A STUDY OF INCREASING NOISE POLLUTION IN A SPECIFIC CITY NODE OF DHAKA CITY, BANGLADESH

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ABSTRACT

Noise pollution in expanding city of Dhaka is also increasing with growing number of vehicles and people which has become an irritating and harmful feature of the city life. According to a WHO study, noise level is exceeding the standard limits in Dhaka city, threatening human health, especially that of elderly people and children. The situation is critical at major nodes of the city because of accumulation of large number of vehicles and human activities. The study aims at generating an investigation methodology to analyze the relation between noise factors and human responses; also to give some recommendation to prevent the noise or unwanted sounds producing at the nodes. It is necessary to recommend guidelines for architects to help in reducing noise effect for people living at such nodes of the city.

Keywords: Noise, Noise Pollution, Noise Source, Noise Control, City Node.

1. INTRODUCTION

Dhaka, the capital city of Bangladesh, is one of the noisiest cities in the world. Despite low level of industrialization and motorization, the average level of noise remains far above the acceptable limits for most of the time. With economic development, the situation is expected to worsen further. Motor vehicle is the principal source of noise pollution in the city (Ahmed et.al., 2000).

According to a report, "Dhaka City State of Environment: 2005", noise level in Dhaka city is now a major concern for general people because it has exceeded the tolerance level. According to a recent study conducted by WHO at 45 locations of Dhaka city, most of the traffic points and many of the industrial, residential, commercial, silent and mixed areas are suffering with noise level exceeding the standard limits. Details of noise level at different zones of Dhaka city are shown in Figure-1 indicating the exceeding limits of sound.

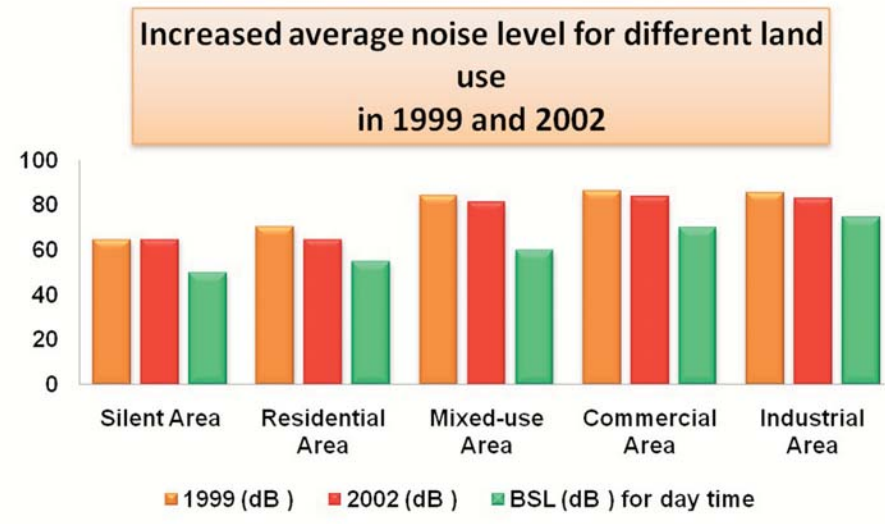

Figure-1: Increased noise level in different areas of Dhaka city (Source: WHO, 2002)

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This research study dealts with the noise pollution of "Shapla Chattar" which is one of the major nodes of the city situated at the Central Business District (CBD) area of Dhaka (Motijheel commercial area). The sound level data was collected at four specific times of a day (at 9:30am, 12:30am and 4:00pm and 6:00pm) and at four different location points of the same area. This study provides a new possibility to view the actual scenario of noise pollution at a city node.

2. OBJECTIVES

Primary objective of the study is to create and enhance awareness about the ways in which people respond to the city nodes and their immediate surroundings on basis of sound level. It further aims:

- To determine the sound pressure level (dB) of noise, by a device Sound Level Meter (SLM), at a selected node of the Dhaka city.
- To recommend guidelines for the architects to adopt measures to mitigate the situation.

3. DESCRIPTION OF THE NODE

3.1. Location of Node

The national flower of Bangladesh is Shapla (Water Lily).

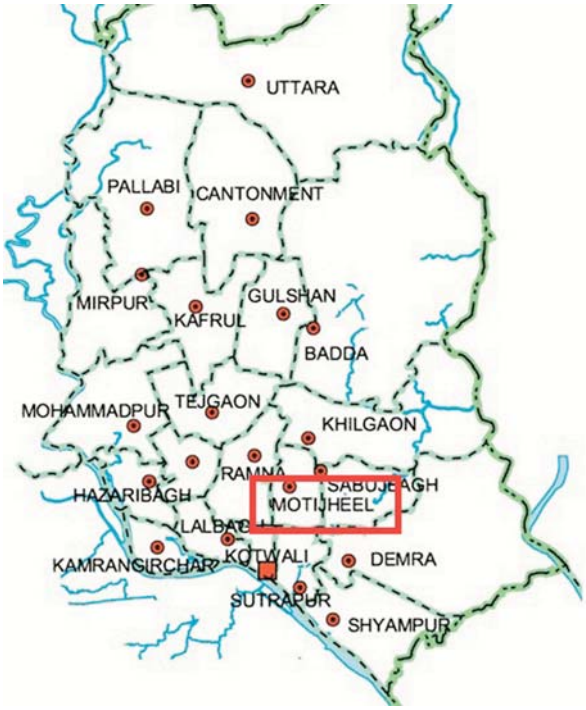


Figure-2a: Location of Motijheel in Dhaka city map

Bangladeshis' love for this flower is expressed beautifully by erecting a monumental flower of Shapla called '**Shapla Chattar'** at Motijheel in Dhaka (Fig-2a,b and 3). Motijheel is situated at the heart of the Dhaka city. Motijheel is major business and commercial hub of the Dhaka city and has more offices and business institutions than any other part of the city.

Figure-3: Shapla Chattar, situated in a crossing of Dhaka's commercial area

Figure-2b: Location of Shapla Chattar at Motijheel (Right)

Figure-4: Frequent Use of glass as building material near Shapla Chattar.

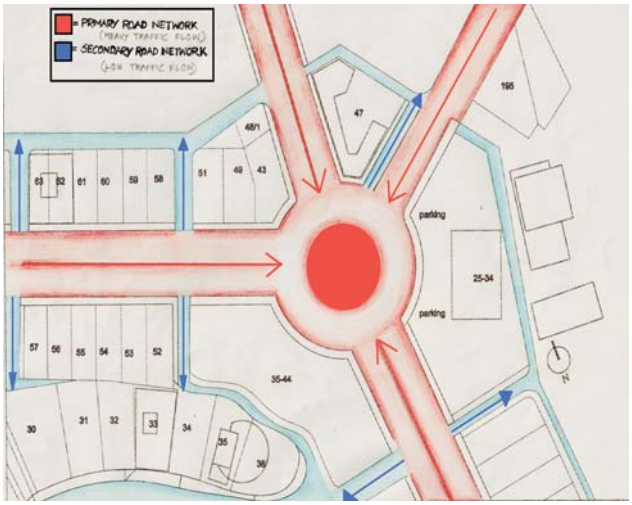


Figure-5: Road network system of Shapla Chattar.

3.2. Analysis of the Present Building Fabric

Effect of noise can be reduced on buildings through fabric of the building itself (roof, walls, floor, windows and doors). It can also be reduced by careful selection of construction materials in buildings. For example brick as construction material is more preferable than glass. But most of the buildings have been erected circling the Shapla Chattar without considering this fact (Figure-4).

3.3. Analysis of the Road Network System

This node is extremely noisy because of the busy roads. There are four main roads towards North-South, North-East and North-West where movement of the vehicles is very frequent. A network of subsequent secondary roads carries relatively less traffic load of vehicles like private cars and rickshaws (Figure-5). Noise level is higher near the primary roads as both light and heavy vehicles like rickshaws, private cars, buses etc. move there (Figure-6). The site is not free from unnecessary disturb of hydraulic horns. The hydraulic horns used by buses, trucks and scooters in the crowdy city streets are dangerous for human being. The horns cause serious harm, especially to the children.

Figure-6: Presence of light & heavy vehicles around node like rickshaws, van private cars, buses etc.

3.4. Analysis of the Surface Pattern and Vegetation

In Motijheel at Shapla Chattar the presence of green area is almost negligible. For this reason the area remains dry and dusty all the time. There are many open spaces which are not green but covered with pitched and paved area for human and vehicular access (Figure-7a,b).

Figure-7a: Surface pattern of Shapla Chattar.

