Jurnal Kejuruteraan 35(5) 2023: 1239-1247
https://doi.org/10.17576/jkukm-2023-35(5)-23

Assessing the Levels of Traffic Noise in Selected Schools in Bandar Baru Bangi
(Penilaian Tahap Kebisingan Trafik di Sekolah Terpilih di Bandar Baru Bangi)

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Received 22 May 2023, Received in revised form 3 July 2023
Accepted 3 August 2023, Available online 30 September 2023

ABSTRACT

Traffic noise during school hours can disrupt students' learning focus especially in the classroom and can affect communication between teachers and students. This study was conducted to asses traffic noise levels for four selected schools along few main roads in Bandar Baru Bangi and analyse the data using the guideline recommended by the Malaysia Department of Environment (DOE). Data was collected using 01dB SOLO sound level meters using the decibel A-weighted (dBA) for L_{Aeq}, L_{10}, L_{50}, L_{90}, L_{Aeqmax} dan L_{Aeqmin}. The measurement was collected during the respective peak hour on school days which are 7.00am -9.00am for morning session, 12.00pm -2.00pm for noon and 5.00pm -7.00pm for evening session. The measured noise then analysed and compared with the recommended standards set by the DOE. From the measurement, it was found that traffic near the Greenview Islamic International School recorded up to 76.3dB(A) for $L_{Aeq,}$ 110.3 dB(A) for L_{Amax}, L_{10} = 78.4 dB(A) and L_{90} = 67.6 dB(A) during the period of 12.00pm to 1.00pm. All the measured traffic noise at the respective school also logged a high noise level for their L_{Aeq} measurement. In conclusion, the study showed that the traffic noise level pollution experience by the schools along the main roads in Bandar Baru Bangi district were alarming which are exceeding the recommendation from DOE. This finding can help policymakers and stakeholders used as reference in sense of noise pollution management for better acoustics comfort at school area.

Keywords: Traffic noise; sound level meter; school; noise pollution

ABSTRAK

Kebisingan lalu lintas semasa sesi persekolahan boleh mengganggu tumpuan pembelajaran pelajar di dalam bilik darjah dan menjejaskan komunikasi di antara pengajar dan pelajar. Kajian ini dijalankan untuk menilai tahap bunyi trafik bagi empat sekolah terpilih di beberapa jalan utama di Bandar Baru Bangi dan seterusnya menganalisis data dengan data rujukan cadangan dari Jabatan Alam Sekitar Malaysia JAS. Data dikumpul menggunakan meter aras hingar SOLO 01dB dengan menggunakan pemberat desibel A (dBA) untuk L_{Aeq}, L_{10}, L_{50}, L_{90}, LA_{eqmax} dan L_{Aeqmin}. Pengukuran dilakukan pada waktu puncak hari persekolahan iaitu 7.00 pagi - 9.00 pagi untuk sesi pagi, 12.00 tengah hari - 2.00 petang bagi sesi tengah hari dan 5.00 petang -7.00 malam untuk sesi petang. Data yang diukur dibandingkan dengan cadangan limit kebisingan yang telah ditetapkan oleh Jabatan Alam Sekitar Malaysia (JAS). Dari hasil pengukuran, didapati bahawa kebisingan trafik berhampiran Sekolah Antarabangsa Islam Greenview telah menunjukkan L_{Aeq} sebanyak 76.3dB(A), L_{Amax} 110.3 dB(A), L_{10} = 78.4 dB(A) dan L_{90} = 67.6 dB(A) di antara tempoh 12.00pm sehingga 1.00pm. Selaian itu, semua bunyi trafik yang diukur di lokasi sekolah terpilih juga merekodkan tahap hingar yang tinggi bagi pengukuran L_{Aeq} masing-masing. Kesimpulannya, kajian menunjukkan pencemaran tahap hingar lalu

lintas oleh sekolah-sekolah di sepanjang jalan utama di daerah Bandar Baru Bangi berada pada tahap membimbangkan. Penemuan ini boleh menjadi rujukan dan membantu penggubal dasar dan pihak berkepentingan dalam memahami pengurusan pencemaran bunyi untuk keselesaan akustik yang lebih baik di sekitar kawasan sekolah.

