

A STUDY ON NOISE INTENSITY IN THE INDUSTRIAL DISTRICT IN KARBALA CITY BY USING GEOGRAPHIC INFORMATION SYSTEMS (GIS)

ZUHAIR ABDUL WAHAB AL JAWAHERY

Assistant Professor, College of Engineering, University of Kerbala, Iraq

ABSTRACT

Healthy environment for human has become a basic need for having a life free from psychological and bodily diseases, therefore the aim of the present work is to shed light on one of the main district in the city, that is, the industrial district devoted to crafts in order to find out how far it meets healthy environment requirements (in terms of noise). From the work on the area under study, the researcher has reached several conclusions from which

- Craft businesses (such as car and truck repair workshops, blacksmithing workshops, car spare parts stores as well as sundry stores) concentrate in this area
- All workers in the district do not use ear-protection headphones
- Two thirds of them suffer from noise
- One third suffers from mild hearing loss, sleep disorder and high blood pressure
- 16% of them suffer from stress
- A noise level chart of the district should be made. It is worth mentioning that blacksmithing workshops and truck repair workshops cause more noise than other craft businesses
- The district stands in need of green belts although they are stipulated in the sector master plan

KEYWORDS: Human Communication, Healthy Environment, Psychological

INTRODUCTION

Environmental planning is considered one type of planning because it is concerned with providing quality life for man. Therefore any contamination of the environment will affect directly or indirectly man's activities. Among these contaminants is noise pollution (noise). On the whole noise is considered a distinctive feature of a modern society though sound has several advantages for example it is a means of human communication, it provides enjoyment when listening to soft music, for example, and birds twittering. It is also a means of drawing attention as in the case of a door bell and even of warning as in the case of a siren and a car horn. Noise at the same time if used excessively or improperly, will be a source of inconvenience as well as if the principles occupational safety in industrial establishment are not applied thus resulting in negative reactions on humans [1]. Scientific research has proved that causes increase in the secretion of adrenaline hormone which is responsible for hardening of arteries (atherosclerosis), high cholesterol level and diabetes. Increase in cortisone hormone will lead to decrease in the body resistance to infection and to increase in stress [2]

Noise has a great effect on man's health and way of living to the extent that man gets hearing loss when exposed to high intensity noise for a long time and may have high blood pressure, stomach ulcer and duodenal ulcers, a rise in blood sugar, heart diseases, stress and migraine [3]

Research Aim

The research aims to study the following

- The distribution of noise intensity within the Industrial district and identification of the places where noise intensity is higher than the permitted level by using modern techniques and means such as GIS
- The effect of noise intensity on the number of people working there

Research Problem

The research problem covers the problem that a number of workers in the Industrial district show symptoms which indicate bad health condition. Moreover, people who frequent the district to have their cars repaired will also suffer.

Research Method Used

The researcher has adopted new techniques used to define coordinates of certain points (GPS), and measure noise intensity. Furthermore, Arc Map which is one of the programs used in Geographic Information System (GIS) is also employed.

RESEARCH METHODOLOGY

The research consists of two parts, the first is theoretical which covers types of noise, means of measuring noise and criteria used while, on the other hand, the second part deals with the way to measure and analyze noise and draw noise lines for the area under study. Then conclusions and recommendations are given

The First Part (Noise Source, Types and Criteria)

Noise

This word is derived from the Latin word NAVSES. The British Encyclopedia defines it as unwanted sound and the American Encyclopedia defines it as undesirable sound [4].

Noise is also defined as a number of contradictory and undesirable sounds resulting from internal or external sources which in one way or another affect man's health and quality of life [5].

From the above mentioned definitions, it is realized that noise is a hearing contaminant which harms man's health

Noise Sources

Noise Sources are classified into three main categories in terms of the distribution of sound waves coming from these sources. These categories are [6]

Point Sources

They are characterized by having fixed location such as electric generator, metal hammering and metal cutting which send out ball like sounds spreading in all directions in a varying way (the noise source in this study is of this type)

Linear Sources

The movement of automobiles and trains is the best example of this type because these sources are point sources but in continuous motion in a straight line. They are separated by equal distance and move at varying speed depending on the speed of the source

Plane Sources

The fronts of building and surfaces of rooms are of this type. Noise is spread from these surfaces to the neighboring areas. The recipient stands at a distance from the source. The surface which reflects the noise is the plane surface (Some noise sources in this research are of this type)

There are some factors affecting noise among which are [7]

- Place and time of exposure whether day
- The time period of exposure to high intensity noise
- The distance between high intensity noise source and the recipient
- The area in which noise is taking place. Sound is reflected by walls and ceiling, resulting in enhancement of intensity of noise.

