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Rathcoole Residential Development

Rathcoole, Dublin 24

Environmental Noise Assessment & Design Recommendations

19 August 2022

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Appendices

1 Introduction

Allegro Acoustics was commissioned by Riverside Projects Ltd. to complete an environmental noise assessment and provide acoustic design recommendations for a 58-unit elderly housing development in close proximity to the N7 in Rathcoole, Dublin 24. The development is located within a residential complex and is also surrounded by a small number of commercial buildings. This is outlined in Figure 1 below.

In order to determine the potential noise impact on the Rathcoole housing development from the N7 motorway, a 3D environmental noise model was developed in SoundPLAN V7.3. This model is comprised of the Rathcoole housing development and the nearby residential dwellings and commercial buildings. The purpose of this assessment is to determine the indoor ambient noise levels from external sources and to subsequently determine the level of façade sound insulation required to ensure that noise level in the proposed facility remains with the internal noise limits as outlined in Section 2.1 below.

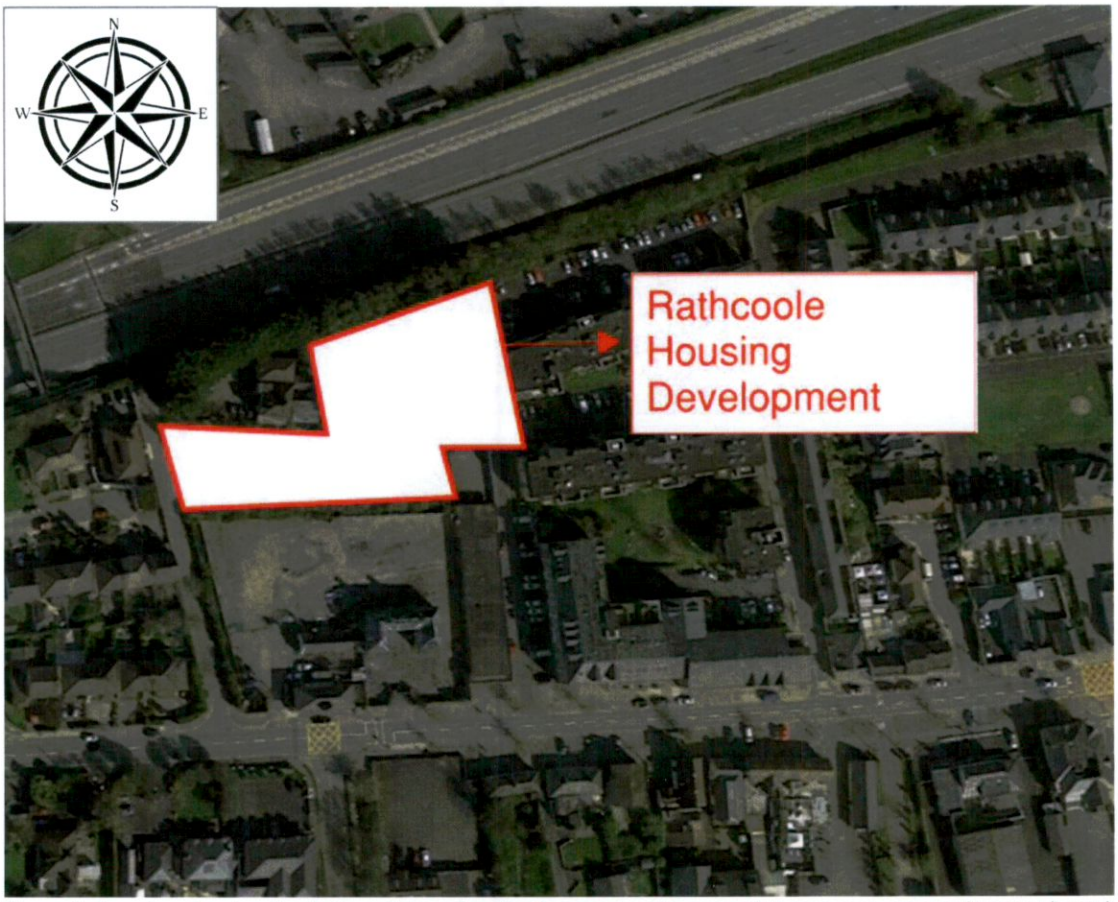


Figure 1: Drawing showing the Rathcoole housing development with some of the nearest surrounding residential and commercial buildings. The Rathcoole housing development site is outlined in red.

2 Methodology

2.1 Assessment Criteria

It is recommended that the Rathcoole housing development facility achieve the below indoor ambient noise levels for dwellings as set out by in BS8223 [1]. This is outlined in Figure 1 below.

Table 4 **Indoor ambient noise levels for dwellings**

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	—
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	—
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Figure 1: Indoor ambient noise levels for dwellings as outlined in BS8223 *[1]*.

In order to provide the most comfortable internal living conditions, the preference is to use natural ventilation in this development. Natural ventilation provides a lower-level sound insulation performance than a mechanically ventilated façade. However, it is considered to be in the interest of the occupants to naturally ventilate the building. As such, it is proposed to apply Note 7 of Section 7.7.2 of BS8223 [1] to this development. This is shown in Figure 2 below.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

Figure 2: Note 7 from Section 7.7.2 of BS8223 *[1]*.

Despite the small increase in internal noise levels, a naturally ventilated environment is considered to result in a more comfortable indoor living area for the occupants. Also as pointed out in Note 7 above, reasonable internal noise levels can still be achieved. The internal noise level criteria as considered applicable to this project is presented in Table 1 below.

