The Quest for a Quiet Room

Successful sound control requires a basic understanding of acoustics, the right choice of materials, and meticulous attention to detail

BY MYRON R. FERGUSON

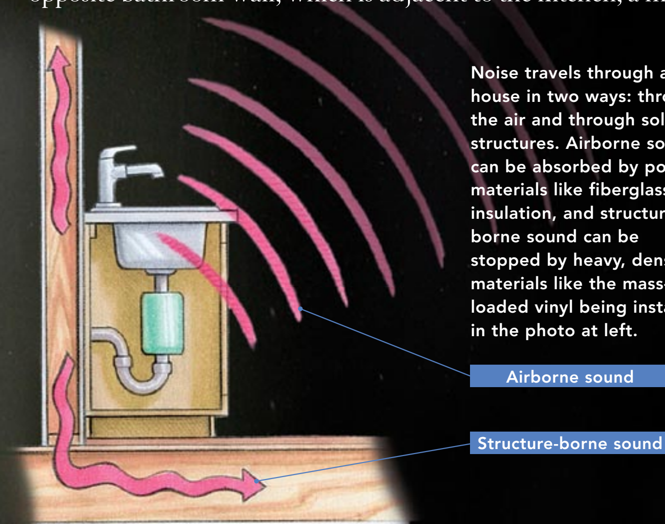
In my experience, residential sound control goes something like this: "Hey Myron, can you insulate the bathroom walls after you get the drywall attached to one side? The owner wants the room soundproofed." Unfortunately for those homeowners, throwing in a few extra fiberglass batts at the last minute won't have the dramatic effect that they want.

Some parts of sound control are highly technical and complicated, but I've found that you can get great results with just a basic understanding of acoustics, a little bit of planning, and a whole lot of attention to detail.

Sound control begins with plumbing and HVAC layout

When I was hired to do the drywall and sound-control work for the house featured here, the framing, HVAC, electrical, and plumbing already had been completed. The common wall between the bathroom and the bedroom was pretty typical: studs spaced on 16-in. centers, ½-in. copper supply lines for the vanity and shower, PVC vent pipes and drainpipes, standard electrical boxes and wiring, and a metal HVAC duct running from floor to ceiling. In short: an acoustical nightmare. Yet with a little forethought, this bathroom could have been laid out, framed, and outfitted so that the bedroom would have been much quieter.

Both the shower and the vanity could have been moved to the opposite bathroom wall, which is adjacent to the kitchen, a much



Noise travels through a house in two ways: through the air and through solid structures. Airborne sound can be absorbed by porous materials like fiberglass insulation, and structure-borne sound can be stopped by heavy, dense materials like the mass-loaded vinyl being installed in the photo at left.

less critical area for soundproofing. Be sure to think about such design issues ahead of time.

The good news is that the materials and methods shown here can address sound control in both new construction and remodels. If you don't attend to even the minutest details, though, you might be disappointed with the results you get.

Noise is often a mixture of sounds

Noise is defined as any unwanted sound, but there are main two types of sound that I need to worry about: airborne and structure-borne (drawing p. 55).

Airborne sound is created when a vibrating object causes surrounding air particles to vibrate. The resulting sound waves then travel outward in all directions like ripples in a pond.

Structure-borne sound is transmitted through walls, ceilings, and floors in the form of vibrations. Typical sources are washers and dryers, window air-conditioning units, bathroom exhaust fans, or footsteps.

