13 - Recording in Improvised Spaces 5-19-2020

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and this is My Take on Music Recording

Ideally, we would all record in a great studio, but often we have to make do with a room at home, or record on location. How do we make this space sound as good as it can be? What can we do to make it work effectively?

We know that great-sounding records have been made in home studios, going back to the real pioneer in this: Les Paul

In the early 1950s, Les Paul converted his garage into a studio and equipped it with an Ampex 8-track tape machine, one of the first ever made, and made records unlike anything anyone had ever heard before.

You could say that Les Paul invented the project studio.

If he could do it 70 years ago, you can do it today.

First, let's talk about where you will record. You have a couple of options:
You could record on location, in a concert hall, church, or other large space that has nice acoustics. This can be a viable choice, especially if you need a room bigger than your basement or garage, or bedroom.

But it means hauling gear to the space, moving it in, and setting it up, even before you start any recording. That's a lot of work.

Unless you are familiar with the space, there may be some acoustic surprises. And often the space is only available for a limited amount of time, or you might have to pay to use it.

If you need to record a string or horn section, on location may be your only option. Well, unless you want to rent a real studio for those overdubs. More likely you will be recording at home. That's a lot more convenient, especially if you can set up a recording environment and leave it set up for an indefinite period of time.

The problem is, of course, that most of us do not have big rooms to use for recording at home. And that puts a limitation on just how good we can make it sound.

I am going to use my recording space for some examples. It has evolved over the years, and now sort of straddles the line between improvised space and a small professional studio. For many years, I had a real professional recording studio. It had a big room, acoustically very nice, and a separate, spacious control room. There was space for a machine room, a separate room for the EMT reverbs and other gear you didn't have to get to all the time, separate dubbing rooms, which could double as simple studios when needed. And even a disc-cutting room. I miss that facility, mostly because of the great sound of a nice room.

As you probably know, I started a new business in the early 1990s for manufacturing the studio products I designed. My products were really developed to fill a need I had for better gear than what I could find.

But that's another story.

The manufacturing business started out based at home, which was fine until the business started taking over the house. After considering the options, my wife and I decided it would be best if we designed a new house, with the ground floor devoted entirely to the business.

We didn't actually do the manufacturing here. All the assembly work was and still is done by really skilled and dedicated craftsmen who worked at home. But all the parts were stored in my facility. And with 12 products in the line, there were a lot of parts. Most of the space was devoted to parts storage, along with my shop where I developed new products and did the final testing and listening before every unit was shipped to the customer.

And then a few years ago, I licensed the manufacturing of my products to Geoff and George Hazelrigg of Hazelrigg Industries. Geoff had worked for me for many years assembling D.W. Fearn products. Now they have all those racks of shelving filled with the parts to build my products. And I have lots of space open for recording.

Actually, I started using the space while it was still filled with metal shelving and it sounded pretty good. I would use the shop as the control room. But the space did not look very good, and it was similar to doing location recording because nothing could be left set up between sessions.

That raw space was about 25 by 35 feet, with a 10-foot ceiling. That's not much smaller than some professional studios, but still not nearly big enough to do a big session.

I also had a large garage within the building, larger than a two-car garage. It's about 21 by 37 feet. That was useful for a drum room, or other isolation of vocals, etc. Of course, it sounded like a garage. But rather than fight that sound, I decided to embrace it. That was fine for some types of music, and terrible for others.

In the main studio area back then, the rows of shelving were filled with lots of cardboard bins filled with small parts, and large areas filled with metalwork assemblies. This actually helped the sound of the room significantly.

There was considerable absorption from the softer stuff, and a lot of diffusion from the shelving and harder parts.

On my podcast web site, dougfearn.com, there are links to photos and videos of the space, showing how it evolved over time.

I also wanted to use the space for shooting video, for my YouTube channel. It was a challenge to make it look presentable, and for some of the videos, I didn't even try to make it look better. The focus was on the topic of the video.

When I finally had the space cleared out, it was time to improve the acoustics, the esthetics, and the creature comforts. Along the way, it became apparent that I needed a real control room.

I know many people are fine with being in the same room as the performers, but it was difficult for me to work that way. For one thing, you never know what you are getting, or if there are any problems, until the take is done and you listen to the playback.