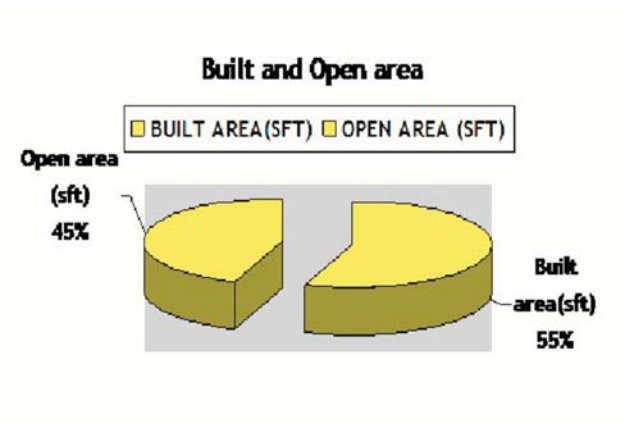


Figure-7b: Surface Area Ratio of Shapla Chattar.

3.5. Analysis of Noise Sources at Node

Sounds are produced around the node usually due to following reasons which are considered as noise sources:

- Movement of vehicles – cars, heavy vehicles, etc.
- Use of loud horn and hydraulic horns.
- Uncontrolled use of music loudspeakers.
- Construction noise.
- Intermittent aircraft noise.
- Noise from generators.
- Human activities (Noise due to people crowd including vendor, visitors etc.). Vendors can be seen almost everywhere in the Motijheel area .The pedestrian footpath is almost occupied by vendors. Vendors can also be found in the streets.

3.6. Analysis of the Relation between Noise Factors and Human Responses

- A common complaint by the regular office going people of the Motijheel area near Shapla Chattar is the excessive noise. This noise creates great annoyance to them during early working hours which ultimately increases their palpitation and consequently lowering their daily work performance.

- Traffic police working at Shapla Chattar are suffering a continuous disturbance during their duty hours.

- The most notable physical effect of long term noise exposure is loss of hearing power which is a common complain of that users of the particular node.

4. METHODOLOGY

Analytical process was conducted in following steps:

- Site analysis is done on the basis of road network, surface pattern and vegetation etc.

- Observation of various sound levels was done at various times of a day according to the changing activities of people.

- Sounds were measured with Sound Level Meter (Model No: NL-21).

- Problems and effects of sound were discussed with general people and the users.

- The entire findings were analyzed on basis of the city noise.

4.1. Preparation of Questionnaire

Questionnaire survey on hearing status assessment of the people at Motijheel Area near **Shapla Chattar** was prepared.

Individual's Name: _____

Age: _____

Profession: _____

Sr. No.	Questions	Comments
1.	How long you have been working here?	
2.	How long do you work here daily?	
3.	Do you know about sound pollution?	
4.	Do you have any hearing problem?	
5.	Do you think you are experiencing hearing loss because of working here?	
6.	Did you consult it with a doctor?	
7.	What are the main sources of noise?	
8.	When noise is the worst?	
9.	Do you ask other to repeat themselves?	
10.	Do you have difficulty in telephone conversation?	
11.	Do you have difficulty in understanding people in a group or social gathering?	
12.	Do you turn up the television too loud?	
13.	Do you feel any of the following health problems? a) Headache b) Irritation c) Depression d) Aggression	

4.2. Preparation of Instruments

Sounds were measured with an instrument known as "SOUND LEVEL METER". In this case **NL-21**(sound level meter) is used for study purpose. There are two types of calibration: electrical calibration and acoustic calibration using a Pistonphone. Calibration cannot be performed if the unit is in measurement mode other than sound level measurement. Calibration is performed after the measurement has been completed. Here acoustic calibration has been done with the sound calibrator **NC-74**.for acoustic calibration, the Rion sound calibrator **NC-74** is mounted on the microphone of the sound level meter and adjustment is performed so that reading of meter is equal to the sound level inside the coupler (Figure-8).

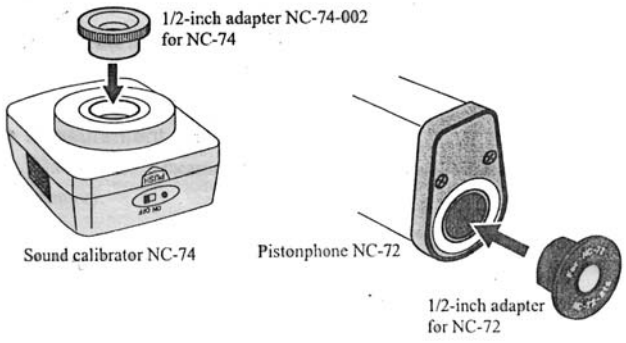


Figure-8: Sound level meter, Sound Calibrator NC-74 and Pistonphone

4.3. Sample Design

A large number of hawkers, traffic police, regular office going people, shop keepers (Figure-9) were in the prime consideration as a sampling group because they remain beside the road and they are directly exposed to the traffic noise. Samples were considered on basis of the following criteria:

- Ear condition: people are chosen as samples who have not been affected by any kind of ear related disease since childhood (Figure-9).
- Age: people of age group between 20 to 50 years.
- Working period: people who had been working more than 5 years in this place.
- Daily working period: people who work here for more than 9 hours daily.

Figure-9: Hawkers, traffic police, people who are directly exposed to the traffic noise.

4.4. Selection of Study Area

For Study purpose the area has been divided into four zones and named as zone A, zone B, zone C and zone D (Figure-10 & 11).

Zone A: Divider situated on West-side of the Shapla Chattar.

Zone B: At Northern part of the Shapla Chattar (just beside the Shapla)

Zone C: North-East corner of the Shapla Chattar adjacent to the pavement.

Zone D: Bangladesh Bank compound, near the gate.

Figure-10: Four venues are shown in the satellite image of the site

Figure-11(a,b,c): Various views of the site.

5. FINDINGS

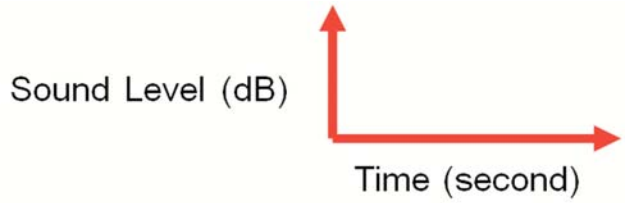
Two kinds of data was collected.

I. Continuous sound pressure level was measured in which people are exposed in the study area.

II. Questionnaire survey has been carried out for hearing status assessment.

5.1. Continuous Data Analysis

Data was collected 1.5 meter above the ground and by standing on the roadside. Any kind of noise barrier was avoided for measuring the actual sound level produced by the vehicles. Noise was measured at various times (at 9:30am, 12:30am, 4:00pm and 6:00pm) of the day to observe people response with changing sound levels. Analysis of the findings at different times and different points A, B, C and D was done by using following format:



Sound variations of first 5 minutes at 9.30 o'clock started from point "A" and gradually other points

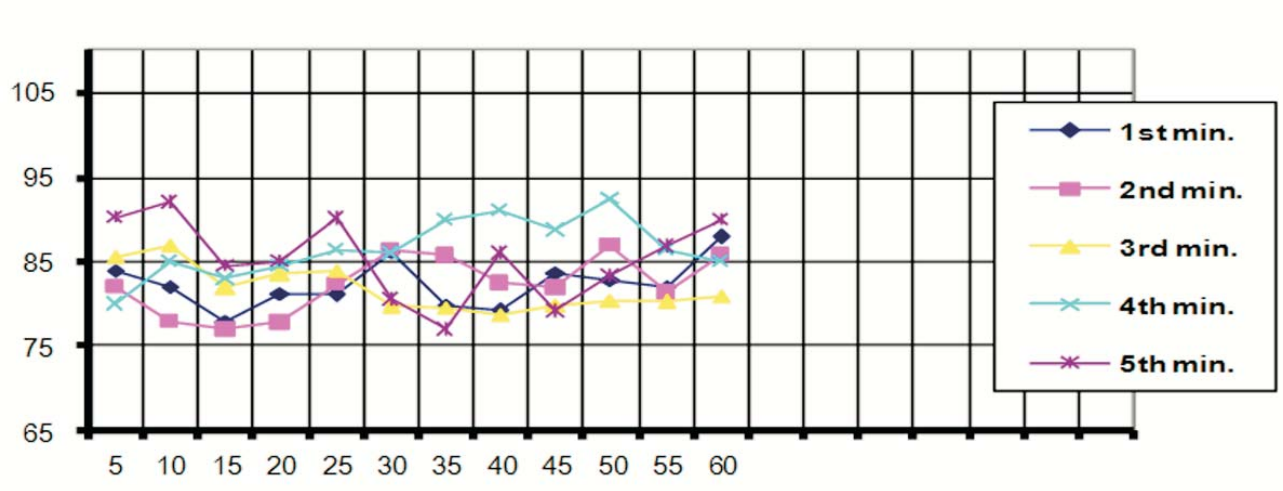


Chart- 1.1: Sound level with respect time (9.30 am, at point 'A').

