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Study of Noise Mapping at Moolchand Road Phargang-New Delhi

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ABSTRACT

India's cities are growing rapidly, resulting in wide variety of environmental stresses. Delhi's current population is 18 million is growing rapidly. The results show that Delhi is developing very rapidly. The study shows that a 122% increase in highly dense area was recorded during last decade in Delhi. The pollution load has increased in terms of air, water, noise, and solid waste generation and disposal, etc. One of the many environmental problems faced is related to noise pollution. Many important places like Hospitals and Residential areas have been to be made Noise free. In most of the surveys conducted by relative Departments and Organizations, Noise levels vary in all three axis and are being represented graphically by Noise Map. In order to assess not only the noise levels, to which the population is exposed, but also to quantify the influence of architectonical aspects, the report presents the steps taken towards a simulation of the noise emissions and propagation in this area. The results of the simulation are compared to measurements in different locations and daily-hours. The discrepancies are analyzed and the methodology is discussed. Efforts were made to implement Guide Lines Prescribed by Indian Standards. Design of noise barriers is also briefly discussed.

KEYWORDS: *New Delhi, Pharganj-Moolchand, Noise pollution, Decibel, Sound level Metre, Octave band Analyzer, Noise Dosimeter. Facade Noise Map, Grid Noise map, Meshed Noise Map*

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INTRODUCTION

A Noise Map is a map of an area which is colored according to the noise levels in the area. Sometimes, the noise levels may be shown by contour lines which show the boundaries between different noise levels in an area.

The noise levels over an area will be varying all the time. For example, noise levels may rise as a vehicle approaches, and reduce again after it has passed. This would cause short-term variations in noise level. In the slightly longer term, noise levels may be higher in peak periods when the roads are busy, and lower in off-peak periods. Then again, there is a greater volume of activity from more people and traffic in the day-time than in the evening or at night. In the longer term, wind, weather and season all affect noise levels

This means that it is not possible to say with confidence what the noise level will be at any particular point at any instant in time, but where the noise sources are well-defined, such as road or rail traffic, or aircraft, then it is possible to say with some confidence what the long-term average noise level will be. It may be thought that the best way of doing this is by measurement, but experience shows that this is not the case. For a start, a long-term average must be measured over a long period of time. Secondly, to obtain complete coverage of an area, measurements would have to be made on private property, where access might be difficult, and thirdly, measurements cannot distinguish the different sources of noise, so they would not be able to give information on how much noise was being made by each of the sources in an area.

For these and other reasons, noise mapping is usually done by calculation based on a computerized noise model of an area, although measurements may be appropriate in some cases. A further benefit of having a noise model is that it can be used to assess the effects of transportation and other plans. Thus the effect of a proposed new road can be assessed and suitable noise mitigation can be designed to minimize its impact. This is particularly important in noise action planning, where a cost-benefit analysis of various options can be tested before a decision is made.

This means that it is not possible to say with confidence what the noise level will be at any particular point at any instant in time, but where the noise sources are well defined, such as road or rail traffic, or aircraft, then it is possible to say with some confidence what the long term average noise level will be. Noise in cities has increased in the past decades, due to a growing urban development. In the last century, population movement to the greater cities, disorder planned city development. Noise community ordinates have been approved at national and local levels in various countries of the world. They usually establish noise limits for various activities and zones, according to the land uses, and define the basis of noise management strategies.

There is an unequal urban growth, which is taking place all over the world, but the rate of urbanization is very fast in the developing countries, especially in Asia. In 1800 AD, only 3% of the world's population lived in urban centers, but this figure reached to 14% in 1900 and 2000, about 47%.India no longer lives in villages and 79 million people were living in urban areas in 1961, but it went upto 285 million in 2001. In India and China alone, there are more than 170 urban areas with population of over 750000 inhabitants (United Nations Population Division, 2001) Statistics show that India's population is the second largest in the world after China, and is higher than the total urban population of all the countries put together barring China, USA, and Russia. The prominent ones in India are Delhi, Mumbai, and Chennai. There is a mass migration of people from rural areas to cities and also from smaller cities to larger cities. The exponential population growth has wreaked havoc on human life in the city environment. Pollution growth and in-migration of poor people, industrial growth, in efficient and in adequate traffic corridors, and poor environmental infrastructure are the main factors that have deteriorated the quality of the city environment.

Objectives and Scope

In Stage –I, i.e. before Noise Barrier Installation :

1. To monitor the various noise parameters (L1, L10, L50, L90, SEL, Leq, Lmax, Lmin sonogramme) at all locations
2. Vehicle prediction for 20 years
3. Collection of data for analysis and modeling
4. Validation / prediction of models for 20 years
5. Noise Mapping of this corridor
6. Suggest the best/economical remedial measures for noise control (Noise Barrier Design)
7. Supervised during installation of Noise Barrier / vibration control system.
8. Suggest best way of barrier installation/ vibration control system installation
9. Recommend the best aesthetic look design

In Stage-II, Study i.e. after installation of Recommendations:-

1. Monitoring of Noise Level and Vibration Levels at same location as in stage-I.
2. Noise Mapping
3. Losses of noise & Vibration before & after installation of noise/vibration control system

Noise Monitoring

Parameter: L10, L50, L90, Leq, SEL, Lmax, Lmin etc. (in dBA/dBC/dBZ weighing)

Location: Both sides of all 7 critical turning floor wise inside building / inside train / at platform / at ground

Duration: At each location the 24 hours Noise levels measurements were carried out,

