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Subject: Corby Cube Noise Investigation
Client: North Northamptonshire Council
Address: Corby Cube, George Street, Corby, Northamptonshire, NN17 1QG
Date: 28/01/2025
Our ref: 41900 L1

1 INTRODUCTION AND BACKGROUND

1.1 Corby Cube is the headquarters of North Northamptonshire council, comprising among other uses a Council Chamber on Level 02; and Theatre between Basement Level 02 and Level 01.

1.2 It is understood that noise transfer from the Theatre during productions is leading to high noise levels in the Council Chamber and complaints have been received from councillors regarding high noise levels.

1.3 Sound Solution Consultants (SSC) have been commissioned to carry out an investigation to determine the extent of the issue and recommend remedial measures.

1.4 SSC have carried out the following investigations during a site visit on Thursday 23rd January 2025:

- Sound insulation testing between the Theatre and Council Chamber;
- Visual and listening observations to determine key routes of noise transmission; and
- Noise measurements and listening observations in the Council Chamber and surrounding areas during an evening Theatre performance.

2 CRITERIA

2.1 In order to assess the suitability of the acoustic environment in the Council Chamber, it is first necessary to determine acoustic performance criteria for the Council Chamber.

2.2 SSC requested a copy of the Acoustic Design Report for the design of the Corby Cube building so that we could review the proposed criteria and acoustic design solutions provided by the design team. However, it is understood that this document is not available.

2.3 In the absence of the original Acoustic Design Report, we have drawn on relevant acoustic design guidance documents to outline suitable criteria for internal ambient noise level and reverberation time in the Council Chamber.

2.4 We have also commented on likely suitable levels of sound insulation between the Theatre and Council Chamber.

INTERNAL AMBIENT NOISE CRITERIA

2.5 Table 1 provides a summary of internal ambient noise guidance for The Council Chamber, including the representative room type and source of information.

Source	Room Type	Internal Ambient Noise Criterion
BB93 (Building Bulletin 93 – Acoustic Design for Schools)	Meeting Room / Video Conference Room	≤ 40 dB $L_{Aeq,T}$
BS 8233:2014 (Guidance on sound insulation and noise reduction for buildings)	Meeting Room	35 – 45 dB $L_{Aeq,T}$
BCO (British Council for Offices Guide to specification)	Meeting Room	≤ 35 dB NR (Approximately 40 dB $L_{Aeq,T}$)

Table 1 – Summary of internal ambient noise guidance.

2.6 Based on an analysis of relevant industry guidance for internal ambient noise levels as summarised in Table 1, a criterion of **≤ 40 dB $L_{Aeq,T}$** would typically be targeted for a meeting room / video council such as the Council Chamber.

2.7 The internal noise level in a space typically comprises noise break-in from external sources, noise transfer from adjacent internal spaces and mechanical services noise.

REVERBERATION TIME CRITERIA

2.8 Table 2 provides a summary of reverberation time guidance for The Council Chamber as taken from BB93. It should be noted that BS 8233:2014 and BCO do not provide specific reverberation time targets, but discuss the use of absorption to reduce reverberation time and provide spaces suitable for speech communication.

Source	Room Type	Reverberation Time Criterion
BB93 (Building Bulletin 93 – Acoustic Design for Schools)	Meeting Room / Video Conference Room	≤ 0.8 s T_{mf}

Table 2 – Summary of reverberation time guidance.

2.9 Based on an analysis of relevant industry guidance for internal ambient noise levels as summarised in Table 2, a criterion of **≤ 0.8 s Tmf** (mid-frequency reverberation time, 500 Hz – 2kHz) would typically be targeted for a meeting room / video council such as the Council Chamber.

2.10 The reverberation time is typically dictated by the acoustic absorption provided by the room finishes and the dimensions of the space.

SOUND INSULATION CRITERIA

2.11 There are no guidance documents which offer a specific criterion for sound insulation between the Theatre and Council Chamber. Any such criterion would be bespoke, aimed at suitably controlling noise transfer between the two spaces to meet the proposed internal ambient noise criterion when the theatre is in operation.

2.12 Given the expected high amplified noise levels during a theatre production, it is expected that this would relate to an in-situ sound insulation performance **in excess of 70 dB $D_{nT,w}$** between the Theatre and Council Chamber. It is also expected that there would be specific guidance on sound insulation at lower (bass) frequencies.

2.13 The in-situ sound insulation is a product of the separating floor construction in combination with the surrounding 'flanking' routes and structures.

3 INVESTIGATION

3.1 SSC visited site on Thursday 23rd January 2025 to carry out an investigation of noise transfer between the Theatre and Council Chamber.

3.2 The investigation has been conducted in accordance with the General Arrangement plans included in Appendix B.

3.3 SSC requested section drawings and floor / wall detail drawings, but it is understood that these are unavailable. As such, it has not been possible to verify the as-built separating and flanking constructions.

3.4 In the absence of detail drawings, it is assumed based on site observations that the separating floor between Theatre and Council Chamber comprises >200 mm concrete slab with undetermined soffit treatment below and raised access floor above.

3.5 An initial analysis of additional potential noise transmission paths has identified the following routes:

- Ventilation air transfer risers adjacent to the south wall of the Council Chamber, annotated green on the Level 02 plan. The ventilation path was provided by louvred walls from the council chamber, but the presence of a separating floor slab means this was found to be an insignificant transmission path between the two spaces.

- Air handling ductwork riser adjacent to the north of the Theatre and Council Chamber, annotated red on the Level 01 and 02 plans. This was found to be a continuous riser across both levels, and a secondary noise transmission path as discussed later in this report.

- Smoke extract void above the Theatre stage gantries and adjacent to the south of the Council Chamber, annotated blue on the Level 01 and 02 plans. This was found to be a significant noise transmission path as discussed later in this report.

