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# OUR LADY'S GROVE STUDENT ACCOMODATION

# ASSESSMENT OF POTENTIAL NOISE AND VIBRATION IMPACTS

Technical Report Prepared For

**Thornton O'Connor Town Planning**

Technical Report Prepared By

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## EXECUTIVE SUMMARY

AWN Consulting has been commissioned to carry out a study in relation to the potential noise and vibration impacts associated with the proposed development at Our Lady's Grove, Goatstown Road, Dublin 4.

A baseline noise and vibration survey has been undertaken at the development site to determine the existing environment at the site. Noise criteria for the development have been derived from appropriate guidelines.

For internal sound insulation within the development it is recommended that a design goal of ≥56 dB $D_{nT,w}$ is adopted for walls and floors separating the first floor bedspaces and living/kitchen/dining areas from the ground floor communal amenity spaces. Additional design advice has been provided for gym areas adjacent to living spaces in order to mitigate noise and vibration impacts.

During the construction phase it is predicted that exceedances of the threshold of potentially significant effect may occur when activities take place within 35m of the nearest sensitive residential receptors. However, activities occurring at a distance greater than 35m from the school are not expected to cause a significant impact when typical mitigation measures are adopted.

Criteria have been defined for mechanical plant noise for both external receptors and also potential future receptors within the development itself. Plant items will be selected and located during the design stage so that the defined criteria will be achieved and so there is no negative impact on sensitive receivers within the development itself or on nearby sensitive receptors.

Outward noise impacts due to increased traffic on public roads has been assessed as having a negligible or imperceptible impact and no further mitigation will be required.

For inward noise impacts to the proposed developments the baseline noise study indicates that reasonable sound levels will be achieved within the proposed buildings when windows are open. Hence, no further mitigation will be required for external to internal noise intrusion.

# CONTENTS

## 1.0 INTRODUCTION

AWN have been commissioned to prepare a noise assessment of The Grove Student Accommodation Project at Goatstown Road, Dublin 14.

The development will principally consist of: the construction of a Student Accommodation development containing 698 No. bedspaces with associated facilities located in 8 No blocks, which range in height from part 3 No. storeys to part 6 No. storeys over part lower ground floor level (7 No. storeys as viewed from an internal courtyard). Some 679 No. bedspaces are provided in 99 No. clusters ranging in size from 5 No. bedspaces to 8 No. bedspaces, each with a communal Living/Kitchen/Dining room. The remaining 19 No. bedspaces are accessible studios. The includes the provision of communal residential amenity space at lower ground floor level (349 sq m) including the provision of a movie room (108 sq m), a music room (42 sq m) and a laundry (37 sq m); communal residential amenity space (1,356 sq m) at ground floor level including the provision of a gym (228 sq m), reception desk and seating area (173 sq m), a common room (338 sq m), a study space (104 sq m), a library (64 sq m), a yoga studio (74 sq m), a prayer room (33 sq m) and group dining (33 sq m).

The development also includes staff and administrative facilities (195 sq m); 9 No. car parking spaces; 4 No. motorcycle parking spaces; 860 No. cycle parking spaces; refuse stores; signage; an ESB substation and switchroom; boundary treatments; green roofs; PV panels; hard and soft landscaping; plant; lighting; and all other associated site works above and below ground. The development includes the demolition of part of the Goatstown Afterschool building (558 sq m) and the construction of a new external wall to the remaining ope, in addition to the demolition of a prefabricated structure adjacent to the Afterschool building (161 sq m).

This report will include an assessment of the following:

- Review of the relevant content of the standards that will be used for the noise assessment;
- Comment on the prevalent and predicted noise levels at the local receptors;
- Review of outward impacts due to the levels of noise incident on the local receptors, and;
- Review of inward impacts due to the level of external noise incident on the proposed development.

Appendix A presents a glossary of acoustic terminology that is used throughout this report.

# 2.0 DESIGN CRITERIA

## 2.1 Inward Noise Criteria

### 2.1.1 Dún Laoghaire Rathdown Noise Action Plan (NAP)

The Dún Laoghaire Rathdown Noise Action Plan (NAP) 2018 – 2023 indicates that guidance within the *ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise* document should be referred to:

> *"In the scenario where new residential development or other noise sensitive development is proposed in an area with an existing climate of environmental noise, there is currently no clear national guidance on appropriate noise exposure levels. The EPA has suggested that in the interim that Action Planning Authorities should examine the planning policy guidance notes issued in England titled, 'ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise'. This has been produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England."*

In accordance with this NAP policy, the following Acoustic Report has been prepared to comply with the requirements of this policy.

### 2.1.2 ProPg Guidance

The *Professional Guidance on Planning & Noise* (ProPG) document was published in May 2017. The document was prepared by a working group comprising members of the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH). Although not a government document, since it's adoption it has been generally considered as a best practice guidance.

The ProPG outlines a systematic risk based 2 stage approach for evaluating noise exposure on prospective sites for residential development. The two primary stages of the approach can be summarised as follows:

- Stage 1 - Comprises a high level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels; and,
- Stage 2 – Involves a full detailed appraisal of the proposed development covering four "key elements" that include:
    - Element 1 - Good Acoustic Design Process;
    - Element 2 - Noise Level Guidelines;
    - Element 3 - External Amenity Area Noise Assessment
    - Element 4 - Other Relevant Issues

A key component of the evaluation process is the preparation and delivery of an Acoustic Design Statement (ADS) which is intended for submission to the planning authority. This document is intended to clearly outline the methodology and findings of the Stage 1 and Stage 2 assessments, so as the planning authority can make an informed decision on the permission. ProPG outlines the following possible recommendations in relation to the findings of the ADS:

*A. Planning consent may be granted without any need for noise conditions;*

*B. Planning consent may be granted subject to the inclusion of suitable noise conditions;*
*C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or,*
*D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").*

Section 3.0 of the ProPG provides a more detailed guide on decision making to aid local authority planners on how to interpret the findings of an accompanying Acoustic Design Statement (ADS).

A summary of the ProPG approach is illustrated in Figure 1.

