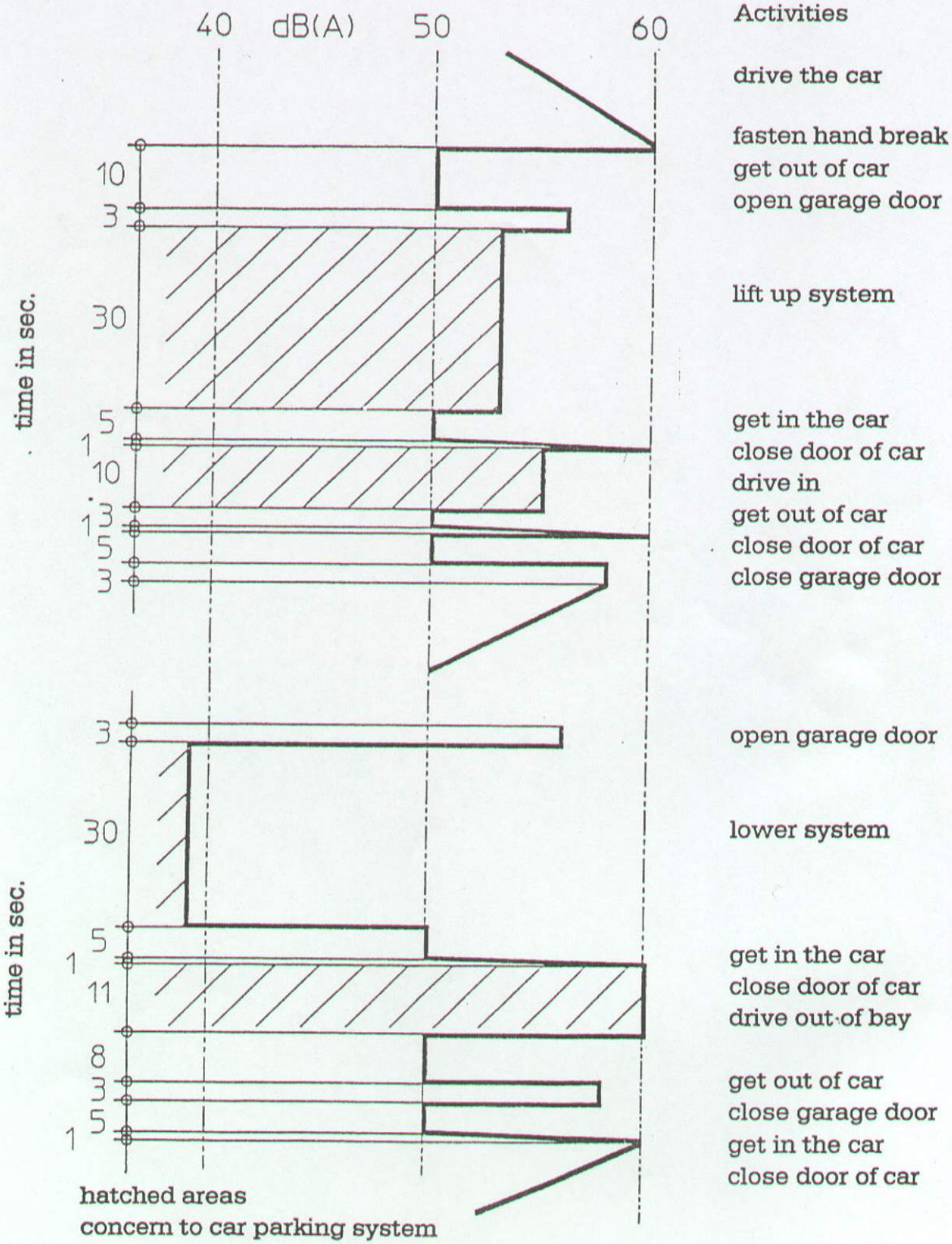
Emmission of air-borne sound

of hydraulic driven Wöhr Car Parking Systems



The sound-measurements were taken from the technical authority TÜV Südwest at 24th April 1990. The distance between garage door and measurement point was 12 m.

WÖHR

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Bickerdike Allen Partners

MEMORANDUM

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Date: 23/02/05

Project:	12 - 22 Finchley Rd		
Subject:	**Wöhr Parklift Noise**		
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Job No:	A6487	File reference:	A6487/M03-AH

Introduction

As part of a proposed, future residential development at 12 to 22 Finchley Road it is intended to use a Wöhr Parklift in an underground, basement car park.

The manufacturer has provided data on the noise produced by a Wöhr Parklift (see Appendix A), the opportunity has been taken to determine indicative design sound levels by measuring a similar Parklift during operation.

This memorandum provides both a description of the work carried out to measure the sound level of the existing Parklift and a summary of the sound level results.

Site and Parklift Description

The Parklift is installed in Eagle Wharf, a residential development at 138-140 Grosvenor Road, London SW1V.

This development uses both the single and the double unit Wöhr Parklift 440-200/195 installed in the lower ground level car park of the building.

Each Parklift is rated to a load of 2000 kg per vehicle and consist of a pair of steel platforms mounted one above the other by means of a steel frame. Each Parklift is mounted in a pit into which the lower platform descends when access to the top platform is required. When access to the lower platform is required a hydraulic system elevates both platforms such that the lower platform is raised to floor

level. The pump and motor are attached to each Parklift frame at floor level independent of the platforms and do not move.

A brochure illustrating the Wöhr Parklift 440 is attached at the end of this memorandum and photographs showing the Parklift system as installed in Eagle Wharf are shown in Figures 1 to 4.

The lower ground parking level is below street level and is accessed directly from Grosvenor Road via a ramp and a swinging pair of steel gates. The walls of the lower ground level is heavy block masonry. Views of the car park are shown in Figures 5 to 6.

The car park has an extractor system for ventilation which was in operation for the duration of the survey.

Measurements

Anthony Hayes of Bickerdike Allen Partners carried out noise measurements on the morning of Thursday 3rd February 2005 in the lower ground levels of Eagle Wharf.

The instrumentation used the Brüel and Kjær Type 2260 Investigator fitted with a Brüel and Kjær Type 4189 microphone. The Type 2260 Investigator was calibrated prior to and after the measurements with a Brüel and Kjær Type 4231 calibrator.

The Type 2260 Investigator was mounted on a tripod with the microphone approximately 1.2 m above the ground and centred 1 m from the lip of the pit. These positions placed the microphone approximately 5 m and 4 m from the motor and pump of the double and single units respectively.

Details of each Parklift measured at Eagle Wharf are given in Table 1.

