



Comparison of Road Traffic Noise at Residential Areas in Klang Valley, Selangor and Nibong Tebal, Penang

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Abstract: In this work, weekdays and weekends noise level were investigated in three residential areas in high density population residential areas and three medium density population residential areas. The objective of this study is to investigate the level of traffic noise at the selected residential areas. Noise level was measured using sound level meter over a range of traffic noise levels. The results revealed that the highest noise levels measured were at Desa Tun Razak in Klang Valley with 74.25 dB(A) in the morning, 74.14 dB(A) in the evening and 73.18 dB(A) at night. The lowest L_{Aeq} was measured at Taman Ilmu Indah with the noise levels of 62.9 dB(A) in the morning, 66.3 dB(A) in the evening and 62 dB(A) at night. The high noise pollution levels in the morning and evening at study areas locations were due to morning rushing hours of office workers and business men and women, e.g. resuming work at offices and opening shops for customers. Noise generated from motorcycles are generally noticeable and contribute to the high value of L_{max} . All the recorded noise levels on peak hours and off peak hours exceeded the guidelines for maximum permissible sound level (L_{Aeq}) for residential (high density and medium density) areas during daytime (from 7.00 am to 10.00 pm) are 60 dB (A) (high density), 55 dB(A) (medium density) and the night-time (10.00 pm to 7.00 am) are 50 dB(A) (high density), 45 dB(A) (medium density).

Keywords: Traffic noise level, traffic composition, noise monitoring, urban and suburban residential areas

1. Introduction

Noise is an undesirable or disturbance sound that can cause irritation to a listener and damage to ears. Noise is defined as negative sound, distributive sound in wrong place and wrong time. Noise is any sound that gives

psychological disturbance to a person, may give social effect to a group of people such as disturbance during conservation, working, resting, recreation, sleeping and other activities. World Health Organization stated that noise must be recognized as a major threat to human well-being [1].

In Germany, the prevalence of hypertension in adults aged from 18 to 79 years is about 30% for women, and 33% for men, with the highest values of above 70% in the oldest age group (65 to 79 years). A possible relationship between noise and hypertension is often explained by a chronic stress response to noise, involving the sympathetic nervous system as well as endocrine responses [2]. More than 40% of the population in the European Union (EU) is exposed to day time traffic noise exceeding 55 dB(A) in terms of L_{Aeq} , and 20% are exposed to levels exceeding 65 dB(A) [3]. 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.

In Japan, a study conducted by Yano et al. [4] shows that noise pollution is high especially at Kumamoto. The noise levels recorded were 75.2 dB(A) during daytime and 72.5 dB(A) for night time. The noise monitoring were taken on weekdays at road shoulder at a height of 2.8 meters. Such noise levels are extremely high and exceeded the 55dB (A) for day time and 45dB (A) for night time levels recommended by the WHO.

Based on a study in Kuala Lumpur conducted by Elfaig et al. [5], the noise pollution in residential and school areas (Blue Boy Mansion and La Salle Secondary School) is significantly different with the WHO recommendation due to the land use located near busy main road and business activities area.

Moreover, exposure to noise during night is believed to be particularly hazardous, as exceeded noise level in urban area (45 to 65 dB(A)) is associated with reduced sleep quality and duration. When sleep is permanently disturbed and becomes a sleep disorder, it is classified as “environmental sleep disorder”. Environmental sleep disorder (of which noise-induced sleep disturbance is an example) is a sleep disturbance due to a disturbing environmental factor that causes a complaint of either insomnia or daytime fatigue and somnolence. Secondary deficits may result in deficits in concentration, attention and cognitive performance, reduced vigilance, daytime fatigue, malaise, depressed mood and irritability [1]. There is a study suggested that traffic noise and railway noise could increase the risk of breast cancer [6]. Normally, patients with existing clinical conditions are sensitive to noise exposure and less sleep quality and quantity can endanger patients [6]. Children exposed to very high road traffic noise level tend to get abnormal blood pressure [7]. The relationship between environment noise and public health is perhaps the most significant reason why environment noise has emerged as a major issue in scientific community.

As noise pollution from road traffic could threat human health, this study is carried out in order to compare road traffic noise levels exposed to the residents in selected residential areas in urban and suburban areas in different regions in Malaysia (north region and central region). The findings will be useful for implementing noise control measures in the future.

2. Materials and Method

Noise descriptors were examined in this research to investigate the different types of noise level percentiles measured. Noise produced was not steady as noise level changed with time. The energy equivalent noise levels of road traffic streams has a pattern of fluctuation over time that they associated with annoyance, depending on the noise emission from vehicles on the road traffic stream and the volume of the traffic flow [8].

In the analysis, L_{Aeq} data were used to describe the traffic noise at the study sites. L_{Aeq} as a widely used noise descriptor, is commonly adopted to explain noise level. Other noise indices used, such as L_{10} , L_{50} and L_{90} , represent the spatial intrusive noise level, the spatial median noise level and the spatial background noise level, respectively.

2.1 Study Areas

Nibong Tebal is located in Seberang Perai Selatan, Penang. Nibong Tebal is a small town with a population of about 40 thousand people. Klang Valley is a relatively large city with a population of about 2 million. This city has been expanding continuously especially in the expansion of road network. The highways in Klang Valley include LEKAS, Kajang SILK, GCE, KESAS, LDP, NPE, SPRINT, ELITE, NKVE, SKVE, BESRAYA, MEX, and DUKE. Klang Valley is located in the middle of Selangor state in west of Peninsular Malaysia, covering an area of 2790 km².

