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Entertainment Noise Control in Algeria

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ABSTARCT

These last ten years, in Algeria noise pollution has become an environmental issue where people are exposed to unacceptable levels of noise. The main noise source is from traffic, from neighbourhood and domestic noise particularly (entertainment premises known as wedding halls). Other significant sources of noise annoyance in Algeria include building construction and household noise as well as car alarms and even barking dogs. In this present study, my concern will be on one of the main noise source in Algeria which is noise from entertainment halls.

In Algeria, there is no existing framework or enforceable code for noise control. In view of the absence of a proper noise control standard in Algeria, a large number of wedding halls have been built without any protection (insulation, double glazing...) causing disturbance and annoyance in the neighbourhood. The noise from these wedding halls is badly affecting neighbours. Modern amplification and music styles make this an increasing problem. Therefore local people saw their lives disturbed by the noise caused by these kinds of recreational halls. As a result of the lack of standards, this study was conducted. A noise survey has never been previously attempted in Algeria.

The aim of this survey is to establish noise level limits and measurements according to the WHO guidelines recommended to create the necessary set off regulations and guidelines on which we could rely in treating the different noise problems in Algeria.

During my investigations in Algiers concerning this subject I have understood that all the entertainment premises I have visited in the centre of the capital and its suburbs have been working without applying any true ,clear regulations concerning noise in general . I have found out that unfortunately (for these premises neighbourhood) no serious standards or codes of practice have been written in Algeria for the purpose of giving guidance or an objective assessment methodology to assist officers investigating neighbour and neighbourhood noise when they happen to deal with noise complaints.

Up to now the only body noise complainers could refer to solve their noise problem is the police who most of the time resolve to make the antagonists meet, to cut the matter short they usually order them to reach a mutual compromise and resolve the problem amicably. In fact, most of the wedding halls which have sprung up everywhere and everyday between 2000 and 2008 have opened up in centre of towns close to places of residence entailing extreme noise nuisance to the neighbourhood. The people affected by noise disturbance do not know who can settle their complaints, except of course, a legal action which of course involves a loss of time and money.

The measurements show a considerable increase in the noise level when the 'weddings' are on. This would not prove acceptable in the UK. Arguments will need to be advanced as to the correct criteria to be used in the specific circumstances of Algeria and how they can be achieved using local materials and construction practices.

ACKNOWLEDGEMENT

First and foremost my family deserves thanks for the years of studentship that they have patiently watched me progress through. Special thanks to dad and mum for their support and understanding.

I dedicate this thesis to my parents who never stopped believing that it could be done.

My gratitude goes to my husband for his support he has given me for so many years. This work is dedicated to him and my daughter Sofia as well as the new born baby Adam.

I am also indebted to my brothers without them, my work would have been harder and I therefore wish to thanks them.

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CHAPTER ONE
Introduction

1.1 *Introduction*

There is no doubt that noise disturbance to the human environment is escalating at such a high rate that it will become a major threat to the quality of human lives. In the past thirty years, noise in all areas, especially in urban areas, has been increasing rapidly. Noise has been defined as unwanted sound that may cause adverse impacts among people, the environment or even both [1].

The most common effect of noise is annoyance and physiological stress. This feeling results from sleep disturbance or interference with communication such noise from loud music. Noise has always been an environmental problem for man. It is hardly surprising then that it has become an issue in our modern society where cars and aircraft, machines and people, and the technology of communication, all contribute to noise levels. Noise may be seen as something, which can pollute the environment where we work or live, when it is too loud, persistent or intrusive.

1.2 *Motivation*

During my master's studies drawing on the UK practice in controlling the noise from entertainment premises, I studied the UK strategy to overcome the noise problem.

At first, the aim of my study was to learn the rules, regulations, guidelines and laws which are applied in the UK and then adapt and apply them in my country Algeria in the future.

On the other hand I have come to the conclusion that the control of the noise from pubs and clubs and or their surrounding areas is legislatively very complex and closely related to the technical solutions.

As a matter of fact the health officers' teams seem to face some difficulties in dealing with the noise problem.

We can summarise this difficulty in two fundamental problems:

- The difficulty in using current and existing standards procedures to equate measured levels of noise emanated with the subjective annoyance caused.
- How to deal with the problem and relieve the nuisance however it is measured.

Entertainment noise control is further complicated by the fact that what does or does not constitute a nuisance is not defined in law but is left totally to the discretion of the local Environmental officer who is given by the 1974 Control of Pollution Act the power to determine ambient noise levels on a neighbourhood basis and to take action through the courts against any infringement. The role of the local authority is also to be careful that « the best practicable means have been used for preventing or counteracting the effect of the noise » section 59 of the Act [2].

BS4142 (1997) is an attempt to help the local authority decide what constitutes a nuisance by setting out a procedure for measurement of the offending noise involving both mean and peak event recording and the use of correction factors depending upon characteristics of the noise itself.

Nevertheless, it has been noticed during my research that the majority of clubs venues whether purpose built or using an existing specific type building (ballroom or theatre type) will attempt to comply with the requirements stated by the authorities, employing if necessary an architect or an acoustician. In addition to that, and from my own experience in joining the HEO (Health and Environment Office) team from Westminster Council on their moving on the field (to check whether the involved venues actually complied with their decisions), it has been observed that whenever music breakout was at the origin of the complaints and investigations of the Environmental officers, the problem was generally dealt with rapidly. The entertainment premises management immediately complied with the authorities' decisions or advices.

That is why through all the different case studies of entertainment noise problems, the issue in the end regarding the provision of licences by the local authorities in charge of the noise a licence allowing an additional opening time (from11-00pm up to 01-00 am or even 03-00am) by or allowing a licence for a high number of patrons, is never caused by music breaking out of the venues themselves, but the external noises caused by cars parking in the venues surroundings, pedestrians, patrons going to or leaving these entertainment premises. Most of the time the local authorities refused the demanded extra licence arguing that any additional noise level (even a small one) added to existing ones or the ambient noise levels would be unacceptable and would be disturbing the resident's sleeping in the neighbourhood. And as it had always proved practically impossible for the venues owners to prevent street noises, then no licence appeal has been favourably considered.

So far, this question of noise has been neglected in Algeria and never had priority due to so many other crucial problems.

1.3 *Aims*

The main aim of this study is to establish a noise level limits and measurement protocols as recommended within the WHO guidelines and create the necessary regulations and guidelines specific to Algeria based on these recommendations.

This can be achieved by the following steps:

1. identification of appropriate subjective indicators of an annoying noise source
2. Collection of viable noise monitoring data both externally and internally to residents premises in attempt to describe the background and specific noise levels arising from wedding halls
3. To analyse data collected form subjective and objective monitoring
4. To propose solutions and recommendation for noise control

1.4 *Contribution of the thesis*

As a noise survey has never been attempted before in Algeria, I have tried through this modest work to get the inspiration from similar work which has been done in UK in by following the same procedure (noise monitoring, data analysis and drawing conclusions and suggesting recommendation).

Having analysed the data from noise monitoring, I have come up to a conclusion that noise from wedding halls is in fact annoying people more and more. I have suggested that both weightings A and C should be used when assessing noise from wedding halls. This choice is explained throughout the thesis. I have also suggested four different criteria to deal with this type of noise as follow:

- *LAeq (ON) - LA90 (OFF)*
- *LAeq (ON) - LAeq(OFF)*
- *LCeq (ON) - LC90 (OFF)*
- *LCeq (ON) - LCeq (OFF)*

These criteria will all be used similarly. For obvious reasons the number of subjects questioned was limited to twenty five person. Therefore, the subjective survey should cover more subjects, say twenty five thousand instead. However, this can only be realistic and done with the help of the government and the local authorities by means of funds and logistic resources.

I hope this present work will contribute to encourage the Algerian public Authorities and services concerned, to find a solution to this nuisance which can lead, if not treated to more serious consequences affecting the public health. My goal is to attempt to transfer and adapt all the knowledge acquired in my study taking into account the specificities of the Algerian environment, the cultural characteristics and financial constrains in particular the control of noise during the period of rest such as "siesta" which is an area requiring original research and not simply an adaptation of UK methods (though the UK approaches themselves remain in contention) .The cultural characteristics impinge on the noise control requirements ,as permitted noise may be different to that in the evening/night.

1.5 *Structure of the thesis*

Chapter 1 describes the main aim of this research and its importance. This chapter also points to the contribution of this thesis in the immediate and long term for Algeria.

Chapter 2 gives an introduction to noise and outlines a literature review for this subject. It starts with the description of basic acoustics definitions, followed by subjective perceptions of the sound types such as intermittent noise, tonal sound. It also introduces the different type of noise sources as well as the impact of noise nuisance impact on health.

Chapter 3 starts with the brief introduction of noise problem in Europe and other countries. This chapter also deals with the different legislations and noise standards in Europe and some of the countries of the rest of the world. It explains how noise nuisance are dealt with locally, what are the solution and action that can be taken to stop and reduce noise pollution. The chapter ends with a critical review of how noise is tackled in Europe.

Chapter 4 is a case study describing noise problem in and noise control in UK. This chapter focuses in a particular noise nuisance which is noise in entertainment music in UK by examining the current standards and codes of practice. This chapter also introduces the UK strategy in controlling the music noise from pubs and clubs and explains licensing and UK legislation and enforcement.

Chapter 5 outlines the Algerian's administrative division as well as the local and regional government; it also gives an overview of a demography growth of Algeria which is closely related to the buildings' quick and urgent needs in the country. It also describes buildings' state in Algeria which is poorly insulated with no thermal or acoustic insulation. Noise types and noise problems in Algeria are enumerated in this chapter pointing the entertainment noise problem as one of the most disturbing noise; this was one of the reasons that influenced the purpose of this study. Noise control standards are also provided with the only decree existing as well as the Algerian's norms which are essentially based on the French norms. Dealing with the noise in Algeria will also be presented in this chapter to understand how this problem is starting to be taken into consideration and tackled.

Chapter 6 describes the noise survey conducted in Algeria. Two types of noise assessment have been identified, subjective and objective. Subjective assessment has been done by means of questionnaire where subjects have been asked to describe their degree of annoyance from all noise nuisance sources. However, this survey was necessarily limited because of problems specific to Algeria. The objective survey has been achieved by monitoring noise levels using sophisticated equipment also in this chapter; the choice of rating criterion has been discussed.

Chapter 7 is the main part of the thesis. It describes the noise monitoring of twenty wedding halls. The location of every wedding hall has been described as well as the positioning of the equipment (microphones). The results of the monitoring are described in tabular and graphical form.

Chapter 8 outlines some examples of room acoustics and sound reduction of building elements related to the present study such as sound transmission from noise source façade to the reception façade as well as sound reduction index calculation.

Chapter 9 describes the findings of the present study as well as suggestion of recommendation on how to tackle noise nuisance from entertainment halls

Chapter 10 summarises the thesis chapters and outlines the suggested noise criteria for the Algerian context.

CHAPTER TWO
Literature Review

2.1 *Introduction*

A person's acoustical environment consists of the sound that he hears at any instant of time. The sound may be pleasant and desirable, or it may be discordant and unwanted. In the latter case, the sound is called "noise", which is defined simply as "unwanted sound". Noise may cause adverse impacts upon people, the environment or both [4]. It could be too loud, too intrusive or just happen at the wrong time or without warning. For example, nobody enjoys being woken up in the middle of the night by a faulty car alarm or noisy generator on a building site. It affects people in a number of ways. It can be loud enough to cause temporary or permanent loss of hearing immediately. Long periods of exposure to relatively low levels of noise can have adverse effects on human health, such as raised blood pressure, hypertension, disrupted sleep and cognitive development in children [5], diminished working memory span, and psychiatric disorders [6]. An estimated 80 million people suffer unacceptable levels of continuous outdoor transport noise within the EU [7]. If a noise is sufficiently loud, it may interfere with one's ability to converse with another person disturb sleep, add to the risk of hearing damage, or otherwise annoy the listener. A noise which adversely affects people in this manner can be considered to pollute the acoustical environment. Thus, noise pollution is the contamination of the acoustical environment by noises which adversely affect people.

A person indoors may experience noise pollution from sources located indoors, such as a vacuum cleaner, air conditioner, or someone else's radio. Or, he may experience noise pollution which enters the house through a closed or partially opened window from sources located outdoors, such as motorcycles, aircraft, and power lawnmowers. A person outdoors is also subject to noise pollution from outdoor sources, in addition to nearby indoor sources such as a loud radio in a room with open windows.

Acoustics is the science of sound, including its production, transmission and effects. Although it is derived from a Greek word meaning "to hear", its meaning has been extended to include sound beyond the limits of hearing.

Acoustics is a broad field, which embraces music, radio, sound reproduction, sonar, medical applications, ultrasonic, and many other specialised subjects of only passing interest to most architects and engineers.

It is a fact of life that we all make noise, talking to others, playing music, entertaining, driving in our cars or just going about our daily business. What is noise to one person may be pleasurable to another. Excessive noise can reduce the quality of life, for example, through lack of sleep or inability to concentrate. If noise is upsetting your life, we can show how you may be able to overcome the problem in a number of positive and constructive ways.

2.2 *Basic acoustics*

The aim of this chapter is to:

- To have a clear understanding of the three basic acoustic parameters: pressure, intensity and power.
- Demonstrate understanding of what sound is and how it works.
- Define noise sources and to identify noise source which is relevant to the present study.
- To be able to collect and interpret primary and/or secondary data and discuss its significance in the context of the investigation and of related studies.
- Demonstrate initiative and critical thinking skills in selecting aims and objectives for the investigation and identifying an appropriate methodology for the investigation.

2.2.1 *Sound*

All environmental noises are derived from overall sound pressure levels, the variation of these levels with time and the frequency of sounds.

In definition, sound pressure is the average variation in atmospheric pressure caused by the sound [8] Sound can produce feelings of pleasure and displeasure. This phenomenon is of course distinct from the interference with communication or work performance or the damage to the human hearing mechanism, which can result from the presence of sounds.

Three basic types of annoyance can be distinguished. Some sounds are considered annoying by people; some sounds produce feelings of great annoyance to a very few people; some sounds produce different feelings of annoyance and pleasure in the same person at different times.

Sound is a sensation detected by the ear as a result of pressure variations set up in the air by a vibrating source or rapid changes in pressure, such as experienced from an impact or explosion. Sound pressure disturbance or vibrations need a medium to propagate through, such as air, fluids or a solid material. The particles in the medium are compressed and expanded and particles oscillate about a position. The vibration is moved from particle to particle but the particles do not move over a distance. Air is the

normal medium that transports the sound to the ear. The sound energy travels in the form of a wave. Sound waves are similar to other waves motion and therefore specify in terms of wavelength, frequency and velocity.

The equation will be then v =f xλ

Where v =velocity in m/s

f =frequency in Hz

λ = Wavelength in m

The velocity of sound in air is higher in denser media and increases very slightly with humidity or the temperature. But stays unaffected by variations in atmospheric pressure. The velocity of sound is however, affected by the properties of the material through which is travelling.

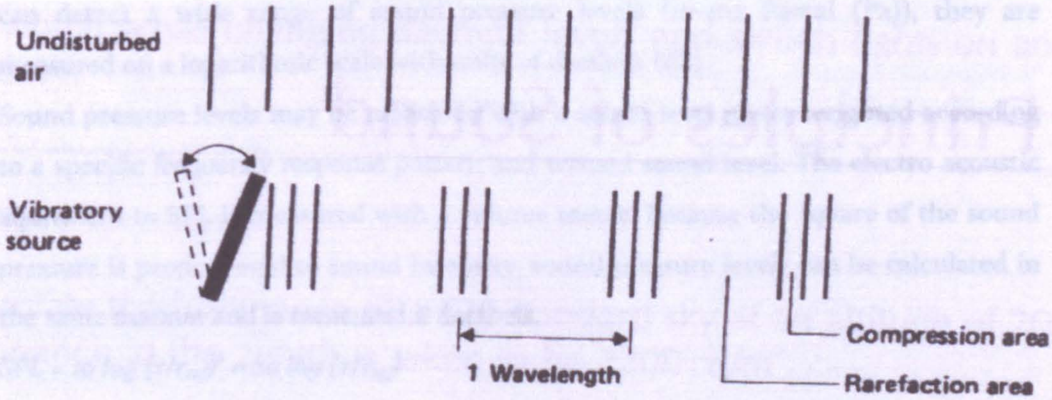

Fig 2.1: Pressure variations in a sound wave
Source:G.Porges, Applied Acoustics.1977

2.2.3 *Sound pressure*

We can define sound pressure as the difference between the actual instantaneous pressure due to sound and the atmospheric pressure, and, of course, it is also measured in Pa. However, sound pressure has usually a value much smaller than the one corresponding to the atmospheric pressure. For instance, unbearably loud sounds may be around 20 Pa, and just audible ones may be around 20 μ Pa (μ Pa stands for micropascal, i.e., a unit one million times smaller than the pascal). Another important difference is that the atmospheric pressure changes very slowly, whereas sound pressure is rapidly changing, alternating between positive and negative values, at a rate of between 20 and 20,000 times per second. This rate is called frequency and is expressed in Hertz (abbreviated Hz), a unit equivalent to a cycle per second. In order

to reduce the amount of digits, frequencies above 1,000 Hz are usually expressed in kilohertz, abbreviated kHz. 1 kHz equals 1,000 Hz.

2.2.4 *Sound Pressure levels*

The sound pressure level is a measure of the air vibrations that make up sound. The term most often used in measuring the magnitude of sound. It is a relative quantity in that it is the ratio between the actual sound pressure and a fixed reference pressure. This reference pressure is usually that of the threshold of hearing_ which has been internationally agreed upon as having the value .0002 dynes/cm². All measured sound pressures are referenced to a standard pressure that corresponds roughly to the threshold of hearing at 1 000 Hz. Thus, the sound pressure level indicates how much greater the measured sound is than this threshold of hearing. Because the human ear can detect a wide range of sound pressure levels (10–102 Pascal (Pa)), they are measured on a logarithmic scale with units of decibels (dB).

Sound pressure levels may be measured with a sound level meter weighted according to a specific frequency response pattern and termed sound level. The electro acoustic equivalent to SPL is measured with a volume meter. Because the square of the sound pressure is proportional to sound intensity, sound pressure levels can be calculated in the same manner and is measured ii decibels.

$$SPL = 10 \log (r/r_{ref})^2 = 20 \log (r/r_{ref})$$

where r is the given sound pressure and r_{ref} is the reference sound pressure.

Two sound pressure levels measurements in decibels may be combined with the aid of the following chart. The difference in decibels between the two readings is found on the upper scale, and the corresponding correction appears opposite it on the lower scale. This correction is added to the higher sound pressure levels to give the combined measurement. Multiple readings may be combined by repeating this process. For example, equal sound pressure levels readings (0 on top scale) produce a 3.0 increase when combined. A 5 dB difference (say between 60 and 65 dB) produces a 1.2 dB increase (a total of 66.2 dB for the same example). A 10 dB difference requires a 0.4 dB correction, and so on.

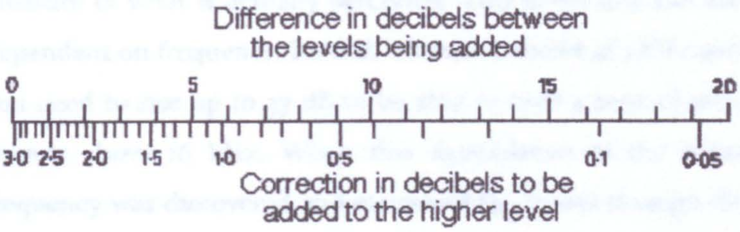

Fig 2.2: Sound pressure measurement scale

Source: Handbook of Acoustic Ecology, Barry Truax, 1999

Table below gives values for the sound pressure levels of common sounds in our environment. Also shown are the corresponding sound pressures and sound intensities.

Chart of sound levels *L* and corresponding sound pressure and sound intensity			
Examples	**Sound Pressure Level dBSPL**	**Sound Pressure *p* N/m² = Pa**	**Sound Intensity *I* watts/m²**
Jet aircraft, 50 m away	140	200	100
Threshold of pain	130	63.2	10
Threshold of discomfort	120	20	1
Chainsaw 1m distance	110	6.3	0.1
Disco, 1 m from speaker	100	2	0.01
Diesel truck, 10 m away	90	0.63	0.001
Kerbside of busy road, 5 m	80	0.2	0.0001
Vacuum cleaner, distance 1 m	70	0.063	0.00001
Conversational speech, 1m	60	0.02	0.000001
Average home	50	0.0063	0.0000001
Quiet library	40	0.002	0.00000001
Quiet bedroom at night	30	0.00063	0.000000001
Background in TV studio	20	0.0002	0.0000000001
Rustling leaf	10	0.000063	0.00000000001
Threshold of hearing	0	0.00002	0.000000000001

Table 2.1: Sound pressure levels

Source:www.sengpielaudio.com/tableofsoundpressurelevels.htm

From these you can see that the decibel scale gives numbers in a much more manageable range.

2.2.5 *A-Weighted Sound Level*

The sound pressure level has the advantage of being an objective yet a handy measure of sound intensity, but it has the drawback that it is far from being an accurate

measure of what is actually perceived. This is because the ear's sensitivity is strongly dependent on frequency. Indeed, whereas a sound of 1 kHz and 0 dB is already audible, you need to rise up to 37 dB to be able to hear a tone of 100 Hz. The same holds for sounds above 16 kHz. When this dependence of the sensation of loudness with frequency was discovered and measured [9], it was thought that by using an adequate filtering (i.e., frequency weighting) network, it would be possible to objectively measure that sensation. This filtering network would work in a similar way as the ear does, i.e., it would attenuate low frequency and very high frequencies, leaving middle frequencies almost unchanged. In other words, it would perform a bass and a treble cut prior to actually measuring the sound.

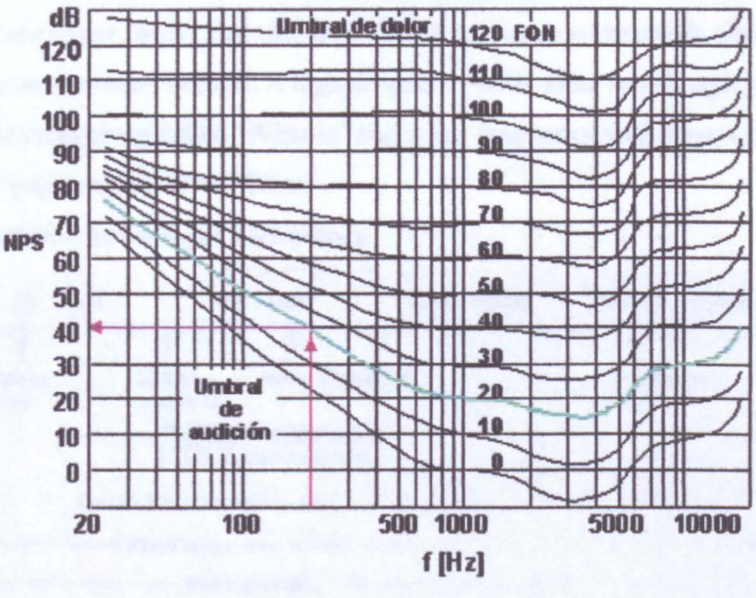

Fig 2.3: Fletcher and Munson Contours

Source: Fletcher and Munson, Loudness, its definition, measurement and calculation. 1933.

Instantaneous A-weighted sound pressure level is not generally considered as an adequate indicator of subjective response to noise because levels of noise usually vary with time. For many types of noise the Equivalent Continuous A-weighted Sound Pressure Level ($L_{Aeq,T}$) is used as the basis of determining community response. The ($L_{Aeq,T}$) is defined as the A-weighted sound pressure level of the steady sound which contains the same acoustic energy as the noise being assessed over a specific time period, T.

The L_{A10} is the noise level exceeded for 10% of the measurement period. It has been used in the Uk for the assessment of road traffic noise.

The L_{A90} is the noise level exceeded for 90% of the measurement period. It is generally used to quantify the background noise level, the underlying level of noise which is present even during the quitter parts of the measurement period.

The L_{Amax} is the maximum value that the A-weighted sound pressure level reaches during a measurement period.

2.2.6 *Frequency*

Frequency is the number of pressure waves, which pass a fixed point in one second. It is also related to pitch of a sound. Pitch is the frequency as perceived by human hearing. Sound travels at a constant speed and the longer the wavelength, (lower frequency and lower pitch) and vice-versa the shorter the wavelength, the more frequencies we have per second. A high frequency with short wavelength gives a high pitch sound commonly called "Whistle" and a low frequency with long wavelength gives a low pitch sound called "Hum".

Speed of sound = wavelength x frequency

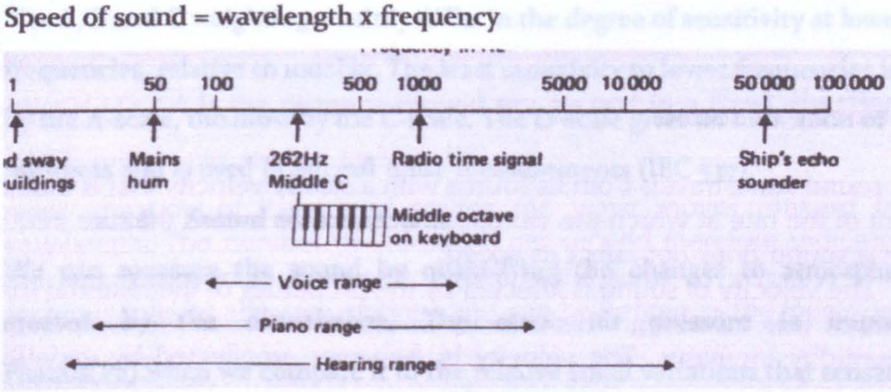

Fig 2.4: frequency ranges of sound waves

Source: P.Parkin, J.R.Cowell, H.Humphreys, Acoustic, Noise and Buildings,1979

2.2.7 *Frequency weighting*

The basic instrument for objectively measuring sound is the sound level meter. In its simplest form it is calibrated to read sound level over a short period of time with a similar response to all frequencies that is a 'linear' weighting. Since the human ear is not uniformly sensitive to all frequencies, several weighting scales have been developed to simulate the various sensitivities. These weightings are known as A, B, C or D weightings (see figure below).

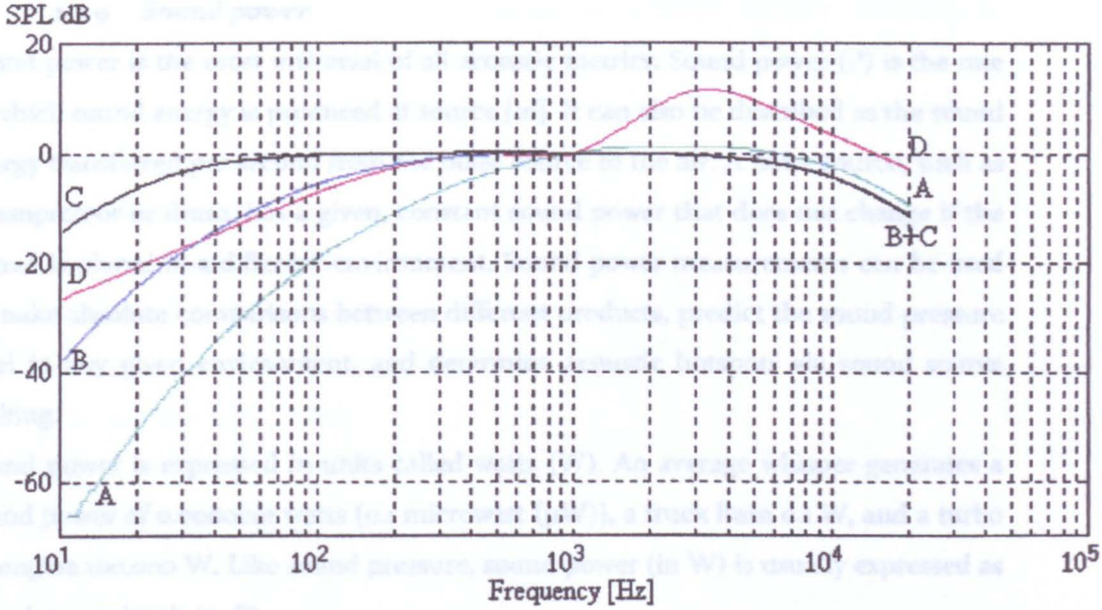

Fig 2.5: A, B, C and D Weightings
Source: http://www.ptpart.co.uk/noise-measurement-briefing/

The A, B and C weightings mainly differ in the degree of sensitivity at lower frequencies, relative to 1000Hz. The least sensitivity to lower frequencies is provided by the A-scale, the most by the C-scale. The D-scale gives an indication of perceived noisiness and is used in aircraft noise measurements (IEC 537).

2.2.8 *Sound measurement*

We can measure the sound by quantifying the changes to atmospheric pressure created by the disturbance. The static air pressure is important,100,000 Pascals(Pa),when we compare it to the relative small variations that sensation of sound causes. 1 Pascal =1N/m²

The range of pressure changes that the ear responds to is nevertheless very large.

	Threshold of Hearing		Threshold of Pain	Range
Pressure Range	0.00002	to	200N/m² (Pa)	10^{7} *
Intensity Range	1E-12	to	100W/m²	10^{14} **

*Pressure range of ten million to one

** Intensity range of one hundred, million, million to one.

Source: D.M.Howard, J Angus,Acoustics and Psychoacoustics,2006

We measure the sound power coming from vibrating sound source in Watts.

2.2.9 *Sound power*

Sound power is the most universal of all acoustic metrics. Sound power (P) is the rate at which sound energy is produced at source [10]. It can also be described as the sound energy transferred per second from the noise source to the air. A noise source, such as a compressor or drum, has a given, constant sound power that does not change if the source is placed in a different environment. Sound power measurements can be used to make absolute comparisons between different products, predict the sound pressure level in any given environment, and determine acoustic hotspots via sound source ranking.

Sound power is expressed in units called watts (W). An average whisper generates a sound power of 0.0000001 watts (0.1 microwatt (μW)), a truck horn 0.1 W, and a turbo jet engine 100,000 W. Like sound pressure, sound power (in W) is usually expressed as sound power levels in dB.

Figure below relates sound power in watts to sound power level in decibels. Note that while the sound power goes from one trillionth of a watt to one hundred thousand watts, the equivalent sound power levels range from 0 to 170 dB.

COMPARISON OF SOUND POWER LEVEL AND SOUND POWER

	Sound Power Level in dB	Sound Power in Watts
	170	100,000
Turbojet Engine	160	10,000
	150	1000
	140	100
	130	10
Compressor	120	1
	110	10^{-1}
	100	10^{-2}
	90	10^{-3}
	80	10^{-4}
Conversation	70	10^{-5}
	60	10^{-6}
	50	10^{-7}
	40	10^{-8}
	30	10^{-9}
	20	10^{-10}
	10	10^{-11}
	0	10^{-12}

Fig 2.6: Comparison of sound power levels and sound power
Source:www.rockwool.com

2.2.10 *Sound intensity*

Sound intensity is the second power distributed over unit area [11]

The sound intensity is the alternative range to pressure (sound intensity is proportional to pressure) .It is quantified in Watts/m^2 and its intensity decreases as it propagates away from the source.

Unit: Watt per square metre (W/m^2)

For any free progressive wave:

$I = P^2_{rms}/\rho c$ (free field)

For a diffuse sound field at the walls of a room:

$I = P^2_{rms}/4\rho c$ (reverberant field)

Where I: is the intensity (Wm^{-2})

P^2 rms :is the square sound pressure $(Pa)^2$

ρ: density of the air(Kgm^{-3})

c :speed of sound (velocity of sound)(ms^{-1})

ρc: is the specific acoustic impedance of air = 410 rayls in air at normal temperatures and pressures

2.2.11 *Thresholds*

Threshold of hearing is the lowest sound pressure that the average human ear can detect. It is defined to have the following values at 1000Hz:

$I = 1 \times 10^{-12}$ W/m^2 when measured as intensity

$p = 20 \times 10^{-6}$ Pa when measured as pressure

Threshold of pain is the highest sound pressure that the human ear can tolerate.

When the sound is very strong it becomes very painful to the ear and it may damage the ear mechanism [12]. The threshold of pain has the following approximate value:

I =100W/m^2 or p=200Pa

2.2.12 *Decibels*

The decibel is defined as one tenth of a *bel* where one bel represents a difference in level between two intensities I_1, I_0 where one is ten times greater than the other. Thus, the intensity level is the comparison of one intensity to another.

For instance, the difference between intensities of 10^{-8} watts/m^2 and 10^{-4} watts/m^2, an actual difference of 10,000 units, can be expressed as a difference of 4 bels or 40 decibels.

The decibel (dB) scale is used as an alternative logarithmic scale in order to avoid the large numbers that would have to be handled. This scale reduces the range to a more manageable numerical scale of 0-140dB .It is a logarithmic ratio of two quantities.

$N = dB = 10\log(I/I_0) = 10\log(P/P)^2$

simply to identify the source of the noise, where N: number of decibels

I and I_0 are 2 intensities being compared or P and P 2 pressure being compared.

Sound power, sound intensity and also sound pressure can be quantified in decibel. They all have an established mathematical relationship.

Values of sound intensity or sound pressure can be changed in decibels by comparing them with the standard value of the threshold of hearing. In this case the word "level" shows that this reference has been used. The mathematical equations are given by:

SIL =10 log (i / I)

Where

i = the intensity of the sound being measured (W /m²)

I =the intensity of the threshold of hearing taken as 1x10 $^{-12}$ W/m²

SPL =20 log (p/ p)

Where

p =the RMS pressure of the sound being measured (Pa)

p= the RMS pressure of the threshold of sound taken as 20? Pa

RMS pressure =0.707 maximum pressure.

The same value in decibels for the same sound are given by SIL and SPL

2.2.13 Frequency measurement

It is possible for the human ear to distinguish between wide ranges of frequencies from 20 to 20000 Hz. The lowest below which people cannot hear is the threshold of hearing as defined above and the other extreme, where the sound becomes painful to hear is the threshold of pain. They vary with frequency of the sound and with the listener's age particularly at the high frequency end of the range. To determine the annoyance or to simply identify the source noise, it is often necessary to determine the amount of sound energy at particular frequencies. Sound pressure level meters with filters can separate the full audible range of frequencies into "slices" of sound called octaves or third octave bands.

We define an octave centre band as being "a doubling or halving of the centre frequency band above or below its own centre frequency, Third octaves are defined as octaves subdivided into additional three component parts" When it is necessary to identify the specific problem frequencies, we can use the Narrow band Analysis. These Narrow bands can be divided as a few Hertz and are generally used for engineering diagnostics.

To identify low frequency noise problems, we generally use the octave on third octave analysis. See (figure 2.8 and 2.9).

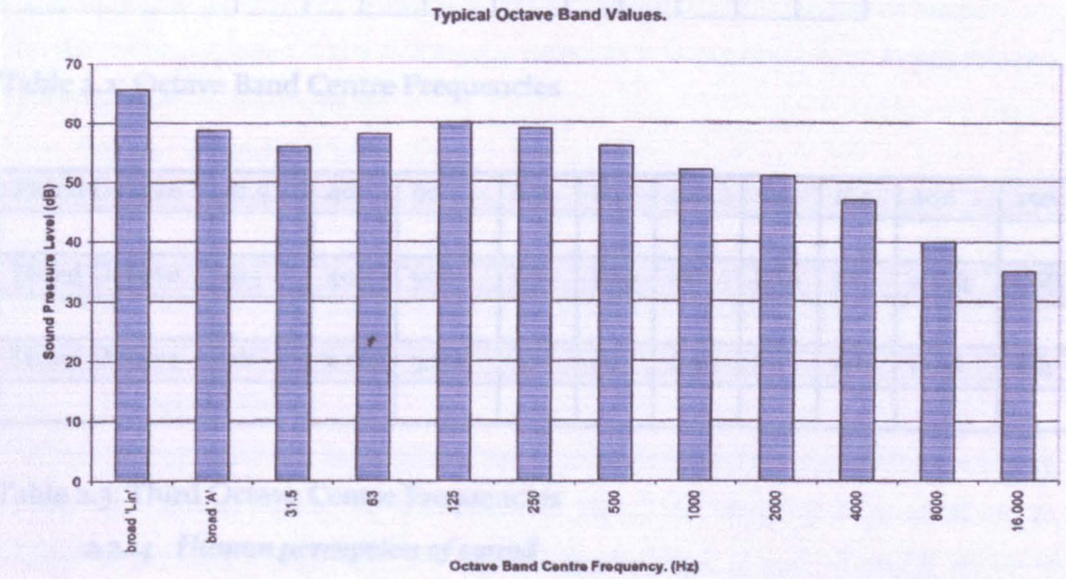

Fig 2.8: Octave band frequency

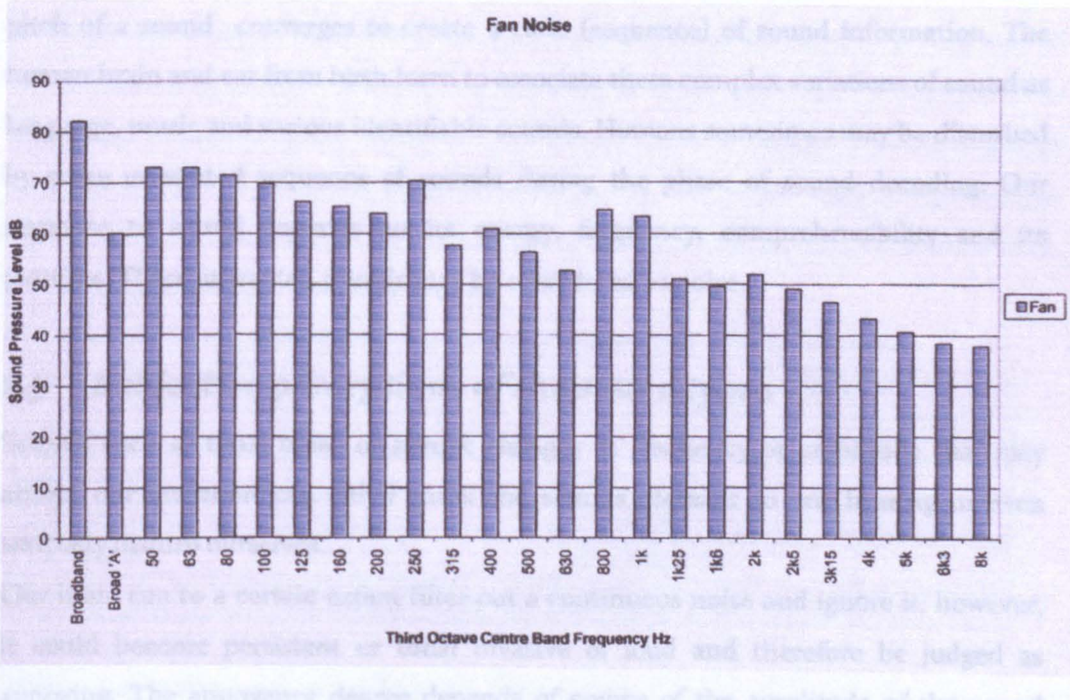

Fig 2.9: Third octave band frequency

Source: A.Bradshaw, Westminster Council Document: licensing policies for public entertainment, 2002.

The frequency bands are internationally agreed as following:

Octave Band	31.5	63	125	250	500	1k	2k	4k	8k	16k

Table 2.2: Octave Band Centre Frequencies

Third Octave	31.5	40	50	63	80	100	125	160	200	250
Third Octave	315	400	500	630	800	1k	800	1k	1.25k	1.6k
Third Octave	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k

Table 2.3: Third Octave Centre Frequencies

2.2.14 *Human perception of sound*

Human perceives noise as unwanted sound, a sound different from the one a listener wishes to hear with pleasure. Sound level or loudness together with the frequency or pitch of a sound converges to create a code (sequence) of sound information. The human brain and ear from birth learn to associate these complex variations of sound as language, music and various identifiable sounds. Humans sometimes may be disturbed by some unwanted sequence of sounds during the phase of sound decoding. Our response to sound depends on its energy, frequency, comprehensibility and its patterns. These unwanted sounds may be considered as noise.

2.3 *Subjective perceptions of the sound types*

Sounds such as tonal noise or abrupt changes in frequency or amplitude that may attract our attention can either mask the sounds pleasant to our hearing or even seriously disturb ourselves.

Our brain can to a certain extent filter out a continuous noise and ignore it, however, it could become persistent or tonal invasive of loud and therefore be judged as annoying. The annoyance degree depends of course of the amplitude of the sound relative to the prevailing background sounds that are present. When a sound is not perceived as information, it is therefore perceived as a disturbance because it is unknown or sudden.

2.3.1 Intermittent noise

We can refer to intermittent noise, when the level suddenly drops to that of the background noise times during the period of observation. One second or more is the time during which the noise remains at levels different from that of the ambient.

As this noise stops and starts at irregular intervals it is therefore more noticeable and more likely to attract attention

2.3.2 Tonal sounds

A tonal noise contains a prominent frequency and it is characterised by a definite pitch. When the tones are very different, louder than the background sounds or occur at a more sensitive frequency for the ears, they then become more noticeable and perceived as very annoying.

3.3 Transient noises

When the regularity of a noise is infrequent(example of individual vehicles passing by a dwelling house regularly but not at definite times), the attention is attracted and is disturbed because it is not a continuous noise unlike a stream of traffic which is considered as a continuous noise.

2.3.4 Impulsive noises

We talk about impulsive noise when a high peak of short duration or a sequence of such peaks is noticed. A sequence of impulses in rapid succession is designated as repetitive impulsive noise. Humans instinctively react to threatened noises just as animals do. The attention of people is attracted by such noises containing messages associated with warnings (ex car horns, shouts, screams, screeching of car brakes etc..).

2.3.5 Subjective Descriptors

Here is a subjective annoyance description of noise types as they affect us.

Noise Type	Subjective Description
Continuous	Bland
Intermittent	Noticeable
Impulsive	Startling
Tonal	Irritating

Table 2.4: Noise type and subjective descriptors

A combination of the above will increase the chance of annoyance.

The ear mechanism is logarithmic to sound stimuli but the human ear does not process sound in a linear fashion. A 3 dB increase in sound level equates to a doubling of sound energy although a 10 dB increase is perceived as an approximate doubling in loudness. This advice can be misleading, as sound-doubling effect is generally true for featureless and continuous noise. Our ears will perceived differently a sudden start or stop or a sound which consequently may be judged as being more noticeable, even at lower db intervals. Also in mid frequency range we are more sensitive to small pressure level changes.

2.3.6 Frequency Analysis

The frequency content becomes important when tonal plant noise or music noise breakout from premises is assessed. Tonal noise can be more noticeable from plant and low frequency "beat" music may often escape through the building fabric. Figure 2 (seen before) shows third octave analysis of some plant items showing tonal noise in the 250Hz, 800 Hz and1000 Hz bands.The increase in these bands is between 5and 10 dB. In the situation of a steady noise a 5 dB increase in a frequency band will probably be perceived as a nuisance.

2.3.7 Sound insulation

Controlling sound emission from a building can be realised in 3 ways:

- Sound insulation: Heavy mass prevents airborne transmission.
- Sound isolation: The impact transfer to the structure can be avoided thanks to the resilient materials.
- Sound absorption: Airborne reflected sound can be absorbed by porous materials. (This reduces reverberant noise)

To prevent sound from escaping from the premises to the street or to another part of the building we can use the building fabric.

There are two types of sound insulation; airborne and structure borne.

Airborne sound attaining the building fabric will be either reflected, transmitted or absorbed. The amount of transmitted sound depends upon the rigidity and mass of the building element. A heavy, thick material such as masonry is a good airborne sound insulation whereas a single light material such as thin glass sheet is not. Even the nature of the surface can determine the amount of the reflected sound. A soft porous surface will tend to absorb sound and dissipate it as heat. Some of the energy transmitted into the solid building element can be retransmitted transversely along the element and be re-radiated to another part of the building.

Sound can find alternative ways to escape through openings, windows, and doors. It is called flanking sound. Sound can also be re-radiated through other building elements that are set into vibration by the resonant frequencies.
Impact sound is caused when a machine or impact process lets the energy pass directly to the structure. To prevent this occurrence the vibrating source must be isolated from the structure. Resilient materials or devices such as rubber mats and mounts or springs act as Anti-Vibration Mounts (AVM's).

2.4 *Room Acoustics*

2.4.1 *Sound in rooms*

Sound interacts with actual environments in complex ways that are affected by nearly every aspect of the physical environment. The propagation of a sound wave in air, for instance, is influenced by all atmospheric conditions, and also by the processes of reflection, absorption and transmission at every surface with which it comes into contact. Such information is useful in predicting and describing how sound behaves in any given environment, and also in controlling or manipulating its behaviour in environments where acoustic communication has a special role.
A sound in a room can be regarded as being made up of two parts. One is the sound which reaches a point ***directly*** from the source, just as it would in a free field. It obeys the free field laws of propagation, and in particular, the inverse square law. The other is the ***reverberant sound*** which, if there are a sufficiently large number of reflections before all the energy is absorbed, reaches any one point from all directions.
Reverberant sound is the collection of all the reflected sounds in a room.

2.4.2 *Reverberation Time*

It is well known that the reverberation time is an important objective descriptor to assess the sound quality in rooms for both music and speech intelligibility [13]. Moreover it is also helpful for the measurement of the sound insulation of building elements (facades, partitions and floors) [14], the evaluation of the sound absorption of items located in a reverberation chamber [15] and the determination of the sound power level emitted by noise sources in a reverberant sound field [16].
Several methods have been developed to obtain the level decay function for evaluating the reverberation time in rooms. Some of them are based on the room response recorded when the steady-state excitation of a random noise sound source is interrupted. These methods can be considered as descendants of the historical method conceived by Sabine who used the interruption of the sound emitted by an organ pipe

and his ears to estimate the duration of the sound-tail [17]. Other methods are based on the measurements of the Room Impulse Response (RIR). Impulse responses are directly obtained when the room is excited by a very short and intense sound. A hand clap can be considered the ancestor of these methods. The instrumentation and signal processing available today have produced many variants of the above-mentioned methods. RT_{60} is the time required for reflections of a direct sound to decay by 60 dB below the level of the direct sound. Reverberation time is defined for wide band signals. Basic factors that affect a room's reverberation time include the size and shape of the enclosure as well as the materials used in the construction of the room. Every object placed within the enclosure can also affect this reverberation time, including people and their belongings.

2.4.3 *The Sabine Equation*

Sabine's reverberation equation was developed in the late 1890s in an empirical fashion. He established a relationship between the RT_{60} of a room, its volume, and its total absorption (in sabins). This is given by the equation:

$$RT_{60} = \frac{c \cdot V}{Sa}.$$

Where *c* is a mathematical constant measuring 0.161, *V* is the volume of the room in m^3, *S* total surface area of room in m^2, *a* is the average absorption coefficient of room surfaces, and *Sa* is the total absorption in sabins. The total absorption in sabins (and hence reverberation time) generally changes depending on frequency (which is defined by the acoustic properties of the space). The equation does not take into account room shape or losses from the sound travelling through the air (important in larger spaces). Most rooms absorb less in the lower frequencies, causing a longer decay time.

The reverberation time RT_{60} and the volume *V* of the room have great influence on the critical distance d_c (conditional equation):

$$d_c = 0.057 \cdot \sqrt{\frac{V}{RT_{60}}}$$

where critical distance r_H is measured in metres, volume *V* is measured in m^3, and reverberation time RT_{60} is measured in seconds.

2.5 *Noise source*

There are various sources of noise that can affect people. It is well known as community noise. Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood. The main indoor sources of noise are ventilation systems, office machines, home appliances and neighbours. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motorsports; playgrounds; car parks; and domestic animals such as barking dogs.

2.5.1 *Industrial noise*

Industrial noise pollution is an ever growing problem and its management is centred around many pieces of legislation, standards, guidance documents. It is responsible for intense noise indoors as well as outdoors. Mainly this noise is due to machinery of all kinds and often increases with the power of the machines. Noise from fixed installations, such as factories or construction sites, heat pumps and ventilation systems on roofs, typically affect nearby communities. Reductions may be achieved by encouraging quieter equipment or by zoning of land into industrial and residential areas. Requirements for passive (sound insulating enclosures) and active noise control, or restriction of operation time, may also be effective.

2.5.2 Noise from transport

Transportation noise is the largest contributor to community and environmental noise. Transportation noise is perhaps the most pervasive and difficult source to avoid in society today. Road traffic noise is a major contributor to overall transportation noise. It is one of the most widespread and growing environmental problems. The impact of road traffic noise on the community depends on various factors such as road location and design, land use planning measures, building design, vehicle standards and driver behaviour. Traffic noise has emerged in recent years as an ever present but often underestimated pollutant in our lives. In Europe, the population exposed to levels above 65 dB (A) increased from 15% in 1980s to 26% in the early 1990s [18]. Railway noise is also considered as transportation noise, its noise source is mainly from speed of the train which depends on the type the train engine as well as the wagons and the rails and their foundations. Noise also can be generated from the train stations because of running of engines, loud speakers. High-speed trains generate noise which is sudden and not impulsive noise.

Aircrafts generate substantial noise in airports. Aircraft take-offs are known to produce intense noise, including vibration and rattle. The landings produce substantial noise in long low-altitude flight corridors. In general, larger and heavier aircraft produce more noise than lighter aircraft. Noise from military airfields may present particular problems compared to civil airports [19]. For example, when used for night-time flying, for training interrupted landings and take-offs (so-called touch-and-go), or for low-altitude flying.

2.5.3 *Construction noise*

Building construction and excavation work can cause considerable noise emissions. A variety of sounds come from cranes, cement mixers, welding, hammering, and other work processes. Construction equipment is often poorly silenced and maintained, and building operations are sometimes carried out without considering the environmental noise consequences.

2.5.4 *Domestic noise*

Noise is common in modern society, and the main outdoor sources are transportation (road, rail, and air traffic), industry, construction, and public work as described earlier. Domestic noise known as "Neighbourhood noise" can be categorised as rural, suburban, or commercial. The main indoor noise sources are ventilation systems, office machines, home appliances, and neighbours. Domestic noise is often sleeping disturbing in residential areas. Studies have shown greater noise induced sleep disturbances in studies conducted in the laboratory than in field settings

2.6 *Health effects of environmental noise*

Noise is an environmental stressor. It can interfere with daily activities in school or work, in people's homes and also during their leisure time. Considerable part of the population exposed to noise will experience all kinds of biological effects: from perception to an – taken by itself- innocuous rise in heart rate or vasoconstriction. A number will experience also higher order effects: annoyance, sleep disturbance, rise in blood pressure. In a smaller number of people these effects may under unfavourable conditions (other stressors, personal characteristics) develop into clinical effects.

The most obvious effect that most people associate with noise is hearing impairment. However the most common effects can be classified as "quality of life" rather than illness problems. What these effects lack in severity is compensated for by the number of people affected, as these effects are very widespread [20]. Though we spend a third of our lives sleeping, a definitive explanation of the function of sleep remains undiscovered; sleep is, nonetheless, known to be necessary to maintaining well-being and good health [21]. Without adequate sleep our bodies and minds do not function to the best of their abilities. Noise is an environmental stressor that has an impact on human health and wellbeing.

Reactions to a stressor can be psychological (feelings of fear, depression, and frustration), behavioural (social isolation, aggression, and the excessive use of alcohol, tobacco, food, and drugs), or somatic, which manifests itself through the stimulation of the central nervous system and hormonal activity resulting in cardiovascular, gastrointestinal, and respiratory illness [22].

According to the International Programme on Chemical Safety [23], an adverse effect of noise is defined as "a change in the morphology and physiology of eleven organisms that results in impairment of functional capacity, or an impairment of capacity to compensate for additional stress, or increases the susceptibility of an organism to the harmful effects of other environmental influences". This definition includes any temporary or long-term lowering of the physical, psychological, or social functioning of humans or human organs.

Effects of noise can be divided in three different categories based on when the response to the noise exposure occurs. Primary effects occur during exposure periods. These are subdivided into acute effects (e.g. activity interference, masking of speech) and cumulative effects that represent the aggregated response over the whole exposure period (e.g. secretion of stress hormones over the course of a night).

Secondary effects result from the primary effects and may occur during (e.g. annoyance) or after the exposure period (e.g. tiredness after working in a noisy environment). Though secondary effects are often tolerated for a considerable time, in the long run they are though to contribute to the third type of effects, tertiary effects, or health disorders. Noise is believed to contribute to chronic diseases, chronic annoyance, and to permanent behavioural alterations [24].

2.6.1 *Acute effects*

2.6.1.1 *Annoyance*

Noise exposure is an important factor contributing to annoyance [25; 26; 27] . Many noise annoyance surveys have been conducted over the years, and international technical specifications have been developed to help harmonise methods of assessing such annoyance by means of social and socio-acoustic surveys [28]. For day-time annoyance, the response scales relate in most cases to disturbance of communication, mental concentration, and recreation. For night-time annoyance, the scales relate to various aspects of sleeping quality [29].

2.6.1.2 *Activity interference*

Noise interferes with a range of activities. Lazarus, for example, has shown that noise interferes with speech communication causing frequent misunderstanding, uncertainty, and problems [30]. The most frequently occurring day-time disturbance is "not being able to open the living room windows as often as one wished to because of the road traffic noise". This complaint is followed by disturbance of relaxation and concentration, of listening to radio or TV, and of communication. Not being able to keep bedroom windows open at night due to road traffic noise is reported by a large majority exposed to noise levels of $L_{Aeq,22-06}$ 57dB and above [31].

2.6.2 *Long-term effects*

Several comprehensive reviews of noise-induced effects have been published, including documents by the Health Council of the Netherlands [32;33], Community Noise, a document prepared for WHO [34]; Guidelines for Community Noise [35], and by Passchier-Vermeer and Passchier [36].

The most recent review [37] evaluated current evidence of the existence of a causal relationship between community noise and various effects found in epidemiological studies. This overview shows that sufficiently strong evidence has been found for such long-term health effects of community noise exposure as hearing impairment, cardiovascular effects (i.e. hypertension and ischemic heart disease), impaired performance at school, and various types of sleep disturbances

2.7 *Noise sources in residential areas*

Noise from neighbours, including voices and music, is one of the main causes of noise complaints in residential areas. In addition, noise from ventilation systems in residential buildings causes considerable concern, even at low and moderate sound pressure levels, due to its low-frequency characteristics [38; 39]. For many, however, transportation noise from road, rail, and air traffic is the main source of community noise pollution. Road traffic - often the dominant noise source - is mainly generated by vehicle engines and by friction between the tyres and the road. Tyre/road noise is generally dominant for nearly all types of vehicle driving, even down to about 40 km/h in the case of trucks [

CHAPTER THREE
Noise Nuisance in Europe and the rest of the world

3.1 *Noise problem in Europe*

There is an increasing concern about noise pollution in Europe. In fact noise in Europe is the only environmental impact for which the public's complaints have increased since 1992 [41]. People frequently complain about noise annoyance, and most of EU citizens live in areas which have disturbing levels of noise. Controlling this form of pollution has now become a priority, because of the negative effects of noise on people's health. The European Commission adopted a directive on noise in order to solve the problem [42].

More than half of the Union's citizens are exposed to an unacceptable level of transport noise. The WHO reports that more than 30% of European Union citizens are exposed to levels of noise which disturb sleep, and 5-15% of all citizens suffer serious noise-induced disturbance [43]. The scale of the European problem is growing together with Europe's roads and airports. With a 3 dB increase in noise equivalent to doubling in the total intensity of noise, this problem requires immediate action [44].

There are two main reasons why noise standards had to be set at a European level: to protect the health of EU citizens and to support the effective working of the common market. Regions and countries within the European Union compete with each other. This has led to a fierce competition between regions and even between countries. For instance, in the case of air transportation, particularly in airports, the economic issue are considered more than the human health costs. For example, Cologne airport authorities refused permission to TNT to expand their activities. This has led to TNT to look at other European airports to expand their activities. Many European airports offered TNT favourable conditions which was the case of Liege Airport in Belgium. Eventually TNT moved their base from Cologne to Liege. This has proved to be a bad decision for Liege airport authorities because the health cost from noise were far heavier than economic gains [44].

However in France, the authorities of the Strasbourg airport have refused to allow the company DHL to increase its air operations because they saw that gains from the increased employment in the area would be more than offset by the costs [45].

For this reason, it was clear that a European legislation to control noise and more importantly to protect the European Union citizen health was the best way to implement standards which will protect the European citizen while not providing competitive advantage for a particular region in the European Union.

Domestic noise in particular is an almost inevitable consequence of urban living and is highly dependent on standards of behaviour and personal consideration. Consequently it is found to cause problems everywhere, although it is likely that the size of the problem varies significantly across Europe depending on local circumstances.

In some Scandinavian countries, for example, high standards of thermal insulation and noise insulation may partly account for an apparent lower level of concern with neighbour noise, particularly in terms of the administrative system which does not appear highly tuned to the issue. [46]

Whereas in some Mediterranean countries such as Spain and Portugal the noise from neighbours is tolerated to a certain extent because of other noise sources like transportation and construction which generate greater noise.

In Europe, many standards and noise regulations exist varying from country to another. Some countries have specific regulations for neighbour noise which are separated from regulations for neighbourhood noise. The latter is usually covered in planning regulations. Other European countries have given local authorities in certain regions power to develop their own laws on community noise.

Germany for example, has national regulations on noise from lawnmowers, sports facilities, construction sites and certain fixed installations, whereas it also has regional (Länder) specific Noise Ordinances for private and commercial activities. In some countries more strict laws and standards are applied to the hours where noisy activities take place. In some countries (eg in Portugal) even DIY and other domestic activities such as mowing the lawn are subject to regulations. In Europe, enforcement is shared between local authorities and police. The use of police power is found to be very beneficial because police can be very efficient in terms of complaints investigation and can cover larger areas of investigation than the local authorities. However, local authorities are more useful than police when it comes to special case where noise assessment is needed. They can provide the skills needed to conduct noise measurements. Hence a cooperation of police and local authorities can only be useful to reduce community noise.

As in Netherlands and France, the collaboration between local authorities and police has proved to be efficient and involves housing association, environmental inspections services as well as health departments. In Denmark, when receiving complaints the housing association have to arrange a council for the matter. Another system is operated within some European countries. This system is called mediation which is exercised in France, Austria and Holland. In most cases mediation is a fairly new idea. However, in Austria, Denmark, France and the Netherlands, in particular, mediation is seen as a common alternative to prosecution.

In UK noise regulations and standards dated from early sixties, now it is providing guidelines and laws to reduce noise and control it.

We can say that in UK, there are four main legislations used to control community noise.

- Control of Pollution Act 1974(COPA) Part III, for England, Wales and Scotland. This act deals with noise from building sites, The Act also led to the preparation of four approved codes of practice on; noise and vibration from construction sites [47], noise from ice cream chimes [48] noise from audible intruder alarms [49] and noise from model aircraft [50]
- Environmental Protection Act 1990, Part III (EPA) (England and Wales) -the EPA addresses statutory noise nuisance from premises (land and buildings). Local authorities in England and Wales have a duty to deal with noise from premises that they consider to be a statutory nuisance. The Act also provides for individuals to complain directly to a Magistrates Court [51].
- Noise and Statutory Nuisance Act 1993 (NSNA) (England, Wales and Scotland) – NSNA amends the Environmental Protection Act 1990 to make noise in a street a statutory nuisance and also provides for greater control over noise from loud speakers in the street and from audible intruder alarms [52].
- Noise Act 1996 (England, Wales and Northern Ireland) – the Noise Act introduced a new night-noise offence relating to domestic premises, and also clarified the procedures associated with the confiscation of equipment giving rise to noise and introduced a fixed penalty scheme. The enforcement of this legislation is not mandatory and few authorities have chosen to adopt its powers [53].

3.2 *Noise legislation in Europe and other countries*

3.2.1 *Argentina*

Most noise pollution in Latin American cities comes from traffic, industry, domestic situations and from the community. Traffic is the main source of outdoor noise in most big cities such as Buenos Aires.

At the municipal level Argentinean Ordinances consider two types of noises: Unnecessary and Excessive [54]. Unnecessary noises are forbidden. Excessive noises are classified according to neighbouring activities and are limited by maximum levels allowed for daytime (7 am to 10 pm) and night-time (10 pm to 7 am). This regulation has been relatively successful, but control has to be continuous. Similar actions have been prescribed at the provincial level in many cities of Argentina and Latin America.

3.2.2 *Australia*

In Australia, Essentially, local councils have powers to control:

- Noise from commercial and industrial operations that are not required to hold a licence from the EPA (and that are not carried out by a State or local public authority).
- Neighbourhood noise from residences, vehicles used off-road, vehicle alarms, and sound systems.

There is much legislation in Australia that deals with noise such as [55]:

- Protection of the Environment Operations Act 1997(POEO Act). An Act that consolidates air, water, noise and waste requirements into a single piece of legislation. The POEO Act repeals and replaces (among other Acts) the Noise Control Act 1975. It contains the provisions for Noise Control Notice, Prevention Notice, Compliance Cost Notice and Noise Abatement Directions discussed in this Guide.
- POEO (Noise Control) Regulation 2000 (Noise Control Regulation). This regulation provides controls on specific community noise situations, including noise from individual motor vehicles, vessel noise and a range of neighbourhood activities such as use of power tools, alarms, air conditioners and amplified music.
- The Environment Protection Authority (EPA) is a statutory body with specific powers under environmental protection legislation. In September 2003, the EPA became part of the Department of Environment and Conservation (DEC).

Councils and Police have a key role in managing local noise problems by providing an impartial and fair assessment of what level of noise is reasonable, taking into consideration the nature of the activity, the surrounding area and number of people likely to be affected.

The ARA is the body responsible for regulating particular activities and can issue Prevention Notices and Noise Control Notices for these activities. Section 6 of the POEO Act specifies which body is the ARA for different activities [56].

Enforcement is dealt by authorised officers who are appointed by an ARA under section 187 of the POEO Act, and act on its behalf in investigating alleged environmental problems relating to activities regulated by the Act. Authorised officers have a range of investigatory powers and can issue Noise Abatement Directions and other notices provided for by the POEO Act or Regulations. The POEO Act provides authorised officers with powers to:

- require information or records
- enter and search premises
- question and identify persons

Essentially, local councils have powers to control:

- Noise from commercial and industrial operations that are not required to hold a licence from the EPA (and that are not carried out by a State or local public authority)
- Neighbourhood noise from residences, vehicles used off-road, vehicle alarms, and sound systems.

Police also have powers to deal with neighbourhood noise and are typically the main agency for control of noise from late-night parties, or where safety may be a concern or where council officers are not available. The Noise Control Regulation contains specific provisions relating to common noise problems, including restrictions on the use of:

- Air conditioners, pool pumps, power tools etc.
- Building and car alarms
- Individual motor vehicles, including car sound systems and defective mufflers
- Recreational marine vessels, including sound systems on vessels and the use of sirens.

3.2.3 *Austria*

According to the Austrian Federal Environment Agency, in 1998, 25 % of the Austrian population felt disturbed by noise in their apartments; among them, 13.7 % felt strongly or very strongly disturbed [57]. These figures show that noise nuisance has again declined compared to 1994, diminishing to half its level since 1970. Figure below shows the total percentage of persons disturbed by noise at all and the share of persons disturbed strongly and very strongly since the beginning of noise nuisance surveys back in 1970.

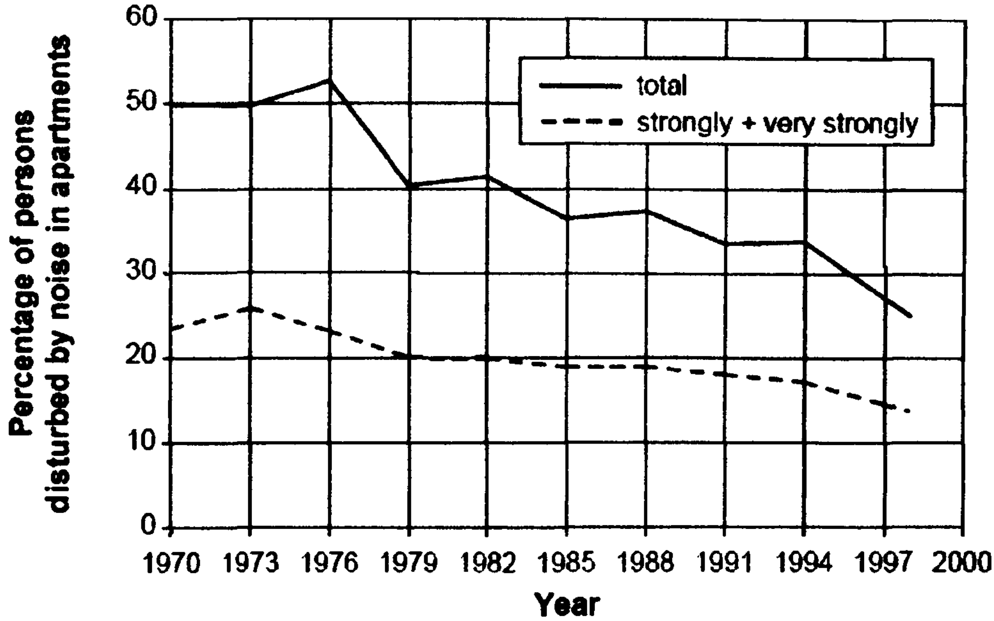

Fig 3.1: Noise nuisances in Austrian apartments.
Source: Austrian Federal Environment Agency

In legal terms, noise control in Austria is a so-called cross-sectional matter, which is implemented under the jurisdiction of the federal government or the provinces together with other administrative affairs. In principle, federal authorities exert noise control

- in "transport" with regard to railways, navigation, and aviation, in lorry transport,
- in matters concerning federal roads,
- in matters of commerce and industry,
- in the Environmental Impact Assessment for positioning railway tracks by ordinance,
- in mining,
- In labour law.
- In principle, the provincial authorities are responsible for noise control in the following fields:
- event industry,
- local security forces (noise in residential areas, street noise, recreational noise),
- construction law,
- agriculture and forestry,
- spatial planning.

In the region of Vienna, this is enforced through the Regional Security Act for Vienna (*Wiener Landes-Sicherheitsgesetz - WLSG*). This legislation includes various procedures to reduce noise within the community (including neighbour noise) and to set requirements for the reduction of noise, including environmental impact assessment for new developments, industry licensing procedures or building permit procedures.

Complaints are dealt by the police, the town council (*Magistrat*) or district authorities (*Bezirkshauptmannschaft*) depending on the source of noise. The police deal with complaints regarding neighbour noise such as loud music, dog bark whereas noise from pubs and clubs is dealt by the town council. When investigating noise complaint, noise measurements are carried out in accordance of noise standards.

The following standards are relevant:

- ÖNORM B 8115 Part 2 und Part 4 - on requirements on the sound insulation in buildings.
- ÖAL - Guideline 3, Part 1 (ÖAL- Richtlinie 3, Blatt 1) on neighbourhood noise from the Austrian Noise Abatement Society.
- ÖNORM S 5004 – Standard for noise measurements.

There are no mediation services when trying to resolve disputes.

3.2.4 *Belgium*

There are three communities (Flemish, French and German speaking communities) and three regions (Flanders, Wallonie and Brussels the capital) that constitute the federal state of Belgium.

In Belgium the control and enforcement of environmental issues is shared between the Federal Government and the regional authorities. Therefore a regional legislation is implemented within a framework of Federal, European and environmental law. In Wallonie, noise legislation is covered by a Royal Decree, a Civil Code and a Penal Code. This National legislation covers noise from small clubs and bars as well as neighbour noise. For instance, in the city of Liege the authorised levels are established in relation to source of the noise, the location, time of day and any existing ambient noise levels. In Wallonie only the environmental police are able to assess noise however, complaints can be dealt by the city health and safety department with the help of the environmental noise.

The main legislative instruments in the Walloon Region are [58]:

- Civil Code (Burgerlijk Wetboek - articles 544 and 1382);

- Royal Decree 24/2/1977 (KB – Koninklijk Besluit);
- Penal Code (Strafwetboek – article art. 561, 1); and
- Framework Law of 18 July 1973 on Fight Against Noise.

The Royal Decree, Penal Code and Civil Code are federal instruments that apply across Belgium. Noise emitted by *non-permanent establishments* is regulated by the Royal Decree 24/2/1977 [59]. This applies to the following:

- Individuals (e.g. neighbours);
- Parties organised in the outdoors (marquees) – limited to twice a year in the same location[1];
- Dancehalls or clubs where dancing is occasional (maximum 12 times a year, twice a month and not more than 24 days in total a year); and
- Smaller sized bars or clubs.

The Civil Code regulates private lawsuits concerning neighbourhood noise at the Peace Court. This is the lowest court in Belgium and is similar to the Magistrates Court in the UK. The Penal Code regulates noise disturbance caused at night, which requires police intervention.

In Flanders, local authorities deliver permit for permanent establishment (where music is played) this permit includes the noise levels to respect. Other legislations cover neighbour noise as well as noise from constructions site. In Flanders the environmental Services deal with the noise complaints with the collaboration of police. There is a right of appeal where premises have closed or where permits have been withdrawn.

There are four legal instruments that allow for the management of disturbance resulting from neighbour and neighbourhood noise in Flanders:

- VLAREM (Vlaams Reglement betreffende de milieuvergunning) - Flemish Regulation on Environmental Permits – 1991, updated and supplemented by Decree in 1995;
- Royal Decree 24/2/1977 (KB – Koninklijk Besluit);
- the Penal Code (Strafwetboek); and

[1] Note that the Royal decree would normally apply to many 'musical activities' organised during the yearly 'Gentse Feesten' (Gent festival). However, organisations can apply to the city Council for an exemption six weeks in advance. If granted the organisations boundary ts are then 100 dB(A) until 12 pm, and 70 dB(A) until 3 am.

• the Civil Code (Burgerlijk Wetboek).

VLAREM and the Royal Decree are used in conjunction with the Civil and Penal Code. VLAREM applies to Flanders only. The Royal Decree, Penal Code and Civil Code are federal instruments that apply across Belgium.

VLAREM is a Flemish legal instrument that regulates environmental permits and sets environmental standards:

• VLAREM I (6 February 1991) deals primarily with procedure aspects; and

• VLAREM II (1 June 1995) describes emission values and qualitative goals.

3.2.5 *Denmark*

There is no existing specific legislation covering neighbour and neighbourhood noise in Denmark. However, there are several acts that deal with noise control.

Environment Protection Act (Miljøloven LBK nr 753 af 25/08/2001) regulates noise from commercial activities in mixed housing and business areas (referred to a category three activities) including, for example restaurants and bars, sports centres, industry etc [60]. The Act is enforced by local authorities. Legal and procedural complaints relating to the enforcement of the Act can be made to the 'Miljøklagenævn'.

• Act on Social Housing (Lov om leje af almene boliger LBK nr 562 af 19/06/2001) regulates neighbour nuisance through a complaints council and prosecution if tenants exhibit 'unsocial behaviour' which includes noise.

• Private Tenant Act – (Bekendtgørelse af lov om leje, LBK Nr 347 ad 14/05/2001) under the Act landlords are obliged to ensure that his tenants can live without significant disturbance from other tenants within his property by setting up house rules (although this is not mandatory), which the tenants must then adopt.

• Act on Environment and Gene Technology (Lov om miljø og genteknologi CIR nr 210 af 16/12/1982 from LOV nr 356 af 06/06/1991) this gives local authorities the power to specify certain hours of the day during which the use of noisy equipment in non-commercial activities, such as lawnmowers and other tools, is prohibited. However, there is no obligation for local authorities to do this [61].

• Police Regulation (Politi Vedtægten) - Section 3 regulates noise that causes a disturbance in public spaces, including for example, excessively loud music played within a building which has open windows, so causing disturbance outside. However, this regulation does not address neighbour noise emanating from within the same block of housing, which is regulated by the Act on Social Housing (as described above).

• Act on Construction of Housing (Lov om Boligbyggeri) sets out requirements for noise insulation in new housing which all developers are required to comply with.

Neighbour noise disputes between individuals living in their own properties are not addressed by any legislation in Denmark, however, mediation exists but needs to be accepted by both parties, this has proved to be successful in dealing with noise complaints. A right to appeal does not exist although there is a possibility to take the matter further by going to court.

3.2.6 *Egypt*

Egyptian President Hosny Mubarak, as one of the highlights of a major national environmental clean-up policy initiated in 1992, charged the Ministry of Environment to institute the Egyptian Environmental Number 4 law in 1994 [62]. The ministry was made responsible for its executive regulation. The law determined maximum permissible noise limits for different land use areas as shown in Table 1.

By comparing road traffic noise levels in Greater Cairo, with Egyptian statutory standard regulations.

Type of area decibel (A)	Permissible limit for noise intensity					
	Day		Evening		Night	
	From	To	From	To	From	To
Commercial, administrative and downtown areas	55	65	50	60	45	55
Residential areas where workshops or commercial establishments are located on a main road	50	60	45	55	40	50
Residential area in the city	45	55	40	50	35	45
Residential suburbs with low traffic	40	50	35	45	30	40
Residential rural areas, hospitals and gardens	35	45	30	40	25	35
Industrial areas (heavy industry)	60	70	55	65	50	60

Table 3.1: Egyptian noise standards and policy on the maximum permissible limit for noise intensity L_{Aeq}(dB) in deferent land use areas.

Source: Road traffic noise mitigation strategies in Greater Cairo, Egypt [S.A.Ali , 2002] (Day from 7 am to 6 pm; evening from 6 pm to 10 pm; night from 10 pm to 7am)

3.2.7 *Finland*

There are a number of legislations or acts which apply to community noise in Finland. These include Municipal ordinance which contain rules and guidance to residents when they move into an area. These legislations are enforced by the police who have the power to stop any noisy activity. Permit from the municipal Environmental Protection Authority is needed for certain commercial activities.

Complaints are dealt by the police, while noise monitoring is conducted by the Municipal authorities (health inspectors and environmental inspectors). Right to appeal exists but can take longer time to go through court system. Unlike Denmark and Norway, there is no mediation system in Finland however; the majority of disputes and complaints are resolved through informal agreement, usually with the support of the housing authority. Involvement from the environmental authority is limited to extreme cases only. There are several Acts that can be applied in cases of neighbour and neighbourhood noise.

The Health Protection Act (736/1994) and the Environmental Protection Act (86/2000) are general acts that guarantee the health of residents and their environment, and public comfort [63].

- The Housing Companies Act (809/1991) and the Act on Residential Leases (481/1995) are acts under private law and contain regulations for occupants on the order to be maintained in dwellings.
- Sound insulation requirements and noise level requirements for technical equipment in buildings are issued in accordance with the Land Use Planning and Building Act (132/1999).
- Municipal ordinances may contain restrictions on noise-generating activity.
- The Act on Neighbourhood Relations (26/1920) is a private law and regulates relations between adjoining properties and includes the prevention of noise nuisance.

The Ministry of the Environment is responsible for directing, supervising and promoting noise abatement in Finland. The regional environmental centres and municipalities are responsible for the practical organisation of regional and local noise abatement matters. As part of the housing health instructions, the Ministry of Social Affairs and Health has issued instructions regarding noise in housing and other living premises for use of municipal health and environment authorities [64].

3.2.8 *France*

Switzerland. The C.I.D.B is a non profit making organization established since 1978 by the ministry of the environment. It brings together almost 2000 members from the public and private sectors intervening in environmental issues and problems related to noise pollution. The C.I.D.B undertakes various initiatives, provides information to anyone requiring them: architects, acousticians, contractors, manufacturers and also teachers, students and the general public. The C.I.D.B is therefore at the crossroad of noise and quietness since they keep their ears open to noise victims and noise makers.
When the conflicts from noise pollution arose and are too complex, their organism used to advise and direct the noise antagonists to other private organisms specialized in noise assessments and measurements such as the LCCP (the central laboratory of the Paris headquarters) [67] .This laboratory accepts the acoustic and vibratory measurements requests on behalf of a public beneficiary:police headquarters, DASS, local authorities or others. This organism carries out the investigations on the spot executes the measurements of the established facts unexpectedly and in accordance with regulated conditions and supervised by an operator these measurements can be used as foundations (basis) to establish an offence.
The measures effected by the LCCP give rise to a record the conclusion of which includes the statutory situation in terms of the presence or the absence of an offence (identification of noisy sources, assessment of their importance in the actual observed sound intensity so as to allow the beneficiary of the measurements to bring out the necessary and adequate corrective actions. This report is of course sent to the beneficiary. The LCCP guarantees the conformity of the applied methods with the regulations in force. (Decree of 18 April 1995 and the application texts artR.1336-6 to 1336-10 of the public health code.) The LCCP is entitled to carry out measurements of neighbourhood noise related to the installation of activity of not classified.
These measurements are carried out so as to verify that the standards in the decree of 18 April 1995 from the ministry of environment are actually respected. The report states the measurements with their temporal representation of their noise levels evolution as well as the representation of their frequency spectrum.
However, this report does not involve any advice or prescription of the works.
The content of this document is as followed and is in accordance with the type model defined by the norms NFS31-010.

1. identity of the operator responsible of the measures, appending of visa

In France many legislative instruments are being used to tackle noise nuisance. These legislations laws and acts cover all types of noise except transportation noise which requires a special operating permit.

The following legislative instruments are relevant to the control of neighbour and neighbourhood noise in France [65]:

- Public Health Code (art.1, L.2);
- Civil Code;
- General Code on Territorial Collective Units (Art. L.2212.2);
- Law on Noise 1992;
- Decree No 95-408 of 18 April 1995 On Fight Against Neighbouring Noise and Modifying the Public Health Code; and
- Law of 1976 on Classified Installations (now integrated in the Environment Code).

Local authorities have considerable powers to control neighbour and neighbourhood noise. Complaints are dealt by the Mayor himself and the police. Mediation plays an important role in resolving conflicts and noise issues between neighbours. A special mediation services provided by the French authorities and can be provided upon the request of complainant. Both parties have the right of appeal to the corresponding superior jurisdiction. In case of neighbour noise, the qualified officer who investigates the complaints makes a judgement as to whether the noise constitutes a nuisance or not. In France there is a geographical map representing a noise map zone.

Yet the conflicts between neighbours are generally treated amicably first, contrary to the UK where a noise team is specially in charge with the noise issues, in France the noise problem being a matter only recently seriously considered there is no proper noise team. Noise monitoring is not very common in France, only specialist organisms are authorised to measure noise nuisance levels. Local authorities do not have the knowledge and the skills to monitor noise. When a serious noise conflict occurs they generally suggest to the complainers or to the person responsible for the noise to contact private firms to assess and measure the noise level.

C.I.D.B (Centre d'Information et de Documentation sur le Bruit) is an association which recommends and informs people about the laws and regulations regarding the noise and noise disturbance in France [66].

Being on the spot, we were kindly handed over by the association plenty of documents dealing with the noise problems in France and European countries such as

2. Mention of the different measurements conditions (date, hour of measurements, conditions of the noise sources functioning) weather conditions, instrumentation, situation plan etc.
3. results under the form of tables

- level of residual noise
- level of residual during the activity
- eventual detail of a spectral emergence
- on request: proper level of sources submitted to separated trials
  - chapter comparing these values to regulated or reference limits
  - advice as to the regulatory situation
  - eventually an advice as to the choice of the sources subject to ulterior action(for exp a corrective action)

It can be noticed that all the reports issued by the LCPP and in all the cases are transmitted to the person or the body who demanded them and who becomes the proprietor . a copy is filed at the LCPP and transmitted whenever requested to the justice courts in accordance with the legal provisions.

