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Report on Plant Noise survey at Crystal Cafe, 66 Mansfield road, Hampstead.

Date of report	**15th October 2011**
Dates of visits	10th and 11th October 2011
Present	Mr Over owner, residents, and Shaun Murkett.
Location	Crystal Cafe, 66 Mansfield Road, Hampstead, London NW3 2HU.
Purpose	To conduct a plant noise survey for planning permission.
Author of report	Shaun Murkett BSc. C.Eng. MIEE. MIOA.

1 Executive summary

1.1 The owner of the property is applying for planning permission for a new kitchen extract fan and flue system. A high level flue was originally installed but was removed and a low level flue installed on advice from the local authority. This has been found to be unacceptable, and a high level flue is now required. It is understood that planning permission has been granted subject to conditions including a noise report. The local authority have concerns that this will potentially give rise to increased noise to nearby residents, and have requested a noise survey and report. This report gives advice about the noise issue and addresses those concerns about the kitchen fan unit.

1.2 The background noise levels have been measured at typical times of operation, and the predicted noise levels of the new plant and fan unit have been calculated. An assessment under BS 4142 has been made, and also regard to BS 8233, and it is predicted that the noise will be well within the local authority criteria, if all the recommendations made in this report are incorporated. This is perfectly acceptable and meets the most stringent of any local authority criteria for plant noise.

1.3 A scheme of building works and noise reduction measures has been proposed to mitigate the potential noise issue. A detailed list of recommendations has been made at the end of the report, and this has been put into action immediately.

1.4 The owners are well aware of the implications of the noise issues surrounding the kitchen extract fan unit, and have taken professional advice in commissioning this report to investigate the noise situation. In my opinion they are currently doing as much as possible to implement the recommendations as quickly as possible in order to keep any disturbance to nearby residents to the absolute minimum.

1.5 When all the building works are complete then a final noise test should be commissioned. This will ensure that the units are working correctly and there is no noise breakout to the residents, and confirm that all the local authority noise planning criteria have been met.

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2 Introduction and Background

2.1 Investigation commission.

This noise survey and report was commissioned by Mr Over, the owner of Crystal Cafe. This cafe has been running a few years but there have been some complaints about the kitchen extract system.
The owner of the property is applying for planning permission for a new kitchen extract fan and flue system. A high level flue was originally installed but was removed and a low level flue installed on advice from the local authority. This has been found to be unacceptable, and a high level flue is now required. It is understood that planning permission has been granted subject to conditions including a noise report. The local authority have concerns that this will potentially give rise to increased noise to nearby residents, and have requested a noise survey and report. This report gives advice about the noise issue and addresses those concerns about the new proposed extract system.

2.2 History

The building dates back to late Victorian times, and it is understood that it has been commercial premises for at least the last 20 years. The building was previously a mini cab office and was converted to a cafe a few years ago, with a small kitchen and extract system. A high level flue was originally installed to the chimney level above, but it is understood that after a visit from officers from the local authority concerning visual planning issues, it was requested that this be removed, and that a low level flue be installed. This low level flue exits at the side of the building at first floor level, and is actually below and very close to some of the residents windows. This is the existing plant layout at present at time of survey visit.
This is a most unusual arrangement, as generally in commercial premises the kitchen extract flues always exit above the nearest resident window height, as there environmental health issues with smell and fumes.
There have been some complaints about noise, but mainly about smoke and smell and odours from the extract flue from nearby residents. After legal issues and consultation with different departments in the London Borough of Camden, the Local Authority, it has been proposed to re install a high level flue, with a new fan unit and silencer. This report deals specifically with the noise issues about the new proposed kitchen extract system.

2.3 Location.

The cafe is on the north side of the busy Mansfield Road in Hampstead, a terraced building with the cafe on ground floor and with residents above. To the east adjoining is commercial premises with residents above, to the west commercial premises with residents above, to the north adjoining an architects office at ground floor level only, and to the south residential property. The area is mixed residential, and commercial.

2.4 Layout and construction of buildings. (See sketch and photos)

The building is built in traditional brick with timber joist floors, arranged with the cafe on the ground floor, and an extension to the rear. There is a flat roof at the rear over the ground floor kitchen; this extends north to become the flat roof over the architects' office at the rear. There are two flats with residents who live above the cafe, and have windows which over look the flat roof. There is also plant from other businesses nearby, including large high level extract flues from other cafes and restaurants.

2.5 Nearby residents.

The nearest residents to the existing extract flue are located in the first floor flat, and the nearest residents to the proposed flue live above the cafe on second and third floor level. At third floor level the roof space has been converted into a living room with additional windows. The nearest residents' windows are 3m from the proposed location of the top of the extract flue, level with the chimneys.

2.6 Plant Machinery

The proposed plant equipment is as follows:
Helios GBD 560 4/1 large centrifugal fan unit of 2.5 kW three phase rating, of capacity $2m^3$ per second at 600 Pascal pressure. This is a large, modern quiet running fan unit and will be mounted internally in the kitchen, and then flexibly connected to a large Acoustica RO2-4 inline attenuator silencer, and then flexibly to the extract flue ducting.
This is to be routed outside near the flat roof and then up the side of the building at the rear, up to the top roof level, and next to the main chimney stack to exit at high level well above the window height.

2.7 Mode of operation.

The kitchen extract fan unit will run from 6am through to close of business at 12 midnight, and there is a comprehensive speed controller to regulate the fan speed depending on demand of the cooking in the kitchen.

2.8 Local authority criteria, and BS 4142.

The usual local authority guideline criteria for noise from industrial plant is given in the British Standard BS 4142. Essentially this relates how loud the plant is then measured near the residents, in dB L_{Aeq} relative to the underlying background noise, measured in dB L_{A90}. It gives an indication by a noise rating value as to the likelihood of complaints about plant noise from residents; if the source noise as a rating level, (including any correction for character), exceeds the background by more than 6 dBA then complaints are likely. The usual criteria for local authorities is now for the plant noise to be at least 10 dBA below background, ie to have a rating value of below -10 dBA. Some local authorities also require an octave band analysis to ensure that each octave band of the predicted plant noise in dB L_{Aeq} is not above the measured background noise in dB L_{A90}

2.9 *London Borough of Camden noise criteria for external plant.*

The usual noise conditions on planning applications for new noise plant in Camden generally state that the noise of the plant at the residents should be at least 10 dBA below the lowest measured ambient background noise in dB L_{A90}, *ie in accordance with BS 4142.*

2.10 General noise criteria. Design targets and BS 8233

The guidelines for external noise intrusion into buildings is described in British Standard BS 8233, which defines what is defined as "good conditions" and "reasonable conditions of internal noise level in various spaces. The local authority follow these guidelines for acceptable values for proposed developments, and planning permission is often granted conditionally on proposals which can show in a consultants report that the building design will achieve the required design targets.

