Philip Acoustics Ltd.

Consultants in Noise and Vibration

REPORT TITLE: DEMONSTRATION OF COMPLIANCE WITH PLANNING CONDITION INTERNAL NOISE LEVELS FOR RESIDENTIAL FLATS AT 264-270 FINCHLEY ROAD, LONDON NW3 7AA

Camden Council Planning Reference 2014/3327/P Condition 13

REPORT REF: 18218-002

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SUMMARY

- Camden Council granted planning permission for residential flats at 264-270 Finchley Road, London NW3 7AA. The Council's reference for the development is 2014/3327/P with Decision Notice 31 March 2015. Condition 13 attached to the permission states limits for internal noise levels to be achieved within the flats and requires that prior to occupation of the development, noise testing and an associated report to demonstrate compliance with the internal noise levels shall be submitted to and approved by the Local Planning Authority.

- Stansted Environmental Services Ltd (SES) carried out a noise validation survey (noise testing) and with associated noise assessment report reference ENV166-FINC-001 dated 01 February 2018. The report was submitted to Camden Council to seek discharge of Condition 13.

- Camden Council's environmental health case officer has provided comment on the submitted SES report including with requests that hourly format noise survey raw data be provided as additional information. The additional information is to aid the Council's decision relating to discharge of Condition 13.

- Philip Acoustics has been appointed by Moran Construction (UK) Ltd to review the submitted SES report including noise survey raw data and provide the additional information as requested by Camden Council, plus with a further more technically detailed and correct assessment of the noise survey raw data to determine whether Condition 13 is complied with.

- Section 2 of this report provides details of Camden Council's Condition 13 noise requirement and Section 3 of this report provides a review of the SES noise report. Hourly format noise survey raw data as requested by the Council is provided in Section 4 of this report.

- Correct assessment / analysis of the SES noise survey raw data is provided within Section 5 of this report and includes details of Reverberation Time measurements carried out to establish the empty room correction for the SES noise survey sample room. The assessment / analysis demonstrates compliance with the requirement for noise into the flats of Condition 13 attached to Camden Council's Decision Notice dated 31 March 2015 application reference 2014/3327/P.

1. INTRODUCTION

Camden Council as Local Planning Authority granted full planning permission for a development of residential flats at 264-270 Finchley Road, London NW3 7AA. The Council's application reference for the development is 2014/3327/P with Decision Notice dated 31 March 2015.

Condition 13 attached to the planning permission states limits for internal noise levels to be achieved within the flats and is imposed for reason *"to ensure the occupiers of the proposed flats are not unduly disturbed by nuisance from traffic noise"*.

Condition 13 requires that prior to occupation of the development, noise testing and an associated report to demonstrate compliance with the internal noise levels shall be submitted to and approved by the Local Planning Authority.

Stansted Environmental Services Ltd (SES) carried out a noise validation survey (noise testing) and with associated noise assessment report reference ENV166-FINC-001 dated 01 February 2018. The report was submitted to Camden Council via Approval of Details application reference 2018/1979/P to seek discharge of Condition 13 to planning permission reference 2014/3327/P.

Camden Council's environmental health case officer as consultee for the Approval of Details application has provided comment on the submitted SES report including with requests that hourly format noise survey raw data be provided as additional information. The additional information is to aid the Council's decision relating to Approval of Details application reference 2018/1979/P.

Philip Acoustics has been appointed by Moran Construction (UK) Ltd to review the submitted SES report including noise survey raw data and provide the additional information as requested by Camden Council, plus with a further more technically detailed assessment of the noise survey raw data to determine whether Condition 13 is complied with.

This report presents results of the review, additional information requested by Camden Council plus further more detailed / technically correct assessment of the survey raw data and includes:

- Camden Council Condition 13 noise requirements including with reference to Policy DP28;
- Review of SES noise assessment report reference ENV166-FINC-001 dated 01 February 2018;
- Hourly format noise survey raw data as requested by Camden Council;
- Technical assessment of the noise survey raw data to determine compliance with Condition 13.

Note: This report unavoidably includes relatively technical and detailed acoustic terminology and process information relating to the Condition 13 noise requirements, the SES noise validation survey and associated SES report, plus raw data requested by the Council and further assessment of the raw data to determine compliance. However, because this report is intended principally to aid Camden Council's environmental health case officer as consultee for the Approval of Details application, and who will be fully conversant with the detailed acoustic terminology and process information (i.e. not as a lay person regarding technical acoustic issues), then this report does not seek to include any lengthy commentary as explanation for acoustic terminology etc.

