Urban Landuse and Traffic Calming Devices in Ibadan, Nigeria: Implications for Improved Road Safety

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Abstract

With the example of Ibadan-Nigeria, this study was set to identify and characterise traffic calming devices across different land uses. This was expected to reveal the different types of calming devices deployed for road safety and areas where improvements in traffic safety should be focused. Observational research was conducted in six traffic hubs in Ibadan using a two-level multi-sampling approach. In each of the selected traffic hubs, investigations focused on the general condition, height and width of identified traffic calming devices. Ten different types of traffic calming devices, classified into three broad groups, were identified. These were vertical devices (speed hump/bump, roundabout, gateway), horizontal devices (raised median and raised median-island) and signage (zebra crossing, speed limit, stop sign, transverse marking, one-way street). Apart from the industrial traffic hub, where only one type of traffic calming device (speed hump) was identified, there were at least two types of traffic calming devices in each of the other traffic hubs. It was established that many of these devices, especially the speed humps, were installed without adequate attention to standard specifications. The study also revealed that signage was predominant in locations where the proportion of literate road users was high. The study concludes that as the distribution of available calming devices varies according to the character and density of the built-up areas, so also does the level of road traffic safety.

Introduction

Transportation is crucial to the growth of human settlements and, more significantly, urban development. (Fadare, 2010; Oyesiku, 2002; Oni, 2004; Spaething, 1999). Transportation aids the movement of people, products, and services, links diverse land uses, and engenders commuting and making trips. Essentially, transportation roles can be more effective and efficient depending on the type of medium (mode) through which movements occur and the facilities (means) employed (Ababio-Donkor et al., 2020; Minal & Ravi, 2014). In many Nigerian cities, the dominant mode of transportation is the road. Observably, the road conditions and the disposition of its users (drivers and passengers), among many other factors, account for many mishaps. On Nigerian roadways, 3,075 fatal vehicle accidents claimed 15,090 lives between May 2006 and June 2014 (Ukoji, 2014). Likewise, 11,072 traffic accidents occurred in 2019, resulting in 35,981 injuries and 5,483 fatalities (National Bureau of Statistics (NBS), 2020). In the second quarter of 2020alone, 3,066 road crashes occurred, and 1,236 people were killed (NBS, 2020a).

Accidents are rising daily due to the increasing usage of motorcycles, tricycles, and other vehicles, particularly in urban neighbourhoods (National Bureau of Statistics, 2018; Ukoji, 2014). To protect the safety and overall experience of all road users, significant measures in traffic management, such as installing road traffic calming devices, have thus become imperative. These are a variety of techniques used in regulating traffic and road environment and ensuring appropriate speed within the neighbourhood (City of Toronto Transportation Services Division, 2016). Traffic calming devices are physical measures that encourage drivers to drive slower and pay closer attention (Gupta, 2014). As posited by Al-Haji, Fowler, and Granberg (2018:7), traffic calming devices are "to deter overtaking and adjust driver behaviour". In other words, traffic calming devices are designed to reduce vehicle speeds so that motorised and non-motorised road users can travel more safely. Cursory observations of available traffic calming devices in a typical Nigerian city - Ibadan, suggest, among others, that one, installation of traffic calming devices varies according to the character and density of the built-up areas, and two, residents, in their own wisdom, often decide to install a desired traffic calming device, most commonly speed humps,

whenever they think the road was no longer safe from the adverse effect of the use of automobiles. Hence, the impetus for this study is the proliferation of traffic calming devices, especially the speed hump, in residential neighbourhoods. To the best of our knowledge, we are unaware of previous efforts in urban mobility studies investigating the distribution of traffic calming devices across different land uses in this Nigerian city. This study was therefore set to examine types of traffic calming devices across different traffic hubs in Ibadan, identify where available devices engender active travel, and where improvements in traffic safety should be focused.

This chapter is laid out in five sections. Following this introduction which provides background and impetus for the study, is the discussion on the types, specifications and standardisation of traffic calming devices. While the discussion in this section is not intended as a detailed engineering or technicality of traffic calming devices, best practices in road safety across the globe are referenced in this section. The third section briefly describes the study area and the data gathering and analysing procedure. The study's findings and discussions are presented in the fourth section of this chapter, while the last section is the conclusion.

