BUROHAPPOLD ENGINEERING

Design Note

Project	St Giles' Circus Zone 3
Subject	Zone 3 construction noise assessment
Project no	0040759
Date	7 November 2017

Revision	Description	Issued by	Date	Approved (signature)
00	Design Note	M Harrison	7/11/207	D Bailey

1 Introduction

1.1 Extent of development

Zone 3 of the Consolidated project at St Giles' Circus is subject to planning conditions with the London Borough of Camden under planning application Ref: 2012/6858/P and consists of the redevelopment of:

- Denmark Street (south side) Nos 4,6,7,9,10;
- Flitcroft Street – No. 4;
- Book Mews – No.1; and
- The rear yard to Book Mews.

1.2 Planning Conditions

Planning Condition #14 issued by the London Borough of Camden (LBC) states:

"Noise from demolition and construction works is subject to control under the Control of Pollution Act 1974. You must carry out any building works that can be heard at the boundary of the site only between 08.00 and 18.00 hours Monday to Friday and 08.00 to 13.00 on Saturday and not at all on Sundays and Public Holidays. You are advised to consult the Council's Compliance and Enforcement team [Regulatory Services], Camden Town Hall, Argyle Street, WC1H 8EQ (Tel. No. 020 7974 4444 or on the website http://www.camden.gov.uk/ccm/content/contacts/council-contacts/environment/contact-the-environmental-health-team.en or seek prior approval under Section 61 of the Act if you anticipate any difficulty in carrying out construction other than within the hours stated above."

1.3 Further guidance or requirements

The "*Guide for contractors working in Camden*" issued by LBC advises the use of Best Practicable Means (BPM) for the control of environmental factors arising from construction activities including noise and vibration. This is in accordance with Section 72 of the Control of Pollution Act (COPA) 1974 and Section 80:7 of the Environmental Protection Act (EPA) 1990.

'CMR 230949' refers to the Camden Minimum Requirements for Building / Construction / Demolition sites which states:

"The quietest and newest vehicles/plant machinery shall be used at all times. All vehicles and mechanical plant used for the purpose of the works shall be fitted with effective exhaust silencers, shall be maintained in good and efficient working order and operated in such a manner as to minimise noise emissions.

The Best Practicable Means (BPM), as defined in Section 72 of the Control of Pollution Act 1974, shall be employed at all times to reduce noise (including vibration) to a minimum, with reference to the general principles contained in British Standard BS5228: 2009 'Noise and Vibration Control on Construction and Open Sites'. When dealing with tall buildings, 3D modelling should be used to predict noise levels and Part 2 vibration (in the case of basement/underground works)."

1.4 Scope of this document

Recognising:

- Planning Condition #14;
- The requirements of the *Guide for contractors working in Camden*; and
- CMR 230949.

Cord (the main contractor for Zone 3) submitted a draft Construction Management Plan (CMP) to LBC on 10 August 2017. LBC provided the following comments on the noise and vibration aspects of the draft CMP:

"The applicant has stated a number of good practices to prevent noise, vibration and dust problems. However, there are a number of issues that the applicant has either not provided or the information is incomplete.

The following is required:

- *A noise report dealing with the effect of noise from the building de-construction and construction activities.*
- *The prediction of noise levels (including structure borne noise) at the potential noise receptors (including any person residing/working inside the building or sharing party wall).*
- *Philosophies to be incorporated, maintained, improved and enforced in:*

(a) Noise/vibration reducing throughout the site and the life of the project.

(b) [sub clause relating to dust only – not included here for clarity].

- *Identification of the worst affected property by the effect of noise/vibration (including structure borne) and 3D (see CMR 230949).*
- *Provide full details describing mitigation measures to be incorporated during the construction/demolition works to prevent noise and vibration disturbances from the activities on the site to the main receptors.*
- *State the actions to be taken in cases where these exceed the predicted noise and vibration levels."*

This document provides the noise report and associated assessments detailed above.

2 Location of demolition and construction works on site

2.1 Overview of the site

The locations of the Zone 3 worksites are shown in Figure 1. Mostly these are contained within the curtilage of retained buildings. There are only two external worksite locations:

- The rear yard to Book Mews; and
- The proposed location for a future site compound in Flitcroft Street.

These are shown on Figure 2.

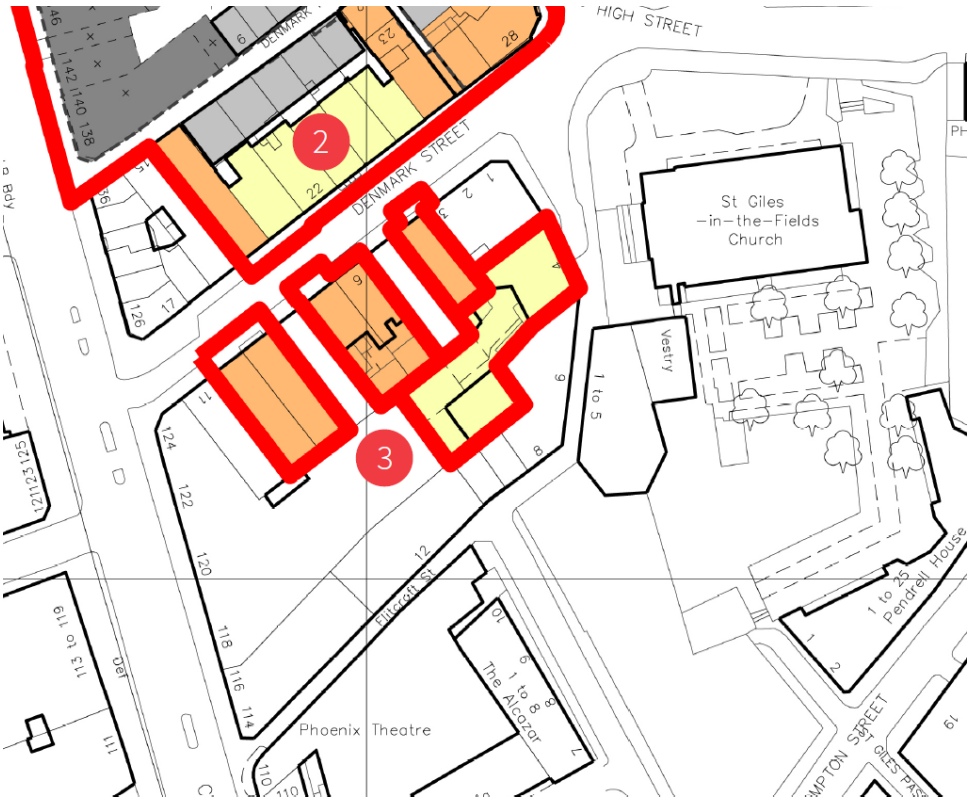


Figure 1 Location of the Zone 3 worksites (Source: Ian Chalk Architects)

