Monitored Community Noise Pollution in Selected Sensitive Areas of Kuala Lumpur

Ahmed H. I. Elfaig, Mohamed Duad, Nor Mariah Adam, Mohd. Zohadie Bardaie, Ramdzani Abdullah

Abstract: This article focuses on the monitoring of community noise pollution in some selected sensitive areas of Kuala Lumpur that include Blue Boy Mansions residential area and LaSalle Secondary School in busiest part of Klang Valley. The objectives of the article were to monitor and to assess the existing noise levels at the selected sites. A modular precision Sound Level Meter (SLM) Type One was used in the measurements. The measurements were taken for 24–hours in the residential area and from 6 am to 7 pm in the school area (schooling hours). The measurements were taken at an interval of ten minutes and each measurement lasted for five minutes at appropriate points in accordance with ISO 1996-1:1982, ISO 1996-2:1987 and ISO 19896-3:1987. Equivalent Continuous Sound Level (L_{eq}), Sound Level exceeded 10% of the measurement period (L_{10}), Sound Level exceeded 90% of the measurement (L_{90}), minimum noise level (L_{min}) and maximum noise level (L_{max}) were measured to assist in assessing the existing noise levels at the selected sites. Results showed that the monitored noise levels in terms of L_{eq}, in residential area ranged between 52.1dB(A) to 72.7dB (A) and in the school area ranged between 68.2dB(A) to 73.7dB(A). These levels highly exceeded the level recommended by the World Health Organization ($p \leq 0.001$). These noise levels cause sleeping disturbance, interfere with speech communication and message extraction. The main causes of such noise levels are related to transportation system, motor vehicles and traffic supported by poor urban planning. To reduce such noise levels suggestion are made for municipalities to consider protection of communities from an environmental noise as an integral part of their policy for environmental protection to create conducive environment for the society.

Key words: Monitoring, Noise, Pollution, Community, residential noise, domestic noise, Kuala Lumpur, Malaysia

1.0 Introduction

Noise is defined as unwanted sound (Thorpe and Holmes, 1976). Noise pollution is disturbing or excessive noise that may harm the activity or balance of human and animal life. Noise is unwanted sound, annoying, and in particular situation it can cause damage (Millne, 1979; Kryter, 1970; Bugliarello, 1976; Gunniff 1977; Davies and Cornwall, 1991; Sato, 1990). Noise has also been defined as undesirable sound, wrong sound, distributive sound in wrong place and wrong time (Magrab, 1975; May, 1978). Its audible acoustic energy adversely affects the physiological or psychological well-being of people (Kryter, 1985). Any form of noise is considered as pollution if it causes annoyance, sleeplessness or any other stress situation. Community noise pollution (CNP), which is also known as residential noise or domestic noise, is defined as noise emitted from all sources except noise at the industrial workplace (WHO,2000).

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Noise, in the large part a subjective phenomenon, relates to the reaction of people to certain types of physical sound. Main sources of community noise include machines, and transportation system, motor vehicles, road, rail and aircraft, traffic, industries, construction and public work, and the neighborhood noise. The main indoor noise sources are ventilation systems, office machines, home appliance and neighbor. Poor urban planning give rise to noise pollution. These definitions reflect that noise pollution is a complex phenomenon (Bugliarello, 1976), Which is different from other pollutants in the following ways:

1. Noise is transient; once the noise source is eliminated the environment is free of it.
2. It is possible to make some form of estimation for other types of pollutants in terms of how much material can be introduced in to environment before harm can be done. However, it is difficult to monitor cumulative exposure to noise or to determine how much is too much.

