

Acoustic Survey

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Acoustic Survey

Notes to the Report

Author

This report is written by Gavin Cantley, principal of the firm of building services engineers, Stream Environmental. The author has ten years experience in various fields of acoustics, including projects in building acoustics (reverberation design and control, noise transmission control, and studio design); HVAC noise control; Planning Noise issues, measurement, reporting and advice; and electroacoustics.

Employer

This report is commissioned by Relicpride Building Company Ltd., in relation to the two air conditioning units installed adjacent to No 2, Connaught Mews, rear of 21 Pond Street, Hampstead.

Scope of Evidence

The investigation is for the purpose of determining the noise control measures necessary to satisfy the tests of BS4142, and to demonstrate compliance with these recommendations, as requested by the local planning authority, by the relocation of the installed plant in question.

The specific noise produced by the air conditioning equipment is basically composed of two separate sources operating semi-continuously. These are the broadband noise from the condenser fan, and the noise of the refrigeration compressor, which has a mild tonal content.

The units typically would at times operate outside of normal hours, and the noise produced is moderately weather and time dependent, in that the equipment will operate to a much greater extent during warm weather and daylight hours, and the noise levels will be slightly influenced by the refrigeration compressor head pressure, which in turn is affected by the ambient temperature.

For this report, the background noise level was recorded in the garden of No 3, and checked against the levels at the boundary of the site. The air conditioning equipment unit noise was recorded, in several different aspects, adjacent to the condensers, and checked against the levels at the boundary of the site, adjacent to the wall of the garden on the east side.

The background noise is typical of a secluded city area, including a mix of meteorological, vehicle, and domestic noise sources. The proximity of the railway line is also material, as can be seen from the ambient noise trace in the appendix.

These recordings are available in calibrated form as digital audio on 44.1 kHz CDR or 48 kHz DAT cassette for audible assessment or other examination, if required.

Standards

This report, and the measurements detailed therein, are carried out in accordance with the requirements of BS4142, with due regard to the stipulations of Camden Council's 'Noise Standards for Planning Applications', and the dictates of good engineering and measurement practice.

Site Description

As can be seen from the site location map and inspection of the site, the new houses are situated in a low lying parcel of land to the north of Pond Street, between the road and the railway. The railway line carries a mixture of traffic, including light passenger and heavier/longer trains, the most noticeable of which is the warning note sounded on entrance to the tunnel.

Measurement Methodology

The site measurements were made using the equipment specified in the following section.

Calibration is checked and noted, and the instruments set up in location.

Measurement and recording direct to DAT are commenced in parallel. This ensures that both optimum accuracy is obtained, and authenticated digital recordings are available for any subsequent analysis or audio examination.

Subsequent laboratory analysis (e.g. frequency distribution of condenser noise) is completed and printed, with results copied to the report.

The report final draft is checked against the site measurement print out data, and the conclusions verified.

The information contained in this document is warranted to be factually correct, relevant and appropriate, to the best knowledge and belief of the undersigned. The user of this information is deemed to be responsible to ensure that the information is applied in its true context.

Signed

GAVIN CANTLEY

Date

for **STREAM ENVIRONMENTAL**

Measurement Details

Site Location: 2 Connaught Mews, 21 Pond Street, Hampstead

Measurement Date: 14 August - air conditioning unit noise and daytime ambient

Measurement Time: 11:25

Temperature: 24.6° C

Weather Conditions: Bright, sunny, little breeze, few clouds

Measurement Date: 7 August 2001 - night time ambient

Measurement Time: 22:00:05 - 23:45:00

Temperature: 19.6° C

Weather Conditions: Dry, intermittent very light breeze

Report Date: 16 August 2001

Instruments: Brüel & Kjær 2231 sound level meter

Calibration Date

Calibration Certificate Number

Calibration Laboratory number

Brüel & Kjær 4230 calibrator

Calibration date

Calibration certificate number

Calibration laboratory number

Brüel & Kjær 2230 sound level meter

Brüel & Kjær 4230 calibrator

Brüel & Kjær 1625 Octave filter

Brüel & Kjær 2143 Analyser

Brüel & Kjær 2317 Chart Recorder

Sony TCD-D7 portable DAT recorder

Sony DTC-A8 rackmounted DAT machine

SLM Settings:

Weighting:

Bandpass:

Detector:

Incidence:

Calibration:

Microphone KO

Note:

All figures are decibels, relative to 20 µPa

Serial No: 1539721

25 May 2000

08315

0174 (NAMAS)

Serial No: 723957

23 May 2000

08303

0174 (NAMAS)

Serial No: 1258473

Serial No: 1103452

Serial No: 1259114

Serial No: 1562311

Serial No: 1437571

Serial No: 73683

Serial No: 4502271

Linear (to DAT)

'A' for Analysis

20 Hz - 20 kHz

RMS Fast

Random

Acoustic 94.2 dB

Internal 93.8 dB

-0.1 dB

Measurement Results

SPECIFIC NOISE LEVEL:

Measured noise level - above @ 1 metre:	58.8 L_{Aeq}
Residual noise level (night):	38.8 L_{Aeq}

Residual noise level is determined by measurement of ambient noise with the air conditioning equipment switched off. No correction is made for residual noise as the background level is more than 10 dB below the specific noise level (at 1 metre from the air conditioning units). Measured noise level averaged from the positions above and to the sensitive side of the existing location is taken as specific level, less correction for increased distance to the determining location at 1 metre from the sensitive facade, (the listener position). This correction is $-20\log(\text{actual distance/measurement distance})$, in this case 1 metre and 16.07 metres respectively, giving a correction of - 24.1 dB.

Specific noise level $58.8 L_{Aeq} - 24.1 L_{Aeq}$:	34.7 L_{Aeq}
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The air conditioning equipment was therefore measured and a correction made according to the ratio of the difference between the distance to the measurement position, and the distance to the listener position. It is considered that averaging the levels measured above and to the north side of the units is representative of the levels emitted in the direction of the adjacent residences.

MEASUREMENT TIME INTERVALS:

Ambient noise in garden of No 3:	105 minutes
Specific noise at air conditioning equipment:	2 minutes
Reference time interval:	5 minutes

RATING LEVEL:

Specific noise level:	34.7 L_{Aeq}
Correction for tonal characteristics of noise:	+ 5.0 dB
Rating level:	39.7 L_{Aeq}

BACKGROUND NOISE LEVEL:

Measurement time interval:	105 minutes
Background noise in garden of house:	33.5 $L_{A(90)}$

EXCESS OF RATING LEVEL OVER BACKGROUND NOISE LEVEL:

Excess (39.7 - 33.5)	6.2 dB
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THE ASSESSMENT INDICATES THAT THE INCREASE IN LEVEL IS OF MARGINAL SIGNIFICANCE

AMBIENT NOISE AT REAR OF 21 POND STREET (Graphical)

Recorder: Brüel & Kjær 2317
Frequency Weighting: 'A'
Chart Speed: 0.03 mm/sec
Pen Speed: Reduced
Scale: 20 - 70 dB 'A'
Time Weighting: RMS 'Slow'

Brüel & Kjær

QP 0102

NOISE LEVELS & CUMULATIVE DISTRIBUTION - Ambient

B&K Modular SLM Type 2231

Cumulative Level Distribution

Module No.	BZ7115	dB level	% time
Mic correction:	0.0 dB		
Incidence correction:	'Frontal'	Overload	0.00%
Preset Time:	01:45:00	Over range	0.00%
Time Weighting:	'Fast'	80.0	0.00%
Frequency Weighting:	'A'	77.5	0.00%
Range:	10.0 - 83.0 dB	75.0	0.00%
Time:	22:00 - 23:45	72.5	0.00%
		70.0	0.00%
		67.5	0.01%
		65.0	0.03%
		62.5	0.07%
		60.0	0.12%
		57.5	0.15%
		55.0	0.17%
		52.5	0.20%
		50.0	0.23%
		47.5	0.35%
		45.0	0.67%
		42.5	1.56%
		40.0	3.24%
		37.5	7.04%
		35.0	32.43%
		32.5	99.69%
		30.0	100.00%
		27.5	100.00%
		25.0	100.00%
		Under range	100.00%

MEASUREMENTS:

MAXP:	78.9
MAXL:	68.4
L (01.1):	49.5
L (10.0):	37.0
L (50.0):	34.5
L (90.0):	33.5
L (99.0):	32.5
MINL:	31.5
LEQ:	38.8
SEL:	76.6

