INVESTIGATION OF THE IMPACT OF ANCILLARY ROADWORKS ON ROAD SAFETY IN UGANDA: A CASE OF KAMPALA – JINJA ROAD

BY

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A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING OF KYAMBOGO UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER OF SCIENCE DEGREE IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT OF KYAMBOGO UNIVERSITY

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DECLARATION

I, **Ssebuliba Isaac**, hereby declare that this dissertation report titled **“INVESTIGATION OF THE IMPACT OF ANCILLARY ROADWORKS ON ROAD SAFETY IN UGANDA: A CASE OF KAMPALA – JINJA ROAD”** is my original work and has never been presented for a degree in any other University.

Signature: ………………………　　　Date: …………………………….

APPROVAL

We as University supervisors confirm that the dissertation titled **“INVESTIGATION OF THE IMPACT OF ANCILLARY ROADWORKS ON ROAD SAFETY IN UGANDA: A CASE OF KAMPALA – JINJA ROAD”** has been done by the candidate under our supervision.

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DEDICATION

This study is dedicated to all Engineers and other stakeholders who ensure that the country’s roads are safe for all users.

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My thanks go to the Almighty God, who lavishly gave me the endurance and resilience to undertake and complete this research to satisfaction. I would also like to express my heartfelt appreciation to my supervisors for their guidance throughout this great study, the leadership of the Uganda Police, for the support during data collection, as well as my esteemed family for their moral, spiritual, and financial support. I am forever indebted to the management of Dott Services Limited for the financial support that has enabled me accomplish this great undertaking.

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LIST OF ABBREVIATIONS

AU	African Union
GDP	Gross Domestic Product
HRAs	Highway Road Accidents
IOV	Inspectorate of Vehicles
LMICs	Low and Middle Income Countries
NRSAP	National Road Safety Action Plan
MoWT	Ministry of Works and Transport
OC	Officer in Charge
RTO	Regional Traffic Officer
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences software
UN	United Nations
UNBS	Uganda National Bureau of Standards
UNECE	United Nations Economic Commission for Europe
UNRA	Ugandan National Roads Authority
USD	United States Dollar
WHO	World Health Organisation

ABSTRACT

The 1949 Geneva Convention on road traffic put in place a unified approach to promote road safety and development of international road traffic. This coupled with the Global Sustainable Development Goals (SDGs), the United Nations Agenda 2030, African Union Agenda 2063, have had a great impact on ensuring safety on the world's roads. However, road safety for Low Developed Countries like Uganda is still a challenge, despite the adoption of the country's Vision 2040 and the launching of the National Road Safety Action Plan (2021-2026). A study to investigate the impact of ancillary roadworks on road safety in Uganda, a case of Kampala – Jinja road was conducted, with an aim of establishing a relationship between Road Signs, Road Marking, Guard Rails, Humped and Rumble Strips, Road Lights, Walkways and Service lanes with Road Safety. This study therefore used correlation research design supported by cross-sectional survey design with qualitative and quantitative approaches for interviews and questionnaires respectively. Primary data were collected from 30 field traffic officers, 19 drivers, 03 Officers in Charge (OC) traffic police stations, 36 road engineers, 01 Inspectorate of Vehicles (IOV), 01 Regional Traffic Officer (RTO) and 12 market leaders, all within the study area, whereas secondary data were extracted from accident data from Uganda Police. Questionnaire data were analysed with SPSS version 24.0. The interview data was analysed using content analysis. Results indicated that 61% of installed informatory signs, 53% of the installed regulatory signs and 40% of installed warning signs still existed on the road and others were missing which exposes road users to risk of accidents. Guardrails were still existing but some had rusted and others covered with grown grass, making them not visible to road users. Majority of road accidents were serious, accounting for 159 (47.8%) cases, followed by 130 fatalities (39.2%) and 43 (13.0%) minor accidents for the period from 2017 to 2022. A relationship between the independent variables and dependent variable, (βeta) of the study was made. Results of correlation analysis indicated that all ancillary road works were significant except road signs, yet regression results indicated that road marking (βeta = 0.207, p-value = 0.029), guardrails (βeta = 0.186, p-value = 0.045) and humps and rumbles strips (βeta = 0.260, p-value = 0.028) have a positive significant effect on the road safety unlike road lights, road signs, walkways and service lanes which were insignificant. Field inspections together with traffic police officers within the study area, identified 14 blackspots with high annual frequency of accident occurrence in the section between Lugazi and Kitigoma village. It is concluded that road marking, guardrails and humps and rumbles strips significantly affect road safety. The study recommended that construction of humps and rumble strips of moderate size, visible road marking with higher retro reflectivity and strong guardrails, can help in ensuring road safety with support of enforcement of traffic laws of Uganda.

Key words: Impact, Ancillary, Roadworks, Road Safety, Accidents

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

More than 1.2 million people die on the world's roads each year, according to the World Health Organization (WHO) worldwide status report on road safety for 2023 (WHO, 2023). Its predicted that road collisions will be the 5th leading cause of death, if nothing is done by 2030. Road collisions and deaths are higher in low and middle income countries (LMICs), with a prediction on over 90% fatalities originating from such countries; yet they have less than 50% of the world's vehicles (WHO, 2022). These countries have got a higher road traffic fatality rate of 21.5 and 19.5 per 100,000 populations respectively, compared to that of high income countries, which is about 10.3 per 100,000 (Haghani et al., 2022). The impact of road crashes on economic development is predicted to reduce health index at 5% for the country (WHO, 2021).

Furthermore, the new global Sustainable Development Goals (SDGs) and Agenda 2030 that were adopted by the United Nations (UN) in 2015, have had three of these SDGs relating to road safety (UNDP, 2022). These include; **SDG target 3.6:** which calls for all governments to half the number of global deaths and injuries from road accidents; **SDG target 9.1:** calling for investment in sustainable and accessible infrastructure, so as to enable growth and employment creation. This SDG further aims at developing a reliable, quality, sustainable infrastructure-inclusive of all regional and trans-border infrastructure, aimed at supporting economic development and human wellbeing; **SDG target 11.2:** which calls for safe, accessible, affordable and sustainable transport system for all by 2030; improving on road safety, by expanding public transport, not forgetting the needs of vulnerable road users such as women, older people, children, persons with disabilities, among others.

The African Union Road Safety Charter, under the Agenda 2063, was enacted with the main objective of making a policy framework for road safety improvement in Africa, as well as facilitating the creation of an enabling environment to drastically reduce road traffic crashes. Under the Agenda 2063, road safety in Africa was seen to be realised through; creation of road safety agencies, which advise governments on matters of road safety; provision of institutional support to these lead agencies; collaboration and consultative processes in preparation of road safety strategies; improvement of road safety data management systems, among others (African Union, 2016). Furthermore, with the Agenda 2063, state parties ought to technically classify roads according to their functionality; developing road safety management policies and principles for road construction; carrying out road safety inspections; putting legislations for road safety audits, among others.

In the African continent, 26.6 deaths per 100,000 of the population occur due to road fatalities, compared to the world's average of 17.5 road deaths per 100,000 people and to 9.3 per 100,000 in the European region annually (WHO, 2021). Uganda, in the last decade alone, recorded an increase in road crash fatalities from 2,597 to 3,503, representing a growth of 25.9%. The accident severity index is 24 people killed per 100 road crashes, averagely accounting for ten (10) people lost per day in road traffic crashes, which is the highest level in East Africa (UNECE, 2018).

Uganda’s vision 2040 points out that a highly integrated transport network is an enabler for economic growth and development by lowering the cost of doing business. It therefore calls for the development of a resilient, sustainable, safe and integrated transport infrastructure network so as to spur the country’s economic growth. As such, the National Road Safety Action Plan – 2021 to 2026 (NRSAP) was made for purposes of developing, implementing and evaluating actions that would systematically improve road safety (MoWT, 2022). The NRSAP developed a framework for realising road safety, which include; safer users – through ensuring lawful behaviour on the road; safer vehicles – through certification and mandatory inspection; safer roads – through audits and assessment by qualified teams; and effective post-crash response – through oversight of rescue services, all in line with the UN legal instruments and international standards.

The Uganda Police annual crime report of 2022 indicates a general increase of 17% in the number of road crashes reported as compared to the year 2021. That is to say, from 17,443 in 2021 to 20,394 in 2022. The report further details the categories of road crashes in Uganda, for the year 2021 and 2022 as follows; fatal crashes increased by 16.9%, from 3,757 in 2021 to 3,901 in 2022; serious crashes increased by 18.8%, from 9,070 in 2021 to 10,776 in 2022; minor crashes increased by 23.9%, from 4,616 in 2021 to 5,717 in 2022 (Uganda Police Force, 2023). Additionally, Uganda launched a legislative plan with an intention of improving on the road safety while on the country’s roads. The plan is aimed at generating legislative action to address road safety policy development, enactment, implementation and evaluation (WHO Regional Office for Africa, 2018).

Several studies to the impacts of road safety in Uganda have been made and the concerns for the causes of accidents detailed. Walekhwa et al., (2022), in their study about the rapid assessment of road crashes in Uganda, established that road traffic accidents are caused due to human error, weather and poor state of some roads and that government spends between USD 245 to 3590 in treating 100 accident victims. Their study concluded that it is imperative for the concerned parties to mitigate on the above causes so as to reduce on accidents and save lives and government expenditure on accident victims. Furthermore, Osuret et al., (2021), in their qualitative study about the state of pedestrian road safety in Uganda, made a desk study review of the country's road safety policy, regulatory documents and report, and established that Uganda had a non-motorised transport policy, whose implementation revealed some gaps. The needs for pedestrians were ignored in road systems of design, implementation and evaluation. This study recommended concerted efforts to coordinate road safety activities, political commitments and budgetary support by government so as to realise safety. Whereas these studies and more have been made, the impact of road ancillaries on road safety has not yet been thoroughly explored, necessitating a research about it.

1.2 Statement of the Problem

A number of road ancillaries, ranging from road signs, road marking, guardrails, humps and rumble strips, among others, have been fixed/installed on different roads within Uganda, in accordance to the General Specification for Roads and Bridge works issued by the Ministry of Works and Transport (MoWT, 2005), with the main aim of achieving a uniform approach to road safety. A fully functioning road ancillary infrastructural system is meant to provide a transport system that is able to accommodate human, vehicle and environment related errors by providing a safe operating environment for all road users of any given road. However, over time, such road ancillaries have faded, been vandalised or knocked down but later on not reinstated. A deteriorated road ancillary system, which is later not refurbished, poses a danger to the safety of the different road users, since the hazard for which they were initially installed still exists throughout the road’s design life and beyond. Statistics from the annual Uganda police crime report over a six (6) year period, that is to say, 2017 – 2022 indicate that, among others, fatalities due to over speeding increased from 115 in 2017 to 125 in 2022, obstacles on the carriageway increased from 0 in 2017 to 05 in 2022 and reckless driving fatalities increased from 1480 in 2017 to 2644 in 2022. These can further be attributed to lack of proper speed control signs, faded road markings; among others. The effectiveness of the road ancillary system on Ugandan roads, if not checked, may give rise in the number of road fatalities and all its adverse effects on the country’s GDP due to anticipated increased expenditure on accidents victims(Walekhwa et al., 2022), among others. Road safety can, among others, be realised through a fully functional road ancillary system, that will ease the pressure on traffic law enforcement officers, since drivers and other stake holders have well guided safety systems when using the country's roads. It is also imperative for government and other stake holders to put up a maintenance budget such that these road ancillaries are replaced once damaged so as to realise safety on our roads. As such, a study was therefore necessary provide information as to how these road ancillaries impact on road safety, given the increasing rate of road fatalities, the maintenance patterns of existing roads and the condition of the key safety features of the country's roads. The findings of this study would give guidance on what needs to be done to reduce on accidents that would actually be avoided if such ancillary infrastructure were to be put in place.

1.3 Objectives of the Study

1.3.1 Main Objective

The main objective of the study was to investigate the impact of ancillary roadworks on road safety in Uganda, a case of Kampala – Jinja road.

1.3.2 Specific Objective

The specific objectives of the study were:

i) To characterize the current status of ancillary works on Kampala – Jinja road.

ii) To determine the relationship between the rate of accidents and the current status of the road ancillaries at black spot sections of the study area.

iii) To examine the effects of external factors to road safety in Uganda.

iv) To develop a framework that could be used in mitigating the impact of lack of road ancillaries on road safety.

1.4 Research Questions

The research was guided by the following research questions.

i) What is the current status of ancillary road features on the Kampala - Jinja road?

ii) Is there a relationship between the rate of accidents and the status of road ancillaries at black spot sections of the study area?

iii) What are the effects of external factors on road safety in Uganda?

iv) What framework can be used to mitigate the impact of lack of road ancillaries on road safety on Kampala – Jinja road?

1.5 Justification of the Study

The annual Global Road Safety Report of 2022 estimated road fatalities in Uganda to be 12,036 as of 2016, a figure whose impact was 10.1% of the death in country. According to the report, road crash fatalities and injuries in the economically productive age group, that is to say, 15 to 64 years, stood at 61% and affected 869 life years as a result of disabilities from road crash injuries per 100,000 people (The Global Road Safety Facility, 2022).

Studies by Stanley et al., (2022), Walekhwa et al., (2022), Haq et al., (2023), Osuret et al., (2021), pointed out the following as the causes of accidents on roads in Uganda; un functional policies, lack of political will on design implementations, human error, weather, nature of the roads, unqualified drivers, vehicle condition, among others as the causes of road accidents in Uganda. There is no published study that relates the impact of ancillary road works (Road Signs, Road Marking, Guardrails, among others) on road safety in Uganda. Most studies mention of the causes of road accidents but do not relate the impact of lack of such road safety measures in ensuring road safety on the country's roads, much as such ancillaries are fixed on all the roads being constructed before their final handover to the client and other stake holders. The study was therefore necessitated; given the fact the previous research has not fully related the impact of such ancillary road infrastructure to road safety for Ugandan roads.

1.6 Significance of the Study

The installation of road ancillaries on road projects is all aimed at guiding on how these roads should be effectively used by the stake holders and how traffic regulations are to be enforced by the concerned authorities. The findings of this study gave an informed view about the effectiveness of these ancillary works in ensuring road safety. The study was aimed at establishing the impact of ancillary road works on road safety in Uganda. The recommendations in this report will help in improving road safety systems within the country's roads, an action that will minimise on the government expenditure on accident victims that are admitted in the different health facility, a venture that will increase Uganda's health index. Furthermore, the findings of this study, once implemented, will minimise on the congestion of accident victims that fill up most of Uganda's health centres, hence less pressure on the emergency units of these health centres. The findings of the study can further be used by future researchers for academic purposes.

1.7 Scope of the Study

1.7.1 Geographical Scope

The study was conducted in Central Uganda, on Kampala - Jinja road, in areas covering Lugazi to Kitigoma. The study area is located in the Sezibwa region police district. Traffic accident data from the Uganda Police annual crime report of 2022, indicated that Sezibwa region recorded 405 accidents and 347 accidents in 2017 and 2022 respectively. The same report, indicated that the neighbouring Busoga North region had 187 accidents and 213 accidents for the same period on the Jinja – Kamuli Road; hence the choice of the study area. A further analysis over the year for accident data for Sezibwa region and Busoga North is detailed in Table 1.1

Table 1. 1 Comparison of Accident Data for Sezibwa Police District and Busoga North Police District

Year	**Busoga North Region**				**Sezibwa Region**			
	Fatal	**Serious**	**Minor**	**Total**	**Fatal**	**Serious**	**Minor**	**Total**
2017	64	97	17	**178**	114	159	73	**346**
2018	45	87	18	**150**	105	144	72	**321**
2019	51	82	23	**156**	122	133	59	**314**
2020	33	52	13	**98**	105	121	43	**269**
2021	57	98	10	**165**	128	112	63	**303**
2022	69	125	19	**213**	119	137	91	**347**

Source: Annual Crime Report 2017 to 2022, Uganda Police

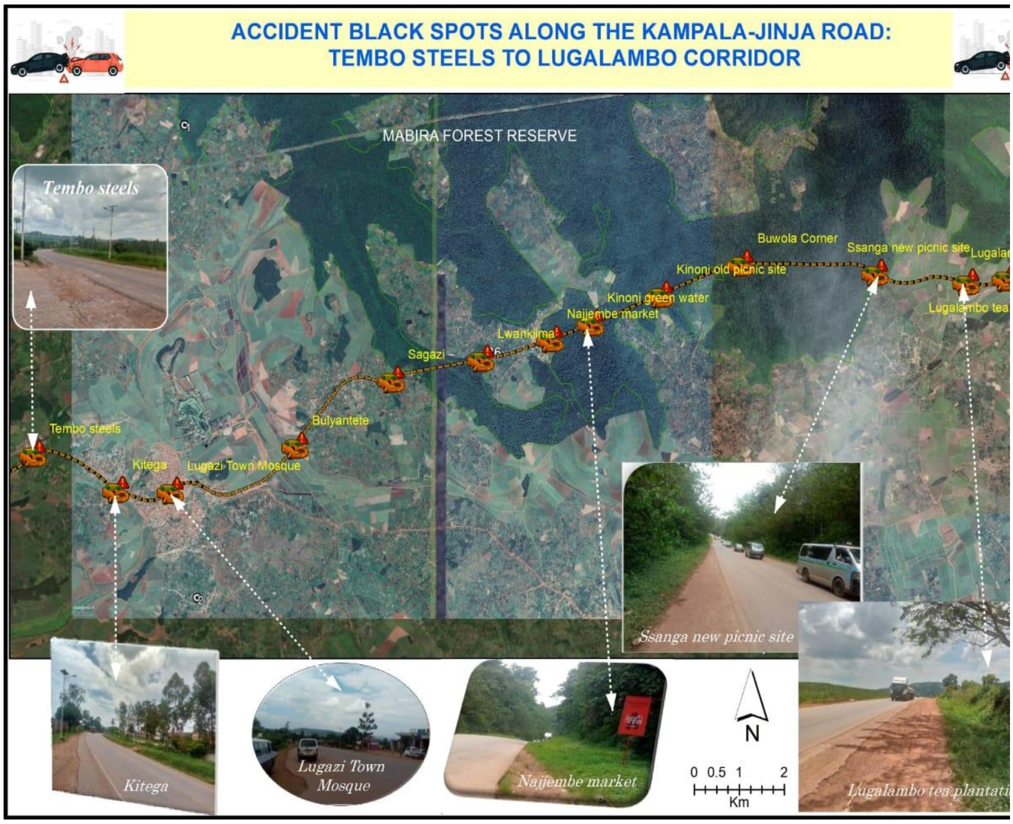


Figure 1. 1 Black Spots within the Study Area

1.7.2 Content Scope

The research was limited to ancillary roadworks along Kampala – Jinja road, specifically covering black spots from Lugazi to Kitigoma village and the fatalities that have occurred since the completion of the project and the data collected covered a period from 2017 to 2022. The ancillaries therefore considered included, road signs, road marking, humps, rumble strips, walkways, road lighting and guardrails.

1.7.3 Time Scope

The research was conducted for a period of one academic year from August 2022 to July 2023.

1.8 Conceptual Framework

The conceptual framework reflected the way variables were adopted to explain the study problem.

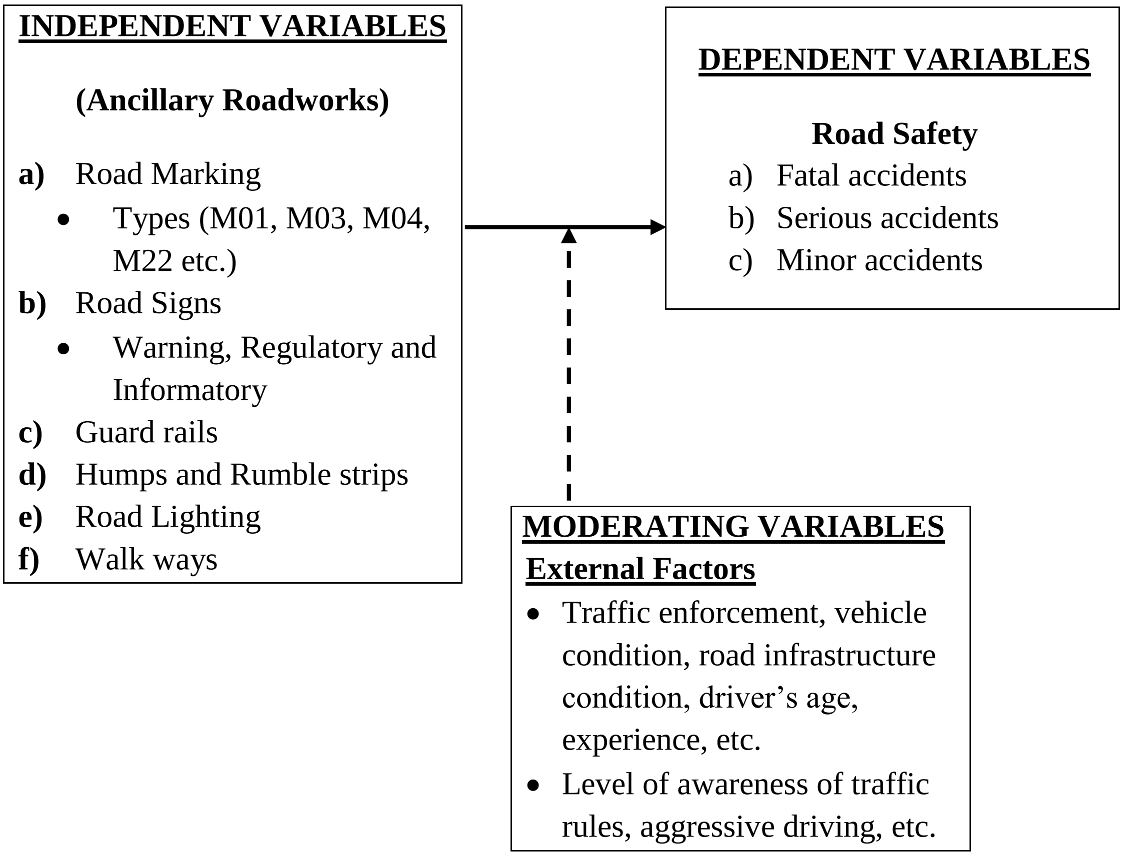


Figure 1. 2 Conceptual Framework

In Figure 1.2, ancillary roadworks was categorised as independent variables while road safety in form of fatal, serious and minor accidents, was the dependent variable for the study.

1.9 Definition of Key Terms and Concepts

Road safety: Refers to the measures that are undertaken to minimise the risk of road traffic injuries and deaths related to fatal, serious and minor accidents.

Fatal accidents. Refer to accidents in which one or more persons dies on spot or within 30 days from the date of occurrence of the accident, as a consequence of the accident.

Serious accidents: The are traffic incidents that result in significant injuries but do not necessarily lead to death. This makes victims to suffer life threatening injuries.

Minor accidents: Refer to traffic incidents that result in relatively small-scale injuries or property damage that does not lead to serious bodily harm or fatalities.

Ancillary road works: These are measures/services that are installed on the roads, with intentions of ensuring road safety. They include guardrails, road marking, road lights, road signs, humps, rumble strips and walkways.

Guardrail: A continuous barrier erected alongside a road to prevent traffic from leaving the roadway or crossing the median by accident.

1.10 Chapter Summary

Road safety is a global concern, with the WHO annual road safety report indicating a deterioration in safety on the world’s roads. However, measures have been devised to curb this, where UN member states have drafted SDGs whose vision is to half road fatalities by 2030. Based on these SDGs, Uganda as a member of the UN has followed suit in ensuring that the annual deaths on the country’s roads are reduced in line with the jointly agreed ‘decade of action’ by the UN member states. As such, a study was conducted to investigate the impact of ancillary roadworks on road safety in Uganda: A case of Kampala – Jinja road.

This study was based on four objectives, that is; examining the current status of ancillary roadworks on Kampala – Jinja road, determining the relationship between the rate of accidents and the current status of the road ancillaries at black spot sections of the study area; examining the effects of external factors to road safety in Uganda and developing a framework that can be used in mitigating the impact of lack of road ancillaries on road safety, all covering a period of one academic year. The results and discussion of the findings are therefore discussed in chapter four. The conclusion and recommendations are covered in chapter five. The next chapter (chapter two) presents the different literature that was reviewed in relation to the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Analysis of the previously researched data in relation to ancillary road works and road safety as reported by different researchers in recent studies is detailed under this chapter.

2.2 Theoretical review

Traffic control devices date back to ancient civilizations, when roads were marked in primitive ways, such as with trees or stones. The purpose of this practice was primarily navigational, and trees and stones can be considered the first directional road signs (Babić et al., 2022). This study is defined by the Geneva protocol of 1949, where the UNECE laid the standards for the widely acceptable road signs, road marking, traffic signals, among others. This protocol was further revised and later named the Vienna convention and is regularly reviewed (UNECE, 2010). The UNECE objective was to mainly achieve a uniform approach to road signs, markings and symbols. This was created with the intention of ensuring that people traveling to different countries understand these signs for their own and other road users' safety (UNECE, 2010). Uganda, like all other UN member states adopted this unified system of road marking, road signs, among others and these are fully installed on the country’s roads, according to series: 5000 of the General Specification for Roads and Bridge works issued by the MoWT, a pre-requite by all road contractors before handing over the projects. Uganda’s commitment to restoration of vandalised or knocked road ancillaries is still wanting, posing a safety danger to the different road users.

2.3 Ancillary roadworks and road safety

2.3.1 The Effect of Road Marking on Driver Behaviour and Safety

Road marking has a significant impact on road safety because it helps to regulate traffic by guiding road users and predicting the traveling trajectory and road boundaries (Babić et al., 2020). Babić et al., (2020) established that road markings form the traffic surface and provide visual guidance for road users which has positive significant relationship on road safety, and that road markings with higher retro reflectivity (>200 mcd/lx/m^2) are positively associated with lowering the number of road accidents at 95%. Road markings have become a common element of road infrastructure and one of the basic low-cost safety measures to reduce or eliminate where possible on the road accidents. According to Babić et al. (2020), drivers drive closer to the centreline on roads without edge line markings because the centreline is located on the driver's side of the vehicle, providing them with a clear and convenient reference for maintaining proper lateral position

2.3.2 The Impact of Road Signs on Driver Behaviour and Safety

Road signs must be visible and draw the attention of drivers. Drivers' awareness of road signs varies according to factors such as sign type, driver experience, familiarity with the sign, and time of day, among others (Oviedo-Trespalacios et al., 2019). Road signs are critical components of safe roads because they represent simple and cost-effective measures that can positively influence road safety, thereby reducing socioeconomic consequences due to care of accident victims, among others.

2.4 Relationship between ancillary roadworks and traffic accidents

2.4.1 Speed Limit Compliance and Speed Reduction Using Road Markings

To create an alerting response as well as the illusion of vehicle acceleration, transverse lines are painted at progressively decreasing distances apart. Furthermore, some countries use colour coded road markings to indicate the speed limit, so roads with different speed limits have different coloured centre and edge lines. In this system, centre and edge lines are painted red in low speed zones (35 km/h), yellow in moderate speed zones (50 km/h) and blue or green for higher speed zones (90 km/h and 130 km/h respectively) which significantly support road safety (Charlton, Starkey & Malhotra, 2018). For roads in Uganda, chevron markings are used at points towards the islands in case of emergency parking, and also the use of zig-zag centreline markings at sections where humps and rumble strips exist.

