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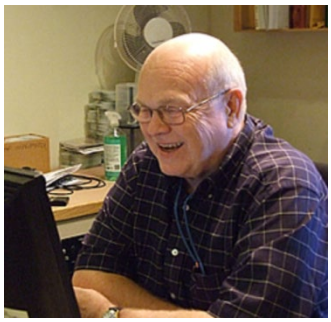
Broadcast Operations

Planning Your Studio Build
Part 4 – Acoustical Considerations



by Gordon S. Carter, CPBE, DRB, CBNT

[August 2021] This is the fourth installment of Gordon's discussion of ways to ensure the process of building a studio goes smoothly.

Contrary to common practice, the time to deal with studio acoustics is in the planning stages, not after it is built. In this section we are going to take a quick look at this very involved subject.

ACOUSTICS FOR BROADCAST STUDIOS

Many books have been written on the subject of studio acoustics. However, in most cases they were referring to large studios, such as large recording studios and sound stages. Even the control rooms typically mentioned in these volumes are large compared to those in a typical radio station.

This is an important point to remember when designing your studios.

Acoustics for the radio studio is divided into three parts – isolation, noise control, and interior acoustics.

Isolation and noise control are often grouped together, but I prefer to treat them separately.

As you will see, each of these items has considerations that may take up space that you may not think about. They are usually hidden so are not thought of. Failure to plan for this and not have the space available may cost you money and compromise your end results.

ISOLATION

Proper studio isolation keeps unwanted sounds out of your studio, and will also keep sounds in the studio from disturbing others around you.

This can be anything from airplanes flying overhead, traffic noise, footfalls from people walking in the building, and conversations in other parts of the building. The best way to keep these sounds out is to not have them in the first place, but that is not always possible or practical. You would not want to build your studio under an airport approach, or over a subway, or near a major highway, but sometimes you are stuck.

Just remember that the louder the unwanted noises, the more expensive it is to keep them out.

TRUE ISOLATION

The best way to isolate rooms is with "room within a room" construction.

The floor for each room is built so that it floats on top of the main supports for the floor. There are several ways to do this, but all are well beyond the scope of this paper. The building techniques are not difficult, and most contractors can handle it as long as the design is properly done.

All of the walls for the room are then built on the floating floor, so there is not contact with the main floor. Each of the walls should extend to the bottom of the floor above, but not be connected to it. The ceiling for the room is then built so it only connects to the walls. When you are finished, the only rigid connection for your room should be to the floating floor.

Where it is necessary to have a connection to anything else, it should be a flexible connection to reduce any transmission of vibrations.

Adjacent rooms are all built in the same way, again with no rigid connections to other rooms.

A GOOD BUT NOT TRIVIAL SOLUTION

All of this takes up unseen space.

The walls between rooms will be at least twice as thick as a normal wall, the floating floor may take up 4 to 6 inches or more depending on construction, and the interior ceiling will reduce the floor to ceiling space of the room. The floating floors will require either a ramp up from the main floor, or some sort of raised floor with transitional ramps to the main floor.

Ramps are required as this would almost definitely have to meet ADA requirements. A quick reminder about ramps – it takes up a lot of space to be compliant with ADA requirements.

To get proper isolation, acoustic doors and windows must be used. The doors will be heavy, and you may want a quiet action on the door. Mechanical closers and latches may not be an option, depending on your needs.

When the door is closed, it should seal on all sides, including to the floor. On the other hand, the bottom of the door must be above the floor when opening. Again, a mechanical floor sweep may not be an option. Many times special hinges are used that lift the door when it is open, but allow it to seal when closed.

LOOKING AROUND

Windows are a bit easier, as they are typically two pieces of glass (one for each side of the wall) with a gap in the frame between them.

When planning for windows, plan your sight lines carefully. Acoustic windows are expensive, and are typically a weak point in the isolation, so you may want to keep the size to a minimum.

Some have chosen to use video cameras and monitors instead of windows. Either will work, but plan carefully. A small room with no openings may feel claustrophobic to some people. Cameras can be limiting as to what they can see but this can be eliminated by using remote pan, tilt, and zoom cameras. Nevertheless that requires a means of control.

WHERE THE WIRES GO

Any studio or control room in a radio station is not much use without a way to get wires in and out.

Floating or not, you need AC, data, audio, and a host of other things in even the smallest rooms. All penetrations of the exterior of the room need to maintain flexibility so they are isolated from the rest of the building.

