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CERTIFICATE OF PERFORMANCE

IMPACT NOISE TESTING

8 mm LIMESTONE COMPOSITE STONE FLOOR

5 mm LIMESTONE COMPOSITE STONE FLOOR

1.5 mm EVA UNDERLAY

NEW OZ BUILDING MATERIALS GROUP

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Approved by	Michael Fan Chiang, MAAS  Consultant
Client	New Oz Building Materials Group Attention: Anthony E-mail: newoz@bigpond.net.au

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1.0 CONSULTANT'S BRIEF

Koikas Acoustics was requested by New Oz Building Materials Group to conduct impact noise test on the 5 mm and 8 mm limestone composite stone floor in conjunction with 1.5 mm EVA underlay.

The purpose of undertaking these impact noise tests was to quantify the acoustic performance of the stone flooring systems (including underlay) over the sub base being concrete with suspending ceiling.

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 Australian Acoustical Consultants (AAAC)***.

All measurements were carried out in accordance with the guidelines and procedures outlined in ***AS/NZS ISO 140.7:2006 "Field measurements of impact sound insulation of floors"*** with the rating determined in accordance with ***AS ISO 717.2-2004 "Rating of sound insulation in buildings and of building elements"***.

2.0 IMPACT NOISE COMPLIANCE TESTING

The impact noise tests were taken within a residential flat unit development in Hurstville NSW.

2.1 PARTITION SYSTEM

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

- 200 mm thick concrete slab;
- Approximately 80~120 mm deep suspended ceiling cavity, and
- 13 mm thick plasterboard ceiling.

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

The test was conducted over the ECFS described above with the following floor coverings:

- Test 01: 8 mm Limestone Composite Stone Floor + 1.5 mm EVA underlay
- Test 02: 5 mm Limestone Composite Stone Floor + 1.5 mm EVA underlay

2.2 IMPACT NOISE CRITERION

2.2.1 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) 2016 states:

Impact: a weighted standardised impact sound pressure level with spectrum adaptation term ($L_{n'Tw'}$) not more than 62 when determine under AS/ISO 717.2

2.2.2 AAAC Star Rating Performance Requirements

Reproduced from the Association of Australian Acoustical Consultants (AAAC) Guideline for Apartment and Townhouse Acoustic Ratings, the following Table (Section C) describes the acoustic ratings with reference to 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

2.3 ASSESSMENT PROCEDURES & MEASUREMENTS

The testing of the ceiling/floor system with the 5 mm and 8 mm limestone composite stone floor laid over the 1.5 mm EVA underlay were conducted inside the unfurnished living/dining area from one residential unit (upper floor level) to another unit (lower floor level) directly below within a residential building in Hurstville NSW on Friday, 2nd November 2018.

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 in accordance with 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 so as 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)***.

2.3.1 *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 bands were measured to take into account the effect of ambient noise during the recording of the transmitted impact noise levels.

2.3.2 *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, and AS ISO 140.4-2006 Section 3.4.

Reverberation time measurements were conducted using the balloon source method. This consisted of bursting a large balloon and measuring the decay of sound pressure level using a spectrum analyser. 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.

2.3.3 *Instrumentation and Calibration*

NTi XL2 Type Approved (TA) precision spectrum analyser S/N A2A-06312-E0 was used to measure the impact noise levels. 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.

2.4 MEASURED RESULTS

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

Table 2. Impact Noise Insulation Performance Summary for Ceiling/Floor System

System Tested	L'_{nTw}[3]	Equivalent AAAC[5] Star Rating	FIIC[4,6]
Bare concrete floor (ECFS[1] only), for comparison purpose only	56	2	44
Test 01: 8 mm Limestone Composite Stone Floor + 1.5 mm EVA underlay + ECFS[1]	43	5	64
Test 02: 5 mm Limestone Composite Stone Floor + 1.5 mm EVA underlay + ECFS[1]	41	5	64

Detail 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 (ECFS) consisting of 200 mm thick concrete sub-base with inclusion of approximately 80~120 mm suspended ceiling cavity and one layer of 13 mm thick plasterboard ceiling.

2. The 5 mm and 8 mm limestone composite stone floor in conjunction with the 1.5 mm EVA

underlay (Test 01 & Test 02) over the existing ceiling/floor system (ECFS) have met both the BCA 2016 criterion ($L'_{nTw} \leq 62$) and the AAAC Star rating of 5 for impact noise insulation.

3. The lower the rating number the better the acoustic performance for L_{nTw} ratings. It is anticipated that the $L'_{nTw} + 5 \approx L_{nTw}$.

