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Noise Emissions Mapping from Ampang Line LRT

A Arbaan[1], M H Othman[1*], Y G Tong[1], A R Ab Ghani[1], K Ambak[2], M N Borhan[3] and N S Abdul Sukor[4]

[1] Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia
[2] Smart Driving Research Center, Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia
[3] Department of Civil Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia
[4] School of Civil Engineering, Engineering Campus, Universiti Sains Malaysia, 14300, Nibong Tebal, Penang, Malaysia
*Corresponding author: hanifi@uthm.edu.my

Abstract. Train transportation is considered safe, sustainable, and climate-friendly mode of transportation. However, it may also lead to higher noise which may be annoying, disrupt sleep, and disturbance on residents who live nearby the train track. The aims of this study are to evaluate Light Rail Transit (LRT) noise level in urban area, at LRT Ampang Line by using grid lines method and to develop LRT noise mapping. The residential area that is located near the track was chosen in this study. The measurement of noise level for train passing-by was measured using B&K Type 2250 which was placed at 1.2 meter above the ground level. Noise measurement was carried out using 25 m x 25 m grid lines with short-term sampling method of 20 minutes of measurement for each point. The LRT noise level in the study areas at distance of 15 m from the centre of train tracks was found to be higher (77.04 dBA) than noise limit (65 dBA) guidelines from Department of Environment. The graph trendline of noise level was decreasing from 15m (30.64 dBA) to 115m (8.68 dBA) from the centre of the train tracks. These shows that the further the distance of the Sound Level Meter (SLM) placement, the lower the difference of the noise train pass-by and the background noise. The LRT noise mapping will be useful for the future LRT noise prediction.

1. Introduction

Noise is described as an unwanted, unpleasant, and undesired sound from various sources that disturbs the physical activities, interrupts with the communication and gives long term effects to peoples' health [1]. Nowadays, noise pollution has become a common issue in Malaysia especially towards people that lives nearby the main road, airport, and railway areas. As the capital city of Malaysia, Kuala Lumpur has various modes of rail transportation such as Light Rail Transit (LRT), Mass Rapid Transit (MRT), KTM commuter and monorail. Rail transportation is one of the alternative ways to avoid from the traffic congestion in Kuala Lumpur and at the same time able to save the environment by saving energy and reduce the consumption of fuel [2]. However, rail transportation is one of the most significant sources of noise which generates an unpleasant environment for those who live nearby the railways [3].

Rail noise issues are significantly increasing with the rapid development of rail transportation in Malaysia. The railway noise was initiated from various sources such as rolling noise, propulsion noise, noise from auxiliary equipment, and aerodynamic noise at high speeds. These causes the people lives nearby the railway tracks are exposed to a consistent noise pollution every day [4]. From this situation, it may affect the people's daily lifestyle and health in a long term. It can give effects on cardiovascular or metabolic functions through sleep disturbances [5].

Based on previous studies, the gridline method has been the most commonly used in noise mapping. The elements of the grid are generally square. The gridline size can be regular or vary depending on the particular locations. According to [6], the suitable gridline size is within 100 m x 100 m where the chosen study locations are at Netherlands while a recent study from [7], recommended the gridline size of 200 m x 200 m and it was carried out in Spain. In this study, the size of 100 m x 150 m is a suitable size to predict the exposed and consent areas that might affect the lifestyle and health to the nearby residents where the size of the gridline was reduced to get more precise and significant noise level between each point.

The aim of this research is to investigate the noise level at a residential area near to rail track and to develop the noise mapping model of LRT by using gridline method. With this, the residential areas that were affected by the LRT noise level can be determined.

2. METHODOLOGY

2.1. Case Study Location

The case study location was at Jalan Pinggiran Cempaka where it was selected for the fieldwork measurement to determine the noise level emitted by the LRT. The criteria in choosing the study location were the residential areas that are nearby with the LRT Ampang Line train tracks and the visibility of the trains' traffic flow. Jalan Pinggiran Cempaka consists of residential area, playground area, parking lot area and a mosque in the area of 100 m x 150 m.