Kata kunci: Bunyi lalu lintas; meter aras bunyi; sekolah; pencemaran bunyi

INTRODUCTION

Traffic noise has long been recognized as one of the major sources of noise in cities, and it has been shown that noise can have an impact on both physical and mental health. High-density traffic, especially in the metropolitan areas, are likely to spread broadly, including to schools, residences, and public spaces. This high traffic noise can become a disruption for learning activities in school and potentially contributed health problems. The lack of a good acoustic environment in the classroom has been identified as a crucial issue affecting students' academic performance all around the world (Yassin 2016; Puglisi et al. 2015; Stansfeld 2005). Classroom comfort is crucial since it serves as a platform for students to learn especially involving the medium of teaching communication between teachers and students.

According to Ozdemir (2014), noise is defined as a sound that exceeds an acceptable level and causes annoyance. The term "noise" is derived from the Latin word "nausea," which means "unwanted sound" or "loud, unpleasant, or unexpected sound. Noise can be transferred through a medium such as air (Garg et al. 2015). When this sound reaches the ear, it may be considered either a desired or unwanted sound. According to Sciences (2014), noise is generally referred to as an unwelcome sound. In recent times, noise has become a significant source of pollution due to the increasing commercial, industrial, and social activities (Norina 2022; Alnabih et al. 2021; Münzel 2014; Miedema et al. 1998 and Jarup 2008).

Noise pollution is distinct from other forms of pollution due to its sources and the way it spreads, which can affect both public health and the overall environmental quality in urban areas. The impact of noise pollution on quality of life is substantial and it has the potential to adversely affect public health (Alnabih et al. 2022, Rauf et al. 2015).

Noise measurements are usually calculated in decibels (dB). Noise is caused by air pressure fluctuations or oscillations. The ear mechanism is elicited, as well as the feeling of hearing. Goines & Hagler (2007) give formula for measuring P (dB), namely:

$$Lp = 10log\frac{P_1}{P_0}$$

With P_1 is sound pressure in pascal and P_0 is the reference of sound pressure measurement, 20µPa. In Malaysia, numerous schools are situated in close proximity to roads, which consequently exposes students to high levels of noise. This excessive loudness can negatively impact their attention and social behavior, potentially leading to misbehavior (Balasbaneh et al. 2020). Detailed studies and literature have identified urban road traffic noise as the primary source of exposure, particularly in areas where roads are adjacent to important infrastructures such as schools, offices, and residential buildings (Basu et al. 2021). Furthermore, building acoustics field become more important since it plays a crucial role in various aspects such as communication, health and well-being, privacy and confidentiality and more (Gréhant 2018 & Mak 2015)

In 2014, the number of registered automobiles witnessed a significant increase of 45 percent, which was considerably higher compared to the 11 percent rise observed in 2012. Projections indicate that Malaysia's transportation demand will continue to grow at an annual rate of 8 percent, with the population expected to increase from 28.6 million people in 2010 to 41.5 million people in 2040.

Moreover, in 2015, Malaysia's Department of Environment (DOE) received approximately 130 reported incidents of noise pollution. A study conducted by Nayan (2020) focused on four secondary schools located in Perak along federal roads, with a duration of 3 hours. The results indicated that all the monitored stations recorded high levels of noise during both working and non-working hours, surpassing the 60 dB standard set by the DOE for daytime.

Another study by Mamat (2021) involved conducting a Noise Exposure Assessment at a secondary school located in the city of Pulau Pinang within the school compound. Some locations within the school recorded the highest average noise level (L_{Aeq},8h) of 77.9 dBA, indicating a significant level of noise exposure.

Similarly, Segaran (2019) conducted a study in residential, school, hospital, and commercial areas along Jalan Kluang, Batu Pahat. The findings revealed that all nine locations along Jalan Kluang exceeded the standard limit set by the DOE during daytime, further emphasizing the issue of noise pollution.

