

Acoustical Material Used in Auditorium

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ABSTRACT- By questioning the way in which sound reacts to account spaces, engineers can design spaces that enrich audile comfort. probing the critical representatives impacting auricular design in bulky amphitheatres. Through the review of several literature stuff, the writer demonstrated 8 factors impacting audile design in amphitheatres videlicet; (a) volume of room, (b) form of room, (c) platform design, (d) reverberation moment, (e) ceiling design, (f) deck design, (g) bottom rake, sitting layout and sightlines, and (h) accoutrements. choice of good audile material is meaningful in the design of the theater innards. Designing the theater that has well-founded acoustics can be decided through the selection of accoutrements used, videlicet by applying qualitative styles so that the developer can find out the characteristics of the material in agreement with the theater. The conclusions attained when applying aural accoutrements, the grade will be better because the material is veritably durable and can absorb and dampen sound veritably well.

Keywords aural material, reflection, immersion, absorber, material plot.

Definition of Terms

Auricular Analysis- The thorough study of sound roots, transmission routes, receptors, absorbers, mirrors and reverberation moments in the environment of an individualized auricular problem.

Clarity- The position to which you can tell piecemeal fleetly assign sounds.

Decibel- A introductory metric for depicting the magnitude of sound.

Echo- A reflected sound of enough intensity that detainments in appearance and is heard as distinct from the Source.

Forestage- The portion of the stage in front of the proscenium or curtain line.

Frequency- It's the number of complete cycles per second of vibration. It's measured in Hertz (Hz)

Intensity- The rate of sound energy propagated in a distinct direction over a unit area.

Octave band - A division of the audible frequency range, the centre frequency of which is twice that of the preceding band centre frequency.

Reverberation - The persistence of sound within a space after the source of the sound has stopped.

Room Shape - The configuration of enclosed space coming out of the orientation and arrangement of surfaces defining the space.

Sound propagation - The transmission of sound energy through various media to a listener.

Wavelength - The distance between two close regions of a wave of sound where there is similar conditions of particle displacement or occurrence of pressure.

1 Introduction

Acoustic design is the use of architectural and engineering techniques to control the behaviour of sound in an enclosed space (in this case an auditorium). The **purpose** is to improve sound distribution in the enclosed space by enhancing the desired sound suited for the program. Acoustic design **also aims** to eliminate noise and undesired sound that would negatively affect the desirability of the sound. For instance, specific measures will be taken to make speech more intelligible or to make music sound better for the users. Building materials and architectural designs will be taken into consideration while engaging in acoustic designs.

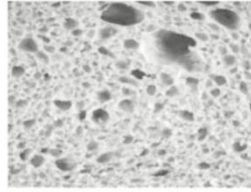
When sound travels in each medium, it strikes the surface of another medium and bounces back in other directions, this phenomenon is called the **reflection of sound**. The waves are called the incident and reflected sound waves. Different type of surfaces that contact with the sound waves react differently, for instance, hard surfaces will reflect almost all of the incident sound energy. Convex surfaces will disperse sound while concave surfaces will concentrate the reflected sound. A perfect absorber has an **absorption coefficient of 1.0**, for instance, an open window.

2 Types of Sound Absorber

1. Porous absorbers

Porous sound absorbers react to the materials in its network of interconnected pores and the thermal interaction cause sound energy to be dissipated and converted to heat. The absorption

of porous material is most effective at frequencies above 1 kHz.



2. Cavity absorbers

Cavity absorbers, also known as Helmholtz Resonators, are perforated devices with incredibly small pores that are connected to the environment through a small hole. Maximum sound energy absorption occurs in a constrained area in the low frequency band.



3 Direct and Indirect Sound Path

Direct sound is the sound that is emitted from the sound source and arrives to the audience without any reflections; indirect sound is the sound that arrives at the audience after one or more reflections. In an auditorium or other acoustical space, people seating near the stage tend to hear direct sound more than those farther away, who frequently hear indirect or reflected sound.

