Study of Noise pollution at the campus of university of Sulaimani

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Accepted:2012/1/9 received:2011/5/9

Abstract

Pollution disturbs the concentration of people, as a result, they will be spending longer time for completing the work than that would be done in a quiet environment, in addition they feel more tired in the noisy area.

This study was carried out at the University of Sulaimani to show the level of noise pollution in this educational area, by using a digital noise dosimeter with a range of 43-130 dB. The areas chosen for the study were 25 areas in total, including the vacant spaces between halls of study at different floors of 5 colleges, in addition to 3 regions chosen from the field of the campus of the University.

Excel's computer program used for fitting model equations to the obtained experimental data. The noise intensity was above 70 dB in most studied areas, a level which is supposed to be the start of point causing harm to the hearing process of human beings. The source of most of the noises was the crowding and gathering of students both inside the buildings of the colleges (corridors) and in the field of the campus of the university, even after many of them having finished their classes and duties in their colleges.

The buildings were designed decades ago and the number of students and staffs is increasing yearly which makes it impossible to hold such a big number. The results showed that the occupational area for each student in general is less than $2m^2$ inside the buildings.

As excessive noise affects health of people deleteriously, the establishment of an agency under the name of Kurdistan Environmental Protection Agency (KEPA) is essential for controlling this and similar hazards.

Introduction

Noise can be defined as "disagreeable or undesired sound" or other disturbance. From the acoustics point of view, sound and noise constitute the same phenomenon of atmospheric pressure fluctuations about the mean atmospheric pressure, the differentiation is greatly subjective. What is considered a sound by somebody can be considered a noise by another person (Lawrence *et al*., 2005).

In common use, the word noise means any unwanted sound in both analog and digital electronics; noise is unwanted perturbation to a wanted

signal. Noise can block, distort or interfere with the meaning of a message in human, animal and electronic communication.

The recognition of noise as a serious health hazard is the result of development of the modern era. Modern industry and multitude of sources have accelerated noise-induced hearing loss. Amplified music also has its contribution to noise in modern life. While amplified music may be considered as sound (not noise) and even may give pleasure to many people, but considered as excessive noise by others (Lawrence *et al*., 2005). Noises health effects are the health consequences of elevated sound levels. Elevated noise can cause hearing impairment, hypertension, heart disease, annoyance and sleep disturbance (Ekin & Koundourl, 2008). Changes in the immune system and birth defects have been attributed to noise exposure but evidence is limited. Elevated noise levels can create stress, increase workplace accident rates, and stimulate aggression and other anti-social behavior. It is clear that noise is not the only industrial hazard to hearing, exposure to certain chemicals such as toluene and trichloroethylene can produce hearing loss, also the reactions to certain drugs. Most importantly is the interaction between noise and chemicals may produce more hearing loss than expected by either one alone, i.e. the two factors act synergistically in causing the damage (Franks & Morata, 1996).

Types of noise

Noise may be classified according to the way they vary with time into:

1. **Steady noise**

Steady noise is a noise with negligibly small fluctuation of sound pressure level within the period of observation; it is a constant continuous sound, Example, Pumps and Electric motor….

2. **Non-Steady noise**

A noise is called non-steady when its sound pressure levels shifts during the period of observation. This type of noise can be divided into:

a. Intermittent noise, which is characterized by a constant but intermittent sound, example, Air compressor and Automatic machinery during a work cycle.

b. Fluctuating noise, which is characterized by one or two single frequencies, fluctuating noise may consists of: *Periodically Fluctuating Pulses ex: Surface grinding *Non-periodically repeated impulses ex: Manual work *Single impulse ex: Hammer blow and*Repeated impulses like Automatic press. The above examples are illustrated in fig. 1.

The non-steady noise is much more annoying than broadband noise characterized by energy at many different frequencies, and of the same sound pressure level as the tonal noise (Lawrence *et al*., 2005).

Sound pressure levels

The range of sound pressures that can be heard by the human ear is very large. The minimum acoustic pressure audible to the young human ear in good health is approximately $20x10^{-6}$ Pascal's or $2x10^{-10}$ atmospheres (since one atmosphere equal $101.3\ x10^{3}$ Pascal). Lower sound pressure levels would be swamped by thermal noise due to molecular motion in air. For the normal human ear, pain is experienced at sound pressures of the order of 60 Pascal's $6x10^{-4}$atmospheres. Evidently, acoustic pressure ordinarily is quite small fluctuations about the mean. A linear scale based on the square of the sound pressure would require 10^{13} unit divisions to cover the range of human experience; however the human brain is not organized to encompass such a range .The remarkable dynamic range of the area suggests that some kind of compressed scale should be used. A scale suitable for expressing the square of the sound pressure in units best matched to subjective response is logarithmic rather than linear. Thus the Bel was introduced which is the logarithm of the ratio of two quantities one of which is a reference quantity (Bosan *et al*., 1995)