2. CAMDEN COUNCIL PLANNING CONDITION 13

Condition 13 attached to Camden Council's full planning permission decision notice application reference 2014/3327/P is reproduced below:

> 13 The internal noise levels in the dwellings hereby approved shall not exceed an indoor ambient noise levels in unoccupied rooms of 30 dB(A) LA eq (1hour) and individual noise events shall not exceed 45 dB LAmax at any time of day or night.
>
> Prior to first occupation of the development hereby approved, noise testing and an associated report to demonstrate compliance with the above levels shall be submitted to and approved in writing by the Local Planning Authority.
>
> Reason: To ensure the occupiers of the proposed flats are not unduly disturbed by nuisance from traffic noise, in accordance with policy CS5 of the Camden Core Strategy and policies DP26 and DP28 of the Camden Development Policies of the Camden Local Development Framework.

Reason attached to Condition 13 refers to Policy CS5 of the Camden Core Strategy plus also Policy DP26 and Policy DP28 of the Camden Development Policies of the Local Development Framework document.

Of these referenced policies, Policy DP28: *Noise & Vibration* from Section 3 of Camden Development Policies 2010-2025 (Local Development Framework) provides the most technically detailed and directly relevant guidance information regarding the requirements of Camden Council with respect to noise from traffic potentially affecting residential occupiers.

Strict interpretation of Condition 13 states a requirement that internal noise levels in unoccupied rooms of the flats shall not exceed:

- Ambient noise level $L_{Aeq\ (1\ hour)}$ 30dB day or night;
- Individual noise events L_{Afmax} 45dB day or night (it is noted Condition 13 states L_{Amax} 45dB, albeit to be properly technically qualified this acoustic parameter should be read as L_{Afmax} 45dB).

The Condition 13 internal noise levels requirement is at slight variance (conflict) with the guidance contained in Camden Council's Policy DP28: *Noise & Vibration* plus also the Key Evidence and Reference documents to which Policy DP28 refers.

It is also at variance (conflict) with the guidance relating to limits for noise into residential dwellings contained within the currently applicable (and thus more up to date) Camden Local Plan 2017; Policy A4 *Noise & Vibration* plus also Appendix 3: *Noise Thresholds*.

An item by item summary listing for the variance (conflicts) is provided below as A) to D):

A) 1 Hour Time Period For L_{Aeq} Ambient Noise Level

Table B of Policy DP28 as relevant for residential sites adjoining roads (i.e. sites affected by traffic noise), separates the full 24 hour period into three periods; day (7am to 7pm), evening (7pm to 11pm) and also night (11pm to 7am).

Guidance on upper limit external ambient noise levels for the day period is in terms of a 12 hour value, for the evening period a 4 hour value and for the night period a 1 hour value.

Therefore, it is only for the night period that Policy DP28 indicates a 1 hour time period should potentially be used for the assessment of L_{Aeq} ambient noise levels.

The Key Evidence and Reference documents to which Policy DP28 refers do not directly specify time periods for L_{Aeq} ambient noise levels, however these documents do refer to relevant British Standard BS8233. Full title of the current edition of this British Standard is BS8233:2014 *"Guidance on Sound Insulation and Noise Reduction for Buildings"*.

The guidance for L_{Aeq} ambient noise levels into residential dwellings contained within BS8233:2014 and as applicable to noise from sources such as road traffic is to separate the full 24 hour period into two periods; day (7am to 11pm) and night (11pm to 7am). The guidance upper limit ambient noise levels into dwellings for the day period is in terms of a 16 hour value and for the night period an 8 hour value.

Table B of Appendix 3: *Noise Thresholds* of the Camden Local Plan 2017 as applicable to residential developments in areas of existing noise is very closely aligned to the guidance of BS8233:2014 and indicates upper limit ambient noise levels into dwellings for the day period is in terms of a 16 hour value and for the night period an 8 hour value.

A requirement for internal ambient noise levels to be assessed over 1 hour periods (i.e. $L_{Aeq\ (1\ hour)}$ values) during the day period and night period is more onerous than the above guidance including the requirements of Camden Local Plan 2017.

B) L_{Aeq} 30dB Ambient Noise Level Requirement For Day & Night

Policy DP28 does not directly specify any limit values for L_{Aeq} ambient noise levels into residential dwellings.