3.2.9 *Germany*

Germany is a federal state consisting of 16 'Länder' or States, which correspond broadly to the Regions in the UK. Each State is divided into a number of 'Bezirkämter' or Boroughs, of which there are 12 in Berlin and seven in Hamburg [68]. Some aspects of noise are legislated for at a national level, and others, at the regional level of Länder. There is no specific national legislation to address community noise; however, many statutes are applied to control of noise from different sources such as sports facilities and building sites. Enforcement is exercised in regional Länder by means of ordinance. For example in the cities of Berlin and Hamburg an ordinance prohibiting noise at a level that causes disturbance during certain hours of the day is applied to commercial activities.

In Germany, Housing estate association are able to establish regulation which combats neighbour noise. Complaints are dealt by the police and the local environment authorities but no mediation is available local authorities encourage both parties to solve the problem amicably.

These are the types of noise legislation that exist in Germany [69]:

- Regulation on Lawnmower Noise (8. Ordinance for the enforcement of the Federal

Immission Control Act - Bundes-Immissionsschutzgesetz (8. BImSchV))

- Regulation on Sports Facilities (18. Ordinance for the enforcement of the Federal Immission Control Act - Sportanlagenlärmschutz-Verordnung(18. BImSchV))
- Technical Guideline on the Protection Against Noise (6. Administrative Regulation for the Enforcement of the Federal Immission Control Act - Technische
  Anleitung zum Schutz gegen Lärm vom 26. August 1998)
- The General Administrative Regulation for the Protection Against Construction Noise (Technische Anleitung zum Schutz gegen Baulärm vom 19. August 1970))

Individuals can make a complaint against a decision taken by the authorities privately; neighbours can also go to the civil court 'Amtsgericht' to complain about noisy behaviour.

3.2.10 Greece

Community noise legislation in Greece are enforced by the police , the ministry of environment, Physical Planning and Public Works (MEPPPW) and the local prefecture [70].

The main legislations are as follow:

- Police Regulation (PR) 3/96 – Greek Government Gazette (GGG) 15/B/12.01.96

This regulation gives powers to the Police for preserving public peace. Hours of public peace hours are defined as:

• summer period - (April 1 to September 30) between 3 pm and 5.30 pm, and between 11 pm and 7 am; and

• Winter period – between 3.30 pm and 5.30 pm and between 11 pm and 7 am.

- Law (L) 1650/86 GGG 160/A/16.10.86 Law for the Protection of the Environment, Article 14 – Protection from Noise

Certain activities are forbidden during the day by the police such as loud musical instruments radios as explained above. Complaints are dealt by the police, the (MEPPPW) and the local prefecture. Mediation is offered by the police where conflicts are solved informally. This also allows technical noise specialists from the (MEPPPW) or local Prefecture to focus time and resources on more complex or persistent complaints.

The complainant may also sue through the civil court process. Noise levels are not recorded during police visits. However, when a case is investigated by a health official, trained personnel undertake noise measurements. Typically, the following parameters are recorded:

- LAeq;
- noise level percentiles (e.g. L1, L10, L95);
- LAmin; and
- LAmax.

3.2.11 *India*

India is rapidly becoming industrialized and more mechanized, which directly affects noise levels. However, no general population study regarding the magnitude of the noise problem in India has been performed.

Only recently has noise pollution been considered an offence in India, under the Environmental (Protection) Act 1986 [71]. For instance, noise from music, specifically religious music is politically difficult to restrict, because it is a religious country, even in the interests of public health. A ban on all music from loudspeakers after 22:00 would decrease the sound pressure levels to below the permissible legal limit. A preventive programme is advocated to measure noise levels with sound level metres.

3.2.12 *Japan*

Noise standards for both general and roadside areas were set in Japan in 1967, through the "Basic Law for Environmental Pollution." [72].

This law was updated in September 1999. Each standard is classified according to the type of land use and the time of day. In ordinary residential areas, the night-time standard is 45 dB LAeq, but in areas that require even lower noise exposure, such as hospitals, this is lowered to 40 dB LAeq. In contrast, the daytime levels for commercial and industrial areas are as high as 60 dBA. Standards for roadside areas are 70 dB LAeq for daytime and 65 dB LAeq for night-time. Between 1973–1997 noise standards for aircraft noise [73], super-express train noise and conventional railway train noise were also implemented. Standards for aircraft noise were set in terms of the weighted equivalent continuous perceived noise level (WECPNL). For residential areas, the WECPNL standard is 70 dBA, and is 75 dBA for areas where it is necessary to maintain a normal daily life.

3.2.13 *Ireland*

The law relating to neighbour and neighbourhood noise from domestic and commercial premises (i.e. those not licensed under the Integrated pollution Control

(IPC) Licensing regime and activities such as pubs, clubs, commercial operations and local industry in Ireland, is governed principally by two legal instruments [74]:

- Environmental Protection Agency Act 1992; and
- Environmental Protection Agency Act 1992 (Noise) Regulations 1994 (S.I. No. 179 of 1994).

The noise legislation in Ireland shows many weakness of the system related to the definition of nuisance. EPA act provides standards but no restrictive limits. Therefore it is not an offence to cause nuisance in Ireland. However the same act gives the right for the complainant to take action against neighbour noise. Most of the complaints are dealt effectively without resorting to prosecution, no mediation is offered. Complaints are dealt by local authorities who forward the complaints to the noise control unit. The complainant may appeal to the Ombudsman if the local authority fails to serve a Notice [75].

3.2.14 *Italy*

In Italy, the acoustic characterization of the territory has received an increasing attention in the last years, in particular since 1991 with the issuing of specific decrees concerning the basic principles and actions aimed at protecting environment against noise pollution.

Legislation in Italy are implemented by the ministry of the environment, however, regional authorities are responsible for establishing regional regulations and guidelines. Municipal and Provencal administrations enforce controls locally [76].

The main legislative instruments relating to noise in Italy are:

- The Civil Code (article 844) for neighbour noise;
- The Penal Code (article 659) also for neighbour noise; and
- Framework Law number 447/95 covering neighbourhood noise.

Neighbour noise is managed by the Civil and Penal Codes. The Civil Code enforced by the Local Health Authority while the Penal Code is enforced by the police and includes the control of noise that causes disturbance. The distinction between the two codes is not clear and may depend upon the view of the police officer who dealt with the initial complaint. For certain noisy commercial or industrial complaints, when it is clear who is responsible for causing the noise, complaints are made to the local public administration. An individual prosecuted in relation to noise can appeal to the civil or penal court, or to the municipality. Italian noise standards and policy establish that all municipalities must draw up an acoustic zoning, i.e., a subdivision of the municipal territory in six acoustically homogeneous areas (acoustic classes) based on the prevalent land-use which specifies daytime and night-time noise levels limited [77;78] If the noise level exceeds the maximum permissible limits fixed for each area municipalities must set up specific noise abatement action plans.

3.2.15 Luxembourg

The law relating to neighbour and neighbourhood noise in Luxemburg is governed principally by the Law on the Fight Against Noise of 21 June 1976, in addition to the General Regulation of the Luxembourg City Police (Chapter II) of 26 March 2001. The main provisions of this legislation are described in more detail below [79].

- Grand-ducal Arrêté of 15 September 1939 on usage of audio equipment;
- Grand-ducal Arrêté of 16 November 1978 on noise levels from music establishments and in neighbouring areas;
- Grand-ducal Regulation of 8 May 1981 on nomination of experts and agents responsible for investigating and reporting non-compliance with legal provisions in the field of fight against noise and air pollution; and
- Grand-ducal Regulation of 1st April 1988 on admissible noise levels for lawn mowers.

The police and certain experts and agents designated by grand-ducal arête are responsible for investigating and identifying cases of non-compliance with the legislation. Monitoring are conducted by the police, use of mediation is under consideration. Complaints are received directly by the police, usually via an intervention centre.

The General Regulation of the Luxembourg City Police compliments national Legislation. This prohibits a disturbance of public tranquillity by excessive noise. Specific provisions cover the following sources of noise:

- animals;
- radio, television and musical instruments as well as singing;
- engines from motionless cars – (at night, shutting car or garage doors or starting or stopping vehicles so loudly that it can disturb other people);
- Skittle games (prohibited between 11.00 pm and 8.30 am if it constitutes a nuisance for the neighbourhood);
- construction works; and
- lawn mowers, saws and other noisy equipment – usage is prohibited at night and on Sundays and bank holidays.

There is a right of appeal to the court decision in the high court. However, the procedure is lengthy and it can take around six months for the court to make a decision on the case in the first instance, followed by another six months if a subsequent appeal is made.

3.2.16 *Netherlands*

Noise norms or limits for companies are included in permits awarded on the basis of the Environmental Protection Act (EPA). Norms for companies that do not require a permit, are included in a General Rule laid down in the EPA.

The main legislative instruments for controlling noise in the Netherlands are:

- The Environmental Protection Act 1993 (EPA) (Wet Milieubeheer [2]);

  and

- The Noise Nuisance Act 1979 (Wet Geluidshinder) [3].

The Milieudienst or communal environmental inspection services deal with noise norms, and complaints relating to commercial operations. The police deal with complaints of neighbour noise in relation to a penal code [80].

Noise problems between neighbours, are dealt with by the "neighbourhood directors" within the police [81]. A defendant can appeal against a decision made by the Milieudienst by going first to the Town Hall and then the High Court.

3.2.17 *Portugal*

The Noise Pollution act 2000 (Decreto – Lei 292/2000 de 14 de Novembro de 2000) came into force in 2001 and is the national legislation for community noise in Portugal [82]. One of the main aims of the act was to clarify complaints procedure by appointing the police as the competent authority for dealing with noise complaints. The police have the power to stop certain activities if they cause disturbance.

In Portugal, there are three different types of police.

- city police - PSP,
- police in small towns; and
- Metropolitan police.

As a result, the general public are unclear as to which authority deals with complaints.

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[2] This law regulates almost all types of environmental problems such as noise, emissions, waste, transport, energy use etc. This is in line with the Netherlands' Integrated Environmental Policy.

[3] Last amendments in Law of 21 December 2000 (technical adjustment - lowering limits values)

In addition, the police do not have the authority to record noise levels, which is also giving rise to problems. The legislation is nationwide. However, operating procedures may vary in different areas depending on the level of resources available. There are no mediators or watchdogs in the Portuguese system, but if the noise problem cannot be solved it is usually down to the lawyers to try to find an amicable solution to the problem and to avoid going to court.

There is a right of appeal under the Portuguese administrative and judicial procedures for both complainants and complainers.

3.2.18 *South Africa*

Noise control in South Africa has a history dating back about three decades. Noise control began with codes of practice issued by the South African Bureau of Standards (SABS) to address noise pollution in different sectors. Since then, Section 25 of the Environment Conservation Act (Act 73 of 1989) made provision for the Minister of Environmental Affairs and Tourism to regulate noise, vibration and shock at the national level [83]. These regulations were published in 1990 and local authorities could apply to the Minister to make them applicable in their areas of jurisdiction. However, a number of the bigger local authorities did not apply for the regulations since they already had by-laws in place, which they felt were sufficient.

3.2.19 *Spain*

The main noise sources in Spain are traffic and recreation, in addition to the noise problems faced by communities living in the vicinity of airports. There are some independent research studies on noise.

There is no national legislation relating to community noise in Spain, although a draft Noise Act has been produced. As a result noise control legislation is enforced locally through General Municipal Orders. The city of Madrid recently adopted a General Municipal Order on Environmental Protection relating to noise (Ordenanza General de Proteccion del Medio Ambiente, articulado referente a contaminacion acustica, de 30 de mayo de 2001) [84]. In addition, the Autonomous Community of Madrid has a Decree on Noise dating from 8th June 1999. This Order includes all sources of noise [85].

In the city of Madrid, complaints are dealt with the Town hall environment department and a 24-hour service is provided. The investigation of complaints includes the measurements of noise levels. The procedure for dealing with complaints is the same for different sources of noise.

In Barcelona, there is no clear definition of responsibilities and complaints may be made to the Town hall of the police [86]. In practice, the authority that has been contacted by the resident will go to the site and investigate the complaint. If the noise occurs between the hours of 10 pm and 8 am and is due to loud music, a loud domestic appliance or other noisy activity such as the moving of furniture, the police officer may request that the activity is stopped immediately. There is a right of appeal under the Law on Administrative Procedures for both complainants and complainers while no mediation is provided.

3.2.20 Sweden

Community noise in Sweden is enforced by local Environmental Health departments through the Environmental Code, which was established in 2000 [87]. The Code provides a framework, which is enforced locally. Although this provides a flexible approach to enforcement, the lack of consistency across the country, which results from the local interpretation of the Code has been criticised. However, the Code presents an advantage where it is possible to reverse the burden of proof. This means that if a complaint is issued against you, it is your responsibility to prove that you are not in breach of the regulations and that you are not causing a disturbance. When a complaint of neighbour noise is made, it is usual for the complainant to approach the person who is responsible for causing the noise directly.

There are additional standards and guidelines (e.g. relating to building methods to minimise noise) in Sweden but they are not used as frequently as the Environmental Code. Guidelines also exist for dealing with noise from commercial premises and construction sites [88].

In Sweden, landlords are considered to be responsible for dealing with complaints between neighbours in the first instance, and the authorities are often reluctant to get involved. If the person responsible for causing the noise would like to challenge the judgement made by the court, they must do so within three weeks to the judgement. If the appeal fails, the case can be taken to the Environmental Court, and beyond that, the case must go through a period of validation before it goes to the Environmental Rights Court of Appeal. It is understood that very few noise cases go to appeal.

Because of this, I really think that the victims of noise pollution think twice before taking to court the responsible of their worries. However in developing countries it is getting more and more difficult to take noise pollution considered as an offence, because they are countries which have been recently urbanized and not used to face this sort of problem (noise pollution).Beside they are confronted to so many other critical social problems. Without forgetting that in some countries like India and often Muslim countries where a religious music of prayers calls from loud speakers is politically difficult to restrict(religious countries) even in the interest of public health.

3.3 *Critical review on how noise issue is tackled in Europe*

The European Union has focused on the problem of noise nuisances for many years. As a matter of fact there is actually an increasing concern about the noise problem in Europe -complaints about noise have awfully increased since 1992 [89]. People frequently complain about noise annoyance, and most of EU citizens live in areas which have disturbing levels of noise. Controlling this form of pollution has now become a priority because of the negative effects of noise on people's health. More the a half of the union's citizens are exposed to an unacceptable level of transport noise for instance the Who reports that more than 30% of European union citizens suffer serious noise induced disturbance[90].

EU regulations firstly provided a framework for motor vehicles (directive 70/157/EEC for cars and lorries). The maximum noise levels authorised were then gradually lowered, by around 10 dB in a quarter of a century, making it possible to peg noise levels near major roads despite increases in traffic. It should be emphasised that without the tightening of these regulations, the noise level by roads would now have increased by 10 dB.

More recently the European Union has produced two major legislative texts:

> • *directive 2002/30/EC of 26 March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports;*
>
> • *directive 2002/49/EC of 25 June 2002 relating to the assessment and management of environmental noise.*

The directive on assessment and management of environmental Noise (also known as the Environmental Noise Directive (END)) seeks to provide a framework in which the member states can draw up "action plans" aimed at cutting noise emissions from the prime sources, particularly land and air transport infrastructures and industry. To that end, it stipulates the production of "strategic noise maps" and "action plans" for large urban areas, major roads, major railways and major airports. It outlines the methodology for drawing up the maps (calculation methods to be used, etc.) and

recommends the production of common indicators such as Lden and Lnight. It also advocates, for the first time, the management of noise as a whole and not, as previously, by source of pollution. It introduces the notion of "quiet area".
However, this directive does not include the nuisances inflicted by humankind on itself, whether voluntary (*by listening to amplified music for example*), imposed by one's professional position and activity (particularly noise in the workplace) or resulting from problems in the neighbourhood. The indicators imposed (Lden and Lnight) are known as "energy level" indicators covering noise over an entire period but not taking account of event noises, despite the fact that people regard these as a major annoyance. In addition, strategic mapping is not imposed as a reference for urban zoning, particularly in the vicinity of airports and railways where noise is sporadic. Finally, the directive leaves the designation of threshold values to the discretion of the States and gives no precise definition of a "quiet area".

Possible issues with the use of the L_{den} indicator

Another issue may arise by the introduction of the L_{den} indicator. Discrepancies are likely to arise when converting results from current standards to the standardised indicator. For example, the UK and Ireland use the CRTN(Calculation of Road Traffic Noise) method to predict noise levels in terms of the L_{10} index and subsequently apply conversion formulae to determine L_{den} ([Abbott & Nelson, 2002] [91] and [O'Malley et al., 2009]) [92]. The conversion methodologies were developed so that authorities would not have to change existing models or software in order to comply with the EU standard. This problem is unique to those Member States who adopted the CRTN method as all other methods may predict noise levels in terms of L_{eq}, which the L_{den} indicator is based upon.Additionally, L_{den} is an annual noise indicator which describes the average day-evening-night-time equivalent sound pressure level over a complete year. Over the course of a year varying meteorological conditions are likely to have a significant impact on noise levels and as such, the manner in which meteorological conditions are incorporated into the calculation model will influence final results. The French method accounts for meteorological conditions using the percentage of time conditions favourable to propagation occur; the CRTN method does not include a correction for meteorological conditions while several parameters detail the influence of meteorological conditions in Nord2000. The Environmental Noise Directive (END) also states that in cases where a Member State adopts a different calculation method from the recommended interim method it must show that the method chosen yields equivalent results. This requirement is designed to ensure comparability of results across member states. Yet, the manner by which to determine 'equivalence' was not described in the Directive which has led to some considerable confusion among competent authorities in Member States.

At the level of the States

Existing EU Standards and noise regulations exist varying from one country to another. They differ from one source of noise pollution to another. The enforcement of these regulations differs from one authority to another depending on the country where the offences occur (enforcement shared between local authorities, the police and other official bodies such as the justice courts). The calculation methods described above were developed prior to the introduction of the L_{den} indicator. Further discrepancies are likely to arise when converting results from current standards to the standardised indicator. For example, the UK and Ireland use the CRTN method to predict noise levels in terms of the L_{10} index and subsequently apply conversion formulae to determine L_{den} ([Abbott & Nelson, 2002] and [O'Malley et al., 2009])[92].

For example in France, there is the law of 31 December 1992 on noise from land transport infrastructures, the decree of 31 August 2006 for neighbourhood noise and the orders of 14 June 1969 and 30 June 1999 for the soundproofing of sensitive housing and buildings. The regulations are based on sound levels for ordinary noise (transport), police regulations for neighbourhood noise and noise abatement levels for buildings (orders of 1969 and 1999).

European regulations applied to noise form entertainment halls have been studied and compared in previous research (Desarnaulds et al.,2003). The regulations vary widely for country to another.

There are three main criteria types:

- Levels at noise-sensitive property (inside the property)
- Levels outside the noise-making property
- Sound insulation requirements where both source and receiver are part of the same building.

Most of the countries use more than one criteria type. France and Italy use all three. Criteria for allowable levels inside or outside the noise-sensitive property in eight countries are summarised in Table 3.2

Country	Text	Descriptor	Requirements inside, dB(A)	Requirements outside, dB(A)
Switzerland*	DEP	LAeq(10s)	24	34
Germany	VDI 2058Bl1	LAeq LAFmax	25 35	40 - 45 (DIN 18005)
France	Recommendation CNB (1993)	LAeq	22	-
Italy	DPCM 14/11/97 No280	LAeq (1 min)	25	40 (open window)
Norway	NS 8175-1997	LAFmax	22 - 37	25 - 45
Netherlands	Catering order (1998)	LAeq (19-07) LAFmax	25 45	40 60
Sweden	SOSFS 1996:7	LAeq	25	-
United Kingdom	Code of practice concerts**	LAeq (15mins)		75 (stadia) 65 (other)

* Exploitation after 1985, night time (22-7h) downtown; ** Max. 3 open air concerts/year.

Table3.2: European limits at the noise-sensitive property,

Source: (Desarnaulds, V., G. Monay and A. P. Carvalho (2003). 'Noise from amplified music played in discotheques, pubs and clubs - A review of some national regulations,' *Acta Acustica* 89(SUPP): 125.)

Country	Text	Descriptor music	Descriptor backgr. noise	Requirement emergence dB(A)
France*	Décret 98-1143	LAeq (1h)	LAeq	< 3
Italy	DPCM 280 14/11/97	LAeq (1 min)	LAeq (1 min)	< 3
Netherland	Catering Order 1998	LAeq (19-7h)	LA95	< 0
Portugal	Noise Code 2000	Lr (22-7h)**	LAeq	[illegible]
UK***	Code of Practice Concerts	LAeq (15 min)	LA90 (4 h)	< 5
UK	Code of Practice Pubs & Clubs	Not defined	Not defined	"Inaudible"

*Limit for each octave band 125 to 4k Hz (measurement method: NF S 31-010); **Lr = LAeq(music+background noise) + Kt,i (tonal and impulsive 0, 3 or 6) - Kd(duration, 0 to 4); ***Maximum 30 indoor venues /year

Table 3.3: Limitation of noise emergence at the reception.

Source: Source: (Desarnaulds, V., G. Monay and A. P. Carvalho (2003). 'Noise from amplified music played in discotheques, pubs and clubs - A review of some national regulations,' *Acta Acustica* 89(SUPP): 125.)

Table 3.3 summarises the criteria for maximum levels in five countries which occurs outside the noise making building. It is also referred as Emergence by Desarnaulds et al.

Cultural factors

Having looked at the noise control regulations in Europe and the rest of the world in this chapter, we remarked that there are differences between European countries in terms of noise control assessments. These differences are due to cultural factors, for example , night-time noise levels limits in certain countries like Netherlands start from 7pm until 7am, whereas in Portugal it's between 10pm until 7am. Another example of cultural difference within the Europe, the Spanish city of Granada has introduced a set of new regulations to ensure its residents can enjoy an undisturbed Siesta (is a short nap taken in the early afternoon, often after the midday meal)[4].This new by-law prohibits noisy activity during the two hours traditionally reserved for an afternoon nap. Between 3 and 5 o'clock in the afternoon anyone making "unnecessary noise" can be fined up to 3,000 euros (£2,640). Among the prohibited activities are shouting, singing, dancing or slamming a door. The rules are part of a swathe of new regulations brought in by Granada's city council in a bid to improve life in the historic Andalucian city, which boasts Spain's most visited monument, the Alhambra.

3.4 *Conclusion*

Throughout the study to know how the noise problem in Europe and other countries of the rest of the world is tackled as well as the different standards in use, it has been noticed that the problem of noise and the related complaints have actually increased since 1992. This problem has become a priority of the concerned authorities because of the dramatic impact on the populations 'health. We have understood through this chapter that each time the question of noise is raised by angry complainers or even noise association, no real concrete action was undertaken by the concerned authorities mainly due to actual economic strakes. Indeed , there are in all countries of Europe several legislative instruments aimed to control the noise in cities bust most of the time a civil mediation is required to resolve issues resulting from noise conflicts especially between neighbours .It is only when complains are persistent that technical noise specialists are called on to solve the problem. Complainers have the right to take to court the responsible of noise disturbance but generally the procedure is lengthy and harassing. In the next chapter, noise nuisance from entertainment halls in UK will be investigated deeply by looking at the standards and the regulation in force as well as the different noise control strategies in UK.

[4] Article in The Daily Telegraph of 19th May 2009

CHAPTER FOUR
Noise Nuisance and Noise Control Standards in UK

4.1 *Introduction*

There are many sources of environmental noise that present an ever-increasing burden of noise pollution that affects well-being of British citizens. Transportation systems are a major source of noise pollution, with road traffic noise being the most prevalent and wide spread source. Ambient noise levels are rising due to the increasing levels of traffic on Britain's roads. Daily routines in the home can expose us to high noise levels from items such as boilers, air conditioning units and household appliances. Many other activities too, pose a risk, such as DIY and especially many leisure or social pastimes ranging from discos, and clubs and pubs.

4.2 *Noise from Entertainment Music in UK*

In UK, music entertainment noise associated with pubs and clubs is generally controlled through the music entertainment-licensing regime operated by local authorities. Licences include discretionary operating conditions, which typically cover hours of operations, fire precautions, safety and control noise [93]. The NSCA (the National Society for Clean Air and Environmental Protection) reported through its national committee and several meetings that the noise coming from pubs and club during 1999 was the major subject of complaints for 200 hundred UK local authorities. [94]. Complaints about noise from Music entertainment have increased dramatically in recent years for many local authorities in UK. Until now, there is no established and agreed method that Public Health Practitioners and Acousticians can rely on when conducting assessments of music entertainment noise coming from pubs and clubs.

A draft code of practice on pubs and clubs was submitted in November 1999 by the Institute of Acoustics (the new one has been issued in march 2003 but only now distributed may 2003) but judged not to be sufficiently stringent to account for the local conditions that are prevalent in different councils. This is why; each local authority has set out and adopted new planning and licensing conditions.

For many acousticians, the 1/3 rd octave band frequency analysis is always the preferred approach for describing annoyance compared to the WHO criteria of internal noise levels of 35 dBA and 30dBA which are compromising and judged inefficient and ineffective when wanted to describe objectively the annoyance and disturbance with low frequency characteristic music associated with night clubs.

Entertainment in pubs and clubs is traditional and is an important part of community life. It brings in business for the licensee and boosts the local economy. However, it can also lead to a noise nuisance affecting neighbours. Modern amplification and music styles make this an increasing problem. If we want to find an issue to the problem of noise pollution we have first to be sure that the location and the structure of the premises are suitable for the entertainment intending to provide, without disturbing the neighbourhood. There have been numerous national and local reviews and policies adopted with Codes and Standards produced to control and advice on noise pollution from entertainment activities over the past 50 years.

UK local authorities may rely on the experience of their environmental health officers to determine the most appropriate method of assessing the alleged annoyance and thus determine the best course of action. Their conclusion will be relying on both subjective and objective assessment including individuals' response such as surveys and describing noise characteristics using objective data collected with a sound level meter and different standards, policies and guidance.

4.3 *Current Standards and Codes*

There is a lack of specific guidance with regards the impact of licensed entertainment and retail premises although several standards and codes give some indication as how to measure and what constitutes an acceptable environmental noise impact.

4.3.1 *BS 4142 Rating industrial noise affecting mixed residential and industrial areas, 1997 [95]*

This standard is used to assess the impact of a specific noise source of an industrial nature in a mixed residential and industrial area .As this title indicates the standard is intended to rate an industrial plant process on the nearest affected residential premise and will only indicate whether the specific noise is likely or disturb or not the residents. The measurement and assessment methodology of comparing the specific noise with the existing background is to be applauded but the standard is often used incorrectly to establish that an entertainment premises will have a low impact on the area. The standard is sometimes used to assess the impact of plant on a residential area in the absence of a specific local planning condition. The standard can be a useful tool in assessing the proposed plant's impact but should not replace the local condition.

The main thrust of the standard is to assess whether the specific noise of new plant is likely to cause complaint at the nearest residential receptor. The specific plant LAeqT value, corrected for background level, is assessed against the prevailing background level LA 90 at the residential unit. One single addition of +5 dB for any tonal or noise characteristics may be added to the specific level as a penalty. Specific level +penalty = Rating level

The assessment is made over a period of an hour during daytime and a 5-minute period at night- time.

Once the specific plant noise rating has been produced the background level is subtracted from it to produce the assessment of rating level over background.

Assessment: (Rating- background)	Assessed Impact
+10 dB and above	Complaints are more than likely
Around +5 dB	Marginal impact
<+5dB	A decreasing likelihood of complaint
-10dB	A positive indication of no complaints

Table 4.1: The assessment method as defined by this standard (BS4142.1997)

4.3.2 *PPG24: Planning Policy and Guidance: Planning and Noise 1994[96]*

It has been reviewed in 2002 and issued by the Department of the Environment this document gives guidance with regard noise in a planning context, it focuses on noise-sensitive residential developments in areas that may already be noisy from road, rail aircraft transport as well as mixed sources.

The PPG 24 document classifies Noise Exposure Categories (NEC's) where the development may proceed without any need for special treatment or with the need for additional noise control treatments if the noise levels are excessive. The base line threshold levels for NEC category A daytime are 55dB and at night 45dB as an LAeqT.

The document makes reference to BS4142 as a method of assessment for determining the likelihood of complaints but does not mention that a minus 10 dB assessment will be a positive indication of no complaints. The code does recognise that associated activities outside the premises should not be overlooked and recommends that where individual night-time LAMax values of 82dB occur several times per hour planning permission should normally be refused. In general terms the advice for plant noise assessment is adequate but specific guidance on the effects of premises on residential amenity is very limited and local planning conditions and policy will need to be applied.

4.3.3 *Codes of Practice for Pubs and Clubs. Draft 1999 reedited in March 2003 [97]*

Until May 2003 when distributed the only guide followed by the local authorities which provides guidance for the control of the noise affecting noise sensitive premises, from the public and private use of public houses, clubs pubs and other similar premises was the Code of Practice for Pubs and Clubs [98].This code was proposed by the Institute of Acoustics working party to address the absence of a standard for entertainment premises.

It proposes that music noise levels are assessed and limited outside the nearest residential premises at one meter from the most sensitive window of a habitable room. In general terms it suggests that there should be no increase in the L Aeq, 5 min noise level for premises that operate more than twice weekly at a measurement position outside a residential property nor should the low frequency un-weighted octave values increase. The same condition applies to all premises that operate at night even though may operate more than 30 times per annum but no more than once per week. Venues that operate more than thirty times per year but no more than once a week may be permitted to increase both the LA eq, 5min value and the low frequency octaves of 63 Hz and 125 Hz by 3 dBLeq, 5min during the day time hours of 10.00-23.00. The code considers that night time music and amplified singing and speech should be, where reasonably practicable inaudible inside noise sensitive premises. When compared with the reedited Draft 2003,we could find out that both of the drafts could usefully insert the general advices for measurement explaining how, where and when the measurement should be done but the significant difference.

The reason given in the draft was that the working party could not agree for noise criteria because objectively it is very difficult to assess the impact of the noise and defining a nuisance is very subjective. (A nuisance could be a 5dB increase but 3dB may also be a nuisance). The code proposes that each local authority should determine their own conditions to reflect their local expectation and should be incorporated in their planning and licensing policies.

Discussion and comment: the 1999 draft code covered only the music breakout, continually music noise but did not cover the noise when the doors are opened and when potential noise might occurring this is why this code was subject to criticism and instead of improving and setting more stringent limits and objective criteria such as imposing the LAMax for the assessment of noise music which is a true indicator of potential disturbance such as impulsive noise, the surprise was that in the new draft distributed in May 2003 no noise limits were set that because the working party which is constituted by owners of premises and members of the institute of acoustics and members of councils didn't agree on what could be a limit noise for music because the entertainment industry is dealing with many practical ,economic and local considerations, in other terms dealing with money. They stated that the noise level for the music should just be inaudible for the residents.

4.3.4 *BS 8233: Sound Insulation and noise reduction for buildings, 1997[98]*

This standard is a general information document giving advice on the noise control within the buildings. The document covers sound insulation, lobbies noise control and recommended internal noise criteria.

4.3.5 *BS7445: Description and measurement of environmental noise, 1991. Part 1-3 [99]*

These standards specify the measurement methodology, the descriptors and the reporting procedure for environmental noise measurements. It provides the underpinning principles for the standards BS4142. None of these standards specifically deal with all the noise issues associated with licensed premises although each provide some information that can collectively be used to assess some of the problem areas. Both the Code of Practice for Pubs and Clubs and the PPG24 guidance recognise that the problems of the street noise should not to be underestimated. A common sense approach is needed to assess these potential disturbances and relate them to the individual premises and locality bearing in mind the number of residents that may be affected.

4.4 *National and International Noise Initiatives*

In recent years there have been international initiatives to correlate and standardise research into ambient noise levels and to assess the levels of noise that populations of various industrialised countries are exposed to. Their common goal is to reduce noise exposures. Amongst these are the World Health Organisation (WHO) and the European Commission and national bodies in England such as the Building Research Establishment (BRE) and more recently the Department for Environment, Food and Rural Affairs (DEFRA).

4.5 *World Health Organisation (Guidelines for Community Noise, 1999) [100]*

Guidelines were published by the organisation of ideal or target ambient noise levels to avoid annoyance and sleep disturbance occurring.

The document states that "***significant annoyance occurs at and above an ambient level of 55 dB LAeq T from the continuous steady noise during the day and the evening periods in outdoors living spaces. A night time internal noise level of not more than 30bB LAeqT for bedrooms is specified so that sleep disturbances would not occur***".[5]

This internal level equates with an external façade level of 45dBLAeq T allowing for 15 dB open widow attenuation. Additional nigh time ambient targets are also quantified by the specification of maximum levels (LAFMax) that are 45 dB internal and 60dB LAFMax external to the window facade. The noise target limits assume a continuous steady noise level generated from transportation systems rather than from other specific sources. Certain professional bodies have spoken out against the misuse of the WHO targets as absolute limiting levels and state than further research and assessment of ambient noise levels should be undertaken before setting national target levels. Indeed recent provisional results of an Ambient Noise Incident Study by BRE /DEFRA have indicated that large proportions of the population in this country are exposed to levels in excess of the WHO guidelines. It is stated that a cost benefit analysis should be undertaken to balance the public commercial and financial interests against the need of those affected by the noise. There is a fair amount of research that indicates that human health and wellbeing can be affected by noise in excess of levels quoted by the WHO. At this present time it would be wrong for licensing authorities to reject an application simply because the local ambient noise levels were in excess of those quoted. However, should the ambient noise levels be well in excess of the stated levels then it would be prudent for the authority to consider the impact of the new licence premise on that noise environment. An already noise stressed environment should not be exacerbated further. Consideration should also be given to the amount of residents affected and their proximity to the premises.

[5] World health Organisation, Guidelines for Community Noise, 1999

4.6 National Noise Incident Study:DEFRA/BRE.2000/2001[101]

These surveys were conducted throughout England and Wales and follow similar studies in 1990.The survey is based on 1000 homes, 24 hours measurement survey and expresses the results in LAeq, LA10 and LA90 index form. The results are expressed in day, evening and night-time periods to equate with various standards and to enable a new 24 hour index of LDEN that quantifies the individual day, evening and night-time components as a average daily ambient level to match the EC noise mapping initiative. Results indicate that values have not changed significantly over the past ten years although whereas the daytime values have reduced fractionally the night-time values have increased by a small amount. In particular the background LA90 values have increased more than the ambient levels [102].

Lden (dB)	Proportion in Band	95%confidence Interval
Lden <55 dB	33%	29-37%
55≤Lden<60 dB	38%	33-43%
60≤Lden <65dB	16%	12-20%
Lden ≥65 (dB)	13%	11-15%

Table 4.2: The proportions of UK population living in dwellings exposed to noise levels in various bands, according to the Lden indicator.

Indicator	WHO Guideline Level	UK (2000/2001)	ENGLAND &WALES(2000)	ENGLAND &WALES(1990)
Day-time Laeq 16h	55dB outdoors living spaces	54±3	55±3	60±3
Night-time LAeq 8h	45 dB internal to the window	67±3	68±3	66±3

Table 4.3: The Proportions of UK population living in dwellings exposed to levels exceeding WHO guidelines levels.

It can be seen in table 4.3 that the proportion of day time exposure to levels above 55 dB has reduced marginally in the ten years between surveys. It can also be seen that the night-time values have increased a small amount.

It should be noted that approximately 55% of the population are exposed to values above the daytime WHO value of 55 dB and 67% are exposed to levels above the WHO night-time recommended value of 45dB.

4.7 *Ambient Noise Strategy*

The British government is so much concerned about the problem of noise that noise strategies have been drafted for both metropolitan areas and for England and Wales as whole. In December 2001, the government published a consultation Paper entitled "Towards a National Ambient Noise Strategy ", fulfilling in its 2000 Rural White Paper to develop such a strategy [103]. The strategy generally relates to transportation noise and its effect on the population including a chapter on neighbour noise. Little guidance is given to the setting of target values but the draft tends to suggest that further study should be undertaken to assess the noise effects on the psychological and physiological wellbeing of the citizens. The results of the noise mapping programmes, (in conformity with EU directive when the population percentage affected is known, will give an indication as to the scale of the problem and assist in determining a suitable strategy to reduce noise. The recent surveys by the Building Research Establishment of the Noise incident and attitude surveys will also assist and help in understanding the nature and areas of the perceived noise problems.

4.8 *Greater London Mayor Noise Strategy*

Noise is a problem for many Londoners. It can be disrupt conversation other activity, increase stress or disturb concentration, rest or sleep. Many see it as a key quality of life issue. The actual London Mayor seems to be very sensitive to the noise problem in greater London and very anxious to find individual solutions to the various sources of noise, even those affecting the entertainment areas. In this case his main concern is indeed to preserve the well-being of citizens living close the entertainment venues who are constantly complaining about the disturbance caused by the noise generated from the surrounding pubs and clubs but without running any risk of losing this substantial source of revenues visited by millions of foreign tourists. The mayor's strategy is part of a Europe-wide move towards more active management of what legislation calls 'ambient' or 'environmental noise' –long term noise mainly from transport sources and entertainment . Among the various propositions listed in the "London plan for entertainment management zones" suggesting solutions to the high level of noise existing particularly in the vicinity of the pubs and clubs (external noise). The Mayor of London seems to retain the idea of an increase in the licence fees of the entertainment venues, this increase should contribute to the cost of managing the problems in these entertainment zones.

In my opinion, any proposition should be considered because the noise problem outside and around the entertainment premises seems to be very difficult to tackle and to manage.

4.9 Noise mapping

A European Directive[6] requires that all member states carry out noise prediction mapping by the year 2007 of [104]:

- Agglomerations exceeding 250.000 persons and then
- Agglomerations of 100.000 persons at a later date.

Birmingham has been involved in noise mapping for a number of years and several authorities have either completed provisional maps or are in the process of doing so. Noise Mapping of England and Wales is in the process of tender and should commence in the near future. Noise Mapping software packages use algorithms to convert raw data to predict noise propagation and noise levels around three-dimensional buildings that are built up from Ordinance Survey and other similar maps with height data from satellite laser scans. Initial noise levels are mainly from transportation data and some industrial sources. Many mapping systems are also capable of predicting noise from plant and noise emissions from building facades. The time required to fully populate the maps with a comprehensive array of noise data indicates that it will take some time before a fully realistic map of all noise is complete. The limitation of noise mapping is that the global results are expressed as an annual 24-hour average although results can be expressed in the individual component periods of daytime, evening and night-time. Software packages do allow individual premises and projects to be individually mapped and this will be of a great benefit in assign individual situations. The mapping predictions will need to be validated by physical sound measurements carried out on a regular if not semi-permanent basis. Local Authorities have a wealth of experience and may possess records of noise levels in their area that can assist the validation process.

4.10 Entertainment Noise objective Assessment

Craik and Starling have both carried out a specific further work on amplified music entertainment and the inaudibility principle as a complement to the work undertaken by Edinburgh Council [105] When Craik [106] investigated the complaint received by

[6] Directive 2002/49/EC of the European Parliament and of the council , of 25 June 2002 ,relating to the assessment and management of environmental noise.

the Scottish authorities concerning amplified music, he pointed out that these local authorities stated 5 different noise assessment criteria among them we have those involving the use of BS4142 recommending the comparison between the music level and the background noise level. Craik discussed the relationship between subjective tests involving 40 Scottish households and analysis of council records. He came to the conclusion that the application of the described objective criteria did not always means the satisfaction of the people complaints. During that period those criteria were the only ones used by most local authorities.

The criteria provided by Wilson's Report for assessment of noise (whereby "the international L10 should not exceed 35d BA". (Craik and Stirling, 1986) were criticized by Craik. Craik argument was that the absolute level of 35d BA was not taking into account the existing background noise levels in the premises of those affected by the noise. He also argued that the background and specific noise levels may be measured as below 35d BA. These criteria may be inappropriate under these conditions.

Craik involved different local authorities when using different criteria, resulting in some modifications in the final interpretation of the alleged noise causing annoyance. Moreover Craik's point of view is that the principle of specific noise level exceeding the audibility even when music noise level well below measured background level in dBA by 5 or 15 dB may seriously underestimate the nuisance caused by amplified music(Craik and Stirling ,1986)[107].

4.11 How can noise pollution be controlled?

Common sense considerations need to be considered for general reduction of noise. Noise can be controlled at:

- Source: choose low noise items
- The sound path: barriers and enclosures
- The receiver location: acoustic glazing etc

Treatment at the receiver location should be seen as a last resort

The clue for best practice and most effective method is to design the source plant and equipment to be as quiet and efficient as possible and be positioned to have the least impact. Although, selecting low noise plant may have initial high cost. It will be cheaper than providing addition attenuation treatments at a later date to reach an effective solution.

4.12 *The UK strategy in controlling the music noise from pubs and clubs*

In this part we will look at the legislative and technical solutions to overcome the noise from pubs and clubs.

4.12.1 *Legislative Solutions*

Responsibilities of local authorities and businesses and their use of different guidelines

The Environmental Protection Act 1990(3) states [108]:

"It ***shall be the duty of every local authority to cause its area to be inspected from time to time to detect any statutory nuisances which ought to be dealt with under section 80...and, where a complaint of a statutory nuisance is made to it by a person living within its area, to take such as steps are reasonably practicable to investigate the complaint***".[7]

Clearly, the local authority must make efforts to reduce the likelihood of noise complaints using appropriate planning and licensing conditions, which are the most powerful methods to control the noise for entertainment premises. It has been understood that each council has the power to set out its new own conditions to the noise level they want to reach because they find that the ones set out in the Draft code of practice is not stringent.

4.12.1.1 *Duty of the local authority:*

The local authority has a duty under the Environmental Protection Act (EPA, 1990)[109] to inspect and investigate any noise nuisance reported to them from a resident living within the authority's areas. Internal noise (breakout music) or any plant generating noise from the premises that is judged to be causing a nuisance should be dealt with under the duty to serve abatement notices (contained in section 80): If the nuisance continues, the owner/operator of the premises could be subject to a £20,000 fine for commercial premises. The licence itself could be ultimately revoked if it were deemed that the premises were not being operated as agreed in the licence application.

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7 Environmental Protection Act 1990 (Part 3), Statutory Nuisances and Clean Air, Statutory nuisances: England and Wales, section 79 statutory nuisance and inspections therefore

4.12.1.2 *Local authorities' tools in controlling the noise pollution: Planning and licensing controls*

There is a degree of subjective opinion about the effect noise has on any individual. Fortunately sound can be measured in decibels and this enables a degree of objectivity to be applied to a subjective response or give weight to a professional opinion.

There are two approaches to the control of the noise:

- Conditions or controls can precede the introduction of the noise into an area with control through the planning or licensing process.
- Statutory nuisance action may be taken retrospectively in order to provide some control.

Planning

The planning system can help to prevent potential noise problems. Planning powers are the one of the main tools for controlling noise arising from development. The council is concerned to ensure, therefore, that development proposals do not give rise to unacceptable noise conditions. Community Services, specifically Environmental Health (CSEH), is a statutory consultant to the Local Planning Authority (LPA).

Any application considered by the LPA as requiring an opinion about noise impact of the development will be passed to CSEH for comment. In addition weekly planning lists are available for officers to consult and they may make relevant comment to an application even if the LPA did not consult them in the first instance. In this way all applications, which may potentially cause a problem are considered. The council will therefore make a careful assessment of likely noise levels before determining planning applications where noise is likely to be present. CSEH will then make a judgement as to the likely effect of the development on existing residential amenity and consider the possibility of nuisance arising. This judgement is invariably made on the basis of experience and judgement. This is because the planning consultation period of 8 weeks gives little time for the necessary extended period of measurements, which might normally be necessary. Standard conditions, as may be appropriate, are recommended. These standards conditions are relevant and reasonable having been formulated from policies adopted by the council and entered into the relevant local plan. In this way a robust defence for such conditions is engendered in any subsequent appeal. These planning conditions concern the source of noise such as, plants and entertainment and they are set to ensure compliance with all aspects of the noise policy, including the hours that a use can operate. Appropriate conditions will be imposed to provide acoustic reports, to set maximum noise levels, to prevent transmission of noise and vibration. Failure to comply with the condition then becomes a matter for the Development Control Enforcement Officer. The Local Planning Authority must also have regard to Planning Policy Guidance (PPG). This is issued by the Department of the Environment Transport and Regions (DETR) and must be considered in deciding any application. There are a number of such guidance notes available and the one dealing with the noise is number 24 (or simply PPG24)[112] seen in section (4.3.2). These notes tend to be very general in their content and loose in their meaning so as to be open to opinion. As with all UK legislation and guidance only the courts can give a definitive meaning to any interpretation. Suitable planning case law is therefore useful to assist the planning authorities (or indeed appellant) at any subsequent planning appeal or inquiry. Interpretation of the planning condition for both Westminster and Camden councils:

For Westminster, these conditions, although adopted, have not been widely applied in their current format and are being altered and modified in light of consultations on the Urban Development Plan. The "Maximum Noise Level" is not necessarily the "LAMax" indices but can also refer to the maximum "LAeq". The wording as we have within the Appendix C was written in an attempt to provide an objective measurement protocol to assess when a noise source was "INAUDIBLE" at the receiver location. The choice of index LAMax or LAeq, is dependent upon the type of noise impinging on the sensitive premises and more importantly upon the persons being affected, normally the residents. The more a sound is not audible means that, in objective terms that the received sound should not increase the sound level that is already present. Therefore if the prevailing noise level is say 45 dB then the additional noise should be lower than the existing noise so that it is not increased .Generally, a continuous and toneless received noise level should be 10 dB below so that the total noise does not increase by more than 0.5dB . However, if the affecting noise is tonal or indeed impulsive, relative to the ambient noise climate the sound will be more noticeable and attract attention. Therefore the additional "Music Noise" may have to be 15dB or less than the background noise level for it to be "INAUDIBLE" .In addition the individual frequency components of the noise would also need to be less than the prevailing noise level for it to be "INAUDIBLE". It is likely that the " new conditions" will require the featureless plant noise to be 10 dB (compared with the LA eq) below the measure background value whilst music noise may have to be 15 dB below background (measured on the "A" Weighting scale to avoid being audible.

Currently plant noise is assessed externally to the premises whereas music noise may have to be assessed internally in the residential premises where the music noise is breaking through the adjoining structure. Where the music premises are some distance away from the affected property the assessment is likely to be made at the external façade. Maximum levels will be required to be set relative to the existing background levels so that the resultant values are not increased and remain inaudible. Concerning Camden council, the conditions are quite similar to those removed from the Code Of Practice for Pubs and Clubs 1999 and the only change that I would recommend in order to conform the code of practice would be that the level measured outside an attached property could or should be 3 db for Camden are divided as following: Day time venue: 07.00-23.00hrs and Night time venues: 23.00-07.00hrs.

Comment and discussions

The Westminster conditions are more stringent than those set out in the Code of Practice 1999 or those adopted by Camden. The concept of "detriment to amenity" is frequently used in the planning process; however PPG24 singularly fails to distinguish between it and "nuisance". Whilst the difference between the two is hard to explain it is important to understand that whilst a matter may be detrimental it may not be so intrusive as to be an actionable nuisance. The authority may be failing in its duty if it permits a development to proceed and which subsequently gives rise to a Statutory Nuisance. Detriment to amenity is a much lower level of effect hence a noise could be detrimental to premises but fall short of a level considered to amount to a nuisance

Statutory Nuisance

A Statutory Nuisance may be defined as the unreasonable interference with a reasonable use of land by another person's activities. In terms of noise the issue is not whether the sound is audible but whether it is at a level, which would substantially interfere and disrupt the ordinary occupation of the affected premises.

A general perception for this subject is that there is an entitlement to a certain level of peace and quiet. Such a state is not defined nor is it laid down in any national legislation. The World Health Organisation has set some recommendations, which are used when possible. They do not have a legal standing but are useful as a reference point. Invariably contentious noise matters tend to be resolved by a compromise and it is only when there is a breakdown in communication between parties or one party adopts a defiant stance that the local authority environmental health officer steps in. His decision will be based on sound common sense supported where necessary by noise measurements. Such a process is termed "mediation". Final action by an Environmental Health Officer is backed by the necessary legislative powers to abate a nuisance by service of notice, which of course is subject to appeal.

4.12.1.3 Licensing

All references to "Licences" are to public entertainment (music and dancing).

Any licence which the city council is required or permitted to grant by Schedule 12 to the London Government Act 1963 (as amended) [113]or the Theatres Act 1968 [114]. Noise from entertainment premises can give rise to complaint at some stage. A recent survey carried out by Local Authorities revealed that pubs and clubs produce the majority of complaints coming from ambient noise. Such noise tends to give rise to a disturbance, which may constitute a Statutory Nuisance but invariably is more a residential amenity issue. Powers exist under the licensing Acts to impose suitable conditions when issuing a Public Entertainment Licence (PEL). Westminster Authority always issues a PEL with such a condition to ensure noise does not disturb residents in close proximity [115]. The role of the council as licensing authority is to balance between the needs of the entertainment industry and the needs of residents for an acceptable environment in which to live taking into account the need for a good night's sleep. The first condition concerns the closing time of the doors and windows of the entertainment venues so as to keep the ambient noise level reduced after 11.00pm (for the wellbeing of the local residents). The second is related to noise limiting device fitted to the musical amplification system set at a level determined by the environmental health service's community protection.(this noise limiter is designed to ensure that no music breakout is heard above the normal background level 1 one metre from the premises or within adjoining occupier's premises. The third specifies that no alternation or modification to any existing sound systems should be effected without the authorisation of the officer of the environmental health services (this is to ensure that no additional equipment amplifiers bass bins etc... are fitted to the already fitted sound system). The fourth condition stipulates that any additional sound generating equipment shall not be on the premises without being routed through the sound limiter device (this aims at ensuring that the pre-set sound levels are maintained. The fifth condition specifies that an acoustic lobby must be provided to all public entrances to minimise breakout of noise. The sixth compels all the licensed premises to install a comprehensive CCTV ensuring the monitoring of entry and exit points for prompt frontal identification of any entering or leaving the venue. The video recordings must be kept available for a minimum of 31 days and available to police officers whenever required.

The councils will apply policies set out for granting new licenses or renewals applications. These policies are POLICY ENVI1 and POLICY ENV2 for Westminster council. Westminster council was chosen for this study because it could be taken as a sample as Westminster council is the most organized council to the control of noise pollution. These polices deal with the considerations that the local authority should take into account when considering a license application without causing detriment to the amenity of local residents or the character of the area. (Westminster document: Licensing policies for public entertainment and night café premises.2002)[116].

4.12.1.4 When is licensing condition needed?

Entertainment licences are required for public music or music and dancing or other entertainment of a like kind. For Night Cafe Licence, the city council requires or permits to grant the licence by Part II of the London Local Authorities Act 1990[117]. Premises such as pubs can have musical entertainment other than that associated with either a private function or Public Entertainment. The liquor licensing is a complex matter and often legal advice will be needed they are issued by licensing justices (magistrates court). The liquor licence (on license) enables a Public house to have maximum of two performers either playing musical instruments and/or singing with alternatively amplified music. No dancing is permitted. These activities are limited to those times defined by the licence. Premises, which have liquor licence, may also hold private functions at which music singing and dancing are permitted. Invariably such functions tend to have an extended hours licence granted but not necessarily. Such functions are not however subject to conditions such as are to be found on a public entertainment licence. Thus any complaint about noise would have to be investigated as a statutory nuisance. This, places the authority in a difficult position, as any investigation following a complaint is always retrospective. The licensee does not have to give notice of future private functions, which tend to be held on an irregular basis. Witnessing the problem may therefore be difficult especially as the authority have no dedicated noise patrol officers. The cooperation of the public is therefore paramount in these cases.

4.12.1.5 When is planning condition needed?

Planning conditions is required for new buildings, for most extensions and alternations to existing buildings and for many changes of use.

4.12.1.6 Relationship between licensing and planning

There a fundamental difference between planning and licensing legislation. Planning permission unlike licences relates to the premises and is not personal to the occupier.

- A new occupier does not generally need to get a new planning permission, but automatically need to apply for a new licence or a transfer of an existing licence.
- Planning relates to the use of the land Licensing concerns include fitness of the operator, and detailed issues of the operation and management of the premises.
- Planning permissions do not generally expire. But licences need to be renewed annually. This enables the city council to take a fresh look at whether there should be a licence, and on what terms, depending on the current needs of the area, the nature and the history of the operation and the suitability of the licensee.

In general, the planning position should be resolved before an application is made for a licence.

4.12.1.7 UK legislation and enforcement

UK legislation gives the city council a range of power to prevent noise and to take action to enforce against excessive noise. Powers to prevent noise are largely those relating to planning and licensing legislation. Powers to enforce against excessive noise are primarily those of the Environmental Protection Act 1990, which gives Environmental health officer authority to take action against statutory noise nuisance. Environmental health officers will be consulted on all new planning and licensing applications and renewals. They will carry out inspections to monitor compliance with the conditions wanted and to ensure that the premises are suitable for the purpose applied for. If all matters are finally approved, officers in administration can then issue a license or the case may be referred to the licensing Sub-committee (councillors)(a hearing would be necessary for example where residents object to the application and their view will be heard at the hearing.) If no objections and all matters are satisfactory, an administration officer by means of delegated authority may approve the licence. If there is a matter and the conditions are breached, Environmental Health will refer the matter to licensing and / or planning enforcement to take action using their statutory powers. Environmental Health officers will attend meetings of the licensing Sub-committee as expert witness in support of licensing colleagues and if an appeal is lodged against a refusal of planning permission or a planning enforcement notice, evidence may have to be given at a hearing or local public enquiry. They will also take enforcement action using Environmental Health powers, in accordance with the enforcement policy for noise in the event that the breach in conditions also represents a statutory nuisance. Action taken under planning enforcement powers may lead to injunctions where persistent breaches are identified. Action under licensing powers may lead to objections being raised to the renewal of the licence, to prosecution or to injunction where persistent breaches are identified.

4.12.2 Technical solutions

Controlling the noise coming from entertainment premises (pubs and clubs) has to be done at the source.

The main noises sources can be divided into three categories:

- Plant and Machinery used in the operation of the premises
- Music and/or internally generated noise that may or could escape from the premises.
- Street based activity that may create noise outside and in the vicinity of the premises.

For the need of the present study, only music breakout will be presented.

In his research A. Bradshaw took in consideration music Breakout only getting out of the premises via several different ways by both airborne and structure-borne paths.

As a matter of fact noise breakout can occur through:

- The external building façade elements and ceilings.
- Poorly sealed or open doors or windows.
- Non-attenuated ducts and fresh air louvers.
- Unfinished structures.

And to prevent any sound breakout this consultant could then advise on the necessary sound treatment by first of all measuring the value of sound insulation of the building fabric and in the second place by recommending the necessary improvements that have to be achieved on a number of building elements such as:.

- "Fitting secondary glazing.
- Enclosing internal service voids and sound attenuating fresh air vents.
- Increase sound insulation of external or party walls.
- Increase sound insulation of ceilings.
- Provide sound lobbies for all main entrances and check door exits.

- Alarm fire exits so that they cannot be used except in an emergency.
- Isolate speaker assemblies from the structure.
- Zone the speakers to reduce sound in areas close to exits.
- Install a sound limiter on the music system to control the music level"

Among all these recommendations given by Mr A. Bradshaw[8] it could be more advisable to concentrate on two of them so as to decrease the noise levels at the boundary of the property and to avoid affecting the bordering residential properties. Consultants advise therefore to provide large sound lobbies so that visitors cannot open the second door whilst the first is open. They also advise not to place the two doors in line but at 90 degrees to each other in order to allow the sound passing through one open door would have to turn 90 degrees before getting out of the second opening. In case the doors both open simultaneously and to reduce the noise escape, it is recommended to reduce the amplitude output of the speakers which are close to entrances. As a second recommendation and in order to avoid music noise affecting the adjoining residential properties late at night, consultants advise the use of music noise limiters: Various and inexpensive music noise limiters are available now to solve the problem of Music bass beat especially .These systems range from cutting the power supply to the electrical ring circuit whenever the set limits are exceeded and computer based sound cards which are installed into the amplification system. These sound cards are set by computer software electronically. However, it is advisable to use limiters that can restrict individual frequency bands. This method is very good for controlling the music noise because members of staff and Disk Jockey cannot adjust the settings once a limit has been agreed and set by the later sound card system without the presence of the independent engineer and his computer software. Inaudibility tests may be used to set the limits; so to carry out the sittings of limits the requested Environmental Health Officer may make measurement of the music level from the affected residence itself. He makes the music play in the entertainment premises using a representative compact disc of music that contains rhythmic bass music. He then makes the levels increased and decreased alternatively until the music is at last inaudible. When this is achieved the limiter is set in the entertainment premises. A measurement of the music level is also carried out for any future checks of compliance.

[8] A.Bradshaw: Senior Technical Officer for Westminster City Council.

4.12.2.1 The role of the local authority

People who are bothered by the noise emanated from pubs and clubs could try talking to them politely because it is usually better to resolve it informally. If the problem persists and they do wish to complain formally, they could take their complaint to their local authority. Local authorities are legally obliged to investigate complaints of noise coming from premises such as pubs and clubs under section 80 and 81 of the Environmental Protection Act 1990. (as already seen above). The local authority may send an environmental health officer to visit the complainant's house. When investigating, the methodology consists firstly, on a subjective questionnaire designing the noise exposure factors seen during the literature review. This will be used in an interview with the complainant who is bothered by the amplified music coming from the source (clubs discotheques and pubs). Then the objective assessment will rely on the use of different instrumentations for monitoring, noise parameters and the use of relevant guidance documents seen in the literature review. The use of the standards is very important because the measurement found by the acoustic team will be compared with the current guides for example the levels recommended by the WHO is 30 dB required for an undisturbed night sleep. This value equates an external LAeq (8h) of 45 dB and LAmax external value of 60 dB is not exceeded. These values assume a resident may require an open window for ventilation. Then a final report will be set out in order to see the action to be taken. An acoustic report can assess the impact of plant and noise breakout adequately prior to the installation and operation of the premises. The planning department would therefore be in a position to form a positive impression as to the probability of the plant and premises operating within planning criteria. The licensing authority may require that the planning department and local environmental health officers report to them that they are satisfied with the arrangements of plant and sound insulation before hearing of a license application.

4.13 Conclusion

In the UK music entertainment noise associated with pubs and clubs, is generally controlled through the music entertainment licensing regime operated by local authorities. Licences include discretionary operating conditions, which typically cover hours of operation, fire precautions, safety and control of noise [118].UK local authorities may rely on the experience of their environmental health officers to determine the most appropriate method of assessing noise annoyance from clubs and pubs and thus determination of the best course of action. However, the justification and presentation of both subjective and objective evidence in magistrate's court can be subject to strict rules of evidence and professional scrutiny. In the absence of precise legal standards, the proposed methodology for any investigation is frequently inconsistent.

Chapter FIVE
Noise Pollution and Noise Control Standards in Algeria

5.1 *Introduction*

These last ten years, in Algeria noise pollution has become an environmental issue where people are exposed to unacceptable levels of noise. The main noise source is from traffic, from neighbourhood and domestic noise particularly (entertainment premises known as wedding halls). Other significant sources of noise annoyance in Algeria include building construction and household noise as well as car alarms and even barking dogs. In this present study, my concern will be on one of the main noise source in Algeria which is noise from entertainment halls. In Algeria, there is no existing framework or enforceable code for noise control. In view of the absence of a proper noise control standard in Algeria, a large number of wedding halls have been built without any protection (insulation, double glazing...) causing disturbance and annoyance in the neighbourhood. The noise from these wedding halls may affect neighbours. Modern amplification and music styles make this an increasing problem. Therefore local people saw their lives disturbed by the noise caused by these kinds of recreational halls. As a result of the lack of standards, this study was conducted. As far as is known a noise survey has never been previously attempted in Algeria.

The aim of this survey is to establish noise level limits and measurements according to the WHO guidelines [119] recommended creating the necessary set off regulations and guidelines on which we could rely in treating the different noise problems in Algeria.

5.2 *Local and regional government*

The system of local government existing in the early 1990s was established in the late 1960s. The decentralization of local government during the latter period provided an alternative focus to the concentration of power in the highly centralized single-party apparatus. An extensive system of administration restricted the autonomy and independent action of provincial and local assemblies. Communal and provincial councils are generally confined to purely administrative and/or distributive functions, rubber stamping national government initiatives.

5.3 *Administrative divisions of Algeria*

Algeria gained independence from France in 1962. The legislative administrative framework in Algeria still show the French influence. The administrative divisions have changed several times since independence. The national government and its local constituency coordinate between them by three different executive bodies which are the Wilayat (provinces), Dairat (Districts) and Baladiayat (councils) in hierarchic order.

5.3.1 *Wilayat*

Below the national level, the country is divided into 48 Wilayat (sing. Wilaya) (provinces), each with its own elected assembly (Assemblée Populaire de Wilaya; APW), executive council, and governor, which are, in effect, provinces.

The Wilayat owe their origins to the colonial system, where they served as bureaucratic units of colonial administration. The system was reformed and expanded (from fifteen provinces to forty -eight) by the Wilaya Charter of 1969, which enumerated a specific legal code for the government of the provinces. The system was reformed again in 1976 by the national constitution [120].

Each Wilaya is governed by a Popular Wilaya Assembly (Assemblee Populaire de Wilaya APW). This deliberative body consists of thirty deputies and holds elections every five years. Each Wilaya is also governed by a Wali , or governor, who is appointed by the president and is the latter's direct political representative at the regional level. Wilaya government is responsible for the distribution of state services, the regulation of small and medium –sized industry, agriculture, tourism, road transport and education institutions, and the creation of new state-owned enterprises.

5.3.2 *Daira*

The provinces are in turn divided into da'irat (administrative districts). Districts in Algeria are called Dawair .Algeria has 553 administrative Dawair , (sing Dairah),units between Wilayat and communes. Certain licences and permits must be obtained from the Dawair, although most are distributed by the local communal authorities [121].

5.3.3 *Baladiyat*

There are more than 1,500 Baladiyat (communes) in Algeria, each one having its own assembly to run local affairs.

The local rural governing authority is the Communal Popular Assembly (Assemblee Populaire Commulale, APC). The APCs are responsible for local administration, economy and finance, social and cultural affairs, and planning. APCs have not economic autonomy as they are directly responsible to the national Ministry of Interior, Local Communities, and Tourism and receive much assistance, direction and supervision from various ministries. Having no economic and little political autonomy, however, the communes administer central government programs rather than initiate independent projects. Each communal assembly has ten to eighty members, who are elected for five year-terms. The assembly elects a communal executive from its membership. The communal executive generally consists of a president, two or more vice presidents, and several councillors.

5.4 *Demography profile of Algeria*

Ninety-one per cent (91%) of the Algerian population lives along the Mediterranean coast on 12% of the country's total land mass. Forty-five per cent (45%) of the population is urban, and urbanization continues, despite government efforts to discourage migration to the cities. Currently, more than 15 million Algerians live in urban areas while another 15 million live in rural area. About 1.5 million nomads and semi-settled Bedouin still live in the Saharan area [122].

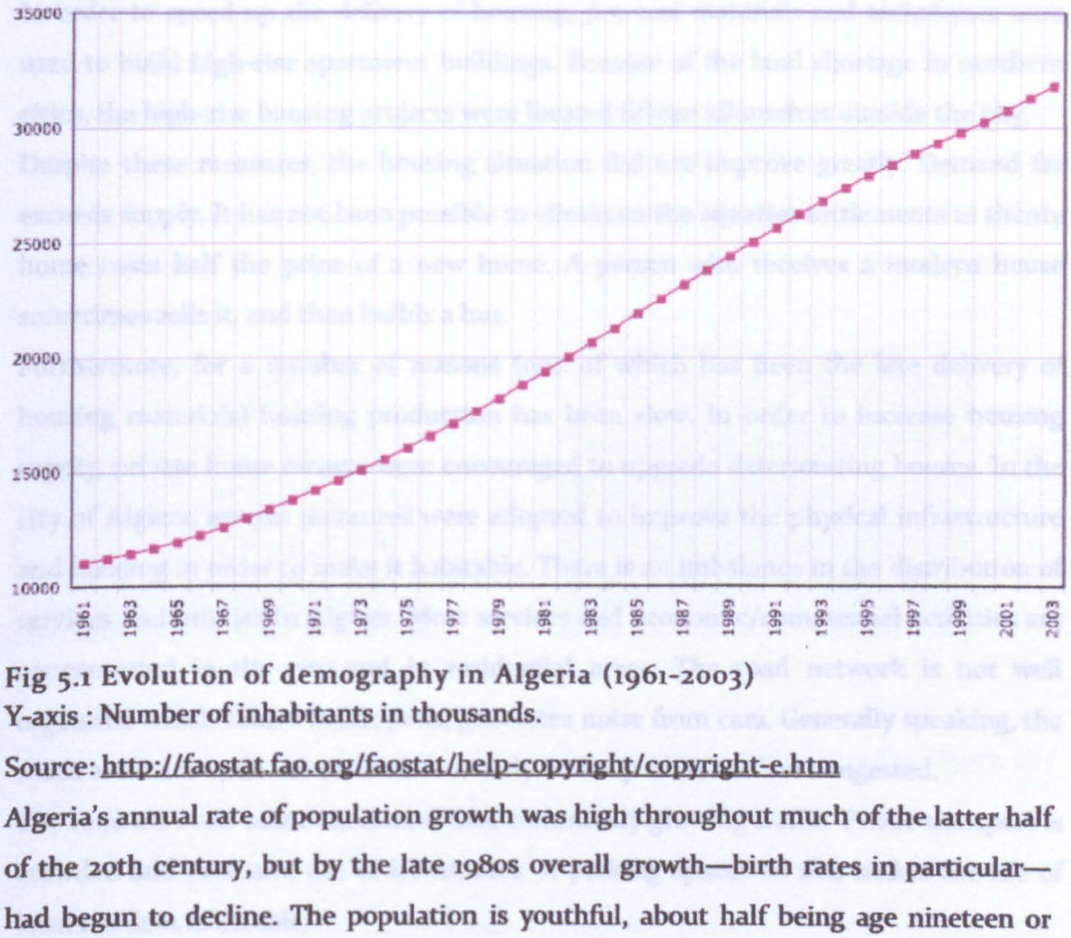

Fig 5.1 Evolution of demography in Algeria (1961-2003)
Y-axis : Number of inhabitants in thousands.

Source: http://faostat.fao.org/faostat/help-copyright/copyright-e.htm

Algeria's annual rate of population growth was high throughout much of the latter half of the 20th century, but by the late 1980s overall growth—birth rates in particular—had begun to decline. The population is youthful, about half being age nineteen or younger. A drop in infant mortality rates has contributed to a decline in overall death rates, but these have been partly offset by the lower birth rates. The decline in fertility has occurred in the cities, where the government has focused some efforts at family planning. The growth in population has been the main factor that contributed to urban deterioration and the housing shortage.

To remedy the housing stock deficit and rationalize urban land use, in the mid-1970s the central government adopted the following measures:

- The local governments were given financial resources to form public works corporations to build houses and infrastructure facilities.
- A real estate law was issued to:
    a) Preserve the agricultural land by delimiting city limits,
    b) Create new urban areas within the city limits for the construction of high-rise buildings, and
    c) Encourage personal savings to be used for the purchase or construction of private homes.

In order to speed up the delivery of housing, pre-cast materials and techniques were used to build high-rise apartment buildings. Because of the land shortage in northern cities, the high-rise housing projects were located fifteen kilometres outside the city. Despite these measures, the housing situation did not improve greatly. Demand far exceeds supply. It has not been possible to eliminate the squatter settlements as shanty home costs half the price of a new home. A person who receives a modern house sometimes sells it, and then builds a hut.

Furthermore, for a number of reasons (one of which has been the late delivery of housing materials) housing production has been slow. In order to increase housing supply, private home owners were encouraged to upgrade deteriorating houses. In the city of Algiers, several measures were adopted to improve the physical infrastructure and housing in order to make it habitable. There is an imbalance in the distribution of services and utilities in Algiers. Most services and economic/commercial activities are concentrated in the city and in residential areas. The road network is not well organised which causes traffic jams, generates noise from cars. Generally speaking, the roads are narrow, do not cover the recently built-up areas and are congested.

The road network cannot accommodate continually growing traffic. Public transport is crowded and excessive use of horns, lack of parking spaces all this makes the life of local resident miserable.

5.5 *The state of buildings in Algeria*

Algeria, a gateway between Europe and Africa, is located in Northern Africa. The Sahara desert covers over 80% of the country's territory. The population of Algeria is over 30 million – most of the population lives in the northern part of the country. The capital city Algiers (including the suburbs) has the population of around 3.5 million. In the last forty years, rapid population increase in Algeria (the population has grown from 10 million to over 35 million) has resulted in a high demand for housing construction [123]. At that time Algeria's need was new buildings for the fast growing population. One of the main demands was to build houses with a good functionality but there was no consideration whatsoever of the climate of the site. There was also a lack of comprehensive planning, and urban design, as a result, more than 67% of the construction in the most affected cities in the last earthquake which has occurred Algiers and Boumerdes was undertaken in the last 30 years [124]. In general, the construction has been mostly done by private contractors, often without the required professional qualifications without any concern for to thermal or acoustic performance. The prevalent type of private single-family construction includes one to three-storey high concrete frame buildings cavity wall without any insulation with outer and inner leaves .(see Fig.5.2). Most of the buildings are left without any external finishes and poorly insulated or no thermal or acoustic insulation, this was due to shortage in owners' budget and to decrease the cost of the building. In some urban municipalities, a large proportion of the private construction is illegal (without building permits).

Figure 5.2. Typical single-family housing construction.
Source: Ministry of Housing and Construction

The aim of this study is to draw guidelines and construction techniques for Algeria and to develop construction materials locally available to reduce noise breakout.

5.6 *Noise types and noise problems in Algeria*

The sources of noise that are covered in Algeria are the noise emanated from neighbourhood , loud parties ,noise from the street, people who rent their house for weddings, parties, communities hall ,carpenters as well as noise from road traffic and construction sites [124]. Road traffic is the most significant sources of noise in the city. Road traffic noise problems arose in Algeria in 1990's due to population increase stemming from accelerated growth, internal immigration, the larger number of vehicles, motor vehicles which are poured and added into the already overcrowded streets [125]. Algiers the capital was estimated to have populations of 4 million [126]. Add population swell daily as workers flow into the city from surrounding area, they clogging roads and rail lines every morning and evening. So there are traffic jam and traffic noise problems.

Many areas contain dense pattern of constant activity as commercial, administrative, cultural institutions, business establishments, governmental offices, universities, and hotels, which together create a dense pattern of constant activity. So its roads are too crowded and there are traffic jams everywhere. There is also the private transport which has increased significantly in the last decade, it is run anarchically and contribute to the traffic jam by not respecting the law and traffic signs as well as a an anarchic use of car horns. Other community noise sources include rail and air traffic; industries; construction and public work; dog barking and the neighbourhood. The main indoor noise sources are ventilation systems, office machines, home appliances and neighbours and noise from entertainment premises. However, noise complaints in Algeria are not very common possibly because people do not know how and where to complain. Having investigated this matter personally, the local authorities confirmed that they have never received complaints about any source of noise; they in fact directed me to the police where all sort of complaints are recorded. The police confirmed that the noise complaints are very rare but in the last five years complaints about noisy neighbours and noise from wedding halls as well as noise from the mosques when calling for prayers especially the call for the first prayer where most of the time happens in the early hours of the night have increased. However, people avoid making a formal complain about the noise generated from the mosques loud speakers when calling for the early Morning Prayer, because they think it is a sin. While others believe it may hurt the feelings of worshipers and other categories try to avoid any repercussion if they ever complain about it.

Other complaints regard the noise from road works during the day (siesta time) especially in the summer. Others complain about excessive use of car horns and car alarm testing which disturbs children as well as old and ill people. Some people are forced to keep their windows closed to avoid the occurring noise which sometimes come from local workshops such as carpenters and car mechanics. These workshops are mainly located in the residential areas, where people use their garage or rent it for commercial purpose. To sum up, noise source in Algeria are varied from traffic noise to noise from mosques calling for prayers. However, at the moment the most disturbing noise in Algeria is noise emanating from entertainment halls and wedding hall (see newspaper article in section 5.10.2). Nevertheless, noise complaints are not consistently high as some people do not complain because they respect their neighbour or are scared of them and also to void any type of reprisal or backlash with them. Complaints about the mosques exist but are very rare because it is a delicate situation and they think that the y cannot complain about their religion. The police also consider that noise is not a big issue as they have more important problems to deal with. This is due mainly to the absence of enforcement law, most of the noise complaints are dealt by mediation between the complainer and the noise maker. Another noise problem comes from the kids and teenager where they use the streets as football ground day and night, they are very noisy and shout all the time as well as swearing which really disturbs and not acceptable in most of the Algerian families.

5.7 *Noise control standards in Algeria*

As mentioned earlier, in Algeria noise control standards are almost absent. However, a decree exists within the local authorities since 27 July 1993 [127] see appendix B. This decree is mainly based on the French norms. This decree outlines the legal measures. It defines the limits for noise exposure where the maximum sound intensity levels accepted in the close vicinity of hospitals or schools premises and in rest areas or relaxing areas as well as in their enclosed spaces are of 45 decibels (45 dB) in diurnal periods (6am to10pm) and 40 decibels (40 dB) at night (10 pm to 6 am) [128].

In the decree, guidelines are described on how constructions for housing purpose or for professional use should be conceived and realised taking into account the acoustics quality of the walls and floors. Are considered as a breach of vicinity quietness, excessive discomfort, nuisance for health and a compromising of the population quietness any sound emission above the limited values indicated above. In the decree it is mentioned that any physical or moral person exploiting activities requiring the use of engines, tools, machines, equipments or appliances generating sounds intensity levels above the limited values such as defined by this decree, is bound to set sound proofing devices or appropriate arrangements installations so as to avoid disturbing people or to prejudice their health.

In the decree, guidelines are described on how constructions for housing purpose or for professional use should be conceived and realised taking into account the acoustics quality of the walls and floors.

5.8 Entertainment halls licensing bodies in Algeria

CNERIB (The National Integrated Research and Studies Center of Building industry) is an organism created in 1982 has the role of undertaking all scientific and technical work referring itself to the development, with the development and the control of the techniques to increase the performances of the apparatus of production of the sector of construction [129]. This organisation has the mission to:

- Proceed to the study, research and the development building material, components, material and constructive system adapted to the economic context.
- Collect and treats the whole of technico-economic information relative to the various components and materials entering the construction industry.
- Proceed to tests and experiments related to the research tasks within the framework of its object or for any petitioning organization.
- Gives technical opinions on materials and components of construction.
- Assist the companies in their development and the innovation.
- Assist the building owners in the objective definition of the requirements,
- Aim at the improvement of the quality of construction by the elaboration of technical documents being used as a basis for lawful or normative texts.

This organisation has started it first work in the field of the research in acoustic in the 80's. In that time Algeria was not giving any interest to the noise nuisance in general. A noise team from this organisation in this time requested the ministry of housing for an authorisation to explore this field. This project was entitled "Study of performances in Algeria". This organisation owned its first sound level meter in 1982 (Bruel Kjaer) [130]. An acoustic laboratory is available with the latest sophisticated instruments. This team simulate the noise in its laboratory. In 2005, a new law regarding the noise control was voted unanimously in the parliament [131]. This law regards a new licensing for the landlords of the entertainment hall. Old and new entertainment halls have the obligation to own a certificate of conformity to obtain a license.
The licensee needs also the approval of the police, fire brigade, and the local authorities after an investigation. However, there is only one organism that gives the certificate of conformity which enables the wedding hall to be licensed. This organisation is known as VERITAL.

VERITAL is a joint Economic Company of Technical Control which is based in Algiers [132]. The control is generally carried out at the business owner request and comprises

- Entertainment Halls
- Any business receiving the people (discotheques, wedding halls etc...)

Before delivering a license, VERITAL appoints a technician who undertakes noise measurements at the site with music being played to the maximum volume of the speakers system. The monitoring is undertaken with the help of adjusted measurement appliance (Sonometer). The document of reference official journal N50D93-184 of the 27th July 1993 Norm NFS 31 00 [133].

- The business must be put in the normal state working
    1. All the set up equipments have to be put in working order
    2. If it is a wiring sound (volume to a maximum)
- The measurements have to be taken outside the building in the vicinity of the 4 facades and in several points (the average will have to be taken into consideration).

This certificate of conformity delivered by VERITAL is accompanied by a short report where, all the measurements descriptions are given.

In this report you will find:

- The name and surname of the owner
- Type of the activity
- Address
- Results obtained after measurement
- References
- Equipment used
- The description of the activity
- The modalities of measurement (conditions, windows closed. door closed...)
- The date
- Name and signature of the expert who made the measurement and the VERITAL, s stamp.

The licence is valid for a minimum of 3 years or more depending on the premises.

However, this license is not considered as a proper license because there is no noise specialist within that company, hence the noise measurements conditions cannot be guaranteed.

5.9 *Algerian Norms*

NA 3279/ ISO 1996 contain three parts [134]:

Part 1: Basic quantities and assessment procedures

Part 2: acquisition of data pertinent to land use

Part 3: application to noise limits

The first part of ISO 1996 defines the basic quantities to be used for the description of noise in the public environments and also to describe the basic assessment procedures. This part specifies also assessment procedures of noise in the environment and gives indications to predict the reaction of people due to a long term exposition to different types of environmental noise. The noise source can be distinctive or combines. The application of this method to predict the nuisance reaction is limited to habitation zones and to land use. The reaction of people to noise can be different towards the noise source which are characterised by identical acoustic levels. The present part of ISO 1996 describes the noise correction with different characteristics. The second part describes how the data is acquired and the last part describes the application to noise limits.

5.10 *Dealing with noise in Algeria*

Any authorization for the licensing of an entertainment Hall is subject to a study and approval by a security committee consisting of [135]:

- The prefect (Wali in Algeria),
- The president of the communal Assembly,
- The security chief officer of the sub prefecture,
- Local police authorities
- Fire brigade.

After three months of investigation and inquiry, the approval for the Trade Register is issued from the police after the fire brigade inquiry.

Entertainment Halls and Bars are under the control of the General Police. The Trade Register is obtained from the Prefecture. The concerned owner of the entertainment hall fills in an application to the communal assembly. This application is sent to the prefecture. A police investigation is carried out on the spot as well as a civil protection inquiry. After that a meeting is held by the concerned services in order to present and discuss both investigations and make a decision whether to approve the application or not. The existence of a car park is the main condition required for obtaining the authorization for opening an entertainment hall so as not to disturb the neighbourhood quietness. It is important to underline that the "Trade Register" alone is not sufficient. The police authorization is very important. If the owner of the hall does not have this authorization his business is immediately closed down. A closing down proposal is issued by the police. The closing down is instant as soon as the decision is released from the sub prefecture. The entertainment hall owner can be prosecuted if the he does not respect the police decision. In case of a problem of sound nuisance, local residents may call the police who then intervene. A noise complaint is investigated however noise monitoring is not conducted because of the lack of instrument and lack of skilled noise officers in the council.

Currently a decree in the governmental and official journal is available since July 1993 which fixes common rules and noise levels not to be exceeded 70 dB during the day (6 to 22 h) and 45 dB at night (22h to 6h) in the residential areas and other areas such as hospitals schools but in fact, this is not applicable and followed because no instruments available to check the level of noise nuisance. The regulatory approach to neighbour and neighbourhood noise are related to planning and licensing for entertainment licensing (community hall in a private house, or pubs and clubs). There are limits on hours ,days of operation and a special authorisation is given to who wants to open a commercial and community halls in his house. This authorisation is delivered after a working party between the mayor, the chef of the police, fire brigade, the president of the council and even in the case of the availability of the licence the absence of this authorisation is sufficient to not to allow the opening of this kind of entertainment . The legal power is given to the environmental Ministry. There, there is a service (the environmental inspection) which has the power to act and to deal with complaints. On the other hand, there is a service in the council called hygiene service which has the prevention and awareness job, it can only records the complaint and try to solve the conflict by mutual consent between the complainer and the noise maker. People who can make complaint but have to address it to both police and the mayor who will refer complainants to the hygiene service, this service will investigate the complaints at source [136]. When a complaint is recorded, the repetitive noise scene can be attended by both the hygiene service of the council and the police but no noise levels recorded because of the lack of instruments. The police are available to help to resolve the problem and disputes. Very few complaints are received by the police or by the council, only an average of three complaints each year, populations may be less prone to being annoyed by neighbour and neighbourhood noise and may be less inclined to complain if they are unaware of the existence of complaint procedure , so they prefer to not complain, it is perceived as something that one has to "learn to live with" which may explain the reported passivity of the authorities in dealing with complaints and the lack of links to other strategies in Algeria without forgetting the security problem which is occurring and more important to deal with as it is a serious problem.

