



GET THE ROOM RIGHT

FIRST

U N D E R S T A N D I N G A C O U S T I C S



by Doug Gould, Worship MD

I teach at a lot of workshops and conferences, and I'm often asked by church techs and pastors, "How can we improve the overall sound in our sanctuary?" So, I ask, what's wrong with the sound? Then I often get a generally vague description of the problem, and since I'm not physically in the church being described, I can't hear or see what those problems are.

SO, LET'S START WITH "TELL ME ABOUT THE ROOM."

Room acoustics are the make-or-break, first step and primary component of how well an audio system will behave and perform. I can give you example after example where a church was designed for form and not function, aesthetically glorious and yet a sonic nightmare. When you see these structures like the one pictured below, you ask yourself, "What were you thinking?" A church made from glass, and you want to put a PA in it?

"Faith comes by hearing" and, to put it bluntly, a room like this wouldn't allow anyone to hear anything very well, unless the entire congregation is wearing headphones.



*"If even lifeless instruments, such as the flute or the harp,
do not give distinct notes, how will anyone know what is played?"*

1 Corinthians 14:7

GET IT RIGHT THE FIRST TIME

Acoustic consultants address this head on when designing a room for construction, and the best time to consider the space's acoustics is — before you build it. However, if the room was built without consideration for the purpose to which it's used, an acoustician, with the help of analytical software and other tools, will often recommend acoustic treatment solutions.

These usually take the form of absorption, diffusion, and reflection, to minimize, as best they can, the acoustic problems with the room. For example, a church with all hard surfaces and a concrete floor.



Designing a sound system without paying attention to the acoustical anomalies of the room it's going to be installed in is a bad investment, and yet many still proceed with the installation without first making the room right. This is the same as saying, "We'll fix it in the mix." Always start with designing the room to sound as good as it can, before doing anything else: creating a clean canvas to paint on.

That is not to say there aren't acoustical solutions that can be applied after the fact. There are, and the results can often be great. However, it will never be as good as having prepared or built the room for its intended purpose.

WHAT IS THE MUSICAL CULTURE OF YOUR CHURCH?

- **TRADITIONAL:** Focused on organ/piano and choir. You may want more reflection.
- **MODERN:** Focused on praise and worship, usually a full band. You will want to reduce the reflection.
- **BLENDED:** A little of both, now what do you do?



If the church was built sometime in the 19th century, traditional music was all there was, and the church was built with that purpose. They were usually rectangular in shape, made of wood or stone and glass to allow natural light to fill the room, enhancing the sound of the choir and congregation, all singing as with one voice, reflecting the sound throughout the sanctuary.

Today, churches often use more modern worship bands (drums, guitar, bass, and keyboards) in this same 19th century space, and it doesn't work as well, does it? You are often limited in how you can acoustically treat the room, because of the aesthetics, room shape, building materials, and overall cubic volume, plus the positioning of the musicians with their instruments.

UNDERSTANDING REVERBERATION – AKA BOUNCE OR SLAP

Sound consists of pressure waves, so it makes sense that in a room with hard surfaces it's going to bounce around. Sound waves bounce off the floor, walls, ceiling, and any other reflective surface; gradually losing energy over time. Reverberation is the collection of those reflected sounds. Reverberation Time is the amount of time it takes the sound to fade away after the source of the sound has stopped.

To make an objective measurement of a room's "Reverberation Level," we use the metric: Reverberation Time 60 or RT60. RT60 is defined as the measure of the time after a sound source stops that it takes for the sound pressure level (SPL) to reduce by 60 decibels.

Why 60dB? One way to think of it is, the loudest sound level in orchestral music is typically 100dB, while 40dB is a reasonable background noise level for listening to music. So, RT60 measures the time it takes for the loudest noise in a room to fade to the background level. It is important to note that Reverberation Time in a particular space varies with the frequency of the sound source.

You can find various usable RT60 graphs online, but in most spaces, it will vary somewhere between 0.8 and 1.5 seconds at 500Hz (which is the target frequency for speech intelligibility) depending on size, surface materials, and usage.

Here are some examples of reverberation in various locations.

It is a good idea to ask your AVL Integrator if they have someone on staff that can analyze what your room may require acoustically, and then ask this simple question: "Can you perform an RT60 measurement to determine solutions for our space?" If they look bewildered, you may want to consider moving on to another integrator.

