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PRACTICAL MEASUREMENT AND CONTROL OF MUSIC NOISE BREAK-OUT FROM SMALL VENUES

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1. INTRODUCTION

Since the early eighties the issue of music break-out from music venues has been the subject of considerable debate. The debate has not so focused on the control of the noise, but rather on what objective measure best correlates with people's subjective response to music noise. This problem has become increasingly evident over recent years. There appear to be two main reasons for this intensification.

The first reason relates to the expectations of those people exposed to music noise. These people are usually residents living close to pubs or clubs in which music is played. Over recent years there has been an increasing public awareness that noise is a pollutant and that its effects can be just as deleterious to health as some of the more 'traditional' pollutants. The issue of the Environmental Protection Act 1990 defines as a statutory nuisance noise that is prejudicial to health or interferes with a person's enjoyment of their property.

The second reason relates to the customers of small venues where music is played. Recent trends in music have pushed the spectrum of the music to lower frequency limits, with the style of the music becoming reliant on regular, high amplitude bass beats. Coupled with this change in the style of music, there have been significant recent advances in the design of sound systems, and particularly in loudspeaker design, that have enabled the frequency response of these sound systems to be pushed ever lower, and to produce greater sound power output without distortion. I am not sure whether the advances in sound system design prompted the change in music style, or vice versa, but whatever the chronology of events the result is the same: customers of music venues now generally expect to hear music played at a high volume with a significant low frequency content and with minimal distortion.

In a bid to meet the customer led demand for higher quality sound system, and thus to retain their existing clientele and to attract new customers, owners of small venues are replacing existing sound systems with the much improved systems that are now readily available. All too often, however, little or no regard is given to the consequences of this upgrade, and it may not be too long before the complaints start rolling in. These complaints are often much to the bemusement of the venue owners who previously may have operated with no complaints at all.

The problem is best appreciated by recourse to a typical example. Consider a town centre club which operates at a music level inside the venue of 95dB(A). Due to poor sound insulation of the venue, part of this music noise breaks-out to the local environment, resulting in a noise level inside a closely located residence of 35dB(A). Being in a town centre, there is enough road traffic around to produce a minimum background noise level of 40dB(A) in the residential property. The traffic noise within the residence is therefore always at least 5dB(A) higher than the music noise and the music noise is effectively masked out.

The music system is then upgraded to increase the music level from 95dB(A) to 105dB(A) within the venue, with a much increased level at low frequencies. Everything else remains unchanged. The consequence of the 10dB(A) increase in noise level within the venue is to also increase the noise level in

the nearby residence by 10dB(A), to produce a noise level of 45dB(A) within the residence. The music noise level is now 5dB(A) above the 40dB(A) background noise of traffic, thus making it clearly audible and a potential source of disquiet for the neighbours of the venue.

The basic problem, therefore, is that for every decibel added to the music level within a venue, if nothing else is done to contain that noise, a decibel will be added to the noise that breaks out to the surrounding environment. If the increase in music noise that breaks-out takes it sufficiently high relative to the level of background noise, then residents who may previously have been oblivious to the venue's operation will become aware of the music and complaints may ensue.

The correct way forward for venue operators is therefore clear. Before investing in an expensive sound system upgrade, check that the venue can contain the increased sound levels, particularly at low frequencies. To ignore this simple advice could easily result in a wasted investment in a sophisticated sound system that can not be used to its full potential. It is therefore with some dismay I have to report that virtually all the small venue noise issues I have been involved with over the past five years have been complaint driven, and these complaints have resulted directly from sound system upgrades. Indeed, with the exception of appointments from large nightclub and cinema operators, I can count on one hand the number of appointments I have received to check out the acoustic suitability of venues prior to a sound system upgrade.

It is with this historical background in mind that I now address some of the practical issues that have emerged from my recent involvement with noise break-out from smaller venues.

