Assessment of noise pollution and its impact to the residential areas in Ho Chi Minh City

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Abstract:

Noise pollution can cause health and well-being problems for people including hearing loss, stress, high blood pressure, sleep disturbances, etc. Ho Chi Minh City is the primary economic center of Vietnam. Its rapidly development, especially in recent year bring along serious noise pollution. This study assesses the current noise pollution in Ho Chi Minh City and its impact to residential areas by measuring the noise levels due the traffic; industrial and commercial activities in the urban areas. The results show that the noise pollution in Ho Chi Minh city is at alarming level. Several technical solutions has been recommended to reduce the noise level that ultimately improve life quality and further sustainable development in Ho Chi Minh City.

Keywords: Noise pollution, noise measurement, noise reduction.

1. Introduction

Noise pollution has become a serious environmental problem, especially in urban areas [1]-[3]. The noise control has not been getting enough attention due to the insufficient knowledge of its effects on human beings. This issue receives less attention than other environmental impacts [4].

Noise increases the risk of health problems such as noise-induced hearing impairment; disturbance of rest and sleep; psychophysiological, mental-health and performance effects; effects on residential behaviour and annoyance; as well as interference with intended activities [4][5]. The urban noise pollution is derived mainly from three kinds of activities: (1) traffic; (2) industrial and commercial activities and (3) construction [6]. Ho Chi Minh City is the largest city in Vietnam having the population of more than 9 million as in 2021 with the highest average population density in the country [7]. The city is facing many inadequacies and problems in urban planning and management. The transport infrastructure does not catch up with the increasing number of vehicles [8].

According to the Vietnam Registry Department and policeman in HCMC, in 2019, there were approximately 825,000 cars and about 8.12 million motorcycles. The traffic congestion is becoming more serious [9] and the noise pollution arising from traffic was already exceeding the set standards in many places along the streets in Ho Chi Minh City [10]. Commercial and industrial activities are also big contributors to noise pollution in Ho Chi Minh City. Currently, Ho Chi Minh City has 18 industrial parks with total about 4,500 ha and more than 10,000 small medium industries with residential areas [11].

These production facilities cause continuous noise affecting the health and life of surrounding people [12]. In this study, the authors survey and evaluate the current status of noise levels at several locations in the city caused by different noise sources to assess the noise pollution and to provide solutions to reduce the effect of noise.

2. Measurement of noises

The measurements in this study have been conducted at 19 locations representing the noise from traffic activities, industrial and commercial activities in Ho Chi Minh City. The equipment used is a noise measuring device SL-4035SD.

Noise from traffic activities

To study the correlation of noise levels caused by road vehicles between peak and off-peak hours, the noises are measured at 12 intersections with heavy traffic in the inner city; at the city's ring road and one road having intersection with a rail track. Measurements were carried out during peak and off-peak hours for weekdays and weekends. A measurement record of locations and times is shown in table 1.

Table 1. The noise levels measurement of traffic by locations and times.

No	Location	Peak hours			Off-peak hours		Weekdays	Weekends
		7-9 h	11-13 h	17-19 h	9-11 h	14-16 h		
I	**Intersections in the inner city**							
1	Dinh Tien Hoang	x	x	x			x	x
2	Bay Hien	x	x	x			x	x
3	3 Thang 2	x			x		x	
4	Cay Go	x			x		x	
5	Hang Xanh			x		x	x	
6	Hoang Van Thu			x		x	x	
7	Nguyen Kiem			x		x	x	
II	**Intersections in the city's ring road**							
8	Thu Duc			x		x	x	
9	Linh Xuan			x		x	x	
10	Binh Phuoc	x			x		x	
11	An Suong	x	x	x	x		x	x
12	Song Than			x		x	x	
III	**Intersection with the rail way**							
13	Intersection between Nguyen Kiem Street and the railway tracks			x				x

At the road intersections (no. I and II in table 1), the measurements were taken on the sidewalk near a residential house having a distance of 200 m from the central of the intersection. The noise is recorded every five seconds and within five minutes for each location. For the measurement of noise at the rail way crossing the road (no. III in table 1), the noise was recorded near the residential house having a distance of 50 m from the railway. The noise is also measured every five seconds from the beginning of the sound (as the train goes by) until when the noise from train is no longer audible.

