Proceedings of the 9th World Congress on New Technologies (NewTech'23)
Brunel University, London, United Kingdom - August 09-11, 2023
Paper No. ICEPR 145
DOI: 10.11159/icepr23.145

Analysis Of Indoor And Outdoor Noise Quality At The University – A Case Study

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Abstract – Noise is an invisible environmental hazard that many people ignore in their daily lives. Exposure to high levels of noise can cause many health problems in people of all ages. This study aims to measure indoor and outdoor noise quality and to observe student noise exposure at Mahindra University premises. The noise in classrooms and laboratories was recorded as a measure of indoor noise. In the afternoon sessions, the noise level in the classroom peaked up to 80 dB, which might be potentially dangerous to the students. The outdoor noise measurements were recorded at twelve different locations inside the University campus during working and non-working. The spatial distribution of the noise map was plotted. The frequency distribution curve suggested that the students were exposed to higher noise levels mainly in indoor areas than in the outdoors. The overall outdoor noise at the selected sites ranged from 53 to 65 dB when the traffic noise data at the main entry gate was excluded. The University has exceeded the maximum permissible noise level, which is 55 dB(A) suggested by WHO. This can result in noise pollution issues that annoy individuals, make it difficult to concentrate, hinder communication, and increase stress which could result in the poor academic performance of students.

***Keywords*:** Indoor noise, Noise pollution, Outdoor noise, ArcGIS pro

1. Introduction

Noise pollution is one of the invisible environmental stressors that have an impact on both land and water. There are many different sources of sound, some of the ones that people frequently encounter include the sounds of conversation, radios, phones, electrical equipment, and moving automobiles. When this sound impairs or lowers the quality of life, especially when it interferes with daily activities, it is considered noise pollution. The adverse impacts of noise do not immediately affect the environment; rather, they accumulate within each person and can have serious negative effects on their overall health body, mind, and society. These include emotional turmoil, decreased work efficiency, stress reactions with sleep disturbance, depression, anger or hostility hormonal changes, elevated blood pressure, increased risk of heart attack, and even decreased overall well-being and quality of life. The World Health Organization (WHO) defines noise pollution as noise that is greater than 65 decibels (dB). Noise that exceeds 75 decibels (dB) is dangerous, while noise that exceeds 120 dB is painful. A considerable portion of people, particularly adolescents and young adults, engage in social and private actions that put them at risk without always being aware of the potential harm [1], [2].

Many studies have reported that educational institutions frequently have noisy learning environments and that the noise is continually growing worse [3]. The relationship between noise in schools and educational activities has direct negative effects on learning because it increases distraction and annoyance [4]. According to several studies, excessive noise is bad for teaching and learning because it distracts students, lowers their attention span and cognitive abilities, makes it harder for them to hear and comprehend their teachers, and reduces their hearing [4]–[6]. An examination of noise pollution at a Brazilian university campus found that interior and external noise levels ranged from 44 to 70 dB [7]. An average noise level of 62.70 dB was measured at Ataturk University [8]. The University of Uyo had high afternoon noise levels of 89.5 dB [9]. Indoor noise levels in the University of Babylon's environmental engineering department building ranged from 60 to 100 dB [10]. Although the WHO-recommended noise limit for universities is 55 dB, reported university noise levels exceeded the recommended limit. These noises can come from a variety of sources, including noise around the university, background noise from classrooms, and sounds generated during class activities, club activities, and sports. Several factors affect indoor

acoustics, including classroom size, background noise within the classroom, instructional style, and vocal effort. Lundquist et al. investigated class type, class size, grade level, and external noise factors and found that class type and size had a significant impact on indoor noise levels [11]. However, annoyance is also considered to be influenced by non-acoustic factors, such as psychological and social aspects that alter individuals' awareness and attitudes towards noise. Moreover, previous studies have demonstrated that subjective sensitivity to noise is an important indicator of noise annoyance [12]. The aim of this study is to analyse the indoor and outdoor noise quality in the University premises especially the areas where the students spend most of their time.

