Materials Science & Engineering
37 Graham Rd (PO Box 56) Highett Victoria 3190
Telephone: (03) 9252 6000 Facsimile: (03) 9252 6244

www.csiro.au
ABN 41 687 119 230

LABORATORY MEASUREMENT

OF

THE REDUCTION OF TRANSMITTED IMPACT SOUND PRESSURE LEVELS BY A FLOOR COVERING ON A HEAVYWEIGHT STANDARD FLOOR

MEASUREMENT NO: INR159a & INR159b

DATE OF MEASUREMENT: 7-8 August, 2008

COMMISSIONED BY: Synteko P/L

SUMMARY

The reduction of impact sound pressure level (ΔL), the impact isolation class (IIC), $L_{n,w}$ and C_I, the weighted reduction in impact sound pressure level (ΔL_w) and the ΔL_{lin} value for two timber/underlay flooring systems have been measured.

The ΔL values reported are the decibel reductions in normalized impact sound pressure level (L_n) measured in a reverberant room beneath the test floor, achieved by the floor covering material compared to the bare test floor. The ΔL_w and ΔL_{lin} are single number ratings for the improvement in impact sound levels between the bare reference floor and the same floor with the floor covering material. ΔL_w is the difference between $L_{n,w}$ for the bare reference floor and $L_{n,w}$ for the reference floor plus the floor covering, as defined in AS ISO 717.2-2004. ΔL_{lin} is the difference between $L_{n,sum}$ for the bare reference floor and $L_{n,sum}$ for the reference floor plus the floor covering combination, as defined in AS ISO 717.2-2004. IIC (ASTM E989-89), $L_{n,w}$ and C_I (AS ISO 717.2-2004) apply to the combination of the floor covering and the 150mm thick concrete test slab.

DESCRIPTION OF TEST SPECIMENS

The two floor covering systems, each with the dimensions of 3.6m x 3.2m, were tested on a 150mm thick concrete slab. The systems comprised:-

(a) Test "a" – Parquetry. 260 x 65mm Blackbutt Block Parquetry boards, 19mm thick glues with "SikaBond-T55(J)" Timber Flooring Adhesive on "ComfortTech 3.3" underlay, loose-laid over the 150mm thick concrete slab.
(b) Test "b" – Overlay Boards. 80mm wide Blackbutt Tongue-and-Groove overlay flooring 13mm thick, glued with "SikaBond-T55(J)" Timber Flooring Adhesive on "ComfortTech 3.3" underlay, loose-laid over the 150mm thick concrete slab.

METHOD OF TEST

(a) Specific

The measurement complies with the requirements of ISO 140-8:1997(E) *"Measurement of sound insulation in buildings and building elements – Part 8: Laboratory measurement of the reduction in transmitted impact noise by floor coverings on a standard floor"*. It also complies with ISO 140-6 *"Measurement of sound insulation in buildings and building elements – Part 6: Laboratory measurement of sound insulation of floors"*.

(b) General

The test-material is installed onto a standard test-floor, this being a 150mm reinforced concrete slab satisfying the requirements of ISO 140-8. A standard tapping-machine is operated on the test-material, and again on the bare-floor. The reduction in the sound pressure levels produced in a chamber beneath the floor is reported. Measurements for the floor covering are made at four different tapping machine positions on the standard test-floor and the average results reported.

DESCRIPTION OF TEST FLOOR AND TEST FACILITY

The standard floor used was a reinforced concrete floor with dimensions 3.66 m x 3.20 m x 0.150 m - this is in accordance with the requirements of ISO 140-8.

The tests were conducted with the standard floor-slab placed in an aperture between two purpose-built concrete rooms, all the bounding surfaces of which are 305 mm in thickness. The rooms were designed and built to minimise any structure-borne noise (induced by test signals) from outflanking sound passing through the test specimen.

The "sending" and the "receiving" rooms are both pentagonal in shape; the receiving room has a volume of 105 m^3 and a floor area of 32 m^2.

