Technical Note

Project:	**Central Somers Town**				
Client:	**Morgan Sindall Construction & Infrastructure Limited**				
Subject:	**Vibration Assessment Report**				
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1 Introduction

RSK Acoustics (RSKA) has been instructed by Morgan Sindall Construction & Infrastructure Limited to undertake a desktop vibration assessment of their proposed construction activity at Central Somers Town, Camden (NW1 1HW). The site is located off Brill Place Gardens and accessed from Purchase Street; the proposed site plan is reproduced below:

Figure 1.1 Proposed site plan (reproduced from drawing 3873-LBA-ZZ-ZZ-DR-A-110500-P01)

Site activity consists of the demolition of an existing community centre in the corner of the site to allow for ground level dig reduction and construction of two apartment blocks (plots 5 and 6) with 34 residential units. The proposals further incorporate a new community centre on the ground floor of plot 5. The apartment blocks are to be built on a piled foundation, of brick façade with polyester powder coated cladding on a reinforced concrete frame. The façade of plot 5 is 3 metres from the nearest residential building on Hampden Close, with the façade of plot 6 at 12 metres from the nearest residential property along Coopers Lane.

Discussions with the client have been sought, which has isolated the following construction plant items likely to cause discernible levels of vibration; those include:

- 20 tonne excavators;
- 9 tonne dumpers; and
- CFA rig capable of 600 mm diameter piles at circa 25 metres deep.

Given the design of the groundwork/piling is in its infancy, there are no specific details regarding equipment specifications or likely locations. The assessment has therefore adopted a conservative assessment methodology and assumed the equipment operates at closest distance of approach to the nearest receptors.

2 Methodology

British Standard 5228-2: 2009+A1: 2014 *'Code of practice for noise and vibration control on construction and open sites. Vibration'*, provides a series of calculation methodologies and historical data for various construction tasks including piling, compaction and tunnelling. In this instance, this assessment shall be informed by the information within this standard and RSKAs own, in-house monitoring data to inform likely vibration levels at nearest properties.

3 Assessment Criteria

3.1 Cosmetic Damage to Residential Property

British Standard 7385-2 (reproduced in BS 5228-2:2009+A1:2014) provides guide values to prevent cosmetic damage to property. Between 4 Hz and 15 Hz, a guide value of 15 - 20 mm/s peak particle velocity (PPV – greatest instantaneous particle velocity of the three perpendicular directions of measurement within a given time interval) is recommended for unreinforced and residential property, whist above 40 Hz the guide value is 50 mm/s PPV.

Table 3.1 and **Figure 3.1** details the transient vibration guidance values to prevent the onset of cosmetic damage.

Line	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 commercial 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;
Note 2 – for line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

Table 3.1 Transient vibration guide values for cosmetic damage (BS 7385-2: 1993, page 5)

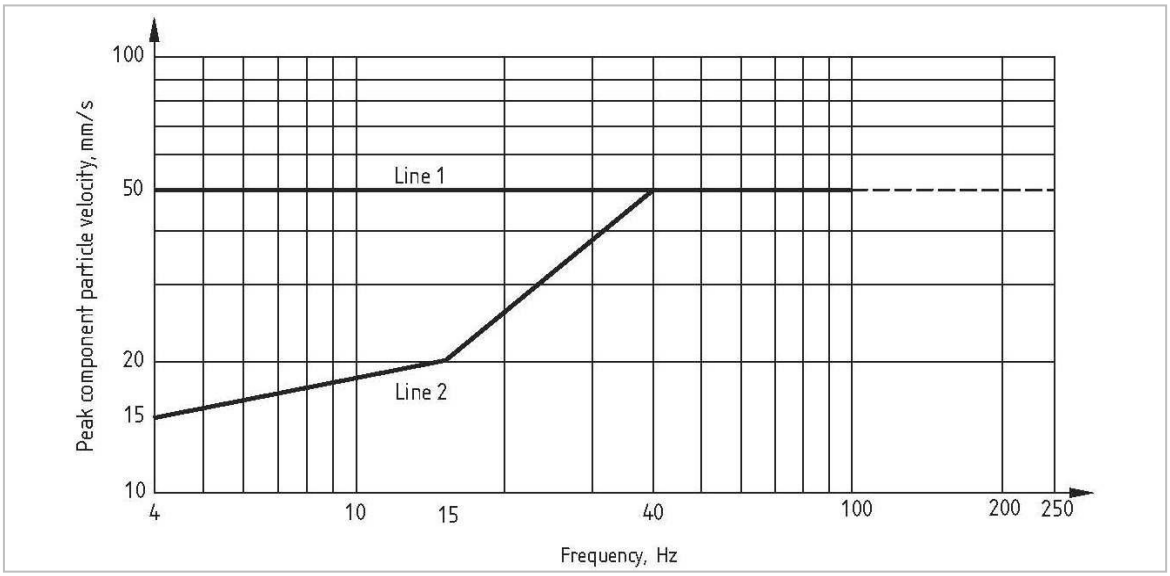

Figure 3.1 Transient vibration guide values for cosmetic damage (BS 7385-2: 1993, page 6)

According to BS 7385-2, *"Minor damage is possible at vibration magnitudes which are greater than twice those given for cosmetic damage, and major damage to a building structure may occur at values greater than four times the tabulated values"*.

