Environmental Impact and Behaviour of People Due to High Level of Noise Pollution at Construction Sites at Delhi/NCR

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Abstract- Noise pollution refers to the excessive and unnecessary intensity of sound that can pose harmful or dangerous effects on humans and the surrounding ecosystem. Unfortunately, noise pollution is worsening due to ongoing development in Delhi/NCR. Construction sites have emerged as significant contributors to noise pollution, especially in urban areas, as continuous development and construction projects generate high levels of noise. This research conducts a study on "Environmental Impact and Behavior of People Due to High Levels of Noise Pollution at Construction Sites in Delhi/NCR."

The presence of noise pollution at construction sites poses a significant health risk to individuals involved in construction projects and those who spend extended periods at these sites. Therefore, the primary goals of this study are to identify the factors contributing to noise pollution at construction sites and examine the health impact of this noise on various parties such as workers, operators, engineers, contractors, and nearby residents. Additionally, this study aims to propose solutions to mitigate and reduce noise pollution at construction sites to minimize its negative effects.

A questionnaire survey was designed and data was collected from 108 respondents working at construction sites in Delhi/NCR to identify the most significant factors that impact noise pollution and potential solutions for minimizing it. Construction projects necessitate the use of heavy machinery, power tools, and equipment, exposing construction workers and nearby residents to high noise levels. The collected data were analyzed to achieve the results, and it was found that the operation of heavy machinery significantly affects construction workers and surrounding residents, particularly disturbing their sleep. Based on these findings, this study suggests that construction stakeholders should take necessary precautions to reduce noise pollution.

1.INTRODUCTION

Noise pollution is an increasingly critical environmental issue, especially in rapidly urbanizing areas such as Delhi/NCR. Characterized by excessive and unnecessary levels of sound, noise pollution poses significant risks to human health and well-being, as well as to the surrounding ecosystem. The ongoing development boom in Delhi/NCR has intensified this problem, with construction sites emerging as major contributors to high noise levels.

Construction projects, which often involve the use of heavy machinery, power tools, and other equipment, generate substantial noise, impacting both construction workers and nearby residents. The continuous exposure to such high noise levels can lead to various health issues, including hearing loss, stress, sleep disturbances, and cardiovascular problems.

This dissertation, titled *"Environmental Impact and Behavior of People Due to High Levels of Noise Pollution at Construction Sites in Delhi/NCR,"* aims to explore the multifaceted effects of noise pollution emanating from construction activities. It seeks to identify the key factors contributing to noise pollution at construction sites and to examine its health impacts on various stakeholders, including workers, engineers, contractors, and local residents.

Furthermore, the study aims to propose practical solutions to mitigate noise pollution and its adverse effects. By conducting a comprehensive questionnaire survey among 108 respondents working at construction sites in Delhi/NCR, this research will pinpoint the most significant sources of noise pollution and suggest effective measures to minimize its impact. The findings will provide valuable insights for construction stakeholders, enabling them to implement better noise

control strategies and improve the quality of life for all affected individuals.

2.AIM AND OBJECTIVES

This study aims to assess the noise level in various construction sites in Delhi/NCR and, as a result, inform workers about safety precautions to take to guard against serious health problems caused by noise. This research was also aimed to identify the impacts which affects the society through noise pollution in construction sites. To achieve the aim, an objective has been identified as following:

(a) To study the impact of noise pollution at construction site.
(b) To measure the Noise level at Various Construction work sites in Delhi/NCR at different timings of the day
(c) Comparative Assessment of Noise level with respect to prescribe standards for various zone
(d) Identification and consideration of suitable mitigation and abatement measures.

3. MATERIALS AND METHOD

3.1 Site Description

Delhi/NCR (National Capital Region) is one of the fastest-growing metropolitan areas in India, characterized by extensive urban development and construction activities. While these projects are pivotal for the region's economic and infrastructural advancement, they have also contributed to making Delhi/NCR one of the noisiest regions in the country. The rapid development of residential complexes in Delhi/NCR and expansion of the Delhi Metro rail project has been one of the major sources of noise pollution. Despite its benefits in easing traffic congestion and providing efficient public transport, the construction phase has been noisy.

