

Project

Faculty of Arts and Humanities
Demolition/Construction Noise & Vibration
Assessment

Prepared for

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Rev 1	24/05/2019	Revisions to title page and Figure 2
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Summary

SRL Technical Services Limited has been commissioned to complete a demolition and construction noise and vibration assessment for the demolition and construction works on the Faculty of Arts and Humanities building.

A noise survey around the proposed site was completed by BDP in June 2018 and vibration measurements were taken by SRL in December 2017.

The average daytime noise levels at the proposed site were between 62-66dB $L_{Aeq,T}$ during the day. Baseline vibration levels are below the just perceptible criteria (for residential dwellings) of Peak Particle Velocity (PPV) stated within BS5228-2:2009+A1:2014 at the site.

Demolition/construction noise and vibration may exceed the recommended threshold criteria at the nearest receptors (University owned buildings). However, they will not likely exceed the criteria at the nearest residential receptors. Implementing Best Practicable Means (BPM) will help to reduce the noise and vibration levels and possible annoyance.

A detailed method statement for the demolition and construction (to be produced by the contractor) will include the recommendations for BPM detailed in this report.

Joe Conaghan

For and on behalf of

SRL Technical Services Limited

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1.0 Introduction

SRL Technical Services Limited has been commissioned to complete a noise and vibration assessment for the demolition of Coventry University's Bugatti Building and the construction of a new Faculty of Arts and Humanity Building.

The scheme involves:

'Proposed demolition of the Bugatti Building and erection of a part four- and part five-storey extension (class D1 use); various internal alterations and external refurbishment to the Maurice Foss and Graham Sutherland Buildings; alterations to the service yard; landscaping and associated works'

This report sets out the baseline survey results, and an assessment of likely noise and vibration impacts from the demolition and construction works. The location of the site (outlined in blue) is shown in Figure 1 below.

