Hawkins environmental

Noise Assessment: 61 Grays Inn Road, London

Blue Suede Limited

20th November 2012

Report Details:

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Client	Blue Suede Limited
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1. INTRODUCTION

Hawkins Environmental Limited has been instructed by Blue Suede Limited to undertake a noise assessment in respect of a proposed stair lift on the ground floor of 61 Grays Inn Road. It is proposed to substantially redevelop the existing building and create a number of apartments over five floors.

A previous scheme was given planning permission by the London Borough of Camden in 2011; however the new owners of the property wish to submit a revised planning application which includes a stair lift from the north mews entrance to the rear on the ground floor, to provide step free access to the property. However, in a pre-application meeting, concerns have been raised by the planning officer that noise from the stair lift may cause a disturbance to the residents of the dwellings within the building. The purpose of the study is primarily to determine whether acceptable noise levels will be achieved in the proposed dwellings from the stair lift, based on the noise rating of the lift and the construction of the building. Recommendations for mitigation are also made where appropriate, in order to achieve reasonable internal noise levels.

2. THE NATURE, MEASUREMENT AND EFFECT OF ROAD TRAFFIC NOISE

Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to measure the loudness of that noise. 'Loudness' is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.

The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting 'A' weighted decibel, dB(A), has been shown to correlate closely to the subjective human response.

When related to changes in noise, a change of ten decibels from say 60 dB(A) to 70 dB(A) would represent a doubling in 'loudness'. Similarly, a decrease in noise from 70 dB(A) to 60 dB(A) would represent a halving in 'loudness'. A change of 3 dB(A) is generally considered to be just perceptible[1]. **Table 2.1** details typical noise levels.

Table 2.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In car noise without radio
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain

[1] Communities & Local Government (1994). Planning Policy Guidance 24: Planning & Noise.

3. ASSESSMENT CRITERIA

3.1. BS 4142

British Standard BS 4142: 1997 *Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas* provides a method for the measurement and rating of industrial noise or noise of an industrial nature and background noise levels outside dwellings in mixed residential and industrial areas. The rating level (defined in the BS) is used to rate the industrial noise source outside residential dwellings (this is defined as the "specific noise source").

The procedure defined in BS 4142 for predicting the likelihood of complaints is based on establishing the difference between the rating level and the background level outside the residential property of interest. The greater the difference the greater the likelihood of complaints and more specifically:

- A difference of around +10 dB or more indicates that complaints are likely;
- A difference of around +5 dB is of marginal significance;
- If the rating is more than 10 dB below the measured background noise level then this is a positive indication that complaints are unlikely.

It should be noted that BS 4142 is not suitable as an assessment methodology when the background noise levels and the rating noise levels are very low. Very low background noise levels are defined as being below about 30 dB and very low rating noise levels are defined as being around 35 dB.

Primarily due to a lack of alternative guidance, BS 4142 is often widely misapplied to a diverse range of situations. The scope of the standard is very precise in that it provides a method for assessing whether an industrial type of noise source in industrial or commercial buildings is likely to give rise to complaints to residents, based on the noise level outside their dwelling. It is not appropriate for the assessment of noise from fixed plant and equipment during the early hours of the morning, when the primary concern is to ensure the noise level inside the dwellings is at a suitable level. For night time noise, it is generally accepted to use absolute limits for the maximum level of sound from mechanical plant and equipment, specifically inside the rooms of interest. Consequently, the absolute limits for internal noise levels from the World Health Organisation (WHO) and BS 8233 are normally applied to night time noise.

3.2. WHO Guidelines and BS 8233

Guidance on absolute limits for noise inside and outside of buildings is provided in BS 8233:1999 'Sound insulation and noise reduction for buildings –Code of practice'. Similar guidance can also be found in the current World Health Organisation (WHO) "Guidelines on Community Noise". A summary of the noise criteria can be seen in **Table 3.1** and **Table 3.2.**

Table 3.1: Summary of Noise Criteria: BS8233

Criterion	Typical situations	Good Level $L_{Aeq,T}$	Reasonable Level $L_{Aeq,T}$	Reasonable Peak L_{Amax}
BS 8233 Reasonable resting/sleeping conditions	Living rooms	30	40	-
	Bedrooms	30	35	45

Table 3.2: Summary of Noise Criteria: WHO

Residential Environment	Critical Health Effect(s)	L_{Aeq}	L_{AFmax}	Time Base
Outdoor living area	Serious annoyance, daytime and evening	55	-	07:00-23:00
	Moderate annoyance, daytime and evening	50	-	07:00-23:00
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	07:00-23:00
Inside bedrooms	Sleep disturbance, night-time	30	45	23:00-07:00
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	60	23:00-07:00

4. NOISE EVALUATION

4.1. Plant Noise Levels

Acoustic details of the stair lift have been provided. It is proposed to install a Pollock Steplift, which noise measurements provided by Pollock suggest have a noise level of 70 dB at 1m from the lift, i.e. a sound power level (L_W) of 81 dB.

