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Evaluation Of Vehicular Noise Pollution In The City Of Hebron, Palestine

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ABSTRACT: *Noise generally is known as unwanted and unwelcome sound. It is considered as the most pervasive pollutant besides the emission pollutants. Noise pollution generated from vehicles with its influence on life quality and the environment may be considered as a hot topic in scientific research and one of the main concerns of the world, especially in urban areas. Because in Palestinian Territories (PT), there are neither legal legislations nor sufficient studies on noise pollution, this paper was carried out to evaluate vehicular noise level in Hebron city (the largest city of about two hundred thousand population), located at the south of (PT). Noise measurements were taken at two chosen areas with high population density, heavy traffic, commercial and residential buildings. The value of equivalent level noise (L_{Aeq}) was measured during three intervals ranged from 7-8 am (peak traffic hours), 14-15 pm (peak traffic hours), and 17-18 pm (non-peak traffic hours) in June 2012. Noise pollution was measured and analyzed and it was noticed that the maximum average of noise level was measured 83.05 dB(A) from 14 to 15 pm, while the minimum average was measured 74.4 dB(A) from 17 to 18 pm. The results showed and emphasized that in regard to high (L_{Aeq}) compared with international legislations, implementing strategy and greater priority must be devoted to control the noise levels.*

Keywords: *Hebron, L_{Aeq} , noise level, noise pollution, traffic.*

I. INTRODUCTION

The word "noise" is derived from the Latin word "nausea" meaning seasickness. Noise can be defined as the level of sound that exceeds the acceptable level and creates an annoyance. Noise is any sound independent of loudness which can produce an undesired physiological or psychological effect on an individual group. Noise is a major source of friction between individuals [1]. The major sources of noise are industrial noise, community noise and traffic noise. Out of three parameters, the source that affects the most is traffic or vehicular noise. In this traffic noise, almost two- third of the total noise pollution in an urban area is contributing by vehicle noise.

Vehicle noise includes the following sources:

- Engines.
- Exhaust systems.
- Tires interacting with the road.
- Horns.
- Aerodynamic friction and by the interaction between vehicles.
- Sounds of cooling fans, gearboxes and brakes.

The increase in magnitude and severity of traffic noise depends on the following factors [2]:

- Population growth and urbanization associated with the growing number of automobiles.
- Vehicle type, its mode of operation and flow.
- Dimension, position and surface materials of the roads.
- City prior planning.
- City center crossroad signal system.
- Commercial and industrial activities in the residential areas, in addition to high traffic density.
- Disobeying traffic rules.

All the above mentioned factors combined together lead to increased vehicular noise levels.

Noise pollution does not get noticed and it is not like a kind of chemical reaction. It is only like a wave which widespread in the air and does not have any stable and normally observable effect like water or soil pollution. Noise pollution is regarded as a significant criterion in determining the quality of life in cities and affects the social welfare [3].

1.1 Noise Pollution; its Magnitude, Sources, and Effect

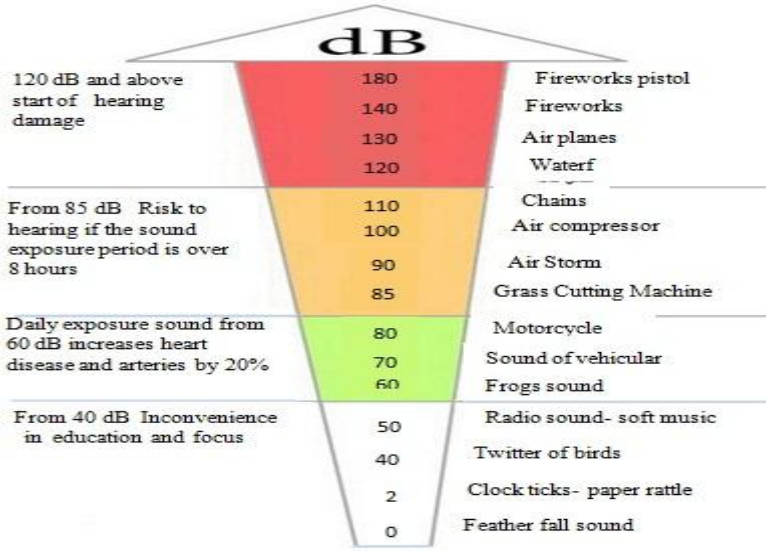

Fig.1. Noise pollution sources and influence due to its levels in (dB)

In general, previous figure schematically illu s the magnitude of noise pollution, sources, and its influence on human beings [4].

1.2 Typical Traffic Noise Levels

The typical traffic noise levels can be summarized as follows [5]:

- Areas with heavy traffic or close to loud speakers: 80-105 dB(A).
- Areas with over flying aircrafts: 90-100 dB(A).
- At railway stations, busy markets, and traffic junctions: 70-90 dB(A).
- Industries markets and residential areas close to traffic: 60-80 dB(A).
- Residential areas that are away from heavy traffic roads or other noisy sources: 40-60 dB(A).

