# THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

# Contribution of Road Design to Road Accidents along Thika Superhighway, Kenya

# Rachael M. Munge

Senior Superintendent, Department of Community Policing Gender and Child Protection, Kenya Police Service, Kenya

**Casper Masiga** 

Senior Lecturer, Departments of Gender and Development Studies,

Kenyatta University, Kenya

Lazarus Ngari

Senior Lecturer, Department of History and Archaeology Kenyatta University, Kenya

# Abstract:

The construction of Thika Superhighway was aimed at addressing road safety by improving transportation and reducing traffic accidents. Despite this effort, the numbers of accidents along this road still continue to occur claiming more lives. The study sought to examine the contribution of road design on road accidents on Thika Superhighway. Accident Cessation Theory and the Reciprocal Determinism Theory were used to guide the study. The study adopted descriptive and exploratory research designs to collect quantitative and qualitative primary data. The study was carried out along Thika superhighway in 2016. The study targeted a population of 249 respondents drawn from traffic police officers, road safety personnel, senior officers from traffic police, officers in the National Transport Safety Authority and Ministry of Transport and Infrastructure, drivers and pedestrians. Questionnaires, interview schedules and focus group discussions were used to collect primary data. Qualitative data was analysed using thematic method, while quantitative data was analysed using descriptive statistics. The analysed data was presented in tables and charts to represent quantitative findings while qualitative findings were presented in narratives, verbatim reporting, discussions and inferences. Results showed that poor road design is a major contributor of traffic road accidents. The study recommends for redesigning of defective road sections and construction of additional footbridges that will ensure safety on the highway. It is hoped that the study findings will benefit all stakeholders and users of roads in an effort to ensure safety on Kenyan roads.

Keywords: Road design, contribution, causes determinants increased accidents

# 1. Background of the Study

Road accidents rank high among the major development challenges currently facing many countries of the world (Borowy, 2013). The frequency, magnitude, and impact of global road carnage are very worrying. Traffic road accidents are ranked ninth in the cause of death in the world where over 50 million people are hurt or seriously injured. An estimated 85% of the deaths occur in developing countries with 65% of the deaths being pedestrians and 35% are children (WHO, 2015). A World Bank report on road accidents in developing countries depicts worrying trends as the number continues to rise causing more harm to the economies of these countries as compared to developed countries (Koptis & Cropper, 2003). They also noted that developed countries register fewer traffic road accidents compared to developing countries though they have more vehicles. Japan, whose number of registered motor vehicles stood at 707 vehicles for every 1000 people, registered 5507 fatal accidents.

South Africa, with 165 vehicles for every 1000 people, registered 13954 fatal accidents while Kenya with 24 vehicles for every 1000 people, registered 3302 fatal accidents in 2011 (Verster & Fourie, 2018). In an effort to address road safety, the developed countries have put elaborate measures such as speed control, helmet and seat-belt use, use of road signs, child restraint, deterring drunk-driving and having stringent standards for acquiring driving license among others. These measures are strictly followed and whether they have resulted in reduced traffic road accidents. Tingvall (2009) observed that apart from road safety measures directed to motorists, passengers, and pedestrians, developed counties have also developed road safety policies and enacted laws to address traffic road accidents.

Kenya has a fairly good road network as compared to its neighbours in East Africa region. In an article published in World Bank website, Morisset (2012) argued that good road network has a direct impact on the development of a country. He further noted that Tanzania lags behind in economic development as compared to Kenya due to an inferior road network. He also argued that there is a very strong positive correlation between a country's economic development and the quality of its road network. That has been observed in disparities of economic development in Kenya and Tanzania; a case attributed to differential road networks in both countries. Road transport in Kenya is currently the most widely used mode of transport, handling to about 80 per cent of both cargo and passenger transportation. Between 1998 and 2002, this mode of transport contributed to 2.9 per cent of the Gross Domestic Product (GDP) in Kenya (Asingo & Mitullah, 2007).

Since 2003, the government of Kenya has embarked on a major rehabilitation of the road networks to ease transportation of goods and passengers in an effort to spur development (GoK, 2011). Many roads have been redesigned, others constructed, while others have been rehabilitated. According to Ikiara (2005), it was projected that between 2003 and 2007, the Kenyan transport sector will grow at an annual rate of 6.26 per cent. It is with this in mind that the government of Kenya has put in place development plans to construct adequate road network with an efficient infrastructure to realize vision 2030 objectives (GoK, 2007).

