

Assessment of Vehicular Noise Pollution at Different Squares in Bhopal City, MP(India)

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Abstract: The Current study was carried out to assess the noise level from vehicular traffic in Bhopal city during a different portion of the day i.e., morning, afternoon and evening. This has been determined by collecting the noise level samples from different squares of Bhopal city. The sampling locations are as follows: 1 Rani Kamalapati railway station 2. Board office square 3. Bhopal railway station 4. Prabhat Square 5. Bhopal talkies Square.

The noise level samples were analyzed for various parameters of noise during different portions of the day i.e. morning, afternoon and evening. The different noise descriptors like percentile exceeded sound level (L_x), equivalent continuous sound level (Leq), Traffic noise index (TNI), noise pollution level (NPL) and noise climate (NC) were further analyzed.

Keywords: Noise meter, Squares, Railway station, Pollution, Bhopal

1. INTRODUCTION

The disturbance caused in the environment by loud and harsh sounds from different sound sources like vehicles, trains etc. that may result in different health hazards is called noise pollution. According to a report given by the World Health Organization ((WHO), 2005), the third most hazardous type of pollution is noise pollution, Noise pollution is an invisible danger. It cannot be seen, but it is present nonetheless, both on land and under the sea. Noise pollution is considered to be any unwanted or disturbing sound that affects the health and well-being of humans and other organisms. Sound is measured in decibels. The study examines the problem of noise pollution from one of the major sources i.e. automobiles. An attempt was made to measure and analyze various noise levels emanating from vehicles and trains on selected squares in Bhopal city.

1.1 Effects on humans and wildlife

Noise is more than a mere nuisance. At certain levels and durations of exposure, it can cause physical damage to the eardrum and the sensitive hair cells of the inner ear and result in temporary or permanent hearing loss, known as noise-induced hearing loss. Hearing loss does not usually occur at SPLs below 80 dBA (eight-hour exposure levels are best kept below 85 dBA), but most people repeatedly exposed to more than 105 dBA will have permanent hearing loss to some extent things are as follows:-

- Interference with speech communication;
- Interference with intended activities
- Disturb excessive noise exposure can raise blood pressure and pulse rates, cause irritability, anxiety, and mental fatigue, and interfere with sleep effects;

2. Study Area

Bhopal is known as the City of Lakes due to its various natural and artificial lakes. It is also one of the greenest cities in India. It was carved out of the erstwhile Sehore District of Bhopal division vide in 1972. The district derives its name from the district headquarters town Bhopal which is also the capital of Madhya Pradesh.

“The name (Bhopal) is popularly derived from Bhojpal or Bhoj’s dam, the great dam which now holds up the Bhopal city lakes, and is said to have been built by a Minister of Raja Bhoj, the Parmar ruler of Dhar. Noise Pollution Standards The present study was conducted from 15 November 2022 to 29 November 2022 with the help of portable precision noise level meter type.



Noise Pollution Standards

In India, the Noise Pollution (Regulation and Control) Rules, 2000 have been framed under the Environment (protection) act, 1986 to control community noise. Noise Pollution (Regulation and Control) Rules, 2000 notified in February 2000 and amended from time to time. The recent amendments to Noise Rules, 2000 were published in the official Gazette on 11th January 2010. The ambient levels of noise for different areas/zones are specified in the rules indicated in Table 2.1.

| Area Code | Category of Area/Zone | LeqdB(A) | |
|-----------|-----------------------|-------------------------|---------------------------|
| | | Day time (6a.m.–10p.m.) | Night Time (10 p.m–6a.m.) |
| (A) | Industrial area | 75 | 70 |
| (B) | Commercial area | 65 | 55 |
| (C) | Residential area | 55 | 45 |
| (D) | Silence Zone | 50 | 40 |

2.1 Ambient Noise Quality Standards as given by CPCB

Noise standards for automobiles have been notified in Part 'E', Schedule-VI of Environment (Protection) Rules, 1986, as amended on 19th May, 1993, as given in the Tables [19] below.

