Description	Analysis of vibration affecting the proposed residences at 143 Adelaide Road, NW3 3NL
Date	11 March 2016
Issued by	Phill Banks
Issued to	Derek Butler, Oakdean Construction Ltd
Ref No	PJB7748/15399

1. INTRODUCTION

Following an instruction from Oakdean Construction Ltd, Spectrum have undertaken vibration monitoring surveys at the boundaries of the former Adelaide public house, 143 Adelaide Road, NW3. This technical note describes the background to the survey along with the measurement method, the results obtained, the assessment of the results and the recommendations arising from it.

2. BACKGROUND

The subject site is in proximity to tunnels serving the west coast main line from London Euston to Scotland as shown in Attachment 1.

Planning permission 2012/3923/P for redevelopment of the subject site to provide 5 No. 4 bedroom houses with basement car parking (Class C3) following demolition of the existing public house was granted planning permission by London Borough of Camden, subject to a number of planning conditions, including No. 18, which states:

a) *Before building works commence on the site, a scheme, including the standards to be used shall be submitted to and approved in writing by the Local Planning Authority for the insulation from the externally generated vibration from road and underground railway. The scheme shall provide adequate sound insulation to prevent the transmission of noise and/or vibration from the underground/train/underground maintenance to ensure structure borne noise and vibration levels are not perceived as measured according BS 6472-1- 2008 Guide to evaluation to human exposure to vibration in buildings".*

b) *On completion a test on each dwelling shall be carried out to verify compliance with this condition and a report shall be produced containing all raw data and showing how calculations have been made. The Noise report shall clearly contain standards used, measurements locations, raw tabulated and graphically represented data, time, date as a minimum. A copy of such report shall be submitted to the Local Planning Authority for its approval in writing prior to occupation.*

Thereafter, the measures shall be maintained for the lifetime of the development.

3. STANDARDS FOR ACCEPTABILITY

3.1 BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings – part 1: vibration sources other than blasting

BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting* states, in relation to perception, that:

3.3 Thresholds of perception

Perception thresholds for continuous whole-body vibration vary widely among individuals. Approximately half the people in a typical population, when standing or seated, can perceive a vertical weighted peak acceleration of 0.015 $m \cdot s^{-2}$. The weighting used is W_b. A quarter of the people would perceive a vibration of 0.01 $m \cdot s^{-2}$ peak, but the least sensitive quarter would only be able to detect a vibration of 0.02 $m \cdot s^{-2}$ peak or more. Perception thresholds are slightly higher for vibration duration of less than about 1 s.

However, it goes on to state

3.5 Vibration dose summation

The effect of building vibration on the people within is assessed by finding the appropriate vibration dose. Present knowledge shows that this type of vibration is best evaluated with the vibration dose value (VDV).

Therefore, this standard uses the measurement parameter Vibration Dose Value (VDV) to classify exposure to vibration in terms of likelihood of adverse comment. VDV takes into account both vibration level and the duration of vibration, thereby giving additional weight to vibration levels that are frequent or of high level.

Table 1, below, provides the vibration dose values at which various degrees of adverse comment may be expected in residential dwellings, taken from this Standard.

Vibration dose value ranges ($m/s^{1.75}$) in which various degrees of adverse comment may be expected in office buildings			
Place and time	**Low probability of adverse comment $m/s^{1.75}$ – note 1)**	**Adverse comment possible $m/s^{1.75}$**	**Adverse comment probable $m/s^{1.75}$ – note 2)**
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 1: Rating of VDV values in accordance with table 1 of BS6472-1 2008

note 1) Below these ranges adverse comment is not expected
note 2) Above these ranges adverse comment is very likely

3.2 Camden Development Policies DP28 – Noise and vibration

DP28 states that

The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for:

a) development likely to generate noise pollution; or
b) development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided.

Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted.

In assessing applications, we will have regard to the Noise and Vibration Thresholds, set out below.