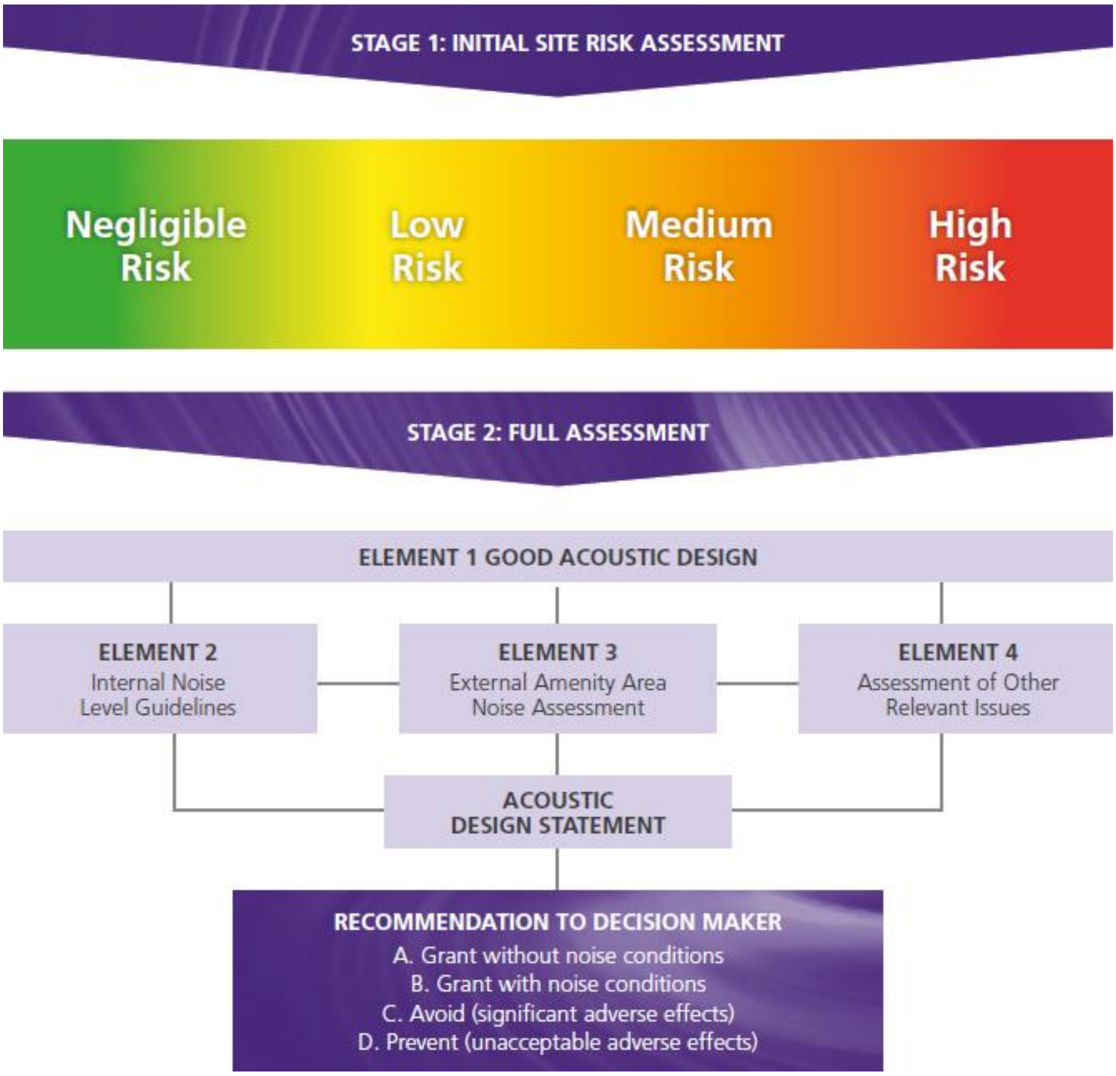


***Figure 1*** *ProPG Approach (Source: ProPG)*

ProPG sets out recommended internal noise levels for several different building types from external noise sources such as traffic. The guidance is derived from BS8233. The recommended indoor ambient noise levels for residential dwellings are set out in Table 1.

| Activity | Location | (07:00 to 23:00hrs) | (23:00 to 07:00hrs) |
|---|---|---|---|
| Resting | Living room | 35 dB $L_{Aeq,16hr}$ | - |
| Dining | Dining room/area | 40 dB $L_{Aeq,16hr}$ | - |
| Sleeping (daytime resting) | Bedroom | 35 dB $L_{Aeq,16hr}$ | 30 dB $L_{Aeq,8hr}$<br>45 dB $L_{Amax,T}$* |

***Table 1*** ProPG Internal Noise Levels

*Note The document comments that the internal $L_{AFmax,T}$ noise level may be exceeded up to 10 times per night without a significant impact occurring.

In addition to these absolute internal noise levels ProPG provides guidance on flexibility of these internal noise level targets. For instance, in cases where the development is considered necessary or desirable, and noise levels exceed the external WHO guidelines, then a relaxation of the internal $L_{Aeq}$ values by up to 5dB can still provide reasonable internal conditions.

## 2.2 Internal Sound Insulation

### 2.2.1 Communal Areas

Sound insulation design goals for airborne sound are set in terms of the indicator Weighted Standardised Level Difference ($D_{nT,w}$). This relates to the level of sound insulation performance between rooms when measured in-situ and is a measure of the sound reduction provided by the separating construction plus the influence of any sound transfer via flanking walls and floors; the higher the value the better the performance. However, manufacturers' data typically quotes the acoustic performance of partitions in terms of the indicator Weighted Sound Reduction Index ($R_w$), which is measured in a test laboratory and represents the performance of the partition in isolation (i.e. without the influence of flanking paths for sound). The measured in-situ performance in terms of $D_{nT,w}$ is less than the $R_w$ value measured in a laboratory. It is therefore important to specify partition performances in terms of $R_w$ with an appropriate margin, typically of the order of 7dB for the types of spaces under consideration here. Assuming a good standard of workmanship, partition systems selected to meet these performance targets should readily achieve the in-situ performance standards.

A review of the current scheme confirms the presence of a common amenity areas adjacent to bedspaces and communal living/kitchen/dining areas from the Ground Floor to the 1st Floor of the development. Due to the nature of these spaces it is recommended that consideration is given to the sound insulation between the communal spaces and the bedspaces and living/kitchen/dining areas during the design stage. A typical floor build-up will provide ≥56 dB $D_{nT,w}$ which would be expected to provide a suitable level of noise attenuation between the spaces. It is therefore proposed a design goal of ≥56 dB $D_{nT,w}$ is adopted floors separating bedspaces and living / kitchen / dining areas from the communal amenity space on the ground floor.

In conjunction with an appropriate management of activities within these spaces[1], it is envisaged that this specification should limit excessive noise transfer to sensitive areas.

1 Appropriate management deemed to include restricted hours of use, limits on amplified music and volume control on TV's

## 2.3 Outward Noise Criteria

### 2.3.1 Construction Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. In lieu of statutory guidance an assessment of significance has been undertaken as per BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise.

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a significant noise impact is associated with the construction activities.

BS 5228-1:2009+A1:2014 sets out guidance on permissible noise levels at residential receptors relative to the existing noise environment. Table 2 sets out the values which, when exceeded, signify a potential significant effect at the facades of residential receptors.

| Assessment Category and Threshold Value Period ($L_{Aeq}$) | Threshold Value (dB) | | |
|---|---|---|---|
| | Category A [A] | Category B [B] | Category C [C] |
| Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00) | 65 | 70 | 75 |
| Evenings and weekends [D] | 55 | 60 | 65 |
| Night-time (23:00 to 07:00hrs) | 45 | 50 | 55 |

***Table 2*** Example threshold of potential significant effect at dwellings

[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
[B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
[C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
[D] 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

For the appropriate assessment period (i.e. daytime in this instance) the ambient noise level is determined through a logarithmic averaging of the measurements for each location and then rounded to the nearest 5dB. If the construction noise exceeds the appropriate category value, then a significant effect is deemed to occur. For the purposes of this development it is considered appropriate to assign Category A values to all nearby sensitive receptors.

Note that for this assessment it is appropriate to consider the sensitivity of the school as well as residential receptors, hence the above guidance applies to the school also.

### 2.3.2 Construction Vibration

Guidance relevant to acceptable vibration within buildings during construction works is contained in the following documents:

- British Standard BS 7385: 1993: *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration*, and;
- British Standard BS 5228: 2009 +A1 2014: *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (BS5228-2).