Noise from industrial and commercial activities

Noise levels were also measured at residential areas located near industrial and commercial zone. The measurement took place on weekdays and weekends during daytime and night-time as shown in table 2.

Table 2. The noise levels measurements at industrial and commercial areas with locations and times.

No	Location	Weekday		Weekend	
		Daytime 8-17 h	**Night-time** 21 h-6 h	**Daytime** 8-17 h	**Night-time** 21 h-6 h
I	**Industrial activities**				
1	Textile Factory 1 District 12	x			
2	Textile Factory 2 District 12	x	x	x	
II	**Commercial activities**				
3	Dien May Xanh	x		x	
4	Speaker shop (Truong Chinh Street)		x		x
5	Bui Vien pedestrian street		x		
6	Beer club - Hoang Sa street		x		

The selected areas to carry out noise measurements are characterized by industrial and commercial activities, which are interspersed with existing residential areas. The measurement is carried out at the residential areas having a distance of 200 m from the noise source. The measurement duration is five minutes per location and the reading is taken each five seconds.

3. Results and findings

For each measured location, the average noise level (Leq) is the average value of 60 readings. According to the National technical regulation on noise, it is required that the noise causes by production, trade and service activities should not exceed 70 dB during the daytime (from 6 AM to 21 PM) and 55 dB at night (21 PM to 6 AM) [13].

Table 3. The average noise level (Leq) at peak-hour on weekday of three intersections.

Unit: dB.

Time	Dinh Tien Hoang	Bay Hien	An Suong
7-9 AM	74,12	79,01	80,46
11-13 PM	74,92	78,23	79,03
17-19 PM	76,12	76,78	81,16
Average	75,05	78,01	80,22

Table 3 presents the measurement results at peak-hours on weekday at 3 intersections (Dinh Tien Hoang, Bay Hien, and An Suong). It can be seen that there is slightly difference in noise levels among measurements at each location. The deviation of the noise level from the average value of the measurement points is approximately 1%. It is also noted that the traffic situation at different peak times during the day can be quite similar. The authors therefore use the measurement of any peak-hour as the representative data for other peak hours during the day.

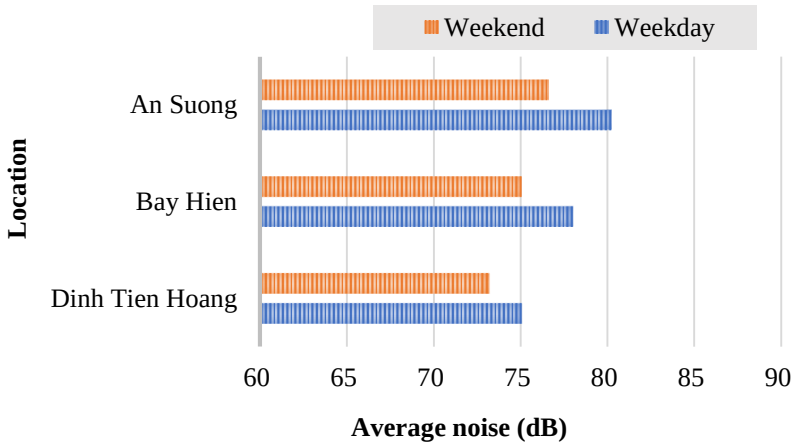

Figure 1: Comparison of average noise at three intersections in different peak-hour on weekday and weekend.

Figure 1 shows the noise levels of weekdays and weekends at Bay Hien, An Suong and Dinh Tien Hoang. It is found that all noise levels exceed the allowance of 70 dB stated in national regulations [13] for 3 to 10 dB. The differences between weekday and weekend at the same location is small, ranging from 1.9% to 3.6%.