2. IS THERE REALLY A PROBLEM ?

When assessing noise break-out from music venues a number of separate issues must be addressed. The first and most fundamental of these issues lies in establishing whether or not a noise problem really does exist, and if it does then what is the cause of the noise. In the case of an existing venue it is obvious that a problem exists as soon as a noise complaint is received. However, it still should not be taken for granted that just because the complaint refers to noise the major cause for the complaint is music noise break-out. In fact it shouldn't even be taken for granted that the complaint is driven by noise at all.

There are a number of sources of noise that can be associated with music venues, all of which may give rise to justifiable complaints. It is therefore essential that the true source of any noise complaint is identified before time and money are expended on reducing music noise break-out. Possible sources of noise associated with small venues that may drive complaints include:

- noise from mechanical and electrical plant installed to service the venue;
- noise from people in the street arriving at and leaving the venue (particularly late night rowdiness);
- noise from the cars arriving at and leaving the venue (late night slamming doors and revving engines);
- noise from people using external amenity areas associated with the venue;
- noise from children's play areas;
- noise from delivery vehicles servicing the venue.

When considering any noise complaints it is important that all possible sources of noise are positively identified such that any noise control measures may be targeted at those sources of noise that really are causing the problems.

Also, even though noise may be raised as an issue for complaint, this does not automatically mean that noise is the root cause of the complaint. It is not uncommon for noise nuisance to be used as a vehicle for complaint when the actual issues are quite disparate. For example, where planning permission is being sought for a new venue, or where an existing venue is seeking to expand, local residents may have consequential fears. These fears might include damage to their property, their personal safety on the street or merely increased levels of rubbish. However, fears such as these frequently are not voiced as such. Instead they manifest themselves as claims of potential noise nuisance should the development of the venue be allowed to go ahead. It is also sometimes the case that if trouble starts occurring in the vicinity of a previously trouble-free venue, local residents may also use noise complaints to try and force the venue operator to adopt a different opening and management strategy.

Finally in this discussion on identifying the root cause of any complaint, it is not just residents that may lodge noise complaints. Local businesses may also complain, although they have somewhat different rights to residents in that they must be able to demonstrate a loss of income rather than solely a loss in amenity. One example is a noise complaint lodged by restaurant owner against a club located immediately adjacent to his restaurant. The restaurant owner claimed a loss of income due to noise from the adjacent club driving his customers away. The drop in takings of the complainant's restaurant was easily proven by reference to till receipts. However, the problem then arose of establishing whether or not noise was the cause for this drop in takings. A number of matters were shown to be of relevance. The two most important were that, first, the period of concern was during the recession when peoples' spending on eating out was already on the decrease and, second, the new club offered dining facilities. It transpired that many customers of the restaurant were choosing to alternate their dining between the restaurant and the new club, thus resulting in a drop in the takings of the restaurant.

Assuming that it is positively identified that music noise break-out from the venue in question is, or is likely to be, a problem, then an objective metric must be chosen to allow the extent of the problem to be determined. It is only once the extent of the problem is known that possible remedial measures can be suggested for the control of the music noise break-out to an acceptable level. In the following section I briefly review some of the objective measures suggested to assess music noise affecting residential properties.

3. OBJECTIVE MEASURES OF MUSIC NOISE AFFECTING RESIDENTIAL PROPERTIES

In contrast to other sources of noise which can give rise to complaints, such as industrial noise or road traffic noise, guidance on the control of entertainment noise is limited. The first guidance was the GLC's "Code of Practice for Pop Concerts", which was published in June 1976. The GLC document went through a number of revisions and the final version was published in 1985. After the demise of the GLC, the Noise Council set up a working party to produce a revised Code of Practice, resulting in the publication of "The Noise Council Code of Practice on Environmental Noise Control at Concerts", published in 1991. The Noise Council document built on the guidance given in the GLC 'Pop Code', and resulted in the guidelines on the following page.