The Kenya Vision 2030 development plan aims at transforming Kenya to a middle-income country by the year 2030. To achieve this economic development, the vision 2030 blueprint has identified three pillars, economic, social and political pillars to guide the achievement of this vision. Under the economic pillar, road improvement has been identified as one of the drivers of the vision. The successful implementation of the vision would need building key roads to support the proposed resort cities, revitalized tourist circuits and wholesale hubs. Thika Superhighway was designed and constructed following the international standards (APEC Consortium, 2012). The international standards adhered to, comprises of having consulting engineers throughout the construction period and construction of guardrails. Kenya is faced with challenges of ensuring safety on the roads. It is estimated that Kenya has one of the highest road fatality rates in relation to vehicle ownership in the world, with an average of 7 deaths from the 35 road crashes that occur each day (Odero, Meleckidzedek & Heda, 2003). Kenya loses nearly 3000 persons due to roads accidents annually which translates to approximately 68 deaths per 10,000 registered vehicles, which is higher (30–40 times greater) than in highly motorized countries(Mogambi & Nyakeri, 2015).

Due to rising numbers of road accidents, the Traffic Act was reviewed in 2012 to give the traffic law enforcement officers more teeth to deal with traffic offenses and road safety (GoK, 2013). The National Transport Safety Authority (NTSA) was created in 2012 through an Act of Parliament as a body responsible for coordinating road safety (GoK, 2012). Despite all these efforts by the government to address road safety the number of traffic road accidents is still a concern and therefore the need to conduct a study to determine the causes. Road accidents ranks high among the major development challenges currently facing many countries of the world (Asingo & Mitullah, 2007). The frequency, magnitude and impact of global road carnage are very worrying bearing in mind that traffic road accidents are ranked the ninth cause of death in the world with most of them occurring in developing countries (WHO, 2015). Many roads have been redesigned, others constructed, while others have been rehabilitated. According to Ikiara (2005), it was projected that between 2003 and 2007, the Kenyan transport sector would have grown at an annual rate of 6.26%. It is with this in mind that the government of Kenya has put in place development plans to construct adequate road network with efficient infrastructure to realise vision 2030 objectives (GoK, 2007).

#### 1.1. Study Objective

The study sought to examine the contribution of road design on road accidents along Thika Superhighway.

# 1.2. Theoretical Framework

This study was guided by two theories, which are; the Accident Cessation Theory (ACT) and the Reciprocal Determinism Theory. The Accident Cessation Theory (ACT) was advanced by Herbert William *Heinrich*, a safety engineer and pioneer in the field of industrial accident safety, in 1932 (McKinnon, 2007). According to Heinrich, an "accident" is one factor in a sequence that may lead to an injury. The factors can be visualized as a series of dominoes standing on edge; when one falls, the linkage required for a chain reaction is completed. Each of the factors is dependent on the preceding factor. This theory was developed to address the causes of accidents in industries but in this study, it will be used to inform the causes of accidents on roads. The theory was used to inform on the factors that will be investigated in order to establish the determinants of road accidents on the roads as discussed on the conceptual framework below.

Reciprocal Determinism Theory developed by Albert Bandura was also used to inform the study. The theory holds that the behaviour of a person can be changed by his or her social environment as well as personal factors (Locke, 2019). Behaviours that lead to accidents on the roads can be influenced by changes in the social environment, for instance, changes in traffic laws, and personal factors, including training aimed at enhancing personal cognitive skills and attitudes (Wåhlberg, 2017). The theory holds that there is a significant probability that a person's conduct can be amended if the associated consequences are reviewed. Rosli, Mohd Rani, Mustaffa and Abdul Hanan (2017) used the theory in a study whose findings implied that changing driver license conditions may help stem traffic accidents. In the present study, the theory was developed to address how traffic accidents may be mitigated. The theory was used to inform on the factors that will be investigated in order to establish the determinants of road accidents on the roads as discussed on the conceptual framework below.

