

House Of Worship Acoustics

By Eric Smith

2-4-14, 2-9-14

“In the beginning, there was perfect sound. Then man invented rooms.”™

Auralex has become the world's undisputed #1 acoustical products and services company for good reason: we know what we're doing and we take good care of our customers. After all, the largest names in worship trust Auralex to help tame their sound. Joel Osteen, Joyce Meyer Ministries, John Hagee and countless other houses of worship have all looked to Auralex to help them sound their best and to most effectively convey their important message to their congregations.

This document is an outgrowth of all the decades of work we've done with countless houses of worship large and small. We hope you get a lot out of this chapter on house of worship acoustics and that you, too, make the decision to entrust your sound to the professionals at Auralex.

If you are unclear about anything I say here, feel free to contact Auralex for clarification or to ask any questions you might have. We take the very technical topic of acoustics and sound-related construction and design of houses of worship and make it all as easy to understand as possible. I promise.

Okay. Let's jump in and start looking at house of worship sound.

Why Do Houses Of Worship Typically Sound So Notoriously Bad?

I could be snarky here and answer, “Because the people who design houses of worship don't understand acoustics and they frequently put form ahead of function.”

The truth is that, while there's some validity to my answer, there are multiple factors that come together to equal the sub-standard house of worship (HOW) sound that is far too common.

Client demands. Budgetary constraints. Lack of full understanding of acoustics. An eye for design, not functionality. Ego. A lack of knowledge of the current crop of acoustical products. All these and more contribute to the bad sound we've all heard in houses of worship.

In What Ways Do Houses Of Worship Sound Bad?

I've been helping facilities control their sound since 1977, and it has become clear to me that houses of worship are typically far too reverberant and laden with too-delayed echoes to function properly for their intended purposes.

What Makes Bad House Of Worship Sound So Detrimental?

Poor intelligibility! As I've been saying since the mid-'90s: “The congregation can't heed The Word if it can't hear The Word!”™

House of worship sound has been notoriously poor for a *long* time — likely as long as there have been houses of worship. I can picture people sitting in ancient cathedrals and whispering to each other, “Can you understand what he's saying???”

This is a shame, because houses of worship really are built for one purpose: to be venues in which important information is conveyed to groups of people hungry for that information. It follows then that a house of worship that fails to provide an environment that's suitable for the conveyance of important, perhaps life-altering, information seems to fail at its primary mission.

As I said, this is a shame. And it's **exactly** the situation at most houses of worship.

How House Of Worship Sound Control Differs From That Of Smaller Spaces

To get a grasp on how to properly control sound in a HOW, one must first understand the difference between small-room acoustics and large-room acoustics.

Small rooms' acoustics are more governed by room geometry — and the resulting room modes and nodes, which are peaks and dips in a room's frequency response and time-domain signature — than are large rooms. In small rooms, the tonal character of the room can change dramatically if one moves six inches, but I don't find this in larger spaces. Yes, there can be tonal differences in large rooms, but they tend to occur over broader areas.

Due to their modal activity, small rooms suffer from bass buildup in their corners, which is why we tend to implement bass "traps" — often a misnomer, as we're more diminishing in strength than we are truly "trapping" the waves — in small rooms' corners. Small rooms also suffer from prominent axial mode interference (axial modes form when waves bounce between two parallel surfaces), which is why we often will also "trap" the front and rear walls, as well as certain parts of the ceiling, in sound-critical smaller spaces. These types of treatments are inappropriate, though, for larger spaces like houses of worship, which suffer from different modal activity and thus require a different plan of acoustical attack.

In larger spaces, low-frequency waves don't fold back onto themselves like they do in smaller spaces; they tend to propagate farther and grow in intensity...then come back for a second pass throughout the space. This behavior dictates that instead of putting bass traps into corners, we spread the low-frequency absorption throughout the room. Whereas this plan of attack would do little to alleviate low-frequency anomalies in a small room, it tames low-frequency issues quite nicely in a larger space, but only as long as the appropriate products are chosen and they're properly implemented.

