# TYPOMORPHOLOGICAL ELEMENTS OF URBAN SPACE AND NON-MOTORIZED TRANSPORT IN NAIROBI CITY

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**ABSTRACT**

At the rate the world is urbanizing, it is predicted that by 2030 all developing regions will have more people living in urban than rural areas. The rapid urbanization has led to change in urban structures leading to sprawling cities. The urban sprawl has resulted in challenges of mobility thereby making access to work opportunities and services more difficult for urban residents. The challenge for urban planners is how the urban space can be transformed innovatively to solve the mobility problem in the midst of incalculable complexity of the cities, composed as they are of so many different actors groups and institutions. This paper is based on a study conducted in Nairobi city, Kenya on Non-Motorised Transport (NMT) users. Most NMT users in Nairobi are captive to this mode of transport but are faced with long travel distance and difficult and dangerous travel environment. The study hypothesizes that the unfavourable travel environment is as a result of the poor planning and design of the urban space. It seeks to establish the effect of typo-morphological elements of the urban space on NMT travel environment by focusing on the journey to work. The study covered selected neighbourhoods in Nairobi as trip origins and the work places in the industrial area as the trip destination. A multi-stage technique was used in obtaining the primary data: interview schedule applied at trip destinations, a walk-through interview schedule applied along travel route and an observation checklist applied on four major routes selected on the basis of frequency. Preliminary results show that the spaces NMT users select to walk or cycle through are at variance with those areas designated for their use through urban planning. The study is expected to contribute towards the development and refinement of guidelines for designing new neighbourhoods and for retrofitting existing ones to better reflect current NMT planning goals. Ultimately, the predictions will be used to help determine how public resources can be best prioritized and allocated to achieve the planning goals of the city and create a safe and attractive travel environment for NMT users.

**Key words**: Typo-Morphology, Urban space, Innovative, Complexity, Computations

## 1. INTRODUCTION

Many transportation planners have noted that cities in all parts of the world are struggling to achieve some acceptable standard of mobility due to its significance to all social and economic activities of any city. Pacione(2009) has shown that demand for transport in the cities whether for people or goods, is determined largely by the spatial arrangement of different land uses. In most countries, passenger cars and trucks have become the most important transport modes (Joewono, 2005). This

scenario is encouraged by the post-war "modernist" planning practices that focused on the large scale and efficiency of the motorised transport (Salingaros, 2012).

In many developing cities high growth of the vehicle fleet has taken place in recent years (Pacione, 2009) and planners have tended to plan at large scale to accommodate growing vehicle numbers. Non-motorized transport (NMT), which in earlier times was the common way of linking together places of activities, has to a large extent been substituted by the car in daily mobility, and by trucks, for freight movement (Fjellstrom, 2002). Nevertheless, NMT still has a significant beneficial impact to users and their environment. In many cities, it is the main mode of transportation for the majority of urban dwellers, and in some a significant source of income. It therefore has a very significant poverty reduction impact. Where NMT is the main transport mode for the work journeys of the residents, it is also critical for the economic functioning of the city (Joewono 2009). Despite this obvious merit, NMT has tended to be ignored by policymakers in the formulation of infrastructure policy and sometimes discouraged as a transport mode. Further, it is sometimes viewed as an unpleasant and dangerous, mode of transport in some of the very poor countries (Witink, 1998).

In the recent years, the problems associated with motorised transportation systems have led urban planners and designers of cities in highly industrialized countries to re-evaluate the approach to planning of cities are in respect to mobility and the general quality of the urban life. As Joh et al. (2012) point out, planning for sustainable communities has arguably become the dominant paradigm for urban and community planners in the twenty-first century with the promotion of walkable communities and walking behaviour as its primary thrust. In this endeavour, the over-arching view has been that the city is a very complex entity and that its problems, be they mobility related or other cannot be solved by focusing on one aspect in isolation. In other words, the city needs not only to be efficient but also liveable (Marshal, 2012). Thus, the problems of mobility must be studied in the context of the entire urban space.

The emerging urban space planning and design concept promotes an approach which seeks to limit car use in cities by focusing on small-scale mixed use neighbourhoods. This concept, promoted by the New Urbanism movement recognizes the significant role played by NMT in urban environments and aims at developing neighbourhoods and other urban spaces that are not only NMT friendly but also contribute to the liveability of the city in the overall.

## 2. THE NAIROBI SITUATION

The world is rapidly becoming urban. By the year 2030 all developing regions, including Asia and Africa will have more people living in urban than rural areas. Today, half the world's population lives in urban areas and by the middle of the twenty first century all regions will be dominantly urban, with the tipping point in Eastern Africa anticipated slightly after 2050 (UN-Habitat, 2008).
In most third world cities, rapid urban expansion driven by in-migration has led to many new arrivals being forced to live at increasing distances from the job opportunities found in the central city (Pacione, 2009). With the growing population and the expansion of the city, the greatest challenge, among others competing for the urban space is mobility. The challenge is compounded by the fact that in most of these cities, public transport systems are not well established leading to rise in the number of private cars. Most urban areas are faced with urban transportation problems mostly resulting from over reliance on motorized transport. Some of the problems are; traffic congestion (figure 1-3)and limited parking space, environmental pollution due to vehicle emissions and noise, and high cost of fuel resulting in high cost of travel for public transport (Makajuma, 2009)


Figure 1: Congestion on Eastleigh First Avenue; one of the streets in the study area
Source: Author

Figure 2:Traffic congestion on Jogoo road during

Source: Author

Nairobi City in Kenya faces similar mobility challenges as do other cities in the developing countries. Rapid increase in population due to rural urban-migration has multiplied these challenges significantly. There has been a rapid increase in the number of informal settlements within and at the fringes of the city. As a result of the sprawl, workers are increasingly living farther from the places where they work.

To make matters worse, available public transport is unreliable, expensive and sometimes inconvenient to workers since it does not link their residences directly to the places where they work (Mitullah and Makajuma, 2009). The problem is further compounded by the fact that even where public means of transport is available and reliable, most of these workers would not afford the chargeable fares. As a result, most of the workers have become captive to either walking or cycling to work. This study is built on the premise that this unfavourable NMT travel environment has resulted from poor urban planning and design (Siringi, 2013). A design that is not cognisant of the local circumstances and attitudes (Sangira, 2013). Although this study examines the transformation of the urban space as a whole, NMT offers a framework in which the wider urban space development issues can be examined and provides an opportunity to interrogate the space users on their experience on a one on one basis as a prerequisite for an empirical study.

