Sound Control Manual − Sound Construction
System Selection

With the required amount of sound attenuation determined, selection of the best system becomes the question. There are literally hundreds of parition, exterior wall and floor−ceiling sound control assemblies to choose from −− some with high performance, some offering moderate performance, many fire−rated, all with their own particular characteristics. Every feasible type of construction is represented in the many systems promoted by material manufacturers. At first glance, finding the right system for the particular job may seem a difficult task; however, the process can be simplified through elimination of assemblies that do not meet job requirements.

The first step is to determine the general type of construction: plaster or drywall, wood frame, steel frame, or masonry (the last two may both be considered if the construction is non−load bearing). This will eliminate nearly half of the assemblies to be reviewed.

Next, the fire rating that must be met for local building codes is determined. If the requirements are hight (2 or 3 hours), many more systems will be eliminated from consideration. If the requirements are low, or if no fire rating is required, the 2−hr. and higher assemblies probably can be excluded because of their higher cost.

Finally, the remaining systems are evaluated and those that do not provide sufficient sound attenuation or balance the performance against the cost are disregarded. Availability of material, familiearity of construction methods, reputation of the manufacturer and reliability of his products are all considered. Some systems will immediately stand out because of their refinement of design −− combining high performance, simplicity, and low−cost assembly. This is the goal of all progressive building product manufacturers.

The question of overbuying should be considered again at this point: are there defects in teh design that will negate the performance of the system? It is pointless for the owner to spend money for a high−performance system if he is not going to get high performance. For instance, a hollow core door in an STC−48 partition can reduce the overall performance to as low as STC 24 (lower than a common wood−stud drywall partition). Yet, the owner will pay considerably more for a STC−48 partition.

Another point should be considered: the performance of an assembly can vary as much as 15 STC points with the quality of the workmanship (demonstrated by actual construction tests conducted at United States Gypsum). If a high−performance system is selected, the necessary precautions must be taken to obtain top−quality installation. If this brings the cost too high, it is wise to select a less−expensive system with lower performance and use the extra money to obtain dependable, quality construction

Partitions
Desirable qualities in sound attenuation partitions are:

- the required degree of resistance to transmission of airborne sound (not necessarily the highest level)
- reasonable cost in proportion to the performance
- require fire rating
- ease of installation
- minimum weight
- minimum thickness
- good appearance
- reliable structural performace

It is entirely reasonable to expect the selected partition to embody all of these features.

The performance level being sought will usually fall in the STC range of 45 to 60. The partitions used in most single−family dwellings today would test about STC 35 (although the actual performance is often even less due to leaks and flanking paths). On the other end of the scale, STC−60 partitions are found increasingly in luxury multi−family dwellings, and other quality buildings. Partition performance of STC 60 will, for practical purposes, reduce an 85 db noise level (the maximum normally encountered in a residence) to a 25 db background sound (comparable to a night−time rural sound level) −− near ideal for sleeping rooms. The actual performace needed should be determined by a careful analysis of the prevailing conditions, keeping in mind that the actual installation will rank at least 5 db, and perhaps as much as 15 db, below the rated performace, depending on the care taken in construction.

In selecting a partition system it often is helpful to know why the system is effective. Relating the factors affecting sound attenuation to actual partition construction is fairly simple.

[Insert Figure 57]

Effective mass is contributed by the gypsum panels or plaster. For example, a common wood−stud partition with 5/8−in. SHEETROCK® FIRECODE "C" Gypsum Panels on each side will test STC 34. Using double−layer panels on each side (Figure 57, above) will increase the rating to STC 41 −− an improvement, but certainly not optimum. Increasing the mass beyond this point is of little value since other, less expensive methods of achieving better performance are available.

The effects of isolation (decoupling) are easily demonstrated: the wood−stud double−layer drywall partition described above, but with the gypsum panels decoupled on one side with RC−1 SHEETROCK® Resilient Channels, will have sound attenuation of STC 49! This improvement is simply the result of breaking the direct transmission path through the studs. The resilient channel increases the cost of the partition only about 10% −− a small price to pay for the vastly improved performance gained.

The same type of decoupling can be provided for plaster systems by a series of resilient lath−mounting clips. USG Metal Studs provide resiliency by virtue of the flanges being formed at slightly greater than right angles to the webs.

