ASSESSMENT OF AMBIENT NOISE LEVELS IN ROHINI AREA, NEW DELHI

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CERTIFICATE

This is to certify that the work which is being presented in thesis entitled **"ASSESSMENT OF AMBIENT NOISE LEVELS IN ROHINI AREA, NEW DELHI "** is submitted by NEERAJ KUMAR Student Roll No- 2K12/ENE/09 in the partial fulfillment of the requirement for the award of the degree of MASTER OF ENGINEERING in ENVIRONMENTAL ENGINEERING to Department of ENVIRONMENTAL ENGINEERING, DELHI TECHNOLOGICAL UNIVERSITY. It is record of student's own work carried under the supervision and guidance.

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DECLARATION

I, hereby declare that the work being presented in the Project Report entitled **"ASSESSMENT OF AMBIENT NOISE LEVELS IN ROHINI AREA, NEW DELHI "** is an original work and an authentic report carried out as a part of my major project. The contents of this report have not been previously formed the basis for the award of any degree, diploma or other similar title or recognition and is being utilized by me for the submission of my Major Project-2 Report to complete the requirements of Master's Degree of Examination in Environment Engineering, as per Delhi Technological University curriculum.

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ABSTRACT

Ambient noise is a composite of sounds from many sources. The ambient noise level is increasing day by day in urban estates due to fast growth of urbanization and rapid change in life style of people. Acoustic noise beyond a certain limit is harmful. Noise is usually unwanted sound pollutant which produces undesirable physiological and psychological effects in an individual, by interfering with one's social activities like work, rest, recreation, sleep etc. The fact that a regulation to abate noise is in force should remove all doubts about the damaging aspect of noise pollution. The Delhi cities are being more polluted and the main thrust is towards the estimation of level of noise pollution in these cities. The main objective for estimation of noise level in Rohini area are given below.

- Noise measurement at various locations in different designated zone of urban area.
- Noise level prediction using CRTN noise prediction model in near field of urban road way.
- Comparative analysis of measured and predicted noise level along with prescribed standards.

Measurement of noise levels were carried out in 7 location at Rohini area in Delhi, viz. Commercial, Industrial, Residential and Silence zones. Based on the data of the measured equivalent noise levels in the residential, commercial, industrial, and silence zones of the 7 location, it can be stated that during day time noise levels from 40 to 60 dB(A) prevail in residential areas away from traffic roads, noise levels from 60 – 80 dB(A) prevail in residential areas close to traffic roads and in commercial areas, noise level from 70 – 90 dB(A) exits at the traffic junctions , and noise level from 80 - 105 dB(A) exists in areas with heavy traffic . Even the silent zones are observed to be quite noisy when measured noise level are compared with the prescribed standard provided by the CPCB.

CHAPTER-1

INTRODUCTION

1. INTORDUCTION

1.1 General

What is noise

In simple terms, noise is unwanted sound. Sound is a form of energy which is emitted by a vibrating body and on reaching the ear causes the sensation of hearing through nerves. Sounds produced by all vibrating bodies are not audible. The frequency limits of audibility are from 20 HZ to 20,000 HZ.

A noise problem generally consists of three inter-related elements- the source, the receiver and the transmission path. This transmission path is usually the atmosphere through which the sound is propagated, but can include the structural materials of any building containing the receiver (See Fig. 1)

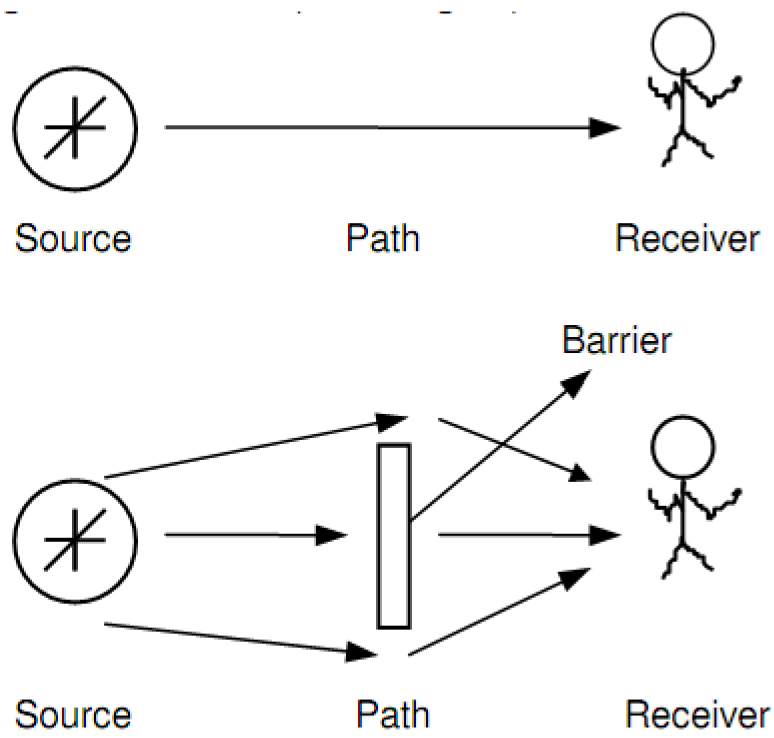


Fig. 1.1:- Inter-relationship between the elements of noise

Noise may be continuous or intermittent. Noise may be of high frequency or of low frequency which is undesired for a normal hearing. For example, the typical cry of a child produces sound, which is mostly unfavorable to normal hearing. Since it is unwanted sound, we call it noise. The discrimination and differentiation between sound and noise also depends upon the habit and interest of the person/species receiving it, the ambient conditions and impact of the sound generated during that particular duration of time. There could be instances that, excellently rendered musical concert for example, may be felt as noise and exceptional music as well during the course of the concert. Sounds of frequencies less than 20 HZ are called infra sonics and greater than 20,0000 Hz are called ultrasonic. Since noise is also a sound, the terms noise and sound are synonymously used and are followed in this module.

1.2 Motivation

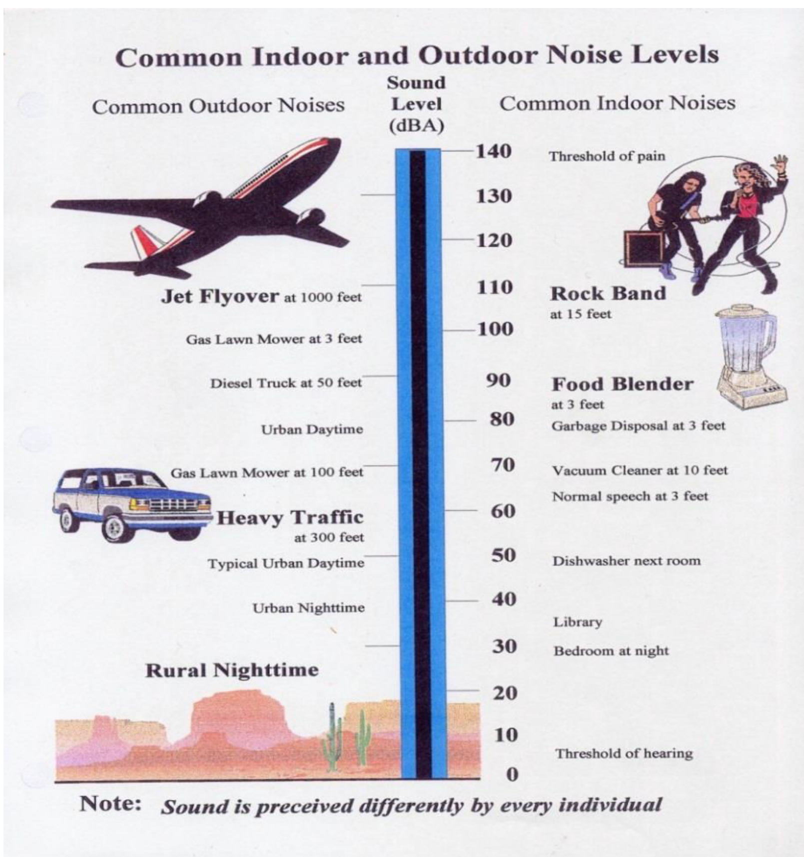


Fig :-1.2 (indoor and outdoor noise level)

The effects of noise pollution on cognitive task performance have been well-studied. Noise pollution impairs task performance at school and at work, increases errors, and decreases motivation. Reading attention, problem solving, and memory are most strongly affected by noise. Two types of memory deficits have been identified under experimental conditions: recall of subject content and recall of incidental details. Both are adversely influenced by noise. Deficits in performance can lead to errors and accidents, both of which have health and economic consequences. Cognitive and language development and reading achievement are diminished in noisy homes, even though the children's schools may be no noisier than average. Cognitive development is impaired when homes or schools are near sources of noise such as highways and airports. Noise affects learning, reading, problem solving, motivation, school performance, and social and emotional development. These findings suggest that more attention needs to be paid to the effects of noise on the ability of children to learn and on the nature of the learning environment, both in school and at home. Moreover, there is concern that high and continuous environmental noise may contribute to feelings of helplessness in children.

1.2.1 Significance of Noise measurement

- In cases where constant noise is present e.g. constant machine noise, the LA90,can be used as an equivalent to LAeq, . This generally has the advantage of removing extraneous ambient effects from the measurement. For example, noise from occasional traffic and birds won’t be captured by the LA90,T. The LA90,T descriptor is commonly used to assess noise emissions from sources including fan noise, domestic air-conditioners and pool pumps.

- LAeq, is used to quantify the noise where the Lp varies over time. In most situations, the LAeq, is the most appropriate descriptor used to investigate environmental noise complaints.

1.2.2 Significance of Prediction noise level

Environmental noise predictions are used in an increasing range of decision-making applications. The most common application is for assessments where a decision is to be made regarding some future change to an environmental noise field. However, given the practical and technical challenges to noise measurement strategies, there are an increasing number of situations in which predictions complement or substitute for measurement-based noise assessment techniques. Common uses of predictions for practical noise assessment are as follows:

• Forecasting the impacts or benefits of proposed changes to an environmental noise field such as introduction, change or removal of a commercial/industrial installation, or modification of significant features in physically environment that affect noise propagation, such as the construction or removal of barriers or enclosures.

• Assessment of existing commercial/industrial installations where the need to be evaluated. Prediction to be used to rank the relative contribution of individual component source of installation comprising multiple complex source. These rankings can then be used to focus noise mitigation resources on to the component sources whose treatment will enable the greatest reduction in total noise levels.

• Investigating the results of a measurement study to better understand the causes of the measured levels. For example, predictions may be used to assist the investigation of observed but unexplain results. Alternatively, predictions may be used to provide an estimate of the extent to which a particular source, or group of sources, may have influenced the total noise level measured from all sources affecting the environment in question.

• Assisting the design of measurement studies by using predictions to understand the possible criticality of the situation before committing to expensive measurement studies. The predictions can be used to identify situations that are most critical to the assessment outcome, such as locations where noise levels might be expected to be similar to some threshold value where the assessment outcome significantly differs.

1.3 Scope of the present study

The major source of noise in urban areas is road traffic, which is in Indian context, heterogeneous in nature, therefore, the selected road stretches of Delhi will be taken into account. The continuous monitoring of noise at various locations will give clear picture about the variation of the noise intensity. The study will be valuable contribution in the area of noise management/abatement, especially at planning stage and redevelopment of urban areas. The study will be helpful in traffic planning, development of realistic objectives for noise management. It will be supportive tool for the identification of areas with high potential of reduction measures. It will also provide more effective use of local, regional and national planning procedures to control and reduce noise. Besides, it will be useful in monitoring the effectiveness of action plans and other planning procedures. Besides, the present study will provide an extended spatial database, spatial tools and computation force to quantify and visualize noise effects. The current trend of noise level in the close proximity of urban roadways and its complex propagation algorithms to predict noise data will be another major outcome of the study. It will give the appropriate directives to objectify/clarify and to improve the decision making process concerning measures

1.4 Need of the study

Nowadays, besides congestion, air pollution, accidents people are also very much concerned about the ill effects of noise and vibrations generated by traffic. At the same time the issue of noise pollution is increases day by day. So we need to study how much noise variation is taking place on that area.

1.5 Objectives of study

I. Noise measurement at various locations in different designated zone of urban area.
II. Noise level prediction using CRTN noise prediction model in near field of urban road way.
III. Comparative analysis of measured and predicted noise level along with prescribed standards.

CHAPTER-2

LITERATURE REVIEW

2. LITERATURE REVIEW

2.1 Discuss basic fundamental of noise pollution

In recent years, due to the rapid increase in population density, building density, traffic density and energy consumption, the outdoor air quality has deteriorated in the crowded urban areas. Noise is also a pollutant which has a significant effect on air pollution level.

A study was conducted in the residential areas of Delhi, India, to assess the variation in ambient noise levels during Pre-Diwali month (DM), Diwali day (DD) and post Diwali month during the period 2006 to 2008. The use of fireworks during DD showed the ambient noise level were 1.2 to 1.3 times higher than normal day. The correlation between noise level and gaseous pollutant were moderate ($R2 \geq 0.5$). The average concentration of the pollutants during DD was found higher in 2007 which could be due to adverse meteorological conditions. The statistical interpretation of data indicated that the celebration of Diwali festival affects the ambient air and noise quality. The study would provide public awareness about the health risks associated with the celebration of Diwali festival so as to take proper precautions (**Mandal et al., Prakash et al.; 2011).**

A study was conducted which shows a new approach to monitor noise pollution involving citizens and built upon the notions of participatory sensing and citizen science which enable citizens to measure their personal exposure to noise in their everyday environment by using GPS-equipped mobile phones as noise sensors. The geo-localized measures and user generated meta-data can be automatically sent and shared online with the public to contribute to the collective noise mapping of cities. The prototype, called Noise Tube, can be found online **(Maisonneuve et al., Stevens et al.; 2008).**

A noise assessment study was conducted in Kerala, which shows the measurement of noise levels in the three major cities in Kerala viz., Thiruvananthapuram, Kochi, and Calicut shows that commercial zones experience about 15 dB(A) noise level above the prescribed limit silence zones experience similar noise levels and hence about 25 dB (A) above the prescribed limit. Special events like festivals, election campaigns generate noise levels that are prohibitively above the permissible limit with the only redeeming factor being that they last over a comparatively shorter duration **(Sampath. et al., Murali Das et al., 2004).**

The acoustic group at the Andhra University, Waltair, had reported a very systematic and comprehensive study of road traffic noise. Measurements of noise levels are made in the city of Vishakhapatnam. In a paper by Seshagiri Rao et al (1981), hourly traffic noise measurements at 5 distinct locations in the residential cum commercial areas of Vishakhapatnam city during the day hours of 8.30 AM to 4.30 PM were reported. The SLM was placed t a distance of 2 m from the exposed façade of the dwellings. The distance from the nearest traffic lane was between 8-12 m. The measurement sites covered from noisy to very noisy conditions due to mainly free flowing traffic. The results were reported (table 2.1) in terms of noise climate of the place, affixing values of equivalent continuous sound level L_{eq}, traffic noise index TNI, noise pollution level L_{NP}, and noise percentile levels L_{10}, L_{50}, and L_{90} etc.

Table 2.1:-Mean values of the measured noise parameters for five different sites in the city of Vishakhapatnam (Seshagiri Rao et al 1981)

Site	L_{eq} dBA	L_{90} dBA	L_{50} dBA	L_{10}dBA	L_{NP} dBA	TNI dBA
A	70.7	72.0	77.9	84.0	92.5	82.0
B	69.8	70.9	74.9	80.9	86.5	80.9
C	68.3	65.5	70.3	79.1	89.9	87.2
D	74.5	71.4	76.9	84.6	93.2	94.2
E	70.3	65.5	70.3	77.8	84.7	85.3

From the above table it may be seen that Leq noise level is close to 70dBA in the noisy areas and around 75 dBA in the very noisy areas. L10 values are close to 80 dBA at most of the locations compared to the safe limit of 70 dBA in the residential aras during the busy hours of the day (Cuniff, 1977). Again TNI and LNP are fairly high at all the sites compared to the standard values of 74 dBA and 72 dBA respectively defined by BRS study (Scholes and Sargent, 1970). Of course, these differences are very much possible since while the standard values are based on the 24 hour averaged hourly values of L10 and L90, the present values have been obtained on the basis of data collected for 8 hours of the day time when the traffic density is the highest. Single event noise exposure level LAX, were also measured and were found to be around 110 dBA.

Ramalingeswara Rao and Seshagiri Rao (1990a) later on (during the year 1986) extended these measurements to 10 locations, which included residential, commercial, industrial and residential cum commercial zones. The period of observations was also enhanced from 8 hours to 12 hours (8.00 hours to 20.00 hours). it was found that Leq, LNP, and TNI values had become higher at most of the test locations compared to the earlier observations. These measurements were again repeated for the subsequent year i.e. for the year 1987 (Ramalaingeswara Rao and Seshagiri Rao, 1990b). The measured values of Leq for both the years 1986 and 1987 are given in Table 2.2. It may be seen from this table that out of 10 locations where measurements were made, Leq values decreased at5 locations, differed slightly at 2 locations and increased at the other three places compared to the restrictions imposed on the movement of the heavy vehicles during daytime in those localities. Installation of traffic lights (traffic management) and widening of roads were the other reasons for this decrease in noise level.

Table 2.2 :- Comparison of measure Leq values for the years 1986 and 1987 for various localities of Visakhapatnam (Ramalaingeswara Rao and Seshagiri Rao, 1990b).

