A Study of some Noise Pollution Variables in Sport Halls and Classrooms for College of Sport Education–Tikrit University–Iraq

Article Info

Received: March 31, 2014
Accepted: April 24, 2014
Published online: December 01, 2014

Muhammad S. K. Al-Samarrie, Mohanad F. Salman, Abbas Hadi

Faculty of Physical Education, University of Samarra
Faculty of Physical Education, University of Thiqar
Faculty of Physical Education, University of Tikrit
dr.sport864@gmail.com
Muhannad1515@yahoo.com
envabbas@yahoo.com

Abstract

This paper investigates some of noise pollution variables in sport halls and classrooms for college of sport education- Tikrit University Iraq were studied. These variables are represented in measuring of indoor and outdoor noise for sport halls and classrooms and, calculating the noise damping before and after walls and ceiling coating, calculating the indoor equivalent noise, and calculating signal to noise ratio (SNR) and reverberation time. The results showed that the coating had contributed in noise damping in the large sport hall with a value of 7.33 dB (A). Also the research paper showed that the reverberation time (TR) for large sport hall before was 1.685 seconds while it became 1.151 seconds after coating .This is high TR in spite of the coating is contributing in reducing the TR .With respect to classrooms the indoor noise pollution was higher than recommended levels and TR was within accepted limit and the classroom wall and ceiling coating is contributing in reducing of small value of noise. SNR value was negative before coating and after coating the SNR of front students sitting row was positive only.

Keywords: Noise, variables, sport, classrooms, SNR.

1. Introduction

The world is developing dramatically, especially in the areas of environment and its effects, and how to keep it out of all types of contaminating materials. This became one of the most important ways to help and maintain the accelerated completion and construction due to its effect on the biological side of athletes, whether inside the halls or in the open-air stadiums. The environmental aspect now walks side to side with the massive developments in the world, and it affects directly the future of the human beings.

The purpose of doing sport activities is to create a recreational and healthy atmosphere for those who practice sports. This requires creating a healthy environment free from all effects that may be a negative factor. Noise was the only known source in all previous studies, which were limited to the study of noise in factories and traffic (vehicular traffic). Nowadays, with the spread of technology, noise hasbecome part of our daily lives and has become an important element in human comfort inconvenience. This is what we see every day in simpler things such as when the electricity goes off and all the machines and household appliances shut down. Many researchers has studied and determined the acoustic specifications of the classrooms by analyzing the control of the noise in the campus and many classrooms.(Michel vaiiet and zahran.2002) studied the noise determinants in the classroom , which should be in the range between (30 - 33) dB (A) (standard equivalent).

Dave,2003 studied the acoustic specifications through the senses that affect the speech, including the teacher's speech to the noise ratio (Signal-to-noise ration SNR) and the reverberation tine of the teacherin classrooms.For sport halls,all types of environmental pollution have a very large effect on the athletes;difficulty of breathing, nervous tension,or partial or temporary hearing loss may occur. Many studies have shown that continuous exposure to noise leads to partial or total loss of hearing.Tens millions of age group (50-60 years) lost their hearing partly or totally, and it is currently expected that the young are also under the danger of losing their hearing because of the increased exposure to noise.This is where the importance of this study comes.

Paulo et. al. 2009 in their study entitled " 'Afield measuring of sound quality inside university classes in Brazil " compare the quality of sounds in eight classes at the technical university which was established in 1963 and seven classes in college of applied science which was established in 2000.They concluded that there was one class that showed internal equivalent sound pressure level higher than allowable value which is 50 dB(A) and also the reverberation time was identical to six classes of technical university which showed increase in reverberation time up to 0.6 s in class size of less than 283 m3

S.K.J HA et. al. 2010 studied the effect of noise in classrooms on academic performance of students in Krishta Engineering College (KEC) in India. They concluded that the lecturers positions are not make any any disturbance on the lecturer, students listen carefully to lecturer and noise does not affect that student listening. (Abbas, 2012) Studied noise pollution for selected classrooms in Tikrit university-Iraq. This research paper is accomplished to study some criteria which are related to noisepollution and their effects on the educational processes for selected classrooms in TikritUniversity-Iraq. These criteria are representing in the equivalent indoor noise (Leq), Signal to Noise ratio (SNR), Reverberation time and the damping of walls, windows and doors to theoutdoor noise.