Two major assumptions are made in the study of this problem: Firstly, that NMT offers one of the best and sustainable solutions to the urban transport problems (UN Habitat, 2008). It is convenient, environmentally friendly, and faster in areas where there is vehicular congestion, and is affordable (I-CE, 2000). Therefore, the study does not seek to make any case whether the use of NMT as a mode of transport in Nairobi is desirable or not. Secondly, that through design, urban spaces that nurture human life and imbue people with sense of community can be developed. According to Alexander (2006), this degree of life is an objective quality that may be measured by reliable empirical methods.

The focus of this study is to determine how the existing urban structure has influenced the cyclists' and pedestrians' behaviour and route choice in a complex urban environment. As Marshal (2012) has shown, the urban space is very complex and that no urban problem can be solved without considering the wider urban context. The study seeks to examine not only the travel route but also its relationship to the typo-morphological elements found in the urban space.

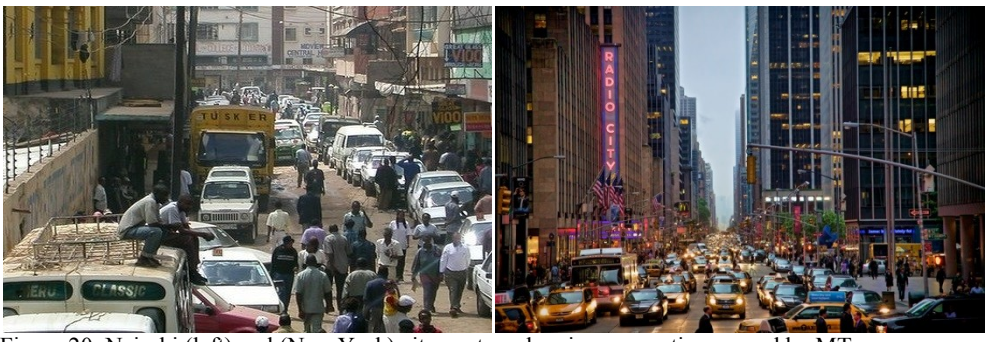


Figure 20: Nairobi (left) and (New York) city centres showing congestion caused by MT
Source:megatraveloffers.com

The study further seeks to link NMT design parameters of comfort, attractiveness, safety, directness and coherence recommended by (I-CE, 2000) to the

typology and morphology of the NMT routes in the light of new-urbanism theories and evaluate the applicability of algorithmic design promoted by Salingaros and Leitner (2010), Smart Codes promoted Duanny and Elizabeth Plater-Zyberk (1992,1994,1997) and genetic coding by Hillier (Hillier, 2012)as approaches to design of sustainable, adaptive and humanistic urban spaces.
(Figure4&5) show challenges faced by NMT users in the study area.

Figure 4: Vehicular and Pedestrian conflict on
Source: Author

Figure 5: Pedestrian access blocked by residents
Source: Author

## 3. RESULTS AND DISCUSSION

### 3.1 Introduction

This study was set on the premise that the unfavourable travel environment for NMT users in Nairobi is as a result of poor urban space planning and design. The independent variables of typological and morphological elements of urban space are looked at in terms of density, diversity, design and destination against the dependent variables for NMT defined in terms of coherence, directness, attractiveness, safety and comfort. This section identifies the typological and morphological elements and seeks to establish which of these elements and the extent to which they influence the NMT users' behaviour and route choice on a home-to-work trip. The data is presented following the objectives set out for this study. Firstly, the typological and morphological characteristics of the NMT routes in selected Eastland's estates are established according to route choices by NMT users; and secondly the NMT users' behaviour in their travel environment and their response to it are established

### 3.2 Typological and morphological characteristics of the routes

The NMT user interview carried out at the travel destinations identified four major routes used by respondents on the home to work trips. The respondents were shown the area map of the travel routes on which landmarks had been identified. The respondents were then asked to identify the routes which they frequently used shows the main routes used by NMT users as identified from the interview at travel destinations. The table shows the numbers that use the routes after cleaning out the data by eliminating routes that do not fall directly within the study area.

