

Road Traffic Noise Assessment at Sekolah Kebangsaan Sungai Bakap, Sungai Bakap, Penang, Malaysia.



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Abstract This study is intended on the assessment of traffic noise at Sekolah Kebangsaan Sungai Bakap where this study area located near the main road (Jalan Sungai Bakap). The objectives of this study are to determine noise levels during school hours, to identify the source of noise and to establish the noise profiling in the Sekolah Kebangsaan Sungai Bakap environment. With using sound level meter instrument, the noise levels at school were measured where 19 points were selected at school area in order to collect the value of all parameters measured in this study (L_{eq} , L_{max} , L_{min} , L_{10} , L_{50} , and L_{90}). Each of the noise measurements was taken for 3 minutes in duration and the time taken for all measurements conducted from 8.30 a.m to 12.00 p.m. Noise mapping performed using ArcMap and My maps website based on the latitude, longitude and also noise parameters. Manually traffic count was conducted to count the number of vehicles on the road. Traffic composition data in this study was categorized into four types, which passenger car and van, motorcycle, medium lorries and heavy lorries. The result showed that the measured noise levels at school area in term of L_{eq} were between the range of 54.8–72.9 dB (A), where it was found that the highest noise level generated was at road zones. From this study, all noise data collected exceeded the Malaysian noise limit. Apart from that, based on the noise mapping it showed that highest noise levels were located in traffic zones area.

Keywords Road traffic noise · School area · Noise mapping

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1 Introduction

Nowadays, high technology has changed the human's lifestyle as well as their activities. Most of the countries develop very fast years in terms of many aspects such as high-rise building construction, transmitting information around the world. Malaysia was one of the countries that developed very fast and this can be seen on the numbers of the world-class and modern buildings, the construction of complex road network, various types of transportation, modes and infrastructure. Unfortunately, this development has contributed to a lot of pollutions in Malaysia such as noise pollution, air pollution, and other types of pollutions. Rapid urbanization and development have begun to spread to large suburban areas. Big cities are exposed to this traffic's noise pollution problems [5]. Excessive noise levels in school areas can affect teachers and students' psychology and physiology [5].

Noise pollution causes various adverse effects on people, such as cardiovascular effects, increased blood pressure, increased stress and vascular constriction, and increased risk of coronary artery disease. According to Oh et al. [6], they stated that high noise dB(A) significantly affects stroke, hypertension, and heart disease. The number of hospitalizations due to cerebrovascular disease increased by 0.66, 0.17% due to hypertension, and 0.38% due to heart disease, when the noise increased by 1 dB(A) [6]. According to Babisch et al. [1], due to vehicle traffic, very high levels of environmental noise caused disturbance and even some health problems. Most students reported being affected by air and noise pollution as a result of traffic vehicles [3].

In Malaysia, many schools located in a large residential area or even near busy roads that are fully equipped with infrastructure are prone to noise problems. The children spent a huge part of their day at school, including all the period of the peaks of daily traffic pollution. According to Ismail et al. [5], the findings showed that school receptors were exposed to equivalent noise level (L_{eq}) ranging from 63.7 dB(A) until as high as 66.4 dB(A) on school day and 64.7–68.4 dB(A) on non-school day. Furthermore, from the study done by Foong [3], most monitoring sites at three schools were severely affected by traffic noise as the average noise levels were higher than the Department of Environment (DOE) Malaysia guidelines. The main reason was that there were many motor vehicles traveling on the main road in front of the school and sometimes the traffic was mostly occupied by heavy trucks such as lorries and trailer trucks [5]. Children attending low—exposure schools had a slightly better maternal education; had less behavioural issues, obesity, and foreign origin; had more siblings and residential greenery; and lived farther from school and walked less than children from high-polluted schools [7].

Many researchers abroad are worried about noise pollution and they are doing research because loud noise can cause many human health problems. Noise pollution specifically traffic noise around the school area can have a negative impact and affect teachers and student's performance. The noise in the school area is a concern among the researcher because of the high noise levels that can reduce

children's hearing ability and reduce their learning concentration. The noise level at the school should be around 55 dB(A), as required by the DOE.

