Opinion on Impact Insulation Rating of Batten & Cradle Flooring Systems

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Project:	**Opinion on Impact Insulation Rating of Batten & Cradle Flooring Systems**
Prepared for:	**Batten & Cradle Acoustic Flooring Ltd** **PO Box 5074** **New Plymouth 4343**
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1.0 INTRODUCTION

Marshall Day Acoustics was asked to provide an opinion on the Impact Insulation Class (IIC) rating that would be achieved by variations of the Batten and Cradle flooring system with variety of typical concrete floor constructions and ceiling types, with and without cavity insulation. This opinion is based on previous tests of the floor systems on a monolithic test slab and previous tests and computer prediction models of floor and ceiling combinations without the flooring overlay.

2.0 CONSTRUCTION

2.1 Floor build-up constructions

The floor coverings for which the opinion is provided are:

A - Batten and Cradle – Bare Floor – No Cavity Infill

- 20 mm Strandfloor tongue and groove flooring system, screw fixed at 200 mm centres to
- Dressed 42 mm x 42 mm fingerjoint timber battens spaced at 450 mm centres on
- RC-20 rubber cradles spaced at 450 mm centres
- 65 mm floor cavity with no infill

B - Batten and Cradle – Bare Floor – With Cavity Infill

- 20 mm Strandfloor tongue and groove flooring system, screw fixed at 200 mm centres to
- Dressed 42 mm x 42 mm finger joint timber battens spaced at 450 mm centres on
- RC-20 rubber cradles spaced at 450 mm centres
- 65 mm floor cavity containing 75 mm Pink Batts Silencer

C - Batten and Cradle – Tiled Floor – With Cavity Infill

- Glazed ceramic PEI 3 tiles 600 mm x 600 mm adhered with monoflex C2S2et Tile Adhesive (applied with a 10 mm notched trowel) to
- 6 mm James Hardie Tile Underlay, screw fixed to
- 20 mm Standfloor tongue and groove flooring system, screw fixed at 200 mm centres to

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- Dressed 42 mm x 42 mm finger joint timber battens spaced at 450 mm centres on
- RC-20 rubber cradles spaced at 450 mm centres
- 65 mm floor cavity containing 75 mm Pink Batts Silencer

2.2 Ceiling constructions

The plasterboard ceilings referred to in Table 1 overleaf are as follows:

- 10 mm standard Gib® on Gib Rondo or USG ScrewFix ceiling batten system, minimum 100 mm ceiling cavity,
- 13 mm standard Gib® or 2 layers of 13 mm standard Gib® as specified (minimum 300 mm ceiling cavity), USG ScrewFix steel frame suspension system comprising 2.5 mm wire hangers at 1200 mm centres supporting DJ38 strongback channels spaced at 600 mm centres maximum.installed in accordance with manufacturers recommendations.
- The perimeter of the ceiling is sealed with flexible acoustic sealant such as Gib® Soundseal.

2.3 Ceiling cavity absorption

The cavity absorption referred to in Table 1 overleaf is as follows:

- R1.8 Pink Batts, Autex Greenstuff or approved equivalent such as 75 mm thick fibreglass of minimum density 9.6 kg/m3.

3.0 TEST RESULTS

The floor build-up constructions described in Section 2.1 were tested by the University of Auckland Acoustics Testing Service (Test Reports T1006-1, T1006-2 & T1006-3 March 2010). The impact performance of the laboratory test slab was tested with and without the floor covering described.

The impcat performance of the constructions was ΔL_w 22 dB, ΔL_w 27 dB, ΔL_w 31 dB respectively.

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4.0 OPINION: BATTEN AND CRADLE – BARE FLOOR – NO CAVITY INFILL

The following table details the expected impact performance of floor system A as described in Section 2.0 with various ceiling and floor slab combinations, including whether cavity insulation is installed:

Table 1 Batten and Cradle – Bare Floor – No Cavity Infill – Impact Insulation Prediction

Ceiling		Floor									
		120 mm Hibond (average concrete thickness 90 mm)		75 mm Unispan + 75 mm topping		200 mm Dycore with 65 mm topping		135 mm Stahlton Rib and Infill (minimum concrete thickness 135 mm on 25 mm timber infills)		90 mm Interspan (minimum concrete thickness 90 mm on 25 mm timber infills)	
Thickness /layers	Cavity Insulation Present?	Impact Insulation Class	$L'_{nT,w}$ (+C_1) (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ (+C_1) (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ (+C_1) (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ (+C_1) (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ (+C_1) (See Note 1)
No plasterboard ceiling	N/A	IIC 48	62 (0) dB	IIC 53	56 (0) dB	IIC 54	54 (+1) dB	IIC 53	56 (+1) dB	IIC 48	62 (0) dB
1 x 10 mm plasterboard	No	IIC 42	63 (+2) dB	IIC 50	55 (+3) dB	IIC 51	54 (+3) dB	IIC 49	55 (+3) dB	IIC 42	63 (+2) dB
	Yes	IIC 50	52 (+5) dB	IIC 55	48 (+3) dB	IIC 56	46 (+5) dB	IIC 55	49 (+3) dB	IIC 50	52 (+5) dB
1 x 13 mm plasterboard	No	IIC 46	58 (+3) dB	IIC 54	50 (+3) dB	IIC 55	49 (+4) dB	IIC 53	51 (+3) dB	IIC 46	58 (+3) dB
	Yes	IIC 61	43 (+3) dB	IIC 68	36 (+3) dB	IIC 69	35 (+4) dB	IIC 67	38 (+2) dB	IIC 61	43 (+3) dB
2 x 13 mm plasterboard	No	IIC 50	53 (+4) dB	IIC 58	45 (+5) dB	IIC 58	45 (+4) dB	IIC 56	46 (+5) dB	IIC 50	53 (+4) dB
	Yes	IIC 65	40 (+3) dB	IIC 73	33 (+2) dB	IIC 74	31 (+3) dB	IIC 71	34 (+2) dB	IIC 65	40 (+3) dB

