

This Quiet House

Noise Control for the Home — Reducing the Intrusion of Indoor Sources

This is the second in a series of articles concerning noise control for the home. The first article discussed ways to control outdoor noise sources from intruding on your peace and quiet. This article targets the noise sources that are inside your home.

As was mentioned in the earlier article, any noise control process involves controlling sound either at its source, in the path between the source and listener, or at the listener. The most effective way to control noise is at its source. If the source of noise is an appliance, your best option is to replace it with a quieter model. This may be less expensive than your other options, depending on the situation. NPC and the Consumer Union have lots of useful information on the noise ratings of household appliances, so you should check these out, especially if your other options would involve reconstruction. In some cases, however, replacing the source is not possible or practical, especially when that source is a person or animal. Since controlling noise at the listener is often intrusive itself (requiring such measures as having the listener wear hearing protectors), we most often look at the path between the source and listener when designing noise control measures.

Distance and intervening walls are the most practical options for noise control in the house. Whenever possible, it's best to avoid setting up an inherently loud room (a bathroom or utility room, for example) sharing a common wall with an inherently quiet room (such as a bedroom). Beyond that, there are generally three categories of indoor noise control measures – sealing, insulation, and isolation. All of these need to be addressed for adequate sound privacy in a typical house having a wood frame design with gypsum board walls. If you can use concrete in your floors and walls, more reduction is possible.

Sealing

If you can clearly understand speech or hear a sound source from an adjacent room in your house, the place

See the Summer 2005 Special Report, *Noise Control for the Home* available online at www.nonoise.org/library/qz7/HomeNoiseControl.pdf, for the first article in this series for ways to control exterior noise from intruding into your home.

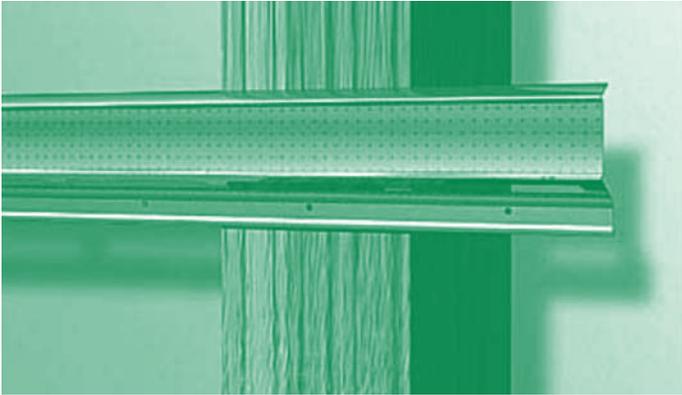
to start is to seal any air gaps in the common wall or floor/ceiling assembly. The most common openings are around penetrations for pipes, ducts, and electrical outlets, however, the walls themselves must also be completely sealed around their perimeters. Think in the same terms as if you were waterproofing a room. All openings must be sealed

with non-hardening materials, such as silicone caulk for smaller openings or firestop putty for larger ones. For windows and especially doors, this means surrounding them with rubber or neoprene gaskets, including bottom seals for doors that seal onto solid (uncarpeted) thresholds. It's impossible to get a tight seal between door gaskets and carpet and, because of that, more than 10 decibels of sound reduction capability can be lost by trying to seal gaskets to a carpeted floor.

Insulation

In the context of this article, insulation refers to the reduction of airborne sound between two rooms separated by a common wall. Assuming that the wall is sealed properly, there are two main aspects of walls that dictate their abilities to reduce sound transmission – mass and resilience. Doubling the mass of a wall (by adding a layer of drywall, for example) can add up to 6 decibels of sound reduction. A reduction of 6 decibels is noticeable, but it's not a significant amount. Since there is a practical limit to the amount of weight a typical home's structure can support, resilience is the key issue for insulation in houses. This can come in the form of pads, mats, springs, resilient channels and clips, and air spaces. There are also resilient glues and sheetrock that incorporate a resilient layer. The principal concept is stopping the channeling of vibrational energy through rigid connections in building components.