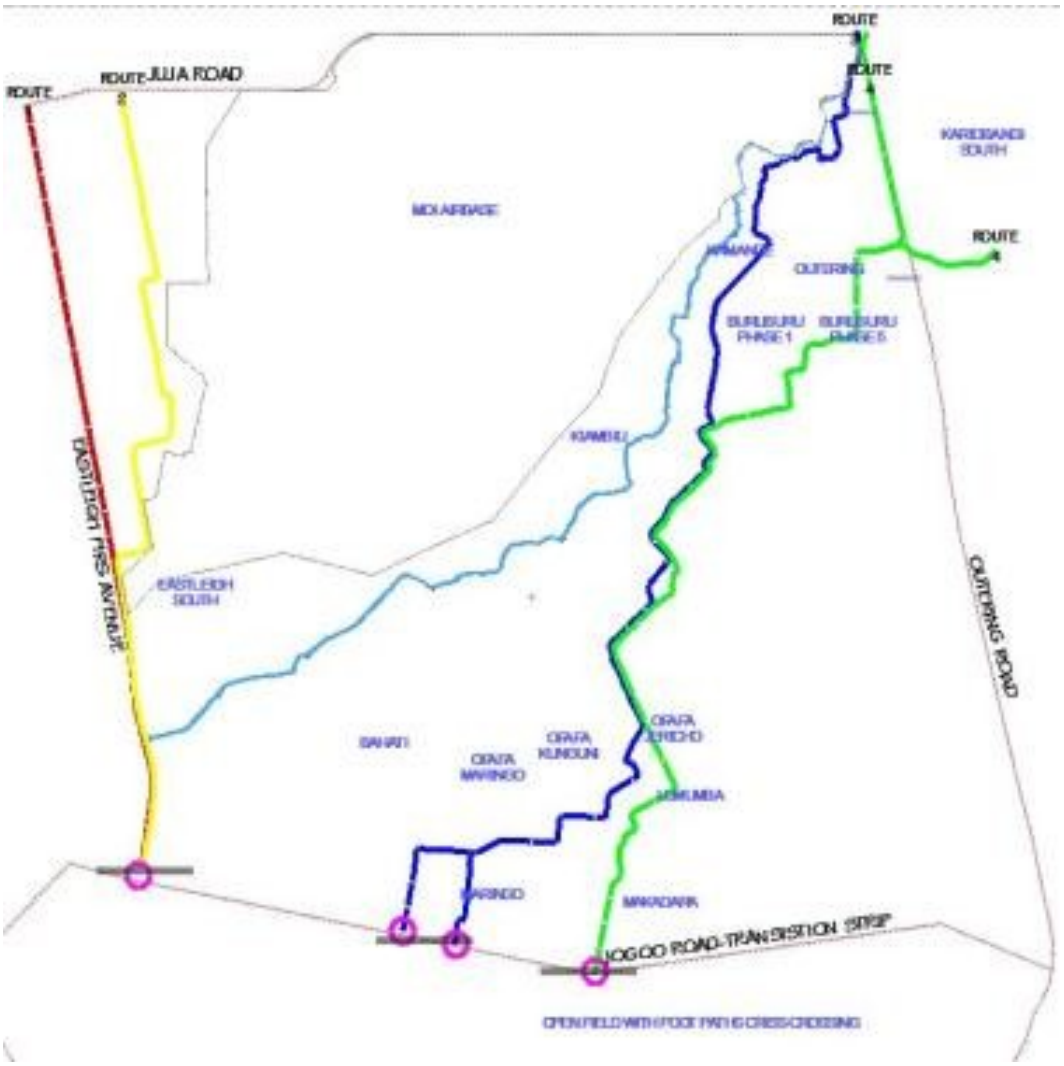


Figure 6: The four routes in the study area

Source: Author shows the routes on a map of the study area. Route one runs through the outer edge along Eastleigh First Avenue and connects Jogoo road directly to Juja road. Route three and four cut through the study area in the north-easterly direction. At one point, the two routes merge within Jericho estate. It is notable that due to the large area covered by the Moi Airbase, there is a large distance, almost four kilometres between route 2 and 3. NMT users that live beyond the airbase have therefore to cover much longer distances to reach their destinations. It is also clear that the NMT users using route three and four follow a more convoluted route to reach their destination at the junction of Outer Ring road and Juja road. From the

study, it was noted that most NMT users avoid routes which have high vehicular traffic and would rather travel longer distances than use more direct routes that have higher vehicular traffic. This is evident in the fact that route three and four users converge at an area which has almost no vehicular traffic.

**3.3 Typological characteristics of the four routes**

The study sought to identify the typological characteristics of the NMT routes in the study area. Four main routes were identified. Shows the typology of buildings found in selected sections along the four routes. Route one has predominantly high rise (more than two storey) buildings with either commercial function or mixed use. In the mixed use buildings, most commercial activities take place at ground floor level while the upper floors are used as residential premises. Route two is predominantly high rise residential blocks. There are also a significant number of single storey informal structures along this route. Route three has predominantly single storey and double storey residential blocks. However, there are other typologies such as schools, commercial blocks, churches and community centres. The route also passes through an area of informal settlements (Kamande) along the Airbase boundary. Route four has almost similar typology to route three except that some sections of the route have high rise residential blocks while others have mixed use functions especially in the Hamza area.

Shows a figure ground image of the four routes. Route one and two show high densities with most areas covered by building blocks. Route three has sections which show varying densities. The area between Jogoo road and Eldebi road has a variety of built and open spaces along the route. The section passing through Kamande informal settlement is heavily built with very few open spaces left. Route four has the largest areas that are open. The routes passes through a number of neighbourhoods with low rise residential blocks planned around courtyards.

Figures 9-12 show different typologies found along the four routes.