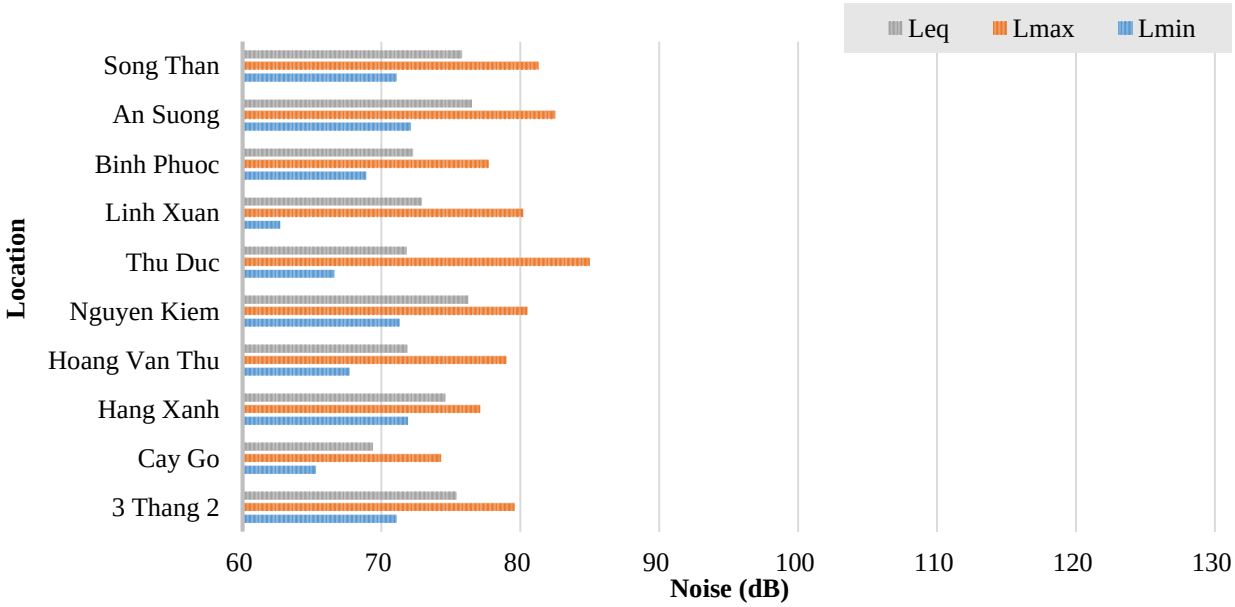

Figure 2. Noise levels at intersection locations in different off-peak hours on weekday.

Noise levels at off-peak hours at intersections in the city are given in figure 2. The average measured was 73.5dB and at intersections of the ring road was 73.9 dB showing that the noise levels in the inner city and the ring road are somehow similar. Despite the off-peak hours, the average value of noise levels recorded at most of the measurement locations still exceeds the allowable value of 70 dB.