Name of the locality	**Noise level dBA**		
	Leq value		
	1986	**1987**	**Difference**
Collector office	77.00	75.93	1.07
Poorna Market	75.00	73.52	1.48
Daba Garden	77.00	78.40	1.40
APSRTC	82.00	77.00	5.00
Rama Talkies	77.50	75.08	2.42
Seethammapeta	73.50	75.77	2.27
AkkayaPalem	69.40	72.91	3.51
Dolphin Junction	74.50	75.12	0.62
KanchanaPalem	75.50	75.75	0.25
NAD Kotha Road	75.70	74.85	0.85

Ramalaingeswara Rao et al (1989) also made measurements of traffic noise over the 24-hour period at one of the busiest traffic junctions of the residential cum commercial areas (Jagadamba junction) in the city of Visakhapatnam during the years 1986 & 1987. This study showed that noise level started increasing from 06.00 Am in the morning, developed peaks during the morning and evening traffic rush hours, and started continuously falling after 9.00 PM reaching a minimum value around 04.00-0500 AM. A comparison of Leq values for the years 1980, 1986, and 1987 but were significantly lower from the values corresponding to the year 1980, although the traffic density was comparatively less in 1980. This difference was attributed to the fact that ply6ign of trucks had been banned through this junction, roads had been widened and automatic traffic lights had been installed to regulate traffic flow. Further, it was seen that noise level during nighttime was substantially higher than the desirable levels for comfort. Based on the fact that average noise level of a vehicle within the speed limits of 30 km/h (which mostly exists on the inner city roads) is quite insensitive (within $\pm$ 1dB) to factors like road width, conditions of road surface, and presence or absence of reflecting and absorbing surfaces, Seshagiri Rao et al (1989) and Ramalingeswara Rao and Seshagiri Rao (1991a) also worked out an empirical relationship connecting the overall noise level in the environment to the motor vehicle density contributing to noise level. The expression obtained for Leq was of the form :

$$Leq = C + K \log_{10} Nx$$

Where C and K are constants and Nx is the equivalent number of vehicles plying on road per hour of a category (say light vehicles) corresponding to the total mixed traffic density. The constants C & K of this equation cab be evaluated from a plot of Leq values against the logarithm of the equivalent number of vehicles of a particular category. The values of these constants for the equivalent number of light vehicles (scooters) and heavy vehicles (trucks) in terms of individual mean noise levels for the various categories of vehicles worked out by SeshagiriRao et al (1989) are given in Table 2.3. An analysis of the values of C showed that this constant represented the general background noise level in the absence of vehicular traffic activity.

Table 2.3 :- Values of C and K for different zones and for all zones combined in terms of equivalent numbers of light and heavy vehicles (Seshagiri Rao et al, 1989)

Zone type	**Vehicle Category**	**C dBA**	**K**
All zones (Combined)	Heavy	44.60	13.9
	Light	41.50	9.3
Residential	Heavy	41.96	16.4
	Light	41.10	10.2
Commercial	Heavy	49.36	12.2
	Light	43.40	9.2
Residential cum commercial	Heavy	40.37	15.3
	Light	41.80	9.4
Industrial	Heavy	40.54	15.4
	Light	40.60	9.5

RamaligeswaraRao and SeshagiriRao (1991b) later on generalized the above empirical relationship into a regression equation of the form :

$$\mathbf{Leq = a \log 10\ Nx + b}$$

to predict equivalent continuous noise level, Leq of an area, where Nx, represents the equivalent number of vehicles per hour of a particular category corresponding to the total mixed traffic density plying in that area, a is the regression coefficient i.e. slope obtained from the analysis of data and b is the intercept. Leq could be predicted from this equation to an accuracy of $\pm$ 3 dB. A similar type of regression equation was also obtained for LA10T, the traffic noise level exceeding10% of the time measured on A-weighting networks, by Ramalingeswara Rao and Seshagiri Rao (1991c). The values of the constant for equivalent number of both heavy and light vehicles were also worked out for qu8ck prediction of La10T values.

Muralikrisha and Vittal Murty (1983), Rao et al (1987) and Rathor and Sudhkar (1993) also carried out noise surveys of ambient noise level due to traffic noise pollution only at three important junctions, Rathor and Sudhakar made measurements at 13 locations covering residential, commercial, industrial and silence zones. The latter survey was conducted for a period of one month at a stretch during October 1992 from 6.00AM to 10.00 PM. The results of this survey are given in Table 2.4 along with the computed values of traffic noise index TNI, noise pollution level LNP and noise climate NC. it may be seen from this table that the residential areas and silence zones are quite noisy due to industrial activities like forging, metal cutting and dumping, as also due to horns, sirens and loudspeakers etc., was getting added indistinguishably to traffic noise, which did not allow to develop a satisfactory correlation between noise level and number of vehicles.

Table 2.4 :- Measured noise levels in the city of Vishakhapatnam during October, 1992 (Rathor and Sudhakar, 1993)

Location	Leq	L10	L50	L90	Lmax	Lmin	NC	LNP	TNI
Residential Areas									
Seethammadhara	65.5	66.5	64.3	59.4	69	60	7.1	72.6	57.8
MVP Colony	67.7	68.0	63.8	58.9	74	61	9.1	76.8	65.3
Madhava Dhara	64.3	63.8	61.0	56.8	70	59	7.0	71.3	54.8
Commercial Aeras									
RTC complex	72.0	71.9	69.9	67.6	74	70	4.3	76.3	54.8
Jagdamba Jn.	78.8	79.8	75.8	71.5	85	73	8.3	87.1	74.7
Purna Market	75.7	74.7	70.5	67.6	84	70	7.1	82.8	66.0
Gajuvaka Jn.	74.1	75.2	71.5	68.8	77	71	6.4	80.5	64.4
Industrial Areas									
IDA-Marripalem	63.0	63.6	60.2	53.5	67	51	10.1	73.1	63.9
Autonagar-Ganjvaka	68.3	67.8	64.0	60.2	75	64	7.6	75.9	60.6
Sensitive Areas									
K.G. Hospital	64.6	65.8	63.0	56.4	69	62	9.4	74.0	64.0
Distt. Courts	68.6	69.2	66.6	64.2	71	58	5.0	73.7	54.2
Andhara Univ.	59.7	61.2	59.0	56.3	63	57	4.9	64.6	45.9
Zoological Park	66.5	65.7	61.8	58.2	75	61	7.5	74.0	58.2

Rama Reddy and Rama Chandraiah (1995) studied temporal variations of noise level in three of the several traffic lanes in the commercial districts of Chennai city. Continuous equivalent noise levels of 80.2, 73.5 and 79.0 dBA were measured in the three respective lanes giving a mean Leq of 77.56 dBA which is quite high for a traffic lane. A multiple regression equation relating Leq levels with sped, flow rate and percentage of heavy vehicles was fitted to predict equivalent continuous noise level of a commercial area. The best fitted equation is:

$$\mathbf{Leq = 68.4237 + 0.1654\ V + 0.00308\ Q + 0.07133\ P}$$

Where V is the stream speed in Km/h, Q is the traffic flow rte of vehicles per hour per lane and P is the percentage of heavy vehicles. A correlation coefficient of 0.7947 and a standard error of estimation equal to 0.1699 were found.

Chhapgar and Mohanan (1984) made measurements of noise levels at selected sties covering residential, commercial, industrial and semi-rural areas of Delhi. The selected sites included areas with heavy, medium and light vehicular traffic, pedestrian traffic, railway tack and air flight path. It was observed that during morning and evening rush hours, traffic noise was between 6090 dBA depending upon the density of prevailing vehicular traffic. In areas like Cannuaght Place, Dryaganj, Subzi Mandi and Shahdara continuous equivalent noise level (Table 2.5) was the highest (85-90 dBA). Subzimandi and Daryaganj were reported to be equally noisy even in 1959 (Panchly et al, 1960a) which means tht the roads at these places were maximally used for vehicular traffic even in 1959. Connaught Place became more noisy in 1983 compared to 1959, and in areas like Aryua Samaj Road (karol Bagh), Jama Masjid (back), Chandani Chowk (near Jain Mandir), the morning rush hour noise level was lower than in 1959, may be due to some traffic controls imposed in these areas. Further, background noise level L90, was not seen to fall below 55 dBA at any time of the day in any one of the localities except in institutional areas like Pusa which are nearly traffic free (noise level was around 50 dBA in Pusa area during day time). Over flying aircrafts were seen to raise the ambient noise level of the residential areas by 20-25 dBA and the transit trains were observed to raise the noise level in areas adjacent to the rail tracks by 10-20. It was also seen that noise pollution had a horizontal spread in the sense of encompassing more areas of Delhi.

Table 2.5 :-Depicting Data of noise survey (day time) of Delhi conducted by NPL during 1959 and 1983 (Pancholy et al, 1960a; Chhapgar and Mohanan, 1984)

Location	Traffic(light, medium, heavy and other Conditions	Continuous Equivalent Noise Level Leq dBA	
		1959	1983
AryaSamaj Rd	Medium, Market	82	76
Connaught Place	Heavy, Mkt	81	87
Daryaganj	Heavy, Mkt	89	88
Jama Masjid	Light , Congested	80	74
SubziMandi	Heavy, Mkt, Congested	87	89
ChandniChowk	Medium, Market, Congested	88	82
SarojaniMkt	Light, Mkt	76	74
Patel Nagar	Medium	79	79
PaharGanj	Light, Mkt, Congested	-	81
New Rohtak Rd	Medium	-	81
InderPuri	Light, Residential	-	63
ChanakyaPuri	Medium, Diplomatic area	-	82
Lodi Rd Fly over	Heavy	-	81
Tilak Nagar	Medium, Market	-	82
Palam Village	Light, Rural	-	71
Delhi Cantt	Light, Mkt	-	76
Shahdara	Medium, Market, Congested	-	85
IIT Campus	Light, Institute	-	64
Nizamuddin	Light, Residential	-	70
NPL Colony	Light, Residential	-	60

In another investigation near the railway tracks, Mohanan et al found that the pass by noise due to diesel locomotive at a distance of 30m from the centre of the non welded railway tracks was characterized by a noise level of 75 dBA while the passenger cars developed a pass by noise level of 60 -65 dBA. The empty freight wagons developed a noise level of 5 dBA more than the loaded wagons. Further, noise level on welded tracks was 3-4 dBA lower compared to that on non-welded tracks, Pass by noise level due to a electric engine was 3 dBA lower than a diesel engine and the horn noise of the passing train was as high as dBA at a distance of 30 m from the tracks. A frequency analysis of the noise showed that the fundamental frequency of the locomotive horn (pneumatic type) was at 315 Hz and dominant frequencies of the wheel-rail contact noise on non-welded tracks were in the frequency range 250-1000 Hz.

Mohanan et al (1989 a& b) also reported noise levels in an underground railway system in the country. Noise levels for the moving train (maximum speed=80 km/h)were measured to be 102 dBA on the platform, 92 dBA inside the coach and in the driver's cabin with doors and windows closed, and 108 dBA under the carriage, while similar measurements for the train standing at the platform gave noise levels of 81 dBA at the middle of he platform, 77 dBA in the driver's cabin and 82 dBA near the carriage. For a train parked in the car shed, the compressors fitted under the carriage measured a noise level of 86 dBA at a distance of 1m form the ear level, 72 dBA inside the coach with doors and windows closed and 74 dBA inside the coach with dorrs and windows open. The alternators fitted inside the carriage developed a nose level of 80 dBA inside the coach with doors and windows closed and 73 dBA outside the carriage. These measurements showed that compressor noise was primarily responsible for the measured noise level on the platform during the period the train was stationary on the station and fans and alternators contributed to the nose inside the coach. Spectrum profile of the compressor noise was in the frequency range 50 Hz to 3 kHz. The coach body offered substantial suppression (up to 20 dBA) to the nose at frequencies above 1000 Hz and low suppression below 1000 Hz, and further that noise level of the moving train was higher in the mid frequency range possibly due to the rail-wheel contact.

Central Pollution Control Board(1989) conducted a day long noise survey of Delhi. Fifteen places including residential, commercial, industrial and institutional areas with light, medium and heavy traffic were identified for this survey and measurements of noise levels were made from 10.00 AM to 06.00 PM. The significant result of the survey was that the so called quiet areas like hospitals had high noise level and pusa campus was the most quiet area in Delhi during day time.

Kumar and Jain (1991 a) carried out measurements of noise levels and spectra during lean (02.30-04.30 PM) traffic periods at 10 important road crossings in Delhi. The results (Table 2.6) showed that all the crossings were more or less equally noisy, Minto Road crossing was the most noisy crossing, and Ashram and Azadpur crossings had more noise level during the lean period compared to the peak traffic period, meaning thereby that there was no lean period for these crossings (in fact during the so called lean period, trucks piled through these crossings). Analysis of the traffic noise index showed that there was significant variability in traffic flow at Moti Bagh (TNI was maximum here and minimum at ITO) compared to ITO and other crossings.

Table 2.6:- Average noise levels at 10 important traffic crossings in Delhi during lean and peak time periods (Kumar and Jain, 1991 a)

Name of traffic Crossing	Average Noise Level (dBA) with confidence limits at 1% level of significance		Traffic Noise Index TNI dBA	
	Lean Period 2.30-4.30 PM	Peak Period 5.00-7.00 PM	Lean Period 2.30-4.30 PM	Peak Period 5.00-7.00 PM
Punjabi Bagh	78.4 ± 1.10	81.14 ± 1.07	82.5	83.0
Moti Bagh	75.82 ± 1.85	79.34 ± 1.27	97.5	88.0
AIIMS	77.36 ± 1.21	80.92 ± 1.08	82.0	82.0
Ashram	80.81 ± 1.07	78.83 ± 1.01	79.0	75.0
ITO	78.46 ± 0.79	80.30 ± 0.84	69.0	71.0
Red Fort	79.52 ± 0.93	80.97 ± 0.84	74.0	72.0
ISBT	79.38 ± 1.03	81.38 ± 1.14	79.0	81.0

Azadpur	79.58 $\pm$ 0.85	78.65 $\pm$ 1.00	77.5	83.5
Jan path	77.42 $\pm$ 1.47	81.26 $\pm$ 1.20	87.0	77.5
Minto Road	81.38 $\pm$ 1.15	82.13 $\pm$ 0.93	84.0	81.5

In a subsequent paper, Singh et al (1972) reported noise measurements in Delhi in the vicinity of high traffic zones for three types of configurations: Semi open (Bhikaji Cama place), open (Maharani Bagh) and Closed (Sewa Nagar). Measurements were made during peak traffic hours (morning 08.30-11.00 AM and evening 04.00-07.00 PM) as a function of horizontal distance normal to the traffic flow by mounting the SLM at a height of 1.5 m from the road surface at a distance of 1 m away from the kerb side. Analysis of data was made assuming that continuous equivalent nose level was a simple linear function of the number of heavy and light vehicles passing through the time interval of measurement. The relation is of the form:

$$\mathbf{L_{eq}(x) = C_H\, V_H + C_L\, V_L + C_0}$$

Where V_H and V_L are the average number of heavy and light vehicles passing during the measurement period and C_H, C_L and C_0 are the constants, which are evaluated at a point distant x from the vehicle, using multiple regression analysis. The result showed that for the open site L_{eq} was approximately a plateau (inverse horizontal distance dependence) up to a distance of 3 m after which it had a sharp decrease (power spectra showed that it may be due to diffracted sound from 1.5 to 3.0 m long vehicles), for the closed site L_{eq} values varied with distance in the shape of standing wave pattern having an estimated wave length of 2 m for a frequency of 100 Hz, and for the semi open site L_{eq} increased slightly up to a distance of 6 m (may be due to multiple reflections between the sources and the building structure on one side of the site). Variation of L_{eq} values as a function of vertical distance were also studied at each site and it was noticed that while in case of semi open site a steady decrease in the L_{eq} values was observed as expected, at the open site an anomalous behavior was observed.

Kumar and Jain (1991b) also carried out a study of the A-weighted noise levels and their spectral characteristics inside two major public transport modes in Delhi, the buses and the auto rickshaws. The measured values (average) for L_{10}, L_{90} and L_{eq} given in Table 2.7 show that peak level, background level and L_{eq} values are the highest in auto rickshaws followed by DTC and private buses. Spectral distribution study further showed that noise levels for all modes were high at low frequencies. Further, buses were more noisy in the fourth gear compared to expected higher noise levels in the first gear. This anomaly was attributed to poor maintenance of the body frame of the buses.

Table 2.7:- Measured noise level parameters in the major public modes of transport in Delhi (Kumar and Jain, 1991 b)

Modes of Transport	L_{10} dBA	L_{90} dBA	L_{eq} dBA	L_{eq} dBA		Spectral Levels (dB) at Octave Bands (Hz) of			
	Level of Confidence	Level of Confidence	Level of Confidence	Level of Confidence					
	5%	1%	5%	1%	5%	1%	31.5	1000	16 k
DTC Buses	85.98 +1.29	85.98 +1.88	75.39 +0.97	75.39 + 1.41	83.95 +1.39	83.95 + 2.02	102	79	50
Private Buses	83.75 ±0.87	83.75 ±1.27	73.88 0.74	73.88 ± 1.08	81.29 ± 1.40	81.29 ± 0.96	99	76	44
Auto Rickshaws	90.42	90.42 ± 0.96	82.37 1.40	82.37 ± 0.75	88.89 ± 1.09	88.89 ± 1.12	91.5 ± 1.64	82	55

Tandon and Pandey (1998) reported traffic noise at some of the major road crossings in south Delhi. They observed like others that traffic junctions are very noisy. Noise levels (L Aeq) of 82 dBA, 81 dBA and 80 dBA were respectively observed at the traffic junctions of AIIMS, Nehru place and IIT. The observations were made for 30 minutes each at all the sites during day time. Noise levels of individual vehicles were also measured using the standard acceleration pass by test. It was found that maximum noise level of the two wheeler scooters ranged from 75 to 80 dBA, of the motor bikes from 80 to 85 dBA, of the auto rickshaws from 80 to 86 dBA and of cars from 66 to 80 dBA.

Padma nabha murty and Mishra (2000) have reported the effect of meteorological parameters, wind speed and direction, temperature and humidity in relation to noise levels in 3 different orientations along, opposite an perpendicular. The measurements were made in Delhi during November to March 1998, every hour from 6.00AM to 6.00PM. It was observed that there was slight increase in the intensity of noise level along with wind direction, while there was no appreciable change in the noise level perpendicular to wind direction. Increase in relative humidity and the existence of inversion conditions were observed to attenuate the sound intensity.

CPCB (2001) has reported ambient noise level status in Delhi during 1995 and 1999. Noise level survey was carried out at ten different locations covering residential, commercial, industrial, silence, and traffic intersections in the city of Delhi during May- June in the year 1995 and June-July in 1999. The noise level was monitored for about half an hour in each location during morning, afternoon, evening, and night hours. It was found that the temporal Leq average ambient noise level which was around 57 dBA in 1995 had increased to around 68 dBA in the residential zone during the year 1999. Similar changes were also noticed in the L10 and L90 values, which were respectively ranging between 56-65 dBA and 50-53 dBA during the year 1995, had been ranging respectively between 65-72 dBA and 53-62 dBA during the year 1999. In the commercial zone, however, hardly any noticeable change was observed for the years 1995 and 1999. The temporal Leq average ambient noise level, which were in the range 73-78 dBA during the year 1995, had been ranging 74-76 dBA during the year 1999. In the silence zone there was a slight decrease in the temporal Leq average ambient noise level values from the range 67-72 dB during 1995 to 61-66 dBA during 1999. In the industrial zone thee was a slight increase in the temporal Leq average ambient noise level values from the range 70-76 dBA during the year 1995- to 75-78 dBA during 1999. Zone-wise average percentage of violation in noise level above the prescribed limits have also been calculated, and have been found to be more or less the same, with the difference that noise level is higher during the year 1999 compared to 1995.