2. Materials and methods

2.1. Selected study area & Methodology

Mahindra University (MU) is a 130-acre campus in Hyderabad, India. The university consists of four schools: engineering, management, law, and education, as well as a center for life sciences. In our study, we examined third-year civil engineering students' exposure to noise both indoors and outdoors. According to their timetables, students have classes from 8:25 to 17:30. During working days (Monday through Friday), the noise level in the classrooms was measured for each class. Every class lasts 55 minutes, with a 5-minute break before the following class. The students had two laboratories each week for two hours each: one in environmental engineering (EE) and one in surveying lab. The environmental engineering lab is located inside the School of Engineering (SOE) building while the surveying lab is located outside of SOE building. During non-working days noise in the classes was measured in the morning and afternoon. The outdoor sites for noise measurement were selected based on the opinions offered by the students on the areas where they spend most time after classes. The outdoor areas included the main entry and exit gates, students mess, dormitory area, school of law (SOL), school of management (SOM), parking area, cricket ground, and civil engineering labs. The selected outdoor sites named O1 to O12 are given in Table 1. The selected sites were marked on the MU map using ArcGIS pro as shown in Figure 1 (a). Noise measurements were performed three times a day - morning, noon, and evening. Morning measurements are recorded between 09:30 and 10:30, afternoon measurements are taken between 12:30 and 14:30, and evening measurements are taken between 16:30 and 18:30. The noise data is collected between March to May 2023. The spatial distribution of outdoor noise levels on working and non-working days was plotted by the “inverse distance weighted” interpolation method using ArcGIS pro software.

Table 1: Selected outdoor sites for noise level measurement.

Selected Site	**Nomenclature**
Outside Entrance gate	O1
Main Entrance and Exit Gate	O2
SOL	O3
SOM	O4
Round about	O5
Flagpole	O6
Cricket ground	O7
Girls Hostel	O8
Boys Hostel	O9
Parking area	O10
SOE Courtyard	O11
Civil Engineering Lab	O12

