International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-4, February 2020

Assessment of Fluctuations in Traffic Noise Levels with Simultaneous Traffic Density

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Abstract: ***Transportation is one of the important pillars of the nation's economic and overall growth. As transportation is very important, it has its negative impacts on the environment as well as human health. One of its negative impacts is traffic noise pollution. This paper focuses on the study of the relation between traffic density and an increase or decrease in noise levels. The study has been conducted in Surat city, India (tier 2). The noise levels were monitored in a total of 5 stretches and 12 locations of a busy commercial area of Surat city for the day time. Traffic count was done in the form of 2 wheelers, 3 wheelers, 4 wheelers, bus, and trucks. It was found that noise levels in the area are 77dBA, which is higher than the permissible standards set by the Central Pollution Control Board (CPCB) in the Government of India. Also, the study indicates that, if the number of vehicles is increasing, it is not necessary that the equivalent noise level should increase and vice versa, because noise levels are dependent on a lot of other factors like traffic flow, honking of horns, lane indiscipline, unauthorized parking, heterogeneity of vehicles in traffic. Heterogeneous nature of traffic in India and lane indiscipline by vehicle users, traffic often gets congested which results in honking of horns. Ttraffic noise levels are not always directly proportional to traffic count, they may fluctuate very randomly, due to reasons enumerated above.***

Keywords: ***Traffic noise, Leq, Heterogeneous traffic, Lane indiscipline, Unauthorized parking, Honking of horns.***

I. INTRODUCTION

India, as a developing country has many issues related to its road transport systems, especially in urban areas. Due to population explosion and rapid urbanization in tier 1 and tier 2 cites, high traffic volume has become a big issue in these cities. With an increase in traffic volume, the problem of air pollution and noise pollution has become severe these days. Traffic noise is one of India's major contributors to overall environmental noise[1]. The population and the consequent number of vehicles have grown tremendously in an unprecedented manner, which has shown that urban planning in major cities is inadequate[2]. This has engulfed our cities in problems related to traffic and noise pollution.

Revised Manuscript Received on February 28, 2020.
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Due to the above-mentioned health effects, traffic noise is also associated with reduced work performance in exposed people with workspaces near the road[3]. Now there is a new challenge for people who are particularly sensitive to traffic noise to examine health safety and well-being. Given all the variables that are unique to the high traffic environment and its effects on humans, it is important to systematically examine the effects of noise.

Traffic noise emission measurement is not simple and varies with vehicle types and physical conditions, speed, honking, and geometry on the road [4]. Especially for Indian cities study of traffic noise is tedious because of lack of road discipline, heterogeneous traffic, bad conditions of the road, narrow lanes, honking of horns and traffic congestion [5]. In developed countries, unlike Indian conditions traffic is homogeneous i.e. consists mostly of cars as well as citizens would nor honk horns frequently which results in direct correlation between a number of vehicles and traffic noise associated with it [6]. In this paper, an attempt has been made to study traffic flow characteristics and their correlation with noise levels in busy crowded markets of a tier-II Indian city.

II. METHODOLOGY

The study was conducted in Surat City (Gujarat), India's tenth largest city which currently has an estimated 4.6 million-plus population. Over the past decade, an incomprehensible population growth level of 76.02% was observed as a by-product of rapid industrialization [5]. Chowk Bazar area in the central Surat is chosen for this analysis. The area is one of Surat city's most popular and busy commercial areas as all kinds of shops exist in the surrounding area. The area is having very high traffic volume since it contains important collector roads. Fig. 1 shows five different stretches for noise monitoring and traffic survey picked. Two noise monitoring stations have been chosen on each stretch as shown in Table I

Table I: Details of different stretch selected for study and noise monitoring stations

Sr no.	Stretch	Monitoring station
1	A (Bhaga Talav main road)	A1 & A2
2	B (Bhagal to station road)	B1 & B2
3	C (Kaskiwad bhagal road)	C1 & C2
4	D (Kot safil road)	D1 & D2
5	E (Nanpura main road)	E1 & E2

Noise level monitoring in the area was done using KIMO DB300 class 2 sound level meter, which is highly precise and takes 8 readings of noise levels in one second.

Noise monitoring protocol by the Central Pollution Control Board (CPCB) was followed for monitoring[6].