Mohan and associates (2000, 2002) have also made noise level, vehicular speed, and traffic volume surveys under free flow conditions of traffic for more than 10 sites in Delhi. Based on this data they have made an attempt to develop a model for prediction of road traffic noise as per Indian road conditions suing the concept of CoRTN (Calculation of Road Traffic Noise) model (Steele, 2001). The basic noise level equation was composed assuming zero percent heavy vehicles, zero gradient, and an average vehicular speed of 30km/h. Correction factors were then added to it for percent increase in heavy vehicles, speed of the vehicles, road surface, distance of noise measurement from the road and from the barrier at the roadside. The error in the predicted data for the actual road conditions was found in 5% coherence with the observed noise levels (L10).

In the city of Mumbai, the measurements of noise level were made under the aegis of the Society for Clean Environments. **Mukherji et al (1980)** reported measurements of noise level in the residential areas, at the railway stations and in a moving passenger train. In residential areas like Matunga which is badly affected by vehicular traffic, noise levels in the range 59-77 dBA were measured, while in remote residential areas like Anushakti nagar, noise levels less than 45 dBA during night time and around 50 dBA during day time were observed (Table 2.8). Busy railway stations like Dadar and Basin Road had noise levels around 90 dBA during morning rush hours an around 73 dBA at other hours. Non-busy railway stations had noise level of 55 dBA and less for most of the time (leaving the transit period of the train), equivalent to the background noise level in that area. Noise level in a moving passenger train was measured to be around 83 dBA over land and 96 dBA over a bridge.

Table 2.8 :- Measured noise levels in the residential areas of Mumbai (Mukherji et al , 1980)

Location	Morning	Noon	Evening	Night	Midnight	Remarks
Matunga	64	71	77	71	63	Traffic
Collector's Colony						
(i) Room	51	-	53	52	-	Factory
(ii) 3rd Floor Balcony	61	-	62	61	-	Noise
Anushakti Nagar						
(i) Room	43	-	47	46	42	Residential
(ii) 3rd Floor Balcony	44	-	50	51	43	

Naik (1998) studied noise levels at two traffic junctions, Sion Circle and Bhendi Bazar, in Mumbai during the day time as a function of traffic volume and it s composition. Equivalent noise levels around 80 dBA were measured at both of these places. A social survey of these areas was also made. It was found that 45% o the people surveyed complained of annoyance due to this heavy traffic noise and 35% complained of sleep disturbance (insomnia) also. It was an increase of 10% in the complaints of annoyance over the last 5 years.

Shrivastava et al (1986) made measurements of noise pollution levels over day and night in the city of Ahmedabad and found LDN to be 62 dBA. Due to the operation of the textile industry, the main city remained noisy even during night time (Fig. 5.2). In the suburbs the nose level subsided after 11.00 PM, and reached a minimum around 45 dBA at 4.00 AM in the early morning hours. In the residential areas, noise level was maximum up to 60 dBA during morning 8.00 -11.00 AM and evening 5.00-9.00 PM. In the commercial areas, noise level was at its peak (80 dBA) during 10.00 AM to 1.30 PM and evening 4.00-7.00 PM. In the industrial areas, noise level was 90 dBA during day time, peaking during shift change periods and was around 80 dBA during evening and later evening hours.

Gupta et al (1986) made studies of noise pollution level and traffic noise index on Meerut-Roorkee highway and Roorkee town under different land use conditions. Representative samples of traffic noise were taken during peak traffic hours for working days and holidays. Similar to these measurements, Narsimha Murty and Ragha vachari (1986) made highway traffic noise studies for Hyderabad city.

Tiwari and Ali (1988 a& b) carried out a noise survey in Rourkela township. It was found that on Ring Road (New Rourkela) noise level was 110.4 dBA maximum, 62.8 dBA minimum and 74.9 dBA average around worker's shift change periods, while under similar traffic conditions prevailing on the main road of the Old Rourkela city during the periods, 10.00 AM to 12.30 PM and 6.00-8.00 PM, the respective noise levels were measured as 103.6 dBA (maximum), 65.4 dBA (minimum) and 79.9 dBA (average). The noise levels in the Old Rourkela city are evidently higher than on Ring Road, New Rourkela, may be it is due to traffic congestion in the old city. Along the residential areas close to Ring Road, the noise level was slightly low, 56.1 dBA (average). In the commercial areas of the civil and steel townships, the minimum, maximum and average noise levels were measured to be 69.8 dBA, 103.6 v, 82.3 dBA and 53.6 dBA, 93.3 dBA**,** 70.5dBA respectively in the two areas, with the main city market the noisiest of all. Higher noise level in the civil townships, maybe, due to denser road traffic in the old city area.

Tiwari and Ali (1998c) also studied the effect of height and type of houses on noise levels in residential areas. it was observed that noise levels in localities having multi-story houses were higher than in those localities where there were single story houses. Further, localities with two bed room houses compared to one bed room houses were noisier probably due to the presence of more noise making gadgets in these houses. Furthermore, unplanned civil townships and slums were noisier than planned townships. Another interesting observation was of the enormous increase in night time noise level (of the order of 35 dBA or more) in the planned township. This noise was found to be due to the high pitched sound of the grass hoppers especially during the monsoon season.

Patel and Tiwari (1997) measured noise levels at bus stand and railway station of Rourkela during the day time and evening hours. The measured noise levels were found to vary from 62.7 dBA to 100.9 dBA during day time and from 65.4 dBA to 103.0 dBA during evening hours.

Yagnanarayana and RanalingeswaraRao (1994) made measurement of traffic noise at Ramagundam, a township near Bangalore which is fast developing industrially as also is serving as a major highway center connected to various big cities in South India. Noise level was reported to be high needing immediate attention of the appropriate authorities.

Mohan et al (2000) and Kumar et al (2001) have made studies of the dependence of noise emission characteristics on the traffic situation and composition in Bangalore. They have measured, along with other usual parameters of equivalent sound level and percentile levels, the noise emission spectra of 1/1 octave bands over the frequency range 20 Hz to 16 KHz for six different permutations of traffic situations and compositions. These situations were traffic without heavy vehicles, mixed traffic intersections, high density traffic of heavy vehicles, free flow traffic with dominance of light vehicles, traffic over a slope, and traffic on residential roads. Analysis of the spectral data has shown that irrespective of the noise level, the presence of lower frequencies in the sound energy is responsible for annoyance. Thus annoyance is more in a situation where traffic is dominated by heavy vehicles or where vehicles (even light) are moving over a slope. Non-linear regression equations have been obtained for the observed frequency spectra having correlation factors between 70 to 98 %.

Bhattacharyya and De (2000) have carried out a noise study in the steel city of Durgapur. They selected two road intersections for their study. On one of the intersection, traffic had by and large a constant flow of medium to heavy class of vehicles, while on the other the traffic was mostly related to business hours and was composed of generally light vehicles, interspersed occasionally with a few heavy vehicles. Data were collected for 3 weeks during December 1996 and January 1997. Analysis of data showed that the maximum Leq was around 94 dBA while the mean was around 76 dBA, and further that the noise data clearly reflected the movement pattern of the vehicles and the class of vehicles in the sense that Leq was mostly influenced byL5 percentile alone at both the intersection, so much so, that this parameters alone can be used to get Leq values by employing a simple low cost analog SLM capable of measuring instantaneous SPL values only.

Singh and associates (2000b) have made measurements of noise level in the Dhanbad Municipal area, the coal township. It was found that none of the areas in the city had noise level less than 45 dBA at any time of the day. Even the silence zone had noise level exceeding the prescribed limit. High transportation activities, nearness of industries, nature and poor quality of roads were found to be mainly responsible for the observed high noise level. Other facts responsible for high noise level were frequent blowing of hours due to congested roads, use of generators due to poor electric supply conditions and commercial activities.

Bhatnagar and associates (1990, 1991) reported measurements and analysis of ambient noise levels in the city of Chandigarh. The results given in Table 2.9 show that noise level in Chandigarh ranges between 42 dBA and 77 dBA, with maximum noise level of 63 dBA (average 51 dBA) in any residential area. These noise level values indicate that Chandigarh is a comparatively quieter city in relation to many other state capital cities of India.

Table 2.9 :-Measured noise levels at various locations in the city of Chandhigarh (Bhatnagar et al, 1990).

Location	**Max. noise level dBA**	**Min. noise level dBA**	**Avg. noise level Dba**
Quarter sectors	63	42	51
Markets	74	46	64
Vertical roads	77	45	62
Intermediate traffic Junction	74	48	61
Round abouts	77	45	63
Mid points along	77	43	61

Chakrabarty et al (1997) have also made day-night measurements of noise levels at 24 sites in the city of Kolkata representing residential, commercial, residential –commercial, residential-industrial and office complex areas of the city. values of hourly equivalent continuous noise level, 24 hourly equivalent continuous noise level, average day-night should level, percentile levels, noise pollution level, and traffic noise index were determined from the measured data. Since the distance of the microphone from the traffic center line was different for different sites depending on the width of the foot path and road, the whole data were normalized to a distance of 4.6 m before computing the various parameters.

Analysis of the computed parameters showed that hourly values of the continuous equivalent noise level were the lowest (a difference of 15-20 dBA) during the early morning hours of 2.0 - 3.00 AM.

2.2 Traffic noise a review (Indian scenario)

National status

There is not a single Indian model in noise pollution, which is up to the international standard for the noise prediction and no one in India has done the noise mapping for urban area. For the traffic management at airport /road, noise mapping is a big tool internationally. Hence, it is a right time for the traffic management (Road) in India. The Prime Minister, Dr. Manmohan Singh has said that new steps being taken today so that this city is ready to host the Commonwealth Games in 2010, and hopefully the Olympics in 2016. The development of the nation, having an important role of pollution, it may be noise pollution. It is our combined responsibility to make our city free from noise pollution.

The major source of noise in urban area is road traffic, which is in Indian context, heterogeneous in nature, therefore, the selected road stretches of Delhi city will be taken into account. The master plan of Delhi will be only success when it will be free from pollution and without traffic management pollution may not be control. The monitoring of noise at various locations will give clear picture about the variation of noise intensity. The study will be valuable contribution (through mapping and modeling) in the area of noise management/abatement, especially at planning stage and redevelopment of urban areas. The study will be helpful in traffic planning, development of realistic objectives for noise management. It will be supportive tool for the identification of areas with high potential of reduction measurement. It will also provide more effective use of local, regional and national planning procedures to control and reduce noise.

Besides, it will be useful in monitoring the effectiveness of action plans and other planning procedures. The noise database will provide a platform for further research and development. The validation of models with real time life noise data will provide the information regarding suitability of prediction models in Indian conditions. On the basis of prediction results the development of noise prediction model will be developed and they can be used at planning stage of the urban areas.

CHAPTER-3

METHODOLOGY

3. METHODOLOGY

The ambient noise level termed as the total noise associated with a given environment and usually comprises sound from many sources both near and far. In order to assess the ambient noise level at different stations in the seven location at Rohini. The noise level was monitored continuously at each station, through central receiving station located at Rohini. Morning, afternoon, evening, are considered according to the various activities of the entire day. Methodology of the project are given below.

- perform statistical analysis of noise monitoring data in Rohini area
- Compare the measure noise level against noise standard level given by CPCB
- calculate traffic volume of Bawana road
- calculate the predicted noise level by using CRTN model
- compare the measured noise level against predicted noise level

International standard ISO 2204 gives three types of method for noise measurement: (1) the survey method, (2) the engineering method and (3) the precision method.

3.1 Measurement method

3.1.1 The survey method

This method requires the least amount of time and equipment. Noise levels of a working zone are measured with a sound level meter using a limited number of measuring points. Although there is no detailed analysis of the acoustic environment, time factors should be noted, such as whether the noise is constant or intermittent and how long the workers are exposed. The A-weighting network is usually used in the survey method, but when there is a predominant low-frequency component, the C-weighting network or the linear response may be appropriate.

3.1.2 The engineering method

With this method, A-weighted sound level measurements or those using other weighting networks are supplemented with measurements using full octave or 1/3 octave-band filters. The number of measuring points and the frequency ranges are selected according to the measurement objectives. Temporal factors should again be recorded. This method is useful for assessing interference with speech communication by calculating speech interference levels (SILs), as well as for engineering noise abatement programs and for estimating the auditory and non-auditory effects of noise.

3.1.3 The precision method

This method is required for complex situations, where the most thorough description of the noise problem is needed. Overall measurements of sound level are supplemented with full octave or 1/3 octave-band measurements and time histories are recorded for appropriate time intervals according to the duration and fluctuations of the noise. For example, it may be necessary to measure peak sound levels of impulses using an instrument's "peak hold" setting, or to measure levels of infrasound or ultrasound, requiring special frequency measuring capabilities, microphone directivity, and so forth.

Those who use the precision method should make sure that the instrument's dynamic range is sufficiently great to prevent "overshoot" when measuring impulses and that the frequency response should be broad enough if infrasound or ultrasound is to be measured. The instrument should be capable of making measurements of frequencies as low as 2 Hz for infrasound and up to at least 16 kHz for ultrasound, with microphones that are sufficiently small.

The following "common sense" steps may be useful for the novice noise measurer:

i. Listen for the main characteristics of the noise to be measured (temporal qualities, such as steady-state, intermittent or impulse qualities; frequency characteristics, such as those of wide-band noise, predominant tones, infrasound, ultrasound, etc.). Note the most prominent characteristics.
ii. Choose the most suitable instrumentation (type of sound level meter, noise dosimeter, filters, tape recorder, etc.).
iii. Check the instrument's calibration and performance (batteries, calibration data, microphone corrections, etc.).

iv. Make notes or a sketch (if using a system) of the instrumentation, including model and serial numbers.

v. Make a sketch of the noise environment to be measured, including major noise sources and the size and important characteristics of the room or outdoor setting.

vi. Measure the noise and note down the level measured for each weighting network or for each frequency band. Also note the meter response (such as “slow,” “fast,” “impulse,” etc.), and note the extent to which the meter fluctuates (e.g., plus or minus 2 dB).

If measurements are made outdoors, pertinent meteorological data, such as wind, temperature and humidity should be noted if they are considered important. A windscreen should always be used for outdoor measurements, and even for some indoor measurements. The manufacturer’s instructions should always be followed to avoid the influence of factors such as wind, moisture, dust and electrical and magnetic fields, which may affect the readings.

3.2 Noise measurement instruments

Noise measurement is an important diagnostic tool in noise control technology. The objective of noise measurement is to make accurate measurement which give us a purposeful act of comparing noises under different conditions for assessment of adverse impacts of noise and adopting suitable control techniques for noise reduction. The various equipment used for noise level measurement are summarized at Table 3.1. The principle and the components of noise measuring instruments is summarized below. A sound level meter consists basically of a microphone and an electronic circuit including an attenuator, amplifier, weighting networks or filters and a display unit. The microphone converts the sound signal to an equivalent electrical signal. The signal is passed through a weighting network which provides a conversion and gives the sound pressure level in dB. The instructions laid down by the noise level meter manufacturers shall be followed while using the instruments.

The time constants used for the sound level meter standards are

S (Slow) = 1 second

F (Fast) = 125 milli seconds

Relatively steady sounds are easily measured using the "fast" response and unsteady sounds using "slow" response. When measuring long-term noise exposure, the noise level is not always steady and may vary considerably, in an irregular way over the measurement period. This uncertainty can be solved by measuring the continuous equivalent level, which is defined as, the constant sound pressure level which would have produced the same total energy as the actual level over the given time. It is denoted as Leq. The display of Leq facility is also available in certain models of sound level meters. This is the desired parameter for assessment of ambient noise levels.

Table 3.1:- Equipment used in the measurement of noise levels

S.NO	**Equipment**	**Specification/Area of Usage**
1	Sound level meter	Type-0 : Laboratory reference standard Type-1: Lab use and field use in specified controlled environment Type-2: General field use (Commonly used) Type-3: Noise survey
2	Impulse meters	For measurement of impulse noise levels e.g. hammer blows, punch press strokes etc.
3	Frequency analyzers	For detailed design and engineering purpose using a set of filters.
4	Graphic recorders	Attached to sound level meter. Plots the SPL as a function of time on a moving paper chart.
5	Noise dosimeters	Used to find out the noise levels in a working environment attached to the worker.
6	Calibrators	For checking the accuracy of sound level meters.

Fig 3.1 :- (Sound level meter)

3.3 Noise sampling

Bureau of Indian Standards (BIS) has published several code books for sampling and analysis of noise pollution and guidelines for control of noise pollution from domestic and industrial sources. The reader is advised to refer to the BIS code books (table 2) for a better understanding of methods of noise sampling. For sampling of noise levels from industrial sources, noise levels in the different octave bands are measured by a sound level meter in conjunction with octave - band filters at the workers ear level or at about a distance of one meter from the source of noise.