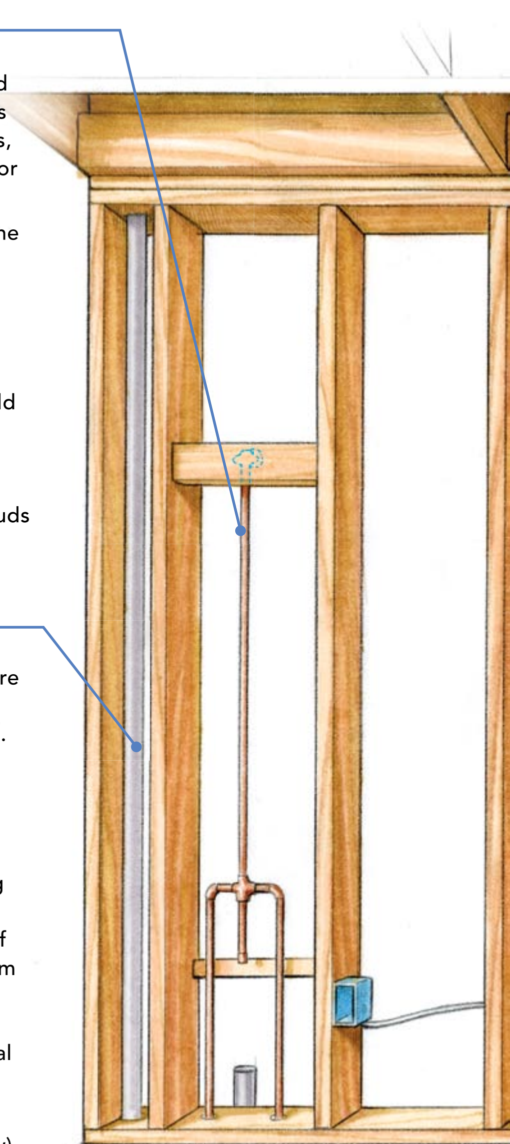
There are several options for reducing noise transmission between rooms. But because airborne sound often enters floors, walls, and ceilings and becomes structure-borne, a combination of both airborne and structure-borne solutions is usually the best course of action.

Option No. 1: Replace or treat the source. The first step in managing noise problems is to look at the source. These solutions are comparatively inexpensive and can be easy to implement. For instance, a noisy, old dishwasher can be replaced with a quieter model. Or a rattling garage-door opener can be mounted on the ceiling with rubber connectors to isolate vibration.

Option No. 2: Absorption. The key to absorbing sound is to use lightweight, porous materials. Each time a sound wave hits the

SOUND CONTROL IS ONLY AS GOOD AS ITS WEAKEST LINK

In sound-control terms, a typical wall has electrical, plumbing, and HVAC weaknesses. It's tempting to avoid addressing details, especially because they will be unseen under drywall, but skipping the caulk in a single 1⁄16-in.-wide by 16-in.-long gap can reduce an STC-52 wall (loud speech inaudible) to STC-40 (loud speech easily understood). Based on the sound-transmission classification (STC) scale, that's almost twice as loud. The STC scale is a series of logarithmic ratings that assess how well a material or structure resists the transmission of airborne sound.



Water lines

Problem: The constant opening and closing of small-diameter water lines can create noise from banging pipes, water rushing around a tight bend, or even normal flow.

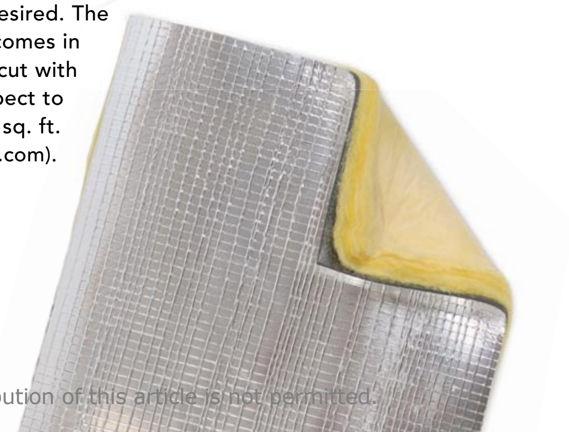
Solution: Isolate water lines from the surrounding framing to eliminate structure-borne noise. Insert a vinyl pad between the plumbing and any solid blocking to which it's attached (photo top left). Areas that have multiple bends or connections should be covered with an absorptive material. Use caulk, spray foam, or flexible plastic flanges around pipes where they pass through holes in studs or joists (photo bottom left).

Drainpipes

Problem: Plastic (PVC) drain lines are much noisier than the heavyweight cast-iron pipes used in older houses.

Solution: Isolate PVC drainpipes from any rigid framing or blocking to prevent the transfer of structure-borne noise. Typically, I do this by filling any holes through the framing with expanding foam. To block airborne noise caused by the flow of wastewater within pipes, I wrap them in a fiberglass-backed mat of dense vinyl (also called mass-loaded vinyl), secure the mat with zip ties, and seal the overlap with seam tape.

