



Evaluation of Noise Pollution Level in the Metro Construction Site in Mumbai, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.56557/upjoz/2024/v45i154221>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://prh.mbimph.com/review-history/3702>

Original Research Article

Received: 02/05/2024
Accepted: 04/07/2024
Published: 05/07/2024

ABSTRACT

Biological communities in natural systems may show more complex responses to noise than expected from direct effects on acoustically oriented taxa through indirect effects that cascade through communities. There is no doubt that the construction of large infrastructure such as railroads, highways, airports, bridges and subways contribute magnificently towards the social-economic opportunities for the development of a region. But the infrastructures though contributing greatly towards development/civilization their construction is also responsible for the deterioration of the natural environment in the greater areas where these projects are located. In this study, we used a simple decibel meter (HT-80A) and other basic assessment techniques to study the environmental impact of the construction work. Noise can directly affect organisms via several

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Cite as: Massey, Joel, and Swati Bande. 2024. "Evaluation of Noise Pollution Level in the Metro Construction Site in Mumbai, India". *UTTAR PRADESH JOURNAL OF ZOOLOGY* 45 (15):57-64. <https://doi.org/10.56557/upjoz/2024/v45i154221>.

mechanisms, such as acoustic masking, distraction and aversive effects, noise should have stronger direct impacts on animals with, as opposed to without, auditory receptors. The radius for the assessment of the negative impacts of construction work on the environment is set based on the observation of the high noise level of construction work reaching a certain distance in comparison to the standard noise level of traffic (75dB(A) – 85dB(A)). The main reason for this study is the daily observation of the use of high-tech & big machinery on the site of metro construction which was emitting high levels of noise & air pollution exceeding the standard noise level set by The Government of India (45dB(A)-65dB(A)) [1]. The findings of this noise level pollution evaluation revealed negative impact such as anxiety, depression, headache, stress etc. due to the construction work of the metro. The environment is deteriorating which is harmful to the social-economic and richness of the ecosystem as well as to the organism living in the locality. This study contributes to society's richness and maintenance by creating awareness and giving a near to accurate value on the harmful impact of construction work. The project contractors like Stakeholders, Policy Makers and Urban Planners can use this study for refinement of their project in a way such as to use sound-proof barrier around the machines like SANY SR285R which produces noise levels as high as 115 dB(A). This study can also be used to do carry out proper maintenance of the machines depending on the noise level generated.

Keywords: Metro constructions; climatic pollution; noise pollution; decibel meter.

1. INTRODUCTION

The all-time increasing population of India, pressurizes cities especially the metropolitan cities like Mumbai (Kumar, 2003). The reason for increasing population in these cities also lies in the migration of people seeking jobs and the advance lifestyle of the region. This rise in population gives rise to various scarcity and environmental problems in the region viz. increase in the goods consumption, land use, waste generation, crowd, transportation demand and pollution which arises due to all of the above. To alleviate the problems of city dwellers with respect to transportation and increasing pollution of the city, infrastructural projects are undertaken on a large scale which includes the construction of metro system (Ambade, *et al.*, 2023, 17-18). These construction of metro systems once finished is surely helpful to reduce the problem of transportation and pollution level of the city. the construction phase of such systems produces many environmental problems and it also increases the traffic of the area during the construction process. Substantial evidence suggests that noise alters a variety of behaviours in animals such as acoustic communication, foraging, vigilance and movement and a smaller body of evidence has documented noise-induced changes to animal physiology, fitness, population dynamics and ecosystem functioning. Avoidance responses to noise may be more rapid in taxa capable of higher mobility, such as birds, than in those with lower mobility, such as many ground-dwelling insects. Furthermore, because noise can directly affect organisms via several

mechanisms, such as acoustic masking, distraction and aversive effects noise should have stronger direct impacts on animals with, as opposed to without, auditory receptors. However, non-auditory animals may also be directly affected by substrate-borne vibrations caused by noise [2].

The noise generated due to traffic at such a site increases substantially and it reaches human pain threshold for noise when construction noise levels are added in the data. The construction workers use ear protectors which reduces the possibility of hearing impairment. The following study focuses on the Noise Pollution generated by the heavy machineries during the late phase of the construction. The study has recorded the noise level generated by Backhoe Loader (JCB) with drill attachment and SANY SR 285R machines which exceeded the standard noise level set by the Government of India. The aim of this study is to identify and control the Noise Pollution caused by Metro Rail Construction Activities.