Residential

"Good conditions" are defined as no more than 30 dB L_{Aeq} in living rooms and bedrooms for day time, and night time. The design value for "reasonable conditions", for the daytime ambient noise level inside residential lounges and living areas is 40 dB L_{Aeq}
For residential bedrooms at night the guideline design target is 35 dB L_{Aeq}, and with a 45 dB $L_{A\,Max}$. These internal noise levels are to include noise sources from inside and outside the building, including traffic noise, and any commercial noise source in adjacent buildings.
"Good conditions" are design targets to aim for, however most planning conditions generally stipulate achieving the "reasonable conditions" noise levels inside new developments.
It is generally accepted that the noise attenuation through a slightly open window is of at least 10dBA.
This requirement to meet BS 8233 has not been specified in these planning conditions, although it is good practice to be aware of the standards and to check if the plant will meet the guidelines.

3 Measurements and Observations.

(Survey made Monday 10th October 2011, from 5.40 pm through to 7 pm 11th October 2011).

3.1 The noise visit was made to meet the management, to inspect the premises and to investigate and measure the background noise in the afternoon and evening and then leave the sound monitoring equipment unattended to monitor the background noise overnight when it would typically be at its lowest level. The background noise was measured on the flat roof at 1m from the facade of the residents' windows, close to the nearest noise sensitive residents at the rear of the house, without the new plant running, to measure the existing background noise levels.

3.2 Monitoring near the residents. (See photos)

The background noise early on in the survey in the evening was dominated by the noise from the busy traffic on Mansfield road, and plant noise from other premises nearby. There was also overhead planes, police sirens and the sound of the birds and wind in trees.

3.3 Monitoring positions.

Sound measurements and monitoring were made at the location listed below:-
Height 1.5 m on flat roof :-

A 1m from façade of residents' windows on second floor to rear on the flat roof.

3.4 Sound measuring equipment.

The main sound level meter, a type 1 CEL 490 was set up on a tripod with full weather protection at 1m from the facade of the residents window, at a height of 1.5 m, level with the second floor windows. The meter was calibrated before and after the survey. The meter was set to record in broad band environmental mode, including dB L_{Aeq} and dB L_{A90} in five minute periods. The measurements were made from around 5 pm in the evening through the night to the following evening. The weather at the start of the survey was about 16 °C, dry, and with a slight breeze.

A Type 1 Bruel and Kjaer 2260 sound level meter was also used to independently monitor the octave band background noise for reference at the start of the survey, in the same location on the flat roof near the residents windows.

4 Results and analysis. (10th - 11th October 2011)

4.1 Sound monitoring near the residents, Location A (see graphs at end of report).

Existing background noise level dB L_{Aeq} and dB L_{A90} was measured through the day and night, over one night

Sound level =

39 - 61 dB $L_{Aeq\ (5\ min)}$
37 - 53 dB $L_{A90\ (5\ min)}$

4.2 Lowest background noise measured location A (for operation from 7am to 10 pm).

The lowest background noise level dB LAeq occurred at 9.55 pm,
Sound level = 47 dB $L_{Aeq\ (5\ min)}$

The lowest background noise level dB LA90 occurred at 9.55 pm
Sound level = 43 dB $L_{A90\ 5\ min}$

4.3 Background noise octave band at start of survey.

Frequency Hz	63	125	250	500	1k	2k	4k	Overall dB LA90
Background noise L90	54	49	46	44	38	33	26	47

Table 1 Octave frequency spectrum of background noise L90

4.4 Published octave band sound power level of Helios Fan unit.

Frequency Hz	63	125	250	500	1k	2k	4k	Overall dBA
Sound power level SWL of Plant in dB	62	74	75	75	75	74	70	81

Table 2 Published Octave band (and overall dBA), Sound Power levels for extract system in dB for Helios GBD 560 fan at full duty.

The manufacturer publishes the tested sound power levels of the fan, as tested in anechoic or fully reverberant conditions, for the intake, extract and fan casing breakout parts of the fan system. These sound power levels are then converted to actual sound pressure levels by calculation or actual measurement when the fan unit is in place and running.

4.5 Published octave band sound attenuation for inline Acoustica attenuator.

Frequency Hz	63	125	250	500	1k	2k	4k
Attenuation of sound level In dB	5	8	12	23	30	30	23

Table 3 Published Octave band sound attenuation for Acoustica RO2.4 inline attenuator duct silencer.

4.6 Calculation of noise levels at end of kitchen extract flue and at residents windows. (See Appendix 2).
The noise levels at the far end of the flue are calculated from the sound power of the fan unit at the start of the ducting system, and the noise level is reduced or attenuated, by various factors, including the size of the duct, the number of bends in the duct work and type of bend, the overall length of the duct, any inline attenuator silencers, and then the termination attenuation of the duct at the end as it exits into the fresh air outside.
The noise level at the top of the flue can then be used in a calculation to predict the noise level heard at the resident's window at a certain distance away from the end of the flue.
This final predicted noise level at the residents' window is then used in the BS 4142 assessment to confirm acceptability of the proposal to meet local authority noise criteria.

The calculations for predicting the sound pressure level at the residents' window are shown in Appendix 2. The new proposed kitchen extract system comprises the fan motor, the inline attenuator, 21m of 250 mm by 400 mm ducting, with four 90 degree bends and two 45 degree bends to follow the roof line. The references for the attenuations have been taken from the manufacturers published data, and industry standard source reference hand book on fan ducting and fan noise "Woods Practical Guide to Noise Control". The calculations are for the fan motor running at maximum, at full duty, and any variable attenuations are calculated as conservative to indicate the worst case conditions. The final value is 20dBA , however looking at the octave bands it appears it may be tonal at around 250 Hz and so for BS4142 a tonal correction of 5 dBA has been added for the calculations.

4.7 Calculation of Sound pressure levels from sound power from a point source.

The sound pressure level is given by the equation below:-

SPL = SWL – 20 log r – 8 dB for hemispherical propagation.

Where SPL is sound pressure level, SWL is sound power level and r is the distance away.

For full spherical propagation, (with the source in free space away from any walls), the last term is -11 dB. In this case the flue and outlet will be near the chimney but not a full wall, however the worst case situation has been calculated for hemispherical propagation.
The results indicate a sound pressure level of 18 dBA at the residents' window.

4.8 Attenuation of sound due to distance, calculations.
(Hemispherical propagation)
This is given by the equation $A = 20 \log r^1 / r^0$ dB
Where A is attenuation due to distance in dB
where r^1 is distance from source to receiver
where r^0 is distance from source to reference measurement distance (usually 1m or 3m)

for example in this case
distance $r^1 = 3$ m (for residents below)
$r^0 = 1$ m (for kitchen fan)
A = 9.5dB attenuation

4.9 Barrier calculation.
If the source noise is effectively screened by a barrier from direct line of sight then there is a reduction in noise depending on the frequency of the source, the angle into the sound shadow, and the "effective height" of the barrier, and the effective path length difference δ.
For general point sources the Maekawa formula is generally used.
In this instance there will be windows in direct line of sight of the extract flue opening.

4.10 BS 4142 analysis.

BS 4142 gives an idea of the acceptable predicted source noise from the plant, at the residents' window, relative to measured background noise.

The latest version (1997) of the BS 4142 has been used to make an assessment from the published sound source levels and the measured background noise levels.