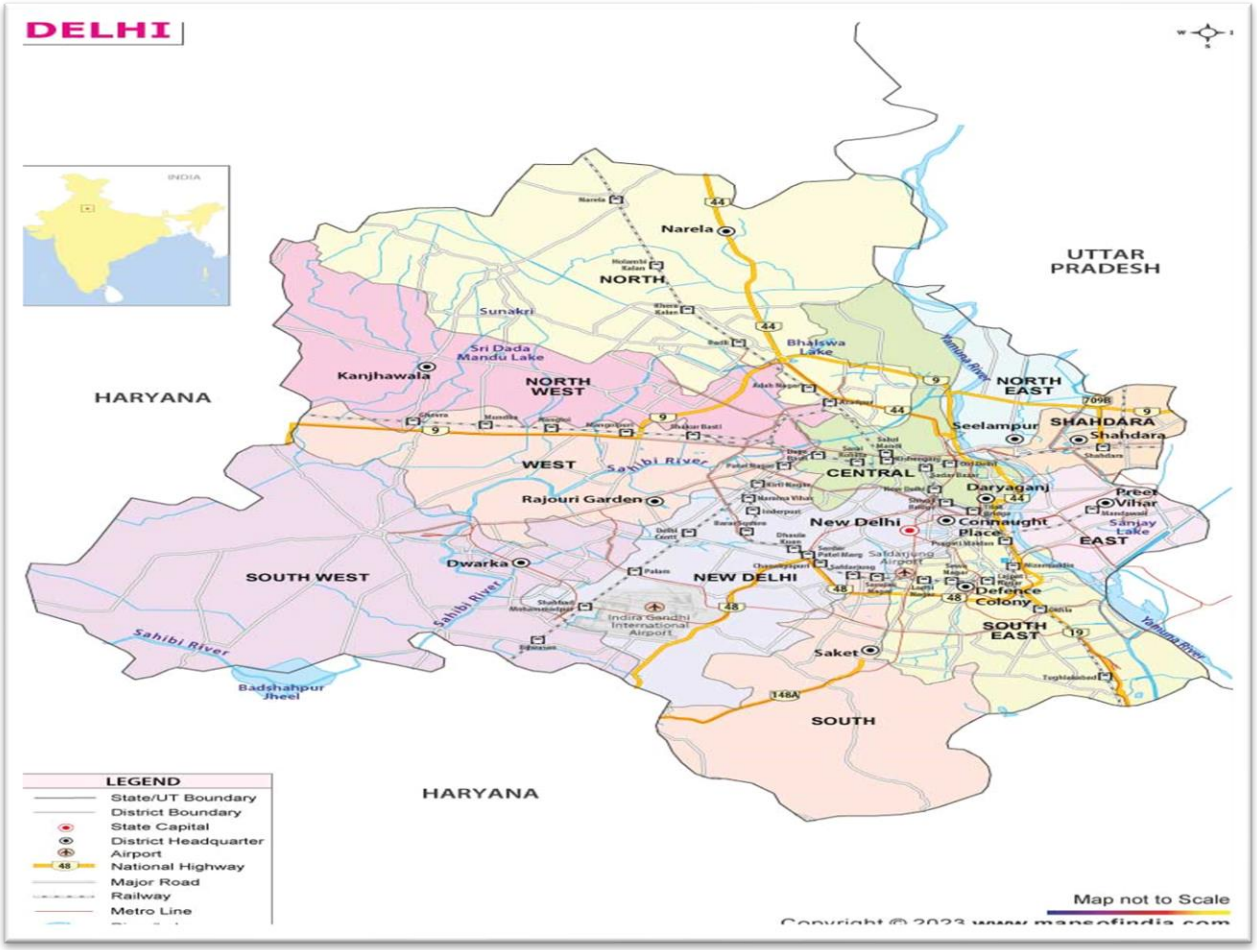

Photo-1: Map of Delhi/NCR

4.METHODOLOGY PROPOSED:

For the purpose of this research, noise monitoring involves the use of questionnaires/social surveys and physical/acoustic measurements. The research process includes the following steps:

1. Literature Collection: Different journals, papers, books, and related literature about noise pollution in construction were collected and studied in detail. These studies were very useful for obtaining knowledge about the work study.
2. Literature Review: From the literature survey, various impacts of noise pollution on society were identified.
3. Noise Level Measurement at Site: Noise levels at construction sites were measured using a noise level meter.
4. Questionnaire Survey and Preparation: A questionnaire was designed for an easy assessment, addressing the objectives and impacts mentioned. It included questions about noise levels from equipment and heavy machinery, as well as health issues caused by noise in construction. Various methods were used to distribute the questionnaires, including direct distribution to companies and collection in person.
5. Analysis: Microsoft Office Excel was used to analyze the collected data. Factor analysis was employed to determine the societal impacts of noise pollution based on the responses.

5.FACTORS OF NOISE POLLUTION IN CONSTRUCTION

The factors influencing noise pollution in construction and its impact on society have been identified. The main sources of noise at construction worksites include:

1.Diesel Generators
2.Drilling operation
3.Operation of Heavy machinery like JCB, Breaker, trucks etc.
4.Transport of materials Demolition work
5.Maintenance and repair Erection
6.Use of Power tools

Photo-2 : Construction Machine (Breaker)

6. EFFECTS OF NOISE POLLUTION AT CONSTRUCTION SITE

The main harmful effects of noise pollution at construction sites are:

a) Hearing problems
b) Health issues
c) Sleeping disorders
d) Cardiovascular issues

The effects of noise on humans at construction sites can be classified into two types:

I. Hazards of Noise
a) Permanent hearing loss
b) Stress on the nerves

II. Noise Nuisance
a) Reduced productivity
b) Stress and anxiety
c) Anger
d) Disruption to sleep
e) Loud talking habit
f) Hearing impairment
g) Lack of concentration

7. TARGETED MITIGATION MEASURES FOR CONSTRUCTION NOISE

To reduce the harmful effects of noise pollution at construction sites, the following targeted mitigation measures are proposed:

7.1 Equipment Maintenance and Upgrading

- Regular maintenance of machinery to ensure they operate efficiently and quietly.

