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Evaluation Study of Noise Pollution in Pune City

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Abstract

Noise pollution, in the recent times, has been well recognized as one of the major trepidations that impact the quality of life in urban areas across the globe. Pune, an ancient city of India, has rapidly emerged as industrialized and urbanized city and has started facing severe noise pollution problems. Day-time urban noise quality assessment will be studying in Pune for five critical zones viz. Educational, Commercial – cum - residential, Industrial – cum - residential, Residential and Silence zone. Pune is one of the important metro cities in India as well as Maharashtra but due to ongoing large construction projects and migrating population is causing serious environmental and noise is one of them. In this study, we are going to evaluate different parameters related to traffic noise in Pune city, for recording various noise parameter digital sound meter will be used.

Keywords: *Noise Pollution, Pune City, Decibel, Kilo Hertz)*

INTRODUCTION

Environmental pollution is currently recognized as a global phenomenon that draws people's attention due to its serious long-term implications. Environmental contamination is on the rise, and the status of the environment continues to deteriorate. Environmental contamination is a global concern that affects both industrialized and developing countries. All of these issues are the result of fast population increase, excessive natural resource exploitation, urbanization, and industrialization. Although beneficial to human progress and welfare, such activities result in the creation and release

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of unwanted elements into the environment, fouling it and making our lives unpleasant. Pollution not only pollutes the environment, but it also has an impact on human health and productivity.

Noise pollution is a major issue not just in rich nations, but also around the world, and India is one of the developing countries that suffers from and produces a lot of it. Noise has increased quickly in all locations, particularly in metropolitan areas, over the last thirty years. The increased noise pollution has a variety of repercussions on the human environment. Because of the spectacular development in vehicles and other noise pollutants as a result of unregulated urban population expansion, India's major cities are suffering from noise pollution. The majority of India's major cities have significant levels of noise pollution, with noise levels typically exceeding 70 decibels (Shrivastava, 2004). Vehicle traffic, neighborhood, electrical appliances, TV and music systems, public address systems, train and air traffic, and generating sets are all sources of noise pollution. The majority of individuals who live in metropolitan areas or large towns, as well as those who work in industries, are exposed to the negative impacts of noise. It impacts both the affluent and the poor, as is typical. Noise pollution is less of an issue in small towns and villages. Those who live in villages/towns along national/state roads or near railway tracks, on the other hand, are subjected to excessive noise. In India, the number of automobiles has increased from over 54 million in 2001 to over 141 million in 2011. (The Red Book, 2013). The extensive use of loud speakers in Indian social and religious rituals, as well as the indiscriminate use of horns by automobiles, pose a number of health risks to city dwellers (Singh and Davar, 2004). Another important contributor to noise pollution in India is that in many cities, industrial and commercial facilities are either located close to residential areas or are occasionally built right in the middle of them. India acknowledged restrictions on maximum limits of concentration of environmental contaminants, including noise, by the passage of the comprehensive Environment (Protection) Act in 1986. Noise pollution was mentioned in the Indian Penal Code (1860), the Motor Vehicles Act (1939), the Industries Act (1951), the Air Act (1981), and some state legislation prior to this act; however, the problem of noise pollution remained a source of inconvenience to the people because it was vaguely defined in the acts and no specific standards/limits of noise

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pollution were defined. The Ministry of Environment and Forests of the Government of India issued draught noise pollution regulations in 1999, detailing the standards/limits for noise pollution in several categories, and the Government notified the Noise Pollution (Regulation and Control) Rules, 2000 the following year.

Study Area

Maharashtra is a state in India that is located in the western and central parts of the country as shown in figure 3.1. Latitude extension of Maharashtra in from North is 15'37 North latitude to 22'6 North Latitude as well as Longitude extension of Maharashtra from East is 72'36 East longitude to 80'54 East longitude. The Sahyadri and Satpuda mountain ranges provide natural protection along its 720-kilometer coastline along the Arabian Sea. Gujarat is bordered on the northwest by Madhya Pradesh, on the north by Chhattisgarh, on the east by Telangana, on the southeast by Karnataka, on the south by Karnataka, and on the southwest by Goa.

The total area of the State is 3, 07,713 Sq. In terms of km and area, it ranks third in the country after Rajasthan (3,42,239 sq km) and Madhya Pradesh (3,08,313 sq km). By area, Maharashtra is third largest state after Rajasthan and Madhya Pradesh, and it is the second largest state by population. Maharashtra has 6 administrative divisions, 36 districts, 535 cities, 355 talukas, and 63,663 villages. Maharashtra is heavily urbanized, with 45.2 percent of its inhabitants residing in towns. Maharashtra has a sex ratio of 929 females per 1,000 males and an 82.3 percent literacy rate.