3.

| S.No. | Types of vehicles | Noise level in dB |
|-------|--|-------------------|
| 1 | Motorcycle, scooters and three wheelers. | 80 |
| 2 | Passenger Cars | 82 |
| 3 | Passenger or Commercial Vehicle upto 4MT | 85 |
| 4 | Passenger or Commercial Vehicle above 4MT and upto 12 MT | 89 |
| 5 | Passenger or Commercial Vehicle exceeding 12MT | 91 |

MATERIALS AND METHODOLOGY

A sound level meter is a fundamental requirement for measuring the noise levels. It is designed to estimate the sensitivity level of loudness for the human ear and gives the desired, reproducible measurements for the sound pressure level. To determine the frequency range, spectral weighting of sound, along with the function of time constants, and computation of the equivalent continuous

level the sound level meter does more complex work. It consists of a microphone which acts as a transducer to convert the sound into its equivalent electrical signal. The sound level meter was held at a height of 1.2-1.5 m above the ground level as suggested by Central Pollution Control Board. The SLM100 Sound Level Meter has been designed for ease in field operation.

3.2. NOISE LEVEL PARAMETERS

L_{eq} , L_{10} , L_{50} and L_{90} are considered as basic parameters and all other parameters like TNI, LNP and NC are determined on the basis of their values.

3.3 Equivalent Sound level (L_{eq})-

$$L_{eq} = 10 \log \sum_{i=1}^{i=n} 10^{\frac{L_i}{10}} \times t_i$$

This is the steady noise which in the measurement period would carry the same energy as is extended by fluctuating level over the same time.

Where,

n = total number of sound samples L_i = noise level of any n th sample

t_i = time duration of the i th sample expressed as a fraction of the total time sample

3.4 Percentile exceeded sound Level (L_x) decibel-

The noise level exceeded for x per cent of the time is denoted by L_x . The most common noise exceeded level used is L_{10} , i.e. noise level exceeding 10 per cent of the time. It is an indication of the peak level of the intruding noise, whereas L_{90} level is an indicator of the background noise level. L_{50} is the median value of different sound levels.

3.5 Traffic Noise Index (TNI)-

The traffic noise index is a method used to estimate annoyance responses due to traffic noise. The value of TNI over 74 dB(A) (Scholes and Sargent, 1971; Maetal., 2006) is defined as the threshold of over criterion. It is computed using the following formula (Langdon and Scholes, 1968):

$$TNI = 4 (L_{10} - L_{90}) + L_{90} - 30 \text{ dB(A)}$$

3.6 Noise Pollution level (LNP)-

It is found that L_{eq} on an energy basis is not sufficient to describe the degree of annoyance caused by fluctuating noise. A new parameter noise pollution level was developed by Robinson in the late 60's (Schultz, 1972) and has a threshold value of 72 dB (A) (Scholes and Sargent, 1971). At times to describe community noise, which employs the equivalent continuous (A-weighted) sound level and the magnitude of the time fluctuations in levels, Noise Pollution Level (LNP) is used. The measurement is conceived so that it combines the degree of steadiness in time of the noise (assuming that the less steady it is, the more distracting and annoying it becomes).

$$LNP = L_{50} + (L_{10} - L_{90})^2 / 60 + (L_{10} - L_{90})$$

3.7 Noise Climate (NC)

Sound levels will be fluctuating over an interval of time. The range over which the fluctuations occur is known as Noise Climate (NC) and is assessed by the following formula.

$$NC = (L_{10} - L_{90})$$

4. RESULT AND DISCUSSION

Average for all the noise parameters is taken as the representation of noise level parameter of Bhopal city as a whole. In such analysis it is found that Evening time has maximum value of L_{eq} , i.e. 69.8 dB. Further whole analysis is done under morning, evening and afternoon time durations.

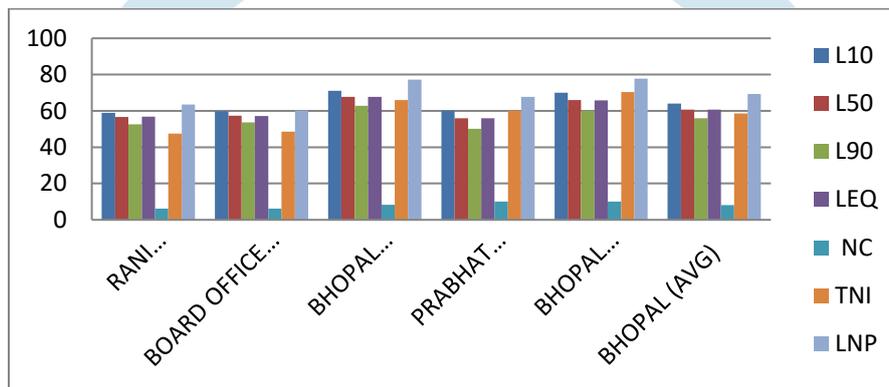
4.1. MORNING

Study time between 6 am to 12 am has been taken as morning time. It is that portion of the day in which generally schools of Bhopal open, people go to their workplace or engage in their business activities. Bhopal railway station has maximum value of all the basic noise parameters during morning (Chart-1). So we can say that Bhopal railway station is the noisiest among all squares of Bhopal during morning.