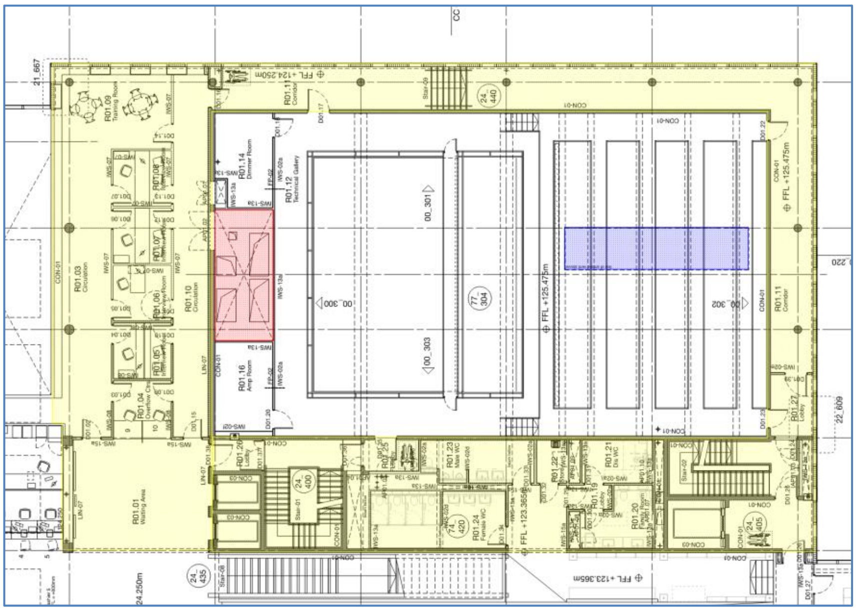

Figure 1 – Level 01 Theatre Plan annotated

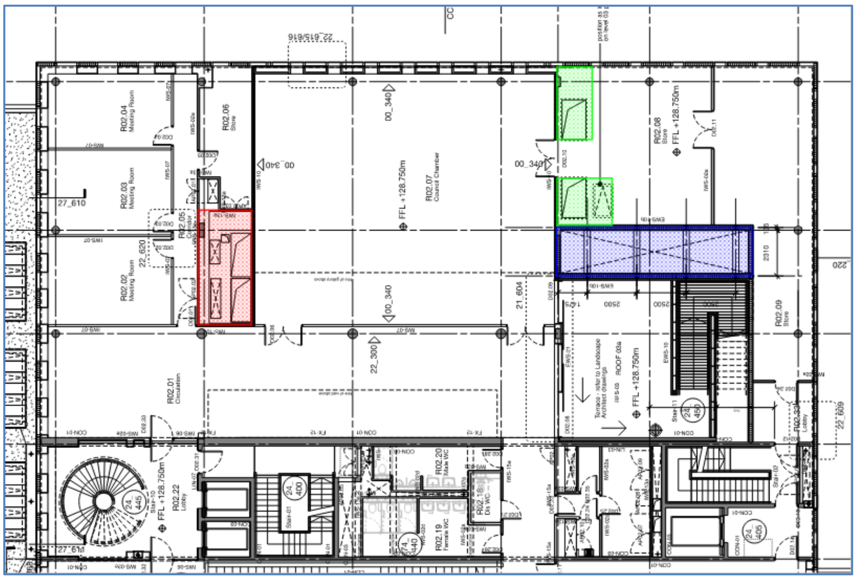

Figure 2 – Level 02 Council Chamber Plan annotated

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3.6 The design of the Theatre has utilised circulation and ancillary spaces as a buffer zone between the external walls of the building as annotated yellow on the Level 01 plan. For this reason, in addition to the findings of the listening observations, flanking via the external walls is considered an insignificant noise transmission route.

3.7 Key photographs from the investigation have been included in Appendix D.

SOUND INSULATION TESTING AND LISTENING OBSERVATIONS

3.8 Sound insulation testing was carried out between the Theatre and Council Chamber, roughly in accordance with SSC's UKAS procedures and ISO 140-4:1998 .

3.9 As we were not able to use the in-house PA to generate sound in the Theatre, 2 no. loudspeakers were used to generate noise simultaneously on the Level 01 technical gallery, directly underneath the Council Chamber.

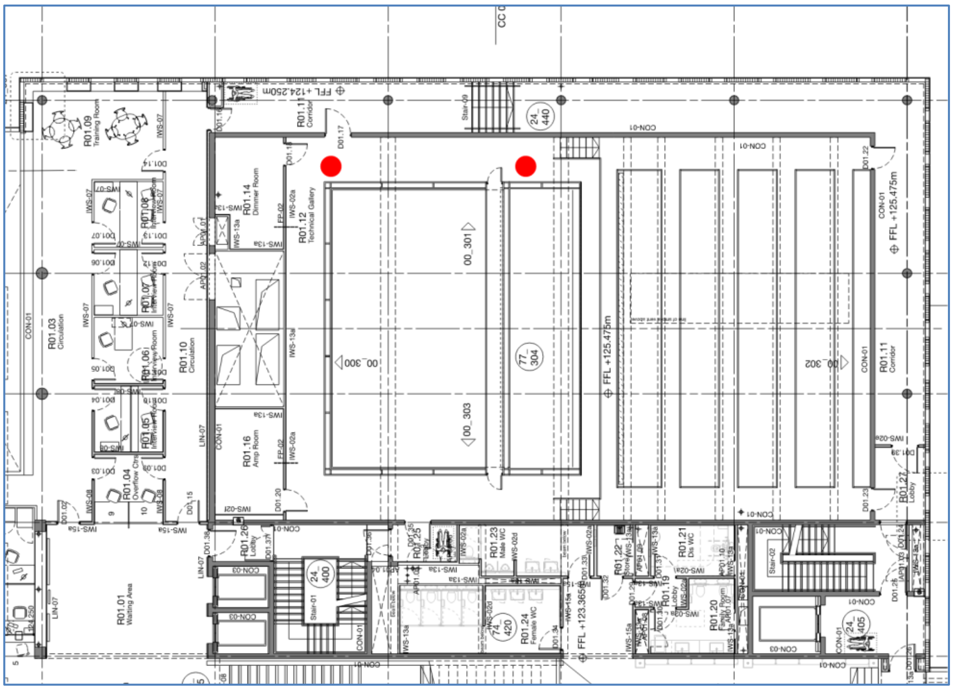

Figure 3 – Level 01 loudspeaker positions annotated red.

3.10 The sound insulation testing determined an in-situ sound insulation performance of **63 dB D_w** between the Theatre and Council Chamber. It is not known whether this complies with the sound insulation criteria developed during the design of the building.

3.11 Full details of the equipment and test certificate are provided in Appendix C.

3.12 Listening observations during the sound insulation testing were made in the Council Chamber while pink noise was generated in the Theatre. It was apparent that noise transfer was predominantly heard from the south wall of the Council Chamber, but it was not possible to determine an exact transmission route.

3.13 There was no significant noise transfer heard via the separating floor or the external walls. Noise from the theatre was clearly audible in the riser north of the Council Chamber, but this did not appear to significantly contribute to noise transfer to the Chamber itself.

3.14 Following the acoustic testing, the loudspeakers were used to generate high levels of pink noise in the Council Chamber and listening observations were made in reverse.

3.15 It was immediately clear that noise breakout from the Council Chamber to the Theatre was dominated by the smoke extract void transmission route. This was observed by walking around the Technical Gallery and above stage gantries while pink noise was generated in the Chamber.

3.16 This was further confirmed when the loudspeakers were placed directly adjacent to the smoke extract void wall in the Council Chamber. With the loudspeakers in this position, noise transfer was especially obvious when stood on the gantries below the smoke extract void.

REVERBERATION TIME TESTING

3.17 Reverberation time measurements were carried out in the Council Chamber in accordance with the engineering method of ISO 3382-2:2008.

3.18 The measurements determined a reverberation time of **1.1 s T_{mf}** (mid frequency, 400Hz – 2.5 kHz) and 1.2 s T_{AV} (100 Hz – 5kHz). **The measured mid frequency reverberation time is higher than the suggested ≤ 0.8 s T_{mf} criterion for meeting rooms and rooms for video conferencing.**

3.19 The council chamber was found to have a volume of 1381 m^3 with room finishes comprising carpeted floor; slatted timber wall panels with textile or louvred infil; and concrete soffit. The space was furnished ready for a council meeting.

COUNCIL CHAMBER NOISE MEASUREMENTS AND OBSERVATIONS DURING THEATRE PERFORMANCE

3.20 Luke Pickering (SSC) attended a council meeting in the Chamber in the evening of Thursday 23rd January 2025 during a live music performance in the Theatre. The live music performance comprised a full band (guitar, bass, drums and vocals) and is considered representative of a worst-case scenario of noise levels during a Theatre performance.

