PRIMEACOUSTIC

https://www.primacoustic.com/

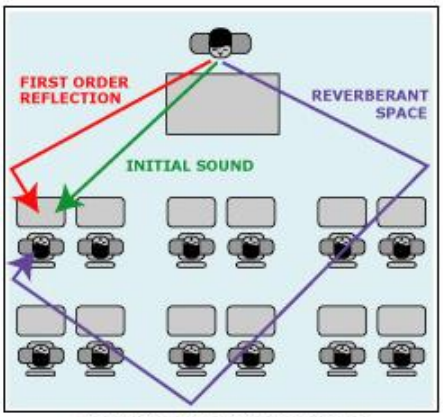
This overview discusses how Primacoustic panels work, how to select the right one for the job, basic guidelines on where to use them and how they compare to others that can be found in the market. This web page is not intended to turn you into an expert, but it will provide a general understanding of the science involved and how to apply it.

Why Control Sound in the First Place?

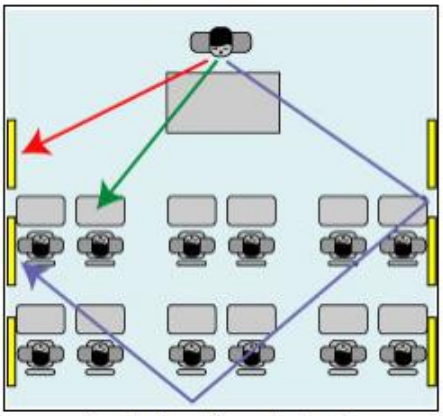
In general terms, controlling sound is all about improving intelligibility or our ability to comprehend what is being communicated. Or more simply stated: taking the clutter out of the sound so that you can clearly hear the message. In a church, this may be the spoken word. In an airport, it may be flight announcements. In a factory, it may have to do with safety paging. In a hotel lobby or restaurant, it may simply be an attempt at controlling the reverberant time to make communication between patrons more comfortable. And in a recording studio, controlling the acoustics allows us to create a predictable outcome so that the recording will translate to other audio systems with relative confidence.

Without treatment, sound will echo off the walls, floor and ceiling and reach a point where the room's ability to handle and dissipate energy has been exceeded. For instance, a teacher quietly speaking in a classroom is very different than one yelling above a room full of excited kids. Once the room's natural threshold is exceeded, conversation and communication require much more attention. This causes an effect known as 'ear fatigue' – whereby we have to work hard at listening and speak louder to be heard in an attempt to overpower other competing sounds.

These competing sounds are called reflections. They can be powerful primary or first order reflections that echo off nearby surfaces or be secondary reflections that create a reverberant field. Controlling the ambiance or reverberant field is generally done by mounting acoustic panels on the walls or hanging them from the ceiling. Adding sound absorption to a room can easily turn a dreadful sounding space into one that is comfortable, quite effective for communication. The following are common types of echo:



Sounds from reflections compete


Sound absorption controls echo

Direct Sound
The direct or initial sound is the sound coming from your mouth, the instrument being played, or from the loudspeaker. ***This is the message that is being communicated and usually the most important.***

Primary or First-Order Reflections
These powerful reflections occur as sound echoes off nearby walls. Because they usually arrive a few moments after the direct sound, they can interfere causing what is known as phase cancellation or comb-filtering and can make hearing what is being said difficult. Controlling first order reflections is usually the first plan of action. ***Reducing the reverb decay time is usually a matter of increasing the amount of absorption in the room. The more panels you put up, the more energy you will absorb. While classical music benefits from a long reverb, communication via spoken word vastly improves with shorter decay times.***

Flutter Echo or Room Chatter

Clap your hands in an empty room and you will hear the sound ricochet off the walls, ceiling and floor. Flutter echo is mostly caused by reflective parallel surfaces that allow the echo to sustain itself. ***Reducing flutter echo is easily done by placing panels on opposing parallel walls in such a way that the echo cannot sustain itself.***

Secondary Reflections or Reverberation
This is the long trailing echo that you can hear in an old church. Back before the modern public address system, churches were designed with long reverberation to carry the voice. This is particularly effective when listening to choirs or Gregorian chant. Classical music also benefits from a long trailing reverberant field as it allows the instruments to excite the room. ***Controlling the reverberant time is usually a matter of increasing the amount of absorption in the room. The more panels you put up, the more energy you will absorb. Acoustic music or singing voice benefits from long reverb while communication via spoken word is best with shorter times.***

