Evaluation of Noise Level: Experimental Case Study for Some External Arenas in the University of Technology at Baghdad

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ABSTRACT

The problem of noise in the learning environment (schools and universities) are consider as one of the environmental problems that has an effect on the process of concentration and assimilation and on the efficiency of the performance of students and their educational abilities, so the goal of current research is to study the noise in one of the educational environments by measuring and evaluate the noise level experimentally by using a Sound Pressure Level Meter Type 2 UT 351 to measure noise levels for each site 100 times for 10 minutes in some arenas in campus of the University of Technology at Baghdad, by choosing a number of selected sites (31 sites) during working hours for the periods from 9 to 10 AM and 11 to12 AM. After recording the data for noise level of the maximum and minimum noise levels which recorded in the measurement locations was identified for periods 9-10 AM and 11-12 AM ,then calculate the average equivalent noise level for each location in order to compared with the limits of noise allowed which defined by the World Health Organization (WHO). The results of this study showed that the equivalent noise level at all measurement locations ranged between (59.29 - 79.01) dBA for a period of 9-10 AM and between (58.23- 70.1) dBA for the period of 11-12 AM, where exceeded the permissible limits, which require the level of noise less than 55 dBA for such educational institutions as recommended by the World Health Organization (WHO).

Keywords: noise environment, noise pollution, noise signal measurement, sound level measurement.

INTRODUCTION

One of the more important factors of environment pollution is the high noise signals problems. Human health, education and communications services can be affected due to the unwanted signals of noise environment.

Many researches in the field of education, psychology, audiology and engineering has been applied to the acoustic in the university and the educational buildings.

The noise environment effects are analyzed around the academic buildings in the faculty of engineering of King Abdulaziz University to specified unwanted source of high noise signal level which has an impact on the faculty activities such as lectures, seminars and discussions [1]. Noise pollution has been studied in Delta State University experimentally using Sound Pressure Level Meter of Type 2 model IEC 651. The average noise level 87 dB is generated by the business center location as a result of the electricity generated from different power plants. The noise levels for Balasore-India University which caused by different types of vehicles was calculated. The important generators of noise pollution are the power units, tyres and braking systems [2, 3, and 4]. The noise can be monitored using fixed wired and wireless sensor nodes in Intelligent Distributed Environmental Assessment (IDEA).Quality of Service (QoS) has been

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evaluated by data transmitting, data processing and data aggregation to provide the best suited composite service for each propose [5].Pedestrian activities mixes with traffic and machinery noise within enclosed and semi-closed spaces as underground metro stations , multi-story garages are studied to provide ideal solutions of high levels noise [6].The noise pollution of temporal and spatial distribution of road traffic has computed in an urban environment using monitoring and mapping. Results demonstrate that the schools and hospitals that are subject to high noise level to a great extent throughout the day to take immediate necessary mitigation measures to alleviate the problem [7]. Sources and control of noise pollution problems effects are examined in Delhi state points. Loudspeakers and automobiles are the main source of noise pollution that produce the interference with communication, sleeplessness [8].Noise and vibration problems which produce by building mechanical, power and plumbing systems are analyzed to achieve noise mitigation and vibration control to improve the building operations which increase the performance efficiency. New construction of acoustical design can be implemented to reduce the noise and vibration effects [9]. Human health can be affected by environmental noise pollution. Important political issues in many countries such as the European Commission are interested to avoidance, prevention and reduction of the harmful effects of exposure to environmental noise. Public parks, quiet urban areas, quiet area in the open country, areas near schools, hospitals and other sensitive buildings are taken into consideration in the development of the Vehicle Ad Hoc Network (VANET) to collect data from GPS equipped mobile phones [10]. Noising map can be used to show the distribution of noise signal levels in the real time by monitor the noise pollution situation of cites environment [11]. Central Pollution Control Board (CPCB) is used for investigating the sound level generated by various machines. The average concentration of noise in the period of mine operation activity was obtained from day time and night [12].