To avoid a scale which is too compressed over the sensitivity range of the ear, a factor of 10 is introduced giving rise to the decibel. The level of sound pressure p is then said to be L_p decibels (dB) greater or less than a reference sound pressure P_{ref} according to the following equation:

$$L_p = 10 \log_{10} p_{rms}^2 / pref^2 = 20 \log p_{rms}^2 / p_{ref}^2$$

$$L_p = 20 \log 10\ p_{rms} - 20 \log 10\ p_{ref}\ (dB)$$

For the purpose of absolute level determination, the sound pressure is expressed in terms of a datum pressure corresponding to the lowest sound pressure which the young normal ear can detect. The result is called the sound pressure level L_p (or SPL) which has the units of decibels. This is the quantity which is measured with a sound level meter. The sound pressure is measured by roots mean square value and internationally agreed reference pressure $P_{ref} = 2x10^{-5}\ N\ m^{-2}$ (Devichenskii, 2009). When the value of the reference pressure is substituted in the previous equation, the following alternative form is obtained:

$$L_p = 20 \log 10\ P_{rms} + 94$$

Experimental details

Data collections were made in the buildings of 5 colleges with a total of 25 different areas at different floors, in addition to 3 different regions in the field of the university park by using a high quality Sound Level Meter(SLM) with a range of 43-130 dB.. The measurements were obtained during 3 normal attendance study days on 6th, 7th and 8th of October 2009 during the time period 9(am) to 3 (pm).Noise intensity was measured in

the mentioned areas every half hour. Each time the average values of 3 repeated measurements were taken. The results are illustrated in the figures 2 to 13.Figures 4, 8, 9, and12 are the mean values of the noise of all the floors for the relative college at that time.

Excel's computer program used for fitting model equations to the obtained experimental data , the obtained equations are showed in figures 4, 6, 8 and 12.

Results and Discussion

Fig. 2 shows noise intensity in 3 different regions of the field of the University Park which was around 66 dB which is considered as an average outdoor noise pollution. Indoor and outdoor noise pollution sources include motor vehicles noise, emergency service sirens and many others, in addition to loudly speaking people of different backgrounds, from university students to sellers on the outside road shouting to declare their goods.

Fig. 3 and 4 show the measurements that we obtained inside the buildings of the college of science. Fig. 3 shows that the intensity of the noise was higher at the second floor in comparison to other floors as this floor encompasses the staff and students from 2 different departments. Fig 4 shows that the time intervals 10-11(am) and 12 – 1 (pm) had the highest noise intensity, because of the activity of peoples at that time, and the rest time of the students in between the lectures. The average noise pollution in the college as a whole was 73.7 dB.

The results for the college of Engineering are shown in figures 5 and 6. The time interval between 10 (am) and 11 (am) is the noisiest period since most of the experimental labs are free at that period as was seen from their time tables and the voice pollution in the third floor has its maximum value, because must of the labs and lecture rooms of the college are in this floor . The average of voice pollution in the college is 65.7 dB.

Fig.7 and 8 shows our study in the college of dentistry that shows that the noise pollution has its maximum value one the first floor because of its small area, and it is the entrance to the other steers of the same building the time interval between 10.5 (am) and 11.5(am) is the noisiest period in floor 1, the average value of noise pollution in the college was 64 dB.

The Dentistry College is quiet relative to the other colleges; these differences arise from the fact that it is the only college with one department. In general the number of the students in most of the buildings is much more than the capacity of the buildings.

Figure 9, 10, 11 and 12 presents our data for the colleges of language and human science, in the college of language the average noise pollution is between 65dB to 85 dB and the floor number 2 is the noisiest floor because of the administration biros and the lecture rooms, plus the large number of students. The average value of pollution for the college is about 72.9, but college of human sciences 5th floor has a considerable pollution, and the range of pollution in the college is from 75dB to 85 dB, with an average of 77.5dB.

Figure 13 represents the average of voice pollution in the 5 colleges and we can see that the noise in the college of human science is above the permissible range. This has bad effect on the process of education in the college. The above results are clear in the model equations.

Conclusion

The study shows that in the campus of university of Sulaimani, the noise classified as a mixture of a Steady noise superimposed by a Non-Steady (Fluctuating noise). Noise Pollution inside the campus is more than its value at the center of the city.