4.2. Identification of Sound Paths

The concern with regards to noise from the stair lift, is to ensure that noise within the dwellings are below acceptable limits. In order to calculate internal noise levels, it is important to consider the paths along which noise must pass.

In this situation the only two sound paths that need to be considered are the noise through the wall between the lobby and Flat B on the ground floor and noise through the floor to flat D above.

4.3. Sound Insulation of the Structure

4.3.1. Party Walls

Between the lobby and Flat B on the ground floor, it is proposed to construct a wall party consisting of a 100mm lightweight block, with two layers of acoustic performance plasterboards, plus 50mm Rockwool RW6 in the cavity. It is understood from the client that the "sound block" of the wall will be 45 dB. It is not known what index this has been described in, but party walls are typically described as a $D_{nT,w} + C_{tr}$. Since a $D_{nT,w} + C_{tr}$ is a weighted index, weighted towards the characteristics of road traffic noise, this is likely to underpredict the sound reduction afforded by the partition and therefore overpredict the resultant noise level in the adjoining flats, thus providing a worst-case noise level.

4.3.2. Party Floors

Between the lobby and Flat D on the first floor, it is proposed to construct a party floor consisting of a 150mm reinforced concrete slab with 55mm screed, a 3mm acoustilay absorbent floor covering, plus an 18mm solid timber floor. It is anticipated that this will pass the minimum requirements of Approved Document E of the Building Regulations and as such will have weighted sound reduction of at least 43 $D_{nT,w} + C_{tr}$.

4.4. Assessment of Internal Noise Levels

In order to determine the internal noise levels from the stair lift and whether the noise levels exceed the recommended internal noise level criteria, the first stage is to determine the noise level from the plant adjacent to the partition in question. This can be done by logarithmically adding both the reverberant sound and direct sound in the room using the following formulas:

$$L_{TOTAL} = L_{DIRECT} + L_{REV}$$

$$L_{DIRECT} = L_w - 20\log(r) - 11$$

$L_{REV} = L_w + 10\log(4/R_c)$

Where:

L_{TOTAL} is the total sound pressure level at a specific point in the room, including both reverberant and direct sound pressure levels;

L_{DIRECT} is the direct sound pressure level at a specific point in the room;

L_{REV} is the reverberant sound pressure level at a specific point in the room;

L_w is the sound power level of the plant in question;

r is the distance from the source of the noise to the specific point in question;

R_c is the room constant which is a function of the total area of all room surfaces and the average absorptive coefficients of those surfaces.

Using the results of the above equation and our knowledge of the likely performance of the party wall and floor, it is possible to calculate the likely noise levels in the adjacent flats using the following formula to calculate sound transmission between rooms:

$L_2 = L_1 – R + 10\log S – 10\log A$

Where:

L_2 is the noise level in the lobby;

L_1 is the noise level in the receiving room;

R is the Sound Reduction / acoustic performance of the dividing element;

S is the area of the dividing element; and

A is the equivalent absorption area in the receiving room. This can be calculated using Sabine's Formula of 0.161 x (Room Volume/Reverberation Time). 0.5s is frequently used as the reverberation time of most furnished modern rooms.

Table 4.1 summarises the calculations described above and determines an internal noise level within the adjoining flats.

Table 4.1: Summary of Noise Transmission Calculations

Receptor	Flat B	Flat D
Sound Power Level (L_w)	81 dB	81 dB
Distance from source to partition (r)	1 m	2 m
Total area of room surfaces (source room) (S)	111.09 m^2	111.09 m^2
Average absorptive coefficient (α_{AVGE})	0.14	0.14
Room Constant (R_C)	18.44	18.44
L_{DIRECT}	70.0 dB	64.0 dB
L_{REV}	74.4 dB	74.4 dB

Receptor	Flat B	Flat D
Total sound pressure level at the partition (L_{TOTAL} or L_1)	**75.7 dB**	**74.7 dB**
Sound reduction of the partition (R)	45 dB	43 dB
Surface area of the partition (S)	8.1 m^2	20.31 m^2
Receiving room volume	22.72 m^3	83.16 m^3
Reverberation time of the receiving room	0.5s	0.5s
Absorption in the receiving room (A)	7.32	26.78
Total sound pressure level in the receiving room (L_2)	**31.2 dB**	**30.5 dB**

It can be seen from **Table 4.1** that the predicted noise levels from the plant will be below the *"Reasonable"* noise levels contained within BS 8233, but above the *"Good"* levels, as shown in **Table 3.1**. It can be concluded that the noise levels should not be high such that they would cause a disturbance, for example they are unlikely to disturb sleep; however this does not infer that they would be inaudible, since this would in part depend upon the ambient noise levels within the rooms. Since the rooms in question face away from Grays Inn Road, it is likely that the internal noise levels within the rooms will be fairly low (possibly in the region of 25 dB, although it is difficult to estimate), therefore a noise level in excess of 30 dB would be audible above ambient noise levels.

