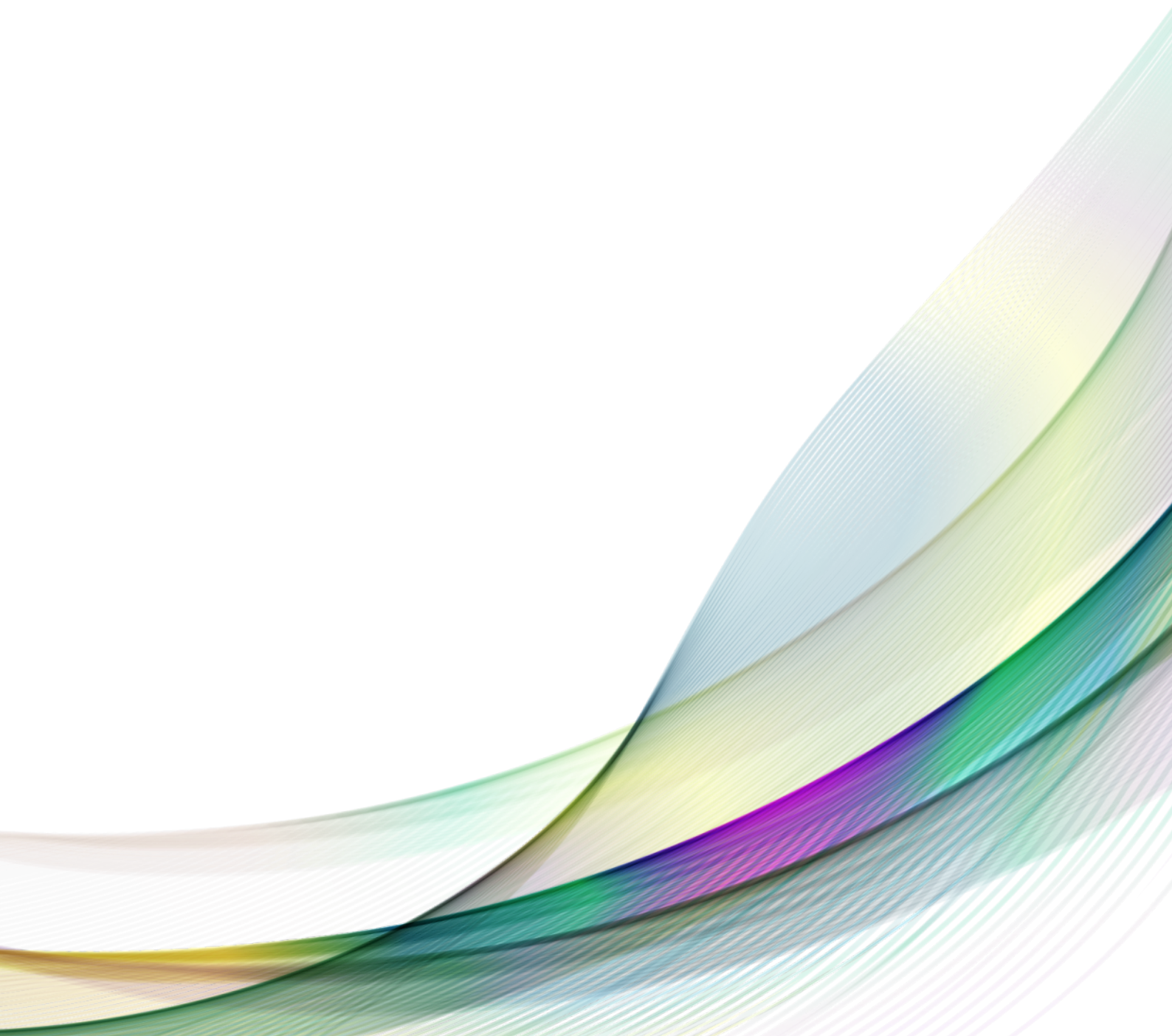




MACH
GROUP

MANCHESTER NEW SQUARE

Final Acoustic Planning Report



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Document Reference:

Manchester New Square – BS 8233 Noise Assessment

Revision	Description	Author	Checked by	Issued by	Issue Date
00	First Issue	ZN	AR	ZN	25/05/2019
01	Second Issue	ZN	RP	ZN	01/07/2019
02	Second Issue	ZN	RP	ZN	21/08/2019

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1.0 INTRODUCTION

The aim of this document is to compliment MACH Acoustics' "Manchester New Square - BS8233 and MCC Facade Assessment" 01/07/2019 report. This report was issued to ensure that the façades to this development meet Manchester City Council's acoustics façade requirements. The report was issued as an initial draft report such that the façade construction could meet the required procurement times. The approach held within MACH's initial report has therefore been adopted by the construction team.

This report is therefore seen to be the Acoustic Planning report, bringing together some further façade studies and additional information relating to plant noise and the façade requirements to the retail units on the Ground Floor.

In summary, this report is seen to discharge Condition 17, below, by providing an acoustic attenuation scheme for plant noise, noise break out from the retail units and façade requirements to ensure that no adverse effect is imposed upon the future residents of the Manchester New Square development or residents around this site.

Manchester City Council – Planning condition notice, Condition 17

Planning condition 17 outlined within the decision notice (application number: 114585/FO/2016, December 2016) states:

"17) Before the development commences an acoustic attenuation scheme including particulars of the acoustic glazing and acoustically treated ventilation to be installed as part of (a) the residential development and (b) the ground floor uses within these blocks; shall be submitted to and approved in writing by the City Council as local planning authority. The approved scheme shall be implemented in full before use of the residential premises first commences. Reason - To protect the amenity of the occupants of the premises once the development hereby approved is occupied, pursuant to policies SP1, H1 and DM1 of the Core Strategy."

For the information of the reader, the design and development of Manchester New Square has been supported by both Sandy Brown and MACH Acoustics, with Sandy Brown taking the project from its early stages through to Stage 4 and MACH Acoustics supporting the project from this point onto completion.

Finally, this report is seen to take on board the comments made by the Manchester City Council to MACH Acoustics original draft assessment.

1.1 Additional Information

In the main, this document is based upon MACH Acoustics Manchester New Square - BS8233 and MCC Facade Assessment" 01/07/2019 report, which has now been fully adopted by the contractor. Thus, this document is also based upon the following reports.

1.1.1 Princess Street, Manchester - Acoustic Planning Report - 16th of November 2016

As noted above, Sandy Brown has supported the acoustics design of this project up to the construction stages. As such a planning report "Princess Street, Manchester - Acoustic planning report -16th of November 2016" has been submitted to the Manchester City Council.

In summary, this report includes a range of environmental noise levels measured at different locations around the site and noise level measurements over a 24 hour period. Indicative over all façade performance levels and plant noise levels have been then been provided.

Since only an overall facade specification has was provided by Sandy Brown, MACH Acoustics has extended Sandy Brown's work to include an assessment of the proposed/as built façades. However, elements relating to plant have simply been copied over to this report and other reports, on the grounds that Manchester City Council and MACH Acoustics are in agreement with Sandy Brown's work in this area.

1.1.2 Environmental Noise Levels Assessment – 1st of July 2019

Such to assess the suitability of the proposed façade to the development as a whole, a second environmental noise assessment has been undertaken by MACH Acoustics between 02/05/2019 (Thursday) and 07/05/2019 (Tuesday). The noise surveys were carried out over a bank holiday weekend, establishing worst case noise levels. During this weekend, "The Village People Weekend" was taking place within the adjacent Gay Village area. Here, pop up stands and pop up bars holding music events, including a variety of local and international acts, took place between Friday 3rd - Monday 6th May 2019. The aim of "The Village People Weekend" is to entertain, promote, and bring as many people as possible to Manchester Gay Village. It is therefore seen that noise levels where measured across an exceptionally noisy weekend.

1.1.3 Internal Ambient Noise Levels Assessment - 1st of July 2019

As well as undertaking the above additional Environmental Noise Assessment, MACH Acoustics undertook an indoor, 24 hour (Friday 3rd to Saturday the 4th of May), ambient noise assessment. This assessment was undertaken to a completed room, however some elements within this room remained unfinished.

The results of this on-site assessment show that the as built façade meets Manchester City Councils indoor ambient noise levels. Additionally, this internal noise assessment has proven useful in establishing the calculation tolerance, by comparing calculated internal noise levels to measured levels on site. The results of this have shown that the measured internal noise levels are lower than those calculated.

2.0 PERFORMANCE STANDARDS FAÇADE & PLANT NOISE

The table below outlines the various performance standards and guidance documents which have formed the basis of the acoustic design criteria for the facades and plant. Any standards which have been included in the table below but are not marked mandatory, have been referred to for guidance only.

Document	Mandatory to demonstrate compliance with:	
	National Planning Guidance	Employed British Standards Guidance
Sandy Brown's Planning and Stage 4 Report	-	✓
MCC Music Levels	-	✓
BS 8223:2014	-	✓
BS4142:2014	X	X
Plant Noise	X	X
NPSE	✓	-
NPPF	✓	-

Table 2-1: Performance Standards

From the table above, it can be seen that internal noise levels have been benchmarked against guidance given within BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' and Manchester City Council's requirements regarding music levels have also been used. BS4142:2014 has been used as a benchmark document for plant noise emission. Finally, Manchester City Council's requirements for music noise have been used as the basis for specifying the façade to the retail units. These requirements are provided below.