Both standards contain the same guidance relating to building damage criteria for intermittent vibration such as those generated during construction. The standards note that the risk of cosmetic damage to residential buildings starts at a Peak Particle Velocity (PPV) of 15 mm/s at 4 Hz rising to 20 mm/s at 15Hz and 50 mm/s at 40 Hz and above for unreinforced or light framed structures. The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero. Taking the above into consideration the vibration criteria in Table 3 are recommended.

| Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of | | |
|---|---|---|
| Less than 10Hz | 10 to 50Hz | 50 to 100Hz (and above) |
| 12 mm/s | 20 mm/s | 50 mm/s |

***Table 3*** Recommended Allowable Vibration During Construction Phase

### 2.3.3 Additional Vehicular Traffic

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. In this instance, to assist with the interpretation of the noise associated with vehicular traffic on public roads, *Design Manual for Roads and Bridges (DMRB), Highways England, Transport Scotland, The Welsh Government and The Department of Infrastructure 2019* offers guidance as to the likely impact associated with any particular change in traffic noise level.

| Long Term Magnitude | DMRB Magnitude of Impact Long Term Noise Change (dB $L_{A10,18hr}$ or $L_{night}$) |
|---|---|
| Greater than or equal to 10.0 | Major |
| 5.0 to 9.9 | Moderate |
| 3.0 to 4.9 | Minor |
| Less than 3.0 | Negligible |

***Table 4*** Likely Impact Associated with Change in Traffic Noise Level

### 2.3.4 Plant Noise Emissions

British Standard 4142: 2014+A1:2019: *Methods for Rating and Assessing Industrial and Commercial Sound* is the industry standard method for analysing building services plant noise emissions to residential receptors.

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

For an appropriate BS 4142 assessment it is necessary to compare the measured external background noise level (i.e. the $L_{A90,T}$ level measured in the absence of plant items) to the rating level ($L_{Ar,T}$) of the various plant items, when operational. Where noise emissions are found to be tonal, impulsive in nature or irregular enough to attract attention, BS 4142 also advises that a penalty be applied to the specific level to arrive at the rating level.

The subjective method for applying a penalty for tonal noise characteristics outlined in BS 4142 recommends the application of a 2 dB penalty for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.

The following definitions as discussed in BS 4142 as summarised below:

| | |
|---|---|
| *"ambient noise level, $L_{Aeq,T}$"* | is the noise level produced by all sources including the sources of concern, i.e. the residual noise level plus the specific noise of mechanical plant, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T]. |
| *"residual noise level, $L_{Aeq,T}$"* | is the noise level produced by all sources excluding the sources of concern, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T]. |
| *"specific noise level, $L_{Aeq,\ T}$"* | is the sound level associated with the sources of concern, i.e. noise emissions solely from the mechanical plant, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T]. |
| *"rating level, $L_{Ar,T}$"* | is the specific sound level plus any adjustments for the characteristic features of the sound (e.g. tonal, impulsive or irregular components); |
| "background noise level, $L_{A90,T}$" | is the sound pressure level of the residual noise that is exceeded for 90% of the time period T. |

If the rated plant noise level is +10 dB or more above the pre-existing background noise level then this indicates that complaints are likely to occur and that there will be a significant adverse impact. A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

### 2.3.5 Other Noise Sources

For operational activities associated with the development that are not continuous in nature, it is considered more appropriate to set noise limits at the nearest noise sensitive locations using guidance contained within British Standard BS 8233 (2014): *Guidance on Sound Insulation and Noise Reduction for Buildings*. This Standard sets out recommended noise limits for indoor ambient noise levels as previously listed in Table 3.

For the purposes of this study, it is appropriate to derive external limits based on the internal criteria noted in the paragraph above. This is done by factoring in the degree of noise reduction afforded by a partially open window. This is typically taken to be 15dB(A).

As short periods of noise have the potential to cause a greater disturbance at night-time, a shorter assessment time period (T) is adopted. Appropriate periods are 1 hour for daytime (07:00 to 23:00 hours) and typically 15 minutes for night-time (23:00 to 07:00 hours).

In summary, the following criteria for non-plant items apply at the façades of those residential properties closest to the proposed development:

- Daytime (07:00 to 23:00 hours) 50dB $L_{Aeq,1hr}$
- Night-time (23:00 to 07:00 hours) 45dB $L_{Aeq,5min}$

## 3.0 SITE LOCATION & EXISTING NOISE / VIBRATION ENVIRONMENT

### 3.1 Survey Details

An environmental noise survey has been conducted at the site in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise.*

Measurement locations were selected as shown in Figure 2.


***Figure 2*** Measurement Locations

### 3.2 Survey Periods

The unattended noise survey (Location UTT) was conducted between the following periods:

- 10:48hrs on 3 March 2020 to 10:03hrs on 4 March 2020.

The attended noise surveys (Locations ATT1 and ATT2) were conducted between the following periods:

- 10:38hrs to 12:20hrs on 3 March 2020.

The measurements cover a period that was selected in order to provide a typical snapshot of the existing noise climate, with the primary purpose being to ensure that the proposed noise criteria associated with the development are commensurate with the prevailing environment.

### 3.3 Measurement Parameters

The noise survey results are presented in terms of the following parameters.

**$L_{Aeq}$** is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

**$L_{A90}$** is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

**$L_{AFmax}$** is the instantaneous maximum sound level measured during the sample period using the 'F' time weighting.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

### 3.4 Results and Discussion

The results of the surveys at the unattended monitoring location are summarised in Table 5 below.

| Date | Period | Measured Noise Levels, dB | | |
|---|---|---|---|---|
| | | $L_{Aeq,T}$ | $L_{Amax}$ | $L_{A90,T}$ |
| 03/03/2020 | Day (11:03 – 23:03hrs) | 51 | 82 | 44 |
| 03/03/2020 | Night (23:03 – 07:03hrs) | 48 | 75 | 33 |
| 04/03/2020 | Day (07:03 – 10:03hrs) | 51 | 78 | 41 |

***Table 5*** Measured Noise Levels at Location U1

The results of the surveys at attended monitoring locations ATT1 and ATT2 are summarised in Tables 6 to 7 below.

| Time | Measured Noise Levels, dB | | |
|---|---|---|---|
| | $L_{Aeq}$ | $L_{Amax}$ | $L_{A90}$ |
| 10:57 | 50 | 63 | 46 |
| 11:31 | 52 | 63 | 49 |
| 12:05 | 53 | 75 | 47 |

***Table 6*** Measured Noise Levels at Location ATT1

| Time | Measured Noise Levels, dB | | |
|---|---|---|---|
| | $L_{Aeq}$ | $L_{Amax}$ | $L_{A90}$ |
| 10:38 | 48 | 59 | 45 |
| 11:31 | 52 | 63 | 44 |
| 12:05 | 53 | 75 | 47 |

***Table 7*** Measured Noise Levels at Location ATT2

The noise environment at locations ATT1 and ATT2 was dominated by distant road and aircraft traffic, as well as distant construction works.

# 5.0 ASSESSMENT

## 5.1 Construction Noise

It is predicted that the construction programme will create typical construction activity related noise on site. During the construction phase of the proposed development, a variety of items of plant will be in use, such as excavators, lifting equipment, dumper trucks, compressors and generators.

The proposed general construction hours are 07:00 to 19:00hrs, Monday to Friday and 09:00 to 13:00 on Saturdays.

Due to the nature of daytime activities undertaken on a construction site of this nature, there is potential for generation of significant levels of noise. The potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation works and lorry movements on uneven road surfaces. Due to the nature of the construction works on site there is little likelihood of structural or even cosmetic damage to existing neighbouring dwellings as a result of vibration.

Due to the fact that the construction programme has been established in outline form only, it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, it is possible to predict typical noise levels using guidance set out in BS5228-1:2009+A1:2014. Table 8 outlines typical plant items and associated noise levels that are anticipated for various phases of the construction programme at a standard reference distance of 10 metres from the various plant items.

