



جامعة الاسكندرية  
كلية الفنون الجميلة  
قسم الديكور  
شعبة العمارة الداخلية

رساله مقدمة بعنوان :

"تأثير العماره الداخليه الرقميّه على البيئّه الصوتيه وتطبيقاتها على خامات عزل الصوت "

**"The Effect of Digital Interior Architecture on the Acoustic Environment and its Applications on Sound Insulation Materials"**

لنيل درجة الماجستير فى الفنون الجميله

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## Thesis Summary

Acoustic engineering is a branch of engineering that deals with sound and vibration from its physical aspects, as it is the application of sound and vibration science in technology, usually concerned with sound design, analysis and control, and also covers additional uses of sound, from the use of ultrasound in medicine to programming devices Digital audio synthesis.

Building materials become economical in terms of structural characteristics in favor of saving space and cost, as these products create an additional burden on noise production and provide a safe environment for users, which entails the necessity of linking the interior design with the acoustic tone to be delivered and implementing it with soundproof materials.

### **Chapter One: Planning the acoustic environment in the interior architecture**

Through which it was studied that acoustics is one of the most important elements of interior architecture that affects the human being and attention to it leads to the improvement of the efficiency of the performance of the place and the success of its employment. The phrase "good acoustics" is the end of all spaces in the interior spaces in which communication takes place through speech or music True, if speech cannot be understood properly in a lecture hall or classroom, this is often a big problem. Vivid or very boring acoustics are both undesirable. The interior designer in charge of designing a theater or an opera house must strive to have a good audio communication between the actors and musicians in the opera house. Therefore, the sound must be studied and the definition of frequency, pitch, reflection and sound absorption.

Since from the perspective of biology, sound is a signal emitted by the organism that owns the sound-emitting organ, used as a means of communication, through which it expresses what it wants to say or do consciously or unconsciously. Normal at 340 meters per second or 1026 kilometers per hour. The speed of sound is related to the stiffness factor and density of the material in which the sound is moving. From the perspective of physics, it is a mechanical frequency, or a wave capable of moving in several physical mediums such as solid bodies, liquids, and



gases, and does not spread in a vacuum, and the organism can sense it through a special organ called the ear.

And by another definition, sound is a mechanical vibration of the medium. Sound is not a wave, but the wave is one of the forms (propagation patterns) that distinguish the sound and as an example of other patterns: sound currents and sound flow.

There are other factors that affect the spread of sound and its speed, such as the nature of the material (viscosity, its influence on the magnetic field), which shows the basic tones and the first 6 tones of a vibrating chord. Early records of studying this phenomenon are attributed to the ancient Chinese language 3000 BC.

The sound generates an audible sensation each time a vibratory movement occurs. Sound needs to travel from the source of the vibration to our ears to a physical medium. Direction is one of the most important characteristics of hearing in the human ear. Using both ears together, a person can determine the direction of the sound and estimate the distance from its source within an angle of about 15 degrees in the horizontal plane, where the person instinctively turns to face the sound he hears until it stops in its direction completely. However, it decreases a lot in the vertical plane, as it is difficult for the listener to determine the position of the sound source in the vertical plane.

The characteristic of direction in the ear, and this feature is only found in people who have normal hearing powers in the ears, where the two ears work together to collect and transmit stereophonic sound to the brain, just as the eyes work to form a stereo image on the retina. Knowing the importance of sound, we can communicate with each other by speaking in the inner space. Also, many sounds, such as music and birdsong, bring joy to the soul. And the voices of radio and television broadcasts convey to us the verses of the Noble Book of God and information. There are sounds that warn us of dangers, such as car horns and fire bells. We also use sound in many other ways. We can tell if an object is hollow if we knock on it. The doctor can diagnose the disease after using a stethoscope to listen for heart sounds. And the lungs and this happens through the process of transmission of sound.

Alas Sabine Kleiman, Professor of Physics at Harvard University, is considered the pioneer of architectural sound engineering. Sabine put his summary of his research and experiences into the design of the Boston Conservatory, which opened in 1900

Sabine's regression equation is:

$$T = 0.163 V/A$$

Where  $T$  = echo time per second,  $V$  = volume of the room in cubic metres,  $A$  = the so-called equivalent absorption surface in square metres.

Loudness of the acoustic room

Study of sound reflections in rectangular rooms.

Reflection of sound from curved surfaces.

Reflection of sound from circular surfaces.

- Other types and shapes of theaters and sound reflections inside them.

Isolation requirements

Determine the sources of noise

Determining the means of noise in the building

Determining the specifications that allow removing noise from the source whenever possible, such as specifying the maximum

Permissible noise from machines and determine the means of absorbing the resulting vibrations.