L10 = 10% of the time noise was more than that levels; if hourly means 6 minutes

L50 = 50% of the time noise was more than that levels, if hourly means 30 minutes

L90 = 90% of the time noise was more than that levels; if hourly means 54 minutes;

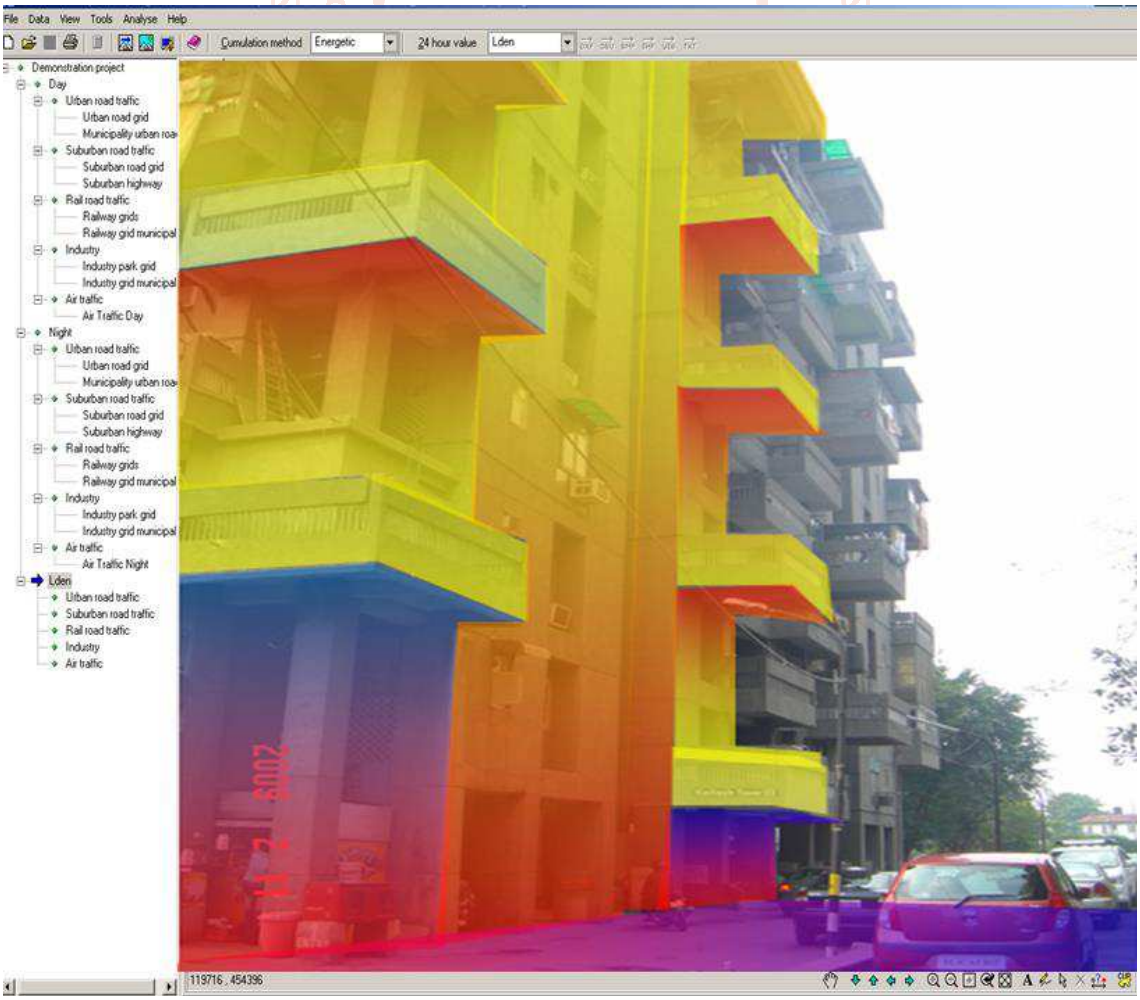
this is also called background noise

Leq = logarithmic average the noise

Lmax = Maximum Noise Levels during that time period

Lmin = Minimum Noise Levels during that time period

SEL = Sound Exposer Level



Before Noise Barrier installation

After Noise Barrier Installation

Literature Review

A noise map shows the hotspots where it is noisy and the cooler areas where it is quiet. Noise maps are produced by computer software which predicts the noise level at a specific point as it spreads out from the sources of noise that have been included. The first well-designed naturalistic field study to examine the effects of chronic noise exposure focused on primary school children living in four 32-floor apartment buildings adjacent to a major road. The rationale behind this study was that children in the lower floor of the apartment building would be exposed to higher amounts of noise from the road than those higher up the building. Seventy-three children were tested for auditory discrimination and reading level and the results indicated that children living on the lower floors had greater impairments on these measures than those living higher up the buildings.

There is also an increased interest in obtaining more detailed analyses of the acoustical environment of building complexes and neighborhoods.

