daima footbridge had a shade covering pedestrians from inclement weather. Lighting was however provided on all the three footbridges which enhanced feeling of personal safety and security.

It was further observed that pedestrian crossing near constructed footbridges recorded reduced incidences of road accidents. Eka Hotel and Shell Petrol station which are situated near the Belle Vue crossing recorded -40% and -43% reduction respectively. This can be attributed to provision of footbridge at Belle Vue hence pedestrians no longer needed to cross at dangerous crossings. However, near Nyayo footbridge, which was existing before and after the two years in focus did not show any change of behavior of pedestrians. There was 100% increase in accident incidences at Mantrac, undesignated crossing abut 100m from the footbridge.

Another important observation from the Police accident report is that there were multiple pedestrian crossing over the corridor for the stretch under study. From Nyayo Footbridge to near Imara Daima Crossing there were 18 informal crossings. It is possible that there were many more crossings but since those did not experience accidents, they did not appear on the Police Accident report. This is an important consideration that Planners and designers ought to take into consideration. Emergence of multiple pedestrian crossings could be attributed to lack of channeling of pedestrians.

A properly provided pedestrian network that is well designed, direct, aesthetic appealing, comfortable and provides connectivity with other transport modes can attract pedestrians and channel them to designated crossing. Which was one of the recommendations of the Consultant to the road agency (Multiscope Consulting Engineers, 2012).

The consultant also observed that more than 50% of all trips were less than 5km which means they are local trips comprising of work to home trips. This calls for design of a good NMT network design as opposed to increasing and expanding roads.

In conclusion, the survey was able to evaluate footbridge provision considerations and utility of the same. As discussed, these facilities are constructed for the NMT, cost a lot of money and occupy prime land. Their proper utilization therefore must be secured through consultative and research efforts inorder to determine the point of equilibrium or optimal point of utilization.

CHAPTER 5 : PLANNING IMPLICATIONS FOR PEDESTRIAN FOOTBRIDGES ON MOMBASA ROAD CORRIDOR, NAIROBI

5.1 Introduction

This chapter highlights the discussion on Provision and Utilization of Footbridges on Mombasa Road Corridor and generally in Cities. It will discuss the emerging issues on status of the footbridges on Mombasa Road Corridor, interventions that may be applied, level of provision and their level of utilization. A study and comparison world's best practices on provision of footbridges is also discussed in order to inform Policy Makers on what can be integrated in the current practices.

The following discussion considered six models or options. The first is nil intervention or 'Do Nothing' treatment where everything stays as is. The second is a land use model, the third is a transport model, fourth is a formal informality model, fifth is an Integrated approach comprising harmonization of land use, transport and informality models provided side by side and lastly is Urban design where the pedestrian facility is integrated with functional land uses.

5.2 Nil Intervention

This model involves a 'Do Nothing' treatment, which means the situation is left as is. In this model, the current footbridges would be left as they are, that is at Nyayo roundabout, at Belle Vue and at Imara Daima in the Study area. The footbridges will continue to be used as they are being used. It was observed during the study that Nyayo footbridge had the highest pedestrians and so it is expected that the footbridge will continue conveying more pedestrians than the other two footbridges. The Pedestrian sidewalk is currently discontinuous and undeveloped, which would continue to be the state of affairs and pedestrians would have to do with what is provided.

Another observation from the police records was the existence of numerous crossings on Mombasa Road Corridor. These multiple crossings would continue to expose pedestrians to dangers of collisions with oncoming motorists.

The land use around the study area was found to be of mixed type. That comprised of industrial, commercial, residential, institutional, public utility and conservation. There was also real estate development coming up in various areas adjacent to Mombasa Road Corridor. With continual growth of these developments, the land use will remain mixed which at the moment gives priority

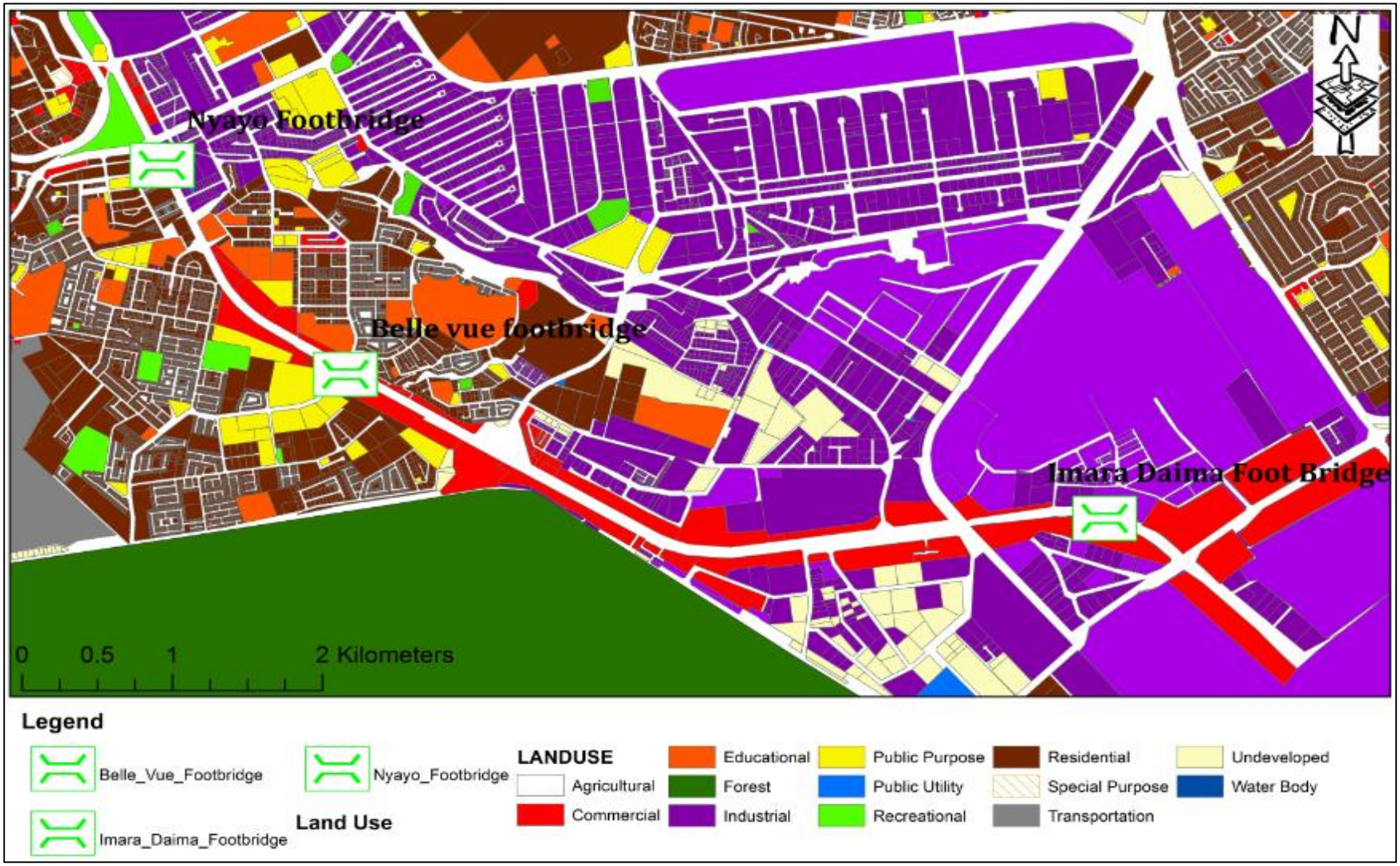
to motorized travel. On the other side, the advantage of this intervention is that there would be no costs incurred thereby saving the scarce resources available.

5.3 Land Use Intervention

This model involves re-organizing land use inorder to separate incompatible land uses and put together similar land uses. In the study area, there was mixed land use observed; comprising of industrial, commercial, institutional, transport, public purpose and conservation. Incompatible land use in the study area included residential land use in the midst of industrial land use. Some institutional land use was also found to be incompatible with industrial land use. This was attributed to emissions from factories that may affect residents and students from nearby learning institutions. Noise levels from industries were also distractive to learning activities and residential homes. Public purpose land use on the other hand was complemented by residential land use, hence when located within proximity of one another, they are better utilized. Such proximity would also bring about need for NMT infrastructure development hence changing form and character of land use.