Figure 2 Location of exterior worksite locations: Rear yard to Book Mews and Flitcroft Street works compound shown in red

2.2 The most noise or vibration intensive activities

The most noise or vibration intensive demolition / construction activities planned for Zone 3 relate to the proposed basement extending single storey from 4 Flitcroft Street, the rear of 4 Denmark Street, the entire service yard up to the line of 1 Book Mews (avoiding the flying freehold above) and beneath 1 Book Mews itself. There is also a double basement in the central area of the rear yard and beneath 1 Book Mews.

Specifically, the noisiest activities will be:

- Concrete breaking under 4 Flitcroft Street and 1 Book Mews;
- Piling around the Book St Mews yard. This involves secant piling using a crawler rotary piling rig; and
- Removing spoil to form the basement.

The works in the Denmark Street buildings relate to the renovation of building interiors and only involve hand tools. Therefore they are not particularly noisy, do not create significant vibration or structure-borne noise and therefore are not subjected to further noise assessment here. BPM will be applied in all cases.

For reference the nearest residential dwellings are noted to located along Stacey Lane to the south which are heavily screened from noise generating activities by intervening buildings.

3 Vibration assessment

3.1 Classification of buildings in accordance with BS 7385-2: 1993

Guidance on the damage to building structures caused by vibration is given by:

> BS 7385-2: 1993
> *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration.*

Strictly, the threshold limits given in this standard for the likely onset of cosmetic damage relate to transient vibration arriving at low rise buildings through the ground. These are given for two classes of building:

- Reinforced or framed structures. Industrial and heavy commercial buildings; and
- Unreinforced or light framed structures. Residential or light commercial type buildings.

It is recommended that the Zone 3 buildings are classified as unreinforced structures.

For the lighter buildings, below a frequency of 4 Hz, where a high displacement is associated with a relatively low peak component particle velocity value, a maximum displacement of 0.6mm (zero to peak) should be used.

In cases where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at lower frequencies (<15 Hz), then the guide values in Figure 3 may need to be reduced by up to 50%. BS 7385-2:1993 notes that there are insufficient cases where continuous vibration has caused damage to buildings to substantiate these lower guide values but they are based on common practice.

Minor damage is possible at vibration magnitudes that are greater than twice those shown in and major damage to a building structure may occur at values greater than four time the tabulated values.

Table 1 — Transient vibration guide values for cosmetic damage

Line (see Figure 1)	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commerical type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

NOTE 1 Values referred to are at the base of the building (see 6.3).

NOTE 2 For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

Figure 3 Reproduced from BS 7385-2: 1993

3.2 Vibration monitoring

It is understood that Cord have a contract in place for continuous vibration monitoring with a specialist environmental monitoring contractor.

3.3 Vibration warning thresholds versus vibration damage thresholds

The vibration levels shown in Figure 3 are *damage threshold levels* being the highest vibration level at which no cosmetic, minor, or major damage occurs.

It is common practice to set *warning vibration thresholds* that are typically two-thirds of the value assigned to each damage threshold.

The maximum threshold is commonly referred to as a *red warning level* – that which shall not be exceeded, and if breached, would cause the cessation of works until mitigation is put in place.

Commonly, red warning levels are accompanied by *amber warning levels* – usually set at two-thirds of the red level. An amber warning should trigger the review of working methods to avoid future red warnings.

The recommendation for the Zone 3 buildings during the forming of the basement in and around Book Mews is therefore:

RED warning level – 10 mm/s (peak particle velocity in any direction)

AMBER warning level – 7 mm/s (peak particle velocity in any direction)

3.4 Adverse comment due to vibration or structure-borne noise

It is possible that adverse comment from neighbours could result from the Zone 3 basement works in relation to structure-borne noise. Should this occur, the good neighbour clauses in the CMP shall be followed along with the application of BPM for vibration control as per BS5228-2: 2009 +A1:2014.

4 Noise assessment

4.1 Noise survey data

Comments on the CMP received from LBC refer to noise survey data collected by Acoustic Consultants *Cole Jarman* in 2016. The measurement data has been obtained and is reproduced here.

Unattended noise measurements were taken by Cole Jarman at 3 no. locations between 1200hrs on 6 June 2016 and 1200hrs on 9 June 2016. The three locations are shown in Figure 4 and are described as:

- MP1 – Unattended free-field measurement position located on the roof of 24 Denmark Street;
- MP2 – Unattended free-field position located at the southern façade of Centre Point Tower – 8th floor; and
- MP3 – Unattended free-field measurement position located at the south west corner of the roof of Centre Point House.