Figure 1 - Site Location

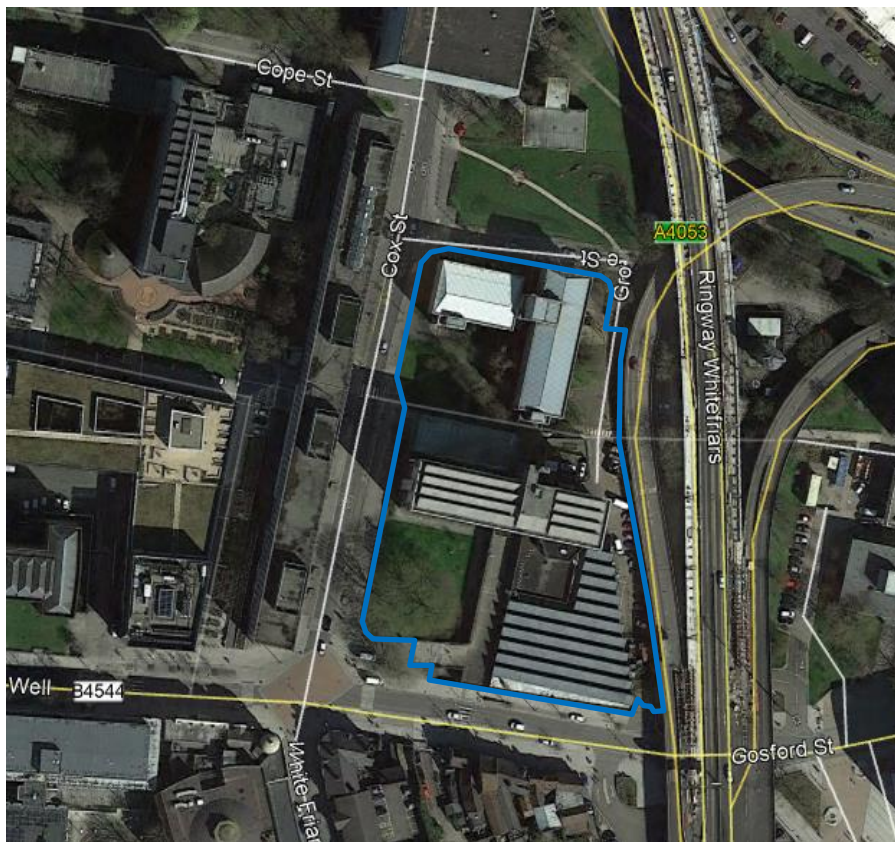
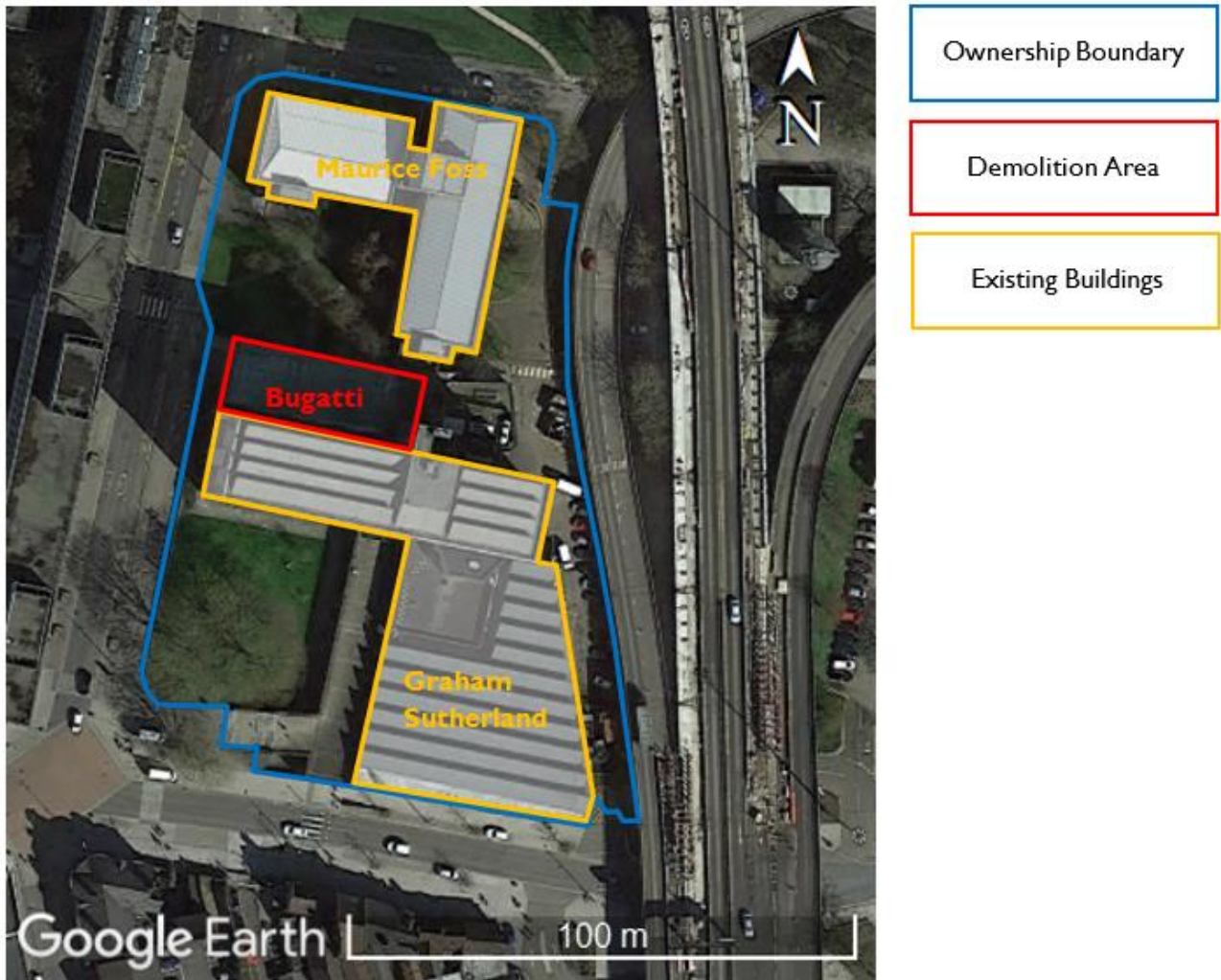


Figure 2 shows the planned demolition areas (outlined in red), the existing buildings (outlined in yellow) and the site boundary (outlined in blue).

Figure 2 - Planned Area of Works



2.0 Relevant Policies and Guidelines

The Control of Pollution Act 1974 references the adopted construction code of practice as the means to control noise from construction sites. The adopted code of practice for noise and vibration from demolition sites is BS5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites - Part 1: Noise* and BS5228-2:2009+A1:2014, *Part 2: Vibration*. Local guidelines from Coventry City Council will also apply.

2.1 BS5228:2014 Code of practice for noise and vibration control on construction and open sites

2.1.1 Noise

BS5228-1:2009+A1:2014 gives recommendations for the basic methods of noise and vibration control relating to demolition and construction sites. It also provides guidance concerning methods of predicting and measuring noise and vibration and assessing its impact on those exposed to it. The prediction method considers the noise emission level of the plant, the separation distance between the source and the receiver, along with the effect of the intervening topography and structures.

