CHAPTER 1

General Requirements and Common Errors

This chapter lays out the fundamental requirements of premises for professional recording purposes, including: common underestimation of need for good isolation; avoidance of disturbance from plant and equipment noises; influence of location on isolation requirements; consideration of artistic needs; control room monitoring basics; types of buildings to avoid; and the need for adequate space and building strength.

1.1 The General Requirements

Some of the things that set a professional recording studio apart from a personal studio are listed below:

1. The ability to work during the chosen hours of use (in many cases 24 hours per day) without disturbing, or being disturbed by, anything or anybody in the local community.
2. The studio should be able to record musicians without delays or impediments to the needs of the musical performance.
3. Studios should inspire confidence in all the personnel involved in any recording.
4. The achievable quality of recording should not be limited by the inadequacy of the studio design or installation. Even a modest studio performing optimally may well outperform a much more elaborate one that has been poorly conceived and installed.
5. The studio should always provide an adequate supply of clean, fresh air, in a temperature and humidity-controlled environment. (See Chapter 9.)

So now, let us look at these points in some more detail.

1.2 Sound Isolation and Background Noise Levels

In the enthusiasm that often accompanies the idea to build a recording studio, the lack of experience of the people involved often leads to a tendency to fail to realise the need for good sound isolation. In far too many cases, people believe that they can work around most of the restrictions which poor isolation imposes. This is a dangerous attitude, because once it

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is realised that the compromises severely restrict the success of the studio it is often too late or too financially burdening to make the necessary changes. The result is often either a ceiling placed on the ability of the studio to develop, or financial ruin. In 2001, European banks reported bad debts on over 20,000 studio project loans, and this has made things difficult ever since. Optimism must be tempered by reality.

Isolation is a two-way problem. The most obvious need for isolation is to prevent sound escaping from the studio and disturbing any noise-sensitive neighbours. Almost everybody realises that repeated disturbance of neighbours is probably going to lead to complaints and, if nothing is done about it, cause the closure of the studio. Conversely, noises from the local community activity entering the studio can disrupt recordings and disturb the creative flow of the artistic performances. Sound isolation also sets the dynamic range limit for a studio. This latter point is very important in a professional recording situation, but it is often woefully under-appreciated.

1.2.1 From the Inside Out

If a studio only has an effective isolation of 40 dB, then any sounds above 75 dBA in the studio will risk annoying neighbours. The resulting 35 dBA reaching them would certainly be considered a potential noise nuisance, at least if the studio were to be used after 10 pm and was sited in a residential area. For example, one cannot turn down the volume of a drum kit. Playing quietly is no solution, because it produces an entirely different tone quality to playing loud. Realistic drum levels are more in the order of 110 dBA, so 75 dB of isolation (the 110 dBA SPL [Sound Pressure Level] of the drums minus the 35 dBA acceptable to the neighbours) would be a basic requirement, though this could be reduced at low frequencies, as will be discussed in Chapter 2.

Many people decide that they can mix in the control room at night in rooms with reduced isolation, in the belief that they can work with the monitor volume controls reduced below their daytime levels. It soon becomes apparent that if the studio is to be used commercially, it is usually the clients, not the studio owners, who decide at what level they wish to monitor. If they cannot work in the way that they wish or need to work, they will perhaps look elsewhere when planning their next recordings. In addition, when the ability to monitor at higher levels is denied, low level noises or distortions may go unnoticed, only to be heard at a later date. This may result in either the work having to be done again or the bill for the wasted session going unpaid.

Even more disturbing (see next chapter and Figure 2.1 for reasons), mixing at a relatively quiet SPL of 75 dB is at the lower end of the preferred range for music mixing, because it is already descending into a region where the ear is less sensitive to the upper, and especially the lower, frequency ranges. Mixes done at or below this

level may tend to sound excessive in bass when reproduced elsewhere at higher SPLs, as would often be the case. Therefore, mixing at a low level so as not to annoy the neighbours is not really a professional option.