The equivalent indoor noise for all classrooms ranges were (66.92-59.24) dB (A) while the results showed acute decreasing in SNR especially to the students' whomsitting in the classroom back sitting desks. Also the results showed that the Reverberationtime was (0.24-0.28) sec which was within allowable limits. The damping ranges were (9.1-15.2) dB (A) and it is too much lesser than the acceptable limits. Through the extensive reading to many studies the researchers have noticed that not only the outdoornoise effecton the performance of educational process but also the indoor environment has a big impact and is a source of environmental pollution in Tikrit University classroom and gymnasiums college of sport education. Thus , the research objectives ,First is to determine the level of noise pollution in sports halls and classrooms for undergraduate and postgraduate studies in college of sport education Tikrit –University and Second to make comparison between the level of noise pollution in sport halls and classrooms before and after insulation of walls with standard specification.

2. Methodology

2.1 Field procedures (the practical side):

First: the tools and materials used: a device for measuring acoustic level (model 407730), production of (Extechinstrument) company, as shown below:

Figure (1): device for noise measuring (sound level)

A –How to use: When measuring the acoustic level, it must be reset the (A\C) button. In the case of wind - a piece ofsponge (filter) is placed in the top of the machine to avoid any errors caused by wind in reading.

It is possibleto set fast reading (F) and slow reading (S) of the button (F\S) placed in the picture above.

- Read can be eithermanual after setting the button (RNG) or automatic, which is preferred.

To adjust the appropriate reading, the reading is stopped by the button (Hold), which confirms the highest reading during the process of reading.

B - Measuring tape: a strip of linen, with length of (30 m) for the purpose of measuring the distance during the study.

C - Insulation materials: cork is used, with thickness of (5 cm) and a length and width of (1 m) fixed byvertical wooden partitions, with measurement of (5 × 5 cm).Then all the surfaces of the cork are covered by woodenstrip, with width of(10 cm) and length of (3 m).

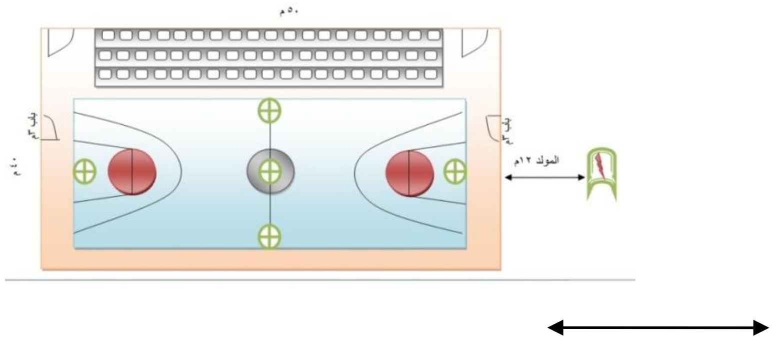
D –The classrooms sides were painted withenamel paint, and the large sports hallswere painted with emulsified alcoholic paints, special for wood.

2-2 Field Procedure

Research measured variables:

- A - internal noise level.
- b - The external noise level.
- c - Thelevel of the lecturer's voice.

The acoustic noise level was measured in the large sports hall of dimensions (50 m × 40 m × 8 m) and capacity of more than 750 audience before and after the coating.The measurements are shown in Figure (2)



Traffic street

16m

Figure (2) large sport hall of the Faculty of Physical Education - University of Tikrit

The acoustic noise level, variablesof the lecturer's voice andreverberation timewere measured in the sports hall and a classroom of undergraduate and postgraduate studies, with dimensions (10 x 7 x 3 m) before and after coating (in the Hall of Graduate Studies).

