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Short Communication

Traffic Noise Enhancement due to Speed Bumps

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Abstract

A study was carried out to assess the effect of speed bumps on road traffic noise levels. Noise levels of different categories of vehicles were measured before and after speed bumps. Vehicles were categorized as passenger cars, passenger vans, three wheelers, motorcycles, and lorries. Depending on the vehicle category, the maximum noise level varied between 71 and 80 dB (A) under uninterrupted traffic conditions. The maximum noise level increased by over 5 dB (A) due to speed bumps for lorries and three wheelers. The results indicated that there is a considerable effect on the noise levels at a short distance from the speed bump perhaps due to the action taken by drivers to increase the speed of the vehicles. The equivalent noise level at 20 m from the speed bump was found to be on average 1.2 dB (A) higher than at the speed bump. The L_{Aeq} values at 80 m after the speed bumps were found to be similar to the average noise level at the speed bump. Since speed bumps are often placed near schools and other public places, the noise impact should be taken into consideration when planning speed bumps.

Keywords: Road noise; Environment; Motor ways; Vehicular traffic

1. INTRODUCTION

Environmental noise is a worldwide problem. The methods used to control environmental noise vary widely from country to country depending on the culture, the economy and politics. Noise problems exist even in areas where resources have been used extensively to regulate, assess and monitor potential noise sources[1].

The effects of community noise on human beings range from feeling of annoyance to hearing damage[2]. The main sources of community noise are transportation systems, industries, construction and public works, and the neighborhood. While noise originates from many different sources, transport noise is perhaps the most consistent

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and the difficult to avoid. The road, air and rail systems are considered as the main sources of transport noise. Countries are expected to develop their own standards based on the amount of noise exposure they are prepared to accept. The National Environmental Act No. 47 of 1980[3] has set the maximum permissible noise levels at the boundary of the land in which any source of noise is located. Unfortunately, these regulations do not cover the control of noise emitted by mobile sources, transportation corridors or within public transport systems.

Road traffic is the most widespread source of noise and the most prevalent cause of annoyance and interference especially in metropolitan areas. Therefore, traffic noise reduction and mitigation measures must be adopted. A number of measures have been taken to reduce traffic noise at the source. As a result, today's vehicles are less noisy than their predecessors. However, the increase in traffic volume has nullified this effort and annoyance levels have increased.

To decrease the risk of accidents, a reduction of the vehicle speed is an important practical action that is increasingly introduced in cities. To decrease the speed of vehicles in residential areas, speed bumps are often used. These require the vehicle to slow down before a bump and increase the speed after the bump, adding an accelerating engine to the noise sources.

Relatively well-established models for predicting free flowing traffic noise are available[4-5]. The problem of dealing with stop-and-go traffic noise at speed bumps or signal intersections has not been well established possibly due to the complexity of the parameters affecting noise at speed bumps and intersections, and the interaction between these parameters[6].

The main objective of this study is to evaluate the effect of speed bumps on road traffic noise levels in urban settings.

2. EXPERIMENTAL

A street with a maximum allowed speed limit of around 50 km/h was selected for this work. Two speed bumps separated by a distance of about 300 m are present in the selected section of the road to reduce the speed of the vehicles. Two types of measurements were taken for several categories of vehicles (cars, vans, lorries, three wheelers and motorcycles). The first set of measurements was taken before (steady state condition) and after the speed bump to assess the noise enhancement due to speed bumps. Equivalent noise levels were measured in L_{Aeq} [1] in units of dB on an A weighted scale for 10 seconds. The second set of measurements was taken at six different locations 20 m apart, in the region where vehicles tend to accelerate after passing the speed bump. In this region, equivalent noise levels were measured in L_{Aeq} in units of dB on an A weighted scale for 1 minute. All measurements were collected during normal working hours of the week (between 8.00am and 4.00pm). The sound level meter was placed on a stand, 1.0 m from the outer driving lane edge and 1.5 m above the road surface. The background noise at the selected site is 63 dB (A).