Regarding the above mentioned, the study and investigation of noise are necessary before presenting the noise control policies in order to investigate the distribution

of existing noise levels compared to noise standard levels and then finding out the main sources of noise. Hence came the importance of this study.

II. STUDY AREA PROFILE

2.1 Why Hebron city

In the Palestinian Territories, geographical point of view Hebron city is about of 35 km north of Jerusalem. It is one of the most dynamic cities. It was chosen to achieve the goals of this study for the following reasons:

- It is considered as the largest and the most populated city.
- The increasing number of people is accompanied by an increase in the industrial and commercial utilities which requires an increase in the number of vehicles.
- Hebron is considered as the biggest and the most important industrial and commercial center.
- The growth rate due to immigration from the countryside and the purpose of shopping increases the proportion of noise pollution.
- A big ratio of older vehicle model causes pollution and noise. Since then, ignoring the control procedure results in neglecting the necessity of maintenance operation needed for these vehicles.
- The city of Hebron features from other cities in Palestinian Territories that is still adhering to the customs and traditions, especially those are related to happy occasions and weddings: that are vehicles used for this purpose are going in ceremonial convoys in the streets and these festivals consist of numerous number of vehicles (cars and buses).
  The result then is making a very annoying sound with the use of horns and musical instruments. In addition, they cause traffic jam through over the streets which increases the noise.
- Due to limited availability of land resources, finances and occupation, many important roads are in the commercial and residential areas. Hens there will be some adverse and environmental effects including physiological and psychological effects to those living close to these corridors.

Figure 2 shows a general view photographed for one of these occasions in Hebron streets.

Fig.2 View of occasion (wedding party in streets of Hebron city)

Due to explosion of population in Hebron city (about 250.000 people-Palestinian Central Bureau of Statistics 2011), rapid industrialization and highest growth rate in vehicles number made the traffic problems and noise pollution very complicated. Table 1 shows the number of registered vehicles in Hebron city (the number of unregistered vehicles is neglected).

Table I. Composition of registered vehicles in Hebron city

Type of vehicles	Number of vehicles
Private cars	31124
Trucks	8673
Taxi	2155
Vehicles without custom duties	1243
Buses	459
Others	166

*(Statistics of Palestinian Ministry Of Transport-2012).

2.2 Site Selection

To measure the traffic noise pollution, the first task was site selection. So, due to surveys of different areas and nature of noise problem in Hebron city, a two cross roads (squares) where the continuous uninterrupted flow of vehicles occurs were selected. The first crossroad was Sebta square (figure 3) which matches the north of the city to the south and the severs with the city center.

The second cross road was Ras Al- Joura square which extends towards the north of the city and the south through the city center (figure 4).

2.3 Noise Measurement Instrument

For traffic noise problems it is useful to measure the equivalent sound level L_{Aeq}. Such information was obtained using the sound level meter model *Noise Pro Series DLX 1* with upper limit 114 dB (and with accessories such as microphone Random Incidence Corrector) available at REERU at Palestine Polytechnic University (figure 5).

Fig.3 Sebta square view of the noise measurement site

Fig.4 Ras Al- Joura square view of the noise measurement site

Fig. 5 Sound level meter

III. MEASUREMENT PROCEDURE

The measurement procedure was as follows:

- Measurements were performed in two days in June 2012 with a sunny day.
- Before taking the measurements, the sound level meter was suitably calibrated according to level meter producer instructions.
- The sound level meter was placed on the pavement of the street at a height of about 1.2 m and at a distance of about 7.5 m from the existing road level as shown in figure 6.

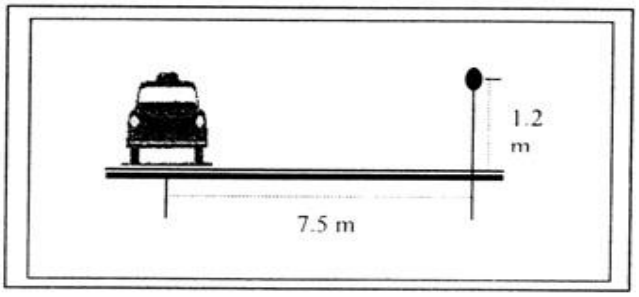

Fig.6 Location of the sound level meter

- The sound level meter was provided with a windscreen to minimize the influence of wind during measurements.
- The 15 time duration is considered during every hour measurement.
- A vehicle count was recorded based on various classification of vehicles.
- Noise level for different categories of vehicles was measured during three intervals ranged from 7-8 am (peak traffic hours), 14-15 pm (peak traffic hours), and 17-18 pm (non-peak traffic hours).

After all noise measurements in two sites (areas), statistical evaluation was done. Results are illustrated in tables 2-5 and figures 6-7.

