

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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Fenix, Manchester Goods Yard

Acoustic design review

London, Manchester, Edinburgh, Birmingham, Belfast, Leeds

Sandy Brown Ltd

Registered in England & Wales

No. 13227735

Registered Office: 55 Charterhouse Street, London EC1M 6HA

post@sandybrown.com

www.sandybrown.com

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B	8 Aug 22	Updated in line with latest design information	Kane Mitchell	Matthew Robinson
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D	12 Apr 23	Updated following comments from design team and MCC	Kane Mitchell	Matthew Robinson
E	2 May 23	Updated following comments from MCC	Kane Mitchell	Matthew Robinson

Disclaimer

This report has been prepared for the sole benefit and use of our client based on their instructions and requirements. Sandy Brown Ltd extends no liability in respect of the information contained in the report to any third party.

Summary

Sandy Brown has been appointed by Fenix Restaurant Limited to provide acoustic advice in relation to fit-out of the Fenix restaurant located within ground and mezzanine floor units of Manchester Goods Yard. This report provides a review of the design proposals.

The principal acoustic considerations include the following:

- Achieving appropriate levels of sound insulation between spaces
- Controlling noise from building services to an acceptable level
- Ensuring that reverberation is suitably controlled within the FoH bar / restaurant areas as well as within acoustically sensitive cellular spaces.

Recommendations have also been made following a site inspection visit on 16 June 2022 and acoustic review of the design proposals. Acoustic issues have been highlighted for consideration and acoustic performance standards have been recommended.

Key issues include:

- Operational noise levels –Internal operational noise level limits have been set such that external operational noise egress and internal operational noise transfer both comply their respective limits. Enhancements that could be implemented to accommodate greater operational noise levels are discussed.
- Building services – A review of the proposed ventilation layouts has been undertaken. Crosstalk attenuators have been recommended where the proposed ductwork routing is expected to undermine the sound insulation performances of acoustically rated partitions.
A review of noise emissions from proposed items of plant has been undertaken and attenuation requirements have been set out.

Contents

1 Introduction 5

2 Development proposals 5

3 Basis..... 6

4 Key design considerations 6

5 Site inspection..... 6

6 Building envelope..... 8

7 Proposed acoustic standards..... 9

8 Partition and door strategy 10

9 Floors..... 11

10 Interface details 12

11 Operational noise..... 12

12 Building services noise and vibration 13

13 Construction (Design and Management) Regulations 17

Appendix A 18

 Glossary of useful acoustic terminology..... 18

Appendix B..... 21

 Partition and door sound insulation mark-ups 21

1 Introduction

Sandy Brown has been appointed by Fenix Restaurant Limited to provide acoustic advice in relation to fit-out of the Fenix restaurant located within ground and mezzanine floor units of Manchester Goods Yard.

This report provides a review of the design proposals.

A glossary of acoustic terminology is provided in Appendix A.

Partition and door sound insulation mark-ups are provided in Appendix B.

2 Development proposals

The proposed development is the fit out of a new restaurant and bar located within ground and mezzanine floor units of Manchester Goods Yard.

The following spaces are proposed at ground level:

- Bar and seating areas
- Greeter lobby
- Staff room
- FoH managers office
- WCs, changing rooms and storerooms.

The proposed ground floor layout is provided in Figure 1.

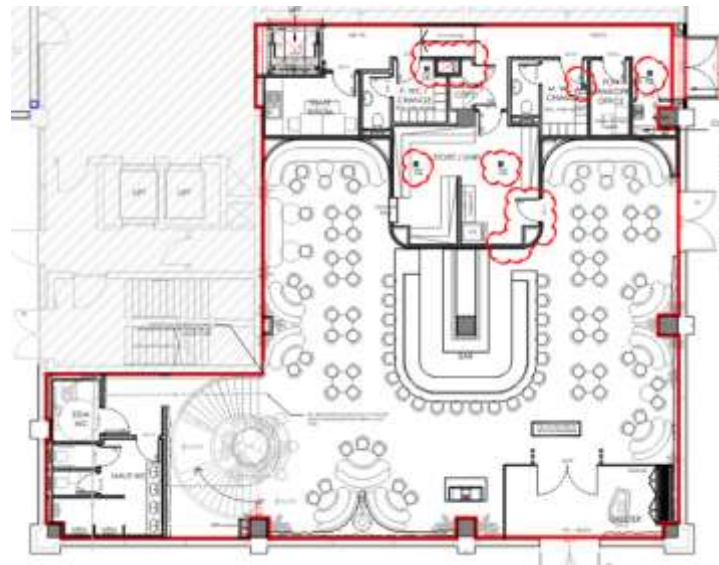


Figure 1 Proposed ground floor layout

The following spaces are proposed at mezzanine level:

- Restaurant and seating area
- Show kitchen
- Kitchen and dishwash area
- WCs
- Storerooms.

The proposed mezzanine layout is provided in Figure 2.

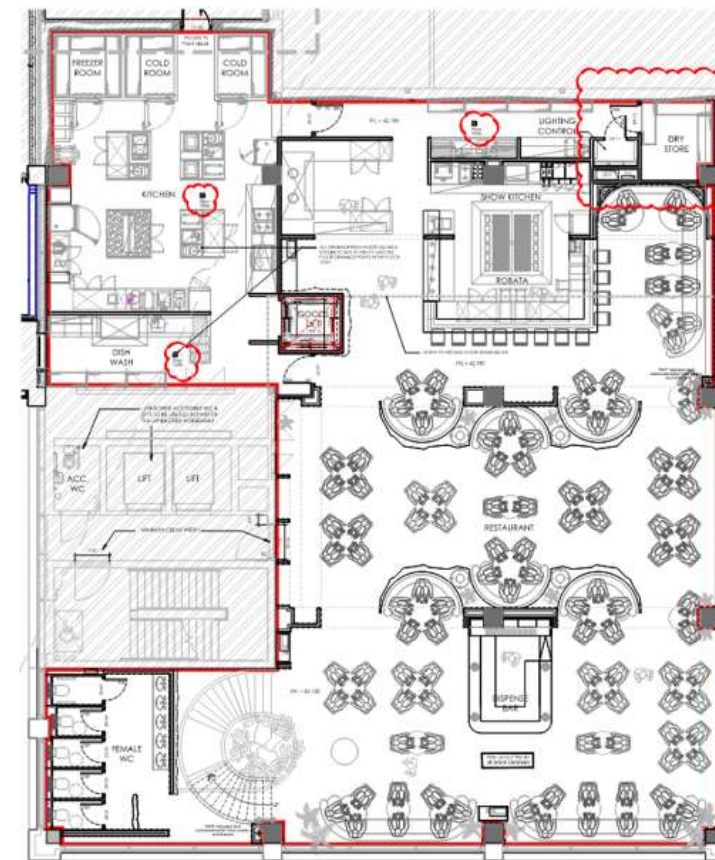


Figure 2 Proposed mezzanine floor layout

3 Basis

3.1 Design information

This review is based on the following information:

- Existing layout drawing ref 8116-WD-01 dated April 2022
- Proposed ground floor plan drawing ref 8116-WD-02 Rev C dated May 2022
- Proposed mezzanine floor plan drawing ref 8116-WD-03 Rev B dated May 2022
- Proposed ground floor ceiling finished drawing ref 8116-WD-08 Rev A dated June 2022
- Proposed mezzanine ceiling finishes drawing ref 8116-WD-09 Rev A dated June 2022
- Proposed ground floor finishes drawing ref 8116-WD-10 Rev A dated June 2022
- Proposed mezzanine floor finishes drawing ref 8116-WD-11 Rev A dated June 2022
- Wall linings and partition types drawing ref 8116-WD-400 dated June 2022
- Ground floor wall substrates drawing number 8116-WD-05 Rev B dated June 2022
- Mezzanine floor wall substrates drawing number 8116-WD-06 Rev B dated June 2022
- Proposed section drawing number 8816-WD-04 dated May 2022
- Ground level mechanical services drawing 00-M110 Rev P3
- Mezzanine level mechanical services drawing 00-M110 Rev P2
- Updated mechanical package provided via email on 25 August 2022
- Mechanical plant package provided via email on 9 September 2022
- Updated architectural package provided via email on 12 September 2022
- Sandy Brown technical memos.