5.10.1 Radio program on noise nuisance from wedding halls

A program was broadcasted on the national radio on 7th April 2004 .[9]

This program was related to the environment and takes place every Wednesday between 11.00am and 12.00am, every week an environmental issue is debated and the listeners are invited to participate by calling and exposing their views. The program host invites in general the persons responsible of ministries and department concerned about the discussed issue. In this program, a representative member of the local police representing the enforcement authority and a director of health and hygiene department from the ministry of Population and Health were the main guests. As soon as the program started, many listeners called and expressed their views and most of them complained about the noise emanated from different sources. The program was dividing into two main parts. The first one was mainly people opinion and views regarding the noise nuisance. The second part was reserved for the main guests reaction. During the program, a journalist was interviewing people in the street living in the capital in a very noisy street, to find out if they are victims of the noise disturbance in their houses. They were also asked if the noise is a real problem in Algiers and what are the main noise sources that annoy them. For this purpose five people were very keen to answer because they were really disturbed by different sources of noise.

The first one was disturbed by the mosques calling to the prayer with their high speakers that are a discharge of decibels very early in the morning (in the paddle) from 3.00am in summer time to 5.00am in winter time. The second caller was a lady who was complaining about the use of the high speakers for the electoral campaign which was held in these days as well as car horns from 6.00 am in the morning. Another caller was complaining about the parties and the weddings celebrated every day every especially in hot season at the siesta times. Another caller complained about the cars

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[9] Radio program on noise nuisance from wedding halls, (recorded on 7th April 2004)

horns, which were a real problem disturbing vulnerable people such as the elderly and ill people as well as the children. The second part of this program was, firstly, to talk about the regulation in force in Algeria so the program host explained the executive decree of the 27th July 93 . Secondly, he asked the police representative about the frequency of t complain they receive especially at night and if his section was sometimes proactive. The commissar answered that his section are usually acting for disturbance of the peace at night caused by drunken people and neighbours who are celebrating parties or weddings. He said that we have to know that it is not forbidden to celebrate weddings or make parties, the thing is to respect the neighbours and the time permitted which is 00.00am. He also talked about the proactive act which the police take especially at night .His team make regular visits into the capital districts every night to check if everything is ok. They only act when it is necessary. A warning is first given, then if the person causing the noise carries on, then a major action is taken in a form of a fine or eventually the closing of the venue. The second guest of the program: the director of Health and Hygiene department talked about the levels approved by WHO (World Health Organisation) sitting the accepted noise levels as follow:

- 35 dBA is the quite level that we can find in bedroom with all the windows closed
- 40-50 dBA is the level of a conversation and it is a tolerated
- 85-90 dBA is a disturbance and in long term can cause troubles on the health such as increasing the blood pressure and stress
- Above this level very dangerous this starts with Sleep disturbance, mental stress and sometimes could cause deafness.

During the program, an interview with a professor in one of the psychiatric hospital in Algiers about mental stress and health effect of noise on people.

The choice of the hospital was done in purpose as it is surrounded by a community hall and a stadium. Regarding the community hall the professor said that it is situated near the women's ward, so when parties and wedding are celebrated they have to organise a party for the patients to mask the noise because the patients get excited and would want to go and join the party in the wedding hall. The question asked by the radio operator was if a patient wants to take a rest and does not want to take part to the party, especially we know the state of the persons in this kind of hospitals and how they feel? The professor said that this patient can go with the nurses in another part of the building like the garden for example where no noise is heard. The only thing that could and should do the person who is in charge for the entertainment hall is to let us know before. He also said that he knows that his hospital should be isolated and not surrounded by these kinds of buildings. But he can't do anything about it so he has to work with this. The program was submerged with calls from listeners, once again a lady phoned to complain about the noise occurring from the electoral campaign. She said that she was very disturbed by the horns of the cars and the big speakers.

Elderly women phoned from the suburb of Algiers complaining about the electric central which disturb them in the neighbourhood especially in summer time when they have to open the windows. She said that they can not cope with this noise and added to this she heard that they will install soon a station of desalinisation close to it which will make the matter worse. The program host replied that *article 7 of the executive decree of 27th July 1993* [137] is dealing with this problem it is saying that before any activity or infrastructure take place it is necessary to consider the neighbourhood so people can accept or not this activity ,so to the people to take action like writing a petition. Another question was directed to the director of Health and Hygiene department whether the ministry of the health is consulted before any delivery of planning permission for new wedding halls? The answer was not for all the buildings but every building that could affect the people's health should be our concern. Otherwise, it is the responsibility of the people concerned to take some actions. There is a hygiene and health service in each district in each council that cover this problem. So people can complain and the neighbourhood should be consulted when delivering planning permission for entertainment hall buildings. A commodo-incommodo inquiry has to be carried out by the members of the Public Health Service of the council accompanied by the Environment and Town Planning Service.

The commissar suggested installing double-glazing for all the people who leave in the neighbourhood or for the factories the owners have to offer AC units for each neighbour. Another caller complained about the mosque in her neighbourhood just next door she said that her husband is very ill and he is disturbed by three speakers fixed on the façade of this mosque. She said that some of her neighbours had to move out, and the children are very scared to be waked up in the early morning by these loud speakers. She was asked if she had ever complained to the police, and the answer was no because it is a delicate situation and we cannot touch on the religion ...but she said that they complained to the Ministry of the Religious Matters but without any result. For this case, the radio operator took her details and insures her that they will try to resolve the problem. For the same case, a responsible in the Ministry of the Religious Matters was contacted and he said that they are preparing a notice will be issued to every mosque Imam to reduce the levels and to respect the allowed levels 70dB for the day time and 45 d B at night . Another phone call was from a person who is living in a residential area near a car wash station .This person was complaining about the noise that was occurred by this activity the noise was so loud that he could not open the windows.. He was wondering how a licence could be delivered to this kind of activity in a residential area. The operator radio said that for the residential areas, only few activities (not noisy) should be permitted as a baker for example. This question was directed to the commissar: can we complain when a noisy activity like a factory open in a residential area? The answer was no, because we should know that if this activity opened it means that the owner had obtain his agreement. And here again the APC "Communal Popular Assembly" should play its role. The APC services advertise in the national newspapers. The application for the Trade Register during 15 days so as to allow all the citizens living in the neighbourhood to be informed and complain in case they think this hall could be a source of sound nuisance for their environment. In case of a complaint lodging, the APC services move about on the spot within 15 days in order to state whether the complaint is well founded.(but this is carried out with subjective means.) If there is an official statement account of the sound nuisance released by the APC services, an unfavourable notice is then issued by the control squad. This unfavourable notice is then sent by mail to the Trade Register applicant to notify him of the APC refusal with the supply of proofs.

If the applicant for the Trade Register even though opens his entertainment hall despite the orders of the APC services, these latter call out the public force.

The fourth phone call received was also from a person living in a very posh area of the capital. He was complaining about some new spaces games for the youth implanted near schools, he said that they are very noisy people shouting and insulting using bad words and disturbing the neighbourhood during all the day and at night. He said that it was impossible for them to support this kind of behaviour especially near a school as pupils could not concentrate in their studies. They made several complains to the police station without result. For this case the commissar insures him that he will resolve this problem as soon as possible. Reaching the end of the program, the operator radio said that many others calls were recorded and all of them were about the same problem: noise emanating from factories and private who open factories in their garages, weddings and parties from entertainments halls. And she concluded by saying that the noise problem in Algeria is a fact and many efforts from the government and the citizens should be done to try to find issues for this problem by working together.

5.10.2 *Article about noise nuisance from Entertainment Halls in Algeria.*

Translation of the article on ElWatan newspaper dated on the 9th October 2004 see appendix

Article Title: Wedding halls, a source of noise[10]

Having been convenient spaces for the celebration of marriages and circumcisions and organizing all kinds of festivities, wedding halls that have proliferated in recent years are becoming a source of noise for residents.

Indeed, the opening of some halls was not without causing inconvenience to residents of the neighbourhood, at the expense of rest and well-being of the elderly and children. That is to force decibels outlet different kinds of songs and rhythms raï promoting a deafening pandemonium that the atmosphere is lively. As part of establishments classified as receiving the public, the hall is subject to many rules governing the terms of operating and granting permission to open. Among the criteria set by the regulation, it is especially required the guarantee of safety, health and sound insulation. If certain criteria set are designed to preserve the safety of persons within the establishment, the other criteria to ensure the peace and the neighbourhood. However, some wedding halls have been opened against the rules laid down, regardless of conditions. Remember, it cannot be allowed to open this type of facility near a cemetery, a place of worship, near a school in a densely populated. While some owners eager to gain quick and easy by ignoring the rules were quickly suppressed by control services, others seem not to want to comply with the law. The most illustrative is the premises of Algerian Red Crescent, which have been converted in two halls, and have become a source of impossible and unbearable noise for residents of the neighbourhood. Indeed, the building located in the heart of a city population has become an obsession for fans of the meridian in the summer and those who aspire to take some rest at home afternoons and evenings whole. Since the opening

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10 Article on ElWatan newspaper dated on the 9th October 2004.

of these halls at the expense of requirements, including installation of windows with double walls and lack of air conditioning, it is the neighbourhood that is affected by the decibels from disc jockey music, loud voices and cacophonous music. In fact, the humanitarian mission should in no way obscure the rules of neighbourhood to create a good harmony with the surrounding environment. Thus, should the Algerian Red Crescent team halls means required to give them the particular commercial exercised and, therefore, not be a source of nuisance for residents.

5.11 Conclusion

There is no doubt that there is an increasing concern about noise pollution in Algeria. However, in Algeria the public's complaints are almost inexistent because people do not know how and where to complain. The scale of environmental noise is growing especially with entertainment halls. In the last ten years, the number of wedding halls in activity has risen sharply and their implementation has been sporadic and uncontrolled. As a result of this, the number of people affected by the noise from these halls is constant rise, causing them annoyance and disturbance on the daily basis especially in summer period where weddings are celebrated daily. Despite the existence of an Executive Decree [138] controlling this form of pollution has become a priority because of the negative effects of noise on people's health and well-being.

It has to be noted that the existing decree is not specific to noise from entertainment halls. Therefore, wedding halls owners and managers are using this as loophole.

We have seen in this chapter that when given the opportunity (radio program) people complain and express their annoyance to noise from wedding halls. For this reason, there is an urgent need for a new and more appropriate noise control standard which will tackle noise from entertainment halls with its modern amplification and music styles. Thankfully the Algerian government is going towards this direction seriously by introducing a tougher laws and conditions in licensing and in controlling these types of halls and is now aware that type of environmental noise is causing annoyance and disturbance to the local communities.

CHAPTER SIX
Subjective and Objective Survey Description

6.1 Introduction

The proposed method of study is divided into two distinct sections. Firstly, a subjective assessment by means of questionnaire used to collect data from the subjects who are annoyed by the noise from entertainment halls. The second phase will involve the use of noise monitoring instrumentation to undertake a range of noise monitoring exercises in attempt to describe the noise source and noise levels in an objective manner. Objective standards to be used are the application of WHO Guidelines Values (LAeq, LCeq, LA90, LC90) as well as a comparison of frequency spectrum of background and specific noise levels [139].

6.2 Subjective noise survey

The subjective response to noise nuisance was measured by means of a social survey. The survey was carried out at different sites mostly representing residential areas to investigate individual attitudes and opinions in respect of different aspects of noise problem in the city. The questionnaire contained questions about demographic data, social status, noise annoyance and perception and was distributed by hand. The respondents completed the questionnaire themselves.

An initial survey has been held in by mean of questionnaires. Two types of subjects have been selected for the survey as follow:

- Subjects representing people bothered by the noise from entertainment premises
- Subjects representing landlords or owners of the entertainment halls

A total number of twenty five subjects has been interviewed and asked to fill in a questionnaire.

6.2.1 Questionnaire

During the survey we have been confronted to many difficulties when asking the subjects, because it was difficult for them to answer this kind of questions. Therefore the subjects were not keen to cooperate to avoid reprisals. In one hand, the subjects annoyed by the noise who live in the immediate neighbourhood of the entertainment halls have been asked about whether the noise is affecting their wellbeing. Also the subjects have been asked about degree of annoyance emanated from these halls, as well as whether any form of complaints have been made. In the other hand, the landlords have been asked whether they have received any form of complaints from the neighbourhood and from the local authorities. The landlords have also been asked about when the noise occurs and the actions taken to overcome the problem.

6.2.2 *Results of the social survey*

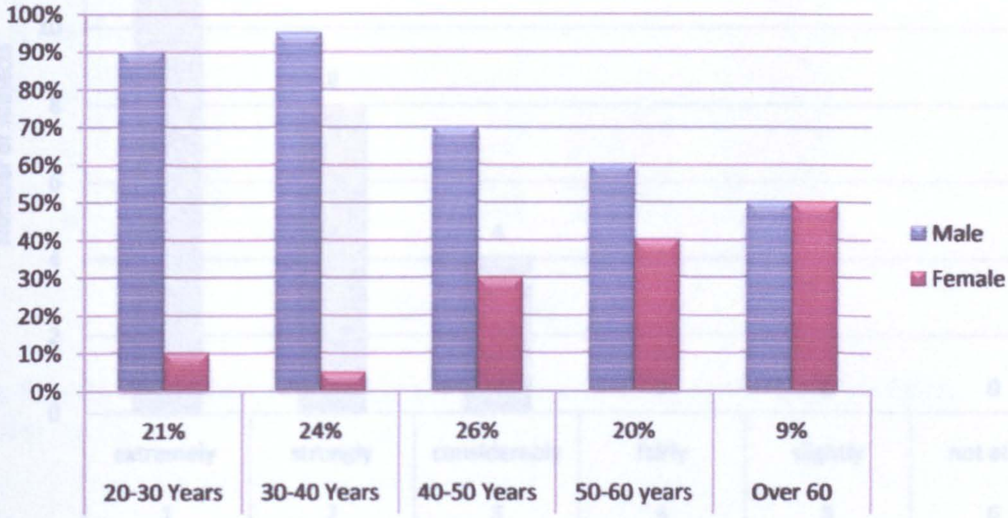


Fig 6.1: Gender and age distribution of the subjects

The majority of the respondents were male (73%). The ages of interviewed people exhibit a wide range: 21% were 20–30 years, 24% were 30–40 years, 26% were 40–50 years, 20% were 50–60 years and 9% were older than 60. 27% of interviewers were single, 64% married, 9% divorced, and 12% were widower.

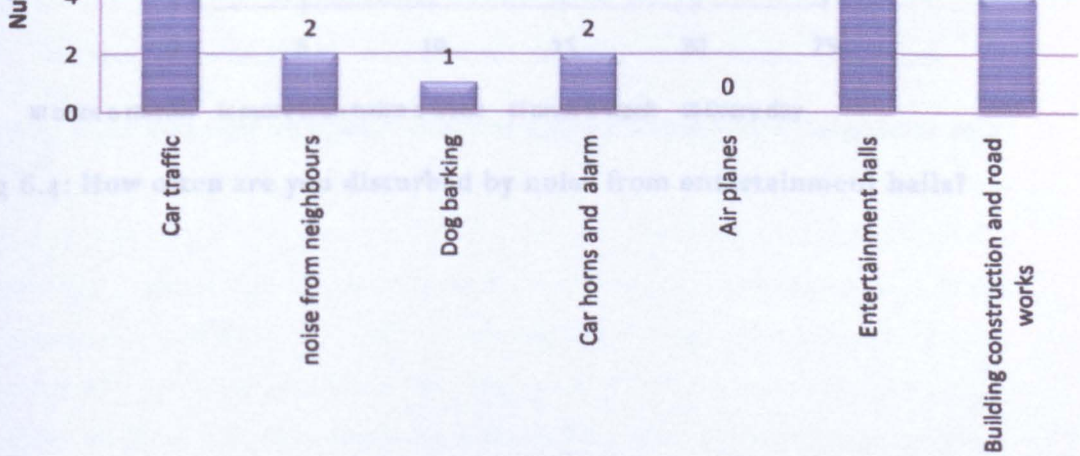


Fig 6.2: What type of noise that bothers you at home?

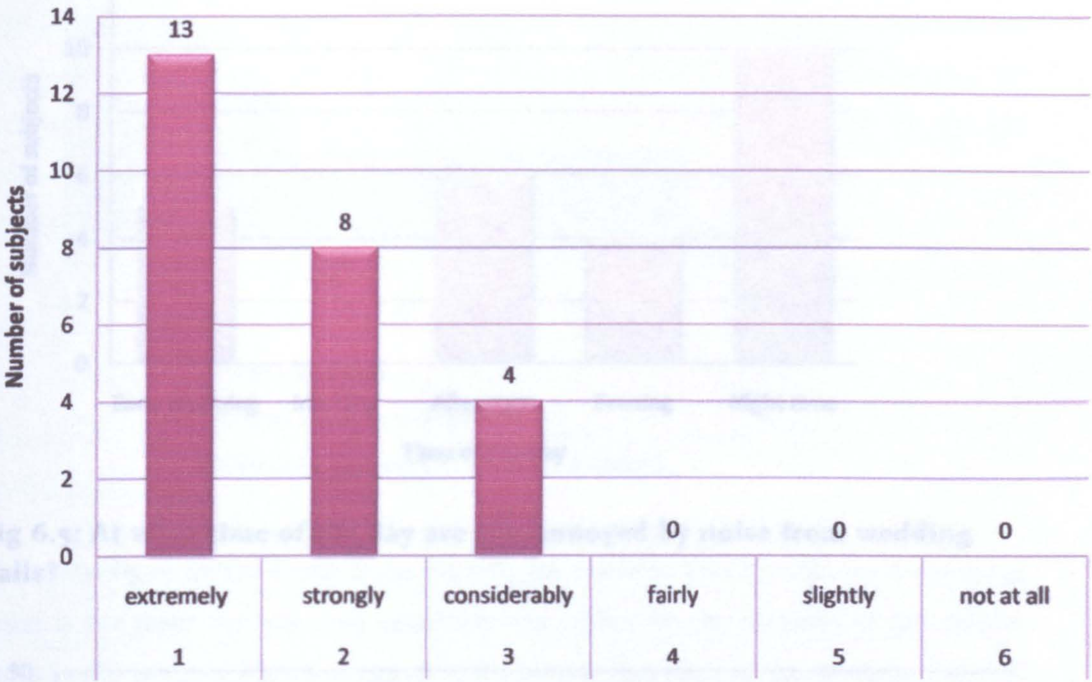


Fig 6.3: How annoying are the noise levels from entertainment halls?

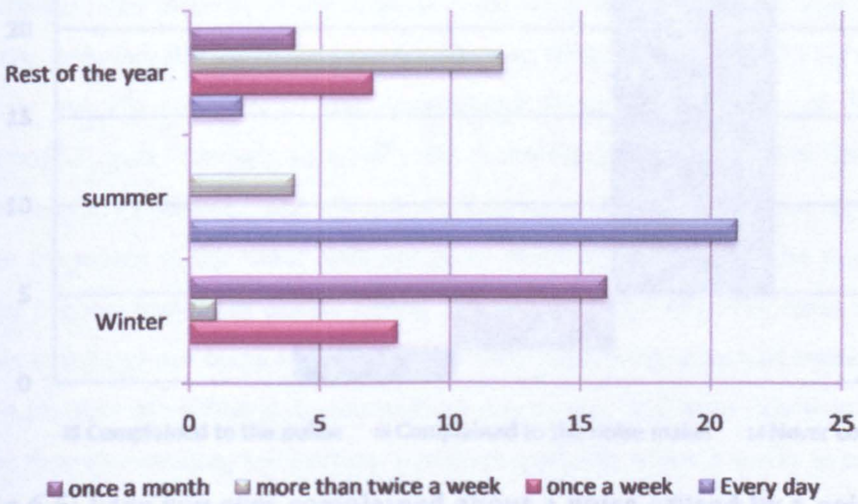


Fig 6.4: How often are you disturbed by noise from entertainment halls?

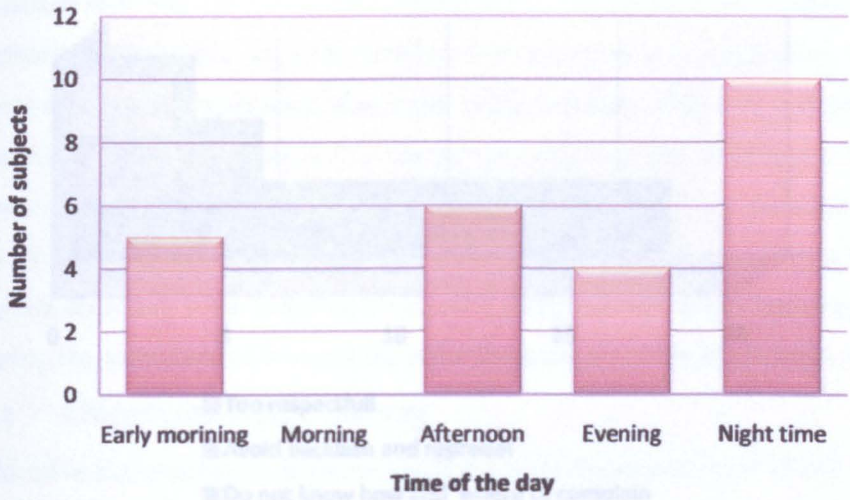


Fig 6.5: At what time of the day are you annoyed by noise from wedding halls?

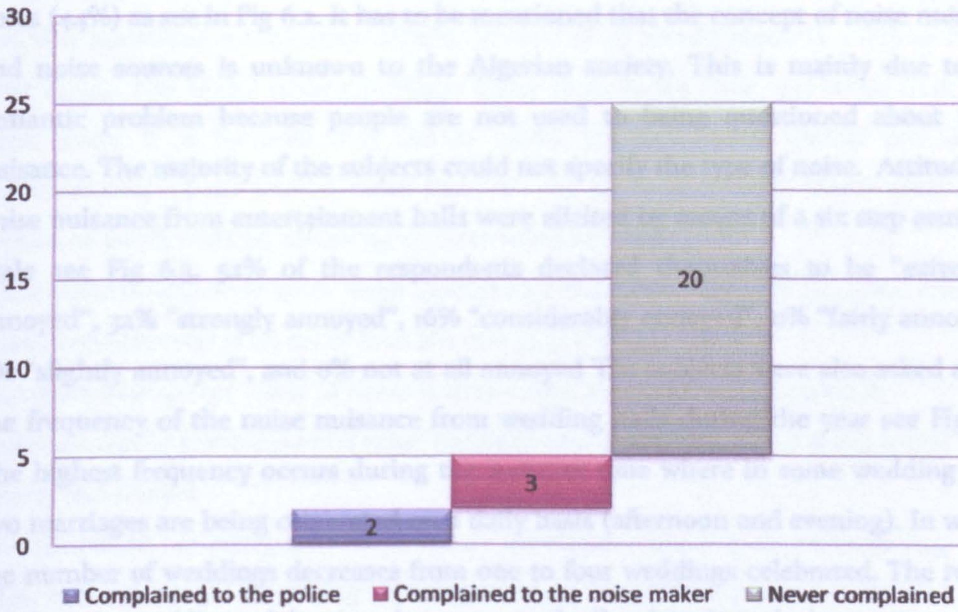


Fig 6.6: have you ever complained about a noise caused by a neighbour or a venue?

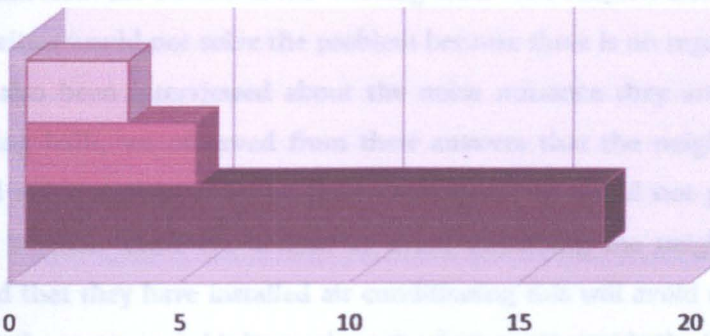


Fig 6.7: what are the reasons for not complaining?

The preliminary results drawn from the subjects answers show that the most annoying noise is the noise coming from entertainment halls with the majority of the subject votes (44%) as see in Fig 6.2. It has to be mentioned that the concept of noise nuisance and noise sources is unknown to the Algerian society. This is mainly due to the semantic problem because people are not used to being questioned about noise nuisance. The majority of the subjects could not specify the type of noise. Attitudes to noise nuisance from entertainment halls were elicited by means of a six step semantic scale see Fig 6.3. 52% of the respondents declared themselves to be "extremely annoyed", 32% "strongly annoyed", 16% "considerably annoyed", 0% "fairly annoyed", 0% "slightly annoyed", and 0% not at all annoyed The subjects were also asked about the frequency of the noise nuisance from wedding halls during the year see Fig 6.4. The highest frequency occurs during the summer time where in some wedding halls two marriages are being celebrated on a daily basis (afternoon and evening). In winter the number of weddings decreases from one to four weddings celebrated. The rest of the time the wedding celebrations increases gradually where it peaks in summer.

From Fig 6.5, we can see that the subjects are mostly annoyed during night time when the weddings are celebrated because they cannot sleep. When asked whether they have ever complained when disturbed by the noise from theses entertainment halls see Fig 6.6. Eighty per cent of the subjects never complained at all whereas some subjects complain to the directly to the landlord and a small percentage complain to the police. The reason for not complaining is mainly because they do not know how and where to complain see Fig 6.7. Another reason is to protect them from repercussion and to avoid

backlash from the owners of the wedding halls. The subjects also believe that the local authorities would not solve the problem because there is no regulation. The landlords have also been interviewed about the noise nuisance they are creating from their wedding halls, we observed from their answers that the neighbours have not and would not complain and that the local authorities would not penalise them. When asked whether there are actions to avoid disturbing the neighbours the landlords replied that they have installed air conditioning this will avoid opening the windows during the summer and it keeps the noise from music inside the premises.

6.3 *Objective noise survey*

Objective measurements of sound levels are an indispensable part of any environmental noise protection program.

6.3.1 Relevant Guidance Documents and Suitable Measurement Units

The World Health Organisation document for Community Noise [140] indicates that for undisturbed sleep the external 'Ambient' level should not exceed 45 dB $L_{Aeq\ (8\ hours)}$., and that maximum noise events should not exceed 60 dB measured as a fast averaging time L_{FAMax}. The WHO noise guidelines (*Sleep disturbance Para. 3.3*) states that, for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB LAmax more than 10 – 15 times per night. (Equivalent to an LAmax of 60 dB outside, assuming an open window) [141].

If the noise is not continuous, sleep disturbance correlates best with L_{Amax} and effects have been observed at 45 dB or less. (60 dB L_{Amax}. external level)

The most widespread effect of noise is annoyance, and annoyance caused in communities by environmental noise has been thoroughly evaluated using social survey techniques.

The threshold for annoyance for a steady continuous noise is an external L_{Aeq} of 50 dBA, with few people becoming seriously annoyed for exposures less than 55 dBA.

The number of people seriously annoyed increases between 55 - 60 dBA, and increases rapidly between 60 – 65 dBA. Exposure levels at or above 65 dBA are generally considered to be unacceptable because most people will be seriously annoyed in the daytime, and there will be severe disturbance to sleep at night.

6.3.2 Type of analysis

The L_{eq} or, better, the L_{Aeq}(the A-weighted equivalent continuous sound level) is the most important parameter. Broadband measurements, i.e., measurements covering the whole of the audible frequency range, are made using the "A" frequency weighting when assessing environmental noise.

Some cases it is good practice to state the applied frequency weighting. Noise with distinct tones, for example, noise from fans, compressors, or pneumatic drill machine is generally far more annoying than other types of noise. This annoyance factor is not taken into account in a broadband measurement. A spectral analysis may be needed to assess annoyance.

6.3.3 *Which rating criterion to monitor noise from entertainment halls?*

Noise in dwellings emanated from entertainment halls is often characterized by high levels within the low-frequency range (i.e., below 250 Hz). This noise is often generated by musical instruments, and also by the muffling of higher frequencies of external noise and noise from other locations transmitted through windows, doors, walls, and floors. In the scientific literature, there have been extensive discussions on how such noise should be evaluated. Guidelines and recommendations are usually expressed in A-weighted sound levels, dB(A). The question is whether the frequency weighting with an A-filter gives correct results when assessing the annoyance response of noise containing strong low-frequency components. The A-weighting gives small weight to the lower frequencies since it is based on how the human sensitivity to different frequencies varies at low sound pressure levels. Experimental laboratory studies have shown that A-weighting under some circumstances leads to underestimations of the annoyance response to noise with dominant low-frequency components as compared to noise with other spectral distribution [142];[143];[144].

It has also been pointed out that other frequency weightings, e.g., B- or D weighting, might give more correct predictions of annoyance [145]. Both these weightings put greater emphasis on the low-frequency components of the noise. The highest levels are often found at low frequencies, followed by a progressive reduction of levels at higher frequencies. One method of identifying low-frequency noise is to measure both the A- and C-weighted sound level. The main difference between these two weighting filters is that the C-weighting puts much greater emphasis on the low-frequency part of the noise. The difference between the C- and A-weighted values will, therefore, in most cases, constitute a measure of how much energy is found in the low-frequency area. This is the main reason why we have used these two types of weighting when monitoring the noise from wedding halls. If the C-level is 15 dB over the A level it is regarded as low frequency and that serious noise annoyance can arise at greater differences than 25 dB. From the subjective survey, we have seen that the majority of the surveyed subjects expressed their annoyance regarding noise from wedding halls and all sort of entertainment halls. Increasingly powerful music systems, the desire for entertainment and the increase in wedding celebration time have all contributed to a situation where many residents have their sleep and wellbeing disturbed by music being played in nearby entertainment premises. As mentioned before music consists of energy at a wide range of frequencies. Modern musical styles contain a relatively large amount of energy at low-frequency, which provides a rhythm to the music; this is sometimes referred to as bass beat. Therefore, the effects of low-frequency noise differ from broadband noise and research has shown that noise containing large amount energy at lower frequency is more annoying than the same sound pressure level without the low frequency element [146]. In the absence of a specific objective criterion, the guideline values contained in the WHO Guidelines for Community Noise are frequently used [147]. These criteria are predominantly based on A-weighted, equivalent continuous measurements. A-weighting is a decibel correction applied to a sound to represent how the human response varies with frequency. It applies a large negative correction at the lower end of the frequency spectrum. However, the use of A-weighting to evaluate amplified music has been subject to fierce criticism from Dibble [148].He suggests that many complaints are due to low and poorly-characterised sound insulation at low frequencies. He clearly suggested avoiding using the A-weighted to measure noise from amplified music as well as calling for more research on the prevalence of panel modes and airborne transmission generally at low frequencies. Dibble also proposed a measurement method using a 1/3 octave analyser, with criterion that Leq should not exceed L90 in each band [149]. In another paper, A-weighted noise levels have been shown to under-represent the annoyance caused by low-frequency noise [150]. Therefore, A-weighted measures should not be used for the assessment of low-frequency bass beat; indeed even the WHO document [151] itself advises that A-weighted measures are inappropriate when prominent low-frequency components are present. However, despite this advice, a 2002 survey of Chief Environmental Health Officers in UK local authorities indicated that A- weighted levels were still being frequently used by Environmental Health Practitioners when investigating complaints of low frequency noise disturbance [152].

It is clearly becoming apparent that when studying the subjective and objective assessment of noise, specific research relating to music entertainment is fairly limited. Choosing the right methodology for noise assessment is always debatable by the acoustic professionals and experts

6.3.4 Microphone positioning

Proper positioning of the microphone is necessary to obtain accurate measurements. Most of the noise legislation often specifies where measurements should be made, for example at property boundaries or at a complainant's property. Other factors also need to be taken into account when measuring because sound levels vary at different heights above ground level. They will also vary depending on the distance between the measurement point and facades and obstacles. These requirements must be noted and applied. This will often mean making measurements:

- away from facades
- away from obstacles
- downwind
- in dry conditions with a wind speed of less than 5 m/s
- with the microphone 1.2 - 1.5 m above ground level

However, measurements can be made at the façade or at other specified heights (the European Union is considering making 4 m the standard).

6.3.5 Calibration

It is common practice to calibrate sound level meters using an acoustical calibrator before and after each series of measurements. The role of calibration is checking the instrument's sensitivity at one specific frequency and sound level (usually 1 kHz and 94 dB). Some think that this is unnecessary because state-of-the-art instrumentation and microphones are not affected very much by temperature, static air pressure, or humidity. While this is true for high-quality instruments, calibration data should always be reported for anything but survey measurements for three reasons:

1. Calibration assures that a day's work is not lost. Any transducer or instrument failures are detected on the spot
2. Calibration data is required by legislation and standards
3. Extreme environmental conditions can affect results

Most sound measurement equipment suppliers issue a Certificate of Conformance (COC or MCOC) with each instrument. This states that the instrument complies with published specifications and applicable standards. Such a certificate must not be taken to be a certificate of calibration. Certified calibration of a sound level meter (or a sound level calibrator) is a full examination of the instrument's conformance to relevant standards. The calibration certificate contains all test results, information about calibration uncertainty, location and conditions of calibration, and a traceability statement. It is important that all measurements have the proper traceability according to national or international standards, and that the calibration laboratory is accredited.

6.3.6 Noise assessment in entertainment halls in Algeria

In the present investigation, noise measurements were carried out at building facades in the residential areas of Algiers. Time of measurement varied from site to site. A-weighted and C-weighted sound pressure levels were logged every second for not less than 3 hours in each site measurement. Points of measurements were at least at 1m from reflecting surfaces. The logged data were then downloaded to a personal computer for later analysis. Twenty wedding halls (venues) were noise monitored with a total of 40 valid measurements were carried out, where 20 monitoring have been conducted when the wedding was celebrated, thus the music was on. The other 20 monitoring were conducted when the wedding hall was not in service and no music was played on. The measurement period in practice is also divided into daytime (13:00–19:00), Night-time period (19:00–23:00).

6.3.6.1 Noise measurement equipment

All-time records of noise level fluctuations used in the present investigation were measured on sites using multi-channels Front-Ends (Symphonie) which consists of one or two transducers (microphones, accelerometers or intensity probe) connected to a small acquisition unit (single or dual channel), which transfers data in real-time to a notebook computer.

- ***SYMPHONIE (PCCard 2 channels front end)***

Symphonie consists of one or two transducers (microphones, accelerometers or intensity probe) connected to a small acquisition unit (single or dual channel), which transfers data in real-time to a notebook computer.

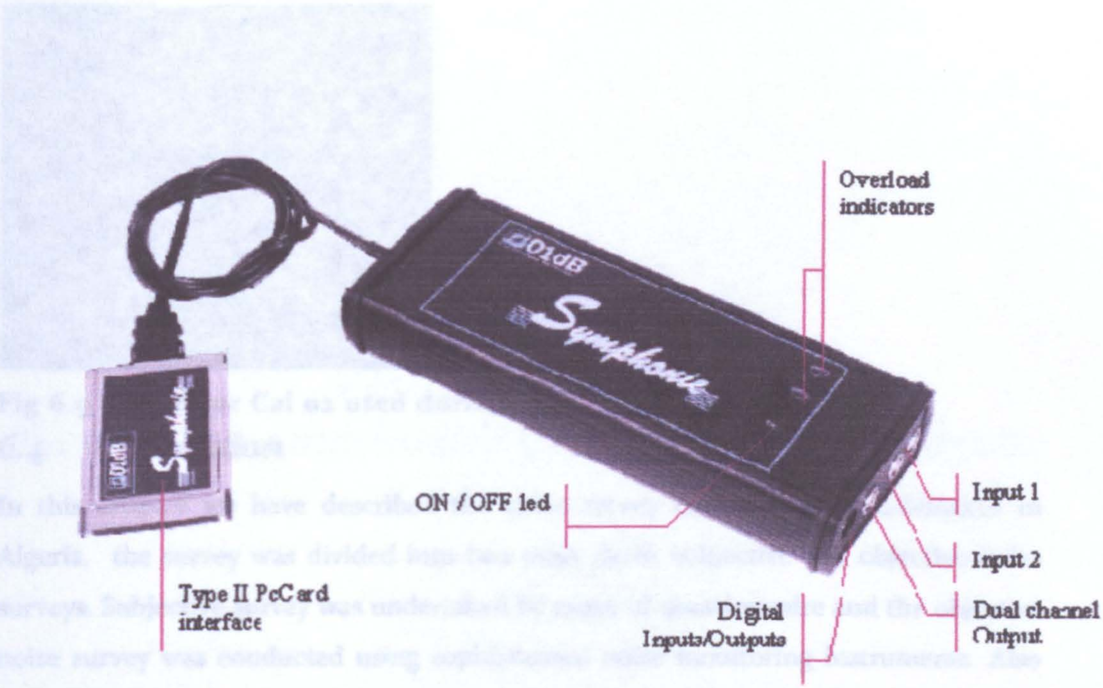


Fig 6.8 Symphonie card and acquisition unit

SYMPHONIE is a versatile unit with features that meet all the current standards. Data acquisition and calculation of Leq and Peak values conform to IEC 804 and IEC 651 type I specifications, while real time analysis available on both input channels in octave or third octave spectra, from 20 Hz to 20 kHz conform to IEC1260 Type 0 specifications for digital filtering. Frequency weighting filters A, B, C and G are available and simultaneous recording of the input signal to the hard disk is a particular feature of SYMPHONIE that enables post processing and further analysis. Vibrational frequency weightings according to ISO2631 may also be applied. Equipment was calibrated before and after each measurement, using Calibrator CAL02.

Cal02 is compact and battery powered acoustic calibrators. Used for accurate calibration of microphones and acoustic measuring systems. Fulfils IEC 60942 for class 1 (CAL21) and 2 (CAL02) acoustic calibrators. Acoustic pressure level : 94 dB (0.3 dB accuracy - class 2 and 0.1dB for class 1) / 1000 Hz (2% accuracy). Stability better than 0.1 dB.

Fig 6.9 Calibrator Cal 02 used during noise monitoring

6.4 Conclusion

In this chapter we have described the noise survey that has been undertaken in Algeria. the survey was divided into two main parts, subjective and objective noise surveys. Subjective survey was undertaken by mean of questionnaire and the objective noise survey was conducted using sophisticated noise monitoring instruments. Also described in this chapter, the detail of the objective noise monitoring, which includesthe microphone location and their calibration. Critical review, of the choice of rating criteria to monitor noise from entertainment halls have been discussed. Several candidate assessment methods were identified. These include methods specifically proposed for pub and club noise, those for general low frequency noise, those relying on absolute criteria and those based on relative assessments. In the next chapter, the results of the objective noise survey in entertainment halls is described and analysed in details in a tabular and graphical form.

CHAPTER SEVEN
Noise Survey methodology, Results and Analysis

7.1 *Introduction*

A total of twenty venues have been monitored. The venues location was representative of the city of Algiers and was divided into three different zones. These zones are city centre, urban and sub-urban as seen in figure 7.2. Eleven venues were monitored in the urban zone, four in the city centre and five in the sub-urban zone. The majority of the venues (sixteen) were located in residential area and the rest in a mixed area (commercial and residential) as described in table 7.1 (a). Most of venues exercised an exclusive activity of wedding hall with only a few venues which have multi- purpose halls such as conference rooms. Almost half of the venues were structurally connected to the noise receiver as described in table 7.1 (b). Most of the monitoring has been undertaken in the receiver side opposite the venue with seven noise monitoring. Other monitoring was held above the venues as well as in premises adjacent to the venue. noise monitoring was also undertaken inside some of the venues where microphone were located inside and outside the venues using the same weighting (A) in order to see if the building material such as walls and ceiling were acoustically insulated or not. The microphones location varied from venue to another. for instance, ten (10) venues out of the twenty (20) venues (1,2,3,4,5,7,8,10,19 and 20) involved noise monitoring of ' music ON' and 'music OFF' in residential areas where the receiving façade is either adjacent (vertically or horizontally) or opposite the venue. From the above ten (10) noise monitoring seven (7) were held in the daytime and three were recorded at night. Having carried out the objective noise monitoring, the collected data was logged on a computer and stored. The following details have been recorded for all measurements: noise indices such as (LAeq, LCeq, LA90, LC90, LAmax, LCmax, etc..), time period, weighting, range, response, events and noise incidents, calibration and location of the microphone, description of the noise source and locality. Using the analyser from the SYMPHONIE software results of the noise measurements were analysed and compared in a tabular and graphical form. The aim of these tests was to analyse the difference in noise levels (both in dBA and dBC) outside the residences when wedding was on and when music off. It has to be noted that noise monitoring when music ON and music OFF were held in different days except one venue this was due to in some of the venues weddings were celebrated every day hence not been able to monitor when music was OFF. Also in some occasions the non-availability of the same noise receiving house was another reason why the recording times were different. However, I made sure that the noise climate conditions were the same for all monitoring. There a number of venues (6, 11,12,13,14,15, and 16) which involved simultaneous monitoring inside and outside the receiving location (residential premises opposite or adjacent to the wedding hall). In five (5) out of the seven (7) venues noise recording were held during the day and the rest at night. Noise recordings have been held inside the wedding halls (9,17 and 18) when music was ON in order to establish noise source levels within the venues. The duration of the monitoring varied from venue to another ranging from 1 hour to 7 hours with noise levels being measured at different intervals (from 2mn to 20mn). The goal of these tests was to look at the noise transmission of the noise from the wedding halls into the receiving buildings. Each venue has been monitored when music was on and when no music was being played. It has to be noted that it was very difficult to conduct this noise monitoring because the majority of people (neighbours of the venues) were not eager to help and were a bit reluctant and hesitant before letting us monitor the noise coming from the venues. Most of the venues managers did not show co-operation and most of the pictures taken of the venues were snapshots taken from a car. During the collection of noise levels, the venues operators were unaware that data was being collected. This was conducted in attempt to ensure that venue management did not interfere deliberately with noise levels and turned down the speaker's volume to reduce the likely impact upon the community.

The noise monitoring was undertaken in three different locations in Algiers representing city centre, urban and sub-urban areas as seen in the below map.

Fig 7.1: Map of Algeria (Algiers in red)

Fig 7.2: map of Algiers showing the three principal locations where monitoring was held

The results of noise monitoring in each venue have been analysed separately as case studies using the following structure:

- Site location description with illustration and photos of the venue
- Subjective Impressions of the Area.
- Noise Survey Description.
- Environmental noise survey, results and observations (in graphical
- form)

	Zone Type			Area Type		Activity Type	
Venue	Urban	City Centre	Sub-Urban	Residential	Mixed (residential &Commercial)	Wedding Hall Only	Multi-Purpose Hall
1	■				■	■	
2	■			■		■	
3		■		■		■	
4			■		■	■	
5	■				■	■	
6	■			■		■	
7		■		■		■	
8	■			■			■
9		■		■			■
10	■			■		■	
11			■	■			■
12		■			■	■	
13	■			■		■	
14			■	■		■	
15			■	■			■
16	■			■		■	
17	■			■		■	
18			■	■			■
19	■			■			■
20	■			■		■	

Table 7.1 (a) Recapitulative table showing type of zone, area and activity of the venues

Venue	Noise source and receiver structurally connected: yes	Noise source and receiver structurally connected: no
1		■
2	■	
3		■
4	■	
5	■	
6		■
7	■	
8		■
9	■	
10		■
11		■
12		■
13	■	
14	■	
15		■
16	■	
17	■	
18	■	
19		■
20		■

Table 7.1 (b): Table showing whether the venue and the noise receiver are structurally connected or not

Structure of data analysis

The analysis of the data will cover four main areas:

- ON vs. OFF levels differences, in order to establish that the weddings do cause significant increase in noise levels.
- dBA vs. dBC comparisons, in order to establish whether there is a significant component of low frequency content in the noise from the weddings.
- Test for possible annoyance/disturbance, by looking at the difference between LAeq ON - LA90 OFF.
- Inside vs. Outside Tests , in venues 6 and 11-16

Venue	Time of monitoring	Time of day	Interval	Duration of monitoring	Microphones location	Weighting	L max	Leq	L90	Activity	Zone Type
1	14:33-16:25	Day	4mn	1h52	1 m outside opposite neighbour window	A	86.9	67.8	58.1	music off	Urban
						C	89.9	69.6	62.4	music off	
1	14:35-17:55	Day	5mn	3h20	1m outside opposite neighbour window	A	99.6	72	57.2	music on	Urban
						C	103.3	77.1	61.2	music on	
2	21:17-22:19	Night	2mn	1h02	1m outside a flat above the venue window	A	88.3	67	57	music off	Urban
						C	92.9	73.9	61.4	music off	
2	19:05-23:05	Night	10mn	4h	1m outside a flat above the venue window	A	101.7	77	66.5	music on	Urban
						C	104.9	82	71.6	music on	
3	12:51-17:51	Day	10mn	5h	1m outside neighbour window adjacent to the venue	A	80.2	42	37.7	music off	City Centre
						C	92.1	51	37.3	music off	
3	14:35-19:50	Day	15mn	5h15	1m outside neighbour window adjacent to the venue	A	100.3	72	56.4	music on	City Centre
						C	112.3	75	64.8	music on	
4	15:13-17:49	Day	6mn	2h36	1m in balcony ,2 floors above the venue	A	90.3	64.2	57.2	music off	Sub-Urban
						C	89.9	76	66	music off	
4	14:48-18:48	Day	10mn	4h	1m in balcony ,2 floors above the venue	A	97.5	72	64.1	music on	Sub-Urban
						C	98	83	73.8	music on	
5	15:44-16:48	Day	4mn	1h04	1m from window above the venue	A	92.1	72.2	63.9	music off	Urban
						C	96.7	79.1	70.8	music off	
5	15:19-19:43	Day	12mn	4h24	1m from window above the venue	A	106.9	86	72.6	music on	Urban
						C	107.8	91	77	music on	
6	14:48-16:48	Day	4mn	2h	1m from window opposite the venue (outside)	A	93.1	67.5	53.1	music off	Urban
					opposite the venue around 7 metres (inside)	A	84.1	54.1	39.1	music off	
6	14:36-18:12	Day	8mn	3h48	1m from window opposite the venue (outside)	A	98.9	78	67.9	music on	Urban
					opposite the venue around 7 metres (inside)	A	86.3	57	54.8	music on	
7	13:57-21:17	Day	20mn	7h20	1m from window above the venue	A	96.1	67.4	63.7	music off	City Centre
						C	98	75.5	63.2	music off	
7	14:18-15:08	Day	2mn	50mn	1m from window above the venue	A	101.6	78	67.9	music on	City Centre
						C	104.3	86	81.4	music on	
8	19:47-23:27	Night	10mn	4h40	1m from window opposite the venue	A	77.4	53	48.6	music off	Urban
						C	100.6	70	57.4	music off	
8	18:39-22:39	Night	10mn	4h	1m from window opposite the venue	A	106.1	76	56.2	music on	Urban
						C	114.2	81	62.8	music on	
9	13:42-17:18	Day	9mn	3h36	1m inside the venue but in the above floor (bride changing room)	A	88.9	70.1	62.2	music off	City Centre
						C	93.1	72.4	65.9	music off	
9	15:25-18:25	Day	10mn	3h	1m inside the venue but in the above floor (bride changing room)	A	101.8	87	63.8	music on	City Centre
						C	113.6	104	77.8	music on	
10	14:26-16:56	Day	6mn	2h30	1m outside opposite the venue	A	85.1	65.9	54.4	music off	Urban
						C	93	73.1	66.2	music off	
10	15:51-19:41	Day	10mn	3h50	1m outside opposite the venue	A	97.3	68.5	58.6	music on	Urban

						C	104.4	81	70.1	music on	
11	15:05-17:02	Day	6mn	2h	inside a bungalow opposite venue	A	66.8	46.7	35.7	music off	Sub-Urban
					outside	A	80	61.3	56	music off	
11	15:03-16:03	Day	2mn	1h	inside a bungalow opposite venue	A	89.4	55.1	41.9	music on	Sub-Urban
					outside	A	94.9	72	61.3	music on	
12	15:07-17:43	Day	6mn	2h36	inside adjacent house to the venue	A	58.3	45	38.5	music off	City Centre
					outside	A	73.6	66.3	59.3	music off	
12	14:30-17:30	Day	6mn	3h	inside	A	85.5	54.5	40.2	music on	City Centre
					outside	A	100.1	72.8	61.8	music on	
13	21:04-23:34	Night	6mn	2h30	inside	A	54	42	37.3	music off	Urban
					outside balcony overlooking the venue	A	72.7	60.1	53.4	music off	
13	20:00-01:48	Night	12mn	5h48	inside	A	87.1	55.9	41.9	music on	Urban
					outside balcony overlooking the venue	A	105.3	73.4	59.3	music on	
14	14:23-17:23	Day	10mn	3h	inside 1m from window attached to the venue	A	71.6	53.6	43.5	music off	Sub-Urban
					outside	A	84.8	66.8	56.3	music off	
14	14:15-17:15	Day	6mn	3h	inside 1m from window	A	77.7	57.1	46.7	music on	Sub-Urban
					outside	A	92.6	70.7	60.3	music on	
15	20:28-23:10	Night	6mn	2h50	inside 1m from window opposite to the venue	A	53.2	44.9	40.7	music off	Sub-Urban
					outside	A	69	59.1	53.9	music off	
15	20:16-23:44	Night	8mn	3h20	Inside 1m from window opposite to the venue	A	95.1	59.7	46.2	music on	Sub-Urban
					outside	A	106.2	72.9	59.8	music on	
16	14:45-17:57	Day	6mn	3h12	inside 1m from window above the venue	A	49.5	44.4	41.2	music off	Urban
					outside	A	67.7	58.6	53.8	music off	
16	13:59-19:59	Day	12mn	6h	inside	A	90.2	59.3	46.1	music on	Urban
					outside	A	104.5	72.7	60	music on	
17	15:09-17:27	Day	6mn	2h18	mics inside venue in courtyard doors and window closed	A	98.7	87.7	51.6	music off	Urban
						C	97.8	89.3	58.5	music off	
17	14:41-18:17	Day	8mn	3h40	mics inside venue in courtyard doors and window open	A	101.8	90.6	86.6	music on	Urban
						C	105.1	96.9	93.4	music on	
18	14:14-15:56	Day	6mn	1h50	mics inside venue @30 m from speakers (break time noise from guests)	A	95.5	90.3	86.9	music off	Sub-Urban
						C	104.5	99.3	96.4	music off	
18	15:29-18:41	Day	6mn	3h12	mics inside venue @30 m from speakers	A	102.1	90.7	85.8	music on	Sub-Urban
						C	108.2	99.5	94.8	music on	
19	16:02-17:44	Day	6mn	1h42	1m from window adjacent the venue	A	85.8	59.8	49.7	music off	Urban
						C	88.8	63	57.3	music off	
19	15:15-18:52	Day	7mn	3:52	1m from window opposite the venue	A	96.6	81.6	54.6	music on	Urban
						C	105.3	91.6	60.4	music on	
20	21:11-23:32	Night	3mn	1h22	1m from window opposite the venue	A	71.3	39.6	37.8	music off	Urban
						C	80.7	55.3	45.7	music off	
20	21:12-01:42	Night	9mn	4h30	1m from window opposite the venue	A	107.9	72.3	59.7	music on	Urban
						C	110.5	80.7	70.8	music on	

Table 7.2 Recapitulative table of noise levels recorded from the noise monitoring.(Leq and L90 values are arithmetic averages over each measurement period)

7.2: *Leq –L90*

Venue	Weighting	Leq	L90		Leq - L90
1	A	67.8	58.1	music off	9.7
	C	69.6	62.4	music off	7.2
1	A	72	57.2	music on	14.8
	C	77.1	61.2	music on	15.9
2	A	67	57	music off	10
	C	73.9	61.4	music off	12.5
2	A	77	66.5	music on	10.5
	C	82	71.6	music on	10.4
3	A	42	37.7	music off	4.3
	C	51	37.3	music off	13.7
3	A	72	56.4	music on	15.6
	C	75	64.8	music on	10.2
4	A	64.2	57.2	music off	7
	C	76	66	music off	10
4	A	72	64.1	music on	7.9
	C	83	73.8	music on	9.2
5	A	72.2	63.9	music off	8.3
	C	79.1	70.8	music off	8.3
5	A	86	72.6	music on	13.4
	C	91	77	music on	14
6	A	67.5	53.1	music off	14.4
	A	54.1	39.1	music off	15
6	A	78	67.9	music on	10.1
	A	57	54.8	music on	2.2
7	A	67.4	63.7	music off	3.7
	C	75.5	63.2	music off	12.3
7	A	78	67.9	music on	10.1
	C	86	81.4	music on	4.6
8	A	53	48.6	music off	4.4
	C	70	57.4	music off	12.6
8	A	76	56.2	music on	19.8
	C	81	62.8	music on	18.2
9	A	70.1	62.2	music off	7.9
	C	72.4	65.9	music off	6.5
9	A	87	63.8	music on	23.2
	C	104.4	77.8	music on	26.6
10	A	65.9	54.4	music off	11.5
	C	73.1	66.2	music off	6.9
10	A	68.5	58.6	music on	9.9
	C	81	70.1	music on	10.9
11	A	46.7	35.7	music off	11

	A	61.3	56	music off	5.3
11	A	55.1	41.9	music on	13.2
12	A	72	61.3	music on	10.7
	A	45	38.5	music off	6.5
12	A	66.3	59.3	music off	7
	A	54.5	40.2	music on	14.3
13	A	72.8	61.8	music on	11
	A	42	37.3	music off	4.7
13	A	60.1	53.4	music off	6.7
	A	55.9	41.9	music on	14
14	A	73.4	59.3	music on	14.1
	A	53.6	43.5	music off	10.1
14	A	66.8	56.3	music off	10.5
	A	57.1	46.7	music on	10.4
15	A	70.7	60.3	music on	10.4
	A	44.9	40.7	music off	4.2
15	A	59.1	53.9	music off	5.2
	A	59.7	46.2	music on	13.5
16	A	72.9	59.8	music on	13.1
	A	44.4	41.2	music off	3.2
16	A	58.6	53.8	music off	4.8
	A	59.3	46.1	music on	13.2
	A	72.7	60	music on	12.7
17	A	87.7	51.6	music off	36.1
	C	89.3	58.5	music off	30.8
17	A	90.6	86.6	music on	4
	C	96.9	93.4	music on	3.5
18	A	90.3	86.9	music off	3.4
	C	99.3	96.4	music off	2.9
18	A	90.7	85.8	music on	4.9
	C	99.5	94.8	music on	4.7
19	A	59.8	49.7	music off	10.1
	C	63	57.3	music off	5.7
19	A	81.6	54.6	music on	27
	C	91.6	60.4	music on	31.2
20	A	39.6	37.8	music off	1.8
	C	55.3	45.7	music off	9.6
20	A	72.3	59.7	music on	12.6
	C	80.7	70.8	music on	9.9

Table 7.3 : Leq –L90 (music on and music off) of all venues

	LAeq (wedding on)-LA90 (wedding off) dBA	LAeq (wedding on)-LAeq (wedding off) dBA
Venue 1	13.9	4.2
Venue 2	20	10
Venue 3	34.3	30
Venue 4	14.8	7.8
Venue 5	22.1	13.8
Venue 6	24.9 outside	10.5 outside
	17.9 inside	2.9 inside
Venue 7	14.3	10.6
Venue 8	27.4	23
Venue 9	24.8	16.9
Venue 10	14.1	2.6
Venue 11	16 outside	10.7 outside
	19.4 inside	8.4 inside
Venue 12	13.5 outside	5.7 outside
	16 inside	9.5 inside
Venue 13	21 outside	13.3 outside
	18.6 inside	13.9 inside
Venue 14	14.4 outside	3.9 outside
	13.6 inside	3.5 inside
Venue 15	19 outside	13.8 outside
	19 inside	14.8 inside
Venue 16	18.9 outside	14.1 outside
	18.1 inside	14.9 inside
Venue 17	39	2.9
Venue 18	3.8	0.4
Venue 19	32	12
Venue 20	34	32

Table 7.4: LAeq (wedding on)-LA90 (wedding off) dBA and LAeq (wedding on)-LAeq (wedding off) dBA

The criteria (**LAeq ON – LA90 OFF**) has been proposed as a methodology in "Noise from Pubs and Clubs – Phase 1: NANR 92" by the IoA working group annex and BS 4142/Noise Act 1996 to assess noise from pubs and clubs for further tetsting and comparative assessment in order to determine their effectiveness for assessing noise from entertainment halls. Column 1 shows the difference between LAeq ON and LA90 OFF. It can be seen that the differences vary significantly from one venue to another. The difference ranges from 34 dBA to 13.9dBA in venues 1-5,7,8,19 and 20. This shows that the noise levels are unacceptable. However, in venues 17 and 18 the difference is huge from 39 dBA in venue 17 and 3.8 in venue 18. This due to that the monitoring in venue 18 was undertaken inside the wedding hall and the noise was constant because the there was some speakers testing and a significant number of noise events. Whereas in venue 17 the monitoring was held in a courtyard of the venue and when the music was on the windows overlooking the courtyard were most of the time open hence the huge difference between ON and OFF. In venues 6 and 11-16, the difference is well above 13 dBA but the margin is quite stable between inside (6dBA) and outside (7dBA). Tables 7.4 (second column) also shows the difference between LAeq when the music is on and the LAeq when the music is off in dBA. Tables 7.5 (second column) shows the difference between LCeq when the music is on and the LCeq when the music is of in dCA .In table 7.4 (second column) we can see that the difference from as little as 0.2 dBA to 30 dBA. In venues (1-5, 7,8,9,10,19 and 20) the ON/OFF difference varies between 2 dBA and 30 dBA. We also noticed that most of the ON/OFF differences are about 10 dBA or more this give us a strong evidence that the music from the wedding halls are causing disturbance hence the high noise levels. However, in some venues the difference is low particularly in venues (10 , 17 and 18). This is due to noise incidents in venue 10 such as car horns when the wedding was off. In venue 17 the duration of the monitoring was different and when the music was off the owner of the venue was tetsting the speakers for almost an hour. In venue 18, in this particular case, the OFF monitoring was held an hour before the music start and inside the venue. However, the there was a significant number of noise incidents especially from guests and the bride's family movement as well as the preparation of the hall and the installation of the DJ's equipment and testing. Having analysed the results of the monitoring there does not appear to be any significant difference between venues because the venues are located in different areas and the monitoring was undertaken in different times. Also may be the number of the wedding halls investigated is very large. In table 7.4 the ON/OFF difference in the case of INSIDE/OUTSIDE tests in venues (6, 11-16) is almost the same except in in venues (6, 11 and 12) where the difference is slightly different. Because in venue 6 the house where the microphones were located was not the same when the music was ON and OFF. In venue 12 when the wedding was ON the doors were left open frequently as well as the noise events from car horns and celebration scream this contributed to the non-similarity of the difference between the ON/OFF monitoring.

	LCeq (wedding on)-LC90 (wedding off) dBC	LCeq (wedding on)-LCeq (wedding off) dBC
Venue 1	14.7	7.5
Venue 2	20.6	8.1
Venue 3	37.7	24
Venue 4	17	7
Venue 5	20.2	11.9
Venue 6	No C monitoring	No C monitoring
Venue 7	22.8	10.5
Venue 8	23.6	11
Venue 9	38.5	32
Venue 10	14.8	7.9
Venue 11	No C monitoring	No C monitoring
Venue 12	No C monitoring	No C monitoring
Venue 13	No C monitoring	No C monitoring
Venue 14	No C monitoring	No C monitoring
Venue 15	No C monitoring	No C monitoring
Venue 16	No C monitoring	No C monitoring
Venue 17	38.4	7.6
Venue 18	3.1	0.2
Venue 19	35	29
Venue 20	35	26

Table 7.5: LCeq (wedding on)-LCeq (wedding off) dBC and LCeq (wedding on)-LC90 (wedding off)dBC

Table 7.5 describes the difference between LCeq ON – LC90 OFF and LCeq ON – LCeq OFF.In column 1, the difference between LCeq ON – LC90 is outrageously high especially in venue 9 and 17 where it peaked at more than 38dBC this is mainly due to the music through façade and traffic noise. However, in venue 18 the difference dropped dramatically to as low as 3.1 dBC this was caused by numerous noise incidents such as celebration screams and shouting.

	LCeq (wedding on) - LAeq (wedding on) dB	LCeq (wedding off) - LAeq (wedding off) dB
Venue 1	5.1	1.8
Venue 2	5	6.9
Venue 3	3	9
Venue 4	11	11.8
Venue 5	5	6.9
Venue 7	8	8.1
Venue 8	5	17
Venue 9	17.4	2.3
Venue 10	12.5	7.2
Venue 17	6.3	1.6
Venue 18	8.8	9
Venue 19	10	3
Venue 20	8.4	15.4

Table 7.6: LCeq (wedding on) - LAeq (weding on) dB and LCeq (wedding off) - LAeq (wedding off) dB

The difference between dBC and dBA levels indicates the amount of low frequency sound present (between 20 and 1000 Hz). Outdoor urban environments are characterized by a difference of at least 10 - 15 dB (dBC - dBA); motorized traffic and some buildings show 20 - 30 dB difference, whereas in natural environments, the difference may drop to 0 - 3 dB. There are many sources of low frequency noise which can cause disturbance and/or annoyance both indoors and outdoors. Sound enters buildings through their structure, through open windows, or can be generated inside the building. Low Frequency Noise can be more noticeable indoors, which is why it is often associated with disturbance. In the open air other noises such as traffic may mask the annoying low frequencies. Indoors, middle and high frequency noise from outside is reduced because the insulating effect of the building increases with sound frequency. Table 7.6 shows the difference between dBA and the dBC levels when the music is on and when no music is being played the investigated wedding halls. dBA is the usual indicator for environmental noise, and filters out low frequencies. dBC does not filter out low frequencies. The amount by which the dBC level exceeds the dBA level therefore gives an approximate indication of the low frequency content in the sound. When the wedding is on (music played) the largest difference is up to about 17.4dB in Venue 9. However, when the wedding is off, the largest difference between dBA and dBC levels was recorded in venue 8, this mainly to the presence of noise events particularly dogs barking.

In all venues indicated in table 7.6 except venues 17 and 18, the microphones were located outside the building. We can see that difference between LCeq and LAeq is higher when the wedding is off in some venues (2, 3,4,5,7,8,18 and 20). This can be explained by the fact that low frequency noise travels further than higher frequencies, so the source is often difficult to trace. May be there have been low frequency noise from other sources that cannot be detected. This might explain the higher values when there was no wedding. Also because low frequency travels with less attenuation than higher frequency. Furthermore, there have been some noise events during the monitoring when there was no wedding such as car traffic, even some ventilation plants can emit low frequencies.

7.3 *Description of venues monitoring and data analysis*

7.3.1 Venue 1

Site location

The premises are at ground level. A residential block is immediately opposite the premises and there are a number of residential blocks in the surrounding area. Off the venue the area is mainly commercial and residential.

Fig 7.3 Entrance of the venue

Fig 7.4 Façade of the venue

Fig 7.5 Arial view of the venue (X) and the microphones location (X)

- ***Subjective Impressions of the Area.***

During daytime the area is a popular retail area attracting a number of shoppers. Later in the evening the area is dominated by the activities of the cafes, restaurants and public houses, many with outside tables and chairs. It appears that many of the food outlets operate to and beyond 00:00 hours and several up to 01:00 hours.

There are large numbers of pedestrians in morning and afternoon. In the evening and the number appear to decrease (mostly people who live in the area) and sometime stay beyond 00:00 hours. Traffic noise is high and is added to by a number of car horns from all vehicles. During the wedding ,It is noticeable that groups, predominately males, tend to gather around on the pavements outside this venue most of the wedding celebration time as some families do not like to mix woman and men in a same space. It was noted that a large number of vehicles arrive at the venue to bring families attending the wedding this is most of the time accompanied with car horns and celebration screams.

- ***Noise Survey Description.***

Equipment was installed on the 'House' 1st floor balcony opposite the venue. The outdoor microphones were set up on a boom to a point one metre forward of the parapet some 4 metres above the pavement level. Measurements were undertaken before the wedding when the venue was empty and no music playing, and when families and guests started to arrive and to enter the venue with no music being played and the second measurement when the wedding kicked off with music. The data was logged every 1 second. The equipment was calibrated before and after measurement without any noticeable drift. Noise incidents and events were noted and recorded together with contemporaneous notes.

- ***Environmental noise survey, results and observations.***

Observations were conducted from a car parked across from the premises. The noise monitoring was carried out by a static monitoring station positioned on the 1st floor opposite the premises.

- ***Wedding on***

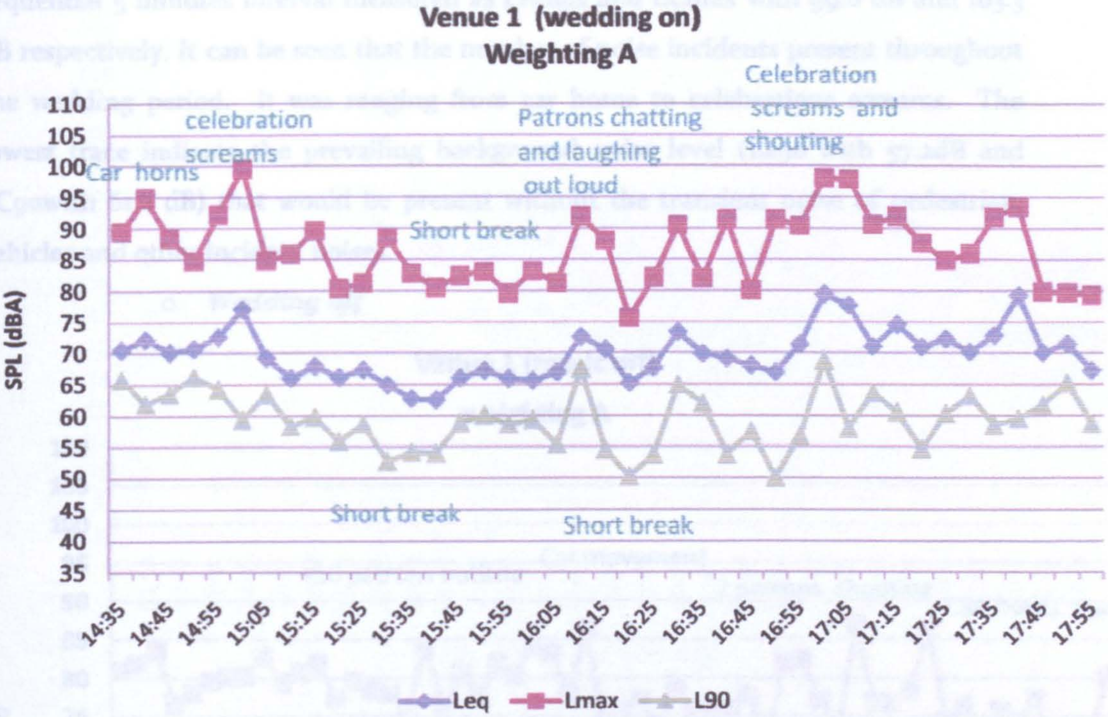


Fig 7.6: Venue 1(wedding on) , weighting A

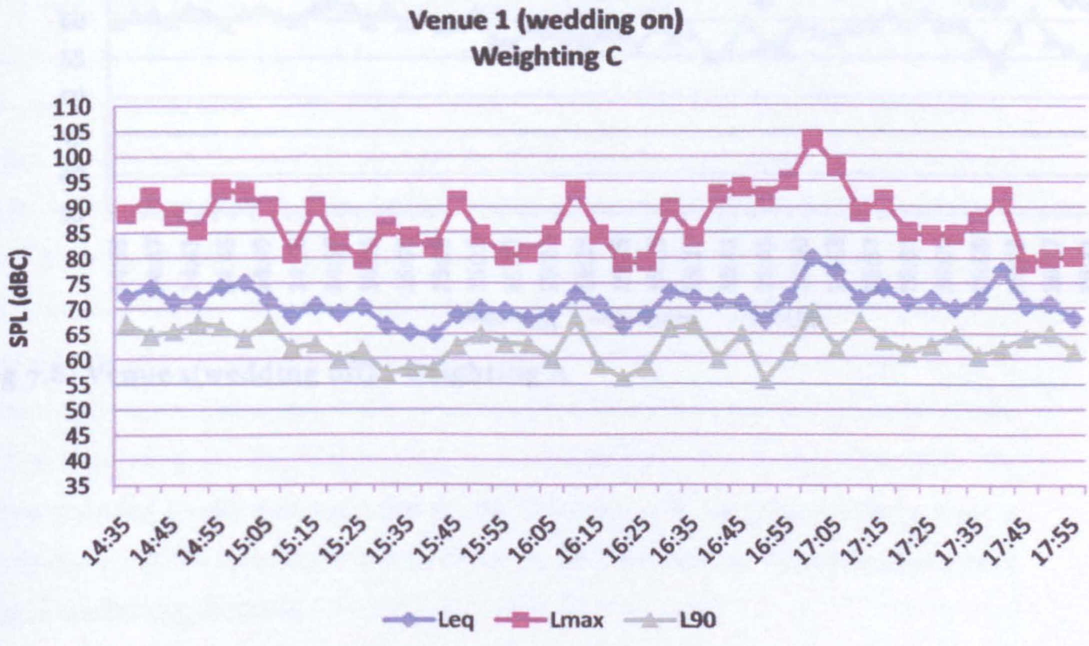


Fig 7.7: Venue 1(wedding on) , weighting C

The above graphs (7.6 and 7.7) represent the different traces of noise monitoring when the wedding started and the music kicked off. The graphs show a high ambient noise level of LAeq 72dB. The top trace is the highest maximum noise recorded in each sequential 5 minutes interval measured as LAmax and LCmax with 99.6 dB and 103.3 dB respectively. It can be seen that the number of noise incidents present throughout the wedding period. It was ranging from car horns to celebrations screams. The lowest trace indicate the prevailing background noise level (La90 with 57.2dB and LC90with 61.2 dB) that would be present without the transient noise of pedestrian, vehicles and other incident noises.

- ***Wedding off***

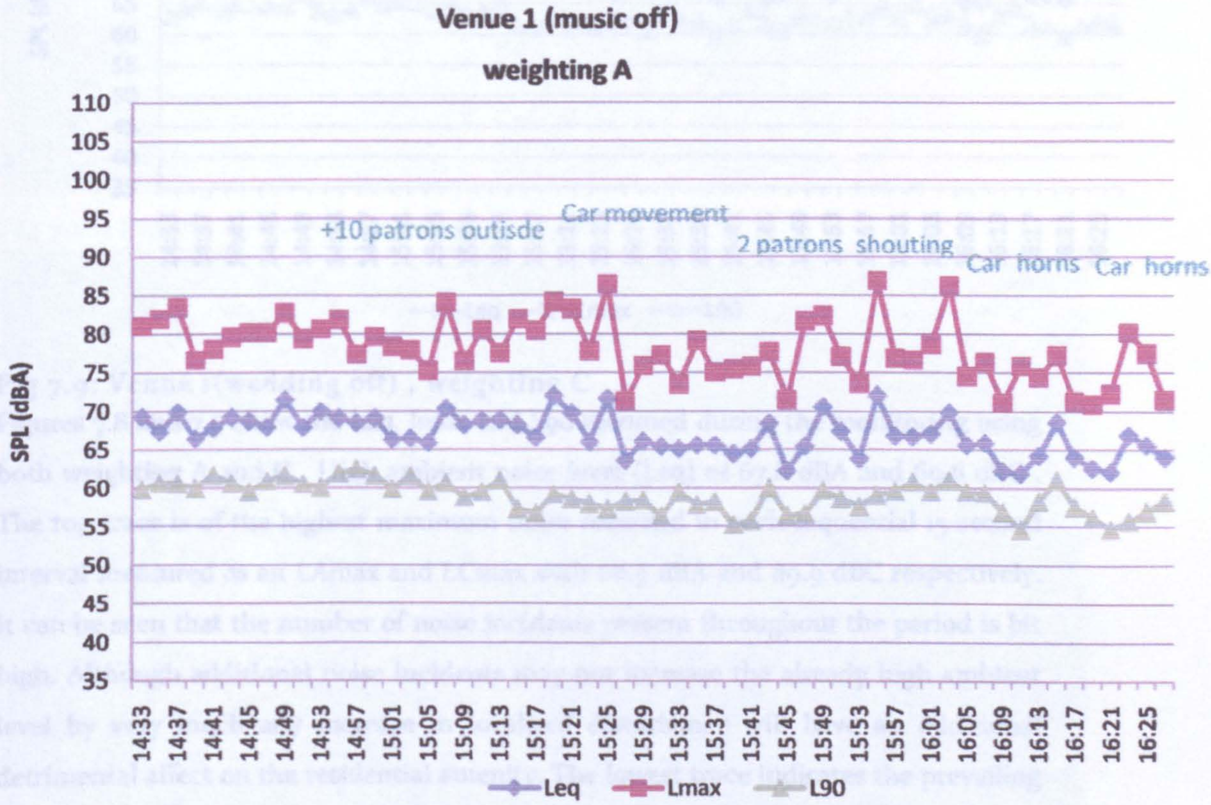


Fig 7.8: Venue 1(wedding off) , weighting A

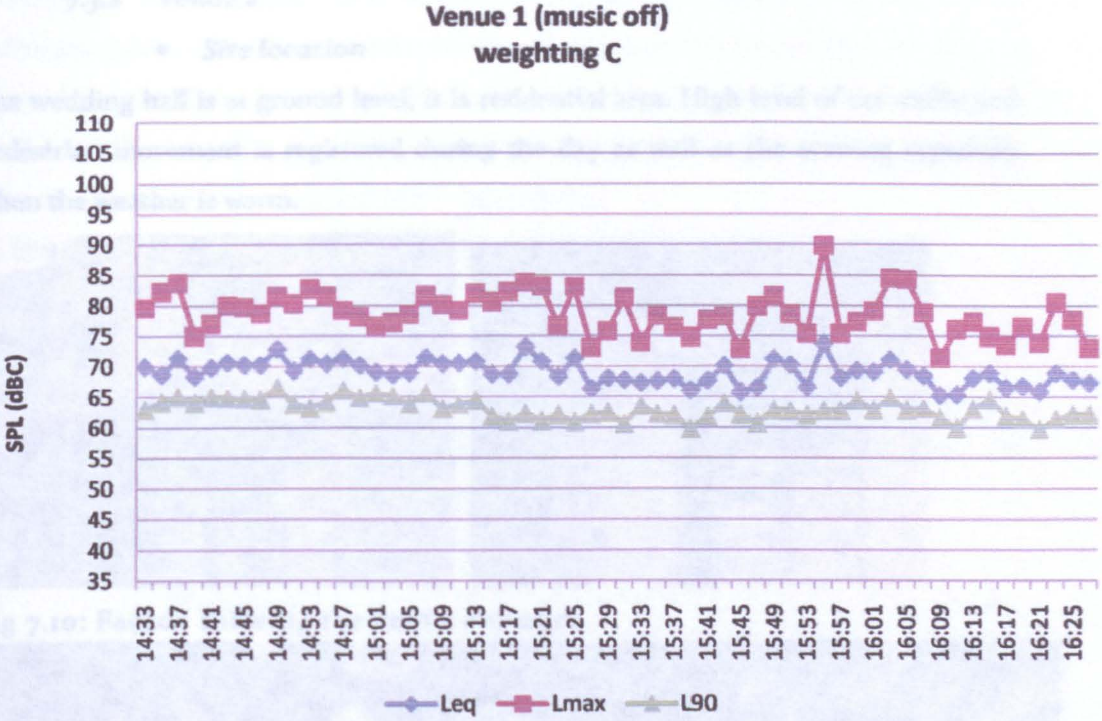


Fig 7.9: Venue 1(wedding off) , weighting C

Figures 7.8 and 7.9 show the Leq, lmax and L90 recorded during the monitoring using both weighting A and C. High ambient noise level (Leq) of 67.8 dBA and 69.6 dBC . The top trace is of the highest maximum noise recorded in each sequential 15 second interval measured as an LAmax and LCmax with 86.9 dBA and 89.9 dBC respectively. It can be seen that the number of noise incidents present throughout the period is bit high. Although additional noise incidents may not increase the already high ambient level by very much any increase in localised disturbance will have an additional detrimental affect on the residential amenity. The lowest trace indicates the prevailing background noise level (LA90) and (LC90) .It was noted that there a number of noise events such as car horns and traffic as well as pedestrians and patrons who seem to be family organising the wedding as they were entering the venue very often.\The car horns sounded loudly and exceeded 85 dB (LAmax). All noise events were from a range of 80 – 87 dB is clearly in excess of the 75 dB LAeq limit as recommended by the World Health Organisation.

7.3.2 *Venue 2*

- ***Site location***

The wedding hall is at ground level, it is residential area. High level of car traffic and pedestrian movement is registered during the day as well as the evening especially when the weather is warm.

Fig 7.10: Façade showing the venue entrance

Fig 7.11: Arial view of the venue (X) and microphones location (X)

- ***Subjective Impressions of the Area.***

There are large numbers of pedestrians in morning and afternoon. In the evening and the number appear to decrease (mostly people who live in the area) and sometime stay beyond 00:00 hours.

Traffic noise is high and is added to by a number of car horns from all vehicles.

During the wedding, guest and families movement was registered in and out the premises quite often. Consequently the venue front door was frequently open and s as a results music from the hall can be easily audible from passer-by and from nearby buildings. The wedding started late in the afternoon and lasted just after 11pm. Noise events were observed during the whole monitoring.

A large number of vehicles parked near the venue adding extra noise,

- ***Noise Survey Description.***

Equipment was installed on 1st floor window above the venue. The outdoor microphones were attached to a pole and placed horizontally towards the street 1 metre from the window and approximately 4 metres from the ground floor. The equipment used is the same as specified and described in earlier section.