Most of the people I work with have very busy schedules, and/or have to travel a great distance to record. Time is critical, and most sessions are less than 3 hours, or 4 to 5 hours at most.

I couldn't afford to waste the time waiting to hear what we got, so, a real control room was a priority.

If you are recording yourself, or you and some friends, that might not be an issue, and you can all be in the same space.

I've done sessions like that, and it certainly makes communications a lot easier. But on balance, I want a real, isolated control room. Let's get into how we can optimize the space no matter how you are going to work.

There are some basic acoustical principles that apply no matter how big or small your space.

We will start with the size and proportions of the room. As a general rule of thumb, the bigger the space, the easier it is to make it sound good. Conversely, the smaller the space, the more of a challenge it becomes. Even if you do not need a lot of room for your projects, a bigger space will make your life a lot easier.

But most of us do not have that luxury, so, we have to make do with the space we have, which is always going to be too small.

The proportions of the room will be critical. That is, the ratio between the height, width, and depth of the space.

Why? Well, between any two boundaries there are going to be certain frequencies that are emphasized, or lacking. That is physics, and cannot be changed. Even in the most sophisticated rooms, the proportions, in large part, determine the intrinsic sound of the room.

If we have the luxury of specifying the dimensions of our space, we can optimize the proportions to give us the best possible distribution of these emphasized frequencies.

Small rooms will have those resonant frequencies right in the mid-range, where they will almost certainly be obvious and sound bad.

You know the sound: tubby, muddy, lacking in clarity.

Designing a room from scratch, with enough flexibility in the space, can make even a fairly small room sound acceptable. You can find online formulas, calculators, and design suggestions for good proportions.

The worst possible room is a cube. That will never sound good, no matter what you do to try to correct it. Not many rooms are cubes, fortunately, but a lot of construction in the last 70 years or so utilized

standardized building materials, which are usually multiples of 4 or 8 feet. That applies to both houses and commercial space. It's just cheaper, faster, and easier to build rooms that do not require cutting materials, like drywall.

The problem is that you end up with rooms that are acoustically problematic. For example, a typical household room might be 12 by 16 feet with an 8-foot ceiling. That's going to have room resonances, or modes, that are very obvious. And it won't sound good. It's much better to pick dimensions that won't cause those frequency anomalies in the first place.

Calculating this is much simpler than it was in the old days, when you had to do all the math by hand. For example, my control room was, by necessity, very small. The room is about 13 by 10, with an 8-and-a-half-foot ceiling. This was the best I could do in the space available. And it worked out very well.

When the room was completed, but empty with just a concrete floor, and heavy multi-layer drywall ceiling and walls, it was very reverberant, as you might imagine. I went in there and clapped my hands, to hear how the room responded. And it sounded very smooth, just like the calculations said it would.

It's not a great control room, but it is about as good as possible for its size.

So, if you have the ability to build your studio or control room, in an existing space, spending the time optimizing the dimensions will be worth it.

Interestingly, the actual boundaries of your space may not be what you determine with a tape measure.

How can that be?

Well, in typical home construction, with thin sheets of drywall on wooden framework, the walls are not very soundproof.

You know that if someone is talking in an adjacent room, you can hear them, but the high frequencies are missing. The bass frequencies go right through the wall. Those materials do not stop low frequencies, so, the actual boundary for lows, may be many feet beyond the wall.

That can help make your small room sound better than you might expect, given its size.

That virtual dimension is difficult to calculate.

Which leads us to the concept of **soundproofing**. Let's start by saying that nothing is really soundproof. It's a matter of degree. And let's dispel a myth:

Sound absorbing materials like fiberglass insulation or drapery or moving blankets
do not provide any significant blockage of sound.

Think about it: if you held up a piece of insulation and talked into it, could a person on the other side hear you? Of course they could. Your voice would be muffled, since high frequencies are being absorbed by the material. But it does not stop the sound. It does not stop any sound.

The most materials like that can do is attenuate the high frequencies by a few dB.

What you need to stop sound is mass. Thick, heavy walls made of dense materials like concrete or brick. And the wall has to be tightly sealed. Even a tiny gap in the wall will degrade the soundproofing significantly – You might lose half the sound isolation.