This intervention proposes zoning the Eastern and North Eastern of the study area as Industrial land use. This would see concentration of factories and industries in one area. It would translate into easier and cheaper provision of utility services e.g. water, waste disposal, electricity etc. Land subdivision would also be reduced to a minimum as there would be larger land tracts allocated to industries as opposed to residential homes and institutions. Commercial and institutional land use may also be allocated here to provide for support services to manufacturing and processing businesses and operations. Provision of transport infrastructure would also be cheaper and easier for example railway, pipeline and road. Transportation of workers and employees would be better organized by use of mass transit and dedicated roads and walkways. On the Western side of the study area, this study proposes compact residential, institutional, commercial, transport and public purpose land use which complement one another. Due to compact residential areas, it would be cheaper and easier to distribute services e.g. electricity, water supply and waste water reticulation. A recreation and shopping area is also proposed in this area to provide a place for residents to unwind and relax as well as do shopping. Learning institutions would also be located in this area to allow for local travel from home to school whereby walking and cycling would be the preferred mode of transport. This model is represented in Map 5.1 below.

Map 5.1: Land Use Model



Source: Adapted from Survey of Kenya, 2017

5.4 Transport Intervention

This is another alternative where the study proposes developing a transport policy with priority on NMT against Motorized modes. In this intervention, the study proposes development of a good network of NMT transport infrastructure.

This includes well defined, clean and appealing walkways in the residential and work that easily attracts people to walk. Interconnectivity of pedestrian infrastructure to Public transport infrastructure is also proposed in this model so as to ensure that pedestrians are able to change from walking to Public transport seamlessly.

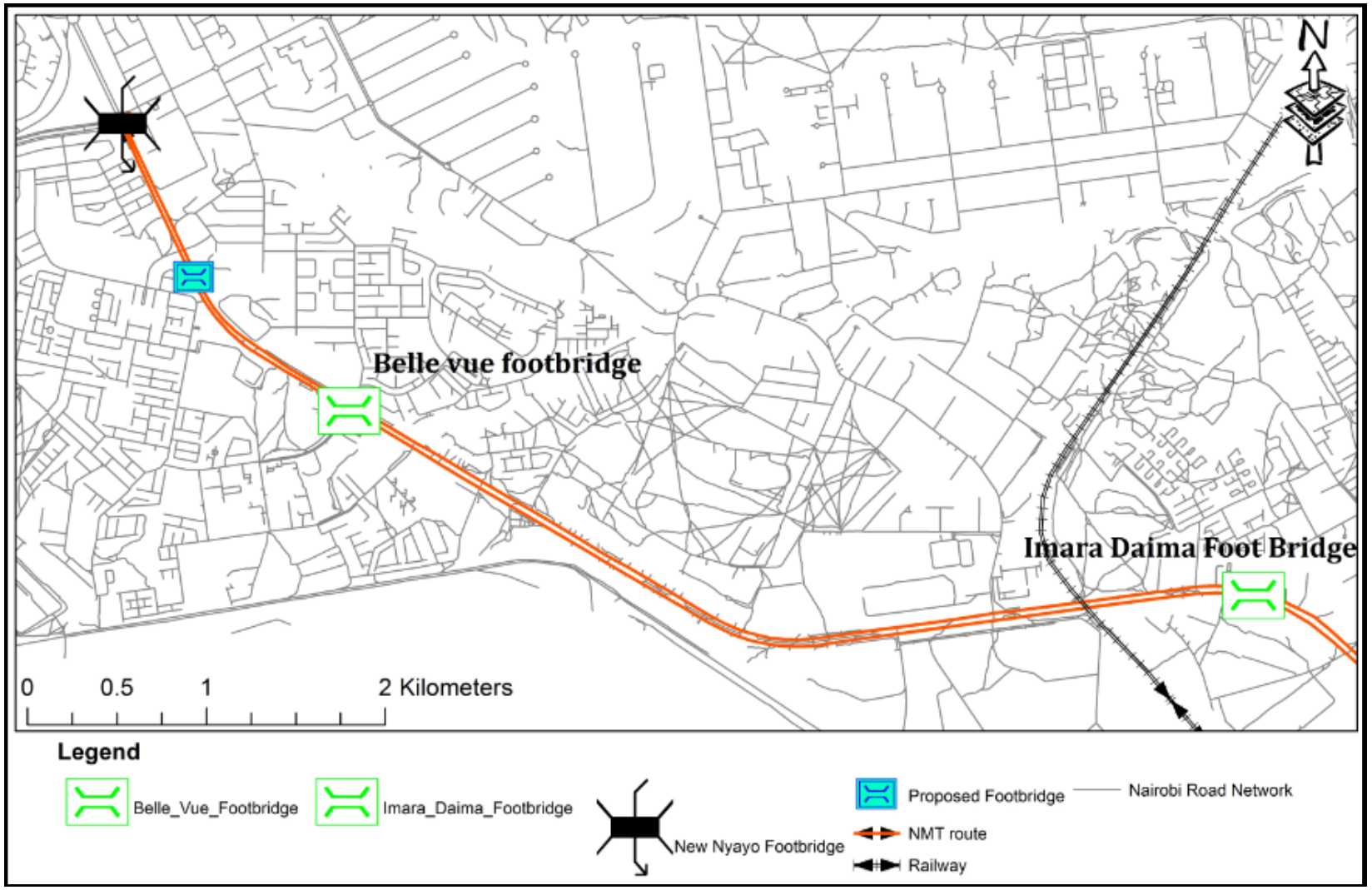
Along the busy Mombasa Road corridor, a well-defined walkway is proposed which will channel pedestrians along the NMT route onto the provided crossings thereby avoiding indeterminate crossings. The model is shown in Map 5.2. This would be seen as the most important addition to the Pedestrian infrastructure in curbing pedestrian –motorist conflicts.

A new footbridge is envisaged between Belle Vue and Nyayo Footbridges. This is proposed at the Police Band/DCI crossing which according to the Police records, table 4.12, had a higher proportion of pedestrian accidents compared to other undesignated crossings. This would provide a safe crossing of pedestrians who need to access institutional land use, shopping and residential areas too.

The transport intervention also proposes a land mark footbridge to be constructed at the intersection of Lang'ata road, Mombasa road and Lusaka road. This would replace the current Nyayo footbridge and would act as an urban design element to liven the space.

For hearing impaired pedestrians, use of traffic lights and proper signage is proposed to ensure they can move around unaided. Voice prompts and pedestrian priority signals are also proposed at all grade crossings in order to prioritize pedestrians.

Map 5.2: Transport Model



Source: Author, 2017 (Adapted from Survey of Kenya, 2017)

5.5 Informal and Formal Sector Intervention

This intervention proposes designing the land use for both formal and informal business activities which would attract pedestrians to them.

From the field survey, it was observed that informal business operators had established their activities on all the three footbridges and in areas surrounding whereby they sold mobile phone airtime, fruits, water and soft drinks, peanuts, boiled maize and other snacks. Monthly income distribution is shown on table 5.1.

Table 5.1: Earnings for the Informal Sector at the Footbridges

Earning range, per month (KShs.)	Proportion, %
1,000-5,000	27
5,001 -10,000	40
Over 10,001	33