Marathi is the most widely spoken language, with Hindi, English, and Konkani also being widely spoken. It has a tropical monsoon climate, lush and abundant forests, and six outstanding tiger reserves as well as six national parks. Between 17 degrees 54′ and 10 degrees 24′ north latitude, and 73 degrees 19′ and 75 degrees 10′ east longitude, lies the Pune district as shown in figure 3.2. The district covers a total size of 15.642 square kilometres. Ahmadnagar district is to the north- east, Solapur district is to the south-east, Satara district is to the south, Raigad district is to the west, and Thane district is to the north-west.

It is the state's second biggest district, with 5.10 percent of the state's total geographical area.

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Study Site

In Pune city, there is lot of places for industries, workshops/factories, institutions, offices, and hospitals. Therefore, on the basis of location, the study area was divided into four zones such as Educational Zone, Hospital Zone, Traffic Zone and Industrial Zone. In each zone, one sites each are selected from different locations of the city. The selected sites are as follows:

- **Zone 1 – Educational zone**
  According to the standards prescribed by the Noise Pollution (Regulation and Control) Rules, 2000, the permissible limit of noise level (Leq) in the educational zone during day time is 55 dBA. The Savitribai Phule Pune University sites were selected under the educational zone.

- **Zone 2 – Hospital zone**
  According to the standards prescribed by the Noise Pollution (Regulation and Control) Rules, 2000, the permissible limit of noise level (Leq) in the silence zone during day time is 50 dBA. The Sasoon Rugnalaya Pune sites were selected under the Silence zone.

- **Zone 3 – Traffic zone**
  According to the standards prescribed by the Noise Pollution (Regulation and Control) Rules, 2000, the permissible limit of noise level (Leq) in the commercial zone during day time is 65 dBA. The Model Colony Bridge Pune sites were selected under the commercial zone.

- **Zone 4 – Industrial zone**
  According to the standards prescribed by the Noise Pollution (Regulation and Control) Rules, 2000, the permissible limit of noise level (Leq) in the industrial zone during day time is 75 dBA. The Garware Technical Fibres site were selected under the industrial zone.



Fig. 1: Different Study Sites

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RESEARCH METHODOLOGY

The Integrating Sound Level Meter EUROLAB-SL 4010 was used for recording the noise level in the study sites. This integrating sound level meter is a type-1 instrument with SPL, Leq, Lmax, Lmin and SEL measurement. It is very simple to operate and is an ideal and essential tool for noise measurement and data collection in the field. It has a wide measurement range and a host of features like A, C, and Linear weighting. The meter can be used to read spot values, calculate short or long term Leq, SEL, maxima and minima and time duration of the data collection. A slow, fast and impulse time response, Max Hold, detachable microphone, rechargeable battery and an alphanumeric display are provided on the instrument. All parameters of the instrument are software controlled and are checked internally by the self-test mode.

Steps in taking the noise level:

1. The operational function of data recording was done on a switch on mode of SLM at the selected sites and the numerical values displayed on LCD were recorded.
2. Readings were taken thrice a day (morning 6 a.m – 7 a.m, daytime 12 noon – 1 p.m and evening 4 p.m – 5 p.m) and a month (one week interval) at each site.
3. In case of institutions and workshops readings were taken from 9 a.m – 10 a.m for morning time since these places were opened only from 9 a.m.
4. After recording Lmax, Lmin and Leq of the noise level, the result was compared with the standards of Noise Pollution (Regulation and Control) Rules, 2000.



Fig 2: Sound Level Meter

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METER SPECIFICATION

Table 1: Specification of sound level meter (EUROLAB-SL 4010)