3.21 Due to noise generated by the council meeting, only listening observations were made for the duration of the meeting. It was noted that noise from the theatre performance was audible in the Council Chamber at a level considered capable of interfering with speech communication.

3.22 After the meeting, noise measurements were taken in the Council Chamber and surrounding key areas as summarised in Table 3.

Measurement #	Description	Measured Noise Level, dB LAeq,T
1	Store 1 Adjacent to Council Chamber – During performance (with music)	54
2	Store 2 Adjacent to Council Chamber – During performance (with music)	52
3	Store 2 Adjacent to Council Chamber – Between songs (no music)	37
4	Council Chamber Position 1 (North End) – During performance (with music)	47
5	Council Chamber Position 2 (South End) - During performance (with music)	48
6	Council Chamber – Between songs (no music)	35
7	Riser adjacent to north of Council Chamber - During performance (with music)	63

Table 3 – Summary of measured noise levels.

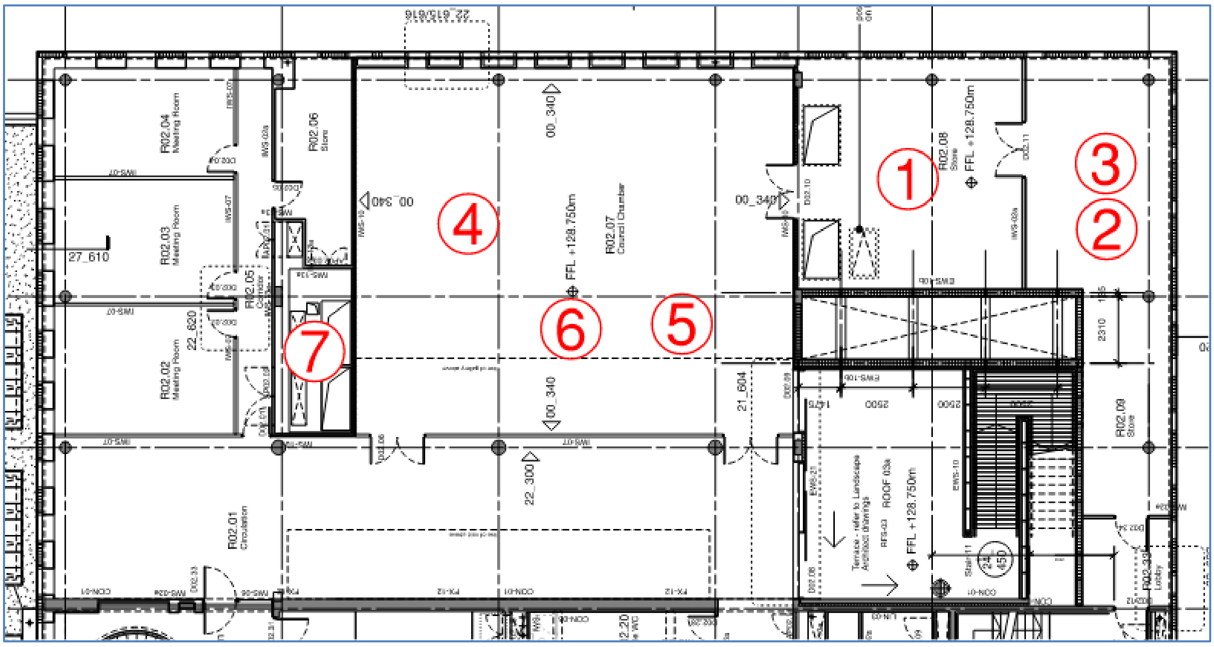

Figure 4 – Noise measurement positions annotated.

3.23 The measured noise levels in Table 3 show measured noise levels of 47 – 48 dB $L_{Aeq,T}$ in the Council Chamber during the performance. The higher noise level was measured closer to the adjacent smoke extract void. This is significantly higher than the suggested internal noise criterion of ≤ 40 dB $L_{Aeq,T}$.

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3.24 Even higher noise levels (52 – 54 dB $L_{Aeq,T}$)were measured in the store areas adjacent to the smoke extract void, where the rooms had a smaller volume and a greater proportion of shared wall area with the smoke extract void. The performance could be clearly heard in these areas, including performance vocals and crowd noise.

3.25 Background measurements showed that noise levels in these spaces between songs were significantly below the levels during the performance (> 10 dB difference) in each location.

3.26 Measurements in the riser adjacent to the north wall of the Council Chamber show a noise level of 63 dB $L_{Aeq,T}$ in this riser during the performance. Although this appears a high noise level, noise transfer between this riser and the council chamber is expected to be insignificant based on listening observations and the assumed riser wall build-up (assumed to be a multi-boarded fire-rated shaftwall construction).

3.27 It is expected that noise levels in the smoke extract void above the theatre stage could be > 30 dB higher than the riser. This is expected to be the principal transmission route between Theatre and Council Chamber based on listening observations and the assumed lightweight shaftwall construction.

4 REMEDIAL OPTIONS

4.1 Please note that the following remedial recommendations are based on stated assumptions about the existing separating and flanking constructions due to limited available information about the as-built constructions.

SOUND INSULATION OF SMOKE EXTRACT VOID WALL

4.2 The investigation described in Section 3 has identified the smoke extract void wall as the key transmission route for noise between the Theatre and Council Chamber.

4.3 Although the exact construction of this wall is not known, it is expected that that the wall comprises a fire-rated shaftwall construction similar to that shown below.

4.4 Depending on the number and mass of boards, the depth of the stud and presence of insulation, the shaftwall construction is likely to achieve a laboratory sound insulation performance in the region of 40 – 50 dB R_w. This is likely to be significantly lower than the sound insulation of the assumed concrete slab separating floor slab, providing a route of less resistance for sound to travel between the Theatre and Council Chamber.

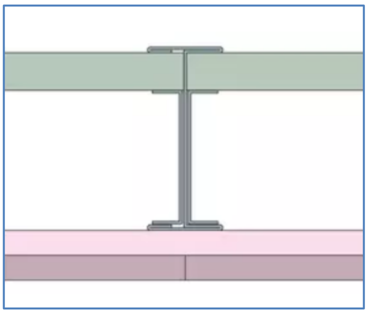

Figure 5 – Indicative British Gypsum shaftwall construction

4.5 In order to enhance the sound insulation of the existing smoke extract void wall, it would be recommended to provide an independent wall lining within the council chamber and surrounding rooms. The aim of the independent frame would be to reduce structural connections between the council chamber linings and shaftwall and increase the overall mass of the system.