The occupational area for each student in general is less than $2m^2$ inside the buildings.

Pollution inside the colleges is considerable it has its maximum value in the college of Human science, which is by 4 dB more than college of science and by 5 dB more than college of language, these results are clear in the fitting equations because the occupational area of the students in this college has its minimum value relative to the other colleges, it is about one student in1.5 meter square of the building area , while the occupational area in the other colleges is around two meter square per student which is still less than its standard value .

Since the noise levels could affect the students' concentration, installing noise barriers and relocating the university to areas 'free from noise pollution', is a good solution.

The establishment of an agency under the name of Kurdistan Environmental Protection Agency (KEPA) is essential for controlling this and similar hazards in the region.

	Characteristics	Type of Source
0 5 10 15 20 s small variation 10dB	Constant continuous sound	Pumps, electric motors, gearboxes, conveyers
intermittent noise 10dB 10dB background noise	Constant but intermittent sound	Air compressor, automatic machineryduring a work cycle
large fluctuations 10dB	Periodically fluctuating sound	Mass production, surface grinding
large irregular fluctuations 10dB	Fluctuating non-periodic sound	Manual work, grinding, welding, component assembly
similar impulses 10dB 10dB	Repeated impulses	Automatic press, pneumatic drill, riveting
isolated impulse 10dB 10dB	Single impulse	Hammer blow, material handling, punch press, gunshot, artillery fire

Fig. 1: Noise characteristics classified according to the way they vary with time [1].

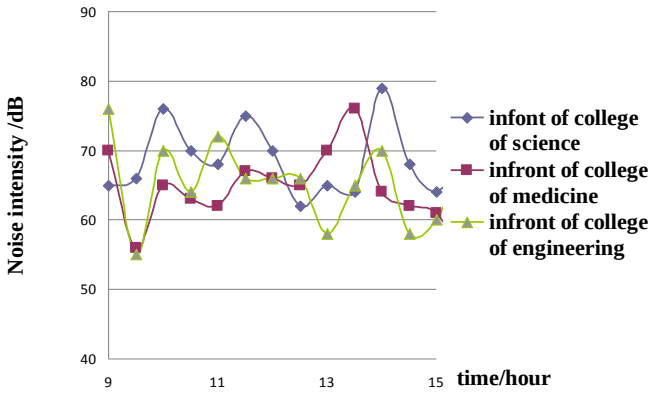

Fig. 2:Noise intensity as a funtion of time in 3 points of the garden of the campus of university of sulaimani