The highest equivalent road traffic noise levels that are encountered near a dwelling are used initially by Klæboe et al. [3] to indicate the quality of the neighborhood sounds cape. The focus is on the adversity of the acoustic sounds cape in the neighborhood of a dwelling and not silent sides or supportive areas. The operational definition of the neighborhood sounds cape maximum noise level (Lneigh,max) is thus the highest equivalent noise exposure value encountered at dwellings or along pavement areas within a fixed distance (75 m) of an apartment. A more detailed presentation is provided in [3]. Analyses that compare the respective impacts of localized noisy and silent areas in the area are provided in For use in statistical analyses, Klæboe et al. [3] introduced the neighborhood maximum difference: Ldiff,max = Lneigh,max _ Lden, facade. The neighborhood maximum difference is simply the number of decibels that the equivalent noise level in the immediate neighborhood of an apartment exceeds the noise level at the most exposed facade of the residence. It describes the adversity of the immediate neighborhood relative to the noise level encountered in front of the most exposed fac¸ade of the apartment itself (Lden,fac¸ade).

Methodology

The following methodology was used as enlisted below:
Noise Evaluation Instrument Care and Calibration:
Instruments that measure noise contain delicate electronics and require practical care. Store and transport the

equipment in its custom case. Be aware of the instrument manufacturer's recommendations for proper storage (for example, some manufacturers recommended removing all batteries from stored equipment, while others require a primary battery to remain in the instrument). Make sure batteries will last the anticipated sampling period. There are two types of Calibration:

- Periodic Factory Calibration
- Pre & Post use calibration

Both Pre and Post inspection calibrations are required for any noise instruments used. It is important to understand the difference between these two types of calibrations. Calibrators must also be calibrated on an annual basis.

Equipment manufacturers typically recommend periodic calibration on an annual basis. These rigorous testing protocols ensure that the electronic components are in good working order and detect shifts in performance that indicate gradual deterioration. Periodic calibration results in a calibration certificate documenting the standard of performance.

Sound Level Meters

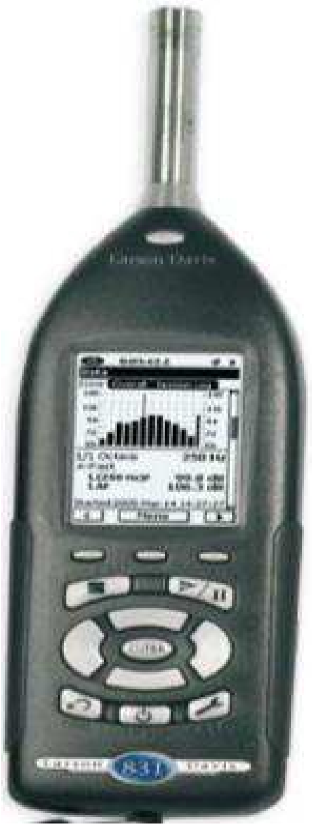


Figure Showing Sound Level Meter

A sound level meter or sound meter is an instrument that measures sound pressure level, commonly used in noise pollution studies for the quantification of different kinds of noise, especially for industrial, environmental and aircraft noise. However, the reading from a sound level meter does not correlate well to human-perceived loudness, which is better measured by a loudness meter. Sound level meters provide instantaneous noise measurements for screening purposes. During an initial walk around, a sound level meter helps identify areas with elevated noise levels where full shift noise dosimetry should be performed. Sound level meters are useful for:

- Spot checking noise dosimeter performance .
- Determining workers noise dose when the dosimeter is unavailable or inappropriate.
- Identifying and evaluating individual noise sources for abatement purposes.
- Aiding in engineering control feasibility analysis for individual noise sources being considered for abatement.

Sound Level Meter was used in this study for checking noise levels and finding different parameters relating noise.

Octave Band Analyzer

Octave Band Analyzers or Real Time Analyzers are special sound level meters that divide noise into its frequency components. Electronic filter circuits are used to divide sound or noise into individual frequency bands. Most Octave Band filter sets provide filters with the following center frequencies: 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz (Hz).Most sounds are not a pure tone but rather a mix of several frequencies.

The frequency of a sound influences the extent to which different materials attenuate that sound. Knowing the component frequencies of the sound can help determine the materials and designs that will provide the greatest noise reduction. Therefore, octave band analyzers can be used to help determine the feasibility of controls for individual noise sources for abatement purposes and to evaluate whether hearing protectors provide adequate protection.

Fig. Octave Band Analyzer

Noise Dosimeter

Like a sound level meter, a noise dosimeter can measure sound levels. However, the dosimeter is actually worn by the worker to determine the personal noise dose during the work-shift or sampling period. Noise dosimetry is a form of personal sampling, averaging noise exposure over time and reporting results such as a TWA exposure or a percentage of the PEL.

Dosimeters can be used to:

- Make compliance measurements according to CRRI Noise standard.

Measure the worker's exposure to noise over a period of time (e.g., a task or an entire work-shift) and automatically compute the necessary noise calculations.

Figure Noise dosimeter

Types of Noise Maps
This section offers a glimpse of the noise maps. There are three types of noise maps
1. The Facade Noise Map
2. The Grid Noise Map and
3. The Meshed Noise Map

The Facade Noise Map:
The Facade Noise Map places and calculates receivers along the façades of buildings. Receivers can be placed every floor with either a fixed number of receivers per facade or a set spacing between them. The results are used for two main purposes; to show noise levels at buildings and to generate the data for the end noise statistics where the exposed people are tailed. From the building the receivers are attached to the receivers "know" the type of building, the status of the noise control and the number of inhabitants per building / floor. This Facade Noise Map is a great tool for noise planning as it directly allows statistics and graphics to be generated from a single calculation. The entire building can be painted in the maximum noise level found anywhere on the outside, facades can be marked if they exceed the allowable noise limit, individual receivers can indicate an infringement of the limits by using different symbols below / above the limit. The Façade Noise Map like any other noise map in Sound PLAN allows to be displayed as a regular map projected on the floor plan or as a rendered 3D model.