These studies highlight the growing concern of noise pollution in various settings, including schools, residential areas, and commercial zones. The increase in the number

of registered automobiles and the projected growth of Malaysia's transportation demand underscore the need for effective measures to address and mitigate the impacts of noise pollution on public health and quality of life.

Insufficient acoustic conditions in classrooms have emerged as a significant concern impacting students' educational achievements globally (Chan et al. 2015). Due to variances in regional culture, economic growth, and other environmental variables, the noise of a place, whether urban or rural, and its impact on the inhabitants is always diverse. As a result, the World Health Organization (WHO) advised in 1999 that the L_{Aeq} exterior noise level for school areas not exceed 55 dB for the sake of uniformity and control. This research was conducted to assess traffic noise levels for four selected schools near main roads in Bandar Baru Bangi and to analyze comfort levels based from the recommendation guideline from the DOE.

METHODOLOGY

In this research, four schools were selected, all of which are situated near the main roads in Bandar Baru Bangi, as depicted in Figure 1. The schools were chosen based on their location, specifically their proximity to the main road, and the fact that these roads experience significant traffic congestion, being major thoroughfares within the city. Additionally, the selection of schools took into consideration the geographic location and the functional level of the roads. It is worth noting that the selected schools have similar characteristics, including a student population ranging from 500 to 1000 individuals, as well as comparable layout and structural features such as dimensions, height, and interior surfaces.

FIGURE 1. Four schools selected for measurement and their map location (google map)

The road traffic noise level data was taken using a sound level meter as shown in Figure 2a and Table 1 shows the specification for the respected sound level meter. The sound level meter was calibrated using the calibrator before the measurement can be begun. Figure 2b shows the example of the measurement setup beside the road near of the selected schools during school hours.

TABLE 1. 01dB Solo GDB-S DUO Sound Level Meter Specifications

Specifications	Value/Description
Permitted standards	IEC 61672-1 Standard
Single dynamic range	30-137 dB (A)
Frequency Weighting	A,B,C dan Z
Time Weighting	Fast (F), Slow (S), Impulse (I)
Type of Measurement	Leq/Lp, Lpmin, Lpmax (S,F,I) / Lpk (C,Z)

continue ...

... cont.

Parallel measurements	Equivalent measurements Leq, Lp and Lpk (1 time weighting)
Real -time frequency analysis	1s average 1/1 or 1/3 octave (from 12.5 Hz to 20 kHz)
Bekalan kuasa	Rechargeable battery
Early amplifier type	Early sound amplifier PRE21S
Microphone type	½", 50 mV/Pa, class 1 atau 20 mV/Pa, class 2
Operating lifespan	24 hour
Hardware	External battery charger, auxiliary battery, CAL21 (class 1) or CAL02 (class 2) adjuster, serial printer and microphone extension cable

The measurements were conducted over a duration of six hours, specifically during the following time intervals: 7.00am-8.00am, 8.00am-9.00am, 12.00pm-1.00pm, 1.00pm-2.00pm, 5.00pm-6.00pm, and 6.00pm-7.00pm. These periods were selected to represent the peak hours and the transition periods when the majority of activities are expected to take place.

During the morning period hours, from 7.00am to 9.00am, it is anticipated to be the busiest time for commuting to work and for students to arrive at school. Most school sessions typically begin around 7.30am. In the afternoon session, from 12.00pm to 2.00pm, it is expected to be the busiest time for traffic, as road users are occupied with their lunch breaks. This period also marks the transition time between the morning and afternoon school sessions.

Finally, from 5.00pm to 7.00pm, it is the peak commuting time when people travel from their workplaces to their homes. By conducting measurements during these specific time intervals, the study aimed to capture the highest levels of traffic activity and its corresponding noise levels.