The sound level meter used in this work was a RION NL-04. The bandwidth of the instrument is in the range between 20 to 8000 Hz and it is capable of measuring noise levels in the range of 20 to 140 dB with A weighting with an accuracy of ±0.1. The sound level meter was calibrated using an electrical calibration method and an acoustical calibration method prior to the use.

3. RESULTS AND DISCUSSION

A summary of the measurements taken before and after the speed bump is given in Table 1. The results show that depending on the vehicle type, the maximum noise levels vary between 71 and 81 dB (A) during uninterrupted traffic flow. The maximum noise levels increased by 1-5 dB (A) after the speed bump with an increase of 5 dB (A) for lorries and three wheelers. The average noise levels which vary between 68 and 77 dB (A) increased by more than 2 dB (A) after the speed bump for lorries, three wheelers and motor bikes. Passenger cars show the lowest increase in average noise levels followed by passenger vans. Considering the traffic composition, the results indicate that three wheelers contribute heavily to increasing the overall noise levels.

Table 1: Average and maximum noise levels of vehicles before and after speed bumps. Buses are not allowed to operate on the selected street.

Type of vehicle		At steady state	After speed bump
Passenger car			
	Measurements	28	41
	Average dB (A)	68.5±1.5	69.4±1.7
	Max dB (A)	71.2±0.1	71.9±0.1
Passenger van			
	Measurements	30	45
	Average dB (A)	72.5±2.1	74.3±2.1
	Max dB (A)	76.1±0.1	77.2±0.1
Three wheeler			
	Measurements	30	31
	Average dB (A)	73.9±1.7	76.7±3.0
	Max dB (A)	77.4±0.1	82.1±0.1
Motor bike			
	Measurements	35	31
	Average dB (A)	71.1±2.0	73.1±2.1
	Max dB (A)	75.8±0.1	76.3±0.1
Lorry			
	Measurements	22	23
	Average dB (A)	77.3±1.9	81.6±2.6
	Max dB (A)	80.6±0.1	85.3±0.1

A study carried out in Sweden for speed bumps reported very similar results for maximum noise levels with the highest increase caused by passenger cars[7]. However, they did not find an increase in average noise levels due to speed bumps perhaps due to not having light vehicles such as three wheelers or motor bikes in their categories. This study shows that there is a clear increase in average noise levels due to speed bumps especially for light and heavy vehicles.

There is ambiguity as to which principle should be used to describe road traffic noise exposure, (whether to use the maximum noise level or the average noise level as the relevant dose descriptor) from an annoyance point of view. A study on road traffic noise reported that the maximum noise level in a mixed road traffic noise situation is the most important determinant of the extent of annoyance[8]. According to our results both the average and the maximum noise levels increased after the speed bump in comparison to noise levels obtained under uninterrupted traffic flow. However, since highest increases in maximum noise levels are seen for lorries and three wheelers, they can be considered as the vehicles that generate the highest annoyance.