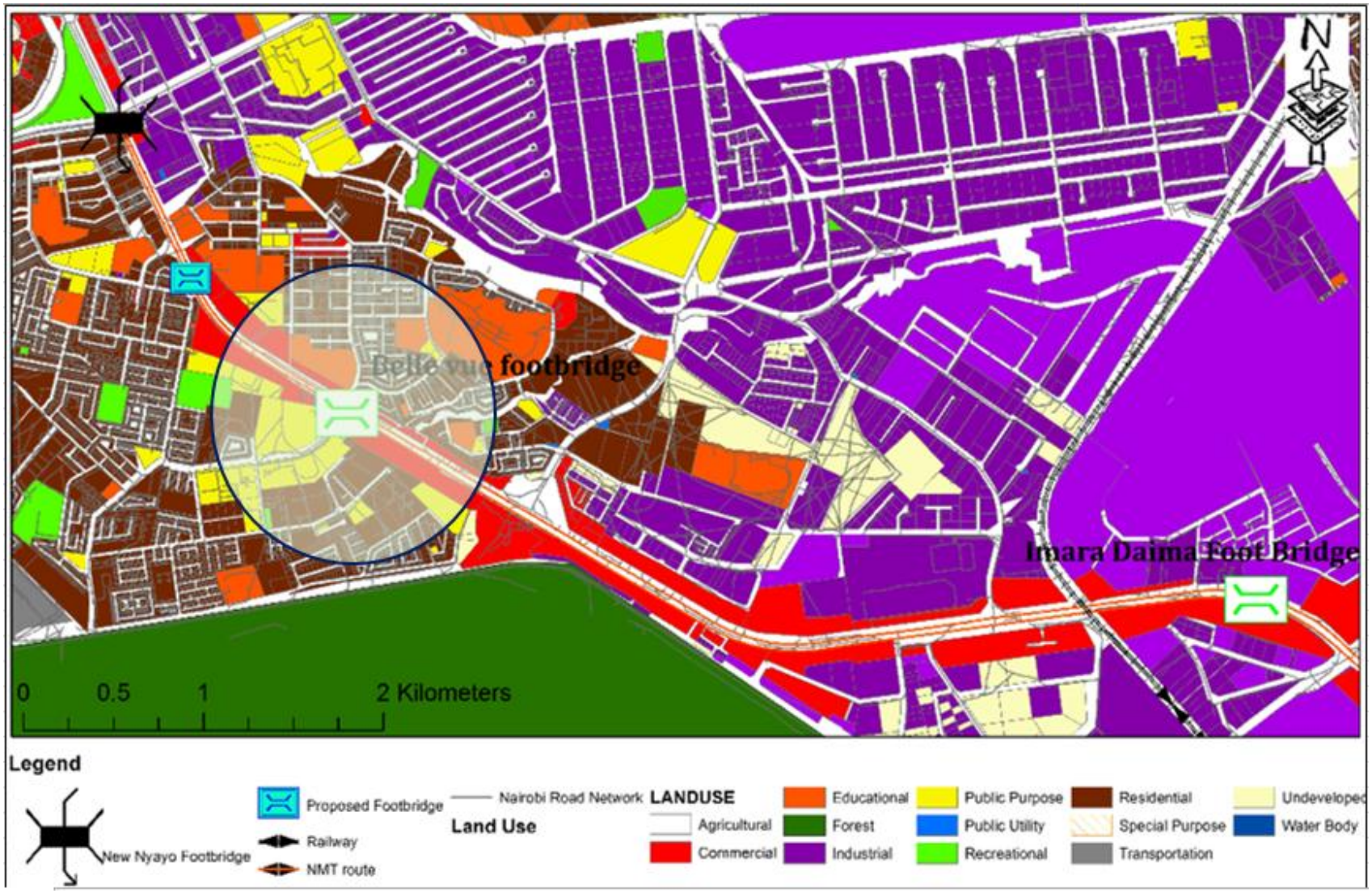
Source: Field Survey, 2017

Out of the business operators that were interviewed, 73% confirmed that they earned over 5,000/- per month as shown on table. This sector is important in creation on employment. In 2017, the informal sector employment was at 83% of total employment in the country (KIPPRA, 2017).

Table 5.1 also shows that the informal traders located around the footbridges realized the incomes due to the availability of a market made up of pedestrians. The Kenya Vision 2030, seeks to raise incomes through development of the retail trading sector by providing opportunities to allow the sector to transform itself into an organized industry that is efficient with diversified and innovative product portfolio. Some of the ways to realize this is by creating formal market outlets for these operators, encouraging investment in retail trade, development of credit and development of outreach programmes and training for the traders to improve their skills (GoK, 2007).

This Study therefore proposes creation of a zone for informal trading at the pedestrian crossing on Mombasa Road Corridor. The preferable site is at Belle Vue Footbridge. This would incorporate a raised pedestrian corridor with vibrant pedestrian spaces comprising of well paved walking areas, shops, resting areas, amenities, shading from inclement weather with aesthetically appealing vistas. Map 5.3 shows the formalized informal model.

Map 5.3: Formal Informality Model



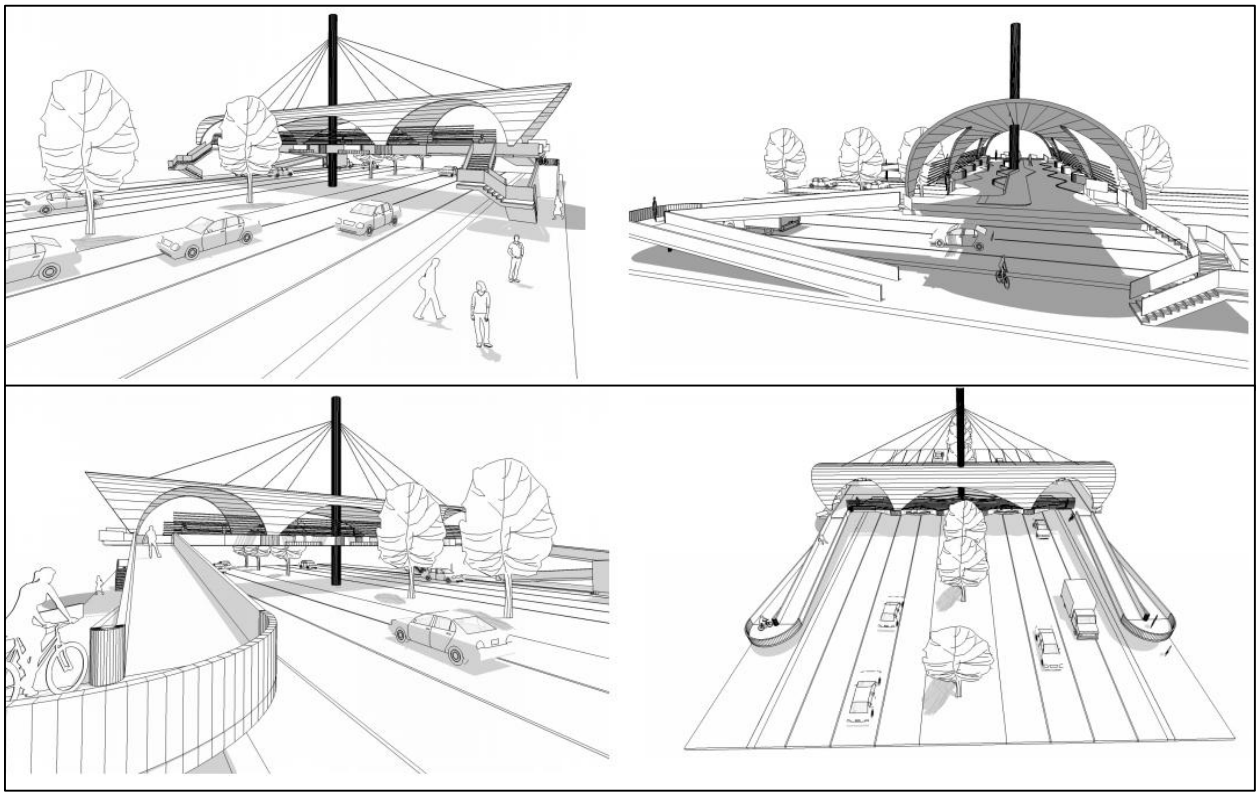
Source: Adapted from Survey of Kenya, 2017

This corridor is proposed to be expansive with interconnecting walkways into the residential estates, shopping areas, learning institutions and other pedestrian areas.

The motor carriageway would remain at grade and uninterrupted with pedestrian crossings. This is expected to improve capacity whilst reducing Road Traffic Accidents involving pedestrians.

The hashed area in the map is the proposed site for creating the business area. The circle shows area of influence of the business activities as well as catchment area for customers. Figure 5.1 below shows an impression of the proposed facility for business activities.

Figure 5.1: Artist's Impression of Trading Area and Infrastructure



Source: Author, 2017

5.6 Integrated Approach Model

The integrated approach proposes combined treatment to deal with land use, transport and informality/formality. By so doing, all the areas will have been looked at wholesomely giving rise to cohesive living, working and enjoyment space with adequate infrastructure and amenities. In this model, land use changes are proposed in the study area where eastern and North Eastern of the study area is proposed to be residential, institutional and light commercial with no industrial land use. This is designated to be living areas, work areas and learning institutions. The residents,

especially children can easily walk to school and if they have to use motorized transport, it would be quick as it would be near residential homes. Shopping trips would also be accomplished by walking unless heavy loads are being carried in which case public and private transport may be applied. Inorder to meet the walking demand, comprehensive walk ways are proposed along all the motorized carriageways complete with signaled intersections, pedestrian footbridges and sidewalks complete with signage to channel pedestrians. The walkways will have all weather surface finishing, good drainage and raised kerb to prevent motorists from encroaching on the pavement. Guard rails or another channeling measure shall be introduced along the walkway especially near former informal crossings to ensure pedestrians do not cross the road at those areas. Footbridges shall also be provided at Belle Vue, Nyayo and a new one at DCI. These footbridges shall consist of a ramp with a gentle slope and covered from inclement weather. The designs shall be creative and aesthetically appealing inorder to improve the urban form of the area. Pedestrian amenities are also proposed along the walkways and footbridges consisting of public restrooms, bicycle repair shops, snacks shops, benches among others amenities.

