Tips for Understanding and Maximizing the Acoustics of Your Ensemble Rehearsal Space

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Ideal Rehearsal Space Acoustics:

When rehearsing for a performance, our ability to perceive the sound we produce is crucial. Making appropriate evaluations and adjustments during rehearsal time depends entirely on reliability and accuracy of the acoustic feedback we receive. Therefore understanding the aspects of acoustic environments, the factors that affect our rooms acoustics, and methods for adjusting them when needed is crucial knowledge for any musician, especially an ensemble director. This pamphlet will present an overview of key terminology, guidelines for room acoustics, and problem-solving methods to help you develop awareness for how the characteristics of a room affect your perception of sound.

After several years of experience performing, directing, and listening to music we develop strong preferences regarding acoustic spaces. Some performers may even be able to instinctively adjust their approach based on how 'live' or 'dead' a performance space sounds. Regardless of personal preference, the most effective acoustic space for rehearsal allows for the director and the musicians to clearly hear themselves and others without extensive exposure to high sound pressure levels or disturbing sound from outside the room.

Key Terms for Evaluating the Acoustic Quality of a Room:

Musicians with experience performing in a wide variety of environments likely have developed vocabulary to describe the feedback of the space. For example, It's very common to hear rooms described as acoustically "live" or "dead." The following section will present technical term analogy from research they can help you pinpoint the specific qualities acoustic qualities of a room.

Direct Sound:

Direct Sound is the sound that a listener receives directly from the sound source.

The ***perceived loudness*** of a sound is affected by distance. Each time the distance is doubled, the perceived loudness is decreased by 6 dB (Backus, 1977).

Reflection:

A ***reflection*** is the sound that a listener receives after it has bounced off a surface.

Reflected sounds are always at least slightly weaker than direct sounds.

Reverberation:

*"**Reverberation*** is the persistence of sound in a room because of continuous reflections of sounds at the walls once the sound source is turned off. Reverberation depends on the size and shape of the room and on the frequency of the sound" (Kamichik, 1998, pg. 85)

"***Reverberation Time*** is the time in seconds for the sound pressure to decrease by 60 decibels of its original value after the sound source is turned off" (Kamichik, 1998, pg. 86). Rooms with too little reverberation time may not seem to be loud enough, but rooms with too much reverberation time may have echoes.

Reverberant sound is the sound a listener hears after a reflection.

Echo:

Echoes are reverberations the strike the listener at long intervals. "An ***echo*** is heard if the reflected sound reaches the listener at least one-tenth second after the original sound reaches the listener. Sound travels 110 feet in one-tenth second; therefore, the reflecting sur- face must be at least 55 feet from the sound source to produce an
echo" (Kamichik, 1998, pg.92).

Sound Absorption:

Sound Absorption describes the conversion of sound energy into heat and kinetic energy. “Draperies, carpets, suspended space absorbers and moveable absorptive panels can be used to absorb unwanted sounds in rooms and buildings” (Kamichik, 1998, pg. 89). When a sound comes in contact with absorbent material the intensity of the reflection is greatly reduced.

Sound Distribution:

Sound distribution describes how the sound pressure level varies with the position in a room (Kamichik, 1998, pg. 90). Rooms with “dead spots” have highly uneven sound distribution.

Learning about the Sound in Your Current Room:

You can get to know the acoustic quality of your current rehearsal space through a few simple techniques.

Calculating Reverberation Time:

Reverberation time for room can be estimated by accounting for the volume of the space and the absorption level of the materials.

Reverberation Time = Constant of Proportionality (0.049) x [Volume of the Room (in feet^3) / Absorption of the Room (e.g openings or absorbent materials) (in feet^2)

Measuring Reverberation Time:

In some cases it's easier to *measure* the reverberation time of your rehearsal space.

This can easily be done through the use of a sharp sound (e.g. clapping, popping a balloon). Simply begin the stopwatch at the exact moment of sound and stop the stopwatch when the reverberation becomes in audible. This can also be accomplished by recording sound and analyzing the wave file on a computer program (e.g. Protools, Audacity).

Aspects of Room Design and their Effect on Perceived Sound:

The acoustic environment of your rehearsal space is affected by a number of factors:

Total Volume:

The most important factor in affecting reverberation time and sound distribution is total volume. Setting aside differences in absorption, larger spaces have longer reverberation times and reverberation intensities.