SPECIFICATIONS	
Display	18 mm (0.7") LCD (Liquid Crystal Display), 3 1/2 digits.
Measurement Range	35 to 130 dB, 3 ranges: range 1 - 35 to 80 dB, range 2 - 50 to 100 dB, range 3 - 80 to 130 dB, Each range with warning indicator for over & under load.
Resolution	0.1 dB.
Measurement Frequency	31.5 Hz to 8,000 Hz.
Frequency Weighting Network	Characteristics of "A" frequency weighting network. The "A weighting" characteristic is simulated as "Human Ear Listing" response.
Time Weighting	Default to "Fast" time weighting characteristics." Fast time weighting " is simulated the human ear response character.
Accuracy (23 ± 5 ℃)	Characteristics of "A" frequency weighting network meet IEC 61672class 2. Under 94 dB input signal, the accuracy is: 31.5 Hz - ± 3.5 dB, 63 Hz - ± 2.5 dB, 125 Hz - ± 2.0 dB 250 Hz - ± 1.9 dB, 500 Hz - ± 1.9 dB, 1 kHz - ± 1.4 dB 2 kHz - ± 2.6 dB, 4 kHz - ± 3.6 dB, 8 kHz - ± 5.6 dB
Calibrator	B & K (Bruel & kjaer), multi-fuction acoustic calibrator, model: 4226.
Microphone type	Electric condenser microphone.
Size of microphone	1/2-inch standard size.
Calibration VR	Build in external calibration VR, easy to calibrate on 94 dB level by screw driver.
Data Hold	Hold function to freeze the display value.
Operating Temp.	0 ℃to 50 ℃(32 ℉to 122 ℉).
Operating Humidity	Less than 80% RH
Power Supply	006P DC 9V battery (heavy duty type).
Power Consumption	Approx. DC 6 mA.
Dimension	225 x 70 x 28 mm (8.9 x 2.8 x 1.1 inch).
Weight	250 g/0.55 LB (including battery).
Standard Accessories	Instruction Manual.....1 PC.
Optional Accessories	94 dB Sound Calibrator, Model: SC-941.
	94 dB/114 dB Sound Calibrator, Model: SC-942.
	Hard carrying case, Model: CA-06.

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INDICATORS OF NOISE

- **Equivalent Continuous Sound Level (Leq)**

  The equivalent continuous sound level has been adopted in a number of countries ring and assessing noise. It is sometimes referred to by various other as means of measuring a lent continuous sound level, such as mean energy level and equivalent terms than equivalent conti suivalent continuous sound level is given by the level of study noise sound level. The equivalent as the same energy as the actual time varying noise in question.

- **Noise pollution level (LNP)**

  Noise pollution level specifically devised to take the account of more complex time varying noises. The scale takes account of the equivalent continuous sound level over a particular period of time together with the variability of the noise environment. LNP is significant because in principle, it accounts for annoyance from aircraft, traffic and other sources such as industrial noise.

- **Traffic noise index (TNI)**

  It correlates with dissatisfaction towards traffic noise expressed by people. The measurement of TNI is difficult because of the uncertainty arising from background Se coming from sources other than traffic on the road being considered. Prediction is also difficult because of proble because of problem in predicting the background noise at large distance from the road.

- **Noise Climate (NC)**

  It is the range over which the sound levels are fluctuating in an interval of time It is the range over which the e, TNI, LNP and NC are calculated using the formulae as given below.

a. Equivalent Sound Energy Level (Leg)

Leq = L50 + [(L10 - L90)2 /60) dB(A)

b. Noise pollution level (LNP)

LNP = Leq + (L10 - L90) dB(A)

c. Traffic Noise Index (TNI)

TNI = 4 (L10 - L90) + L90 - 30 dB(A)

d. d. Noise Climate (NC)

NC = L10 - L90 dB(A)

RESULTS & DISCUSSION

The first day of monitoring, the maximum noise level was recorded at garware technical fiber (99.6) dB(A), while the lowest was recorded at Sasoon Hospital (54.3 dB) (A). On the second day of noise monitoring, the maximum daytime noise level was recorded at Savitribai Phule Pune University (102.3) dB(A), whereas

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the highest nighttime noise level was recorded at Model Colony Bridge (98.2 dB) (A). The Noise calculation parameters at selected location has given below.

Table 2: Computation of Number of Noise for Educational Zone (Location 1: Savitribai Phule Pune University)

Noise Level Range in dB(A)	Average Noise Level dB(A)	Number of Noise Day wise							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
52-56	54	0	0	0	0	0	0	0	**0**
56-60	58	0	0	0	0	0	0	0	**0**
60-64	62	0	0	3	0	0	0	0	**3**
64-68	66	3	3	4	0	0	0	0	**10**
68-72	70	10	11	8	1	1	5	2	**38**
72-76	74	11	11	8	5	3	6	5	**49**
76-80	78	8	10	9	7	15	18	11	**78**
80-84	82	11	11	14	16	19	10	12	**93**
84-88	86	12	7	7	15	10	13	14	**78**
88-92	90	2	5	3	6	3	5	9	**33**
92-96	94	1	2	3	5	4	3	4	**22**
96-100	98	1	0	1	5	2	0	2	**11**
100-104	102	0	0	0	1	2	0	1	**4**
Total		**59**	**60**	**60**	**61**	**59**	**60**	**60**	**419**