4.6 Due to the large height of the chamber, this would involve substantial steel I-studs to provide the following overall construction:

- Existing assumed shaftwall construction
- Minimum 20 mm clear void
- Independent steel I-studs (e.g. Gypframe 146 I 80) forming overall minimum 175 mm void
- 50 mm mineral wool insulation in the void
- 2 layers of 15 mm high performance dense board (minimum 34 kg/m^2 total, e.g. 2 layers of 15 mm Fermacell board)

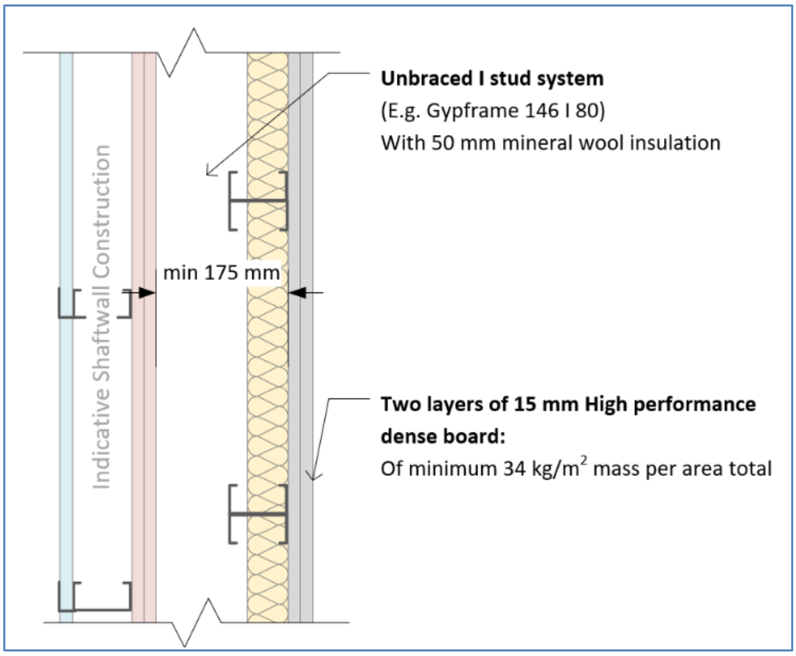

Figure 6 – Indicative recommended independent wall remedial construction

4.7 This construction would be capable of achieving a laboratory sound insulation performance of > 65 dB R_w, which would provide a sound insulation performance increase in the region of 20 dB R_w.

4.8 It is recommended that the independent wall be provided between the smoke shaft and the Council Chamber as a minimum. It could also be provided in the adjacent store spaces to reduce indirect noise transfer via these spaces to the Council Chamber.

SMOKE EXTRACT VOID CAPPING

4.9 An alternative means of reducing noise transfer between the Theatre and Council Chamber would be to reduce the noise levels within the smoke extract void.

4.10 This could be achieved through installation of acoustic rated smoke extract louvres to cap the underside of the smoke extract void. These louvres would typically remain closed to reduce noise levels in the smoke extract void, but would be automated to open in the event of a fire or smoke in the Theatre.

4.11 It is acknowledged that installation of louvres on the underside of the smoke extract void may not be feasible due to the presence of stage gantry equipment below the void.

4.12 Please note that this option is less robust than the previously recommended independent wall construction in the Council Chamber and has been offered as an alternative option, or as an additional measure in conjunction with the independent wall.

REVERBERATION TIME IN THE COUNCIL CHAMBER

4.13 The investigation described in Section 3 has additionally noted that the reverberation time in the Council Chamber is higher than would typically be targeted for a meeting room / video conferencing room.

4.14 This can lead to excessive build-up of reverberant sound and reduce speech intelligibility, making verbal communication more difficult.

4.15 Although improving (reducing) the reverberation time in the Council Chamber would not reduce the noise transfer from the Theatre, it could indirectly provide some improvement to the acoustic environment in the Council Chamber with regards to verbal communication during meetings.

4.16 The council chamber was found to have a volume of 1381 m^3 with room finishes comprising carpeted floor; slatted timber wall panels with textile or louvred infil; and concrete soffit. Acoustic treatment could be applied to the concrete soffit to reduce the reverberation time in the chamber.

4.17 The reverberation time in the Chamber could be reduced with the ≤ 0.8 s T_{mf} criterion using a proprietary Class C acoustic treatment to the entire soffit, e.g. 12 mm Sonaspray K-13 spray on treatment or equivalent.

4.18 Alternatively, Class A treatment (e.g. proprietary acoustic panels) could be installed to approximately 40 % of the soffit area (approx. 80 m^2). Where a partial soffit treatment is preferred, treatment should be spread evenly across the soffit area.

Appendix A: Acousticians Qualifications and Status

Author:	**Luke Pickering BSc. (Hons) MIOA**
Position Held:	Senior Acoustic Consultant.
Qualifications:	BSc. (Hons) Sound Engineering and Design
	Institute of Acoustics Diploma in Acoustics and Noise Control.
Affiliations:	Member of the Institute of Acoustics.
Acoustics Experience:	8 years.

Checked:	**Lee Denson BSc. (Hons) MSc. MIOA**
Position Held:	Principal Acoustic Consultant.
Qualifications:	BSc. (Hons) Music Technology.
	MSc. Music Technology.
	Institute of Acoustics Diploma in Acoustics and Noise Control.
Affiliations:	Member of the Institute of Acoustics.
Acoustics Experience:	9 years.