Individuals and governments are paying little attention to noise pollution in the school environment, particularly in Malaysia. Most studies related to noise pollution since the 1980s revealed that noise levels exceeded the WHO level of 55 dB (A) in all selected schools without stating the time of measurement for outdoor school areas [4]. Based on the Sustainable Development Goal #11, it is estimated that in 2030, 60% of world population will live in urban areas and the urban areas are expanding in developing countries. As noise in urban areas is well known has exceeded the limit of any noise guidelines, a noise study in suburban areas is rarely carried. Therefore, less information on noise levels in suburban area are published. Due to the scarcity of noise study in suburban areas, this study is intended to evaluate the level of noise pollution at suburban school; Sekolah Kebangsaan Sungai Bakap, Sungai Bakap, Penang.

2 Materials and Methods

This study was conducted to identify the noise level at Sekolah Kebangsaan Sungai Bakap, Sungai Bakap, Penang, Malaysia. Noise measurement was carried out in accordance to the Planning Guidelines for Environmental Noise Limit and Control, 2007, and the device of choice was Sound Level Meter (SLM). The SLM was placed on a tripod stand at a height of 1.5 m above the ground and at an angle of approximately 70° to the incoming noise source. The device was placed at least 1 m from any reflecting surface, and no noise measurement was gathered beyond the wind speed of 5 m/s. The parameters measured were L_{eq} , L_{max} , L_{min} , L_{10} , L_{50} and L_{90} . Measurements were taken from 0830 h to 1200 h daily for each sampling points. 19 points were used in this noise measurement at Sekolah Kebangsaan Sungai Bakap area. The noise data was subsequently inserted into the excel file before being analysed using ArcMap 10.3.1 to produce noise map. In order to perform noise mapping, My Maps google was used. The results were then interpreted after the noise data analysis. For the traffic volume, the data was collected manually then converted into passenger car unit (pcu) before data interpretation. The procedure for counting the traffic volume was referred to the Arahan Teknik Jalan by Jabatan Kerja Raya (JKR). Firstly, the vehicles were divided into six categories that is cars, buses, motorcycles, commercial vans, trucks (more than 2 axles) and medium lorries. The volume of traffic was transformed into (pcu) by multiplying the passenger car's traffic volume by 1.00, 0.75 for motorcycles, 2.50 for medium lorries, 3.00 for heavy lorries, 2.00 light van and 3.00 for buses.

3 Results and Discussions

In order to investigate the noise levels along the main road at Sekolah Kebangsaan Sungai Bakap area, the noise level was measured using sound level meter (SLM) for 3 minutes duration of each reading. The data of noise recorded was

measured during school hours. Table 1 shows the average values of each noise descriptors of L_{eq} , L_{max} , L_{min} , L_{10} , L_{50} , and L_{90} recorded at Sekolah Kebangsaan Sungai Bakap.

Based on the tabulated result shown in Table 1, the highest and lowest equivalent noise level value (L_{eq}) at Sekolah Kebangsaan Sungai Bakap area was 73.5 dB(A) at point 6 and 54.8 dB(A) at point 8, respectively. Besides, the highest and lowest value of maximum noise level (L_{max}) recorded was 87.8 dB(A) at point 3 and 63.7 dB(A) at point 8, respectively. Based on the previous study carried out by Ismail et al. [5], the noise level in school at Terengganu had equivalent noise level (L_{eq}) ranged from 64.7 to 68.4 dB(A) on the school day. It was stated that the equivalent noise level in school at Terengganu mainly comes from motor vehicles and sometimes noise from heavy trucks traveling on the main road in front of the school where this study also found that most of highest noise level recorded at Sekolah Kebangsaan Sungai Bakap contributed by traffic on the main road (major source). For the value of L_{min} , the highest and lowest value of noise level recorded at Sekolah Kebangsaan Sungai Bakap was 59.6 dB(A) at point 17 and 43.8 dB(A) at point 11, respectively. The value of L_{10} is the noise level exceeded for 10% of the time of the measurement duration and used to give an indication of the upper limit of fluctuating noise, like road traffic noise. Based on Table 1, the value of L_{10} noise level of Sekolah Kebangsaan Sungai Bakap recorded between the range of 57.4–77.5 dB(A). The highest value recorded was located at the major road (Jalan Sungai Bakap). The value of L_{50} defined as noise level that exceeded 50% of the measurement period and it is also known as a median of the recorded noise level. From Table 1, the highest and lowest value of L_{50} at Sekolah Kebangsaan Sungai Bakap were 70.2 and 51.2 dB(A), respectively. L_{90} is known as residual noise and it represents background of noise level at a particular measurement site. For this study, the value of L_{90} at Sekolah Kebangsaan Sungai Bakap between the range of 47.4–61.7 dB(A). Most of the noise data recorded in Table 1 exceeded the planning guidelines for environmental noise limits and control [2] which is above 50 dB(A) were located near to the main road while the low noise levels were located far from the road in front of school. This indicates that the distance from the source of noise, which is particularly traffic noise, influences the increase of the noise levels at Sekolah Kebangsaan Sungai Bakap.