4 Materials on Building Component

Floor

Any product made from wood and intended for use as flooring, whether for functional or purely decorative reasons, is known as wood flooring. Due of its reflected qualities, this type of flooring is typically utilised for special purpose floors, such the theatre. Wood is a popular option for flooring and is available in a variety of forms. Solid hardwood flooring is the kind that is used in MBSA Auditorium. Planks from a single piece of wood are machined to make solid hardwood floors. Solid wood floors can be sanded and finished more frequently than engineered wood floors due to their thicker wear surface. For large halls in particular, a sloping floor is ideal since it enhances audience sight lines. Moreover, when sitting on a sloping floor, the listeners receives more direct sound compared to when it is on a flat floor. Generally, the slope of an auditorium floor should not be less than 8° and for safety purposes the slope should not exceed about 35°.



Wall

In order to lessen reverberation, the walls of the auditorium are typically coated with sound-absorbing materials like compressed fiberboard or drapes. These materials absorb sound waves, which lessens the occurrence of echoes. The acoustic material that the audience generally sees is used for a completely different purpose: to absorb or reduce the sound waves coming from the stage in front of them. Most often, the purpose of utilising these materials is to prevent sounds from reverberating off the walls of an enclosed room. If this phenomena were to go uncontrolled, it would probably result in an extremely auditorily disorienting experience for the audience. Foam that absorbs sound is the sort of material utilised on the walls in MBSA Auditorium. It is layered on with wooden panels of different widths that act as a diffuser, which is to match the high and low frequencies of sound.



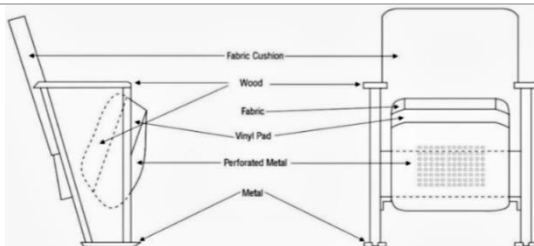
Ceiling

To reflect sound, MBSA's ceiling has a slanted profile. It is hanging plaster, offering several planes that reflect sound waves of different wavelengths. The ceiling is built on metal lath and heavily plastered to prevent panel vibration. Additionally, the large mass of plaster and a suitable suspension system will prevent outside noise from entering the building. For optimal acoustics, the auditorium hall should be played at a loud volume.



Seating

The auditorium can accommodate 1237 people in total. They are arranged in 34 arena configuration, allowing for inclusion at any angle between 180 and 270 degrees. All seats are fixed, cushioned, and have moulded metal leg supports. While the backs of the seat pans are made of perforated aluminium over sound-absorbing material, the fronts of the chairs are covered with fabric that absorbs sound. This is done to make sure that the reverberation duration is unaffected by the audience's presence or absence. The absorption effect is lessened when the seats are occupied since they face the floor instead of the stage when vacant.



Stage

With one fixed central stage and two fore-stage platforms, the stage is divided into three sections. Depending on the purpose of the event, the fore-stage platform can be changed from 0.00m to +1.00m. Since there is a hollow area underneath the stage, sound will pass through the flooring and empty area before reflecting off the concrete base at the bottom. The sound's strength would have been diminished when it was reflected back to the flooring's surface. The stage's flooring is hardwood lumber.

Openings

The auditorium has a total of 7 fire exit doors. Four doors are on the ground floor, with the remaining eight on the second. The steel-framed, acoustically-designed wooden doors. There are heavy curtains covering every door. As a sound absorber, the curtains keep the hall from becoming noisy when the door is opened. It also covers the door's reflecting surface.

Balcony

The wing has two balconies, one on each side. The VIP chairs on the balconies are fixed, and the floors are carpeted. The ceiling is constructed from plasterboard. Wooden bars and substantial clear acrylic panels serve as the balcony's railings, preventing audience members from slipping over. To prevent panel vibration, the panels are manufactured thick.