Use flexible couplings on conduit, pipes, air ducts, and anything else. All entrances should be from "quiet" areas. In other words, do not make a connection from one room directly to another. Instead, go from each room to a "quiet" area. This reduces the ability of sound to travel from one room to another.

In the case of conduits (regardless of what is in them) the ends of the conduits should be sealed around the contents. There is special flexible material available for this. Also, outlet boxes and other fixtures in the wall should all be sealed to the wall.

A PAUSE FOR REFLECTION

Now that you are thoroughly confused – and we really have just started – it is a good time to remind you that this is an appropriate time to reach out for help.

While a good consultant is worth his weight in gold, someone who is experienced in building studios can also be a big help. It has been my experience that every time you do one of these projects, you learn more about how *not* to do it.

Tapping into available experienced folks will help minimize the mistakes on this project.

NOISE CONTROL

The subject of noise control is one that is often overlooked until it is way too late to effectively do anything about it.

There are two primary types of noise that can be a problem in a broadcast studio – mechanical noise and electrical noise.

The primary contributor to mechanical noise is the air handling system. The blowers, fans, heaters, compressors, ducts, and even the air itself make noise. Since they are so common in our modern world we often overlook them or tune them out. Also, if you are doing any critical monitoring these noises can hide things that you may be looking for.

However, all of these things can be heard, especially by a microphone.

We are so good at tuning these noises out in our everyday world that white noise (the sound of air moving) is often used in office environments as a "masking" system. A small amount of noise, usually introduced to the room from hidden speakers or paging speakers, is very effective at limiting the distance at which something can be heard.

While such actions are often used in open office environments to help insure privacy from work space to work space you really will not want to have them affect your Control Room acoustics.

DESIGN CONSIDERATIONS

While a very quiet space requires careful design, there are some common sense things that can be done to start with.

First of all, anything with rotating components (motors, blowers, compressors, etc.) should be on isolation mounts. These are usually supplied with some sort of spring assembly mounts, but not always. It is important that these mounts be matched to the device. If a mount is too stiff, it will have no effect. If it is not stiff enough, it will compress too much and again have little or no effect.

Additionally, whenever possible rotating devices need to have good bearings and be properly balanced.

There are several classes of bearings, and each class has a different "smoothness." Higher class bearings are smoother, but also much more expensive. Balancing is also important, just like it is on your automobile tires. A rotating device that is not balanced will vibrate, especially at higher speeds – and excessive vibration will create excessive noise.

Belts also need to be properly aligned, again to reduce vibration.

Finally, all of these things need to be checked regularly to make sure they have not deteriorated over time. Belts and bearings wear, balancing weights fall off, and other things happen that will increase vibration and noise.

GETTING THE AIR INSIDE THE ROOM

At the other end of the system, where the air enters the rooms, is another spot that designers often overlook for noise control.

Air, when it is not moving, is quiet. As the speed of the air, and the resultant turbulence increases, so does the noise it generates. Since the purpose of the air handling system (HVAC) in a studio is to keep the room warm or cool, air has to move to carry the heat from one place to another.

The amount of heat the air can carry is dependent on the volume of the air being moved within a certain period of time – there are only a few things that can be adjusted to make it quieter. Slowing moving air will reduce the noise, but will also reduce the volume unless you increase the duct size and thus the register size. As you increase the air speed you can reduce the duct size, but at the cost of increased noise.

As you might expect, these trade-offs all affect the amount of space required for the air handling.

MORE ON AIR SPEED

When the air enters the room, the air speed should be at a minimum.

This will reduce the noise from the air itself, and will also make microphone placement easier, as you would not want to put a microphone in moving air. Ideally, the air supply for the room (both heating and cooling) should be at as low a velocity as practical. This is commonly achieved by having the air fall into the room rather than being forced in by a fan or blower. This will keep air noise to a minimum.

Registers with diffusers should be avoided as much as possible, as the diffuser will increase the air turbulence and thus noise. Again, the more area for the registers the lower the air velocity can be, and thus the noise.

PUTTING YOUR DUCTS IN A ROW

The ducts themselves are another potential source of noise. Rooms sharing a duct should be totally avoided

Each room should be fed by a separate duct that connects to the system as near the core of the system as possible. As we noted, larger ducts allow for lower air velocity as the duct itself can contribute to the air turbulence. If possible, the ducts should be lined on the inside with a fireproof soft material. The idea here is to provide a diffuse interior of the duct to reduce air turbulence.