Parklift	Description
Double Unit, Loaded (Spaces 9 to 12)	Motorbike and car on top platform, two cars on bottom platform. Unit approximately located half way between entrance and far wall of car park. Background noise consists of traffic noise from Grosvenor Road and extractor system.
Double Unit, Unloaded (Spaces 13 to 16)	Unit approximately located half way between entrance and far wall of car park. Background noise consists of traffic noise from Grosvenor Road and extractor system.
Single Unit, Loaded (Spaces 35 to 36)	Car on bottom platform only. Unit approximately located at far wall of car park. Background noise consists mainly of extractor system noise.
Single Unit, Unloaded (Spaces 37 to 38)	Unit approximately located at far wall of car park. Background noise consists mainly of extractor system noise.

Table 1 Parklift Measurement Details

Measurements were taken during both platform ascent and decent. Duration for ascent and descent were as follows:

Detailed measurement results for each position are given in Appendix B. The maximum equivalent continuous A-weighted sound pressure level and associated duration during operation for each position are given in Table 2.

Parklift	Direction	L_{eq}, dB(A)	Approximate Duration (s)
Double Unit, Loaded	Descent	60	45
	Ascent	60	70
Double Unit, Unloaded	Descent	64	60
	Ascent	59	70
Single Unit, Loaded	Descent	63	50
	Ascent	63	40
Single Unit, Unloaded	Descent	62	50
	Ascent	64	40

Table 2 **Measurement Results**

From the plots in Appendix B it can be seen that in general the Parklift is not much noisier than the background levels. The peak noise events during operation were caused by elements of the Parklift scrapping against each other during ascent or descent.

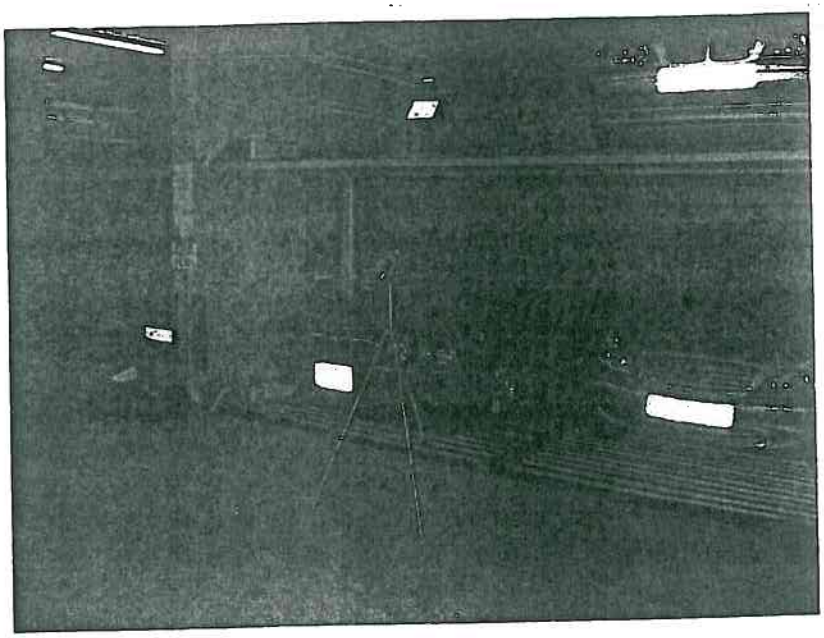

Figure 1 **Double Unit, Loaded**

Appendix A Comparison between Manufacturer's Data and Measured Data

A data sheet showing airborne sound levels from a car stacking system have been provided by Wöhr (see Appendix C). This shows that, 12 m from the system, the maximum $L_{eq,\ 30secs}$ is 53 dB(A) for an ascent operation. This is equal to a $L_{eq,\ 15min}$ of 37 dB(A), 20 m from the stacker (see BAP memorandum A6487/M02-AH, 24th January 2004).

A comparison can be made between supplied data and measured data by taking the highest measured L_{eq} from Table 2 and converting it to a $L_{eq,\ 15min}$ 20 m from the stacker. This gives a measured $L_{eq,\ 15min}$ of 41 dB (A).

The measured data gives a higher L_{eq} than the supplied. This is likely to be due to the presence of peak noise events during measurement caused by elements of the Parklift scrapping against each other during ascent or descent.

Appendix B Measurement Results

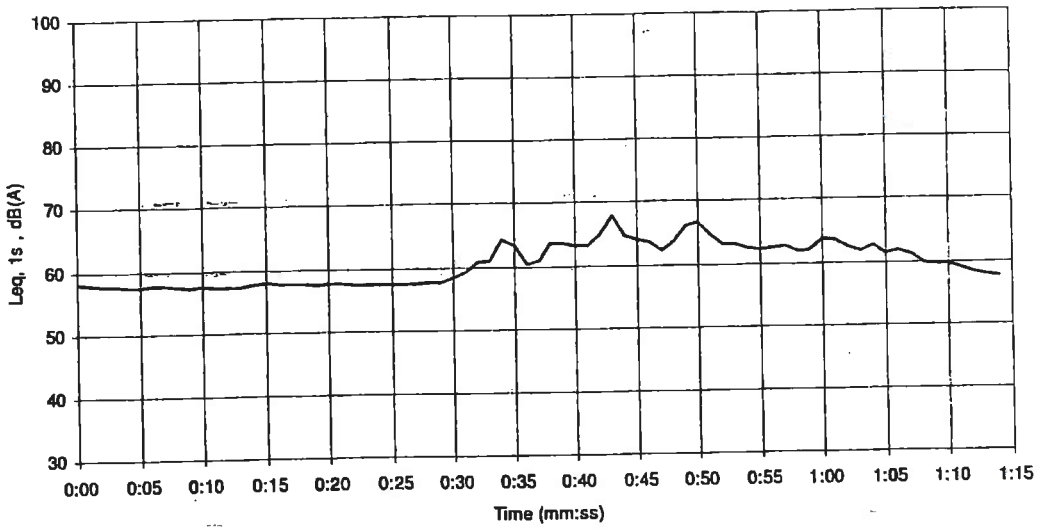

Figure 5 **Parklift: Double Unit, Loaded**
Platform Movement: N/A (Background)

