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Impact of Vehicular Dynamics on Urban Noise: A Study of Speed and Honking Patterns in Ahmedabad"

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ABSTRACT

Expanding urbanization has posed serious concern of noise pollution globally. Accurate thorough analysis of this problem is therefore necessary to arrive at pragmatic solution. The prime purpose of this study is to measure traffic noise level at three prime intersections of Ahmadabad city and further analysing the using ANNOVA. As usual, the primary measurements were carried out at selected intersections at commercial, residential and industrial areas; during peak time, non-peak hours, in different seasons using SLM 109 noise meter and parameters of noise level were concluded like L_{eq}, L_{10}, L_{50}, L_{90}, L_{max} and $L_{min.}$ Also, Traffic volume, noise levels, honking, road geometry and vehicular speed were measured on selected intersections based on commercial, residential and industrial area in Ahmadabad city India. All the above measurements and observations were then rationally processed using ANNOVA analysis. Conclusions have been drawn which indicate that noise level pollution at present is at alarming level and tends to exponentially increase with urbanization, demography, betterment of life style. Therefore, there is an urgent need of attending this problem with adequate statutory backing...

Key words: Noise level, (ANOVA). Etc

1. INTRODUCTION

1.1 Background

India is a developing country and with the increase in infrastructural facilities, the urbanization is accelerated approaching to about 50 % of the total population is now residing in urban areas. This has posed serious concern over the traffic situation. India is facing drastic demographic growth and with the increase in per capita income, the number of vehicles is multiplying with time [I]. Due to this, traffic load in urban areas has been increased manifold, posing serious health hazards. In India, about 52% residents living near roadways are reported frequent irritation, 46% hyper-tension and loss of sleep to about 48.6% due to noise pollution [XIV]. Chennai is the nosiest among six metro cities. However, metros, Mumbai, Delhi, Kolkata, Chennai, Bangalore and Hyderabad exceeds noise pollution standard as per CPCB. In Europe, 120 million people are affected by traffic noise level above 55 dBA. In India, it is apprehended that this figure would have been much more. With the increase in the traffic, which expected to grow exponentially with temporal and spatial growth of urban areas, the issue will be aggravated adversely affecting the citizen health [III]. It is therefore necessary that a scientific study is to be carried out relating noise level verses health, for Indian urban conglomerates and

sensitize the law makers to come out with stringent statutory laws safe guarding people health. One of such application is GIS-Geospatial Information System, with which, the accurate analysis with effective glimpse can be presented **[II]**. Many tools and mathematical models are available like CRTN, RLS90 etc. In the present study of noise impact, popular FHWA-TNM model is used because it is efficient, accurate and its ease of handling. It is further to mention here that this study is based on the works of Abo-qudais and Alhiary, who evolved statistical models generating scenarios for maximum, Minimum and equivalent noise levels at controlled road intersections [IV]. In this study, the noise level has been assessed at specified locations of commercial, residential and industrial areas. Using GIS, the maps have been generated earmarking the spatial and temporal noise level higher than 50 dB [V]. **(Obaidat, 2008**) A model correlating noise level with different input parameters like types of vehicles, average speed, road widths, building height, traffic volume etc have been developed and validated for the study areas of Ahmadabad [VII]. **(Shukla, 2006)** This statistical regression model can be used for temporal and spatial predictions of noise level dynamics at different hotspots [XV]. This study has used the standards of GPCB, almost matching with the Indian National Standards. The noise level variability with respect to locations and time is estimated and presented using arcGIS 9.2[VII].

1.2 LITERATURE REVIEW

In 2020, researchers focused on the studying the connection between traffic 97 density and an expansion or reduction in noise levels [XVI]. The noise levels were checked in a total 98 of 5 stretches and 12 areas of a busy commercial area of Surat city. It was discovered that noise 99 levels in the region are 77dB, which is excess that of admissible limits framed by the CPCB of 100 Government of India. It is reported that, if the quantity of vehicles is expanding, it isn't fundamentals that the proportional noise level should increment and the other way around, on the grounds that noise levels are subject to different factors such as traffic flow, honking of horns, lane indiscipline, unapproved parking, and heterogeneity of vehicles in traffic [VIII].

