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REFURBISHMENT OF BARNSLEY CIVIC

PLANNING NOISE ASSESSMENT

On behalf of:

HLM Architects

hepworth acoustics

Report No. P19-389-R03v2
July 2021

REFURBISHMENT OF BARNSLEY CIVIC

PLANNING NOISE ASSESSMENT

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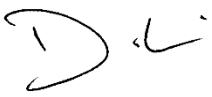

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1.0 INTRODUCTION

1.1 Hepworth Acoustics Ltd was commissioned by HLM Architects on behalf of Barnsley Civic to provide acoustic consultancy services in connection with the refurbishment of the existing Barnsley Civic buildings located between Eldon Street and Hanson Street in Barnsley town centre. This report sets outs a planning noise assessment for the redevelopment proposals, focusing on the potential impact of noise on the proposed new apartments along the Eldon Street elevation of the building.

1.2 This report is an update to the previous issue (ref. P19-38-R03v1 dated March 2021) that incorporates some additional information and clarification to address queries from Adam Cattell, Environmental Health Officer (EHO) at Barnsley MBC.

1.3 Due to the COVID-19 lockdown restrictions at the time of writing the original version of this document, the noise climate in the area was unlikely to be representative of the noise climate under 'normal conditions' when these restrictions on peoples movements are not imposed. On this basis, we have agreed with Paul Denton, EHO at Barnsley MBC, to base our review on noise survey data obtained nearby the redevelopment which was captured but Nova Acoustics Ltd prior to the COVID-19 restrictions. The results of these noise survey have been used to determine the requirements for control of noise impact due to new plant/equipment and sound insulation requirements for the building to adequately control the ingress of external noise.

1.4 The location of the Barnsley Civic Centre is shown in Figure 1. Barnsley Civic is a large multi-purpose building in Barnsley town centre. The building has a traditional substantial masonry external wall construction located on the Eldon Street side of the site, with a large steel-framed extension with a mix of brick and curtain wall façade which backs onto Hanson Street and Civic Gardens.

1.5 Proposals are for the refurbishment of the existing building to form an arts centre in the newer steel frame extension and mixed-use in the original part of the building which backs onto Eldon Street, primarily made up of apartments with some commercial spaces including a café and offices. The proposed floor layouts are shown in Figures 2 to 6. The café will not serve hot food and will not have any dedicated kitchen ventilation equipment.

1.6 This report includes assessments of external noise break-in to the apartments; sound insulation between the residential apartments and adjacent commercial spaces; and plant noise design limits for any new externally mounted mechanical services equipment.

1.7 Specifically, the noise assessment has included:

- An inspection of the site and surrounding area;
- Adoption of appropriate acoustic design criteria;
- Review of pre-COVID-19 lockdown restrictions noise survey data for the area;
- Assessment of noise break-in to proposed apartments;
- Recommendations for appropriate noise mitigation measures;
- Advice on sound insulation between residential and commercial spaces; and,
- Determination of appropriate noise limits for any externally mounted plant;

1.8 Whilst advice in this report includes initial sound insulation between the residential and commercial spaces; the scope of this assessment does not extend to advising on measures to achieve the requirements of Approved Document E (ADE) of the Building Regulations. The ADE requirements for the residential parts of the redevelopment will be considered separately.

1.9 The advice given in this report is provided solely with respect to acoustics and all recommendations will need to be checked with other suitably qualified engineers/consultants (e.g. fire, structural, ventilation etc.).

1.10 The various noise units and indices referred to in this report are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 GUIDANCE & ACOUSTIC DESIGN CRITERIA

Acoustic Design Criteria for Residential Apartments

2.1 The National Planning Policy Framework (NPPF) in paragraph 180 states that "Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life[60];"

2.2 The *Noise Policy Statement for England* (NPSE) 2010, which is referred to the in NPPF, includes three aims:

i. Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

ii. Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

iii. Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

2.3 However, there is as yet no specific guidance on numerical acoustic assessment/design criteria for proposed residential developments provided in the NPPF and accompanying on-line guidance, nor in the NPSE document.

2.4 Therefore, it is necessary to refer to established national guidance such as the acoustic design goals for residential development that are set out in BS 8233:2014, *Guidance on sound insulation and noise reduction for buildings*, which carries the full weight of an adopted British Standard. The design criteria recommended in BS 8233:2014 for daytime periods (07:00 - 23:00) and night-time periods (23:00 - 07:00) are summarised in Table 1.

Table 1: BS 8233:2014 Recommended Acoustic Design Criteria

Activity	Location	Daytime (07:00 - 23:00)	Night-time (23:00 - 07:00)
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

2.5 BS 8233:2014 also recognises that regular individual noise events at night can cause sleep disturbance but does not provide specific design criteria. Peaks of noise from individual events are usually described in terms of L_{Amax} values.

2.6 Suitable targets for controlling peak noise events inside dwellings are generally accepted to be controlling peaks within 45 dB L_{Amax} where practicable; and for this level to be exceeded typically no more than 10-15 times per night. This is based in WHO 'Guidelines for community noise' (1999) research: "For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night…".