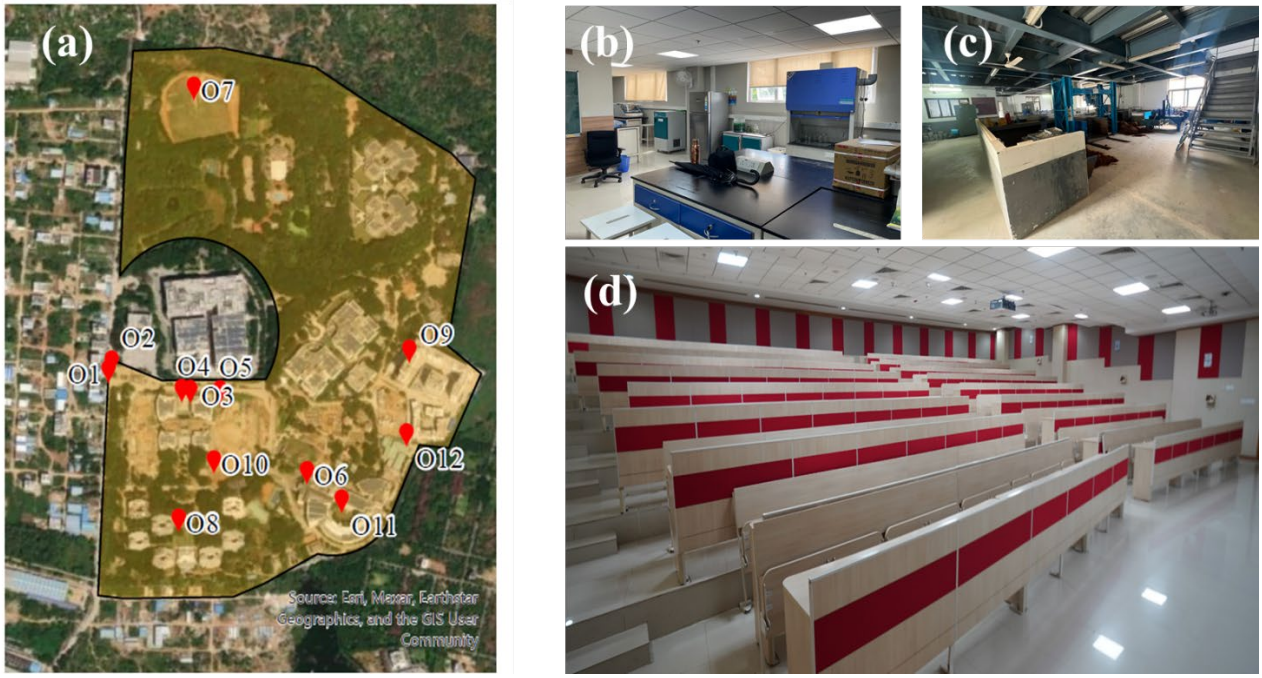

Fig. 1: Noise measurement sites (a) outdoor, (b) EE lab, (c) civil lab, and (d) classroom.

2.2. Sound pressure measurement

The noise level or sound pressure (dB) was measured using a sound level meter. The sound level meter is self-calibrated 10 seconds after the device is turned on. The meter displays the minimum and maximum sound pressure levels on the LCD of the device in decibels for recording purposes. The microphone was positioned around 1.5 meters above the surface of the ground to prevent any sound reflections. The noise measurements were performed in the absence of any external or internal festivities, heavy winds, and precipitation.

3. Results and Discussion

The collected hourly noise data in classrooms had been grouped into morning and afternoon slots. The classes from 8:25 to 12:30 before lunch break were taken as morning slots and the classes after the lunch break that is from 13:35 to 17:30 were considered as afternoon slots. The average noise levels were computed for morning and afternoon slots and were shown in Figure 2(a). From the figure it was observed that the students were exposed to high levels of noise in the afternoon sessions compared to the morning sessions on all the days. The maximum noise level of 82 dB was recorded in the afternoon sessions and the minimum value of 65 dB. In morning sessions, a maximum noise of 75 dB and a minimum value of 61 dB was recorded. The loudness of the teacher's voice during class is a major factor in the noise level. Teachers may speak loudly to get students' attention because students' concentration is low in afternoon classes. This may be one of the reasons for the high noise level in the afternoon. The indoor noise in the SOE building was also measured in corridors, faculty office, reception desk, and labs. The noise detected in the indoor areas of the building were shown in Figure 2(b). The average noise levels in the classrooms, EE lab, and faculty office are higher than in the other areas of the building. From the above results, we can observe that the students are exposed to high levels of noise mainly in the classrooms and during lab hours.