2.4.2 Road Markings and road safety

Multicolour road marking acts as a counter measure, with effectiveness in accident prevention, behavioural intervention and crash risk mitigation. The different colours that are used act as speed reducing elements to the drivers. Zhang et al., (2023); in their study concluded that using multicolour perceptual marking as a form of road marking was key to mitigating crash risk factors. The different marking patterns yielded great speed reduction, increased distance headway, and were effective in the correction of the lane deviation vehicles, among others. The study further noted that these multicolour patterns help in stimulating vigilance due to varying brightness and contrasts against the pavement.

2.4.3 Guardrails and road safety

The guardrails protect drivers, motorcyclist and bicycles who turn off of the road from hitting obstacles such as steep embankments, hillsides, utility poles, retaining, bridge pillars, among others, and they have a positive significant effect on road safety (Bambach, Mitchell & Grzebieta, 2013). The guardrails are key dimension used to protect road users from the accidents. Lioi et al., (2022), in their study, suggest that drivers take guardrails as a protection system, a sight obstruction and as a hard obstacle. They further suggest that the use of barriers which are higher and superior than the minimum required standards should be evaluated, and its impact on driver behaviour checked to reduce on the effects. This study therefore confirms that guardrail height has a significant impact on lateral and longitudinal behaviour. With the minimum height, drivers tend to stay closer to the roadside, while higher guardrails result in drivers increasing their lateral distance. Speeds are influenced by the interaction between the guardrail and other geometric and human factors. For Ugandan roads, according to the road safety design manual, the guardrails are amounted such that the centre of the beam is 0.55 meters (m) above the outer edge of the road shoulder and at a minimum distance of 0.60 meters (m) away for the edge of the shoulder.

2.4.4 Humps and rumble strips and road safety

Obeng et al., (2022) stated that humps and rumble strips have a positive significant relationship on road safety to limiting high-speed roadways which deter shoulder driving, or the low speed control version. The humps and rumble strips reduce some of the danger by alerting the inattentive road user when to have a right combination of interventions of reducing speed, a gesture that further minimises on traffic crashes and ensure road safety. Rumble strips are one vertical deflection traffic calming measures designed to cause noise and discomfort (tactile vibrations and audible rumbling) when vehicles pass over them. As a result, humps and rumble strips have been mostly adopted and used along major trunk roads and highways to ensure road safety.

2.4.5 Walkways and service lanes and road safety

Galanis, Botzoris & Eliou, (2017) assert that walkways and service lanes promote pedestrian mobility and have a positive significant relationship on road safety. Walkways and service lanes are safety measures that split vulnerable road users from vehicular traffic and also increase the sustainability index of an urban area as well as improving the citizens' quality of life.

2.5 Characteristics of Ancillary Roadworks in Developing Countries

2.5.1 Road signs; Road Marking and Traffic Rules Compliance

Akple, Sogbe and Atombo, (2020) examined the impact of familiarity and comprehension of traffic signs and marking on traffic rules compliance in Ghana. The study established that the percentage of drivers who correctly comprehend the meaning of road signs was lower than those who recognized such road signs. The study concluded that the familiarity and comprehension widely varies among different traffic signs and marking, and that comprehension was a major factor for driver compliance to traffic rules. It was therefore recommended that education should be offered to optimize driver knowledge of traffic signs and markings that were poorly recognized and comprehended.

2.5.2 Performance of Road signs and Road Markings

Chengula, (2018) expressed a need for appropriate signs and markings; planning; designing and implementation programs like regular maintenance and replacement of traffic signs and marking so as to realise effective performance of such road ancillaries. This study further suggested that safety to road users could increase once missing signs are installed, replacing the knocked down signs and remarking of worn out road markings as well as improving on night time retro reflectivity of road signs and markings.

2.5.3 Performance of Guardrails on Road Safety

Although guardrails are designed to reduce on the impact of road crashes for errant drivers, Li, Park & Lambert, (2017), in their study, used road crash data to assess the effectiveness of guardrails in reducing severity as a result of road crashes. This study developed a crash severity model and conducted a statistical proportions test. The results indicated that guardrails with a strong post W-Beam had more fatal and severe crashes as compared with low tension cables systems.

2.6 Road Safety Challenges and Maintenance Status in Developing Countries

Odonkor, Mitsotsou-Makanga & Nene Dei, (2020), in their study about road safety challenges in Sub Saharan Africa, categorized these into; institutional; executional; managerial and operational; attitudinal and behavioral; among others. The study conducted interviews on officials working in Road and Highways Authorities and all related road agencies; academicians with in-depth knowledge on road safety issues; members of the general population that drive vehicles; and road pedestrians. It was concluded that weak policy formulations were a challenge to road safety, and that African governments and stake holders ought to build a collaborative environment which involves everyone in the process of developing and implementing road safety strategies. Mostafa, (2018), analysed the approaches to road maintenance in Africa. In his study, it was noted that in East African, for example Ethiopia, blocks of management ownership, financing and responsibility were formed as a way of enhancing on road maintenance. The study further noted that the financial and technical requirements for effective road maintenance in Nigeria could not match the rate of deterioration of the country's road infrastructure. For Egypt, the maintenance of the country's road network constituted only 0.15% of the country's GDP; compared to countries like Ecuador (0.23%), Morocco (0.24%) and Ukraine (0.45%), and that 75% of the roads in Egypt needed maintenance. The same study further established that Angola spends close to 4.3 billion US Dollars per year on rebuilding infrastructure, equivalent to 14% of its GDP. Neupane et al., (2020), in their study, point out that road maintenance failures in developing countries are as a result of low bidding in maintenance contracts, causing poor performance and lack of adequate quality control by contractor, since the awarding systems of contracts in developing countries is based on price competitiveness. This study further recommends that there should be a quality cost trade-off, where contractors for road maintenance works are selected based on technical evaluation, financial evaluation, among others, for effective and reliable works.

2.7 External factors and road safety

Road crashes are not caused by just one factor. There are three major factors that contribute to road crashes, which are; human related, vehicle related; and road Infrastructure and Environment related factors.

2.7.1 Human Factors

a) Aggressive driving and road safety. A study by Su et al., (2023) discovered that speed was a major stimulator to aggressive driving, where aggressive drivers tend to drive much faster than natural drivers, hence causing more errors. The study further suggests that there is a positive relationship between speed and the risk of crash; making aggressive driving a road safety risk factor. Drivers would choose to drive at higher speeds due to frustrating events like slow leading vehicles, traffic congestion, hence use aggressive behaviour in response.

b) Distraction due to mobile phone usage. Mobile phone use while on the road is currently considered as one of the most road safety issue for the different road users, right from drivers to pedestrians. A study conducted on mal adaptive mobile phone use while on the road found out that 90.9% of road users with a high mal adaptive phone use were more likely to use their phones while on the road (Rahmillah et al., 2023). The study further associates this as a determinant of distraction while on the road for both motorists and vulnerable road users. It links it to road safety risk events like falling, slipping, collision, moving violations, road traffic injuries, motor vehicle crash, among others.

2.7.2 Vehicle Factors

The elements that affect motor vehicle crashes include those that result from collisions with other vehicles, people, and the environment on the road. Technically, any vehicle is characterised by both the electro-mechanical components and accessories. One of the vehicular variables considered when determining the causes of a road traffic collision is the condition of the vehicle's parts, including its tyres, braking system, and lighting system. As a result, failure of any vehicle component, such as the braking system, tyres, or lighting system, can result in an accident at any time (Haq, Ampadu & Ksaibati, 2023).

2.7.3 Road Infrastructure and Environment factors

Road infrastructural factors include the road layout, roadside environment, communication from the road signs and road marking, the road’s lighting status, among others. Cvahte Ojsteršek and Topolšek, (2019), in their study, noted that thinking of personal problems, chores and roadside advertisements, and looking at them, as well as the natural environment presents a negative impact on drivers.

2.8 Mitigation methods of road ancillaries on road safety

The WHO and the World Bank jointly released a global report on road traffic injury prevention, which described the global burden of road traffic injuries. The primary goal was to persuade governments and other stakeholders to address the issues of road traffic accidents and the consequences of those accidents. A comprehensive approach to reducing injury and death caused by traffic accidents was developed, and governments were urged to take specific actions in preventing traffic accidents, minimizing injuries, and other consequences. Among the mitigation measures, included setting Laws requiring seat belts or child restraints for all motor vehicle occupants; laws requiring bicycle and motorized two-wheeler riders to wear helmets; blood alcohol limits for drivers, with random breath testing at checkpoints (WHO, 2013). Furthermore, the report stressed that institutional assessment be carried out, which will include identifying the government ministries or institutions that are directly responsible for road safety (or whose activities have an impact on road safety) and determining their legal and regulatory roles and responsibilities.

2.9 Chapter Summary

The Geneva Protocol of 1949 defined road ancillaries. These were seen as a unifying factor in road safety for all road users, and have greatly improved road safety. For road signs, road marking, among others to be effective, they must be made of retro-reflective material to allow drivers and other road users to see them. The external factors to road safety include human factors like aggressive driving, distraction due to mobile phone usage, among others, vehicle factors are limited to the mechanical condition of the vehicle and its worthiness to be used on the road and road infrastructure and environmental factors include; road layout, roadside environment, communication from the road signs and road marking, the road's lighting status, among others. However, road ancillaries have proved to effectively minimise the risk of accidents by regulating driver and other vulnerable road users while on the roads. Several factors contribute to road accidents, and the WHO and World Bank have developed mitigation strategies to address their effects on road safety. The next chapter discusses the methodology that was used to conduct the study.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The methodology and steps that guided the study are covered in this chapter. This chapter also explains how data were collected, analysed, and presented.

3.2 Research Design

The study was intended to determine the relationship between ancillary roadworks and road traffic accidents within the study area. A correlation research design, that sought to relate both the dependent and independent variables was therefore used during the study. The correlation method helped in determining the relationship between two or more variables (Crawford, 2014). The correlation research design therefore helped in investigating the impact of ancillary roadworks on road safety for the area under study.

The study also used a cross-sectional survey design that included both qualitative and quantitative approaches to data collection, data quality control, and analysis throughout the sampling process. The qualitative approach involved the use of observations and interviews data collection methods. A series of questions, both open ended and closed ended, were structured as regards the crucial areas of the research. These interviews were done on various people, including traffic in-charges at the different police stations within the study area, Inspectorate of Vehicles (IOV) and Regional Traffic Officer (RTO). For the quantitative approach, the data was analysed numerically by finding the extent to which the variables relate and their characteristics. This was done using both inferential and descriptive statistics, for example, frequency distributions, regressions, among others (Apuke, 2017). Furthermore, in-depth information was collected through questionnaires and documentation relating to the accident data for the section under study. This yielded the required data in an economic and faster way.

3.3 Area of Study

The research was carried out along the Kampala-Jinja road, in areas covering from Lugazi to Kitigoma. This section of the road was chosen due to the high number of Highway Road Accidents (HRAs). Accident data from the published annual crime report of the Uganda Police 2022, showed that Sezibwa Police District, where the study area is located, had more accidents compared to the neighbouring Busoga North Police District. This gave a basis for choosing the study area as detailed in Table 3.1.

Table 3. 1 Comparison of Accident Data for Sezibwa Police District and Busoga North Police District

Year	**Busoga North Region**				**Sezibwa Region**			
	Fatal	**Serious**	**Minor**	**Total**	**Fatal**	**Serious**	**Minor**	**Total**
2017	64	97	17	**178**	114	159	73	**346**
2018	45	87	18	**150**	105	144	72	**321**
2019	51	82	23	**156**	122	133	59	**314**
2020	33	52	13	**98**	105	121	43	**269**
2021	57	98	10	**165**	128	112	63	**303**
2022	69	125	19	**213**	119	137	91	**347**

Source: Annual Crime Report 2017 to 2022, Uganda Police

Furthermore, the study area included several traffic checkpoints and major police stations, including Lugazi, Mabira, and Njeru, all of which were major data collection centres for road accidents, and any other information that was deemed relevant in the study.

3.4 Study population

The study targeted engineers, traffic officers at the different police stations and check points, drivers, local leaders, market leaders, and other stake-holders, all within the areas along the Kampala – Jinja road. These were presumed to give detailed information from their perspective, in line with the research since they were familiar with the area of study. The study population comprised of 42 field traffic officers from accident data collection centre police stations (that is to say, Lugazi police station, Mabira police station and Njeru police station), 03 Officers-in-Charge (OCs) traffic police (from Lugazi, Mabira and Njeru police stations), 01 Regional Traffic Officer (RTO), 01 Regional Inspector of Vehicles (IOV), 48 road engineers with knowledge about road construction, the study area and the importance road ancillaries in ensuring safety on national road networks in Uganda, 12 top management committee members representing the markets along the section under study (that is to say, Mabira/Najjembe, Lugalambo and Njeru markets), 08 local leaders form Lugazi and Njeru Town councils and 35 drivers, all totalling to a population of 150 respondents. The respondents therefore provided data regarding road user behaviours, details of black spots, road accident details, road worthiness of vehicles that use the road under study mainly those involved in road accidents, status of road ancillaries, their risk exposures (vulnerability) while conducting business long the road, among others

3.5 Sample size and Selection

Simple random and purposive sampling methods were used to select the participants, and the required sample size calculated using the Krejcie and Morgan formula (Bukhari, 2021).

Table 3. 2 Sample size determination and selection

Population Category	**Population Size (N)**	**Sample Size (n)**	**Sampling Technique**	**Instrument / Tool**	**Rationale for tool**
Field Traffic Officers	42	30	Purposive	Questionnaire	Nature of Operation
OC Traffic Police Station	03	02	Purposive	Questionnaire and Interview	Nature of Operation
Drivers	35	25	Random in interval	Questionnaire	Nature of Operation
Road Engineers	48	35	Random	Questionnaire	Expertise
Local Leaders	08	06	Purposive	Questionnaire	Nature of Operation
RTO	01	01	Purposive	Interview	Expertise
IOV	01	01	Purposive	Interview	Expertise
Market Leaderships	12	08	Purposive	Questionnaire	Nature of Operation
Total	**150**	**108**			

The Krejcie and Morgan formula.

$$n= \frac{X^2\ Np(1-p)}{e^2(N-1)+X^2P(1-p)} \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ \mathbf{3.1}$$

Where; n= Sample size; N= population; e= acceptable sampling error; X^2 = Chi-square of degree of freedom 1 and confidence of 95%; p = Proportion of population (0.5).

The Krejcie and Morgan sample determination Table was used for this study. The population category of respondents was identified in the Table to track the corresponding sample size, which was suitable for this study.

3.6 Sampling Techniques

The study used both systematic random sampling and purposive sampling techniques.

3.6.1 Systematic Random Sampling

This is a sampling method in which sample members from a given bigger population are selected randomly over a fixed periodic interval. The sampling interval was determined by dividing the population size by the sample size required. The choice of using this technique in sampling was due to its practicality (Mostafa & Ahmad, 2017). This sampling technique was used to collect data from drivers and road engineers.

3.6.2 Purposive Sampling

Under this sampling technique, a deliberate choice was made regarding the choice of respondents basing on the research specific objectives. This was based on the qualities possessed by the respondents, judgment of the researcher, among others. This technique was used to collect information from the field traffic officers, OC traffic police stations, RTO, IOV, local leaders and market leaders. Drivers were selected based on the interval of 25 minutes, since this was done by a traffic officer and were chosen with concern to commercial, passenger and private vehicles on the road at time of data collection.

3.7 Data collection methods

Quantitative data were collected through questionnaires and review of previous documentations and records, precisely road traffic accident data, while qualitative data were collected through interviews and observations.

3.7.1 Questionnaire Survey

Under this, structured questions were asked to the participants about the subject matter and their opinion as a result detailed. This enabled the collection of useful information from a bigger pool of respondents so easily. It also helped in collecting data easily from busy respondents, due to the kind of their respective work operations, for example traffic officers, some engineers, drivers, local leaders and market leaders.

3.7.2 Documentation and records

This enabled the use of existing data to conduct the study. The documents reviewed were mainly police reports, accident data for black spots, usually recorded in the accident log/book at every police station within the study area and other relevant documents that were deemed necessary, all relating to the case study. Using documents and records was efficient and inexpensive because it involved predominantly using data that had already been compiled.

3.7.3 Interviews

These helped in the collection of qualitative data. Oral responses were directly got from the respondents by asking questions that were in line with the study problem. The respondents freely exposed their views as a result. There was controlled and guided discussions, seeking clarifications where necessary. A simple and polite language, with short and clear interview questions were administered face to face to the interviewees. Interviews were conducted on the RTO, IOV and the OC traffic for Mabira and Njeru police stations.

3.7.4 Observation

Observation involved collecting information without asking questions. This method was more subjective, as it required one's judgment to the data. This was used to collect first hand data relating to the conduct of different road users in certain sections of the road, mostly black spots. The status of existing ancillary works was also assessed.

3.8 Data collection tools

The data collection tools used during the study included; questionnaires, review of the existing documents and records, interview guide and checklists. These tools were assumed to be appropriate for the study's objectives, given the timeframe of the study, budget, and type of data to be collected.

3.8.1 Questionnaire Survey

Information deemed necessary for the study was collected through self-administered questionnaires. These were close-ended questionnaires with question items based nominal and ordinal scales. The questionnaire was made of two (2) sections, whose analysis was based on the ordinal and nominal scale. One of the sections within the questionnaire required the respondents to fill in their background information, and the other section sought the opinion of the respondents as regards the impact of ancillary road works such as, road marking, road signs, road lighting, humps and rumble strips, guardrail and walkways on road safety along the Kampala – Jinja road. The details of the questionnaire used in the study is appended for ease of reference.

3.8.2 Documentation and records

Different literature that was relevant was summarised and processed for the suitability of the study. This involved previously published research, police accident reports and accident logs.

3.8.3 Interview guide

This was used to collect qualitative data, involving administering both structured and unstructured interview questions. These were asked depending on the level of expertise of the respondents. This means that different open ended interview questions were administered to different categories of people. This allowed the participants to give detailed information and further stimulate responses. The details of the interview guide used in the study is appended for ease of reference.

3.8.4 Check list

This involved direct collecting and noting of data visually, quickly and easily. Under this, all the data as regards the status of the existing ancillary services, road conditions, driver behaviour, ancillary features at black spots, among others was detailed.

3.9 Research Procedure

Upon successful defence and submission of the research proposal, written authorisation from the Directorate of Research and Graduate Training of Kyambogo University was obtained, authorising the data collection. This was further presented to the Directorate of Traffic and Road safety for further authorisation to collect data. The data collection instruments were administered personally.

3.10 Data Quality Control

3.10.1 Validity

This is the extent to which a given data collection instrument is accurately able to measure what it is supposed to be measuring. The data was checked for content validity by assessing the extents to which the instruments for research provided adequate coverage of the study and criterion-related validity where some outcomes were expected, based on the current conditions. This was, however, free from bias. The two subject-matter experts and 10 participants that were excluded in the main data collection were contacted for pre-testing the data collection tools. The correlation coefficient (r) was used to evaluate the criteria-related validity; whereby; the higher the correlation, the more valid the criterion. Data was entered in the Statistical Package for Social Sciences software (SPSS), which generated the correlation using the Pearson Coefficient. The coefficient variations were above 0.5 which indicated validity of data as recommended by Creswell (2019). The coefficients for variables expressed the strength of the relationship between the two variable correlated in this study.

The Content Validity Index (CVI) was calculated using their collective opinions. Each of them rated the items for relevance (R) and irrelevance (IR) on a two-point scale, with the average index calculated by dividing the ratings on either side of the scale by two (CVI). The deemed irrelevant elements were deleted or changed with ones that were pertinent. The questionnaires were pre-tested to 10 participants excluded in this study, with knowledge about road safety, road design and the study area.

$$\textbf{The CVI formula} = \frac{\textit{Relevant questions}}{\textit{Total questions}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{3.2}$$

The Content Validity Index (CVI) for; road marking was 0.857, road sign was also 0.857, guardrail was 0.800, humps and rumble strips was 0.833, road light was 0.833, walkways and service lanes was 0.800, and road safety was 0.889, as shown in Table 3.3. The CVI for all the study parameters was above the recommended value of 0.7 to guarantee validity of the data as recommended by Ishtiaq, (2019). The items rated irrelevant were eliminated in the final data collection tool for this study.

Table 3. 3 Content Validity Index

Variables	Relevant questions	Total questions	CVI
Road marking	6	7	0.857
Road sign	6	7	0.857
Guardrail	4	5	0.800
Humps and rumble strips	5	6	0.833
Road lights	5	6	0.833
Walkways and service lane	4	5	0.800
Road safety	8	9	0.889
Average CVI			**0.841**

3.10.2 Reliability

This refers to the degree to which a given data collection instrument gives consistent scores when used under different conditions. Stability and equivalence aspects were improved by minimising external sources to broaden on the sample of items used. Once the data were collected, it was systematically checked for the identification and correction of errors. Cronbach Alpha, a standardized 0 to 1 scale, was used to assess quantitative data reliability. For Cronbach Alpha, higher values indicate greater agreement between items, with 0.7 serving as the reference value (Taber, 2018). At this level and higher, the items are consistent enough to indicate reliability. All Cronbach alpha for road marking, road signs, guardrails, humps and rumble strips, road lights, walkways and service lanes, and road safety were above 0.75 cut off to support reliability of the data collected for this study.

Cronbach’s alpha is calculated by taking a score from each scale item and correlating it with the total score for each observation. The resulting correlations are then compared with the variance for all individual item scores. Cronbach's alpha is best understood as a function of the number of questions or items in a measure, the average covariance between pairs of items, and the overall variance of the total measured score to measure the reliability of data.

Cronbach's alpha

$$\alpha = \frac{N * \bar{c}}{\bar{v} + (N - 1) * \bar{c}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{3.3}$$

N = number of items

$\bar{c}$ = mean covariance between items.

$\bar{v}$ = mean item variance.

Table 3. 4 Cronbach Alpha Reliability Coefficient

Variables	**Relevant questions**	**Cronbach Alpha**
Road marking	6	0.77
Road sign	6	0.78
Guardrail	4	0.87
Humps and rumble strips	5	0.76
Road lights	5	0.86
Walkways and service lane	4	0.78
Road safety	8	0.82
Average α		**0.81**

3.11 Data analysis

3.11.1 Quantitative Data Analysis

The data were prepared for analysis by coding, categorising, summarising it using frequency tables, identifying and editing errors and processing using the Statistical Package for Social Sciences software (SPSS 24.0).

This involved calculation of descriptive statistics for getting the mean, standard deviation, as well as inferential specifically correlation and regression to determine the relationship and contribution of ancillary roadworks to road safety. Pearson's correlation coefficient is the covariance of the two variables divided by the product of their standard deviations. Interpret of correlation. Zero means there is no correlation, where 1 means a complete or perfect correlation. The sign of the r shows the direction of the correlation. A negative r means that the variables are inversely related. The strength of the correlation increases both from 0 to +1, and 0 to −1.

Correlation (r) = r = $\sum (x_i - \bar{x})(y_i - \bar{y}) \sum (x_i - \bar{x}) 2 \sum (y_i - \bar{y}) 2$ **……………………. 3.4**

Regression represents the correlation coefficient between the observed and predicted values of the dependent variable. Beta coefficient indicates unit change of independent variable on dependent. R-squared provides the proportion of the variance in the dependent variable that is explained by the independent variable(s) in a regression model. t-distribution indicates the continuous probability distribution that generalizes the standard normal distribution of the collected data for this study.

Beta coefficient (β), determined the way a unit change in independent variable contributed to unit change to dependent variable for this study. The beta coefficient of regression analysis is basically the linear relationship between the independent (x) and dependent (y) variables expressed in the equation $y = \alpha + \beta x$, called the regression line. The first calculation coefficient is beta coefficient (β), also known as the slop.

$y = \alpha + \beta_0 + \beta_1 X + \varepsilon$ **………………………………………………………… 3.5** where y is the dependent variable or response variable, x is the independent variable or explanatory variable, and β_0 is the y-intercept. The y-intercept is the value of y when x = 0, and β_1 is the slope of the line. β_1 gives the amount of change in y for every unit change in x. Finally, ε is the random error.

Beta (β) $= \frac{[n(\varepsilon XY-(\varepsilon x)(\varepsilon Y)]}{[n(\varepsilon X\Delta 2)-(\varepsilon x)\Delta 2)}$ **………………………………………….……… 3.6**

This formula is incorporated in the SPSS quantitative analysis software.

R-squared: R-squared (R^2), also called coefficient of determination, measures how many points fall on the regression line between the two variables.

$R^2 = 1 - \frac{RSS}{TSS}$ **…………………………………………………………………… 3.7**

Where; R^2 = Coefficient of determination, RSS = Sum of square of residuals and TSS=Total sum of squares

Adjusted R-squared: This number reflects a more accurate r^2 if the number of variables used are more than one.

Adjusted R-Square $= 1- \frac{(1-R)(n-1)}{(n-k-1)}$ **…………………………………….……. 3.8**

n: is the number of data points

k: is the number of independent variables

R: is the R-squared value

Standard error (SE) of estimates: The standard error in a regression analysis measures how precise the regression coefficient.

$SE = \frac{\sigma}{\sqrt{n}}$ **………………………………………………………………..... 3.9**

Where; SE = standard error of the sample; σ = sample standard deviation

n=number of samples

Significance of p-value: The p value, or probability value, is expressed from 0-1 and it measures the percentage difference in the combined average of the variables. It is 95% level of significance.

T-distribution for the sample size is presented as follows;

The student’s t-distribution is provided by (x̄−EBM, x̄+EBM)

Where:

- ✓ EBM is the error bound for the population mean, calculated as $EBM = t\alpha/2(sn\surd)$
- ✓ $t\alpha/2$: is the t-score with area to the right equal to
- ✓ s: is the sample standard deviation
- ✓ n: is the sample size

The degrees of freedom for the Student's t-distribution is calculated as

df=n−1; d f equals n minus 1 $df = n - 1$

The t-value is used instead of a Z-score when calculating a confidence interval for a sample size such as road safety on Kampala Jinja road for this study. The t-results indicates the significant level of the variable whereby; the higher the t-value the significant is the variable under study.

3.11.2 Qualitative Data Analysis

After collection, data were organised, analysed, coded, among others, to explore the relationship between the different categories with content analysis. Conclusions were drawn as regards how the different variables were relating. The interviewees were arranged with codes to develop theme in relation to the objectives of the study.

The codes therefore used were 001 for the RTO, 002 for IOV, 003 for OC traffic for Mabira police station and 004 for OC traffic for Njeru police station.

3.12 Measurement of Variables

The study variables for the questionnaire data were measured on both the ordinal and nominal scale. Ordinal scales that were applied to the data were ranked according to a Likert scale of; 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree. The nominal scale divided data into various categories, all with the goal of identifying the demographic characteristics of the respondents.