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 AAAC Star Rating the better the impact insulation.

6. The higher the IIC and FIIC 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, water proofing, and the likes.

9. Product installation details and methodologies must be sought from 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 and for comparative purpose 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 environmental, acoustic ratings can vary from room to room and so buildings to buildings as no two buildings are identical.

11. Floor covering must not make contact with any walls or joineries (kitchen benches, cupboards etc). During installation of any hard floor coverings, temporary spaces of 5~10mm should be used to isolated 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. Acoustic ratings could be degraded if the above precautions and treatments are not implemented.

3.0 CONCLUSION

Koikas Acoustics was requested by New Oz Building Materials Group to undertake impact noise test of the 5 mm and 8 mm Limestone Composite Stone Floor in conjunction with the 1.5 mm EVA underlay. The acoustic performances of composite stone flooring were calculated and compared against the acoustic requirements of the current BCA and AAAC Star Ratings which are commonly used in Australia.

The calculated acoustic rating of the tested flooring system was summarised and presented in **Table 2** of this report. Detailed graphically presentation of the acoustic performance of the tested flooring is attached as **Appendix A**.

The acoustic ratings provided in this report are indicative and for comparative purpose 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 buildings to buildings.

It is recommended that testing be conducted prior to any full fit-out as the sub-base ceiling floor system and the wall junctions can impact upon the resultant flanking noise in the unit below.

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

Floor covering must not make contact with any walls or joineries (kitchen benches, cupboards etc). During installation of any hard floor coverings, temporary spaces of 5~10mm should be used to isolated 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. Acoustic ratings could be degraded if the above precautions and treatments are not implemented.

APPENDIX A

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FIELD MEASUREMENTS OF IMPACT SOUND INSULATION OF FLOORS (Test 01)

Date of Test :	Tuesday, 23 October 2018
Project No. :	3252
Testing Company :	Koikas Acoustics
Checked by :	Nick Koikas
Place of Test:	Residential flat unit in Hurstville NSW
Client	New Oz Building Materials Group
Client Address	-

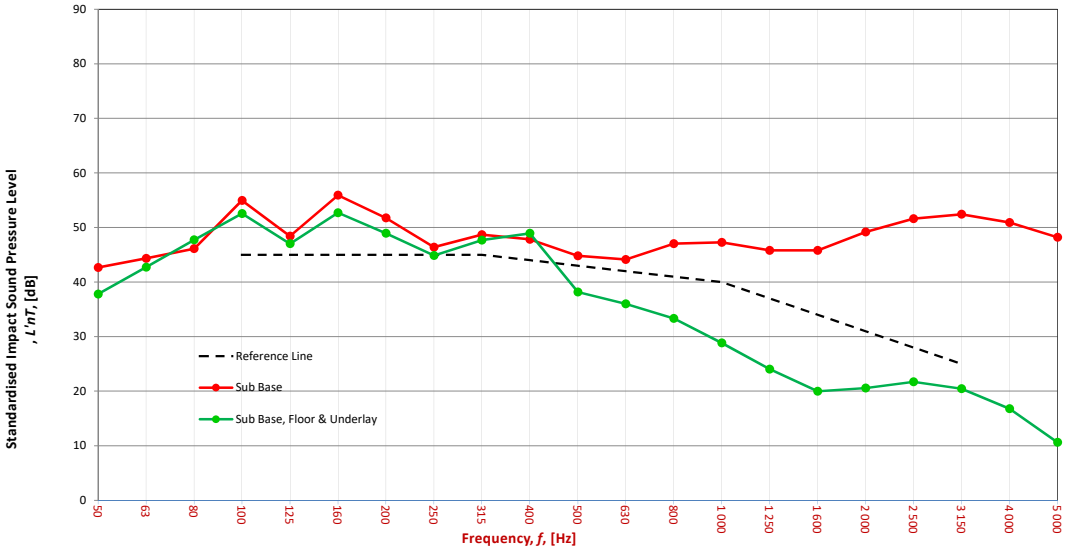
	Name	Thickness (mm)	Density (SI)
Description of Floor System	8mm Limestone Composite Stone Floor	8	--
	1.5mm EVA acoustic underlay	1.5	--
	200 mm reinforced concrete slab	200	--
	80~120 mm suspended ceiling cavity + 13 mm plasterboard ceiling	80~120 + 13	--

Room Floor Dimensions	Width :	6	m
	Length :	4	m
	Area :	24	m^2
Sample Dimensions	Width :	1	m
	Length :	1	m
	Area :	1	m^2

