1.0 Acoustic Design

Building acoustics is the science of controlling noise in buildings, including the minimisation of noise transmission from one space to another and the control of noise levels and characteristics within a space. The term 'building acoustics' embraces sound insulation and sound absorption. The two functions are quite distinct and should not be confused.

Noise has been defined as sound which is undesired by the recipient, but it is very subjective and it depends on the reactions of the individual. However, when a noise is troublesome it can reduce comfort and efficiency and, if a person is subjected to it for long enough periods, it can result in physical discomfort or mental distress. In the domestic situation, a noisy neighbour can be one of the main problems experienced in attached dwellings. The best defence against noise must be to ensure that proper precautions are taken at the design stage and during construction of a building. This means that the correct acoustic climate must be provided in each space and that sound transmission levels are compatible with the usage. Remedial measures, after occupation, can be expensive and inconvenient. Ideally, the sound insulation requirements for a building should take into account both internal and external sound transmission.

Sound Insulation Any wall system that separates one dwelling from another, or that separates one room from another, should be selected to provide a sufficient level of insulation against noise. There are two types of noise transfer through partitions: airborne transfer, and structure-borne transfer. Both may need to be considered in order to achieve the desired result. Noise sources, such as voices, televisions and musical instruments, generate noise in the air in one room and this noise passes through the partition and into the room on the other side. This is known as airborne noise.

As we know, some partitions are better than others at isolating airborne noise. In order to simply compare the isolating performance of partitions, the STC (Sound Transmission Class) rating was developed. A partition with a high STC rating isolates sound better than a partition with a low STC rating. If we compare two partitions, and one has an STC which is 10 rating points higher, then the noise passing through the wall with the higher STC will be about half the loudness when compared with the noise passing through the wall with the lower STC. The STC ratings are obtained from tests carried out in certified laboratories, under controlled conditions. When identical partitions are part of buildings and tested insitu, it is often found that the actual STC rating obtained, usually called the FSTC (Field Sound Transmission Rating) is lower than the laboratory STC. This reduction in performance can be due to flanking paths (that is to say that noise also passes through other parts of the building such as floors or ceilings) or may be due to poor detailing such as incorrect installation of pipes, power points etc. It is likely that future revisions of the Building Code will use the ratings Rw (which is similar to STC) and Weighted Standardised Level Difference (Dnt,w) which is similar to FSTC.

Structure-borne Noise & Weighted Normalised Impact Sound Pressure Level (L'n,w) When a building element is directly, or indirectly, impacted or vibrated then some of the energy passes through the partition and is re-radiated as noise to the room on the other side. This is called structure-borne noise or impact noise. For walls, the most common sources of structure-borne noise are:

- Cupboard doors, fixed to party walls, being closed
- Kitchen appliances being used on benches touching walls
- Plumbing fittings, particularly taps, being connected to walls
- Light switches being turned on and off, and
- Dishwashers, washing machines, clothes dryers etc. touching walls

Although floors and ceilings must meet specific impact sound ratings there is no requirement for walls. Noise Reduction Coefficient (NRC) Designers of theatres, music rooms and power transformer enclosures, etc, may often choose materials which have an efficient sound absorption value and incorporate them within the building design to dampen the reverberation within the room. The level of sound absorption for material is stated as the NRC (Noise Reduction Coefficient). This value is derived as a result of acoustic testing on the material, and determined by calculation from the average amount of sound energy absorbed over a range of frequencies between 250Hz and 2000Hz.

Sound Isolation Criteria Specifications for minimum levels of sound isolation are:

- Unit to corridor or stairs STC ≥55
- Unit to unit STC + Ctr ≥55
- Where a wet area of one unit adjoins a habitable room in another unit, the wall construction must be of a "discontinuous type".

Guidelines for Optimum Performance: To achieve the optimum performance for a wall system, the exact construction as specified, including perimeter sealing, must be adopted. Any variation from the systems detailed in this guide should be approved by the project acoustic consultant as it can increase or decrease the acoustical isolation of wall systems.

1.1 Installation

Unless careful attention to installation detail is followed, significant reductions in sound isolation can occur, particularly with high performance walls. The following need to be taken into account.