Evening and night time use 11 pm – 7 am

Measured background noise, lowest sound level at residents

(43dB $L_{A90\ (5mins)}$ at 9.55 pm)

	dB L_{Aeq}	= 47 dBA
Calculated noise level of fan	dB L_{Aeq}	= 20 dBA
Residual noise level at similar time	dB L_{Aeq}	= 47 dBA
Correction due to high background noise		= 0
Specific noise level of new fan	dB L_{Aeq}	= 18 dBA
Correction factor for characteristic including tonality and regularity, (appears to be tonal)		= +5 dBA
Addition of all units on roof and calculations		
Predicted noise level of fans at 1m from facade of residents windows		= 23 dBA
Background level lowest (measured)	dB $L_{A90\ (5\ min)}$	= 43 dBA
Rating level		**= 23 dBA**
Excess of rating level over background		= - 20 dBA

This will be **Acceptable**

This is acceptable according to BS 4142 analysis, with a good safety margin of 10 dBA and is not likely to lead to complaints. Generally the local authority criteria is for the source noise to be at least 10 dBA below and so the result is perfectly acceptable.

4.11 London Borough of Camden regulations in planning permission.

The planning regulations usually states that the noise from the plant shall be 10 dBA below the measured existing L_{A90} background noise at any time when the plant is operation, if it does not have a distinguishable characteristic, which applies for this situation. It is indicated from the BS412 calculation that the predicted plant noise will be at least 20 dBA below the measured background noise, and this is therefore acceptable, if all the recommendations are put in place.

4.12 BS 8233 Assessment

The predicted noise level outside the nearest residents' window is predicted to be no greater than 25 dBA at all the locations, even without the recommended increase in barrier height.

The "reasonable conditions" design value for the ambient noise level inside lounges and living areas is 40 dB L_{Aeq} *daytime..*

For residential bedrooms the guideline acceptable design target is 35 dB L_{Aeq}, *at night, and with a dB* L_{Amax} *of 45 dBA, to include noise sources from outside the building, including traffic.*

It is generally accepted that a partially open window will give a noise reduction of at least 10 dBA. This would then indicate that for external noise to be acceptable with a good safely margin, for daytime the external noise level would need to be less than 50 dB L_{Aeq} *measured just outside the residents window, and for night time after 11pm the external noise should be less than 45* dB L_{Aeq}.

The predicted plant noise at the residents windows is up to 23 dBA, and this is much less than the requirement under BS 8233. This is well with in the acceptable levels with a good safety margin of at least 20 dBA.

5. Discussion.

5.1 The noise issue with the new proposed kitchen extract system has been investigated and the potential for noise break out has been considered. Existing ambient and background noise levels have been monitored, at the residents nearest to the unit, at typical times of the day. The construction of the building and the layout of plant and location of residents was examined and the potential sources of noise and vibration break out identified and pointed out to the owner. Calculations and assessments have been made in this report for the potential for any change in noise levels at the residents due to the new plant, and the calculations have confirmed that the plant will meet the noise regulations, if all the recommendations made in this report are followed.

5.2 Monitoring at residents.

The existing ambient and background noise was monitored over a period of one day and night at the nearest noise sensitive residents to the proposed plant location. The noise climate was primarily road traffic noise from the nearby busy Mansfield road.

5.3 Plant Machinery, and potential noise breakout routes.

The new kitchen extract fan unit is by Helios, which are of modern design, with smooth running and quiet centrifugal fans, compared to older units, and from a good reputable manufacturer. The published sound data and octave bands was available to confirm the quiet running. The units will be installed in a good location internally, and as far away from nearest residents as practically possible. The potential noise breakout routes identified were :

Airborne noise breakout from end of flue to windows.

Structureborne noise and vibration from fan motor and flue fixed to external wall.

5.4 Predicted sound level at residents.

The plant sound level has been measured and also calculated and predicted at the nearest residents' windows and found to be 25 dBA, if all the recommendations in this report are followed. This is well below the measured background level, by a good safety margin of at least 18 dBA.

5.5 BS 4142 Assessment.

BS 4142 is the main British standard used for assessing the likelihood of complaints with industrial noise. This can be used to give a guide as to the relative levels of each noise source and if this constitutes a possible noise problem. The basis of BS 4142 is an interpretation of the difference in level between the problem noise source measured in dB L_{Aeq} *and the underlying background noise measured in* dB L_{A90}.

It gives an indication of the likelihood of complaints about plant noise from residents; if the source noise exceeds the background by more than 6 dBA then complaints are likely, and up to 6 dBA there is marginal significance of complaints.

The results from the measurements and calculations demonstrates that the calculated source noise of the plant will be acceptable. The calculated noise at the receiver, the residents windows is 23 dBA, and this will be below the background level by 20 dBA, which is completely acceptable. Generally the local authority noise criteria is for the source noise to be 10 dBA below the ambient background level, and so the result is acceptable, and meets all current planning regulations.

5.6 London Borough of Camden noise conditions in the planning permission.

The usual noise conditions on a planning applications for new noise plant in Camden is for the noise of the plant at the residents to be at least 10 dBA below the lowest measured ambient background noise in dB L_{A90}, ie in accordance with BS 4142. The new predicted source noise is 23 dBA at nearest residents' window, and is therefore perfectly acceptable with a good safety margin of 10 dBA., and should meet the requirements, if all the recommendations are followed.

5.7 BS 8233 Assessment

The BS 8233 guidelines require that the predicted noise from external sources is ideally to be less than 45 dBA outside the nearest residents' window at night. The assessment shows that the predicted noise level from all the new plant running at maximum, outside the nearest residents' window, is 23 dBA. This is well within the acceptable levels with a safety margin of at least 20 dBA and the sound of the units should be inaudible inside the residents' rooms, even with the windows open, if all the recommendations are followed.

5.8 Recommendations for works

A Install fan and inline attenuator.

It is recommended that the fan unit be installed with the inline attenuator as proposed, on good quality anti-vibration spring mounts (suitable professional high performance mounts are available from Christie and Grey of Tonbridge)

B Isolate fan motor from ductwork and building

Isolate the fan motor housing from any rigid structure of the building or ducting by installing flexible rubber coupling sleeves between the fan and ductwork. Isolate any cables by using flexible components.

C Isolate the inline attenuator from the extract flue

Isolate the attenuator from the extract flue by using flexible rubber coupling sleeves.

D Isolate the flue from the building by using anti-vibration mount spring hangers.

Isolate the flue by using professional anti-vibration mounts from Christie and Grey. The design should include four 90 degree bends and two 45 degree bends.

E Raise the flue outlet as high as possible above the level of residents windows.

Raise the flue height as much as possible and point the outlet away from nearest residents' windows.

5.9 Completion Monitoring.

As each phase of the work is completed it is recommended that monitoring is considered at the residents flat. When all the building works are complete, and the air conditioning system has been commissioned, and all the plant running correctly, then it is recommended to re-measure the ambient and background noise at the residents. This will ensure that the plant is working correctly and the works have been successful and there is no excessive noise breakout from the fans, and confirm that all planning noise criteria have been met. A brief letter to the local authority noise team will then confirm the requirements of the planning criteria have been fulfilled.

6 Conclusion and Recommendations.

6.1 The owner of the property is applying for planning permission for a new kitchen extract fan and flue system. A high level flue was originally installed but was removed and a low level flue installed on advice from the local authority. This has been found to be unacceptable, and a high level flue is now required. It is understood that planning permission has been granted subject to conditions including a noise report. The local authority have concerns that this will potentially give rise to increased noise to nearby residents, and have requested a noise survey and report. This report gives advice about the noise issue and addresses those concerns about the kitchen fan unit.