In this study, six locations of residential area were chosen for data collection. Study areas chosen involve three residential area at located at Nibong Tebal (Taman Seri Acheh, Taman Pekaka and Taman Ilmu Indah) and the other three located in Klang Valley (Desa Tun Razak (DTR), Sentul Utama and Kinrara Court). These residential areas were chosen due to the location of the areas near major roads, the availability and accessibility of the measurement points. The studied sites in Klang Valley and Nibong Tebal are as shown in Fig. 1 and Fig. 2.

2.2 Noise Level Measurement

The primary objective of this study is to access the level of traffic noise at residential areas in Nibong Tebal, Penang. The noise level measurement was conducted using a sound level meter, (Cirrus (UK) – CR:1710). Noise levels were recorded periodically (morning: 7.00 am – 11.00 am, evening: 4.00 pm – 7.00 pm, and night: 8.00 pm – 11.00 pm). In this study, 15 minutes noise measurement were carried out at every session. The sound level meter was

deployed on a tripod at a 1.5 m height, separated from noise reflection surfaces from at least 1.5 m, and directed to the traffic. The device was calibrated for every before and after measurements. Road traffic noise measurement in Klang Valley were carried out from 16 June 2011 to 14 January 2014. The secondary data was obtained from previous study carried out by Halim et al. [9] for data analysis purpose. On the other hand, noise measurement in Nibong Tebal was carried out from 13 January 2018 to 28 April 2018. These measured were acted as primary data. Data control was applied by conducting noise measurement during sunny day with wind speed less than 5 m/s in order to avoid weather condition affecting the noise levels measured.

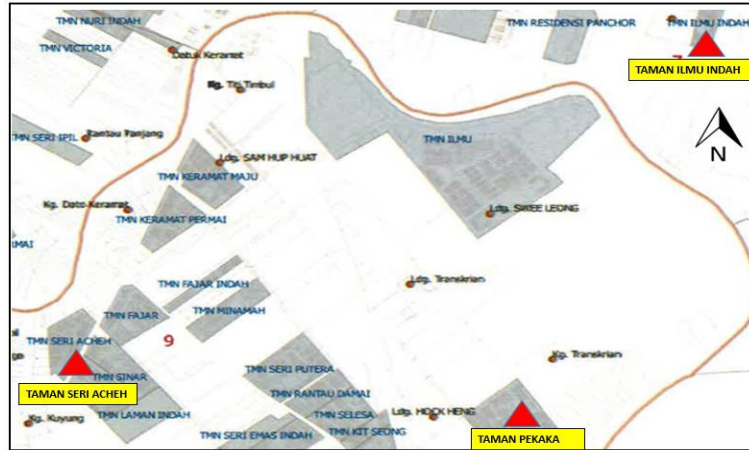


Fig. 1 - Study sites in Nibong Tebal, Penang

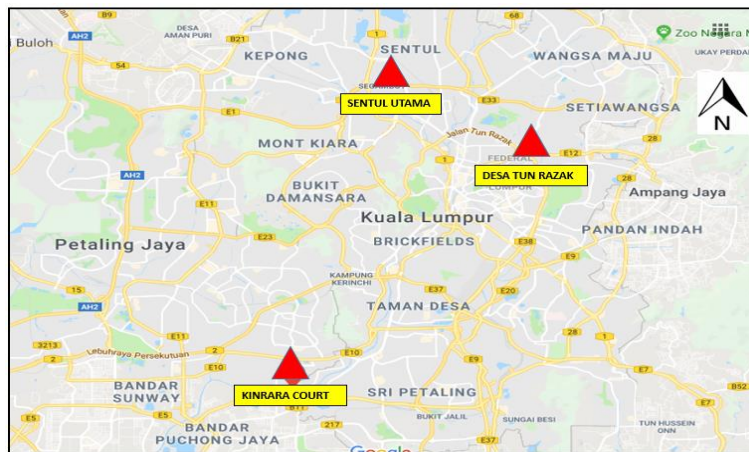


Fig. 2 - Study areas in Klang Valley, Selangor

2.3 Traffic Composition Data

Traffic composition data in this study is categorized into four main types which are car, motorcycle, heavy vehicle and light lorry. Heavy vehicle involves vehicle with more than 2 axles such as lorry and busses. For the purpose of this study, the traffic compositions were recorded using manual count for 15 minutes to identify the percentage of traffic composition.

The instrumentation for real time traffic recording included manual vehicles counts and speed gun. The manual count was used to measure traffic composition and volume on the road. Speed gun was used for measuring traffic speed of vary types of vehicles on the roads. The speed gun was shot at different types of vehicles several times in order to compute the average speed of each type of vehicles.

3. Results and Discussion

The monitoring results of the six different residential areas were evaluated and summarized in Fig. 3. Average L_{Aeq} in Klang Valley and Nibong Tebal residential areas for weekday are categorised into three sessions; morning, evening and night. According to Malaysia Department of Environment [10], the guidelines for maximum permissible sound level (L_{Aeq}) for residential (high density and medium density) areas during daytime (from 7.00 am to 10.00 pm) are 60

dB (A) (high density), 55 dB(A) (medium density) and the night-time (10.00 pm to 7.00 am) are 50 dB(A) (high density), 45 dB(A) (medium density).

