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Atteunation of Noise Using Barrier in the Form of Enclosures

KEYWORDS: noise – crowded location, pollution, measurement, barrier, attenuation, mitigation

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ABSTRACT *The installation of sound barriers is feasible enough to cause a significant decrease in noise pollution on roads. This study analyzes how the noise barriers affect the sound intensity level on roads. Noise level generated by a traffic flowing across open stream is compared to that of roads provided with sound barrier. Based on the field measurements an in-depth discussion is carried out to analyze the effectiveness of installing the barriers. The main objective of this paper is to predict the sound attenuation after the installation of the sound barrier on the road side. The priority of this project is to determine whether the installation of sound barriers is feasible enough to cause a distinct decrease in noise level on the roads.*

Introduction

Discussions relating to mitigation of traffic noise, in particular the installation of noise barriers on new roads, have often sparked off keen interest. In addition, the problem of excessive traffic noise from existing roads, at which no mitigation measures were provided when the roads were built, has also been raised from time to time. During the past decades complaints were raised on noise pollution and the discussions are generally related to the lack of proactive measures to address the noise impact arising from the construction of new roads or widening of existing roads[1,2]. These discussions have often led to questions on the Government's policies on the provision of noise barriers and assessment of noise levels. Due to rapid urbanization and consequent improvement in transportation facilities in metropolis such as Chennai, Delhi, Mumbai and other major cities, there has been a large increase in the number of vehicles on the road for the past decades an example of which is presented in Fig. 1.

Figure 1 Traffic flow at the study area

As a result, control of traffic noise has become an issue of major concern for the communities residing in the area and attempting to maintain a satisfactory environment to work and live in. Highway traffic can be reduced by means of vegetation absorption, roadside barriers or shielding by structures such as tunnels. In many cities (other than India), tunnels have been commonly used to solve noise pollution[2,3,4], but in India where road side traffic is of high volume is still a need to tackle the high traffic noise level generated at the roads.

The noise propagation is a three parts process: starting from the sound emission from vehicles, followed by the sound propagation on the road comprising direct and indirect (reverberant) sound, and finally reaching the receivers, mainly the residential flats, the pedestrians and the road users. Generally, larger and heavier vehicles emit more noise than lighter and smaller vehicles. The noise of vehicles is mainly generated from the engine, gear and from interaction of wheels with their running surfaces. The noise generated will propagate as acoustic rays in a "close field" due to twice two parallel walls (ground, ceiling and the lateral walls). This gives rises to multiple reflections for a single acoustic ray and creates noise pollution[4].

The objectives of the field measurement is to predict the sound attenuation on roads after the installation of sound barrier and to determine whether the installation of sound barrier is feasible enough to cause distinct decrease in noise level at roads. The paper presents description of field measurements of sound level at selected locations in Chennai where traffic level is high with and without any barrier. It also presents the reduction in sound level due to construction of barrier.

Study Area

The OMR (Old Mahabalipuram Road) and presently rechristened as Rajiv Gandhi Salai by the State Government was selected for study purpose and lies within Chennai Corporation under Sholinganallur constituency. The corridor is fully developed with IT companies, change in land use, clustered developmental works related to residential zones and 3 industrial estates. The sampling locations were toll plaza at Perungudi and an intersection namely SPR tools.

Variation of noise levels due to road traffic is both spatial and temporal. The time period selected in such a way that in both the locations traffic noise was recorded conveniently and the exposure method of measurement are shown in Table 1. The table also presents the details of the sound barrier erected for the purpose of measurement.

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Table 1 Details of traffic noise recorded

Sl. No.	Location	Duration	Size of the shed	Nature of exposure
1	Toll Plaza	3 hours	Length 1.50 m Width 1.20 m Height 2.0 m	Open place
		1 hour		Shed with one layer of thatched leaves
		1 hour		Shed with two layers of thatched leaves
2	SRP tools	3 hours		Open place
		1 hour		Shed with one layer of thatched leaves
		1 hour		Shed with two layers of thatched leaves

Equipment

An important part of noise assessment is the actual measurement of the noise levels. The 'A' weighted network was used as it corresponds very closely to a person's hearing sensitivity. The noise level at two locations were measured with the help of HTC make Sound Level Meter (3241 – c type II data logger) on a digital display type.

