



**Persimmon Homes**

**Proposed Residential Development  
Parcels A2 and B6 Hampton Park,  
Littlehampton**

**Vibration Assessment  
February 2020**

Executive Park, Avalon Way, Anstey, Leicester, LE7 7GR

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Persimmon Homes  
Parcels A2 and B6 Hampton Park

A116535  
February 2020



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## 1.0 Introduction

### 1.1 Purpose of this Report

This report presents the findings of a vibration assessment for Parcels A2 and B6 of a residential development at Hampton Park, Littlehampton. This report has been compiled to address concerns regarding vibration following comments regarding the site from Arun District Council following a pre-application enquiry:

*"Those dwellings which are within 15m of the railway track must be subject to an assessment of the impact of possible vibration from the railway prior to commencement of development. The assessment to include details of the recommended remedial measures should vibration levels be found to be unacceptable. This assessment must be supplied to and approved by the Local Planning Authority prior to commencement of the development. The assessment shall be carried out in accordance with the method and rating system as detailed in BS6472: 2008 and raw data gathered shall be presented as an appendix to such as assessment. Reason: To safeguard the amenities of residents".*

### 1.2 Vibration Assessment Criteria

There are two applicable British Standards to describe vibration which are:

BS 6472-2:2008, "Guide to Evaluation of Human Exposure to Vibrations in Buildings (1 Hz to 80 Hz)"; and BS 7385-2:1993 "Evaluation and Measurement for Vibration in Buildings" Parts 1 (1990) and 2 (1993).

#### 1.2.1 Building Damage

BS 7385-2:1993 *Evaluation and Measurement for Vibration in Buildings* provides guidance on acceptable values of transient vibration for the avoidance of cosmetic damage to buildings as follows.

**Table 1.1 Transient Vibration Guide Values for Cosmetic Damage**

| Type of Building      | Peak Component Particle Velocity in frequency range of predominant pulse |                                                           |
|-----------------------|--------------------------------------------------------------------------|-----------------------------------------------------------|
|                       | 4 Hz to 15 Hz                                                            | 15 Hz and above                                           |
| Residential 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 50 Hz and above |

Table 1.1 above shows the limits for transient vibration, above which cosmetic damage could occur. Minor damage is possible at vibration magnitudes which are greater than twice those given above and major



damage to a building structure may occur at values greater than four times the tabulated values. PPV values of below 15 mm/s are unlikely to result in any damage to buildings. Damage is classified into the following categories:

**Table 1.2 Damage Classification**

| Damage   | Description                                                                                                                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cosmetic | The formation of hairline cracks <sup>2</sup> on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction. |
| Minor    | The formation of large cracks or loosening and falling of plaster or drywall surfaces, or cracks through bricks/concrete blocks.                                                                                                         |
| Major    | Damage to structural elements of the building, cracks in support columns, loosening of joints, splaying of masonry cracks, etc                                                                                                           |

### 1.2.2 Human Exposure

BS 6472-2:2008 Guide to evaluation of human exposure to vibrations in buildings provides general guidance on human exposure to building vibration in the range of 1 Hz to 80 Hz and includes curves of equal annoyance for humans.

Human reaction to vibration depends on displacement, frequency, the duration (exposure time), point of application and direction of the vibration. It appears that the effect of vibration on the people within a building will be far more serious than the effect on the building itself. The units in which VDV is measured are metres per second raised to the power of minus 1.75 (or  $\text{ms}^{-1.75}$ ).

The Standard gives recommended vibration dose values above which various degrees of adverse comment may be expected in residential buildings, with a daily 16-hour VDV of 0.2 to 0.4  $\text{ms}^{-1.75}$  likely to give low probability of adverse comment as shown in the following table.

