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ASSESSMENT OF NOISE IMPACT: A CASE STUDY DUE TO AIRCRAFT ACTIVITIES

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ABSTRACT

This paper presents the results obtained from an environmental noise measurement at a selected location in Malaysia in order to establish the impact of noise to human at residential area. The measurement site was situated less than three kilometers from the nearest airport and any major activities can be expected to be heard. The noise measurement was carried out for 24 hours monitoring for 30 days by using integrated B&K SLM equipments to obtain the equivalent sound level (L_{eq}), L_{10} and L_{90} so that the exposure of noise to community can be assessed. Maximum sound level (L_{max}) and sound exposure level have been measured as specified by the Federal Aviation Administration (FAA) for aviation noise assessment. The results revealed that the overall noise level exceeded the requirement of standard which is stated at 65dBA. These finding are very useful to be used as reference and guideline for future regulations on noise limit to be implemented for urban areas in Malaysia not only to human but also for wildlife and building structure.

Keywords: Background noise, dominant noise, equivalent sound level.

INTRODUCTION

Noise and ubiquitous environmental pollutant, is a public-health issue because it leads to annoyance, reduces environmental quality and might affect health and human recognition. The environmental noise can be classified as any unwanted or harmful outdoor sound that is detrimental to the quality of human life. There were many research initiated in determining the impact of noise to human in several years back. Most of these research have been concerned with the impact of noise on the human auditory system and it is now well established that exposure to noise levels of relatively high degrees can lead to direct hearing loss and hearing impairment (Prasher, 2003). However, more recent research has concentrated on the relationship between noise and non-auditory effects especially the association between noise and noise annoyance to human.

Noise pollution is by now recognized worldwide as a major problem for the quality of life in any urban area (Piccolo and Plutino 2005). In most developed

countries, standards for air pollution and noise exposures are an important part of environmental policy to improve local environmental quality. Often these standards are based on expert judgments and do not take into account people's preferences. Noise could lead to human annoyance, reduces life quality, and might affect health and physiological well-being. Annoyance is a term used in general for all negative feelings such as disturbance, dissatisfaction, displeasure, irritation, and nuisance (Guski, 2004; Quasch et al., 2002). Numerous noise surveys treating the problem of noise pollution in many cities throughout the world have been conducted (Peter et al., 2008; Rehdanz and Maddison, 2008; Tang and Wang, 2007; Driussi and Jansz, 2006; Gündoğdu et al., 2005; Padma et al., 2004; Guasch et al, 2002; Sadan et al., 1986; Stansfeld et al., 1983).

A common finding in the syntheses of annoyance and sleep disturbance studies was that at the same A-weighted average noise exposure level or noise indicator, aircraft noise was more annoying than road traffic noise and railway noise less annoying than road traffic noise (Wolfgang et al., 2009). In some surveys, noise impact was treated as a stress indicator, and in consequence the role of noise as a risk factor for human health was discussed. Noise effect includes various impacts on mental and physical health and disturbance of daily activities which may affect sleep, conversation, lead to perception of annoyance, cause hearing loss, instigate cardiovascular problems as well as affect human judgment and performance (Ouis, 2001; Langdon, 1976).

Traditionally, quality of life measures include environmental features. Zaheeruddina and Jainb (2006) for instance, the questionnaire developed within this framework by the World Health Organization, the WHOQOL includes the relationship to salient aspects of the subject's environment such as: home environment, physical environment (pollution, noise, traffic and climate), transport and recreational opportunities. Looking at the impact of environmental conditions would naturally leads to analysis scheme for the quantification and expression of annoyance level. Discomfort and stress, which involve complex inter-relation of life space dimension, may have long-term effects on human health. This study was carried out using noise measurement equipment. This paper takes a closer look into the background noise level (L_{90}) and dominant noise sources (from L_{10}). L_{max} and L_{eq} also have been captured since this study mostly related with noise from aircraft. These data are very useful to be used as reference and guideline for future regulations on noise limit to be implemented for urban areas in Malaysia.

METHODOLOGY

Equipment utilized to measure existing background noise levels subscribes to the International Electro-technical Commissioning (IEC) specifications. The instrument was placed at a height of about 1.2 meter above the ground. Steps were also taken to ensure that no reflections took place near the instrument. ISO 1996/1 standard suggests that the monitoring time selected for the measurements of the environmental noise as recommended by ISO 1996/1 standard. The 'A'-weighted measurement, are more reliable when associated with people's reaction for many applications.

Existing Noise source

The measurement site located less than three kilometer from the nearest airport and any major activities can be expected to directly being heard.