For a better understanding of the variability of the Sekolah Kebangsaan Sungai Bakap noise pressure over the areas around it, noise maps were developed by considering the noise from traffic flow at Jalan Sungai Bakap. Figure 1a shows the points of noise levels measured while Fig. 1b shows noise mapping for L_{eq} data at Sekolah Kebangsaan Sungai Bakap.

Figure 1b shows that the existing road which is Jalan Sungai Bakap (main road), Jalan Sekolah and Jalan Balai Polis noise level exceeded the permissible sound, above 50 dB(A). The school area was exposed to the noise level between the range of 55–65 dB(A) approximately. From this study, these three roads display dominant noise level between 55 and 73 dB(A) which is the highest noise level that contributes to the noise level at Sekolah Kebangsaan Sungai Bakap area. Thus, traffic

Table 1 The noise levels at Sekolah Kebangsaan Sungai Bakap

No. of points	Descriptions	Noise pressure levels, dB(A)					
		L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}
1	The position of noise measurement was located at the parking area. The noise comes from mainly from main road	61.6	69.3	48.8	65.4	59.7	54.0
2	The position of noise measurement was located at Jalan Sungai Bakap	72.8	86.2	53.8	76.7	69.3	58.0
3	The position of noise measurement was located at Jalan Sungai Bakap	72.9	87.8	53.1	76.7	66.9	56.5
4	The position of noise measurement was located at Jalan Sungai Bakap	72.5	83.7	56.3	76.8	67.7	59.1
5	The position of noise measurement was located at residential area near the school and located at Jalan Balai Polis	72.8	85.4	50.8	77.3	67.2	56.9
6	The position of noise measurement was located at Jalan Sungai Bakap	73.5	85.0	56.7	77.5	70.2	60.3
7	The position of noise measurement was located at the building inside the school where the building is for special student's class	55.3	64.5	44.6	59.2	52.6	48.3
8	The position of noise measurement was located near Jalan Sekolah and as well as near Sekolah Kebangsaan Cina	54.8	63.7	46.9	57.4	53.2	50.2
9	The position of noise measurement was located at Jalan Sekolah	56.1	73.3	43.8	57.6	51.2	47.4
10	The position of noise measurement was located near the field school	55.7	70.1	48.4	57.7	52.3	50.4
11	The position of noise measurement was located at Jalan Sungai Bakap	59.7	76.8	48.3	60.7	54.6	51.3
12	The position of noise measurement was located at Jalan Sekolah dan residential area	59.0	73.1	51.2	61.3	57.4	54.1
13	The position of noise measurement was located near the Jalan Balai Polis and residential area	60.2	69.3	53.7	62.9	59.0	56.2
14	The position of noise measurement was located at Jalan Balai Polis as well as residential area	60.5	69.9	49.0	63.8	58.7	53.1
15	The position of noise measurement was located near the Jalan Sungai Bakap and near the security cottage	61.0	76.0	49.5	64.2	59.6	54.2
16	The position of noise measurement was located beside the café building inside the school	59.8	73.4	51.0	62.3	58.2	55.3
17	The position of noise measurement was located beside the classrooms	65.3	79.8	59.6	67.6	63.7	61.7
18	The position of noise measurement was located beside the building at school	63.2	80.6	55.0	64.9	60.2	57.3
19	The position of noise measurement was located near residential area	62.2	71.5	51.3	65.3	60.2	56.4