**Table 1.3 VDV and Various Degrees of Adverse Comment in Residential Buildings**

| Location                                                   | Low probability of adverse comment | Adverse comment possible       | Adverse comment probable       |
|------------------------------------------------------------|------------------------------------|--------------------------------|--------------------------------|
| Residential Buildings<br>(16 hour DAYTIME 07.00 – 23.00)   | 0.2 to 0.4 $\text{ms}^{-1.75}$     | 0.4 to 0.8 $\text{ms}^{-1.75}$ | 0.8 to 1.6 $\text{ms}^{-1.75}$ |
| Residential Buildings<br>(8 hour NIGHT-TIME 23.00 – 07.00) | 0.1 to 0.2 $\text{ms}^{-1.75}$     | 0.2 to 0.4 $\text{ms}^{-1.75}$ | 0.8 $\text{ms}^{-1.75}$        |



### **1.2.3 Vibration from Lyminster Bypass**

The Highways Designer for the project (Stantec) has supplied the following comments to address vibration from Lyminster Bypass road:

*"Stiff structures, such as the ones proposed for Toddington Lane Road Bridge (WSCC Ref. 1740) and the Railway Overbridge (WSCC Ref. 1741), are significantly less susceptible to vibrations induced by external forces (e.g. wind, passing vehicles, crowd loading, etc.) than slender structures such as footbridge. Therefore, the codes of practice do not require vehicle induced vibrations to be checked for the design of these two bridges.*

*Semi-integral bridges have been proposed for the two bridges carrying the Lyminster Bypass (Toddington Lane Road Bridge and Railway Overbridge). The proposed structures will be constructed from precast prestressed concrete U-beams with an in-situ reinforced concrete deck slab supported on reinforced concrete abutments via elastomeric bearings. Vertical, horizontal and torsional vibrations of the deck due to traffic loads will be accommodated and isolated by the deformation of the bearings".*



## 2.0 Vibration Survey

### 2.1.1 Vibration Survey Methodology

A monitoring survey was undertaken to characterise baseline vibration levels currently experienced on and around the site from the adjacent railway. Equipment used during the survey included:

Vibrocock V901      Serial Number: 783

The accuracy of the calibrators can be traced to National Physical Laboratory Standards, calibration certificates for which are available on request.

Attended vibration measurements were undertaken at nine locations; seven of those are representative of proposed dwelling foundations (V2-V6 & V9-V10) and with two being representative of gardens (V7 & V8). Continuous vibration measurements were undertaken at one location representative of the foundations of the nearest proposed dwelling to the railway track (V1). Measurements were carried out from 28<sup>th</sup> January 2020 to 29<sup>th</sup> January 2020 at the following locations which are shown on SK01 of Appendix A.

**Table 2.1    Vibration Monitoring Locations**

| Ref. | Description                                                                      |
|------|----------------------------------------------------------------------------------|
| V1   | Southwestern part of the development site (approximately 13m from railway line)  |
| V2   | Southern part of the development site (approximately 18m from railway line)      |
| V3   | Southern part of the development site (approximately 17m from railway line)      |
| V4   | Southern part of the development site (approximately 16m from railway line)      |
| V5   | South-eastern part of the development site (approximately 16m from railway line) |
| V6   | South-eastern part of the development site (approximately 16m from railway line) |
| V7   | Southern part of the development site (approximately 8m from railway line)       |
| V8   | Southern part of the development site (approximately 9m from railway line)       |
| V9   | North-eastern part of the development site (approximately 75m from railway line) |
| V10  | Northwest part of the development site (approximately 65m from railway line)     |

### 2.1.2 Vibration Survey Results

Table 2.2 below shows the maximum Peak Particle Velocity (PPV) levels measured at each monitoring location from the continuous 24 hours monitoring at location V1 during both the daytime and night-time periods. Full raw data (hourly breakdown) of all measurement positions is available upon request.