Noise descriptors

Noise descriptors such as L_{max}, $L_{10,}$ L_{90} and L_{eq} were recorded. The Noise measurement was carried out 24 hours monitoring for 30 days by using integrated equipments. Definition for the noise descriptors are presented as follows:

L_{eq}: The equivalent continuous dBA level which has the same energy as the original fluctuating noise for the same given period of time.
L_{10}: A specified dBA levels which is exceeded ten percent of the time during the whole period of measurement.
L_{90}: A specified dBA levels which is exceeded ninety percent of the time during the whole period of measurement.
L_{max}: The root means squared maximum level of a noise source or environment where peak is the maximum level of the raw noise source.

Equipments

Two types of equipment for environmental noise level assessment. Hand held analyzer model of Bruel and Kjaer will be as the main equipment in measurement and Sound Level meter (Quest) will verify the value taken. Both equipments were indicated in Figure 1.

1) Bruel and Kjaer.

Hand-held Analyzers Types 2250 with Sound Level Meter Software BZ-5503 as shown in Figure 1 (a) and Figure 1(b).

(a) (b)

Figure 1: (a) Hand-held Analyzers Types 2250 and (b) Equipment setup for measurement.

2) Quest

Precision Integrating Data Logging Sound Level Meter: SoundPRO SE/DL; Model 29000

Origin	QUEST Technologies USA
Model	QUEST 2900 Integrating and Logging Sound Level Meter
Calibration	NML/2082/E/03National Metrology Lab.SIRIM Berhad. (Date 18/11/2003)
Sound Calibrators	QC-10 114dB - 1000Hz

(a) (b)

Figure 2: (a) QUEST 2900 and (b) Description of the equipment.

RESULTS AND DISCUSSION

The measurement location has a different and unique of characteristic and that one of the reason why the study has been carried out. Normally, there are three parameter will be used to represent or analysis for environmental noise measurement that is L_{eq} (equivalent noise level), L_{90} (background noise level) and L_{10} (dominant noise source). Figure 3 shows graph taken from 24 hours measurement using the Hand-held Analyzers Types 2250. It is clearly indicated in Figure 3 that many peak noise occurred during the measurement. This particular scenario indicated that the increasing noise level can be respectively associated with some aircraft activities.

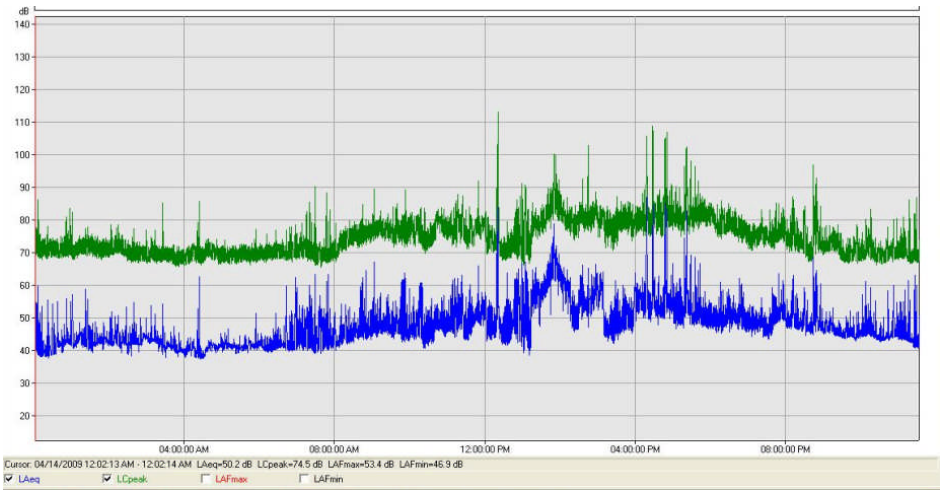

Figure 3: Measurement taken by the equipment device

Table 1 shows the occurrences of aircraft events with the time and L_{Aeq} during the occurrences of aircraft. Most of the noise peak took place due to the excessive noise level from the aircraft.

Table 1: The measurement taken with time and event happen.

No.	Time Period	Event	L_{Aeq} (dBA)
1	12.18 pm	Aircraft	93.3
2	4.17pm	Aircraft	86.9
3	4.18pm	Aircraft	63.3
4	4.26pm	Aircraft	88.5
5	4.30pm	Aircraft	62.3
6	4.36pm	Aircraft	61.2
7	4.46pm	Aircraft	85.2
8	5.15 pm	Aircraft	74.5
9	5.19 pm	Aircraft	59.5
10	5.20 pm	Aircraft	82.9