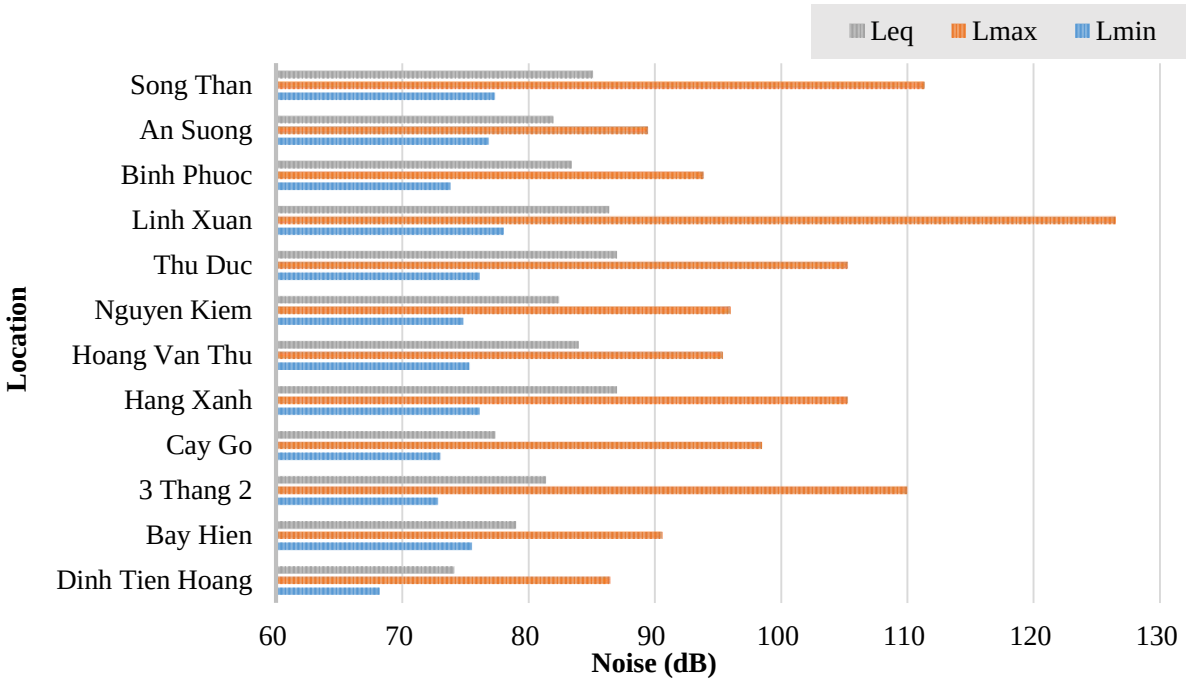

Figure 3. The noise level at intersections during peak hours on weekdays.

At peak-hours, it is observed from Figure 3 that the noise levels are significantly high to an extend that may do harm for human's health. The average noise level measured at urban intersections is 82.46 dB and at ring road intersections is 84.47 dB, both values exceed 80 dB, which is the noise level at warning stage. The maximum noise value of 126.5 dB was recorded at the intersection of Linh Xuan, and the average maximum value at the measurement points was 102.58 dB. This obviously has a significant impact on the longterm health of road users and residents in neighboring areas.

Table 4. The average noise level and the frequency of occurrence of noise ablove 85 dB at peak hours on weekdays.

Location	**Leq (dB)**	***f (%)***
Hang Xanh	87,00	55,00%
Linh Xuan	86,40	41,67%
Thu Duc	85,47	33,33%
Song Than	85,12	21,67%
Hoang Van Thu	84,10	33,33%
Binh Phuoc	83,42	41,67%
Nguyen Kiem	82,42	48,33%
3 Thang 2	81,38	6,67%
An Suong	81,08	35,00%
Bay Hien	78,01	3,33%
Cay Go	77,43	3,33%
Dinh Tien Hoang	75,05	29,39%
Average	**82.24**	**29.00%**

f: The frequency of noise level higher than 85 dB in one measurement.

The frequency of noise level above 85 dB has been shown in Table 4, with the average value at 12 locations of 29%, meaning that in 5 minutes there will be 1,45 minutes the loudness value is above 85 dB. From which we can approximate that in one hours, there will be 17 minutes the noise levels reach above 85 dB.

The noise levels recorded at the intersection between Nguyen Kiem Street and the railway tracks from the beginning of the sound until the train has passed by is shown in figure 4. Measurements were taken at the weekend, at a location with little traffic, so when there is no train passing by, the average noise level is at 60 dB, which is acceptable. However, while the train was passing, the average noise level raises to 90 dB, and the largest noise level was 126.7 dB. Depending on the length of the train, the time for the noise to appear is different from 30 seconds to one minute. Therefore, the high frequency of trains passing through Saigon train Station may affect the health of people living near the tracks, such as reducing hearing ability, afecting concentraion in study and work, or causing dificulty in sleep,…

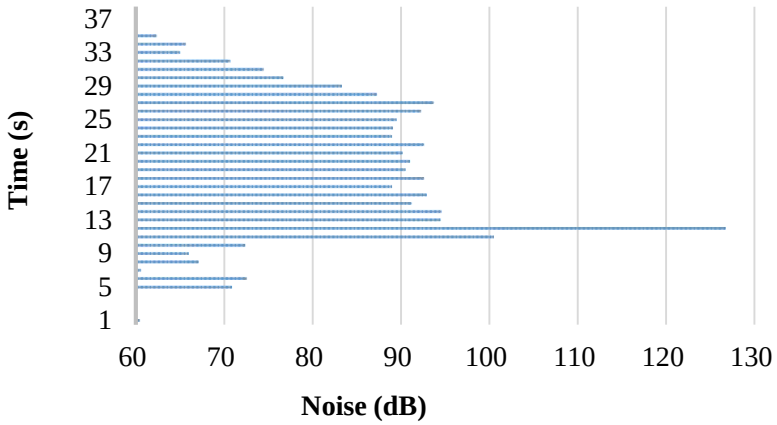

Figure 4. The noise level recorded at the intersection between the road and the railway track legend when the train is passing.