The Key Evidence and Reference documents to which Policy DP28 refers also do not directly specify limit values for L_{Aeq} ambient noise levels, however and as described in item A), these documents do refer to relevant British Standard BS8233.

The guidance for L_{Aeq} ambient noise levels into residential dwellings contained within BS8233:2014 and as applicable to noise from sources such as road traffic is for $L_{Aeq\ (16\ hour)}$ ≤35dB during the day period (applicable living areas & bedrooms) and for $L_{Aeq\ (8\ hour)}$ ≤30dB during the night period (bedrooms).

Table B of Appendix 3: *Noise Thresholds* of the Camden Local Plan 2017 as applicable to residential developments in areas of existing noise is again very closely aligned to the guidance of BS8233:2014 and indicates the same upper limit ambient noise levels into dwellings, i.e. $L_{Aeq\ (16\ hour)}$ ≤35dB during the day period and $L_{Aeq\ (8\ hour)}$ ≤30dB during the night period.

A requirement for $L_{Aeq\ (1\ hour)}$ ≤30dB during the day period and night period is considerably more onerous than the above guidance including the requirements of Camden Local Plan 2017. In effect, Condition 13 requires that noise into the flats during the day be same (not higher) than during the middle of the night when people are sleeping.

C) L_{Afmax} 45dB Individual Noise Event Requirement For Day & Night

Table B of Policy DP28 as relevant for residential sites adjoining roads (i.e. sites affected by traffic noise), includes guidance on upper limit external individual noise event levels in terms of L_{Afmax} values, but only applicable for the night period (11pm to 7am).

The Key Evidence and Reference documents to which Policy DP28 refers also only apply any guidance for individual noise event levels in terms of L_{Afmax} values for the night period (11pm to 7am).

The guidance of BS8233:2014 for individual noise event levels in terms of L_{Afmax} values is only applicable for the night period (11pm to 7am).

Similarly, Table B of Appendix 3: *Noise Thresholds* of the Camden Local Plan 2017 indicates upper limit individual noise event levels in terms of L_{Afmax} values only for the night period (11pm to 7am).

A requirement for individual noise event levels L_{Afmax} ≤45dB during the day period is considerably more onerous than the above guidance including the requirements of Camden Local Plan 2017.

D) L_{Afmax} 45dB Individual Noise Event Requirement At Any Time

The guidance of Table B of Policy DP28 on upper limit external individual noise event levels in terms of L_{Afmax} values includes the specific qualification *"Individual noise events several times an hour".*

Expanding on this qualification and as per available guidance in the Key Evidence and Reference documents to which Policy DP28 refers, it is normal acoustic design and assessment practice to apply a residential bedrooms internal upper limit L_{Afmax} 45dB for individual noise event levels on the basis defined as occurring generally not more than ten times during the night period (11pm to 7am) and/or not more than several times in any one hour during the night period (11pm to 7am).

This acknowledges it is not practicable or reasonable to apply (or comply with) the individual noise event limit for all external noise events, including very high noise events such as the sirens of passing emergency vehicles, sounding of vehicle horns, fireworks celebrations, or atypical occasional very loud motorcycles etc.

In considering the requirements of Condition 13 and also the details as items A) to D), it is considered the Condition 13 internal noise levels requirement be reasonably / correctly qualified and applied as below:

- Ambient noise levels not exceeding $L_{Aeq\ (1\ hour)}$ 30dB day or night, but also including a comparison as informative against an upper limit criterion of $L_{Aeq\ (1\ hour)}$ 35dB for the day period;
- Individual noise events not exceeding L_{Afmax} 45dB for the night period, occurring not more than ten times during the night period and/or not more than several times in any one hour during the night period.

Condition 13 requires the internal noise levels to be achieved in unoccupied rooms of the flats. This is agreed appropriate / correct else noise of residents themselves would generally cause the noise requirement to be exceeded within their flat. As normal acoustic design and assessment practice, the internal noise levels requirement is therefore to be achieved inside unoccupied rooms, but completed and normally furnished rooms, of the flats. Further and more technical explanation regarding this necessary qualification to Condition 13 is provided in Section 5 of this report.

3. REVIEW OF SES NOISE REPORT *(Reference ENV166-FINC-001 Dated 01 February 2018)*

The SES report provides details of a noise survey carried out internally in a sample flat within the development over an extended period between 18 January 2018 and 24 January 2018. The sample flat was selected as worse case directly overlooking Finchley Road.