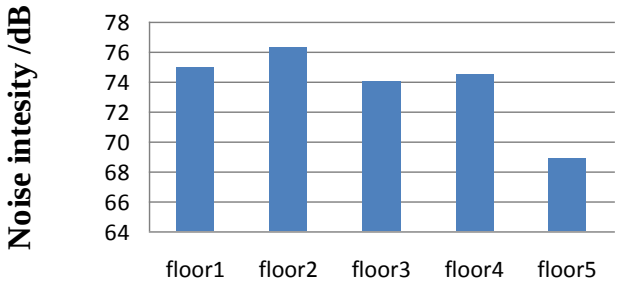

Fig. 3:Average intensity of noise versus the floors in College of Science

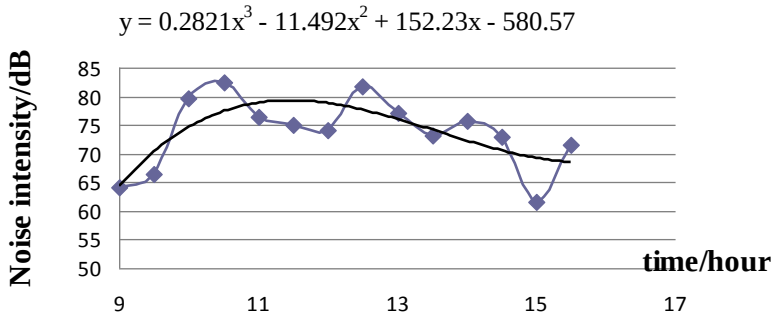

Fig. 4: Average intensity of noise versus time in College of Science

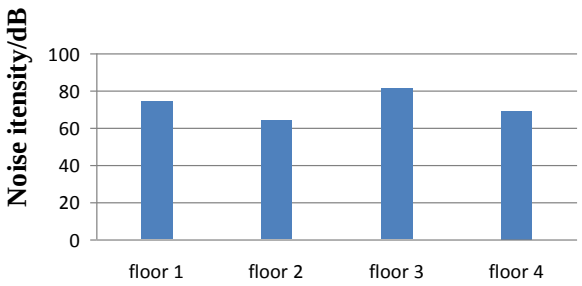

Fig. 5: Average intensiy of noise versus the floors in College of Engineering

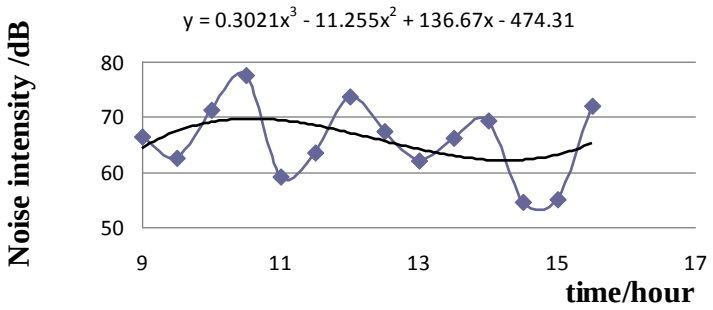

Fig. 6: Average Intensity of Noise versus time in College of Engineering

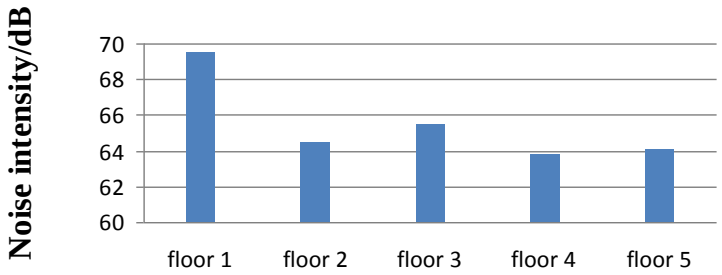

Fig. 7:Average intensity of noise versus the floors in College of Dentistry

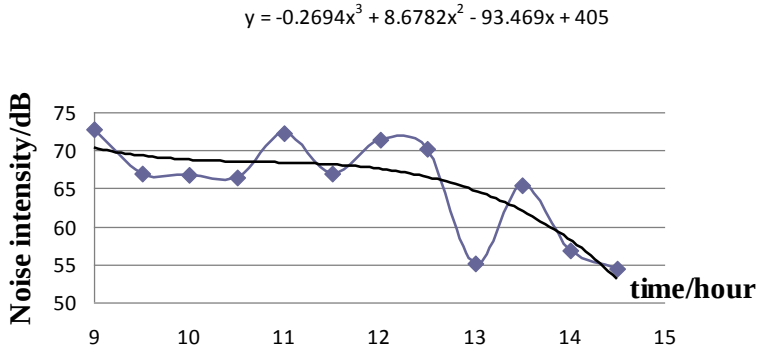

Fig. 8:Average intensity of noise versus time in College of Dentistry

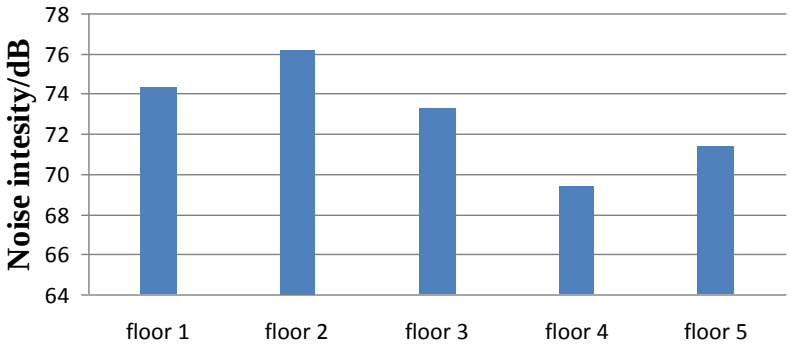

Fig. 9:Average intensity of noise versus the floors in College of Language

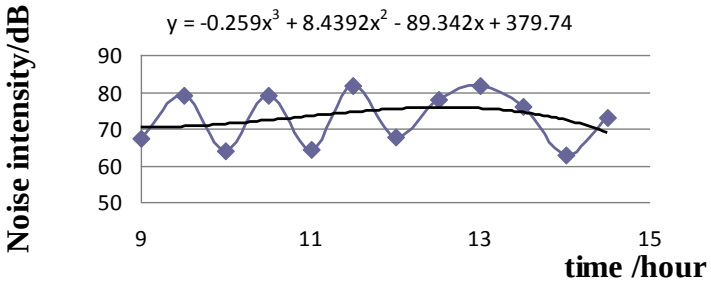

Fig. 10:Average intensity of noise versus time in College of Language

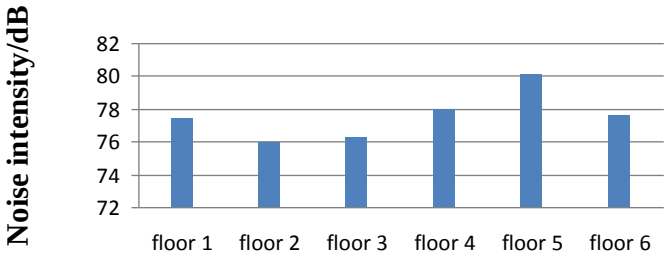

Fig. 11: Average Intensity of noise versus the floors in College of Human Science

