by Henry R. Spies

How to Control Sound Transmission Through Floors

Reducing sound transmission through floors and ceilings is much more difficult than controlling sound on the same level. The builder faces all the problems of airborne-sound control, plus the problem of structure-borne impact noise. The expression "waiting for the other shoe to drop" must have been coined by an apartment dweller in a building with poor floor construction.

How Much Isolation Do We Need?

A building component's ability to resist sound transmission is rated by Sound Transmission Class. (For a full explanation of STC, see "The ABCs of STC Ratings," page 32.) For instance, a floor-ceiling system with an STC of 35 could reduce a noise level of 75 decibels (inside a moving car with the radio on) to 40 decibels (the average bedroom) downstairs.

In general, the perceived sound level doubles for each 10-decibel increase. The minimum desirable separation between units in multifamily buildings is 45, and preferably 50, decibels.

Materials

The ideal material to control sound transmission is both heavy and flexible. Sheet lead would be an ideal candidate, but it has no useful structural properties. Therefore, a combination of materials supplying both mass and a cushioning effect (called resilience) must be used.

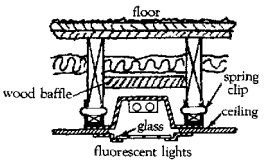
Sound-deadening board, a relatively soft fiberboard that is usually made from cane fibers, provides resilience. So do flexible metal ceiling channels for hanging drywall. Mass generally is provided by heavy gypsum drywall, plaster, poured gypsum floors, or ceramic tile set in mortar.

Although modern music systems are capable of blasting sound through almost any type of construction, the greatest problem is impact noise—primarily footsteps. The floor-ceiling structure becomes the equivalent of a drum, transmitting the sound undiminished (or so it seems). The two aims here are to muffle the impact sound by covering the floor with a resilient material, such as carpeting, and to decouple the floor from the ceiling below by making a resilient connection between them.

One approach to decoupling is a "floating" floor, which uses a layer of sound-deadening board between the subfloor and the underlayment or finish floor. The sound-deadening board must also be installed between the edge of the floor and the wall to prevent sound transmission through the wall framing to the floor joists below.

Another method of decoupling uses resilient channels or clips to attach the drywall ceiling. As shown in the drawings, resilient channels can raise the STC of a given floor-ceiling construction by 9 to 11 decibels. An airtight resilient connection (caulked joint) between the ceiling and walls is best, but a conventional taped joint between the ceiling and the walls is nearly as good. Considering cost and ease of application, this appears to be one of the most effective ways to reduce sound transmission between floors.

In bathrooms, a poured floor or ceramic tile set in mud, rather than adhesive, will be more effective because of the additional mass. A layer of sound-deadening board between the structural floor and the mud or poured floor will help even more.



For good sound isolation, light fixtures should be isolated from the ceiling, or attached to a ceiling that's isolated from the structure.

Flanking Paths

Even the best sound-resistant construction can be made ineffective by a seemingly minor error.

Any spaces that allow airborne sound to travel between floors must be tightly sealed with a resilient material, such as flexible caulks or gaskets. This includes pipe chases and electrical raceways. Thin materials do not provide adequate isolation—rather, they serve as additional drumheads to transmit the sound.

Balloon framing forms continuous air passages through the walls. Platform framing is a more effective sound isolator.

Ventilation and heating ducts also can be offenders. Common ventilation ducts for bathrooms can create a virtual speaking-tube system. If the two floors have a common heating-and-cooling system, all ducts should be of fiberglass or have acoustical liners.

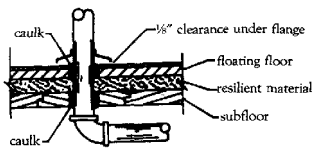
Ceiling light fixtures—particularly recessed ones—can provide a path for sound leakage. Avoid recessed fixtures where possible, and seal around all electrical junction boxes in the ceiling.

Pipes themselves contribute significantly to the problem. Use resilient couplings on all pipes that extend between floors to prevent vibration transmission. Plastic and copper drainpipes are a particular problem, since they tend to transmit more sound from waste flowage than does cast iron.

Resilient couplings, plus the padding at pipe supports, will help. But a better solution is to plan the floor layout so that the waste piping from an upper floor will not run through the walls of a quiet area on the lower floor.

I was once in a funeral home where the soil pipe from the living quarters upstairs passed through the wall of the chapel, producing a sound like Niagara Falls behind the dearly departed every time the facilities were used—an outstanding example of poor planning.

Water-supply piping should be sized sufficiently large to reduce the flow velocity, which also will reduce the noise of the running water. Again, resilient couplings and padded supports make a large contribution.



Resilient materials, such as caulk and gaskets, should isolate piping from structural components.

By combining proper planning, careful choice of materials, and meticulous attention to construction details, you can produce living units where the shoe never drops. ■

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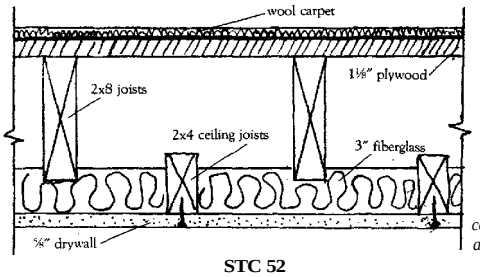
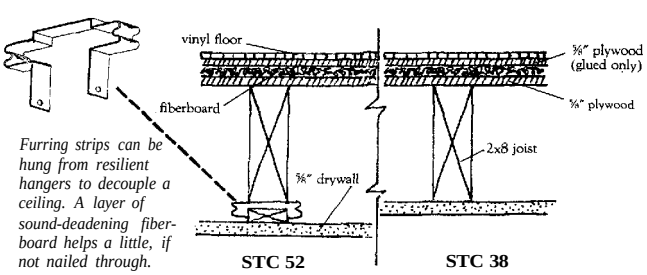


A conventional floor system (a) is inadequate for sound isolation between multifamily units. Adding fiberglass (b) improves it a little. But it's the resilient ceiling channel (c) that really does the trick.

Two-by-four floor joists staggered between the ceiling joists yield a high-STC floor system.



Furring strips can be hung from resilient hangers to decouple a ceiling. A layer of sound-deadening fiberboard helps a little, if not nailed through.