[Insert Figure 58]

Decoupling in wood−stud partitions can also be provided to some degree by slotting the studs (Figure 58, above), by staggering the studs and attaching the wall diaphragm to alternate studs, or by providing a double row of studs on independent floor and ceiling plates. The slotted studs are only partially effective since the ends of each stud provide a continuous sound transmission path as do the sill plates. The staggered studs are somewhat more effective but again, the plates transmit some sound energy. The double row of studs is by far the most effective; its disadvantage is the amount of extra labor, material and space required, but this may not be objectionable if it is to be used as a chase wall. Resilient channels will provide similar results with less material cost and less labor.

[Insert Figure 59]

Probably the greatest degree of decoupling is provided in the double party walls now being installed in some luxury−type garden apartments. As seen in Figure 59 (above), these are made up of two separate partitions, totally isolated from each other, even to the extent of resilient joints in the foundation and roof. If the installation is performed with care, these partitions will approach total privacy.

Insulating blankets are applied to an assembly in the cavity between the diaphragms. The STC−49 wood−stud partitions described, with one diaphragm attached by resilient channel, will test STC 59 with the addition of 3−in. THERMAFIBER Insulating Blankets; a USG Metal Stud Partition with double−layer 5/8−in. SHEETROCK® Gypsum Panels on each side can be improved from STC 46 (metal studs are resilient) to STC 53 by adding 1−1/2 in. THERMAFIBER Sound Attenuation Blankets.

Wood fiber sound deadening board, when used as a base layer under gypsum panels, offers some advantages by virtue of its decoupling and damping characteristics. A wood−stud partition with 1/2−in. USG Sound Deadening Board base layer and 5/8−in. SHEETROCK® Gypsum Panel face layer laminated to each side, will provide STC 49. The same construction with SHEETROCK® nail−applied will test only STC 36 −− the nails providing a direct sound transmission path through the studs. One obstacle to the use of wood fiber sound deadening board is the installed cost index of 151. By comparison, the cost index of an STC−52 wood stud−resilient channel−wool blanket partition with single−layer gypsum panels is only 136.

The important point is that the two diaphragms of a partition must be decoupled in order for sound−insulating materials to be effective. If there is a direct path for the sound to travel through the partition, it will bypass the insulating material.

Limpness in a partition, as mention before, is very difficult and expensive to obtain. Since a partition by its function must be structurally self−supporting and often load−bearing, it must be reasonably rigid. If extremely high performance is required of a partition, and the need justifies the expense, sheet lead can be applied to one diaphragm of the partition with excellent results. Such an application misght be used in a sound−testing room or an extremely critical recording or broadcast studio. In such cases, the advice of the manufacturer should be obtained. Suppliers of protective rooms and installations for X−ray and R.F. radiation purposes are familiar with sheet lead systems. However, the capabilities of gypsum panels and sound attenuation blankets shouls be investigated first.

Sealing is an easlily understood principle of sound conditioning, but too frequently neglected. If a partition is to stop the transmission of sound, it must be airtight at all points. The perimeters must all be sealed with acoustical sealant (a special type that doesn't stiffen, shrink, or crack), as must the penetrations for electrical outlets, medicine cabinets, plumbing, heating and air conditioning ducts, telephone and intercom hookups and television antenna outlets. Doors must have weatherstrip seals on all four sides. If one point is missed −− for example, one electrical outlet without caulking −− the entire partition will suffer in sound attenuation performance. Sound control sealing must be covered in the specifications, understood by the workmen of all related trades, supervised by the foreman, and inspected carefully during construction.

In test conducted at the United States Gypsum Acoustical Research Facility, five electrical outlets, installed in normal locations without caulking in a 50−STC partition, lowered the partition performance to STC 41. Sealing the outlet boxes with the caulking on the backs, sides, tops and bottoms increased the overall partition performance to STC 48 −− conclusive evidence of the importance of good sound control construction details.

Selecting the most desirable partition for any particular application will depend on many factors. While some systems tend to excel for certain applications, no specific guideline can be established. As an example, most local building codes require a 2−hr. fire rating for multi−story construction, yet in a few areas only a 1−hr. rating is required, permitting wood−frame partitions up several stories. Another consideration is the type of construction being used elsewhere in the building; if metal studs are being installed in another area, a metal stud partition will probably be the best choise for economy and scheduling.