Air spaces in walls (using staggered stud or double-stud designs) provide the most effective sound reduction. The larger the air space, the better, but a 2-inch minimum is needed for significant reductions. If you have the space



The resilient channel is attached to the wall studs before sheetrock is applied. It decreases noise levels by dampening vibrations. Absorptive insulation should also be installed in the air cavity to prevent an amplification of sound within the wall.

to incorporate these kinds of designs, it's best to have at least a 2-inch thickness of acoustically absorptive material (such as fiberglass batts or cellulose spray) in the air cavity to prevent the amplification of sound energy inside the walls. Using these types of designs can increase your noise reduction by at least 15 decibels over what you would get from a typical gypsum wall rigidly attached to studs.

Windows and doors often have lower sound reduction ratings than those of the walls they sit in. It is important, then, that windows and doors have sound reduction ratings similar to those of the walls they rest in. Solid wood doors offer more than 10 decibels more sound reduction than the same thickness of hollow wooden doors (which typically provide less than 20 decibels of reduction). This, however, is assuming your windows and doors are sealed properly. If they're not, you may get no additional sound reduction by replacing them.



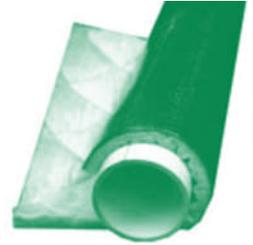
Acoustical door seal.

Ducts and pipes, even when their associated penetrations are sealed, can carry sound energy through them from one room to another. Lining the inner walls of ducts with absorptive layers of 1-inch thick fiberglass or mold-resistant cotton, combined with bending duct paths so that there are not straight lines of ductwork between any two rooms, can significantly reduce sound transmission between rooms. Wrapping the outside of pipes with so-called lagging materials is an effective measure for reducing sound travel along pipes into other rooms. Lagging materials are commercially available and usually come in sheets. They are heavy, flexible materials that typically provide 20 to 30 decibels of sound reduction. Lagging materials are also effective for controlling the sounds generated by fluids traveling through pipes, so they serve a dual purpose of reducing sound energy traveling from one room into the

next (conversations and such) along the pipe wall and reducing the sound of fluid flow coming from pipes.

Isolation

Isolation refers to the reduction of structure-borne sound between two rooms separated by a common wall. Structure-borne sound can be caused by footfalls on floors, appliances, plumbing, and loudspeakers. Drum sets can also generate structure-borne sound, which can travel throughout a house, not only to the adjacent room.

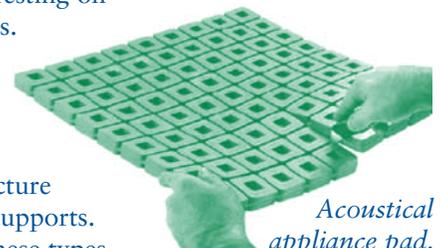


Example of lagging around a pipe.

Isolation of sound energy in wood-frame houses is a challenge. The single most effective treatment for reducing footfall noise to floors below is adding carpet and padding to a hardwood floor. If footfall noise is a concern but carpets are not an option, the other choice would be a resilient pad between the subfloor and finished floor. If floors are being vibrated by heavy equipment or high sound levels (as may occur in a home theater or studio), it's best to completely isolate the floors in adjacent rooms from the floor in the sound source's room. In this case, not only should the floor rest on a resilient layer of material but the finished floor above the resilient material should not touch the outer walls of the room.

When heavy appliances that have moving parts, such as washers, dryers, and furnaces, are above the basement level in a house, they may generate vibrational energy that can travel throughout a building's structure unless they are properly isolated from the floors they are sitting on. These appliances should be resting on resilient neoprene pads.

Pipes associated with showers, baths, sinks, and flushing toilets can be isolated from a building's structure using resilient clamp supports. The combination of these types of supports with lagging materials wrapped around the pipes can reduce plumbing noise by as much as 30 decibels, a welcome reduction in any home with a teenager.



Acoustical appliance pad.

These are the basic components of noise control for the most common sources in homes. You should seek expert advice for more complicated issues. I hope this helps in your quest for quiet.

James P. Cowan has more than 25 years of acoustics experience and is the author of Handbook of Environmental Acoustics (John Wiley & Sons, 1994) and Architectural Acoustics Design Guide (McGraw-Hill, 2000).