- During the design, consideration must be given to specifying the specifications of the materials that guarantee the least transmission of sound in all places where sound prevention and distance are required.

Types of acoustic insulation

Airborne sound insulation

Impact sound isolation

Types of soundproofing materials:

- monospaces

- double spacers

Compound spacers

- passive isolation

## **Chapter Two: The effect of digital programs on the formation of audio architecture in interior architecture**

Apply minimum sound insulation requirements for residential buildings, educational institutions, hospitals, offices, as well as conference centers, mosques, churches, courts, restaurants and all interior spaces. Sound insulation is a set of methods and methods used in order to reduce the intensity of the sounds affecting buildings.

The construction of acoustics must be a study and evaluation inside the building, as it includes all the components of the building and its facilities. Therefore, the sound insulation properties in different types of buildings, as well as in historical buildings, must be studied.

The effect of digital programs on the formation of audio architecture in interior architecture:

Studying theatres.

Where the sound processors for music theaters, stage acoustics in double volume spaces, and realization of dual theater acoustics using a computer model, and the location of the listener were studied.

Study the space of restaurants.

Where the echo time is calculated inside restaurants by calculating the area of materials and then drawing the absorption drawing test with clarification of the absorption coefficient inside the restaurant.

Study of residential buildings



By studying the categories of residential buildings that are eligible for sound insulation and studying planning and evaluation criteria for controlling and treating noise in dwellings, whether the house is separate or with several floors, by studying the condition of external noise and the structural elements of the building and the materials used inside it and calculating the sound absorption ratio.

Study of office buildings

Where to study open-plan office structures

Studying phonetics in mosques

By classifying mosques, whether they are local, in the center, or mosques for celebrations and holidays only, and studying the acoustic requirements for clarity of sound in the mosque, and determining the main factors that affect the sound behavior in mosques, where the shape of the ceiling, the design of the mihrab, and the quality of the floor surface and walls affect.

Study of phonetics in churches

Where he studied the architecture of the church in the interior architecture, sound reinforcement systems and induction loop systems.

Study schools and nursery facilities

Studying room acoustics in schools, the required reverberation times, and the distribution of absorbent surfaces.

### **Chapter Three: The development of sound insulation materials as a result of modern technology**

Insulators of all kinds are considered among the utmost necessities in interior design technology, and they are one of the elements that achieve the completion and construction of a successful design. Organic insulating materials, mineral insulating materials, and fire-retardant insulation materials. In terms of shape, insulating materials are found in the form of solid materials, including what is mixed with some other materials, foam materials, or in the form of panels.

The importance of sound insulation

Acoustic insulation is a set of standards and procedures that aim to provide adequate insulation for a place in order to mitigate the annoying sounds generated by different sound sources in many buildings and various activities due to its importance and achieving the goal within the place.

Advanced materials used in acoustic insulation and their applications to interior architecture

First: the materials for walls, ceilings and furniture

Decustik from Dukta . Wood Flexible Acoustic Panel

Describing the material system, materials and finishes to the material, the systems for fixing the material, and the uses of the material products.

As for the types of Decustik from Dukta, the first type is double-faced Janus, the second type is Foli, the third type is Sonar, and the fourth is Linear.

Decustik From Dukta material attributes, quality and certification of the material, and applications of Decustik From Dukta material to furniture parts.

Vapor Soft material

By studying the general characteristics of the material, presenting Vapor Soft acoustic panel systems, the acoustic performance of the material, the encyclopedia of colors, and the realization of acoustics, lighting, and Vapor Soft accessories.

As for the types of Vapor Soft materials: Cora Panels, Soft Cluster panels, Trail panels, Bloom panels, Breeze panels, Frequency panels, Liana panels, Sky panels, Gradient panels, Elements panels, Liana panels Syntax, Pixel Boards, Cumula Boards, Bytes Boards, Shift x Boards.

Second: the materials used in the walls

Wood Wool Wall Tiles

Third: The materials used in the ceilings

- Soundproof Ceilings - Heartfelt Confusing Ceiling System

Soundproof Ceilings - Origami Heartfelt Ceiling System

Fourth: Sound insulation of floors:

Canyon Carpet Tiles

Escape Carpet Tiles

Monitor Carpet Tiles

#### **Chapter Four: Application of sound insulation materials to the determinants of interior spaces**

Place-making for a modern world We design at every scale and at every stage in the place-making process, from vision to enclosure, design, delivery and operation. The places we create are distinct; Social, natural, useful and beautiful - a reflection of humanity. The practice has grown to more than 1,200 people operating from a collaborative network of city studios, and all creative hubs connected to the cities and regions they serve. Our acoustics team combines scientific analysis, creative design skills and practical experience to work across all sectors.

Through this chapter, a number of examples of materials and spaces were Studied.