A COMPARATIVE STUDY BETWEEN NOISE LEVELS IN CAIRO AND THE PREFERRED NOISE CRITERIA.

Thesis Submitted in Partial
Fullfilment for Master Degree
in Audiology

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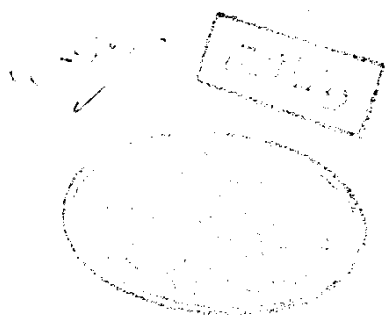

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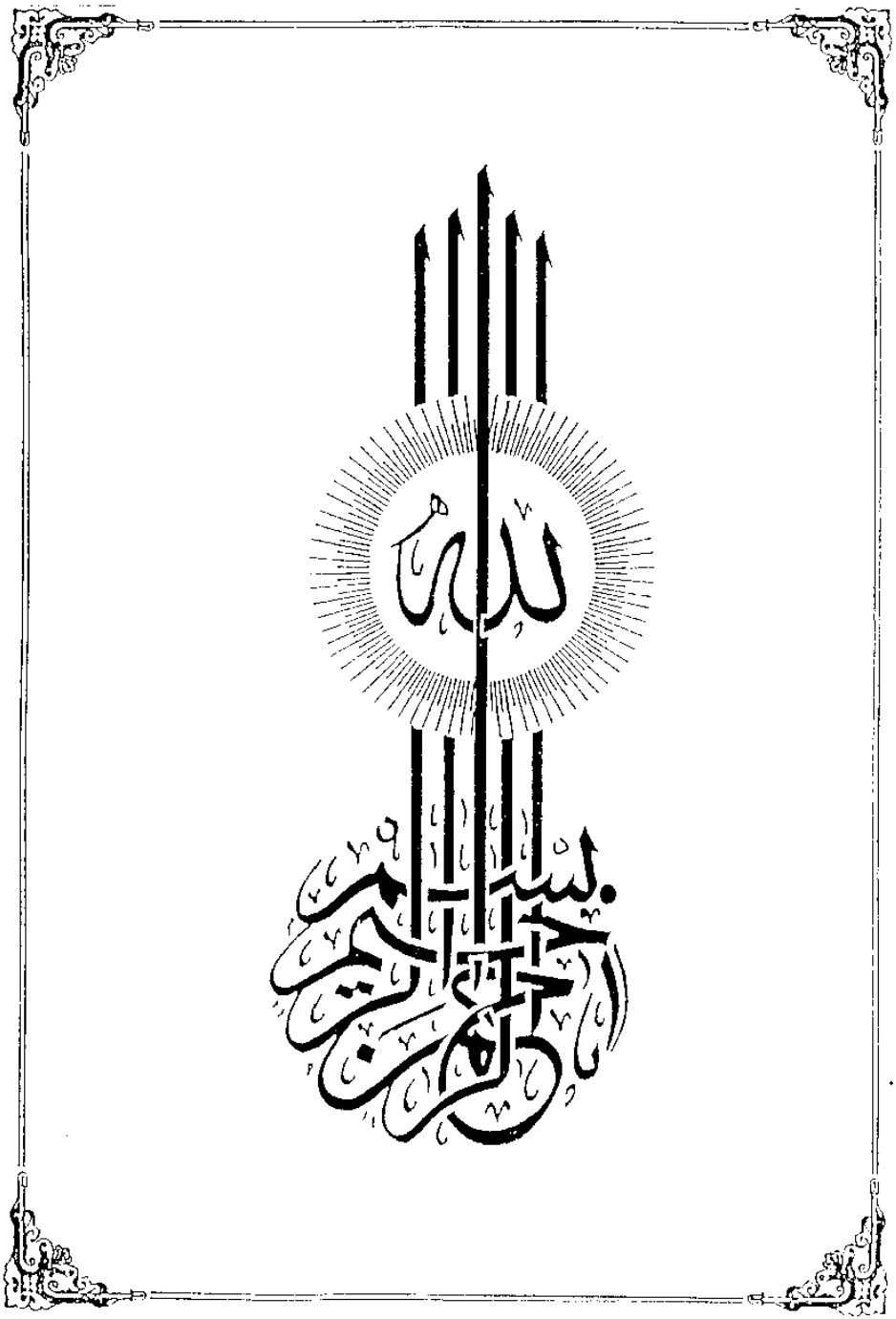