Table 3: Computation of Cumulative Percentage of Noise for Location 1

Noise Level Range in dB(A)	Average Noise Level dB(A)	No. of Noise	Percentage of Time Noise Level Exist	Cumulative Percentage (%)
52-56	54	0	0	100
56-60	58	0	0	100
60-64	62	3	0.72	99.28
64-68	66	10	2.38	96.9
68-72	70	38	9.06	87.84
72-76	74	49	11.69	76.15
76-80	78	78	18.61	57.54
80-84	82	93	22.19	35.35
84-88	86	78	18.61	16.74
88-92	90	33	7.87	8.87
92-96	94	22	5.25	3.62
96-100	98	11	2.62	1
100-104	102	4	0.95	0.05

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L10 = 90 dB (A), L50 = 79 dB (A), L90 = 69 dB (A), Lmax = 102 dB (A), Lmin = 61.5 dB (A)

Equivalent Sound Energy Level (Leq)

Leq = L50 + [(L10 - L90)2 /60) dB(A)

Leq = 79 + [(90 - 69)2 /60) dB(A)

Leq = 86.35 dB(A)

Noise pollution level (LNP)

LNP = Leq + (L10 - L90) dB(A)

LNP = 86.35 + (90 - 69) dB(A)

LNP = 65.35 dB(A)

Traffic Noise Index (TNI)

TNI = 4 (L10 - L90) + L90 - 30 dB(A)

TNI = 4 (90 - 69) + 69 - 30 dB(A)

TNI = 123 dB(A)

Noise Climate (NC)

NC = L10 - L90 dB(A) NC = 90 - 69 dB(A) NC = 21 dB(A)

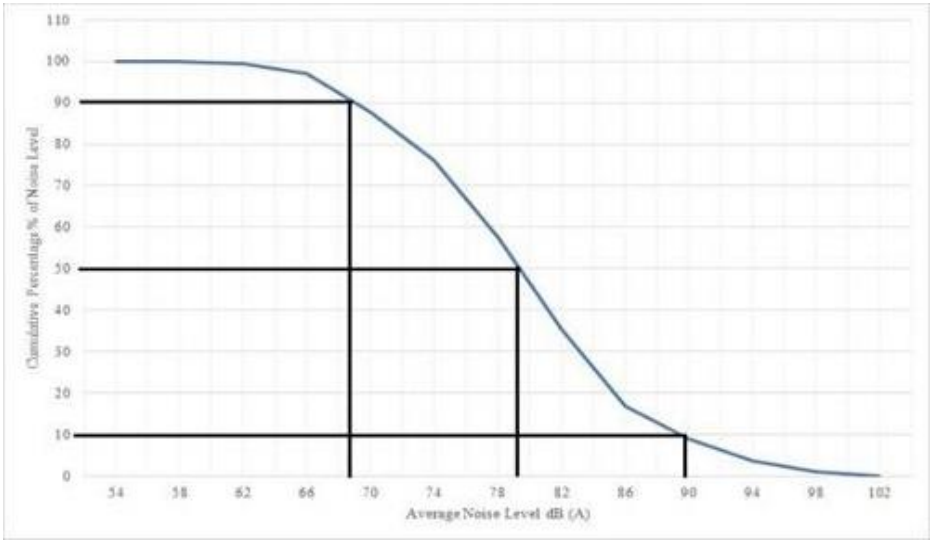


Fig. 3: Variation of Average Noise Level with Cumulative Percentage of Noise Level for Educational Zone

Table 4: Computation of Number of Noise for Hospital Zone (Location 2: Sasoon Sarvopachar Rugnalaya Pune)

Noise Level Range in dB(A)	Average Noise Level dB(A)	Number of Noise Day wise							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
52-56	54	0	0	0	1	0	0	0	**1**
56-60	58	0	0	0	1	0	0	0	**1**
60-64	62	0	0	5	1	0	0	0	**6**

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64-68	66	4	0	6	1	0	0	0	**11**
68-72	70	10	11	12	1	1	5	2	**42**
72-76	74	9	12	13	5	2	8	4	**53**
76-80	78	6	10	8	6	14	21	11	**76**
80-84	82	14	11	12	11	18	16	17	**99**
84-88	86	14	9	2	14	12	6	11	**68**
88-92	90	2	4	1	5	4	3	7	**26**
92-96	94	0	3	1	6	4	1	6	**21**
96-100	98	1	0	0	9	2	0	2	**14**
100-104	102	0	0	0	0	1	0	0	**1**
Total		**60**	**60**	**60**	**61**	**58**	**60**	**60**	**419**