3.13 Achievement of specific objectives

The study achieved the specific objectives in the following ways;

3.13.1 Current status of ancillary works on the section under study

The first objective was achieved by taking an inventory of the existing road ancillary features in relation to what was actually installed before project handover. The list of the initially installed ancillaries was got from M/S Stirling Civil Engineering Limited, the contractors who constructed the road under study. A detailed analysis from the observation checklist and reports were made by assessing the road ancillaries that were currently existing along the study area, and at black spot sections against what was actually required/installed in such areas. The status of the currently existing road ancillaries guided in assessing the vulnerability of the different users of the road section under study. The vulnerability of road users was assessed by taking an inventory of the existing signs in the different accident spots and relating them to what was actually required in such sections, if full safety was to be realised in such road sections. This was also done using some of the sketch maps made at some accident scenes, as availed by the traffic departments at the different police stations within the study area. These sketch maps gave a picture of what actually used to happen at these accident sections, which helped in further assessment of the vulnerability of road users in the study area.

3.13.2 Relationship between the rate of accidents and the current status of the road ancillaries

Achieving the second objective was through questionnaires and assessing the available police accident data for the areas under study, and revisiting some of the black spot sections with frequent accident occurrences, in accompaniment of a traffic officer to establish the status of road safety features at such road sections. The study area has several black spot sections which include; Kasaku, Tembo, Kitega. Lugazi town, Lugazi mosque, Kawolo hospital mortuary, Bulyantete, Sagazi, Najjembe, Kinoni, Lwankima, Lugalambo, Kikaula, Picnic, among others, all of which were assessed for safety in relation to accident occurrence.

3.13.3 Effects of external factors to road safety in Uganda

The third objective was achieved through the several interviews conducted on the OC traffic officers for the police stations, the RTO and IOV, to get a detailed view of the worthiness of the vehicles that are usually involved in accidents, whether they are fit to be on the roads, and also detail the known external factors to road safety as per the police records. Furthermore, content analysis was conducted on the collected data, to determine the impact of external factors such as, levels of traffic enforcement, vehicle condition, level of awareness of traffic regulations, the status of the road infrastructure, among others, in relation to road safety.

3.13.4 Develop a framework that can be used in mitigating the impact of road ancillaries on road safety

The fourth objective was based on giving an informed judgement of what needed to be done over a period of time both in the short and long run to improve on safety of road users, basing on the finding of the study in specific objectives (i), (ii) and (iii). The variables used in the linear regression analysis included; Road Marking (RM), Road Signs (RS), Guardrails (GR), Humps and Rumble Strips (HR), Road Lighting (RL) and Walkways and Service Lanes (WS). The significant variables of road ancillaries; that is to say, Road Marking (RM), Humps and Rumble Strips (HR) and Guardrails (GR); were selected from the regression analysis and used as inputs to develop the framework, intended to ensure road safety in Uganda.

3.14 Ethical consideration

The necessary attendant documents that permitted the collection of the required data from different entities were acquired. These included, among others; an introduction letter from Kyambogo University, Graduate School, which was presented to the Senior staff officer under the Directorate of Traffic and Road Safety from Uganda Police Force, who later issued a letter permitting data collection for the different police stations within the study area. This was presented to the traffic in-charges of the different police station from where data were collected. The participants under this study were also assured of confidentiality and anonymity of the information given and a voluntary informal consent was required from them and that the research was purely for educational purposes whose findings were to be shared with them accordingly.

3.15 Chapter Summary

The research was aimed at investigating the impact of ancillary roadworks on road safety in Uganda: A case of Kampala – Jinja road. This research was a correlational research that involved a comparison of the interaction between the independent and dependent variables. This was conducted along the Kampala – Jinja road, with a section from Lugazi to Kitigoma as the study area. It involved the collection of data (for example traffic accident data from Lugazi police station, Mabira police station and Njeru police station). As such, the study involved a population size of 150 respondents, from which 108 respondents were sampled during data collection, a sample size determined using the Krejcie and Morgan formula. Both random and purposive data collection techniques were used, and the data was collected through observation (check list), interviews, Questionnaire and by use of existing secondary data. These data collection tools were assessed for validity and reliability and it was analysed for fruitful results. The collected data were subject to both content and criterion based validity to check the suitability of the tools used during the study. The next chapter analyses and discusses the results obtained during the study.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter covers the presentation, analysis and discussion of the results from the data collected. The study investigated the impact of ancillary works on road safety in Uganda; A case of Kampala – Jinja road. It sought to find the relationship between ancillary road works and road safety in Uganda.

4.2 Respondents Response Rate

The research targeted a sample size of 108 respondents, of which 30 were Field Traffic Officers, 02 were Officers in charge of Traffic (OC), 25 drivers, 35 road engineers with knowledge about the study area and road safety, 01 Regional Traffic Officer (RTO), 01 Inspectorate of Vehicles (IOV), 06 local leaders and 08 market leaders, to whom questionnaires and Interviews were administered accordingly. A total of 105 respondents gave feedback regarding the research.

The average response rate of 98.5% was obtained from the collected data and it was deemed acceptable because Fincham, (2008) suggests that a 60% is good enough. This was attributed to the ample time given to the respondents provide the necessary information/data required in the study. The higher response rate can also be attributed to the fact that the respondents fully understood the contents of the questionnaires and other data collection tools used, and that they were well conversant with the study area. The response rate is as shown in Table 4.1.

Table 4. 1 Response Rate

Respondents	Sample Size	Responding Sample	%age Response Rate
Field Traffic Officers	30	30	100
OC Traffic Police Station	02	02	100
RTO	01	01	100
IOV	01	01	100
Drivers	25	22	88
Road Engineers	35	35	100
Local Leaders	06	06	100
Market Leadership	08	08	100
Total	**108**	**105**	**98.5**

4.3 Respondents Background Characteristics

The biographic details of about 105 respondents are presented in this section. These include their; gender, age groups, levels of education, years within the study area and their positions within the study area.

Table 4.2 indicates that 83.8% of the respondents were male and 16.2% were female, indicating more male respondents than the female. The data obtained therefore represented both genders, hence the results captured views of both genders as regards the impact of ancillary road works on road safety in Uganda. The study findings indicated that, 17.10% of the respondents were of the age group below 30 years, 54.30% were between 31 to 40 years, 22.90% were between 41 – 50 years and 5.70% were above 51 years, which represented the least age group among the respondents.

Table 4. 2 Respondents Background Characteristics

Details	Categories	Frequency	Percentage
Gender	Male	88	83.8
	Female	17	16.2
	Total	**105**	**100.0**
Age groups	Below 30 years	18	17.1
	31 – 40 years	57	54.3
	41 – 50 years	24	22.9
	Above 51 years	6	5.7
	Total	**105**	**100.0**

Table 4.3 indicates that a larger percentage of the respondents (37.10%) was that of people who attained an A-Level secondary education and below (22 Field Traffic Officers, 07 Market Leaders and 10 Drivers), followed by 39.00% with Bachelor's degrees (02 Field Traffic Officers, 04 Drivers, 25 Road Engineers, 06 Local Leaders, 02 OC Traffic Officers, 01 RTO and 01 IOV), 8.70% of the respondents had Masters degrees, and all these were Road Engineers, 9.50% had Certificates (04 Field Traffic Officers, 01 Market Leader and 05 Drivers) and 5.70% were Diploma holders (02 Field Traffic Officers, 03 Drivers and 01 Road Engineer). The level of education of the respondents indicated their ability to understand the data collection tools administered. In addition, majority of the respondents (33.30%) were road engineers, who have had sufficient knowledge about the study area; followed by 28.60% Field traffic officers who enforce traffic regulations within the study area. The 21.00% of the respondents were

drivers that traverse through the study area (Kampala – Jinja road, particularly Lugazi to Kitigoma); 7.60% were market leaders; 5.70% were local leaders within the study area, 1.90% was a representative of the OC traffic for the three police stations within the study area, 0.95% was a representation for the RTO and IOV Respectively.

Table 4. 3 Position and Level of Education of Respondents

Position in the study	**Level of Education**						
	A level	**Certificate**	**Diploma**	**Degree**	**Masters**	**Total**	**%age**
Field traffic officers	22	04	02	02	-	**30**	**28.60**
Market leaders	07	01	-	-	-	**08**	**7.60**
Drivers	10	05	03	04	-	**22**	**21.00**
Road engineers	-	-	01	25	09	**35**	**33.30**
Local leaders	-	-	-	06	-	**06**	**5.70**
OC traffic police	-	-	-	02	-	**02**	**1.90**
RTO	-	-	-	01	-	**01**	**0.95**
IOV	-	-	-	01	-	**01**	**0.95**
Total	**39**	**10**	**06**	**41**	**09**	**105**	**100**
% age	**37.10**	**9.50**	**5.70**	**39.0**	**8.70**	**100**	

Table 4.4 revealed that 41.0% of the respondents have resided within the study area for a period of 5 years and below, 29.5% have resided within the study area for a period between 6 – 10 years, 17.1%, a period between 11 – 15 years and 12.4% have resided within the study area for a period exceeding 15 years. These figures indicate that the respondents have at least had enough experience as regards the area of study and were presumed to have sufficient information about the study problem and therefore the data provided were reliable, leading to reliable findings.

Table 4. 4 Years resided by respondents in study area

Position in the study	Years resided within study area				
	< 5 years	6 -10 years	11-15 years	Above 15 yrs	Total
Field traffic officers	22	03	04	01	30
Market leaders	01	03	01	03	08
Drivers	09	05	06	02	22
Road engineers	06	16	06	07	35
Local leaders	01	04	01	-	06
RTO	01	-	-	-	01
IOV	01	-	-	-	01
OC traffic police	02	-	-	-	02
Total	**43**	**31**	**18**	**13**	**105**
% age	**41.0%**	**29.5%**	**17.1%**	**12.4%**	**100%**

4.4 Current Status of Road Ancillaries in the Study Area

4.4.1 Status of Road Signs

Data were acquired as regards the earlier installed road signs during the construction of the Kampala – Jinja road. This was obtained in order to attend to the requirements of the first objective of the study. Using observation (check list), the road signs that were existing during the time of data collection were recorded so as to make a comparison with those that were earlier installed before project handover. The findings are tabulated in Table 4.5.

From Table 4.5, 40% of the earlier installed warning signs were missing, while 60% were still existing; 53% of the installed regulatory signs were still existing and 47% were vandalised. Furthermore, 61% of the informatory signs were still existing while 39% were missing and only 16.7% of the earlier installed guidance signs were still existing, with 83.3% vandalised. Available records from the Uganda Police have linked vandalism of these road signs to the booming scrap business within the area, where people sell these signs for money to scrap dealers. Furthermore, studies have also linked vandalism to be caused by humans, with high rates of vandalism happening in densely populated area and that it can lead to unsafe driving behaviours (Khalilikhah, Heaslip & Hancock, 2016).

Table 4. 5 Status of Road Signs in the Study Area

Details	**Instructed Signs (2017)**	**Existing Signs (2022)**	**Missing Signs**	**Rate of Vandalism (%)**
Warning Signs (W)	25	15	10	40.0
Regulatory Signs (R)	34	18	16	47.0
Guidance Signs (G)	12	02	10	83.3
Informatory Signs (I)	41	25	16	39.0
Total	**112**	**60**	**52**	

Source: ***M/s Stirling Civil Engineering Limited, 2017 and Field Observations/Inventory***

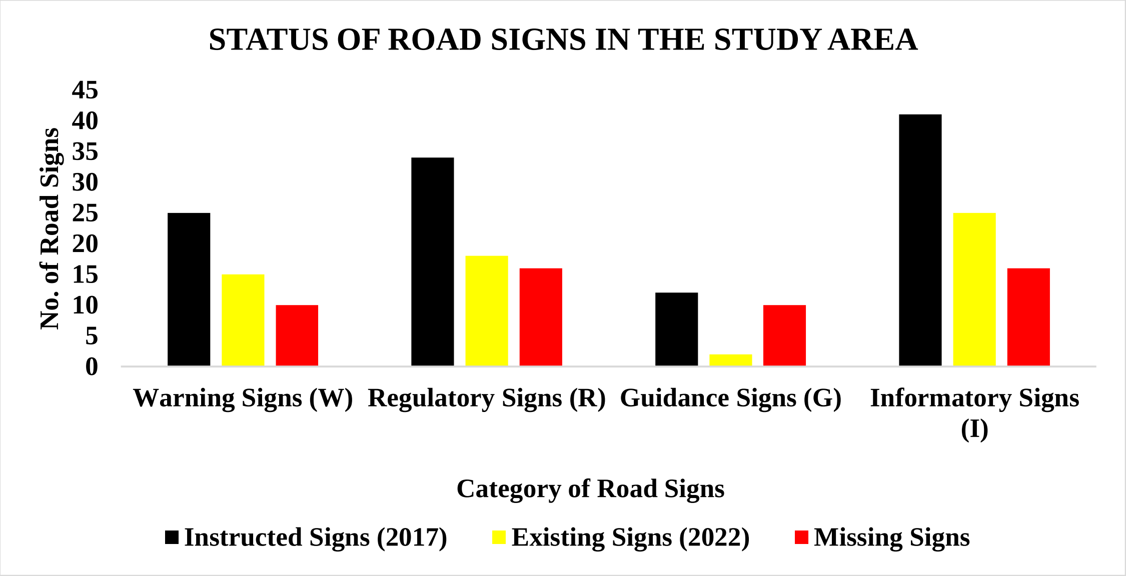


Figure 4. 1 Current Status of Road Signs in the Study Area

4.4.2 Status of Road Marking

The study area spans for about 28.43Km and a total of 19.565Km was marked with a continuous centreline marking, the balance being marked with a broken centreline marking. During the study, it was found out that only a stretch from Namagunga to Najjembe had clearly marked road marked sections, a stretch covering about 9.95Km, with the rest having faded or worn out road markings for both centrelines and edge lines, possibly because of wear and tear due to the time lapse since the road was last marked. Road markings tend to influence the behaviour of drivers, and therefore road safety. For example, an increase in the width of road markings might lead drivers to perceive lanes to be narrower than they actually are, hence prompting the drivers to reduce on their speeds (Garach, Calvo & De Oña, 2022). Furthermore, a study by Diamandouros & Gatscha, (2016), which aimed at monitoring the speed over a whole climatic cycle and undertook an accident analysis, established that the presence of enhanced road markings did significantly increase driver comfort, especially for older drivers.

4.4.3 Status of Guardrails

The study found out that most of the guardrails earlier installed were still existing, although some of them were covered with over grown grass and others deformed, requiring immediate replacement. The police accident records, however, did not show that there existed any accidents where vehicles had fallen off the roadway.

4.4.4 Status of Walkways and Service lanes

The study area has got some service lanes around Lugazi town and Najjembe market area but these have their wearing course worn-out, hence not serving their intended purpose. The walkways along Lugazi town also need a face lift since they are not worked on.

4.5 Rate of Accidents and Current Status of Road Ancillaries

4.5.1 Accidents Details in the Study Area

Road accident data for the black spot sections within the study area were collected from Lugazi, Mabira and Njeru police stations, and this was done as part of achieving the second objective of the study, which sought to determine the relationship between the rate of accidents and the current status of the road ancillaries. The accident data collected covered a period running from 2017 (a period after re-construction of the Kampala – Jinja Road) up to 2022 and is presented in Table 4.6.

Table 4.6 indicates that a total of 130 Fatal road accidents were recorded for a period covering 2017 to 2022, 159 serious accidents and 43 minor accidents for the same period. The highest fatalities were recorded in 2019 with the lowest in 2020. The most serious accidents were recorded in 2022 with the lowest in 2020, while most minor accidents were received in 2022 with the lowest minor accidents recorded in 2020. The records indicating the lowest fatal, serious and minor accidents in the year 2020 can be attributed to the Covid-19 lockdown that saw fewer vehicles (goods vehicles) only allowed to move on the roads for most part of the year as per the presidential directive at that time. This Covid-19 lockdown period made less risk exposures for vehicles to accidents since the road had very few vehicles. More so, even the various traffic police check points and road blocks that have been mounted within the study area, particularly Lugazi, Mabira and Njeru helped in reduction of accidents since they guided traffic accordingly.

Table 4. 6 Summary of Road Traffic Accidents in the Study Area

Year	Accident Details			Total
	Fatal	Serious	Minor	
2017	18	26	13	**57**
2018	23	29	05	**57**
2019	35	28	02	**65**
2020	10	09	01	**20**
2021	18	29	02	**49**
2022	26	38	20	**84**
Total	**130**	**159**	**43**	

Source: Uganda Police accident logs for Lugazi, Njeru and Mabira police stations, 2017 to 2022

This data is further illustrated using trend analysis graph from 2017 to 2022 as presented in figure 4.2

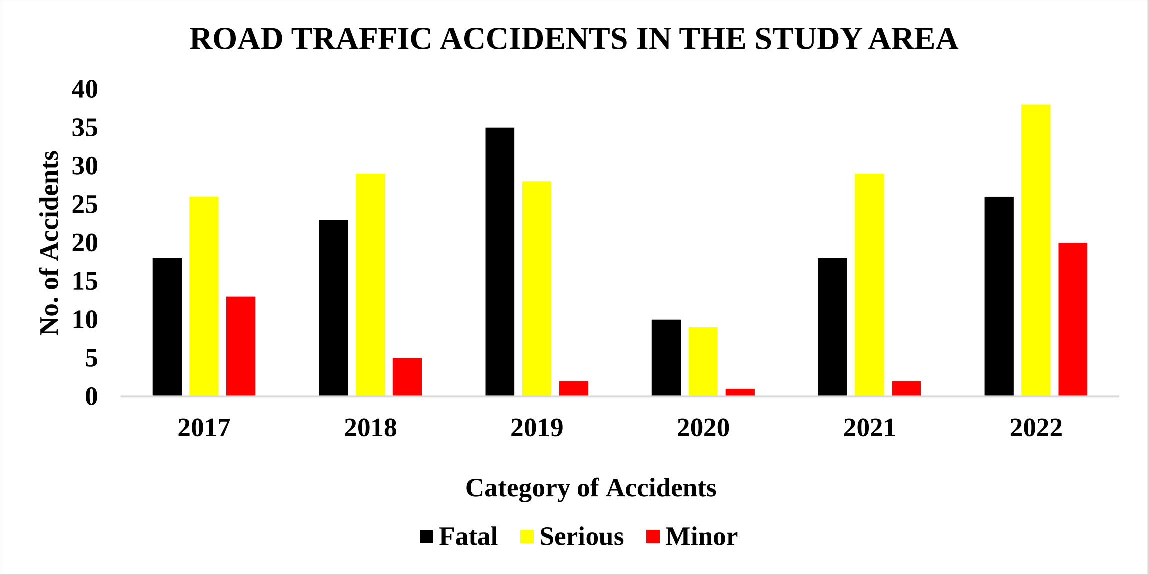


Figure 4. 2 Road traffic accidents in the Study Area

Furthermore, as part of achieving the second objective, black spot sections within the study area were revisited in accompaniment of a filed traffic officer, to assess the vulnerability of road users and the status of some of the road ancillary infrastructure within these section, by further redistributing the accident data in Table 4.6 above to the sections of their exact occurrences. In such sections, a road safety audit was conducted to check the possible remedies that could reduce on accident occurrences within the area accordingly, given the earlier installed road signages, road marking patterns and other road ancillary infrastructure in these areas.

The data presented in Table 4.7 indicates the situation on all the fourteen (14) black spot sections whose road safety status was assessed during the study. It was established that most of the earlier installed road signs in these sections were not available and the road markings had faded, among other features like guardrails that were meant to be fixed at high embankment sections like old picnic and other areas had not been done. Further still, the town sections like Lugazi mosque had not fixed humps and rumble strips to regulate the speed within this section, among others. Accidents were majorly fatal and serious in all the 14 blackspot areas, with causes such as speeding, overtaking, brake failure, reckless driving and poor visibility on the road. The combination of crest and horizontal curve reduces visibility to approach drivers in both directions after long tangents, hence the need to restore climbing lane signs and markings in these area for easy visibility.

From the condition assessment of these black spot sections, its believed that the rate of accidents in these areas has been increasing with the deterioration of some of the road ancillary infrastructure in such sections.

Table 4. 7 Current Status of Road Ancillaries and Rate of Accident at Black Spot Sections in the Study Area

Black Spot	**Chainage**	**Ancillaries Installed**	**Ancillaries Present**	**Road Accidents**			**Comments**
				Fatal	**Serious**	**Minor**	
1. Tembo Steel (TS)	**21+600**	- Sharp Curve (W01)-3 Signs - Start of Extra Lane (I09) - Speed Limit-50 (R49 & R52)-4 Signs - Bus Stop (I05)-2 Signs - Side Road (W05) - Continuous Roadmaking (M01)	- Speed Limit-50 (R49 & R52)-2 Signs - Bus Stop (I05)-2 Signs - Road Marking is all faded	**11**	**14**	**3**	- Restore centerline road marking and re-install the signs. - Traffic police enforce overtaking prohibition and speeding.
2. Kitega (K)	**23+500**	- Speed Limit-50 (R49 & R52)-4 Sign - Sharp Curve (W01) - Extra Lane (I09 & I10)-2 Signs - Continuous Roadmaking (M01)	- Speed Limit-50 (R52)-1 Sign - Sharp Curve (W01) - No visible road markings	**19**	**23**	**3**	- Speeding and overtaking enforcement by Traffic Police. - Clearing obstacle objects at curve to increase visibility - Road marking needs to be done

3. Lugazi Town Mosque (LTM)	**24+700**	- Sharp Curve (W01) - Round About (R77)-2 Signs - Hospital (I21) - Stop (R61) - Side Road (W05) - Extra Lane (I09 & I10)-2 Signs - Continuous Roadmaking (M01)	- All Signs Not Existing and Road markings are faded	**8**	**10**	**2**	Installation of road signs and continue with rehabilitation of road marking
4. Bulyantete (B)	**27+800**	- Extra Lane (I09)-2 Signs - Narrow Bridge (W26)-2 Signs - Bus Stop (I05) - End of Extra Lane (I10) - Continuous Roadmaking (M01)	- Bus Stop (I05) - End of Extra Lane (I10) - Road marking is faded	**10**	**17**	**2**	- Regular road marking of the lane to allow sufficient visibility
5. Ssagazi (S)	**30+400**	- Combined Curve (W03) - Stop (R61) - Bus Stop (I05) - Extra Lane (I09 & I10)-2 Signs - Broken Road Marking (M03)	- All Signs are Existing and Road marking is faded	**8**	**4**	**3**	- Consider road marking of the lane to allow sufficient visibility
6. Lwankima (L)	**32+300**	- Combined Curve (W03) - Continuous Road marking (M01)	- All Signs are Existing and Road marking is faded	**5**	**6**	**3**	- Enhance visibility of the combined curves and continuous road marking

7. Najjembe Market (NM)	**34+000**	- Extra Lane (I09 & I10) - Speed Limit (R49 & R52)- 2 Signs - No Over Taking (R43) - Broken Road Marking (M03)	- All Signs Not Existing and Road markings are faded	**6**	**8**	**1**	- Installation of the signs and continuous road marking to increase the visibility
8. Kinoni (Green Water) (K)	**34+700**	- Extra Lane (I09 & I10) - Speed Limit (R49 & R52)- 2 Signs - No Over Taking (R43) - Broken Road Marking (M03)	- All Signs Not Existing and Road markings are faded	**7**	**11**	**6**	- Restore the signs and marking. Install the signs at this location
9. Kinoni (Old Picnic) (KOP)	**36+200**	- Extra Lane (I09 & I10) - Speed Limit (R49 & R52)- 2 Signs - No Over Taking (R43) - Broken Road Marking (M03)	- All Signs Not Existing and Road markings are faded	**12**	**7**	**2**	- Installation of the signs and continuous road marking to increase the visibility
10. Buwola Corner (BC)	**38+000**	- Sharp Curve (W01)-3 Signs - Speed Limit-50 (R49 & R52)-4 Signs - Bus Stop (I05)-2 Signs - Side Road (W05) - Broken Road Marking (M03)	- All Signs Not Existing and Road markings are faded	**8**	**6**	**2**	- Installation of the signs and continuous road marking to increase the visibility

11. Ssanga (New Picnic) (SNP)	**40+800**	- No Overtaking (R43) - Sharp Curve (W01) Side Road (W05) - Steep Descent (W30) - Continuous Road marking (M01) - Guardrails on the RHS	- Guardrails are deformed, all Signs Not Existing and Road markings are faded	**11**	**7**	**3**	- Fix the guard rails, and road marking to increase the visibility
12. Lugalambo Tea Plantation (LTP)	**42+800**	- Speed Limit-50 (R49 & R52)-4 Sign - Continuous Road marking (M01)	- All Signs Not Existing and Road markings are faded	**14**	**23**	**2**	- Enforce speed limit 80 km/h and overtaking restriction
13. Lugalambo Valley (LV)	**43+600**	- No Overtaking (R43) - Speed Linit-50 (R49 & R52) - Broken Road marking (M03)	- All Signs Not Existing and Road markings are faded	**4**	**10**	**4**	- Enforce speed limit and overtaking restriction
14. Kitigoma (K)	**45+600**	- No Overtaking (R43) - Kitigoma (G22.1) - Speed Linit-50 (R49 & R52) - Continuous Road marking (M01)	- All Signs Not Existing and Road markings are faded	**7**	**13**	**7**	- Install the road signs and remark the road

Source: Uganda Police Force Field inspections: Lugazi to Kitigoma on Kampala - Jinja road

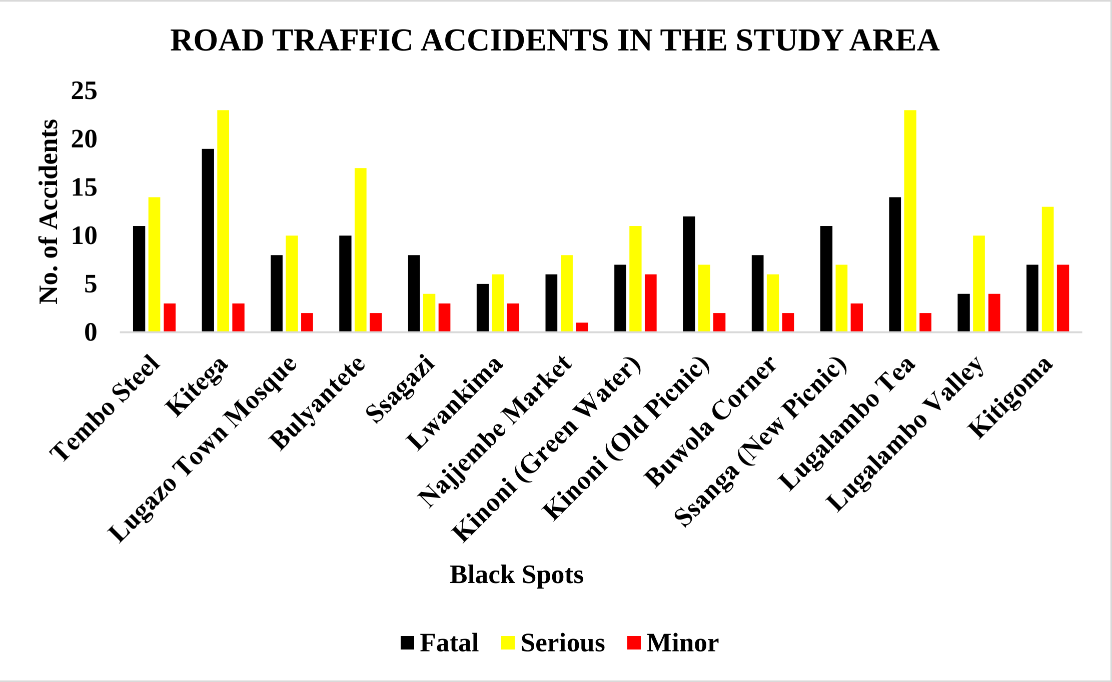


Figure 4. 3 Graphical Details on Road Accidents at Black Spot Sections in the Study Area

Figure 4.3 illustrations the accidents categories within each of the black spots on the study area.