Table -1: Values of Noise level parameters in dB(A) at different squares during morning in Bhopal city

| PARAMETER | RANI KAMALAPATI RAILWAY STATION | BOARD OFFICE SQUARE | BHOPAL RAILWAY STATION | PRABHAT SQUARE | BHOPAL TALKIES SQUARE | BHOPAL OF ALL |
|-----------|---------------------------------|---------------------|------------------------|----------------|-----------------------|---------------|
| L10 | 58.9 | 59.9 | 71.1 | 60.2 | 70.1 | 64.04 |
| L50 | 56.6 | 57.4 | 67.7 | 56.0 | 65.9 | 60.72 |
| L90 | 52.7 | 53.7 | 62.8 | 50.2 | 60.0 | 55.88 |
| LEQ | 56.75 | 57.1 | 67.72 | 55.99 | 65.87 | 60.69 |
| NC | 6.2 | 6.2 | 8.3 | 10 | 10.1 | 8.16 |
| TNI | 47.5 | 48.5 | 66 | 60.2 | 70.4 | 58.52 |
| LNP | 63.44 | 60.24 | 77.15 | 67.67 | 77.70 | 69.24 |

Chart -1: Variation in noise level parameters (L10, L50, L90 & LEQ) in dB(A) at different squares. Since, TNI and LNP has maximum value (Table-1) at State Bank Square, it is most annoyed place during morning with respect to noise pollution.



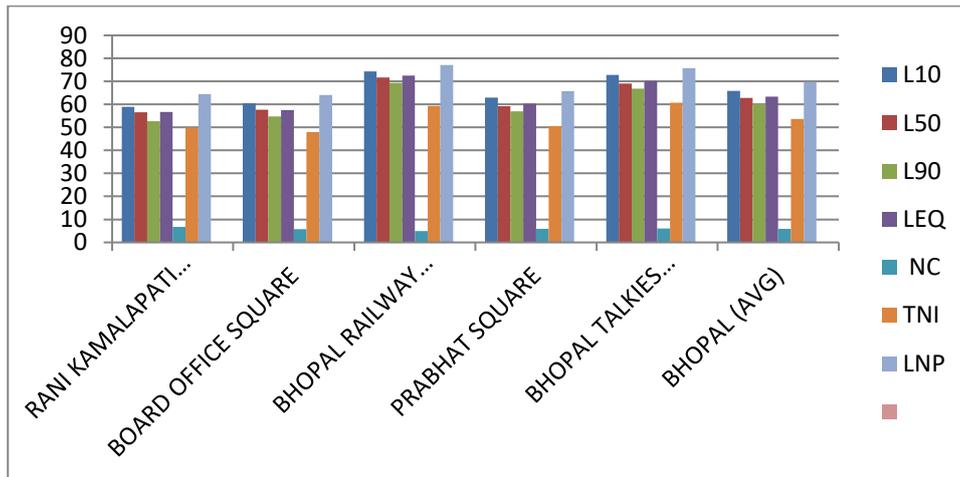
4.2. AFTERNOON

Study time between 12 am to 6 pm has been taken as afternoon time. It is that portion of the day in which generally closing of schools happens. Lunch time of offices also happens during this time. Bhopal railway stations has maximum value of all the basic noise parameters during afternoon as shown below in (Chart-2). Most annoyance responses due to traffic will be at Bhopal talkies square due to maximum value of TNI. Distraction and annoyance due to fluctuation of noise will be maximum at Bhopal talkies square due to maximum LNP (Table-2).

