ACOUSTICAL DESIGN PERFORMANCE FOR MUSIC LEARNING INSTITUITIONS.

THE CASE OF NAIROBI .

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DECLARATION

This thesis is my original work and has not to the best of my knowledge been published or presented in any University for the awarding of a degree or any academic qualification.

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DEDICATION

I dedicate this to God Almighty for seeing me through the hard times
To my Father Boniface Waweru Njenga who has made this degree possible through his support.
To my Mother Dr. Majory Waweru for encouraging me and showing that this world is for the takers .

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ASANTE SANA

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

CHAPTER 2

3

List of Tables

ABSTRACT

Small music practice rooms for non-amplified musical instruments are essential requirements in the teaching of music in music education facilities. The requirements for wall partitions and doors sound insulation performance for music practice rooms are usually the primary consideration and generally well understood.

This thesis seeks to focus on the sound quality within the music practice room as perceived by the music student and teacher. The size, shape and finishes of the small music practice rooms decided at the design phase would determine the final cost, floor areas utilised and resulting acoustic quality of the built music practice rooms.

The determination of music practice room sizes, proportions, shapes and finishes and their potential impact on the sound quality of the rooms are discussed. Issues regarding standing waves, room modes and the even distribution of the modes in small music practice rooms are also addressed. The various methods of varying the reverberation times and diffusivity in the music practice rooms with the use of alternative room elements and finishes are meant to be discussed in these thesis.

CHAPTER 1

INTRODUCTION

"Music and silence combine strongly because music is done with silence, and silence is full of music."

Marcel Marceau

Figure 1.0 : Ghetto Classics Orchestral Training Session at Korogocho Slums

Source : Art of music.co.ke

1.1 BACKGROUND

The small music room probably receives the greatest level of usage of all the specially built music spaces. Small music rooms vary in size, and accommodate diverse groups ranging from a solo instrumentalist to small music ensembles.Rehearsal spaces have proved to be a very important space especially for music learning as it offers an environment where a young musician can harness and master his or her instrument during practice times .

Good room acoustics in a small music room enable a music teacher to more effectively teach subtle concepts such as intonation, articulation, balance, dynamics and tone production while a poor acoustical environment can adversely affect the development of basic musical skills of a music student.

Music education facilities and professional orchestras need facilities that can be used both for playing and for quiet activities. Music students need to study the theory of music, history, sheet music, etc., while professional musicians study sheet music before they actually start to play them. Professional musicians also wish for quiet facilities during their breaks . For all of these factors, sufficient sound insulation between the different facilities is the key.

Good acoustics are essential for a musician, professional or student to achieve perfect performance. If these conditions are not met, a music student will not develop into the professional they have potential to be. Studies show that, with proper acoustics within small rooms can be achieved . However, the question remains whether the sound exposure of teachers if reduced is adequate for developing a good teaching environment .

Figure 1.1 : Ghetto Classics Orchestral Training Session at the Conservatoire School of music
Source : Art of music.co.ke

Figure 1.2 : Ghetto Classics Orchestral Training Session at St Josephs' Parish Korogocho Slums.
Source : Art of music.co.ke

1.2 THE PROBLEM

Although some designers may have a musical background, they may not be acquainted with the problems of teaching music, which requires a different acoustical situation from that of the auditorium or concert hall. Another issue confronting and architect is the the design of small music rooms which is the lack of understanding of the problems of teaching young musicians. The job of solving the acoustical problems has been complicated,in part, by the lack of communication between the musician-teacher and those involved in building construction.

Most of the focus of the acoustical issues is still the background noise from external and internal sources andsound isolation between the adjacent music rooms. This indicates that not much has transferred from research work of the design small room acoustics of music practice rooms in construction.

Unfortunately, functional solutions are often more expensive than nonfunctional ones, and the possibility to build surroundings that everyone can enjoy, both students and professionals alike, is often undermined by a tight budget. When room acoustics are designed, little or no attention is paid to small rooms. Practice rooms for small teaching classes of one student or a small group of students are often neglected and built at the minimum cost. This usually backfires with a need for repairs when the sound insulation is insufficient and complaints arising about the rooms being too small for loud instruments.

1.3 RESEARCH QUESTIONS

i)What adjustments can be made to optimise the acoustic performance of music learning spaces?

ii)How does the current Kenyan Music learning space respond to its design acoustically?

iii)What parameters are used to design the most effective and acoustically sound musical learning spaces?

1.4 AIMS & OBJECTIVES

i) Identify & Recommended Acoustical design stragies for music learning Instituitions.

ii) Acoustical Analysis of Existing Music Spaces In Nairobi when used during rehearsals and learning.

iii) Identify adjustments that can be made so as to optimize acoustical performance in music learning spaces.

