Measurement of Noise Level Coming from Electric Generators in Karbala University

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***Abstract*—**Noise pollution has become a phenomenon affecting most places and activities of Man within towns. No doubt, universities are part of these activities. The researcher has taken several readings of noise levels in open spaces within the University by using sound level meter. Noise was measured before and after the operation of the generators which are distributed near colleges. It is noted these generators, when operating, emit a higher level of noise than that permitted by standards. The highest level is produced by the generator installed in the College of Engineering which reached 98 dB and the lowest level is produced by the generator installed in the College of Medical Sciences which reached 84 dB while the level permitted by International standards is 55 dB, the reason for this rise is discussed in the research. Contour maps were prepared showing the distribution within University precincts by using GPS.

***Keywords*—** pollution, noise, GPS

I. Introduction

NOISE at present has become one of the sources of Man annoyance especially in urban areas because of overlapping of a variety of activities such as road traffic, trains, aircraft, plants with their machinery and power plants. Noise is felt both indoors and outdoors>

Noise is defined in several ways.

- It is undesirable sound, making abnormal or intermittent frequencies (1)
- It is a number of annoying sounds which has annoying effect on the ears and makes one irritated intensely (2)

If noise goes uncontrolled source, it becomes one type of pollution called noise pollution, it is then defined as an undesirable sound which comes from a variety of human daily activities and has harmful environmental effect, posing a risk to public health (3).

Noise has auditory and non- auditory effects. For auditory effect, it has been proved clinically that continuous exposure leads to the loss of hearing and it affects Man's physiological system and psychological health (4).

From a number of studies carried out in some European cities, it has been proved that students whose schools are located close to airports, railway lines and motorways suffer from hearing impairment and frequent nervous tension leading to low academic level compared with students whose schools are located far from noise sources. (5).

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II. Research Aim

The research aims to achieve the following

Measuring the noise level within University of Karbala staff area when the electric generators are operating and comparing the results with those of normal condition to find out the extent these generators affect the people nearby and specify the areas where noise effect is over the acceptable limit by using modern technological instruments and GPS. The research aims also to determine which generator more noise pollution.

III. Research Problem

It is that students spend their leisure time close to the electric generators when they are operating and thus they produce noise.

IV. Research Materials and Methods

The researcher has adopted modern technological instruments used to define the coordinates of point locations for GPS and measure noise intensity. Use is also made of (Arc map) program which is one one program of GIS package.

V. Research Procedure

The research is composed of two parts. The first is theoretical part which covers types of noise, the way it is measured and its criteria. The second part, on the other hand, involves way to measure noise level, analysis and drawing of noise routes within the study area as well as conclusions and recommendations.

The First Part includes noise (sources, types of noise, its criteria and ways to reduce it.

VI. Noise Sources

Noise sources are classified into three main types which differ in terms of propagation of sound waves they emit. These sources are (6).

A. Point sources

Point sources are characterized by fixed location of sound source like electric generator, hammering of metals, iron cutting machine. They emit sound in spherical form in all directions and in varying ways. (The noise source in this research is of this type). Diagram (1) illustrates the level of noise emitted by electric generators.

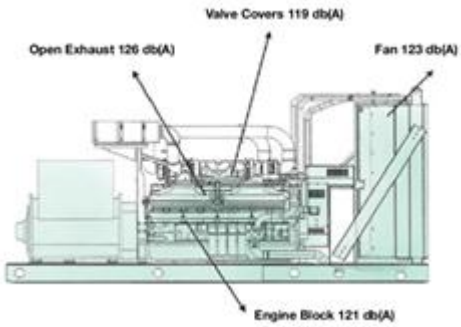

Fig 1 illustrates the level of noise emitted by electric generators
Sources: The Internet under heading (types of electric generators)

B. Line sources

Vehicle traffic and train running are considered the best example of this type of noise source because they are point source but in constant motion in a straight line. The noise levels get apart at equal distances and varying speeds depending on source speed.

C. Plane sources

Building fronts or rooms are examples of this type of noise source because noise spreads through these surfaces to the neighboring places. The noise recipient is at a distance from the front. The surface reflecting the noise is the surface source. (Some noise sources in this research are of this type).

Types of Noise (7)

1. Indoor noise

It is all types of noise a person is subject to inside a building (whether a home or else) and different institutions whether industrial or not.

2. Outdoors noise

It is all types of noise whose waves travel into the building (whether a home or else). It is classified into.