Notes:
1. The $L'_{nT,w}$ (+C_1) has been calculated based on a receiving room volume of 50 m^3. No allowance has been made for on-site flanking transmission.
2. Refer to Section 2.0 for construction information in relation to Table 1 above.

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5.0 OPINION: BATTEN AND CRADLE – BARE FLOOR – WITH CAVITY INFILL

The following table details the expected impact performance of floor system B as described in Section 2.0 with various ceiling and floor slab combinations, including whether cavity insulation is installed:

Table 2: Batten and Cradle – Bare Floor – With cavity Infill – Impact Insulation Prediction

Ceiling		Floor									
		120 mm Hibond (average concrete thickness 90 mm)		75 mm Unispan + 75 mm topping		200 mm Dycore with 65 mm topping		135 mm Stahlton Rib and Infill (minimum concrete thickness 135 mm on 25 mm timber infills)		90 mm Interspan (minimum concrete thickness 90 mm on 25 mm timber infills)	
Thickness /layers	Cavity Insulation Present?	Impact Insulation Class	$L'_{nT,w}$ $(+C_I)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_I)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_I)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_I)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_I)$ (See Note 1)
No plasterboard ceiling	N/A	IIC 49	57 (+2) dB	IIC 55	51 (+2) dB	IIC 56	50 (+1) dB	IIC 54	52 (+2) dB	IIC 49	57 (+2) dB
1 x 10 mm plasterboard	No	IIC 42	58 (+5) dB	IIC 50	50 (+5) dB	IIC 51	49 (+5) dB	IIC 49	50 (+6) dB	IIC 42	58 (+5) dB
	Yes	IIC 50	48 (+7) dB	IIC 56	43 (+6) dB	IIC 56	41 (+8) dB	IIC 55	44 (+6) dB	IIC 50	48 (+7) dB
1 x 13 mm plasterboard	No	IIC 46	53 (+6) dB	IIC 54	45 (+6) dB	IIC 55	44 (+7) dB	IIC 53	46 (+6) dB	IIC 46	53 (+6) dB
	Yes	IIC 62	38 (+6) dB	IIC 68	31 (+6) dB	IIC 69	30 (+6) dB	IIC 67	33 (+5) dB	IIC 62	38 (+6) dB
2 x 13 mm plasterboard	No	IIC 50	49 (+6) dB	IIC 58	40 (+7) dB	IIC 59	40 (+7) dB	IIC 57	42 (+7) dB	IIC 50	49 (+6) dB
	Yes	IIC 65	35 (+5) dB	IIC 73	28 (+5) dB	IIC 74	27 (+5) dB	IIC 72	29 (+5) dB	IIC 65	35 (+5) dB

Notes:
1. The $L'_{nT,w}$ $(+C_I)$ has been calculated based on a receiving room volume of 50 m^3. No allowance has been made for on-site flanking transmission.
2. Refer to Section 2.0 for construction information in relation to Table 1 above.

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6.0 OPINION: BATTEN AND CRADLE – TILED FLOOR – WITH CAVITY INFILL

The following table details the expected impact performance of floor system C as described in Section 2.0 with various ceiling and floor slab combinations, including whether cavity insulation is installed:

Table 3 Batten and Cradle – Tiled Floor – With cavity Infill – Impact Insulation Prediction

