A Study on Noise Pollution Levels and the Impact of Sound Barriers in Urban Redevelopment

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Abstract: This study investigates the effectiveness of sound barriers in mitigating noise pollution at redevelopment sites in Pali Hill. As urbanization intensifies, noise pollution has emerged as a significant environmental concern affecting community well-being. This research employs a comprehensive approach, measuring noise levels at a redevelopment site at two different stages of construction—shore piling and excavation—before and after the installation of sound barriers. Through collaboration with developers and the collection of quantitative data, we conducted statistical analyses to assess the impact of these barriers on noise reduction. The findings indicate a notable decrease of 9 to 14 dB in noise levels post-installation, supporting the argument for mandating sound barriers in future redevelopment projects. This research not only highlights the importance of proactive measures in urban planning but also advocates for enhanced community peace and quality of life in Pali Hill

***Index Terms* – Sound, Sound level meter, Noise, decibel, Construction, Redevelopment, Builder, Sound measurement, Drilling, Shore Piling, Excavation**

I. INTRODUCTION

The rapid pace of urbanization has led to a surge in construction activities, resulting in increased noise pollution, which poses significant risks to residents' physical and mental well-being [1]. In densely populated areas like Mumbai, where redevelopment is common, noise pollution can severely disrupt daily life.

This study was undertaken to evaluate the effectiveness of sound barriers [2] in reducing noise levels during two key stages of construction: shore piling and excavation. By assessing noise data collected during these phases, we aim to provide insights into the role of sound barriers in improving residents' quality of life.

The findings of this research will offer evidence-based recommendations to urban planners and policymakers, advocating for the integration of sound barriers into future redevelopment projects to ensure a more peaceful environment amid ongoing urban growth.

II. RESEARCH OBJECTIVE

The primary objective of this research is to evaluate the effectiveness of sound barriers in reducing noise pollution during two key construction phases—shore piling and excavation—at a redevelopment site in Pali Hill. By systematically measuring and analyzing noise levels before and after the installation of sound barriers, this research aims to present quantitative evidence that can guide urban planning decisions and promote the mandatory use of sound barriers in future projects to improve the living conditions of residents.

III. RESEARCH METHODOLOGY

The study followed a systematic approach to evaluate the effectiveness of sound barriers at different construction stages. The methodology involved the following steps:

1. **Sound Data Collection**: Noise levels were measured using a sound meter calibrated at an NABL-accredited laboratory, ensuring precise and reliable readings.
2. **Data Collection Schedule**: Measurements were taken daily over a two-week period for each construction phase, allowing for a thorough analysis of noise fluctuations across the stages.

3. **Measurement Locations**: Data was gathered from the same location on the street, across the site during various stages of construction.
4. **Data Analysis**: The collected data was subjected to statistical analyses to compare noise levels before and after the installation of sound barriers. This analysis aimed to quantify the effectiveness of the barriers in reducing noise pollution and to identify any significant trends across the various stages of construction.
   Through this methodology, the study aimed to provide robust evidence regarding the impact of sound barriers on noise pollution, ultimately informing recommendations to local authorities for future urban planning initiatives in Pali Hill.

IV. RESULTS AND DISCUSSION

4.1 Raw Data:

Shore piling [3] is a soil stabilization technique that involves driving concrete or steel piles into the ground to support structures like buildings and retaining walls. It's also known as shoring, which is a temporary bracing method to prevent the collapse of a tunnel, trench, wall, or soil. It is typically the noisiest stage of a redevelopment project. In this stage, two sets of noise data were collected, during - *A. Drill Cleaning, and B. Drilling-* both before and after installation of *sound barriers (SB)*. These data are shown below in Tables 1A and B.

Table 1A: Sound Data during Shore Piling Stage - Drill Cleaning

Date	Drill Cleaning Before SB, Sound Level, decibels	Date	Drill Cleaning After SB Sound Level, decibels
06-06-2024	103	01-08-2024	94
07-06-2024	100	02-08-2024	90
08-06-2024	107	03-08-2024	98
10-06-2024	103	05-08-2024	93
11-06-2024	99	06-08-2024	90
12-06-2024	107	07-08-2024	98
13-06-2024	104	08-08-2024	95
14-06-2024	100	09-08-2024	91
15-06-2024	106	10-08-2024	98

Table 1B: Sound Data during Shore Piling Stage – Drilling

Date	Drilling Before SB, Sound Level, decibels	Date	Drilling After SB Sound Level, decibels
06-06-2024	87	01-08-2024	72
07-06-2024	89	02-08-2024	76
08-06-2024	84	03-08-2024	70
10-06-2024	90	05-08-2024	75
11-06-2024	86	06-08-2024	71
12-06-2024	86	07-08-2024	70
13-06-2024	89	08-08-2024	74
14-06-2024	83	09-08-2024	70
15-06-2024	87	10-08-2024	74

From the above data, it can be seen that, surprisingly, the drill cleaning process is much noisier than the actual drilling process.

Excavation is a practice that involves the removal of rocks or soil from the ground in order to prepare foundations for buildings, by excavation, splitting, trench digging and also for wells and tunnels [4]. Excavation is the preliminary stage for the construction of any type of foundation, to ensure the solidity of the building or structure to be built. For this stage, data were collected both before and after installation of sound barriers (SB). This data is shown below in Table 1C.

Table 1C: Sound Data during Excavation Stage

Date	Excavation Before SB, Sound Level, decibels	Excavation After SB, Sound Level, decibels
04-09-2024	84	65
05-09-2024	85	70
06-09-2024	85	75
08-09-2024	90	65
09-09-2024	85	73
10-09-2024	80	75
11-09-2024	75	65
12-09-2024	80	70
13-09-2024	75	65

4.2 Statistical Analysis of Noise Data:

The raw data were analyzed using the Data Analysis Tool in MS Excel. t-Tests were performed on the 3 data sets of Table 1A, Band C, the results of which are shown in Table 2A, B and C, respectively.