The Three Types Of Room Modes

They are axial (a wave touches two surfaces), tangential (four surfaces) and oblique (six surfaces). In small rooms, axial modes are the most prominent, but tangential and oblique are more common in many houses of worship, due to their geometry. This plays into our treatment planning.

Can A Big Room Be Made To Sound As Intelligible As A Smaller Room?

Yes, with the proper choice, positioning and installation of the acoustical treatments. Having said that, even when properly treated, many larger rooms will still sound like larger rooms. Tamed, yes, but still large. Can this be overcome? Sure, if one is prepared to implement enough treatment. We could certainly make a large house of worship sound like a recording studio if you wanted us to. Now, at certain parts of the service, this might be appropriate, but not all parts. More on this later.

Should all houses of worship be made to sound the same? Obviously not. A gothic cathedral is expected to sound like a gothic cathedral, not a big recording studio and not even like a contemporary house of worship. But is it ever appropriate for the room to dominate the sound to such a degree that intelligibility is nil? Never. Attaining the appropriate degree of intelligibility in an inherently reverberant space can be challenging, sure. In fact, some might call that the understatement of the decade. But there are always creative ways to nibble away at reverberant, unintelligible sound. Again, more on this later.

So, Then, What's The Correct — And Easiest! — Way To Acoustically Treat A House Of Worship?

Generally speaking, the most effective — and cost-effective — way to attain controlled sound in a house of worship is to spread 3” or 4” absorptive acoustical panels evenly around the space. Yes, this is a simplification, but it is a useful rule of thumb that will generally yield pleasing results and may keep a house of worship from spending a bunch of money on acoustical testing — money that, in my opinion, is often better spent on the treatments themselves. [NOTE: Auralex provides free-of-charge modeling of houses of worship as long as you can provide us the proper dimensional and construction data.]

Why does this spread-treatment plan tend to work well? Because, as the BBC discovered in their research years ago, when you spread acoustical treatments around a room instead of grouping them, you attain up to FOUR TIMES the absorption from the same square footage of acoustical treatment. It's true. FOUR TIMES. That's a factoid that any house of worship's board can sink its teeth into. Talk about getting something for nothing. Sometimes one does equal four.

Actually, one can equal more than four. Why? Because when we treat houses of worship, we not only spread the treatments, which yields plenty o' bonus absorption due to the panels' exposed edges, we also stand the treatments an inch or two or more off the mounting surface. This yields even more bonus absorption, due to the exposed rears of the panels. It also increases the overall absorption and specifically with regard to low frequencies. Given that we're not generally doing corner bass trapping in houses of worship, we count on the treatments that are spread around the facility to contribute the low-frequency absorption. Without mounting the treatments in a fashion that gets them away from the mounting surface, we don't get the low-end absorption we need out of the panels. Mounting them in this way is far less expensive than installing thicker panels and mounting them directly to the room boundaries, believe me.

Now, the problem is that houses of worship are rarely laid out in such a way as to lend themselves to even distribution of the acoustical treatments. Often, there are large expanses of windows that preclude treatment in significant areas of square footage. There are doorways, archways, balconies and other room features that keep us from treating the space in the manner we know it needs. Not to worry, though. We've found that implementing treatments wherever feasible can sometimes yield results that are deemed quite acceptable. Even if a textbook layout can't be obtained, treated the available surfaces properly is absolutely worth the effort and expense, and will yield beneficial results.

What about facilities that have precious little available boundary space for treatment? Then we look to hanging acoustical “clouds” to do the heavy lifting for us. These can be quite effective, as Auralex proved a couple decades ago when we worked on a large house of worship in Houston with designer and acoustician Bob Suffolk. Bob had it in his mind that a very large (60+ feet in length, as I recall) parabola of absorptive material would be suspended from the ceiling in this massive sanctuary. It took our engineers a boatload of work to figure out how to cut this giant absorber into smaller pieces for the installers to tile together, but we did it and the result was nothing short of stunning. The reverberation went from over thirteen seconds down to the recording-studio range. Bob and his client were thrilled.

Now, that was a full-on custom project that had a big pricetag attached to it. If you don't have that kind of money, you can certainly attain a lot of success by suspending Auralex's stock acoustical products in your own “clouds.” With proper structural engineering and an eye for design, your results can be visually stunning and enormously acoustically effective.