It is important to note that the sound reduction level of the partition used in the calculations was a $D_{nT,w} + C_{tr}$, which is a level difference weighted towards the characteristics of road traffic noise. This notation has been used as this is standard notation used in the building regulations in England and Wales and as such, all building partitions are expressed in this way. However, the actual unweighted level difference between the rooms is likely to be greater. Experience dictates that the difference between a $D_{nT,w} + C_{tr}$, and D_{nT}, which would be a more accurate representation of the sound reduction of the facade, is on average in the region of 5 dB. Therefore, it is not unreasonable to suggest that the internal noise levels in the receiving room above could be overpredicted by 5 dB. Furthermore, the $D_{nT,w} + C_{tr}$ of 43 dB used for the floor is an estimate, since 43 dB is the minimum requirements of the building regulations and the floor will need to meet the minimum requirements of the building regulations and as such the floor will have a minimum $D_{nT,w} + C_{tr}$ of 43 dB, but could be considerably higher, although it is impossible to say without testing. As a consequence, the predicted in **Table 4.1** should be seen as a maximum noise level and may be lower than the noise levels quoted.

5. MITIGATION MEASURES

Whilst the predicted noise levels should not necessarily cause a disturbance, it is recommended that additional mitigation is implemented to further reduce noise levels in an effort to achieve inaudibility.

The client has specified that the wall party would consist of a 100 mm lightweight blockwork, with two layers of acoustic performance plasterboards, plus 50mm Rockwool RW6 in the cavity. Assuming that the lightweight blockwork has a density of between 660 to 850 kg/m^3 (i.e. a surface density of 66 to 85 kg/m^2 with a 100mm thickness), which is typical of lightweight blockwork, plus the acoustic performance plasterboards is similar to Gyproc SoundBloc 12.5mm (which has a surface density of 10.6 kg/m^2 per sheet), the total mass per unit area of the wall will be in the region of 88 to 106 kg/m^2. If the lightweight blockwork is replaced with a high density block, typically with a density of 1900 kg/m^3 (i.e. a surface density of 190 kg/m^2 with a 100mm thickness), this is likely to increase the total mass per unit area of the wall to around 211 kg/m^2, which represents a doubling of the mass of the wall. It is well documented that a doubling of mass would typically result in a 5 to 6 dB increase in sound insulation performance and as such, the worse-case noise levels in Flat B can easily be reduced to 25 to 26 dB just by replacing the lightweight blocks.

With regards to the party floor, it is proposed to construct this of concrete, with a resilient floor covering and wooden floor. This already has considerable mass and therefore doubling the mass of the floor would come with structural issues plus would add considerable extra thickness to the floor; therefore it is not common to increase the mass of a party floor, unless absolutely necessary. In this situation, it is more common to install a suspended ceiling. A suspending ceiling, typically constructed with two layers of acoustic plasterboard with staggered joints, either on resilient bars/hangers, or on joists attached only at the perimeter of the room (which is likely to be possible given the narrow nature of the hallway), not only provides additional mass, but also physical separation and isolation between the two rooms. Typically, the addition of a suspended ceiling can add up to 3 to 4 dB of sound insulation performance and as such, the worse-case noise levels in Flat D can easily be reduced to 26.5 – 27.5 dB just by the installation of a suspended ceiling.

6. CONCLUSIONS

A detailed noise impact assessment has been carried out to determine whether the installation of a stair lift during the refurbishment of 61 Grays Inn Road, London, is likely to cause complaints relating to noise.

Calculations have shown that given the likely noise levels emanating from the stair lift, and the likely sound attenuation of the building components as presently planned, noise from the lift in the dwellings is likely to be low such that the noise is unlikely to disturb, but may still be audible, depending on the actual internal ambient noise levels within the rooms. However, it should be stressed that the calculations represent a worst-case scenario, since worst-case levels of sound insulation performance of the wall and floor has been used in the calculations, since the precise transmission loss of the building element is unknown. However, to further ensure that noise will not cause a nuisance and to increase the likelihood of inaudibility, it is recommended that the party wall incorporates dense blockwork instead of lightweight blocks, plus the ceiling incorporates a suspended ceiling, both of which will effectively significantly improve the sound insulation performance of the building elements.