Knowledge in the classroom is transmitted in through oral communication, the communication quality in classroom is linked by the acoustic quality of the classroom, this acoustic quality can be characterized based on the reverberation time, speech transmission index, sound insulation and the noise levels inside and outside the classroom, high noise levels in the classroom weaken the oral communication causing a negative effect on the cognitive skills for student [13].

According to the World Health Organization (WHO), a permissible noise level in the School environment should not exceed 35 decibels in the classroom in the course of teaching and should not exceed the level external noise level 55 decibels during the timeout period in school yard.

Scientific evidence suggests that chronic exposure to noise in the incident areas close to transport routes, or from any other sources emitting noise, can especially among school students lead to negative consequences for health, such as high blood pressure, deafness and inconvenience and stress disorders in mental and behavioral health, such as poor school performance and slower absorption and inability to distinguish words and delay in reading and in solving mathematical problems and poor memory and lack of communication. Children in schools located near airports, railway lines and roads fast suffering from weak assimilation and concentration, which leads to lower their level of scholastic than their peers who live in environments less noise [14].

Practical

The acoustic noise measurements were taken around various buildings within the University of Technology, at Baghdad - Iraq of one hour for each interval starting from 9 AM and 11 AM.The digital Sound Pressure Level Meter shown in Fig. (1) is used for the acoustic noise measurements ,this meter is of type 2 UT 351 with specifications shown in Table (1):

Table (1): Specifications of digital Sound Pressure Level Meter of type 2 UT 351.

Frequency range	31.51 Hz to 8000 Hz
Measuring range selection between	50 - 100 dBA, 60 – 110 dBA and 80 -130 dBA
Frequency weighting	A , C
Time weighting	(fast 125 msec) and (slow 1 msec)

(1): The device used for measuring noise level (Sound Pressure Level Meter Type 2 UT 351)

All readings were taken on "A- weighting" frequency network, at height of about 1.5 m from ground level and on "fast" range time weighting with range selection 80- to-130 dBA. The "A-weighting" and "fast" range is simulated as human ear listening response. The data were recorded at interval of 5 sec, and all noise values were expressed in dBA unites. Noise measurements were taken from 31 locations around various building whitens the University of Technology during working hours from 9 AM and 11 AM. The locations which are shown in Fig.(2) represent the variety outdoor spaces in the university.

The noise levels from each location were taken 100 times each at period (time) of 5 minutes interval. All noise values were expressed in dBA unites. For the proper assessment and analysis of the results, the continuous A-weighted equivalent sound level $L_{eq}(\mathrm{dBA})$, maximum and minimum noise values were calculated and compered with standards prescribed by World Health Organization (WHO).

$L_{eq}(\mathrm{dBA})$ Is computed using following equation [7]:-

$$L_{eq}(dBA) = 10 \times \log_{10}[(\frac{1}{N}) \sum_{i=1}^{N} 10^{li/10}\ ]$$

Where, li is the noise level of the i^{th} reading and N is the total number of the recorded samples.

The detected noise levels in the present study were compared with permissible limit of noise in education area as World Health Organization standard i.e. 55 dBA [14, 15].