1.1 Literature Review

Similar findings of this article can be found during Delhi Metro Rail Project in which near Connaught place the maximum noise level was of 80dB(A) and minimum of 69dB(A) near Shyamnath Marg and Delhi Assembly [3]. Likewise, near Qutubminar (Delhi) The Noise levels were 74.5dB(A) Leq to 81.0dB(A) Leq [4]. According to social media data on public inconvenience in construction of Indian metro rail projects, 9.08%

of the parameter data was covered by Noise Inconveniences [5]. In a study of Ahmedabad Metro Rail Project Links, the minimum noise level was 80dB(A) and maximum was 110.6dB(A) [6]. Similarly, a study in Rourkela City of Lucknow showed high noise levels of approx. 92.7dB(A) [7].

In Contrary, a study in Lucknow concluded that during construction noise was not a major impact as the construction was on commercial area site [8]. Similar Findings were reported in the Dhaka Metro Rail Project in Bangladesh along the high court – Raju Vashkorjo Route, where the recordings of 55dB(A) – 75dB(A) of noise was recorded [9].

Heavy industrial and construction equipment utilisation can instantly increase ambient noise levels and induce some severe vibrations during the construction process. The vibrations produced during the building phase can have a number of negative effects, such as the development of cracks on the nearby buildings, which can seriously compromise the structural stability [10].

2. METHODOLOGY

Measurement of the level of Noise at selected site (Metro Line 2B – D.N. Nagar to Mandale; Near Santacruz Bus Depot, Swami Vivekananda Road, Santacruz West). The decibel meter (HT-80A) was used in recording the noise level in 500m radius of the Metro rail Construction Activity. The noise meter also known as sound level meter was calibrated with the standard noise level of regular traffic (80dB(A)). The decibel meter was held with hand (HT-80A is a hand-held sound level meter) and was not

installed anywhere (Tripod stand was not used). The readings/data recorded for 500m taken on foot.

