Gymnasium

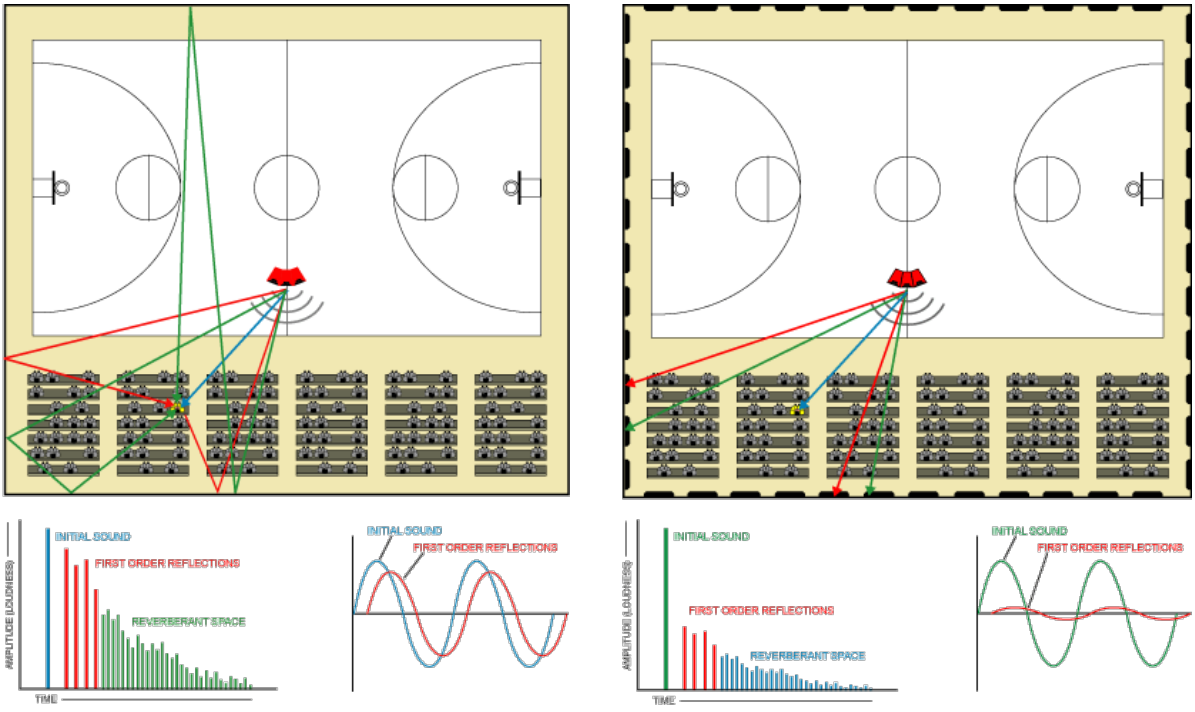
Walk into a gymnasium and you can hear the echo from your footsteps as the sound ricochets off the floor, walls and ceiling. In some gyms, the echo can last as long as 10 seconds! The excessive reverberant field is the primary reason gymnasiums are one of the most challenging spaces of all in which to deploy a sound system.

More often than not, these spaces must not only perform as a sports venue, they are often imposed upon to be used as an assembly hall. This means that there must be sufficient acoustic treatment to subdue the reverberant field so that reasonable intelligibility can be achieved. The acoustic panels must seamlessly integrate with the surroundings, both from an esthetic and a practical point. For instance, the acoustic panels must be able to handle the abuse from soccer balls, basketballs, and all other forms of projectiles that will surely be launched by students during playtime.

The ultimate goal in a gym is to increase the intelligibility of the sound system while ensuring that the installation address the hazards that will surely come into play.

Defining the problem

If we look at a typical gymnasium, sound from the public address system is aimed at the audience. The voice in amplified as a means to be loud enough to overpower the crowd. Sound reflecting off hard surfaces generates first order and secondary reflections causing a cacophony of echo. The brain must at once attempt to understand what is being said, while trying to ignore crowd noise and the reverberant field. As the sound system level is increased, the room becomes over-excited, the problem gets worse and more often than not, squealing feedback is introduced.

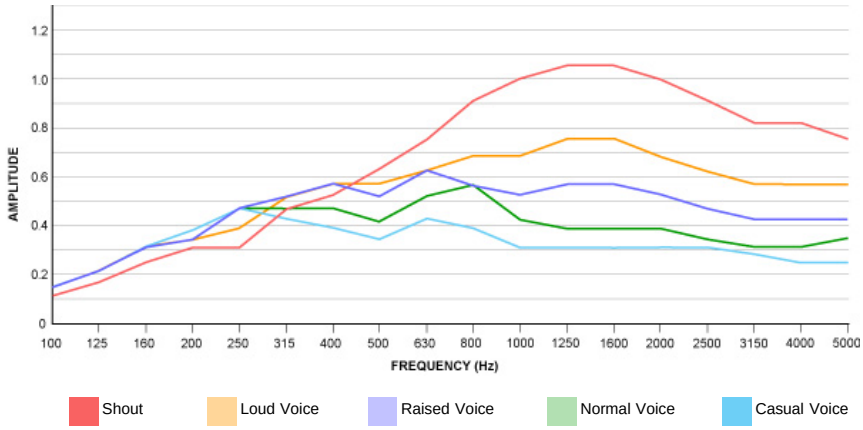


The fundamental solution is simple: put up as many absorptive acoustic panels as budget permits. These are usually distributed on the wall surfaces or suspended high, up in rafters. Once panels are in place, echo is greatly reduced. For speech, a reverberant time of less than one second is preferred.