2.1 Manchester City Council - Planning & Noise Technical Guidance

Manchester City Council's "Planning & Noise Technical Guidance" starts off by saying:

"Noise is often an important factor in assessing the environmental acceptability of a development proposal and it should be one of the factors addressed in a planning application submission. The planning process is the primary mechanism for local authorities to prevent serious conflicts between different land uses."

"... What is clear is that with the Government's localism agenda and the introduction of the national planning changes, they expect noise policy to be driven by local authorities."

Within Section 3.5 "National & International Standards" the following statements are made:

"BS 8233: 2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Provides design guidelines for appropriate internal acoustic environments within buildings according to their function. It deals with the control of noise from outside the building, noise from plant and services within it and room acoustics for non-critical situations.

Table 4 in Section 7.7.2 of the standard, provides indoor ambient noise levels for residential dwellings which are shown below:

Activity	Location	07.00 to 23.00	23.00 to 07.00
Resting	Living room	35 dB L _{Aeq} , 16hour	-
Dining	Dining room/area	40 dB L _{Aeq} , 16hour	-
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq} , 16hour	30 dB L _{Aeq} , 8hour

It states that where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB. However, consultants should not base their assessment on the 5dB relaxation."

Section 3.6.1.1 Residential Developments then provides the following requirements:

Manchester City Council has adopted the following internal noise limits for residential properties:

- Bedrooms (night time - 23.00 - 07.00) 30 dB L_{Aeq} (individual noise events should not normally exceed 45 dB L_{Amax,F} by more than 15 times)
- Living Rooms (daytime - 07.00 - 23.00) 35 dB L_{Aeq}
- Gardens and terraces (daytime) 55 dB L_{Aeq}

These criteria have been adopted for the following reasons:

- BS 8233: 2014 recognises these levels as a good standard for resting/sleeping conditions.
- The WHO document 'Guidelines for Community Noise' recommends an internal L_{Aeq} of 30dB for optimal sleep conditions (and no more than 35dB for internal rooms during daytime).
- The performance of acoustic insulation schemes can often be below that specified, according to the quality of installation, materials, noise spectrum and deterioration / wear and tear of building elements. A high design specification introduces a 'safety margin' should building elements not perform as well as expected ('on-site' performance).
- Performance specification for glazing does not usually take into account the detrimental effect of vents on the sound insulation. Even 'acoustic' vents will reduce the performance of the facade insulation, as they will inherently contain a free open area for air exchange.
- There is a general increase in urban noise levels, which can in the future be reasonably accommodated by these standards.
- The standards support the Local Authority corporate objective to prevent ill-health and improve local people's health and well-being."

Due to the fact that this development is adjacent to the Gay Village and therefore music is likely to form part of the noise spectrum, Section 3.6.1.2 Entertainment Venues of Manchester's City Councils Planning

Noise document, has also been used to provide the performance requirements with respect to music break in. The planning guidance provides the following:

"... They also provide a workable prediction for planning applications and a measurement method and assessment for in-situ low frequency issues in existing habitable spaces. Therefore a criterion that would achieve a condition of 'inaudible' / 'virtually inaudible' which is applicable for new residential developments that are structurally connected to entertainment venues (or vice versa) would be:

Music noise levels in the 63Hz and 125Hz octave centre frequency bands (Leq) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB (Leq), respectively.

This criterion may also be applicable for new residential developments that are structurally separate from an existing entertainment venue."

2.2 Manchester New Square Development - Traffic & Street Noise Ingress – Performance Requirements

As per Section 5.3 of Sandy Brown's report "Princess Street, Manchester Acoustic Planning Report" 15226-R08-B, 16 November 2016 and Manchester City Council's "Planning and Noise Technical Guidance", the following noise criteria has been adopted:

Rooms	Internal noise limits	
	Daytime (07:00 23:00)	Night-time (23:00 – 0:700)
Living Rooms	35 dB L _{Aeq}	-
Bedrooms	-	30 dB L _{Aeq}
		45 db L _{Amax} *
* (individual noise events should not normally exceed 45 dB L _{Amax,F} by more than 15 times)		

Table 2-2 - Manchester City Council's internal noise criteria for residential developments

2.3 Manchester New Square Development - Music Noise Ingress – Performance Requirements

With respect to music noise, Manchester City Council's targets have been adopted to all flats effected by music, even though these units are not structurally connected to entertainment venues:

Rooms	Internal Music Limits	
	63 Hz (07:00 23:00)	125 Hz (07:00 23:00)
Bedrooms	47 dB	41 dB

Table 2-3 - Manchester City Council's internal music criteria for residential developments

These criteria apply to both music noise from existing premises in the surrounding areas and from any non-residential units proposed as part of the development.

2.4 Manchester New Square Development - Music Noise Egress – Performance Requirements

The text below is taken from Section 3.6.1.2 Entertainment Venues. This section contains considerably more information which is seen to have been followed by MACH, but not necessarily repeated below.

“... applicants and consultants should predict the noise impact of a proposed entertainment venue using noise levels that are representative of those found in ‘typical’ venues of the kind being applied for. Consultants should provide their rationale for using particular noise levels and reference the source of the noise levels used during their predictions.

... A planning application for a new entertainment venue that is structurally detached from other building uses should demonstrate that music noise from the proposal will not be ‘audible’ in nearby residential properties, assuming that the residential properties in question have their windows open. The criterion here is:

Entertainment noise (LAeq) should be controlled to 10dB below the background noise level (LA90) without the entertainment noise present, in each octave band at the nearest noise sensitive location.”

The Manchester New Square planning requirement does not allow for the installation of music venues into this development. However, there are wide range of retail units on the Ground Floor. As such, the guidance given above has been used as the basis of the façade assessment to the retail units to be held in this development.

In summary, Section 4 below provides the expected sound levels within retail units, and subsequently a façade specification to achieve sound levels 10 dB below the L90 levels, at the nearest residence

2.5 Manchester New Square Development – Plant Noise Egress – Performance Requirements

With respect to plant noise break out, Section 3.6.1.5 Industrial / commercial developments of Manchester City Council Planning & Noise Technical Guidance, provides the following guidance:

“BS 4142 should be used to assess the likely impact of noise from industrial and commercial sources at noise sensitive premises (section 3.5). One of the indications of the impact of a BS 4142 assessment is 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, *depending on the context*.

The Council consider that new developments should contribute and enhance the area in which they are located and where possible, contribute to the improvement of people's health and quality of life as per the NPSE. With this in mind, the design objective should be:

The development should be designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location"

Sandy Brown and MACH Acoustics have therefore used this later target to ensure that plant noise emissions are in line with Manchester City Council's planning requirements.

3.0 NOISE CLIMATE, SITE DESCRIPTION AND 3D ACOUSTIC MODELLING

3.1 Site Description

As per the introduction of this report, this assessment is based upon an environmental noise assessment *190510 - Manchester New Square - Environmental Noise Report*. This site description should therefore be read in combination with this document. Note that MACH Acoustics has not used the noise levels given in Sandy Brown's planning document, since spectral levels have not been provided within this document. Appendix A of the Environmental Noise Report does provide a comparison between MACH Acoustics and Sandy Brown's A weighted levels.

The Manchester New Square development is in the heart of Manchester, located adjacent to the Gay Village. As such, environmental noise levels around the site are high due to music from clubs within the Gay Village, traffic and pedestrians around the site.

Due to the proximity of the Gay Village, there are a number of bars and clubs running along the site adjacent to Canal Street, these include; New Union, G-A-Y and ONN Bar. Outdoor seating areas are also present along Canal Street which have an impact upon noise levels experienced along the northern elevation of the site.

In addition, a number of residential premises overlook the site; The Atrium serviced apartments lie across from the site on Princess Street. Venice Court, Bombay House, Whitworth House and Regency House located along Whitworth Street, also overlook the site. Brazil House lies nearby to the North East of the site on the corner of Brazil Street and Sackville Street. It is therefore important to ensure that noise from the New Square development does not adversely affects these residential premises.

Commercial premises are located on the ground level of Venice Court (a bank) and Regency House (a fitness centre and a restaurant) and a mixed office/residential building, Amazon House, adjoins the site to the North East at 3 Brazil Street.

3.2 Environmental Noise Results

As noted in the introduction of this report, this assessment is based upon the noise levels given in MACH's "Environmental Noise Levels Assessment" 01/07/19, as well as Sandy Brown's Planning Report, November 2016. This document should therefore be consulted for further information.

3.3 Comparing Environmental Noise Levels Found by MACH Acoustics and Sandy Brown Acoustics

As per MACH Acoustics Environmental Noise Survey, a comparison has been made between measured noise levels undertaken by both companies. Again, please see MACH Acoustics "Environmental Noise Levels Assessment", where a strong level of correlation is shown between Sandy Brown and MACH Acoustics noise assessments.

3.4 Noise Mapping

As per MACH's Environmental Noise Report, two microphone locations have been used to assess environmental noise levels around this development. This data, along with data included within Sandy Brown's Planning Report, has then been used to establish noise levels around the site as a whole, through 3D acoustics modelling.

The measured noise level data has been used to calibrate a detailed model in CadnaA, a noise prediction software, such to accurately understand and assess the propagation of noise across and around the site, at the different facades making up this development.

