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Roundtable
The New Era of Show Choir

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Report: Acoustics

Five Key Acoustical Concepts for Choral Rehearsal Rooms

By Denny Meyer

Excellent choral performances are rooted in effective choral rehearsals. While both require supportive acoustics, rehearsal spaces merit special consideration because a choir typically spends the majority of its time there.

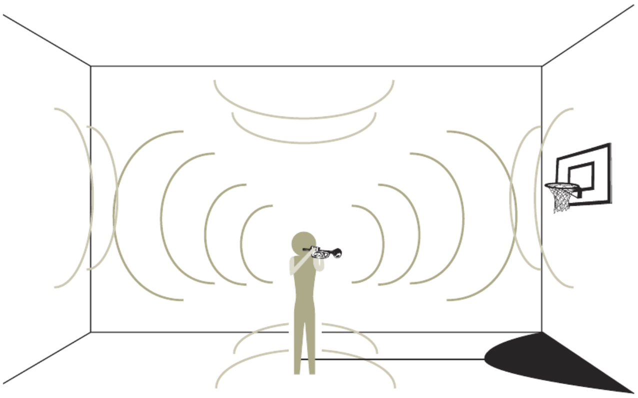
Understanding five key acoustical concepts and their relevance can help you maximize the positive impact your rehearsal space has on your choir. If your rehearsal room currently has any acoustical shortcomings, learning to articulate them can be the first step in finding a solution.

1 Reverberation: Maintaining Sound in the Room

Concept: Reverberation – the persistence of sound in an enclosed space – affects the character and quality of music. It's measured in seconds, from when a sound is generated to when it becomes inaudible. Room size and the absorptive characteristics of interior surfaces affect reverberation, along with the absorption provided by people, chairs and other furnishings. When cited as a single number, a space's reverberation is the time it takes for a sound to decay by 60 dB. Smart phone apps can take approximate measurements of decibel levels.

Relevance: Excessive reverberation can interfere with accurately hearing definition and detail. Typically, this is more of a problem with instrumental rehearsal rooms than with choral rooms. The average human voice generates less sound energy than most musical instruments, so choral rehearsal rooms often require additional reverberation to help the sound produced stay in the space and be heard.

Ideally, choral rehearsal rooms have up to 1.3 seconds of reverberation time, compared to 0.8-1.0 seconds for band/orchestra rehearsal rooms. A rehearsal space with inadequate reverberance may have too much carpet, drapes, or absorptive acoustical panels on the walls and ceiling. Inadequate cubic volume, often attributed to small rooms or ceilings less than 10 feet from floor to structural deck, can also limit reverberation.



2 Cubic Volume: Dissipating Loudness

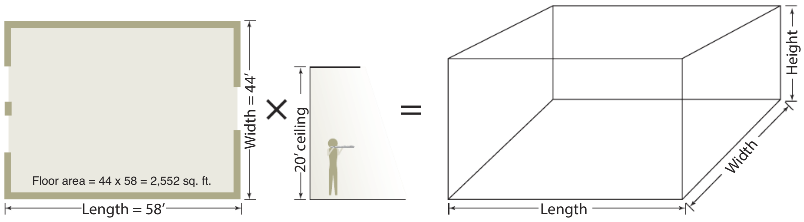
Concept: A rehearsal room's cubic volume is the floor area (square feet) multiplied by the ceiling height (feet). For example, a 44-foot by 58-foot rehearsal room with a 20-foot ceiling height has a cubic volume of 51,040 cubic feet (44' x 58' x 20').

Relevance: Cubic volume is the single biggest factor affecting rehearsal room acoustics, for better or for worse. Cubic volume is often insufficient, frequently caused by low ceiling height. Adequate cubic volume helps dissipate loudness while providing an area large enough to slightly delay sound reflections off the walls, floor and ceiling. This delay allows the human ear and mind to process the sound, resulting in an ability to accurately hear the entire spectrum of musical sound and generating the "presence" cited below.

The ideal rehearsal room size is somewhat dependent on ensemble type and size, but should provide musicians with enough room to move about and sufficient cubic volume to handle the sound they produce.

For a choral rehearsal room designed to accommodate 60 to 80 students, we recommend a ceiling height of 16 to 20 feet and floor space of 1,800 square feet, resulting in 350 to 500 cubic feet per musician.

To help ensure sufficient cubic volume, portable choral risers offer an important advantage over poured concrete tiers. When the space under portable risers is left open, the room's cubic volume is not reduced. Portable risers also offer the flexibility of a flat floor for various activities like choreography and show choir.



The space under risers in the choral room at Charleston (N.C.) County School of the Arts is left open, so the risers do not reduce the room's overall cubic volume.