6.2 The background noise levels have been measured at typical times of operation, and the predicted noise levels of the new plant and fan unit have been calculated. An assessment under BS 4142 has been made, and also regard to BS 8233, and it is predicted that the noise will be well within the local authority criteria, if all the recommendations made in this report are incorporated. This is perfectly acceptable and meets the most stringent of any local authority criteria for plant noise.

6.3 A scheme of building works and noise reduction measures has been proposed to mitigate the potential noise issue. A detailed list of recommendations has been made at the end of the report, and this has been put into action immediately.

6.4 The owners are well aware of the implications of the noise issues surrounding the kitchen extract fan unit, and have taken professional advice in commissioning this report to investigate the noise situation. In my opinion they are currently doing as much as possible to implement the recommendations as quickly as possible in order to keep any disturbance to nearby residents to the absolute minimum.

6.5 When all the building works are complete then a final noise test should be commissioned. This will ensure that the units are working correctly and there is no noise breakout to the residents, and confirm that all the local authority noise planning criteria have been met.

6.6 Recommendations.

A Install fan and inline attenuator.

B Isolate fan motor from ductwork and building

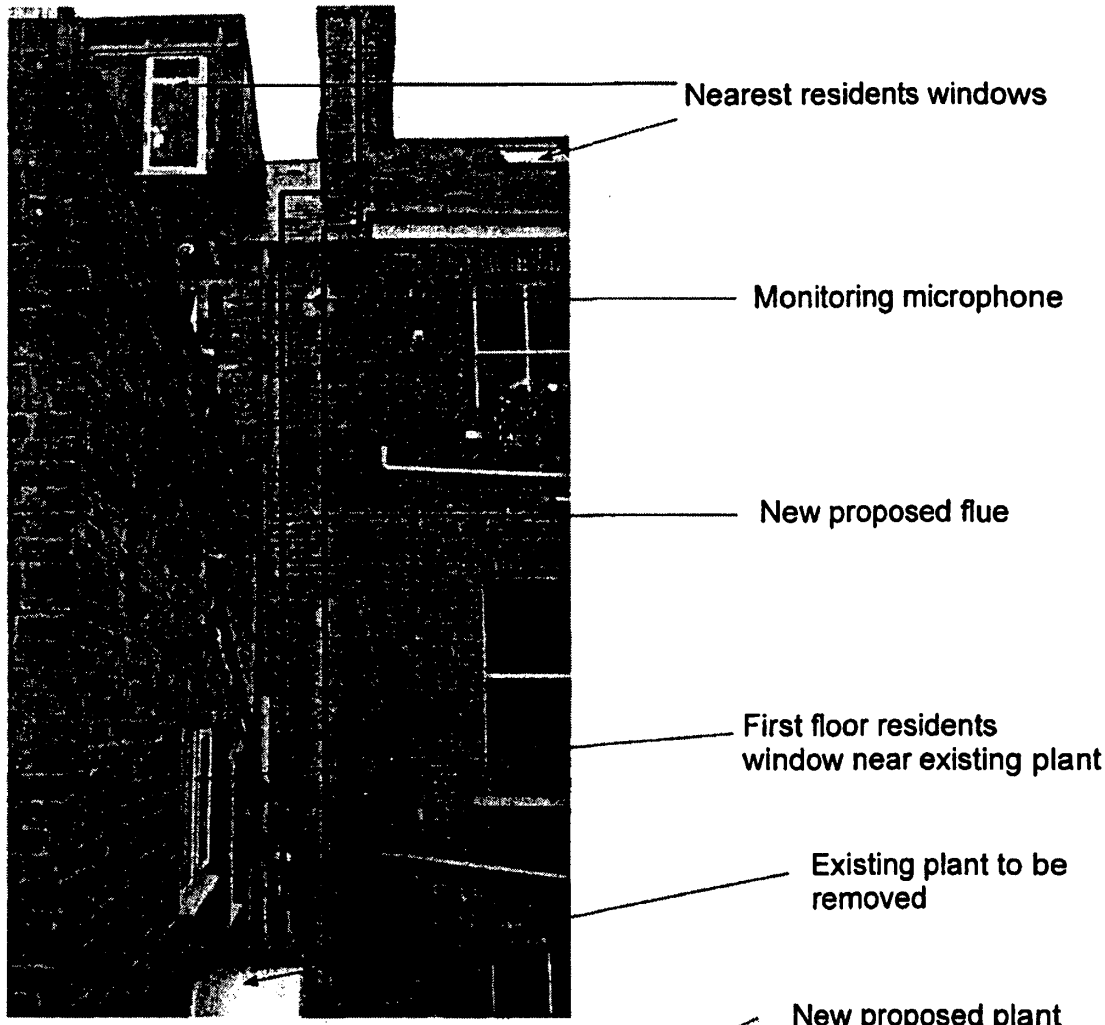
C Isolate the inline attenuator from the extract flue

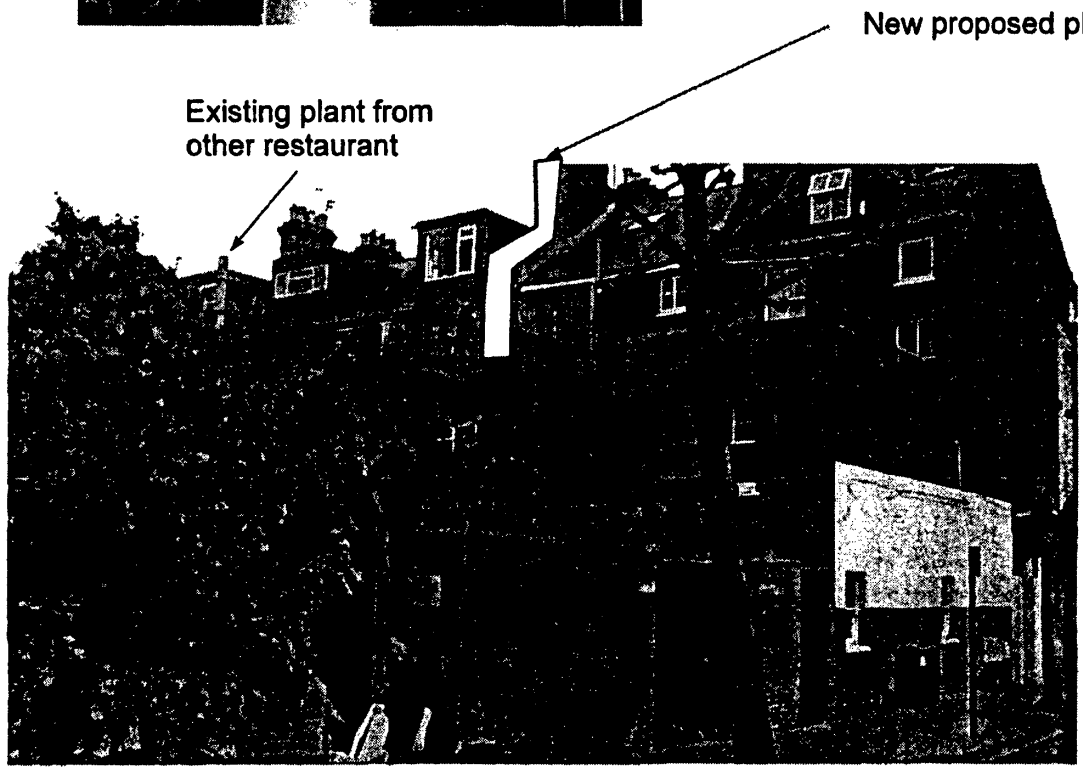
D Isolate the flue from the building by using anti-vibration mount spring hangers.