The ten most popular sound control partitions, which will be discussed, are but a few of the many partition systems designed by United States Gypsum and described in detail in U.S.G. Architectural Technical Literature.

Top performer in drywall construction is the double−solid partition built around two rows of 1−in. USG Gypsum Coreboard secured by metal runners. Single−layer 1/2−in. SHEETROCK® Gypsum Panels are laminated to the outside faces and 1−1/2 in. THERMAFIBER Sound Attenuation Blankets are placed in the cavity space (Figure 60, below).

[Insert Figure 60]

This STC−60 partition with 2−hr. fire rating is idea for luxury high−rise apartments and offices. The two diaphragms are completely decoupled; individually, they contrubute considerable mass, complemented by the effect of the sound attenuation blankets. The installed cost index of 165 makes this an outstanding value in high−performance partitions.

A variation of the double−solid is the triple−solid drywall partition. With the addition of a third row of USG Coreboard, it produces virtually the same test performance, but reduces the possibility of caulking leaks in the actual construction. If there is a question of workmanship quality, the triple−solid drywall partition may be worth the higher installed cost index of 210.

[Insert Figure 61]

The widely used STC−54 metal stud double−layer drywall partition (Figure 61, above) has a 2−hr. fire rating. It consists of USG Metal Studs and Runners with one layer of 1/2−in. SHEETROCK® FIRECODE "C" Gypsum Panels screw−attached, second layer laminated, with 1−1/2 in. THERMAFIBER Sound Attenuation Blankets between studs.

The assembly gains its high performance from the natural resiliency of the metal studs, producing effective decoupling, and the effect of the sound attenuation blankets. The double−layer construction contributes mass to the two diaphragms.

Popular for luxury high−rise apartment party walls, it is equally suitable for other multi−family dwellings and in motels and hotels. With the rising costs of labor and lumber, this partition is replacing wood−frame construction in many applications. The installed cost index is 164, one of the lowest of high−performance partitions.

[Insert Figure 62]

In wood−frame drywall construction, this STC−52 single−stud partition with resilient channel panel attachment on one side (Figure 62, above) is the most popular. While some doulbe−row wood stud systems will give slightly higher test performance, the added cost is rarely justified. The advantages of this system are apparent: an ordinary 2*4 wood stud frame; easily attached RC−1 SHEETROCK® Resilient Channel (no special skill required); 3−in. THERMAFIBER Insulating Blankets installed between studs (familiar procedure to workmen); and a single layer of 5/8−in. SHEETROCK® FIRECODE "C" Gypsum Panels on each side, screw−attached.

Sound attenuation is provided by the decoupling action of the resilient channel, the mass of the gypsum panels, and the insulation. A double layer of 1/2−in. SHEETROCK® FIRECODE "C" Gypsum Panels on each side will bring the partition up to a silencing STC 59 if all−out performance is required. Either way, it makes an ideal party wall for garden apartments, motes and anywhere that a 1−hr. fire rating is adequate. Installed cost indices are 136 for the STC−52 system and 188 for the STC−59 assembly −− both well below the cost of double−stud partitions with comparable performance.

[Insert Figure 63]

A useful variation of the metal stud partition is the STC−51 unbalanced drywall system (Figure 63, above). It duplicates the metal−stud double−layer drywall partition except that single−layer 1/2−in. SHEETROCK® FIRECODE "C" Gypsum Panels are used on one side, reducing the cost with little loss in performance. In principle, the coincidence dips of the two diaphragms occur at different frequencies. One diaphragm effectively retards transmission at the frequency at which the other diaphragm is acoustically transparent. This results in more uniform overall performance at all frequencies.

The installed cost index of the partition is 136 −− one of the lowest in the range above STC 50. At this cost, it is ideal for private office partitions and most other applications of the double layer partition. A 1−hr. fire rateing is estimated, based on

similar construction.

[Insert Figure 64]

Where separate plates are desired, this STC−51 staggered wood stud drywall partition (Figure 64, above) is outstanding. Two separate 2*3 frames provide "foolproof" decoupling, while 2−in. THERMAFIBER Insulating Blankets add the damping and absorption. Diaphragms of single−layer 5/8−in. SHEETROCK® FIRECODE Gypsum Panels complete the system. Because the frames are independent of each other, there is little chance of "grounding out" during erection.