3 Absorption: Soaking Up Sound Energy

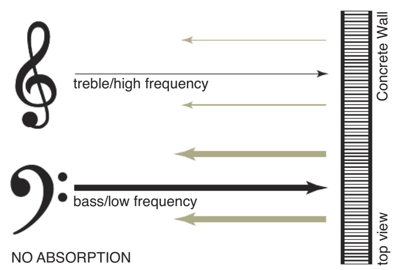
Concept: Absorption is the reduction of sound energy that occurs when it contacts surface materials. Hard, solid surfaces like concrete reflect most sound energy back into the room, providing little absorption but a lot of reverberation. When sound energy hits thick, fibrous surfaces, it attempts to pass through the material and essentially loses energy by friction.

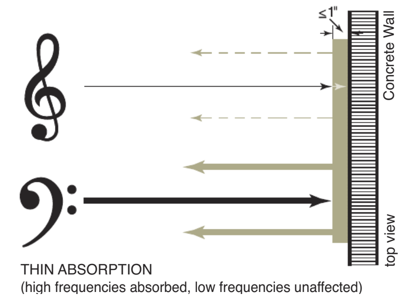
It is critical to understand that the absorptive material's physical nature, such as porosity and thickness, determines the level of absorption and sound frequencies affected. Lower frequencies have a longer wavelength and more energy, so they require thicker absorptive materials with large surface areas. Absorption of musical sound is more difficult than absorption of speech because music spans a much broader frequency range.

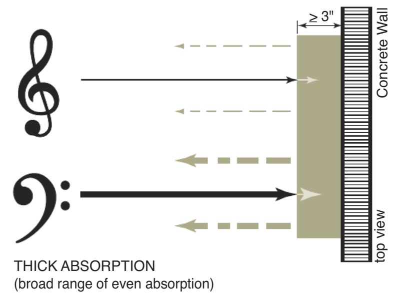
Relevance: Rooms with little or no absorption can be overly loud, making hearing difficult. Excessive reverberation also makes clarity difficult because the truly balanced sound required for critical listening is lacking. In many cases poor absorption causes acoustical anomalies such as flutter echo: a prolonged buzz caused by sound energy bouncing between parallel hard surfaces.

Ineffective sound absorption is one of the most common mistakes found in rehearsal rooms. For example, to control loudness, thin, one-inch absorbers or carpeting are sometimes applied to the walls or floor. While they may be effective for speech absorption or give the impression of a quieter space, these solutions only strip out high frequencies, leaving middle and low musical frequencies unaffected. The result is a room that sounds boomy, distorts tone colors, and is a poor environment for critical listening.

To absorb sound equally across all frequencies, acoustical consultants usually recommend a treatment of absorber panels







The absorptive characteristics of interior surfaces affect reverberation, along with absorption provided by people, chairs, and other furnishings.

on the walls, typically constructed of pressed fiberglass. The thicker the panels, the greater the absorption; panels should be three inches thick, at a minimum. For ceiling tiles, one-inch-thick fiberboard panels are recommended.

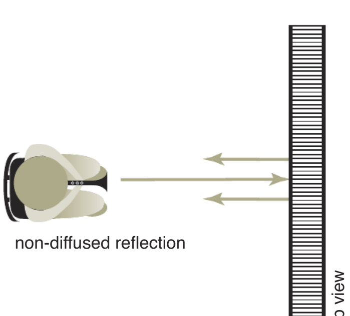
For effective critical listening, sound absorption must be used in conjunction with properly placed reflection and diffusion.

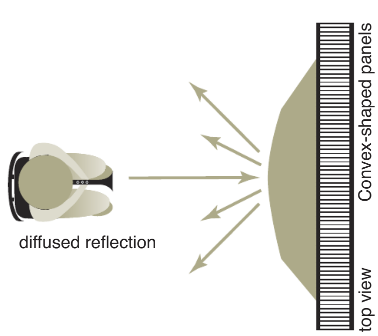
4 Reflecting and Diffusing Sound: Spreading Sound Around

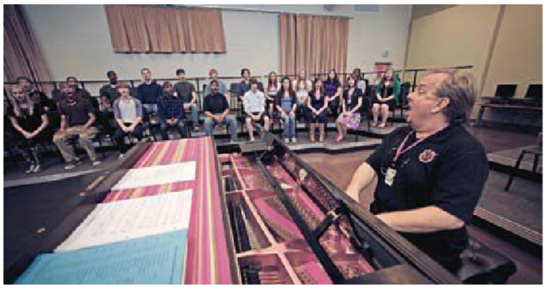
Concept: The concepts of reflection and diffusion go hand-in-hand with, and in some ways are opposite to, absorption. Reflection occurs when sound strikes a hard, dense surface and is reflected at the angle of incidence, like shining a flashlight into a mirror. Diffusion occurs when the shape of a hard surface scatters and redirects the sound so that it is heard in other parts of the space, like shining that same light at a mirrored ball.