The SES noise survey details and procedure, including position, instrumentation used, calibration etc. is all agreed as appropriate, valid and correct.

However, analysis and assessment of the noise survey results as contained within the SES report is flawed and technically incorrect, plus does not address the specific noise requirements of Condition 13.

Results of the noise survey are presented within the SES report in summary tabular form and also graphically for each completed day and night period of the survey. Table 4: *Summary of measured noise levels* from the SES report is reproduced below for reference:

Table 4: Summary of measured noise levels - free field (dB).

Time period - 24 hour fixed monitoring station	L_{Aeq}	$L_{A,Max}$
23:00 – 07:00 (8 hour) 18th/19th January 2018	27.7dB	44.8dB
23:00 – 07:00 (8 hour) 19th/20th January 2018	28.7dB	42.9dB
23:00 – 07:00 (8 hour) 20th/21st January 2018	28.6dB	40.6dB
23:00 – 07:00 (8 hour) 21st-22nd January 2018	28.4dB	42.1dB
23:00 – 07:00 (8 hour) 22nd/23rd January 2018	28.8dB	41.9dB
23:00 – 07:00 (8 hour) 23rd/24th January 2018	29.1dB	40.8dB
07:00 – 23:00 (16 hour) 19th January 2018	33.1dB	--
07:00 – 23:00 (16 hour) 20th January 2018	31.7dB	--
07:00 – 23:00 (16 hour) 21st January 2018	31.7dB	--
07:00 – 23:00 (16 hour) 22nd January 2018	32.6dB	--
07:00 – 23:00 (16 hour) 23rd January 2018	32.7dB	--

The SES report's analysis / assessment of the noise survey results is flawed and technically incorrect, plus does not address the specific noise requirements of Condition 13 for the following reasons:

- Although the SES report refers throughout to Condition 13, results of the survey indoor ambient noise levels are assessed only in terms of overall 16 hour levels for the day period i.e. $L_{Aeq\ (16\ hour)}$ values and overall 8 hour levels for the night period i.e. $L_{Aeq\ (8\ hour)}$ values. The survey results are not assessed in terms 1 hour levels i.e. $L_{Aeq\ (1\ hour)}$ values as required by Condition 13;
- Results of the survey are assessed against a requirement for the day period of $L_{Aeq\ (T)}$ ≤35dB, whereas Condition 13 requires $L_{Aeq\ (T)}$ ≤30dB for the day and night period;
- The SES report does not explain or qualify how the individual noise event L_{Afmax} values stated within Table 4 for the night periods are derived, i.e. how the night period survey results have been analysed to give these L_{Afmax} values;
- The SES report omits to include an empty room correction; it is not mentioned anywhere in the report. Correspondingly, there are no reverberation time measurements for the noise survey selected sample flat / room, as technically and fundamentally necessary to then establish the empty room correction as applicable to the survey results. *It is noted that specifically this omission potentially indicates some inexperience of SES in undertaking an analysis of survey results to determine compliance or otherwise with residential internal noise limits as in this scenario and as required by Condition 13*.

4. NOISE SURVEY RAW DATA REQUESTED BY CAMDEN COUNCIL

Subsequent to submission to Camden Council of the SES report, via Approval of Details application reference 2018/1979/P, the Council's environmental health case officer as consultee provided comment on the report including with requests that hourly format noise survey raw data be provided as additional information. The comment requests are copied below:

> Request 06 June 2018*:*
>
> *Can SES (the acoustic consultant) provide hourly LAeq data, as per Condition 13 requests. Table 4 presents LAeq 8 hour data. Can SES also provide LAmax hourly data for the night time period as ranges (lowest to highest).*
>
> Request 19 July 2018*:*
>
> *We need to see the raw survey data, which isn't graphically interpreted. Condition 13 is explicit, indoor hourly noise levels need to comply with 30dB LAeq and individual events shouldn't exceed 45dB LAmax. The report presents the survey data over 8 hours which has dilution tendencies. Can we ask the agent to provide the hourly survey data.*

Philip Acoustics has obtained the complete noise survey raw data from SES via Moran Construction and the Council's requested information is provided in terms of hourly raw survey data $L_{Aeq\ (1\ hour)}$ values in Table 1 and L_{Afmax} values in Table 2 on the following pages. As normal noise survey and acoustic assessment practice the values are rounded to the nearest whole dBA.

