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TEN WAYS TO AVOID MAKING COSTLY BUILDING-NOISE MISTAKES

Building Acoustics White Paper

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INTRODUCTION

How many times have we heard Henry de Bracton's famous quote, "An ounce of prevention is worth a pound of cure"? Yet, when it comes to buildings, proper acoustical measures during initial design are often overlooked with unfortunate consequences. These consequences include poor sound isolation between residences, lack of speech privacy in offices, noisy common areas, deafening HVAC systems, building vibration, and, in the end, unhappy clients.

Of course, with proper planning, all of the issues can be avoided. This White Paper outlines ten ways to avoid the most common acoustic design pitfalls.

RULE 1 – OVERBUILD TO CODE

The Uniform Building Code (UBC) provides standards for sound transmission between walls in residential units and sound and impact isolation for floor/ceiling assemblies. Basically, these ratings are a Sound Transmission Class (STC) 50 for separating walls and floors, and an Impact Insulation Class (IIC) 50 for floor ceiling assemblies.

Really, the first rule, is to build to code. But building to code does not always result in meeting code. because, in practice, partitions and floors never are as good as they are rated. In the real world, assemblies are never installed perfectly and it is an unfortunate fact that the wall or floor may not achieve the proper ratings.

In addition, the UBC represents a *minimum* standard. We have found that even when the UBC is met, there still can be complaints regarding noise transmission. This is especially true when dealing with music, which can include a lot of low frequency sound.

Therefore, we recommend overbuilding to code. That is, choose a structure with an assembly that has a rating better than code requires. See the Figure 1 for an example.

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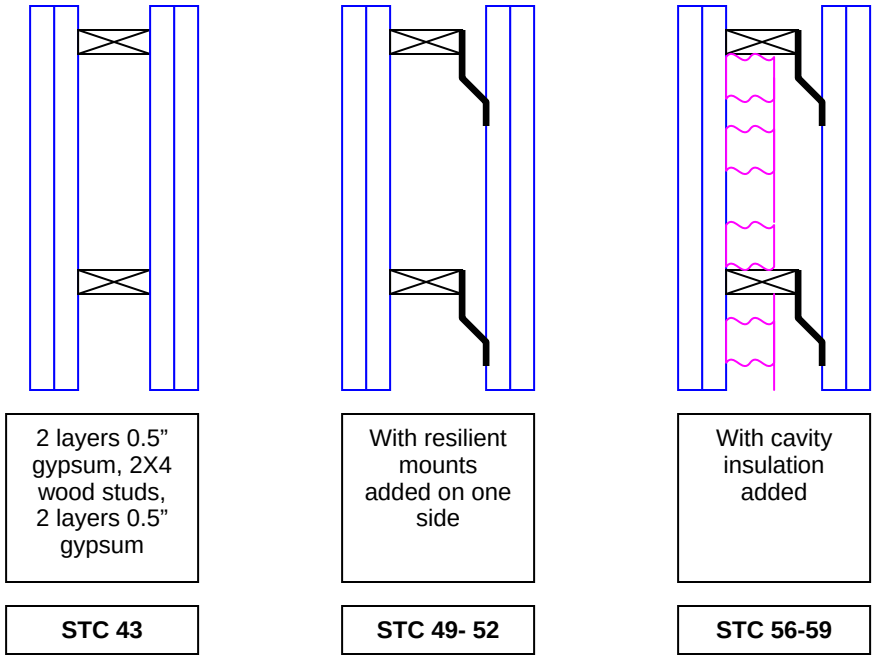


Figure 1: Comparison of STC Ratings with Relatively Minor Changes

A good free reference on walls and floor assemblies is U.S. Gypsum's "Acoustical Assemblies," Catalog number SA 200 (www.usg.com).

RULE 2 – CONSIDER THE RIGHT AMOUNT OF PRIVACY

Too little noise can be just as bad as too much noise. Consider a hospital waiting room where the receptionist is only a few feet from the nearest chair. If that room is too quiet, then the conversations between the receptionist and patient can easily be overheard by others in the waiting room. The same is true in open-plan offices, where only a small half-height partition separates workers. In an environment that is too quiet, phone conversations can be heard across the room.

Speech privacy can be improved by strategically adding absorption to the room to reduce reflections and by adding to the background sound level. In most applications, room sound absorption is accomplished through absorptive ceiling tiles and carpet. Background sound can be introduced through the HVAC system or through commercial noise systems.