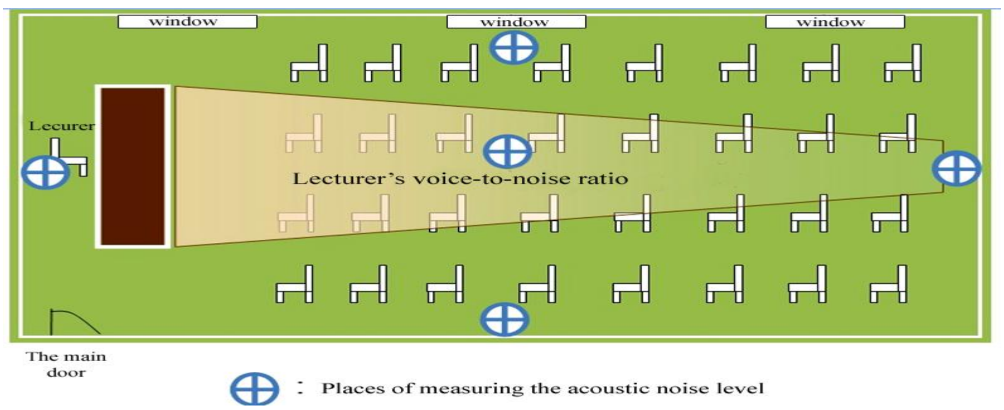


Figure (3): undergraduate and postgraduate classrooms of the Faculty of Physical Education - University of Tikrit

2.3 The found out variables:

1 –The level of external noise reduction by the walls, windows and doors.It is calculated by the following equation: level of noise reduction dB (A) = the external noise level dB (A) - the level of internal noise dB (A)

2 - Calculatethe proportion of the signal (lecturer) to noise SNR. It is calculated as follows:

SNR = lecturer's voice at a certain distance - the noise level in the classroom.

Lecturer'svoice at a certain distance is calculated by the following equation:

SPL (sound at certain distance) = LW (Lecturer actual voice) -20log r-8

When the distance from the sound source is doubled (at a distance measurement site) amount of 6 dB (A) of noise is reduced.

Measure the level of EquivalentContinuous Noise Level (Leq):

It is calculated using the following mathematical equation:

Leq = 10 Log [(t1× $10^{L_1/10}$ + t2× $10^{L_2/10}$+ t3× $10^{L_3/10}$ + t4× $10^{L_4/10}$ …..) / T]

Leq: attributable equivalent of continuous noise dB (A).

t1, t2, t3 ...: the time required for each particular sound pressure level (hour).

L1, L2, L3, ...: sound pressure level for each time dB (A).

T: total time (hour).

The resultant noise for more than one reading is calculated through a curved set out in below:

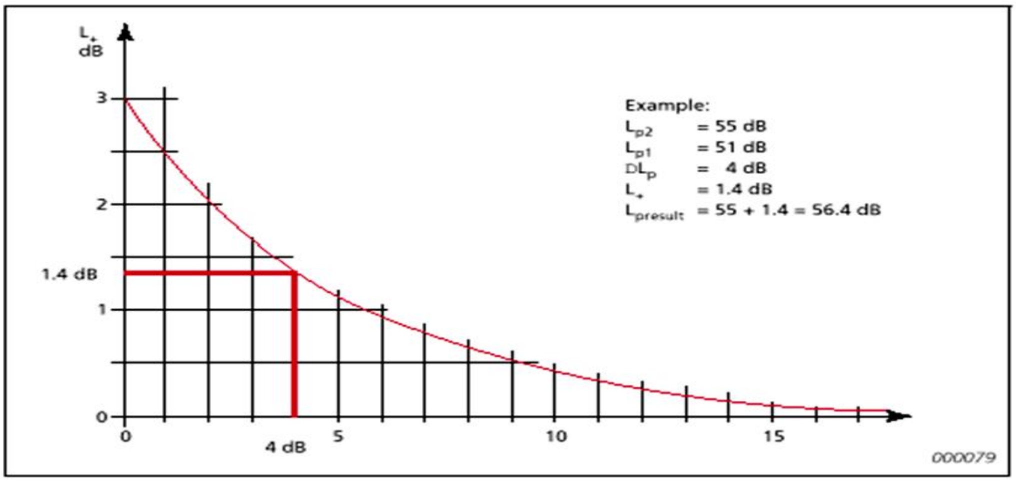


Figure (4): calculating the resultant noise for more than one reading

Reverberation time (Sabine equation)

TR = C V / Atot

Atot = S1 a1 + S2 a2 +.........

Time reflection in seconds = TR

A constant rate: C = 0.161

The volume of the space (Hall): V = m3

Total Area A tot = m2

Sound absorption factor (fixed values and according tocoating or finishing material).