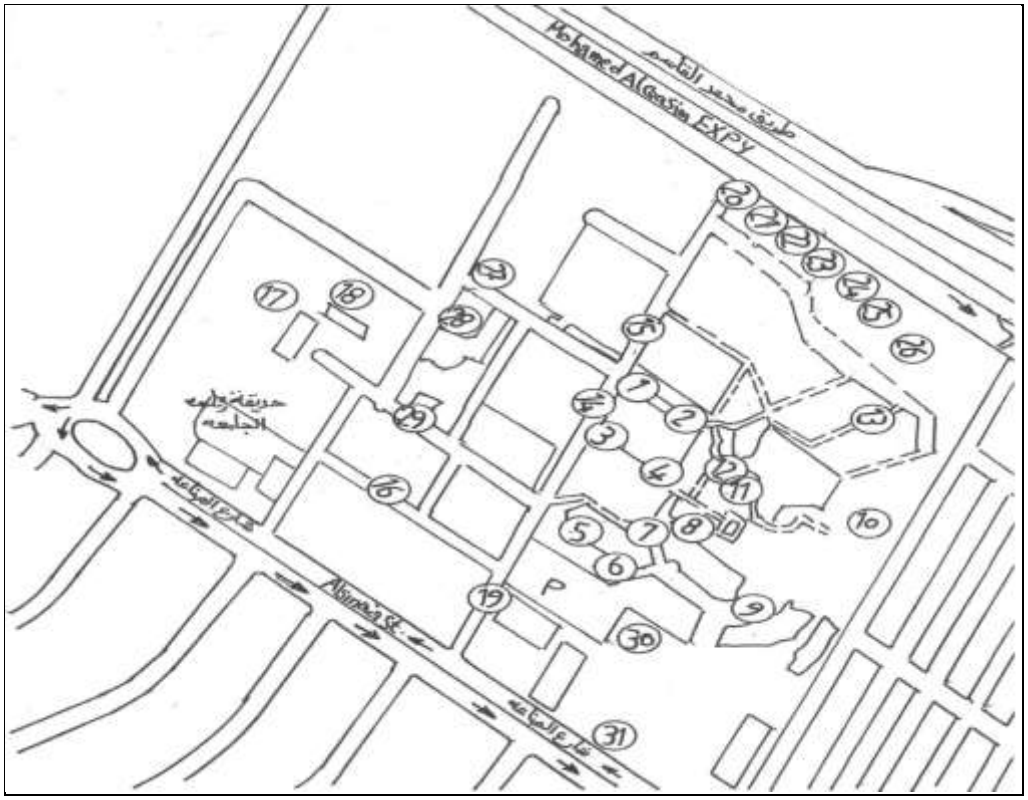

Figure (2): Details of noise measurement locations in the campus of the University of Technology at Baghdad.

(1, 2, 3, 4) Department of Electromechanical Engineering, (5, 6) Department of Mechanical Engineering, (7, 8) Department of Chemical Engineering, (9) Department of Electrical and Electronic Engineering, (10) Department of Architectural Engineering, (11) Department of Laser Engineering and Electronic Optics, (12) Saif Private Library shop for cloning and sale of the stationery , (13) Second site of Department of Laser Engineering and Electronic Optics, (14) Department of Materials Engineering, (15) Department of Production Engineering and Metallurgy , (16) Department of Computer Engineering, (17) Department of Control and Systems Engineering, (18) Central Library, (19) Department of Computer Sciences,(20) Department of Engineering Affairs, (21) Nanotechnology and Advanced Materials Research Center, (22,23) Department of Petroleum Engineering, (24,25,26) Department of Applied Sciences, (27) Mosque, (28) Department of Physical Education and Artistic Activity, (29) Center, (30) Laser Science, (31) Al-Rashed Bank .

Results and Discussion

The results of noise levels measurements for this study demonstrated in Table (2) summarizes the locations which were selected for noise measurements around the various buildings in the university , and Figure (2) showing view part of the university which demonstrates the thirty one locations for the measurements. Tables (3) and (4) shows the maximum and minimum noise levels recorded in the measurement locations at (9-10) AM and at (11-12) AM respectively. In Table (5) gives the computed equivalent noise level for different locations at (9-10) AM and (11-12) AM respectively. Figures (3) and (4) are graphical representation of the equivalent noise levels for (9-10) AM and (11-12) AM respectively, and Figure (5) shows the graphical representation for the comparison between the levels of equivalent noise at (9-10) AM and (11-12) AM.

Study of these representations revels that the overall maximum noise levels in the university ranged from (57.8 dBA) to (86.2 dBA) for (9-10) AM , and ranged from (62.5 dBA) to (77.6 dBA) for (11-12) AM , and the overall minimum noise level ranged from (74.8 dBA) to (50.6 dBA) for (9-10) AM and from (52.1 dBA) to (67 dBA) for (11-12) AM as given in Tables (3 and 4) respectively .