Table C: Vibration levels on residential sites adjoining railways and roads at which planning permission will not be granted

Vibration description and location of measurement	Period	Time	Vibration levels
Vibration inside critical areas such as a hospital operating theatre	Day, evening and night	0000-2400	0.1 VDV ms-1.75
Vibration inside dwellings	Day and evening	0700-2300	0.2 to 0.4 VDV ms-1.75
Vibration inside dwellings	Night	2300-0700	0.13 VDV ms-1.75
Vibration inside offices	Day, evening and night	0000-2400	0.4 VDV ms-1.75
Vibration inside workshops	Day, evening and night	0000-2400	0.8 VDV ms-1.75
Where dwellings may be affected by ground-borne regenerated noise internally from, for example, railways or underground trains within tunnels, noise levels within the rooms should not be greater than 35dB(A)max			

Spectrum contacted Edward Davis, an Environmental Health Officer with Camden Council who confirmed that criteria for residential properties above represents the standard the Council would apply to this development.

4. VIBRATION SURVEY

The following instrumentation was used to measure vibration levels at the site during the survey:

Survey Dates	Equipment	Serial Number
24-27 February, 2014	SVAN 958 vibration meter Dytran triaxial accelerometer type 3233A	15173 646

Table 2: Vibration monitoring equipment used

The meter and accelerometer are laboratory calibrated biennially in accordance with UKAS procedures or to traceable National Standards.

Measurements were undertaken at 2 locations. Continuous vibration monitoring was carried out from Thursday 11 to Tuesday 16 February, 2016 inside the entrance lobby at ground floor level facing Adelaide Road. Measurements were then conducted between Tuesday 16 and Friday 19 February, 2016 against the northern retaining wall of the basement of the existing building. These locations are as shown in Attachment 2.

Short-term measurements were also undertaken against the southern boundary of the site, next to the dwellings at houses 3 and 4, 4 to 12 Elsworthy Rise.

Vibration measurements comprised all ambient sources of vibration, including the nearby underground national rail lines and any other ambient source

Vibration was measured in terms of RMS acceleration between 0.5-80 Hz in three orthogonal directions as detailed in BS 6472-1:2008. The vibration monitor records the vibration data in the three axes simultaneously and stores them over contiguous 5 minute periods. The measured acceleration data is weighted according to the standard to produce Vibration Dose Values directly. The data has been processed to determine the day-time and night-time VDV values for comparison with the guidelines for acceptability shown in Table 1.

5. RESULTS OF VIBRATION MONITORING

The measured Vibration Dose Values at the monitoring location are shown in Table 3 below. The highest daytime and night-time levels in any of the ordinate directions are shown in **bold**.

Period	Duration	Measured VDV $m/s^{-1.75}$		
		x	y	z
Daytime VDV	7.75 hour period to 11pm on 11/2/16 note 1.	0.010	0.005	0.048
Night-time VDV	8 hour period from 11pm on 11/2/16	0.010	0.004	0.049
Daytime VDV	16 hour period from 7am on 12/2/16	0.010	0.005	0.053
Night-time VDV	8 hour period from 11pm on 12/2/16	0.009	0.004	0.047
Daytime VDV	16 hour period from 7am on 13/2/16	0.012	0.004	0.050
Night-time VDV	8 hour period from 11pm on 13/2/16	0.009	0.003	0.047
Daytime VDV	16 hour period from 7am on 14/2/16	0.010	0.004	0.050
Night-time VDV	8 hour period from 11pm on 14/2/16	0.010	0.004	0.044
Daytime VDV	16 hour period from 7am on 15/2/16	0.011	0.005	0.054
Night-time VDV	8 hour period from 11pm on 15/2/16	0.010	0.004	**0.049**
Daytime VDV	5.75 hour period from 7am on 16/2/16 note 1.	0.012	0.005	**0.058**