The standard sets out methods and criteria for assessing the significance of noise effects.

"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. Noise levels, between 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.

Reduced limits are likely to apply outside of typical working hours.

Noisy work likely to cause annoyance locally should not be permitted between 22:00 and 07:00 hours.

These limits are for daytime working outside living rooms and offices. In noise-sensitive situations, for example, near hospitals and educational establishments – and when working outside the normal hours say between 19.00 and 22.00 hours – the allowable noise levels from building sites will be less: such as the reduced values given in the contract specification or as advised by the Environmental Health Officer (a reduction of 10 dB(A) may often be appropriate). Noisy work likely to cause annoyance locally should not be permitted between 22.00 hours and 07.00 hours."

2.1.2 Vibration

BS5228-2:2009+A1:2014 Part 2: Vibration gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/ operations generate significant vibration levels, including industry specific guidance. Guidance is provided concerning methods of measuring vibration

and assessing its effects on the environment. Annex B, Significance of vibration effects, provides guidance on perceptible levels of vibration (shown below).

Table B.1 Guidance on effects of vibration levels

Vibration level ^{A), B), C)}	Effect
0.14 mm·s ⁻¹	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm·s ⁻¹	Vibration might be just perceptible in residential environments.
1.0 mm·s ⁻¹	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm·s ⁻¹	Vibration is likely to be intolerable for any more than a very brief exposure to this level ^{A1)} in most building environments ^{A1)} .

^{A1)}

- ^{A)} The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.
- ^{B)} A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.
- ^{C)} Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment. ^{A1)}

2.2 Control of Pollution Act 1974, Section 61 consent

A Section 61 is a formal agreement between a contractor undertaking noisy demolition / construction activities and the Local Authority. The application for the section 61 is made at least 28 days prior to work commencing and allows for the contractor and Local Authority to agree noise limits and hours of work for a project operating near to sensitive receptors. If the Local Authority agrees to the Section 61 Consent and the work is undertaken in a manner that complies with the agreed terms, the contractor will be protected from Local Authority action under Section 60 of the Control of Pollution Act 1974 or Section 80 of the Environmental Protection Act 1990. Proceedings can still be brought against the contractor under Section 59 of the Act if an occupier of any premises can prove that he is aggrieved by noise amounting to a nuisance, regardless of compliance with the Section 61 agreement.

The following information will be required to form part of the Section 61 Application submitted to the Local Authority 28 days prior to work commencing.

- Site location;
- Contractor's details;

- Particulars of works to be carried out;
- Methods to be used in each stage of the development;
- Hours of works for each stage;
- Number, type and make of equipment and machinery (including heavy vehicles) stating Sound Power Levels;
- Proposed steps to minimise noise and vibration;
- Predicted Noise Levels;
- Construction programme defining each stage of the works; and
- Site plans identifying approximate locations of fixed plant or machinery, areas of significant activity, site entrances and exits and the location of noise barriers (including site buildings) or enclosures.

Regardless of whether a formal Section 61 agreement is sought it is best practice to know the emissions from the demolition that is affecting the surrounding land uses so that appropriate controls can be adopted prior to the works commencing.

2.3 Coventry City Council - Guidance on Controlling Pollution from Construction and Demolition Sites

Coventry City Council - Guidance on Controlling Pollution from Construction and Demolition sites provides details to contractors and developers on the reasonable measures that Coventry City Council expects them to take to minimise the environmental impact on the local community. The council recommends that 'noisy works' on sites, such as use of heavy plant or machinery, are limited to the following hours of work:

- Monday to Friday – 07:00 to 19:00
- Saturday – 08:00 to lunchtime
- Sundays & Bank Holidays - no noisy works

Any works outside these hours will require prior approval from Coventry City Council Environmental Protection Team. The legislation expects that the contractor uses the principle of 'Best Practicable Means' or 'BPM', when ensuring the control of pollution and environmental nuisance. The guidance outlines that all operations should be carried out to conform with British Standard 5228 Parts 1 & 2. In the event of excessive noise being generated by site activities, the Local Authority can impose a formal stop notice under section 60 of the Control of Pollution Act 1974 whereby all works will need to cease until it can be demonstrated that the noise can be controlled.

3.0 Baseline Survey Results

3.1 Noise Measurements

A noise survey was completed by BDP on 22nd June 2018 as part of the acoustic design of the scheme. Full details can be found in BDP document 'P2007391(REP)U003' dated May 2019. The measurement positions and nearest receptors have been replicated in Figure 3, and summary of the measurement results is in Table I below.