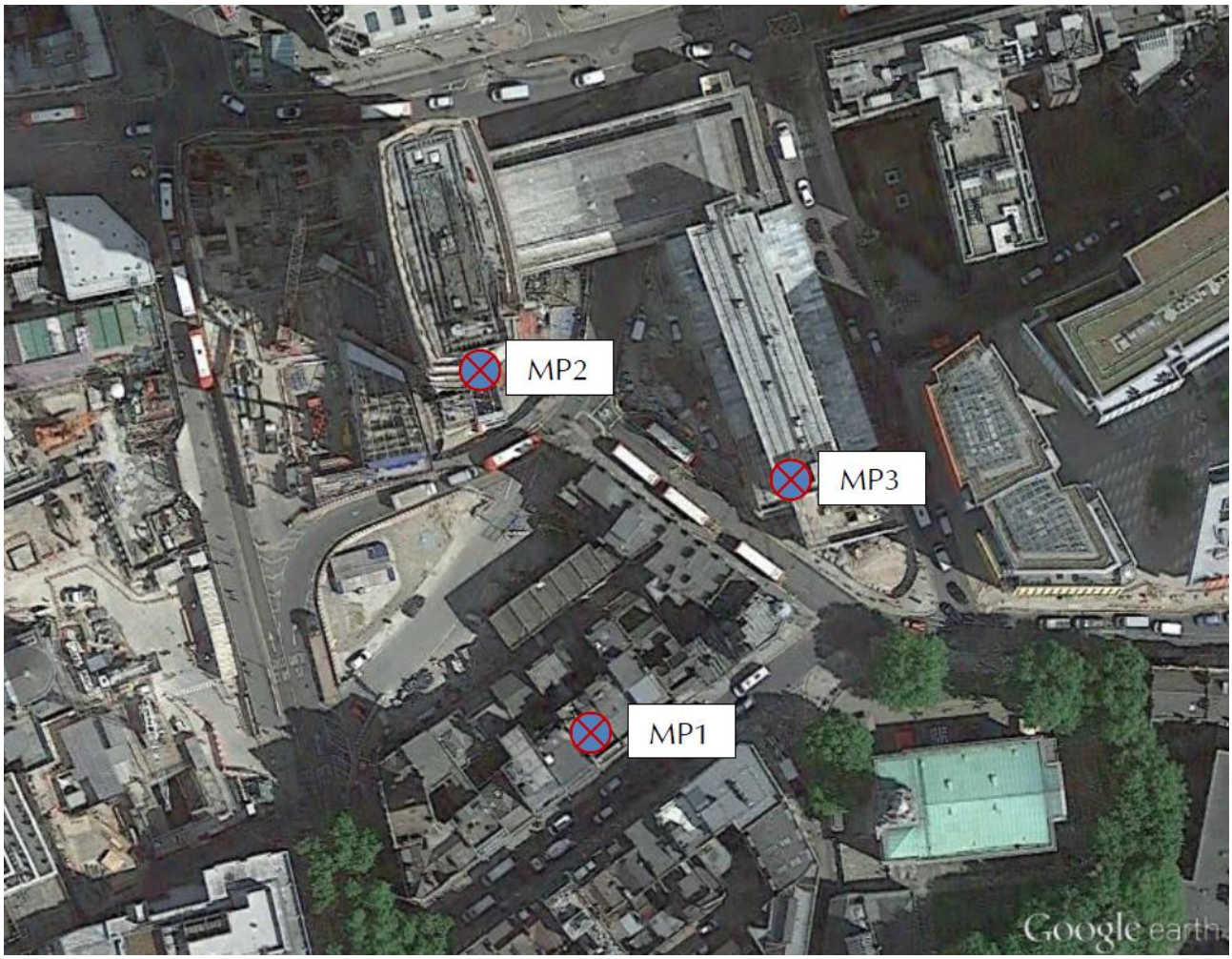


Figure 4 Cole Jarman noise monitoring locations 2016 (Source: Cole Jarman)

The Cole Jarman noise survey data, is summarised in Figure 5, Figure 6 and Figure 7.