#### 2. Literature Review

Engineers designs roads with the following road safety in mind; hazard visibility measures, safe roadway surfaces, traffic control measures, road users' behavioural control, traffic flow guidance, roadway signs and weather factors in an effort to ensure road safety. Superhighways are constructed with an aim of ensuring the smooth and fast flow of traffic between cities and countries (Swift, 2011). Their design allows exit and entry points at designated junctions without

greatly affecting traffic flow. There is deliberate segregation of mopeds, pedestrians, and slow-moving vehicles from using the main lanes in superhighways.

Bad road designs include narrow roads and bridges, invisible signs, lack of street lighting, lack of acceleration lanes, lack of road markings among others (Findley, Schroeder, Cunningham & Brown, 2015). Badly designed roads may lead to drivers making errors thus causing accidents. Different road classes call for different design requirements with superhighways or express motorways being constructed with the highest standards of designs to ensure highest road safety possible. International designs of super highway call for guard rails between opposing lanes. Poor road designs have been blamed on road accidents mostly by drivers and other stakeholders.

A report titled "Road Crash Problem" by World Bank in 2002 indicated that poor road designs are a major cause of traffic road accidents in developing countries since most of these countries modify road designs borrowed from developed countries (World Bank, 2002). Some countries when modifying the borrowed road designs remove the element of separating mopeds (motorcycles) and bicycle riders from the other motorists which in the end makes the roads unsafe. A report by Asian Development Bank lauded the effort of the China government for improving road network coupled with adequate road designs which have greatly reduced traffic road accidents considerably (Ono, Silcock &Teknom, 2013). The report recommended that developing countries need to learn a lesson from China to address poor road designs in an effort to address road carnage.

A study conducted in Kenya in 2011 on whether road accidents are caused by human error or poor roads established that the condition of roads contributed to less road traffic accidents as compared to human error (Muchene, 2012). Although poor road designs contribute to fewer accidents in Kenya, in situations where road designs cause accidents the end results are devastating. Tharaka Nithi Bridge near Chuka town in Tharaka-Nithi County presents a good example of poor road design where accidents have occurred (Mwithimbu, 2014). In a study conducted in Kenya on road traffic injuries, Odero, Khayesi and Heda (2003) established that 5.1% of the road accidents are caused by poor road designs.

Poorroad designs can be as a result of challenging terrain like valleys, hills, lack of space for expansion, cost implication among other factors. The other factors that have contributed to poor road design are lack of stakeholder's involvement in road design and construction. The involvement of the traffic police during road design is non-existent in Kenya yet they are the same people who are expected to ensure safety on the roads. Lack of pedestrians' facilities such as walkways, footbridges, and designated zebra crossing during road designs could pose risks resulting in road accidents.

Kenya has experienced high numbers of road accidents claiming more than three thousand lives every year. Road accidents in Kenya are the third leading cause of death after malaria and HIV/AIDS and pose major public health problem in terms of mobility, disability, and associated medical care costs (Muchene, 2012). The cause of traffic road accidents is usually blamed on the drivers, pedestrians, lack of adequate enforcement of traffic laws, quality of roads among other reasons. The government has tried to address this road carnage by coming up with road safety measures and improvement of road infrastructure. The construction of Thika Superhighway was one of the efforts of addressing road safety to reduce accidents, improve transportation and spur development. Despite this effort, the numbers of accidents along Thika Superhighway still continue to occur claiming more lives.

Data from the traffic department indicates that more road accidents continue to be recorded on Kenyan roads especially on the new and improved roads. Thika Superhighway is not an exception as many traffic or road accidents have been reported since its improvement to a superhighway as compared to when it was a dual carriageway. A lot of studies (Augustus, 2012, Chitere & Kibua, 2003, Muchene, 2012) among others have been done on road traffic accidents but none has been done on the determinants of rising road accidents especially along Thika Superhighway. This study therefore aimed at establishing the determinants of road accidents on Thika Superhighway - Kenya.

#### 3. Materials and Methods

#### 3.1. Research Design

The study adopted descriptive research design which was complimented by exploratory research design to collect primary data. This design was used because it helped the researcher to understand more of an idea or provide details of the phenomenon under study. This study collected both qualitative and quantitative primary data.