The raw survey data L_{Afmax} values in Table 2 are for the range of values (lowest to highest) for each hour. Because the highest range L_{Afmax} values are in some instances caused by atypical outlying events this potentially leads to a skewed impression of the data, and therefore as appropriate and applicable to the Condition 13 requirement, L_{Afmax} values are also provided in Table 2 for each night period in terms of values that are exceeded more than ten times (over the whole night period) and/or exceeded several times in one hour, whichever is greater.

In assessing this raw survey data, it is important that the data in Table 1 and Table 2 is not simply and directly compared with the Condition 13 noise requirement. The data is correctly assessed to determine compliance or otherwise with the Condition 13 noise requirement in Section 5 of this report.

Note the sound level meter was set up to measure over consecutive nominal 1 minute (60 seconds) periods for the complete noise survey duration and as default set to record various parameters as overall dBA values plus also one third octave band values from 6.3Hz up to 20kHz. Therefore, the SES noise survey conducted over several days generated a very large quantity of data, with well in excess of 1 million individual data points and thus is contained within a massive size Excel spreadsheet format file of circa 17MB, albeit most of the data is irrelevant to the assessment to demonstrate compliance with the requirement of Condition 13.

Time Period: 1 Hour Commencing	Hourly Raw Survey Data $L_{Aeq\ (1\ hour)}$ dB Values					
	19/01/2018	20/01/2018	21/01/2018	22/01/2018	23/01/2018	24/01/2018
00:00	31 (28)[1]	28	29	28	26	28
01:00	25	29	29	26	25	28
02:00	24	27	28	28	26	26
03:00	25	26	26	28	26	26
04:00	25	27	28	26	28	28
05:00	27	28	28	27	31	30
06:00	31	29	27	29	33	33
07:00	31	32	31	32	34	
08:00	33	31	29	34	34	
09:00	36[2]	32	32	33	33	
10:00	32	32	31	34	32	
11:00	32	32	32	33	33	
12:00	34	32	32	33	34	
13:00	32	32	33	32	32	
14:00	32	32	32	32	32	
15:00	33	32	32	33	32	
16:00	33	32	32	32	32	
17:00	33	31	33	33	33	
18:00	34	32	31	32	33	
19:00	32	32	32	33	32	
20:00	33	31	31	31	32	
21:00	33	31	30	31	31	
22:00	32	31	29	31	30	
23:00	33	30	32	30	29	

Note 1: Value in brackets is raw data $L_{Aeq\ (1\ hour)}$ dB value for 1 hour period commencing 23:00 on 18/01/2018 (i.e. as part of the complete night period 18/01/2018 through 19/01/2018).

Note 2: Value for 1 hour period commencing 09:00 on 19/01/2018 includes unidentified contaminating non typical event (this value should be excluded from analysis / assessment of survey results)

Table 1: SES noise survey hourly raw data $L_{Aeq\ (1\ hour)}$ dB values

Time Period: 1 Hour Commencing	Raw Survey Data L_{Afmax} dB Values					
	19/01/2018	**20/01/2018**	**21/01/2018**	**22/01/2018**	**23/01/2018**	**24/01/2018**
00:00	32 to 70 (33 to 50)[1]	33 to 51	38 to 47	35 to43	38 to 66	36 to 53
01:00	35 to 43	36 to 66	38 to 53	37 to 47	32 to 47	37 to 55
02:00	31 to 43	36 to 48	35 to 43	32 to 66	36 to 48	32 to 53
03:00	34 to 45	35 to 42	33 to 49	33 to 47	32 to 48	37 to 44
04:00	34 to 50	36 to 50	36 to 54	36 to 56	37 to 43	37 to 45
05:00	35 to 44	40 to 53	37 to 58	40 to 45	40 to 51	40 to 51
06:00	39 to 54	39 to 50	38 to 60	40 to 55	42 to 62	42 to 57
23:00	33 to 50	37 to 67	36 to 50	33 to 57	38 to 51	37 to 52
Value exceeded more than 10 times (whole night period) and/or exceeded several times in 1 hour; whichever greater	**46**	**48**	**47**	**46**	**47**	**48**

Note 1: Value in brackets is raw data range of L_{Afmax} dB values for 1 hour period commencing 23:00 on 18/01/2018 (i.e. as part of the complete night period 18/01/2018 through 19/01/2018).

Table 2: SES noise survey raw data L_{Afmax} dB values

In viewing the raw survey data L_{Afmax} range of values (lowest to highest) for each hour in Table 2, it is important to note that for all time periods the spread of L_{Afmax} values within the range lowest to highest is not evenly distributed. The significant majority of L_{Afmax} values within the range for all time periods tends towards the lower-mid end of the range, such that in many cases the upper end value of the range is due to isolated / not regularly occurring events.