Published damage criteria will not necessarily differentiate between these damage types, instead, the guidance values will be at such a level that precludes the onset of cosmetic damage and therefore automatically prevent any higher grade of damage.

3.2 Human Annoyance

In addition to criterion levels to prevent the onset of cosmetic damage, BS 5228- 2:2009+A1:2014 provides guidance on vibration levels to assess the likely impacts of construction activities on humans. Annex B of the standard gives guidance on the significance of vibration effects in terms of human response to vibration (T**able 3.2** refers).

Vibration Level (PPV)	Effect
0.14 mm/s	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	Vibration might be just perceptible in residential environments
1.0 mm/s	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	Vibration is likely to be intolerable for any more than a very brief exposure to this level

Table 3.2 Guidance on effects of vibration levels perceptible on humans

4 Likely Vibration Levels

4.1 CFA Piling

CFA piling is the preferred method of piling due to the significantly lower levels of vibration that would be generated when compared with other piling techniques i.e. vibratory or percussive. The use of CFA piling is also referenced in BS 5228-2 (Section 8.5.3) as a vibration mitigation measure i.e. an alternative method that is least likely to give rise to unacceptable levels of vibration. Section F3.2.4 of BS 5228-2 provides the following statement in respect of vibration from CFA techniques:

"The levels of vibration associated with continuous flight auger injected piling and pressed-in piling are minimal, as the processes do not involve rapid acceleration or deceleration of tools in contact with the ground but rely to a large extent on steady motions. Continuous vibrations at a low level could be expected from the prime movers."

RSKA previously undertook monitoring of CFA piling in Maidstone (former South Essex College - August 2020) where a PPV level of 0.9 mm/s was measured at a distance of 18 metres. In addition, BS 5228-2 (Table D.6, Ref. no.105) provides measured data of rotary piling (using 600 mm diameter piles) at distances of 3.5 metres and 8 metres from the pile location. The resultant peak particle velocity vibration level was recorded at a level of 0.23 mm/s and 0.04 mm/s respectively.

Based on a potential nearest distance to residential property of 3 metres, vibration produced by CFA piling, is unlikely to exceed the guidance criteria for the onset of cosmetic damage within Section 3 of this technical note (i.e. lower limit of 15 mms/s disregarding frequency). It is likely that such levels may cause complaint (i.e. exceed 1.0 mm/s).

4.2 Excavators and Dumpers

It is expected that construction would also involve the use of both excavators and dumpers, particularly during the initial demolition, groundworks and substructure phases. BS 5228-2 does not provide historical data of vibration levels from the general movement of plant and equipment. In this case, it is expected that levels of vibration from general operations of these plant items would not cause significant levels of vibration, nor exceed the guidance levels for cosmetic damage provided in Section 3 (i.e. lower limit of 15 mms/s disregarding frequency).

RSK Acoustics previously undertook monitoring of a Kobelco SK210 22 tonne excavator in Maidstone (former South Essex College - August 2020) where a PPV level of 3.4 mm/s at a distance of 5 metres was measured. Furthermore, attended monitoring by RSK Acoustics of lorry and dumper movements measured levels of 0.4 mm/s at a distance of 4 metres.

4.3 Concrete Breaking

At this stage, it is unknown whether the site would require concrete breaking to facilitate the foundation works but for the purposes of this technical note, likely vibration levels from concrete breaking have been included to inform future mitigation measures.

In the absence of specific formulae in BS 5228-2 to calculate vibration levels from this task, data from a representative exercise measured by RSKA during concrete breaking activities of a car park area in Reigate, Surrey has been used. Vibration levels at various distances from a concrete slab were measured during the operation of a JCB 3CX ECO backhoe loader with a ProDem PRB100 breaker attachment (93 mm diameter and maximum impact energy of 1,350 Joule). Based on the individual vibration samples obtained during the monitoring exercise a trendline was created to provide a continuous prediction of the vibration decay under test conditions:

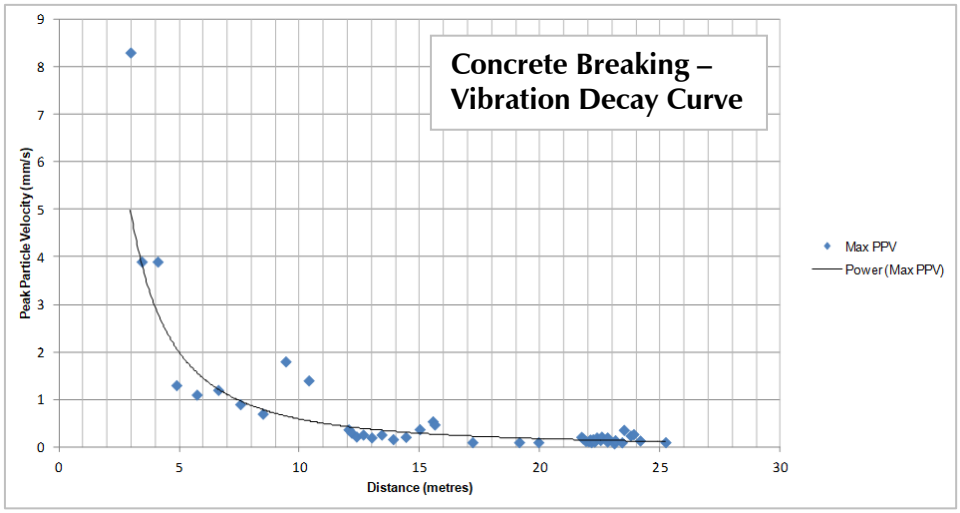

Figure 4.1 Ground Vibration Decay Curve (concrete breaking)

A maximum vibration level of 8.3 mm/s was measured at a distance of 3 metres and decreased considerably to levels below 3 mm/s at a distance of 5 metres (and beyond) from the breaker.

5 Discussion

Based on the assessment of likely vibration levels from proposed construction activity at the upcoming Central Somers Town construction site, vibration levels are likely to remain below the lower limiting level of 15 mm/s for the onset of cosmetic damage to residential property, although are predicted to exceed 1 mm/s which may cause complaint by adjacent receptors. It should be noted that this assessment is based on historical data and empirical formula within BS 5228-2, and RSKA's inhouse data of similar operations.

Given the proximity of the proposed works to adjacent residential receptors, it is recommended that prior warning and explanation be given to residents and that monitoring be undertaken at strategic positions during the construction activity, the scale of which (number of positions and monitoring length) is not covered within this note. It is recommended that monitoring be undertaken adhering to the recommendations in Section 6 of this technical note.

6 Construction Monitoring

It is recommended that long-term vibration monitoring be conducted throughout the duration of the project where large scale plant items, such as the piling rig and movement of excavators/dumpers. The vibration monitor(s) should have the facility to measure (as a minimum) Peak Particle Velocity (PPV – in mm/s), at a suitable resolution to enable the vibration to be quantified against stipulated criteria. The instrumentation should be appropriate for the measurement of building vibration with respect to human response in line with ISO 8041-1:2017 *'Human response to vibration — Measuring instrumentation — Part 1: General purpose vibration meters'*.

It is recommended that monitoring positions be chosen which provide a representative sample of the worst-case incidence on the receptors. The vibration monitor(s) should be buried, or suitably coupled to the ground in the horizontal position on a suitably flat, hard surface at the base of the receptor (or structure) via a ground spike and/or steel plate to the requirements of BS ISO 4866: 2010 '*Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures'*.

The vibration monitor(s) should be installed with modem capability, enabling the real-time and historical noise data to be viewed via a dedicated web server. The system should allow for both 'amber and 'red' alert triggers to be set, in order to warn the construction team of criterion exceedances (via email or text). Trigger levels should be based on the guidance within Section 3 of this technical note.

If the 'amber' alert level is exceeded, a review of on-site activities should take place to check that working methodologies and the use of plant is in accordance with BPM and that appropriate onsite mitigation measures are in place. If the 'red' alert level is exceeded, the relevant works

causing the high vibration levels should cease when safe to do so, and only recommenced once ameliorative actions are undertaken.

Where the results of the vibration monitors corroborate that the measured levels are attributable to construction works, the following actions should be undertaken:

- Review the vibration monitoring data in conjunction with an acoustic specialist to determine as far as is reasonably practicable the activities / plant responsible for the exceedance(s); and
- Ascertain if there are any additional reasonably practicable means of reducing the construction vibration levels. Vibration criteria exceedances, causes, and any corrective action should be documented.

When necessary, and due to complaints or predicted levels of excessive vibration, additional attended vibration levels should be measured to validate both the predicted levels within this technical note and to ensure trigger levels are not exceeded at sensitive receptor. When attended measurements are being undertaken, the plant in operation should be checked to ensure appropriate Best Practicable Means (BPM) measures are being adopted and that working hours are adhered to.