BS8223 Criteria [1]		Concluded Criteria Including +5dB Relaxation Outlined In Note 7
Daytime	35dB L_{Aeq}	40dB L_{Aeq}
Night-Time	30dB L_{Aeq}	35dB L_{Aeq}

Table 1: Concluded internal noise level acoustic criteria.

2.2 Predictive Noise Modelling

In order to assess the noise impact from the N7 on the proposed development, Allegro Acoustics has created a 3-D Environmental Noise model for the Rathcoole housing development using SoundPLAN Version 7.3 environmental noise modelling software. This software implements the calculation and prediction methodologies outlined in *ISO 9613 Acoustics – Attenuation of sound during propagation outdoors* [2] [3].

The Rathcoole housing development was represented in this model using CAD drawings provided by PAC Studio Architects. This information was used to develop the building envelope in the model. A site survey was carried out by Allegro Acoustics personnel on the 20th October 2021 to build a knowledge base for all additional buildings and objects that form noise barriers at the site. This site survey was supplemented with additional information freely available from Google™ Earth regarding the study area.

Using this information, a comprehensive and detailed environmental noise model was developed for the site. This model includes all objects which form barriers for noise, including buildings and perimeter walls.

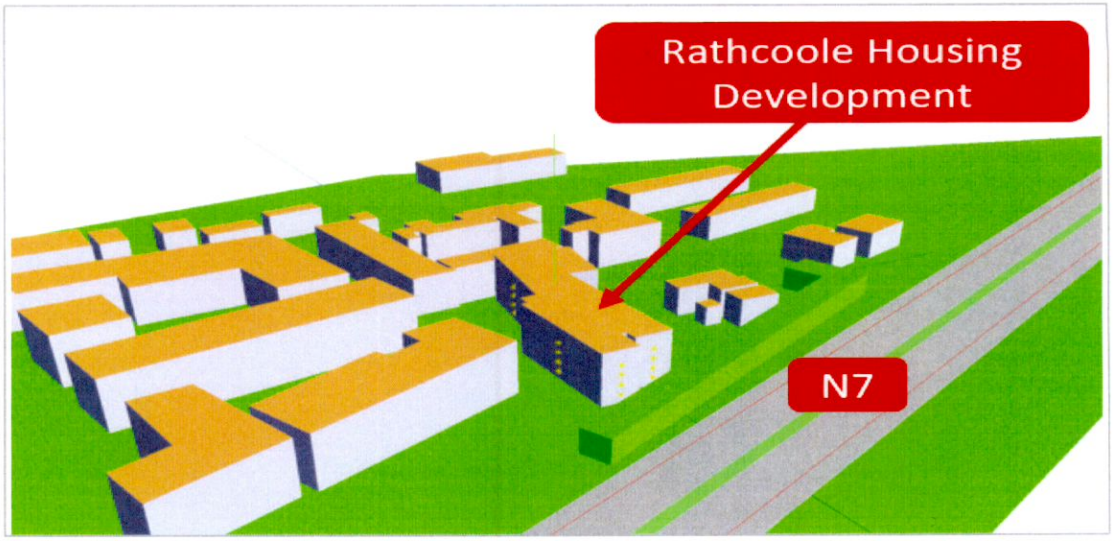


Figure 2: 3D graphic from the SoundPLAN noise model.

3 Results

3.1 Environmental Noise Survey (Validation Measurements)

An environmental noise survey was carried out at the site of the proposed Rathcoole residential development to determine the levels of environmental noise at this location due to the N7. Validation measurements were carried out at 2 locations over 15-minute periods on the 20th of October 2021. Cognisance was paid to the methodologies as outlined in *Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)* [4] and *ISO 1996 Acoustics – Description and Measurement of Environmental Noise* [2].

All measurements were recorded using a Bruel and Kjaer 2250 Sound Level meter. The Sound Level Meter (SLM) was calibrated before the noise monitoring survey commenced using a Bruel and Kjaer Type 4231 acoustic calibrator. The Bruel and Kjaer 2250 SLM is a Class 1 instrument in accordance with IEC 61672 regulations. The time weighting used was fast and the frequency weighting is A-weighted as per IEC 61672. Calibration certificates for all sound monitoring equipment are included in Appendix A.

Noise measurements were taken in suitable conditions with wind speeds lower than 5 m/s and no precipitation present as outlined in NG4 [4].

Table 2 below outlines the measured L_{Aeq} noise levels (as defined in Appendix D - Glossary of Terminology) at monitoring locations N1 and N2. The full noise data is presented in Appendix A. The noise monitoring locations are shown in Figure 3 below.

Receptor	Measured dB L_{Aeq}
N1	84.9
N2	61.2

Table 2: Measured L_{Aeq} noise levels at monitoring locations N1 and N2.