#### 3.2. Site of Study

The study was conducted along Thika Superhighway stretch from Nairobi Pangani Police station and Globe roundabout to Thika Chania River. The choice of Thika Superhighway was informed by the realization it was the only Superhighway in Kenya by the time the study was conducted. The Superhighway was constructed to improve road transport and reduce accidents. However, more accidents continue to occur despite the construction. This called for the need to carry out a study to determine the causes of rising number of traffic road accidents along the Superhighway.

#### 3.3. Target Population

The target population consisted of drivers of both public and private vehicles and pedestrians using Thika Superhighway. The study also targeted a population of 249 subjects that comprised of traffic police officers and personnel of National Road Safety Authority (NTSA) and Ministry of Transport and Infrastructure, drivers (Public Service Vehicles, Private/Personal and Motorcycle riders) and pedestrians.

#### 3.4. Sample Size Determination and Sampling Procedure

A purposive sampling technique was used to select senior traffic police officers along Thika Superhighway. Likewise, purposive sampling technique was used to select two senior officers from the ministry of transport and NTSA. Convenient sampling method was employed to identify drivers, passengers, and pedestrians who were involved in the study. Slovin's formula  $n = \frac{N}{1+N(e)^2}$ , at 0.05 margin of error was used to determine the sample size of the traffic police officers for each police station. Traffic police officers were drawn from Pangani, Muthaiga, Traffic Headquarters, Kasarani, Ruiru, and Juja Police Stations along Thika Superhighway. Table 1 presents the target population and sample size.

Institution	Category	Target Population	Sample Population	
Kenya Police	Senior traffic police	7	3	
	officers			
	Junior Traffic police	84	69	
	officers			
National Transport Safety	Senior officers	6	2	
Authority				
Ministry of Transport and	Senior officers	5	2	
Infrastructure				
Drivers	Public Service Vehicles	35	35	
	Private/Personal	40	40	
	Motor bike	20	20	
Pedestrians	Pedestrians	52	52	
Total		249	223	

Table 1: Target Population and Sample Size

# 3.5. Research Instruments

The study used questionnaires, interview schedule and focus group discussions to collect primary data. Questionnaires were used to collect primary data from junior traffic police officers, safety officers (NTSA), safety engineers, drivers, and pedestrians. This research instrument consisted of open and closed-ended items/questions. Interview Schedules were used to collect data from the senior officers from police traffic department, NTSA and from the Ministry of Transport and Infrastructure. The choice of this instrument was informed by the fact that it would provide an avenue for asking questions and making clarifications on the responses. Focus Group Discussion was used to collect data from motorcycle riders. Since the motorcycle riders were many, purposive sampling method was used to select one participant from six SACCOs to form one focus group discussion (FGD) subjects. The findings of FGD were used to supplement other methods of data collection.

# 3.6. Data Collection and Ethical Considerations

Permission was sought from National Commission of Science, Technology, and Innovation (NACOSTI), National Police Service and Kenyatta University. A consultation was done between traffic police department, Ministry of Infrastructure and Transport and NTSA on the methodology and the purpose of the study. A briefing on data collection was done to ensure participants were aware of what was expected of them. A self-administered questionnaire was administered to the respondents with the help of research assistant at their workplace for the respondents to fill. Face to face interviews with the senior traffic police officer, personnel of the Ministry of Transport and NTSA were conducted by the researcher at convenient places. Confidentiality of the respondents was maintained where no names or employment numbers were recorded, in case of the traffic police officers.

# 3.7. Data Analysis

Statistical Package for Social Sciences computer software was used to analyse quantitative data into descriptive statistics (Frequencies, per cent ages, means and standard deviations) and findings presented in tables and charts. Qualitative were analysed according to the themes and patterns formed. The data qualitative findings were presented in narrative and verbatim quotations.

# 4. Findings

# 4.1. Response Rate of the Self-administered Questionnaires

The study earmarked to interview a total of 75 drivers, 69 junior police officers, and 52 pedestrians. Table 2 tabulates the response rate for each category of respondents.

