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MEASUREMENT AND ANALYSIS OF NOISE AT SIGNALISED INTERSECTIONS

Patil Vilas K.* and Nagarale P. Prashant

Department of Civil Engineering, Sardar Patel College of Engineering, Andheri , Mumbai, Maharashtra (INDIA)

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ABSTRACT

Most of the cities of developing countries are facing serious noise pollution problem, due to the concentration of motor vehicles and human population within the limited urban areas. The study presents the status of noise pollution at selected signalized intersections of Nashik city, Maharashtra, India. The study is conducted using sound level meter and simultaneously classified traffic volume data is collected manually. The study shows that, the noise levels at selected locations, exceeded permissible noise level prescribed by Central Pollution Control Board. The present study is useful for planning of road alignment, intersection, flyover, deciding signal timings, traffic management, land use planning and to control noise pollution.

Key Words : Noise pollution, Interrupted traffic flow, Classified traffic volume data, Noise parameters, Urban areas

INTRODUCTION

Noise emissions from various transportation modes have become a major concern to the environmental and government agencies because of great annoyance they cause to surrounding community. Among all of the sources responsible for noise pollution, such as traffic noise, industrial noise, construction activities and community noise, traffic related sources are of great concern to the environment. Traffic noise is affected by factors like traffic volume, vehicle mix, pavement type and vehicle condition.

The stop and go or interrupted traffic flow in urban areas generates traffic noise, which is significantly different from that of uninterrupted or free-flow traffic conditions normally occurring on highways and expressways outside the urban limit. Traffic related noise pollution is about two third of the total noise pollution in urban area. Traffic noise of interrupted flow lowers the quality of life and property value for community residing in vicinity of such locations.[1] Prolonged exposure to certain noise levels can have adverse impact on human health, including decrease in concentration, increased stress, diminishing sleeping ability and decrease in hearing activity leading to partial or total deafness. More than 70% of total noise in our environment is due to vehicular noise.[2] The noise generated by traffic under interrupted flow condition may also be regarded as the aggregation of individual vehicle noise.[3] The environmental quality of Indian cities is gradually degrading by an incessant growth in the number of vehicles, resulting in the increase in traffic noise.[4] This study presents the status of noise pollution at selected signalized intersections in Nashik city, Maharashtra, India.

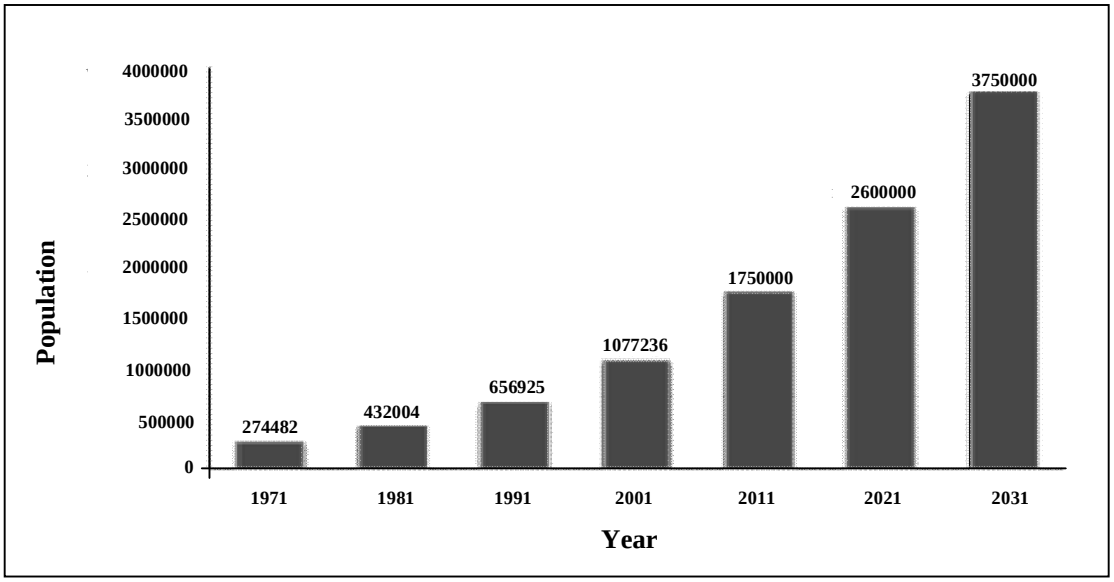
Nashik is one of the fast growing cities in Maharashtra. The city has more than 6 lakh vehicles which are shared by 15 lakh population. The trend of growth of population is as shown in **Fig. 1**.