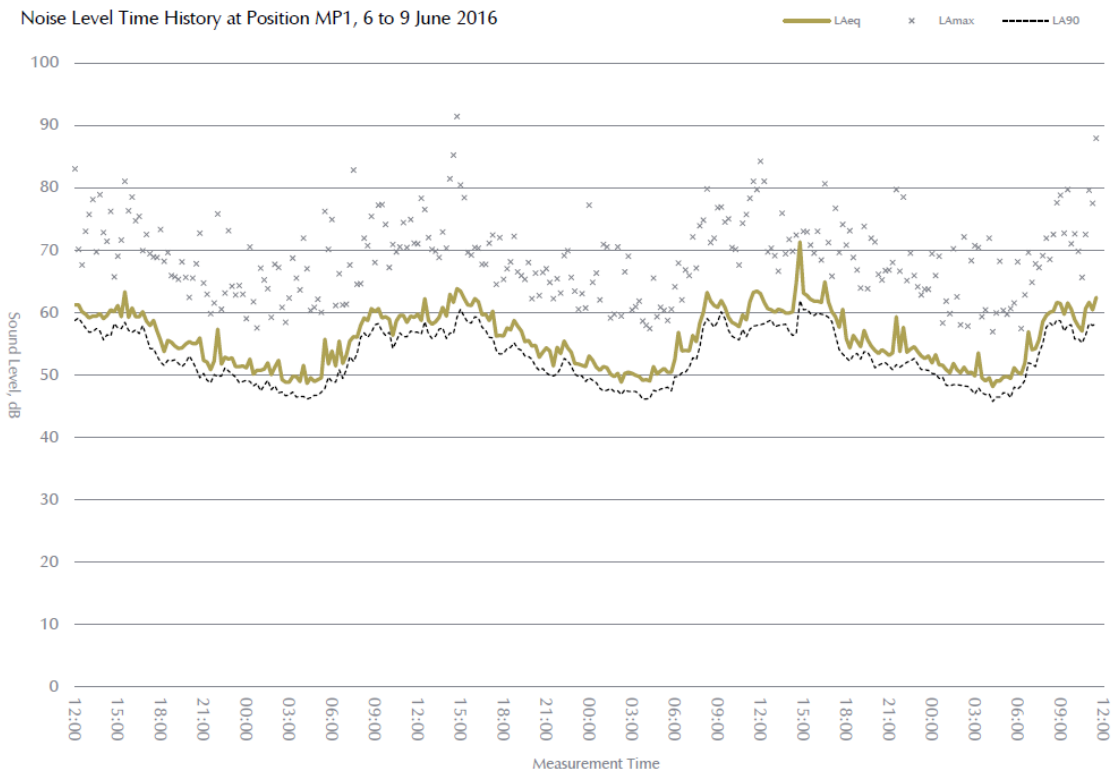


Figure 16/0210/TH01

Figure 5 Cole Jarman noise survey data – position MP1

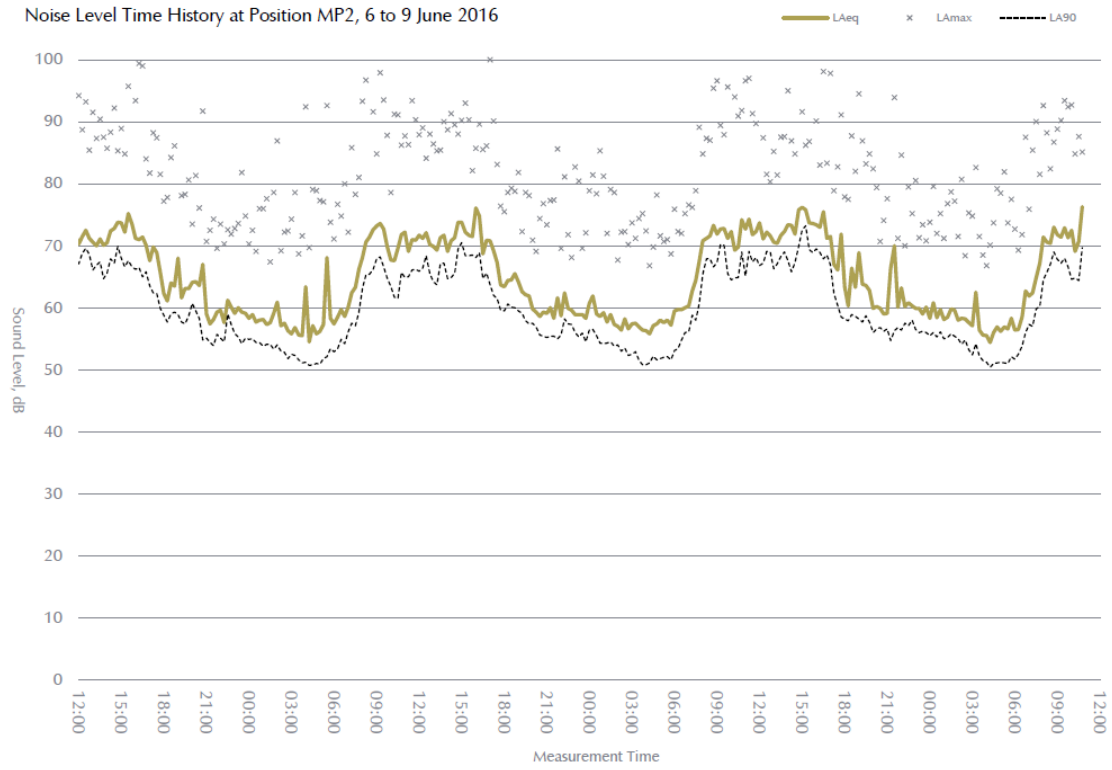


Figure 16/0210/TH02

Figure 6 Cole Jarman noise survey data – position MP2

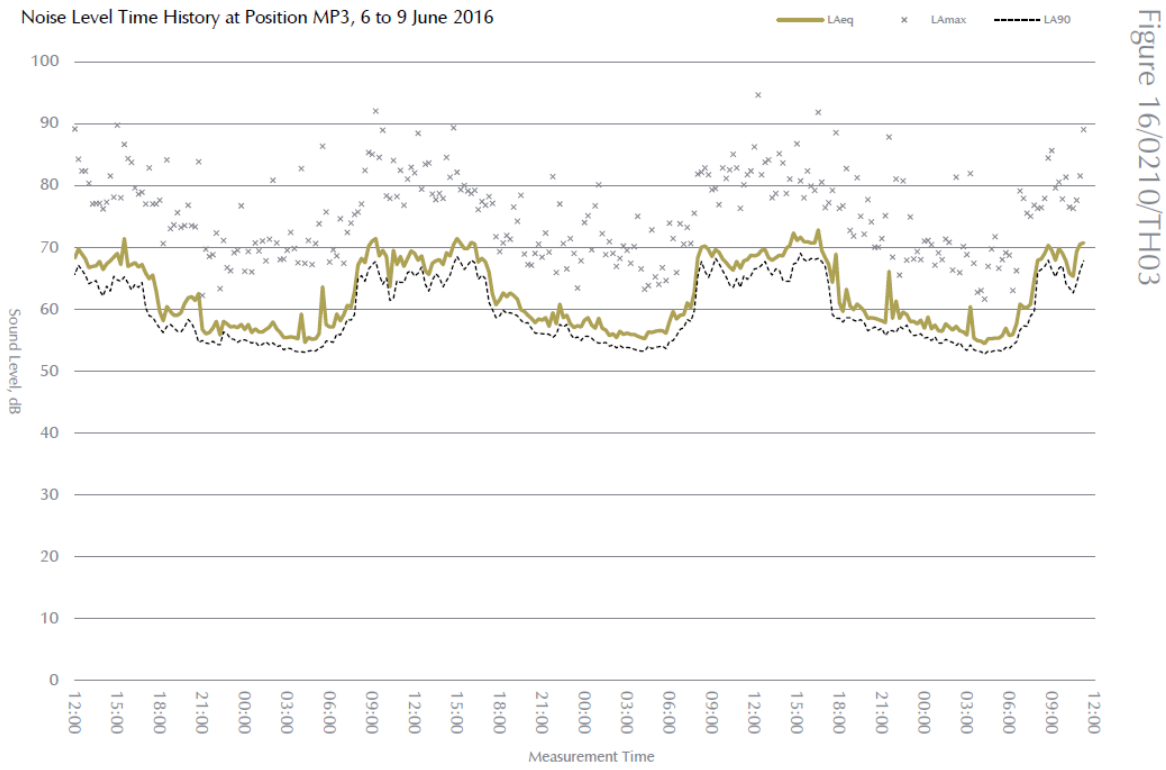


Figure 16/0210/TH03

Figure 7 Cole Jarman noise survey data – position MP3

4.2 3D acoustic modelling

A 3D acoustic model of Zone 3 has been produced using the CADNA software suite. This is based on drawings supplied by Ian Chalk Architects and is shown in Figure 8 and Figure 9.

The realism and detail of the model can be checked against the 3D renders of the proposed development shown in Figure 10. Buildings in white are pre-existing and are included in the 3D acoustic model. Future structures are not included.

Further assessment of the 3D acoustic model can be obtained from views of Book Mews yard (Figure 11) and the location of the proposed site compound on Flitcroft Street (Figure 12).