All Together Now

There is a certain area, though, that is definitely a candidate to receive solid treatment, not spread: the back wall (meaning, the wall at the rear of the room, behind the congregants and at the end opposite the stage). Why? Because the back wall is where sound ends up after emanating directly

from the loudspeakers and after bouncing off the other room surfaces. Left untreated, or only sporadically or minimally treated, the back wall will reintroduce greatly delayed sound back into the sanctuary, both as reverberation and as a discrete echo, and can be extremely detrimental to the overall intelligibility in the sanctuary. We want soundwaves — particularly at low frequencies — to only impact the congregants once. Yes, there are exceptions. And yes, some people advocate for far more reverberance in houses of worship than do I. I'll grant you that there's room for some nuance in treating houses of worship, but I'm secure in my conviction to the premise that houses of worship should exhibit far greater intelligibility than they often do.

Sometimes One Equals Two

If you don't treat the back wall of the sanctuary, or the expansive face of a balcony, you most definitely will have a prominent delayed reflection coming right back at the congregants, choir, musicians and worship leaders. This gets in the way of concentration and intelligibility, and can seriously degrade the worship experience for both the attendees and the people conducting and contributing to the service. One direct sound can equal two — or more — echoes PLUS excessive reverberation. This is why it's of critical importance to treat the rear wall and balcony of a house of worship.

Get A New Sound System Without Spending Money On A New Sound System

We've already learned from the experiences of a number of top (read: famous and well-funded) houses of worship that severe acoustical problems cannot be overcome by throwing more dollars at additional, or replacement, sound equipment. So, if you are involved with a facility with abysmal sound, don't allow your facility to throw money down a rathole like so many others have. Put the money and effort into taming the room. Can a properly tamed room yield results as good as, or better than, the implementation of a new sound system? Absolutely!

A Couple Personal Auralex Experiences

I was asked to consult a sizable Catholic church in the Midwest. The church had raised a large sum of money over the years and had built what it thought was going to be a wonderful facility, only to get nothing but complaints from the parishioners. The sanctuary was exceptionally tall, with a cupola up at the apex of faceted, pseudo-domed, wooden ceiling. There were enormous wooden, laminated beams supporting the ceiling; these might have been 6' thick. There was no a single acoustical treatment in sight, not even of the virtually invisible type we sometimes recommend.

My schedule dictated that I visit the facility at a certain time, but it just so happened that a small wedding was to be held in the sanctuary at the only time I could visit. I asked if it was ok with the church leadership if I visited then, as I thought it would give me a chance to hear the sanctuary "in action." They had no problem with it, so I put on a suit and paid the facility a visit.

The wedding was small, with perhaps less than 35 people in attendance. All the visitors were grouped in the center of the sanctuary, in the first three rows. I walked around the sanctuary as unobtrusively as I could, having arrived just before the start of the service. It was obvious to me that the facility was highly reverberant and exhibited poor speech intelligibility, but once the service started, it became clear to me that the intelligibility was *far* worse than I had imagined.

As I said, the attendees were grouped in the center of the sanctuary and were only about three rows deep. Even with that, instead of being up on the alter and speaking from the pulpit, the priest was standing at the front of the alter, just above the steps. In just the short time I was there, though, I saw it become obvious to the priest that the attendees couldn't understand him. So, the priest came down the few steps from the alter and walked right up to the front row of people. He started leaning down toward them and, in an exaggerated fashion, enunciating his words to the v-e-r-y l-o-u-d-l-y and v-e-r-y s-l-o-w-l-y. Even with this odd presentation, though, he could not be understood. I know this for a

fact, because I quickly joined the attendees and took a seat just so I could experience what they did. I only stayed in the pew for a minute or so, then got up and walked the back of the sanctuary, where I would no longer disturb anyone's special day.

Talk about an ear-opening experience! It was HORRIBLE!

