Technical and Applied Papers

Noise Measurements in the Community of Nablus in Palestine

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Summary
This paper presents the main results obtained in a general study of noise pollution in the city of Nablus in Palestine. The equivalent noise level values (L_{eq}) were measured and tabulated for 50 locations spread over the area of the city. The obtained result of noise level of the 50 L_{eq} values is in average 68.0 dB(A). It has been found that the L_{eq} values for 58% of the selected locations are exceeding 65.0 dB(A). This result is obviously higher than the adopted international standards. Accordingly, the area of Nablus is considered an unacceptable living area. Hence, its buildings, streets and factories require severe reconstruction and modification plans. In addition, there should be adequate updated plans for setting up community noise surveys and ordinances.

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1. Introduction

Noise pollution is a hidden parameter having a great influence on the environment. Therefore, the life of human being through his direct and daily contact to it is affected. Accordingly, it is not surprising that the issue of noise pollution is a hot topic in scientific research [1, 2]. The necessity for noise pollution studies and its influences on the surrounding environment is increasing especially by increasing the number of noise sources as machines, markets, vehicles and factories. In the local society of Palestine of area 27000 km^2 there are some specific issues affecting the noise level. These issues are the crowded living of our cities, the refugee camps that are not subjected to regulations and recommendations of safety and health laws, the shortage of open spaces, the heavy road traffic as a consequence of narrow streets, and finally the military activities especially by using the airforces. Additionally, Palestine cities have no clear boundaries between residential, commercial and industrial zones. The design of many buildings, factories and streets did not follow any kind of regulations in order to reduce noise pollution. All these factors and others contribute strongly to increase the noise level to which most of the people are exposed most of the time at homes, streets, factories and elsewhere. This in its turn affects the health and the quality of life of everybody in the region.

National standards frequently guarantee the availability of quiet new machines, automotive vehicles and other noise sources by legislating their maximum allowable noise blaring. Usually, noise enforcement legislation limits are set as the maximum dB(A) level generated during daylight time [3, 4, 5, 6, 7]. During the last twenty years, noise level measurements have been the topic of research of many groups in different countries [8, 9, 10, 11, 12, 13, 14, 15, 16]. Several of these studies have produced noise maps of some big cities for planning and designing new roads, buildings and factories. In an attempt to initiate similar study in Palestine where there is no real noise level measurements have been taken yet we started our experiments. This paper presents the main results obtained in all urban areas of the community of Nablus. The noise level was measured in 50 different selected locations then studied and compared to the international standards.

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2. Experimental apparatus

The noise levels were measured by using the Quest model 2900 type 2 integrating and logging sound level meter. The accuracy of this meter is ±0.5 dB(A) at 25°C and its precision is 0.1 dB(A) [4, 17].

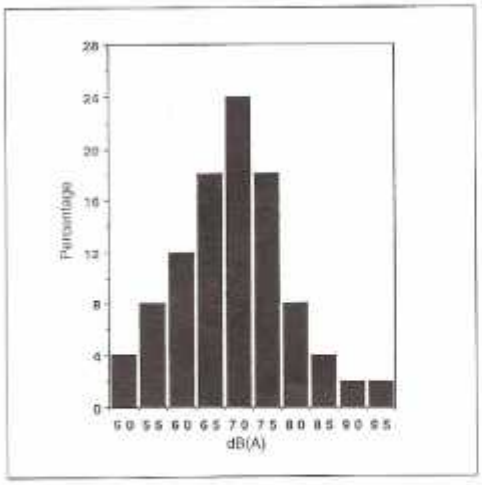

Figure 1. The percentage of the mean of L_{eq} values in dB(A) in different locations as taken from Table I.

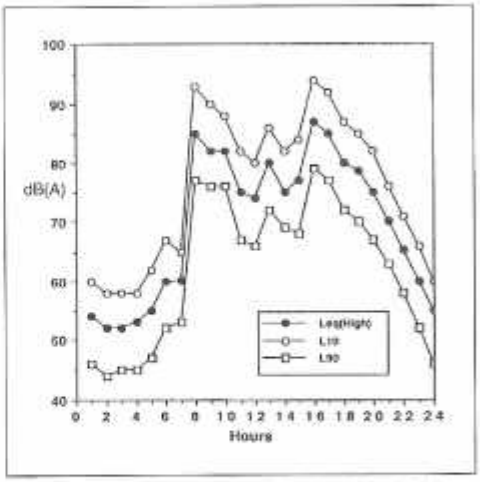

Figure 2. Variation of hourly values of noise levels through 24 hours at urban areas with high traffic volume.

3. Results and discussion

Noise level measurements were carried out in 50 locations spread through all urban areas in the community of Nablus (150000 inhabitants). This means that the city of Nablus has been divided at a rate of one location for each 3000 inhabitants. The mentioned criteria guaranteed that the results obtained from the measurements are statistically good representative of noise levels within the entire urban area of the city. All these measurements were carried out during working days of the week. The duration of each measurement in every location was 60 minutes and was done three times. The first time was during the early rush hour (8.00 to 9.00 o'clock), the second time was during the late rush hour (15.00 to 16.00 o'clock), and the third time was during the sleeping time (23.00 to 24.00 o'clock). For longterm trends in studying the environmental noise it is convenient to use a single-number descriptor to define an entire day's noise history. The most common descriptor used in this field is the equivalent dB(A) level (L_{eq}) that is an excellent criterion for studying long term trends in ambient noise. However, it does not reveal complete information about the quality of the environment because human response is partially dependent upon the range of noise level variation. Consequently, the environmental noise pollution is best described by the L_{10} and L_{90} values. For these two values the dB(A) sound pressure level exceeds 10% and 90% of the time, respectively, which reveals maximum and minimum noise levels. The average values of L_{eq}, L_{10} and L_{90} have been measured for each location. Table I shows the distribution of the measured equivalent sound level values (L_{eq}) across all the measurement locations. A plot of the percentage of the mean values in different locations is shown in Figure 1. The mean of the L_{eq} values of the 50 locations obtained in these measurements is 68.0 dB(A) with a standard deviation of 9.8 dB(A). The minimum and maximum registered L_{eq} values are 49.2 dB(A) and 95.0 dB(A), respectively.