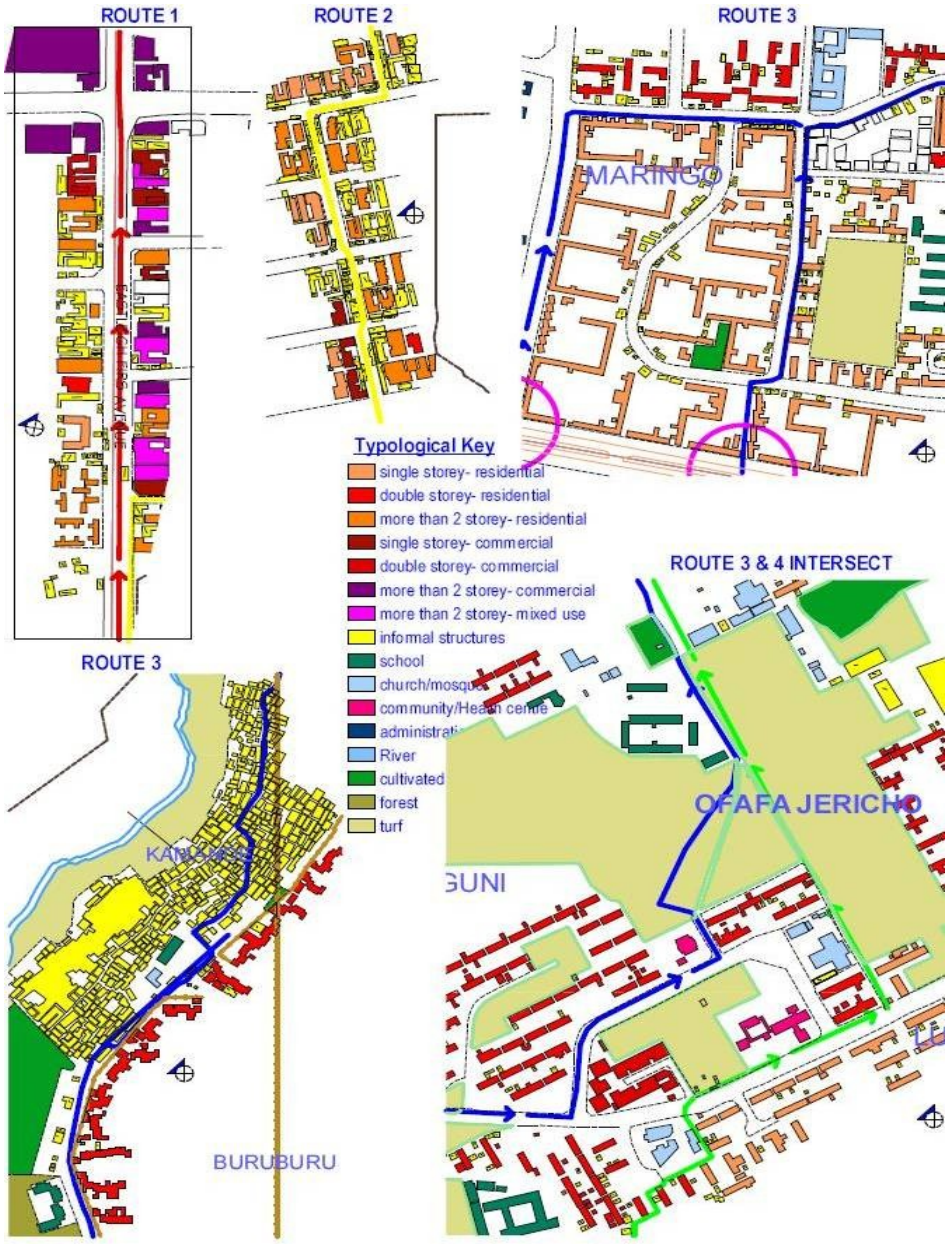


Figure 7: Typologies at Selected Sections Along the Four Routes
Source: Author

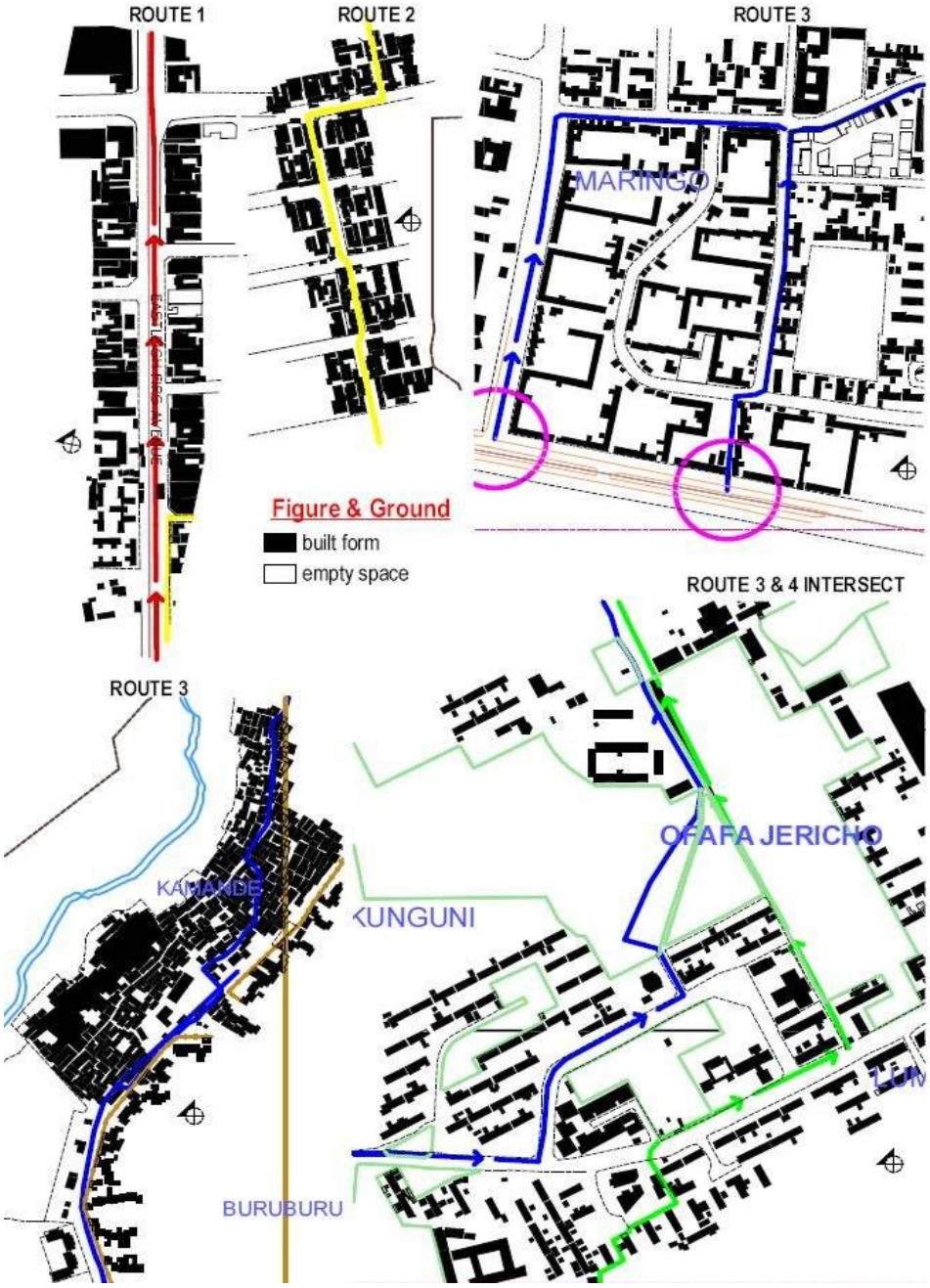


Figure 8: The figure ground image of the routes showing the building densities.
Source: Author