3. Results and Discussion

3.1 First: large sport halls:

Table (1)
Shows the equivalent noise level in large sport halls (a diesel electric generator is working outside)

Time	No. of students	Before coating		After coating		Coating difference dB (A)
		Initial noise reading dB(A)	Equivalent noise leq Db (A)	Initial noise reading dB (A)	Equivalent noise leq dB (A)	
9:00 amto 10:00 am	24	78.9	84.61	74.4	77.28	7.33
11:00 amto 12:00 pm	70	87		79		

Table (1) shows that the noise equivalent has decreased from 84, 61 dB (A) before coating to 77, 28 dB (A) after coating, which means that the difference is 7,33 dB (A).This shows that the coating has contributed slightly in the infiltration of outside noise that came from the diesel electrical generator which had a key role in the infiltration of external noise. (24) student, at leastwere exposed to the noise equivalent of 84,61 dB (A) before coating and 77,28 dB (A) after coating for four continuous hours.This falls within the global determinations which states that the period of exposure to noise for four hours should not be more than (95) dB (A).

Table (2)
Shows the period of reverberation (echo) of the large sport halls before and after coating the walls

	Hall volume V (m3)	Total space area x sound factor A (tot)	Time of reverberation (echo) T (s)
Before coating	16000	1538.8	1.685
After coating	15912	2225.7	1.151

Table (2) shows us that the period of reverberation before coating was 1,685 (s) and after coating has become 1,151 (s). This means that coating contributed in the decreasing of reverberation time, which means that coating has added a positive aspect.

3.2 Second: classrooms of undergraduate and postgraduate studies:

Table (3)
Shows the equivalent noise level in the classrooms of the undergraduate and postgraduate studies (diesel electric generator is working outside)

<table>
<tr><th>Time</th><th>No. of students</th><th>dB (A) in Summer</th><th>Leq dB (A) in Summer</th><th>dB (A)in Winter</th><th>Leq dB (A) in Winter</th><th>Diff. dB (A)</th><th>Echo T (s)</th></tr>
<tr><td>9:00 am to 10:00 am</td><td>23</td><td>67.6</td><td rowspan="2">67.3</td><td>66</td><td rowspan="2">64.4</td><td rowspan="2">2.85</td><td rowspan="2">0.25</td></tr>
<tr><td>11:00 am to 12:00 pm</td><td>25</td><td>66</td><td>62.2</td></tr>
</table>

First reading is in winter and number of cooling devices are (2) and fans are (2) (not running). Second reading is in summer and number of cooling devices are (2) and fans are (2) (running).

In table (3), it is noted that the effect of the operation of shutdown of the internal appliances on the noise was clear through the readings taken in summer and in winter. It was also noted that the internal noise equivalent during the operation of the cooling devices and fans was 67,3 dB (A) and during the shutdown was 64,4 dB (A).These values show that fans and cooling devices contribute slightly, with 2,85 dB (A). (23) student,at least, has been exposed to the noise equivalent level in the summer and winter 67,3 dB (A) and 64 , 4 dB (A) respectively for four hours.Comparing these results with the determiners, it was found that they are within the acceptable limits that do not exceed 90 dB (A) for a period of four hours (mahmood,T.A.1988,46)But the internal noise was higher than the acceptable limits of 35 db (A) of the classrooms.The period of reverberation time was 0,25 (s) and it is accepted, as the specifications thatreverberation time should not exceed 0.6s according to theWorld Health(Organization WHO determinations).

Table (4)
Shows the internal noise equivalent before and after coating for the Hall of Graduate Studies, Faculty of Physical Education, University of Tikrit

<table>
<tr><th rowspan="2">Time</th><th rowspan="2">No. of students</th><th colspan="2">Before coating</th><th colspan="2">After coating</th><th rowspan="2">difference dB (A)</th></tr>
<tr><th colspan="2">Level of noise dB(A)</th><th colspan="2">Level of noise dB(A)</th></tr>
<tr><td>9:00 amto
10:00 am</td><td>5</td><td>68.3</td><td rowspan="2">67.69</td><td>63.6</td><td rowspan="2">63.3</td><td rowspan="2">4.39</td></tr>
<tr><td>11:00 amto
12:00 pm</td><td>21</td><td>67</td><td>63</td></tr>
</table>

Reading of internal noise + infiltrated from outside (diesel electric generator 12m away (operated) + passing cars on the street 16 m away + no fence or trees).