3.2 Performance standards

- BS 8233: 2014 Guidance on Sound Insulation and Noise Reduction for Buildings
- BS 6472-1: 2008 *Guide to evaluation of human exposure to vibration in buildings: Part 1 Vibration sources other than blasting*
- The Control of Noise at Work Regulations 2005
- CIBSE Guide A: *Environmental design* (2015)
- Local Authority planning requirements.

3.3 Tenant criteria

It is understood that there are no specific tenant criteria or brand standards being targeted. We have therefore made recommendations based on previous design experience.

Operational noise transfer to the Level 1 tenant unit from the Fenix demise will need to be suitably controlled such that it does not result in disturbance to its occupants. It is recommended that operational noise transfer be controlled to be at least 10 dB below the internal noise levels within the Level 1 tenant unit in each octave band. The internal noise levels within the Level 1 tenant unit are further discussed in Section 5.2.

4 Key design considerations

The key acoustic issues for the scheme are as follows:

- Sound insulation: Internal walls, floors, ceilings and doors will need to adequately reduce sound transmission.
- Acoustic quality: The acoustic environment within the development will need to be compatible with the proposed uses, in particular the control of reverberation and noise build-up.
- Building services: Noise & vibration from building services plant and systems will need to be controlled by suitable attenuation and isolation measures both inside and outside the development.

Each of these is discussed in more detail in the following sections.

5 Site inspection

A site inspection was carried out on 16 June 2022 of the base build ground and mezzanine units.

Photographs of the ground floor base build unit are provided in Figure 3 and photographs of the mezzanine base build unit are provided in Figure 4.



Figure 3 Photographs of ground floor base build unit



Figure 4 Photographs of mezzanine base build unit

5.1 Base building

The base building comprises of the following:

- Concrete floor comprising of 250 mm thick solid normal-weight concrete
- Concrete core walls with no plasterboard linings
- Blockwork walls between ground / mezzanine units and adjacent spaces
- Concrete columns with no plasterboard linings

- The slab edge details at ground and mezzanine levels were exposed at the time of inspection.

Suitable interface details will need to be developed such that the sound insulation performances of acoustically rated elements are not undermined.

5.2 Measured internal noise levels

Measurements of internal noise levels were undertaken. There were no building services operating at the time. Extraneous noise sources such as construction noise were avoided and did not influence the measured noise levels.

The measured noise levels ranged between L_{Aeq} 33-35 dB / NR28-30. The measured levels of environmental noise ingress measured are expected to be compatible with the types of spaces proposed.

The measured noise levels are low and not considered representative of the Level 1 tenant unit when occupied and fitted-out.

For the purpose of assessing operational noise transfer, a typical NR 35 FCU spectrum has been considered within the Level 1 tenant unit. This is considered a reasonable worst-case scenario, as such noise levels would be expected within cellular meeting rooms and offices, which would be considered acoustically sensitive spaces. The spectrum considered is provided in Table 1 for reference.

Table 1 NR35 FCU sound pressure spectrum

	Sound pressure level L_{eq} (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
NR 35 FCU spectrum	42	39	39	35	35	32	27	23

5.3 Adjacent spaces

Horizontally adjacent to the ground unit and mezzanine unit areas are BoH circulation spaces as well as a plant room. These spaces are not considered acoustically sensitive.

Directly above the mezzanine unit is a Level 1 tenant unit. This space is considered acoustically sensitive and so a sound insulation test of the floor was carried out. The results of this test are discussed within the following section.

5.4 Sound insulation test between mezzanine and Level 1 space

A sound insulation test was also carried out between the mezzanine unit and the Level 1 tenant space directly above. The measured sound insulation performance was $D_{nT,w}$ 60 dB. There were no notable weaknesses observe, despite the slab edge detail being exposed. The slab edge will be sealed and closed up as part of the fit-out works.

6 Building envelope

It is understood that the same cladding system installed to the office floors has also been installed to the commercial units. The installed cladding system is expected to achieve a minimum sound insulation performance of $R'_w + C_{tr}$ 35 dB.

As part of the fit-out works, it is understood that a FoH greeter lobby is proposed as shown in Figure 5. This is expected to aid in controlling noise egress from operational noise when patrons enter / leave.

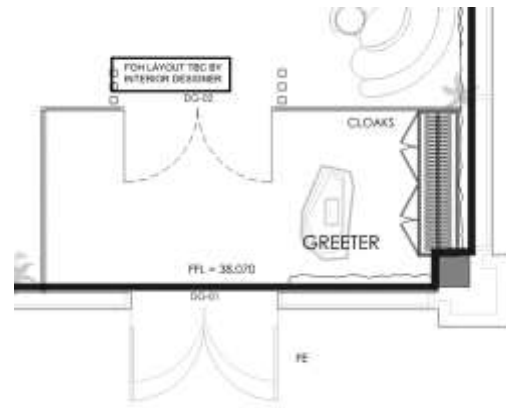


Figure 5 FoH greeter lobby

7 Proposed acoustic standards

Acoustic standards for sound insulation, room acoustics and background noise levels are specified in Table 2.

Table 2 Acoustic performance standards

Space	Sound insulation	Maximum building services noise level
Bar / restaurant seating areas	N/A	NR 40
Show kitchen	N/A	NR 40
Kitchen and dishwash	Crosswalls: <i>R_w</i> 40 dB drywall partition Room fronts: <i>R_w</i> 40 dB drywall partition	NR 55
FoH managers office	Crosswalls: <i>R_w</i> 50 dB drywall partition Room fronts: <i>R_w</i> 40 dB drywall partition Doors: <i>R_w</i> 30 dB hinged doorset	NR 35
Staff room	Crosswalls: <i>R_w</i> 50 dB drywall partition Room fronts: <i>R_w</i> 40 dB drywall partition Doors: <i>R_w</i> 30 dB hinged doorset	NR 35
Greeter lobby	No specific sound insulation performance requirements	NR 40
WCs and changing rooms	Crosswalls: <i>R_w</i> 40 dB drywall partition Room fronts: <i>R_w</i> 40 dB drywall partition	NR 40
Storerooms.	Crosswalls: <i>R_w</i> 40 dB drywall partition Room fronts: <i>R_w</i> 40 dB drywall partition	NR 45

8 Partition and door strategy

8.1 Lab to site tolerances

8.1.1 Drywall partitions

The laboratory sound insulation performance (Weighted Sound Reduction Index, R_w) is the sound insulation provided by a given construction when tested in a laboratory. It is used to select the drywall construction from relevant manufacturer’s technical literature such as the British Gypsum White Book.

The site sound insulation performance (Weighted Standardised Level Difference, $D_{nT,w}$) is the sound insulation provided by a given construction when installed on site. Ultimately it is this performance that is of greater importance. It is accepted that there will be a reduction in the sound insulation performance of a drywall between laboratory and site.

The following maximum laboratory to site tolerances should be used:

- Structural slab to structural soffit partitions $R_w \geq D_{nT,w} + 7$ dB

8.1.2 Doorsets

Doorsets provide considerably less sound insulation than partitions although this is offset to some extent by the higher background/activity noise level in circulation spaces.

The acoustic performance of doorsets depends on three principal factors, namely:

- The weight of the door leaf and any weaknesses due to vision panels, etc
- The tolerances around the door leaf when hung
- The type and extent of seals including meeting jambs for double doors.

Where acoustically rated doorsets are required, they would need to close onto a frame and have perimeter acoustic seals. Drop threshold seals are required on higher performance doorsets whereas lower ratings typically require a diminishing strip under the threshold in order to close off the gap when the door is shut.

