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Reviewing the Effectiveness of Speed Arrestors on West African Road Infrastructure: An Asset or Liability?

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Abstract:- The number of fatalities from traffic accidents is steadily rising at an alarming rate. However, this has been linked to bad road conditions, drunk driving, excessive speeding, disobeying traffic laws, and irresponsible or reckless behaviour on the part of road users. To avoid this ugly experience, several measures have been implemented over time, including traffic calming measures. Speed arrestor is essential for enforcing speed limits, deterring vehicle overspending and preventing incidents that could result in injuries, deaths, and vehicle damage to improve overall road safety. This study analyses the relevant articles to explore the construction of speed bumps on west African road infrastructure. The study's findings indicated that speed arrestors exhibit both positive and negative characteristics. To maximize the potential, recommendations were made.

Keywords:- *Speed Arrestor, Road Construction, Infrastructural Sustainability, Construction Quality.*

I. INTRODUCTION

Speed arrestors, otherwise called speed humps, speed bumps or traffic calming measures (TCM) is a physical mechanism designed to forcefully reduce vehicular speed on roads, as well as enhance the safety of non-motorists or pedestrians (Hallmark, et al., 2007). This is a popular measure to calm motorists travelling at high speeds in western countries such as Europe, the USA and developing countries as could be found in Cameroon, Egypt, Ghana, South Africa, and Nigeria (Derry, Lumor, Bawa, & Tikoli, 2020). Speed arrestors are typically expected to be placed in densely populated areas, residential streets and where the presence of pedestrians or minors is felt, with the motive of reducing pedestrian and infant mortality from the road crossing. Statistics (Institute Building and Road Research, 2018) show that in 2017, forty per cent of road accident death victims in Ghana were pedestrians. In Nigeria, between the fourth quarters of 2020 and 2021, over 11,800 casualties from road accidents were recorded of which 1.7 were fatalities while 10.2 were injured (Sasu, 2022). In west African countries, roads account for approximately 90% of all commodities and passengers' transportation, making them the key investment target for the industries (Bofinger, 2011). A road is intended to offer trustworthy routes for transporting people and products from one location to another without becoming a deadly trap for users. Major contemporary roads that link cities in developed and developing nations typically have elements aimed at varying degrees of improving the road's capacity, efficiency, and safety. These attributes include fewer user access points, dual carriageways with multiple lanes on each carriageway, and grade-separated intersections with other roadways (Hughes et al., 2016).

In developing countries, vehicle traffic was sparsely dispersed throughout the available road network in the early stages of west Africa's road network development (Buys et al., 2006). Traffic congestion in urban areas and a spike in traffic accidents on road networks, which were never built for the volumes and kinds of traffic that they are required to carry, are both results of growing urbanization and the number of cars on the road (Hallmark, et al., 2007). Along with poor road maintenance, terrible and inadequate provision of road infrastructure, including a sense of competition between various types of road users has increased speeding and the rate of accident occurrences in emerging nations like Nigeria (Oyedepo and Makinde, 2010).

Road travel is the method of transportation that puts individuals at the greatest risk of injury per kilometre travelled and the issue with road safety goes beyond the transportation industry. Rapid motorization, inadequate road signs, and inefficient road construction, as well as road users' negligence and nonchalant attitude, are all contributing to an increase in morbidity and death in emerging nations (Nantulya and Reich, 2002).

(Mohammed et al., 2019) identified the issue of speed as a major risk factor in traffic injuries, affecting both the likelihood of a collision and the severity of the injuries that arise from such an effect. Further, he stated that for more vulnerable road users, such as pedestrians and cyclists, the link between speed and injury severity is crucial. Since there are so many pedestrians and bikers in metropolitan locations, this risk is especially high for these users.

However, as speed arrestors are labelled as a way of calming the excesses of motorists and averting road accidents, it also has an adverse effect on the health and safety of drivers, commuters, pedestrians, community, and residents as well as the environment in general where they are erected.

