Traffic Noise under Stop and Go Conditions in Intersections – A Case Study

Nima Jahandar, Amin Hosseinpour, Mohammad Ali Sahraei

***Abstract*—**Whit the increasing of traffic, noise emanated from motor vehicles increases as well, which subsequently causes adding to the stress of modern city. Thus, it is needed to look for most critical areas in terms of environmental and social impact of noise. There are several critical situations for noise emanated from motor vehicles such as *stop and go* situation which usually occurs near junctions or at-grade intersections. This study was conducted in two locations, most common types of intersections, crossroads and T-junctions. The highest average noise levels are recorded during Go phase for T-junction, 64.4 dB, and Drive phase for crossroad, 64 dB. It implies that the existence of intersection caused the noise level to increase. The vehicles starting to move produce more sound than when they travel at a constant speed along the intersection. It is suggested that special considerations and priority of allocating funds should be given to these critical spots.

***Keywords*—**Crossroad, T-junction, Traffic Noise, Stop and Go, Urban noise

I. Introduction

WITH the increasing of traffic, noise emanated from motor vehicles increases as well, which subsequently causes adding to the stress of modern city. Noise is one of the concerns in designing and improving of new and existing transportation systems. It should be noted that making a noise-free transportation system whit existing technologies is practically impossible. On the other hand, there is limitation in financial resources allocated to noise prevention and reduction schemes. Therefore, it is needed to look for most critical areas in terms of environmental and social impact of noise.

There are several critical situations for noise emanated from motor vehicles such as *stop and go* situation which usually occurs near junctions or at-grade intersections. As the traffic light turns red, vehicles full stop to allow safe crossings of other traffic streams, and subsequently with green light the vehicles begin to travel along the intersection. In this situation, namely *stop and go*, vehicles emanate noises more than usual in terms of both level and nature.

For instance, as the vehicles stop before the stop line they tend to break which produce breaking noise and when they start to move, usually a higher level of noise would be heard compare with an uninterrupted crossing.

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This study was conducted in two locations to include two most common types of intersections, crossroads and T-junctions. Locations are in an urban area and near a shopping mall which predicted to attract high volume of traffic.

II. Previous Research

Previous studies show difficulties in establishment of a successful model for emanated noise in interrupted traffic flows due to many direct and indirect influences. However, some researchers developed models for urban traffic noise exposure where the pattern of flow is naturally interrupted by signalized intersections and priority junctions. These models consider various factors such as land use, road and traffic characteristics and human factor. Jraiw [1] used three groups of models. First group estimate noise level according to vehicle classification, building configurations and intersection geometric characteristics. Second group of models used traffic flow and proportion of heavy vehicles, vans, and RV's. Third group consider human response and attitude.

Olge and Wayson [2] studied the effect of vehicle speed on the emanated noise and developed a mathematical model. Pamanikabud [3] tested two common existing traffic noise prediction models on Singapore roadways. One was introduced by Federal Highway Administration (FHWA) and the other one was introduced by United Kingdom's Department of Environment (DoA). Tests' results show that there is a need to develop a new model to meet the characteristics of traffic and roadways in Asian countries.

Dravitzki and Wood [4] developed a model that predict equivalent noise level (L_{eq}). Model evaluations in various sites, such as urban streets and urban arterial roads, prove the reliability of their model. Moreover, pavement texture was found to have a significant effect on noise level for a more accurate prediction.

Abu-qdais and Abo-qudais [5] stated that traffic noise has a remarkable unpleasant psychological impact on inhabitants of building near the roads specially the ones face to the road which provide a direct path to the traffic noise.

III. Data

Data for this study was collected from two signalized intersections in Skudai, Johor, done by author. During data collection level of traffic noise and other related factors which had effect on noise level were measured. Equivalent, maximum, and minimum noise levels were measured during traffic light cycles. Data were classified in terms of Stop, Go and Drive phases. Stop noise refers to measurements starting from the moment that traffic light turns red and vehicles stops at the stop line of the intersection. Go noise was measured while traffic light turn green to allow traffic to move along. Once the traffic queue were completely disappeared and vehicles pass through intersection continuously whit no interruption, noise was measured as Drive noise. This condition can imitate the characteristics of a straight section of a roadway when there is no intersection.