	Targeted Sample Size	No. of Respondents Interviewed	% Response Rate
Junior Police Officers	69	49	71.01
Drivers	75	62	82.67
Pedestrians	52	47	90.38
Total	196	158	80.61

Table 2: Response Rate

The analysis in Table 2 indicates that overall, the response rate is 80.61 per cent of all the respondents. The highest response rate was 90.38% and the least was 71.01% within all categories of road users. According to Mugenda and Mugenda (2012) a 50% response rate is adequate, 60% good and above 70% rated very well hence based on this assertion, the response rate for this study at 80.61% was very good. About 19.39% of the respondents were established not valid for analysis. However, this number did not affect the authenticity of the data collected since no categories recorded unacceptable response rates.

#### 4.2. Response Rate of the Interview Schedule

This study targeted three senior police officers, two senior officers in the National Transport Safety Authority and Ministry of Transport and Infrastructure managers. The study was able to interview all targeted officers representing 100 per cent response rate. The high response rate can be attributed to support of the management from the respective institutions.

# 4.3. Drivers Responses Contribution of Road Design on Traffic Road Accidents

The study sought to establish from drivers the contribution of road design to increased traffic accidents on Thika Superhighway. This was important because drivers are in better position to determine if the road design causes road accidents. The research findings are as presented in Table 3.

	Drivers Responses	Count	Mean	Std. Deviation
a)	Road exits from the inner lane (highway) to the service lanes contribute to traffic road accidents along Thika Super Highway	62	2.03	1.008
b)	The location of some exits especially downhill area major cause of traffic road accidents along Thika Superhighway	62	1.98	.820
c)	Lack of and wrong placement of road signs is a cause of traffic road accidents along Thika Superhighway	62	2.55	1.237
d)	Inadequate foot bridges area major cause of traffic road accidents along Thika Superhighway	62	2.53	1.339
e)	Poor design of storm water drainage is one cause of traffic road accidents when it rains along Thika Superhighway	62	2.18	.859
f)	Inadequate passenger dropping points is a major cause of traffic road accidents along Thika Superhighway	62	2.53	1.411
g)	Inadequate space for parking of stalled vehicles is one cause of traffic road accidents along Thika Superhighway	62	2.48	1.238

Table 3: Drivers Responses on the Contribution of Road Design on Traffic Road Accidents Key: Strongly Agree – SA [1], Agree - A [2], neither Agree nor Disagree (NAD) [3], Disagree - DA [4] And Strongly Disagree - SD [5]

The research findings in Table 3 ranged from a mean of 1.98 – 255 and falls under "Strongly Agree and agree" measurement in the Likert scale. This finding is an indicator of a poor highway road design. The above findings imply that poor road design may be contributing to rising number of traffic road accidents along the highway. According to the ACT, a poor road design may be viewed as being a domino whose fall causes the fall of the traffic road accidents domino (McKinnon, 2007). However, the above findings were disputed by the senior police officers who noted the following;

"... Thika Superhighway has some design challenges which mostly contribute to major traffic jams. These design challenges do not significantly contribute to rising number of traffic accidents along the Superhighway. Our reports show that majority of traffic road accidents are caused by human error, indiscipline among the drivers and lack of skills of driving on three to four lane roads like Thika Superhighway which most drivers are not used" (O.I April 2016).

The sentiments above are supported by the findings of Amedorme and Nsoh (2014) in a study on the causes of traffic road accidents in Ghana. Amedorme and Nsoh (2014) established that indiscipline among the drivers was found to be the major contributor of accidents.

# 4.4. Pedestrians Responses Contribution of Road Design on Traffic Road Accidents on Thika Superhighway

NTSA report on the state of road safety in Kenya for 2015 indicated that majority of the victims were pedestrians. The study, therefore, found it necessary to establish from the pedestrians the contribution of road design to traffic road accidents on Thika Superhighway. The findings are presented in Figure 1.



Figure 1: Pedestrians Responses on the Contribution of Road Design on Road Accidents

The findings in Figure 1 established that limited passenger dropping stages (87.2%) and few footbridges (80.9%) are some of the anomalies of the road design that is contributing to the traffic road accidents on Thika Superhighway. A focus group discussion with the motorcycle riders identified Witeithie, Njomoko in Thika, Ndarugo, Homeland, Kihunguro and Drive Inn as some of the areas where the designers of the highway failed to erect footbridges. Also, lack of bus stages or passenger dropping points at already constructed footbridges at Car Wash Food Bridge and Guru Nanak stage is another anomaly of the road design which contributes to road accidents. These observations were supported by one senior safety officer who noted the following;

"...... Though the design of exit lanes were properly designed following international standards to prevent accidents, they in turn created the problem of creating traffic jams especially at Roysambu, Muthaiga, Kimbo, Githurai among others. In order to avoid traffic, jam the motorists especially Public Service Vehicle drop passengers on the undesignated places on the highway which has resulted in traffic accidents involving pedestrians and vehicles. The traffic road accidents cannot be therefore be entirely be blamed on the defective road design but on the indiscipline among drivers where they abide to the required regulations" (O.I, April 2016).