Table 3.2:- Selected BIS code books on noise pollution

BIS CODE	DESCRIPTION
IS-4954-1968	Noise abatement in town planning recommendations
IS-3098-1980	Noise emitted by moving road vehicles, measurement
IS-10399-1982	Methods of measurement of noise emitted by stationary road vehicles
IS-6098-1971	Method of measurement of air borne noise emitted by rotating electrical machinery
IS-4758-1968	Methods of measurements of noise emitted by machines
IS-3483-1965	Code of practice for noise reduction in industrial buildings
IS-1950-1962	Code of practice for sound insulation of non-industrial buildings
IS-9167-1979	Ear protectors

3.4 Study area

Seven locations were selected for collection of traffic data and noise level monitoring as stage

- Station 1 (DTU CAMPUS)
- Station 2 (both side open at Bawana road Rohini)
- Station 3 (near G3S mall, Rohini)
- Station 5 (F-1 Park Sector-16 , Rohini)
- Station 4 (Residential Area Pocket-4 sector 11 block c , Rohini)
- Station 6 (Building on Both Side at Sahabad Daulatpur Near DTU)
- Station 7 (Krishna Apartment (one Side open and one Side Building) at Rohini

. The study area showing the survey locations is shown in fig 3.2 and fig 3.3

Fig 3.2:- (Rohini Area, New Delhi)

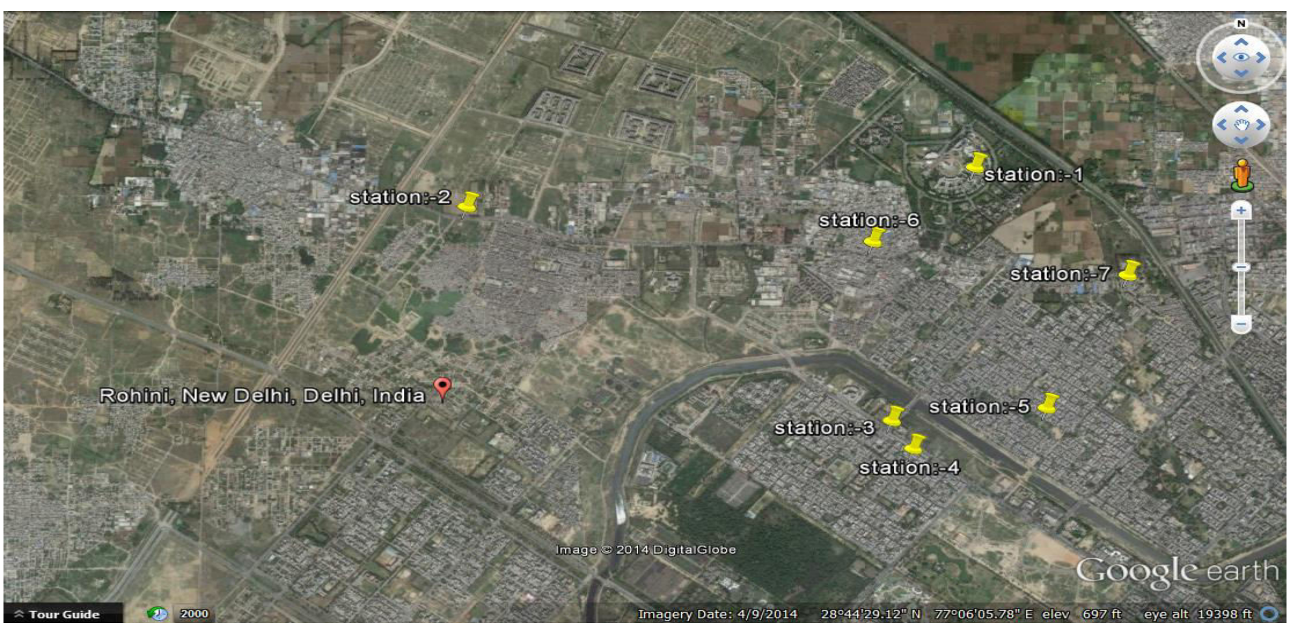


Fig 3.3:- (Selected location at Rohini, New Delhi)

CHAPTER-4

RESULT & DISCUSSION

4. RESULTS & DISCUSSION

Ambient Noise Level data of 7 station at Rohini (New Delhi) cities and their respective calculated noise parameters are given in Table 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 and 4.7 and figures 4.1 to 4.7. Raw data is taken from the Central Pollution Control Board in txt. format.

4.1 Variation of measured noise level at 7 location in Rohini

Table 4.1:-Station 1 (DTU Campus, near canteen)

Time	Leq	Lpeak	L5	L10	L50	L90
6:00AM-7:00AM	52.1	84.2	54.8	55.3	48.8	47.1
7:00AM-8:00AM	57.8	100.6	55.8	55.6	54.5	53.2
8:00AM-9:00AM	59.6	95.6	62.5	61.1	57.7	55.3
9:00AM-0:00AM	63.5	99.7	71.6	70.4	65.7	59.3
10:00AM-:00AM	67.8	96.2	67.2	65.9	58.9	54.5
11:00AM-:00PM	67.2	102	70.6	69.8	64	57.6
12:00PM-1:00PM	73.2	104	79.3	78.6	71.9	70.2
1:00PM-2:00PM	74.7	108.2	72.7	72	66.2	63.1
2:00PM-3:00PM	75.4	101	83.5	80.7	71.9	67.9
3:00PM-4:00PM	75.1	107.7	80.6	79.6	72.9	68.4
4:00PM-5:00PM	74.5	106.1	78.3	77.2	72.3	68.6
5:00PM-6:00PM	68.8	101	71	70	66	62.5
6:00PM-7:00PM	72.2	108.6	74.7	72.9	69.1	66.6
7:00PM-8:00PM	56.6	103.5	64.5	57.8	52.1	51
8:00PM-9:00PM	52.5	89.3	58.9	57.6	49.7	48.1
9:00PM-10:00PM	49.4	84.5	52.1	51.6	49.5	47.5

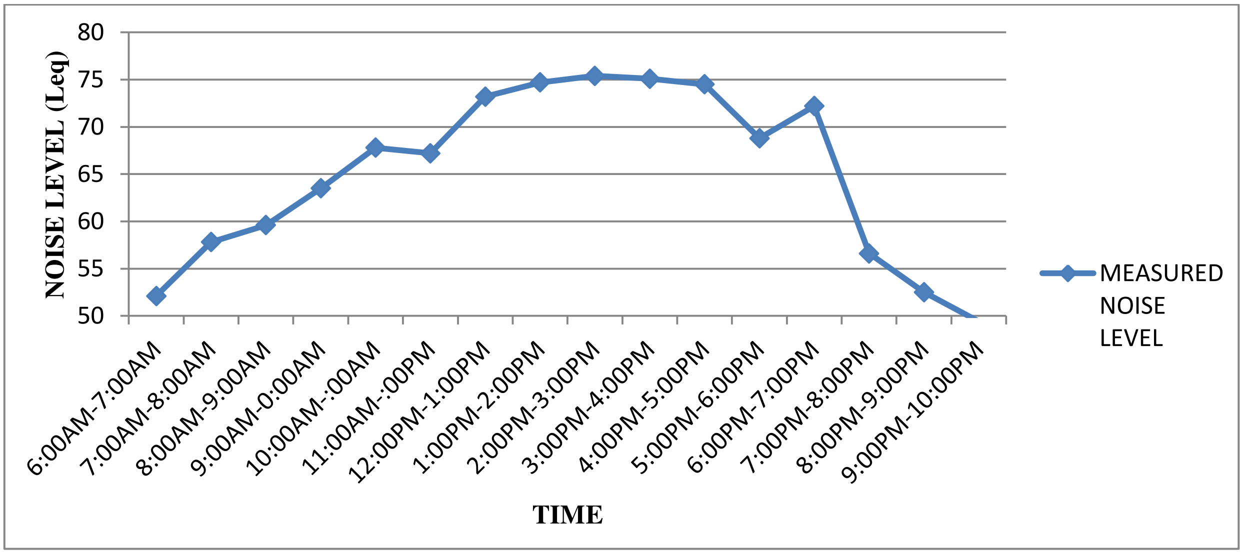


Fig 4.1:- (Noise variation at DTU Campus)

In fig. 4.1 A significant variation of noise level at station 1(DTU) is observed. Minimum noise level is observed at morning (6:00-7:00 AM) and at night (9:00-10:00 PM) and the maximum noise level is observed at afternoon (12:00-4:00 PM).

Table 4.2:- Station 2 (both side open at Bawana road, Rohini)

Time	Leq	Lpeak	L5	L10	L50	L90
6:00AM-7:00AM	79.2	111.4	85.8	83	77.1	73.7
7:00AM-8:00AM	81.4	112	79.7	79.2	75.9	72.6
8:00AM-9:00AM	81	105.9	55.7	83.7	78.9	73.7
9:00AM-10:00AM	83.4	108.8	90.4	87.5	79.6	75.9
10:00AM-1:00AM	83.1	124.1	85.2	86.1	79.6	74.2
11:00AM-12:00PM	83.4	125.4	87.4	85.7	77.9	73.7
12:00PM-1:00PM	84.2	124.1	86.8	85.6	81	75.9
1:00PM-2:00PM	81.1	119.9	86	83.2	73.2	66.1
2:00PM-3:00PM	83.1	120.9	84.3	83.5	77	72.3
3:00PM-4:00PM	78.9	122.4	80.2	79.8	76.8	72.8
4:00PM-5:00PM	80.5	117.6	93.1	90.6	78.5	73
5:00PM-6:00PM	80.6	116	83.2	82.6	77.2	70.9
6:00PM-7:00PM	81.2	117.1	84	82.9	76.3	71
7:00PM-8:00PM	81.1	115.9	93	90.9	79.4	70.3
8:00PM-9:00PM	84.1	110.4	86.8	83.3	84.7	78.7
9:00PM-10:00PM	81.1	109.5	83.2	86.9	99.6	76.2

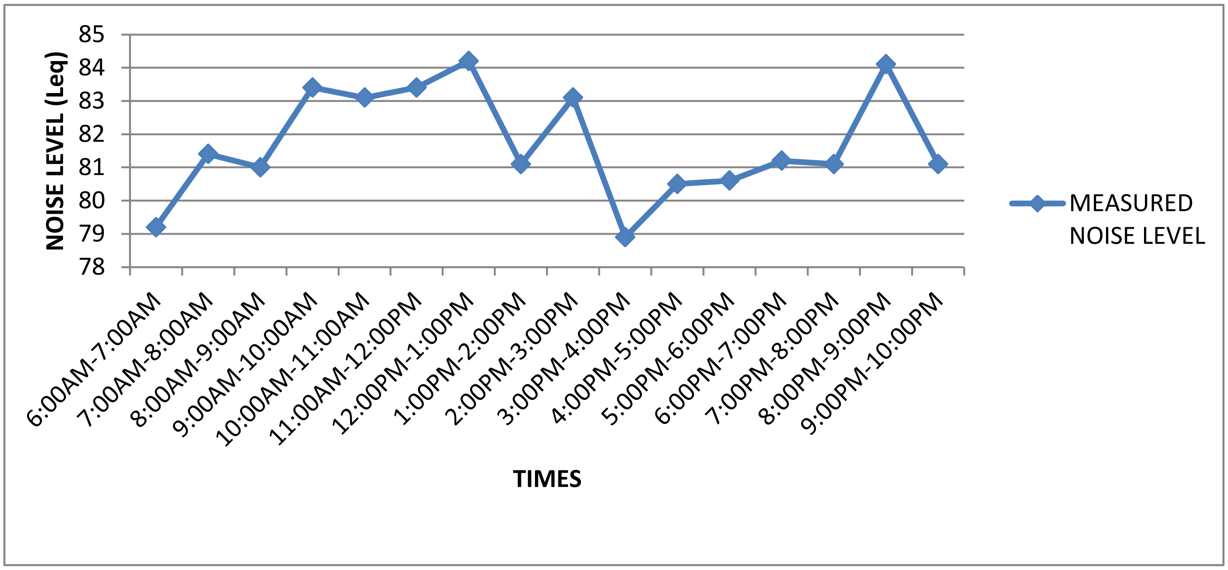


Fig 4.2:- (Noise variation on both side open at Bawana road , Rohini)

In fig. 4.2 A significant variation of noise level at Station 2 (both side open at Bawana road, Rohini) is observed. Minimum noise level is observed at afternoon (3:00-4:00) and the max level is observed at evening (8:00-9:00).

Table 4.3:- Station 3 (Near G3S mall, Rohini)

Time	Leq	Lpeak	L5	L10	L50	L90
6:00AM-7:00AM	62.8	87.7	76	66.7	58.4	55.2
7:00AM-8:00AM	64.5	102.5	75.4	73.4	53.8	54.4
8:00AM-9:00AM	76.3	106.4	83.7	82.4	78.4	71.9
9:00AM-0:00AM	74.7	104.2	72.7	72	68.2	63.6
10:00AM-:00AM	74.3	102.1	83.5	80.7	71.9	67.9
11:00AM-:00PM	76.6	118.3	82.3	80.3	75.8	70.2
12:00PM-:00PM	74.4	116.4	78	75.9	69.8	64.5
1:00PM-2:00PM	75.2	111.9	80.2	78.3	72.6	71.2
2:00PM-3:00PM	74.1	106	82.8	81.1	76.3	72
3:00PM-4:00PM	73.2	104.7	79.9	74.7	71	69.9
4:00PM-5:00PM	73.1	102	79.2	77.6	70.8	68.2
5:00PM-6:00PM	75	108.5	80.3	80.1	73.8	67.6
6:00PM-7:00PM	76.4	114.1	78.9	78.1	72.2	69.6
7:00PM-8:00PM	76.7	104.1	78	78.9	73.3	71.4
8:00PM-9:00PM	74.8	104	83.8	81.1	75.8	72.2
9:00PM-10:00PM	73	101.9	80	79.1	73.2	68.4

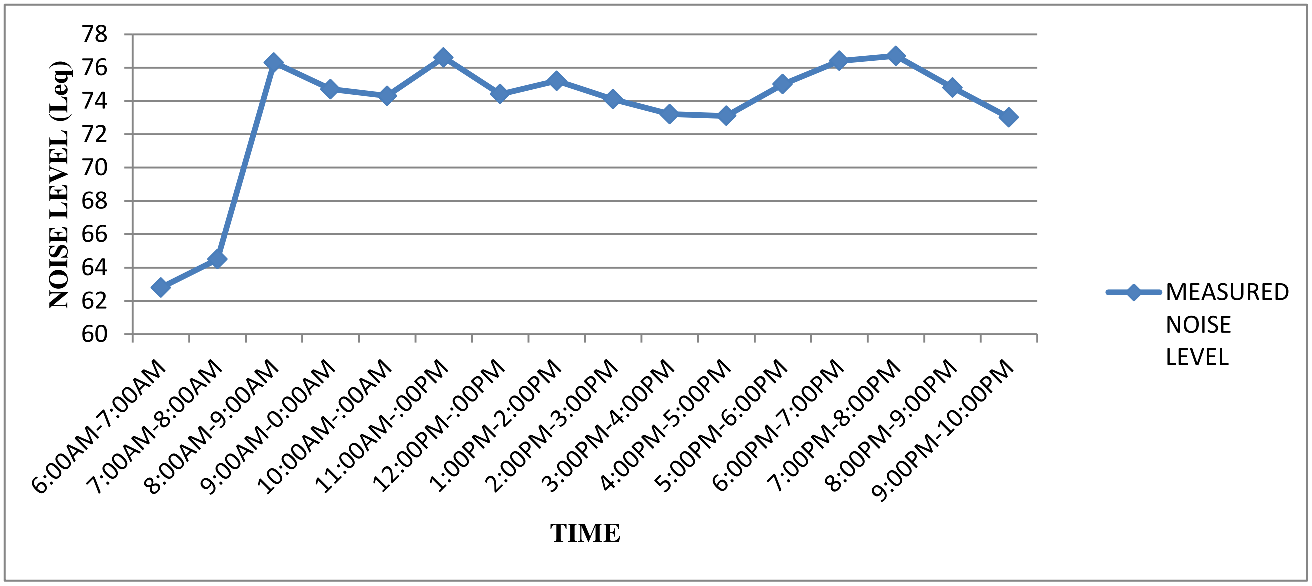


Fig. 4.3:- (noise variation at G3S mall, Rohini)

In fig 4.3 A significant variation of noise level at Station:-3 (near G3S mall, Rohini) is observed .Minimum noise level is observed at morning (6:00-7:00 AM) and the maximum noise level is observed at afternoon (7:00-8:00 PM).

Table 4.4 :- Station 4 (Residential Area Pocket-4 sector 11 block c , Rohini)

Time	Leq	Lpeak	L5	L10	L50	L90
6:00AM-7:00AM	62	86.2	64.2	63.5	61.1	59.4
7:00AM-8:00AM	68.2	96.7	70.6	69.5	66.8	66.8
8:00AM-9:00AM	71.8	99.6	79.1	75.7	68.6	64.2
9:00AM-0:00AM	70.2	94.1	73.8	71.7	68.8	68.3
10:00AM-1:00AM	69.9	103.6	68.2	67.9	66.7	66
11:00AM-2:00PM	67.3	105.6	76.2	75.5	68.3	61.8
12:00PM-1:00PM	66.5	99	75.9	75	61	54.9
1:00PM-2:00PM	67.5	102.7	76.2	71.7	62.1	56.3
2:00PM-3:00PM	66.3	97.2	67.8	66.1	56.5	53.2
3:00PM-4:00PM	64.5	103.6	60.7	59.3	55	53.6
4:00PM-5:00PM	63.4	103.6	67.2	63.9	58.3	55.2
5:00PM-6:00PM	67.8	110.1	71.4	70.9	62.4	59.2
6:00PM-7:00PM	68.8	100.8	65.8	63.6	57.9	54.8
7:00PM-8:00PM	69.4	96.6	95.1	93.2	65	57.6
8:00PM-9:00PM	65.1	97.1	63	62.2	59.3	57.8
9:00PM-10:00PM	59.4	88.9	61.6	61.2	57.1	56.7

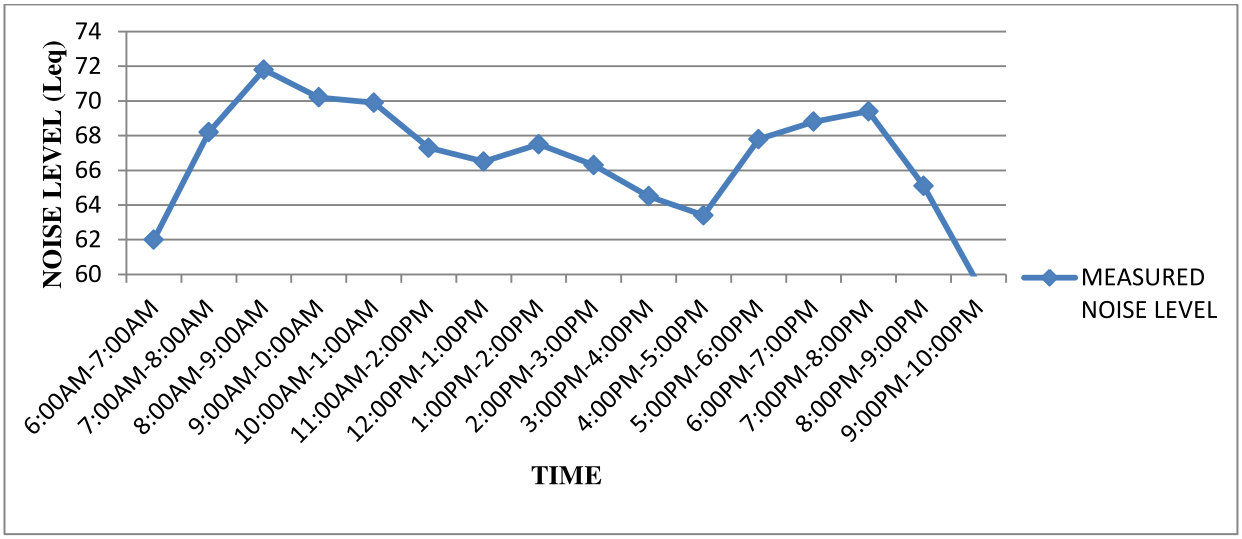


Fig 4.4:- (Noise variation at Resident area near G3S, Rohini)

In fig. 4.4 A significant variation of noise level at Station 4 (Residential Area Pocket-4 sector 11 block c , Rohini) is observed. Minimum noise level is observed at morning (9:00-10:00 AM) and the maximum noise level is observed at afternoon (8:00-9:00 PM).