2.7 BS 8233:2014 states that if there is a reliance on closed windows to meet the guide values, "there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level".

2.8 For this development, we therefore recommend that the following noise criteria be adopted for the proposed residential apartments with windows closed:

- Daytime noise within 35 dB $L_{Aeq,T}$ inside bedrooms and living rooms;
- Night-time noise levels within 30 dB $L_{Aeq,T}$ and generally not exceeding (typically no more than 10 times per night) 45 dB L_{Amax} in bedrooms.

Plant Noise Limits

2.9 British Standard 4142:2014+A1:2019, 'Methods for rating and assessing industrial and commercial sound' is the appropriate guidance for assessing and controlling the potential noise impact from noise sources such as mechanical services plant installations.

2.10 BS 4142 requires a 'rating' level ($L_{Ar,Tr}$) calculated from the operation of the noise source to be compared with the background sound level (L_{A90}) which is measured in the absence of the noise source,

evaluated over a 1-hour period for daytime operations and 15-minute period for night-time operations.

2.11 The rating level ($L_{Ar,Tr}$) is based on the 'specific' sound level ($L_{Aeq,Tr}$) attributed to the operating noise source, with 'character corrections' added for sound sources where 'certain acoustic features can increase the significance of impact'.

2.12 The character correction is applied to the specific sound level in order to obtain the rating level and can take into account tonality, intermittency, impulsivity and characteristics otherwise distinctive against the prevailing noise climate in the area.

2.13 An initial estimate of the potential noise impact from the operating noise source is determined by comparing the difference between the rating level and the background level and.

2.14 Regarding the outcome of the initial estimate, BS 4142 states that:

- Typically, the greater this difference, the greater the magnitude of impact;
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and,
- The lower the rating level is relative to the measured background level, the less likely it is that the operation will have an adverse impact or a significant adverse impact. Where the rating level is does not exceed the background sound level, this is an indication of the specific sound source having low impact, depending on the context.

2.15 BS 4142 states that all pertinent factors must be taken into account regarding the context in which the noise occurs, including but not limited to:

- The absolute level of sound.
- The character and level of the residual sound compared to the character of the specific sound; and,

- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will actually incorporate design measures that ensure good internal and/or outdoor acoustic conditions such as acoustic screening or upgraded sound insulation measures.

3.0 ENVIRONMENTAL NOISE CLIMATE

3.1 The available noise survey data for the area which has been used as the basis for this assessment is from a report by Nova Acoustic Ltd '*Noise Survey of Proposed Residential Development*' (ref: 1604AM) dated 16/07/2017.

3.2 The noise survey was carried out in July 2017, with the measurements taken on the corner of Eldon Street and Market Hill which is approximately 140m to the west of Barnsley Civic and, as such, the noise survey results are considered to be broadly representative of those that will prevail outside apartment windows on the Eldon Street elevation.

3.3 The results of the noise survey as provided in the Nova Acoustics report are reproduced in Tables 2 below.

Table 2: Summary of Noise Survey Results (dB)

Period	L_{Amax}	$L_{Aeq,T}$	$L_{A90,T}$
Day 1: 07/07/17 - 11:00 - 23:00	92	62	55
Night 1: 07/07/17 - 23:00 - 07:00	86	60	48
Day 2: 08/07/17 - 07:00 - 23:00	103	67	54
Night 2: 08/07/17 - 23:00 - 07:00	89	63	56
Day 3: 09/08/17 - 07:00 - 23:00	93	58	49
Night 3: 09/07/17 - 23:00 - 07:00	85	55	34
Day 3: 10/08/17 - 07:00 - 11:30	91	62	53

3.4 The 10th highest peak noise levels measured during each night over the course of the noise survey ranged between 80 and 84 dB L_{Amax}.

3.5 The implications of these noise levels are discussed more in Sections 4 and 6.

4.0 SOUND INSULATION OF BUILDING ENVELOPE

4.1 The sound insulation of the building envelope for the arts centre and commercial spaces within the refurbished civic centre will be dealt with as part of the redevelopment design at a later stage. For the purpose of this planning noise assessment we have focussed on the potential noise break-in to residential apartments.

4.2 The highest measured daytime and night-time noise levels ($L_{Aeq,T}$) from Table 2 have been adopted for the purpose of noise break-in calculations, as well as the highest of the 10th highest peak noise levels (L_{Amax}) from the three nights of the noise survey.

4.3 Whilst the measured spectrum of the noise climate is not provided in the report, a spectrum is provided in their recommendations for sound reduction index (R) values of the façade which is calculated based on the unknown measured noise spectrum. We have approximated the noise spectrum based on the sound reduction index values and normalised the levels to the adopted A-weighted noise levels, as presented in Table 3.

