# SOUND-STUDIO RETROFIT

## *Good design and workmanship are more important than specialty products*

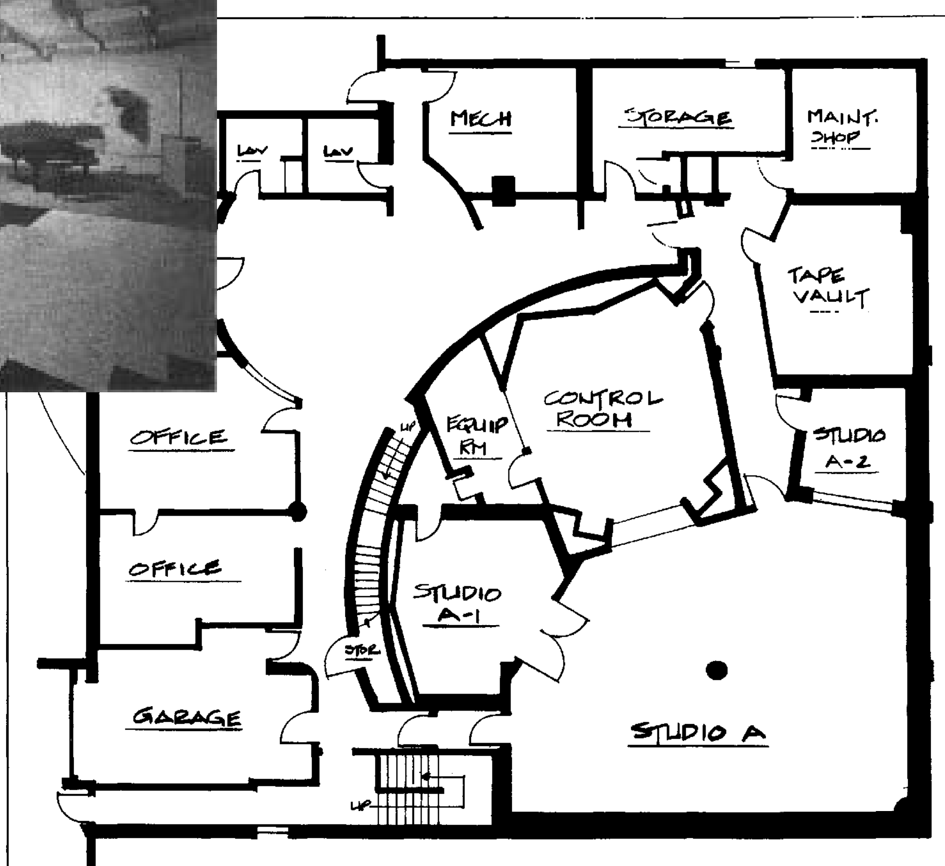
***by Steven Bliss***

*A sand-filled concrete-block wall goes up just inside the existing wall of the warehouse (top). The completed studio (bottom) has an array of boxes on the ceiling to diffuse sound. The large mural on the far wall disguises one of several sound-absorber panels made of Owens Coming Type 703 rigid fiberglass.*

An urban location presents many challenges for a recording studio. A first-class professional studio must have near-dead silence: free of noise originating either inside or outside the building. It must also have excellent interior acoustics. Furthermore, the sensitive electronics and musical instruments require good environmental control. That includes dust- and smoke-free air kept at relatively constant temperature and humidity levels.

Owner Todd Lockwood wanted to meet these high standards in a building he was renovating into a 6,000-square-foot commercial recording studio. The main studio (1,200 square feet) and the adjacent control room would need to be sound-isolated from each other, from the rest of the building, and from the world at large.

The old warehouse in Burlington, Vt., that Lockwood chose for the studio—dubbed White Crow Audio—presented both opportunities and challenges. Like most urban settings, it presented some difficult noises to control: a busy street, a freight train a block away, and jets overhead. On the plus side were the building's massive brick walls, which helped block sound transmission from outdoors, and high ceilings (16 feet). The high ceilings gave the design team plenty of space to create "a room within a room," which is ideal for sound isolation. Other acoustical assets were a heavy slab floor to help block sound transmission from below and a second story to shield the studio from airplane noise above.




