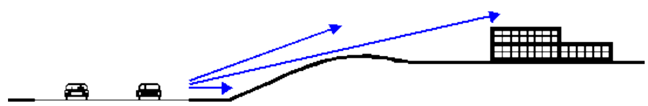
Sound Control Manual − Sound Construction
Planning

Site Selection

Too often, sound control receives little consideration in site selection since so many other factors affect the decision. However, in weighing these factors, the presence of existing noise sources should certainly be studied. This is true, not only for the occupants' acoustical comfort, but as a factor in the total cost of the building. The cost of creating a suitably sound−conditioned environment will certainly be greater if a high−level noise source exists near the property.

In inspecting a site for sound, most experts feel that actual meter measurements of the sound level at various times of the day and night are absolutely necessary. Even the ear can be decieved by existing sound. When United States Gypsum was looking for a site for its new acoustical laboratory, it naturally wanted a location with as little ambient sound as possible. The rolling farm land near Round Lake, IL seemed an ideal spot; but, meter measurements indicated a sound that no one had detecting in visiting the site. The sound −− the chirping of crickets −− was so serene that no observer had noticed it.

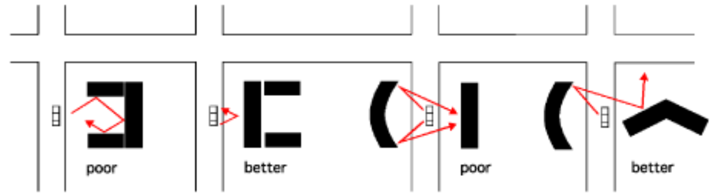


Natural sound barriers between sever noise sources and the proposed building location may exist. Small hils and significant elevation differences will oftern lower the noise level enought to reduce the sound control requirements of the building. See Figure 33 (above). Trees and other plantings provide virtually no noise reduction.

Orientation

The location of the building on the site can also affect the sound control conditions to be encountered later. The distance between the noise source and the building for instance, is a significant factor. Frequently too, the front of the building itself can be used as a sound barrier if the areas requiring quiet are placed to the rear. While these factors must be balances with appearance and function, they nevertheless should be considered.

Situations that designers try to avoid are long, parallel buildings or other arrangements that may tend to contain the reflected sound. Existing buildings across the street can also affect he propagation of sound reflections. A curved building can reflect and focus the sound from the street to combine with the direct sound, to create and extremely high level of noise at the proposed building site. If a courtyard is to be included in a U or L−shaped building, it may be possible to orient the building so that it will shield the courtyard from the major noise source. See Figure 34 (below).



Barriers

If the noise source is intense and no natural sound barrier exists, a man−made sound barrier should be considered as part of the design. A solid fence−type barrier may remove from 10 to 20 db from the noise level. High−frequency sounds will be reduce more than low frequency sounds. The cost of an outside barrier may be less than the cost of reducing the sound transmission in the construction.

This type of sound barrier must completely shield the building from the noise source. It should be placed as close to the sound source as possible to obtain the greatest sound−shadow angle. If a fence or wall is used, no louvers or openings should be permitted.

Floor Plan

Early in the building design it is wise to consider location of use areas within the building. Areas intended for quiet functions should be grouped, separate from areas that are potentially noisy. Quiet areas shouls be away from main halls and entrances. Kitchens and bathrooms are best located toward the noise source, and the machanical or utility room away from the sleeping area. In larger buildings, the mechanical equipment room should be seperated as far from the quiet area as possible. Large windows and doors facing outside noise sources should be avoided −− and particularly avoid bedroom windows near building entrances.

Sound control considerations in the early design stages can often do much to isolate quiet areas from problem noise sources. At this point, undesirable situations can often be avoided before they become costly or impossible to overcome.

Required Attenuation

After the inital design is complete, and all the possible steps have been taken to protect the quiet areas from noise sources, the amount of remaining and anticipated noise must be determined. This will indicate the amount of sound attenuation required of the construction to achieve the desired sound conditioning in the building. A guide to the amount of sound created by different situations is provided in Figure 35 (below); however, if a high level of outside noise is suspected, it is best to take instrument measurements in the site during the period when the noise level is at its peak.

Figure 35 − Sound Levels

Aircraft: Near the Plane	140 dbA
Aircraft: Residence Near Airport	80 to 90 dbA
Elevated Train	120 dbA

Industrial Plant	100 dbA
Auto Horn at 25 ft.	100 dbA
Jazz Band	85 to 100 dbA
Loud Stereo	90 dbA
Person Shouting	80 dbA
Noisy Household	75 dbA and up
Truck at 25 ft.	75 dbA
Busy Street at Curb	70 dbA
Dense Traffic at 200 ft.	65 dbA
Office Conversation	60 dbA
Average Conversation	50 dbA
Quiet Household	40 dbA
Quiet Conversation	25 dbA

Outdoor Background Noise:	Night	Day
Rural	20 dbA	45 dbA
Suburban	30 dbA	55 dbA
Urban	40 dbA	65 dbA