Types of Noise [8]

- **Indoor Noise:** It covers all noise sources to which people are subjected inside a building (whether home or somewhere else) or various establishments whether industrial or non industrial
- **Outdoor Noise:** It covers all noise sources whose waves come from outside of a building (whether home or somewhere else) into the inside. They are classified into
 - Traffic noise
 - Airplane noise
 - Industrial noise
 - Societal noise

Noise Measurement [9]

Noise is measured by a meter called sound level meter. It is designed to detect sound in a way similar to that used by human ear to measure sound level. In this instrument the sound waves are converted into electrical waves by means of a microphone. They are amplified by the amplifier and then passed through specialized meter to record the magnitude of these waves.

The sound level (dBA) represents the average of noise level. (The researcher has adopted this system to study the area)

Time Period

Normally, when recording noise level for any area, it is important to define the time period of the recording. For any area, there is permitted threshold. The time periods adopted by most countries are given below (some countries differ in the classification of time periods) [10]

- Daytime between (7 am-6 pm). This time period is adopted in this study)
- Night time between (6 pm – 10 pm)
- Night time between (10 pm – 7 am)

Noise Intensity Criteria

Since the study on noise is very important since it concerns man’s health, international and regional organizations have certain set criteria for a variety of activities. Some of these criteria are given below

- Criteria set by WHO (Geneva)
- Table 1 gives the criteria adopted by WHO whose mains office is in Geneva. From the table it is seen that the highest noise level permitted for industrial areas is 70 decibels

Table 1: Gives the Criteria Adopted by WHO-Geneva

Specific environment	Critical health effect(s)	L _{Aeq} [dB(A)]	Time base [hours]	L _{Amax} fast [dB]
Outdoor living area	Serious annoyance, daytime and evening Moderate annoyance, daytime and evening	55 50	16 16	- -
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms & pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoor	Sleep disturbance	30	sleeping-time	45
School, playground outdoor	Annoyance (external source)	55	During play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time Sleep disturbance, daytime and evenings	30 30	8 16	40 -
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music and other sounds through headphones/ earphones	Hearing impairment (free-field value)	85 #4	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	-	-	140
	Hearing impairment (children)	-	-	#2 120 #2
Outdoors in parkland and conservations areas	Disruption of tranquillity	#3		

#1: As low as possible.
 #2: Peak sound pressure (not LAF, max) measured 100 mm from the ear.
 #3: Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low.
 #4: Under headphones, adapted to free-field values.

REFERENCE [11]

Arab Code Criteria

Table 2 shows the criteria adopted by the Arab League (whose mains office is in Cairo). From this table, it can be seen that the highest noise level permitted in an industrial area is 70 decibel in daylight (as is done in this research for the area under study). This Code has been adopted in the evaluation of noise intensity in the area under study

Table 2: Shows the Criteria Adopted by the Arab League

Type of the area	The highest noise level permitted					
	Daylight		Evening		Night	
	From	to	From	to	From	to
Commercial and administrative areas and town center	55	65	50	60	54	55
Residential areas with some workshop or businesses or on public roads	50	60	45	55	40	50
Residential areas in towns	45	55	40	50	35	45
Residential areas with low movement	40	50	35	45	30	40
Rural dwellings, hospitals, gardens	35	45	30	40	25	35
Industrial areas (heavy industries)	70	60	55	65	50	60

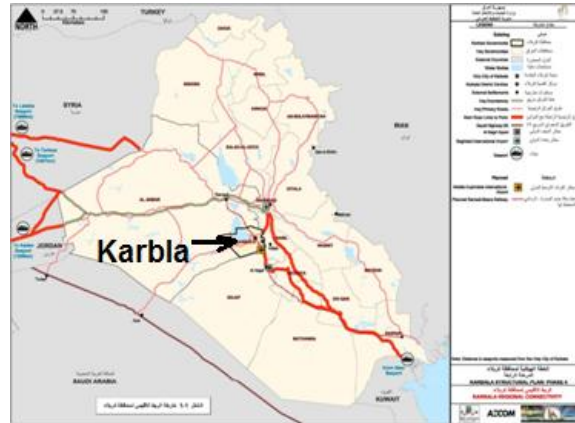
Daylight from 7 am to 6 pm
 Evening from 7pm to 10 pm
 Night from 10 pm to 7 am