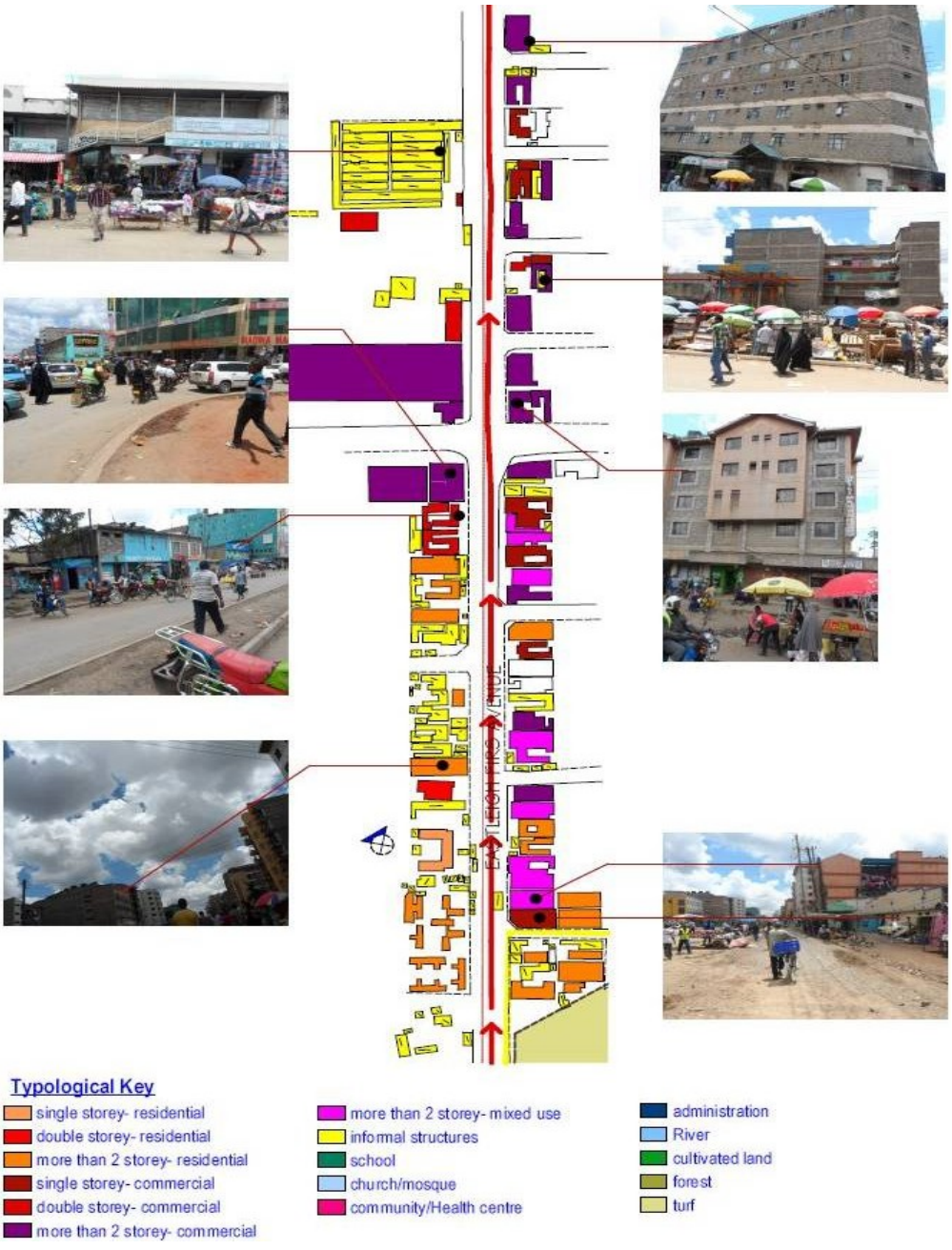


Figure 9: Building typologies on route 1
Source: Author


Figure 10 : Route 2 Building Typologies
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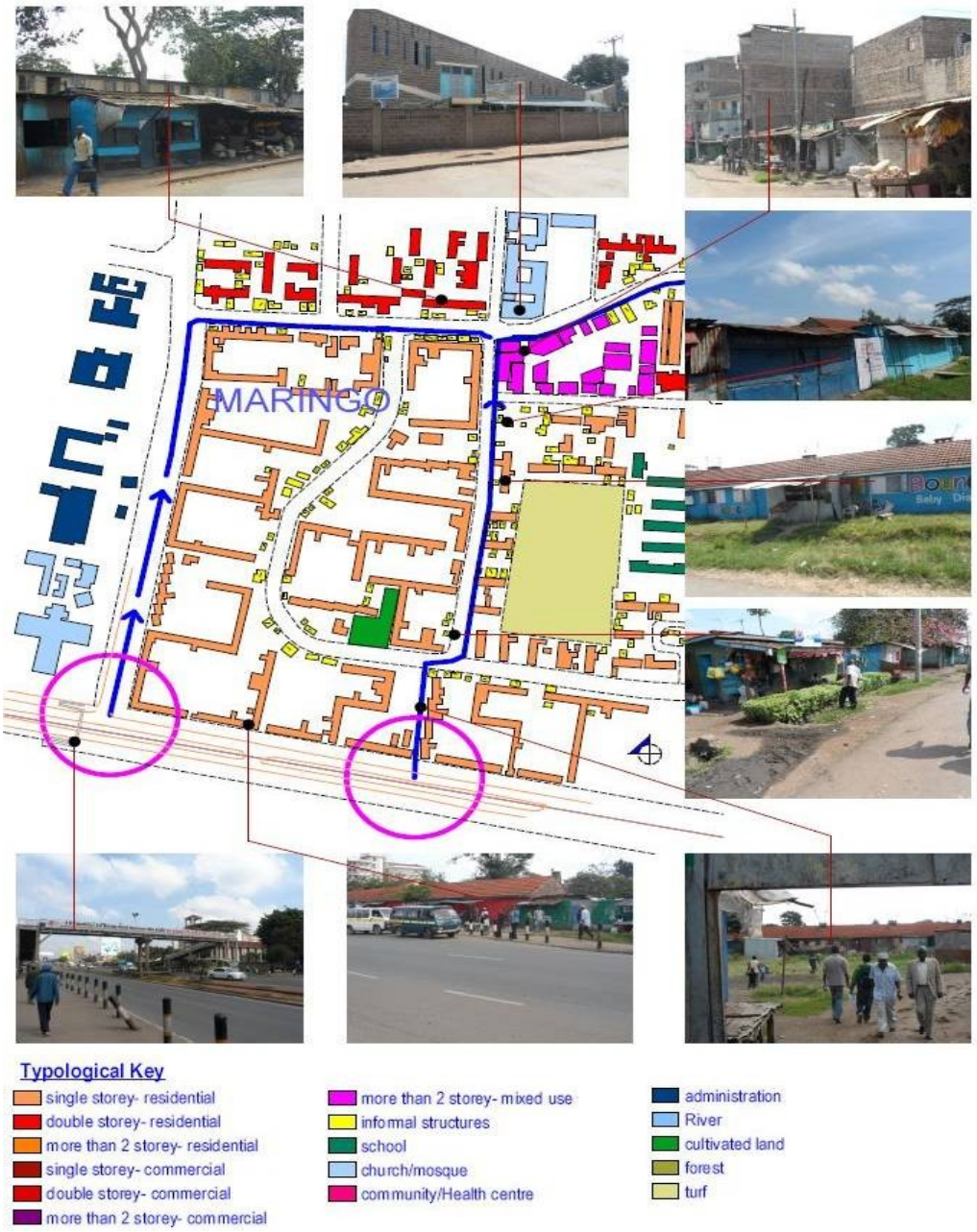