In Table (5), shows the study of these representations revels that the overall equivalent noise levels in the university ranged from (59.29 dBA) to (79.01 dBA) for (9-10) AM, and ranged from (58.23 dBA) to (70.1 dBA) for (11-12) AM.

Observed during (9-10) AM the location of Applied Since Department (locations no: 25 and 24) has maximum equivalent noise level of about (79.01 dBA and 76.61 dBA), and another highest equivalent noise levels occurs at location of Petroleum Engineering Department (location no:22) and Leaser Engineering Department (location no:13) of about (73.17 dBA) and (70.98 dBA) respectively, while the lowest values of equivalent noise observed which are(59.29 dBA, 59.5 dBA, and 59.88 dBA) occurs at locations of Mechanical Engineering Department (location no:6), Central Library(location no:18), and University Mosque (location no:27) respectively.

The period of (11-12)AM in Table (5), Figures (3) and (4) show that the Department of Petroleum Engineering (locationno:22), Department of Applied Sciences (location no: 26), and Al-Rashed Bank (location no: 31) has maximum equivalent noise level of about (70.1 dBA, 69.31 dBA and 69.15 dBA) respectively, while observed the lowest values of equivalent noise are (58.32 dBA, 60.35 dBA, and 61.27 dBA) occurs at center of the university(location no:29) , Central Library (location no:18), Departments of Electromechanical Engineering and Department of Mechanical Engineering (locations no:1&6).

The permissible equivalent standard level (Leq) for education institutes as prescribed by World Health Organization (WHO) is 55 dBA [14, 15], thus the noise level recorded in all the locations of the university exceeded the prescribed standard level of 55 dBA. One explanation due to exist large electricity generators near the departments due to the frequent power failures, such as the Department of Applied Sciences, Department of Electromechanical Engineering, Department of Petroleum Engineering and others. In addition to that, as well the construction works near to the Department of Production Engineering and near to the Department of Mechanical Engineering.

Another reason for increasing of noise is the sound of air conditioners, and the movement of students within the university as well as unsuitable design of narrow green areas between the buildings which contributes for the increasing of noise and this whole reasons need to reconsideration.

In Table (5), shows sound levels is high at locations of the Department of Petroleum Engineering and the Department of Applied Sciences (22, 23, 24, and 26) this is because they are nearer to the highway as well as the presence of the electrical generator between the Department of Applied Sciences and Petroleum Engineering Department as well the sounds resulting from air condition, while the sound level shown be minimum at locations of the Mechanical Engineering Departments, Laser Engineering Department, Central Library, and Center of University (locations 6, 11, 18, 29), because this locations far from the highway.

It is clear from the comparison between the equivalent noise levels for the period (9-10) AM and (11-12) AM as shown in the Fig (5) that in most of the measurement locations note that the equivalent noise level for the period (9-10) AM higher than the period (11-12) AM due to begging of student lectures and staff work, such as Electromechanical Engineering Department, Leaser Engineering Department, Material Engineering Department, Nanotechnology Research Center and Advance Materials Research Center , Projects Organization , Petroleum Engineering Department and Applied Sciences Department.

Table (2): The locations where selected for noise measurements.

Site number	Site name	Site number	Site name
1	Dept. of Electromechanical Eng.	16	Dept. of Computer Engineering
2	Dept. of Electromechanical Eng.	17	Dept. of Control Eng.
3	Dept. of Electro-mechanical Eng.	18	Central Library
4	Dept. of Electromechanical Eng.	19	Dept. of Computer Sciences
5	Dept. of Mechanical Eng.	20	Dept. of Engineering Affairs
6	Dept. of Mechanical Eng.	21	Nanotechnology Research Center
7	Dept. of Chemical Eng.	22	Dept. of Petroleum Eng.
8	Dept. of Chemical Eng.	23	Dept. of Petroleum Eng.
9	Dept. of Electrical and Electronic Eng.	24	Dept. of Applied Sciences
10	Dept. of Architectural Eng.	25	Dept. of Applied Sciences
11	Dept. of Laser Eng.	26	Dept. of Applied Sciences
12	Saif Private Library shop	27	University Mosque
13	Second site of Dept. of Laser Eng.	28	Dept. of Physical Activity
14	Dept. of Materials Eng.	29	Center of University
15	Dept. of Production Eng.	30	Dept. of Laser Science
		31	Al-Rashed Bank

