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CERTIFICATE OF PERFORMANCE

IMPACT SOUND INSULATION

KRADAL FLOORING

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IMPACT SOUND INSULATION

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1.0 CONSULTANT'S BRIEF

Koikas Acoustics was requested by Kradal to conduct impact noise tests of a:

- **12 mm composite vinyl**

floor system.

A total of one (1) test was conducted which included the base ceiling/floor system with reinforced concrete slab and suspended ceiling.

The purpose of undertaking these impact noise tests was to quantify the acoustic performance of the flooring systems.

Test results were compared to the acoustic requirements of *Part F5 of BCA (Building Codes of Australia)* and the standards prescribed by the *Association of Australasian Acoustical Consultants (AAAC)*.

All measurements were carried out as per the guidelines and procedures outlined in:

- *AS/NZS ISO 140.7:2006 "Field measurements of impact sound insulation of floors" and* the rating determined, and as per
- *AS ISO 717.2-2004 "Rating of sound insulation in buildings and of building elements"*.

2.0 IMPACT NOISE COMPLIANCE TESTING

2.1 PARTITION SYSTEM

Koikas Acoustics has been advised that the ceiling/floor system between the residential units is constructed with the following building materials:

- Approximately 200 mm thick concrete slab;
- 80~150 mm deep suspended ceiling cavity, and
- 13 mm thick standard plasterboard ceiling.

Hereafter referred to as the "*existing ceiling/floor system*" (ECFS).

The tests were conducted with the following floor covering in conjunction with the selected flooring over the ECFS:

- Test 00: Bare concrete floor (ECFS only) – *for comparison purposes only*
- Test 01: 12 mm composite vinyl flooring

2.2 ASSESSMENT PROCEDURES & MEASUREMENTS

The impact noise tests were taken within residential flat units in Sydney, NSW on Tuesday, 29th March 2022.

Spectrum sound level measurements of transmitted impact noise were recorded in 1/3 octave band centre frequencies between 50 and 10,000 Hertz.

A standardised BSWA Technology Co. Type TM002 S/N 440504 Tapping Machine was used to generate the sound field in the source rooms for the impact noise test. Impact noise measurements were carried out per the recommendations of *AS/NZS ISO 140.7:2006 "Field measurements of impact sound insulation of floors"*. This document provides information on appropriate measurement equipment and the proper implementation of measurement practices to achieve reliable results of impact sound insulation between rooms in buildings.

For determining a single number quantity for impact sound insulation between rooms in buildings

when measurements are conducted "in-situ", $L'_{nT,w}$ (weighted standardised impact sound pressure level), the relevant standard is *AS/NZS ISO 717.2-2004 "Impact sound insulation".* The calculated $L'_{nT,w}$ derived from applying the formulae in this standard allows for a comparison between these calculated levels and the nominated acceptable levels outlined in the *Verification Methods* of the *Building Code of Australia (BCA).*

2.3 AMBIENT BACKGROUND NOISE MEASUREMENT

A measure of the underlying ambient noise was taken in the receiving rooms to account for the perceived noise in the space. Inaccuracies in the measurements and calculations can occur in areas of high ambient noise however the location of the site and receiver rooms meant little ambient noise was evident in this case. Ambient noise levels in each 1/3 octave frequency band were measured to take into account the effect of ambient noise during the recording of the transmitted impact noise levels.

2.4 REVERBERATION TIME MEASUREMENTS

To determine the $L_{nT,w}$ reverberation time measurements need to be performed in the receiving rooms. The reverberation time in the receiver room is calculated to 'standardise' the airborne/impact noise transmission measurements to reference reverberation time of 0.5 seconds as required by AS/NZS ISO 140.7:2006 Section 3.4.

Reverberation time measurements were conducted using the impulse-source method. This consisted of averaging the sound level decay time associated with several large balloon bursts within the receiver room. This transient response was analysed by the sound level meter and a measure of the reverberation time in 1/3 octave bands was used to calculate the standardised impact noise rating.

2.5 INSTRUMENTATION AND CALIBRATION

NTi XL2 precision spectrum analyser S/N A2A-19160-E0 was used for all measurements (impact noise, ambient noise, reverberation). The equipment used for taking noise level measurements is traceable to NATA certification. Field calibrations were taken before and after the impact noise measurements with a NATA calibrated pistonphone. No system drifts were observed.