For motorized transport network, this approach proposes that they remain as they are, however, at grade pedestrian crossings are proposed in the residential estates and towards the learning institutions and shopping areas. Towards South East of the Study area, this intervention proposes industrial, commercial and transport land use. With concentration of work areas, in terms of factories and industries, it would also be cheaper to provide infrastructure for the factories and the workers. Among the infrastructure required is energy, transport and health. Therefore public service bus station, base stations for electricity, hospital and health clinics, fire station, police station among others will be provided. Pockets of green spaces are also proposed to break the monotony of factories and to act as carbon sinks. This model being integrated, informality is proposed to be interspersed with residential and transport land use where pedestrians are likely to walk. As shown on the current status of the footbridges, there were informal businesses selling snacks, packaged water, airtime, clothes, shoes and others offering services e.g. weight measurement, pay toilet though not operational among others. An expanded footbridge or elevated pedestrian crossing mixed with shopping and recreation area is proposed at Belle Vue crossing. The detailed land use, model and composite maps are shown by map 5.4 and figures 5.2 and 5.3.

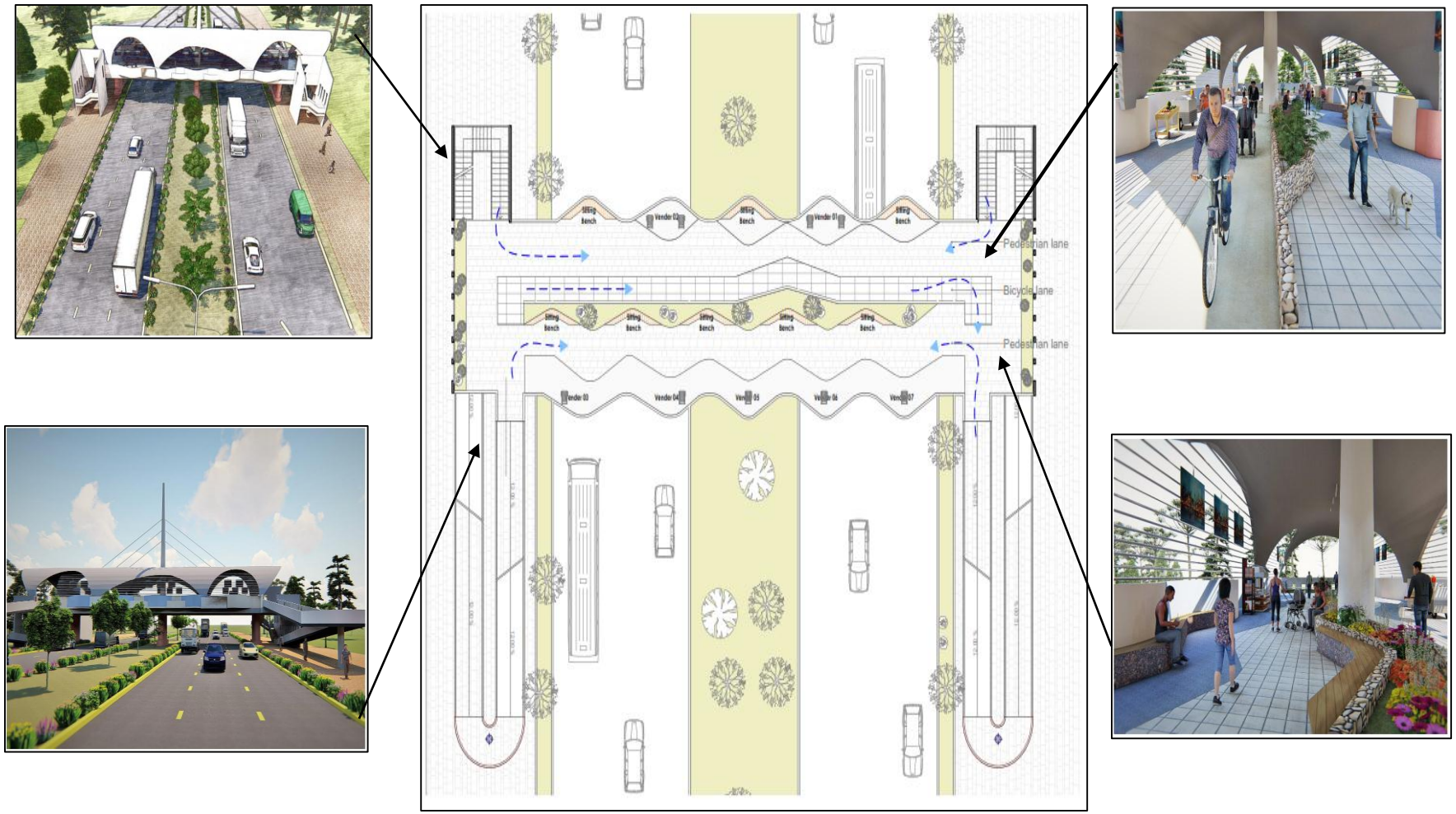
Map 5.4: Integrated Approach Model: Spatial Plan

Source: Author, 2017 (Adapted from Survey of Kenya, 2017)

Figure 5.2 Belle Vue Integrated Footbridge: Artistic Impression

Source: Author, 2017

Figure 5.3: Detailed Design Elements of Belle Vue Integrated Approach Model Footbridge



Source: Author, 2017

The proposed Integrated Belle Vue shows an all-inclusive footbridge provided with features that are attractive to pedestrians while at the same time maintaining separation of pedestrians and motorists. This would comprise many shops, eateries, an open air public gallery for arts and pockets of botanical gardens with seating benches as shown on figure 5.2. This would act as an extension of the residential, shopping and institutional land use around Belle Vue.

The model footbridge is shaded from the elements, consists of a gentle ramp which is suitable for the sick, old, PWDs and young children as less energy is expended. This design also allows mixed pedestrian traffic like joggers, strollers, mothers with children, cyclists, school children etc. Besides the ramp a staircase is provided for shorter travelling distance and is also used by persons doing exercises. The footbridge also is provided with amenities, like sitting benches, shopping areas and restrooms. The footbridge is also provided with aesthetically appealing features and a lively living space like the overall design, flower pots, well paved areas and art gallery.

Due to these attractive features, utility and amenities, it is expected that the footbridge will act as a pull factor for pedestrians out of the carriageway and thereby channel them towards safe crossing. It is therefore expected that the informal crossings will reduce. The carriageway on the other hand is expected to remain unobstructed thereby providing higher throughput on the Corridor.

5.7 Urban Design Model

Footbridges may equally be incorporated into the urban design of a City. Current designs of footbridges observed on Mombasa road were found to be of poor aesthetics and thus unattractive. Creative and innovative designs can be used to lure pedestrians and thus promote walkability and livability of a City.

This may be achieved by putting forth proposals which are integrated with NMT infrastructure. In the case of mixed land use, for example residential, industrial, commercial and institutional, a socialization function maybe met by provision of a central meeting area. This meeting area could be a physical building, built-up complex or an open space. In the case of the study area, where a barrier exists, an extended meeting/shopping and relaxation area can be installed over the highway to provide connectivity between land uses. In addition, the area was found to be heavily built up and the road reserve along the highway provided potential land for this kind or redevelopment as long as they did not interfere with transportation. An extended redevelopment of shopping areas,

relaxation and socialization areas would take place at grade while the road carriageway would remain depressed below grade.

Another function that the Authorities can consider is to promote active transportation by developing lively walking environments. In this example, barriers to walking would be removed e.g. discontinuity of walking environment, insecurity, provision of amenities etc. Another function that can be promoted is to reduce overreliance on the car. Another function would be to promote health, curb pollution and provide easy connection between public transit modes and pedestrians.

This study makes a proposal of creating an elevated walking environment complete with amenities, green spaces and safe tidy walking environments that act to channel pedestrians to the walking areas. This elevated area would run from Nyayo Stadium to the Railway Station in the Central Business District where many people are known to walk to work and school. The high number of walking population would also provide a large market to small businesses that would be incorporated on the extended walking area. Due to financial constraints by the Government, Public Private Partnerships [PPP] are envisaged where a shopping mall may be constructed on the walkway to act as a pull factor of pedestrians from walking at grade.