FIGURE 2a. Sound level meter 01dB Solo GDS-S DUO

FIGURE 2b. Examples of Noise Level Meters Installed for Ambient Noise Measurement

RESULTS AND DISCUSSION

EQUIVALENT CONTINUOUS SOUND PRESSURE LEVEL (L_{AEQ}) DATA ANALYSIS

The measurements conducted over the span of six hours are documented in Table 3. The recorded data includes the average sound pressure level (L_{Aeq}), the minimum sound pressure level (L_{Amin}), and the maximum sound pressure level (L_{Amax}). The Department of Environment (DOE) has established a standard that considers a sound pressure level of 60 dB(A) as acceptable in school areas (DOE, 2017 & DOE, 2019).

Among the schools monitored, Greenview Islamic International School recorded the highest L_{Aeq} reading of 76.3 dBA during the 12pm-1pm measurement duration. On the other hand, Sekolah Rendah Agama Integrasi observed a slightly higher reading of 76.1 dB(A) during the 6.00pm-7.00pm period. Furthermore, only Greenview Islamic International School registered a few readings exceeding 100 dBA for the L_{Amax} component.

These findings highlight the varying levels of sound pressure experienced in different schools, with Greenview Islamic International School exhibiting the highest levels during certain measurement durations.

Based on the measurements, it can be observed that all other three schools generally had higher readings during the evening session, with the exception of Greenview Islamic International School, which recorded the highest activity during the afternoon session. This observation can be attributed to the location of Greenview Islamic School, which is situated near a busy roundabout where all four main roads experience heavy traffic.

During the period from 12.00pm to 2.00pm, significant traffic activity was observed, particularly due to the lunch break of the staff from the nearest university. One of the main roads leading to the roundabout connects to various businesses, restaurants, and commercial shopping areas, resulting in increased traffic volume.

Therefore, it can be inferred that the higher noise levels during the afternoon session at Greenview Islamic International School are influenced by the proximity to the bustling roundabout and the associated traffic activities from the nearby university and commercial establishments.

Sekolah Rendah Agama Integrasi noted a highest reading during the evening time 6.00pm-7.00 pm. Beside the slow traffic flows due to the parents try to pick up their children from school after extra curriculum activity, the heavy traffic also contributed from one of the industries which located just near opposite of the school that have their shift transition time around 6.15 pm.

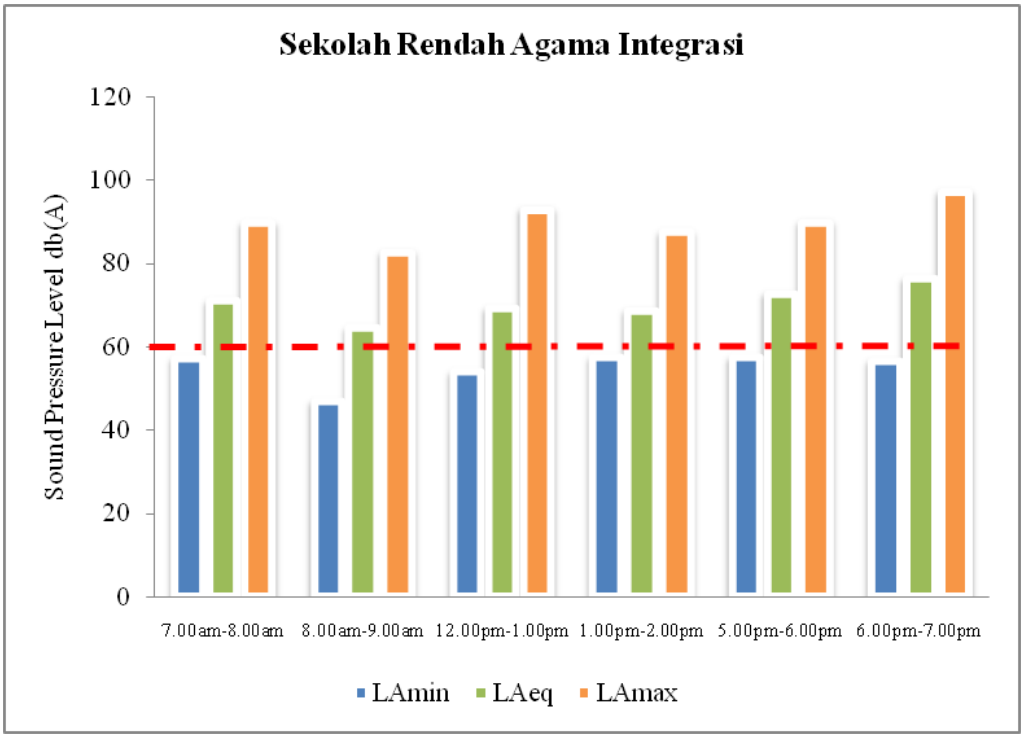
TABLE 3. The L_{Aeq}, L_{Amin} and L_{Amax} for Sekolah Rendah Agama Integrasi, Greenview Islamic International School, Sekolah Menengah Kebangsaan Jalan Reko and SJK(Tamil) Ladang West Country Timur.