Table 3: Adopted External Noise Levels for Noise Break-in Calculations (dB)

Value	Sound Level at Octave Band Centre Frequency (Hz)							A
	63	125	250	500	1K	2K	4K	
Daytime $L_{eq,T}$	72	69	71	66	58	50	45	67
Night-time $L_{eq,T}$	68	65	67	62	54	46	41	63
Night-time L_{max}	89	86	88	83	75	67	62	84

4.6 Windows of standard well-sealed thermal double glazing (4mm glass - 12mm cavity - 4mm glass) have a typical sound reduction performance of 25 dB $R_w + C_{tr}$. Therefore, based on the adopted internal noise level criteria, where external noise levels exceed 60 dB $L_{Aeq,16h}$ during the daytime and/or 55 dB $L_{Aeq,8h}$ and/or 70 dB L_{Amax} at night, higher specification glazing is necessary.

4.7 We understand that the background ventilation for the apartments will be provided via a mechanical ventilation heat recovery (MVHR) system and there will be no terminations for ventilation on the Eldon Street elevation. Therefore, we have not included penetrations for ventilation in our noise break-in calculations. Windows will be openable for purge ventilation, but they need not be open for typical ventilation requirements.

4.8 We understand that the existing glazing is to be retained, therefore, in order to provide adequate sound insulation we have provided our recommendations based on installing secondary glazing.

Recommendations to Control Noise Break-in to Apartments

4.9 In order to ensure that the ambient noise levels and in particular the peak night-time noise levels are controlled within the BS 8233 criteria, we recommend installing upgraded secondary glazing with the following minimum specifications:

- Bedrooms & Living Rooms: Upgraded secondary glazing with a minimum sound insulation performance of 38 dB $R_w + C_{tr}$. This would typically be achieved by inspecting and making good the seals of the existing windows (or replacing existing outer windows with new standard thermal double glazing) and installing secondary glazing in a separate frame with a minimum 4mm glass and a cavity of at least 100mm between the existing (or new double glazed) windows and the secondary glazing.

4.10 We understand that on the top floor, there are small circular windows above eaves level on the Eldon Street elevation where secondary glazing cannot be accommodated. External break-in of noise via these small windows at the top of the building (i.e. furthest from ground level on Eldon Street) will be less significant than via the much larger windows on the lower floors and so a suitable alternative for these small windows would be high specification double glazing with a minimum sound insulation performance of 35 dB $R_w + C_{tr}$. This would be typically be achievable with double glazing formed of 8mm glass – nominal (10-20mm) cavity – 8.8mm acoustic laminated glass.

4.11 On the basis of the above, all apartments will have windows that are openable in order to provide sufficient purge ventilation.

5.0 SOUND INSULATION BETWEEN RESIDENTIAL & COMMERCIAL SPACES

Level 0 Café/Bar to Level 1 Apartments - Floor Sound Insulation

5.1 We understand that floors in the building are of timber joist construction. As can be seen in Figures 2 and 3, apartments on Level 1 are positioned above a café/bar on Level 0.

5.2 Whilst the development will be designed to meet the requirements of Part E of the Building Regulations, the sound insulation between residential and commercial spaces typically requires greater performance due to likely higher noise levels in the commercial spaces.

5.3 In order to assess the sound insulation between the Level 0 café/bar and the Level 1 apartments, we have adopted trading noise levels within the café/bar of 85 dB(A) and a low noise limit of NR20 for café/bar noise within the apartments.

Table 4: Adopted Café/Bar Trading Noise Levels (dB)

L_p at Octave Band Centre Frequency (Hz)							L_{pA}
63	125	250	500	1k	2k	4k	
88	86	83	81	78	77	76	85

Table 5: Noise Rating 20 Limits for Café/Bar Noise in Apartments (dB)

NR20 Values at Octave Band Centre Frequency (Hz)							NR
63	125	250	500	1k	2k	4k	
51	39	31	24	20	17	14	20

5.4 We have calculated the required sound reduction index performance of the ceiling/floor construction required in order for the Café/Bar to operate within the adopted NR20 limits based on the shared floor surface areas, likely room absorption properties', the room volumes and the adopted Café/Bar trading noise levels.

5.5 Based on our calculations the airborne sound insulation performance of the separating floor/ceiling should be designed to achieve the following minimum performance shown in Table 6.

Table 6: Minimum Recommended Ceiling/Floor Sound Reduction Index (dB)

Minimum *R* at Octave Band Centre Frequency (Hz)							R_w
63	125	250	500	1k	2k	4k	
45	55	60	65	66	68	70	66

Level 1 Office to Level 2 Apartments - Floor Sound Insulation

5.6 We have calculated the minimum required laboratory sound insulation performance ($R_w + C_{tr}$) of the floor separating the Level 1 Office and the apartments on Level 2 above, based on the adopted criterion (48 dB $D_{nT,w} + C_{tr}$) as well as the likely room absorption properties', the room volume and surface area of the shared floor.

5.7 On this basis, we recommend ensuring that the ceiling/floor construction here is design to achieve a minimum sound insulation performance of 61 dB $R_w + C_{tr}$.