4.6 Ancillary Roadworks and Road Safety

The independent variables, ancillary roadworks, was measured using six parameters, namely road marking, road signs, guardrails, humps and rumble strips, road lighting and walkways and service lanes.

4.6.1 Road Safety (RF)

According to the self-administered questionnaire, road safety was measured using 8 items, and the descriptive statistics for each of the items used to measure road safety during the study are detailed according to percentage, frequency and means, and are presented in Table 4.8.

From the results in Table 4.8, as regards the sufficiency of road signs and other ancillaries with in the study area, 90.4% of the respondents noted that the road signs and other ancillaries were insufficient, 3.8% were undecided and 5.8% responded that road signs and other ancillaries are sufficient within the study area. A mean of 4.33 ranked in the first position (1st) reaffirms that the road signs and other road ancillaries were insufficient within the study area in relation to the five point Likert scale.

Furthermore, 90.5% of the respondents agreed that the rate of accidents at black spots is high, 2.9% disagreed and 6.7 were undecided. The mean of 4.23 ranked in second position (2nd) indicated that the respondents strongly agreed on the five point Likert scale used. As regards to whether the rate of motor vehicle accidents was high, a bigger percentage of the respondents (84.7%) agreed, while the remaining 9.5% disagreed and 5.7% were undecided. A mean of 4.11 ranked in the third position (3rd), indicates that the respondents agreed on the five point Likert scale used. The results therefore suggest that the rate of motor vehicle accidents in the study area are high.

Finding whether there was a high rate of accidents due to over speeding, 81.9% of the respondents agreed, 12.4% disagreed and 5.7% were undecided. The mean of 4.10 ranked in fourth position (4th) indicated that the respondents were in agreement. In regards to whether road accidents are a public problem, a majority 82.8% of the respondents agreed, 14.3% disagreed and 2.9% were undecided. With a mean of 4.01 ranked in fifth position (5th), suggests that the respondents agreed that road accident were a public problem. Of the total respondents, 71.4% agreed that vehicles fall off the road embankment in absence of guardrails, 17.2% disagreed and 11.4% were undecided. A 3.77 mean ranked in sixth position (6th), close to 4 therefore suggest that the respondents agree to the narrative mentioned. In regard to whether there were high cases of over speeding in urban sections of the road under study, 8.6% of the respondents were undecided, 20% disagreed and 71.4% agreed. A mean of 3.70 ranked in seventh position (7th), close enough to four, indicates that the respondents agreed accordingly. Lastly, as to whether accidents involving pedestrians are high at market places and other urban sections of the road section under study, 71.4% of the respondents were in agreement, 18.1% disagreed, whereas 10.5% were undecided. The data from the respondent gave a mean of 3.61 ranked in eighth position (8th), just enough to conclude that they agree to the statement raised.

Table 4. 8 Percentages, Frequencies and Means on Road Safety

Road Safety (RF)	**F/%**	**SD**	**D**	**U**	**A**	**SA**	**Mean**	**SD**	**Rank**
The number of road signs and other ancillaries on the road are insufficient. (RF8)	**F**	3	3	4	41	54	**4.33**	**0.902**	**1**
	%	2.9	2.9	3.8	39.0	51.4			
The rate of accidents at black spots is high. (RF6)	**F**	1	2	7	57	38	**4.23**	**0.992**	**2**
	%	1.0	1.9	6.7	54.3	36.2			
The rate of motor vehicle accidents is high. (RF1)	**F**	0	10	6	52	37	**4.11**	**0.887**	**3**
	%	0	9.5	5.7	49.5	35.2			
There is a high rate of accidents due to over speeding. (RF3)	**F**	1	12	6	42	44	**4.10**	**0.073**	**4**
	%	1.0	11.4	5.7	40.0	41.9			
Road accidents are a public problem. (RF2)	**F**	1	14	3	52	35	**4.01**	**0.995**	**5**
	%	1.0	13.3	2.9	49.5	33.3			
Vehicles fall off the road embankment in absence of guardrails. (RF4)	**F**	3	15	12	48	27	**3.77**	**1.076**	**6**
	%	2.9	14.3	11.4	45.7	25.7			
There are high cases of over speeding in urban sections of the road. (RF7)	**F**	0	21	9	56	19	**3.70**	**0.992**	**7**
	%	0	20.0	8.6	53.3	18.1			
Accidents involving pedestrians are high at market places and other urban sections of the road. (RF5)	**F**	6	13	11	61	14	**3.61**	**0.052**	**8**
	%	5.7	12.4	10.5	58.1	13.3			

The findings are further illustrated in Figure 4.4.

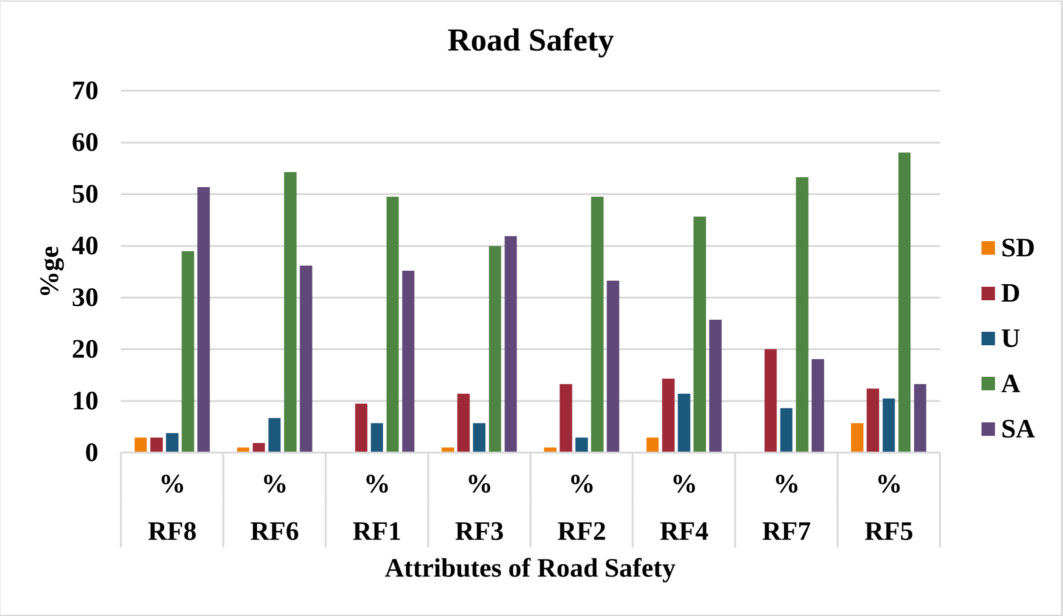


Figure 4. 4 Response Rate Ranking on Road Safety

This further suggests that the insufficiency or absence of road ancillaries on any road jeopardises the safety of the different road users and other stake holders. An average index was calculated to establish whether the results in Table 4.8 were normally distributed. The curve in Figure 4.5 shows that the results were not normally distributed.

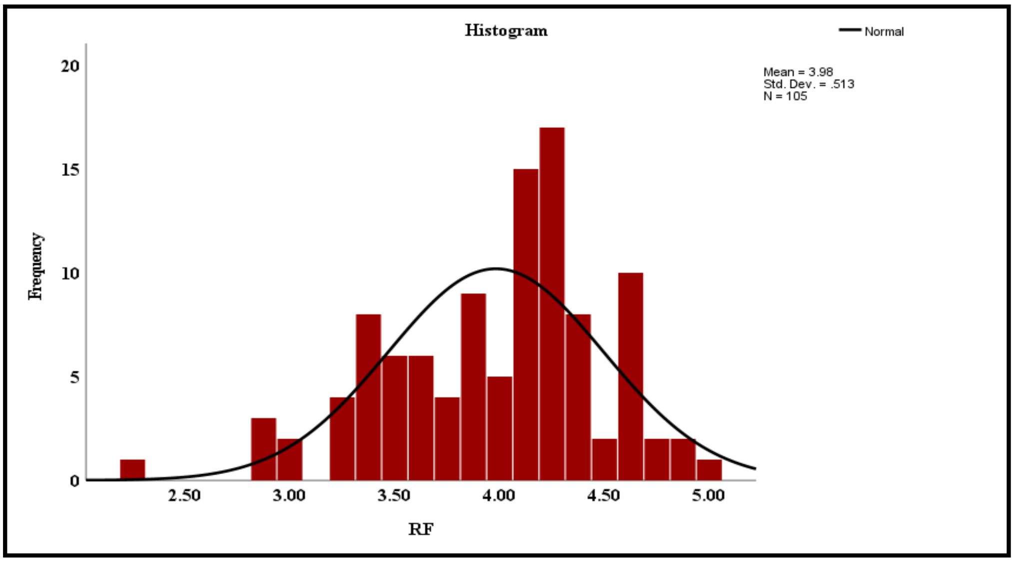


Figure 4. 5 Histogram for Road Safety (RF)

The curve in Figure 4.5, being not normally distributed means that the data obtained on road safety were to be subjected to ordinal regression and spearman rank correlation to obtain appropriate results.

Interviews were conducted on the respondents as shown in Table 4.6 and their comments as regards the impacts of ancillary roadworks on road safety within the study area noted.

Table 4. 9 Details of Interview Respondents

Category	**Sample Size**	**Response Code**
RTO	01	001
IOV	01	002
OC Traffic (Mabira Police Station)	01	003
OC Traffic (Njeru Police Station)	01	004

They however revealed that road safety is still a concern that needed to draw the attention of all the stake holders, including UNRA, MoWT, Uganda Police, among others.

For instance, when asked about their opinion about the rate of accidents as a result of the current status road ancillaries in the study area;

Respondent 001 state that’

“Whereas we note the inefficiency of these road furniture, it’s important to educate the people how these work, how they can adhere to these safety features and how important these are when it comes to road safety. Replacing them can be done and you still record an increase in accidents, not until their importance is made known to the end users.

Respondent 002 also noted that,

"Other accidents are as a result of brake failures, tyre burst, among others. These vehicle systems should be thoroughly checked, but drivers find this not necessary. Hence some accidents that we get on our roads. Much as ancillaries are still a problem but vehicle conditions also matter when it comes to road safety."

respondent 003 stated,

"Most black spots are common for accidents occurrences, and we have actually increased on the number of the previously known black spots based on the accident records that we have apparently."

Respondent 004 also noted that,

"Nearly every month, we get records of victims that have died as a results of hit and run vehicles and these largely occur at night. More still adherence to the few existing road safety features by drivers, like road signs, no overtaking zones is still a challenge."

4.6.1 Road Marking (RM)

The results indicated in Table 4.10 show that majority of the respondents agreed to the fact that a clearly marked road is easier to drive on at any time of the day (97.1%), while only 2.9% were in disagreement. Furthermore, a mean of 4.58 ranked in the first position (1st), close to five shows that they strongly agreed based on a five point Likert scale. As to whether road markings easily guide when to overtake or not while driving, 96.1% of the respondents agreed, 1.9% were undecided and 1.9% were in disagreement. A mean of 4.51 ranked in the second position (2nd) showed that they strongly agreed. As regards whether marked pedestrian crossings were key to ensuring road safety at any busy sections, 92.3% of the respondents agreed, 5.8% disagreed while 1.9% were undecided. The results therefore suggested that the respondents were in strong agreement, with a mean of 4.41 ranked in third position (3rd).

With respect to whether enforcing traffic regulations on overtaking is hard for a road with faded road marking, 85.8% of the respondents agreed, 11.3% disagreed while 2.9% were undecided. A mean of 4.12, ranked in the fourth position (4th) indicates that the respondents agreed that it's hard to enforce traffic regulations on overtaking for a road with faded road marking. 78.1% of the respondents agreed that the road marking in the study area was inadequate, 9.5% disagreed, whereas 12.4% were undecided. A mean of 4.07 ranked in fifth position (5th) indicated that the respondents agreed on the five point Likert scale that the road marking in the study area is not adequate. Over 80% of the respondents agreed that some traffic accidents are as a result of driving on wrong lanes, due to faded centreline markings, 15.2% disagreed while 4.8% were undecided. A mean therefore of 3.94 ranked in sixth position (6th), close to four, indicated that the respondents agreed to the statement on road marking.

Table 4. 10 Percentages, Frequencies and Means for Road Marking

Road Marking (RM)	**F/ %**	**SD**	**D**	**U**	**A**	**SA**	**Mean**	**SD**	**Rank**
A clearly marked road is easier to drive on at any time of the day. (RM 1)	**F**	2	1	0	33	69	**4.58**	**0.731**	**1**
	%	1.9	1.0	0.0	31.4	65.7			
Road markings easily guide as to when to overtake or not to while driving. (RM 2)	**F**	2	0	2	39	62	**4.51**	**0.722**	**2**
	%	1.9	0	1.9	37.1	59.0			
Marked pedestrian crossings are key to ensuring road safety at any busy section of the road. (RM 4)	**F**	3	3	2	37	60	**4.41**	**0.895**	**3**
	%	2.9	2.9	1.9	35.2	57.1			
Enforcing traffic regulations on overtaking is hard for a road with faded road marking. (RM 5)	**F**	3	9	3	47	43	**4.12**	**0.016**	**4**
	%	2.9	8.4	2.9	44.8	41.0			
The road marking in the study area is not adequate. (RM6)	**F**	4	6	13	38	44	**4.07**	**0.059**	**5**
	%	3.8	5.7	12.4	36.2	41.9			
Some traffic accidents are as a result of driving on wrong lanes, due to faded centerline markings. (RM 3)	F	4	12	5	49	35	**3.94**	**0.090**	**6**
	%	3.8	11.4	4.8	46.7	33.3			

The critical factors on road marking are set out in Figure 4.6 below.

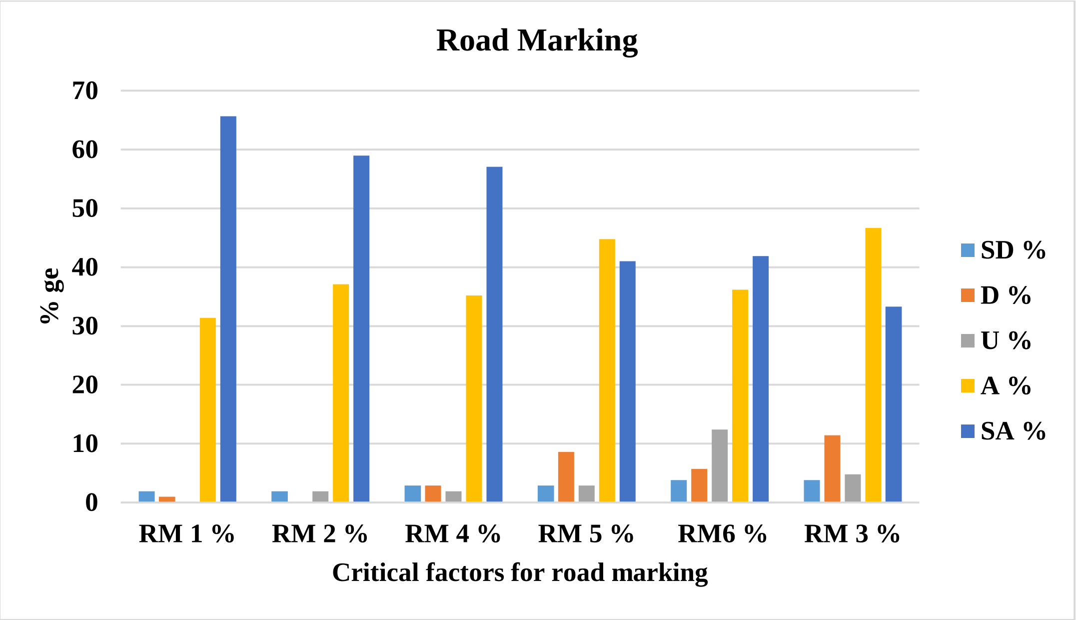


Figure 4. 6 Response Rate Ranking on Road Marking

The results from Table 4.10 were plotted and the distribution curve attained showed that they were not normally distributed. This implied that non parametric methods of analysing the results had to be used for further analysis.

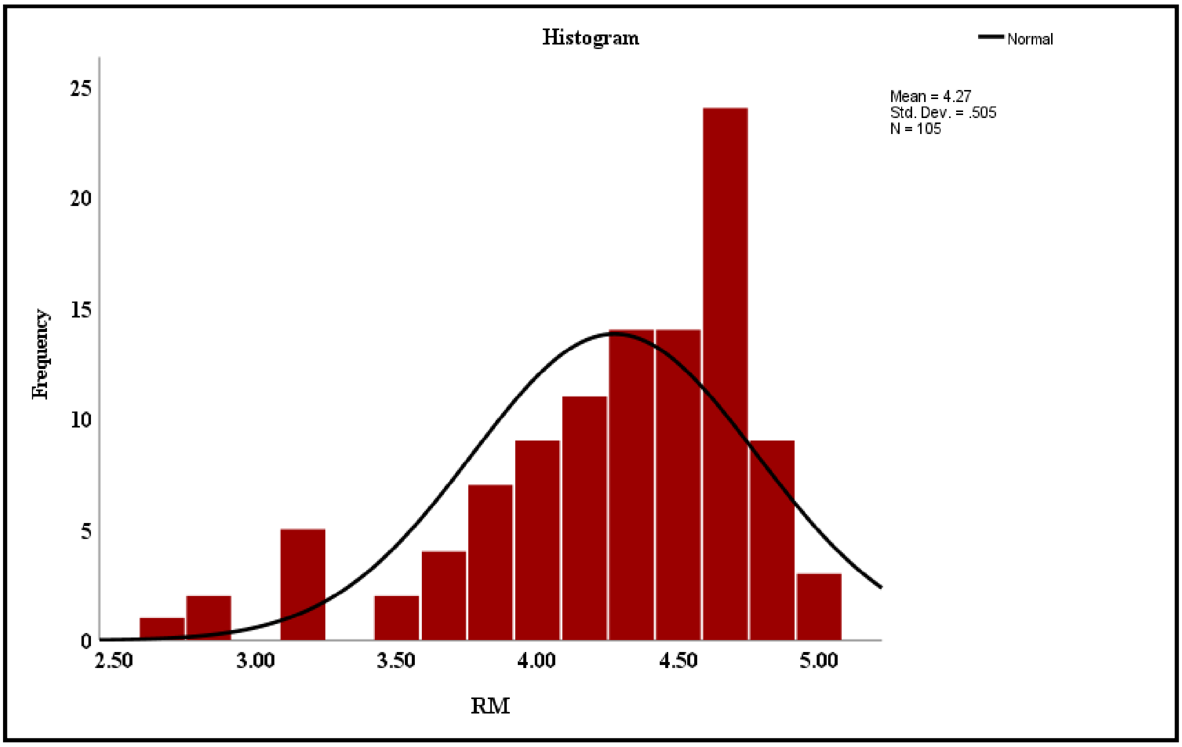


Figure 4. 7 Histogram for Road Marking (RM)

Furthermore, the respondents were interviewed about the adequacy of road marking in the study area and its impacts on road safety.

Respondent 001 stated that,

‘’ These road marking patterns mean a lot in road safety, we have had accidents that are due to careless overtaking. These drivers need to understand these marking patterns and what they mean, even when they are fully in place. Some drivers do not understand them.”

Respondent 003 stated that,

“We are well conversant with these road markings and what they mean when it comes to regulating driver behaviours on the road. But even some sections, like Njeru market area, you cannot mark it has an overtaking (broken lines at centreline) section yet it’s a market area.”

4.6.2 Road Signs (RS)

The results from Table 4.11, indicate that 91.4% agreed that warning signs at black spot sections of the road would help in minimising accidents, 2.9% disagreed while 5.7% were undecided. Based on the mean of 4.34 ranked in the first position (1st), this indicates that the respondents strongly agreed. Regarding to whether road signs regulate road user behaviours while using the road, 86.7% of the respondents agreed, 4.8% disagreed while 8.6% were undecided. With a mean of 4.28 ranked in second position, the respondents were in strong agreement. The respondents were asked whether the absence of road signs at any given road was a safety hazard to all road users and other stake holders. 88.5% of them agreed, 8.6% disagreed and 2.9% were undecided. The mean of 4.27 ranked in the third position suggests that road signs are of great importance if safety is to be realised on the roads.

Regarding whether speed limit signs are of great help in minimising accidents due to over speeding, majority of the respondents (89.6%) agreed, 8.6% disagreed and 1.9% were undecided. A mean of 4.27 ranked in fourth position was an indication that the respondents agree that speed limit signs can minimise accidents that occur due to over speeding. When asked whether the rate of vandalism of road signs was high, 76.2% of them agreed, 20.0% were undecided and 3.8% were in disagreement. With a mean of 4.10 ranked in fifth position, the respondents agree that the rate of vandalism of road signs was high in the study area. 83.8% of the respondents clearly understood the meaning of all road signs on the road, 11.5% were in disagreement and 4.8% were undecided. The mean of 3.97 ranked in the sixth position, close to four, suggested that the respondents agreed that they clearly understand all road signs on the road.

Table 4. 11 Percentages, Frequencies and Means for Road Signs

Road Signs (RS)	**F/%**	**SD**	**D**	**U**	**A**	**SA**	**Mean**	**SD**	**Rank**
Warning signs can minimize accidents in blackspots and other sections of the road. (RS4)	**F**	0	3	6	48	48	**4.34**	**0.71**	**1**
	%	0	2.9	5.7	45.7	45.7			
Road signs regulate road user behaviors while using the road. (RS2)	**F**	0	5	9	43	48	**4.28**	**0.814**	**2**
	%	0	4.8	8.6	41.0	45.7			
Absence of road signs at any given road is a safety hazard to all road users and road side vendors. (RS5)	**F**	4	5	3	39	54	**4.27**	**0.289**	**3**
	%	3.8	4.8	2.9	37.1	51.4			
Regulatory signs (like speed limit signs) greatly help in minimising accidents caused due to over speeding. (RS3)	**F**	3	6	2	45	49	**4.27**	**0.385**	**4**
	%	2.9	5.7	1.9	42.9	46.7			
The rate of vandalism of road signs is high. (RS6)	**F**	0	4	21	40	40	**4.10**	**0.658**	**5**
	%	0	3.8	20.0	38.1	38.1			
I clearly understand the meaning of all road signs on the road. (RS1)	**F**	3	9	5	59	29	**3.97**	**0.965**	**6**
	%	2.9	8.6	4.8	56.2	27.6			

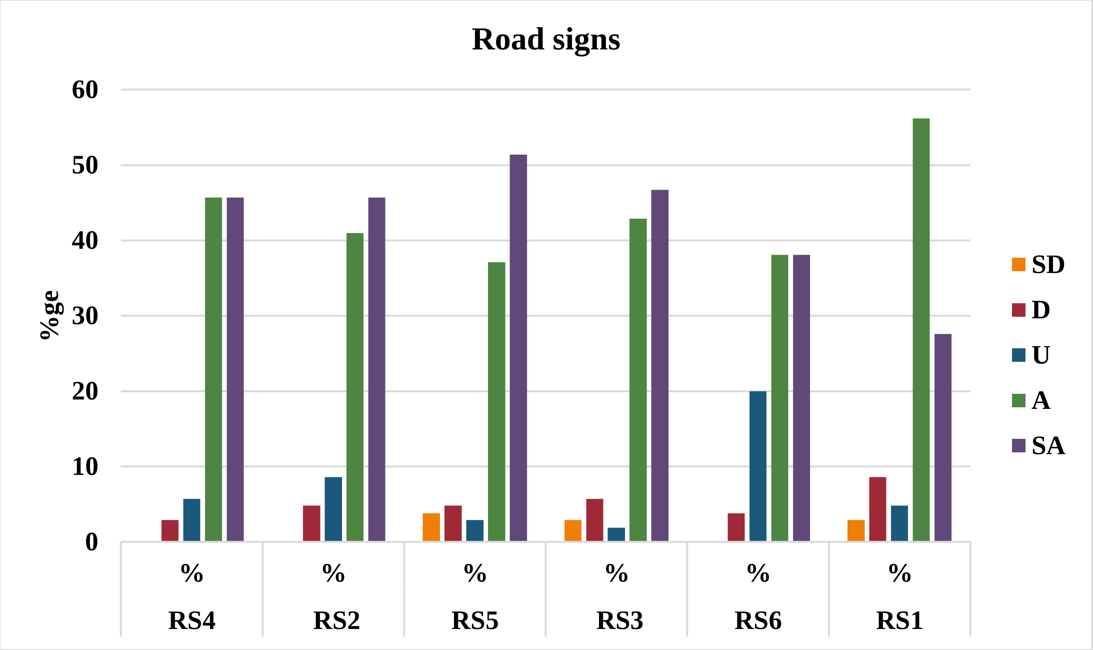


Figure 4. 8 Response Rate Ranking on Road signs

To establish whether the results in Table 4.11 were normally distributed, an average index was calculated. The curve in Figure 4.9 indicated that the results were not normally distributed. Ordinal regression method was therefore used in the analysis of the results.

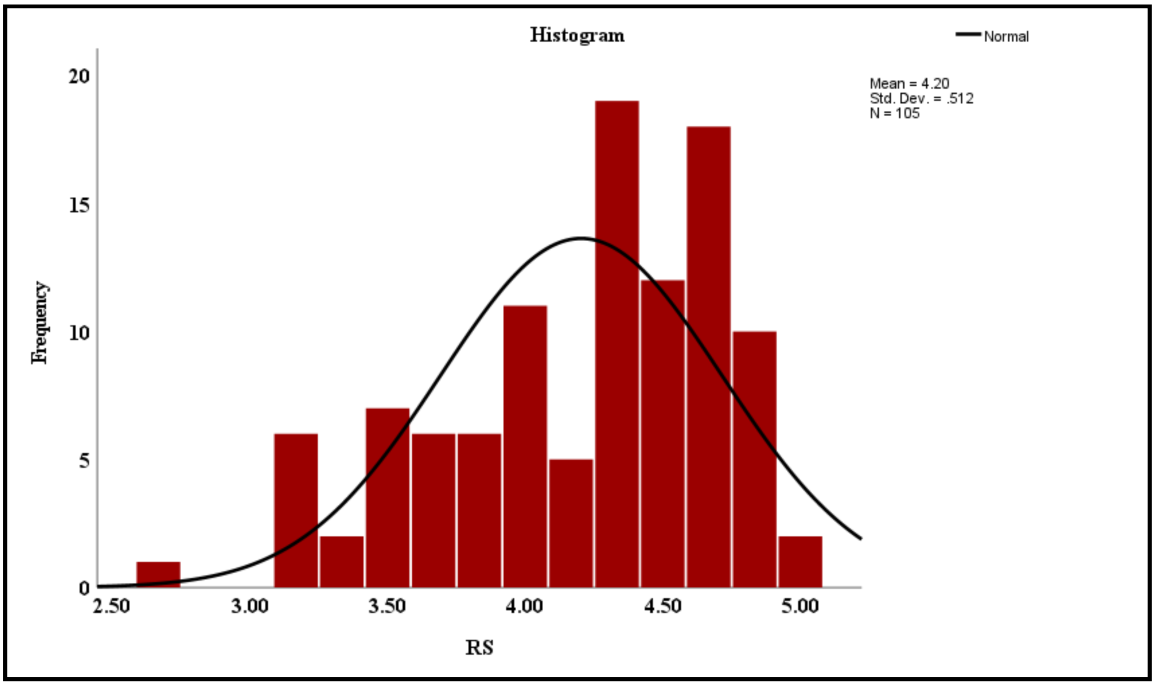


Figure 4. 9 Histogram for Road Signs (RS)

Through interviews, when asked how they regulate traffic guidelines on speed, even in the absence of speed limit signs on most sections of the road;

Respondent 003 that,

"It's known that even without speed limit signs, no driver should exceed 50Km/hr in town sections. You do not need a sign to regulate this, we can charge any driver for over speeding in case this speed limit is exceeded in such town sections."