The growth in community noise pollution problem is unpredictable because it involves direct as well as cumulative adverse health effect. It also adversely affects future generations, and has socio-cultural, aesthetic and economic effects (WHO,2000). Noise pollution can cause annoyance, aggression, hypertension (Field, 1993; Kryter 1985). It can also cause high stress level, tinnitus, hearing loss, sleep disturbance (Rosen and Olin 1965; Field 1993). To abate noise problem, many laws and regulation have issued around the world. Such laws and regulations are related to noise levels and time of noise emissions. However, most of them come under legislation relating to public health and motor vehicles. In the United Kingdom (UK) noise pollution was dealt by legislation for long time. However, noise abatement aspect was simply included into the list of statutory nuisances under either the Public Health Act 1936 (England and Wales) or, in Scotland, by the Public Health (Scotland) Act 1987. In Malaysia many laws and regulations were aimed at minimizing exposure to noise.. One such law is Minor Offences Ordinance, 1953. This ordinance prohibits noise to be omitted after eleven (11) p.m. and the police are empowered to act on complaints relating to noise. This is followed by the Environmental Quality Act, 1974. In this act, several provisions could be

utilized to control and abate the noise pollution problem. Other laws and regulations to curb noise were also established such as the Local Government Act, 1976, which contains provisions enabling due action to be taken against, including prosecution of owners, occupiers of premises, whether public or private, emitting noise that can be characterised as constituting nuisance. The Environmental quality Act, 1985 makes it mandatory for EIA to be prepared for various activities scheduled by the ministry of Science, technology and Environment. Approval of such project is usually bound with the maximum permissible noise limits in the affected areas that must be complied upon the construction of the project and upon the operation of the proposed project. This indicates the importance of keeping the noise levels to an acceptable levels. This is followed by the Environmental Quality (Motor Vehicles Noise) Regulation, 1987. It stipulates permissible noise emission from vehicles as measured in accordance to procedures stated. These laws and regulations are sufficient to deal with current and future situation of noise , but the main problem is the lack of the enforcement of such laws. The main shortcomings of these regulations is that they did not specify any noise standard and they use fuzzy logic in describing noise situation and climate such as low and high noise level, hence making enforcement activities difficult, if not impossible. In Malaysia noise pollution was also determined by the Department of Environment (DOE) as one of the physio -chemical parameters that must be addressed in conducting Environment Impact assessment (EIA) for certain development project (DOE, 1991). It ranked as a third pollution problem after air and water pollution in terms of number of complaints received (DOE, 1995). As the noise pollution continued to get worse, the number of complaints from noise increased as from 633 to 817 to 2708 and later to 2875 for the years 1986, 1989, 1995 and 1998, respectively (DOE, 1998). A noise level of 82dB(A) Leq has been reported in some selected residential areas of Kuala Lumpur (Elfaig 2002). As such this study aims at monitoring and studying the outdoor community noise pollution in some selected sensitive areas of Kuala Lumpur , namely, Blue Boy Mansions and LaSalle secondary school.

2.0 Materials and Methods

Noise is a worldwide problem for example in the United States of America (USA) the league for the hard of hearing (2000) estimated that twenty eight (28) millions people have hearing loss. It added that to be present for just fifteen (15) minutes on many New York City subways a day over time can affect your hearing. In the European Union(EU) an estimate of more than 40% of the population is exposed to daytime traffic noise exceeding 55dB(A) in terms of L_{eq}, and 20% are exposed to levels exceeding 65dB(A) (WHO, 200).when all transportation noise is considered, more than half of all EU citizens are estimated to live in zones that do not ensure acoustical comfort to residents. At night, more than 30% are exposed to Leq exceeding 55dB(A), which is not conducive to sleep (WHO, 2000; Elfaig, 2002). In Japan noise pollution is also high as reflected by a study conducted by Yano *et al*., (1991) at Kumamoto. It recorded a noise level in terms of $L_{eq(24\ Hours)}$ of 75.2dB(A) during daytime, while at night, it was 72.5dB(A). The measurements for such study were taken on weekdays at road shoulder at a height of 2.8 meters. Such levels are extremely high and exceeded the 55dB(A) for day time and 45dB(A) for night time levels recommended by the WHO. In New Zealand noise problem situation was reflected by the number of people complaining to Christchurch City Council against noise, for example in 1981 the number of complaints was 127 person (Moody, 2000). Since then there appears to be an increase in the numbers of complaints received particularly in regard to noise from residential premises. Between the year 1992 to 1996 total noise complaints rose by 69%. In Malaysia a study conducted by the DOE in 1981-1982, showed that the noise levels in 96% of the surveyed areas in Kuala Lumpur, Ipoh, and Pulau Penang failed to meet the WHO recommendation. A follow up survey in 1984 indicated that noise environment continues to deteriorate. As such, noise levels in residential areas had exceeded the recommended level 100% of the time compared to 96% in 1982 (DOE, 1985).In all the selected residential areas results showed that 10% of the population were exposed to noise levels exceeding 73dB(A). At the school compounds similar situation also existed throughout Peninsular Malaysia. A survey of noise levels conducted by the DOE (1982) in school areas in Kuala Lumpur, Ipoh and Penang indicated that over 85% of the time the L_{eq} level exceeded the acceptable noise recommendation of 55dB(A) as shown in Table 1