*The main studio is joined by two smaller studios—A-l and A-2—which allow a singer or musician to maintain visual contact with the others, but sound privacy.*

the more it reduces sound transmission, since it is hard for airborne sound waves to set massive materials into motion.

Both physical isolation (double walls) and massive materials were used because they effectively reduce the transmission of low-frequency sound. Low-frequency sound is difficult to block (which is why apartment dwellers are often subjected to the thumping bass sounds of their neighbor's stereo).

Interior partitions used standard commercial fare—steel studs and drywall. Resilient channels were not needed for the drywall, since the double walls break the vibration paths. Fiberglass insulation was added to most partitions for a little extra sound insulation. The resulting double-stud walls, with double drywall on both sides, and fiberglass insulation, provide excellent sound insulation with STC ratings as high as 60 (see "Rating Sound Barriers," next page).

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One minor problem, says Lockwood, was that the flimsiness of the lightweight steel studs made them difficult to work with on the complex wall assemblies, so they switched to a heavier gauge steel.

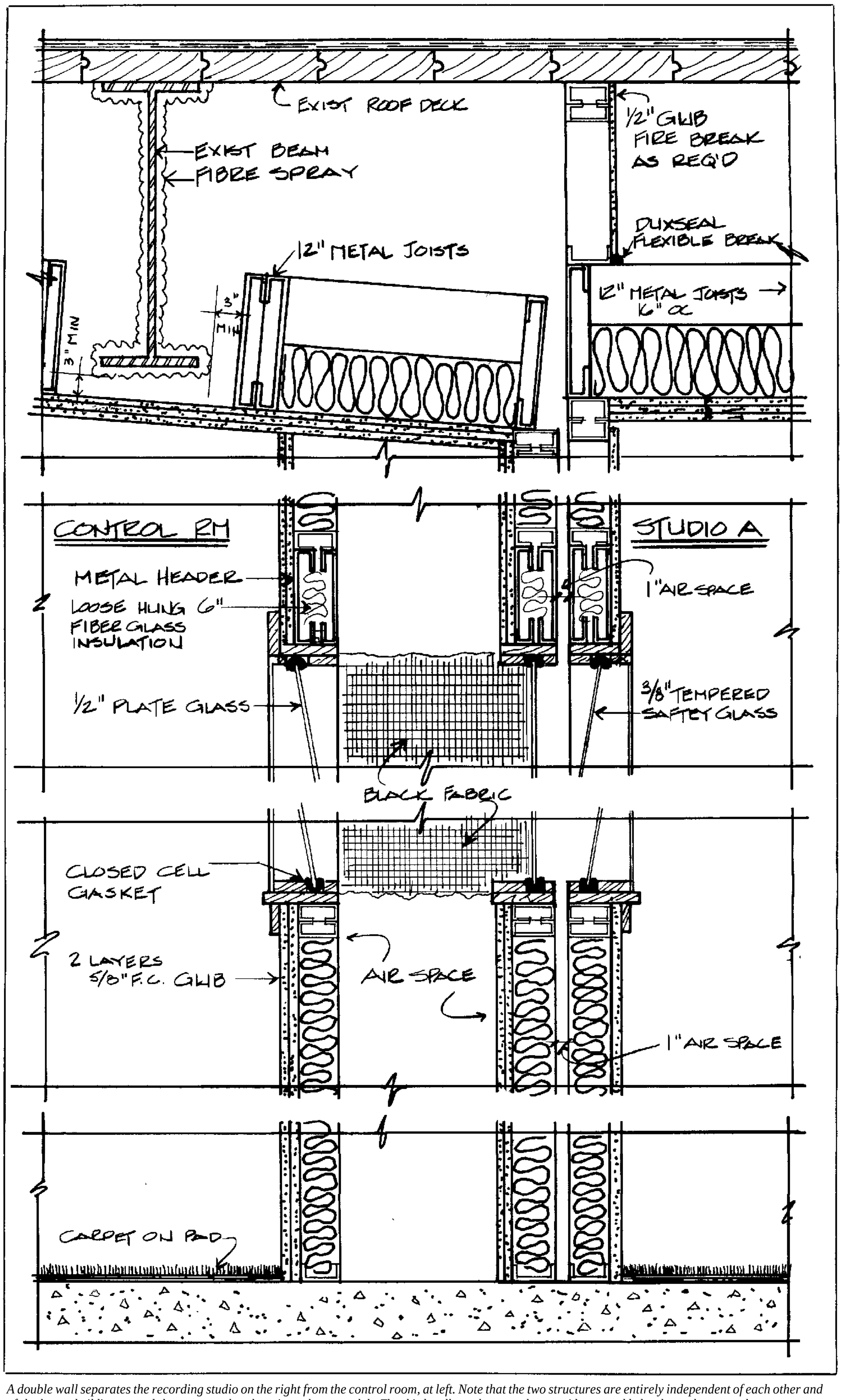
Another problem they faced was a large structural column running up the center of the main studio space. The solution was to frame a false column around, but not touching, the existing steel column. The false column attaches to the new dropped ceiling that covers the studio space—keeping the studio structure isolated from the surrounding structure.