- ***Environmental noise survey, results and observations.***
    - **Wedding on**

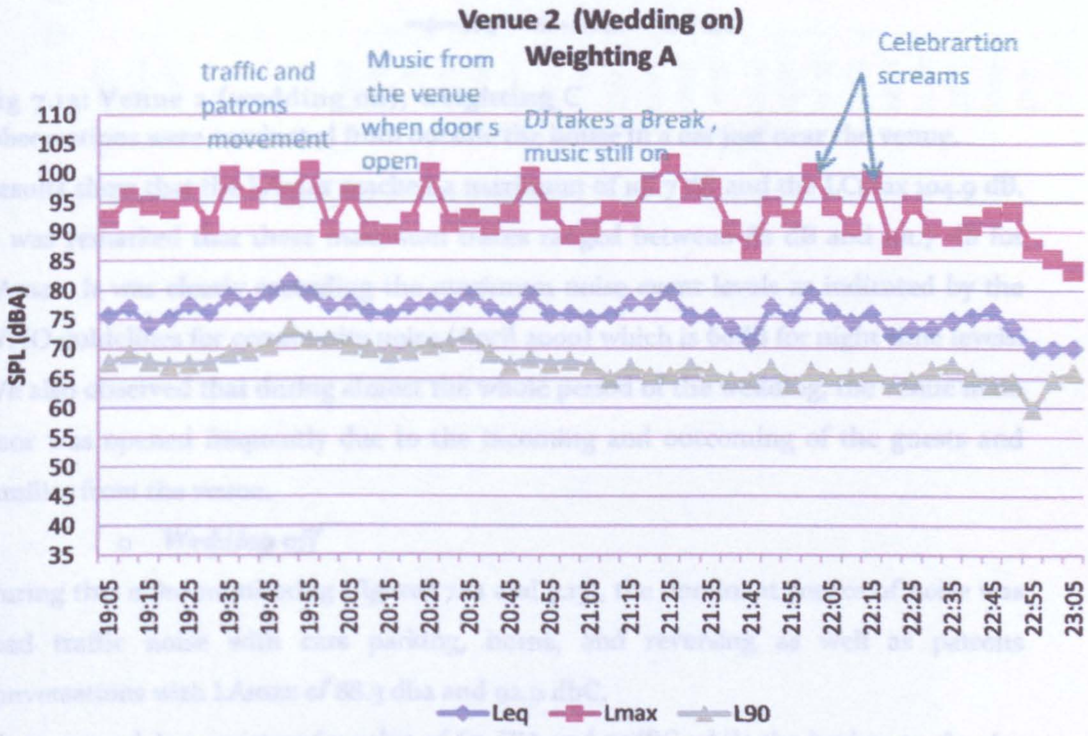


Fig 7.12: Venue 2 (wedding on), weighting A

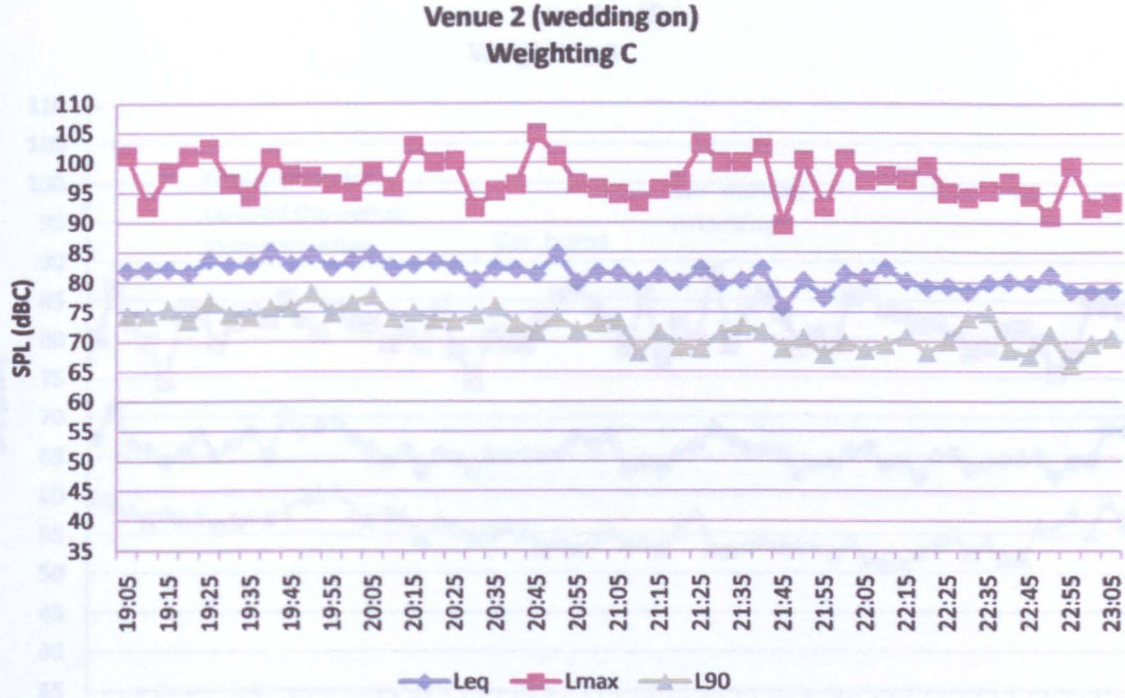


Fig 7.13: Venue 2 (wedding on), weighting C

Observations were conducted from outside the house in a car just near the venue.

Results show that the LAmax reached a maximum of 101.7 dB and the LCmax 104.9 dB. It was remarked that these maximum traces ranged between 82 dB and 101.7 dB for LAmax. It was clearly exceeding the maximum noise event levels as indicated by the WHO guidelines for community noise (April 2000) which is 60dB for night time levels. We also observed that during almost the whole period of the wedding, the venue main door was opened frequently due to the incoming and outcoming of the guests and families from the venue.

- ***Wedding off***

During this noise monitoring (figures 7.12 and 7.13), the dominant source of noise was road traffic noise with cars parking, horns, and reversing as well as patrons conversations with LAmax of 88.3 dba and 92.9 dbC.

The average LAeq registered a value of 67 dBA and 73dBC while the background noise recorded 57dBA and 61 dBC.

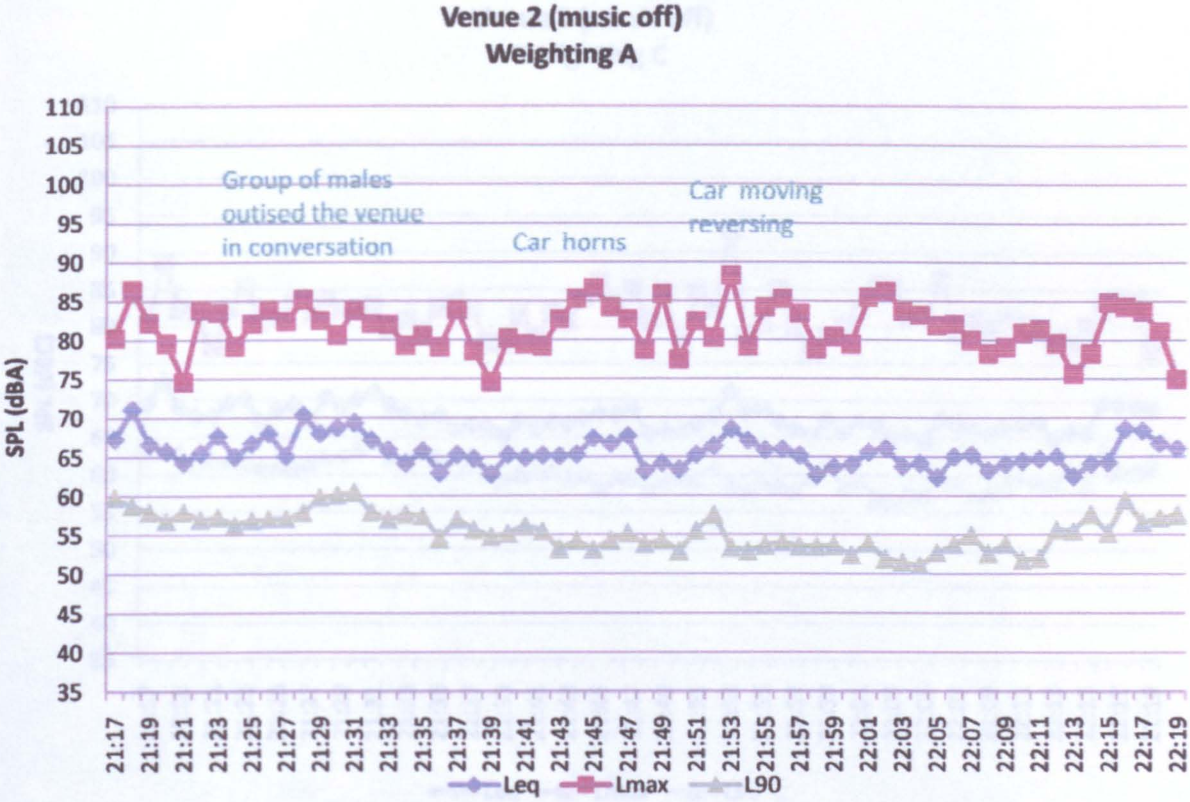


Fig 7.14: Venue 2 (wedding off), weighting A

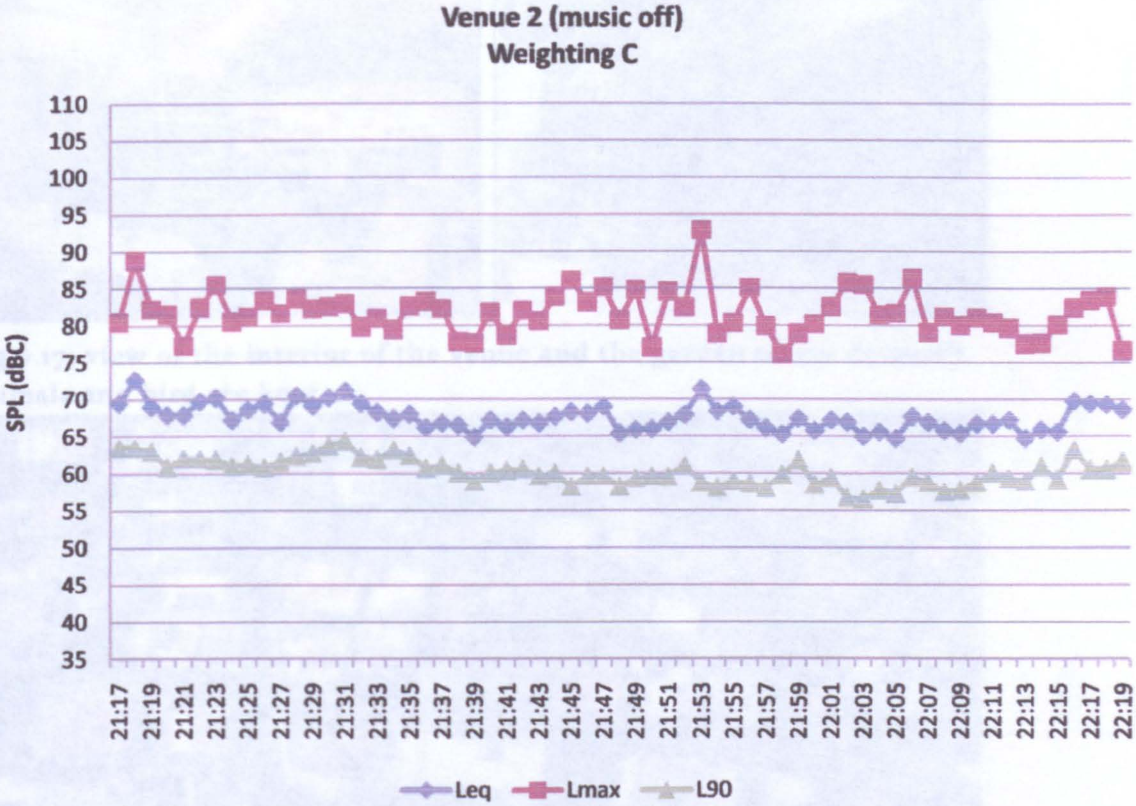


Fig 7.15: Venue 2 (wedding off), weighting C

7.3.3 *Venue 3*

- ***Site location***

The venue is located in a residential area, in a dead end street, traffic noise is very low. The venue is an extension to the original villa.

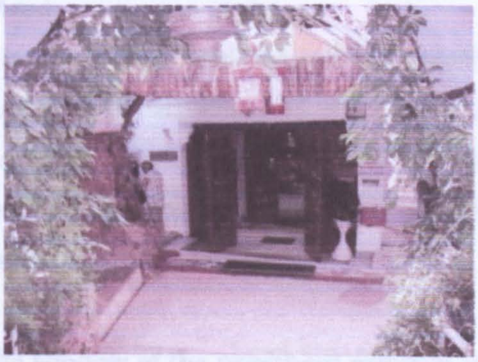


Fig 7.16: venue entrance


Fig 7.17: view of the interior of the venue and the garden where domestic animals and bird are kept

Fig 7.18: Arial view of the venue (X) and the microphones location (X)

- ***Subjective Impressions of the Area.***

According to the venue owner, the hall is acoustically insulated and with sound proof doors and windows. The venue is surrounded by private villas and is low frequented by cars except on wedding days. It has been noted a presence of domestic animals and different kind of birds in the back garden of the venue. Noise generated by these animals has been indicated in the graphs below as noise incidents.

- ***Noise Survey Description***

The microphones were set up in from the window of the neighbour which is adjacent to the venue. The microphones were calibrated before and after the monitoring with no calibration drifts observed. The noise data was recorded every second and plotted in the graph every five minutes in order to see the fluctuation clearly. The observations were made from the neighbour's villa in the terrace.

- **Environmental noise survey, results and observations**
  - **Wedding on**

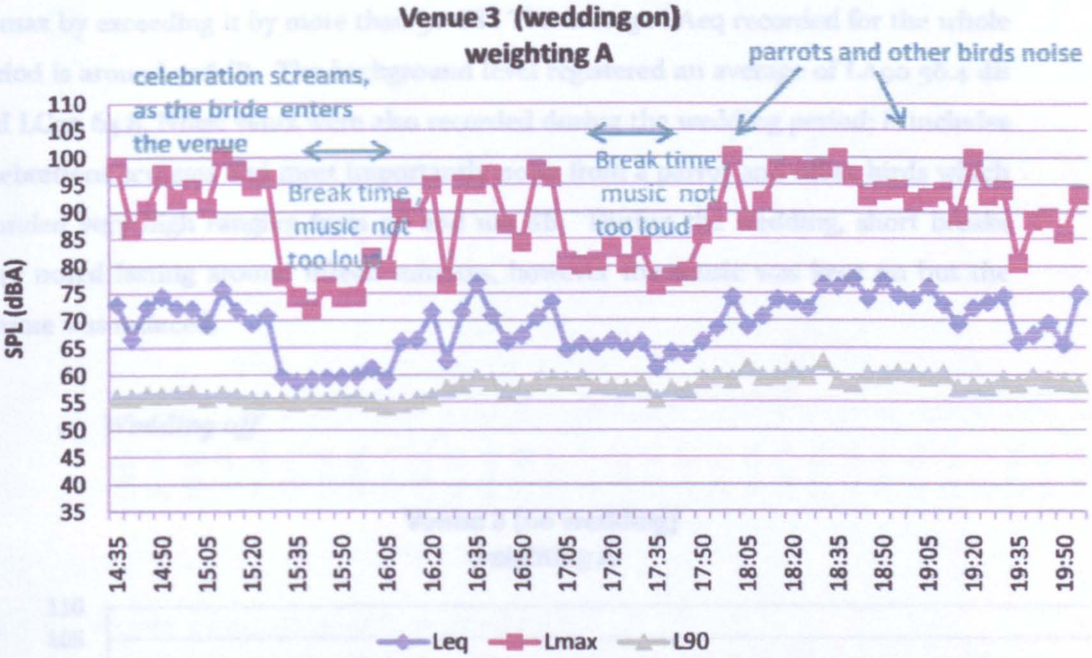


Fig 7.19: Venue 3 (wedding on), weighting A

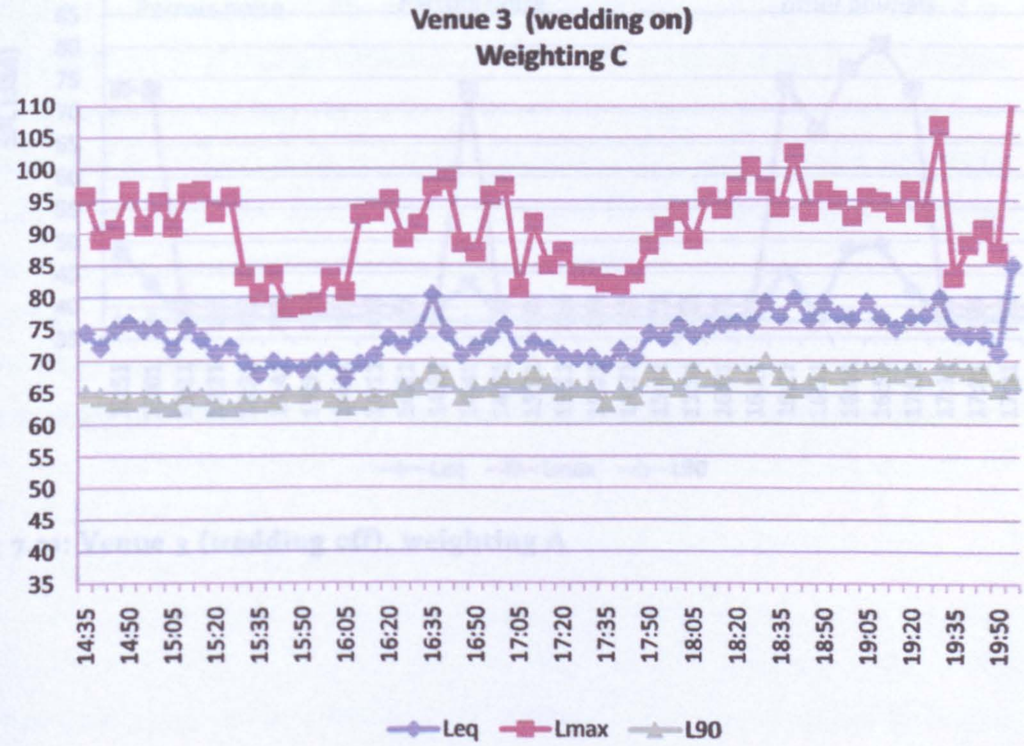


Fig 7.20: Venue 3 (wedding on), weighting C

The trace shows noise levels for the whole period for the ambient level, the Lmax and the background level L90 for both weighting A and C. The LAmax reached 100.3 dB and the LCmax 112.3 dB which is more than the recommended WHO guidelines for the LAmax by exceeding it by more than 30 dB . The average LAeq recorded for the whole period is around 71.6dB. The background level registered an average of LA90 56.4 dB and LC90 64.8. Noise vents were also recorded during the wedding period; it includes celebrations screams and most importantly noise from a parrot and other birds which sounded very high ranging from 98 and 100 dB. During the wedding, short breaks were noted lasting around fifteen minutes, however the music was kept on but the volume was reduced.

- ***Wedding off***

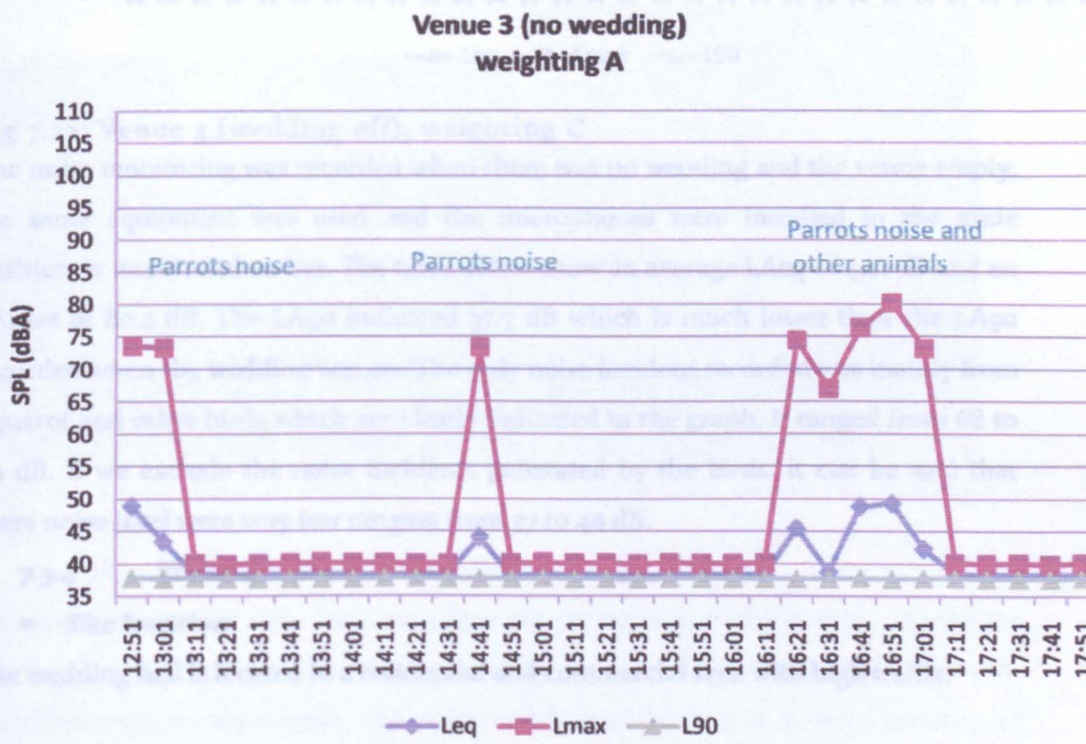


Fig 7.21: Venue 3 (wedding off), weighting A

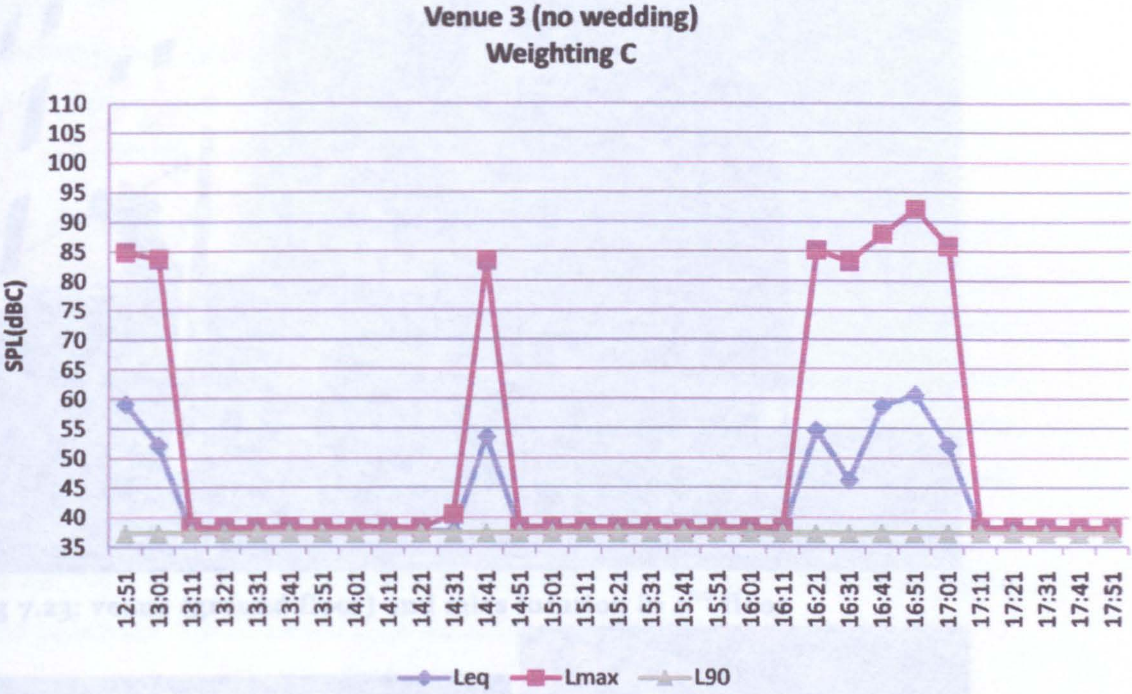


Fig 7.22: Venue 3 (wedding off), weighting C

The noise monitoring was recorded when there was no wedding and the venue empty, the same equipment was used and the microphones were installed in the same position as mentioned earlier. The trace below show an average LAeq of 42.1 dB and an LAmax of 80.2 dB. The LA90 indicated 37.7 dB which is much lower than the LA90 recorded when the wedding was on. The only noise incident recorded was mainly from a parrot and other birds which are clearly indicated in the graph, it ranged from 68 to 80 dB. If we exclude the noise incidents generated by the birds, it can be said that there noise level were very low ranging from 37 to 40 dB.

7.3.4 *Venue 4*

- ***Site location***

The wedding hall is located in a residential and commercial area with high traffic.

Fig 7.23: venue (ground floor) and mics location in 2nd floor

Fig 7.24: inside view of the venue

Fig 7.25: venue (X) and mics location (X)

- ***Subjective Impressions of the Area.***

The premises street is quite busy, with frequent car horns and large number of vehicles passing by the venue in the rush hours. The area is also dominated by different activities such as restaurants and cafes which tend to attract a large number of pedestrians and shoppers.

- ***Noise Survey Description***

The noise monitoring was undertaken during day when there was no wedding celebrated in the venue. The microphones were installed above thy venue in the second floor about 8 metre from the ground level. The measurements data were logged every second and plotted every minute on the graph shown below.The equipment was calibrated before and after without any noticeable drift.

- ***Environmental noise survey, results and observations***
  - ***Wedding on***

Same microphone location and conditions as mentioned above were applied for the noise monitoring when the wedding was on. The graphs below show a high ambient noise level of LAeq 72.1 dB and LCeq 83.1 dB. The top trace show the highest maximum noise recorded in each sequential 5 minutes interval measured as a LAmax and LCmax with 97.5 and 98 dB respectively.It can be seen that the number of noise events present throughout the wedding period is quite high. There were celebrations screams and car horns and sometimes music coming from the venue when the door was left open for about 5 minutes.The lowest trace shows the L90 of the venue ranging from 64.1dB and 73.8 db for the LA90 and LC90 respectively.

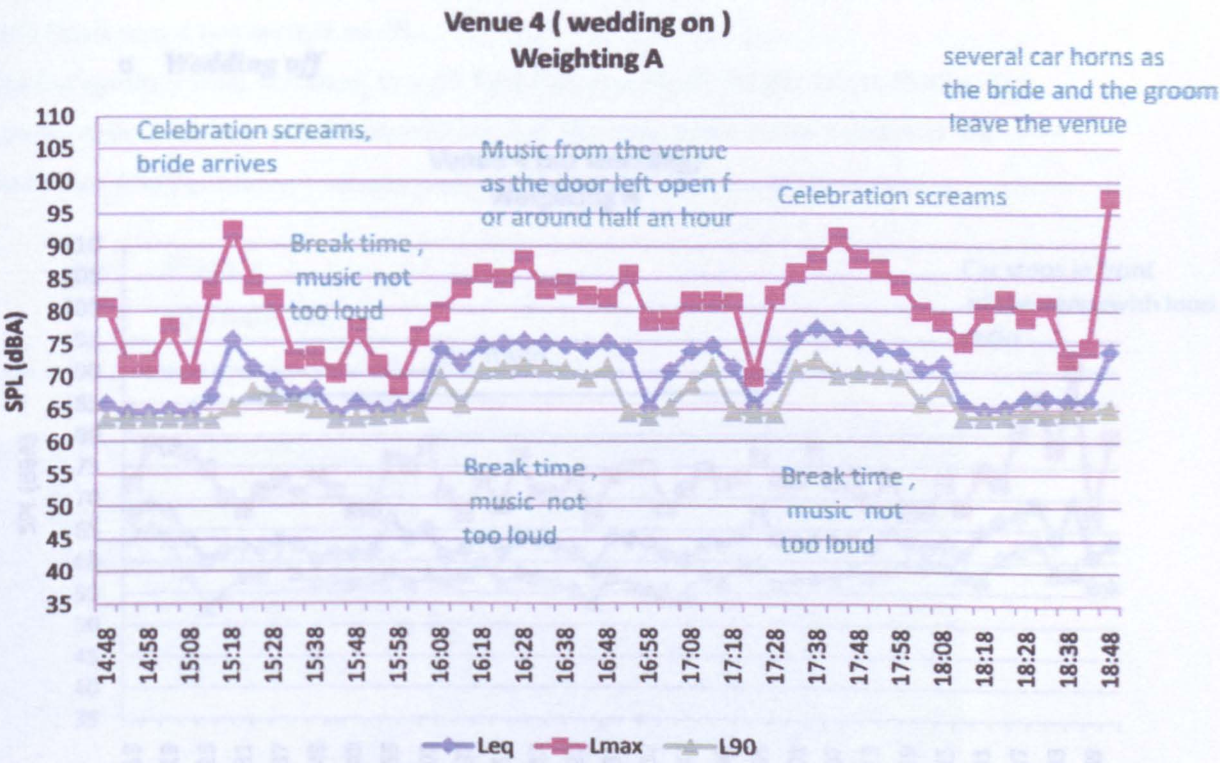


Fig 7.26: Venue 4 (wedding on), weighting A

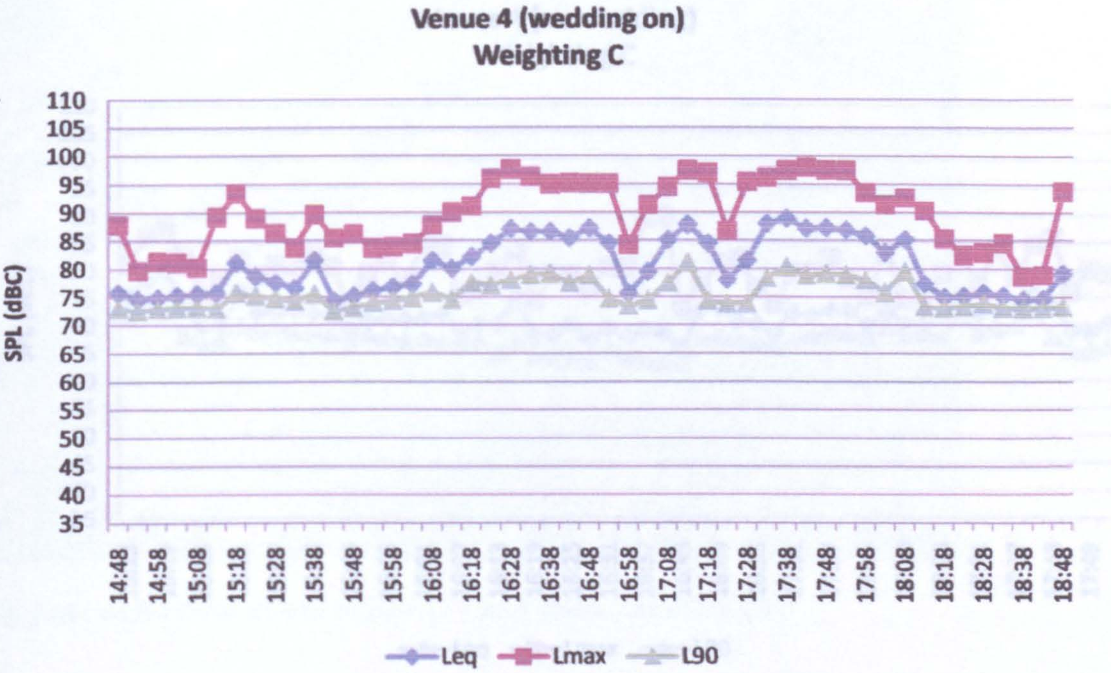


Fig 7.27: Venue 4 (wedding on), weighting C

- ***Wedding off***

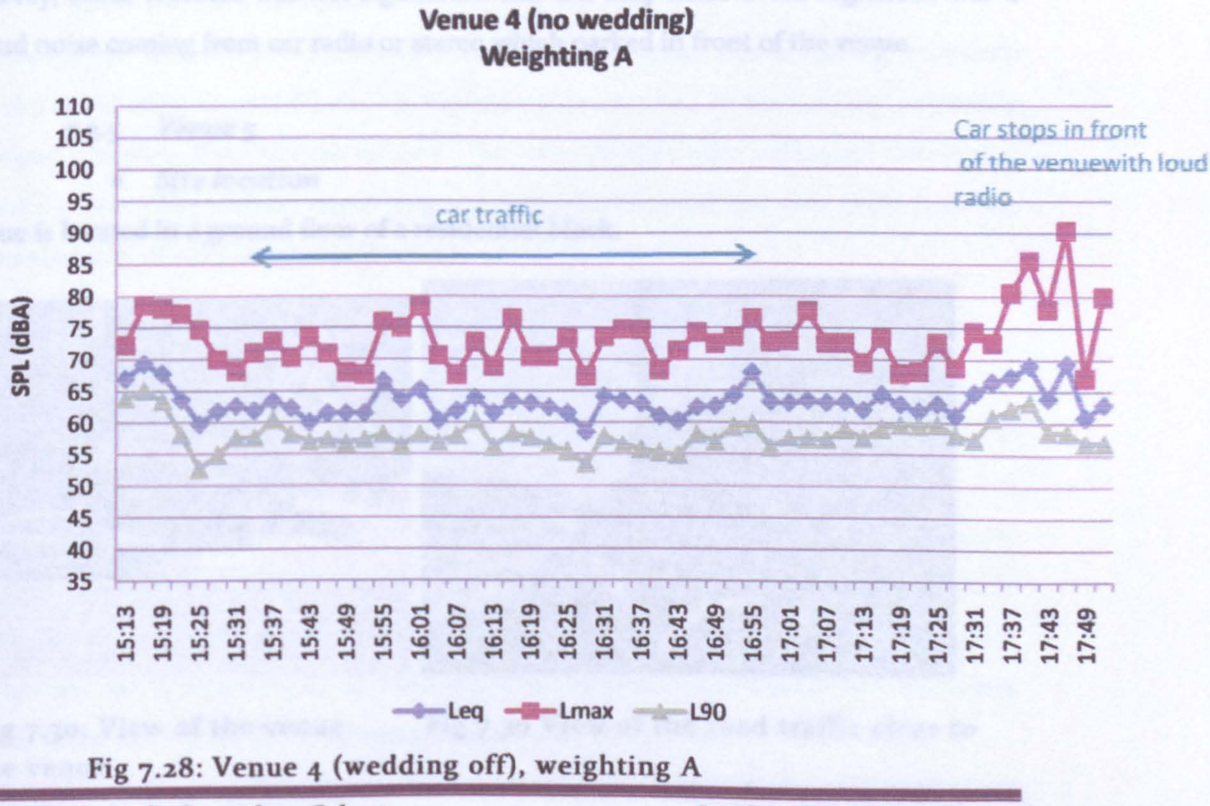


Fig 7.28: Venue 4 (wedding off), weighting A

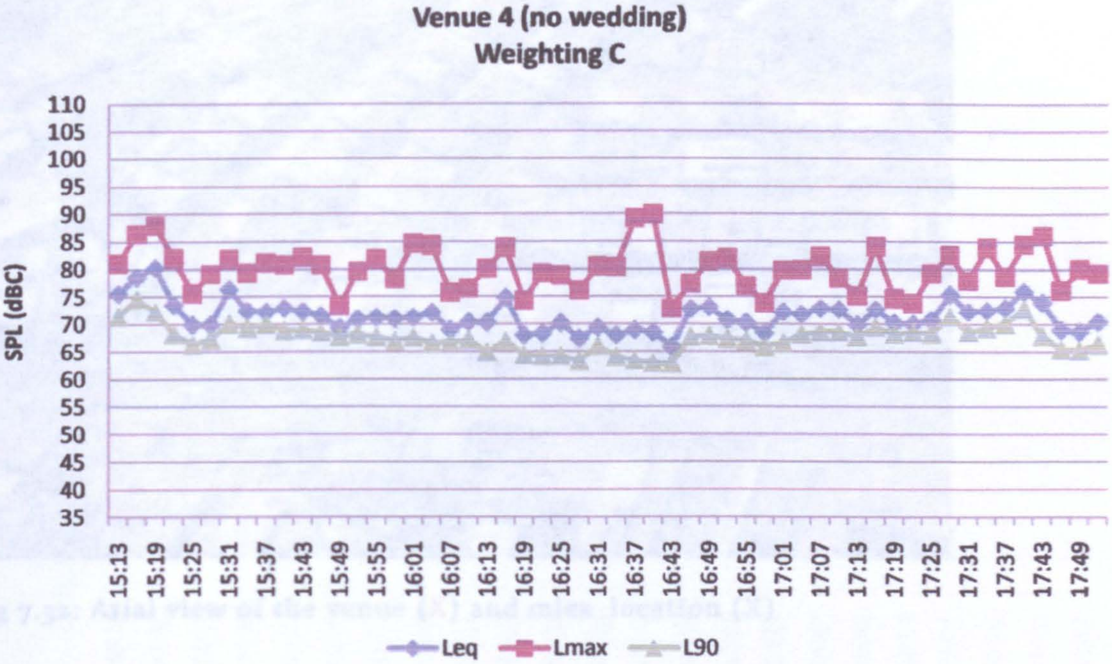


Fig 7.29: Venue 4 (wedding off), weighting C

The figures above show that the average LAeq recorded 64.2 dB and LCeq 76 dB and the LAmax noted was around 90 dB.

The background level indicated 57.2 dB for LA90 and 66 dB for the LC90. During the survey, noise incident was not significant and the only noise event registered was a loud noise coming from car radio or stereo which parked in front of the venue.

7.3.5 *Venue 5*

- ***Site location***

The venue is located in a ground floor of a residential block.

Fig 7.30: View of the venue   Fig 7.30 View of the road traffic close to the venue

Fig 7.32: Arial view of the venue (X) and mics location (X)

- ***Subjective Impressions of the Area.***

The premises are was originally a local mini-market which was converted to wedding hall. The venue is surrounded by high level buildings and busy main road. The area is a popular street and frequented by a lot of pedestrians and vehicles.

- ***Noise Survey Description***

The equipment was set up in a balcony of flat above the venue, two weighting were used in the monitoring (A and C), the microphone were attached to the balcony balustrade around 5 metres from the street level. The microphones were calibrated before and after the recording without registering any drift. The observations were taken from the same balcony any noise event was noted

- ***Environmental noise survey, results and observations.***
    - ***Wedding on***

From the graphs below, it can be clearly seen that the different noise levels recorded are higher than the normal level recommended by the WHO. The average LAeq indicates a value of 86.4 dB and the LCeq a level of 91.4 dB. The maximum noise level LAmax and LCmax recorded was very high with level ranging from 106.9 and 107.8 dB. This due to the celebration screams coming from the venue. This gives greater concern when any Lmax exceeding 87 dB will result in the noise levels inside flats exceeding 45dB Lmax even when the windows are closed and well sealed.

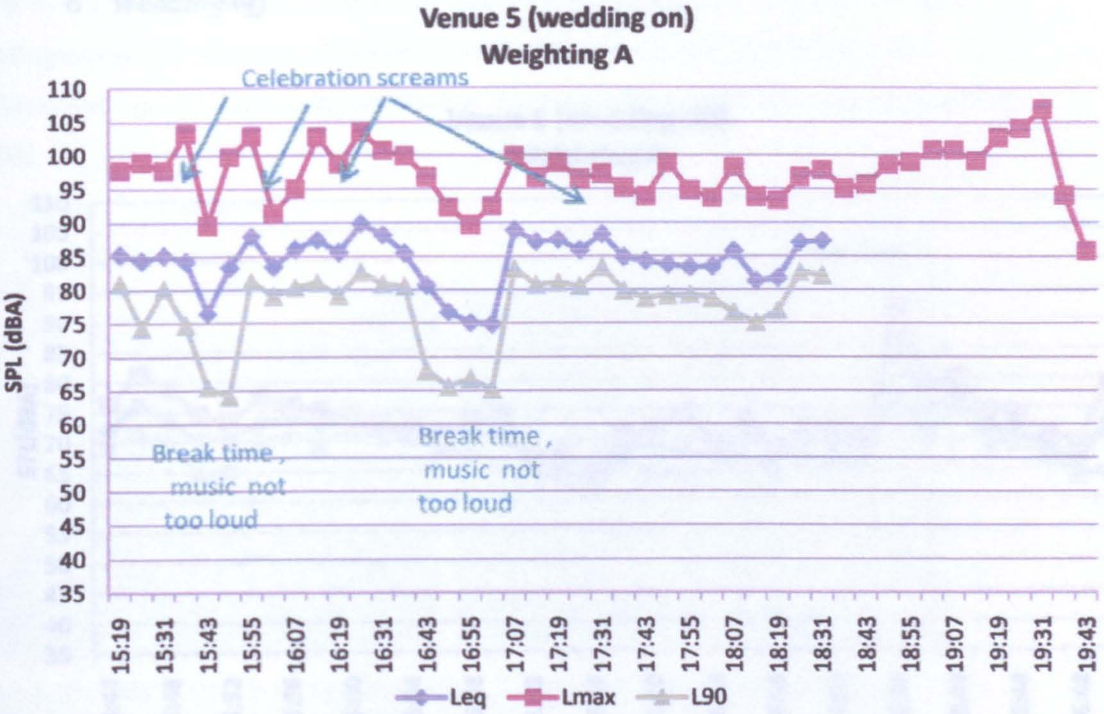


Fig 7.33: Venue 5 (wedding on), weighting A

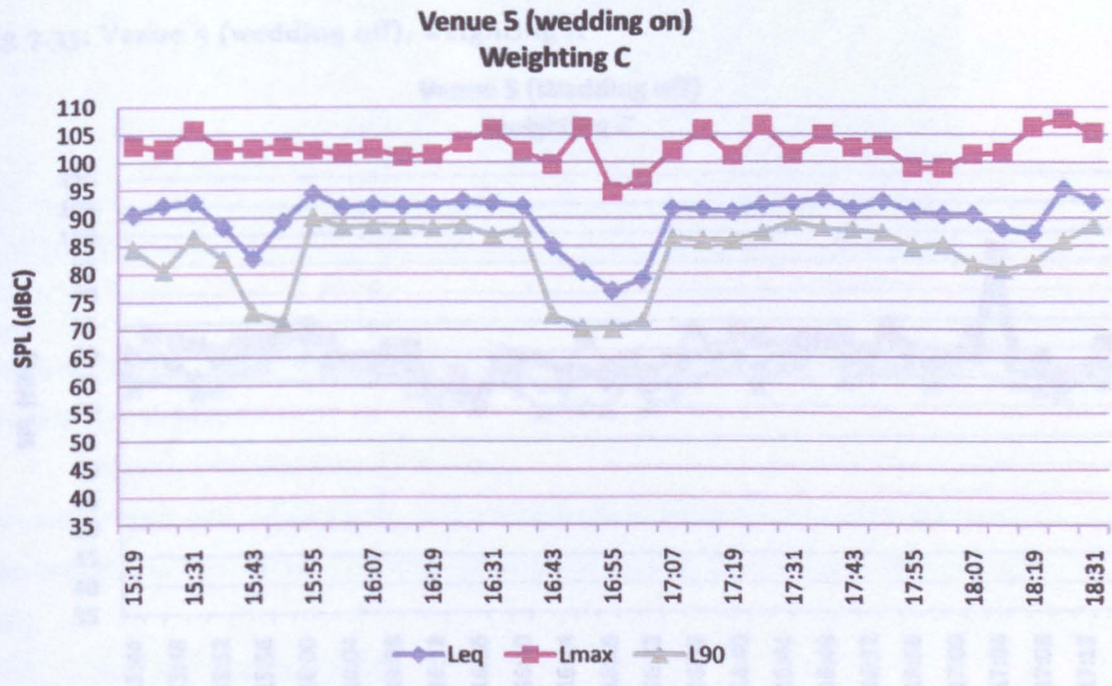


Fig 7.34: Venue 5 (wedding on), weighting C

- *Wedding off*

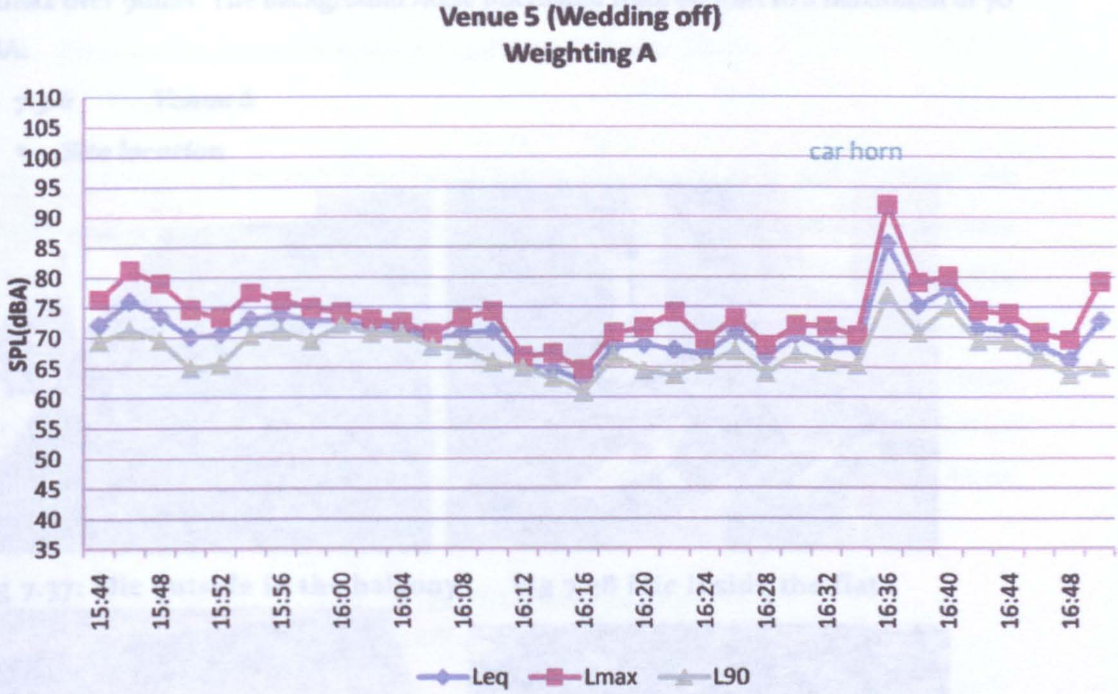


Fig 7.35: Venue 5 (wedding off), weighting A

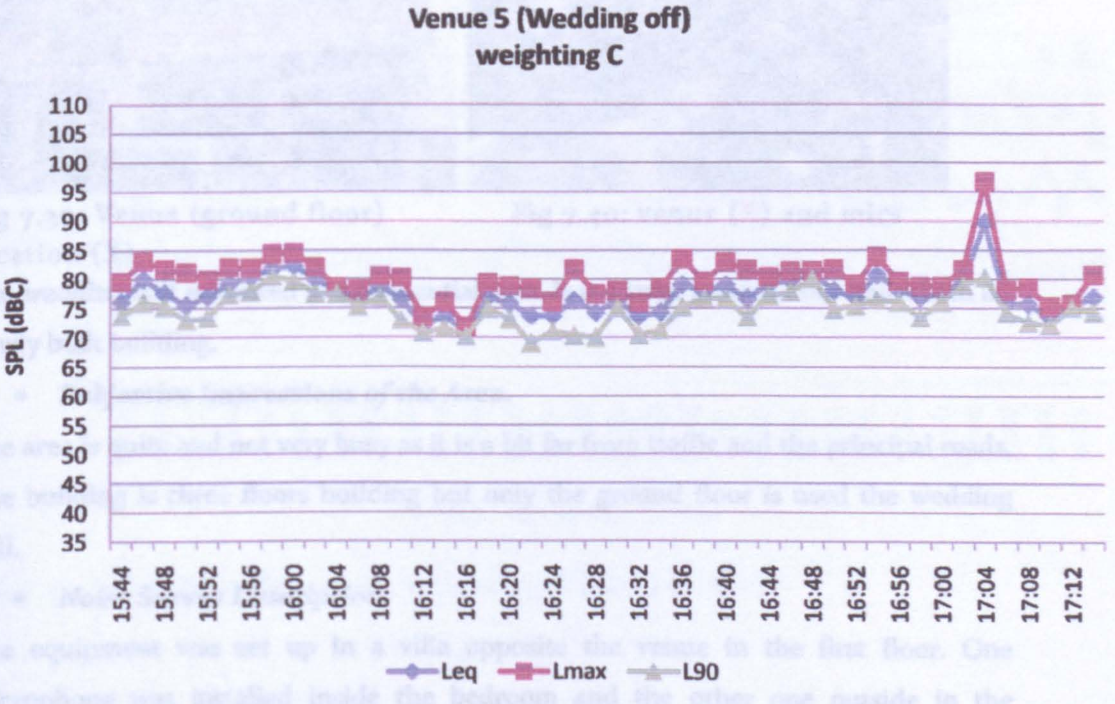


Fig 7.36: Venue 5 (wedding off), weighting C

The monitoring was held on day of the weekend, the traffic noise was not as high as during weekdays. Noise levels varied from 63 dBA and 85 dBA for the LAeq with LAmax over 91dBA. The background noise fluctuated from 60 dBA to a maximum of 76 dBA.

7.3.6 *Venue 6*

- ***Site location***

Fig 7.37: Mic outside in the balcony

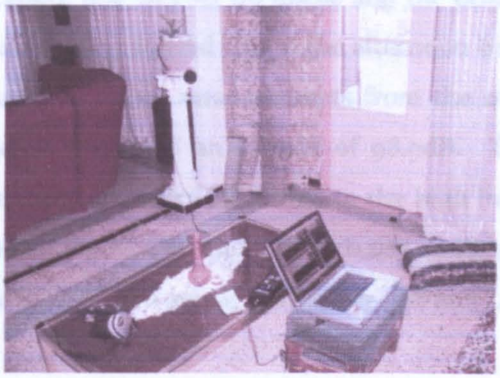


Fig 7.38 Mic inside the flat

Fig 7.39: Venue (ground floor)

Fig 7.40: venue (X) and mics location (X)

The wedding hall is located in a residential area. It is a large ground floor hall which is newly built building.

- ***Subjective Impressions of the Area.***

The area is quite and not very busy as it is a bit far from traffic and the principal roads. The building is three floors building but only the ground floor is used the wedding hall.

- ***Noise Survey Description***

The equipment was set up in a villa opposite the venue in the first floor. One microphone was installed inside the bedroom and the other one outside in the balcony. Only one weighting was used (A). The distance between the microphones

and the venue is around 7 metres. Both microphones were calibrated before and after the measurements.

- ***Environmental noise survey, results and observations***
  - ***Wedding on***

Same equipment and microphones location, one was set up inside and the other one outside with only one weighting (A).The wedding started late in the afternoon because of the heat, as the air conditioning was faulty. The measurements from the outside microphone recorded an average LAeq of 78dB and an LAmax of 98.9dB. This is largely due to the opening of the venue front door very often due to the high internal temperature inside the hall as shown in the graph. The music was clearly audible from outside. Inside the flat, the microphone recorded an average LAeq 57 dB and LAmax of 86.3 dB.

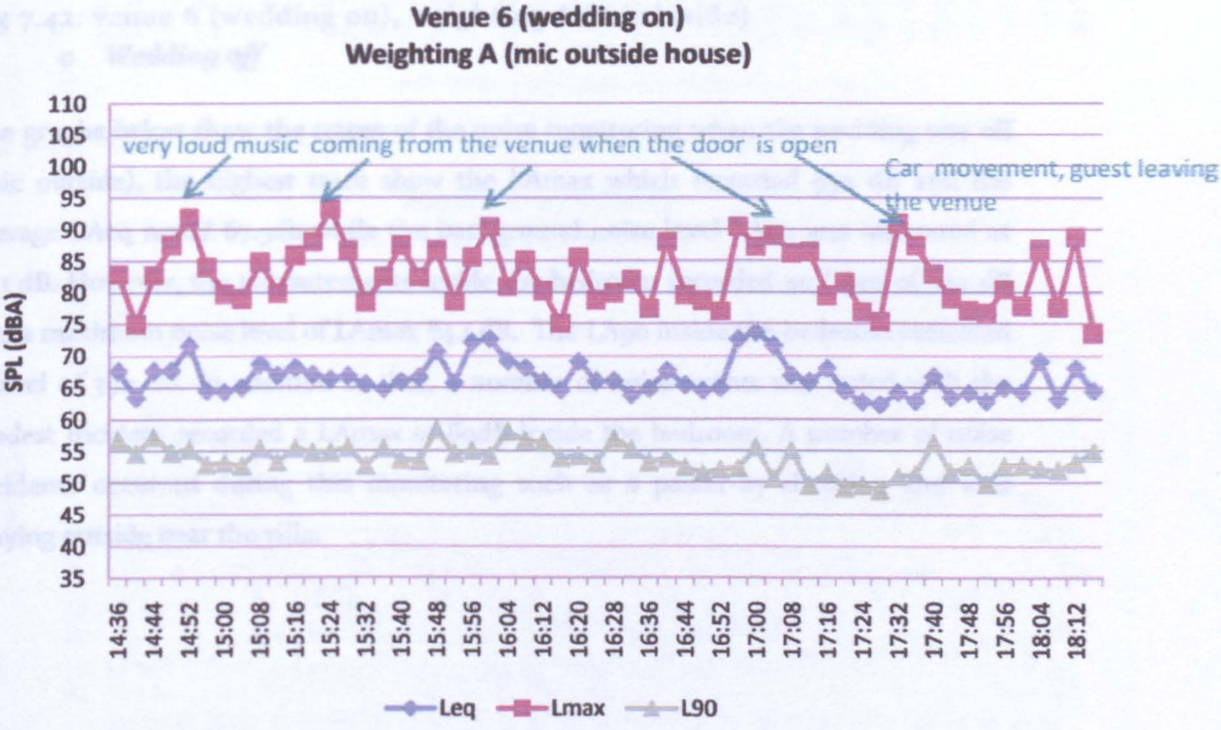


Fig 7.41: venue 6 (wedding on), weighting A (mic outside)

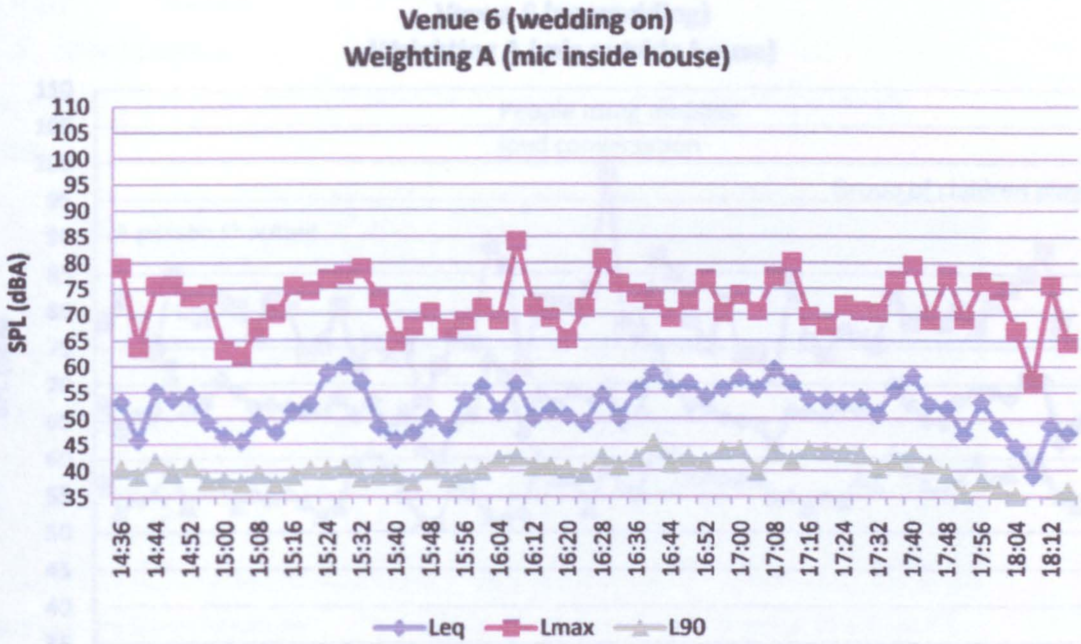


Fig 7.42: venue 6 (wedding on), weighting A (mic inside)

- *Wedding off*

The graphs below show the traces of the noise monitoring when the wedding was off (mic outside), the highest trace show the LAmax which recorded 93.1 dB and the average LAeq noted 67.5db while the background noise level LA90 was measured at 53.1 dB. However, the measurements inside the bedroom recorded an LAeq of 54.1 dB and a maximum noise level of LAmax 84.1 dB. The LA90 inside the bedroom indicated a level of 39.1 dB. In addition to that, a number of noise events was noted with the loudest incident recorded a LAmax of 89dB inside the bedroom. A number of noise incidents occurred during this monitoring such as a passer-by shouting and kids playing outside near the villa.

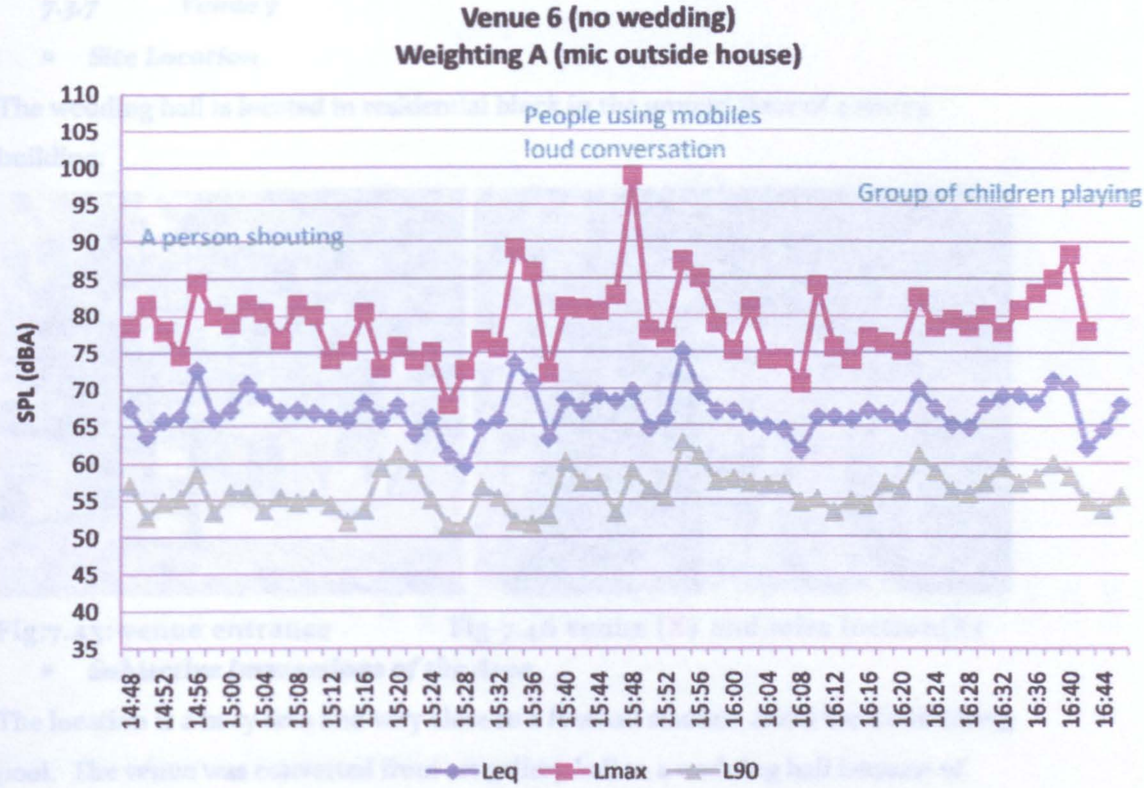


Fig 7.43: venue 6 (wedding off), weighting A (mic outside)

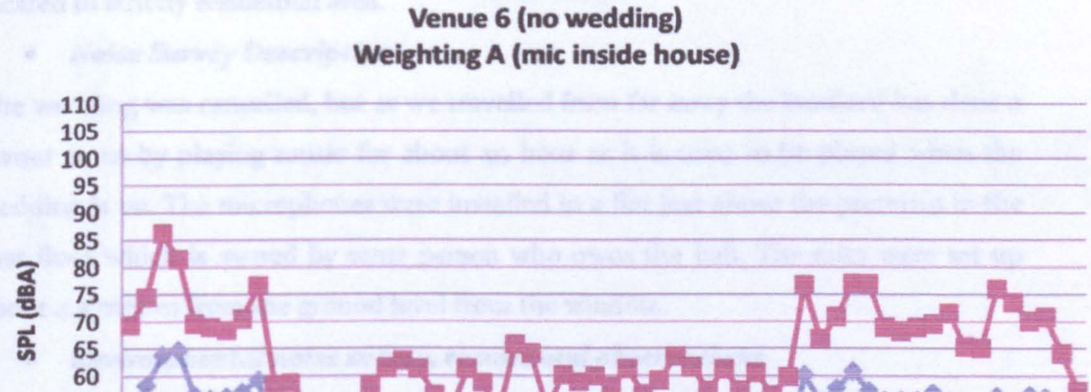


Fig 7.44: venue 6 (wedding off), weighting A (mic inside)

7.3.7 *Venue 7*

- ***Site Location***

The wedding hall is located in residential block in the ground floor of 4 storey building.

Fig:7.45: venue entrance Fig 7.46 venue (X) and mics loction(X)

- ***Subjective Impressions of the Area.***

The location is a busy area and very close to a football stadium and a local swimming pool. The venue was converted from art gallery hall to a wedding hall because of economical reason. It has been said that the venue has a valid licence although it is located in strictly residential area.

- ***Noise Survey Description***

The wedding was cancelled, but as we travelled from far away the landlord has done a favour to us by playing music for about an hour as it is used to be played when the wedding is on. The microphones were installed in a flat just above the premises in the first floor which is owned by same person who owns the hall. The mics were set up about 4.5 metres from the ground level from the window.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

During the first hour of the monitoring when the music was on the LAmax recorded was around 101.6 dB and the average LAeq indicated 78 dB while the background level LA90was varying between 66 and 68 dB. The C measurements show the LCeq of 86 dBC and and LCmax of 104.3 dBC.

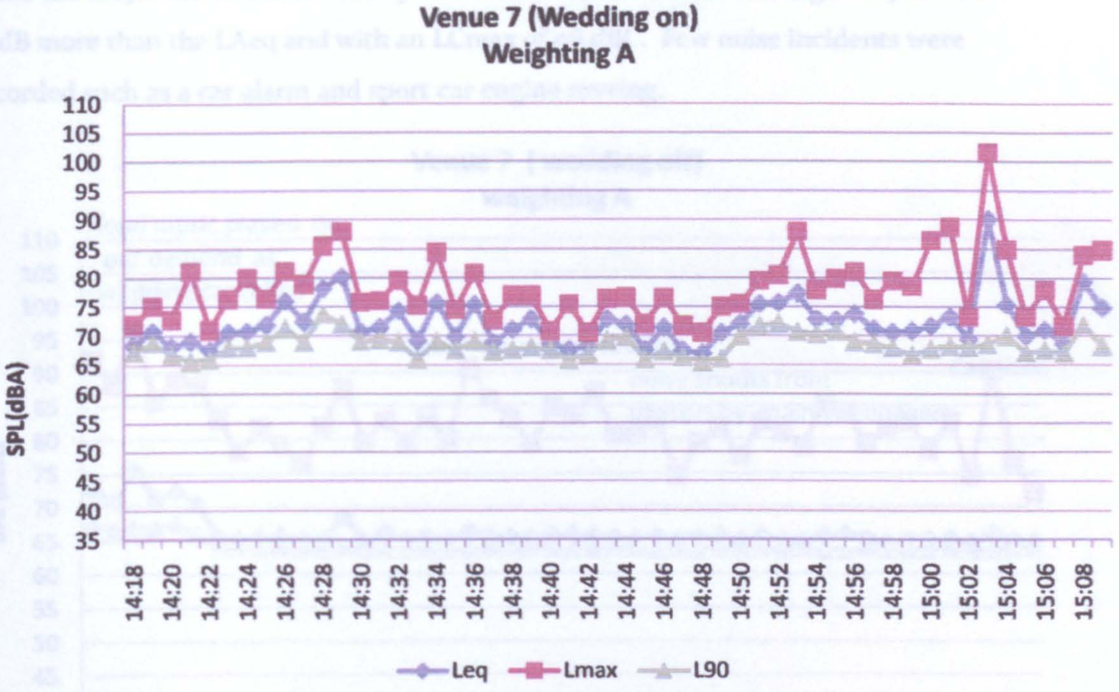


Fig 7.47: venue 7 (wedding on) weighting A

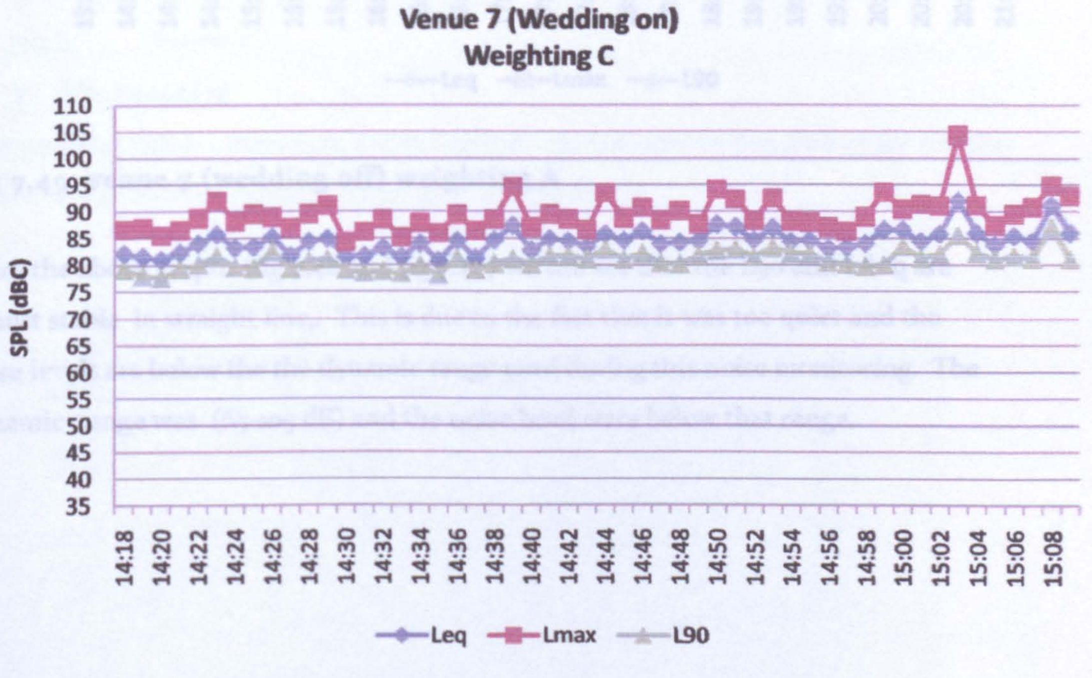


Fig 7.48: venue 7 (wedding on) weighting C

- ***Wedding off***

After one hour of loud music, the landlord switched off the music completely, and for the rest of the period the LAeq varied between 64.9 and 67.4 dB and LCeq of 75.5 dBC , while the LA90 was stable around 63 dB . However, the LAmax was higher by almost 20dB more than the LAeq and with an LCmax of 98 dBC. Few noise incidents were recorded such as a car alarm and sport car engine revving.

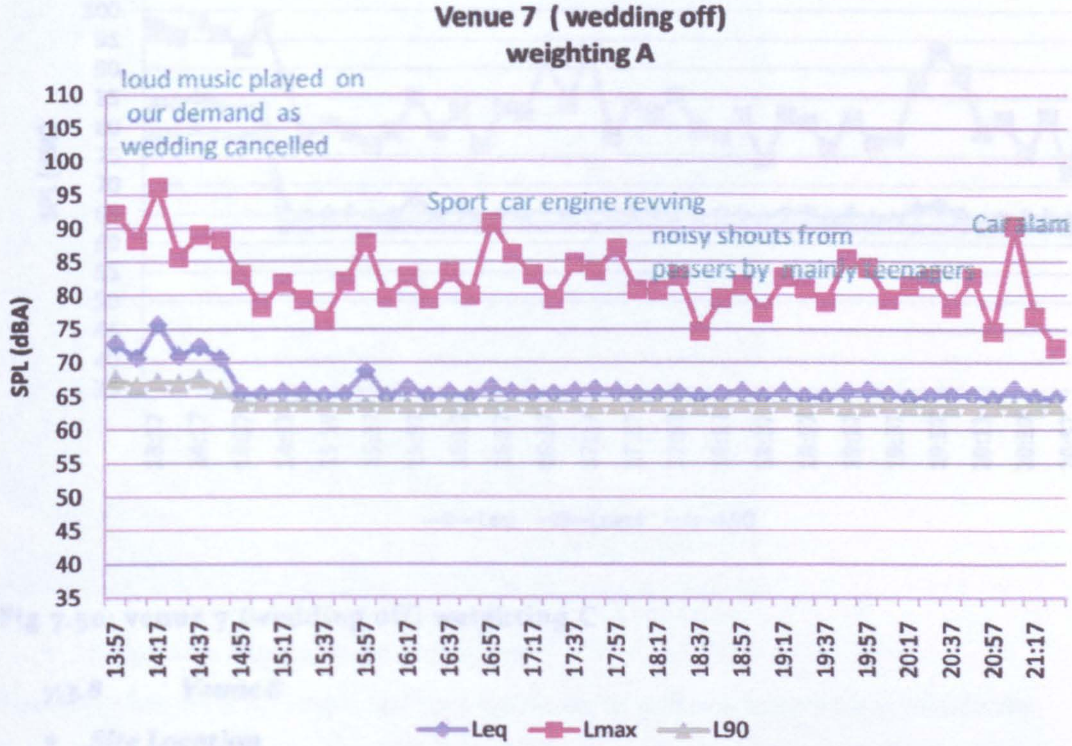


Fig 7.49: venue 7 (wedding off) weighting A

From the above graphs (fig 7.48 and fig 7.49) we can see that the L90 and LAeq are almost stable in straight line,. This is due to the fact that it was too quiet and the noise levels are below the the dynamic range used during this noise monitoring. The dynamic range was (65-105 dB) and the noise level were below that range.

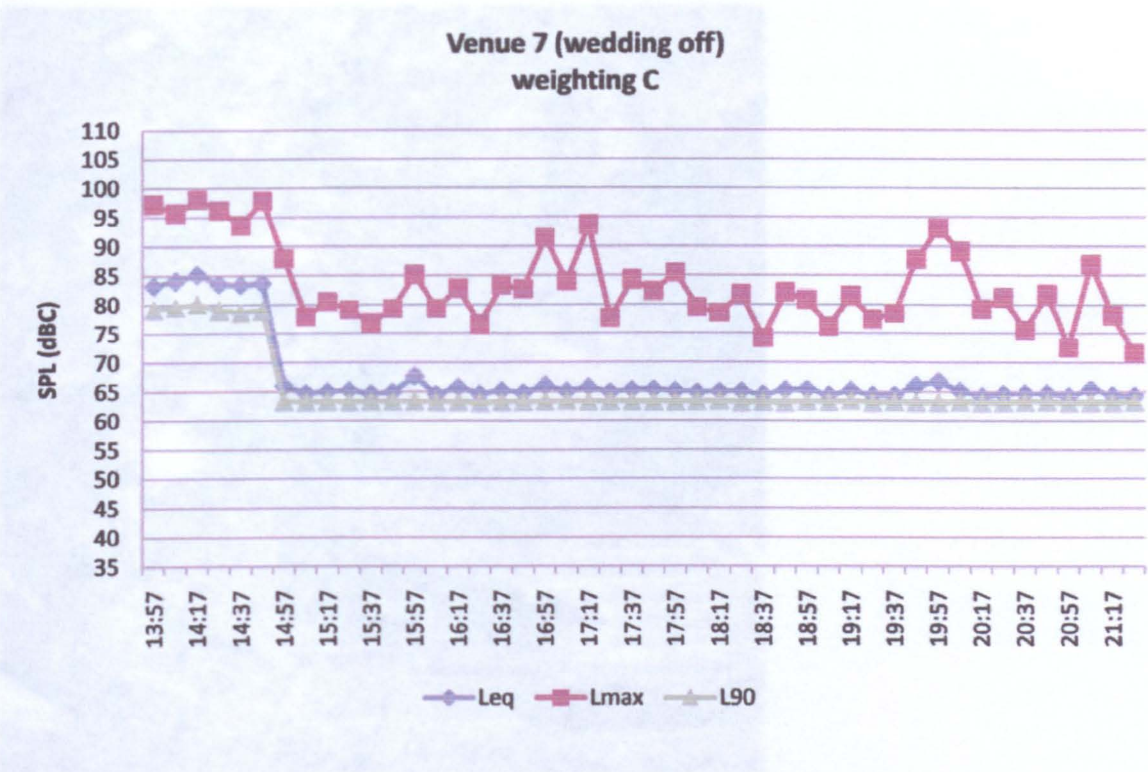


Fig 7.50: venue 7 (wedding off) weighting C

7.3.8 *Venue 8*

- ***Site Location***

The wedding hall is a large one, and is licensed and has been in this activity for a while. The venue is used for private parties, as well as weddings

Fig 7.51: venue entrance

Fig 7.52: Arial view of venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The venue has different stages and dancing floors, as well as a large terrace, which can be used when the venue is crowded. The area is situated near few houses. The venue is not connected to the adjacent building, and the traffic is very quite in the area.

- ***Noise Survey Description***

The equipment was set up in a house opposite the venue in the window, the microphones were attached to a wooden pole around 2 meters from the window. Both microphones were calibrated before and after the monitoring.

- ***Environmental noise survey, results and observations***
    - ***wedding on***

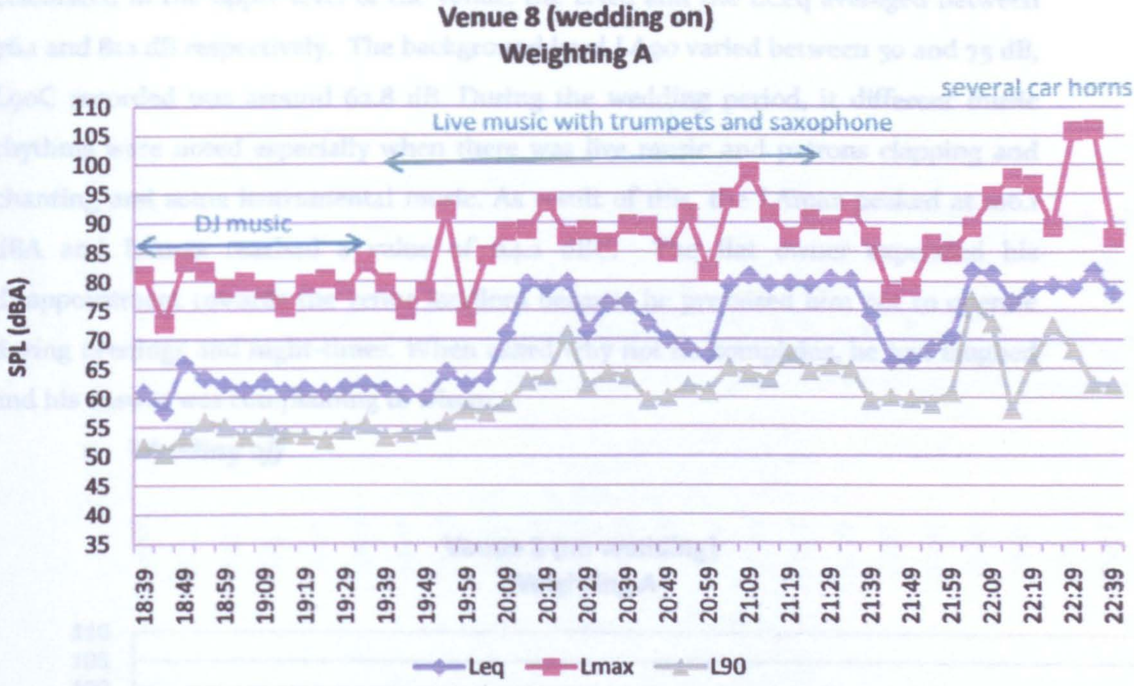


Fig 7.53: Venue 8 (wedding on), weighting A

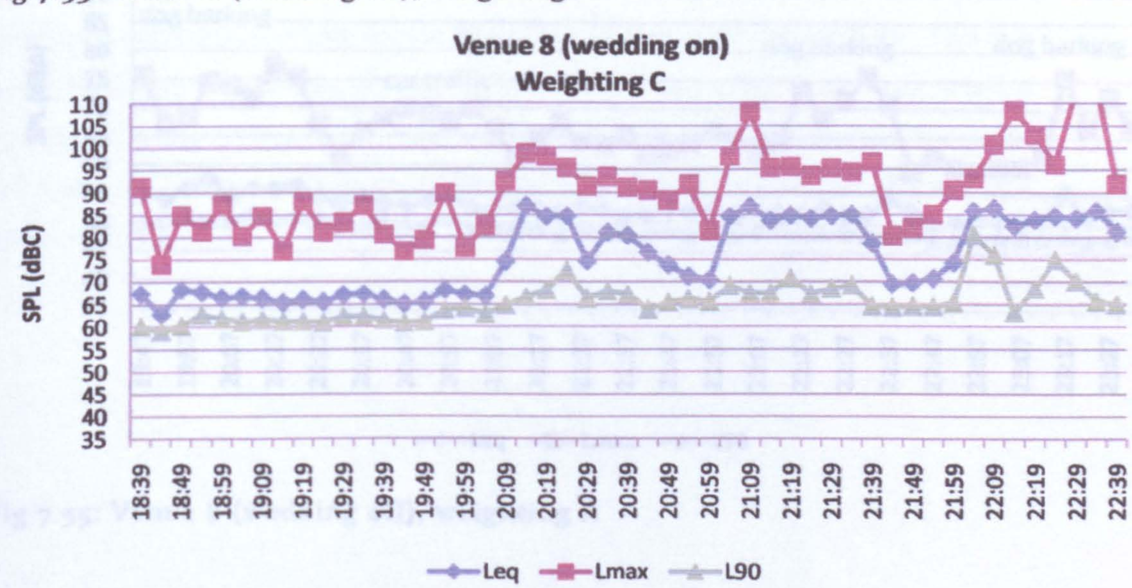


Fig 7.54: Venue 8 (wedding on), weighting C

The same conditions apply to the same venue when the wedding was off, except that there was no dog presence in the surrounding areas. The monitoring started around 8:15pm in the afternoon and lasted just after 12:30 am but the wedding continued until dawn, we could not stay more because we have agreed with flat occupier to leave after midnight. The music from the venue was audible from the street as the wedding was celebrated in the upper level of the venue. the LAeq and the LCeq averaged between 76.1 and 81.1 dB respectively. The background level LA90 varied between 50 and 75 dB, L90C recorded was around 62.8 dB. During the wedding period, it different music rhythms were noted especially when there was live music and patrons clapping and chanting and some instrumental music. As result of this, the LAmax peaked at 106.1 dBA and LCmax reached a value of 114.2 dBC. The flat owner expressed his disappointment towards the venue landlord because he promised him not to operate during evenings and night-times. When asked why not he complains, he just laughed and his answer was complaining to whom.