TABLE 1

NOISE LEVELS IN TERMS OF Leq AT THE BOUNDARY OF SCHOOLS 1981-1982

Town	No. of selected schools	% out of selected schools	Leq dB(A
Kuala Lumpur	46	10	71
		50	62
		90	52
Penang	43	10	76
		50	69
		90	52
Ipoh	17	10	76
		50	71
		90	59

Source: DOE 1982

The Table shows that noise levels in 10% of all selected schools exceeded the 55dB(A) recommendation by the WHO for outdoor school areas. Such levels may affect teachers' and students' performance. In 1985 a survey conducted by DOE showed that 10% of the samples taken in federal Territory of Kuala Lumpur and Penang revealed that schools were exposed to noise levels exceeding 69.5dB(A). In a more recent study, a similar noise problem was also found around some selected schools especially those within the Federal Territory of Kuala Lumpur as shown in Table 2 (DOE,1995).

TABLE 2
NOISE POLLUTION AT SELECTED SCHOOLS : 1995 STUDY

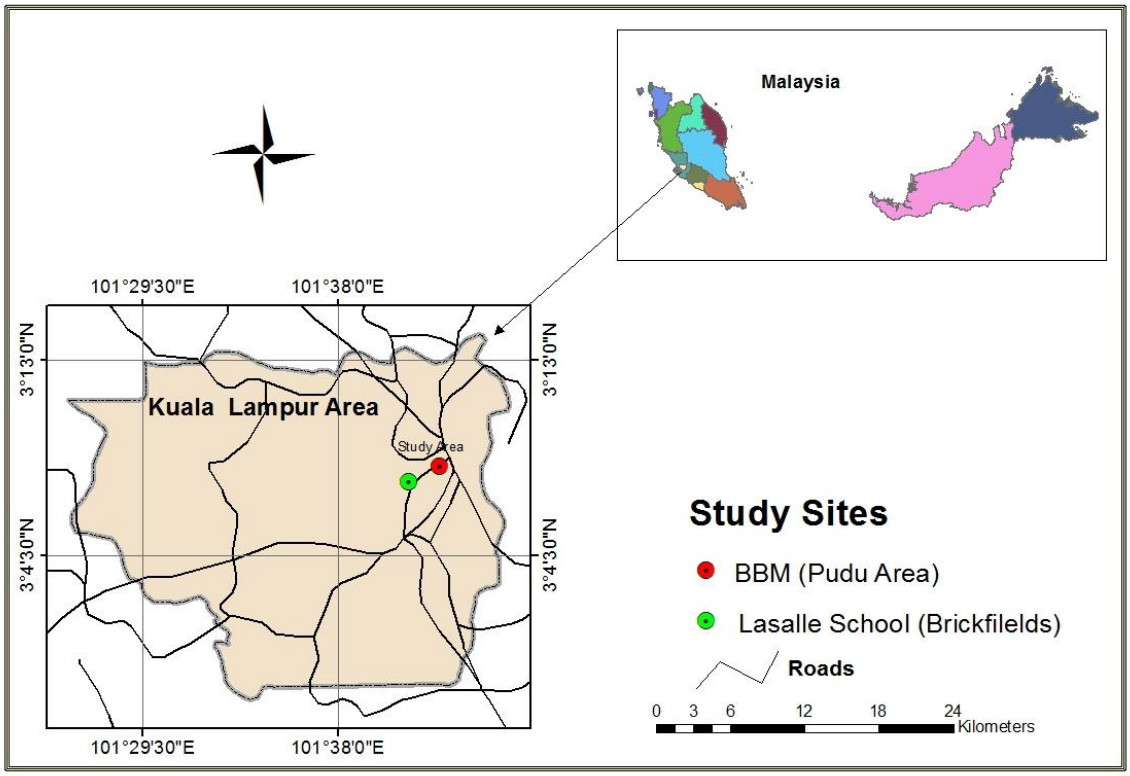
School area	School name	Noise range L_{eq} dB(A)
Federal Territory of Kuala Lumpur	S.M. Victoria Institution	47-60.8
	S.M. St. John	53.3-64.
	S.M. Convent Bukit Nanas	49.3-65.9
	SRK. St. John Land2	57.4-71.1
Johor	S.M. Sultan Ibrahim	59.8-72.2
	Maktab Sultan AbuBakar	48-64.6
Melaka	SRK St. Francis	47.5-75.2
Terengganu	S.M. Sultan Sulaiman	56.9-67.5