Noise monitoring was done for only day time interval mentioned in noise monitoring protocol, which is 6 AM to 10 PM or 75 percent of the time between 6 AM to 10 pm as area selected for study was a busy commercial area having peak traffic density throughout the day and evening timing rather than in the late night. After 10 PM due to closure of shops traffic density drops 80 to 90 percent as compared to day time.Traffic characteristics in the form of traffic count were done manually on all 5 stretches. Number of vehicles in the form of 2 wheelers, 3 wheelers, 4 wheelers, bus, and truck were counted throughout the noise monitoring period.

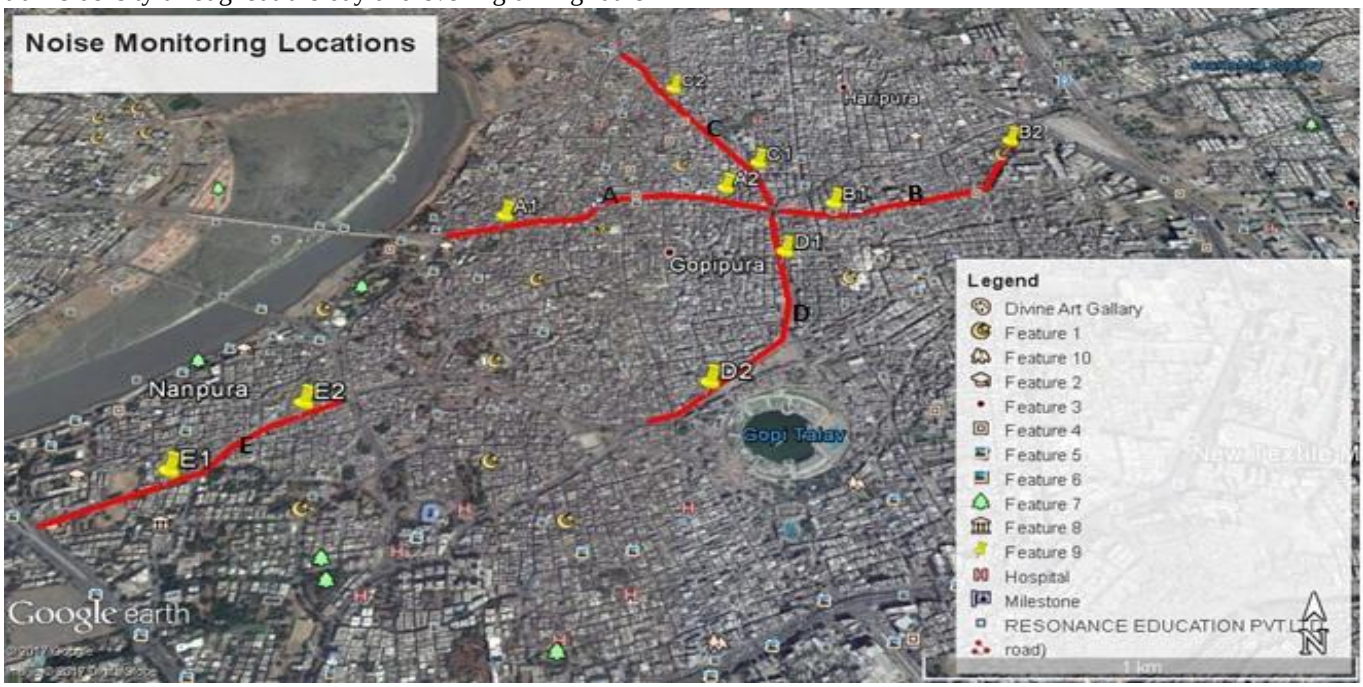

Fig 1. Map showing different stretch selected for study and noise monitoring stations

III. RESULTS AND DISCUSSIONS

A. Noise monitoring survey

With the use of the noise level meter, the noise levels were measured at different points within the study area. It was carried out in five separate stretches at ten sites. Table No. 1 shows the specifics of the noise monitoring stations. The noise levels in the study area were monitored between 9 AM to 9 PM, as covering 75 percentage time intervals of 6 AM to 10 PM mentioned in the noise monitoring protocol by CPCB. The noise level meter was set up upon a tripod stand, adjusting the height of the microphone in sound level meter to be between 1.2 to 1.5 meters above the ground as it is considered as the average height of the human ear. This tripod was kept on a footpath alongside of study road as it was an appropriate distance from the flow of traffic. Following table number II shows equivalent, minimum and maximum noise levels observed in the area for 12 hours of monitoring.