Industrial and commercial areas

The results of noise measurement at one service location (Dien May Xanh) and two textile industry factories in daytime in district 12 has shown that the average noise level at neighboring residential areas is beyond the allowable threshold by 8 to 10 dB. The loudest noise is sometimes recorded up to 89 dB (figure 5).

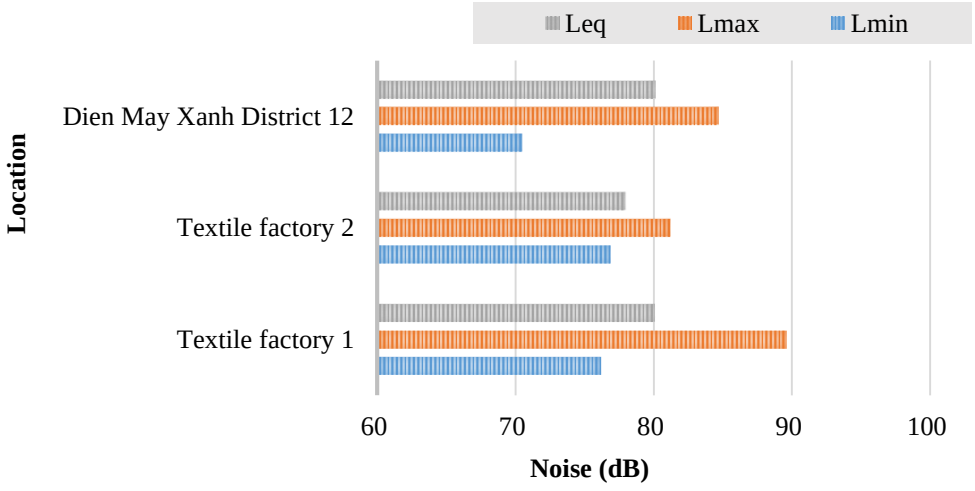

Figure 5. The noise level at residential areas near the industrial and service areas during day time.

Figure 6 shows that the average noise level at night recorded at the Textile Factory 2 is 72 dB having 17 dB higher than the allowance. Commercial areas in Ho Chi Minh city can be very busy the whole day. Even at night-time, the noise level recorded at a residential area near a speaker shop on Truong Chinh Street, showed an average noise level up to 90 dB. This show a serious violation of the regulations for the permissible noise levels in the surrounding residential areas.

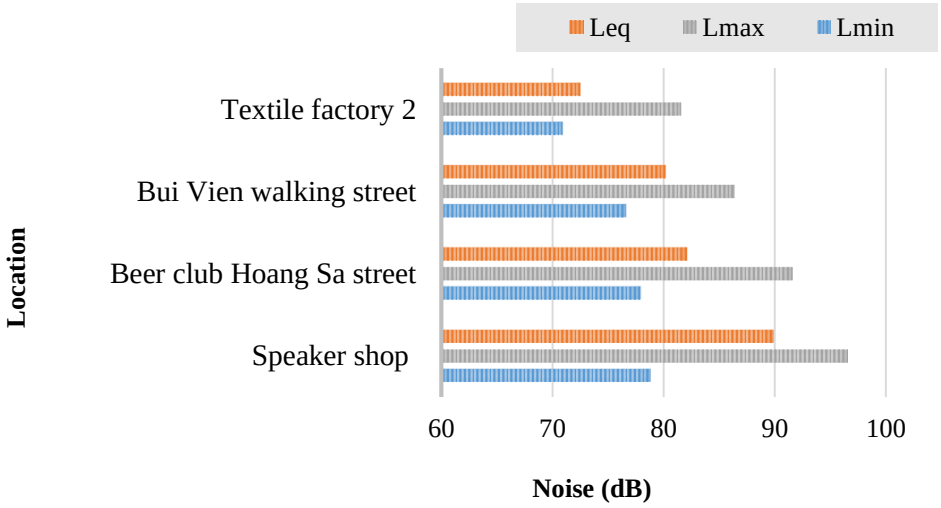

Figure 6. The noise level at residential areas near the industrial and service areas during night time.