Source: DOE, 1995

Table 2 reveals that all schools monitored were exposed to a maximum noise levels exceeding the 55dB(A) L_{eq} the level recommended by the WHO, which could affect student' concentration and their ability to Learn. It suggested that this problem could be solved by relocating the affected schools to more conductive areas that is free from noise pollution, or by constructing noise barriers that could absorb some of the traffic noise.

2.1 Study Site

The study sites are deliberately selected as the sites suffer from CNP. Accordingly, two areas, namely, residential (Blue Boy Mansions), and school (LaSalle Secondary School) were selected in Kuala Lumpur , the busiest part of Klang Valley as shown in Map 1.



Map 1: The Study Sites

2.2 Noise Monitoring Procedures

The noise monitoring processes consisted of 24-hours noise measurements at appropriate point in residential area and for twelve hours (12hours)at the selected school 7am to 6pm in school area (schooling hours). The measurements were taken during these hours with an interval of ten minutes and each measurements lasted for five minutes on weekdays. The primary objective of this measurement was to determine the exiting noise levels at the selected sites to show the real situation. As such a type 1 modular precision Sound Level Meter (SLM) and a Statistical Analysis Module (SAM) were used . The SLM was calibrated at 93.8dB(A) .The SLM was placed at a height of 130cm above the ground and at a distance of 500cm from the receivers. These measurements were done in accordance with ISO 1996-1:1982, ISO 1996-2:1987 and ISO 1989-3:1987.

2.3 Noise Measurement Parameters

Various noise levels data recorded at the measurements point in terms of levels exceeded certain proportion of the measured time is an important way of assessing the annoyance from community sound . This due to the fact that the sound varied and fluctuated over time . Thus, the descriptors Equivalent Continuous Sound Level (L_{eq}), Sound Level exceeded 10% of the measurement period (L_{10}), Sound Level exceeded 90% of the measurement (L_{90}), minimum noise level (L_{min}), and maximum noise level (L_{max}) were measured to assist in assessing the existing noise levels at the selected sites. The Logarithmic and mathematical models that were used to calculate noise levels were based on average and expression of sound levels variation over time using Equation1 and 2 (Nelson, 1985; Schultz, 1972) as shown below:

$$L_{eq} = 10Log_{10}\frac{1}{T}\left[t_1 * 10^{\left(L_1/10\right)} + T_2 * 10^{\left(L_2/10\right)} + \cdots + t_n * 10^{\left(L_n/10\right)}\right] \quad \{1\}$$

Where,

L_{eq},: is equivalent continuous sound level.