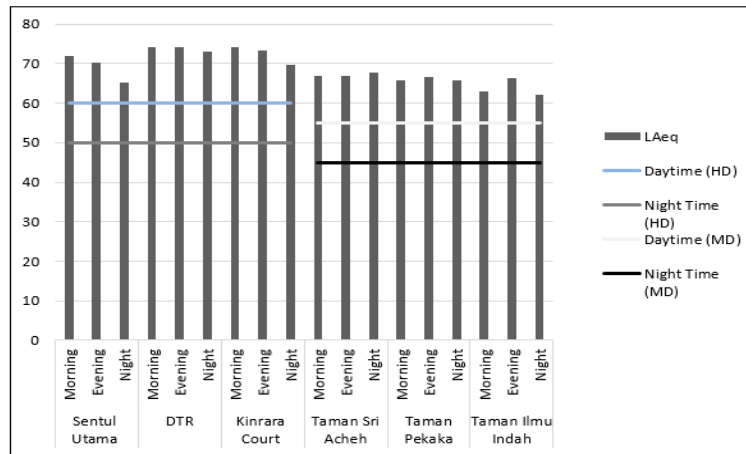


Fig. 3 - Average LAeq at Klang Valley and Nibong Tebal area for weekdays (HD-high density, MD-medium density)

DTR recorded the highest reading of LAeq for three sessions (74.25 dB(A)) in the morning, evening (74.14 dB(A)) and at night (73.18 dB(A)). The lowest LAeq was at Taman Ilmu Indah, with readings of 62.9 dB(A) in the morning, 66.3 dB(A) during evening and 62 dB(A) at night. DTR recorded the extremely high LAeq during daytime exceeded the maximum permissible sound level (LAeq) guidelines value of Malaysia by significant margin with the range of 14.14 dB(A) to 14.24 dB(A), followed by the Kinrara Court 9.75 dB(A) to 14.22 dB(A), Sentul Utama 5.14 dB(A) to 11.95 dB(A), Taman Sri Acheh 6.8 dB(A) to 7.8 dB(A), Taman Pekaka 5.8 dB(A) to 6.6 dB(A) and Taman Ilmu Indah 2.0 dB(A) to 6.3 dB(A).

Noise levels data recorded in all studied sites exceeded the maximum permissible limit stated by Department of Environment, Malaysia. However, Klang Valley recorded higher noise levels compared to Nibong Tebal. The high noise levels in the morning and evening at these locations can be justified as a result of morning rushing hours of office workers and business men and women, to resume work at offices and open shop for customers. The noise levels in the evening time (1400 – 1500) at high density residential area was high. This is because majority of the residents contributing to trip generation from the workplace to their homes. Consequently, the trip increases the number of vehicles on the major road and eventually increase the noise levels of the road.

The results clearly indicate that all the studied sites experienced very high noise levels all the time including night time. This result shows that people live in this study areas are exposed to the high noise levels continuously throughout the day. The residents living in these areas are exposed to noise levels of 60 to 78 dB (A) or more every day. This is very dangerous to the health of the people in these areas. According to World Health Organization, noise level of 60 dB(A) can result in temporary hearing impairment and 100 dB(A) can cause permanent impairment [11] for a certain period of exposure time.

Nibong Tebal recorded the lowest LAeq may be due to no trip generated by the residents during afternoon [13]. The noise pollution was lowest compared to Klang Valley during daytime and night time because majority of the residents are away from their home in the afternoon. Some are in their offices, markets, or shops while children were in their schools by this time of the day [11]. Therefore, no trip generated by the residents during afternoon.

The monitoring results for average noise descriptor, LAeq for weekends of the six different residential area were evaluated and are summarized in the graph shows in Fig. 4.

It can be observed that on weekends, DTR recorded the highest reading of noise level for the evening (75.59 dB (A)) and the lowest average reading of noise level disturbance is at Taman Ilmu Indah, the reading was 62.4 dB (A) on night. As can be seen, DTR recorded the extremely high LAeq during daytime exceeded the maximum permissible sound level (LAeq) guidelines value of Malaysia by significant margin with the range of 15.05 dB (A) to 15.59 dB(A), followed by the Kinrara Court 10.8 dB(A) to 12.68 dB(A), Sentul Utama 6.19 dB(A) to 9.21 dB(A), Taman Sri Acheh 7.3 dB(A) to 7.8 dB(A), Taman Pekaka 2.1 dB(A) to 6.9 dB(A) and Taman Ilmu Indah 2.4 dB(A) to 4.9 dB(A). In other words, the results of weekdays and weekends results have a same trend and Klang Valley recorded higher noise level compared to Nibong Tebal. On the other hand, the exceeding LAeq compared to the maximum permissible sound level (LAeq) guideline value of Malaysia during night time even higher than the daytime. The results clearly indicate that all the study sites experienced very high noise levels all the time including night time. This shows that the people live in this study area are exposed to high noise level that exceeded the permissible limit. Vehicle speed might be one of the factors increasing the traffic noise level. This is given by a study where the average speed of vehicles in Makassar City reaches less than 40 km/h, which in return would contribute to a low noise level [12].

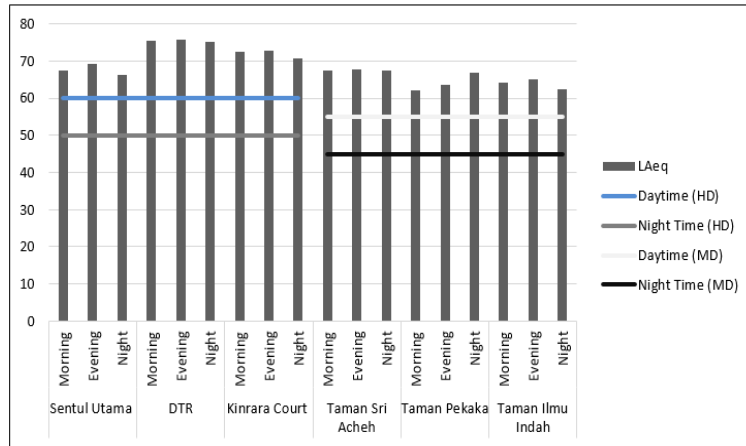


Fig. 4 - Average noise descriptors at Klang Valley and Nibong Tebal area for weekends (HD-high density, MD-medium density)

The monitoring results for maximum noise level, L_{max} for both weekdays and weekends of six different residential area are illustrated in Fig. 5 and Fig. 6, respectively.