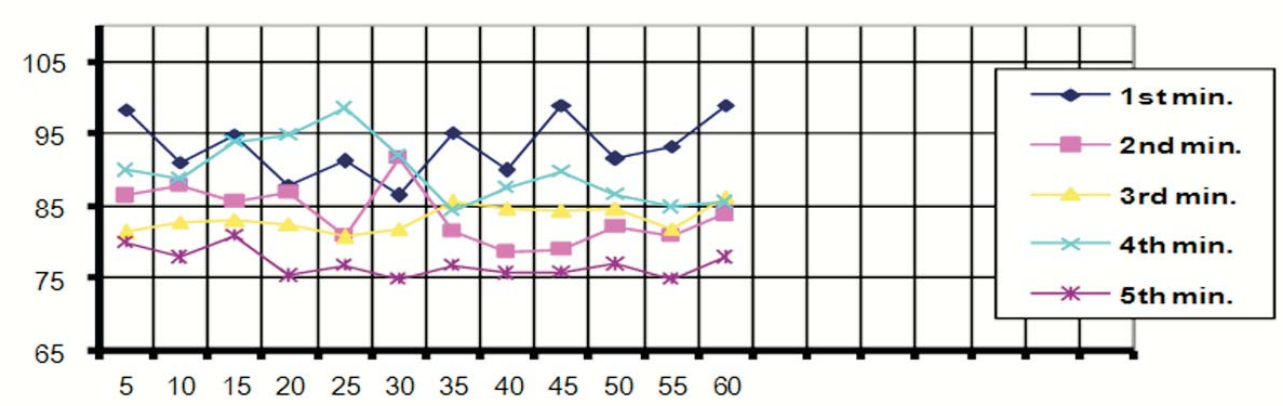


Chart- 1.2: Sound level with respect time (9.45 am, at point 'B').

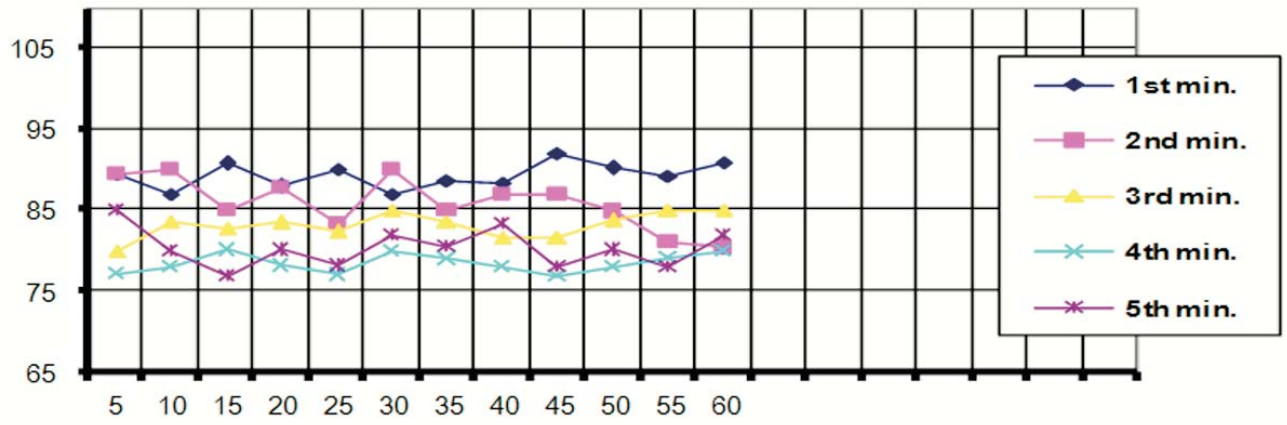


Chart- 1.3: Sound level with respect time (9.55 am, at point 'C').

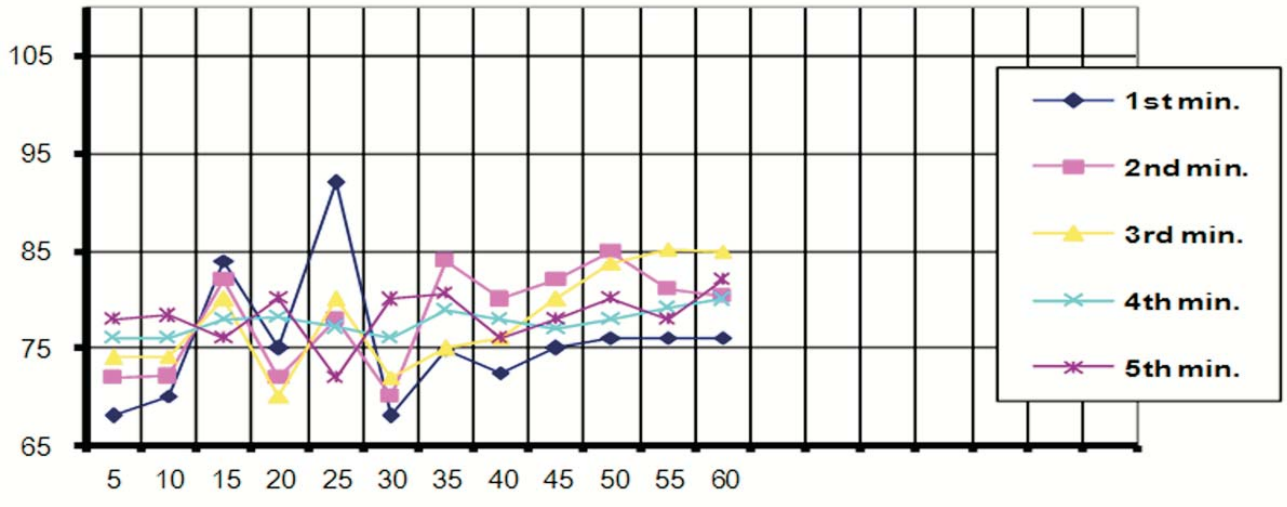


Chart- 1.4: Sound level with respect time (10.10 am, at point 'D').

Sound variations of first 5 minutes at 12.30 o'clock started from point "A" and gradually to other points

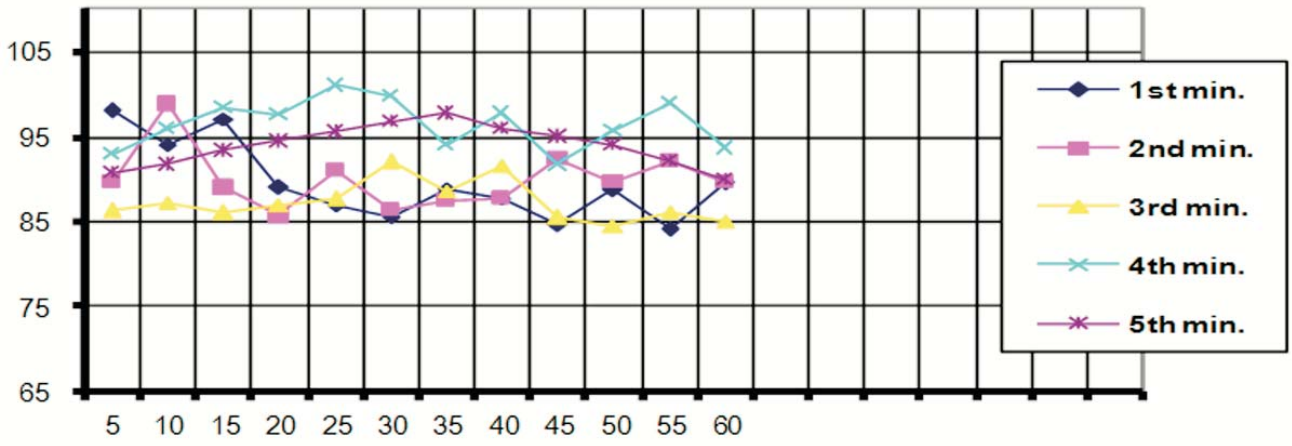


Chart- 1.5: Sound level with respect time (12.30 pm, at point 'A').