- Using newer, quieter models of construction equipment.

7.2 Noise Barriers and Enclosures

Installing barriers or enclosures around noisy equipment and the construction site to contain and reduce noise levels.

7.3 Work Scheduling

- Planning noisy activities during times when they will have the least impact on nearby residents and workers.
- Implementing shift rotations to minimize prolonged exposure to high noise levels for workers.

7.4 Use of Sound-Absorbing Materials

Applying sound-absorbing materials to surfaces around the construction site to dampen noise.

7.5 Noise Monitoring:

- Regularly monitoring noise levels to ensure they remain within acceptable limits.
- Using noise level meters to identify and address sources of excessive noise.

7.6 Worker Protection

- Providing personal protective equipment (PPE) such as earplugs and earmuffs to workers.
- Educating workers on the risks of noise exposure and training them on the proper use of PPE.

7.7 Public Communication

- Informing the local community about construction schedules and expected noise levels.
- Establishing a communication channel for residents to report noise concerns and receive updates.

7.8 Engineering Controls

- Implementing engineering controls like vibration isolation and damping techniques to reduce noise at the source.
- Using quieter construction techniques where possible, such as hydraulic crushing instead of pneumatic breaking.

7.9 Design Considerations

- Incorporating noise control measures into the design phase of construction projects.
- Selecting building materials and construction methods that minimize noise production.

8. NOISE MONITORING INSTRUMENTS & PROCEDURE

Noise measurements to be made with a Type 1 integrating sound level meter with free-field microphone which meets the Accuracy of noise measurement as per IEC 804 (BS 6698) Grade I or ANSI Type I or equivalent IEC 61672-1(2002- 05) Class-I

Picture-3: Noise Level Meter

8.1 Noise Monitoring Procedure

In this study, a sound level meter (SL-4001) is used to measure the noise level at a construction site in Delhi/NCR. The monitoring of noise has taken place between 9:00 AM and 6:00 PM on weekdays when construction is ongoing. Noise monitoring has been done in each zone for 12 hours at several sites. At a height of 1.2-1.50 meters above the ground level, noise has been monitored three meters away from construction sites and equipment.

9. RESULTS AND DISCUSSION

The noise levels at various Construction sites of Delhi/NCR taken and recorder for research are as shown below.

The monitored noise levels at Location-1, a commercial area, are shown in Figure 1. The recorded data highlights the variability of noise levels throughout the day:

- The minimum noise level (Leq) is 58.1 dB, observed between 1:00 PM and 2:00 PM. This

lower value suggests reduced activity, likely due to the lunch hour.

- The maximum noise level is 78.2 dB, recorded between 10:00 AM and 11:00 AM, possibly due to peak traffic flow and heavy construction machinery operation.
- The average Leq is 71.6 dB, which exceeds the permissible level of 65 dB for commercial areas during daytime.

The higher-than-permissible noise levels are primarily attributed to the heavy construction activities and significant traffic flow observed during the monitoring period. The lunchtime dip in noise levels further supports the conclusion that specific periods of reduced activity led to lower noise readings.