Table -2: Values of Noise level parameters in dB(A) at different squares during afternoon in Bhopal city

| PARAMETER | RANI KAMALAPATI RAILWAY STATION | BOARD OFFICE SQUARE | BHOPAL RAILWAY STATION | PRABHAT SQUARE | BHOPAL TALKIES SQUARE | BHOPAL OF ALL |
|-----------|---------------------------------|---------------------|------------------------|----------------|-----------------------|---------------|
| L10 | 58.9 | 60.5 | 74.4 | 62.9 | 72.8 | 65.9 |
| L50 | 56.6 | 57.7 | 71.7 | 59.2 | 69.1 | 62.86 |
| L90 | 52.7 | 54.7 | 69.4 | 57.0 | 66.8 | 60.12 |
| LEQ | 56.75 | 57.5 | 72.55 | 60.26 | 70.11 | 63.43 |
| NC | 6.7 | 5.8 | 5 | 5.9 | 6 | 5.88 |
| TNI | 49.9 | 47.9 | 59.4 | 50.6 | 60.8 | 53.72 |
| LNP | 64.44 | 64.06 | 77.12 | 65.68 | 75.7 | 69.8 |

Chart -2: Variation in noise level parameters (L10, L50, L90 & LEQ) in dB(A) at different squares during the afternoon time.



4.3. EVENING

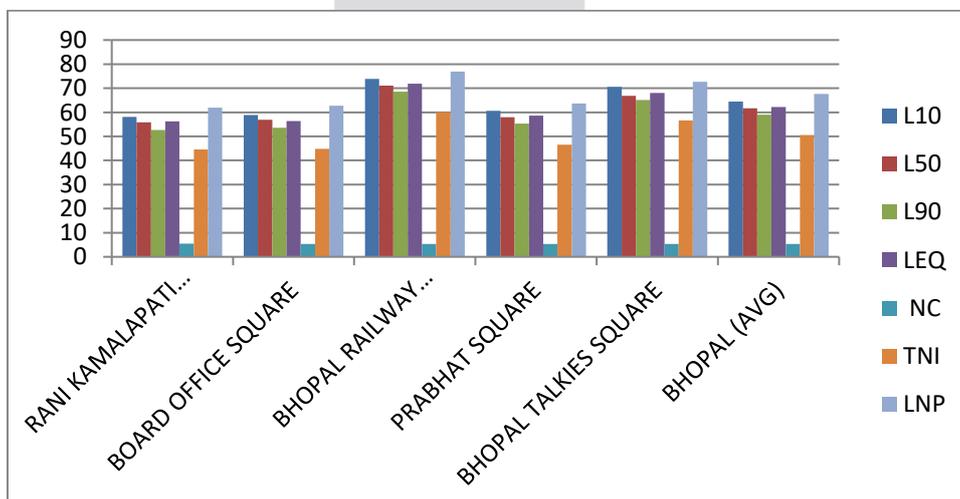
Study time between 6 pm to 10 pm has been taken as evening time. It is that portion of the day in which where generally closing of offices happens and people return from their workplaces. It is a very important duration of the day as far as commercial activity in Bhopal is considered on normal Working days. In the evening time, Bhopal railway station has the maximum value of all basic noise parameters during evening as shown below (Chart-3). So we can say that the noisiest among all squares of Bhopal during evening time.

Since, TNI and LNP has maximum value (Table-3) at Bhopal railway station, it is most annoyed place during evening with respect to noise pollution.

Table -3: Values of Noise level parameters in dB(A) at different squares during evening in Bhopal city

| PARAMETER | RANI KAMALAPATI RAILWAY STATION | BOARD OFFICE SQUARE | BHOPAL RAILWAY STATION | PRABHAT SQUARE | BHOPAL TALKIES SQUARE | BHOPAL OF ALL |
|-----------|---------------------------------|---------------------|------------------------|----------------|-----------------------|---------------|
| L10 | 58.1 | 58.9 | 73.9 | 60.6 | 70.5 | 64.4 |
| L50 | 55.9 | 56.9 | 71.1 | 57.9 | 66.8 | 61.72 |
| L90 | 52.6 | 53.6 | 68.5 | 55.3 | 65.1 | 59.02 |
| LEQ | 56.26 | 56.4 | 71.84 | 58.62 | 68.08 | 62.24 |
| NC | 5.5 | 5.3 | 5.4 | 5.3 | 5.4 | 5.38 |
| TNI | 44.6 | 44.8 | 60.1 | 46.5 | 56.7 | 50.54 |
| LNP | 61.90 | 62.67 | 76.98 | 63.67 | 72.686 | 67.58 |

Chart -3: Variation in noise level parameters (L10, L50, L90 & LEQ) in dB(A) at different squares during evening time