4.6.3 Guardrails (GR)

The impact of guardrails on road safety was measured using four parameters as indicated in Table 4.12.

Table 4.12 indicates that, 97.1% of the respondents agreed that guardrails should be replaced once knocked, to avoid further road fatalities, while 1.9% of the respondents disagreed and 1.0% were undecided. With a mean = 4.44 ranked in first position (1st) close to five, the results indicate that the respondents strongly agreed to the statement made. Regarding to whether the guardrail end sections should be crashworthy to avoid vehicle damage and death of occupants due to accidents, 90.5% of the respondents agreed, 5.7% disagreed, while 3.8% were undecided. A mean of 4.24 ranked second position (2nd) indicated that the respondents agreed for the guardrail end section to be crashworthy.

Eighty-eight point five percent (88.5%) of the respondents agreed that guardrails are a major safety feature that prevents vehicles from falling off the roadway, 5.7% were undecided and 5.7% disagreed. The mean = 4.22 ranked in third position (3rd) was an indicator that they were in agreement based of the five point Likert scale. On asking whether the number of guardrails are low within the study area, 79% of the respondents agreed that the guardrails are inadequate within the study area, 12.4% disagreed and 8.6% were undecided. With a mean of 4.01 ranked in fourth position (4th) close to four, the respondents agreed that the guardrails were inadequate in the study area.

Table 4. 12 Percentages, Frequencies and Means for Guardrails

Guardrails (GR)	F/ %	SD	D	U	A	SA	Mean	SD	Rank
Guardrails should always be replaced once knocked, to avoid further road fatalities. (GR2)	F	2	0	1	49	53	**4.44**	**0.706**	**1**
	%	1.9	0	1.0	46.7	50.5			
Guardrail end sections should be crashworthy to avoid damage of vehicles and death of occupants as a result of accidents. (GR3)	F	1	5	4	53	42	**4.24**	**0.815**	**2**
	%	1.0	4.8	3.8	50.5	40.0			
Guardrails are a major safety feature in preventing vehicles from falling off the roadway. (GR1)	F	0	6	6	52	41	**4.22**	**0.796**	**3**
	%	0	5.7	5.7	49.5	39			
The adequacy of guardrails is low within the study area. (GR4)	F	3	10	9	44	39	**4.01**	**0.052**	**4**
	%	2.9	9.5	8.6	41.9	37.1			

The findings are further illustrated below.

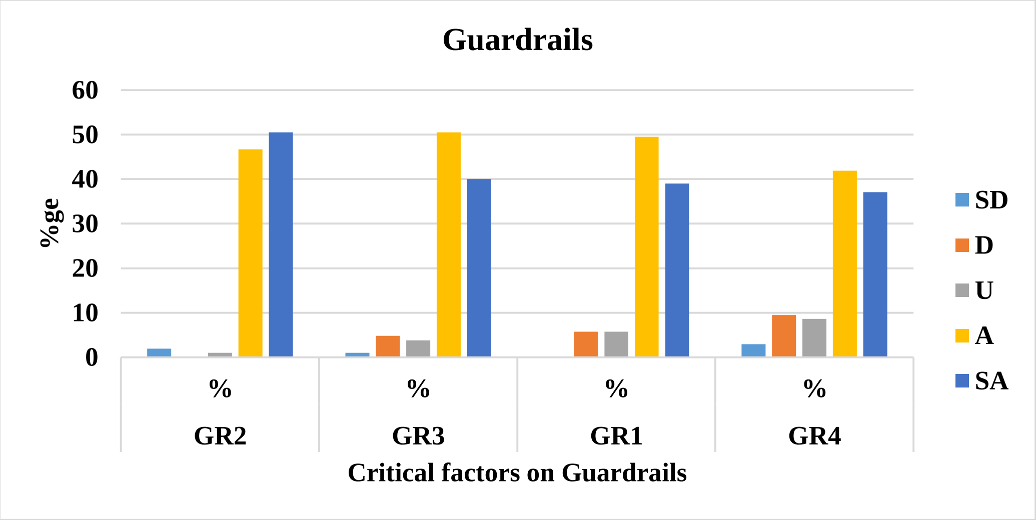


Figure 4. 10 Response Rate Ranking on Guardrails

The data was slightly normally distributed with mean of 4.23 and standard deviation of 0.521 as indicated in the figure below.

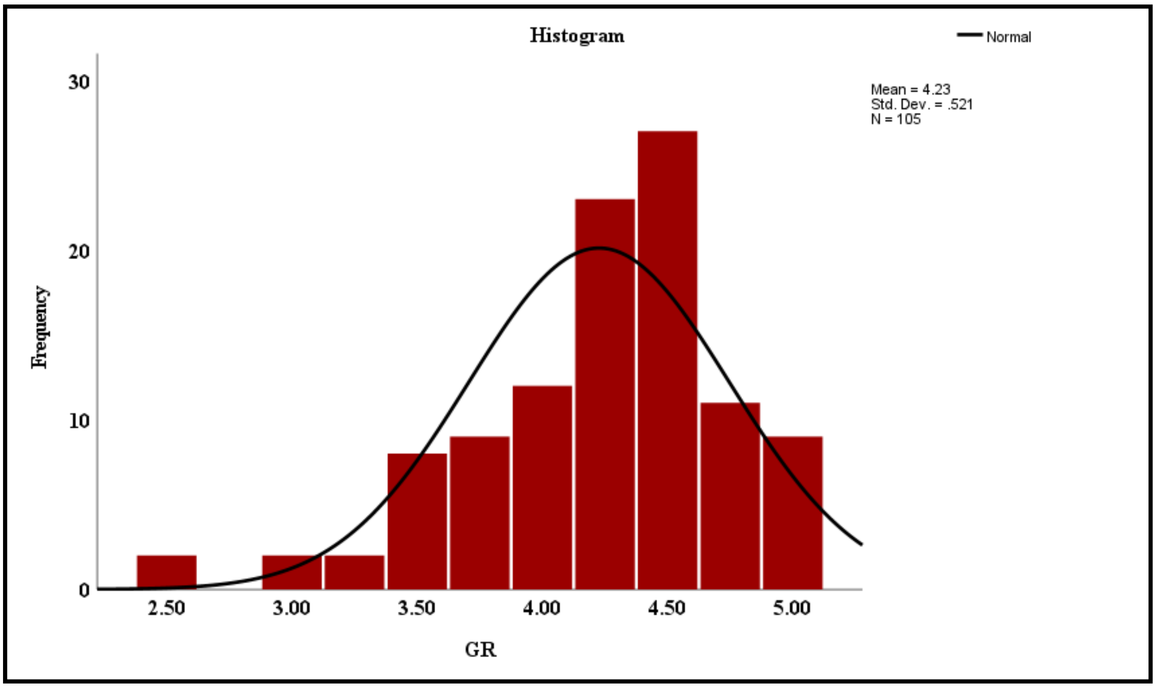


Figure 4. 11 Histogram for Guardrails (GR)

4.6.4 Humps and Rumble strips (HR)

The self-administered questionnaire about humps and rumble strips was also aimed at getting an appropriate response to the second objective of the study, which sought to determine the relationship between the rate of accidents and the current status of the road ancillaries and was measured using five parameters, whose findings are detailed in Table 4.13. The results from Table 4.13, indicate that humps and rumble strips should be clearly marked for easy visibility of both drivers and other road users, 95.1% of the respondents agreed, 2.0% disagreed and the rest (2.9%) were undecided. With a mean of 4.60 ranked first position (1st), close to five, indicates that the respondents strongly agreed that the humps and rumble strips should be clearly marked for easy visibility of both drivers and other road users. Majority of the respondents (95.2%) agreed that humps and rumble strips should be put in urban and market sections of the road while 3.8% of them disagreed, while 1.0% were undecided. The mean values obtained (4.46) ranked second position, close to five, indicates that the respondents strongly agreed that these humps and rumble strips should be put in the above mentioned sections of the road.

As to whether humps and rumble strips should be of moderate sizes to avoid further accidents, 92.3% of the respondents agreed, 3.9% were un decided while 3.8% of them disagreed. A mean of 4.42 (ranked 3rd), close to five indicated that the respondents strongly agree to the statement raised. As regards to whether humps and rumble strips in some road sections had become worn-out, 89.5% of the respondents agreed, 5.7% disagreed and 4.8% were undecided. The mean of 4.24 ranked in fourth position, indicated that the respondents were in agreement with the question administered. Majority of the respondents (85.7%) agreed that road users in urban sections of the road were vulnerable in absence of humps and rumble strips, 6.7% of them disagreed while 7.6% were undecided. The results further suggested that the respondents agreed, given a mean value of 4.19, ranked in fifth position.

Table 4. 13 Percentages, Frequencies and Means for Humps and Rumble strips

Humps and Rumble strips (HR)	**F/ %**	**SD**	**D**	**U**	**A**	**SA**	**Mean**	**SD**	**Rank**
These should be clearly marked for easy visibility of drivers and other road users. (HR4)	**F**	1	1	3	29	71	**4.60**	**0.688**	**1**
	%	1.0	1.0	2.9	27.4	67.7			
Humps and rumble strips should be installed on urban sections and market places. (HR1)	**F**	0	4	1	43	57	**4.46**	**0.707**	**2**
	%	0	3.8	1.0	41.0	54.2			
Humps and rumble strips should be of moderate sizes to avoid further accidents. (HR5)	**F**	1	3	4	40	57	**4.42**	**0.782**	**3**
	%	1.0	2.9	3.8	38.1	54.2			
In some places humps and rumble strips have become worn-out. (HR2)	**F**	0	6	5	52	42	**4.24**	**0.791**	**4**
	%	0	5.7	4.8	49.5	40.0			
Road users in urban sections of the road are vulnerable in absence of humps and rumble strips. (HR3)	**F**	3	4	8	45	45	**4.19**	**0.942**	**5**
	%	2.9	3.8	7.6	42.9	42.8			

The critical factors are further illustrated as set out below:

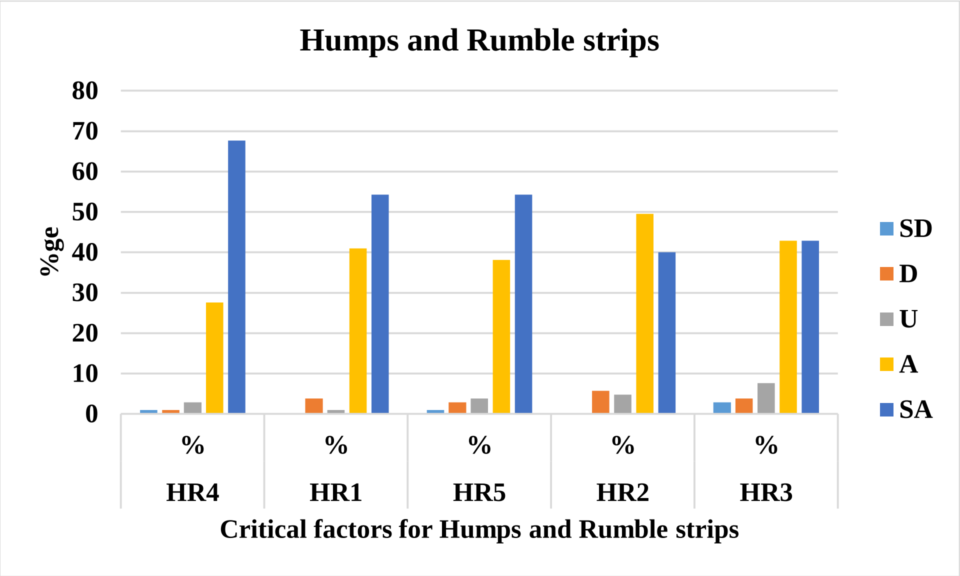


Figure 4. 12 Response Rate Ranking on Humps and Rumble Strips

The curve of the average indexed results from the responses as shown in Figure 4.13 was not normally distributed with mean of 4.38 and standard deviation of 0.501, necessitating an ordinal regression analysis of the results.

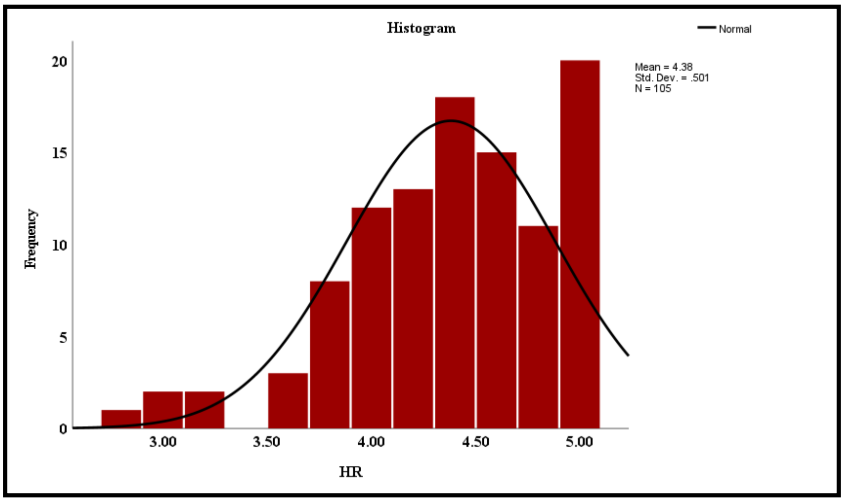


Figure 4. 13 Histogram for Humps and Rumble Strips (HR)

4.6.5 Road Lighting (RL)

Road lighting, as an independent variable was also aimed at achieving the second objective of the study, and was also measured using five items and indicated in Table 4.14.

Table 4.14, indicates that a 4.58 mean ranked in first position, close to five, indicated that majority of the respondents (98.0%) strongly agreed that road lighting is of great impact on road safety for both pedestrian and drivers, while the rest (1.0%) disagreed, whereas 1% were undecided. As to whether street lights should be installed on all urban sections of the road to minimise accidents due to poor night visibility, 96.1% of the respondents agreed, 2.9% were undecided, while 1.0% disagreed. A mean of 4.53 ranked in second position indicated that the respondents strongly agreed to lighting the urban sections of the road to minimise accidents due to poor visibility. Further, 91.4% of the respondents agreed that some sections of the road were dark at night, making visibility poor, 5.7% disagreed while the rest (2.9%) were undecided. With a mean of 4.41 ranked in third position, the results indicated that some sections of the road get dark at night, making visibility hard for the road users.

Whether street lights within the study area were insufficient, a majority 90.5% of the respondents agreed, 1.9% were undecided and 7.6% disagreed. A mean of 4.37 ranked in fourth position is an indicator that the respondents strongly agreed that the street lights in the study area were insufficient. Regarding to whether lighting of black spots' sections of the road would help in mitigating accidents at these sections especially at night, a mean of 4.26 ranked in fifth position indicated that 92.4% of the respondents agreed, while 1.9% disagreed and 5.7% were undecided.

Table 4. 14 Percentages, Frequencies and Means for Road Lighting

Road Lighting (RL)	**F/%**	**SD**	**D**	**U**	**A**	**SA**	**Mean**	**SD**	**Rank**
Road lighting has a great impact on road safety for both pedestrians and drivers. (RL2)	**F**	0	1	1	39	64	**4.58**	**0.568**	**1**
	%	0	1.0	1.0	37.1	61.0			
Street lights should be installed on all urban sections of the road to minimize accidents due to poor night visibility. (RL3)	**F**	1	0	3	39	62	**4.53**	**0.651**	**2**
	%	1.0	0	2.9	37.1	59.0			
Some sections of the road are dark at night, making visibility poor. (RL1)	**F**	3	3	3	35	61	**4.41**	**0.906**	**3**
	%	2.9	2.9	2.9	33.3	58.1			
The street lights within the study area are insufficient. (RL5)	**F**	3	5	2	47	48	**4.37**	**0.683**	**4**
	%	2.9	4.7	1.9	44.8	45.7			
Lighting black spots can help in mitigating accidents at these sections especially during night time. (RL4)	**F**	0	2	6	48	49	**4.26**	**0.931**	**5**
	%	0	1.9	5.7	45.7	46.7			

The critical factors are further illustrated as set out below:

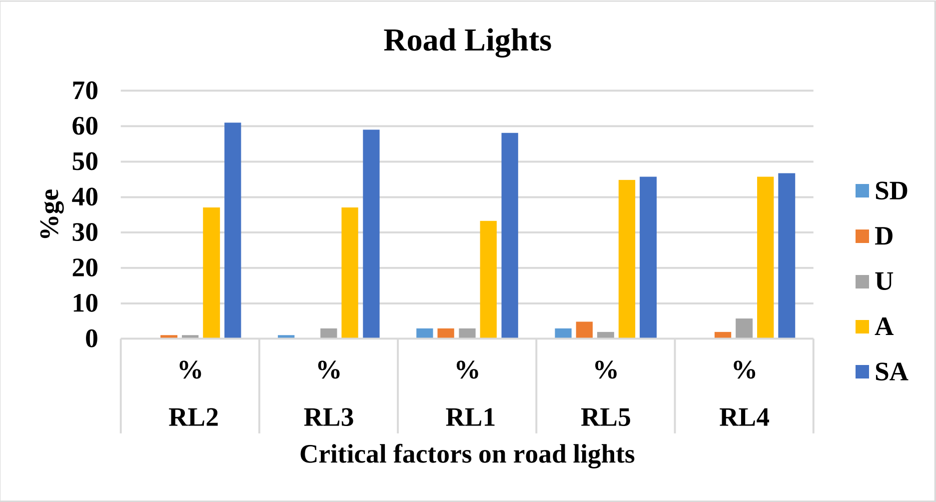


Figure 4. 14 Response Rate Ranking on Road Lighting

The curve in Figure 4.15 indicated that the results were not normally distributed with mean of 4.43 and standard deviation of 0.513. Ordinal regression method was therefore used in the analysis of the results.

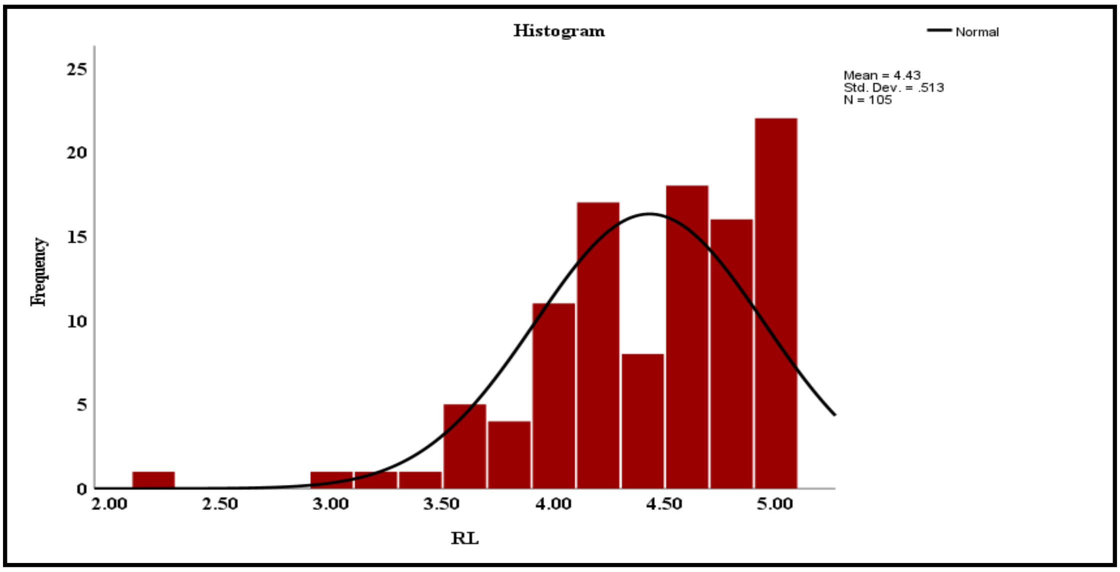


Figure 4. 15 Histogram for Road Lighting (RL)

4.6.6 Walkways and Service Lanes (WS)

The part of the self-administered questionnaire about walkways and service lane was measured on four parameters as tabulated in Table 4.15, all aimed at achieving the second study objectives.

The results from Table 4.12, indicated that service lanes were important in isolation of vehicles and pedestrians at urban and market places of the road, 95.2% of the respondents agreed and 4.8% were undecided. A mean of 4.49 ranked in first position, which is close to five on the Likert scale indicated that the respondents strongly agreed to construction of service lanes at market places and urban sections of the road.

In addition, majority (93.3%) of the respondents agreed that walkways should be laid on all urban sections of the road, with a mean of 4.47, while 2.9% were undecided and 3.8% disagreed. Therefore, a mean (4.47) ranked in second position close to five indicated that the respondents strongly agreed to laying walkways in urban sections of the road. So as to separate vehicles from pedestrians.

Eighty-five point seven percent (85.7%) of the respondents further agreed that walkways and service lanes separate fast moving vehicles from pedestrians and slow moving vehicles. 8.6% disagreed and 5.7% were undecided. A mean of 4.21 ranked in third position indicated that the respondents were in agreement. Furthermore, when asked whether there were no walkways in sections where they were required, 79% of the respondents agreed, 8.6% disagreed and the rest (12.4%) were undecided. With a mean of 3.99 ranked in fourth position, indicated that the respondents agree that the section under study had no walkways at sections where they are required.

Table 4. 15 Percentages, Frequencies and Means for Walkways and Service Lanes

Walkways and Service Lanes (WS)	F/ %	SD	D	U	A	SA	Mean	SD	Rank
Service lanes are important for isolation of vehicles around market places and urban sections of the road. (WS2)	**F**	0	0	5	44	56	**4.49**	**0.590**	**1**
	%	0	0	4.8	41.9	53.3			
Walkway should be laid on all urban sections of the road. (WS1)	**F**	0	3	4	39	59	**4.47**	**0.708**	**2**
	%	0	2.9	3.8	37.1	56.2			
Walkways and service lanes separate fast moving vehicles from pedestrians and slow moving vehicles. (WS3)	**F**	2	7	6	42	48	**4.21**	**0.953**	**3**
	%	1.9	6.7	5.7	40.0	45.7			
There are no walkways on sections where they are required. (WS4)	**F**	1	8	13	52	31	**3.99**	**0.904**	**4**
	%	1.0	7.6	12.4	49.5	29.5			

The results on critical factors are illustrated in graph below:

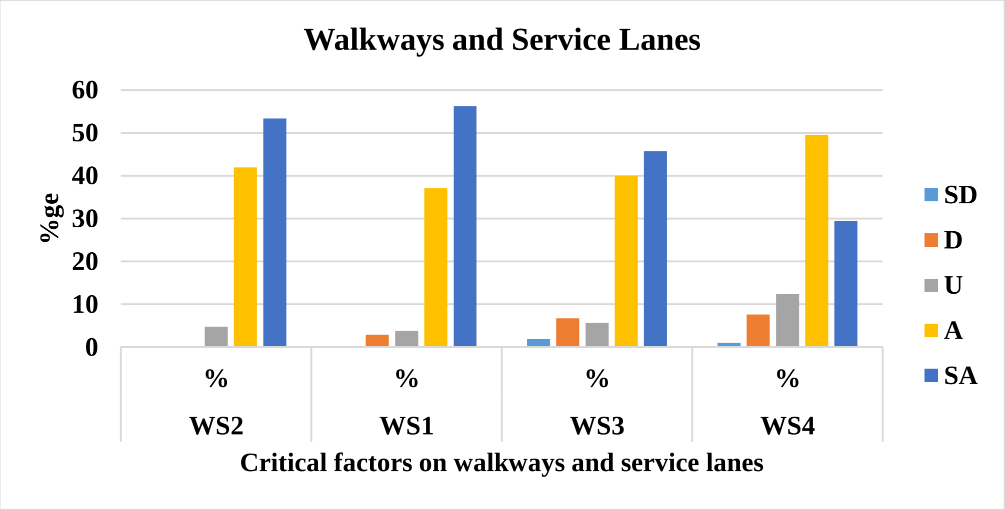


Figure 4. 16 Response Rate Ranking on Walkway and Service Lanes

An average index was calculated to establish whether the results in Table 4.15 were normally distributed. The curve in Figure 4.17 shows that the results were not normally distributed.

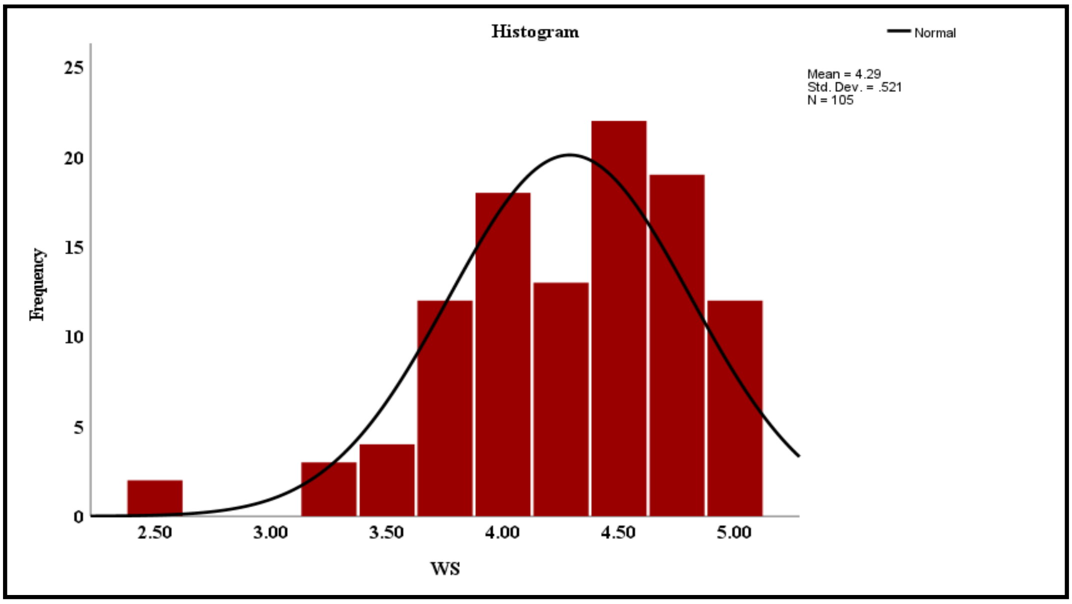


Figure 4. 17 Histogram for Walkways and Service Lanes (WS)

The curve in Figure 4.17, not being normally distributed means that the data obtained were to be subjected to ordinal regression and spearman rank correlation to get appropriate results.

During the interviews to different respondents, when asked about their opinion on other factors that cause accidents other than road ancillaries and how these can be mitigated; Respondent 001 stated that;

"some drivers do not really understand these signs and other features. There is really need for timely training, possibly during permit renewals because some of them are really lacking in this area."