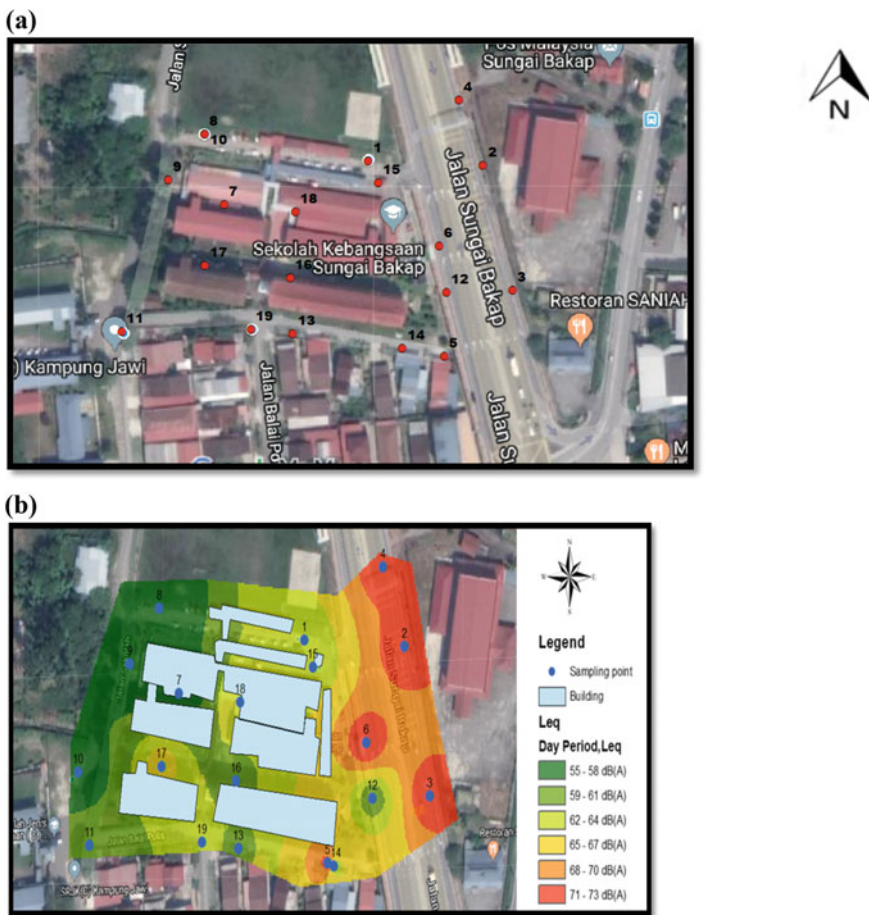


Fig. 1 a The noise levels measurement points located in the Sekolah Kebangsaan Sungai Bakap area, b noise mapping of L_{eq} at Sekolah Kebangsaan Sungai Bakap

noise is the major source that contributed to the noise pollution at Sekolah Kebangsaan Sungai Bakap area. The noise level at the main road near the school recorded the highest noise level where it can be observed from the noise mapping (Fig. 1) shows the level of noise between the range of 65–73 dB(A). Next, the noise level at Jalan Sekolah was in the range of 55–59 dB(A) while for the Jalan Balai Polis was in the range of 59–70 dB(A), respectively. The analysis of noise map in Fig. 1 indicates a few buildings at Sekolah Kebangsaan Sungai Bakap that near the main road prone to the high noise level from the traffic noise which exceeded 70 dB(A). The study of noise measurement at University in Brazil done by Zannin et al. [8] identified that the campus had a noise level exceed 70 dB(A) based on the noise map produced. Zannin et al. [8] reported that the high noise level at the campus mainly generated from the traffic noise (noise from road that connects

the two entrances to the campus). The result of the study is similar with the result measured in this study due to the traffic noise from the existing road near the site studied.

From the observation of Fig. 1, it can be concluded that the highest noise distribution level of the equivalent noise level (L_{eq}) at Sekolah Kebangsaan Sungai Bakap is at the Jalan Sungai Bakap followed by the school area zone that close to the main road.

4 Conclusions

From the noise level measurement at Sekolah Kebangsaan Sungai Bakap, it can be concluded that almost all the values of noise levels exceeded the planning guidelines for environmental noise limits and control which is above 50 dB(A). The results showed that the highest noise levels were 73.5 dB (A) while the lowest noise levels were 54.8 dB (A), respectively. Based on the observation during noise measurement, most of the high noise levels in the school environment came from the traffic noise from the main road. The highest noise level also due to the location of the school itself where it is located near to the main road. From the noise mapping, it reveals that most of the highest noise levels recorded at Sekolah Kebangsaan Sungai Bakap at the main road area. Apart from that, it is better to introduce a noise barrier at Sekolah Kebangsaan Sungai Bakap since the noise level at the school area exceeds the permissible limit. Some actions proposed for noise barrier such as planting more trees and create more green areas around school compounds as trees help in noise reduction to a considerable extent. Sound absorbing curtains also can be installed in all classrooms to further reduce the noise level.

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