Perimeter Acoustical Sealing

It should be noted that as the sound isolation performance of a partition increases, then the control of flanking paths becomes more critical. Consequently, the perimeter sealing requirements for a low sound rating wall, such as STC40, are much less than for a high sound rating wall, such as STC55. However, it is neither necessary, nor is it cost effective, to provide very high perimeter acoustic sealing for a low rating STC wall. The perimeter isolation for each leaf must be commensurate with the acoustic isolation of the leaf. It cannot be over emphasised, however, that for high performance walls, the sealing of each leaf must be virtually airtight. For a sealant to be effective at controlling noise passing through gaps, it must have the following properties:

- Good flexibility, elastic set
- Low hardness
- Excellent adhesion, usually to concrete, timber, plaster and galvanised steel
- Minimal shrinkage (less than 5%)
- Moderate density (greater than 800 kg/m^3), and
- Fire rated where required (all walls required by the NZBC to be sound-rated also have fire ratings)

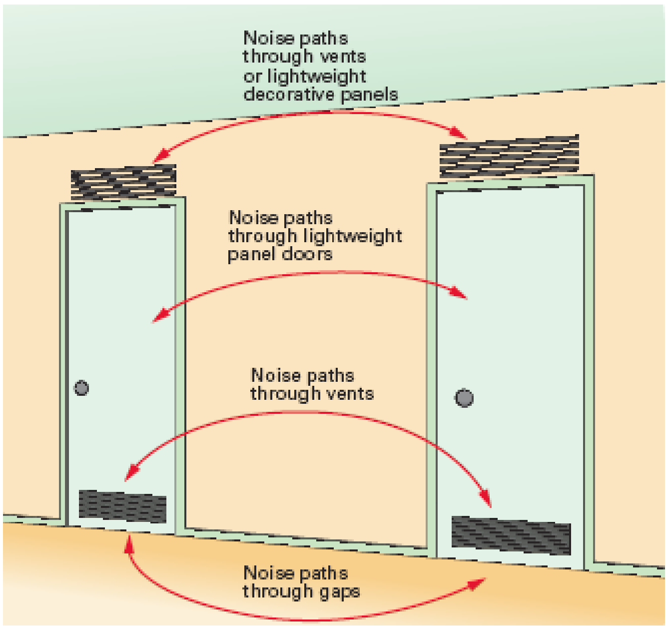
All of the above properties must be maintained over the useful life of the building, that is, greater than 20 years. Examples of suitable sealants include:

- Bostik Acoustic Sealant
- Bostik Fireban One (high movement; fire-rated)
- Firepro M707 Fire Seal Mastic (1-part; high movement)
- Fosroc Flamex 1 (fire-rated 4 hours min; 2-part) indoors
- Fosroc Flamex PU (fire-rated 4 exterior applications) outdoors
- Holdfast Soudaflex 14LM
- Sika Firerate PU
- Winstone Wallboards Gib Soundseal Acoustic Sealant (low movement acrylic sealant)

IMPORTANT: The use of expanding foam sealants is not acceptable. Reference should be made to the manufacturer to ensure that the particular type or grade of sealant is fit for purpose.

1.2 Noise Flanking

It is beyond the scope of this data to provide full details for control of all flanking paths. However, flanking can significantly reduce the perceived isolation of a wall system and should therefore be given careful consideration. Typical flanking paths are shown in the following illustration:



Laboratory test results are achieved under ideal controlled conditions and estimates are calculated from known performance, experience and computer simulation programs. To repeat the performance in the field, attention to detail in the design and construction of the partition and its adjoining floor/ceiling and associated structure is of prime importance. Even the most basic principles, if ignored, can seriously downgrade the sound insulation performance of a building element.

Litecrete cannot guarantee that field performance ratings will match laboratory or estimated opinions. However, with careful attention during erection of the wall, correct installation to specification and proper caulking/sealing, the assembly should produce a field performance close to and comparable with tested or estimated values. Apart from installation procedures, workmanship and caulking, the following items can also affect the acoustic performance on site.

1.3 Doors

Hollow, cored and even solid doors generally provide unsatisfactory sound insulation between rooms. Doors can also provide direct air leaks between rooms thus having a bad effect on the overall sound insulation of the partition in which they are inserted. The higher the insulation of the partition, the worse is the effect of doors.
Where sound insulation is important, specialised heavyweight doors or, preferably, two doors separated by an absorbent lined airspace or lobby should be used.