Ideal for most low−rise party−wall installations, this partition provides a bonus of clear horizontal and vertical chase for mechanical and electrical devices. The construction is familiar to all workmen and requires no special skills except in caulking and sealing leaks. The cost index of 150 appeals to most buyers. A 1−hour fire rating is estimated.

In plaster partition systems, the best buy is the USG Metal Stud −− IMPERIAL Veneer Plaster assembly with STC of 53. The 2−in. THERMAFIBER Sound Attenuation Blankets work with the natural decoupling action of the metal studs and the mass of double−layer 1/2−in. IMPERIAL Plaster Base and 1/16−in. IMPERIAL Plaster.

[Insert Figure 65]

This system (Figure 65, above) combines the benefits of fine plastered walls with the erection simplicity of drywall, making it ideal for luxury high−rise apartments and condominiums where a 2−hr. fire rating is required. The installed cost index of 174 is competitive with all plaster systems in this performance range.

[Insert Figure 66]

Simplicity sets this masonry partition apart (Figure 66, above) wit its STC−52 and 3−hr. estimated fire rating. The wall is laid up with 3−in. PYROBAR Gypsum Tile, to one side of which 3/8−in. Rocklath Plaster Base is attached with R−5 Resilient Clips. The plater base is finished with 1/2−in. gypsum sand plaster, and similar 5/8−in. plaster is applied direct to the tile on the other side.

Performance stems from the obvious mass of the assembly and the decoupling of the plaster base. The installed cost index of 178 is appealing, making this partition particularly desirable where the masonry contractor is already on the job, in luxury high−rise and other prestigious applications. Because it is easily dismantled, the gypsum tile assembly is widely used in commercial buildings where future space changes are anticipated. The 24−psf weight, while exceeding tat of metal−stud partitions, is well below the weight of other comparable masonry construction.

[Insert Figure 67]

The most economical of plaster partitions in the above−50−STC range is the STC−52 TRUSSTEEL Stud system (Figure 67, above) with 2−in. THERMAFIBER Sound Attenuation Blankets in the cavities. TR−1 Resilient Clips on one side and wire clips on the other attach 3/8−in. Rocklath Plaster Base to the studs.

This partition has a 1−hr. estimated fire rating and installed cost index of 147. It is ideal for many low−rise party wall applications and may be a feasible substitute for wood−stud construction in some localities. It offers the extra advantage of open vertical and horizontal chase space for mechanical and electrical services.

[Insert Figure 68]

The top plastered wood−stud partition (Figure 68, above), rated STC−50, consists of a standard 2*4 wood frame with RC−1 Resilient Channel one side, and is faced with single−layer 5/8−in. IMPERIAL Plaster Base and 1/16−in. IMPERIAL Veneer Plaster. The stud space has 3−in. THERMAFIBER Insulating Blankets. The assembly is 1−hour fire rated; installed cost index is 150.

Probably the most widely−used plaster partition of all is the STC−49 USG Metal Stud system with 3/8−in. Rocklath Plaster Base attached on each side with MS−1 Clips and finished with 1/2−in. gypsum sand plaster. THERMAFIBER Sound Attenuation Blankets, 1−in. thick, are provided in the stud space. While the MS−1 Clips are not resilient, the metal stud provides the needed decoupling.

[Insert Figure 69]

Good sound attenuation plus low installed cost index of 138 make this partition (Figure 69, above) the best buy for most noncombustible construction calling for plaster finish. Estimated fire rating is 1 hour.

Special−Application Partitions
[Insert Figure 70]

ULTRAWALL Movable Paritions (Figure 70, above) stand out in a group not usually noted for high sound control performance. With concealed H−studs 24−in. o.c., 1−1/2−in. THERMAFIBER Sound Attenuation Blankets, 3/4−in. by 24−in. Ultrawall Gypsum Panels, single−layer one side, and double−layer other side with 3/4−in. Z−splines between layers, this assembly comes up to an impressive STC 50. The same assembly with the single−layer both sides test STC−47, and the single−layer panel T−stud assembly tests STC 48.

All of these assemblies owe their performance to the resiliency of the stud systems, mass of the gypsum panels and to the damping−absorption action of the THERMAFIBER Sound Attenuation Blankets. They are 1−hour fire−rated with standard components and are tested without joint treatment. As such, they are ideal for virtually all movable partition applications.