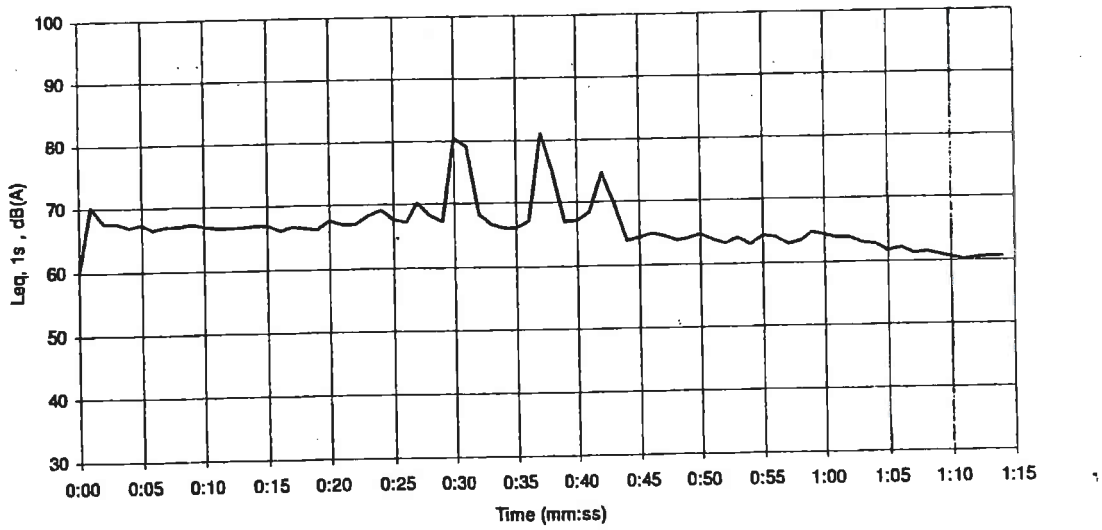

Figure 6 **Parklift: Double Unit, Loaded**
Platform Movement: Descent

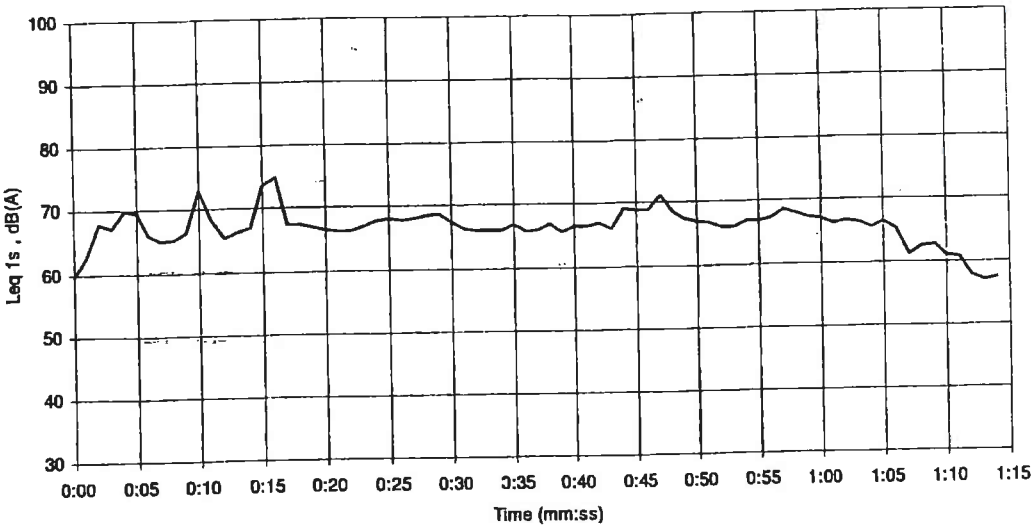

Figure 7 **Parklift: Double Unit, Loaded**
Platform Movement: Ascent

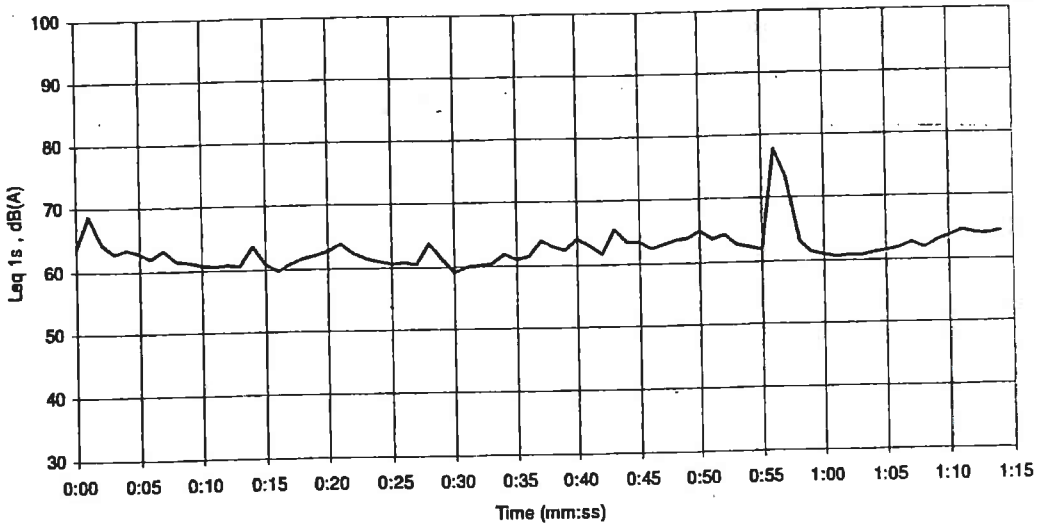

Figure 8 **Parklift: Double Unit, Unloaded**
Platform Movement: Descent

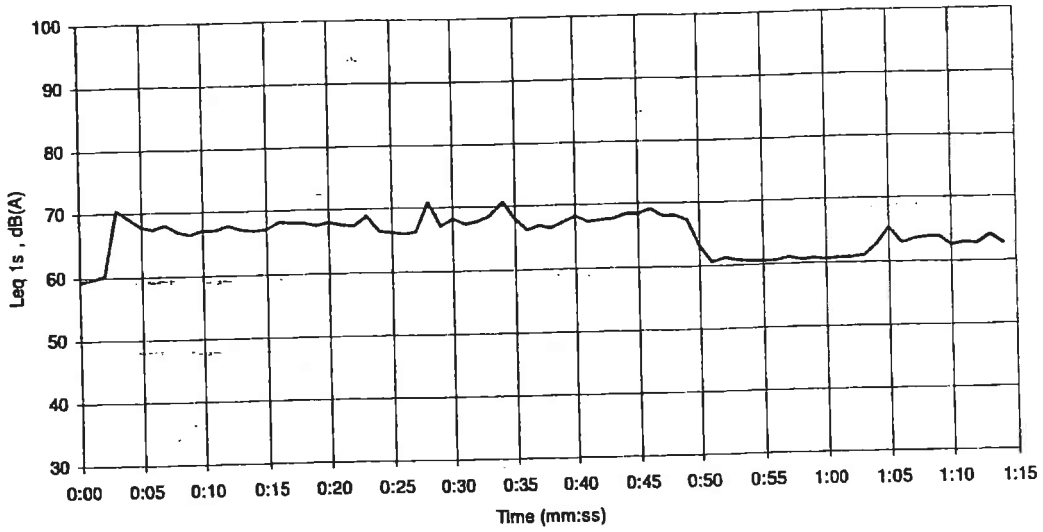

Figure 9 **Parklift: Double Unit, Unloaded**
Platform Movement: Ascent

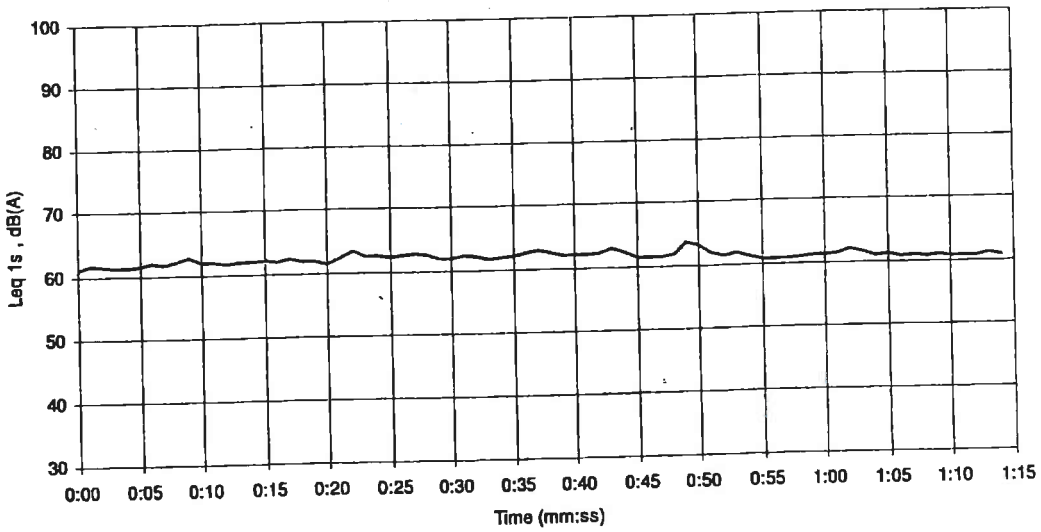

Figure 10 **Parklift: Single Unit, Loaded**
Platform Movement: N/A (Background)