Any transitions in the duct (changes in direction or size) should be smooth. A change in size should be tapered, with the taper being as long as possible, but at least two to three times the duct size (diameter for round or diagonal for rectangular). Turns should be as gentle as possible with no hard corners but flowing curves. Similarly, all transitions should be at a length of least two to three duct sizes removed from the registers to the rooms.

In most cases, studio facilities will also need dampers or duct silencers. These are typically used to reduce sound being transmitted through the ducts, either from the HVAC system itself or from other room. Duct silences work similar to a car muffler.

There are several performance levels for duct silencers, so make sure you have ones that are suitable. As with duct transitions, the duct silencers should be as far removed from the entrance to the room as possible – at least a

length of two to three duct sizes from other transitions. There are solid reasons for all of this, but the calculations and discussion again is beyond the scope of this paper.

DO NOT RUN OUT OF SPACE

As you can see, doing all of this right takes up a lot of "hidden" space. Failure to plan for this will definitely compromise the performance of the system.

While we are primarily talking about the planning stages here, it is likely that your mechanical contractors (sheet metal and HVAC) will try to convince you that there are better ways to do this. They may want to put in hard right-angle turns instead of sweeping curves, because it will take up less space.

Or they may want to put things in the ducts too close to each other, or use smaller duct silencers, all in the name of saving space. Yes, it will save space, but at the cost of performance.

Also, it is typically easier for them to make and install that way. Again, a good consultant who is familiar with this type of construction can help you make the right decisions, as well as helping convince the contractors to do it the right way.

INTERIOR ACOUSTICS

It seems that many people simply build the shell of their studios, install the equipment, and then –
after the installation is finished – decide to do something about the interior acoustics.

However, that is the point when they find out there is not enough room to do what they want – or what is necessary – and the room then becomes a studio that no one wants to use. Even worse, sometimes they the room is simply built wrong and they find it is thus basically unusable.

A much better way to go is to plan the acoustics, along with the equipment and other parts of the building.

Allow enough space for any acoustic treatment on the walls, as this is often overlooked. If possible, it is best to do an acoustic model of the room with the equipment in it prior to construction. This will give you an idea of where you will need acoustic treatment on the walls.

Small rooms are a bit tricky to model accurately, especially for low frequencies. Also, many consultants do not regularly work with small rooms and do not take into consideration the special needs of small rooms, so choose your options wisely.

On the other hand, I have found it is often easier and cheaper to design the acoustics in a small room, especially one used by only a few people at fixed locations, so that each location is an acoustic "sweet spot." If it is a room with live microphones, each microphone should be in a "sweet spot." For listening, a single pair of speakers that covers all the listeners may be necessary, but all listeners should all be in a decent listening area.

Ultimately, it may be worth the cost to have a consultant run an acoustic evaluation software program to identify the sweet spots – and those that are not!

ROOM PROPORTIONS

Before proceeding, a few words about proportions of the room.

Typically, when you are building a studio you have a limited finished ceiling height, usually

determined by the distance from the floor to the floor above and the mechanical equipment (ducts, pipes, conduit, etc.) that must be above the finished ceiling. Careful choices of sizes and placement will give you some flexibility here, but not much.

You will generally have more flexibility on the length and width of the room, but there are always limitations.

For decent acoustics, it is best to avoid dimensions that are multiples of each other or some common number. Using dimensions that are prime numbers (numbers that are divisible only by 1 and themselves) is a help for this. If any two dimensions in the room are divisible by a common number the chance of this supporting an acoustic standing wave, and thus destroying your sound quality, is greatly increased.

There are a number of "golden proportions" that have been suggested, and I will leave it to you to find them, but the best way is to keep the proportions of the finished room as far from a common divisor as possible.

YOU NEED ROOM FOR YOURSELF

When planning the room size, be sure to allow enough room around any equipment to provide access for service.

Having to contort your body or otherwise lay on the floor (sometimes upside-down) to access wiring is never a good situation. Some designers plan a shallow closet for most wiring and ensure there is plenty of room around the furniture.

This will also apply to rack rooms and even the engineering shop. And do not forget storage. All too often the shop – or worse, the transmitter room – becomes a storage site for all sorts of gear, paper, etc. Having sufficient space for ongoing storage will solve a lot of problems.

READY TO GET GOING

Now that we have designed our facility, it is now time to begin building.

Yes, often it is necessary to begin some construction prior to having final plans for the interior, but for the sake of writing convenience we will address construction as a separate subject in our next installment.

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