The underside of the concrete test slab forms part of the ceiling of the receiving chamber; no intermediate ceiling is present beneath the test slab.

INSTRUMENTATION AND EQUIPMENT

(a) Tapping Machine

The tapping-machine employed was a Brüel & Kjær type 3204. (A rotating cam allows five, 500 gm, steel hammer-heads to be raised, then dropped under gravity through 40 mm, at a rate of 10 impacts/s). The tapping machine fulfils the requirements of ISO 140.

(b) Microphone

The microphone used was a Brüel & Kjær type 4166 mounted on a Brüel & Kjær type 2619 preamplifier and was mounted at end of a rotating boom of radius 1.35 m which had a rotation period of 32 s.

INSTRUMENTATION AND EQUIPMENT (cont)

(c) Calibration of Microphone Sensitivity

The gain of the microphone was adjusted to read absolute dB re 20 μPa prior to measurement by using a Brüel & Kjær type 4220 pistonphone. The pistonphone was calibrated by a NATA registered laboratory on 20 April 2007.

(d) Analysis Equipment

Microphone signals were analysed using a Norwegian Electronics type 830 Real-Time-Analyser (RTA). This enables measurements in each of the standard 1/3-octave bands simultaneously, and also can perform internal averaging of repeated measurements. The measured levels reported below are each the result of internally averaging 4 x 32 s integrals in the 100 Hz to 5000 Hz bands.

The reverberation times in the receiving room were measured by overlaying 60 decays using the internal program of the RTA.

Measured Impact Sound Pressure Levels

Table 1 presents the impact sound pressure level (L_i), corrected for background levels, for the Bare Floor (L_{io}) and each specimen averaged over four different tapping machine positions as measured in the receiving room.

Table 1. Measured impact sound pressure level (L_i), corrected for background levels, averaged over four different tapping machine positions for the reference-floor and the floor-coverings laid over the reference-floor.

	L_{io} (dB)	L_i (dB)	
Freq (Hz)	Bare Floor	(a) Test "a"	(b) Test "b"
100	65.3	63.5	63.0
125	67.9	64.7	65.7
160	69.3	66.3	67.4
200	75.1	71.3	71.9
250	76.0	70.0	71.5
315	78.2	69.5	72.2
400	76.0	62.4	68.3
500	76.9	58.6	63.0
630	78.7	56.7	60.5
800	77.7	55.0	54.8
1000	77.9	55.9	50.7
1250	78.4	54.0	45.9
1600	78.0	50.6	42.0
2000	77.2	46.5	36.8
2500	75.6	35.4	28.9
3150	74.6	33.1	21.5
4000	72.3	23.6	15.8
5000	69.4	14.2	<10.3

Correction for Background Sound Pressure Level

ISO 140-6 & 8 both require the measured impact sound pressure level to be corrected if it is close to the background sound pressure level. The symbol ≥ indicates that the measured Sound Pressure Level was less than the required 6 dB above background. In this case 1.3 dB was subtracted from the measured Sound Pressure Level, this being the correction required for a measured Sound Pressure Level of 6 dB above background. All corrections are presented in Table 2.

Table 2. Background Corrections

	Size of correction, dB	
Freq (Hz)	(a) Test "a"	(b) Test "b"
3150		0.1
4000	0.1	0.4
5000	0.9	≥1.3

Normalized Impact Sound Pressure Level of Bare Floor

ISO 140-6 & 8 both require the reporting of the normalized impact sound pressure level for the bare floor, L_{no}. The normalized impact sound pressure levels are the levels that would be measured if exactly 10 m^2 of sound absorption was present in the receiving room at each frequency. Accordingly, this information is presented in Table 3, together with the normalized impact sound pressure level for the test floors.

Table 3. Normalized impact sound pressure levels (dB) for the test floors.