2.2. Data Collection

The noise level emitted by the LRT was collected by using gridline method. The gridline method will be assessed by using coordinates. The fieldwork measurement was taken from a residential area which nearby with Cempaka LRT Station and it was carried out during weekdays from 7am to 7 pm. The data collection was taken for 35 points. The noise level of LRT was collected by short term sampling with 20 minutes samples (equivalent with 1200 seconds) for each point [8]. The frequency of LRT during peak hours are every 6 minutes where it will have at least 3 train pass-by during the 20 minutes to obtain the train pass-by average data. The proposed area of noise mapping is 100 m x 150 m where the interval between each point are 25 m x 25 m grids of line. The chosen distances were used to determine the different noise level at different distances as the gridlines are getting further from the train tracks. The noise data points from the centre of the train tracks were measured at distances of 15 m, 40 m, 65 m, 90 m, and 115 m respectively in the gridline forms.

The Sound Level Meter (SLM) was used to collect the noise level that was emitted by the LRT in A-weighted decibel, dBA where it is an expression of relative loudness of sound that were aware by human ear. The distances of SLM were similar from each point to another which is 25 m unless there were any obstacles that cannot be prevented such as buildings, trees and private properties. The point that cannot be measured needed to choose the nearest point that are accessible. All the points are illustrated in gridline forms as per shown in Figure 1. The noise mapping gridlines for location A1, Jalan Pinggiran Cempaka is shown in Figure 2. The Sound Level Meter should be set up at 1.2 m from the ground level and are 3.5 m away from any reflecting surfaces other than the ground [8]. The recorded data were then transferred into the SLM software, BZ-5503 measurement partner suite B&K. The successfully collected noise data were then interpreted and properly analysed.

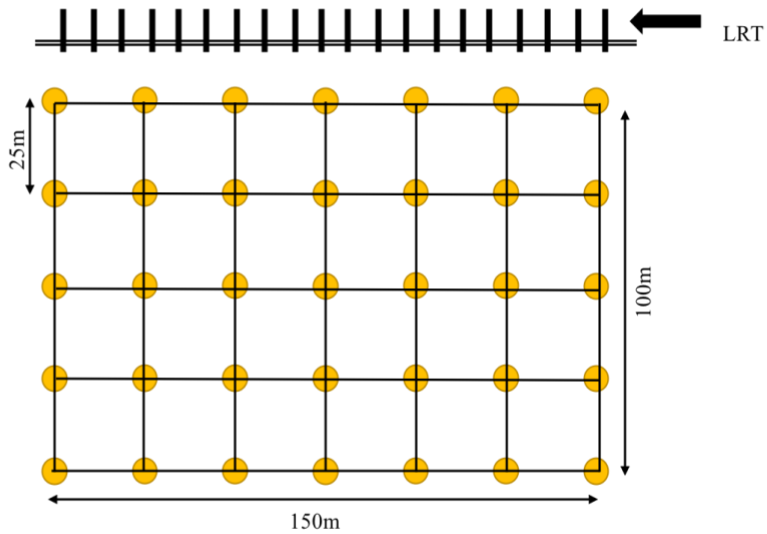

Figure 1. Noise mapping grid lines.

Figure 2. Noise mapping grid lines for Jalan Pinggiran Cempaka.

3. Result and Discussion

3.1. Noise Level Emitted by LRT

From the fieldwork measurement, 35 points of noise level data were collected from LRT Ampang Line in a residential area at Jalan Pinggiran Cempaka to determine the equivalent noise level, LAeq that was emitted by the LRT. However, there were some restrictions and unavoidable objects that prevent for some points to be recorded and collected the noise data. The restrictions were private properties, houses and mosque. Thus, from 35 points of noise level data, there were only 25 points that were accessible and were recorded.

The gridline method was implemented to determine the noise level emitted by LRT Ampang Line. The size of the gridline was 100 m x 150 m where the interval between each point are 25 m x 25 m. The recorded noise level in gridline for Jalan Pinggiran Cempaka is shown in Figure 3. The coloured pattern of noise level in gridline form shows the visual representative of the noise level emitted. According to the DOE [8], The red colour shows that the noise limit is exceed the DOE guidelines which is greater than 70 dBA, the orange colour shows that the noise limit is in range of 60 dBA to 70 dBA, the yellow colour shows that the noise limit is in range of 50 dBA to 60 dBA and the green colour shows that the noise limit is in range of 40 dBA to 50 dBA where this is the range for usual background noise in the urban residential area.