Relevance: A good choral rehearsal room should have ample diffusion so that all sound can be clearly heard throughout the space. This allows an individual singer in an ensemble to hear all of the other voices. In performances, diffusion helps audience members hear accurately. Historic theaters, for example, often feature extravagant plasterwork and ornamentation with irregular angles and curves. Along with offering aesthetic benefits, these architectural features enhance diffusion by creating acoustically reflective surfaces.

While absorber panels reduce loudness, diffuser panels on the walls and ceiling help blend sound. For music spaces shared by a variety of ensembles, including rehearsal rooms or recital halls, adjustable acoustical panels are also widely available. These panels can provide either absorption or diffusion, enabling the room's acoustics to be tuned to suit each ensemble, even varying from one class period to the next.







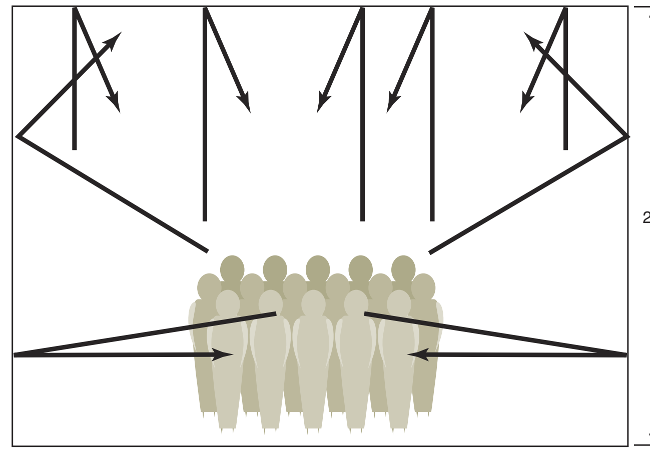
Delayed sound reflections allow the human ear and mind to better process and hear the entire spectrum of musical sound.

5 Musical Presence and Envelopment: Feeling Immersed in Sound

Concept: "Presence" is a general term musicians use to describe the positive acoustic attributes of a space. When a choral rehearsal room has "good presence", early sound reflections from walls and ceilings are returned to the singers' ears in approximately 30 milliseconds. "Envelopment" is a similar term used to define the characteristics of larger spaces, with lateral reflections from side and back walls returning to the ear approximately 80 milliseconds after the direct sound. Envelopment is the sense of being immersed in, or surrounded by, the music.

Relevance: When musicians can hear their sound "out in the room" it allows them to better focus on phrasing, intonation, and communication with other musicians in an ensemble. Rooms with presence and envelopment simply feel more supportive and can be more musical.

While the proper installation of acoustical panels can help with both presence and envelopment, these qualities are still often lacking from rehearsal spaces. Most music educators would agree that the best place for a musician to practice is where they'll be performing. Just as tennis players practice on the court, musicians practice most effectively onstage. At many schools, however, this is impractical due to logistics and scheduling factors.



With advancements in computer technology, one solution is digital signal processing equipment that simulates performance-area acoustics inside a rehearsal room, including presence and envelopment. "Virtual acoustics" can ease the transition from rehearsal to performance – students can focus more on the skills and habits they've developed in rehearsal and less on an unfamiliar performance area.

The choral room at Muskego (Wis.) High School.

"Rooms with presence and envelopment simply feel more supportive and can be more musical."

Further Reading

One article cannot provide an exhaustive, technical resource on the physics of sound and its application to choir rooms. Improving the acoustics in your rehearsal room may also require input from an acoustical consultant. The efforts you make today will be rewarded with better rehearsals and ultimately better performances.

Denny Meyer is an acoustics product manager at Minnesota-based Wenger Corp., a manufacturer of products and services for music education and performing arts markets around the world. He has made numerous presentations on music facility planning at national and regional conventions during his 30-year career with Wenger. Meyer played a key role in developing the company's Acoustics Primer, *on which this article is based, along with the* Planning Guide for Secondary School Music Facilities. *He can be reached at denny.meyer@wengercorp.com.*

Additional Resources

Musician's Acoustics; by Scott E. Parker and Jamison A. Smith; 2013 by CreateSpace Independent Publishing Platform; ISBN-10: 1482566338.

Architectural Acoustics; by Marshall Long; 2013 by Elsevier Academic Press; ISBN-10: 0123982588.

Architectural Acoustics; by Christopher N. Brooks; 2003 by McFarland & Company; ISBN-10: 0786413980.

Deaf Architects & Blind Acousticians? A Guide to the Principles of Sound Design; by Robert E. Apfel; 1998 by Apple Enterprises Press; ISBN-10: 0966333101.