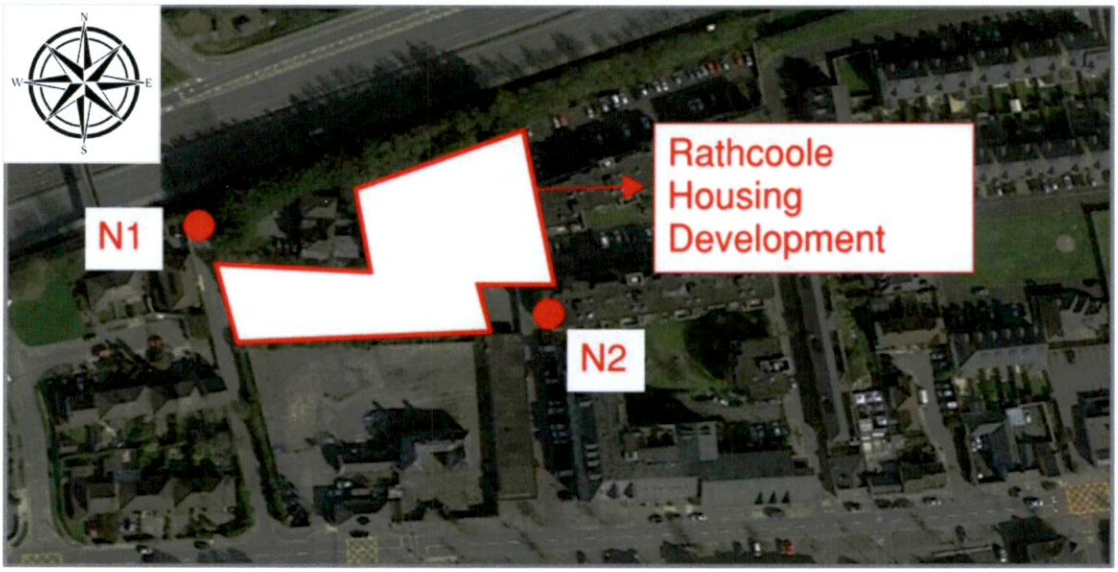


Figure 3: Noise Monitoring locations N1 and N2 relative to the site boundary of the proposed development.

3.2 Model Validation

The dB L_{Aeq} taken at measurement locations N1 and N2 as outlined in Section 3.1 above was used to validate the SoundPLAN environmental noise model. The validation points used are shown in Figure 3 above. The L_{Aeq} noise level at these validation points is compared to the L_{Aeq} noise level predicted by the SoundPLAN environmental noise model at the same locations.

As a general rule, an environmental noise model should predict within ±3dB of the measured noise level at the same location, to be considered to be a valid representation of the study area. As can be seen in Table 3 below, the model has been successfully validated at the validation points for the L_{Aeq} noise levels. The validation results from SoundPLAN noise model can be seen in Appendix B.

Model Validation			
Location	**Measured dB L_{Aeq}**	**Modelled dB L_{Aeq}**	**Difference**
N1	84.9	83.8	-0.9
N2	61.2	61.6	+0.4

Table 3: Comparison of measured L_{Aeq} noise levels and model predicted L_{Aeq} noise levels at the same location.

3.3 Noise Source Representation

Road traffic data was taken from an NRA traffic survey carried out in 2019 for the N7 between Junction 3 and Junction 4. This AADT (Annual Average Daily Traffic) data was provided by the National Roads Authority.

A road histogram diurnal profile for the non-HGV traffic and H.G.V traffic, from the document *National Roads Authority Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004* [5] was used in the acoustic model for the N7. The percentage of HGV's used for the M50 and N2 were based on the document *Transport Infrastructure Ireland – National Road Network Indicators, 2016* [6].

3.4 Noise Level Predictions at the Rathcoole Housing Development

Figure 4 below outlines the locations of model receivers R1 to R7 around the façade of the proposed Rathcoole housing development. The external noise levels at façade locations R1 to R7 as predicted by the SoundPLAN environmental noise model are presented in Appendix B.

Figure 4: Location of receivers R1 to R7 around the external façade of the proposed development.

3.5 Façade Assessment

Upon determination of the predicted external noise levels at façades R1 to R7 and comparison with the intrusive noise limits as outlined in Figure 1 above, the sound insulation specification required of façade elements was calculated. A detailed façade assessment was carried out to determine the required façade sound reduction index, R_w.

It is proposed to use five different façade designs for this building. These are as follows:

- 47dB $R_w + C_{tr}$ & no passive vents;
- 47dB $R_w + C_{tr}$ & 51dB $D_{n,e,w} + C_{tr}$;
- 44dB $R_w + C_{tr}$ & 50dB $D_{n,e,w} + C_{tr}$;
- 37dB $R_w + C_{tr}$ & 43dB $D_{n,e,w} + C_{tr}$;
- 32dB $R_w + C_{tr}$ & 38dB $D_{n,e,w} + C_{tr}$.

Figure 5: Façade Specification for Rathcoole Housing Development

Note:

R_w values are measured in laboratory settings. As such, they cannot always give a true reflection of the sound insulation when glazing is installed on-site. Depending on how the glazing is assembled, it can underperform at low, medium or high frequencies. As such, correction factors are added to the R_w value in order to give a more accurate determination of the sound insulation offered by a glazing configuration.

These corrections are expressed in the following format: R_w (C; C_{tr}) with C representing a correction factor for outside background noise, and C_{tr} representing a correction factor for traffic noise. The most prevalent outside noise source for bedrooms is road traffic, hence why the C_{tr} correction is applied when assessing the interior dB L_{Aeq} criteria. Below is a sample glazing specification that utilises the C_{tr} correction.

Example: if a glazing test certification gives the following rating R_w (C; C_{tr}) = 44 (-2; -6), the R_w + C_{tr} value is 44 – 6 = 38dB R_w + C_{tr}.

3.5.1 Noise Model Results

The predicted noise level from the SoundPLAN noise model at each receiver (Figure 4) are listed in Table 4 below.

Modelled Façade Noise Level			
Receiver (See Figure 4 above)	Floor	L_{day} dB(A)	L_{night} dB(A)
R1	GF	69.3	64.1
	F 1	70.3	65.1
	F 2	71.4	66.2
	F 3	72.1	66.9
R2	GF	73.4	68.2
	F 1	74.6	69.4
	F 2	75.1	69.9
	F 3	75.6	70.4
R3	GF	78.8	73.6
	F 1	79.3	74.1
	F 2	79.5	74.3
	F 3	79.6	74.4
R4	GF	78.2	73.1
	F 1	78.7	73.5
	F 2	78.9	73.7
	F 3	78.9	73.8
R5	GF	72.1	66.9
	F 1	73.2	68
	F 2	73.8	68.6
	F 3	74.2	69
R6	GF	58.7	53.5
	F 1	59.2	54
	F 2	59.9	54.7
	F 3	60.6	55.4
R7	GF	63.2	58
	F 1	63.8	58.6
	F 2	64.7	59.5
	F 3	65.2	60

Table 4: SoundPLAN predicted noise levels at R1 to R7 for day and night-time periods.