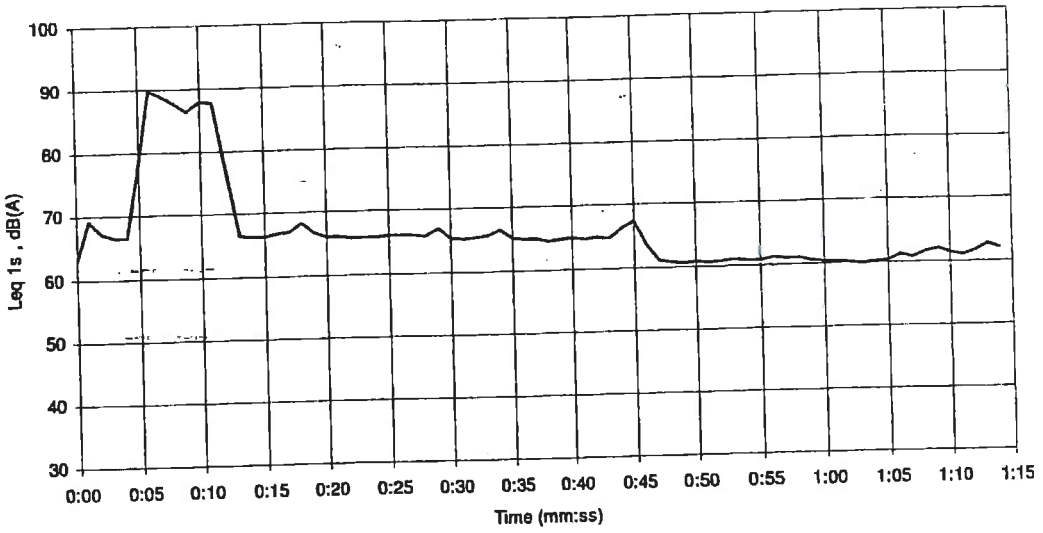

Figure 11 **Parklift: Single Unit, Loaded**
Platform Movement: Descent

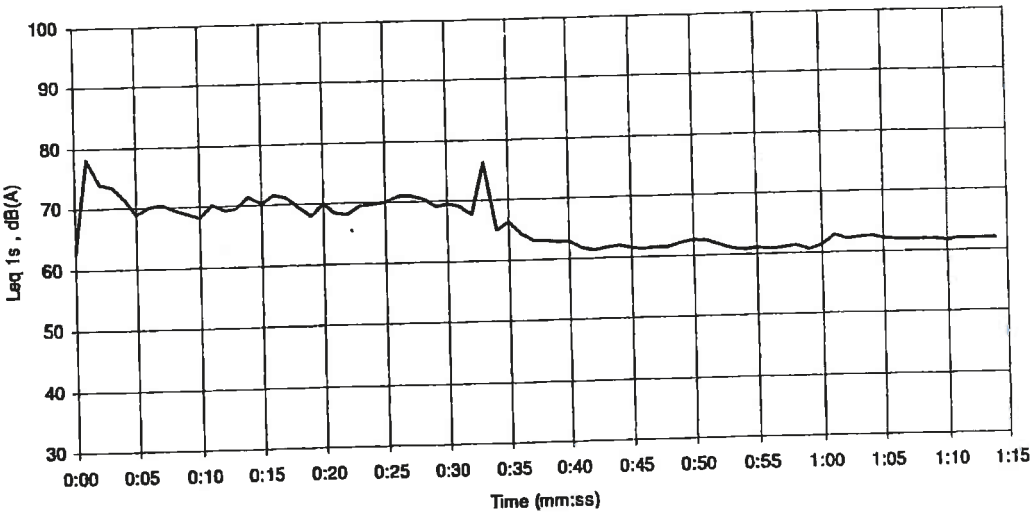

Figure 12 **Parklift: Single Unit, Loaded**
Platform Movement: Ascent

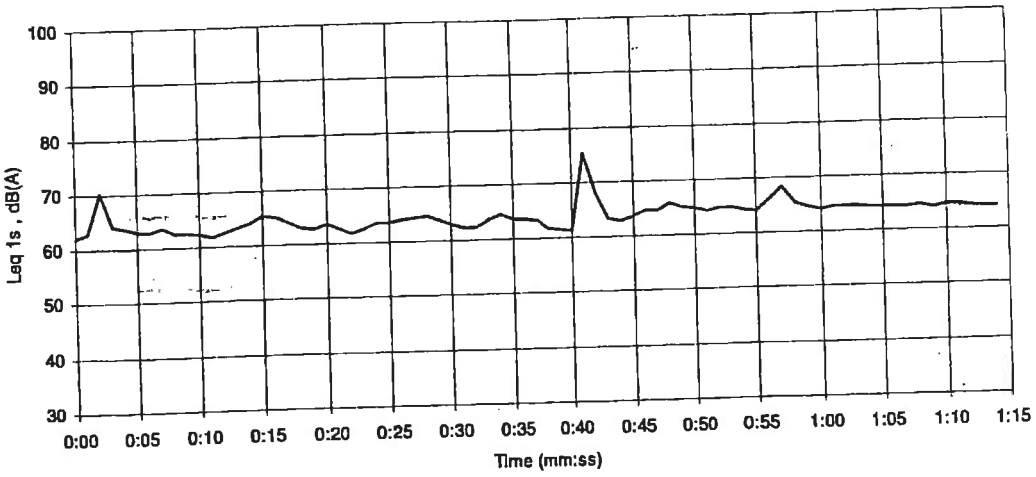

Figure 13 **Parklift: Single Unit, Unloaded**
Platform Movement: Descent

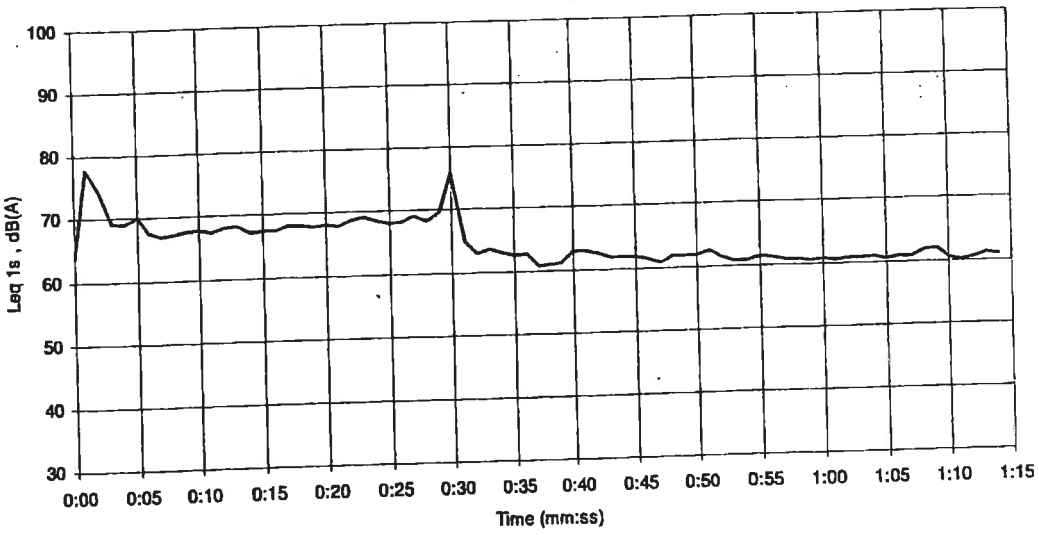

Figure 14 **Parklift: Single Unit, Unloaded**
Platform Movement: Ascent

Bickerdike Allen Partners

MEMORANDUM

121 Salusbury Road
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Date: 14/07/2010

Project: 85 Addison Road, W14

Subject: Parklift vibration measurements

From: Anthony Hayes

To: Gregory Neil, ABA International

Copy: Alain Bouvier, ABA International

Job No: A9208 File reference: A9209/M008

Introduction

As part of the acoustic consultancy services for 85 Addison Road W14, Bickerdike Allen Partners (BAP) are carrying out an acoustic review of the Parklift proposed for the garage.

This memorandum consists of an assessment of vibration measurements taken of a Parklift similar to that proposed for Addison Road to determine the likelihood of structure-borne sound transmission from the unit to the neighbouring property.

This memorandum should be read in conjunction with BAP memorandum M002[1] which consisted of a review of the proposed Parklift and included recommendations for control of airborne and structure-borne noise transmission to the neighbouring property. These recommendations were based on the assumption that the Parklift would be used for regular parking at any time of the day or night.

Proposed Parklift arrangement and structure-borne noise

Proposed arrangement

It is currently proposed that a Wöhr 461 electro-hydraulic vehicle Parklift is installed in an excavated basement pit in the garage building to the side of the main house.

The Wöhr 461 Parklift is a self-contained unit designed to support two vehicles and is fitted between two vertical pillars which are securely fastened to the pit floor. The Parklift is powered by a hydraulic power pack including a pump and electric motors fitted in the maintenance shaft area of the pit.