Table 5: Computation of Cumulative Percentage of Noise for Location 2

Noise Level Range in dB(A)	Average Noise Level dB(A)	No. of Noise	Percentage of Time Noise Level Exist	Cumulative Percentage
52-56	54	1	0.23	99.77
56-60	58	1	0.23	99.54
60-64	62	6	1.43	98.11
64-68	66	11	2.62	95.49
68-72	70	42	10.02	85.47
72-76	74	53	12.64	72.83
76-80	78	76	18.13	54.7
80-84	82	99	23.62	31.08
84-88	86	68	16.22	14.86
88-92	90	26	6.2	8.66
92-96	94	21	5.11	3.55
96-100	98	14	3.34	0.21
100-104	102	1	0.23	0

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L10 = 90 dB (A), L50 = 79 dB (A), L90 = 67 dB (A), Lmax = 103.4 dB (A), Lmin = 54.5 dB (A)

Equivalent Sound Energy Level (Leq)

Leq = L50 + [(L10 - L90)2 /60) dB(A)

Leq = 79 + [(90 - 67)2 /60) dB(A)

Leq = 87.81 dB(A)

Noise pollution level (LNP)

LNP = Leq + (L10 - L90) dB(A)

LNP = 87.81 + (90 - 67) dB(A)

LNP = 110.81 dB(A)

Traffic Noise Index (TNI)

TNI = 4 (L10 - L90) + L90 - 30 dB(A)

TNI = 4 (90 - 67) + 67 - 30 dB(A) TNI = 129 dB(A)

Noise Climate (NC)

NC = L10 - L90 dB(A) NC = 90 - 67 dB(A) NC = 23 dB(A)

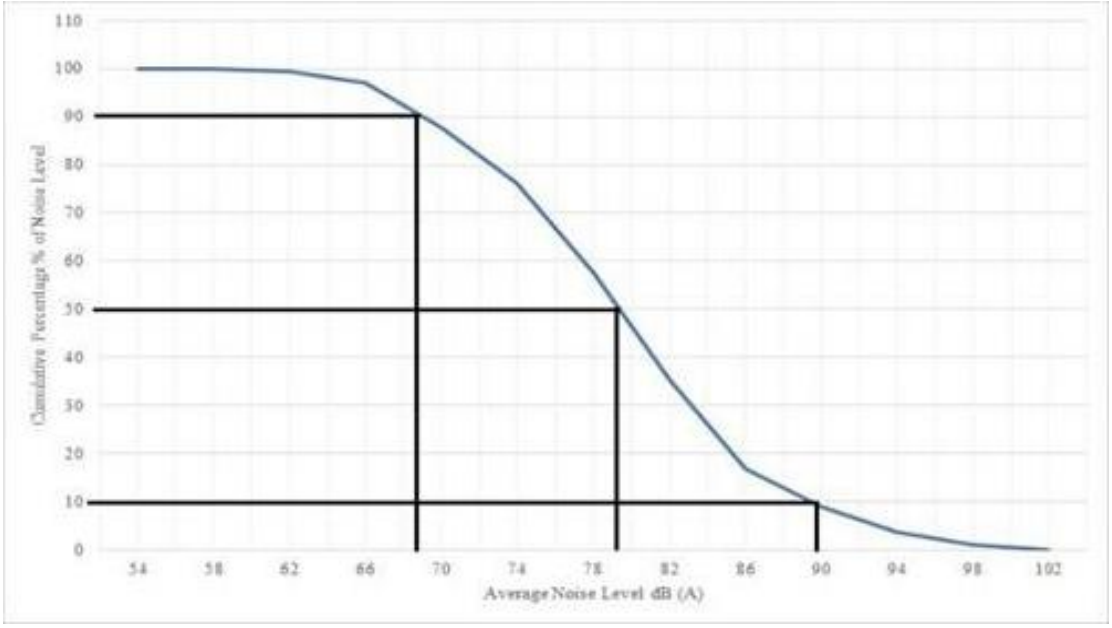


Fig. 4: Variation of Average Noise Level with Cumulative Percentage of Noise Level for Educational Zone

Table 6: Computation of Number of Noise for Hospital Zone (Location 2: Sasoon Sarvopachar Rugnalaya Pune)

