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OUTDOOR AND INDOOR NOISE EXPOSURE: EFFECT ON UNIVERSITY STUDENTS' WELL-BEING IN RESIDENTIAL COLLEGES.

Muhammad Hafeez Fikhri Bin Mohd Yussof [1] and Norishahaini Mohamed Ishak [2]
[1 2] Centre of Studies for Construction, Faculty of Architecture, Planning, and Surveying, Universiti Teknologi Mara,40450, Shah Alam, Selangor.
Email: hafeezfikhri6177@gmail.com[1] , norish@uitm.edu.my[2]

Abstract:
Noise is a result of human activities, such as urbanization, transportation development and industry. Despite the widespread of the noise, it has been treated differently than other pollutions. This research aims to determine noise levels and sources in college buildings at university. The objectives of this research are designed to assess the noise exposure levels experienced by students at a residential college building, find out the factors and recommend the solutions. To understand the source, and the degree of annoyance of the students due to the outdoor and indoor noise level, a total of 60 respondents were randomly selected from three residential colleges (Perindu, Teratai, and Delima) with 20 respondents each. The noise level measurement using the sound level meter in daytime and nighttime was adopted to find out the equivalent continuous level (L_{Aeq}) and traffic noise level (L_{A10}) at the college area. Analysis showed that road vehicles are the major cause of noise nuisance that contributed 43% of the total respondents. The results for the outdoor and indoor noise level showed 10 dB increment from the permissible value of daytime and nighttime L_{Aeq}.

Keywords: Noise exposure; Permissible sound level; Traffic noise, College residents

1.0 INTRODUCTION

Noise occurrences are resulted from human activities, such as urbanization, transportation development and also industry. Usually, the population in the urban area is most affected by noise because it is situated in the congested and the center of attention area. However, small town or villages are also affected by this noise pollution (Singh & Davar, 2004) even though the areas are less exposed to the sources of the noise. According to Hammer et al. (2014), despite the widespread occurrence of exposure of the noise, noise has been treated differently than pollutions of a chemical or radiological nature and especially air pollution. This is the cause for the noise pollution is exposed uncontrollably. Besides, 16 percent of the worldwide population, mostly adults are losing their hearing attribute to occupational noise. The researchers believe that a study of four industrial trades reported that 40 percent of workers were exposed to noise levels exceeding 85dBA. Furthermore, it has been reported that industrial noise is the most common source of noise pollution, with 68 percent of complaints on industrial noise, followed by complaints on traffic noise (13%).

2.0 LITERATURE REVIEW

2.1 Major Sources of Noise

Traffic noise is the most significant source of noise as almost 70% of the traffic noise is contributed by vehicle noise. This is regarding the noise produced by the vehicles engine and exhaust system, aerodynamic friction, interaction between the vehicle and road system and by the interaction among vehicles (Subramani et al., 2012). The impact of urban noise on individual health is a concern due to the expanding of more roads and a bigger population. Table 1 shows the permissible sound level for traffic noise stated by the Department of Environment, Malaysia.

Table 1: Limiting Sound Level (Laeq) From Road Traffic

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm - 7.00 am
Noise Sensitive Areas Low Density Residential Areas	55 dBA	50 dBA
Suburban Residential (Medium Density)	60 dBA	55 dBA
Urban Residential (High Density)	65 dBA	60 dBA
Commercial, Business	70 dBA	60 dBA
Industrial	75 dBA	65 dBA

Neighbourhood noise includes disturbance from household gadgets and community. The disturbance of neighbourhood noise to the environment has been doubling every ten years (Mrinal, 2013). Weinhold (2016) made a statement that the loud neighbours noise is often unpredictable unlike traffic or airport noise, make it the unforeseen source of noise as it is not observable. Based on research by Rasmussen & Ekholm (2015), they asked the respondents on the annoyance of noise from neighbours, mostly the answers from them were 'Yes, very annoyed' and 'Yes, slightly annoyed.'

2.2 Risks of Noise upon Human Health

There are risks of noise pollution for human will experiences. Firstly, acute effects such as shock reflex, sleep disturbance, noise annoyance, stress and temporary change in hearing are mostly the mimplications of the noise exposure (Rylander, 2006). Secondly, chronic effects due to continuous exposure to noise over longer time periods may lead to the development of some different effects which are hypertension, reduced learning ability and productivity, as well as endocrine disruption (Kalantary et al., 2015). Thirdly, Hammer et al. (2014) believes that long term exposure to the noise level that is more than 75 dBA could cause metabolic changes in sensory hair cells within the cochlea.