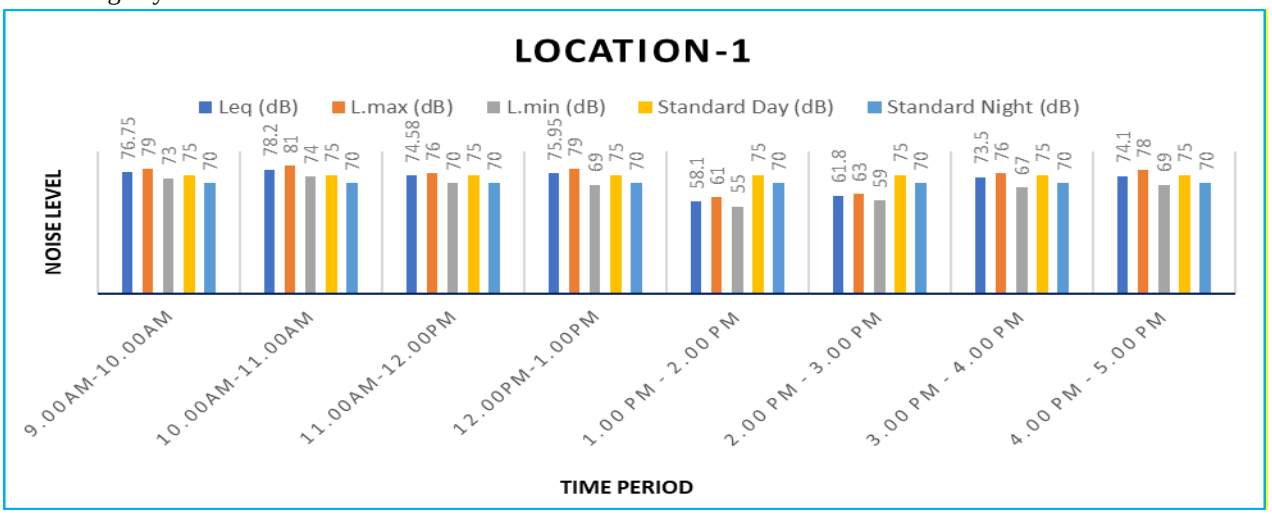

Fig.-1: Comparison of Maximum Levels Noise with Standards at Peeragarhi (L1)

At Location-2, a sensitive or silent zone, the monitored noise levels are shown in Figure 2:

- The minimum noise level (Leq) is 56.1 dB, recorded between 1:00 PM and 2:00 PM. This level is still above the permissible limit for sensitive areas.
- The maximum noise level is 77.9 dB, observed between 11:00 AM and 12:00 PM, likely due to construction activities, particularly drilling work.
- The average Leq is 73.55 dB, which significantly exceeds the prescribed permissible level of 50 dB for sensitive areas during daytime.

The elevated noise levels are primarily attributed to the intensive construction activities, with drilling being a significant contributor during the noise measurement period. Even during the minimum recorded period, the noise level remains above the permissible limit, indicating persistent noise issues in this sensitive zone.

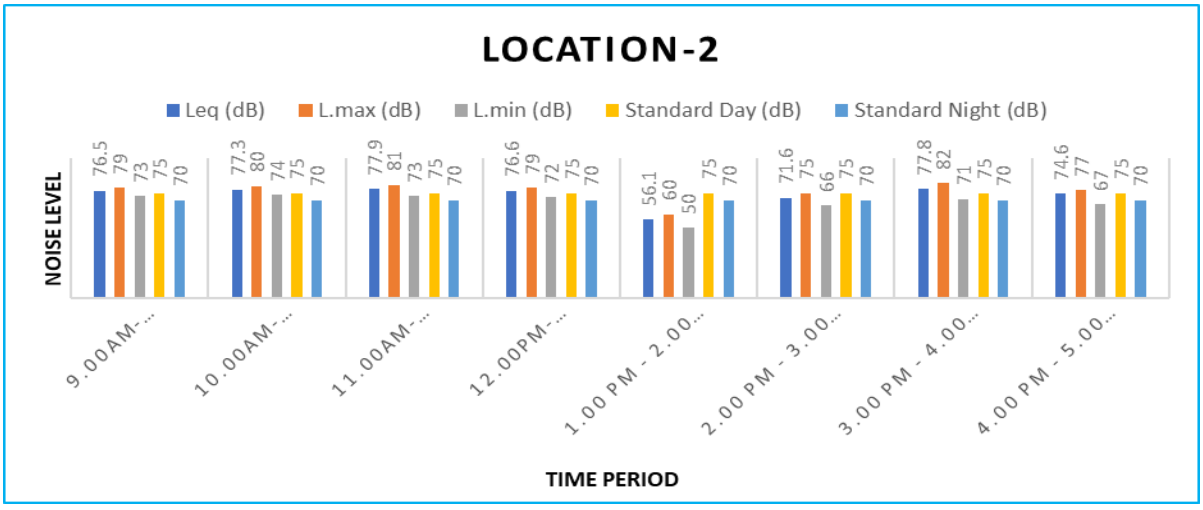

Fig.-2: Comparison of Maximum Levels Noise with Standards at Paschim Vihar (L2)

At Location-3, categorized as a Residential Area, the monitored noise levels are depicted in Figure 3:
The minimum noise level (Leq) is 53 dB, recorded between 1:00 PM and 2:00 PM, indicating a period of reduced activity, possibly during lunch hour.
The maximum noise level is 82 dB, observed between 11:00 AM and 12:00 PM, likely due to construction activities such as using of vibrators for concreting work during the noise measurement period.
The average Leq is 73.90 dB, which is significantly higher than the prescribed permissible level of 55 dB for residential areas during the daytime.
The elevated noise levels are primarily attributed to construction activities, contributing to the high noise readings. Even during the period of minimum recorded noise, the levels remain close to the permissible limit, highlighting the persistent noise issues in this residential area.