Frameless doors are acoustically weak owing to typically large perimeter gaps. Likewise, doors with integral pivot hinges and standard sliding doors are often acoustically weaker owing to the difficulty of accommodating perimeter acoustic seals. Offset pivot or side hung doors tend to perform better as perimeter seals are easier to fit and can be continuous.

The following maximum laboratory to site tolerances should be used:

- 2 dB for hinged doors (ie, $R_w \geq R'_w + 2$ dB)
- 3 dB for sliding doors (ie, $R_w \geq R'_w + 3$ dB).

8.2 Partition and door sound insulation requirements

Mark-ups setting out the partition and door sound insulation performance requirements are provided in Appendix B.

8.3 Proposed partition types

A review of the proposed partition types is provided in Table 3.

Table 3 Review of proposed partition types

Partition ref	Proposed construction	Expected sound insulation performance, R_w (dB)
P1	1 x 18 mm plywood either side of a 48 mm or 70 mm ‘C’ stud	30
P2	1 x 18 mm plywood to one side and 1 x 12.5 mm Wallboard to the other side of a 70 mm ‘C’ stud	40
P3	1 x 18 mm plywood and 1 x 12.5 mm Wallboard to one side and 2 x 12.5 mm Wallboard to the other side of a 48 mm or 70 mm ‘C’ stud with 50 mm mineral fibre insulation within the cavity	50
P4	2 x 12.5 mm Wallboard either side of a 70 mm ‘C’ stud with 50 mm mineral fibre insulation within the cavity	50
P5	1 x 18 mm plywood and 1 x 12.5 mm Wallboard to one side and 1 x 18 mm plywood to the other side of a 70 mm ‘C’ stud	35
P6	1 x 18 mm plywood and 1 x 12.5 mm Wallboard to either side of a 70 mm ‘C’ stud	40
P8	1 x 12.5 mm wallboard either side of a 70 mm ‘C’ stud	34

8.3.1 Review of partition setting out

The partition type setting out appears to be in line with our requirements where we have specified R_w 40 dB drywall partitions.

It is understood that the partition setting out where we have specified R_w 50 dB drywall partitions has been updated to ensure this requirement is met.

8.4 Partition extents

From the proposed partition details, it is understood that all partitions are to be constructed from structural floor to structural soffit.

9 Floors

9.1 Mezzanine floor

Due to the interconnecting staircase running between ground and mezzanine level, the sound insulation performance of the separating floor is expected to be limited. It is understood that the Client is aware that noise transfer will result between the two floors as a result of this, and this works with their aspirations for the floors.

If greater acoustic separation were required between the ground and mezzanine floors in the future, consideration could be given to lobbying the staircase.

9.2 Level 1 floor

To aid in controlling operational noise transfer from the mezzanine Fenix demise to the Level 1 tenant demise, a sound insulating ceiling is proposed within the mezzanine front of house area.

The proposed mezzanine acoustic ceiling detail is shown in Figure 6. The ceiling extent is shown in Figure 7 in green.

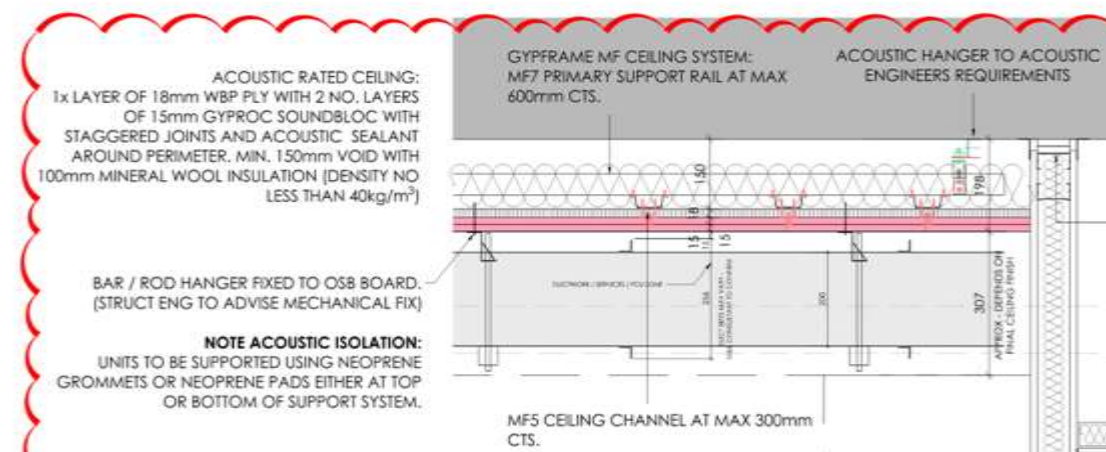


Figure 6 Proposed acoustic ceiling detail



Figure 7 Proposed acoustic ceiling extent

The ceiling is shown to comprise of 1 x 18 mm plywood, 2 x 15 mm Soundbloc, with a 150 mm ceiling cavity with 100 mm mineral fibre insulation within the cavity. The ceiling is shown to be suspended on acoustic hangers. The ceiling hangers should be discrete resilient isolation hangers (spring type) and should be selected so that the ceiling has a maximum mass-spring-mass frequency of 16 Hz, and accounts for the relevant loads.

As discussed in Section 5.4, the base build floor alone achieved a sound insulation performance of $D_{nT,w}$ 60 dB. When considering the acoustic ceiling build-up above, the sound insulation performance of the floor is expected to be in the region of $D_{nT,w}$ 85-90 dB.

Penetrations to the acoustic ceiling should be minimised as much as possible. Any penetrations should be well sealed, and it should be ensured that the ceiling does not become resiliently bridged. Recessed lighting or similar should be avoided.

It is understood that the building services are to be suspended from the layer of plywood forming the acoustic ceiling itself. This works from an acoustic perspective, as it avoids drop rods or similar penetrating through the acoustic ceiling. The load of the building services will need to be considered when specifying the resilient isolation hangers.

10 Interface details

The on-site sound insulation performance of partitions and doors will be dependent on their interfaces to adjoining building elements.

All interface details should be well sealed and airtight.

Any holes or gaps within the slabs should be sealed with non-setting acoustic mastic.

10.1 Base build wall linings

Where acoustically rated partitions abut base build wall linings, the partitions shall penetrate through any base build or facade linings and be sealed airtight to structure behind, and where there are masonry walls about the base building structural walls directly.

From the inspection of the base build units, it does not appear that there are any base build linings.

10.2 Drywall head details

An example drywall head detail is provided below.

It is understood that a 25 mm deflection gap is required. Metal cloaking angles will need to be provided to ensure that the specified ratings are met.

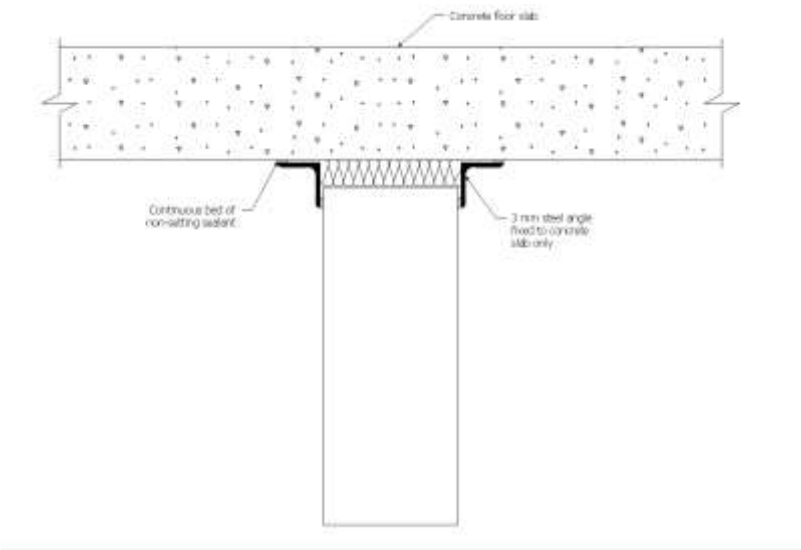


Figure 8 Sketch detail of drywall partition meeting concrete floor slab

10.3 Partition junction detail

An example sketch detail for instances where a single stud drywall partition abuts another single stud drywall partition is provided in Figure 9.