3.5 Recommended Façade Elements

The façade glazing to achieve the internal noise criteria for the proposed development are detailed in Table 6 below. It is assumed that a standard structural element as outlined in Table 5 will be utilised, e.g. a build-up similar to the following:

- Outer layer: brickwork
- SFS packed with mineral wool
- Inner layer: double layer of plasterboard.

Façade (Structural Element) Sound Insulation Assessment			
Wall Type	Construction Details (Outside to Inside)	INSUL Predicted Sound Reduction Index	Modelled Construction
Brick Cavity Wall	• 100mm Brick • 175mm Cavity with Insulation • 215mm Blockwork • 38mm Battens • 1 x 12mm Plasterboard	64dB $R_w + C_{tr}$	

Table 5: Predicted Sound Reduction Index for the structural elements of the Building Envelope.

Glazing & Frame Specification	
Required Sound Insulation Performance dB $R_w + C_{tr}$	Description of Recommended Glazing
≥47 Legend Ref:	Double Glazing: Pilkington Insulating Glass Unit [12.8mm Pilkington Optiphon Glass, 20mm Argon, 16.8mm Pilkington Optiphon Glass] 51dB R_w (-1; -4) = 47dB $R_w + C_{tr}$
≥47 Legend Ref:	Double Glazing: Pilkington Insulating Glass Unit [12.8mm Pilkington Optiphon Glass, 20mm Argon, 16.8mm Pilkington Optiphon Glass] 51dB R_w (-1; -4) = 47dB $R_w + C_{tr}$
≥44 Legend Ref:	Double Glazing: Pilkington Insulating Glass Unit [10.8mm Pilkington Optiphon Glass, 24mm Argon, 16.8mm Pilkington Optiphon Glass] 52dB R_w (-2; -6) = 46dB $R_w + C_{tr}$
≥37 Legend Ref:	Double Glazing: Pilkington Insulating Glass Unit [10mm Glass, 16mm Argon, 8.8mm Pilkington Optiphon Glass] 44dB R_w (-2; -6) = 38dB $R_w + C_{tr}$
≥32 Legend Ref:	Double Glazing: Pilkington Insulating Glass Unit [10mm Glass, 6-16mm Argon, 6mm Glass] 35dB R_w (-1; -3) = 32dB $R_w + C_{tr}$
Product Link: www.pilkington.com/en-gb/uk/products/product-categories/noise-control/pilkington-optiphon	

Table 6: Acoustic specification for façade structural and glazed elements.

Note

1) The dB $R_w + C_{tr}$ performance for the glazing and frame to be implemented, must be verified by carrying out acoustic testing to ISO 10140-2 [7] in a suitably certified acoustic testing laboratory.

Recommendations for glazing and background ventilators are specified in Table 7 below.

Trickle Vents Specification	
Required Sound Insulation Performance $D_{n,e,w} + C_{tr}$	**Description of Recommended Trickle Vent**
No Trickle Vents Legend Ref:	No trickle vents are to be installed on this façade. This has been discussed and approved by the project M&E Consultant.
≥51 Legend Ref:	DucoMax Largo 10. Achieves 51dB $D_{n,e,w} + C_{tr}$ in the open position.
≥50 Legend Ref:	DucoMax Largo 10. Achieves 51dB $D_{n,e,w} + C_{tr}$ in the open position.
≥43	Duco Medio 10. Achieves 44dB $D_{n,e,w} + C_{tr}$ in the open position.
≥38 Legend Ref:	Duco Alto 20. Achieves 39dB $D_{n,e,w} + C_{tr}$ in the open position.
Product Link: www.duco.eu/uk	

Table 7: Acoustic specification for trickle ventilators.

Note

1) The $D_{n,e,w} + C_{tr}$ performance for the background ventilation solutions to be implemented, must be verified by carrying out acoustic testing to ISO 10140-2 [7] in a suitably certified acoustic testing laboratory.

3.6 Good Practice Measures for Noise Control

The measures outlined in this section are designed to further mitigate against noise ingress from the nearby road network.

- It is recommended that no vents are used on the purple façade as indicated in Figure 5.
- It is recommended to install a sound absorbing ceiling on the balconies located on the orange-coloured facades in Figure 5. This is to prevent reverberant noise build up that could lead to increased noise levels within the apartments. The sound absorbing ceiling material must be a Class C sound absorber or better. See below sample product: Quietstone Light Acoustic Panels: http://www.quietstone.co.uk/product/quietstone-light/ Ab example location for installation is shown in Figure 6 below.