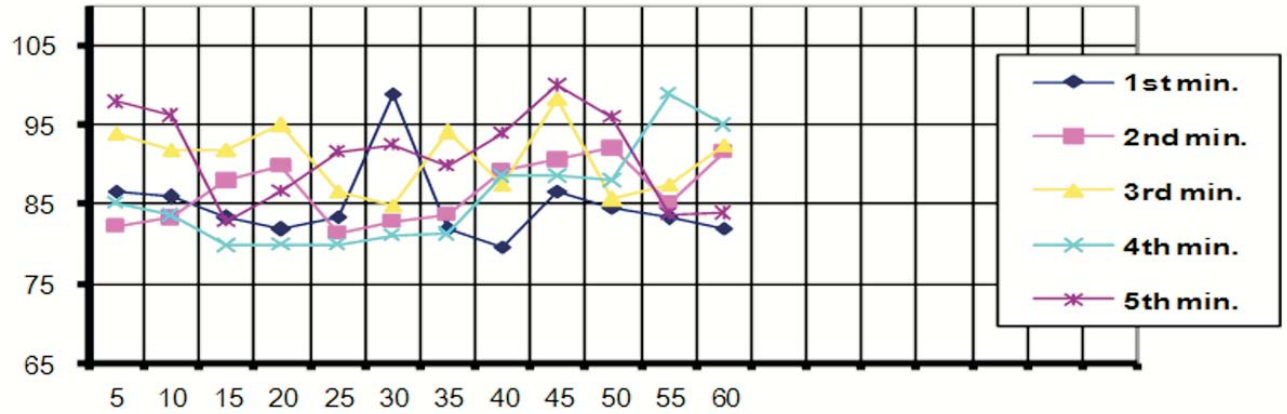


Chart- 1.6: Sound level with respect time (12.40 pm, at point 'B').

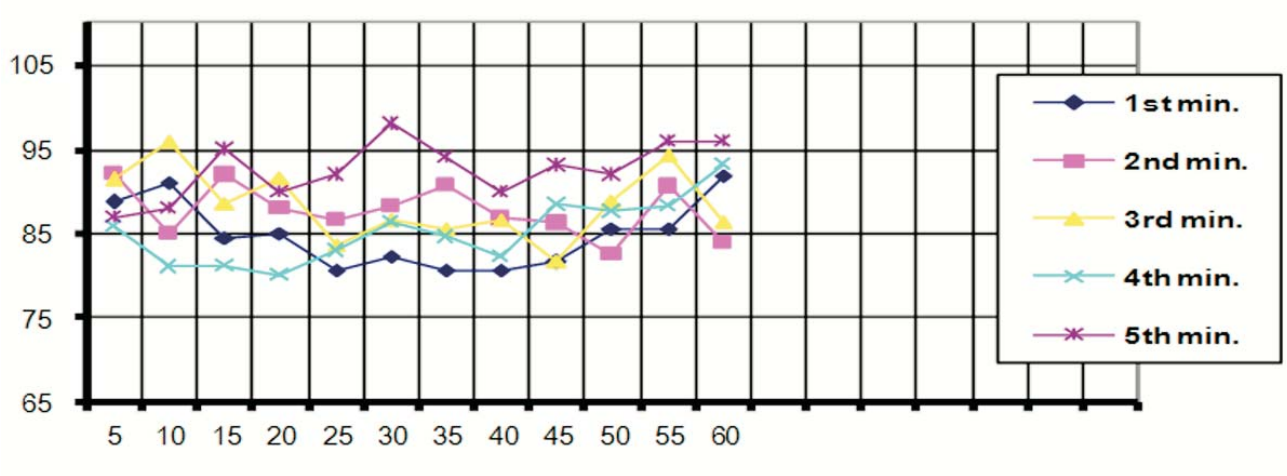


Chart- 1.7: Sound level with respect time (12.50 pm, at point 'C').

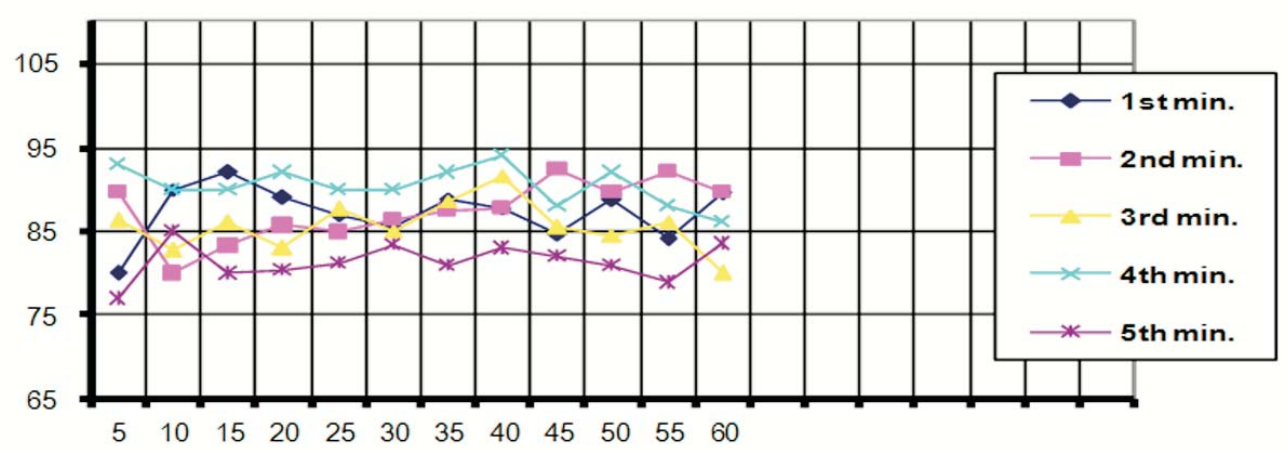


Chart- 1.8: Sound level with respect time (1.00 pm, at point 'D').

Sound variations of first 5 minutes at 4.00 o'clock started from point "A" and gradually to other points

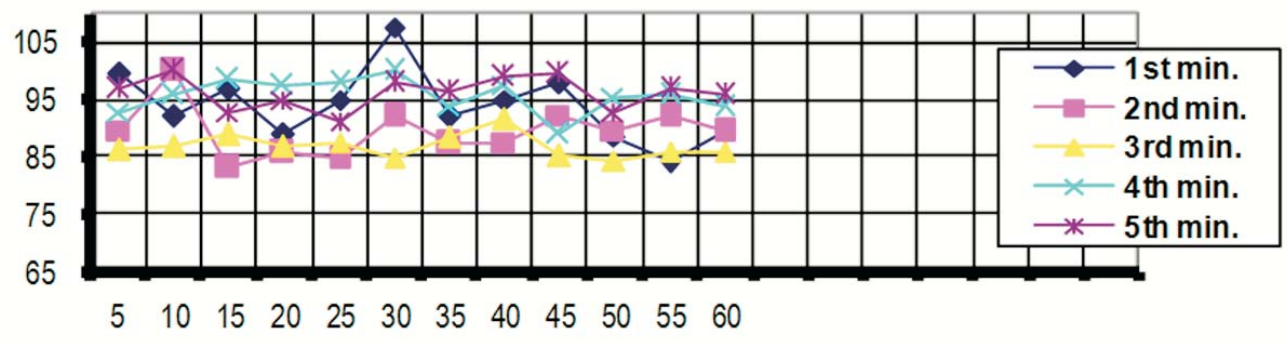


Chart- 1.9: Sound level with respect time (4.00 pm, at point 'A').

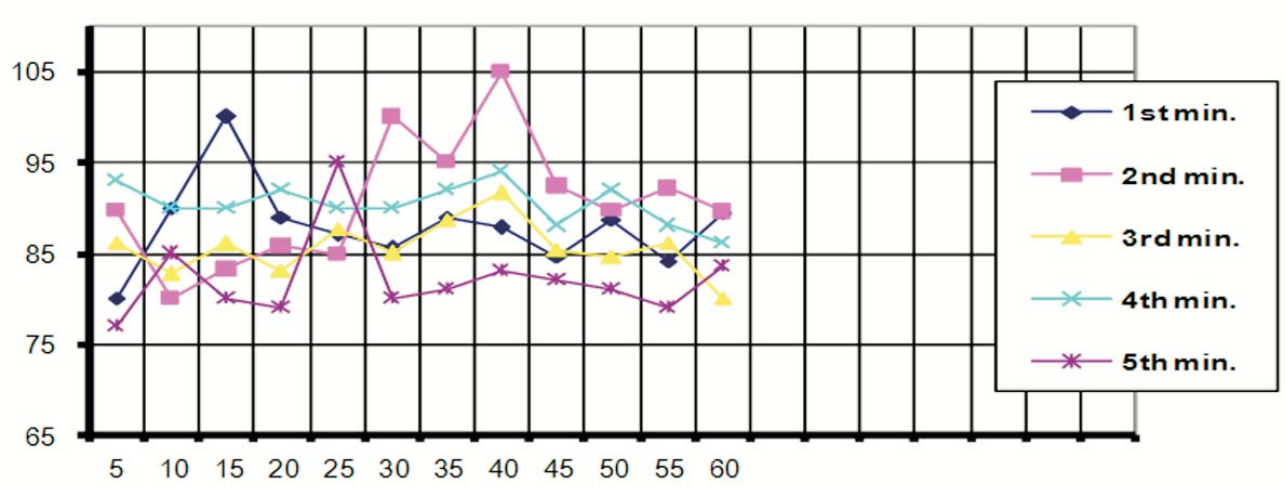


Chart- 1.10: Sound level with respect time (4.15 pm, at point 'B').