Appendix B: Architectural Drawings

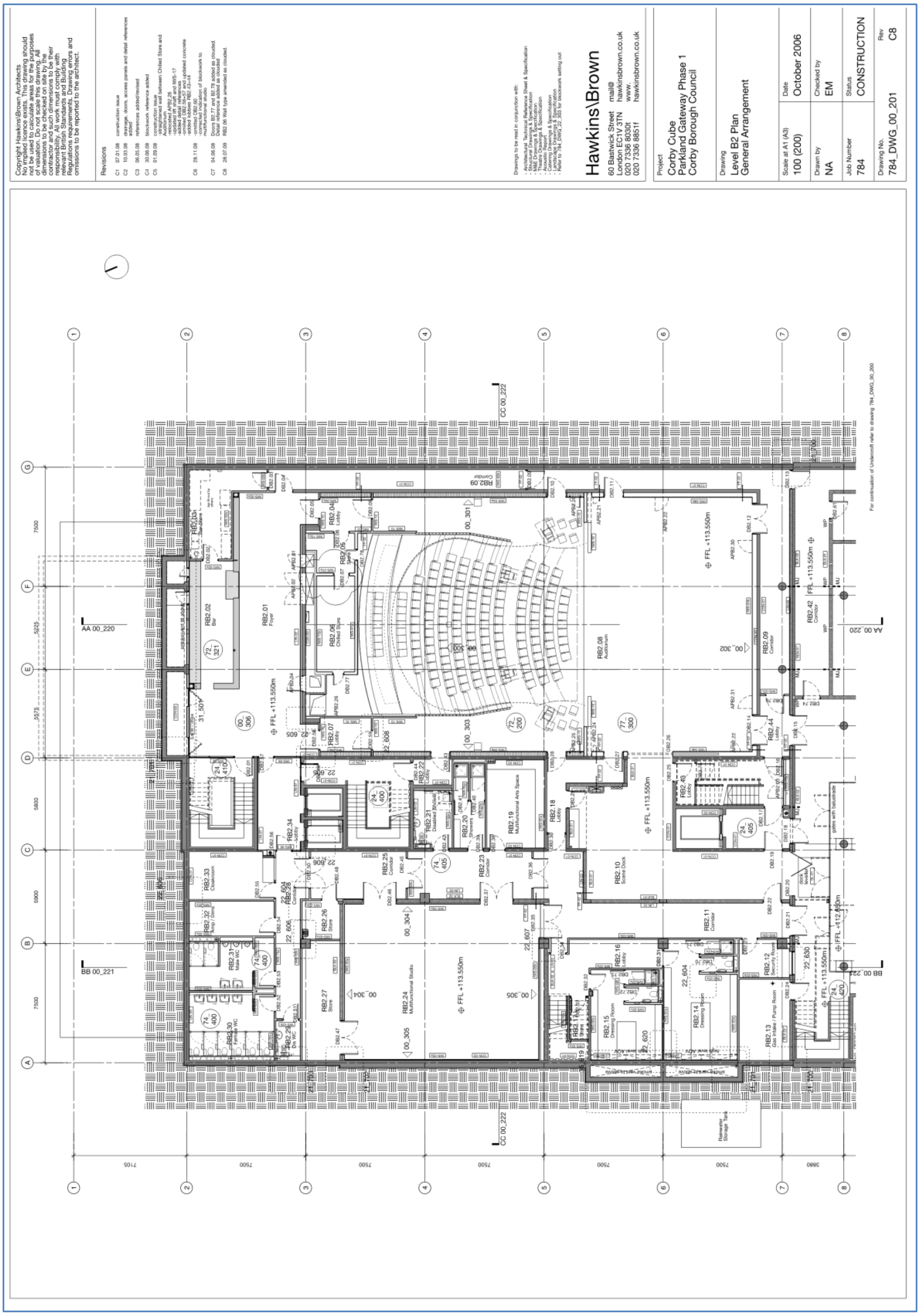

Figure B1 – Level B2 General Arrangement Plan

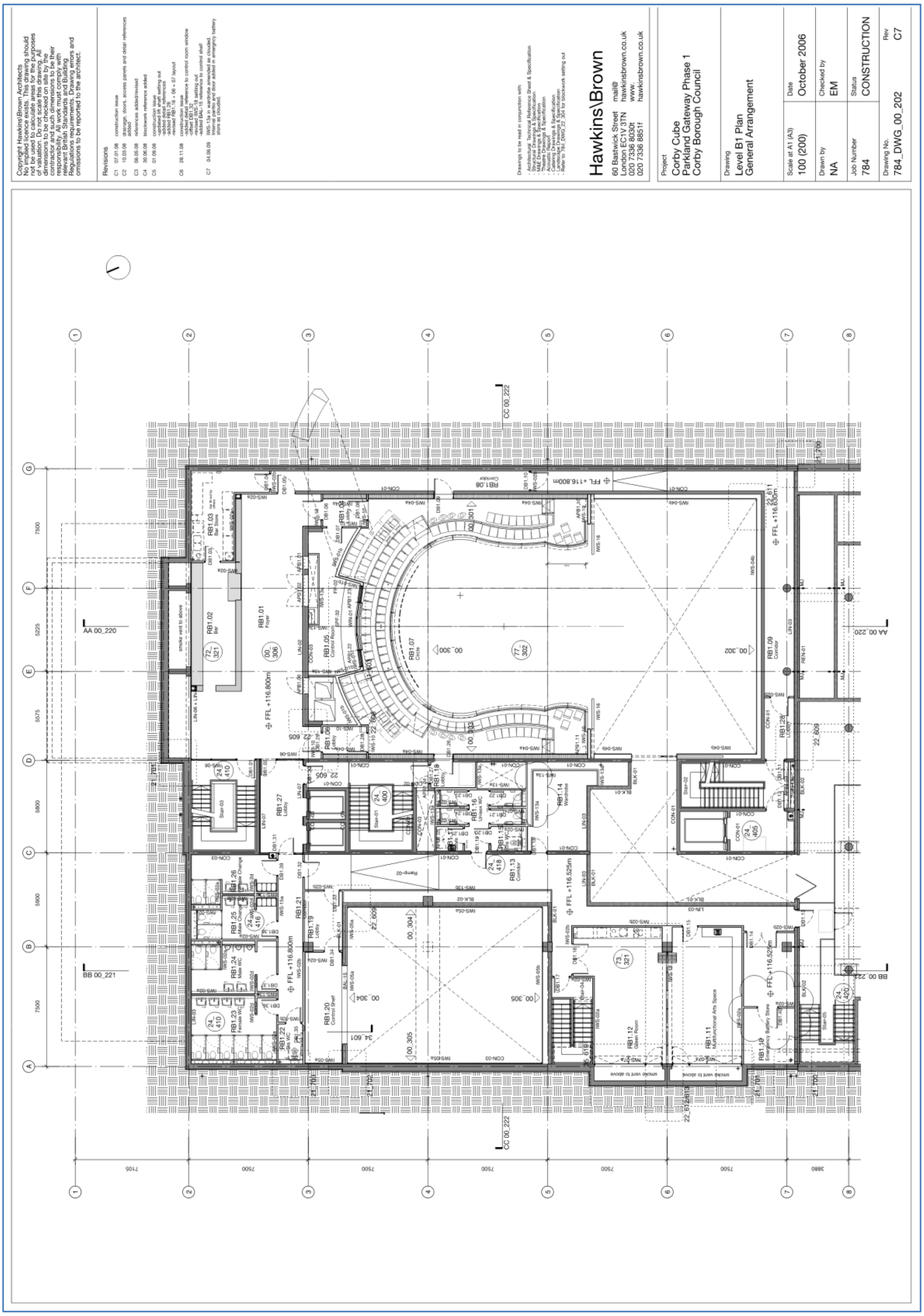

Figure B2 – Level B1 General Arrangement Plan

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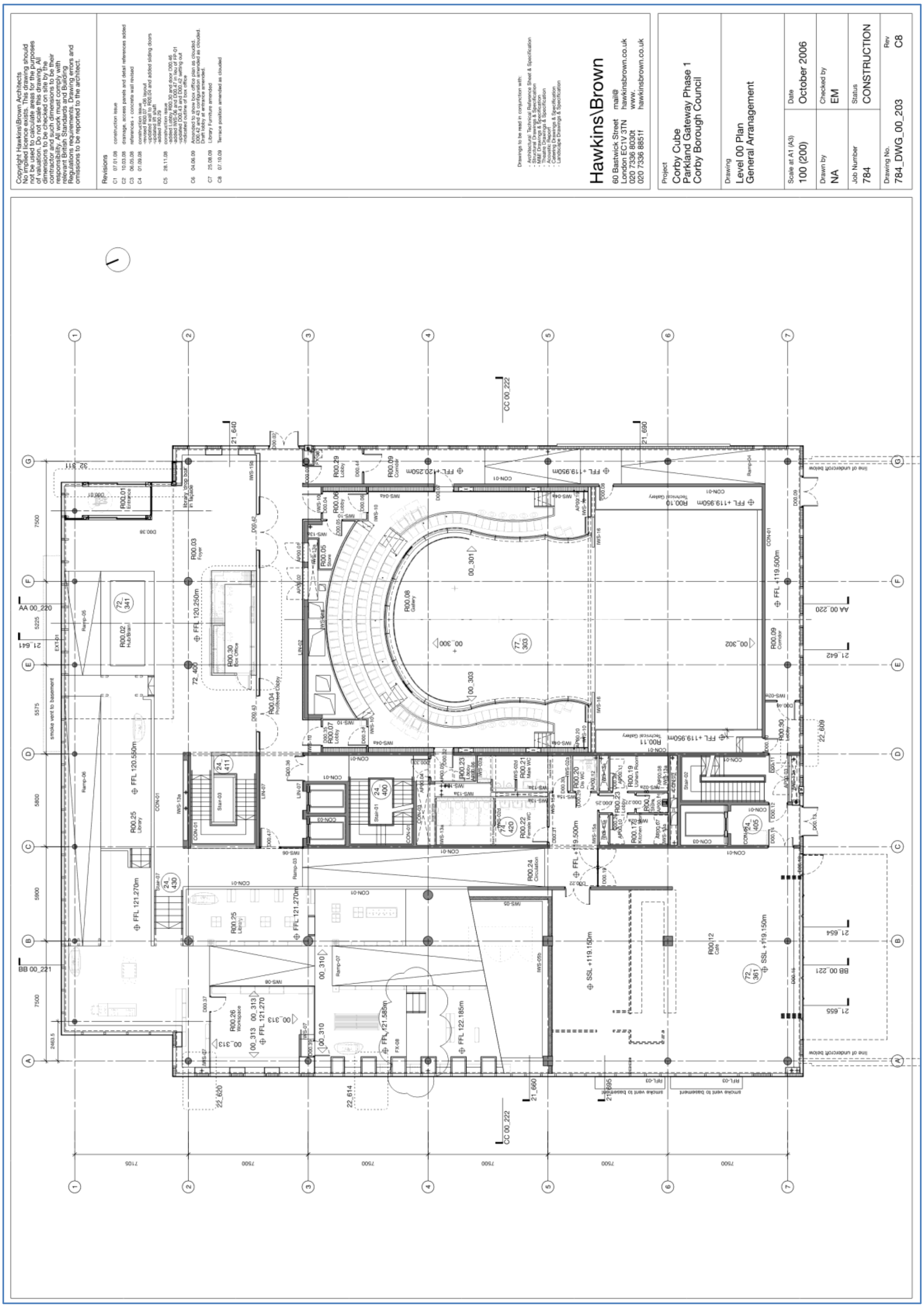