CadnaA is an industry standard noise propagation software. The software calculates how sound travels over distance. The models take into account reflections on hard surfaces, ground absorption and geometrical spreading. The calculations are performed in accordance with ISO 9613: Attenuation of sound during propagation outdoors. The figures below present some of the results of this modelling which have then been used within MACH Acoustics façade noise break in assessments, which are in line with BS12354 and the guidance in Manchester Planning Noise technical note.

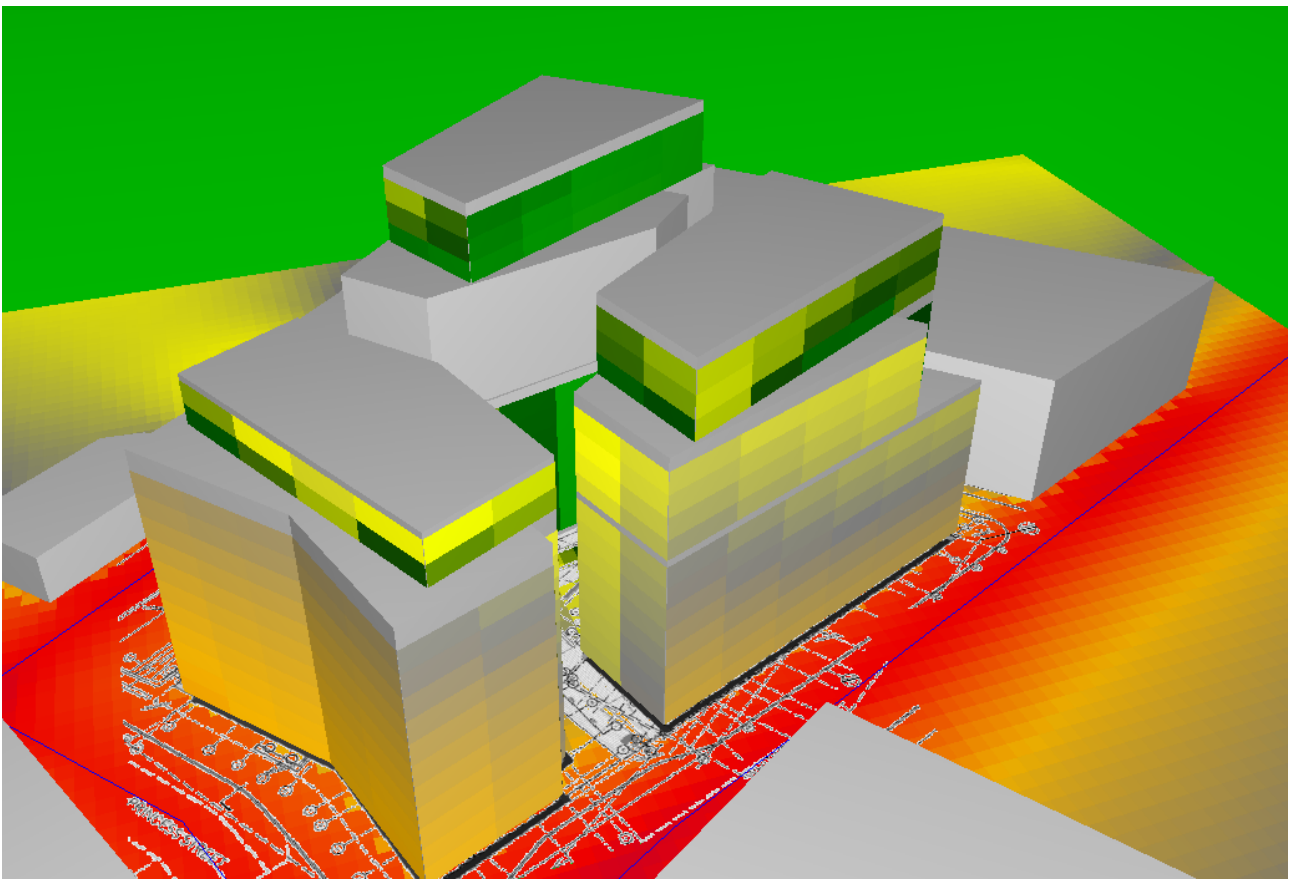


Figure 3-1: CadnaA noise model

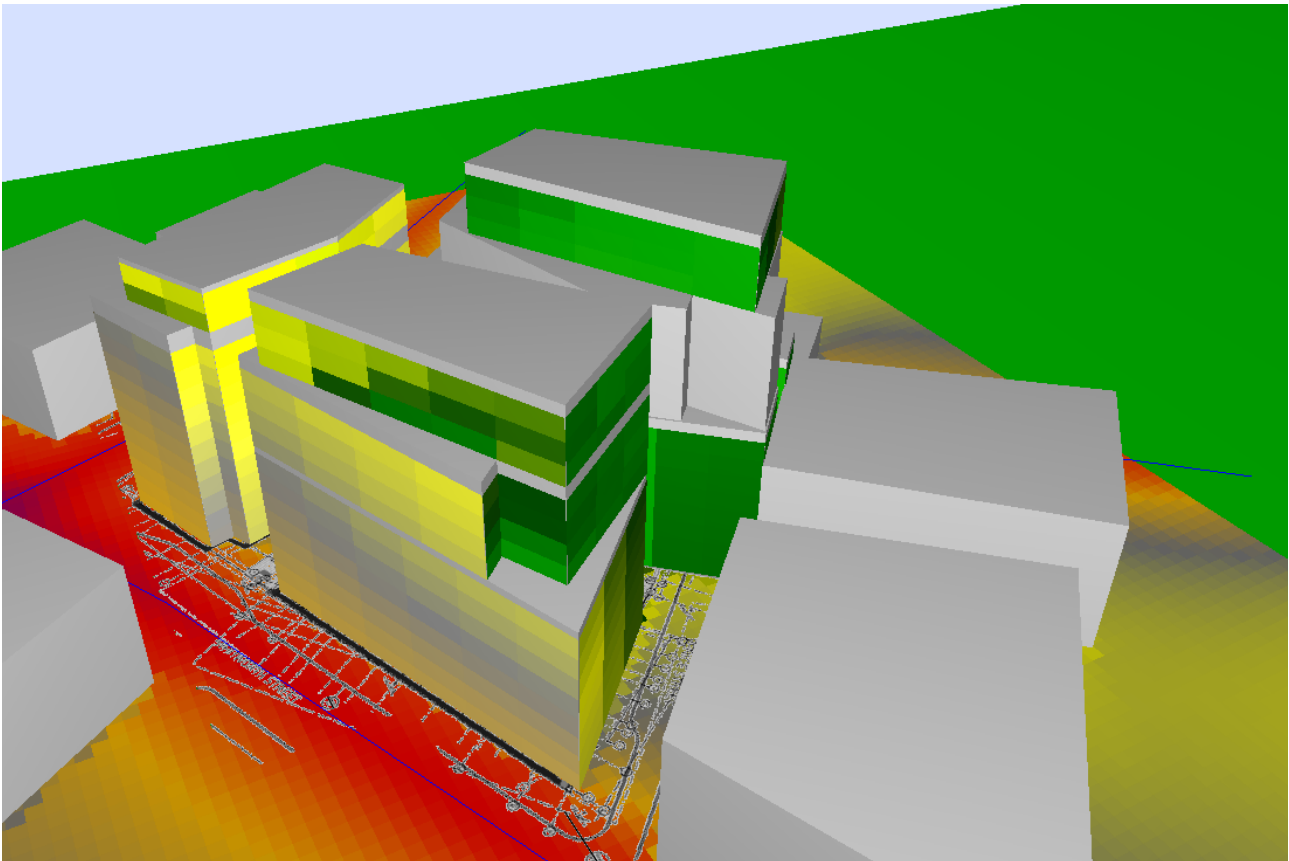


Figure 3-2: CadnaA noise model

As can be seen from the results in Figure 3-1 and Figure 3-2, noise levels incident upon the façades are not the same throughout the whole of the site. Those parts of the development which are shielded from the roads experience lower noise levels than those parts adjacent to the roads.

Within the subsequent calculations, MACH have taken into account the worst-case dwellings. MACH have also ensured that dwellings with both types of glazing are taken into account, along with room size and room types, see Section 4 for the acoustics performance of façades and Section 5 for a summary of the facade calculations undertaken.

3.5 Music, Traffic and Pedestrian Noise

Two acoustic performance standards apply to this development, Section 2.1 “Traffic & Street Noise Ingress” and Section 2.4 ‘Music Noise Ingress”, above. Music is typically assessed separately from traffic and street noise, since music contains larger intermittent and dynamic components than traffic/street noise and is considerably intrusive.

MACH has therefore split this assessment in two, assessing music and street noise separately. This has been done by running two different 3D models, one representing the spread of music from Canal Street, see Figure 3-3, the second model representing the site as a whole, where noise from Princess Street and Whitworth Street have been included with noise from Canal Street, see Figure 3-4. Note, in both cases, a 3D assessment has been undertaken.

Figure 3-3 shows that Blocks 2 and 3 are affected much less by the noise coming from Canal Street/music. As Block 1 is adjacent to Canal Street, it is fair to say that the dominant noise source will be noise coming from Canal Street. For Blocks 2 and 3 which are adjacent to Princess Street and Whitworth Street, both busy roads, the noise levels on these facades are dominated by traffic noise, see Figure 3-4.