Construction and installation of noise barrier

Noise barriers are designed to cut off direct sound from various sources, aiming to diminish noise levels through energy losses that are created upon the occurrence of sound diffraction. While the effect of noise barriers varies with such factors as barrier size and the distance between the noise barrier and sound receiving points, a reduction of noise is usually achieved at the edge of the road. There are various types of noise barriers such as vertical and cantilever noise barriers, and semi-enclosures. Materials used for noise barriers usually involve concrete, wood, light-transmitting glass, sound-absorbing metal, fibre reinforced plastic, cost effective measures and ceramics[5].

Selection of Sound Barrier

To address the problem of noise effects on roads, a porous natural material called thatched leaves is used as a sound barrier and implemented on the road side. The sound barrier is installed as a rectangular shed of Size 1.5 m ´ 1.2 m ´ 2.0 m on the side of the road. The road selected is the then OMR (Old Mahabalipuram Road) and presently rechristened as Rajiv Gandhi Salai by the State Government. Figure 2 shows a schematic view of a noise barrier as a shed constructed with layer of thatched leaves near the roads at the selected locations.

Continuous L_{eq} measurement during day time was carried out in residential areas and at an intersection on OMR during March 2013. The results show that the noise pollution at the places of measurements is wide spread throughout most of its time. The noise in this area is composite in nature.

Fig. 2 Noise barrier as a shed at both locations

After the introduction of the shed there is a considerable reduction in the level of noise inside the shed. Other mitigation measures like Public participation, education, traffic management, and structural design play a major role in noise reduction. An attempt has been made to find the noise levels reduction at OMR section; two sensitive places were selected along OMR. It was observed that the noise levels were above the standards prescribed by the CPCB (Central Pollution Control Board)[6] standards (Table 2) on the outside of the shed whereas in the inside of the shed the reduction is considerable by about 20%.

Table 2 Permissible noise levels

Sl. No	ZONE	NOISE LEVEL IN dBA*	
		DAY TIME	NIGHT TIME
1	INDUSTRIAL	75	70
2	COMMERCIAL	65	55
3	RESIDENTIAL	55	45
4	SILENCE	50	40

A sound source may be enclosed within a panelled structure such as room as a means of reducing the noise levels at the receiver. The actual difference between the sound pressure levels inside and outside an enclosure depends not only on the transmission loss of the enclosure panels but also on the acoustic absorption within the enclosure. The enclosure details selected for noise reduction is presented in Table 1.

Noise reduction

The techniques employed for noise control[7] can be broadly classified as

- Control at source
- Control in the transmission path
- Using protective equipment.

Out of all the three techniques noise control using transmission path is employed here to reduce noise against traffic

The noise control measures against road traffic are examined in the following heads

- Major legislation on road traffic noise and prescribed road traffic noise limits
- Assessment of road traffic noise - without noise barrier
- Procedure for installing noise barriers and installing noise barriers
- Noise assessment after installation of barrier and comparison of results

- **Results and discussions**

As present, there is no specific and detailed legislation to control the noise pollution. However, there is an urgent need that the Central and State Governments should manage to get a legislation passed for the control of noise pollution. Apart from such kind of Central legislation, there should be a city noise control code for all major cities in India. Creation of unnecessary noise has to be prohibited and should be punishable under law.

Assessment of road traffic noise - without noise barrier and with barrier

The assessments of road traffic noise are summarized as Select the measurement points where people are likely to be disturbed by road traffic noise. This step is intended to identify black spots and ensure an effective quantification of noise levels in areas where roads are in service. As a rule, measurements are taken from a height of 1.2 to 1.5 m above ground level.

Parameters[7,8] Calculated From Survey

The following noise parameters L_{10}, L_{50}, L_{90}, L_{eq}, L_{np}, L_{min}, L_{max}, L_{ave}, NI and Nc were calculated.

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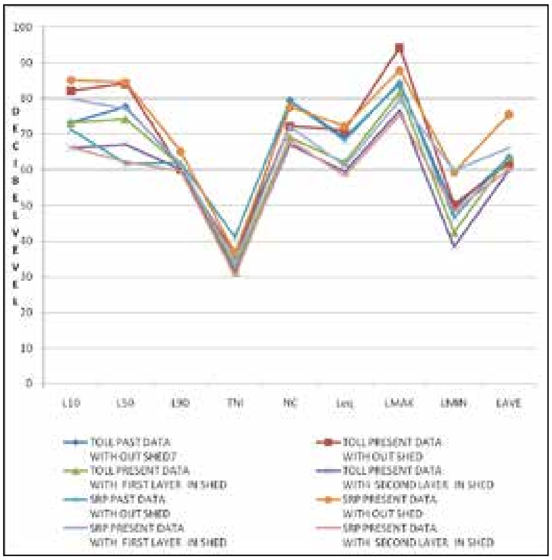
L_{10}, L_{50}, L_{90} = noise level exceeded for 10%, 50%, 90% of the time in noise recording
$L_{eq} = L_{50} + (L_{10} - L_{90})^2/60$
$L_{np} = L_{eq} + (L_{10} - L_{90})$
$NI = L_{90} + (L_{10} - L_{90}) – 30$
$NC = (L_{10} - L_{90})$
L_{min}, L_{max}, L_{ave} from data logger from sound level meter.