Is making a space soundproof even necessary? Well, maybe you live in a very quiet environment and are not bothered by traffic or neighbors. In that situation, you can get away with minimal soundproofing.

But most people live in places with an unavoidable amount of background noise, which can vary quite a bit from minute to minute. If you are recording yourself, you might be OK with an occasional re-take because of an interfering outside noise. That would be inexcusable in a professional studio.

Another soundproofing factor is bothering other people with your music. This could be neighbors or other people in your home. Many musicians like to work at night, which is often quieter than daytime, but it is also when you are most likely to bother others.

Soundproofing works both ways, so you have to consider your situation in the design stage.

When I design a studio for someone, I meet with the contractor and tell them that when we are finished with this job, we are going to fill the room with water and if it leaks, you don't get paid. Funny, sure, but it makes the point.

And you can't just seal the gaps with caulk, or tape, or molding, or paint.

Whatever seals the gap has to be as heavy and dense as the rest of your wall, or else you are wasting your money.

Well-designed professional studios use heavy concrete or brick walls.

Abbey Road studios in London are isolated from each other and from the outside world with massive double-brick walls. These walls are inside the building's outer walls. And they use the bricks end-on, unlike the usual form of brick construction. And the walls are a double layer of these end-on bricks.

They can run three studios simultaneously with perfect isolation, and never bother their neighbors in the residential area where the studios are located.

Doors and windows are always going to be the weak link in your soundproofing. For one thing, the materials are not going to be as massive as the walls. But another factor usually overlooked in the construction is the way doors and windows are integrated into the walls.

Conventional construction frames out the opening, leaving an inch or so around the framework that will support the door or window. This makes it easy to set the door frame in place, with enough of a gap to allow room to adjust the door to be perfectly vertical and square.

The space between your expensive walls and your expensive heavy door is usually filled with shims to adjust the door position. Once everything is properly adjusted the door frame is fastened in place.

The shims are usually lightweight wood, and they are only present in key places around the frame. So now there is a gap between the wall and the door. To cover this over and make it look nice, wood molding is usually nailed around the door frame. Looks very nice. But you have lost most of your soundproofing.

The same applies to windows.

The only way to do this properly is to fill the space with material that is at least as heavy and dense as the walls. Expandable foam or caulk won't do it.

This is always a challenge in studio construction and it is a difficult concept for most otherwise highly-skilled craftsmen to understand.

Fill those spaces properly and you will be getting the soundproofing you paid for.

Or you can live with the problems, which is what many people are forced to do. But understanding the principles will help you avoid frustration and disappointment.

We now have our space soundproofed as best we can. The next acoustical principle is sound **absorption**. This is an area that also has many misconception

Remember that sound absorbing materials do next to nothing to stop sound. What they do do is reduce the reverberation time of the room.

Wait, I don't hear any reverberation in my room!

Probably you don't notice it, but reverberation is present in all rooms, except in an anechoic chamber.

But the sound does bounce around your room whether it is obvious or not.

It's not going to be like a concert hall or church, but your room does have echoes.

In a small room, the time delay between the sound and its echo is measured in milliseconds, thousandth or a second, instead of several seconds you would hear in a concert hall. Those reflected sounds will influence how your recording sounds. Our hearing is remarkably capable of discerning these echoes. They help us know how big the room is, and what's in it, consciously or not.

If you combine bad proportions and sound reflections In a small room, you often end up with a recording that sounds small. It may sound like a closet or other small space.

It's going to detract from your recording, unless you want that kind of sound.

Absorbing some of the sound in the room will reduce the echoes. But what material to use?
Many people think things like household insulation, curtains, or sound-absorbing foam will fix the problem. And to some extent, they do.

But these materials do not absorb all the audible frequencies equally. They absorb high frequencies much better than low frequencies. That results in a very dull-sounding room, often with prominent mid-frequencies emphasized.

Absorbing mid- and low-frequencies is much more complicated. Mostly, absorbing lower frequencies requires a lot more depth of materials than the usual 3 to 5 inches used.

An anechoic chamber, which has no reflections at any frequency, has absorbers that are many feet thick. Not practical at home.

So, you will have to live with the fact that there are going to be an unpleasant emphasis on lows and mids. This can muddy up your recording, and no amount of equalization is really going to fix it.

