Plot H, Manchester

Ground-borne Vibration Impact Assessment

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1. Introduction

Heyda Ltd has been commissioned to conduct a groundborne vibration impact assessment from existing rail traffic movements at the location of the Proposed Development at Plot H, situated in Manchester City Centre, on behalf of RGRE Ltd, ID Manchester Ltd and The University of Manchester.

The Proposed Development comprises the redevelopment of the Plot H site for Purpose Built Student Accommodation, with ancillary commercial uses, landscaping, access and associated works.

The impact of vibration from the passage of trains on the adjacent Altrincham Railway Viaduct has been assessed to determine the suitability of the Proposed Development for residential use. Vibration exposure has been evaluated in accordance with BS 6472-1:2008: Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting, which provides guidance for assessing human response to vibration within buildings, and vibration dose values (VDV) have been calculated from the on-site measurements. In addition, the assessment considers ground-borne re-radiated noise resulting from vibration transmitted into the proposed development. As part of the works, a detailed vibration survey was undertaken at the site, to inform the assessment.

Recommendations for mitigation or design measures are provided where the measured or predicted levels indicate a potential exceedance of relevant criteria.

2. The Site

2.1. Site Location

The Site is in Manchester City Centre and is bound by Charles Street to the south, Manchester South Junction and Altrincham Railway Viaduct and Granby Row to the north, Sackville Street to the east and Princess Street to the west. The red line encompasses all highways works proposed as part of the Proposed Development.

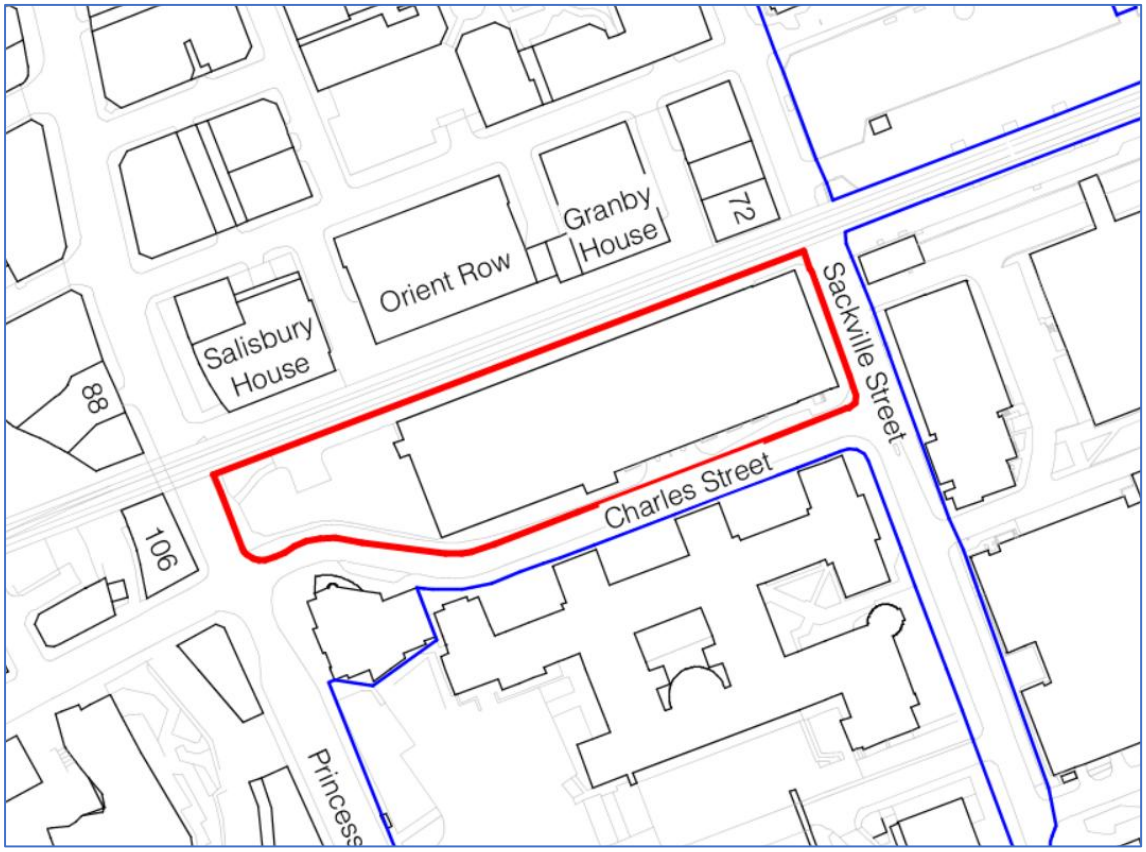
The Altrincham Railway Viaduct accommodates frequent train movements at relatively low speeds, comprising both passenger and freight services. Passenger trains are more prevalent during the daytime, while freight operations are more common during night-time periods.