2.3 The Solution for the Noise

First of all, buildings should be located as far as possible from the source of noise. 6 dB of the noise level drops every doubled distance. To provide some absorption for the sound, trees, and shrub should also be planted in front of the buildings (Savale, 2014). According to Savale (2014), specific legislation must be made to the developed countries, and scientific methods for investigation of noise pollution have been invented. The new, quieter equipment must be used to replace the old noisy equipment.

3.0 METHODOLOGY

The basis of analysis that was used for the data collection is conducted in selected UiTM residential colleges. Three residential colleges were selected as the case studies namely Perindu, Teratai, and Delima. The sound level meter was set-up at a different point which is at level 1 and level 5 of the residential college building and also outdoor noise measurement point that is near to the source of the noise.

Figure 1: Layout Plan for Residential College

The measurements were taken for 4 hours in the morning and 2 hours in the night as stated in the guideline for noise impact assessment, ISO 1996-1 (2016). According to ISO 1996-1 (2016), the traffic noise is considered as L_{A10}, which is the noise level exceeded 10% of the time. Thus, the measurement for L_{A10} is used for this noise level measurements. There are several methods in measuring the noise levels. For the noise level L_{A90} , the noise level measurement was conducted for 8 hours morning and night. This is for the noise level that exceeds 90% of the time which describing a steady background noise level. Therefore, L_{A90} is not suitable to be used as the reference method for this measurement. The L_{Aeq} data were then analysed using the formula below.

$$\text{Logarithmic Average} = 10 \times log_{10}\left[\frac{\sum_{i=1}^{n} 10^{\left(\frac{LAeq,(15\ minutes),i}{10}\right)}}{n}\right]$$

The second data collection which is questionnaire survey was collected from the targeted respondents. There were 60 copies of questionnaires survey collected from all the three experimental areas of UiTM Shah Alam dormitory. IBM SPSS Statistic Software was used to analyse the data and represent the result in the forms of tables and charts.

4.0 ANALYSIS AND FINDINGS

4.1 Research Findings and Analysis for Quantitative of Noise Level

Figure 2 shows the different types of age with the different number of respondents. Based on the data collection, 50 from the overall of 60 respondents of the respondents (83%) are aged between 21 to 23 years old. The minority (5%) of the respondents are aged between 18 to 20 years old.

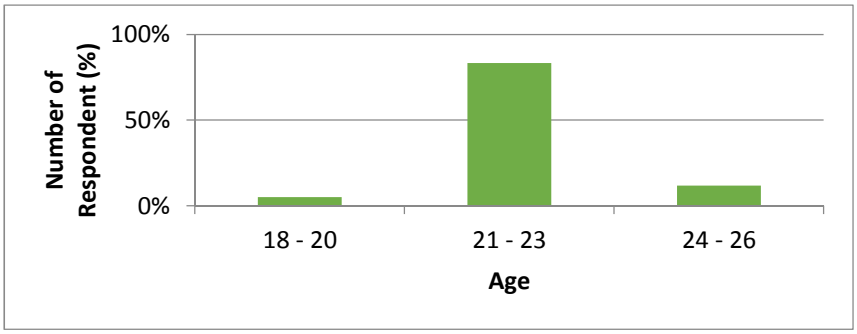

Figure 2: The percentage age of respondents

In terms of noise exposure level experienced by students, based on Table 2, majority of the respondents agreed that the traffic noise pollution mostly took place during peak hour with the mean value of 3.72 with 38.3 percent. For the noise annoyance that occured on a daily basis, most respondents moderately agreed with the mean value of 3.35 with 40 percent. Most of the respondents somewhat agreed that road traffic noise was a disturbance, and the occurrence of noise pollution might affect health. Respectively the mean value and percentage for both were 3.25 (30%) and 2.77 (35%). All of this result can be concluded that majority of respondents experienced the traffic noise that occured in the room, especially during peak hours.

Table 2: The noise exposure level experienced by the students in the room.

Questions	Mean	Percentage
Q4: Traffic noise pollution mostly take place during peak hour	3.72	38.3%
Q2: Any particular noise annoy you on a daily basis	3.35	40.0%
Q3: Road traffic noise in some way will disturb you	3.25	30.0%
Q1: The occurrence of noise pollution in your area affected health	2.77	35.0%

Question 5 and 6 represent the level of annoyance and traffic noise exposure experienced in the students' room (Table 3). The moderate annoyance and exposure traffic noise level were voted 46.7% and 43.3% of the total respondents. It can be concluded the mean value results indicates the respondents have a moderate degree of experience.