Table (4) shows that coating with insulation materials and secondary ceiling has contributed in the reduction of noise from 67,69 dB (A) to 63,3 dB (A).The researchers attribute the cause to the insulation material (coated wood) and (false ceiling) contributed in the reductionof noise infiltrated from outside. Coating also contributed in reducing thereverberation time, as shown in the table (5):

Table (5)
Shows time of reverberation in undergraduate and postgraduate studies classes

Hall status	Hall volume V (m3)	Total space area x sound factor A(tot)	Time of reverberation (echo) T (s)
Before coating	210	103.1	0.328
After coating	166.6	168.96	0.158

Table (5) shows us that the value of reverberation before packaging was 0,328 s and after coating it became 0,158 s. Despite the fact that these values fall within the determinants of WHO which suggest that the period of reverberation must not exceed0.6 (s),It is noted that the coating has contributed well in reducing the period of reflectionalmost up to half.This is a positive indicator in favor of the educational process through lecturing, understanding and a concentrating on receiving information, and reducing the effort for the teachers by not being forced sometimes to increase their voice to overcome the noise.

Table (6)
Shows the level of noise damping of the lecturing hall of Graduate Studies in the Faculty of Physical Education

Time	No. of students	Before coating	After coating	Before coating	After coating	difference in damping after coating dB (A)
		Level of inside noise dB(A)	Level of inside noise dB(A)	Damping dB(A)	Dampin g dB(A)	
9:00 am to 10:00 am	75.1	68.3	63.3	6.8	11.5	4.7
11:00 am to 12:00 pm	72	67	63	5	9	4

Table (6) shows that the damping of the outside noise was equal to 6, 8 dB (A) before coating and 11.5 after coating in the period from 9 to 10am. The level of damping was 5 dB (A) before coating and 9 dB (A) after coating in the period from 11am to 12pm. Researchers confirm that the coating has contributed in the increasing of damping ratio by 4.7 and 4 for the periods 9 to10am and 11am to 12pm respectively. In spite of this ratio, damping here is less than the required limit in classrooms,in which, the less damping must be of 40 dB (A) (shaheen,B.R,2000,12)Moreover, the internal noise washigher than allowed, which should be 35 dB (A) (WHO).The reason of this is becausethe insulating material was not sufficient enough.It isalso possible that the doors and the windows has openings which helped in the infiltration of noise,especially as diesel electric generator was operatingduring the time of measuring - generatorshavea big role in the infiltration of noise.

Table (7)
Shows the details of the speaker -to-noise ratio (Signal to Noise Ratio) (SNR)

Time	Lecturer's voice LW	Lecturer's voice distance			Internal noise before coating	SNR before coating			Internal noise before coating	SNR after coating		
		1m	4m	7m		1m	4m	7m		1m	4m	7m
9:00 am to 10:00 am	74	66	54	49	68.3	-2.3	-14.3	-19.3	63.3	+ 2.4	- 9.6	-14.6
11:00 am to 12:00 pm	74	66	54	49	67	-1	-13	-18	63	+3	-9	-14

Table (7) shows the details of the speaker to noise ratio (signal to noise ratio) SNR. Readings have been taken for the periods (9-10) and (11-12) and (SNR) was calculated before and after coating for several distances (1, 4,7m), represented by the rows of sitting students. For the first period, all the values of (SNR) that appeared before coating were negative, which is considered as a negative indication. Onlythe first row, which is (1m) away, showed positive value of (SNR). That is a good indication but not at the required level,as the specifications state that the (SNR) must be at least (+12).There are several reasons behind (SNR) decreasing: the voice of the lecturer is low, high internal noise that much of it is infiltrated from outside as a result of running diesel electric generator, which is (12m) away.
The decline in the (SNR) to negative values affects mainly on understanding the lecture, and hides the oral information from the lecturer. And those who havehearing weakness suffer the most.Since it was noticed that the voice of the lecturer was good, so it was concluded that the main reason is the noise infiltrated from outside to the hall.

4. Conclusions

The level of noise equivalent for large sport halls during the period of the research was between (74-79) dB (A). This value is high and it has bad effects on the nervous system of the human being. The ratio of the noise equivalent level in the large sport hallshas declined after coating by (7.33) dB (A). However, it did not reach the level of international standards for sport halls. The period of reverberation timein the sport halls has reduced after coating by (0,534) s, which is a positive value. In the classrooms and graduate studies, the value of noise equivalent level was between (67.3 -64.4) dB (A).This value is within the acceptable healthy limits (noise period), but it is not acceptable in terms of the classroom (calmness standard), which is 35 (A) dB. As for the reverberation time in the classroom and graduate studies, it reached (0, 25) S, and that is acceptable and within the determinants of the World Health Organization. The damping before and after coating is much lower than required, 40 dB (A) for classrooms. Coating contributed in the reduction of the equivalent noise level between (4-4, 7) dB (A), but this value is less than the value of coating for large sport halls. Coating contributed in the reduction of the period of reverberation to almost the half, and that is a positive indicator.