- noise from taffic and airplanes
- noise from plants and machines
- community noise

VII. Noise Measurement

Sound level is measured by sound level meter which is designed to sense sound like a human ear thus giving sound level measurement; dB A represents the mean noise level. (The researcher has used this system in the study area). Sound level is measured in decibel (dB).

VIII. Noise Level Criteria

International and regional organizations have set specific criteria for noise measurement to accommodate various activities. World Health Organization (Geneva) has set the criteria listed in Table (1) which shows that the highest permissible noise level for educational institutions is 55 dB.

Table I
The Criteria Set By World Health Organization (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 Inside bedrooms	Speech intelligibility & moderate annoyance, daytime & evening Sleep disturbance, night-time	35 30	16 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) Hearing impairment (children)	- -	- -	140 #2 120 #2
Outdoors in parkland and conservations areas	Disruption of tranquility	#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.

Source: (9)

IX. Noise Level Reduction Methods

There are different methods to reduce noise coming from machines and equipment. They include :(10).

1. Installing generators in areas where there are evergreen trees which absorb and disperse noise and thus reduce noise level. - Tsohos,Gorge has shown that trees planted for 100 meters will reduce noise level by 40 dB. This is illustrated in diagram (2).

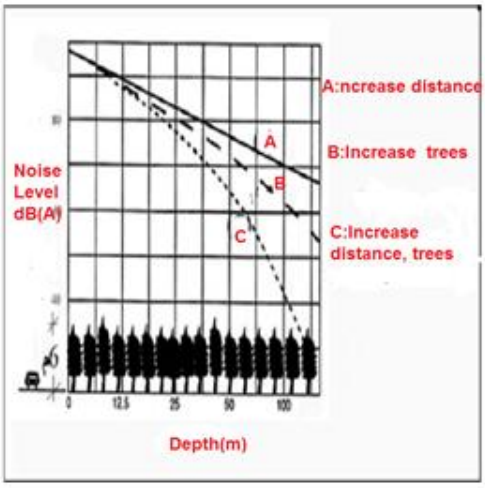

Fig. 2 illustrates the extent of tree effect on noise level reduction

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2. Sound barriers can be used in places where trees cannot be planted. The efficiency of the barrier depends on its

height and distance from noise source. The higher the barrier and the closer to the noise source, the more efficient it is. With sound barrier, the reduction in noise level can reach up to 20 dB. This is illustrated in diagram (3).

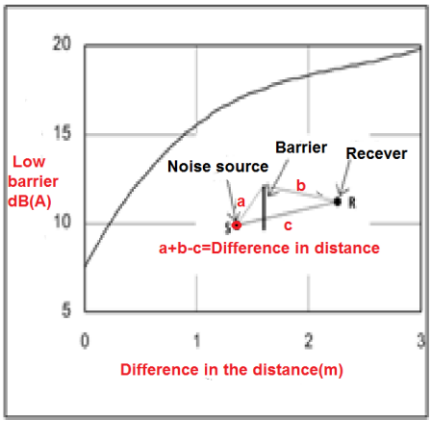

Fig 3 illustrates the extent of barrier effect on noise level reduction

3. Use should be made of silent electric generators which can reduce noise level by 15dB on average. Photo (1) illustrates this type.

Fig 4 illustrates this type of electric generators
Source: Internet under the heading Types of electric generators

Scond Part: Study and Analysis of Noise within the Study Area, Description of the Study Area Karbala is an Iraq city lying in the south west of Baghdad. It lies 100 km from Baghdad. Map (1) (1) illustrates this

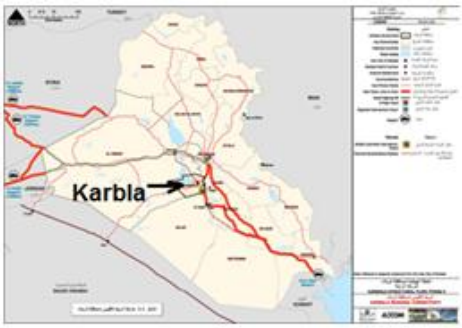

Fig 5 shows the location of Karbala province relative to Iraq
Source: Ministry of municipalities and Public Works-General Directorate of Urban Planning-Structural Plan Project for Karbala Province – eport on the Fourth Stage, August 2013 p 13

University of Karbala occupies two sites, one of them is inside the City (Site Two) in Hay Muathafeen and the other is outside the City (Site One). Photo (2) illustrates this

Fig 6 illustrates the locations of University of Karbala Site 1 and 2 relative to Karbala
Source: The researcher

The study area (Site Two) covers (121060) sq m and houses six colleges they are Colleges of Medicine, Dentistry, Pharmacy, Engineering, Medical Sciences, and Physical Education. Photo (3) illustrates locations of colleges. One can see the green zones among the buildings as well as the playground of Physical Education College.