5. CONCLUSION

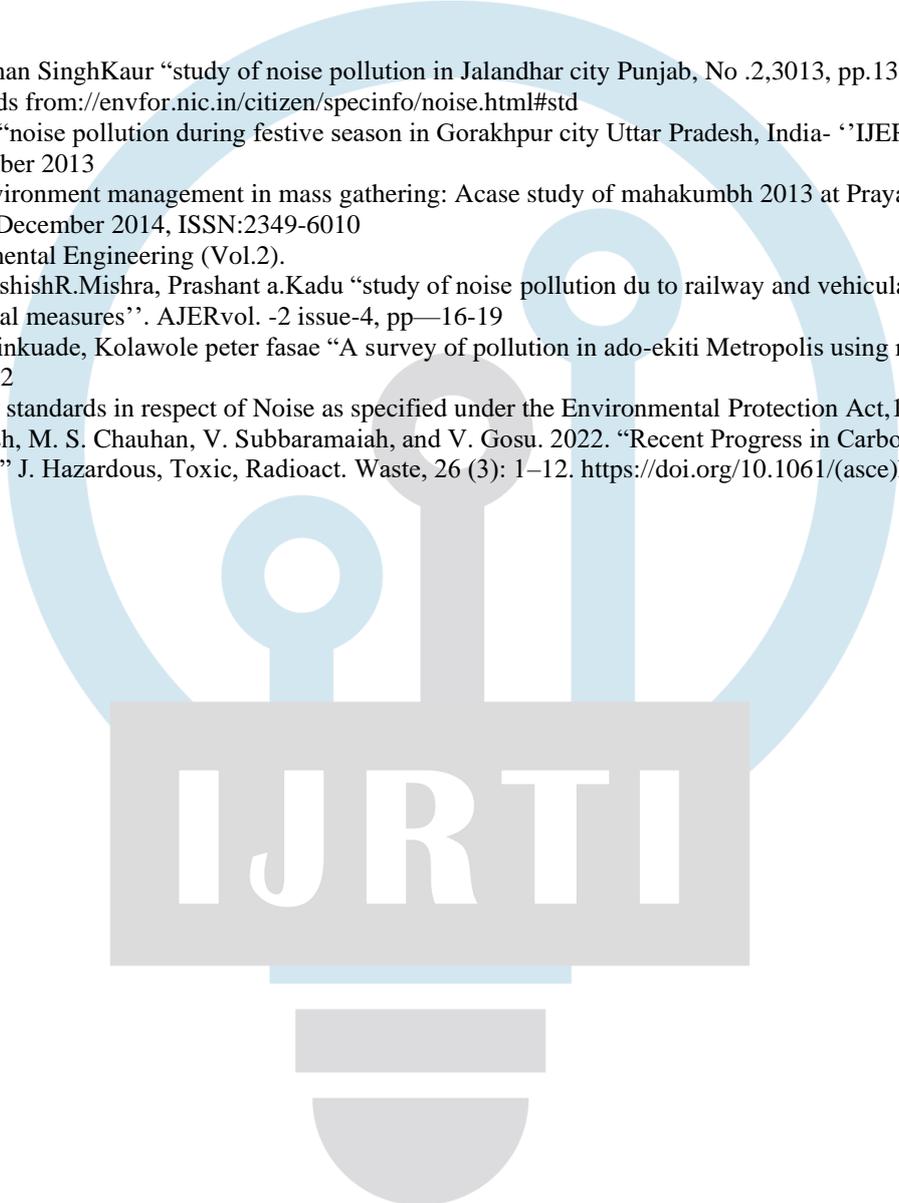
Traffic noise level at all the squares of Bhopal city are well above the standard prescribed by CPCB of India. Although heavy vehicles are not permitted to enter the city in the daytime 06:00 – 22:00 o'clock but still the main fraction of transport activities are relied to personal gasoline cars and diesel buses which generate the high level of noise pollution due to poor maintenance and old technology.

Traffic jams and unregulated traffic has become an endemic feature even at major squares of Bhopal city due to insufficient street capacity. The major parts of public buildings situated near Bhopal railway station are directly exposed to excessive traffic noise.

Strategic approach to noise pollution control in big urban areas like Bhopal is crucial and should start with proper noise measurement and mapping program. If properly enforced, a series of effective and applicable control measures are available, starting from limitation of vehicles access, speed limits reduction, tires quality specification or even changes in road material. Low-noise behavior of drivers should be encouraged as well, by advocating defensive driving manners.

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