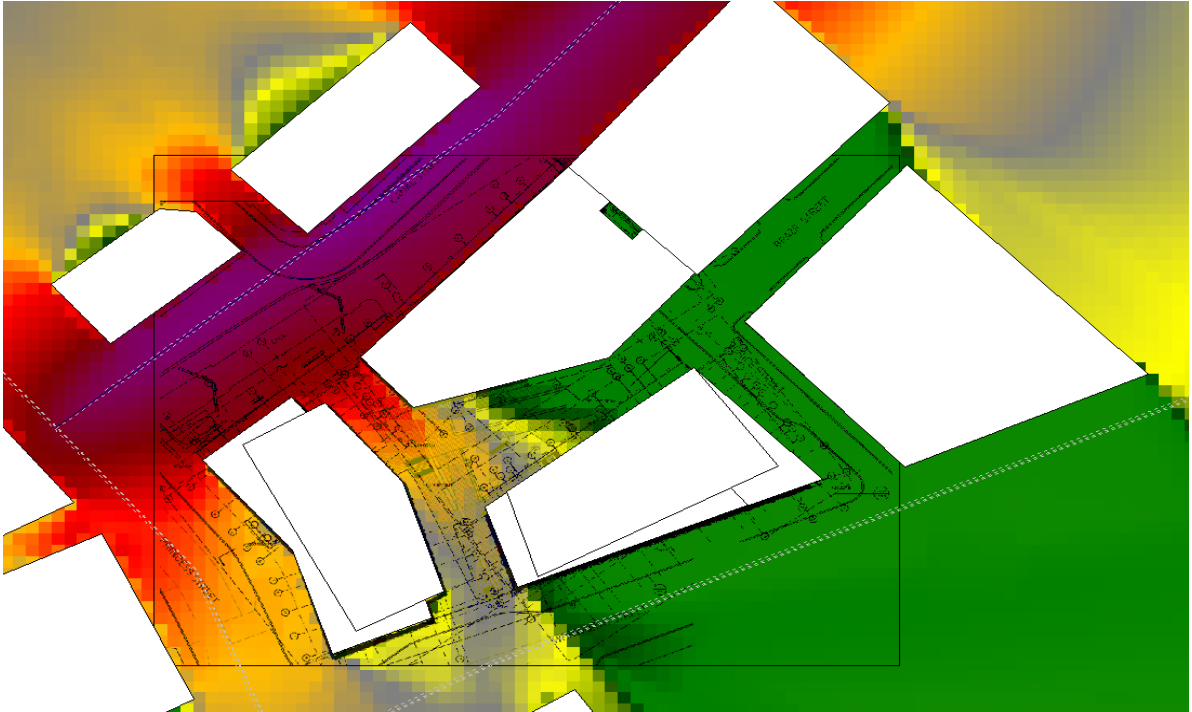


Figure 3-3: Noise break out from Canal Street only (MUSIC).

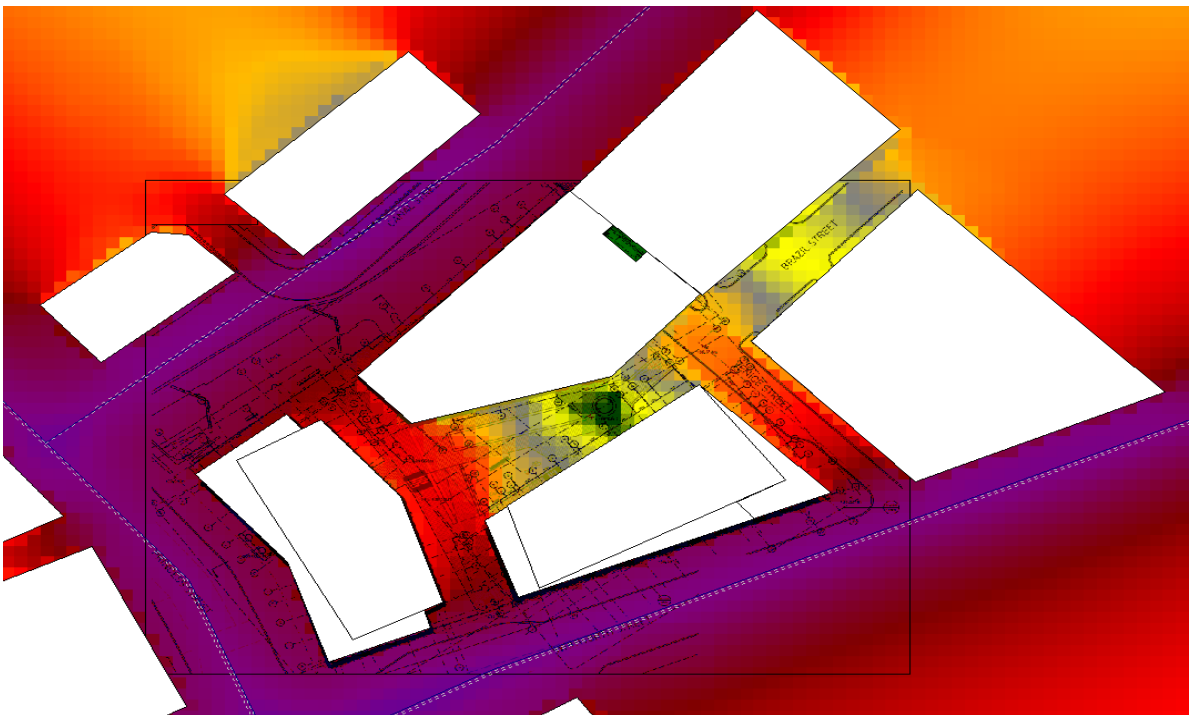


Figure 3-4: Noise map of the site with road noise and music present

4.0 RETAIL FAÇADE SPECIFICATIONS

4.1 Introduction

MACH Acoustics understands that the consented Ground Floor commercial uses are class A1 (shop), A3 (restaurant and cafe) and D1 (non-residential institution use - art gallery), this excludes bars and similar (class A4) or nightclubs.

However, there is still considered to be a risk of noise break out from these spaces to nearby residential dwellings and other properties. As such, MACH Acoustics has used the guidance set out in Section 2.4 above, to provide a noise target for music/sound break out from the retail units to the nearby residential buildings.

It is worth noting that the requirements set out in Section 2.4 could be seen to be over onerous, since as per Manchester City guidance, music is identified as a highly disturbing noise source compared to other sources, such as those from a retail unit. It may therefore be acceptable to use a lesser target than 10dB below all octave L90 levels. On the flipside, based on the projects adopted façade specification for the retail units, Manchester City Council's requirements are being met.

4.2 Internal Noise Levels

As per Section 2.4 above, the consultant is required to provide the internal noise levels when undertaking a noise break out assessment. Table 22 of Sandy Brown's Stage 4 report provides the following internal noise limits for operational noise in the retail unit, this is repeated in Table 4-1 below:

Description	63 Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	dBA
Operational noise limit in ground level commercial & amenity units, L_{eq} (dB)	70	77	85	82	82	86	84	90

Table 4-1: Shows the proposed noise limit in the commercial units on the Ground Floor.

The sound level in Table 4-1 is very unlikely to occur within retail units, cafés or restaurants. It should be noted that 90 dB is above the upper exposure limit value as stated in the Noise at Work Regulations 2005, please see these requirements below. It is also important to note that noise levels in the retail unit need to be sufficiently low such that consumers and retailers can easily communicate, enabling the process of selling to take place.

Lower exposure action values: a weekly or daily noise exposure of 80 dBA

Upper exposure limit values: a weekly or daily noise exposure of 85 dBA

Upper exposure limit values: a weekly or daily noise exposure of 87 dBA

In the description of these values, the lower exposure action value is the point at which “the exposure values are the levels of exposure to noise at which you are required to take certain actions .. the exposure limit values are the levels of noise above which an employee may not be exposed ... ”

Above the lower exposure action value, hearing protection should be allowed for upon the request of employees. Above the upper exposure limit value, hearing protection is mandatory, and above the upper exposure limits, actions should be taken where reasonably practicable, to reduce the noise level and hearing protection provided.

Taking into account the noise at work regulations, MACH suggests that the maximum indoor ambient noise level should be 79 dBA. Thus, the used amplified sound noise level within the retail units is shown below in Table 4-2.

Description	63 Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	dBA
Restaurant/Retail Noise Levels (dB, $L_{Aeq, 1hr}$)	59	66	68	71	71	75	73	79

Table 4-2: Shows the internal noise levels used within the calculations. Measurements taken on site.

4.3 Assessment Process

In order to assess the required sound reduction of the facades to the retail areas, the above levels have been added into MACH’s 3D acoustic model. This has been done by representing the facades of a retail unit as area sources.

CadnaA is an industry standard noise propagation software. The software calculates how sound travels over distance. The models take into account reflections off hard surfaces, ground absorption as well as geometrical spreading and other factors. The calculations are performed in accordance with ISO 9613: Attenuation of sound during propagation outdoors.

