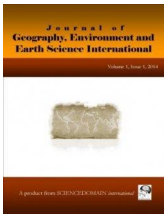

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The Use of GIS in the Spatial Distribution of Speed Bumps within Afikpo

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Authors' contributions

This work was carried out in collaboration between both authors. Author AEM produced the map, performed the spatial analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AEM and AAF collected the field data for the study. Both authors managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Speed bumps (also called speed breakers, or a sleeping policeman) are the common name for a family of traffic calming devices that use vertical deflection to slow motor-vehicle traffic in order to improve pedestrian's safety. However, Speed bumps often meet resistance from residents and road users because of their discomforting nature arising from unlawful and indiscriminate installation/construction by zealous individuals. The aim of this study is to map out the speed bumps within Afikpo using GIS as a tool with a view to providing a guide (especially to visitors) on best alternative route to adopt. To produce the map, the coordinates of the speed bumps acquired using a handheld global positioning system (GPS) receiver were plotted on a georeferenced map covering the study area using ArcGIS 9.3 software. The result of this study revealed that speed bumps within Afikpo have their shapes, sizes, and height to be too inconsistent. The map produced will therefore be a useful guide to the populace (especially visitors) informing them of spots to expect speed bumps (and therefore to be more careful especially as there are no traffic signs around) and also, routes to avoid in cases of emergencies so as not to increase the response time

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of emergency. There is therefore the need for regular and increased education on the variety of speed bumps, their roles, standards, and rational for their installation in addition to the need to shun illegal installation or use of sub-standard or alternate materials such as woods by communities. Further Studies should be carried out to assess the level of compliance with laws guiding the installation of speed bumps and to be able to identify installations that fall short of standard. This will help to draw the attention of the authorities towards the removal of such illegal or substandard installations.

Keywords: ArcGIS 9.3; map; GPS; speed bump; GIS; roads.

1. INTRODUCTION

Speed is an aggravating factor in the severity of all accidents [1]. Speed management is therefore, an essential tool in ensuring the improved safety of users of urban roads, particularly vulnerable users. Roads of different categories and under different situations are designed for specific speeds at which vehicles can travel with convenience and safety. Hence, at certain locations such as approaches to manned and unmanned level crossings, sharp curves, congested/accident-prone locations, residential streets, etc., control of speed may become necessary to promote orderly traffic movement and improved pedestrian's safety [2,3].

Speed bumps (also called speed breakers, or a sleeping policeman) are the common name for a family of traffic calming devices that use vertical deflection to slow motor-vehicle traffic in order to improve safety conditions. They can be used to influence driver behaviour towards non-motorised road users [4]. Variations include the speed hump (or speed ramp), speed cushion, and speed table (see Fig. 1). Each of these devices can be made from a variety of materials, including asphalt, concrete, recycled plastic, metal, or vulcanized rubber. Speed bumps vary in length, its heights typically ranging between 3 and 4 inches (7.6 and 10.2 cm). Speed bumps are always designed leaving space between them and either edge of an enclosed road to allow for drainage [5-7]. Speed bumps are the best way to communicate to drivers to keep their speed to the barest minimum.

In Nigeria (like in many other countries), the law prohibits the construction of speed bumps on highways and it is only with government approval that bumps should be erected even in residential areas [8-10]. According to [2], drivers should be warned of the presence of speed breakers by posting suitable advance warning signs (to prevent sudden application of brakes due to late awareness of speed bump ahead). Speed breakers should also be painted with alternate black and white bands or yellow and black colours to give additional visual warning. For better night visibility, it is desirable that the markings are in luminous paint/luminous strips. Embedded cat-eyes can also be used to enhance night visibility.