The Site currently comprises the vacant Charles Street multi-storey car park and three ancillary commercial uses, all of which are now vacant. As of today (October 2025) the buildings are in situ.

While the Site is not located within a Conservation Area, the Site's northern boundary lies adjacent to the Whitworth Street Conservation Area.

The Site location is illustrated in Figure 1 below.

Figure 1: Site Location



2.2. Proposed Development

The Proposed Development comprises Purpose Built Student Accommodation (PBSA) with ground floor flexible commercial floorspace across three buildings of 8, 11 and 38 storeys, connected by a five-storey podium.

The northern façade of the existing as well as the Proposed Development is located approximately 5 meters from the adjacent Altrincham Railway Viaduct.

The relevant ground and first floor GA Layouts are presented in Figures 2 and 3 below.

Figure 2: Ground Floor GA Layout



Figure 3: First Floor GA Layout



2.3. Sensitive Receptors

In this instance, the receptors anticipated to be most affected are the future occupants of the proposed first-floor cluster flat located on the northern façade of the central block. This assessment focuses on that representative location as the worst-affected receptor.

3. Relevant Guidance

3.1. British Standard 6472-1:2008

BS 6472:2008 Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blasting describes how to determine the vibration dose value, VDV, from frequency-weighted vibration measurements.

The vibration dose value is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop. BS 6472 states that in homes, adverse comment about building vibration is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

BS 6472 contains a methodology for assessing the human response to vibration in terms of either the vibration dose value, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as peak particle velocity.

The advice contained in BS 6472 states that when the vibration is intermittent, as is the case at this site with the only significant potential source of vibration being the railway lines to the north, the vibration dose value, or VDV, may be used to assess the potential for impacts.

Appropriately-weighted vibration measurements can be aggregated to derive the vibration dose values. The vibration dose value is a single figure descriptor that represents the cumulative dose of transient vibrations, taking into account the frequency spectrum and duration of each event. The vibration dose value is determined over a 16-hour daytime period or 8-hour night-time period, and the guidance in BS 6472 is set out as follows:

Table 1: Vibration Dose Values ($m/s^{-1.75}$) Above Which Various Degrees of Adverse Comment May Be Expected in Residential Buildings

Period	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings – 16-hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential Buildings – 8-hour night	0.13	0.26	0.51

3.2. ANC Guidelines-Measurements & Assessment of Ground-borne Noise & Vibration

This document provides practical guidelines on the measurements and assessment of Ground-borne noise and vibration. A wide range of vibration issues and sources are covered, with particular attention paid to railway vibration and ground-borne noise.

The ANC Guidelines acknowledges that "there are no UK or international standards for the assessment of ground-borne noise levels inside dwellings. Early proposals for maximum acceptable levels of ground-borne noise in the 1980s were based on the guidelines published in the USA by the American Public Transit Association (APTA). These criteria are still in widespread use."

The APTA guidelines were published in 1981 and specify maximum acceptable levels of ground-borne sound depending on the type of residential development:

Table 2: APTA Maximum Groundborne Sound Levels in Dwellings

Community Area	Maximum A-Weighted Sound Pressure Level	
	Single Family dwelling	Multi-family dwelling
Low Density Residential	30	35
Average Density Residential	35	40
High Density Residential	35	40
Commercial	40	45
Industrial/Highway	40	45

Such guidance has been used and extended in the guidelines for the impact of transit ground-borne noise published by the Federal Transit Administration (FTA) of the US Department of Transportation. FTA guidance takes account of the spectral characteristics of the vibration. Limits of 35 dBA and 43 dBA are defined for ground-borne sound associated with frequent and infrequent events in bedrooms.

In this case, given the high-density nature of the proposed development, comprising a substantial number of studio and cluster units, reradiated noise should not typically exceed 40 dB $L_{Amax,S}$, although this is not considered an absolute limit. This threshold aligns with international best practice and represents a suitably conservative yet

pragmatic criterion, recognising that occasional, short-duration exceedances are unlikely to give rise to perceptible or materially adverse impacts on residents.

4. Vibration Survey

4.1. Survey Overview

The prevailing ground-borne vibration conditions have been determined by a vibration survey at a single location within the existing building on site. The vibration survey was undertaken between Monday 13th and Wednesday 15th October 2025.

The results of the survey are used to:

- Quantify existing vibration levels at the site.
- Assess the potential for vibration and ground-borne re-radiated noise impacts from the adjacent railway lines on the Proposed Development.