Noise Level Range in dB(A)	Average Noise Level dB(A)	Number of Noise Day wise							
		1	2	3	4	5	6	7	Total
52-56	54	0	0	0	1	0	0	0	**1**
56-60	58	0	0	0	1	0	0	0	**1**

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60-64	62	0	0	5	1	0	0	0	**6**
12	66	4	0	6	1	0	0	0	**11**
68-72	70	10	11	12	1	1	5	2	**42**
72-76	74	9	12	13	5	2	8	4	**53**
76-80	78	6	10	8	6	14	21	11	**76**
80-84	82	14	11	12	11	18	16	17	**99**
84-88	86	14	9	2	14	12	6	11	**68**
88-92	90	2	4	1	5	4	3	7	**26**
92-96	94	0	3	1	6	4	1	6	**21**
96-100	98	1	0	0	9	2	0	2	**14**
100-104	102	0	0	0	0	1	0	0	**1**
Total		**60**	**60**	**60**	**61**	**58**	**60**	**60**	**419**

Table 7: Computation of Cumulative Percentage of Noise for Location 2

Noise Level Range in	Average Noise Level dB(A)	No. of Noise	Percentage of Time Noise Level Exist	Cumulative Percentage
52-56	54	1	0.23	99.77
56-60	58	1	0.23	99.54
60-64	62	6	1.43	98.11
64-68	66	11	2.62	95.49
68-72	70	42	10.02	85.47
72-76	74	53	12.64	72.83
76-80	78	76	18.13	54.7
80-84	82	99	23.62	31.08
84-88	86	68	16.22	14.86
88-92	90	26	6.2	8.66
92-96	94	21	5.11	3.55
96-100	98	14	3.34	0.21
100-104	102	1	0.23	0

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L10 = 90 dB (A),
L50 = 79 dB (A),
L90 = 67 dB (A),
Lmax = 103.4 dB (A),
Lmin = 54.5 dB (A)

Equivalent Sound Energy Level (Leq)

Leq = L50 + [(L10 - L90)2 /60) dB(A)
Leq = 79 + [(90 - 67)2 /60) dB(A)
Leq = 87.81 dB(A)

Noise pollution level (LNP)

LNP = Leq + (L10 - L90) dB(A)
LNP = 87.81 + (90 - 67) dB(A)
LNP = 110.81 dB(A)

Traffic Noise Index (TNI)

TNI = 4 (L10 - L90) + L90 - 30 dB(A)
TNI = 4 (90 - 67) + 67 - 30 dB(A)
TNI = 129 dB(A)

Noise Climate (NC)

NC = L10 - L90 dB(A)
NC = 90 - 67 dB(A)
NC = 23 dB(A)

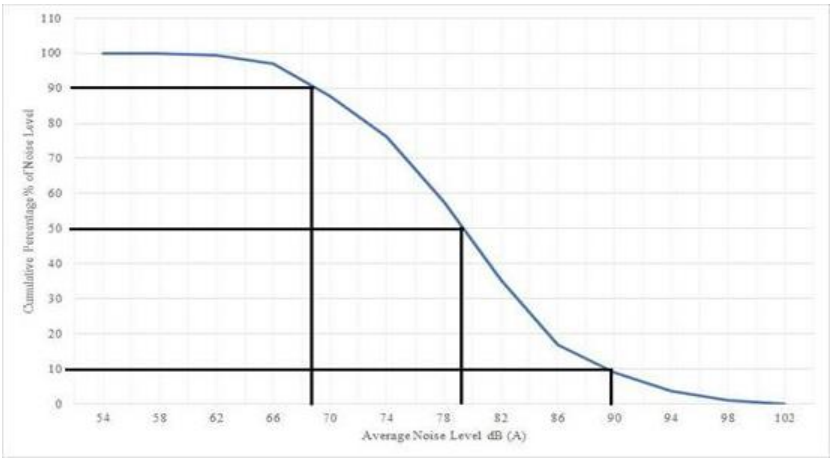


Fig. 5: Variation of Average Noise Level with Cumulative Percentage of Noise Level for Hospital Zone

Table 8: Computation of Number of Noise for Traffic Zone (Location 3: Model Colony Bridge Pune)

Noise Level Range in dB(A)	Average Noise Level dB(A)	Number of Noise Day wise							
		1	2	3	4	5	6	7	Total
52-56	54	0	0	0	0	0	0	0	**0**
56-60	58	0	0	0	0	0	0	0	**0**