- ***Wedding off***

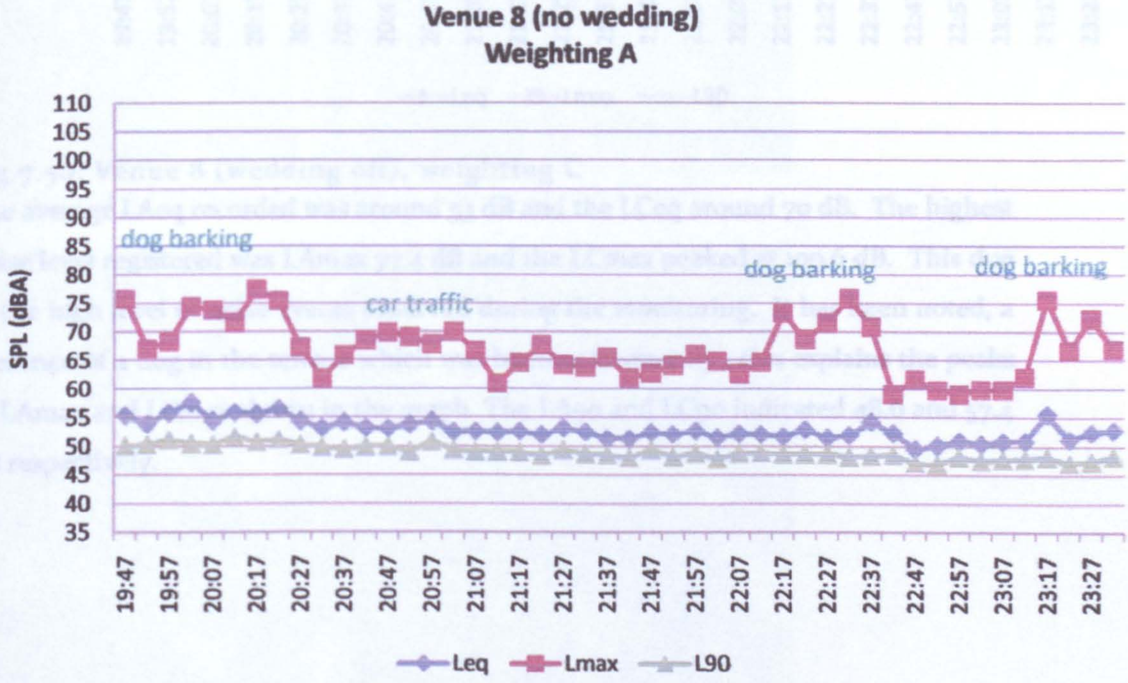


Fig 7.55: Venue 8 (wedding off), weighting A

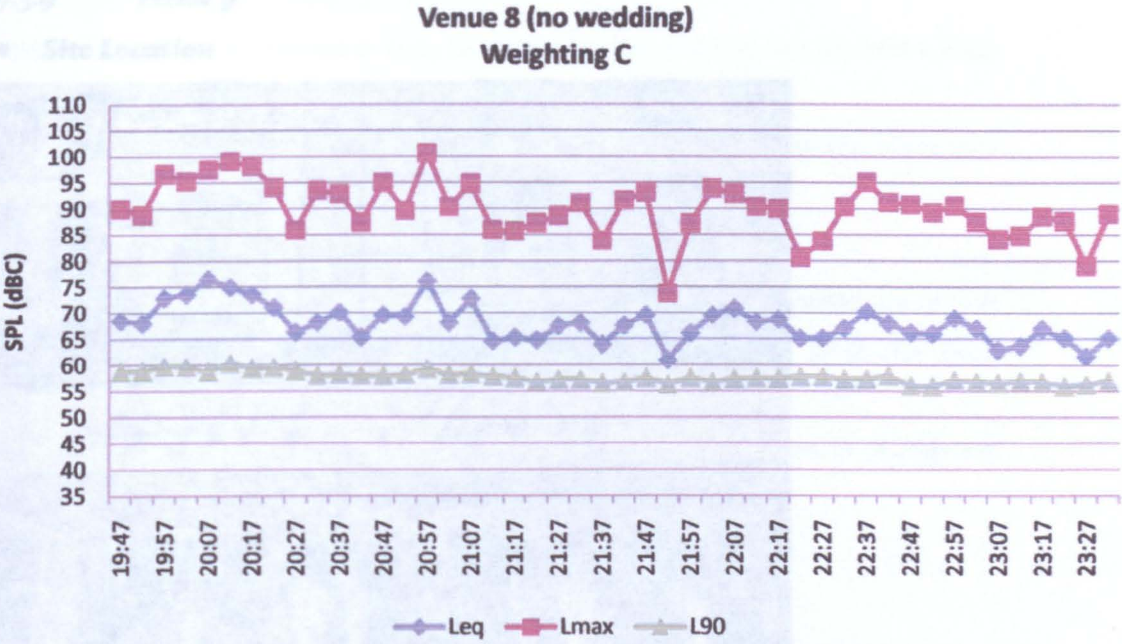


Fig 7.56: Venue 8 (wedding off), weighting C

The average LAeq recorded was around 53 dB and the LCeq around 70 dB. The highest noise level registered was LAmax 77.4 dB and the LCmax peaked at 100.6 dB. This due to the high level of noise events observed during the monitoring. It has been noted, a presence of a dog in the terrace which was barking frequently , this explains the peaks in LAmax and LCmax shown in the graph. The LA90 and LC90 indicated 48.6 and 57.4 dB respectively.

7.3.9 Venue 9

- ***Site Location***

Fig 7.57: Hotel entrance (wedding hall in ground floor)

Fig:7.58: Arial view of the Hotel (X) and mics (X) location

The venue is located in a hotel and is a multidisciplinary hall, where conferences, meetings, weddings as well as private parties.

- ***Subjective Impressions of the Area***

The hotel is located in a residential area, the traffic is high and the area attracts a large number of pedestrians and visitors as it is close the city centre.

The area is dominated by different activities such as restaurants and retails. It appears that many of the food outlets operate to and beyond midnight.

- ***Noise Survey Description***

The equipment was set up inside the venue but in the upper level inside the groom changing room. The microphones were calibrated before and after the each monitoring, with both weighting used A and C.

During the wedding the groom comes to the changing room quite often to change her dress, consequently the changing room door is opened frequently.

- ***Environmental noise survey, results and observations***

    - ***Wedding on***

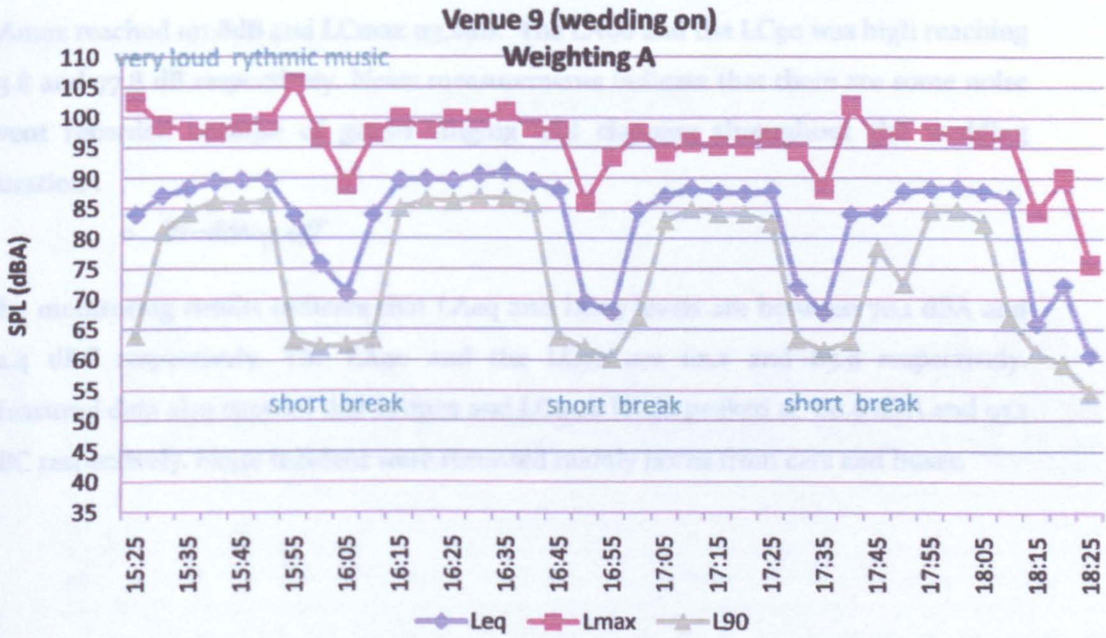


Fig 7.59: venue 9(wedding on), weighting A

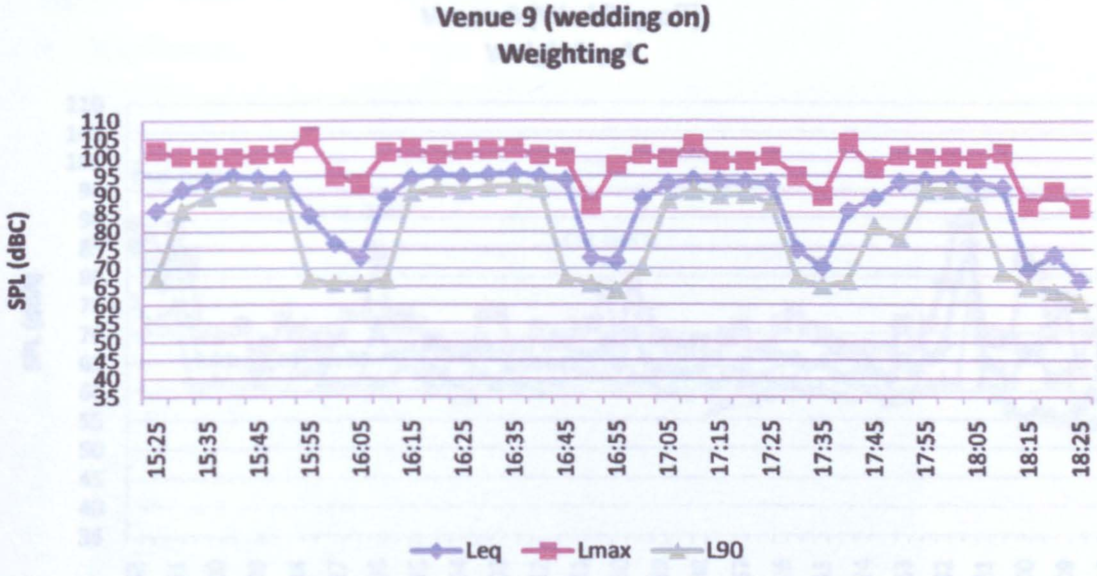


Fig 7.60: venue 9(wedding on), weighting C

The average ambient LAeq recorded 87 dB and LCeq 104 dB, the highest noise level LAmax reached 101.8dB and LCmax 113.6dB. The LA90 and the LC90 was high reaching 63.8 and 77.8 dB respectively. Noise measurements indicate that there are some noise event recorded because of guests singing and clapping throughout the wedding duration .

- ***Wedding off***

The monitoring results indicate that LAeq and LCeq levels are between 70.1 dBA and 72.4 dBC respectively. The LA90 and the LC90 are 62.2 and 65.9 respectively. Measured data also showed that LAmax and LCmax levels peaked at 88.9 dBA and 93.1 dBC respectively. Noise incident were recorded mainly horns from cars and buses.

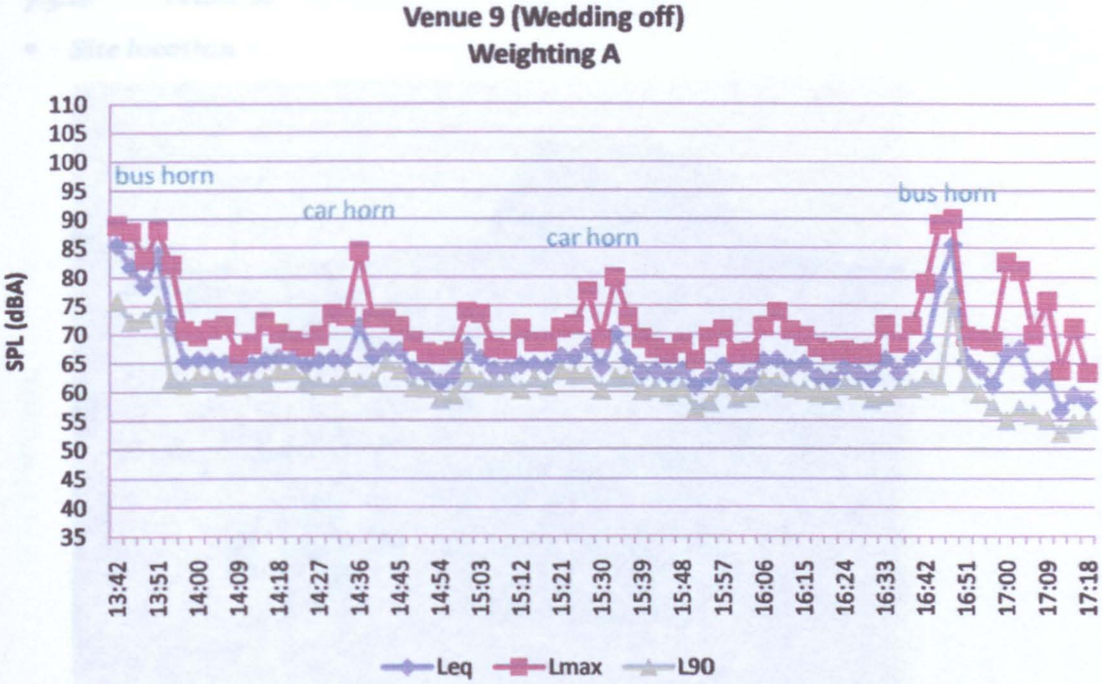


Fig 7.61: venue 9(wedding off), weighting A

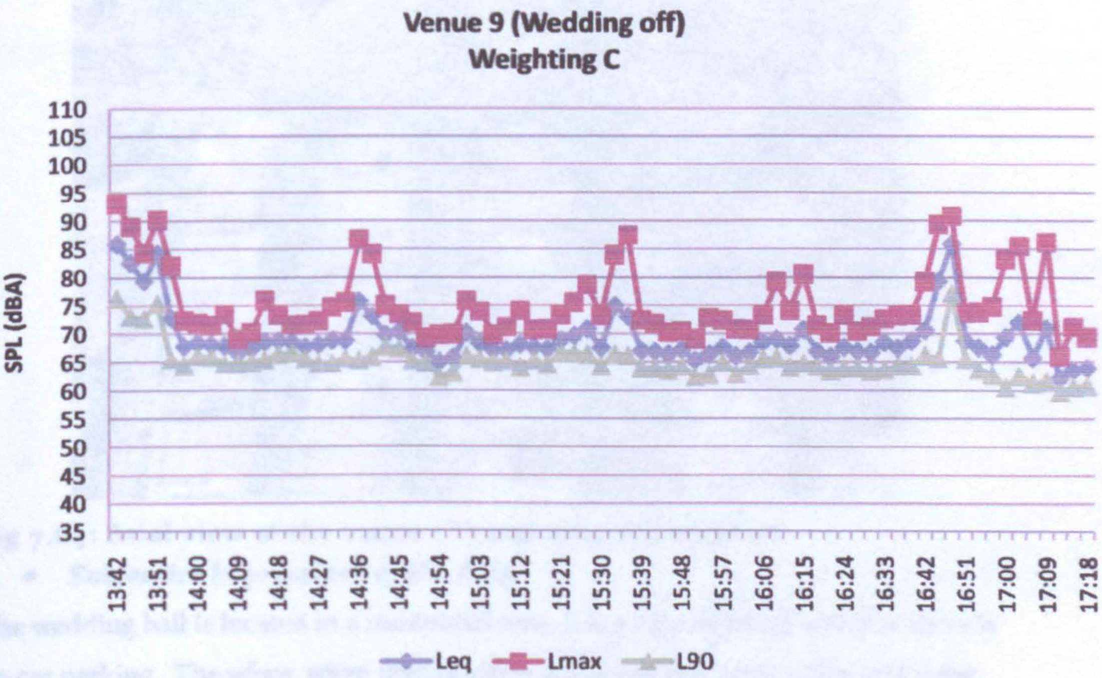


Fig 7.62: venue 9(wedding off), weighting C

7.3.10 Venue 10

- ***Site location***

Fig 7.63: venue entrance

Fig 7.64: Arial view of the venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The wedding hall is located in a residential area, it is a new building however there is no car parking . Therefore, when invites arrive at the hall it creates traffic and noise.

- ***Noise Survey Description***

The equipment was set up outside the venue in an opposite house. The microphones were calibrated before and after the each monitoring, with both weighting used A and C.The main hall is located in the first floor, windows and ground floor garage door are often kept open..

- ***Environmental noise survey, results and observations***
  - ***Wedding on***

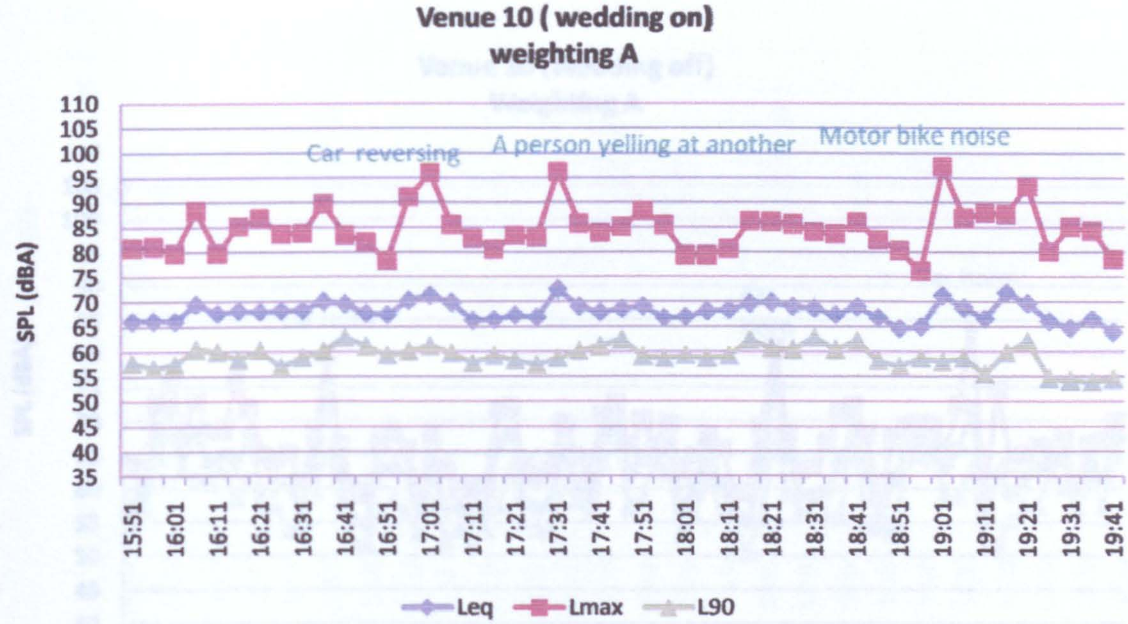


Fig 7.65: venue 10 (wedding on), weighting A

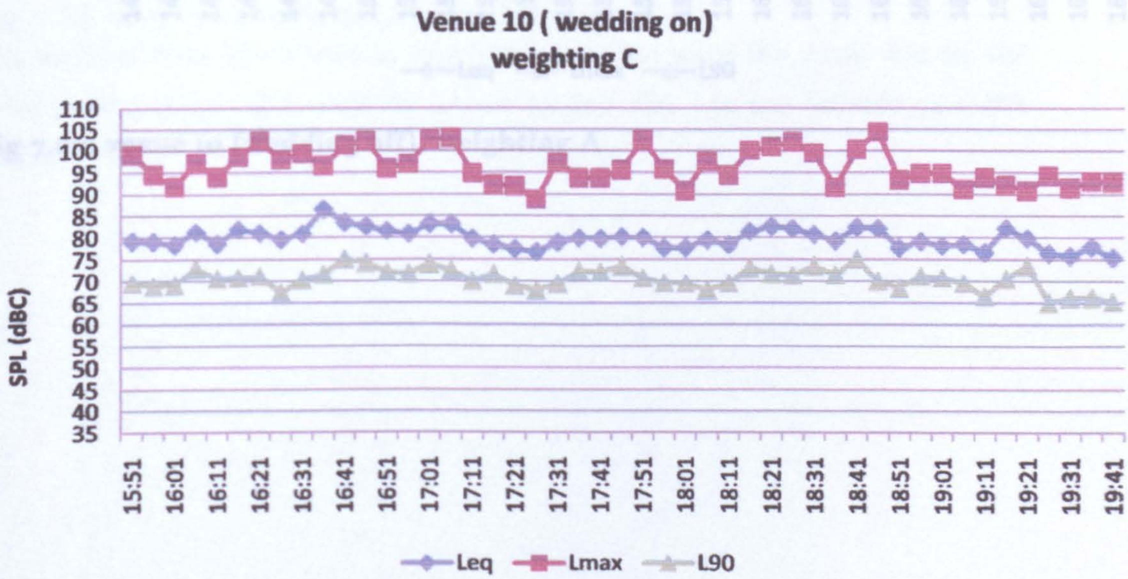


Fig 7.66: venue 10 (wedding on), weighting C

Monitoring data showed Leq levels of 68.5 dBa and 81 dBC with LAmax of 97.3 dBA and LCmax of 104.4 dBC. The background noise was between 58.6 dBA for LA90 and

70.1 dBC for Lc90. Most of the noise incidents recorded are caused by car noises such as reversing or parking as well as motor bike noise.

- ***Wedding off***

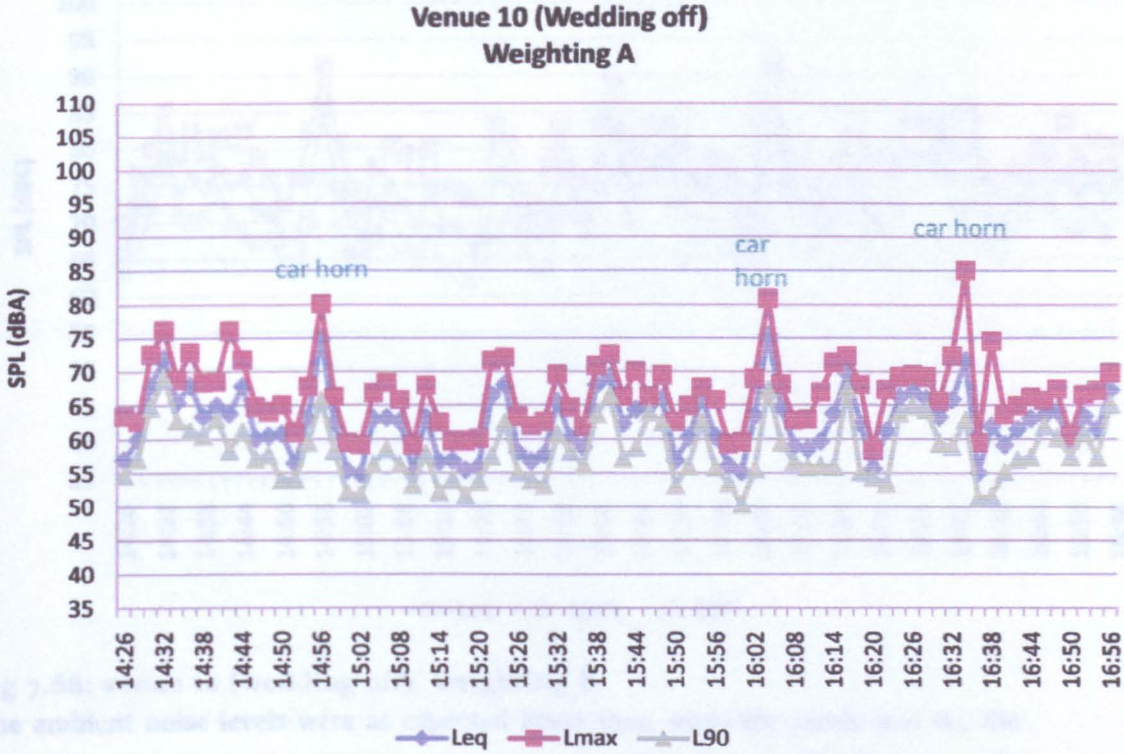


Fig 7.67: venue 10 (wedding off), weighting A

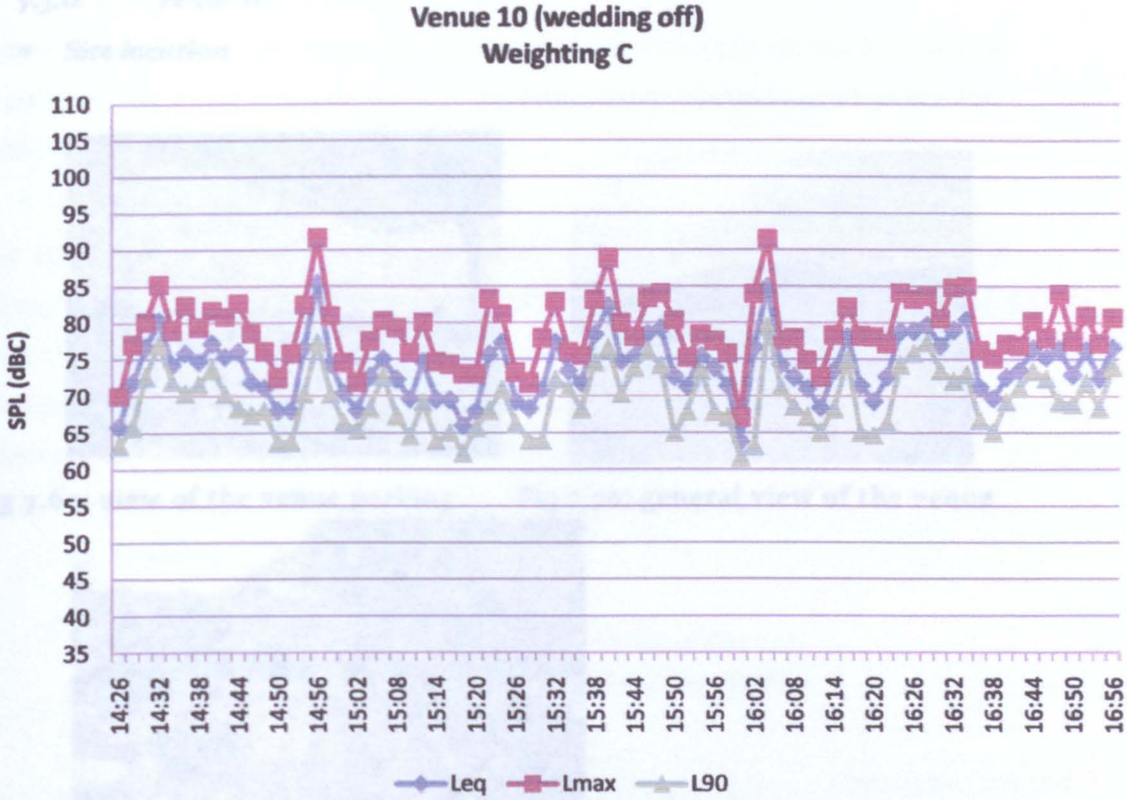


Fig 7.68: venue 10 (wedding off), weighting C

The ambient noise levels were as expected lower than when the music was on, the LAeq peaked at 65.9 dBA while the LAmax hit 85.1 dBA. L90 was between 54.4 dBA and 66.2 dBC.

7.3.11 Venue 11

- ***Site location***

Fig 7.69: view of the venue parking Fig 7.70: general view of the venue

Fig 7.71: venue's open windows

Fig 7.72: Arial view of the venue (X) and the mics (X) location

- ***Subjective Impressions of the Area***

The venue is a dedicated hall used for weddings and other type of parties, it is located in enclosed residential area near the sea. The venue has it own parking; therefore the traffic is not high and very quiet.

- ***Noise Survey Description***

The equipment was set up inside a detached bungalow opposite the venue. The microphones were calibrated before and after the each monitoring, only weighting A used in this monitoring one microphone inside and the other one outside the apartment with the window closed during the monitoring. The bungalow is newly built however; it has single glazing windows and no insulated external walls.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

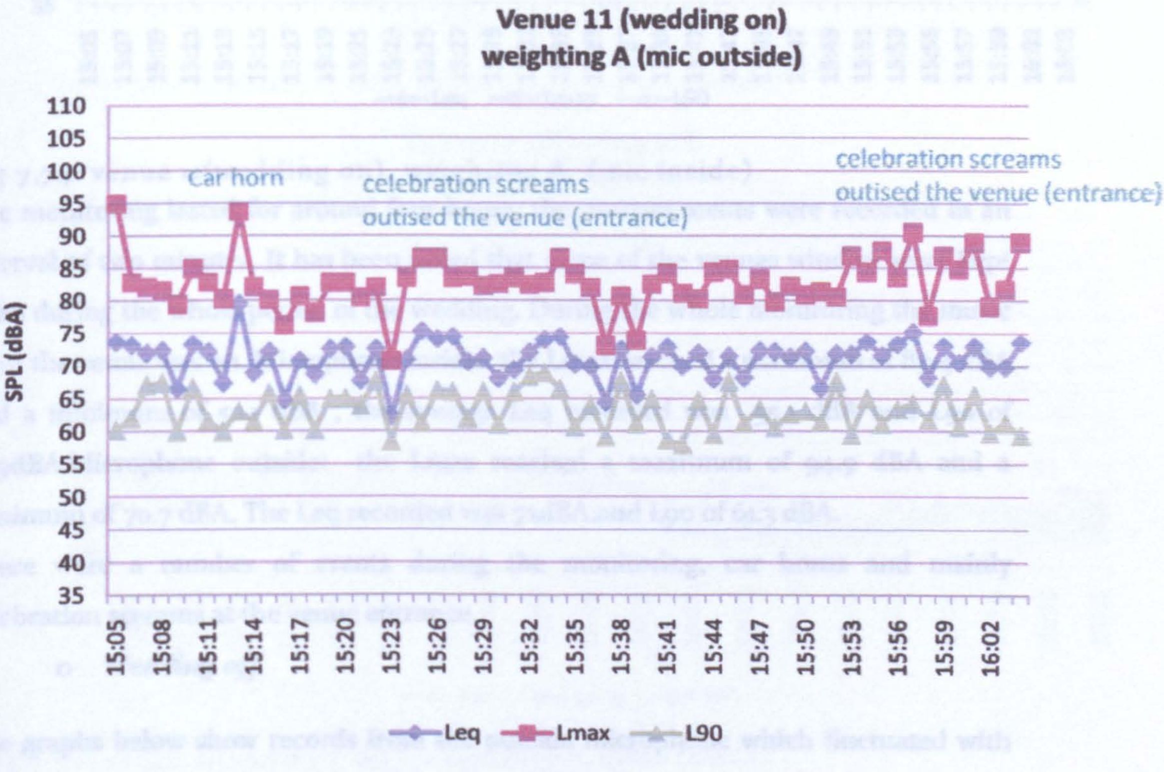


Fig 7.73: venue 11(wedding on), weighting A, (mic outside)

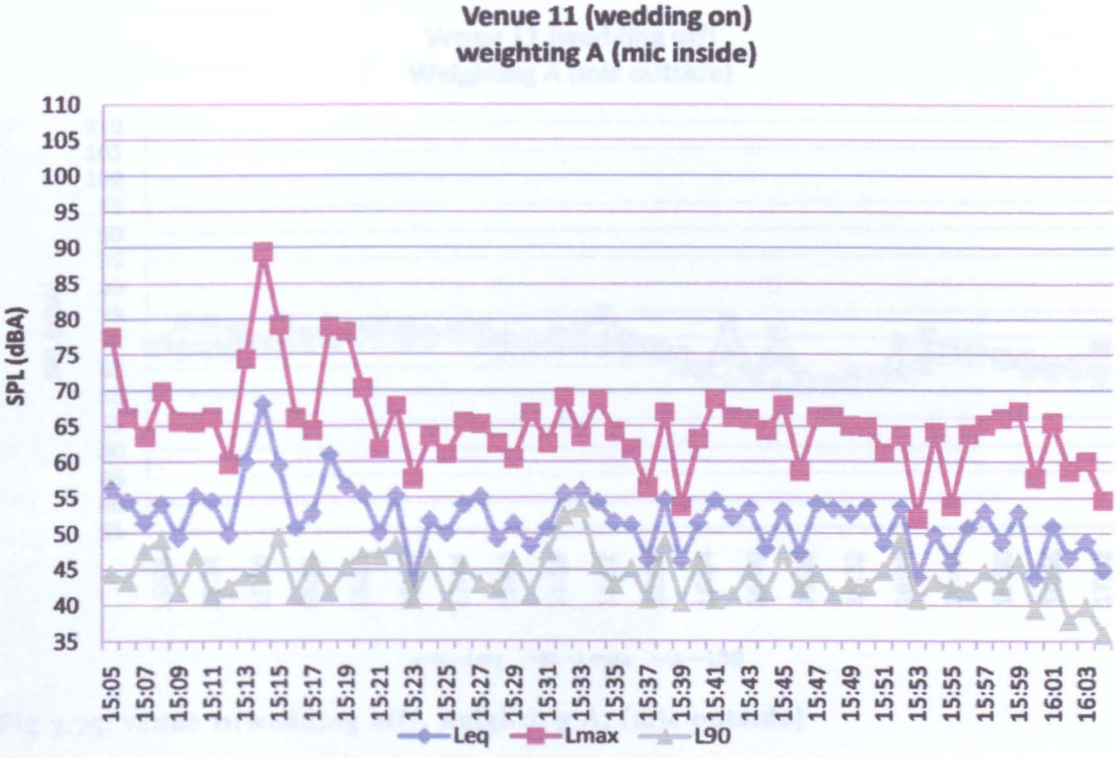


Fig 7.74: venue 11(wedding on), weighting A, (mic inside)

The monitoring lasted for around four hours; the measurements were recorded in an interval of two minutes. It has been noted that some of the venues window were kept open during the whole period of the wedding. During the whole monitoring the music from the venue was on. Microphone inside: the Lmax reached a maximum of 89.4 dBA and a minimum of 52.1 dBA , the average Leq recorded was 55.1 dBA and L90 of 41.9dBA.Microphone outside: the Lmax reached a maximum of 94.9 dBA and a minimum of 70.7 dBA. The Leq recorded was 72dBA.and L90 of 61.3 dBA.

There were a number of events during the monitoring, car horns and mainly celebration screams at the venue entrance.

- ***Wedding off***

The graphs below show records from the outside microphone which fluctuated with 80dBA of LAmax and LAeq of 61.3 dBA and a background noise of 56dBA.

Whereas the microphone located inside the apartment showed a values of 46.7 dBA for the LAeq and a relatively low figure of L90 with 35.7 dBA.

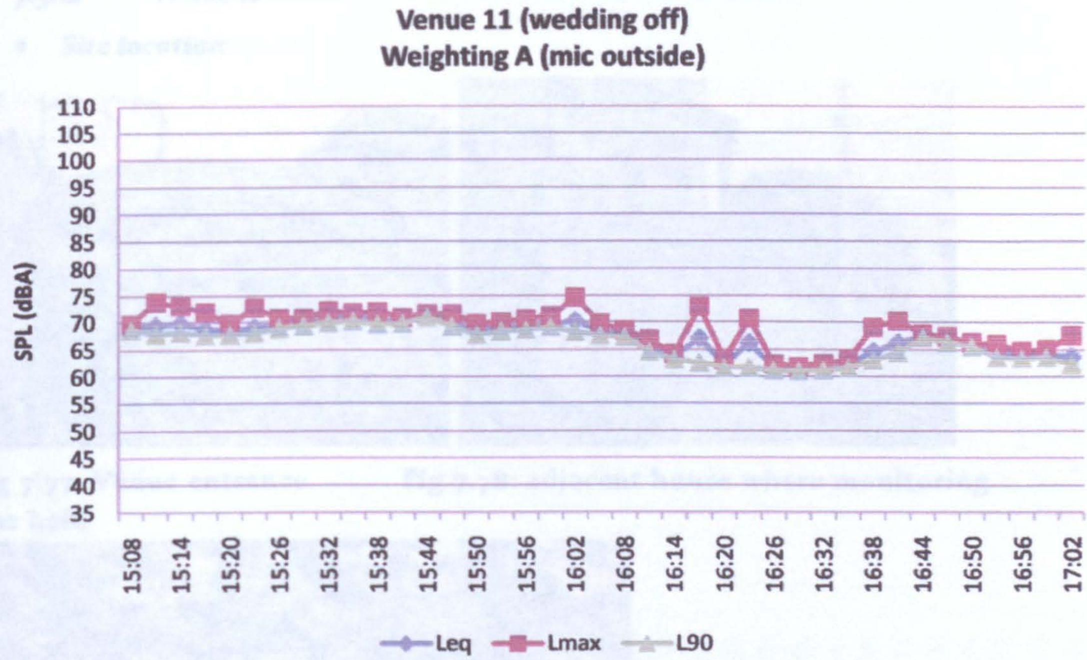


Fig 7.75: venue 11(wedding off), weighting A, (mic outside)

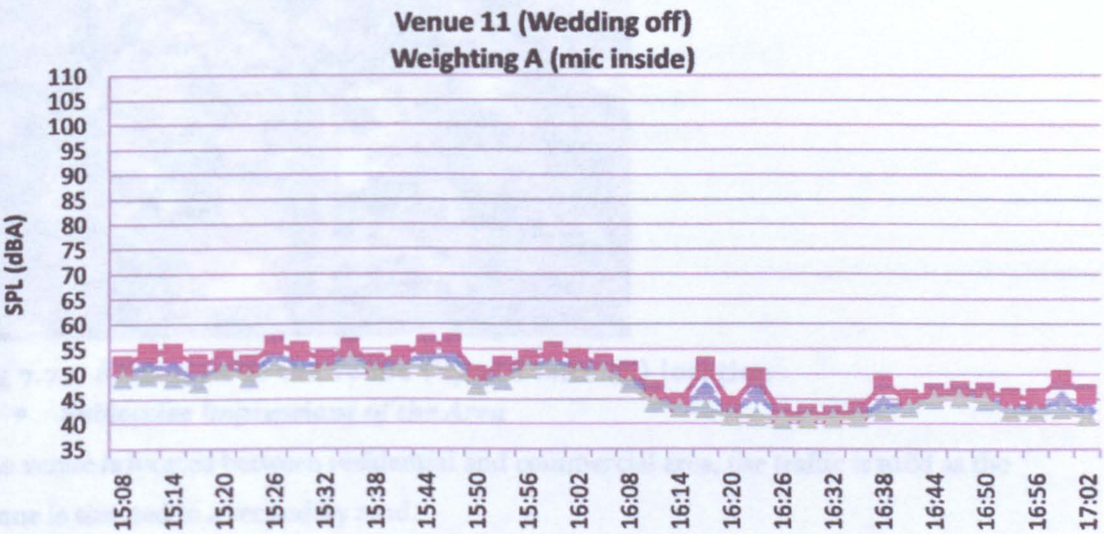


Fig 7.76: venue 11(wedding off), weighting A, (mic inside)

7.3.12 Venue 12

- ***Site location***

Fig 7.77: Venue entrance Fig 7.78: adjacent house where monitoring was held

Fig 7.79: Arial view of the venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The venue is located between residential and commercial area, the traffic is mild as the venue is situated in a secondary road.

- ***Noise Survey Description***

The equipment was set up inside a semi-detached house adjacent to the venue. The microphones were calibrated before and after the each monitoring, only weighting A used in this monitoring one microphone inside and the other one outside in the house courtyard. The house is approximately 10 and 20 years old with single glazing windows and no insulation for walls and floors.

- ***Environmental noise survey, results and observations***
  - ***wedding on***

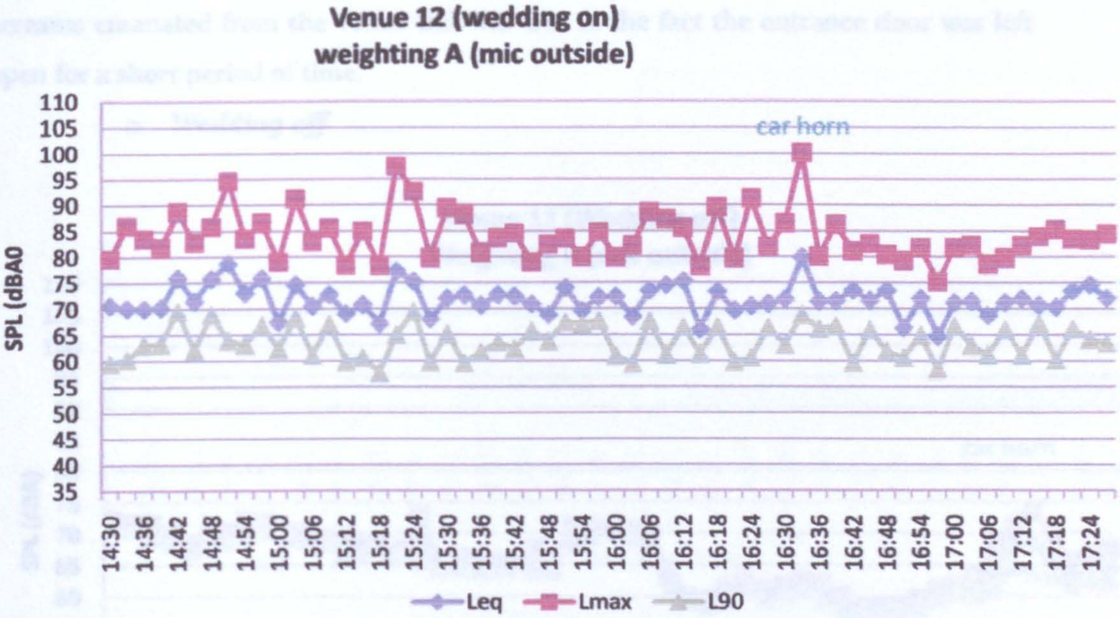


Fig 7.80: Venue 12 (wedding on), weighting A (mic outside)

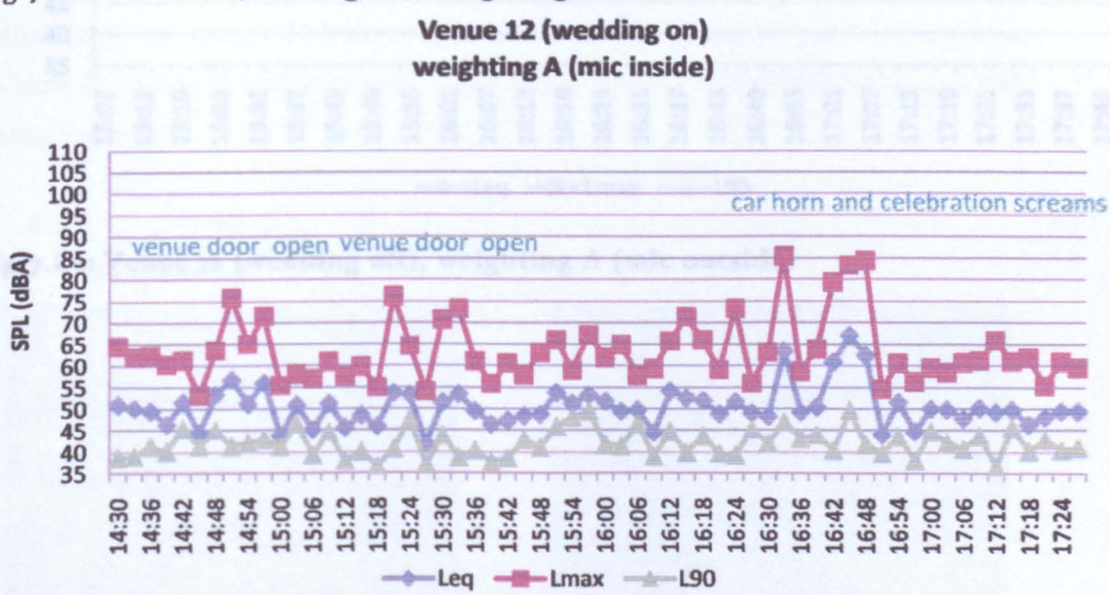


Fig 7.81: Venue 12 (wedding on), weighting A (mic inside)

The monitoring was undertaken at the end of the afternoon, the measurements were recorded in an interval of two minutes. During the whole monitoring the music from the venue was on.Microphone inside: the Lmax reached a maximum of 85.5 dBA and a minimum of 53.2 dBA , the Leq recorded was between 67.2dBA and 40.8 dBA. L90 recorded a figure of 40.2 dBA. Microphone outside: the Lmax reached a maximum of 100.1 dBA and a minimum of 75.2 dBA. The Leq recorded was between 64.7 dBA and 80 dBA. L90 recorded was around 61.8 dBA . The main event was mainly celebration screams emanated from the venue this was due to the fact the entrance door was left open for a short period of time.

- ***Wedding off***

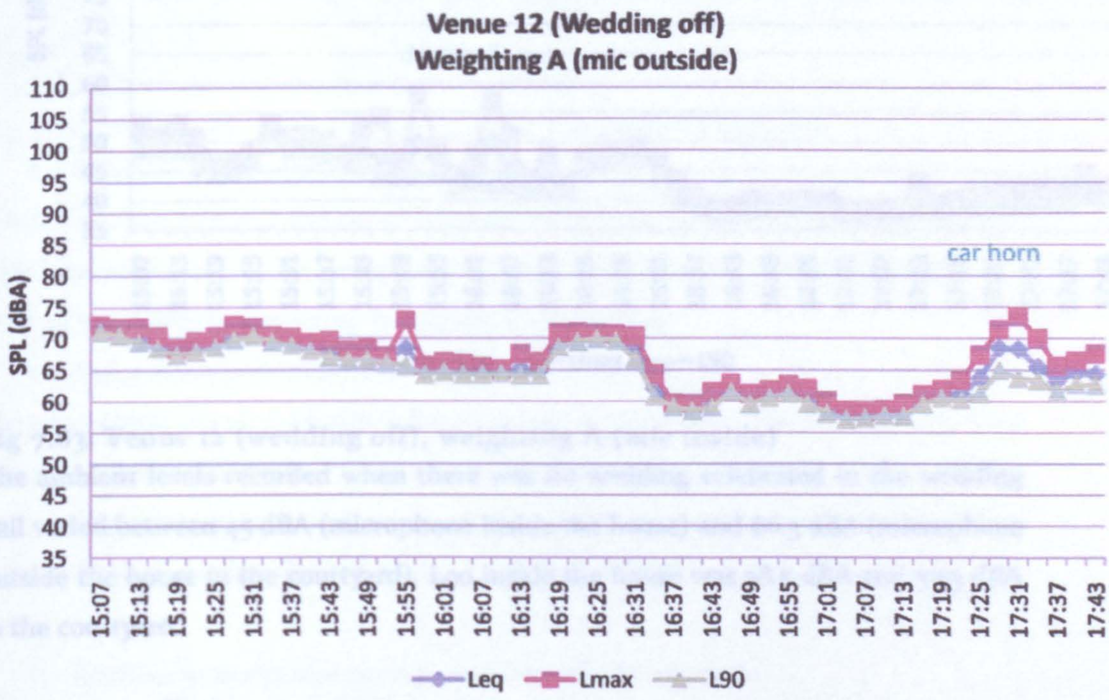


Fig 7.82: Venue 12 (wedding off), weighting A (mic outside)

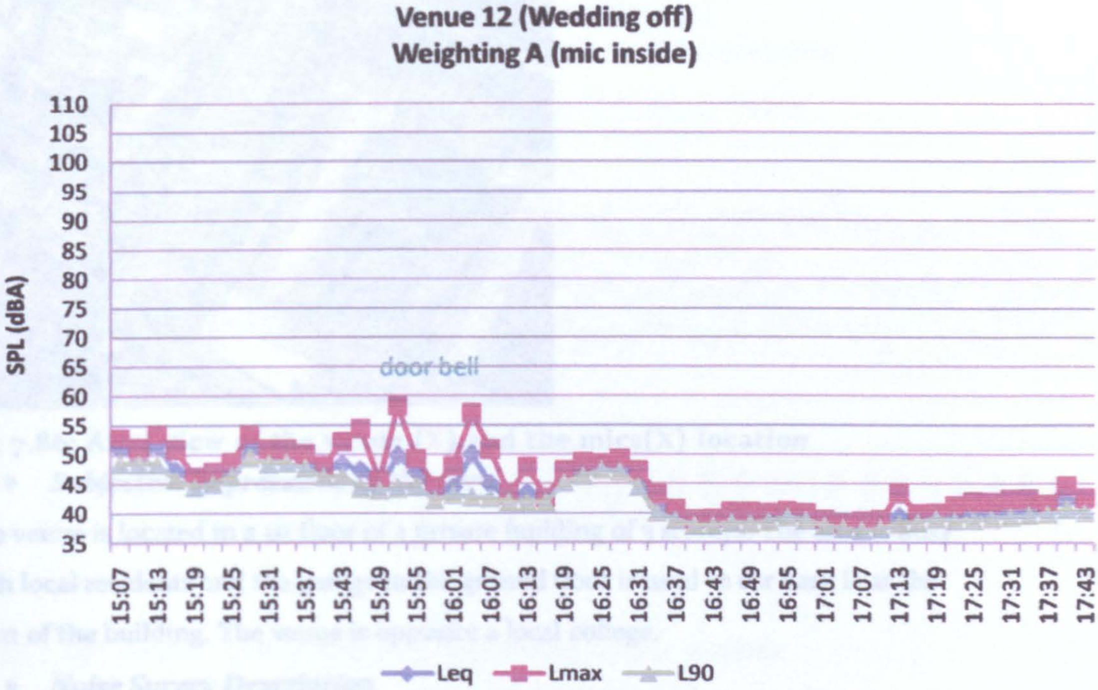


Fig 7.83: Venue 12 (wedding off), weighting A (mic inside)

The ambient levels recorded when there was no wedding celebrated in the wedding hall varied between 45 dBA (microphone inside the house) and 66.3 dBA (microphone outside the house in the courtyard). L90 inside the house was 38.5 dBA and 59.3 dBA in the courtyard.

7.3.13 *Venue 13*

- ***Site Location***

Fig 7.84 Front façade of the venue

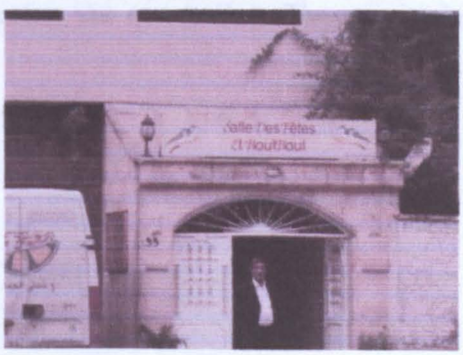


Fig 7.85: main entrance of the venue

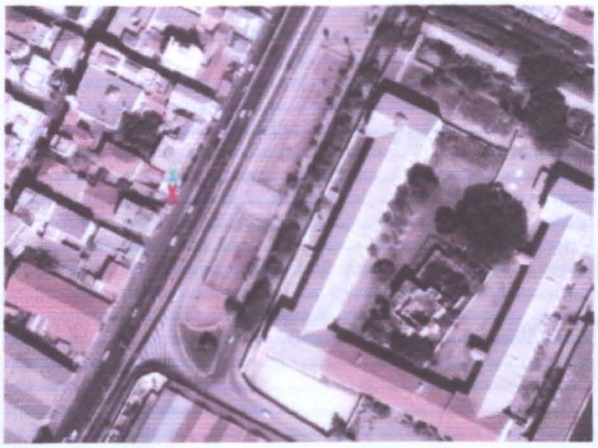


Fig 7.86: Arial view of the venue (X) and the mics(X) location

- ***Subjective Impressions of the Area***

The venue is located in a 1st floor of a private building of 3 storeys. The area is busy with local residents and the garage in the ground floor is used as car park is at the front of the building. The venue is opposite a local college.

- ***Noise Survey Description***

The equipment was set up inside a flat overlooking the venue. The microphones were calibrated before and after the each monitoring, only weighting A used in this monitoring one microphone inside and the other one outside in the attached to a balcony balustrade. The Flat has single glazing and with no n insulated cavity wall.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

The windows of the flat were kept closed during the monitoring. The monitoring started at around 8pm and ended after 1:30 am.

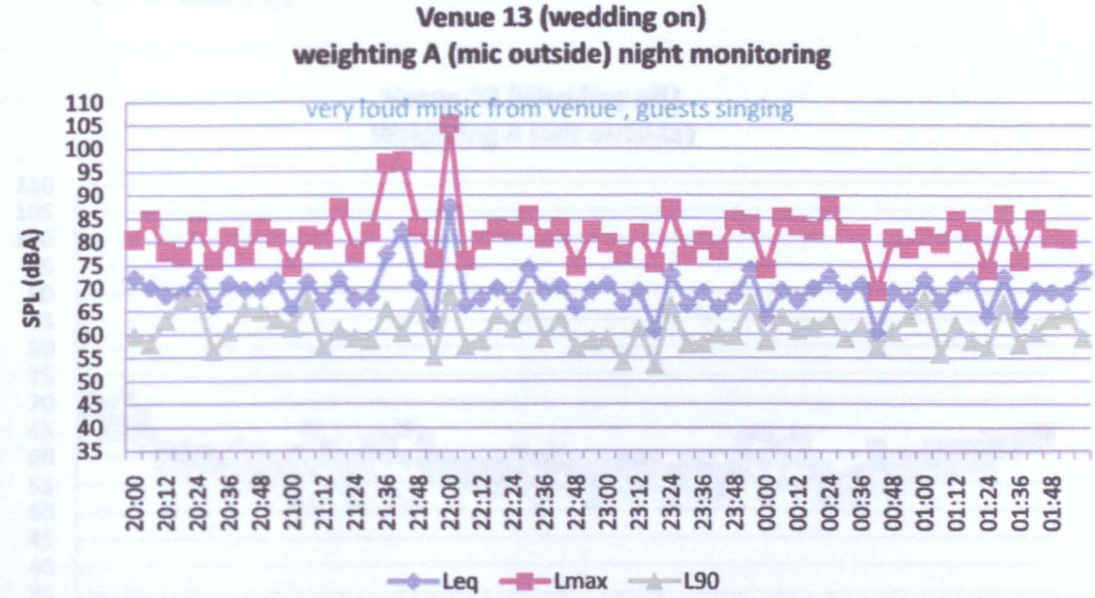


Fig 7.87: Venue 13 (wedding on), weighting A, mic outside

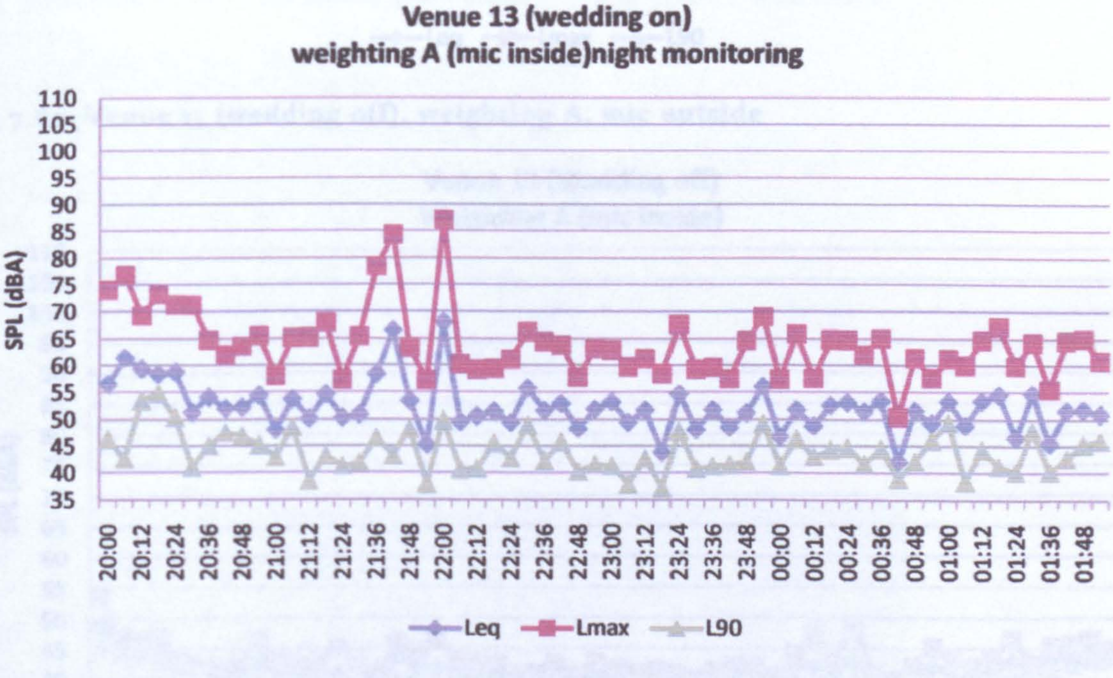


Fig 7.88: Venue 13 (wedding on), weighting A, mic inside

The highest level of noise recorded was LAmax 87.1 dB (inside microphone) and LAmax 105.3 dB (outside microphone) and this was due to a noise incident coming from the venue mainly music and singing. The LAeq averaged around 55.9dB (inside microphone) and LAeq 73.4 dB (outside microphone) while the background level was 41.9 dB (inside microphone) and 59.3 dB (outside microphone)

- *Wedding off*

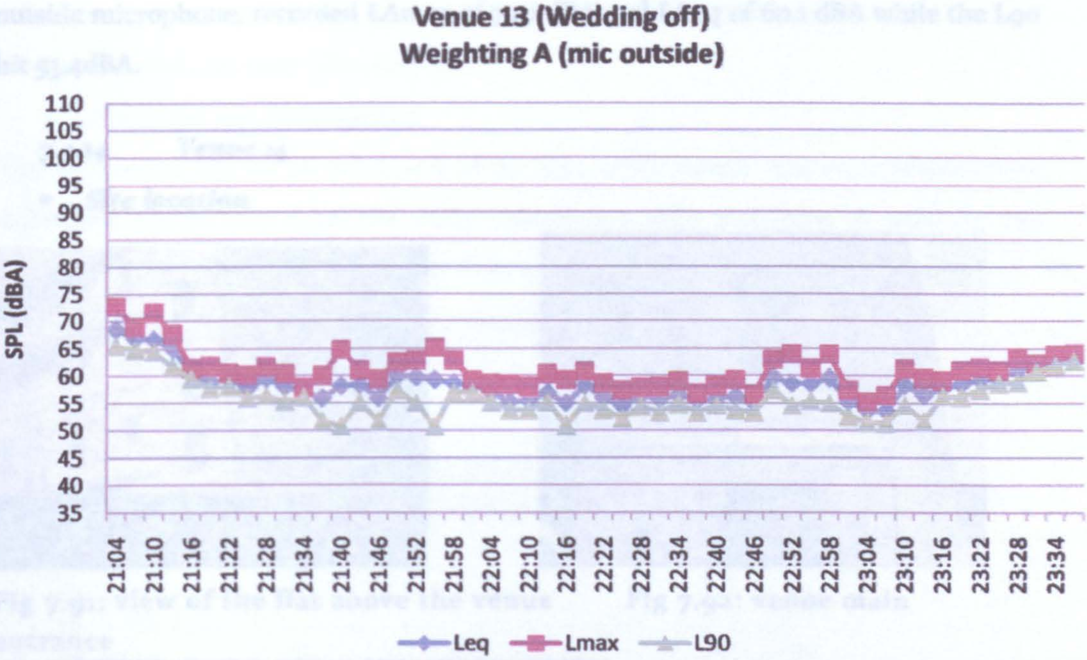


Fig 7.89: Venue 13 (wedding off), weighting A, mic outside

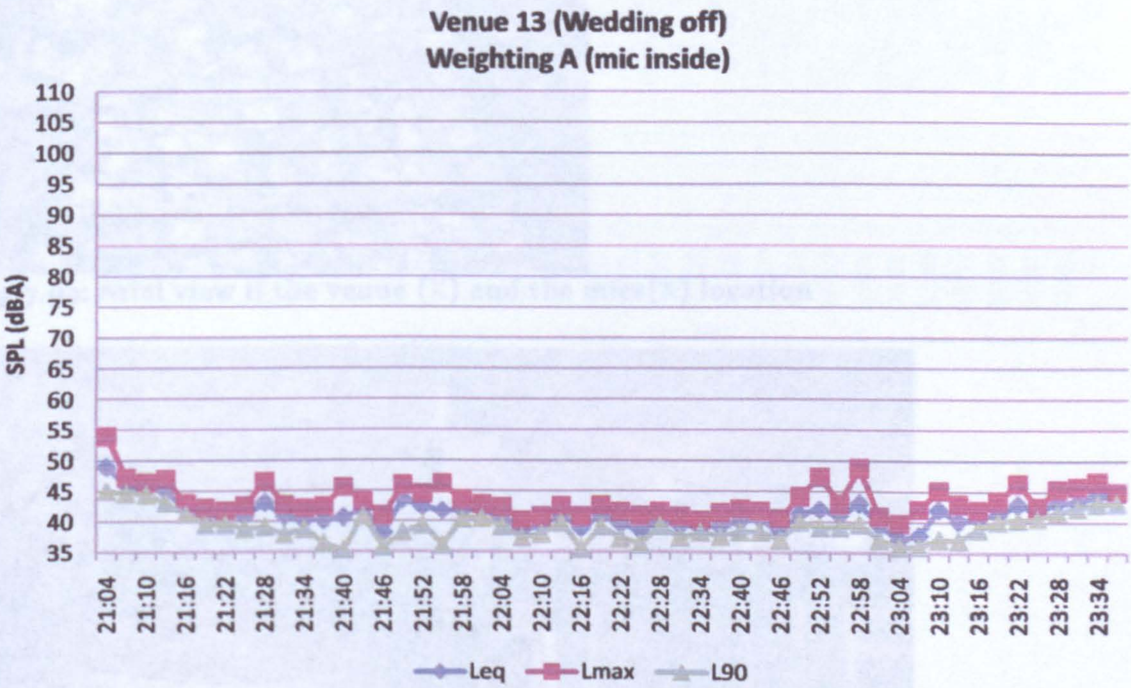


Fig 7.90: Venue 13 (wedding off), weighting A, mic inside

The monitoring was undertaken during the evening, with the same conditions as when the wedding was on. The microphones were set in the same position and the windows of the flat were kept closed during the measurements. The levels on LAeq inside the apartment reached 42 dBA with LA90 value of 37.3 dBA. Measurements taken from the outside microphone, recorded LAmax of 72.7 dBA and LAeq of 60.1 dBA while the L90 hit 53.4dBA.

7.3.14 Venue 14

- ***Site location***

Fig 7.91: view of the flat above the venue   Fig 7.92: venue main entrance

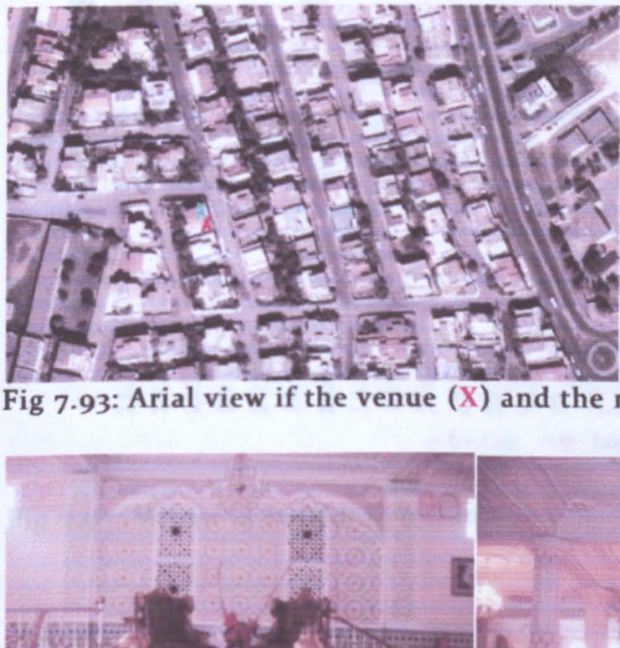


Fig 7.93: Arial view if the venue (X) and the mics(X) location

Fig 7.94: view of the venue inside

- ***Subjective Impressions of the Area***

The venue is located in residential; the venue is surrounded by private houses and close to a primary school. The venue is not managed by the landlord but it has been rented to another person who runs it.

- ***Noise Survey Description***

The equipment was set up inside one of the flats to the venue. The microphones were calibrated before and after the each monitoring, only weighting A used in this monitoring one microphone inside and the other one outside in the flats balcony.

- ***Environmental noise survey, results and observations***
  - ***Wedding on***

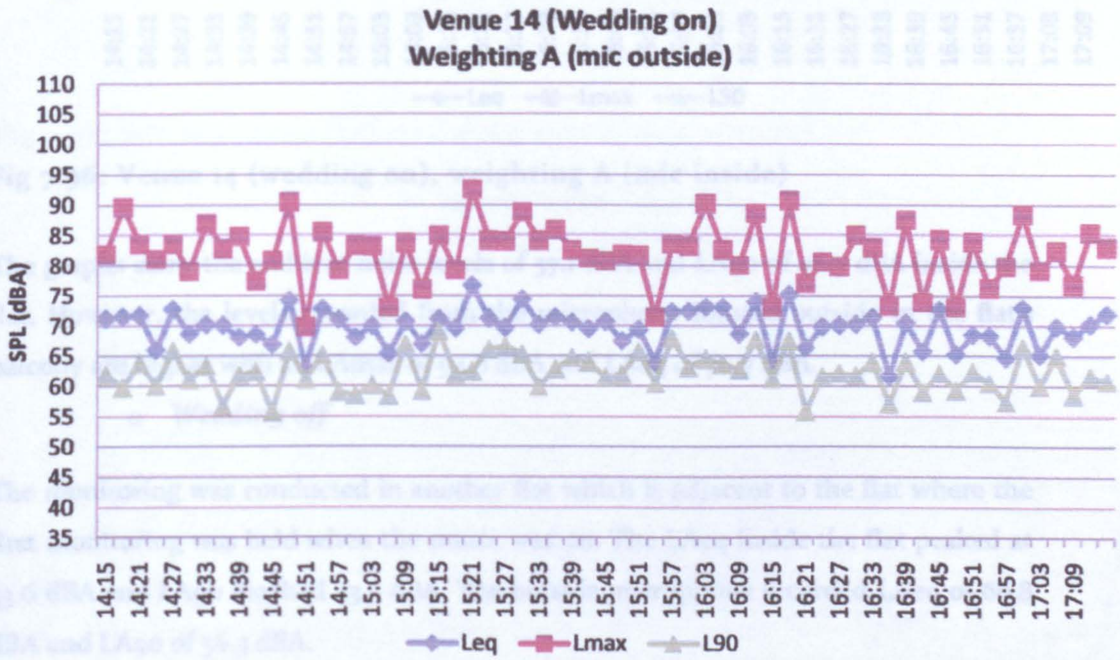


Fig 7.95: Venue 14 (wedding on), weighting A (mic outside)

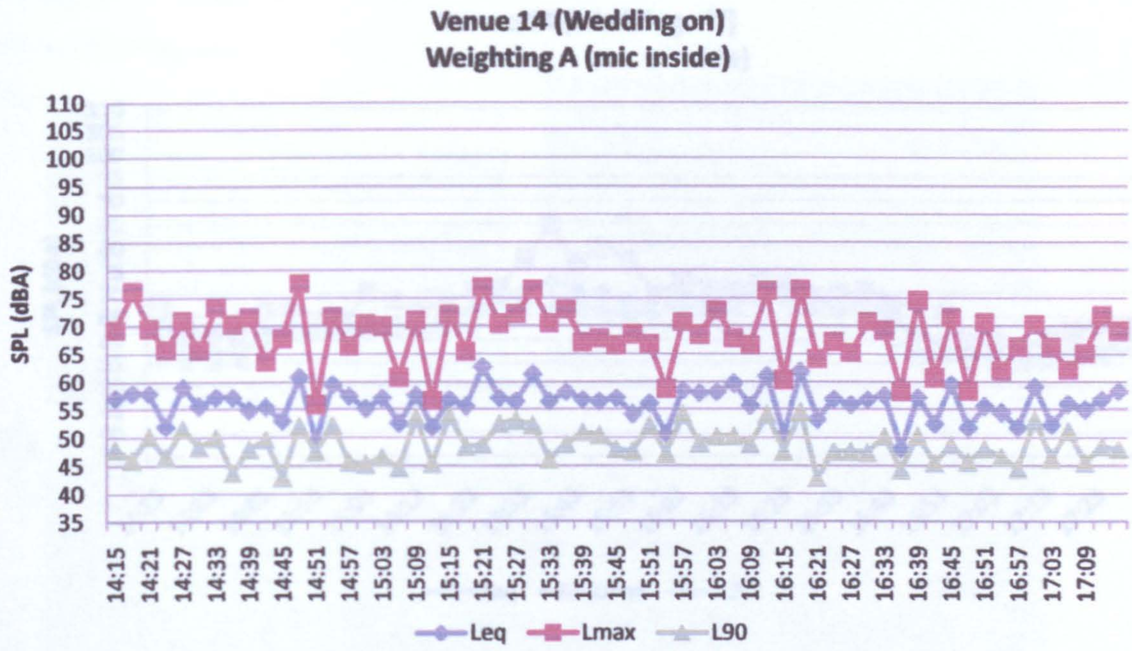


Fig 7.96: Venue 14 (wedding on), weighting A (mic inside)

The graphs show the ambient noise levels of 57.1 dBA and LA90 of 46.7 dBA inside the flat. However, the levels recorded from the microphone located outside in the flat's balcony are higher with an LAmax of 92.6 dBA and LAeq of 70.7 dBA.

- ***Wedding off***

The monitoring was conducted in another flat which is adjacent to the flat where the first monitoring was held when the music was on. The LAeq inside the flat peaked at 53.6 dBA and LA90 reached 43.5 dBA. The outside microphone recorded LAeq of 66.8 dBA and LA90 of 56.3 dBA.

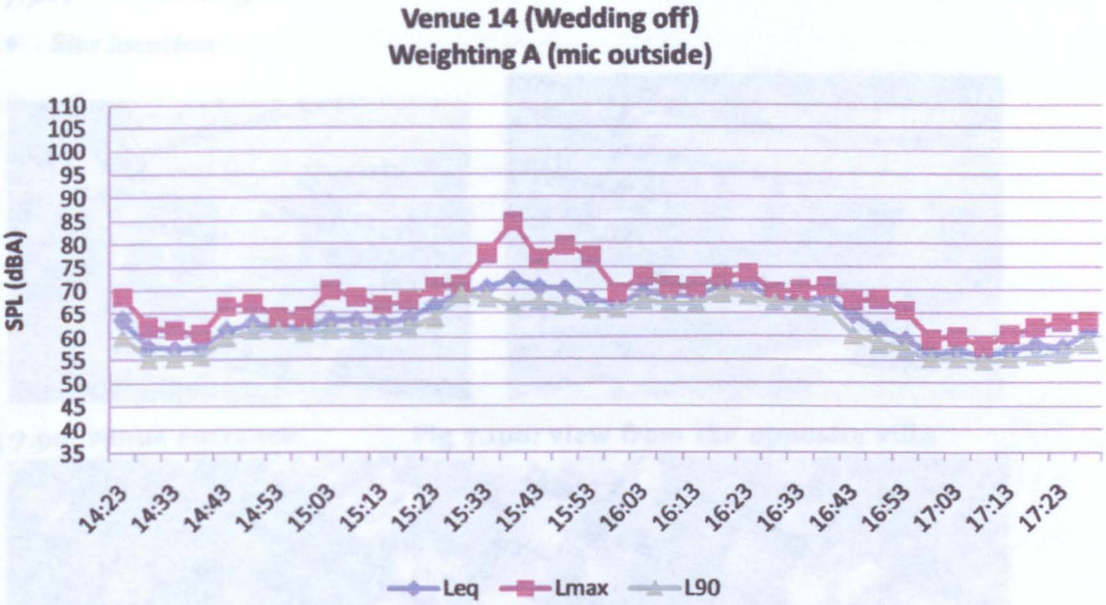


Fig 7.97: Venue 14 (wedding off), weighting A (mic outside)

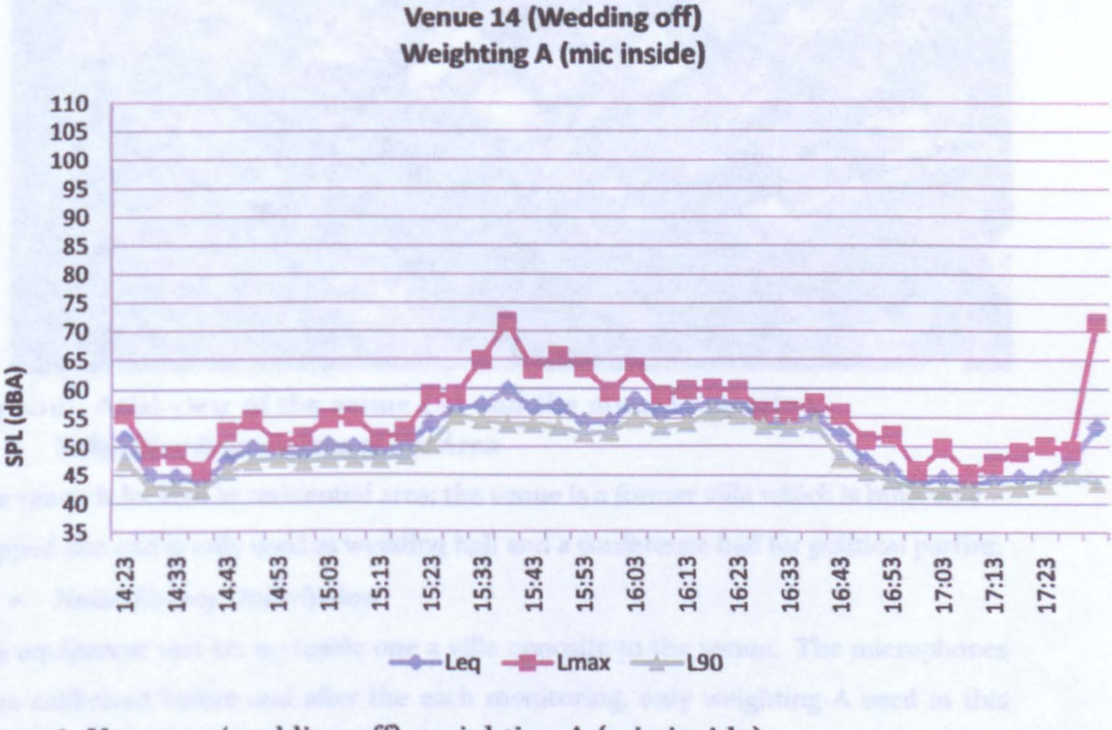


Fig 7.98: Venue 14 (wedding off), weighting A (mic inside)

7.3.15 *Venue 15*

- ***Site location***

Fig 7.99: venue entrance

Fig 7.100: view from the opposite villa

Fig 7.101: Arial view of the venue (X) and the mics(X) location

- ***Subjective Impressions of the Area***

The venue is located in residential area; the venue is a former villa which is built on a slopped site and is only used as wedding hall and a conference hall for political parties.

- ***Noise Survey Description***

The equipment was set up inside one a villa opposite to the venue. The microphones were calibrated before and after the each monitoring, only weighting A used in this monitoring one microphone inside and the other one outside in the terrace.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

The monitoring was undertaken during the evening time between 8:30 pm to 12:30pm, the measurements were recorded in an interval of two minutes.

During the whole monitoring the music from the venue was on.

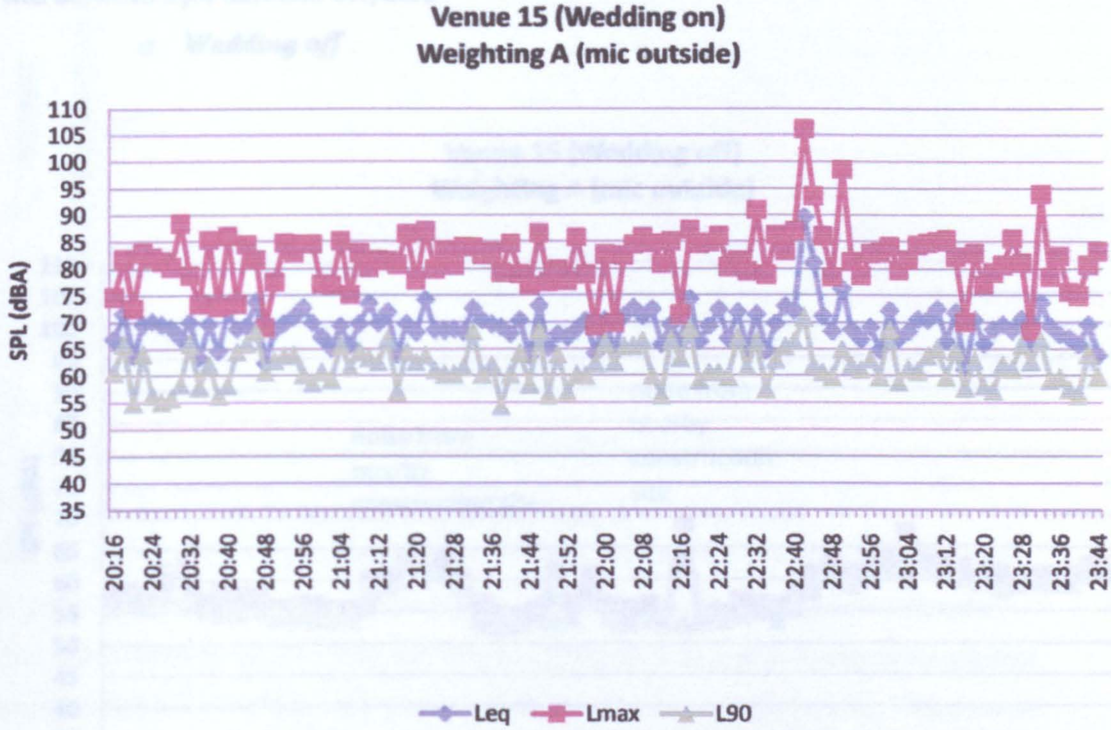


Fig 7.102: Venue 15 (wedding on), weighting A (mic outside)

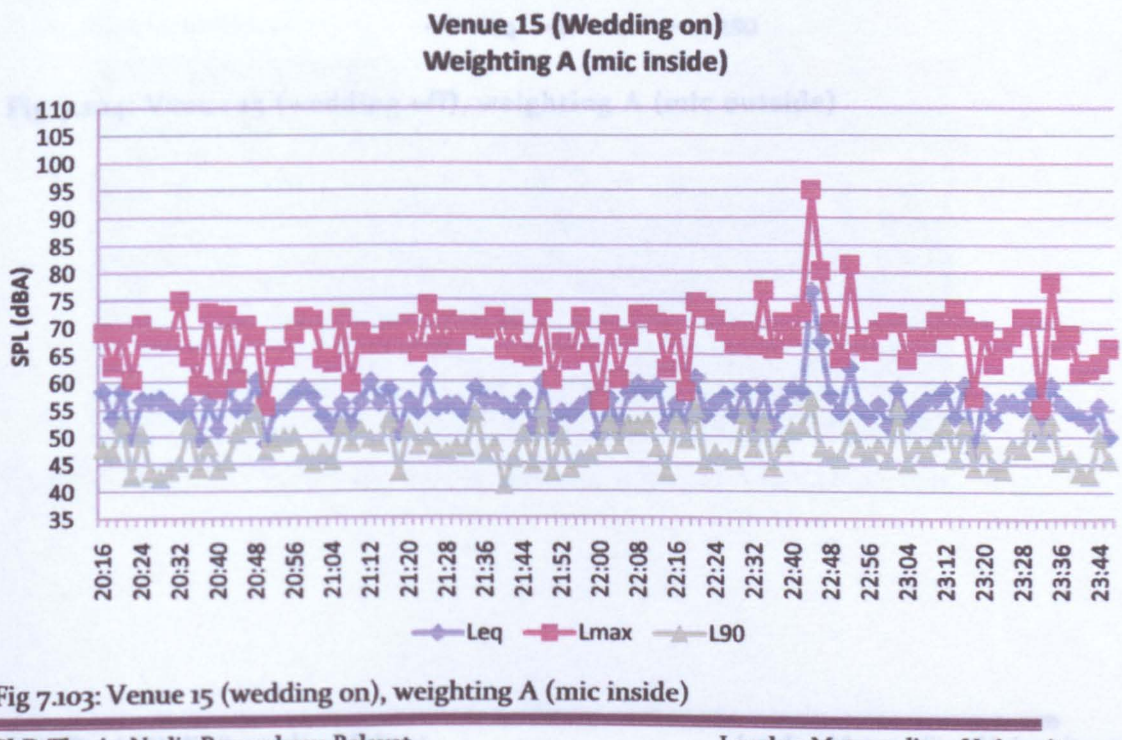


Fig 7.103: Venue 15 (wedding on), weighting A (mic inside)

Microphone inside: the Lmax reached a maximum of 95.1 dBA and a minimum of 56.2dBA, the Leq recorded was between 76.6 dBA and 53 dBA.Microphone outside: the Lmax reached a maximum of 106.2 dBA and a minimum of 69.5 dBA. The Leq recorded was between 89.6 dBA and 66.7dBA.