## Doors and Windows

Another key component of successful sound isolation is the tight sealing of leakage paths between spaces—sometimes called "flanking" paths. Sealing these bypasses is particularly critical at doors and windows.

Professional studios often use patented steel acoustic doors. To cut costs, however, White Crow settled for standard solid-core 1¾-inch wood doors, which worked fine. To seal around the door perimeter, any high-quality weatherstripping will do. On this job, a commercial closed-cell sponge weatherstripping set in a heavy aluminum flange was used. At the thresholds, the contractor used a standard spring-loaded seal (the type that retracts upward when the door is opened). To match the performance of an STC 50-plus wall, two such doors can be hung in a split frame. On this job however, single doors proved adequate.

A window is necessary between the studio and control room, and its sound-transmission rating should be comparable to that of the partition that separates the two rooms. Windows are problematic in that they readily vibrate and transmit sound. The solution is to use two panes of heavy glass with at least 4 or 5 inches in between. Each sheet of glass should be set into its own frame and supported by resilient gaskets. Furthermore, it's best that the two panes are of different thickness, and




*A double wall separates the recording studio on the right from the control room, at left. Note that the two structures are entirely independent of each other and of the larger building around them, except that they sit on the same slab. The third wall, on the control room side, was added to house large speakers.*

## A Room Within a Room

To make the project fly financially, the work had to be done at a modest price—less than $60 per square foot was budgeted. This ruled out many of the materials and techniques commonly specified for professional studios, in favor of off-the-shelf stock. Working closely with New York City-based sound consultant Alan Fierstein, of Acoustilog, Inc., White Crow's main strategy was to create a room within a room that did not touch the surrounding structure except at the concrete slab floor. In effect, all partitions and ceilings for the studio spaces were double structures with no connecting elements.

To keep structure-borne sound (such as from slammed doors or vibrating machinery) from entering the studio area, the plans initially called for cuts in the concrete at the partitions. But this was deemed unnecessary by the consultant. A further refinement would have been to build a new floor for the studio area floated on high-density fiberglass or rubber pads. If Burlington had subways rumbling underground, this might have been considered. As it is, the train comes through only once a day.

An additional strategy to block airborne noise was to use inexpensive massive materials—sand-filled concrete block on the outside walls and double or triple layers of 5/8-inch drywall on interior walls and ceilings. Generally, the more massive a wall (measured as pounds per square foot of surface area)

*Operators at the control console look through the double window into the recording studio. Note sound diffusers on the ceiling and absorber panels on the wall.*

that they are set non-parallel. The White Crow studio used 3/8- and 1/2-inch plate glass. Varying the glass thickness and angling the panes help keep the window from amplifying and transmitting sound at selected frequencies (those that happen to match the natural resonance of the window configuration).