I wish I could tell you that there was a happy ending to this story, but there wasn't. The church's board poo-poo'd the lengthy report I prepared for them. They thought that acoustical treatments would be too visually obtrusive and too expensive. Apparently they didn't get the memo that the pews don't stay full for long in such a lousy-sounding sanctuary. And that parishioners who can't hear the sermon and be sufficiently moved by it don't fill the collection plate.

Sometime later, I had an opportunity to speak with a member of the church. I inquired as to whether the board members had gotten their heads on straight and had decided to move forward with treating their beautiful, but entirely non-functional, sanctuary. Nope. But the church member encouraged me to reach back out to them in another effort to convince them that the sanctuary needed acoustical help. Not a chance, I said. I was not about to waste my time --- *again*.

The end of the story? No. I heard a few years later that the church had hired someone to come in a "put up a few panels." They didn't even have the grace or brains to hire Auralex, the world leader and the company that had been generous enough to pay them a free site visit and to draft a lengthy, educational report about their sanctuary's issues. They hired a fly-by-nighter who threw up a few panels. But the person relating the story to me told me that the church might take down the panels, 'cause "they didn't work." Who knows how many were put in, what their acoustical performance was, where they were put up, what mounting method was used and whether they were even the right type of product for the sanctuary's needs.

Buy A Large Gymnasium For A Few Thousand Dollars

There was a Midwestern church that raised money for years and finally had enough to build a large gymnasium onto the side of their existing building, the intent being that they'd use it for Christian sports leagues for the kids and for overflow worship, coffee hour between services, etc. Imagine their disappointment, though, when they completed the structure and it became immediately apparent that its acoustics were so bad that the facility was too unpleasant to be in. You know what they did, not knowing where to turn and feeling that proper acoustical treatments were out of their grasp? They shut the doors to the facility and never used it again for EIGHT YEARS. Yes. EIGHT YEARS.

Then, one day someone mentioned Auralex to them. They called and spoke with me, personally, and I helped guide them to a solution that took care of their sound problems and cost them far, far less than they ever dreamed. You know how much they spent? Now, this was not in today's dollars, so the figure would definitely be higher today than it was then, but all they spent was less than \$4700.

They enlisted the labor help of capable members of their congregation, who, with our guidance, installed the panels in the facility on a Saturday.

Later, the church's leadership wrote me a thank-you note and told me that they could hear the room's sound improving with each additional panel they installed. At the end of the project, they were ecstatic with the result. They had bought their previously unused facility back for less than five thousand dollars.

The next weekend, they packed the gym with hundreds of teenagers for a highly amplified contemporary Christian concert.

A few years later, they sent me a letter. It was one of those “You may not remember me, but...” types of letters. Of course I remembered them. It’s hard not to remember a group of people who were so gracious and grateful for the help we’d given them! Anyway, their letter said that they just wanted to drop me a line to tell me that even though a few years had passed, they remained exceptionally happy with the result of their Auralex treatments, that the money they spent was more than worth it...and that they’d be happy to speak to any prospective Auralex customers I might want to steer their way. ☺

Beauty Is Most Definitely NOT In The Ear Of The Beholder

A member of Auralex management was traveling on company business and had an opportunity to attend a service at a famous cathedral one Sunday morning. Imagine his surprise, though, when the service started and he realized that the acoustics were so bad that they had their multi-million-dollar PA system turned down so low that he could hardly hear it...and that they even had their periodic 4” pew-back speakers turned down so far that he could hardly hear them, too! He said that the place was gorgeous, but that he heard virtually none of the service.

I had previously read an article in one of the audio industry’s leading professional publications about this facility’s acoustical woes. The article stated that the facility had purchased and installed a number (five, I recall) of the world’s top brands of PA systems, only to continue to have non-functional acoustics. Millions of dollars had been spent on new gear, but they were never able to overcome the inherent acoustical shortcomings of their facility’s design. Beautiful, yes. Functional, no.

