Road Humps as Traffic Calming Device on Urban Roads

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Abstract
This paper discusses the role of road humps as traffic calming device on some major roads in Minna metropolis. Traffic studies and analysis were carried out on the roads. It was found that the humps function very well as traffic calming device on the roads on which they are placed. However, it was also noticed that the humps have a high tendency to deteriorate within a very short time. The traffic humps were further found to have drastically reduced the occurrence of accidents on the roads on which they are constructed. This is as a result of reduction in design speed to 26km/h, which allows for safer crossing for pedestrians and better manoeuvrings for two wheelers like motorcycles. Traffic humps was also used to force drivers moving through city centres to move at reduced speed.

Keywords
Road Humps; Traffic Calming Device; Speed, Traffic control Device

1.0 Introduction and Concept
The need to maximize the capacity of existing highway networks within finite budget, with a minimum of a new construction has led to the introduction of traffic control measures in many cities. Traditional traffic management uses physical measures and legislations to coerce, and mould driver behaviour and consequently attain higher capacity out of the highway network, with improved level of safety (Slinn *et al.*, 2005)

A speed hump is a rounded traffic calming device used to address issue of excessive vehicle speed and volume on residential streets. They are mostly placed across the road in series to prevent vehicles from speeding and causing accidents, noise and others discomforts to residents. They are constructed in parabolic, circular and sinusoidal shapes. There heights general range between 7.5 cm and 10 cm. Typical speeds resulting from humps lie between 15 and 30km/h. Traffic calming devices has two main objectives: the reduction of accidents and improvement in local environment for people living, working or visiting the area. Traffic calming can alter the balance and impress upon the driver that the street in primarily for shopping and residential use and that vehicular traffic is of secondary importance (Kadyali and Lal, 2008). Humps generally have pavement markings to enhance visibility and tapper edge near the curb to allow a gap for drainage. They are not expected to be placed on major rural road, busy road or primary emergency road. Placement is generally mid–block between interceptions. It is appropriate to use humps on both urban single and dual carriage way, provided that they have speed limit of 48km/h and not open to truck traffic (Department of Transport, 1996). The high way (road hump) regulation 1990 permit considerable flexibility in sitting and shape of humps. Both flat and round top humps are permitted and each may be tapered at the sides to allow a drainage or channel between the humps and kerb. Consequently, road hump must be preceded by a speed reducing feature like another hump, a junction, road markings, etc. (Department of Transport, 1990). However, humps should not be constructed on a bridge or subway or inside a tunnel, as there could be risk of structural damage due to vehicle impact loads (Gupta and Gupta, 2008). In many developing cities, there are no separate bus or truck roads. Humps are placed indiscriminately, probably for only one reason, reduction of the occurrence of accidents. This paper is aimed at determining the suitability of traffic road humps on some urban roads as well as their effects on the road traffic performance.

2.0 Materials and Methods

2.1 Project Area

Two very busy roads in study area (Minna metropolis namely, Keteren-Gwari and Mypa roads) which have speed humps were chosen for the study. A third study area (airport road) was chosen since it is quite busy yet has no hump on it. The Keteren –Gwari road is a single carriageway of 2.2km length and a width of 7.3m. It links neighbouring towns and villages like Gidan-Kwano, Bida, Mokwa with the state capital, Minna. The road is also connected to 123 roads and ultimately links with Airport road in state capital. The road has a total number of twenty humps of 450mm width and 120mm height placed in series at irregular intervals, covering the first 1000m of the road from the south end.

Mypa road is located within Bosso area, a thickly populated residential area of the town. The road is 1km long and has a width of 6.00m with four humps located within the first 200m of the road. The humps have a width of 1500mm and 105mm height. The old Airport road is about 1.3km long with 6.5m carriageway and lies northwest of the main Bosso road and joins it at right angles. The road also lies in a densely populated area.

2.2 Traffic Studies

Traffic flow and spot data were collected before and after some of the selected humps. Traffic volume from adjoining roads was also collected to determine the adequacy of the humps to handle the traffic flowing into the project road. The studies carried out on Airport road were mostly done to determine the effects of the humps on traffic performance of main adjoining roads to those with humps. The studies were carried out for seven weekdays between 7am and 7pm. The average time for vehicle to traverse a hump was also measured and a simple model relating vehicle speed, hump length and width was obtained. The length of the road from the starting point of the project to the location of the hump is termed the distance travelled by the vehicle and from which the approach speed was measured. The distance between the humps was taken as the distance travelled after the hump.

2.3 Accident and Safety Studies

During traffic census periods accident studies were also carried out to ascertain the safety or otherwise of the humps. These involved watching the traffic for fatal, near fatal and minor accidents. The humps were constructed because of the occurrence of accidents but since their construction, accidents have been drastically reduced. This is the reason why no accidents were recorded during the period of study.

3. Results and Discussion

The data collected are presented in this section and discussions have been made based on the inferences drawn from the analysis of the data. The arrangements have been structured to accommodate discussions on all relevant data collected.

3.1 Traffic Volume Study

Data obtained for the study are presented in Tables 1 and 2.