Material Absorption Coefficient

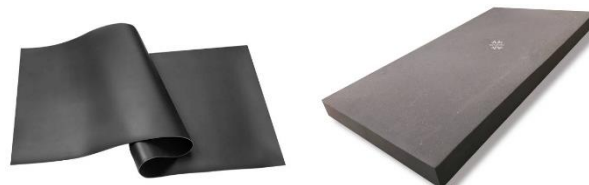
Building Components	Material	Surface Area (m ²)	125 Hz	500 Hz	2000 Hz
Ceiling	Plaster on lath, deep air space	630.7	0.20	0.10	0.05
Seating	Fabric well-upholstered seats, unoccupied	1484.4	0.19	0.56	0.61
Curtain	Curtains in folds against wall	45.5	0.05	0.35	0.50
Wall	Wood Slat Acoustic Diffuser	102.3	0.18	0.42	0.83
	Wood Panel Sound Diffuser	232.66	0.28	0.17	0.10
	Concrete	697.33	0.02	0.02	0.05
Floor	Carpet, Heavy, on Concrete	352.72	0.02	0.14	0.60
	Wooden Flooring	281.12	0.40	0.20	0.15
Door	Acoustic door with steel frame	65	0.35	0.44	0.54
	Thick Clear Acrylic Panels	32.36	0.44	0.70	0.16
Balcony	Wood Railing	16.95	0.15	0.10	0.06
	-	-	0.39	0.8	0.92
Openings	Deep Balcony	110.4	0.50-1.00		
	Ventilation Grills	2.97	0.15-0.50		

5 Auditorium Soundproofing & Acoustic Treatment Products

The main purposes of soundproofing goods are to improve the acoustics and sound quality of an auditorium. For soundproofing an auditorium, products like Sound Axe hardwood acoustic panels, Acoustic foam panels, Sound Absorbing: Sound Insulation Pads, and Sound Barriers: MLV are employed. Correct use of soundproofing materials lowers mic distortions, bass reflections, echo and reverb, and slap back noises.



1. Mass Loaded Vinyl noise barrier is a high-density membrane which can easily spread on floor and walls to isolate the sound from one space to another. For auditorium soundproofing, mass loaded vinyl is utilised to prevent low frequency sounds. MLV is available in various thicknesses and is offered in roll form.



2. Sound Insulation Pad is a fire-retardant polyurethane-based sound absorber which easily blocks high and mid sound frequencies. The finest non-carcinogenic wall and ceiling soundproofing product is sound insulation pad. It comes in sheet form, and SR adhesive makes it simple to stick to any surface.

3. Wooden Acoustic Panels are pre-made acoustic panels in size 23"x23"x1" which can be easily pasted on existing wall system. Applying them next to each other or in design can perfectly improve sound quality and aesthetics of an auditorium.



4. Acoustic foam panels are used widely to absorb sound reflections and are rated best in its type. The product is available in a range of sizes, hues, and designs to meet the requirements of every project. The Turbo and Groove acoustic foam panel is the most popular design. This product's NRC is higher than 0.90.

5. Glasswool is a silencer made of wool textured fiberglass with a thickness of 25 MM to 50 MM. Due to this material's ability to absorb water, which results in a drop in sound absorption, the NRC is quite tiny and its use is not permanent.



6. The ability of **polyethylene terephthalate (PET)** material to serve as both an absorbent and a silencer makes it a popular choice among manufacturers. Compared to other materials, it is excellent at blocking sound. Since PET is made from recycled materials, it is very simple to apply and shape, and it is also very safe to use.

7. Acourete mat resin 2A Material capable of making spaces impermeable, this material is in the form of black sheet made of rubber and a mixture of chemicals. the installation is very easy. This material can insulate sound better than other material and its durability can be more than 15 years.



8. Acoustic Absorbent form is a sound dampening foam that can eliminate echoes in the room and improve sound quality in a room so as to produce sound in the room to be more comfortable to hear, this silencer foam while reducing sound leakage out of the room.



9. Rockwool is sound absorbing material composed of lightweight material fibre products that can absorb sound and heat. Rockwool is non-flammable material, but this material is not durable because it is easy to fall out, so it is not safe enough to use.



No	Material	Absorber	Silencer
1	Glasswool	Yes	No
2	Polyethylene Terephthalate (PET)	Yes	Yes
3	Acourete Mat Resin 2A	No	Yes
4	Rockwool	Yes	No
5	Accoustic Absorbent Foam	No	Yes

6 Conclusions

Most of the time, a room's material cannot be replaced, so correct treatment is required to improve the room's acoustical performance. Above, many techniques for handling auditorium material were covered.

In order to improve accuracy, the placement of the absorption material has also been discussed. The acoustical efficiency is increased when broadband absorbers are applied, even if only 20% of their surface area is used. To improve the acoustical qualities of interiors, a variety of materials including rockwool and PET can be employed. It is obvious that much more research is required before feasible methods for replacing subpar acoustic materials can be implemented.

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