Figure 11: Route3 Building Typologies
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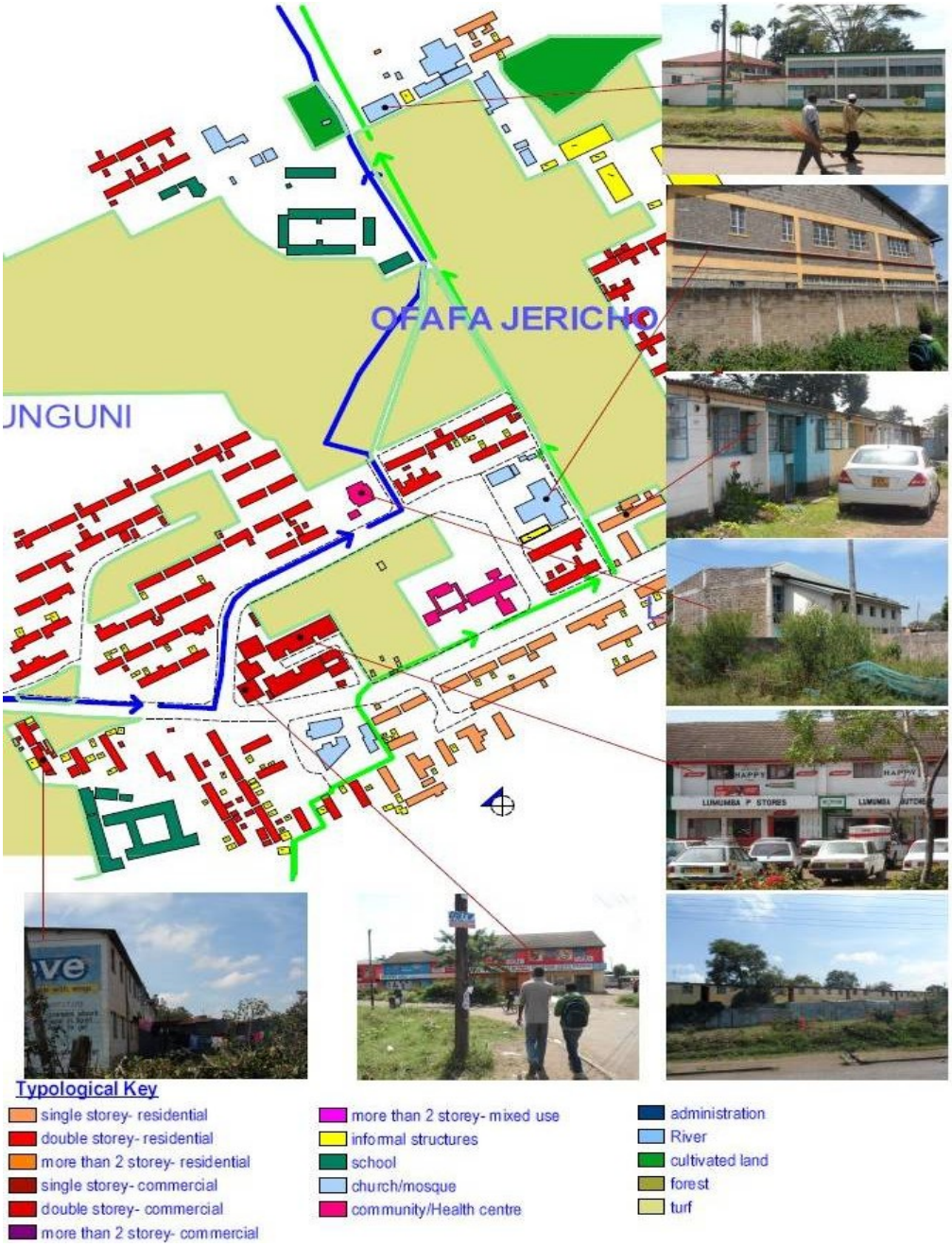


Figure 12: Route4 Building Typologies
Source: Author

### 3.4 Route analysis by variable

There were five factors under the dependent variable that were evaluated to determine the effect of the route characteristics on NMT users from the users' view point. The factors were: coherence, directness, attractiveness, safety and comfort. The factors were broken down into a set of questions. The respondents were asked to rate the quality of their route on a scale of one to five.