**Table 2.2 Unattended Vibration Results – PPV mm/s**

| Location | Date                                    | Period (Daytime/Night-time) | Max PPV mm/s |
|----------|-----------------------------------------|-----------------------------|--------------|
| V1       | 29/01/2020 11:45am – 30/01/2020 11.45am | Daytime 30/01/2020 09:50    | 0.950        |
|          |                                         | Night-time 30/01/2020 06:54 | 0.975        |

VDV measurements were undertaken at location V1 over the 24 hour period; the results are presented in Table 2.3 below. Full raw data (hourly breakdown) of all measurement positions is available upon request.

**Table 2.3 Unattended Vibration Results – VDV m/s**

| Location | Monitoring Date                         | Period     | Total Measured VDV |       |       |
|----------|-----------------------------------------|------------|--------------------|-------|-------|
|          |                                         |            | X                  | Y     | Z     |
| V1       | 29/01/2020 11:45am – 30/01/2020 11.45am | Daytime    | 0.022              | 0.031 | 0.043 |
|          |                                         | Night-time | 0.018              | 0.026 | 0.033 |

Short-term attended VDV and PPV measurements were undertaken at locations V2-V10 on the morning of 29<sup>th</sup> January 2020 to characterise vibration levels from background and train pass events; the results are presented in Table 2.4 below.

**Table 2.4 Attended Vibration Results – PPV mm/s and VDV m/s**

| Location | Monitoring Date & Time | Description of Measurement    | Measured PPV | Measured VDV |      |      |
|----------|------------------------|-------------------------------|--------------|--------------|------|------|
|          |                        |                               |              | X            | Y    | Z    |
| V2       | 29/01/2020 10:37       | Background                    | 0.150        | 0.04         | 0.03 | 0.06 |
|          | 29/01/2020 10:39       | Passenger Train Nearside Rail | 0.400        | 0.04         | 0.06 | 0.06 |
| V3       | 29/01/2020 10:17       | Background                    | 0.175        | 0.04         | 0.03 | 0.03 |
|          | 29/01/2020 10:15       | Passenger Train Nearside Rail | 1.02         | 0.04         | 0.03 | 0.07 |
| V4       | 29/01/2020 10:05       | Background                    | 0.175        | 0.04         | 0.04 | 0.03 |
|          | 29/01/2020 10:12       | Passenger Train Nearside Rail | 0.350        | 0.05         | 0.03 | 0.03 |
| V5       | 29/01/2020 09:42       | Background                    | 0.150        | 0.04         | 0.03 | 0.06 |
|          | 29/01/2020 09:43       | Passenger Train Nearside Rail | 0.725        | 0.04         | 0.04 | 0.06 |
| V6       | 29/01/2020 09:04       | Background                    | 0.150        | 0.04         | 0.03 | 0.05 |
|          | 29/01/2020 09:36       | Passenger Train Nearside Rail | 0.500        | 0.04         | 0.03 | 0.09 |
| V7       | 29/01/2020 10:22       | Background                    | 0.175        | 0.04         | 0.03 | 0.07 |
|          | 29/01/2020 10:29       | Passenger Train Nearside Rail | 0.550        | 0.04         | 0.03 | 0.07 |
| V8       | 29/01/2020 09:47       | Background                    | 0.175        | 0.04         | 0.03 | 0.06 |



| Location | Monitoring Date & Time | Description of Measurement    | Measured PPV | Measured VDV |      |      |
|----------|------------------------|-------------------------------|--------------|--------------|------|------|
|          |                        |                               |              | X            | Y    | Z    |
|          | 29/01/2020 09:51       | Passenger Train Nearside Rail | 1.07         | 0.06         | 0.05 | 0.04 |
|          | 29/01/2020 09:56       | Passenger Train Far Side Rail | 0.625        | 0.04         | 0.03 | 0.25 |
| V9       | 29/01/2020 09:11       | Background                    | 0.150        | 0.04         | 0.03 | 0.05 |
|          | 29/01/2020 09:16       | Passenger Train Nearside Rail | 0.175        | 0.04         | 0.03 | 0.05 |
| V10      | 29/01/2020 10:45       | Background                    | 0.125        | 0.04         | 0.03 | 0.06 |
|          | 29/01/2020 10:49       | Passenger Train Nearside Rail | 0.250        | 0.04         | 0.04 | 0.06 |



## 3.0 Assessment of Key Effects

### 3.1 Potential Building Damage

Table 3.1 shows the worst-case maximum Peak Particle Velocity (PPV) measured at the site over the 24-hour period at location V1; the only proposed dwelling within 15m of the railway track. The results are compared to the BS 7385 criterion of 15 mm/s.