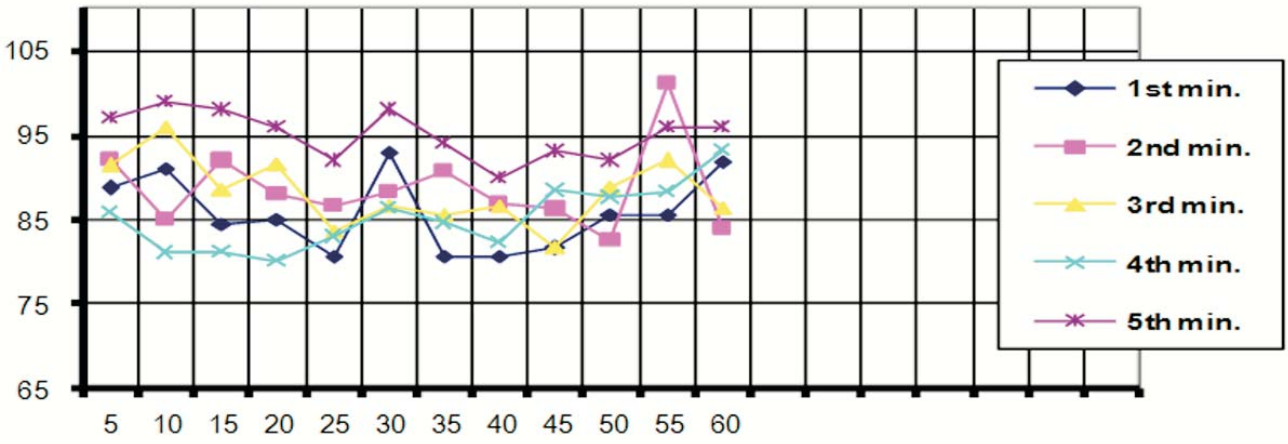


Chart- 1.11: Sound level with respect time (4.25 pm, at point 'C').

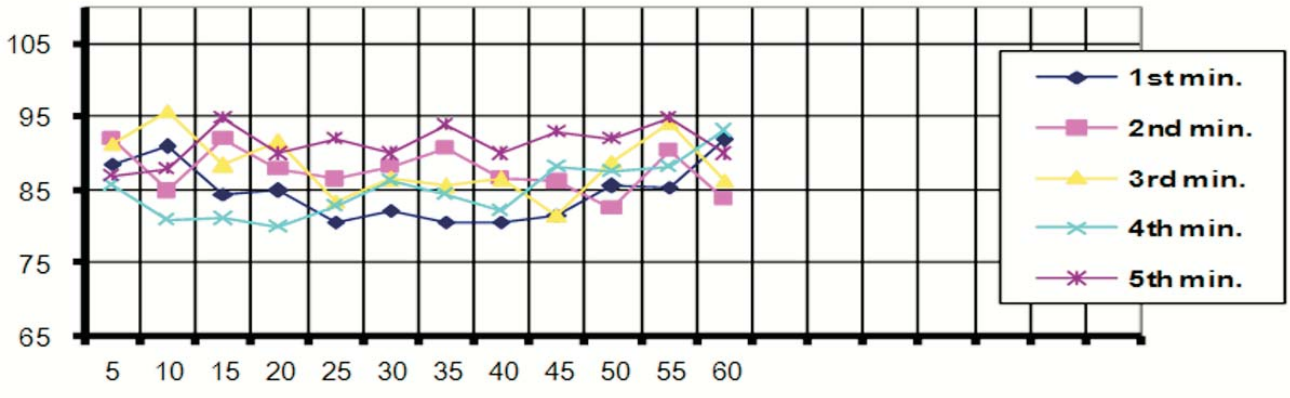


Chart- 1.12: Sound level with respect time (4.45 pm, at point 'D').

Sound variations of first 5 minutes at 6.25 o'clock started from point "A" and gradually to other points

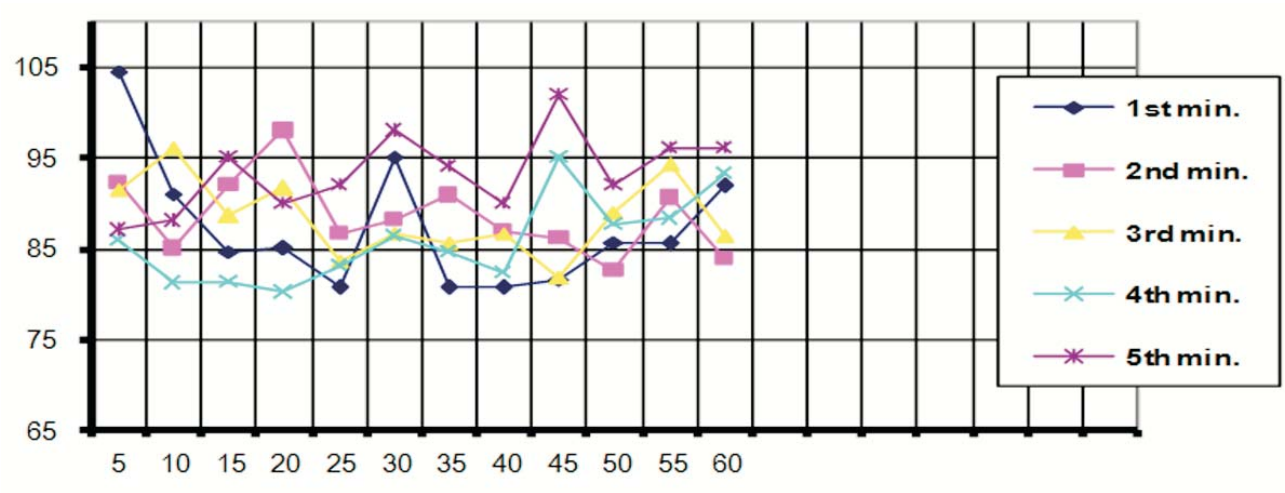


Chart- 1.13: Sound level with respect time (6.25 pm, at point 'A').

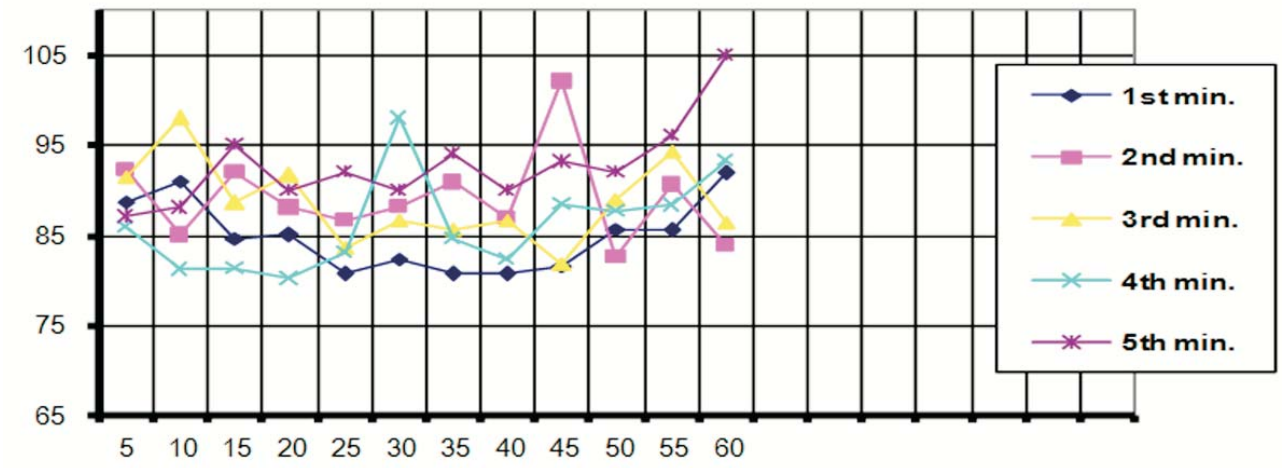


Chart- 1.14: Sound level with respect time (6.35 pm, at point 'B').