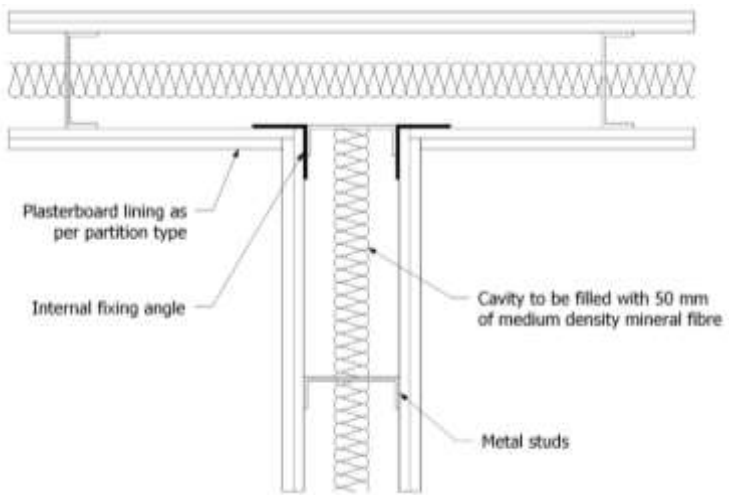


Figure 9 Example sketch detail – Single stud drywall partition T-junction

11 Operational noise

11.1 External operational noise egress limits

External operational noise egress limits for individual tenants are provided in Table 4.

Table 4 Maximum operational noise egress limits at noise sensitive premises

Time period	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{eq,5min}$ (dB)						
	Octave band centre frequency (Hz)						
	63	125	250	500	1k	2k	4k
Daytime (07:00 – 23:00)	39	36	35	30	34	28	14
Night-time (23:00 – 07:00)	36	33	31	26	26	21	11

The nearest daytime (07:00-23:00) noise sensitive receptor is Old Granada Studios, located approximately 25 m to the southeast of the site.

During the night-time (23:00-07:00), the nearest noise sensitive receptor is the Old Granada Studios guestrooms, located approximately 55 m to the southeast of the site.

11.2 Internal operational noise transfer limit

Operational noise transfer to the Level 1 tenant unit from the Fenix demise will need to be suitably controlled such that it does not result in disturbance to its occupants. It is recommended that operational noise transfer be controlled to be at least 10 dB below the internal noise levels within the Level 1 tenant unit in each octave band. The internal noise levels considered within the Level 1 tenant unit are discussed in Section 5.2.

11.3 Internal operational noise limits

Based on the external operational noise limits set out in Table 4, the distances between the Fenix unit and the surrounding noise sensitive receivers and the sound insulation performance provided by the facade and the measured sound insulation performance between the mezzanine area and the Level 1 demise as per Section 5.4 in conjunction with the proposed acoustic ceiling discussed in Section 9.2, the maximum daytime and night-time amplified sound limits are provided in Table 5.

Table 5 Maximum permissible levels from amplified sound

Time period	Maximum operational noise level, $L_{eq,5min}$ (dB)						
	Octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
Daytime (07:00 – 23:00)	70	68	71	74	76	72	65
Night-time (23:00 – 07:00)	74	72	73	77	76	72	65

The above operational noise levels equate to broadband sound pressure levels of $L_{Aeq,5min}$ 79 dB during the daytime and $L_{Aeq,5min}$ 80 dB during the night-time.

These limits are driven by external operational noise egress.

Maximum operational noise level (L_{Fmax}) should not exceed 10 dB above these limits.

The night-time limits are greater than the daytime since the nearest noise sensitive receptor is further away, resulting in increased distance attenuation of operational noise egress.

These limits would typically be suitable for a lively restaurant and bar with amplified music. They would not however typically be suitable for loud amplified music associated with live bands.

These operational noise limits are indicative, and the finalised operational noise limits will need to be undertaken following pre-completion testing on site.

As these limits are driven by operational noise egress, enhancements to the facade such as the provision of secondary glazing would be required in order for higher operational noise levels to be accommodated. It is expected that this would not be preferable from a design perspective.

In addition to the above, it is recommended that at this stage, loudspeakers be mounted on furniture items rather than structural elements ie, the soffit or columns. Where this is unavoidable, an allowance should be made for resilient loudspeaker mounts. It is understood that resilient mounts are currently allowed for to all loudspeakers.

Sound pressure levels of operational noise will be controlled by a staff-operated volume control, normalised to a 0-100 % scale, where 100 % has been calibrated to the internal operational noise limits as per Table 5.

12 Building services noise and vibration

12.1 Internal noise

The maximum internal noise levels due to building services are provided in Table 2.

12.1.1 Ventilation routing and crosstalk

Crosstalk attenuators are proposed at ground floor level as shown in Figure 10 highlighted in red.

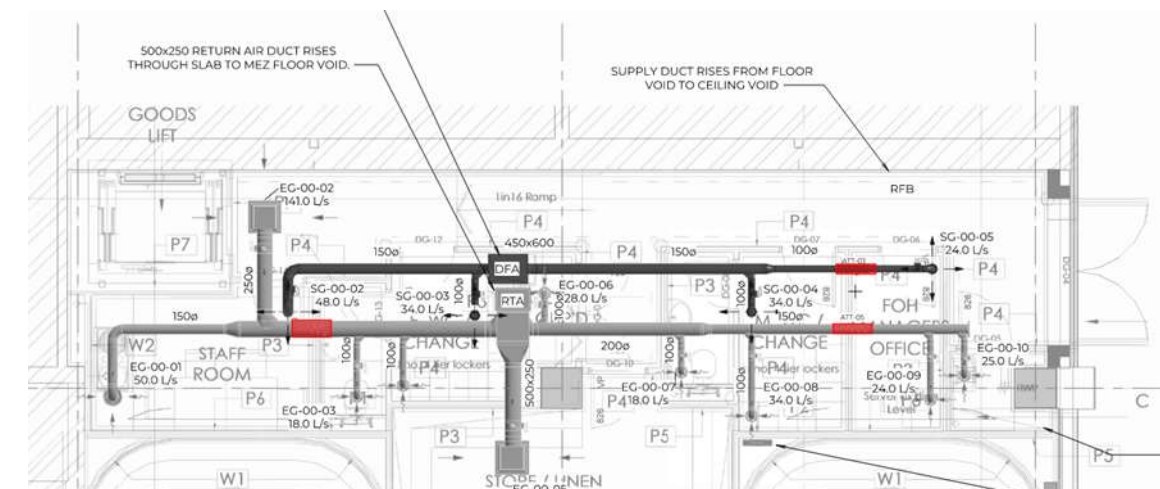


Figure 10 Proposed locations of ground floor crosstalk attenuators

These crosstalk attenuators should achieve the minimum insertion losses set out in Table 6.

Table 6 Minimum crosstalk attenuator insertion losses

		Minimum attenuator insertion loss, D_i (dB)							
		Octave-band centre frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Crosstalk attenuator		3	5	8	16	21	24	15	10

The above losses can typically be achieved with 600 mm long crosstalk attenuators. It should be ensured that regenerated noise via the crosstalk attenuators is suitable controlled such that the internal noise criteria are not exceeded.

12.2 External noise

12.2.1 Planning condition 21

Planning condition 21 within decision notice 121511/FO/2018 imposed by Manchester City Council states the following:

‘Externally mounted ancillary plant, equipment and servicing shall be selected and / or acoustically treated in accordance with a scheme as relevant to each phase and designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.

The scheme shall be submitted to and approved in writing by the City Council as local planning authority prior to occupation of each phase in order to secure a reduction in the level of noise emanating from the site’

The following external plant noise egress limits have been set such that the levels of plant noise egress comply with planning condition 21.

