

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 overlook 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 2m³ 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 L_{Aeq} occurred at 9.55 pm,

Sound level = 47 dB L_{Aeq} (5 min)

The lowest background noise level dB L_{A90} 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 L_{A90}
Background noise L_{90}	54	49	46	44	38	33	26	47

Table 1 Octave frequency spectrum of background noise L_{90}

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:-

$SPL = SWL - 20 \log r - 8 \text{ dB}$ 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 $A = 20 \log r^1 / r^0 \text{ dB}$

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 $r^1 = 3 \text{ m}$ (for residents below)

$r^0 = 1 \text{ m}$ (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 safety 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