Table II: Noise levels observed in different locations

LOCATION	Leq (dBA)	Lmax (dBA)	Lmin (dBA)
A1	79.3	112.4	62.4
A2	78.6	107.4	62.3
B1	78	104	60.2
B2	78.1	104.4	60.8
C1	79.7	105.9	63.4
C2	78.5	104.8	60
D1	77.1	105.4	66.8
D2	79.2	103.9	64.4
E1	78.5	103.3	62.4
E2	78.8	105.1	60.3

Also figure 2 shows, in all noise monitoring locations the noise levels are higher than 78dBA. This implies that in the study area noise pollution is crossing its limit set by the ministry of environment and forest (MoEF) as well as the Central pollution control board which is 65 dBA for the commercial area for the day time.

Figure 3 indicates the hourly difference between 9 am and 9 pm on noise levels. It can be found that the noise levels are high in the morning from 10 am to 11 am and from 6 pm to 9 pm in the evening as it is peak hours of traffic. Thus, these hours can be named for the study area as peak noise hours.

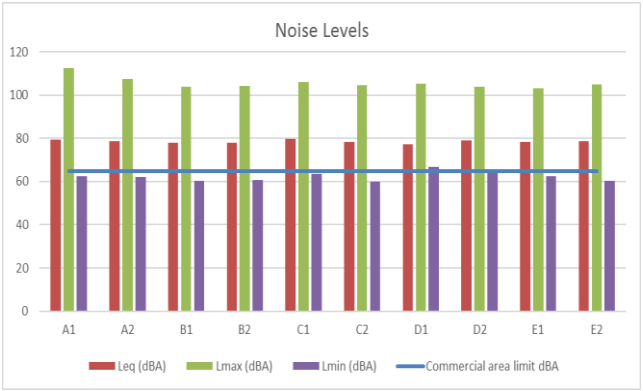

Fig 2. Equivalent, minimum and maximum noise levels in all locations

B. Traffic survey

A second important part of the study conducted was a traffic survey.

As mentioned in methodology traffic count was done manually, by counting a number of vehicles passing from monitoring location. Five different individuals were counting vehicles as 2 wheelers, 3 wheelers, 4 wheelers, buses, and trucks respectively for the entire monitoring period. Table III shows the total number of vehicles passed from different locations as well as its classification according to its type.

Following figure 4 shows that the traffic in the study area is not homogeneous in nature, it is heterogeneous in nature as a number of 2 wheelers and 3 wheelers are highly dominating the traffic flow.