## Mechanical Systems

Like a hospital, a sound studio needs clean, dust-free air delivered at a fairly constant relative humidity. In addition, it must be dead silent. To meet these requirements, the hvac contractor provided each room with a separate supply and return duct, oversized all the ductwork, and lined the ducts to the studio and control room with fiberglass duct lining. An in-line electrostatic air cleaner (Smokeeter) pulls cigarette smoke and dust out of the air. The resulting air flow is slow, silent, and clean.

A series of in-line hydronic duct heaters supply each room with the temperature called for. The control room, because of its maze of electronics (see photo), must be cooled year-round with 61°F air.

To maintain humidity in wintertime, which is important for the piano, an in-line electric steam generator was used at first. When the owner discovered, however, that the humidifier was doubling the building's wintertime electric bill, it was ditched in favor of three off-the-shelf Sears humidifiers.

To protect the electrical system from spikes and other current irregularities, the engineers specified an "isolation transformer" at the main panel. In addition, variable auto-transformer-type dimmer switches were used rather than solid-state, since the solid-state devices can cause electical noise. These dimmers, however, hum a bit.

Finally, the contractors were careful to avoid running outlets back-to-back in double-wall partitions. This could create a sound leak and slightly degrade the sound insulation of the wall.

## Room Acoustics

All of the above discussion is devoted to keeping unwanted sounds from penetrating into the sound studio and control room.

The other key design consideration is how to control the acoustics within the studio space and control room. The general goal is to have the sound diffused and uniformly distributed throughout the space-without echoes, unwanted reverberations, or other sound distortions. This is a highly specialized area requiring advanced knowledge of acoustics and studio design. But the construction techniques used are fairly straightforward: Select the right room proportions, and position sound-absorbing and diffusing surfaces in the right places.

The room shape and proportions will determine whether sounds at certain frequencies get amplified due to sound reflections. Many books (see list at end) offer advice on preferred dimensions. Some experts prefer to position the walls out of parallel, which was the tack taken at White Crow. Others prefer rectangular rooms of specific dimensions, feeling their sound performance is easier to analyze and predict.

Many options exist for sound diffusers and absorbers, which work along with the room configuration to balance the sound within the space. Whereas fabrics and acoustical ceiling tiles will absorb high-frequency sound, the lower frequencies require thicker, denser material. The drywall itself helps some, but the real work is best done by specialty products- in this case, Type 703 high-density fiberglass panels from Owens Corning.

Diffusion is achieved by lining selected surfaces with specially shaped bumps and contours. On the ceiling of the White Crow studio and control room (see lead photos) large boxes of various depths do the job. On the back wall of the control room, a series of wood strips, sized according to acoustic formulas, perform the same function.

Although acoustic designers can recommend where to place absorbing and diffusing surfaces within the room, it must be fine-tuned after everything is in place, says Lockwood. Sensitive sound instruments and the human ear are the final judges. Even then, area rugs are moved around to deaden or brighten the sound, depending on what effect is desired for a given recording.

## Sounds Good

The finished product works well, says Lockwood. An office party in the rented space upstairs cannot be heard in the sound studio. Nor can studio users hear outside street noises or indoor hvac sounds. Within the studio and control room, tonal qualities have been tweaked to perfection by adjusting absorbers and diffusers on the wall and

## Rating Sound Barriers

The ability of a wall to reduce airborne sound transmission can be improved by (1) increasing its mass, (2) breaking the sound vibration path (with resilient connections or double studs), and (3) providing absorption in the cavity with insulation. A given wall, however, will block out sound at some frequencies better than others.

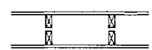
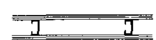
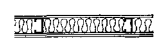
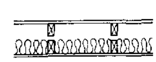
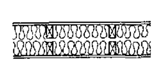
Because this gets rather complex, acoustic engineers have come up with a single-number system to roughly indicate the decibel (dB) reduction caused by a wall. This is the sound-transmission class or STC. To find a wall's STC rating, scientists measure its sound reduction over a range of frequencies, then follow a procedure specified by the American Society of Testing Materials (ASTM) in Standard E 90.