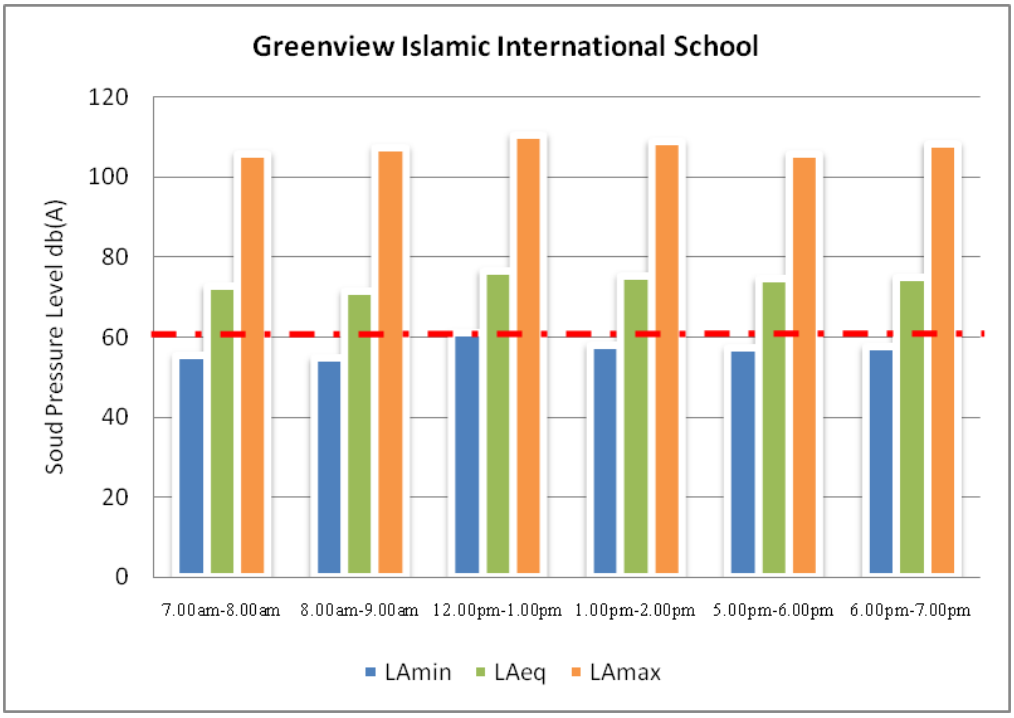
	Sekolah Rendah Agama Integrasi			Greenview Islamic International School			Sekolah Menengah Kebangsaan Jalan Reko			SJK(Tamil) Ladang West Country Timur		
Period	L_{Amin} dBA	L_{Aeq} dBA	L_{Amax} dBA	L_{Amin} dBA	L_{Aeq} dBA	L_{Amax} dBA	L_{Amin} dBA	L_{Aeq} dBA	L_{Amax} dBA	L_{Amin} dBA	L_{Aeq} dBA	L_{Amax} dBA
7.00am-8.00am	56.9	70.8	89.4	55.3	72.4	105.7	47.3	67.1	87.3	44.0	67.5	90.8
8.00am-9.00am	46.6	64.3	82.5	54.5	71.3	107.2	45.1	64.5	93.7	41.2	64.0	88.2
12.00pm-1.00pm	53.7	69.0	92.8	60.8	76.3	110.3	47.9	68.3	92.1	42.4	64.4	89.4
1.00pm-2.00pm	57.2	68.5)	87.3	57.8	75.2	108.6	44.8	65.8	89.5	41.9	65.3	88.1
5.00pm-6.00pm	57.1	72.5	89.7	57.2	74.3	105.6	50.1	70.2	89.0	47.6	69.6	88.3
6.00pm-7.00pm	56.4	76.1	97.0	57.4	74.8	108.1	48.1	68.0	90.8	44.6	66.7	87.4