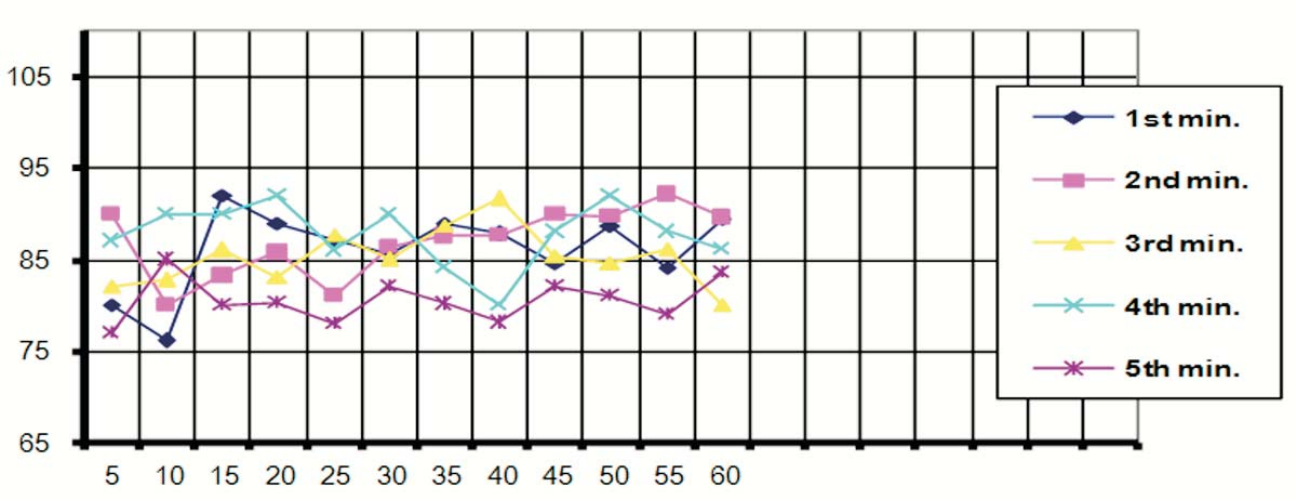


Chart- 1.15: Sound level with respect time (6.45 pm, at point 'C').

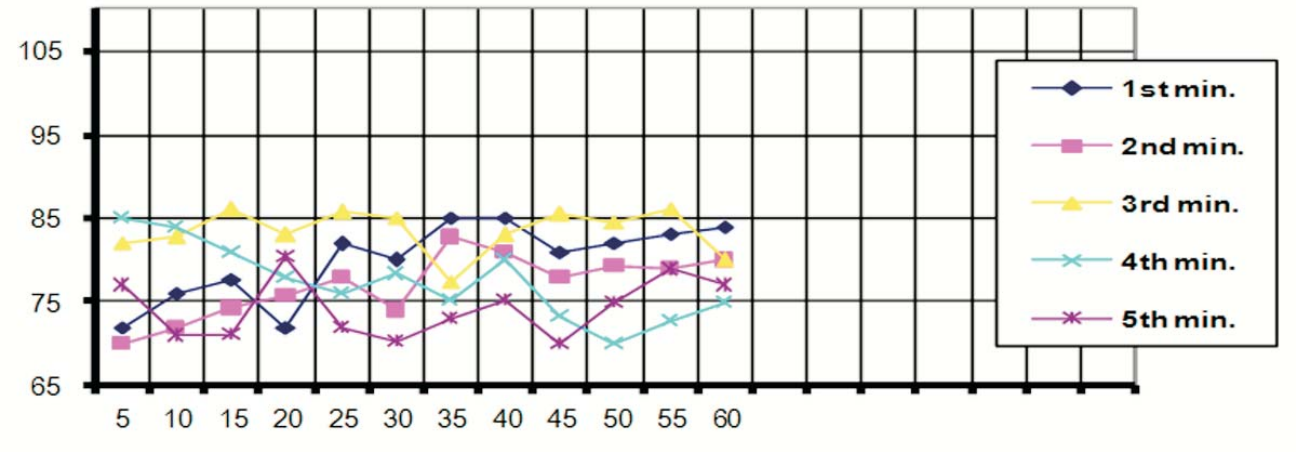


Chart- 1.16: Sound level with respect time (7.00 pm, at point 'D').

Data has been collected repeatedly at various times (at 9:30am, 12:30am, 4:00pm and 6:00pm) of the day. Data has been plotted on graph (**Chart**: 1.1 to **Chart**: 1.16). It is evident through these graphs that the sound level of the node remained 87.6 (Avg) dB throughout the time. These graphs also show the changing patterns of noise at different points on different times of the day. Point A shows significant rise at mid of the day. At onset, the noise level at point B is higher than other points but between 12:30 to 4:30pm it falls gradually and then again it shows an increase by end of the day. Point C almost maintained the same level for most of the time. Compared with other points, point D showed lowest noise level in the beginning and by end of the day; however some fluctuations were observed at mid of the day.

5.2. Questionnaire Analysis

The findings of the study through questionnaire survey are presented in following table. It shows that out of 40 persons, 28 persons have hearing problem and others are normal.

Occupation	Age Group	Hearing ability	Person	Percentage (%)
Regular office going people, shop keepers	25-35	Normal	12	30%
Traffic police & hawkers	35-45	Hearing problem	10	25%
Hawkers	35-55	Hearing problem	18	45%

6. RESULTS AND DISCUSSION

Zone A: As seen in the graph lines, this point is highly sound polluted.It boomed at 107.8 dB which is the highest sound level in this node. This unwanted sound is usually produced by the horns of heavy vehicles.

Zone B: As per graphical analysis, it is observed that Zone B is the second highly polluted zone with maximum 105 dB and minimum 75 dB of sound intensity.

Zone C: This zone is crowded by the vendors. Sound level varies between 75 dB to 100 dB. This noise is usually caused by the vendors and buyers. So general people are mostly responsible for this noise.

Zone D: The graph line articulates the fact that this zone is comparatively better than other three zones. Noise level remains between 65-95 dB.This sound level declines as the time increases.

Table-1: Noise quality standards, by zone and time of day

Zone class	Limits in dB	
	Daytime (6 a.m -9 p.m)	Nighttime (9 p.m -6 a.m)
Silent zone	45	35
Residential zone	50	40
Mixed(residential/commercial/industrial) zone	60	50
Commercial zone	70	60
Industrial zone	75	70

Source: Unnayan Shamannay, peoples report on Bangladesh environment 2001, volume 2, database (The University press limited, Dhaka, 2001).

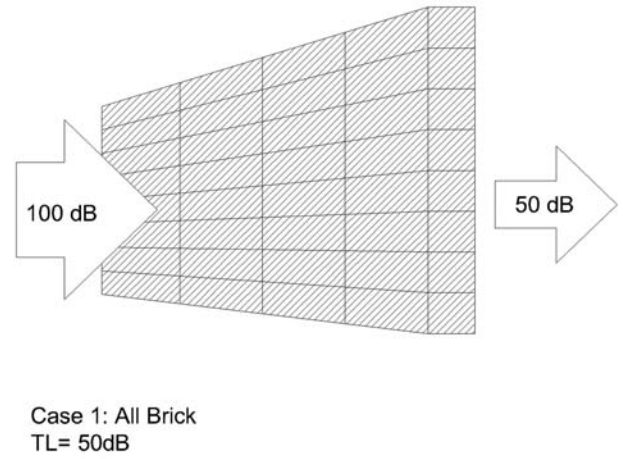
Table 01 revealed that noise quality standard of commercial zone was 70 dB in 2001. But according to the survey, noise level of Motijheel area at Shapla Chattar is higher than this level. The average noise level is about **91.6 dB at point A**, **89 dB at point B**, **83.86 at point C** and **79.3 at point D.** According to the survey report of SAHIC (Society for Assistance to Hearing Impaired Children) the noise level of Shapla Chattar, Motijheel is 89 dB .It is quite similar to the survey result of this research study which is calculated to be 87.6 dB. According to the statistics of World Health Organization (WHO), generally 60 dB sound can make a man deaf temporarily and 100 dB sound can cause complete deafness. When the sound exceeds this limit, there is noise pollution. So this node can be considered as highly polluted noise zone.

Noise inducing hearing loss has not been observed in those people who have been working here for 10-15 years of an age group of 25 to 35 years. People of more than 35 years of age and working here for more than 15 years are more vulnerable for noise inducing hearing loss. From the survey result it is clear that hawkers and traffic police are more vulnerable than shopkeepers and regular office going people. Main cause for this situation is that hawkers spend their time on footpath without using any precautionary barriers to reduce the impacts of noise intensity whereas the shopkeepers and officers work in indoor environment with partition walls and do not face such intensive noise directly.