Outline Recommendations for Floor Sound Insulation

5.8 The existing floor construction alone will not provide the high sound insulation performance values in Table 6 or the recommended performance of 61 dB $R_w + C_{tr}$ given above.

5.9 We have provided the following outline recommendations for the design, which will be taken forward in more detail at a later stage to achieve the minimum recommended performances given above:

- Install a mass barrier acoustic ceiling e.g. multiple layers of dense board on acoustic hangers with mineral wool laid in the cavity.
- Install a robust floating floor treatment e.g. cradle and batten system.

5.10 The flanking sound transmission via different paths e.g. internal leaf of the external wall, service penetrations etc. can have an effect on the resulting sound insulation performance and should be looked at in detail at the design stage. Nevertheless, the following general recommendations have been provided:

- The perimeter of the plasterboard ceiling should be well sealed using flexible acoustic sealant.
- The plasterboard acoustic ceiling should not have any holes or penetrations.
- If the internal leaf of the outer walls are common between Level 0 and Level 1, the walls may need to be independently lined.

Level 1 Apartments to Level 1 Office Circ. - Wall Sound Insulation

5.11 Whilst offices do not generate as much noise as a café/bar restaurant, it is considered that the sound insulation between and office and a residential apartment should ideally be better than the minimum requirements of Approved Document E (ADE) of the Building Regulations, i.e. 43 dB $D_{nT,w} + C_{tr}$ for flats formed by material change of use.

5.12 Therefore, we have adopted a design target of +5dB of the ADE requirements, resulting in a design target of 48 dB $D_{nT,w} + C_{tr}$.

5.13 We have calculated the minimum required laboratory sound insulation performance ($R_w + C_{tr}$) of the wall based on the adopted criterion above as well as the likely room absorption properties', the room volume and surface area of the shared partition.

5.14 On this basis, we recommend installing a wall with a minimum sound insulation performance of 56 dB $R_w + C_{tr}$.

5.15 The flanking sound transmission via different paths e.g. the ceiling, service penetrations etc. can have an effect on the resulting sound insulation performance and should be looked at in detail at the design stage. Nevertheless, the following general recommendations have been provided:

- The separating wall should be built 'full height' from structural floor to soffit, forming a break in the ceiling between the two spaces.
- The perimeter of the wall should be well sealed using flexible acoustic sealant.
- The separating wall should not have any holes or penetrations.

Acoustic Separation between Performances Spaces & Apartments

5.16 The proposed apartments are very well isolated from performance spaces and gallery in the arts centre. At first and second floor level, there are access lobbies/stairwells located between the performance spaces/gallery and the apartments area. On the third floor, there is a substantial buffer provided by ancillary spaces such as WCs, etc. Furthermore, habitable rooms of apartments will be generally located on the Eldon Street elevation beyond entrance hallways, bathrooms, etc.. As such, noise from performances would have to travel through multiple entirely separate separating wall constructions and large buffer areas followed by at least one further separating wall in order to enter apartment living rooms/bedrooms. Such a transmission path is likely to provide a sound insulation

equivalent to at least around 90 dB R_w and so it is inconceivable that there will be any significant noise impact on apartments from performances in the arts centre.

6.0 ENVIRONMENTAL PLANT NOISE LIMITS

6.1 As BS 4142 is the applicable guidance for assessing plant noise, appropriate design limits for noise from proposed plant at this redevelopment would be to control the rating level from any new externally mounted plant, to within the existing representative background sound levels ($L_{A90,Tr}$) at the nearest dwellings.

6.2 The nearest dwellings will actually be the new apartments formed within the Eldon Street elevation of the redevelopment itself.

6.3 Based on the background sound data provided shown in Section 3, we have adopted the plant noise design limits for new equipment installed as part of the redevelopment are shown in Table 7.

Table 7: Plant Noise Design Limits at Nearest Dwellings (dB)

Daytime (07:00-23:00) Limit	Night-time (23:00-07:00) Limit
49 $L_{Ar,1h}$	34 $L_{Ar,15\ min}$

6.4 Whilst details of any new plant and their installation locations are not currently available, providing plant noise design limits will ensure that these considerations are part of the design process at an early stage.

7.0 SUMMARY & CONCLUSION

7.1 Hepworth Acoustics Ltd was commissioned by HLM Architects on behalf of Barnsley Civic to provide acoustic consultancy services in connection with the refurbishment of the existing Barnsley Civic buildings located between Eldon Street and Hanson Street in Barnsley town centre. This report sets outs a planning noise assessment for the redevelopment proposals, focusing on the potential impact of noise on the proposed new apartments along the Eldon Street elevation of the building.

7.2 We have adopted appropriate acoustic design criteria for the apartments on BS 8233 guidance.

7.3 We have revied the results of a pre-COVID-19 restrictions noise survey and adopted external noise levels for the purpose of noise break in calculations.

7.4 Recommendations for sound insulation measures have been provided in order to adequately control external noise ingress to the apartments.