The Grid Noise Map:
The Grid Noise Map comes in two variants, as a horizontal map (Grid Noise Maps) where the receivers follow the terrain or in the vertical format as Cross-sectional Noise Map. Spacing of receivers and height above the ground are user selectable. There is no size limit for Grid Noise Maps, however as Sound PLAN can load an unlimited number of Grid Noise Maps into each sheet, it is probably wise to partition the Grid Noise maps for very big areas. Grid Noise Maps have a whole gambit of output options to generate contour lines and smooth them or to leave the grid in place and show the values or have the grid painted in a fluid scale. Cross-sectional Noise Maps are noise maps that start at the terrain and reach to a user selected height, again the receiver spacing us user defined. This mapping option is very user friendly allowing the calculation to be interrupted and resume later on or to calculate a new grid or to re-calculate only part of the grid. If the single PC with multi-threaded calculation proves to take too long for the job, with Distributed Computing (DC description is under Tools) the application is scalable to the need of the user.

The Meshed Map:
The Meshed Map is similar to the Grid Noise Map as it is a mapping option to follow the terrain horizontally but instead of having a fixed grid of receivers, the receivers are located on the nodes of a mesh. The Meshed Map has two prime applications. The first is to calculate the noise in cities with very narrow streets. In order to obtain sensible contour lines, the grid spacing needs to be narrow thus creating a huge file and causing long calculation times. The Meshed Map helps by generating more receivers where it is needed (around sources and obstacles) and having a thinner base mesh. This way the density of calculated receivers is higher where the noise levels are changing rapidly and less receivers for the rest. The Meshed Map has proved itself invaluable in the noise mapping cities with small streets. The second strong point of the Meshed Map is its capability to store more information than just the noise levels for day, evening and night. Calculate a Meshed Map once and display multiple maps depicting singular frequencies or frequency bands. This particular feature is especially helpful for industrial noise control where it is often necessary to document a noise map frequency by frequency.

Results
1. KAILASH COLONY:

Day:

Time	L10	L50	L90	SEL	LEQ	MaxL
6-7	72.9	68.6	63.4	107.8	70.4	93.4
7-8	80	72.4	65.4	109.5	76.2	94.2
8-9	81.4	74.3	67.8	110.2	78.1	95.7
9-10	82.7	75.7	68.7	110.8	79.6	96.3
10-11	82.2	75.7	68.7	112.8	78.9	100.2
11-12	81.2	75.2	69.2	113.7	78.3	107.9
12-13	81.2	75.2	68.7	113.6	78.2	99.4
13-14	81.2	74.7	68.2	113.3	77.9	97.4
14-15	80.7	74.7	68.7	111.6	77.2	92.6
15-16	80.7	75.2	69.2	113.4	77.6	97.9
16-17	81.2	75.7	69.7	108.2	78.1	99.3
17-18	81.2	75.2	70.2	107.6	78.5	96
18-19	81.9	76.1	73.5	107.2	77.8	107.2

19-20	79.9	75.3	69.4	95.5	78.1	89.4
20-21	80.2	73.7	68.2	112.7	77.2	98.6
212-2	79.7	73.7	67.7	112.5	76.7	101.9
	80.51875		**68.54375**		**77.425**	**97.9625**

Night:

Time	L10	L50	L90	SEL	LEQ	MaxL
22-23	78.7	72.7	68.2	107.5	70.3	93.1
23-24	77.4	72.6	63.2	95.2	74.5	86.6
0-1	73.7	67.9	60	106	70.5	90.2
1-2	74	68.2	61.7	106.5	71.5	88
2-3	74.7	66.7	58.6	106.5	71	88.3
3-4	65.1	62.8	58	101.4	63.2	82.1
4-5	63.8	58.9	54.4	95.2	60.6	76.9
5-6	68.2	63.1	59.2	112	65.2	92.4
	71.95		**60.4125**		**68.35**	**87.2**

2. NEHRU VIHAR:

Time	L10	L50	L90	SEL	LEQ	MaxL
0-1	75.7	72.7	64.2	112.7	72.5	100.5
1-2	70.2	65.8	61	102.2	67.9	92.1
2-3	69.2	63.9	59	110.7	64.8	98.9
3-4	67.3	62.2	58.2	99	64.2	91.7
4-5	64.3	61.9	53.4	97.2	62.2	77.9
5-6	68.9	63.1	59.1	101.4	63.8	96
6-7	68.4	65.2	60.1	101.8	66.5	101.5
7-8	79.2	76.2	67.8	110	77.2	89.9
8-9	80.9	75.5	66.8	111.2	78.6	100.2
9-10	83.1	77.9	71.4	95.5	80.5	89
10-11	80.7	76.1	68.4	111.4	78.5	111.7
11-12	78.2	76.4	65.8	101.8	77.4	101.6
12-13	79.4	76.5	64.9	100.8	77.3	100.5
13-14	76.6	73.1	67.2	111.5	74.4	92.5
14-15	77.9	74.5	66.6	111.1	76.4	98.1
15-16	75.5	73.1	65.3	89.5	75.5	74.6
16-17	78.7	72.2	65.7	113.4	77.9	101.3
17-18	78	72.9	67.5	111.1	76.7	101.7
18-19	78.9	75.8	64.8	100.5	77.6	94.5
19-20	77.7	73.4	66.6	111.2	75.5	95.5
20-21	78.9	75.2	67.1	110.2	77.9	100.2
21-22	76.9	74.1	65.9	110.5	75.6	98.7
22-23	77.8	72.3	67.3	110.1	74.7	94
23-24	76.5	72.1	67.1	110.2	73.6	97.4
					73.633333	**95.83333**