The garage adjoins the garage of the neighbouring property and is separated from it by the existing 225 mm brick wall at ground floor level and a new solid concrete wall (approx. 300 mm thick) at basement level.

1. BAP Memorandum A9208/M002 “Parklift noise” 16/02/2010.

There is a room adjacent to the Parklift pit in the neighbouring property below ground level that may possibly be used as a living space.

The Parklift is not intended for everyday use. It will be used for secure storage of vehicles when the owners are abroad.

The Parklift and structure-borne noise

As the Parklift is rigidly fixed to the base of the pit in the garage, which is rigidly connected to the party wall, vibration from the operation of the Parklift may be transmitted directly through to the neighbouring property and re-radiated as noise.

To ensure that this structure-borne noise will not be a source of disturbance to the occupant of the basement in the neighbouring property, BAP recommended that the Parklift is mounted on a 'floating' concrete slab or structural cage on elastomeric vibration isolation bearings (max. resonant frequency 10 Hz) resting on the concrete ground slab forming the base of the pit. It was also recommended that the associated lift/motor pump plant should be located on the same isolated structure as the Parklift[1].

Wöhr considered that this arrangement was impractical and would impose unacceptable loadings on the Parklift. Their suggested method of structural isolation, a resilient mat underneath the unit, did not provide complete isolation as bolts are still required to anchor the unit to the floor. An alternative arrangement suggested by Wöhr that utilised the 'floating' concrete slab required fixing of the Parklift via bolts to the wall of the pit. Complete isolation of the unit would also not be provided by this arrangement.

Wöhr do not have data on the expected level of structure-borne noise from the Parklift. To provide information to determine whether there is a possibility that vibration from the Parklift may disturb the neighbours, it was agreed with ABA International that BAP would take measurements of an actual Parklift 461 unit installed in an arrangement similar to that planned for Addison Road.