CONTENTS

ABBREVIATIONS AND SYMBOLS

1- C F: characteristic frequency.

2- D_c : critical distance.

3-D O L : Department of Labour.

4-D R C : damaging risk criteria.

5-E P A : Environmental Protection Agency.

6- h/w,H/W : hour/week .

working day = 8 hours

working week= 5 days.

7-I S O: International Standards Organization.

8- L : the sound pressure equivalent level acconding to the Organization of Safety and Health Administration (Acts).

9- L_8 :the 8 hours time weighted average sound pressure level.

10- L_{eq}: the equivalent sound pressure level.

11- LTASS : long term average spectrum of speech.

12- m^2 O P : $meter^2$ Open Window.

13- M R C: MEDICAL RESEARCH COUNCIL.

14- NIPHL : noise-induced permanent hearing loss.

15- NIPTS : noise-induced permanent threshold shift.

16- NIL : noise immission level.

17- NIOSH :National I stitute for Occupational Safety and Health.

18-O p. : Opus.

19-O S H A : Organization of Safety and Health Administration(Acts).

20- O.W. : Open Window.

21-P A R : percentage of acceptable risk.

22- t_c : centeral time.

23 - T W A ; time weighted average.

24- # :one sharp =one semitone above. ♭ : one flate=one semitone below.

INTRODUCTION
AND
AIM OF THE WORK

INTRODUCTION AND RATIONALE

Sound is a complex physical phenomenon. The instantaneous variations of all acoustic signal parameters result in a compound interaction with the subject perceiving this acoustic signal (Lipscomb, 1988). Current usage of the word noise in technical parlance usually implies an absence of information in the acoustic signal. In reference to auditory process, the word can also be synonymous with a more subjective term "annoyance", a meaning much more in tenor with its Latin root "nausea" (Schmiedt, 1984).

Music, on the other hand, is an art of organizing or arranging sounds into meaningful pattern or forms (New Webster's Dictionary, 1975). Sound either in the form of unwanted noise or leisure activity may be a problem at two levels. The first level is hearing damage when the level of sound and duration of exposure exceeds the level of safe noise exposure. The second level includes a large group of effects such as speech communication interference, sleep disturbance, interruption of concentration and degradation of task performance (Lipscomb, 1988).

Since 1969, the Walsh-Healey Public Contracts Act was approved and hearing conservation practice has been introduced into a sizeable segment of occupational scene with the force of federal law (Lipscomb, 1988). Few years later, there was an increasing interest in the subject of socioacusis i.e. non-occupational hearing loss. Although hearing damage due to non-occupational hearing loss covers a large number of topics, music is still considered the most possible auditory hazard in population term (Medical Research Council Institute of Hearing Research, 1986).

In U.S.A. the Occupational Safety and Health Acts (OSHA) has put a legislation in 1981. that: whenever employee noise exposure is equal to or exceeds an eight hours time-weighted average sound level of 80 dB SPL (A) (slow response), hearing conservation program should be carried out. The International Standards Organization (ISO) published in (1990) a model of hearing damage due to occupational noise exposure. In this model the limit for safe noise exposure was 75dB SPL (A) during 5 days working/week (8 hours/day).

A part from the hearing damage risk due to noise exposure in working places. Bernake et al., (1971) developed acceptable noise criteria curves for various enclosures.

These were described as Preferred Noise Criteria (PNC) curves.