4.2. Inventory

A full inventory of the vibration monitoring equipment is shown in Table 3 below:

Table 3: Inventory of Equipment

Item	Make & Model	Serial Number
Vibration Monitor	01dB Orion	10229

4.3. Measurement Description

Unattended vibration measurements were undertaken at basement/ground floor level within the existing multi-storey car park. The monitor and associated accelerometer were securely levelled and placed directly on the existing masonry floor slab, approximately 5 metres from the nearest structure of the adjacent Altrincham Railway Viaduct. This position was generally representative of the separation distance between the viaduct and the nearest proposed habitable rooms within the development.

A review of historical train movements along the adjacent railway lines (source: www.realtimetrains.co.uk) indicated approximately 400 train movements during the monitored daytime period, and around 90 movements during the night-time period. As noted, passenger services predominated during daytime hours, while freight services were more frequent overnight.

The approximate location of the vibration monitoring position is shown in Figure 4 below.

Figure 4: Vibration Monitoring Location



4.4. Measurement Results

4.4.1. Vibration Dose Values (VDV)

A summary of the measured Vibration Dose Values (VDV)s are presented in Table 4 below.

Table 4: Measured Vibration Dose Values (VDV) at VP1

Date	Period	Vibration Dose Value Levels ($m/s^{1.75}$) per Axis		
		X Axis	Y Axis	Z Axis
13/10/2025	Night-time (23:00-07:00	0.004	0.001	0.009
14/10/2025	Daytime (07:00 – 23:00)	0.004	0.002	0.013
	Night-time (23:00-07:00	0.004	0.001	0.010

4.4.2. Re-radiated Noise Levels from Ground-borne Vibration

A summary of the calculated re-radiated noise levels resulting from ground-borne vibration is presented in Table 5 below. These noise levels were derived directly from the measured vibration velocity data, using slow time-weighting and applying a standard correction for a typical furnished room.

For information, the three highest vibration events during each measurement period have been presented for information.

Table 5: Measured Re-radiated Noise Levels from Ground-borne Vibration at VP1

Date	Period	Event	L_p (dB) per Axis		
			X Axis	Y Axis	Z Axis
13/10/2025	Night-time (23:00-07:00)	1st highest	43	43	30
		2nd highest	41	42	29
		3rd highest	39	39	29
14/10/2025	Daytime (07:00 – 23:00)	1st highest	50	55	37
		2nd highest	46	45	34
		3rd highest	39	41	31
	Night-time (23:00-07:00)	1st highest	39	37	29
		2nd highest	35	35	28
		3rd highest	35	35	27

5. Assessment of Vibration Impacts

5.1. Vibration Dose Value Impact Assessment

5.1.1. Assessment Overview

An assessment of Vibration Dose Values (VDV) arising from train movements along the adjacent Altrincham Railway Viaduct has been undertaken using data measured at the basement/ground floor slab of the existing multi-storey car park.

As the proposed residential accommodation begins at first-floor level, the measured values are considered conservative and representative of a worst-case condition, given that vibration levels typically attenuate with height as they propagate through building structures.

5.1.2. Assessment Results and Discussion

The measured VDV levels have been compared against the guideline values presented in BS 6472-1:2008 – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz). The results are summarised in Table 6 below.

Table 6: VDV Impact Assessment

	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Measured VDV at VP1	0.013 $m/s^{1.75}$	0.010 $m/s^{1.75}$
BS 6472-1:2008 – Low Probability of Adverse Comment	0.2 – 0.4 $m/s^{1.75}$	0.13 – 0.26 $m/s^{1.75}$
Probability of Adverse Comment	< Low	< Low

The results demonstrate that the measured vibration levels at the existing basement/ground floor, are well below the threshold for a low probability of adverse comment, in accordance with BS 6472.

Accordingly, no mitigation measures are considered necessary to control VDV levels from the adjacent railway.

5.2. Ground-borne Re-radiated Noise Assessment

5.2.1. Assessment Overview

Ground-borne noise occurs when building surfaces vibrate in response to train-induced vibration and re-radiate as audible sound, typically perceived as a low-frequency rumble depending on vibration amplitude. Although there are no UK or international standards specifically for assessing ground-borne noise within dwellings, guidance has been drawn from the ANC Guidelines, the FTA Transit Noise and Vibration Impact Assessment Manual, and early APTA guidance. For the high-density nature of the proposed development, comprising studios and cluster flats, re-radiated noise should not normally exceed 40 dB $L_{Amax,S}$, especially during more sensitive night-time periods. However, this value should not be regarded as an absolute threshold, but rather as a guideline representing a conservative target for ensuring a high standard of residential amenity.

This assessment is also based on the measurements obtained from the basement/ground floor slab of the existing multi-storey car park. In this instance, the predictions incorporate a transfer function for potential losses to the proposed new-build first floor level, where the worst-affected residential amenities will be located. Given the anticipated heavy masonry construction of the proposed development, a -3 dB attenuation for a single storey loss have has been applied. This value reflects expected structural damping and energy loss through dense floor slabs, finishes, and junctions in robust building structures. While the precise attenuation will vary with detailed design and material interfaces, this reduction is considered representative of typical performance and provides a realistic basis for assessing potential ground-borne re-radiated noise.