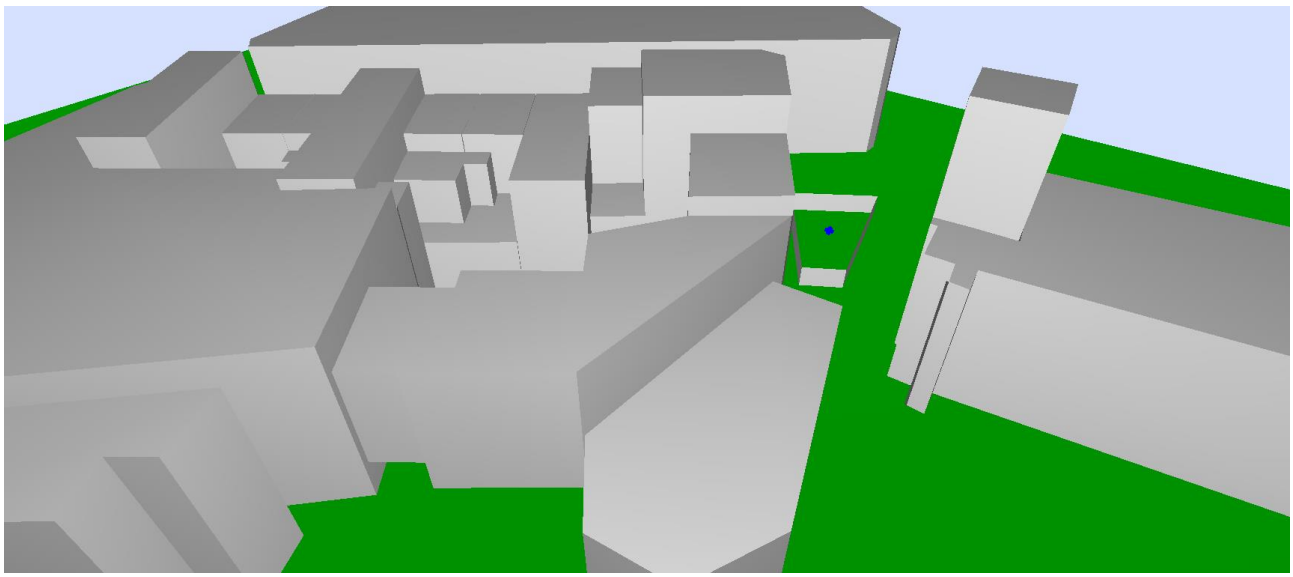


Figure 8 3D acoustic model of Zone 3 of the St Giles' Circus development

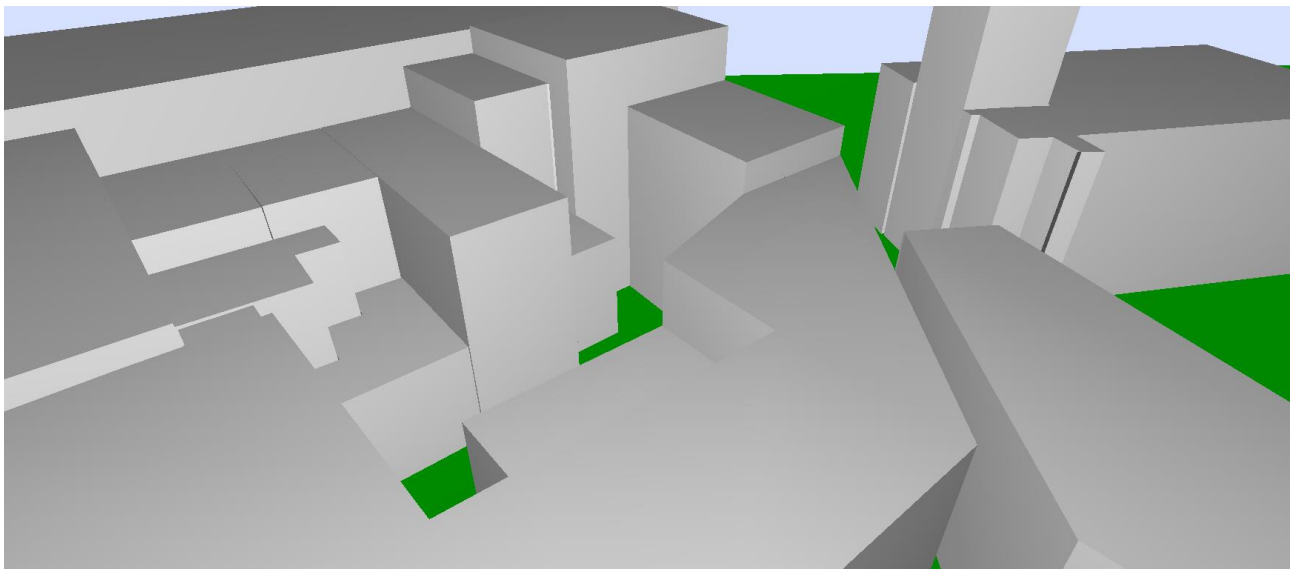


Figure 9 3D acoustic model of Zone 3 of the St Giles' Circus development

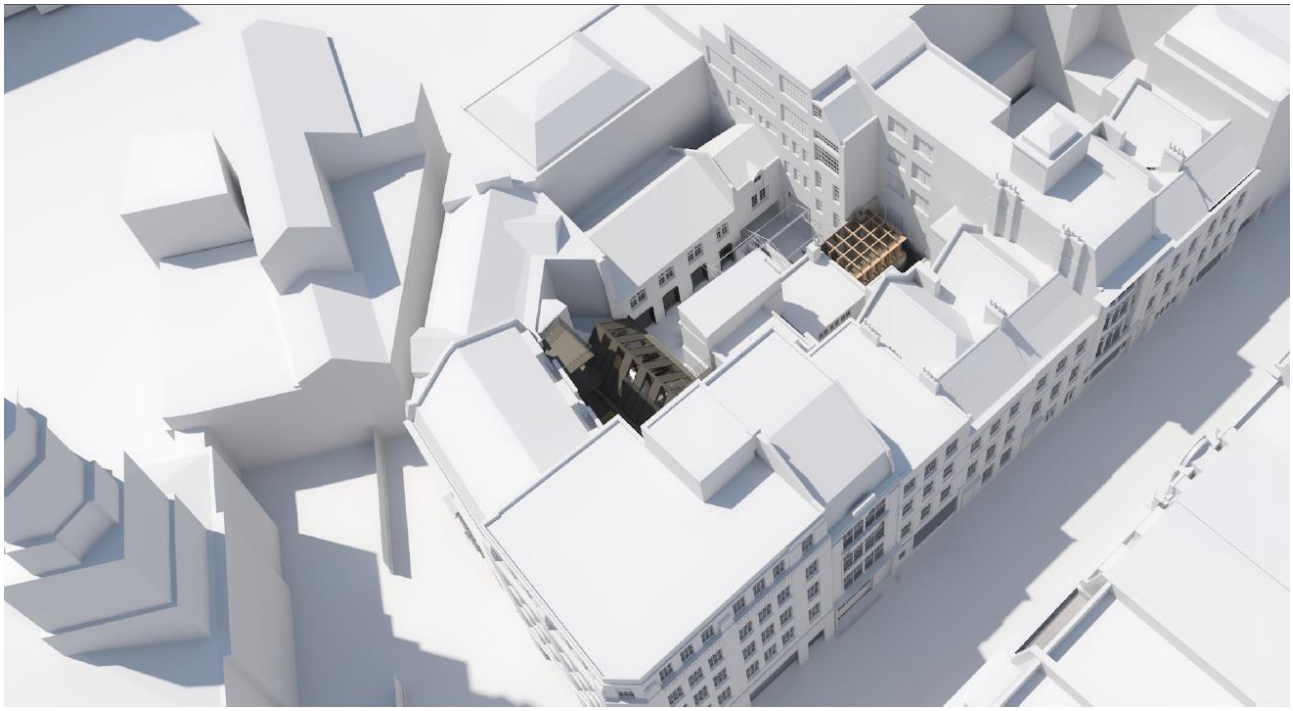


Figure 10 3D render of the proposed Zone 3 development. Buildings in white are pre-existing.

Figure 11 Photographs of pre-development Book Mews yard (Source: Ian Chalk Architects)

Figure 12 View of the street outside 4 Flitcroft Street – location of the proposed site compound

The noisiest activities set out in Section 2.2 have been analysed and equipment selected for the exterior noise assessment. The selections are shown in Table 1.

Activity	Equipment modelled	Data source	L_{aw} dBA	SPL @ 10m dBA
Rotary piling	Hydraulic crawler drill rig Type KR-702	Manufacturer	106	78
Concrete breaking	Breaker on backhoe	BS5228 C1.1	120	92
Excavation	Tracked excavator 14 tonne	BS5228 C2.7	98	70