Overload No

Elapsed Time: 30 minutes

No. of Interrupts: none

NOISE LEVELS & FREQUENCY DISTRIBUTION - Air Conditioning

B&K Analyser Type 2143

MEASUREMENTS:

Frequency	Centre (0.3 m)	South (1 m)	North (1 m)	Above (1 m)
32 Hz	63.0	64.0	68.4	55.3
63 Hz	67.0	65.9	64.9	58.9
125 Hz	64.8	63.9	60.6	57.4
250 Hz	64.3	56.9	55.1	56.0
500 Hz	61.3	59.6	54.3	55.9
1 kHz	57.7	54.4	49.0	50.5
2 kHz	53.3	52.0	47.0	47.8
4 kHz	50.5	48.0	44.2	44.7
8 kHz	41.7	41.2	36.0	35.6
16 kHz	31.4	30.6	26.4	23.4
'A'	63.3	60.6	55.9	56.9
Linear	72.2	70.7	70.9	65.1

FREQUENCY DISTRIBUTION - Air Conditioning (projected to adjacent properties)

B&K Analyser Type 2143

MEASUREMENTS:**CALCULATED at new location:**

Frequency	Ambient	A/C	Barrier	Distance	Boundary	Margin
32Hz	48.8	59.7	6.5	-21.5	31.7	-17.1
63Hz	46.4	62.4	7.7	-21.5	33.2	-13.2
125Hz	43.3	60.7	8.4	-21.5	30.8	-12.5
250Hz	40.0	56.5	11.9	-21.5	23.1	-16.9
500Hz	36.8	57.8	14.6	-21.5	21.7	-15.1
1kHz	33.6	52.5	17.4	-21.5	13.6	-20.0
2kHz	29.7	49.9	19.9	-21.5	8.5	-21.2
4kHz	22.8	46.4	22.9	-21.5	2.0	-20.8
8kHz	16.0	38.4	26.0	-21.5	-9.1	-25.1
16kHz	13.2	27.0	29.1	-21.5	-23.6	-36.8
'A'	39.1	58.8		-21.5	22.2	-16.9
Linear	54.1	67.9		-21.5	37.1	-17.0

From the above figures, it can be seen that the air conditioning units noise level, as reduced by the proposed relocation of the units, will be more than 10 dB'A' below the night time L_{A90} level, and therefore complies with Condition 1a (old CG08).

In each octave band, the noise levels for the air conditioning units, as reduced by the proposed relocation of the units, will be below the night time L_{Aeq} background level by a minimum of 12.5 dB, and therefore complies with Condition 1b (old CG09).