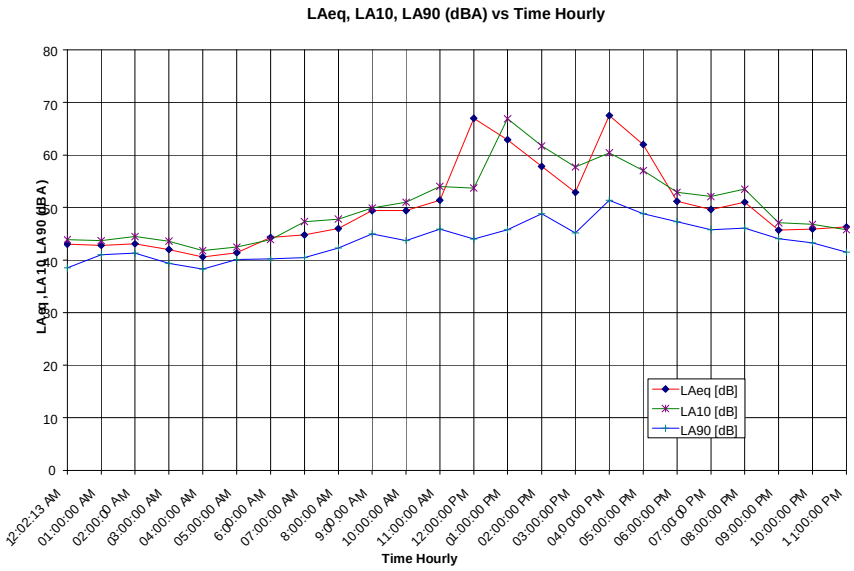

Figure 4: Graf for L_{Aeq}, L_{A10}, L_{A90} (dBA) vs Time (hourly).

Figure 4 above present some example from the full result of the L_{Aeq}, L_{A10}, L_{A90} (dBA) versus Time (hourly) for one day. From the graph it shows most of the peak happen from 12 pm to 5 pm and it's consistent with the event happen as shown in Table 1. Speech interference associated with aircraft noise is primary annoyance to individuals. The disruption of routine activities such as telephone use or conversation gives rise to frustration and irritation. The quality of speech communication is also important in office, business or industrial setting and can cause fatigue and vocal strain in those who want attempt to communicate over the noise. Research has shown that the use of SEL metric will measure speech interference successfully, and that an SEL exceeding 65 dB will begin to interfere with speech communication. From the result indicated in Figure 5, most of the occurrences of aircraft may contributed to the noise level that exceeded more than 65 dBA. This definitely will interrupt normal conversation between people especially at the outside of building. However since the aircraft took off with a high noise level occurred only in a short period of time, it may not contribute to high level in the L_{Aeq}.

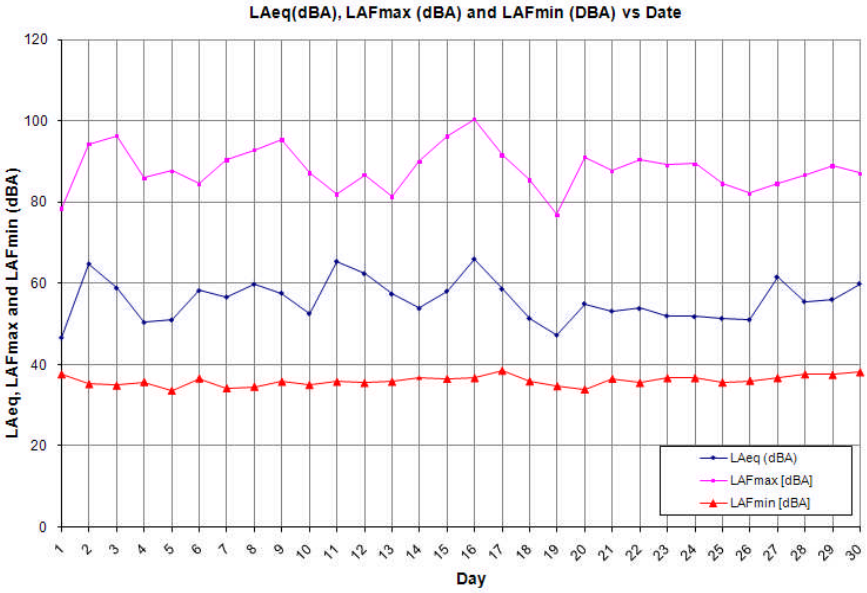

Figure 5: Graf for L_{Aeq}, L_{AFmax}, L_{AFmin} (dBA) vs Day.

CONCLUSION

Environmental noise analysis at the selected location was presented to represent typical equivalent noise level and also typical background noise level near to the airport. The measurement site situated less than three kilometer from the nearest airport and any major activities can be expected to directly being heard. This paper gives a preliminary data and it's believed this area will be developing in the coming future. In the next five to ten years, the noise level will also increase proportionally with the development happen to the country especially to that specific location. Analysis of equivalent noise level, dominant noise sources and background the selected locations in Malaysia being presented in this paper will benefit the researchers and policy makers in this field, especially for those who are directly involve with the study of noise pollution for environmental impact assessment (EIA) with the Department of Environment (DOE) Malaysia.

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