Table 3: Summary of measured vibration levels between 11 and 16 February

Period	Duration	Measured VDV $m/s^{-1.75}$		
		x	y	z
Daytime VDV	7.75 hour period to 11pm on 16/2/16 note 1.	0.005	0.004	0.050
Night-time VDV	8 hour period from 11pm on 16/2/16	0.004	0.003	0.044
Daytime VDV	16 hour period from 7am on 17/2/16	0.004	0.004	0.052
Night-time VDV	8 hour period from 11pm on 17/2/16	0.004	0.003	0.046
Daytime VDV	16 hour period from 7am on 18/2/16	0.005	0.004	0.050
Night-time VDV	8 hour period from 11pm on 18/2/16	0.004	0.005	0.045
Daytime VDV	13.25 hour period from 7am on 18/2/16 note 1.	0.005	0.004	0.049

Table 4: Summary of measured vibration levels between 16 and 19 February

Note 1: These part-period measurements have been extrapolated to simulate the VDV obtained for the full daytime period as described below.

It should be noted that VDV is a cumulative measurement parameter which increases the longer the measurement continues. Therefore, the VDV measurements from partial periods at the beginning and end of the measurement may underestimate the true 16 hour VDV on those days. Accordingly, these measurements have been extrapolated to the full 16 hour period, assuming that the same level of vibration occurs for the remainder of the period. The resultant is shown in the rows in Tables 3 and 4.

The measured peak acceleration resulted in levels up to $0.05 m/s^2$. According to BS6472, these levels would be perceptible. Other surveys have noted that there is perceptible vibration within the existing building. However, it must be noted that the BS6472 assessment, particularly in respect of intermittent

vibration, is carried out in terms of VDV therefore, the peak vibration acceleration is included here for reference only.

Subjectively vibration at the southern part of the site due to passing trains was imperceptible. Measurements were observed to be at or near the noise floor of the instrument and accordingly, vibration levels are assessed to be acceptably low.

6. ASSESSMENT OF VIBRATION AFFECTING THE PROPOSED DEVELOPMENT

Section 5 above indicates that, even for the highest measured level throughout the survey, measured vibration levels are approximately one quarter of the lower limit for low probability of adverse comment from residents during the daytime. At night-time, the worst-case results are around half of the lower limit of the range for possible adverse comment from residents. The highest measured night-time VDV level is also less than 40% of the Camden DP28 limit.

It should be noted, however, that the guidelines for acceptability in BS6472 relate to the locations in proposed habitable rooms where people may be disturbed by this vibration.

The Association of Noise Consultant's Guidelines on the measurement and assessment of groundborne noise and vibration, 2nd edition, shows that there are a variety of factors which can increase or reduce ground vibration levels transferred to buildings, depending upon site and building specific factors. It is not possible to know, at this stage, the significance or relative level of these individual factors at the subject site.

However, for information, the ANC Guidelines indicate that there is a 10 dB reduction in vibration level from the ground to the foundations of a 2-4 storey masonry building. In addition, there is a further 2 dB reduction for each floor up to 5th floor level. Therefore, as a minimum, there is likely to be a further 12 dB reduction of vibration inside the proposed building, relative to the measured levels.

Separately, there would be an increase of between 5 and 15 dB due to floor resonance, although for a concrete framed building such as this, the likely amplification would be nearer to 5 dB than to 15 dB.