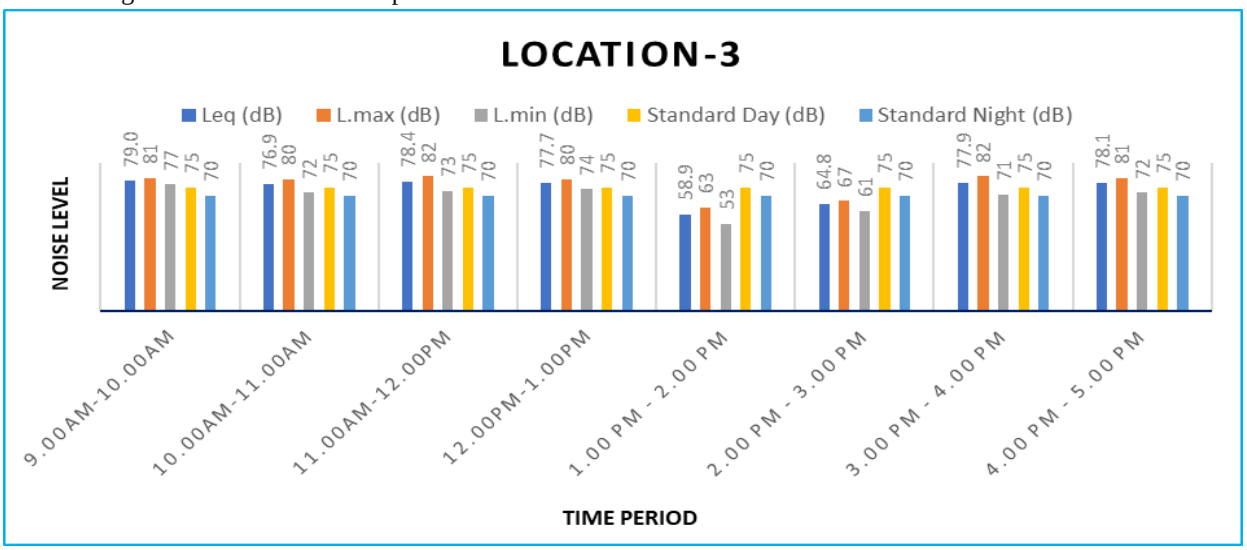

Fig.-3: Comparison of Maximum Levels Noise with Standards at Mundka (L3)

In Location 4, which is an industrial area with ongoing construction activities, the monitored noise levels throughout different hours of the day are shown in Fig. 4. The data indicates that the minimum noise level (Leq) was recorded at 52 dB between 1:00 pm and 2:00 pm, while the maximum noise level reached 86 dB between 4:00 pm and 5:00 pm. The average noise level (Leq) is calculated to be 74.64 dB, which is very close to the prescribed permissible level of 75 dB for industrial areas during the daytime. The peak noise levels observed may be attributed to both the Construction and industrial activities during the noise measurement period.

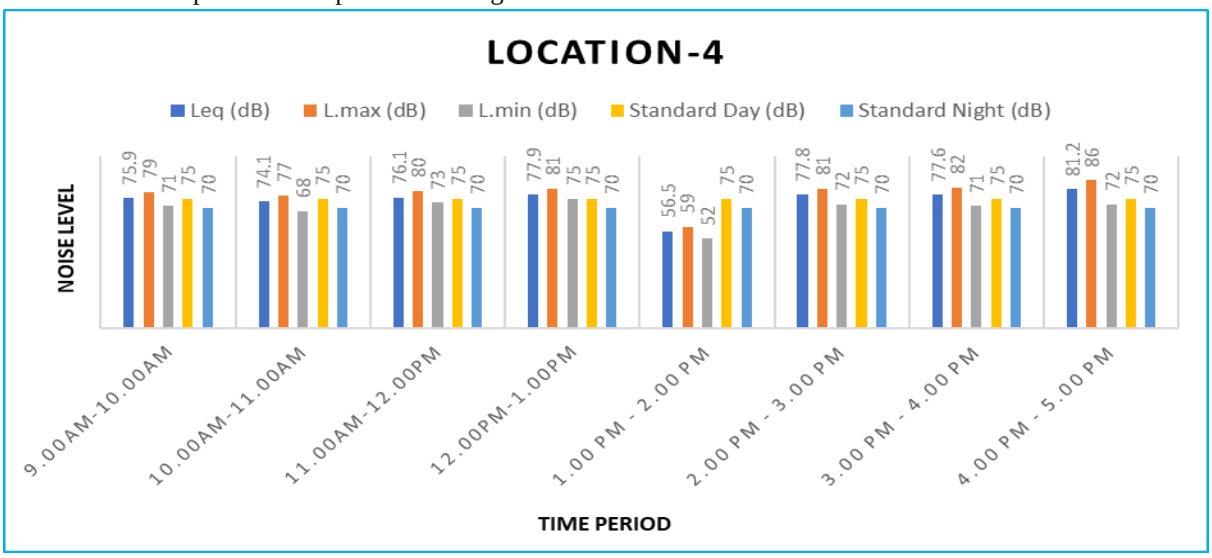

Fig.-4: Comparison of Maximum Levels Noise with Standards at Mangolpuri (L4)

In Location 4, which is a residential area with ongoing construction activities of Metro project, the monitored noise levels throughout different hours of the day are shown in Fig. 4. The data indicates that the minimum noise level (Leq) was recorded at 56.5 dB between 1:00 pm and 2:00 pm, while the maximum noise level reached 81.2 dB between 4:00 pm and 5:00 pm. The average noise level (Leq) is calculated to be 73.9 dB, which is higher to the prescribed permissible level of 55 dB for residential areas during the daytime. The peak noise levels observed may be attributed to both the Construction and industrial activities during the noise measurement period.