Spoil removal	Dump truck dumping rubble	BS5228 C1.11	108	80
Spoil removal	Conveyor	Manufacturer	103	75
Concreting	Concrete pump	BS5228 C3.25	106	78
Lorry	Skip wagon	BS5228 C8.21	106	78

Table 1 Equipment selections for 3D acoustic model

The predicted noise results from two construction case studies are presented in Figure 13 and Figure 14:

- Continuous ($L_{Aeq,T}$) construction noise levels predicted for the rotary pile rig located in the centre of Book Mews yard; and
- Continuous ($L_{Aeq,T}$) construction noise levels predicted for the concrete pump located in the centre of the proposed site compound on Flitcroft Street.

The maximum predicted façade incident noise level for construction noise is shown in a white circle marked on each building.

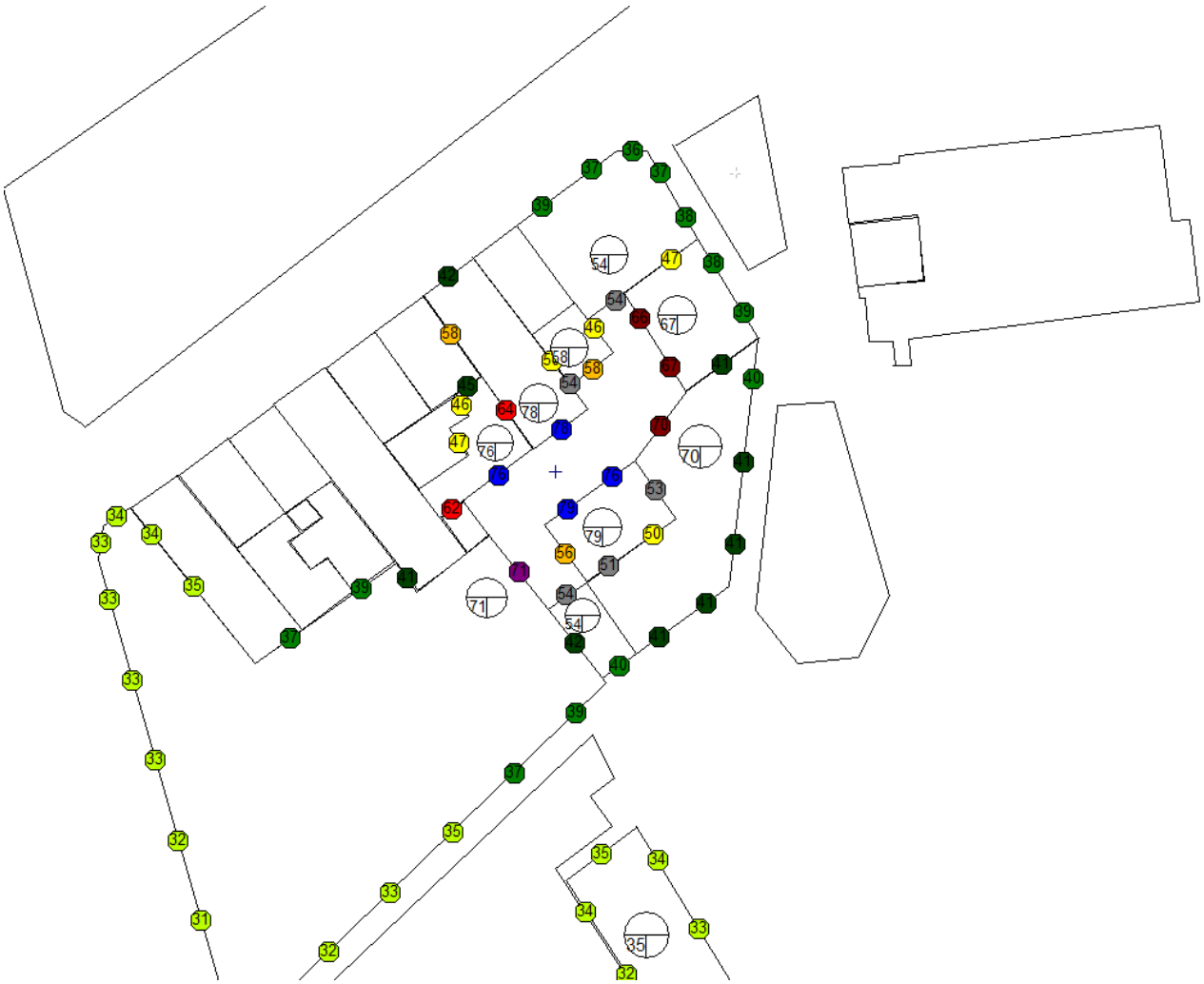


Figure 13 Continuous ($L_{Aeq,T}$) construction noise levels predicted for the rotary pile rig located in the centre of Book Mews yard ('x' marks the location)

