THE SOUND AND THE FURY

How to tame the noise that annoys: HVAC rumble, TV blare, raucous-kid racket, thumping treadmill... BY STEVE HAAS

For centuries, grand homes have been created with wonderful architecture and beautiful interiors—designed to appeal to one's sense of sight and touch. Yet how do these same houses *sound*? Odds are, not very good. Can conversations and music be heard through the walls and doors? When the kids run around upstairs, does the thumping sound, from below, like a stampede? Are the heating and plumbing systems so noisy that your home sounds like a factory?

In many cases, the answers are a resounding "yes." Just ask a couple we'll call John and Michelle, who have five children and are building a very large estate in southern Connecticut. After years of living in a modest home that provided little serenity after their busy days at work, they decided to do it right—from an acoustic perspective—in their new home. They are implementing widespread design upgrades to ensure a controlled and quiet environment within their common living areas—*and* freedom from excessively loud sounds emanating from the more unique spaces: a sports court, a bowling alley, an arcade, several exercise rooms. They have even commissioned a place they affectionately call the "hideaway room"—a completely soundproofed sunroom where John and Michelle can go to escape the cacophony that five kids and their friends are bound to generate.

Creating the Sound-Taming Envelope

Considering all the noise problems that inarguably exist within homes of all sizes and types, why is it that designers and builders rarely give the widespread attention to acoustic issues that they give to visual and tactile issues? Probably because homeowners rarely ask them to do so—unless they are commissioning a specialty room (home theater, music room, exercise room, game room) and therefore are focusing on not only quality of sound but also acoustic privacy.

The disparate schedules of today's family members often result

in activities that produce "acoustic conflicts" like these: (a) watching movies or listening to audio in a home theater—or, worse, in a living room or bedroom—late at night while others are trying to sleep; (b) using a treadmill in a home gym located right above a bedroom; (c) situating a master bathroom, in which someone may regularly take a shower much earlier or later in the day than other family members, directly next to other bedrooms; (d) having kids in adjacent bedrooms who have different takes on sound—one cranking the music system, the other studying for an exam.

As homes get larger, noise distraction only increases, since larger houses require major mechanical and electrical rooms—some of which contain small commercial-grade equipment that radiates significant noise and vibration.

Once the homeowner makes a list of potential noise conflicts, a plan can be developed by the architectural design team to upgrade the wall, floor, ceiling, and door constructions to better isolate sound between specific rooms. While sources of major sound, like home theaters, often require a high degree of acoustical engineering to accomplish complete isolation, many other rooms in the home can benefit from simple additions, such as—

- Adding multiple layers of drywall or plywood on each side of a partition
- Upgrading to acoustically engineered composite drywall or plywood
- Caulking around partition intersections, electrical boxes, and other gaps with acoustical sealant
- Utilizing resilient rubber spacers and furring strips to attach drywall to the stud framing
- Adding commercial-grade sound gaskets around the entire perimeter of doors
- Installing a resilient underlayment below hardwood or tile floors where footfall noise to spaces below is a concern

All of these modifications can be done in an existing home, but they are, of course, best addressed during the initial design, since there are obvious dimensional and aesthetic issues involved in this type of upgrade. Using material in a thickness that is relatively significant in terms of sound-muffling early on in the home-building process—by building out moldings, electrical devices, light fixtures, etc.—is a whole lot easier than retrofitting acoustic treatments in a room that is already drywalled and finished. In fact, I have successfully incorporated special low-frequency treatments up to 12 inches in depth by using extended doorjambs or treating them as architectural elements covered with sound-transparent finishes. The treatment possibilities are many when acoustic and aesthetic designs are approached in harmony at an early stage in any project. >>

Choosing Effective (but Good-Looking) Materials

Classic home design dictates the use of a variety of sound-reflecting materials: hardwood and marble floors, plaster and stone walls, and vast expanses of exterior windows, to name a few. Just imagine inviting a few dozen friends over for an evening of entertainment in your new house and finding, before the first round of hors d'oeuvres has been passed, that your living room sounds like a noisy restaurant—you have to shout just to be heard by a guest who's standing three feet away!