Respondent 002 stated that;

"Some accidents are due to mechanical failures in the vehicles. These are notably brakes, tyre burst, among others. Other accidents are as a result of

aggressive driving mostly on weekends and public holidays. Some of the drivers are first time drivers within this area and they don't take extra care while driving."

When further asked their opinion as to whether engineers should be involved while assessing the possible causes of accidents at a given road section and whether this would help mitigate on further fatalities;

Respondent 003 stated that;

"It would be better for them to be part of our accident investigation. With this, they will be able to notice and plan for replacement of all the failed signs, knocked guardrails, among others. This can even give a better maintenance planning policy for our roads. Some accidents couldn't even have happened if some of these ancillaries were replaced on time."

When asked about the challenges they face in enforcing traffic guidelines as a way of curbing road accidents;

Respondent 001 stated that;

"With all that has happened, we still manage to do our duty because we are entrusted to perform this. We still enforce the regulation and some drivers are disciplined on the road. This is a score for us as traffic enforcers."

4.7 Inferential Analysis of the Data

The correlation and regression analysis were adopted for this study.

4.7.1 Correlation of Ancillary Roadworks and Road Safety

Correlation analysis was computed to establish the relationship between ancillary road works and road safety. Karl-Pearson's correlation analysis was used to establish the relationship between the variables for this study as presented in Table 4.16.

Table 4.16 revealed that road marking with correlation coefficient has 0.367 has positive weak significant relationship on the road safety. This implies that improvement on the road marking takes the same direction with the road safety. The increase in the road marking enables users of the roads specifically drivers, pedestrian, cyclist and motorcyclist move in the safe zone to ensure road safety. Road markings minimise accidents since the users can ably see and interpret them to make decision to the next course of action. The findings of this study is in agreement with (Babić et al., 2020) who established that road markings form the traffic surface and provide visual guidance for road users which has positive significant relationship on road safety. In the same earlier study of (Babić et al., 2020), it was also established that road markings with higher retro-reflectivity (>200 mcd/lx/m^2) are associated with the lower number of road accidents at 95%. The road markings perform an important function of guiding and controlling traffic and serve as a psychological barrier and signify the delineation of the traffic path to ensure road safety.

Road signs with correlation coefficient at 0.162 with p-value 0.098 has insignificant positive weak relationship on the road safety. This implies that improvement on the road signs does not take same direction with road safety. The road users specifically drivers, pedestrian, cyclist and motorcyclist encounter difficulty in knowing and interpreting all the road signs due to probably speed and these can be many in numbers which makes quick interpretations by drivers difficult while driving. The road signs provide valuable information to drivers and other road users which represent guidelines that are in place to keep them safe so as to maintain order and reduce accidents. Road users always know and interpret dominant road signs such as speed limit signs, stop signs, yield signs, pedestrian crossing signs, construction signs which enable them to reduce on accidents to realize road safety.

Guardrails with correlation coefficient has 0.388 have weak positive significant relationship on the road safety. This implies that improvement on guardrails takes the same direction with the road safety. The increase in number of guard rails in required sections of any road relates to increase in the road safety. The finding concurs with Venkataraman, (2019), who stated that guardrail infrastructures have a positive significant relationship on the road safety. The guardrails typically either protects motorists from entering a steep embankment, or it prevents collisions with objects like trees or bridge columns off the roadway to prevent serious injuries. The guardrails are used to prevent drivers from hitting obstacles such as steep embankments, hillsides, utility poles, retaining and bridge pillars to ensure road safety. In some cases, guardrails are installed for reasons other than to safeguard motorists against obstacles for example road closure barricades and barriers protecting pedestrians or sensitive area to ensure road safety.

Humps and rumble strips with a correlation coefficient has 0.427 have moderate positive significant relationship on the road safety. This implies that improvement on humps and rumble strips takes the same direction with the road safety. The increase in number of humps and rumble strips regulates speed by alerting inattentive drivers through noise and vibration, an action that ensures safety for road users. The findings are in agreement with Obeng et al., (2022) who stated that humps and rumble strips have positive significant relationship with road safety to lining high-speed roadways which deter shoulder driving, or the low speed control version. The rumble strips make drivers a little more alert that the roadway is changing (uneven) to force them slow down to go over a speed hump. The vibration and sound of rumble strips immediately alert the driver that there could be a danger to themselves or pedestrians, a measure that improves on road safety.

Road lighting with correlation coefficient has 0.325 had a weak positive significant relationship on the road safety. This implies that improvement on road lighting takes the same direction with the road safety. The increase on the numbers and quality of road lights improve safety by increasing visibility of roadside hazards and by reducing the effects of glare from other light sources in the visual environment, such as vehicle headlamps. The road lighting helps to reduce night-time crashes by improving visibility. It reduces pedestrian crashes by approximately 50% as suggested by the interviewees. The finding concurs with Bullough, (2016), who established that road lights have a positive significant relationship on road safety which reduces crime and road accidents.

Road lighting allows drivers, motorist and pedestrians to see the roadway further ahead than their vehicles and motorcycle headlamps can allow and it also reduces on glare from other headlamps which is generally associated with reduced night time crash rates by bright sources of light in the driver's field of view, thereby ensuring road safety.

Walkways and service lanes with a correlation coefficient has 0.341, have a weak positive significant relationship on the road safety. This implies that improvement on walkways and service lanes takes the same direction with the road safety. The walkways and services lane are preferred for pedestrians as a means of providing many benefits including safety, mobility, and healthier communities to minimise walking along roadway crash sections. These walkways and service lanes provides a stable surface off of the roadway for pedestrians to use with minimum or no attacks from road accidents to ensure safety, by isolating pedestrians form vehicular traffic. The finding agreed with those of (Galanis, Botzoris and Eliou, 2017) who asserts that walkways and service lanes promote pedestrian mobility and have a positive significant relationship on road safety. The separation of vehicles and pedestrians reduces crash risk on the road as well as provide visual indication of prioritised connection to community amenities with convenience and safely.

Table 4. 16 Ancillary Roadworks and Road Safety

		Log_RM	**Log_RS**	**Log_GR**	**Log_HR**	**Log_RL**	**Log_WS**	**Log_RF**
Log_RM	Pearson Correlation	1						
	Sig. (2-tailed)							
Log_RS	Pearson Correlation	0.214*	1					
	Sig. (2-tailed)	0.029						
Log_GR	Pearson Correlation	0.354**	0.241*	1				
	Sig. (2-tailed)	0.000	0.013					
Log_HR	Pearson Correlation	0.315**	0.494**	0.412**	1			
	Sig. (2-tailed)	0.001	0.000	0.000				
Log_RL	Pearson Correlation	0.224*	0.332**	0.273**	0.515**	1		
	Sig. (2-tailed)	0.022	0.001	0.005	0.000			
Log_WS	Pearson Correlation	0.296**	0.475**	0.439**	0.569**	0.564**	1	
	Sig. (2-tailed)	0.002	0.000	0.000	0.000	0.000		
Log_RF	Pearson Correlation	0.367**	0.162	0.388**	0.427**	0.325**	0.341**	1
	Sig. (2-tailed)	0.000	0.098	0.000	0.000	0.001	0.000	

***. Correlation is significant at the 0.05 level (2-tailed).**

****. Correlation is significant at the 0.01 level (2-tailed).**

4.7.2 Regression on Ancillary Roadworks and Road Safety

Regression determined the unit coefficient beta contribution of ancillary roadworks and road Safety in this study as demonstrated in Table 4.17.

Table 4.17 revealed that model summary on linear regression model of independent variables; Log_RM Road marking, Log_RS Road signs, Log_GR Guardrails, Log_HR Humps and Rumble strips, Log_RL Road lighting, Log_WS Walkways and Service Lanes on Log_RF Road Safety on Kampala - Jinja road.

The use of ancillary roadworks through road marking, road signs, guardrails, humps and rumble strips, road lighting, walkways and service lanes explains

29.0% variation on road safety at 95% level of significance, (R-Square = 0.290), and the remaining 71.0% could be from other factors such as enforcement of law on road users, installation of speed limit governor, fastening seat belts, among other external factors not included in this study.

F-Change of 6.683 indicates that the predictors have significant influence on road safety. The ancillary roadworks requires continued maintenance and improvement with support of police enforcement of road traffic laws such as strict observation of road signs, adherence to road marking details, proper use of walkways and service lanes, among others, to ensure road safety. The findings on upgrade on road infrastructure is supported by (Cvahte Ojsteršek and Topolšek, 2019), who established that road infrastructural factors include the road layout, roadside environment, communication from the road signs and road marking, the road's lighting status, among others.

Table 4. 17 Model Summary of the effect of ancillary road works and road safety

				Change Statistics				
R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
0.539^a	0.290	0.247	0.05181	0.290	6.683	6	98	0.0002

a. Predictors: (Constant), Log_WS, Log_RM, Log_RS, Log_GR, Log_RL, Log_HR

b. Dependent Variable: Log_RF

Table 4.18, shows the effect of ancillary road works on road safety, and it revealed that road safety with 0.125 cannot be attained when study predictors are zero. This, therefore, explains that road safety is hardly ensured in absence of the ancillary road works with other factors. The ancillary road works are one of the key elements in ensuring road safety and these must be maintained or replenished throughout the design life of a given road, and police ought to enforce their adherence by the different road users.

The findings from the regression analysis established that road marking with standardized coefficient beta 0.207 has a positive significant contribution on road safety. This implies that a unit change in road marking improvement contributes 0.207-unit change in road safety. Road markings and signs represent basic means of communication between the road authorities and road users and, as such, provide road users with necessary information about the rules, warnings, obligations, and other information related to the upcoming situations and road alignment to ensure road safety. The findings agreed with (Babić et al., 2020), who stated that road marking has a significant impact on road safety because it helps to regulate traffic by guiding road users and predicting the traveling trajectory and road boundaries.

Finding from regression analysis established that road signs with standardized coefficient beta -0.111 has negative insignificant contribution on the road safety. Road signs are good although quite many to be mastered by the drivers and pedestrians which make them insignificant on road safety. The road signs represent rules that are in place to keep road users safe, and help to communicate messages to drivers and pedestrians that can maintain order and reduce accidents. Never the less, neglecting them can cause road accidents.

Furthermore, the finding from regression analysis also established that guardrails with standardized coefficient beta 0.186 has positive significant contribution on the road safety. This implies that a unit improvement and change in guardrails contributes to 0.186 unit change in road safety. Guardrails on the sides of the road, protect drivers and pedestrians from falling and hitting obstacles to ensure road safety. The guardrail systems also serve as a warning for people to be aware of the road infrastructure facilities and other utility services like electricity poles to ensure safety. Furthermore, guardrails can help to deflect a vehicle back to the roadway, slow the vehicle down to a complete stop, among others.

In addition, regression analysis established that humps and rumble strips with standardized coefficient beta 0.260 have positive significant contribution on the road safety. This implies that a unit improvement and change in humps and rumble strips contribute to 0.260 unit change in road safety. Humps and rumble strips forcefully control the speed of the drivers and motorists which reduces on the road accidents due to over speeding in sections having such road ancillaries.

Findings from regression analysis also established that road lights with standardized coefficient beta 0.107 have positive insignificant contribution on the road safety. This implies road lights are good and desired for visibility purposes for road users although insignificantly affect road safety. Similarly, walkways and service lanes with standardized coefficient beta 0.042 have positive insignificant contribution on the road safety.

The walkways and service lanes help to separate motorists from the people, which is desirable and good although does not significantly contribute to road safety.

Table 4. 18 Regression on effect of ancillary road works and road safety

	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
(Constant)	0.125	0.084		1.485	0.141
Log_RM	0.219	0.099	0.207	2.214	0.029
Log_RS	-0.118	0.108	-0.111	-1.088	0.279
Log_GR	0.191	0.102	0.186	1.865	0.045
Log_HR	0.292	0.131	0.260	2.231	0.028
Log_RL	0.114	0.115	0.107	0.996	0.322
Log_WS	0.044	0.125	0.042	0.353	0.725

4.8 External factors which impact on road safety in Uganda

External factors are behavioural elements undertaken to supplement the ancillary roadworks' impact on the road safety. Respondents stated that traffic enforcement through issuing express penalties, warnings, inspection of observable elements to determine the vehicle condition, regular improvement on road infrastructure condition, evaluation of driver's age and experience as well as renewal and upgrade of driving permit support the effective use of roads to minimise on the accidents.

For example, Respondent 001 stated that;

"Introduce road-safety education in schools as a subject right from pre-school; regularly update the Uganda highway code (Rules of the Road) to international standard and avail it free online for the public, increase the number of random breath tests to reduce "Drink-Drive and Drugs".

The road safety rules require road users to obey all traffic signals like stop signs, red lights with exception of those with a right of way; wear seatbelts or crash helmets for motor cyclists, maintain the speed limit and safe distance, don't drink & drive, and also don't drive without having a driving licence to ensure road safety, among others.

Respondents 003 establishes that;

"Improve on the awareness levels of traffic rules and regulations in the community by visiting them with use of local language and media, and ensuring that defensive driving is done from licensed training schools, and also strict adherence on monitoring and evaluation of drivers' behaviour status ensures road safety.

4.9 Framework to mitigate on the impact of lack of road ancillaries on road safety

The operation of the mitigation framework for the impact of lack of ancillary roadworks on road safety, as presented in Figure 4.18, is that, for safety to be realized on Ugandan roads, the road markings on such roads should be clear, with the paint visible for easy identification by drivers and other road users, with the required standard width of the marking. Furthermore, the installation of guardrails should be such that these are made of strong approved material and their end sections should be crashworthy, with the ones knocked replaced timely to ensure that the safety of the different road users is not jeopardized. Furthermore, humps and rumble strips that are intended to be installed at various sections of any road in Uganda, should be clearly marked for easy visibility, they should be of a moderate size, so as not to cause accidents due to swaying off of the vehicles, say on the rumble strips, and those that have become worn-out should be reinstated, if safety is to be realized.

4.9.1 Planning Stage (Stage 1)

The road marking (beta = 0.207, p value = 0.029), guardrails (beta = 0.186, p value = 0.045), humps and rumble strips (beta = 0.260, p value = 0.028) have a significant contribution on road safety.

At this stage, experts ought to identify any black spot within a section of the road and do a conditional assessment to assess the accident risks involved due to lack of the above road ancillaries. With this, such risk areas will be mapped out and the safety requirements for road marking, guardrails, humps and rumble strips detailed as a result.

4.9.2 Design Stage (Stage 2)

This stages involves the production of geometrical designs for the sections under analysis, provide detailed dimensions of the ancillary requirements in adherence to the road safety standards of Uganda, and the quantification of material requirements as regards road marking, guardrails, humps and rumble strip; parameters that the study confirmed as being significant to road safety. The designs, will seek to restore all the road marking in these black spot sections, fix guardrails and also install humps and rumble strips-mostly in town sections of the study area.

4.9.3 Procurement of Material and Quality Tests (Stage 3)

Once the designs are finalised and material requirements establishes, the procurement process of road marking paint, guardrail posts and beams (guardrails) and material for fixing humps and rumble strips (asphalt concrete) has to commence. To ensure that these material conform to the quality requirements, quality test should be done on such material in line with the established standards as recommended on the National Bureau of Standards (UNBS) and quality test certificates issued to make such material worth fixing on the sections under study.

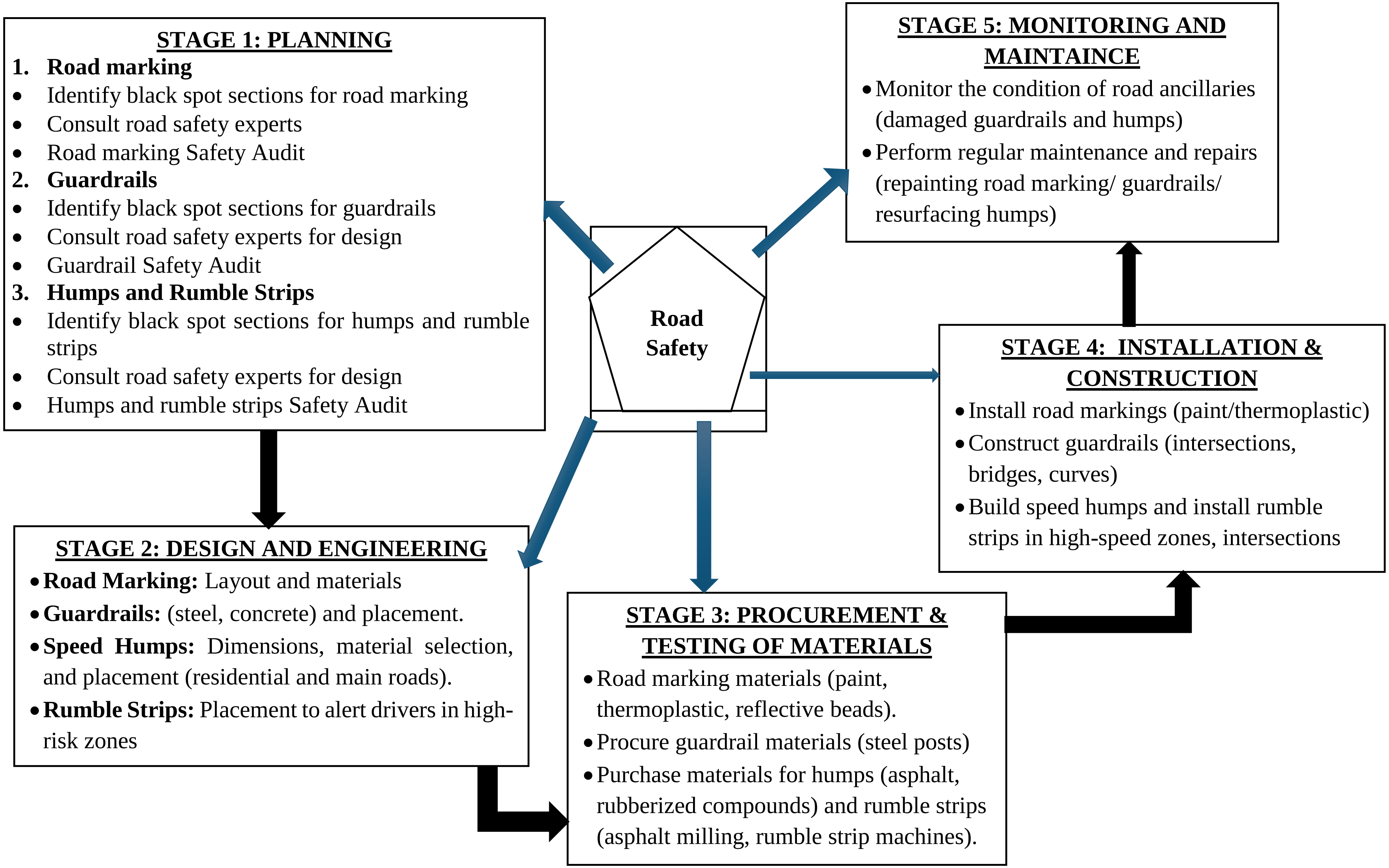
4.9.4 Installation and Construction (Stage 4)

The installation and construction of these road ancillaries should be such the; road markings are painted in a form that they a clear, visible, among other standards as detailed in Uganda’s road safety design manual. The guardrails, on the other hand, should be firmly fixed in the ground, encased in concrete and should be made of such strong material to prevent vehicles from falling off the roadway. Humps and rumble strips should also be construction such that they are of moderate sizes, visible and cannot easily wear out in a short time.

According to the Road Safety Design Manual of Uganda, road marking should be yellow for centreline marking, broken for overtaking zones and continuous in non-overtaking zones and should be marked white for edge lines. Furthermore, it is advised under the same manuals that guardrails should be fixed at a distance of 0.50m from the edge of the shoulder and humps should be fixed with a height of 0.30m above the wearing course, with rumble strips fixed at a height of 0.10m above the wearing course.

4.9.5 Monitoring and Maintenance (Stage 5)

Road ancillaries have a positive impact on the road safety and this can be achieved through continued monitoring and maintenance. The performance of these ancillaries should be such that they are not allowed to deteriorate so as to achieve the desired need for road safety. Further to note, ensuring road safety is so important because it saves many lives of road users and minimises government expenditure on accident victims and such road ancillaries help in realising safety on the country's roads. All the above, coupled with full enforcement of traffic laws by police and other stake holders help in minimizing on the number of fatal, serious and minor accidents on roads in Uganda.



STAGE 1: PLANNING

1. **Road marking**
- Identify black spot sections for road marking
- Consult road safety experts
- Road marking Safety Audit

2. **Guardrails**
- Identify black spot sections for guardrails
- Consult road safety experts for design
- Guardrail Safety Audit

3. **Humps and Rumble Strips**
- Identify black spot sections for humps and rumble strips
- Consult road safety experts for design
- Humps and rumble strips Safety Audit

STAGE 2: DESIGN AND ENGINEERING

- **Road Marking:** Layout and materials
- **Guardrails:** (steel, concrete) and placement.
- **Speed Humps:** Dimensions, material selection, and placement (residential and main roads).
- **Rumble Strips:** Placement to alert drivers in high-risk zones

STAGE 3: PROCUREMENT & TESTING OF MATERIALS

- Road marking materials (paint, thermoplastic, reflective beads).
- Procure guardrail materials (steel posts)
- Purchase materials for humps (asphalt, rubberized compounds) and rumble strips (asphalt milling, rumble strip machines).

STAGE 4: INSTALLATION & CONSTRUCTION

- Install road markings (paint/thermoplastic)
- Construct guardrails (intersections, bridges, curves)
- Build speed humps and install rumble strips in high-speed zones, intersections

STAGE 5: MONITORING AND MAINTAINCE

- Monitor the condition of road ancillaries (damaged guardrails and humps)
- Perform regular maintenance and repairs (repainting road marking/ guardrails/ resurfacing humps)

Figure 4. 18 Framework to mitigate the Impact of Lack of Road Ancillaries on Road Safety

Table 4. 19 Budget Framework for stages to mitigate the Impact of Lack of Road Ancillaries on Road Safety

Stage	Ancillaries	Activities	Budget Allocation	Final Output
1. Stage 1 Planning	Road marking (Beta = 0.207, p=0.029)	• Identify black spot sections for road marking • Consult with road safety experts for appropriate design and placement • Road Marking Safety Audit	• Identification of black spot section for road marking = Ushs 400,000,000 • Consultation with experts = Ushs 300,000,000 • Site survey = Ushs 200,000,000 **Total = Ushs 900,000,000**	• Mapping the black spots for road marking
	Guardrail (Beta = 0.186, p=0.045)	• Identify black spot sections for guardrails • Consult with road safety experts for appropriate design and placement • Guardrail Road Safety Audit	• Identification of black spot section for guardrail = Ushs 300,000,000 • Consultation with experts = Ushs 200,000,000 • Site survey = Ushs 200,000,000 **Total= Ushs 700,000,000**	• Marking the black spots for guardrails
	Humps and Rumble strips (Beta = 0.260, p=0.028)	• Identify black spot sections for Humps and Rumble strips • Consult with road safety experts for appropriate design and placement • Humps and Rumble strips Safety Audit	• Identification of black spot section for humps and rumble strips = Ushs 900,000,000 • Consultation with experts = Ushs 500,000,000 • Site survey = Ushs 200,000,000	• Marking the black spots for humps and rumble strips

2. Stage 2: Design and Engineering	Road ancillaries (Roadmaking, Guardrails and humps and rumble strip)	• Road Marking: Layout and materials (paint, thermoplastic, etc.) • Guardrails: (steel, concrete) and placement. • Speed Humps: Dimensions, material selection, and placement (residential and main roads). • Rumble Strips: Placement to alert drivers in high-risk zones	• Design and geometry for road marking, guardrails, humps and rumble strips at Ushs 30,000,000.	• Detailed design for restoring center road marking and re-install the signs, Guardrails and humps and rumble strips
3. Stage 3 Procurement of materials & Testing the quality	Ancillaries (Roadmaking, Guardrails and humps and rumble strip)	• Road marking materials (paint, thermoplastic, reflective beads). • Procure guardrail materials (steel posts, concrete barriers • Purchase materials for humps (asphalt, rubberized compounds) and rumble strips (asphalt milling, rumble strip machines).	• Roadmaking 24,000 meters **a)** Yellow line (Center line) Purchase@ 5,000X 24,000 Ushs 120,000,000/= **b)** White line (Edge line) Left + Right hand side Purchase@ 4500X2X24,000 **Ushs 216,000,000**	• Procurement Contracts • Material Inventory for Installation
			• Guardrails Purchase @ 200,000X1572 **Ushs 314,400,000**	
			• Humps and rumble strips 4 Humps (Kitega, Lugazi, Najjembe, Rugalambo market) Rumble strips, 3 Sets of 4	

4. Stage 4: Installation & Construction	Ancillaries (Roadmaking, Guardrails and humps and rumble strip)	- Install road markings (paint/thermoplastic) in identified areas. - Construct guardrails (intersections, bridges, curves). - Build speed humps and install rumble strips in high-speed zones, intersections.	- Road marking 24,000 meters **a)** Yellow line @ 2000X24,000 Ushs 48,000,000 **b)** White line @ 2,000 X 2 X 24,000 **Ushs 96,000,000**	- Installed Road Markings, Guardrails, Speed Humps, and Rumble Strips
			- Guardrails @ 50,000 1572X50,000 **Ushs 78,000,000**	
			- Humps and rumble strips **a)** Hump Ushs 730,000 12X4X730,000 **Ushs 35,040,000** **b)** Rumble strips ushs 156,000 3 X 12 X 156,000 **Ushs 22,464,000**	
5. Stage 5 Monitoring & Maintenance	Team to monitor ancillary deterioration	- Monitor the condition of road ancillaries i.e damage to guardrails, settling of humps). - Perform regular maintenance and repairs (repainting road markings, repairing guardrails, resurfacing humps)	- Maintenance Labor: Ushs 500,000,000 per year - Monitoring Tools: Ushs 300,000,000 per years	- Feedback and adjustments to Road Safety ancillaries

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the conclusions, recommendations and area for further research.

5.1 Conclusions

5.1.1 Current status of ancillary roadworks in the study area

The study on first objective concluded that there were insufficient road signs on the Kampala – Jinja road, because those still existing were 61% of the earlier installed informatory signs, 53% of the earlier installed regulatory signs, 60% of the earlier installed warning signs, and 16.7% of the earlier installed guidance signs before project handover.

Whereas all earlier installed road signs were critical, it was established that 40% of the earlier installed warning signs were missing/vandalised, 47% of the earlier installed regulatory signs were also missing, 83.3% of the earlier installed guidance signs were non-existent and 39% of the earlier installed informatory signs were also missing. In other words, road signs within the study area were few, therefore making the different road users vulnerable to accidents and other adverse effects.

Road markings were also insufficient, since only about 9.95Km out of 19.565Km representing 50.8% are clearly marked which indicated that 49.2% were faded marks which increases the risk of road accidents. In addition, guardrails earlier installed were still existing, but were covered with over grown grass which makes them invisible to road users and those that were knocked had not yet been replaced, thus poor maintenance of the road infrastructure.