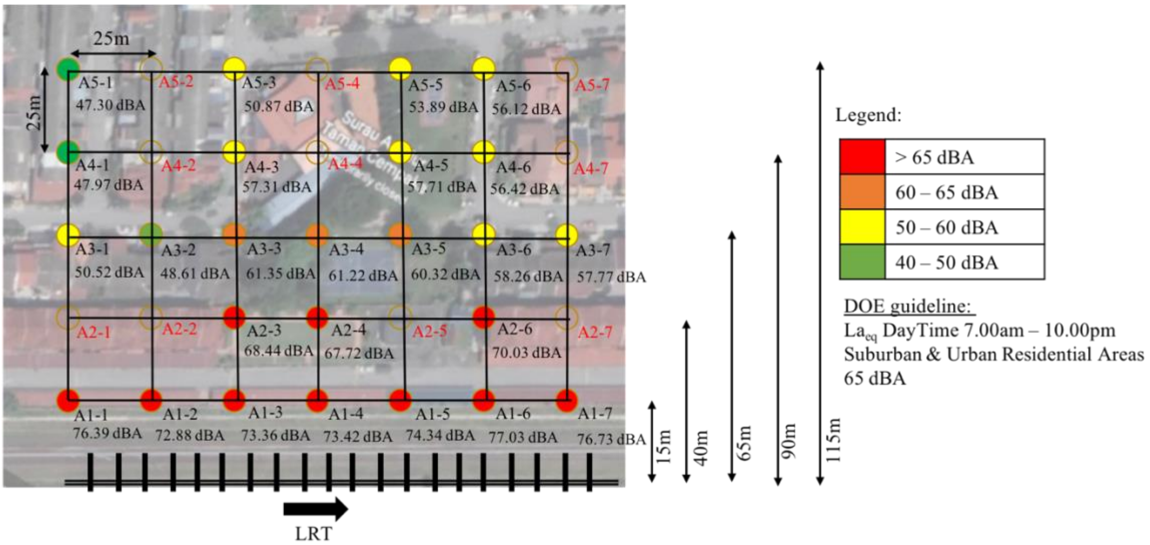

Figure 3. Noise level in gridline form at Jalan Pinggiran Cempaka.

Figure 3 shows the coloured pattern of noise level in gridline form at Jalan Pinggiran Cempaka according to the noise limit in urban residential areas of DOE. From Figure 3, the total points of noise level data that were collected are 25 points from 35 points. The obstructions that prevents from taking the data for points A2-1, A2-2, A2-7, A4-2, A4-7, A5-2 and A5-7 are private properties and houses, for point A2-5 is a TNB substation while for points A4-4 and A5-4 are a mosque.

The first row (A1-1 to A1-7) were 15 m from the centre of the train tracks where the highest noise level was 77.03 dBA for point A1-6. Meanwhile, the second row (A2-1 to A2-7) were 40 m from the centre of the train tracks where the highest noise level was 70.03 dBA for point A2-6. The first row and the second row were the nearest distance with the centre of the train tracks resulting in the noise level emitted are all exceeding the noise limits from the guidelines of DOE which are greater than 65 dBA. The first row and second row distances were 40 m from the centre of the train tracks. Therefore, this may say that the safe distance for the nearby residential to avoid the annoyance that was emitted by the LRT was 40 m.

The 3rd row (A3-1 to A3-7) were 65 m from the centre of the train tracks where there are three coloured patterns from orange to yellow to green. The highest noise level for 3rd row which is orange in colour is 61.35 dBA for point A3-3 and the lowest noise level which is green in colour is 48.61 dBA for point A3-2. From the gridline noise mapping, between the point A3-2 and point A3-3, there were natural barrier in form of tall trees and vegetation that surround it where it may play its role in lowering the noise level as it was the lowest noise level compared to the other point at same the distance. For points A3-3, A3-4 and A3-5 where it was orange in coloured, the surrounding area are an open space such as a futsal court and a playground where the area was not blocked from any barriers.

The 4th row (A4-1 to A4-7) were 90 m from the centre of the train tracks where there are two coloured pattern which are yellow and green. The highest noise level for 4th row which is yellow in colour is 57.71 dBA for point A4-5 and the lowest noise level which is in green colour is 47.97 dBA for A4-1. The 5th row (A5-1 to A5-7) are 115 m from the centre of the train tracks where there was also two-coloured pattern which are yellow and green. The highest noise level for 5th row which is yellow in colour is 56.12 dBA for point A5-6 and the lowest noise level which is in green colour is 47.30 dBA for A5-1. For point A4-1 and point A5-1 shows the lowest noise level for each row compared to the other point at the same distance. This may due to its location was surrounded by double-storey house and was far from the centre of the train tracks.