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60-64	62	0	0	5	0	0	0	0	**5**
64-68	66	4	0	8	0	0	0	0	**12**
68-72	70	11	11	11	1	1	5	2	**42**
72-76	74	8	10	11	4	1	7	4	**45**
76-80	78	6	10	8	5	11	20	11	**71**
80-84	82	14	13	13	14	23	18	14	**109**
84-88	86	14	9	2	13	13	6	13	**70**
88-92	90	2	4	1	7	4	3	8	**29**
92-96	94	0	3	1	8	4	1	6	**23**
96-100	98	1	0	0	9	2	0	2	**14**
100-104	102	0	0	0	0	1	0	0	**1**
Total	**60**	**60**	**60**	**61**	**60**	**60**	**60**	**421**	**Total**

Table 9: Computation of Cumulative Percentage of Noise for Location 3

Noise Level Range in dB(A)	Average Noise Level dB(A)	No. of Noise	Percentage of Time Noise Level Exist	Cumulative Percentage
52-56	54	0	0	100
56-60	58	0	0	100
60-64	62	5	1.18	98.82
64-68	66	12	2.85	95.97
68-72	70	42	9.97	86
72-76	74	45	10.68	75.32
76-80	78	71	16.68	58.64
80-84	82	109	25.89	32.75
84-88	86	70	16.62	16.13
88-92	90	29	6.88	9.25
92-96	94	23	5.46	3.79
96-100	98	14	3.32	0.56
100-104	102	1	0.23	0.33

L10 = 89 dB (A),L50 = 79 dB (A), L90 = 69 dB (A), Lmax = 101.5 dB (A), Lmin = 63.5 dB (A)

Equivalent Sound Energy Level (Leq)

Leq = L50 + [(L10 - L90)2 /60) dB(A)

Leq = 79 + [(89 - 69)2 /60) dB(A)

Leq = 85.66 dB(A)

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Noise pollution level (LNP)

LNP = Leq + (L10 - L90) dB(A)

LNP = 85.66 + (89 - 69) dB(A)

LNP = 105.66 dB(A)

Traffic Noise Index (TNI)

TNI = 4 (L10 - L90) + L90 - 30 dB(A)

TNI = 4 (89 - 69) + 69 - 30 dB(A)

TNI = 119 dB(A)

Noise Climate (NC)

NC = L10 - L90 dB(A)

NC = 89 - 69 dB(A)

NC = 20 dB(A)

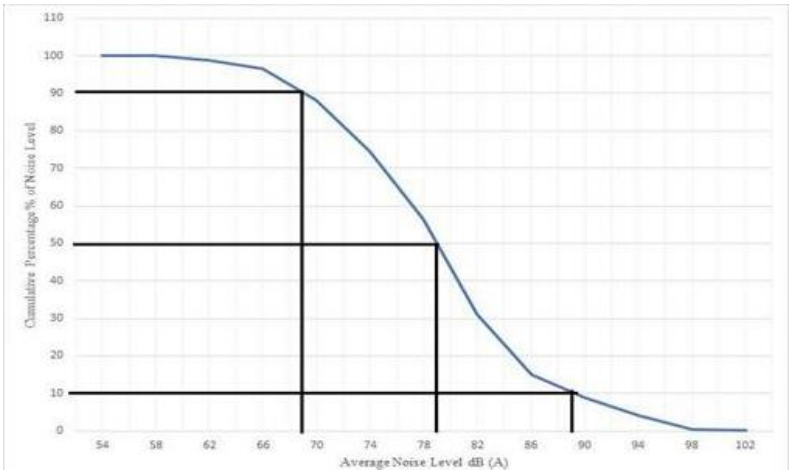


Fig. 6: Variation of Average Noise Level with Cumulative Percentage of Noise Level for Traffic Zone

Table 10: Computation of Number of Noise for Industrial Zone (Location 4: Garware Technical Fibers)

Noise Level Range in dB(A)	Average Noise Level dB(A)	Number of Noise Day wise							
		1	2	3	4	5	6	7	Total
52-56	54	0	0	0	0	0	0	0	**0**
56-60	58	0	0	0	0	0	0	0	**0**
60-64	62	0	0	5	0	0	0	0	**5**
64-68	66	4	0	5	0	0	0	0	**9**
68-72	70	6	11	10	1	1	5	2	**36**
72-76	74	11	13	12	3	0	14	4	**57**
76-80	78	8	6	6	6	18	18	14	**76**
80-84	82	14	14	18	18	14	14	14	**106**

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84-88	86	14	9	2	13	13	5	11	**67**
88-92	90	2	4	1	6	4	3	6	**26**
92-96	94	0	3	1	5	4	1	6	**20**
96-100	98	1	0	0	10	2	0	3	**16**
100-104	102	0	0	0	0	1	0	0	**1**
Total		**60**	**60**	**60**	**62**	**57**	**60**	**60**	**419**