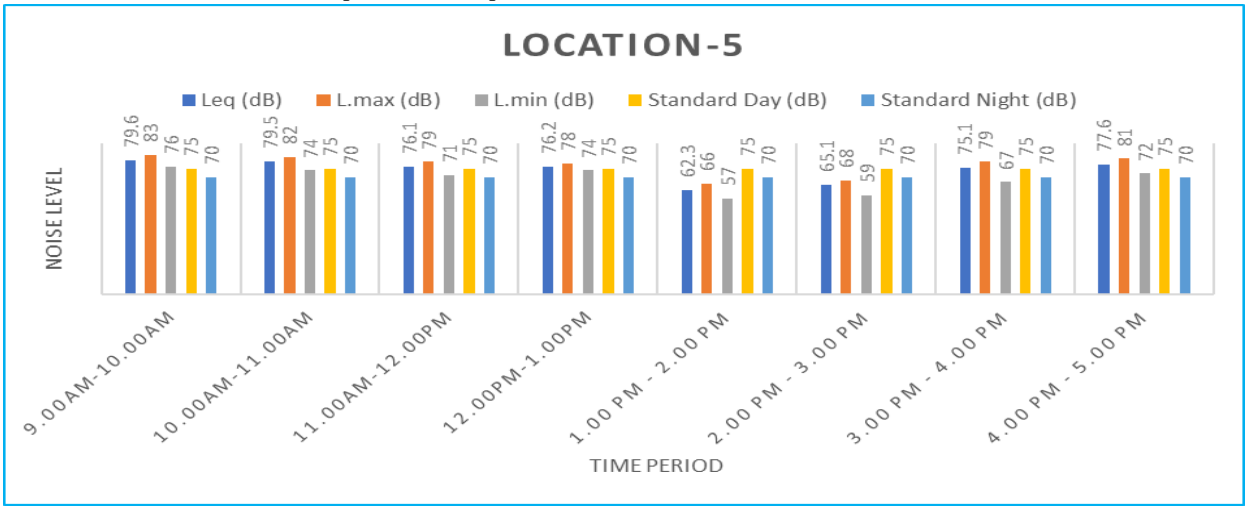

Fig.-5: Comparison of Maximum Levels Noise with Standards at Dadri (L5)

The monitored noise levels at Location-5, a commercial area, are shown in Figure 5. The recorded data highlights the variability of noise levels throughout the day:

- The minimum noise level (Leq) is 62.3 dB, observed between 1:00 PM and 2:00 PM. This lower value suggests reduced activity, likely due to the lunch hour.
- The maximum noise level is 79.6 dB, recorded between 10:00 AM and 11:00 AM, possibly due to peak traffic flow and heavy construction machinery operation.
- The average Leq is 73.93 dB, which exceeds the permissible level of 65 dB for commercial areas during daytime.

The higher-than-permissible noise levels are primarily attributed to the heavy construction activities and significant traffic flow observed during the monitoring period. The lunchtime dip in noise levels further supports the conclusion that specific periods of reduced activity led to lower noise readings.

