Adding Ceilings and Floor Coverings to a Hibond Concrete Floor

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Non-refereed

A paper previously presented at the 14th New Zealand Acoustical Society conference, Christchurch, 1997, under the title "Impact of Ceilings and Floor Coverings on a Proprietary Concrete Floor."

Note: When this paper was originally presented, the author was employed by Winstone Wallboards Ltd.

Abstract

Clause G6 of the New Zealand Building Code, dealing with inter-tenancy noise, only provides an acceptable solution for a concrete floor with carpet and underlay and a bare soffit. However, designers and customers require a variety of floor coverings and ceilings to meet their needs and expectations. This paper sets out to address this shortfall in the code, by the provision of simple, cost effective alternatives which meet clause G6 performance requirements.

The instigation of the work was essentially to investigate impact noise and various floor coverings, and the effectiveness of a proprietary concrete decking system 'Hibond', manufactured by Dimond Industries ltd. The prediction of impact isolation is a rather difficult issue, and therefore an empirical test program was chosen as a pragmatic option. Essentially, the project is in two parts; firstly, impact noise and secondly, airborne noise.

The impact isolation items included several types and qualities of carpet and underlay, together with tiles, cork and timber surfaces. The airborne insulation items included various methods of supporting a plasterboard soffit and the effect of a cavity absorber. The outcome was a range of both commercial and residential solutions for a proprietary concrete floor system, which met the verification requirements of clause G6 in respect of both IIC and STC. Emphasis was given to the need to bridge the gap between the difficulty of prediction by acousticians and the pragmatic requirements of the end user.

Introduction

All the testing was carried out at the Acoustic Testing Service Laboratory, Auckland. The procedure was in accordance with ISO 140 in all respects, except for sample size, Telarc signatory check and authorised report.

From previous tests, over many years, it has been established that the testing at this laboratory is consistent to within 1 dB. Given this high reliability of the test facility, a decision was made to utilise a program which used indicative tests on small samples.

This decision avoided prohibitively expensive testing costs which would have resulted from full scale testing on the large number of test samples.

The testing work has been designed to investigate;

- Impact insulation of various underlays
- Impact insulation of carpets without underlay
- Impact insulation of carpet and underlay combinations
- Impact insulation of vinyl floor covering and underlay

combinations

- The contribution from the ceiling construction to IIC and STC
- The possibility of achieving IIC 55+ using non-carpet floor coverings

Tested samples were approximately 1000mm x 1000mm in size, with the exception of ceiling systems which were 3200 x 3200.

The concrete floor consisted of a steel Hibond system, with a concrete topping having a minimum thickness of 65mm. Figure 1 shows a view from underneath the slab, with the Hibond steel decking clearly visible. The average concrete thickness of this system is approximately 91mm.

The plasterboard used for the tests was 12.5mm thick "Gib® Plasterboard" as manufactured by Winstone Wallboards Ltd.

The following tables provide summarised results, outcomes and brief subjective assessments.

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Figure 1: Underside of floor showing Hibond Steel Decking with USG direct fix clip and steel batten ceiling suspension system.

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Criteria" (PNC) curve. In calibrating the electronic system described above, PNC curves have been found to provide a good neutral sound with good masking ability.

The challenge for future installations is to obtain a similar spectrum within the other constraints which exist.

Conclusions

Improved cooling has been achieved by designing an acoustically treated ducted ventilation system for medium sized electrical transformers. The design aim of 40 dBA at a distance of 45 metres has also been achieved.

There are options for further noise reductions if required for specific sites, and the system shows good promise for use as a sound masking system. ❑

Tables 1-4 show results for various floor coverings on a Hibond concrete slab with no ceiling.

Table 1: Carpet Underlays		
Carpet Type	**Underlay Type**	**IIC**
Bare Slab Surface		26
Background Noise		94
None	Foam backed Hessian	60
None	8mm Vitafoam Budget	64
None	8mm Vitafoam Extra	67
None	9.5mm Vitafoam Budget	65
None	Bridgestone Rubber Waffle	69

Outcome: Different Underlay types and qualities provide very similar performance; IIC 65± 5

Table 2: Carpets without Underlay		
Carpet Type	**Underlay Type**	**IIC**
32oz wool	None	63
40oz wool	None	65
48oz wool	None	64
60oz wool	None	70
Nylon Heavy Duty	None	63

Outcome: Different Carpet types and qualities without underlay also provide very similar performance; IIC 67± 4