**Table 3.1 Max PPV Vibration Assessments – Building Damage**

| Location | Reference Date | Period     | Max PPV<br>(mm/s) | Damage<br>Criterion<br>(mm/s) | Within<br>Criterion? |
|----------|----------------|------------|-------------------|-------------------------------|----------------------|
| V1       | 30.01.2020     | Daytime    | 0.950             | 15.0                          | Yes                  |
|          | 30.01.2020     | Night-time | 0.975             | 15.0                          | Yes                  |

The results in the table above show that the worst-case maximum daytime and night-time peak particle velocity (PPV) measured compared to the damage criteria outlined in BS 7385. Measured levels are considerably lower than the damage criteria. Therefore, there is a positive indication that there is unlikely to be any building damage associated with vibration from the adjacent railway.



## 3.2 Human Response

Table 3.2 shows the worst-case maximum total measured vibration dose value (VDV) over the 24-hour monitoring period at location V1; the only proposed dwelling within 15m of the railway track. The results are compared with the BS 6472 criteria.

**Table 3.2 Vibration Assessment – Human Response**

| Location | Period     | Total VDV<br>( $\text{ms}^{-1.75}$ ) |       |       | Onset of Low<br>probability of<br>adverse comment<br>(daytime ( $\text{ms}^{-1.75}$ )) | Within Criteria |
|----------|------------|--------------------------------------|-------|-------|----------------------------------------------------------------------------------------|-----------------|
|          |            | X                                    | Y     | Z     |                                                                                        |                 |
| V1       | Daytime    | 0.022                                | 0.031 | 0.043 | 0.2 – 0.4                                                                              | Yes             |
|          | Night-time | 0.018                                | 0.026 | 0.033 | 0.1 - 0.2                                                                              | Yes             |

The results in the table above show that during both the daytime and night-time, the maximum total VDV measurements at locations representative of the closest foundations of the proposed redevelopment are considerably below the criteria outlined in BS 6472. This indicates that it is significantly lower than 'low probability of adverse comment' when compared to the BS 6472 criteria.



## 4.0 Conclusions

Continuous 24-hour vibration measurements have been undertaken at the nearest proposed residential dwelling to the railway track south of Parcels A2 and B6 at Hampton Park, Littlehampton. Short term attended vibration measurements were also conducted at multiple locations around the site.

An assessment of vibration levels has shown that maximum peak particle velocity (PPV) measurements during both the daytime and night-time, are considerably lower than the damage criteria outlined in BS 7385. This is a positive indication that there is unlikely to be any building damage associated with vibration from the existing use of the adjacent railway.

Worst-case measured VDV levels at the development during both the daytime and night-time are considerably below the criteria outlined in BS 6472. Levels are significantly below the level stated as the onset of 'low risk of adverse comment'.

Consideration of vibration from the traffic using the Lymister Bypass has been provided by the Highways Designer (Stantec).



# Appendices



## Appendix A – Sketches

SK01 Vibration Monitoring Locations



Client:  
Persimmon Homes

Project:  
Parcel A2 and B6  
North Littlehampton  
Hampton Park Vibration

Project Number:  
A116535

Drawing Title / Scenario:  
Vibration Monitoring  
Locations

Key:  
Site Boundary: - - - - -

Scale : Not to scale

WYGE Leicester 03.02.20

Licence Number AL 553611



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