It is true that for a voice studio for publicity or radio recording (and especially when the end-product is not likely to be listened to from an audiophile perspective), 40 or 50 dBA of isolation and a 75 dB maximum operating level may suffice, but such conditions would certainly not be suitable for music recording. In conditions of poor isolation, frustrating moments of lost artistic inspiration can be frequent, such as when a good take is ruined by an external noise, or when operating level restrictions deny the opportunity to do what is needed when the moment is 'hot'. Professional studios should be ready for whatever the musicians reasonably require, because capturing the artistic performance is the prime reason for their existence.

1.2.2 From the Outside In

Background noise levels of below 20 dBA (or NR20 or NC20 as variously used) were the norm for professional studios. In recent years, cost constraints on air-conditioning systems, together with the appearance of ever more computer disc drives in the control rooms, have pushed these levels higher. These problems will also be discussed in later chapters, but background noise levels above 25 or 30 dBA in either the studio rooms or the control rooms seriously begin to encroach on the recording operation. Twenty dBA is still optimal.

Most musical instruments have been designed to have sufficient loudness to be heard clearly over the murmur of a quiet audience, but if the background noises in a recording room exceed around 30 dBA there will be a tendency for the extraneous noises to enter the microphones with sufficient level to degrade the clarity of some recordings. Much important low-level information in the tone of an instrument or voice may then be masked by the noise. In the control rooms, we should reasonably expect a background noise level at least as low as that of the recordings. Otherwise, when monitoring at life-like levels similar to those produced by the instruments in the studio, one could not monitor the background noise level on the recording because it would tend to be masked by the higher background noise level in the control room. The number of so-called recording studios which now have 50 dBA or more of hard disc and cooling fan noise in the control room, with monitoring limits of only 90 dB SPL, is now reaching alarming proportions. That represents a monitoring signal-to-noise ratio of only 40 dB. It is absurd that many such studios are promoting their new, advanced, 24-bit/96 K recording systems as part of a super-low-noise/high-quality facility, when the 100 dB + signal-to-noise ratio which they offer cannot even remotely be monitored. One cannot trust to luck and call oneself professional.

1.2.3 Realistic Goals

The previous two subsections have outlined the basic reasons why good sound isolation is required in recording studios. The inside-to-outside isolation is usually dominant, as few studios are sited next to neighbours producing upwards of 110 dBA. As the 30 dBA region is reasonably close to the limit for tolerance of background noise by either the neighbours or the studio, it is principally the 110 dBA or so produced in the studio that dictates the isolation needs.

Of course, a well-judged choice of location can make life easier. Siting the studio in the middle of nowhere would seem to be one way of reducing the need for so much isolation. However, the owners must ask themselves if their clients are likely to travel to such a remote location in commercially viable numbers. Furthermore, one should be wary of other likely problems. One expensive studio was located in a place with little sound isolation because it was so remote from any neighbours. Three months of unseasonably strong winds and heavy rain almost drove them to ruin because of the weather-related noise entering the studio. At great cost, improved sound isolation had to be added after the studio had been completed, which proved to be far more expensive than it would have been had it been incorporated during the initial construction of the studio.

It is client convenience which often drives studio owners to locations in city centres or apartment buildings. Convenient for the clients they may be, but high property prices and/or high isolation costs often cause the owners to look for premises which are too small. Often there is simply no room for adequate isolation in their chosen spaces, even when very expensive techniques are employed. This subject will be dealt with in greater depth in Chapter 2.

1.2.4 Isolation versus Artistry

Artistic performance can be a fragile thing. Curfews on what can be done in the studio and during which hours can be a source of great problems. No matter how clearly it is stressed that the working hours are 10 am to 10 pm, for example, the situation will always arise when things are going very well or very badly, where a few extra hours of work after the pre-set deadline will make a good recording great or perhaps save a disaster. In either case, using a studio where this flexibility is allowable is a great comfort to musicians and producers alike, and may be very much taken into account when the decision is made about which studio to use for a recording.