You can reduce this effect by close-micing, and minimizing the number of mics in the room.

The ceiling is often the easiest place to add sound absorption. An acoustic tile ceiling is a start, but like many sound-absorbing materials, their effectiveness drops as the frequency goes down.

Usually, however, there is space above the acoustic tile suspended ceiling, and you can use that space to add additional absorbing material.

In my studio and control room, there is about two feet of rock-wool insulation above the suspended ceiling.

Absorption above also has an advantage for performers. Although our microphones don't really know where the sound reflections are coming from, our ears do. So, for musicians playing in the room, they lack of reflections from above sounds more natural to us.

This may be because humans have spent most of their evolution under an open sky, and out hearing has adapted to the lack of reflection from above to provide us with a better sense of sound localization.

And the fact that your not-very-soundproof walls might absorb a significant amount of the low frequencies simply by passing them through the wall largely unattenuated.

But the mid-frequencies are where small rooms have their largest problem.

There are ways to "trap" some of these mid-frequencies, using devices tuned to the problem range, but don't expect miracles from that approach, and be prepared to lose a lot of space.

Of course, performers wearing headphones may not notice the difference. But it does make the space more comfortable during the set up and run-through phase.

Am I making small rooms sound impossible to use for recording?

No, there are ways to get around most of these problems, but it will certainly make you appreciate a larger room.

One other technique we can use to improve our space is **diffusion**. This is simply reflecting the sound around the room in a random fashion. Rather than a hard, even surface of a wall, think of things that have random depth and angles.

The easiest way to hear this at work is in a cathedral, where the sound echoes for a long time after bounding off the stone walls. But most cathedrals have columns, side chambers, pews, and an arched ceiling. The sound you hear has bounced off all these different surfaces and merged into a pleasant jumble of reflections we call reverberation. As opposed to the hard echoes off a flat surface.

Well, your spare room is not a cathedral, but you can still take advantage of random reflections using a device called a diffusor.

These can be purpose-built, or even bought commercially, but you need to understand what and how they work. And you may have a lot of diffusion already in your room, especially if there is furniture, bookcases, or other objects that can reflect sound randomly due to their uneven surfaces.

If you need to build your own diffusors, it's not difficult. There are several photos of different diffusors at the web page linked to this episode.

Keep in mind that minor variations in reflecting surfaces are minimally effective. You want the maximum depth possible, to spread out the sound in time. As an easy approximation, sound travels about one foot in one millisecond – a thousandths of a second. Your hearing needs at least 5 to 10 milliseconds to perceive a time difference, which means, in theory, a diffusor has to be 5 to 10 feet deep to be effective.

In reality, you don't need that much depth to improve the sound, but keep in mind that the deeper the diffusor the better it is going to work. Within reason, of course. And installed a couple of square feet of diffusion in a room is unlikely to make a dramatic difference. It takes a significant amount of diffusion area to help the sound.

In my studio, in its early state, the rows of metal shelving and mostly random contents on the shelves provided a remarkably good sound. Also, in the space were utility structures, such as a hot water heater, water storage tank for our well, and cylinders for a water conditioner. It was a wall of diffusion, and helped a lot with the sound.

Cylinders make great diffusors. Even a half-round object will help.

Abbey Road Studio 2 is a large, brick, rectangular box with no dedicated diffusion at all. However, there are sound-absorbing hanging structures that help control the high-frequency reverberation, and it is a room with a lot of stuff in it: several pianos, organs, Leslie cabinets, racks for folding metal chairs, many mic stands, large and small, and even larger rolling racks for headphones. All these things provide significant diffusion. And your space might also have objects that will diffuse the sound.

Suppose you are recording your band in your improvised space. You might want to provide a lot of isolation between the pickup of the various instruments. This might be because you might replace an

instrument later, of maybe you just want good isolation so you can process that one sound without affecting the other instruments.

Achieving good isolation between instruments in a small room can be challenging. Everyone is close together, by necessity. You might be recording instruments that are not compatible in level, such as a vocalist standing near the drums or electric guitar.

You can help this problem in several ways:

You can improve the isolation by placing sound baffles between instruments. This can help to some extent.

You can use directional mics to reject the unwanted sounds.