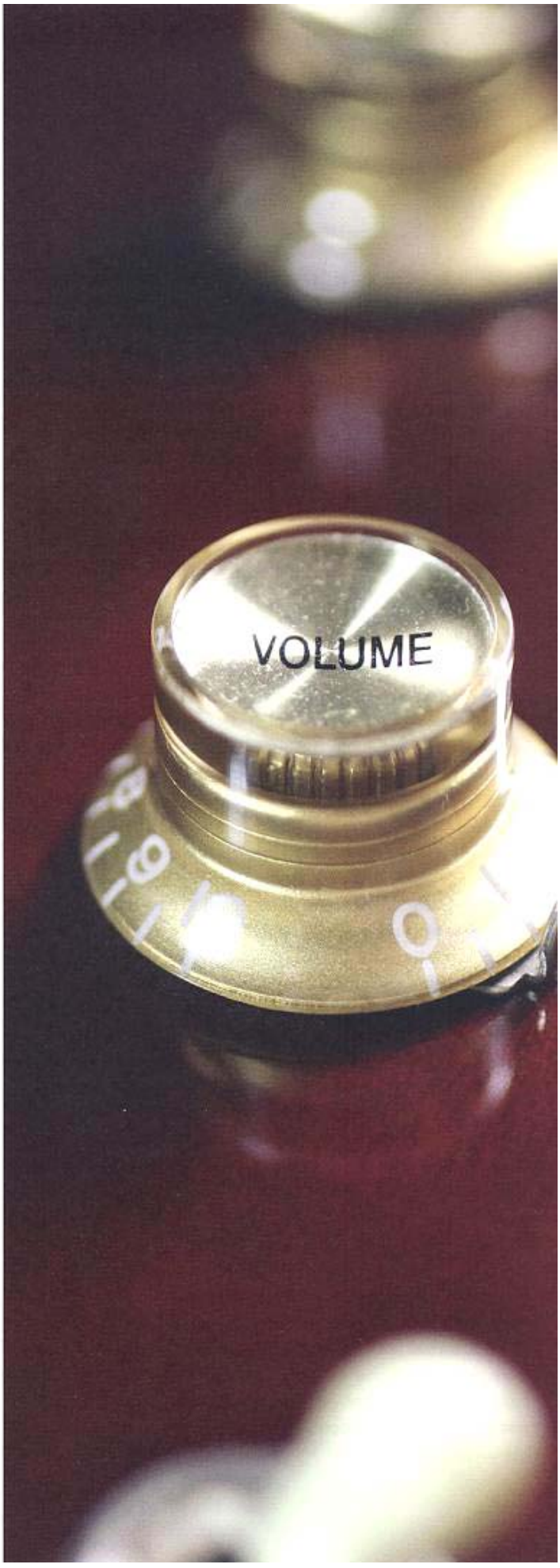
Like the difference in light spill from a room that's painted bright white and one that's a dark color—the brighter surfaces will reflect the light and amplify it in nearby areas—hard surfaces will reflect sound. The goal, then, is to reduce the sound energy as it reflects within a space and travels to nearby areas with materials that absorb sound, ideally those tested for sound-absorbing properties.

One must realize that the integration of acoustic treatments into a high-end space has two parts: (a) the core acoustic material that actually does the work of absorbing or diffusing sound, and (b) the aesthetic "skin" that covers up the often raw-looking material. An unfortunate fact of physics dictates that acoustical materials need to be at least 1-1/2 to 2 inches thick to start controlling the majority of speech frequencies, and even thicker to affect the mid-to-low frequencies of music. There is no magic "acoustic" paint that can get rid of sound problems!

This is also why the "carpeting-and-upholstered-wall" solution that most homeowners and even interior designers think will completely solve acoustic problems only ends up taking the "edge" off the sound, but still results in a resonant, unbalanced space for speech and music.

Core materials typically don't look particularly good. But there are a variety of ways to blend them with facing materials that allow sound to transparently pass back and forth without distorting. Micro-porous plasters, slatted woods, metal meshes, and a host of other unique materials have been used by interior designers to cover both acoustic materials and loudspeakers successfully.