1.4 Lightweight Panels Above Doors

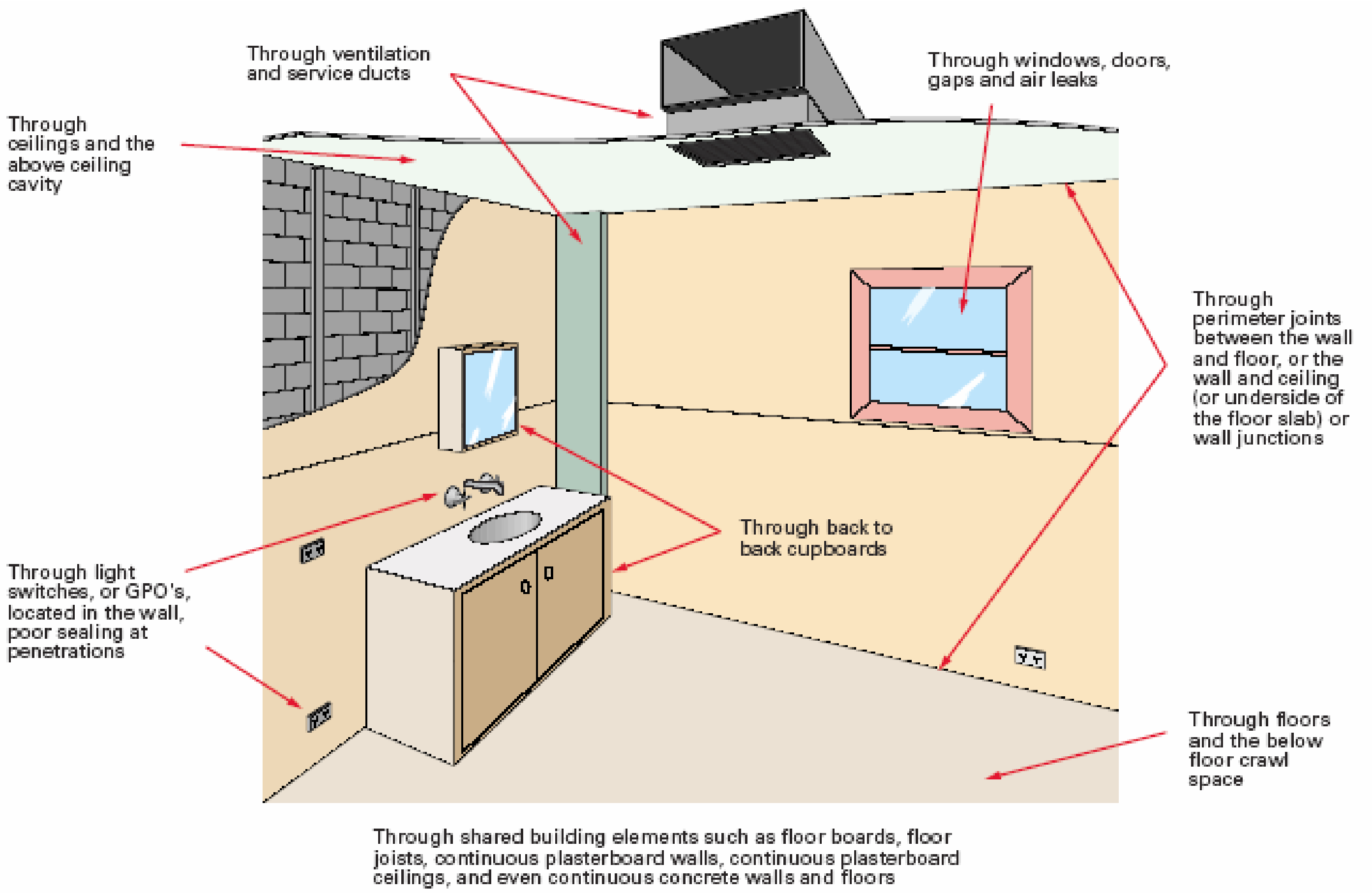
These are often incorporated for aesthetic reasons, however the performance of a partition with good sound insulation can be considerably degraded by lightweight panels such as thin MDF or plywood.

1.5 Air Paths

Through Gaps, Cracks or Holes Gaps, cracks or openings, however small, readily conduct airborne sounds and can considerably reduce the sound insulation of a construction.

1.6 Appliances

In cases where sound insulation is important, noise producing fixtures or appliances such as water closets, cisterns, water storage tanks, sluices, dishwashers, washing machines and pumps should be repositioned or isolated from the structure with resilient mountings and flexible service leads and connections. Where fittings are duplicated on opposite sides of partitions, they should be offset.



1.7 Electrical Outlets & Service Pipes

Electrical outlets, switch boxes and similar penetrations should not be placed back to back. If power outlets are installed back-to-back, they will create a flanking path or sound leak. Seal backs and sides of boxes and the perimeter of all penetrations with acoustic sealant. Penetrations should be avoided where sound insulation is important. This includes recessed fittings or ducts such as skirting heating, electrical or telephone wire trunking, light fittings, inter-communication systems and alarms, medical and laboratory gas outlets. Plumbing connections between fittings or appliances on opposite sides of a partition offer a path for transmission of sound and should be sealed. If possible introduce discontinuity in the pipework between fittings, such as a flexible connection within or on the line of a partition.

Acoustic Test Report. Litecrete wall panels provide excellent sound insulation and meet the performance requirements of NZBC G6.3.1 for inter-tenancy walls. The approved acoustic system achieved Sound Transmission Class (STC) 60 when constructed in accordance with the method described in *Litecrete Construction Details*.