Figure 3 – Noise Survey Measurement Positions

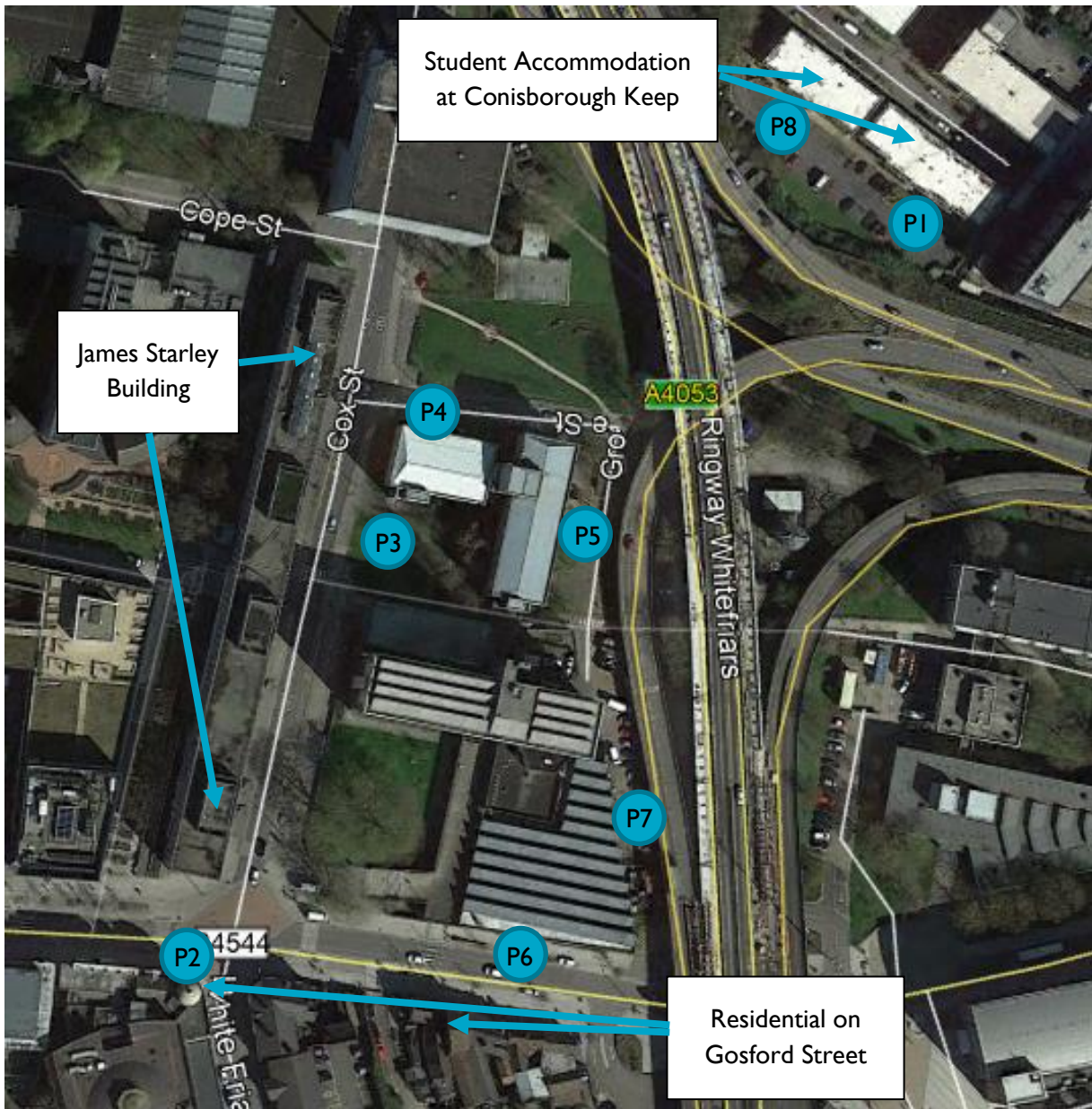


Table 1 – Noise Survey Measurement Results Summary

Measurement Position	Time (hh:mm:ss)	L _{Aeq,5mins} Range (dB)	L _{AFmax,5mins} Range (dB)	L _{A90,5mins} Range (dB)
1	01:59:53	50	60 – 63	39
2	02:32:52	56 – 59	73 – 75	43 – 44
3	09:44:19	63 – 65	74 – 77	53 – 56
3	10:55:36	62 – 66	75 – 93	53 – 54
4	09:20:00	59 – 65	70 – 84	52 – 56
4	12:52:02	59 – 60	69 – 76	52
5	12:52:42	53 – 54	58 – 68	50 – 51
6	10:22:16	66 – 71	82 – 93	51 – 55
6	11:20:17	66 – 68	76 – 86	56 – 57
7	12:26:13	53 – 54	58 – 66	50
8	13:25:21	58	67 – 69	52 – 53

The daytime noise at the site reported to be dominated by road traffic noise from the continuous traffic on the A4053 Ringway flyover, Cox Street and Gosford Street along with distant traffic noise from other surrounding roads.