Figure B3 – Level 00 General Arrangement Plan

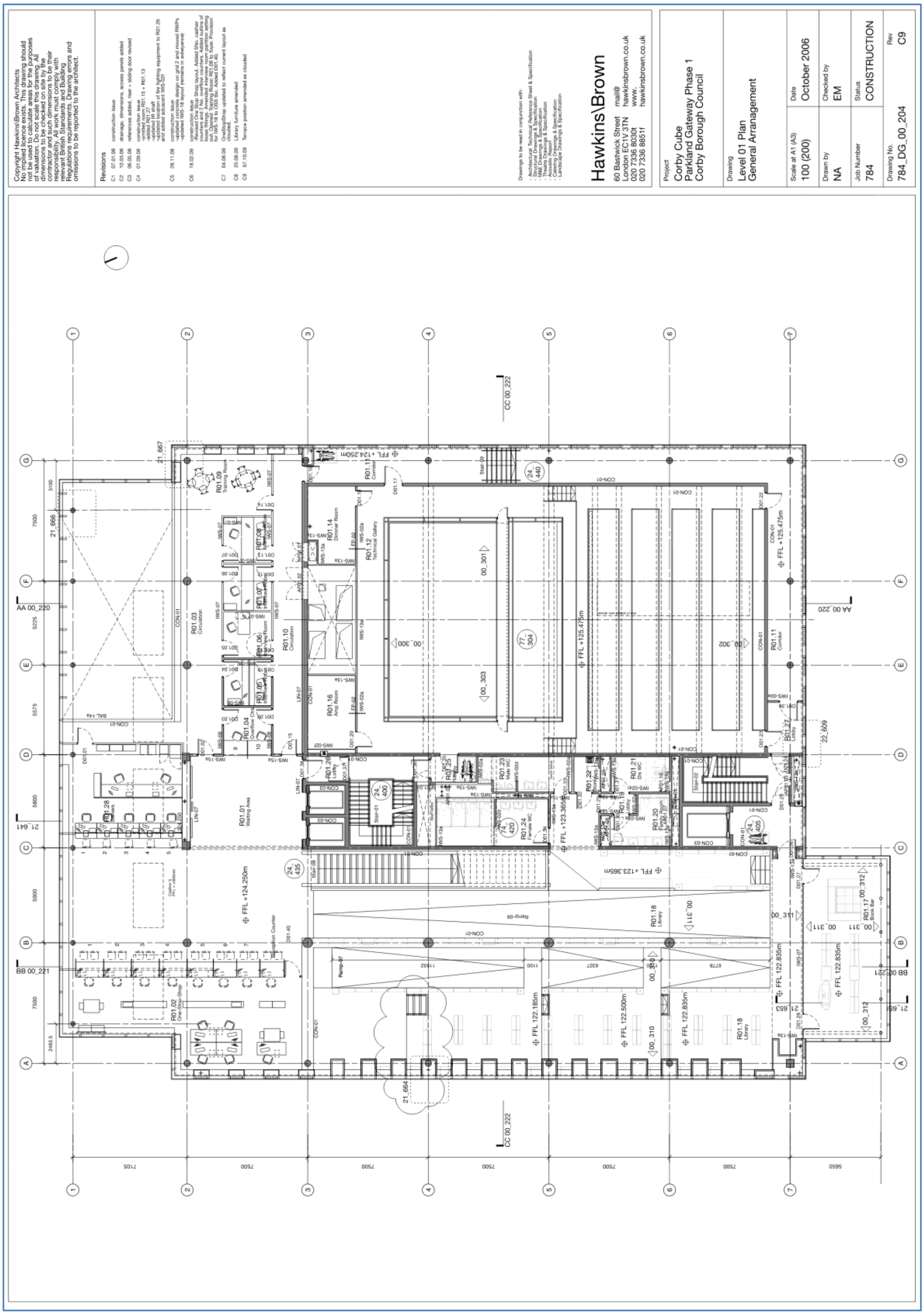

Figure B4 – Level 01 General Arrangement Plan

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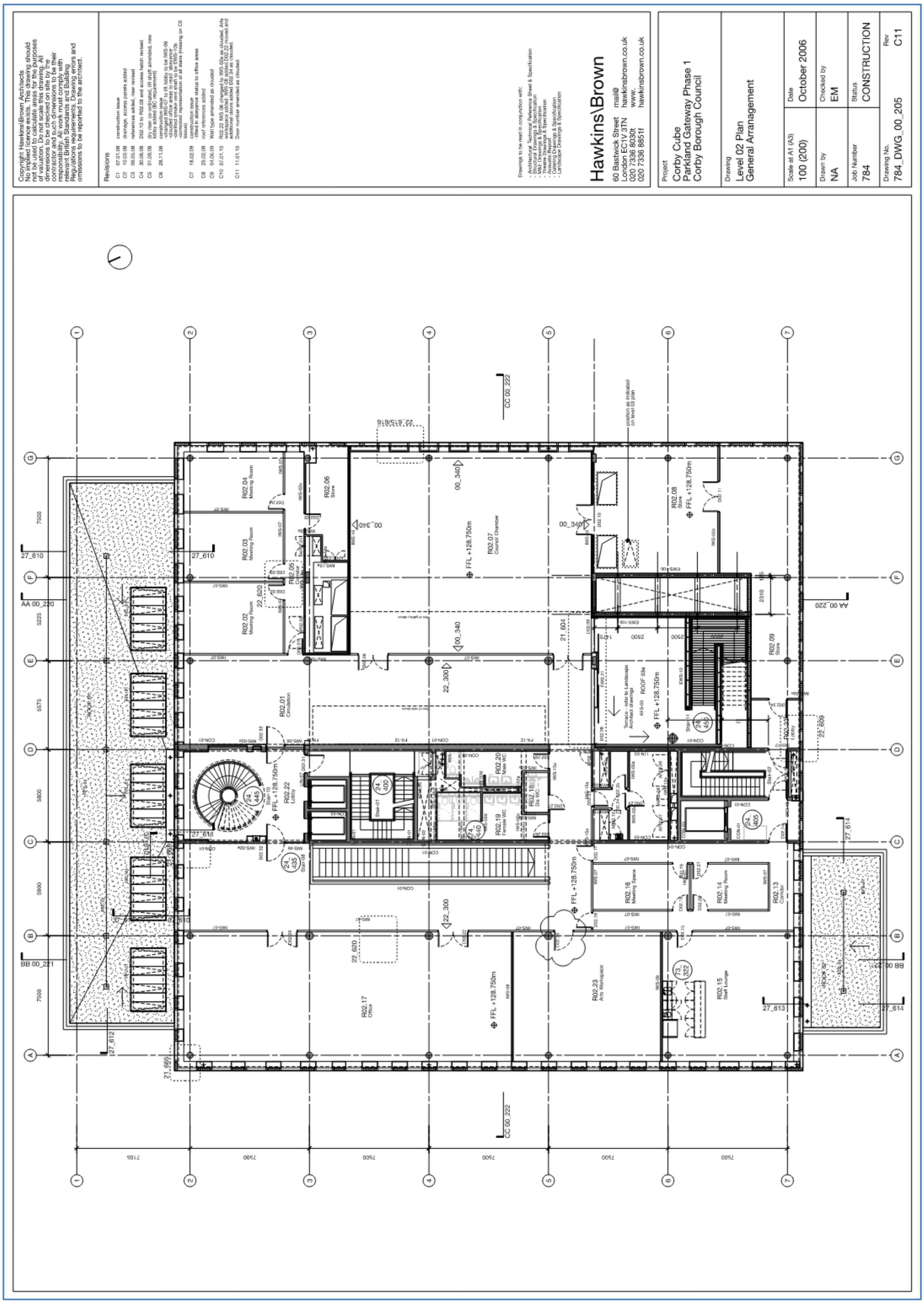

Figure B5 – Level 02 General Arrangement Plan

Appendix C: Sound Insulation Testing Details

TECHNICAL STAFF

- Luke Pickering – SSC
- Steve Barry – SSC

EQUIPMENT

All equipment used accords with UKAS publication LAB23 *Traceability for Equipment Used in Acoustic Testing (edition 3, January 2023)* for calibration.

A field calibration check of the sound level meter was carried out at the beginning and end of the testing period.

Manufacturer	Model Number	Serial Number	Description
Larson Davis	831	4557	Sound level meter
Larson Davis	PRM831	051299	Microphone pre-amplifier
Larson Davis	377B02	305560	½" Electret microphone
Larson Davis	CAL200	8121	Sound level calibrator
Norsonic	Nor211A	031088	Tapping machine
Norsonic	Nor250	31428	Hemi-dodecahedron loudspeaker
Norsonic	Nor280	2803636	Power amplifier & signal generator
Norsonic	Nor276	2766362	Dodecahedron loudspeaker
Norsonic	Nor280	2803674	Power amplifier & signal generator

METHODOLOGY

The sound insulation testing largely complied with SSC's in-house UKAS test procedure as follows:

- All sound pressure level and reverberation time measurements have been recorded in 1/3rd octave bands over the frequency range reported.
- Background sound pressure level measurements consisted of a minimum 40-second sample in each receiving room.
- The source for all airborne sound insulation tests consisted of an integrated pink / white noise generator and power amplifier, with multi-directional loudspeaker. It was ensured as far as possible that receiving room sound pressure levels were at least 10 dB above the background sound pressure levels at all reported 1/3rd octave bands.