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II. METHODS

This study conducted systematic reviews following the recommended Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PRISMA provides a methodical and reproducible procedure for finding, selecting, and evaluating the most recent studies. (Vrabel, 1969). Additionally, it offers recommendations for deciding on, locating, and evaluating the studies. (Page et al., 2021).

A. Search Strategy and Selection

To locate the articles that are most relevant to this stud, search terms that are relevant to the research topic of this study can be combined using Boolean operators like "OR" and "Speed Arrestor" AND "Speed Bump" AND "Road infrastructure" OR "West Africa" where the search terms utilized. Multiple well-known databases were searched for the terms. The phrases are modified to generate the appropriate input searches for each digital library search.

B. Perspectives on speed arrestor construction

Speed arrestor is the common name for a class of traffic calming devices that use vertical deflection to alter the speed of motor-vehicle traffic to improve safety conditions (Betus, 2022). Based on the reviewed articles, speed arrestor construction on road infrastructure can be broadly professed to be an asset or could be seen as a liability, depending on the effect experienced by road users. This can be further explained in the following subsection.

III. ADVANTAGES OF SPEED ARRESTORS

A. Crash reduction

This applies recognized health and safety concepts to decrease road crash fatalities and make roads feel safe for any users. (Chukwugozi and Science, 2014) conducted a study in Nigeria and found that speed arrestors helped to decrease and prevent crashes by reducing the overspeeding of passing vehicles. In a similar vein, (Igbinosun and Izevbizua, 2020) suggested that congestion control techniques including speed warning signs, zebra crossings, and speed arrestors minimize road traffic crashes. Furthermore, speed arrestors have proven to have a significant tendency for crash reduction, according to a study on observational studies of road traffic engineering solutions in Nigeria presented by (Omidiji, 2010). Another study conducted (Akinyemi, 2019) highlighted the importance of interventions including lowering and enforcing speed restrictions with the use of speed cameras, speed arrestors, and rumble strips. (Hagan et al., 2021) presented a report on commercial motorcycle riders' compliance with road safety standards in a Ghanaian peri-urban community. According to the study, speed arrestors occasionally prevent road traffic accidents and fatalities in residents' communities. Similarly, (Mock et al., 1999) proposed in their study on the Epidemiology of transport-related injuries in Ghana that speed arrestors may be used for collision reduction in problematic places.

B. Minimize accidents

Due to the complicated road network flow patterns and the existence of traffic conditions with pedestrians, the problem of accidents is acute in road transportation. Property and lives are lost in traffic accidents. Although traffic engineering and management such as speed arrestors can help minimize accidents. (Solagberu et al., 2015) conducted a study on pedestrian injuries in Nigeria's most densely populated metropolis and discovered that speed arrestor addresses traffic complexity in favour of pedestrians rather than automobiles. Similarly, (Paddison and Tiafack, 2022) did a study on the environment of accidents in Cameroon and discovered that installing a speed arrestor is useful in lowering the frequency and severity of vehicle crashes. Similarly, In Senegal (Tchanche) because of the high speed and numerous accidents, officials believe it is necessary to add a speed arrestor.

C. Congestion control

Most individuals on the road seek faster travel, subconsciously comparing routes to choose the shortest one. Speed humps strategically positioned can guide traffic from one roadway to another. They force automobiles to slow down and are often installed in congested pedestrian zones. Drivers will shun these routes in favour of speedier ones. Some interventions, such as roundabouts and speed bumps, have been used to alleviate congestion on the roads in Nigeria (Igbinosun and Izevbizua, 2020). As a result, (Eriksson et al., 2009) noted in their study on traffic safety in Ghana that reduced congestion allows motor vehicles to raise their speed, and thus speed limiting measures should be applied. Speed restrictions can be enforced and managed by adding physical traffic calming devices such as speed arrestors (Anebonam et al., 2019). Similarly, (Kolo et al., 2016) demonstrated the existence of a speed arrestor in Nigeria, which causes traffic to move at a slower pace.