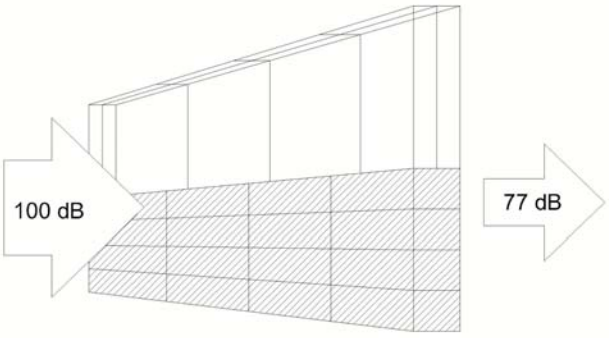
7. RECOMMENDATION

For node design following things should be considered:

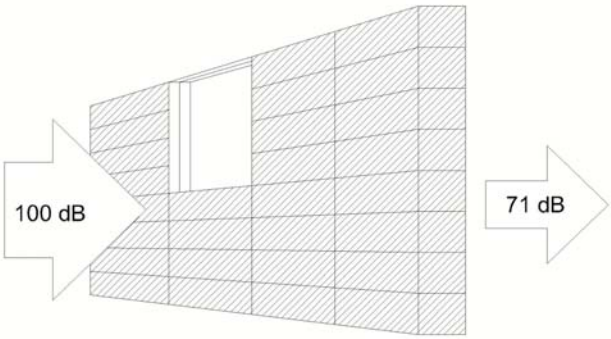
- Air, human being, vegetation and solid building surfaces are considered as sound absorbing elements. Solid building surface is incorrigible for buildings which are near to the city node to reduce the noise level to come inside the building. When a "weaker" element, such as a window or door, is used in a construction, the composite TL for the combination is usually closer to TL of "weaker"(Egan, M. David, 1972, page:63) as shown in Figure-12.



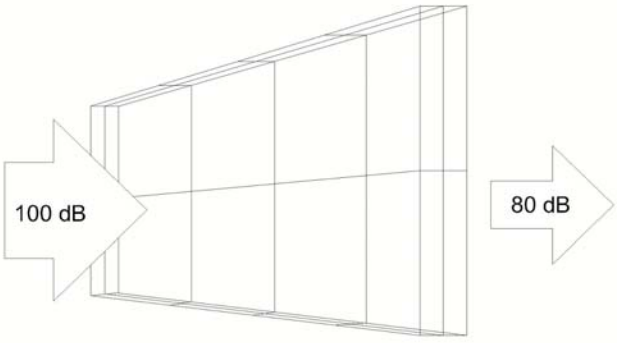
Case 1: All Brick
TL= 50dB



Case 3: 1/2 glass, 1/2 Brick
TI = 23 dB



Case 2: 1/8 glass, 7/8 Brick
TL= 29dB



Case 4:All Glass
TI = 20 dB

Figure-12: Careful use of building materials can reduce noise

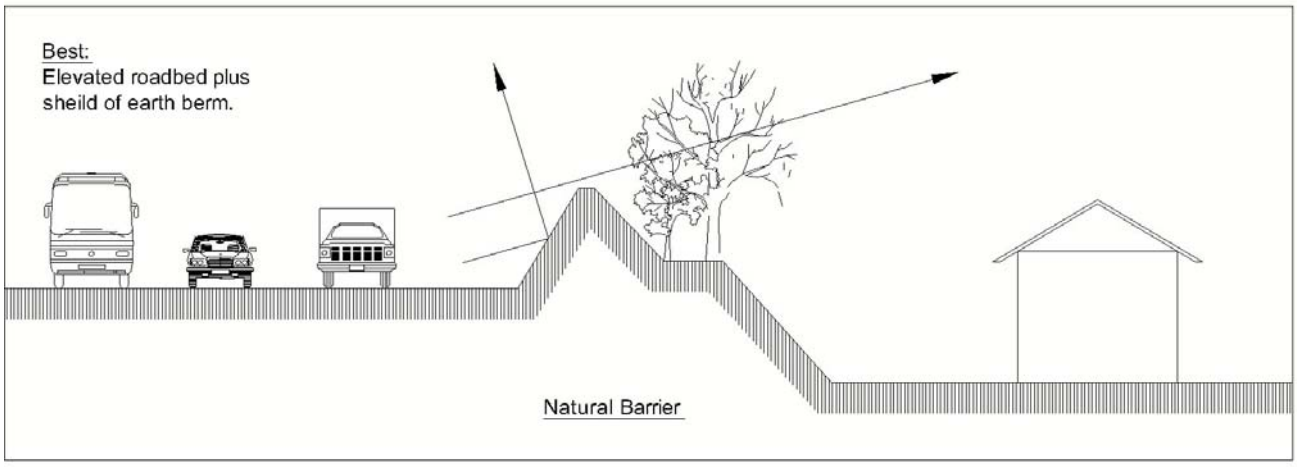


Figure-13: Use of natural barrier

- Barriers can be effectively used to reduce outdoor noise, particularly high frequency sound such as vehicle tire whine (Egan, page 90). Noise barriers can be designed near the nodes as shown in Figure-13.

- Trees and vegetation are not much effective as sound barriers. For example, dense plantation of minimum 100 feet depth will provide only 7 to 11 dBs of sound attenuation. But many rows of trees have certain value as an acoustical barrier (Egan, page 94) as shown in Figure-14.

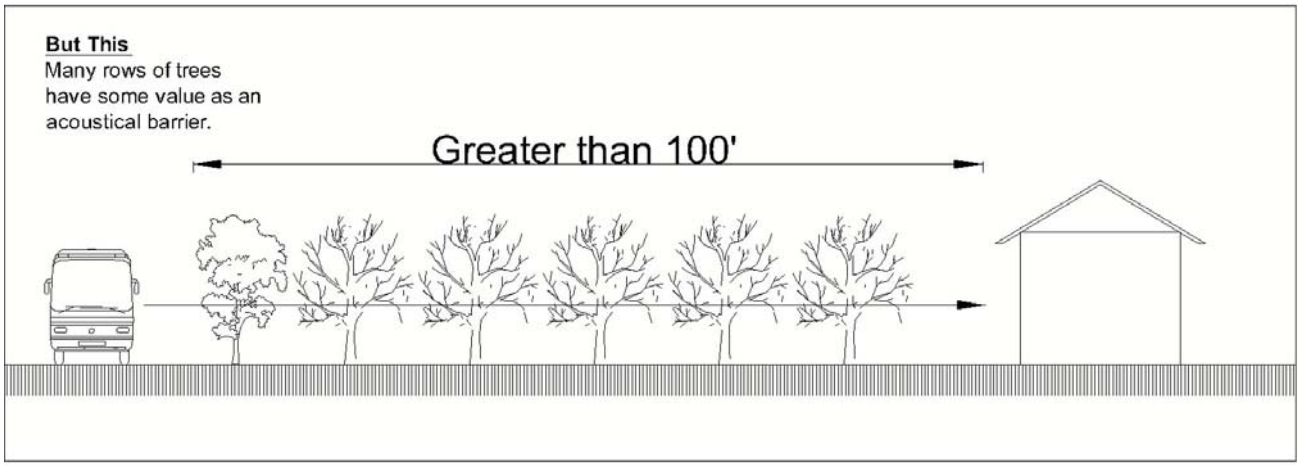


Figure-14: Best use of natural barrier

- Sound absorption by porous sound absorbers (called "FUZZ") is predominantly indirect conversion of sound energy into thermal energy. The amount of absorption is determined by porous absorber's actual physical properties of (1) thickness, (2) density, (3) porosity, and (4) fiber orientation. "FUZZ" (1"to 2" thick glass-fiber blanket) can also be used as wall treatment as shown in Figure-15. Porous material with open facing can be used for sound absorption as shown in Figure-16 (Egan, M. David, 1972, page: 29, 45).