- For airborne sound insulation tests, a minimum of two, multi-directional loudspeaker positions are used with a manually moving microphone technique, for both the source and receiving rooms, to record minimum 40-second samples in each room, per loudspeaker position.

- For reverberation time measurements, the interrupted source method was used to record six readings using a total of two multi-directional loudspeaker positions and six microphone positions, with two decays per point. The values have been arithmetically averaged to obtain a final value for each frequency band.
- The weighted level difference dB D_w defines a single number quantity of sound insulation, without standardising to a target reverberation time.

Please note the following deviations from the above methodology:

- Two loudspeakers (1 no. hemispherical and 1 no. dodecahedron) were used to generate pink noise for the source and receive measurements due to the large volume of the source room.
- The loudspeaker positions were fixed for all source and receive measurements due to limitations on the position of the speakers on the Technical Gallery of the Theatre.

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TEST CERTIFICATES

Standardised level difference according to ISO 16283-1 and Building Bulletin 93 (V17)
Field measurement of airborne sound insulation between rooms

Site Address: Corby Cube

Test Description: Test 1, airborne separating floor between Theatre and Council Chamber.

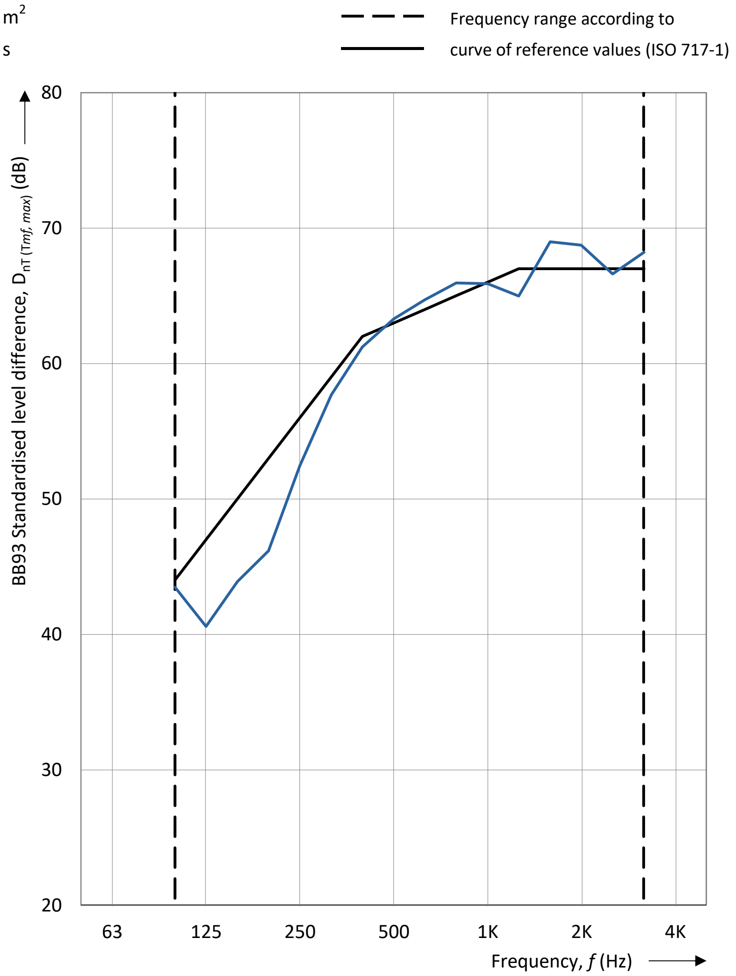
Separating Element: Not Confirmed

Notes: None

Source Room Volume: 5500 m^3
Receiving Room Volume: 1381 m^3
Common Partition Area: 192 m^2
$T_{mf,\ max}$ reference time: s