3.0 IMPACT NOISE REQUIREMENTS

3.1 BCA REQUIREMENT

For verification of the impact noise rating for floors, Part FV5.1 (b) of the latest update of the Building Code of Australia (BCA) 2019 states:

Impact: a weighted standardised impact sound pressure level ($L_{nT,w}$) not more than 62 when determine under AS ISO 717.2

3.2 AAAC STAR RATING PERFORMANCE REQUIREMENTS

Reproduced from the Association of Australasian Acoustical Consultants (AAAC) Guideline for Apartment and Townhouse Acoustic Ratings, the following Table (Section C) describes the acoustic ratings regarding the Star Rating System.

Table 1. Star Rating requirements for Inter-tenancy Activities – Published by the AAAC

INTER-TENANCY ACTIVITIES	2 Star	3 Star	4 Star	5 Star	6 Star
(c) Impact isolation of floors					
- Between tenancies $L_{nTw} \leq$	65	55	50	45	40
- Between all other spaces & tenancies $L_{nTw} \leq$	65	55	50	45	40

Note, Koikas Acoustics is of the understanding that the impact noise ratings in Table 1 infer L'_{nTw} and not L_{nTw}. L_{nTw} is an impact noise rating derived from tests undertaken in a laboratory and L'_{nTw} is derived from field tests.

4.0 MEASURED RESULTS

The results of the impact noise tests are summarised in Table 2 below.

Table 2. Impact noise insulation performance summary for tested ceiling/floor Systems			
System Tested[1]	**L'_{nTw}[3]**	**FIIC[4,5]**	**AAAC[6]**
Test 00: Bare concrete floor (ECFS only) – *for comparison purposes only*	60	44	2
Test 01: 12 mm composite vinyl flooring	42	64	5

Detailed calculations of the partition system's impact noise insulation of the ceiling/floor systems are attached as **Appendix A**.

The following are also noted:

1. All tests were undertaken with the existing ceiling/floor system consisting of between 200 mm thick concrete sub-base with approximately 80~150 mm suspended ceiling cavity and one layer of 13 mm thick plasterboard ceiling.

2. The tested flooring systems as listed in Table 2 (Test 01) have met both the BCA 2019 minimum requirement ($L_{nT,w} \leq 62$) and the AAAC Star rating of 5 for impact noise insulation.

3. The lower the $L'_{nT,w}$ rating the better the impact insulation.

4. The relation between Field Impact Insulation Class (FIIC) and Impact Insulation Class (IIC) can be described by the formula FIIC + 5 ≈ IIC.

5. The higher the IIC and FIIC the better the impact insulation.

6. The higher the AAAC Star Rating the better the impact insulation.

7. The information contained herein should not be reproduced except in full.

8. The information provided in this report relates to acoustic matters only. Supplementary advice should be sought for other matters relating to flooring installation, construction, design, structural, fire-rating, waterproofing, and the likes.

9. Product installation details and methodologies must be sought from the product supplier, installer, or other experts. Koikas Acoustics is not liable for any product defects.

10. The acoustic ratings provided in this report are indicative of a 1 m^2 sample and should be used for comparative purposes only. Acoustic ratings will vary depending on the testing environment/conditions including, materials/structures of the existing ceiling/floor system, room volume, internal layout, and workmanship. Even with the same testing environment, acoustic ratings can vary from room to room and between buildings as no two buildings are identical. A fully laid flooring system typically presents a lower acoustical rating, i.e. up to 3 rating points less. For example, where the flooring is system is quantified with a 1 m^2 sample as being L'_{nTw} 45 when the same flooring is laid from wall to wall, the acoustical rating could reduce up to L'_{nTw} 48.

11. Where possible, floor coverings are not make contact with any walls or joineries (kitchen benches, cupboards etc). Where the vinyl top layer makes contact with the walls or any joinery, the acoustic performance may be slightly reduce, though Koikas Acoustics notes that due to the flexibility of the vinyl, any reduction in performance is likely to be small, and may be negligible in certain settings.

    Where it is possible to isolate the floor coverings, the following procedure is recommended. During the installation of any hard floor coverings, temporary spaces of 5~10mm should be used to isolate the floor covering from walls and/or joineries and the resulting gaps should be filled with a suitable mastic type sealant or off-cut of underlay or the equivalent where available.

5.0 CONCLUSION

Koikas Acoustics was requested by Kradal Flooring to undertake impact noise tests of the **12 mm composite vinyl** flooring system. The acoustic performances were calculated and compared against the acoustic requirements of the current BCA and AAAC Star Ratings that are commonly used in Australia.