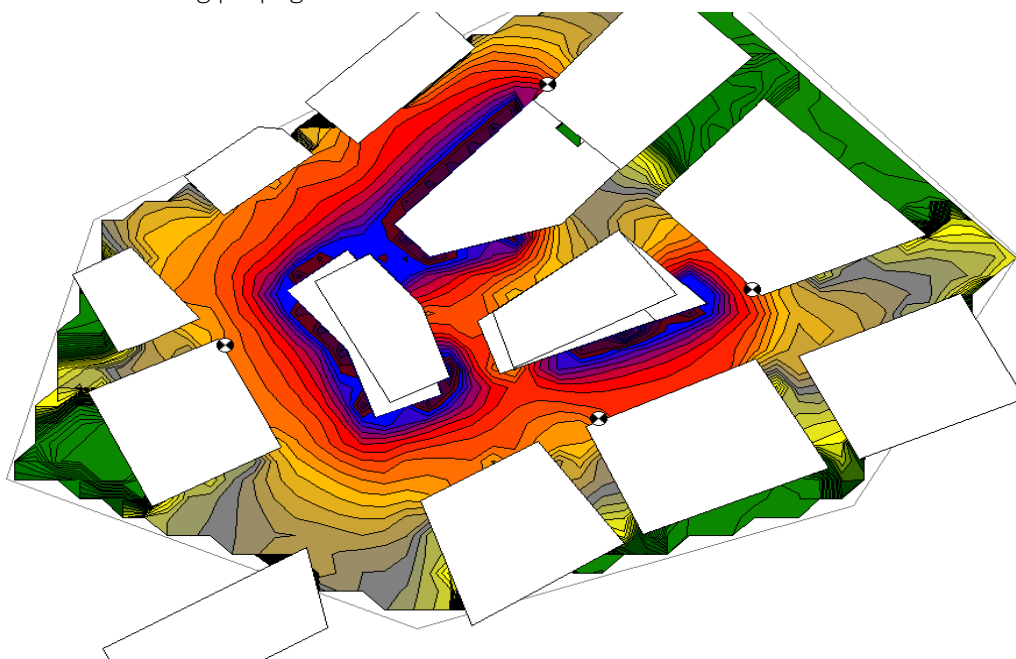


Figure 4-1: Shows the noise mapping study of the maximum noise levels from retail units

As per the planning specification, noise attenuation from the retail units has been designed to 10 dB below each measured L90 background noise level. For the purpose of continuity, these levels have been taken from Sandy Brown's Planning Report and are repeated within the table below.

Time	description of limit	Location	63	125	250	500	1000	2000	4000	dB, L _{Aeq}
Day Time (23:00 – 07:00)	Amplified music Leq limits at the nearest noise sensitive receptors	The Atrium, 80 Princess, Street & Venice Court	49	47	43	39	38	34	30	43
		Bombay House and Whitworth House	55	49	49	41	40	36	28	46
		Regency House & Brazil House and Amazon House	54	47	43	41	40	35	27	44

Table 4-3: Shows the limits, in line with the council's planning conditions, which Sandy Brown suggest in their Stage 4 report.

From here, the glazing requirements have been ascertained so that the noise levels do not exceed those values shown in Table 4-3.

4.4 Glazing Specification

From the process given in Section 4.3, directly above, the glazing specification in Table 4-4 has been established in order to achieve the targets set by Manchester City Council's Section 2.4 above.

Description	63 Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Rw (+Ctr)
Glazing Specification	2	13	19	25	26	34	40	28(-5)

Table 4-4: Shows the minimum glazing specification required when the internal ambient noise levels are 79 dBA, in order to meet MCC's targets at neighbouring residential developments.

4.5 Conclusion - Retail façade Specifications

In summary, Table 4-4 provides the minimum sound reduction values required for the facades to the retail units as a whole, in order to meet Manchester City Council's targets at the neighbouring residential developments when the sound levels are as shown in Table 4-2. As such, these values have been adopted by the construction team ensuring that the proposed facades to these units will meet planning requirements.

5.0 PLANT NOISE RATING LIMITS

5.1 Introduction

Plant noise break out is an important aspect of planning and noise. However, this development is a residential development and therefore only contains a minimal level of plant. In the main, there are two plant types across this development, individual heat recovery units providing ventilation to flats and ventilation servicing the Ground Floor retailers.

5.2 Performance Requirements

As per the planning condition, Section 2.5 above, the noise levels from any plant units should be at least 10 dB below the prevailing A weighted background levels. Sandy Brown's maximum noise limits provided in their report "Princess Street, Manchester - Acoustic planning report" are as shown in Tables 15 and 16.

Time	Description	Maximum plant noise rating level (dB L _{Ar,T})
Day Time (07:00 – 23:00)	The Atrium, 80 Princess, Street & Venice Court	48
	Bombay House and Whitworth House	50
	Regency House & Brazil House and Amazon House	53
Night Time (23:00 – 07:00)	The Atrium, 80 Princess, Street& Venice Court	42
	Bombay House and Whitworth House	49
	Regency House & Brazil House and Amazon House	56

Table 5-1: Shows the maximum noise levels for plant at 1 m from the noise sensitive receptors at various locations.

The following noise levels are for emergency plant noise limits, as per Sandy Brown's maximum noise limits given in Tables 17 and 18 and repeated below:

Time	Description	Maximum plant noise rating level (dB L _{Ar,T})
Day Time (07:00 – 23:00)	The Atrium, 80 Princess, Street & Venice Court	57
	Bombay House and Whitworth House	64
	Regency House & Brazil House and Amazon House	62
Night Time (23:00 – 07:00)	The Atrium, 80 Princess, Street& Venice Court	63
	Bombay House and Whitworth House	65
	Regency House & Brazil House and Amazon House	64

Table 5-2: Shows the maximum noise levels for emergency plant at 1 m from the noise sensitive receptors at various locations.

5.3 Conclusion -Plant Noise Rating Limits

The above conditions were set down in 2016 by Sandy Brown and have been added to the projects Stage 4 Reports. These performance requirements have been imbedded in the M&E specifications for plant and thus ensuring that Manchester City Council's noise planning requirements will be met.

6.0 FACADE CONSTRUCTION

The Manchester New Square development is now in its construction stages, being developed off the back of Sandy Brown Acoustics Stage 4 report and Sandy Brown's Planning Document. As the project has developed, the number of façade types have been reduced to two solid façade types and four glazed elements, consisting of two different glass construction types.

The façades across all residential flats are based upon a modular, composite concrete panel, formed with windows and louvers within it, that have been prefabricated before arriving on site. The panels are therefore complete and fixed directly to the façade of this development. These panels are then finished with an internal stud wall, lined with a plasterboard finish as per Sandy Brown's recommendations.

The acoustic performance of windows has been ascertained through on-site measurements, please See MACH Acoustics report "Internal Ambient Noise Levels Assessment - 1st of July 2019".

The results of these tests and modelled sound levels for the solid façade have then been used within a noise break in assessment to BS12354-Part 3 'Building acoustics --Estimation of acoustic performance of buildings from the performance of elements - Part 3: Airborne sound insulation against outdoor sound break in assessment', see Section 5.

6.1 The Acoustic Performance of the Solid Façade

As above, two solid façade types have been used throughout this development. Both these constructions are provided in the Sandy Brown Stage 4 report with a description of these façades being provided in Table 6-1 below.

The descriptions of these two elements are provided below. The first is made up of the façade, the second is the construction loaded into INSUL. INSUL is a software used for predicting the sound insulation of walls, floors, roofs, ceilings and windows. This software makes a good estimation of the Transmission Loss (TL) in 1/3 octave bands and Weighted Sound Reduction Index for use in noise transfer calculations.

The result of this modelling is presented as R_w and R_w+C_{tr} in Table 6-1, over leaf. Table 6-2 over leaf provides the octave values for these constructions that have then be used within MACH Acoustics assessments.

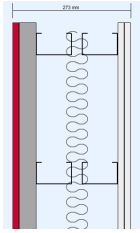
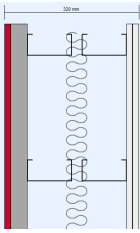
Wall Type	Description	Insul Description	Indicative Illustration	Calculated R_w	$R_w + C_{tr}$
C1	• 15mm thick brick slips • 40mm UHPC panel ($\geq 2500 \text{ kg/m}^3$) • 188mm cavity containing rigid insulation • $\geq 50\text{mm}$ mineral fibre insulation ($30\text{-}60 \text{ kg/m}^3$) • 2 x 15mm Wallboard (independent lining)	• 15mm thick brick (Outer Layer) • 40mm Concrete (density=2500 kg/m^3) • Independent Steel studs (cavity depth:188mm) • 50mm rockwool insulation (33 kg/m^3) • 2 x 15mm Gyproc Wallboard		79	72
C2	• 15mm thick brick slips • 40mm UHPC panel ($\geq 2500 \text{ kg/m}^3$) • 235mm cavity containing rigid insulation • $\geq 50\text{mm}$ mineral fibre insulation ($30\text{-}60 \text{ kg/m}^3$) • 2 x 15mm Soundbloc (independent lining)	• 15mm thick brick (Outer Layer) • 40mm Concrete (density=2500 kg/m^3) • Independent Steel studs (cavity depth:235mm) • 50mm rockwool insulation (33 kg/m^3) • 2 x 15mm Soundbloc (independent lining)		81	75

Table 6-1: Details of the proposed façade construction.