Here’s another story about a beautiful, yet non-functional, worship facility: the Thorncrown Chapel in Eureka Springs, AR. As reported in the February, 2014, edition of Systems Contractor News, new sound equipment was installed in the chapel in an attempt to overcome the chapel’s inherent sound problems. The challenge, as reported in SCN, was to “improve intelligibility amidst the 33-year-old “acoustical nightmare” (their words and quotes) produced by the chapel’s 425 windows and 6000 square feet of glass.” While I was reading about Thorncrown Chapel in SCN, I got online and looked it up. To be fair, it is a beautiful structure in an idyllic setting in the woods of Arkansas. But does it function well for its intended purpose? Apparently not. Designed by the late esteemed architect E. Fay Jones, a student of Frank Lloyd Wright’s work, the facility was deemed one of the four best pieces of architecture by members of the American Institute of Architecture. It is held in such high regard that it was added to the US Register of Historic Places after only twenty years of existence. Beautiful, yes. A feat of amazing engineering, yes. Appropriate for use as a house of worship, no. The fact that it is so revered by architects makes it easy to understand why the beautiful structures architects often design fail to successfully serve their intended purpose. Do all architects fail to properly address acoustical issues? Absolutely not! Auralex works with a number of architects around the world who pay as much attention to acoustics as they should. Sadly, though, I find them to be the exception, not the rule.

I hope that these short stories have served to illustrate for you the fact --- yes, fact --- that houses of worship need dramatically more acoustical treatment than their designers often specify for the facilities. If you are in a position to influence a facility’s design and to help guide the inclusion of proper acoustical treatments, please do the worshippers a favor. Make sure that acoustical treatment is one of the first aspects of the facility’s design that gets discussed. Don’t let acoustics be the forgotten stepchild or one of the “we’ll deal with it if there’s any money left over” items on the proposal.

A Type Of Treatment Not Worthy Of Too Much Consideration

As I’ve said, I prefer a drier (less reverberant) house of worship, likely with higher volume out of the loudspeakers than some people would advocate. Given that I’m not a fan of excessive reverberation, there is one category of acoustical treatment that I generally don’t consider applicable in houses of

worship: acoustical diffusors. These devices, which are based on intricate mathematics and/or geometry, redistribute acoustical energy throughout a space without, theoretically at least, removing it from the space. Is this desirable in a house of worship? In my opinion, most often not. Diffusion, by its very nature, helps prolong ambient sound that has been altered in frequency content and in arrival time compared to the original, direct sound. While this can provide a false sense of sonic envelopment, it does nothing to encourage intelligibility and faithfulness to the original sound. It leads to sonic PROduction, not Reproduction.

Yes, Auralex manufactures what we and many others consider to be the world's best-performing acoustical diffusors. But I do not believe that they enjoy the broad applicability in houses of worship that acoustical absorbers do. Having said that, can a quantity of diffusors be added to the acoustical treatment plan of a house of worship if done so with taste and with good, sound reasoning? Sure. But not in an over-the-top, willy-nilly fashion like some people advocate. Let me give you an example.

A number of years ago, there was an article in a professional publication that targets the house of worship sound market. The article was written about a sizable house of worship that exhibited terrible acoustics. How terrible? I don't any longer have the article to refer to, but I recall that the reverberation time (RT60) of the sanctuary was, at critical frequencies, something like 13.7 seconds. Talk about unintelligible! And yet the owner of a competing acoustical company advocated for treating the sanctuary with perhaps six figures worth of, you guessed it, diffusors. Would this have been better than nothing? Perhaps. But would it likely have improved the intelligibility in the sanctuary and brought the RT60 down to a reasonable level? Do I really have to answer that?

You see, every surface in a sanctuary changes the tonal character of the sound. So, if we're diffusing sound all over the place, encouraging it to bounce hither and yon, what we're doing is analogous to EQing the sound...so much so that it ultimately bears little resemblance to the original sound. Again, this amounts to sonic PROduction, not Reproduction.

Is there anyplace where diffusion can be useful? Yes: around the choir. You see, if you absorb too heavily around musicians or singers, they won't be able to hear themselves or others. They'll overplay or oversing, and their intonation may suffer. Not treating the boundaries proximate to the musicians and singers isn't generally a viable option, as this can contribute sonic anomalies throughout the sanctuary, so diffusing these areas may be the best choice. Let your ears — and those of the musicians and singers, who will have no reluctance in letting you know their opinions — be your guide. Nearfield individual monitors, in-ear monitors, floor wedges, suspended wedges and diffusion are all useful tools in crafting the sound that the performers hear.