The above sentiments reveal that the road designer did not foresee the challenges of traffic jam and how it would change the drivers' behaviours that will lead to breaking laws and in turn lead to traffic road accidents. According to the ACT, as explained by McKinnon (2007), the high number of accidents along the superhighway may be attributed to undesirable driver behaviour which may in turn be attributed to the road designers' lack of foresight regarding the challenges of traffic jams. These findings are in agreement with the observation of Sharples (2014) in a study on motorists' habitual traffic behaviour that established that motorist behaviour changes are dependent on the situation of traffic flow on the roads. Road designs should involve many stakeholders like police, association of engineers, consultants among other in order to provide diverse ideas relevant in designing safe roads.

# 4.5. Police Officers Responses Contribution of Road Design on Traffic Road Accidents

According to Traffic Act Cap 403 (GoK, 2014), the Traffic Police department is mandated to enforce traffic laws and regulations. They have the responsibility of ensuring safety on roads by educating the road users and also to arrest and charge offenders. It was with this in mind that the study sought to establish from the traffic police department if the road design has contributed to rising number of road accidents on Thika Superhighway. The research findings are presented in Table 4.

	Responses	Count	Mean	Std. Deviation
a)	Road exits on the inner lane are major contributors of traffic road	49	2.51	1.210
	accidents along Thika Superhighway			
b)	The location of some entry lanes (joining lanes to the highway)	49	2.59	1.257
	especially downhill are a major cause of traffic road accidents along			
	Thika Superhighway			
c)	Inexistence and wrong placement of road signs is a cause of traffic	49	4.14	0.791
	road accidents along Thika Superhighway			
d)	Inadequate foot bridges area major cause of traffic road accidents	49	2.98	1.233
	along Thika Superhighway			
e)	Poor design of storm water drainage is one cause of traffic road	49	4.08	1.256
	accidents when it rains along Thika Superhighway			
f)	Inadequate passenger dropping points is a major cause of traffic road	49	4.27	1.095
	accidents along Thika Superhighway			
g)	Inadequate space for parking of stalled vehicles is one cause of traffic	49	2.82	1.318
	road accidents along Thika Superhighway			

Table 4: Police officers Responses on the Contribution of Road Design on Road Accidents

Key: Strongly Agree – SA [1], Agree - A [2], neither Agree nor Disagree (NAD) [3],

Disagree - DA [4] And Strongly Disagree - SD [5]

The findings in Table 4show mixed responses on the contribution of road design on traffic road accidents along Thika Superhighway. This is so because the police officers agreed that the design and location entry lanes together with exit

lanes have a contribution to traffic road accidents. The study also established that the police agreed that the road designers did not factor enough footbridges and adequate space of parking for stalled vehicles which in turn contribute to traffic road accidents. The above observation is supported by Machara (2014) who argued that the designers of Thika Superhighway did not adequately address the pedestrian crossing facilities. This is so because only eight footbridges were incorporated in the first design until stakeholders intervened. A senior police officer who was interviewed noted the following;

"..... the highway has areas which have poor road design especially where the exit and entry lanes joins the highway. These lanes lack accelerationor decelerationlanes. The most notable ones are lanes joining the highway at GSU downhill on the way to Thika, Juja at Thirika river on the way to Nairobi to mention a few. Theseareas and others have contributed to traffic road accidents" (O.I. April 2016).

Police officers disagreed that the design for passenger dropping points, road signage, and storm water contributes to traffic road accidents on the highway. However, the observation of senior police officers and safety officer interviewed noted that:

"..... though there are few areas that lack passenger dropping points like Guru Nanak, Car Wash area and Ha-Kairu, many of the accidents involving passengers alighting from vehicles happens when they alight from undesignated areas. Drivers have a habit of dropping passengers on these areas instead of designated areas to avoid traffic jams. This behaviour sometimes tempts the passengers to cross the highway without using the foot bridges resulting in fatal accidents" (O.I. April 2016).