Table 4.5:- Station 5 (F-1 Park Sector-16 , Rohini)

Time	Leq	Lpeak	L5	L10	L50	L90
6:00AM-7:00AM	54.9	81.2	55.1	56.3	52.1	51.8
7:00AM-8:00AM	55.2	84.8	56.9	55.8	53.7	52.6
8:00AM-9:00AM	56.2	99.1	58.1	56.5	53.2	51.6
9:00AM-10:00AM	56.6	93.3	59	58.3	56.4	54.9
10:00AM-11:00AM	55.7	91	61.4	58.1	53.7	52
11:00AM-12:00PM	54.9	84.5	58	57.3	53.6	51.7
12:00PM-1:00PM	56.4	95.5	56.5	55.1	53.1	51.8
1:00PM-2:00PM	55.7	95	56.4	55.1	53.6	52.7
2:00PM-3:00PM	57.7	93.9	57.8	57.2	54.8	53.5
3:00PM-4:00PM	57.2	96.4	59	56.9	54.1	52.2
4:00PM-5:00PM	57.9	102	59.5	57.8	54	52.4
5:00PM-6:00PM	60.9	97.3	66	65.4	60.7	58.4
6:00PM-7:00PM	61.5	99.3	61.4	61.1	59.5	57.5
7:00PM-8:00PM	62.5	92.9	66.3	66.7	60.3	57.5
8:00PM-9:00PM	61.5	102.6	67.8	66.4	62.6	59.6
9:00PM-10:00PM	58.5	92.8	63.3	60.4	57.5	55.9

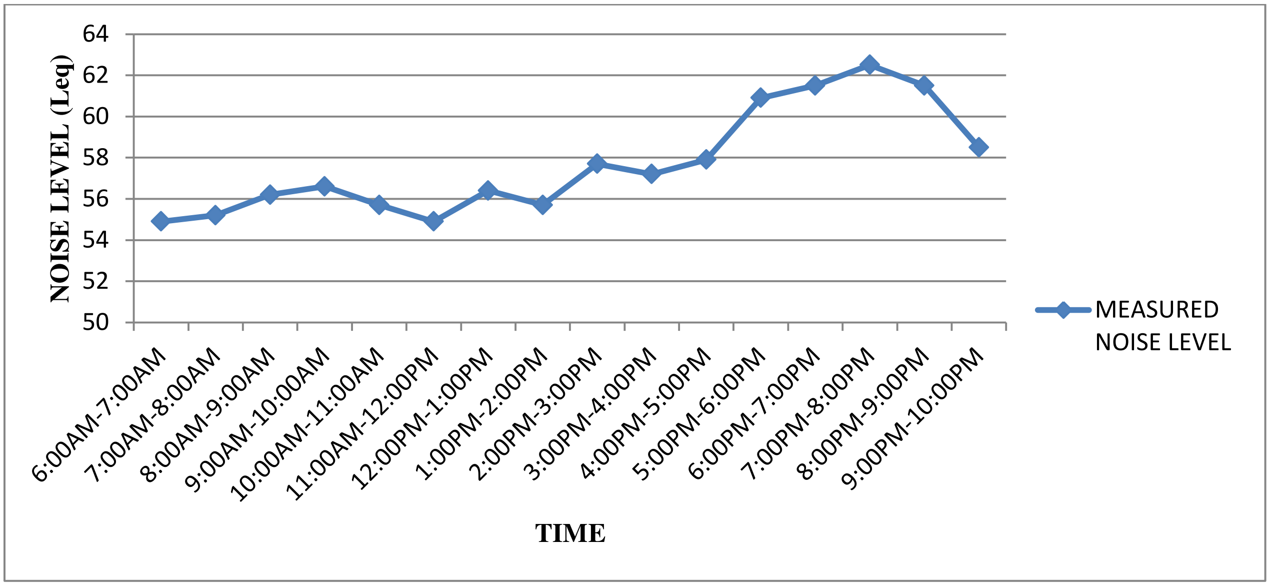


Fig 4.5:- (Noise variation at F1 park sector-16 , Rohini)

In fig. 4.5 A significant variation of noise level at Station 5 (F-1 Park Sector-16 , Rohini) is observed. Minimum noise level is observed at morning (6:00-07:00 AM) and the maximum noise level is observed at night (9:00-10:00 PM.

Table 4.6:- Station 6 (Building on Both Side at Sahabad Daulatpur Near DTU)

Time	Leq	Lpeak	L5	L10	L50	L90
6:00AM-7:00AM	79.3	107.2	79.7	79.2	75.9	72.6
7:00AM-8:00AM	81	105.9	55.7	83.7	78.9	73.7
8:00AM-9:00AM	83.1	114.7	93.3	91.2	83.3	80.4
9:00AM-10:00AM	84.7	118.2	93.3	90.7	83.2	76.1
10:00AM-1:00AM	83.5	117	84.8	82.3	75.2	71.4
11:00AM-2:00PM	83.7	112.7	93	87	79.1	75.7
12:00PM-1:00PM	82.8	110.9	89.3	86.5	81.6	78.3
1:00PM-2:00PM	81.3	114.7	78.3	77.4	71.2	67.6
2:00PM-3:00PM	86.6	109.6	84.9	84.2	77	68.4
3:00PM-4:00PM	83.1	112.5	85.2	84.5	78.3	66.1
4:00PM-5:00PM	83	114.9	92.9	90.8	82.6	77.5
5:00PM-6:00PM	83.9	112.5	80.9	80.1	74.4	71.4
6:00PM-7:00PM	84.6	116.6	89.5	88.4	78.8	70.2
7:00PM-8:00PM	85.2	111.1	91.9	93	81.6	77.4
8:00PM-9:00PM	86.1	115.5	96.1	95.2	85.2	80.5
9:00PM-10:00PM	86.8	115.2	80	86	79.5	74.7

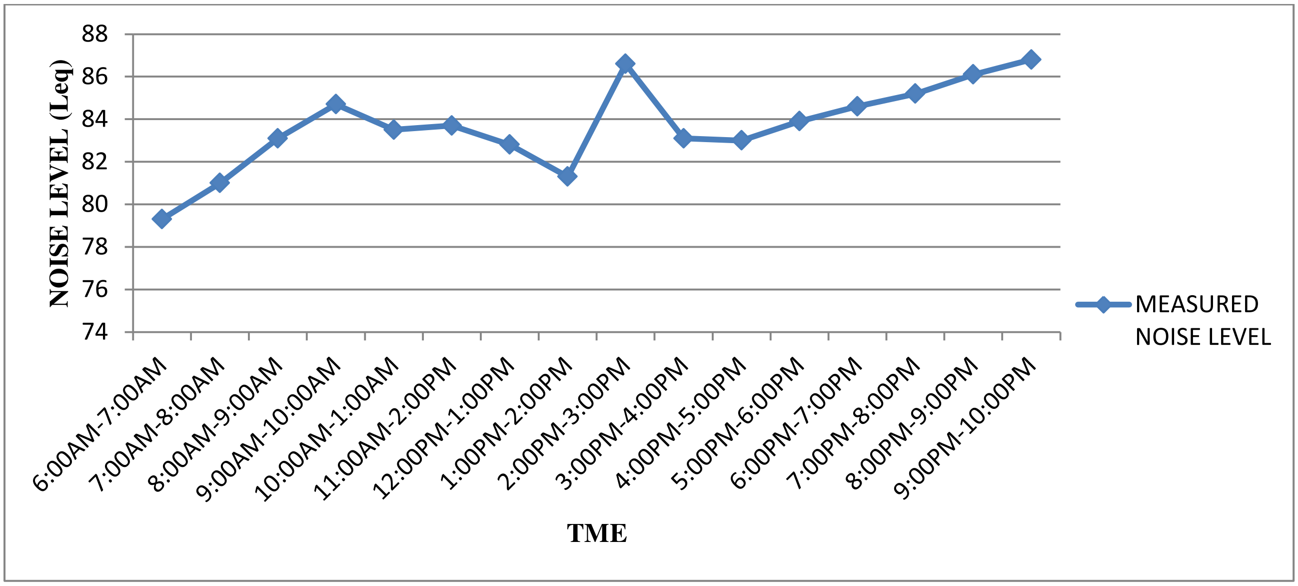


Fig 4.6:- Noise variation at Bawana road(building on both side), Rohini

In fig. 4.6 A significant variation of noise level at Station 6 (Building on Both Side at Sahabad Daulatpur near DTU) is observed. Minimum noise level is observed at morning (6:00-07:00 AM) and the maximum noise level is observed at night (9:00-10:00 PM).

Table 4.7:- Station 7 (Krishna Apartment (One Side Open and One Side Building) ,Rohini

Time	Leq	Lpeak	L5	L10	L50	L90
6:00AM-7:00AM	67.1	102.2	70.6	66.8	64	57.6
7:00AM-8:00AM	72.3	108.6	74.7	72.9	69.1	66.6
8:00AM-9:00AM	73.1	106	79.2	76.7	67	63.2
9:00AM-10:00AM	74	104.6	83.8	78.9	71.3	68.2
10:00AM-1:00AM	75.5	109	77.3	75.9	70.2	65.5
11:00AM-2:00PM	71.6	105.5	75	73.7	70.4	67.4
12:00PM-1:00PM	70.8	103.8	76.1	71.6	67.6	62.2
1:00PM-2:00PM	72	100	76.9	75.7	71.8	68.6
2:00PM-3:00PM	71.9	108.1	72.7	69.1	63.7	60.4
3:00PM-4:00PM	74.4	106.3	73.8	73.1	68.2	64
4:00PM-5:00PM	74.6	105.4	74.1	73.9	59.3	66.6
5:00PM-6:00PM	73.8	107.2	82.2	81.8	72.9	69
6:00PM-7:00PM	72.7	107.7	75.3	73.5	68.3	63.1
7:00PM-8:00PM	75.4	113.6	74.1	73.7	71.6	68.3
8:00PM-9:00PM	70.7	107.2	74.6	74.8	71	68.6
9:00PM-10:00PM	70.9	107.7	72.3	70.9	66.8	62.9

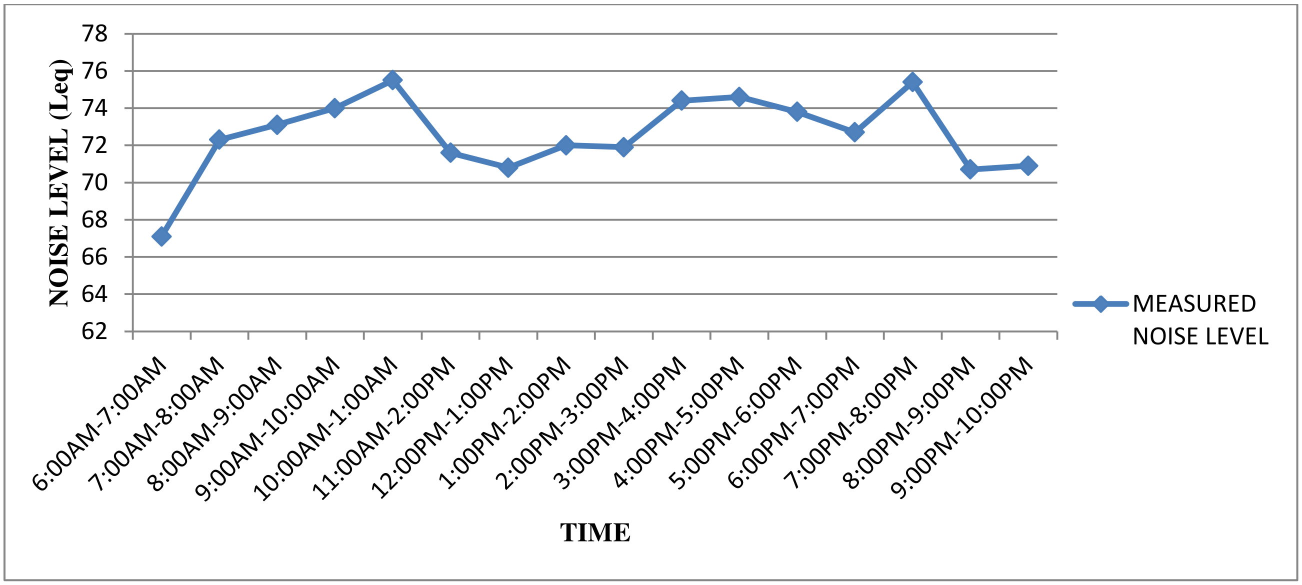


Fig.4.7 :- (Noise variation at Krishna apartment(one side building and one side open)

In fig. 4.7 A significant variation of noise level at Station 7 (Krishna Apartment (One Side Open and One Side Building) is observed. Minimum noise level is observed at morning (6:00-07:00 AM) and the maximum noise level is observed at night (7:00-8:00 PM).

4.2. Ambient noise level parameters have been calculated and compare with standard given by CPCB as shown in figure

Table 4.8:- Station 1 (DTU Campus, near canteen)

Time	Leq	Std Noise Level
6:00AM-7:00AM	52.1	45
7:00AM-8:00AM	57.8	45
8:00AM-9:00AM	59.6	45
9:00AM-10:00AM	63.5	45
10:00AM-11:00AM	67.8	45
11:00AM-12:00PM	67.2	45
12:00PM-1:00PM	73.2	45
1:00PM-2:00PM	74.7	45
2:00PM-3:00PM	75.4	45
3:00PM-4:00PM	75.1	45
4:00PM-5:00PM	74.5	45
5:00PM-6:00PM	68.8	45
6:00PM-7:00PM	72.2	45
7:00PM-8:00PM	56.6	45
8:00PM-9:00PM	52.5	45
9:00PM-10:00PM	49.4	45

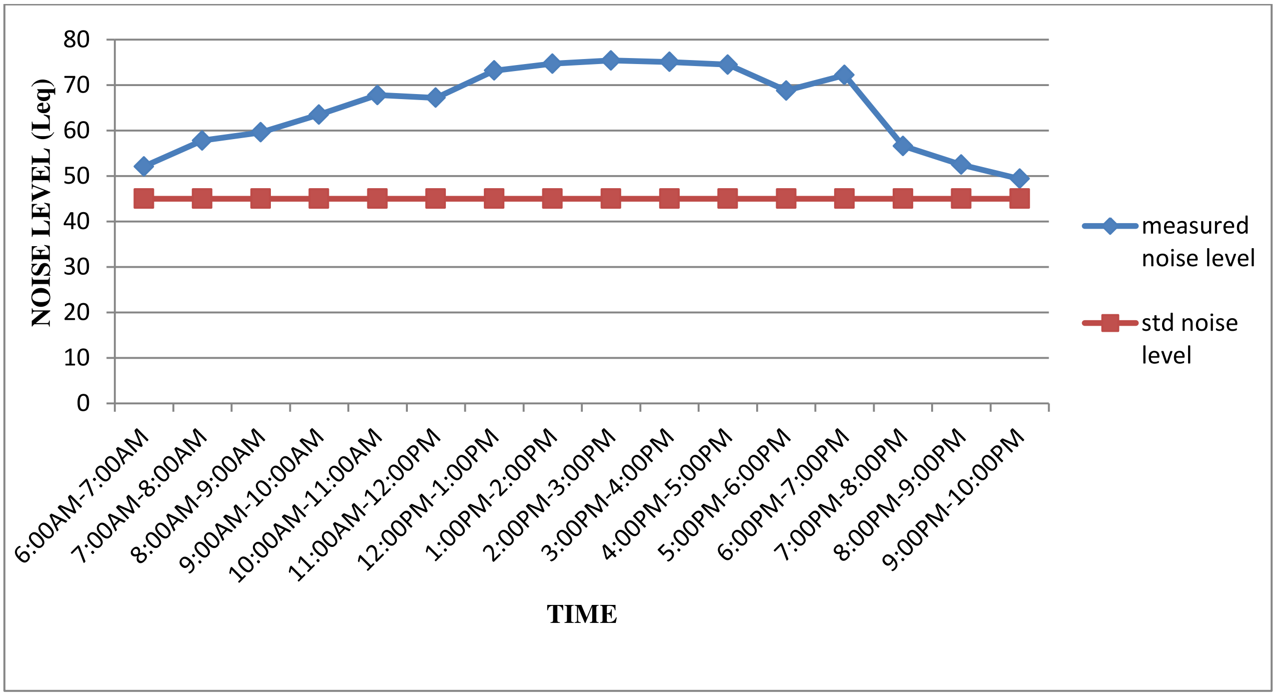


Fig 4.8:- (Comparison between noise level and std. noise level)

In fig 4.8 Station 2 (noise level at DTU Campus),the noise levels at all time is exceeding the standards of 45 dBA.

Table 4.9:- Station 2 (Both side open at Bawana road, Rohini)

Time	Leq	Std. Noise Level
6:00AM-7:00AM	79.2	65
7:00AM-8:00AM	81.4	65
8:00AM-9:00AM	81	65
9:00AM-10:00AM	83.4	65
10:00AM-11:00AM	83.1	65
11:00AM-12:00PM	83.4	65
12:00PM-1:00PM	84.2	65
1:00PM-2:00PM	81.1	65
2:00PM-3:00PM	83.1	65
3:00PM-4:00PM	78.9	65
4:00PM-5:00PM	80.5	65
5:00PM-6:00PM	80.6	65
6:00PM-7:00PM	81.2	65
7:00PM-8:00PM	81.1	65
8:00PM-9:00PM	84.1	65
9:00PM-10:00PM	81.1	65

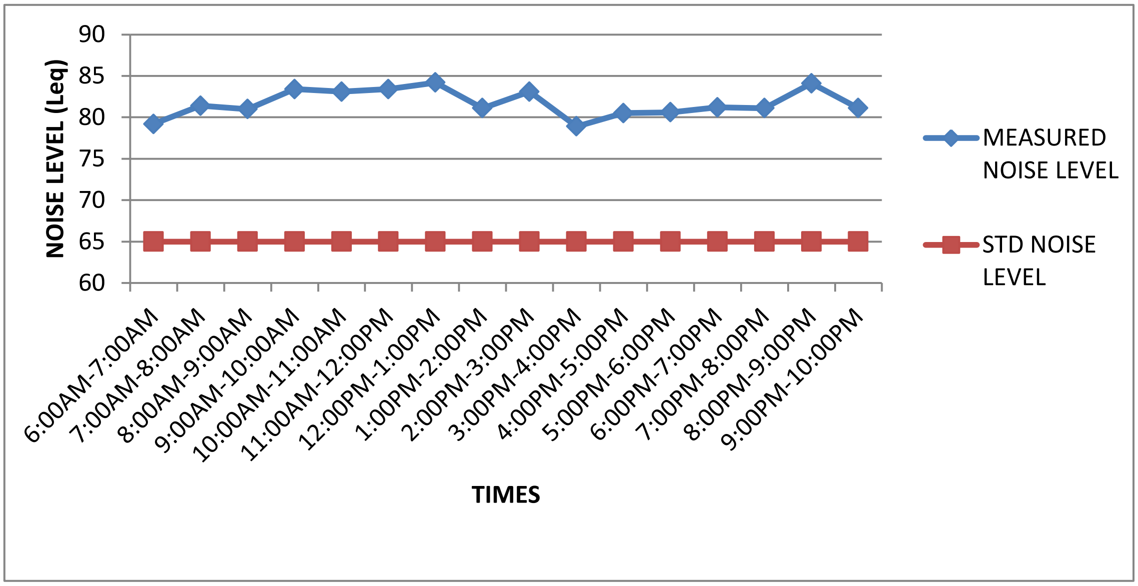


Fig 4.9:- (Comparison between noise level and std. noise level)

In fig 4.9 Station 2 (both side open at Bawana road Rohini),the noise levels at all time is exceeding the standards of 65 dBA.