Table (3): Maximum and minimum of noise levels recorded in the measurement locations at (9-10) AM.

site number	Site Name	maximum value (dBA)	minimum value (dBA)	site number	Site Name	maximum value (dBA)	minimum value (dBA)
1	Det. of Electro-mechanical Eng.	77.6	50.6	16	Dept. of Computer Eng.	76.4	56.8
2	Dept. of Electro-mechanical Eng.	77.1	55.9	17	Dept. of Control Eng.	61.9	58
3	Dept. of Electro-mechanical Eng.	73.1	62.1	18	Central Library	60.9	57
4	Dept. of Electro-mechanical Eng.	73.8	61.3	19	Dept. of Computer Sciences	72.6	54.3
5	Dept. of Mechanical Eng.	72.7	63.8	20	Dept. of Engineering Affairs	75.3	65.9
6	Dept. of Mechanical Eng.	66.5	55.4	21	Nanotechnology Research Center	72.1	66.5
7	Dept. of Chemical Eng.	69.8	60.3	22	Dept. of Petroleum Eng.	86.2	57
8	Dept. of Chemical Eng.	69.9	61	23	Dept. of Petroleum Eng.	80.1	65
9	Dept. of Electrical and Electronic Eng.	69.8	60.5	24	Dept. of Applied Sciences	78	74.8

10	Dept. of Architectural Eng.	69.9	60.4	25	Dept. of Applied Sciences	78.9	74.8
11	Dept. of Laser Eng.	57.8	68.5	26	Dept. of Applied Sciences	67.8	63
12	Saif Private Library shop	68.9	61.2	27	University Mosque	60.9	58
13	Second site of Dept. of Laser Eng.	70.9	65.5	28	Dept. of Physical Activity	70.7	58
14	Dept. of Materials Eng.	61.9	58	29	Center of the University	63.5	60
15	Dept. of Production Eng.	70.2	62.6	30	Dept. of Laser Science	70.4	59
				31	Al-Rashed Bank	77.8	66.8

Table (4): Maximum and minimum noise levels recorded in the measurement locations at (11-12) AM.

site number	Site Name	maximum value (dBA)	minimum value (dBA)	site number	Site Name	maximum value (dBA)	minimum value (dBA)
1	Dept. of Electro-mechanical Eng.	70.2	52.1	16	Dept. of Computer Eng.	71.2	58.9
2	Dept. of Electro-mechanical Eng.	72	60.9	17	Dept. of Control Eng.	67.1	58.9
3	Dept. of Electro-mechanical Eng.	76.5	61.8	18	Central Library	62.5	57
4	Dept. of Electro-mechanical Eng.	70.3	58.5	19	Dept. of Computer Sciences	67.5	55.9
5	Dept. of Mechanical Eng.	70.4	65.5	20	Dept. of Engineering Affairs	68.5	59.9
6	Dept. of Mechanical Eng.	63.1	59.9	21	Nanotechnology Research Center	65.7	59.5
7	Dept. of Chemical Eng.	66.5	60.1	22	Dept. of Petroleum Eng.	71.1	58.9
8	Dept. of Chemical Eng.	67.1	59.5	23	Dept. of Petroleum	67.7	57.7
9	Dept. of Electrical and Electronic Eng.	70.7	62	24	Dept. of Applied Sciences	70.9	65.9
10	Dept. of Architectural Eng.	67.5	61.5	25	Dept. of Applied Sciences	70.6	60.5

11	Dept. of Laser Eng.	63.5	59.9	26	Dept. of Applied Sciences	71	67
12	Saif Private Library shop	68.1	60.1	27	University Mosque	66.5	60
13	Dept. of Laser Eng. (annex)	69.5	64.3	28	Dept. of Physical Activity	63.1	55
14	Dept. of Materials Eng.	68.7	65	29	Center of the University	66.7	60.3
15	Dept. of Production Eng.	70.4	66.1	30	Dept. of Laser Science	70.2	63.2
				31	Al-Rashed Bank	77.6	65

Table (5): The computed equivalent noise level for locations (1-31).