[Insert Figure 71]

While Shaft Walls are not selected primarily for their sound control performance, it is an important factor to be considered, particularly where high−speed elevators are to be installed. USG Cavity Shaft Walls (FIgure 71, above) have STC 39 performance which increases to STC 44 with the addition of 1−in. THERMAFIBER Sound Attenuation Blankets in the cavity. Basic construction is two layers of 5/8−in. SHEETROCK® FIRECODE "C" Gypsum panels on one side, 1−in. USG Shaft Wall Liner Panels on the other side set between USG Metal T−studs 24−in. o.c., with joints finished.

The outstanding resistance of these systems to air−pressure loads and fire ratings up to 3−hours, make them the logical choice for modern high−rise construction.

As can be seen, these particular systems all rely on the three basic methods of sound attenuation −− mass, decoupling, and insulation −− for their performance. But one other important ingredient is present in all of them −− the ingredient that makes them outstanding −− design. Hundreds of systems have been submitted by United States Gypsum for analysis by independent sound−testing laboratories. In each case, the results have been analyzed and the findings incorporated in the design of future systems.

This tedious, time−consuming and costly process has resulted in constantly improving designs for the needs of the building industry over the years. The systems represented here and in U.S.G. literature are designed for practicality as well as sound attenuation; a high−performance system is of little use unless it is practical.

These and all other rated systems should be used exactly as described, with no changes in details or materials. Every detail of these systems has been carefully established by experience and any deviation will endanger the performance; in addition, the materials called for are of known tolerances and physical characteristics, and are known to be compatible. Any substitution may throw off the sensitive balance of the system at great loss of performance.

Floor−Ceilings

Desirable qualities in sound control floor−ceiling systems are much the same as those in partitions but the emphasis is somewhat different. The structural integrity is much more important because floors are always load−bearing. In addition, floor−ceiling assemblies usually provide more resistance to airborne transmission than to impact sound transmission; and, the most annoying intruding sounds in most buildings originate at the floor.

The fire rating is, of course, important as are the cost, ease of installation and good appearance. On the other hand, weight and thickness, within practical limits, are not usually of major concern.

The degree of tenant satisfaction desired will dictate the amount of sound attenuation needed in a floor−ceiling assembly for a multi−family dwelling. Generally, assemblies in the IIC range of 50 to 55 will give good tenant satisfaction, those in the 55 to 60 range will produce high satisfaction and any construction above IIC 60 can be considered of luxury quality and unlikely to produce complaints. Other factors affecting tenant satisfaction are the level of background sound (higher background sound will mask some noise), and the price or rental range of the building (higher income groups tend to be more critical of noise).

It is virtually impossible to block the transmission of all impact sound. Footsteps on a floor can be heard through the best floor−ceiling construction inf the receiving room is completely quiet. However, in a room with a normal amount of background sound, it is possible to reduce the loudness of the impact noise to a level not annoying to the occupants. This is the goal of impact sound attenuation.

The best place to attack sound is at the source. If the floor surface is covered with a resilient material such as foam−backed tile or soft carpet, the impact will be muffled −− less impact sound will have to be dealt with in the construction. While not always practical, a floor covering of heavy carpet with thick pad can often be used effectively for this purpose.

For example, a standard wood−frame assembly of 1−in. wood flooring over plywood on 2*10 joists 16−in. o.c. with a 5/8−in. SHEETROCK® FIRECODE Gypsum Panel ceiling will have an IIC rating of 32; with an addition of 44−oz. carpet and 40−oz. pad, this same construction will test IIC 58 −− a change from poor to high performance. The resistance to airborne sound transmission is virtually unchanged at about STC 40 because the carpet and pad are acoustically transparent. Resilient tile is a poor second choice and wood floors are lease effective in controlling impact noise (Figure 72, below).

[Insert Figure 72]

The next point of attack is in the construction itself, with isolation (decoupling) being the best approach. Often the floor can be "floated" on a resilient subfloor to interrupt the direct transmission path. On the underside, resiliently mounted ceilings, using the same methods as for partitions, will produce dramatic improvements. The wood−frame system below, with carpet and pad, and RC−1 Resilient Channel for ceiling attachment, has an IIC rating of 66 (Figure 73, below).

[Insert Figure 73]

With decoupling, insulating wool blankets can be effectively introduced, usually placed in the plenum above the ceiling. The IIC 66 system with standard floor, carpet and pad can be improved to IIC 70 with addition of 3−in. THERMAFIBER Blankets (Figure 74, below).