Though Speed bumps have gained acceptance by North American and international jurisdictions since their development in the early 1970s by the Transport and Road Research Laboratory (TRRL) in Great Britain, their design and application varies widely between jurisdictions. The result of surveys carried out has revealed that speed bumps often meet resistance from residents and road users [11]. This is because they are usually installed instantaneously without considering the characteristics of vehicles plying the highways, neither the nature of the road environment nor safety of other road users [12,13]. In Nigeria, almost all the existing bumps were indiscriminately erected without specification, the spacing were inconsistence, their heights and widths varies from one to another and to sum it up the bumps have no recourse to specification [14]. The disadvantages of speed bumps are: they stress the drivers and can be annoying to impatient drivers as a result in the need for the change of gears especially for manually operated vehicles. They can cause misalignment and loss or damage to goods especially low-stable vehicles like trucks and trailers. They invariably increases fuel consumption as energy required in moving up the bumps is higher compared to when the road is leveled. They increase the response times of emergency vehicles. They sometimes cause traffic as a broken-down vehicle can lead to vehicular congestion [15,16]

Geographic Information System (GIS) is an automated information system for capturing, storing, analysing, displaying and managing data and associated attributes that are spatially

referenced to the earth. GIS is a tool that allows users to create interactive queries (user created searches), analyse the spatial information, edit data, maps, and present results of all these operations [17].

(a) Speed Table

(b) Speed Cushion

(c) Speed Hump

Fig. 1. Variation of speed bumps

Maps are universal medium for communication, easily understood and appreciated by most people regardless of language or culture. A map is a representation on a plane surface of the physical features, both natural and artificial, of some parts or whole of the earth's surface at a given scale, by the use of signs and symbols with the method of orientation indicated. It is a means of conveying geographic information [18].

Owing to the fact that there has been an increased use of speed humps that were placed without obtaining proper permits and did not meet the design specifications [19]. The aim of this study is to map out the speed bumps within Afikpo using GIS as a tool with a view to providing a guide (especially to visitors) on best alternative route to adopt. The scope is thus limited to mapping of speed bumps (speed limiting installations) and does not cover accessing or investigating the level of compliance with the law guiding their installation. The map produced will therefore be useful to the populace especially visitors informing them of spots to expect speed bumps (and therefore to be more careful) and also routes to avoid in cases of emergencies (because of the too many speed bumps available that could slow down the traffic).

2. MATERIALS AND METHOD

2.1 Study Area

Afikpo (Ehugbo) is the second largest town in Ebonyi State Nigeria. The population is approximately half a million people and growing. It lies between Latittude 7º 55' 17.4"N – 7º 56' 35.4"N and Longitude 5º 53' 12"E – 5º 53' 59.4"E. It is bounded to the north by the town of Akpoha, to the south by Unwana and Edda in Ubeyi and Afikpo South Local Government Areas respectively, to the East by the Cross River and to the west by Amasiri (See Fig. 2). Afikpo spans an area approximately 164 square kilometers in size [20].

2.2 Data Acquisition and Processing

A topographic map covering the study area (Afikpo N.E, Sheet 313NE at scale 1:50,000) was obtained from the Office of the Surveyor General of the Federation (OSGOF) Abuja Nigeria to serve as the base map. This map was scanned using a scanner in order to allow the map to be imported into a Computer (with ArcGIS 9.3 software installed in it). The Topographic map (already Scanned) was imported into the ArcGIS environment from where different layers were created using the ArcCatalog, it was Georeferenced and thereafter digitised using the ArcMap.

Fig. 2. Map of the study area

A Handheld Global positioning System (GPS) receiver (Garmin 76), was used to acquire the position coordinates of the speed bumps and also the coordinates of some points of interest were also acquired for the purpose of updating the map. From the acquired coordinates, the map was updated and the coordinates of the speed bumps were also plotted using the ArcMap.

3. RESULTS AND ANALYSIS

From this study covering up an area of 2204.253 ha, forty-four (44) speed bumps were captured

with the highest concentration of speed bumps per distance noticed along Ukpa road. From the findings, none of the guidelines for the installation/construction of speed bumps (mentioned in section 1 of this study) seems to have been met by any of the existing speed bumps within Afikpo. Their shapes, sizes, height are just too inconsistent (see Fig. 3) and these speed bumps are usually installed or built by zealous individuals who feels that the speed for a particular area is needed to be reduced. Figure 4 shows the map of these speed bumps. From the map produced, it is obvious that there is a high concentration of speed bumps on Ukpa road, the speed bumps have some that are very close at 10m spacing from each other. This has a negative effect on the time of travel and the overall comfort of the motorist. Hence, such route should be avoided (if possible) at any time of emergency where time of travel is needed to be minimum or periods where a steady travel devoid of gallop is needed, this map is a sure guide for quick decision making.