In 15 measurement locations, i.e. 30% of the total locations considered in our samples, the results of noise level ranged between 55 and 65 dB(A). These are considered as acoustically undesirable for residential areas. In 29 measurement locations, about 58% of the total samples, the L_{eq} sound level values exceeded 65 dB(A), therefore, they are considered unacceptable residential areas. It should be noted that in about 16% of locations the L_{eq} values exceeded 75 dB(A), which is an extremely high value for residential areas. As mentioned before, the mean value of the L_{eq} values obtained in the 50 locations is 68.0 dB(A), that is also unacceptable for residential areas. It should be noted that all the measured L_{eq} values are compared to the report issued by the organization for economic cooperation and development [7].

Table I. Distribution of the measured L_{eq} values in 50 different locations spread over all urban areas of the community of Nablus. All values of L_{eq} are given in units of dB(A).

	Number of locations	Percentage
$L_{eq} < 50$	2	4
$50 < L_{eq} < 55$	4	8
$55 < L_{eq} < 60$	6	12
$60 < L_{eq} < 65$	9	18
$65 < L_{eq} < 70$	12	24
$70 < L_{eq} < 75$	9	18
$75 < L_{eq} < 80$	4	8
$80 < L_{eq} < 85$	2	4
$85 < L_{eq} < 90$	1	2
$L_{eq} > 90$	1	2

The variation of hourly values of noise levels through 24 hours at one location with high traffic volume is typically represented in Figure 2. From such diagram, several important features can be understood. There exist two major peaks at 8.00 o'clock and 16.00 o'clock. These two peaks represent the early and tile late rush hours, respectively. In addition, there is a little obvious peak at about 13.00 o'clock that reveals the lunch time. Another important point is that the figure can be divided into two major parts. The working day time (8.00–16.00 o'clock) during which we got extremely noise levels with average L_{eq} values above 75 dB(A), and night time during which the L_{eq} values drop down to an acceptable value around 55 dB(A).

The variation of the hourly values of noise levels was then measured during 24 hours in a low traffic volume urban area. The result of that experiment is shown in Figure 3 which reflects very similar features as Figure 2 but, in general, with lower noise levels. For comparison purposes of the low and high traffic volume areas, the L_{eq} values for both regions are shown in Figure 4. In the high traffic streets the average of L_{eq} values is about 70 dB(A) compared to

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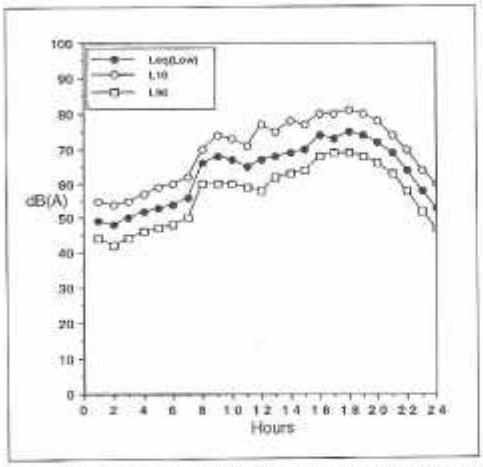

Figure 3. Variation of hourly values of noise levels through 24 hours at urban areas with low traffic volume.

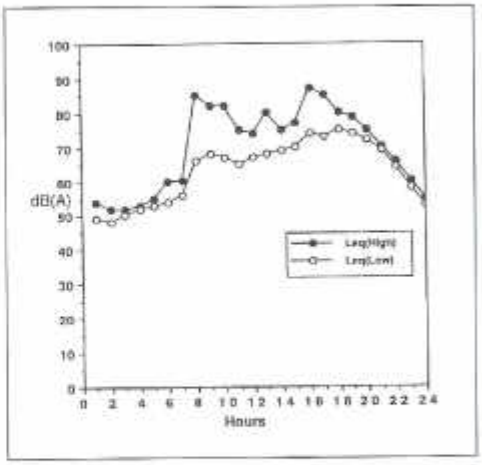

Figure 4. Variation of hourly values of L_{eq} for high and low traffic through 24 hours at urban areas.

63 dB(A) in the low traffic which means an increase of about 11% in the sound level.

At the end of this study, we can conclude that the city of Nablus as one of the most populated cities in Palestine is environmentally noise polluted. About 16% of the inhabitants of Nablus are exposed to diurnal extremely high value of equivalent sound levels over 75 dB(A). In addition, during the working hours the city in general is unacceptable for living purposes.

Many things can be done to relieve the environmental noise pollution problem in the city of Nablus. Some of these are: quieting the noise sources, putting barriers or allowing enough spaces between residential areas and noise sources, limiting the exposure time, following safety and health regulations, and setting up community noise surveys and ordinances. Moreover, there should be adequate plans for an early step in any noise control program for industrial or residential areas. The proposed legislation should be accompanied by favorable publicity program so that the public will view it as a mean to improve their lives and community not as an interference with their personal freedom.

Acknowledgement

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