1.3 Confidence in the System

A professional studio should be able to operate efficiently and smoothly. Not only should the equipment be reliable and well maintained, but also all doubts should be removed as far as

possible from the whole recording process. This means that a professional studio needs recording rooms with adequately controlled acoustics and a monitoring situation which allows a reliable assessment to be made of the sounds entering the microphones. This latter requirement means reasonably flat monitoring systems are needed, in control rooms that allow the flat response to reach the mixing position and any other designated listening regions of the room. The monitoring systems should also have good transparency and resolution of fine detail, uncoloured by the rooms in which they are placed or by the disturbances caused by the installed recording equipment. Where doubt exists about the monitored sound, musicians may become insecure and downhearted, and hence will be unlikely to either feel comfortable or perform at their best.

The decay time of the control room monitoring response should be shorter than that of any of the main recording rooms (dead isolation booths may be an exception), otherwise the recording personnel may not know whether the decay that they are hearing is a part of the recording or a result of the monitoring environment. This subject can arouse many strongly opinionated comments from advocates of some older control room design philosophies, but the fact remains that adequate quality control monitoring can be difficult to perform in rooms with typically domestic decay times.

When recording personnel and musicians realise that they can trust that what they are hearing is what the audiophiles will hear in good conditions, it tends to give them more confidence. Despite the fact that very many people now listen to downloaded, data-reduced music via mobile telephones and ear-buds, the majority of musicians still want their recordings to sound good on top quality systems. It is a question of artistic and professional satisfaction. Confidence is often lacking in an insecure artistic world, so anything which can boost it is much to be valued. Small loudspeakers are effectively *de rigueur* in all studios these days, both as a mixing tool and as a more domestic reference. This is a very necessary requirement, as one obviously wants to know what the likely result of a mix will be in 95% of the record buyers' homes. Nevertheless, it still seems to be incumbent on a professional studio to be able to provide the means to monitor the full range of a recording. Those paying fortunes for their super hi-fi systems will not then be disappointed, as they would be when buying poorly monitored recordings that could have been so much better if only the recording studio had had better monitoring. The large monitors are also necessary for a good, full frequency range, *quality control* assessment of the basic recordings, even if they are not to be used at the mixing stage, but this will be dealt with in much more detail in Chapter 19. If there is any one thing that disgraces so much of the 'less than professional' part of the recording industry it is the widespread use of appalling monitoring conditions.

A further point for consideration, although a detailed discussion is outside of the scope of this book, is that it should still not go without mention that nothing really inspires more confidence in a recording process than the participation of an experienced and knowledgeable staff.

1.4 The Complete System

A recording studio is a system, just as a racing car is a system. No haphazard combination of high-quality gearbox, engine, wheels, tyres, axles and chassis will guarantee a well-performing car. The whole thing needs to be balanced. The same principle applies to recording studios. A hugely expensive, physically large mixing console, with large flat surfaces will tend to dominate the acoustic response of a small control room. In such situations, even when using the flattest monitors available, there is little chance of achieving a flat response at the listening position(s) in a small room. When studio equipment outgrows the rooms as the studio expands, the results usually suffer.

Studios should also be well ventilated, with good stability of temperature and humidity, otherwise musicians can become uncomfortable and instruments can vary in their tuning. Correcting the tuning later by electronic means is not a professional solution to any of these problems, because if the problems exist at the time of the recording they will almost inevitably affect the performance negatively. In fact, speaking about negativity, perhaps we should look at some of the typical things that many prospective studio owners get wrong, or misunderstand most often.

1.5 Very Common Mistakes

In an enormous number of cases, prospective studio owners' purchase or lease premises which they consider suitable for their studio before calling in a studio designer or acoustical expert. They often realise that there could be potential problems, but they believe that they can talk their way around any difficulties with neighbours. They invest considerable money in building something which they deem to be suitable for their needs, and then only call in specialists once the whole thing has been completed but the neighbours refuse to 'see reason'.