T: is the time for which sound is described

$t_1,t_2,\ldots t_n$ are the time period for which sound levels are $L_1,L_2\ldots L_n$ and so on

$$L_{eq} = L_{50} + \left(\frac{L_{10} - L_{90}}{56}\right)^2 + (L_{10} - L_{50}) \quad \{2\}$$

The assessment procedures of the monitored CNP at the selected areas consist of comparing an actual noise exposure (measured levels) with the WHO recommended level for outdoor residential and school area. The collected data for both selected sites are presented in Table 3.

TABLE 3

MEASURED NOISE LEVELS Db (A) AT THE SELECTED SITES

Day hours	Blue Boy Mansions – residential area					LaSalle Secondary School	
	L_{min}	L_{90}	L_{eq}	L_{10}	L_{max}	L_{eq}	L_{10}
7	59.0	63.0	65.0	68.0	77	71.0	75.0
8	56.1	63.5	64.7	69.8	80.0	70.1	74.2
9	63.2	65.1	67.4	70.6	83.0	70.0	74.0
10	62.0	63.1	65.4	68.7	84.2	69.8	74.7
11	57.3	61.1	64.3	68.2	83.0	70.0	74.0
12	59.3	62.1	64.5	67.4	80.8	72.0	75.5
13	58.8	62.2	65.2	69.7	83.1	67.1	70.3
14	61.0	62.4	64.2	66.0	80.0	65.0	68.2
15	58.0	60.3	62.5	68.3	81.2	70.0	75.0
16	59.0	63.1	65.4	68.8	82.0	67.2	70.1
17	59.4	63.0	65.0	73.0	81.0	67.0	70.8
18	66.4	68.3	70.1	75.0	85.0	68.7	74.3
19	59.0	62.0	64.5	67.2	82.3		
20	58.0	61.0	65.0	72.3	82.0		
21	57.0	65.0	68.2	76.4	88.0	End of schooling hours	
22	57.5	61.3	62.4	69.1	78.0		
23	54.0	57.0	66.5	72.1	77.4		
24	55.0	65.2	66.1	67.5	74.0		
1	57.1	65.2	66.0	67.3	72.0		
2	50.0	54.0	57.1	63.2	72.0		
3	51.0	53.1	57.0	65.1	78.2		
4	52.0	55.1	58.2	65.3	79.1		
5	53.0	55.7	57.2	63.4	75.8		
6	56.2	60.9	63.5	72.4	80.1		

3.0 Results and Discussion

The results presented the existing outdoor monitored CNP in selected residential and school areas. These are Blue Boy Mansions, and LaSalle Secondary School

3.1 Noise pollution in Blue Boy Mansion Area

The result of noise levels measurements in the Blue Boy Mansion area (BBM) have shown that the existing noise level exceeded the recommended WHO level for L_{eq} , day and night hours. For example L_{eq} ranges between 64.3dB(A) at the minimum level to 73.7dB(A) at the maximum level during day hours as shown in Figure 1. These levels greatly changed during night hours and ranged between 52.1dB(A) to 67.6dB(A), at the minimum and maximum levels. In numerical terms the average of these levels exceeded the WHO recommended level by 22.2% at the maximum level and 7% at the minimum level. Other monitored noise parameters are also high as shown in Figure2.