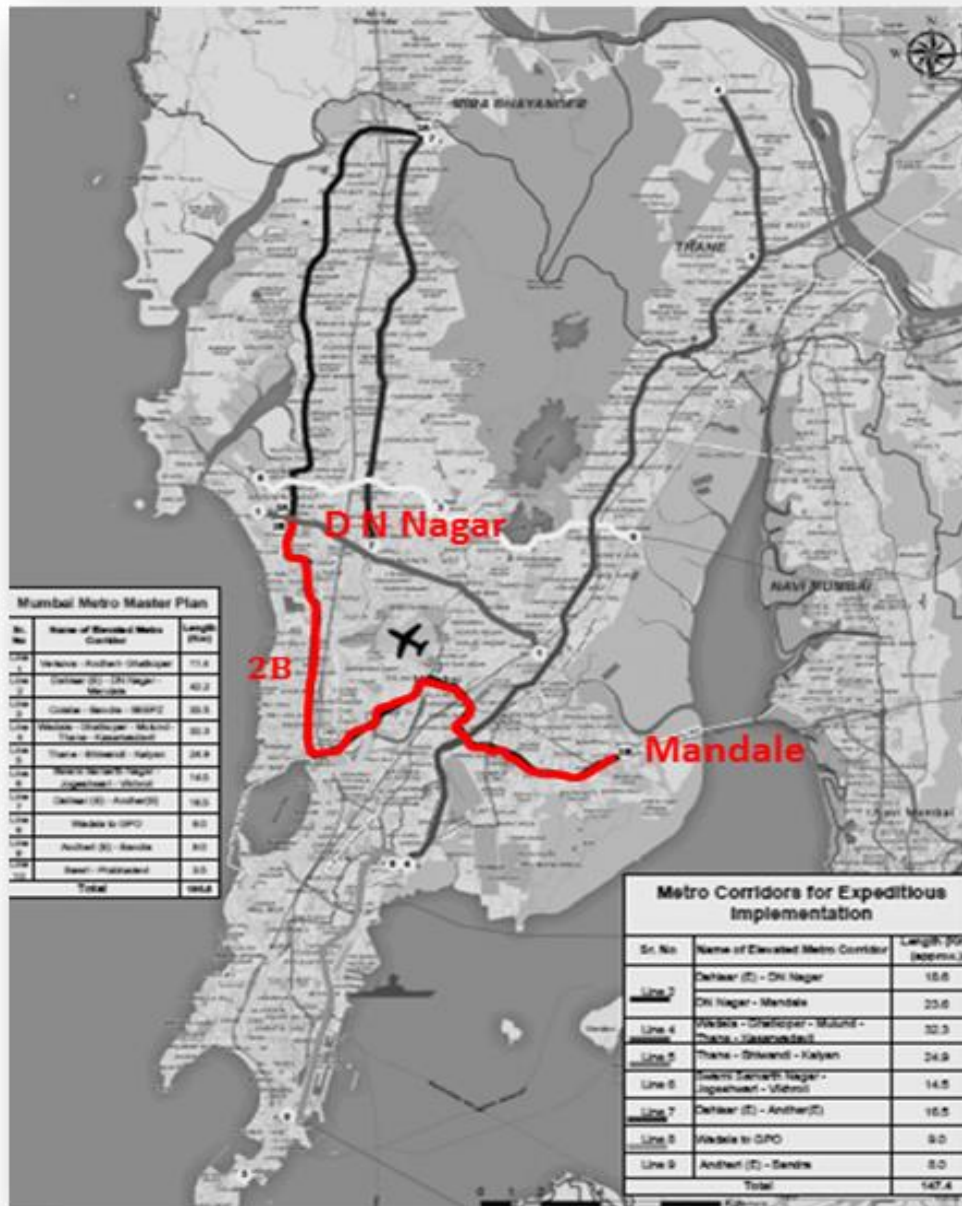
3. OBSERVATION & RESULTS

Metro Line 2B: Metro Line 2B from D.N. Nagar to Mandale is 23.643 km. long elevated corridor with 20 stations. The future benefit of this project is estimated reduction in travelling time between 50% and 75% which depends upon the road conditions. The aim of this project is to provide interconnectivity among the existing metro line 1 (Ghatkopar to Versova) and metro line 2A (Dahisar to D N Nagar), Metro Line 4A (Wadala to Kasarvadavali) & Metro Line 3 (Colaba to SEEPZ). It also aims for interconnectivity between Eastern & Western Suburban Mumbai. The following is the Key Map of Metro Line 2B:

The data recorded for Noise generation by heavy machineries during construction of Metro Line 2B includes two of the machineries viz. Backhoe Loader (JCB) with drill attachment and SANY SR285R as reported by The Head of the Construction site and by checking the model of the machines, which were getting used in a mixed type of commercial and residential area viz. Near Santacruz Depot, Swami Vivekananda Road, Santacruz West. At the time of the noise level data collection, only two machines were recorded due to lack of availability of preferable construction site and late phase of the construction. The data of each machine was recorded on different days but both followed each other, data collected for total 7days between 11:00AM to 3:00PM, whenever the construction was in process. The data was recorded with permission of Head of each construction site.

Table 1. Noise Level (dB(A)) generated by Backhoe Loader (JCB) with drill attachment in 500m radius

Distance from Backhoe Loader (JCB) with drill attachment(meters)	Noise Level (dB(A))
0	112
50	104
100	100
150	95
200	92
300	89
400	85
500	79



Map 1. Metro Line 2B from D.N. Nagar to Mandale

Source: mmrda.maharashtra.gov.in

Table 2. Noise Level (dB(A)) generated by SANY SR285R in 500m radius

Distance from SANY SR285R (meters)	Noise Level (dB(A))
0	115
50	113
100	110
150	107
200	101
300	92
400	83
500	76



Fig. 1. SANY SR285R



Fig. 2. Backhoe Loader with Drill attachment

3.1 Data of Study

The selected site of this study i.e. Metro Line 2B (D.N. Nagar – Mandale) has two recordings for Noise Level, One of Backhoe Loader (JCB) with drill attachment at Pillar No – P171 and other of SANY SR285R at Pillar No – P200. Calibrated Decibel Meter was used and the data was collected on foot for 500m.. The Noise level was recorded when both of the machines was working and with the traffic source noise, the noise level in the aforesaid tables (Tables 1 and 2). The noise level recorded consists of Maximum and Minimum for 0 m and 500 m Respectively. The recordings were taken in average due to constant fluctuation in the readings of the sound meter, Refer Tables 1 & 2.

4. DISCUSSION

A less background noise level of 50dB(A) which is of lesser noise level in comparison with perceptual noise level of 65dB(A). [11]. Generally, long exposure to 75VdB(A) to 80VdB(A) range is annoying and the range of vibration in safety is 50VdB(A) to 100VdB(A) [11]. The Noise Levels at the two construction sites i.e. Metro Line 2B - P171 and P200, are as shown in Table 1 and Table 2. The noise levels were high within 150m radius in both of the studies i.e. the noise generated by Backhoe Loader with drill attachment and SANY SR285R. Noise Pollution at peak hours was maximum due to construction of different components of Metro Rail Network and Traffic Congestion [12].