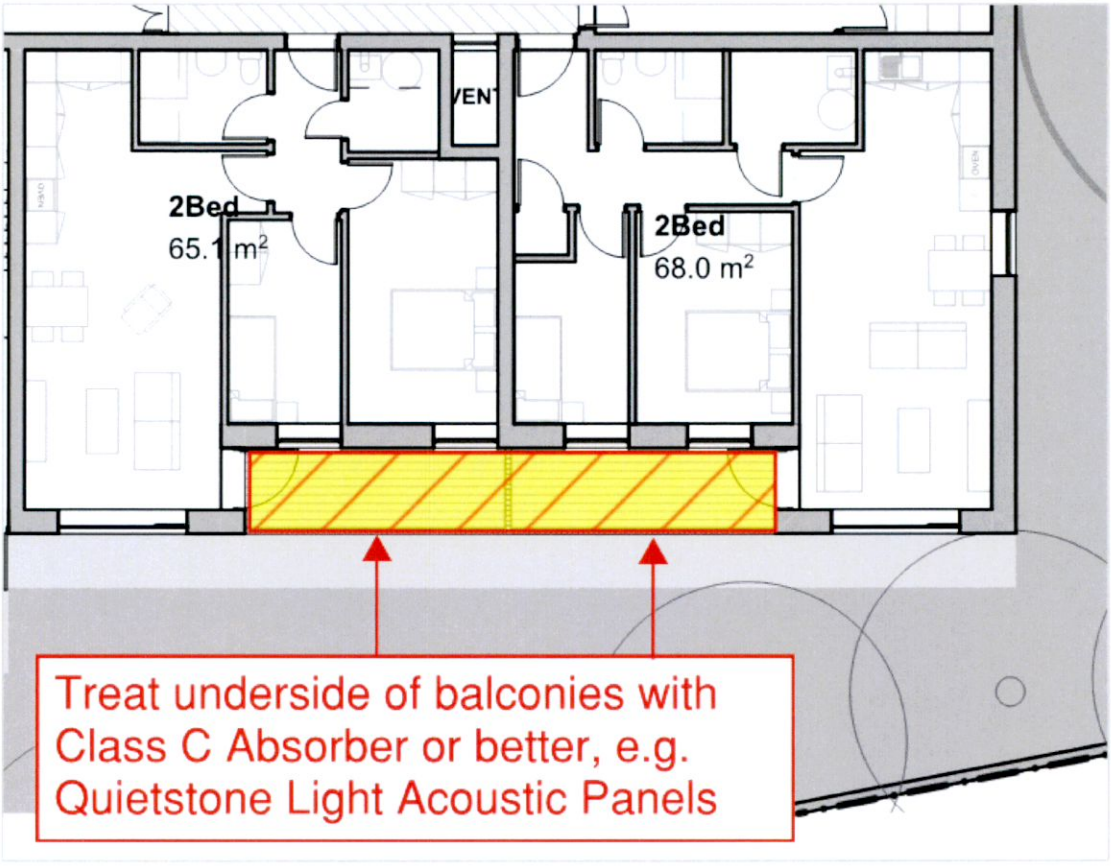


Figure 6: Example recommended locations for sound absorption treatment to the underside of balcony spaces.

3.7 Predicted Internal Noise Levels With Recommended Façade Elements

Table 8 below shows the calculated internal noise levels once the recommended façade elements as outlined in Section 3.5 and the good practice measures outlined in Section 3.6 above are implemented. The 5dB relaxation as outlined in Figure 2 above has been applied to the acoustic criteria. As evidenced in Table 8, the internal noise levels due to the N7 are predicted to be within the 40dB L_{Aeq} and 35dB L_{Aeq} noise limits.

Floor	Location	Façade Sound Reduction Index, dB $R_w + C_{tr}$	Calculated dB L_{Aeq} Inside	
			Daytime Criteria: ≤40dB L_{Aeq}	Night-time Criteria: ≤35dB L_{Aeq}
All	R1	44	34.1	28.9
All	R2	47	36.6	31.4
All	R3	47	38.6	33.4
All	R4	47	37.9	32.8
All	R5	47	35.2	30
All	R6	32	34.6	29.4
All	R7	37	34.2	29

Table 8: The recommended sound insulation of the Rathcoole housing development façade in addition to the resulting dB L_{Aeq} inside the residences represented by the receivers R1 to R7 relative to the intrusive noise criteria as outlined in Section 2.1.

4 References

[1] British Standards Institution, "BS 8233 Guidance on sound insulation and noise reduction for buildings," 2014.

[2] International Standards Organisation, "ISO 1996-1 Acoustics - Description and measurent of environmental noise - Part 1: Basic quantities and assessment procedures," 2016.

[3] International Standards Organisation, "ISO 9613-2 Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation," 1996.

[4] Environmental Protection Agency, "Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities," 2016.

[5] National Roads Authority, National Roads Authority Guidelines for the Treatment of Noise and Vibration in National Road Schemes 2004, 2004.

[6] Transport Infrastructure Ireland, Transport Infrastructure Ireland - National Road Network Indicators - 2019, 2019.

[7] International Standards Organisation, ISO 10140-2 Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation, 2010.

[8] International Standards Organisation, "ISO 9613-1 Acoustics -- Attenuation of sound during propagation outdoors -- Part 1: calculation of the absorption of sound by the atmosphere," 1993.

Appendix A

Validation Measurements

ALLEGRO
acoustics

Brüel & Kjær

Testing Agency:	Allegro Acoustics
Testing Operator:	Stephen Kearney BE MIEI MIOA
SLM:	Bruel & Kjaer 2250
SLM Serial Number:	2722891
SLM Factory Calibration Date:	13/03/2020
Sound Field Correction:	Free Field
Bandwidth:	1/3rd Octave - Fully Integrating
Time Weighting:	Fast