Table 3: The level of noise annoyance experienced by the students in the room.

Questions	Mean	Percentage
Q5: The degree annoyance level that occurs in your area	2.82	46.7%
Q6: The degree of exposure to road traffic noise in your residential	2.68	43.3%

Table 4 shows the survey result of the respondents that complained about neighbour being noisy. Based on the findings, majority of the respondents had no issue regarding their neighbours. While a minimal percentage had a problem with the noise created by their neighbours.

Table 4: The percentage of the respondents complained about neighbour being noisy

Variable	Number of Respondents	Percent	Cumulative Percent
Yes	7	11.7%	11.7%
No	53	88.35%	100.0
Total	60	100	

In terms of major source of noise pollution in the room, Table 5 shows the percentage of the sources of noise that occured in the room. The result indicates that the noise from vehicles was ranked first (43%) and followed by surrounding people (37%). The lowest rank is the noise created by household item with only 7% of the total respondents.

Table 5: The percentage of the source of noise that occured in the room

Source of Noise	Number of Respondents	Percent	Rank
Vehicles	26	43.33%	1
People	22	36.67%	2
Commercial & Construction Site	8	13.33%	3
House-hold items	4	6.67%	4
Total	60	100	

In terms of the effect or problem that may be experienced due to exposure to traffic noise, Based on the result in Table 6, the general disturbance had the highest rank compared to the other type of effects from traffic noise exposure. This disturbance includes focusing on work, speech, and others.

Table 6: The percentage of the effect that may be experienced due to exposure to traffic noise

Effect of Noise	Number of Respondents	Percent	Rank
General Disturbance	18	30.00%	1
Sleep Distrubance	15	25.00%	2
Stress	14	23.33%	3
Headache	7	11.67%	4
Hypertension	5	8.33%	5
Temporary change in hearing	1	1.67%	6
Total	60	100	

4.2 Research Findings and Analysis for Measurement of Noise Level

Figure 3 and 4 presents the average of the noise level for LAF10 and LAeq for outdoor of Perindu College in the morning and night. By referring to graph 4.1, the average of noise for LAF10 was 64.1 dB and for the LAeq was 62.0 dB. The average noise for LAF10 is higher compared to the LAeq with the differences of 2.1 dB. For graph 4.2, the average noise at Perindu college for LAF10 is higher which is 63.9 dB when compared to LAeq of 60.4 dB. The difference between this average noise level is about 3.5 dB.