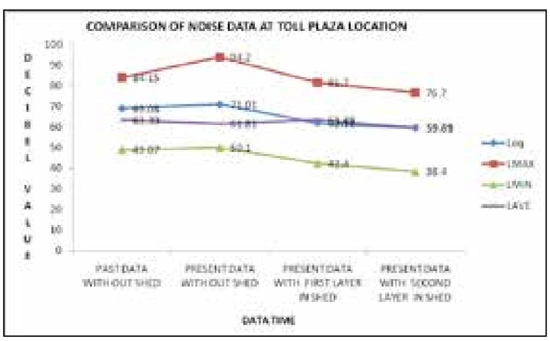
All the parameters presented in Fig. 3 for both the locations.



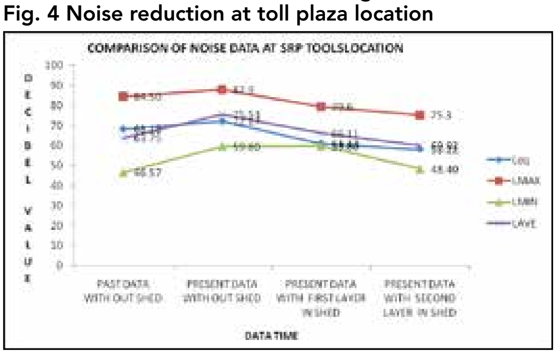
Past data with out shed taken during Oct. – Nov. '12[7]
Fig. 3 Noise parameters for both the locations

Comparison of noise values with noise levels prescribed by CPCB

The data collected from the survey is further compared with noise levels prescribed by CPCB and are shown in Fig. 4 and Fig. 5 for both the locations.



Past data with out shed taken during Oct. – Nov. '12[7]
Fig. 4 Noise reduction at toll plaza location



Past data with out shed taken during Oct. – Nov. '12[7]
Fig. 5 Noise reduction at SRP tools location

Results and Discussion

Various factors need to be considered to produce an acoustically effective barriers i.e., a barrier that provides the required noise reduction without being "over-designed". The noise reduction goal is the first and an important element of the barrier design process which influence the acoustical considerations such as height, length, location and the material of the barrier. From the results it shows that the noise reduction is reducing by the introduction of barriers. The noise reduction and the percentage of noise reduction is shown in Table 3

Table 3 Details of Noise Reduction at both locations

PARAMETER	% INCREASE OF NOISE FROM PAST TAKEN DURING OCT. – NOV. '12[7] TO PRESENT		% OF REDUCTION OF NOISE FROM PRESENT TO FIRST LAYER		% OF REDUCTION OF NOISE FROM PRESENT TO SECOND LAYER	
	Toll plaza	SRP tools	Toll plaza	SRP tools	Toll plaza	SRP tools
L_{eq}	3	6	13	15	16	19
L_{MAX}	12	4	13	9	19	14
L_{MIN}	2	28	15	0	23	19
L_{AVE}	-2	18	3	12	3	21

Conclusions

- The noise L_{eq} is increased from the past data to present data
- The increase in noise level is 3 to 6 per cent from the past data to present data
- The effect of sound barrier is very useful in attenuating the noise
- The percentage reduction of noise level ranges from 13 to 19
- The provision of thatched leaves shows that the noise level can be reduced considerably.
- The selected area is a suitable location because of highly congested place
- The provision of noise barrier as an enclosure found to be a suitable alternative solution for noise control measure.
- The noise enclosure is not reflecting noise rays since the emission is direct from the location place.
- Thus this study focuses with the noise reduction by way of providing a noise enclosure which is an apt technique to reduce noise.
- This is suitable for all the places, low cost technique and does not require skilled manpower for installation, flexible in altering the design, and can be installed in critical places where other measures are ineffective.
- The thatched hut is a simple barrier for noise attenuation and easily erectable.

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