Vehicular growth of Nashik City, Maharashtra India

Since last 6 to 8 years, industrial development has picked up, particularly after declaration of a five-star mega industrial estate on 2700 hectares of land in Sinnar block. There are 174 medium and large scale industrial units employing more than one lakh people.

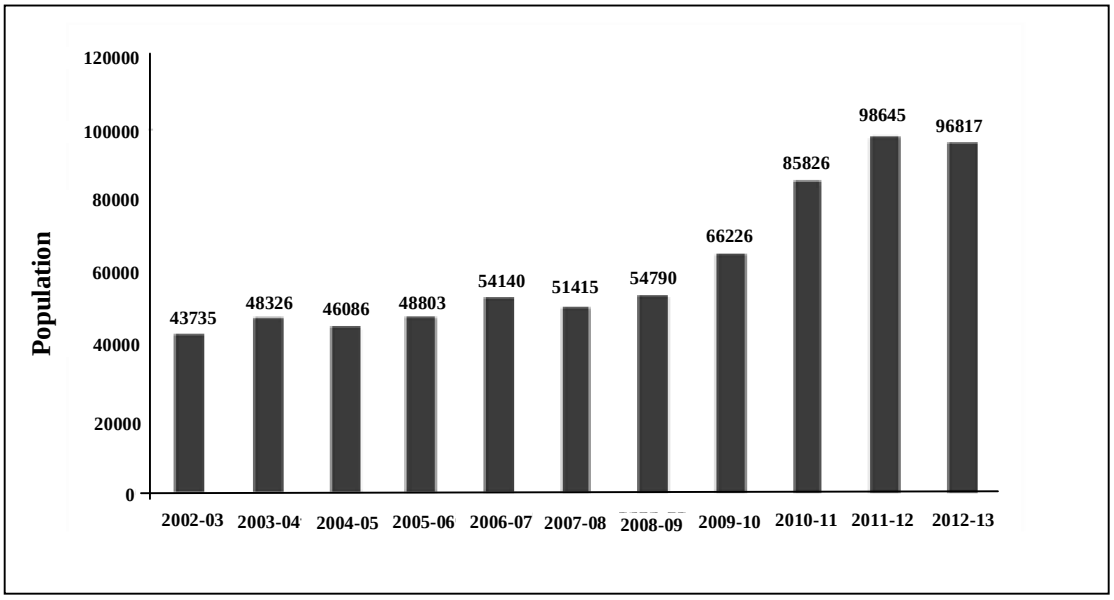
*Author for correspondence

Nashik is also housing many important industrial units including Hindustan Aeronautics Limited (HAL), manufacturing MIG aircrafts, currency note press of Government of India and the biggest artillery centre of Asia. Nashik is one of the most developing towns in Maharashtra in which day by day vehicular traffic is increasing at an alarming rate. The trend of growth of registered vehicles in Nashik is as shown in **Fig. 2**.



Source : Nashik Municipal Corporation, Nashik

Fig. 1 : Population of Nashik City, Maharashtra, India



Source : Regional Transport Office, Nashik

Fig. 2 : Vehicular growth of Nashik city, Maharashtra, India

Noise standards

Keeping in view the alarming increase in environmental noise pollution and related health issues, many countries are implementing stringent rules to control the noise pollution. The various standards are being laid down in different countries regarding the acceptable levels of noise depending on the situation. Limits of acceptable noise level established by different countries are given in **Table 1**.

Table 1 : Permissible noise level in residential areas in different countries

Country	L_{eq} Day (dBA)	L_{eq} Night (dBA)
Sweden	55	45
Germany	55	40
Austria	48-51	36-43
Switzerland	60	50

The ambient noise level standards prescribed by Central Pollution Control Board (CPCB)[5] of India are given in **Table 2**. The acceptable noise levels recommended for residential areas by The Bureau of Indian Standards (BIS) are as below **(Table 3)**.