Traffic Calming Devices: Types, Specifications and Standard Practices

Historically, the introduction of calming devices in traffic management is traced to the 1865 Red Flag Act in the UK (Transport Department, 2007). This followed a successful plan that increased safety in continental Europe. The 1865 Acts limited the speed of moving vehicles to around 4 miles per hour (mph), allowing people to move in front of them. Depending on local rules, cars might go 12 to 14mph by 1896. The Motor Car Act upped the vehicle speed limit to 20 mph in 1903. However, it was later repealed in 1930. In 1934 a limit of 30mph was introduced in built-up areas, but other roads had no speed limit until a national limit of 70mph was introduced in 1965. Until recently, European state members have embarked on some other best, good and promising practices for ensuring road safety, halving the number of deaths on European roads (European Union Commission, 2007). Other actions for the use of traffic calming devices, such as speed breakers, roundabouts, and road markings and signs, have also been employed at the local, regional and national scale in Europe (Tödtling-Schönhofer & Pucher, 2010). The early usage of traffic calming devices can be regarded as the result of government legislation, which up-to-date has not changed in European countries. Governments at various levels in Nigeria have also established regulations and agencies to ensure improved road safety (Ajala, 2016). However, much is still desired in the area of traffic calming design, installation and enforcement.

In developed and developing nations, traffic calming measures are installed as a design element to enhance existing neighbourhoods or new ones (Murphy, 2003). Generally, traffic calming devices contribute significantly to urban design, increase the possibility of walking, cycling, and transit use (City of Sunnyvale, 2008; McCann, 2005; Lockwood, 1997), and promote improved neighbourhood liveability and development (Rahman et al., 2018; Polloni, 2017; Grana et al., 2010). Traffic calming devices are effective measures of road safety (Werner, 2015; Jiang et al., 2014; Cottrell et al., 2006). According to the Department of Transport (2007), traffic calming devices can be grouped into five. These are road hump, rumble, chicane, vehicle deactivated design and road marking. However, Kotsiopoulos (2000), Tester et al. (2004), Metzger (2008), and Ziolkowski (2014) categorise traffic calming devices into four, namely: vertical, horizontal, obstruction and signage.

Vertical traffic calming devices are mounted to affect the driver’s speed by vertical deflections of cars travelling over the device. They include speed, a hump/bump/table, a rumble strip and raised crosswalk. On the other hand, horizontal traffic calming devices are deployed to influence the driver’s speed by lateral deflections of cars navigating the device. Examples of these are: raised median island, gateway, circle (mini roundabout), chicane and curb extension, among others. Obstruction calming devices are features installed on roads to discourage short-cutting, reduce conflict points and enhance the neighbourhood environment. Right-in and right-out islands, intersection channelisation, diagonal diverter, raised median and full closure, among others, are examples of obstruction traffic calming devices. Signage comprises features installed to regulate traffic movements and often requires enforcement. Signage devices include maximum speed, one-way, turn prohibition, zebra crossing, stop, warning and yield signs. Irrespective of type, the construction and or installation of traffic calming devices is/are expected

to follow certain threshold priority scoring criteria (City of Pleasanton Neighbourhood Traffic Calming Program, 2012). Such a scoring system contains an analysed and prioritised list which shows current traffic volume and speed, accident history, pedestrian-generating land uses and adjacent land uses. In some climes, the design of traffic calming devices is expected to follow prescribed legislation. For example, vertical devices like humps can only be constructed on roads with 30mph or less speed limits in Norway, England and Wales. Such device height and width must not exceed 100mm and 370mm, respectively (Transport Department, 2007). In some other regulations, the type of traffic calming measure deployed for road safety depends on street classifications, which explain the purpose of each street and the design standards (Burden, 2007). Accordingly, the traffic calming device deployed in an area, especially a residential neighbourhood, is expected to meet the design standards of the local jurisdiction (government) and be accepted by at least 60-70% of residents. Hence, the plan for installing traffic calming devices must be reviewed and approved by the appropriate public authority and the generality of the people.

Each type of traffic calming has design specifications. For example, it is recommended that the installation of speed humps should be in streets with closed drainage and curbs, streets with little through traffic, occasionally collector roads, residential streets, and school and playground zones, where the speed limit is 50 mph or less, and where low speeds around 30 kmph are desired (Berthod & Leclerc, 2013). Accordingly, the use of speed humps is not to be allowed on approaches to intersections, in curves or approaches to curves, on roads with prominent gradients or where the device cannot be appropriately noticeable or could shock motorists. On the other hand, the installation of road islands is usually introduced when approaching built-up areas. It signals where many pedestrians are crossing the road (Republic of Ghana Ministry Of Transportation, Ghana Highway Authority Road Safety and Environment Division, 2007). It should not be used if the street speed limit exceeds 50 mph. It should have sufficient road signs and markings to ensure drivers see it promptly.