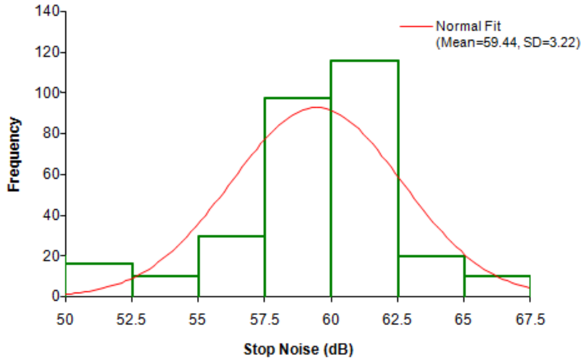

Fig. 1 T-junction Stop phase

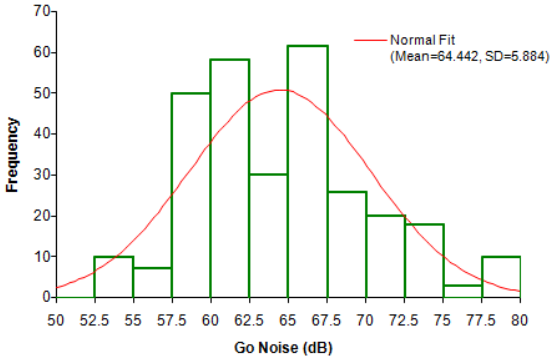

Fig. 2 T-junction Go phase

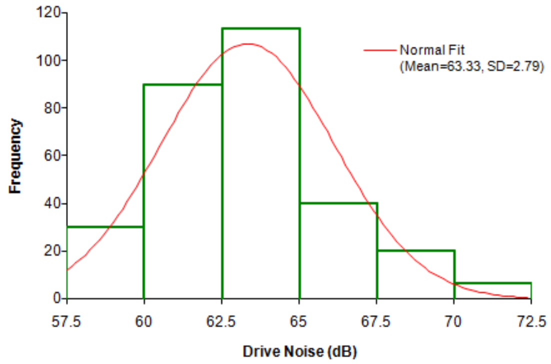

Fig. 3 T-junction Drive phase

An integrated sound level meter (ISLM) was used to measure the noise levels. Device was situated one meter off the left hand lane of the approach and 1.5 meter above the ground. Noise levels are measured in Decibels (dB).

Every approach of crossroad and T-junction measured in terms of traffic noise separately for three hundred traffic light cycles. Output data for each phase are sort out to produce the frequency diagrams (see Fig. I to VI). Summary of data for T-junction and crossroad are presented in table I and II, respectively.

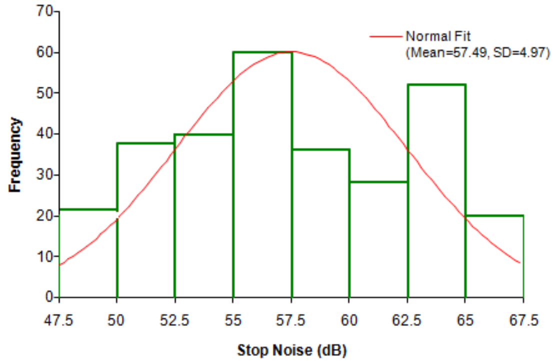

Fig. 4 Crossroad Stop phase

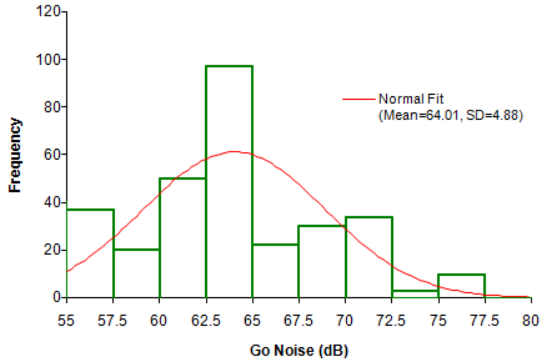

Fig. 5 Crossroad Go phase

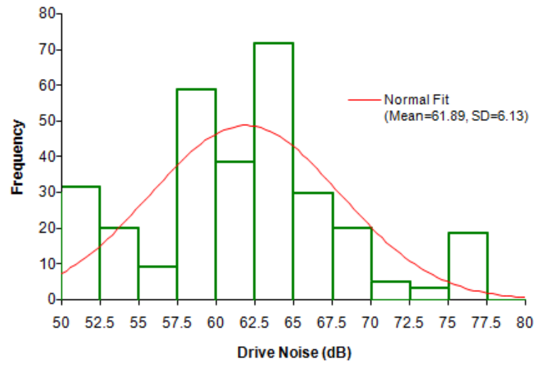

Fig. 6 Crossroad Drive phase

IV. Results and Discussions

According to the collected data, the highest mean noise level for T-junction is for Go phase, and for the crossroad is for Drive phase. However, recorded noise during Go phase in crossroad is also relatively in same level as the Drive phase. Stop phase hold the minimum level of noise either in T-junction and crossroad. It might have happened for the reason that when vehicles start to move, the throttle will open wide in order to gain the power. After a few minutes of driving, the noise will decrease as the throttle starts to set in stationary condition. The Stop situation will have the lowest noise level as the vehicles were stayed on the place. This concept is shown in Figs. 7 and 8 via comparison the frequencies of recorded data for more illustrations.