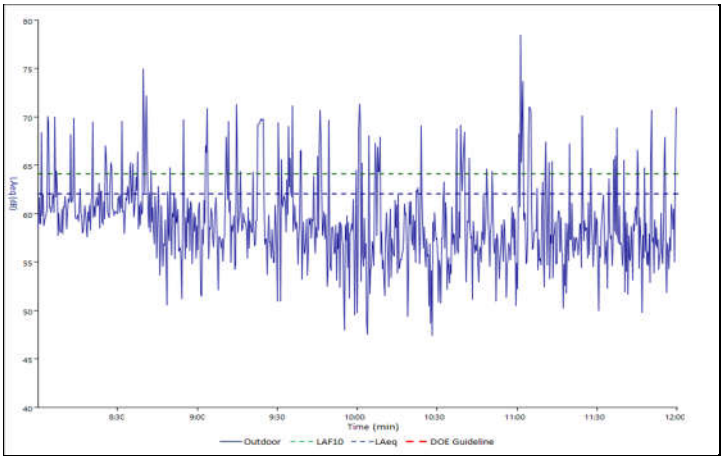

Figure 3: Daytime outdoor noise level for LAF10 & LAeq at Perindu college

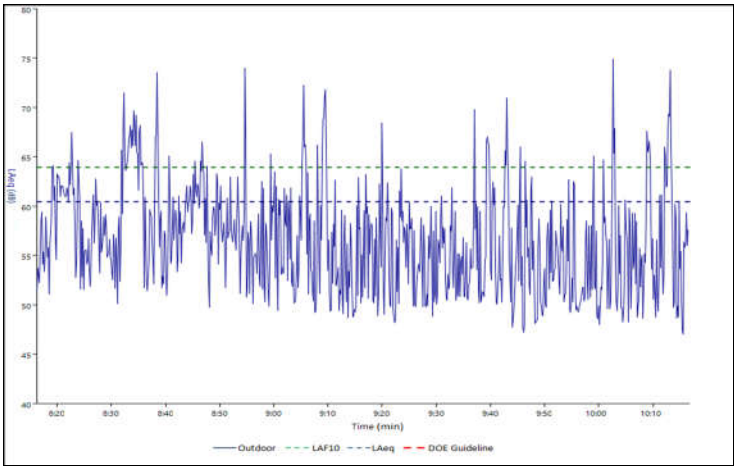

Figure 4: Night time outdoor noise level for LAF10 & LAeq at Perindu college

Figure 5 shows the noise level at Perindu college for daytime. During daytime, the highest average of noise levels (Laeq) was 62.0 dB which was taken outdoor. By referring to the survey, it is somehow related to this noise level measurement as the majority of the respondents agreed that the noise came from the outdoor which is vehicle noise. While the noise level readings at the level 1 were 59.2 dB which is higher than noise at level 5 which is 58.9 dB. This can be supported that most of the respondents agreed that the source of noise usually comes from the outdoor noise and people via communication. All of this noise level was considered noise when compared to the permissible sound level which is 55 dB for institutional as stated by the Department of Environmental. For the night measurement, the outdoor measurement shows the highest average noise level reading which LAeq was 60.4 dB as shown in Figure 6. The reason could be from the vehicles that passed by during the night time even though they were not as many as daytime. The second highest noise level in the room was at level 1 with LAeq of 57.1 dB and the least noise level was conducted at level 5. This noise level reading was considered high as it was above the permissible sound level for night time (50 dB) as stated by Department of Environment.

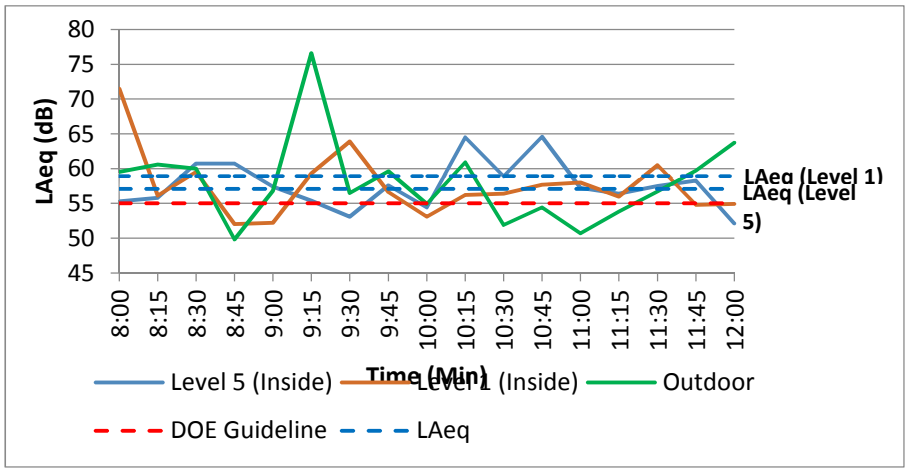

Figure 5: Daytime noise level at Perindu college.

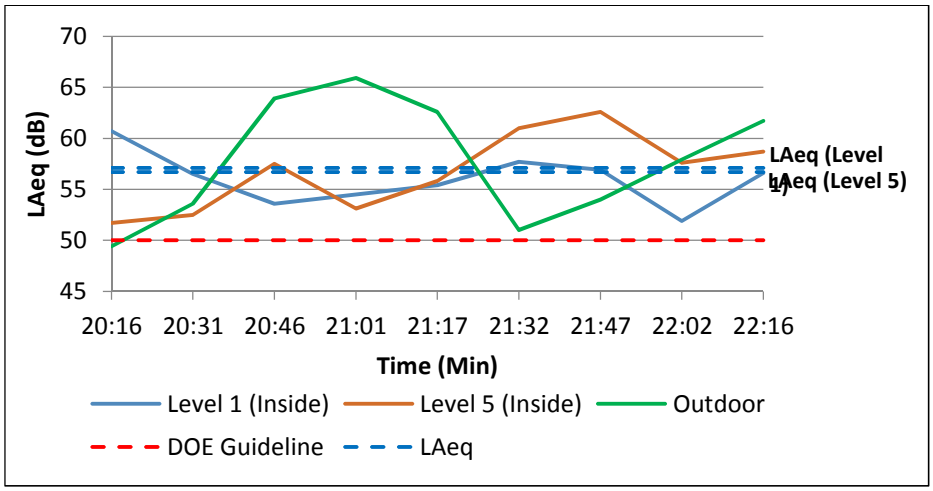

Figure 6: Night time noise Level at Perindu college.