Table 2 : Ambient noise level standards in India

Area	L_{eq} dBA	
	Day time*	Night time**
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence zone***	50	50

* Day time 06 am to 09 pm, **Night time 09 pm to 06 am, ***Areas up to 100 m around certain premises like Hospitals, Educational institutions and Courts may be declared as silence zone

Table 3 : Noise level standards for residential areas in India

S/N	Locations	Acceptable noise level in dBA
1.	Rural	25-35
2.	Suburban	30-40
3.	Residential	35-45
4.	Urban (residential and business)	40-45
5.	City	45-50
6.	Industrial areas	50-60

MATERIAL AND METHODS

Measurement of traffic volume

Taking into consideration the layout of city streets and trend of business trips the four signalized intersections were selected for present study. At each location classified traffic volume survey was conducted and volume of vehicles was recorded at one minute interval.

Measurement of noise levels

Measurements were taken with SLM 100, which continuously displays the Sound Pressure Level (SPL), Equivalent sound level (Leq), Maximum and Minimum sound pressure level and the Sound Exposure Level (SEL) integrated over the duration of operation. Noise levels were measured in range two and in fast mode to catch the peak values of sound levels due to blowing of horns.

At each of the three selected locations, traffic noise was measured for two hours daily covering morning, afternoon and evening peak hours: 8.00-10.00 am (morning peak), 2.30-4.30 (afternoon peak), 5.00-7.00 (evening peak).

These time periods were selected to match with peak hour traffic. Noise levels were measured at 1-minute interval, approximately at the distance of 15 m from the nearside edge of carriageway. The sound level meter was set at a height of 1.2 m above the ground level.

Noise parameters[6-10]

Noise Pollution level is used to express varying level of noise. It can be computed using the following equation :

$$L_{np} = L_{50} + \frac{(L_{10}-L_{90})^2}{60} + (L_{10} - L_{90}) \quad (1)$$

Where L_{10}, L_{50}, L_{90} indicates the level exceeded for 10%, 50% and 90% of time respectively in a set of records of noise levels in a given interval of time.

Traffic Noise Index (TNI) is another parameter which indicates the degree of variation in traffic flow. This is also expressed in dBA and can be computed by using following equation:

$$TNI \text{ in dB (A)} = L_{90} + 4\,(L_{10} - L_{90}) - 30 \quad (2)$$

Noise Climate (NC) : provides range over which the sound level fluctuates in an interval of time and is given by the following equation,

$$NC \text{ in dB (A)} = (L_{10} - L_{90}) \quad (3)$$

RESULTS AND DISCUSSION

Data collection

This study is mainly intended to measure the noise levels at different signalised intersections and locations were chosen as to represent different zones within a Nashik city like, residential, commercial and mixed. The details of identified locations are given in **Table 4**.

Table 4 : Details of identified locations

S/N	Locations	Land use	Footpath	Geometric condition	Traffic composition	Surface	Barrier	Gradient	No. of lanes
1	TTS	Residential	Present	Divided	Heterogeneous	Bituminous	Low	Ruling	6
2	NMC	Commercial	Present	Divided	Heterogeneous	Bituminous	Low	Ruling	4
3	LIC	Mixed	Absent	Divided	Heterogeneou	Bituminous	Low	Ruling	6

Noise levels were measured at the identified locations near ,Taran Talav Signal (TTS), Nashik Municipal Corporation (NMC), Life Insurance Corporation (LIC). The traffic volume was also determined by counting number of vehicles at these junctions and the same is expressed in terms of Passenger Car Unit (PCU) **Table 5** depicts the average traffic volume in PCU, noise levels and permissible noise levels at selected locations.

Table 5 : Traffic noise measurement at selected intersections

Location	Monitoring time	Average traffic volume (PCU)	Measures of noise levels (dBA)				Permissible Noise Levels (dB)
			L_{eq} (dB)	L_{max} (dB)	L_{min} (dB)	SEL (dB)	
TTS	Morning	7105	85.30	93.00	61.29	114.00	55
	Afternoon	10224	86.13	89.60	60.12	108.00	
	Evening	10426	89.28	97.00	60.11	115.60	
NMC	Morning	5662	89.20	94.30	59.03	109.60	65
	Afternoon	8806	90.95	92.00	65.00	107.00	
	Evening	12313	91.00	93.00	66.90	114.20	
LIC	Morning	5764	88.64	89.40	64.53	108.00	55
	Afternoon	8408	86.46	89.00	55.60	106.50	
	Evening	9614	88.72	91.00	60.70	113.20	

Fig. 3 is depicts the relationship between traffic volume and equivalent noise level Traffic noise level data was analyzed to evaluate noise descriptors in the form of L_{10}, L_{50}, L_{90},TNI, and NC. The typical values of the noise parameters described earlier for selected locations are shown in **Table 6**.