In comparison to The Noise Pollution (Regulation & Control) Rules, 2000 published by The Ministry of Environment & Forest of India, The Noise levels in this study is far above the standard noise levels set by the Ministry of Environment & Forest [1]. Similar findings can be found during the Metro Rail Project in Delhi in which the maximum noise level of 80dB(A) near Connaught place and minimum of 69dB(A) near Shyamnath Marg and Delhi Assembly [3]. Likewise, In Delhi, near Qutubminar, The Noise levels were 74.5dB(A) Leq to 81.0dB(A) Leq [4]. According to social media data on public inconvenience in construction of Indian metro rail projects, 9.08% of the parameter data was covered by Noise Inconveniences [5]. In a study in Lucknow, it was concluded that during construction noise was not a major impact as the construction was on commercial area site [8]. Similar Findings were reported in the Dhaka Metro Rail Project in Bangladesh along the high court – Raju

Vashkorjo Route, where the recordings of 55dB(A) – 75dB(A) of noise was recorded [9]. In a study of Ahmedabad Metro Rail Project Links, the minimum noise level was 80dB(A)(A) and maximum was 110.6dB(A)(A) [6]. Similarly, a study in Rourkela City of Lucknow showed high noise levels of approx. 92.7dB(A) [7]. During the construction of Mumbai Metro Line-3, average noise levels were still higher than the standard noise but the noise levels observed in this study exceeds in comparison [13]. Likewise, during a survey study of Namma Metro Project Construction in Bengaluru, it revealed through 69 responses where 69.6% of the people faced problems like dust, sound pollution and traffic jam [14].

Heavy industrial and construction equipment utilisation can raise ambient noise levels and induce vibrations during the construction process. The vibrations produced during the building phase can have a number of negative effects, such as the development of cracks on the nearby buildings, which can seriously compromise the structural stability [10]. Noise may cause stress in animals, increase the risk of mortality by unbalancing predator-prey interaction, and interfere with sound-based orientation and communication, especially in reproductive contexts [15]. The majority of metro rail lines, particularly elevated lines, are being constructed inside the existing right-of-way (ROW) or alongside existing highways. Traffic must therefore be temporarily redirected, or only a small portion of the current route may be used for traffic flow, in order to facilitate construction activities and prevent accidents involving construction equipment or machinery. During the project's development phase, this diversion of traffic away from the current road corridors increases the traffic loads on the nearby roads, causing congestion and traffic jams during peak hours [10,16]. There was traffic congestion all around the city as the metro alignment work was being done. The majority of Hingna, Kamptee Road, Sardar area to Pagal Khana square, Pardi Square to Hindustan Builder's buildings on Bhandara Road, and Wardha Road from Airport Square to Ajni Square are the areas most impacted and observed to be congested as a result of the metro project's construction in Nagpur. Most of the time, the traffic men were unable to keep an eye on the situation. Users of these routes frequently deal with traffic congestion. They must therefore leave their home early in order to get to the job or office, and vice versa [12].

In accordance to the above comparisons, the traffic congestion at the construction site was high compared to normal days and since the construction work is happening right next to Santacruz Bus Depot, the traffic increases even more. This can result into high release/concentration of vehicular fumes i.e. carbon dioxide and carbon monoxide in that specific area. Even though Metro Project comes under Rapid Economic Growth scheme, the construction has high noise pollution emission [17]. According to the National Highways Authority of India, the average growth rate of number of vehicles is 10.16 percent per year in India. The predominant sufferers of traffic congestion are cities like Mumbai where every km of road is holding about 674 vehicles [18,19,20].

5. CONCLUSION

The result of the study revealed that the Noise level recorded was above the specification of India stand of exposure and could have adverse effects on the workers and people living in close proximity to the construction site. The maximum recorded noise of 115dB(A) produced by SANY SR285R at 0m can have major adverse effect on the mental health which can be hypothesized based on interview with local workers & Shop owners to anxiety, depression, stress, hearing impairment and headache of the workers. The same side effects of the construction might be visible in the people closely situated to the construction site. The people residing >200m away from construction site may show mild health effects which can also be hypothesized to slight acute headache at irregular days, discomfort to ears, difficulty in relaxing, irregular irritated mood etc.

From the discussion above, it can be understood that at some places like in Lucknow and Bengal Dhaka Metro Rail Project the noise levels did not exceed the mark of 75dB(A) [8,9]. By looking at such articles, the construction methods, equipments, machineries & various techniques can be studied which led to negligible noise inconvenience cases.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented and published in the conference: An International Conference on Coastal and Marine Conservation CMC-2024 dated from 1st and 2nd March, 2024 in Mumbai, India. Web Link of the proceeding: <https://mithibai.ac.in/wp-content/uploads/2024/02/CMC2024-CONFERENCE-brochure..pdf>

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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