Material: Dense vinyl with a layer of fiberglass insulation (photo below) is perfect for covering pipes, ducts, or any area where both mass and absorbency are desired. The flexible material comes in a roll and can be cut with a utility knife. Expect to pay about $4 per sq. ft. (www.soundsense.com).

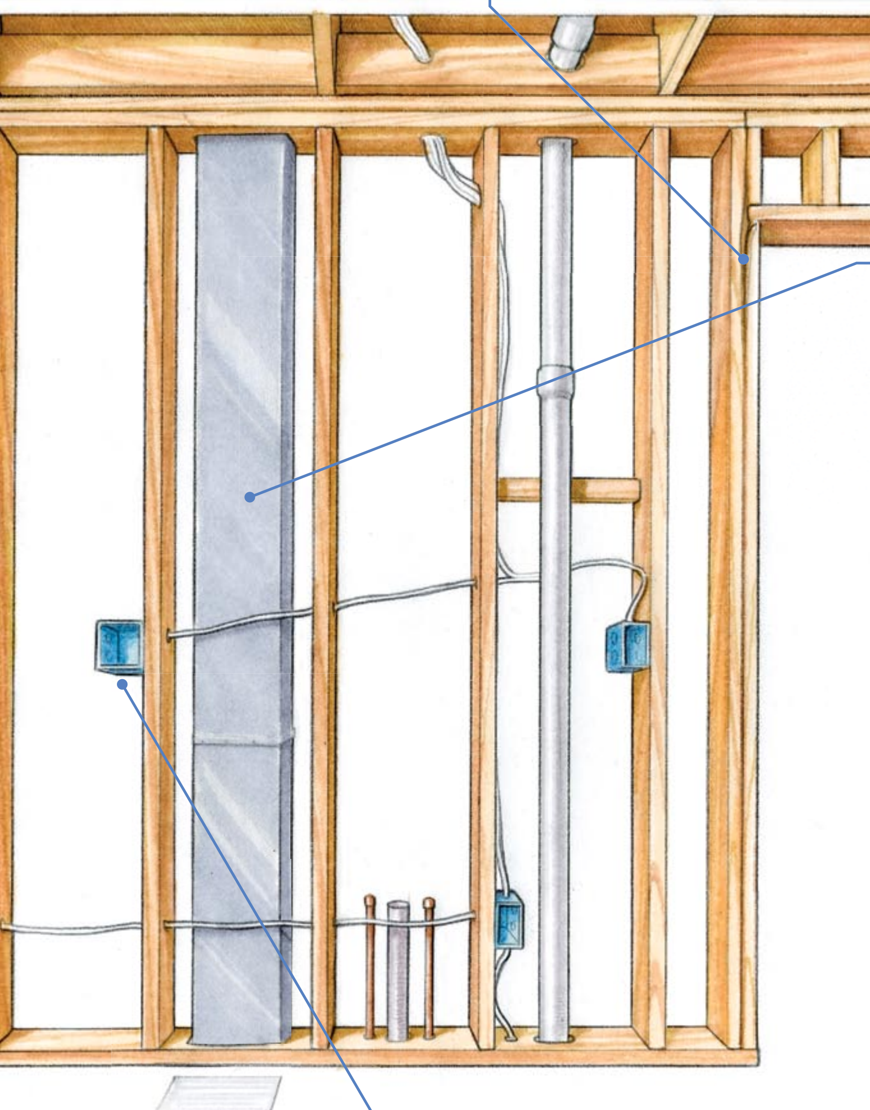


Lumber joints and defects

Problem: Defects that aren't large enough to be of structural concern almost always are large enough to be of acoustical concern. These details often are the weakest link in a sound-control solution because they frequently are overlooked or ignored. Airborne sound needs only the slightest gap to travel easily from one room to another.

Solution: Fill the joint between the top plate and the subfloor above, and the bottom plate and the subfloor below with a continuous bead of caulk. Also, make sure to caulk or foam any lumber with wany edges, knotholes, or large gaps.

Material: Several manufacturers make special **acoustical caulk**, but I prefer to use a high-quality off-the-shelf brand of synthetic caulk. The key here is using a caulk that stays flexible over a long period of time. I've had good luck with Big Stretch (www.sashcosealants.com).