BASIS of CALCULATION

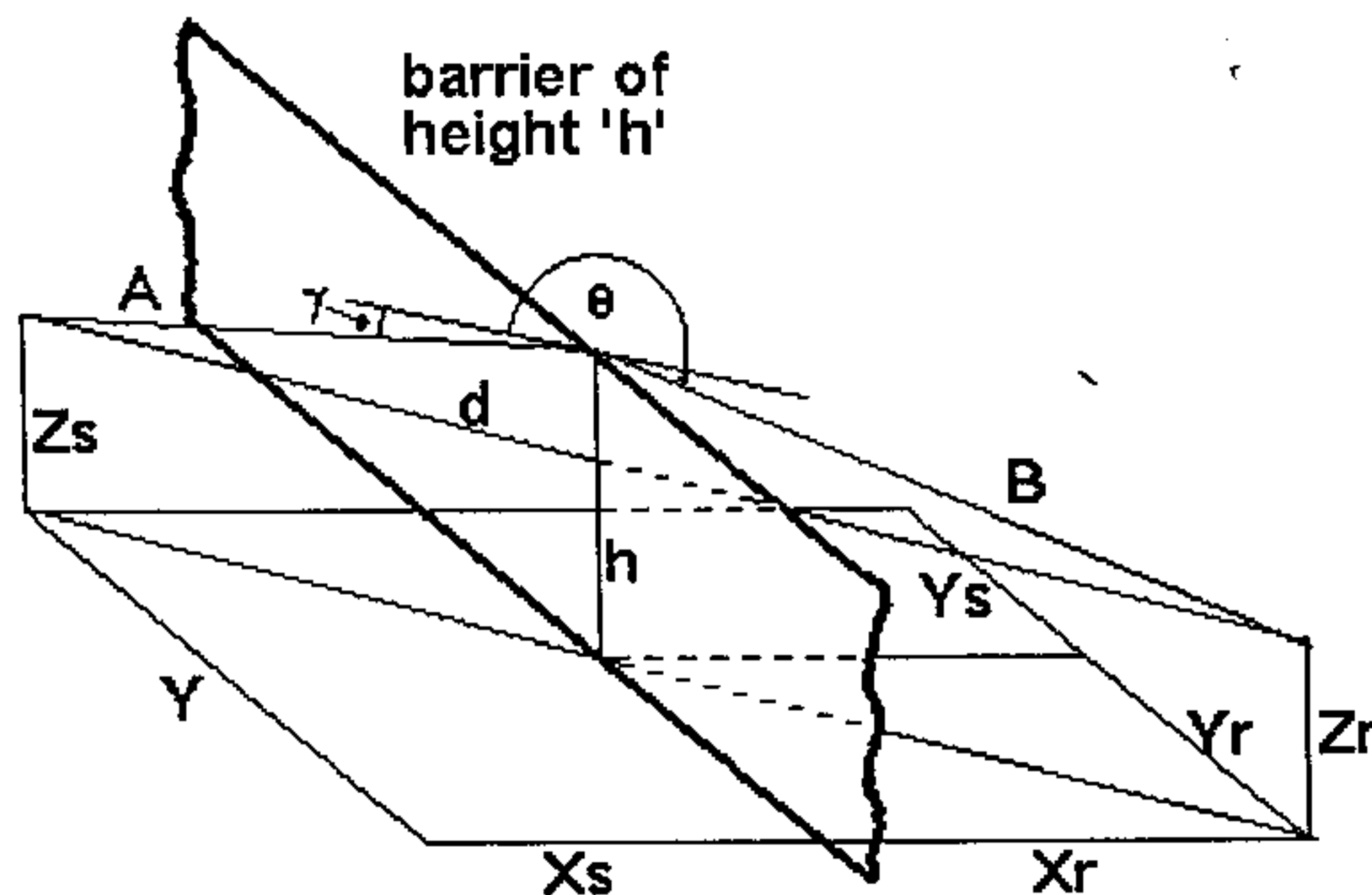
The effective attenuation provided by the existing wall, acting as a barrier, is calculated according to the model developed by Bies & Hansen (1997). Essentially, the dimensions A and B are introduced as two segments of the shortest path over the barrier from the source to the receiver. These line segments lie in the plane which crosses the barrier plane at a normal to the diffracting edge of the barrier. These path lengths are calculated as follows:

$$d = [(X_R + X_S)^2 + (1 + X_S/X_R)^2 + (Z_R - Z_S)^2]^{1/2}$$

$$A = [X_S^2 + (X_S/X_R)^2 Y_R^2 + (h - Z_S)^2]^{1/2}$$

$$B = [X_R^2 + Y_R^2 + (h - Z_R)^2]^{1/2}$$

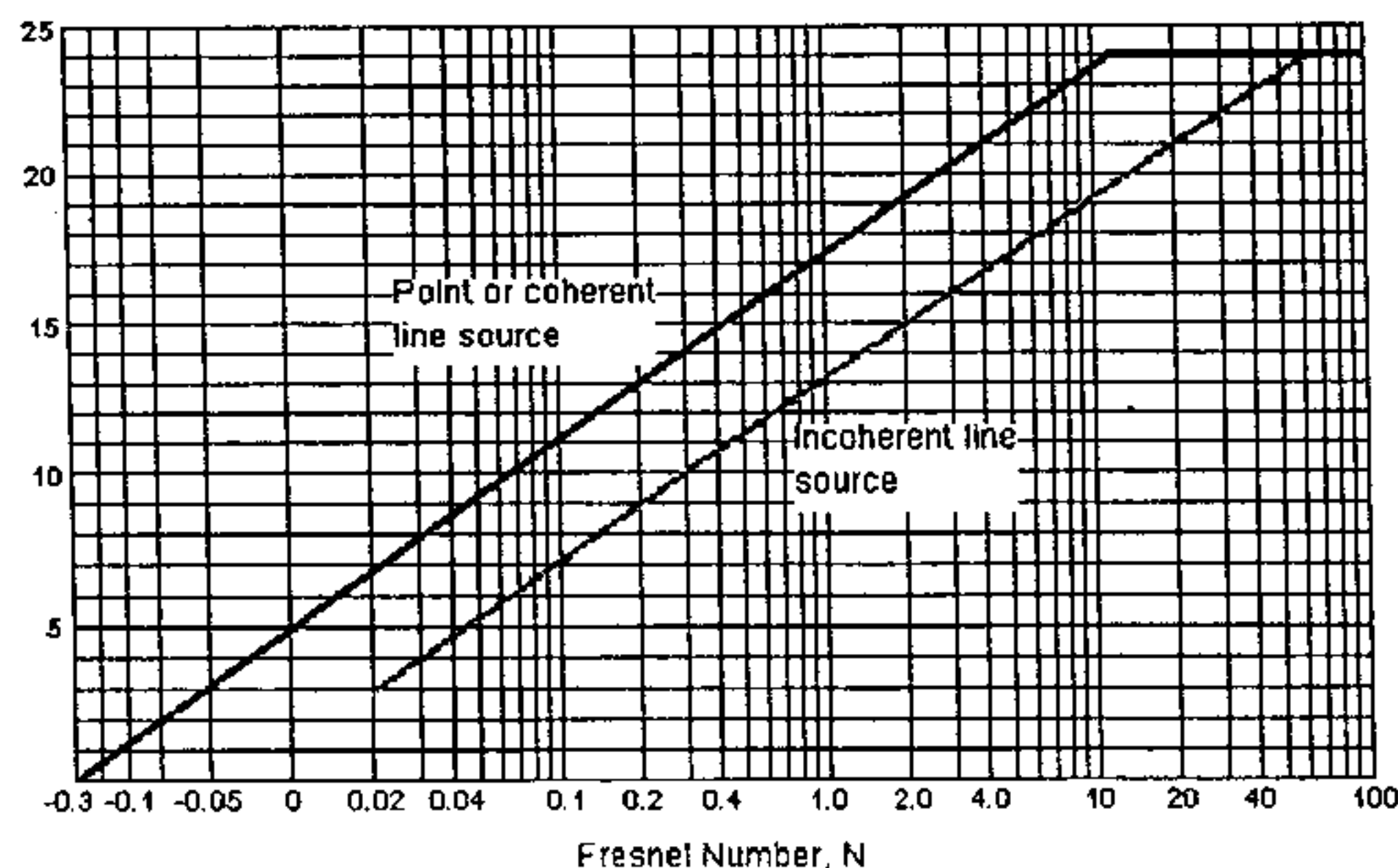
$$Y_R = YX_R/(X_R + X_S)$$



In terms of path lengths, the Fresnel number is calculated thus:

$$N = \pm(2/\text{wavelength}) * (A + B - d)$$

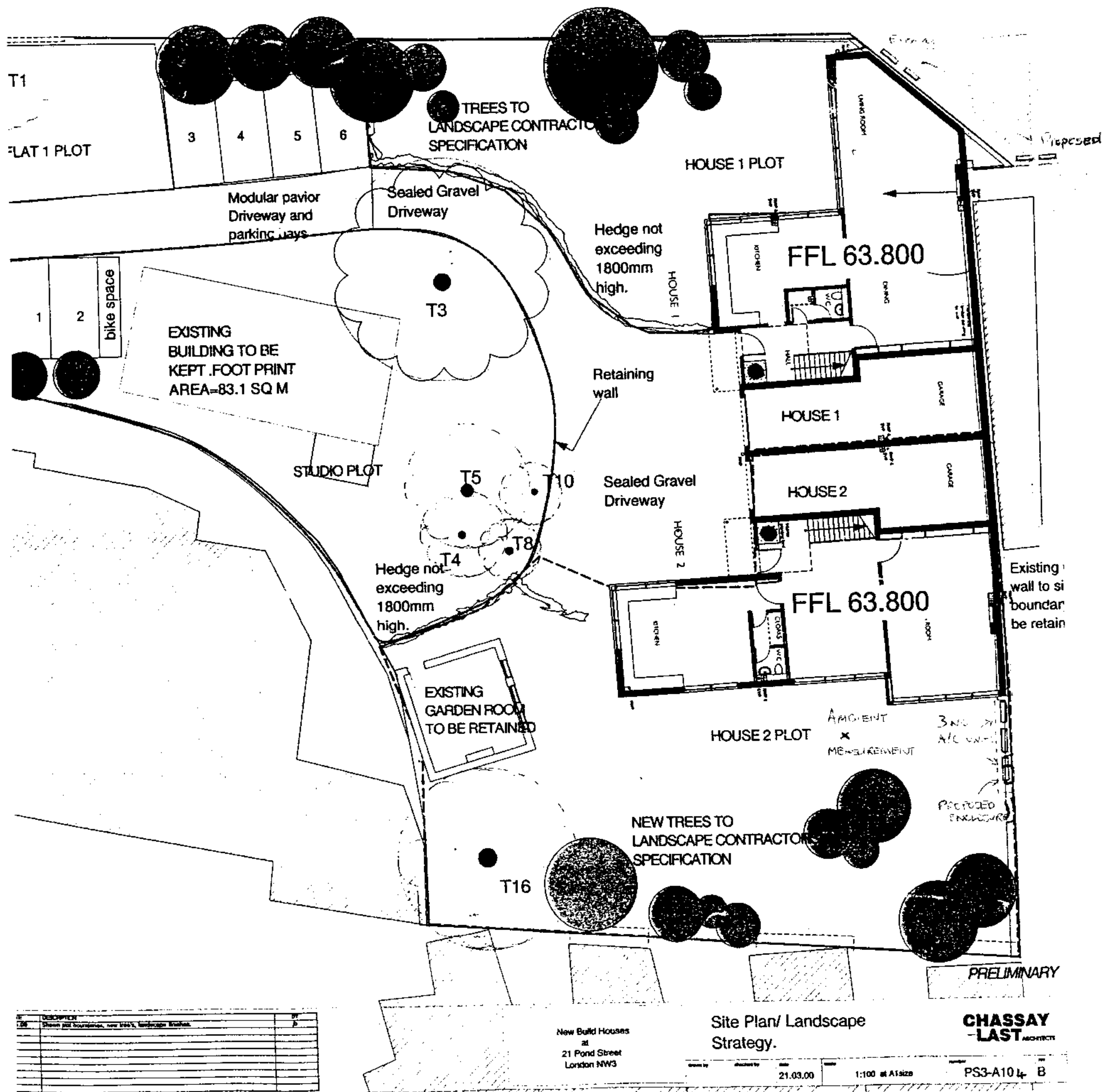
An attenuation factor associated with diffraction at the edge of the barrier, is plotted as a function of the Fresnel number (after Maekewa 1968, 1977, 1985)



The total attenuation of the barrier is given by the following equation (Beranek 1971):

$$A_b = \text{factor}_b + 20 \log_{10} [(A + B)/d] + \text{directivity factors.}$$

SITE PLAN - REAR OF 21 POND STREET



Recommendations (Additional)

Proposal A

1] Relocation of Units - A

As the assessment is marginal, and the octave band levels would not comply with the Council's requirements as existing, it is recommended that the air conditioning condenser units should be relocated in order to minimise the impact upon the residents of adjacent properties.

The units shall both be moved to the base of the wall which runs south from the back corner of the property, i.e. further along the blind passageway in which they are located at present, as shown on the site plan appended.

The units shall be located within 200 mm of the face of the existing wall, mounted at ground level, with the existing step removed, in order to validate the calculated projections.

Proposal B

1] Barrier - B

As an alternative to the above, a barrier wall and roof may be constructed adjacent to the air conditioning equipment. In this case the air conditioning condenser units should be enclosed within a small open ended enclosure, forming a barrier above and behind the equipment. The wall shall be constructed of brick or dense concrete block and face render, with 300 mm clearance to the larger rear unit to allow for maintenance.

The roof construction shall include a mass layer to achieve a density of at least 105 kg/m², using sand filled panels or lead sheet layer, and shall be securely affixed to the adjacent structural walls.

The enclosure shall be 2.4 metres high internally and shall allow 300 mm clearance to the side of the air conditioning units. The access opening shall be the width of the passageway.

The enclosure roof shall extend at least to cover the air conditioning units, as viewed from above, in which case it is evident that the calculated predictions will be validated, with additional reduction of levels due to the increased distance.

2] Ventilation

In order to provide proper cooling and ventilation for the air conditioning condensers, it will be necessary to ensure that there is a free space of 400 mm minimum to the front of the units, and no restriction within 800 mm above the units.