Based on this approach, the corrected re-radiated noise levels for the three highest events during both daytime and night-time periods are presented in Table 7, for the first, second, third and fourth residential floor levels. Exceedances and compliances relative to the adopted internal criterion of 40 dB $L_{Amax,S}$ have been highlighted in red and green, respectively.

Table 7: Predicted Re-radiated Noise Levels from Ground-borne Vibration

Floor Level	Period	Event	L_p (dB) per Axis		
			X Axis	Y Axis	Z Axis
First Floor	Daytime (07:00 – 23:00)	1st highest	47	52	34
		2nd highest	43	42	31
		3rd highest	36	38	28
	Night-time (23:00-07:00)	1st highest	40	40	27
		2nd highest	38	39	26
		3rd highest	36	36	26
Second Floor	Daytime (07:00 – 23:00)	1st highest	44	49	31
		2nd highest	40	39	28
		3rd highest	33	35	25
	Night-time (23:00-07:00)	1st highest	37	37	24
		2nd highest	35	36	23
		3rd highest	33	33	23
Third Floor	Daytime (07:00 – 23:00)	1st highest	41	46	28
		2nd highest	37	36	25
		3rd highest	30	32	22
	Night-time (23:00-07:00	1st highest	34	34	21
		2nd highest	32	33	20
		3rd highest	30	30	20t
Fourth Floor	Daytime (07:00 – 23:00)	1st highest	38	43	25
		2nd highest	34	33	22
		3rd highest	27	29	19
	Night-time (23:00-07:00)	1st highest	31	31	18
		2nd highest	29	30	17
		3rd highest	27	27	17

As shown, at the worst-affected residential location (first floor), predicted re-radiated noise from ground-borne vibration exceeds the internal recommendation of 40 dB $L_{Amax,S}$ only twice and only during daytime periods. Considering the high frequency of train movements (approximately 900 during the daytime), these exceedances are rare and isolated events and are unlikely to be perceived as disturbing. Crucially, no exceedances are predicted during the more sensitive night-time periods.

Based on these results, ground-borne re-radiated noise is not anticipated to cause disturbance, and no mitigation measures are required under normal circumstances.

However, if these rare daytime exceedances were considered a concern by the client or the local planning authority, the following mitigation options could be implemented:

Increase building mass or structural robustness:

- Use heavy materials for floor slabs and walls to increase structural damping and reduce vibration transmission.

Vibration isolation techniques:

- Introduce structural bearings or isolators between the building and foundations/floor slabs to decouple the structure from ground vibration.
- Use resilient layers (floating floors, resilient ceilings) to reduce transmission to habitable rooms.

Source-to-receiver separation:

- Open trenches or barriers between the railway and building can reduce transmitted vibration, though this may not be feasible for an existing structure.
- Increase distance between the railway and building, though this may also not be feasible given the small footprint of the site.

Specialist consultancy review:

- Engage a vibration isolation or acoustics specialist to assess the predicted effectiveness of upgrades and propose targeted measures to ensure compliance with internal $L_{Amax,S}$ criteria.

6. Conclusion

This Technical Note presents a comprehensive assessment of railway-induced vibration and associated ground-borne re-radiated noise for the proposed redevelopment of Plot H, Manchester City Centre.

The assessment concludes the following:

1. **Vibration from Adjacent Railway**

   - Measured Vibration Dose Values (VDV) at the existing basement/ground floor were significantly below the thresholds for a low probability of adverse comment, according to BS 6472-1:2008.
   - First-floor residential units represent a conservative worst-case scenario, as vibration levels are expected to attenuate with height.
   - No mitigation is required for VDV impacts from the railway.

2. **Ground-borne Re-radiated Noise**

   - Predicted re-radiated noise levels, applying a -3 dB per-floor attenuation for heavy masonry construction, were assessed for the first, second, and third floors.
   - At the first-floor worst-case receptor, only two daytime exceedances of the 40 dB $L_{Amax,S}$ recommendation were predicted. These events are infrequent, of short duration, and unlikely to be perceptible. More importantly, no exceedances are expected during the much more sensitive night-time periods.

- On this basis, no mitigation measures are necessary, as the exceedances are limited in frequency and magnitude and do not pose a significant impact on residential amenity of the future occupants (students).

The proposed redevelopment of Plot H is suitable for residential use, with railway-induced vibration and associated ground-borne noise considered to be well managed. Future occupants are expected to experience high levels of acoustic comfort, and no adverse impacts are anticipated.