Element	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Weighted
C1	44	58	72	77	78	88	93	79 R_w
C2	48	62	74	79	79	85	96	81 R_w

Table 6-2: Façade, sound reduction indices

6.2 Glazing and Ventilation Specification

Sandy Brown Acoustics' planning document states the following with respect to the glazed façade elements:

7.2.3 Assessment of glazed facade elements"

An assessment of the maximum allowable glazed areas is set out in Table 13, based on the non-glazed constructions given in Section 7.2.2 and the following glazing constructions:

- G1 - 12.8 mm laminate glass/160 mm cavity/12.8 mm laminate glass
- G2 - 12.8 mm laminate glass /70 mm cavity/12.8 mm laminate glass
- G3 – 9.1 mm Pilkington Optiphon /20 mm argon/13.1 mm Pilkington Optiphon
- G4 - 10 float glass /12 mm cavity/6 mm float glass
- G5 - 6 float glass /12 mm cavity/6 mm float glass (standard thermal double glazing).

It should be noted that due to the limited test data available, performances at 63 Hz have been estimated for the thinner build-ups (G3 – G5).

Neither the planning document nor the Stage 4 report contains acoustic specifications for the solid element or glazed element to comply with. Additionally, the Stage 4 report includes slightly different specifications based around Saint Gobain glazing, see overleaf.

Wall Type	Stage 4 – Acoustics Specification	NorDan - Glazing
G3 – Glass Type	8.8 mm Saint Gobain Stadip Silence 20 mm cavity 12.8 mm Saint Gobain Stadip Silence	13.52 Low E Heat Strengthened Clear Laminated Outer 22mm Warm Edge Argon Cavity 8.76 Laminated Inner
G4 – Glass Type	8.8 mm Saint Gobain Stadip 16 mm cavity 12.8 mm Saint Gobain Stadip	9.52 Low E Heat Strengthened Clear Laminated Outer 22mm Warm Edge Argon Cavity 8.36 Laminated Inner

Table 6-3: Glazing Specification Types

Due to difficulties in procuring Saint Gobain glazing, the project has moved forwards with glazing provided by NorDan, as presented in the Table 6-3 above. This glazing has been taken forwards since the glazing mass and air gap between the glazing, is both heavier and larger than that advised by Sandy Brown and therefore is likely to have a higher sound reduction level than those used in Sandy Brown's assessments.

NorDan glazing has then been used within the two window types, an openable window with a smaller pane and a full length, fixed window. Table 6-4 below provides the measured sound reduction levels for four window types used in this development. These windows have then been used within MACH's façade noise break in assessments.

Element	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
G3 Mk 1000 Openable	25	25	35	41	43	44	46
G3 Mk 1003 Fixed Frame	24	19	33	41	46	50	55
G4 Mk 1007 Openable	24	23	32	38	41	43	48
G4 Mk 1008 Fixed Frame	26	20	29	37	41	45	51

Table 6-4: Measured spectral data for window types used

6.3 Opaque Windows Plates

In addition to windows, opaque spandrel panels have also been used within this development. These elements are based upon an opaque, glazed unit, but are then lined internally with plasterboard. As such, the sound reduction of these elements will be considerably higher than that of the windows. As a result of this higher acoustic performance, these elements have not been included in the façade noise break in assessment.

6.4 Air Vents

The very top section of the windows includes air vents that are taken back to the flats ventilation systems. These vents are therefore above the ceiling line and are designed with acoustic attenuators as detailed by Sandy Brown, this will ensure that noise break in will not contribute to the overall noise levels within dwellings and have therefore not been considered within noise break in assessments.

7.0 FAÇADE ASSESSMENT

7.1 Introduction

The basis of all façade assessments is principally based upon the difference between the external noise levels and the sound reduction provided by the facade, with the addition of room size and room finish corrections. The sound reduction of the façade is a function of the area of the façade, the area of the elements making up the façade and the sound reduction of these elements. At this point in this report, each of these elements have been discussed. This section therefore now addresses the final calculation used to assess the suitability of the proposed facades.

In the following sub-sections therefore, calculations have been carried out to predict the noise levels at the different facades on site. Following this, the internal noise levels have been predicted in the dwellings. These levels have then been compared to BS8233:2014 guidelines, as well as Manchester City Council's music levels.

7.2 Summary of Noise Climate

From a noise perspective, this is an extremely complex site, in that it contains three dominant noise sources;

- Noise/music from the Gay Village
- Traffic and pedestrian noise on Whitworth Road
- Traffic and pedestrian noise on Princess Street

Façade assessments are further complicated by the fact that there is a total of 32 different facades, split across three different blocks, with each of these blocks and façades being exposed to different noise levels, containing and not containing music.

In addition, four sets of calculations need to be undertaken. The first for day time (1) $L_{eq}(16 \text{ hour})$, the second the night time (2a/b) $L_{eq}(8 \text{ hour})$ (with and without music) and the third the night time (3) L_{Max} levels.

Such to simplify the assessment, MACH has classified the site into a range of different noise exposures, where each of these exposures is split into the three components (1, 2a/b and 3) provided above. Table 7-1 below provides a summary of these levels.

Block	Exposure	Day (07:00 – 23:00)	Night (23:00 – 07:00)		
		L _{Aeq}	dBA (63 – 125 Hz)	L _{Aeq}	L _{Amax}
Block 1	Red	67	69	68	83
	Orange	64	66	65	80
	Green	61	-	62	77
Block 2	Red	70	-	69	89
	Orange	67	50	67	83
	Green	64	44	61	79
Block 3	Red	69	-	66	83
	Orange	66	-	63	80
	Green	60	-	60	77

Table 7-1: Noise exposure categories

Music noise has not been included in façade assessments when facades are not seen to be exposed to music from Canal Street.

7.3 Summary of Room Types

As per the introduction of this report, the effective sound reduction of the façade is a function of the room size, room types (bedroom / living room), the glazing type and size, the solid façade type and the overall area of the façade. MACH has therefore reviewed drawings and grouped rooms into types, based upon their functions, size and facade types. In the main, the façades are based upon either having one openable window or two windows (one openable and the other fixed). The notation below has therefore been used to describe these rooms.

The third component added to this notation is the noise exposure level. The noise exposure level is shown in the figures below by a coloured line and denoted within rooms by N1, N2 or N3, for each of the different levels given in the table above.

Notation - Room Type – Glazing – Noise exposure

Example - R1 – G3 – N3

Room Type 1 - G03 glazing – Noise exposure levels 3.

Note, as an example, R1 contains one openable window and R3 for example contains one fixed window and one openable window.

Such to provide a more extensive assessment to that in MACH's original report, additional calculations have been undertaken calculating noise levels within living rooms. This information has been added overleaf.

7.4 Noise Levels and Building Height

As one moves away from a noise source, the level of sound is reduced. As such the required sound reduction needed from façades also reduces. MACH has therefore started this assessment by reviewing the suitability of the façade at the First Floor, i.e. the worst affected facades. From here, the impact of the building height has been considered.

The table below therefore provides the sound reduction taken from the 3D model, at intervals of every 3rd floor.

Road	Floor	Absolute Level (L_{Amax})	Difference from First Floor
Canal Street	1 st floor	83.2	-
	4 th floor	81.3	2
	7 th floor	79.9	3
	11 th floor	79	4
	14 th floor	78.2	5
Princess Street	1 st floor	91.1	-
	4 th floor	89.5	2
	7 th floor	87.3	4
	11 th floor	85.9	5
	14 th floor	83.7	7
Whitworth Street	1 st floor	87.6	-
	4 th floor	85	3
	7 th floor	83.1	5
	11 th floor	81.6	6
	14 th floor	80.5	7

Table 7-2: Sound reduction levels for different floor highest

7.5 Façade Assessment – Building 1



Figure 7.1: Floor mark-up of Building 1, showing room types and exposure levels (red line = 1, orange line = 2, green line = 3)

Floors with a shortfall	Room Reference	Room Type	Exposure Level	Day (07:00 – 23:00)	Night (23:00 – 07:00)			Night (23:00 – 07:00)
				dB, L _{Aeq,16hr}	dB, L _{Aeq,8hr}			15 th highest L _{Amax}
				dBA	63 Hz	125 Hz	dBA	dBA
-	Target	-	-	35	47	41	30	45
-	R1-G3-N1	Bedroom, 1 window	1	24	41	38	25	39
-	R2-G3-N1	Bedroom, 1 window (larger façade)	1	23	40	36	24	37
1 – 3	R3-G3-N1	Bedroom, 2 windows	1	29	44	43 (+2)	30	41
1 – 3	R3-G4-N1 (1 st Floor)	Bedroom, 2 windows		30	44	43 (+2)	30	43
-	R3-G4-N1 (7 th Floor)	Bedroom, 2 windows	1 (7 th floor)	25	40	40	26	37
-	R5-G3-N2/3	Bedroom, 3 windows	2/3	24	40	37	24	40
-	R1-G4-N3	Bedroom, 1 window	3	17	-	-	15	33
-	R2-G3-N3	Bedroom, 1 window (larger façade)	3	14	-	-	13	30

Table 7-3: Building 1 results table

From the table above, it is seen that the only shortfall in performance is for those spaces marked in Red in Figure 5.1. This shortfall is seen to relate to music break in, with the shortfall being 2 dB at 125 Hz. From Table 5-3 above, it can be seen that once you move up to the 4th Floor, noise levels will be reduced by 2 dB. As such, the above shortfall is only seen to apply between the 1st and 3rd Floors.