Ceiling		Floor									
		120 mm Hibond (average concrete thickness 90 mm)		75 mm Unispan + 75 mm topping		200 mm Dycore with 65 mm topping		135 mm Stahlton Rib and Infill (minimum concrete thickness 135 mm on 25 mm timber infills)		90 mm Interspan (minimum concrete thickness 90 mm on 25 mm timber infills)	
Thickness /layers	Cavity Insulation Present?	Impact Insulation Class	$L'_{nT,w}$ $(+C_1)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_1)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_1)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_1)$ (See Note 1)	Impact Insulation Class	$L'_{nT,w}$ $(+C_1)$ (See Note 1)
No plasterboard ceiling	N/A	IIC 55	55 (-2) dB	IIC 61	47 (0) dB	IIC 62	46 (0) dB	IIC 60	49 (-1) dB	IIC 55	55 (-2) dB
1 x 10 mm plasterboard	No	IIC 49	53 (+4) dB	IIC 57	45 (+4) dB	IIC 58	44 (+4) dB	IIC 56	45 (+5) dB	IIC 49	53 (+4) dB
	Yes	IIC 56	43 (+6) dB	IIC 62	38 (+5) dB	IIC 63	36 (+6) dB	IIC 61	39 (+5) dB	IIC 56	43 (+6) dB
1 x 13 mm plasterboard	No	IIC 53	48 (+5) dB	IIC 61	40 (+5) dB	IIC 61	39 (+5) dB	IIC 60	41 (+5) dB	IIC 53	48 (+5) dB
	Yes	IIC 68	35 (+3) dB	IIC 75	28 (+3) dB	IIC 76	26 (+4) dB	IIC 74	29 (+3) dB	IIC 68	35 (+3) dB
2 x 13 mm plasterboard	No	IIC 56	44 (+5) dB	IIC 64	36 (+5) dB	IIC 65	35 (+5) dB	IIC 63	37 (+5) dB	IIC 56	44 (+5) dB
	Yes	IIC 72	33 (+1) dB	IIC 80	25 (+2) dB	IIC 80	24 (+2) dB	IIC 78	26 (+2) dB	IIC 72	33 (+1) dB

Notes:
1. The $L'_{nT,w}$ $(+C_1)$ has been calculated based on a receiving room volume of 50 m^3. No allowance has been made for on-site flanking transmission.
2. Refer to Section 2.0 for construction information in relation to Table 1 above.

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7.0 LIMITATIONS

The above opinions are an estimate of the laboratory performance not the field performance. The estimate is based on the original laboratory tests, the materials as currently manufactured and the construction details set out above. Readers are advised to check that this opinion has not been revised by a later issue. The estimate is expected to be in error by less than 3 IIC/dB.

8.0 INTERPRETATION

8.1 Rating Systems

8.1.1 NZ Building Code

The Impact Insulation Class (IIC) of a floor/ceiling system reflects its ability to prevent impact on its surface from being transmitted as structure-borne vibration and radiating as air-borne noise. Higher IIC ratings indicate that less noise is transmitted to the room below. The existing NZ Building Code requires that new floors have a laboratory rating of IIC 55 or higher. In addition the floor must be constructed to ensure the on-site Field Impact Insulation Class (IIC) is no less than FIIC 50.

8.1.2 Proposed Building Code

The proposed NZ Building Code (G6) requires a Standardised Impact Sound Pressure Level + Impact Spectrum Adaptation Term ($L'_{nT,w}$ +C_1) of 55 dB or less between habitable spaces. This is a rating for the impact sound measured rather than a floor performance rating. Therefore, the lower the $L'_{nT,w}$ +C_1 the lower the impact noise and correspondingly the higher the performance of the floor. The Impact Spectrum Adaptation Term C_1 has been included as, according to the proposed Building Code, this has "been shown to better relate to the problem of low frequency footfall noise, and also high frequency impact sound, such as chairs scraping on hard surfaces." For concrete floors the C_1 figure tends to be negative.

The calculation of $L'_{nT,w}$ +C_1 from a laboratory measurement requires an estimation of room size. The results presented in the table above have been based on a receiving room size of 50 m^3. It should be noted that the figures would not be appropriate for rooms considerably larger or smaller than 50 m^3 and calculation of alternative allowances would be required.

The performance estimates have been made considering only vertical transmission of impact borne sound. It should also be noted that whilst $L'_{nT,w}$ +C_1 describes a field measurement in this instance, no allowance has been made for on-site flanking transmission and no consideration has been given to horizontal transmission.

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8.2 Field Performance

To ensure the on-site measurements are similar to the laboratory results the products must be installed and constructed in a similar way to the laboratory tests and any substitution of materials must be approved by the project's Acoustic Consultant. In addition, potential flanking paths, such as external walls, need to be considered and mitigated against.

Structure-borne vibration is readily transmitted in all directions in concrete flooring substructures. There is often little difference between measured impact noise levels in rooms directly below the source room compared with rooms that are diagonally below. Therefore the impact isolation to rooms other than those directly below the floor area should also be considered.

Where horizontal transmission or flanking is likely to be of concern it is recommended that concrete slabs of no less than 120 mm effective (average) thickness be used. Hard floor surfaces on lightweight concrete floors are likely to require specialist isolation to avoid high levels of impact noise being transmitted to adjacent spaces.

The use of materials other than those referred to in Section 2 or the introduction of additional materials (e.g. underfloor heating), including the lack of any perimeter isolation, can significantly affect the field performance rating (i.e. may result in a failure in accordance with the NZ Building Code). MDA strongly recommend trial performance testing on site before proceeding with full installation.

<u>Note:</u>

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