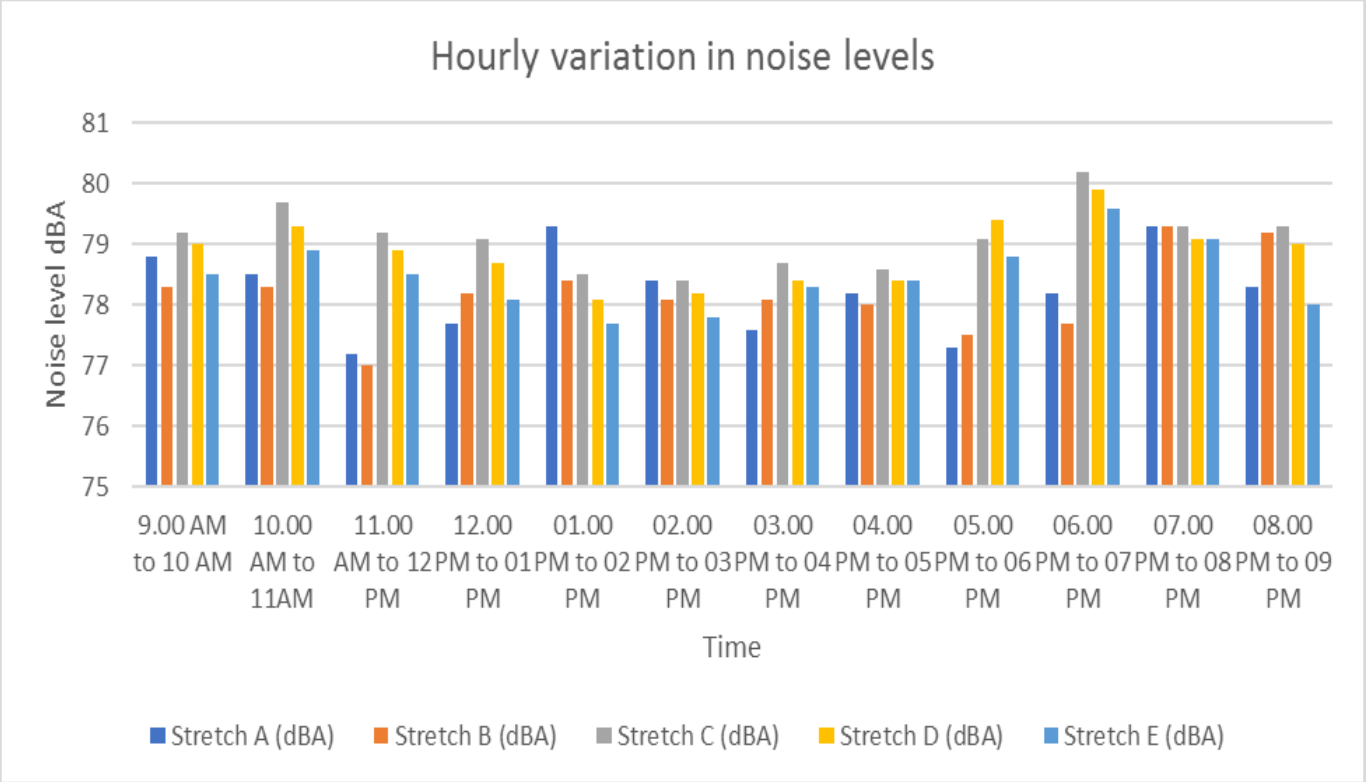

Fig 3: Hourly difference in noise levels for all stretches

Table III: classification of traffic count

Stretch	2W	3W	4W	Bus	Truck	Total
A	24084	6822	4036	165	3	35437
B	26963	8617	8382	112	65	44565
C	27584	11337	5800	183	43	45211
D	28080	10808	8329	143	49	47733
E	18815	4078	6614	155	0	29517

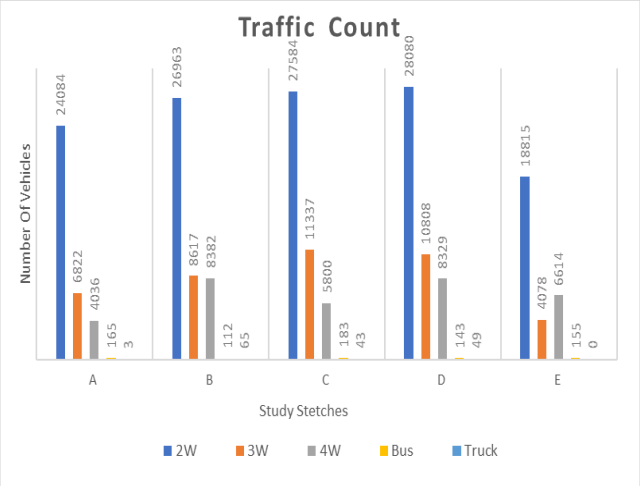

Fig. 4: Traffic count in all stretches

Figure 5 displays hourly traffic changes for all five stretches from 9 a.m. to 9 p.m. It can be found that the traffic count for stretch A and B is less than other stretches, this is because three-wheelers are prohibited on stretch A and B from 10 a.m. to 12 p.m. and from 5 p.m. to 7 p.m., and three-wheelers take high traffic count percentages.

While carrying out the analysis, it was observed that in any instance of time the auto-rickshaws are high in number as these roads are main collector roads that link important commercial areas. Because of the high number of auto-rickshaw traffic flow is congested leads to horn honking, which raises noise levels in the region.

The traffic composition in all study stretches is heterogeneous. Two-wheelers share 68 to 70% and three-wheelers share 18 to 20% of total traffic, due to this heterogeneous nature of traffic and lane indiscipline by vehicle users, traffic often gets congested which results in honking of horns.

