acoustic design & control

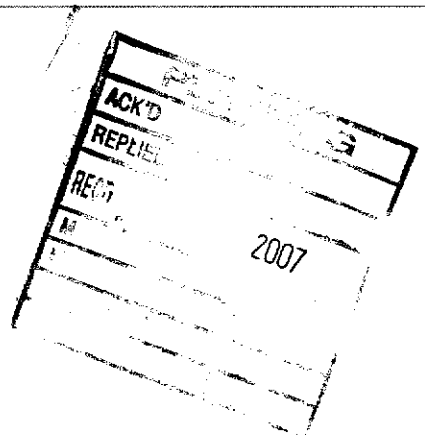
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Dear Simon

Karaoke Bar, Amadeus House, George St, Manchester – Supplementary Report

This report covers additional information about internal floors and partitions.

Summary

All party walls and floors have been discussed in our main report dated 28th February 2007. Internal partitions are specified to achieve reasonable separation between Karaoke booths and other areas. Their specification will, in any case have no impact on surrounding properties or the surrounding environment.

Introduction

Planners requested information about the specification of internal partitions. We can confirm that internal partitions and floors will have absolutely o impact on surround properties and on the surrounding environment, but the applicant was prepared to instruct us to provide the information requested. Party walls and floors are discussed in our main report dated 28th February 2007.

This report begins by briefly discussing design criteria. We go on to describe party wall and floor specification which will meet them.

Design Criteria

There are no specific design criteria that we know of for sound insulation between karaoke booths. One of two nearest equivalents that we can think of would be to cite BB93 which provides design advice for schools. It categorises different rooms as sources of noise generation from "Low" to "Very High" and rooms for their tolerance

of intrusive noise from other areas from "Very Low" to "High". We would suggest that adjacent karaoke booths would be HIGH source rooms with Medium to HIGH tolerance to intrusive noise from other rooms. Using the following table, also from BB93, we can see that it recommends a sound insulation of 45 to 50 dB D_{nTw} between such areas.

Minimum D_{nT} ($T_{mf,max}$)$_w$ (dB)		Activity noise in source room (see Table 1.1)			
		Low	Average	High	Very high
Noise tolerance in receiving room (see Table 1.1)	High	30	35	45	55
	Medium	35	40	50	55
	Low	40	45	55	55
	Very low	45	50	55	60

To put this into perspective, the old version of the of the Building Regulations Approved Document E (ADE) specifies party walls and floors around 50 dB D_{nTw} (it varies slightly for different testing conditions). This was considered adequate sound insulation for domestic party walls. Note that we have cited the old version of ADE simply because the new version does not express the performance requirements as a single number, but they are not more stringent. The new ADE also requires sound insulation performance of internal walls (ie. walls within a welling) to be 40 dB R_w. This s the required insulation you would expect between, say, a bedroom and living room of a single dwelling. We would suggest that this is not quite enough for the Karaoke booths.

So we suggest a design target of 45 to 50 dB D_{nTw}. Two adjacent booths in which both sets of customers are eating, which will mutually more of less inaudible. Two adjacent booths in which both sets of customers are using the karaoke at similar levels are also unlikely to hear each other. In the extreme case one set eating while the other is using the karaoke will result in the singing being clearly audible but, subject to the client's agreement, we suggest that it will be a customer expectation. We strongly urge you not to accept such performance as part of the planning process as these discussion will have no impact at all on surrounding properties and areas.

Internal Floors

Please see our main report dated 28th February which discusses the party floor between the Karaoke Bar and the ground floor restaurant. We are advised that internal floors will be to the same specification. The following table is copied from that report and shows the level differences across the party walls and floors (please ignore the party wall figures).

Breakthrough Noise

Octave Band Centre Frequency	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Music Noise Internally at Room Edges	Leq	89	86	89	83	85	86	81	74	65
	Lmax	96	90	93	87	92	92	90	77	68
Party Wall Level Difference	All	n/a	33	42	49	56	61	74	74	69
Predicted through Party Walls	Leq	34	53	47	34	29	25	7	0	-4
	Lmax	39	57	51	38	36	31	16	3	-1
Party Floor Level Difference	All	n/a	30	39	48	50	56	60	53	48
Predicted through Party Floor	Leq	38	56	50	35	35	30	21	21	16
	Lmax	43	60	54	39	41	36	30	24	20
Typical executive office design target	NR 35	44	63	52	45	39	35	32	30	28
Typical general office/restaurant design target	NR 40	48	67	57	49	44	40	37	35	33

The floor performance translates very conservatively to and overall sound insulation performance of 55 dB D_{nTw}, ie. well above the criteria suggested above.

Internal Partitions

We understand that the partition specifications for booth to booth walls will be :-

- Two layers of plasterboard*
- 92 to 110 mm British Gypsum Gypframe 'C' Studs** at 600mm centres with 3 x 25mm British Gypsum Isover APR 1200** in the cavity.
- Two layers of plasterboard*

* the boards can be 15mm Fireline** or 12.5mm Soundbloc**, both from British Gypsum.
** or equivalent products from reputable manufacturers such as Knauf and Lafarge

This system has a test performance of 54 to 56 dB R_w and should easily achieve the suggested performance of 45 to 50 dB D_{nTw}.