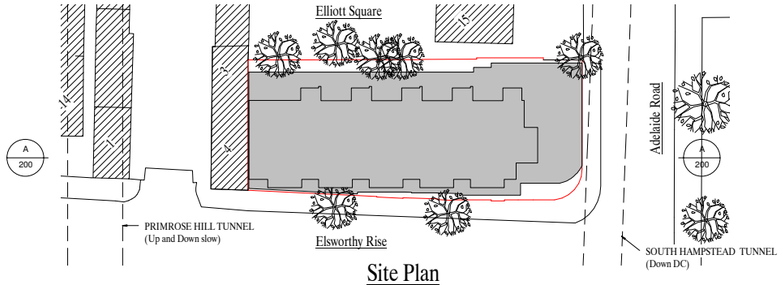
In any case, these effects when applied to the measured VDV levels would result in vibration levels inside the proposed residences that will still be below the lower bound of the 'Low probability of Adverse Comment' according to BS6472. This is the case for both daytime and night-time

Accordingly, no building isolation measures are considered necessary to control or attenuate railway vibration for the proposed building.

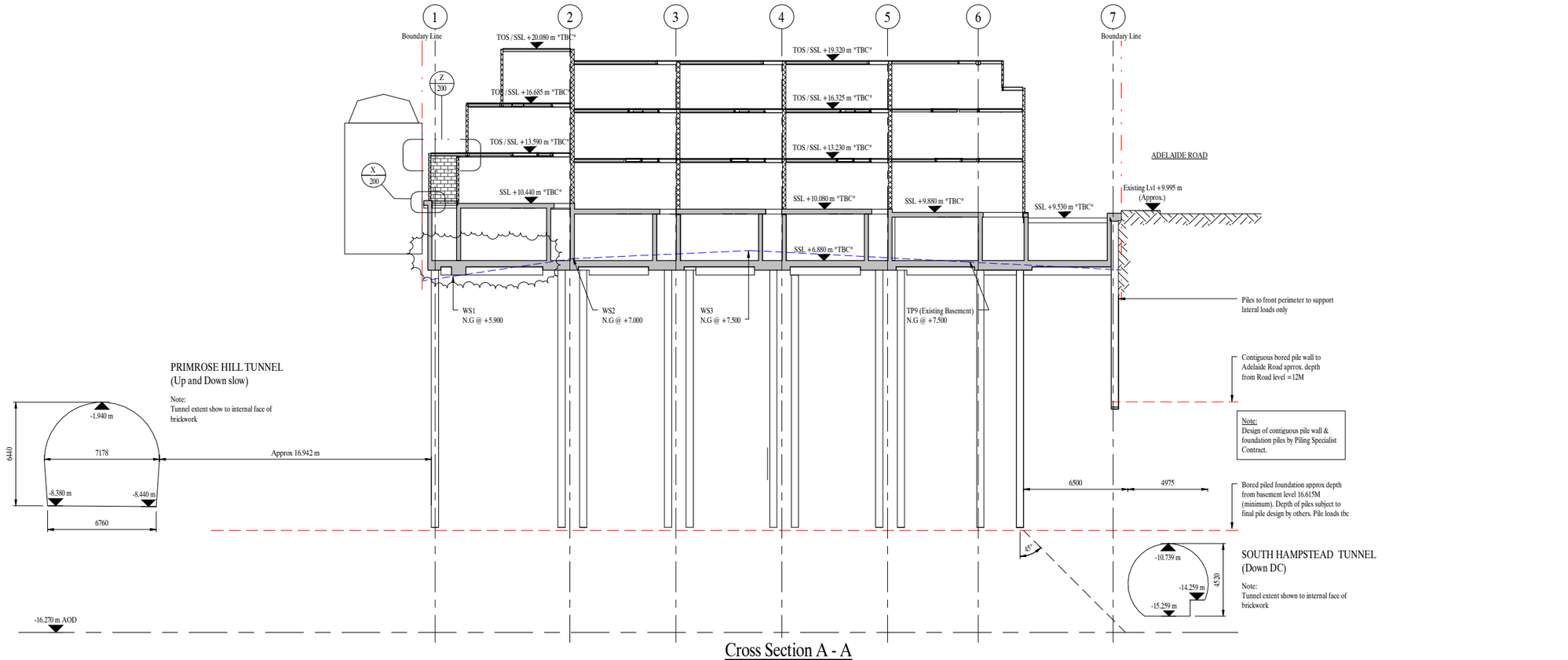
7. CONCLUSION

The findings of this survey and assessment indicate that no adverse vibration impact is expected at this development and no vibration mitigation measures are considered necessary for the building.