- ***Wedding off***

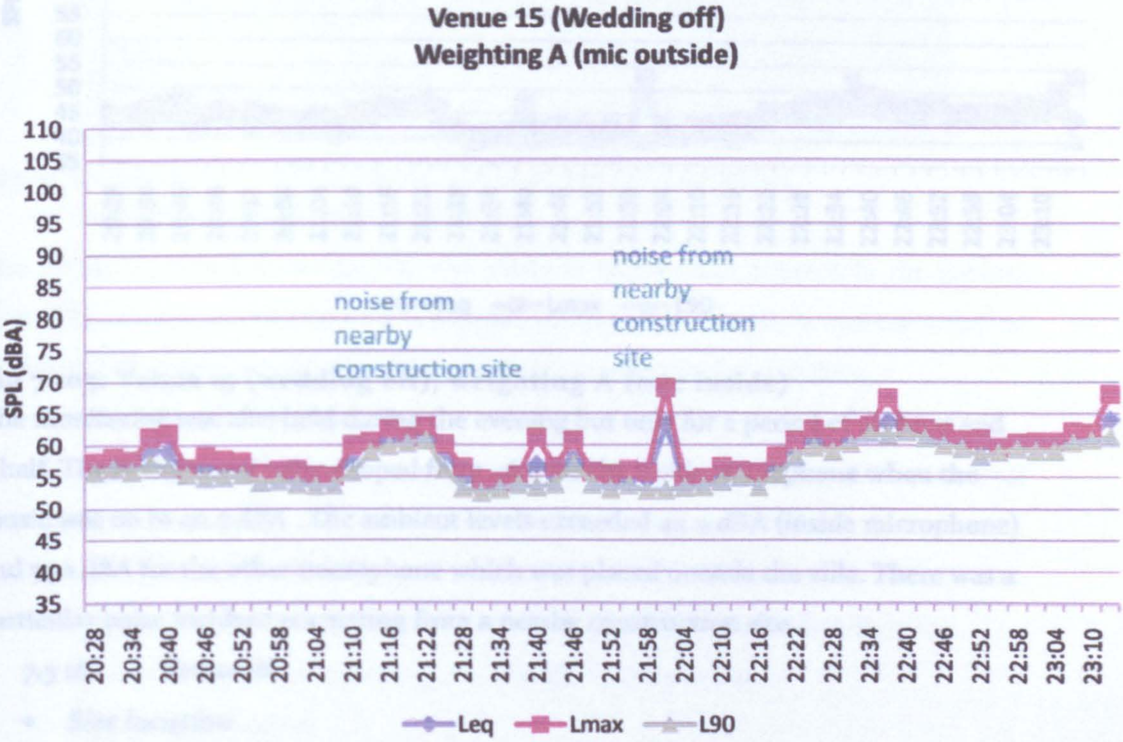


Fig 7.104: Venue 15 (wedding off), weighting A (mic outside)

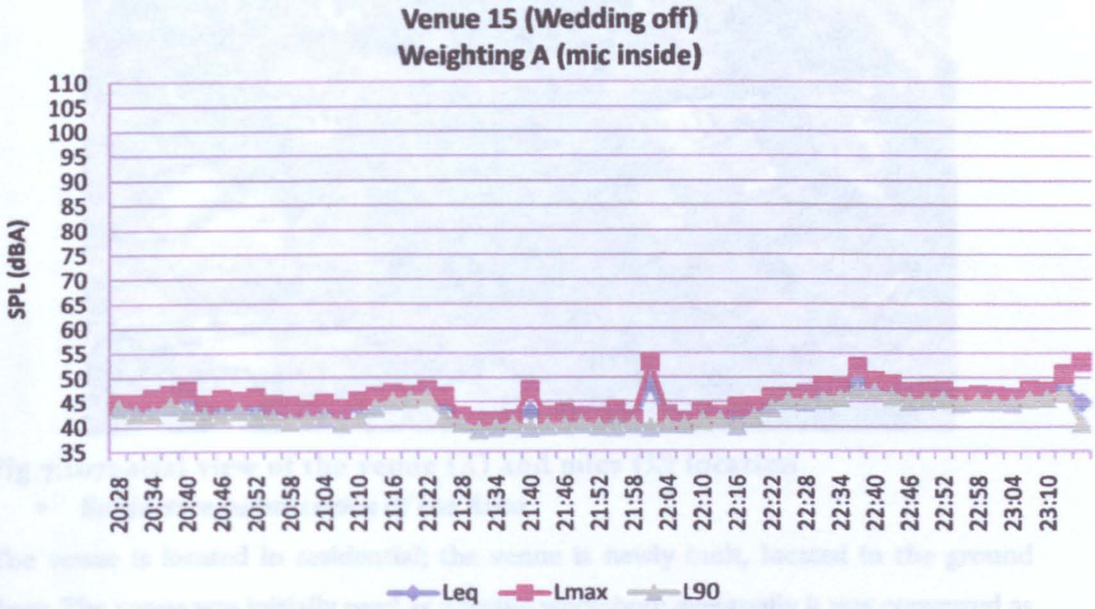


Fig 7.105: Venue 15 (wedding off), weighting A (mic inside)

The monitoring was also held during the evening but only for a period of an hour and a half. The background value droped from 46.2 for the inside microphone when the music was on to 40.7 dBA . The ambient levels exceeded 44.9 dBA (inside microphone) and 59.1 dBA for the other microphone which was placed outside the villa. There was a particular noise incident emanating from a nearby construction site.

7.3 16 *Venue 16*

- ***Site location***

Fig 7.106: general view of the venue (ground floor) and the above flat.

Fig 7.107: arial view of the venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The venue is located in residential; the venue is newly built, located in the ground floor. The venue was initially used as a textile workshop; eventually it was converted as wedding hall and is rented for wedding celebrations only during day-time.

- ***Noise Survey Description***

The equipment was set up inside one of the flats above the venue. The flat has no wall finishes or any rendering and all windows are single glazing. The microphones were calibrated before and after the each monitoring, only weighting A used in this monitoring one microphone inside and the other one outside in the flats balcony.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

The monitoring was undertaken during the afternoon time between 14:00 pm to 19:50pm, the measurements were recorded in an interval of two minutes.

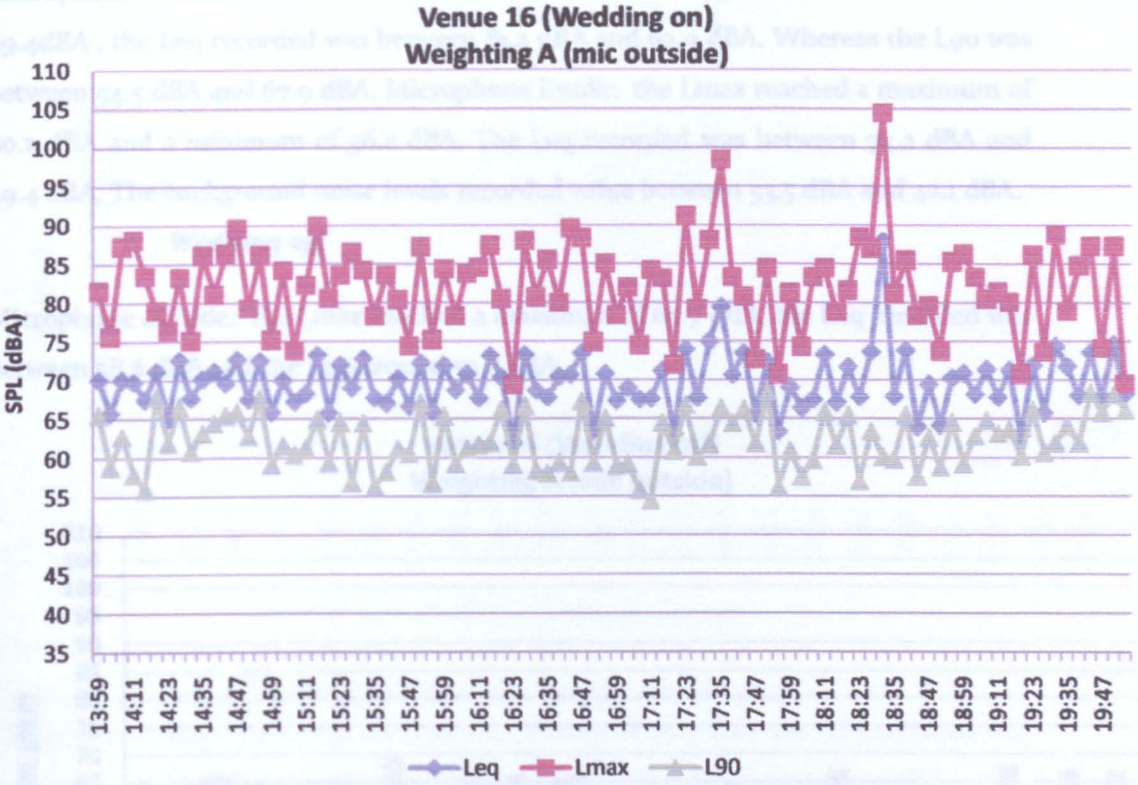


Fig 7.108: Venue 16 (wedding on), weighting A (mic outside)

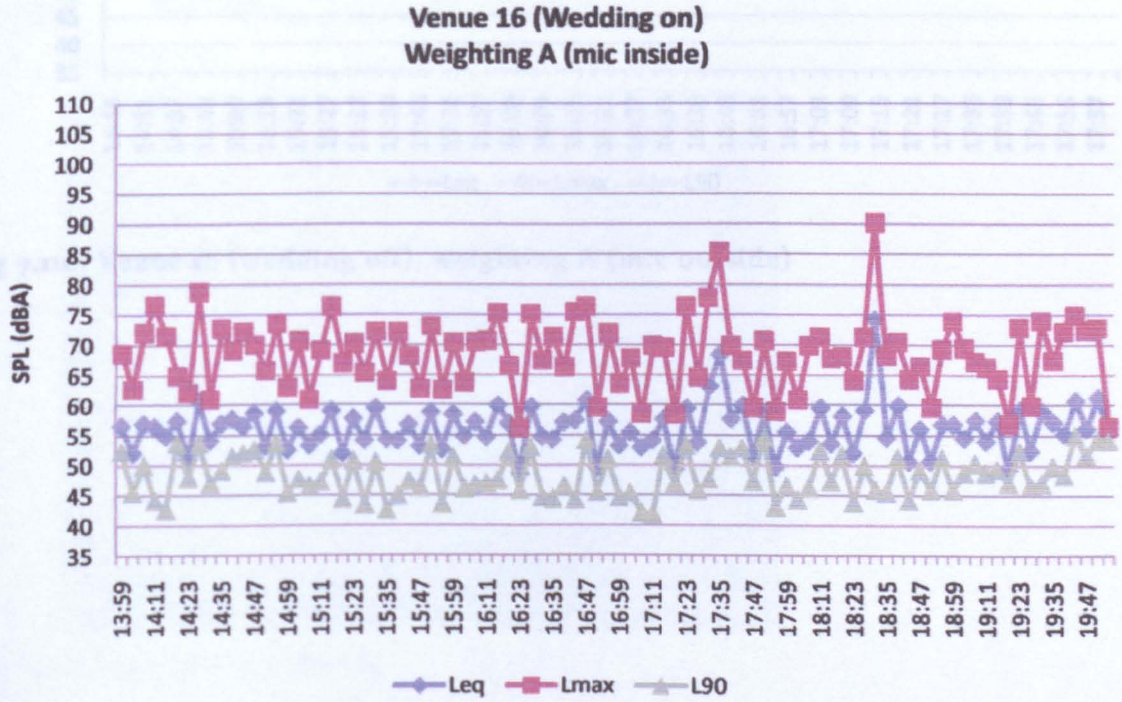


Fig 7.109: Venue 16 (wedding on), weighting A (mic inside)

Microphone outside: the Lmax reached a maximum of 104.5 dBA and a minimum of 69.4dBA , the Leq recorded was between 81.2 dBA and 62.9 dBA. Whereas the L90 was between 54.5 dBA and 67.9 dBA. Microphone inside: the Lmax reached a maximum of 90.2 dBA and a minimum of 56.2 dBA. The Leq recorded was between 74.2 dBA and 49.4 dBA. The background noise levels recorded value between 53.5 dBA and 42.1 dBA.

- ***Wedding off***

Microphone outside: the Lmax reached a maximum of 67.7 dBA, the Leq recorded was between 58.6 dBA and the L90 around 53.8 dBA.

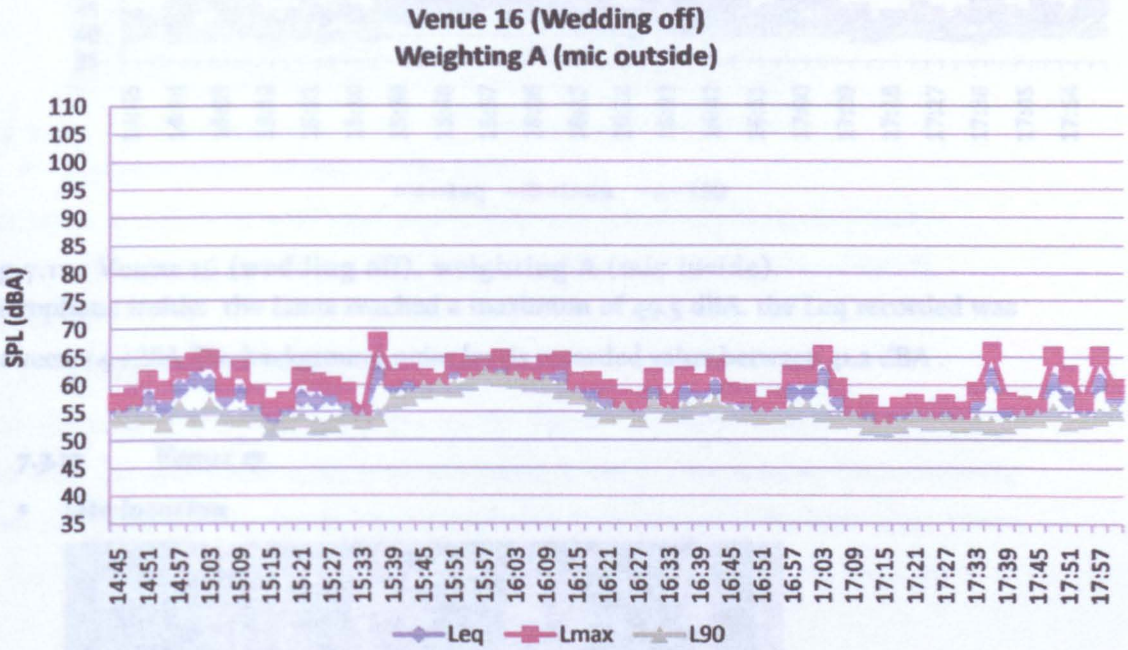


Fig 7.110: Venue 16 (wedding off), weighting A (mic outside)

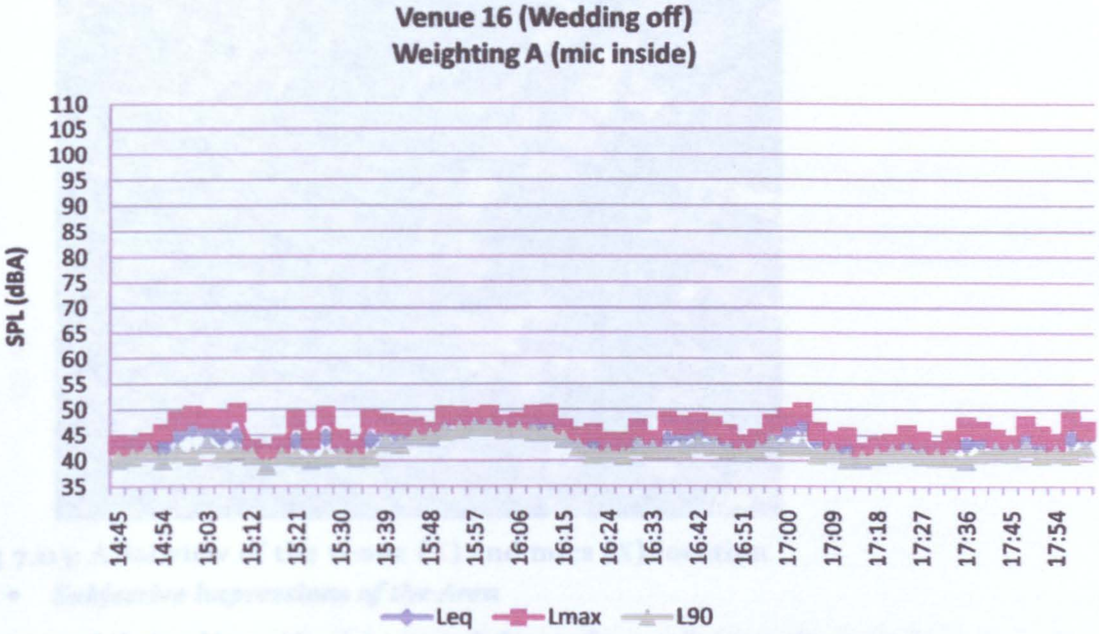


Fig 7.111: Venue 16 (wedding off), weighting A (mic inside)

Microphone inside: the Lmax reached a maximum of 49.5 dBA. the Leq recorded was between 44.4dBA.The background noise levels recorded value between 41.2 dBA .

7.3.17 *Venue 17*

- ***Site location***

Fig 7.112: venue main entrance

Fig 7.113: Arial view of the venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The venue is located in residential area and close to few retail shops, the venue is newly built building and the landlord assured us that the building is acoustically insulated.

- ***Noise Survey Description***

The equipment was set up inside the venue. The microphones were calibrated before and after the each monitoring, both weighting A and C were used in this monitoring both of them inside the venue. The microphones were located at the back of the venue in the courtyard. Windows of the venue overlooking the courtyard were often open.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

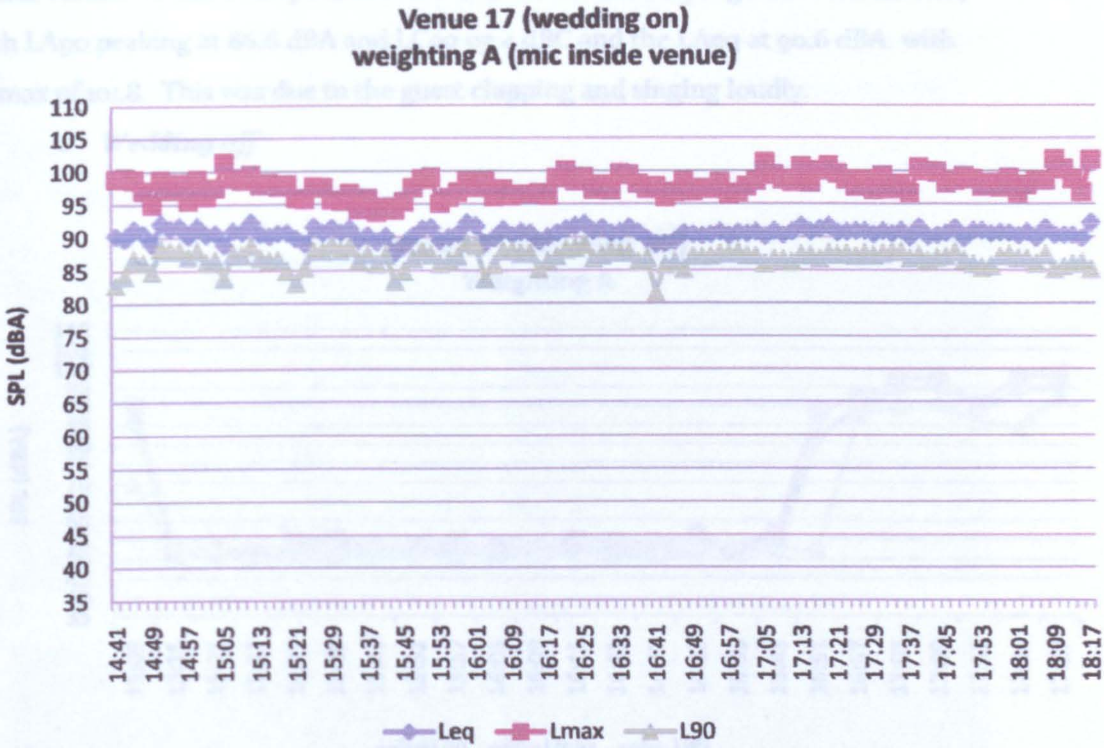


Fig 7.114: venue17 (wedding on), weighting A

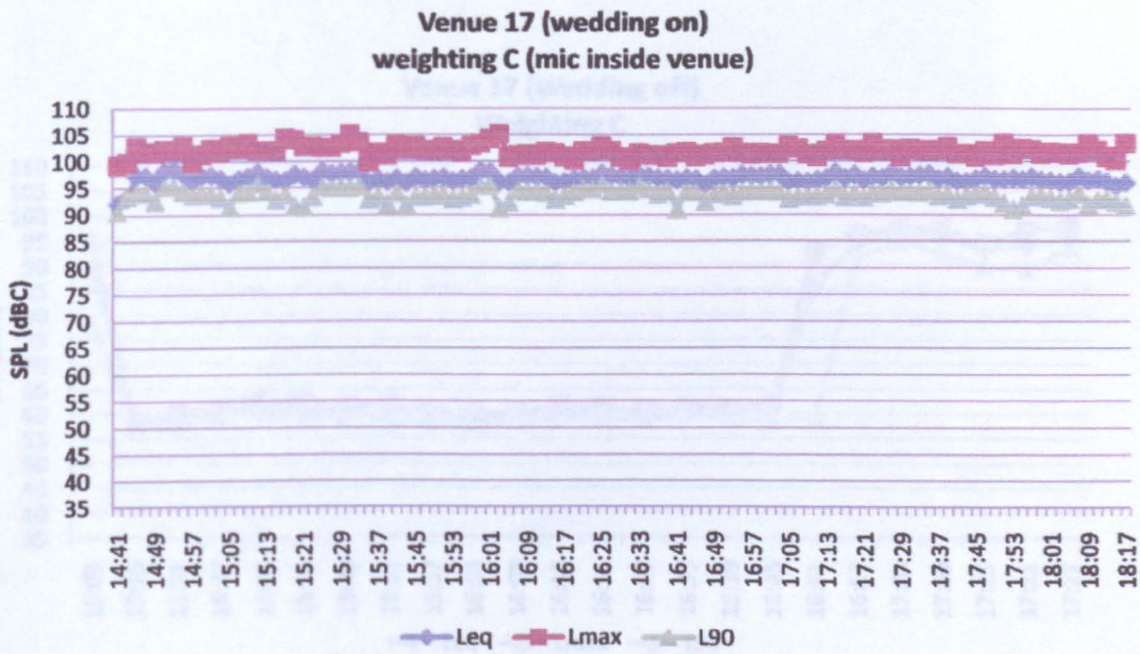


Fig 7.115: venue17 (wedding on) weighting C

In this record we can clearly see that the three traces are very high than the normal, with LA90 peaking at 86.6 dBA and LC90 93.4 dBC and the LAeq at 90.6 dBA with LAmax of 101.8. This was due to the guest clapping and singing loudly.

- ***Wedding off***

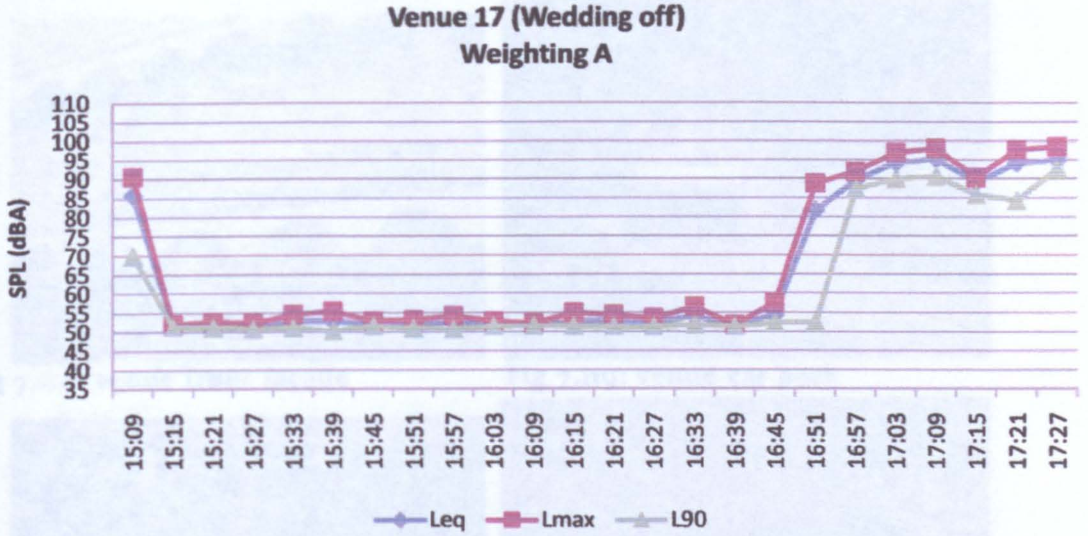


Fig 7.116: venue17(wedding off), weighting A

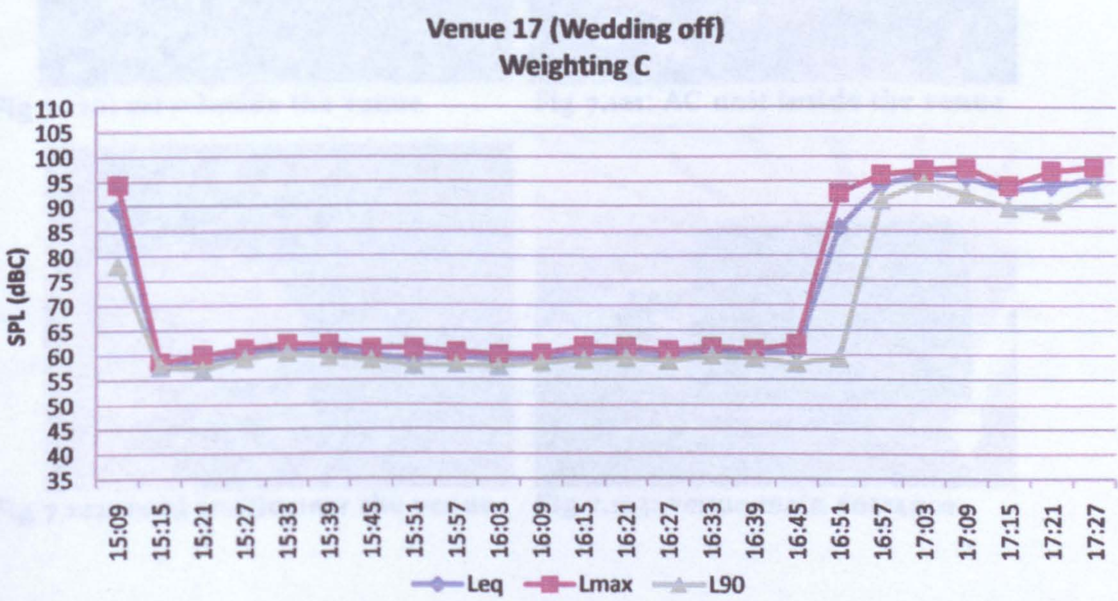


Fig 7.117: venue17 wedding off weighting C

The microphones were kept at the same position as it was when the wedding was on.

During this monitoring the landlord was testing the speakers at the start of the measurements and at the end as well this explains the high levels of LAeq and LCeq which hit 87.7 and 89.3 dB. Between these two periods there were no noise events and the noise levels were almost stable with an LAeq of 54.4 dBA and LCeq of 60.6 dBC.

7.3.18 Venue 18

- ***Site location***

Fig 7.118: venue front façade

Fig 7.119: venue car park

Fig 7.120: view inside the venue

Fig 7.121: AC unit inside the venue

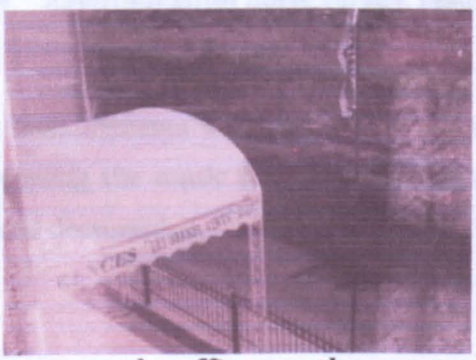


Fig 7.122: road traffic near the venue

Fig 7.123: venue main entrance

Fig 7.124: Arial view of the venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The venue is located in residential area, and it is close to a motorway junction. Car traffic is frequent.

- ***Noise Survey Description***

The microphones were calibrated before and after the each monitoring, both weighting A and C were used in this monitoring both of them inside the venue. The microphones were located at the back of the venue inside a small room with door left open all the time at about 30m away from the main speakers.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

The measurements were recorded in an interval of one minute. During the whole monitoring the music from the venue was on with short breaks but the speakers volume decreased.

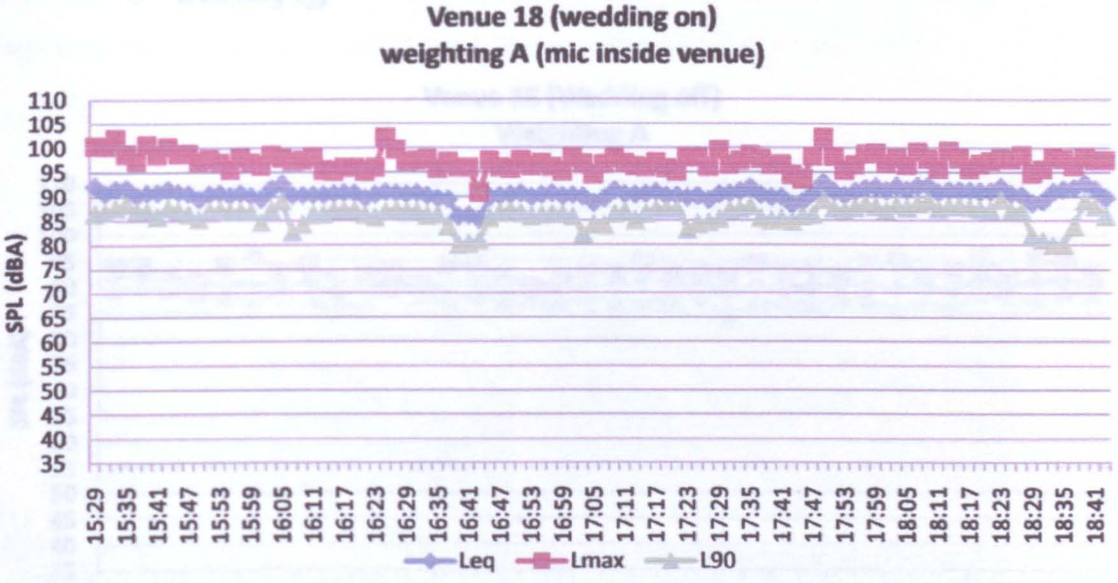


Fig 7.125: venue 18 (wedding on), weighting A

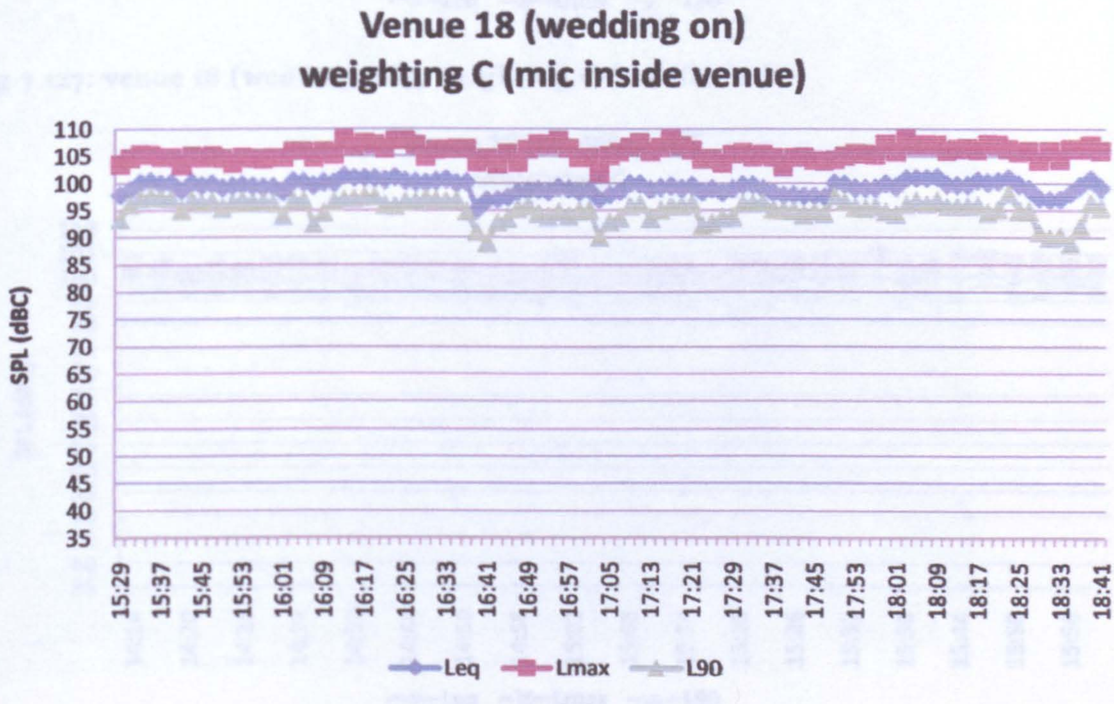


Fig 7.126: venue 18 (wedding on), weighting C

Microphone (A) : the Lmax reached a maximum of 102.1dBA and a minimum of 90.8dBA , the Leq recorded was between 90.7 dBA and 85.2dBA, L90 was as high as 85.8 dBA and 94.8 Microphone (C): the Lmax reached a maximum of 108.2 dBA and a minimum of 100 dBA. The Leq recorded was between 101.2 dBA and 95 dBA, L90 hit a value of 94.8 dBC.

- *Wedding off*

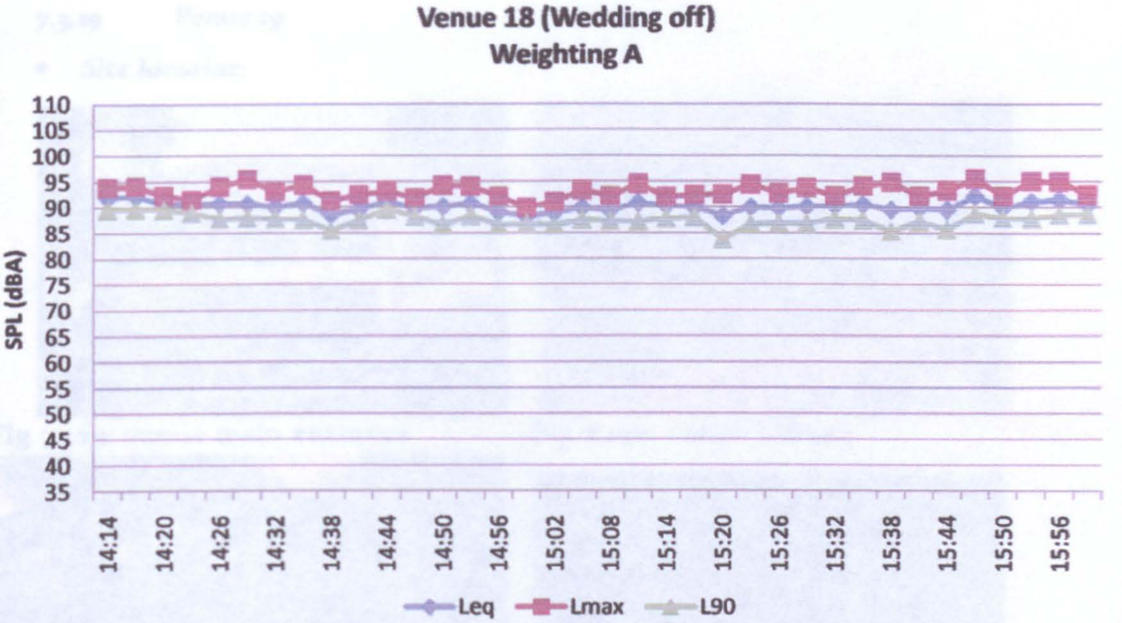


Fig 7.127: venue 18 (wedding off), weighting C (mic inside)

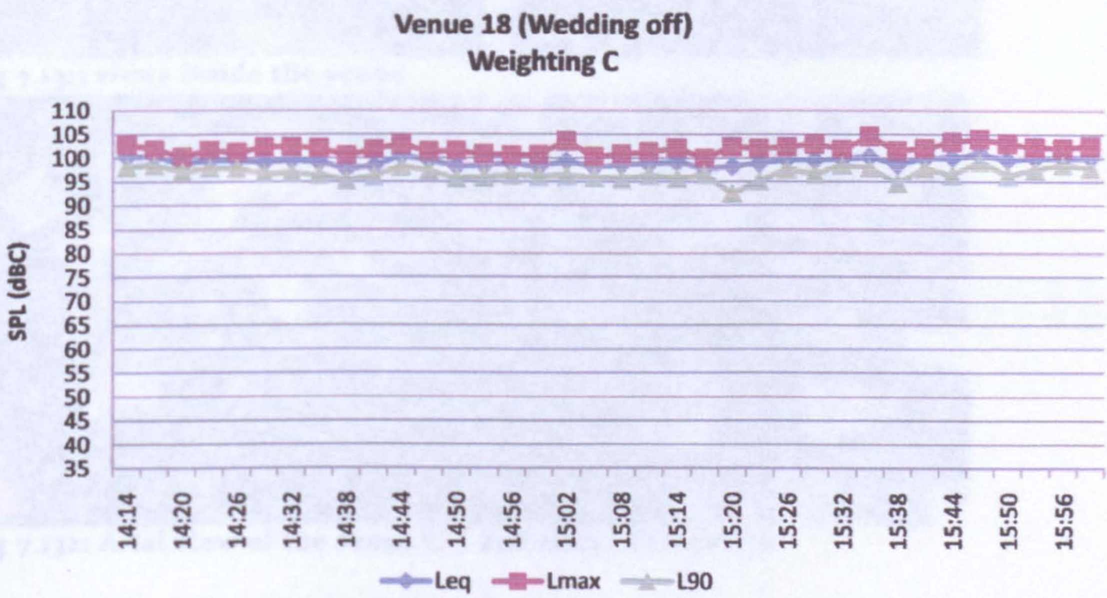


Fig 7.128: venue 18 (wedding off), weighting C (mic inside)

The monitoring has been undertaken before the wedding of about an hour. The noise levels are high because of the movement of brides family as they prepared the scene for the bride and as well as setting up the tables and also the DJ installing his music equipments. Therefore, LAmax was 95.5dBA and LAeq 90.3 dBAand LA90 86.9dBA , regarding the LCmax was 104.5dBA and LCeq 99.3 dBAand LC90 was 96.4dBA

7.3.19 Venue 19

- ***Site location***

Fig 7.129: venue main entrance

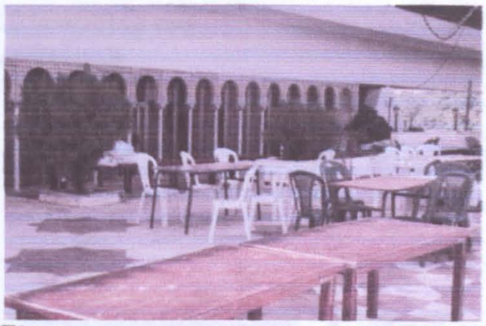


Fig 7.130: venue terrace

Fig 7.131: views inside the venue

Fig 7.132: Arial view of the venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The venue is located in a quite residential area.

- ***Noise Survey Description***

The microphones were calibrated before and after the each monitoring, both weighting A and C were used in this monitoring. The microphones were located in a house opposite to the venue at 1m from window.

- ***Environmental noise survey, results and observations***
  - ***Wedding on***

The measurements were recorded in an interval of one minute.

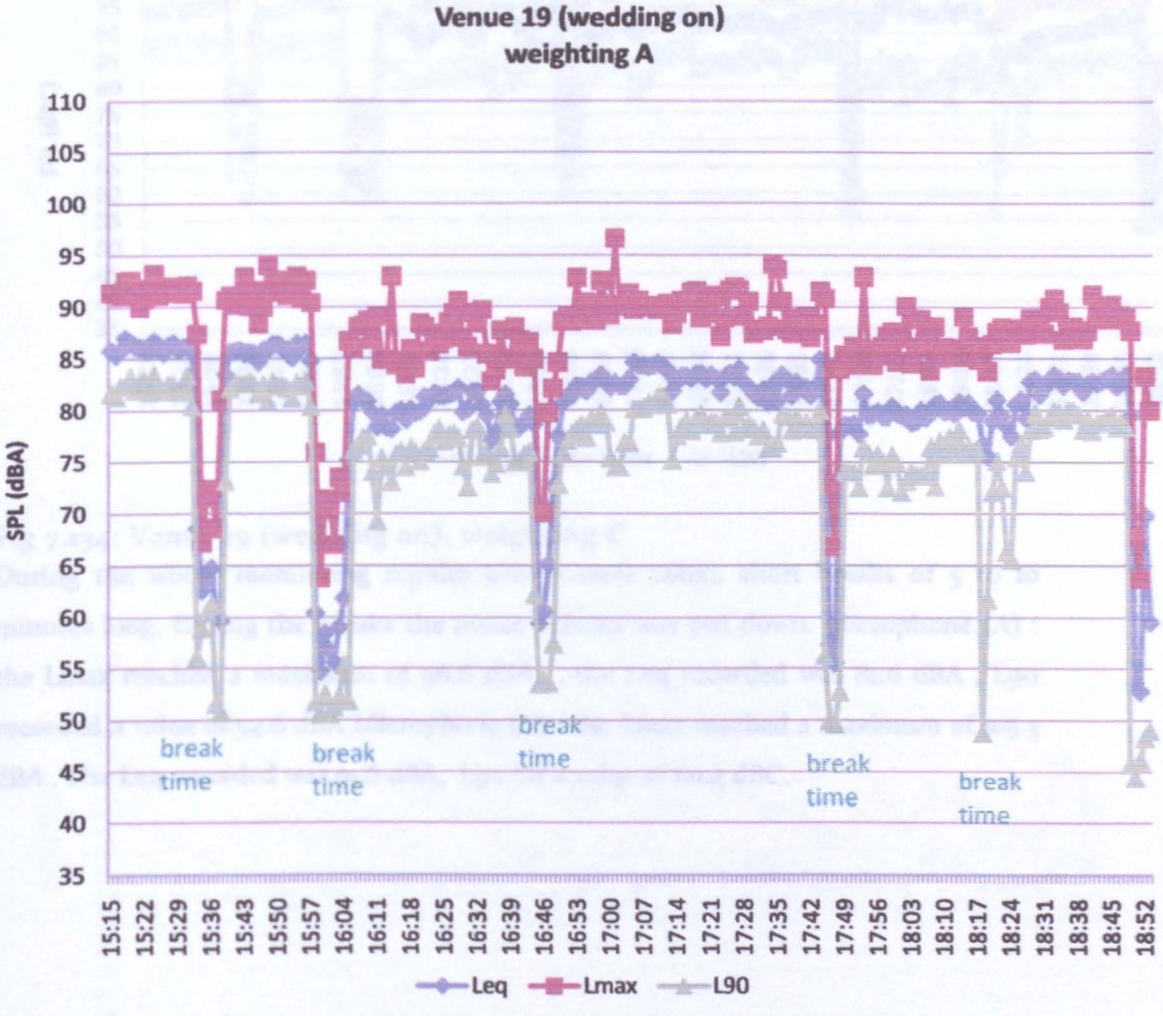


Fig 7.133: Venue 19 (wedding on), weighting A

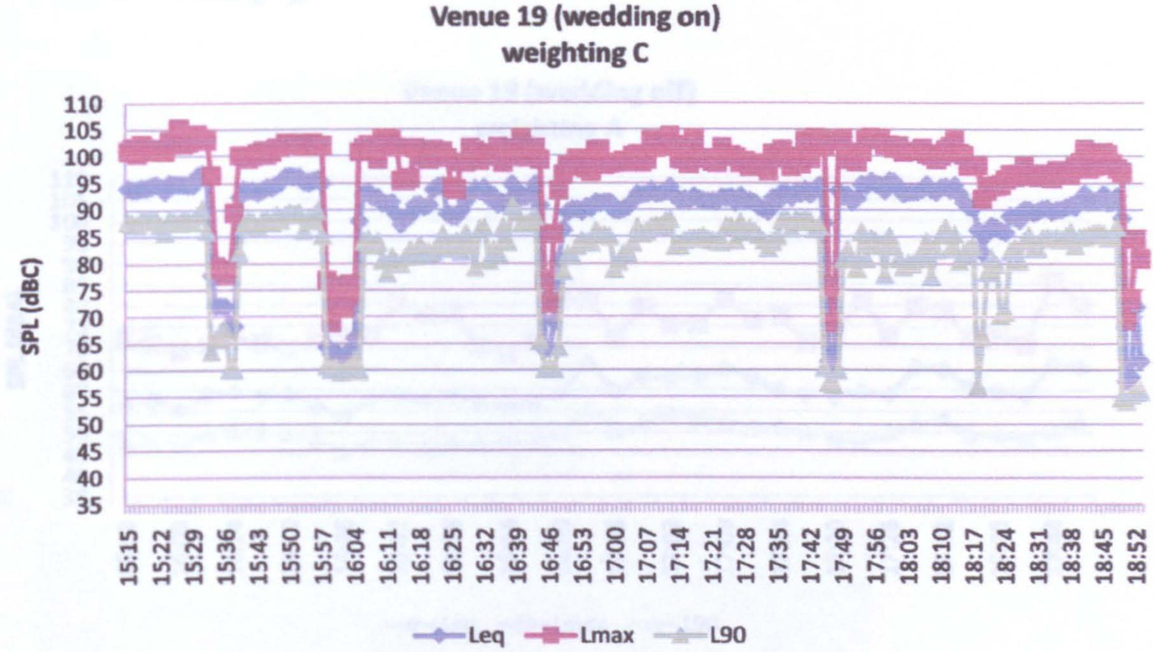


Fig 7.134: Venue 19 (wedding on), weighting C

During the whole monitoring regular breaks were taken, short breaks of 5 to 10 minutes long. During the breaks the music volume was put down. Microphone (A) : the Lmax reached a maximum of 96.6 dBA , the Leq recorded was 81.6 dBA , L90 recorded a value of 54.6 dBA Microphone (C): the Lmax reached a maximum of 105.3 dBA . The Leq recorded was 91.6 dBA, L90 hit a value of 60.4 dBC.

- *Wedding off*

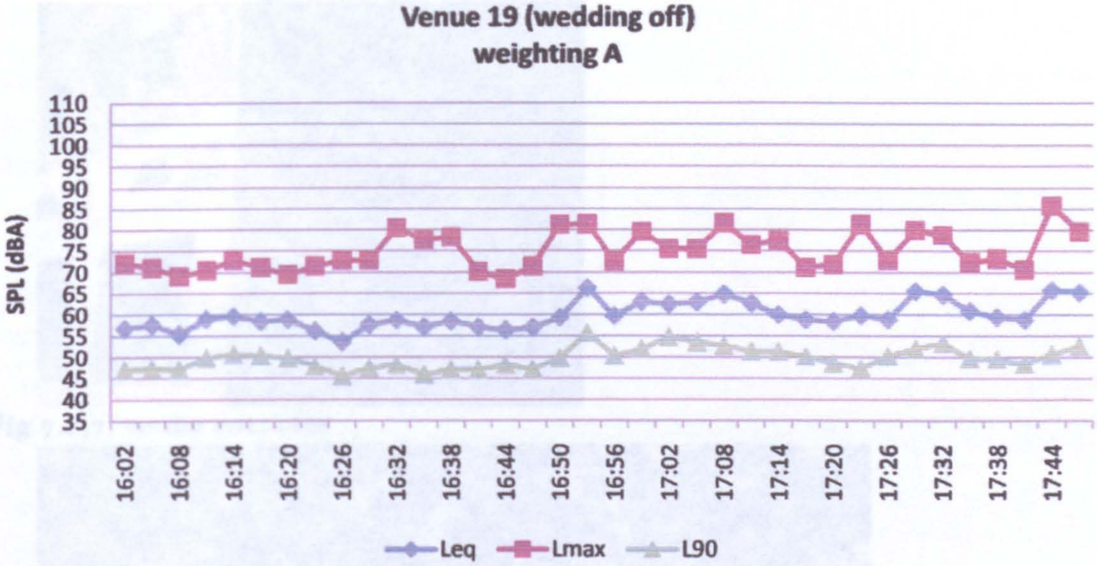


Fig 7.135: Venue 19 (wedding off), weighting A

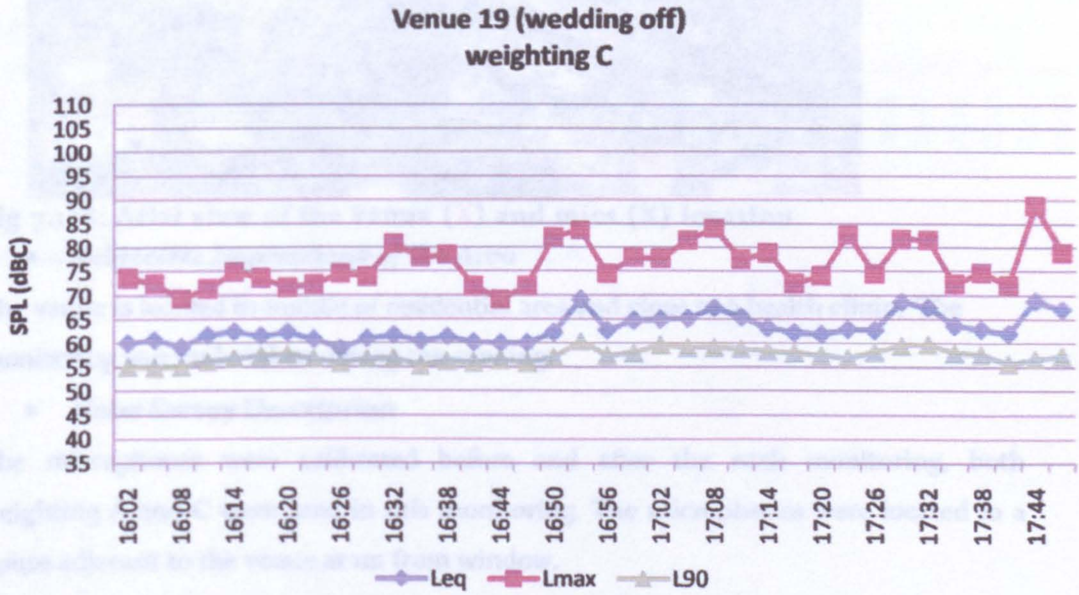


Fig 7.136: Venue 19 (wedding off), weighting C

The monitoring was held the following , the noise levels recorded an LAeq of 59.8 dBA and LA90 of 49.7 dBA. While the C monitoring measured an LCeq of 63 dBC and 57.3 dBC for L90. The L Amax reached a maximum of 85.8 dBA ,while L Cmax reached a maximum of 88.8 dBC

7.3.20 Venue 20

- ***Site location***

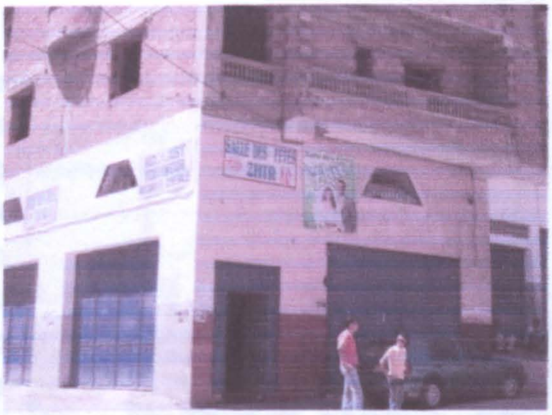


Fig 7.137: venue entrance

Fig 7.138: Arial view of the venue (X) and mics (X) location

- ***Subjective Impressions of the Area***

The venue is located in middle of residential area and close to a health clinic. The monitoring was undertaken during the evening.

- ***Noise Survey Description***

The microphones were calibrated before and after the each monitoring, both weighting A and C were used in this monitoring. The microphones were located in a house adjacent to the venue at 1m from window.

- ***Environmental noise survey, results and observations***
    - ***Wedding on***

The measurements were recorded in an interval of one minute few noise incidents occurred during the monitoring mainly celebration screams and clapping.the music was kept on all the time even during the breaks.

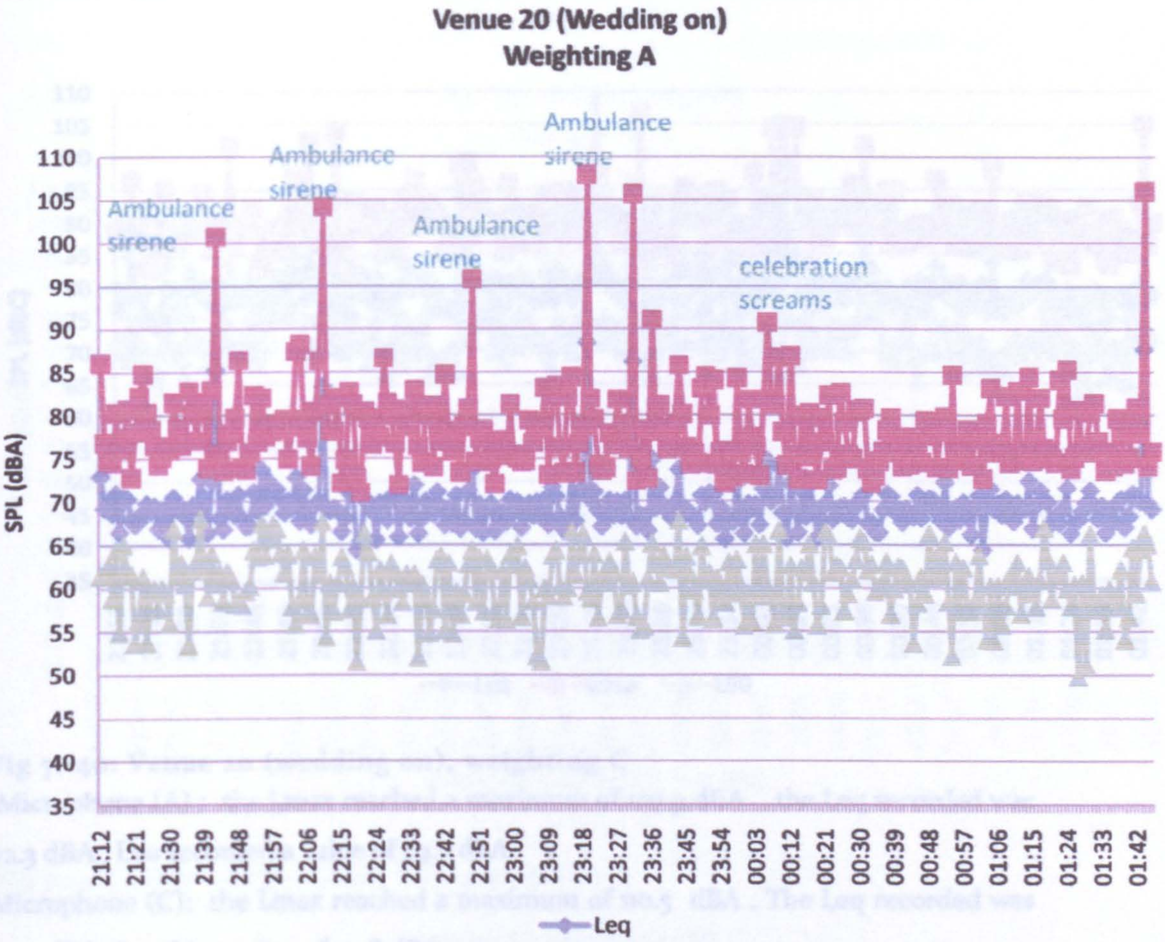


Fig 7.139: Venue 20 (wedding on), weighting A

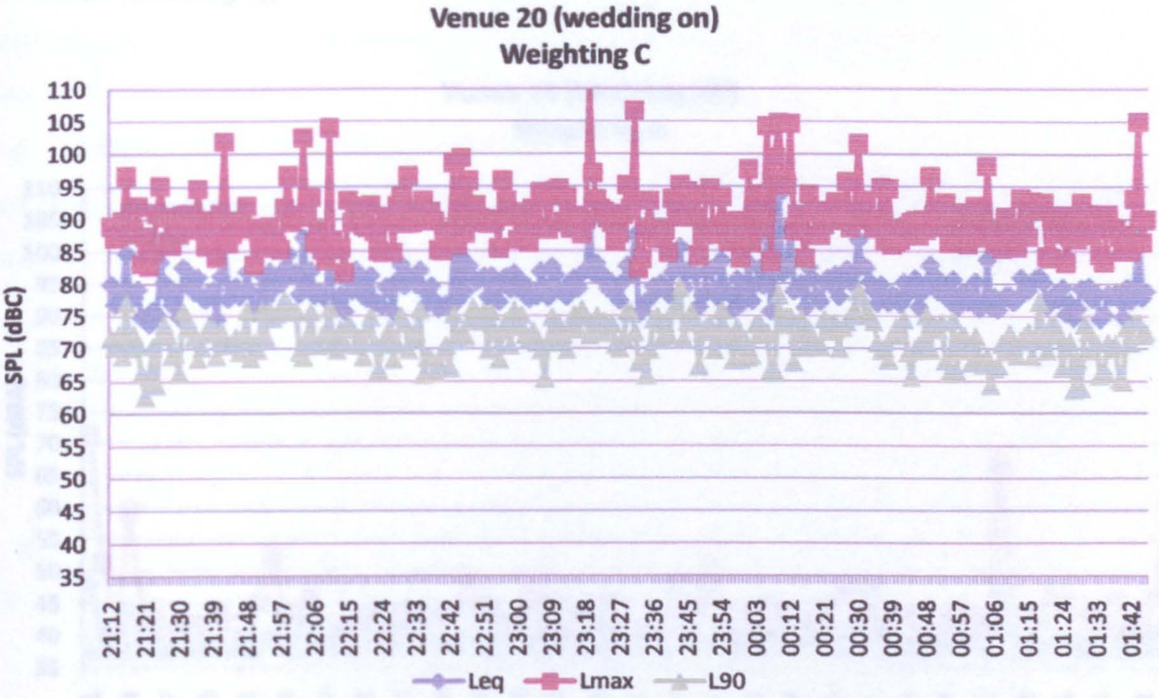


Fig 7.140: Venue 20 (wedding on), weighting C

Microphone (A) : the Lmax reached a maximum of 107.9 dBA , the Leq recorded was 72.3 dBA , L90 recorded a value of 59.7 dBA

Microphone (C): the Lmax reached a maximum of 110.5 dBA . The Leq recorded was 80.7 dBA, L90 hit a value of 70.8 dBC.

- *Wedding off*

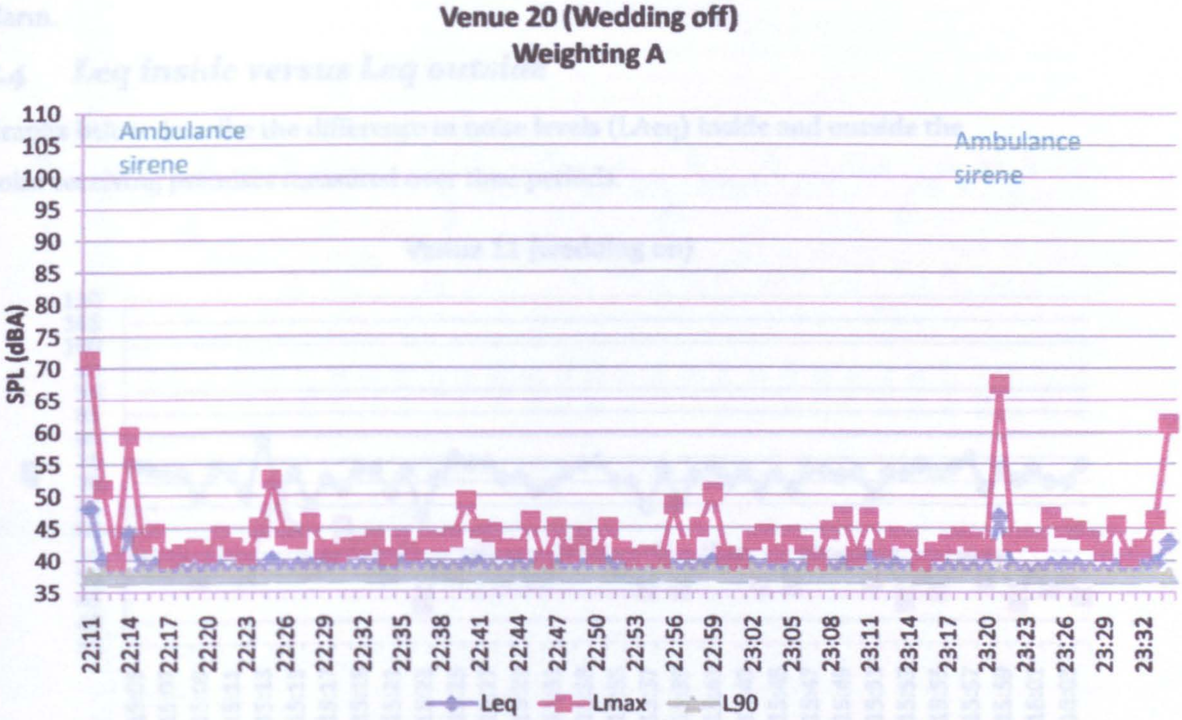


Fig 7.141: Venue 20 (wedding off), weighting A

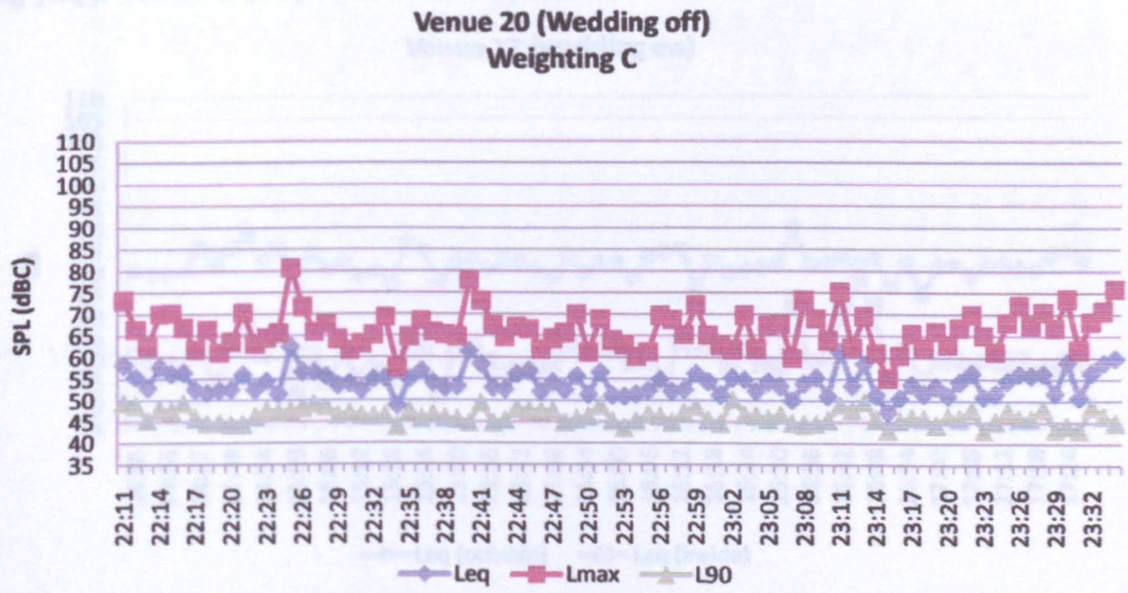


Fig 7.142: Venue 20 (wedding off), weighting C

From the graphs, the ambient noise was relatively low with an LAeq of 39.6 dBA and LA90 of 37.8. Two noise events occurred during this monitoring which was due to a car alarm.

7.4 *Leq inside versus Leq outside*

Graphs below describe the difference in noise levels (LAeq) inside and outside the noise receiving premises measured over time periods.

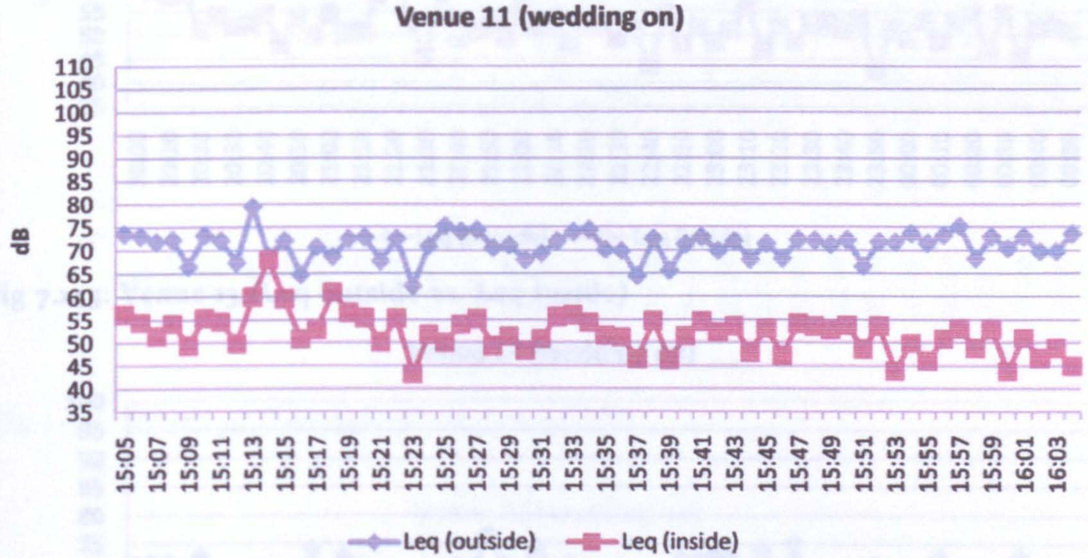


Fig 7.143: Venue 11 (Leq outside vs. Leq inside)

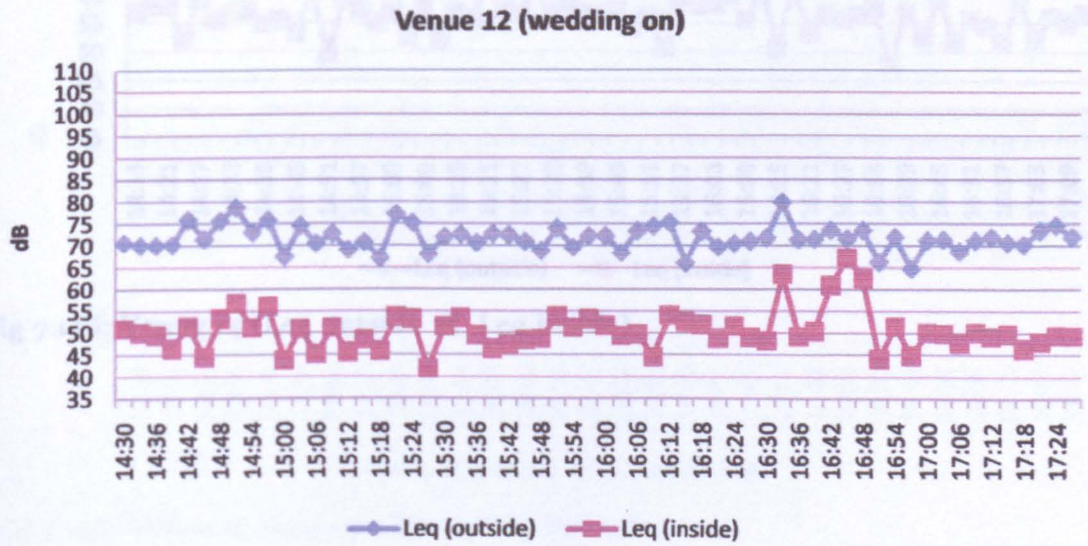


Fig 7.144: Venue 12 (Leq outside vs. Leq inside)

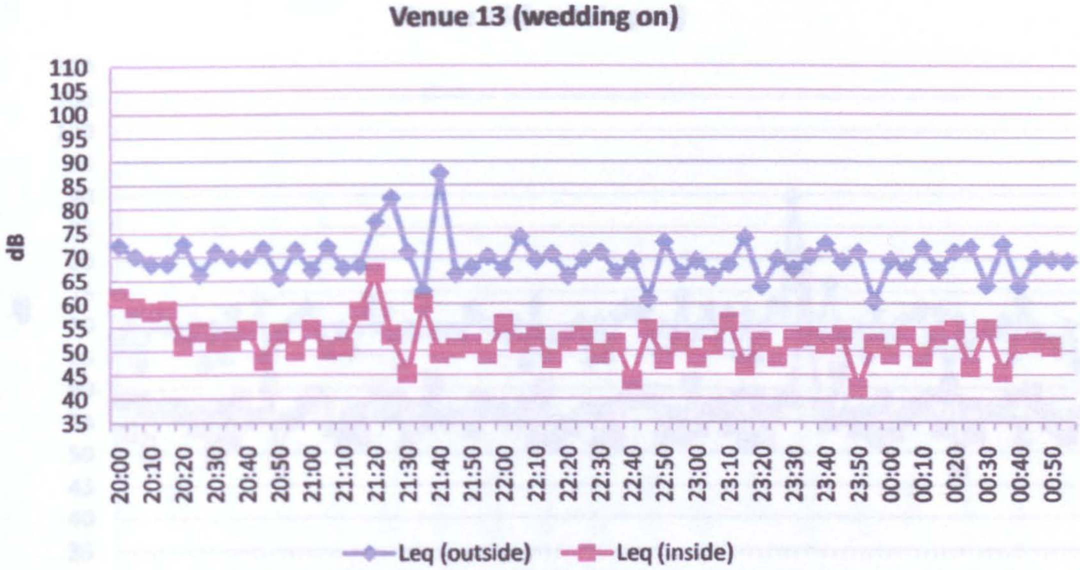


Fig 7.145: Venue 13 (Leq outside vs. Leq inside)

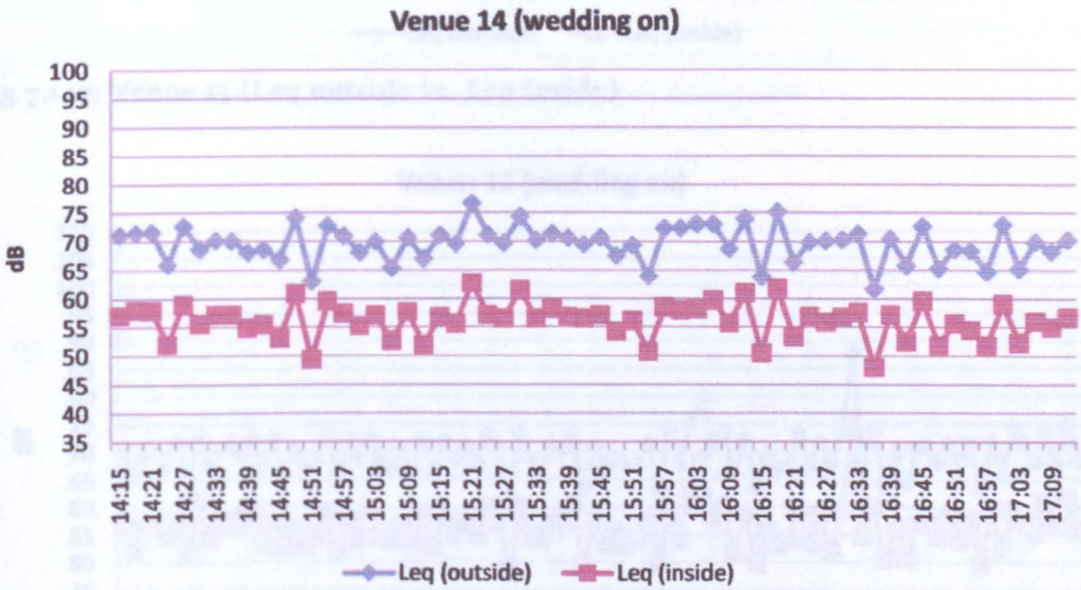


Fig 7.146: Venue 14 (Leq outside vs. Leq inside)

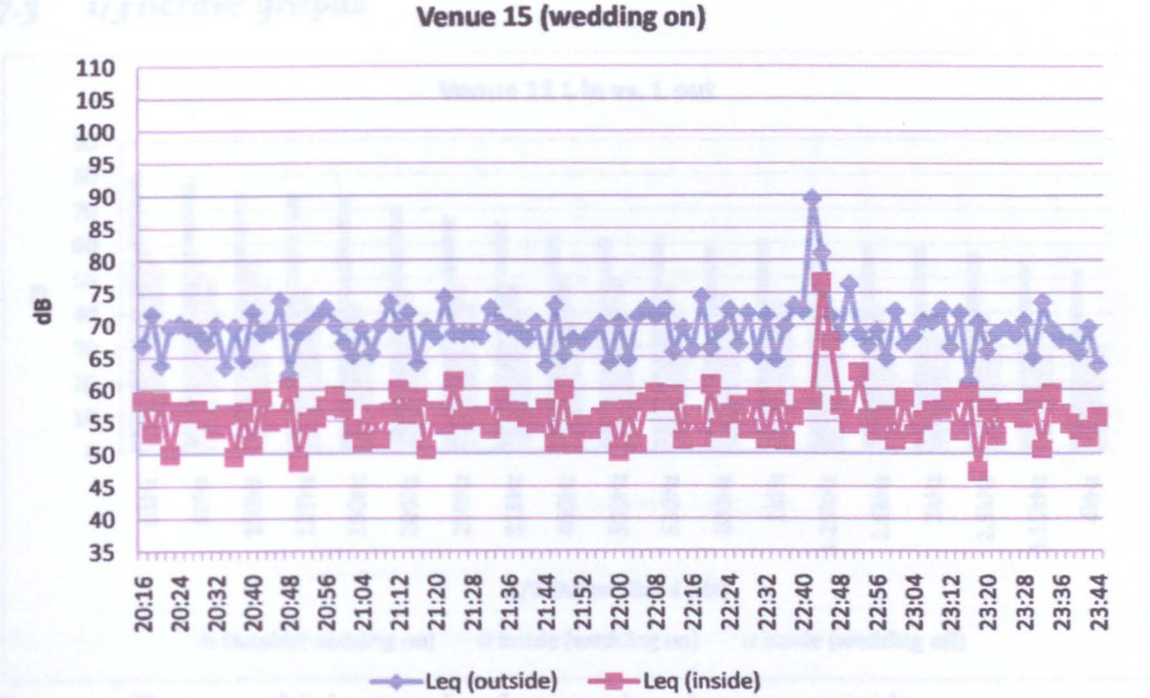


Fig 7.147: Venue 15 (Leq outside vs. Leq inside)

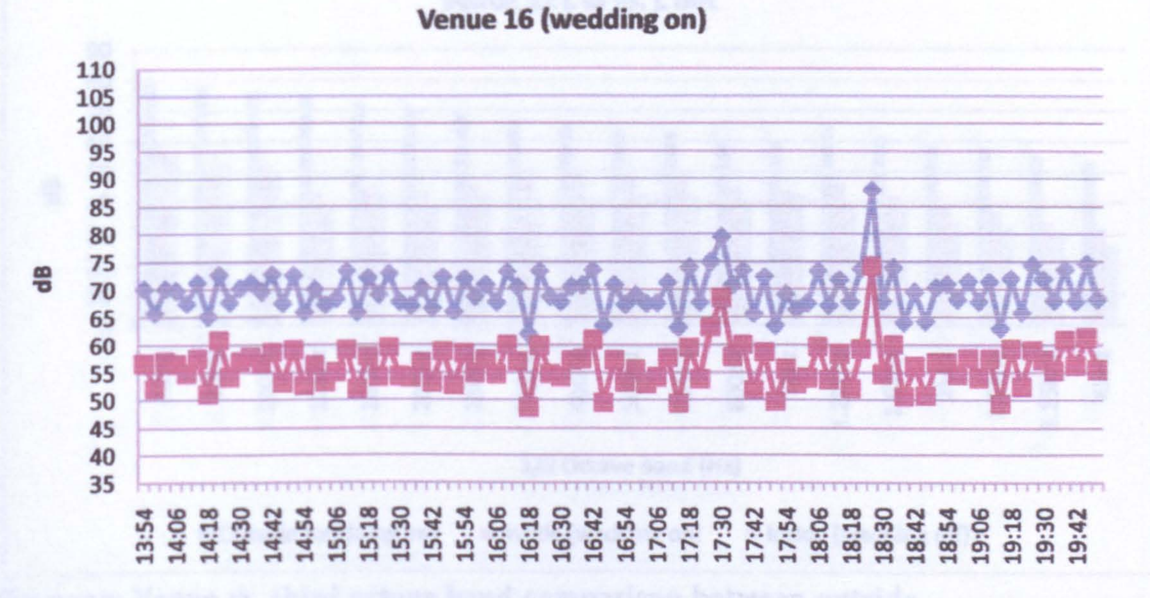


Fig 7.148: Venue 16 (Leq outside vs. Leq inside)

Graphs overleaf indicate the difference in noise levels (LAeq) inside and outside the noise receiving premises measured over time periods. The difference recorded is constant between 16 and 20 dB most of the time however, when a noise event occurs the difference is between 10 and 13 dB.