D. Safety of pedestrians

In their study "Identification of risk factors involved in road accidents in Ghana," (Mohammed et al., 2015) discovered that speed arrestor help reduces crashes in which a pedestrian was hit. In a research study on solving pediatric trauma difficulties in sub-Saharan Africa, (Ademuyiwa et al., 2012) concluded that road traffic accidents cause the greatest number of fatalities and severe injuries among African children. The majority are caused by pedestrian injuries, with risk factors including street vending, crossing roads, and sending kids on errands. The deployment of speed breakers such as speed arrestors and the enforcement of traffic laws are two straightforward, affordable approaches that are successful.

In Ghana, a study was done to determine the impact of traffic calming measures on vehicle speeds and the severity of pedestrian injuries (Damsere-Derry et al., 2019). Based on their findings, it was concluded that installing traffic calming measures reduces the frequency and severity of pedestrian injuries.

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IV. DISADVANTAGES OF SPEED ARRESTORS

A. Damage to the vehicle:

Speed bumps can potentially cause harm to vehicles. Especially, when a speed arrestor is encountered without realizing it, where no road signs or warnings, certainly, the vehicle may get damaged. It is most usually associated with vehicle wheels and suspension damage due to abnormal heights of the speed bump. The impact of the speed arrestor may cause the suspension to collapse and as a result, automobiles may sustain permanent damage (Ikechukwu et al., 2016). So speed bumps cause the most significant pain to car occupants when travelling at a greater speed and can cause the greatest damage to vehicle suspensions (Damsere-Derry et al., 2020). Similarly, According to research done in Nigeria (Agbolade, 2020), the spread of indiscriminate, improperly constructed speed arrestors has made the situation in developing nations like Nigeria even worse. The majority of speed arrestors are installed without accompanying road safety signage to alert and caution drivers. This can be highly risky at night or when visibility is poor, especially for drivers who are not familiar with the road. Further, the study argued that speed arrestors on highways increase accidents rather than prevent them.

B. Increase travel time:

Along with other vehicles, those transporting essential and emergency services like ambulances, fire trucks, police cars, water trucks, and food supplies are also slowed down by speed arrestors (Kosakowska, 2022). For vehicles to arrive at their destinations on time, speed is essential. (Gyaase et al., 2022) studied the impact of speed arrestors on injury effects on trunk roads passing through towns in Ghana and discovered that an increase in speed arrestor use may lengthen travel times. Furthermore, (Abdulrahman and Research, 2014) conducted research in Nigeria and found that speed arrestors tend to cause approaching vehicles to drive more slowly through the bump section, so drastically slowing down vehicles' speed. It has been anticipated that this abrupt slowdown will result in increase in travel time.

C. Pavement Deterioration:

The placement of speed bumps or other forms of speed reduction measures on road pavements causes a negative effect on the road surface thereby reducing the efficiency of the pavement. Especially when this is poorly constructed without required authorization, no approved construction design, spacing, or inappropriate materials are used or where heavy trucks are plying (Bekheet, 2014). Vehicular movements and vibrations on the humps may also affect the stability of the pavement and eventually reduce service life (Talaat & Hashimb, 2017) (Goenaga, Underwood, & Fuentes, 2020)

D. Health and Safety of Commuters:

The vibration impact of the vehicle on the speed arrestor usually leaves a negative effect on the passengers occupying the car. In a study conducted on spinal column injury caused by speed bumps, it was evident that exposure to bumps on roads could cause injuries, neck pain, spinal aches, and frustration or general discomfort (Aslan, Katirci, Kandiş, Ezirmik, & Bilir, 2005) (Munjin, et al., 2011)

E. Increased Cost:

Motorists believe the erection of speed bumps on roads causes more financial burden on them than when roads are free of physical obstructions. (Akanmu, Alabi, & Agboola, 2014) conducted a study where the efficiency of speed bump applications was measured, respondents lamented about increased fuel consumption as they travel at low speeds, some mentioned damage to wheels, dislocation of suspension and other parts, burning of vehicle clutch plates or discs and wheel balancing were all issues that eventually cost motorists some money to replace or fix.