Parklift vibration measurements

Access could not be arranged by Wöhr to take measurements of an actual Parklift 461 installed in an arrangement similar to that planned for Addison Road. Therefore measurements were taken of a Parklift 440 unit in the underground car park of 55-57 Holmes Road, London, NW5 on 8/07/2010. The results of these measurements would give some indication of what might be experienced by an occupant of the basement of the neighbouring property to the Addison Road when the Parklift is in operation.

There were a number of 440 single and double units at Holmes Road. A single unit, separated from adjacent spaces on both sides by concrete walls was selected as it was considered to be the most similar with respect to the proposed configuration at Addison Road. Measurements could be taken on walls outside of the Parklift bay which would give the closest indication of the vibration levels that would be expected in a neighbouring room to the Parklift.

The measurements taken at Holmes Road are considered to represent a reasonable alternative to measurements of a 461 unit and give an indication of conditions likely to arise at Addison Road.

Figure 1 shows the Parklift chosen for measurement. To the right of the bay is another single 440 unit. The bottom of the access ramp to the car park is to the left of the bay. The pump for the 440 is shown at high level on the rear wall.

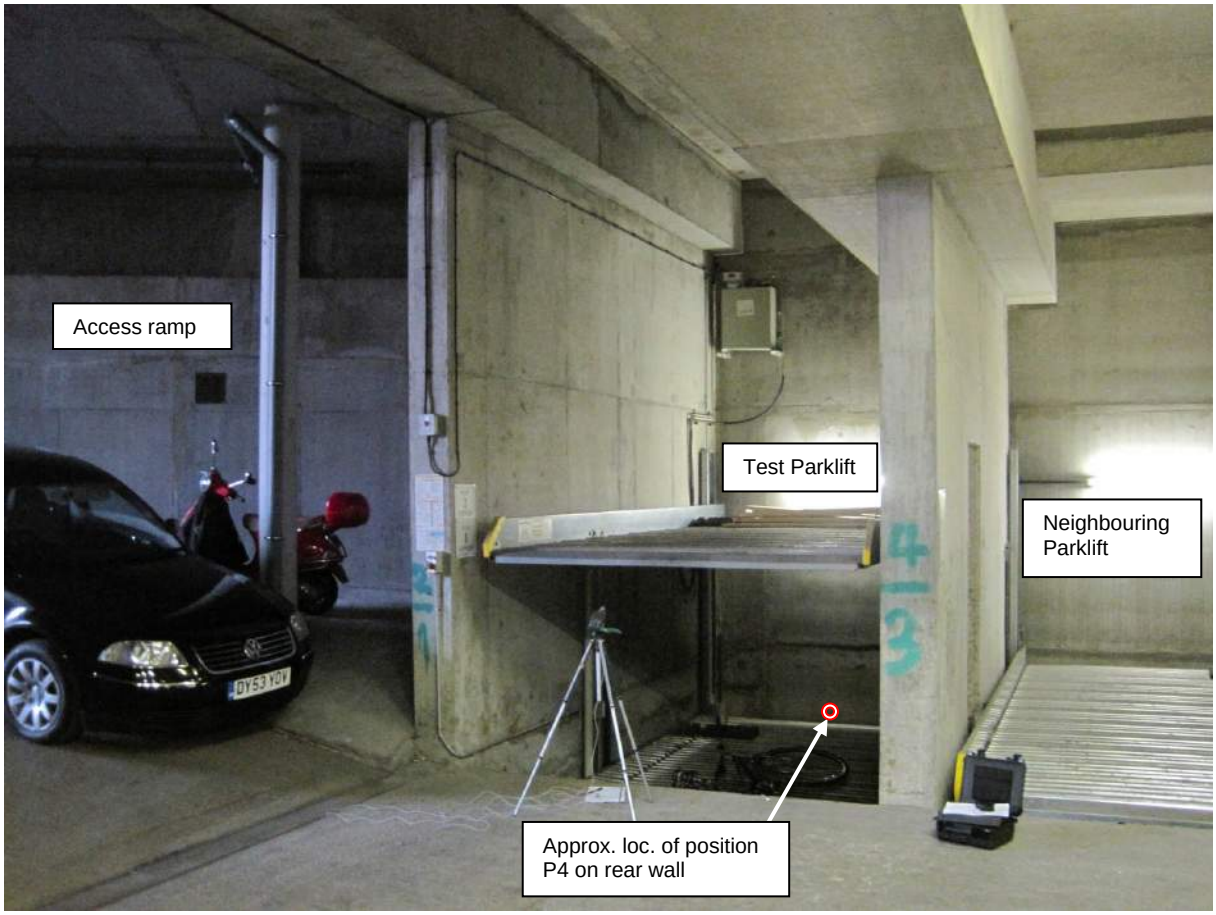

Figure 1 – Parklift 440 at 55-57 Holmes Road NW5 used for measurements

Measurements were taken using a Norsonic Type 140 sound level meter with a Brüel & Kjaer 4381 accelerometer and calibrated using a Brüel & Kjær Type 4294 calibrator. Calibration was carried out before and after the measurements and no significant drift was observed.

Measurements were taken in a number of different positions both inside and outside the Parklift bay. The measurement positions that were considered to be the most representative with respect to Addison Road were one on the rear wall of the lower bay (P4) and two on the wall separating the Parklift from the access ramp (P7 and P8). Position P4 is shown in Figure 1. Positions P7 and P8 are shown in Figure 2.

Measurements were taken with the Parklift ascending and descending. An ascent or descent takes around 40 seconds. A measurement resolution of 1 second was used so that those parts of the ascent or decent process that resulted in the highest levels of vibration could be identified.