Preachers (I use that term to cover priests, rabbis, etc., as what they're all doing is preaching) also have their own sonic needs, as they need to hear themselves just enough to feel connected to their own speech, but not to be bathed in echoes, which are quite disorienting. They prefer their own sound in a room with a controlled rear wall and/or balcony and with just enough P.A. signal or monitor loudspeaker bleeding into their area that they can hear themselves, particularly their consonants.

So, you must balance the sonic needs of the congregants with the needs of the musicians & choir, as well as with the sonic need of the worship leader(s).

The ceiling above the stage/alter is often quite tall, which can generate a delayed echo for the musicians/choir/worship leaders if the vertical reflections are not controlled. Absorption or diffusion can be implemented here, either boundary-mounted or as a cloud, but must be considered in the greater acoustical context of the whole sanctuary.

You *can* diffuse the rear wall or balcony area of a house of worship (or other such large space) in lieu of absorbing it, but I encourage you to make sure that the treatments you choose provide broadband (full-frequency-range) control. Don't just diffuse the upper frequencies. As you can imagine, I'm not in favor of treating the rear wall or balcony this way, as it doesn't lend improved intelligibility, but I know that some of you are going to do it anyway, so I thought I'd mention here the right way to do it. [BTW, Auralex has a number of diffusors that are also effective at trapping low frequencies.]

How To Have Any Type Of Sanctuary Sound You Want — At A Moment's Notice

As I mentioned earlier, a reverberant-sounding sanctuary can be appropriate for the acapella choir during the Christmas Eve service, but I guarantee that it's not the appropriate sound during the sermon. It also is not appropriate if the sanctuary is ever used for events in which there is a guest speaker, say a former president or some pillar of industry or motivational speaker. So, what can we do to give ourselves the acoustics we need for a variety of types of presentation?

There are so-called "active acoustics" systems that involve big-money sound systems, processors and motorized acoustical panels, but these are often impractical and out of reach for most facilities.

Having been involved in acoustics since 1977, and having helped a sizable number of houses of worship tame their sanctuaries, I am of the opinion that there is an easier way to tailor the sound of your sanctuary at a moment's notice.

It's with loudspeakers, amplifiers and digital reverberation. There, I said it.

"Blasphemy!," I can hear some of you yelling. "That's not how it's always been done. We design a beautiful space, raise a boatload of money, install a gazillion dollars worth of sound equipment and hope that it sounds like everyone envisioned it would sound." Exactly. And what you end up with — even if the place, against all odds, is the one in a million sanctuary that actually does sound usable — is a one-trick pony of a sanctuary. It might sound acceptable for the choir. It might sound acceptable for the musicians. It might sound acceptable for the preacher. But it won't sound acceptable for all of the above.

These days, super-powerful amplifiers are readily available and very affordable. Digital reverberation can give you the exact sound of any of the great cathedrals or opera houses of Europe and beyond. Loudspeakers are incredibly accurate compared to what they were just a decade or two ago. So why not use them to their full advantage? When it's time for the choir to perform an ages-old hymn, dial up one of the great halls of Europe. The choir will LOVE you for making them sound so good. Same for the time when the musicians crank up and the choir performs more-contemporary music with them. Dial in the appropriate amount of reverberation and delay, just like all your congregants are used to hearing on major-label recordings. When it's time for the preacher to speak or a guest speaker to deliver a talk, turn off a lot of the reverb and let the room's inherent sparkle contribute to the overall sound, but not so much that it overcomes the direct signal emanating from the P.A. As I said earlier, a big room — even a well controlled one — will always have inherent big-room sound, so use it to your advantage...when the time is right.

I urge you to control the room adequately, then lean on modern technology to give you the sound you desire for any particular purpose. Don't cross your fingers and hope against hope that your room ends up sounding right. Do it the digital, controllable way, not the dumb, analog, one-trick pony way.