Table 11: Computation of Cumulative Percentage of Noise for Location 4

Noise Level Range in dB(A)	Average Noise Level dB(A)	No. of Noise	Percentage of Time Noise Level Exist	Cumulative Percentage
52-56	54	0	0	100
56-60	58	0	0	100
60-64	62	5	1.19	98.81
64-68	66	9	2.14	96.67
68-72	70	36	8.59	88.08
72-76	74	57	13.6	74.48
76-80	78	76	18.13	56.35
80-84	82	106	25.29	31.06
84-88	86	67	15.99	15.07
88-92	90	26	6.2	8.87
92-96	94	20	4.77	4.1
96-100	98	16	3.81	0.29
100-104	102	1	0.23	0.06

L10 = 89 dB (A), L50 = 79 dB (A), L90 = 69 dB (A), Lmax = 103.5 dB (A), Lmin = 62.5 dB (A)

Equivalent Sound Energy Level (Leq)

Leq = L50 + [(L10 - L90)2 /60) dB(A)

Leq = 79 + [(89 - 69)2 /60) dB(A)

Leq = 85.66 dB(A)

Noise pollution level (LNP)

LNP = Leq + (L10 - L90) dB(A)

LNP = 85.66 + (89 - 69) dB(A)

LNP = 105.66 dB(A)

Traffic Noise Index (TNI)

TNI = 4 (L10 - L90) + L90 - 30 dB(A)

TNI = 4 (89 - 69) + 69 - 30 dB(A)

TNI = 119 dB(A)

Noise Climate (NC)

NC = L10 - L90 dB(A)

NC = 89 - 69 dB(A)

NC = 20 dB(A)

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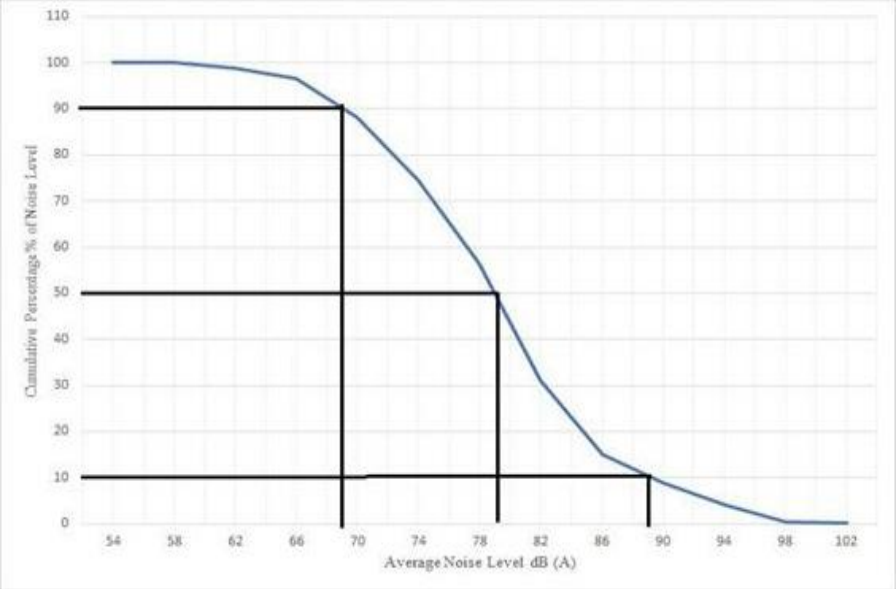


Fig. 7: Variation of Average Noise Level with Cumulative Percentage of Noise Level for Industrial Zone

CONCLUSION

In silence zone, the noise level ranged from 53.7 dBA – 63 dBA. The highest mean noise level was found in Sasoon Hospital. The reason for high noise level in Sasoon Hospital lies on the fact it is the largest hospital in the city and is located in the market area and center of the city. As it is the government hospital as well as the largest hospital in the city thousands of patients and visitors also contributed to the high level of noise in the hospital every day. Sometimes, loud speakers are used in this hospital that also contributes to high level of noise. The present study depicts that the intensity of noise in Pune city is increasing and it certainly will continue to increase due to ongoing urbanization, Population growth, increase in vehicles and also due to lack of knowledge and understanding about the health effects of noise pollution. The increase in population coupled with the increase in number of motor vehicles is showing alarming levels of traffic congestion, air pollution, and noise pollution and road accidents

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