Researchers have explained that that a large portion of the regions of city have exposed to unacceptable noise, and the noise level was high as 70–95 dB which is excessively high than the permissible limits [IX]. High noise levels in developed and organized zones such as residential areas, shopping zones are a significant concern. This is because of more utilization of the roads close by it by a wide range of public, commercial, loader trucks and private vehicles [IX]. Some of the alleviation measures suggested are upkeep of automobiles, regular servicing, and tuning of vehicles, fixing of silencers, installation of controlling barriers between noise source and receiver. Other measures incorporate raising the awareness among the local community and severe enforcement of laws.

It has been studied that the noise prompted by the traffic congestion and its effects on the wellbeing of people in the Chittagong city corporation. The noise level in the roadside was about 93dB, which is about surpassed as far as the acceptable limit. It is observed that the level of noise pollution is firmly associated with traffic volume, especially with the quantity of heavy vehicles such as trucks, buses as well as auto rickshaw [XI]. Due to this noise pollution, majority were experiencing the headache, bad temper, restlessness, disturbance, hearing issues, etc. [XIII]. Ignorance of the population about noise pollution is likewise a factor for expanding noise pollution. It is recommended to develop awareness about noise pollution [XVIII].

In 2008, it has been attempted to monitor and evaluate the road traffic noise in a urban zone. It is revealed that current noise level in all the areas surpasses the limit recommended by CPCB. In view of the discovering, it can be said that the population in this industrial town are presented to essentially high noise level, which is caused generally because of road traffic [XIX].

2. STUDY AREA AND METHODOLOGY

2.1 Study area

The data used in this study are collected during months of March, June and December, 2019 at three representative intersections of Ahmadabad City. SLM 109 sound level meter is used placing it at 1.2 m above the ground and 1.0 m away from the road side. The data were collected at these locations between 9:00 to 12:00 hrs [peak hrs] and thereafter in between 13:00 to 16:00 hrs [Non-peak hrs] and at 17:00 to 20:00 hrs.[peak hrs] [XII].Data on traffic volume is simultaneously collected, categorizing the vehicles as two wheelers, three wheelers four wheelers and heavy vehicles. Speeds of different types of vehicles then randomly observed using a radar gum. Average speed of different types of vehicles is used in the analysis of noise level pollution [XIV]. Other parameters such as building heights, road widths etc have been collected for all the designated locations. These data is further processed by Statistical method of analysis of variance (ANOVA). Ahmadabad is a commercial and economic capital of Gujarat with a present population of 7.8million and it is likely increased to 10 m by 2030. With the flourishing economy of the state, the total registered vehicles in Ahmadabad city is 43 lacs, which is likely to be increased manifolds in coming years. Therefore, it is obvious that the noise level which has already crossed the standard 50dB level may increase exponentially to unbearable level [XIV]. This is shown in map at fig No.1 and table no-1. Observations were taken during peak and non-peak hours as stated in above para. Noise level is measured at the cross section, i.e. where vehicle stopped at the signal and thereafter at different locations at 250 m where it gained speed. This is done partly manual and partly using camera. Speeds of passing vehicles were observed. Using radar gun. The parameters like road width, Honking, average speed, traffic volume and noise level is assessed by using statically analysis ANOVA.

Table 1: Study area of given location

Sr no	Location	Latitude	longitude	Categorized area
1	Memnagar	23.0525	72.5337	Commercial
2	Nava vadaj	23.0732	72.5604	Residential
6	Narol	22.9642	72.5903	Industrial