Attachment 1 - 1 page



Site Plan



Cross Section A - A

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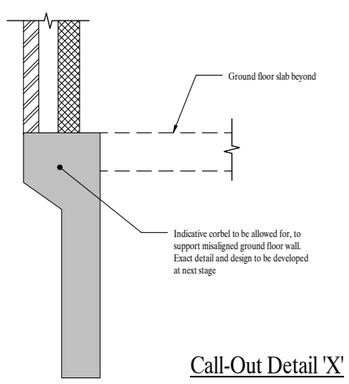

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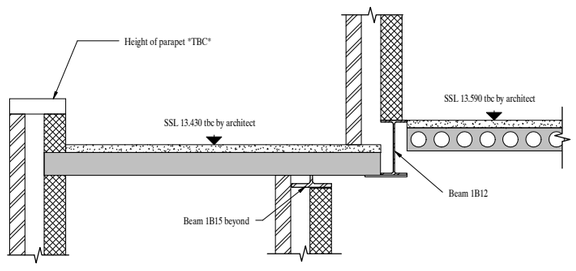

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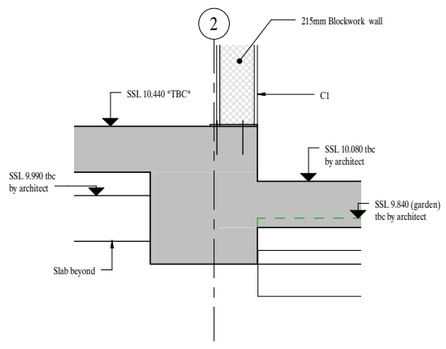

Section 1 - 1

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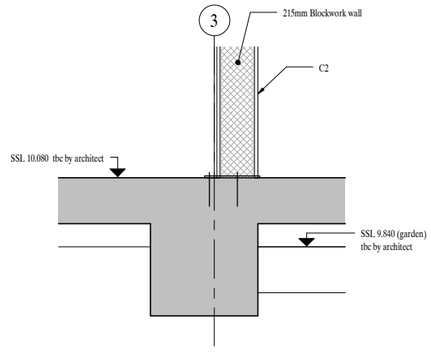

Section 2 - 2

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For General Notes drawing refer to drawing L1870-15-001

All Structural Engineering drawings are to be read with the specification and with all relevant Architects drawings and specifications.

Do not scale from any Structural Engineers drawing. All dimensions are in millimetres and levels in metres.

All waterproofing (DPM & DPC) works to Architects details.

All fire protection works to Architects details unless specifically noted otherwise.

Rev	Date	Drawn	Amendment
01	28.08.15	DA	Issued For Stage 03
-	18.08.15	DA	Issued For Stage 03

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143 ADELAIDE ROAD
LONDON, NW3 3NL
CROSS SECTION A - A

Status : **PRELIMINARY**

Scales : As indicated @ A1		Date :
Drawn : DA	Engineer : BB	Checked : JL
Drawing No. L1870-200		Revision : 01