Please see Section 5.9 for further discussion in relation to these shortfalls.

Room Reference	Room Type	Exposure Level	Day (07:00 – 23:00)
			dB, L _{Aeq,16hr}
			dBA
	-	-	35
5W – G04 – N1	Living room, 5 windows	1	28
2W– G04 – N1	Living room, 2 windows	1	25
2W– G04 – N3	Living room, 2 windows	3	15
3W– G04 – N3	Living room, 3 windows	3	17

Table 7-4: Building 1 Results Table for the living rooms in building 1

As can be seen in Table 7-4 the results for the living room are all in line with the internal ambient noise levels in BS8233 for living rooms during the day

7.6



Figure 7.2: Mark-up of Building 2, showing room types and exposure levels (red line = 1, orange line = 2, green line = 3)

Floors with a shortfall	Room Reference	Room Type	Exposure Level	Day (07:00 – 23:00) dB, L _{Aeq,16hr}	Night (23:00 – 07:00) dB, L _{Aeq,8hr}			Night (23:00 – 07:00) 15 th highest L _{Amax}	Night (23:00 – 07:00) 15 th highest L _{Amax}
				dBA	63 Hz	125H Hz	dBA	Saturday	Friday
								dBA	dBA
	Target	-	-	35	47	41	30	45	45
1 - 7	R1-G4-N1	Bedroom, 1 window	1	28	-	-	26	48 (+3)	45
1 - 7	R1-G3-N1	Bedroom, 1 window	1	26	-	-	24	46 (+1)	44
1 - 7	R4-G3 -N1	Bedroom, 2 windows	1	31	-	-	29	48 (+3)	45
1 - 7	R3-G3-N1	Bedroom, 2 windows	1	30	-	-	29	48 (+3)	45
7 - 13	R3-G3N1 (7 th floor)	Bedroom, 2 windows	1	25	-	-	26	45	45
-	R1-G3-N2	Bedroom, 1 window	2	23	39	36	23	41	38
-	R3-G3-N2	Bedroom, 2 windows	2	27	42	41	28	44	41
-	R4-G3/G4-N2/N3	Bedroom, 2 windows	2 / 3	27	44	41	27	44	41
-	R3-G3-N3	Bedroom, 2 windows	3	25	39	36	22	41	38
-	R1-G4-N3	Bedroom, 1 window	3	23	39	32	20	40	27
-	R4-G4-N3	Bedroom, 2 windows	3	27	40	37	23	43	40
-	R5-G3-N3	Bedroom, 3 windows	3	27	24	24	24	42	39

Table 7-5: Building 2 results table.

The Table and Figure above highlights a range of failures, these failures are down to the L_{Amax} level only. In this case, the shortfall is between 1 and 3 dB. However, undertaking the same assessment but for data on Friday rather than on Saturday, it is seen that the above spaces meet the required L_{Amax} performance standards.

Room Reference	Room Type	Exposure Level	Day (07:00 – 23:00)
			dB, L _{Aeq,16hr}
			dBA
Target	-	-	35
6W – G04 – N1	Living room, 6 windows	1	30
5W– G04 – N1	Living room, 5 windows	1	26
3W– G04 – N1	Living room, 3 windows	1	26
2W– G04 – N1	Living room, 2 windows	1	25
3W– G04 – N2	Living room, 3 windows	2	24
3W– G04 – N3	Living room, 3 windows	3	22
2W– G04 – N3	Living room, 2 windows	3	20

Table 7-6: Building 1 Results Table for the living rooms in building 2

As can be seen in Table 7-6 the results for the living room are all in line with the internal ambient noise levels in BS8233 for living rooms during the day

7.7 Façade Assessment – Building 3



Figure 7.3: Mark-up of Building 3, showing room types and exposure levels (red line = 1, orange line = 2, unexperienced line = 3)

Floors with a shortfall	Room Reference	Room Type	Exposure Level	Day (07:00 – 23:00)	Night (23:00 – 07:00)	
				dB, L _{Aeq,16hr}	dB, L _{Aeq,8hr}	15 th highest L _{Amax}
				dBA	dBA	dBA
	Target		-	35	30	45
-	R1 - G4 – N1	Bedroom, 1 window	1	26	24	45
-	R3 - G3 – N1	Bedroom, 2 windows	1	30	26	45
1 - 3	R4 – G4 – N1	Bedroom, 2 windows	1	23	20	38
-	R1 - G4 - N2	Bedroom, 1 window	2	24	21	42
-	R1 - G4 – N3	Bedroom, 1 window	3	21	18	37
-	R3 – G4 – N3	Bedroom, 2 windows	3	24	21	40

Table 7-7: Building 3 results table

From the Figure and Table above, it can be seen that this block is fully compliant with Manchester City Councils acoustics planning requirements.

Room Reference	Room Type	Exposure Level	Day (07:00 – 23:00)
			dB, L _{Aeq,16hr}
			dBA
Target	-	-	35
5W – G04 – N1	Living room, 5 windows	1	28
4W – G04 – N1	Living room, 4 windows	1	27
2W – G04 – N1	Living room, 2 windows	1	25
4W – G04 – N2	Living room, 4 windows	2	25
6W – G04 – N1	Living room, 6 windows	3	29
2W – G04 – N1	Living room, 2 windows	3	18

Table 7-8: Building 1 Results Table for the living rooms in building 3

As can be seen in Table 7-8 the results for the living room are all in line with the internal ambient noise levels in BS8233 for living rooms during the day

7.8 Summary and Analysis of Shortfalls – Block 1

7.8.1 2dB Relaxation at 125Hz

The only shortfalls in this block are four rooms facing Canal Street on the 1st, 2nd and 3rd Floors. This shortfall is a 2dB music exceedance at 125Hz.

With respect to this shortfall, Section 7.5 above states:

“... Therefore a criterion that would achieve a condition of 'inaudible' / 'virtually inaudible' which is applicable for new residential developments that are structurally connected to entertainment venues (or vice versa) would be:

Music noise levels in the 63Hz and 125Hz octave centre frequency bands (Leq) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB (Leq), respectively.

This criterion may also be applicable for new residential developments that are structurally separate from an existing entertainment venue.”

Since this development is not seen to be structurally connected to an entertainment venue (or vice versa), the 2 dB shortfall may be seen to be acceptable.

7.8.2 Calculation Tolerances

Putting a relaxation to one side, it is also worth noting that there are calculation tolerances used within acoustics assessments. Such to calculate the effect of these tolerances, measured façade levels have been used to establish internal music levels within rooms failing to meet the 125Hz requirements. This assessment is based upon external and internal noise measurements undertaken on Friday 3rd May, see MACH's report “Internal Ambient Noise Levels Assessment”.

During this survey, levels were measured both externally and internally at the same time. This has allowed MACH to establish the difference between the internal noise levels and the external noise levels to Room 3 – 102.

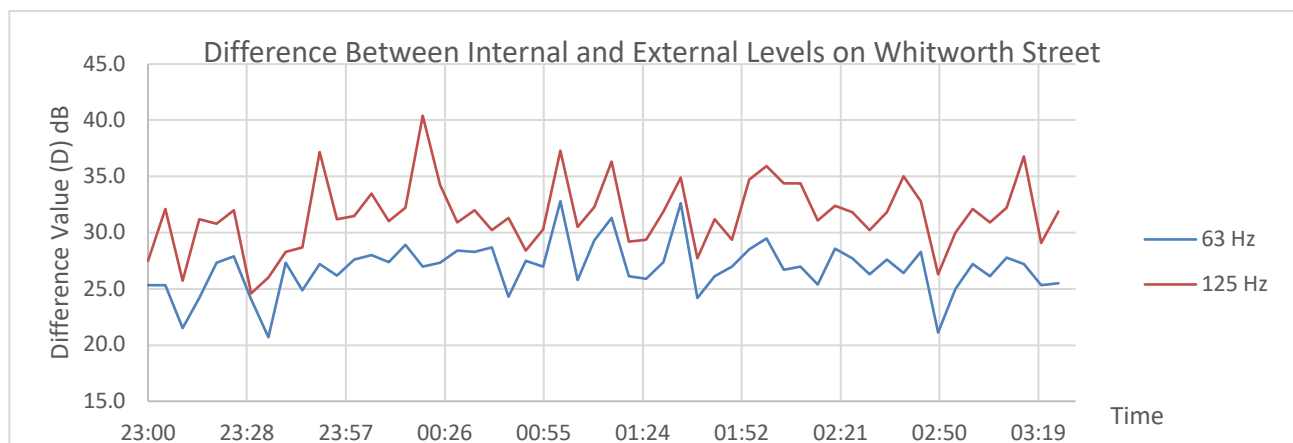


Figure 5-8: Showing the difference between internal and external noise measurements

The internal noise measurements have been taken in Room 3 – 102. This room has two G03 windows. The average differences between the measured internal and external noise levels are shown in Table 5-8 below. Note that Room 3 – 102 is very similar in size, shape and façade to that of those failing along Canal Street, please see Figure 5-9 below.