You might be able to use different rooms in your house for different instruments, keeping in mind the acoustical problems of soundproofing, absorption, and diffusion. Or you can record each instrument separately, over time, so there is never more than one sound at a time.

All these techniques can be used as needed to isolate instruments or vocals.

Just keep the acoustical principles in mind so that when you put everything together in the mix, it still sounds like you are recording in a believable acoustic space.

Another approach to recording at home might be to close-mic everything, and make your space as acoustically dead as possible, so that there is no discernable sound of the room. This alone can be effective on some types of music.

But mostly it is not a good sound, in my opinion. You need the sound of a real space to make the recording appealing.

And this can be entirely subconscious to the listener. Or even to you. Adding artificial reverberation may be useful in this scenario.

Other considerations for you improvised space include lighting and HVAC. Even if your space has good heating and cooling, and nice lighting, these things can still affect the sound.

Let's take **HVAC** first. It should not make any noise you can hear on the recording, obviously.

One easy solution is to simply turn it off during recording. That's what I do in my studio.

Of course, the space will eventually get to hot or too cold, so you may have to turn the system back on during a break.

But another potential problem with HVAC is sound transmission through the ductwork.

Even if you have gone to considerable effort to soundproof your space, ductwork can render that worthless.

Sound travels easily through metal ducts, from room to room, throughout your house.

And never let an HVAC contractor tell you that sound cannot travel against the airflow. This is ridiculous, but I have heard it often.

The design of ductwork for sound isolation is complex, expensive, and takes up a lot or room. Something to keep in mind.

One solution, if the ductwork does not already exist, is to use a separate HVAC system for your recording space. This might be less expensive than you might think, so it's worth looking into.

If you have a separate studio and control room, they should be on separate HVAC systems if you want reasonable sound isolation between the rooms.

Lighting seems so simple. What could possibly go wrong?

A lot, actually, and its mainly because of the newer, higher efficiency lighting we use.

Newer technologies like LEDs and the obsolescent compact fluorescent bulbs can be significant sources of electrical interference.

Well-designed and properly installed professional recording equipment
is largely immune to this electrical interference, But electric instruments, and even some microphones, will pick up the electrical static from these bulbs and you will hear it on your recording. It sounds like a hum or buzz and it can be difficult to minimize after the fact.

Incandescent bulbs, despite their inefficiency and heat, never make any electrical noise.

That's why in my studio, and in a lot of professional studios, only incandescent lighting is used.

By the way, traditional florescent lights are relatively quiet – unless the bulbs have been replaced with LED substitutes. I'm all for saving energy with new lighting technology, and I use it extensively in non-audio critical application, but you need to be aware of this potential noise source.

Another major electrical noise source are light **dimmers**. Dimmers produce the same sort of noise as LED bulbs, and usually cause similar problems in the studio.

Dimmers, LED bulbs, and other common devices work by chopping the income electrical power into short segments, which contain a lot of unwanted energy that can affect a wide range of electronic equipment.

In my studio, I found that the LED bulbs that came with the light fixtures were so noisy that the buzz even got into some of my ribbon microphones. I replaced the bulbs with incandescent bulbs, but they produced a lot of heat, and sometimes were too bright for the session.

I installed a dimmer, one that purported to be electrically quiet, but the noise was intolerable.

I used a portable radio as a noise detector, to see just how far this noise traveled. I was amazed to discover that the noise was strong throughout the building. Evidently the noise was radiated by the building AC wiring.

The problem was solved by using a rheostat-type of dimmer, which is completely noise-free.
But at a price. The rheostat dimmer was about 5 times the cost and much larger.

If you want quiet lighting, I would suggest incandescent bulbs without dimmers, or if dimmers are necessary, use the expensive rheostat type.

You can get excellent results in your home studio, as long as you understand the principles of

- soundproofing
- sound absorption
- sound diffusion
- and use the proper HVAC and lighting techniques.

All of these things will not only make your recordings sound better, but will also make your recording environment more comfortable.

Ideally, the technology will disappear, and your space will be comfortable to work in. Those things are key to providing a creative atmosphere.

And what could be better than having a recording set up that is always convenient and ready to go.

This is My Take of Music Recording.
I'm Doug Fearn
See you next time.