The above observation confirms that the road designers did not foresee the emerging issues posed by traffic jam occasioned by unprecedented positive impacts of Thika Superhighway. The positive impact is manifested by increased economic activities like development of shopping malls and housing estates, which attract a large number of clients. According to Wairimu (2016), these economic activities have resulted in many vehicles (both public and private) using the highway thus creating heavy traffic jams. According to the ACT, as explained by McKinnon (2007), the high number of accidents along the superhighway may be attributed to undesirable driver behaviour which may in turn be attributed to the road designers' lack of foresight regarding the challenges of traffic jams. The poor road designs need to be corrected before road construction commences. This can be done by performing simulations using computer software.

#### 5. Summary of the Findings

The study sought to examine the contribution of road design on road accidents on Thika Superhighway. The study found that several defective road designs have contributed to rising traffic accidents along the highway. The study established that the designers factored an inadequate number of footbridges in densely populated places like Witeithie and Homeland to mention a few not factored for construction. The study established that the exit and entry lanes are poorly designed since they do not provide adequate acceleration or deceleration opportunities to the drivers. The study also, found that some areas in the service lane lack designated bus stops, for example at Guru Nanak and Car Wash stage. The poor road designs have been blamed on the increase of traffic jams which in turn have lured the public service vehicles to dropping passengers on the highway. The study established a great contribution to the road design to rising number of traffic road accidents.

# 6. Conclusions and Recommendation

The study concludes that Thika Superhighway has several areas with defective designs which in turn contribute to traffic road accidents. The engineers responsible for Thika Superhighway should re-design and construct new footbridges and bus stops. In addition, stakeholders should be involved in auditing the exit lanes and entry lanes and re-design them to address their anomalies.

#### 7. References

- i. Amedorme, S. K., & Nsoh , S. N. (2014). Analyzing the Causes of Road Traffic Accidents in Kumasi Metropolis. International Journal of Engineering Innovation & Research, 3(6), 894 - 899.
- ii. APEC Consortium LTD. (2012, September 09). Mega Nairobi-Thika Super Highway. Retrieved Apri 18, 2015, from www.apecltd.co.ke: http://apecltd.co.ke.
- iii. Asingo, P. O., & Mitullah, W. V. (2007). Implementing Road Transport Safety Measures in Kenya: Policy Issues and Challenges. Nairobi: Institute for Development Studies, Nairobi University.
- iv. Augustus , A. (2012). Determinants of road traffic accident occurrences in Lagos state: Some lessons for Nigeria. International Journal of Humanities and Social Science, 2(6), 252 - 259.
- v. Boone, H. N., & Boone, D. A. (2012). Analyzing Likert Data. Journal of Extension, 50(2), 1 5.
- vi. Borowy, I. (2013). Road Traffic Injuries: Social Change and Development. Medical History, 57(1), 108-138.
- vii. Caroline, G., & Silcock , D. (1997). Socio-economic aspects of road accidents in developing countries. London: Transpoti Research Laboratory.
- viii. Chitere, O. P., & Kibua, T. N. (2003 November and 2004 March ). Efforts to improve road saety in Kenya: Archievement and limitations of reforms in the Matatu indsustry. A paper presented to Institute of Policy Analysis and Research. Nairobi: Institute of Policy Analysis and Research.
- ix. Findley, D. J., Schroeder, B., Cunningham, C., & Brown, T. (2015). Highway Engineering: Planning, Design, and Operations. Oxford, UK: Butterworth-Heinemann.