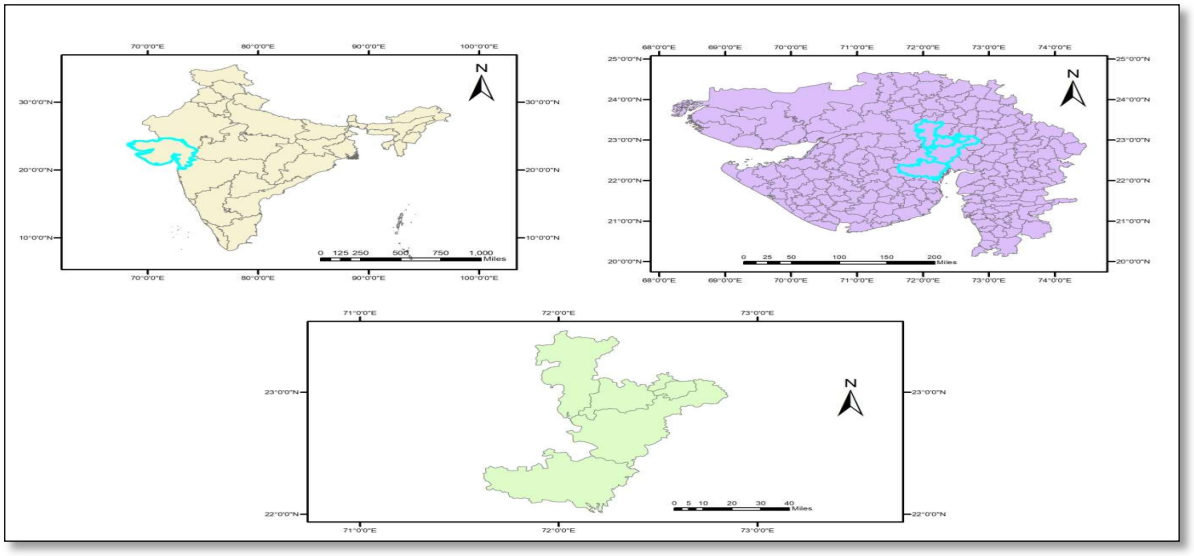


Figure 1: LOCATION MAP OF STUDY AREA

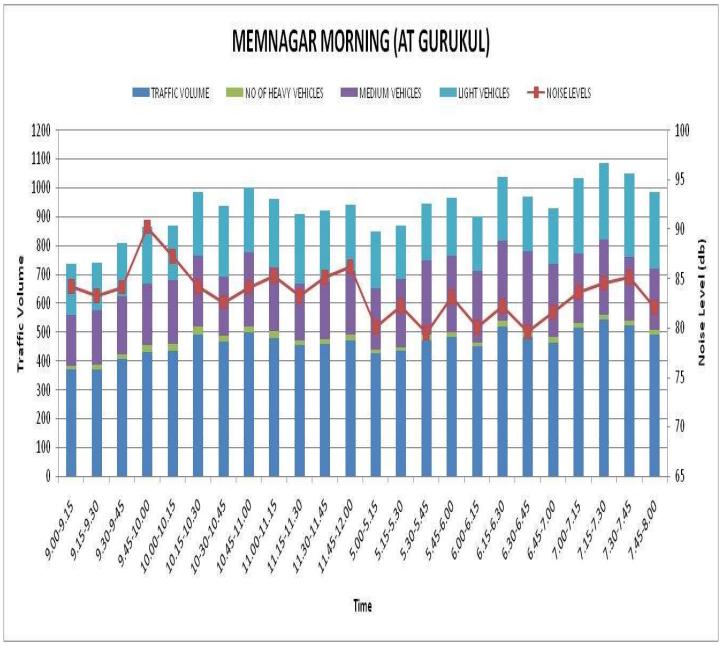
2.1 Data Collection

Traffic volume studies were conducted to determine number, movements, and classification of vehicles at a given location and sampling period. Traffic volume was recorded using video camera and vehicles were counted by viewing recorded footages from cameras on computer system. Vehicles were classified as heavy

(truck, bus, bulldozer, trailer, dumper), medium (car, jeep, auto-rickshaw, loading auto rickshaw) and light (motorcycle, scooter) based on their size and noise emission level. Auto-rickshaw is a three-wheeler used as a common means of transportation in India. Noise emitted by traffic vehicles was measured as per standard methods using sound level meter. Sound level meter was mounted on a tripod stand1.5 m above ground level with slow response mode, frequency weighting "A" and data logging of 1 second time interval. Traffic noise was measured using sound level meter at a distance of 10 m from the centre all intersection road respectively. Similarly, speedometer was mounted on tripod stand for monitoring speed of vehicles Noise emitted from a particular vehicle with corresponding speed was also measured and analysed for noise-speed response.