This traffic congestion situation is very common in peak hours hence noise levels are high in peak hours. Also, a very important reason observed in the area for traffic congestion is unauthorized perking. People park their vehicles at the roadside which lowers the space available to free flow of ongoing vehicles which ultimately results in traffic congestion and horn honking.

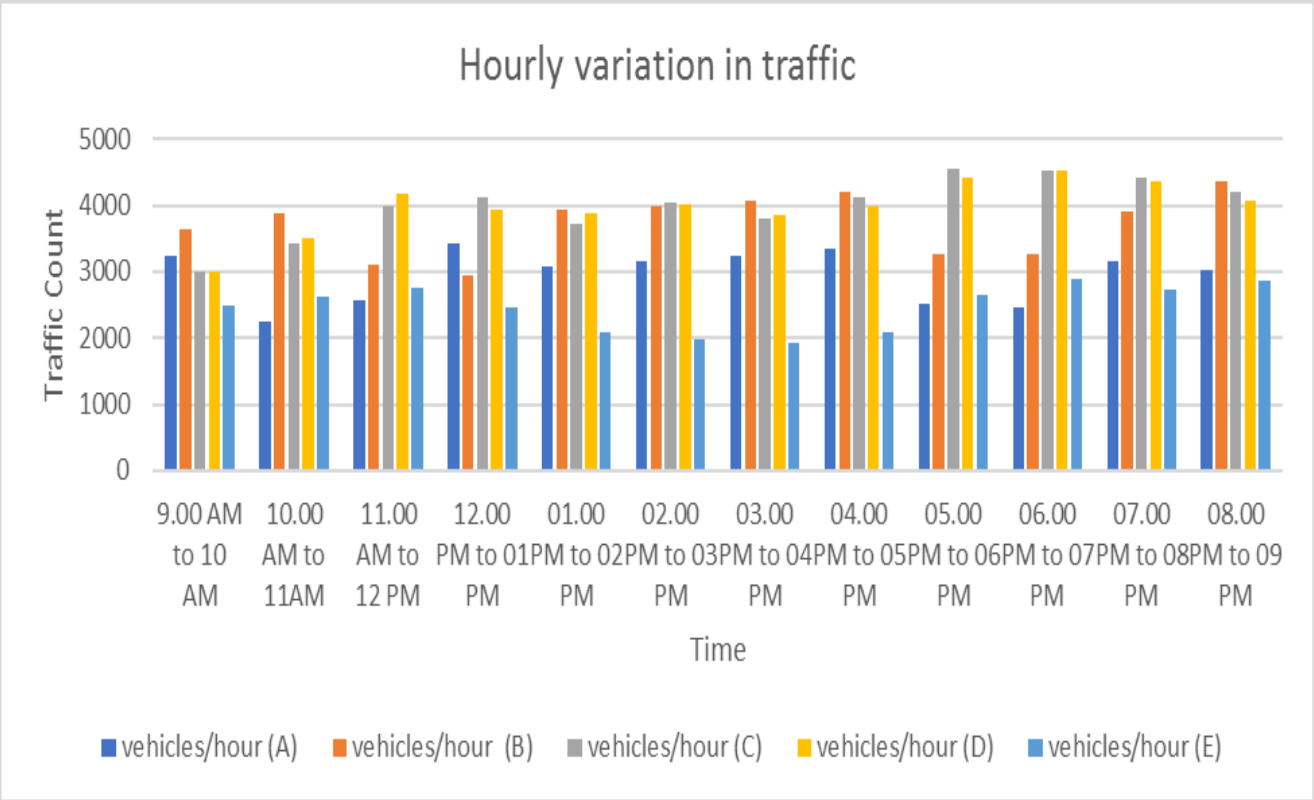

Fig. 5: Hourly variation in traffic flow

C. fluctuations in noise levels and simultaneous traffic density

figures 6 to 10 shows variations/ fluctuations in noise levels to its simultaneous traffic count on an hourly basis. The vehicle count is a normal integer scale, on the other hand, noise levels are in logarithmic scale. It means that if one or two decibels of noise is also increasing, it can be considered a significant change in noise level. The first observation from these figures implies it is not always necessary that, if the number of vehicles is increasing, simultaneous noise levels will also increase. As these figures are showing in a particular hour sometimes noise levels are simultaneously increasing with a respective traffic count of that particular hour, for example in figure 6 at 9 AM and 11 AM, in figure 7 at 11 AM, etc. On the other hand, most of the time, almost the same noise levels are appearing at different traffic counts of the respective hour, for example, in figure 7 at 9 AM and 10 AM, figure 8 at 9 AM and 11 AM, etc. Also, in some instances, noise levels are decreasing