Table 4.10:- Station 3 (near G3S mall, Rohini)

Time	Leq	Std Noise Level
6:00AM-7:00AM	62.8	65
7:00AM-8:00AM	64.5	65
8:00AM-9:00AM	76.3	65
9:00AM-10:00AM	74.7	65
10:00AM-11:00AM	74.3	65
11:00AM-12:00PM	76.6	65
12:00PM-1:00PM	74.4	65
1:00PM-2:00PM	75.2	65
2:00PM-3:00PM	74.1	65
3:00PM-4:00PM	73.2	65
4:00PM-5:00PM	73.1	65
5:00PM-6:00PM	75	65
6:00PM-7:00PM	76.4	65
7:00PM-8:00PM	76.7	65
8:00PM-9:00PM	74.8	65
9:00PM-10:00PM	73	65

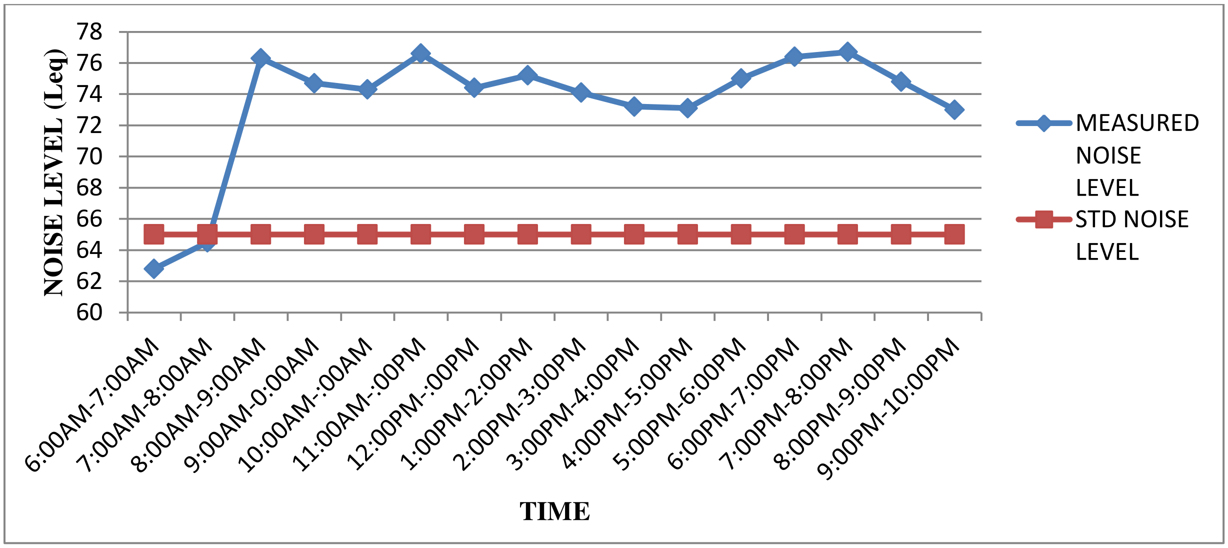


Fig 4.10:- (Comparison between noise level and std. noise level)

In fig 4.10 Station 3 (near G3S mall, Rohini), the noise levels from 6:00 AM to 8:00 AM is below the standard limit of 65 dBA given by CPCB. And from 8:00 AM to 10:00 PM noise level is exceeding standard limit of 65 dBA.

Table 4.11:- Station 4 (Residential Area Pocket-4 sector 11 block c, Rohini)

Time	Leq	Std Noise Level
6:00AM-7:00AM	62	55
7:00AM-8:00AM	68.2	55
8:00AM-9:00AM	71.8	55
9:00AM-10:00AM	70.2	55
10:00AM-11:00AM	69.9	55
11:00AM-12:00PM	67.3	55
12:00PM-1:00PM	66.5	55
1:00PM-2:00PM	67.5	55
2:00PM-3:00PM	66.3	55
3:00PM-4:00PM	64.5	55
4:00PM-5:00PM	63.4	55
5:00PM-6:00PM	67.8	55
6:00PM-7:00PM	68.8	55
7:00PM-8:00PM	69.4	55
8:00PM-9:00PM	65.1	55
9:00PM-10:00PM	59.4	55

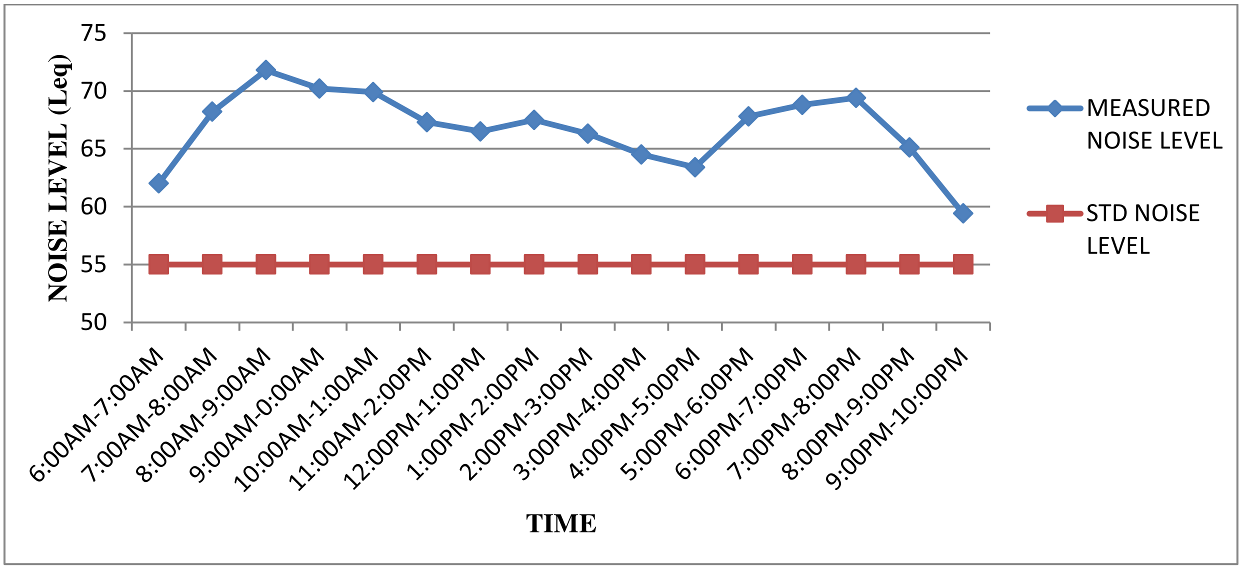


Fig 4.11:- (Comparison between noise level and std noise level)

In fig 4.11 Station 4 (Residential Area Pocket-4 sector 11 block C, Rohini), the noise levels at all time is exceeding the standards of 55 dBA.

Table 4.12:- Station 5 (F-1 Park Sector-16 , Rohini)

Time	Leq	Std. Noise Level
6:00AM-7:00AM	54.9	50
7:00AM-8:00AM	55.2	50
8:00AM-9:00AM	56.2	50
9:00AM-10:00AM	56.6	50
10:00AM-11:00AM	55.7	50
11:00AM-12:00PM	54.9	50
12:00PM-1:00PM	56.4	50
1:00PM-2:00PM	55.7	50
2:00PM-3:00PM	57.7	50
3:00PM-4:00PM	57.2	50
4:00PM-5:00PM	57.9	50
5:00PM-6:00PM	60.9	50
6:00PM-7:00PM	61.5	50
7:00PM-8:00PM	62.5	50
8:00PM-9:00PM	61.5	50
9:00PM-10:00PM	58.5	50

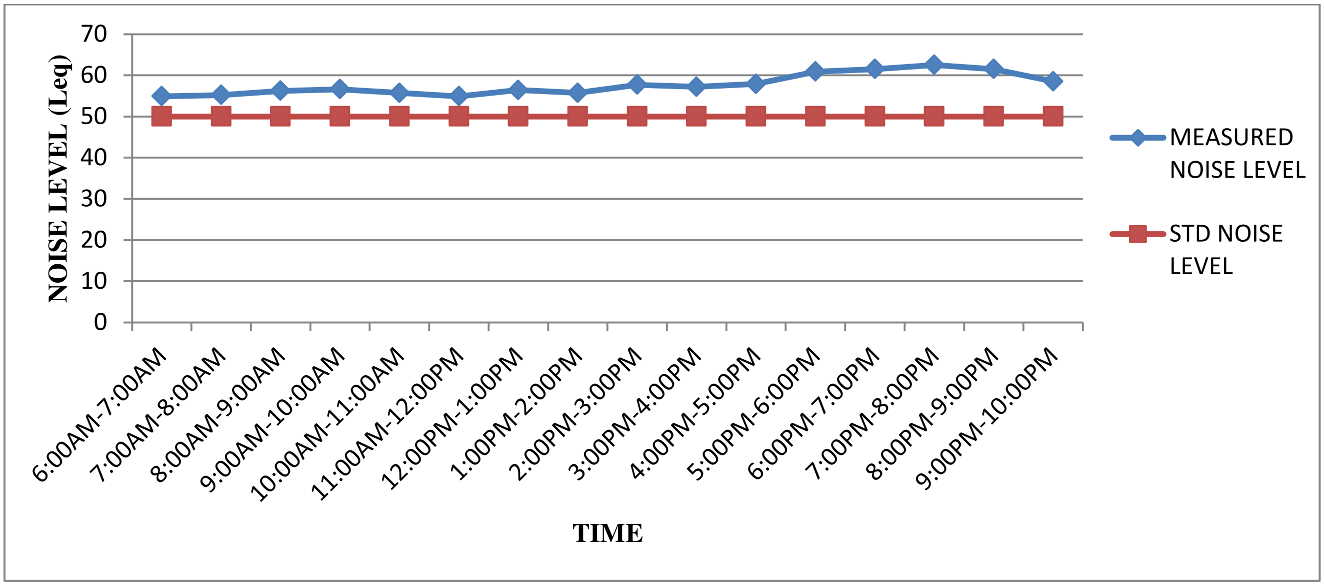


Fig 4.12:- (Comparison between noise level and std. noise level)

In fig 16 Station:-5(F-1 Park Sector-16 , Rohini),the noise levels at all time is exceeding the standards of 50 dBA.

Table 4.13:- Station 6 (Building on Both Side at Sahabad Daulatpur near DTU), Rohini

Time	Leq	Std. Noise Level
6:00AM-7:00AM	79.3	65
7:00AM-8:00AM	81	65
8:00AM-9:00AM	83.1	65
9:00AM-10:00AM	84.7	65
10:00AM-1:00AM	83.5	65
11:00AM-2:00PM	83.7	65
12:00PM-1:00PM	82.8	65
1:00PM-2:00PM	81.3	65
2:00PM-3:00PM	86.6	65
3:00PM-4:00PM	83.1	65
4:00PM-5:00PM	83	65
5:00PM-6:00PM	83.9	65
6:00PM-7:00PM	84.6	65
7:00PM-8:00PM	85.2	65
8:00PM-9:00PM	86.1	65
9:00PM-10:00PM	86.8	65

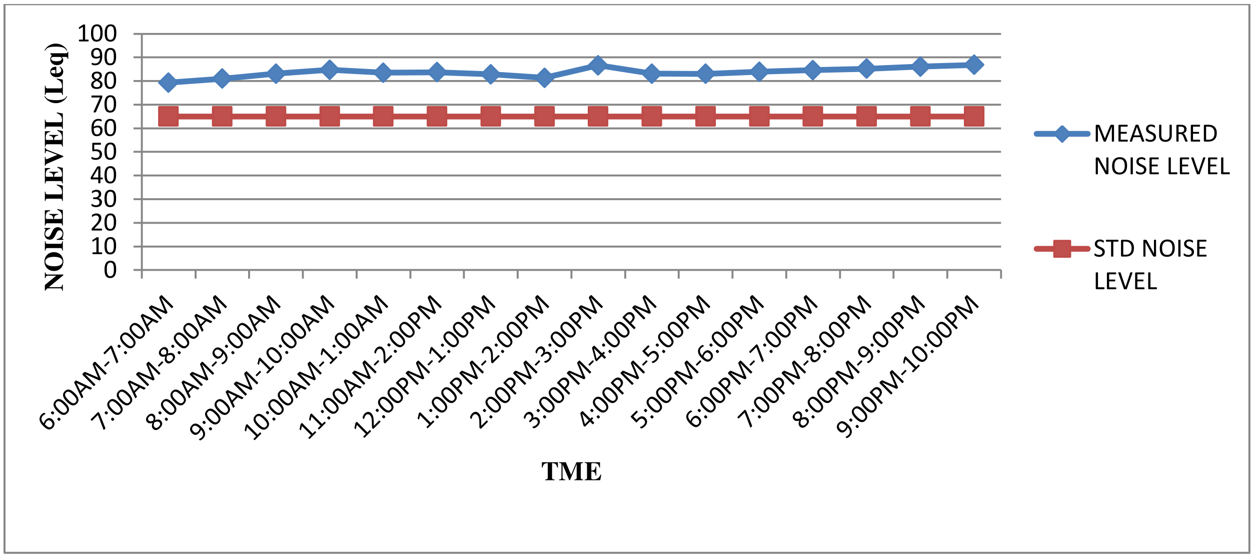


Fig 4.13:- (Comparison between noise level and std. noise level)

In fig 4.13 Station 6 (Building on Both Side at Sahabad Daulatpur near DTU), the noise levels at all time is exceeding the standards of 65 dBA.

Table 4.14:- Station 7 Krishna Apartment (one side open and one side building), Rohini

Time	Leq	Std Noise Level
6:00AM-7:00AM	67.1	65
7:00AM-8:00AM	72.3	65
8:00AM-9:00AM	73.1	65
9:00AM-10:00AM	74	65
10:00AM-1:00AM	75.5	65
11:00AM-2:00PM	71.6	65
12:00PM-1:00PM	70.8	65
1:00PM-2:00PM	72	65
2:00PM-3:00PM	71.9	65
3:00PM-4:00PM	74.4	65
4:00PM-5:00PM	74.6	65
5:00PM-6:00PM	73.8	65
6:00PM-7:00PM	72.7	65
7:00PM-8:00PM	75.4	65
8:00PM-9:00PM	70.7	65
9:00PM-10:00PM	70.9	65

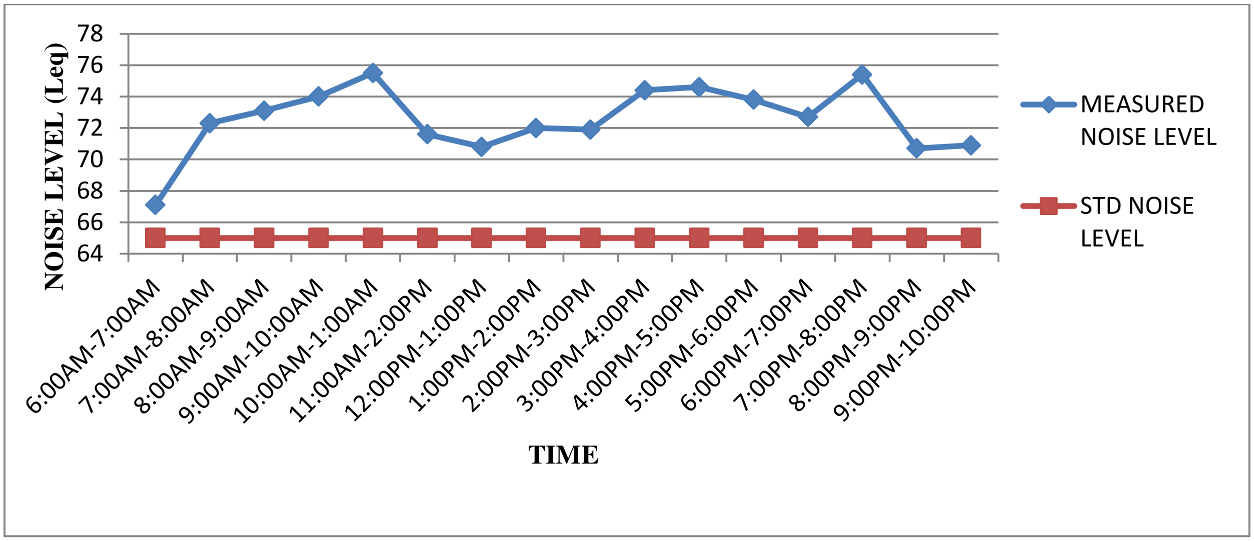


Fig 4.14:- (Comparison between noise level and std. noise level)

In fig 18 Station 7 Krishna Apartment (One Side Open and One Side Building), the noise levels at all time is exceeding the standards of 65 dBA.