7.5 Outline recommendations have been provided with respect to the sound insulation performance between the apartments and adjacent commercial spaces.

7.6 Suitable plant noise limits have been derived for any new externally mounted plant which forms part of the redevelopment.


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Key:
Illustrative outline of Barnsley Civic Centre
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Title: Figure 1: Aerial View of Civic Centre & Environs
Project: P19-389
Eldon Street
Kendray Street
Civic Gardens
Hanson Street
George Yard
Google Earth

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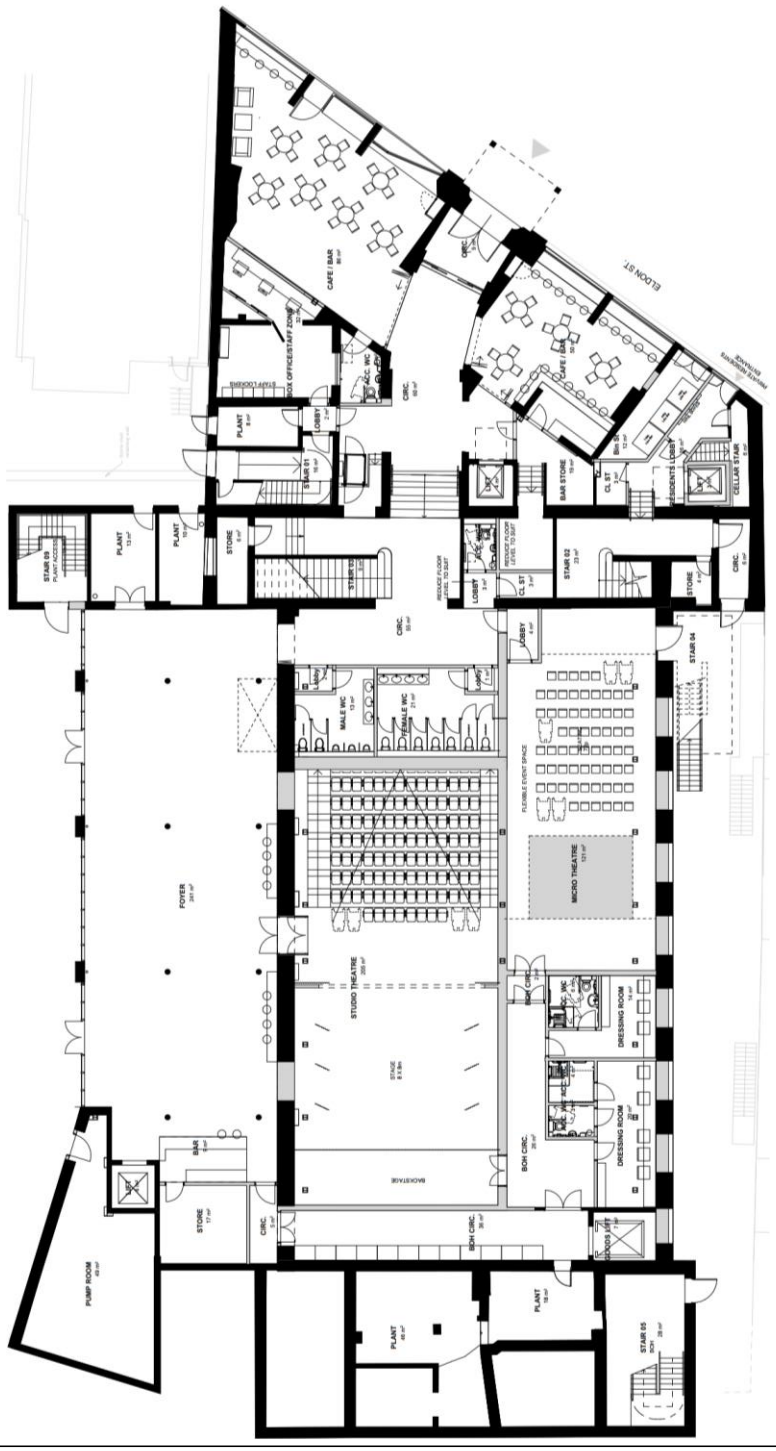
Title: Figure 2: Proposed Level 0 Layout