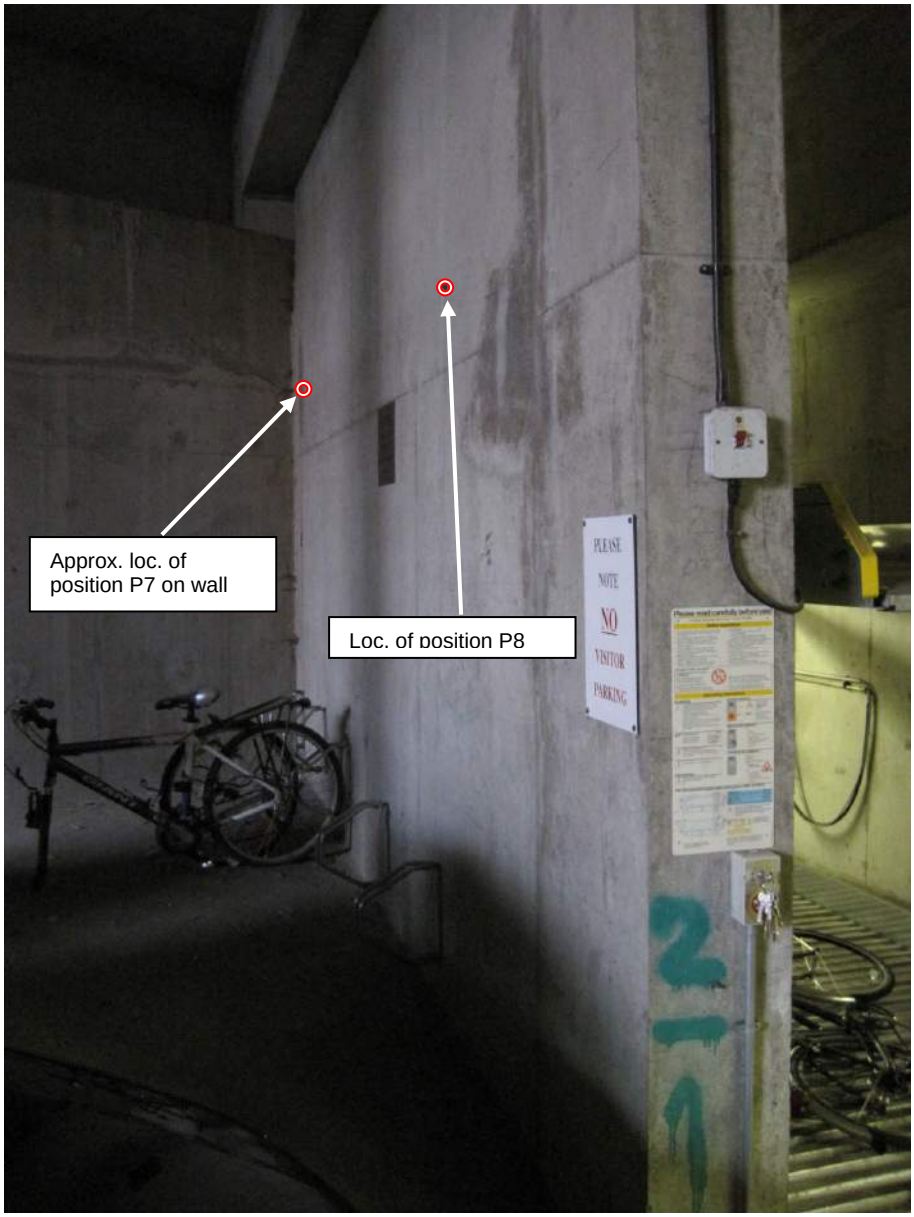

Figure 2 – Photograph showing measurement positions P7 and P8

Graphs showing the variation in measured vibration levels during a typical ascent and a typical descent are shown in Figures 3 and 4 respectively.

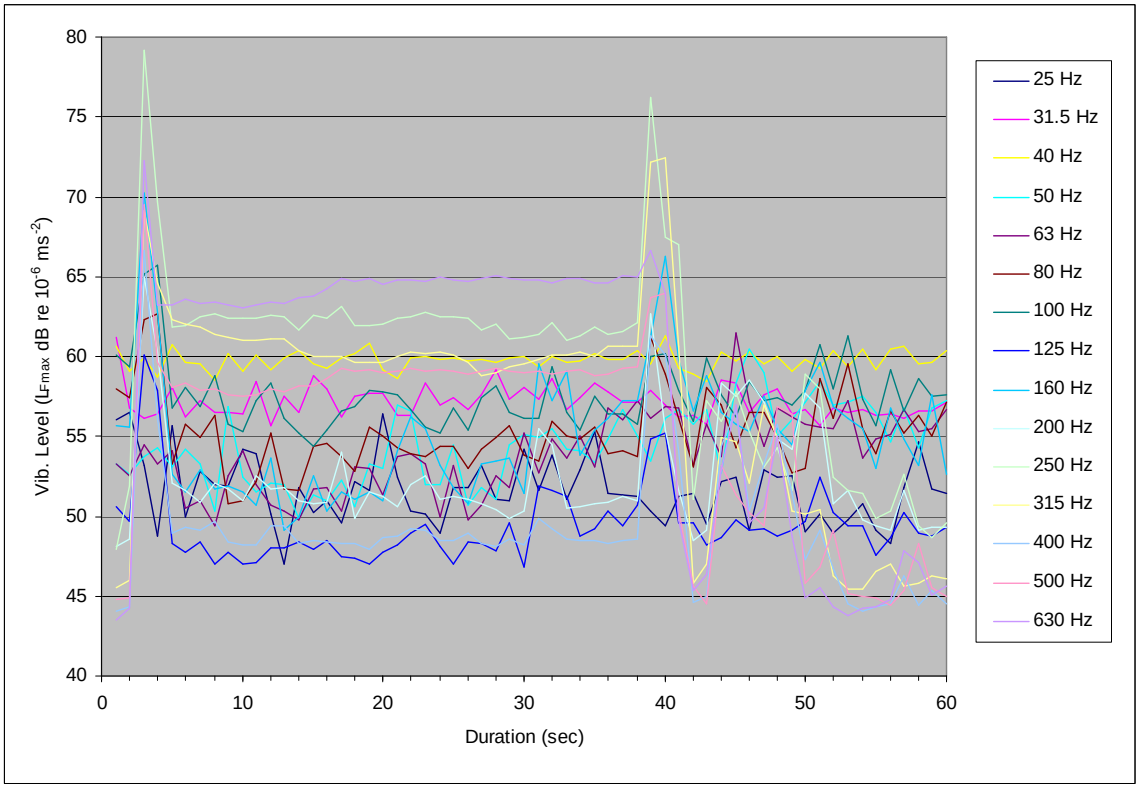

Figure 3 – Variation in vibration level during Parklift 440 ascent at Position P7