These curves represents the tolerance of normal listeners to noise levels at frequencies between 31.5 Hz and 8KHz. Whenever the spectrum of background noise does not conform to the PNC curve for this enclosure the normal listener will find it unpleasant i.e. hissy or rumbley. The PNC curves had been widely accepted (Lipscomb, 1988), and their clinical applications for different enclosures were used as a guideline to design building and to study their acoustic perfection.

Cairo, considered as one of the most overcrowded capitals in the world has high noise levels (Soliman, 1984; Hassen et al., 1991).

This work is designed to assess the noise pollution in a working area versus a recreational area in Cairo. This, in turn, will help to introduce legislation to protect against noise effects of the daily activity and to provide the necessary measures against future noise pollution.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

1. *Noise and physiology of hearing.*
2. *Noise effects:*
    - I. Auditory effects of noise
        - i. effects on hearing threshold level.
        - ii. effects on speech discrimination in different enclosures.
    - II. Non auditory effects of noise
3. *Preferred noise criteria curves.*
4. *Musical terms and music instrumental physics.*
5. *Orchestra and physiology of music perception.*
6. *The acoustic* architecture *of the main hall of the Egyptian Opera House.*
7. *Sound pressure level measurement in hospitals and during music playing.*

I. Noise and the physiology of hearing

The overall understanding of cochlear physiology has been changed over the past few years. Now, it seems clear that the various events in the transduction process are coupled i.e. mechanical event can alter the electrochemical receptor events which in turn alter the neural events and vice versa. (Schmiedt, 1984).

The noise effect and its relation to audition can be subdivided into two main headings: vascular effects and electro-physiological effects

Concerning the vascular effects of noise, there is little agreement in more current studies as to what indeed happens to cochlear vasculature with acoustic injury. (Schmiedt, 1984). Some authors have reported decreased blood flow, loss of vasculature and decreased blood cell density within the cochlear vessels (Lawrence and Yantis, 1957; Lawrence et al., 1967; Hawkins, 1971; Lipscomb and Roettger, 1973, and Clark and Bohne, 1978).

Others reported no change in cochlear blood flow and vascular patterns (Schnider, 1974).

Also, some authors reported an increase in blood flow (Perlman and Kimura, 1962; Morimutsu, et al., 1965).

Recently, the use of blood vessels casting method and stylene cracking method have helped to observe the morphological changes occurring in the inner ear due to sound exposure. Nakai and Masutani (1988) noticed vasoconstriction of the blood vessels in the cochlear lateral wall and spiral lamina due to sound exposure. Sludging of the blood cells in these vessels was also recognized.

The electrophysiological studies include a very large number of studies and there is still room for many new researches. Schmiedt (1984) gave an excellent review of this topic.

Lonsbury-Martin and Meikle (1978) using the single unit approach to study the tuning and threshold characteristics of the auditory system, exposed a single unit (cell body or nerve fiber) to noise at the characteristic frequency, half octave above and half octave below the characteristic frequency (C.F.). They found that the half octave phenomenon is applied at the level of single unit. The greatest

threshold shift occurred in response to noise 1/2 octave below the C.F.

Robertson and Johnstone (1979); Cody and Johnstone (1980); and Robertson (1982), also, found that the half octave phenomenon at the level of the spiral ganglion i.e. ganglion cell associate with 15 KHz characteristic frequency, became more sensitive to 10 KHz in pathological ear as shown in figure (1).

They suggested that the half octave phenomenon was due to non-linearity in cochlear mechanics. In other words, a location which is tuned to a certain frequency at low intensity level is retuned to a frequency half octave below its C.F in high stimulus intensity level.

Another group of studies tried to explain the discrepancy between the hair cell loss and behavioral threshold after noise exposure (Liberman and Kiang, 1978; Saunders et al., 1984). For example, in Liberman and Kiang, study (1978), two animals with the same behavioral audiogram had shown very different amounts of hair cell loss. This was explained by the fact that chronic noise exposure leading to hair cell damage resulted in hypersensitive tail of the tuning curve. So, a hair cell with characteristic frequency