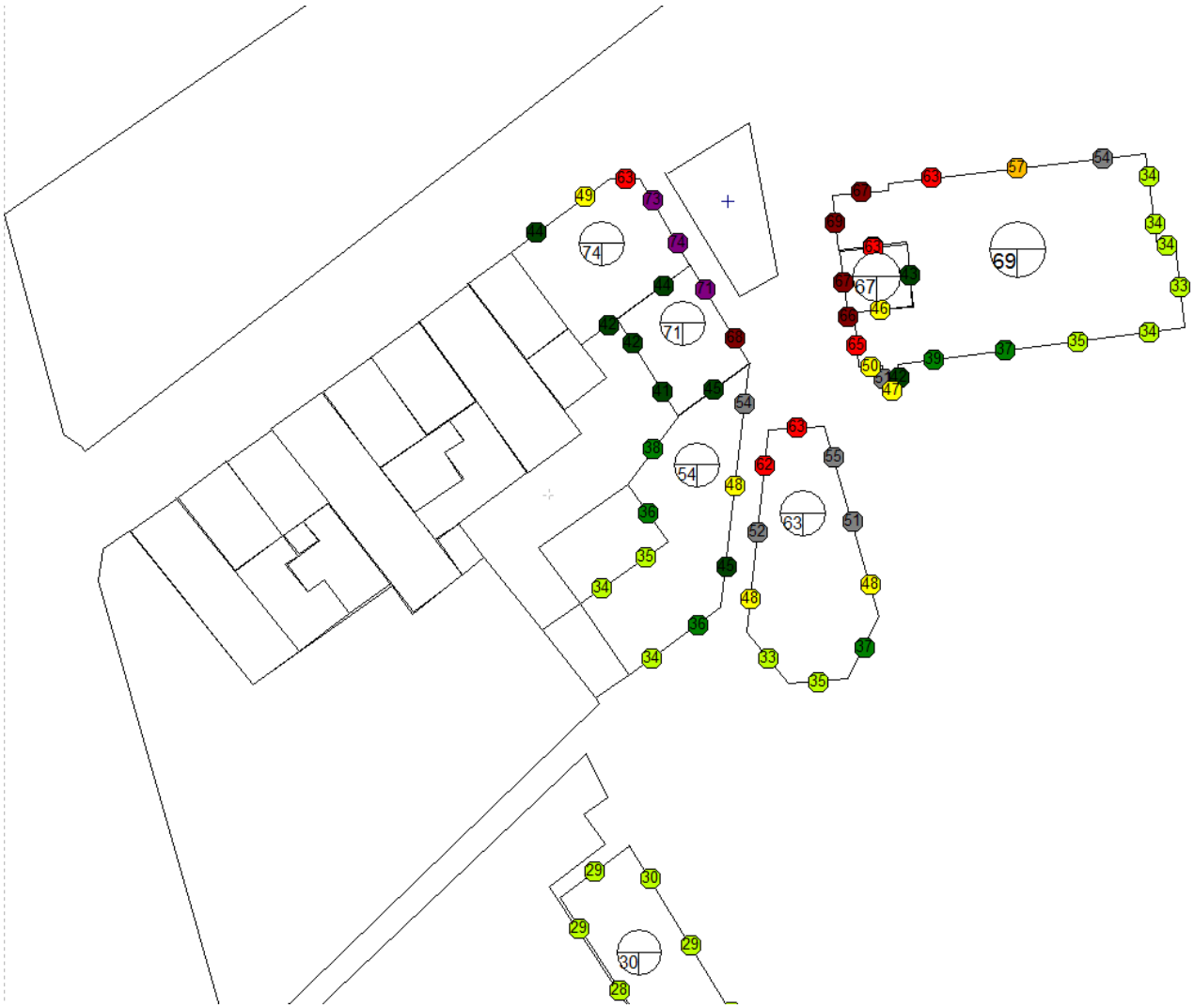


Figure 14 Continuous ($L_{Aeq,T}$) construction noise levels predicted for the concrete pump located in the centre of the proposed site compound ('x' marks the location)

The results from only two case studies are shown for brevity as the noise levels due to the other equipment to be assessed can be inferred by simple inspection of the relative sound power emissions in Table 1.

Therefore, by inspection:

- The concrete breaking activity is inherently noisier than the piling operation (Table 1), however, this takes place within the curtilage of 4 Flitcroft Street and 1 Book Mews. Providing the roller doors to these buildings are closed (with mechanical ventilation provided) during the breaking operation, the noise levels at the facades of the nearby buildings from concrete breaking will be lower than those from piling.
- Excavation activities in Book Mews cause very similar noise levels to those of piling operations.
- A skip wagon in the proposed compound (including modelling the effect of the proposed 2.4m high hoarding) would produce the same noise levels as the concrete pump modelled in the second case study

Therefore, assessment based on the two case studies represents the worst case exterior construction noise scenario.

4.3 Noise effect magnitude and impact assessment

The criteria for the assessment of effect magnitude upon high sensitivity receptors are derived from the ABC method in Annex E of BS 5228-1:2009+A1:2014. This criterion is based on the total construction noise level which is a combination of the pre-existing ambient noise level plus construction noise.

If the total construction noise level exceeds the assessment category then a moderate or large effect is deemed to occur. The assessment categories are set out in Table 2 with magnitude of effect given in Table 3.

Inspecting the daytime periods (0800-1800hrs as stipulated in Planning Condition #14) in Figure 5, Figure 6 and Figure 7 it is clear that prevailing daytime ambient noise levels measured around the Zone 3 development site are always above $L_{Aeq,T}$ 60 dBA and frequently significantly above $L_{Aeq,T}$ 70 dBA. Therefore Category C in the ABC the ABC method applies.