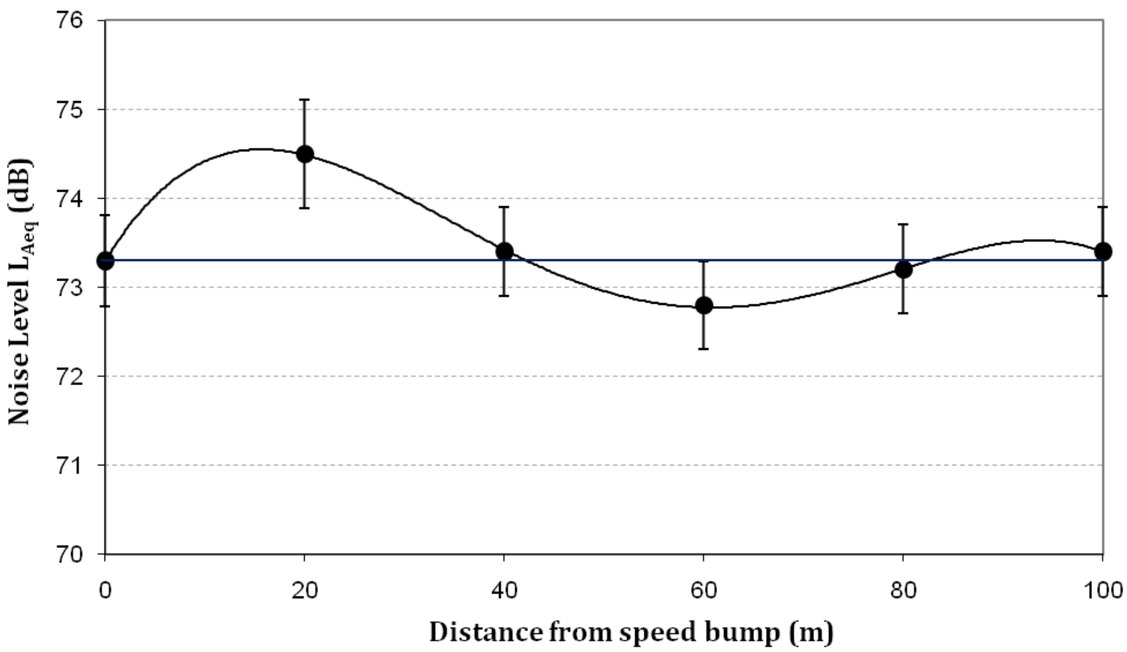

Figure. 1: Average equivalent noise levels (1 minute intervals) at increasing distances from the speed bump. Line is drawn to guide the eye.

Figure 1 shows the relationship between the average equivalent noise levels and the distance from the speed bump in the direction the vehicles are travelling; i.e., towards the region of acceleration after passing the speed bump. The error bars in the figure indicate the errors of the average noise levels (i.e., $\sigma/\sqrt{n}$ where σ is the standard deviation and n is the number of measurements). In each location, roughly 30 measurements were taken (A weighted scale for 1 minute interval) where vehicles are allowed to move freely. The standard deviation of the measurements varied between 2-3 dB (A).

The average noise levels indicate that L_{Aeq} increases as the distance from the speed bump increases up to 20 m, after which it starts to decrease up to 60 m. Then, it again increases slightly to up to the noise level at the speed bump and remains constant as the distance increases. The equivalent noise level at 20 m from the speed bump was found to be on average 1.2 dB (A) higher than at the speed bump. This can be explained by the fact that after slowing down at a speed bump, drivers tend to accelerate their vehicles to reach the desired speeds. The radiated noise is a function of engine speed (revolutions per minute) and vehicle speed (meters per second). After a speed bump both these increase. This leads to a higher noise emission by vehicles. The lowering of average noise levels at 60 m distance from the speed bump could be due to the shifting of gears.

A speed bump has a considerable effect on the value of L_{Aeq} just after the bump, while it has no significant effect on the mode of variation as the distance from the speed bump increases. Although the data show the general variation in the equivalent noise level with distance from the speed bump, the total variation of L_{Aeq} values at each distance is dependent on a number of other factors such as traffic volume, composition, speed, style of driving etc, which were not considered in this work.

4. CONCLUSIONS

In this study it was found that for all the vehicle categories, both the average and the maximum noise levels increased shortly after the speed bump. The highest increase of 5 dB (A) was seen for lorries and three wheelers, for maximum noise levels. Therefore, maximum noise levels can be used as the relevant dose descriptor to monitor the effect of noise in the vicinity of speed bumps to describe road traffic noise exposure. It was observed that at a short distance (20 m) from the speed bump, average noise levels increased by 1.2 dB (A) and when the distance increased up to approximately 80 m it was almost equal to the average noise level at the speed bump. Thus, 100 m could be taken as a safe distance at which the average noise level has no effect due to the speed bump.

The average, maximum and minimum noise level measurements obtained for this study at 20 m distance from the speed bump were 74.3, 84.0 and 67.2 dB (A) respectively. These noise levels exceed the standard limits recommended for noise levels in school areas (50 dB(A) day time at the boundaries) and can cause serious problems to school children unless the class rooms are located at a considerable distance from the traffic routes to minimize exposure.

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