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Architectural and Interior Acoustics

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ABSTRACT

Acoustics is the interdisciplinary science that deals with the study of all mechanical waves in gases,liquids and solids including topics such asvibration, sound, ultrasound and infrasound.Arch itectural Acoustics alsoknown as room acoustics and Building Acoustics is the scienceandengine ering of achieving a good sound within a building and is a branch ofacousticalengineering. Archi tectural acoustics can be about achieving good speech intelligibility in atheatre, restaurant or rail way station, enhancing thequality of music in a concert hall recording studio, or suppressing noi se tomake offices and homes more productive and pleasant places to work and live in.With a little thought and careful placement of the following solutions, one can tame the distracting sounds and create a more peaceful space without the echoing.

1. Hang textiles and wall art on parallel walls.
2. Use a tall bookcase and add objects to the room.
3. Add an area rug on to bare floors
4. Use acoustic panels to enhance sound absorption. A flutter of echoes canmake any space feel clinical, cold and uninviting. Treating your roomwithsmart acoustic choices like the ones can improve understanding movie dialog,clarity of music from the stereo, and most importantly, keep conversationseasy and comfortable.

Introduction

Acoustics is the interdisciplinary science that deals with the study of all mechanical waves in gases, liquids and solids including topics such as vibration, sound, ultrasound and infrasound.**Architectural Acoustics**also known as room acoustics and **Building Acoustics**is the science and engineering of achieving a good sound within a building and is a branch of

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acoustical engineering. Architectural acoustics can be about achieving good speech intelligibility in a theatre, restaurant or railway station, enhancing the quality of music in a concert hall or recording studio, or suppressing noise to make offices and homes more productive and pleasant places to work and live in.Architectural acoustic design is usually done by acoustic consultants.

Interior Acoustics is about theairborne sound inside rooms, i.e; how it propagates and interacts with the room's surfaces and objects. But it's also about our perception of the room's acoustic properties.At room temperature sound propagateswith 344 m/s (1,250 km/h), which results in many reflections at walls or objects in a normal-sized room before a sound wave is damped below the hearing threshold.Inside the room the sound waves get affected at its reflections on walls or objects. Three things can happen with the incoming sound energy:

- **Reflection**. A hard surface, such as concrete, glass or wood, acts as a mirror for the sound wave and thus reflects it.
- **Absorption.**A sound wave can propagate into a porous material where it is transformed into heat by viscous friction.
- **Scattering.**The sound wave is reflected in an unordered, almost random way.

All of these three processes are important in creating the acoustics of a room. Most practical objects includes all three, but to a varying degree. A completely flat glass surface has very little absorption and scattering, its acoustic characteristics is dominated by pure reflection. An upholstered sofa, on the other hand, is dominated by absorption and scattering due to its softness and shape.The acoustic properties of a room should be designed to support the activity in the room. Good room acoustics are seldom noticeable. Since there are so many different activities that can take place in rooms there are no such thing as universally good room acoustics. Each activity has its own challenges, and consequently its own acoustic design.

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Absorption and Reflection of Sound

Sound waves can be reflected or absorbed, and the science of acoustics is largely about what to reflect (send back into the room, what to transmit (sent to the next room), and what to absorb (turn into heat energy). Environment for music want more reverberation, enough to "warm" the sound with reflections. If too much is absorbed, less sound reaches the audience and it sounds "dry" or "dead" , the musicians need to work harder, and the lack of reverberation makes the slightest error more apparent. By contrast, environment for speech want less reverberation, although moderate amounts of reflection are useful to reinforce the sound as long as the overall time that it takes a sound to decay (or die away) isn't too long. A desirable reverberation time for classrooms is about .75 seconds for interactive (discussion-based) spaces and 1.0 seconds for lecture halls. By contrast, a symphony hall might have a two second reverb time.