For the purposes of the assessment we have assumed that standard good practice measures for the control of noise from construction sites will be implemented. These issues are commented upon in further detail in the mitigation section of this chapter.

| Phase | Item of Plant (BS 5228-1:2009+A1:2014 Ref.) | Construction Noise Level at 10m Distance (dB $L_{Aeq}$) |
|---|---|---|
| Site Preparation | Wheeled Loader Lorry (D3 1) | 75 |
| | Track Excavator (C2 22) | 72 |
| | Dozer (C2.13) | 78 |
| | Dump Truck (C4.2) | 78 |
| Foundations | Tracked Excavator (C3.24) | 74 |
| | Concrete Pump (C3.25) | 78 |
| | Compressor (D7 6) | 77 |
| | Poker Vibrator (C4 33) | 78 |
| General Construction | Hand tools | 81 |
| | Tower Crane (C4.48) | 76 |
| | Pneumatic Circular Saw (D7.79) | 75 |
| | Internal fit – out | 70 |
| Landscaping | Dozer (C2.13) | 78 |
| | Dump Truck (C4.2) | 78 |
| | Surfacing (D8.25) | 68 |

***Table 8*** Typical Noise Levels Associated with Construction Plant Items

Table 9 presents the predicted daytime noise levels from an indicative construction period on site at the nearest off-site receptor. Note construction noise sources for site are assumed to be running 50% of the time. The predictions have been prepared for various distances to reflect the varying distances that works will take place from nearby sensitive receptors.

| Phase | Item of Plant (BS 5228-1:2009+A1:2014 Ref.) | Construction Noise at 15m $L_{Aeq}$ dB | Construction Noise at 35m $L_{Aeq}$ dB | Construction Noise at 55m $L_{Aeq}$ dB |
|---|---|---|---|---|
| Site Preparation | Wheeled Loader Lorry (D3.1) | 63 | 56 | 52 |
| | Track Excavator (C2.22) | 60 | 53 | 49 |
| | Dozer (C2.13) | 66 | 59 | 55 |
| | Dump Truck (C4.2) | 66 | 59 | 55 |
| **Site Preparation Total** | | **71** | **64** | **60** |
| Foundations | Tracked Excavator (C3.24) | 62 | 55 | 51 |
| | Concrete Pump (C3.25) | 66 | 59 | 55 |
| | Compressor (D7.6) | 65 | 58 | 54 |
| | Poker Vibrator (C4.33) | 66 | 59 | 55 |
| **Foundations Total** | | **72** | **64** | **60** |
| General Construction | Hand tools | 69 | 62 | 58 |
| | Tower Crane (C4.48) | 64 | 57 | 53 |
| | Pneumatic Circular Saw (D7.79) | 63 | 56 | 52 |
| | Internal fit – out | 58 | 51 | 47 |
| **General Construction Total** | | **72** | **64** | **60** |
| Landscaping | Dozer (C2.13) | 66 | 59 | 55 |
| | Dump Truck (C4.2) | 66 | 59 | 55 |
| | Surfacing (D8.25) | 56 | 49 | 45 |
| **Landscaping Total** | | **70** | **62** | **58** |

***Table 9*** Construction Noise Predictions

The results indicate that construction noise levels are likely to cause a potentially significant effect when works take place within 35m of a noise sensitive receptor. At distances further from the receptors, where the vast majority of construction works will take place, it is expected that noise levels will be lower than the construction noise thresholds.

<u>Mitigation</u>

With regard to mitigation for construction activities, best practice control measures from construction sites within BS 5228 (2009 +A1 2014) Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2 will be used to control noise and vibration impacts. The contractor will ensure that all best practice noise and vibration control methods will be used as necessary in order to ensure impacts to nearby residential noise sensitive locations are not significant. This will be particularly important during demolition, foundation construction including piling works which are likely to be the activities to have the highest potential noise and vibration impact.

Noise-related mitigation methods are described below and will be implemented for the project in accordance with best practice. These methods include:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise;
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract;
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers;

- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use;
- During construction, the contractor will manage the works to comply with noise limits outlined in BS 5228-1:2009+A1 2014. Part 1 – Noise;
- All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures;
- Limiting the hours during which site activities which are likely to create high levels of noise or vibration are permitted;
- Monitoring levels of noise and vibration during critical periods and at sensitive locations.

Furthermore, it is envisaged that a variety of practicable noise control measures will be employed. These may include:

- Selection of plant with low inherent potential for generation of noise and/ or vibration;
- Erection of good quality site hoarding to the site perimeters which will act as a noise barrier to general construction activity at ground level;
- Erection of barriers as necessary around items such as generators or high duty compressors, and;
- Situate any noisy plant as far away from sensitive properties as permitted by site constraints.

Due to the close proximity of the school there is a potential for the adopted criteria to be exceeded when construction works are taking place immediately along the boundary between the school and the development site. This assumes, however, that all items of equipment assessed are operating simultaneously along this boundary. Given that these noise levels constitute worst case conditions with the listed construction activities all being conducted at the closest development area to the nearest noise sensitive location, actual construction noise level emission will likely be lower than the levels listed above. Notwithstanding, suitable noise mitigation measures should be adopted to reduce the noise exposure at this as far as is reasonably practicable and dialogue should be maintained with the school throughout the construction programme.

## 5.2 Construction Vibration

In terms of construction vibration, it is anticipated that excavations will be made using standard excavation machinery, which typically do not generate appreciable levels of vibration close to the source. Taking this into account and considering the distance that these properties are from the works and the attenuation of vibration levels over distance, the resultant vibration levels are expected to be well below a level that would cause disturbance to building occupants.

## 5.3 Mechanical and Electrical Plant

Once operational, there will be building services plant items required to serve the development. Details of the items of plant are as yet unknown, therefore it is not possible to calculate noise levels to the surrounding environment. These items will be selected at a later stage and will be designed and located so that there is no negative impact on sensitive receivers within the development itself or on nearby sensitive receptors. The cumulative operational noise level from building services plant at the nearest noise sensitive locations external to the development will be designed/attenuated to meet the relevant BS 4142 noise criteria for day and night-time periods provided in Table 10 below.

| Day, dB $L_{Aeq,1hr}$ | Day, dB $L_{Aeq,1hr}$ | Night, dB $L_{Aeq,15min}$ |
|---|---|---|
| Existing Receptors External to the Development | 41 | 33 |
| Receptors within the Development | 50 | 45 |

***Table 10*** Proposed Noise Criteria for Plant Noise at Receptors External to the Development

## 5.4 Additional Vehicular Traffic

A traffic impact assessment relating to the proposed development has been prepared by DBFL Consulting Engineers as part of the planning application documentation and has informed this noise impact assessment. Information from this report has been used to determine the predicted change in noise levels in the vicinity of a number of roads in the area that surround the proposed development.

For the purposes of assessing potential noise impact, it is appropriate to consider the relative increase in noise level associated with traffic movements on existing roads and junctions with and without the development. Traffic flow data in terms of the AADT figures has been assessed and the calculated change in noise levels during these two periods are summarised in Table 10. Route locations are presented in Figure 3.

The predicted increase in traffic noise levels associated with the development is less than 1 dB for both the opening and design year. Reference to Table 11 confirms that this increase is negligible.

| Road Link | Year 2023 | | | Year 2038 | | |
|---|---|---|---|---|---|---|
| | Do Nothing | Do Something | Change in Noise Level (dB) | Do Nothing | Do Something | Change in Noise Level (dB) |
| A | 1,935 | 2,032 | +0.2 | 1,935 | 2,032 | +0.2 |
| B | 12,430 | 12,472 | 0.0 | 14,347 | 14,389 | 0.0 |
| C | 12,658 | 12,712 | 0.0 | 14,574 | 14,629 | 0.0 |
| D | 17,459 | 17,493 | 0.0 | 20,350 | 20,383 | 0.0 |
| E | 10,425 | 10,434 | 0.0 | 12,151 | 12,160 | 0.0 |
| F | 1,185 | 1,185 | 0.0 | 1,185 | 1,185 | 0.0 |
| G | 10,257 | 10,299 | 0.0 | 11,887 | 11,929 | 0.0 |