[ANECHOIC CHAMBER](#)

Reverb time: ~0

[A MEETING ROOM](#)

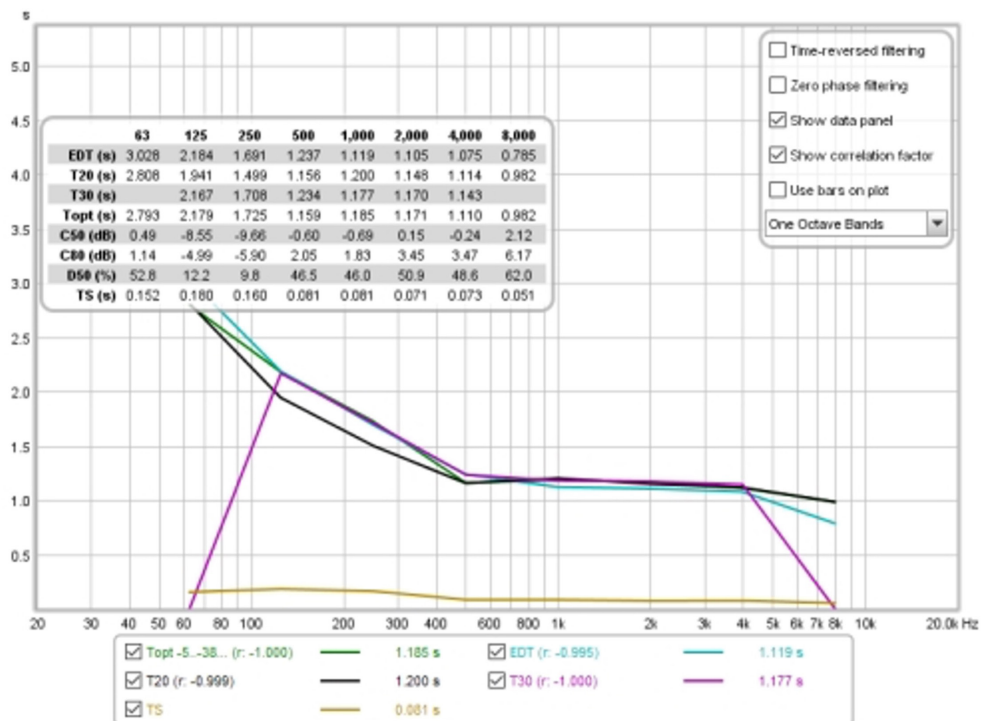
Reverb time: ~ 1 second

[A CORRIDOR](#)

Reverb time: ~ 2 seconds

[A PARKING BASEMENT](#)

Reverb time: ~ 3 seconds



WHAT ELSE CAN I DO?

Once the room has been properly diagnosed and then acoustically treated, there are additional things that can be done to help everyone on the stage, in the sanctuary and listening at home via livestream to hear everything better.

Watch [this video](#) to see how Faith Baptist Church solved their acoustics issues. You can see how acoustic panels were applied to the bare walls to reduce reflection and absorb oppressive sound.

In [this video](#), NEXO ID speakers are used as an alternative solution, utilizing loudspeaker design to acoustically cover the area, the speakers are designed to focus sound waves, preventing them from bouncing off walls that make it difficult to hear and understand what's being amplified. In other words, aiming the speakers at people, not hard surface walls, windows, or reflective flooring.

Something else you can do, if you are using floor monitors for the band: acoustically treat the wall behind the band and aim the speakers at the musician's ears and not at their kneecaps (more on this in a later article).

SILENT STAGE

Consider transitioning the band to a “Silent Stage” by using in-ear monitors instead of floor monitors, direct boxes or amp modelers/EFX devices like the Line 6 Helix instead of amplifiers for guitars and basses. Creating a Silent Stage has been proven to notably improve the clarity of the audio for both the congregation and the worship team. Converting your acoustic drum set to electronic drums can also go a long way to mitigating the acoustic energy of these instruments.



[Line 6 Helix](#)



[Yamaha DTX10](#)

CONCLUSION

Acoustically fixing your room before any installation will always provide the greatest benefit. Don't accept the sales line that a new system or additional components are what you need to solve your room's "built-in" problems.

If you need an acoustics consultant to analyze your space, you can visit the [National Council of Acoustical Consultants](#) site.

There are several acoustical solutions providers that can analyze your space and provide acoustical design solutions along with the products needed, and installation of those products. They will be able to answer all your questions and provide educational resources to help you understand the process. Here are two examples:

- [Auralex Acoustics](#)
- [Primeacoustic](#)



ABOUT THE AUTHOR

Doug Gould is the CEO and Founder of Worship MD and has been a veteran of the Pro Audio and Music Technology industry for nearly 30 years, serving in management roles at Shure, Tascam, and E-Mu Systems. Doug has served as a worship leader, musician, and sound tech at various churches throughout his career.

Over the last 18 years, Doug has been a very effective presenter at hundreds of worship conferences all over North America and beyond, focusing his experience on consulting and teaching others.

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For more about Yamaha, please visit usa.yamaha.com/house-of-worship. Keep up on what's happening by following our Facebook group: facebook.com/groups/YamahaWorship