12.2.2 External plant noise egress limits

Noise egress from tenant plant shall be controlled to 10 dB the landlord plant noise egress limits. Based on this, the following overall noise limits outside the nearest noise sensitive premises are applicable:

- L_{Aeq} 38 dB during the daytime (07:00 to 23:00)
- L_{Aeq} 32 dB during the night-time (23:00 to 07:00) on the basis that landlord plant items operate during the night-time (23:00 to 07:00).

12.2.3 External amenity and publicly accessible areas

The cumulative noise level resulting from the operation of all new plant in external amenity and publicly accessible areas should not exceed a limit of L_{Aeq} 55 dB.

12.3 Noise characteristics

Noise from building services plant and systems will need to be designed such that it does not contain any distinguishable attention catching characteristics (eg, whine, hiss, screech, hum, bangs, clicks, clatters or thumps) and is not irregular enough to attract attention.

Where this is not possible, noise limits for new plant will be at least 5 dB lower than those identified in Table 2.

12.4 Proposed plant items

12.4.1 Rooftop plant area

An extract fan is proposed to the rooftop plant area. This is shown in Figure 11 highlighted in green.

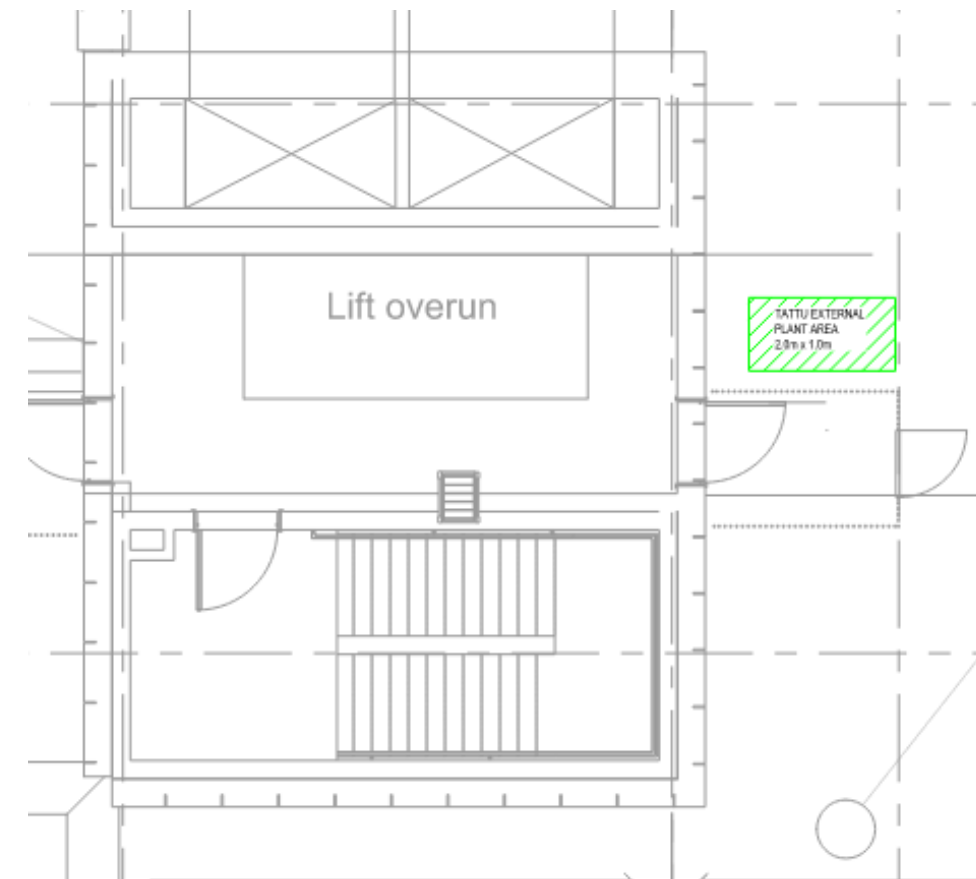


Figure 11 Rooftop plant area

12.4.2 Mezzanine plant area

An air handling unit is proposed within the mezzanine plant area. This is shown in Figure 12 highlighted in red.

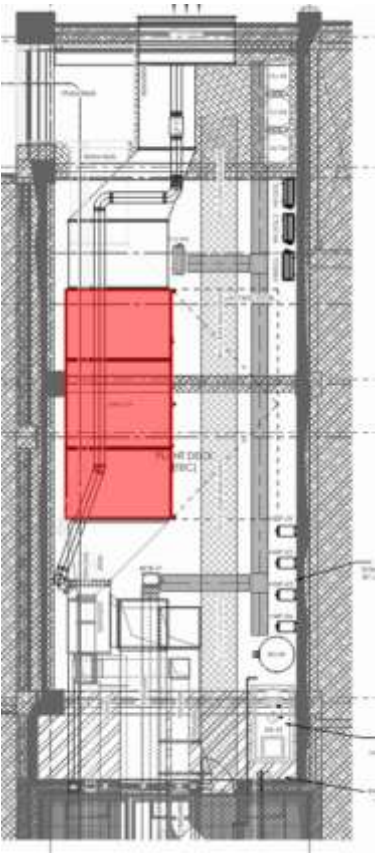


Figure 12 Mezzanine plant area

12.4.3 Received plant data

The sound power data provided for the rooftop kitchen extract fan is set out in Table 7

Table 7 Kitchen extract fan sound power data

	Sound power level, L_w (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
KEF extract	94	92	97	104	103	98	92	85
KEF exhaust	95	93	97	102	102	97	91	85

The sound power data provided for the mezzanine AHU is set out in Table 8.

Table 8 AHU sound power data

	Sound power level, L_w (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
AHU intake	73	86	73	66	62	56	45	41
AHU exhaust	93	90	85	83	80	75	69	63
AHU supply	90	83	76	69	61	52	40	34
AHU extract	81	95	83	84	81	77	71	66

12.5 Assessment of plant noise egress

Calculations have been carried out to assess plant noise egress from the proposed items of external plant. These calculations consider distance attenuation and screening. The results of these calculations indicate that without attenuation, noise egress from the proposed items of plant is expected to be in the region of L_{Aeq} 60-65 dB. This exceeds the plant noise limits as per Section 12.2.2. The required attenuation measures are set out within the following sections.

12.5.1 In-duct attenuators

To control noise egress from the ducted atmospheric terminations, in-duct attenuators are required. The minimum atmosphere side attenuator insertion losses required are provided in Table 9, along with attenuator lengths typically capable of achieving the required losses. It should be noted that the attenuator losses required to the KEF exhaust are high due to this item of plant being particularly noisy. Care will need to be taken when selecting the KEF exhaust attenuator to ensure the insertion loss requirements are met.

Regenerated noise via the attenuators will need to be suitably controlled such that the plant noise egress criteria are not exceeded.

Table 9 Minimum attenuator insertion losses - atmosphere side

	Minimum attenuator insertion loss, D_i (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
AHU intake (900 mm)	6	12	16	20	28	24	16	8
AHU exhaust (1500 mm)	8	16	24	30	35	30	24	16
KEF exhaust (1500 mm)	6	16	22	38	42	44	38	24

12.5.2 KEF casing

No casing breakout noise data has been provided for the kitchen extract fan. Due to the in-duct noise levels being high, there is a chance that the breakout noise levels will also be high. Therefore, at this stage it is recommended that an enhanced double skin casing is allowed for. If breakout noise data becomes available, it should be provided for review.

12.6 Plant within basement car park

It is understood that condenser units are proposed within the basement plant area, however details are not available at this time. It will need to be ensured that noise emissions from these plant items do not exceed L_{Aeq} 55 dB in publicly accessible areas as per Section 12.2.3.