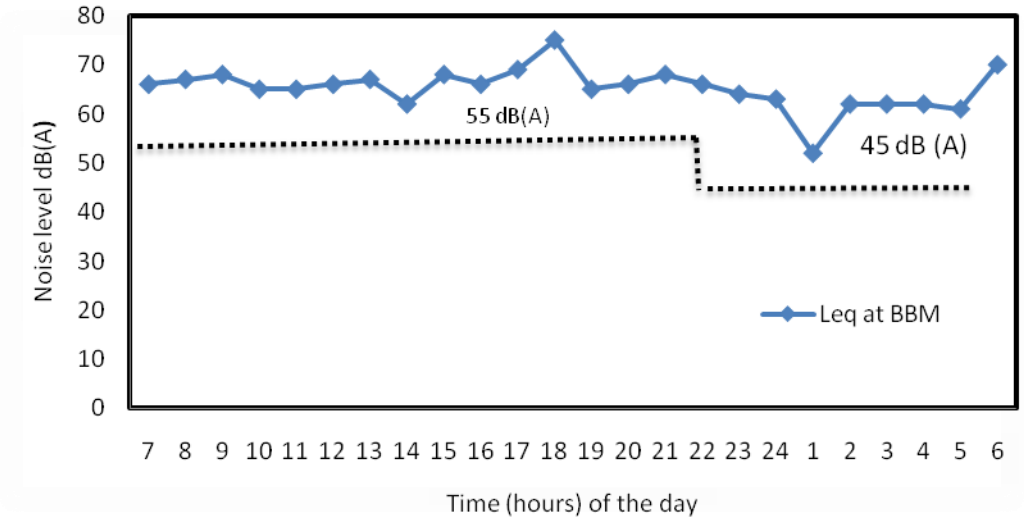


Figure 1: Comparison between measured Leq in BBM Area during a 24 hours Measurement and WHO Recommendation

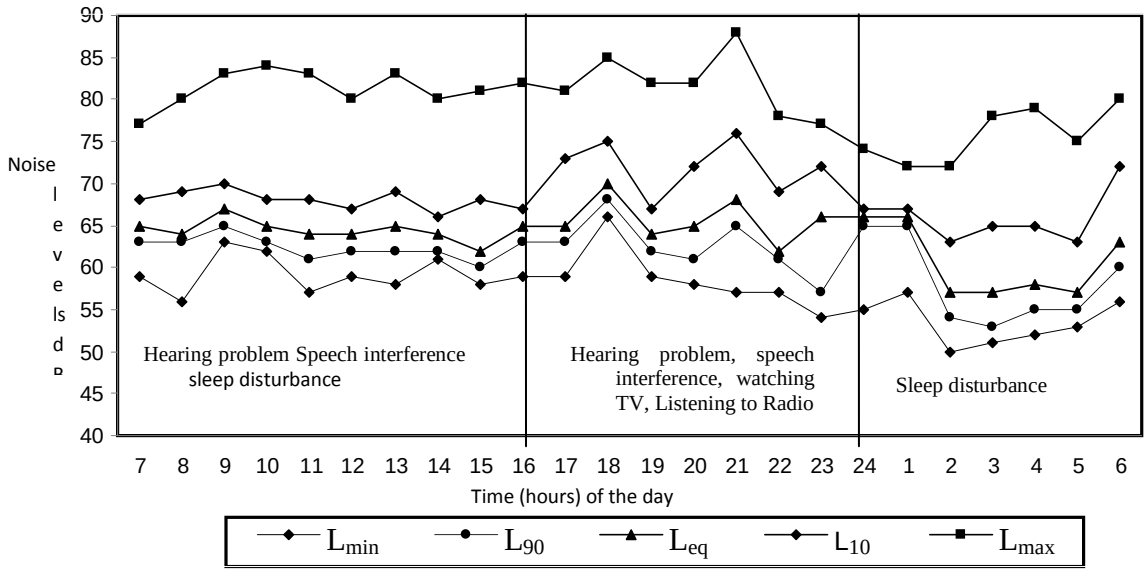


Figure 2: Different measured noise parameters and related noise Effects at BBM

The results of statistical analysis on the measured levels showed that there is a highly significant difference ($p < 0.001$) in the noise levels between the Blue Boy Mansions area and the WHO recommendation as shown in Figure 1. Such results indicated that the speech intelligibility is moderately affected, sleep is widely disturbed and the possibility of Noise Induced Hearing Loss (NIHL) is minor. The existing noise levels at this place is due to the system of land use pattern as BBM is located near the main road coupled with a few business activities. The study further identified that the transportation system and lack of proper attenuation and unsatisfactory planning decision are the main contributing causes of community noise pollution