E Raise the flue outlet as high as possible above the level of residents windows.

F Completion noise monitoring to confirm all noise criteria is met.

Shaun Murkett 14th October 2011





Photographs of noise survey at Crystal Cafe, 66 Mansfield rd © London Borough of Camden

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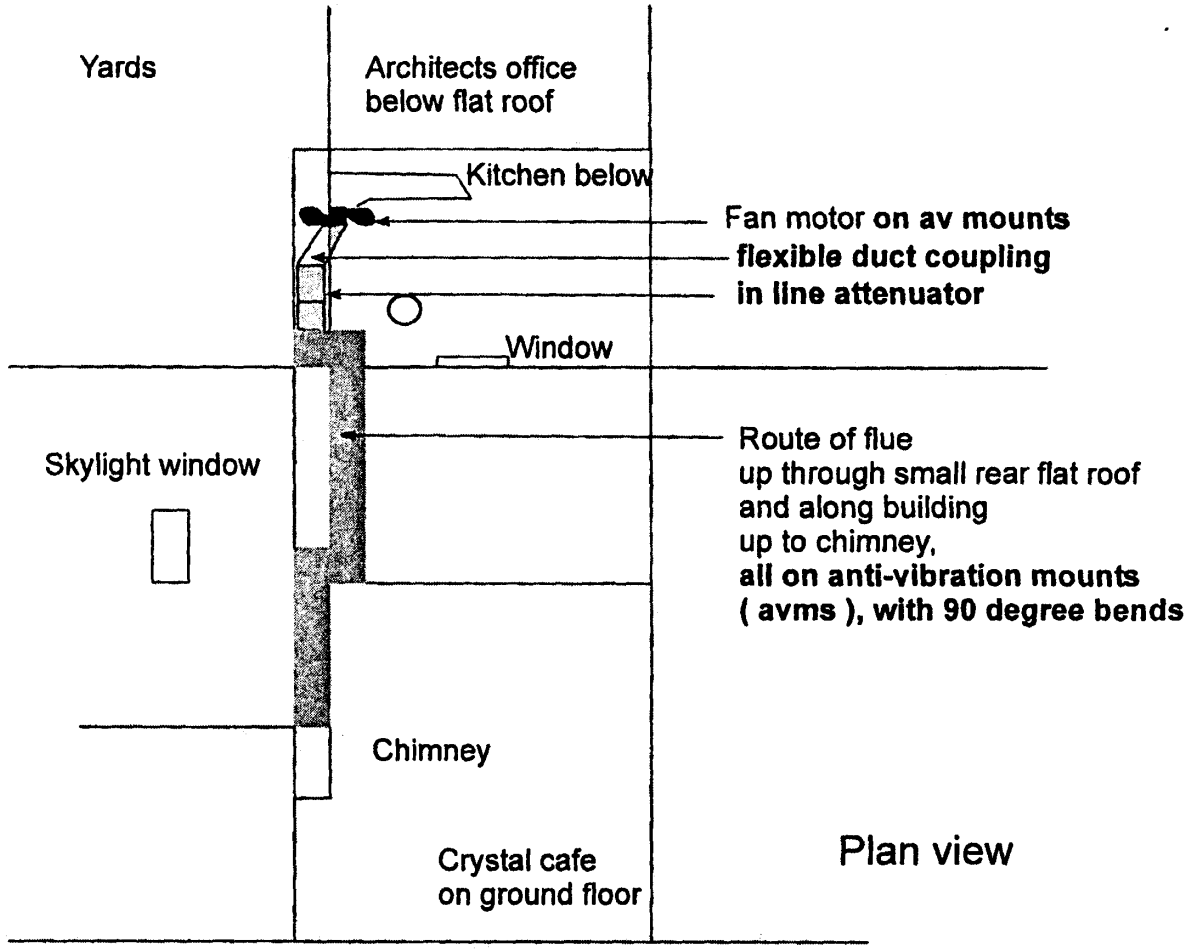
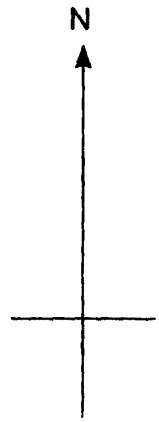




Key

Recommendations are shown in **bold**

Plant position

Sound level monitor point

Layout of new plant at Crystal Cafe, 66 Mansfield rd, Hampstead, showing recommendations.

Appendix 1 Glossary of Acoustic terms.

Annoyance A feeling of displeasure associated with any agent or condition known or believed by an individual or a group to be adversely affecting them. Emotion associated with any noise that is perceived as irritating or a nuisance.

A-weighting A frequency dependent correction or weighting that is applied to the measured or calculated frequency spectrum of a sound or noise to correlate with the varying sensitivity of the ear to sound of different frequencies. The ear is less sensitive to sound at low and very high frequencies, compared to the mid range frequencies. This A weighted response corresponds more closely to the frequency response of the human ear.

Ambient noise All encompassing sound at a given place, usually a composite of sounds from many sources near and far.
This is generally measured as dBA $L_{Aeq\ T}$ as recommended in ISO 1996.

Background noise Long term ambient noise or residual noise, generally expressed by dBA L_{Aeq}, as recommended in ISO 1996 and followed by PPG 24.
(Still described in BS 4142 and many standards by dBA L_{A90} , .and which is often stated to give a broader picture of the ambient background noise).

BS 4142 This is the main British Standard used for assessing the likelihood of complaints with industrial noise. In essence if a noise source measured in L_{Aeq} exceeds the measured background noise L_{a90} by more than 6dBA then complaints are likely, by no more than 10dBA, then complaints are highly likely. There are also loading factors for impulsive sounds and tonal sound sources which are subjectively more annoying.

Decibel (dB) Decibel. A unit of logarithmic ratio between a sound pressure and a known reference pressure (which corresponds to the threshold of hearing). For sound pressure level the reference quantity is 20μPa, the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1dB is only perceptible under controlled conditions. but a 3 dB change is easily perceptible.

dBA "A" weighted dB. Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency, (pitch), in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessments of loudness. An increase of 10 dB(A) corresponds roughly to doubling of the perceived loudness of a sound.

dB Lin dB Linear. Unweighted sound pressure level in dB, and is used as a more appropriate parameter to dBA when low frequencies predominate in the spectrum, and "A" weighting would under represent these low frequencies; as recommended in WHO 1999. This is of particular use when measuring sound of music as the dBA weighting would not give a fair representation of the low frequency content, which usually dominates modern music.

dBC dB "C" weighted sound pressure level. The C weighting curve is closer to the linear response than the A weighting curve, and often used as an alternative to dB Lin.