- x. GoK. (2001). Medium Term Expenditure Framework: Report of the Sector Working Group on Physical Infrastructure. Nairobi: Goverment Printer.
- xi. GoK. (2007). The Kenya Vision 2030. Nairobi: Government Printer.
- xii. GoK. (2011). Road Sector Investment Programme & Strategy 2010 2024. Nairobi: Ministry of Roads, Kenya.
- xiii. GoK. (2012). National Transport Authority of 2012. Nairobi: Goverment Printer.
- xiv. GoK. (2013). Traffic Act: Chapter 403: Revised Edition 2013. Nairobi: Government Printer.
- xv. GoK. (2014). The Kenya Traffic Act, Cap 403. Nairobi: Government Printer.
- xvi. Ikiara, G. (2005). Challenges of Implementing Road Safety: Speech presented in a workshop of on the Challenges of Implementing Road Safety. Nairobi: Author.
- xvii. Koptis, E., & Cropper, M. (2003). Traffic fatalities and economic growth. Policy Research Working Paper No. 3035. Washington, DC: World Bank.
- xviii. Locke, E. A. (2019). The Illusion of Determinism: Why Free Will Is Real and Causal. London: BookBaby.
- xix. Machara, M. (2014, August 1). Poor Thika superhighway design is a threat to lives and a massive drain on the economy. Retrieved May 16, 2016, from www.nation.co.ke: http://www.nation.co.ke/oped/Opinion/Thika-superhighway-design-a-threat--to-lives/-/440808/2405632/-/hdy2ccz/-/index.html.
- xx. McKinnon, R. C. (2007). Changing Safety's Paradigms. Washington DC: Government Institutes.
- xxi. Mogambi, H., & Nyakeri, F. (2015). Media Priming of Road Traffic Accidents in Kenya: Praxis, Patterns, and Issues. Sage Journal(2015), 1-13.
- xxii. Morisset, J. (2012, September 27). Got a road? The importance of a good road network. Retrieved April 22, 2015, from http://blogs.worldbank.org/africacan: http://blogs.worldbank.org/africacan/got-a-road-the-importance-of-a-good-road-network
- xxiii. Muchene, L. K. (2012). Road accidents in Kenya: a case of poor road network or human error? 1 6.
- xxiv. Mugenda, O., & Mugenda, A. (2012). Research Methods: Quantitative and Qualitative Approaches. Nairobi: Acts Press.
- xxv. Mwithimbu, K. (2014, December 19). Road Accidents in Kenay: The demons awaken. Retrieved April 14, 2015, from www.accidentsinkenya.wordpress.com: https://accidentsinkenya.wordpress.com/.
- xxvi. Odero , W., Khayesi, M., & Heda, P. M. (2003). Road traffic injuries in Kenya: Magnitude, causes and status. Injury Control and Safety Promotion, 2003(10), 53 61.
- xxvii. Ono, Y., Silcock, D., & Teknom, G. G. (2013). International Lessons for Road Safety in the People's Republic of China. Manila, Philippines: Asian Development Bank.
- xxviii. Rosli, N. H., Rani, M., Najwa, N. F., Mustaffa, S. H., & Abdul, H. S. (2017). Road safety: Factors influencing young driver behaviour among UUM students. 323-332.
- xxix. Sharples, R. (2014). A Qualitative Study of Motorists' Habitual Traffic Behaviour in a Situation of Reduced Road Capacity: A Published PhD Thesis. Sydney : University of Technology.
- xxx. Swift, E. (2011). The Big Roads: The Untold Story of the Engineers, Visionaries, and Trailblazers Who Created the American Superhighways. New York: Mariner Books.
- xxxi. Tingvall, C. (2009). ISO paves the road to traffic safety management systems. ISO Focus, 6(9), 1.
- xxxii. Verster, T., & Fourie, E. (2018). The good, the bad and the ugly of South African. South African Journal of Science, 114(7/8), 1-7.
- xxxiii. Wåhlberg , A. (2017). Driver Behaviour and Accident Research Methodology: Unresolved Problems [Human Factors in Road and Rail Transport] (1st ed.). Florida, USA: CRC Press.
- xxxiv. Wairimu, I. (2016, January 14). Kenya: The Good, the Bad, and the Ugly of Thika Road. Retrieved May 13, 2016, from www.allafrica.com: http://allafrica.com/stories/201601141181.html
- xxxv. WHO. (2013). Global status report on road safety 2013: Supporting a decade of action. Geneva: Author.
- xxxvi. WHO. (2015). Global status report on road safety. Geneva, Switzerland: World Health Organisation.
- xxxvii. World Bank. (2002). Road Crash Problem. Retrieved April 27, 2015, from www.worldbank.org: http://www.worldbank.org/transport/roads/safety.htm#driver.