REFERENCE [12]

The Second Part: Study and Analysis of Noise in the Area

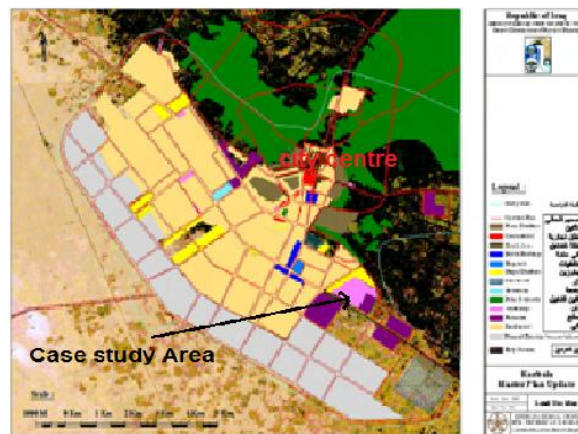
Description of the Area under Study

Karbala is an Iraqi city located south west of Baghdad at a distance of 100 km as shown in map 1. The Industrial district, the area under study, lies south east of Karbala City according to the Master Plan shown in Map 2. The Industrial district lies at 4.2 km from City center on the main road between Karbala and Najaf.



Map 1: The Location of Karbala Relative to Iraq

Reference: Ministry of Municipalities and Public Works, Directorate General of Urban Planning, Structural Plan Project for Karbala Governorate, Report on the Fourth Phase, page13. August 2013

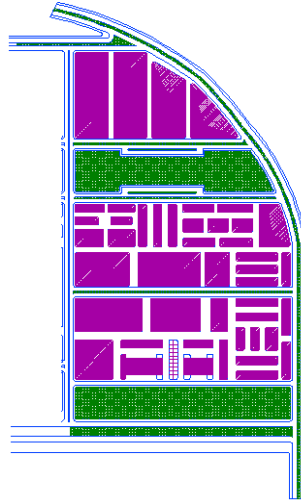


Map 2: The Location of the Industrial District (The Area under Study) in the Master Plan of the City

Reference: Ministry of Municipalities and Public Works, Directorate General of Urban Planning, Project for Updating the Master Plan of the city of Holy Karbala, Report on Data Collection page 20. June 2007

The Industrial district occupies the area of 0.627km square and consists of a number of blocks where a variety of activities are carried out such as repair of small and large vehicles, sale of vehicle spare parts. There are blacksmith workshops, and a number of restaurants. Most operators do their work at the entrance to the block that is outside the building.

Map 3 illustrates the Industrial district, the area under study where green belts are marked but as a matter of fact there are no green belts except for some trees here and there. The aerial photo no 1 confirms this.



Map 3: Illustrates the Design of the Industrial District

Reference: The Directorate of Municipality of Holy Karbala, the Branch of Town Planning



Photo 1: The Aerial Photo 1 Illustrates the Area under Study and its Neighborhoods

Field Survey

In order to prepare a contour map showing the distribution of noise intensity in the area under study and bring out its effect on the people working there a field survey was made in the Industrial district, using two procedures. They are:

- Outdoor A sound level meter model DS-102 whose photo is shown in Figure 2 and GPS map model shown in Figure 1 to record measurement of noise intensity for 100 randomly selected locations close to the blocks. The coordinates of these locations were fixed and then arranged in tables using Excel program as shown in Table no 3 which gives the locations and the related noise intensity against each.



WACO 102 Sound Meter

Source: The Researcher

Figure 1: A Sound Level Meter Model DS-102



Figure 2: GPS MAP 78

Table 3: Shows the Coordinates of Locations and the Related Noise Intensity against Each Location