3.2. Noise Level Graph by Row at Jalan Pinggiran Cempaka

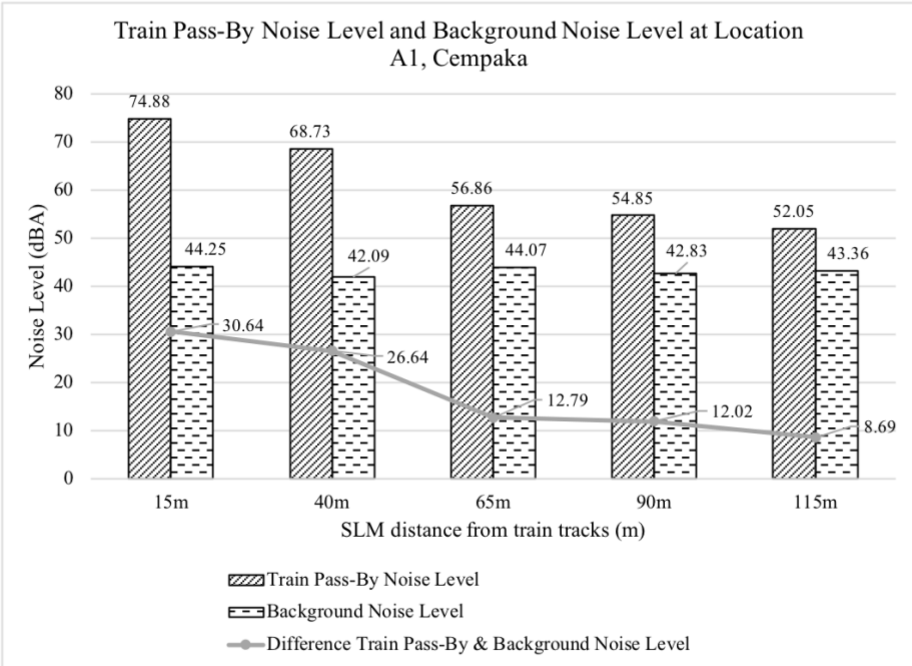

Figure 4. Noise level graph by row at Jalan Pinggiran Cempaka.

According to Figure 4, the graph shows the noise level of train pass-by and the background noise level by row in dBA was illustrated in bar chart while the difference of those parameters was illustrated in dotted line. From the graph, the highest difference of train pass-by and background noise is shown in the 1st row where the distance is 15 m from the centre of the train tracks (30.64 dBA) while the lowest difference of train pass-by and background noise is shown in the 5th row where the distance is 115 m from the centre of the train tracks (8.68 dBA). The trendline of the noise level emitted by LRT Ampang line is decreasing from the 1st row (15m) to the 5th row (115m).

4. Conclusion

From the gridline of noise mapping, the highest noise level emitted by the LRT Ampang Line was 77.04 dBA for point A1-6 with red coloured point where the noise level exceeded the DOE guidelines (70 dBA) with the distance of 15m from the centre of the train tracks. Meanwhile, the lowest noise level emitted by the LRT Ampang Line was 47.97 dBA for A4-1 with green coloured point with the distance of 115m from the centre of the train tracks. These proved that the distance of the source of train noise level will highly affected the receiver. A natural or artificial barrier plays an important role in reducing the high noise level that was emitted by the LRT that caused annoyance to the nearby residential. From this study, the safe distance for the residential areas to avoid the high noise level emitted by the LRT was more than 40 m offset from the centre of the train tracks.

From the noise level graph results, the trendline of noise level was decreasing from 15m (30.64 dBA) to 115m (8.68 dBA) from the centre of the train tracks. These results show that the further the distance of the Sound Level Meter (SLM) placement, the lower the difference of the noise train pass-by and the background noise. This can be concluded that the residential areas that were nearby with the train tracks might get affected by the noise emitted by the LRT Ampang line where the noise level (74.88 dBA) were greater than 65 dBA which were recommended by DOE.

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