7.5 *1/3 octave graphs*

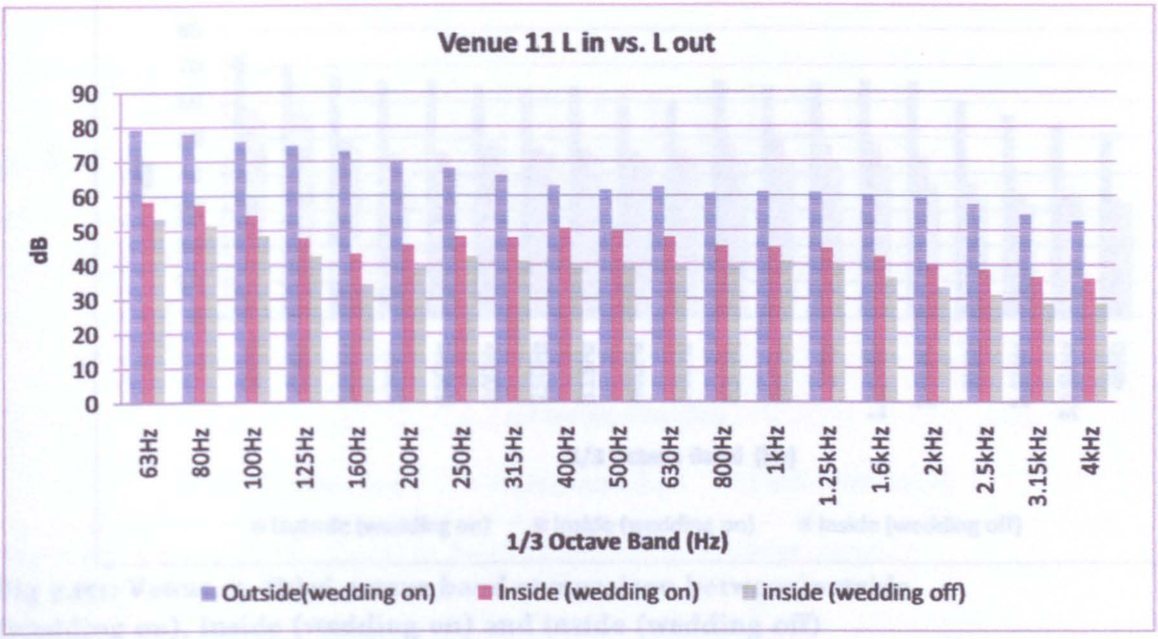


Fig 7.149: Venue 11, third octave band comparison between outside (wedding on), inside (wedding on) and inside (wedding off)

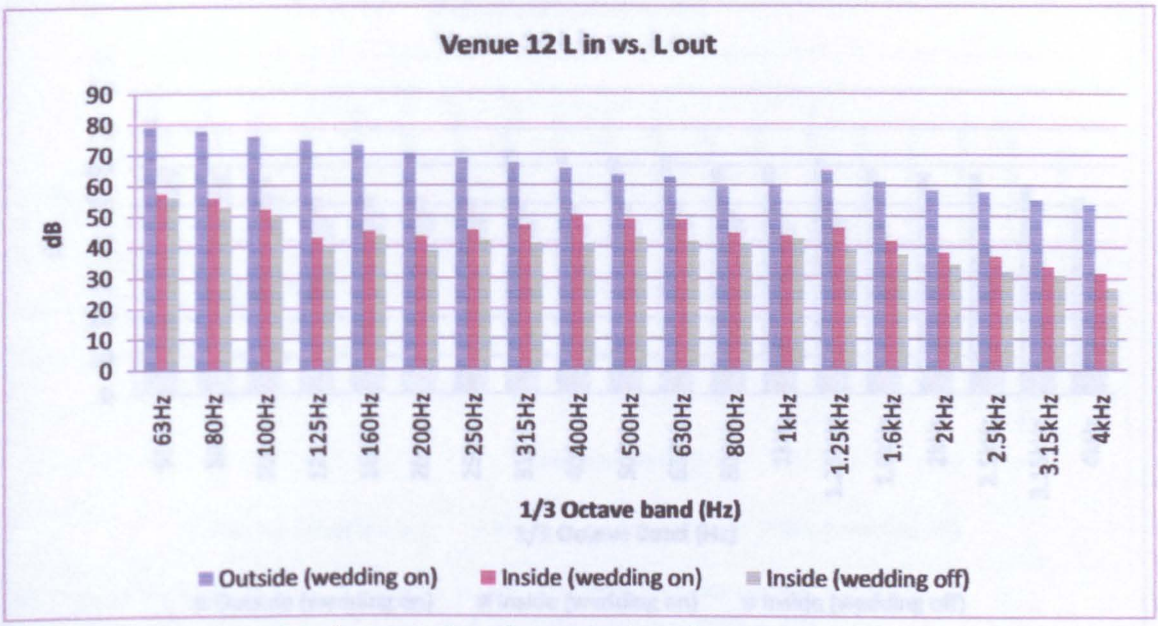


Fig 7.150: Venue 12, third octave band comparison between outside (wedding on), inside (wedding on) and inside (wedding off

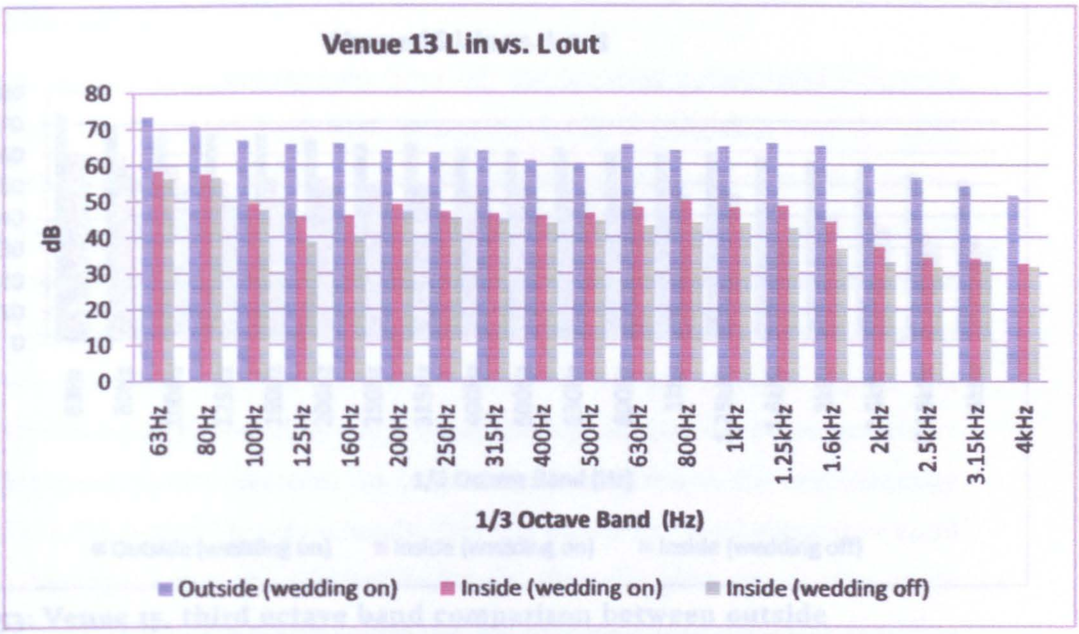


Fig 7.151: Venue 13, third octave band comparison between outside (wedding on), inside (wedding on) and inside (wedding off)

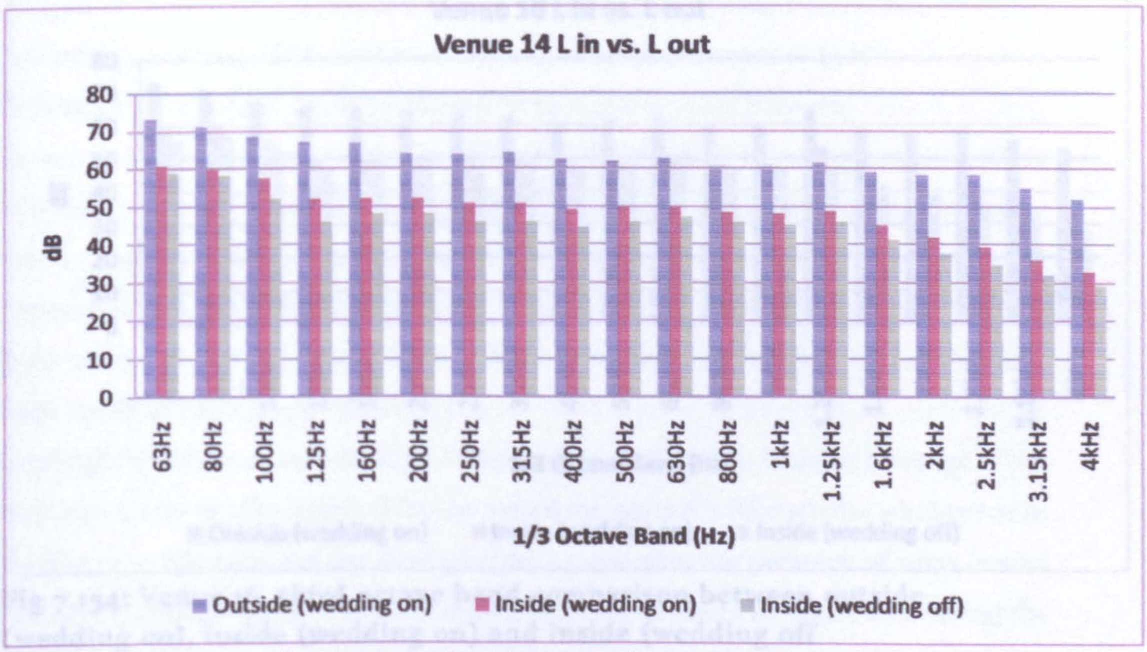


Fig 7.152: Venue 14, third octave band comparison between outside (wedding on), inside (wedding on) and inside (wedding off

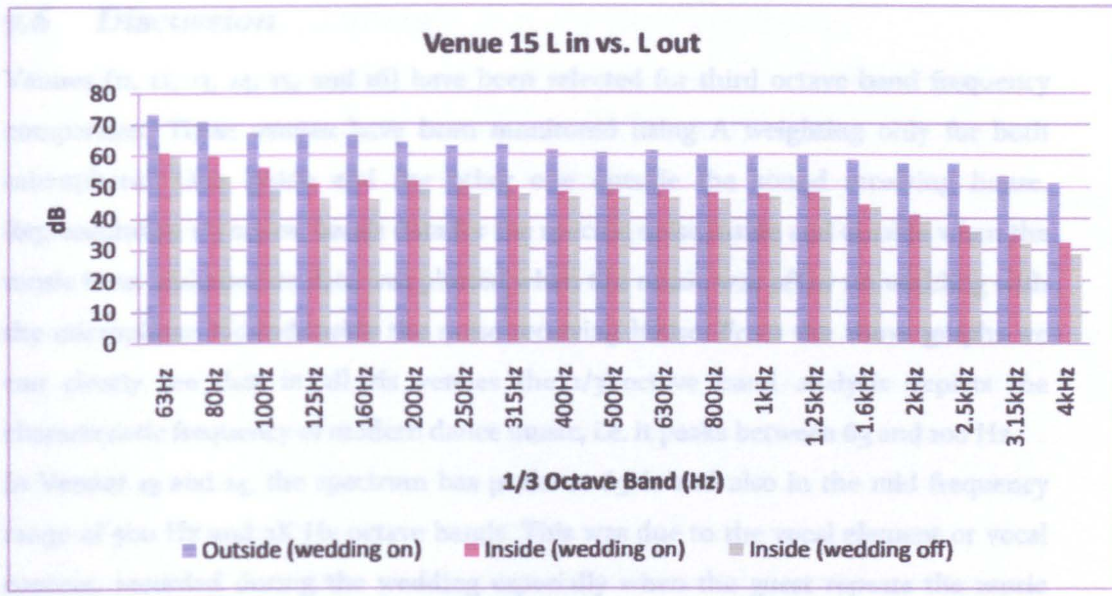


Fig 7.153: Venue 15, third octave band comparison between outside (wedding on), inside (wedding on) and inside (wedding off

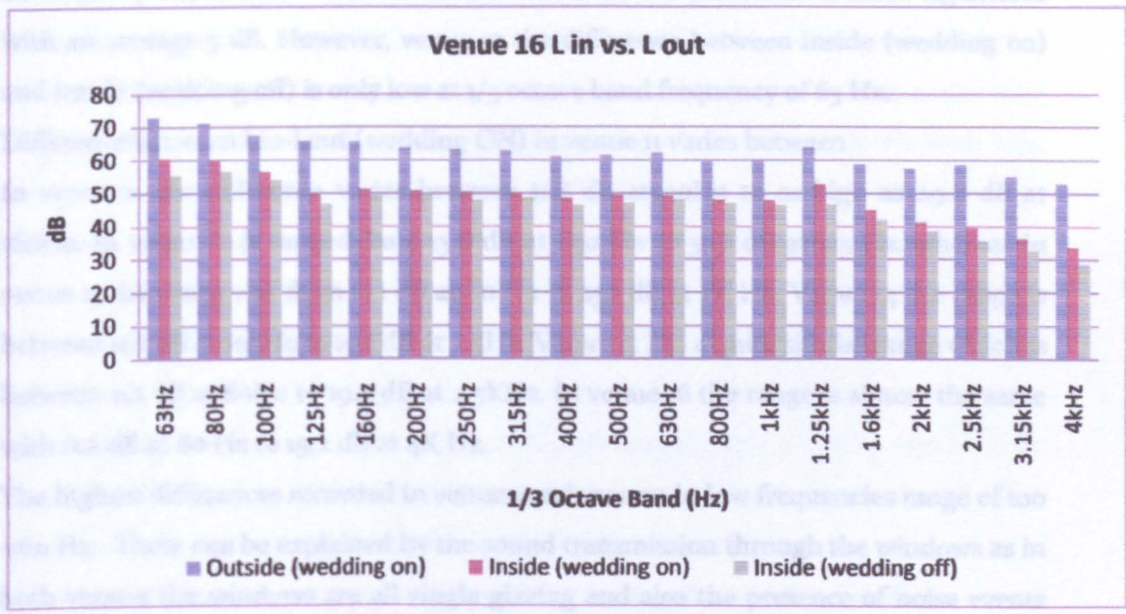


Fig 7.154: Venue 16, third octave band comparison between outside (wedding on), inside (wedding on) and inside (wedding off

7.6 Discussion

Venues (11, 12, 13, 14, 15, and 16) have been selected for third octave band frequency comparison. These venues have been monitored using A weighting only for both microphone. One inside and the other one outside the sound receiving house. Representative 1/3 octave bands data for the specific noise inside and outside when the music is on and another data was plotted when the music was off or no wedding with the microphone located inside the noise receiving house. From the above graphs we can clearly see that in all six venues the 1/3 octave band analysis depicts the characteristic frequency of modern dance music, i.e. it peaks between 63 and 100 Hz.

In Venues 13 and 14, the spectrum has peaks at 63Hz and also in the mid frequency range of 500 Hz and 2K Hz octave bands. This was due to the vocal element or vocal content, recorded during the wedding especially when the guest repeats the music lyrics such as karaoke. It is also apparent that the difference between inside (wedding on) and inside (wedding off) is low with an average of 1.5 dB in venues 12, 13 and 14 between 63 and 100Hz. While in venues 11 and 16, the difference is more significant with an average 5 dB. However, venue 15 the difference between inside (wedding on) and inside (wedding off) is only low at 1/3 octave band frequency of 63 Hz.

Difference between Lin-Lout (wedding ON) in venue 11 varies between

In venue 11 the difference varies between 11.8 dB at500Hz to as high as 29.8 dB at 160Hz. In venue 12 it ranged from 13.8 dB at 630 Hz to 31.6 dB at 125 Hz. whereas in venue 13 the range was from 13.1 dB at 80 Hz to 23.1 dB at 2K Hz. Venue 14 the range is between 11.2 dB at 100Hz to 19.1 dB at 2.5Hz. Venue 15 has a quite similar range which is between 11.1 dB at 80Hz to 19.4 dB at 2.5KHz. In venue 16 the range is almost the same with 11.2 dB at 80 Hz to 19.2 dB at 4K Hz.

The highest differences recorded in venue11 and 12 were in low frequencies range of 100 -160 Hz. These can be explained by the sound transmission through the windows as in both venues the windows are all single glazing and also the presence of noise events such as celebration screams as well as some karaoke. It has to be noted that during the wedding in these two venues windows and doors were frequently opened.

In the rest of the venues the difference was generally between 11 and 20 dB , for instance in venues 14-16 the highest noise levels occurred at low frequencies between 2.5K -4K Hz. The sound transmission was mainly through the walls because they were not insulated and not even rendered externally. So the sound might have travelled through the infiltration and joints.

7.7 *Summary of findings*

The results of the analysis have shown that there is obvious evidence that noise levels emanating from all twenty venues are unacceptable. The study has focused on the background noise levels as well as ambient levels as well as low frequency content. Noise levels recorded during the monitoring were higher that the WHO recommended values with sometimes 10-15 dB higher. The analysed spectrums (1/3 octave bands) as usually at greater distances comprises a lot of noise at low frequencies. Most of the energy is present between 160 Hz and 500 Hz. having analysed the recording data we have noticed that noise incidents and noise events have had a significant impact on the noise levels monitored. in some venues the increased noise levels have been caused by noise events such as car horns, screams and shouting. All the venues and all the receiving buildings have single glazing. We have also observed that when weddings are celebrated during the night time the noise levels are higher than the WHO guidelines values. The WHO guidelines for community noise recognise that levels above 45 dB LAeq outside a bedroom (window open) would cause sleep disturbance.

The analysis of the A weighting readings and the C weighting readings showed that there is a relative increase in C readings when the wedding was on, this could have been caused by music travelling through facades as well mixed noise levels from road traffic and constructions sites. However the decrease of the relative C readings difference might mean the existence of extra noise such as celebrations screams and car horns sounding. The assessment of the degree to which noise levels from weddings might cause disturbance through LAeq (ON)-LA90 (OFF) differences (see figures 7.155-157) showed that there is strong evidence that the weddings cause significant increase in noise levels. However, this is not the case in all venues. This is can be explained by the fact that criteria such as venues location (city centre or sub-urban) also whether the venue and the receiving building are structurally attached

To sum up, there are many factors that affect noise pollution. Road traffic is one of them; people also have an effect on noise nuisance. There other Factors that affect whether noise is a nuisance this includes the time of the day or night; duration; location and frequency of the noise (is it a one off, or is it every day for several hours.)

In terms of wedding halls location , it can be more suitable to implement them in noisy areas because the impacts of noise nuisance emanating from wedding halls will be less if they are implemented in residential areas. People or neighbours will be more tolerant to noise from wedding halls if they already live in a noisy area.

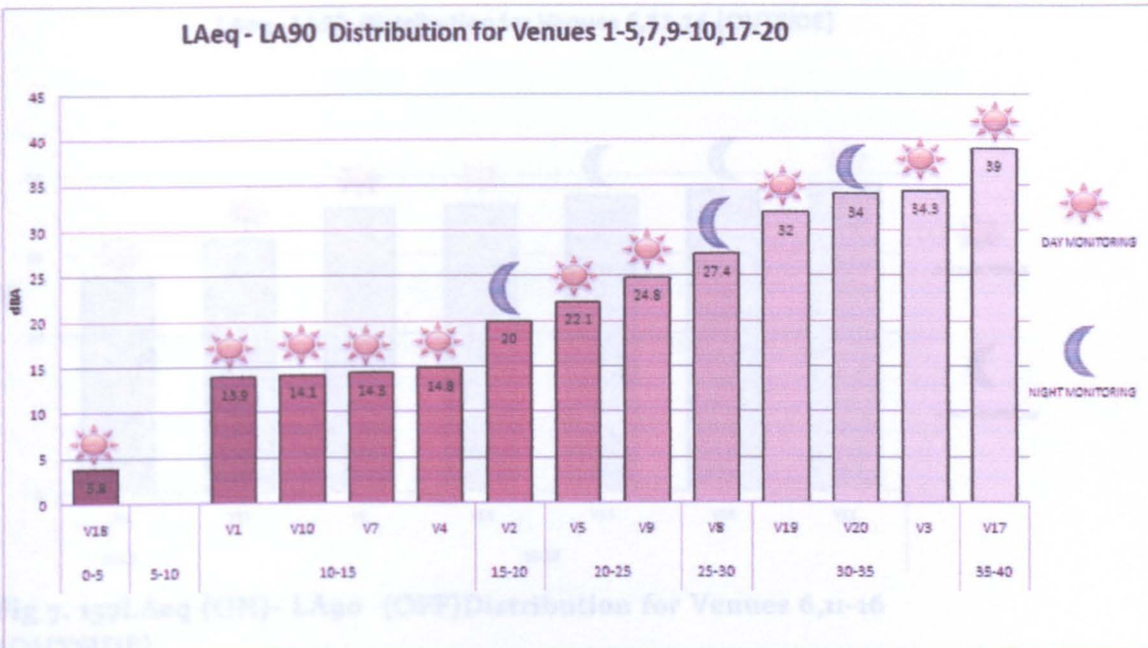


Fig 7.155. LAeq (ON) - LA90 (OFF) distribution for venues 1-5,7,9-10,17-20

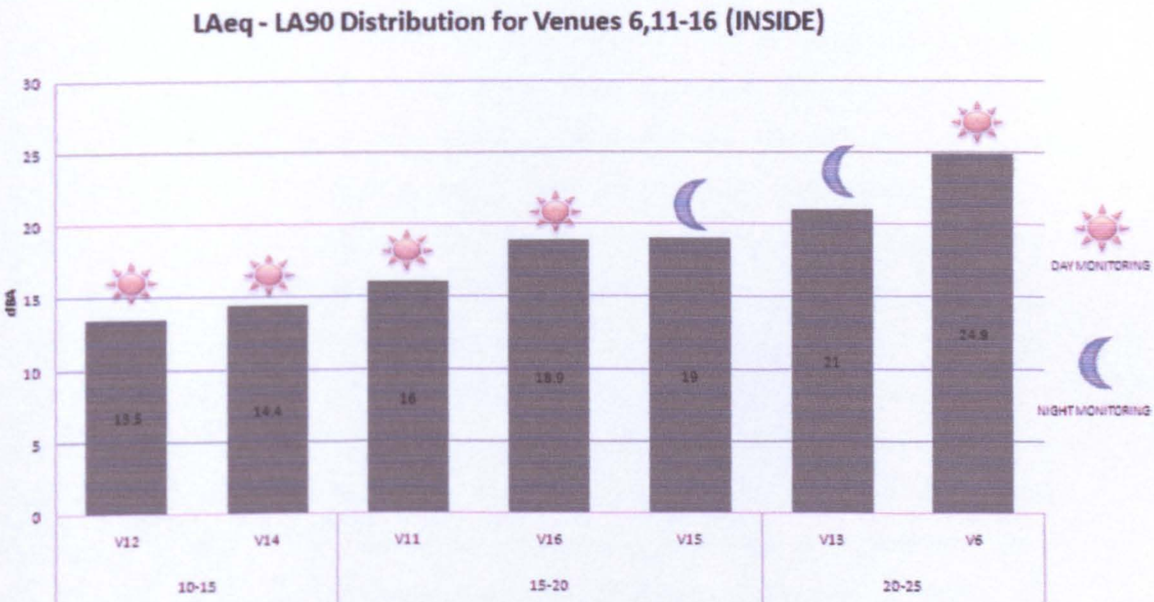


Fig 7.156 LAeq (ON) - LA90 (OFF) Distribution for Venues 6,11-16 (INSIDE)

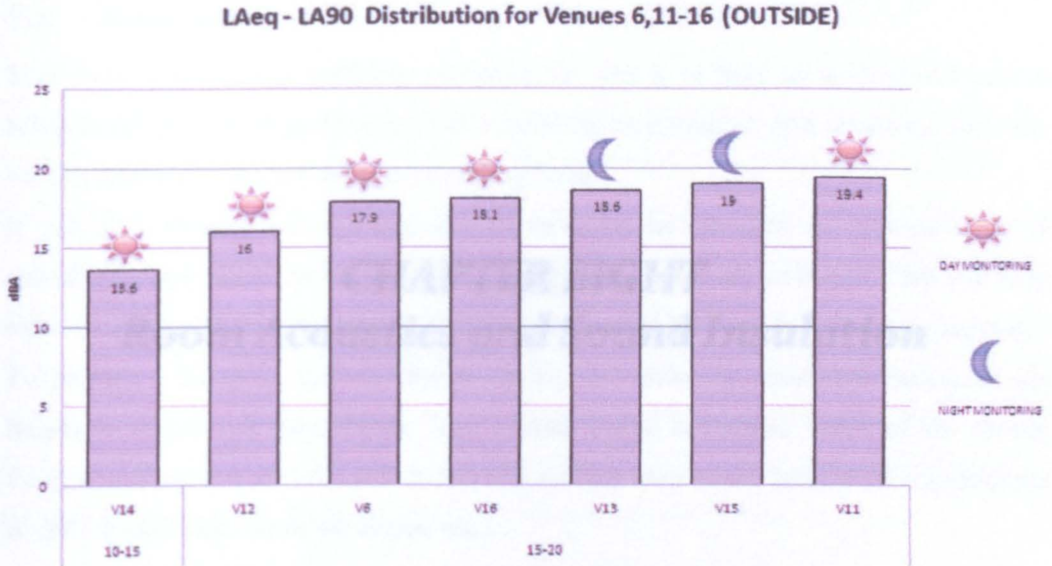


Fig 7. 157LAeq (ON)- LA90 (OFF)Distribution for Venues 6,11-16 (OUTSIDE)

CHAPTER EIGHT
Room Acoustics and Sound Insulation

8.1 Introduction

This chapter deals with building acoustics, its aim is to help us understand and to analyse the acoustical performance of a building components and structure and how we can relate it to the investigated wedding halls.

It will also identify and use appropriate formulae to calculate the transmission of sound between rooms and from inside to outside and outside to inside. This will help us to understand how noise from wedding halls travels through building components.

To protect a building against exterior noise, the airborne sound insulation of the facade is of primary importance. The overall sound reduction index of the facade depends on the sound reduction index and surface area of the individual components of the facade (wall, windows, doors, etc.)

8.3 Sound absorption versus sound insulation

The reduction and control of noise whether in buildings or rooms generally involves the use of sound absorbing materials and sound insulating materials. These materials have different purposes, which cannot be interchanged. But due to confusion, both materials often are missed. Sound absorbing materials such as acoustic tiles, carpets play an indispensable part in controlling noise generated within a room or in reverberant areas such as lobbies, corridors and staircases. Although such materials are highly effective as sound absorbers, they are relatively poor sound insulators because of their soft, porous and lightweight construction. In short, they transmit noise very easily. To illustrate this point, for instance a wall constructed solely of acoustic tile, carpet or drapery material. Such a wall would provide virtually no resistance to the passage of sound through it. A brick o wall on the other hand, is a very poor absorber of sound but it is an extremely effective sound insulator. Because it is massive, it resists the passage of sound. Because sound insulators and sound absorbers are both called "acoustical treatment" , confusion arises between their proper uses. Improper application of sound-absorbing treatment to reduce the transmission of noise between adjoining areas in an existing building has often been an expensive and annoying error. Sound-absorbing materials are generally light and porous. They should not be used on the interior surface of one room with the sole intention of preventing the transmission of sound to the next room. The porosity of the material actually facilitates sound transmission.

8.4 *What is the sound absorption coefficient?*

The absorption coefficient of a material is ideally the fraction of the randomly incident sound power which is absorbed, or otherwise not reflected. It can be determined in two main ways, and there are often variations in the results depending upon the method of measurement chosen. It is standard practice to measure the coefficient at the preferred octave frequencies over the range of at least 125Hz - 4kHz.For the purposes of architectural design, the Sabine coefficient (calculated from reverberation chamber measurements) is preferred. Interestingly some absorbent materials are found to have a Sabine coefficient in excess of unity at higher frequencies. This is due to edge effects and when this occurs the value can be taken as 1.0

8.5 *Sound reduction index*

The prediction of the sound reduction index is essential in the acoustical engineering of buildings. The Sound Reduction Index of a partition can be measured according to the method described by ISO 140-3 [153].This physical problem has been approached in various ways in the past. The value of sound reduction index or SRI quoted for a building element normally describes the expected reduction in sound energy across the facade when exposed to a source field of randomly incidence sound. Since in many instances this type of source field closely approximates the incidence of common exterior noise sources such as traffic noise this SRI is generally used to describe facade acoustical insulation in the field. The standard equation for sound reduction index (SRI) of a composite panel consisting of an aperture of area AA and sound reduction index SRI_A in a wall of area A_w and sound reduction index SRI_W is

$$SRI_{W+A}(dB) = -10 \log[A_W 10^{(-SRI_W/10)} + A_A 10^{(-SRI_A/10)}] /(A_W + A_A) \qquad : (1)$$

Eq. (1) shows that the efective sound insulation of a composite facade is a function of the sound reduction indices and relative areas of each component.

A major source of exterior noise in areas of high noise concentration such as urban areas is road traffic. An example of a typical one-third octave spectrum of 'A' weighted road traffic noise is shown in Fig. 1 after Ref. [154]. The traffic noise spectrum in Fig. 1 has been normalized such that when summed over all the third octave bands it gives an overall level of 0 dB(A).

To assess the noise insulation a composite facade with regard to such a noise source, the SRI must be calculated in frequency bands using Eq. (1) and applied to the source noise spectrum to give an attenuated spectrum.

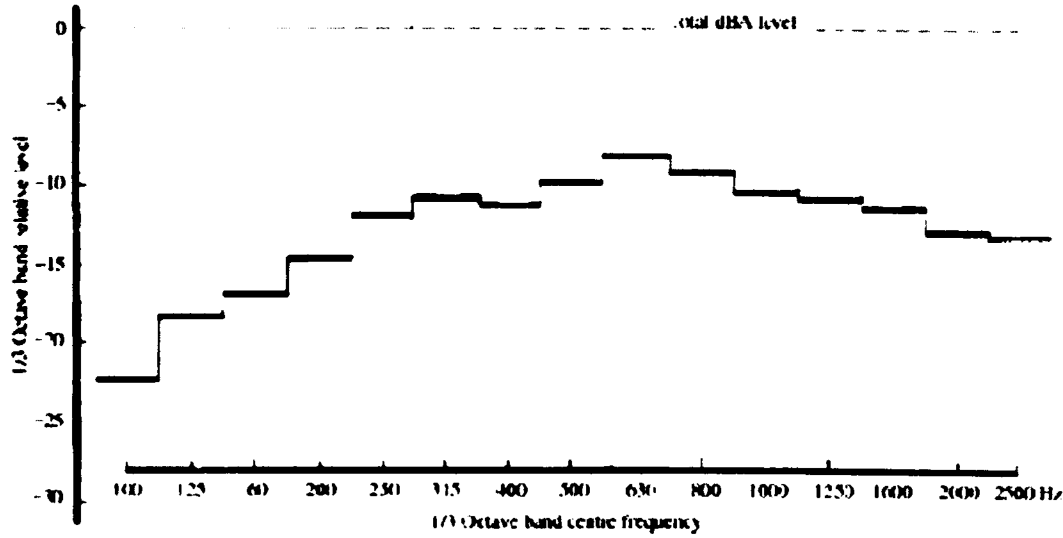


Fig. 8.1 Typical one third octave spectrum of 'A' weighted vehicle noise relative to broadband sound pressure level= 0 dB(A) after Delany [154]

To obtain a single figure facade sound reduction index or SRI to road traffic noise in dB(A) the frequency band levels in the attenuated spectrum must be logarithmically summed and subtracted from the logarithmic sum of the frequency band levels in the original unattenuated 'A' weighted spectrum. (As noted above the logarithmic sum of the frequency band levels in the unattenuated source spectrum of Fig. 8.1 is 0 dB(A) which simplifies this calculation.) Once the source spectrum is determined, the level of attenuation that a composite facade must achieve over the frequency range must be assessed with a view to meeting internal criteria. Once the source spectrum is determined, the level of attenuation that a composite facade must achieve over the frequency range must be assessed with a view to meeting internal criteria. To maintain a good overall facade SRI an aperture must provide useful attenuation over the entire spectral frequency range of interest. Looking at the road traffic noise spectrum in Fig. 8.1 it has the majority of sound energy in the region between 250 and 2500 Hz hence the aperture should provide useful attenuation over this range to prevent any major deterioration in the overall facade SRI when exposed to road traffic noise.

Average broad band noise levels due to road traffic in areas of high noise concentration such as urban areas will often reach 70–80 dB(A) which may require facade sound insulation in the region of 35-40 dB(A) SRI $_{road\ traffic}$ to achieve comfortable internal levels recommended in guidance documents .

8.6 Insulation between inside and outside of buildings

We often need to estimate level differences between the outside and the inside of buildings. In such cases, it is nearly always a matter of calculating L_2 (the level at the receiving position) from a knowledge of L_1 (the level on the other side) and a known SRI, rather than obtaining SRI from measurement of L_1 and L_2. The relationships given below show how to calculate L_2 and cannot always be used to measure SRI. For various reasons it is impossible to give accurate relationships and in each case the best approximation can be provided.

8.6.1 Inside to the outside

The first case is the insulation from a relatively reverberant room to outside. If L_1 is the average sound pressure level in the room and L_2 is the level very close to the outside of the wall then:

$L_2 = L_1 - SRI - 6\ dB$:(2)

For indoors to outdoors calculation, we usually want to know the level at a certain distance from the wall, approximately

$L_2 = L_1 - SRI + 10\log S - 20\log r - 14dB$:(3)

Where L_1 is the average level in the reverberant room, L_2 is the level at a distance r (in meter) from the wall along a line normal to the wall (r is assumed large compared with size of the wall) and S is the area of the wall in (square meter).

8.6.2 Outside to the inside

For calculations concerning noise travelling outside to the inside, the following relationship may be used oif the room involved is relatively reverberant.:

$L_2 = L_1 - SRI + 10\log S - 10\log A + 6dB$:(4)

Where L_2 is the reverberant sound level in the room, L_1 is the level at one meter from the façade of the building, S is the surface area (m^2) of the perimeter construction, A is the total absorption in the room (m^2) .

We can also make an approximate estimate of the sound pressures on the surfaces of a building not directly facing the noise source, assuming that the distance to the noise source is large compared with the building dimensions.

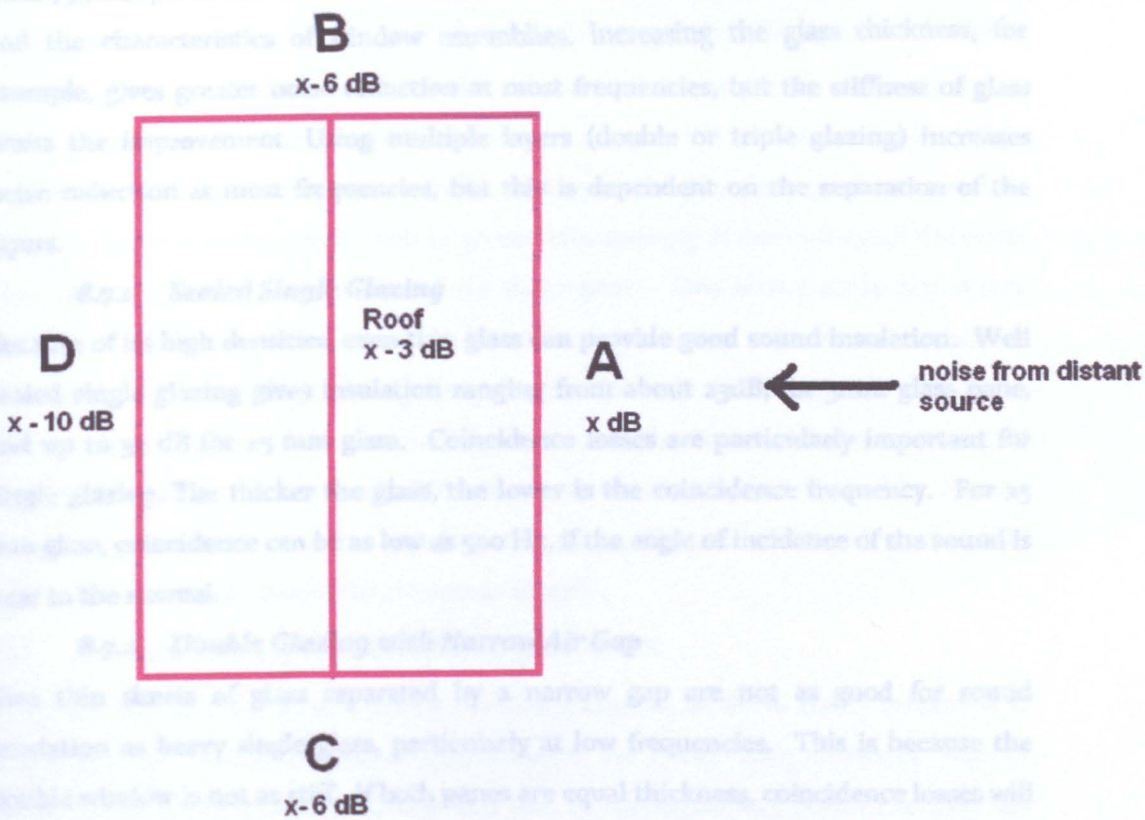


Figure 8.2 : Typical variation of exposure to noise of facades of a building

For example, from figure 8.2 Façade A can be treated on the basis of the above equation. Facades B and c are likely to receive levels approximately 6dB below those on facade A. Façade D is most difficult to assess because reflections from other buildings are likely to influence this situation strongly. However, a level 10dB below the exposure of façade A is likely. A pitched roof offers a reduced projected area to the source and a reduction of 3 and 4 dB in exposure is a likely result.

If the sound is coming vertically, such as noise from aircraft in flight, then for a flat roof the above equation is appropriate, for a pitched roof 2 to 3 dB less is likely and for walls again about 2 to 3 dB less.

8.7 *Sound Transmission from Windows*

In addition to their primary function as visual openings, windows also transmit sound. This is of concern not only for the exterior surfaces of a building, but also for interior applications ranging from office doors to control booths in recording studios. Sound transmitted through windows often limits the overall acoustical insulation. Sound transmission through windows is governed by the same physical principles that affect walls [9], but practical noise control measures are influenced by the properties of glass and the characteristics of window assemblies. Increasing the glass thickness, for example, gives greater noise reduction at most frequencies, but the stiffness of glass limits the improvement. Using multiple layers (double or triple glazing) increases noise reduction at most frequencies, but this is dependent on the separation of the layers.

8.7.1 Sealed Single Glazing

Because of its high densities, even thin glass can provide good sound insulation. Well sealed single glazing gives insulation ranging from about 23dB, for 3mm glass pane, and up to 33 dB for 25 mm glass. Coincidence losses are particularly important for single glazing. The thicker the glass, the lower is the coincidence frequency. For 25 mm glass, coincidence can be as low as 500 Hz, if the angle of incidence of the sound is near to the normal.

8.7.2 Double Glazing with Narrow Air Gap

Two thin sheets of glass separated by a narrow gap are not as good for sound insulation as heavy single glass, particularly at low frequencies. This is because the double window is not as stiff. If both panes are equal thickness, coincidence losses will be superimposed on one another and will show up strongly. Therefore windows of this type of construction often allow a narrow band of noise to pass through, which is heard as a "hiss" inside. It is good practice, particularly with narrow double glazing, to spread the coincidence frequencies apart and so allow each pane to cover for the coincidence loss of the other for instance, by using different weights of glass.

8.7.3 Double Glazing with Deep Air Gap

A deep air gap is needed (50 mm minimum, often 100 mm or 200 mm) for the sound insulation of double glazing to be significantly better than single glazing. Frequently, there are practical advantages in avoiding a very deep air gap. With a gap of 50-80mm, double glazing gives an improvement of some 3 or 4dB over the same weight of single glass, this is often enough. If so, the window is still narrow enough to be hung as one unit (even if the panes are set in separated frames linked together across resilient seals). This allows smoke vents and cleaning to be arranged easily. However, there are many cases where even deeper air gaps are needed to meet performances between 37 dB and 50 dB, particularly where insulation is needed at low frequencies.

Secondary glazing is often installed behind existing windows to improve sound insulation. To make the best of this method, the existing windows should be well sealed. This may give up to 10dB improvement immediately. Very often, sliding panes are preferred for the secondary glazing. Although not quite as effective as well sealed casement, they are likely to raise insulation by a further 5-10 dB, if a deep air gap is allowed (>100 mm). This overall improvement of 15-20 dB is often adequate. High insulation can be achieved (up to 30dB) with open double glazing where sound is forced to follow a devious path such as 50 mm slot opening at the bottom of the outer pane and a similar one at the top of the inner pane. This allows some permanent ventilation whilst maintaining reasonable sound insulation. The sound reduction index provided by doubling glazing depends quite strongly on the separation between the two panes of glass. When the shutter is retracted, the mass–air–mass frequency of the double systems in the study with an air space of 12 mm is located at around 300 Hz, regardless of the order in which the panes of glass are placed, and in this region the sound reduction index decreases sharply.

8.8 Sound Transmission through Doors

Doors are probably the most exacting building elements, as far as sound insulation is concerned. The sound insulation requirements for doors have increased due to increased consciousness of acoustics and due to accompanying policies stating the specifications of building products. Doors are usually the weakest sound-insulating elements between rooms and therefore need careful acoustic design. The requirements for partition walls range usually from R_w=40 up to 60 dB, while commercial doors are available usually from R_w=25 to 35 dB. Single-leaf doors are available for special purposes at least up to 48 dB but they are seldom used. In fact, twin doors are preferred when higher insulation than R_w=35 dB is required.It is well known that imperfect sealing of a door can impair essentially the total sound reduction index of the door. The sound insulation performance of a door can be defined by the set of numbers $R_{w,struct}/R_{w,total}/R_{w,struct}/R_{w,total}$ dB, where $R_{w,struct}$ and R_w, *total* are the weighted sound reduction indices by ISO 717-1 [155] in the laboratory when the door is tape-sealed or normally mounted, respectively.

Sound transmission through doors is assumed to comprise two factors:

- Structural transmission
- leak transmission,

Having sound transmission coefficients τ_{struct} and τ_{leak} respectively. This is elucidated in Figure 2.

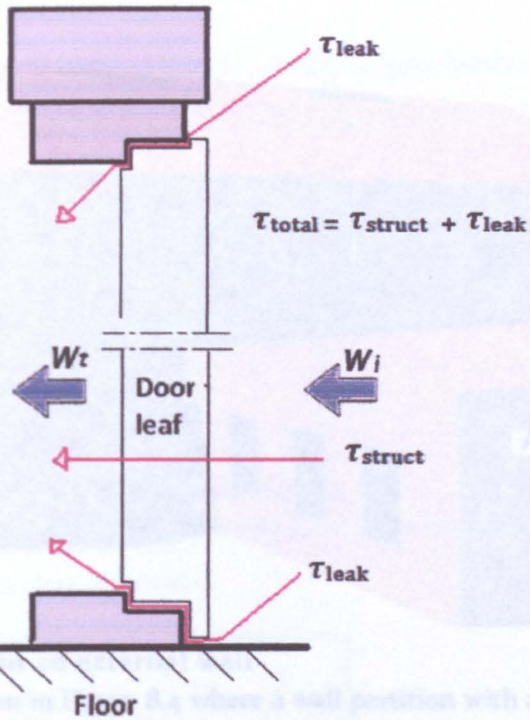


Figure 8.3. The principle of sound transmission through doors (cross section, side view). The leak transmission and the structural transmission are separated. [10]

The areas are S_{struct} and S_{leak} respectively. The sound leaks can comprise, e.g., regular slits, irregular apertures, holes, etc. The transmission through door frames is ignored here since the area of frames is usually below 10% of the door area, the mass is higher than the mass of the door and the transmission coefficient of the frames is difficult to determine experimentally.The structural sound reduction index of a door (denoted by R_{struct}) is usually determined by tape-sealing the slits and the lock device. The SRI of the door without tape sealing (i.e., normal mounting) is denoted by R_{total}, where "total" refers to the sum of leak t ansmission and structural transmission. The total sound reduction index of a door can be calculated by the area-weighted sum of transmission coefficients as:

$$R_{total} = 10\log\left(\frac{1}{\tau_{total}}\right) = 10\log\left(\frac{1}{\tau_{struct}+\tau_{leak}}\right) \quad :(5)$$

$$= 10\log\left(\frac{S_{total}}{S_{struct}\,10^{\frac{-R_{struct}}{10}} + S_{leak}\,10^{\frac{-R_{leak}}{10}}}\right)$$

where $\tau = W_t / W_i$ is the transmission coefficient determined by the incident $=i$ and transmitted W_t sound powers (see Figure 3) and S_{total} is the total area of the door, or $S_{struct} + S_{leak}$.[4]

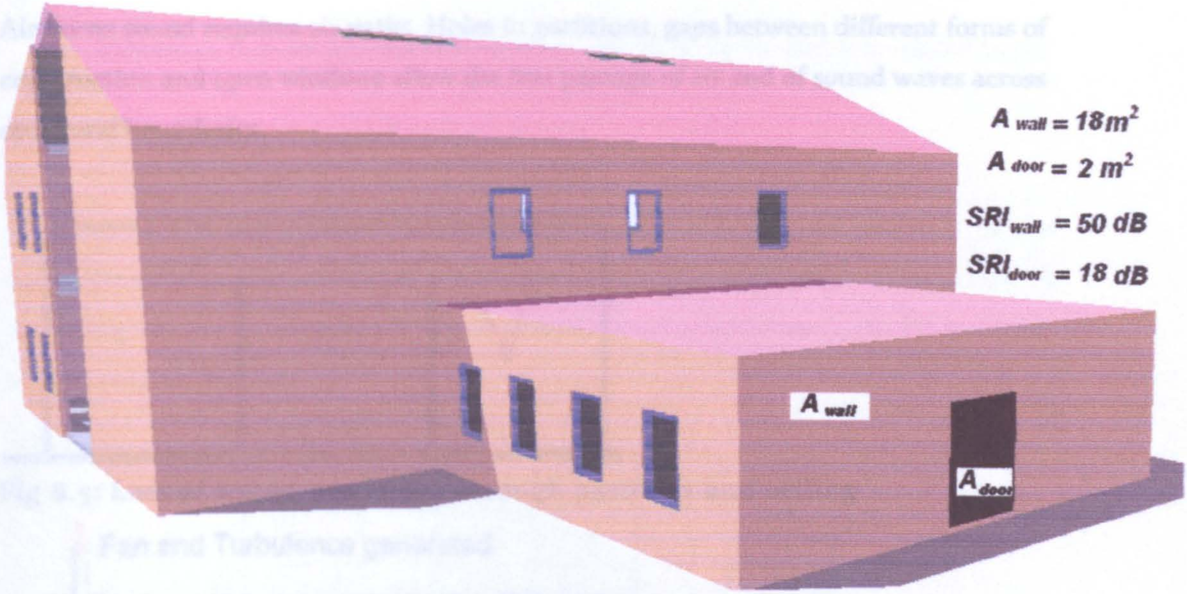


Fig 8.4: SRI of door in an external wall

Using the example given in Figure 8.4 where a wall partition with a SRI of 50 dB has a door within it that has a SRI of 18 dB.

For the wall, for the door

$$\tau = 10^{-\frac{50}{10}} = 10^{-5} = 0.00001$$

$$\tau = 10^{\frac{18}{10}} = 10^{-1.8} = 0.01585$$

Using these two sound transmission coefficients to calculate the average ${}_{Average,}$

$$\tau = \frac{A_{door} \times \tau_{door} + A_{wall} \times \tau_{wall}}{A_{door} + A_{wall}}$$

$$\tau = \frac{2 \times 0.01585 + 18 \times 0.00001}{2 + 18}$$

$$= 0.001594$$

giving an overall Sound Reduction Index of,

$$SRI_{Overall} = -10\log_{10} 0.001594 = -10 \times -2.798$$
$$= 28\ dB$$

8.9 *Air borne sound*

Air borne sound requires air paths. Holes in partitions, gaps between different forms of construction and open windows allow the free passage of air and of sound waves across structural boundaries.

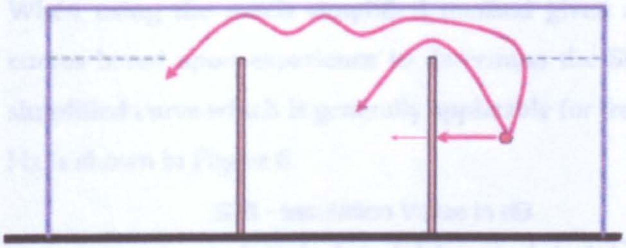


Fig 8.5: Loss of sound insulation through partition and ceiling

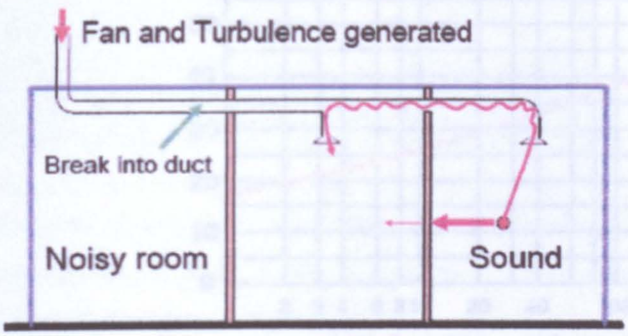


Fig 8.6: loss of sound insulation through ducts

It is important to recognise that there are often sound paths that are not immediately apparent. Thus in Figure 8.5 the void above a lightweight false ceiling can act as a sound path across heavy weight partitions, and in Figure 8.6 the air route through ductwork can similarly act to transmit sound between rooms and from noisy to quiet areas. This additional sound path to the direct route is sometimes called flanking.

Distance will diminish the intensity of sound and circuitous routes will also provide opportunities for the sound to be absorbed along its route. The surface of a partition or structure needs to be moved in order for the sound energy to enter into the structure. A thin light flexible structure is easily flexed and sound energy thus can easily enter into it. However, the stiffer a structure is then the more difficult it is for the compressible air to move the surface of the structure. Thus the sound insulation of a partition is primarily determined by the mass of the partition. The sound loss across a partition is given by the Sound Reduction Index (SRI) that will be defined later. Theoretically the SRI for a single partition is given by,

$$SRI = Constant + 20 \times \log_{10}(m \times f) \qquad :(6)$$

Where, m is mass per unit area of the partition in kg/m^2 and it is related to the density.

f is frequency.

When using the much simplified method given above. It is more practical to use curves based upon experience to determine the SRI of a single layer of structure. A simplified curve which is generally applicable for frequencies between 100 Hz and 3000 Hz is shown in Figure 6.

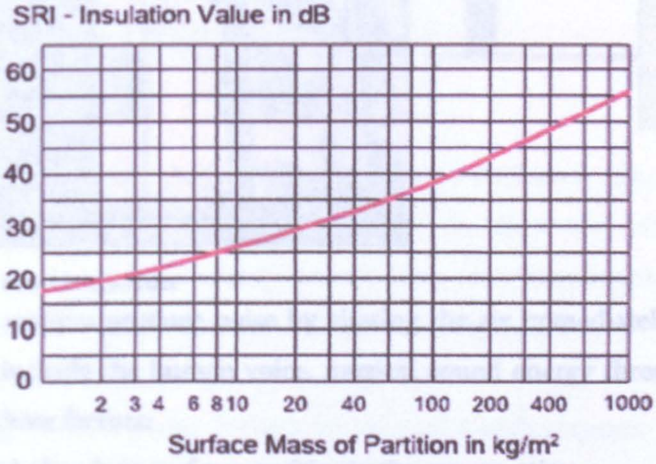


Fig 8.7: Practical values of mass law

8.10 Noise Transmission

Unwanted sound can travel through different paths such as direct transmission, impact noise and through flanking paths as seen below.

8.10.1 Direct Transmission

Fig 8.8:Direct transmission

Airborne sound sources produce noise by virating the air immediately around them. Typical sources include the human voice, musical aound energy through it is largely determined by three factors:

1. The sound absorbancy of any cavities in the construction
2. The structural isolation between the two outer surfaces
3. Its mass

The air tightness of the construction is also important

Increasing the mass of a wall or a floor will improve its sound insulation.

However, the amount of extra weight that can be safely supported by an existing construction is often limited so other design approaches are usually employed in remedial work ie isolation, absorbent materials and resilient layers.

8.10.2 Impact Sound

Fig 8.9: Impact noise

Impact noise sources produce noise by direct physical excitation of part of a building. Examples include slamming doors, stamping on the floor and vibrating washing machines. With impact noise, a relatively small noise source can result in a loud sound being transmitted through the structure, often over long distances.

Impact noise can be controlled by:

1. Providing a resilient layer at the point of impact such as carpet
2. Structural isolation such as adding a resilient layer between the floor deck and the floor stucture.

There is some variation depending on the floor construction,, for instance filled timber floors will help isolation. To counter low-frequency impact, a floating floor is preferable. Surface treatment ned not to be soft.. in this case the base floor should be heavy. However, impact noise at low frequencies is difficult to isolate in separated light timber floors.

8.10.3 Flanking transmission

Fig 8.10:Transmission through flanking paths

Flanking sound transmission usually refers to sound travelling through flanking structural elements, such as the external wall that flanks a separating wall between two dwellings.Flanking sound can also include sound that travels along unitended airpaths, such as unsealed gaps in the structure and around service penetration.

1. Flanking transmission can be controlled by:
2. Extending the separating wall to the underside for the roof
3. Sealing open air paths
4. Forming a lining backed by resilient layer to prevent sound energy entering the flanking element

Doors should not be opened unnecessarily during events (weddings).

8.10.4 Example of single partition

The sound insulation required by a partition may be found quite easily by subtracting the required sound level from the sound level on the other side of the partition as shown in Figure 8.11. The sound insulation provided by a partition is called the Sound Reduction Index of the partition and is defined as:

– : (7)

Where, is the Sound Transmission Co-efficient which is itself defined as:

$$\tau = \frac{\textit{sound power transmitted}}{\textit{incident sound power}} \quad :(8)$$

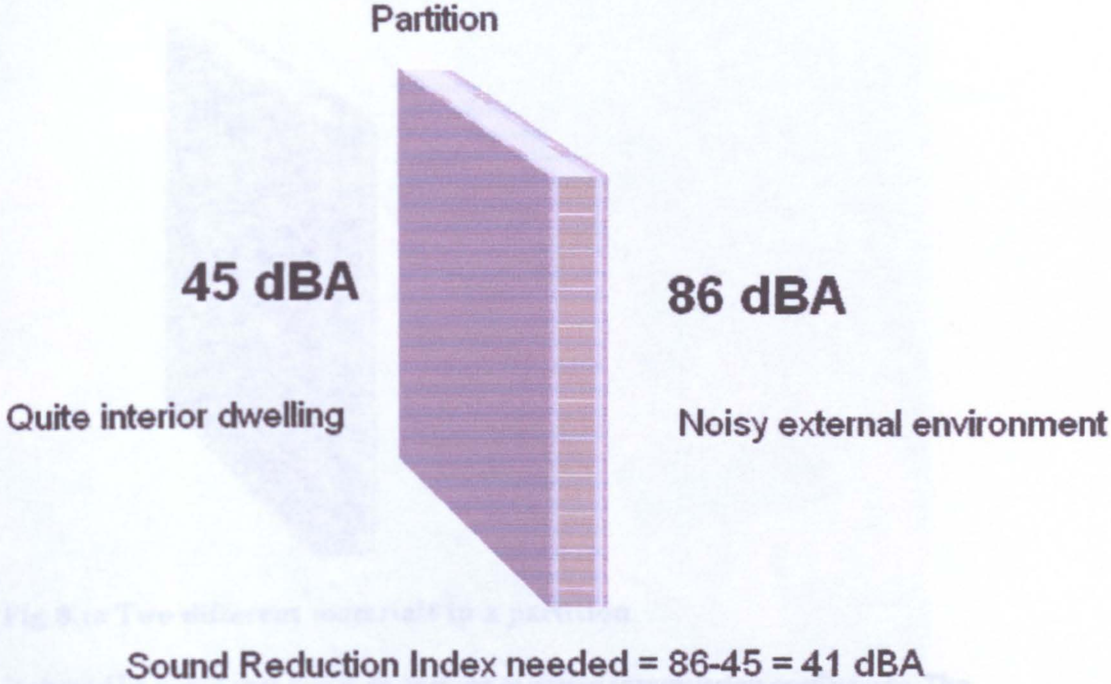


Fig 8.11: Sound reduction index of a partition

Where a panel between two rooms comprises a number of different materials e.g. a door within a partition, or a window within a wall, then there are a number of parallel paths that the sound might take. This can be taken into account by using the average sound transmission co-efficient. This is an area weighted average sound transmission co-efficient and where there are two materials making up the panel as shown in Figure 8.8,

$$\tau_{Average} = \frac{A_1 \times \tau_1 + A_2 \times \tau_2}{A_1 + A_2} \quad :(9)$$

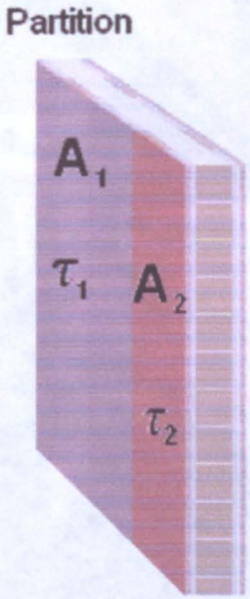


Fig 8.12 Two different materials in a partition

It should be noted that this is an average of power transmission coefficients. The properties of particular materials are given in terms of the Sound Reduction Index measured in decibels and these need to be converted into sound transmission coefficients in order to calculate the average value of τ. using the definition of the Sound Reduction Index given earlier:

$$-10log_{10}\ (\tau) = SRI\ dB \qquad : (10)$$

$$log_{10}\ (\tau) = -\frac{SRI}{10}\ dB$$

$$\tau = 10^{-\frac{SRI}{10}}$$

8.10.5 Example of windows within a wall

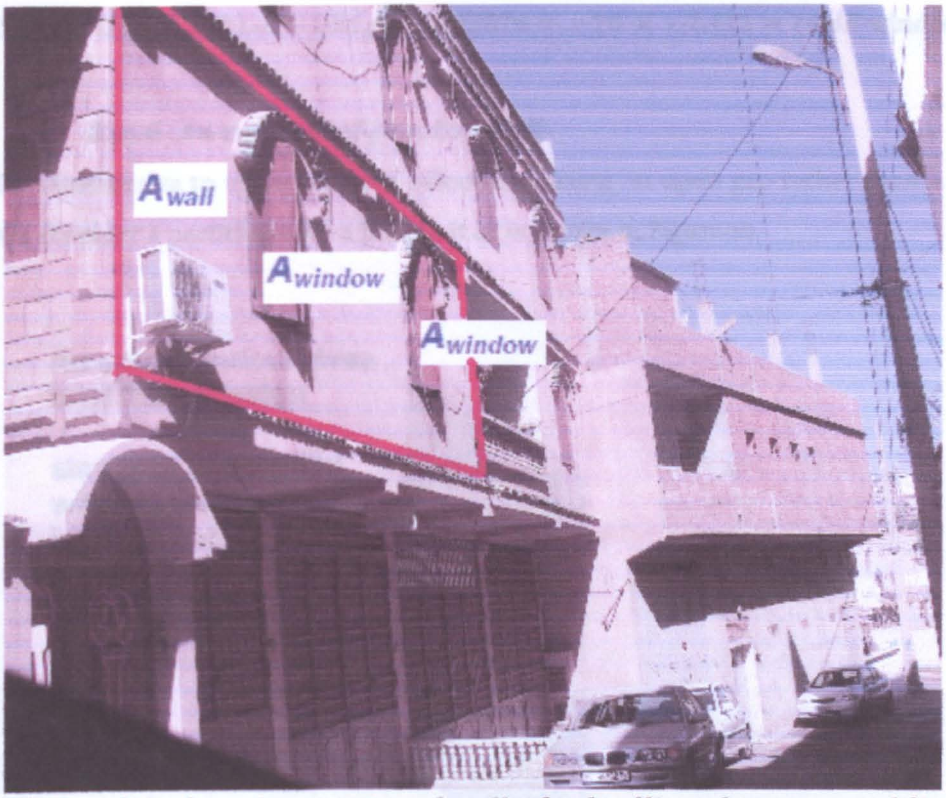


Fig 8.13: Windows in an external wall of a dwelling close to a wedding hall (Venue 15)

Using the example given in Figure 8.10 where an external wall with a SRI of 50 dB has a window within it that has a SRI of 18 dB.

Wall area : A_{wall} = aprox 18m²

Window area: $A_{window\,(total)} = A_{window\,1} + A_{window\,2}$ = approx 2 X 1.5 m² = 2.5 m²

From equation (10)

For the wall

$\tau = 10^{-\frac{50}{10}} = 10^{-5} = 0.00001$

For the windows

$\tau = 10^{-\frac{18}{10}} = 10^{-1.8} = 0.01585 \times 2 = 0.0317$

Using these two sound transmission coefficient to calculate the average, $\tau_{Average}$

$$\tau_{Average} = \frac{A_{windows} \times \tau_{windows} + A_{wall} \times \tau_{wall}}{A_{windows} + A_{wall}}$$

$$\tau_{Average} = \frac{2.5 \times 0.0317 + 18 \times 0.00001}{2.5 + 18}$$

$\tau = 0.003874$

$SRI = -10log_{10}\ (\tau) = -10log_{10}\ 0.003874 = -10 \times -2.411 = 24\ dB$ windows

8.10.6 An example of gaps in a wall

It is instructive to undertake this calculation using an open gap rather than a door. If we consider a partition with a hole in it as is shown in Figure 10.

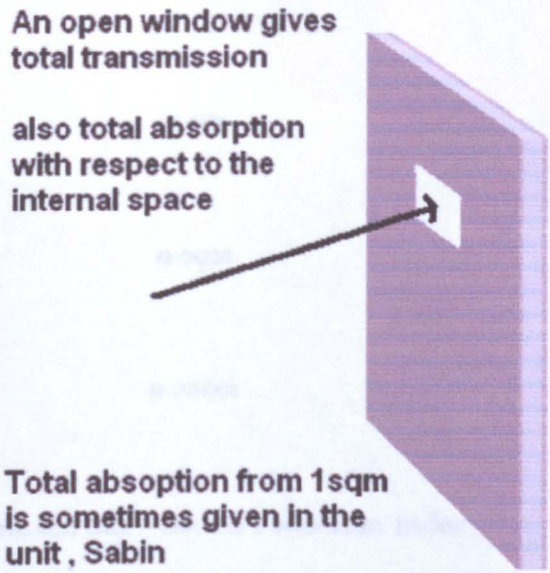


Fig 8.14 : SRI of gaps in wall

Simplifying the example by assuming the following:

The wall transmits no sound through it, so τ_{WALL}=0,

The hole transmits all sound incident on it, so τ_{HOLE}=1.

Using, $\tau = \frac{A_{hole} \times \tau_{hole} + A_{wall} \times \tau_{wall}}{A_{hole} + A_{wall}}$: (11)

And the overall SRI is given by,

$SRI_{overall} = 10log_{10}\left(\frac{A_{wall}}{A_{hole}}\right)$ dB

And using this for a number of different area ratios in Table 8.1.

$\frac{1}{\tau} = \frac{A_{wall}}{A_{hole}}$	$SRI_{overall} = 10log_{10}\left(\frac{A_{wall}}{A_{hole}}\right) dB$
0.1	10
0.01	20
0.001	30
0.0001	40
0.00001	50

Table 8.1: SRI – Sound Reduction Index

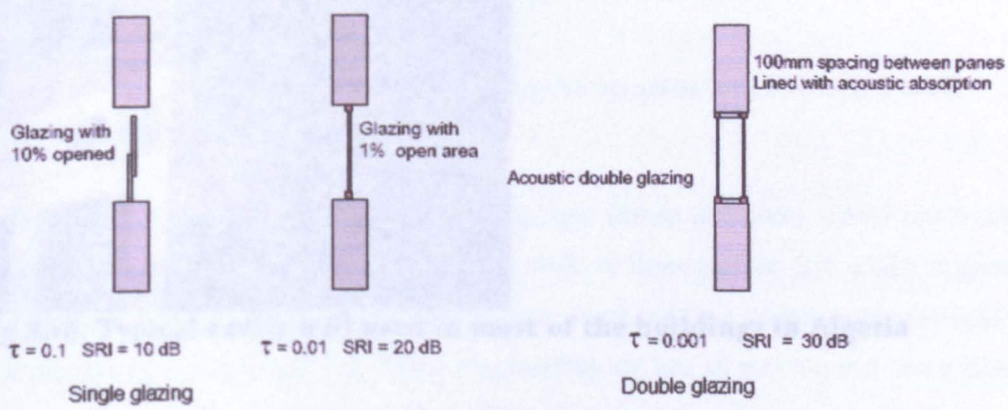


Fig 8.15: Construction gaps in different glazing types

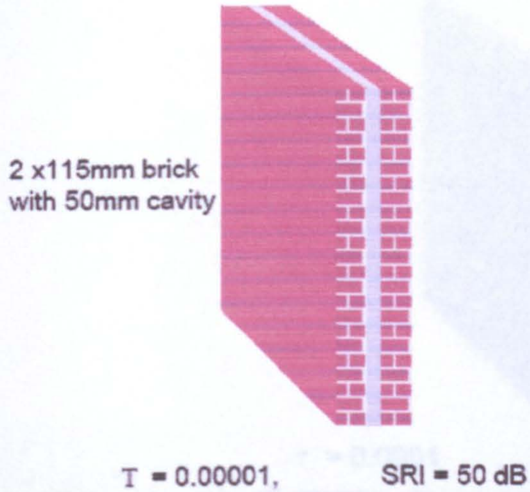


Fig 8.16: Typical cavity wall used in most of the buildings in Algeria

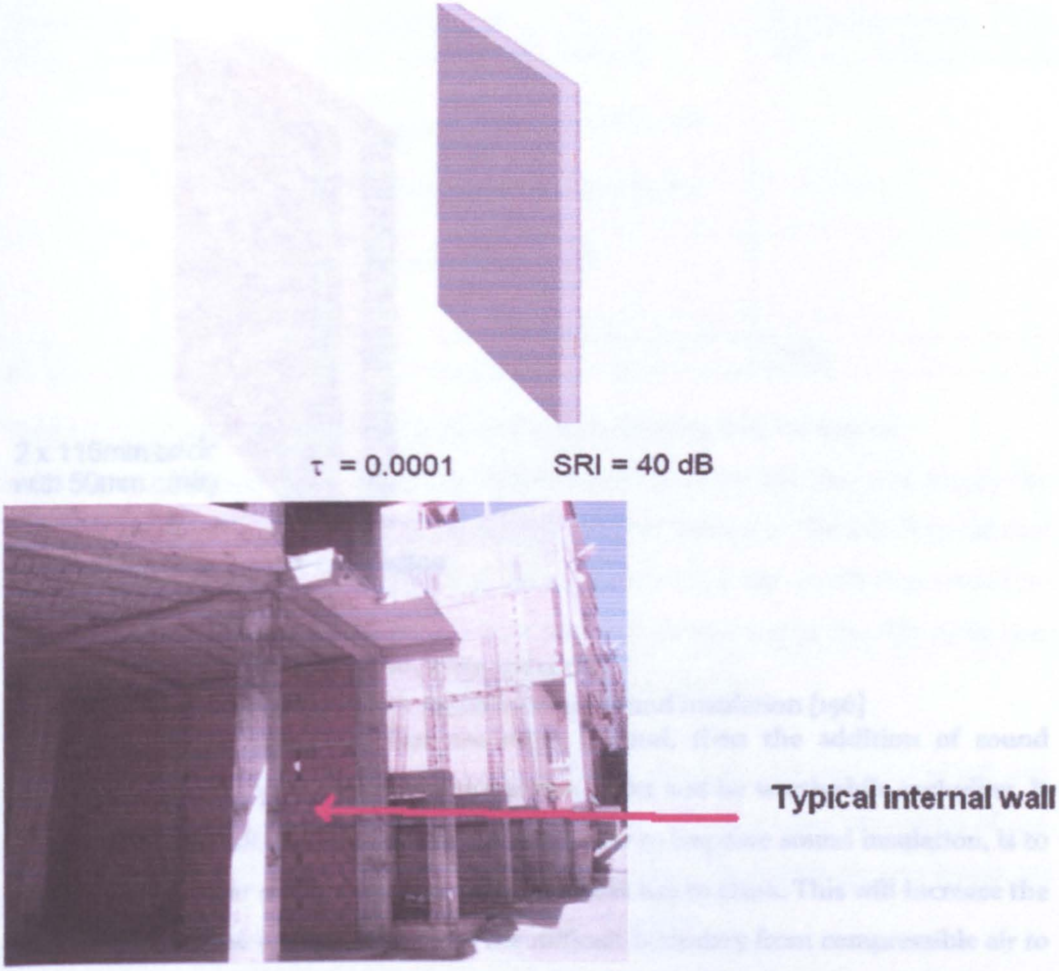


Fig 8.17: Typical partition wall used in social housing as separating wall between two flats

8.10.7 Multiple layer partitions

As shown in Figure 8.18, putting an absorbing layer within the cavity would not much reduce the sound transmitted through the wall; it does not in fact make a great difference. This is because the sound insulation provided by a partition is principally determined by the difficulty that the compressible air has in moving the more rigid surface of the partition. The dampening effect of an absorbing layer that absorbs even 50% of the sound power is insignificant in comparison with that rejected at the surface of the partition.

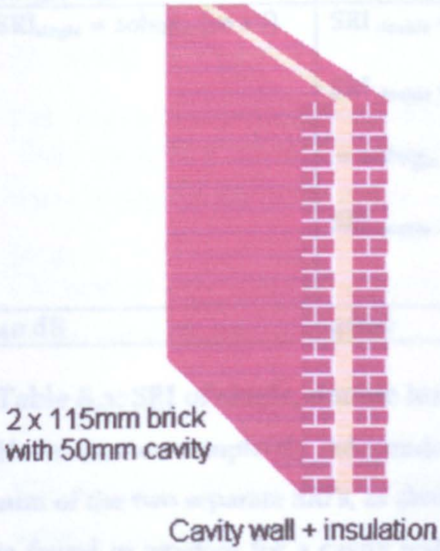


Fig 8.18: cavity wall with absorbing material

Absorbing material in gap will not much increase sound insulation [156]

For lighter weight partitions that are more flexural, then the addition of sound absorbing materials within a cavity can have an effect and be worthwhile including. It might appear that all that needs to be done in order to improve sound insulation, is to increase the number of rigid surfaces that the sound has to cross. This will increase the number of times the sound has to cross the difficult boundary from compressible air to rigid solid. Indeed it is found that multi-layer partitions do have better sound insulation than single layer partitions. However, the effects of multiple layers is quite complex and does not provide all the benefit that might be expected [157],.

The theoretical sound insulating effect of a single leaf, will be given by the mass law,

$$SRI = Constant + 20 \times \log_{10}(m \times f). \qquad :(12)$$

Because the constant will apply to each case to be considered, it is 2 x115mm brick omitted for simplicity and,

$$SRI = 20 \times \log_{10}(m \times f) \qquad :(13)$$

As an example, a single leaf of brick by itself has a SRI of 40 dB, then two bricks built into a single leaf, as shown in Figure 8.15, will have twice the surface mass of the single leaf, and its theoretical SRI will be calculated as shown in column two of table 8.2.

Single leaf	Double leaves	Two independent leaves
$SRI_{single} = 20\log_{10} (m \times f)$	$SRI_{double} = 20\log_{10} (2m \times f)$ $SRI_{double} = 20\log_{10} (m \times f) \times (2)$ $= 20\log_{10} (2m \times f) + 20\log_{10} (2)$ $SRI_{double} = SRI_{single} + 6$	$SRI_{twice} = SRI_{single} + SRI_{single}$
40 dB	46dB	80dB

Table 8.2: SRI of single, double leaf wall and two independent leaves

However, two completely independent leaves would have an SRI that was simply the sum of the two separate SRI's, as shown in column 3 of Table 8.2. The SRI of 50 dB that is found in practice for a cavity wall is indeed better than the 46 dB that would be expected from doubling the surface density, but it is nowhere near the SRI of 80 that might be expected theoretically from two independent leaves.

This is due to the fact that the air in the cavity is captive, and cannot expand and contract freely. This increases the stiffness of the air and allows the vibrations of one leaf to be more easily transferred to the second leaf. This means that the two leaves are effectively coupled together and not entirely independent.

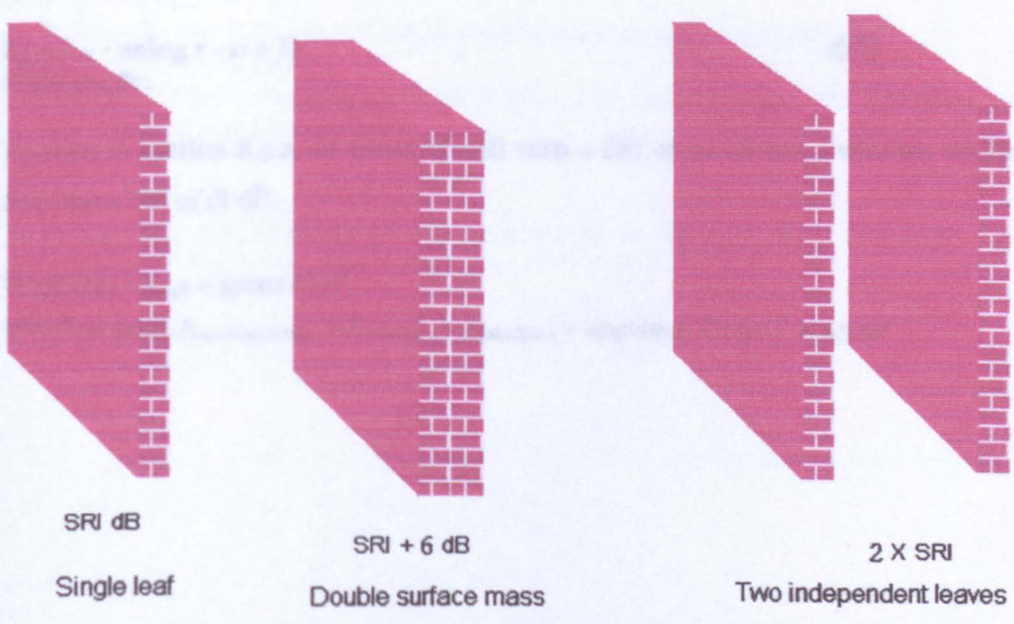


Fig 8.19: example of single and multiple layer SRI calculation

8.11 Sound Transmission via Building Facades, from Inside to Outside

Sound propagation out of a building

There are three stages to this calculation, which may relate either to sound transmission via the entire façade, or via an element of the facades such as a window.

Stage 1

Calculate the sound level, L_{OUT}, just outside the façade arising from sound transmission through the façade:

$$L_{OUT} = L_{IN} - R - 6 \qquad :(14)$$

Where = L_{IN} is the reverberant sound level inside the room and R is the sound reduction index of the facade or façade element.

Stage 2

Calculate the sound power level, L_W, of the façade element acting as a sound source radiating source towards the reception point:

$$L_W = L_{OUT} + 10\log S \qquad :(15)$$

where S is the area of the façade or facade element.

Stage 3

For reception point at distances, r, much greater than the dimensions of the façade, it may be assumed that the façade (or façade element) behaves as a point source radiating into a free field, with a directivity index D.

$$L_R = L_W - 20\log r - 11 + D \qquad :(16)$$

Case study:

As seen in section 8.9.2, an external wall with a SRI of 50 dB has a window within it that has a SRI of 18 dB.

Wall area : A_{wall} = aprox 18m^2

Window area: $A_{window\,(total)} = A_{window\,1} + A_{window\,2}$ = approx 2 X 1.5 m^2 = 2.5 m^2

1/3 Octave Band	L_{IN}
1/3 Oct 63Hz	85.5
1/3 Oct 125Hz	76.3
1/3 Oct 250Hz	106.2
1/3 Oct 500Hz	99.5
1/3 Oct 1kHz	98.4
1/3 Oct 2kHz	96.5
1/3 Oct 4kHz	80.6

Table 8.3: Third octave band (Lin) of Façade opposite Venue15.

At 1/3 octave 63Hz,

Lin = 85.5 dB

Stage 1

R= Sound reduction index of the façade (window) = 18 dB

$L_{OUT} = L_{IN} - R - 6$
$L_{OUT} = 85.5 - 18 - 6 = 61.5$ dB

Stage 2

$L_W = L_{OUT} + 10\log S$
$S = A_{windowl} = 2.5\ m^2$
$L_W = 61.5 + 10\log 2.5 = 65.5$ dB
Stage 3
$L_R = L_W - 20\log r - 11 + D$
r= distance between noise source and reception point= 25 m approximately
D is the directivity index
We assume a directivity index of +3 dB because the r is greater than the dimensions of the two windows which is 2.5 m²
Therefore
$L_R = 65.5 - 20\log 25 - 11 + 3 = 29.4$ dB
Using the same calculation procedure as shown above, L_{OUT}, L_W, L_R have been calculated and summarized in Table 8.4

1/3 Octave Band	L_{IN}	L_{OUT}	L_W	L_R
1/3 Oct 63Hz	85.5	61.5	65.4	29.44
1/3 Oct 125Hz	76.3	52.3	56.2	20.24
1/3 Oct 250Hz	106.2	82.2	86.1	50.14
1/3 Oct 500Hz	99.5	75.5	79.4	43.44
1/3 Oct 1kHz	98.4	74.4	78.3	42.34
1/3 Oct 2kHz	96.5	72.5	76.4	40.44
1/3 Oct 4kHz	80.6	56.6	60.5	24.54

Table 8.4: Recapitulative table of L_{IN}, L_{OUT}, L_W and L_R (venue 15)

Concerting Octave-Band levels to A weighted Octave Bands levels

Octave Band frequency (Hz)	dBA weighting
31.5	-39.4
63	-26.2
125	-16.1
250	-8.6
500	-3.2
1000	0
2000	1.2
4000	1.1
8000	-1.1

Table 8.5 : Corrections (dBA weighting) to convert linear octave band levels into A-weighted Octave band levels.

This correction factor is the amount by which the A-weighting de-emphasizes the level of the sounds within each octave-band. Table 8.5 shows the corrections (dBA weightings) that can be used to convert linear octave band levels into A-weighted octave bands levels. For example, dBA de-emphasizes the 125 Hz octave band by 16.1 dB. Thus, if the 125 db OBL is 60 dB then the correction would be that its dBA value by subtracting

60-16.1 = 43.9 dB. Therefore, using the same principle, Octave band levels in Table 8.4 will be converted to dBA weighting as follow.

1/3 Octave Band	L_{IN}	L_{OUT}	L_W	L_R
1/3 Oct 63Hz	59.3	35.3	39.2	3.24
1/3 Oct 125Hz	60.2	36.2	40.1	4.14
1/3 Oct 250Hz	97.6	73.6	77.5	41.54
1/3 Oct 500Hz	96.3	72.3	76.2	40.24
1/3 Oct 1kHz	98.4	74.4	78.3	42.34
1/3 Oct 2kHz	97.7	73.7	77.6	41.64
1/3 Oct 4kHz	81.7	57.7	61.6	25.64

Table 8.6: Recapitulative table of converted L_{IN}, L_{OUT}, L_W and L_R (venue 15) to dBA weighting

8.12 Sound transmission control methods

8.12.1 Flexible, Sound insulating Materials

Heavy, limp and felexible materials such as lead or plastic can be very effective for sound insulationm and have applications where rigid material cannot be used well. They can be used as covers or wrapping over curved or virregular surfaces such as ducts.

8.12.2 Seals

Seals often fail simply because they do not fill the width of the joint. Dry seals must offer good enough compliance and must be well compressed. Compression can be applied over a long length such as round a door or window frame. Good seals cannot be expected where access is difficult. Adjoining surfaces must be clean, dry and free of oil before the application.

8.12.3 Acoustic doors

A very high proportion of doors are very poorly sealed. As a result, they tend to develop their full potential for sound insulation. Door seals, even when provided are often not of the right type or material. To improve insulation of doors, we must add mass to it and improve the seals and the ironmongery. For example timber doors can be improved by incorporating steel or lead sheet. Insulation improves above 35dB; the quality of seals becomes very important.

8.12.4 *Acoustic lobbies*

Acoustic lobbies with inner and outer acoustic doors often provide good noise control. They are designed to prevent both sets of doors being opened at the same time However, care should be taken that any door to a lobby on a fire exit route is still capable of easy and rapid opening in the direction of exit in the case of emergency evacuation, and that the appropriate fire protection is provided after acoustic treatment

8.13 *Conclusion*

In present-day acoustics, noise control or sound conditioning in rooms is one of the most important problems .To protect a building against exterior noise, the airborne sound insulation of the façade is of primary importance. The overall sound reduction index of the façade depends on the sound reduction index and surface area of the individual components of the façade (wall, windows, doors, etc.). In this chapter, several prediction and measurement results are presented concerning both structural transmission and leak transmission. These have been shown, theoretically and also by calculation examples.

In Algeria, most of the façades are commonly masonry cavity walls without any insulation. . Under these circumstances, it is necessary to measure the sound absorption characteristics of wall materials and the sound insulation characteristics of partitions, windows, or doors.

Premises such wedding halls will usually require sound insulation to prevent noise break out, whereas schools and other public buildings will usually require sound insulation to reduce noise break in.

Therefore, sound insulation of building parts, such as walls, roofs and doors will reduce the noise levels entering a building.

CHAPTER NINE
Recommendation for Mitigation of Noise from Entertainment Halls in Algeria

9.1 *Introduction*

The present study has showed us that noise is a significant issue in Algeria especially noise coming from wedding halls .Entertainment in discotheques and wedding halls have become an important part of community life, of course these premises also bring in business for the licensees and also boost the local economy .However it is obvious that the musical entertainments used in these premises also lead to noise nuisance affecting local residents.