Fig. 3. An example of a speed bump in Afikpo

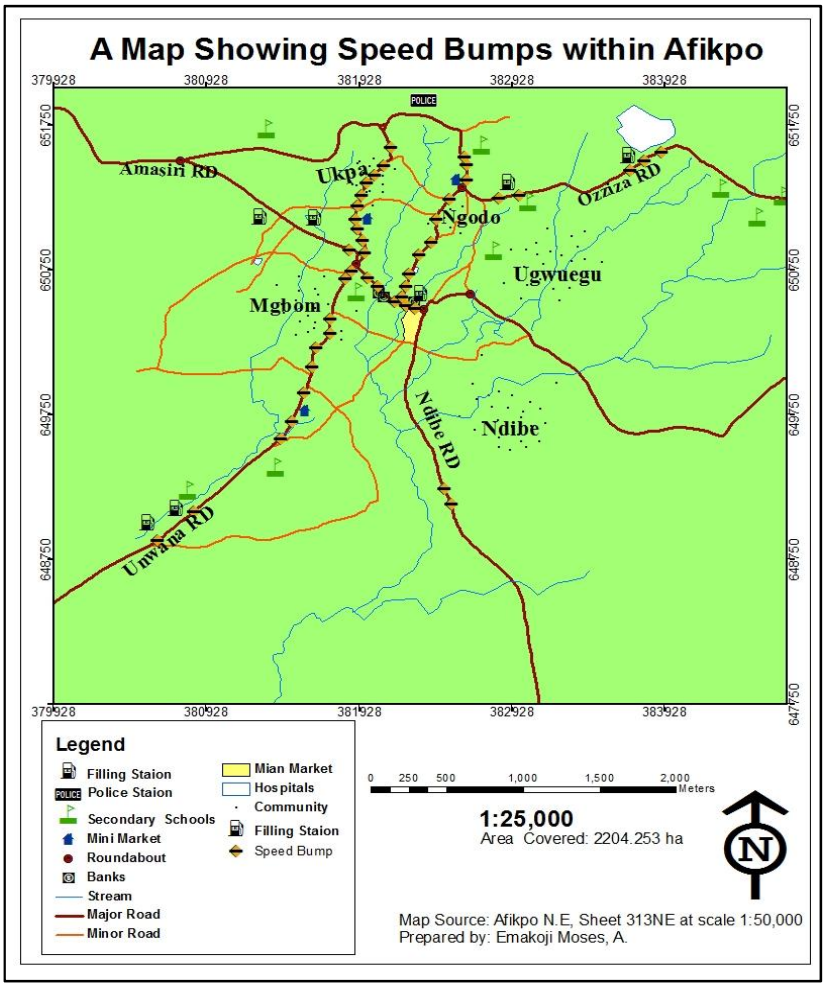

Fig. 4. A Map showing speed bumps within Afikpo

4. CONCLUSION AND RECOMMENDATIONS

Geographic information System (GIS) has been fully utilized in spatially representing geographical features. The map produced shows the spatial distributions of speed bumps within Afikpo which from a glance can be a useful tool especially in time of emergency in deciding the best shortest route from any spot having in mind the slowing effect of speed bumps. The following are the recommendation;

i. Notwithstanding the efforts of relevant authorities like the Federal Road Safety Commission (FRSC) to educate the motorist, there is the need for regular and increased education on the variety of traffic calming measures, their roles, standards, and rational for their installation and in addition the need to shun illegal installation or use of sub-standard or alternate materials such as woods by communities.

ii. Further Studies should be carried out to assess the level of compliance with laws guiding the installation of speed bumps and to be able to identify installations that fall short of standard. This will help to draw the attention of the authorities towards the removal of such illegal or substandard installations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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