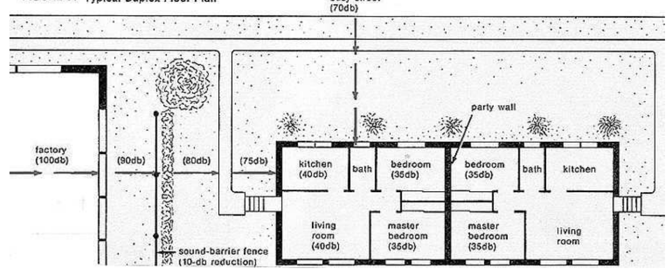
Figure 36 (below) indicates the normal tolerable noise levels in rooms of different functions. These are the amounts of noise that can be tolerated by the occupants performing their particular functions. The acceptable level of intruding noise is usually higher in rooms with a normally high internal sound level. Some functions may fall outside of this chart and require individual analysis.

Figure 36 − Optimum Background Sound Levels

Broadcast Studios	20 to 30 dbA
School Rooms	40 dbA
Conference Rooms	35 dbA
Homes, Apartments, and Hotels: Sleeping Rooms	35 to 45 dbA
Homes, Apartments, and Hotels: Living Rooms	40 to 45 dbA
Theaters, Movie	40 dbA
Hospitals	35 dbA
Libraries	35 to 45 dbA
Churches	30 dbA
Private Offices	35 to 45 dbA

Large General Offices	45 dbA
Large Engineering and Drafting Rooms	40 to 50 dbA
Restaurants	45 dbA
Stenographic Offices	50 to 60 dbA

FIGURE 37 Typical Duplex Floor Plan



A typical duplex sound−control situation is shown in Figure 37 (above). Note that the kitchen and living room, with higher acceptable background sound levels, are placed next to the factory, a high noise level source. The kitchens, bathrooms and second bedrooms are arranged to face the secondary noise source −− the street. All bedrooms have been placed back−to−back to lower the required party−wall performance. Windows, being weak in sound attentuation, have been omitted from the wall facing the factory; the door can be fitted with storm sash to improve its performance.

It should be assumed that the factory will be in operation for all shifts even if it presently shuts down at night −− the schedule may change. The factory noise level will determine the requirements of the facing wall. Its 90−db level may be reduced by 10 db for the sound −barrier fence and 5 db for the distance between the factory and duplex. This will leave a noise level of 75 db at the wall. The acceptable background sound level of the living room (the most critical room on the wall) is subtracted from the outside noise level. The remaining 35 db is the required sound attenuation performance of the wall. Since the actual performance will probably be at least 5 db, and possibly 15 db, below the tested value, a wall system in teh STC 50 range is justified.

For an ecaluation of the wall facing the street, street noise may be estimated at 70 db (busy street at curb, from Figure 35) . Reducing the value by 1 db for the distance leaves a 69−db noise level at the wall. While this is 6 db lower than the noise level at the wall facing the factory, the acceptable level of the bedroom is 5 db lower −− so about the same wall performance will be needed. The weakest point in this wall will probably be the windows; they should be sealed and include a storm sash if air conditioning is provided.

The party wall between apartments could be subjected to sound levels from 25 db (quiet conversation, from Figure 35) to 80 db (person shouting), depending on the tenants. For a moderate−income dwelling, a level of 60 db (slightly above normal conversation) will suffice. Subtracting 25 db (acceptable background level of adjacent room) from this value will leave 35 db to be stopped y the wall. Since the actual performance will be below the test values, a partition in the STC 45 to 50 range should be selected to insure privacy. This corresponds to guideline values in Figure 38 (below).

Figure 38 − Sound Attenuation Performance: Suggested Values for Typical Installations

(Click to here to view Figure 38)

As can be seen from the example, a certain amount of judgement and interpolation must be used. It is wise, especially in luxury buildings, to consider the intruding noise at its maximum, and the acceptable background level at minimum. In moderate− and low−income dwellings, where the tenant is mainly concerned with protection from normal noise levels, a few intruding sounds are not objectionable. The selection of systems, from the many available, involves not only obtaining the needed sound attenuation, but also the type of construction desired, fire rating required and the functional needs. A discussion of partition and floor−ceiling assemblies designed especially for sound control follows later in this chapter.

It should be noted that the performance of doors, windows and other openings will affect the sound attenuation values of entire wall assemblies. If doors or windows are located in a line of critical sound travel, the selection of ultra−high−performance assemblies would be unwise, since their potential will not be realized. The intruding sound will follow the path of least resistance −− in this case the door or window −− in spite of the sound attenuation qualities of the rest of the barrier.

Then, too, total attentuation is not the goal. It is physically impossible to keep all sound from a room; and, a certain amount of background noise is desirable −− total silence can be disturbing.

With the degree of sound attentuation determined and the system selections made, it remains to ensure that the performance is actually realized. Between selection of the system and occupancy, a multitude of things can happen to lower the performance. Understanding the principles involved will simplify the taks of preventing defects.