Site Locution	Leq./9-10AM	Leq./11-12AM	Site Locution	Leq./9-10AM	Leq./11-12AM
1	66.46	61.27	17	60.34	63.14
2	68.57	66.23	18	59.5	60.35
3	67.3	65.39	19	68.16	66.82
4	67.89	63.51	20	69.4	62.87
5	67.97	68.35	21	68.41	61.9
6	59.29	61.28	22	73.17	70.1
7	62.83	63.34	23	72.49	62.98
8	63.95	63.99	24	76.61	68.15
9	66.08	64.71	25	79.01	66.77
10	67.2	65.68	26	65.85	69.31
11	62.38	62.33	27	59.88	63.06
12	64.43	64.87	28	67.5	64.5
13	70.98	67.08	29	61.95	58.32
14	60.21	66.67	30	65.81	66.7
15	66.08	68.38	31	70.75	69.15
16	67.51	65.85			

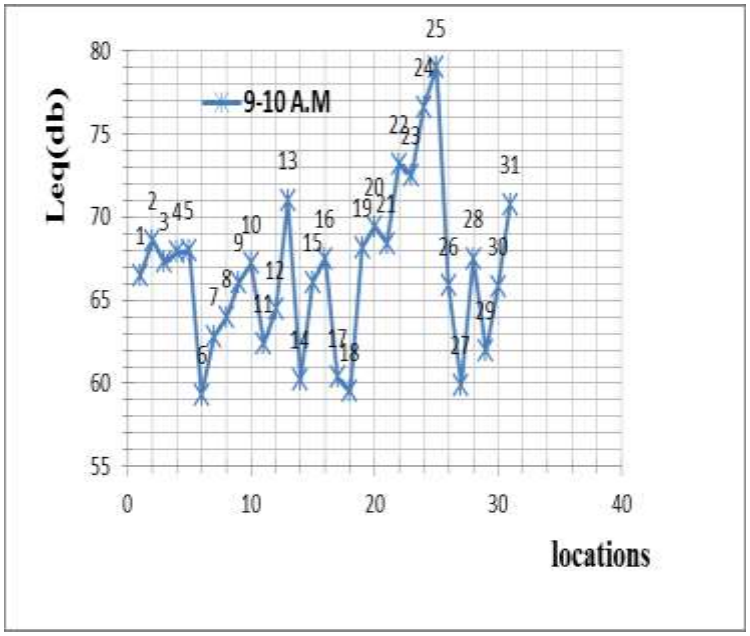

Figure (3): The graphical representation of the equivalent noise levels for (9-10) AM

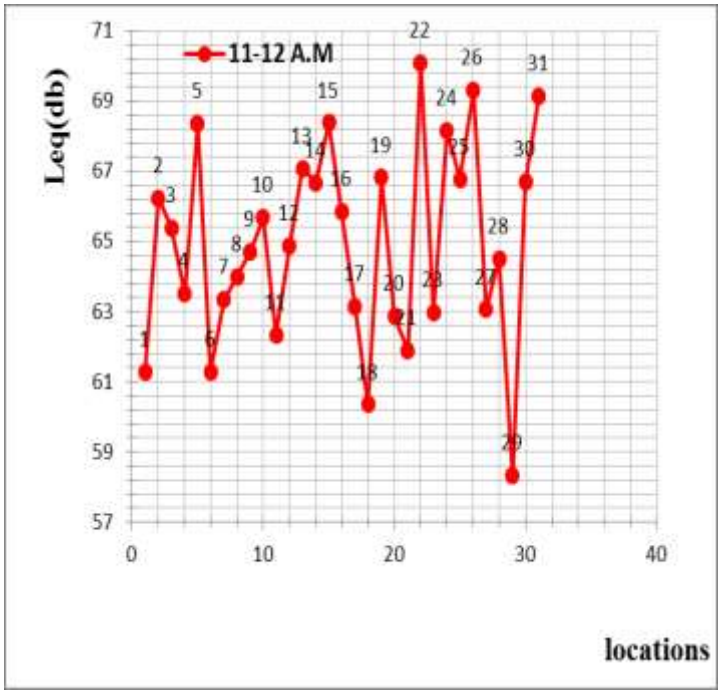

Figure (4): The graphical representation of the equivalent noise levels for (11-12) AM.