Majority of road accidents registered with the study area were serious accidents at 46.3% representing 149 accidents, followed by 130 fatalities at 40.4% and lastly 13.3% represented by 43 minor accidents for a period running from 2017 to 2022. However, low accidents in 2020 was possibly due to limited movements of vehicles, motor cycles, peoples, among others, due to the Covid-19 lockdown. Therefore, road ancillaries are insufficient and require quick fixing with regular maintenance to avoid further accidents from over speeding, careless overtaking, passing and following too close, careless driving, reckless driving, careless pedestrian and mechanical failure of vehicles and motor cycles, among others in Uganda.

5.1.2 Relationship between rate of accidents and the current status of the road ancillaries

The study concluded from the correlation findings that, road ancillaries which include road marking, guardrails, humps and rumble strips, road lighting, walkways and service lanes have a positive significant relationship on road safety unlike road signs. Therefore, according the correlation findings, the above mentioned road ancillaries have a positive impact on road safety.

Findings from regression results, however, indicated that road marking with coefficient beta 0.207, guardrails with coefficient beta 0.186 and humps and rumbles with coefficient beta 0.260 have a positive significant effect on the road safety whereas road lights, walkways and service lines, and road signs were insignificant. Safe roads should therefore have clear road markings, strong guardrails, moderate humps and rumbles to regulate and control the users especially drivers, motor cyclists, pedestrians, among others, so as to minimize and prevent road accidents.

Furthermore, it was established from the visit of some of the black spots within the study area, that some accidents are avoidable once the required road ancillary infrastructure are put in place. A conditional assessment of such areas indicated that these black spot sections are risky to the different stake holders who use the road under study, since the required ancillary features are worn out or non-existent. It is therefore concluded that such infrastructure should be in place so as to minimise on the number of accidents and as well reduce on government expenditure on accident victims, loss of lives and productivity, among others.

5.1.3 Effects of external factors to road safety in Uganda

From the third objective, it was concluded that use of express penalties, warnings; inspection of observable elements to determine the vehicle condition, regular improvement on road infrastructure condition, evaluation of driver's age and experience as well as renewal and upgrade of driving permit support the effective use of roads to minimise on the accidents in Uganda. Therefore, the mentioned external factors, among others, are desired to supplement the road ancillaries to achieve road safety.

5.1.4 To develop a framework that can be used in mitigating the impact of road ancillaries on road safety

Road marking that is clear, broader, visible; strong and maintained guardrails to prevent vehicles, motor cycles, among others from falling off the roadway, humps and rumble strips with moderate size, visible and of a required standard to control vehicles, motor cycles, among others, contribute to road safety. However, enforcement of road traffic laws and policies supplement compliance with the ancillary road works for road safety. Therefore, human behaviour and behavioural modification is required in the struggle to develop formal and informal educational road safety campaigns.

5.2 Recommendations

Based on the study findings, the following recommendations should do be adopted: -

i) The humps and rumble strips should be moderate in size to ease usability of the roads by the vehicles for road safety. The moderate size should be standard to accommodate all motorist with high rate of stability so as to foster sustainable road transport and travel safety in Uganda. The humps and rumble strips should also be maintained at standards with regular replacement of those that have worn out and construction of average number so as to avoid stressing the motorist to ensure road safety.

ii) The government through MoWT, UNRA and other agencies should widen the roads and mark them clearly with standard approved colours so as to reduce vehicle crashes, a measure that will ensure safety on the country's roads. Road markings with higher retro reflectivity (>200 mcd/lx/m^2) are associated with the lower number of road accidents as indicated by Babić et al., (2020) in study about road infrastructure and accidents.

iii) Regular maintenance and informal education should be conducted to sensitize people on the interpretation of the road markings to avoid miss interpretation, a move that will ensure safer roads.

iv) The MoWT, UNRA and other stake holders should make sure that guardrails of strong materials are constructed on the country's roads. They should also endeavour to replace knocked ones in all places as well as engaging police to reprimand and penalize the culprits found guilty of vandalising.

v) The MoWT, UNRA and other stake holders should ensure right combinations of road ancillaries' interventions to control speed and traffic crashes to ensure road safety. Minimum levels of retro reflection required by driver's ranges between 100 and 150 mcd/lx/m^2 in dry conditions and about 150 mcd/lx/m^2 in wet conditions.

5.3 Area for further research

a) Road lights and their impact on driver behaviour and Road Safety.

b) Effectiveness of humps and rumble strips installation in speed reduction on highways in Uganda.

c) Similarly, study can be conducted in another country at the same level of economic development like Uganda to foster benchmarking of findings.

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APPENDICES

Appendix A Plagiarism Certificate, Similarity Index Digital Receipt, Originality Report

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APPENDIX 7: PLAGIARISM CLEARANCE CERTIFICATE

NAME OF STUDENT: SSEBULIBA ISAAC

REGISTRATION NO: 21/U/GMET/14617/PE

DEPARTMENT: CIVIL AND ENVIRONMENTAL ENGINEERING

FACULTY /SCHOOL: ENGINEERING.

I Sam Bulolo do hereby declare that the proposal/Dissertation of the above mentioned student titled INVESTIGATION OF THE IMPACT OF ANCILLARY ROAD WORKS ON ROAD SAFETY IN UGANDA: A CASE OF KAMPALA - JINJA ROAD has been subjected to anti plagiarism software (turnitin) and found to have similarity index of ……………against the Senate threshold of 20%.

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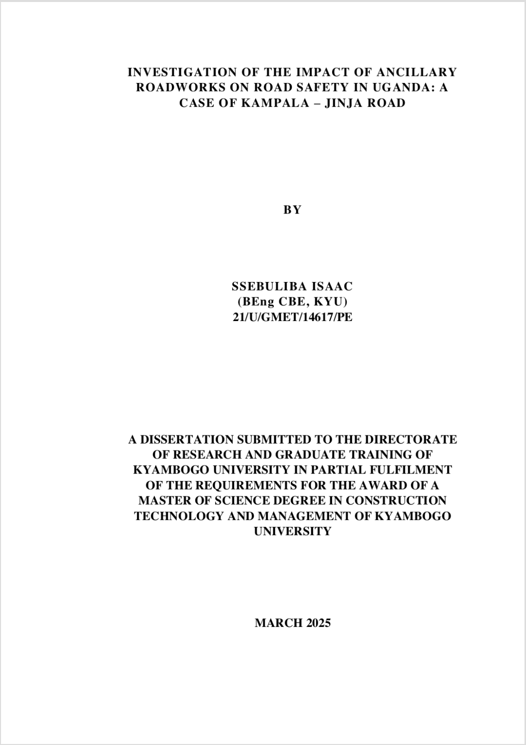

INVESTIGATION OF THE IMPACT OF ANCILLARY
ROADWORKS ON ROAD SAFETY IN UGANDA: A
CASE OF KAMPALA – JINJA ROAD

BY

SSEBULIBA ISAAC
(BEng CBE, KYU)
21/U/GMET/14617/PE

A DISSERTATION SUBMITTED TO THE DIRECTORATE
OF RESEARCH AND GRADUATE TRAINING OF
KYAMBOGO UNIVERSITY IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE AWARD OF A
MASTER OF SCIENCE DEGREE IN CONSTRUCTION
TECHNOLOGY AND MANAGEMENT OF KYAMBOGO
UNIVERSITY

MARCH 2025

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Appendix B Progress Reports for Research Work

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APPENDIX 2: PROGRESS REPORT RESEARCH WORK

FACULTY ENGINEERING DEPARTMENT CIVIL AND ENVIRONMENTAL ENGINEERING

STUDENT'S NAME: SSEBULIBA ISAAC

REG. No. 21/U/AMET/14617/PE PhD/MSc/MA/MA Phil MSc [✓ Full]/Part Time

PROJECT TITLE: INVESTIGATION OF THE IMPACT OF ANCILLARY ROADWORKS ON ROAD SAFETY IN UGANDA - A CASE OF KAMPALA -JINJA ROAD

SUMMARY OF WORK COMPLETED
DATA COLLECTION, DATA ANALYSIS AND DRAFT DISSERTATION WRITING (CURRENTLY UNDER REVIEW)

PROPORTION OF ORIGINAL WORK PLAN COMPLETED 85%

CONSTRAINTS, PROBLEMS/SUGGESTIONS

WORK PLAN FOR THE NEXT SIX MONTHS SUBMISSION OF FINAL DISSERTATION AND PRESENTATION

STUDENT'S SIGNATURE DATE 14th/AUG/2023

COMMENTS: BY THE PROGRAMME COORDINATOR
Good progress

NAME & SIGNATURE Ssenyondo Vicent
DATE 14/08/2023

COMMENTS: BY THE PRINCIPAL SUPERVISOR OR SECOND SUPERVISOR

The candidate's dissertation is under review by supervisors. It will be ready for examination by the said date.

NAME &SIGNATURE: Assoc. Prof. Lawrence Muhwezi

DATE 16/08/2023

COMMENTS: BY CHAIRMAN OF DEPARTMENTAL GRADUATE & RESEARCH COMMITTEE (WHO IS HEAD OF DEPARTMENT)

Good progress

NAME & SIGNATURE Ssenyondo Vicent

DATE

COMMENTS: BY FACULTY GRADUATE AND RESEARCH COMMITTEE (WHO IS THE DEAN OF FACULTY/SCHOOL)

Address all requirements by DRGT

NAME & SIGNATURE Dr Anne NAKAGIRI

DATE 18/08/23

COMMENTS: BY DIRECTOR, RESEARCH AND GRADUATE TRAINING

Processing appointment letters of examiners

NAME & SIGNATURE Justin Kwetonyeay

DATE 18/8/2023

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APPENDIX 2: PROGRESS REPORT RESEARCH WORK

FACULTY ENGINEERING DEPARTMENT CIVIL AND ENVIRONMENTAL ENGINEERING

STUDENT'S NAME: SSERULIBA ISAAC

REG. No. 21/U/GMET/14617/PE PhD/MSc/MA/MA Phil MSc [✓ Full]/Part Time

PROJECT TITLE: INVESTIGATION OF THE IMPACT OF ANCILLARY ROAD WORKS ON ROAD SAFETY IN UGANDA: A CASE OF KAMPALA - JINJA ROAD

SUMMARY OF WORK COMPLETED COLLECTION OF DATA FOR CURRENTLY EXISTING ROAD ANCILLARIES (OBJECTIVE 1); COLLECTION OF ROAD ACCIDENT DATA AT BLACK SPOTS (OBJECTIVE AND INTERVIEWS TO ASSESS THE EFFECTS OF EXTERNAL FACTORS TO ROAD SAFETY (OBJECTIVE 3).

PROPORTION OF ORIGINAL WORK PLAN COMPLETED 60%

CONSTRAINTS, PROBLEMS/SUGGESTIONS

WORK PLAN FOR THE NEXT SIX MONTHS ANALYSIS AND INTERPRETATION OF THE COLLECTED DATA; DRAFT REPORT WRITING, PRESENTATION OF THE ~~THESIS~~ FINDINGS AND FINAL SUBMISSION

STUDENT'S SIGNATURE DATE 26th/JUNE/2023

COMMENTS: BY THE PROGRAMME COORDINATOR

To speed up with data analysis, write the dissertation and think about drafting the manuscript

NAME & SIGNATURE Dr. Ssemyondo Vicent

DATE 26/06/2023

COMMENTS: BY THE PRINCIPAL SUPERVISOR OR SECOND SUPERVISOR

More effort, is required to start writing dissertation and complete on time.

NAME &SIGNATURE: Assoc. Prof. Lawrence Muhwezi

DATE 26/06/2023

COMMENTS: BY CHAIRMAN OF DEPARTMENTAL GRADUATE & RESEARCH COMMITTEE (WHO IS HEAD OF DEPARTMENT)

Focus on the activities within the planned next six months.

NAME & SIGNATURE Charles Onyutha

DATE 26/06/23

COMMENTS: BY FACULTY GRADUATE AND RESEARCH COMMITTEE (WHO IS THE DEAN OF FACULTY/SCHOOL)

Work closely with the supervisor to complete on time
Address all requirements by DRGT

NAME & SIGNATURE Dr. Anne NAKAGIRI

DATE 27/06/23

COMMENTS: BY DIRECTOR, RESEARCH AND GRADUATE TRAINING

Progress noted. Proposal submitted.

NAME & SIGNATURE Justine [illegible]

DATE 13/7/2023

Appendix C Introduction Letter for Research

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APPENDIX 8

Date:

TO WHOM IT MAY CONCERN

RE: SSEBULIBA ISAAC

Dear Sir/Madam,

This is to introduce to you the above named student Reg: No 21/U/GMCT/14817/PE pursuing MSc. CONSTRUCTION TECHNOLOGY & MANAGEMENT, Department of CIVIL & ENVIRONMENTAL ENGINEERING, Kyambogo University.

She/he intends to carry out research on INVESTIGATION OF THE IMPACT OF ANCILLARY ROAD WORKS ON ROAD SAFETY IN UGANDA A CASE OF KAMPALA - JINJA ROAD in partial fulfillment of the requirements of the award of MSc. CONSTRUCTION TECHNOLOGY & MANAGEMENT

The purpose of this letter therefore is to request you to grant him/her permission to carry out his/her study in your institution.

Any assistance rendered to her/him will be highly appreciated.

Yours sincerely,

Prof. Bosco Bua
AG. DIRECTOR

KYAMBOGO UNIVERSITY
★ 04 JUL 2023 ★
DIRECTOR
DIRECTORATE OF RESEARCH AND GRADUATE TRAINING

Appendix D Police Letter – Permission to Conduct Research

TELEGRAMS: "GENPOL"
TELEPHONE: 231761, 233814
FAX NO: (041) 255630)

IN ANY CORRESPONDENCE ON.
THIS SUBJECT QUOTE NO. TRS 50 VOL1/47

UGANDA POLICE FORCE
POLICE HEADQUARTERS
P.O. BOX 7055
Kampala
Uganda

PROTECT & SERVE

24th March 2023

The Regional Traffic Officer Sezibwa

Permission to conduct Research

Reference is made to the above mentioned subject matter.

Mr. Ssebuliba Isaac is a student at Kyambogo University and is currently pursuing a Master's of Science in Construction Technology and Management. He is conducting a study entitled "*Investigation of the Impact of Ancillary Roadworks on Road Safety in Uganda: A case of Kampala – Jinja Road*."

As part of the study, he would like to collect road crash data along the road from 2017 - 2022. He will also interview traffic personnel and Inspectors of Vehicles along the stretch.

He has been granted permission by the Director Traffic and Road Safety, Uganda Police Force.

Please accord him the necessary support.

Sincerely,

SSP Nalugo Bettinah
For: Director, Traffic and Road Safety
Uganda Police Force

OC/TRAFFIC BUIKWE POLICE STATION
08 APR 2023
SIGNED
P.O. BOX 132, LUGAZI

Received by:
No. [illegible]
Records Officer
8/4/2023

OIC TRAFFIC NJERU DIV. POLICE STATION
08 APR 2023
Received
ASP

OC TRAFFIC MABIRA POLICE STATION
08 APR 2023
P.O. BOX 132, LUGAZI

Received
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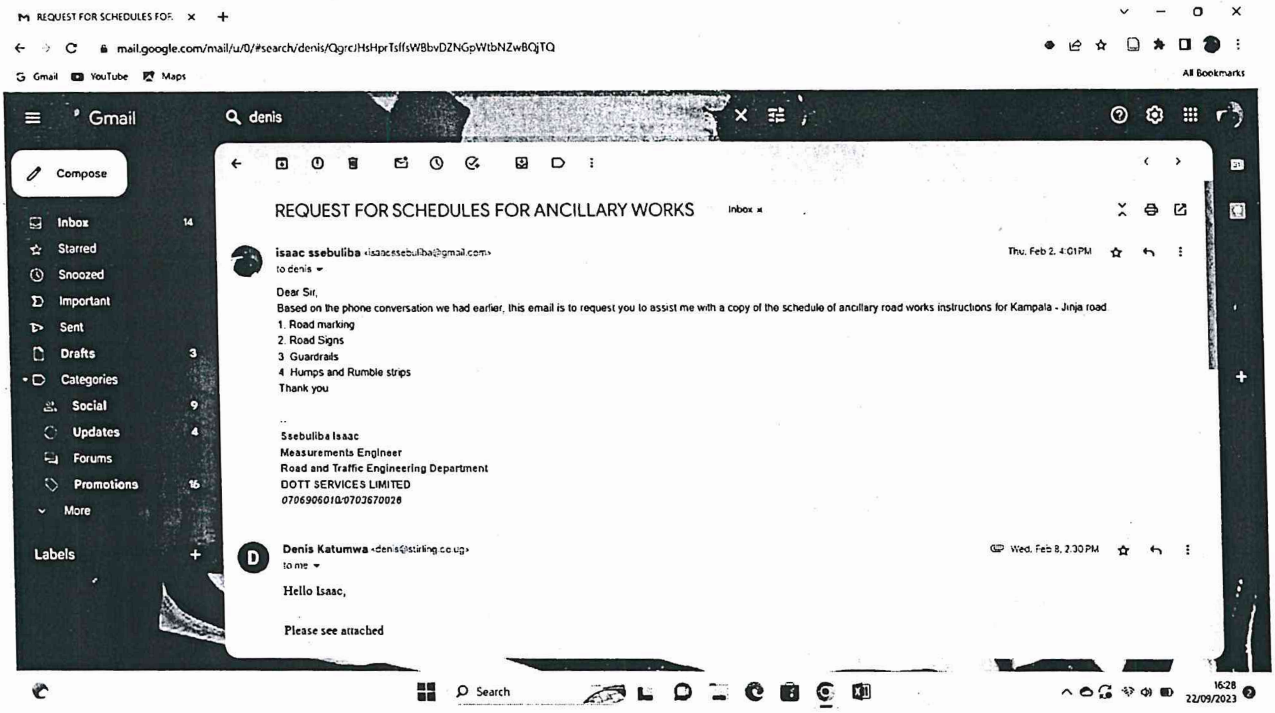
Appendix E Schedules for Ancillary Roadworks On Kampala – Jinja Road



REQUEST FOR SCHEDULES FOR ANCILLARY WORKS

isaac ssebuliba <isaacssebuliba@gmail.com>
to denis
Thu, Feb 2, 4:01PM

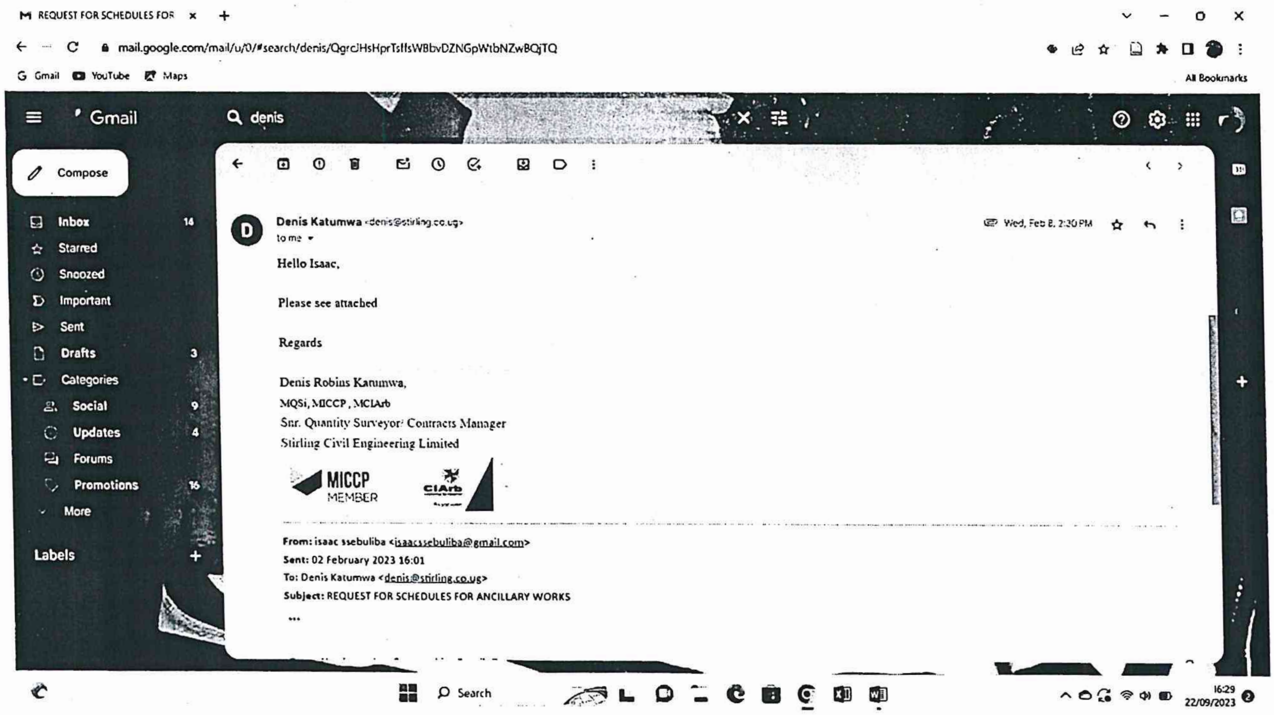
Dear Sir,
Based on the phone conversation we had earlier, this email is to request you to assist me with a copy of the schedule of ancillary road works instructions for Kampala - Jinja road
1. Road marking
2. Road Signs
3 Guardrails
4 Humps and Rumble strips
Thank you

..
Ssebuliba Isaac
Measurements Engineer
Road and Traffic Engineering Department
DOTT SERVICES LIMITED
0706906010/0703670026

Denis Katumwa <denis@stirling.co.ug>
to me
Wed, Feb 8, 2:30 PM

Hello Isaac,

Please see attached



Denis Katumwa <denis@stirling.co.ug>
to me
Wed, Feb 8, 2:30 PM

Hello Isaac,

Please see attached

Regards

Denis Robins Katumwa,
MQSi, MICCP , MCIArb
Snr. Quantity Surveyor/ Contracts Manager
Stirling Civil Engineering Limited

From: isaac ssebuliba <isaacssebuliba@gmail.com>
Sent: 02 February 2023 16:01
To: Denis Katumwa <denis@stirling.co.ug>
Subject: REQUEST FOR SCHEDULES FOR ANCILLARY WORKS
...

SPENCON **Spencon - Stirling JV** Stirling

STAGED RECONSTRUCTION OF MUKONO - JINJA ROAD (52 KM) - LOT C

BILL NO 5: ANCILLARY ROAD WORKS

Item No. 55.02 (b): Yellow lines (broken/unbroken) with reflectorised pavement markers (100 mm wide)

From	To	Type	Length (m)	Length of Line (m)	Remarks
A) MAIN CENTRE LINE					
0+000	2+840	Solid	2,840.00	**2,840.00**	
2+840	3+400	Broken	560.00	**187.00**	
3+400	4+900	Solid	1,500.00	**1,500.00**	
4+900	5+100	Broken	200.00	**67.00**	
5+100	6+200	Solid	1,100.00	**1,100.00**	
6+200	6+850	Broken	650.00	**217.00**	
6+850	10+000	Solid	3,150.00	**3,150.00**	
10+000	10+550	Broken	550.00	**183.00**	
10+550	11+200	Solid	650.00	**650.00**	
11+200	11+460	Broken	260.00	**87.00**	
11+460	12+100	Solid	640.00	**640.00**	
12+100	12+540	Broken	440.00	**147.00**	
12+540	14+500	Solid	1,960.00	**1,960.00**	
14+500	14+740	Broken	240.00	**80.00**	
14+740	16+200	Solid	1,460.00	**1,460.00**	
16+200	16+550	Broken	350.00	**117.00**	
16+550	17+160	Solid	610.00	**610.00**	
17+160	17+200	Broken	40.00	**13.00**	
17+200	20+580	Solid	3,380.00	**3,380.00**	
20+580	20+875	Broken	295.00	**98.00**	
20+875	21+050	Solid	175.00	**175.00**	
21+050	21+250	Broken	200.00	**67.00**	
21+250	22+140	Solid	890.00	**890.00**	
22+140	22+400	Broken	260.00	**87.00**	
22+400	23+200	Solid	800.00	**800.00**	
23+200	24+100	Solid	900.00	**900.00**	
24+100	26+040	Solid	1,940.00	**1,940.00**	
26+040	26+300	Broken	260.00	**87.00**	
26+300	26+500	Solid	200.00	**200.00**	
26+500	27+620	Broken	1,120.00	**373.00**	
27+620	30+080	Solid	2,460.00	**2,460.00**	
30+080	31+200	Broken	1,120.00	**373.00**	
31+200	32+140	Solid	940.00	**940.00**	
32+140	32+250	Broken	110.00	**37.00**	
32+250	33+860	Solid	1,610.00	**1,610.00**	
33+860	35+600	Broken	1,740.00	**580.00**	
35+600	36+000	Solid	400.00	**400.00**	
36+000	36+600	Broken	600.00	**200.00**	
36+600	37+600	Solid	1,000.00	**1,000.00**	
37+600	39+560	Broken	1,960.00	**653.00**	
39+560	40+400	Solid	840.00	**840.00**	
40+400	40+600	Broken	200.00	**67.00**	
40+600	42+160	Solid	1,560.00	**1,560.00**	
42+160	42+600	Broken	440.00	**147.00**	

Item No. 55.02 (b): Yellow lines (broken/unbroken) with reflectorised pavement markers (100 mm wide)

From	To	Type	Length (m)		Length of Line (m)	Remarks
A) MAIN CENTRE LINE						
42+600	43+100	Solid	500.00		**500.00**	
43+100	43+380	Solid	280.00		**280.00**	
43+380	43+900	Broken	520.00		**173.00**	
43+900	44+980	Solid	1,080.00		**1,080.00**	
44+980	45+125	Broken	145.00		**48.00**	
45+125	47+160	Solid	2,035.00		**2,035.00**	
47+160	48+200	Broken	1,040.00		**347.00**	
48+200	48+700	Solid	500.00		**500.00**	
48+700	50+000	Broken	1,300.00		**433.00**	
50+000	51+000	Solid	1,000.00		**1,000.00**	
51+000	52+825	Solid	1,825.00		**1,825.00**	
52+825	53+320	Broken	495.00		**165.00**	
B) ADDITIONAL CENTRE LINE (at double line sections)						
2+675	2+840	Broken	165.00	LHS	**55.00**	
5+100	5+320	Broken	220.00	RHS	**73.00**	
6+000	6+200	Broken	200.00	LHS	**67.00**	
6+850	6+900	Broken	50.00	RHS	**17.00**	
10+140	10+300	Broken	160.00	RHS	**53.00**	
10+360	10+550	Broken	190.00	LHS	**63.00**	
10+550	10+860	Broken	310.00	RHS	**103.00**	
11+200	11+300	Broken	100.00	RHS	**33.00**	
11+900	12+100	Broken	200.00	LHS	**67.00**	
13+650	14+000	Broken	350.00	RHS	**117.00**	
14+280	14+500	Broken	220.00	LHS	**73.00**	
14+740	15+000	Broken	260.00	RHS	**87.00**	
15+950	16+200	Broken	250.00	LHS	**83.00**	
16+550	16+780	Broken	230.00	RHS	**77.00**	
16+920	17+160	Broken	240.00	LHS	**80.00**	
17+200	17+440	Broken	240.00	RHS	**80.00**	
20+340	20+580	Broken	240.00	LHS	**80.00**	
20+875	21+050	Broken	175.00	LHS	**58.00**	
21+250	21+500	Broken	250.00	RHS	**83.00**	
21+850	22+140	Broken	290.00	LHS	**97.00**	
22+400	22+600	Broken	200.00	RHS	**67.00**	
24+700	25+000	Broken	300.00	LHS	**100.00**	
25+800	26+040	Broken	240.00	LHS	**80.00**	
27+620	27+800	Broken	180.00	RHS	**60.00**	
29+900	30+080	Broken	180.00	LHS	**60.00**	
31+400	31+740	Broken	340.00	LHS	**113.00**	
31+920	32+140	Broken	220.00	LHS	**73.00**	
32+250	32+450	Broken	200.00	RHS	**67.00**	
35+600	35+800	Broken	200.00	RHS	**67.00**	
35+900	36+000	Broken	100.00	LHS	**33.00**	
36+600	36+800	Broken	200.00	LHS	**67.00**	
37+380	37+600	Broken	220.00	LHS	**73.00**	
39+560	39+800	Broken	240.00	RHS	**80.00**	
40+100	40+400	Broken	300.00	LHS	**100.00**	
40+600	40+850	Broken	250.00	RHS	**83.00**	
42+000	42+160	Broken	160.00	LHS	**53.00**	