Proper preparation of land use maps can help the Planners and other stakeholders determine future traffic generators and thereby make provision for comprehensive NMT infrastructure beforehand. This includes footbridges, speed bumps, Signaled crossing and other traffic calming measures.

Besides the various models proposed herein, education is very important in sensitizing all City dwellers on the traffic rules, highway code, code of ethics and expected attitudes while using the active transportation corridors. The study recommends inclusion of basic safety education into the school curriculum, programs by the City Authority and Institutions to various members of the public.

It has also been established from research that as opposed to providing pedestrian crossing in designated areas, the road or barrier is installed and the pedestrians are left to determine the path/route of choice, also known as desire lines which then determine the exact area and location where pedestrian crossings are to be provided.

5.8 Conclusion

Study done in 2013 revealed that there were 27no. footbridges in Nairobi which were found on the major roads, that is Thika Superhighway, Mombasa Road, Jogoo Road, Lang'ata Road, Waiyaki Way, University Way, Haile Sellasie among other roads in the City. There were also 185no. Pedestrian signal points and 150no. Zebra Crossings. The safe and cohesive walkways were about 500km long against a requirement of 1,500km by year 2020 (NCC, 2015). These coupled with a short supply of amenities made walking unattractive, unsafe and uncomfortable as a mode of transport.

An improved and enhanced pedestrian experience is desirable for any pedestrian but even more so where nearly 50% of all trips are done by walking. The alternatives proposed in this chapter aim at improving this pedestrian experience by working around land use, transport infrastructure, formality/informality and Urban design. The integrated approach encompasses all interventions with an objective of creating an all-inclusive land use action plan to improve pedestrian experience through impacting on residential zones, working areas, recreation areas, institutional areas, infrastructure and thereby improve standards of living.

The proposals put forward in this study report are applicable to other urban motorway in Cities with a character like the study area, this includes mixed use areas on Thika Highway, Waiyaki Way and the By-passes. They may however be inapplicable in areas with very different characteristics for example when the land uses around the barrier are not heavily populated as in the study area, the cost benefit of installing pedestrian's segregation systems may not be justified. In this case, other means of crossing a barrier would have to be devised. Availability of resources may also impact provision of footbridges.

It has also been revealed when footbridges are provided where not required, they are often disused or misused. This over-provision may be in areas with alternative crossing of the barrier, for example signaled crossing at grade. In this case, the footbridge is no longer attractive and pedestrians use it for other purposes e.g. vending clothes and other wares. In very dire cases of under-use, these facilities are abandoned, soiled and often times are crime spots.

CHAPTER 6 : RECOMMENDATIONS AND CONCLUSIONS

6.1 Synthesis of the Findings

This chapter gives a summary of the issues that have been discussed in this study report and justification of carrying out this report. It therefore gives a summary of the whole study and its contribution to the field of Planning. It also makes recommendation for areas of further research. From the survey, there were various reasons that influenced provision of footbridges. Other than Nyayo Footbridge where the research did not find responsible person to answer to the questionnaire, the other two footbridges were well covered. On Belle Vue, the locational siting was principally influenced by proneness of the site to Road Traffic Accidents. Besides safety on the road, the footbridge was able to address the accessibility problem by linking the land uses but introduced exclusion of the elderly, children and persons living with disability who are unable to go up the footbridge unaided. The footbridge also failed to address comfort, with many respondents complaining of a steep slope and lack of shade.

On the Imara Daima footbridge, the Project Manager attested the locational siting of the footbridge was informed by high pedestrian volumes experienced on that area and for their safety. The land use around this area is of mixed type. There were industrial, residential, commercial, infrastructural and institutional land uses.

Footbridges are expensive to construct and occupy prime land, that is along transport corridors. These are public goods provided by the Government inorder to prevent traffic accidents and thereby raise standards of living of its citizenry. A healthy, long life has a direct and indirect relation to the Human Development Index, HDI, which is a measure of development of a nation. As Kenya embraces its new status as a middle income Country, it has the responsibility of ensuring an increasing HDI amongst other indicators.

When accidents are prevented or reduced, the populace is healthy and fit to do meaningful work. Families and especially dependants are also cushioned from loss of support and loss of their loved ones, thereby reducing mental and emotional stress and related conditions. There is less financial burden on the medical sector and thereby on the Government expenditure. Pedestrian injuries and fatalities also have a direct impact on motorists. There is vehicle repair costs, insurance expenditure as well as trauma which cannot be quantified.

From the field survey, one respondent confirmed to using the footbridges for exercising. This indicated a need for cost effective physical exercising areas which may well be provided by footbridges. The designers of the footbridges in question confirmed the facilities were not planned for activities besides walking and cycling. However, with lifestyle diseases on the rise and rising costs of living, a cost effective way of staying fit would be much welcomed by the residents. This ought to come with assurance of comfort, security and connectedness across the pedestrian walking environment. A healthy nation, as discussed above, has immense advantages on a Country's economic and social standing.

Besides providing security against Road Traffic Accidents, footbridges are important to provide access to land uses. Their provision therefore determines whether a certain population will access education, health facilities, proper nutrition from market areas and social interaction especially among families divided by barriers.

Footbridges are mainly provided as NMT facilities, it has been shown that even motorists at one point are pedestrians especially at the beginning or end of their journeys. These facilities are useful in interconnecting pedestrians with Mass Transit modes which goes a long way to ensure the heavy investment of Mass Transit modes is put to its optimal or maximum use.
When properly designed, footbridges and the walking environment have a positive impact on self-esteem of pedestrians who are mainly looked down upon by motorists and even Road Authorities whereby walking is termed as a poor man's mode of transport. Proper provision and utilization of footbridges and walking network is also an energy efficient mode by reducing over-reliance on fossil fuels through use of motorized modes and wastage due to idling engines in inefficient road networks.

6.2 Recommendations

Multidisciplinary approach to land use and designing infrastructural facilities is a prerequisite to provision of these infrastructure which eventually influence their utilization. These include Behavioral Sociologists, Economists, Engineers, Planners, Urban designers among others. Footbridges are designed for people who are organized in a certain way and behave in a certain way.

Behavioral Sociologist can be engaged to address these concerns as well as promoting cohesion among communities. Planners on the other hand prepare land use plans and can propose interconnection of various infrastructural modes. Environmentalists on the other hand look after issues of the environment for now and the future.

Settlements are mainly organized in communities. When transport infrastructure is installed, it is known to cut across family settlements and separates brothers and sisters. It is therefore expected that these people will eventually need to socialize with one another and the road becomes a barrier. Footbridges can be installed across the roads but better still an interconnection of comprehensive walking environment is better suited to serve such a community where people need to be connected to one another and to different land uses.

Where provided, footbridges must ensure that they include all pedestrians. Therefore special consideration must be made for Persons Living with Disabilities, the elderly and the young.

Mombasa road has very many crossing points, as shown by the Police report on table 4.12. Land use Planning may be applied on such an area to provide a walking environment that interconnects the area and minimizes crossing points on the highway. This reasoning may be used for similar areas especially with mixed land use and road barring NMT.

Footbridges can also be incorporated into the urban design of a City. Current designs of footbridges observed on Mombasa road were found to be of poor aesthetics and thus unattractive. Creative and innovative designs can be used to lure pedestrians and thus promote walkability and livability of a City.

6.3 Conclusion

This chapter started by synthesizing the field findings with data obtained from secondary sources. The survey was able to establish that all the footbridges were in use. Imara Daima and Belle Vue were designed for many more pedestrians than were currently being handled. Nyayo footbridge also was found to be in use nearly 20 years after its construction.

Current use of footbridges was influenced by nearness to work and residential area, provision of pedestrian access, ease of use, application of treatment discouraging at-grade crossing and legal enforcement.

It was evident from the survey that Imara Daima and Belle Vue had a lot of pedestrians who were using them to access their work areas and return to their homes (after work). Other trips included school trips, shopping and some leisure.

Another reason for use of these facilities was ease of use. The Imara Daima footbridge was named as the most user friendly footbridge with Belle Vue and Nyayo not being very user friendly. This was attributed to gentle slope and roof covering protecting users from inclement weather. Pedestrians also preferred crossings where they expend little energy therefore overcrossings with "easy" and "convenient" access provisions were found to have greater potential for attracting users (NCC, 2015).