However, the Code was not designed to address the question of environmental noise arising from discotheques, clubs and public houses where music noise might be present every night, nor environmental noise affecting noise sensitive premises which are structurally attached to the venue. Therefore, over the years EHOs have in general assessed whether music noise is acceptable in dwellings near to the small venue by other means, either by using the concept of inaudibility or basing their assessment on BS4142 type assessment procedures. The problem with 'inaudibility' is that it is a purely subjective assessment, and as such it is open to possible conflict between the different parties involved in resolving any claim of noise nuisance.

Potentially the 125Hz octave band could therefore increase by more than 10dB and the overall music noise level would still be within 10dB(A) of the background noise level. This effect is frequently encountered and is by no means unique to the specific situation considered here.

As a consequence of the subjective predominance of low frequency noise, it is essential that in all assessments of music noise break-in for the purposes of specifying noise control measures, due account should be taken of the frequency content of the noise. Merely to design a noise control solution on the basis of reducing the overall dB(A) noise level is likely to result in an unsatisfactory outcome.

5. PRACTICAL CONTROL SOLUTIONS FOR MUSIC NOISE BREAK-OUT

Where a music noise break-out problem occurs from a small venue to nearby unattached properties, it is more often than not the result of a simple defect and can be easily rectified. Ordinarily the main structural building fabric (usually cavity brickwork or blockwork) is capable of containing the sound to an adequate degree, and it is only via penetrations through the structural envelope that problems occur. It may appear an obvious that openings in the building envelope of a venue will inevitably allow sound to escape to the local environment, but this is not always obvious to those operating the venues. Classic problems include:

- single doors opening direct onto the street (often propped open for easy customer access);
- single glazed windows;
- poorly fitting windows;
- open windows (problems abound in the summer when windows are left open);
- unattenuated ventilation ducts serving the venue;
- unattenuated 'through-the-wall' extractor fans;
- lightweight roof structures and rooflights.

All of the foregoing have straightforward solutions, such as lobbying external doors, installing attenuators in ventilation ducts and fitting acoustically sealed double glazed windows. However, whilst the solutions may in themselves be straightforward, their knock-on effects must not be ignored when estimating the cost of the works. Controlling noise break-out effectively will often mean sealing up the building, and it may become necessary to force ventilate the venue. The cost of this can be significant.

However small the cost of the remedial works, it is important that the full extent of the noise break-out problem is established before commencing the remedial works. All too often considerable sums of money are spent on noise control measures only to discover that a noise problem, albeit a different problem to that originally encountered, still exists following the completion of the works. This situation can occur if the initial problem was assessed in terms of reducing the overall A-weighted noise level. The noise control measures adopted would therefore have concentrated on reducing noise in the 500Hz to 4000Hz mid frequency region. In some instances this reduction will be sufficient to negate the problem. However, in other instances the effect of reducing these mid frequency noise levels will be to raise the level of the lower frequency noise relative to the mid frequency noise, thus making features such as the thumping bass even more prominent. The discussion in Section 4 of this paper has stressed the potential unsuitability of the overall A-weighted noise level in assessing music noise break-out, and this must be borne in mind when assessing music noise break-out problems with a view to specifying noise control measures.

The foregoing examples relate to airborne noise break-out from the music venue to other properties in the vicinity of the venue, but not attached to it. Where noise sensitive properties are physically attached to the building fabric of the venue then, as a general rule, the successful control of the music noise break-out is much more difficult to achieve. This is because, in addition to the potential airborne noise paths just

discussed, there also exists the potential for the music noise to directly excite the building structure. If this occurs then the induced vibrations may transmit via the structure from the music area into the attached noise sensitive properties where the vibrations may be re-radiated as noise wherever conditions allow.

Once a building structure is set into vibration, those vibrations will propagate through the structure with little attenuation unless they meet a resilient structural break. However, unless a building has been specifically constructed with a view to controlling structureborne noise transmission, it is highly unlikely that such breaks will be present. Many music venues in town centres are located in parts of large Victorian or Georgian terraced houses, with people living either in flats above the venue or in the attached houses to the side. These are classic examples where structureborne noise problems occur.