Table 2A: t-Test on Drill Cleaning Noise Data during Shore Piling Stage

t-Test: Two-Sample Assuming Unequal Variances

	Drill Cleaning Before SB dB	*Drill Cleaning After SB dB*
Mean	103.2222222	94.11111111
Variance	9.444444444	11.36111111
Observations	9	9
Hypothesized Mean Difference	0	
df	16	
t Stat	5.992429581	
P(T<=t) one-tail	9.39456E-06	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	**1.87891E-05**	
t Critical two-tail	2.119905299	

Table 2B: t-Test on Drilling Noise Data during Shore Piling Stage

t-Test: Two-Sample Assuming Unequal Variances

	Drilling Before SB dB	*Drilling After SB dB*
Mean	86.77777778	72.44444444
Variance	5.444444444	5.527777778
Observations	9	9
Hypothesized Mean Difference	0	
df	16	
t Stat	12.98138882	
P(T<=t) one-tail	3.26723E-10	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	**6.53445E-10**	
t Critical two-tail	2.119905299	

Table 2C t-Test on Noise Data during Excavation Stage

t-Test: Two-Sample Assuming Unequal Variances

	Excavation Before SB dB	*Excavation After SB dB*
Mean	82.11111111	69.22222222
Variance	25.11111111	19.19444444
Observations	9	9
Hypothesized Mean Difference	0	
df	16	
t Stat	5.809083796	
P(T<=t) one-tail	1.33178E-05	
t Critical one-tail	1.745883676	
P(T<=t) two-tail	**2.66356E-05**	
t Critical two-tail	2.119905299	

From the above tables it is seen that in each case, the p-value is much less than the assumed significance level of 0.05 which suggests that we can reject the null hypotheses in each of the 3 stages. This means that for each stage, the difference between the two means are statistically significant. It is deduced that the sample data provides strong enough evidence to conclude that the two population means (i.e. before and after sound barriers) are different, suggesting that sound barrier installation indeed changes the noise levels measured.

Let us look at the Average (mean) Noise data for both before and after sound barriers during each stage, in Table 3 below

Table 3: Average (Mean) Noise levels and Noise Reduction using Sound Barriers at Various Stages

	Average Noise Level, decibels (dB)		
Stage	**Before SB**	**After SB**	**Noise Reduction, ΔN using SB**
Shore Piling - Drill Cleaning	103.2	94.1	9.1
Shore Piling - Drilling	86.8	72.4	14.3
Excavation	82.1	69.2	12.9

It can be seen that the noisiest process is drill-cleaning during shore piling, with an average noise level of 103.2 dB before sound barrier installation and 94.1 dB after, leading to a noise reduction, ΔN of 9.1 dB. The average noise level during drilling before sound barriers was 86.8 dB and after sound barrier installation was 72.4 dB, leading to a ΔN of 14.3 dB. The noise level during excavation before sound barriers was 82.1 dB and after sound barrier installation was 69.2 dB, leading to a ΔN of 12.9 dB.

The safe range for hearing in humans is generally considered to be sounds at or below 70 decibels. Sounds at or above 85 dB can cause hearing loss if you listen to them for long periods of time. The data show that the installation of sound barriers led to a significant decrease in noise levels ranging from ΔN of 9 to 14 dB and brought the sound levels to around 70 dB during drilling and excavation stages. This strongly suggests that sound barriers are very effective in reducing noise levels during reconstruction projects. The data also suggest that during Drill cleaning, some more noise reduction solutions could be implemented to bring noise levels further down from 94dB.

V. CONCLUSION

This study highlights the significant role sound barriers can play in mitigating noise pollution during two key stages of construction—shore piling (drilling and drill cleaning) and excavation – at a redevelopment site in Pali Hill. By systematically measuring noise levels before and after the installation of sound barriers, the research provides clear evidence of their effectiveness in reducing harmful noise levels, contributing to a more peaceful living environment for residents.

The findings strongly support the case for mandating sound barriers in future redevelopment projects. As urbanization continues, it is crucial that urban planners and policymakers prioritize noise reduction strategies to safeguard community well-being. By integrating sound barriers as a standard practice, neighbourhoods can benefit from ongoing development without compromising their quality of life.

This research serves as a foundation for further exploration into noise mitigation strategies in urban environments, and its recommendations offer a practical solution for balancing urban growth with the needs of local communities.

To address noise pollution concerns in local redevelopment projects, I would propose implementing several mitigation strategies. These could include requiring construction companies to use noise barriers and sound-absorbing materials around work sites. Limiting construction hours to daytime periods and enforcing strict noise level regulations would help minimize disruption to residents. Encouraging the use of quieter electric or hybrid construction equipment instead of diesel-powered machinery could significantly reduce noise. Additionally, I would advocate for better communication between developers and the community, ensuring residents are informed about project timelines and noise reduction efforts. Incorporating green spaces and sound-dampening landscaping into redevelopment plans could further mitigate noise impacts long-term. By taking a proactive approach to noise pollution, we can balance progress with quality of life for residents.

VII. ACKNOWLEDGEMENT

The above study was conducted in cooperation with PHRA (Pali Hill Residents Association). I would like to thank Mrs Madhu Poplai for her support and encouragement, Mr. Adil Mohammed Ramzan Ali of the Rustomjee Developers for his complete cooperation, and Mrs Sumaira Abdulali for her valuable mentorship and guidance during the entire study.

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