Acoustics is not an intuitive science, and many people cannot appreciate just how many 'obvious' things are, in reality, not that obvious at all. It is a very unpleasant experience for acoustics engineers to have to tell people, who have often invested their hearts, souls and every last penny in a studio, that the building simply is not suitable. Unfortunately, it happens regularly. The problem in many of these cases is that the buildings are of lightweight construction and the neighbours are too close. The three things most important in providing good sound isolation are rigidity, mass and distance. Lightweight buildings are rarely very rigid, so if the neighbours are close, such buildings really have nothing going for them except cheapness. Even if there is space to build internal, massive, floated structures, the floors may not be strong enough to support their weight because the buildings are only of weak, lightweight construction. In many cases, such premises will have been purchased precisely because they *are* inexpensive; perhaps they were all that could be afforded at that time, which often also means that the money for expensive isolation work is not available. The cost of

massive isolation work in a cheap building will obviously be greater than a smaller amount of isolation work in a more sturdily constructed building, and usually the overall cost of the building and isolation work will be cheaper in the latter case.

An actual set of plans for the isolation work in a rather unsuitable building in southern Spain is shown in Figure 1.1. It is sited in the ground floor garage of an apartment building. Initial tests with bass and drums in the proposed studio, *after* it had been purchased, produced 83 dBA in a neighbour's bedroom. This would have meant trying to sleep with the equivalent of a loud hi-fi system playing in the adjoining room. The almost absurd quantity of required sound isolation work eventually reduced the noise level in the bedroom to around 30 dBA, but the cost was not only financial; much space was also lost.

1.5.1 The Need for Space

Space is also something which many potential studio owners underestimate. Whilst it is not universally appreciated just how much space can be consumed by acoustic isolation and control measures, it is still alarming that so many studio owners buy premises in which the rooms, when empty, have precisely the floor area and ceiling height that they expect to be available in the finished rooms. The owners of the studio shown in Figure 1.1 were very distressed when they saw their space being eaten up by the acoustic work. They could only breathe easily again when they realised that the isolation was adequate and that the relatively small remaining space had an open sound in which they could make excellent recordings. They eventually had to market the studio on its sound quality, and not on its size; which on reflection was perhaps not a bad idea. The studio became very successful.

If prospective studio owners can consider space in a *new* building *before* it is completed, then access by the acoustics engineer to the architects can usually provide some remarkably inexpensive solutions. Concrete, steel and sand are relatively cheap materials, and most structures can cope with supporting a lot of extra weight if this is taken into account at the planning stage. What is more, results are more easily guaranteed because the precise details of the structure will be known. Old buildings often lack adequate plans, and the acoustic properties of the materials used are often unknown. Hidden structural resonances can thwart the results of well-planned isolation work, so it is often necessary to err on the safe side when trying to guarantee sound isolation in old buildings, which usually leads to more expense.

Obviously, though, what we have been discussing in the previous few paragraphs require long-term investments. Many start-up studios are underfinanced, and the owners find themselves in short-lease premises in which the acoustic treatment is seen as a potential dead loss when the day comes to move. These people tend to be very resistant to investing in acoustics. Not very much can be done to make serious studios in such premises, certainly not for high-quality music recording, though exceptions do exist.