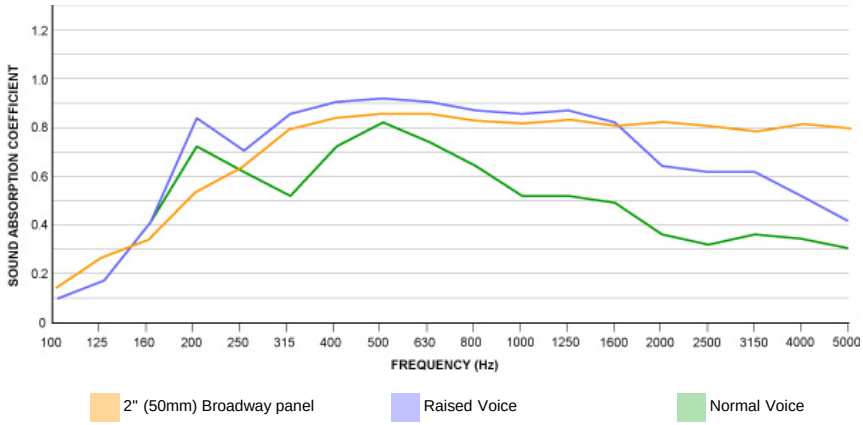
Managing the acoustics

The graph below shows the frequency response of a voice at various levels. At the upper limit is the sound of kids screaming and yelling during play. Notice how the energy tends to peak in the upper mid range around 1500Hz. The good news is that high frequencies are much easier to control than low frequencies and simply adding acoustic panels will help attenuate the problem.

The challenge is that today's gymnasiums employ full range PA systems. These are not merely reproducing high frequencies like old bell horns, but these full range systems are capable of amplifying bass as well. This means that we need to focus the acoustic treatment on absorbing the frequency range of a 'normal' spoken voice of a principle or the 'raised' voice of an enthusiastic announcer.



Most of the energy in a human voice ranges between 250Hz and 2000Hz with the 'hot spot' between 350Hz and 1Khz. The human ear is most sensitive to this range as this is where we communicate. It is therefore important that when we are selecting an acoustic panel, the acoustical performance provide adequate absorption in the critical voice range. By superimposing the frequency range of the human voice on top of the absorption coefficient of a Broadway 2-inch panel, we can immediately see how the two will interact. As shown, the Broadway 2-inch panel is ideally suited to absorb energy in the voice range. The absorption will of course will be determined by the number of panels in the room and relative loudness of the PA system.

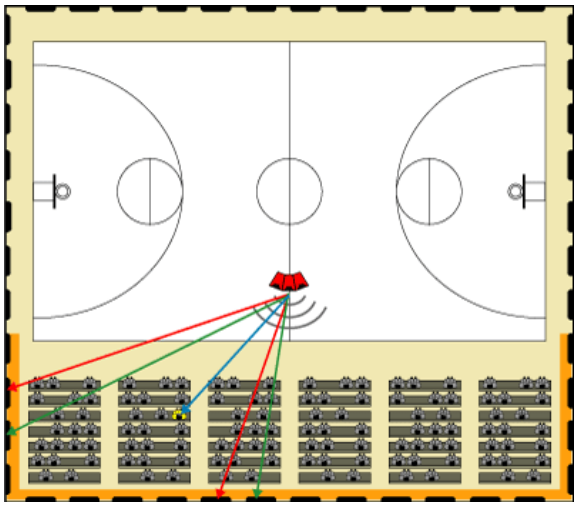


If we then compare the absorption of a Broadway panel to other types of absorbers, we can easily make an informed decision on what type of acoustic treatment will be most effective for the planned outcome. This graph compares Tectum™ hard board and Sonex™ melamine foam with a Broadway panel. At 500Hz the Broadway shows 100% efficiency while the others only show 60% and 80% respectively. This performance varies even more drastically down around 350Hz where the Broadway is till providing 95% absorption while the other two fall to 50% or less. This basically means that you would need twice as many of the competitor panels to absorb the same amount of low frequency energy as the Primacoustic Broadway. (Data derived from each company's published specifications)

Panel Placement

While bass is omni-directional meaning that is goes everywhere, mid and high frequencies above 300Hz tend to beam like a flashlight. Because sound in the voice range is in this region, it tends to be directional. This means that we can predict where sound problems will be by drawing vectors from the sound source to the hard surfaces that will cause first order reflections.