	Location	Width	Length	Area	Height	Volume
Receiver Rm	Unit 301 living	6	4	24	2.4	57.6

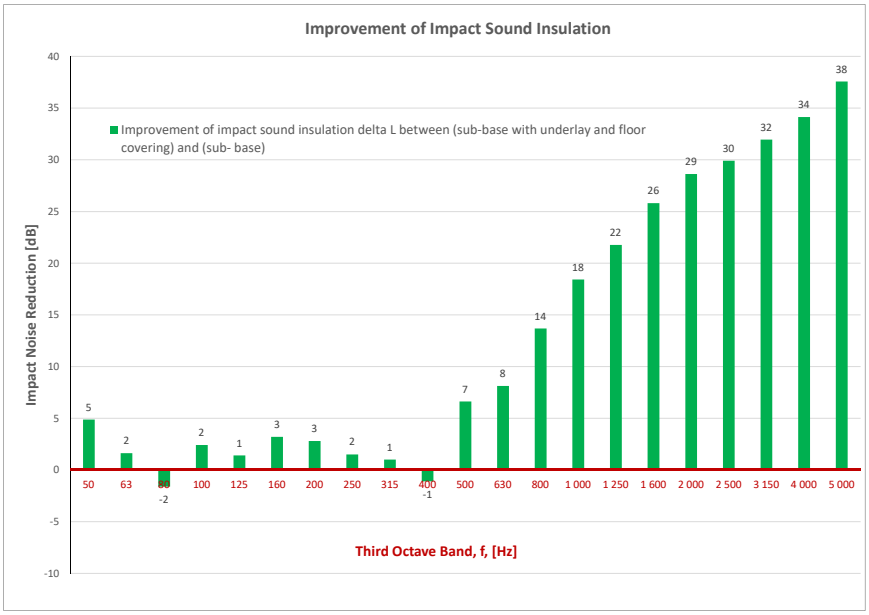
Room Surfaces		
Walls	Floor	Ceiling
Concrete/plasterboard	Carpet (covered with plastic sheets)	Plasterboard

Frequency f Hz	L'nT (one-third octave) dB		
	Sub Base	Sub Base Floor	Sub Base Floor Underlay
50	42.7	35.0	37.8
63	44.3	42.4	42.7
80	46.1	46.4	47.7
100	55.0	50.1	52.5
125	48.4	46.9	47.0
160	55.9	51.3	52.7
200	51.7	47.7	48.9
250	46.4	43.5	44.9
315	48.7	47.7	47.7
400	47.8	48.3	48.9
500	44.8	43.4	38.2
630	44.1	37.4	36.0
800	47.0	33.6	33.3
1 000	47.3	30.5	28.8
1 250	45.8	24.7	24.0
1 600	45.8	22.7	20.0
2 000	49.2	24.3	20.6
2 500	51.6	23.8	21.7
3 150	52.4	21.9	20.5
4 000	50.9	18.9	16.8
5 000	48.2	14.9	10.6



Sub Base (Test 00)		
L'nT,w	56	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 & Underlay (Test 01)		
L'nT,w	43	AS ISO 717.2 - 2004
Ci	0	AS ISO 717.2 - 2004
Ci(50-2500)	1	AS ISO 717.2 - 2004
Ci(63-2000)	1	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

FIELD MEASUREMENTS OF IMPACT SOUND INSULATION OF FLOORS (Test 02)

KOIKAS ACOUSTICS PTY LTD

Date of Test :	Tuesday, 23 October 2018
Project No. :	3252
Testing Company :	Koikas Acoustics
Checked by :	Nick Koikas
Place of Test:	Residential flat unit in Hurstville NSW
Client	New Oz Building Materials Group
Client Address	-

	Name	Thickness (mm)	Density (SI)
Description of Floor System	5mm Limestone Composite Stone Floor	5	--
	1.5mm EVA Foam acoustic underlay	1.5	--
	200 mm reinforced concrete slab	200	--
	80~120 mm suspended ceiling cavity + 13 mm plasterboard ceiling	80~120 + 13	--

Room Floor Dimensions	Width :	6	m
	Length :	4	m
	Area :	24	m^2
Sample Dimensions	Width :	1	m
	Length :	1	m
	Area :	1	m^2

	Location	Width	Length	Area	Height	Volume
Receiver Rm	Unit 301 living	6	4	24	2.4	57.6

Room Surfaces		
Walls	Floor	Ceiling
Concrete/plasterboard	Carpet (covered with plastic sheets)	Plasterboard