Attachment 2 - 1 page

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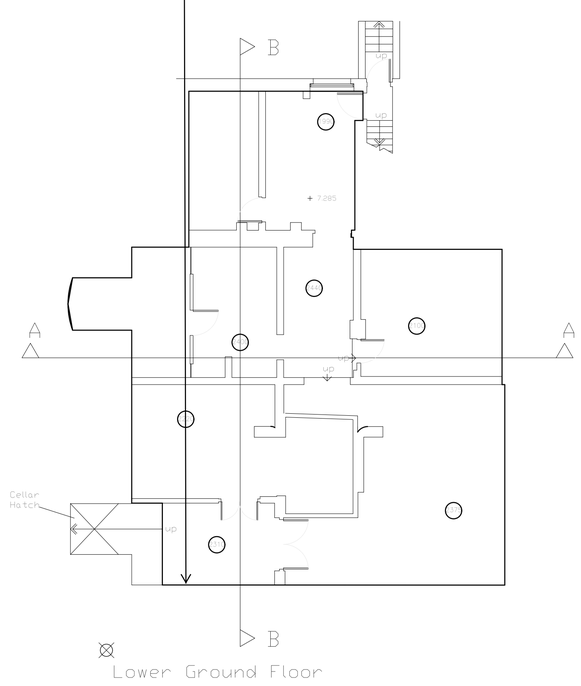
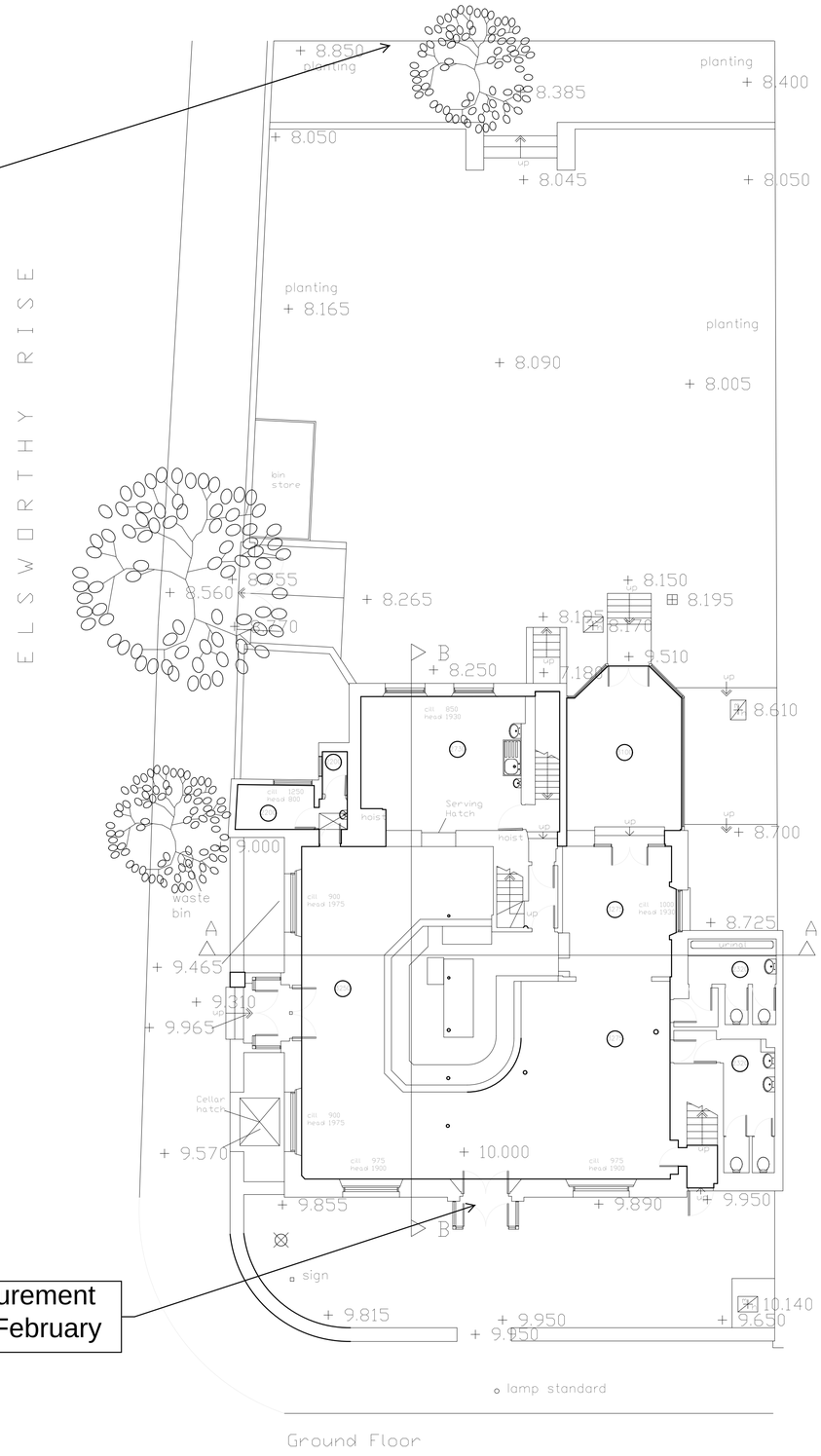
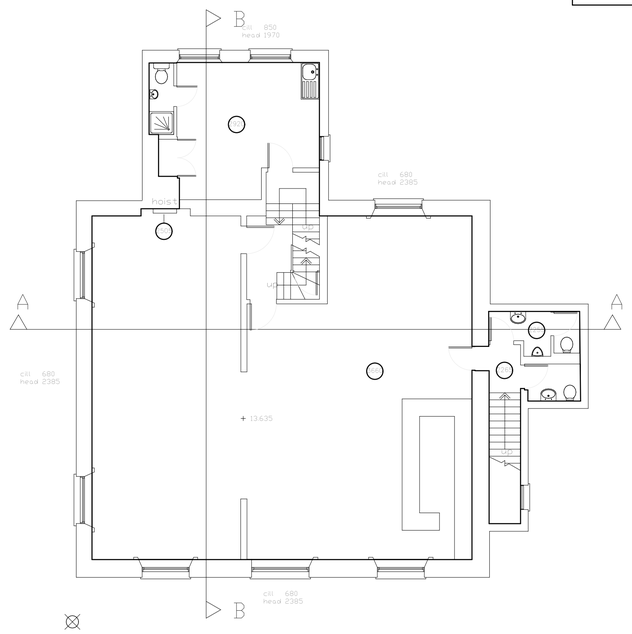
Short-term vibration measurement location