Materials and Method

Ibadan is the capital city of Oyo State, South-west Nigeria. It lies approximately between Latitude 07º 22' and 07º 40' North of the Equator and 03º 53' and 04º 10' East of the Greenwich Meridian. In its regional setting, Ibadan is located at a distance of 65km South of Abeokuta (Ogun State capital city), 75km and 90km South East of Osogbo (Osun State capital city) and Akure (Ondo State Capital city), respectively, as well as 100km East of Ado-Ekiti (Ekiti State capital city). Ibadan is 128km north of Lagos and 345km south of Abuja, the nation's capital territory. The development of Ibadan was greatly aided by the construction of the Lagos-Ibadan Expressway and the establishment of the railway line and academic institutions. The railway to the North reached Ibadan in 1901, and all road traffic from Lagos to the North converged in Ibadan. Ibadan has an internal road network connecting various land uses. For the purpose of this study, activity areas in the city were identified and stratified into six prevailing land uses, hereafter referred to as traffic hubs (Table 1). Subsequently, simple random sampling was employed in selecting a hub in each stratum where the study was conducted. Hence, the Oyo State Government Secretariat, Bodija Market, University of Ibadan, University Teaching Hospital and Oluyole Industrial Estate were selected as the administrative, commercial, educational, healthcare and industrial traffic hubs. The residential zones were further divided into three densities: high, medium, and low. In each density, a major hub was purposively selected. Thus Bere, Odo-Ona and Oluyole Estate were selected respectively in the high, medium and low residential densities.

Table 1: Identified Traffic Hubs in Ibadan

Traffic Hubs		Names of Major Hubs in Ibadan Municipality
Administrative		Ibadan North Local Government Secretariat, Mapo Hall, ***Oyo State Government Secretariat***
Commercial		Aleshinloye Market, ***Bodija Market***, Dugbe Market, Gbagi Market
Educational		Federal College of Animal Science, Lead City University, The Polytechnics Ibadan, ***University of Ibadan (UI)***
Healthcare		Adeoyo Hospital, New State Hospital, Oluyoro Catholic Hospital, Oni & Son Hospital, ***University College Hospital (UCH)***
Industrial		***Oluyole Industrial Estate***
	High	Agbongbon, Agugu, ***Bere***, Bode,

Residential		Foko, Idi-Arere, Kudeti, Ode-Aje, Odinjo, Ojaoba, Oje, Oke-Aremo, Oke-Offa, Oke-Padi, Oniyanrin, Oranyan, OritaAperin, Popo, Yemetu,
	Medium	Agbowo, Bashorun,Challenge, Felele, Garage, Ijokodo, Mokola, New Idi-Ape, ***Odo-Ona***, Ring Road, Sango
	Low	Aerodrome GRA, Agodi GRA, Alalubosa GRA, Bodija Estate, Iyaganku GRA, New Bodija Estate, - ***OluyoleEstate,***Onireke GRA

Note: Selected hubs are presented in italics

In each of the selected traffic hubs, meticulous observation of available traffic calming devices, involving taking measurements and photographs, was conducted. A previous study (Olojede, 2019) adopted this method as it provided a robust understanding of the situation being examined. This method was considered appropriate as the study aimed to obtain a snapshot of what characterised traffic calming devices in Ibadan and draw implications for traffic safety. The characteristics of available traffic calming devices examined included the height, width and condition. This study can thus be described as an observational research, otherwise referred to as unobtrusive research (Russell, 2011; Crossman, 2020). All Information is presented in tables and figures in this chapter from the author's fieldwork.

Findings and Discussions

Ten (10) traffic calming devices were identified in the study area. These included speed hump/bump, raised median -island, gateway, raised median and roundabout. Others were zebra crossing, speed limit, one-way street, transverse marking and stop signs. These devices can be classified into vertical, horizontal and signage (Table 2). With the exemption of the industrial traffic hub, where only one type of traffic calming device (speed hump) was identified, there were a minimum of two (2) types of traffic calming devices in each of the other traffic hubs. The following sub-sections present findings on each type of identified traffic calming device.