Accepting that once a building structure has been set into vibration there is little that can be done to prevent noise propagating throughout that building, the only effective means of controlling structureborne noise is to prevent the structure from being set into vibration at all. To achieve this a secondary skin must be installed within the existing structure. The purpose of this skin is to reduce the level of music noise impinging on the structure itself. Internal skins may vary from simple dry lining systems to heavy duty jumbo stud or blockwork walls that are fully isolated from the structural walls. The importance of flanking transmission can not be overlooked. If all exposed surfaces are not lined then overall sound reductions of greater than around 50 to 55dB(A) can not be expected. If overall reductions of 65dB(A) are required then the only solution generally will be to install a fully floating room within a room. Remembering that music noise levels within venues are often 100dB(A) and above, and that a maximum noise level of 35dB(A) may be required in the attached residential accommodation, it is apparent that in many instances a fully floating room will be the only successful solution, even based on an assessment of the overall A-weighted levels.

Even more so than with airborne noise problems, the important factor in tackling structureborne noise is to match the noise control solution to the problem. The use of the overall A-weighted noise level as a design criterion for specifying remedial noise control measures must be treated with caution, because in structureborne problems it is usually the bass frequencies that are the real problem. It may be very expensive for a venue operator to install a fully floating room within a room, but it is far better to know the real requirement at the outset rather than to install lesser treatments, still at significant cost, if these are later found to be insufficient to negate the problem. If a floating room is really required, then likely as not the costs of any remedial structural measures along the way will have been entirely abortive.

The basic conclusion of this section is that traditional passive solutions are available for the control of music noise break-out from smaller venues, but the success of these measures depends on the correct quantification of the problem.

6. NOISE CONTROL FOR THE FUTURE ?

The possibility of applying active noise control techniques to reduce music noise break-out is a subject that is often talked about, but has not been seriously considered. However, an initial feasibility study has recently been undertaken at the Institute of Sound and Vibration Research to investigate the potential of the method. This study has used a feedback controller to produce a zone of quiet around a single microphone using a single secondary source. The system has been shown to be capable of successfully producing localised zones of attenuation around the microphone. However, there are limitations. First, control can only be effected over the frequency ranges where the music can be 'predicted' by the controller. This means that the music must be repetitive, which restricts the range of applicability to the low frequency bass beats. The good news is that this is precisely the region where additional attenuation is required. The second limitation is more restrictive and concerns the extent of the zone of quiet.

Original work on the application of active noise control systems on steady sound fields demonstrated that effective zones of quiet typically extend for around one tenth of a wavelength around the control microphone. However, initial subjective tests on the results of the active control of music noise have revealed that, due to the rhythmic variation of the bass frequencies, the controlled frequencies are still quite discernible even when they are attenuated to a level well below the uncontrolled frequencies. The effective zones of quiet are therefore reduced to a fraction of what they would have otherwise been.

The possibilities for active control of music noise break-out would therefore seem, at the present, to be quite restricted, although worthy of further research. However, of more immediate interest is a possible offshoot of the work. In order to actively control bass noise, the feedback control system developed for the active noise control trials must identify and track the music noise. It may therefore be possible to develop the system as an advanced tool for accurately assessing the level of music noise break-out relative to the general background noise level.

7. CONCLUSIONS

The success of any noise control measure designed to control music noise break-out depends heavily on the correct quantification of the problem.

The use of overall dB(A) noise levels to quantify the noise break-out problem without due regard being taken of the lower frequency content of the noise will often lead to an inadequate noise control solution.

Traditional solutions are available for the successful control of music noise break-out from smaller venues, but these solutions may be expensive and impractical for many smaller venues if they are to be truly successful at both low and high frequencies, particularly if the venue is physically attached to a noise sensitive neighbour.