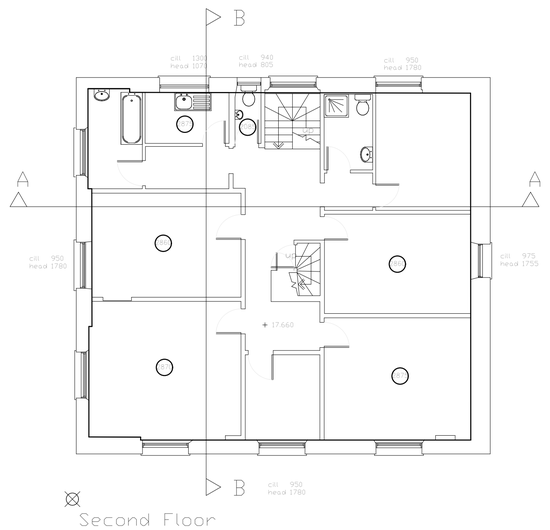
Vibration measurement location 16-19 February





Vibration measurement location 11-16 February





The Adelaide
143 Adelaide Road
London
NW3 3NL

Survey Drawing
Floor Plans

Date: October 2009
Scale: A1 @ 1:100

CAD Ref: 1687-01B

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ALL DIMENSIONS TAKEN TO FACE OF DRY LINING OR WALL CLADDING IF APPLICABLE

ALTHOUGH EVERY ENDEAVOUR IS MADE TO PROVIDE AN ACCURATE SURVEY DRAWING IT IS RECOMMENDED THAT CRITICAL DIMENSIONS SHOULD BE CHECKED ON SITE. INACCESSIBLE AREAS WILL BE SHOWN USING A BROKEN LINE.

A1 @ 1:100