Choose The Right Equipment

These days, even the least expensive equipment is better than the most expensive equipment from decades past. So don't think that you have to spend, spend, spend to attain good sound in your

house of worship. Get reasonable, trustworthy gear that delivers the feature set you require, but focus a sufficient amount of your resources on properly taming the acoustics of the space. Don't let your architect put form ahead of function to such a degree that your space becomes unusable for its primary intended purpose.

Do you just get online and order a bunch of P.A. loudspeakers that any band would use in a nightclub on the weekend? Sometimes, sure, if your room is properly controlled you can get by with this approach. But many times you need to spend up and buy some technology that will inherently give you an acoustical advantage. How? By keeping as much sound "painting" the congregants and as little sound bouncing off the room boundaries as possible.

One such technology is from Bose. It's called their RoomMatch system and I am extraordinarily impressed by it. Using dozens of differently engineered loudspeakers and digital processing, Bose engineers have figured out a way to keep as much sound as possible away from the room boundaries. I heard a big RoomMatch system demonstrated in a sizable performance venue in the summer of 2013 and I was incredibly impressed. The system sounded like a bigger version of the sound I'm used to hearing come out of some of the recording industry's best studio monitors. The RoomMatch system painted sound throughout the venue in the most even way I've ever heard. It's not without a commensurate pricetag, but it can help you spend less on other components of your system...and even, at times, less on acoustical modifications to your space. I urge you to give it your strong consideration.

If RoomMatch isn't in the cards, acoustically treat your sanctuary to the best of your ability (based on available space and money), then installed zoned loudspeakers, all correct controlled by digital delays so as to be time-aligned with the primary loudspeakers' signal. Zoned loudspeakers will allow you to maximally control the volume and coverage pattern hitting each area of the sanctuary. They can all be EQd differently, thus tailoring their sound to their particular zone of coverage.

What Else Has Bearing On The Sound Throughout The Sanctuary?

The stage itself, the drum riser, the choir riser and the pulpit stand can contribute negatively to the overall sound throughout the sanctuary, so we advise daily on how to build them correctly. Done right, they function as bass traps that benefit the sound throughout the sanctuary. Building them correctly costs very little more in the way of time or materials than building them wrong, so don't!

Even if you build the aforementioned items correctly — and especially if you don't! — it is very important that any sound producers be physically isolated from the surfaces on which they rest or to which they are attached. This is called "floating" and can have a far greater impact on sonic clarity than you'd ever imagine. Drums, subwoofers, bass rigs, guitar rigs, floor monitors, mic stands and more can all benefit from being floated. [Auralex has a variety of patented isolation platforms for this intended purpose.]

Another aspect of sanctuary sound that many people overlook is the effect that neighboring or segmented spaces can have on the overall sanctuary sound. For instance, many of today's larger houses of worship have balconies. Well, for every balcony there is an area under the balcony that will virtually always be bass-heavy. If such a design feature is part of your existing facility or the facility you plan to build, plan accordingly and use this inherent sonic characteristic to your advantage. If you trap low frequencies appropriately under the balcony, you'll be benefiting the sound throughout the sanctuary, which will be much more even because of your efforts. I bet that some of you are confused by this concept, as dedicated bass trapping isn't something we normally implement in sanctuaries. But think of it this way: an under-balcony area is almost like its own room, thus it will tend to exhibit something more akin to small-room acoustics.

Often there will be smaller seating areas that are off to the side of the main sanctuary; these areas can also be bass-heavy and can be used to your advantage if properly designed and treated.

Another factor that influences the low-frequency accuracy of the main sanctuary is the lobby. Often the lobby is at the rear of the sanctuary and is separated from the main sanctuary by sets of double doors that might be closed during services. If this is the case, the lobby still is having an effect on the sound in the main sanctuary — sometimes a far larger effect, either beneficially or detrimentally — than you might think. But, as with under-balcony areas, you can use the lobby to your advantage, whether the doors between it and the sanctuary are open or closed. Here's why.