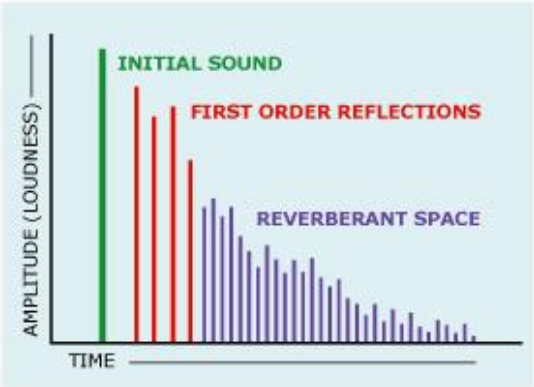
Sound Absorption… a Thermo Dynamic Transfer

When loud music is playing, place your hand on the loudspeaker, floor, nearby furniture or even a window and you will feel the vibrations. Sound energy travels through air, solids or liquids in the form of vibrations and when the medium is set into motion, it inevitably generates heat. Sound absorption is in fact an energy transfer function. The scientific term for this occurrence is called a thermodynamic transfer.

When sound penetrates a Broadway acoustic panel, it causes the minute glass wool fibers in the panel to vibrate. The same thermodynamic transfer occurs only this time, it is very efficient due to the minute size of the glass strands and their ability to vibrate freely with very little energy. By distributing acoustic panels around the room, the echo is quickly attenuated.

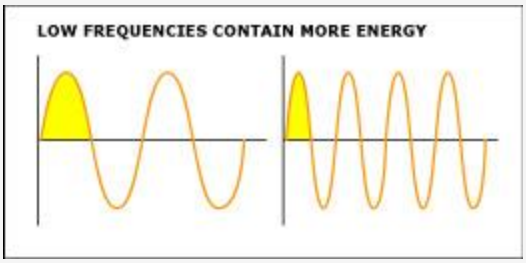
In the world of acoustics, bass or low frequencies are difficult to control due to their long wavelengths. With enough power, bass will pass through just about anything. This means that it not only requires more energy to generate bass *(think elephant versus mouse)*, it is a lot tougher to stop it once it gets going *(think trying to stop a freight train versus stopping a bicycle)*. High frequencies are much less of a problem as the shorter wavelength is much less powerful.

The easiest way to absorb low frequencies is to increase the thickness of the panel. One can predict the required thickness of an acoustic panel by employing ‘quarter wavelength’ calculations. But actual acoustic testing generally delivers surprising results. Unless the panel is sufficiently dense, bass will pass right through. This is the problem with low density foam; it is ineffective at absorbing bass. On the other hand, if the panel is too dense; the high frequencies will simply bounce off and reflect back into the room.



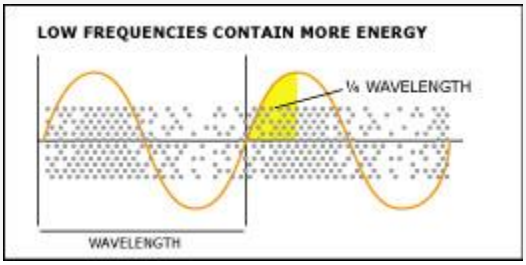
Bass Contains More energy

The two graphs below compare low and high frequencies at the same amplitude. Notice that the longer bass frequency contains more energy as depicted by the yellow area. Since more energy is in the sound wave, bass will be more difficult to contain.



Quarter Wavelength Calculation

The math used to predict the low frequency performance of an acoustic panel is known as the 'quarter wavelength calculation' whereby the thickness of the panel is equal to 1/4 the wavelength of the lowest frequency plus a factor for the angle of incidence. The panel density plays an important role.



Solving the Acoustic Problem

The actual process involved can be simplified into four steps:

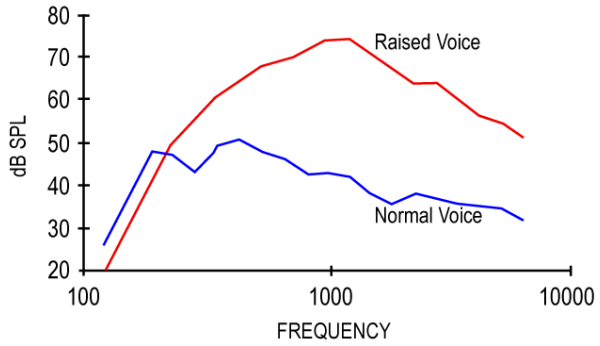
1. Determine the problem frequency range
2. Select the correct acoustic panels to solve the problem
3. Estimate the amount of coverage and budget
4. Install acoustic panels in strategic areas for maximum benefit

First, you need to determine where the problems are in the room by identifying the offending frequency range. In other words, you must ***consider what frequencies you are trying to absorb before you simply put up some panels on a wall and expect them to work.***

For instance, in a studio, it is essential that you balance the absorption throughout the audio range so that the recording will translate well onto other audio systems. In this case, you really want to create a neutral listening environment. In a home theater, you want to both create excitement within the room while assuring that the all-important center channel that carries the dialogue is crystal clear. In a classroom, boardroom or call center, the human voice is being transmitted and therefore your choice of acoustic treatment must properly address this frequency range.