Table 2: Identified Traffic Calming Devices in Ibadan

Classification	Types of Traffic Calming Devices	Locations (traffic hub)
Vertical	Speed hump	Commercial, Administrative, Healthcare, Educational, Industrial and Residential
Horizontal	Roundabout (traffic circle), raised median, gateway and raised median island	Commercial, Administrative, Health, Educational and Residential
Signage	Zebra crossing, speed limit, one-way street, transverse marking and stop sign	

Vertical Traffic Calming Devices in Ibadan Municipality

The only type of vertical calming device identified in the different traffic hubs in Ibadan was the speed hump. Other types of vertical calming devices, such as the rumble strip and raised crosswalk identified by Hallmark, Peterson, Fitzsimmons, Hawkins, Resler, and Welch (2007); Metzger (2008); Pardon and Average (2013), were not available in the selected traffic hubs. The speed hump is a round raised area placed laterally on the roadway. Materials used to construct identified speed humps varied from one locality to another. These materials included rubber (Figure 1), asphalt (Figure 2) and concrete (Figure 3). These are similar to materials used in other cities in Nigeria and other countries of the world (Bellefleur& Gagnon, 2011; Renčelj, 2014). As the materials differed, so also were the configurations (height, width, spacing and gradient). Some identified speed humps were painted yellow and black, while others were painted white and black. The colours were essentially to signify the vertical change in the level of the road. The height of the speed hump varied between 80mm and 120mm, while the width was between 200mm and 450mm. The spacing of the devices ranged between 1000mm and 2500mm. The gradient of identified speed hump also varied considerably.

Figure 1: Speed hump made of rubber

Figure 2: Speed hump made of asphalt

Figure 3: Speed hump made of concrete

Figure 4: A speed hump where beggars seek alms

The above descriptions of the only type of identified vertical calming device – the speed hump- indicate no uniformity in the design of these devices in Ibadan. Specifically, the height and width of identified speed humps were beyond the limits specified by Transport Department (2007). Among others, it can be inferred that individuals or groups who constructed the identified speed humps do not pay adequate attention to specification. Likewise, it suggests that no particular government agency is responsible for designing and approving the speed hump installation. As evident in Figure 1, the speed hump was on the road without closed drainage and curbs. This negates the standard as specified by Berthod and Leclerc (2013). It was also observed during the study that speed humps were installed on different categories of roads, including the primary, secondary and collector roads. Aside from being the only identified vertical calming device, the speed hump was also the predominant traffic calming device in the study area, available in all identified traffic hubs in Ibadan municipality. As mentioned earlier, the speed hump was the only traffic-calming device identified in the industrial hub. Speed humps were also available at the Oyo State Government Secretariat, within the Bodija Market, University College Hospital (UCH), University of Ibadan (UI), and the different residential areas (Bere, Odo-Ona and Oluyole Estate).

The study's findings revealed that speed humps were primarily installed in areas where human activities were predominant and where land use(s) that attracted high traffic flow were located. The study revealed that identified speed humps were effective and efficient calming measures in that they encouraged or forced motorists to drive slowly on approaching and across it. Similarly, drivers'

alertness and attentiveness were easily noticed when approaching a speed hump. Speed humps allowed to some certain level, easy pedestrian crossing and safety of the non-motorised road users; although, there were no adequate indications (signage) that speed humps were ahead in transit at different locations. A few instances when motorised road users drive across the device hurriedly, at high speed and without caution were observed during the survey. The motorcyclists, otherwise known as the *okada* riders, were more culpable in these instances. The speed humps also served other tangential purposes. For example, in the sub-urban residential traffic hub, beggars took over the speed humps, turning it into a nucleus where they seek alms from road users (Figure 4). In other words, as motorised road users slowed down the speed of their vehicles, it was an opportunity for beggars "*to do their job"*- seeking alms.

Evidence also abounds that hawkers and street children often clustered around some of the identified speed humps for various activities, such as selling goods and begging. This finding corroborates the work of Taiwo (2018), who established locations on the road as one of the various beggars' and street children's nuclei in Ibadan. It can also be reasoned that the speed hump was capable of causing drivers' stress and fatigue, vehicle wheel misalignment, increased fuel consumption, as well as an increase in response times of emergency vehicles. It also resulted in damage to the carriageway surface, as presented in Figure 2, more importantly in the absence of standardised specifications and technical guidelines.

Horizontal Traffic Calming Devices in Ibadan Municipality

As established in the literature, one of the categories of traffic calming devices is the horizontal traffic calming devices (Malaysian Highway Planning Unit [MHPU], 2002; Murphy, 2003; Abdul et al., 2009). Four (4) types of horizontal traffic calming devices were identified in the study area. These were roundabout (traffic circle), raised median, gateway and raised median island (Table 2). Though the types of horizontal traffic calming devices in the different traffic hubs differed, the study established that horizontal traffic calming devices were installed in five of the six identified hubs. The four identified types of horizontal traffic calming devices were available in UCH and UI, whereas none were in the industrial hub.

