NPC
Special Report

Summer 2005

This Quiet House

Noise Control for the Home – Reducing the Intrusion of Outdoor Sources

by James P. Cowan

This is the first in a series of articles concerning noise control for the home. The next article will consider noise control for sources within the home.

From an engineering standpoint, noise problems are usually addressed in three general categories (in order of priority):

1. At the noise source,
2. In the path between the source and a listener, and
3. At the listener.

If the noise source can be controlled at its origin, there is no need to deal with the path or listener's location because the problem will have been solved before it leaves the source area. This is obviously the most effective and least intrusive (on listeners) way to solve a noise problem, and it has been the focus of most of the fine work that the Noise Pollution Clearinghouse has been doing since its inception.

As all of us who have dealt with an environmental noise problem are well aware, quieting noise at its source requires the cooperation of the owner of that source. Although laws and guidelines may assist us in that direction, they don't always provide full relief for everyone. When this is the case, it would be helpful to know what you can do in your own house to reduce the intrusiveness of an outdoor noise source.

Controlling Environmental Noise Outdoors

Our options for controlling environmental noise outdoors are more limited than are our indoor options. In the outdoor path between a noise source and listener, the main options are either enclosing the source or erecting a barrier between the source and listener. Since enclosing the source is often impractical, a barrier is often our only practical noise control measure for outdoor sources.

Barriers are often thought of as the cure for any outdoor noise problem, but they actually do little to reduce noise when significant reduction is needed. To provide any noise reduction to a listener, a barrier must completely break the line-of-sight. In other words, if you can see a noise source on the other side of a barrier (either over or around the sides of the barrier), the barrier is providing no appreciable noise reduction for you. Another critical part of effective barrier design is that the barrier does not have any openings that would permit light to pass through it. Air gaps in barriers will significantly compromise the already small effect that the barriers provide.

Bear in mind that diffraction effects cause sound waves to bend over and around barriers, so their maximum noise reduction effectiveness is limited to the 10 to 15 dBA range, and this is only when the barrier is fairly close to the source or listener. Also note that barriers lose their noise reduction effects with distance, and are minimally effective beyond 200 feet from the listener or the source.

As far as barrier materials are concerned, any solid wall that can stand up to the elements will perform equally as

well as any other. Although layers and mass will make a difference for enclosure walls, they will not make a difference for outdoor barrier walls. This is because the 10 to 15 dBA diffraction limit of a barrier. Any wall that can stand up to the elements also has the capability of reducing noise levels by at least 15 dBA.

Along these lines, trees generally provide no significant noise reduction. For trees to provide any significant noise reduction (more than 3 dBA) you would need a forest with trees being at least 100 feet in depth and dense enough so that you can't see through the first few rows. When most homeowners and developers think of using trees as noise control, they don't have this kind of vegetation in mind. If you prefer something natural, a berm would provide similar noise reduction to a barrier wall, but you would need much more space available to you to make that work.

So, the bottom line for outdoor noise control is that if 10 dBA of noise reduction (generally recognized as half the loudness) is enough for your purposes, a solid barrier fully blocking your line-of-sight and within 50 feet of you or the source will fit the bill, as long as you are within 200 feet of the source. If cutting the loudness in half is not enough, the noise source still will be a problem for you outdoors, even with a barrier.

Noise barrier design is not rocket science. The keys are breaking the line-of-sight between the source and listener while erecting the barrier within 50 feet of the source or the listener. This may take some geometric calculations, but you don't need a noise consultant to do them for you. The more you invest in the barrier, however, the more it makes sense for a professional consultant to double check your work and confirm that the noise will be reduced.

Controlling Environmental Noise Indoors

We have many more options for controlling noise in an enclosed space. The key here is the word "enclosed." This assumes that your windows and doors will be closed at all times; otherwise, all bets are off. Speaking of windows and doors, they are the best places to start since they are usually the least effective wall components for reducing outdoor noise. Of critical importance is that all exterior walls in your house are sealed. Any air gaps in window or door frames should be sealed with non-hardening materials, such as silicone caulk for small spaces. Non-hardening sealants are critical because hardening sealants can crack to cause air gaps. Air gaps can significantly reduce the noise reduction effectiveness of a wall, so this step should be performed before replacing any windows or doors. You may not be able to see these gaps if they are behind molding or trim, so you need to check everywhere.

Double-paned, insulated windows (when properly sealed) will provide an average of 9 dBA more sound reduction than standard single-paned windows. Adding a properly-sealed storm window or replacing single-paned glass with laminated glass can add an average of 5 dBA to the noise reduction of standard windows. Fully-gasketed, solid-core doors can easily provide more than 10 dBA more noise reduction than hollow-core ungasketed doors. The gasketing alone (including floor seals on solid thresholds, not on carpet) can improve the noise reduction effectiveness of a door by 5 to 10 dBA. Adding insulation to an attic area can add another 5 dBA of reduction from outdoor noise.

The noise reduction effectiveness of any exterior wall is driven by the least effective component of that wall. In this spirit, the first step would be to eliminate air gaps, and the next step would be to upgrade windows, doors, and attic insulation. Don't consider beefing up your exterior walls until these steps have been considered. Adding layers to exterior walls will provide little if any additional interior noise control if the windows and doors are not properly designed to match the effectiveness of the wall materials.

In a future article, I will explain how you can control noise sources that reside within your house. Insulating your home to address low frequency (below 250 Hz) noise is more complicated than described above, and this will be addressed in another future article.

James P. Cowan is a senior consultant with Acentech Incorporated, an acoustics consulting firm in Cambridge, MA, and he is the author of two books on noise, Handbook of Environmental Acoustics (John Wiley & Sons, 1994) and Architectural Acoustics Design Guide (McGraw-Hill, 2000).