RULE 3 – USE SOFT FLOORS OR UNDERLAYMENTS

There is nothing worse in an apartment than being woken by your upstairs neighbor's kid clomping around in the middle of the night. In both office buildings and apartments, sound and impact insulation in the floor/ceiling assembly is a critical component of building design. Laying carpet is one of the best ways to reduce impact noise; however, where carpet cannot be used, commercial underlayments that dampen footfall and other impact noise should be used. Adding mass in the floor, such as poured concrete, combined with resiliently mounted ceilings, is an excellent way to reduce low frequency noise.

RULE 4 – DON'T STRAY FROM STANDARD DESIGNS WITHOUT EXPERT ADVICE

Noise is a tricky business. Acousticians regularly deal with tracking down resonances, flanking paths, and various oddities in construction. So, if a partition has been tested to meet code, don't change it unless you have expert advice. We have seen many times when an architect or contractor adds to a specific design to make it better, only to make it worse.

The most common of these mistakes is to add a resilient mount between layers of sheetrock, rather than between the stud and the sheetrock. Often, the only way to correct for these mistakes is to rip out the entire assembly and start over.

Another mistake is to use a different truss system than has been specified. You will find very different IIC ratings when you replace, say, a 2 X 10 wood joist with a manufactured beam. For example, we have found that TJI joists have a lower performance with respect to impact noise than solid wood or web joists.

RULE 5 – SEAL UP SOUND LEAKS

The best wall system can end up as a disaster if sound leaks and flanking paths are not sealed. For best results, seal all wall-to-floor and wall-to-ceiling joints, as well as any other openings (electrical panels, recessed lights, etc.) with acoustical caulking. If double or triple layers of sheetrock are used, then caulk the seams of the inside layers with non-hardening acoustic caulk.

In offices, build wall partitions up to the structural ceiling rather than to the dropped ceiling to avoid noise flanking over the top of the partition. In one of my old buildings (not built by us) we had individual offices with stud walls that went only up to the dropped ceiling. The space above the dropped ceiling was an open plenum, and, needless to say, I could hear much of what went on in the adjacent office.

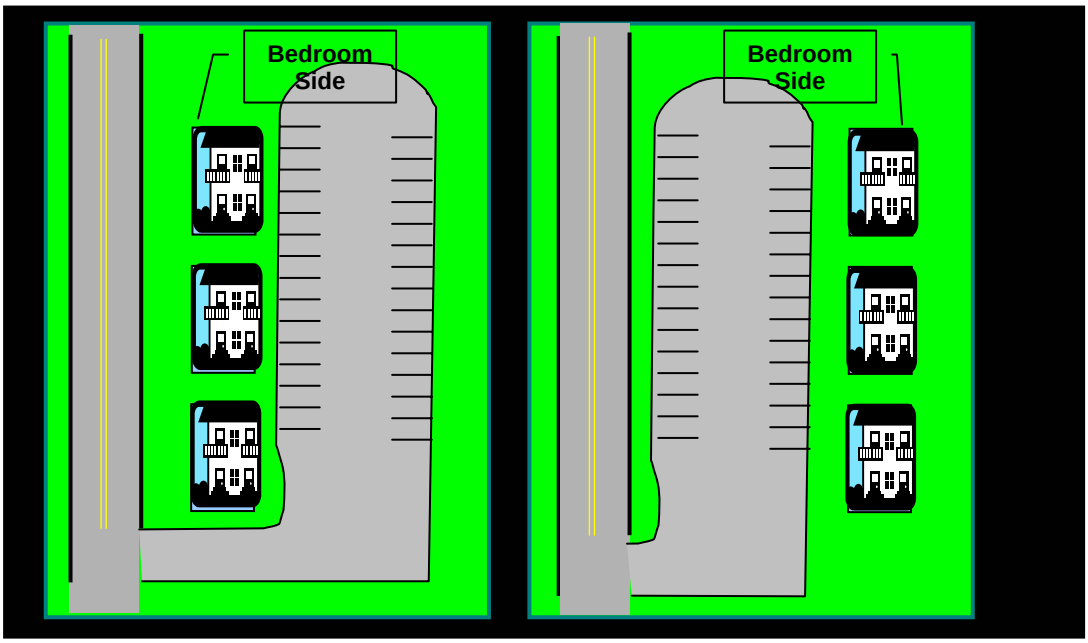
RULE 6 – ISLOLATE HVAC EQUIPMENT WITH VIBRATION MOUNTS

HVAC equipment can create an enormous noise problem, especially if located on a roof or above occupied areas. The vibrations from this equipment can travel throughout the building via structural elements.