Day:

Time	L10	L50	L90	SEL	LEQ	MaxL
6-7	68.4	65.2	60.1	101.8	66.5	101.5
7-8	79.2	76.2	67.8	110	77.2	89.9
8-9	80.9	75.5	66.8	111.2	78.6	100.2
9-10	83.1	77.9	71.4	95.5	80.5	89
10-11	80.7	76.1	68.4	111.4	78.5	111.7
11-12	78.2	76.4	65.8	101.8	77.4	101.6
12-13	79.4	76.5	64.9	100.8	77.3	100.5
13-14	76.6	73.1	67.2	111.5	74.4	92.5
14-15	77.9	74.5	66.6	111.1	76.4	98.1
15-16	75.5	73.1	65.3	89.5	75.5	74.6
16-17	78.7	72.2	65.7	113.4	77.9	101.3
17-18	78	72.9	67.5	111.1	76.7	101.7
18-19	78.9	75.8	64.8	100.5	77.6	94.5
19-20	77.7	73.4	66.6	111.2	75.5	95.5
20-21	78.9	75.2	67.1	110.2	77.9	100.2
21-22	76.9	74.1	65.9	110.5	75.6	98.7
	78.0625	**66.36875**			**76.46875**	**96.96875**

Night:

Time	L10	L50	L90	SEL	LEQ	MaxL
22-23	77.8	72.3	67.3	110.1	74.7	94
23-24	76.5	72.1	67.1	110.2	73.6	97.4
0-1	75.7	72.7	64.2	112.7	72.5	100.5
1-2	70.2	65.8	61	102.2	67.9	92.1
2-3	69.2	63.9	59	110.7	64.8	98.9
3-4	67.3	62.2	58.2	99	64.2	91.7
4-5	64.3	61.9	53.4	97.2	62.2	77.9
5-6	68.9	63.1	59.1	101.4	63.8	96
	71.2375		**61.1625**		**67.9625**	**93.5625**

3. ASHRAM FLYOVER:

Time	L10	L50	L90	SEL	LEQ	MaxL
0-1	77.8	71.8	66.3	110	73.5	91.7
1-2	76.3	71.8	65.8	110.2	73.8	90.7
2-3	69.1	64.2	59.4	101.3	66.1	97.8
3-4	67.6	61.9	56.7	102.8	64.3	96.2
4-5	64.3	61.9	53.4	97.2	62.2	77.9
5-6	68.9	63.1	59.1	101.4	63.8	96
6-7	68.4	65.2	60.1	101.8	66.5	101.5
7-8	79.2	76.2	67.8	110	77.2	89.9
8-9	80.4	76.1	68.6	101.1	78.4	101.6
9-10	82.9	78.3	71.4	95.5	80.1	89
10-11	82.7	77.2	73.2	115.5	80.3	103.3
11-12	78.2	76.4	65.8	101.8	77.4	101.6
12-13	79.4	76.5	64.9	100.8	77.3	100.5
13-14	76.6	73.1	67.2	111.5	74.4	92.5
14-15	77.9	74.5	66.6	111.1	76.4	98.1
15-16	76.5	72.4	64	110.2	74.7	92.6
16-17	75.5	71.8	66.2	100.1	73.7	97.6
17-18	80.2	76.6	67.2	109.1	78.1	105.2
18-19	80.3	75.8	68.5	111.5	77.1	100.6
19-20	77.7	73.4	66.6	111.2	75.5	95.5
20-21	77.4	73.6	67.7	75.2	75.2	75.7
21-22	76.9	74.1	65.9	110.5	75.6	98.7
22-23	69.2	66.1	59.9	111.1	67.6	100.1
23-24	67.8	64.4	58.8	100.2	65.3	99.9
					73.104167	**95.591667**