Additionally, Figure 3 displays a bar chart depicting the L_{Aeq}, L_{Amin}, and L_{Amax} values for all the schools. It is evident that all the LAeq measurements exceed the Department of Environment's (DOE) recommended permissible sound level, as indicated by the red dot color across the bar chart. Throughout the six-hour measurement period, every school recorded an average sound pressure level of over 60 dBA.

The lowest recorded measurement was 64.0 dBA at SRJK(T) Ladang West at 8.00am, while the highest was 76.3 dBA at Greenview International School at 12.00pm. The recommended permissible sound level set by the DOE can be seen in Figure 4.

This situation is concerning, as all measurement locations at the school borders are exposed to a noisy environment. The traffic noise pollution poses potential health risks to the students, particularly when they engage in outdoor activities or participate in activities outside the classrooms within the school compound area.





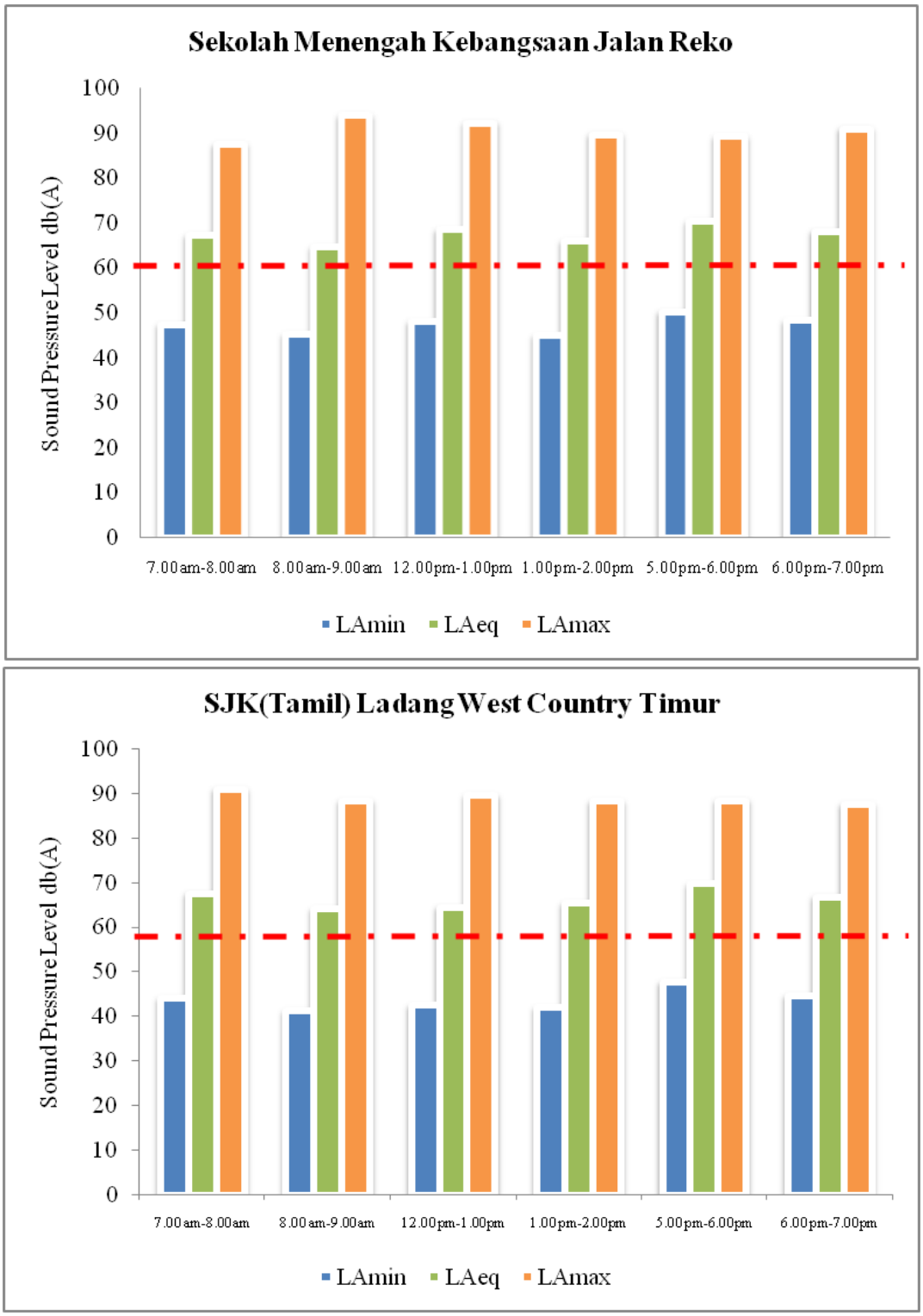


FIGURE 3. The $L_{Aeq,}$ L_{Amin} and L_{Amax} for Sekolah Rendah Agama Integrasi, Greenview Islamic International School, Sekolah Menengah Kebangsaan Jalan Reko and SJK(Tamil) Ladang West Country Timur with red doted line of DOE guideline 60 dB for sensitive area

SECOND SCHEDULE

RECOMMENDED PERMISSIBLE SOUND LEVEL (L_{Aeq}) BY RECEIVING LAND USE FOR EXISTING BUILT UP AREAS

Receiving Land Use Category	L_{Aeq} Day 7.00 am - 10.00 pm	L_{Aeq} Night 10.00 pm - 7.00 am
Low Density Residential, Noise Sensitive Receptors, Institutional (School, Hospital, Worship).	60 dBA	55 dBA
Suburban and Urban Residential, Mixed Development	65 dBA	60 dBA
Commercial Business Zones.	70 dBA	65 dBA
Industrial Zones	75 dBA	75 dBA