Frequency Spectrum	The range of audio frequency generally associated with the range of human hearing from 20 Hz to 20 kHZ
Hertz (Hz)	Unit of frequency, equal to one cycle per second. Frequency is related to the pitch of a sound.
$L_{eq\,T}$	Equivalent continuous sound pressure level. This is a time averaged level taken over a specified time period, which gives a measure of the average sound energy over that period. The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over the same specified measurement period (T). It is measured with a fast time weighting, over periods such as one minute, 5 minutes, 15 minutes, 1 hour etc.
$L_{Aeq,T}$	"A" weighted equivalent continuous sound pressure level, over measurement period T. This is an average of the total sound energy measured over the time period. $L_{Aeq,\,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter. This is the preferred sound measurement parameter for most types of environmental noise as recommended by ISO 1996.
L_{max}	The highest linear unweighted noise level recorded during a measurement period.
L_{Amax}	The highest or maximum A weighted noise level recorded during a measurement period.
L_n	This is the percentile sound level. Since the variation in sound level can be large over a long period of time, the sound level can be described statistically. Thus n refers to the percentage of the total measurement time for which that level is exceeded.
$L_{A10,T}$	The A weighted level of noise exceeded for 10% of the specified measurement period (T). It gives an indication of the upper limit of fluctuating noise such as that from road traffic. $L_{A10,\,18h}$ is the arithmetic average of the 18 hourly $L_{A10,\,1h}$ values from 06.00 to 24.00.
$L_{A90,T}$	The A weighted noise level exceeded for 90% of the specified measurement period (T) and used to be commonly taken to be the background noise level parameter in the UK. In BS 4142 it is still used to describe the nominal background noise level, although background noise level is now usually described by L_{Aeq} according to ISO 1996.
Noise	Undesired sound
Noise induced Temporary Threshold shift	Temporary hearing impairment occurring as a result of noise exposure, often phrased temporary threshold shift (adapted from ANSI 1994) The ears need a time to "recover" or settle, after exposure to high noise levels, and until that time will not perceive low sound levels as normally.
Noise level	Level of undesired sound, usually measured in dB L_{Aeq}

Octave bands The frequency spectrum can be divided into a number of octave bands centered around the frequencies 32 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1kHz, 2kHz, 4kHz, 8kHz and 16kHz to encompass the range of human hearing. Third octave spectrum divides each of these octave bands into three frequency bands to give even greater detail of the distribution of the sound across the frequency spectrum.

PPG 24 Planning Policy Guidance document 24: Planning and noise.1994.
This is a planning guide that gives considerations to noise issues with regard to planning. Noise exposure categories are defined for areas under consideration.

Rating level The noise level of an industrial noise source which includes an adjustment for the character of the noise. Used in BS 4142. (1997)

R_w Single number rating used to describe the sound insulation of building elements. It is defined in BS 5821: (1984).

rpm revolutions per minute , the rotational speed of a machine or engine.

Sound level The level of sound measured, as Sound pressure level, usually in dBA

SPL Sound pressure level, usually measured in dBA

Typical everyday sound levels

140 dBA	jet aircraft take off at 25m
130 dBA	gunshot from revolver at 1m
120 dBA	riveting workshop
120 dBA	threshold of pain
110 - 115 dBA	circular saw on hardwood at 0.5m, chainsaw at 0.5m
100 - 110 dBA	police car, or ambulance, siren at 7m
100 - 105 dBA	night club; music festival at 30 m from stage
90 - 95 dBA	heavy lorry at 7m
90 - 95 dBA	bar or pub with music
85 - 90 dBA	power drill at 0.5m, food blender at 0.5m; car horn at 7m
80 - 85 dBA	inside London tube train
75 - 85 dBA	busy restaurant or café
75 - 80 dBA	vacuum cleaner at 1.5m
70 - 80 dBA	busy street
70 - 75 dBA	inside bus
70 - 75 dBA	passing car 40 mph at 7m
65 - 70 dBA	loud radio at 1m ; inside car at 50 - 60 mph
60 - 65 dBA	general office; supermarket
50 - 60 dBA	conversation
40 - 50 dBA	quiet office; quiet living room, day time
30 - 35 dBA	quiet bedroom, at night
20 - 25 dBA	empty concert hall or theatre
20 dBA	broadcast or recording studio
10 - 20 dBA	faintest audible sounds
0 dBA	threshold of hearing

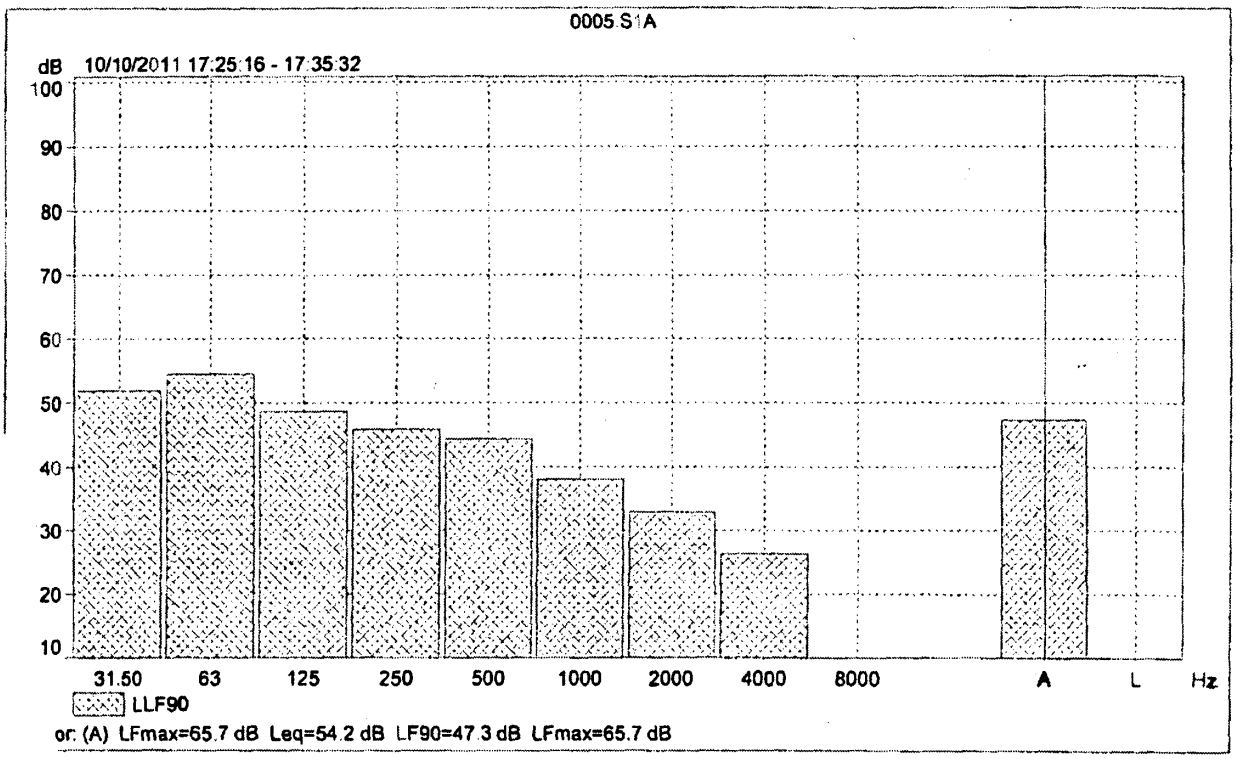
WHO 1999 World Health Organisation . Guidelines for Community Noise 1999.
This document sets out guideline limits on noise levels to prevent hearing damage, annoyance, and sleep disturbance in various situations, including residential, leisure, and workplace buildings.