3.RESULT ANALYSIS

An attempt has been made to analyse traffic volume, vehicle speed and honking with their corresponding noise levels. Initially traffic volume was monitored for 9 am to 12pm, 1pm to 4 pm and 5pm to 8pm with 15 min time intervals to identify peak traffic time in morning and evening. Later, two sets of traffic volume and noise data were monitored during morning and evening peak traffic hours. In the first set of data, traffic and noise levels while in the second set, honking along with traffic and noise level were measured for 15 minutes with time interval of 1 minute duration. A statistical analysis was performed to assess the impact of diverse conditions on traffic noise based on the relationship between traffic volume, road geometry and noise data
For this, analysis of variance (ANOVA) and correlation analysis were carried out to quantify the dependence of traffic volume - equivalent noise, honking – equivalent noise and vehicular speed - corresponding noise level.



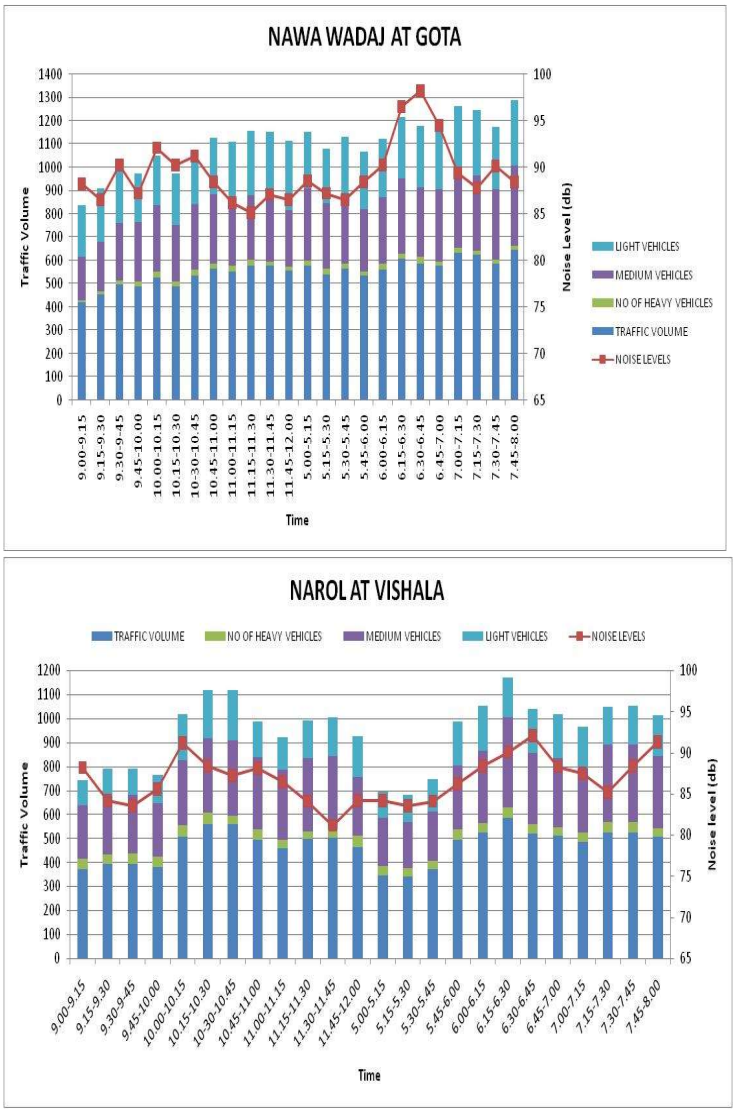
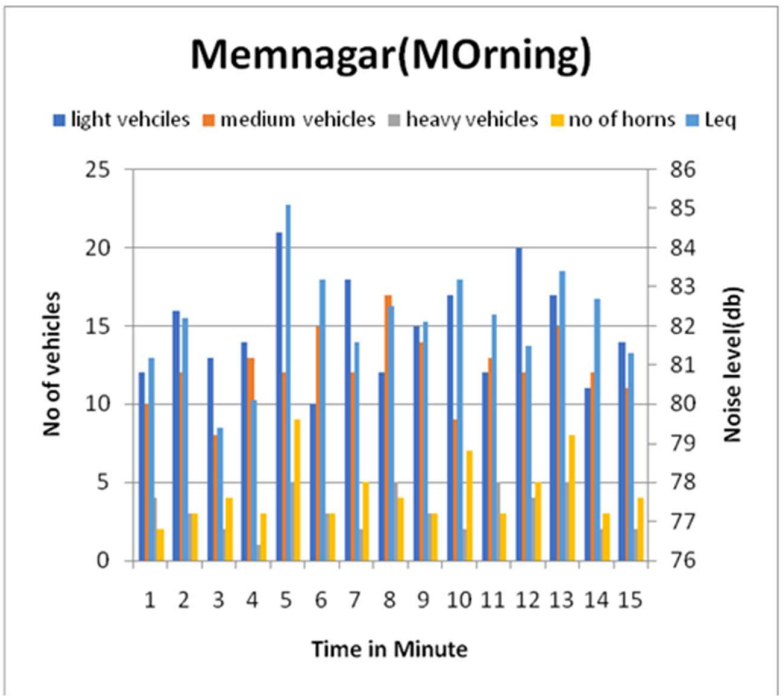
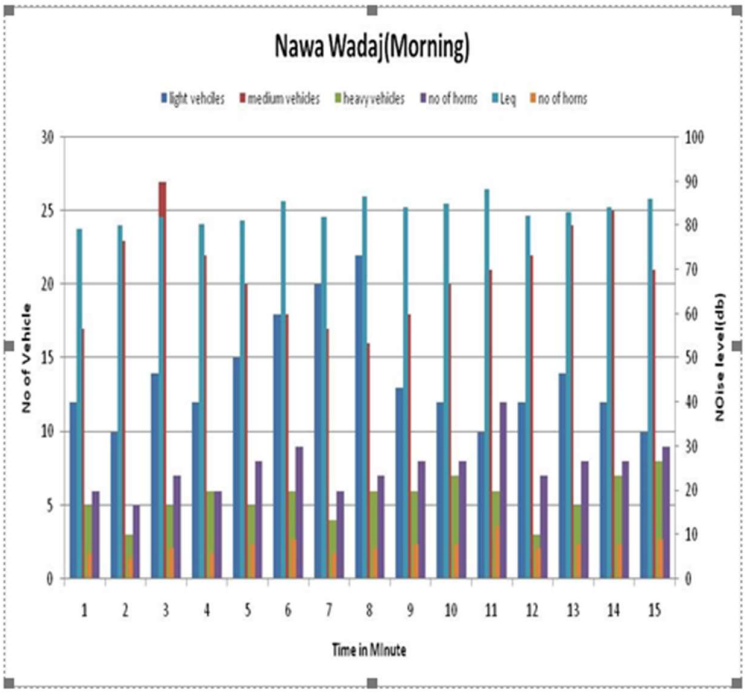
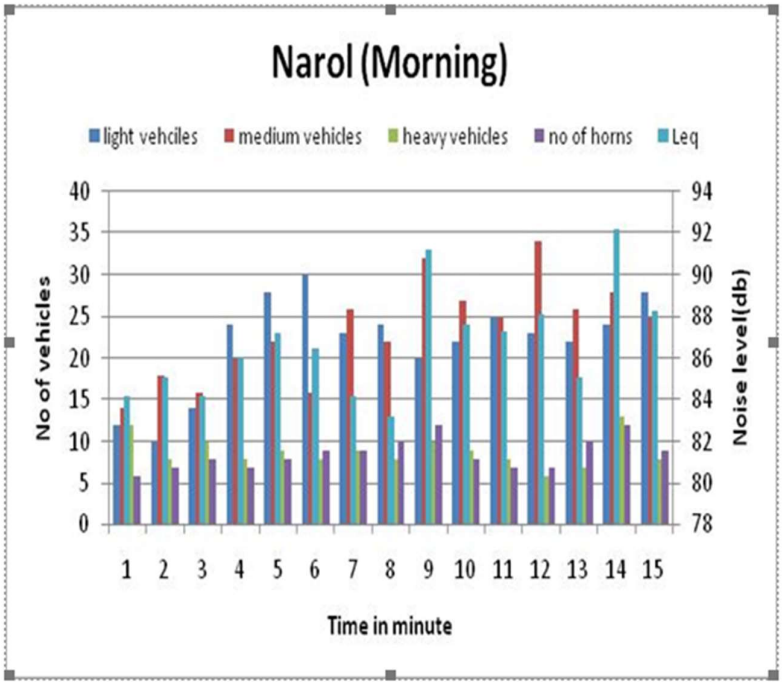
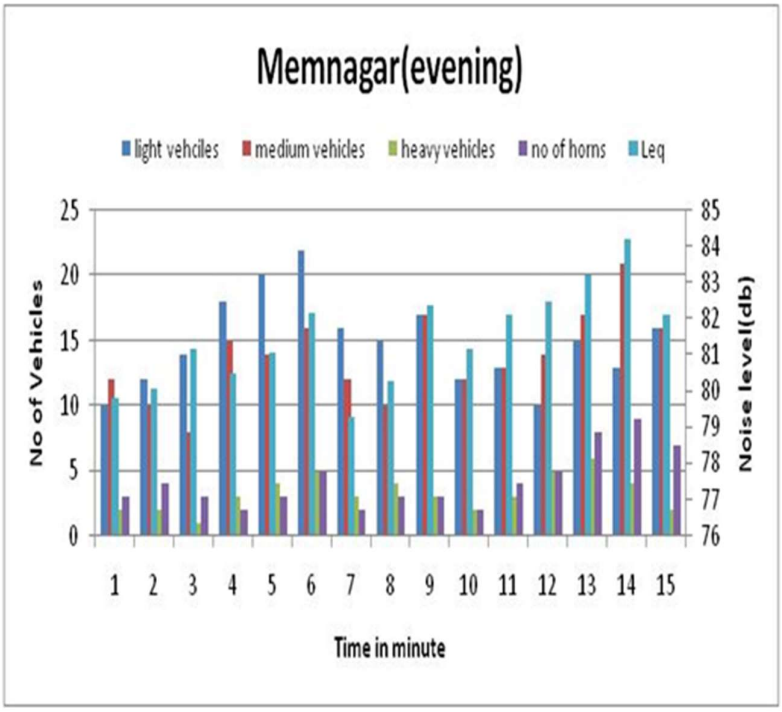