Project: P19-389



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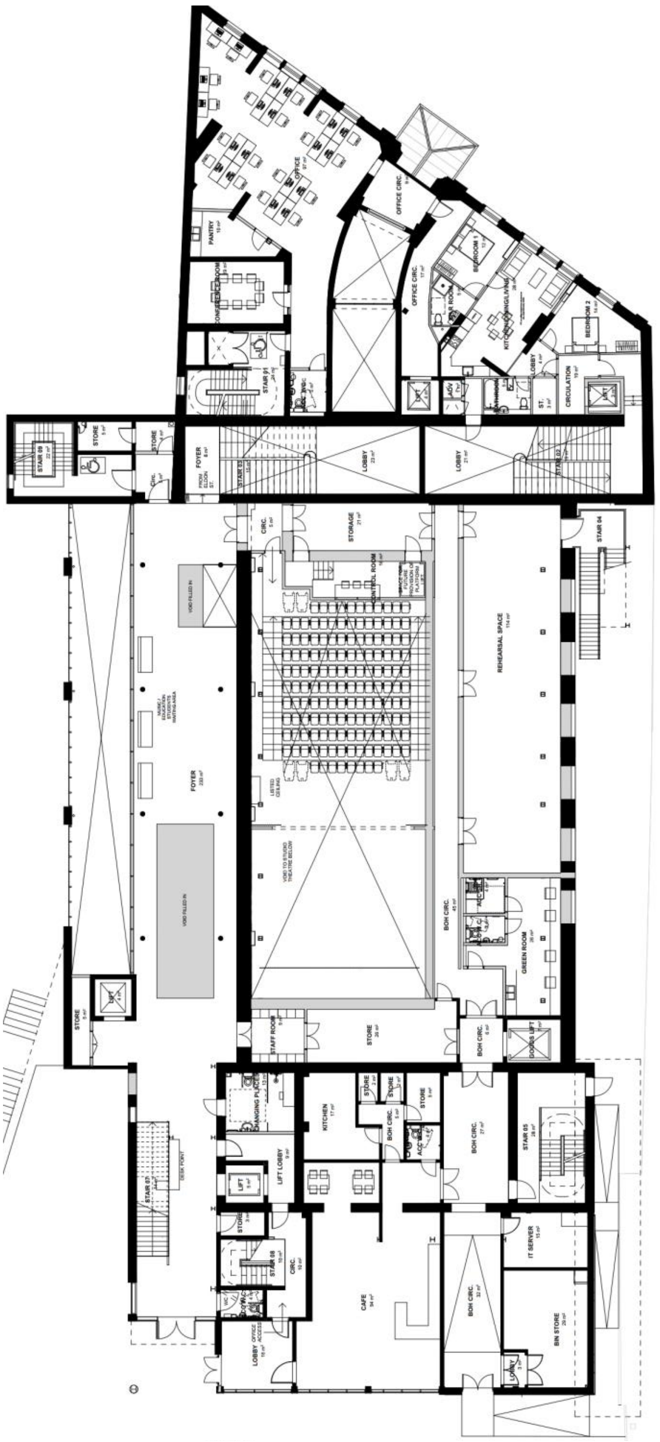
Title: Figure 3: Proposed Level 1 Layout

Project: P19-389



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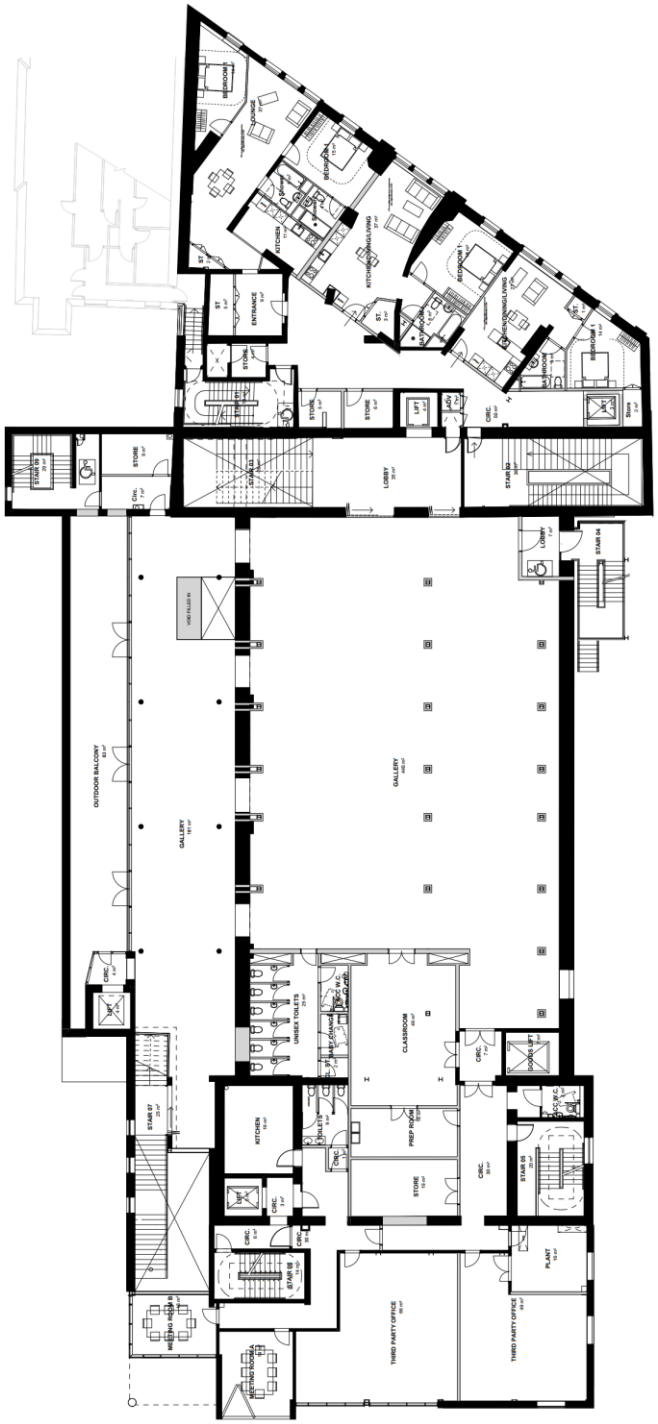
Title: Figure 4: Proposed Level 2 Layout