dB Leq Measurement Data

Location	Period	Measurement	Start Time	Elapsed Time	LZeq 12.5Hz	LZeq 16Hz	LZeq 20Hz	LZeq 25Hz	LZeq 31.5Hz	LZeq 40Hz	LZeq 50Hz	LZeq 63Hz	LZeq 80Hz	LZeq 100Hz	LZeq 125Hz	LZeq 160Hz	LZeq 200Hz	LZeq 250Hz	LZeq 315Hz	LZeq 400Hz	LZeq 500Hz	LZeq 630Hz	LZeq 800Hz	LZeq 1 kHz	LZeq 1.25 kHz	LZeq 1.6 kHz	LZeq 2 kHz	LZeq 2.5 kHz	LZeq 3.15 kHz	LZeq 4 kHz	LZeq 5 kHz	LZeq 6.3 kHz	LZeq 8 kHz	LZeq 10 kHz	LZeq 12.5 kHz	LZeq 16 kHz	LZeq 20 kHz
N1	Day	Meas004	20/10/2021 14:59	00:15:00	69.9	71.96	71.82	73.38	71.48	71.42	73.34	76.6	74.67	71.88	72.12	70.72	71.64	72.43	73.43	73.55	75.34	76.92	78.77	78.69	76.71	74.59	70.79	66.39	62.31	58.56	54.17	50.43	46.75	43.17	39.95	35.71	30.84
N2	Day	Meas005	20/10/2021 15:20	00:15:00	60.47	65.65	63.42	62.05	63.23	60.51	59.27	57.47	55.28	53.09	52.28	51.47	51.23	50.67	51.57	51.56	52.65	54.43	56.1	55.93	53.84	50.65	46.26	41.46	37.28	33.24	32.95	30.41	27.57	22.2	17.81	15.6	11.21

dB L90 Measurement Data

Location	Period	Measurement	Start Time	Elapsed Time	LZ90 12.5Hz	LZ90 16Hz	LZ90 20Hz	LZ90 25Hz	LZ90 31.5Hz	LZ90 40Hz	LZ90 50Hz	LZ90 63Hz	LZ90 80Hz	LZ90 100Hz	LZ90 125Hz	LZ90 160Hz	LZ90 200Hz	LZ90 250Hz	LZ90 315Hz	LZ90 400Hz	LZ90 500Hz	LZ90 630Hz	LZ90 800Hz	LZ90 1 kHz	LZ90 1.25 kHz	LZ90 1.6 kHz	LZ90 2 kHz	LZ90 2.5 kHz	LZ90 3.15 kHz	LZ90 4 kHz	LZ90 5 kHz	LZ90 6.3 kHz	LZ90 8 kHz	LZ90 10 kHz	LZ90 12.5 kHz	LZ90 16 kHz	LZ90 20 kHz
N1	Day	Meas004	20/10/2021 14:59	00:15:00	57.3	60.25	61.09	61.71	62.39	62.95	65.1	67.68	66.4	64.64	63.75	62.21	63.16	63.79	63.49	64.38	66.25	69.42	72.71	73.46	72.46	70.31	66.3	61.45	57.16	52.64	47.36	42.9	38	33.11	28.33	22.61	15.18
N2	Day	Meas005	20/10/2021 15:20	00:15:00	53.41	56.28	56.19	55.49	56.98	54.61	53.54	52.74	50.49	48.69	48.25	47.64	47.32	47.07	47.33	47.59	48.97	51.52	54.14	54.16	52.05	48.83	44.1	38.78	33.66	28.1	22.14	17.24	13.1	10.13	9.09	8.37	8.17

SONITUS SYSTEMS

Statement of Calibration

Issued to:

Allegro Acoustics
South City Business Park
C1
Tallaght
Dublin 24

Calibration Reference
SLM200090

Test Date: 13/03/2020
Procedure: TP-SLM-1

Equipment

Item Calibrated:	Sound Level Meter	**Model**	Type 2250
Make:	Bruel & Kjaer	**Serial Number:**	2722891

Calibration Procedure

The sound level meter was allowed to stabilize for a suitable period, as described in the manufacturer's instruction manual, in laboratory conditions. The sound level meter was calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), Periodic tests, specification of sound level meters. Tolerances for verification procedures are specified in IEC 61672-1 (2003).

Calibration Standards

Description	Serial Number
National Instruments PXI-4461	19C91D2
Stanford Research DS360	123803

The standards used in this calibration are traceable to NIST and/or other National Measurement Institutes (NMI's) that are signatories of the International Committee of Weights and Measures (CIPM) mutual recognition agreement (MRA).

Signed on behalf of Sonitus Systems:

SONITUS SYSTEMS

Certificate of Calibration

Issued to:

Allegro Acoustics Ltd
South City Business Park
C1
Tallaght
Dublin 24

Certificate Number

AC200092

Test Date: 19/05/2020

Equipment Information

Item Calibrated:	Acoustic Calibrator	**Model:**	Type 4231
Make:	Bruel & Kjaer	**Serial Number:**	2725165

Calibration Procedure

The above calibrator was verified in line with the requirements of BS EN 60942:2003. The calibrator was allowed to stablize for a suitable period, as described in the manufacturer's instruction manual, in laboratory conditions. The sound pressure level in the cavity (half-inch). The operating frequency and signal distortion were also measured.

Calibration Standards

Description	Serial Number
National Instruments PXI-4461	19C91D2
GRAS 42AA Pistonphone	227947
GRAS 46A0 Pressure Field Microphone	228216

The standards used in this calibration are traceable to NIST and/or other National Measurement Institutes (NMI's) that are signatories of the International Committee of Weights and Measures (CIPM) mutual recognition agreement (MRA).