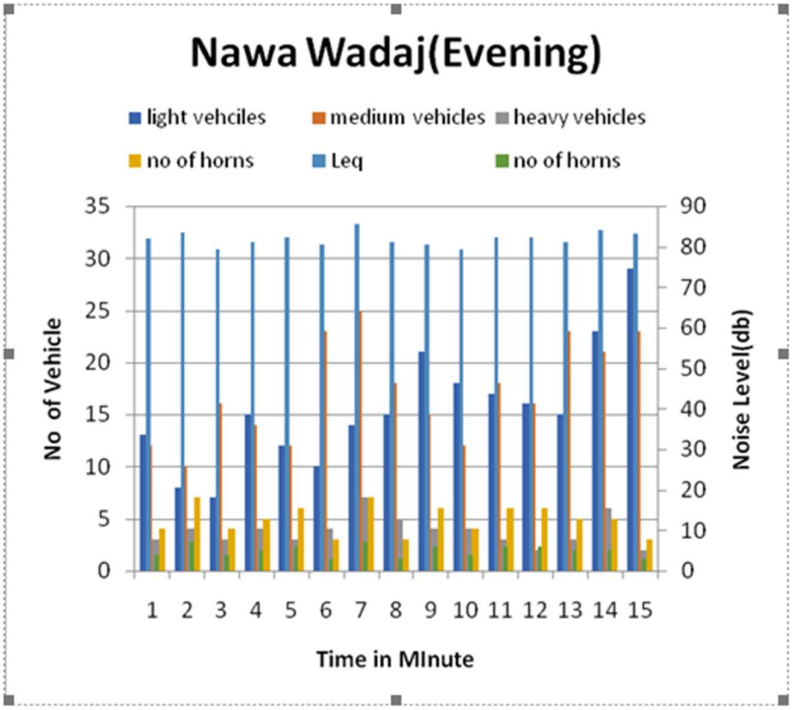
Figure 2 First set of data for traffic and noise during morning and evening hours