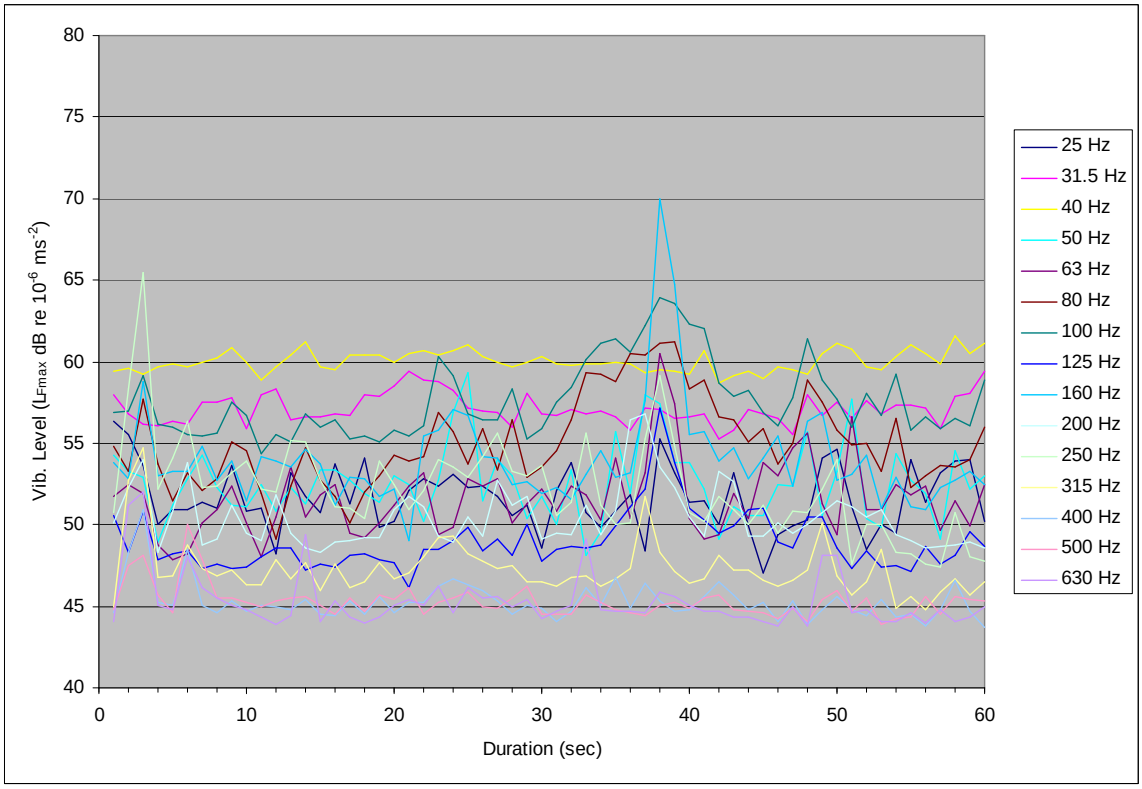

Figure 4 – Variation in vibration level during Parklift 440 descent at Position P7

Both figures correspond to what was observed on site during the operation of the Parklift. From Figure 3 it can be seen that when the Parklift is being raised, the impulsive mechanical vibration at the end and the beginning of the operation result in the highest measured vibration levels. The vibration levels between these start and finish events is due to the steady running of the pump and the lifting operation.

From Figure 4 it can be seen that when the Parklift is being lowered, opening of the valve to the pump at the beginning of, and the impulsive mechanical vibration at the end of, the descent results in the highest measured vibration levels.

Parklift structure-borne noise assessment

The results of the vibration measurements have been used to predict the likely levels of structure-borne noise resulting in the adjacent basement room on the Addison Road project. These are given in Table 1 for Positions P4, P7 and P8 for the peak events at the start, end and when the lift is moving up or down.

Position	Operation	Event	$L_{Amax(fast)}$, dBA	Approx. NR
P4	Ascending	Start	26	23
		In motion	17	8
		Finish	21	18
	Descending	Start	23	10
		In motion	16	7
		Finish	19	11
P7	Ascending	Start	39	37
		In motion	26	22
		Finish	36	35
	Descending	Start	21	14
		In motion	21	16
		Finish	29	26
P8	Ascending	Start	34	32
		In motion	20	15
		Finish	31	28
	Descending	Start	24	16
		In motion	19	9
		Finish	22	18

Table 1 – Parklift structure-borne noise

These results indicate that operation of the Parklift may be audible to an occupant of the basement next door. When the Parklift is being raised, the impulsive mechanical vibration at the end and the beginning will be the most noticeable aspects of the operation in the adjacent basement. If the background noise level in the adjacent basement is particularly low, the steady running of the pump may also be audible during the lift operation.

When the Parklift is being lowered, the impulsive mechanical vibration at end of the descent will be most noticeable in the adjacent basement. If the background noise level in the adjacent basement is particularly low then the impulsive vibration associated with the opening of the valve to the pump at the beginning of the descent may also be noticeable in the adjacent basement.

Although a direct comparison between the measured 440 and planned 461 units cannot be made, there is enough similarity between the machines to determine that there is a risk that the occupant of the adjacent basement may be disturbed by operation of the Parklift at Addison Road.

If the Parklift is intended to be used for storage then use of it could be considered to be relatively infrequent. If use could be confined to the daytime, then the intended frequency and hours of use do not seem unreasonable with respect to disturbance. Night-time or evening use, however, would be likely to disturb an occupant of the adjacent basement. At reduction in at least 10 dB in re-radiated noise would be required to reduce the risk of complaints from the neighbouring property at unsociable hours.

Recommendations

From previous correspondence with Wöhr it is our understanding that complete isolation of the unit from the surrounding building structure at Addison Road is not feasible. Although some degree of isolation can be provided, some rigid connection between the unit and the surrounding building structure is necessary.

Any rigid connection between the unit and the surrounding building structure will result in transmission of structure-borne noise and there is always a possibility that an occupant of the adjacent basement may be disturbed, particularly during the evening or night-time periods.

An expensive, ‘bespoke’ arrangement such as a floating base with a rigid connection may therefore not provide any substantial improvement compared to more economic ‘off-the-shelf’ methods to reduce structure-borne noise transmission, particularly if the Parklift is to be used infrequently and use could be confined to the daytime.

Considering this approach, and the causes of the peak vibration levels measured and observed at Holmes Road, it is recommended that:

1. Any ‘off-the-shelf’ modifications that can be applied to the 461 unit by Wöhr to reduce transmission of vibration of the Parklift into the surrounding building structure such as a resilient mat underneath the unit etc. are adopted;

2. Reduce the magnitude of vibration associated with starting and stopping the lift by beginning and ending the lift cycle more gradually, and by a more gradual opening of the pump valve;

3. A high level of mechanical noise (manifested as vibration in the surrounding building structure) is generated by use of solid, profiled metal decking as the lift starts and stops with the 440 unit. For the 461 unit it is recommended that solid, profiled metal decks are replaced by material with greater damping characteristics or dampening mats are fixed to the underside of the decks;

4. The 440 pump at Holmes Road is rigidly fixed to the wall. This provides an efficient transmission path for transmission of pump vibration into the surrounding building structure. The pump at Addison Road should be mounted on completely resilient supports and, if feasible, not to be attached to wall common with the adjacent property;

5. Install, and regularly maintain, the Parklift to a high standard.