Technical Features − Sound Construction
Sound Control Construction

ACOUSTICAL TIPS HELP ASSURE SUCCESS AND AVOID SURPRISES

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If you have ever been involved in the construction of a project with acoustic performance criteria, you know that sound control can be elusive—always invisible and rarely present when wanted. Many a project that started out with good sound control design intentions somehow lost the expected performance as it went through the hurdles of the stages of design and construction. Finishing a project with the same level of sound control that it starts with requires diligence and teamwork—diligence in systematic attention to design details and teamwork in effective construction supervision.

Sound control, the regulation of the transmission of sound, must first be properly designed and detailed by the architectural and engineering team. It then can be "built into a system during the construction phases of the project. Too often the owner/client expects and pays for a well−designed and sound−controlled building, but loses the performance through inconsistent design, improper methods of workmanship and/or the indiscriminate substitution of materials. Once construction is completed, corrective measures are often very expensive and sometimes not even feasible.

The importance of rigid workmanship standards for sound control increases as the expectations for acoustic privacy increase. The current emphasis on better acoustic separation between living or working units has made partition and floor/ceiling assem−blies providing greater degrees of attenuation (higher sound transmission class [STC] ratings) more common. These designs are, in turn, creating the need for closer and informed supervision of the construction.

In a large project, each phase of design and construction offers opportunities to ensure adequate sound control. The article on the last page describes the design and construction process as it relates to sound control design and construction, and outlines a suggested approach far ensuring adequate sound control.

General Factors Affecting Acoustic Performance

Sound is divided into two general types by origin: Airborne (sound traveling through the air)—conversation, music, street noise; and Structure−borne or impact (sound traveling through the structure)—footsteps on a hard floor, ringing of a wall−mounted phone, chalk taps on a slate board, vibration from machinery rigidly mounted to the structure. Airborne sound becomes structure−borne sound when it passes through a partition or follows a common wall from one room to another. Structure−borne sound becomes airborne when it is radiated by a wall.

For clarity and simplicity, the type of sound is classified by its origin. Airborne and structure−borne noise therefore is controlled by different means, e.g., what affects one may have no effect on the other.

The following physical properties of building materials, individually and in combination, are used to control the transmission of airborne and structure−borne sound.

- MASS for increased inertia against excitation; for example, the use of multiple 5/8−in, layers of gypsum board in lieu of 1/2−in, gypsum board.
- DECOUPLING to prevent the transmission of sound between contiguous building elements; RC−1 Resilient Channel attached to one surface of wood studs, or separated rows of studs.
- ABSORPTION to convert and dissipate acoustic energy; 1−1/2−in, thick, 2.5 lb./cu. ft. THERMAFIBER Sound Attenuation Fire Blankets in every stud or joist cavity.
- SEALANT to prevent the passage of airborne sound through gaps and cracks; e.g., SHEETROCK® Acoustical Sealant

For airborne sound control, greater mass is generally proportional to increased sound isolation. This is not necessarily true for the isolation of structure−borne sound, where an increase in mass may have little or no effect on the isolation performance of a system.

Decoupling, e.g., the use of foam−backed vinyl floor tile, will have a dramatic effect on the structure−borne isolation but a negligible effect on the airborne sound transmission loss characteristics. The use of a resilient channel system for the installation of a gypsum board ceiling can have similar effects of improved airborne and structure−borne sound isolation.

The improved performance due to the use of mineral wool in a stud or joist cavity is also dependent on the other components of the partition assembly and the type of sound source. Cavity insulation works best in combination with decoupling. The use of THERMAFIBER Sound Attenuation Fire Blankets in conjunction with RC−1 Channels has a synergistic effect greater than the sum of both treatments individually.

Air is the basic medium of acoustic transmission. If air transmission is eliminated, then the passage of airborne sound is also eliminated, e.g., through use of acoustic sealant. A 1/4−in, perimeter crack surrounding a 96−sq. ft. partition system represents an approximate 1−sq. ft. hole. In terms of sound rating, this untreated perimeter crack will reduce the overall performance from 53 STC to 29 STC (see Fig. 7).

All changes made after the original design is completed should be viewed with suspicion. Often an acoustical engineer or consultant assists in the design and specifications, but during the time that passes between design and construction, changes in the form of "value engineering" may be made without the acoustical engineer’s knowledge. These changes, which may seem minor, may completely nullify the sound performance of the original design.

We recently were involved in the design of a multi−story apartment building. Our design was based on using light−gauge metal studs with multiple layers of gypsum board and sound attenuation blankets in each stud cavity, a nominal 50 STC design. The contractor convinced the owner that the same wall could be built using wood studs at a lower cost. Upon consultation with the architect all parties agreed and the change was authorized without verifying the effect on the acoustic performance of the system. After construction and occupancy multiple complaints arose. The demising wall system was tested to reveal a transmission loss rating of 40 FSTC*. An acceptable and very expensive correction consisted of adding an additional layer of gypsum board to each side of the partition thereby raising the rating to the range of 45 FSTC.