3.2 Vibration Measurements

SRL completed vibration measurements near Position 3 (see Figure 3) on 15th December 2017. Vibration levels were measured in 3-orthogonal axes; tangential (x, perpendicular to Cox Street), radial (y, parallel to Cox Street), and vertical (z).

The highest resulting peak particle velocities that were measured are detailed in Table 2.

Table 2 - Vibration Measurement Results

Position	Date	Start time	PPV result (mm/s-l)	Vibration affect	Comments
P3	15/12/2017	09:33	0.08	Below perceptible criteria	Road traffic, buses, pedestrians

It should be noted that the perception criteria are based on residential properties. The measurements taken were next to University owned buildings, which are expected to be less sensitive to vibration.

4.0 Noise assessment

In line with the guidance of BS5228, the daytime thresholds for demolition noise at the nearest sensitive receptor are detailed in Table 3.

Table 3 - Daytime Noise Threshold at the Nearest Receptors

Description	Criterion dB(A)
Receptors along Gosford Street and Student Accommodation at Conisborough Keep	75
University Receptors on Campus	65 (up to 75)

The threshold of 65dB(A) outside university buildings is taken from the potential worst-case implied by BS 5228. It is possible that a threshold of 70 or 75dB(A) could also be deemed acceptable.

If demolition / construction works needs to be done outside of normal working hours, then a reduced threshold of 65 dB(A) at all receptor locations may be appropriate (subject to agreement with the Local Authority).

Detailed demolition and construction method statements have not been prepared at this stage. Therefore, likely plant and methodologies have been assumed (based on projects of a similar nature and previous experience) to determine potential impacts. The plant that we expect to have the greatest potential for generating high levels of noise and vibration include:

- Excavator – including fitted with long boom and hydraulic concrete pulverising jaws
- Mobile Tower Crane
- Dozer
- Hand-held pneumatic breakers
- Petrol circular saws
- Concrete pump

The nearest noise sensitive receptors are located around the site boundaries, shown in Figure 3, with the minimum distances from the works to the receptor shown in Table 4.

Table 4 - Distance from Receptor to Closest Works

Receptor	Graham Sutherland Building	Maurice Foss Building	James Starley Building**	Residential on Gosford Street	Student Accommodation at Conisborough Keep
Minimum Distance to Demolition Works (m)	2	8	20	90	160
Minimum Distance to Construction Works	n/a *	n/a *	20	20	110

* - These receptors are part of the construction/refurbishment works site, so construction noise has not been predicted to them. I have predicted noise from the demolition works because they could be affected by demolition.

** - The James Starley building is currently vacant awaiting demolition

Noise levels have been assessed for each phase of the demolition and construction works. The predicted noise levels are given in Table 5.

Shaded cells indicate where site activities are likely to exceed the threshold for normal working hours. The full calculation is provided in Appendix B.

A percentage on-time for each plant item has been assumed (see Appendix B). Although unlikely in practice, the noise levels predicted in table 5 assume a worst-case that plant will be operating at maximum duty and running simultaneously. The 2.4m high fence hoarding will provide shielding for plant and site activities at ground level. To account for this, we have applied a -10dB(A) reduction for screening for low level works. A +3dB(A) façade correction has also been applied.

Table 5 - Predicted Worst-case Demolition/Construction Noise Levels

Receptor	Predicted noise level (dB(A)) at receptors				
	Graham Sutherland Building	Maurice Foss Building	James Starley Building	Residential on Gosford Street	Student Accommodation at Conisborough Keep
Site Mobilisation	100	88	80	67	62
Site Preparation	97	85	77	64	59
Demolition Works	102	90	82	69	64
Pile Mat Creation	-	-	69	69	55
CFA Piling	-	-	72	72	57
Pile Cap Break Down	-	-	75	75	61
Foundations	-	-	71	71	56
Pre-Cast Floors	-	-	67	67	52
Concrete Frame	-	-	69	69	54
Brickwork	-	-	62	62	47
Roof Structure	-	-	62	62	47
External Works/Landscaping	-	-	78	78	63

Due to their proximity to the site, the predicted noise levels at the university buildings are expected to exceed the most onerous potential 65dB(A) threshold. However, the James Starley Building is already vacant awaiting demolition itself, and the use of Graham Sutherland Building and Maurice Foss Building is a management issue for the University. It is likely that alternative accommodation will be required for rooms overlooking the demolition site and therefore these rooms will most likely be vacant during the construction/refurbishment works.