HVAC ductwork

Problem: A run of ductwork is like an intercom system when it comes to sound movement. Noise reverberates through the thin metal walls of the ductwork, travels to adjacent rooms, and broadcasts through registers and air returns.

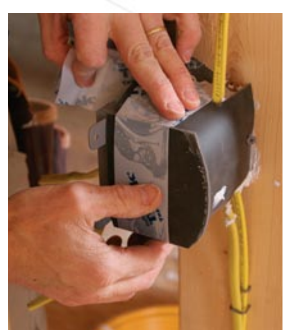
Solution: Isolate the ductwork with a sheet of fiberglass-insulated mass-loaded vinyl. I cut this sound-deadening material a bit larger than the stud bay and fasten it to the studs with drywall screws. A bead of spray foam around the edges ensures a tight seal. For extra sound dampening or for quieting ductwork in walls that don't have room for vinyl coverings, consider a product designed to line the interior of the ductwork, such as Silent-Mod duct silencers (www.acousticalsurfaces.com).

Material: Some holes are too big for caulk, so I like to keep a can of **expanding spray foam** handy for sound-control jobs. You can buy one-time-use cans at any hardware store, or you can purchase a reusable foam gun that allows for better flow control (www.dap.com; www.greatstuff.dow.com).

Electrical boxes

Problem: Because electrical boxes are hollow and full of holes, they are major culprits for transmitting airborne sound. Even worse, back-to-back electrical boxes create an almost direct path from room to room.

Solution: To seal the box, fill all the routing holes with caulk; then wrap the fixture with mass-loaded vinyl, again sealing gaps in the vinyl with caulk. Seam tape can tie together any small pieces of vinyl. Back-to-back electrical boxes should be moved so that they are separated by at least a couple of stud bays. Holes drilled through the framing to run wires should be filled with spray foam.



Product photos: Krysta S. Doerfler. Drawings: Bob La Pointe.

face of an absorptive material, a portion of the wave's energy is sucked up. The more times the sound wave bounces into the absorbing material, the more energy it loses.

Option No. 3: Blocking. If you can hear appliances in the next room or footsteps from the floor above, sound-absorbing materials likely won't help too much. Unlike absorbers, sound-blocking materials are usually dense and nonporous. They rely on mass to stop sound movement and vibration.

Compare, for example, a stereo playing in a room made with walls of smooth concrete to a stereo playing in a conventionally framed room with fiberglass insulation. The hard, nonporous surface of the concrete walls causes sound waves to bounce repeatedly within the room, but the dense walls also prevent the stereo noise from being heard in adjacent rooms. The conventionally framed room with porous fiberglass insulation, on the other hand, has less echo and better acoustics within, but is much less effective at stopping sound travel to adjacent rooms. Two different types of materials, each with a strength and a weakness.

Option No. 4: Breaking. Sound waves like to travel through solid, directly connected materials (drywall attached to wood framing, for instance). To disrupt the path of structure-borne sound waves, create an airspace or physical break between solid materials. Constructing staggered stud walls, building rooms within rooms, and applying resilient-channel strips to walls or ceilings (see facing page) are all common techniques of breaking the sound path. □

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COVER THE WALL, BUT KEEP THE FRAMING ISOLATED

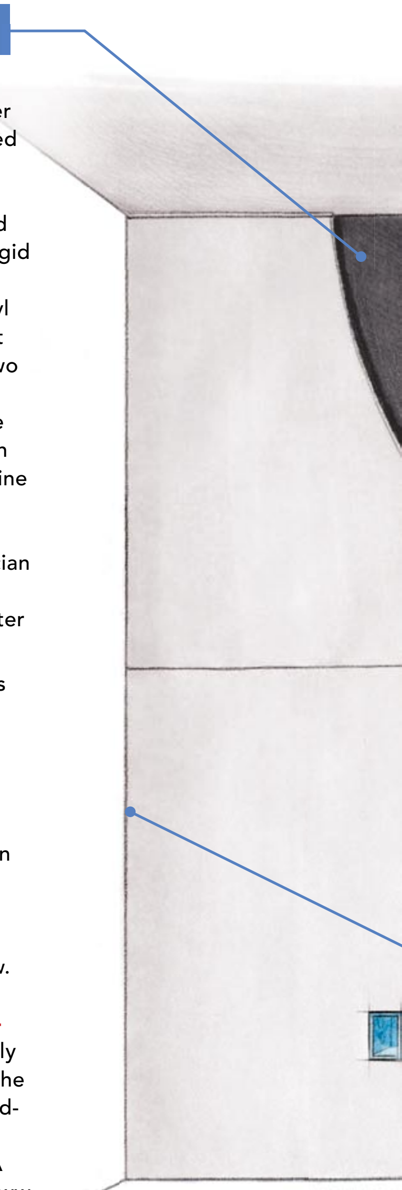
Unlike the numerous potential problems found within a wall, the outside covering really has one major problem: It makes a direct, solid connection between the living space of one room, a shared wall structure, and the living space in an adjacent room. Drywall is the conventional choice for finishing residential homes, but it's not designed to be a sound-controlling product. Depending on budget and on how quiet the room needs to be, I rely on several different products to control both airborne and structure-borne noise.