In, the box plot shows the coherence scores for all the four routes. Route three is judged to be the most coherent while route two is the least coherent. The test for coherence was to determine the route that was easiest to read, that is, the route in which one was most likely to find his way easily after a single use. The respondents were asked questions concerning; access to main network at points of origin and destination; integration of their route with the public transport; hierarchical approach to the route from urban, district to the neighbourhood network; constancy of the route quality; and ease of recognition of the route. It can be seen in the box plot the mean score for coherence in the four routes does not vary significantly. The most

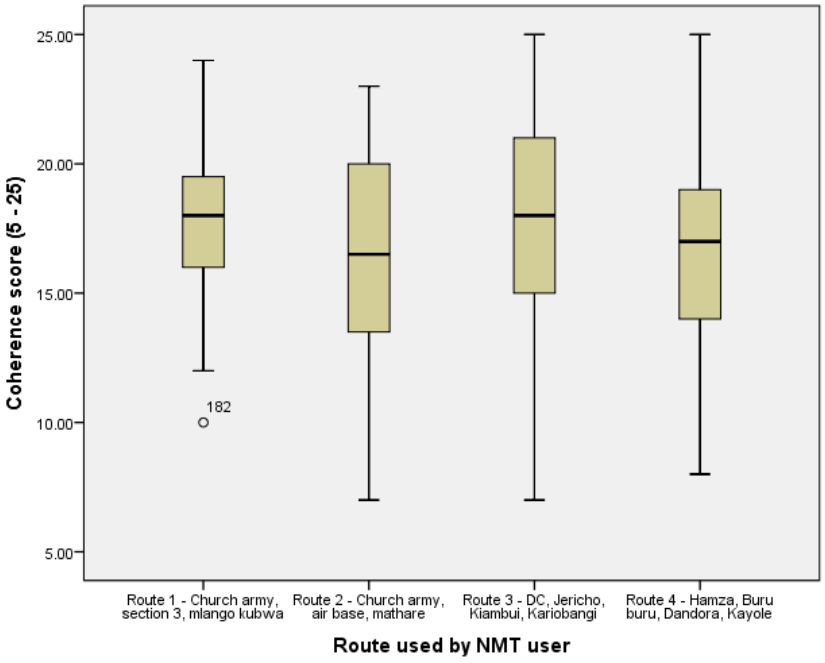


Figure 13: Box plot for Coherence Score of the Four Routes
Source: Author

coherent route has a score of 71% while the least coherent route has a score of 64%.

In, the box plot shows the directness scores for all the four routes. Route one is the most direct while route two is the least direct. Route two was also seen by the respondents to be the least coherent, indicating that there could be a relationship between directness and coherence. The standard deviation from the mean for all the routes does not vary significantly and that the median is very close to the mean. The

most direct route has a score of 59% while the least coherent route has a score of 54% and a mean of 56%. This could mean that the respondents view their routes to be more coherent than direct.

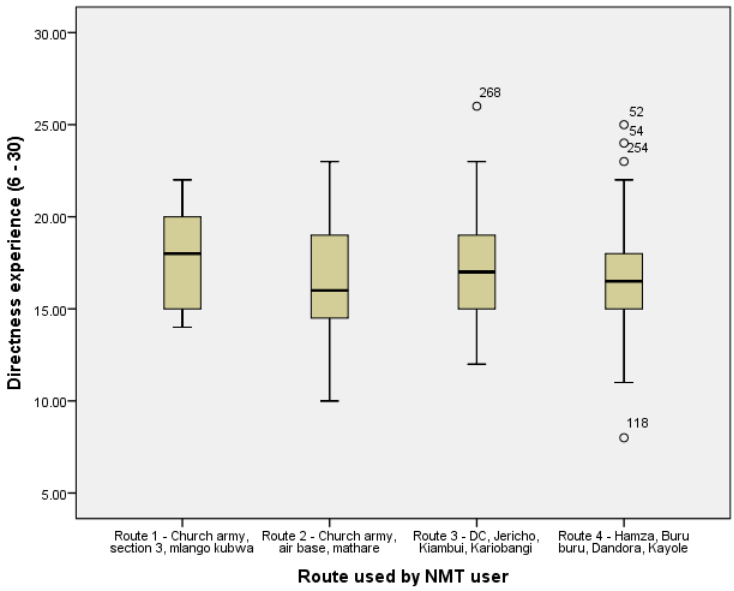


Figure 14: Box plot for Directness Score of the Four Routes

, the box plot shows the attractiveness scores for all the four routes. Route one is the most attractive while route three is the least attractive. The standard deviation for all the routes does not vary significantly and the median is very close to the mean. The most attractive route has a score of 54% while the least attractive route has a score of 49.6% and a mean of 51.3%. The mean score for attractiveness at 51% is lower than that for directness at 56% and coherence at 64%. This means that of all the three factors, the respondents felt that attractiveness of the routes is a more serious problem than coherence and directness.

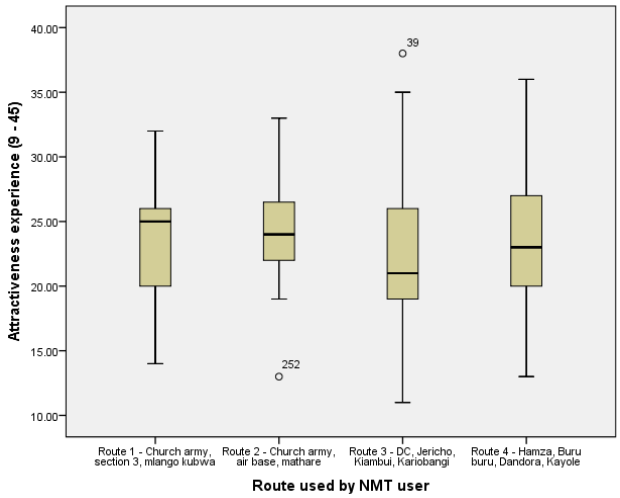


Figure 15: Box plot for Attractiveness Score of the Four Routes

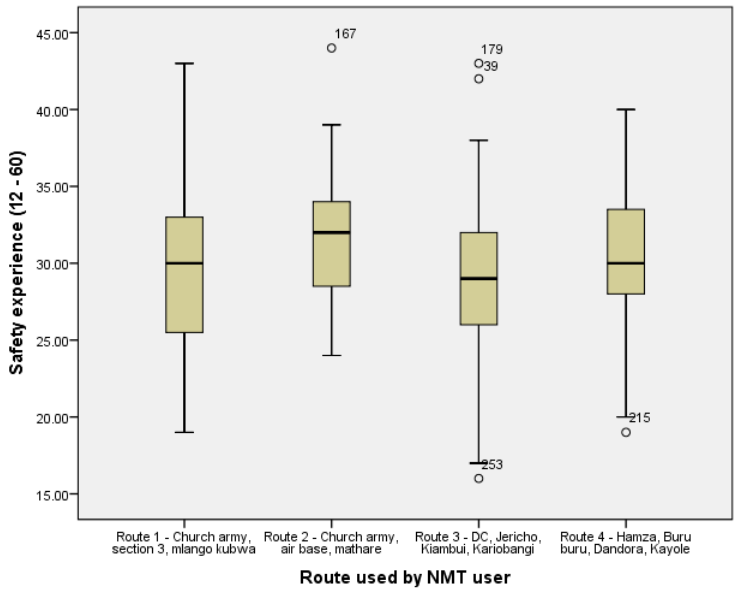


Figure 16: Box plot for Safety Score of the Four Routes

The box plot shows the safety scores for all the four routes. Route two is the safest while route three is the least safe. The standard deviation for all the routes does not vary significantly and the median is very close to the mean. The safest route has a