Many acoustical materials are optimized for office environments, such as glued-down carpet, acoustical panels, and relatively inexpensive mineral ceiling tile. This environment is designed to provide speech privacy by muddying consonants (high frequency sound) and not absorbing vowels (low frequencies), making speech unintelligible a short distance away. This is the REVERSE of good classroom design where you want to reinforce speech intelligibility. Keep reading for a pattern for excellent classroom acoustics for learning.Absorption of sound is particularly difficult in special environments like cafeterias, kitchens, gymnasiums, and swimming pools. Conventional materials may be subject to damage, or absorb odors, or be incompatible in other ways. However, materials do exist that work well. For example, for a gym, walls can be built of a special slotted concrete block. Because the absorption is inside the block's core, no amount of ball impact can compromise its integrity.

Transmission of sound between rooms

The control of noise from one room to another is the other major challenge in acoustics. As with absorption, different materials transmit more or less sound at different frequencies. In transmission, blocking the entire speech range is important, and this factor is reflected in the

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STC rating (Sound Transmission Class) of a wall. The STC value of a wall is a relatively reliable relative indicator of the number of decibels of attenuation that can be expected from a wall system. STC values are a very useful tool in acoustical design but should be downrated for actual field conditions, as even the best installation will never match the lab rating.Critical to sound transmission issues is the background noise in the receiving room. If the background noise is higher than the amount of sound passing through (and around) the wall, then users won't hear the sound from the adjacent room. If background is lower than what's transmitted, then room occupants will hear sounds from the adjoining space. This tells us that some acoustical problems can be overcome by increasing background sound, but that can cause problems as people need to raise their voices to be heard.

Transmission Tips

- In general, materials with more mass block sound more than lighter materials, especially for low frequencies (which are very hard to block)
- Sound likes to travel around barriers. To be fully effective, walls should go from floor to the structure above, and holes should be carefully caulked or filled. Even small holes make a big difference. Most transmission failures are caused by cracks and holes.
- Batt insulation is useful, but it has to be installed very carefully or the effectiveness is compromised. It's best to have it inspected by someone who understands this before walls are covered up. Unlike thermal insulation, even minor gaps, cracks, and other installation problems result in a major reduction in effectiveness.
- Making the wall finishes of different thicknesses/masses helps stop sound waves, perhaps by adding an extra layer of gypsum board to one side of the wall.

Building Skin Envelope

This science analyzes noise transmission from building exterior envelope to interior and vice versa. The main noise paths are roofs, eaves, walls, windows, door and penetrations. Sufficient control ensures space functionality and is often required based on building use and local

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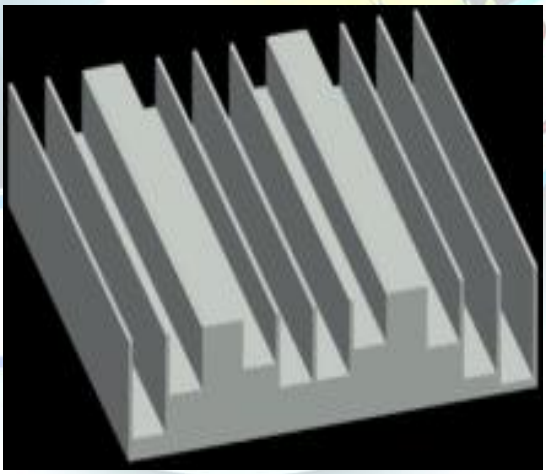
municipal codes. An example would be providing a suitable design for a house which is to be constructed close to a high volume roadway, or under the flight path of a major airport, or of the airport itself.

Inter-Space Noise Control

The science of limiting and/or controlling noise transmission from one building space to another to ensure space functionality and speech privacy. The typical sound paths are ceilings, room partitions, acoustic ceiling panels (such as wood dropped ceiling panels), doors, windows, flanking, ducting and other penetrations.Technical solutions depend on the source of the noise and the path of acoustic transmission, for example noise by steps or noise by (air, water) flow vibrations. An example would be providing suitable party wall design in an apartment complex to minimize the mutual disturbance due to noise by residents in adjacent apartments.