The average of noise level for LAF10 and Laeq at the outdoor of Teratai College was stated in Figure 7 and 8. 58.8 dB of LAF10 and 56.4 dB of LAeq were the average of the noise level which was conducted in the morning. The average noise for LAF10 is also higher than the average noise for Laeq

with a difference of 2.4 dB. By referring to Figure 8, the LAF10 is higher which is 55.8 dB when compared to Laeq of 54.0 dB.

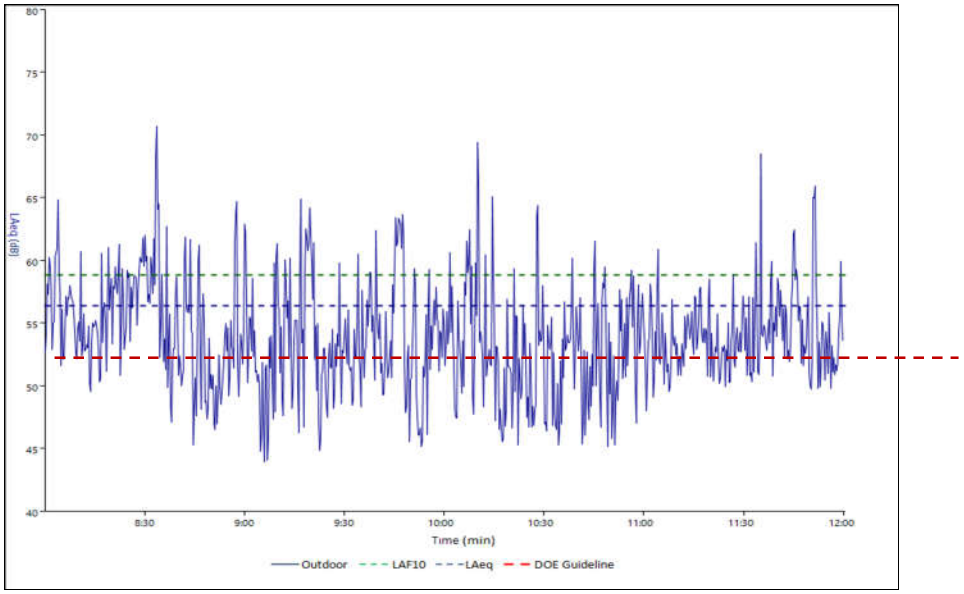

Figure 7: Daytime outdoor noise level for LAF10 & LAeq at Teratai college.

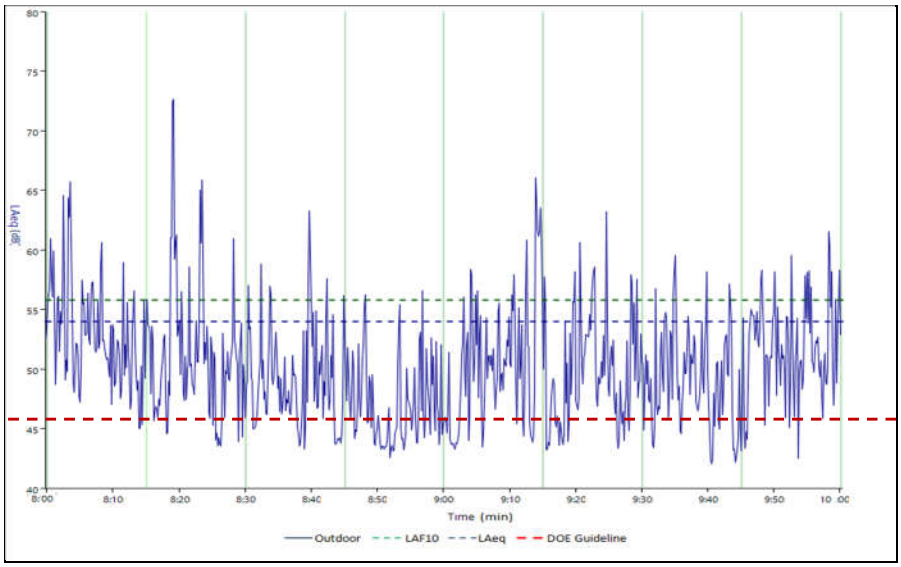

Figure 8: Night time outdoor noise level for LAF10 & LAeq at Teratai college.