Based on Fig. 5, the highest L_{max} recorded was at Taman Sri Aceh, on the night during weekdays with 91.1 dB(A) followed by Taman Pekaka, Taman Ilmu Indah, DTR, Kinrara Court and Sentul Utama. For weekends as in Fig. 6, the highest L_{max} recorded was at Taman Sri Aceh, on evening during weekends with 88.4 dB (A). The highest noise levels of L_{max} was at Taman Sri Aceh followed by Taman Pekaka, Taman Ilmu Indah, DTR, Kinrara Court and Sentul Utama. Both weekdays and weekends showed the same result trend for L_{max} . Based on the observation while monitoring the noise levels, the high value of L_{max} at Taman Sri Aceh was due to engine sound generate from heavy vehicles and widespread misuse of horns. A study conducted by Hustim et al. [13] stated that a road segment that produces high amount of horn increases the noise level of the road.

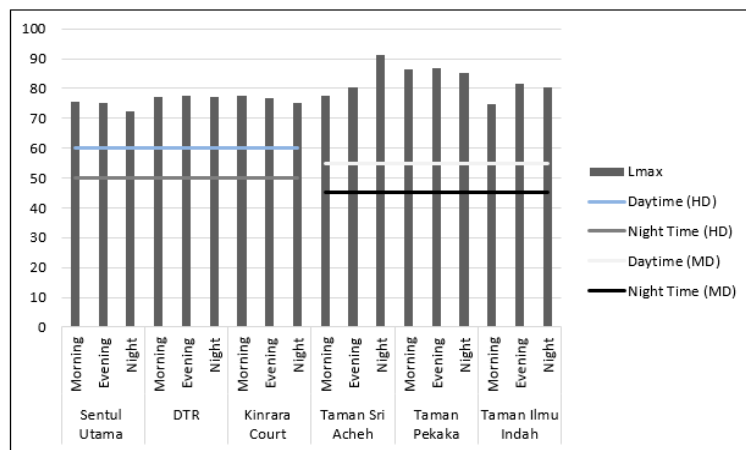


Fig. 5 - Maximum noise level, L_{max} during three measurement periods (morning, evening and night) on weekdays

Although Nibong Tebal recorded lower noise level compared to Klang Valley in L_{Aeq} , for maximum noise level descriptors, L_{max} Nibong Tebal recorded higher value compared to the urban residential areas in Klang Valley. This may be due to the existence of transverse rumble strip (TRS) on road. TRS is a series of marked (either flat or raised) transverse bars placed across the road in the direction of traffic flow. TRS assists driver to become aware through optical, vibration and audible effect thus encouraging drivers to reduce speed and increase their alertness in order to face any hazard that may exist ahead [14]. Apart from that, the number of heavy vehicles recorded was high at Taman Sri Aceh because the road is the main the route used by heavy trucks from Eppor Pack Sdn Bhd factory that located next to Taman Sri Aceh. Eppor Pack Sdn Bhd is a packaging manufacturing factory that operates seven days per week and they deliver their products every day and the noise continuously disturbing the people live in Taman Sri Aceh area. Besides, as the traffic on the road congested, many road users tend to excessively use horns towards other drivers. Noise generated from motorcycles is generally noticeable and contributes to the high value of L_{max} .

The monitoring results for noise level descriptor, L_{10} for weekdays of the six different residential area were evaluated and are summarized in the graph shown in Fig. 7.

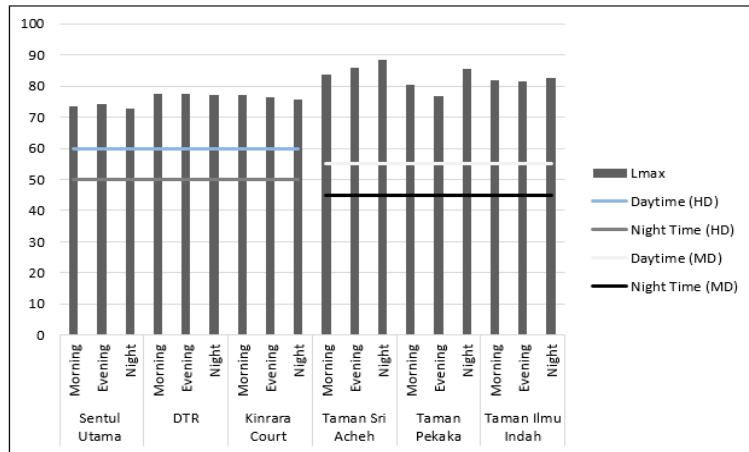


Fig. 6 - Maximum noise level descriptor, L_{max} during three measurement periods (morning, evening and night) on weekends