12.7 Assessment of internal noise levels

Calculations have been carried out to assess the resultant internal noise levels from the proposed items of plant. The results of these calculations indicate that without attenuation, noise emissions are expected to be in the region of L_{Aeq} 93 dB / NR90 from the kitchen extract fan and L_{Aeq} 61 dB / NR58 from the AHU supply and extract. These levels exceed the plant noise limits as per Section 7. The required attenuation measures are set out within the following section.

12.7.1 In-duct attenuators

To suitably control internal noise levels resulting from the proposed items of plant, in-duct attenuators are required. The minimum room side attenuator insertion losses required are provided in Table 10, along with attenuator lengths typically capable of achieving the required losses. It should be noted that the attenuator losses required to the KEF exhaust are high due to this item of plant being particularly noisy. Care will need to be taken when selecting the attenuator to ensure the insertion loss requirements are met.

Regenerated noise via the attenuators will need to be suitably controlled such that the internal building services noise limits are not exceeded.

Table 10 Minimum attenuator insertion losses - room side

	Minimum attenuator insertion loss, D_i (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
AHU supply (1500 mm)	5	8	10	15	22	22	20	15
AHU extract (1500 mm)	5	8	10	15	22	22	20	15
KEF extract (2000 mm)	5	8	16	33	43	44	40	35

12.8 Vibration

The maximum permissible vibration amplitudes shall not:

- a) exceed a Vibration Dose Value (VDV) of $0.4 \text{ m/s}^{1.75}$ as given in BS 6472-1: 2008 *Guide to evaluation of human exposure to vibration in buildings: Part 1 Vibration sources other than blasting* in any occupiable space
- b) be of a magnitude which causes the maximum noise criteria to be exceeded.

In addition, vibration transfer from plant to occupied areas shall not exceed 0.01 m/s^2 peak acceleration, based on W_b weighting as defined in clause 3.3 of BS 6472-1: 2008.

To meet these criteria, all vibration producing equipment shall be fitted with suitable anti-vibration equipment (anti-vibration mounts, flexible connections, resilient hangers etc) to reduce the transmission of vibration.

12.9 Building services penetration details

Service penetrations through partitions and other sound insulating elements will need to be acoustically sealed to ensure the sound insulation between rooms meets the specified requirements.

Example building services penetration details are provided in Figure 13 and Figure 14.

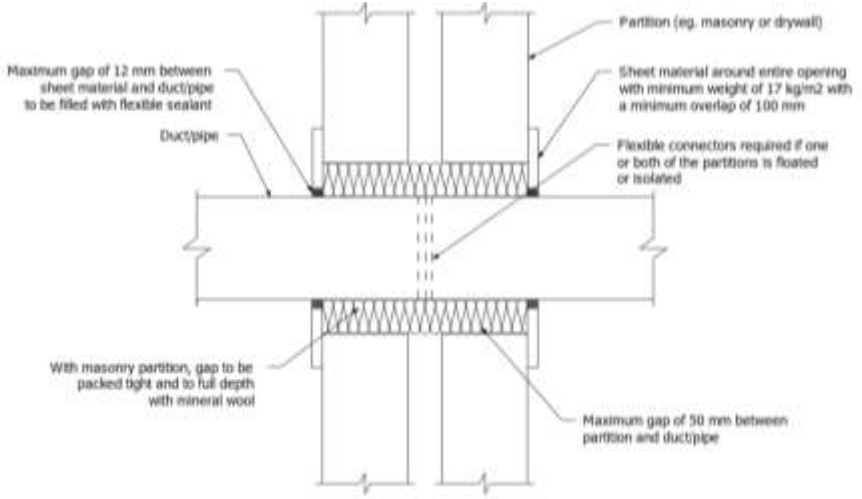


Figure 13 Example sketch duct/pipe penetration detail through double partition

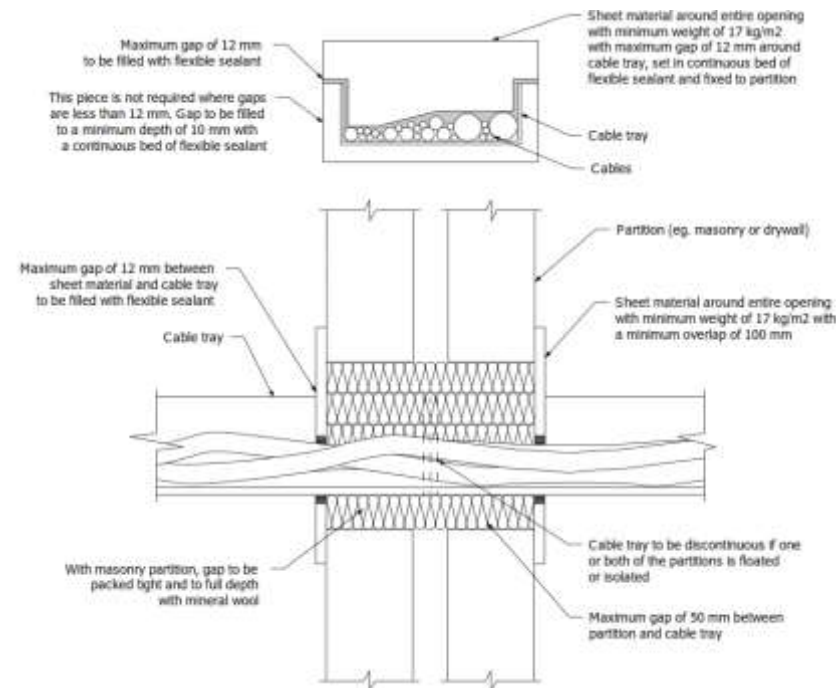


Figure 14 Example sketch cable tray penetration detail through double partition

13 Construction (Design and Management) Regulations

The Construction (Design and Management) Regulations 2015 places legal duties on virtually everyone involved in construction work. Those with legal duties are commonly known as 'dutyholders' and include clients, designers, contractors and workers.

Typical risks specifically associated with acoustic design are:

- Access at height to install and to maintain such elements as acoustic sound absorbent ceilings
- Manual handling of heavy building elements such as high density concrete blocks

Acoustic treatment is specified which will require installation at height, eg, soffit of spaces. However, this would be required in any event for installation of ceiling finishes, lighting, etc and is therefore not a risk specifically related to the acoustic design.

Man-made mineral fibres (MMMf) are used extensively in the construction industry and these are sometimes specified for their acoustic properties. When contractors make use of MMMf they should act on relevant legislation and the latest guidance issued by the Health and Safety Executive. The above risks are not unusual and would be appropriately managed by a competent contractor.

Appendix A

Glossary of useful acoustic terminology

General terms

Absorptive material	Material that absorbs sound energy. Soft or porous finishes such as mineral fibre are effective sound absorbers.
Acoustic absorption	The conversion of sound energy, often by the use of a porous material. It is a term used to describe the amount of sound absorbed by a finish or object within a room.
Airborne sound	Sound propagating through the air.
Airborne sound insulation	The ability of building elements or structures to reduce airborne sound transmission.
Density	Mass per unit volume, expressed in kilograms per cubic metre (kg/m³).
Direct sound transmission	The process in which sound that is incident on one side of a building element is radiated by the other side.
Flanking element	Any building element that contributes to the sound transmission between rooms in a building that is not the separating element in question. It is typically an element which continues past the separating element
Flanking sound transmission	Sound transmitted between rooms via flanking elements instead of directly through separating elements, or along any path other than the direct path.
Floating/isolated floor	A floating or isolated floor consists of a floating layer that is decoupled from the main structure by a resilient layer or other resilient element (see also ‘Resilient layer’ and ‘Floating/isolated layer’). The type of resilient element depends on the level of isolation required.
Floating/isolated layer	A surface that rests on a resilient layer or other resilient element and is therefore isolated from the main structure (see also ‘Floating/isolated floor’ and ‘Resilient layer’).
Frequency	The number of cycles per second. The unit of frequency is the Hertz (Hz). Frequency gives a sound its distinctive tone.
Frequency band	A continuous range of frequencies between stated upper and lower limits (see also ‘Octave band’ and ‘One-third octave band’).
Impact sound	Sound resulting from direct impact (such as footsteps) on a building element.
Impact sound insulation	The ability of building elements or structures to reduce impact sound transmission.
Independent ceiling or lining	A ceiling or lining which is mounted independently of (ie with no direct physical connections to) a separating floor or wall.
Isolation	The absence of rigid connections between two or more building elements.
Mass per unit area	The mass per unit area, expressed in terms of kilograms per square metre (kg/m²). Also known as ‘surface density’.
Resilient layer/element	A layer or other resilient element that isolates a floating layer from a base floor and the surrounding walls.
Resiliently mounted ceiling or lining	A ceiling or lining which is mounted resiliently from (ie connected only via specialist resilient hangers or ties) a separating floor or wall.