as traffic count is increasing, for example in figure 7 at 7 PM, in figure 9 at 1 PM, 2 PM and 3 PM, etc. several reasons are observed for such fluctuations in noise levels, the primary reason is honking of horns. For instance, at a non-peak hour, due to unauthorized parking, sometimes the free flow of traffic gets disrupted and traffic congestion happens where people will start honking horns which will lead to an increase in noise levels at a lower number of vehicles also.

The second reason can be enlisted as lane indiscipline observed in the selected study roads, for overtaking another vehicle, people may leave their respective lane of free flow and try to go by another lane at which already vehicles in motion are available, this also results in honking of horns that fluctuates noise levels.

Another important reason is the heterogeneity of traffic in India. Unlike in developed countries where traffic is homogenous i.e. mostly consists of four-wheelers, in Indian conditions the number of two-wheelers and three-wheelers is higher than four-wheelers and the same was observed in the study area. Hence because of the lack of driving discipline of two-wheelers and three-wheelers also contribute to increasing in noise levels at lower traffic count.

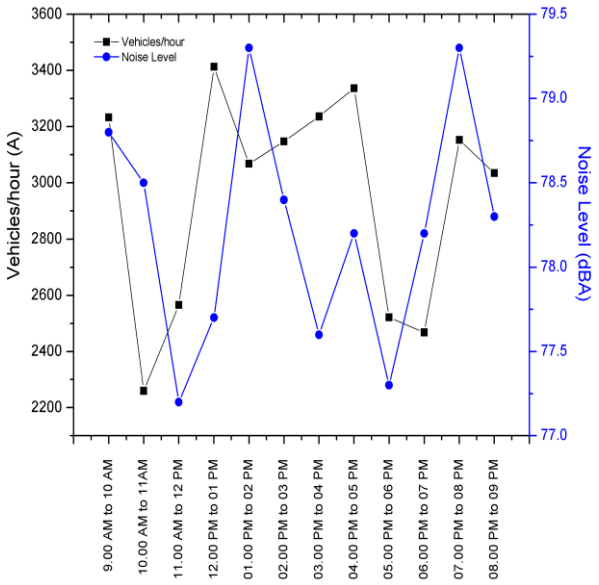

Fig. 6: hourly variation in noise levels with simultaneous traffic count for stretch A

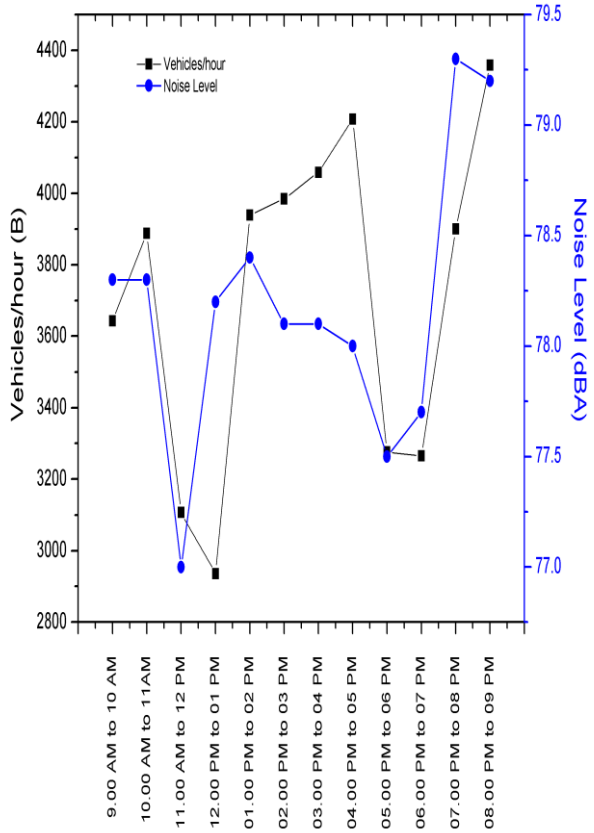

Fig. 7: hourly variation in noise levels with simultaneous traffic count for stretch B