Project: P19-389



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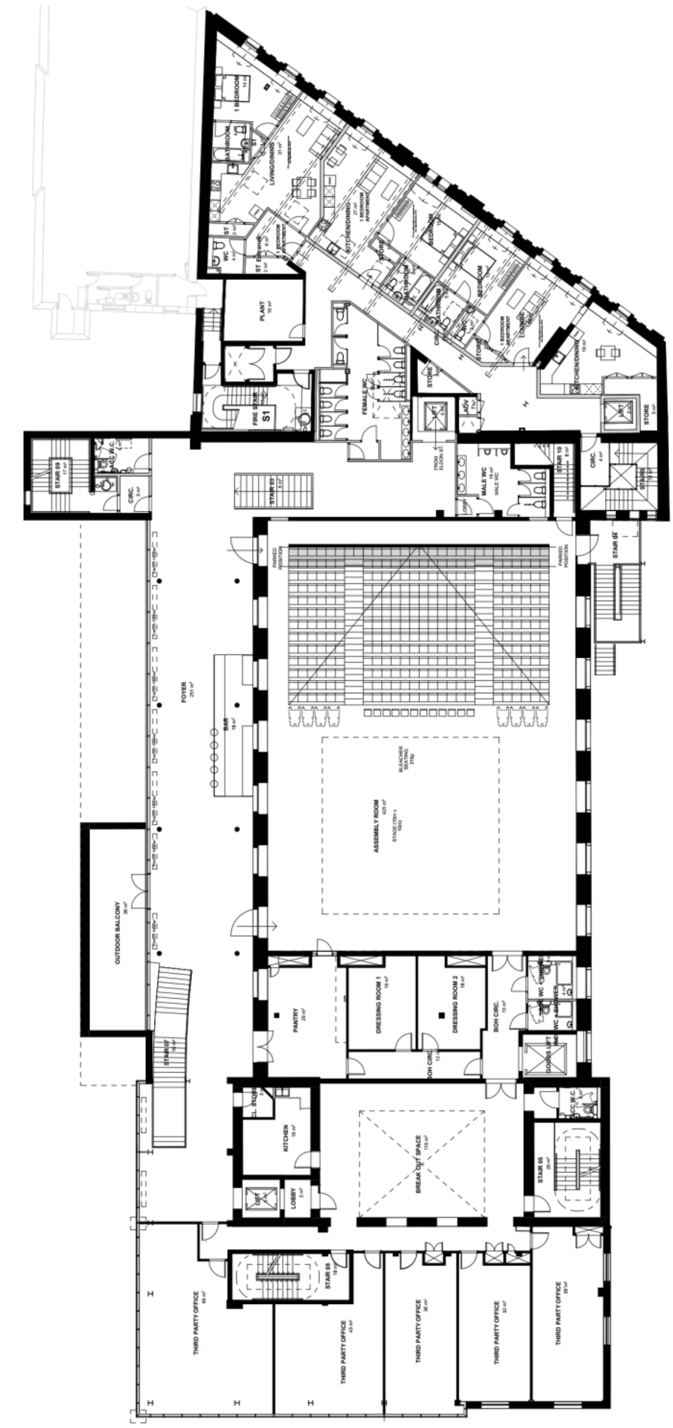
Title: Figure 5: Proposed Level 3 Layout