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	easting	northing	decible		No	easting	northing	decible		No	easting	northing	decible	
2	409814	3604951	55.4		41	410424	3605106	69.2		81	410567	3604495	69.4	
3	409851	3604982	60.2		42	410462	3605165	68.5		82	410514	3604534	71.4	
4	409895	3605013	69.2		43	410505	3605227	69.4		83	410553	3604590	75.1	
5	409969	3605041	60.8		44	410549	3605261	71.9		84	410601	3604572	70.1	
6	410025	3605073	68.5		45	410593	3605240	74.3		85	410631	3604602	66.7	
7	410109	3605103	62.9		46	410639	3605207	77.5		86	410664	3604651	65.8	
8	410183	3605129	58.8		47	410681	3605177	78.5		87	410699	3604694	68.3	
9	410231	3605167	60.9		48	410674	3605138	71.2		88	410720	3604741	68.1	
10	410280	3605219	69.2		49	410650	3605096	77.7		89	410627	3604800	72.2	
11	410345	3605261	65.1		50	410589	3605010	73.6		90	410562	3604843	68.4	
12	410410	3605310	66.1		51	410551	3604995	66		91	410521	3604925	69.5	
13	410453	3605335	69.3		52	410516	3604915	69.4		92	410463	3604826	74.5	
14	410456	3605299	66.9		53	410485	3604864	75.8		93	410445	3604797	68.3	
15	410418	3605244	64.5		54	410436	3604801	69.3		94	410331	3604751	65.3	
16	410388	3605198	67		55	410408	3604760	66.4		95	410290	3604783	69.2	
17	410343	3605208	62		56	410388	3604729	66.1		96	410198	3604790	68.1	
18	410349	3605156	67.9		57	410366	3604701	65		97	410161	3604703	68.3	
19	410327	3605116	66.5		58	410340	3604669	74.4		98	410187	3604680	71.2	
20	410295	3605063	67.7		59	410298	3604608	72.4		99	410227	3604652	73.2	
21	410256	3605010	74.3		60	410388	3604608	72.5		100	410258	3604630	70.3	
22	410214	3605029	60.7		61	410449	3604576	72.1						
23	410232	3604979	67.3		62	410479	3604619	74.3						
24	410187	3604913	69.6		63	410511	3604668	75.3						
25	410412	3605930	62.8		64	410545	3604713	76.9						
26	410091	3604967	70.9		65	410582	3604764	70.1						
27	410051	3604919	70.3		66	410624	3604734	75.9						
28	410062	3604870	77.1		67	410655	3604779	62.3						
29	410085	3604844	66.6		68	410692	3604822	70.3						
30	410050	3604784	71.2		69	410723	3604863	71.3						
31	410069	3604750	73.3		70	410789	3604929	72						
32	410104	3604788	73.5		71	410813	3604973	68.1						
33	410137	3604832	70.8		72	410903	3604910	73.6						
34	410145	3604724	74.6		73	410884	3604758	61.3						
35	410181	3604755	67.8		74	410856	3604721	68.2						
36	410225	3604825	67.5		75	410823	3604678	67.7						
37	410268	3604883	68.5		76	410785	3604619	76.3						
38	410313	3604954	73.5		77	410744	3604567	71.5						
39	410342	3604996	67.3		78	410693	3604496	73.3						
40	410381	3605045	70.4		79	410651	3604440	76.3						
41	410424	3605106	69.2		80	410605	3604467	70.6						

Source: The Researcher

After the data were transferred to ARC MAP Program where they were processed and a contour map was drawn showing noise intensity in the area under study as shown in map no 2 where one can see the distribution of noise intensity in the area under study. The contour map was transferred to the aerial photo as shown in photo No 4 where lines of magnitude of over 70 decibels concentrate in area where there workshops for the repair of trucks, blacksmiths and small plants

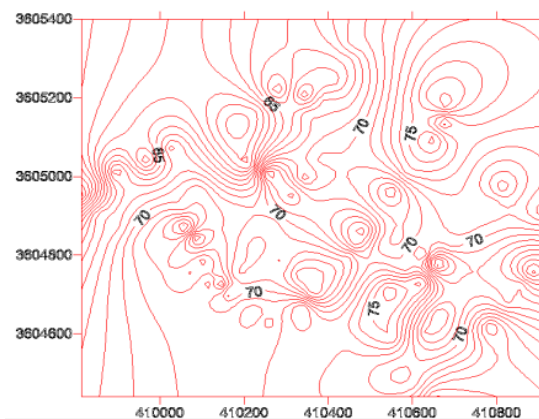


Figure 3: The Map 2 the Distribution of Noise Intensity Lines in the Area under Study



Source: The Researcher

Figure 4: The Aerial Photo 4 the Distribution of Noise Intensity Lines in the Area under Study

- Questionnaire Forms: (100) questionnaire forms were distributed among operators working in the areas which have recorded high noise intensity to find out how far they are affected by the noise. Form No 1 in the Appendix shows the noise percentage of the each area and thus shows the areas which suffer most of noise according to the Arab Code.