Treatment discouraging at-grade use for example barrier at the median, Police or other authority arrests and sometimes the speeding traffic are some of the deterrents for pedestrians to cross the road at-grade crossing. Where not effectively applied, like on Imara Daima footbridge, pedestrians still crossed at grade risking their lives and those of other motorists. Legal enforcement also coerced pedestrians to use footbridges. Police arrest pedestrians who try to cross at grade which then forces most of them to use the facility.

Besides crossing the road, all the three footbridges had presence of small business operators although most activities were not authorized on the footbridge. The only allowable business activity was at the ground level of Belle Vue footbridge. The presence of business people however can be harnessed to pull pedestrians to the footbridge.

Current land use Planning does not support compact land use that is supportive to coherent NMT infrastructure. The City Planner at time of the study[6] pointed out that the current City formation was restraining integrated transport. NIUPLAN envisaged self-contained mini cities within the City with Imara Daima and Syokimau being marked as potential zones. These mini cities were expected to be of mixed compact land uses with areas for living, working and recreation. This however was yet to be incorporated by the Roads Authority, KENHA, who were responsible for international highways like Mombasa Road.

[6] City Planner, NCC

With the Mini-City Planning option, it is expected that NMT networks will be interconnected with other modes of transport.

Habitat Agenda III called for inclusion of all City dwellers. Transport infrastructure that excludes some people for whatever reason must be disallowed and in their place systems that are more responsive to users' needs should be adopted.

Extensive education and awareness ought to be disseminated amongst stakeholders and especially NMT users.

When asked about sustainability of footbridges, the Nairobi City County Roads Engineer at the time of Study[7] said these facilities are not sustainable. The current design of having pedestrians go up and down unaided is not attractive and the City ought to invest in lifts and escalators as developed in Japan, Singapore and Dubai. The Planner on her part agreed that footbridges of the future will need to be all inclusive, user-friendly and comfortable towards Livable and energy efficient Cities.

In conclusion, this study recommends an Integrated approach to provision of Footbridge in Urban areas which will tackle road crossing safety as well and an inclusive option for informal traders to carry their activities in a safe and fair manner near their customers. Another important factor is the affirmation of the pedestrians that they matter on the road. With walking mode having the highest share, it is only justified that pedestrians are provided with dignified walking and crossing areas that not only consider their safety but their convenience and comfort too.

6.4 Areas for Further Research

From the methodology of the study, the sample was conducted on three out of five footbridge which made an assumption that the same would be applicable across the footbridges in the City. Another study on the other two footbridges, i.e. City Cabanas and GM would need to be conducted inorder to compare findings with what was carried out within this study. The choice of Mombasa Road Corridor as the areas of study was assumed to represent other highways in the City. It would therefore be inorder to conduct similar research on other Urban Highways, e.g. Thika Highway,

[7] Roads Engineer, NCCG

Waiyaki Highway or other Urban Highways in Cities of other Developing Countries which have not been studied.

The study relied upon pedestrian traffic counts done before construction of Belle Vue and Imara Daima footbridges. This study recommends research into the current pedestrian traffic trends over the three footbridges and the other informal crossings on Mombasa Road.

For this study, the barriers to pedestrian crossing was a high volume, high speed motorway, since footbridges are also used over railways, water channels and natural terrain, different studies will need to be conducted over water courses, Railways (in Kenya's case the newly installed Standard Gauge Railway), over difficult natural terrain to provide comparison and contrast with this study. An integrated study of all these identified areas of further research would provide even better insight into provision and utilization of these facilities.

Finally, this study has proposed an Integrated Model as the recommendation for better provision and utilization of Pedestrian Footbridges on Mombasa Road Corridor. A detailed study on its implementation, operation, monitoring and evaluation would be required which would bring together multi-disciplinary experts overseeing the project from start to finish with an aim of increasing utilization thereby making better use of the available scarce resource.

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APPENDICES

Appendix 1 – Pedestrian Questionnaire

UNIVERSITY OF NAIROBI

ORAL INTERVIEW QUESTIONNAIRE FOR PEDESTRIANS

My name is Lilian Maigo, M.A Urban and Regional Planning Student at the University of Nairobi. I am carrying out a research project entitled "*Provision and utilization of Pedestrian footbridges in Nairobi: A Case Study of Mombasa Road Corridor*." The information provided towards this research will be treated with utmost confidentiality and will be used for academic purposes only. Kindly provide us with your name and phone number incase we might need to call you back for clarifications.

Name of Interviewee:.....
Tel no. .....
Date: .....

Part 1: PEDESTRIAN PROFILE ***(To be filled by Interviewer)***

1. What is your age bracket?
   a. 1 - 10Yrs
   b. 11-20yrs
   c. 21-30yrs
   d. 31-55yrs
   e. Over 55yrs
2. Gender
   a. Male
   b. Female
3. Interviewee`s Physical Condition
   a. Able Bodied
   b. Physically Challenged
4. What is the approximate household income (KShs.)
   a. 0 – KShs.10,000,
   b. 10,001 - 20,000
   c. 20,001 - 30,000
   d. 30,001 - 50,000
   e. Above 50,000
5. What is your educational Level?
   a. Not educated
   b. Primary Level
   c. Secondary Level
   d. Tertiary Level
6. What is your everyday occupation?
   a. Employed
   b. Businessman/woman
   c. Student (college, secondary and primary school pupils)
   d. Unemployed
   e. Retired
   f. Informal (technicians, hawkers, salonists, jua kali artisans)
7. Including yourself, how many adults over 18yrs living in your house are

a. Retired ……..
b. Not employed……..
c. Working……..

8. Do they use the footbridge?
    a. Yes
    b. No
9. If there are children in your house, how many are
    a. Under six yrs**.....**
    b. In Primary School…….
    c. In high school…….
    d. In college and University…….
    e. Not applicable…….
10. Do you have a bicycle in your home?
    a. Yes
    b. No
11. If yes, how often do you ride it?
    a. One a day
    b. Once a week
    c. Once a month
    d. Never
12. Do you have a driver's license?
    a. Yes
    b. No

Part 2: ORIGIN AND DESTINATION (*Select all that apply*)

13. What brings you to this area?
    a. Live_____
    b. Work_____
    c. Attend school/college _____
    d. Shop _____
    e. Recreation_____
    f. Other (specify)_____

14. How many times do you use this bridge?
    a. Never
    b. Once or twice a day
    c. More than twice per day
    d. Several Times per Week
    e. Few Times per Month
15. On a scale of 1 – 5, with 1 being the lowest, how do you rate footbridge in terms of?
    a. Safety (street lighting, mugging free)_____
    b. Comfort(energy use, protection from elements)_____
    c. Directness_____
    d. Amenities (sit, refresh oneself)_____

e. Beauty_____
f. Other_____

16. Were you consulted during the planning stage of the bridge construction?
    a. Yes
    a. No
    b. Not sure/Don't know

17. If yes, were your ideas incorporated?_____

    b. Yes
    c. No
    d. Not sure/Don't know

18. If not, how can the footbridge be improved?_____

19. Are pedestrians educated or encouraged to use the footbridge?
    a. Yes
    b. No
    c. Not sure/Don't know
20. Do you think awareness creation on usage among pedestrians would improve use of the footbridge?
    a. Yes
    b. No
    c. Not sure/Don't know
21. What sort of awareness do you think should be used to increase awareness of bridge usage?
    a. Television
    b. Radio
    c. Newspapers
    d. Road signage
    e. Community leaders like in church, funerals, political rallies
    f. Other.....

22. Can community groups be encouraged to organize safety workshops and proper use of footbridge?

PART 3: NEIGHBOURHOOD CHARACTERISTICS

23 Do you own the home you live in? Yes/No_____
24. How long have you lived at your present location?
    a. Less than one year
    b. 1-5years
    c. 5-10Yrs
    d. Over 10years

25. How long have you been using this footbridge?

    a. Less than one year

b. 1-5years
c. 5-10Yrs
d. Over 10years

26. Is the area around the footbridge designed to promote walking and cycling? Yes/No____
27. If no, what would you like to see provided?_____
_____
28. What do you like most about this footbridge?_____
_____
_____
29. What are the challenges you face with this footbridge?_____
_____
30. How do you think the above challenges can be addressed?_____
_____

THANK YOU!! ASANTE SANA!!

Appendix 2 – Business Operator Questionnaire

UNIVERSITY OF NAIROBI

ORAL INTERVIEW QUESTIONNAIRE FOR BUSINESS OPERATORS

My name is Lilian Maigo, M.A Urban and Regional Planning Student at the University of Nairobi. I am carrying out a research project entitled "*Provision and utilization of Pedestrian footbridges in Nairobi: A Case Study of Mombasa Road Corridor*." The information provided towards this research will be treated with utmost confidentiality and will be used for academic purposes only. Kindly provide us with your name and phone number incase we might need to call you back for clarifications.