Project: P19-389



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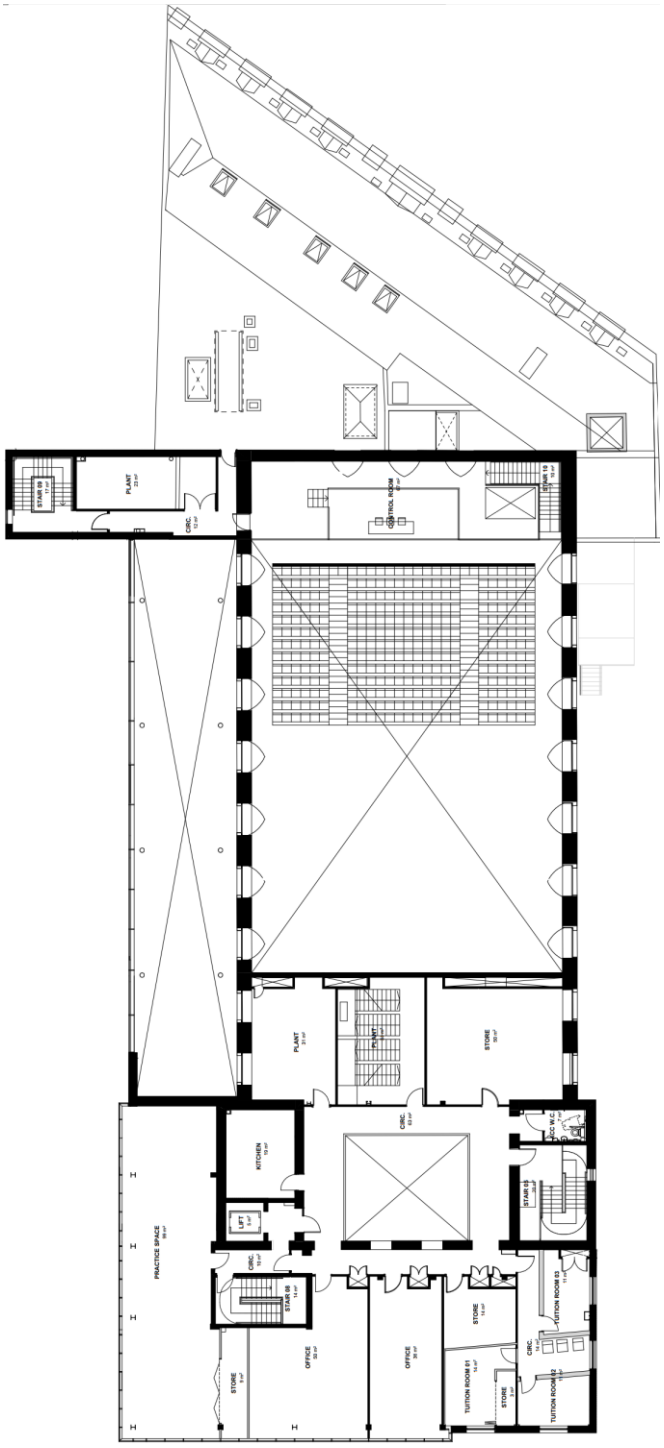
Title: Figure 6: Proposed Level 4 Layout

Project: P19-389



Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the pressure values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that the human response to sound most closely follows a logarithmic relationship. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (at the threshold of hearing) to 120 dB (at the threshold of pain).

Due to the logarithmic nature of decibels, when two sounds of the same level are combined together, the total sound level is (under normal circumstances) 3 dB higher than each of the individual sound levels e.g. 60 dB plus 60 dB = 63 dB. In terms of perceived 'loudness', a 3 dB(A) variation in sound level is a relatively small (but nevertheless just noticeable) change. An increase in sound level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in sound level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' the frequency spectrum appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using a mathematical filter called the 'A' weighting, which is built into sound level meters. Sound levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or Hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case, it is therefore not possible to represent the noise with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The various indices used in this report, along with other relevant parameters are described below.

L_p This is the Sound Pressure Level which is a logarithmic ratio between a sound pressure quantity and the threshold of hearing.

L_{pA} This is the A-weighted 'Sound Pressure Level', which is the Sound Pressure Level (L_p) adjusted to account for the average hearing response at difference frequencies for a given sound pressure range.

$L_{Aeq,T}$ This is the A-weighted 'equivalent continuous sound level' which is an average of the total sound pressure measured over a specified time period. In other words, $L_{Aeq,T}$ is the level of a steady sound which has the same total (A-weighted) sound pressure as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for most forms of environmental noise.

L_{Amax} This is the maximum A-weighted noise level that was measured during the monitoring period. L_{Amax} used in this report refers throughout to L_{Amax} measured using the fast time weighting of the sound level meter, $L_{Amax,f}$.

L_{A90} This is the A-weighted sound level exceeded for 90% of a measurement time period. L_{A90} is used as a measure of background sound level.

D_n This is the Normalised Level Difference and is a field measurement of the airborne sound insulation between adjacent spaces. As well as being a field measurement, this term and other D_n terms below include on-site conditions other than direct noise transmission through the separating partition (e.g., a wall), which is known as flanking sound transmission.

D_{nT} This is the Standardised Level Difference, which is equivalent to the measured D_n and corrected to a standardised reverberation time of 0.5s.

$D_{nT,w}$ This the Weighted Standardised Level Difference, is a single figure value of D_{nT}, and is the field measurement of airborne sound transmission

R This is the 'Sound Reduction Index' as measured in a laboratory, which is a measure of the sound insulation properties of a building element (e.g. a wall) in a stated frequency band.

R_w This is the 'Weighted Sound Reduction Index' (R_w), which is a single figure quantity of R, the laboratory measured Sound Reduction Index.

C_{tr} This is a weighted transport noise spectrum, which can be added to $D_{nT,w}$ or R_w in some standards to take into account the spectral composition of different sound sources.