The following graphs show the frequency range of a typical spoken voice and then how the voice energy shifts depending on how loud it is. You will notice that as the voice level increases, the energy increases in the mid band.

If we take a closer look, we can see that most of the energy in the human voice is centered between 300Hz and 1500Hz. It therefore makes complete sense that when it comes time to select the right acoustic panel for the task, that you want to select one that works within this range.



Graph shows range of a typical male voice with much of the energy contained in the mid-range from 400Hz to 1000Hz with harmonics extending to 3500Hz.

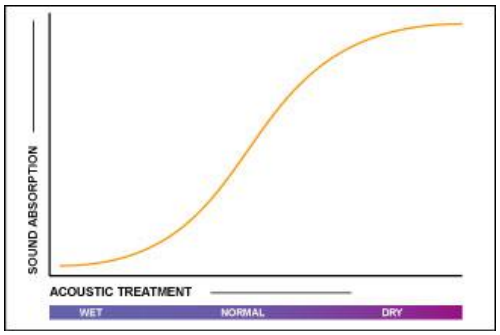
Determining the Coverage

Put one small panel up in a gymnasium and you will likely not hear any change. Put a million panels on the walls and ceiling and the sound will be completely dead. Most room treatment lies somewhere in between. And as simple as it may sound, the more acoustic panels you put up, the more sound you will absorb. This follows what is commonly called the acoustic bell curve.

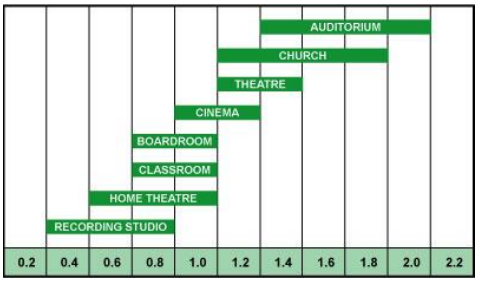
The acoustic bell curve indicates wall surface coverage versus absorption. As the wall coverage increases or number of panels are used in the room, the effectiveness slowly starts to rise. At one point the room begins to transform from a cavernous echo chamber into a comfortable environment. Then, as more panels are added, the effect diminishes and adding panels no longer provides any appreciable benefit. You have reached the top of the bell curve.

There are no absolute rules when it comes to ‘how much coverage will do the job’. For ‘speech’ where maximum intelligibility is desired, acoustical engineers generally specify a reverberant time of less than 1 second. This can be longer in larger rooms. For a classical music concert hall, long trailing reverberation is usually preferred as the instruments combine with the ambiance to excite the room and audience.

The amount of coverage comes down to application, common sense and preference. For instance, if you are treating a studio, you may prefer to mix in a livelier environment. On the other hand, if you are treating a house of worship that switches between spoken word and a lively rock band, you may find it beneficial to have more sound absorption. The wonderful thing about acoustics is that you really cannot go too far wrong. Start with 10% to 20% coverage. If you are not satisfied, simply add more. It really is that easy.



The Acoustic Bell Curve



Common reverberation times in various spaces in seconds

Fire and Safety

Another area that should be of concern is fire and safety. This primarily applies to commercial spaces where people gather or work. Be aware! There are all kinds of misinformation regarding panel fire safety in the market and on the web. For the most part, fire safety is a matter of regional jurisdiction by local government bodies and these will have specific requirements when it comes to putting materials such as acoustic panels on wall surfaces. If you are unsure, always check with your local building authority or insurance underwriter for details.

In the United States, the ASTM E 84-05 test is used to verify smoke development and flame spread. In Canada, a similar test is employed known as the CAN/UL-S102-03. Each test is slightly different which means that one must perform each test independently. In fact, new regulations require these tests be performed three times to average the results. If the tests show a flame spread below 25 with a smoke development under 450, the panel is designated as Class-A or Class-I. The following table shows the classifications and the corresponding test requirements.

Foam manufacturers will often point to a C-117 classification. This in fact is a spec that was developed by the State of California to use foam padding in bedding and chairs. It has nothing to do with using foam in construction or as sound absorption in a commercial building. One ‘very creative’ manufacturer has gone as far as using an obscure Christmas tree lighting test to ‘prove’ their ‘plastic’ urethane panels are safe. These tests tell you that the product may contain some form of fire inhibitor, but they should in no way be ‘assumed safe for use’ in public places. ***Always consult the local building authority or your insurance underwriter to ensure your acoustic panel installation will not put you in harm’s way.***