Fig 7 illustrates locations of colleges.
Source: The researcher

The electric power supplied by the National Grid is not provided 24 hrs. in fact there many outages which range between 2-4 hours during office hours. In such times, resort is made to electric generators which are installed in many places within the University campus. Table (2) shows the number of generator location for each college and the type of use of the area next to it. Photo (4) shows the locations of the generators, Photo (4) shows the generator for the College of Physical Education. It is seen the generator is enclosed with BRC fence.

TABLE II
SHOWS THE NUMBER OF GENERATOR LOCATION FOR EACH COLLEGE AND THE TYPE OF USE OF THE AREA NEXT TO IT

No	Belonging to	Use of area next to it
1	Engineering College	Student cafeteria
2	Physical Education College	Car park + open area
3	Physical Education College	Open area
4	Pharmacy College	Open area+ green zone
5	Dentistry College	Open area+ green zone
6	Medical Sciences College	Green zone
7	Medicine College	Student cafeteria
8	Pharmacy College	Open area+ green zone

Source: The Researcher

Fig 8 showing the locations of electric generators
Source: The Researcher

Fig 9 showing the electric generator of Physical Education College

X. Field Survey

In order to make a contour map showing the distribution of noise intensity in the study area, a field survey was made of it.

1) Outdoors : Sound level meter model DS-102shown in photo(6) and GPS map model 78 shown in photo (7) were used to measure noise intensity in various location in University campus (200 points) before and after generators' operation. The coordinates of these locations were fixed and put in tables fed to Excel program as shown in Table (3) which shows the coordinates for some locations as well as noise intensity for each location before generator operation. On the other hand, Table (4) shows the readings after operation.

Fig 10 Sound meter model DS-102
Source: The Researcher

Fig 11 GPS MAP 78 instrument
Source: The Researcher

Table III
Shows The Coordinates For Locations Where Noise Intensity Was Measured Before Generator Operation

NO	EAST	NORTH	SOUND LEVEL	NO	EAST	NORTH	SOUND LEVEL	NO	EAST	NORTH	SOUND LEVEL
1	406266	3608234	57	32	406301	3608441	55	63	406410	3608325	60
2	406273	3608238	59	33	406265	3608405	56	64	406370	3608310	58
3	406280	3608245	63	34	406262	3608400	54	65	406365	3608313	55
4	406244	3608244	63	35	406225	3608393	54	66	406379	3608333	60
5	406290	3608244	61	36	406211	3608428	52	67	406342	3608313	60
6	406287	3608248	60	37	406232	3608457	56	68	406316	3608336	61
7	406302	3608264	59	38	406251	3608458	54	69	406331	3608295	60
8	406321	3608261	61	39	406273	3608440	57	70	406307	3608330	60
9	406305	3608291	59	40	406258	3608387	54	71	406338	3608398	54
10	406284	3608279	54	41	406294	3608345	53	72	406379	3608419	58
11	406255	3608264	57	42	406313	3608316	55	73	406423	3608445	56
12	406238	3608264	49	43	406328	3608291	56	74	406467	3608474	55
13	406224	3608286	48	44	406295	3608534	63	75	406513	3608501	57
14	406217	3608298	53	45	406334	3608530	56	76	406533	3608505	59
15	406229	3608309	46	46	406348	3608515	63	77	406561	3608507	54
16	406242	3608311	53	47	406326	3608498	61	78	406568	3608481	57
17	406255	3608291	55	48	406347	3608462	64	79	406531	3608457	56
18	406271	3608315	53	49	406374	3608478	62	80	406538	3608429	57
19	406287	3608319	55	50	406410	3608495	56	81	406569	3608421	59
20	406284	3608347	57	51	406426	3608471	60	82	406595	3608439	57
21	406264	3608360	57	52	406484	3608456	59	83	406577	3608463	57
22	406236	3608351	50	53	406567	3608483	59	84	406501	3608439	57
23	406209	3608341	56	54	406576	3608515	60	85	406464	3608411	57
24	406173	3608396	53	55	406613	3608548	57	86	406398	3608374	59
25	406143	3608403	54	56	406641	3608538	53	87	406368	3608366	55
26	406112	3608381	55	57	406660	3608505	56	88	406384	3608348	56
27	406139	3608460	69	58	406526	3608397	61				
28	406175	3608477	66	59	406475	3608370	61				
29	406217	3608504	60	60	406459	3608393	57				
30	406246	3608519	63	61	406498	3608429	60				
31	406269	3608495	59	62	406395	3608364	63				