Changes in material and application methods on the job are also questionable. Even though they may reduce initial costs or simplify construction, they may sacrifice sound performance. Authority to approve substitutions in materials should be exercised with great care. Materials in a system are designed to work together; substitute materials may be incompatible or compromise the acoustic balance of the system.

One ongoing battle with flooring contractors is the specification for a resilient underlayment system to minimize the transmission of foot impact noise. Where our specification typically involves the use of a resilient sandwich system, the contractor frequently presses for approval to substitute a thin, trowel−applied, resilient latex underlayment compound. Our experience with this type of underlayment is that it is good for leveling an irregular floor surface but inconsequential with regard to improved floor impact insulation.

The question to substitute 1/2−in, thick gypsum board for 5/8−in, gypsum panels is often raised. Our response is against this unless the dimensions are critical. Gypsum board, 5/8−in. thick, nominally weighs 2.3 lb./sq. ft. as compared to 1 .7 lb./sq. ft. for 1/2−in. board. This 33% added weight is extremely beneficial in attaining improved sound control. In fire−rated assemblies, 5/8−in. SHEETROCK® brand Gypsum Panels, FIRECODE Core (Type X) are acoustically more effective than 1/2−in. SHEETROCK® brand Gypsum Panels, FIRECODE C Core (Type C), because of the weight differential.

It is the construction superintendents responsibility to call to the attention of the designer, specification writer and consultant any details or omissions that might affect the sound performance. However, the superintendent cannot obtain more performance than has been designed and specified into the system, nor can the contractor be expected to provide special sound control work unless it is included in the specifications.

A pre−construction meeting and mock−up can serve to work out all the details of construction and coordination. The result minimizes added costs and the aggravation of callbacks and retrofits.

It is extremely helpful, after the initial framing is completed, that the construction superintendent and the consultant "walk the job" to observe the particular details of the project. We prefer this examination to occur prior to the start of the working day so that it can be completed without interruption.

Techniques And Details

Special characteristics and application techniques are required of materials to be used in sound control construction:

Perimeter seals, in order to be effective for the life of the building, must be resilient and nonhardening. Standard weather caulking is unsatisfactory as a partition sealant since it tends to harden, losing the resilience needed to retain the acoustic seal.

Placement of the sealant is also critical. The purpose of the seal is to provide a closure between one side of the partition system and the other. Thus, caulking should not be placed beneath the runner track but should be applied to fill the perimeter gap between the gypsum board faces and the surrounding floor, wall and ceiling elements. The preferred procedure is to place a heavy fillet bead of caulking adjacent to the runner prior to the installation of the gypsum board. When the board is subsequently installed it compresses the "bead" completely filling the gap of each gypsum board layer (Fig. 1).

The question of using tape and joint com−pound to seal the partition perimeter is often raised. Our response is that this method will initially provide a seal. As the building ages and settles it will eventually crack, nullifying the acoustic integrity of the partition system.

Penetrations in a sound−rated system for electrical outlets, recessed cabinets, telephone jacks, etc., should be regarded as a hole in the wall through which sound can travel. These openings must be sealed in order to maintain the performance quality of the demising system.

Piping, electrical, telephone, etc., services should be viewed as penetrations and poten−tial paths for sound transmission. When these openings occur on opposite sides of a demising wall, they must be offset by at least one stud cavity. The gap surrounding the outlet box, pipe, etc., should then be sealed with acoustical caulking. The back and sides of the outlet box should also be caulked (see Figs. 2, 3 4).

Metal resilient components possess a "spring action" to decouple and isolate the elements that they connect, yet provide the strength to firmly support these elements.

An ongoing concern in the installation of gypsum board on RC−1 Resilient Channel is the length of screw used in the attachment. We have seen construction workers using 1−in, or greater length screws to connect the gypsum board to the RC−1 Channel. These screws can extend into the wood stud or joist thus shorting out the resiliency of the system. TIP: An effective installation technique is to place screws only between studs or joists. The channel must also be free to float upon installation and thus a minimum 1/4−in. clearance between it and the adjacent assembly is required (see Figs. 5 6).

In summary, the acoustical engineer or consultant, experienced in building technology, can provide a valuable service as a member of the design/construction team. From the early design development phase through construction and final performance testing, the acoustical specialist contributes an added dimension in attaining the overall quality of the project.

Cognizant of the particular acoustic properties of the individual building elements and their combination, the acoustical professional is able to assist in the creation of a structure that not only meets the basic environmental needs of human shelter but also one which provides effective sound isolation.

*FSTC is Field STC or Sound Transmission Class determined by actual field test.