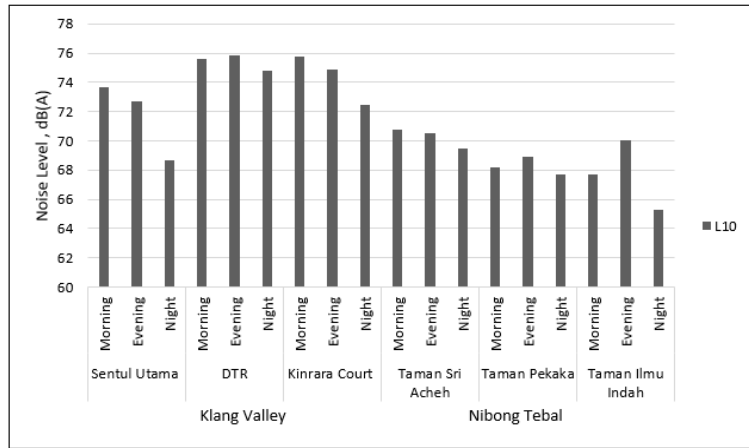


Fig. 7 - Noise level descriptor, L_{10} during three measurement periods (morning, evening and night) on weekdays

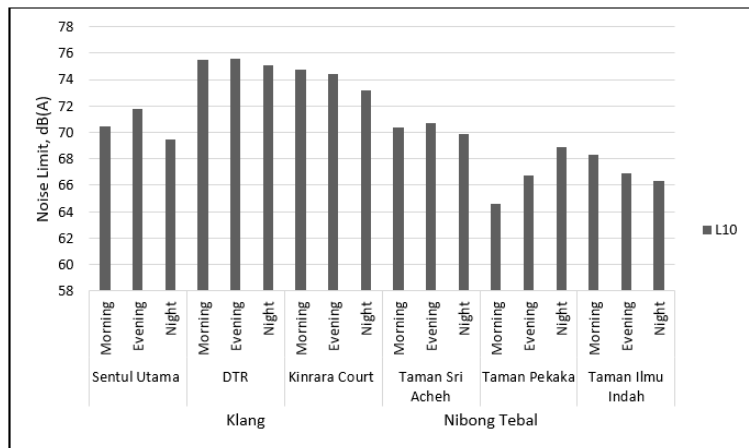


Fig. 8 - Noise level descriptor, L_{10} during three measurement periods (morning, evening and night) on weekends

L_{10} is the noise level exceeded for 10% of the time of the measurement duration and is used to give an indication of the upper limit of fluctuating noise, likes road traffic noise. Based on Fig. 7, Kinrara Court recorded the highest L_{10} in the morning during weekdays. The range of L_{10} recorded at Kinrara Court was at 72.44 – 75.78 dB (A), at DTR was 74.8 – 75.85 dB (A), at Sentul Utama was 68.69 – 73.69 dB (A), at Taman Sri Acheh was 69.5 – 70.8 dB(A), at Taman Ilmu Indah was 65.3 – 70.0 dB(A) and Taman Pekaka was 67.7 – 68.9 dB(A). It means that Taman Ilmu Indah recorded the lowest L_{10} during weekdays. The noise pollution level at Taman Ilmu Indah recorded relatively lower because of no contribution heavy vehicles. The monitoring results for noise level descriptor, L_{10} for weekends of the six different residential area were evaluated and summarized in the graph shown in Fig. 8. The highest L_{10} recorded at DTR in the evening during weekends. The range of L_{10} recorded at DTR was 75.05 – 75.59 dB(A) , at Kinrara Court was 73.21 – 74.76 dB(A), at Sentul Utama was 69.5 – 71.79 dB(A), at Taman Sri Acheh was 69.9 – 70.7 dB(A), at Taman Pekaka was 64.6 – 68.9 dB(A) and at Taman Ilmu Indah was 66.3 – 68.3 dB(A). According to the high noise level at DTR was due to the sirens from fire engines and ambulance were usually left to operate for under 10 seconds on the highway around DTR area. The consequence was that the noise level was raised to a very high level and this airborne noise contributed considerably to the high noise level. High noise levels at Kinrara Court may be due to the sirens from fire engines and ambulance that usually left to operate for 10 seconds on the highway. To et al. [15] stated that the presence of buildings on both sides of a road could increase L_{10} noise level by more than 10 dB(A) when comparing to no buildings on both sides under the same traffic condition. However, at distance of more than 20 m from the buildings, this façade effect would be negligible. This is similar to DTR as there is a business building opposite DTR. The parallel buildings contribute to noise from the highway to reflect and thus increase the noise levels in the residential area.

The monitoring results for noise level descriptor, L_{50} for weekdays of the six different residential area were evaluated and summarized in the graph shown in Fig. 9 (weekdays) and Fig. 10 (weekends).

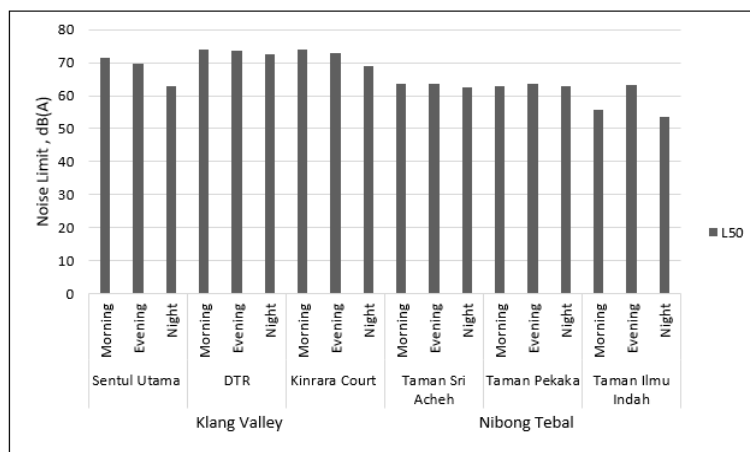


Fig. 9 - Noise level descriptor, L_{50} during three measurement periods (morning, evening and night) on weekdays