Diffusers Which Scatter Sound Are Used In Some Rooms to Improve the Acoustics

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An Anechoic Chamber, Using Acoustic Absorption to Create a "Dead" Space

Interior building surfaces can be constructed of many different materials and finishes. Ideal acoustical panels are those without a face or finish material that interferes with the acoustical infill or substrate. Fabric covered panels are one way to heighten acoustical absorption. Perforated metal shows also sound absorbing qualities.Finish material is used to cover over the acoustical substrate. Mineral fiber board, or Micore, is a commonly used acoustical substrate. Finish materials often consist of fabric, wood or acoustical tile. Fabric can be wrapped around substrates to create what is referred to as a "pre-fabricated panel" and often provides good noise absorption if laid onto a wall.Prefabricated panels are limited to the size of the substrate ranging from 2 by 4 feet (0.61 m × 1.22 m) to 4 by 10 feet (1.2 m × 3.0 m). Fabric retained in a wall-mounted perimeter track system, is referred to as "on-site acoustical wall panels". This is constructed by framing the perimeter track into shape, infilling the acoustical substrate and then stretching and tucking the fabric into the perimeter frame system. On-site wall panels can be constructed to accommodate door frames, baseboard, or any other intrusion. Large panels (generally, greater than 50 square feet (4.6 m^2)) can be created on walls and ceilings with this method. Wood finishes can consist of punched or routed slots and provide a natural look to the interior space, although acoustical absorption may not be great. [4] discussed about Positioning Of a Vehicle in a Combined Indoor-Outdoor Scenario, The development in technology has given us all sophistications but equal amounts of threats too. This has brought us an urge to bring a complete security system that monitors an object continuously. Consider a situation where a

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cargo vehicle carrying valuable material is moving in an area using GPS (an outdoor sensor) we can monitor it but the actual problem arises when its movement involves both indoor (within the industry) and outdoor because GPS has its limitations in indoor environment. Hence it is essential to have an additional sensor that would enable us a continuous monitoring /tracking without cutoff of the signal. In this paper we bring out a solution by combining Ultra wide band (UWB) with GPS sensory information which eliminates the limitations of conventional tracking methods in mixed scenario(indoor and outdoor) The same method finds application in mobile robots, monitoring a person on grounds of security, etc.

There are three ways to improve workplace acoustics and solve workplace sound problems – the ABCs.

- A = Absorb (via drapes, carpets, ceiling tiles, etc.)
- B = Block (via panels, walls, floors, ceilings and layout)
- C = Cover-up (via sound masking)

Measures To Reduce Echo in a Room

If you've ever been inside a large public space or loft with bare walls and hard surface floors, you may have noticed a distinctive ringing sound called flutter echo. This phenomenon occurs when sound waves bounce back and forth between the walls, ceiling, and floor, making conversations difficult. Here are a few ways to combat this acoustic issue for an improved audio and conversational atmosphere.

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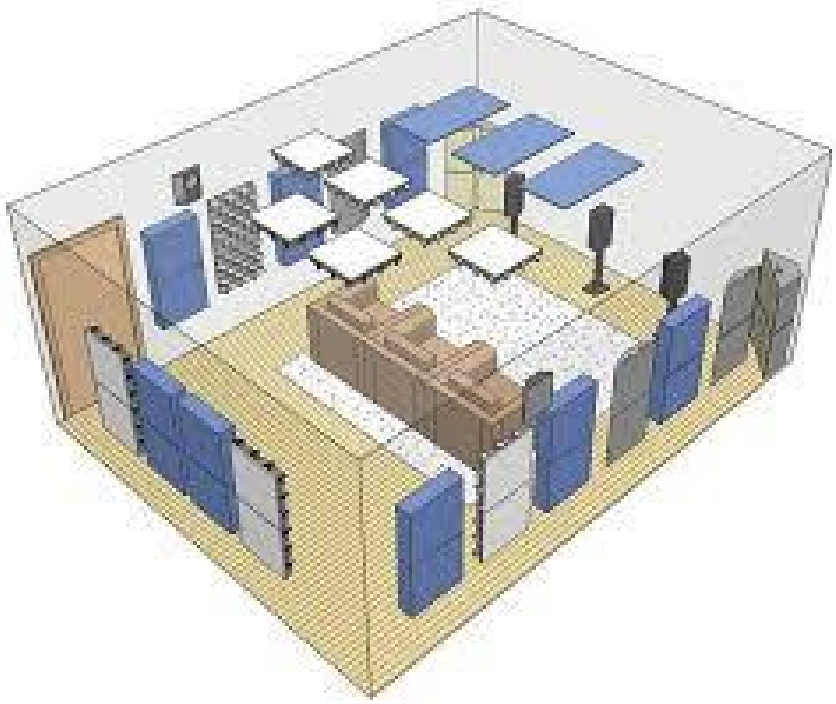