Table 4.15:- Traffic Volume of Bawana road, Rohini

Time	bike	car	Auto	cycle	Bus	mini bus	Truck	tractor	Total no of vehicle/hur
6:00AM-7:00AM	154	123	71	75	21	12	38	7	501
7:00AM-8:00AM	201	173	191	78	34	18	41	2	738
8:00AM-9:00AM	288	234	189	113	42	24	34	0	924
9:00AM-10:00AM	189	201	178	54	36	29	53	1	741
10:00AM-1:00AM	203	192	189	71	28	34	62	2	781
11:00AM-2:00PM	222	188	175	75	31	26	72	0	789
12:00PM-1:00PM	191	168	201	81	38	31	51	0	761
1:00PM-2:00PM	210	156	151	78	37	28	68	4	732
2:00PM-3:00PM	221	144	169	74	45	24	70	2	749
3:00PM-4:00PM	211	156	159	78	32	18	63	6	723
4:00PM-5:00PM	276	232	138	156	40	11	52	3	908
5:00PM-6:00PM	314	216	168	127	35	9	66	1	936
6:00PM-7:00PM	301	234	172	98	48	17	54	0	924
7:00PM-8:00PM	319	241	158	103	39	23	61	2	946
8:00PM-9:00PM	351	175	126	200	40	22	101	1	1016
9:00PM-10:00PM	302	228	112	187	48	18	166	3	1064

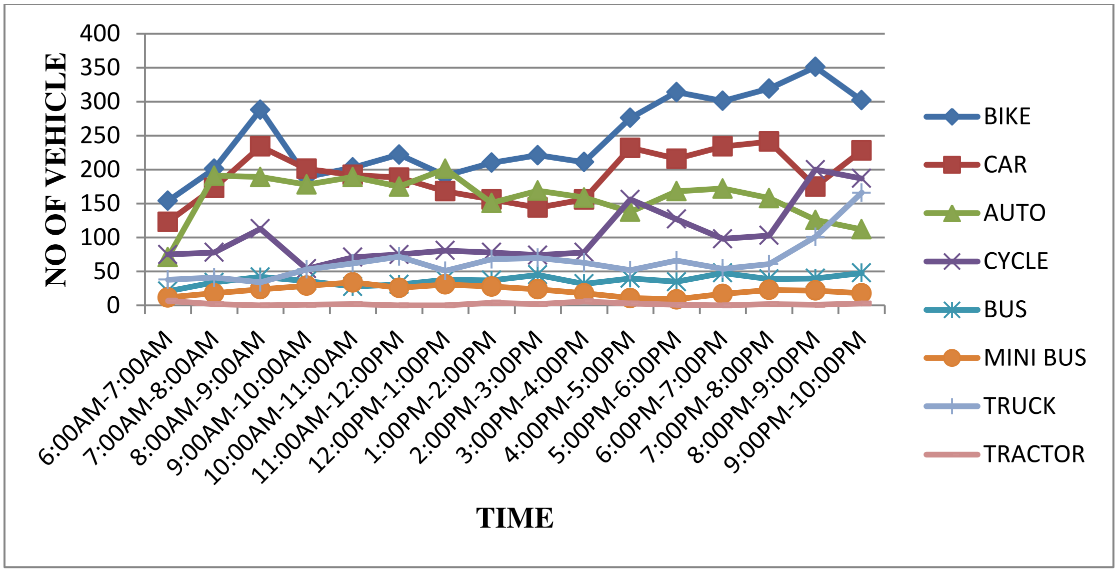


Fig 4.15:- (Variation between the No of the vehicle vs time at Bawana road)

In fig 4.15 we observed the traffic volume variation in whole day (6:00 AM to 10 PM) at Bawana road , as shown in figure above , The no of vehicle passing through section is very high at morning and at evening. But at afternoon is almost constant.

Composition of the total vehicle on Bawana road

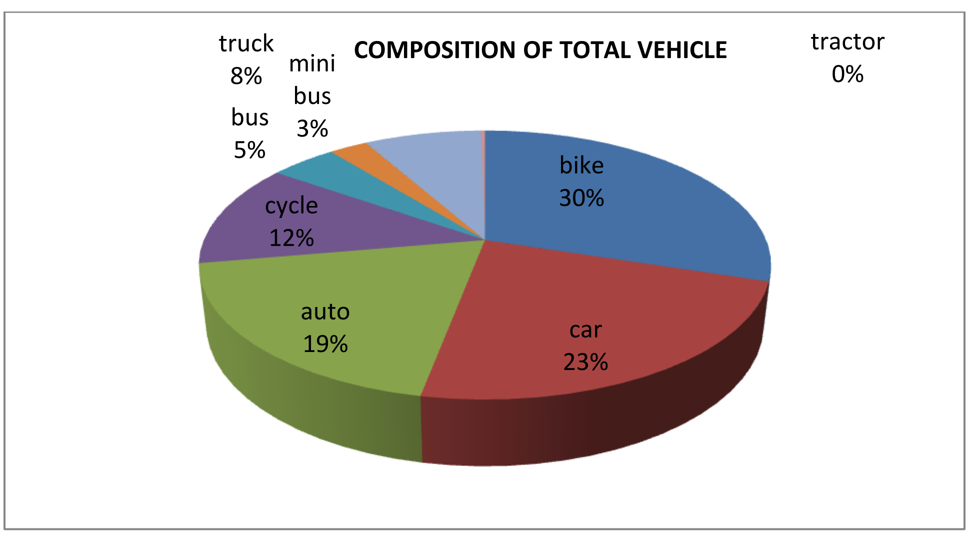


Fig 4.16:- (composition of the total vehicle on Bawana road)

composition of the total vehicle at Bawana road as shown above. In the figure percentage of bike passing through the section are very high whereas percentage of tractor and mini bus passing through section is very less.

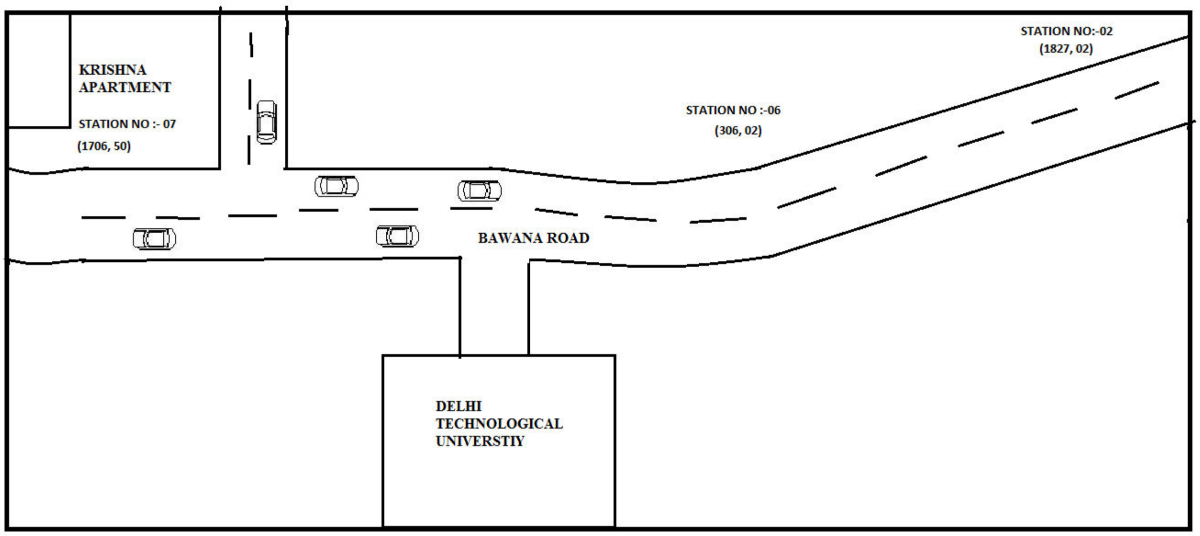
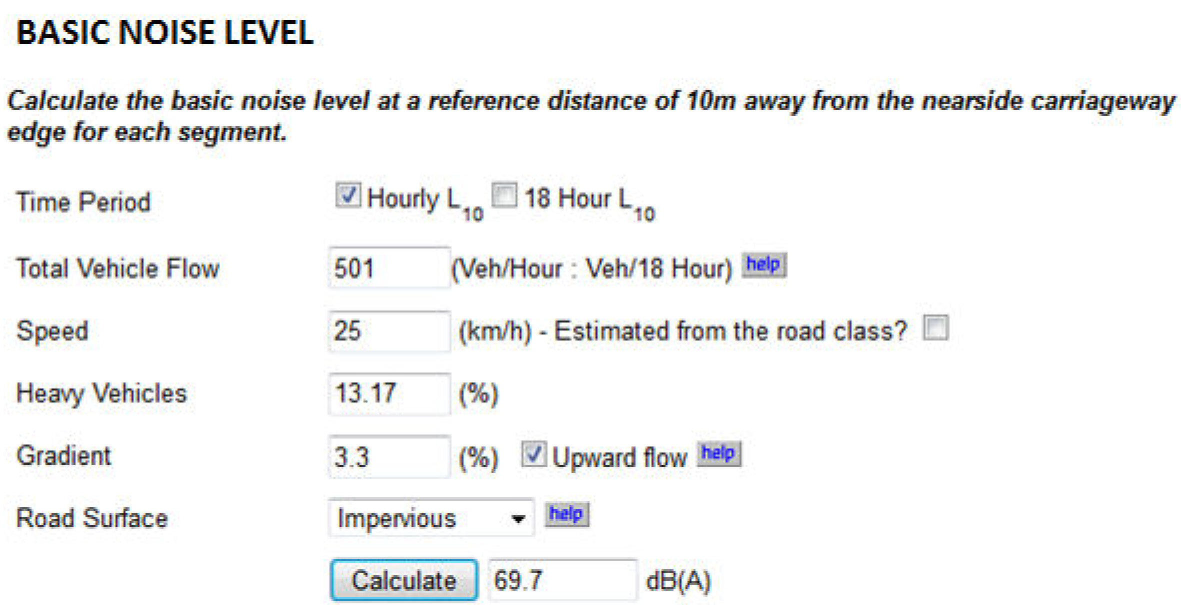


Fig 4.17:- (Layout of Bawana road, Rohini)

In fig.4.17:- layout of Bawana road as shown above, it shows the 3 station location with coordinates.

4.3 CRTN Noise Modeling

This model implements most of the procedure detailed in the calculation of road traffic noise (CRTN - ISBN 0 11 550847 3) issued by the department of transport in 1988. The aim has been to provide a basic platform for calculating road traffic noise levels for non-complex situations. The model is limited where for example; a separate calculation will be needed to take account of any complex arrangements of reflecting surfaces, as only a simple reflective correction is implemented here. Where consideration is to be given to situations where low traffic flows occur, it will be necessary to make specific reference to CRTN. In such cases, a further correction is generally needed, which is not implemented here.



4.4. Ambient noise level parameters has been calculated and compare with predicted noise level calculated by the CRTN model as shown in figure

Table 4.16:- Station 2 (both side open at Bawana road, Rohini)

TIME	Leq	Predicted (Leq)
6:00AM-7:00AM	79.2	69.7
7:00AM-8:00AM	81.4	70.7
8:00AM-9:00AM	81	71
9:00AM-10:00AM	83.4	71.1
10:00AM-11:00AM	83.1	70.2
11:00AM-12:00PM	83.4	70.6
12:00PM-1:00PM	84.2	70.1
1:00PM-2:00PM	81.1	70.7
2:00PM-3:00PM	83.1	70.9
3:00PM-4:00PM	78.9	70.5
4:00PM-5:00PM	80.5	70.6
5:00PM-6:00PM	80.6	70.8
6:00PM-7:00PM	81.2	70.8
7:00PM-8:00PM	81.1	70.9
8:00PM-9:00PM	84.1	72
9:00PM-10:00PM	81.1	73.4

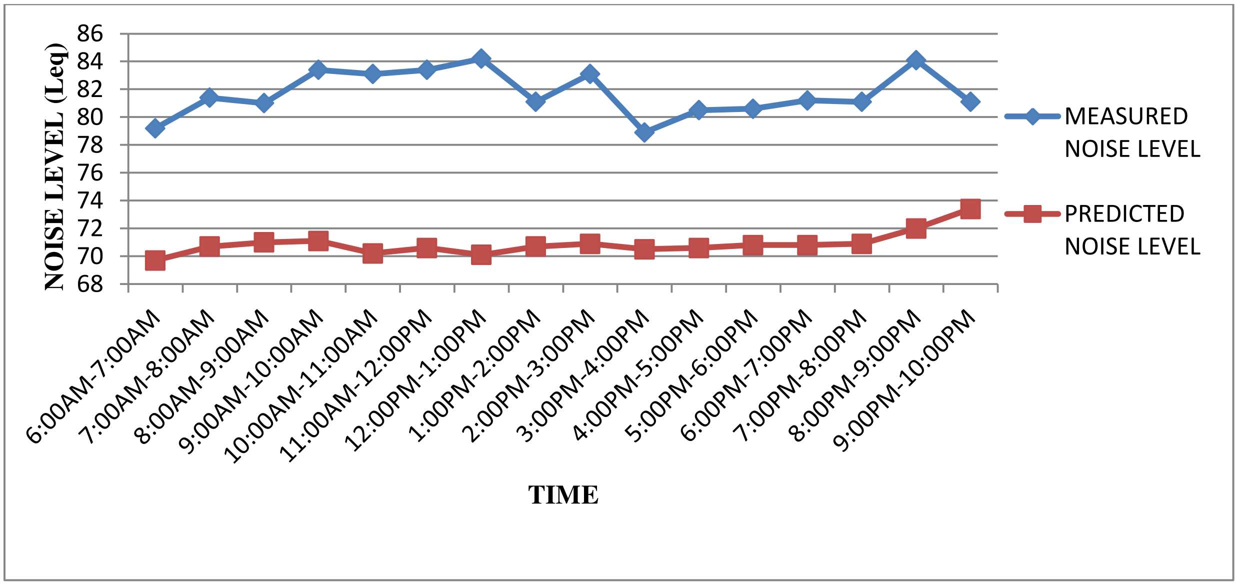


Fig 4.18:- (Comparison between noise level and predicted noise level)

In fig 4.18 Station2 (both side open at Bawana road, Rohini), the noise levels at all time is exceeding the predicted noise level.

Table 4.17:- Station 6 (Building on Both Side at Sahabad Daulatpur near DTU), Rohini

Time	Leq	Predicted (Leq)
6:00AM-7:00AM	79.3	69.7
7:00AM-8:00AM	81	70.7
8:00AM-9:00AM	83.1	71
9:00AM-10:00AM	84.7	71.1
10:00AM-1:00AM	83.5	70.2
11:00AM-2:00PM	83.7	70.6
12:00PM-1:00PM	82.8	70.1
1:00PM-2:00PM	81.3	70.7
2:00PM-3:00PM	86.6	70.9
3:00PM-4:00PM	83.1	70.5
4:00PM-5:00PM	83	70.6
5:00PM-6:00PM	83.9	70.8
6:00PM-7:00PM	84.6	70.8
7:00PM-8:00PM	85.2	70.9
8:00PM-9:00PM	86.1	72
9:00PM-10:00PM	86.8	73.4

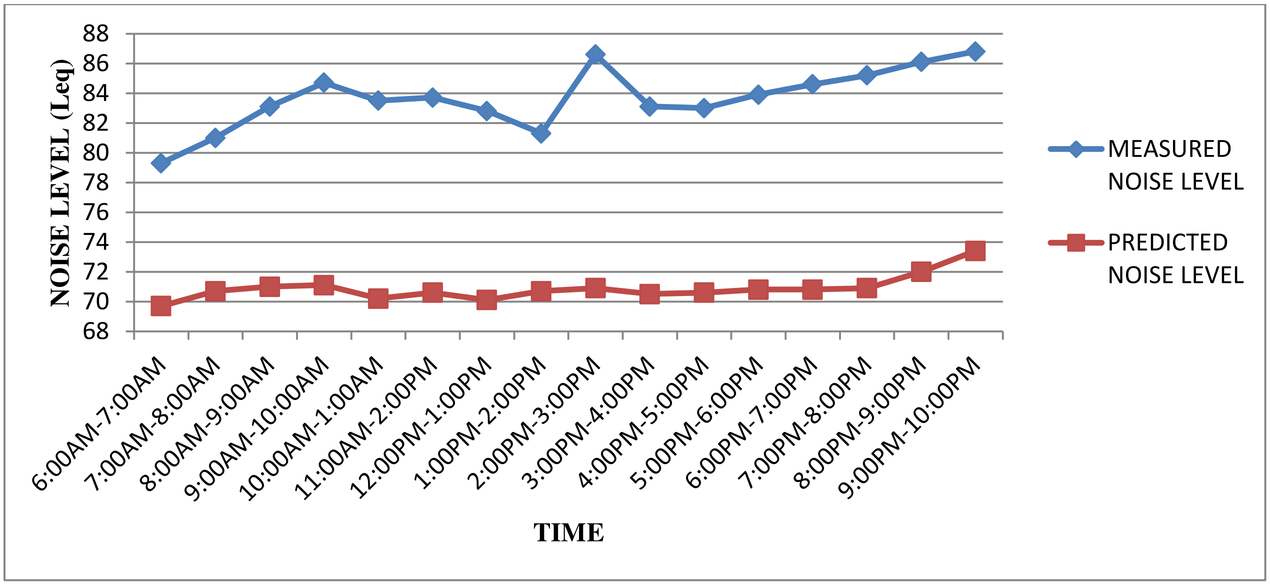


Fig 4.19:- (Comparison between noise level and predicted noise level)

In fig 4.19 Station 6 (Building on Both Side at Sahabad Daulatpur near DTU), the noise levels at all time is exceeding the predicted noise level.

Table 4.18:- Station 7 Krishna Apartment (One Side Open and One Side Building), Rohini

Time	Leq	Predicted (Leq)
6:00AM-7:00AM	67.1	69.7
7:00AM-8:00AM	72.3	70.7
8:00AM-9:00AM	73.1	71
9:00AM-10:00AM	74	71.1
10:00AM-1:00AM	75.5	70.2
11:00AM-2:00PM	71.6	70.6
12:00PM-1:00PM	70.8	70.1
1:00PM-2:00PM	72	70.7
2:00PM-3:00PM	71.9	70.9
3:00PM-4:00PM	74.4	70.5
4:00PM-5:00PM	74.6	70.6
5:00PM-6:00PM	73.8	70.8
6:00PM-7:00PM	72.7	70.8
7:00PM-8:00PM	75.4	70.9
8:00PM-9:00PM	70.7	72
9:00PM-10:00PM	70.9	73.4

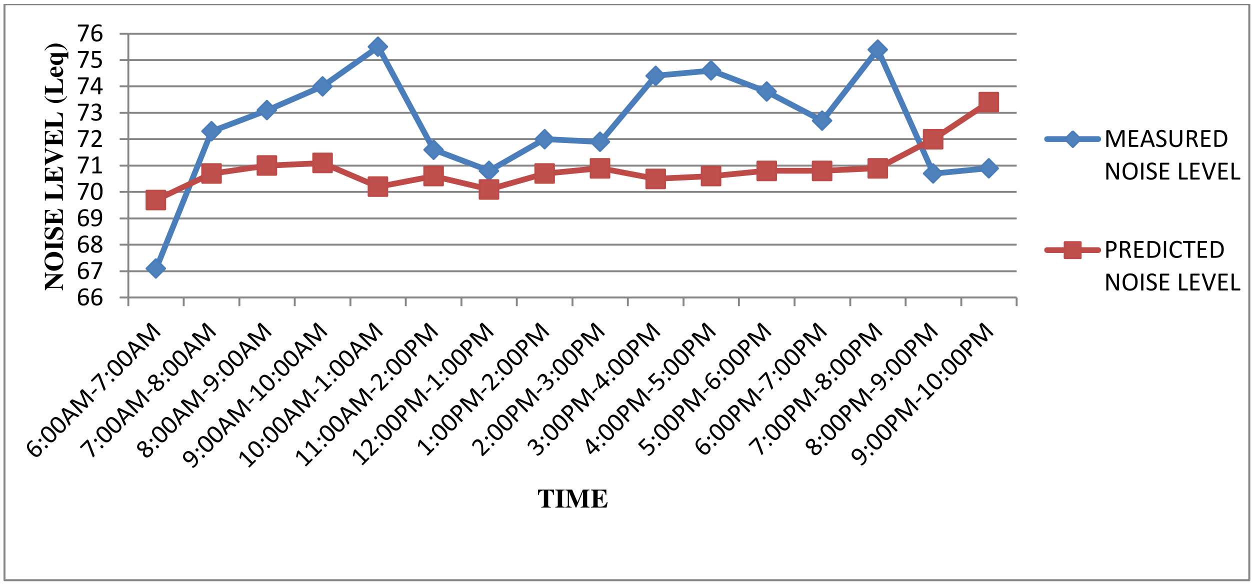


Fig 4.20:- (Comparison between noise level and predicted noise level)

In fig 4.2 Station 7 Krishna Apartment (One Side open and one Side Building at Rohini), the noise levels at all time is exceeding the predicted noise level.