This is best illustrated by consideration of average L_{Afmax} values; the average raw data values for all one hour night periods over each day of the noise survey are L_{Afmax} 40 to 42dB.

5. TECHNICAL ASSESSMENT OF NOISE SURVEY RAW DATA

The internal noise survey was undertaken with the flats and rooms of the development completely empty, with no furniture or furnishings yet fitted, albeit with carpet floor finish already laid. Therefore the empty flats and rooms were (and remain currently) much more acoustically reverberant or "echoey" as compared with when ultimately furnished.

This does not provide appropriate conditions for a measurement survey to establish internal noise that would be experienced / perceived by future residents of the flats, or for direct comparison with the Condition 13 noise levels requirement.

In simple terms, external noise intrusion into the flats, which is predominantly from passing traffic on Finchley Road, is artificially slightly louder now (and was during the survey) than it will be when the flats are furnished.

This is technically explained by the mathematical equation for noise intrusion from outside into a room through a building's façade, the equation is given below in simple lay terms. The more fully detailed technical equation this simple lay terms explanation is based on is given in Annex G (informative), Section G.2 of British Standard BS8233:2014 as applicable for the rigorous calculation method and as referenced in multiple acoustic text books:

L2 = L1 - R + 10logS - 10logA + 3dB Where in very simplistic terms:

L2 is the noise level dB into the room (i.e. external noise intrusion into the room)

L1 is the equivalent free field noise level dB just outside the building facade

R is the overall sound reduction dB of the façade (includes windows, wall & roof etc.) taking each element into account

S is the overall area of the façade taking each element into account

A is the total absorption area in the room

+3dB is a correction to account for angle of incidence which is the angle at which noise hits the facade

The term A within the equation determines the amount of reverberation or echo within the room and is inversely proportional to the room's reverberation time (T). The higher the value of A the more absorption in the room due to furnishings etc, the lower the reverberation time T and less "echoey" the room feels. The lower the reverberation time T, the lower the value of L2 (i.e. lower noise in the room).

The difference of external noise intrusion into a room, between the room empty, and the same room when furnished is directly proportional to the equation ratio $10\log(T_{empty}/T_{furnished})$ dB and is the room's "empty room correction".

Therefore assessment of the internal noise levels raw survey data to demonstrate compliance with the Condition 13 requirement needs to be carried out by adding an "empty room correction" to the survey results to take account the sample surveyed room is empty and unfurnished.

Details for the applicable empty room correction are provided in Section 5.1. Assessment of the internal noise levels raw survey data to demonstrate compliance with Condition 13 is provided in Section 5.2.

5.1 Empty Room Correction

To establish the applicable empty room correction from the equation ratio $10\log(T_{empty}/T_{furnished})$ dB, the following information is required:

- Reverberation Time (T_{empty}) for the sample room as surveyed;
- Reverberation Time ($T_{furnished}$) for the sample room when furnished.

5.1.1 Reverberation Time For Sample Room As Surveyed

Conditions of the sample room used for the noise survey as empty / unfurnished, but with carpet laid are unchanged since the survey in January 2018.

Philip Acoustics therefore carried out a site visit on 15 November 2018 to directly measure Reverberation Time values within the noise survey sample room.

Reverberation Time values were measured in octave bands from 63Hz up to and including 8kHz carried out in accordance with procedures as relevant of British Standard BS EN ISO 16283-1:2014: "*Acoustics - Field measurements of sound insulation in buildings and of building elements; Part 1: Airborne sound insulation*".

Details for the acoustic instrumentation used for the Reverberation Time measurements are provided in Appendix A.

A high volume pink noise impulse of sound was generated in the room from the loudspeaker and the decay time was measured using the interrupted Reverberation Time function of the Bruel & Kjaer sound level meter. Six sample Reverberation Time measurements were obtained using a minimum of three microphone positions with one loudspeaker position to obtain an overall average Reverberation Time result.