Figure 1.3 : Old Cambrian Band Training Session at the Nairobi School Music Center

Source : Author

1.5 JUSTIFICATION

The small music room probably receives the greatest level of usage of all the specially built music spaces. Music students can spend up to 40 hours per week in music practice and rehearsal rooms, these rooms are very important in the daily activity of a music school or department .
Theres a serious need for designers to focus their attention on the learning spaces of musicians as opposed to the performance aspect which is occasionally used as opposed to learning which is done frequently

1.6 SCOPE& LIMITATIONS

Due to the broad nature of music spaces, the study will limit itself to learning spaces especially when it comes to rehearsal rooms where students spend a considerable amount of time during practice times .The research will be biased to acoustics of the room with a an emphasis on materials and detailing for sound control and how to achieve required reverberation time for the spaces .
Limitations for this study will include time, financial constraints & accessibility of the learning facilities during the research.

1.7 SIGNIFICANCE OF STUDY

This study is important as it will act as a guiding tool for the acoustic design of music spaces in learning facilities .It will come up with comprehensive recommendations for appropriate factors and material to be used in the construction of music learning facilities to help in achieve a high acoustic performance which will enhance the environment of the music space .

1.7 DEFINITION OF TERMS

Acoustics : The science of Sound. Its production, transmission and effects. The branch of physics that treats the phenomena and laws of sounds as it effects people.

Acoustical : The properties of a material to absorb or reflect Sound .

Ambient/ Sound : Noise level in a space from all sources such as HVAC or extraneous sounds from outside the space. Masking sound or low-level background music can contribute to ambient level of sound or noise.

Background Noise : The sum total of all noise generated from all direct and reflected sound sources in a space that can represent an interface to good listening and speech intelligibility. (Hearing impaired persons are especially victimized by background noise).

Attenuation : The reduction of sound energy as a function of distance traveled.

Deflection : The distance an elastic body or spring moves when subjected to a static or dynamic force. Typical units are inches or mm.

Echo flutter : Short echoes in a small reverberative spaces that produce a clicking, ringing or hissing sound after the original sound signal has ceased. Flutter echoes may be present in long narrow spaces with parallel walls.

Reverberation : The time taken for sound to decay 60 dB to 1/1,000,000 of its original sound level after the sound source has stopped. Sound after it has ended will continue to reflect off surfaces until the wave loses enough energy by absorption to eventually die out. Reverberation time is the basic acoustical property of a room which depends only on its dimensions and the absorptive properties of its surfaces and contents.

Reverberation Time : Sound after it is ended at the source will continue to reflect off surfaces until the sound wave loses energy by absorption to eventually die out.

Sound : Sound is an oscillation in pressure, stress particle displacement, particle velocity in a medium – in room temperature. (In air speed of sound is 1125⍰/ second or one mile in 5 seconds.) Sound produces an auditory sensation caused by the oscillation.

Sound Absorption : The property possessed by materials, objects and air to convert sound energy into heat. Sound waves reflected by a surface causes a loss of energy. That energy not reflected is called its absorption coefficient.

Sabin - A measure of sound absorption of a surface. One sabin is equal to 1 square foot of open window. Sabins are calculated by multiplying the absorption coefficient of a material multiplied by its area.

Pitch - The human perception of frequency. In general, the higher the frequency, the higher the pitc

Reflection - The bouncing of a sound wave off of a surface. Sound is reflected much as light is reflected, with the angle of incidence equaling the angle of reflection.

Sound isolation - The degree of acoustical separation between two locations, especially adjacent rooms.

Sound level - The intensity of sound measured with a sound level meter and one of its weighting networks.

Diffraction - The bending of a sound wave around an obstacle, or through an opening, such as slats. The scattering of sound waves at an object smaller than one wavelength, and the subsequent interference of the scattered wavefronts.

1.8 STRUCTURE OF THE THESIS

CHAPTER 1 The Chapter acts as the Introduction of the study with a clear description of the problem statement which is the basis of the Thesis. ,The research questions help guide the study as well as the objectives of the study as it acts a checklist on the key areas to be researched .The Chapter goes further to describe the scope and limitations of the study which is then concluded by giving a definition of specific terms used in the study followed by a description of thesis structure

CHAPTER 2 Presents the foundation of the study .It begins with the Brief introduction of acoustics of the subject of acoustics.,Then an overview of how room acoustics has transformed over the years .Various acoustic parameters are used to check for good acoustics in Music Education Facilities are ellaborated hence giving a deep overview of acoustic design of Music Facilities.

CHAPTER 3 Gives the description of procedures and techniques which will be undetaken to collect and analyse data is done.These include a description:the research design ,the research strategy ,the sample ,the data sources and finally the data presentation and analysis techniques.The selected research method is the case study method based on the availability to provide primary acoustic data for evaluation.

CHAPTER 4 Based on the established guidelines from the literature review and the set methodology ,this chapter examines the local case studies set namely: Braeburn School Gitanga Road,Brookhouse International School,Conservatoire School of Music .The Chapter using the acoustical factors established in the literature review investigates all three cases studies to analyse these acoustical factors so as to determine implementation levels and how it has affected quality of sound .

CHAPTER 5 Final Chapter answers the research questions in Chapter 1 by giving a summary of the findings and recommendations of questions raised at the beginning of the study .The conclusions drawn highlight the goal of acoustical design in a Music Educational Facility which would be best suited to give a good environment for a Music student . Finally chapter highlights posible fields of study which it reccomends future research .