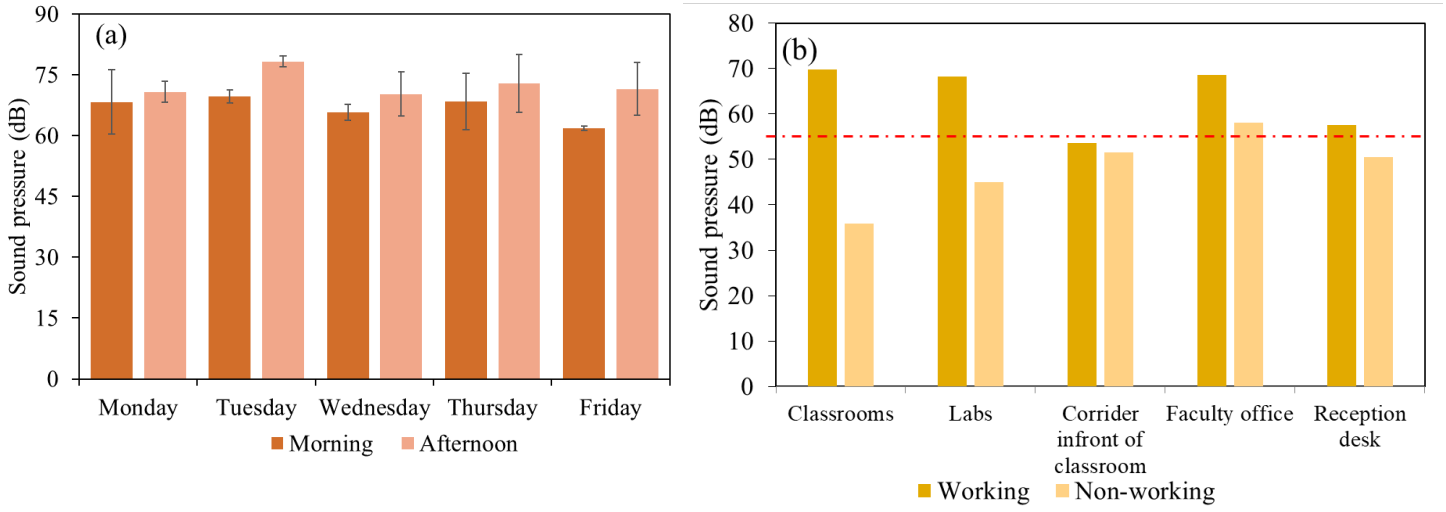

Fig. 2: Indoor noise measurement (a) Classroom noise during working days and (b) SOE building.

The noise measured in the outdoor location sites had been shown in Figure 3. The outdoor noise had been measured at 12 different locations where students spend their time excluding class hours. The average noise levels measured at different sites revealed that average noise levels were above the permitted value of 55 dB in most of the sites. The highest noise level of 86 dB was measured at O2 site which is the Main entrance and exit gate of the campus this could be due to the vehicles that are entering and leaving the campus. In all the locations the noise during non-working days is less than the noise detected during working days except in three locations O7, O8, and O9 these are the girl's hostel, boy's hostel, and cricket ground respectively. During weekends most of the students spend their time either in sports or in their dorms which could be the reason for the high level of noise detected in these locations.

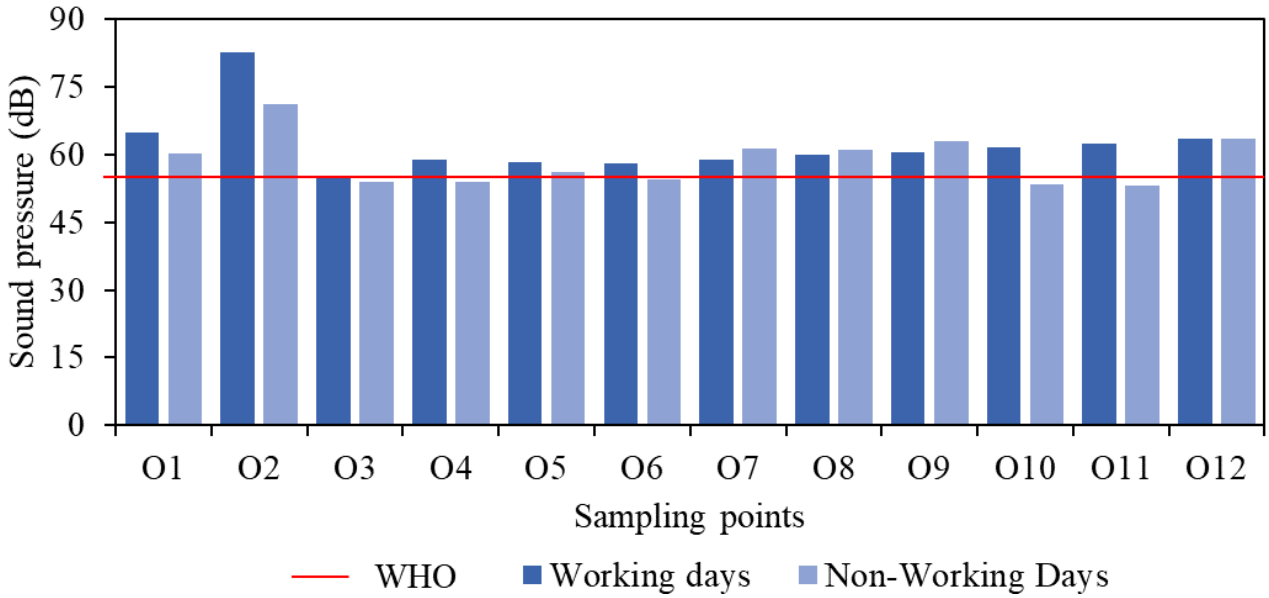

Fig. 3: Outdoor noise levels at the University.