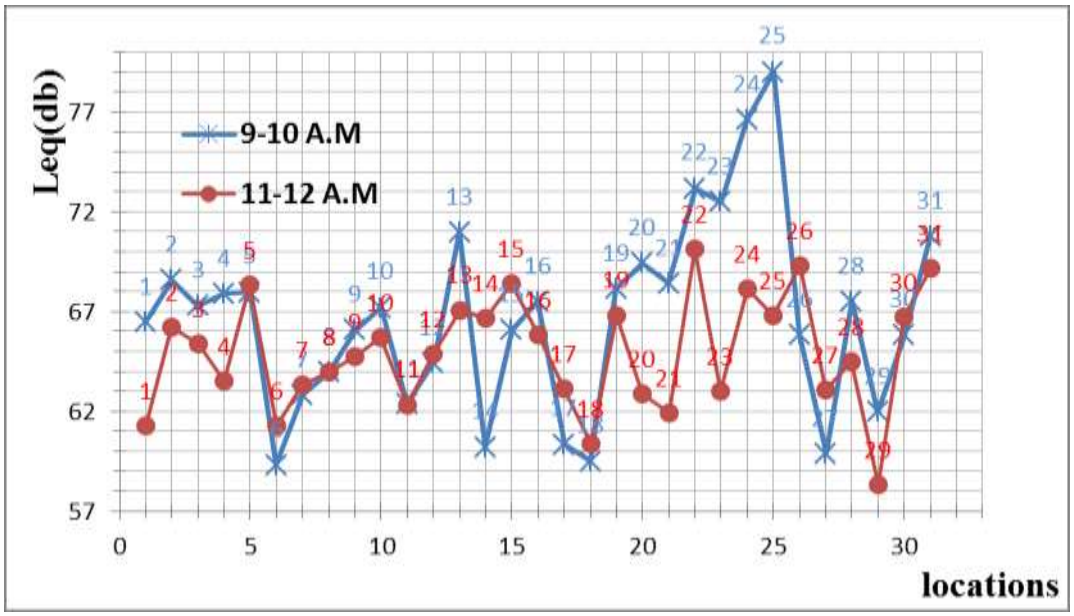

Figure.5: The graphical representation for the comparison between the levels of equivalent noise at (9-10) AM and (11-12) AM.

CONCLUSIONS

1- The results of the measurements presented here indicate that the equivalent noise level recorded in all measurement locations that included in this search, exceeded the permissible standard which prescribed by World Health Organization (WHO) 55 dBA.

2- It is observed that the equivalent sound levels is high at locations of the Department of Petroleum Engineering and the Department of Applied Sciences (locations no: 22, 23, 24, and 26), and is minimum at locations of the Departments of Mechanical Engineering, Laser Engineering, Central Library and Center of University (locations no: 6, 11, 18, 29).

3- The equivalent noise level for the period (9-10) AM is higher than that for the period (11-12)AM such as Department of Electromechanical Engineering, building supplement to department of Laser, Nanotechnology Research Center and Department of Petroleum Engineering and Department of Applied Sciences.

4- The major source of noise within the University of Technology emanate from the indiscriminate use of the large electricity generators and this is due to the constant power failures, as well as the sounds resulting from air-conditioners and some departments near to the highway in spite of that unsuitable design of narrow green area between the buildings .

5- We are recommend to the committee of University of Technology to design a schedule re-habitation of Lecture Rooms due to our results as well unsuitable design inside and outside Lecture Rooms concerning space area, type of materials used and furniture.

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