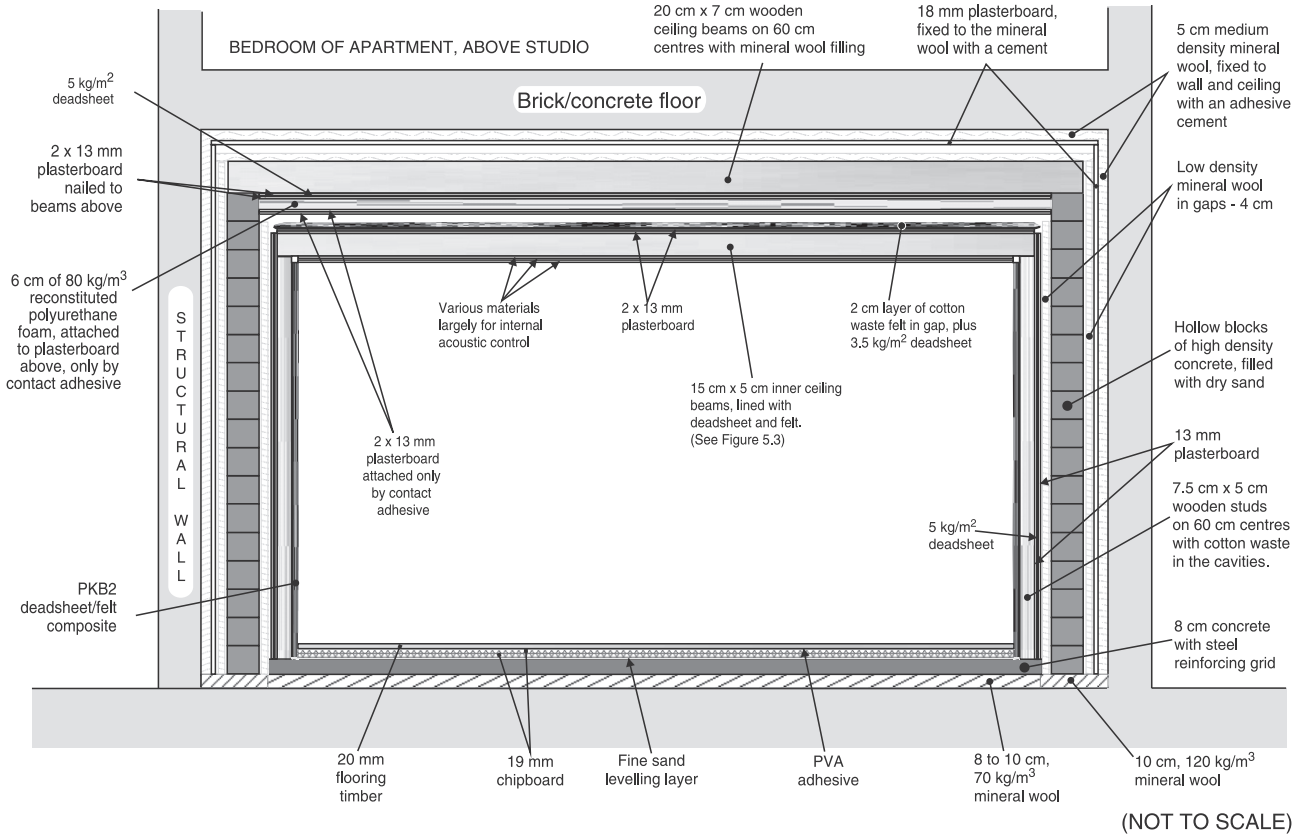


Figure 1.1:
Triple isolation shell in a weak domestic building.

1.5.2 Height

It is very difficult to make a good quality studio, free of problematical compromises, in a space with inadequate height. Control rooms require height because of the need to avoid parallelism between the floor and the ceiling. At low frequencies, all suitable floors are reflective, so the ceilings must be designed such that monitor response problems are not created by the vertical room modes. As will become apparent in later chapters, all forms of suitable treatment for the ceilings are wavelength dependent. So, if a metre is needed for the ceiling structure, and 20 cm or so for a floated floor, then to maintain a ceiling height of 2.5 m within the room, something approaching 4 m will be needed in the empty space before construction.