Full raw data results of the Reverberation Time measurements including overall average Reverberation Time result (T_{empty}) are provided in Table 3:

Description	**Octave Band Centre Frequency (Hz)**							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Sample 1 Reverberation Time (seconds)	0.81	0.62	0.83	0.58	0.63	0.63	0.61	0.50
Sample 2 Reverberation Time (seconds)	0.85	0.63	0.79	0.62	0.69	0.70	0.74	0.51
Sample 3 Reverberation Time (seconds)	0.73	0.58	0.74	0.56	0.71	0.71	0.63	0.53
Sample 4 Reverberation Time (seconds)	0.78	0.60	0.76	0.60	0.72	0.65	0.68	0.48
Sample 5 Reverberation Time (seconds)	0.93	0.67	0.74	0.60	0.64	0.64	0.92	0.53
Sample 6 Reverberation Time (seconds)	0.88	0.65	0.76	0.64	0.68	0.68	0.80	0.55
Average Reverberation Time T_{empty} (seconds)	**0.83**	**0.63**	**0.77**	**0.60**	**0.68**	**0.67**	**0.73**	**0.52**

Table 3: Reverberation Time (T_{empty}) for noise survey room

5.1.2 Reverberation Time For Sample Room Furnished

Since the coming into force in 2003 of mandatory Building Regulations pre-completion sound insulation testing for new and conversion / change of use residential properties, Philip Acoustics as an accredited sound test organisation via the Association of Noise Consultants has carried out well in excess of 10,000 individual sound tests at in excess of 1,000 residential development sites.

All of the testing involves Reverberation Time measurements; which although is predominantly of empty unfurnished rooms / properties, has nevertheless unavoidably included a significant quantity of already furnished rooms in residential flats. This testing provides a substantial evidence base for Reverberation Time values within furnished rooms of flats.

The Reverberation Time values provided in Table 4 are based on average measurements within furnished rooms of multiple flats, all with room size being same or comparable with (+/-10%) the SES noise survey sample room having a volume circa 30m^3.

Description	**Octave Band Centre Frequency (Hz)**							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Average Reverberation Time $T_{furnished}$ (seconds)	**0.40**	**0.32**	**0.30**	**0.31**	**0.32**	**0.32**	**0.31**	**0.30**

Table 4: Reverberation Time ($T_{furnished}$) for noise survey room

5.1.3 Empty Room Correction

The sample noise survey room applicable empty room correction is calculated in Table 5:

Description	**Octave Band Centre Frequency (Hz)**							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Average Reverberation Time T_{empty} (seconds)	0.83	0.63	0.77	0.60	0.68	0.67	0.73	0.52
Average Reverberation Time $T_{furnished}$ (seconds)	0.40	0.32	0.30	0.31	0.32	0.32	0.31	0.30
Empty Room Correction $10\log(T_{empty}/T_{furnished})$ dB	**3.2**	**2.9**	**4.1**	**2.9**	**3.3**	**3.2**	**3.7**	**2.4**

Table 5: Empty room correction applicable for noise survey room

Because the room Reverberation Time is different at different frequencies then correspondingly the empty room correction varies at different frequencies. The empty room correction applied in terms of an equivalent overall dBA value for the frequency (spectrum) profile of traffic noise intrusion into the room is 3.7dBA.

Therefore the difference in traffic noise intrusion between unfurnished and furnished for the sample surveyed room is 3.7dBA. What this means is that noise intrusion as surveyed (and currently) is 3.7dBA higher (louder) than it will be when the room is normally furnished. This a normal / typical magnitude empty room correction.

5.2 Demonstration of Compliance With Condition 13 Noise Requirement

The SES noise survey raw data as detailed in Section 4 plus with the empty room correction equivalent overall value 3.7dBA applied (subtracted), is provided in terms of hourly $L_{Aeq\ (1\ hour)}$ values in Table 6 and in terms of L_{Afmax} values in Table 7 on the following pages.

L_{Afmax} values are provided for each night period in terms of values that are exceeded more than ten times (over the whole night period) and/or exceeded several times in one hour, whichever is greater.

Again, and as normal noise survey and acoustic assessment practice the values are rounded to the nearest whole dBA.

Summary analysis of the SES noise survey raw data plus with the empty room correction applied in Table 6 and Table 7, as compared with the Condition 13 requirement shows the following:

Ambient Noise Levels: $L_{Aeq\ (1\ hour)}$ Values

- Day period values are in the range $L_{Aeq\ (1\ hour)}$ 26 to 30dB plus with average $L_{Aeq\ (1\ hour)}$ 28dB and comply with the Condition 13 requirement not exceeding $L_{Aeq\ (1\ hour)}$ 30dB day or night, and also as informative the advised upper limit criterion of $L_{Aeq\ (1\ hour)}$ 35dB for the day period;
- Night period values are in the range $L_{Aeq\ (1\ hour)}$ 20 to 30dB plus with average $L_{Aeq\ (1\ hour)}$ 24dB and also comply with the Condition 13 requirement not exceeding $L_{Aeq\ (1\ hour)}$ 30dB day or night.