By referring to Figure 9, the highest average indoor noise level (Laeq) was 59.0 dB which was taken at one of the residence's room of Teratai college in level 1. This noise level gave a significant impact to the people in the room. By referring to the survey result, most of the respondents in the building voted for general disturbance and sleep disturbance for the noise impact. The LAeq for outdoor and level 5 noise measurement was 56.4 dB and 56 dB respectively. The Laeq reading for level 1 was considered passing the permissible sound level with 4.0 dB increase from 55dB as stated by the Department of Environment. Thus, it can be classified as unwanted sound or noise. Figure 10 presents the noise levels during night time. The highest average noise level (Laeq) for level 1 of college room was 56.9 dB. This noise level is higher as the location of the room at level 1 is close to the access road and main road. The average LAeq in level 5 is slightly higher (51.5 dB) than the permissible sound level (50 dB). Thus,

this sound level was not considered as noise when compared to the Department of Environment maximum sound level for institutional which is 50 dB for night time.

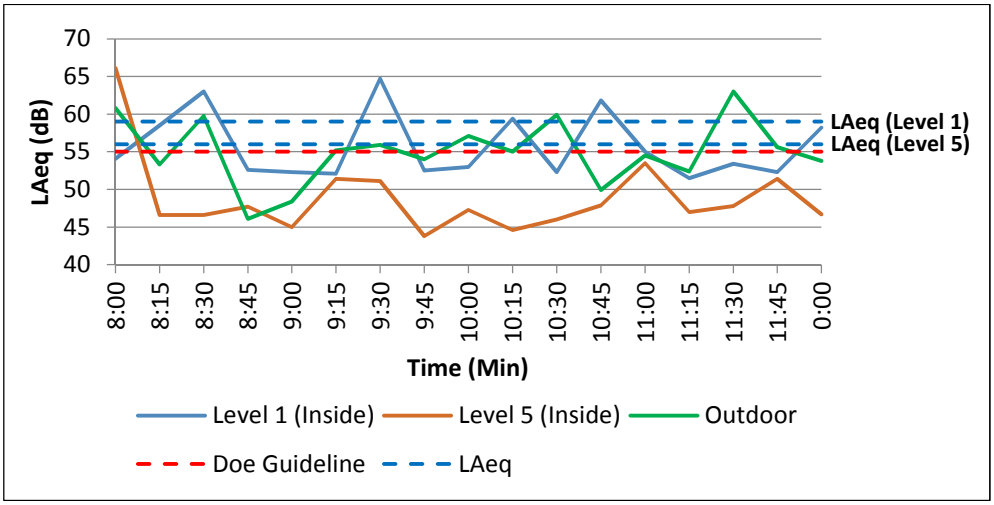

Figure 9: Daytime noise level at Teratai college.

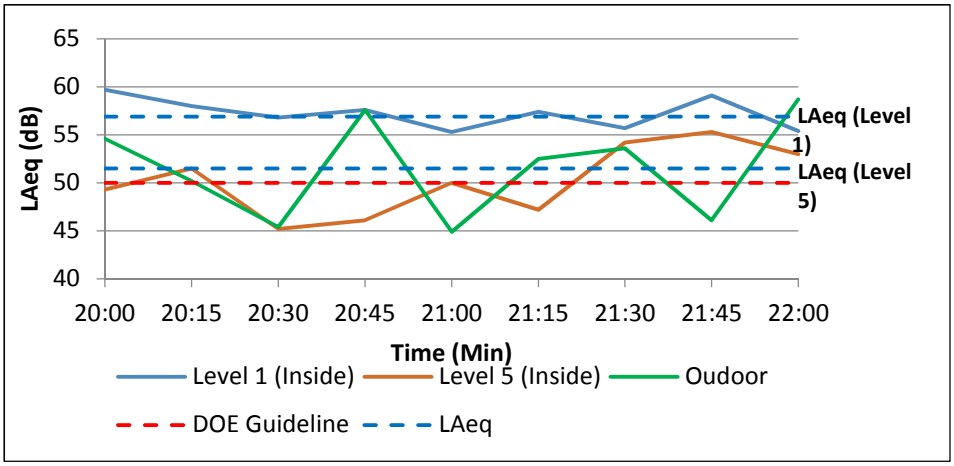

Figure 10: Night time noise Level at Teratai college

Figure 11 shows the average of noise level for LAF10 and LAeq for outdoor of Delima college. LAF10 for this residential college was 60.3 dB and LAeq was 57.7 dB. The LAF10 average for this measurement is higher compared to the LAeq with the difference of 2.6 dB. Graph 4.10 shows that the LAeq is greater which is 65.7 dB when it is compared to LAF10.