Frequency Hz		**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	
duct surface area, **s** for duct 250mm by 400mm, area = 0. 08m2	**0.08**								
attenuation per metre of duct		0.6	0.6	0.4	0.3	0.2	0.2	0.2	
total length of duct in metres, **d**	**21**								
attenuation for total length of duct		12.6	12.6	8.4	6.3	4.2	4.2	4.2	
90 degree bend attenuation dB,		0	1	2	6	4	3	3	
number of 90 deg bends	4	4	4	4	4	4	4	4	
total of attenuation for 90 deg bends		0	4	8	24	16	12	12	
attenuation for a 45 degree bend (estimate)		0	0	1	3	2	1	1	
number of 45 deg bends	1	1	1	1	1	1	1	1	
total attenuation for 45 deg bends		0	0	1	2	2	1	1	
attenution due to open termination at end of duct, area **s** m2,	**0.08**	14	9	5	1	0	0	0	
in line attenuator type **Acoustica RO2-4,** manufacturers data		5	8	12	23	30	30	23	
Total attenuation, inc. length, bends, opening, inline attenuator.		31.6	33.6	34.4	56.3	52.2	47.2	40.2	
SWL of fan unit for extract into duct from manufact data, dB		**62**	**62**	**75**	**75**	**75**	**74**	**70**	
Fan unit. **Helios GBD 560/4/1,** centrifugal fan, 2.5 kW, 3 phase.									
SWL power at far end of duct , in dB, after attenuation.		**30.4**	**28.4**	**40.6**	**18.7**	**22.8**	**26.8**	**29.8**	
distance to window **r** in metres, from fan duct outlet	**3**								
log r	0.48								
20 log r	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	
hemispherical part of propagation , -8 dB	8	8	8	8	8	8	8	8	
SPL = SWL - 20 log r - 8 SPL at residents window		**12.9**	**10.9**	**23.1**	**1.2**	**5.3**	**9.3**	**12.3**	
to convert sound level in octaves to single figure of dBA :-									
weighting		-26.2	-16.1	-8.6	-3.2	0	1.2	1	
spl weighted		-13.3	-5.2	14.5	-2.0	5.3	10.5	13.3	
10 to power of spl /10		0.046319	0.30	27.91	0.62	3.36	11.11	21.17	64.52
log 10 of sum									1.809684
dBA at residents window, converted from octave bands.	**18 dBA**								**18**

This page calculates the SPL in **dBA** at a residents window at a distance **r** metres from a fan duct outlet of area **s** m2 from a length of duct **d** , with a number of 90 degree and 45 degree bends and an inline silencer attenuator, and then open attenuation into the open air. The manufacturers data has been used for the SWL power levels in octaves of the fan motor and the in line attenuator. Other references from industry standard Woods Guide to Noise Control.

APPENDIX 2 Calculation of sound levels at residents' windows.

Project **Crystal Cafe Mansfield road Hampstead October 2011**

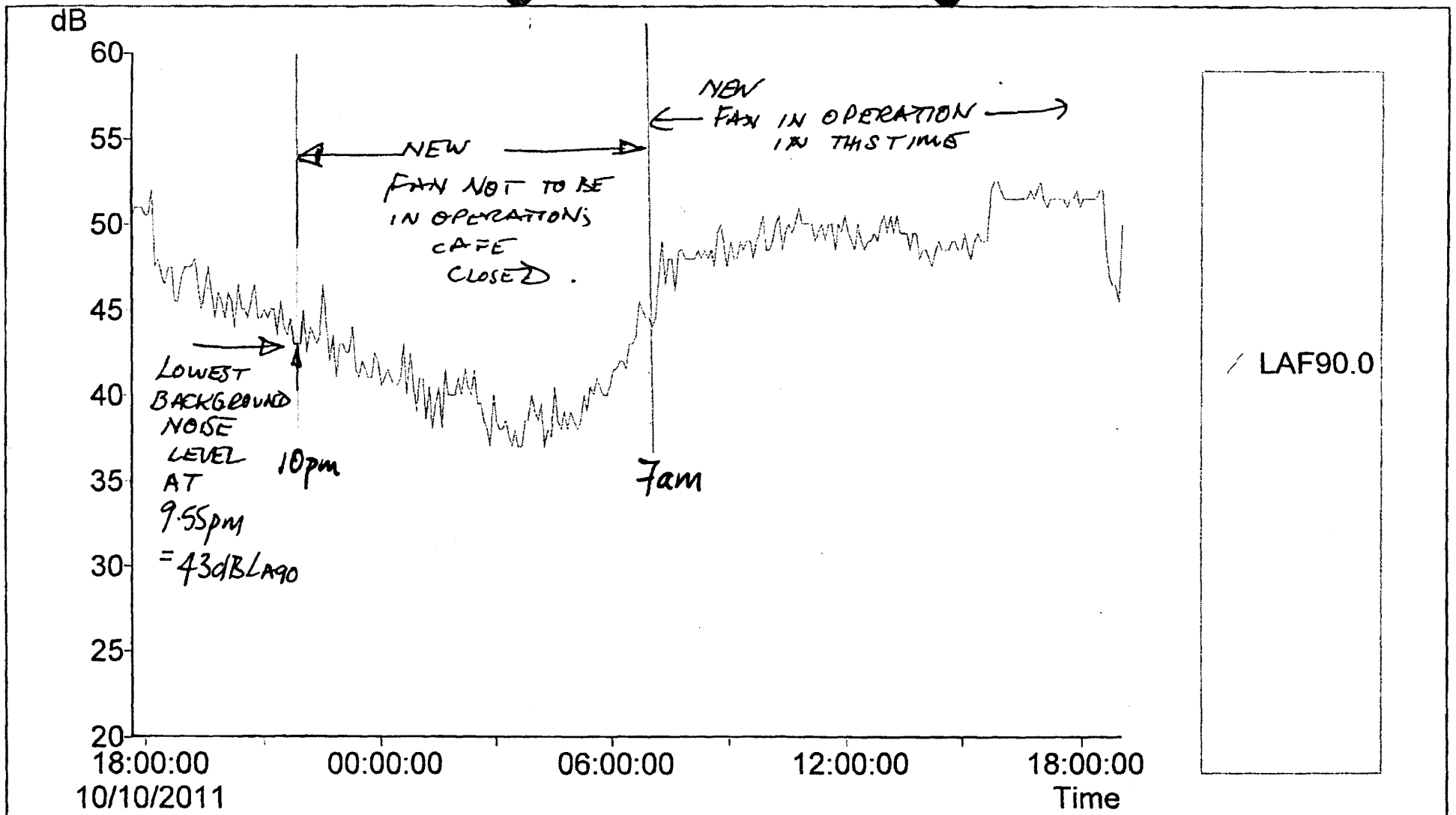


Octave frequency spectrum of background noise at residents, measured near residents' windows above Crystal Cafe, 66 Mansfield rd Hampstead.