Item No. 55.02 (b): Yellow lines (broken/unbroken) with reflectorised pavement markers (100 mm wide)

From	To	Type	Length (m)		Length of Line (m)	Remarks
A) MAIN CENTRE LINE						
42+600	42+700	Broken	100.00	LHS	**33.00**	
43+140	43+380	Broken	240.00	LHS	**80.00**	
43+900	44+100	Broken	200.00	RHS	**67.00**	
44+700	44+980	Broken	280.00	LHS	**93.00**	
45+125	45+400	Broken	275.00	RHS	**92.00**	
46+925	47+160	Broken	235.00	LHS	**78.00**	
48+440	48+700	Broken	260.00	LHS	**87.00**	
TOTAL					**46,410.00**	

STAGED RECONSTRUCTION OF MUKONO - JINJA ROAD (52 KM) - LOT C

BILL NO 5: ANCILLARY ROAD WORKS

Item No. B54.01 (i): Standard road signs as specified in the drawings (area of sign less or equal 1.5 m2)

Chainage	Side	Description	New Signs (No.)	Remarks
1+050	LHS	HUMP	1	
1+150	LHS	SIDE ROAD - TO RIGHT	1	
1+300	RHS	STOP	1	
1+450	RHS	SIDE ROAD - TO LEFT	1	
1+525	RHS	HUMP	1	
1+900	RHS	MUKONO	1	PLACE IDENTIFICATION
1+950	LHS	COMBINED CURVES - RIGHT FIRST	1	
2+510	LHS	SIDE ROAD - TO RIGHT	1	
2+546	RHS	STOP	1	
2+625	LHS	END OF SPEED LIMIT - 50	1	
2+625	RHS	SPEED LIMIT - 50	1	
2+650	RHS	SIDE ROAD - TO LEFT	1	
2+675	RHS	COMBINED CURVES - RIGHT FIRST	1	
3+500	LHS	HUMP	1	
4+050	RHS	HUMP	1	
4+475	RHS	STOP	1	
4+600	RHS	STOP	1	
5+100	LHS	COMBINED CURVES - RIGHT FIRST	1	
6+175	RHS	COMBINED CURVES - LEFT FIRST	1	
7+144	RHS	END OF SPEED LIMIT - 50	1	
7+144	LHS	SPEED LIMIT - 50	1	
7+300	LHS	MBALALA	1	PLACE IDENTIFICATION
7+400	LHS	HUMP	1	
7+800	RHS	CROSS ROAD	1	
8+000	RHS	HUMP	1	
8+050	LHS	END OF SPEED LIMIT - 50	1	
8+050	RHS	SPEED LIMIT - 50	1	
8+100	RHS	MBALALA	1	PLACE IDENTIFICATION
10+500	LHS	NAMAWOJJOLO	1	PLACE IDENTIFICATION
10+590	RHS	END OF SPEED LIMIT - 50	1	
11+700	LHS	WALUSUBI	1	PLACE IDENTIFICATION
11+725	RHS	END OF SPEED LIMIT - 50	1	
11+725	LHS	SPEED LIMIT - 50	1	
11+750	LHS	CROSS ROAD	1	
11+900	RHS	STOP	1	
11+900	RHS	STOP	1	
11+975	RHS	CROSS ROAD	1	
12+025	LHS	END OF SPEED LIMIT - 50	1	
12+025	RHS	SPEED LIMIT - 50	1	
12+100	RHS	WALUSUBI	1	PLACE IDENTIFICATION
13+700	LHS	NAMATABA	1	PLACE IDENTIFICATION
13+750	RHS	END OF SPEED LIMIT - 50	1	
13+750	LHS	SPEED LIMIT - 50	1	
14+050	LHS	SIDE ROAD - TO LEFT	1	
14+075	LHS	BUS STOP	1	
14+080	LHS	STOP	1	
14+300	LHS	STOP	1	
14+375	RHS	SIDE ROAD - TO RIGHT	1	
14+400	LHS	END OF SPEED LIMIT - 50	1	
14+400	RHS	SPEED LIMIT - 50	1	
14+450	RHS	NAMATABA	1	PLACE IDENTIFICATION
15+500	RHS	END OF SPEED LIMIT - 50	1	
15+500	LHS	SPEED LIMIT - 50	1	
15+700	LHS	SIDE ROAD - TO RIGHT	1	
15+790	LHS	STOP	1	
15+850	RHS	STOP	1	AT MAJOR ACCESS
16+000	LHS	END OF SPEED LIMIT - 50	1	
16+000	RHS	SIDE ROAD - TO RIGHT	1	
16+050	RHS	KAYANJA	1	PLACE IDENTIFICATION
16+500	LHS	NAMAGUNGA	1	PLACE IDENTIFICATION
16+550	RHS	END OF SPEED LIMIT - 50	1	
16+550	LHS	SPEED LIMIT - 50	1	
16+850	LHS	STOP	1	
16+875	RHS	SIDE ROAD - TO RIGHT	1	
17+000	LHS	END OF SPEED LIMIT - 50	1	
17+000	RHS	SPEED LIMIT - 50	1	
17+050	RHS	NAMAGUNGA	1	PLACE IDENTIFICATION
17+700	LHS	START OF EXTRA LANE	1	
18+900	RHS	LEFT HAND BEND	1	
18+970	LHS	END OF EXTRA LANE	1	
19+250	RHS	END OF EXTRA LANE	1	
19+650	RHS	RIGHT HAND BEND	1	
19+700	LHS	RIGHT HAND BEND	1	
19+925	RHS	START OF EXTRA LANE	1	
20+500	RHS	LEFT HAND BEND	1	

Item No. B54.01 (i): Standard road signs as specified in the drawings (area of sign less or equal 1.5 m2)

Chainage	Side	Description	New Signs (No.)	Remarks
21+000	LHS	KITEGA	1	PLACE IDENTIFICATION
21+050	RHS	END OF SPEED LIMIT - 50	1	
21+050	LHS	SPEED LIMIT - 50	1	
21+425	LHS	BUS STOP	1	SHARES POST WITH SIGN BELOW
21+425	LHS	SIDE ROAD - TO LEFT	1	SHARES POST WITH SIGN ABOVE
21+700	RHS	BUS STOP	1	
21+825	LHS	END OF SPEED LIMIT - 50	1	
21+825	RHS	SPEED LIMIT - 50	1	
21+900	RHS	KITEGA	1	PLACE IDENTIFICATION
22+375	LHS	LUGAZI	1	PLACE IDENTIFICATION
22+425	LHS	LEFT HAND BEND	1	
22+450	RHS	END OF SPEED LIMIT - 50	1	
22+450	LHS	SPEED LIMIT - 50	1	
22+800	LHS	START OF EXTRA LANE	1	
23+200	LHS	END OF EXTRA LANE	1	
23+250	RHS	RIGHT HAND BEND	1	
23+775	LHS	ROUNDABOUT	1	
24+100	LHS	HOSPITAL	1	
24+100	RHS	ROUNDABOUT	1	
24+100	RHS	STOP	1	
24+275	RHS	END OF EXTRA LANE	1	
24+350	LHS	END OF SPEED LIMIT - 50	1	
24+350	RHS	SPEED LIMIT - 50	1	
24+800	RHS	LUGAZI	1	PLACE IDENTIFICATION
25+375	RHS	START OF EXTRA LANE	1	
26+300	LHS	NARROW BRIDGE	1	
26+500	RHS	NARROW BRIDGE	1	
26+540	LHS	START OF EXTRA LANE	1	
27+050	LHS	BUS STOP	1	
27+900	LHS	END OF EXTRA LANE	1	
28+000	LHS	COMBINED CURVES - RIGHT FIRST	1	
28+400	RHS	STOP	1	AT MAJOR ACCESS
28+425	RHS	END OF EXTRA LANE	1	
29+200	RHS	START OF EXTRA LANE	1	
29+675	RHS	COMBINED CURVES - LEFT FIRST	1	
29+800	RHS	END OF EXTRA LANE	1	
29+900	LHS	MABIRA FOREST	1	PLACE IDENTIFICATION
30+575	RHS	START OF EXTRA LANE	1	
32+400	LHS	NAJJEMBE	1	PLACE IDENTIFICATION
32+450	RHS	END OF SPEED LIMIT - 50	1	
32+450	LHS	SPEED LIMIT - 50	1	
32+975	RHS	END OF EXTRA LANE	1	
33+000	LHS	END OF SPEED LIMIT - 50	1	
33+000	RHS	SPEED LIMIT - 50	1	
33+050	LHS	COMBINED CURVES - LEFT FIRST	1	
33+050	RHS	NAJJEMBE	1	PLACE IDENTIFICATION
33+460	RHS	START OF EXTRA LANE	1	
36+525	RHS	END OF EXTRA LANE	1	
36+900	LHS	RIGHT HAND BEND	1	
37+100	RHS	START OF EXTRA LANE	1	
37+375	LHS	START OF EXTRA LANE	1	
37+600	RHS	LEFT HAND BEND	1	
38+340	LHS	END OF EXTRA LANE	1	
38+800	RHS	END OF EXTRA LANE	1	
39+700	LHS	RIGHT HAND BEND	1	
40+300	RHS	START OF EXTRA LANE	1	
41+100	LHS	MABIRA FOREST	1	PLACE IDENTIFICATION
41+900	RHS	STOP	1	AT MAJOR ACCESS
42+725	RHS	END OF EXTRA LANE	1	
43+565	RHS	START OF EXTRA LANE	1	
43+800	LHS	START OF EXTRA LANE	1	
44+380	LHS	END OF EXTRA LANE	1	
45+600	LHS	KITIGOMA	1	PLACE IDENTIFICATION
45+700	RHS	END OF SPEED LIMIT - 50	1	
45+700	LHS	SPEED LIMIT - 50	1	
46+370	RHS	END OF EXTRA LANE	1	
46+875	RHS	START OF EXTRA LANE	1	
46+900	LHS	STOP	1	AT MAJOR ACCESS
47+000	LHS	END OF SPEED LIMIT - 50	1	
47+000	RHS	SPEED LIMIT - 50	1	
47+100	RHS	KITIGOMA	1	PLACE IDENTIFICATION
47+300	RHS	STOP	1	
47+640	LHS	START OF EXTRA LANE	1	
47+950	LHS	NAKIBIZI	1	PLACE IDENTIFICATION
48+000	RHS	END OF SPEED LIMIT - 50	1	
48+000	LHS	SPEED LIMIT - 50	1	
48+230	LHS	END OF EXTRA LANE	1	
48+600	RHS	BUS STOP	1	
49+700	LHS	MBIKO	1	PLACE IDENTIFICATION
49+700	RHS	NAKIBIZI	1	PLACE IDENTIFICATION
50+200	RHS	BUS STOP	1	
50+300	RHS	END OF EXTRA LANE	1	
50+925	LHS	HUMP	1	

Item No. B54.01 (i): Standard road signs as specified in the drawings (area of sign less or equal 1.5 m2)

Chainage	Side	Description	New Signs (No.)	Remarks
51+300	RHS	HUMP	1	
51+675	LHS	HUMP	1	
52+180	RHS	START OF EXTRA LANE	1	
52+875	RHS	HUMP	1	
53+200	RHS	MBIKO	1	PLACE IDENTIFICATION
53+200	RHS	SPEED LIMIT - 50	1	
TOTAL			**164.00**	

STAGED RECONSTRUCTION OF MUKONO - JINJA ROAD (52 KM) - LOT C

BILL NO 5: ANCILLARY ROAD WORKS

Item No. 55.09 (a): Rumble strips

Chainage	Length (m)	Strips (no)	Quantity (m)	Remarks
1+369	11.20	4.00	11.20	
1+444	11.20	4.00	11.20	
3+600	11.50	2.00	5.75	
3+675	11.50	2.00	5.75	
3+725	11.50	2.00	5.75	
3+795	11.50	2.00	5.75	
3+875	11.50	2.00	5.75	
3+950	11.50	2.00	5.75	
7+500	12.90	4.00	12.90	
7+550	10.80	4.00	10.80	
7+660	11.60	4.00	11.60	
7+800	12.10	4.00	12.10	
7+850	11.10	4.00	11.10	
51+025	14.00	4.00	14.00	
51+200	14.00	4.00	14.00	
51+775	14.00	2.00	7.00	
52+025	14.00	2.00	7.00	
52+525	12.40	2.00	6.20	
52+800	15.00	2.00	7.50	
TOTAL			**171.10**	

SPENCON Spencon - Stirling JV Stirling

STAGED RECONSTRUCTION OF MUKONO - JINJA ROAD (52 KM) - LOT C

BILL NO 5: ANCILLARY ROAD WORKS

Item No. 52.01 (a): Galvanised guardrails on steel posts with two reflectors per post

From	To	Side	Total Length (m)	Less End Unit (4m each)	Net Length (m)	Remarks
1+500	1+576	LHS	76.00	8.00	**68.00**	
1+584	1+620	LHS	36.00	8.00	**28.00**	
9+384	9+416	LHS	32.00	8.00	**24.00**	
9+384	9+416	RHS	32.00	8.00	**24.00**	
13+625	13+825	LHS	200.00	8.00	**192.00**	
17+125	17+213	RHS	88.00	8.00	**80.00**	
20+095	20+215	LHS	120.00	8.00	**112.00**	
20+086	20+234	RHS	148.00	8.00	**140.00**	
26+311	26+411	LHS	100.00	8.00	**96.00**	+1 Safety Beam at Bridge
26+311	26+411	RHS	100.00	8.00	**96.00**	+1 Safety Beam at Bridge
29+155	29+267	RHS	**20.00**		**20.00**	5 New Beams+Posts
31+150	31+302	LHS	152.00	8.00	**144.00**	
32+660	32+791	LHS	**40.00**	8.00	**32.00**	8 New Beams+Posts+2 End Units
33+300	33+424	RHS	124.00	8.00	**116.00**	
33+340	33+424	LHS	84.00	8.00	**76.00**	
33+855	33+999	LHS	144.00	8.00	**136.00**	
33+912	34+000	RHS	88.00	8.00	**80.00**	
37+339	37+419	RHS	80.00	8.00	**72.00**	
37+320	37+376	LHS	56.00	8.00	**48.00**	
39+475	39+575	LHS	100.00	8.00	**92.00**	
39+450	39+574	RHS	124.00	8.00	**116.00**	
40+775	41+135	RHS	360.00	8.00	**352.00**	
46+050	46+202	RHS	152.00	8.00	**144.00**	
46+690	46+902	RHS	212.00	8.00	**204.00**	
52+800		LHS	12.00		**12.00**	Access box culvert
TOTAL					**2,504.00**	

SPENCON Spencon - Stirling JV   Stirling

STAGED RECONSTRUCTION OF MUKONO - JINJA ROAD (52 KM) - LOT C

BILL NO 5: ANCILLARY ROAD WORKS

Item No. 52.03 (a): End sections including foundation in the ground where single guardrail sections used

Guardrail Section				End sections	
From	To	Side	Length (m)	(No.)	Remarks
1+150	1+216	LHS	66.00	**2.00**	Existing guardrail
1+500	1+576	LHS	76.00	**2.00**	
1+584	1+620	LHS	36.00	**2.00**	
9+384	9+416	LHS	32.00	**2.00**	
9+384	9+416	RHS	32.00	**2.00**	
13+625	13+825	LHS	200.00	**2.00**	
17+125	17+213	RHS	88.00	**2.00**	
20+095	20+215	LHS	120.00	**2.00**	
20+086	20+234	RHS	148.00	**2.00**	
26+311	26+411	LHS	100.00	**2.00**	
26+311	26+411	RHS	100.00	**2.00**	
29+155	29+267	RHS	20.00	-	
31+150	31+302	LHS	152.00	**2.00**	
32+660	32+791	LHS	40.00	**2.00**	
33+300	33+424	RHS	124.00	**2.00**	
33+340	33+424	LHS	84.00	**2.00**	
33+855	33+999	LHS	144.00	**2.00**	
33+912	34+000	RHS	88.00	**2.00**	
37+339	37+419	RHS	80.00	**2.00**	
37+320	37+376	LHS	56.00	**2.00**	
39+475	39+575	LHS	100.00	**2.00**	
39+450	39+574	RHS	124.00	**2.00**	
40+775	41+199	RHS	424.00	**2.00**	
46+050	46+202	RHS	152.00	**2.00**	
46+690	46+902	RHS	212.00	**2.00**	
TOTAL				**48.00**	

Appendix F Sample Questionnaire for Respondents

QUESTIONNAIRE FOR RESPONDENTS

Dear Respondent,

My name is **ISAAC SSEBULIBA**, and I am conducting an academic study on the **''Impact of Ancillary Roadworks on Road Safety in Uganda: A Case Study of the Kampala-Jinja Road''**. This is in Partial Fulfillment for the award of a **Master of Science in Construction Technology and Management of Kyambogo University (KYU).** I am honored to request your participation in this study by responding truthfully and honestly to the questions on this questionnaire. Your response in this questionnaire is highly valued and you are among the people with profound knowledge in this study area. The provided information is solely for academic purposes and will be kept strictly confidential.

Thank you very much.

Yours Faithfully

…………………………..

Ssebuliba Isaac
0703-670026/0706-906010
Email: isaacssebuliba@gmail.com

SECTION A: BACKGROUND INFORMATION

Please tick the appropriate box

1. **Sex**

Male	Female

2. **Age group**

Below 30 years	31-40 years	41-50 years	Above 51 years

3. **Level of Education**

A-Level & below	Certificate	Diploma	Degree	Masters	PhD

4. **Years you have resided within the Area of Study**

5 years and below	6-10 years	11-15 years	Above 15 years

5. **Position within the Area of Study**

Traffic Officer	Market Leader	Driver	Road Engineer	Local Leader

Others (Specify) ……………………………

SECTION B: RESPONSE ON RESEARCH VARIABLES

Please indicate your level of agreement or disagreement with the statement on a scale of: 1 **(Strongly Disagree)** 2 **(Disagree)** 3 **(Undecided)** 4 **(Agree)** 5**(Strongly Agree).**

No	**Independent Variables**	**SD**	**D**	**U**	**A**	**SA**
		1	**2**	**3**	**4**	**5**
a)	**Road Marking (RM)**					
RM1	A clearly marked road is easier to drive on at any time of the day.					
RM2	Road markings easily guide as to when to overtake or not to while driving.					
RM3	Some traffic accidents are as a result of driving on wrong lanes, due to faded centerline markings.					
RM4	Marked Pedestrian crossings are key to ensuring road safety at any busy section of the road.					
RM5	Enforcing traffic regulations on overtaking is hard for a road with faded road marking.					
RM6	The road marking in the study area is not adequate.					
		SD	**D**	**U**	**A**	**SA**
b)	**Road Signs (RS)**	**1**	**2**	**3**	**4**	**5**
RS1	I clearly understand the meaning of all road signs on the road.					
RS2	Road signs regulate road user behaviors while using the road.					
RS3	Regulatory signs (like speed limit signs) greatly help in minimising accidents caused due to over speeding.					
RS4	Warning signs can minimize accidents in blackspots and other sections of the road.					
RS5	Absence of road signs at any given road is a safety hazard to all road users and road side vendors.					
RS6	The rate of vandalism of road signs is high.					
		SD	**D**	**U**	**A**	**SA**
c)	**Guardrails (GR)**	**1**	**2**	**3**	**4**	**5**
GR1	Guardrails are a major safety feature in preventing vehicles from falling off the roadway.					

GR2	Guardrails should always be replaced once knocked, to avoid further road fatalities.					
GR3	Guardrail end sections should be crashworthy to avoid damage of vehicles and death of occupants as a result of accidents.					
GR4	The adequacy of guardrails is low within the study area.					
		SD	**D**	**U**	**A**	**SA**
d)	**Humps and Rumble strips (HR)**	**1**	**2**	**3**	**4**	**5**
HR1	Humps and rumble strips should be installed on urban sections and market places.					
HR2	In some places humps and rumble strips have become worn-out.					
HR3	Road users in urban sections of the road are vulnerable in absence of humps and rumble strips.					
HR4	These should be clearly marked for easy visibility of drivers and other road users.					
HR5	Humps and rumble strips should be of moderate sizes to avoid further accidents.					
		SD	**D**	**U**	**A**	**SA**
e)	**Road Lighting (RL)**	**1**	**2**	**3**	**4**	**5**
RL1	Some sections of the road are dark at night, making visibility poor.					
RL2	Road lighting has a great impact on road safety for both pedestrians and drivers.					
RL3	Street lights should be installed on all urban sections of the road to minimize accidents due to poor night visibility.					
RL4	Lighting black spots can help in mitigating accidents at these sections especially during night time.					
RL5	The street lights within the study area are insufficient.					
		SD	**D**	**U**	**A**	**SA**
f)	**Walkways and Service Lanes (WS)**	**1**	**2**	**3**	**4**	**5**
WS1	Walkway should be laid on all urban sections of the road.					

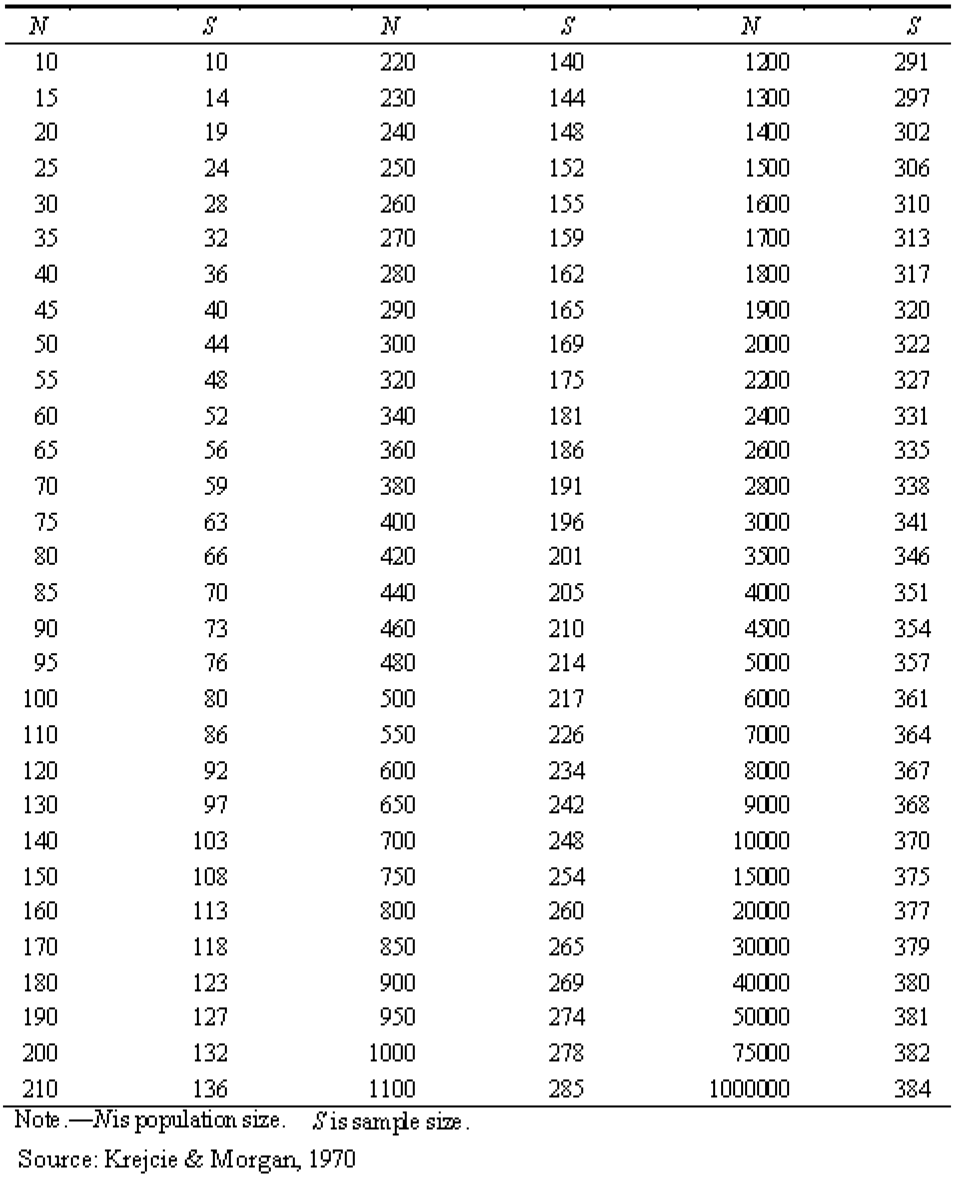
WS2	Service lanes are important for isolation of vehicles around market places and urban sections of the road.					
WS3	Walkways and service lanes separate fast moving vehicles from pedestrians and slow moving vehicles.					
WS4	There are no walkways on sections where they are required.					
	DEPENDENT VARIABLES	**SD**	**D**	**U**	**A**	**SA**
A)	**Road Safety (RF)**	**1**	**2**	**3**	**4**	**5**
RF1	The rate of motor vehicle accidents is high.					
RF2	Road accidents are a public problem.					
RF3	There is a high rate of accidents due to over speeding.					
RF4	Vehicles fall off the road embankment in absence of guardrails.					
RF5	Accidents involving pedestrians are high at market places and other urban sections of the road.					
RF6	The rate of accidents at black spots is high					
RF7	There are high cases of over speeding in urban sections of the road.					
RF8	The number of road signs and other ancillaries on the road are insufficient.					

Appendix G Interview Guide

INTERVIEW GUIDE

1. What is your comment on the rate of accidents as a result of the current status road ancillaries in the study area?
2. How have you been able to regulate traffic guidelines on speed, even in the absence of speed limit signs on most sections of the road?
3. What is your analysis on driver behavior in black spot sections within the study area?
4. Do you think the refurbishment of all ancillary road features on this road will help in reducing on the number of accidents and how do you plan to reduce on vandalism?
5. Please give your opinion on other factors that cause accidents other than road ancillaries and how these can be mitigated?
6. What is your opinion about the conduct of market vendors while doing their works along the road, and how can they be regulated?
7. Do you think engineers should be involved while assessing the possible causes of accidents at a given road section and would this help mitigate on further fatalities?
8. What do you think are the challenges in enforcing traffic guidelines as a way of curbing road accidents?

Appendix H Selecting sample size from a given population (Morgan, 1970)



N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970