score of 52.6% while the least safe route has a score of 48.6% and a mean of 50%. Safety has the lowest mean score at 50%, attractiveness at 51% is lower than that for directness at 56% and coherence at 64%. This means that of all the four factors, the respondents felt that safety is a more serious problem than coherence, attractiveness and directness.

The test for comfort was to determine the route that offered the most ease of use in relation to the built and the natural environments. This had to do with; capacity to prevent congestion; possibility of walking or cycling at a steady speed without hindrance; availability of shelter from rain or sun; bicycle parking and repair facilities; and availability of facilities such as shops or kiosks along the route.

The box plot shows the comfort scores for all the four routes. Route two is the most comfortable while route three is the least comfortable. The standard deviation for all the routes does not vary significantly and the median is very close to the mean. The most comfortable route has a score of 57% while the least comfortable has a score of 51% and a mean of 53%. The mean score for comfort at 53% falls between that of attractiveness at 51% and directness at 56% but much lower than coherence at 64%. Safety at 50% is the lowest score. This means that of all the five factors considered, the respondents felt that safety of the routes is the most critical factor that would require much intervention.

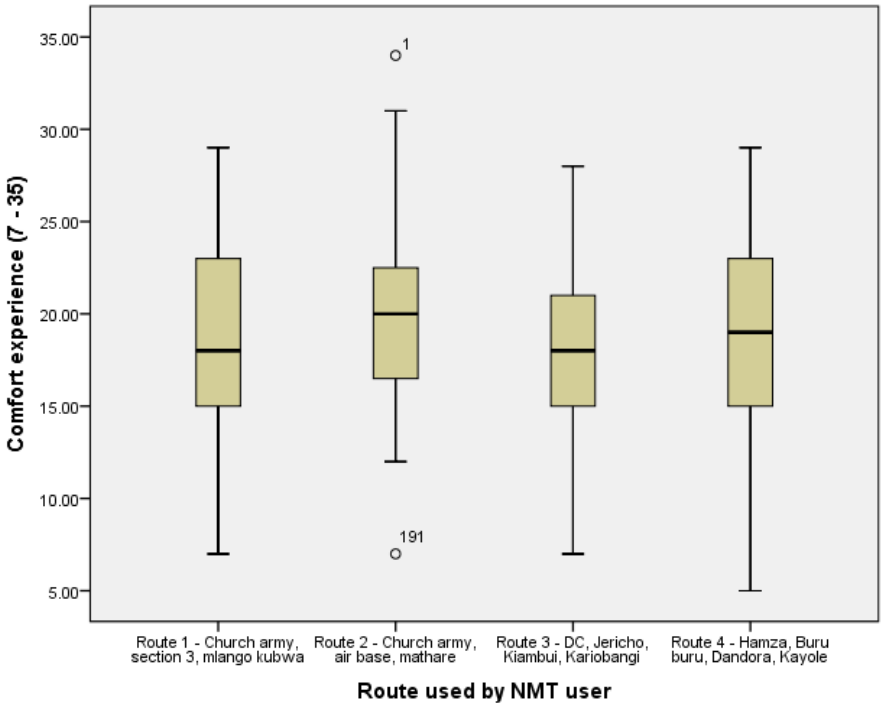


Figure 17: Box plot for Comfort Score of the Four Routes

The box plot shows the overall scores for the four routes. Although there is no significant difference in the quality of the travel environment according to the users' perceptions based on the five factors of the dependent variables, route two turns out to be the most favourable while route 3 is the least favourable.

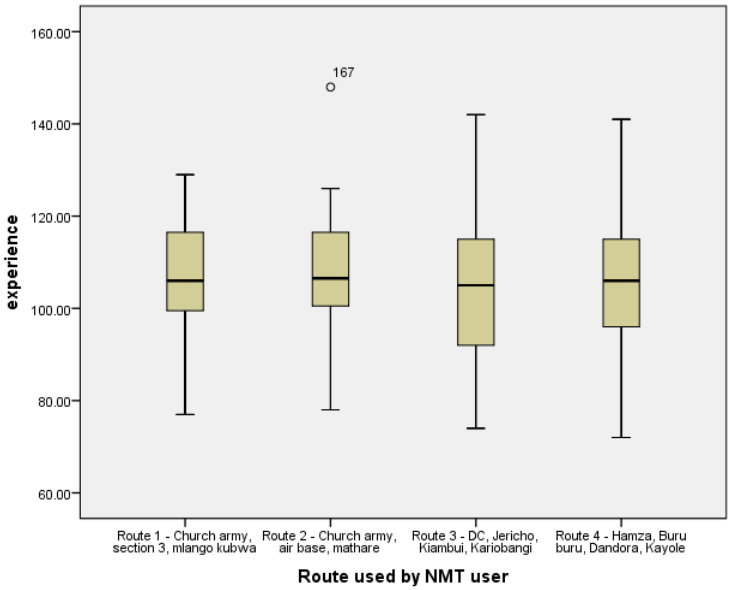


Figure 18: Box plot for Overall Score of the Four Routes

## 4. CONCLUSION

This study has established that typological and morphological elements of urban space do not have significant influence on NMT users' behaviour and route choice on journey to work. However, the study has identified safety of the NMT users as the critical factor to be considered hen designing urban space for these users. Here safety means that the NMT users are segregated from motorized traffic, and that situations or environments that may expose the user to acts of thugery or mugging should be eliminated.

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