Table II. Septa Square 15 minute measurement period

Day time	Measurement periods (minute)	Vehicle Types			LAeq (dB)
		Car	Van	Lorry	
8:00	15	55	25	10	78.4
	30	103	36	21	79.7
	45	40	25	18	75.8
	60	47	63	13	75
14:00-15:00 pm	15	119	36	12	85.8
	30	108	32	19	82.6
	45	64	21	10	78.8
	60	140	32	20	85
17:00-18:00 pm	15	119	42	19	85.5
	30	125	23	11	81.8
	45	101	42	10	79
	60	92	36	8	71.1

Table III. The average measurement Septa Square

Day time	Car and Van	Lorry	Average LAeq (dB)
7:00- 8:00 am	394	62	77.225
14:00-15:00 pm	552	61	83.05
17:00-18:00 pm	580	48	79.35

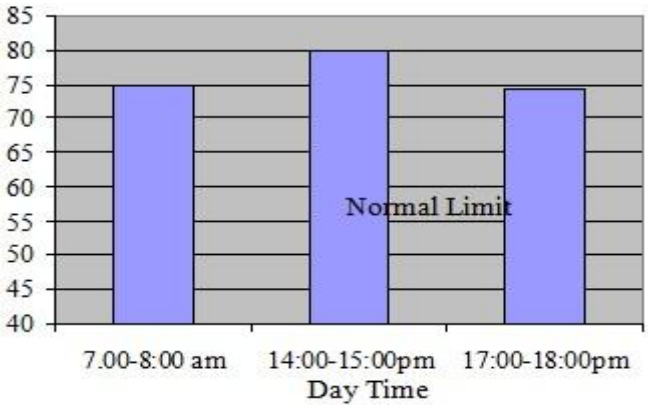

Fig. 6 The average measurement Septa Square

Table IV. Ras Al-Joura Square 15 minute measurement period

Day time	Measurement periods (minute)	Vehicle Types			LAeq (dB)
		Car	Van	Lorry	
7:00-8:00 am	15	112	100	6	74
	30	122	81	11	74.7
	45	40	38	18	75.8
	60	46	55	12	75
14:00-15:00 pm	15	180	91	21	81.5
	30	188	105	20	82.4
	45	132	78	20	78.8
	60	123	82	26	77.2
17:00-18:00 pm	15	157	83	30	71.5
	30	142	70	23	75
	45	157	83	22	80
	60	182	86	14	71.1

Table V. The average measurement Ras Al-Joura Square

Day time	Car and Van	Lorry	Average LAeq (dB)
7:00- 8:00 am	594	47	74.875
14:00-15:00 pm	979	87	79.975
17:00-18:00 pm	960	89	74.4

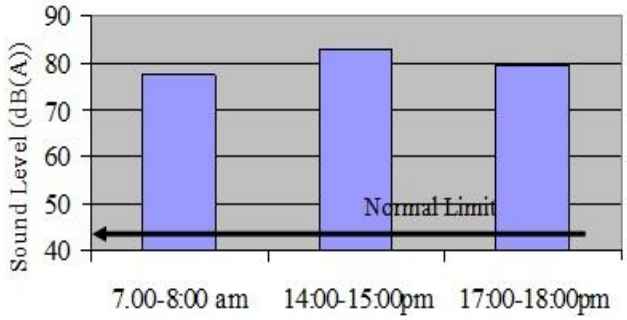

Fig. 7 The average measurement Ras Al-Joura Square

IV. RESULTS AND DISCUSSION

There have been many studies on noise levels in recent years in various countries. In one of these studies (Zeid et al., 2000), the noise level in Arraba city in the Occupied Palestinian Territories since 1948, was found to be 67 dB(A), from 20 measuring points. In Curitiba in Brazil, at 93% of the measurement points, the noise level was over the limit value 65 dB(A) and it was over high noise of being 75dB(A) at 40.3% of these points (Zannin et . al., 2002). In Beijijg (Li et al., 2002) Capital Cities, Assiut (Ali, 2004), Messina (Piccolo et.al., 2005) noise levels exceed the allowed values

Evaluation of traffic noise has several uses, including estimating current noise exposure along roadways, assessing the effect of roadway changes and determining (predicting) the performance of noise abatement options. The basic and main elements of traffic noise evaluation are the traffic source levels and the propagation of sound between traffic and receiver.

Evaluation of noise measurement was based on a limit value of 55 dB(A) in noise control regulation in Egypt (international standards used are limited to 65 dB(A)) and it was found from the measurements that allowed limit values were exceeded of all measurement points (higher than 65 dB(A)). The highest noise value (85.8 dB(A)) was recorded in Sebta Square at peak traffic hours between 14:00-15:00 pm, while the minimum noise value was (71.1 dB(A)) between 17:00-18:00 pm at the same location. The maximum average LAeq was (83.05 dB(A)) and the average minimum value was (77.225 dB(A)).

Noise also exceeded the (65 dB(A)) allowed limit value on Ras Al-Joura square as it is shown in tables 4-5 and figure 7 (almost (80 dB(A)).

V. CONCLUSION

Regarding the data achieved during noise measurement and the high equivalent noise level in all research conducted in the investigation areas, implementing strategies to control the noise in the Palestinian Territories is very necessary and urgent. The results proved that noise pollution must be devoted more attention and reached serious levels and it has become one of the major environmental problems. Therefore, protections related to planning, technical, biological, legislative and educational issues should be taken in order to avoid negative effects of noise pollution on the environment and human beings. In addition, the awareness of the population about the risk of noise pollution is the most effective noise control.

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