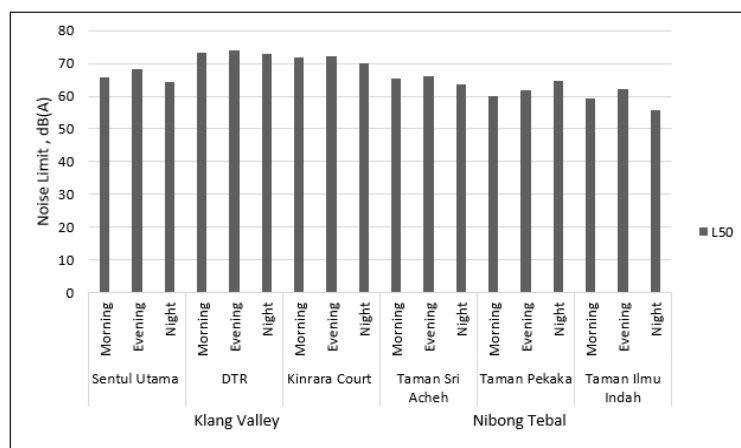


Fig. 10 - Noise level descriptor, L_{50} during three measurement periods (morning, evening and night) on weekends

L_{50} is the sound level that exceeded 50% of measurement period. L_{50} is also known as a median of the recorded noise level. L_{50} in all Kinrara Court, DTR, Sentul Utama, Taman Sri Aceh, Taman Pekaka and Taman Ilmu Indah were also high with 68.81 to 73.85 dB(A), 72.52 to 73.83 dB(A), 62.93 to 71.52 dB(A), 62.7 to 63.7 dB(A), 62.8 to 63.6 dB(A) and 53.5 to 63.1 dB(A), respectively. L_{50} in all DTR, Kinrara Court, Sentul Utama, Taman Sri Aceh, Taman Pekaka and Taman Ilmu Indah were also high with the range of 73.07 to 73.94 dB(A), 70.09 to 72.34 dB(A), 64.46 to 68.29 dB(A), 63.7 to 66.00 dB(A), 60.00 to 64.6 dB(A) and 55.80 to 62.2 dB(A), respectively.

The monitoring results for noise level descriptor, L_{90} for weekdays of the six different residential area were evaluated and are summarized in the graph shown in Fig. 11 (weekdays) and Fig. 12 (weekends).

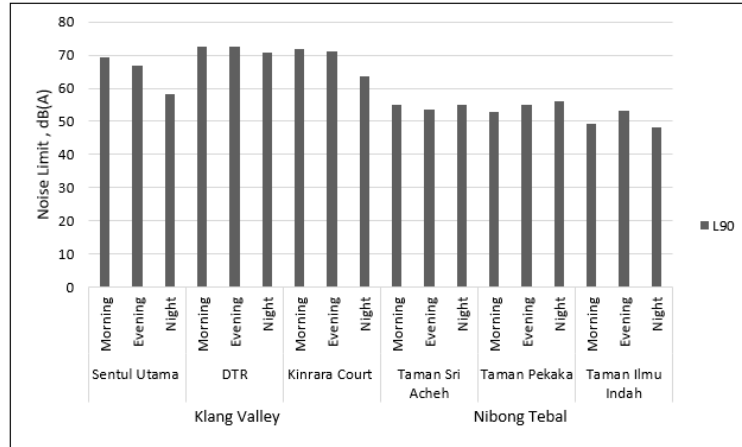


Fig. 11 - Noise level descriptor, L_{90} during three measurement periods (morning, evening and night) on weekdays

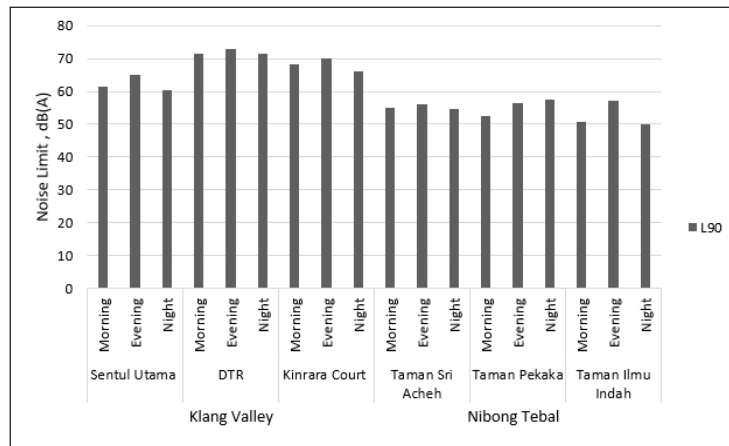


Fig. 12 - Noise level descriptor, L_{90} during three measurement periods (morning, evening and night) on weekends

L_{90} is known as residual noise and also represents background of noise level at particular measurement site. DTR recorded the highest L_{90} with 72.69 dB(A) at morning during weekdays while the lowest L_{90} was 48.2 dB(A) at night during weekdays at Taman Ilmu Indah. For weekends, DTR recorded the highest L_{90} with 79.97 dB(A) at evening while the lowest L_{90} was 49.8 dB(A) at night at Taman Ilmu Indah. L_{90} show that the level of background noise at DTR was relatively high due to increase number of vehicles on weekends.