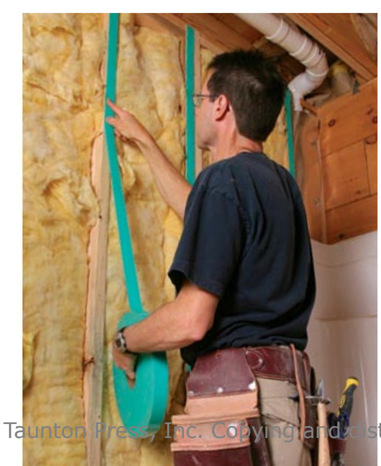
Step 1

Start with heavy vinyl

To start, I install fiberglass insulation as usual; then I cover the wall studs with mass-loaded vinyl and caulk any seams to reduce structure-borne sound transmission. Sound has a hard time traveling through a nonrigid (limp) material, so don't go crazy trying to stretch the vinyl tightly over the framing. Don't sandwich the vinyl between two layers of drywall, either, or it loses some of its value. Locate electrical boxes by pressing on the vinyl until it leaves an outline (photo left); then cut the vinyl with a utility knife. If caulk has time to dry before the electrician returns, I apply it around electrical boxes before and after attaching the drywall.

Material: Typically installed as part of a layered solution to noise problems, a ⅛-in.-thick sheet of **mass-loaded vinyl** weighs about 1 lb. per sq. ft. and is acoustically equivalent to a sheet of lead. You also can cut it into strips and lay it on studs or joists. The material costs from $1.80 to $2 per sq. ft. (www.acoustiblok.com; www.soundsense.com). I've also had good luck installing **foam-gasket strips** (the kind typically applied to floor joists before the subfloor is installed) as a sound-dampening break between the framing and the drywall. A 100-ft. roll costs about $16 (www.integritygasket.com).