[Insert Figure 74]

The effect of insulating blankets is even greater with a floating floor. A construction of 2*10 wood joists 16 in. o.c., with 5/8−in. plywood subfloor topped with 3/4−in. MASTICAL Underlayment Compound and resiliently attached 1/2−in. SHEETROCK® Gypsum Panel ceiling, improves from IIC 44 to IIC 54 when 3−in. THERMAFIBER Blankets are added (Figure 75, below).

[Insert Figure 75]

Acoustical tile or panel ceilings provide sound absorption but are acoustically transparent than plaster or drywall ceilings, so the results are approximately equal. The sound attenuation of acoustical ceilings can be improved with the addition of mineral wool blankets above the acoustical material. Of course, acoustical tile or panel ceilings are highly desirable from the standpoint of controlling sound originating within the room.

The final step in achieving high resistance to impact sound transmission is the introduction of mass. MASTICAL Gypsum Underlayment Compound is such a material, providing a leveling effect in addition to its mass value.

Some assemblies have been tested with a layer of sand poured in above the ceiling with good acoustical results. The procedure is hardly practiced however, because workmen are not familiar with the system and most conventional ceilings are not structurally strong enough to support the dead load.

The selection of a floor system is generally determined by the design of the structure. After the basic construction is established, it is only necessary to choose between acoustical tile or panels, plaster or drywall ceilings, and select a floor covering. Then, the desired additional performance is determined along with the best (most economical) method of obtaining it. Discussion of three and the most common system follows with explanation of the performance characteristics. A number of other, equally satisfactory systems are described in the USG Architectural Technical Literature.

Virtually all single−family and many multi−family dwellings are constructed with the basic 2*10 wood joist floor system. With this construction it has always been difficult to obtain acceptable impact sound attenuation performance without carpeting and pad on the floor. Now USG has a system which rangs in the high−performance class, even with tile or wood parquet on the floor surface; the essential component is MASTICAL Underlayment Compound.

The floor system shown in Figure 75 (above) tests IIC 54 with airborne sound attenuation of STC 56. It gains its effectiveness from the mass of the MASTICAL Underlayment Compound, the damping of the insulating blankets and the isolation provided by a resiliently mounted ceiling. The assembly has a 1−hour estimated fire rating, is little more expensive than standard wood floor, and is easily installed. With this system properly installed, the impact sound attenuation performance of the construction is reliable, regardless of the type of floor surfacing used. A variation of this system with 1−in. MASTICAL Underlayment, 1/2−in. SHEETROCK® FIRECODE "C" Panels nailed directly to joists, without wool, tests STC 48 and IIC 35. This performace can be improved considerably with carpet and pad.

Another popular system that utilizes the sound−retarding qualities of MASTICAL Underlayment Compound is bar joist construction with USG Gypsum Floor Plank. The metal−edged gypsum plank is laid on and welded to the bar joists. The ceiling is constructed of 5/8−in. SHEETROCK® FIRECODE Gyspum Panels attached to USG Metal Furring Channels wire−tied to the bar joists.

With foam−backed vinyl floor covering, this system tests IIC 50 while with 44−oz. carpeting and 40 oz. pad, it yields IIC 69. Either way, it provides STC 51 control of airborne sound and a 2−hour fire rating. This dry floor system is ideal for steel−framed buildings of many types, offering not only top performance, but fast erection, immediate use and reduced dead load.

Variations of the bar joist system include several assemblies of concrete on riblath or formed metal over the bar joists with suspended acoustical ceilings below. The performance of these systems is comparable to values given above. None of the systems, however, offers the erection advantages of USG Floor Plang (Figure 76, below).

[Insert Figure 76]

The most common floor system in reinforced concrete construction is a 6−in. concrete slab with floor finish laid directly on top and the underside plastered. With vinyl on the floor this construction will test about IIC 36; can be increased to IIC 65 with the application of heavy carpet and pad (Figure 77). Where wood or tile floor finishes are anticipated in this construction, the use of 1/2−in. USG Mineral Fiber Sound Deadening Board adhesively applied to the top of the concrete slab, followed by 1/2−in. USG Gypsum Sheathing and 3/8−in. plywood under the floor finish, can be expected to improve the performance considerably, probably near the IIC 50 level.