Other partitions can have a reduced specification of :

- Two layers of plasterboard*
- 70 mm British Gypsum Gypframe 'C' Studs** at 600mm centres with 1 x 25mm British Gypsum Isover APR 1200** in the cavity.
- Two layers of plasterboard*

* the boards can be 15mm Wallboard** or 12.5mm Soundbloc**, both from British Gypsum.
** or equivalent products from reputable manufacturers such as Knauf and Lafarge

This system has a test performance of 50 to 52 dB R_w and can be expected to achieve an on-site performance of 45 to 47 dB D_{nTw}.

Conclusions and Recommendations

We have to emphasise again that we cannot see why these issues are a concern to the planners and we strongly recommend that they are submitted as background information only. It is important that the client is not rigidly tied to specific wall and floor specifications which have no impact on surrounding properties or area, as the architect or contractor may need to modify them for practical reasons as the project progresses.

Having said that, it is important for the client to know that he has adequate sound insulation between his booths for operational purposes and, conversely, that he is not paying too much over over-specification.

I hope this covers everything, but lease call me with any queries.

Yours sincerely

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Appendix 1

Definition of Acoustic Terms

The Decibel

The decibel is the basic unit of noise measurement and is denoted dB. Technically, it is a means of expressing the difference in noise level between the measured noise and a standard level of noise. Most often the threshold of human hearing is used as the standard reference but is really should be stated. The threshold of human hearing is a sound pressure of 20μPa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20μPa). A sound power level or SWL should be expressed in dB(re. 1pW). If the reference levels are omitted, it will often (but not always) be safe to assume that they are referenced to the threshold of human hearing.

A-Weighting and dB(A)

The human hearing system responds differently to different frequencies. The A-weighting system takes account of this by emphasising mid and high frequencies more than low frequencies to given an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted level are discussed below.

Other weighting systems, such as C-Weighting, denoted dB(C), reflect the human hearing system's response at higher noise levels.

Equivalent Continuous Sound Level, L_{eq}

This can be simplistically described as a way of expressing the average noise level.

The unit is dB L_{eq}. For A-weighted levels the unit is dB(A) L_{eq} or, in more modern units, dB L_{Aeq}.

Maximum Level, L_{max}

This is the maximum level reached (usually for a fraction of a second) in the measurement period.

The unit is dB L_{max}. For A-weighted levels the unit is dB(A) L_{max} or, in more modern units, dB L_{Amax}.

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceed for a percentage of the time. L_n is the index representing the level exceeded for n% of the measurement period.

The unit is dB L_n. For A-weighted levels, the unit is dB(A) L_n or, in more modern units, dB L_{An}.

Common examples are as follows :-

dB L_{A90} is the A-weighted level exceeded for 90% of the time and is often used to describe the underlying background noise.

dB L_{A50} is the A-weighted level exceed for 50% of the time. Mathematically, it is the median, another kind of average.

dB L_{A10} is the A-weighted level exceeded for 10% of the time and has traditionally been used to describe the intermittent highs in the noise climate such as passing cars or aircraft.

Frequency Analysis

Here the audible frequency range is divided up into bands and the noise level is expressed in each frequency band form low pitches to high pitches.

Octave Band analysis is where the frequency range is divided into 8 bands from 63 Hz to 8kHz, or sometimes into 10 bands from 31.5 Hz to 16kHz.

1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

Narrow Band analysis takes this further with the possibility of many thousands of bands, possibly only 1Hz wide, or even less.

In all types of frequency analysis, the level in each band can be expressed in terms of L_{eq}, L_{max}, L_n, etc. as defined above.

NR and NC Values

These are a means of expressing a noise level, which varies across the frequency range, as a single number. Basically there is a set of NR or NC curves which represent noise levels across the frequency range. Where a noise in a particular octave band reaches a value on a particular curve, it is given the value of that curve, no matter how quiet the noise is in other octave bands. So the noise from fans at a particular point in a room, for instance, may be required to be NR35. If so, the noise must not exceed the NR35 curve in any octave band. The difference between NC and NR is simply one of slightly different curve shapes. They can also be expressed in third octave bands as well.

Sound Insulation

Sound insulation is best expressed across the frequency range in octave bands or third octave bands. Often, however, in known environments such as domestic sound insulation and speech privacy, it is simpler to express the sound insulation as a single figure. A higher value means better sound insulation.

The most common ways are dB D_{nTw}, dB R_w and $dB_{(mean\ 100\text{-}3150Hz)}$. The first two are ways of expressing average sound insulation, weighted to account for speech frequencies. The third is simply an un-weighted mean value.

The Building Regulations Approved Document E (ADE) routinely refer to $D_{nTw} + C_{Tr}$. The C_{Tr} term is a negative number which is used to modify the D_{nTw} value for the insulation properties at lower frequencies.

ADE also used the L_{nTw} index for impact sound transmission. It is a measure of the level of noise in the room below a standard tapping machine. It represents the impact sound transfer such as footfall noise, scraping chairs, washing machines, etc. A lower value means better insulation.