The calculated acoustic rating of the tested flooring system is summarised and presented in **Table 2** of this report. A detailed test certificate is provided in **Appendix A**.

The acoustic ratings provided in this report are indicative and for comparative purposes only. Acoustic ratings will vary depending on the testing environment/conditions including, materials/structures of the existing ceiling/floor system, room volume, internal layout, and workmanship. Even with the same testing environment/conditions, acoustic ratings would still vary from building to building.

It is recommended that in-situ testing be conducted before any full fit-out as the sub-base ceiling/floor system and the wall junctions could impact the noise transfer to the unit below.

This report should be reproduced in full including the attached Appendix.

Where possible, floor coverings are not make contact with any walls or joineries (kitchen benches, cupboards etc). Where the vinyl top layer makes contact with the walls or any joinery, the acoustic performance may be slightly reduce, though Koikas Acoustics notes that due to the flexibility of the vinyl, any reduction in performance is likely to be small, and may be negligible in certain settings.

APPENDIX A

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FIELD MEASUREMENTS OF IMPACT SOUND INSULATION OF FLOORS

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Date of Test :	Tuesday, 29 March 2022
Project No. :	5232
Testing Company :	Koikas Acoustics
Checked by :	Nick Koikas
Place of Test:	Residential apartments in Belfield, NSW
Client	Kradal Flooring
Client Address	-

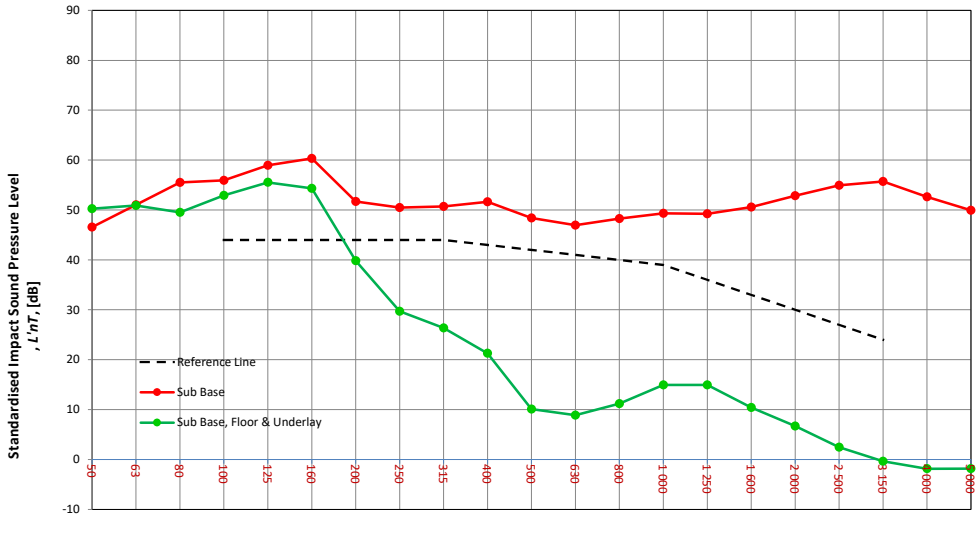
	Name	Thickness (mm	Density (Sl)
Description of Floor System	Composite flooring	12	--
	Concrete slab	180-200	--
	Suspended ceiling	80-150	--
	0	--	--

Room Floor Dimensions	Width :	5	m
	Length :	8	m
	Area :	40.00	m^2
Sample Dimensions	Width :	1	m
	Length :	1	m
	Area :	1	m^2

	Location	Width	Length	Area	Height	Volume
Receiver Rm	en/Dining/Living directly t	5	8	40.00	2.7	108.00