References

Abbas Hadi Abbas (2012) Studying of noise pollution for selected classrooms in Tikrit university-Iraq Journal of Environmental Studies [JES] 2012. 8: 1-7

Dave, G. (2003). (A new standard for acoustics in classroom. Journal of Engineers Newsletter, Volume 32 No.1.

Mahmood, T. A. (1988): Environment Science and Technology – University of Mosul.

Michel, V.and Zerhan K. (2002). (Some European policies regarding acoustical comfort in educational buildings), Noise Control engineers journal m Vol. 50, No. 2.pp 58-62.

Paulo Henrique, Trombetta Zanin and Andressa Maria Coelho Ferreira. (2009). (Field Measurement of acoustic Quality in University Classroom), Journal of Scientific & Industrial Research Vol. 68; PP.1053 – 1057.

S. K. Jha, Rupak Kumar Deb., Vinay Chandra Jha, and Iqbal Ahmed Khan (2010). (Effect of Illumination and Cross Ventilation in Classroom on academic performance of the students) International Journal on Emerging Technologies 1(1): 46-52(2010).

Shaheen, B. R. and Abd Al-Ghani, M. M. (2000): Studying the effect of sound transmitting on concepts and assets of constructing the verbal medium-sized halls (200-400 seats). Field applications. Arabic Conference for insulation techniques in facilities – Baghdad.

WHO: Determinations of noise according to Primary Health Organization.

Appendices

Appendix (1): Determinants of noise according to the used rooms

Country	**Bulgaria**	**France**	**Germany**	**Italy**	**Paraguay**	**UK**	**Sweden**	**Turkey**
Description of noise	**LAeq**	**LAeq**	**LAeq**	**LAeq**	**LAeq**	**LAeq**	**LAeq**	**LAeq**
Year of specification preparation	1977-1987	1955	1983	1975	2000	1997	1995-2001	1986
Type of specification	standard	Legal	std	Std	Std	Guideline	Std	Legal
Classrooms	30-35	38	35-40	36	35	40	26-40	45
Library	40-45	33	30	-	-	40	35	-
Music classrooms	-	-	35	-	-	40	-	-
Corridors, meeting rooms	30	-	35	-	40	40	-	-
Dining rooms, sport halls	35-40	43	45-50	40	40-45	50	40	60

Appendix (2): Determinants of the equivalent level of continuous sound by Leq dB (A) for different countries

Country	**Australia**	**Brazil**	**France**	**Japan**	**Germany**	**USA**
Classrooms	30-35	50-40	38	40-45	40-30	40-35
Library	45-40	45-35	33	40-35	40-30	40-35
Music classrooms	45-40	45-35	-	40-35	40-30	40-35
Gymnasiums	55-45	60-45	43	45	-	40
Corridors	50-45	55-45	-	-	-	45
Dining rooms	55-45	50-40	43	-	-	40

Appendix (3): The high determinants of the internal surrounding noise levels and echo time for the chosen classrooms

Type of classroom	internal surrounding noise levels Leq dB (A)	Echo times / sec
2. Classes in secondary schools	(40)30	more than 0.8 (0.5-0.8)
3. Large lecture halls (more than 50 students)	(30)35	more than 1.0
5. Classrooms in offices	(40)35	more than 1.0 (0.5-1.0)
6. Large meeting rooms	(35)35	0.8 - 1.2
8. Gymnasiums	40	more than 1.5 (1.0-1.5)

Appendix (4): WHO guidelines for noise levels or elevations Great time and echo in schools

Type of room	Level of noise dB LAeq	Reverberation / sec
Classrooms	35	0.6
Outdoor sport fields	55	-

Appendix (5): maximum basic noise levels and the echo time in the teaching halls

Room area m^2	dB LAeq / 1hour	By seconds
1. Bigger than 283 m^2	35	0.6
2. Smaller than 238 m^2 and bigger or equal to 566 m^2	35	0.7
3. Smaller than 566 m^2	40	-

Appendix (6): standard periods of exposure allowed in the work environment

Sound level dB (A)	Exposure time (hours)
90	8
92	6
95	4
97	3
100	2
102	1.5
105	0.5
110	0.25
115	