Name of Interviewee:.....
Tel no. .....
Date: .....

Part 1: ***(To be filled by Interviewer)***

1. What is your age bracket?
    b. 1 - 10Yrs
    c. 11-20yrs
    d. 21-30yrs
    e. 31-55yrs
    f. Over 55yrs
2. Gender
    c. Male
    d. Female

Part 2: ORIGIN AND DESTINATION (*Select all that apply*)

3. When did you come to this area to do business? .....
4. What is the nature of your business? .....
   ……
5. Are you registered by City County to do business here? Yes/No……
6. If yes above, how much do you pay in rent/fees per year? .....
   ……
7. How much do you make in a month?
    a. 1,000 – 5,000
    b. 5,001 – 10,000
    c. Above 10,000

8. Which day do you have most business? .....
   ……..
9. What are your working hours, i.e. opening and closing time? .....
   ……
10. What challenges do you face while conducting your business here? .....
    ……
    ……
11. What do you like the most about this footbridge? .....
    ……
    ……
12. On a scale of 1 – 5, with 1 being the lowest, how do you rate footbridge in terms of?
    a. Business opportunities_____
    b. Safety (street lighting, mugging free)_____
    c. Comfort(energy use, protection from elements)_____
    d. Amenities (sit, refresh oneself)_____
    e. Beauty_____
    f. Other_____

13. Are pedestrians educated or encouraged to use the footbridge? Yes/No……..
    ……..
14. Do you think awareness creation on usage among pedestrians would improve use of the footbridge?
    a. Yes
    b. No
    c. Not sure/Don't know
15. What sort of awareness do you think should be used to increase awareness of bridge usage?
    g. Television
    h. Radio
    i. Newspapers
    j. Road signage
    k. Community leaders like in church, funerals, political rallies
    l. Other.....

16. Can community groups be encouraged to organize safety workshops and proper use of footbridge? .....
    ……
17. How can this footbridge be improved? .....
    ……
    ……

THANK YOU!! ASANTE SANA!!

Appendix 3 – City Planner Interview Schedule

UNIVERSITY OF NAIROBI

DEPARTMENT OF BUILT ENVIRONMENT

INTERVIEW SCHEDULE FOR CITY PLANNER

My name is Lilian Maigo, M.A Urban and Regional Planning Student at the University of Nairobi. I am carrying out a research project entitled "*Provision and utilization of Pedestrian footbridges in Nairobi: A Case Study of Mombasa Road Corridor*." The information provided towards this research will be treated with utmost confidentiality and will be used for academic purposes only. Kindly provide us with your name and phone number incase we might need to call you back for clarifications.

PART 1: RESPONDENT'S PROFILE

Name of Respondent: ..... Tel No……
Name of Organization: .....NCC.....
Designation/Position:.....CITY PLANNER.....

PART 2: HISTORICAL BACKGROUND OF THE BRIDGE

1. When was the bridge constructed? .....
2. What was the justification for constructing Imara Daima/Belle Vue/ Nyayo footbridge? *(Delete as appropriate)* .....
   .....

PART 3: COMMUNITY PARTICIPATION

3. Were the communities involved during the planning and construction of the footbridge?
   ……
4. If yes? Were their views incorporated? .....
   ……

PART 4: LAND USE

5. What is the predominant land use around the footbridge? .....
   ……..
6. It has been revealed by past studies (e.g. JICA, 2013) that the main transport mode is walking? Please explain how this affect Mombasa road……
   ……
7. Are there adequate walking facilities and amenities provided for pedestrians? Yes/No *(delete appropriately)*……
8. Please explain your answer above.....

9. What inspired the design and location of the bridge? .....
……
……
10. How would you rate the footbridge in terms of the below. 1 the lowest, 5 the highest.
    a. Directness…….1 2 3 4 5
    b. Comfort……....1 2 3 4 5
    c. Safety……1 2 3 4 5
    d. Coherence ……1 2 3 4 5

11. Are there guidelines followed in siting footbridges? .....
12. Please explain your answer above……
……
……..
13. Is there a maintenance schedule for the footbridges? Yes/No…….
    9a. Is it enforceable? Yes/No……
14. Mombasa road is set for an upgrade to an 8-lane highway by year 2030 (NUTRANS). How will that affect this footbridge and access between opposite land uses? .....
……
……
15. It is believed that by year 2050, more people will be living in the urban areas than in rural areas. How are you preparing land use around Mombasa road and in the City to handle this?.....
……

PART 6: OTHER ACTIVITIES ON THE FOOTBRIDGE

16. Are pedestrian's enthusiazed about using the bridge? .....
……..
17. What activities besides walking and cycling are planned for on and around the footbridge?.....
……
……
18. Are amenities provided around and along the footbridge to make the walking desirable?
……
19. Are there by-laws regulate provision, location and use of footbridges? .....
20. Are they enforceable? Yes/No.....
21. If not, cite the reason *(pick all applicable)*
    a. Lack of personnel to enforce in local assembly
    b. Corruption
    c. No resources are provided for enforcement
    d. Not aware of the by-laws
    e. No strong punitive measures are given to offender
    f. Other.....
22. Are footbridges sustainable? ……..
……
23. Please state any comment you would like to make on this survey and/or issues addressed
.....

Appendix 4 – City Roads Engineer Interview Schedule

UNIVERSITY OF NAIROBI

Department of Built Environment

INTERVIEW SCHEDULE FOR CITY ROADS ENGINEER

My name is Lilian Maigo, M.A Urban and Regional Planning Student at the University of Nairobi. I am carrying out a research project entitled "*Provision and utilization of Pedestrian footbridges in Nairobi: A Case Study of Mombasa Road Corridor*." The information provided towards this research will be treated with utmost confidentiality and will be used for academic purposes only. Kindly provide us with your name and phone number incase we might need to call you back for clarifications.

PART 1: RESPONDENT'S PROFILE

Name of Respondent: .....
Name of Organization: .....NCC.....
Designation/Position:.....CITY ROADS ENGINEER .....

PART 2: HISTORICAL BACKGROUND OF THE BRIDGE

1. When was the Imara Daima/Belle Vue/ Nyayo footbridge constructed? *(delete as appropriate)*……..
2. What was the justification for constructing? .....
   .....
   .....
3. What was the construction cost of the above footbridge? .....
4. What was the source of the funds for its construction? ……..
   ……

PART 3: COMMUNITY PARTICIPATION

5. Were the communities involved during the planning and construction of the footbridge?
   ……
6. If yes? Were their views incorporated? .....
   ……

PART 4: BRIDGE DESIGN AND USE

7. What is the capacity of the footbridge? .....
8. Is this facility used to capacity? Yes/No *(delete appropriately)*
9 If not, what are the reasons? .....
   ……
   If yes, what are the plans? .....
   ……

10. What is the level of service of the bridge? .....
11. Is above within the intended design? Yes/No…….....
    6a. If no above, please explain the reasons……
    ……
    ……
12. What is the criteria for choice of location for the footbridge? .....
    ……
    ……
13. How would you rate the footbridge in terms of the below. 1 being the lowest and 5 the highest.
    a. Directness……1 2 3 4 5
    b. Comfort……...1 2 3 4 5
    c. Safety……1 2 3 4 5
    d. Coherence ……1 2 3 4 5
14. What is the maintenance plan for the footbridge? .....
    ……
    ……
15. If there is no maintenance plan, what is the reason? (*pick all that are applicable*)
    a. No budget allocation
    b. No suitable personnel to carry out the maintenance
    c. Not included in the annual programme of works for assembly
    d. Other.....
16. Are pedestrian's enthusiazed about using the bridge? .....

PART 6: OTHER ACTIVITIES ON THE FOOTBRIDGE

17. What activities besides walking and cycling are authorized on and around the footbridge?
    ……
    ……..
18. Is there legal regulation around outdoor and billboards advertisement? .....
    ……..
19. Are they enforceable? If not, cite the reason *(pick all applicable)*
    a. Lack of personnel to enforce in local assembly
    b. Corruption
    c. No resources are provided for enforcement
    d. Not aware of the by-laws
    e. No strong punitive measures are given to offender
    f. Other.....
20. How much does the county make in revenues from those activities? And is it appropriated? ……..
    ……
    ……
21. Please state any comment you would like to make on this survey and/or issues addressed
    .....