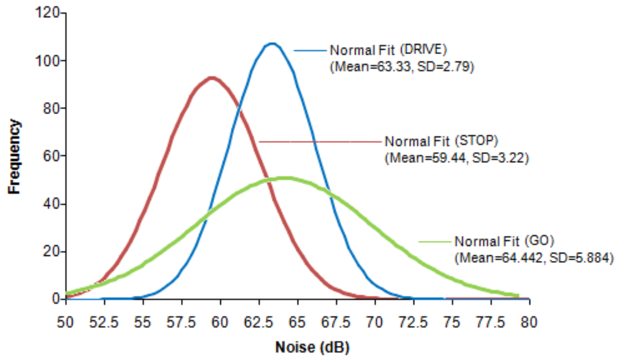

Fig. 7 T-junction noise levels

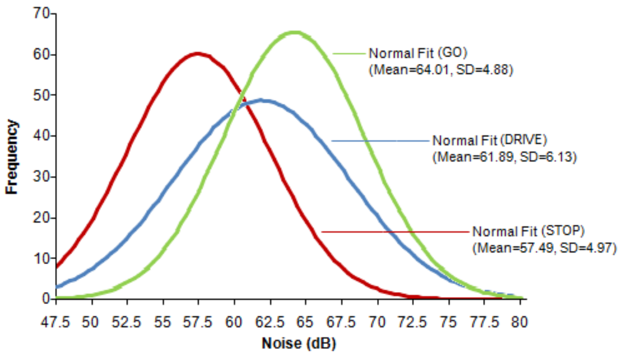

Fig. 8 Crossroad noise levels

As a comparison, the noise level of 60 dB considered as intrusive and above this level is annoying until 80 dB which will cause hearing damage if persisted more than 8 hours (Environmental Protection Agency).

V. Conclusion and Recommendations

According to this study it can be found that noises emanated from vehicles in intersections are potentially high. It implies that the existence of intersection caused the noise level to increase. The vehicles starting to move produce more sound than when they travel at a constant speed along the intersection. On the other hand, possibility of drivers using vehicle horn is significantly higher. The situation gets more critical when the intersection situated in a busy urban area where there are notable amount of residents living or doing their jobs nearby.

TABLE I
T-Junction Noise Level

	Stop phase	Go phase	Drive phase
Mean*	59.44	64.442	63.33
95% CI	58.24 to 60.65	62.244 to 66.639	62.28 to 64.37
SE	0.589	1.0743	0.51
Median	59.95	64	63.15
95.7% CI	58.60 to 60.60	60.80 to 66.70	61.50 to 64.70
Variance	10.39	34.627	7.8
SD*	3.22	5.884	2.79
95% CI	2.57 to 4.33	4.686 to 7.911	2.22 to 3.75
Range	14.6	26.9	11.3
IQR	3.04	8.154	3.67
CV	5.40%	9.10%	4.40%
Skewness	-0.71	0.42	0.71
Kurtosis	0.99	0.19	0.24
Percentile			
0th (minimum)	51.8	52.6	59
25th (1st quartile)	58.4	60.1	61.2
50th (median)	59.9	64	63.1
75th (3rd quartile)	61.3	68.1	64.8
100th (maximum)	66	79.5	70.3

TABLE II
Crossroad Noise Level

	Stop phase	Go phase	Drive phase
Mean*	57.49	64.01	61.89
95% CI	55.63 to 59.34	62.19 to 65.83	59.60 to 64.18
SE	0.907	0.891	1.12
Median	57.25	63.4	62.1
95.7% CI	54.60 to 60.10	62.20 to 64.90	59.40 to 64.40
Variance	24.7	23.83	37.61
SD*	4.97	4.88	6.13
95% CI	3.96 to 6.68	3.89 to 6.56	4.88 to 8.24
Range	17.5	20.1	24.8
IQR	7.81	5.42	6.78
CV	8.60%	7.60%	9.90%
Skewness	0.05	0.31	0.48
Kurtosis	-0.95	0	0.62
Percentile			
0th (minimum)	49	55.4	51.9
25th (1st quartile)	53.3	61.6	58.2
50th (median)	57.2	63.4	62.1
75th (3rd quartile)	61.1	67.1	64.98
100th (maximum)	66.5	75.5	78.7

*Units are in Decibels (dB).

Fast growing cities, as in this case Skudai, needed more considerations for controlling the noise in their intersections. Considering that increasing of noise level is harmful both physically and psychologically to the people, it is highly recommended that serious treatment comes to effect. To achieve this goal following recommendations is suggested for further studies and considerations.

1) Noise barriers can be used to assist reduce or prevent the transmission of noise from its source on the road to the adjacent residential areas. However, these barriers should not impair the visibility and maintain sufficient sight for drivers as it is the most critical in intersections. Low height noise barriers or lacunal or shutter noise barriers are preferred.
2) Rather than reducing the transmission of the noise, decreasing of its generation should be considered. Governments can set regulations to force motor vehicle industries and manufacturers to make improvements to deal with this problem. Also providing a better public transport is highly advantageous.
3) As heavy vehicles emit more sound than passenger cars, percentage of heavy vehicles should be reduced when other alternatives and paths are available. It may be needed to construct new roads for such vehicles to circulate the city instead of entering it.

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