Room Surfaces		
Walls	Floor	Ceiling
Plasterboard	Timber	Plasterboard

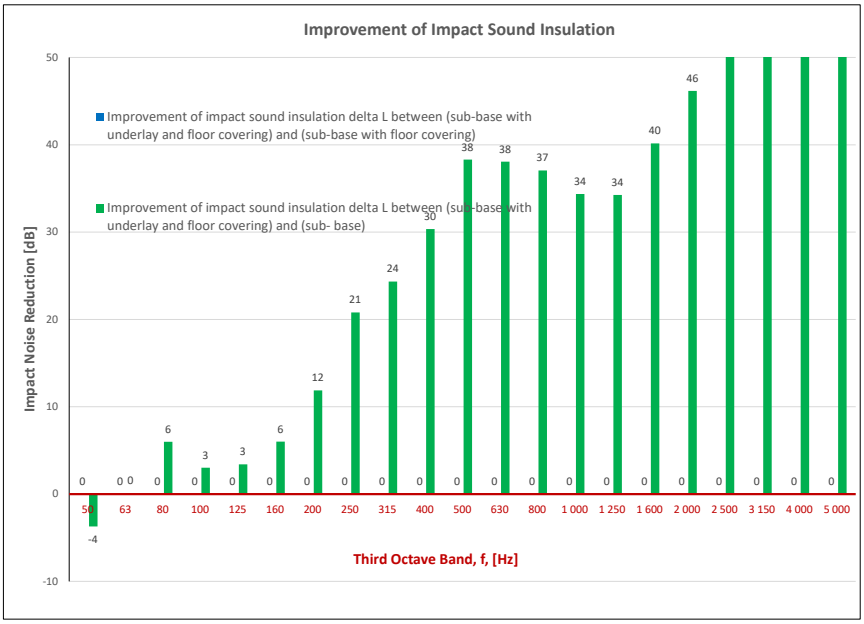
Frequency f Hz	L'nT (one-third octave) dB		
	Sub Base	Sub Base Floor	Sub Base Floor Underlay
50	46.6	N/A	50.3
63	51.0	N/A	50.9
80	55.5	N/A	49.5
100	55.9	N/A	52.9
125	58.9	N/A	55.5
160	60.3	N/A	54.3
200	51.7	N/A	39.8
250	50.5	N/A	29.7
315	50.7	N/A	26.3
400	51.6	N/A	21.3
500	48.4	N/A	10.1
630	46.9	N/A	8.9
800	48.3	N/A	11.2
1 000	49.3	N/A	14.9
1 250	49.2	N/A	15.0
1 600	50.6	N/A	10.4
2 000	52.9	N/A	6.7
2 500	54.9	N/A	2.5
3 150	55.7	N/A	-0.4
4 000	52.6	N/A	-1.9
5 000	49.9	N/A	-1.8



Sub Base		
L'nT,w	60	AS ISO 717.2 - 2004
Ci	-9	AS ISO 717.2 - 2004
Ci(50-2500)	-9	AS ISO 717.2 - 2004
Ci(63-2000)	-9	AS ISO 717.2 - 2004
AAAC ★	2 Star	AAAC Guidleline
FIIC	44	ASTM E1007-14

Sub Base & Floor		
L'nT,w	N/A	AS ISO 717.2 - 2004
Ci	N/A	AS ISO 717.2 - 2004
Ci(50-2500)	N/A	AS ISO 717.2 - 2004
Ci(63-2000)	N/A	AS ISO 717.2 - 2004
AAAC ★	N/A	AAAC Guidleline
FIIC	N/A	ASTM E1007-14

Sub Base, Floor & Underlay		
L'nT,w	42	AS ISO 717.2 - 2004
Ci	2	AS ISO 717.2 - 2004
Ci(50-2500)	4	AS ISO 717.2 - 2004
Ci(63-2000)	3	AS ISO 717.2 - 2004
AAAC ★	5 Star	AAAC Guidleline
FIIC	64	ASTM E1007-14



Definitions of Noise Metrics

FIIC:

Field Impact Insulation Class is a single-number rating of how well a floor system attenuates impact type sounds, such as footsteps. Calculated from third-octave band normalised impact sound pressure level data and referenced to 10 m^2 as described in ASTM E989. The higher the single-number rating, the better its impact insulation performance.

L'nT,w:

The Weighted Standardised Impact Sound Pressure Level when measured in situ referenced to a reverberation time (RT60) of 0.5 seconds. Used by the AAAC to determine their respective Star Rating.

Ci:

Spectrum adaption term is a low frequency correction factor. Typically for massive floors such as concrete, the values are about zero while for timber joist floors Ci is positive because of the low resonant frequencies. Considers frequency range between 100 -and 2500 Hz.

Ci(50-2500):

Same as above, but for the frequency range 50 -2500 Hz.

Ci(125-2000):

Same as above, but for the frequency range 125 -2000 Hz.

AAAC Star R.	2	3	4	5	6
L'nT,w	65	55	50	45	40
FIIC	45	55	60	65	70
Comments	Below BCA 62	Clearly Audible	Audible	Barely Inaudible	Normally Inaudible