From this work a number of conclusions have been drawn

- One third of the Industrial district suffers from noise intensity that is more than 70 decibel
- Nearly two thirds operators have spent more than 10 years working in the district
- Nearly two thirds of operators are more 40 years old
- All operators in working in the district do not use ear-protection headphones
- Nearly two thirds of the shops are automobile repair shops
- Nearly two thirds operators are suffering from noise intensity
- The average working hours in the Industrial district are 7 hours in daylight
- There are no trees close to 93% of the shops in the Industrial district
- Nearly two thirds of operators are suffering from bad hearing, disturbance of the normal sleep pattern and blood pressure
- 16% of operators in working in the district have nervous stress
- 27% of operators in working in the district have diabetes
- 29% of operators in working in the district have migraine
- All operators in blacksmithing and small plants suffer from a variety of diseases.
- Studying The aerial photo No 4 indicated by the contour map for noise intensity, it can be noticed that
 - Noise intensity of truck repair shops ranges between 70 and 75 decibel is more than that permitted
 - Noise intensity of blacksmithing and small plants is 75 decibel is more than that permitted
 - Noise intensity of small car repair shops is within permitted range

The following recommendations are put forward

- Continuous repair of machinery reduces noise coming from them
- The relevant government department should continuously inspect the shops from which high level noise is Coming
- Measure should be taken to plant trees in the places specified according to the Industrial district Plan
- It should be emphasized that operators should wear ear-protection headphones

REFERENCES

1. Al-Fadly, Saoud Abdul Azziz, Noise Pollution in Basra City, Bulletin of the College of Arts, Vol. 1, No 54, 2012, pp 148
2. Dept. of Air Quality, Office of Planning and Technical Follow-up, Ministry of Environment, Republic of Iraq, A Study on Noise Sources, 2008 pp 6
3. Majeed, Neda Numaan, A Study on the Effect of Noise on Town Planning to Define Land Use, Al Anbaar Journal for Engineering Sciences Vol. 1, No 2, 2008, pp 124
4. Ministry of Environment, Republic of Iraq *ibid* pp2
5. The Cooperation Council for the Arab States of the Gulf, Criteria for Noise Level. A Draft to Control Noise in Internal and External Environment 1999, pp 23
6. Ubeyd, Mohammed Abdul Fatah, Principles of Architectural Lighting, King Saud University Press 1999, pp 23
7. Ministry of Environment, Republic of Iraq *ibid* pp 2
8. The Cooperation Council for the Arab States of the Gulf *ibid* pp 25
9. Penn, Christopher, Noise Control, Shaw and Sons Ltd, London, 1979, p3
10. The Council of Arab Ministers of Housing and Reconstruction, the Unified Arab Code for building Design and Construction =the Code on sound Insulation, 2009 pp11
11. Berglund, Birgitta and Thomas, Guidelines for Community Noise, World Health Organization, Geneva, 1999, p xv
12. The Council of Arab Ministers of Housing and Reconstruction, *ibid* 11

APPENDICES

Karbala University College of Engineering

Department of Civil Engineering

Questionnaire No ()

Dear people (please do not mention names because the installed information is for scientific research only)

The correct answer to Questions installed below will help provide a healthy environment within the area of the industrial district and hence the positive results will appear on the health and activity of their employees. Researcher

The amount of noise intensity Less than 60dB 60-70 dB Greater than 70 dB	%3 %65 %32	Duration of the work within the profession Less than 5 years 5 - 10 years More than 10 years	%9 %28 %63
Nature of the work Auto Repair Shop Backup tools shop for cars And a metal workshop Factory Other	%17 %49 %34 %66 %8	Do you use a protective noise Yes Both	%0 %100
Age Less than 20 years 20 - 40 years Greater than 40 years	%19 %2 %5	Do you suffer from noise Yes Both	%65 %35
The number of working hours per day 6 hours 7 hours 8 hours	%40 %46 %14	Are there trees adjacent to the work site Yes Both	%7 %93
Do you suffer from the following symptoms: - Hearing impairment: - Sleep disorders - Feeling upset and nervous tension - A stomach ulcer: - High blood pressure: - Lack of focus and absorption - Increase in the percentage of sugar - A constant headache in the head	%33 %29 %16 %7 %37 %12 %27 %29		