3.2 Monitored Noise Levels in LaSalle Secondary School

This part analyses and discusses the existing outdoor CNP level in LaSalle Secondary School in Kuala Lumpur . Duration of the noise measurements are presented in the methodology . Results revealed that the noise levels in terms of Leq ranged between 67dB(A) to 72dB(A) and this exceeded the 45dB(A) Levels recommended by the WHO(1980) for the school area .It also showed that the existing noise levels in terms of L_{10} ranged between 68.2 dB(A) at the minimum level to 75.5dB(A) at the maximum level. In numerical terms, the existing noise levels exceeded the recommended level by 20% at the minimum level and 30% at the maximum level as shown in Figure 3. The existing noise levels are also exceeded the 70dB(A) L_{10} exterior noise level recommended by the Federal Highways Administration Noise Standard (1976) of the USA. Results also show continuous deterioration of school 's environment as noise level escalate and exceeded the measurements of 1982 (Table 1) and measurement of 1995 (Table 2). The high noise levels would result from land use pattern, as the school is located near a busy main road and accentuated by unsatisfactory planning decision.

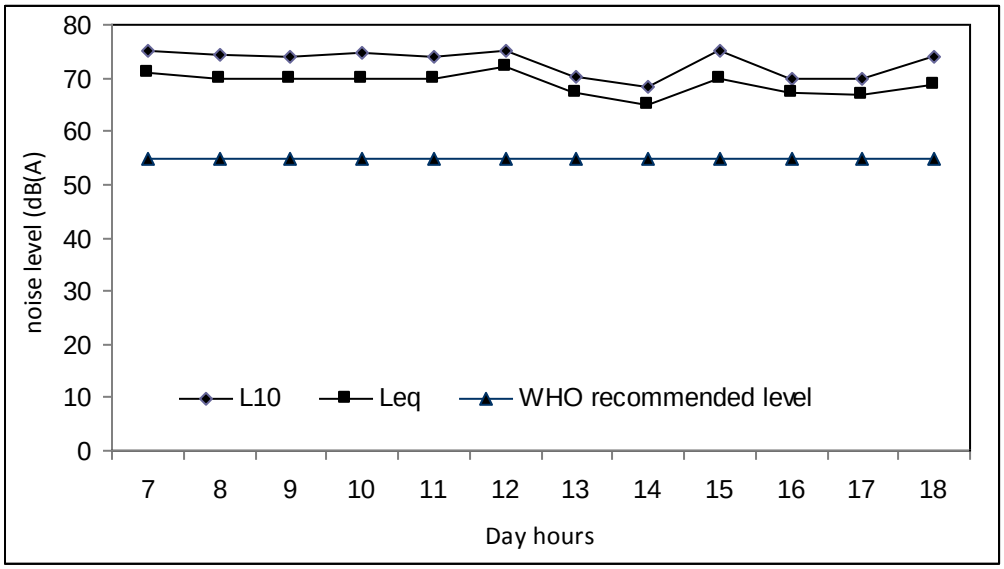


Figure 3: Noise Levels in terms of Leq and L_{10} in LaSalle Secondary school

4.0 Conclusions

The study has shown that the monitored community noise pollution in selected residential and school area (Blue Boy Mansion LaSalle Secondary School) highly exceeded the level recommended by the World Health Organization for residential and school areas and highly fluctuated over time. The monitored noise level in terms of Leq in the residential area ranged between 52.1dB(A) to 72.7dB(A) during day and night time and in the school area ranged between to 68.2 dB(A) to 73.7 dB(A) during school hours. These noise levels have exceeded the WHO recommended level 100% of the measured time. Such monitored noise levels can cause sleep disturbance, interfere with speech and may affect students and teachers' performance as they interfere with speech communication and message extraction, which are the main mechanisms of teaching. Thus, community noise pollution is a serious environmental problem at residential and school compounds within the study area. To abate noise problem, a proper use of vegetation and noise barrier are highly recommended. These should be supported by the enforcement of laws and regulations in order to create a conducive environment for residents, students, teachers and community at large.