Note: The above prescribed L_{Aeq} limits are representative noise levels consistent with developed areas without noise disturbance generally deemed acceptable to majority of receptors occupying in premises at the respective land category.

FIGURE 4. The recommended permissible sound level by receiving land use for existing built-up area as recommended by DOE (DOE, 2019)

CONCLUSION

From the conclusion, it is evident that the noise levels recorded in all school areas have exceeded the standard set by the Department of Environment (DOE) at 60 dBA during the day for sensitive areas. Among the four schools, Greenview Islamic International School recorded the highest measurements, primarily due to its proximity to the roundabout and the presence of four main roads nearby.

Therefore, it is recommended that all schools ensure their buildings possess good soundproofing characteristics to create a conducive learning environment, especially for Greenview School. Additionally, the relevant authorities should play a role in reducing traffic noise pollution by controlling traffic flow or providing proper sound barriers in the respective areas. Nature green wall such as tree along the road or community and urban farming also can be alternative to commercial noise barrier for more sustainability. As the result, this would contribute to providing a comfortable acoustic environment for the schools.

ACKNOWLEDGEMENT

The authors like to acknowledges the Fundamental Research Grant Scheme (FRGS), grant number FRGS/1/2022/TK10/UKM/03/3 funded by the Ministry of Higher Education (MOHE), Malaysia and the part of this research is supported by Geran Galakan Penyelidik Muda (GGPM-2019-014) funded by Universiti Kebangsaan Malaysia.

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