Reverberation	The persistence of sound in a space after a sound source has stopped.
Reverberation time	The time, in seconds, taken for the sound in a room to decay by 60 dB after a sound source has been stopped.
Separating element	An element (such as a wall, floor, door, window) which separates buildings or parts of buildings.
Sound pressure level	A logarithmic measure of the effective sound pressure of a sound relative to a reference value, measured in decibels, dB. Sound pressure levels are dependent on the conditions under which they are measured.
Sound power level	A logarithmic measure of the sound power in comparison to specified reference level, measured in decibels, dB. Unlike sound pressure, sound power is not room or distance dependent.
Spectrum	The composition of a particular sound in terms of separate frequency bands.
Surface density	The surface density, expressed in terms of kilograms per square metre (kg/m²). Also known as ‘mass per unit area’.
Structure-borne sound	Sound which is transferred by vibration via the structure of a building.

Acoustic parameters

‘A’ weighting	Frequency weighting based on the frequency response of the human ear which has been found to correlate well with the subjective response to sound.
C_{tr}	The correction to a sound insulation quantity (such as R_w or $D_{nT,w}$) to take account of a specific sound spectrum with low frequency sound energy.
Decibel (dB)	A logarithmic unit used for many acoustic values to indicate the level with respect to a reference level
D	The difference in sound level between a pair of rooms, in a stated frequency band. A higher numerical quantity represents a better performance.
D_w	A single number weighted quantity which characterizes the airborne sound insulation between rooms. It is not corrected for reverberation or element size and is therefore representative of the sound insulation heard on site. A higher numerical quantity represents a better performance.
$D_{n,f}$, $D_{n,c}$	The difference in sound level between a pair of rooms via a specified flanking sound transmission path in a stated frequency band. $D_{n,c}$ relates specifically to ceilings but has been superseded by $D_{n,f}$ which can relate to any specified path. A higher numerical quantity represents a better performance.
$D_{n,f,w}$, $D_{n,c,w}$	A single number weighted quantity which characterizes the airborne sound insulation between rooms via a specified flanking path. $D_{n,c,w}$ relates specifically to ceilings but has been superseded by $D_{n,f,w}$ which can relate to any specified path. A higher numerical quantity represents a better performance.
$D_{n,e}$	The difference in sound level via a specified small element in a stated frequency band. A higher numerical quantity represents a better performance.

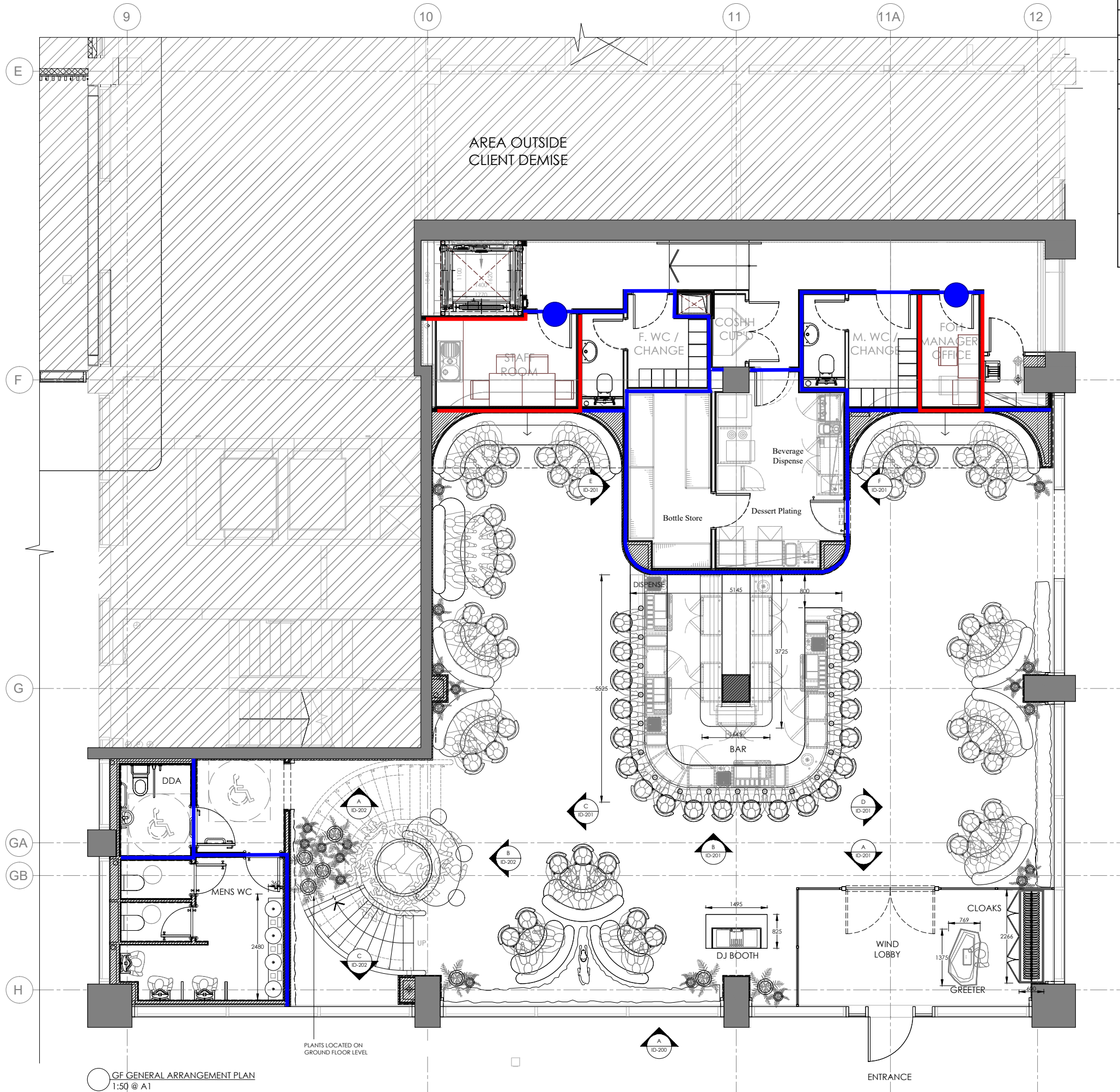
$D_{n,e,w}$	A single number weighted quantity which characterizes the airborne sound insulation via a specified small element. A higher numerical quantity represents a better performance.
D_{nT}	The difference in sound level between a pair of rooms, in a stated frequency band, normalized for the reverberation time. A higher numerical quantity represents a better performance.
$D_{nT,w}$	A single number weighted quantity which characterizes the airborne sound insulation between rooms, corrected for reverberation time. A higher numerical quantity represents a better performance.
Hz	Hertz (Hz) is the unit of frequency (see also ‘Frequency’)
$L_{n,f}$	The impact sound pressure level in a stated frequency band, flanking via a floor connecting adjacent rooms. A lower numerical quantity represents a better performance.
$L_{n,f,w}$	A single number weighted quantity used to characterize the flanking impact sound pressure level via a floor connecting adjacent rooms. A lower numerical quantity represents a better performance.
L'_{nT}	The impact sound pressure level in a stated frequency band, corrected for the reverberation time. A lower numerical quantity represents a better performance.
$L'_{nT,w}$	A single number weighted quantity used to characterise the impact sound insulation of floors. A lower numerical quantity represents a better performance.
$L_{A90,T}$	The A-weighted sound pressure level exceeded 90% of the measurement period (T) over which a noise is measured (ie, the quietest 10% of the period). When not weighted it is denoted $L_{90,T}$. This parameter is generally considered to be representative of a constant noise source, or background noise level.
$L_{Aeq,T}$	Equivalent A-weighted sound pressure level of a steady noise that has the same acoustic energy as a fluctuating noise over the measurement period (T). When not weighted it is denoted $L_{eq,T}$.
$L_{A10,T}$	The A-weighted sound pressure level exceeded for 10 % of the measurement period (T) over which a noise is measured. When not weighted it is denoted $L_{10,T}$.
$L_{Amax,T}$	The highest A-weighted sound pressure level measured in the period (T) with either fast (L_{AFmax}) or slow (L_{ASmax}) time weightings. When not weighted it is denoted L_{Fmax} or L_{Smax} .
NR	Noise rating. Single figure term used to reflect the spectral content of noise. This is generally applied within rooms in relation to building services noise.
Octave band	A frequency band in which the upper limit of the band is twice the frequency of the lower limit.
One-third octave band	A frequency band in which the upper limit of the band is the cube root of two times the lower limit of the band or more simply one third of an octave band.