References

[1]. Bugliarello, G.. The Impact of Noise Pollution . Associo- technical Studies . New York: John Wiles and Son,1976

[2]. Davies, M. and D.A. Cornwell. Introduction to Environmental Engineering. 2nd ed. New York: Mc Grow-Hill Inc, 1991.

[3]. Department of Environment. Malaysian Environmental Quality Report, 1982. Putrajaya: Ministry of Science, Environment and Technology, . 1982

[4]. Department of Environment) .Malaysian Environmental Quality Report, 1985. Putrajaya: Ministry of Science, Environment and Technology, .1985

[5]. Department of Environment. Malaysian Environmental Quality Report, 1991. Putrajaya.: Ministry of Science, Environment and Technology, .1991

[6]. Department of Environment .Malaysian Environmental Quality Report, 1995. Putrajaya: Ministry of Science, Environment and Technology, .1995

[7]. Department of Environment. Malaysian Environmental Quality Report, 1998. Putrajaya: Ministry of Science, Environment and Technology,1998

[8]. Elfaig, A. Community Noise Pollution in Kuala Lumpur : Analyses and Expert System Department Ph.D. Thesis, Universiti Pertanian Malaysia: Serdang, 2002.

[9]. Federal Highway Administration. Procedures for Abatement of Highway Traffic Noise and Construction Noise.In: May, D. (1978). *Handbook of Noise Assessment.* New York. Litton Educational Publishing, INCC., 1976

[10]. Field, M. *Effect of personal and situational variables upon noise annoyance in residential areas*, Journal of the Acoustical Society of America, 1993

[11]. Gunniff, P. Environmental Noise Pollution. New York: John Wiley & Sons, 1977

[12]. International Oranisation for Standardisation. Acoustics- Description and measurement of Environment Noise Basic Quantities and Procedures: ISO 1996-1. Switzerland, 1982.

[13]. International Oranisation Standardisation. Acoustics- Description and measurement of Environment Noise: Acquisition of Data Pertinent to Land Use: ISO 1996-2. Switzerland, 1987.

[14]. International Oranisation Standardisation. Acoustics- Description and measurement of Environment Noise: Application to Noise Limits: ISO 1996-3. Switzerland, 1987.

[15]. Kryter, K. The Effects of Noise on Man. New York: Academic Press, 1970

[16]. Kryter, K. The Effects of Noise on Man. Orlando: Academic Press. 1985.

[17]. League for the Hard of Hearing. Controlling Noise is in your Hands. New York: LHH, 2000.

[18]. Magrab, E . Environmental Noise Control. New York: Wily- Interscience Publication, 1975.

[19]. May, D. Handbook of Noise Assessment. New York: Litton Educational Publishing INC,1978.

[20]. Millne, A. Noise Pollution Impact Counter Measures . London: David and Charles INC, 1979.

[21]. Moody, T. Noise in New Zealand: A paper presented to 6th Congress on Environmental Health: OSLO, 2000.

[22]. Nelson, P. Transportation Noise Reference Book. London : Butterworth & Co. Ltd, .1985

[23]. Rosen, S and P. Olin . *Hearing Loss and Coronary Heart Disease*, Archives of Otolaryngology, 1965

[24]. Sato, T. The effects of vibration on noise annoyance: A survey on traffic noise and vibration in Supporo. Environment International 16:561-566, 1990.

[25]. Schultz, T . Community Noise rating. London: Applied Science Publishers, .1972.

[26]. Thorpe, R. and T. Holmes. Economic Welfare Impacts of Urban Noise .Environmental Protection Agency: Washington, 1976.

[27]. Yano,T., Yamashit, T. and Zuni, I . Community response to road traffic noise in Kumamoto. *Sound and Vibration* (151)10. [28]. 1991.

[28]. World Health Organization. Environmental Health Criteria 12, Noise Executive Summary. Geneva: WHO and United Nations Environment Program,1980.

[29]. World Health Organization. Guidelines for Community Noise. A Paper Presented to 6 Congress ON environmental Health: OSLO. 2000.