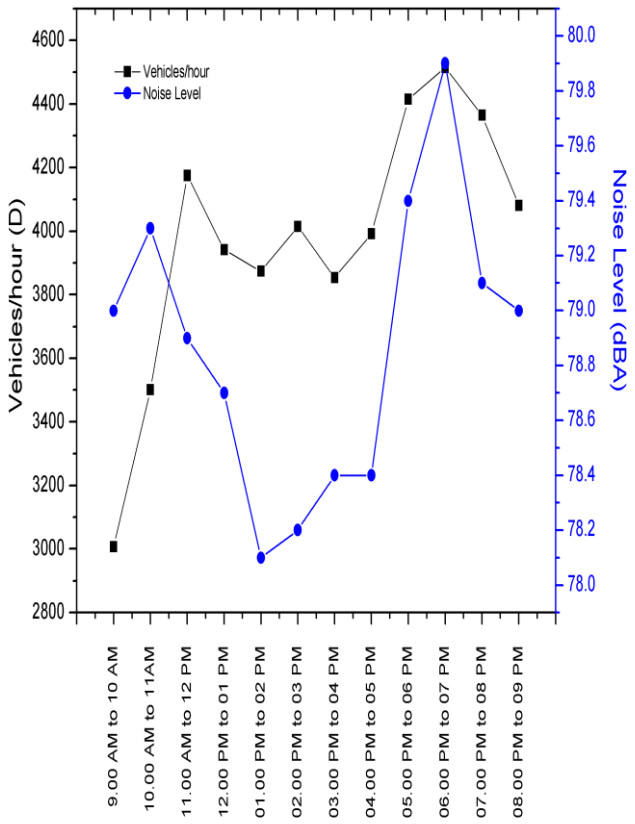

Fig. 9: hourly variation in noise levels with simultaneous traffic count for stretch D

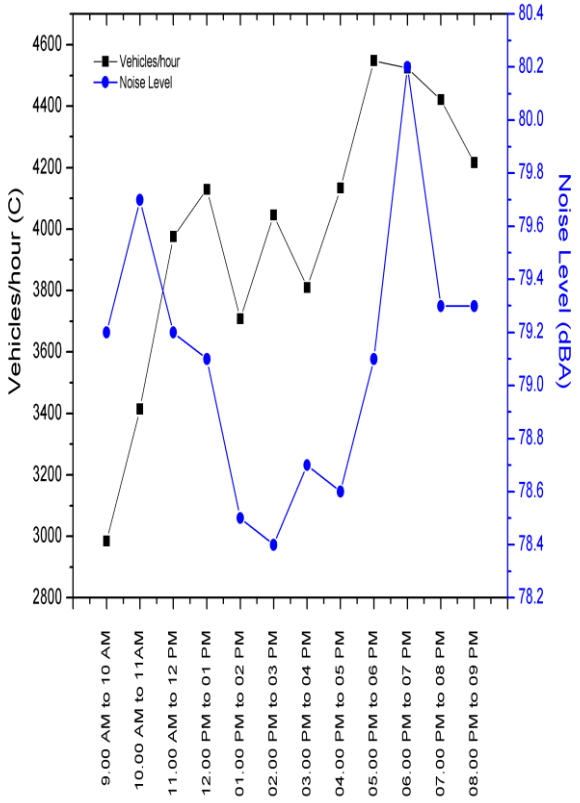

Fig. 8: hourly variation in noise levels with simultaneous traffic count for stretch C