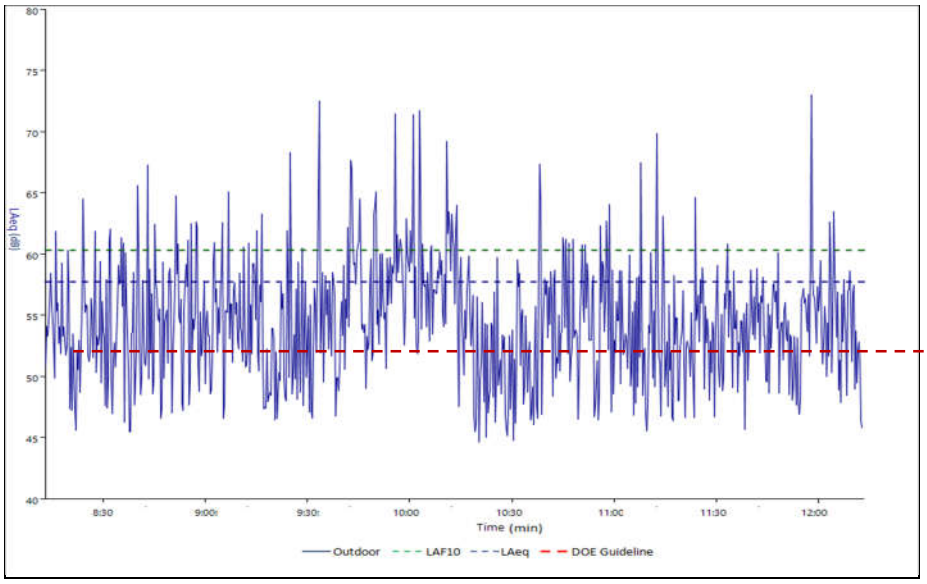

Figure 11: Daytime outdoor noise level for LAF10 & LAeq at Delima college

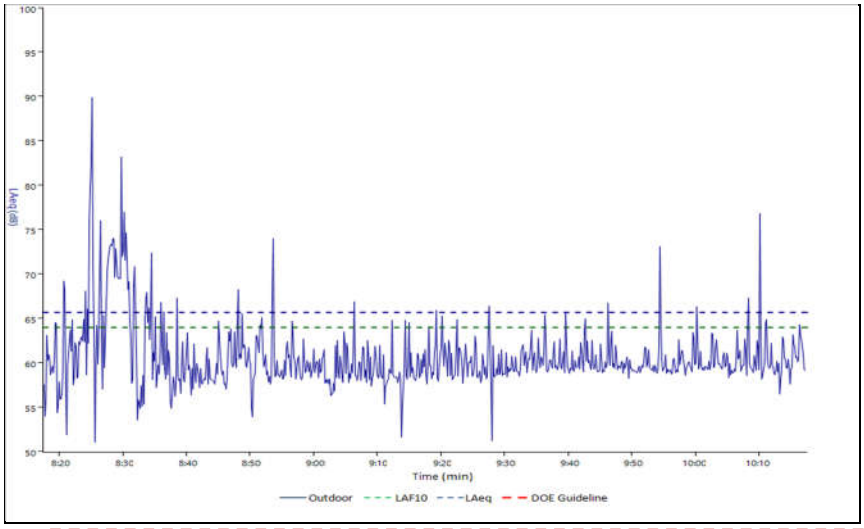

Figure 12: Night time outdoor noise level for LAF10 & LAeq at Delima college.