Memnagar(MOrning)
light vehciles
medium vehicles
heavy vehicles
no of horns
Leq
No of vehicles
Noise level(db)
Time in Minute


Nawa Wadaj(Morning)
light vehciles
medium vehicles
heavy vehicles
no of horns
Leq
no of horns
No of Vehicle
NOise level(db)
Time in MInute


Narol (Morning)
light vehciles
medium vehicles
heavy vehicles
no of horns
Leq
No of vehicles
Noise level(db)
Time in minute


Memnagar(evening)
light vehciles
medium vehicles
heavy vehicles
no of horns
Leq
No of Vehicles
Noise level(db)
Time in minute



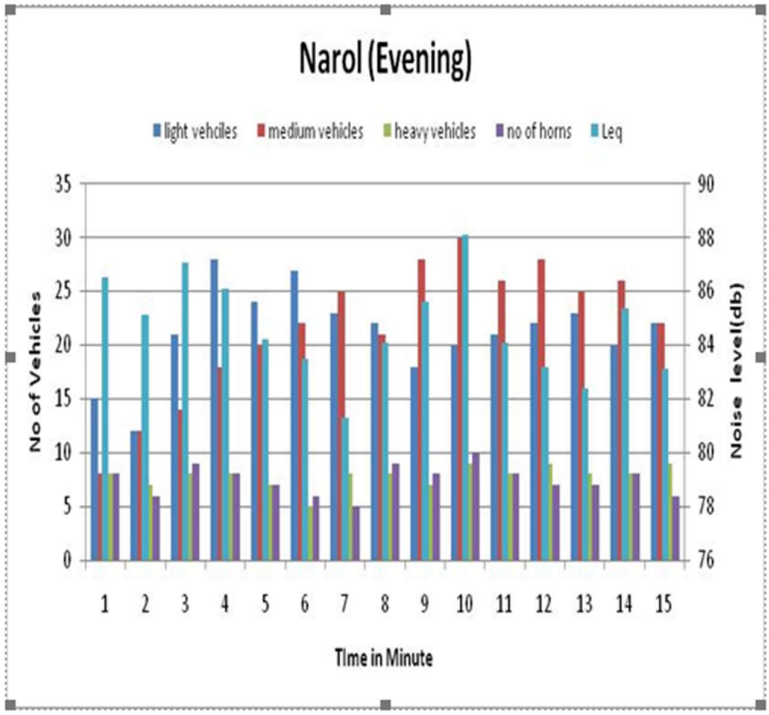


Figure 3 Second set of data for traffic, noise and horn honking for 15 minutes during morning and evening peak hours.