For the commercial activities, the data was recorded at 03 points representing gathering places at night: Bui Vien walking street,a beer club on Hoang Sa street, and a speaker shop on Pham Van Dong street. Although the measurement was taken at night on a weekday, the average noise level measured was over 80 dB which is 45% higher than the allowance at night for 55dB. These activities often start late at night, during people's resting time, thus giving a big impact on the sleep quality. From above findings, it is obivous that the noise level in Ho Chi Minh city had reached an alarming level. Effective measures are of utmost important to reduce the noise levels in the city.

4. Noise reduction methods

Noise is a form of physical pollution. It can be minimized through 3 basic approaches, including: (1) Control at noise sources, (2) noise reduction on the transmission line and (3) protection at the receiver end [14][15].

Control at noise sources

Traffic noise can be reduced at the noise sources through measures relating to vehicles, tyres, road surfaces and traffic management [5]. The city government should carry out a policy to restrict vehicles with excessive noise levelto enter the inner city. In the meantime, it is essential to improve the quality of the road, promptly handle damage like potholes. It is recommended to use asphalt concrete pavements to ensure smoothness and limit noise [12]. Car horns are also the key factors causing traffic noise in the city. In Vietnam, especially in big cities, honking has becoming a bad habit of drivers. It is necessary to arange signboard to limit the horns when traveling in the city and to ban it at special areas. The ultimate solution, from the authors' point of view would be develop more effective and friendly public transport system in order to reduce congestion and the number of private vehicles, then eventually, the noise levels could be lower.

It is also very crucial that regulations on operation for commercial and industrial activities at night and on weekends should be strictly applied. It is nêcsary to seriously carry out the relocation of small and medium industriesout of densely residential areas. Industriesmust have soundproofing, high-level shielding to ensure that noise is not spread out of the factory area.

Noise reduction on the transmission line

Using soundproof retaining walls, especially green retaining walls is one of the effective solutions. Noise cancelling walls can reduce noise levels by 3-6 dB depending on the height and design of the retaining wall [5]. Denmark's National Traffic Noise Strategy shows that measures to reduce noise propagation (including noise barriers) are among the least expensive of the effective solutions for the year 2020 [5]. It is obvious that noise barriers are only feasible for road systems without pedestrian sidewalks such as highways or city ring roads. Soundproof walls are especially effective for railways, and in addition to soundproofing, they also work as traffic safety measure for people in the surrounding area.

Protection at the receiver end

By rearranging the receiver end such as bedrooms facing away from the noise sources, the impact of noise can be significantly reduced.

Acoustic insulation by good glazing can cut down noise. Studies in [10][15] shown that windows with 2 layers of thick glass can reduce noise to 35dB.

In the prevention of noise pollution, publicity, mobilization, and reminders directed at businesses and individual business households are definitely essential and people need to sign commitments to strictly comply with relevant legal provisions. Additionally, strengthening inspection, supervision and strictly handling violations of the law related to noise need to be carried out.

5. Concluding remarks

This study measures the noise levels at 19 different locations in Ho Chi Minh City including: Traffic intersections; residential areas nearby the commercial and industrial zones to evaluate its influence on human’s daily living and health. The authors also provide several measures to effectively reduce the noise levels.

The following observation and findings can be drawn from this research:

(i) The noise pollution levels at the intersections in the center and the ring roads of Ho Chi Minh city is significantly high. Measurements for three (peak) hours during the day give similarly high results. As the duration of peak hours is long, the noise may cause serious health problem for road users and especially nearby resident.

(ii) During the off-peak hours, the noise level has decreased but is still higher than the allowable by 3 to 9 dB. At weekends, the traffic is smoothier so that the noise level can be lower but the loudness is still above the allowable.

(iii) The residential areas built close to the rail tracks are highly not suitable for two reasons: (1) safety and (2) noise pollution. The sound intensity when a train is passing as recorded at residential locations exceeds the prescribed threshold can be over 50 dB. With high frequency of trains passing by during the day, this causes many inconveniences for daily living as well as people's health.

(iv) Many areas of industrial and commercial and activities in Ho Chi Minh City are interwoven with residential areas. These activities cause loud noise, and continue throughout the day. Even at night, the average noise level recorded is much higher than the allowable noise level for residential areas. This is big problem for the city government to reslove.

By effectively carrying out these reduction methods, the noise level in Ho Chi Minh city can significantly reduced to an acceptable level.

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