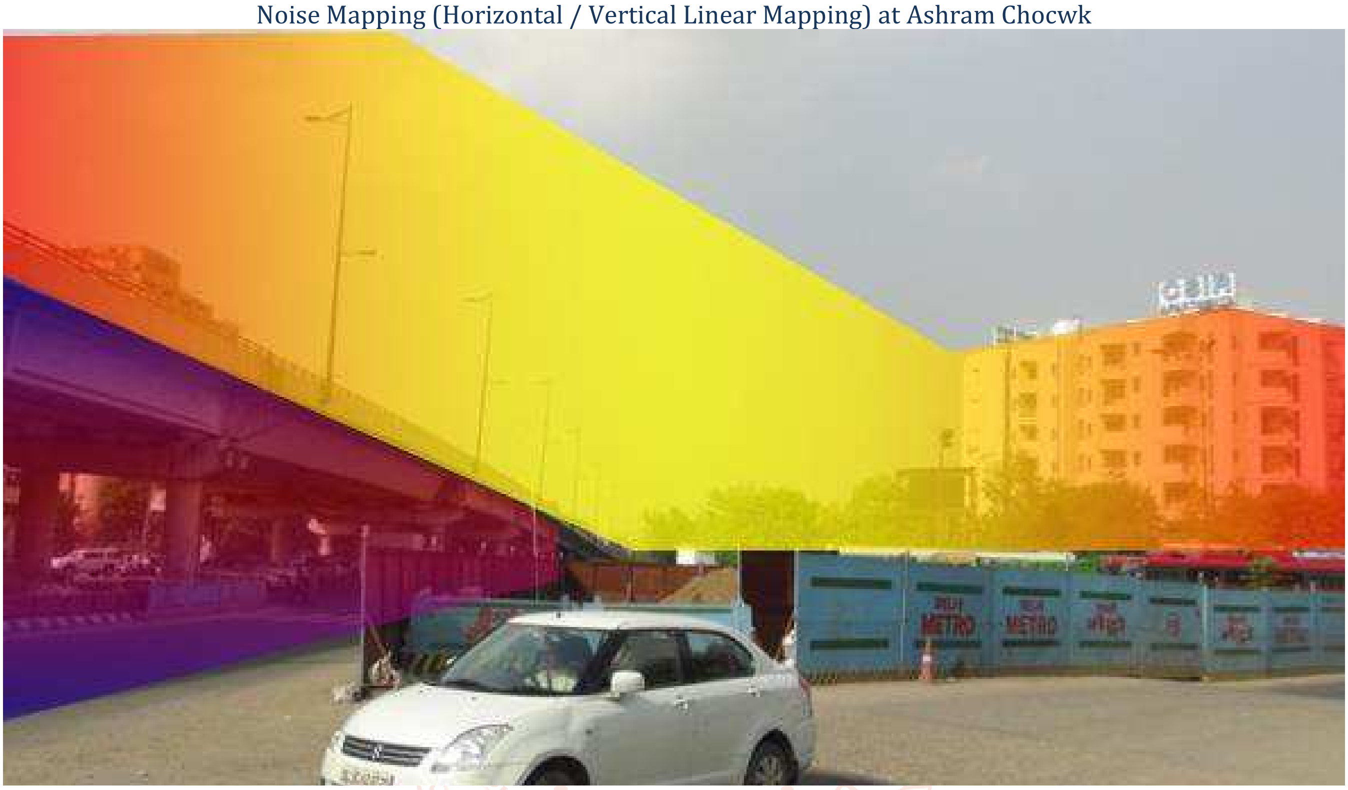
Day:

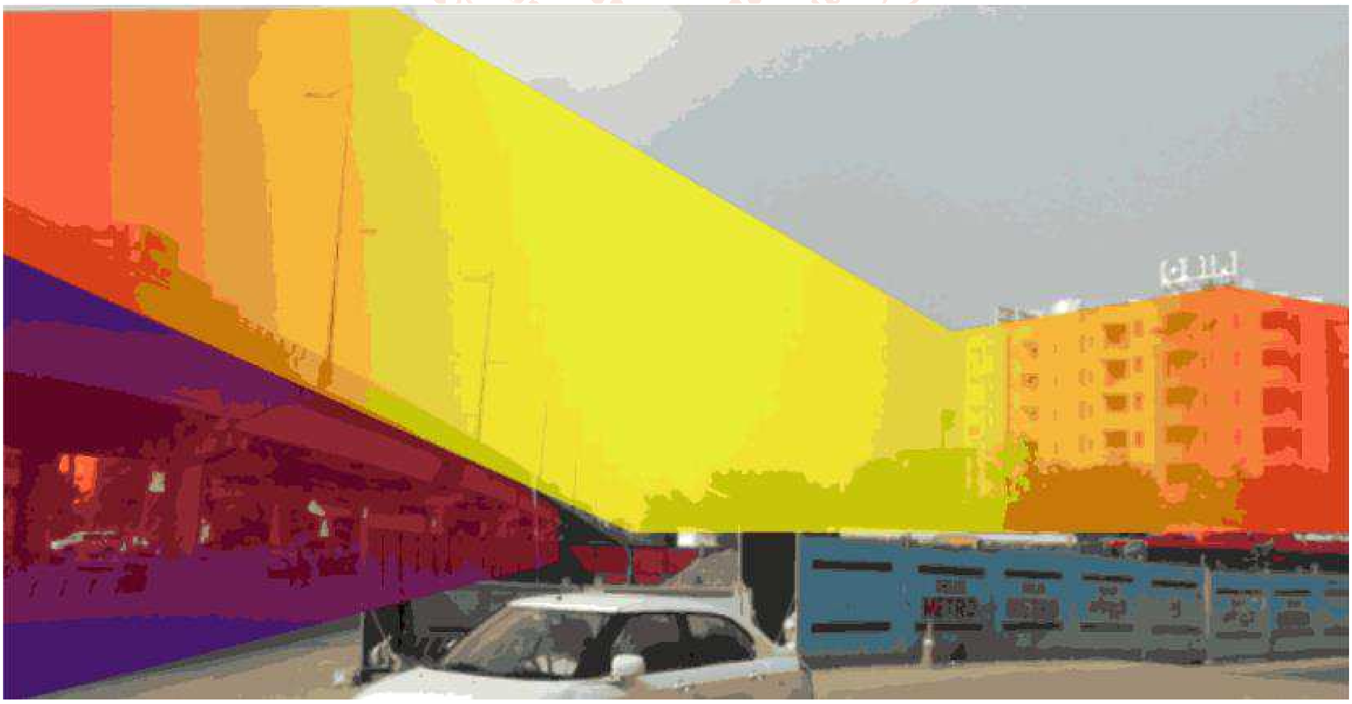
Time	L10	L50	L90	SEL	LEQ	MaxL
6-7	68.4	65.2	60.1	101.8	66.5	101.5
7-8	79.2	76.2	67.8	110	77.2	89.9
8-9	80.4	76.1	68.6	101.1	78.4	101.6
9-10	82.9	78.3	71.4	95.5	80.1	89
10-11	82.7	77.2	73.2	115.5	80.3	103.3
11-12	78.2	76.4	65.8	101.8	77.4	101.6
12-13	79.4	76.5	64.9	100.8	77.3	100.5
13-14	76.6	73.1	67.2	111.5	74.4	92.5
14-15	77.9	74.5	66.6	111.1	76.4	98.1
15-16	76.5	72.4	64	110.2	74.7	92.6
16-17	75.5	71.8	66.2	100.1	73.7	97.6
17-18	80.2	76.6	67.2	109.1	78.1	105.2
18-19	80.3	75.8	68.5	111.5	77.1	100.6
19-20	77.7	73.4	66.6	111.2	75.5	95.5
20-21	77.4	73.6	67.7	75.2	75.2	75.7
21-22	76.9	74.1	65.9	110.5	75.6	98.7
	78.1375		**66.98125**		**76.11875**	**96.49375**