Two opposing walls can allow sound waves to reflect back and forth in a repetitive manner, resulting in a blurred, out of focus, and delayed interior sound. Tall ceilings and long rooms can further increase these distinct echoes, affecting conversations or enjoying music or television at

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home. But with a little thought and careful placement of the following solutions, you can tame the distracting sounds and create a more peaceful space without the echoing.

1. **Hang textiles and wall art on parallel walls:**A large canvas painting or cloth textiles will add a little sound absorption to combat echo. Positioning soft surface items on parallel surfaces will especially help disrupt the ability of sound to bounce back and forth between adjacent walls. One additional note before choosing wall art: heavy oil paint can resemble a hard surface when dry and cause reflection and diffusion.
2. **Use a tall bookcase and add objects to the room:**A large bookcase accessorized with various sized objects can soften/dampen echoes by forcing sound waves to bend around, diffusing and scattering sound throughout the room. Placing books on a bookcase at different depths also enhances this diffusion effect, thus breaking up the flutter of echoes.
3. **Add an area rug on to bare floors:**Floors made of concrete, tile, or hardwood can also act as a reflective surface. Using an area rug not only adds warmth and accents decoratively, but the softer surface is especially useful in reducing echoes in rooms with tall ceilings.
4. **Use acoustic panels to enhance sound absorption:**Traditional acoustic foam panels can be very effective at reducing sound from reflecting back and forth. Acoustic art carries Custom art, text or photography onto materials specifically designed to reduce noise transference and room echoes. A solution is to cut and install foam sheets to place inside the back of canvas mounted artwork; soft foam sheets are often packed while shipping. Foam of various sizes can also be ordered online from speciality retailers like Foam by Mail.

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An example of Acoustic Art panels with decorative designs

Summary

A flutter of echoes can make any space feel clinical, cold and uninviting. Treating your room with smart acoustic choices like the ones can improve understanding movie dialog, clarity of music from the stereo, and most importantly, keep conversations easy and comfortable. Audio Video equipment and control, speakers, projector, projection screen, AV equipment rack, etc. are reviewed to determine physical and aesthetic integration into the room design without compromising visual and acoustical performance of the space.

Bibliography

[1] Morfey, Christopher (2001). Dictionary of Acoustics. Academic Press. p. 32.

[2] Sabine, Wallace Clement (1922). Collected papers on acoustics. Harvard University Press.

[3] Templeton, Duncan (1993). Acoustics in the Built Environment: Advice for the Design Team. Architectural Press. ISBN 978-0750605380.

[4] Christo Ananth, S.Silvia Rachel, E.Edinda Christy, K.Mala, “Probabilistic Framework for the Positioning Of a Vehicle in a Combined Indoor-Outdoor Scenario”, International

Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE), Volume 2, Special Issue 13, March 2016, pp: 46-59

[5] Glen Ballou& Howards Sams, editors. "Handbook for Sound Engineers", page 56.

[6] Stewart, William (2007). "Perforated metal systems as sound absorbing surfaces" (PDF). February.

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