3.1 Data Analysis Results

Based on the analysis of morning 9am to 12 pm and evening 5pm to 8 pm traffic flow and peak traffic flow is observed between 10.45am to 11am and 7.15pm to 7.30 pm in Memnagar which is under commercial area and between 11.15 am to 11.30 am and 7.45pm to 8pm in Nava Vadaj area which is under residential area .and

between 10.15 am to 10.30 am and 6.15 pm to 6.30 pm in Narol area which is under industrial area. The no of light, medium and heavy vehicles passing through Memnagar stretches are 223,259 and 18 respectively during morning peak hour and 267,261 and 16 respectively during evening hour. . The no of light, medium and heavy vehicles passing through Nawa Vadaj stretches are 278,278 and 23 respectively during morning peak hour and 281,345 and 19 respectively during evening hour. The no of light, medium and heavy vehicles passing through Narol stretches are 201,313 and 46 respectively during morning peak hour and 167,376 and 43 respectively during evening hour. To assess the impact of traffic on noise levels, peak hour traffic and noise were measured for 15 min interval. As per reviewed paper noise is directly proportional to traffic volume. However, some conflict results are observed in my research work in all selected locations. As per my research work, I found that there is no specific relation of traffic volume vs. noise. this suggests that other factors are also responsible for contributing noise. To identify other factors responsible for traffic noise assessment, a separate set of reading of equivalent noise, traffic volume and honking was collected. These data were collected for 15 min durations of peak time with 1 min interval. Highest Leq 85.1dB in Memnagar was observed in 5th min for 35 number of vehicles per min. this was due to maximum no of honking is recorded. The maximum traffic volume recorded in Memnagar in 13th minutes even through Leq was 83.4 dB. In each location there is same case more no of honking more noise is produced even traffic volume is less. In some locations same no of honking and also same traffic volume noise level is different is due to vehicle type, speed, width of road, road surface condition. In third set of reading of equivalent noise and speed of different types of vehicles is measured. speed of light vehicles, medium vehicles, heavy vehicles varied in the range of 20 Kmph to 100 kmph for all categories of vehicle noise level linearly with speed. Impact of heavy vehicles and auto rickshaw on traffic noise is comparatively more than 2 wheelers and cars. while in case of 2w while increase in speed 30 kmph to 50kmph increases the noise level by 4 decibel and in case of 3w while increased the speed 30 kmph to 50kmph increases the noise level by 7-8 decibel .in case of heavy while increased the speed 30 kmph to 50kmph vehicles noise level increases by 10 decibel.

Table 2 Analysis of variance for vehicular type, speed, honking Vs Noise.

parameters	Degree of freedom	Sum of squares	Mean square	F	P
Vehicle type	3	123.7	48.2	27.34	.001
Speed	3	27.7	9.4	8.27	.0035
Honking	1	22.6	2.6	5.6	.0027
error	9				
total	16				
S=1.7			**R^2=90.25**		

A statistical analysis using two –way ANOVA was performed to assessed $P< 0.01$ for vehicular type and $P<0.05$ for speed and honking. the analysis suggests that types of vehicles is more dominant than speed and honking.

CONCLUSIONS

It can be seen that with the increase in traffic volume, the equivalent noise level is also increasing. As per the survey, the two wheelers' contributions are about 60 to 70% at almost all the locations. Three wheelers are about 10 to 15% whereas four wheelers are about 15 to 20%, Other heavy vehicles are about 1%. It is found that noise generated by two wheelers is the major contributor. When compared with the permissible noise level as per prescribed limits by CPCB, the equivalent noise level is about 1.5 times greater at almost all locations.

Average noise level is also much higher than the prescribed limits of CPCB. Noise pollution level, high. This is major concern. At present, when the city is developing a very fast pace, if this is not controlled or monitored, may result in to health hazards to the citizens residing in the proximity of such

locations. The main cause is felt to be blowing of horns at the signalling points either during stoppage or getting started at green signal. The narrow road width, lane indiscipline, unauthorized parking, lesser speed at the intersection or signals, irregular vehicular widths, slow moving carting vehicles, resonance of sound due to increasing vertical dimensions of buildings etc are the reasons aggravating the noise pollution.

It is felt that we should now:

1] Plan the road network with least possible level crossing.

2] Efficient mass transit system shall be developed effectively

2] Strict traffic laws to be enforced.

3] Incentives shall be given to electric vehicles.

4] Horns design shall be modified to have low frequency/noise level so that may be less harmful.

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