Appendix 5 – Traffic Commandant Interview Schedule

UNIVERSITY OF NAIROBI

DEPARTMENT OF BUILT ENVIRONMENT

INTERVIEW SCHEDULE FOR TRAFFIC COMMANDANT

My name is Lilian Maigo, M.A Urban and Regional Planning Student at the University of Nairobi. I am carrying out a research project entitled "*Provision and utilization of Pedestrian footbridges in Nairobi: A Case Study of Mombasa Road Corridor*." The information provided towards this research will be treated with utmost confidentiality and will be used for academic purposes only. Kindly provide us with your name and phone number incase we might need to call you back for clarifications.

PART 1: RESPONDENT'S PROFILE

Name of Respondent: ..... Tel No……
Name of Organization: .....KENYA POLICE…….....
Designation/Position:.....TRAFFIC COMMANDANT-INDUSTRIAL AREA.....

PART 2: ROAD SAFETY AND SECURITY

1. What is the state of safety on Mombasa road? .....
   ……
   ……
2. The main causalities of road accidents are pedestrians. On the Imara Daima/Belle Vue/ Nyayo footbridge *(delete as appropriate)* what are the proportions of causalities…..
   .....
   .....
3. What is the relationship between motorists and pedestrians while on the road?.....
   .....
   .....
4. How do the following contribute to accidents?
   a. Pedestrians……
   b. Private Motorists……..
   c. PSV motorists……..
   d. Hawkers and small business operators…….
5. What is the most effective method of curbing road accidents? .....
   …….....
   .....
6. Footbridges, like most infrastructural structures, are security features, what are the measures you have taken to ensure they are secure……
   ……
   ……

PART 3: LEGAL ENFORCEMENT

7. What is the role of the Police in ensuring safety and security on footbridges? .....
   ……
   ……
8. Are there by-laws regulate use of footbridges? .....
   ……
   ……
9. Are they enforceable? .....
   ……..
10. If not, cite the reason *(pick all applicable)*
    a. Lack of personnel to enforce in local assembly
    b. Corruption
    c. No resources are provided for enforcement
    d. Not aware of the by-laws
    e. No strong punitive measures are given to offender
    f. Other.....
11. Are footbridges sustainable? ……..……..
    ……

PART 4: LAND USE

12. Are there adequate walking facilities and amenities provided for all kinds of pedestrians? Yes/No ……..……
    ……
13. Please explain your answer above.....
    ……
    ……
14. How would you rate the footbridge in terms of the below. 1 being the lowest and 5 the highest.
    a. Directness…….1 2 3 4 5
    b. Comfort……....1 2 3 4 5
    c. Safety……1 2 3 4 5
    d. Coherence ……1 2 3 4 5
15. Mombasa road is set for an upgrade to an 8-lane highway by year 2030 (NUTRANS). How will that affect security and safety? .....
    ……
    ……
16. Please state any comment you would like to make on this survey and/or issues addressed
    .....

Appendix 6 – Kura Roads Engineer Interview Schedule

UNIVERSITY OF NAIROBI

Department of Built Environment

INTERVIEW SCHEDULE FOR KURA ROADS ENGINEER

My name is Lilian Maigo, M.A Urban and Regional Planning Student at the University of Nairobi. I am carrying out a research project entitled "*Provision and utilization of Pedestrian footbridges in Nairobi: A Case Study of Mombasa Road Corridor*." The information provided towards this research will be treated with utmost confidentiality and will be used for academic purposes only. Kindly provide us with your name and phone number in case we might need to call you back for clarifications.

PART 1: RESPONDENT'S PROFILE

Name of Respondent: .....Telephone……

Name of Organization: .....KURA……Designation/Position:. ROAD'S ENGINEER.....

PART 2: HISTORICAL BACKGROUND OF THE BRIDGE

1. When was the Imara Daima footbridge constructed? .....
2. What was the justification for constructing? .....
   .....
   .....
3. What was the construction cost of the above footbridge? .....
4. What was the source of the funds for its construction? ……..
   ……

PART 3: COMMUNITY PARTICIPATION

5. Were the communities involved during the planning and construction of the footbridge?
   ……
7. If yes? Were their views incorporated? .....
   ……
   ……

PART 4: BRIDGE DESIGN AND USE

8. What is the capacity of the footbridge? .....
9. Is this facility used to capacity? Yes/No *(delete appropriately)*
10. If not, what are the reasons? .....
    ……
    ……
11. If yes, what are the plans? .....
    ……

12. What is the level of service, LOS, of the bridge? .....
13. Is above within the intended design? Yes/No…….....
    If no above, please explain the reasons……
    ……
    ……
14. What is the criteria for choice of location for the footbridge? .....
    ……
    ii) Preliminary findings from the field show that the respondents find the footbridge located outside the natural walking path, i.e. it is out of the direction of travel for pedestrians. Please
    comment…….
    ……
    ……
15. How would you rate the footbridge in terms of the below. 1 being the lowest and 5 the highest.
    a. Directness……1 2 3 4 5
    b. Comfort……....1 2 3 4 5
    c. Safety……1 2 3 4 5
    d. Coherence ……1 2 3 4 5
16. What is the maintenance plan for the footbridge? .....
    ……
    ……
17. If there is no maintenance plan, what is the reason? (*pick all that are applicable*)
    a. No budget allocation
    b. No suitable personnel to carry out the maintenance
    c. Not included in the annual programme of works for assembly
    d. Other.....
18. Are pedestrian's enthusiazed about using the bridge? .....
    If Yes, please explain…….
    ……

PART 6: OTHER ACTIVITIES ON THE FOOTBRIDGE

19. What activities besides walking and cycling are authorized on and around the footbridge?
    ……
    ……..
    ……
20. Please state any comment you would like to make on this survey and/or issues
    .....
    ……

THANK YOU!

Appendix 7 – KENHA Roads Engineer Interview Schedule

UNIVERSITY OF NAIROBI

Department of Built Environment

INTERVIEW SCHEDULE FOR KENHA ROADS ENGINEER

My name is Lilian Maigo, M.A Urban and Regional Planning Student at the University of Nairobi. I am carrying out a research project entitled "*Provision and utilization of Pedestrian footbridges in Nairobi: A Case Study of Mombasa Road Corridor*." The information provided towards this research will be treated with utmost confidentiality and will be used for academic purposes only. Kindly provide us with your name and phone number incase we might need to call you back for clarifications.

PART 1: RESPONDENT'S PROFILE

Name of Respondent: .....
Name of Organisation: .....KENHA.....
Designation/Position:.....ROADS ENGINEER .....

PART 2: HISTORICAL BACKGROUND OF THE BRIDGE

1. When was the Belle Vue footbridge constructed? .....
2. What was the justification for constructing? .....
   .....
   .....
3. What was the construction cost of the above footbridge? .....
4. What was the source of the funds for its construction? ……..
   ……

PART 3: COMMUNITY PARTICIPATION

5. Were the communities involved during the planning and construction of the footbridge?
   ……
6. If yes? Were their views incorporated? .....
   ……
   ……

PART 4: BRIDGE DESIGN AND USE

7. What is the capacity of the footbridge? .....
8. Is this facility used to capacity? Yes/No *(delete appropriately)*
9. If not, what are the reasons? .....
   ……
   ……
   ……

10. If yes, what are the plans?
    .....
    ……
    ……
11. What is the level of service, LOS, of the bridge? .....
12. Is above within the intended design?Yes/No…….....
    If no above, please explain the reasons……
    ……
    ……
13. What is the criteria for choice of location for the footbridge.....
    …..……
14. How would you rate the footbridge in terms of the below. 1 being the lowest and 5 the highest.

Directness……1	2	3	4	5
Comfort……...1	2	3	4	5
Safety……1	2	3	4	5
Coherence ……1	2	3	4	5

15. What is the maintenance plan for the footbridge? .....

16. If there is no maintenance plan, what is the reason? (*pick all that are applicable*)
    - No budget allocation
    - No suitable personnel to carry out the maintenance
    - Not included in the annual programme of works for assembly
    - Other.....

17. Are pedestrian's enthusiazed about using the bridge?
    .....
18. If Yes, please
    explain……..
    ……

PART 6: OTHER ACTIVITIES ON THE FOOTBRIDGE

19. What activities besides walking and cycling are authorized on and around the footbridge?
    ……
    ……
20. Please state any comment you would like to make on this survey and/or issues
    .....
    ……

THANK YOU!