Signed on behalf of Sonitus Systems:

Appendix B

SoundPLAN Predicted Noise Levels

Rathcoole Housing Development Validation Noise Levels 2

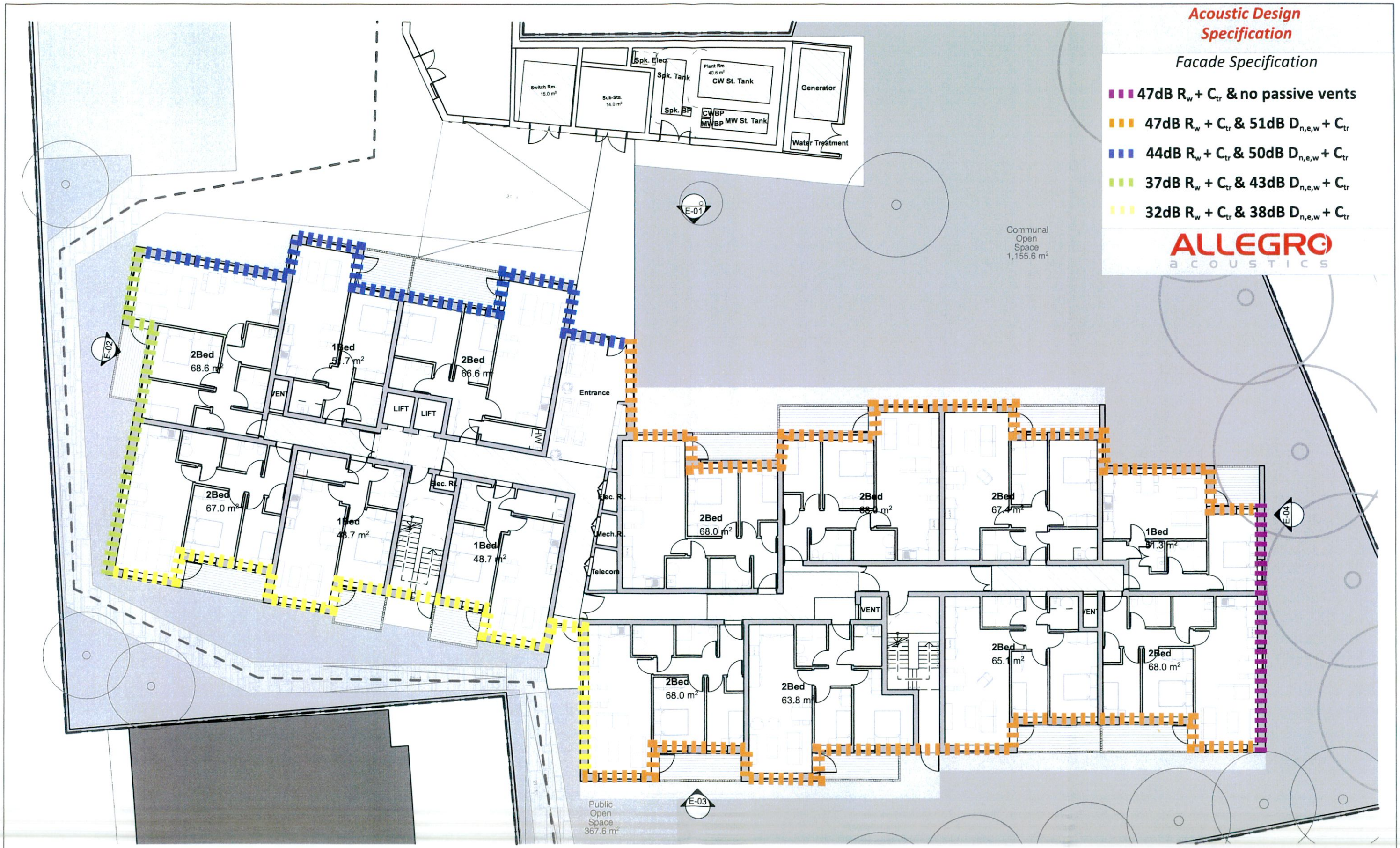
Receiver	Fl	Lden dB(A)	Ld dB(A)	Le dB(A)	Ln dB(A)	
Val R1	GF	86.7	83.8	82.8	78.6	
Val R2	GF	64.4	61.6	60.6	56.4	

Rathcoole Housing Development Predicted Facade Noise Levels 2

Receiver	Fl	Lden dB(A)	Ld dB(A)	Ln dB(A)	
R1	GF	72.1	69.3	64.1	
	F 1	73.2	70.3	65.1	
	F 2	74.3	71.4	66.2	
	F 3	75.0	72.1	66.9	
R2	GF	76.3	73.4	68.2	
	F 1	77.5	74.6	69.4	
	F 2	78.0	75.1	69.9	
	F 3	78.4	75.6	70.4	
R3	GF	81.7	78.8	73.6	
	F 1	82.2	79.3	74.1	
	F 2	82.3	79.5	74.3	
	F 3	82.5	79.6	74.4	
R4	GF	81.1	78.2	73.1	
	F 1	81.6	78.7	73.5	
	F 2	81.7	78.9	73.7	
	F 3	81.8	78.9	73.8	
R5	GF	75.0	72.1	66.9	
	F 1	76.1	73.2	68.0	
	F 2	76.6	73.8	68.6	
	F 3	77.1	74.2	69.0	
R6	GF	61.5	58.7	53.5	
	F 1	62.1	59.2	54.0	
	F 2	62.7	59.9	54.7	
	F 3	63.4	60.6	55.4	
R7	GF	66.1	63.2	58.0	
	F 1	66.7	63.8	58.6	
	F 2	67.5	64.7	59.5	
	F 3	68.1	65.2	60.0	
Val R1	GF	86.7	83.8	78.6	
Val R2	GF	64.4	61.6	56.4	

Appendix C

Façade Specification Markup



REVISION	STAGE	DATE	NOTES

NORTH

S SURVEY SK SKETCH CN CONSTRUCTION
PL PLANNING T TENDER SS SUPERCEDED

Figured dimensions only to be taken from this drawing - All dimensions to be checked onsite
Discrepencies to be brought to the attention of this office before commencement of work.