We predict that the 75dB(A) threshold will not be exceeded for residential receptors further than 20m from the site boundary. It is possible to comply with the recommendations of BS 5228 Parts 1 & 2 if Best Practicable Means are employed. The nearest residential receptors are at least 20m from the site boundary, and so would be within the recommended limits within BS 5228 Parts 1 & 2.

We have also assumed a worst case that all plant will be operating simultaneously. However, this is unlikely to be the case, as each activity will be either at different locations (and therefore distances), or at different times, thus reducing the noise level at the nearest receptors below the levels in table 6.

Noise levels can be reduced further once BPM mitigation measures are used.

A detailed demolition and construction method statement will be produced by the contractor, which will include expected methods of noise reduction and mitigation, including BPM.

The following measures should be adopted as best practice to minimise the potential for disturbance.

- Restrict working hours;
- Plan working hours to take account of the effects of noise and vibration upon persons in areas surrounding site operations and upon persons working on-site;
- Where reasonably practicable, adopt quiet working methods, using plant with lower noise emissions;
- Where reasonably practicable, adopt working methods that minimise vibration generation;
- Vehicles and mechanical plant should be fitted with effective exhaust silencers;
- Compressors should be fitted with properly lined and sealed acoustic covers which should be kept closed whenever in use. Pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Equipment which breaks concrete, brickwork or masonry by bending, bursting or “nibbling” shall be used in preference to percussive tools where practicable. Avoid the use of impact tools where the Site is close to occupied premises;
- Site all noisy equipment away from noise sensitive areas, where practicable, i.e. along Cox Street;
- Complete loading and unloading activities away from noise sensitive areas, e.g. on Cox Street;
- Machinery should be started up sequentially rather than simultaneously;
- Machinery which is used intermittently should be shut down between work periods;
- Acoustic covers to engines must be kept closed when the engines are in use and idling;
- Packaged generators where provided should have sufficient silencing such that they do not exceed the background noise level at the nearest residential property;
- Materials should be lowered and not dropped. Drop heights should be minimised where necessary;
- Regular and effective maintenance of machinery must be done;
- Where periods of noise above the desired target noise levels (see table E.2 of BS 5228-1:2009+A1:2014) are anticipated, residents and occupiers of nearby buildings should be informed by leaflet and given timescales over which the activities will occur and when they are expected to end;
- Audits of Site activities should be done at regular and frequent intervals during the construction program by a designated person to check that noise mitigation is being done. Sample noise level monitoring should also be done and recorded to demonstrate that noise is within acceptable limits;
- Personnel must be instructed on Best Practical Means to reduce noise and vibration as part of their induction training and as required prior to specific works;

- Neither any part of the works nor any maintenance of plant shall be carried out in such a manner as to cause unnecessary noise or vibration except in the case of an emergency when the work is absolutely necessary for the saving of life or property or the safety of the works.

A noise monitoring regime should be agreed with the Environmental Health Officer before any works start to validate the predictions above. This may be spot measurements taken by the contractor during particularly noisy works or a permanent noise logger set up at the nearest sensitive receptor.

If the noise levels are consistently louder than the levels predicted in Table 6, and all BPM control measures are exhausted, BS5228-1:2014 suggests installing noise insulation or temporary/permanent re-housing. Noise insulation would require secondary or additional ventilation systems which allows the windows to be kept closed. Temporary or permanent re-housing should only be considered if noise insulation is not effective.

4.1 Vibration

Some demolition/landscaping activities can produce ground-borne vibration, which has the potential to cause concern at nearby sensitive receptors. There is no accepted method for predicting the vibration at a sensitive receptor due to the ground-borne vibration from demolition plant. However, BS5228-2:2014 suggests that for the majority of people, vibration levels between 0.14 & 0.3 mms⁻¹ PPV are just perceptible. Table 6 details the distances at which certain activities give rise to a just perceptible level of vibration, these figures are based on historical field measurements from BS5228.