***Table 11*** Change in Traffic Noise Levels with Proposed Development

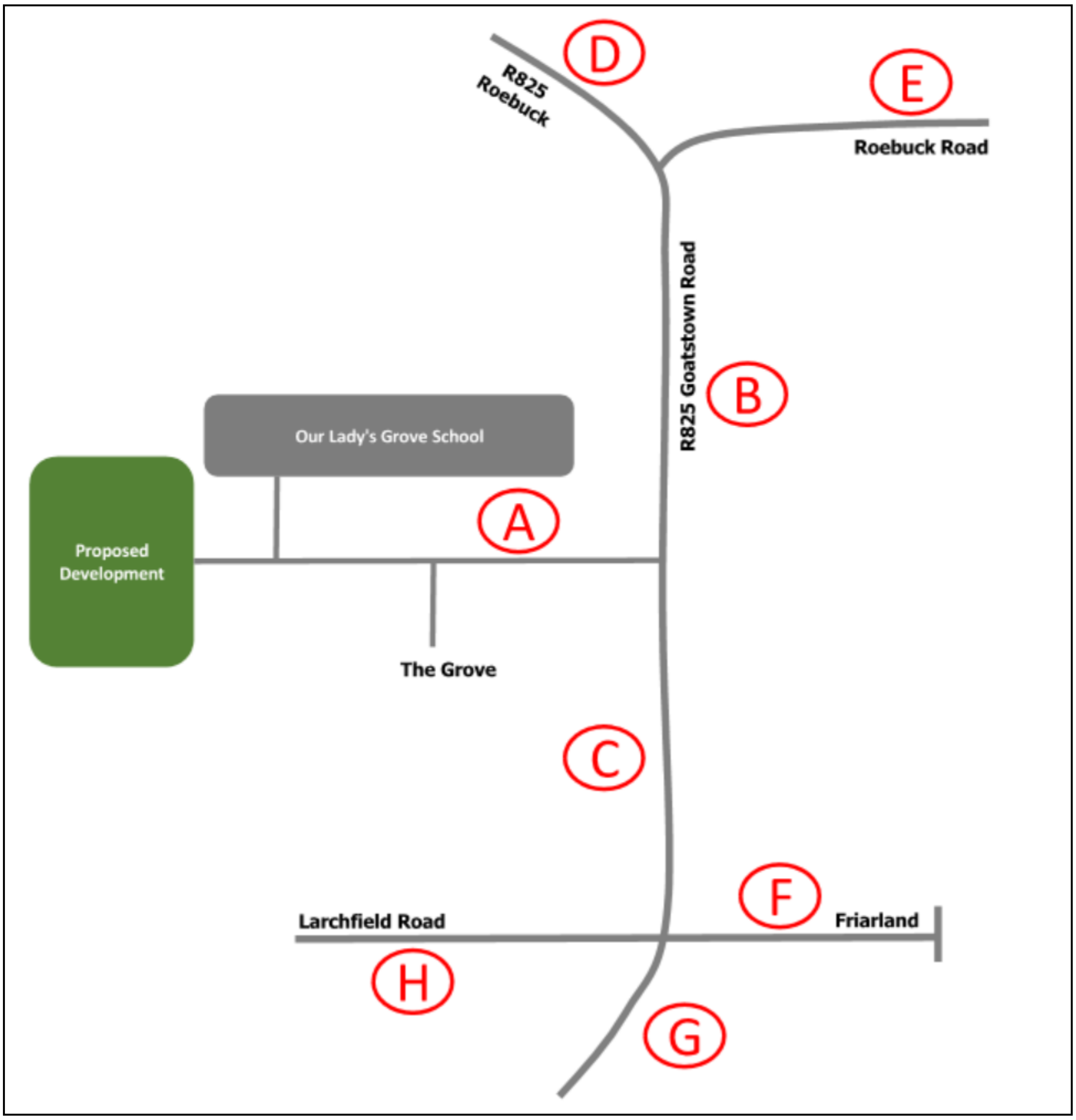


***Figure 3*** Assessed Traffic Routes

## 5.5 Inward Noise Impact

The initial noise risk assessment is intended to provide an early indication of any acoustic issues that may be encountered. It calls for the categorisation of the site as a negligible, low, medium or high risk based on the pre-existing noise environment. Figure 4 presents the basis of the initial noise risk assessment, it provides appropriate risk categories for a range of continuous noise levels either measured and/or predicted on site.

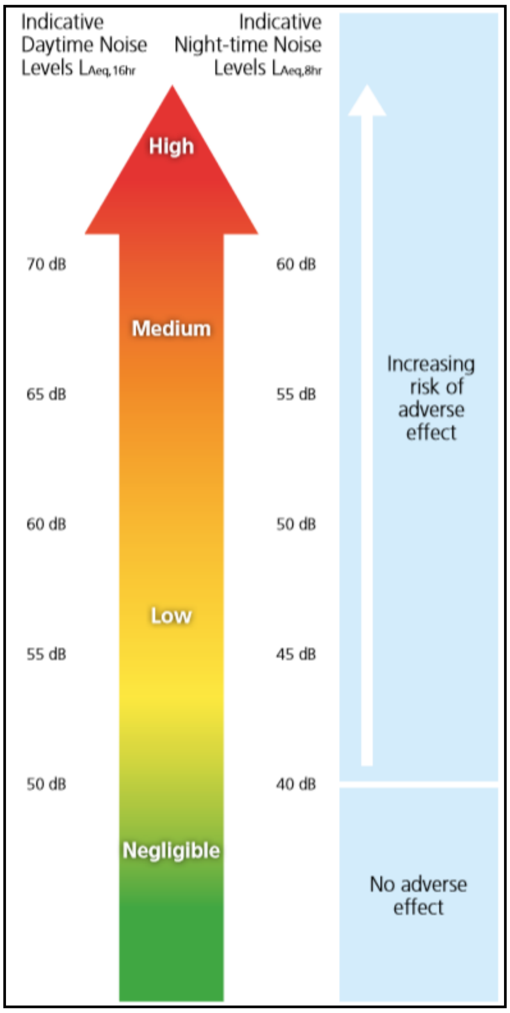


***Figure 4*** ProPG Stage 1 - Initial Noise Risk Assessment

An appraisal of the baseline and the TII's Noise Maps indicates that the site risk will be negligible or low and that a detailed inward noise impact assessment is not required. Figure 5 presents the TII's night-time road traffic noise contours for the development site.

The measured baseline noise levels indicate that reasonable internal noise levels will be met with windows open, hence no further mitigation measures are required.

