

Project: 39 Brunswick Hill, Reading
Client: EB Solutions Ltd

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1.0 Introduction

It is proposed that a parcel of land presently occupied by 39 Brunswick Hill, Reading, be redeveloped to provide new residential accommodation.

The purpose of this vibration screening assessment is, principally through on-site vibration measurements, to assess the extent to which the proposed property would be affected by groundborne vibration due to the passage of rail traffic passing along the overground lines located approximately 55m to the west of the proposed building of the site.

The assessment reported herein is based on the guidance and principles set out in the following documents:

- British Standard BS 6472: Part 1:2008 "Guide to the evaluation of human exposure to vibration in buildings - Part 1: Vibration sources other than blasting";
-

2.0 Site Description

The site is illustrated by plan below.

Figure 1: Site location:



The eastern boundary of the site is delineated by the Brunswick Hill, a lightly trafficked highway that provides access to local areas. The principal interests in this aspect are of residential usage.

The western boundary of the site adjoins a series of overground railway lines running roughly in a northeast to south west orientation. Beyond this to the west are residential areas.

3.0 The Nature, Measurement and Effect of Vibration

When two objects come into contact through movement (such as a pile and the ground), the mechanical energy from the movement causes vibrations in the vicinity of the two objects. Vibrations in the air causes sound, but some vibrations can be felt through the ground or through structures, especially when a large amount of energy is exerted, such as the passage of heavy goods vehicles over an uneven surface.

Groundborne vibration, especially within structures, has a number of affects both to people and to the structures themselves.

The effects of groundborne vibration on buildings are dependent upon a whole range of factors, not least the magnitude and duration of the vibration, the structure of the soil, the properties and quality of the building materials, the design of the structure, as well as the general condition and age of the structure. In extreme cases, vibration can cause severe structural damage, but most vibration damage manifests itself in minor cosmetic damage such as cracks in rendering and roof tiles slipping, which in turn can cause other problems such as damp.

Groundborne vibration on buildings can be assessed using a number of quantities including the Vibration Dose Value (VDV) or the Peak Particle Velocity (PPV); the latter being maximum instantaneous velocity of a particle at a point during a given time interval expressed in mm/s, or as maximum acceleration in m/s^2 .

4.0 Guidance and Criteria for Groundborne Vibration

Building vibrations as they affect people can be classified usefully according to a combination of descriptions. The time history of the vibration input to the subject can be:

- **Continuous:** vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration can be assessed on the basis of weighted rms acceleration values. Examples of continuous vibration include machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery);
- **Intermittent:** vibration can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources (e.g. pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by). This type of vibration can be assessed on the basis of vibration dose values. Examples of intermittent vibration may include Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines and impact pile driving;
- **Impulsive:** vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds. Impulsive vibration can be assessed on the basis of acceleration values. Impulsive vibration is most likely to startle subjects, particularly if irregularly or rarely occurring. Examples of impulsive vibration include occasional dropping of heavy equipment, occasional loading and unloading.

The adverse effects of vibration on people almost invariably occur inside buildings or other

structures. Satisfactory values for sources of vibration are therefore usually set for locations indoors. From a planning viewpoint (or for convenience of measurement), it is sometimes necessary to translate indoor vibration values to values in the ground (for example, when a building has not yet been constructed or when access to an indoor location is not readily available).

Indoor vibration values caused by an external source can be measured externally (in the ground) and translated to indoor values or measured internally, and then compared to criteria such as those reviewed below. It should be noted that although the criteria are non-mandatory, they are goals that should be sought to be achieved through the application of feasible and reasonable mitigation measures.

When predicted or measured vibration values exceed the preferred values, then mitigation measures to meet the preferred values should be considered. The degree of vibration impact quantifies the extent of mitigation required and the mix of vibration control measures to be adopted as a mitigation strategy.

4.1 **British Standard BS 6472: Part 1:2008**

BS 6472 Part 1 "*Guide to the evaluation of human exposure to vibration in buildings - Part 1: Vibration sources other than blasting*" is the main guidance document utilized for this vibration assessment.

It provides guidance for measuring and evaluating human exposure to vibration where the source of vibration does not arise from blasting activities.

Table 1 below summarizes the levels of vibration dose values (VDV) and the corresponding probability of adverse comments.

Table 1: BS 6472 - Vibration dose values which might result in various probabilities of adverse comment within residential buildings

Place and time	Low probability of adverse comment $\text{m}\cdot\text{s}^{-1.75}$ 1)	Adverse comment possible $\text{m}\cdot\text{s}^{-1.75}$	Adverse comment probable $\text{m}\cdot\text{s}^{-1.75}$ 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

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/s^2 . The weighting used is W_b .

A quarter of the people would perceive a vibration of 0.01 m/s^2 peak, but the least sensitive quarter would only be able to detect a vibration of 0.02 m/s^2 peak or more. Perception thresholds are slightly higher for vibration duration of less than about 1 s.

5.0 Vibration Surveys

Vibration screening surveys were carried out between 21st Nov 2017 at 10:47 hours and 23rd Nov 2017 at 11:42 hours at the location described below.

- MPV1: Ground floor rear of property

The vibration measurement survey was undertaken using the following instrumentation:

- Svan 958 four channel vibration meter (serial number 14627);
- Dytran 3233A Tri-axial accelerometer (serial number 328);
- Svan SA207 Tri-axial accelerometer mounting box.

The accelerometer pack was rigidly affixed to a steel inertia block that was in direct contact with the ground floor of the property. The transducer was oriented to monitor vibration such that the x and y-axes were perpendicular and parallel respectively to railway lines, with the z-axis corresponding to vertical vibration.

All instrumentation carries a current manufacturer's certificate of conformance a copy of which is available upon request.

6.0 Results

Vibration survey results are summarized as broadband values in Table 1 and compared with the perception threshold set out in BS 6472:2008 and shown as a time series in Figure 2.

Table 1: Summary of noise measurement results

Period	Measured Vibration Dose Value				Probability of Adverse Comment (from BS 6472:2008, Table 1)
	Horizontal VDV _d	Horizontal VDV _d	Vertical VDV _b	Highest	
Day 1 ^[x]	0.0040	0.0065	0.0186	0.019	Figures fall below the range of values corresponding to "low probability of adverse comment"
Night 1	0.0030	0.0062	0.0086	0.009	
Day 2	0.0041	0.0082	0.0211	0.021	
Night 2	0.0031	0.0065	0.0085	0.009	
Day 3 ^[x]	0.0028	0.0057	0.0126	0.013	

^[x] Part day readings

Examination of Table 1 shows worst case measured Vibration Dose Values of 0.021 ms^{-1.75} for 16 hour daytime and 0.009 ms^{-1.75} 8 hour night-time respectively. Vibration exposure of these magnitudes falls below the range of "low probability of adverse comment" according to BS 6472:2008.

7.0 Conclusions

A screening assessment has been undertaken to determine vibration exposure due to the sources affecting the proposed development site. The resultant data have been assessed in the context of guidance given in the appropriate British Standard and it is concluded that vibration levels from the railway lines to the west of the development are below the range of values corresponding to “low probability of adverse comment” as given in BS6472:2008.