Table 6 - Distances Where Vibration May Be Just Perceptible

Construction Activity	Distance from Activity (m)
Heavy Vehicles (e.g. dump trucks)	5 – 10
Excavation	10 – 15
Hydraulic Breaker	15 – 20
Vibratory Roller	10 – 15

All the nearest University buildings are within the distances detailed in Table 7. Therefore, vibration is likely to be perceptible for the activities or plant items stated. Vibration effects may amplify up the building to the first and second floor levels, if high levels of vibration get into the building structure, and so should be mitigated. As for noise, it is likely that alternative accommodation will be required for rooms overlooking the demolition site and therefore these rooms will most likely be vacant during the construction / refurbishment works.

The minimum distances to the receptors along Gosford Street and the student accommodation at Conisborough Keep, are further than the distances given in Table 7 and therefore are not expected to be subject to perceivable levels of vibration.

BPM will be used to minimize the effect of vibration. Any effects from vibration are not expected to be continuous throughout the demolition/construction works.

Appendix A - Survey Details

A1. Location of Survey

James Starley Building, Cox Street, Coventry.

A2. Date & Time of Survey

15 December 2017 09:07-11:01

A3. Personnel Present During Survey

David Harbon MSc CEng MIOA, SRL Technical Services Ltd

A4. Weather Conditions during Survey

Dry and clear, 2-4°C, wind speeds generally <5m/s in from NE. Some wind gusts exceeded 5m/s.

A5. Instrumentation

Vibration equipment:

Svantek Type 958 Sound and Vibration Analyser (SRL No: 826) (Serial No: 28467)

Dytran 3233A Accelerometer (SRL No: 795) (Serial No: 1003)

A6. Calibration Procedure

The vibration equipment was set to the sensitivity levels described within its calibration certificate.

A7. Survey Procedure

Vibration levels were monitored at various positions around the site as shown on Figure 1. The measurement results are in Tables 1-3 of the main report, and explanations of the parameters used are listed in Appendix C.



Appendix B - BS5228:2009 Calculations

Demolition Works Noise Prediction Calculation

Activity	Plant	Source data ref	Typical Noise level at 10m for one Plant item operating dB(A)	Percentage on time	Screening	Typical LAeq at 10m for each plant item dB(A)	Energy Value	Noise level per activity dB(A)
Site Mobilisation	Mobile crane	C4.38	78	75	0	77	47321800.84	83
	Lorry	C6.21	80	75	0	79	75000000	
	Generator	C8.24	59	100	10	49	79432.82347	
	Small excavator	C2.24	73	75	0	72	14964467.36	
	Hammer	C1.19	69	75	10	58	595746.176	
	Nail gun	C4.95	73	75	10	62	1496446.736	
	Dump truck	C2.30	79	75	0	78	59574617.6	
Site Preparation	Dozer	C2.10	80	75	10	69	7500000	80
	Tracked excavator	C2.3	78	75	10	67	4732180.084	
	Wheeled loader	C2.27	80	75	10	69	7500000	
	Dump truck	C2.30	79	75	10	68	5957461.76	
	Lorry	C2.34	80	75	0	79	75000000	
Demolition Works	Tracked Mobile crane	C4.52	75	75	10	64	2371708.245	85
	Lump hammer	C1.19	69	20	10	52	158865.6469	
	Hand held gas cutter	C3.35	65	20	10	48	63245.5532	
	Petrol hand-held circular saw	C4.70	91	20	10	74	25178508.24	
	Tracked Crusher	C1.14	82	75	10	71	11886698.94	
	Pulvenizer mounted on wheeled backhoe	C1.03	80	75	10	69	7500000	
	Hand-held hydraulic breaker	C1.07	93	75	10	82	149644673.6	
	Wheeled loader	C2.27	80	75	10	69	7500000	
	Dump truck (tipping fill)	C2.30	79	75	10	68	5957461.76	
	Lorry	C6.21	80	75	0	79	75000000	
	Tracked excavator	C2.14	79	75	10	68	5957461.76	
	Generator	C4.86	59	100	10	49	79432.82347	
	compressor	C5.5	65	75	10	54	237170.8245	