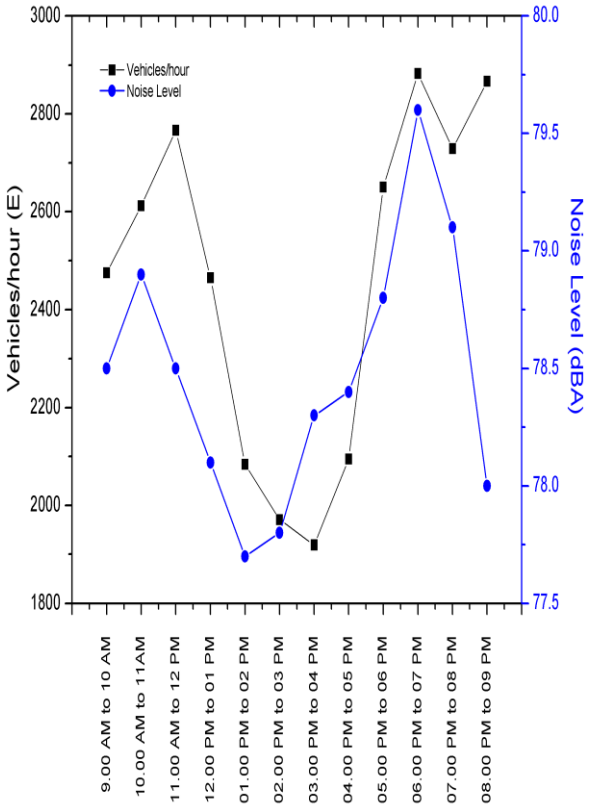

Fig. 10: hourly variation in noise levels with simultaneous traffic count for stretch E

IV. CONCLUSION

A lot of previous researches, especially in developed countries indicates that as traffic count increases, respective noise levels also will increase[7][8]. It is true for developed countries as the traffic is homogeneous as well as people follow lane discipline and won't honk horns until its necessary. But for Indian conditions, it is not necessarily true due to several reasons. Heterogeneous nature of traffic in India and lane indiscipline by vehicle users, traffic often gets congested which results in honking of horns. This traffic congestion situation is very common in peak hours hence noise levels are high in peak hours. Also, a very important reason observed in the area for traffic congestion is unauthorized perking. Due to these observed reasons in the study area, it can be concluded as traffic noise levels are not always directly proportional to traffic count, they may fluctuate very randomly, due to reasons enumerated above. For this season, an evolutionary computing tool-based noise prediction mathematical model may be developed for heterogeneous traffic conditions of developing countries like India.

REFERENCES

1. D. Banerjee, “Research on road traffic noise and human health in India: review of literature from 1991 to current.,” Noise Health, vol. 14, no. 58, pp. 113–118, 2012.
2. J. Quartieri, N. E. Mastorakis, C. Guarnaccia, A. Troisi, S. D’Ambrosio, and G. Iannone, “Road Intersections Noise Impact on Urban Environment Quality,” Recent Adv. Appl. Theor. Mech., pp. 162–171, 2009.
3. D. Pal and D. Bhattacharya, “Effect of Road Traffic Noise Pollution on Human Work Efficiency in Government Offices , Private Organizations , and Commercial Business Centres in Agartala City Using Fuzzy Expert System : A Case Study,” vol. 2012, 2012.
4. A. Sharma and R. Vijay, “Development of GIS Based Noise Simulation Model : a case study of Mumbai India Development of GIS-NSM,” no. May 2014, pp. 10–11, 2011.
5. B. N. Tandel and J. E. M. Macwan, “Road Traffic Noise Exposure and Hearing Impairment Among Traffic Policemen in Surat, Western India,” J. Inst. Eng. Ser. A, vol. 98, no. 1–2, pp. 101–105, 2017.
6. CPCB, Ambient Air Quality Standards in Respect of Noise, Schedule III. In Pollution Control Acts, Rules and Notification Issued Thereunder Central Pollution Control Board, New Delhi. 2002.
7. F. Nejadkoorki, E. Yousefi, and F. Naseri, “Analysing street traffic noise pollution in the city of Yazd,” Iran. J. Environ. Heal. Sci. Eng., vol. 7. 1, no. 1, pp. 53–62, 2010.
8. C. Liu et al., “The associations between traffic-related air pollution and noise with blood pressure in children: Results from the GINIplus and LISAplus studies,” Int. J. Hyg. Environ. Health, vol. 217, no. 4–5, pp. 499–505, 2014.

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Area of Research:- Air and Noise pollution Radioactive Waste Environmental ethics and values Fly ash applications Environmental legislation Environmental health & psychology.