NOTES:

FINAL WINDOW LOCATIONS TBC

0 1 2 3 4 5 6 7 8 9 10

DRAFT

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CLIENT: RUSHMORE DEVELOPMENTS LTD

JOB NO: 2001

JOB TITLE: RATHCOOLE HOUSING
NEWCASTLE ROAD
RATHCOOLE
DUBLIN 24

DWG NO: RATH A2-20

DRAWING TITLE: PROPOSED GROUND FLOOR PLAN

PHASE: -

REV NO

STAGE	SCALE	AUTHOR	DATE
PLANNING	1:200 @ A3	MC	09/11/2021

depiction of "Ctr" after the $D_{n,e,w}$ indicator is in reference to the Road Traffic Noise spectrum. The $D_{n,e,w\ (Ctr)}$ value is typically lower than the standalone $D_{n,e,w}$ value due to the lower frequency nature of Road Traffic Noise.

NR, Noise *Rating*: This indicator refers to the noise level in a room. This is a dB value and is based on a set of ISO derived NR Curve values. This indicator is commonly used to set a limit for or assess air management system noise in a building. The typical relationship between the measured L_{Aeq} and NR for typical building services noise is $L_{Aeq} \approx NR + 5dB$.

RT, *Reverberation Time:* The Reverberation Time or RT is a measure of "echo" in a room and is defined as the length of time taken for a sound to drop by 60dB in a room. This is measured by generating a loud sound in a room and measuring the first 20dB or 30dB of decay across the relevant frequency range. Typically, rooms designed for speech exhibit shorter RT values to accommodate a sharpening of syllabic and phonetic sounds. Rooms designed for music tend to exhibit longer RT values to suit musical ambience.

Reverberation Time, T_{mf} (s): The T_{mf} parameter refers only to the mid frequency (typical speech frequency range) Reverberation Time values (RT) from 500Hz to 2k Hz. The single figure T_{mf} value is an average of measured Reverberation Time (RT) values at each frequency band from 500Hz to 2k Hz.

Environmental Noise

L_{A10}: The A-weighted noise level that is equaled or exceeded for 10% of the measurement period. This is typically used to indicate the noise level due to intermittent, frequent noise events such as the road traffic noise level at a location.

L_{A90}: The A-weighted noise level that is equaled or exceeded for 90% of the measurement period. This is typically used to indicate the background noise level at a location.

Noise Sensitive Receptor: A noise sensitive receptor is regarded as any dwelling house, hotel or hostel, health building, educational establishment, places of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

Tone: A noise with a narrow frequency composition identified in ISO 1996 [10] as where the sound pressure level in any given third octave band is equal to or in excess of 5dB above the sound pressure levels in both adjacent one third octave bands.

$L_{Ar,T}$: *Rating level:* The specific noise level from a facility plus adjustment for the characteristic features of the noise (according to the definition as set out in NG4 [11].

General

dB(A): Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sound of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with human perception of loudness whereby a 10dB increase / decrease is generally perceived as a doubling / halving in loudness respectively.

L_{Aeq}, *Equivalent Continuous A-weighted Sound Level*: The continuous steady noise level, which would have the same total A-weighted acoustic energy as the real fluctuating noise measured over the same period of time. *Relationship between L_{Aeq} and NR: $L_{Aeq} \approx NR + 5$*

L_{Amax}, Maximum A-weighted instantaneous noise level that is measured throughout a noise measurement. In the case of road traffic for example, the L_{Amax} is representative of the noise level due to a passing vehicle at the closest / loudest point.

1/3rd Octave Band: For simplicity, the frequency spectrum is sub divided into bands of one third of an octave each. An octave is taken to be the frequency interval, the upper limit of which is twice the lower limit (in Hertz).

Ambient Noise: Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

Building Acoustics & Sound Insulation

$D_{nT,w}$, *Weighted Standardised Level Difference*: This is a measure of the level of airborne sound insulation provided by the built element between two rooms whereby higher values represent better airborne sound insulation. The $D_{nT,w}$ value is the single number quantity for the airborne sound insulation rating calculated according to ISO 717:1 [5]. The $D_{nT,w}$ performance is verified by carrying out airborne sound insulation testing as outlined in ISO 16283-1 [6].

R_w, *Sound Reduction Index*: This is a measure of sound insulation provided by an individual element (such as a specific wall partition, door or window) when the element is tested in an acoustic testing laboratory. The R_w must be determined by testing in accordance with ISO 10140-1 [7]. The depiction of "Ctr" after the R_w indicator is in reference to the Road Traffic Noise spectrum. The $R_{w\,(Ctr)}$ value is typically lower than the standalone R_w value due to the lower frequency nature of Road Traffic Noise.

C_{tr}, *Traffic Noise Adaptation Term*: this adaptation term accounts for the influence that the low frequency noise components associated with urban traffic have on the Sound Insulation performance of a structural component such as glazing or trickle vents.

$L_{n,w}$, *Weighted Normalized Impact Sound Pressure Level: This is a l*aboratory measurement of sound performance of a building element floor. There is no flanking (indirect) transmission loss, so only the element under test needs to be considered.

$L'_{nT,w}$ (or L_w), *Weighted Standardised Impact Sound Pressure Level*: This is a field measurement of the level of impact sound insulation provided by a floor structure whereby lower values represent better impact sound insulation. The L_w value is the single number quantity for the impact sound insulation rating, in decibels, of the reference curve at 500Hz after shifting it in accordance with the method specified in ISO 717:2 [8]. The $L'_{nT,w}$ performance is verified by carrying out impact sound insulation testing to ISO 140-7 [9].

$D_{n,e,w}$, *Element Normalised Level Difference:* This is a measure of the sound insulation provided by a building element and is typically used in reference to trickle vents. The

Appendix D

Glossary of Noise Terminology