Figure 13 shows the noise level that was conducted during the daytime. The average noise level (Laeq) was 66.4 dB which performed at the level 1 of the college room. While on level 5 the average of noise level was 60.1 dB, which is lower than the noise on level 1. This maybe due to the source of noise did not reach level 5. The lowest LAeq average was outdoor of the college room was 57.7 dB. Figure14 shows the noise level that was conducted during night time. The average of noise level for outdoor noise of LAeq was 65.7 dB. This noise reading was higher at that time because there were few buses that passed by the building. The engine of the bus created more noise rather than the noise made from cars and motorcycles. The lowest average noise level was 56.9 dB. This was taken on level 5 of the college room. All of the readings are considered noise as it passed the maximum permissible sound level for institutional which is 50 dB that had been stated by the Department of Environment.

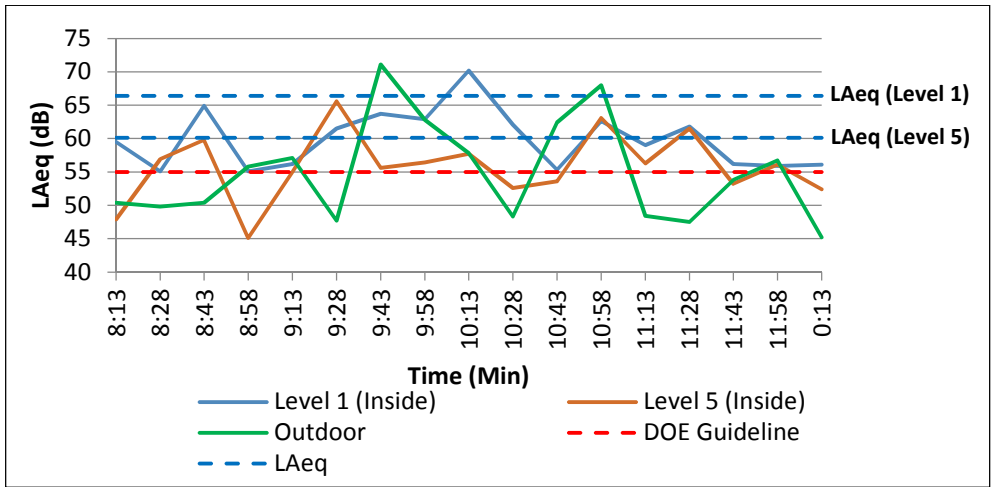

Figure 13: Daytime noise Level at Delima college

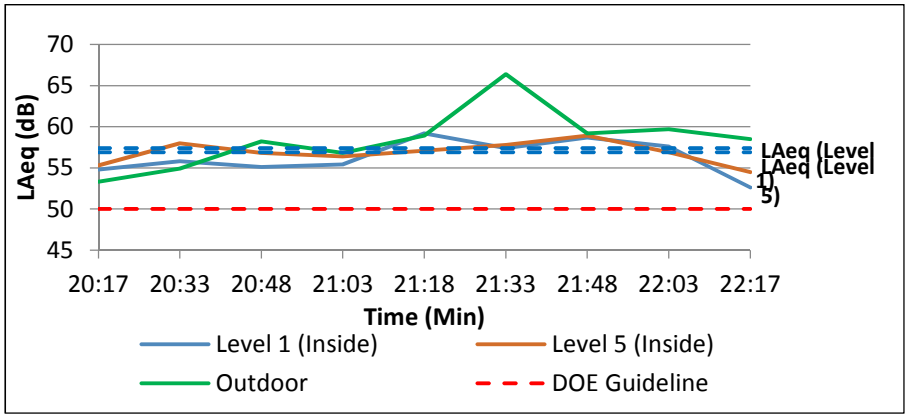

Figure 14: Night time noise Level at Delima college

5.0 CONCLUSION

From the analysis, it can be concluded that the majority of students are currently facing noise problem in their room during daytime and night time. The analysis of the survey and field measurement results are as follows:

1) In general, the LA_{eq} results for outdoor and indoor at all the residential colleges has recorded above the guideline value stated by the Department of Environment, Malaysia. The permissible daytime and night time LA_{eq} value for in institutional area is 55 dB and 50 dB.

2) Traffic noise was voted the highest source of noise that always gives disturbance towards the students' well-being particularly in their daily activity in the room as well as sleep disturbance.

This survey and field measurement were mainly done to understand the current noise problem faced by the residential college students. It is recommended that the University management takes full responsibility to improve the well-being of the students in reducing the noise level. This can be done by limiting the number of vehicles in campus area, and to plan new centralised parking area far from the residential colleges. Furthermore, future research should be carried out to identify the detailed impacts of this noise pollution towards students' well-being, and highlight the fact that this issue should not be ignored.

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