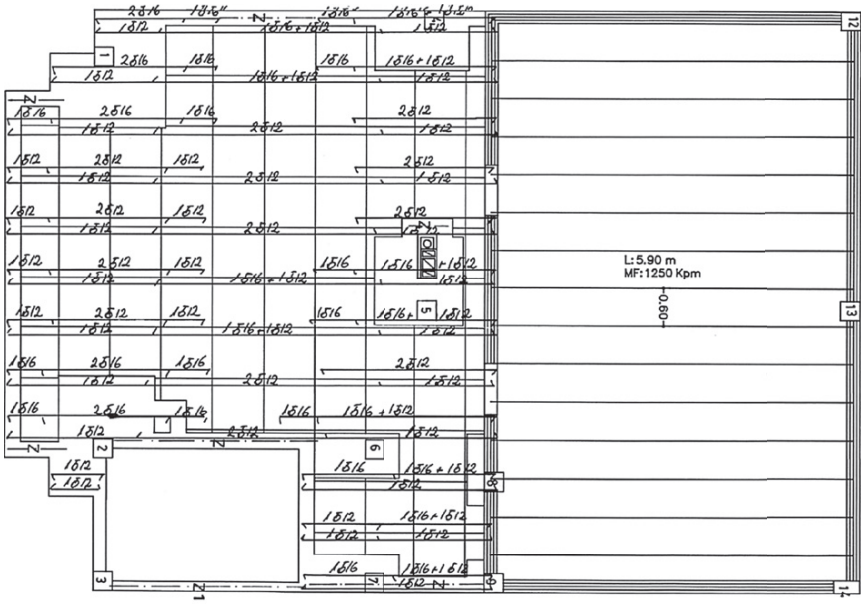
In the studio rooms, microphones placed above instruments, as often they must be, will be far too close to a reflective boundary unless adequate height is available in the room. Again, with less than 4 m of height to begin with it becomes very difficult to achieve the acoustics necessary to make a flexible, high-quality recording room. Six metres is a desirable height for an area in which a music studio is to be built. Less than 3 m makes the construction of an excellent studio almost impossible.

Experience has shown that if less than 3.5 m of height is available before treatment; the best that can be achieved are rooms of either limited flexibility or idiosyncratic sound. Obviously many rooms *are* built, these days, in spaces with much less height than optimum, but few of them could truly claim to have a 'first division' response. The lack of ceiling height in the chosen spaces is one of the most common errors made by prospective studio owners when acquiring premises.

1.5.3 Floor Loading

In general, sound isolation systems are heavy. The details of why and to what degree will be dealt with further in Chapter 3. There is no simple weight per cubic metre figure for typical isolation, but as an example, an adequately isolated room of 10 m×6 m×4 m in a residential building could easily contain 40 tonnes. On the 60 m^2 floor, this would mean an average loading of around 700 kg/m^2 (or around 150 pounds per square foot in imperial measure). This is more than a general light industrial loading, and much more than a domestic loading, and it is made worse by the fact that the weight is not evenly distributed. There may be areas beneath the lines of dividing walls, such as between the control room and the studio, where loads of 4 or 5 tonnes/m^2 may be present.

This is simply often not appreciated by people looking for suitable studio premises. Figure 1.2 shows the steelwork in a reinforced concrete fourth floor of an apartment building in Mallorca. Despite looking quite complex, it was not very expensive to make. Luckily, the prospective studio owner had taken advice from an acquaintance and bought a return air ticket to send to an acoustics engineer to enable him to meet the architect of the building



(ARMADO TRANSVERSAL)

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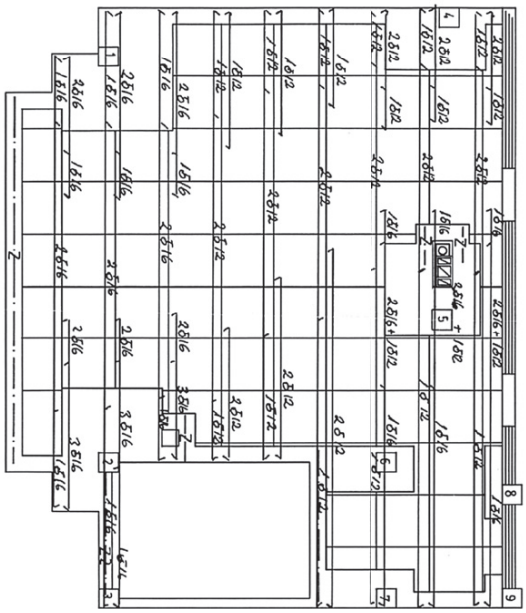
PISO 4