Location	Room Type	125 Hz
Whitworth Street	2 Windows, G03 openable and fixed	32

Table 5-8: Shows the level difference at 63 Hz and 125 Hz for the Southern façade on building 3, facing Whitworth Street.

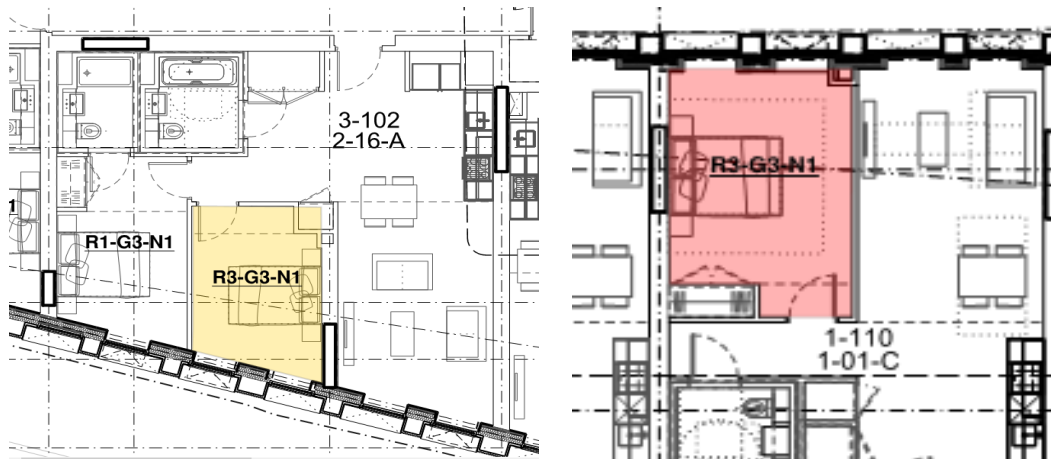


Figure 5-9: Shows the room in which internal ambient noise levels were monitored (Room 3 – 102) - Left. Shows the room in which music levels fail to meet the 125Hz requirement – Right.

Using the levels in Table 5-8 and the predicted façade levels from CadnaA, the internal noise levels in those rooms within Block 1 that fail to meet the music 125Hz requirements, have therefore been recalculated based upon the measured level difference across the façade. These values are presented below.

Location	Room Type	Time Period	125 Hz
Target Value			41 dB
Block 1	Exposure Level 1	Leq Night	41 dB

Table 5-9: Shows the predicted noise levels using the calculated difference level from measured data

As can be seen from the table above, based upon the measured level difference provided by the façade and the New Square Development, the above spaces will comply with Manchester 125Hz music requirements.

7.8.3 Summary and Analysis of Shortfalls – Block 1 – Conclusion

In summary, there is a 2 dB shortfall in a total of 12 rooms, in the 125Hz music requirements. Based upon measured façade levels, this shortfall is not seen. MACH Acoustics are therefore keen to move forwards on the basis of a 2dB mathematical error relaxation for 12 room within Block 1.

It is understood from correspondence with Manchester City Council, that this effective shortfall is acceptable to the council.

7.9 Summary and Analysis of Shortfalls – Block 2

Again, there is seen to be a small number of shortfalls in the acoustics performance of the façade to Block 2, on the corner of Princess Street and Whitworth Street. In this case, the shortfalls are no larger than 3 dB and apply to the internal L_{Amax} levels only.

7.9.1 3dB Relaxation in L_{Amax} levels

The text below is taken from Manchester's Noise Planning Technical Document.

“ It states that where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB. However, consultants should not base their assessment on the 5dB relaxation. ”

Additionally, within the target section of this report, the following wording is used:

“Bedrooms (night time - 23.00 - 07.00) 30 dB L_{Aeq} (individual noise events should not normally exceed 45 dB L_{Amax} , F by more than 15 times)”

7.9.2 Day Change

Failures in L_{Amax} levels are complicated by the fact that the measurements on a different night or weekend may eliminate failures, since whatever drove the L_{Amax} is not likely to be present in the noise spectrum at other times.

To assess this effect, Table 5-6 above presents the L_{Amax} levels based upon measurements undertaken on Saturday and Friday night. As can be seen, the shortfall only occurs on the Saturday night, due to increased peak levels. From the data in the Environmental Noise Report, it can also be said that on no other day of the measurement, other than Saturday, L_{Amax} levels exceed the 45 dB target.

7.9.3 Summary and Analysis of Shortfalls – Block 2 – Conclusion

Based upon the fact that noise levels were measured over a particularly noisy weekend, and the shortfalls are small, along with the fact that the building as a whole is designed to comply with Manchester City Council's requirements, this shortfall has been accepted by the Council.

7.10 Conclusion –Facades Assessments

The findings in this façade document show that all spaces within Block 3 are compliant with the acoustic requirements set down in Manchester City Council's planning needs. Importantly, on-site acoustic measurements within this block, in a worst effected bedroom, confirm compliance with planning

requirements therefore adding confidence to MACH's calculation/assessments. Please see MACH's report "Internal Ambient Noise Levels Assessment"

The vast majority of internal ambient noise levels in Blocks 1 and 2 are in line with the lower limit stipulated in BS8233, and all the internal ambient noise levels are within the levels stated as the upper limit in BS8233. Therefore, all internal ambient noise levels are within BS8233 guidelines.

Thus it is seen that a robust acoustic attenuation scheme is seen to be provided by this development to residential spaces.

APPENDIX A - TERMINOLOGY

dB	Decibel. The unit of sound level.
dB(A)	A-weighted decibel. The A-weighting approximates the response of the human ear.
DnT,w	Weighted standardized level difference. A single number rating of the sound level difference between two rooms. DnT,w is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, sound may be transmitted around a wall by travelling up into the ceiling space and then down into the adjacent room.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.
Impact sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor.
LAeq	The equivalent continuous sound level. This is commonly referred to as the average noise level and is measured in dB(A).
LA90	The noise level exceeded for 90% of the measurement period, measured in dB(A). This is commonly referred to as the background noise level.
L'nT,w	Weighted, standardized impact sound pressure level. A single number rating of the impact sound insulation of a floor/ceiling when impacted on by a standard 'tapper' machine. L'nT,w is measured on site. The lower the L'nT,w, the better the acoustic performance.
Ln,w	Weighted normalised impact sound pressure level. A single number rating of the sound insulation of a floor.
NR	Noise Rating. A single number rating which is based on the sound level in the octave bands 31.5Hz – 8kHz inclusive, generally used to assess noise from mechanical services in buildings.
Octave band	Sound, which can occur over a range of frequencies, may be divided into octave bands for analysis. The audible frequency range is generally divided into 7 octave bands. The octave band frequencies are 63Hz, 125Hz, 250Hz, 1kHz, 2kHz and 4kHz.
Reverberation time (T60)	Reverberation time is used for assessing the acoustic qualities of a space. T60 is measured in seconds (s) and describes how quickly sound decays within a space.
Rw	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. Rw is measured in a laboratory. Rw is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Sound absorption	When sound hits a surface, some of the sound energy is absorbed by the surface material. 'Sound absorption' refers to ability of a material to absorb sound.
Sound insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.
Structure-borne transmission	Transmission of sound energy as vibrations inside the structure of a building.

APPENDIX B - BS 8233:2014

The Noise Policy Statement for England does not provide guidance on internal noise levels within residential buildings. As a result, the advised levels within BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' have been adopted. BS8233 states that to achieve adequate sleeping and living conditions, background noise levels should be 30 dB L_{Aeq} or less within bedrooms at night, and 35 dB L_{Aeq} or less within Living rooms during the day. The advised levels are tabulated below.

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	35 dB L_{Aeq} , 16 Hour	-
Dining	Dining Room	40 dB L_{Aeq} , 16 Hour	-
Sleeping	Bedroom	35 dB L_{Aeq} , 16 Hour	30 dB L_{Aeq} , 8 Hour

Table C.1 BS8233 internal noise levels

BS 8233: 2014 provides no definitive methodology for assessment of L_{Amax} levels. The standard simply states that a guideline value for the internal level may be set depending on the character of the noise source and number of events occurring. Due to the proximity of the proposed site to sources of road traffic noise, assessment of L_{Amax} is critical to ensuring that disturbance is avoided.

In order to provide an assessment of L_{Amax} levels, the recommendations of the World Health Organization have been employed. The WHO state that in order to avoid sleep disturbance within bedrooms during the night, the internal sound pressure level should not exceed 45 dB L_{Amax} .

APPENDIX C - NOISE POLICY STATEMENT FOR ENGLAND

The aim of the Noise Policy Statement for England (NPSE) is to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion. The NPSE applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise.

Noise Policy Vision: Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

Noise Policy Aims: Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life

The Noise Policy Statement for England does not provide any specific guidance on noise levels for residential developments therefore it is seen that it is up to the discretion of the Local Planning Authority to decide on what is deemed acceptable.

APPENDIX D - GOVERNMENT GUIDANCE DOCUMENTATION – NOISE CONTROL.

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

With regards to noise the Framework states that 'Planning policies and decisions should aim to:

- avoid noise from giving rise to significant adverse impacts²⁷ on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts²⁷ on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;²⁸ and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

[27] The NPPF does make reference to The Noise Policy Statement for England, published by Defra in March 2010.