Appendix B

Partition and door sound insulation mark-ups

AREA:	
FRONT OF HOUSE	248 M ² / 2670 FT ²
BACK OF HOUSE	76 M ² / 818 FT ²
TOTAL	324 M ² / 3488 FT ²

COVERS:	
BAR SEATING:	75
BAR STOOLS:	20
TOTAL	95



GF GENERAL ARRANGEMENT PLAN
1:50 @ A1

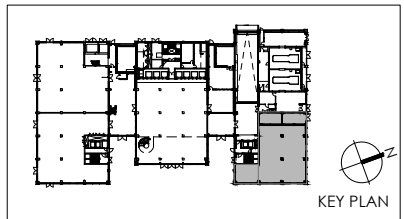
Title	Partition and door sound insulation performances
Project	Fenix, Manchester Goods Yard
Project no.	22195
Version	C
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	21 August 2022

Mark-up key laboratory ratings

- R_w 50 dB drywall partition
- R_w 40 dB drywall partition
- R_w 30 dB door

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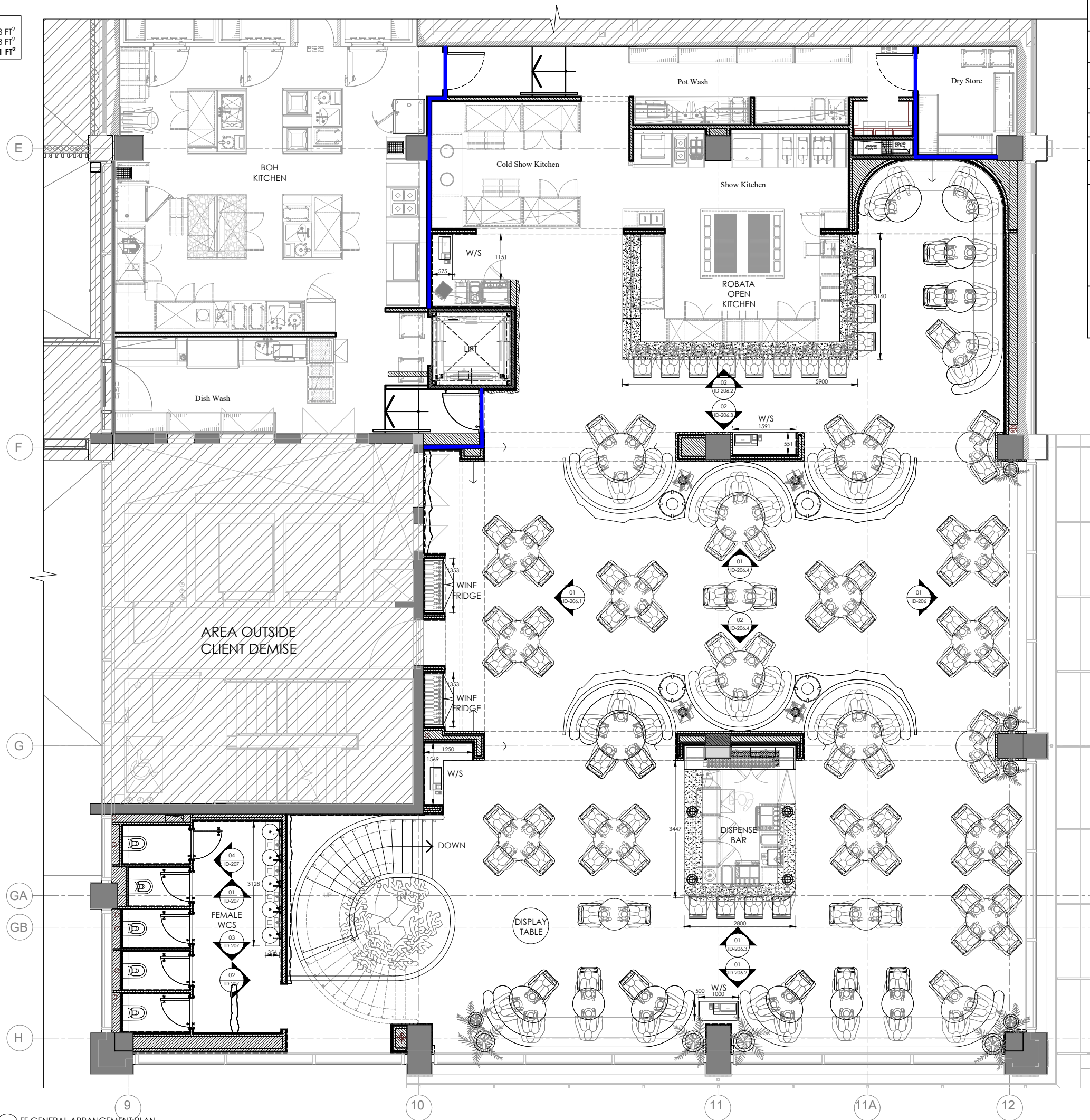


PRICING ISSUE

CLIENT:	TATTU RESTAURANT GROUP		
PROJECT:	FENIX		
DRAWING TITLE:	GF GENERAL ARRANGEMENT PLAN		
SCALE:	1:50 @ A1	PROJECT NUMBER:	298
DATE:	08.09.2022	DRAWN:	DE
DRAWING:	ID-105		REVISION:
			T1

AREA:
FRONT OF HOUSE 311 M² / 3348 FT²
BACK OF HOUSE 122 M² / 1313 FT²
TOTAL 433 M² / 4461 FT²

COVERS:
DINING 113
STOOLS 16
TOTAL 129

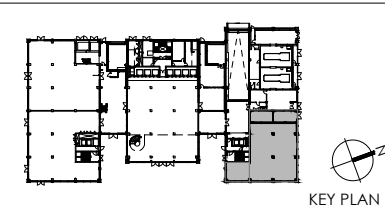


Title	Partition and door sound insulation performances
Project	Fenix, Manchester Goods Yard
Project no.	22195
Version	C
Marked-up by	Kane Mitchell
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Date	21 August 2022

Mark-up key laboratory ratings

- R_w 50 dB drywall partition
- R_w 40 dB drywall partition
- R_w 30 dB door

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REVISIONS		
REV.	DATE	DESCRIPTION

PRICING ISSUE

CLIENT:		TATTU RESTAURANT GROUP	
PROJECT:		FENIX	
DRAWING TITLE:		FF GENERAL ARRANGEMENT PLAN	
SCALE:		1:50 @ A1	298
DATE:		08.09.2022	DE
DRAWING:		ID-155	
		T1	