Basically, the Independent Samples t -test was conducted to compare the means of two independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different. A quick check of the box plot shown in Fig. 13 (weekdays) and Fig. 14 (weekends) illustrate the mean of noise level for Klang Valley and Nibong Tebal.

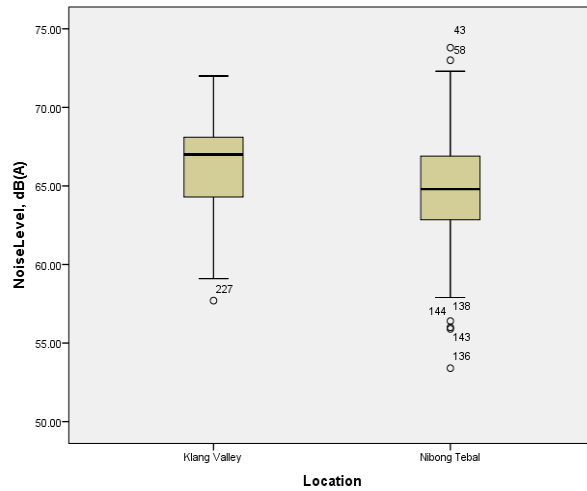


Fig. 13 - The boxplot of means of noise level for Klang Valley and Nibong Tebal during weekdays

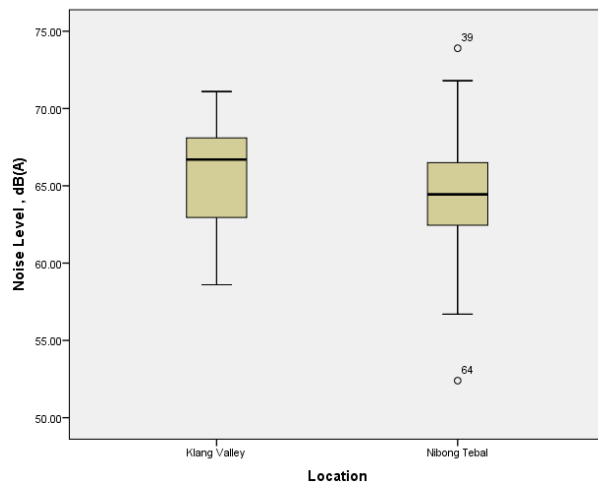


Fig. 14 - The boxplot of means of noise level for Klang Valley and Nibong Tebal during weekends

Based on Fig. 13 and Fig. 14, the mean noise level for Nibong Tebal was 64.79 dB(A) on weekdays and 64.40 dB(A) on weekends and the mean noise level for Klang Valley was 65.80 dB(A) for both weekdays and weekends. Based on the Independent Sample *t*-Test output, there was statistically significant difference between noise level located at Nibong Tebal and Klang Valley ($t = -2.637$) and ($p\text{-value} < 0.05$) for weekdays and ($t = -3.612$) and ($p\text{-value} < 0.05$) for weekends. The average L_{Aeq} for Nibong Tebal was 1.0142 (weekdays) and 1.40 (weekends) lower than noise level descriptor for Klang Valley. The values show that mean of traffic noise level was higher at Klang Valley compared to Nibong Tebal because Klang Valley was surrounded by busy road such as LEKAS, KESAS, NPE, SPRINT, ELITE, SKVE, BESRAYA, MEX, and DUKE that there may be significant heterogeneity in types and high amount of vehicles using highways compared to Nibong Tebal. In Nibong Tebal, there was Federal Routes 282 that connecting Transkrian in the southwest to Bukit Panchor in the northeast used by many types of vehicle but the number of vehicles was less compared to Klang Valley.

Besides, based on the result at Klang Valley (Fig. 15), the recorded total number of vehicles passing the monitoring area during 15 minutes interval was 9,528 vehicles for Klang Valley, while 614 vehicles for Nibong Tebal. For weekends (Fig. 16), it was recorded that the number of vehicles passing the Klang Valley area during 15 minutes interval was 6,911 vehicles, while 840 vehicles for Nibong Tebal. The result shows that the high number of vehicles at Klang Valley may be due to the high number of density population in that area and vice versa.

In conclusion, this result indicates that Klang Valley, which known as high population density, recorded high number of vehicles on the road during weekdays compared to Nibong Tebal and people in Klang Valley residential areas are exposed to high noise pollution compared to Nibong Tebal. According to Carrier et al. [16], their studies found that visible minorities and low income individuals tend to live in areas where the maximum road noise level is slightly higher than that experienced. Road noise levels are indeed highest in residential areas with large proportions of visible minorities and low income individuals.