However, BS 5228 proposed this method for residential premises only. The nearest, Nos 1-8 The Alcazar (see Figure 1) are predicted to be exposed to construction levels in the range $L_{Aeq,T}$ 30-35 dB at this location (i.e. below Category A), **Therefore, the application of the ABC method to the results from the two case studies predicts no significant effect and negligible impact on residential premises in the Zone 3 area.**

Assessment category and threshold value period	**Threshold value, in decibels (dB)**		
	Category A[A)]	**Category B[B)]**	**Category C[C)]**
Night-time (23:00-07:00)	45	50	55
Evening and Weekends[D)]	55	60	65
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75
NOTE 1 *A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.* ***NOTE 2*** *If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.* ***NOTE 3*** *Applied to residential receptors only.*			
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.			
Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values.			
Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values.			
19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays.			

Table 2 Threshold of significant effect at dwellings.

Change dB	**Effect**	**Magnitude of effect**
Zero	No perceptible change	Negligible
0-5 dB	A perceptible change	Minor
5-10 dB	Up to a doubling in loudness	Moderate
>10 dB	Significant increase in noise	Major

Table 3 Magnitude change for construction noise.

For the assessment of effect and impact for the commercial premises that surround the yard at Book Mews and the proposed site compound the guidance given in Annex E of BS 5228-1:2009+A1:2014 is used:

"Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut. The noise can be measured with a simple sound level meter, as we hear it, in A-weighted decibels (dB(A))– see note below. Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

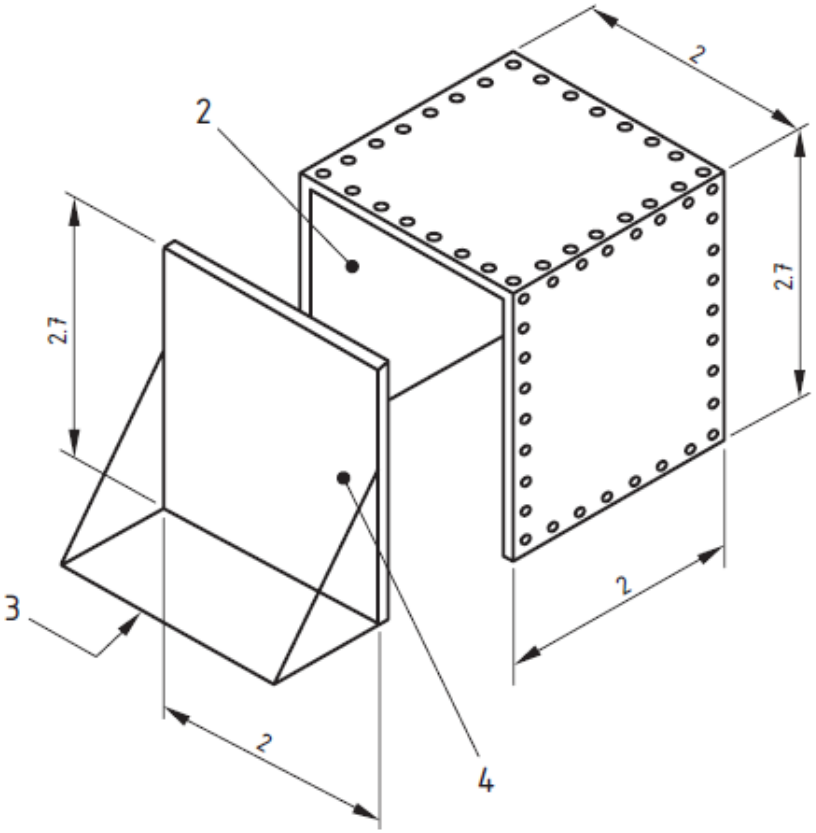
70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise;

75 decibels (dBA) in urban areas near main roads in heavy industrial areas.

These limits are for daytime working outside living rooms and offices"

The predicted levels of construction noise in Book Mews yard are of similar magnitude to the prevailing ambient noise levels measured around Zone 3 and are generally below the 75 dBA recommended for urban areas in BS 5228 (above).

However, the piling rig and a dumper truck could cause façade noise levels above 75 dBA and therefore BPM for noise control is recommended for each. For the piling, local screening as recommended in BS 5228 and illustrated in Figure 15 would reduce façade noise levels to below 75 dBA. For the dumper truck, the selection of a modern, quieter example would also mean compliance with a 75 dBA façade noise level.



b) Open-sided shed with screen

Key

1	9 mm plywood outer covering on wood framework	3	Weighted or tied down
2	Inner lining of 50 mm sound-absorbent material (see B.3)	4	9 mm plywood screen

Figure 15 Example of Best Practicable Means noise control for the power pack to a rotary piling rig (Source: BS 5228-1)

The predicted levels of construction noise surrounding the proposed site compound in Flitcroft Street are below the prevailing ambient noise levels measured around Zone 3 and are below the 75 dBA recommended for such urban areas in BS 5228 (above). Therefore negligible impact is expected.

5 Conclusions

5.1 Vibration and structure borne noise

A system of red and amber vibration warnings is recommended for the protection of buildings from damage due to vibration.

The recommendation for the Zone 3 buildings during the forming of the basement in and around Book Mews is therefore:

RED warning level – 10 mm/s (peak particle velocity in any direction)

AMBER warning level – 7 mm/s (peak particle velocity in any direction)

It is possible that adverse comment from neighbours could result from the Zone 3 basement works. Should this occur, the good neighbour clauses in the CMP shall be followed along with the application of BPM for vibration control as per BS5228-2: 2009 +A1:2014.

5.2 Airborne exterior construction noise

The nearest residential premises, Nos 1-8 The Alcazar (see Figure 1) are predicted to be exposed to noise levels associated with demolition / construction activities in Zone 3 in the range $L_{Aeq,T}$ 30-35 dB at this location (i.e. below Category A on the BS5228 – ABC method). **Therefore, the application of the ABC method from BS 5228-2:2009 +A1:2014 implies no significant effect and negligible impact on residential premises.**

The predicted levels of construction noise in Book Mews yard are of similar magnitude to the prevailing ambient noise levels measured around Zone 3 and are generally below the 75 dBA recommended for urban areas in BS 5228. Low impact is expected and this can be mitigated using Best Practicable Means for noise control as recommended in Section 4.3.

The predicted levels of construction noise surrounding the proposed site compound in Flitcroft Street are below the prevailing ambient noise levels measured around Zone 3 and are below the 75 dBA recommended for such urban areas in BS 5228 (above). Therefore negligible impact is expected.