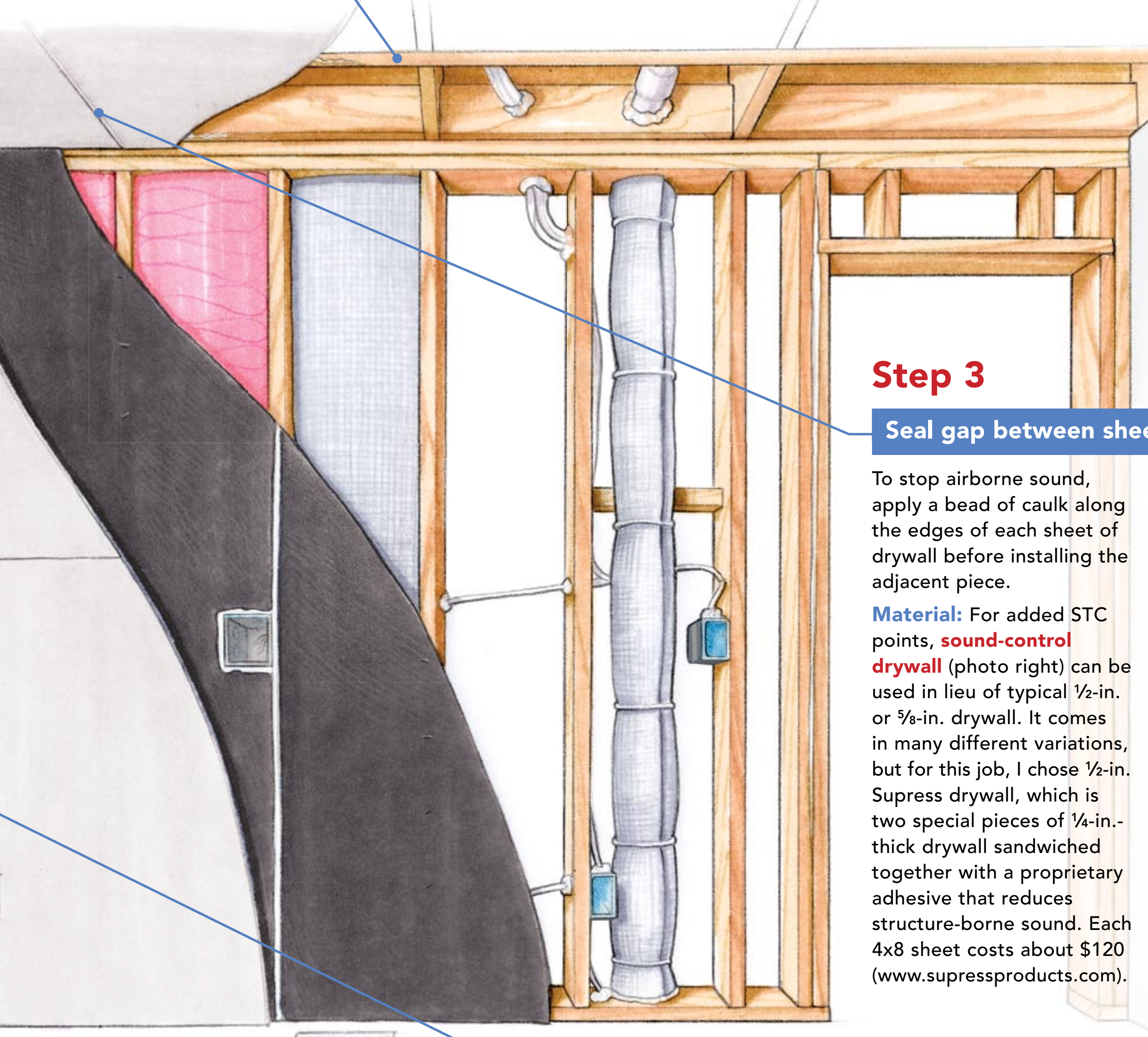


Step 2

Minimize the use of screws

Screws provide a direct acoustical connection between drywall and framing. I either reduce the number of screws by using drywall adhesive to help secure the sheets to studs and joists, or I install resilient channel as a physical separation. Resilient channel is attached perpendicular to the framing with drywall screws.

Material: Lightweight-metal **resilient channel** (photo right) is effective and easy to install. To ensure acoustical separation, the screws used to fasten the drywall to the resilient channel must not penetrate the framing. A 12-ft. piece of channel costs about $2.25 (www.dietrichindustries.com).

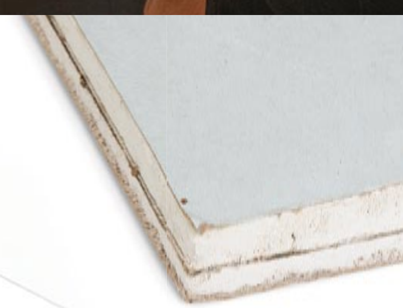


Step 3

Seal gap between sheets

To stop airborne sound, apply a bead of caulk along the edges of each sheet of drywall before installing the adjacent piece.

Material: For added STC points, **sound-control drywall** (photo right) can be used in lieu of typical ½-in. or ⅝-in. drywall. It comes in many different variations, but for this job, I chose ½-in. Supress drywall, which is two special pieces of ¼-in.-thick drywall sandwiched together with a proprietary adhesive that reduces structure-borne sound. Each 4x8 sheet costs about $120 (www.supressproducts.com).



Step 4

Caulk the corners

Even though the butts and seams are later taped and covered with joint compound, I always seal these drywall joints with caulk to ensure an airtight seal. Choose paintable caulk, and smooth the bead with your finger to prevent lumps when it comes time for tape and joint compound.