(ARMADO LONGITUDINAL)



Transverse and
longitudinal
steelwork

Figure 1.2:
Reinforcing steelwork for supporting a studio on the fourth floor of an apartment building.

before construction began. The floor in Figure 1.2 *can* carry 40 tonnes, and the proposed studio eventually went into operation without problems. Had the owner not had the foresight to consult an acoustics engineer, and had he begun the internal isolation work without the required knowledge, then the studio could have been forced to close soon after opening due to poor isolation to the rest of the buildings. What is more, and in fact worse, the owner could have *tried* to provide sufficient isolation, only for the floor to collapse with perhaps fatal consequences.

The underestimation of the need for adequate floor strength and rigidity is a very common error made by prospective studio owners. What makes the situation worse is that in many cases the buildings that have weak floors often also have weak walls and weak ceilings, which make them the very buildings that *require* the heaviest isolation, which of course they cannot support. Obviously, therefore, they are not suitable as recording studios unless they are without neighbours and in areas of very low external noise, but as previously mentioned, the weather can then cause problems. The lowest floor of a solidly constructed building is clearly a better option.

The requirements for, and the cost of, the sound insulation/isolation can therefore be very much influenced by the nature of the structure of the building and its situation *vis-à-vis* noise sources and noise sensitive neighbours. The cost difference between needing 50 dB or 70 dB of isolation is very great, so if an appropriate building and location can be chosen, even if it is more expensive to buy or lease, it may still work out cheaper when the cost of the entire studio is fully appreciated.

If the things mentioned in this chapter are given due consideration at the very early stages of studio planning, then many problems can be avoided. In addition, if many things are *not* duly considered, problems in the realisation of the studio can be so deep-seated that they may have to be lived with for its working lifetime. Such problems can severely limit the potential for upgrading the studio to suit new ideas or a higher standard of recording. There is no doubt that a comprehensive knowledge of what one is seeking to achieve is a good starting point in almost any form of construction, but when choosing studio buildings it is especially important.

1.6 Summary

The general requirements of a studio should be carefully thought about before a location is chosen.

Good sound isolation is essential, and many people greatly underestimate its importance.

One cannot work more quietly at night time and expect to achieve the same results as working at normal SPLs.

Noisy electromechanical systems, such as ventilator fans, disc drives and air-conditioning units should not be allowed to disturb the recording or monitoring environments. Background noises above 30 dBA are not acceptable for professional use.

Choice of location can greatly simplify sound isolation requirements, but convenient access for the clients may drive studios into more noise sensitive areas. In the latter case, costs must be expected to rise. Potential earnings, on the other hand, may also be greater.

An undisturbed recording environment may be essential for achieving great artistic performances.

Control room and monitor system decay times should be shorter than the decay times in the principal studio (performing) rooms. Otherwise, monitoring environment decay may mask the performing room decay, and make the recorded ambience very difficult to assess.

Large and small monitor systems tend to be needed, each for different reasons.

It is best to seek expert advice *before* choosing a building in which to site a recording studio, because acoustics is not an intuitive science.

Lightweight, inexpensive buildings rarely make good studios. Buildings should also be considerably larger than what is needed solely for the interiors of the finished rooms. Isolation and acoustic control work can be space consuming. Adequate height is also beneficial. Old buildings often have hidden problems, so the prediction of conversion costs can sometimes be difficult to assess accurately.

Adequate low frequency isolation can often require the use of considerable quantities of heavy materials. These need not be expensive, but the question often arises as to whether a given building can support the weight.