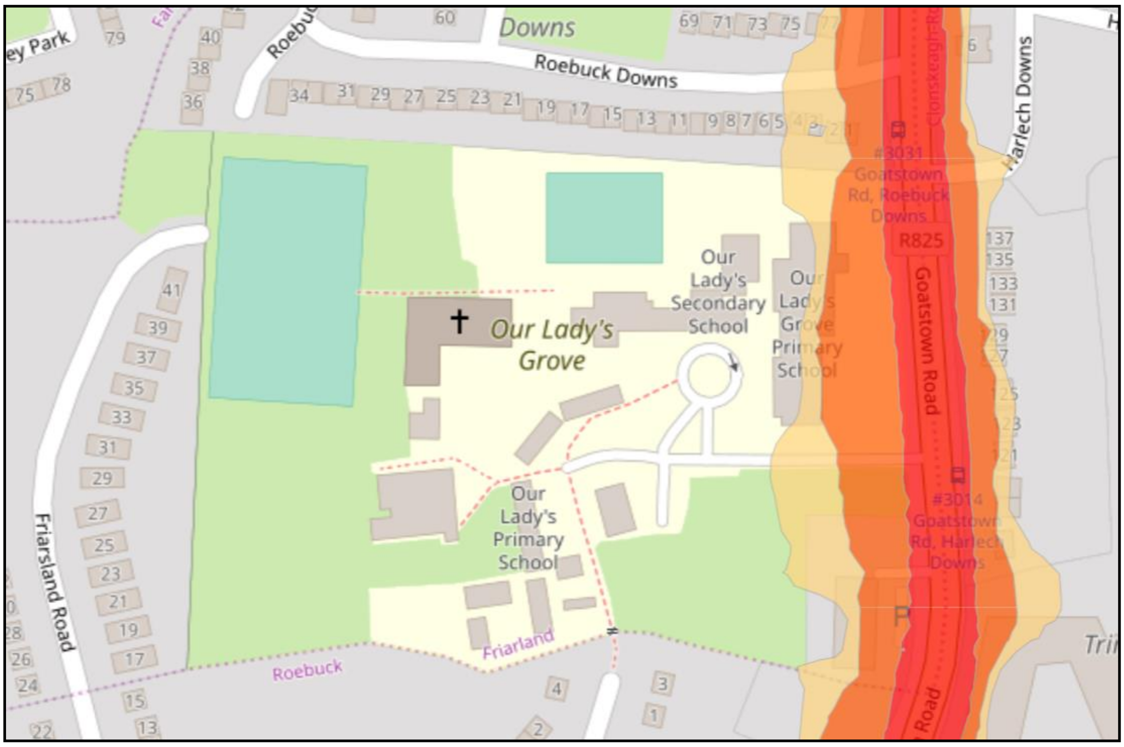


***Figure 5*** ProPG Stage 1 – TII Night-time Road Traffic Noise Map

## 5.6 Sound Insulation

The following are some indicative measures to mitigate noise and vibration from gyms or movie/music rooms. Note that these are indicative only and the final design will need to account for the usage of the rooms and the expected noise and activity levels. Other mitigation measures may be available that would be suitable for the defined usages, hence, these preliminary designs may be developed on, iterated on or alternative designs may be used at the detailed design stage.

### 5.6.1 Gym Area

The following recommendations have been prepared in relation to any potential proposed gym areas.

In terms of a gym consideration needs to be given to the issue of airborne noise transfer (e.g. aerobics classes with music) and impact noise (e.g. dropping of weights). As discussed previously there may be a further requirement to impose a noise limit within the gym area despite the recommendation of the below specifications.

*Ceiling Treatment*

The following typical ceiling treatment may be considered in relation to gym areas:

> *2 layers of 12.5mm SoundBloc on vibration isolation hangers to form 150mm cavity (approx.) between the rear of the plasterboard and the underside of the concrete slab. 50mm Rockwool insulation ($\geq$12kg/$m^3$) placed in the cavity.*

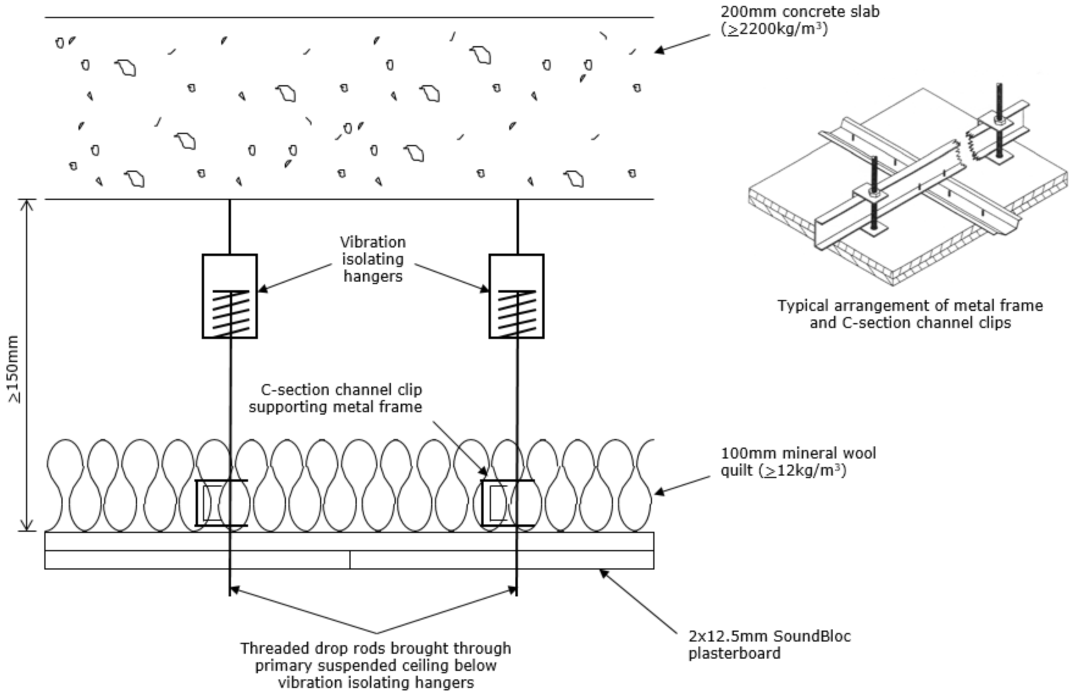


***Figure 7*** Typical Suspended Ceiling for Gym

The concrete slab construction shall offer a minimum mass per unit area of 365kg/m$^2$.

*Vibration Isolation*

Finally, it is also recommended that a suitable vibration isolated floor is installed in any gym area adjoining a residential dwelling to avoid structureborne transfer to the apartments. Due to the complexities of vibration transfer within a building, it is largely not possible to predict the level of building response to vibration excitation without conducting specific site testing. Buildings of a similar construction can respond significantly differently depending on small changes in the structural make up.

The most common forms of vibration isolation used for gym floors within sensitive buildings tend to comprise one or a combination of the following:

- Acoustic Floating Floor, or;
- Resilient Mat Build up Floor.

An isolated floor, commonly called a "floating floor", is used to minimize impact and airborne sound transmissions through the floor/ceiling structure.

Floating floor composite constructions consist of a built-up floor (e.g., concrete slab, wood, etc.) supported by a resilient mount placed on top of the base concrete slab (i.e. non-isolated floor).

Floating floor systems must be decoupled at all edges from walls and other non-isolated building components. Creating airspace and resiliently decoupling the mass of the isolated floor from the non-isolated structure will disrupt noise transmission into the floor/ceiling structure. There are a range of different options for resilient mounts including springs, rubber pads or a combination of both, depending on the level of isolation required.

*Example Floating Floor*

A concrete floating floor with spring mounts provides the highest level of impact and airborne isolation whereas a timber floating floor on rubber/foam underlay for example provides the least.

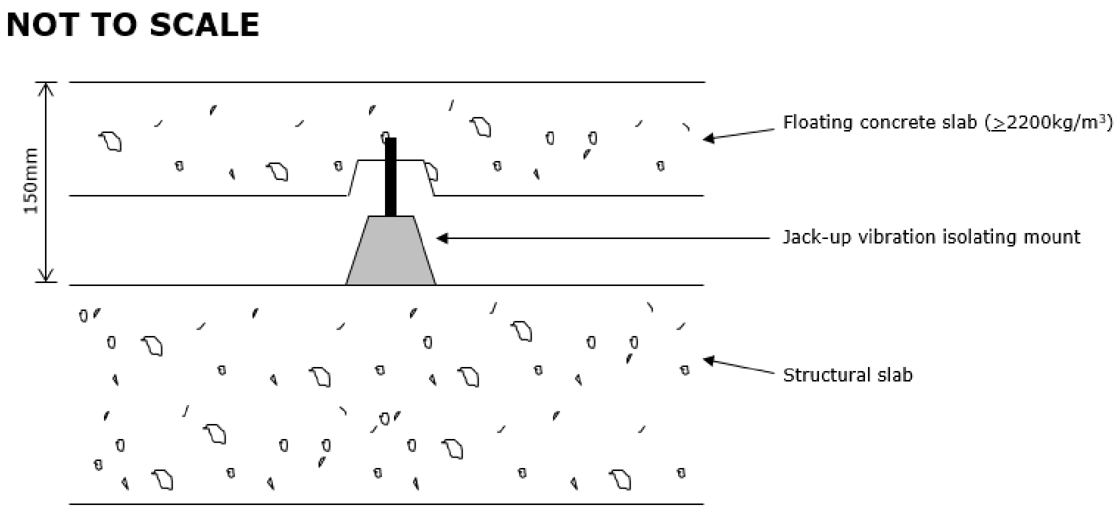


***Figure 8*** Floating Floor Build Up

The exact construction of a floating floor would require detailed consideration at the design stage.