We recommend, as a matter of course, to isolate HVAC systems that are located above occupied areas. Vibration isolates are relatively inexpensive to install during construction, but can be very expensive to retrofit later on.

RULE 7 – CONSIDER THE LOCATION OF NOISY EQUIPMENT INSIDE AND OUTSIDE

Sometimes the best noise control solutions are often the most obvious. My favorite is "keep people and noisy things away from each other." This means that if there is a choice between putting a kitchen or a bedroom next to a busy road, then choose the kitchen. See Figure 2 as an example. Or, if a building has an emergency generator, put it below a noisy common area or bathroom, rather than below an office or conference room.



BAD **BETTER**

Figure 2: Moving the People away from the Noisy Road in a Development Site Plan

RULE 8 – RUN MAIN LINE OF HVAC EQUIPMENT THROUGH CORRIDORS AND USE LINED DUCTS

HVAC ducts can be excellent movers of noise from one room to the next. Without any significant absorption or sharp turns, they can conduct sound for over a mile. Therefore, it is best to line ducts as much as possible and to run the main lines through corridors rather than between rooms. See Figure 3 as an example.

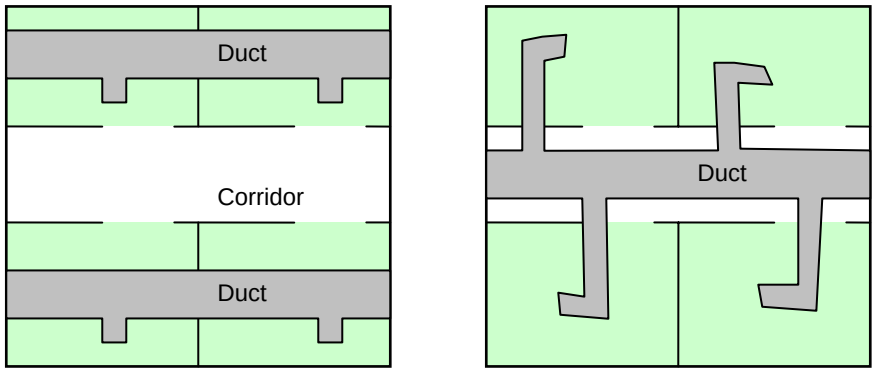


Figure 3: Example of Running Lined HVAC Ducts to Avoid Flanking Noise

RULE 9 – WRITE A SPECIFICATION TO MAKE EVERYTHING CLEAR

While a wall may have a certain STC rating in "the book," it means nothing if the wall is not installed correctly. One should not assume that contractors are familiar with proper acoustical techniques. Therefore, it is always best to write up a very clear specification for how the wall is to be constructed. That includes specifying where and how acoustical caulking is to applied, how sheetrock is to be screwed to resilient mounts, etc.

RULE 10 – GET EXPERT ADVICE AND REVIEW

Proper acoustics should be part of the plan rather than an add-on. The best buildings I have seen incorporate acoustical principals without it being obvious. Acousticians and noise control engineers have a vast array of tools and materials to accommodate proper design. We recommend having a properly trained expert as part of the design team and involved in the earliest stages of planning. A good place to find these individuals is through the National Council of Acoustical Consultants at www.ncac.com.

About RSG, Inc. – RSG specializes in the planning, analysis, and management of business, infrastructure and natural resources. We believe that high-quality, objective analysis is a prerequisite to resolving complex problems. More than just analysts, scientists, and technicians, we're communicators – our study results are clear, concise, and directly applicable to a client's particular questions and challenges. Our solutions are creative and grounded by 20 years of experience with clients as large as federal government agencies and Fortune 500 companies and as small as local interest groups and municipalities.

About the author – Ken is a licensed professional engineer and is Board Certified through the Institute of Noise Control Engineering. He is also a member of the Acoustical Society of America and has participated in the National Council of Acoustical Consultants. At RSG, he is director of the Environmental Services Division and has been with the firm since its founding in 1986.