Table1: Total Average Daily Traffic for the Roads

Daily traffic (No of vehicles)			
Weekday	K- Gwari	Mypa	Old Airport
Monday	7081	6043	6060
Tuesday	6726	6010	5956
Wednesday	6961	6080	6071
Thursday	6684	6011	5220
Friday	7558	6468	5823
Saturday	5411	6078	4269

Table 2: Daily Truck Traffic on Keteren-Gwari and Old Airport Road

Weekdays	Truck traffic	
	K-Gwari	Old Airport
Monday	35	105
Tuesday	29	109
Wednesday	33	119
Thursday	31	109
Friday	30	113
Saturday	24	89

Table 1 presents total daily vehicle count for the roads while Table 2 shows the volume of trucks on the two roads with more commercial activities. The total volume of vehicles in Keteren-Gwari is higher than that at Airport road by 8.1% while the truck volume on Airport road is 71% more than that on Keteren-Gwari road indicating a diversion of traffic from Keteren-Gwari road to old airport road going to the main market at the central area commonly called Mobil. The general complaints from most of the truck and lorry drivers wishing to discharge their cargo at the central market was that although the Keteren-Gwari road is shorter to the market, they prefer using the longer old airport road because it is devoid of humps.

3.2 Spot Speed Studies

Fiftieth percentile spot speed values are presented in Table 3.

Table 3.Average Spot Speeds on the Roads

Roads	Spot speed (km/h)		
	Before humps	Between humps	After humps
K- Gwari	23	14.76	28.44
Old Airport	40	N/A	N/A
Mypa	23.3	17.2	25.5

The speeds presented above are medians for the drivers population studied. This can be taken to mean 50% of the drivers are comfortable with the operations of traffic on the road while the remaining 50% are not happy. The average operating speed in the streets without humps is 40km/h. From Table 3, it can be seen that the humps have drastically reduced the speed to values less than 50% at location between the humps. The humps forced drivers to slow down and the main reason the driver give for slowing down is to avoid destruction of the spring system of their vehicles. They do not feel the humps are there to calm traffic. The 85th and 98th percentile speeds are 23.04km/h and 28.44 km/h respectively for the Keteren – Gwari road. The 85th percentile speed is the speed limit while the 98th percentile speed is the design speed in highway design. This implies that the new speed limit for Ketere-Gwari road is 23.04 km/h which is less than the maximum stipulated speed of 55km/h. It implied that the humps have tampered with the geometrical features like vertical alignment, sight distance and slope of the road which was taken into consideration in the geometrical designs of roads.

With an average travel speed of 17.46km/h and classifying the Keteren –Gwari road as a class III arterial, the road generally operates at a level of service D according to provision of the highway capacity manual TRB (2000). Level of service D borders on a range in which small increases in flow cause substantial increase in approach delay, hence decreases in arterial speed. The average travel speeds are about 40% of free flow speed.

3.3 Relationship Between Speed and Hump Dimensions

Assuming that speed is inversely proportional to the height of hump but directly proportional to the hump width, then

$$\mathbf{V = k\,\frac{w}{h}} \qquad (1)$$

Where V is the speed of vehicle, w is the width of the hump, h is the height of hump and k is a constant of proportionality with units km/h. Setting K=1, it can also be seen that the vehicle speed is inversely proportional to the gradient of the bump. Practically, wider humps with smaller heights, i.e. flatter humps allow for higher vehicular speeds. A simple arithmetic calculation was carried out to proof this point. The values obtained are presented in Table 4.

Table 4: Relationship Between Vehicle Speeds and Humps Dimensions

Humps Dimensions (M)			
Width (x)	Height (y)	Gradient (x/y)	Vehicle speed (km/h)
1.5	0.105	0.07	14.29
0.9	0.105	0.117	8.57
0.5	0.105	0.21	4.76
1.5	0.12	0.08	12.0
1.5	0.15	0.1	10
1.5	0.2	0.21	7.5

The values presented in Table 4 shows that, keeping the height of the hump constant but decreasing the width leads to a reduction in speeds. It can be seen from the values obtained for the gradients that the vehicle speed is inversely proportional to the gradient of the hump. This is in agreement with findings by Kisisa *et al* (1998).

3.4 Hump and Road Safety

Observation showed that no accident was recorded during the study period. This shows a strong improvement of traffic safety for pedestrians and motorcycles. The reduction in speeds led to this. There were safer crossings. The humps in Keteren-Gwari road are many with shorter distances in between them. This greatly reduces the occurrence of accidents. These findings are in agreement with Mburu (2002).

4.0 Conclusion

1. It was found that the humps function very well as traffic calming devices by reducing the speed from 55 km/h to 23.04 km/h on the roads on which they are placed. However, it was also noticed that the humps have a high tendency to deteriorate within a very short time.
2. The traffic humps were further found to have drastically reduced the occurrence of accidents on the roads on which they are constructed. This is as a result of reduction in speeds which allow for safer crossings for pedestrians and

better maneuverings for two wheelers like motorcycles. The vehicle speed reduction achieved depends on the slope.

3. Areas around the humps were also found to have more potholes than others. This is as a result of the reduction in speeds which makes the heavier vehicles behave more like point loads than continuous moving loads when they approach the humps.
4. From the reduced speeds obtained, drivers can be forced by the humps to drive through the city at speeds below 50km/hr. The humps promptly check driver excesses as they become aware of apparent damage to their vehicles if the humps are ignored.

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