During investigations undertaken in the present study in Algiers concerning the noise we have observed that all the entertainment premises we have visited in the centre of the capital and its suburbs have been working without applying any true ,clear regulations concerning noise in general . We have also found out that (for these premises neighbourhood) no serious standards or codes of practice have been written in Algeria for the purpose of giving guidance or an objective assessment methodology to assist officers investigating neighbour and neighbourhood noise when they happen to deal with noise complaints.

Up to now the only body noise complainers could refer to solve their noise problem is the police who most of the time resolve to make the antagonists meet, to cut the matter short they usually order them to reach a mutual compromise and resolve the problem amicably. In fact, most of the wedding halls which have sprung up everywhere and every day between 2000 and 2007 have opened up in centre of towns close to places of residence entailing noise nuisance to the neighbourhood. The people affected by noise disturbance do not know who can settle their complaints, except of course, a legal action which of course involves a loss of time and money.

Being more and more aware of the health impacts of community noise and the harmful effects of noise in non-industrial environments, several associations (Med Psy School has organised a conference on noise nuisance in Algeria on 29th March 2008 have involved themselves in order to attract the attention of the Algerian Authorities on the health risks to humans from exposure to environmental noise. They have addressed several warnings on the issue of noise control and health protection. One way to stop noise nuisance would be to enact regulation, guidance or equipment to use to measure noise levels and decide which level can be considered as a nuisance depending on the local circumstances.

The choice of the criteria will depend on the time of day. Although Algeria does not have a significant 'Siesta' culture, noise during the afternoon is perceived as a problem but not as much as in the late evening (after 10pm). The measurements show a considerable increase in the noise level when the 'weddings' are on. This would not prove acceptable in the UK. Arguments will need to be advanced as to the correct criteria to be used in the specific circumstances of Algeria and how they can be achieved using local materials and construction practices. Also during our investigation in the present study, we have noticed that there is only one organisation (VERITAL) dealing with noise measurement and whose main role is to provide the entertainment premises with the required certificate entitling their opening up. There is very limited official documentation and publication relating to the noise in Algeria regarding who is allowed to issue these certificates and in addition an absence of the appropriate equipment to measure the noise levels (a very simple sound level meter is being used to monitor noise levels from wedding halls), and this cannot give a true assessment of the effect of these noise levels on the surrounding community and control noise nuisance.

During the subjective survey, many people living in the neighbourhood of wedding halls were questioned and have expressed their frustration because there is no possibility to get a proper assessment of the noise nuisance levels from entertainment halls when to support their complaint which can help them gather and determine evidence of the noise disturbance and therefore assist them to give sufficient evidence to establish statutory nuisance in court. As a consequence, the legislative regulations regarding noise emanated from music entertainment halls have to become stringent in Algeria. In order to tackle the issue of noise disturbance from entertainment halls two solutions should be considered, the first one being legislative and the second one technical.

9.2 *Legislative solution*

Nowadays, it is becoming increasingly evident that a different approach to the noise problem from entertainment halls is required in Algeria. Policy makers need to find new solutions for the noise problem. We have seen from the present study that amplified music has potential to cause problems; it depends on how loud it is played and at what time of the day or night. Important questions for policy makers and decision makers in the government should be debated and discussed in parliament and in local authorities.

- What will be an effective system of rules and legislation to enforce noise reductions at sources?

- How will effective noise legislation protect citizens against unacceptable noise levels?
- What is the expectation for technical solutions for reduction of noise at the source?

The only people who can influence policy and decision makers are engineers and acoustician specialists. The latter can advise and support policy makers and influence their choices to implement and establish new noise legislation.

However, in Algeria there is an absence of competent persons (acousticians and noise control officers) in the field of noise control. Therefore, it is important that government start to invest and fund programs to help universities and local authorities to encourage training of noise control officers and acousticians. Also a creation of a body of research on the noise environment in each council should be considered.

The role of the noise control officers will mainly be investigating the noise complaints and enforce the law. This can be done as follow:

- Tackle and look at the cause of the problem from its root.
- Determine where the noise source or sources are and how much each is contributing to the overall level and their frequency signatures.
- Record and analyse noise related complaints and present evidence on noise sources, levels, type and temporal distribution.
- Enforce the law and legislation by taking action such as withdrawal of licence

This will start with implementing a noise team or environmental health officers in each council of the country offering them proper and sophisticated materials to measure and assess the level of the noise .This team will have the power to deal with any complain from :

- loud music
- domestic noise such as DIY work
- barking dogs
- construction site noise
- noise from entertainment and wedding halls
- noise from commercial premises

The council should deal with noise problems by assessing whether the noise is unreasonable, by taking into account factors such as loudness, intensity ,cause ,type ,duration ,how often it lasts, how often it occurs ,time of day and background noise levels. Having environmental health officers in each council who will be available and contactable will encourage people who are disturbed by any noise to complain. Complainants should be aware that environmental health officer must witness the noise before taking action and if the noise is thought to be excessive the law require serving an "abatement notice" on the person responsible. Each council will have to provide leaflets. The purpose of these leaflets is to give practical guidance to the people in control of premises on how to control the noise levels coming from the music instruments and loud speakers they use.

We aim to maintain an acceptable acoustic environment for the community through planning, noise abatement and other controls. However, music entertainment noise is our biggest concern and solutions will be difficult to achieve on existing halls.

Improving a good sound quality is relatively easily achieved with good planning. There are a lot of products on the market that afford simple cost effective practical solutions.

9.3 Technical solutions

Sound insulation is one of the best options to control noise nuisance. Typical Algerian construction is mainly made with hollow blocks and bricks which are not good enough for the acoustic comfort. The cavity between the inner and the outer leaf is causing big problems, because most of the buildings do not have any insulation inside the cavity. Windows and doors also allow the sound to pass through frames and leaks.

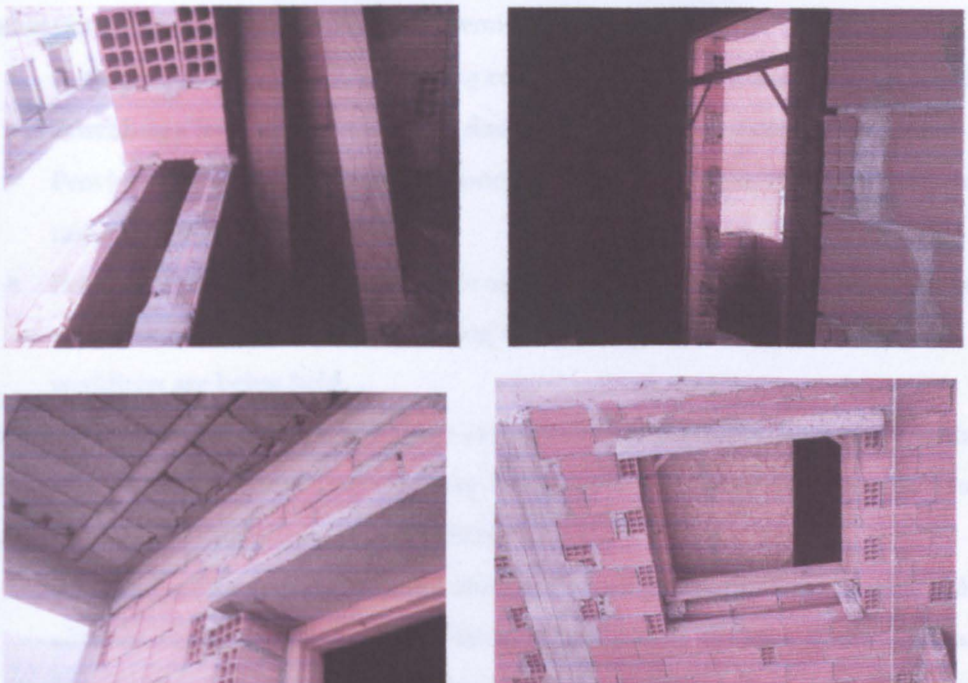


Fig: 9.1 typical building constructions in Algeria

Noise is known as a major environmental problem and is the cause of increasing public concern and interest. If wedding halls owners and managers find that they cannot achieve reasonable levels of entertainment noise without causing complaints it may be necessary and obligatory to strengthen the acoustic structure of their premises to prevent noise breakout in order to avoid the withdrawal of their licence.

There are many ways in which wedding halls managers and owners may consider to control the noise emanating from their premises.

- Fitting secondary glazing or locking certain windows on noise sensitive façade.
- Providing a lobbied entrance with double doors on automatic closers
- Provision of well-sealed acoustic doors on emergency exits where they are on noise sensitive facades.
- Providing mechanical ventilation or air conditioning to avoid the need to open windows and doors especially during the hot season where most of the weddings are being held.

Other measure should be applied if these entertainments premises share party walls or floors with residential neighbours it may be necessary to carry out specific sound insulation works to upgrade walls and ceiling.

- Installing noise sound limiters connected to all permanent music and public address equipment and all available mains power sockets within the area around the stage. The limiter should be set at a level agreed with the local authority .It should however be noted that in very noise-sensitive situations.
- Keeping speakers away from party or neighbouring walls.
- Placing speakers on acoustic mats or absorbent material which will absorb some sound. Speakers can also be hung from the ceiling, this helps to stop the noise transmitting through the building structure.

The control of the noise is also important at the source, either by reducing the overall sound level of the music, or by reducing the sound level at individual frequencies which are causing, or have the potential to cause, the disturbance. Wedding guests should also control their noisy behaviour and must rest with the person responsible for the management of the premises, who should take all reasonable steps to ensure that they do not cause noise nuisance whilst on the premises, or disturbance whilst dispersing from the premises. This is a real issue in Algeria especially when weddings are celebrated in the evening and finish late at night, patrons and guests tend to use horns and celebration screams when leaving the premises without any consideration to the neighbourhood. Another common cause of disturbance is taxis picking up people after the event has finished and cars screeching, sounding horns car stereo on, this also can cause a disturbance. Wedding halls should ensure good management control over patrons when they are leaving by implementing the following:

- Providing notices in conspicuous positions requesting the co-operation of patrons particularly when leaving the premises
- Employing experienced and trained door stewards to restrict entry at certain times and to control noisy patrons.

The wedding halls operators should also keep amicable relations with the neighbours All staff should be approachable and sympathetic to the concerns or complaints from neighbours. Wedding hall operators should let neighbours know how to contact them and take time to visit them to listen to their side of the problem.

Establishing a good relationship with them will be in the halls managers' advantage

9.3.1 *Approach to acoustic design at each stage of the planning and design process for new wedding halls*

Early Design Stage

- Selection of the site: councils should allocate a site for new wedding halls outside residential areas.
- Noise survey to establish external noise levels.
- Consideration of need for external noise barriers using fences and screens and landscape features if weddings are celebrated in courtyards and terraces.
- Preliminary calculation of sound insulation provided by building envelope including the effect of ventilation openings.

Detailed Design

- Determine appropriate noise levels and reverberation times for the various rooms.
- Provide the necessary façade sound insulation whilst providing adequate ventilation
- Consider sound insulation separately from other aspects of room acoustics using walls, floors and partitions to provide adequate sound insulation.
- Specify the acoustic performance of doors, windows and ventilation openings.
- Specify performance of any amplification systems.

Building Control Approval

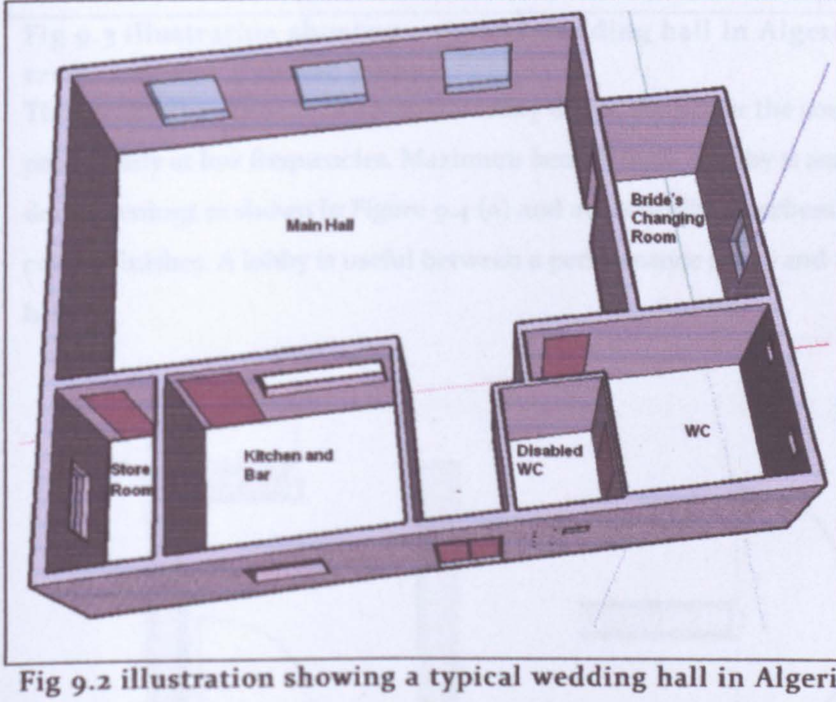
- Submit plans, including specific details of the acoustic design, for approval by Building Control Body known in Algeria as CTC (Controle Technique de Construction) in each council.

9.3.2 *Approach to the approval of wedding hall licence*

- Approval of fire brigade department: fire exist will be checked as well as sprinklers system and fire doors
- Approval of local police department: Police should be informed about the time of the use of the premises beforehand.
- Approval of council environment department.
- Consultation of local residents needed if wedding hall is located nearby residential area before approval of planning permission
- Annual review of licence.
- Fines will be handed to wedding hall managers and licence will be withdrawn if any violation of the council noise laws occurs.
-

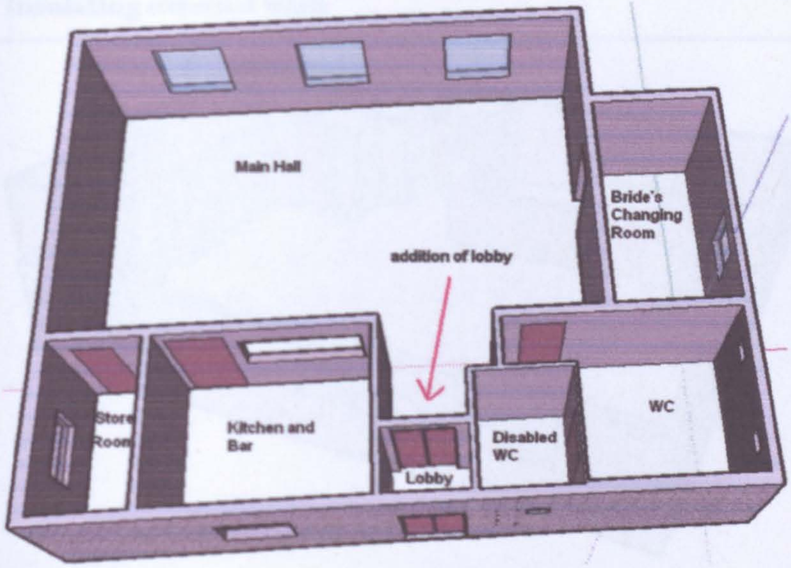
Suggested Solutions for Wedding Halls

Addition of a lobby



Wedding hall without a lobby will let noise and music out when guest enter the hall.

Fig 9.2 illustration showing a typical wedding hall in Algeria



Installing an acoustic lobby to the entrance of the entertainment hall; provides a good noise control doors should be closed at all times to ensure effective insulation.

using thick timber door (45-55 mm) can achieve an acoustic performance of between 30 and 35 dB *Rw* in sound insulation.

Fig 9.3 illustration showing a typical wedding hall in Algeria with recommended acoustic lobby

The greater the distance between the lobby doors, the better the sound insulation, particularly at low frequencies. Maximum benefit from a lobby is associated with offset door openings as shown in Figure 9.4 (a) and acoustically absorbent wall and/or ceiling finishes. A lobby is useful between a performance space and a busy entrance hall

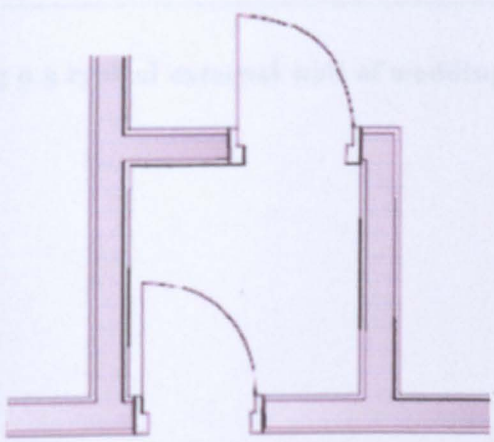


Figure 9.4(a).

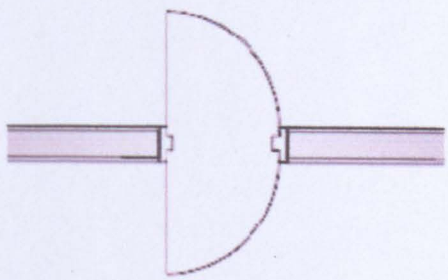
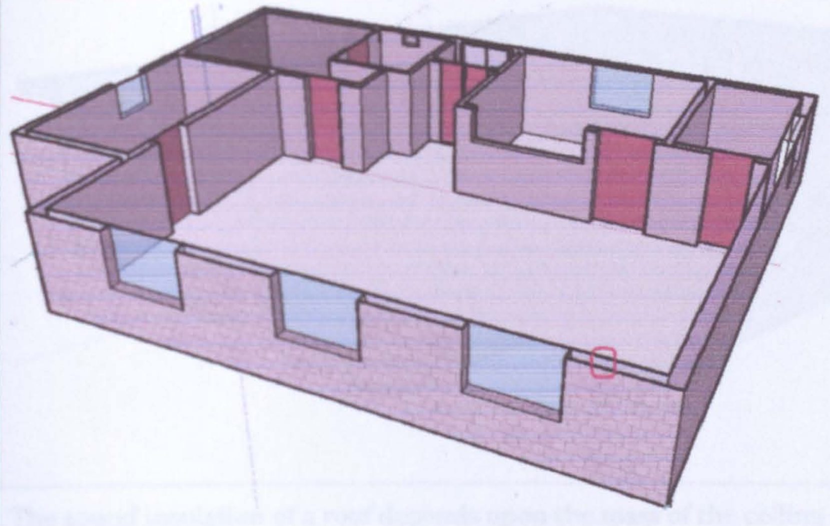


Figure 9.4(b).

Where limitations of space preclude a lobby, a double door in a single wall will be more effective than a single door; this configuration is illustrated in Figure 9.4(b).

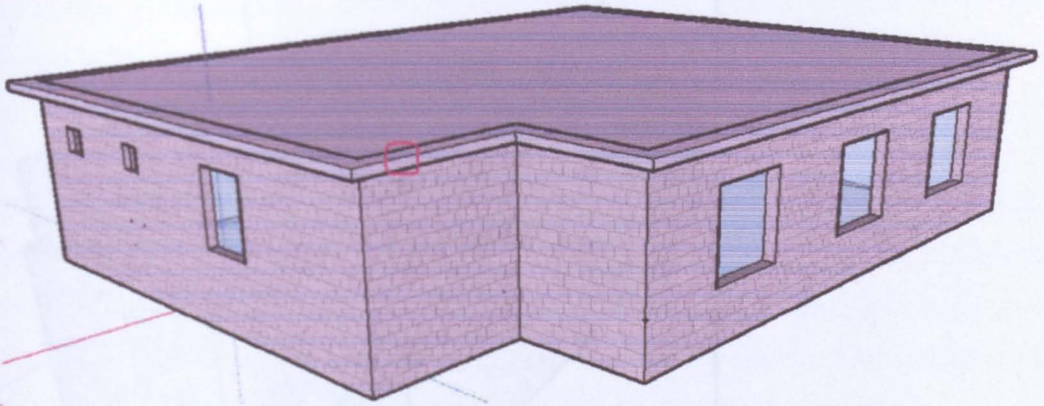
Insulating external walls



For masonry walls, such as a solid brick wall, a brick/block cavity wall or a brick-clad timber frame wall, the sound insulation performance will normally be such that the windows, ventilators and, in some cases, the roof will dictate the overall sound insulation of the building envelope. For a 225 mm brickwork wall plastered or rendered in both
sides can achieve between 50-55 *Rw* (dB) in sound insulation

Fig 9.5 typical external wall of wedding hall with and without insulation

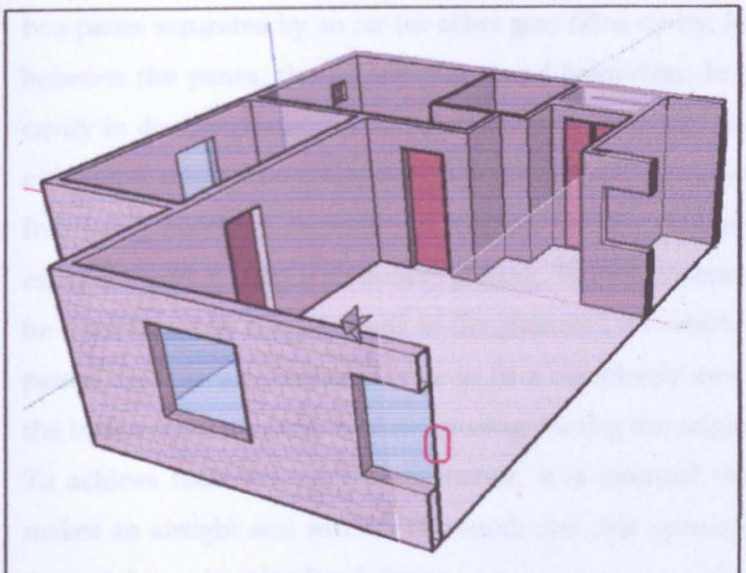
Insulating roofs

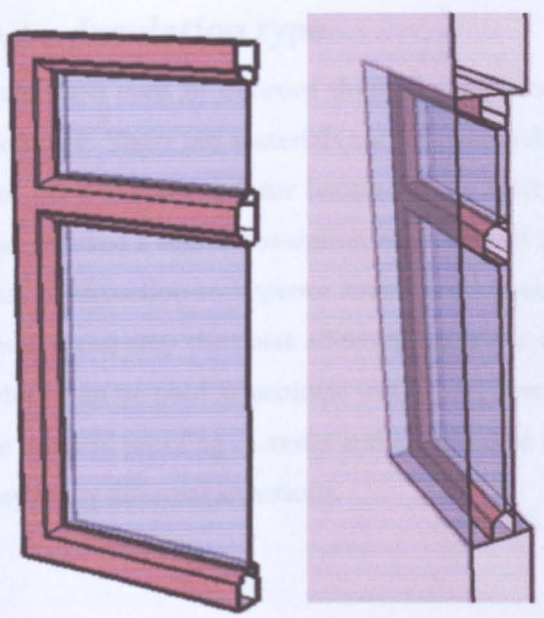


The sound insulation of a roof depends upon the mass of the ceiling and the roof layers and the presence of a sound absorbing material in the roof space. Mineral wool, used as thermal insulation in the ceiling void, will also provide some acoustic absorption, which will have a small effect on the overall sound insulation of a roof. A denser specification of mineral wool, as commonly used for acoustic insulation, would have a greater effect on the overall sound insulation of the roof.

Fig 9.6 typical flat roof of wedding hall with and without insulation

Glazing





Single glazing should be replaced by double glazing or triple glazing plus another single layer of about 50 mm from the main window as shown (left)

sound insulation is approximately 10-15 dB *Rw*

Fig 9.7 typical single glazing used in wedding halls and suggested double glazing

When choosing suitable windows using measured data, care must be taken to differentiate between measured data for glazing and measured data for windows. The reason is that the overall sound insulation performance of a window is affected by the window frame and the sealing as well as the glazing.

To achieve the required sound insulation with thin glass it is often necessary to use two panes separated by an air (or other gas) filled cavity. In theory, the wider the gap between the panes, the greater the sound insulation. In practice, the width of the cavity in double glazing makes relatively little difference for cavity widths between 6 mm and 16 mm. wider cavity widths perform significantly better.

In existing buildings, secondary glazing may be installed as an alternative to replacing existing single glazing with double glazing. The effectiveness of secondary glazing will be determined by the thickness of the glass and the width of the air gap between the panes. Another alternative may be to fit a completely new double-glazed window on the inside of the existing window opening, leaving the original window intact.

To achieve their optimum performance, it is essential that the glazing in windows makes an airtight seal with its surround, and that opening lights have effective seals around the perimeter of each frame.

9.4 *Insulation type*

Insulation used to improve thermal comfort can also been used to reduce the noise nuisance. There are materials such as mineral fibre which is a good thermal insulator but poor sound insulator because of its lightweight nature). However, mineral fibre can be used a sound absorption material and can be placed in the cavities of a double leaf construction to improve sound insulation. Using acoustic insulation material can reduce and stop the noise affecting our environment. There are many insulation types which can be used as acoustic insulation; however the choice of the insulation should be a sound proofing material and should deal with unwanted transmission of sound in any many different situations.

Here is an example of natural sound insulation materials which can be used in Algeria to prevent and reduce sound transmission. These insulation materials can be applied to external walls, ceilings and floors.

The acoustic and thermal properties of some traditional and sustainable natural insulating materials are reported in Table 9.1. When not specified, absorption coefficient refers to 4 cm thick panels while index of reduction of impact noise refers to 2 cm thick panels.

	Thermal conductivity ▯ (W/mK)	Rel. resistance to vapour flux μ (.)	Absorption coefficient αS at 500 Hz (-)	Index of reduct. of impact noise ΔLW (dB)
Hemp	0.04	2	0.6 (30 cm)	-
Kenaf	0.044	2	0.74 (5 cm)	-
Coco fiber	0.043	18	0.42	23
Sheep wool	0.044	3	0.38 (6 cm)	18
Wood wool	0.065	5	0.32	21
Cork	0.039	12	0.39	17
Cellulose	0.037	2	1 (6 cm)	22
Flax	0.04	1	-	-
Glass wool	0.04	-	1 (5 cm)	-
Rock wool	0.045	-	0.9 (5 cm)	-
Expanded polystyrene	0.031	100	0.5	30

Table 9.1: Acoustic and thermal properties of some traditional and natural insulating materials.

Sound absorption

Many natural materials as kenaf, flax, sisal, hemp, cork, sheep wool, bamboo or coconut fibres [161], [162] show good absorbing performances and can therefore be used as sound absorbers in room acoustics and noise barriers (Table 9.1). At 500 Hz, nevertheless, the absorption coefficient of synthetic materials is generally superior to the one of natural materials. Expanded clay, which may be also considered a natural product, shows good sound absorption performances in a wide frequency range (higher than 0,80 in the range 500-5000 Hz) [163].

Airborne sound insulation

Several natural materials are commonly used as thermal and acoustical insulation in multi-layered walls: among these flax, coconut, cotton, sheep wool and kenaf mats are the most present on the market [164]. Their sound and thermal insulation performances are in many cases as good as those of traditional materials (Table9. 1): many studies have demonstrated that the sound insulation of double-leaf walls with low density animal wool (sheep wool) or heavy vegetal wool (latex-coco) is equal or better than the one of walls with mineral wool or polystyrene of the same thickness [164].

Impact sound insulation

This is probably the most common use for many natural materials (cork, coconut fibres, wood wool). Resilient layers made of natural materials can be very good for floating floors to increase impact sound insulation [165]: when the panels are accurately designed and installed, their performances are as good as other traditional materials.

CHAPTER TEN
Summary and Conclusions

10.1 *Introduction*

A successful implementation policy for an environmental noise strategy for music venues depends on four factors

1. Political agreement between the government and interested parties (e.g. venue owners). This is the most important and will be the result of lobbying and compromises. This might be termed political will.
2. The development of a set of criteria
3. A suitably trained and equipped team of enforcement officers (environmental health offices and police)
4. The ability to adapt premises at a reasonable cost

Established noise regulations and code of practice have been discussed in chapter four. The main objective of this thesis has been establishing noise criteria which can be used in Algeria. It has to be noted that the enforcement team was outside the scope of thesis and has not been discussed. The present chapter (10) is divided into two main sections. section one deals with thesis review in which a shot summary of the chapters as well as some findings. the second part of the present chapter deals with noise criteria which might be applicable in Algeria. thesis review has been described

10.2 *Thesis review*

As we have seen in the present study, noise from wedding halls is a major noise nuisance in Algeria. Throughout this study I tried to identify, investigate and analyse the issue in order to highlight the problem of noise from entertainment halls and to suggest different solutions either technical or legislative. This thesis starts with a description of the main aim of this research and its importance and also its contribution to the immediate and long term for Algeria. In chapter Two, a description of literature view of basic acoustics was highlighted as well as impact of noise nuisance on health. In Chapter three, noise problem in Europe and other non European countries were reviewed. Different legislations and noise standards in Europe and some of the countries of the rest of the world have been reviewed by looking at how the noise pollution is being dealt. It can be seen that in all European countries, several legislative instruments exist to deal with issue however, most of the time a civil mediation is always used to solve conflicts between the noise maker and the complainer.

Chapter four, dealt with the specific issue of noise nuisance from music entertainment in UK. Current standards and codes of practice have been examined as well as the UK strategy in controlling the music from pubs and clubs by looking at licensing and enforcements operated by locally.

Chapter 5 outlined the Algerian's administrative division as well as the local and regional government It also describes buildings' state in Algeria which is poorly insulated with no thermal or acoustic insulation. Noise types and noise problems in Algeria are enumerated in this chapter pointing the entertainment noise problem as one of the most disturbing noise; this was one of the reasons that influenced the purpose of this study. Noise control standards are also provided with the only decree existing as well as the Algerian's norms which are essentially based on the French norms.

Chapter 6 described the noise survey conducted in Algeria. Two types of noise assessment have been identified, subjective and objective. Subjective assessment has been done by means of a questionnaire where subjects have been asked to describe their degree of annoyance from all noise nuisance sources. However, this survey was necessarily limited because of problems specific to Algeria. in this chapter , the objective survey has been briefly described as an introduction to chapter 7.

Also in this chapter, a critical review of the choice of rating criteria to monitor noise from entertainment halls has been discussed. Several candidate assessment methods were identified. These include methods specifically proposed for pub and club noise, those for general low frequency noise, those relying on absolute criteria and those based on relative assessments Chapter 7 was the core of the thesis. It described the noise monitoring analysis of twenty wedding halls. The location of every wedding hall has been described as well as the positioning of the equipment (microphones). The measurements covered a range of premises from wedding halls to hotels where special rooms dedicated to weddings and other type of parties. The measurements have been carried out at a two type of locations (residential and commercial). Most of the measurements were carried out during the day and with a number of nights monitoring when music was played when no music being played. All of the noise measurements carried out recorded both A and C weighted broadband.

The idea behind using the C measurement was for two main reasons.

- To give an indication of low frequency problems when compared to A

- The present Algerian noise regulations use C weighting

One method of identifying low-frequency noise is to measure both the A and C-weighted sound level. The main difference between these two weighting filters is that the C-weighting puts much greater emphasis on the low-frequency part of the noise. The difference between the C- and A-weighted values will, therefore, in most cases, constitute a measure of how much energy is found in the low-frequency area. This is the main reason why we have used these two types of weighting when monitoring the noise from wedding halls.

Other noise indices, such as Lmin , Lmax , and L90 were recorded on some of the surveys The results of the monitoring have been analysed. From the analysis of the investigated venues, it was clear that noise from wedding halls is an issue in Algeria. The noise levels recorded were in most venues above the recommended WHO limits by at least 10dB. Poor acoustic insulation of buildings and the non respect of noise levels limits from wedding halls managers are the main reasons of noise disturbance of the people.

Chapter 8 outlined some examples of room acoustics and sound reduction of building elements related to the present study such as sound transmission from noise source façade to the reception façade as well as sound reduction index calculation. also in this chapter practical ways of improving wedding hall premises have been discussed.

Chapter 9 summarised the findings of the present study as well as suggestion of recommendation on how to tackle noise nuisance from entertainment halls .

10.3 Recommendations on Noise Criteria for Algeria

Prevention is better than curing. The most effective way to control noise from entertainment halls in Algeria can only be done by good planning rather than by mitigation. Effective noise control should be focussed on environmental planning throughout design with taking into consideration the local residents. Implementation of wedding halls should go through a meticulous process involving the respect of noise criteria. In the absence of a specific objective criterion, the guideline values contained in the Guidelines for Community Noise (WHO, 2002) are frequently used. These criteria are predominantly based on A-weighted, equivalent continuous measurements. As seen in this study, the use of A-weighted target levels generally based on World Health Organisation values for music noise intrusion within residential premises has not been sufficient, because of the bass elements of the noise.

The ambiguity of developing a new noise control criteria is clearly evident. Nevertheless, rating criteria are essential if effective policies for noise control are to be developed. In Algeria, there is an urgent need for a clear and appropriate noise criteria used for the assessment of disturbance due to entertainment music. As we have seen in throughout the present study, assessment methods vary from country to another. Generally objective noise criteria are supported by subjective assessment of the disturbance caused by the noise. There is also a general trend towards the use of LAeq to assess all noise because of the failure of old predictive noise metrics. Some people are criticising this method saying that many complaints are due to low and poorly-characterised sound insulation at low frequencies.

However, there is a substantial proportion of the annoyance from entertainment noise (music) is caused by low frequency components which are not well characterised by a single measurement of LAeq. There are many assessment criteria for different kinds of noise in different contexts, but they can be broadly divided into two types: fixed and relative. Fixed ratings specify a limit that the noise should not exceed. For example, BS 8223 (1999) gives desirable maximum noise levels inside various different buildings and rooms, expressed as LAeq values. Relative ratings compare the noise level (usually LAeq) with the background noise level without the noise source (usually LA90). The noise level is allowed to exceed the background by only a certain amount. For instance, in UK relative method is widely used (BS 4142). However, assessments of music emanating from wedding halls in Algeria using the existing noise level limits (The Executive Decree No. 93-184 of July 27, 1993) tend to under-estimate the disturbing effect of the noise and therefore the likelihood that a nuisance exists. Mainly because, this particular decree is not specific to noise control from wedding halls. This is the main reason why a more robust criterion is needed as new assessment tool.\An effective criterion has to take into consideration the objective assessment as well as the subjective assessment. This is crucial for the evaluation of the effectiveness of any noise criteria. In order to achieve this, it is wise to look at the existing noise criteria internationally.

In UK, the code of practice for concerts criterion has been defined as LAeq (15 min) when music is being played. However, an assessment criterion for the code of practice for pubs and clubs could not be defined.

The criteria evaluated have been the relative criteria (on/off). Differences on the C scale were evaluated as well as the A scale for reasons described above. In assessing the noise nuisance of the music in the range of venues below the A scale and C scale differences have been used to judge the impact

- LAeq (ON) – LA90 (OFF)
- LAeq (ON) – LAeq(OFF)
- LCeq (ON) – LC90 (OFF)
- LCeq (ON) – LCeq (OFF)

NOISE INDICATOR	VENUE CLASSIFICATION					
	CITY CENTER		URBAN		SUB-URBAN	
	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
LAeq (on)-LA90 (off)	< 10dB	<5dB	<10dB	<5 db	<10dB	no noise should be audible with any noise sensitive room with an open window
LAeq (on - LAeq (off)	≤ 10db	< 5dB	≤ 10dB	<5 dB	≤ 10 dB	no noise should be audible with any noise sensitive room with an open window
LCeq (on) - LC90 (off)	<10 dB	<5dB	< 10dB	zero increase	<10dB	no noise should be audible within any noise sensitive premises
LCeq (on) - LCeq (off)	≤ 10 dB	<10dB	≤ 10	zero increase	≤ 10	no noise should be audible within any noise sensitive premises

Table 10.3 Suggested noise control criteria to be used in the Algerian context

In chapter 7, Table 7.4 showed LAeq (wedding on)-LA90 (wedding off) dBA and LAeq (wedding on)-LAeq (wedding off) dBA. And table 7.5 described differences of LCeq (wedding on)-LCeq (wedding off) dBC and LCeq (wedding on)-LC90 (wedding off)dBC

By assessing the data in that table (specified only in A weighting) against the suggested limits in table 10.3 we can clearly see that all venues which had wedding celebrated at night fail to satisfy the suggested noise limits as seen in the table below (table 10.4 and table 10.5).

	Time of the day	Venue Classification	LAeq (wedding on) - LA90 (wedding off) dB
Venue 1	Day	Urban	✗ 13.9
Venue 5	Day	Urban	✗ 22.1
Venue 6	Day	Urban	✗ 24.9
Venue 10	Day	Urban	✗ 14.1
Venue 16	Day	Urban	✗ 18.9
Venue 17	Day	Urban	✗ 39
Venue 19	Day	Urban	✗ 32
Venue 2	Night	Urban	✗ 20
Venue 8	Night	Urban	✗ 27.4
Venue 13	Night	Urban	✗ 21
Venue 20	Night	Urban	✗ 34
Venue 3	Day	City	✗ 34.3
Venue 7	Day	City	✗ 14.3
Venue 9	Day	City	✗ 24.8
Venue 12	Day	City	✗ 13.5
Venue 4	Day	Sub-urban	✗ 14.8
Venue 11	Day	Sub-urban	✗ 16
Venue 14	Day	Sub-urban	✗ 14.4
Venue 18	Day	Sub-urban	✓ 3.8
Venue 15	Night	Sub-urban	✗ 19

Table 10.4: Assessment of LAeq (wedding on) – LA90 (wedding off) dB against the suggested criteria for Algeria

	Time of the day	Venue Classification	LAeq (wedding on) - LAeq (wedding off) dB
Venue 1	Day	Urban	✓ 4.2
Venue 5	Day	Urban	✗ 13.8
Venue 6	Day	Urban	✓ 10.5
Venue 10	Day	Urban	✓ 2.6
Venue 16	Day	Urban	✗ 14.1
Venue 17	Day	Urban	✓ 2.9
Venue 19	Day	Urban	✗ 12
Venue 2	Night	Urban	✗ 10
Venue 8	Night	Urban	✗ 23
Venue 13	Night	Urban	✗ 13.3
Venue 20	Night	Urban	✗ 32
Venue 3	Day	City	✗ 30
Venue 7	Day	City	✓ 10.6
Venue 9	Day	City	✗ 16.9
Venue 12	Day	City	✓ 5.7
Venue 4	Day	Sub-urban	✓ 7.8
Venue 11	Day	Sub-urban	✓ 10.7
Venue 14	Day	Sub-urban	✓ 3.9
Venue 18	Day	Sub-urban	✓ 0.4
Venue 15	Night	Sub-urban	✗ 13.8

Table 10.5: Assessment of LAeq (wedding on) - LAeq (wedding off) dB against the suggested criteria for Algeria

As we can see in tables 10.4 almost all the venues monitored in this present study failed when compared against the suggested criteria. The difference between LAeq (wedding on) – LA90 (wedding off) exceeded the suggested limits regardless of the venue location and area except in venue 18. Whereas, in table 10.5 a number of venues have not exceeded the suggested criteria of 10 dB increase during the day LAeq (wedding on) – LAeq (wedding off). However, all venues which have been monitored during night have failed the suggested criteria of 5dB.This clearly shows that these values are high and therefore cause disturbance to the occupants of premises nearby the wedding halls.

The below table (10.6) shows suggested noise control criteria to be used in the Algerian context in few years time. As we can see noise level limits have been decreased by 5 db. However these limits cannot be immediately implemented in Algeria because local authorities will struggle to enforce them. When the suggested noise criteria shown in table 10.3 are enforced, they can be reviewed in few years' time and noise limits shown in table 10.6 can be introduced gradually and eventually enforced and accepted.

	VENUE CLASSIFICATION					
NOISE INDICATOR	CITY CENTER		URBAN		SUB-URBAN	
	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT
LAeq (on)- LA90 (off)	< 5dB	<LA 90	<5dB	<0 db	<5dB	no noise should be audible with any noise sensitive room with an open window
LAeq (on - LAeq (off)	≤ 5db	< 5dB	≤ 5dB	<0 dB	≤ 5dB	no noise should be audible with any noise sensitive room with an open window
LCeq (on) - LC90 (off)	<10 dB	<LC90	< 5dB	zero increase	<5dB	no noise should be audible within any noise sensitive premises
LCeq (on) - LCeq (off)	≤ 10 dB	<10dB	≤ 5 dB	zero increase	≤ 5 dB	no noise should be audible within any noise sensitive premises

Table 10.6 Suggested noise control criteria to be used in the Algerian context in few years time

As we can see from the below tables 10.7 and 10.8 most of the venue failed when compared against the suggested noise criteria described in table 10.6. The limits in the above table will be very difficult to comply for the existing venues as they need to reduce the noise levels by installing acoustic insulation, and the introduction of lobbies to stop music noise disturbing the local residents. This will be at cost and venue landlords will be reluctant to do so in the immediate time.

	Time of the day	Venue Classification		LAeq (wedding on) - LA90 (wedding off) dB
Venue 1	Day	Urban	✗	13.9
Venue 5	Day	Urban	✗	22.1
Venue 6	Day	Urban	✗	24.9
Venue 10	Day	Urban	✗	14.1
Venue 16	Day	Urban	✗	18.9
Venue 17	Day	Urban	✗	39
Venue 19	Day	Urban	✗	32
Venue 2	Night	Urban	✗	20
Venue 8	Night	Urban	✗	27.4
Venue 13	Night	Urban	✗	21
Venue 20	Night	Urban	✗	34
Venue 3	Day	City	✗	34.3
Venue 7	Day	City	✗	14.3
Venue 9	Day	City	✗	24.8
Venue 12	Day	City	✗	13.5
Venue 4	Day	Sub-urban	✗	14.8
Venue 11	Day	Sub-urban	✗	16
Venue 14	Day	Sub-urban	✗	14.4
Venue 18	Day	Sub-urban	✗	3.8
Venue 15	Night	Sub-urban	✗	19

Table 10.7: Assessment of LAeq (wedding on) – LA90 (wedding off) dB against the suggested criteria for Algeria using table 10.6 noise level criteria

	Time of the day	Venue Classification		LAeq (wedding on) - LAeq (wedding off) dB
Venue 1	Day	Urban	✗	4.2
Venue 5	Day	Urban	✗	13.8
Venue 6	Day	Urban	✗	10.5
Venue 10	Day	Urban	✓	2.6
Venue 16	Day	Urban	✗	14.1
Venue 17	Day	Urban	✓	2.9
Venue 19	Day	Urban	✗	12
Venue 2	Night	Urban	✗	10
Venue 8	Night	Urban	✗	23
Venue 13	Night	Urban	✗	13.3
Venue 20	Night	Urban	✗	32
Venue 3	Day	City	✗	30
Venue 7	Day	City	✗	10.6
Venue 9	Day	City	✗	16.9
Venue 12	Day	City	✗	5.7
Venue 4	Day	Sub-urban	✗	7.8
Venue 11	Day	Sub-urban	✗	10.7
Venue 14	Day	Sub-urban	✗	3.9
Venue 18	Day	Sub-urban	✓	0.4
Venue 15	Night	Sub-urban	✗	13.8

Table 10.8: Assessment of LAeq (wedding on) - LAeq (wedding off) dB against the suggested criteria for Algeria using table 10.6 noise level criteria

The tables above show that even allowing an increase of 10dB in the noise levels while the music was being played the majority of venues were failing. There is therefore a major noise problem in Algiers due to entertainment noise.

Future work to be done

There are two main areas of research that have been examined in this study. First the context of the noise problem from wedding halls in Algeria was identified and the methods and possible solution that can be used for noise control purposes outlined.
As mentioned before, the aim of this study is to raise the alarm of the government that noise from wedding halls needs to be considered seriously.
I am hoping that the present study will be presented to the local authorities of Algiers as well as the Ministry of Environment and I hope that they will be able to refer to this thesis as an important document and tool and that they can draw some conclusion from it.
In the future, there should be more involvement from the government and the local authorities in order to control environmental noise. This can be done by:

- Launching awareness campaigns on the unhealthy effects of noise.
- Coordination between the government and the local authorities to adopt all procedures to eliminate environmental noise.
- Establishing noise monitoring network to monitor noise according to the international standards. These areas include all kind of activities (industrial, commercial, and tourist activities, roads, railways, residential areas).
- Funding noise monitoring and extending noise survey to all cities of Algeria and not only the big cities such as Algiers. For example it might be beneficial to have a large number of subjects when conducting noise surveys.
- Encouraging more investigation and research on noise pollution and noise control.

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APPENDICES

APPENDIX A

Article about noise nuisance from Entertainment Halls in Algeria.

Accueil > Edition du 9 octobre 2004

L'info. au quotidien

Salles des fêtes,une source de nuisance sonore

Devenues des espaces commodes pour la célébration des mariages et des circoncisions et l'organisation de toutes sortes de réjouissances, les salles des fêtes qui ont proliféré ces dernières années sont en passe de devenir une véritable source de nuisance sonore pour les riverains.

En effet, l'ouverture de certaines salles ne s'est pas faite sans causer des désagréments aux habitants du voisinage, au détriment du repos et du bien-être des personnes âgées et des enfants. C'est d'ailleurs à force de décibels débitant différents genres de chansonnettes raï et autres rythmes favorisant un charivari assourdissant que les ambiances sont animées. Faisant partie des établissements classés parce que recevant le public, les salles des fêtes sont soumises à de nombreuses règles régissant les conditions de leur exploitation et l'octroi de l'autorisation d'ouverture. Au nombre des critères fixés par la réglementation, il est surtout exigé la garantie des normes de sécurité, de salubrité et d'isolation sonore. Si certains critères édictés visent à préserver la sécurité des personnes à l'intérieur de l'établissement, les autres critères permettent de garantir la tranquillité publique et celle du voisinage. Cependant, certaines salles ont été ouvertes au détriment des règles prévues, sans tenir compte des conditions exigées. Pour rappel, il ne peut être autorisé l'ouverture de ce type d'établissement près d'un cimetière, d'un lieu de culte, à proximité d'une école et dans un endroit à forte densité de population. Si quelques propriétaires avides de gain rapide et facile en faisant fi des règles énoncées ont vite été réprimés par les services du contrôle, d'autres semblent ne pas vouloir se conformer à la loi. Le cas le plus illustratif est celui des locaux du Croisant-Rouge algérien, qui, aménagés en deux salles des fêtes, sont devenus une source de tohu-bohu impossible pour les habitants de tout le quartier. En effet, la bâtisse implantée au cœur d'une cité populeuse est devenue une hantise pour les amateurs de la méridienne en été et des personnes qui aspirent à prendre quelque repos chez elles des après-midi et des soirées entières. Depuis l'ouverture des salles aux dépens des conditions requises, dont l'installation des vitres à double paroi, et faute de moyens de climatisation, c'est plutôt le voisinage qui subit les effets des décibels du disc-jockey, des voix bruyantes et des musiques cacophoniques. En fait, la mission humanitaire ne doit en aucun cas occulter le respect des règles de voisinage pour créer une bonne osmose avec l'environnement immédiat. Ainsi, il convient que le CRA équipe les salles de moyens adéquats requis pour leur donner le caractère commercial particulier exercé et, de ce fait, ne plus être une source de nuisances pour les habitants du quartier.

Par Moussa El Bey

APPENDIX B

Executive decree n93-184 of the 27th July 1993 regulating Sound Emission

The Head of Government

- *Upon the report of the secretary of State for Education and Science*
- *Considering the constitution notably its articles 81 and 116*

- *Considering law n82-02 of the 6th February 1982 related to the plotting and building licence;*
- *Considering law n 83-03 of the 5th February 1883 related to the protection of the environment;*
- *Considering law n85-05 of the 16th February 1985 related to the Health protection and promotion, modified and completed;*
- *Considering law n87-03 of the 27th January 1987 related to the territory planning;*
- *Considering law n 87-09 of 10th February 1987 related to the organization 'security and traffic police;*
- *Considering decree n 87-91 of the 21st April 1987 related to the study of the impact on territory planning;*
- *Considering decree n88-149 of the 26th July 1988 defining the regulation applicable to the classified facilities and fixing their nomenclature;*
- *Concerning the order in council n92-304 of 8th July 1992 bearing appointment of the head of government;*
- *Considering the order in council n92-307 of 19th July 1992 modified and completed, bearing, appointment of the government members;*
- *Considering the executive decree n90-78 of 27th February 1990 related to the impact studies over the environment;Enact;*

***Article 1**-This decree aims to regulate the sounds emission and this, in pursuance of article 121 of above countersigned law n83-03 of 5th February 1983.*

***Article 2**- The maximum sound intensity levels accepted in residence areas and public or private thorough (area or places are 70 decibels (70 d B) in individual periods (6am to10pm) and 45 decibels (45 d B) at night (10 pm to 6 am).*
***Article 3**-The maximum sound intensity levels accepted in the close vicinity of hospitals or schools premises and in rest areas or relaxing areas as well as in their enclosed spaces are of 45 decibels (45 d B) in diurnal periods (6am to10pm) and 40 decibels (40 d B) at night (10 pm to 6 am).*
***Article 4**-Are considered as a breach of vicinity quietness, excessive discomfort, nuisance for health and a compromising of the population quietness any sound emission above the limited values indicted in above-mentioned article2-3 .*
***Article 5**-The methods of characterisation and measurement of noises are affected in accordance with the Algerian Standards in force.*
***Article 6**-Any physical or moral person exploiting activities requiring the use of engines, tools, machines, equipments or appliances generating sounds intensity levels above the limited values such as defined by this decree, is bound to set sound proofing devices or appropriate arrangements installations so as to avoid disturbing people or to prejudice their health.*
***Article 7**-The infrastructures should be built, realised and exploited taking into consideration the aerial sound emitted by their activities.*
***Article 8**-Constructions for housing purpose or for professional use should be conceived and realised taking into account the acoustics quality of the walls and floors.A conjointly order from the Secretary of State in charge of the Housing and from the Secretary of State for the environment defines the modes of application of this article.*
***Article 9**-Site machines with internal combustion engines, concrete breakers, hewing hammers, power generating sets, motor compressing sets, compressors and super compressors must be equipped with a noise sound proofing or sound lessening device whenever used at less than 50m from premises used for housing or for working.*
A co jointly order from the Secretary of State in charge in charge of the normalization and from the Secretary of State for the environment will precise the limits to the sound intensity levels emitted by each type of material or equipment.
***Article 10**-Are forbidden all sorts of repairing or setting of any motors vehicles and motorcycles in any public or private places whenever disturbing or prejudicing the neighbourhood vicinity Health.*

Article 11-Is forbidden any animal noise likely to disturb the vicinity quietness whenever caused between 10pm and 6 am .The animal owners are responsible for the noise caused by these animals.
Article 12-The provisions provided in above articles n6-7-8-9 and 10 must take effect 2 years at the latest from the date of the issue of this decree in the Official Gazette of the Democratic and Popular Algerian Republic.
Article 13- Any offence against this present decree will be punished in compliance with the provisions of article 129 of the above countersigned law n 83-03 of the 5 the February 1983.
Article 14- This decree will be emitted in the Official Gazette of the Democratic and Popular Algerian Republic.

Algiers: 27th July 1993
Belaid Abdesselem

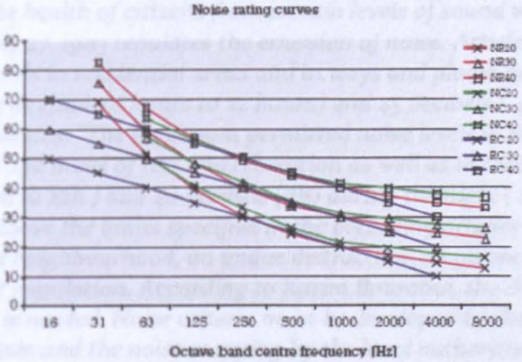
APPENDIX C

Glossary of Acoustic Terminology

Absorption	the process by which sound energy is converted into heat
Absorption co-efficient	the fraction of incident sound energy that will be absorbed by a given surface
Airborne sound	sound radiated directly from a noise source into the surrounding air
Ambient noise	the totally encompassing noise in a given situation at a given time
Audible range	20Hz to 20kHz (approximately)
A-weighting	a frequency weighting network corresponding approximately to the sensitivity of the human ear
Background noise	as defined in BS4142, it is the A-weighted sound pressure level that is exceeded for 90% of a given time (L_{A90})
Broadband noise	sound energy distributed over a wide range of frequencies
Crosstalk	the transfer of sound from one area to another - often used in connection with ducted ventilation systems
dB	decibel - the basic unit of sound - most commonly used to refer to sound pressure level, but can equally refer to sound power level, sound intensity level etc.
dB(A)	the A-weighted dB level
D_{nT}	the standardised level difference
D_{nTw}	the weighted standardised level difference - a unit of sound insulation used, for example, in Approved Document E of The Building Regulations
Damping	a process whereby vibration energy is converted into heat through some form of frictional mechanism
Echo	a delayed reflection of sound that is perceived by the ear as a separate distinguishable sound.
Flanking transmission	the indirect transfer of sound between adjacent areas other than directly through the separating structure
Gain	the increase in power level of a signal produced by an amplifier
Hertz (Hz)	the unit of frequency expressing the number of cycles per second
Impact noise	noise resulting from the impact of one object on another
Insertion loss	a term usually applied to silencers which is simply the reduction in noise level achieved by the insertion of the noise control device between the noise source a "receiver" position
L_{10} (L_{A10})	the (A weighted) sound pressure level exceeded for 10% of the time,

	commonly used as a measure of road traffic noise
L_{90}, (L_{A90})	the (<u>A weighted</u>) sound pressure level exceeded for 90% of the time, used by BS 4142 and other standards to quantify the background noise level
L_{eq} (L_{Aeq})	the (<u>A weighted</u>) equivalent continuous sound pressure level, used to quantify the average noise level over a given period
L_A	the <u>A weighted</u> sound pressure level
L'_{nT}	standardised impact sound pressure level
$L'_{nT,w}$	the weighted standardised impact sound pressure level
Loudness	a subjective quantity - a difference of 10 dB is very approximately equivalent to a doubling / halving of loudness
NC (noise critieria) curves	a set of defined curves used to provide a single figure rating to a broadband noise - an American standard
NR (noise rating) curves	a set of defined curves used to provide a single figure rating to a broadband noise - a British standard

Noise rating curves



Octave	the range between two frequencies whose ratio is 2:1
PPG24	the planning policy guidance document used by Local Authorities to assess the acoustic implications of a planning application, particularly in respect of residential development
R_w	the weighted sound reduction index (excludes the effects of <u>flanking transmission</u>)
R'_w	the apparent weighted sound reduction index (includes the effects of <u>flanking transmission</u>)
Reverberation Time (RT)	the time required for a steady sound pressure level in an enclosed space to decay by 60dB
Sound Intensity Level (SIL)	the sound intensity of a noise source, expressed as a decibel value
Sound Pressure Level (SPL)	the sound pressure level of a noise source, expressed as a decibel value
Sound Power Level (SWL)	the sound power level of a source, expressed as a decibel value
Sound Reduction Index (R)	the airborne sound insulation of a material in a particular frequency range, expressed as a decibel value

APPENDIX D

Article on Noise in Algeria published on daily newspaper El Watan on 11th March 2008

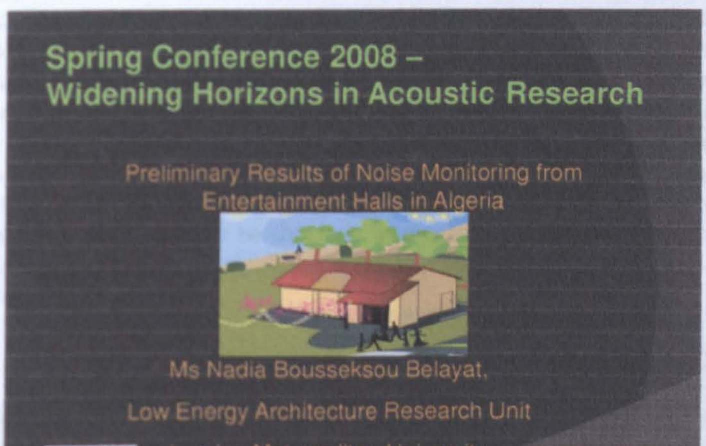
Noise nuisance in Algeria:The unbearable noise

A seminar on noise and noise pollution will be held at the EGT Center (shopping center El Hamma) March 29 by Medpsy School, school of higher education continues.
When contacted, Mrs Karima Bouraoui, executive director of the school explains that the goal is "to educate policymakers, HRD and local noise and the need to diminish in the presence of national and international experts. In a footnote, she asks: "how can we explain the silence that surrounds these issues at the country's institutional life, the media or simply at public opinion? File a complaint about noise at night with police in a neighbourhood is a challenge, knowing it will never lead. On another level to our knowledge, no study has been launched by the ONS or other government department on the impact of noise on our people. "The state appears to ignore this issue. The cities are transformed, from the first light of day in a large municipal market where hawkers dictate their law. Citizens are increasingly hampered by noise from vehicular traffic on public roads, businesses receiving public (disco, pub, gym) and site work. The noise affects not only the quality of life, but also the health of citizens from certain levels of sound volumes. Executive Decree No. 93-184 of July 27, 1993 regulates the emission of noise. Article 2 states that "the maximum permitted noise levels in residential areas and in ways and places are public or private 70 decibels (70 dB) during daytime (6 hours to 22 hours) and 45 decibels (45 dB) during the night (22h to 6 pm). Article 3 states: "The maximum permitted noise levels in the immediate vicinity of hospitals and teaching and areas of rest and relaxation as well as in their walls are 45 decibels (dB) during daytime (6am to 22h) and 40 decibels (dB) during the night (22h to 6h). According to this law, any noise above the limits specified in the preceding articles shall be considered a violation of the quiet neighbourhood, an undue distraction, a nuisance to health and compromise the tranquility of the population. According to Karim Bouraoui, the decree "remains insufficient and a new regulation is needed. Noise criteria must be developed by the Ministry of Planning, Environment and Tourism and the noise mapping by the local authorities, according to regional specificities.

APPENDIX E

Published work

The Institute of Acoustics Spring Conference, University of Reading from 10th to 11th April 2008.



PRELIMINARY RESULTS OF NOISE MONITORING FROM ENTERTAINMENT HALLS IN ALGERIA

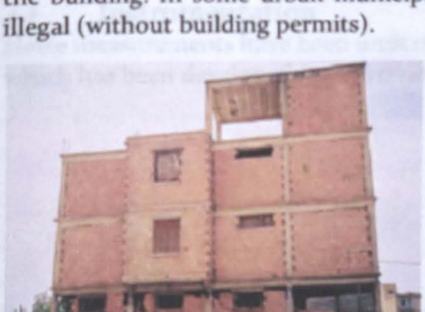
N Bousseksou Low Energy Architecture Research Unit, London Metropolitan University
A Peters Low Energy Architecture Research Unit, London Metropolitan University
M Wilson Low Energy Architecture Research Unit, London Metropolitan University

1 ABSTRACT

These last ten years, in Algeria noise pollution has become an environmental issue where people are exposed to unacceptable levels of noise. The main noise source is from traffic, from neighbourhood and domestic noise particularly (entertainment premises known as wedding halls). Other significant sources of noise annoyance in Algeria include building construction and household noise as well as car alarms and even barking dogs. In this present study, my concern will be on one of the main noise source in Algeria which is noise from entertainment halls. Unfortunately in Algeria, there is no existing framework or enforceable code for noise control. In view of the absence of a proper noise control standard in Algeria, a large number of wedding halls have been built without any protection (insulation, double glazing...) causing disturbance and annoyance in the neighbourhood. The noise from these wedding halls is badly affecting neighbours. Modern amplification and music styles make this an increasing problem. Therefore local people saw their lives disturbed by the noise caused by these kinds of recreational halls. As a result of the lack of standards, this study was conducted. A noise survey has never been previously attempted in Algeria.
The aim of this survey is to establish noise level limits and measurements according to the WHO guidelines recommended to create the necessary set off regulations and guidelines on which we could rely in treating the different noise problems in Algeria.

2 INTRODUCTION

Algeria, a gateway between Europe and Africa, is located in Northern Africa. The Sahara desert covers over 80% of the country's territory. The population of Algeria is over 30 million – most of the population lives in the northern part of the country. The capital city Algiers (including the suburbs) has the population of around 3.5 million. In the last forty years, rapid population increase in Algeria (the population has grown from 10 million to over 35 million) has resulted in a high demand for housing construction'. At that time Algeria's need was new buildings for the fast growing population. One of the main demands was to build houses with a good functionality but there was no consideration whatsoever of the climate of the site. There was also a lack of comprehensive planning, and urban design, as a result, more than 67% of the construction in the most affected cities in the last earthquake which has occurred Algiers and Boumerdes was undertaken in the last 30 years. In general, the construction has been mostly done by private contractors, often without the required professional qualifications without any concern for to thermal or acoustic performance. The prevalent type of private single-family construction includes one to three-storey high concrete frame buildings (see Fig.1).
Most of the buildings are left without any external finishes and poorly insulated or no thermal or acoustic insulation, this was due to shortage in owners' budget and to decrease the cost of the building. In some urban municipalities, a large proportion of the private construction is illegal (without building permits).



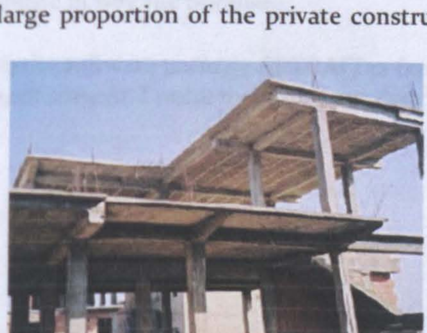


Figure 1. Typical single-family housing construction.

Source: Ministry of Housing and Construction

The aim of this study is to draw guidelines and construction techniques for Algeria and to develop construction materials locally available to reduce noise breakout

3 NOISE CONTROL STANDARDS IN ALGERIA

As mentioned earlier, in Algeria noise control standards are almost absent. However, a decree exists within the local authorities since 27 July 1992. This decree is mainly based on the French norms. This decree outlines the legal measures. It defines the limits for noise exposure where the maximum sound intensity levels accepted in the close vicinity of hospitals or schools premises and in rest areas or relaxing areas as well as in their enclosed spaces are of 45 decibels (45 dBA) in diurnal periods (6am to10pm) and 40 decibels (40 dBA) at night (10 pm to 6 am)[2].
In the decree, guidelines are described on how constructions for housing purpose or for professional use should be conceived and realised taking into account the acoustics quality of the walls and floors.

4 NOISE MONITORING IN ALGERIA

A noise survey has been conducted in the city of Algiers, during the hot season where most of the weddings are held. The survey was divided into two types:
Subjective survey, involved collecting data from the subjects through questionnaire.
Objective survey, which involved measuring the noise levels where the subjects have been questioned. A number of twenty wedding halls have been monitored using a sophisticated instrumentation.
An initial survey has been held in winter by mean of questionnaires. Two types of subjects have been selected for the survey as follow:

- Subjects representing people bothered by the noise from entertainment premises
- Subjects representing landlords or owners of the entertainment halls

A total number of twenty five subjects has been interviewed and asked to fill a questionnaire.
All subjects were mostly annoyed by almost all sort of noise source, especially noise from traffic and noise from neighbours (music, dog barking...) this represents 90% of the subject's votes. Also the subjects feel that the noise from entertainment halls is more disturbing than traffic noise especially when weddings are celebrated during night-time.
Asked how often they are annoyed by the noise from wedding halls, the subjects reply varies from daily to once in a week to once in fortnight. This was due to the period of the year where most weddings are celebrated in summer on a daily basis. The subjects were also asked whether they have ever complained to local authorities about the noise from entertainment halls. The answer was never because the subjects do not know the complain procedure and have no idea where to complain and most of the time they fear reprisal from wedding halls owners. Another reason is that the subjects believe that the local authorities would not solve the problem because there is no regulation. From the landlords answers, we observed that they are confident that the neighbours would not complain and that the local authorities would not penalise them. When asked whether there are action to avoid disturbing the neighbours the landlords replied that they have installed air conditioning this will avoid opening the windows during the summer and it keeps the noise from music in side the premises.

4.1 Instrumentation

Noise measurements have been undertaken using the software package **dBTRAIT32** (see Fig 2) which has been developed for the treatment of environmental noise measurement data[3].

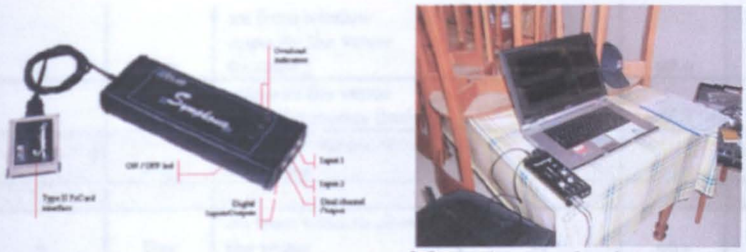


Figure 2: measurements equipment used for noise monitoring

Monitoring has been held in some premises when there was no wedding (music off) and when the wedding was on. Two weighting scales have been used (A) and (C) using two different microphones. Both microphones were calibrated before and after each measurement. The microphones were located at 1 metre from the neighbours' window attached to a pole.

The monitoring was conducted over the whole period of the weddings with the microphones located in the neighbours affected by the noise and inside the venue sometimes. During the monitoring, Leq, Lmax, Lmin, L90 were measured for both channels

5. RESULTS AND ANALYSIS

Table1

Venue	Time of day	Microphones location	Weighting	LA max	Leq	L90	Activity
1	Day	1 m outside opposite neighbour window	A	86.9	68	58.1	music off
			C	89.9	70	62.4	music off
1	Day	1m outside opposite neighbour window	A	99.6	72	57.2	music on
			C	99.9	72	61.2	music on
2	Night	1m outside a flat above the venue window	A	84.8	67	57	music off
			C	90.6	73.9	61.4	music off
2	Night	1m outside a flat above the venue window	A	101.7	77	66.5	music on
			C	104.9	82	71.6	music on
3	Day	1m outside neighbour window adjacent to the venue	A	80.2	42	37.7	music off
			C	92.1	51	37.3	music off
3	Day	1m outside neighbour window adjacent to the venue	A	100.3	72	56.4	music on
			C	112.3	75	64.8	music on
4	Day	1m in balcony ,2 floors above the venue	A	90.3	64.2	57.2	music off
			C	89.9	76	66	music off
4	Day	1m in balcony ,2 floors above the venue	A	97.5	72	64.1	music on
			C	98	83	73.8	music on
5	Day	1m from window above the venue	A	92.1	72.2	63.9	music off
			C	96.7	79.1	70.8	music off
5	Day	1m from window above the venue	A	106.9	86	72.6	music on
			C	107.8	91	77	music on
6	Day	1m from window opposite the venue (outside)	A	93.1	67.5	53.1	music off
		opposite the venue around 7 metres (inside)	A	84.1	54.1	39.1	Music off

6	Day	1m from window opposite the venue (outside)	A	98.9	78	67.9	music on
		opposite the venue around 7 metres (inside)	A	86.3	57	54.8	music on
7	Day	1m from window above the venue	A	96.1	67	63.7	music off
			C	98	76	63.2	music off
7	Day	1m from window above the venue	A	96.1	78	67.9	music on
			C	98	86	81.4	music on
8	Day	1m from window above the venue	A	77.4	53	48.6	music off
			C	100.6	70	57.4	music off
8	Night	1m from window above the venue	A	106.1	76	56.2	music on
			C	114.2	81	62.8	music on
9	Day	1m inside the venue but in the above floor (bride changing room)	A	88.9	70.1	62.2	music off
			C	93.1	72.4	65.9	music off
9	Day	1m inside the venue but in the above floor (bride changing room)	A	101.8	87	63.8	music on
			C	105.8	92	67.3	music on
10	Day	1m outside opposite the venue	A	97.3	69	58	music off
			C	103.6	84.1	70.1	music off
10	Day	1m outside opposite the venue	A	97.3	77	58.6	music on
			C	104.4	81	78.4	music on

Table 1 describes the Leq, Lmax and L90 recorded during the monitoring using both weighting A and C as well as the location of the microphones and the activity inside the venue when the wedding is on and off. It can be clearly seen that the ambient noise level is higher when the wedding is on.

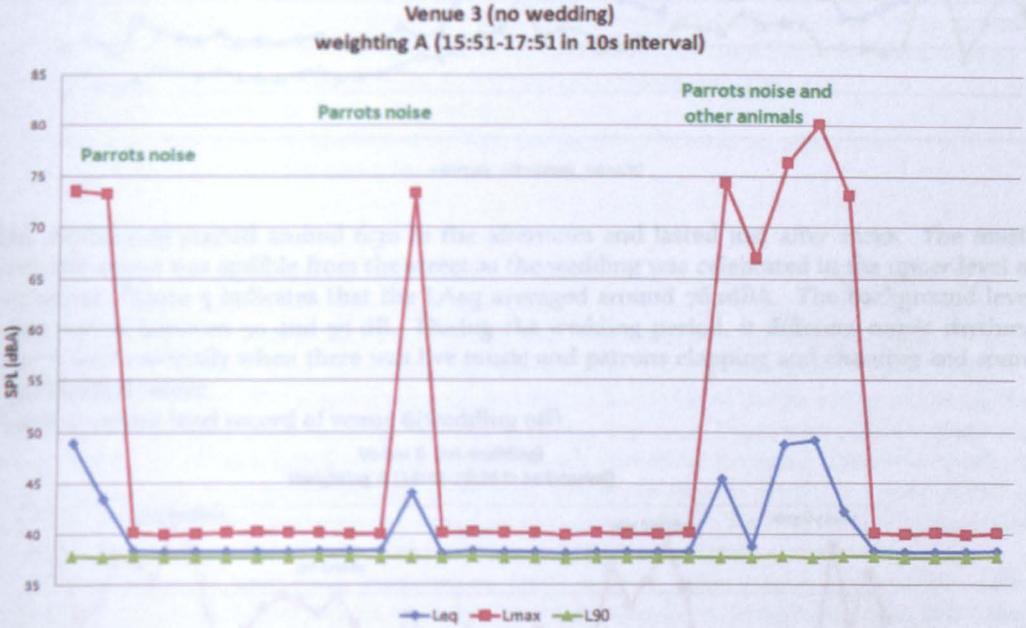
A sample analysis is presented showing noise monitoring at two venues, one in day-time and the other one in night-time

5.1 Case study 1 (day monitoring)

Figure 3: sound level record of Venue 3 (wedding on)

Figure 3 shows that the LAmax reached 100.3 dB which is more than the recommended WHO[4] guidelines for the LAmax by exceeding it by more than 30 dB.
The average LAeq recorded for the whole period is around 71.6dB. The background level (L90) registered an average of 56.4 dB.
Noise vents were also recorded during the wedding period; it includes celebrations screams and most importantly noise from a parrot and other birds which sounded very high ranging from 98 and 100 dB. During the wedding, short breaks were noted lasting around fifteen minutes, however the music was kept on but the volume was reduced.

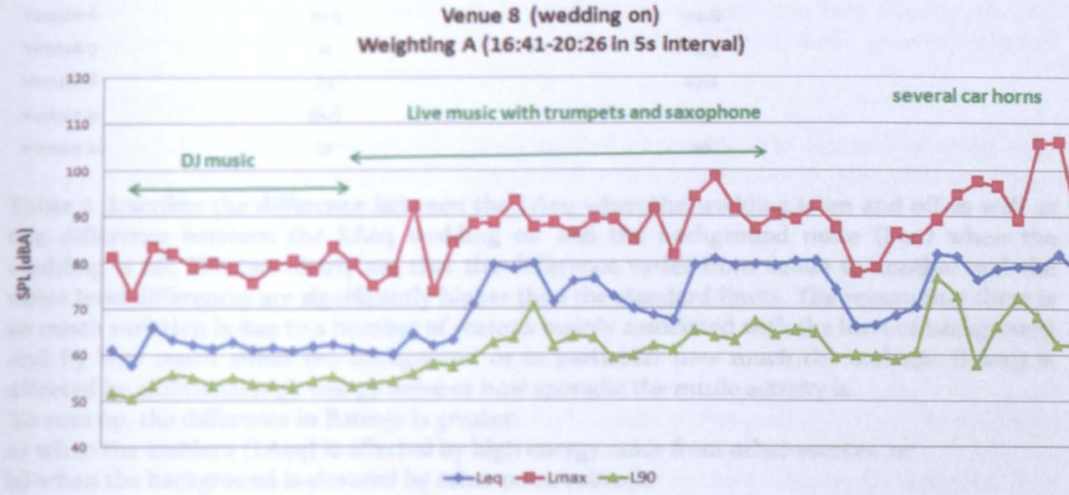
Figure 4: sound level record of Venue 3 (wedding off)



The noise monitoring was recorded when there was no wedding and the venue empty, the same equipment was used and the microphones were installed in the same position as mentioned earlier. Figure 4 shows that an average LAeq of 42.1 dB and an LAmax of 80.2 dB was recorded. The LA90 indicated 37.7 dB which is much lower than the LA90 recorded when the wedding was on. The only noise incident recorded was mainly from a parrot and other birds which is clearly indicated in the graph, it ranged from 68 to 80 dB.

5.2 Case study 2 (night monitoring)

Figure 5: sound level record of venue 8 (wedding on)



The monitoring started around 6:30 in the afternoon and lasted just after 22:30. The music from the venue was audible from the street as the wedding was celebrated in the upper level of the venue. Figure 5 indicates that the LAeq averaged around 76.1dBA. The background level LA90 varied between 50 and 75 dB. During the wedding period, it different music rhythms were noted especially when there was live music and patrons clapping and chanting and some instrumental music.

Figure 6: sound level record of venue 8(wedding off)

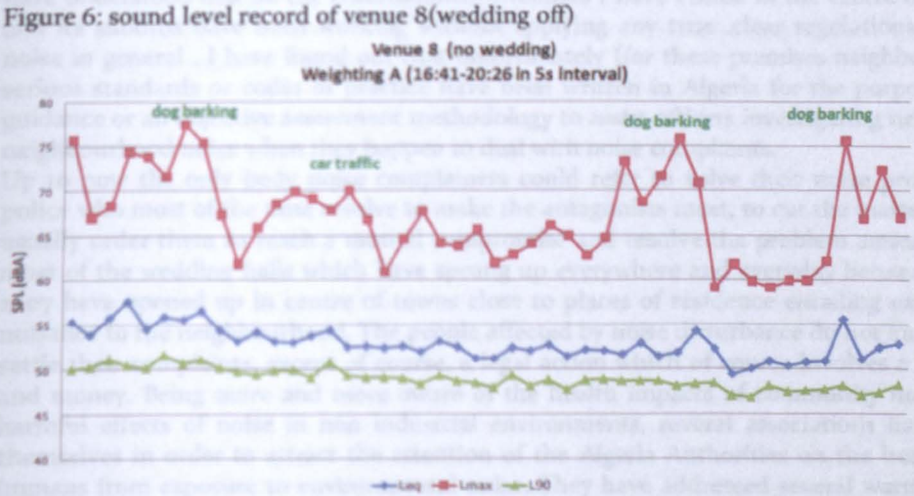


Figure 6 shows that the average LAeq recorded was around 53.3dB. The highest noise level registered was LAmax 77.4 dB. This due to the high level of noise events observed during the monitoring. It has been noted , a presence of a dog in the terrace which was barking frequently , this explains the peaks in LAmax shown in the graph and table. The LA90 indicated 48.6 and dB.

Table 2

	LAeq(music on)-LAeq (music off) dBA	LAeq(music on)-L90 (music off) dBA
venue 1	4	13.9
venue 2	10	20
venue 3	30	34.3
venue 4	7.8	14.8
venue 5	13.8	22.1
venue 6	2.9	17.9

venue 6	10.5	24.9
venue 7	11	14.3
venue 8	23	27.4
venue 9	16.9	21.1
venue 10	12	19

Table 2 describes the difference between the LAeq when the wedding is on and off as well as the difference between the LAeq wedding on and the background noise (L90) when the wedding is off. We can clearly see that the difference varies from venue to another and the noise level differences are significantly higher than the standard limits. The reason that there is so much variation is due to a number of reasons mainly associated with the level of background and by how much either the background or in particular how much the ambient (LAeq) is affected by additional high energy noise or how sporadic the music activity is.
To sum up, the difference in Ratings is greater:
a) when the ambient (LAeq) is affected by high energy noise from other sources or
b) when the background is elevated by other noise sources.

6 DISCUSSION

Entertainment in discotheques and wedding halls have become an important part of community life, of course these premises also bring in business for the licensees and also boost the local economy .However it is obvious that the musical entertainment also leads to noise nuisance affecting local residents. During my investigations in Algiers concerning this subject I have understood that all the entertainment premises I have visited in the centre of the capital and its suburbs have been working without applying any true ,clear regulations concerning noise in general . I have found out that unfortunately (for these premises neighbourhood) no serious standards or codes of practice have been written in Algeria for the purpose of giving guidance or an objective assessment methodology to assist officers investigating neighbour and neighbourhood noise when they happen to deal with noise complaints.
Up to now the only body noise complainers could refer to solve their noise problem is the police who most of the time resolve to make the antagonists meet, to cut the matter short they usually order them to reach a mutual compromise and resolve the problem amicably. In fact, most of the wedding halls which have sprung up everywhere and everyday between 2000 and 2007 have opened up in centre of towns close to places of residence entailing extreme noise nuisance to the neighbourhood. The people affected by noise disturbance do not know who can settle their complaints, except of course, a legal action which of course involves a loss of time and money. Being more and more aware of the health impacts of community noise and the harmful effects of noise in non industrial environments, several associations have involved themselves in order to attract the attention of the Algeria Authorities on the health risks to humans from exposure to environmental noise. They have addressed several warnings on the issue of noise control and health protection. One way to stop noise nuisance would be to enact regulation, guidance or equipment to use to measure noise levels and decide which level can be considered as a nuisance depending on the local circumstances. The choice of the criteria will depend on the time of day. Although Algeria does not have a significant 'Siesta' culture, noise during the afternoon is perceived as a problem. But not as much as in the late evening (after 10pm). The measurements show a considerable increase in the noise level when the 'weddings' are on. This would not prove acceptable in the UK. Arguments will need to be advanced as to the correct criteria to be used in the specific circumstances of Algeria and how they can be achieved using local materials and construction practices. The only organisation dealing with noise measurement and whose main role is to provide the entertainment premises with the required certificate entitling their opening up. There is very limited official documentation and publication relating to the noise who decide to issue these certificates and in addition an absence of the appropriate equipment to measure the noise levels, or source of the noise (construction materials, exposure of openings. .etc..)Which can help to give an assessment of their effects on the surrounding community and control noise nuisance.Many people living in the neighbourhood of wedding halls were questioned and have no possibility to get a proper

assessment of the noise nuisance when they complain about which can help them gather and determine evidence of the noise disturbance and therefore assist them to give sufficient evidence to establish statutory nuisance in court.

7 CONCLUSION

Noise pollution must be seriously and rapidly tackled by the Algerian Authorities. Architects, town planners, property developers, building constructors, preventive or repressive regulation conceptors ,town hall officers have a role working hand in hand to define at the source, the most adequate means-materials equipments, regulations-necessary to provide the most efficient acoustical isolation taking cost into consideration. It is therefore the role of building professional to conciliate the population necessary comfort without noise problem with the economic preoccupation of the constructors and entertainment building owners. My task when I go back to my country is to intervene with the results of my research to struggle against noise pollution in the most efficient way. As an architect, all my efforts have focussed on all the construction aspects, the analysis of their technical aspects so as to perform the best insulation in defining the best insulation, the human being perception of noise and some theoretical notions of our auditory organs our needed without forgetting the principles of transmission of noise necessary of the choice of the most adequate building materials aiming to limit noise transmission. The most efficient way is to initially foresee the noise risks of the buildings exposure with regard to the neighbouring environments

8 REFERENCES

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