F. Environmental Pollution:

Travelling at lower gear and travel speed, especially heavy-duty trucks have been reported to cause pollution in the form of noise, intense vibrations, and the release of more exhaust fumes into the air (Akanmu, Alabi, & Agboola, 2014).

G. Cause of crashes and accidents

Speed arrestors on major roads have been blamed for the cause of some vehicular crashes and road accidents. Especially those constructed with concrete by the residents and community leaders. They are usually done without necessary planning, design, materials, implementation, and approvals. Due to their ignorance and lack of technical experience, placement of caution and awareness signs are omitted, causing drivers not familiar with the route or ones not aware of the new development on the road to keep travelling only to hit a physical barrier unexpectedly (Adedeji, 2016).

V. DISCUSSION AND CONCLUSION

Traffic management is a very important measure to ensure the safety of road users and pedestrians is maintained. One of the easiest ways to achieve this is forcefully reducing the speed at which motorists travel on road surfaces, especially on busy and densely populated routes. Speed arrestor is one of these prodigious plans to deliberately enforce slow or safer travel speed on the roads. Speed is one of the contributory elements of any type of road or traffic collision, and it could determine the severity of injury or loss. Speed arrestor is an excellent traffic management strategy for slowing down automobiles in locations where there are a lot of people. This not only reduces vehicle speed but also raises driver awareness. Correct use of traffic calming measures helps in crash reduction, minimising accidents, congestion control and the safety of pedestrians.

Nevertheless, the enormous advantages of speed-arresting devices cannot be overemphasized, however, their adverse effect also has a great impact on people. Many road users have expressed displeasure in the presence of speed bumps along their routes due to the discomfort they feel. Damage to vehicles, increase travel time, pavement deterioration, health and safety

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of commuters, increased cost, environmental pollution, and cause of crashes and accidents are some of the negative impacts speed bumps have on commuters where they are constructed.

RECOMMENDATIONS

From the highlighted points above, it is obvious that speed bumps exhibit both positive and negative characteristics on road users. The perception of which would be different from one person to another. To maximize the potential of speed bumps and improve the experience of road users, a balance needs to be drawn based on the advantages and disadvantages mentioned above. Hence,

- Laws and regulations should be put in place guiding the construction of speed bumps and where these rules are already existing, compliance must be enforced.
- No unauthorized construction of speed bumps should be encouraged or allowed on road pavements. Especially those erected by residents and communities with poor materials and technicalities.
- All speed bumps must be adequately planned, designed, approved, constructed, and supervised relative to used materials, height, width, shape, spacing and other dimensions.
- New pavements on local or residential streets should have speed humps planned and designed from the conception stage. Hence, the use of the same material and process would eradicate failure which could occur as a result of distortion to existing infrastructure.
- Sensitization and public awareness on the importance of regulated and approved construction of traffic calming devices should be embarked on by the government, engineering regulating organizations and other stakeholders including communities and religious leaders.
- Unnecessary construction of speed bumps especially on federal roads and supposed highways should be discouraged. That a federal highway passes across a town shouldn't be a basis for speed bump erection.
- Road marks and signage should be given priority. Erased, fallen, missing and blurred road signs/marks should be replaced.
- Speed limits should be used on roads, placed at regular intervals throughout the distance of the road
- The use of technological means in the tracking of speed and recording traffic offenders should be introduced. Where offenders are made to face severe penalties for recklessness.
- Rubber materials should be considered, or subgrade made and compacted as a hump before blinding and paving with tar.

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