Common sense tells us that the more panels we put up, the more echoes we will absorb. This in fact follows what is known as the acoustic bell curve. Ultimately, panel placement comes down to available budget and then strategically placing the panels where they will be most efficient. Because most schools are given yearly capital budgets, a common practice is to create a two or three year budget whereby acoustic treatment will be implemented in stages.

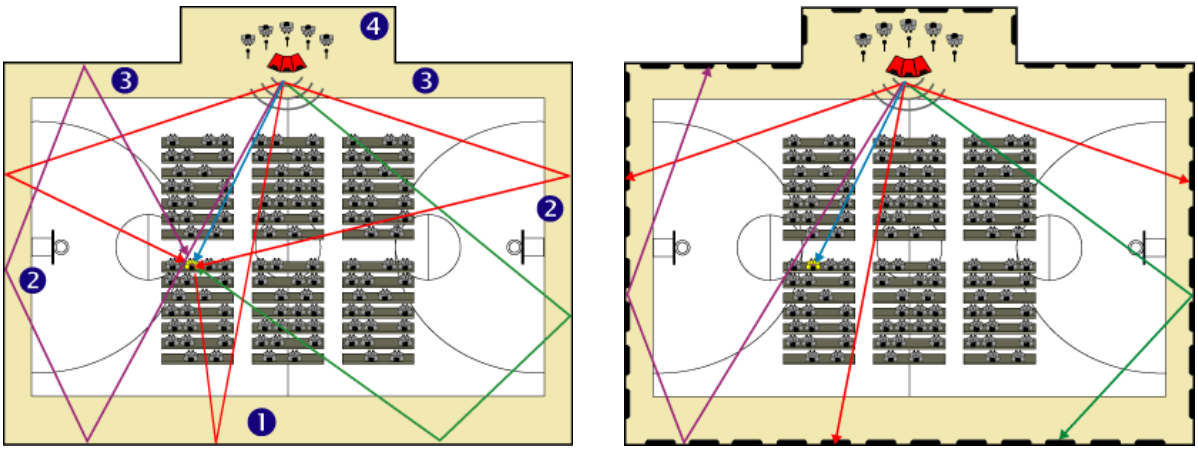


The seating area (orange) is the first area you would want to acoustically treat as this will improve intelligibility while also reducing the sound from the PA system from reflecting off the back walls and exciting the room. Try to position the panels away from damage and dirty hands as this will reduce maintenance costs. Adding panels around the periphery should then be considered as budgets become available.

Most public schools incorporate some form of stage within the gymnasium. This allows the venue to be used for theater productions, general assembly, concerts and so on. For these facilities, a multi-stage approach is recommended.

Begin by treating the opposite wall where first order reflections will be greatest (1). Then, applying acoustic panels to the long ends of the room (2) where back and forth echo will naturally occur. The next area would be the 'source' wall (3) and finally, the stage (4).

As most production today is 'electrified', feedback on stage tends to be more of a concern than providing ambiance for a vocal choir or violin quartet. Reducing the ambiance on stage with acoustic treatment will allow the PA system level to be increased before feedback. A moderate level on the walls and ceiling will generally work well.



Baffles versus wall panels

Baffles like the Primacoustic Saturna™ or ceiling clouds like the Nimbus™ present very effective forms of acoustic treatment. This is because they hang from the ceiling exposing two sides, thus doubling the absorptive properties as sound reflects off the ceiling. The problem however is that what may look like acoustic treatment to an adult, may look more like a target to a young teen with a soccer ball! In professional arenas or gyms where damage is less likely, ceiling baffles or acoustic clouds are a good choice. These are usually hung in a tic-tac-toe arrangement and suspended high up between the rafters.

The perimeter walls are treated with acoustic panels and placed up near the ceiling where they will be most efficient. To address potential damage caused by balls and other projectiles, Primacoustic has developed a wall-mounted solution called EndZone™. This combines a 2-inch thick standard 24" x 48" Broadway™ panel with a protective metal grid. These of course are intended for areas where ball damage will be most prevalent.

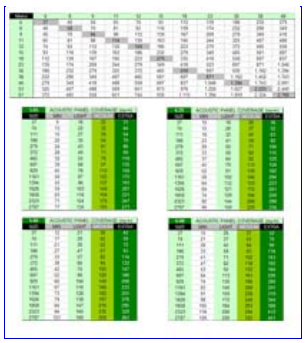
For large wall surfaces, multiple panels may be ganged together using Primacoustic PushOn Impalers. This 'modular approach' eliminates the high cost of shipping oversized panels on a flat bed truck and extra rental costs of heavy duty equipment required during installation.

Achieving acceptable intelligibility in a gymnasium is not difficult. It is merely a matter of looking at the budget and identifying the hot spots in the room. As one would expect, the more acoustic panels you put up, the greater the absorption and better the acoustic space will become.

Determining Coverage

To determine the coverage, we have created a series of easy-to-use tables that enable you to choose between various degrees of treatment depending on your budget and the desired outcome. Most facilities find that a 'light' level of treatment provides sufficient sound abatement while keeping the budget in check. If budgets are tight, start with minimal treatment and then add more panels as funds become available.

Room Calculation Tables in Feet Room Calculation Tables in Meters



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