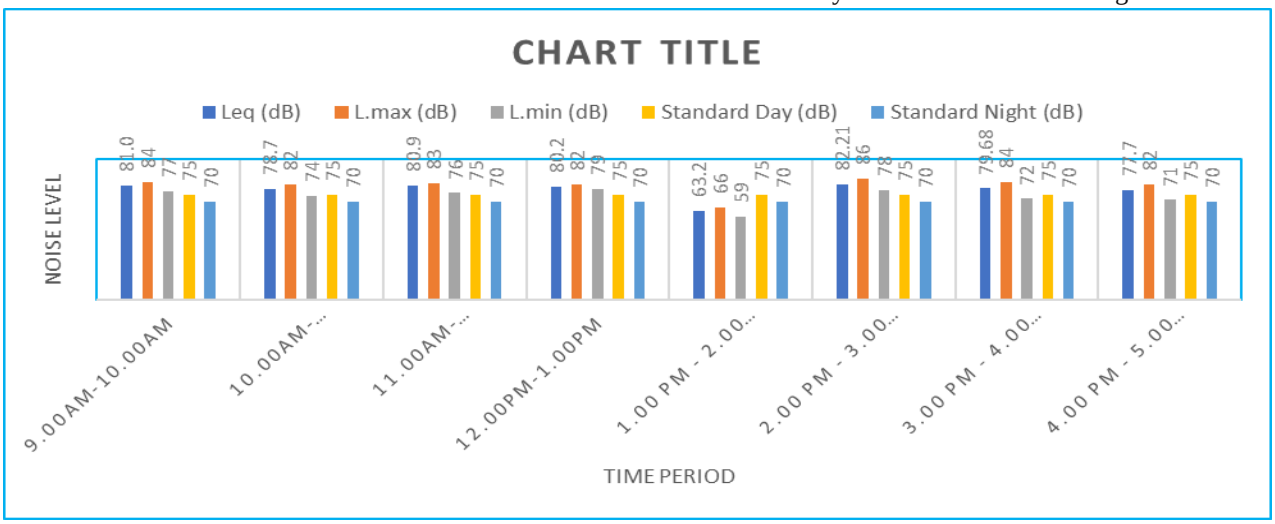

Fig.-6: Comparison of Maximum Levels Noise with Standards at Greater Noida (L6)

In Location 6, which is a residential area with ongoing construction activities of Railway project, the monitored noise levels throughout different hours of the day are shown in Fig. 4. The data indicates that the minimum noise level (Leq) was recorded at 63.2 dB between 1:00 pm and 2:00 pm, while the maximum noise level reached 82.2 dB between 2:00 pm and 3:00 pm. The average noise level (Leq) is calculated to be 77.95 dB, which is higher to the prescribed permissible level of 55 dB for residential areas during the daytime. The peak noise levels observed may be attributed to both the Construction and industrial activities during the noise measurement period.

10.QUESTIONNAIRES AND SOCIAL SURVEY

A total of 15 questionnaires were designed and distributed randomly among 125 respondents. Responses were received from 108 individuals.

10.1 Important Research Questions

- How frequently are you exposed to construction noise in your work environment?
- Have you received any training or guidance on how to protect yourself from construction noise exposure?
- What specific construction activities contribute most to noise pollution in your locality?
- Have you experienced any health problems that you attribute to construction noise exposure?
- Have you sought medical attention for any health problems related to construction noise exposure?
- Are there any safety measures or equipment provided to mitigate construction noise exposure in your workplace?

10.2 Analysis of the Research Data

The research conducted via questionnaires and social surveys provides insights into the impact of noise pollution at construction sites in the Delhi/NCR region. Below is an analysis of the data collected:

a) Age Group Distribution

Description	Age Group	Number of Participants
Age group	18-25	36
	26-35	30
	36-45	26
	46-60	16
	Total	108

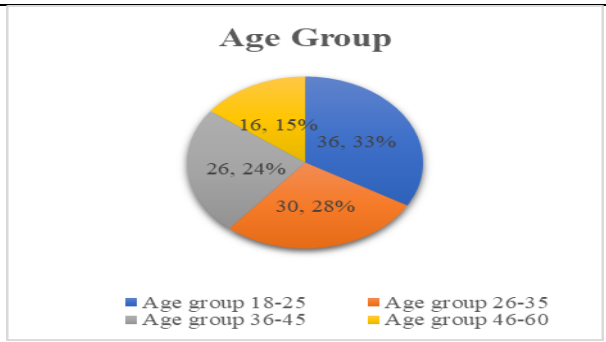

Fig.-7: Age Group Distribution

Observation: The majority of the respondents are within the 18-35 age group, which makes up approximately 61% of the total participants. This suggests that a significant portion of the workforce exposed to construction noise is relatively young.

b) Occupation Distribution

Description	Occupation	Numbers
Occupation	Worker	70
	Driver/Operator	18
	Engineer/Staff	11
	Resident	9
	Total	108

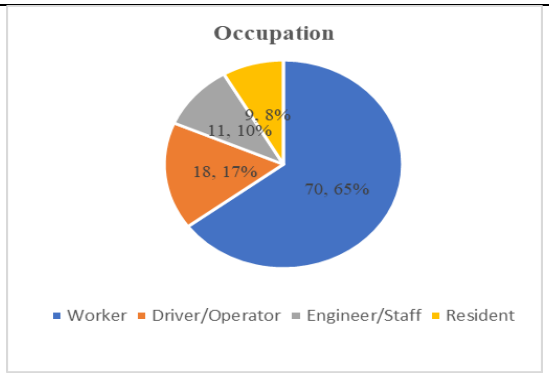

Fig.-8: Occupation Distribution

Observation: The largest group of respondents consists of workers (64.8%), followed by drivers/operators (16.7%). Engineers/staff and residents make up smaller portions of the respondents, indicating that the primary group affected by noise pollution is the construction workers themselves.

c) People's Response

Residential Status	Number of People Responded
Resident near the construction site	9
Worker at the construction site	99
Other (please specify)	0
Total	108

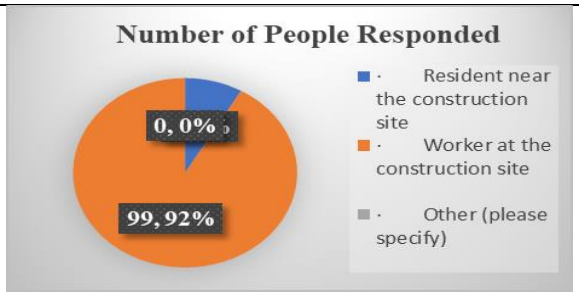

Fig.-9: Response from Peoples

Observation: A significant number of respondents (91.7%) are workers at the construction site, while only 8.3% are residents near the construction site. This highlights that the primary concern regarding noise pollution is for the on-site workers.