The histogram had been plotted based on the measured noise data. The histogram had been fit to the normal distribution as shown in Figure 4. From the figure it was observed that the students are frequently exposed to high levels of noise greater than 70 dB indoors mainly in classrooms and labs compared to the outdoor environment. Sounds at or below 70 dBA are generally considered safe. Any sound at or above 85 dBA is more likely to damage your hearing over time. In our study, we did not detect sounds greater than 85 dB in indoor places whereas sound levels up to 90 dB were detected mainly at the entrance gate where there is high vehicle movement.

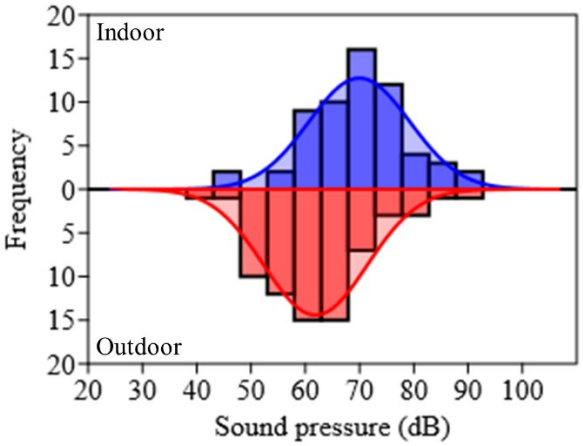

Fig. 4: Outdoor noise levels at the University.

The spatial mapping of outdoor noise during working and non-working days was plotted with the average noise values shown in Figure 5. From the map, it can be inferred that the prevalent noise in the university during working days will be ranging from 61 – 62 dB and 58 – 60 dB on non-working days. The high noise levels in the outdoor areas of the University can also be due to the construction work happening inside the University.

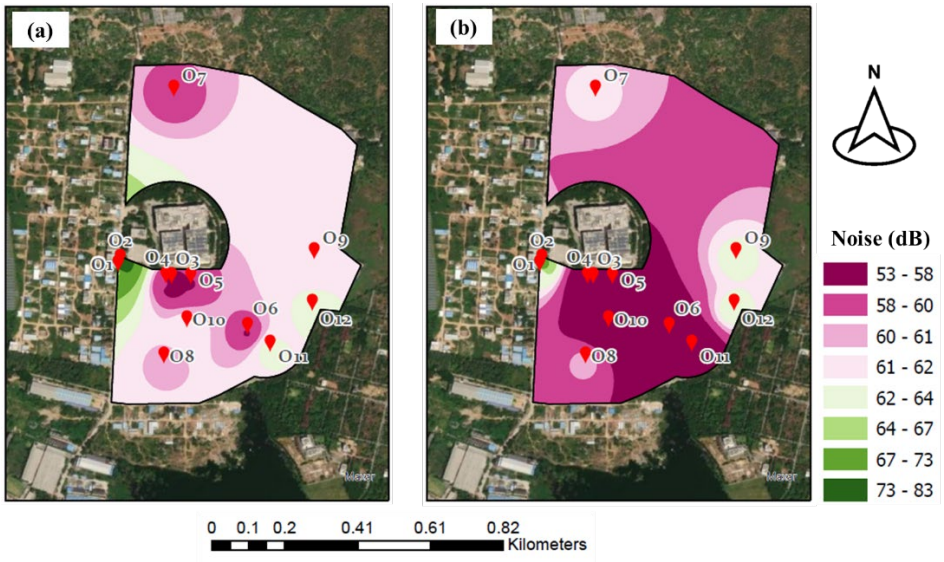

Fig. 5: Outdoor noise mapping (a) working days (b) non-working days.

4. Conclusion

This study was conducted to understand the indoor and outdoor noise quality and to the study noise-exposed by students in the University. The study was conducted at Mahindra University for third-year Civil engineering students. the results, it was observed that the classrooms and the labs had more noise compared to other areas in the SOE Excessive noise in Civil labs is obvious due to the continuous running of machines. However, in classrooms, the noise above the WHO-recommended threshold value of 55 dB which can be detrimental to students physical and mental health. In outdoor regions, the students are exposed to more noise near the main entrance and exit gates. The university's ambient noise level varied from 58 – 62 dB based on the spatial interpolated noise map. The average noise level of 60 dB is considered safe for humans.

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