Table 4.19:- Ambient Noise Level Comparison between residential area, commercial area and silence area

Time	Leq 1	Leq 2	Leq 3
6:00AM-7:00AM	62.8	62	54.9
7:00AM-8:00AM	64.5	68.2	55.2
8:00AM-9:00AM	76.3	71.8	56.2
9:00AM-10:00AM	74.7	70.2	56.6
10:00AM-11:00AM	74.3	69.9	55.7
11:00AM-12:00PM	76.6	67.3	54.9
12:00PM-1:00PM	74.4	66.5	56.4
1:00PM-2:00PM	75.2	67.5	55.7
2:00PM-3:00PM	74.1	66.3	57.7
3:00PM-4:00PM	73.2	64.5	57.2
4:00PM-5:00PM	73.1	63.4	57.9
5:00PM-6:00PM	75	67.8	60.9
6:00PM-7:00PM	76.4	68.8	61.5
7:00PM-8:00PM	76.7	69.4	62.5
8:00PM-9:00PM	74.8	65.1	61.5
9:00PM-10:00PM	73	59.4	58.5

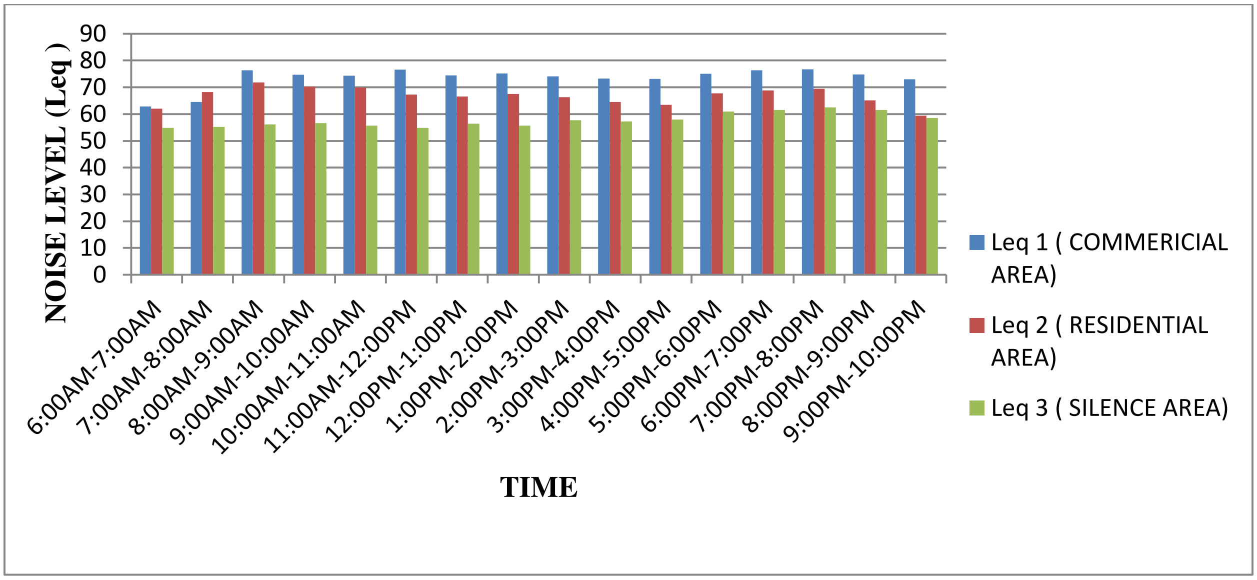


Fig 4.21:- (Comparison between noise level at residential, commercial and silence area)

In fig. 4.21 as shown above figure we draw the graph in between commercial, residential and silence area. as seeing the graph noise level is very high in commercial area whereas the noise level is very low in silence area and noise level in residential area in between two.

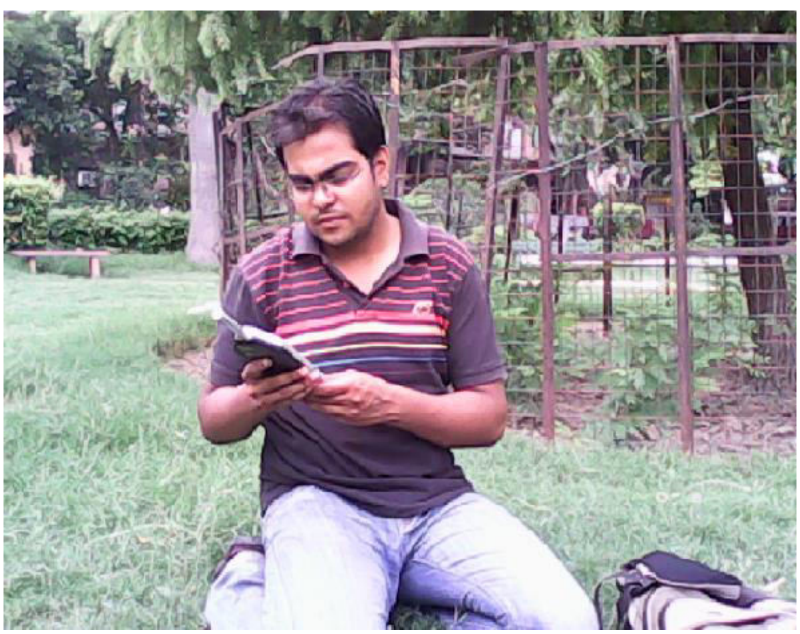


Photo:- 1

Photo :- 2

Photo :- 3

Photo :- 4

Photo :- 5

CHAPTER-5

CONCLUSION & REMEDIAL MEASURES

5. CONCLUSIONS & REMEDIAL MEASURES

5.1 Conclusion

From the observations taken by using noise level meter and by using CRTN MODEL at the selected station at Rohini area , it was found that the

- In fig 4.8 Station 2 (noise level at DTU Campus, near canteen),the noise levels at all time is exceeding the standards of 45 dBA. During day time having average value of 65.025 dBA.

- At Station 2 (both side open at Bawana road, Rohini),the noise levels at all time is exceeding the standards of 65 dBA. during day time average value is 81.7125 dB(A).

- At Station 3 (near G3S mall, Rohini), the noise levels from 6:00 AM to 8:00 AM is below the standard limit of 65 dBA . And from 8:00 AM to 10:00 PM noise level is exceeding standard limit of 65 dBA. At this location noise level having average value of 73.4 dB(A).

- At Station 4 (Residential Area Pocket-4 sector 11 block c , Rohini),the noise levels at all time is exceeding the standards of 55 dBA. At this location noise level having average value of 66.75 dB(A).

- At Station 5 (F-1 Park Sector-16 , Rohini),the noise levels at all time is exceeding the standards of 50 dBA. At this location noise level having average value of 57.70 dB(A).

- At Station 6 (Building on Both Side at Sahabad Daulatpur near DTU, Rohini) .The noise levels at all time is exceeding the standards of 65 dBA. At this location noise level having average value of 83.66 dB(A).

- At Station 7 Krishna Apartment (one Side open and one Side Building) Rohini , the noise levels at all time is exceeding the standards of 65 dBA. At this location noise level having average value of 72.55 dB(A).

- In figure no 19 Station:-4 (both side open at Bawana road, Rohini) the noise levels at all time is exceeding the predicted noise level. At this location noise level having average value of 81.71 dB(A).

- In figure no 23 Station:-6 (Building on Both Side at Sahabad Daulatpur Near DTU), the noise levels at all time is exceeding the predicted noise level. At this location noise level having average value of 83.66 dB(A).

- In figure no 23 Station:-7 (Krishna Apartment (One Side Open and One Side Building , Rohini),the noise levels at all time is exceeding the predicted noise level. At this location noise 098level having average value of 72.55 dB(A).

From the observations taken by using noise level meter and by using CRTN model at the selected station at Rohini area , it was found that the sound exceeds permissible limit of 55 dBA for residential , 65dBA for commercial area and 50 dBA for silent area . On all study at the selected location the maximum noise limits were ranging between 70 dBA to 110 dBA which was almost 1.5 times the permissible limits for commercial zone. This variation of sound from 70dBA to 120dBA may have moderate to very sever effects on human health such as, poor concentrations, stress, cardiovascular illness and many more. It is very essential to control noise at source, along the transmission path and at receivers end by using the remedial measures.

5.2 Remedial measures

Since the fact that public health has been matter of great concern for us control of noise pollution is necessary. The remedial measure for noise pollution can be broadly classified as control at source, control in the transmission path, using protective equipment. The noise pollution can be controlled at the source of generation itself by reducing the noise levels from domestic sectors, maintenance of automobiles, control over vibrations, low voice speaking, prohibition on usage of loud speakers and optimum selection of machinery, tools or equipment reduces excess noise levels. The change in the transmission path will increase the length of travel for the wave and get absorbed/refracted/radiated in the surrounding environment. The noise pollution can be reduced during transmission path by vegetation, installation of barriers and design of the building incorporating the use of suitable noise absorbing material for wall/door/window/ceiling will reduce the noise levels. protective equipment usage is the ultimate step in noise control technology i.e., after noise reduction at source and after diversion or engineer control of transmission path of road. The usage of protective equipment and the worker's exposure to the high noise levels can be minimized by job rotation, exposure reduction, hearing protection, use of equipment like earmuffs, ear plugs etc. are the commonly used devices for hearing protection. Attenuation provided by ear-muffs varies widely in respect to their size, shape, seal material etc. Literature survey shows that, average noise attenuation up to 32 dB can be achieved using earmuffs. Also strict enforcement of existing law to prohibit air horns inside the town, proper maintenance of the vehicles, laying good roads and their maintenance, strict enforcement of the existing law to remove the encroachments on road sides, plantation of trees like neem and coconut and other vegetation inside the town on road sides and around the silence zone, highly noise producing machines can be kept in isolated buildings and glass cabin can be provided, educating people about the hazards of loud sound and restriction on the use of pressure horns, loud speakers and fire crackers shall play an important role in mitigating sound will reduce the noise levels.

6. REFERENCE

(1) A. Khan, and P. Kumkum, “Noise Assessment for Different Equipment and Traffic Modeling for Interrupted Traffic Flow for Dhak City,” B.Sc. diss., Dept. Civil. Eng., Bangladesh Univ. of Eng. and Tech., Dhaka, Bangladesh, 2010.

(2) Akbar Ziauddin, Rohit Sing Bahel and Siddiqui.N.A,(2007), Noise Pollution levels in the city of Dehradun, Ec. Env. & Consrtuction, vol. 13(4), pp. 891-893.

(3) Ahamad Jamrah, Abbas Al Omari and Reem Sharabi, (2006), Evaluation of traffic noise pollution in Amman, Jordan, Environmental Monitoring and Assessment, vol 120, pp 499-525.

(4) British Standards Institution. BS EN ISO 1793, Parts 1 – 3: 1998, *Road traffic noise reducing devices – Test method for determining the acoustic performance.* BSI, London.

(5) British Standards Institution. BS EN ISO 1794, Parts 1 – 2: 2003, *Road traffic noise reducing devices – Non-acoustic performance.* BSI, London.

(6) Deb Dulal Tripura and Partha Pratim Sarkar, (2011), Traffic Noise Prediction Model in Agartala City, India, International Review of Applied Engineering Research, vol 1(1), pp 93-98.

(7) F. Ahmed, “Study on Noise Pollution Caused by Road Traffic in Dhaka City,” B.Sc. diss., Dept. Civil. Eng., Bangladesh Univ. of Eng.and Tech., Dhaka, Bangladesh, 1999

(8) Gabriela Demian, MihaiDemian, Luminita Grecu, Studies about noise pollution in urban areas’ Proceedings of the 10th WSEAS International Conference on Acoustics & Music : Theory & Applications, pp 87-91.

(9) Goswami, Sh, Road Traffic Noise: A case study of Balasore town, Orissa, India, International Journal of Environmental Research, vol 3(2), pp 309-316.

(10) Jobair Bin Alam. Md., Rauf. A.F.M.A and Ahemed. M.F,(2001), Traffic Induced Noise Pollution in Dhaka, Journal of Civil Engineering, The Institute of Engineers, CE29 vol 1, pp 55-63

(11) Jorge Sommerhoff, Manuel Recuero,Enrique Suarez,(2004), Community noise survey of the city of Valdivia, Chile, Applied Acoustics, vol 65 ,pp 643-656.

(12) Krishna Murthy.V, Ahamad KamruzzamanMajunder, Sanjay Nath Khanal, Deepak Prasad Subedi, (2007), Assessment of Traffic noise Pollution in Badepa, a Semi urban town of Nepal, Kathmandu University Journal of Science, Engineering and Technology, vol 1(No IV), pp 1-9.

(13) Kucas, A., Hoej, J., and Frederiksen, R.Efficient Noise Mapping using ArcGIS and detailed Noise Propagation Simulation. 2007 ESRI European User Conference.

(14) L.R. Kadiyali, Traffic Engineering and Transportation Planning, 6th Ed. India: Khanna, 1997, ch. 46, pp.836-842.

(15) Mahesh Chand and Anu. P. Alex,(2010) Traffic Noise Prediction Modelling and Analysis for Trivananthapuram city, Indian Highways, pp 31-40.

(16) Nirjar.R.S., .Jain.S.S, Parida.M,Katiyar.V.S., Mittal.N,(2003), A study of transport related noise pollution in Delhi, IE (I) Journal- EN, pp 6-15.

(17) Part 2 of BS EN ISO 1794, see Reference 4.

(18) Paulo Henrique Trombetta Zannin, Andressa Maria Coelho Ferreria and Bani Szeemetta, (2006), Evaluation of noise pollution in urban parks, Environmental Monitoring and Assessment vol 118 , pp 423-433

(19) Pichai PAmanikabud, Prakob Vivitjinda, (2002), Noise Prediction for highways in Thailand, Transportation Research Part D, vol 7 , pp 441-449.

(20) P.R. Rao, and M.G. Rao, (1991), Urban Traffic Intensity and Prediction of (Leq) Noise Level, Indian Journal of Environmental Health, National Environmental Engineering Research Institute, India.

(21) R.T. Sooriyaarachchi and D.U.J. Sonnadara,“Development of a Road Traffic Noise Prediction Model”, in Proc. of the Technical Sessions, Institute of Physics, Colombo, 2006, pp. 17-24.

(22) Reagan, Jerry A., Grant, Charles A. Special Report Highway Construction Noise: Measurement, Prediction and Mitigation. Washington, DC: FHWA, 1977.

(23) Rawat. K, Katiyar V.K, Praatibha,(2009),Mathematical Modelling of Environmental Noise Impact, International Journal of Biomechanics, Special issue, pp 75-81.

(24) Stjepan Lakusic and Vesna Dragcevic,(2008), Toward noise modelling in urban areas, Second Asia International Conference on Modelling& Simulation, pp 666-671.

(25) Swedish Environmental Protection Agency.Environmental impact from different modes of transport- Method of comparison, March 2002.

(26) The European Parliament and The Council of The European Union, Directive 2002/49/EC of The European Parliament and of The Council. *Official Journal of The European Communities*, 18.7.2002.

(27) Tang. S.K. and Tong K.K.,(2004),Estimating traffic noise for inclined roads with freely flowing traffic, Applied Acoustics, vol 65 , pp 171-181.

(28) The Highways Agency (1995). *Design manual for roads and bridges,* Volume 10 *Environmental design,* Section 5, Part 2, sub section 7. HMSO, London.

(29) The Highways Agency (1995). *Design manual for roads and bridges,* Volume 10 *Environmental design,* Section 5, Part 2, sub section 6. HMSO, London.

(30) T. Subramani, M. Kavitha, and K. P. Sivaraj, (2012), Modelling of Traffic Noise Pollution, IJERA, vol. 2, pp. 3175-3182.

(31) World Health Organization 1999. B Berglund, T Lindvall, D H Schwela editors).*Guidelines or community noise*. WHO.www.who.int/docstore/peh/noise/guidelines2.html

(32) Zekry F. Ghatass, (2009), Assessment and analysis of traffic noise pollution in Alexandria city, Egypt, World Applied Sciences Journal vol 6(3), pp 433-441.

Annexure - I

National Ambient Noise Quality Standard

Category of Area	Limit in dB(A) Leq	
	Day time	**Night time**
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

- Day time is reckoned between 6 am to 10 pm
- Night time is reckoned between 10 pm to 6 am
- Silence zone is defined as areas upto 100 m around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority

Annexure-II

Degree of Hearing Loss (**WHO classification**); WHO (1980) recommended the following classification on the basis of pure tone audiogram taking the average of the thresholds of hearing for frequencies of 500, 1000 and 2000 Hz with reference to ISO : R. 389-1970 (international calibration of audiometers).

Hearing loss and difficulty in hearing speech:

Hearing threshold in better ear (average of 500, 1000, 2000)	Degree of impairment (WHO classification)	Ability to understand speech
0-25	Not significant	No significant difficulty with faint speech
26-40	Mild	Difficulty with faint speech
41-55	Moderate	Frequent difficulty with normal speech
56-70	Moderately sever	Frequent difficulty even with loud speech
71-91	Severe	Can understand only shouted or amplified speech
above 91	Profound	Usually cannot understand even amplified speech