Question 1: How frequently are you exposed to construction noise in your work environment?

Daily	55
Several times a week	20
Occasionally	19
Rarely	14

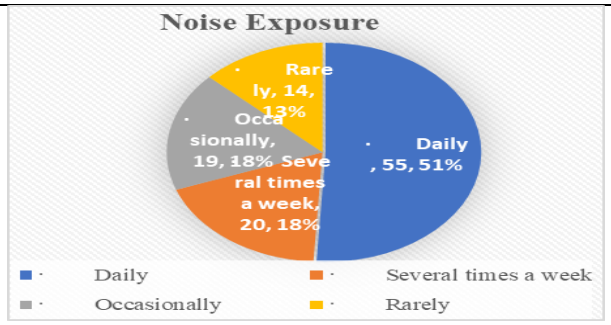

Fig.-10: Noise Exposure

Observation: Over half of the respondents (50.9%) are exposed to construction noise daily, and 18.5% are exposed several times a week. This high frequency of exposure underlines the severity of noise pollution at construction sites

.Question 2: Have you received any training or guidance on how to protect yourself from construction noise exposure?

· Yes	80
· No	28

Observation: A significant majority (74.1%) of respondents have received training or guidance on protecting themselves from construction noise exposure. However, 25.9% have not received such training, indicating a need for improved training and awareness programs.

Question 3: What specific construction activities contribute most to noise pollution in your locality?

Construction Activity	Answer from Participant	% Age
Demolition	5	4.63
Heavy machinery operation	65	60.19
Drilling	18	16.67
Other	20	18.52
Total	108	

Observation: Heavy machinery operation is identified as the largest contributor to noise pollution (60.19%), followed by drilling (16.67%) and other activities (18.52%). Demolition contributes the least at 4.63%. This information is crucial for targeting specific activities in noise mitigation strategies.

Question 4: Have you experienced any of the following health problems that you attribute to construction noise exposure?

Health Issue	Answer from Participant	% Age
Hearing loss	0	0
Tinnitus (ringing in the ears)	4	3.7
Headaches	57	52.78

Fatigue	10	9.26
Stress or anxiety	5	4.63
Sleeping disturbance	27	25
Other	5	4.63
Total	108	

Observations :

- Headaches are the most common health issue, reported by more than half of the participants (52.78%).
- Sleeping disturbance is the second most common, affecting a quarter of the participants (25%).
- Fatigue and tinnitus are less common but still significant, reported by 9.26% and 3.7% of participants, respectively.
- Stress or anxiety and other health problems are reported by 4.63% of participants each.
- No participants reported hearing loss attributed to construction noise exposure.

Question 5: Have you experienced any of the following health problems that you attribute to construction noise exposure?

How severe are these health problems?	Answer on a scale of 1 to 5	Remarks, If any
1: Not severe at all	23	
2: Slightly severe	47	
3: Moderately severe	28	
4: Severe	9	
5: Extremely severe	2	

Observation: Most participants consider their health problems to be slightly to moderately severe, with fewer participants experiencing severe or extremely severe problems.

11.CONCLUSION AND RECOMMENDATIONS

High Exposure: The data reveals a high frequency of noise exposure among construction workers, with a significant portion experiencing it daily. This suggests an urgent need for effective noise control measures at construction sites.

a) Training and Awareness: Although most respondents have received training on noise protection, a quarter have not. It is imperative to ensure 100% coverage in training and awareness programs to protect all workers from noise-related health risks.
b) Targeted Mitigation: Since heavy machinery operation is the primary source of noise pollution, mitigation efforts should focus on controlling noise from these activities. This could include using quieter machinery, implementing noise barriers, and scheduling noisy activities during less sensitive times.
c) Health Monitoring: Regular health check-ups should be conducted to monitor the impact of noise pollution on workers and nearby residents. Providing access to medical attention for noise-related health issues is also crucial.
d) Policy and Enforcement: Strengthening and enforcing regulations regarding noise levels at construction sites can help reduce the incidence of noise pollution. Ensuring compliance with existing laws and guidelines is essential.

By addressing these key areas, the negative impacts of noise pollution at construction sites can be significantly mitigated, leading to a safer and healthier environment for workers and nearby residents.

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