Sum of unfavourable deviations: 27.9 dB

Frequency *f* Hz	$D_{nT\ (Tmf,\ max)}$ ⅓ Octave dB
50	
63	
80	
100	43.5
125	40.6
160	43.9
200	46.2
250	52.5
315	57.7
400	61.2
500	63.3*
630	64.7*
800	65.9*
1000	65.9*
1250	65*
1600	69*
2000	68.7*
2500	66.6*
3150	68.2*
4000	
5000	



Rating based on ISO 717-1

$D_{nT\ (Tmf,\ max),\ w}$ (C ; C_{tr}) = 63 (-3 ; -8) dB

$D_{nT\ (Tmf,\ max),\ w}$ = 63 dB

Evaluation based on field measurement results obtained by an engineering method

Test Report Number: 41900-1-1
Date of Test: 23/01/2025

Testing Laboratory Name: Sound Solution Consultants Limited
Technical Staff: L Pickering

Figure C1 – Sound insulation test certificate for Theatre to Council Chamber

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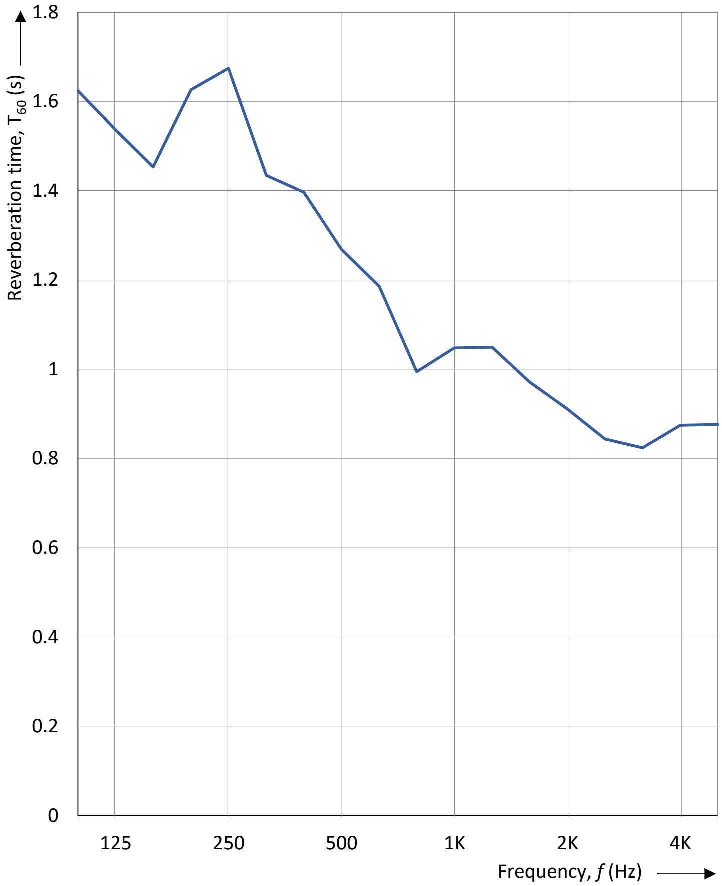
Reverberation time according to ISO 3382-2
Field measurement of reverberation time in ordinary rooms

Site Address: Corby Cube
Test Location: Council Chamber
Room Condition: Furnished for normal use
ISO 3382-2 Accuracy: Engineering
Notes: None

Room Volume: 1381 m^3

Frequency *f* Hz	Rt ⅓ Octave s
100	1.62
125	1.54
160	1.45
200	1.63
250	1.67
315	1.43
400	1.40
500	1.27
630	1.19
800	0.99
1000	1.05
1250	1.05
1600	0.97
2000	0.91
2500	0.84
3150	0.82
4000	0.87
5000	0.88



Arithmetic averaging of 1/3 octave measurements

T_{AV} (400 Hz - 3.15 kHz) = 1.1 s **T_{AV} (100 Hz - 5 kHz) = 1.2 s**

Evaluation based on unrounded measurement results of extrapolated T_{20} reverberation times

Test Report Number: 41900-1
Date of Test: 23/01/2025
Testing Laboratory Name: Sound Solution Consultants Limited
Technical Staff: L Pickering

Figure C2 – Reverberation time test certificate for Council Chamber

Appendix D: Key Investigation Photographs

Figure D1 – L01 Theatre soffit supported by steels

Figure D2 –Sound Insulation Testing on L01 Theatre technical gallery

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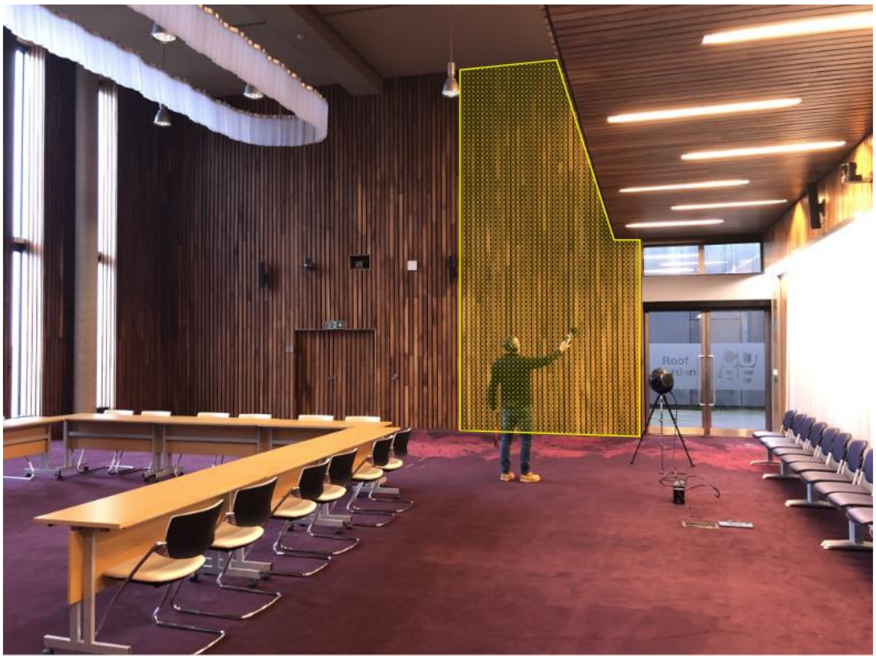

Figure D3 –Reverberation Testing in L02 Council Chamber (approximate extent of shared wall with smoke extract void hatched yellow)

Figure D4 –Smoke extract void opening as viewed from L01 Theatre gantries above the stage