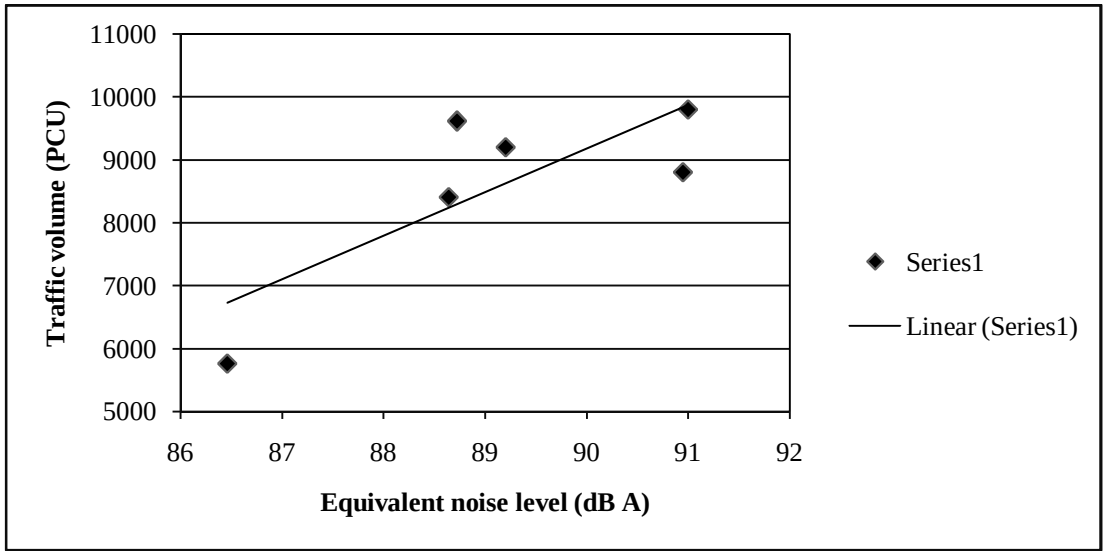


Fig. 3 : Relation between traffic volume and noise level

Table 6 : Brief description of various noise parameters at identified locations

S/N	Location	Monitoring Time	L_{10} dB	L_{50}dB	L_{90}dB	L_{eq} (dB)	Lnpd B	TNIdB (A)	NC dB(A)
1.	TTS	Morning	76.25	74.85	73.50	85.30	77.73	54.50	2.75
		Afternoon	77.04	75.90	74.37	86.13	78.69	55.07	2.67
		Evening	77.45	76.00	74.70	89.28	78.88	55.70	2.75
2.	NMC	Morning	76.90	75.60	73.70	89.20	78.97	56.50	3.20
		Afternoon	77.20	75.80	73.81	90.95	79.38	57.37	3.39
		Evening	77.20	75.60	74.20	91.00	78.75	56.20	3.00
3.	LIC	Morning	76.50	74.40	71.90	88.64	79.35	60.30	4.60
		Afternoon	78.09	76.00	74.31	86.46	80.02	59.43	3.78
		Evening	78.50	76.30	74.60	88.72	80.45	60.20	3.90

CONCLUSION

It is observed that the value of equivalent noise level varies between 85.30 dBA to 91.00 dB, the average noise pollution level was about 79.10 dBA. The noise descriptors used in this study such as, Noise pollution level (Lnp), Noise Climate (NC), and Traffic Noise Index (TNI) are exceeding the permissible noise levels limits specified by Central Pollution Control Board (CPCB).

Road traffic noise is a major concern for people living in roadside of urban street network. Most of the noise at signalized intersections is due to the deceleration of vehicles when they approaches at intersection and acceleration when leaving intersection after getting green light. Increase in noise levels is due to tendency of drivers to blow horn by the end of amber period and start of green period. During classified traffic volume survey it is found that, percentage of two wheelers and three wheelers is significant which is contributing more to noise pollution. Since traffic noise concerns with the health of the people there is a need to enforce the rules and regulation stringently.

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