Gateways, a typical horizontal traffic calming device, were installed on roads in the commercial, administrative, healthcare and suburban residential traffic hubs. As noted during the study, gateways were installed at specific locations of accessibility/entrance into the different traffic hubs. The structure of the identified gateways differed from one location to another. In addition, security checkpoints were mounted at the gateways in the different traffic hubs. The gateways at the four traffic hubs (Administrative, Healthcare, Institutional and one of the Residential areas [Oluyole Estate]) had iron doors (Figures 5, 6, 7 and 8). Gateways were predominant in the suburban residential areas. Gateways were also installed to reduce the speed of vehicles coming into the various streets. In the Commercial traffic hub, the gateway was only at one of the several entrances for the purpose of reducing vehicle speed as drivers approached the market entrance. It was also for restricting and checkmating frivolous entries, collection of levies and generation of revenue from drivers of vehicles (trucks and trailers) coming in and out of the market.

Figure 5: Gateway at the Government Secretariat, Ibadan

Figure 6: Gateway to the Healthcare Traffic Hub

Figure 7: Gateway at the Educational Traffic Hub

Figure 8: Entrance of a Residential area

Another available horizontal traffic calming device identified in Ibadan Municipality was the raised medians. This device was installed to separate directions on the same roadway, serve as a refuge for pedestrians, provide space for the installation of street furniture, minimise the traffic flow a pedestrian can predict and reduce pedestrian crashes. The raised median is a critical traffic-calming device at transit stops, making crossing safer and more appealing to existing and potential transit users. As observed during the survey, identified raised medians in the commercial and core residential traffic hubs were not adequately maintained (Figures 9 & 10), an aberration of the purpose of traffic calming devices in the study area. Exceptional situations where the raised medians were well maintained were the healthcare and educational traffic hubs (Figures 11 and 12). The height and width of a typically raised median in the commercial traffic hub were about 700mm and 225mm, respectively. In contrast, the height and width of raised medians in the administrative, healthcare, institutional and core residential traffic hubs were approximately 600mm wide and 225mm high.

Figure 9: Condition of raised median in the Commercial traffic hub

Figure 10: Condition of raised median in a Residential (Core) Area of Ibadan

Figure 11: Well-maintained raised median in the Healthcare hub

Figure 12: A typical raised median well maintained in the University of Ibadan

The roundabout was another horizontal traffic-calming device identified in the study area. Although this type of traffic calming device was not available in the commercial and industrial traffic hubs, the study revealed that those available in other traffic hubs (locations) in Ibadan municipality eased traffic. The roundabout allowed easy flow of vehicles and road users. The design of the identified roundabouts added to the aesthetic and panoramic views of the locations where they were installed. In other words, the roundabout served as the identified traffic hubs' design and landscape feature. More importantly, it served as the location for historical monuments, hero's statues or cenotaphs, and urban legibility features. The roundabout was identified as the most common after the speed hump in Ibadan Municipality. For example, there was a roundabout at the entrance of the Oyo State Government Secretariat (Figure 13), UCH (Figure 14) and UI (Figure 15). Similarly, roundabouts were available in the residential areas (Figure 16). Observation revealed that in a location where roundabouts were installed, there was a high level of traffic safety and reduced automobile collisions. Roundabouts were mostly installed at cross-junctions. The area covered was landscaped with soft and hard elements.

Figure 13: Roundabout in front of the State Secretariat

Figure 14: Roundabout in the Healthcare Traffic Hub

Figure 15: Typical Roundabout in the University of Ibadan

Figure 16: Roundabout in the residential hub of Ibadan

Raised Median Island was another type of horizontal traffic-calming device identified in the study area. This type of device is distinctive from the raised median. Unlike the raised median, raised median Island was broader/wider in a horizontal direction. It was available in UCH and UI (Figures 17 and 18). This device was installed on a dual carriage roadway. For instance, raised Median Island was installed at the main entrance road of the healthcare traffic hub (University College Hospital) and the main entry road (Oduduwa Road) at the institutional traffic hub (University of Ibadan). As observed, this device aided pedestrian crossing. It allowed pedestrians to cross in two stages and deal with one direction of traffic flow at a time, just like the raised median. Raised Median Island were installed with hard and soft landscape elements such as flowers, grass, kerbs, stones and railings. The height and width were about 0.5m and 2.4m, respectively.