Of course, the most common method of covering acoustic materials is with decorative fabric. And no, that fabric doesn't have to look like ugly burlap to muffle sound. In fact, a number of high-end silks, linens, synthetics, and even some wools—fabrics that meet the aesthetic of the high-end home—have successfully passed my sound-transparency tests. Although the vast majority of high-end fabric suppliers do not label materials as being certified for acoustical use (I hope that changes someday), my firm, SH Acoustics, has found more than 100 fabrics, of all varieties—from companies like Bergamo, Kravet, Scalamandré, Archive, Ralph Lauren, and numerous other high-



The reverberation time in that ballroom was 6 seconds. (Think of a large cave!) We got it down to just over 1.5.

end manufacturers—that work well and that designers love.

One noise-diminishing challenge for me was a large home that was to include an enormous ballroom (60 feet wide by 80 feet long by 30 feet high) in which the clients would host parties, fundraisers, and musical concerts for up to several hundred guests. They also intended to use the space as a place for daily relaxation. My firm was originally hired just to look at the lower-level home-theater design. But I soon became inquisitive about how the clients were planning to deal with the natural sound in the ballroom, since every surface was to be made of hard materials—plaster walls, wood floor, a plaster ceiling painted with an artist's mural, and plenty of exterior glazing. The clients hired us to do remedial design work to "tame" the sound of this large space.

Our initial calculations showed that when it was lightly occupied, the ballroom would have a reverberation time—the time it takes for the sound of a single hand-clap to fade away—of more than six seconds (think of a large cave!). Compounding this problem was the fact that the ballroom is very open to the rest of the house. By looking for aesthetically acceptable acoustic treatments, we worked with the interior-design team to turn what was a painted ceiling mural into a high-quality digital image printed on a wide-span (and sound-transparent) fabric. The ceiling was broken up by moldings and the fabric stretched to the shape of each section, with thick, sound-absorbing insulation material placed above it. Combining this with a smooth acoustic plaster system called BASWAphon on many of the ceiling areas in the surrounding overlooks and adjacent hallways allowed us to reduce the reverberation time to just slightly over 1.5 seconds—a condition that has resulted in a space that is the perfect compromise for hosting both spoken-word and music events.

Diminishing Hisses, Rumbles, and Vibes

Even when sound has been controlled with treatments in critical areas and isolated with construction upgrades, a home still provides a number of noise sources to contend with. Although some people can adjust over time to higher noise levels in their homes, studies have shown that being exposed to such noise only increases general stress levels, and often results in disturbed sleep.

One of the most prominent of these noise sources is the heating, ventilation, and air-conditioning system. As mentioned above, larger homes often require the use of small commercial-grade air-handling units and large outdoor condensing units and chillers, which come complete with an increased level of noise and vibration. Noise is generated both directly, by the fans, and through

turbulence created by high-speed airflow in the duct system itself. The homeowner can diminish some of this noise by working with an experienced mechanical engineer or contractor. Both the fan noise and the duct noise can be addressed through the use of low-velocity ducts, vibration isolation hangers, and sound-absorptive linings on the *inside* of the ducts (fiberglass-free linings now exist to alleviate any health concerns posed by loose fibers in the air-stream). If you're concerned about how much—or little—noise will end up being present in a particular finished room, ask that acoustical engineering software be used. It can predict final results with excellent accuracy.

Other noise sources that may cause problems and need to be considered in the home's design include—

- Lighting and power transformers
- Refrigerator compressors in kitchens and bar areas
- Pool pumps
- Exercise equipment
- Audio/visual rack equipment and video projectors
- In-wall plumbing pipes
- Exterior vehicular and air traffic

In many cases, techniques described above for room treatment and sound isolation may help prevent these noise sources from becoming sore issues. Going to the next level of assurance would involve bringing in an expert to engineer more predictable solutions.

The most important things for homeowners and designers to realize with respect to the quality and control of sound in a home are that (1) problems like those described in this article occur far too often because no one thought to address them at the appropriate early stage of design, and (2) the integration of acoustic materials and methods has come a long way in recent years to embrace the aesthetic concerns of designers so that homeowners can achieve optimal visual *and* aural environments.

In the words of the late orchestra conductor André Kostelanetz, "Everybody should have his personal sounds to listen for—sounds that will make him exhilarated and alive or quiet and calm." And that is what—if the owners have foresight—today's dynamic, personalized home environment can provide: a residence that resonates when they want it to (say, to Chopin in a beautifully sound-controlled living room, or to shouts and crashes in the home theater), but that offers, when they desperately need it, the sweet sound of silence. TME

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