	Normalized Impact Sound Pressure Level (L_n)		
Freq (Hz)	Bare Floor	(a) Test "a"	(b) Test "b"
100	56.0	54.6	53.7
125	59.3	55.5	57.1
160	60.9	57.7	59.0
200	67.1	63.4	63.9
250	68.2	62.2	63.7
315	71.0	62.3	65.0
400	69.0	55.5	61.3
500	70.4	52.1	56.5
630	72.4	50.4	54.2
800	71.7	49.1	48.8
1000	72.5	50.4	45.3
1250	73.4	49.0	40.9
1600	73.7	46.2	37.7
2000	73.7	42.9	33.3
2500	72.9	32.6	26.2
3150	72.7	31.1	19.5
4000	71.1	22.3	14.6
5000	69.1	13.8	<10.0

Results

The reduction of impact sound pressure level (ΔL), (i.e. the improvement in impact sound insulation) is given by the simple difference between the sound pressure level (L_{io}) measured for the bare floor, and the (L_i) measured for the test floors, corrected where appropriate for background levels. The impact isolation class (IIC) on the 150mm thick test slab, as defined in ASTM E989-89, the weighted reduction in impact sound pressure level ΔL_w, and ΔL_{lin}, as defined in AS ISO 717.2-2004, have also been determined for the test floors.

Table 4 presents the impact sound pressure level for the bare slab, and the reduction (ΔL) with each test floor, calculated for each measured 1/3-octave frequency band. The last five rows of the table give ΔL_w, ΔL_{lin}, IIC, $L_{n,w}$ and C_I respectively for the test floors. Appendix A also shows the impact noise level reductions on a graph.

Table 4. Impact Sound Pressure Level for the Bare Slab, and Reduction (ΔL) for the Test Floors.

	Normalized Impact level (dB)	Reduction in Impact Level, ΔL (dB)	
Freq (Hz)	Bare Slab	(a) Test "a"	(b) Test "b"
100	56.0	1.4	2.3
125	59.3	3.8	2.2
160	60.9	3.2	1.9
200	67.1	3.7	3.2
250	68.2	6.0	4.5
315	71.0	8.7	6.0
400	69.0	13.5	7.7
500	70.4	18.3	13.9
630	72.4	22.0	18.2
800	71.7	22.7	22.9
1000	72.5	22.0	27.2
1250	73.4	24.4	32.5
1600	73.7	27.5	36.0
2000	73.7	30.7	40.4
2500	72.9	40.3	46.7
3150	72.7	41.6	53.1
4000	71.1	48.8	56.5
5000	69.1	55.3	>59.1
ΔL_w	**-**	**21**	**19**
ΔL_{lin}	**-**	**10**	**9**
IIC	**27**	**57**	**55**
$L_{n,w}$	**79**	**54**	**55**
C_I	**-11**	**0**	**1**

Test Officer: Checked by:

David Truett ..... Dr. John Davy John Davy

3./SEP./2008 4./9./2008

Reduction of Impact Sound Pressure Level (ΔL) for the Test Floors.

	Normalized Impact level (dB)	Reduction in Impact Level, ΔL (dB)	
Freq (Hz)	Bare Slab	(a) Test "a"	(b) Test "b"
100	56.0	1.4	2.3
125	59.3	3.8	2.2
160	60.9	3.2	1.9
200	67.1	3.7	3.2
250	68.2	6.0	4.5
315	71.0	8.7	6.0
400	69.0	13.5	7.7
500	70.4	18.3	13.9
630	72.4	22.0	18.2
800	71.7	22.7	22.9
1000	72.5	22.0	27.2
1250	73.4	24.4	32.5
1600	73.7	27.5	36.0
2000	73.7	30.7	40.4
2500	72.9	40.3	46.7
3150	72.7	41.6	53.1
4000	71.1	48.8	56.5
5000	69.1	55.3	>59.1
ΔL_w	**-**	**21**	**19**
ΔL_{lin}	**-**	**10**	**9**
IIC	**27**	**57**	**55**
$L_{n,w}$	**79**	**54**	**55**
C_I	**-11**	**0**	**1**