Source: The Researcher

Table IV
Shows The Coordinates For Locations Where Noise Intensity Was Measured After Generator Operation

NO	EAST	NORTH	SOUND LEVEL	NO	EAST	NORTH	SOUND LEVEL	NO	EAST	NORTH	SOUND LEVEL
1	406282	3608235	99	32	406318	3608263	70	61	406262	3608382	74
2	406274	3608238	94	33	406315	3608274	62	62	406270	3608372	72
3	406274	3608238	95	34	406308	3608286	60	63	406282	3608374	70
4	406278	3608240	99	35	406301	3608298	63	64	406293	3608380	75
5	406280	3608239	99	36	406283	3608286	68	65	406311	3608381	82
6	406276	3608243	92	37	406267	3608277	68	66	406329	3608392	83
7	406269	3608238	95	38	406251	3608275	66	67	406337	3608389	94
8	406267	3608237	94	39	406261	3608281	63	68	406344	3608390	98
9	406267	3608234	94	40	406265	3608292	63	69	406348	3608392	91
10	406263	3608231	86	41	406274	3608298	62	70	406351	3608394	96
11	406261	3608235	85	42	406286	3608315	69	71	406352	3608389	92
12	406262	3608244	84	43	406280	3608353	74	72	406355	3608386	91
13	406266	3608248	84	44	406270	3608370	77	73	406348	3608383	89
14	406257	3608252	82	45	406263	3608380	81	74	406344	3608384	86
15	406258	3608257	81	46	406258	3608387	83	75	406341	3608387	82
16	406245	3608263	78	47	406254	3608398	82	76	406333	3608398	78
17	406254	3608272	74	48	406259	3608403	80	77	406349	3608411	76
18	406273	3608252	87	49	406270	3608406	88	78	406361	3608413	76
19	406278	3608248	90	50	406267	3608404	96	79	406372	3608401	69
20	406285	3608241	90	51	406265	3608401	97	80	406377	3608386	66
21	406286	3608242	94	52	406261	3608397	97	81	406368	3608371	64
22	406287	3608245	88	53	406263	3608396	94	82	406368	3608357	79
23	406291	3608245	90	54	406264	3608395	94	83	406417	3608436	87
24	406290	3608248	90	55	406267	3608396	81	84	406426	3608441	96
25	406284	3608250	90	56	406269	3608402	81	85	406433	3608444	88
26	406281	3608249	88	57	406272	3608405	80	86	406437	3608447	90
27	406274	3608247	82	58	406274	3608399	84	87	406441	3608444	88
28	406286	3608261	77	59	406273	3608390	80	88	406436	3608436	83
29	406292	3608267	70	60	406268	3608385	80	89	406434	3608430	82
30	406299	3608272	70								
31	406309	3608259	70								
32	406318	3608263	70								

Source: The Researcher

After that, the data were transferred to ARC MAP which is a program within GPS. After some processing was done, contour maps were drawn which represent noise intensity levels in study area. They are shown in Diagram (4). On the other hand, Diagram (5) shows the locations where noise intensity levels are higher than internationally accepted criteria. They are shown in green.