Frequency f Hz	L'nT (one-third octave) dB		
	Sub Base	Sub Base Floor	Sub Base Floor Underlay
50	42.7	40.3	40.4
63	44.3	44.7	43.6
80	46.1	47.9	43.5
100	55.0	52.2	49.8
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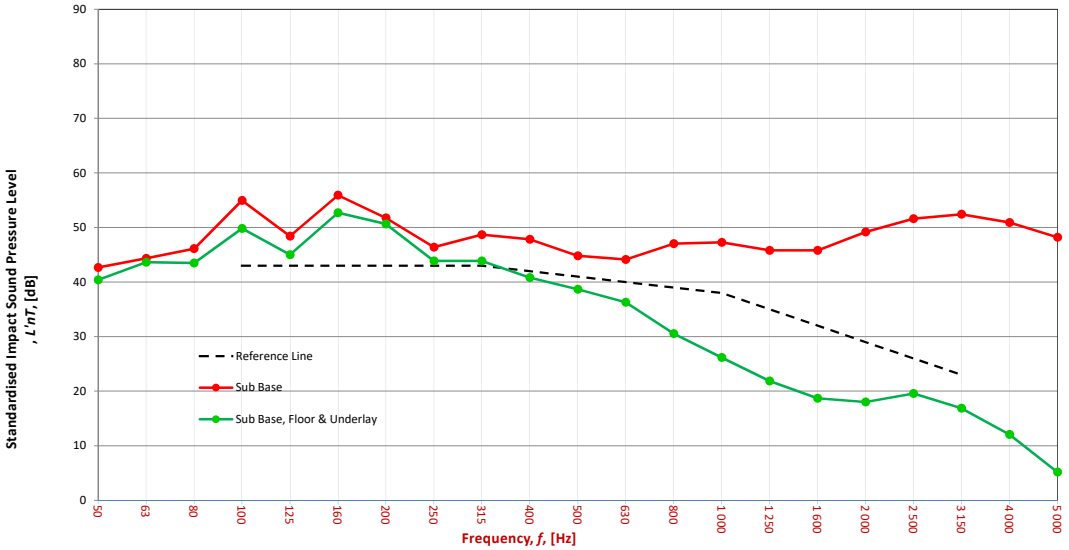

Sub Base (Test 00)		
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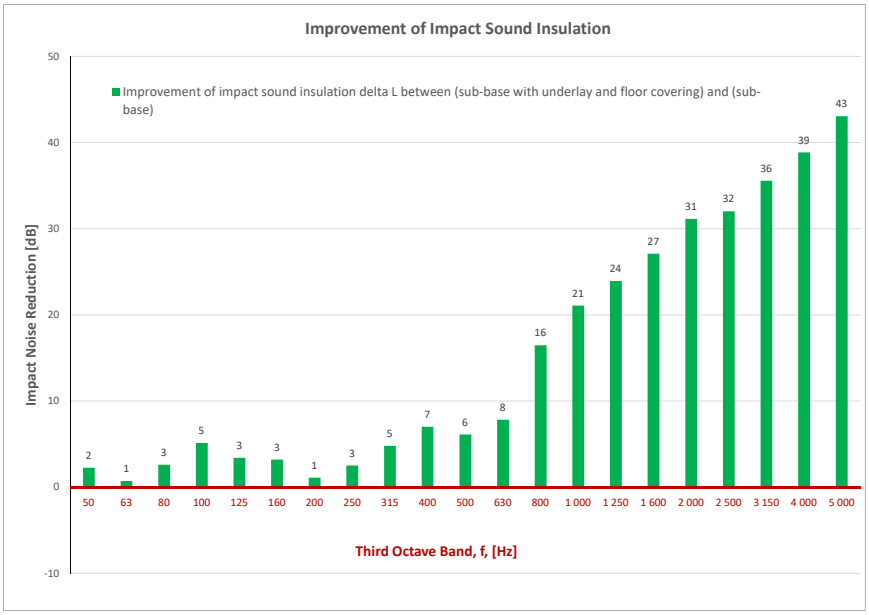
Ci(50-2500)	-9	AS ISO 717.2 - 2004
Ci(63-2000)	-9	AS ISO 717.2 - 2004
AAAC★	2 Star	AAAC Guidleline
FIIC	44	ASTM E1007-14

Sub Base, Floor & Underlay (Test 02)		
L'nT,w	41	AS ISO 717.2 - 2004
Ci	1	AS ISO 717.2 - 2004
Ci(50-2500)	1	AS ISO 717.2 - 2004
Ci(63-2000)	1	AS ISO 717.2 - 2004
AAAC★	5 Star	AAAC Guidleline
FIIC	64	ASTM E1007-14



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