Construction/Refurbishment Works Noise Prediction Calculation

Activity	Plant	Source data ref	Typical Noise level at 10m for one Plant item operating dB(A)	Percentage on time	Screening	Typical LAeq at 10m for each plant item dB(A)	Energy Value	Noise level per activity dB(A)
Pile Mat Creation	Dozer	C2.10	80	60	10	68	6000000	72
	Dozer	C2.10	80	60	10	68	6000000	
	Excavator	C2.29	79	60	10	67	4765969.408	
	Vibratory Roller	C5.20	75	20	10	58	632456.532	
CFA Piling	CFA Piling Rig	C3.22	80	80	10	69	8000000	75
	Crawler Crane	C3.29	70	40	10	56	400000	
	Concrete Mixer truck (unloading)	C4.25	82	30	10	67	4754679.577	
	Silenced generator	C4.78	66	100	10	56	398107.1706	
	Excavator	C2.29	79	30	10	64	2382984.704	
	Excavator	C2.29	79	30	10	64	2382984.704	
	Hand tools	C1.19	69	30	10	54	238298.4704	
	Forklift	C2.35	71	30	10	56	377677.6235	
	Concrete Pokers	C4.33	78	20	10	61	1261914.689	
	Hand-held hydraulic breaker	C1.7	93	5	10	70	9976311.575	
	Hydraulic breaker power pack	C1.8	74	5	10	51	125594.3216	
Pilecap breakdown	Dozer	C2.10	80	30	10	65	3000000	78
	Hand-held hydraulic breaker	C1.7	93	30	10	78	59857869.45	
	Hydraulic breaker power pack	C1.8	74	30	10	59	753565.9295	
	Excavator	C2.29	79	30	10	64	2382984.704	
	Excavator	C2.29	79	30	10	64	2382984.704	
	Hand tools	C1.19	69	30	10	54	238298.4704	
	Forklift	C2.35	71	30	10	56	377677.6235	
	Silenced Generator	C4.75	66	100	10	56	398107.1706	
Foundations	Dump trucks	C2.30	79	40	10	65	3177312.939	74
	Dozer	C2.10	80	30	10	65	3000000	
	Excavator	C2.29	79	80	10	68	6354625.878	
	Excavator	C2.29	79	80	10	68	6354625.878	
	Delivery wagons	C2.26	79	20	10	62	1588656.469	
	Concrete mixer truck (unloading)	C4.25	82	30	10	67	4754679.577	
	Mobile Crane	C3.29	70	20	10	53	200000	
	Silenced Generator	C4.78	66	100	10	56	398107.1706	
	Hand tools	C1.19	69	30	10	54	238298.4704	
	Forklift	C2.35	71	30	10	56	377677.6235	
	Pre-cast floors	Forklift	C2.35	71	30	10	56	
Mobile Crane		C3.29	70	20	10	53	200000	
Delivery Wagon		C2.26	79	20	10	62	1588656.469	
Hand tools		C1.19	69	30	10	54	238298.4704	
Concrete Poker		C4.33	78	20	10	61	1261914.689	
Concrete mixer truck		C4.20	82	40	10	68	6339572.77	
Concrete frame	Tower crane	C4.49	77	60	10	65	3007123.402	72
	Compressor	C3.19	75	70	10	63	2213594.362	
	Concrete poker	C4.33	78	20	10	61	1261914.689	
	Concrete mixer truck (unloading)	C4.25	82	40	10	68	6339572.77	
	Hand tools	C1.19	69	30	10	54	238298.4704	
	Mobile working platform	C4.57	67	60	10	55	300712.3402	
	Delivery wagon	C2.26	79	20	10	62	1588656.469	
	Forklift	C2.35	71	30	10	56	377677.6235	
Brickwork	Delivery wagon	C2.26	79	10	10	59	794328.2347	65
	Tower crane	C4.49	77	40	10	63	2004748.935	
	Mobile Working platform	C4.57	67	60	10	55	300712.3402	
Roof Structure	Tower Crane	C4.49	77	40	10	63	2004748.935	65
	Hand tools	C1.19	67	30	10	52	150356.1701	
	Delivery Wagon	C2.26	79	10	10	59	794328.2347	
External Works/Landscaping	Dozer	C2.10	80	75	10	69	7500000	81
	Tracked excavator	C5.18	80	75	10	69	7500000	
	Tracked excavator	C5.18	80	75	10	69	7500000	
	Articulated dump truck	C5.16	81	75	10	70	9441940.538	
	Lorry	C6.21	80	75	0	79	7500000	
	Vibratory roller	C5.20	75	75	10	64	2371708.245	
	Asphalt paver + tipper lorry	C5.31	77	75	10	66	3758904.252	
	Circular saw	C4.72	79	75	10	68	5957461.76	

Appendix C - Noise Measurement Parameter Definitions

L_{A90} - The "A" weighted sound pressure level that is exceeded for 90% of the measurement period. It is commonly used as the "Background Noise Level".

L_{AFmax} - The maximum "A" weighted sound pressure level recorded during the measurement period.

L_{Aeq} - The "A" weighted equivalent continuous sound pressure level. A representation of a continuous sound level containing the same amount of sound energy as the measured varying noise, over the measurement period. It can be considered as the "average" noise level.

PPV - Peak Particle Velocity. The instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.

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