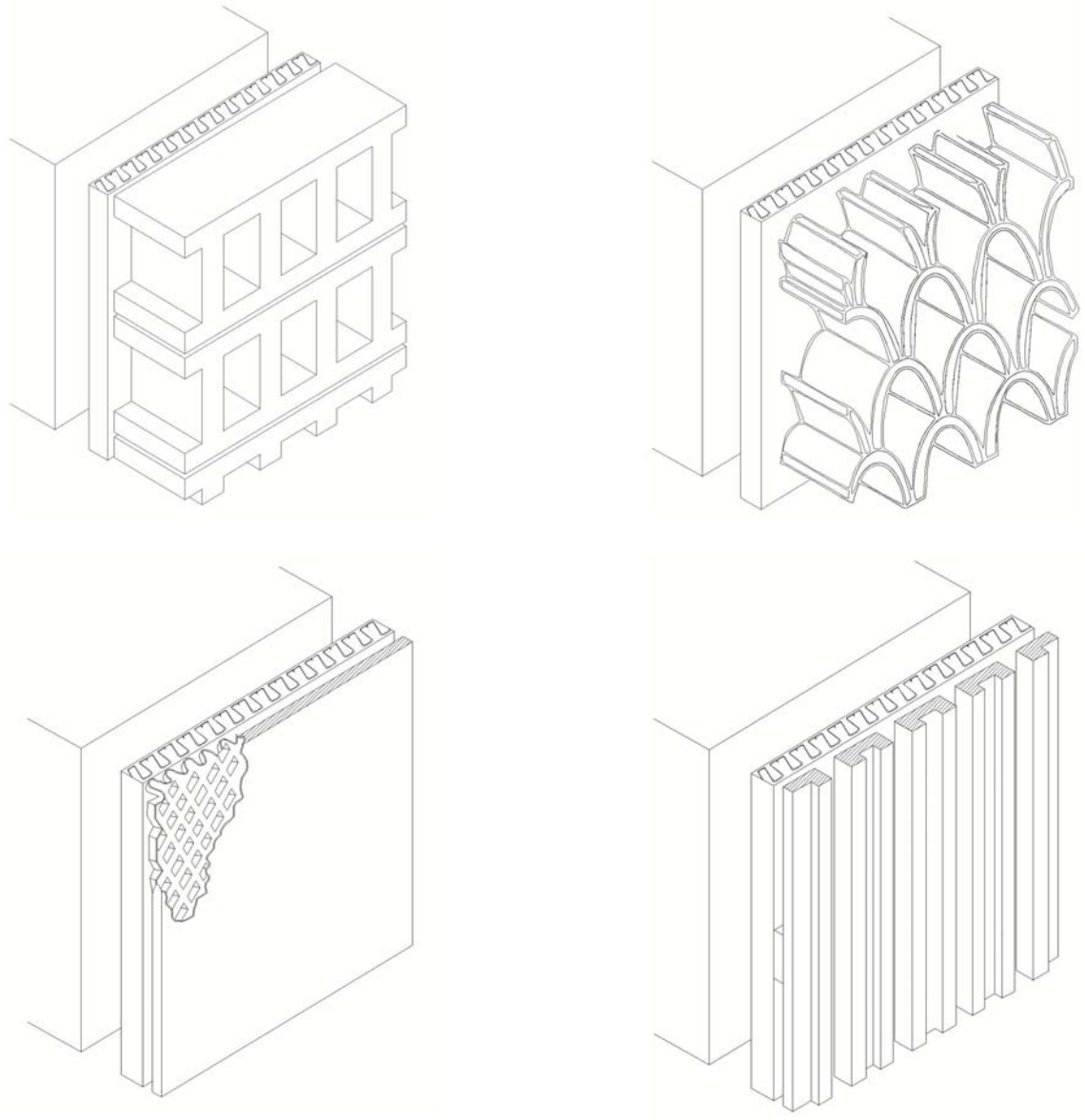


Figure-15: Use of "FUZZ" (1"to 2" thick glass-fiber blanket)
Ref:R.B.Newman,and W.J.Cavanaugh,Acoustics in J.H.Callender(ed.)Time-saver Standards,4th ed.Mc Graw-Hill,NewYork,1966.

- Surface area of facing should be at least 20% open for reverberation or room noise control, where high frequency absorption may not be critical. So many possibilities will satisfy these requirements that wall treatment is often limited only by the designer's imagination. (Egan, M. David, 1972, page:45)

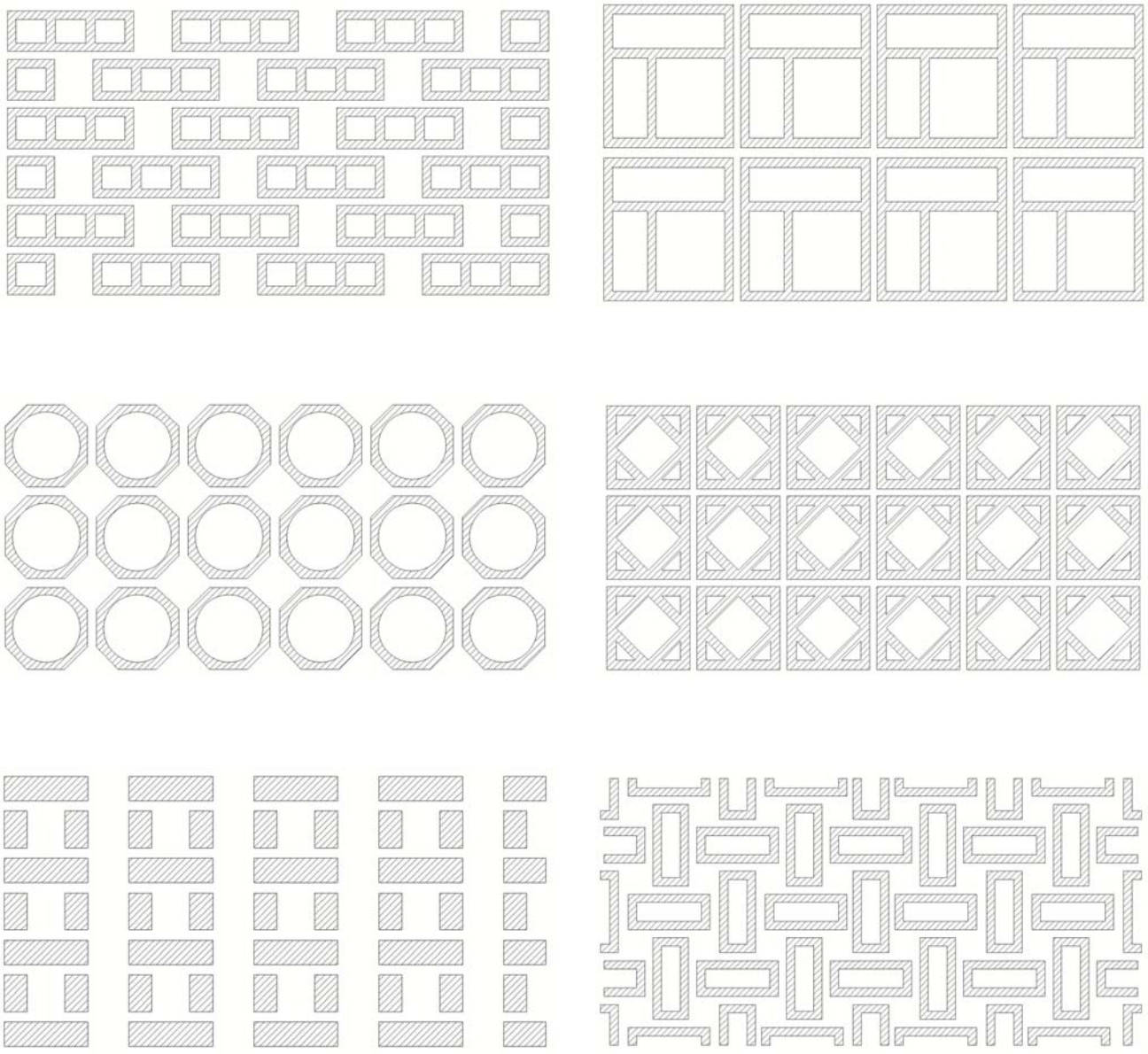


Figure-16: Use of Porous material with open facing in surface treatment

Based on the study carried out to examine noise pollution and sources (*Roy, R., Rahman, M.A., and Uddin, M.J., 2006)* following recommendations are mentioned here with a view to keep the noise pollution of **Shapla Chattar** area bellow an acceptable limit.

- Awareness should be raised among vehicle owners.
- Use of hydraulic horn should be banned immediately.
- Law enforcing authorities should prohibit unnecessary use of sound producing objects.
- Efficient traffic management technique should ensure discipline in vehicular movement.
- The problem can also be reduced by relocating the hawkers.

8. CONCLUSION

After analyzing the collected sound level data, it has been found that,

- Noise level of this area remains 87.6 dB (Avg) throughout the day.
- 28 out of 40 samples reported hearing impairment.
- People above 35 years age and working here for more than 15 years are more vulnerable for noise inducing hearing loss.
- It has also been observed that hawkers and traffic police are more vulnerable than shop keepers and regular office going people.

Noise control is a major factor in planning, designing and construction of the city nodes. Architects, acoustical engineers and transport planners are searching for creative ways to eliminate or greatly reduce noise levels. The challenge lies in attaining desired sound levels while simultaneously maintaining or enhancing the visual environment.

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