Even when the doors are closed, a lot of low-frequency sound is leaking through them and into the lobby area. Why? Because low-frequency waves are very strong and sets of doors are not up to the task of stopping them. So, the low-frequency waves blow right through the closed doors as if they weren't even there. But, this can work to your advantage if you plan accordingly: the lobby area can be your bass trap, helping to smooth out the low end in the main sanctuary. Sometimes the lobby will function this way even if left untreated; other times you need to implement trapping in the lobby so it can do its job. (The latter can help the lobby not sound so bass-heavy itself.) Regardless whether you treat the lobby or not, be sure to take its effects into account when designing the sound of your sanctuary. Auralex can help.

Flame Retardancy Of Acoustical Treatments

It deserves to be mentioned that houses of worship are public spaces, so it behooves us to make them as flame retardant as possible. Often this means choosing acoustical treatments that earn a Class A flame retardancy rating, though in some locales I've seen strong Class B treatments appease local fire marshals, particularly those that pass the stringent California Fire Code #117. Be sure to find out in advance which degree of flame retardancy is mandated for your project, as this will help in planning the placement, quantity and types of acoustical treatments that can be used.

Historically, Class A acoustical products were made of fiberglass and covered with a Class A cloth. Some were melamine foam-based. (Melamine is a lightweight, rather rigid and easily harmed type of foam that has a Class A rating, but is expensive and doesn't offer the acoustical performance that other materials do.) But these days, we have a wide variety of Class A materials we can work with, many recycled.

Appearance — Or Not — Of Acoustical Treatments

Often, acoustical treatments in sanctuaries are cloth-covered fiberglass or one of the other new substrates. These panels are available in a variety of thicknesses, sizes and colors, all with a variety of types of edges to coordinate with any aesthetic desired. These types of panels can be boundary-mounted or can be arrayed in acoustical clouds and suspended from the ceiling. Some are portable and free-standing, as are often used around musicians and their gear. But what if the look of acoustical panels or diffusors or bass traps isn't exactly what you had in mind for your facility? Fear not. We have other options.

One option is a relatively new product that looks and paints like drywall, but is actually an acoustical absorber. Another is custom-printed, cloth-covered acoustical absorbers or diffusors or bass traps, such as Auralex sells under the tradename SonicPrint™. These can look like anything you want, including iconic religious imagery and more. The fabric is printed in a very technically involved way that doesn't degrade its acoustical performance, but which yields highly saturated, high-resolution images that fit nicely into the aesthetic of many houses of worship. The last option, which can be the most expensive but isn't always, is a full-custom engineered acoustical system in which all the acoustical magic occurs behind a stretched-cloth system that our installers fabricate on site. This is applicable to both walls and ceilings, and it can accommodate all manner of room features and

dimensions in a virtually seamless installation that our customers worldwide love. Auralex calls these ELiTE-CFS installations and they are the cream of the crop of our acoustical treatment offerings. With myriad choices of acoustical cloth, we're sure to be able to coordinate or complement your sanctuary's look and color scheme. So, whether your organization desires to see its acoustical treatments or desires them to be virtually invisible, Auralex can accommodate you.

Room Shape

Often, people will ask us what shape of sanctuary they should build. Some shapes inherently lend themselves to better sound than others, of course, so we're happy to offer our opinions. For instance, round, domed sanctuaries present a lot of acoustical challenges that can be more difficult to treat. In general, we don't care what the shape of the sanctuary is per se; we care that there is adequate space allocated for the acoustical treatments these types of facilities require in order to perform their intended function.

The sooner Auralex is brought in on the project, even during the planning stage, the better, as we can help you avoid all manner of pitfalls down the road. We interface with architects and general contractors every day, so please take advantage of all our decades of experience. Bringing us in at the end of the project and saying, "Okay. We've got our shiny new building all built. Now what do we need to do in the way of sound treatments?" is absolutely the wrong approach.

To learn more about how Auralex can help you make your house of worship the best it can be, please visit <http://www.auralex.com/news/featured-installations-photos/houses-of-worship/> or call us at 800-959-3343. We are great to work with and very good at what we do. Let us help you look like a hero to the rest of your organization! We'll be happy to model your room acoustically and help steer you in the right direction, offering as many helpful pointers as you need to get on the road to better sound. You'll end up with a far better, more productive facility if you let the professionals at Auralex take part in your project. Engage with us today!