*Resilient Mat Build Up*

In recent years, there has been considerable development in terms of the flexible solutions to gym vibration isolation given the requirement for retrospective solutions, flexible floor designs due to lease holds and other engineering design constraints.

Alternative options to floating floors include the use of resilient floor mats which can be installed in different configurations to achieve varying levels of vibration isolation. Depending on the configuration chosen, this system can, in certain circumstances, provide an equivalent level of vibration isolation compared to a structural floating floor.

*Impact Absorbers*

The use of impact (shock) absorbers to exercise equipment/machines is an effective means of incorporating vibration isolation at source to reduce the level of impact incident on the separating floor itself.

The use of impact absorbers installed between the weight base and the frame are recommended for resistance machines which can be used either in isolation or in conjunction with a resilient floor covering, depending on the level of vibration isolation required.

***Figure 9*** Resilient Mat Build up Within Free Weights Area

***Figure 10*** Impact Absorbers to Resistance Equipment

In conjunction with an appropriate management of activities within these spaces it is envisaged that this specification should limit excessive noise transfer to sensitive areas.

### 5.6.2 Movie / Music Room

If a movie/music room is proposed then particular care should be given to the sound insulation performance of the surrounding partitions. In certain instances (i.e. depending on the noise level to be generated in a cinema), the following typical mitigation measures may be required. The typical details outlined below may be relaxed in instances where lower noise levels are anticipated or where proprietary noise limiting devices are installed and calibrated to an approved limit value.

*Suspended Ceiling*

A mass barrier plasterboard suspended ceiling may be considered for installation below the concrete slab, specification as follows:

> *metal frame suspension system incorporating proprietary vibration isolating hangers to give a minimum 300mm deep void below the underside of the slab – 100mm mineral wool quilt (>12kg/m$^3$) on the rear of the plasterboard – 2x15mm SoundBloc plasterboard*

In order to preserve the sound insulation performance of this high performance acoustic suspended ceiling, there must be no untreated penetrations of the plasterboard in order to hang services, the architectural suspended ceiling and any other fittings. It will therefore be necessary to bring fixings through the plasterboard directly below the vibration isolated suspension points.

It is important to note that the vibration isolators must be capable of taking the combined load of the acoustic suspended ceiling and everything below it (e.g. ductwork, lights, architectural ceiling). We recommend a spring hanger with a natural frequency no higher than 5Hz. The concrete slab construction shall offer a minimum mass per unit area of 365kg/m$^2$.

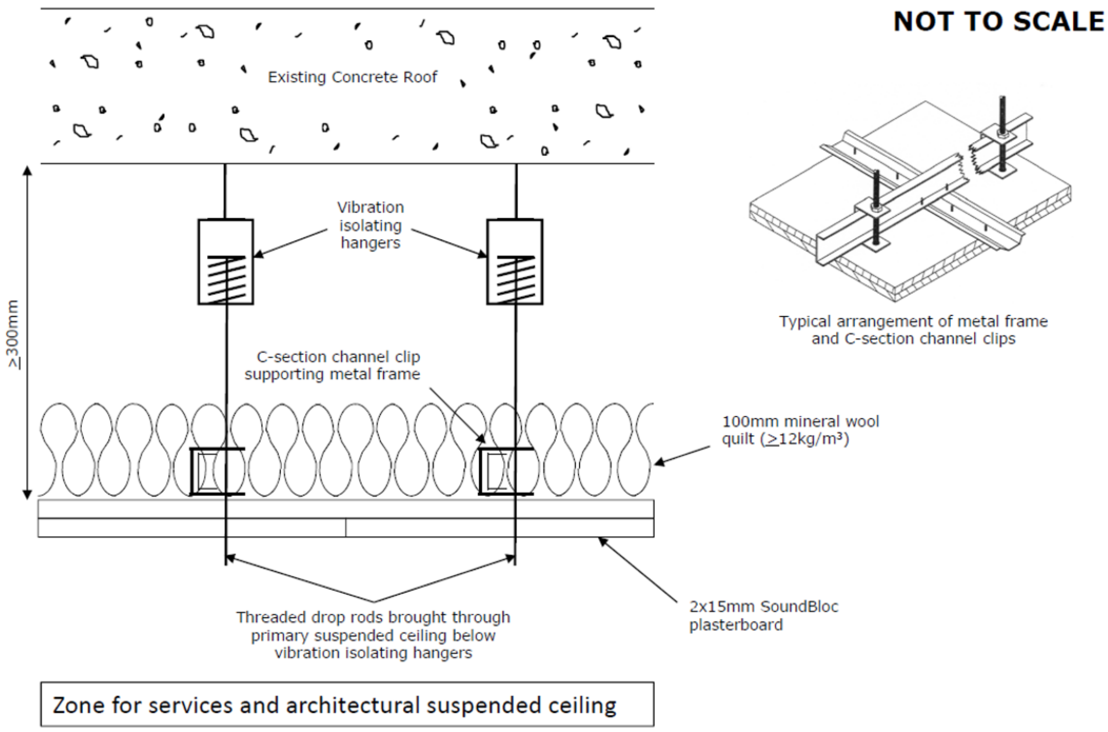


***Figure 11*** Typical Cinema Ceiling

*Wall Linings*

It is also recommended that any structural walls within any potential movie/music room are independently lined to prevent sound transmission through the building. As an example the following build up or similar may be installed:

> *2x12.5mm SoundBloc plasterboard – I-section metal stud erected independent of separating walls to give a minimum cavity depth of 75mm – 50mm mineral wool quilt (>12kg/m$^3$) in cavity (nominal overall depth of lining 100mm)*

**NOT TO SCALE**

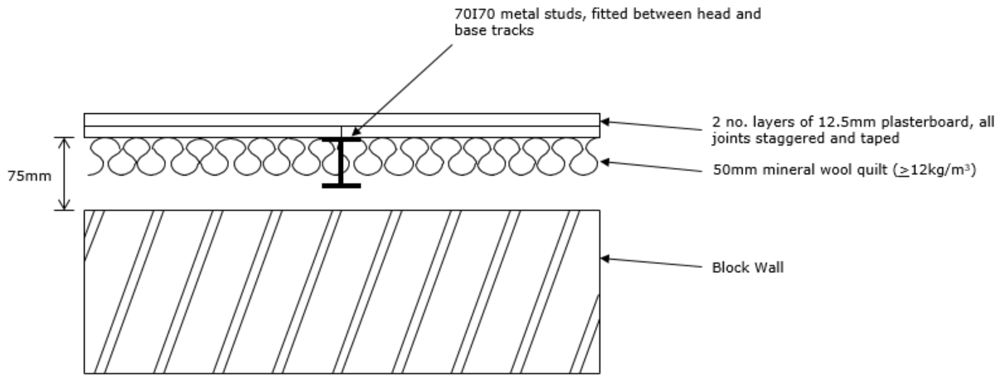


***Figure 12*** Recommended Independent Wall Lining

*Floating Floor*

An acoustic floating floor may also be required for installation onto the existing floor slab within the cinema, an example specification is as follows:

> *sandwich layer comprising 18mm T&G, 2x15mm SoundBloc plasterboard and 18mm T&G – vibration isolated battening system (such as CDM-LAT) to provide a minimum 100mm cavity – 50mm mineral wool quilt (≥12kg/m$^3$) in the cavity*

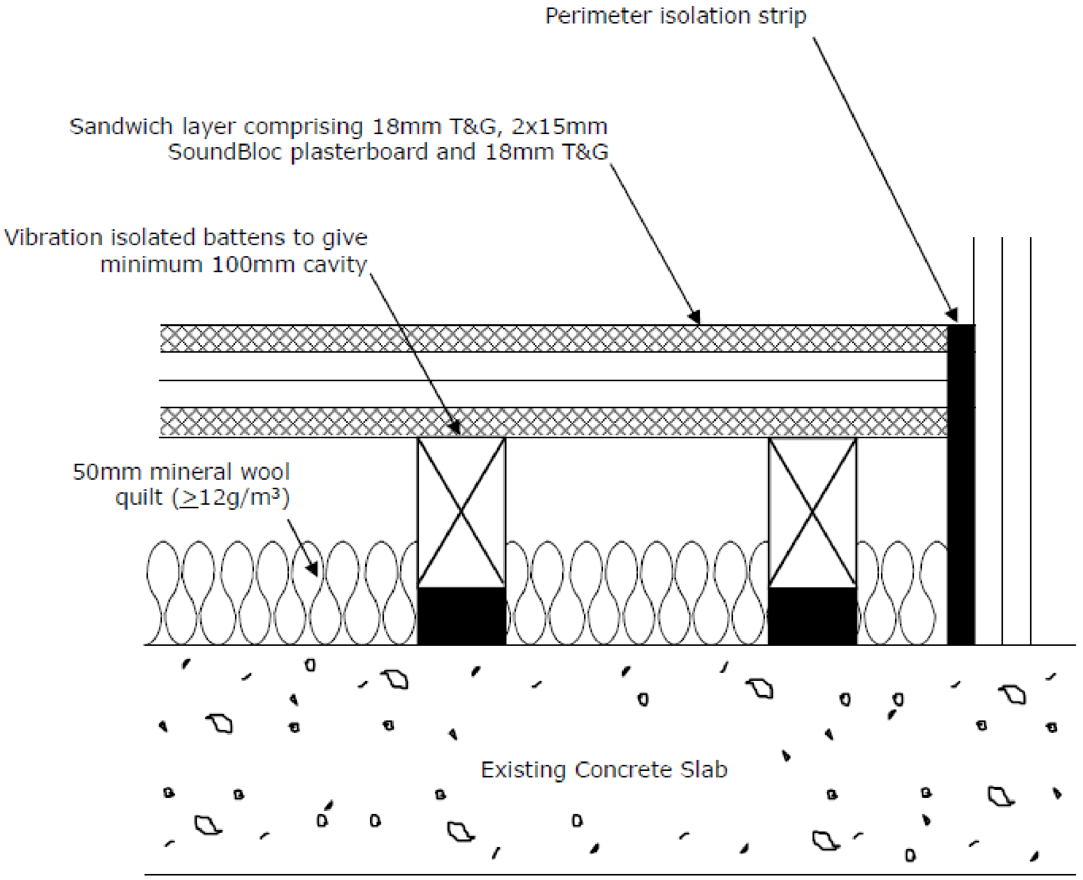


***Figure 13*** Floating Floor Detail

Note that *in-situ* performance of this system will be dictated primarily by the cavity depth and specification of the vibration isolating mounts. The cavity should be as large as possible (with 100mm being the minimum) and the vibration isolating mounts should be selected so as to provide the lowest possible natural frequency.

In conjunction with an appropriate management of activities within these spaces it is envisaged that this specification should limit excessive noise transfer to sensitive areas.

## 6.0 CONCLUSION

Following a baseline noise survey an assessment of noise and vibration impacts relating to the proposed development at The Grove has been undertaken. For internal sound insulation within the development it is recommended that a design goal of ≥56dB $D_{nT,w}$ is adopted for floors of the first floor bedspaces and living/kitchen/dining areas from the ground floor communal amenity space. Additional design advice has been provided for gym areas adjacent to living spaces in order to mitigate noise and vibration impacts.

During the construction phase it is predicted that exceedances of the threshold of potentially significant effect may occur when activities take place within 35m of the nearest sensitive residential receptors.

In terms of construction impacts on the local school suitable noise mitigation measures (examples of which are provided in this report) should be adopted to reduce the noise exposure at this location as far as is reasonably practicable when within 35m of the school and dialogue should be maintained with the school throughout the construction programme, however activities occurring at a distance greater than 35m from the school are not expected to cause a significant impact when typical mitigation measures are adopted.

Criteria have been defined for mechanical plant noise for both external receptors and also potential future receptors within the development itself. Plant items will be selected and located during the design stage so that the defined criteria will be achieved and so there is no negative impact on sensitive receivers within the development itself or on nearby sensitive receptors.

Outward noise impacts due to increased traffic on public roads has been assessed as having a negligible or imperceptible impact and no further mitigation will be required.

For inward noise impacts to the proposed developments the baseline noise study indicates that reasonable sound levels will be achieved within the proposed buildings when windows are open. Hence, no further mitigation will be required for external to internal noise intrusion.

# APPENDIX A
# GLOSSARY OF ACOUSTIC TERMINOLOGY

**Ambient noise** The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.

**Background noise** The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).

**dB** Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μPa).

**dB(A)** An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

**$D_{n,e,w}$** Weighted element-normalized level difference. This is the value of sound insulation performance of a ventilator measured under laboratory conditions. It is a weighted single figure index that is derived from values of sound insulation across a defined frequency spectrum. Technical literature for acoustic ventilators typically presents sound insulation data in terms of the $D_{n,e,w}$ parameter.

**Hertz (Hz)** The unit of sound frequency in cycles per second.

**$L_{Aeq,T}$** This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).The closer the $L_{Aeq}$ value is to either the $L_{AF10}$ or $L_{AF90}$ value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.

**$L_{AFN}$** The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.

**$L_{AF90}$** Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.

**$L_{AF10}$** Refers to those A-weighted noise levels in the upper 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period. It is typically representative of traffic noise levels. Measured using the "Fast" time weighting.

**$L_{AFmax}$** is the instantaneous fast time weighted maximum sound level measured during the sample period.

**Octave band** A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

**PPV** Peak Particle Velocity (PPV) is defined as the instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position and is measured in mm/s.

**$R_w$** Weighted Sound Reduction Index – This is the value of the sound insulation performance of a partition or element measured under laboratory conditions. It is a weighted single figure index that is derived from values of sound insulation across a defined frequency spectrum. Technical literature typically presents sound insulation data in terms of the $R_w$ parameter.

**$R'_w$** Weighted Apparent Sound Reduction Index – This is similar to $R_w$ but is used to express *in-situ* sound insulation performance, where issues such as flanking issue noise transfer may affect the measured level. As stated previously, technical literature typically uses the $R_w$ parameter. In order to reflect the likely *in-situ* performance of an element an appropriate correction should be applied for the expected reduction in performance. Note that in instances where significant flanking issues are present the *in-situ* performance may be further reduced.

**VDV** Vibration Dose Value (VDV). This is an assessment of the effect of building vibration on the people within. The VDV is the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted (as defined in BS6472: 2008). The frequency-weighted acceleration is measured in $m/s^2$ and the time period over which the VDV is measured is in seconds. This yields VDVs in $m/s^{1.75}$.