Room Shape:

The shape of the room, as dictated by the height of the ceiling, will also have a tremendous effect. However, spaces with large floor area and low ceilings will cause your proximity to the sound source to have a large affect on its perceived loudness. In such a room standing closer to one section of your ensemble then the other will affect your ability to accurately perceive balance (Adams, 1996).

On the other hand ceilings that are too high are also problematic. Ceilings that are too far away from the sound source severely play reverberation time and can result in echoes. In many cases, “Good rehearsal-room design dictates a minimum ceiling height of 14 to 16 feet (18 to 20 preferred), but no higher than 22 to 24 feet” (Adams, 1996).

Flooring/Carpeting:

The flooring of the room will have a considerable effect on the perceived sound. Heavy/thick carpet will absorb much of the sound produced by the ensemble and increase the effect distance has on perceived loudness (i.e. as the distance from the sound source is doubled the perceived loudness will decrease by *more* than 6dB) (Backus, 1977). Ideally, rehearsal spaces will have hard floors with no carpet or very thin carpet.

Reflecting Surfaces:

The absorption and placement of reflecting surfaces in a room will have large effects on reverberation time and sound distribution. Draperies, bookshelves, upholstery, and in-use storage shelves are notorious absorbers of sound. Ironically, thin hard surfaces like windows or plywood walls are also strong absorbers of low frequency sounds (Sundberg, 1991).

The shape and direction of reflectors (e.g. Walls and ceiling) affect the distribution of sound within a room. To create an event distribution, a room should have many smaller reflectors angling in different directions.

Occupants:

One of the most frequently overlooked influences on room acoustics are the occupants. The presence of an audience has a tremendous effect on our rooms reverberant quality because each body acts as an absorber of sound (Sundberg, 1991). The effective of This absorption becomes more apparent In halls that seat large audiences or and rehearsal spaces with a large number of players/singers present.

Guidelines for Modifying a Rehearsal Space to Improve the Acoustics:

In almost every situation, there are techniques you can employ to modify the acoustic qualities of your current rehearsal space. This section presents best practices and possible solutions to common problems.

Director Perspective and Ensemble Placement:

In any rehearsal space, the placement of the ensemble and the placement of the Director will have a tremendous impact on the sound the musicians perceive.

Students/performers should be placed within 7m of each other. "As sound travels through air at a rate of about 3 m/msec, it will reach about 7 m during these 20 msec. Therefore, players seated more than 7 m apart may run into synchronization problems in playing, at least if they cannot see each other"(Sundberg, 1991, pg. 183).

The director and the students should be placed with 34 m of reflective surfaces. "The reflections arriving within the first 100 msec after the direct sound produces a clear and distinct character, and they enhance speech intelligibility. The reflections arriving later than that have the opposite effect. They make the sound unclear, jumbly, and muddy…
In 100 msec the sound travels about 34 m in air. This means that all reflecting surfaces are advantageous that offer a straight-line travel distance from the source to the listener that is no more than 34 m long." (Sundberg, 1991, pg. 180) For example, in situations where a small group will perform on a relatively large stage, placing reflectors behind the ensemble or hanging reflectors from the ceiling help improves the musicians' perception of their sound.

(Pictured: Legacy Shell by Wenger)

Be mindful of the effects of setting up close to a front wall. If the wall is close and highly reflective, it will cost the members of the ensemble and the director to perceive the sound as much louder than they would in an open ended performance space. To avoid this effect add absorption to the wall behind the director with specially designed materials or storage.

Reducing the Reverberation Intensity in your Space:

Many rehearsal spaces are simply too loud and reverberant. This is common when rehearsing groups with loud instruments in a small space with many highly reflective hard surfaces.

To reduce sound intensity and reverberation time, use strategic placement of sound absorbers. Amazon.com offers several sound absorbing panels , usually comprised of dense foam or fabric materials, that would be ideal for this purpose. You can also reduce reflections by placing common materials such as curtains, full-clothing racks, or bookshelves in front of large reflecting surfaces.

(Pictured: TroyStudio Acoustic Studio Absorption Foam Panel, 12 X 12 X 2 inches from Amazon.com)

Increasing the Reverberation Time/Intensity in your Space:

In other rehearsal spaces, the sound will be too “dead” or quiet, and be unevenly distributed. This is common in rehearsal spaces with large surface area and low, highly-absorbent ceilings.

To provide evenly responsive feedback to an ensemble you may need to use electronic assistance. A common example of this technology is a stage monitor, which directs amplified sound back to musicians on a large stage. Though these systems can be somewhat expensive, several commercial systems are available for this purpose.

(Pictured: VAE Rehearsal System by Wenger)

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