10th October 2011,

Sound level = 47 dB $L_{A90,\ 10\ min}$.

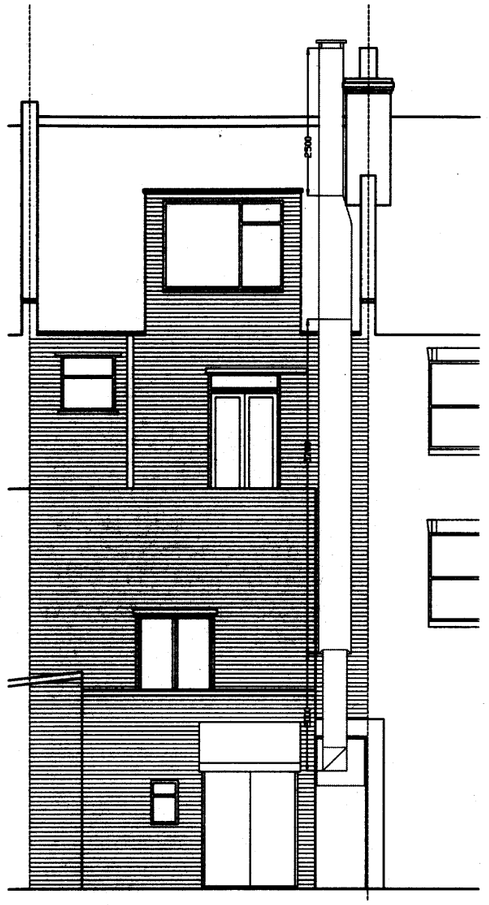
© Shaun Murkett
Acoustic Consultants Ltd.
tel 020 7923 7275



C:\PROGRAM FILES\CASELLA GROUP LTD\DB23\MANSFIELD.DTA
Band = Broadband
Overall profile duration = 25:25:20 (305 samples)

- LAF90.0 -

Sound profile of logged background noise dB LA90 measured outside residents window above Crystal Cafe Mansfield road, Hampstead.
from 5.40 pm 10th October 2011 to 7 pm 11th October .
Lowest Background noise Sound level measured during operating hours:-
43 dBA La90 5 min at 9.55 pm



REAR ELEVATION

FLUE SIZES:

2000mm 400x400mm

4500mm 400x400mm

5700mm 550x250mm

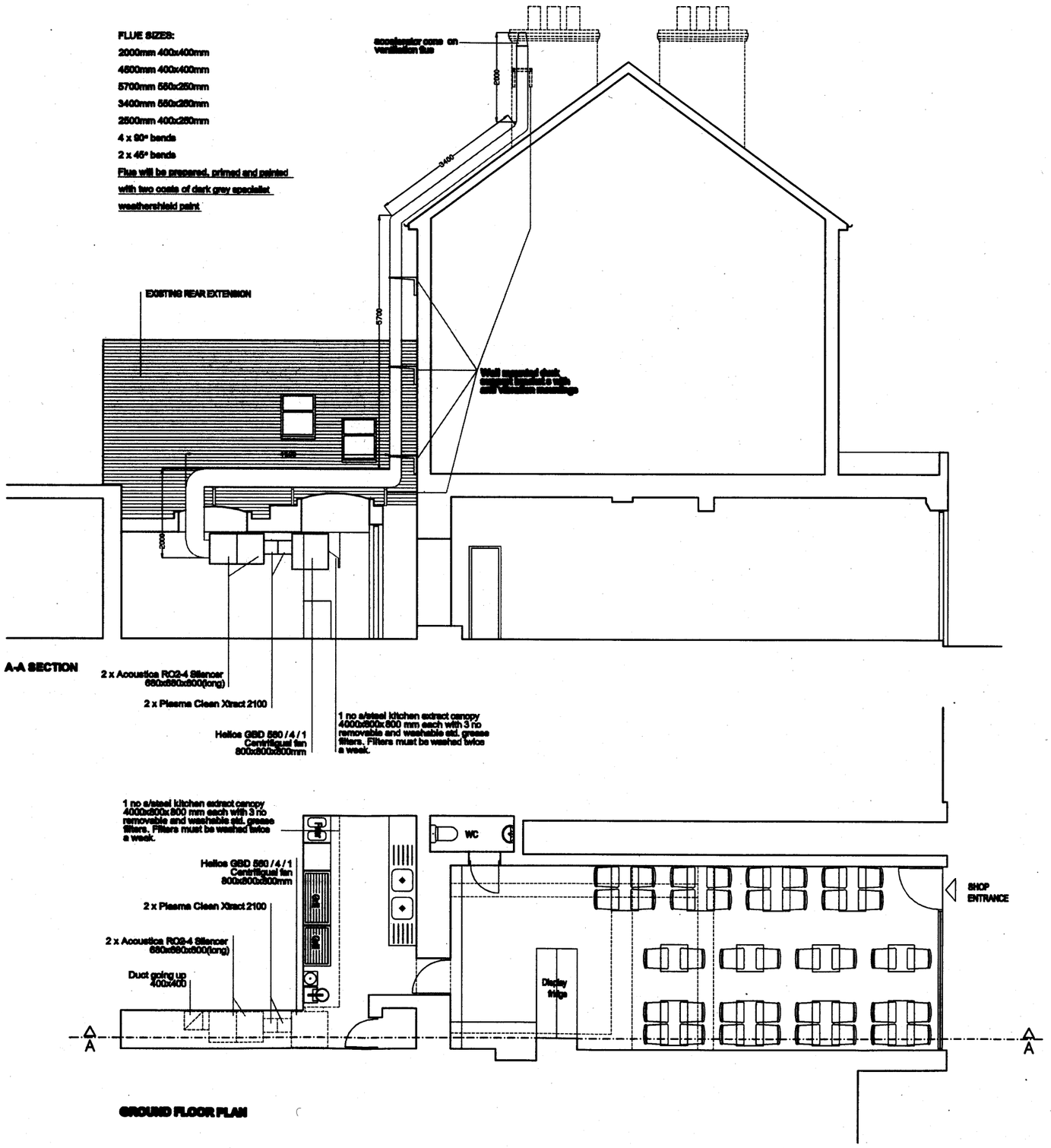
3400mm 550x250mm

2500mm 400x250mm

4 x 90° bends

2 x 45° bends

Flue will be prepared, primed and painted with two coats of dark grey specialist weathershield paint



A-A SECTION

GROUND FLOOR PLAN

AMENDMENTS		
A	Fan details revised.	04/09
B	Scale revised.	08/09
C	Fan details revised.	09/11
D	Fan details revised.	10/11
E	Fan details revised.	10/11
F	Fan details revised.	10/11
G	Fan details revised.	11/11
H	Fan details revised.	11/11

ARCHIPEK

68 GRAND INTERSECTION HIGH STREET

68 MANSFIELD ROAD
NW3 2HU

PROPOSED FLOOR PLAN AND A-A SECTION

1:50@A1	12.08
BM	01

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