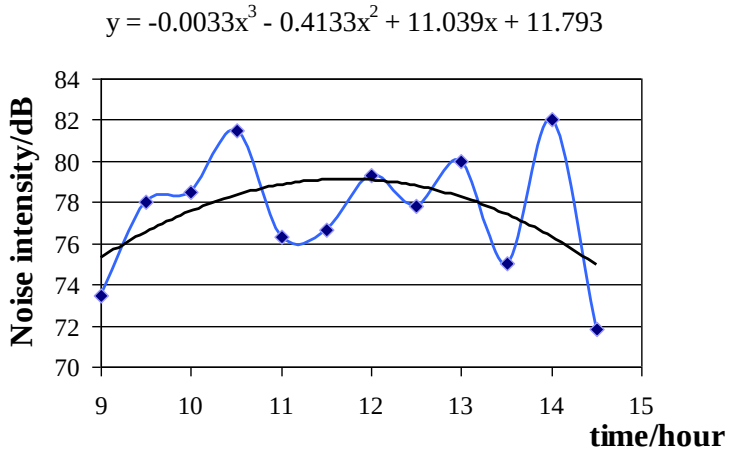

Fig. 12: Average intensity of noise versus time in College of Human Science

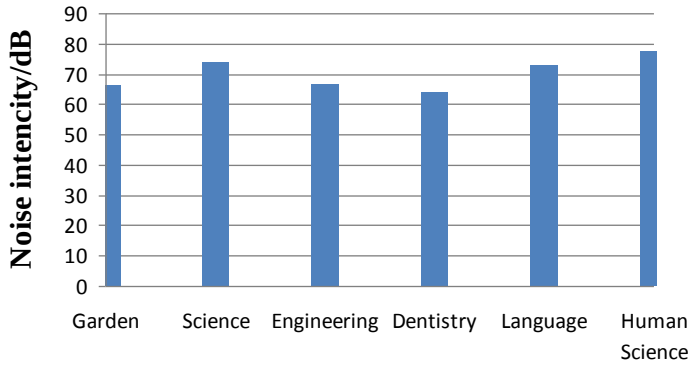

Fig. 13:Average intensity of noise versus the colleges in university of Sulaimani

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دراسة التلوث بالضوضاء في مجمع جامعة السليمانية

بريخان محمد جاف **حسين حسيني**

جامعة السليمانية، كلية العلوم، قسم الفيزياء

تاريخ الاستلام: 2011/5/9 تاريخ القبول: /2012/1

الخلاصة

يؤدي الإنسان نشاطه اليومي بشكل أفضل عندما يكون الجو المحيط به هادئاً اذ تقلل الضوضاء من نسبة التركيز ويشعر الإنسان بالتعب.

انجزت هذه الدراسة في جامعة السليمانية لدراسة درجة الضوضاء في هذا الجو التعليمي باستخدام مقياس خاص بالضوضاء يتراوح مداه بين ٤٣ و ١٣٠ دسبيل.

تم اختيار ٢٥ موقعاً من ضمنها المساحات المحصورة بين قاعات التدريس في مختلف الطوابق لخمسة كليات اضافة الى ٣ مواقع في ساحة الكليات. بينت النتائج بأن شدة الضوضاء ليست ثابتة وتتجاوز عند بعض المواقع ٧٠ دسبيل وهو الحد المتمثل بالحد البدئي لتوليد ضرر في السمع لدى الإنسان.

يعتبرالطلبة المجتمعون داخل البنايات وفي الممرات المحصورة بين القاعات الدراسية وفي باحة الجامعة حتى بعد اكتمال المحاضرات مصدراً لتوليد الضوضاء.

ان بناية الجامعة مصممة قبل عشرات السنين واعداد الطلبة والموظفين في ازدياد مستمر بشكل لا تستوعبه الجامعة، بما ان الضوضاء الزائدة عن حدها تؤثرعلى صحة المرء فان تأسيس منظمة باسم منظمة كردستان للمحافظة على البيئة يعتبر امراً ضرورياً.