Like the EPA mileage rating for cars, the STC is better used to make quick comparisons than to predict actual performance. Thus, it is safe to assume that an STC 50 wall will reduce noise better than an STC 40 wall. But you can't be sure that an STC 40 wall will result in a 40 dB reduction in noise. Also, because of test variations, a difference of two or three STC points is not considered significant.

Also be aware that air leaks, short-circuiting of resilient connections, interconnecting ductwork, back-to-back electrical outlets, and other bypass routes can signficantly compromise a room's sound isolation.

With these cautions in mind, below is a sampling of common wall types with good sound-insulating qualities. We start at STC 45, since most model codes recommend that as a minimum for party walls. For a sound studio, you would probably want better. The ratings are excerpted from the Noise Control Design Guide, published by Owens Corning (see listing at end of article).—SB

### Table: Stud Wall STC Ratings

| STC | Construction Description | Detail |
|---|---|---|
| 45 | Single wood studs, 16" o.c.; double layer ½" type "x" gypsum board each side; one thickness R-11 Fiberglas insulation |  |
| 45 | Double wood studs 16" o.c.; single layer 5/8" type "x" gypsum board each side, no insulation |  |
| 46 | Staggered wood studs 16" o.c.; smgle layer 5/8" type "x" gypsum board each side; one thickness R-11 Fiberglas insulation |  |
| 47 | Staggered wood studs 24" o.c.; double layer ½" type "x" gypsum board one side, single layer other side; no insulation |  |
| 50 | Single wood studs, resilient channel; single layer 5/8" type "x" gypsum board each side; one thickness R-11 Fiberglas insulation |  |
| 50 | Double layer wall, ½" type "x" gypsum board; 35/8" steel stud; no insulation |  |
| 52 | Unbalanced wall, ½" gypsum board; 35/8" steel stud; one thickness R-11 Noise Barrier Batt Insulation, 3½" thick |  |
| 52 | Staggered wood studs 24" o.c.; double layer ½" type "x" gypsum board each side; no insulation |  |
| 52 | Single wood studs, resilient channel; double layer ½" gypsum board one side; no insulation |  |
| 55 | Unbalanced wall, 5/8" type "x" gypsum board, 35/8" steel stud; one thickness R-11 Noise Barrier Batt Insulation, 3½" thick |  |
| 55 | Staggered wood studs 24" o.c.; double layer ½" type "x" gypsum board each side; one thickness R-11 Fiberglas insulation |  |
| 56 | Double wood studs 16" o.c.; single layer ½" type "x" gypsum board each side; one thickness R-11 Fiberglas insulation |  |
| 56 | Single wood studs, resilient channel; double layer ½" type "x" gypsum board each side; one thickness R-11 Fiberglas insulation |  |
| 57 | Double layer wall, 5/8" type "x" gypsum board; 2½" steel stud; one thickness R-8 Noise Barrier Batt Insulation, 2½" thick |  |
| 58 | Double layer wall, 5/8 type "x" gypsum drywall; 35/8" steel stud: one thickness R-11 Noise Barrier Batt Insulation, 3½" thick |  |
| 59 | Double wood studs 16" o.c.; single layer ½" regular gypsum board each side; two thicknesses R-11 Fiberglas insulation |  |

ceiling surfaces. Building a successful studio like this requires a special blending of art and science. But in the end, studio like this requires a special blending of art and science. But in the end, good design and good workmanship—not special products—are the key ingredients.

*Steve Bliss is editor of* The Journal of Light Construction.

**For More Information:**

*Acoustical Manual*, by NAHB, National Association of Home Builders, Washington, D.C.

*Acoustic Techniques for Home & Studio,* by Alton Everest, TAB Books, Inc., Blue Ridge Summit, Pa.

*Detailing for Acoustics*, by Peter Lord and Duncan Templeton, Nichols Publishing Co., P.O. Box 96, New York, N.Y. 10024.

*Noise Control in Residential Construction,* available from Owens Corning Fiberglas Corp., Fiberglas Tower, Toledo, Ohio.