Table 3: Carpet/Underlay Combinations		
Carpet Type	**Underlay Type**	**IIC**
32oz wool	Vitafoam Budget	71
40oz wool	Vitafoam Extra	72
48oz wool	Vitafoam Budget	70
60oz wool	Vitafoam Budget	71
Nylon Heavy Duty	Vitafoam Budget	70
Nylon Heavy Duty	Vitafoam Extra	73

Outcome: Different combinations of carpet and underlay, of differing types and quality provide almost identical performance; IIC 71± 2

Table 4: Vinyl Flooring/Underlay Combinations		
Vinyl Type	**Underlay Type**	**IIC**
None	1mm Polyethylene Foam	39
Novilon Bella	None	43
Novilon Nova	None	45
Novilon Bella	1mm Polyethylene Foam	48
Novilon Nova	1mm Polyethylene Foam	48

Outcome: Vinyl flooring on underlay cannot achieve Building Code requirements with only a slab. Using other available data, it can be shown that Novilon Vinyl floor coverings combined with a Hibond floor system plus a suspended plasterboard ceiling and cavity insulation, will yield values of IIC 60+

Table 5: Hibond Concrete Slab with Suspended Ceiling					
Ceiling Framing	**Distance of lining below underside of**	**Ceiling/ Cavity Insulation**	**STC**	**IIC (bare slab)**	**Subjective Assessment (compared to slab alone)**
Bare Slab		None	42	26	
USG Steel Battens, fixed directly to Hibond	22mm	12.5mm plasterboard No Insulation	50	26	No change to impact[1], perceptible difference to
USG Resilient Rails, fixed directly to Hibond	15mm	12.5mm plasterboard No Insulation	52	30	Perceptible difference to impact, half loudness for
USG Direct Fix Clips	45mm	12.5mm plasterboard	54	35	Half loudness for both
USG Direct Fix Clips with USG Steel Battens	45mm	12.5mm plasterboard 50mm fibreglass blanket	59	37	Half loudness for impact, and almost a quarter as loud
Dimond Suspended Ceiling	300mm	12.5mm plasterboard No Insulation	59	35	Half loudness for impact, and almost a quarter as loud
Dimond Suspended	300mm	12.5mm plasterboard	61	43	Almost a quarter as loud for
Dimond Suspended	300mm	2 x 12.5mm plasterboard	64	-	Almost a quarter as loud for

Note: 1. Impact Noise denoted by IIC values, Airborne Noise denoted by STC values.

Outcomes of Ceiling Investigation:

- An isolated single layer plasterboard ceiling on a 300mm cavity, with cavity absorption results in significantly less impact noise than a bare slab (+17 IIC)
- Ceiling systems without cavity absorption have a relatively small effect on impact noise, irrespective of cavity depth (+9 IIC)
- Despite the reduction in impact noise, cavity insulation has minimal effect on airborne noise (+2 STC)
- USG Direct Fix Clips give greater improvement to airborne noise (+17 STC) than impact noise (+11 IIC)
- Adding a second layer of plasterboard to the ceiling has little effect on either airborne noise or impact noise (+3 STC/IIC)

Table 6: Achieving IIC 55+ with Non-Carpet Floor Coverings (Hibond Slab with 12.5mm Plasterboard ceiling on Dimond Suspended Ceiling System and 75mm Fibreglass insulation unless stated otherwise)

Floor Covering on Substrate	Proprietary Item	IIC[1] with	IIC[1] with
Bare Slab Surface		26	43
6mm Cork Tiles			
with cavity insulation	None	42	**60**[2]
no cavity insulation	None		53
6mm Ceramic Tiles on;			
40mm Sand Bed	None	37	**56**
AVA Acoustic Grout	Heritage Tiles	30	
Sand/Cement Grout	None	27	
Ultraset adhesive	Bostic Adhesive		**56**
Adhesive	Dunlop		**56**
Adhesive	Dunlop		52
Tilebond adhesive	Morgan		44
Noise Guard Barrier and adhesive	Morgan		48
6mm Resinflex adhesive	Morgan		**55**
Laticrete 28 Mortar	Stonecraft		**55**
Laticrete 28 Mortar plus 317 Latex and Mortar	Stonecraft		**58**
Laticrete 317 Latex over Nobleseal Sound Isolation	Stonecraft		49
Laticrete 28 Mortar plus 9235 waterproof membrane	Stonecraft		**57**
20mm T&G timber			
2mm Polyethylene	Woodn it Floors	44	
Parquet timber			
Adhesive	Bostic Adhesive		**59**

Notes: 1. IIC test results are indicative because the tested sample size of the floor covering does not comply with the standard.
2. Test results which achieve NZBC clause G6 performance requirement of IIC 55 are shown in bold.