Night:

Time	L10	L50	L90	SEL	LEQ	MaxL
22-23	69.2	66.1	59.9	111.1	67.6	100.1
23-24	67.8	64.4	58.8	100.2	65.3	99.9
0-1	77.8	71.8	66.3	110	73.5	91.7
1-2	76.3	71.8	65.8	110.2	73.8	90.7
2-3	69.1	64.2	59.4	101.3	66.1	97.8
3-4	67.6	61.9	56.7	102.8	64.3	96.2
4-5	64.3	61.9	53.4	97.2	62.2	77.9
5-6	68.9	63.1	59.1	101.4	63.8	96
	70.125		**59.925**		**67.075**	**93.7875**

Noise Mapping (Horizontal / Vertical Linear Mapping) at Ashram Chocwk





Average density of people living in 100sr yard in Delhi = 4.7
No. of dwelling unit affected in CSIR apartment, Ashram = 72
Hence, No. of people affected from >70 dB(A) noise = 72* 4.7 = 339 people

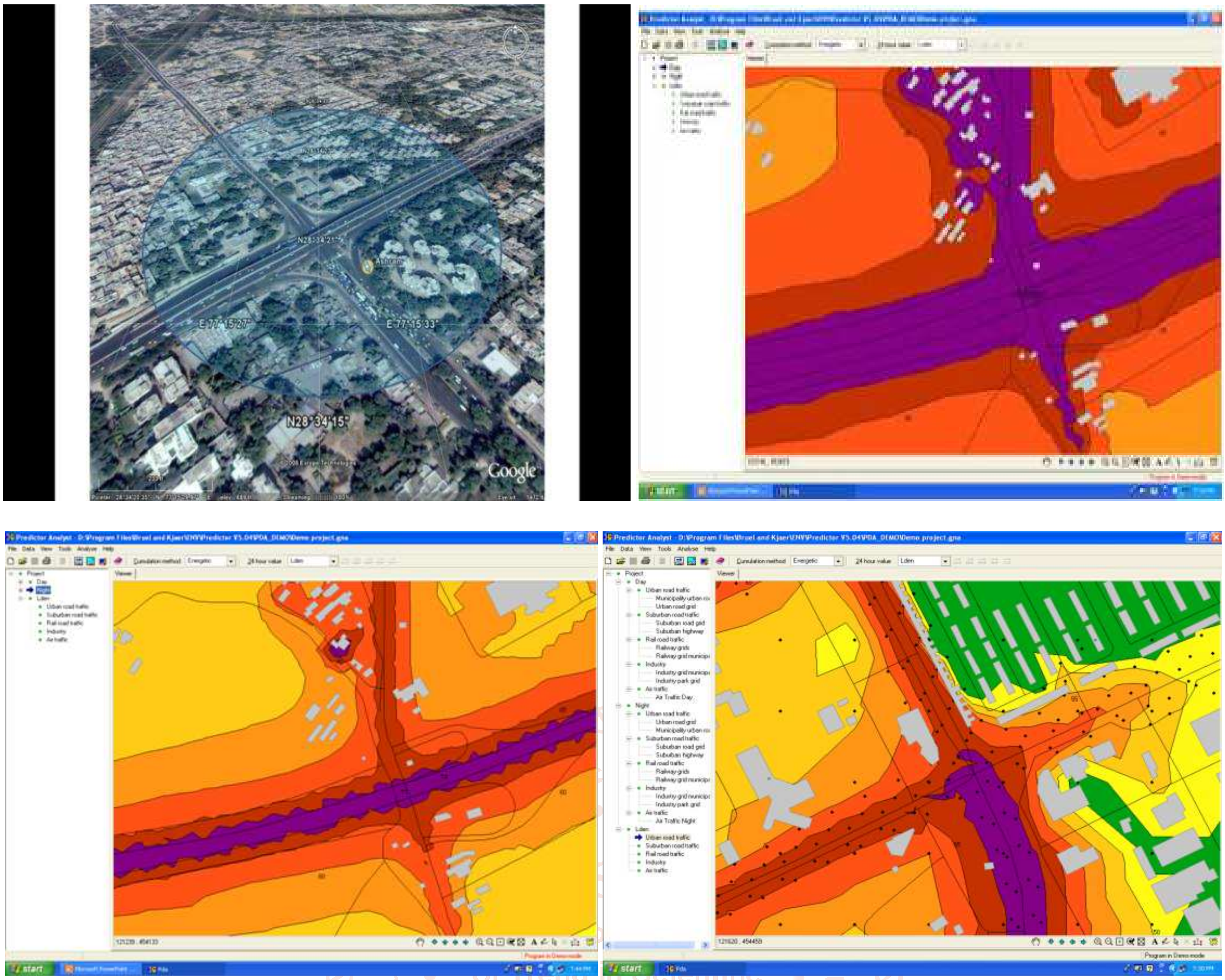
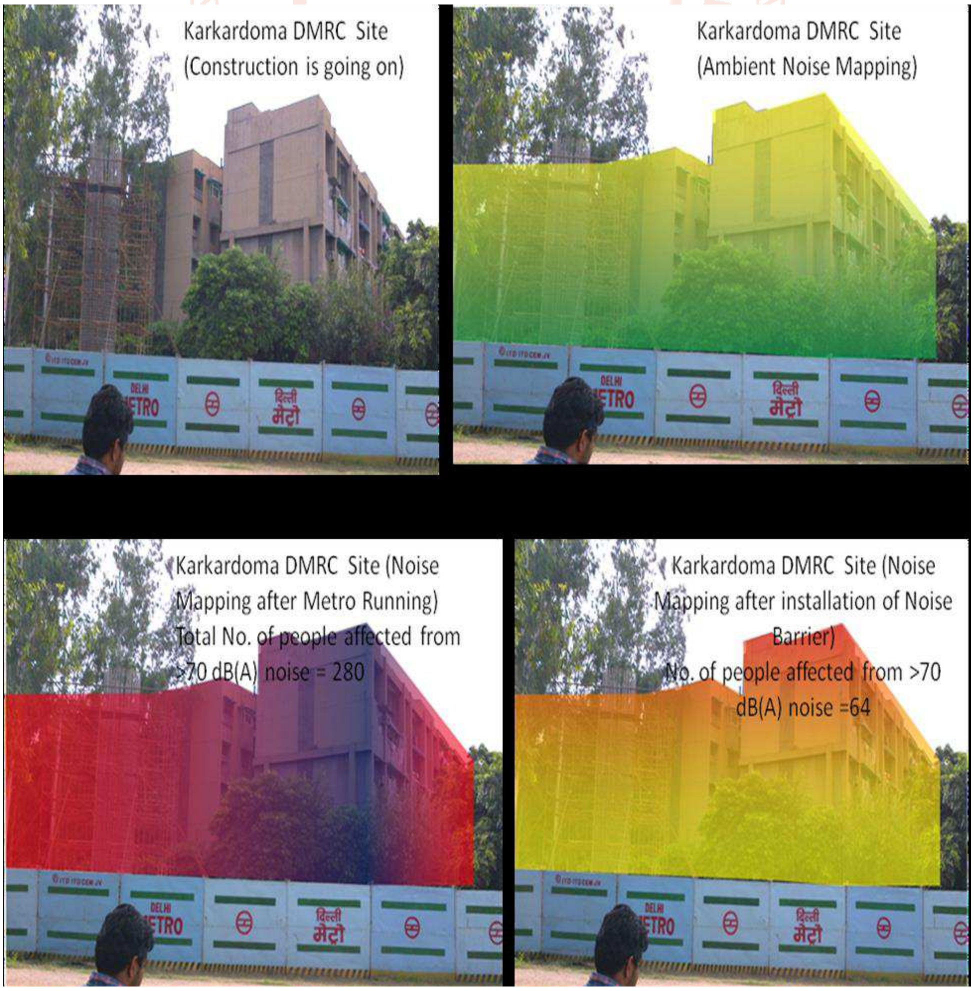


Figure: Noise Mapping at Intersection at various hours of Day



CONCLUSION

The critical issues and challenges of development and management for growing urban centres like Delhi, Mumbai, and Kolkata have been the subject of extensive discussions and debates in recent years. The major problems associated with urban centres in India is that of unplanned expansion, changing land use/land cover, loss of productive agricultural land, increasing rainfall runoff, and depletion of the water table. It is evident from the foregoing study that major urban environmental problems occur due to high population growth (the 46.31% increase during 1991-2001) and the uncontrolled and mismanaged urban expansion which has led to the doubling of the densely built-up area during last decade in Delhi. There is a reduction (16.8%) in agricultural land because of urban expansion in the fringe areas. Pollution loads affecting the air, water and land in Delhi have also increased considerably, and average night-time temperatures (so-called "heat pollution") have increased significantly. The results in this work demonstrate that the environmental noise is an important issue in New Delhi. The studied sector, which is characterized by a high population density and heavy traffic of vehicles from different kinds, present background levels higher than the recommended by the regulations applicable. The analysis of the results shows that the noise levels in all the measured points in New Delhi, and as can be seen from the noise map, in a large area of the neighborhood are over the allowed values. The main cause being the traffic noise. The technology of noise mapping demonstrates to be an excellent means to deal with the problem of noises pollution. The simulations are powerful tools to be used in the urban planning. Many parameters must be known previously or be identified to serve as base for the correct representation of the physical effect. Nevertheless the most laborious, like topography and buildings, can be input to the program almost automatically from CAD and other related softwares. The correct modeling of the sound sources plays the most important role in the results. The noise maps in small scale, as in the case of New Delhi, constitutes a real important first step for a future work in the whole city. Another important thing to be considered in future works, is the study of the number of inhabitants who are affected by the noise levels.

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