Individual Noise Event Levels: L_{Afmax} Values

- Night period values occurring not more than ten times and/or not more than several times in any one hour (whichever is greater) are in the range L_{Afmax} 42 to 45dB and comply with the Condition 13 requirement not exceeding L_{Afmax} 45dB;
- For the significant majority of the night period L_{Afmax} values are much lower and are below L_{Afmax} 40dB.

Correct assessment / analysis of the SES noise survey raw data, including with the empty room correction applied demonstrates compliance with the requirement for noise into the flats of Condition 13 attached to Camden Council's Decision Notice dated 31 March 2015 application reference 2014/3327/P.

Time Period: 1 Hour Commencing	Hourly $L_{Aeq\ (1\ hour)}$ dB Values (room furnished)					
	19/01/2018	20/01/2018	21/01/2018	22/01/2018	23/01/2018	24/01/2018
00:00	28 (24)[1]	24	26	24	22	25
01:00	21	25	25	23	22	24
02:00	20	23	25	25	22	23
03:00	21	22	23	24	23	23
04:00	21	23	24	22	24	24
05:00	23	24	25	24	27	26
06:00	27	25	23	25	30	29
07:00	27	28	27	29	30	
08:00	29	27	26	30	30	
09:00	32[2]	28	28	29	29	
10:00	29	28	27	30	29	
11:00	29	28	28	30	30	
12:00	30	28	28	29	30	
13:00	28	28	29	28	28	
14:00	28	28	28	28	28	
15:00	29	28	28	29	28	
16:00	29	28	28	29	29	
17:00	29	28	30	29	29	
18:00	30	29	28	29	30	
19:00	29	28	29	30	28	
20:00	30	28	28	28	28	
21:00	29	27	27	28	27	
22:00	28	27	26	27	26	
23:00	29	27	28	26	25	

Note 1: Value in brackets is $L_{Aeq\ (1\ hour)}$ dB value for 1 hour period commencing 23:00 on 18/01/2018 (i.e. as part of the complete night period 18/01/2018 through 19/01/2018.

Note 2: Value for 1 hour period commencing 09:00 on 19/01/2018 includes unidentified contaminating non typical event (this value is excluded from analysis / assessment of survey results)

Table 6: SES noise survey hourly data $L_{Aeq\ (1\ hour)}$ dB values with room furnished

Time Period: Night (11pm to 7am)	L_{Afmax} dB Values (room furnished)					
	19/01/2018	20/01/2018	21/01/2018	22/01/2018	23/01/2018	24/01/2018
Value exceeded more than 10 times (whole night period) and/or exceeded several times in 1 hour; whichever greater	42	45	44	42	44	44

Table 7: SES noise survey L_{Afmax} dB values with room furnished

APPENDIX A

Acoustic Instrumentation For Reverberation Time Measurements

Site: 264-270 Finchley Road, London NW3 7AA

Report: 18218-002 Appendix A *(page 1 of 1)*

Date: December 2018

ACOUSTIC INSTRUMENTATION FOR REVERBERATION TIME MEASUREMENTS

Acoustic instrumentation used for the Reverberation Time measurements, plus to download and evaluate the measurement results is listed in Table A1:

Description & Serial Number	Type Number	Manufacturer	Date of Calibration Expiration	Calibration Certificate Number
Sound Level Meter, s/n 2311656 (complete with building acoustics module BZ7204, wireless remote control unit & tripod)	2260	Bruel & Kjaer	16/08/2020	TCRT18/1685
0.5" Microphone s/n 143228	377B02	PCB	16/08/2020	TCRT18/1685
Preamplifier *(no identification s/n visible)*	ZC0026	Bruel & Kjaer	16/08/2020	TCRT18/1685
Calibrator s/n 2326801	4231	Bruel & Kjaer	15/08/2020	UCRT18/1826
Eon 10G2 active loudspeaker s/n 23388 on heavy duty stand	P0349	JBL	N/A	N/A
Graphic Equalizer s/n KC003594	1131	Crest	N/A	N/A
Qualifier software	7830	Bruel & Kjaer	N/A	N/A

Table A1: Acoustic instrumentation for Reverberation Time measurements