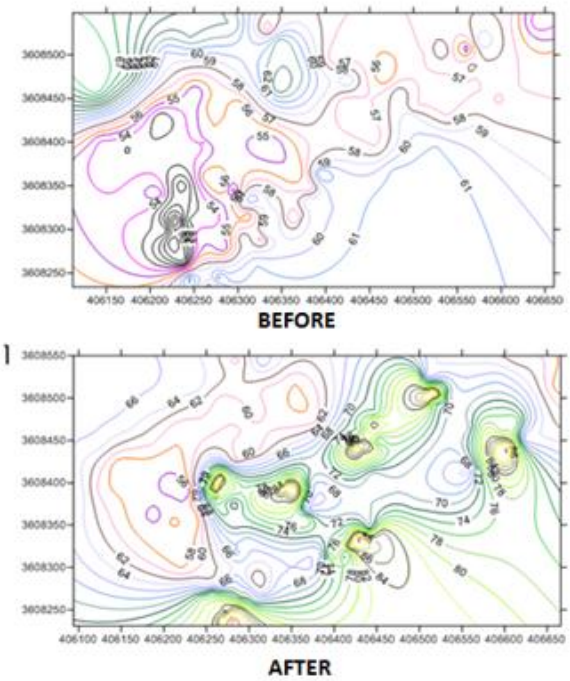

Fig 12 shows the distribution of equal noise intensity levels in the study area on an aerial photo after generators' operation
Source: The Researcher

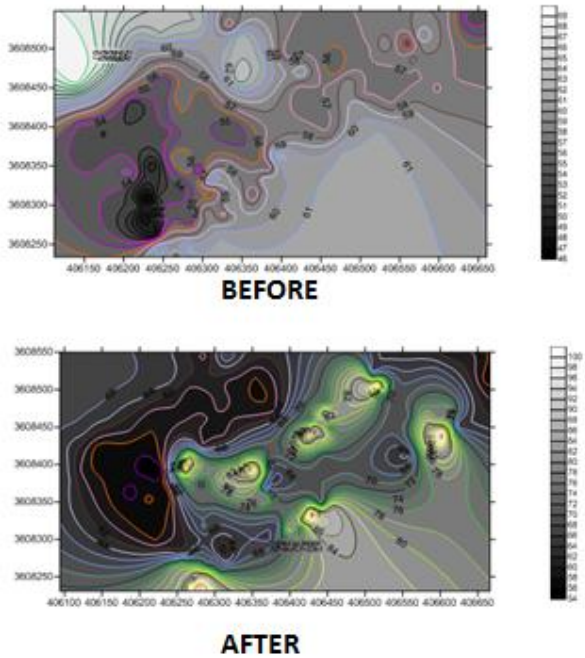

Fig 13 shows the locations where noise intensity levels are higher than internationally accepted criteria. They are shown in green
Source: The Researcher

Diagram (6) shows the locations where noise intensity levels are higher than internationally accepted criterion which is (55) dB before and after generators' operation.

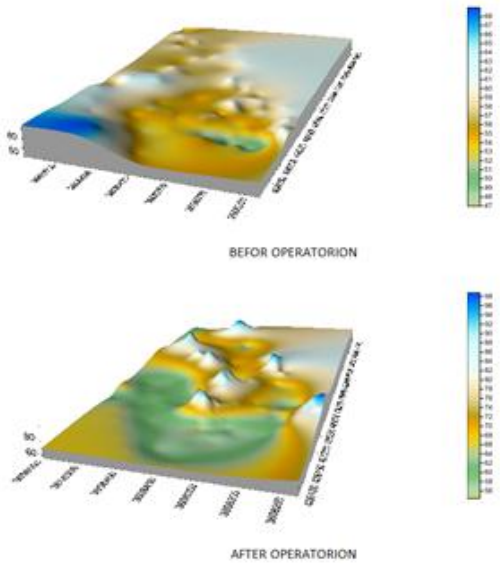

Fig 14 shows holographic view of the locations where noise intensity levels are higher than permissible limit
Source: The Researcher

XI. Conclusion And Recommendations

A. Conclusions

1. Noise intensity levels when generators are in operation are higher than permissible limit.
2. The highest noise level in University campus is 98 dB which is higher than permissible limit.
3. The lowest noise level in University campus is in the College of Medical Sciences (point 8) when generators are in operation is 84. This is because trees surround the generator and the generator itself is of silent type. Photo (8) shows the generator and its surroundings.

Fig 15 shows the silent type generator and its surroundings

4. The trees which surround the College of Medical Sciences reduce noise effect compared with other generators.
5. The location of generator of the College of Engineering (point1) and the location of generator of the College of Medicine (point7) have great effect on the students in the cafeteria.
6. Most generators are not surrounded by trees.
7. Third of University campus lacks environmental as shown in Diagram (5) by green and yellow lines.

B. Recommendations

1. It necessary to plant trees round the electric generators to reduce noise level.
2. It necessary to use silent generators like the one used in the College of Medical Sciences and shown in photo (8).
3. It necessary to use barriers round the electric generators to reduce spread of noise.
4. Continuous supervision should be made to maintain healthy environment

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