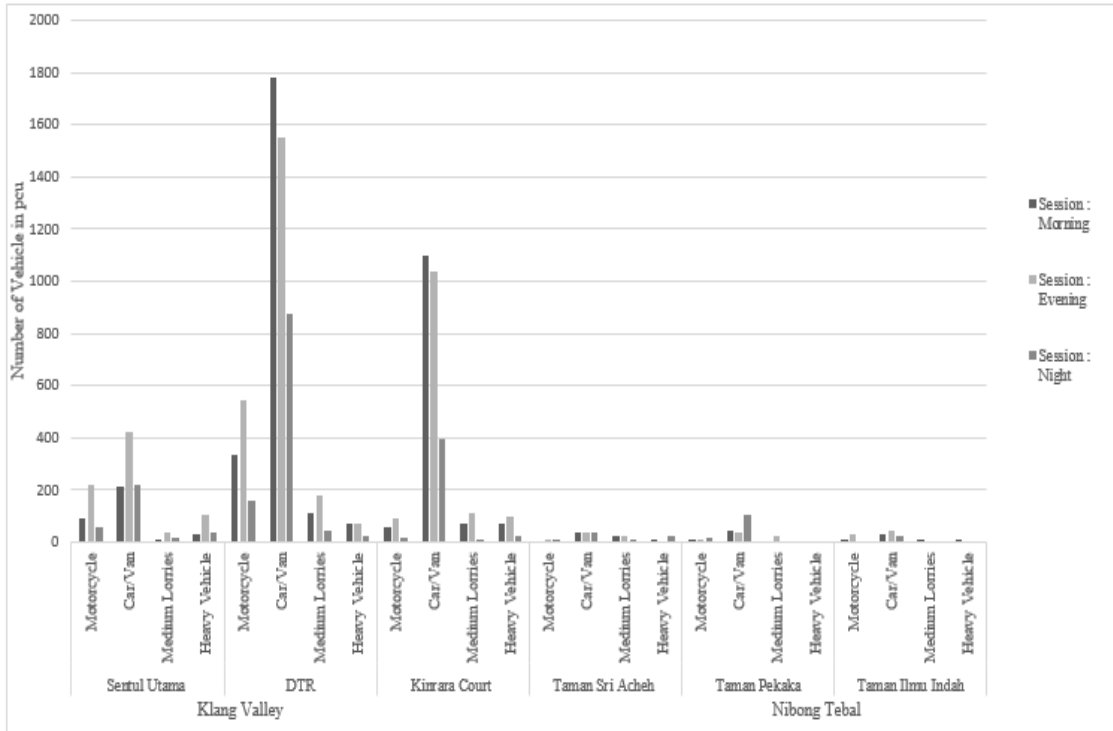


Fig. 15 - Number of vehicles in pcu at all study sites during weekdays

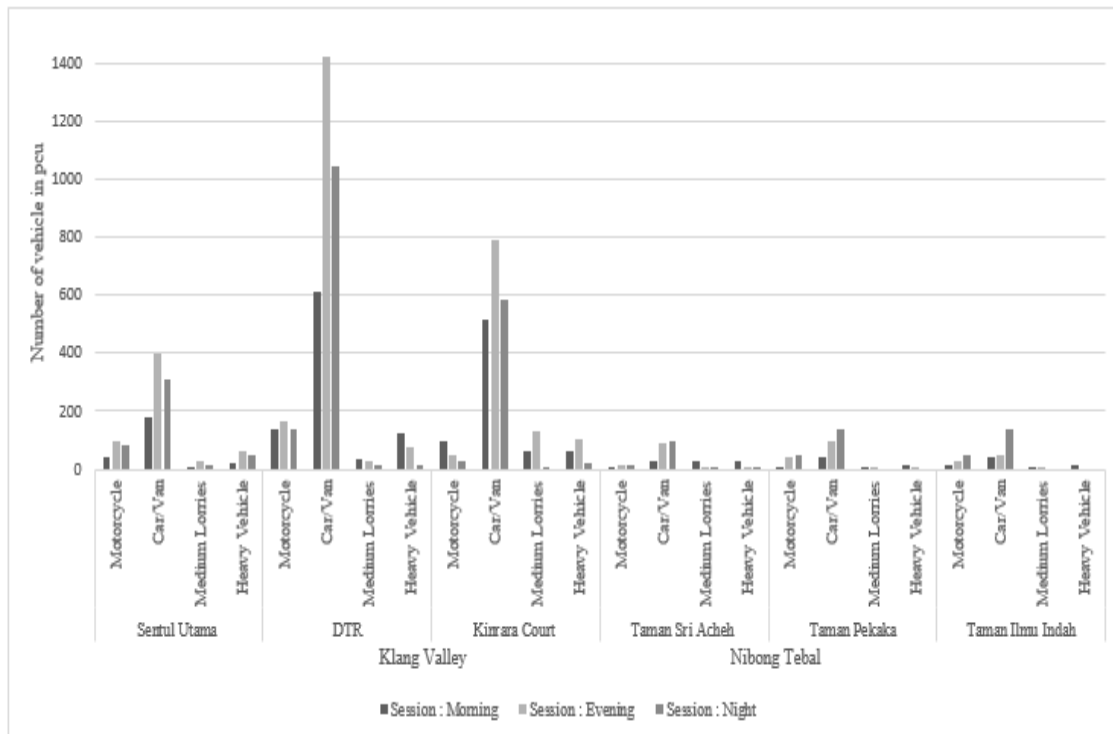


Fig. 16 - Number of vehicles in pcu at all study sites during weekends.

4. Summary

From this study, both study areas experienced very high noise levels all the time including non peak hours period, which is night, as all the measured data exceeded the noise limit guidelines produced by DOE and WHO. Other noise descriptors such as L_{10} , L_{50} , L_{90} and L_{max} were recorded in very high level at all study areas. Most of the noise level is much higher during daytime compared to night time. Therefore, it is suggested for a noise guidelines review to

compliment the noise levels in urban area in Malaysia and higher limits should be proposed. For instance, the normal traffic flow situations encountered in Hong Kong over peak hours is roughly 68 dB(A). Therefore, Hong Kong traffic noise guidelines limit is formulated based on L_{10} of 70 dB(A) measured over the peak hour of traffic after review of similar standards in other developed countries. In conclusion, this result indicates that Klang Valley, which known as high population density, recorded high number of vehicles on the road during weekdays compared to Nibong Tebal and people in Klang Valley residential areas are exposed to high noise pollution compared to Nibong Tebal.

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