Signage Traffic Calming Devices in Ibadan Municipality

Five (5) types of signage were identified in Ibadan municipality. These were zebra crossing, speed limit, one-way street, transverse marking and stop sign. The study established that all identified types of signage were available on the University of Ibadan campus. Other traffic hubs where only one type of signage (one-way street) was available were Oyo State Government Secretariat and the University College Hospital. It can be inferred that the signage (devices) was predominant in locations where the proportion of literate road users was high. For instance, One-way Street signage was installed to allow vehicles to move in a single direction in the Oyo State Government Secretariat (Figure 17). The Oyo State Government Secretariat is the seat of government. The location involves the movement of different government officials working in the different Ministries, hence the installation of a one-way street.

Speed limits were also available in the institutional traffic hub (University of Ibadan). The study, therefore, revealed that speed limits were installed for all motorised road users within the institutional traffic hubs. The maximum speed limit was 40km/h for all categories of road users. The speed limit was installed to caution or reduce drivers' speed and ensure the safety of other road users within the institutional traffic hubs. The maximum speed sign post was installed along the social sciences road to create awareness for road users driving within the Institutional traffic hub (University of Ibadan). A typical example of a speed limit in the institutional traffic hub (University of Ibadan) is shown in Figure 18.

As established previously, signage traffic calming devices (zebra crossing, stop sign and transverse markings) were available only in the institutional traffic hub (University of Ibadan). These devices were installed at different locations within the institutional traffic hub to regulate, warn, guide, and inform road users. For instance, zebra crossing was observed at specific locations in the institutional traffic hub. Some locations where zebra crossings were identified were Oduduwa Road, Abadina Road, Second Gate-Samonda Road and Art Theatre Road. The two-signage traffic calming device (Stop sign and Transverse markings) were observed on Oduduwa Road in the institutional traffic hub (University of Ibadan). Typical examples of zebra crossing and stop signs within the institutional traffic hub are presented in Figure 19 and Figure 20, respectively.

Figure 17: Typical one-way signage in State Secretariat, Ibadan

Figure 18: Speed limit in the Institutional traffic hub

Figure 19: Zebra crossing at the University of Ibadan

Figure 20: **Typical Stop Sign device in the University of Ibadan**

The zebra crossing devices were primarily installed in areas where human activities were predominant and land uses that attracted high traffic flow were located. In other words, it was located at intersections and areas where road users, especially the students and staff, deem it fit to cross roads from one side to another. Cursory observation revealed that these devices serve as road safety measures put in place by the school management to reduce vehicle speed and allow peaceful coexistence among road users at the University of Ibadan.

Conclusion

In Ibadan Municipality, three broad types of traffic calming devices were identified: vertical devices (speed hump/bump, roundabout, gateway), horizontal devices (raised median and raised median-island) and signage (zebra crossing, speed limit, one-way street, transverse marking and stop sign. Hence, ten (10) different traffic calming devices were identified in this study. The distribution of these devices varied as the character of the various land uses also varied. In essence, it is submitted that the type of traffic calming devices deployed in an area or specific land use depends on the primary attribute of such area/land use. It is also established that the availability of traffic calming devices is an essential component of road safety strategies, irrespective of land use character. Likewise, traffic calming devices are neighbourhood-based solutions to local problems identified by residents.

As this study provides a clear understanding of the categories of traffic calming devices available in Ibadan, Nigeria, it indicates areas in the city where road safety should be improved. Areas where the calming devices have become something else serving different and unintended purposes must be looked into. The maintenance of both the vertical and horizontal devices must be well appropriated by concerned authorities. The poor state of the available speed hump, roundabout, gateway and raised median should be improved. As a matter of constitutional responsibility, the local government should see the design and maintenance of traffic calming devices in the different traffic hubs. In essence, local authorities should, from best design practices around the globe, formulate or adopt standards and specifications that best support respective traffic landscapes and local experiences.

For improved urban road safety, it is imperative to have more than one type of traffic calming device across different urban land uses, especially in residential and commercial traffic hubs. More importantly, installing a speed hump, a typical vertical calming device that predominates in the city, should be supported with other calming devices such as signage, including speed limit, zebra crossing and stop signs. In this regard, many lessons can be learned from the educational and healthcare traffic hubs. Stringent rules should be deployed to maintain traffic-calming devices, such as monitoring and evaluating installation and enforcement according to international best practices.

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